

WORK PLAN SUMMARY

May 2014

NEXT
GENERATION
HYDRO
powering our future

A large, dynamic splash of water in shades of blue and white, moving from left to right across the middle of the page. The water is captured in mid-air, with many small droplets and bubbles visible, creating a sense of motion and freshness.

Yukon
Development
corporation

Yukon
Government

It is time for bold leadership with regards to taking charge of our energy future so the next generation of Yukoners will be able to continue to enjoy the benefit of affordable and reliable hydropower. For this reason the Yukon Government has issued a Hydroelectric Power Planning Directive (the Directive) and has asked Yukon Development Corporation (YDC) to develop this Work Plan detailing the steps needed to develop next generation hydro.

The Directive is also a key next step to implementing the Government's *Energy Strategy For Yukon* and the *Climate Change Action Plan*. Specifically, the Directive states YDC is "to plan one or more hydroelectric projects to ensure, together with supporting renewable and, to the minimum extent feasible, non-renewable sources of electrical power, for an adequate and affordable supply of reliable and sustainable electrical power in Yukon." YDC has developed a Work Plan (summarized here) detailing the process it will undertake to address this Directive and build a business case for one or more hydroelectric projects, other associated renewable energy and transmission infrastructure to meet Yukon's future needs (20 to 50 years from now).

Yukon's electrical supply is now close to capacity and there is no transmission connection to another jurisdiction, where power can be bought. Therefore, Yukon must plan and develop its own solutions to ensure there is a future supply of electrical energy – a supply that meets mid-term (10 – 20 years) and long-term (20 to 50 years) needs. In the long-term, it is expected that supply might be, as much or more than double our present hydro capacity. The need for new power will primarily come from expected long-term population growth¹, which is estimated to rise over 10 per percent from 36,700 (2013) to 40,400 by 2019. And secondarily, power will be needed to replace the use of fossil fuels for energy generation (e.g. space heating, electrical use by industrial customers and stranded rate-payers²).

The Work Plan addresses the challenge of having enough hydro electricity available to meet future needs, without negatively impacting Yukon rate or taxpayers. YDC expects to deliver to the Yukon Government, in 2015, a business case to proceed with the planning of one or two future hydroelectric power projects (Next Generation Hydro Project). This is the first step, of a multi-step process that will take 10 to 15 years.

¹ The Yukon Government's 2014 Yukon Economic Outlook includes a medium-term forecast. Population has been increasing each year for 13 consecutive years. This trend is expected to

² Ratepayers are the consumers who pay for electricity produced by regulated utilities.

YDC is a crown corporation tasked through legislation to look at the role of energy³ to promote the development of Yukon resources on an economic and efficient basis; promote employment and business opportunities for Yukon residents; assure a continuing and adequate supply of energy in a manner consistent with sustainable development; and carry out development directives issued to it by Yukon cabinet.

As planning for Next Generation Hydro Project takes place, Yukon's two utilities, Yukon Energy Corporation (YEC) and Yukon Electrical Company Limited (YECL) will continue their work to meet Yukon energy needs. Yukon Energy Corporation is a publically owned utility and Yukon Electrical Company Limited is a private utility. YEC owns and supplies the majority of the electricity in the Yukon through three hydro facilities, a small wind facility and backup fossil fuel generators. YECL owns a small hydro facility and several diesel generators and soon to be diesel natural gas generator in Watson Lake. YECL distributes electricity it buys from YEC to most Yukon communities (except Dawson, Mayo and Old Crow).

Over ninety-five percent of Yukon's on grid electrical generation comes from hydro and a small amount from wind. The remaining amount comes from fossil fuels. To maintain this high renewable energy standard, as directed by Yukon's Energy Strategy and Climate Change Action Plan, demand-side management, new hydro development and other renewable projects are needed to meet expected long-term population growth and economic needs. Without the Next Generation Hydro investment Yukon risks the use of fossil fuels to generate future electricity, which would significantly increase green house gas emissions (GHG). An assortment of new hydro development, other renewables and transmission would be the best energy mix to address the Yukons future energy needs.

Although Yukon has numerous rivers of different sizes flowing through mountainous environments, not all are well suited for medium to large hydro. Hydro projects located far from existing or possible future transmission lines or along the Yukon River are not considered under the Directive. Yukon's remaining rivers are somewhat disadvantaged by geography, as most suitable rivers for medium to large projects lack waterfalls or elevation drops necessary for hydro generation. As well, most Yukon rivers have water flows that are highly concentrated over a 5 month period in the summer. Thus, the ideal Next Generation Hydro project will be one that is on rivers with incised canyons, where

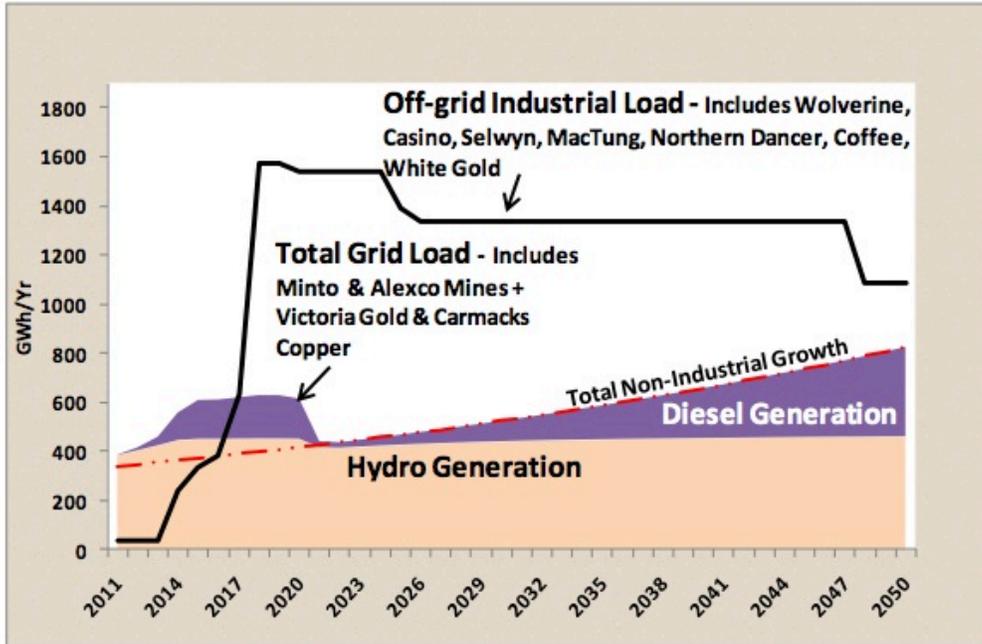
³ An Order-in-Council in 1993 (07) restricted the Corporation's role to the role of energy as it relates to the economic development in the Yukon.

hydro dams can be placed and where water can be stored, ideally in a nearby lake to minimize impacts from flooding.

Recently, experts have reviewed possible medium to large hydro sites, as detailed in the Yukon Energy's 20-Year Resource Plan and Large Hydro Study. The Work Plan will re-assess some of these sites against the Directive criteria and various transmission strategies, to determine the most favorable projects that can meet long-term needs. These sites will be discussed with First Nations, whose traditional territories will be affected, to determine associated possible impacts and benefits are addressed. Further discussions will be held with all First Nations, with the general public, stakeholders and others before the YDC Board recommends its hydro options for business case development.

This diagram conceptually represents the energy future and the associated possible needs and consequences of having a hydro short fall.

Figure 2-4: Existing System Capability to Supply Potential Grid Load & Potential Off Grid Mine Loads: 2011-2050



***Scenario B - Base Case Load Forecast with Victoria Gold, Carmacks Copper & WHCT**

	2011*	2015	2020	2025	2030	2035	2040	2045	2050
Grid Load/Hydro Supply Gap**	2	158	163	40	83	138	204	278	364
(Forecast Diesel Generation-GW.h/yr)									
Potential Off Grid Mines	37	332	1,538	1,390	1,338	1,338	1,338	1,338	1,088
(Forecast Diesel or LNG*** GW.h/yr)									
Total Yukon Diesel or LNG Generation (GW/yr)	39	490	1,701	1,430	1,421	1,476	1,541	1,616	1,451
Total Potential GHG's (tonnes)	26,962	343,073	864,118	674,435	667,793	706,413	752,282	804,481	689,306

* 2011 diesel generation is based on long term forecast (not actuals)

** Assumes connection of Carmacks Copper and Victoria Gold to grid

***Assumes Casino develops using LNG with combined cycle power generation & other off grid mines develop using diesel

The Work Plan will address each of the Directive criteria as follows:

Criteria 1 “evaluate the expected growth in residential, commercial and industrial demand for electrical power in Yukon”. The Work Plan will assess existing new energy growth forecasts and develop various long-term economic scenarios depicting Yukon’s future. As this research is being conducted, conversations will be held with the public, stakeholders and other levels of government.

Criteria 2 directs YDC to “plan for scalability, so as to allow for the increase of energy supply over time to meet projected demand growth”. The Work Plan will explore scalability as a means of mitigating Next Generation Hydro risks. In particular, scalability will be addressed from two perspectives. First, scalability will be examined as it relates to medium and large hydro projects that can be built out or added to in stages to increase capacity and energy output (keeping in mind the need to mitigate negative environmental and socioeconomic effects). And secondly, scalability as achieved through a transmission strategy that leads to an eventual jurisdictional connection. In the latter, the question will be: how can transmission extensions either south toward BC or Alaska make a difference to the selection of Next Generation Hydro projects and other renewable options being considered for business plan development?

Criteria 3 directs YDC to “assess the project’s financial needs and risks, and evaluate options for project financing and financial risk mitigation”. Any new medium to large hydro project and associated transmission infrastructure will mean hundreds of millions of dollars of investment. The Work Plan will determine estimated overall and per stage project costs that are expected be incurred over a 10 to 15 year period. Financial tools, funds, programs and models will be reviewed by looking at the ways other jurisdictions in Canada have approached and financed projects of a similar size.

Criteria 4 and 5 directs YDC to “determine the anticipated positive and negative socio-economic and environmental effects of the project, and develop specific means of maximizing its benefits, minimizing its adverse effects and mitigating any unavoidable negative impacts” and “in respect to the effects have particular regard to the impacts on and opportunities for, the First Nation or First Nations in whose traditional territory the project may be located.” The Work Plan begins this process by first; working with First Nations and then, working separately with interested

stakeholders to identify general values so that impacts and benefits can begin to be discussed. As well, conversations will be started on how to minimize impacts and realize benefits for the possible future Next Generation Hydro Project. These are conversations that will last longer than the time frame of this Work Plan so they will be used to start a pro-active dialogue with YESAB, First Nations governments, stakeholders, the public and regulators on the values that should be assessed if a project were to advance to assessment by YESAB.

Criteria 6 directs YDC to “engage with First Nations to explore options for project locations as well as opportunities for partnership in project planning and execution”. The Work Plan begins this process. First Nations will be partners in future hydro and other renewable energy development in the Yukon. Information will be shared with First Nations to explain Yukon’s energy situation and how hydro, other renewables and transmission projects might fit into future economic growth scenarios. Where a potential medium to large hydroelectric project exists in a First Nation traditional territory, the directly affected First Nation will be more formally consulted. YDC will work with the affected First Nation to develop a mutually agreeable engagement protocol. This will include meetings with the Elder Council, Chief and Council, citizens, agencies and government officials.

Criteria 7 directs YDC to “consider one or more specific possible locations for the project, taking into consideration the above criteria as well as proximity to the existing and expected future customer base”. The Work Plan recognizes past legacy hydro and how its development might inform future hydro development. In the past, legacy hydro facilities refer to hydro assets that were developed largely to supply electricity to longer-term mine loads. These facilities are still helping to pay for assets that today provide Yukoners with affordable electricity. Planning new Next Generation Hydro will require similar foresight. New hydroelectric projects will need to meet a number of criteria including those outlined in the Directive.

With the release of the Work Plan, YDC will begin the public conversation and engagement process that will form the basis of the Next Generation Hydro Discussion Paper. The engagement process will include a number of community visits and events where those that are interested can learn more about Yukon’s energy challenges and how Next Generation Hydro will help meet our mid- to long-term needs. This conversation will be kept focused with the use of the Technical Papers and an

associated speaker series. As well, there will be a multi-day workshop or conference that ties all the topics together.

In 2015, the YDC board will present to the Minister the business case for Next Generation Hydro that highlights one or two hydro options, related renewables and transmission infrastructure.

DELIVERABLES

The Yukon Government has set aside \$2 million in the 2013/2014 Budget (to be approved) for the implementation of the Hydroelectric Power Planning Directive Work Plan.

DELIVERABLES

A series of technical papers will be released to guide the Work Plan Engagement process. These technical papers will be shared with First Nation Governments, agencies, stakeholder groups, and the public.

Technical Paper – Economic Growth Scenarios and Energy Demand Forecasts

This paper will update mid- and long-term scenarios using a variety of different assumptions that take into account GHG targets and other related policies considerations. Different economic scenarios will be developed and for each, an energy demand forecast will be constructed. This work will present Yukoners with scenarios mid (10 to 20 years) to long-term (20 to 50 years) so discussions can be framed in consideration of future generations.

Technical Paper – Scalability of Next Generation Hydro Project Options

This paper will address Next Generation Hydro Project risks by looking at the pros and cons of various hydro projects, in terms of their flexibility to be scalable (build-outs and fit to other renewables) and their relative ability to respond to demand forecasts and growth scenarios in the mid- to long-term.

Technical Paper – Jurisdictional Transmission Line Technical Logistics Analysis

This paper will address Next Generation Hydro project risks by asking the question whether strategic investments to extend Yukon's transmission system to another jurisdiction (for instance from Faro to Watson Lake or Whitehorse to Skagway, Alaska) would make a difference to: 1) the selection of Next Generation Hydro options and 2) the

ability to scale out energy supply and mitigate industrial load interruption risks. As well, what amount and what location of Yukon based load and supply is required to make a transmission line connection technically feasible (line balancing)?

Technical Paper – Jurisdictional Transmission Connection Market Assessment

This paper will address the business case of jurisdictional connection. What is the market economics associated with a jurisdictional transmission connection (Alaska and BC)? Would other jurisdictions sell power to the Yukon? Would other jurisdictions consider Yukon power affordable and would they be interested in buying it? If jurisdictional transmission was to be considered viable, how should it be built out and what Next Generation Hydro Project options would best suit this build-out?

Technical Paper – Project Cost per Hydro Development Phase

This technical paper will address the Next Generation Hydro Project's upfront capital project needs and risks, per phase of development. Project costs can be split into various phases including conceptual design, prefeasibility, feasibility, planning, construction and operations. Financial risk mitigation will be discussed in terms of types of available funding models and the sources of funding and partnership opportunities that exist.

Technical Paper – Positive and Negative Socio-economic and Environmental Effects of the Project

This technical paper will address the possible positive and negative socio-economic and environmental effects of a medium to large hydro project and related infrastructure. Specifically, it will address best practices for maximizing benefits, minimizing adverse effects and mitigating any unavoidable negative impacts. As well, this technical paper will address best practices regarding effects that might have particular impacts on and opportunities for, the First Nation or First Nations in whose traditional territory the project may be located. Important values that will be affected by a hydro project will be noted and discussed with YESAB so that a comprehensive and pro-active approach can be taken to assessment of a potential future project.

Next Generation Hydro and Transmission Viability Options Study will combine the information collected from the above-mentioned technical papers in a new analysis of the medium to large hydroelectric options. This analysis will include the Directive criteria

and the need to address mid-term needs (other renewables), long-term needs and risk mitigation (scalability and transmission strategy). This final document will be given to the YDC board so they can select the most appropriate Next Generation Hydro Projects for business case development.

Next Generation Hydro Discussion Paper – This summarizes the engagement process, which will include community meetings, stakeholder meetings, and a multiday conference.

Yukon First Nation Energy Forum 2 will be held to help inform First Nations leadership, technicians and government officials. This Forum will build from the first Yukon First Nation Energy Forum. It will introduce the energy context, outline the potential for medium to large hydroelectric power and other renewables, discuss transmission strategy, investment models and opportunities and how impacts to values could be addressed. A technical paper may be produced from this Forum. Where a potential Next Generation Hydro Project exists, First Nations will also be asked to work with YDC to create a meaningful set of engagement activities related to the Work Plan. This will likely include meetings with the Elder Council, Chief and Council, citizens, agencies and government officials. For potentially qualifying Next Generation Hydro Projects, particular attention will be paid to identification of socio-economic, heritage and environmental values from both a traditional knowledge and a scientific perspective.

Next Generation Hydro Business Case will act as a business prospectus or business rationale for future investment to proceed with Next Generation Hydro development. Investment will be sought from Yukon Government, First Nations Governments, the Government of Canada, other governments, the private sector and from funding programs. The Business Case will include the cost per stage of work for a Next Generation Hydro Project, which may be a 10 to 15 year process.