Hydropower Vision

Senior Design Group 15-08

Project Plan Version 2

Students

Aldhaheri, Mohammed
Jones, Nicholas
Kraus, Kyle
Martinson, Josh
Tillema, Alex
Ward, Jared

Adviser

Prof. James D. McCalley

Client

Eduardo Ibanez (National Renewable Energy Laboratory)

Table of Contents

Problem Statement 3

Objective 3

Systems Description 3

Proposed Solution 3

Requirements 4

Design Specifications 5

Risk Management/Feasibility 6

Project Schedule 6

Work Breakdown Structure 7

Conclusion 7

References 7

Problem Statement

With the rising demand for electricity, there is an ever increasing need to reduce greenhouse gas emissions and improve the overall quality of our electric grid. Many of the resources that we are currently using are either non-renewable (e.g. fossil fuels) or cannot consistently guarantee generation (e.g. wind and solar). However, hydropower is renewable, consistent, and allows for greater manipulation of output compared to other renewable generation sources. Hydroelectric power has not seen many major developments in North America in the past few decades, leading to a large untapped potential.

Objective

Our objective is to coordinate with the US Department of Energy and the National Renewable Energy Laboratory to help develop a long-term “Hydropower Vision”. The goal of this vision is to establish an analytical basis for responsible growth in domestic hydropower, and become a major source in the renewable energy market.

Systems Description

The project will give a detailed recommendation to the DOE Hydropower Vision. The recommendation will consist of many parts, the first being finding a prime location for Hydropower generation. This will then lead us to several other steps such as developing a power flow model and designing a new transmission line expansion.

Proposed Solution

We are recommending northern Manitoba, Canada. The region is the optimal spot for the hydropower expansion, based on our research. The pros outweigh the cons:

Pros:

- Already shown to be reliable hydro-generation region
- Easily integrated into existing grid
- Will compensate for the expanding wind generation in the Midwest and Canada
- Easily accessible untapped potential that can be expanded on (2,500 MW)

Cons:

- Manitoba has little incentive to build more hydro (export costs, already existing stations, etc.)
- Need more transmission lines to connect U.S and Canada to prevent congestion

Our main alternative would be in Missouri because there would need to be less transmission line expansion than in Manitoba, but there is nowhere near as much potential within this region.

Requirements

In order for our project to be considered functional it must meet the following criteria:

- It must be implemented by the DOE and NREL as a useful tool to develop a new long-term hydropower vision.
- The report/power flow must be developed in a functional and easy-to-use fashion.

Although our project isn't directly being used by consumers, there are a couple of non-functional requirements that it should meet:

- It should represent Iowa State students and faculty in a positive manner by being written and developed in a professional manner.

Each one of these requirements must be met in a timely manner. In order to test that these requirements are met we will consult with the DOE, NREL, Professor McCalley, and other professionals in the field. These assessments will be completed through surveys and user feedback to most optimally decide areas for improvement.

Design Specifications

Our project has 5 main deliverables that we need to successfully complete in order for our system to be successful. These include:

- Identify a region in the U.S. or Canada that would be best for new hydropower resources.
- Obtain or develop a power flow model of the existing electric system.
- Identify likely non-hydro expansion in the system.
- Modify model to include our suggested hydro region and other non-hydro expansions.
- Design a transmission expansion to accommodate hydropower in our chosen region.

In order to implement these design specifications, we must be methodical and proceed with one deliverable at a time. We are currently gathering all of our research and information regarding our choice of focusing on the potential in Manitoba, Canada, and how it will affect the Midwestern region of the United States. From this, we are currently in the process of modeling all of this information to develop a power flow model of the existing along with identifying likely non-hydro in the region.

Our process that we are taking to achieve these deliverables relies heavily upon communication and teamwork. With many moving parts within this project it is important for each member of our team to proactively represent their role, but also help others when available. Thus far, this strategy has allowed to stay on track with our project schedule.

The technical specifications for this project focus mainly on modeling, with some graphic design on the side. Using PLEXOS modeling software, we plan to finish developing the current power flow this semester and then proceed to finish the latter steps within second semester.

Our processes may not be as easily documented as some technical projects, but there are still ways for us to assess the results. Our functional test plan will involve many steps of checking within our PLEXOS modeling software, primarily using our previous research to determine if the information is within a feasible range. We will also have the help from our contact in the industry and a graduate student within the department who is highly knowledgeable in PLEXOS software.

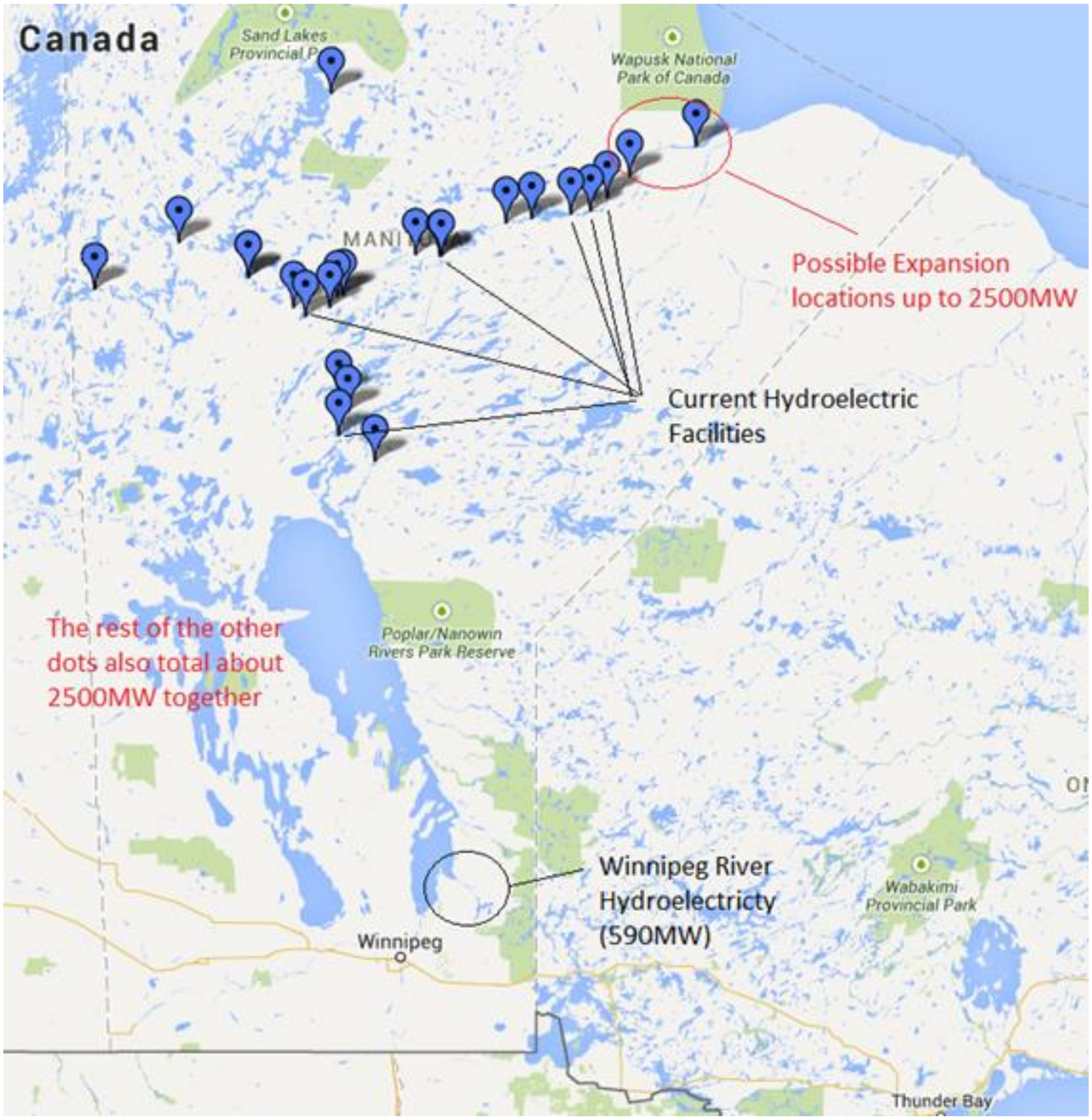


Figure 1: Possible hydroelectric locations

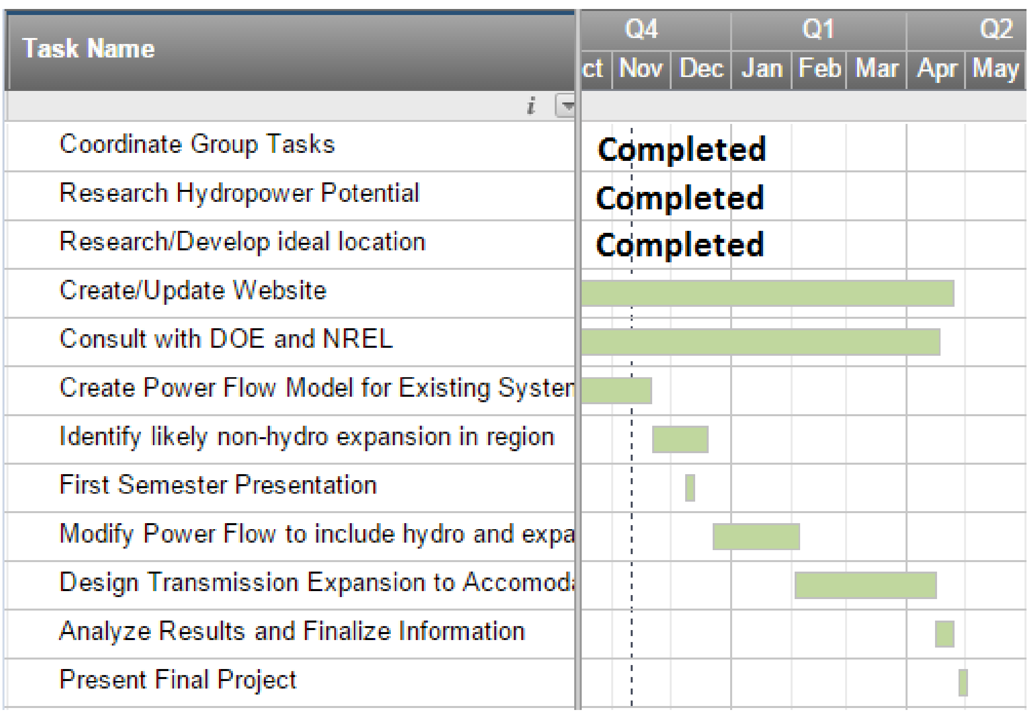
Risk Management/Feasibility

Although our project does not have much for physical risks, such as arthritis from typing and researching, there are some possible risks to the completion of the project itself. Unfortunately, these risks lie mainly within the time management and research category.

Since our project consists of many parts that build on each other, it is important to successfully implement each deliverable in a timely and constructive manner. Meaning, the research has to be thorough, so that the project doesn't advance to the point of modifying the model and finding that it does not work. Thus forcing us to start over. We minimize this risk by looking into and ranking many different potential sites, so that we are not scrambling to find a new starting point for our project.

As shown by our research, Manitoba represents a region which can reliably support hydropower expansion. This, along with many other factors, has allowed us to determine that are project is very feasible. Not only is there plenty of information available to us, we are not constrained by project costs, because they are negligible.

Project Schedule



Work-Breakdown Structure

Our group for this project consists of 6 team members. Every team member was designed a specific role based on our strengths and weaknesses in order to maximize our overall productivity. We decided to implement the roles as follows:

Aldhaheri, Mohammed:	Lead Researcher
Jones, Nicholas:	Communication Leader
Kraus, Kyle:	Webmaster
Martinson, Josh:	Key Concept/Webmaster
Tillema, Alex:	Team Leader
Ward, Jared:	Key Concept Leader

Conclusion

While this project poses many obstacles, we will complete all of our objectives and make our best possible suggestion to the DOE, with the goal that it will be implemented in the future. We are hopeful that this will also lead to more growth in renewable generation in the Midwest and Canada.

References

Bakke, Jordan, Zheng Zhou, and Sumeet Mudga. "Manitoba Hydro Wind Synergy Study." Manitoba Hydro Wind Synergy Study (n.d.): n. pag. Web.

Gu, Yang, Jordan Bakke, Zheng Zhou, and Dale Osborn. A Novel Market Simulation Methodology on Hydro Storage. N.p.: MISO, 13 Sept. 2013. PDF.

"List of Generating Stations in Manitoba." Wikipedia. Wikimedia Foundation, 25 Oct. 2014. Web. 11 Nov. 2014.

"Manitoba Development and Industry." Manitoba Development and Industry. Manitoba Wildlands, n.d. Web. 11 Nov. 2014.

Hydro, Manitoba. "Needs For and Alternatives To Chapter 5 –The Manitoba Hydro System, Interconnections and Export Markets." Needs For and Alternatives To Chapter 5 –The Manitoba Hydro System, Interconnections and Export Markets. Manitoba Hydro, Aug. 2013. Web.