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Wataynikaneyap Power Project

Socioeconomic Impact Analysis of Building Grid Connection to Ontario's Remote Communities

Wataynikaneyap Power Project

June 17, 2015

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Overview of the Wataynikaneyap Power Project

The Wataynikaneyap Power Project is a First Nations-owned and led electricity transmission project that has the potential to dramatically change the way electricity is delivered to remote communities in Northwestern Ontario, which currently rely on diesel generation for their electricity needs. Diesel generated electricity is expensive, causes significant environmental damage and health problems and hinders and stunts economic growth in the region. In Ontario alone, there are 25 remote First Nation communities that currently generate some or all of their electricity from diesel and the far majority of these communities are located in Northwestern Ontario. The Independent Electricity System Operator ("**IESO**") estimates the annual cost of diesel supply in the 25 remote communities is approximately $90 million per year and growing.

The Wataynikaneyap Power Project is currently scoped to connect 16 of these 25 communities. The project would reinforce existing grid service at Pickle Lake, and extend the grid north of Red Lake and Pickle Lake to service these communities. By connecting remote First Nations communities to Ontario's power grid, the project will result in significant cost savings compared to continued diesel generation, and has the potential to generate significant socioeconomic benefits for First Nations communities in Northwestern Ontario and the rest of Ontario and Canada. In the future, the project could also connect other remote First Nations communities, renewable energy projects, and mining developments.

This study focuses on Phase 2 of the project, connection of 16 remote First Nations communities. The capital cost of building transmission infrastructure to these First Nations communities is estimated to be $1,031 million.

Study Objectives

HDR Corporation ("**HDR**") was engaged by PricewaterhouseCoopers ("**PwC**") on behalf of Wataynikaneyap Power to assess the economic impacts and the broader socioeconomic impacts of the project. Specifically, HDR was engaged to:

- Assess the one-time and ongoing economic impacts of the Wataynikaneyap Power Project to Northwestern Ontario, the province of Ontario and the rest of Canada more broadly.
- Estimate the environmental, health/safety and other social benefits of the Wataynikaneyap Power Project employing HDR's Sustainable Return on Investment ("**SROI**") methodology. At a high level, SROI places a monetary value on societal benefits/costs (e.g., improved/worsened health outcomes, decreased/increased risks of fuel spills, etc.) and incorporates them within the business case to provide a more holistic assessment of a project's feasibility.
- Prepare a final report that documents the key findings and outlines the methodology employed.

This study builds on previous studies and specifically the PwC study on financial feasibility of Phase 2 of the project.

Economic Impact of the Wataynikaneyap Power Project

The Wataynikaneyap Power Project is expected to generate significant economic impacts and benefits for First Nations communities, Northwestern Ontario, the rest of Ontario and the rest of Canada more broadly. Overall, the project is expected to generate one-time economic impacts from the construction and development of the project and ongoing economic impacts from increased economic growth. The table below shows the economic impact of the construction and development expenditures of the project.

Cumulative Economic Impact of the Construction and Development of the Wataynikaneyap Power Project

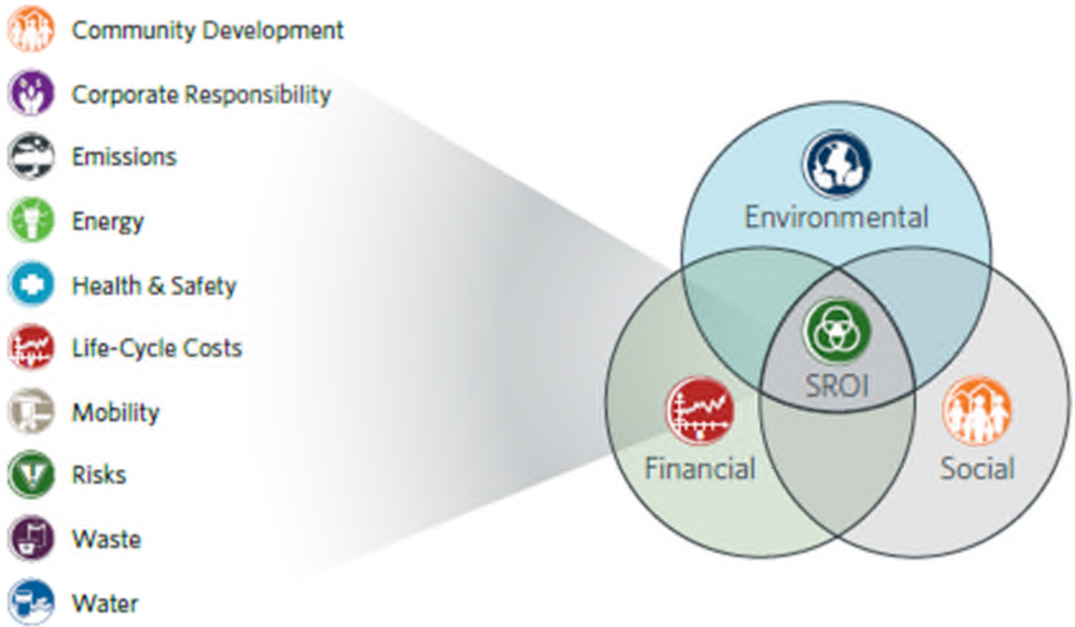
	GDP (CAD$, Millions)	Wages and Salaries (CAD$, Millions)	Employment (FTEs)	Government Revenues (CAD$, Millions)
Canada	$1,189.7	$572.6	769.4	$273.8
Ontario	$957.3	$538.5	685.3	$220.3
Northwestern Ontario	$361.7	$195.9	261.4	$83.2

Construction of the Wataynikaneyap Power Project is expected to generate significant economic impacts and benefits for First Nations communities, Northwestern Ontario, the rest of Ontario and the rest of Canada more broadly. Economic impact and benefits generated from the construction and development of the project, which are forecasted to contribute on a cumulative basis $1,190 million and $957 million in GDP to Ontario and Canada respectively over the construction period and create roughly 261 jobs in Northwestern Ontario and almost 770 across Canada during the construction period. Once operational, the Wataynikaneyap Power Project will help alleviate load growth restrictions, which hinder economic growth in the region. Access to transmission infrastructure is a key component for natural resource development in Northwestern Ontario, in particular, the Far North. Natural resource development (mining, renewable energy) would create additional spin off benefits for the region. The construction of the project also provides opportunities for skills development, which many stakeholders we interviewed indicated were an important part of the benefits of this project and can generate significant economic growth beyond just the construction impacts.

Sustainable Return on Investment of the Wataynikaneyap Power Project

SROI originated from a Commitment to Action by HDR to develop a new generation of public decision support metrics for the Clinton Global Initiative ("**CGI**") in 2007. HDR's Economics and Finance group developed SROI with input from Columbia University's Graduate School of International Public Affairs and launched at the 2009 CGI annual meeting. Since then, SROI has been used by HDR to evaluate the monetary value of initiatives, programs and/or projects with a combined value of over $20 billion.

HDR's SROI Methodology



At its core, HDR's SROI methodology estimates a dollar value for various environmental and social benefits and costs associated with a project, initiative and/or program, which enables a direct "apples-to-apples" comparison to a project's financial metrics. Outputs are split into two perspectives: Financial Return on Investment ("**FROI**") and Sustainable Return on Investment ("**SROI**") which are calculated over the project lifecycle including the construction period followed by 40 years of operations.

- FROI includes only the cash impacts and reflects the net financial impacts of the project from society's point of view. This differs from a traditional financial feasibility analysis which is from the investors' point of view. The FROI in this report was adjusted from PwC's financial feasibility analysis of Phase 2 of the project.
- SROI includes the FROI and adds external non-cash impacts that affect society (items such as diesel spills and air pollution).

Sustainable Return on Investment Metrics

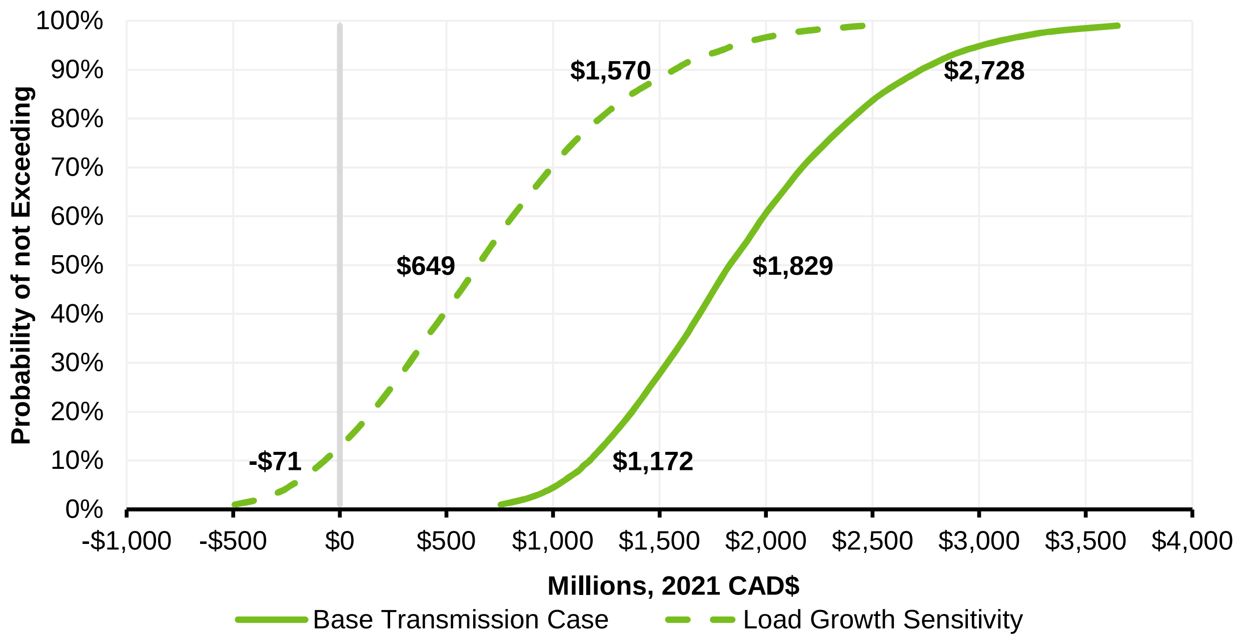
Sustainable Return on Investment ("SROI") Metrics Mean Expected Values (2021 CAD$, Millions)	
Financial Return on Investment ("FROI")	$1,071
Present Value of Avoided GHG Emissions	$472
Present Value of Reduced Adverse Health Impacts	$304
Present Value of Reduced Damage to Vegetation	$35
Present Value of Avoided Diesel Spills	$21
Net Present Value (SROI)	**$1,903**

Sustainable Return on Investment ("SROI") Metrics Mean Expected Values (2021 CAD$, Millions)	
Discounted Payback Period (years)	**20.22**
Internal Rate of Return ("IRR", 2015)	**10.0%**
Benefit-Cost Ratio ("B/C ratio")	**1.80**

At the mean and under the Base Transmission Case, the net present value of the Wataynikaneyap Power Project is estimated at $1,903 million with an in IRR of 10%. Based on the SROI analysis, the project pays back its capital costs in roughly 20 years on a discounted basis, which is a relatively long discounted payback period and reflects the fact that the majority of the financial and socioeconomic benefits of the project occur in later years as energy demand continues to grow. Over 40 years, the Wataynikaneyap Power Project is estimated to result in over 6.6 million tonnes of avoided CO2 equivalent GHG emissions, which is comparable to taking almost 35,000 cars off the road. Under the Base Transmission Case, the Wataynikaneyap Power Project is expected to generate financial and socioeconomic returns in excess of project costs. The SROI of the Wataynikaneyap Power Project depends on assumptions and model inputs and particularly the future electricity load growth. Accordingly, in addition to the Base Transmission Case, we conducted sensitivity analyses:

- **Base Transmission Case** – uses the IESO's (formerly the Ontario Power Authority's) load growth assumption of 4% per year over 40 years.
- **Sensitivity 1** – uses a lower annual load growth rate and allows this value to vary between 1% and 4% with a most likely outcome of 2.5%.

SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years of Operations



Under the Base Transmission Case, the SROI of the Wataynikaneyap Power Project is comfortably greater than zero at all levels of significance. Indeed, even at the 1 percentile the project still delivers a net present value that is substantially greater than zero; however, using a more conservative annual load growth assumption results in a decreased SROI (Load Growth Sensitivity). Nevertheless, even under this sensitivity analysis, the SROI of the Wataynikaneyap Power Project is still substantially positive at the mean and median and there is about an 85% chance of obtaining a positive net present value. Similar to the financial feasibility of the project, SROI results are highly sensitive to the load growth assumption.

> *"This is the first time we can take part in a project of this size and importance. Developing this project will provide our community a sense of pride and self-esteem that we can leverage for other projects."*
>
> – Bill Sainnawap, Big Trout Lake First Nation

Other benefits of the Wataynikaneyap Power Project

The economic impact assessment and the SROI analysis do not include other types of socioeconomic benefits that our research and discussions with stakeholders suggested could be quite considerable. For instance, community members interviewed expressed pride that Wataynikaneyap Power Project will be one of the largest First Nations projects in Ontario and that successfully developing this project could result in an increased sense of confidence. The dollar value on benefits such as this cannot be estimated, however, it is clear that First Nations communities working together and controlling development of infrastructure within their traditional lands will be a catalyst for greater prosperity and economic self determination.

1. Introduction

Overview of the Wataynikaneyap Power Project

The Wataynikaneyap Power Project is a First Nations-owned and led electricity transmission project that has the potential to dramatically change the way electricity is delivered to remote communities in Northwestern Ontario, which currently rely on diesel generation for their electricity needs. Diesel generated electricity:

- Is expensive largely due to the cost associated with fuel transportation in the Far North, which is either through air delivery or ice road trucking
- Is subject to considerable price uncertainty;
- May cause significant environmental damage and health problems;
- Poses energy uncertainty and planning issues; and
- Hinders and stunts economic growth due to load restrictions in the many communities that are approaching or have reached diesel generation capacity.

> *"The Wataynikaneyap Power Project will unlock economic opportunities in our community and for other First Nations communities in Northern Ontario."*
>
> – Mitchell K. Diabo, General Manager, Kasabonika Lake Community Development Corporation

In Ontario alone, there are 25 remote First Nation communities that currently generate some or all of their electricity from diesel and the far majority of these communities are located in Northwestern Ontario.[1] By connecting these communities to Ontario's energy grid, the Wataynikaneyap Power Project has the potential to generate significant socioeconomic benefits for First Nations communities in Northwestern Ontario and the rest of Ontario and Canada.

The Wataynikaneyap Power Project includes two phases:

- **Phase 1** includes developing a new 300 km transmission line to Pickle Lake to reinforce power supply. The existing line is over 70 years old, at capacity, and is prone to frequent, long-lasting power outages.[2]
- **Phase 2**, which relies on the completion of Phase 1, includes connecting 16 remote First Nations communities north of Pickle Lake and Red Lake to Ontario's energy grid by building 1,500km of

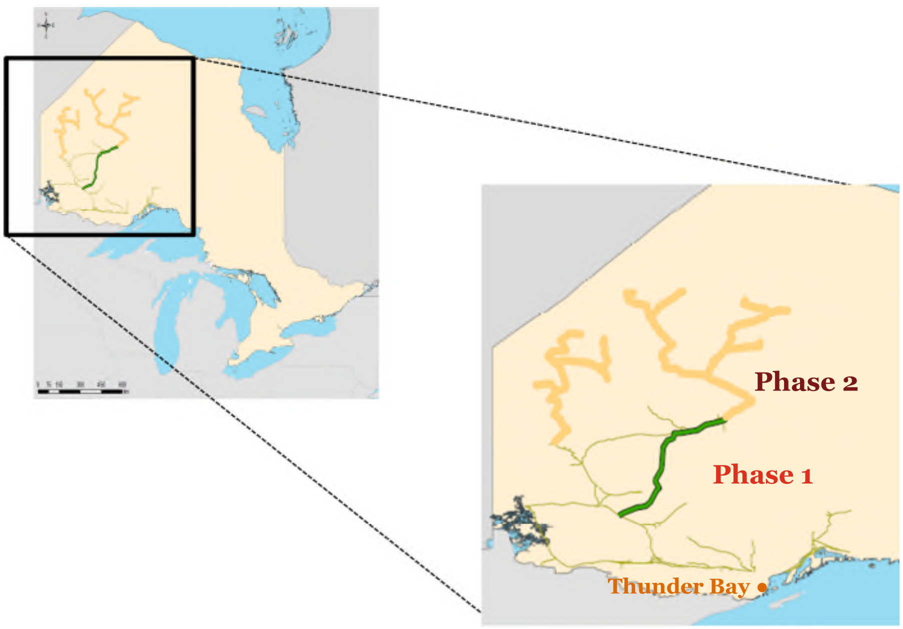
[1] Status of Remove/Off-Grid Communities in Canada (2011). Aboriginal Affairs and Northern Development Canada and Natural Resources Canada. Retrieved from https://www.bullfrogpower.com/remotemicrogrids/presentations/status_of_remote_off_grid_communities_in_canada_2013-118_en.pdf.

[2] Electrical Grid Connection for Northwestern Ontario Remote Communities, Phase 2 – Financial Feasibility Study (2014). Prepared for the Central Corridor Energy Group. Prepared by PricewaterhouseCoopers LLP.

new transmission infrastructure. Hydro One Remote Communities Incorporated ("**HORCI**") or Independent Power Authorities ("**IPA's**") currently manage the diesel services in these communities (with the exception of McDowell Lake First Nation, which does not currently have an electricity supply). The subsection of this report entitled *Study Assumptions* lists the communities currently planned to be connected to Ontario's energy grid as part of Phase 2 of the Wataynikaneyap Power Project.

Figure 1 below shows the approximate location of Phase One (in green) and Phase Two (in yellow) of the Wataynikaneyap Power Project.

Figure 1 – Phase One and Phase 2 of the Wataynikaneyap Power Project



The present study builds on the following previous studies:

- Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project completed by Lumos Energy (with technical assistance provided by the Delphi Group) in June of 2013;

- Electrical Grid Connection for Northwestern Ontario Remote Communities, Phase 2 – Financial Feasibility Study completed by PricewaterhouseCoopers LLP originally completed in August of 2013 and updated in May of 2014; and

- Technical Report and Business Case for the Connection of Remote First Nation Communities in Northwest Ontario completed by the Ontario Power Authority in August of 2014.

Study Objectives

As noted above, the Wataynikaneyap Power Project is expected to generate significant socioeconomic benefits for communities in Northwestern Ontario and for the rest of the Province and Canada. For the project to materialize, a funding framework will be required that recognizes the future financial and social benefits to Canada, Ontario, and Ontario electricity ratepayers. Understandably, this leads to the following questions:

- Will the project benefit First Nations?
- Is this a good use of government/public funding?
- What is the overall rate of return of developing Wataynikaneyap Power Project from a societal perspective?
- What sort of one-time and ongoing economic impacts can we expect from the Wataynikaneyap Power Project?

This study attempts to answer these important questions building on some of the previous studies listed above. Specifically, HDR Corporation[3] ("**HDR**") was engaged to:

- Assess the one-time and ongoing economic impacts of the Wataynikaneyap Power Project to Northwestern Ontario, the province of Ontario and the rest of Canada more broadly.
- Estimate the environmental, health/safety and other social benefits of the Wataynikaneyap Power Project employing HDR's Sustainable Return on Investment ("**SROI**") methodology. At a high level, SROI places a monetary value on societal benefits/costs (e.g., improved/worsened health outcomes, decreased/increased risk of fuel spills etc.) and incorporates them within the business case to provide a more holistic assessment of a project's feasibility. Section 2 of this report provides a more detailed description of our SROI methodology.
- Prepare a final report that documents the key findings and outlines the methodology employed.

> *"The Wataynikaneyap Power Project provides a future for our community's youth."*
>
> – Jacob Strang, Deputy Chief, Poplar Hill First Nation

HDR was engaged by PwC on behalf of Wataynikaneyap Power.

The approach employed to meet and achieve the study objectives are described in detail below.

Approach

[3] HDR is an engineering, architecture, planning and consulting firm. In business since 1917, HDR has over 9,000 employees in nearly 200 offices worldwide. In Canada, HDR has offices in Ontario, Alberta, British Columbia and Newfoundland and Labrador.

Table 1 below lists and provides a detailed description of the approach HDR employed for each phase of this study. This information is provided in Section 1 of this report so the reader/user of this report is clear in terms of our specific scope for this study.

Table 1 – Detailed Description of Study Approach

Phase	Description
Project Initiation	• Conduct formal kick-off meeting. • Agree on structure and content of the final report.
Data Collection	• Collect all relevant data and information from PwC and Wataynikaneyap Power regarding the parameters, capital costs and financial feasibility of the Wataynikaneyap Power Project. • Collect data from other sources (e.g., Statistics Canada) to enable estimation of economic impacts and the SROI.
Economic Impact Analysis	• Develop and populate the model with the data collected to estimate the economic impact of the Wataynikaneyap Power Project. Economic impacts were estimated for standard measures of economic activity (output, GDP, wages and salaries, employment and government tax revenues) at the direct, indirect and induced levels. • Estimate the one-time and ongoing economic impacts associated with the Wataynikaneyap Power Project. Economic impacts are estimated for Canada, Ontario and Northwestern Ontario.
SROI and Qualitative Benefits	• Quantify the key social and environmental benefits associated with the Wataynikaneyap Power Project and incorporate them within the financial business case (completed by PwC) to better demonstrate the societal or public return on investment (i.e., the SROI). • Some benefits with the project are difficult to quantify on a credible basis, but are important nonetheless. Accordingly, HDR have qualitatively assessed these benefits based on interviews with community members, stakeholders and secondary research.
Reporting	• Consolidate key findings into a draft final report reviewed by PwC and Wataynikaneyap Power. • Report finalized based on comments received.

Study Assumptions and Caveats

Results in this study are based on the following important assumptions/caveats:

- This study builds directly upon the financial feasibility study completed by PwC in 2014. HDR have not independently validated the financial model developed by PwC and have used the same assumptions. Specifically, the PwC report showed that the financial feasibility of the Wataynikaneyap Power Project is highly sensitive to load growth assumptions, which were provided by the Independent Electricity System Operator ("**IESO**", formerly the Ontario Power Authority). Our SROI methodology incorporates risk analysis through Monte Carlo simulations to explicitly consider uncertainty in the decision making framework. In addition to providing primary results employing IESO's load growth assumption HDR ran sensitivity analyses with a range of load growth values.

- The Wataynikaneyap Power Project has evolved considerably since the update on the financial feasibility of the project completed by PwC in May 2014. Over the course of this engagement, HRD worked closely with PwC to ensure that it was using the latest financial model and reflected any changes in the parameters of the project in our study.

- As of the date of this study, the Wataynikaneyap Power Project involves connecting the following 16 communities to Ontario's electricity grid:

  Sandy Lake First Nation
  Bearskin Lake First Nation
  North Caribou Lake First Nation
  Kasabonika Lake First Nation
  Sachigo Lake First Nation
  Kingfisher Lake First Nation
  Wapekeka First Nation
  Kitchenumhaykoosib Inninuwug
  Wawakepewin First Nation
  Wunnumin Lake First Nation
  Muskrat Dam First Nation
  Deer Lake First Nation
  Poplar Hill First Nation
  Keewaywin First Nation
  North Spirit Lake First Nation
  McDowell Lake First Nation

  Based on our counts of the available Census data, this represents approximately 9,000-10,000 individuals.

Limitations

PwC has relied upon the completeness, accuracy and fair presentation of all the information, data and representations obtained from various sources which were not audited or otherwise verified. These sources (collectively, the Information), include:

- Wataynikaneyap Power;
- Statistics Canada;
- Environment Canada;
- Hydro One Remote Communities Incorporated;
- Information from interviews with community members; and
- Other relevant studies obtained from secondary research.

The findings in this report are conditional upon such completeness, accuracy and fair presentation of the Information, which has not been verified independently by PwC.

PwC reserves the right at their discretion to withdraw or make revisions to this report should it be made aware of facts existing at the date of the report that were not known to us when this report was prepared. The findings are as of the date hereof and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect the findings and PwC reserves the right to change or withdraw this report.

This information has been prepared solely for the use and benefit of, and pursuant to a client relationship exclusively with the Central Energy Corridor Group ("CCEG") that represents the participants in the Wataynikaneyap Power Project. PwC disclaims any contractual or other responsibility to others based on its use and, accordingly, this information may not be relied upon by anyone other than the participants in the Wataynikaneyap Power Project.

Any use that a third party makes of this report or reliance thereon, or any decision made based on it, is the responsibility of such third party. PwC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken, based on this report.

Notice to Reader

The analysis in this report has been prepared by HDR based on data and information provided by PwC, Wataynikaneyap Power and from other sources. Its assessment of the Wataynikaneyap Power Project is based on its own view of the information it obtained. In conducting its analysis, HDR have strived to be as transparent as possible in terms of the methodology employed, data sources used and any assumptions made. PwC and the CCEG provided overall direction and comments on the final report, but the decision on what content to include was HDR's.

We encourage the reader/user of this report to read Section 2 of this report, which provides a detailed description of the methodology employed and definitions of key terminology.

Lastly, this study uses various data from the 2006 Census and the 2011 National Household Survey. There are several data quality issues that limit the use and applicability of the 2011 National Household Survey. Accordingly, this study relies more heavily on the 2006 Census even though it is a more dated source of information.

Report Structure

This report is structured as follows:

- Section 2 outlines the methodology and data used to estimate the economic impact and SROI of the Wataynikaneyap Power Project.
- Section 3 shows the one-time and on-going economic impacts of the project.
- Section 4 shows the SROI of the project.
- Conclusions and key findings are listed in Section 5.
- Appendix A provides a detailed description of the methodology employed and data used to estimate the SROI of the project.
- Appendix B contains a glossary of key terms.
- Appendix C details the interview guide that was followed in collection of primary data for the study.
- Appendix D presents detailed annual economic impact results.
- Appendix E outlines how HDR estimated the potential future economic growth generated by the project.
- Appendix F presents detailed SROI results for the sensitivity cases.

2. Methodology and Data

Introduction

This section of the report provides a detailed description of the methodology employed in this study. Specifically, we outline the methodology and key terminology associated with the economic impact analysis and the SROI analysis of the Wataynikaneyap Power Project. Differences associated with each approach to measuring the benefits of the Wataynikaneyap Power Project are outlined as well. Lastly, data used as part of the economic impact analysis and SROI is also listed and described.

Economic Impact Analysis

The basic premise behind economic impact analysis is that spending in one industry generates additional spending (i.e., multiplier effects) in other industries and potentially even in the same industry. For example, the purchase of manufactured steel products (e.g., rebar) generates spending in supplying industries: steel refining, energy production, transportation, professional services; which, in turn source this supply from other industries such as coal mining, iron ore mining and several other industries. Statistics Canada produces the Input-Output Tables that quantify the inter- and intra-dependencies of industries that comprise the Canadian economy. The Input-Output Tables enable us to quantify how spending in one industry tracks through the Canadian economy and, thus, how this spending impacts the Canadian economy. Economic impacts are generally estimated for the following standard measures of economic activity:

- **Gross output** – the gross value of all business revenue. This is the broadest measure of economic activity and indicates the total sales and transactions triggered by operations.
- **Value-added or Gross Domestic Product ("GDP")** – the value added to the economy or the unduplicated total value of goods and services. GDP includes only final goods to avoid double counting of products sold during an accounting period. Accordingly, it is a more specific and accurate measure of economic activity.
- **Labour income** – the total value of wages and salaries associated with employment impacts.
- **Employment** – the number of jobs created or supported. It is expressed as the number of Full-Time Equivalent (FTE) jobs indicated in person years.
- **Government tax revenues** – the amount of tax revenues generated. In this study, all taxes paid by economic activity generated by the Wataynikaneyap Power Project are estimated.

Economic impacts are typically estimated at the direct, indirect and induced levels:

- **Direct impacts** are changes that occur in "front-end" businesses that initially receive expenditures and operating revenue as a direct consequence of operations and activities conducted.
- **Indirect impacts** arise from changes in activity for suppliers of the front-end business. For example, the purchase of rebar from a steel product manufacturer requires that the steel product manufacturer purchase refined steel from a steelmaker.

- **Induced impacts** are generated from employees of the direct industries or indirect industries affected spending their wages and salaries on household consumption and other goods and services.[4]

- The **total economic impact** equals the sum of the direct, indirect and induced impact.

The Wataynikaneyap Power Project is expected to generate significant one-time economic impacts during the construction phase of the project and ongoing economic benefits resulting from increased population and economic growth in the region due to decreased energy costs in some communities and the removal of load restrictions. Detailed expenditure data obtained from the transmission line construction company – PowerTel – during the construction phase of the project was used to estimate one-time economic impacts. The profile of expenditures over the construction horizon is provided in Section 3 of this report. Ongoing economic impacts were estimated based on a relationship between energy demand and median incomes and the IESO's load growth assumptions. While this is a higher level approach, it does reflect that there is a strong relationship between energy demand and economic growth.

Sustainable Return on Investment

SROI originated from a Commitment to Action by HDR to develop a new generation of public decision support metrics for the Clinton Global Initiative ("**CGI**") in 2007. HDR's Economics and Finance group developed SROI with input from Columbia University's Graduate School of International Public Affairs and launched at the 2009 CGI annual meeting. Since then, the SROI process has been used by HDR to evaluate the monetary value of initiatives, programs and/or projects with a combined value of over $20 billion. It has been used by corporations and all levels of government in Canada, the US and in other countries.

At its core, HDR's SROI methodology estimates a dollar value fore various environmental and social benefits and costs associated with a project, initiative and/or program, which enables a direct "apples-to-apples" comparison to a project's financial metrics. The figure at right shows the range of socioeconomic categories that comprise the SROI.

Figure 2 – HDR's SROI Methodology

The specific socioeconomic categories included in an SROI analysis depend greatly on the nature of the specific project/program/initiative and availability of underlying data. For instance, by replacing diesel generated electricity, decreasing the cost of electricity and removing load restrictions the Wataynikaneyap Power Project is expected to result in emissions reductions and other environmental benefits, economic/community development benefits and health benefits, but it is not expected to generate significant traffic congestion relief benefits, which is not surprising given the nature of the project and the geographic context. Credibly monetizing changes in socioeconomic benefit categories also requires data on how socioeconomic benefit categories will change as a result of the project and a strong evidentiary basis to enable monetization. This is a high standard to achieve and HDR's approach to estimating the

[4] For the purposes of this study, the indirect and induced economic impacts are reported together.

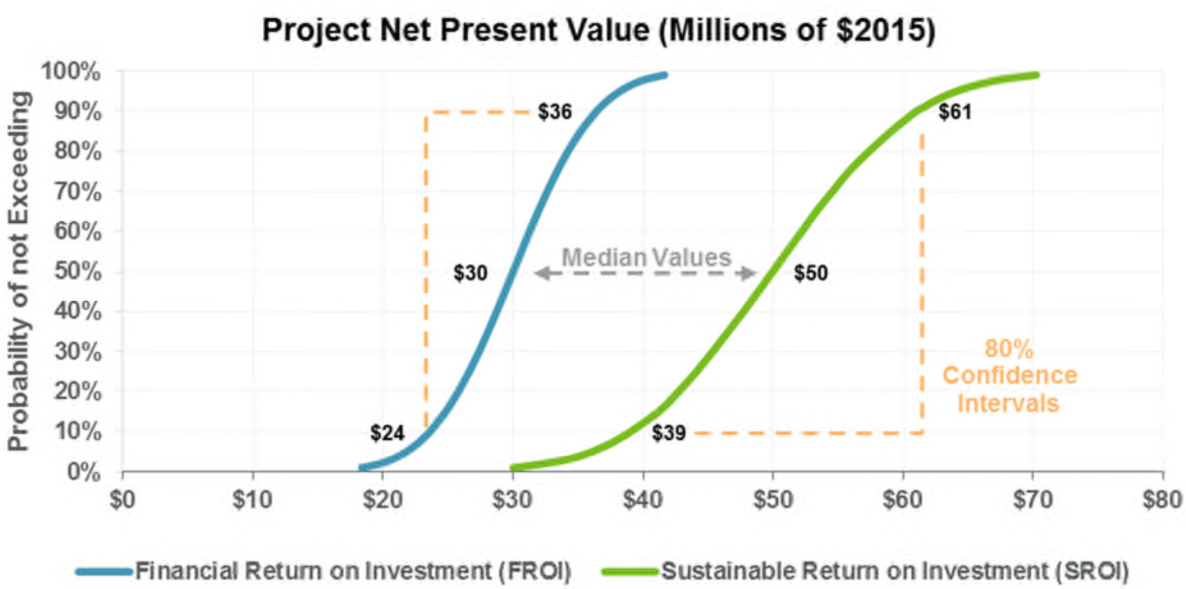
"We believe that HDR's Financial ROI and SROI dual approach is a sensible one for a utility that should consider both financial and non-financial impacts on its resident ratepayers.

– The Sierra Club

SROI of a project/program/initiative requires that it can credibly stand behind the analysis. Socioeconomic benefits and costs that cannot be credibly quantified or monetize due to a lack of data or limited peer-reviewed literature are more qualitatively assessed.

Lastly, risk analysis and Monte Carlo simulation techniques are used to account for uncertainty in both the input values and model parameters. Taking account and reflecting this uncertainty in the underlying analysis provides a more holistic evaluation of the project. For example, the monetary value associated with a reduction in Greenhouse Gas ("**GHG**") emissions ranges dramatically. HDR strongly believe that this uncertainty should be reflected in the underlying analysis and final assessment of a project's feasibility from a financial and societal perspective. Accordingly, HDR use a range of possible outcomes and the probability of each outcome (i.e., a probability distribution) to reflect this risk and uncertainty. As a result, SROI estimates are shown in the same manner – as a range of possible values. A sample output is provided in Figure 3 below.

Figure 3 – SROI sample output



SROI cumulatively builds on the FROI by adding non-financial monetized impacts like GHG emissions reductions and presents the results using several key metrics such as the net present value ("**NPV**") and the internal rate of return ("**IRR**") over the project lifecycle. In this case, the FROI net present value of the project (blue line in the figure above) is $30M at the median (50th percentile) while accounting for social and environmental project impacts increases the median NPV to $50M (green SROI line above). Looking at other sections of the SROI curve, we can see that there is a 10% chance of obtaining an NPV below $39M and conversely, a 90% chance of exceeding it; at the other end we see a 90% chance of a value below $61M and conversely a 10% chance of exceeding it. The spread between these values represents the 80% confidence interval wherein we expect the SROI project NPV to fall between $39M and $61M 80% of the time. The higher spread between the SROI values and the flatter slope relative to the FROI represent higher risk and uncertainty in the SROI outcome. A manager evaluating whether to invest in one project or another would take into consideration both the expected outcomes and the risk profile of those outcomes. The specific steps undertook to estimate the SROI of the Wataynikaneyap Power Project are listed below:

- Obtained and reviewed the financial model prepared by PwC to estimate the financial feasibility of Phase 2 of the project to ensure HDR understood the project and the key parameters and modelling assumptions. During this process, HDR met with PwC a number of times to ask questions and cement our understanding of the model.

- Reviewed past studies and other information provided by Wataynikaneyap Power to better understand the socioeconomic benefits of the project. This enabled us to hypothesize about the socioeconomic benefits of the project and determined whether HDR had enough data, information and peer-reviewed literature to credibly quantify and monetize these benefits. From past experience, HDR has amassed a significant database of literature, data and other information that HDR extensively leveraged for this engagement.

- Quantified and monetized socioeconomic benefits categories where HDR felt it had enough information to credibly estimate these benefits. Section 4 of this report provides a detailed discussion on the types of benefits that could materialize as a result of the Wataynikaneyap Power Project and which of those were monetized as part of the SROI analysis.

- Incorporated these values into PwC's financial model, which included adding uncertainty to key variables that impact the financial business case. For instance, HDR added a risk range to the existing capital cost estimates to account for the potential that construction and development costs could exceed budgeted figures. Risk ranges were added to other variables that PwC identified as having a disproportionate impact on the business case. Accordingly, HDR estimated the FROI and SROI, and while cash flows from PwC's financial model were used to calculate the Basic FROI in Figure 3 above, the FROI values are from a societal point of view and reflect risk ranges around key variables that cause the value to differ from the results of a traditional financial feasibility analysis.

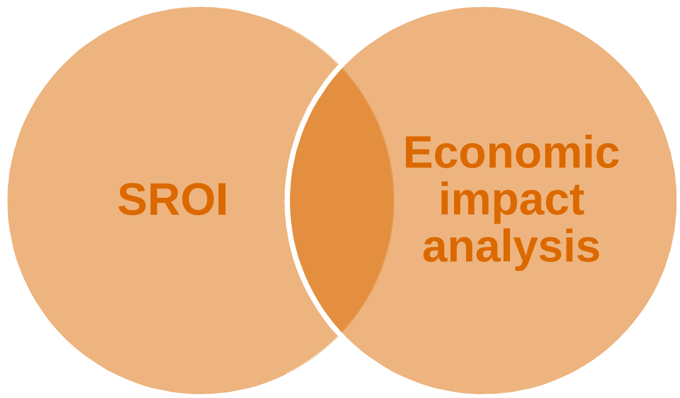
- Estimated the SROI of the Wataynikaneyap Power Project under various scenarios and met with PwC to review key findings and results.

<u>Transparency is a cornerstone of HDR's approach</u> to assessing the SROI of projects and it has provided significant detail regarding how HDR estimated the SROI of the Wataynikaneyap Power Project in Appendix A. More specifically, Appendix A provides a series of Structure and Logic diagrams that illustrate the methodology employed including the key input variables and data sources used for monetary values. We encourage the reader/user of this report to review Appendix A.

Difference between Economic Impact Analysis and Sustainable Return on Investment

This study uses two approaches to estimate and quantify the socioeconomic benefits of the Wataynikaneyap Power Project: economic impact analysis and SROI. Both approaches are valid and informative, but they help answer fundamentally different questions. **The first important point to stress is that the results of economic impact analysis and SROI cannot be added together because they in fact overlap.** Economic impact analysis translates expenditures in an economy into set of well defined economic indicators (e.g., GDP, jobs) taking into consideration the fact that spending in one industry generates spending in other industries. SROI provides a more comprehensive assessment in that non-monetary benefits are considered that do not necessarily impact economic accounts (e.g., GDP). For example, benefits from improved health outcomes can generate increased labour force productivity due to decreased sick days or days off work, which would positively impact economic accounts like GDP, and they can also result in increased quality of life, which is the subjective value individuals place on improved health outcomes. Increased quality of life, however, does not impact GDP. Identifying the proportion of socioeconomic benefits that impact economic accounts is a complex undertaking that requires significant data and information and numerous assumptions. For the purposes of this study, HDR treat the economic impact analysis and SROI as related, but separate analyses that answer fundamentally different questions.

Figure 4 – Relationship between SROI and Economic Impact Analysis



The table below summarizes the key differences between SROI and economic impact analysis.

Table 2 – Difference between Economic Impact Analysis and SROI

	Economic Impact Analysis	SROI
Fundamental questions analysis helps answer	What are economic impacts resulting from expenditures associated with the project? How many jobs will be created? What is the GDP impact?	Is this a good use of government funding? From a societal perspective, does this project generate socioeconomic benefits in excess of costs?
Definition of socioeconomic benefits/costs	Narrowly defines socioeconomic benefits that impact economic accounts in the current period.	More comprehensively defines socioeconomic benefits – includes health, environmental and other social benefits and costs that do not necessarily impact economic accounts.
How socioeconomic benefits are generated	Benefits or impacts generated from expenditures associated with a project, program and/or initiative.	Socioeconomic benefits generated from the existence of the project, program and/or initiative. In the case of a project, socioeconomic benefits generated once project is operational.
Data requirements	Requires detailed data on the project expenditures and Input-Output Tables, which are used to translate expenditures into a set of economic impacts. Other macroeconomic data is also typically required such as household expenditures.	Requires credible, peer-reviewed literature on monetary values associated with changes in socioeconomic benefit categories. Also requires data/methodology to quantify changes in socioeconomic benefits categories (e.g., reduction in GHG emissions, decreased days lost to injury).

Data

For this study, data and information was obtained from several sources. This section of the report describes the key pieces of information that HDR relied upon:

- The financial model PwC developed to estimate the financial feasibility of Phase 2 of the Wataynikaneyap Power Project was transferred to HDR at the outset of this project. In addition to being used to calculate the SROI, the financial model also provided several other inputs that HDR used for other aspects of this engagement.

- PowerTel – a utility construction company with significant experience in developing transmission lines and other energy infrastructure in remote settings – provided us with detailed expenditure data during the construction phase of the Wataynikaneyap Power Project. This included identifying labour versus non-labour expenditures and estimating the proportion of the expenditures that are expected to occur in Northwestern Ontario versus the rest of Ontario. It should be noted that the Wataynikaneyap Power Project has not undergone a detailed design as of yet and expenditure data provided are estimates at this point. It should also be noted that at the time of this study Wataynikaneyap had not selected a contractor for the project.

- The Statistics Canada Input-Output Tables were used to estimate the economic impacts of the of the Wataynikaneyap Power Project construction expenditures. Other data from Statistics Canada was also used including data and information from the 2006 Census and the 2011 National Household Survey.
- Data and information was also used (directly and more indirectly) from previous studies, which are listed in Section 1 of this report.
- HDR maintains an extensive database of data, academic literature and other relevant studies on monetary values associated with socioeconomic benefits and costs. This information was used as part of the SROI analysis and in Appendix A we reference the specific data sources used.

3. Economic Impact Analysis

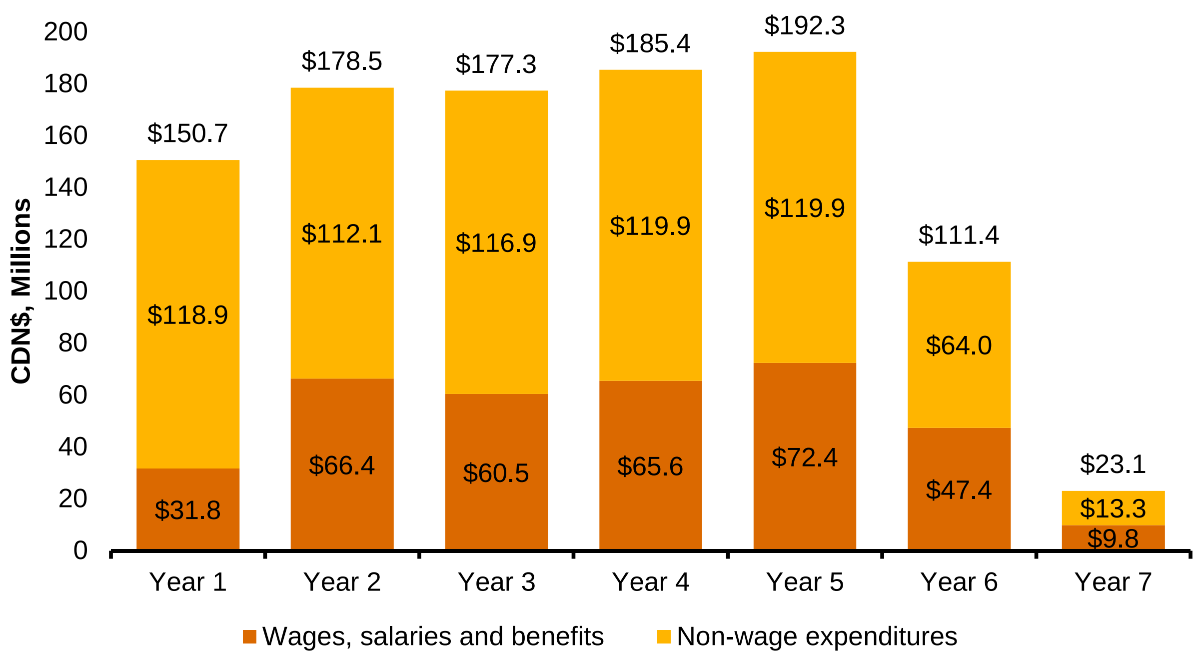
Introduction

The Wataynikaneyap Power Project is expected to generate significant one-time and ongoing economic impacts for Northwestern Ontario and the rest of Ontario and Canada. This section of the report lays out the results of the economic impact analysis. Refer to Section 2 of this report for a description of the methodology employed and definitions for key terminology. As noted in Section 2, economic impacts are driven by expenditures associated with the project. Accordingly, we begin with laying out the expenditure profile of the Wataynikaneyap Power Project during the construction phase, which at the time of this report, is expected to begin in 2017.

Expenditure Profile of the Project

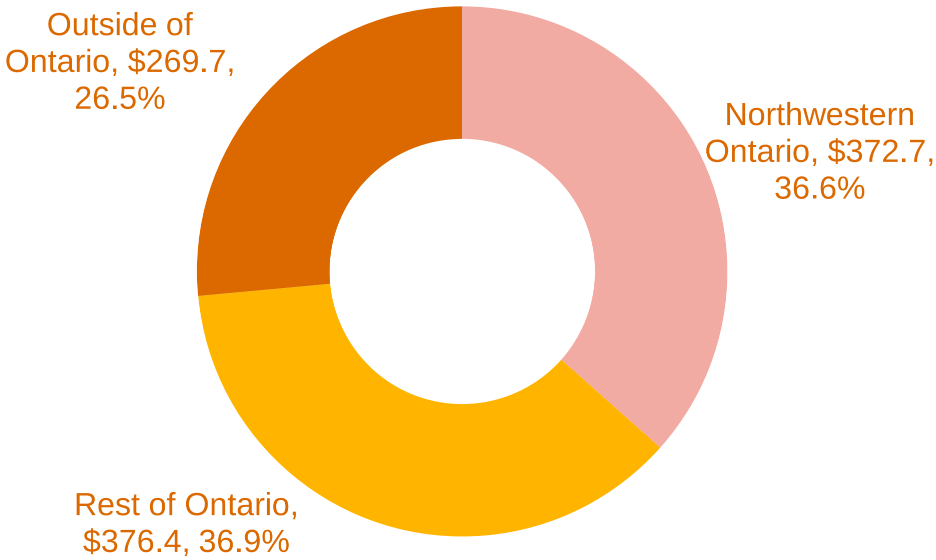
Figure 5 below shows the annual construction and development expenditures associated with the Wataynikaneyap Power Project by expenditure type (wage versus non-wage expenditures).

Figure 5 – Annual Wataynikaneyap Power Project Construction and Development Expenditures by Expenditure Type



Like many multi-year construction projects, annual construction and development expenditures associated with Wataynikaneyap Power Project are expected to vary considerably over the construction period. In Year 1, construction expenditures are expected to total $150.7million, of which $31.8 million are wages, salaries and benefits and $118.9 million are purchases of supplies, equipment and construction materials. In Year 5, construction expenditures are expected to reach a high of $192.3 million including $72.4 million in employment expenditures. During this period, Wataynikaneyap Power is expected to be directly employing 225 individuals in the construction of the project. Figure 6 below shows the geographic distribution of the construction and development expenditures associated with the Wataynikaneyap Power Project.

Figure 6 – Annual Wataynikaneyap Power Project Construction and Development Expenditures by Geography, 2017 to 2023 (CDN$, Millions)



Based on expenditure projections provided by PowerTel, a large proportion of Wataynikaneyap Power Project's construction and development expenditures are expected to remain in Ontario and nearly 37% of these expenditures are expected to remain in Northwestern Ontario. If more source materials and suppliers were available in the region, this number would be higher. Approximately the same amount is expected to occur in other parts of Ontario. A significant proportion, roughly 27%, is expected to occur outside of Ontario.

> *"As owners in the project, we want to ensure that our communities get maximum benefit from this very important infrastructure project."*
>
> – Margaret Kenequanash, Chair - Wataynikaneyap Power

In comparison to some of the previous economic impact study, the methodology used in this study to measure the one-time economic impacts arising from construction and development expenditures focuses on specifically determining expenditures that occur in Northwestern Ontario and other parts of Ontario, which provides a more refined estimate of these economic impacts.

One-time Economic Impacts

During the construction phase, which commences in 2017 and lists until 2023, the Wataynikaneyap Power Project is expected to generate significant economic impacts for Northwestern Ontario, the province of Ontario and the rest of Canada. Table 3 below shows the average annual economic impacts resulting from construction and development expenditures associated with the Wataynikaneyap Power Project. Appendix D provides the annual economic impact results for each year of the construction horizon.

Table 3 – Cumulative Impacts from Construction and Development of the Wataynikaneyap Power Project, 2017 to 2023

	GDP (CAD$, Millions)	Wages and Salaries (CAD$, Millions)	Employment (FTEs)	Government Revenues (CAD$, Millions)
Canada				
Direct	$705.1	$404.6	365.4	$162.3
Indirect	$262.0	$60.6	128.3	$60.3
Induced	$222.6	$107.5	275.7	$51.2
Total	**$1,189.7**	**$572.6**	**769.4**	**$273.8**
Ontario				
Direct	$705.1	$404.6	365.4	$162.3
Indirect	$72.9	$47.9	100.9	$16.8
Induced	$179.3	$86.1	219.1	$41.3
Total	**$957.3**	**$538.5**	**685.3**	**$220.3**
Northwestern Ontario				
Direct	$320.0	$175.8	210.4	$73.6
Indirect	$0.4	$0.2	0.5	$0.1
Induced	$41.3	$19.8	50.5	$9.5
Total	**$361.7**	**$195.9**	**261.4**	**$83.2**

From 2017 to 2023, the Wataynikaneyap Power Project's construction and development expenditures are expected to contribute on a cumulative basis $1,190 million and $957 million in GDP to Ontario and Canada respectively over the construction period. Of this, the Wataynikaneyap Power Project is expected to directly contribute $320 million to Northwestern Ontario's GDP on cumulative basis. Including indirect and induced effects, the GDP contribution to Northwestern Ontario grows to $362 million over the construction horizon. Indirect impacts are small due to the fact that the industries supplying Wataynikaneyap Power Project's construction are much more concentrated in other parts of Ontario. Indeed, the data suggests that supplying industries have very limited supply chains in

"During the construction phase, the Wataynikaneyap Power Project is expected to generate almost 770 jobs across Canada, with nearly 261 jobs in Northwestern Ontario."

– HDR Corporation

Northwestern Ontario. Induced impacts, which result from employees spending their wages, are more highly concentrated in Northwestern Ontario than indirect impacts.

In terms of employment, expenditures resulting from the construction and development of the Wataynikaneyap Power Project are expected to directly generate roughly 325 jobs across Ontario. This includes direct employment at Wataynikaneyap Power and from its non-wage expenditures, which generate and support employment in other companies. Including further downstream indirect and induced impacts, the construction and development of the Wataynikaneyap Power Project is expected to generate on average 595 jobs in Ontario over the construction period of the project. Approximately 261 of these jobs are expected to be generated in Northwestern Ontario. Nearly all of the indirect employment impact is generated outside of Northwestern Ontario for the same reasons described above.

Overall, the results of the economic impact assessment of the Wataynikaneyap Power Project's development and construction expenditures suggest the following:

- The construction and development of the project is expected to generate significant economic impacts across Ontario. The average annual GDP impact of $115.4 represents about 0.02%[5] of Ontario's economy in 2014, which is a relatively large number for one construction project to account for, particularly where expenditures are spread out over several years.

- Economic impacts from the construction of the Wataynikaneyap Power Project are shared across Ontario. Indeed, roughly 62% of the total GDP impacts are expected to be generated in regions outside Northwestern Ontario.

- Northwestern Ontario and the First Nations communities in the region are also expected to benefit significantly in terms of jobs and economic growth as a result of the construction of the Wataynikaneyap Power Project. Discussions with community members indicated that the construction of the project is expected to play an important role in providing opportunities for young people to deepen and enhance their skills. Economic benefits arising from these opportunities are not reflected in the estimates above and are potentially significant. The table below provides a list of relevant job classifications associated with the construction and development of the Wataynikaneyap Power Project. Many of these would be considered high skilled jobs.

> *"Construction of the Wataynikaneyap Power Project provides young people in our community an opportunity to deepen and strengthen their skills in areas with significant demand."*
>
> – Mitchell K. Diabo, General Manager, Kasabonika Lake Community Development Corporation

[5] This is based on a nominal GDP of $721 billion in Ontario in 2014. See Ontario Fact Sheet (May 2015). Ontario Ministry of Finance. Retrieved from http://www.fin.gov.on.ca/en/economy/ecupdates/factsheet.html.

Table 4 – List of Potential Job Classification associated with the Development and Operations of the Wataynikaneyap Power Project[6]

Wataynikaneyap Power Project Job Classifications			
Clerical/site administrators	Environmental laborers	Silviculture technicians	Gradesmen
Site security guards	Environment monitors	Geological surveyors	Welders
Site safety managers	Construction layout surveyors	Dump/Rock truck drivers	Pipe fitters
Site supervisors	Legal surveyors	Drillers/blasters	Batch plant operators
Foremen	Low-voltage electricians	Excavator/dozer operators	Carpenters
First aid attendants	Surveyors	Loader/grader/crusher operators	Iron workers
Quality control engineers	Fallers/Chokemen	Snow removal operators	Crane operators
Aboriginal relations coordinators	Skidder operators	Excavator operators	Concrete truck drivers
Drivers	Logging truck drivers	Rock truck drivers	Linemen
Fire suppression experts	Cutblock layouts	High voltage electricians	Millwrights and assistants
HVAC technicians	Plumbers	Fuel suppliers	Heavy duty mechanics
Cooks	Cleaners	Other support services	

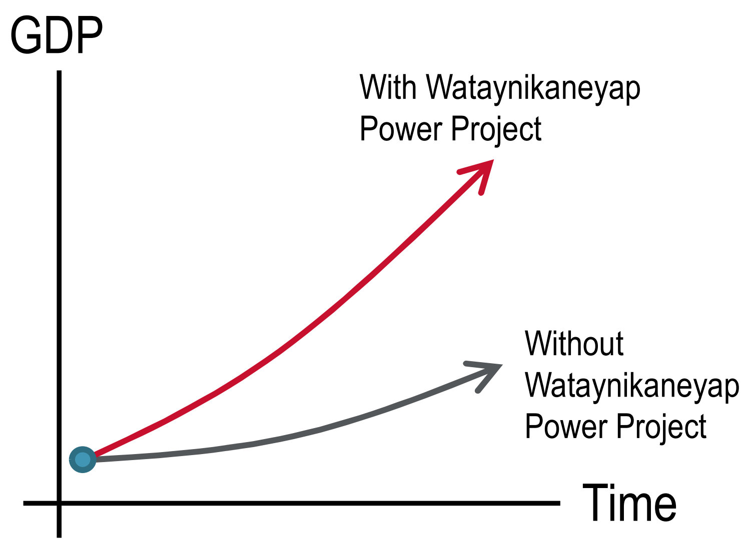
Future Economic Growth

In addition to generating one-time economic impacts from construction and development activities, the Wataynikaneyap Power Project has the potential to generate significant on-going economic growth in Northwestern Ontario and especially for the First Nations communities the will be connected to Ontario's electricity grid. The Wataynikaneyap Power Project is expected to increase the rate of economic growth in

[6] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

the region and in affected communities as demonstrated by the illustration in Figure 7, resulting in a sustained increase in GDP relative to the no-build scenario.

Figure 7 – Economic Growth with and without the Wataynikaneyap Power Project (Illustrative Example)



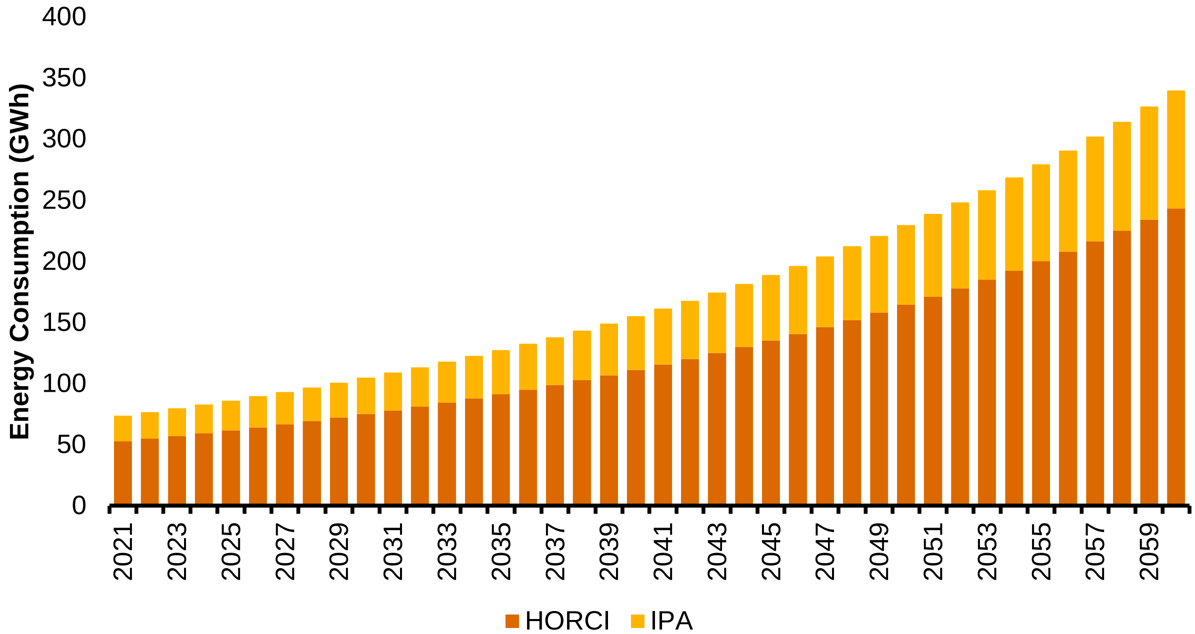
The Wataynikaneyap Power Project is expected to alleviate load restrictions in communities that are currently facing them or will be facing them in the future. Load restrictions severely hinder development and economic growth in affected communities by limiting and even halting growth in the community: businesses cannot develop or expand, families cannot build new homes or purchase appliances and the community cannot develop or provide electricity for new infrastructure. While Aboriginal Affairs and Northern Development Canada (“**AANDC**”) is mandated to provide funding to enable growth in First Nations communities the reality is that obtaining funding to upgrade diesel generation facilities is dependent on federal budgets and can take several years to implement. For example, in 2010, the First Nations community of Kasabonika Lake First Nation issued a press release stating federal funding for an approved upgrading of the community’s local diesel power generating station will have to wait another 5 years; the power station had reached maximum capacity in 2007.[7] Interviews with community members from other First Nations communities indicated similar frustrations. Furthermore, some community representatives also suggested that that load restrictions in their communities even limited their ability to provide electricity to new homes and other community infrastructure that were recently developed.

As a result of load restrictions, the demand for electricity exceeds the available supply, which means that economic growth is constrained too. The diagram shows the IESO’s projected energy consumption for communities that currently comprise the Wataynikaneyap Power Project assuming the removal of load restrictions.

> *“The new houses are sitting empty. They have constructed them and they are just sitting there because the electrical capacity is not there to hook them up.”*
>
> – Simon Sakakeep, Kingfisher Lake First Nation

[7] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

Figure 8 – IESO's Projected Unconstrained Energy Consumption for Wataynikaneyap Power Project Communities



The OPA forecasts that by removing load restrictions energy consumption in the region is expected to increase from 73.6 GWh to 333.9 GWh from 2021 to 2060, which represents a 4% compounded annual growth rate ("CAGR"). As the numbers suggest, this is a significant increase in electricity consumption. A strong relationship exists between energy demand and economic growth: increased energy demand leads to increased economic growth (i.e., GDP growth) and vice versa. Using parameters from developing countries (China and India), HDR estimate that a 4% annual increase in load growth will result in 2% to 6% GDP growth in the region. See Appendix E for more detail regarding how this high level estimate was developed.

"Ontario's Far North has tremendous mineral potential, but will require investments in adequate infrastructure."

– Ontario Mining Association

The industrial structure of an economy plays an important role in determining the relationship between energy demand and economic growth. Generally speaking, economies with a higher degree of energy intensive industries will be more sensitive to changes in the availability of electricity. Resource extraction based industries, which are important economic drivers for Northern Ontario, are extremely energy intensive. By providing access to low cost grid power, the Wataynikaneyap Power Project can help unlock Northwestern Ontario's resource potential. For instance, Phase 1 of the Wataynikaneyap Project will reinforce the grid at Pickle Lake and provide sufficient capacity to serve the needs of Goldcorp's Musselwhite Mine, which provides greater operating certainty for the mine's operations and expansion. While the primary purpose Phase 2 is to meet the electrical needs of the communities, the project also provides capacity that is supportive of mining exploration and development efforts in the region.[8] Availability of infrastructure is a key driver –

[8] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

and in many respects the most important driver – in determining the location of mining investment. Jurisdictions that can attract a higher proportion of mining investment today will be the ones that supply the world's demand for these natural resources tomorrow. The same can also be said about other natural resource industries. All project participants – First Nations, government and industry – cannot lose sight of this imperative. The Wataynikaneyap Power Project can help address the current energy infrastructure gap, which can unlock Northwestern Ontario's resource potential, including clean energy projects. According to the Ontario Waterpower Association, 275 MW of developable waterpower has been identified in proximity to the remote First Nations communities that would be served by the project. Many First Nations communities have made significant progress advancing these projects. Grid connection is required in order to make the projects feasible and sell the energy into the Ontario energy market.[9] Community members interviewed also discussed the potential for various solar projects.

> *"Ontario's Far North holds significant waterpower potential and there are a number of communities actively pursuing development opportunities."*
>
> – Ontario Waterpower Association

Summary of Key Findings

The Wataynikaneyap Power Project is expected to generate significant economic impacts and benefits for First Nations communities, Northwestern Ontario, the rest of Ontario and the rest of Canada more broadly. Economic impact and benefits generated from the construction and development of the project, which are forecasted to contribute on a cumulative basis $1,190 million and $957 million in GDP to Ontario and Canada respectively over the construction period and generate and support roughly 261 jobs in Northwestern Ontario during the construction period. Once operational, the Wataynikaneyap Power Project will help alleviate load growth restrictions, which hinder economic growth in the region. Access to transmission infrastructure is a key component for natural resource development in Northwestern Ontario, in particular, the Far North. Natural resource development would create additional spin off benefits for the region. The construction of the project also provides opportunities for skills development, which many stakeholders HDR interviewed indicated were an important part of the benefits of this project and can generate significant economic growth beyond just the construction impacts.

[9] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

4. Sustainable Return on Investment

Introduction

This section of the report outlines and describes the results of the SROI analysis component of our engagement. In essence, HDR's SROI methodology monetizes socioeconomic benefits (e.g., decreased traffic congestion, improved health outcomes), which enables an apples-to-apples comparison of a project's financial costs to its impacts on society that might otherwise be disregarded as intangible. Section 2 of this report provides a more detailed description of our SROI methodology. Transparency is a cornerstone of our SROI approach and Appendix A provides a detailed description of the methodology employed and data sources used for the assessment of Wataynikaneyap Power Project's SROI. A glossary of key terms pertaining to the SROI analysis is provided in Appendix B. Given the uncertainty associated with various inputs in our SROI analysis, HDR use Monte Carlo simulations to consider a full range of possible outcomes. As a result, SROI results are presented both as mean expected values and as confidence intervals where a certain level of confidence is assigned to a range of potential outcomes. The financial feasibility study completed by PwC showed that the FROI is extremely sensitive to future load growth assumptions. Accordingly, one of HDR's sensitivity analyses presents FROI and SROI results with variability around the load growth input.[10] Within the next few months the Province of Ontario is expected to adopt market-based carbon pricing under a new cap-and-trade system.[11] To account for this, HDR produced SROI results under various carbon pricing scenarios. HDR begin by listing and describing the range of socioeconomic benefits that the Wataynikaneyap Power Project could generate based on its understanding of the project, a review of past studies and relevant literature, and discussions with key stakeholders.

Figure 9 – Relationship between FROI and SROI

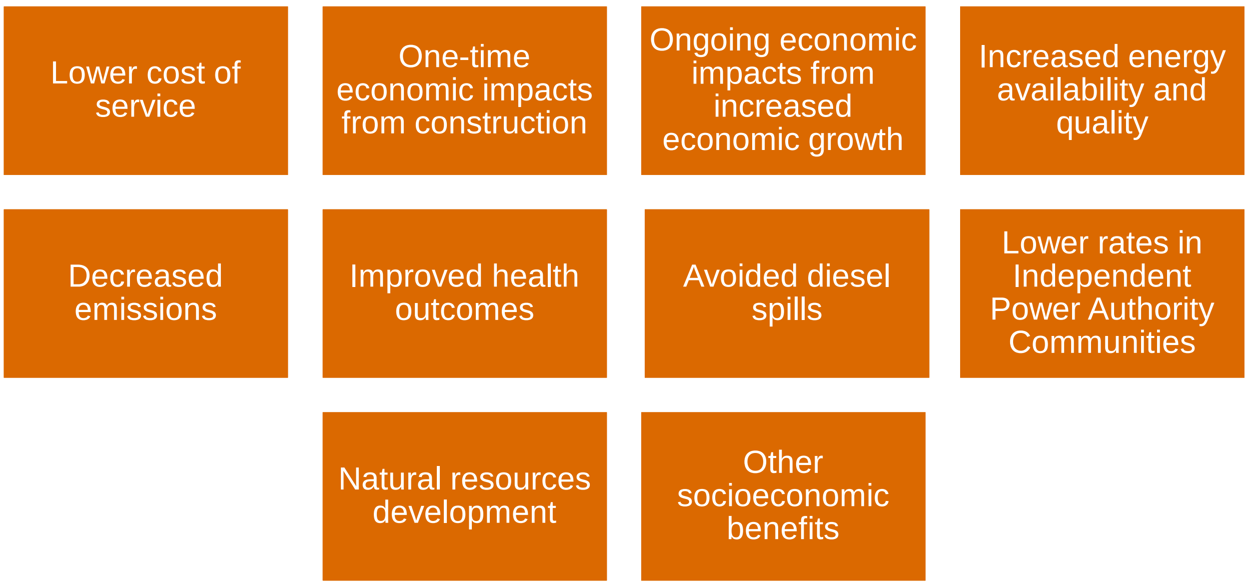
Socioeconomic Benefits of the Wataynikaneyap Power Project

By dramatically changing the way power is delivered and consumed in remote communities in Northwestern Ontario, the Wataynikaneyap Power Project has the potential to generate significant

[10] Please note that the financial model developed by PwC for the report they completed on the financial feasibility of Phase 2 of the Wataynikaneyap Power Project was used to calculate the FROI of the project.
[11] Ontario adopts cap-and-trade system to reduce greenhouse gases – Ontario, Quebec and California team up on cap-and-trade system (2015). CBC News. Retrieved from http://www.cbc.ca/news/politics/ontario-adopts-cap-and-trade-system-to-reduce-greenhouse-gases-1.3030996.

socioeconomic benefits for First Nations communities in Northwestern Ontario and for the rest on Ontario and Canada. This section of the report describes and lists these benefits presented in the diagram below. For each socioeconomic benefit category, HDR briefly describe how these benefits result and whether they are material enough and whether there is sufficient underlying data and information to warrant and enable monetization. As noted in Section 2 in the description of the SROI methodology, socioeconomic benefits are only monetized where there is adequate information that enables us to monetize these benefits on a credible and defensible basis.

Figure 10 – Potential Socioeconomic Benefits of the Wataynikaneyap Power Project



Lower cost of service

The financial business case (i.e., the FROI) of the Wataynikaneyap Power Project relies on the cost savings from replacing expensive diesel generated power with lower cost grid power. In addition to the avoided cost of diesel fuel, there would be significant savings from diesel transportation costs and generator operating, maintenance, and replacement costs. These benefits are already monetized as part of the FROI, and are thus part of the SROI.

One-time economic impacts from construction

As reported in Section 3 of this report, the Wataynikaneyap Power Project is expected to generate significant economic impacts over the construction and development period of the project. HDR estimate that the construction of the Wataynikaneyap Power Project is expected to contribute on average $115 million per year in GDP to Ontario's economy and support roughly 261 jobs in Northwestern Ontario during the construction period, which begins in 2017 and lasts until 2023. Due to the overlapping nature of economic impact analysis and SROI (see Section 2), economic impacts are not added to the FROI to calculate the SROI of the project.

Ongoing economic impacts from increased economic growth

The Wataynikaneyap Power Project is also expected to increase the rate of economic growth in Northwestern Ontario by helping alleviate load growth restrictions, which hinder business and community development, and by providing access to grid power for development projects in the region. Section 3 of this report provides a more detailed description of how the Wataynikaneyap Power Project is expected to generate future economic growth and HDR have used a high level approach to provide an indication of what this future economic growth may look like. To some extent, these benefits are already included in the FROI. The FROI of the Wataynikaneyap Power Project monetizes decreased energy costs based on unconstrained load growth (the IESO estimated 4% per annum load growth over the 40-year life of the project). Discussions with stakeholders and reviewing some of the past studies indicate that many communities that rely on diesel generated electricity face load restrictions. The difference between the unconstrained and constrained FROI, which is not calculated as part of this study, provides a very rough and likely conservative proxy for the value of future economic growth generated from the Wataynikaneyap Power Project.

Increased energy availability and quality

Communities in Northwestern Ontario can face considerable energy reliability issues; especially those communities that currently face load restrictions. Members of these communities indicated that blackouts can occur relatively frequently due to system overloads – the demand for electricity exceeding the available capacity. Unfortunately, this is most likely to occur in the winter months when the demand for electricity peaks and when electricity is most needed. Moreover, when the diesel generators are restarted power surges can occur, which have the potential of damaging appliances and other equipment. Further studies are required to determine how the reliability from transmission service would compare to the existing diesel generation service. For instance, disruptions to the transmission line which can occur for a variety of reasons would likely take a significant amount of time to repair due to the wide geographic coverage of the Wataynikaneyap Power Project. Regardless of the geographical challenges, the transmission system will need to meet the operating standards set by IESO. Due to the uncertainty of reliability benefits, HDR have not quantified or monetized these benefits as part of the SROI analysis.

> *"Current diesel generation does not meet the demands of our community. The lights can go off at any time."*
>
> – Harry Meekis, Capital Projects Manager, Sandy Lake First Nation

Decreased emissions

Connecting Northwestern Ontario's remote communities to the provincial electricity grid is expected to significantly decrease harmful emissions: carbon dioxide ("**CO_2**") and its equivalents, nitrous oxide ("**NO_x**"), volatile organic compounds ("**VOCs**"), particulate matter ("**PM**") and sulphur dioxide ("**SO_2**"). Diesel generation is one of the most emissions-intensive forms of power generation and is significantly more harmful to the environment than the Ontario power grid, which is primarily comprised of renewable energy sources, clean nuclear power, and gas which is the cleanest form of fossil fuel generation. Moreover, harmful emissions are generated from the transport of diesel gas to these communities, which can be quite significant. The Wataynikaneyap Power Project is expected to decrease emissions by replacing diesel fuel with a more environmentally friendly source of energy and by removing the need to transport diesel gas to these communities. The methodology used to monetize these benefits accounts for both sources of emissions and nets out emissions generated from electricity supplied by Ontario's power grid. These benefits are monetized and included in the SROI. See Appendix A for a detailed description of the methodology employed and data sources used.

Improved health outcomes

Combustion of diesel gas can lead to adverse health outcomes and increased prevalence of respiratory disease. First Nations children are disproportionately

> *"People are living in houses that only have a temporary supply of electricity."*
>
> – Bill Sainnawap, Big Trout Lake First Nations

affected by respiratory infections such as bronchiolitis, pneumonia and tuberculosis.[12] Furthermore, the prevalence of asthma is 40% higher in First Nations and Inuit communities than in the general population.[13] For instance, PM, which is generated from the combustion of diesel gas and other fossil fuels, is a leading cause of premature death. The World Health Organization ("**WHO**") estimates that PM air pollution contributes to approximately 800,000 premature deaths each year, ranking it as the 13th leading cause of mortality worldwide.[14] The Wataynikaneyap Power Project is expected to significantly reduce these harmful emissions and thus result in improved health outcomes, which HDR have monetized as part of the SROI analysis. The methodology used to quantify the reduction in criteria air contaminants and to monetize human health impacts is based on social values found in widely accepted literature.[15] See Appendix A for more information.

Avoided diesel spills

Risk of accidental spills associated with the transport of fuel oil into remote communities is well documented. Accidental spills of diesel fuel can generate significant environmental damage and can be costly to remediate and there is always a risk of significant spill occurring during transportation. The previous impact study completed by Lumos Energy indicated that one litre of fuel oil can contaminate one million litres of drinking water with clean-up costs ranging from $250,000 to $500,000, which was based on estimates provided by the Insurance Bureau of Canada.[16] AANDC's long term capital plan also suggests that accidental diesel spills is a relatively wide spread problem: "AANDC has identified and documented 2,495 potential contaminated sites on First Nation reserves. Approximately 60% of these sites are related to hydrocarbon contamination of soil caused by leakage of hydrocarbons from storage facilities (i.e., underground/above ground fuel storage tanks, fuel barrels and drums)."[17] These benefits are also monetized and included in the SROI. Appendix A shows how HDR have estimated the monetary value of avoided diesel spills resulting from connecting remote communities in Northwest Ontario to the provincial power grid.

Other socioeconomic benefits

Interviews with stakeholders also indicated that the Wataynikaneyap Power Project could result in a variety of other socioeconomic benefits that are not necessarily included in the SROI analysis. Socioeconomic benefits described in this section of the report are difficult to quantify and monetize on a credible basis, but are important nonetheless. Many of the stakeholders interviewed suggested that the Wataynikaneyap Power Project would improve the quality of life of individuals within their respective communities. These benefits materialize from a variety of factors including some listed above (e.g.,

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[12] Respiratory disease in Canadian First Nations and Inuit children (2012). Pediatrics and Child Health. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3448538/.

[13] National Lung Health Framework, Phase 1 Lung Health Program, An Exploration of First Nations and Inuit Perspectives on Community Respiratory Health Awareness. Retrieved from http://www.asthma.ca/adults/nlhf_executivesummary.pdf.

[14] Clearing the air: a review of the effects of particulate matter air pollution on human health (2012). American College of Medical Toxicology. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22194192.

[15] PM that is less than 10 micrometers in diameter is referred to as PM_{10}. PM less than 2.5 micrometers is referred to as $PM_{2.5}$ or as "fine particulate matter" and are believed to pose the greatest health risks.

[16] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

[17] Project Benefits Study – Social, Environmental and Economic Analysis: Wataynikaneyap Power Project (2013). Lumos Energy. Retrieved from http://www.wataypower.ca/sites/default/files/Project%20Benefits%20Study%20-%20Wataynikaneyap%20Power.pdf.

improved health outcomes, removal of load restrictions). Social values used to monetize socioeconomic benefits as part of the SROI reflect impacts on quality of life since they are typically estimated using revealed preference or contingent valuation approaches.[18] Accordingly, social values used in this study generally include quality of life benefits, but due to the methods used to estimate these parameters it is difficult to determine the specific value of these benefits.

Other benefits are not included in the SROI analysis because there are no credible valuation methods and/or due to a lack of data and information. The Wataynikaneyap Power Project will be a First Nations lead project and stakeholders indicated that it will be the largest project ever developed by First Nations in Northern Ontario. Some stakeholders stated that developing this project would provide First Nations communities a sense of pride and self-esteem. In conjunction with the know-how and experience gained from developing this project, an increased sense of confidence can generate significant future benefits as new projects are conceived of and undertaken. Socioeconomic benefits such as these are not included in our SROI analysis, but are important to mention and include in the broader assessment of this project.

SROI of the Wataynikaneyap Power Project

This section of the report shows the results of the SROI analysis of the Wataynikaneyap Power Project. To reiterate, HDR's SROI methodology estimates a dollar value for socioeconomic benefits and by doing so enables a like comparison to the financial metrics of a project. Transparency is a cornerstone of its approach and we have provided significant detail in Appendix A to ensure that the user of this report understands how HDR have calculated the SROI and what data sources we have used.

It is equally important to note that the financial analysis of the Wataynikaneyap Power Project was calculated by PwC which drove the FROI results of our analyses. At the outset of this engagement, PwC provided us with the model used to assess the financial feasibility of the project. The SROI model HDR developed for this engagement was developed as an overlay to PwC's financial model, which was augmented with risk ranges around key model variables and parameters such as the price of diesel gas and capital costs. Appendix A lays out the assumptions it used in this regard.

The PwC report showed that the FROI of the Wataynikaneyap Power Project is highly sensitive to future load growth assumptions. The IESO indicated that electricity consumption would increase by 4% per annum over 40 years. In addition to presenting SROI results under this assumption, HDR have shown a Load Growth Sensitivity where the annual load growth assumption is allowed to vary from 1% to 4% (i.e., in any given year the load growth assumption can take a value from 1% to 4% with a normal distribution). The Carbon Value Sensitivity shows SROI results where HDR have used data from the California Carbon Allowance Futures market to value GHG emissions reductions in contrast to the social values found in literature. The distinction between a social value and a market-based traded price of CO_2 emissions is that a social value reflects the value of true anticipated damages to society in the form of climate change, health impacts, etc. from each incremental ton of emissions. A market-based price on the other hand is a policy tool that is meant to change behaviour and achieve broader environmental goals. While the social cost of carbon is the appropriate value to be used in a Sustainable Return on Investment analysis, a sensitivity analysis with market-based prices can add perspective and provide practical estimates to industry stakeholders that may participate in the cap and trade program.

Base Transmission Case

Under the Base Transmission Case HDR have used the IESO's load growth assumption of 4% per year and monetized GHG emissions reductions using social values – specifically, each tonne of CO_2-equivalent reduction is valued using a distribution that ranges from $19 per tonne to $151 per tonne with a median

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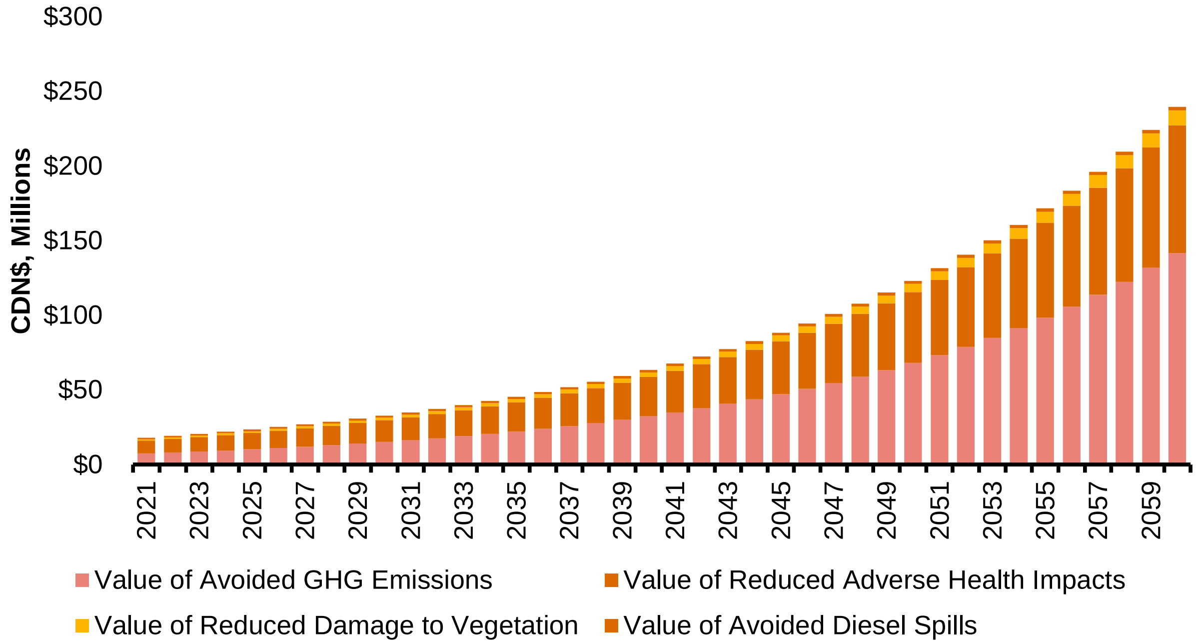
[18] For a description of revealed preference and contingent valuation approaches, see "Valuing non market goods: A comparison of preference-based and experience-based approaches". Retrieved from http://cep.lse.ac.uk/seminarpapers/25-02-08-DOL.pdf.

value of $54 per tonne and an expected value of $82.[19] Figure 11 below shows the monetary value of the socioeconomic benefits of the Wataynikaneyap Power Project under the Base Transmission Case.

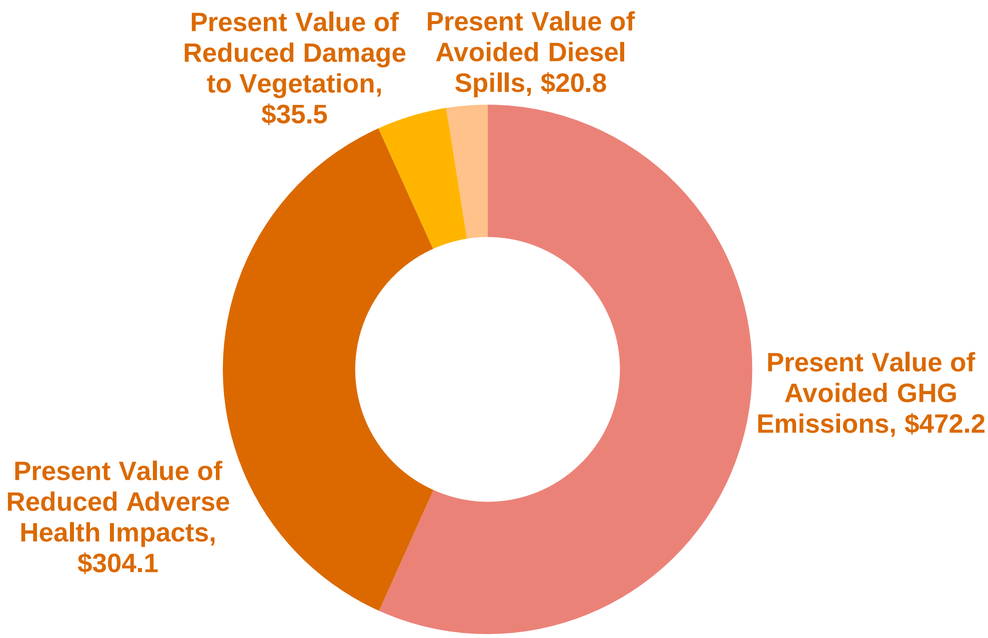
Figure 11 – Base Transmission Case, Socioeconomic Benefits of the Wataynikaneyap Power Project by Type, 2021 to 2060



Socioeconomic benefits of the Wataynikaneyap Power Project start out relatively small, but increase significantly over the 40 year analysis period. In 2021, the mean monetary value of avoided GHG emissions, reduced adverse health impacts, reduced damage to vegetation and avoided diesel spills sums to roughly $18 million. In 2060, the project is expected to result in annual socioeconomic benefits of $240 million at the mean, which is a significant increase from 2021 levels. On an absolute basis, most of this growth occurs in the latter part of the study period and is driven to a large extent by the 4% load growth assumption provided by the IESO. Much like the FROI, the SROI of the project is highly sensitive to this assumption which is not surprising given that socioeconomic benefits of the project are driven largely by the replacement of diesel generated electricity with a cleaner source. The greater the load growth, the greater the amount of diesel generated electricity that can be displaced by the Wataynikaneyap Power Project. Figure 12 below shows the distribution of the present value of the socioeconomic benefits of the Wataynikaneyap Power Project.

[19] See Appendix A for additional information on the values and their sources

Figure 12 – Base Transmission Case, Present Value over 40 Years of Socioeconomic Benefits of the Wataynikaneyap Power Project by Type ($CDN, Millions)

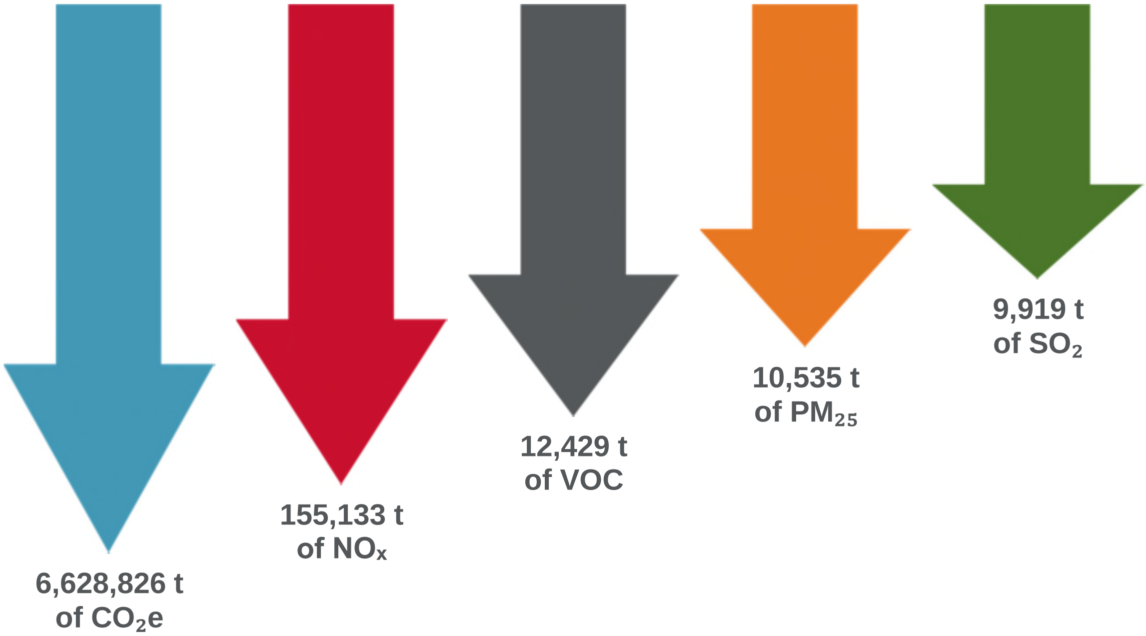


At the mean, the present value of the socioeconomic benefits of the Wataynikaneyap Power Project under the Base Transmission Case amount to roughly $833 million. Avoided GHG emissions represent the majority of the monetized socioeconomic benefits – approximately $472 million. Reduced adverse health impacts also represent a sizeable share of the socioeconomic benefits – $304 million or 37% of the total. It should be noted that HDR discount future socioeconomic benefits at different rates depending on the type of socioeconomic benefit, which follows standard practice in the cost-benefit literature (see Appendix A). GHG emissions reductions are discounted using 3% real discount rate and all other socioeconomic

> *"Over 40 years, the Wataynikaneyap Power Project is estimated to result in over 6.6 million tonnes of avoided CO_2 equivalent GHG emissions, which is comparable to taking almost 35,000 cars off the road."*
>
> – HDR Corporation

benefits and financial costs are discounted using a 4% rate. Socioeconomic benefits of the project are driven by emissions reductions; Figure 13 below shows the total emission reduction of the project by type.

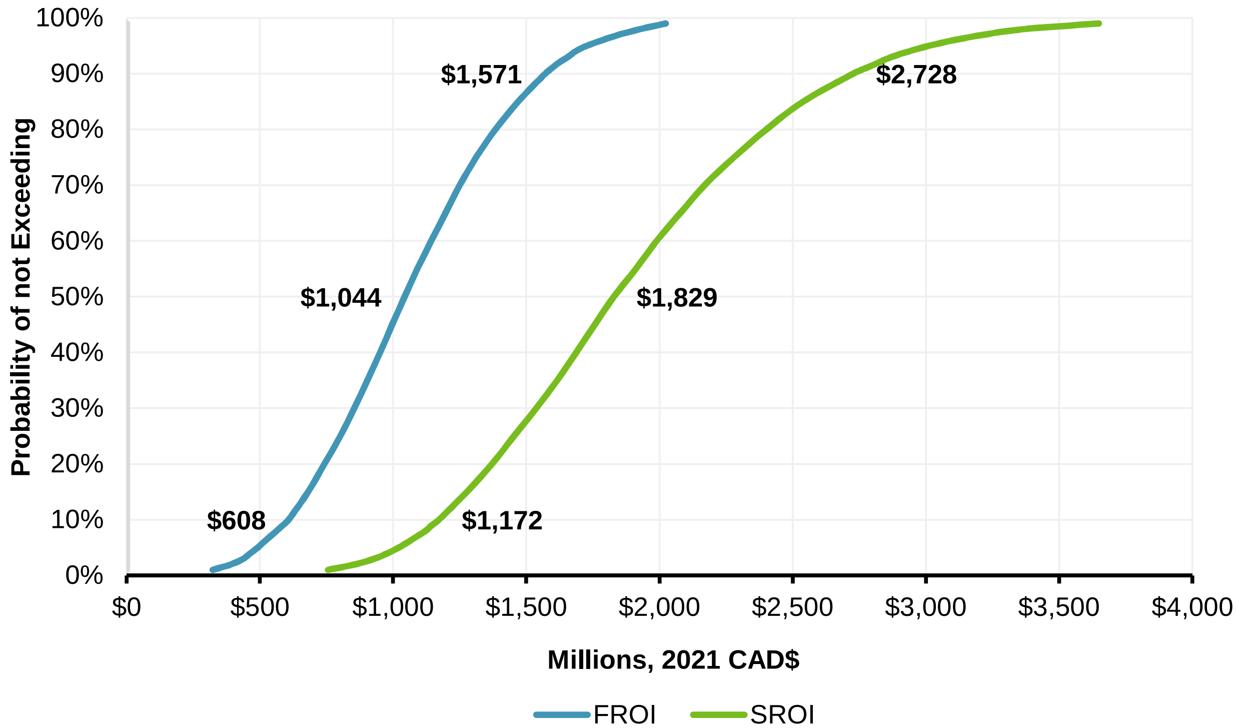
Figure 13 – Base Transmission Case, Total Emissions Reductions of the Wataynikaneyap Power Project



To calculate emissions reductions, HDR consider not only emissions generated by diesel generators, but also emissions generated from transporting diesel gas to each community by truck and aircraft, less the incremental emissions generated by Ontario's power grid. Appendix A provides a detailed description of the methodology employed and data sources used to calculate emissions reductions. Under the Base Transmission Case, the Wataynikaneyap Power Project is estimated to result in over 6.6 million tonnes of avoided CO_2 equivalent GHG emissions, which is comparable to taking almost 35,000 cars off the road. The project is also expected to result in significant reductions of criteria air contaminants like $PM_{2.5}$, which are related to respiratory and cardiovascular disease.[20] The diagram below shows the distribution of the net present values (FROI and SROI) of the Wataynikaneyap Power Project under the Base Transmission Case.

[20] Particle Pollution and Health (2012). Environment Protection Agency. Retrieved from http://www.epa.gov/air/particlepollution/2012/fshealth.pdf.

Figure 14 – Base Transmission Case, FROI and SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years



The diagram above shows the distribution of the financial and sustainable net present value (FROI and SROI) of the Wataynikaneyap Power Project under the Base Transmission Case. S-curves in the diagram above illustrate the confidence interval of the financial and sustainable net present value. At any point along the curve they show the probability of not exceeding a specific value. For instance, at the 10th percentile there is a 10% chance of the FROI and SROI not exceeding $608 million and $1,172 million respectively. Put another way, there is a 90% chance of an outcome higher than these values. The results shown above suggest the following important points regarding the business case of the Wataynikaneyap Power Project:

- Under the Base Transmission Case, the financial net present value of the project at the median (50th percentile) exceeds $1.0 billion. Incorporating the monetized value of socioeconomic benefits to the FROI to calculate the SROI shows that the Wataynikaneyap Power Project generates benefits in excess of $1.8 billion at the median.

- Even at the 10th percentile, the Wataynikaneyap Power Project is expected to generate financial and socioeconomic benefits in excess of the present value of costs associated with the project. There is a 90% chance of obtaining an FROI and SROI greater than $608 million and $1,172 million respectively.

- The SROI is relatively "flatter" than the FROI, which reflects the fact that the SROI is relatively more risky. In other words, the SROI has a relatively larger confidence interval than the FROI. This is because for the Base Transmission Case HDR have assumed no variation in the load growth; it grows by 4% in every year. The Load Growth Sensitivity shows the FROI and SROI results with variation in the load growth. The wider confidence interval for The Load Growth

Sensitivity also reflects uncertainty associated with the social values used to monetize socioeconomic benefits, which tend to be positively skewed.

The table below shows key SROI metrics at the mean. These values are different than the medians in the diagram above as they incorporate asymmetries in the input value distributions. The FROI is slightly negatively skewed (mean is less than the median) and the SROI has a positive skew (mean is greater than the median).

Table 5 – Base Transmission Case, Mean SROI of the Wataynikaneyap Power Project

Sustainable Return on Investment ("SROI") Metrics Mean Expected Values (2021 CAD$, Millions)	
Financial Return on Investment ("FROI")[21]	$1,071
Present Value of Avoided GHG Emissions	$472
Present Value of Reduced Adverse Health Impacts	$304
Present Value of Reduced Damage to Vegetation	$35
Present Value of Avoided Diesel Spills	$21
Net Present Value (SROI)	**$1,903**
Discounted Payback Period (years)	**20.22**
Internal Rate of Return ("IRR", 2015)	**10.0%**
Benefit-Cost Ratio ("B/C ratio")	**1.80**

At the mean and under the Base Transmission Case, the net present value of the Wataynikaneyap Power Project is estimated at $1,903 million with an in IRR of 10%. Based on the SROI analysis, the project pays back its capital costs in roughly 20 years on a discounted basis, which is a relatively long discounted payback period and reflects the fact that the majority of the financial and socioeconomic benefits of the project occur in later years as energy demand continues to grow. Overall, under the Base Transmission Case, the Wataynikaneyap Power Project is expected to generate financial and socioeconomic returns in excess of project costs. However, FROI and SROI results are extremely sensitive to load growth assumptions and the following section shows results where the load growth is assumed to be a range from 1 to 4%.

Load Growth Sensitivity – Annual load growth of 1% to 4%, social values used to monetize carbon

Assumptions regarding future load growth ultimate drive the business case of the Wataynikaneyap Power Project from a purely financial and societal perspective. Under the Base Transmission Case, 4% is used as the load growth consumption. Under The Load Growth Sensitivity, load growth can vary between 1% and 4% for any given year. In this sensitivity analysis, social values are also used to monetize GHG emissions reductions. The two diagrams below show the value of annual socioeconomic benefits and the present value of these benefits.

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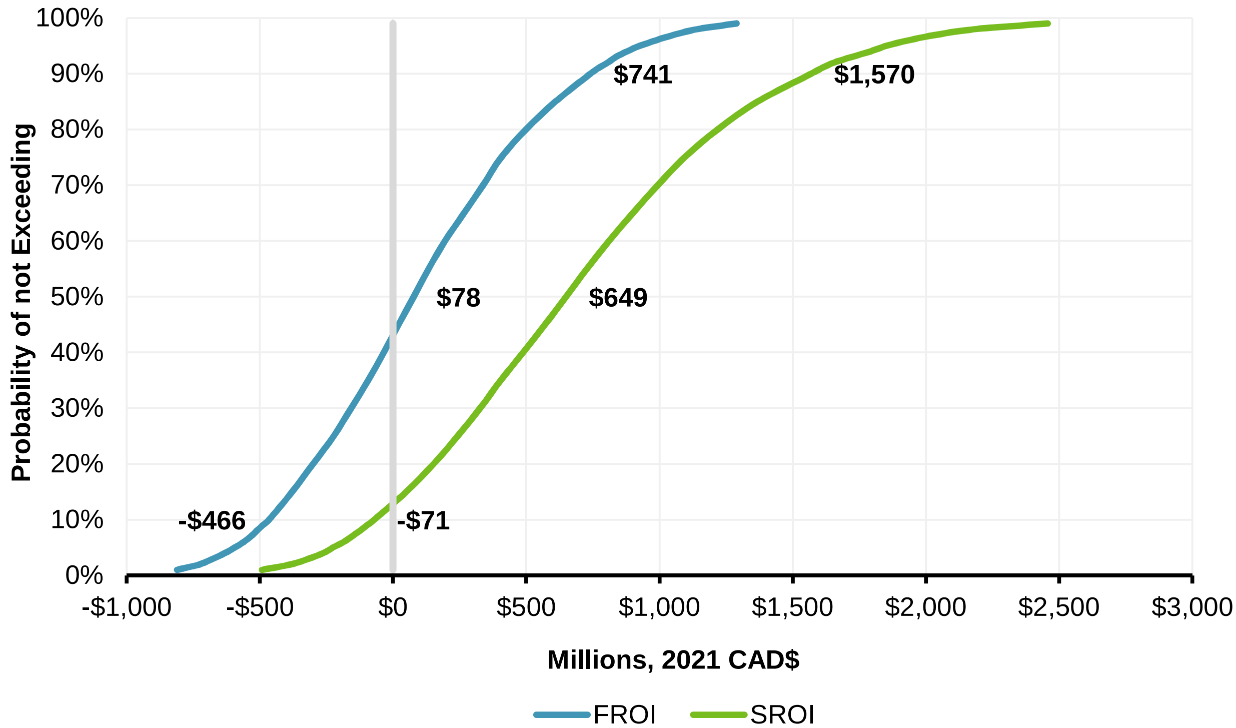
[21] Financial Return on Investment (FROI) includes only the cash impacts and reflects the net financial impacts of the project from society's point of view. This differs from a traditional financial feasibility analysis such as the one performed by PWC which is from the investors' point of view.

The figure below shows the distribution of the net present of the Wataynikaneyap Power Project under The Load Growth Sensitivity.

Figure 15 – Load Growth Sensitivity, FROI and SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years



Using a lower load growth assumption than that developed by the IESO decreases the FROI and SROI of the Wataynikaneyap Power Project. In addition, the range of possible outcomes increase significantly for the FROI and the SROI relative to the Base Transmission Case, which reflects just how sensitive the financial and societal business case of the project is to the future load growth assumption. With respect to the FROI, there is approximately a 55% chance of obtaining a net present value greater than zero. Taking the monetary value of socioeconomic benefits into consideration dramatically improves the business case of the project. In this case, there is about an 85% chance of obtaining a positive net present value. Under The Load Growth Sensitivity, the socioeconomic benefits of the Wataynikaneyap Power Project are much more essential for the business case of the project than in the Base Transmission Case. The table below shows the key SROI metrics of the project at the mean (i.e., expected value).

Table 6 – Load Growth Sensitivity, Mean SROI of the Wataynikaneyap Power Project

Sustainable Return on Investment ("SROI") Metrics Mean Expected Value (2021 CAD$, Millions)	
Financial Return on Investment ("FROI")	**$111**
Present Value of Avoided GHG Emissions	$328
Present Value of Reduced Adverse Health Impacts	$221
Present Value of Reduced Damage to Vegetation	$26
Present Value of Avoided Diesel Spills	$21

Sustainable Return on Investment ("SROI") Metrics Mean Expected Value (2021 CAD$, Millions)	
Net Present Value (SROI)	**$707**
Discounted Payback Period (years)	26.52
Internal Rate of Return ("IRR", 2015)	7.5%
Benefit-Cost Ratio ("B/C ratio")	1.33

Under The Load Growth Sensitivity and relative to The Base Transmission Case, the IRR of project decreases to 7.5% and the discounted payback period increases by over 6 years. Despite that, at the mean, the benefit-cost ratio is still greater than one, which indicates that this is still an economic and welfare-enhancing project to pursue. The detailed results for the Carbon Value Sensitivity are presented in Appendix E.

Carbon Value Sensitivity – Annual load growth of 4%, California carbon market prices used to monetize greenhouse gas emissions

In light of Ontario's expected introduction of the cap and trade program, a sensitivity analysis was run to consider results using a lower CO_2 value based on the California carbon market price (Carbon Value Sensitivity). A price forecast was developed based on the current market price and the ICIS 2030 forecast for California Carbon Allowance Futures prices of US$50 with a low and high of US$30-US$70. The forecast values were applied to a statistical distribution of prices fitted to the historical California Carbon Allowances Futures contracts on the Intercontinental Exchange. The following three diagrams show the annual socioeconomic benefits, present value of these benefits and the FROI and SROI of the project under The Carbon Value Sensitivity. It is important to note that the only thing that has changed between The Base Transmission Case and The Carbon Value Sensitivity is the values HDR are using to monetize carbon. The total amount of emissions avoided does not change.

Relative to The Base Transmission Case, the key SROI metrics worsen slightly. The IRR of the project decreases from 10.0% to 9.7% and the discounted payback period increases by about a year. Under The Carbon Value Sensitivity, the project would still be deemed to generate societal returns in excess of costs. The detailed results for the Carbon Value Sensitivity are presented in Appendix E.

> *"The Wataynikaneyap Power Project could save our community lots of money, which we can use for other purposes in our community.*
>
> – Jacob Strang, Deputy Chief, Poplar Hill First Nation

Summary of Key Findings

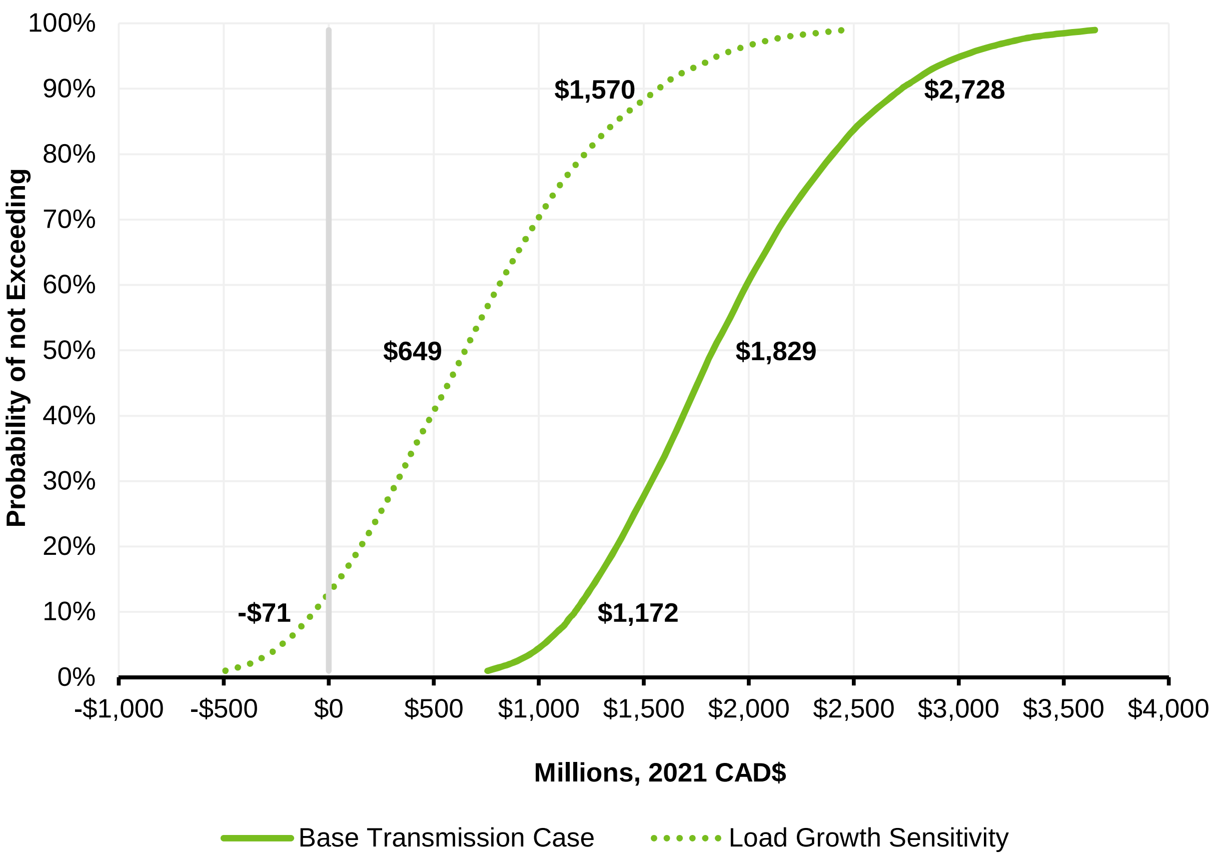
The SROI of the Wataynikaneyap Power Project depends on assumptions and model inputs and particularly the future load growth. HDR have prepared results the Base Transmission Case as well as two sensitivity analyses:

- **Base Transmission Case** – uses the IESO's annual load growth assumption of 4% and monetizes GHG reductions using social values.

- **Load Growth Sensitivity** – uses a lower annual load growth rate and allows this value to vary between 1% and 4% with a most likely outcome of 2.5%. GHG reductions are still monetized using social values.
- **Carbon Value Sensitivity –** is the same as The Base Transmission Case, but uses a price of carbon based on the California carbon market.

Figure 16 below shows the SROI of the Wataynikaneyap Power Project under the Base Transmission Case and Load Growth Sensitivity.

Figure 16 – SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years



Under The Base Transmission Case and The Carbon Value Sensitivity, the SROI of the Wataynikaneyap Power Project is comfortably greater than zero at all levels of significance. Indeed, even at the 1 percentile the project still delivers a net present value that is substantially greater than zero; however, using a more conservative annual load growth assumption results in a decreased SROI. Nevertheless, even under this sensitivity analysis, the SROI of the Wataynikaneyap Power Project is still substantially positive at the mean and median and there is about an 85% chance of obtaining a positive net present value. Similar to the financial feasibility of the project, SROI results are highly sensitive to the load growth assumption.

5. Conclusions and Key Findings

Introduction

This section of the reports summarizes the key findings of the economic impact assessment and SROI analysis HDR completed on the Wataynikaneyap Power Project. HDR also provide a few recommendations that Wataynikaneyap Power may want to consider for future analysis.

Key Findings

The Wataynikaneyap Power Project is expected to generate significant economic impacts and benefits for First Nations communities, Ontario, and Canada. Economic impact and benefits generated from the construction and development of the project are forecasted to generate and support roughly 261 jobs in Northwestern Ontario during the construction period. Once operational, the Wataynikaneyap Power Project will help alleviate load growth restrictions, which hinder economic growth in the region. The construction of the project also provides opportunities for skills development, which many stakeholders HDR interviewed indicated were an important part of the benefits of this project and can generate significant economic growth beyond just the construction impacts.

In addition to these economic impacts the Wataynikaneyap Power Project is also expected to generate significant socioeconomic benefits:

- Lower cost of service;
- On-going economic impacts from increased economic growth;
- Increased energy availability and quality;
- Decreased emissions;
- Improved health outcomes;
- Avoided diesel spills;
- Improved quality of life; and
- Other socioeconomic benefits.

As part of this project, HDR monetized many of these socioeconomic benefits and included them within the financial analysis conducted by PwC to calculate the Sustainable Return on Investment or SROI of the project. The SROI is calculated by adding the present value of the socioeconomic benefits to the financial feasibility of the project and helps answer the following important questions:

- Is this a good use of government funding?
- From a societal perspective, does this project generate socioeconomic benefits in excess of costs?
- How does the SROI of a project compare to its financial outcomes?

The results of the SROI analysis show that the socioeconomic benefits of the Wataynikaneyap Power Project are significant and dramatically improve the business case of the project. The PwC study showed that the financial feasibility of the project is highly sensitive to assumptions regarding future energy use associated with the base case (i.e., the no build scenario). Indeed, this assumption ultimately drives the financial feasibility of the project. The SROI is also highly sensitive to this assumption. Our analysis shows that even under more conservative load growth assumptions that the SROI of the project is substantially greater than zero, indicating that the pursuing the project would generate socioeconomic benefits in excess of costs.

Lastly, the SROI of the project does not include other types of socioeconomic benefits that our research and discussions with stakeholders suggested could be quite considerable. For instance, stakeholders interviewed expressed pride that Wataynikaneyap Power Project will be one of the largest First Nations projects in Ontario and that successfully developing this project could result in an increased sense of confidence. It is next to impossible to put a dollar value on benefits such as this, but if the successful completion of the Wataynikaneyap Power Project leads to First Nations communities working together to develop other projects then these benefits could be substantial.

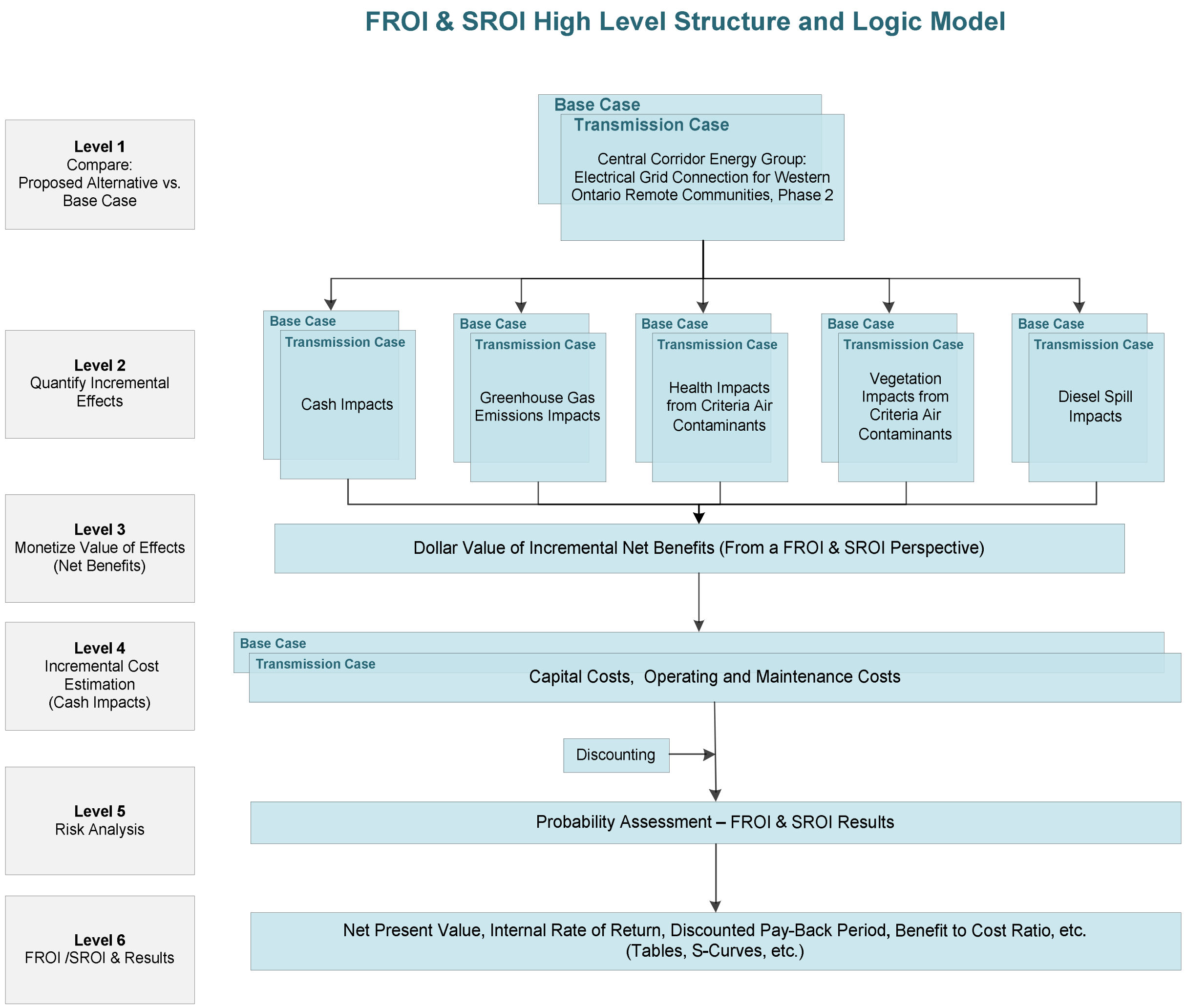
> *"This is the first time we can take part in a project of this size and importance. Developing this project will provide our community a sense of pride and self-esteem that we can leverage for other projects."*
>
> – Bill Sainnawap, Big Trout Lake First Nations

Appendix A – Detailed Description of Methodology

Structure and Logic

The methodology for the various benefits and costs is presented graphically in the form of a flow chart called a "Structure and Logic model". Structure and Logic models provide a graphical illustration of how the various inputs combine to determine the benefit or cost evaluated. They are intended to provide a transparent record of how each benefit and cost is calculated. The figure below outlines the methodological format of the analysis.

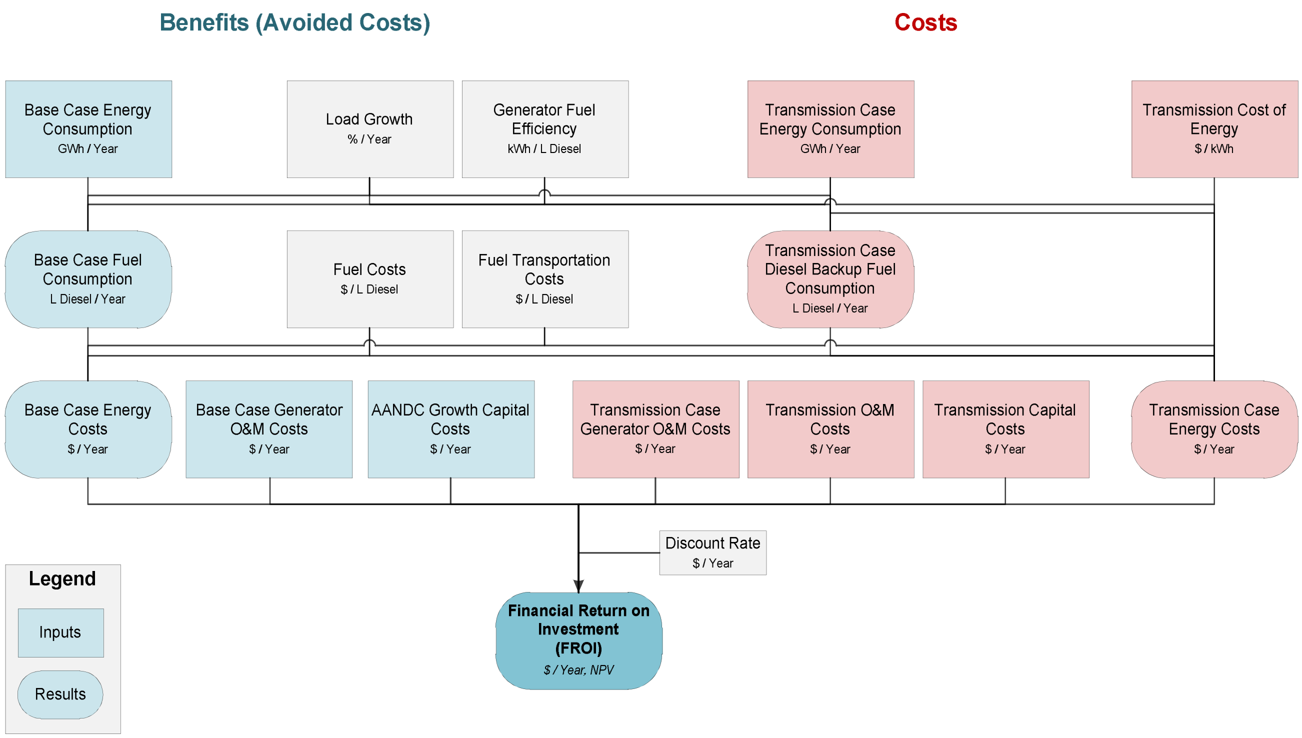
Figure 17 – FROI and SROI High Level Structure and Logic Model



The analysis starts at Level 1 with a detailed description of the design alternative. Level 2 involves the quantification and explicit calculation of financial and socioeconomic impacts. Next, Level 3 monetizes (converts to dollars) those incremental impacts. Level 4 outlines the input costs of the alternative. Each of these inputs is assessed by the model at Level 5 to get the overall probability distribution of the net present value of the alternative. Once the incremental costs for each alternative have been determined they are weighed against the monetized incremental cost to obtain the NPV of the cost-benefit analysis at Level 6.

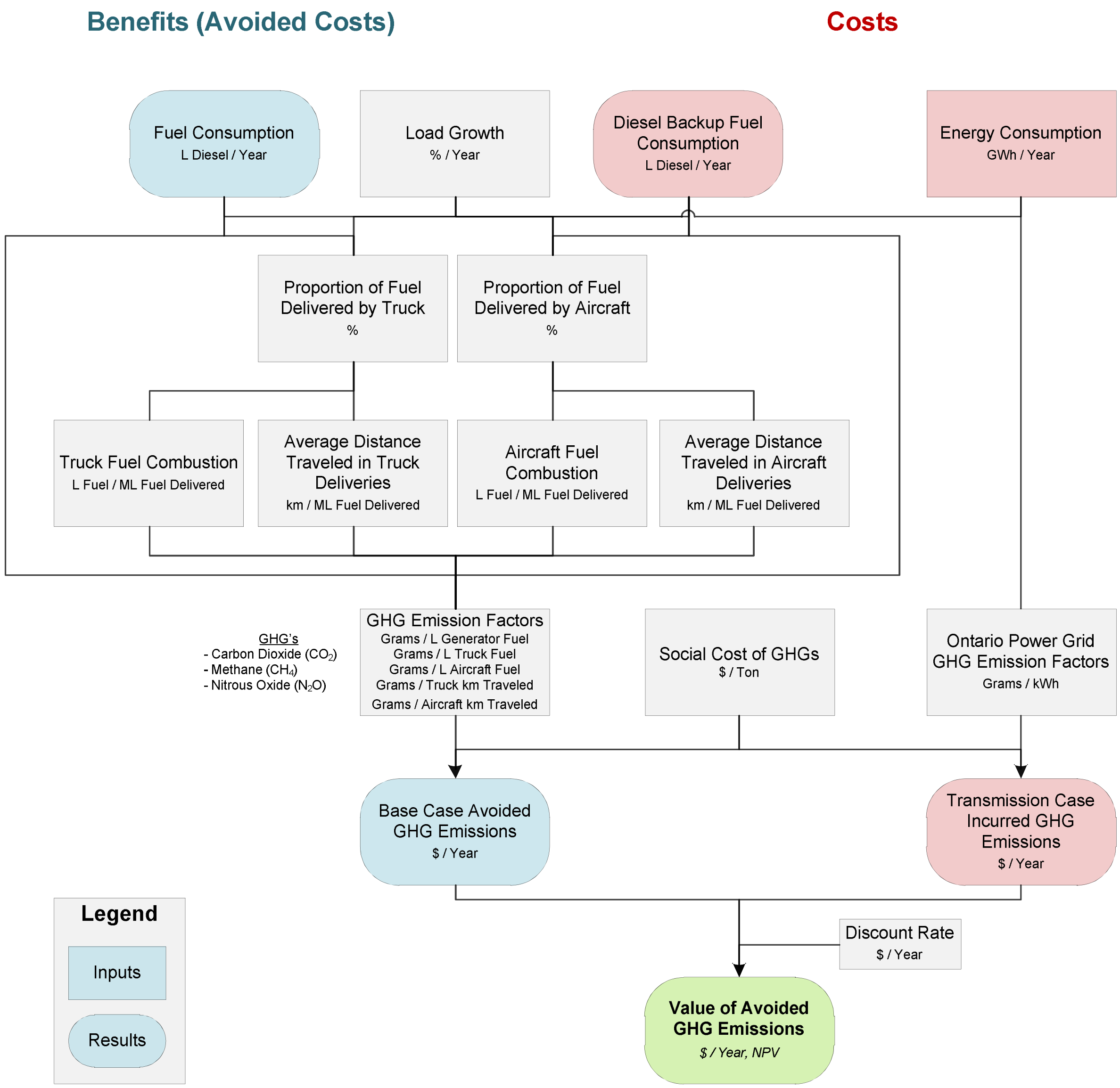
The calculation of cash impacts/ FROI is shown below. The FROI of the Wataynikaneyap Power Project was estimated by PwC. HDR have illustrated its calculation in the diagram below since it is a component of the SROI.

Figure 18 – Structure and Logic of FROI



The diagram below shows the calculation of the present value of avoided GHG emissions.

Figure 19 – Structure and Logic of the Present Value of GHG Emissions Reductions



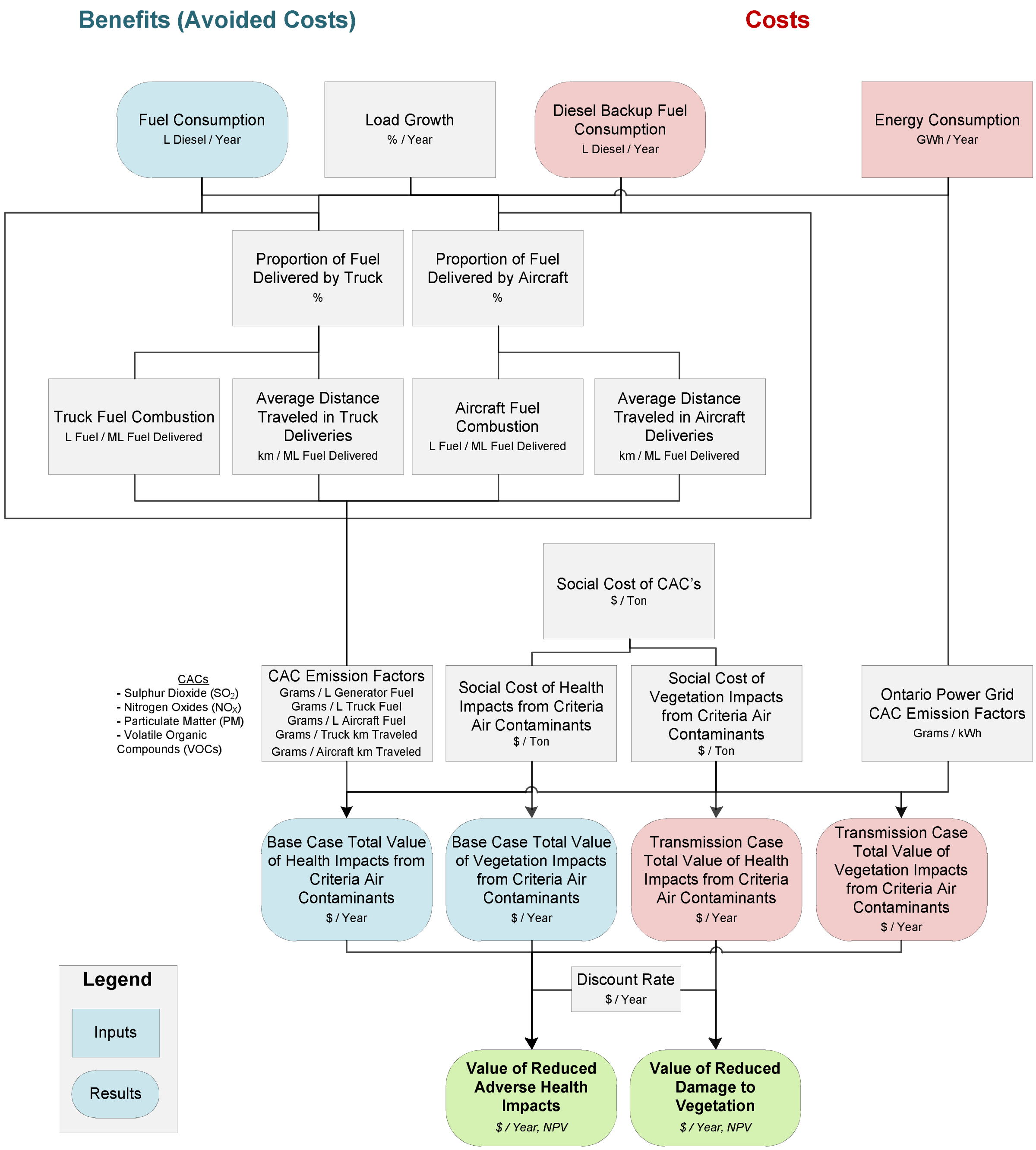
Impacts from diesel fuel deliveries and consumption were derived from Hydro One Remote Communities data as well as from the IEEE report “Renewable Energy Alternatives for Remote Communities in Northern Ontario” (Arriaga M. et al. 2012) as well as individual community websites. Specifically, diesel consumption for generation purposes, distance traveled by truck and aircraft as well as volumes of fuel delivered, number of fuel trips, and fuel combusted were derived from the “2013 Greenhouse Gas Inventory Report and Action Plan” released in September 2014 by HORCI.

Table 7 – Emissions Factors

Variable	Units	Value	Source
Emission Factors			
Diesel Generators			
CO_2e	g/L	2,790	*Environment Canada's National Inventory Report, 1990-2012, Part 2, Annex 8, Table A8-4 Emission Factors for Refined Petroleum Products.*
NO_x	g/L	72.38	*Environment Canada's Guidance Document for Emissions Calculator: Airborne Contaminant Emissions from Fuel Oil Combustion (2009) referring to US EPA's Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, Chapter 3, Table 3.3 (2000).*
SO_2	g/L	4.76	
PM_{25}	g/L	5.09	
VOC	g/L	5.75	
Ontario Power Grid			
CO_2e	g/kWh	110	*Environment Canada's National Inventory Report, 1990-2012, Part 3, Annex 13, Table A13-7: Electricity Generation and GHG Emission Details for Ontario.*
NO_x	g/kWh	0.13	*Calculated based on emissions data from Environment Canada's Air Pollutant Emission Inventory and Environment Canada's National Inventory Report 1990-2012.*
SO_2	g/kWh	0.07	
PM_{25}	g/kWh	0.00	
VOC	g/kWh	0.00	
Diesel Trucks			
CO_2e	g/L	2,689	*Environment Canada's National Inventory Report, 1990-2012 Part 2, Table A8-11: Emission Factors for Energy Mobile Sources.*
NO_x	g/km	5.35	*US EPA's Average In-Use Emissions from Heavy-Duty Trucks, Table 1 (2008). United States Air Force IERA, Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations, Table 4-50 (2003) for SO2.*
SO_2	g/km	0.32	
PM_{25}	g/km	0.13	
VOC	g/km	0.28	
Aircraft			
CO_2e	g/L	2,557	*Environment Canada's National Inventory Report, 1990-2012 Part 2, Table A8-11: Emission Factors for Energy Mobile Sources.*
NO_x	g/L	11.29	*Calculated based on emissions data from Environment Canada's Air Pollutant Emission Inventory and airline energy consumption - Statistics Canada, 57-003-X, Table 2-1.*
SO_2	g/L	0.96	
PM_{25}	g/L	0.14	
VOC	g/L	0.98	
Assumed ranges of +/-25% around the mean with an 80% confidence level			

The diagram below shows the calculation of the present value of avoided health impacts and reduced damage to vegetation.

Figure 20 - Structure and Logic of the Present Value of Reduced Health Impacts and Reduced Damage to Vegetation



The diagram below shows the calculation of the present value of avoided diesel spills.

Figure 21 – Structure and Logic of the Present Value of Avoided Diesel Spills

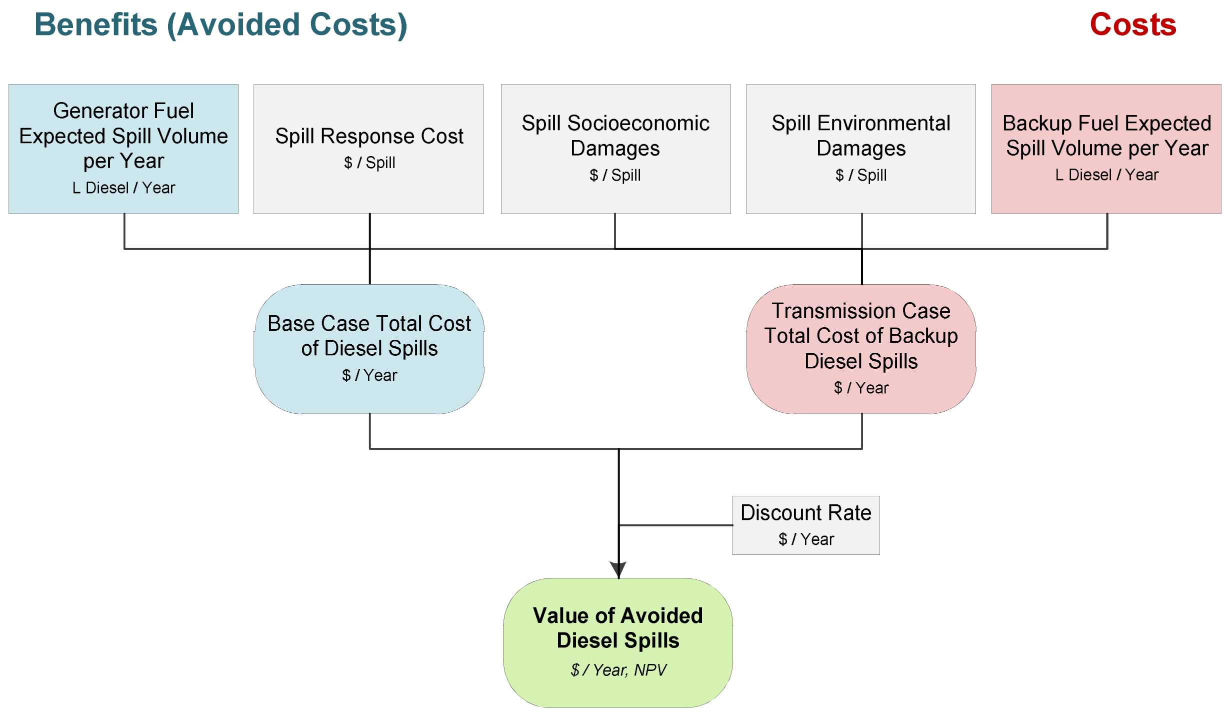
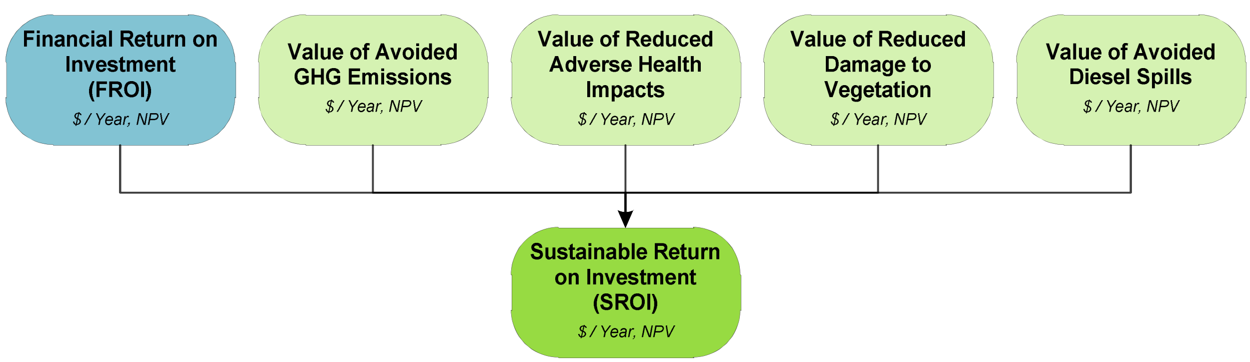


Figure 22 – Structure and Logic of the SROI



Diesel spill emissions were based on values from the United States Environmental Protections Agency Basic Oil Spill Cost Estimation Model ("**BOSCEM**"). The model was developed to estimate cleanup costs as well as environmental and socioeconomic damages caused by actual and hypothetical spills of crude oil and other petroleum derivatives. Most notably, the methodology in the BOSCEM model applies value modifiers to best reflect the particular circumstances of the spill. Specifically, the forest category was assumed for the location cost modifier as well as for the habitat and wildlife sensitivity, a high value rank for socioeconomic & cultural value rankings, and default values for the others. These monetized values were applied to an assumed 5,000 litres of spilled fuel per year with a range of 0 to 10,000 litres, based on historical reports of fuel spills in self-generating communities around Canada.

Table 8 – Diesel Spills Input Values

Variable	Units	Low	Median	High	Expected	Source
Diesel Spills						
Spill Volume	L	0	5,000	10,000	**5,703**	*Assumption based on historical reports of fuel spills in self-generating communities around Canada*
Response Cost	$/L	$35.33	$36.04	$36.39	**$35.92**	*United States Environmental Protections Agency Basic Oil Spill Cost Estimation Model (BOSCEM), "Modelling Oil Spill Response and Damage Costs" (2004)*
Socioeconomic Damages	$/L	$176.67	$117.04	$28.71	**$107.78**	
Environmental Damages	$/L	$29.37	$37.76	$40.28	**$35.78**	
Spill volume range represents an 80% confidence level						
Spill cost and damage value ranges depend on the quantity of fuel spilled and are applied deterministically based on the spill volume						

Monetized Social Values

Green House Gases (GHG's)

As with all inputs used in its studies, HDR uses a probability distribution to represent the potential value for a tonne of CO_2 (in this case a PERT distribution was used). In order to define the PERT distribution it required three key data points: an expected median or 50th percentile value, a low value representing the minimum realistic value and a high value representing the highest realistic value. In order to determine which would be the most appropriate data point, a meta-analysis of over 200 recent scientific estimates of the social cost of CO_2 was conducted.

For the upper and lower bounds, it used two well-established yet extreme views of the theoretical impact on the planet of an incremental tonne of CO_2; the median value was generated under the auspices of several US Federal departments to assist agencies in regulatory impact analysis.

These values are based on the calculation of the expected damage caused by climate change including not only impacts on market outputs like food and forestry but also estimates of losses from non-market impacts. The most comprehensive damage studies include such factors as the greater intensity of hurricanes, impacts of changes in temperature and precipitation on food production, ecosystem services, recreation, and the increased burdens of disease. The estimates also include adjustments for the risk of low-probability, high-consequence events such as abrupt climate change. The primary difference between these estimates is in the discount rate used to value future impacts.

This value is then escalated annually using rates derived from the Federal Interagency Working Group on Social Cost of Carbon. All values are in 2015 CAD dollars per tonne.

Criteria Air Contaminants (CAC's)

The basis for monetizing the social impacts of criteria air contaminants is to primarily use the results from three reputable studies by the U.S. Department of Transportation, the European Commission, and Yale University. As with many other social impact quantification initiatives, the varying methodologies for each study yielded a wide array of results. Furthermore, some studies included certain compounds such as Ozone or Nitrogen Dioxide while others did not. For consistency purposes, only overlapping compounds were analyzed. The results from each study were ranked into a lower, median, and upper range and then analyzed with a PERT distribution to obtain a mean expected value. The main criteria air contaminants analyzed were Nitrogen Oxide (NO_x), Volatile Organic Compounds (VOCs), Particulate Matter (PM), and Sulfur Dioxide (SO_2). The expected values of each CAC and the respective sources are listed below. All values are in 2015 CAD dollars per tonne.

Table 9 – Emissions Monetary Values

Variable	Units	Low	Median	High	Expected	Source
Emission Values						
CO_2e	$/tonne	$19	$54	$151	**$82**	*IWGSCC (2013)[1], Nordhaus (2008)[2], Stern Review (2006)[3]*
NOx	$/tonne	$294	$588	$8,082	**$3,875**	*US DOT / NHSTA (2010)[4], Muller et al. (2007)[5], ECDG/AEA Technology (2002)[6], ECDG/AEA Technology (2005)[7]*
SO_2	$/tonne	$800	$1,600	$9,077	**$4,481**	
PM_{25}	$/tonne	$1,078	$2,155	$26,939	**$12,930**	
VOC	$/tonne	$294	$588	$4,041	**$1,970**	
Value ranges represent an 80% confidence level						
(1) Interagency Working Group on Social Cost of Carbon, US Government. For regulatory impact analysis under Executive Order 12866 (2013).						
(2) Nordhaus 2008 book "A Question of Balance"; represents a conservative estimate.						
(3) The 2006 "Stern Review" study was commissioned by the U.K. government and is widely used in Europe.						
(4) US DOT / NHSTA, Corporate Average Fuel Economy for MY 2012-MY 2016 Passenger Cars and Light Trucks (2010).						
(5) Muller et al. Measuring the damages of air pollution in United States (2007).						
(6) ECDG, "Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas", Average for 25 Member States (2005).						
(7) ECDG, "Estimates of the marginal external costs of air pollution in Europe"; EU average (2002).						

Criteria air contaminants are known to have adverse effect on human health (including morbidity, mortality, acute and chronic conditions), animals, vegetation (including agricultural crops), physical structures (such as buildings and infrastructure), and visibility, both on their own and through chemical reactions with other pollutants that form secondary pollutants. The social cost of CACs reflects the monetary valuation of these damages expressed in terms of dollars per unit of emissions; it is important to note that this dollar value is simply a 'proxy' for the value of the externalities generated by CACs. HDR has reviewed a broad array of literature regarding CAC valuation and elected to use a probability distribution composed of three widely cited sources: the US DOT/National Highway Traffic Safety Administration; the European Commission Directorate-General Environment; and Yale University and the values from these sources were separated into impacts on human health and others composed primarily of impacts on vegetation.

Unlike greenhouse gas emissions, CACs are regional and local in nature. This relates to differing meteorological conditions across geographic locations, the way CAC are dispersed in the atmosphere and their inherent chemical nature. Also, the number of people exposed to the pollutants may differ across various locations contributing to a differing scale of health impacts - the greater the population density, the greater the impacts. Therefore, the impact of CACs and their monetary valuations may differ across geographic locations. Although the impact of air pollution is local in nature, agencies have nevertheless attempted to develop damage estimates per ton of emissions for the most common air pollutants that would be relevant in a range of situations for support in decision making. In their essence, the results are based on impact pathway-type modelling of larger geographic areas with a number of geographic sources included.

Social costs of CACs are estimated using complex methodologies, frequently referred to as impact pathway analysis, that entail a few key steps: (1) Assessment of the impact of the change in CACs emissions from a certain source on ambient air quality in the affected region; (2) A damage function is fitted to determine the impact on human health, the environment such as agricultural crops, buildings and structures; (3) The damages are monetized using monetary unit values or by considering welfare impacts such as health care costs, loss of life, or lost agricultural production; and (4) Damages are allocated to pollutants that are causing them. The detailed list of effects included may differ from study to study depending on the data that is available to the study team at the time of the study. Health impacts typically focus on acute and short-term effects of exposure. Longer-term effects and effects that take place with a lag are also included and discounted at a discount rate to reflect the time lag.

Appendix B – Glossary of Terms

Appendix B provides definitions of key terminology below:

- **Discounted Value:** The discounted value is the present value of a future cash amount. The present value is determined by reducing its future value by the appropriate discount rate (interest rate used in determining the present value of future cash flows) for each unit of time between the times when the cash flow is to be valued to the time of the cash flow. To calculate the present value of a single cash flow, it is divided by one plus the interest rate (discount rate) for each period of time that will pass. This is expressed mathematically as raising the divisor to the power of the number of units of time.

- **Net Present Value (NPV):** The net value that an investment or project adds to the value of the organization, calculated as the sum of the present value of future cash flows less the present value of the project's costs.

- **Discounted Payback Period (DPP):** The period of time required for the return on an investment to recover the sum of the original investment on a discounted cash flow basis.

- **Benefit To Cost Ratio (BCR):** The overall "value for money" of a project, expressed as the ratio of the benefits of a project relative to its costs, with both expressed in present-value monetary terms.

- **Sustainable Return on Investment (SROI):** SROI is an enhanced form of Cost-Benefit Analysis (CBA) - it provides a triple-bottom line view of a project's economic results and goes even further by incorporating state-of-the-art risk analysis. SROI monetizes (converts to monetary terms) all relevant social and environmental impacts related to a given project, and provides the equivalent of traditional financial metrics.

- **Greenhouse Gases:** A greenhouse gas (abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. SROI monetizes carbon dioxide, methane, and nitrous oxide.

- **Criteria Air Contaminants:** Criteria air contaminants (abbreviated CAC) are a set of air pollutants that cause smog, acid rain and other health hazards. CACs are typically emitted from many sources in industry, mining, transportation, electricity generation and agriculture. In most cases they are the products of the combustion of fossil fuels or industrial processes. The basis for monetizing the social impacts of criteria air contaminants was to primarily use the results from three reputable studies by the U.S. Department of Transportation, the European Commission, and Yale University. The main criteria air contaminants analyzed were Nitrogen Oxide (NOx), Volatile Organic Compounds (VOCs), Particulate Matter (PM), and Sulfur Dioxide (SO_2). The latter two were further split and categorized into Rural, Urban, and Dense Urban.

- **Carbon Dioxide (Co2):** Carbon dioxide is a heavy colorless gas that does not support combustion and is absorbed from the air by plans in photosynthesis. Industrial carbon dioxide is produced mainly from six processes: Directly from natural carbon dioxide springs, where it is produced by the action of acidified water on limestone or dolomite; As a by-product of hydrogen production plants, where methane is converted to CO_2; From combustion of fossil fuels and wood; As a by-product of fermentation of sugar in the brewing of beer, whisky and other alcoholic beverages; From thermal decomposition of limestone, $CaCO_3$, in the manufacture of lime, CaO.

- **Nitrogen Oxides (NOx):** Nitrogen oxides include a number of gases that are composed of oxygen and nitrogen. In the presence of sunlight these substances can transform into acidic air pollutants such as nitrate particles. The nitrogen oxides family of gases can be transported long distances in our atmosphere. Nitrogen oxides play a key role in the formation of smog (ground-level ozone). At elevated levels, NOx can impair lung function, irritate the respiratory system and, at very high levels, make breathing difficult, especially for people who already suffer from asthma or bronchitis.

- **Particulate Matter (PM):** Particulate matter refers to tiny particles of solid or liquid suspended in a gas. Sources of particulate matter can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.

- **Volatile Organic Compound (VOC):** Volatile organic compounds (VOCs) are a large and diverse family of chemicals that contain carbon and hydrogen. They can be emitted into indoor air from a variety of sources including cigarette smoke, household products like air fresheners, furnishings, vehicle exhaust and building materials such as paint, varnish and glues. Examples of VOCs are aldehydes, ketones, and hydrocarbons.

Appendix C – Community Member Interview Guide

The questions we asked certain community members are provided in the interview guide below.

Community Member Interview Guide

Dear Participant,

HDR Corporation (“**HDR**”) – an engineering, architecture and consulting firm – has been engaged to assess the socioeconomic impact and benefits of the Wataynikaneyap Power Project on an independent and objective basis. As part of this engagement, we were hoping to interview individuals from the affected local communities and to include these insights in our final report. Outlined below is a list of potential questions:

- Broadly speaking, what does the Wataynikaneyap Power Project mean for you and your community?
- What does the Wataynikaneyap Power Project mean for young people in your community?
- Does your community currently face load restrictions or faced load restrictions in the past? What impact do they have or have had on your community?
- Will the Wataynikaneyap Power Project and removal of load restrictions facilitate increased local infrastructure (e.g., schools, recreation centres) in your community? From a social perspective, what does this mean for your community?
- What economic opportunities does the Wataynikaneyap Power Project provide you and your community? Please provide a few examples of economic activities that the Wataynikaneyap Power Project will enable you and your community to do that you are currently not able to.
- What are some of the most important benefits to your community from reducing diesel deliveries, storage, and generation?
- Please provide any other comments in regards to the importance of the Wataynikaneyap Power project to you and your community.

Following each interview, we will compile our notes and provide them to you to ensure that we have adequately reflected your insights. If you have any questions, I can be reached at (647) 777 4955 or at alex.kotsopoulos@hdrinc.com.

Sincerely,

Alex Kotsopoulos
Principal Economist

Appendix D – Annual One-Time Economic Impact Results

The tables below show the annual economic impact resulting from the construction and development expenditures associated with the Wataynikaneyap Power Project. The main body of the report shows the following economic impact results on an average annual basis.

Table 10 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2017

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$109.5	$50.4	442.1	$25.2
Indirect	$47.4	$11.0	164.6	$10.9
Induced	$29.1	$14.0	252.3	$6.7
Total	**$186.0**	**$75.5**	**858.9**	**$42.8**
Ontario				
Direct	$109.5	$50.4	442.1	$25.2
Indirect	$13.3	$8.8	130.2	$3.1
Induced	$23.5	$11.3	200.6	$5.4
Total	**$146.3**	**$70.5**	**772.9**	**$33.7**
Northwestern Ontario				
Direct	$43.9	$25.2	254.2	$10.1
Indirect	$0.1	$0.0	0.7	$0.0
Induced	$5.9	$2.8	50.6	$1.4
Total	**$49.9**	**$28.1**	**305.4**	**$11.5**

Table 11 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2018

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$124.4	$77.1	429.6	$28.6
Indirect	$44.8	$10.4	155.2	$10.3
Induced	$42.0	$20.3	363.9	$9.7
Total	**$211.2**	**$107.8**	**948.7**	**$48.6**
Ontario				
Direct	$124.4	$77.1	429.6	$28.6
Indirect	$12.6	$8.3	122.6	$2.9
Induced	$33.8	$16.2	289.3	$7.8
Total	**$170.8**	**$101.6**	**841.6**	**$39.3**
Northwestern Ontario				
Direct	$65.2	$35.1	241.4	$15.0
Indirect	$0.1	$0.0	0.6	$0.0
Induced	$8.2	$4.0	70.4	$1.9
Total	**$73.5**	**$39.1**	**312.5**	**$16.9**

Table 12 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2019

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$122.2	$69.9	430.8	$28.1
Indirect	$46.5	$10.8	159.8	$10.7
Induced	$38.5	$18.6	334.2	$8.9
Total	**$207.2**	**$99.2**	**924.8**	**$47.7**
Ontario				
Direct	$122.2	$69.9	430.8	$28.1
Indirect	$13.0	$8.5	125.9	$3.0
Induced	$31.1	$14.9	265.6	$7.2
Total	**$166.2**	**$93.3**	**822.3**	**$38.2**
Northwestern Ontario				
Direct	$55.1	$30.4	239.5	$12.7
Indirect	$0.1	$0.0	0.6	$0.0
Induced	$7.2	$3.4	61.1	$1.6
Total	**$62.3**	**$33.9**	**301.3**	**$14.3**

Table 13 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2020

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$124.7	$71.0	460.3	$28.7
Indirect	$47.4	$11.0	163.2	$10.9
Induced	$39.2	$18.9	339.9	$9.0
Total	**$211.4**	**$100.9**	**963.4**	**$48.6**
Ontario				
Direct	$124.7	$71.0	460.3	$28.7
Indirect	$13.2	$8.7	128.6	$3.0
Induced	$31.6	$15.2	270.2	$7.3
Total	**$169.6**	**$94.9**	**859.0**	**$39.0**
Northwestern Ontario				
Direct	$51.7	$28.9	246.5	$11.9
Indirect	$0.1	$0.0	0.7	$0.0
Induced	$6.8	$3.3	58.1	$1.6
Total	**$58.6**	**$32.2**	**305.3**	**$13.5**

Table 14 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2021

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$128.0	$75.9	484.4	$29.5
Indirect	$46.7	$10.8	159.3	$10.8
Induced	$41.5	$20.0	359.9	$9.6
Total	**$216.3**	**$106.7**	**1,003.6**	**$49.8**
Ontario				
Direct	$128.0	$75.9	484.4	$29.5
Indirect	$12.9	$8.5	124.9	$3.0
Induced	$33.5	$16.1	286.0	$7.7
Total	**$174.4**	**$100.4**	**895.3**	**$40.1**
Northwestern Ontario				
Direct	$55.1	$30.4	251.8	$12.7
Indirect	$0.1	$0.0	0.6	$0.0
Induced	$7.2	$3.4	61.2	$1.6
Total	**$62.3**	**$33.9**	**313.6**	**$14.3**

Table 15 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2022

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$74.4	$49.2	223.8	$17.1
Indirect	$24.3	$5.5	80.2	$5.6
Induced	$26.3	$12.7	228.3	$6.1
Total	**$125.0**	**$67.4**	**532.3**	**$28.8**
Ontario				
Direct	$74.4	$49.2	223.8	$17.1
Indirect	$6.5	$4.3	62.0	$1.5
Induced	$21.2	$10.2	181.3	$4.9
Total	**$102.2**	**$63.6**	**467.1**	**$23.5**
Northwestern Ontario				
Direct	$38.9	$20.6	164.3	$8.9
Indirect	$0.0	$0.0	0.3	$0.0
Induced	$4.9	$2.3	41.5	$1.1
Total	**$43.8**	**$23.0**	**206.1**	**$10.1**

Table 16 – One-Time Economic Impacts from Construction and Development of the Wataynikaneyap Power Project, 2023

	GDP	Wages and Salaries	Employment	Government revenues
Canada				
Direct	$21.8	$11.1	86.7	$5.0
Indirect	$4.8	$1.1	15.9	$1.1
Induced	$5.9	$2.9	51.5	$1.4
Total	**$32.5**	**$15.0**	**154.0**	**$7.5**
Ontario				
Direct	$21.8	$11.1	86.7	$5.0
Indirect	$1.3	$0.8	12.3	$0.3
Induced	$4.7	$2.3	40.4	$1.1
Total	**$27.8**	**$14.2**	**139.3**	**$6.4**
Northwestern Ontario				
Direct	$10.1	$5.2	75.0	$2.3
Indirect	$0.0	$0.0	0.1	$0.0
Induced	$1.2	$0.6	10.4	$0.3
Total	**$11.3**	**$5.8**	**85.5**	**$2.6**

Appendix E – Future Economic Growth

The IESO forecasts that by removing load restrictions energy consumption in the region is expected to increase from 73.6 GWh to 333.9 GWh from 2021 to 2060, which represents a 4% compounded annual growth rate ("**CAGR**"). As the numbers suggest this is a significant increase in electricity consumption. A strong relationship exists between energy demand and economic growth: increased energy demand leads to increased economic growth (i.e., GDP growth) and vice versa. The relationship between GDP growth and energy consumption, however, depends greatly on the existing level of industrialization and development, industrial structure and a host of other factors. Economists use energy elasticities to translate a percent change in energy consumption to a percentage change in GDP growth, which are typically empirically estimated. Data limitations make it very difficult to estimate energy elasticities for the 16 communities that will be connected to the Ontario electricity grid as a result of the Wataynikaneyap Power Project. To get a sense of the likely on-going future economic impacts associated with increased energy consumption HDRe used a range of load growth and energy elasticity scenarios as show in the table below. Energy elasticity estimates were obtained from a high level review of the relevant literature.

Table 17 – Incremental GDP Growth for Wataynikaneyap Power Communities for a Range of Incremental Annual Load Growth and Energy Elasticity Scenarios

	0.50 Energy Elasticity	0.75 Energy Elasticity	1.00 Energy Elasticity	1.25 Energy Elasticity	1.50 Energy Elasticity
2% Annual Load Growth	1.0%	1.5%	2.0%	2.5%	3.0%
3% Annual Load Growth	1.5%	2.3%	3.0%	3.8%	4.5%
4% Annual Load Growth	2.0%	3.0%	4.0%	5.0%	6.0%
5% Annual Load Growth	2.5%	3.8%	5.0%	6.3%	7.5%

The IESO suggested that the removal of load restrictions in the region affected by the Wataynikaneyap Power Project would result in annual growth in electricity consumption of 4.0% over 40 years. Annual GDP growth associated with this increase in electricity consumption ranges from 2.0% to 6.0% depending on the energy elasticity. In comparison, Ontario's economic growth in 2014 was 2.2%. The table above provides economic growth estimates for a range of load growth and energy elasticity assumptions. It should be noted the relationship between economic growth and energy consumption is not constant. Indeed, substantial evidence indicates that this relationship can change quite dramatically over time.[22]

[22] For example, see US economy and electricity demand growth are linked, but relationship is changing (2013). Energy Information Association. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=10491.

Appendix F – SROI Sensitivity Cases

Load Growth Sensitivity – Annual load growth of 1% to 4%, social values used to monetize carbon

Assumptions regarding future load growth ultimate drive the business case of the Wataynikaneyap Power Project from a purely financial and societal perspective. Under the Base Transmission Case, 4% is used as the load growth consumption. Under The Load Growth Sensitivity, load growth can vary between 1% and 4% for any given year. In this sensitivity analysis, social values are also used to monetize GHG emissions reductions. The two diagrams below show the value of annual socioeconomic benefits and the present value of these benefits.

Figure 23 – Load Growth Sensitivity, Socioeconomic Benefits of the Wataynikaneyap Power Project by Type, 2021 to 2060

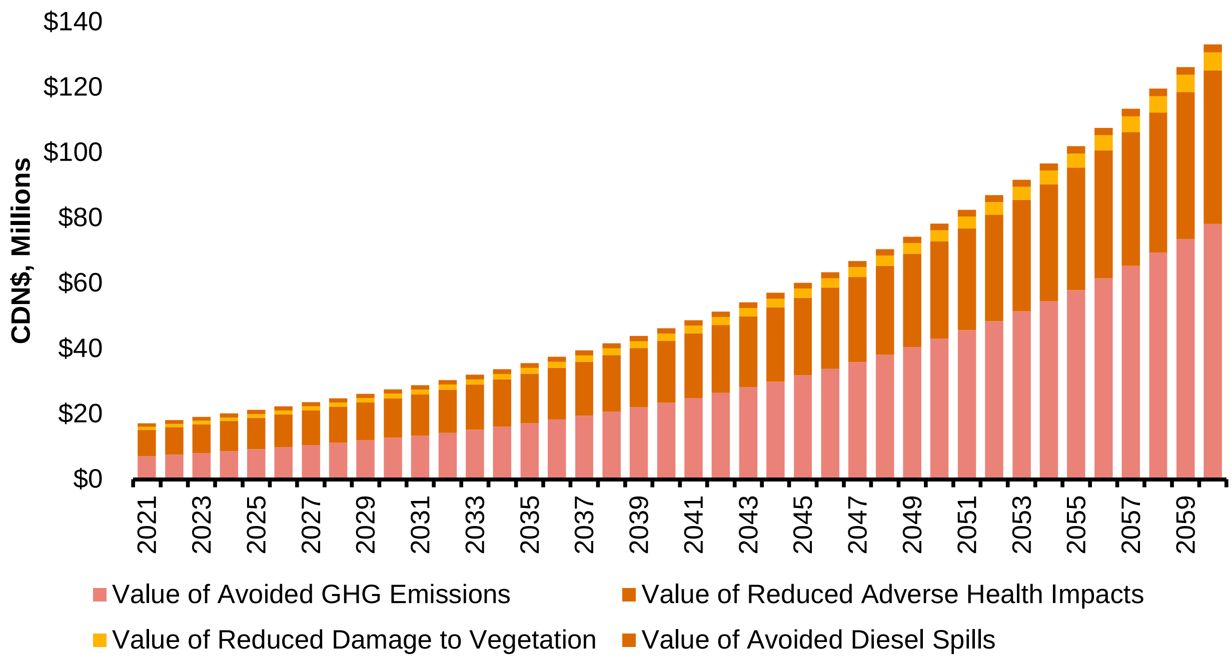
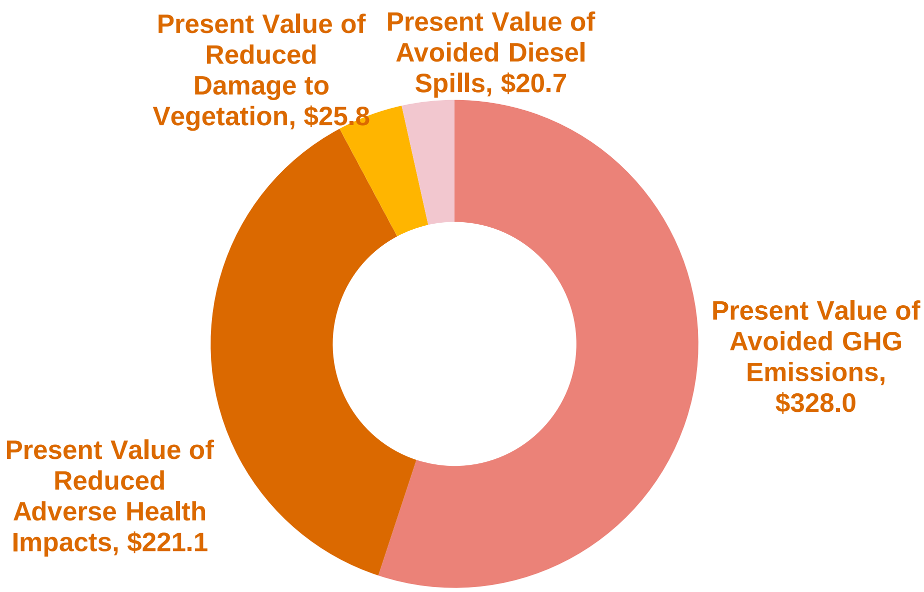
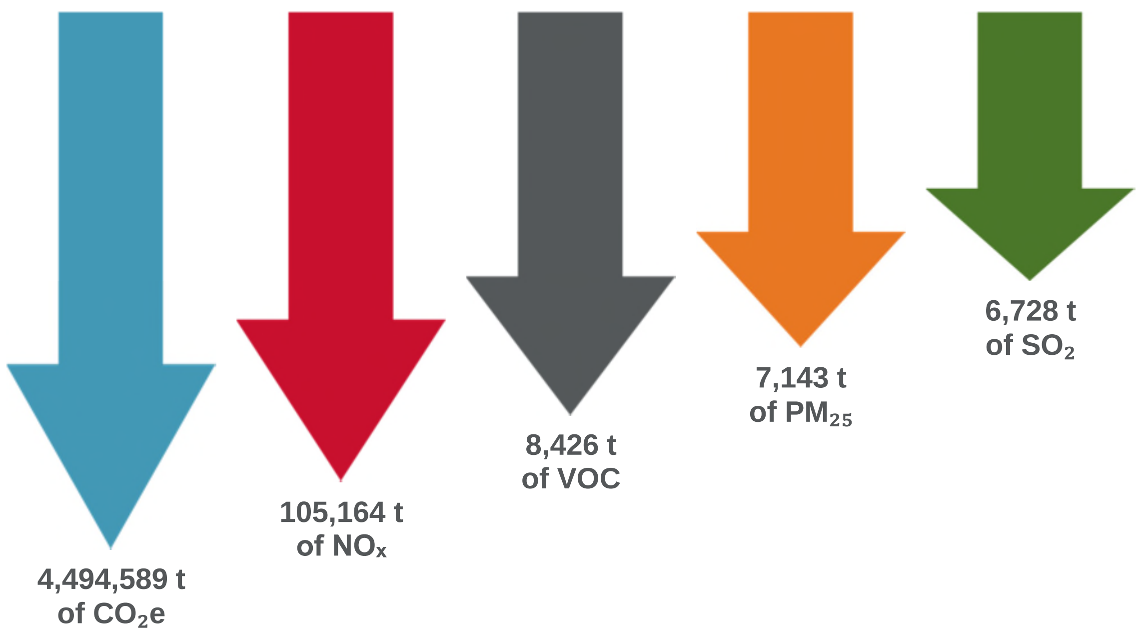


Figure 24 – Load Growth Sensitivity, Present Value over 40 Years of Socioeconomic Benefits of the Wataynikaneyap Power Project by Type in 2021 (CDN$, Millions)



The annual value and present value of these socioeconomic benefits decrease significantly under The Load Growth Sensitivity. For instance, the present value of avoided GHG emissions and reduced health impacts decreased from $472.2 million to $328.0 million and from $304.1 million to $221.1 million respectively. As shown above, these benefits still comprise the far majority of the value of socioeconomic benefits monetized as part of this SROI analysis. The diagram below shows the emissions reductions associated with The Load Growth Sensitivity.

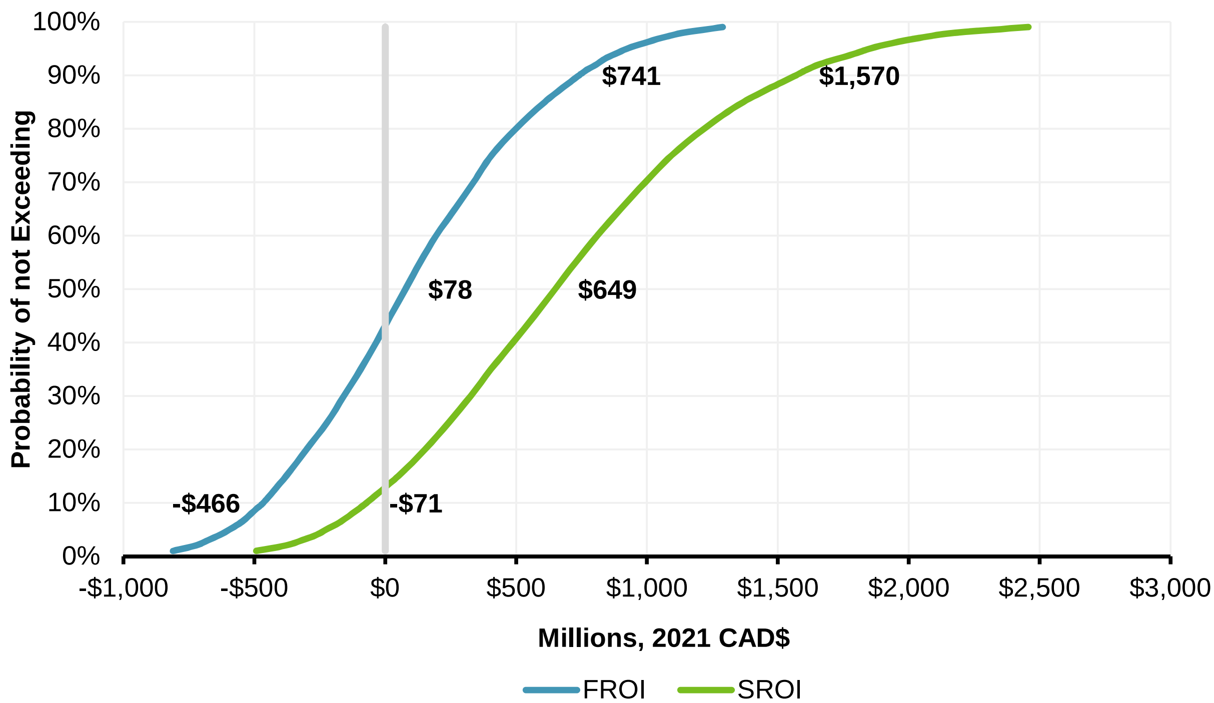
Figure 25 – Load Growth Sensitivity, Total Emissions Reductions of the Wataynikaneyap Power Project



Under the Load Growth Sensitivity, emissions reductions, which drive the monetization of socioeconomic benefits, decrease relative the Base Transmission Case. The Load Growth Sensitivity uses a more conservative load growth assumption, which ranges from 1% to 4% with a most likely outcome of 2.5% (i.e., the midpoint between the low and high bound). This is significantly less than the 4% annual load growth factor used by the IESO. Using a lower load growth assumption means that there is less displacement of diesel generated electricity with cleaner energy sources (i.e., from the Ontario power grid). This means lower emissions reductions and thus a lower monetized value of socioeconomic benefits.

Figure 26 below shows the distribution of the net present of the Wataynikaneyap Power Project under the Load Growth Sensitivity.

Figure 26 – Load Growth Sensitivity, FROI and SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years



A lower load growth assumption than that developed by the IESO decreases the FROI and SROI of the Wataynikaneyap Power Project. In addition, the range of possible outcomes increase significantly for the FROI and the SROI relative to the Base Transmission Case, which reflects just how sensitive the financial and societal business case of the project is to the future load growth assumption. With respect to the FROI, there is approximately a 55% chance of obtaining a net present value greater than zero. Taking the monetary value of socioeconomic benefits into consideration dramatically improves the business case of the project. In this case, there is about an 85% chance of obtaining a positive net present value. Under The Load Growth Sensitivity, the socioeconomic benefits of the Wataynikaneyap Power Project are much more essential for the business case of the project than in the Base Transmission Case. The table below shows the key SROI metrics of the project at the mean (i.e., expected value).

Table 18 – Carbon Value Sensitivity, Mean SROI of the Wataynikaneyap Power Project

Sustainable Return on Investment ("SROI") Metrics Mean Expected Value (2021 CAD$, Millions)	
Financial Return on Investment ("FROI")	**$111**
Present Value of Avoided GHG Emissions	$328
Present Value of Reduced Adverse Health Impacts	$221
Present Value of Reduced Damage to Vegetation	$26
Present Value of Avoided Diesel Spills	$21
Net Present Value (SROI)	**$707**
Discounted Payback Period (years)	26.52
Internal Rate of Return ("IRR", 2015)	7.5%
Benefit-Cost Ratio ("B/C ratio")	1.33

Under The Load Growth Sensitivity and relative to The Base Transmission Case, the IRR of project decreases to 7.5% and the discounted payback period increases by over 6 years. Despite that, at the mean, the benefit-cost ratio is still greater than one, which indicates that this is still an economic and welfare-enhancing project to pursue.

Carbon Value Sensitivity – Annual load growth of 4%, California carbon market prices used to monetize greenhouse gas emissions

In light of Ontario's expected introduction of the cap and trade program, a sensitivity analysis was run to consider results using a lower CO_2 value based on the California carbon market price (Carbon Value Sensitivity). A price forecast was developed based on the current market price and the ICIS 2030 forecast for California Carbon Allowance Futures prices of US$50 with a low and high of US$30-US$70. The forecast values were applied to a statistical distribution of prices fitted to the historical California Carbon Allowances Futures contracts on the Intercontinental Exchange. The following three diagrams show the annual socioeconomic benefits, present value of these benefits and the FROI and SROI of the project under The Carbon Value Sensitivity. It is important to note that the only thing that has changed between The Base Transmission Case and The Carbon Value Sensitivity is the values HDR are using to monetize carbon. The total amount of emissions avoided does not change.

Figure 27 – Carbon Value Sensitivity, Socioeconomic Benefits of the Wataynikaneyap Power Project by Type, 2021 to 2060

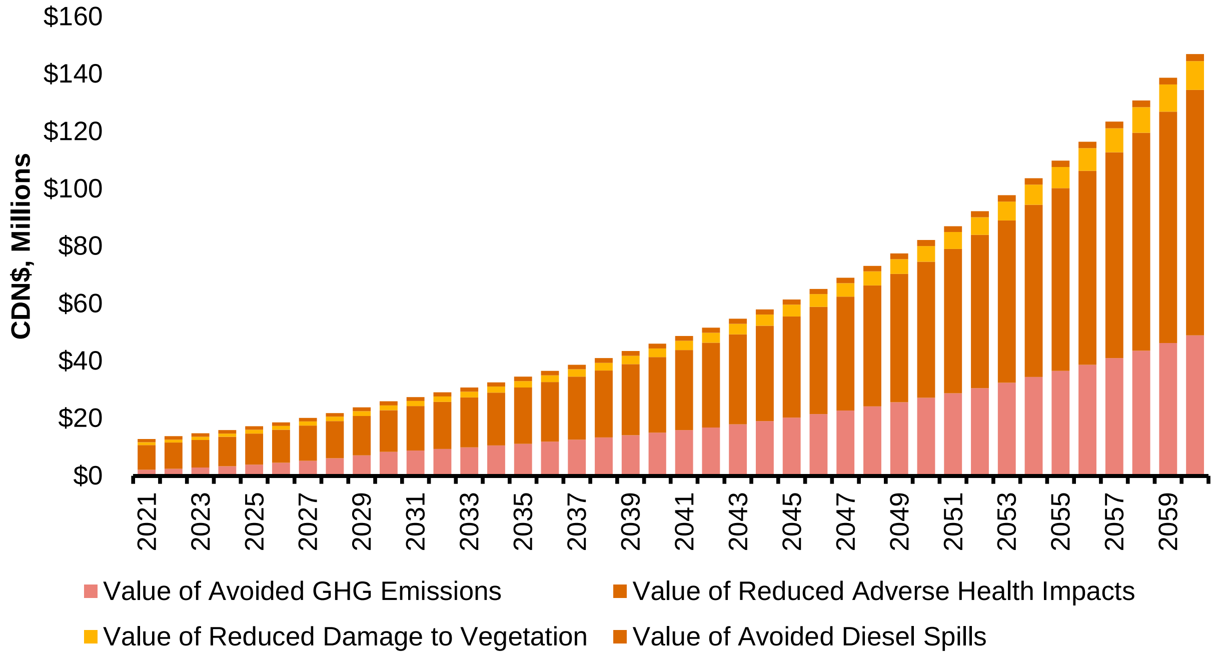
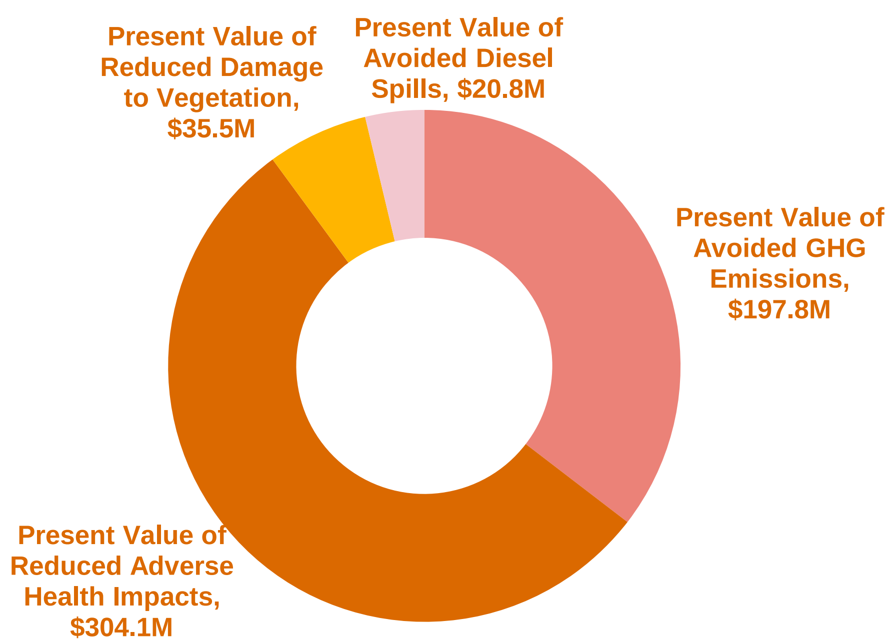
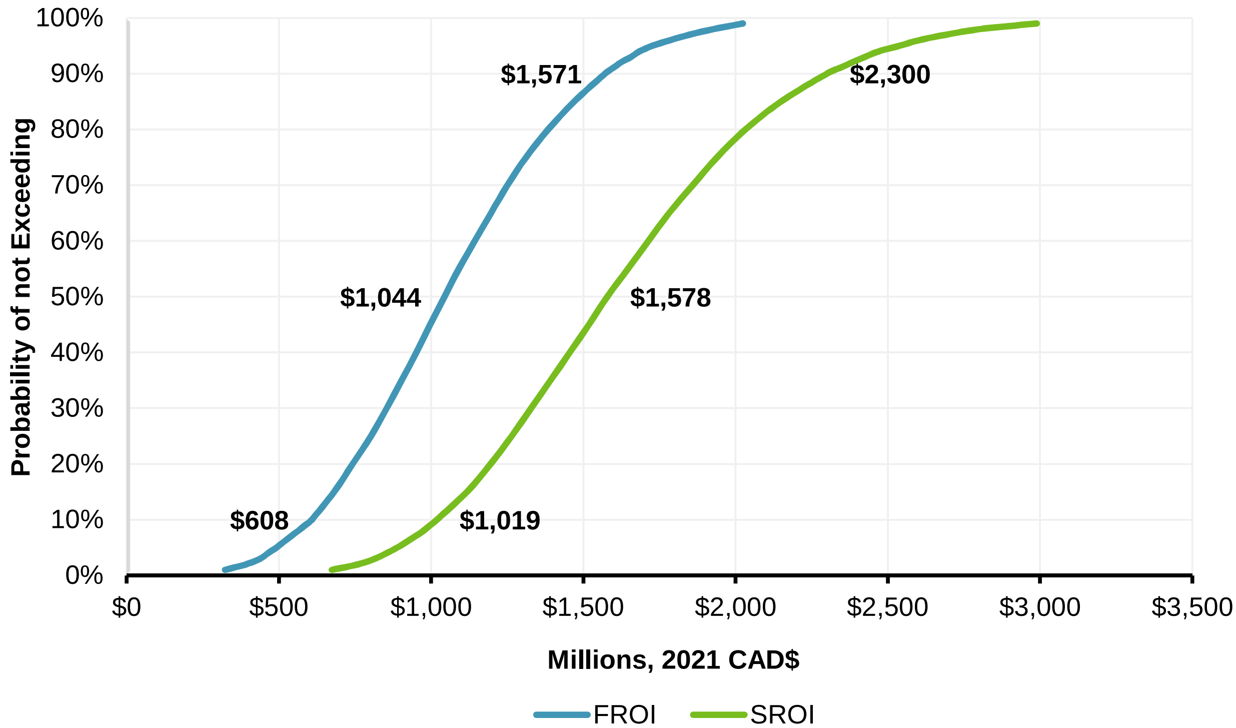


Figure 28 – Carbon Value Sensitivity, Present Value over 40 Years of Socioeconomic Benefits of the Wataynikaneyap Power Project by Type in 2021



Using the California carbon market to monetize avoided GHG emissions significantly decreases the present value of these benefits relative to The Base Transmission Case. Under The Carbon Value Sensitivity, the value of reduced adverse health impacts is the largest component of the value of socioeconomic benefits resulting from the Wataynikaneyap Power Project. Figure 29 below shows the distribution of the net present of the project under The Carbon Value Sensitivity.

Figure 29 – Carbon Value Sensitivity, FROI and SROI Net Present Value of the Wataynikaneyap Power Project over 40 Years



Under The Carbon Value Sensitivity, the confidence interval of the SROI of the Wataynikaneyap Power Project effectively shifts to the left as a result of valuing GHG reductions using a forecast of California Carbon Allowances Futures contracts, which is lower than the social value of CO_2e emissions. At the median, the SROI of the project is estimated at $1,578 million and it has a 90% chance of exceeding $1,019 million. Note that the FROI of the project is unchanged relative to The Base Transmission Case as valuing carbon only affects the SROI of the project. The table below shows key SROI metrics under The Carbon Value Sensitivity at the mean.

Table 19 – Carbon Value Sensitivity, Mean SROI of the Wataynikaneyap Power Project

Sustainable Return on Investment ("SROI") Metrics Mean Expected Values (2021 CAD$, Millions)	
Financial Return on Investment ("FROI")	**$1,071**
Present Value of Avoided GHG Emissions	$198
Present Value of Reduced Adverse Health Impacts	$304
Present Value of Reduced Damage to Vegetation	$35
Present Value of Avoided Diesel Spills	$21
Net Present Value (SROI)	**$1,629**
Discounted Payback Period (years)	21.35
Internal Rate of Return ("IRR", 2015)	9.7%
Benefit-Cost Ratio ("B/C ratio")	1.70

Relative to The Base Transmission Case, the key SROI metrics worsen slightly. The IRR of the project decreases from 10.0% to 9.7% and the discounted payback period increases by about a year. Under The Carbon Value Sensitivity, the project would still be deemed to generate societal returns in excess of costs.