Arviat Clean Microgrid Project

Partnerships for Climate Action

Shivani Chotalia, P. Eng
Mihskakwan James Harper, EIT

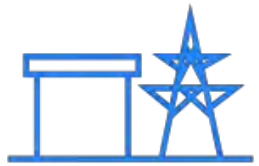
Renewables in Remote Communities Conference April 2022

About NRStor

NRStor works closely with communities, utilities and energy consumers to identify opportunities and deliver world class projects

- NRStor was founded in 2012 to develop low cost, reliable energy storage projects that provide value-add services to customers

- Our success stems from our:
  - **Woman-Led Management Team.**
  - **Proven Track Record Deploying First of Kind Projects.**
  - **Partnership-First Business Model.**
  - **Diversified Value Streams and Monetization Strategy.**
  - **Trusted Relationships.**
  - **Impact Investments.**



Utilities

Enabling clean, flexible and reliable electricity systems through large-scale energy storage projects

Microgrids

Partnering with remote communities and mines to reduce dependence on diesel fuel using clean energy microgrids

Distributed & Residential

Empowering residential customers to take control of their energy supply

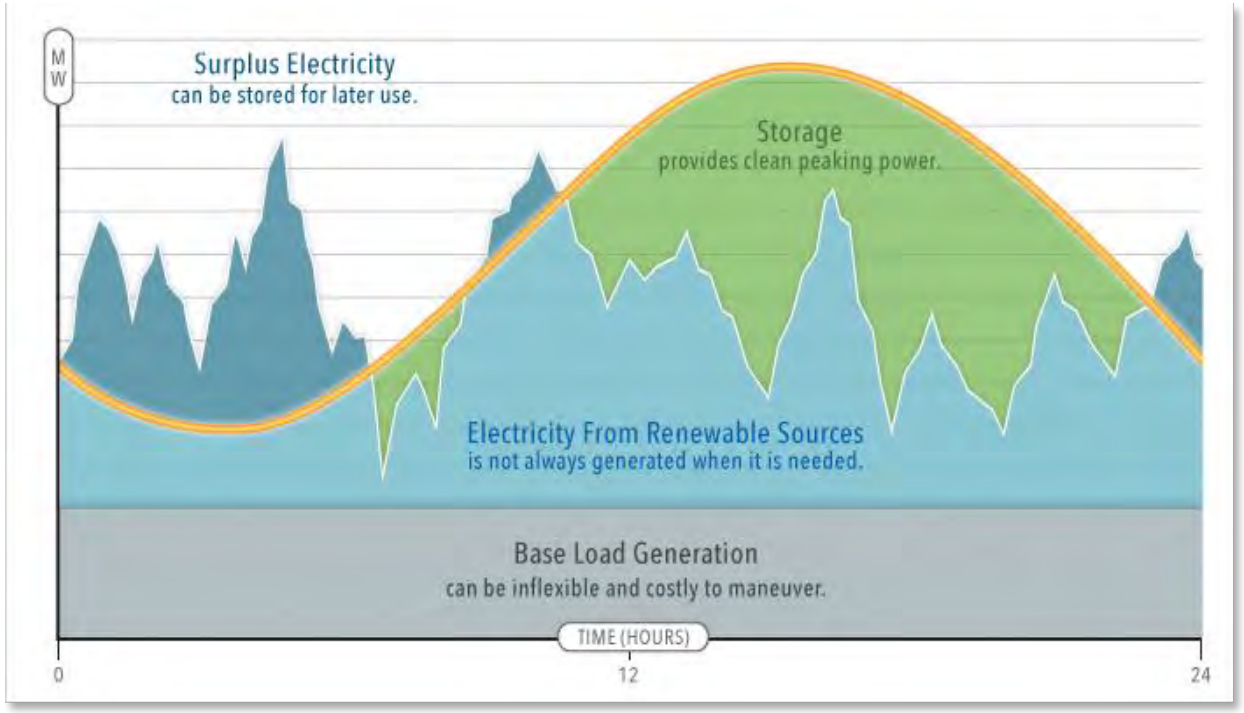
NRStor Remote Communities and Mines

NRStor Remotes actively engages and partners with Indigenous communities to deliver clean energy microgrids reducing dependence on diesel fuel

- **Partnerships First:** We actively seek opportunities for more meaningful engagement, involvement and partnership on community projects
- **Local Economic Benefits:** Our projects can enable significant infrastructure ownership and local revenues for indigenous communities
- **Locally Tailored Solutions:** Our technology agnostic approach identifies community's needs, technology preferences, and economics for owning and operating renewable microgrids

Unlocking Value with Energy Storage

- **Energy storage can balance energy supply and demand to maximize the use of renewable energy, and also make the energy system more reliable.**
- **Energy storage allows wind or solar energy to be stored and used when the wind is not blowing, or the sun is not shining.**
- **Without energy storage, variable renewable generation (wind and solar) may be limited to ~20% penetration of energy needs. Storage is needed to move beyond that.**
- **Energy storage improves the efficiency of the whole system**

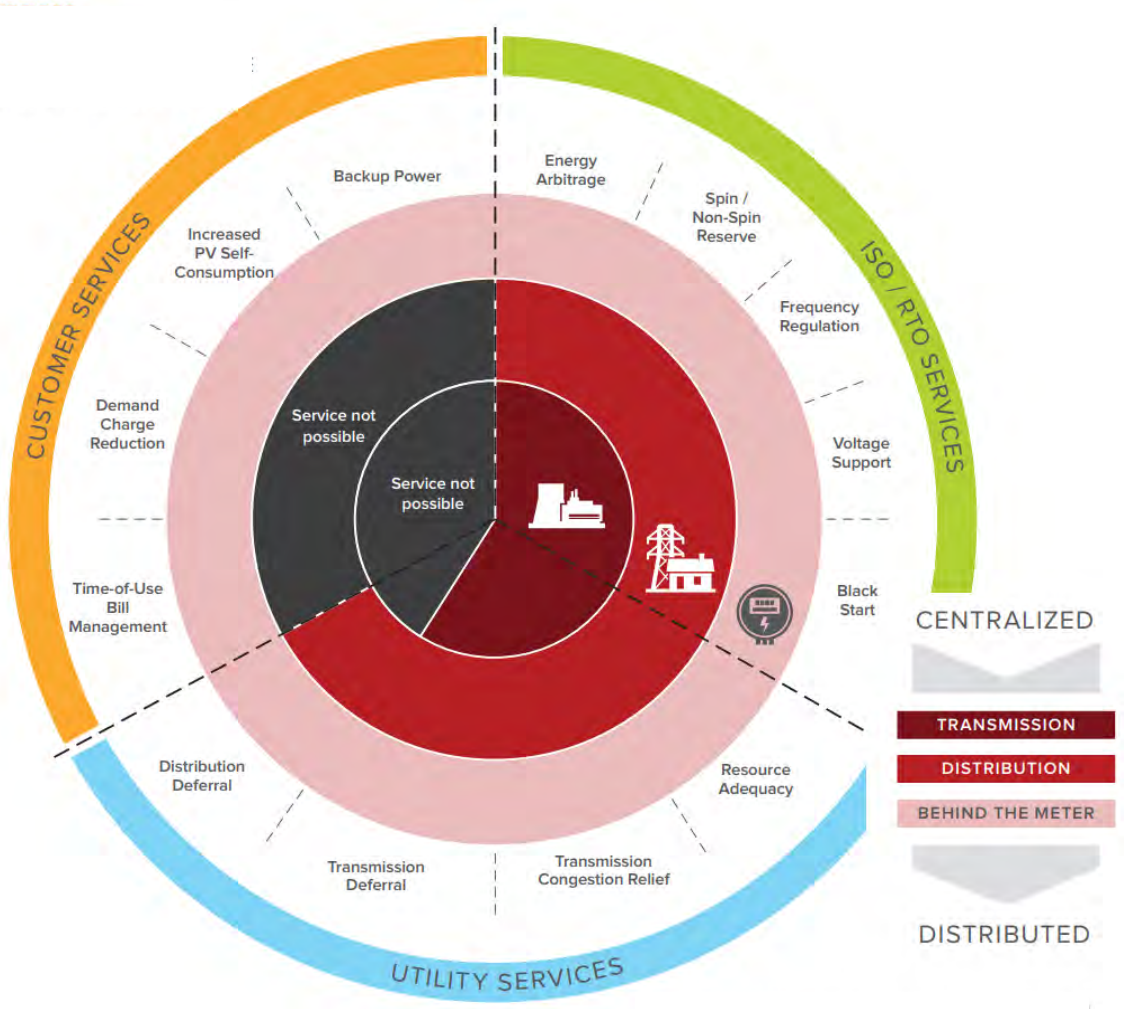


Energy Storage is Fast & Flexible

- Energy storage can respond much more quickly and precisely compared to traditional assets.
- NRStor's 2MW Minto Flywheel Facility has been operating for over 5 years.
- It provides frequency regulation to the Ontario grid under a contract with the IESO.
- The facility is able to provide ***more than 2x the value*** that traditional resources can provide.

Energy Storage Can Provide Many Different Services

- Energy storage can be used to "stack" multiple services
- Consider whether storage should be ***behind-the meter vs. in front of the meter***
- In a microgrid, services could include:
  - Backup power and resilience *(if behind-the-meter)*
  - Renewable energy integration
  - Spinning reserves
  - Voltage support
  - Optimizing the operations of existing diesel generation
- Ex. Aggregating Tesla Powerwalls in Toronto to save on system costs and increase power resilience for homes



Source: Rocky Mountain Institute: The Economics Of Battery Energy Storage

Choose Technology Vendors & Partners With the Right Experience

There are many types and sizes of energy storage – choose the right one for your specific needs.

2MW Minto Flywheel Facility	4MW Strathroy Battery Facility	2MW Goderich CAES Facility
Service: Frequency Regulation	Service: Frequency Regulation	Service: Capacity, Operating Reserve
- No degradation. 30 year+ asset.	- Degrades with usage. Need to augment/replace cells based on life of project. - Not all battery cells made equal; needs to match application.	- No degradation. 30 year+ asset.
- Brand new technology. Impacts maintenance, upgrades, inventory, accessibility requirements.	- Well-known technology. O&M requirements can be easier to define.	- First of a kind project. Undefined permitting process. Delays and cost overruns likely.

Introduction: Clean Microgrids

Energy Use in the Hamlet of Arviat

Arviat's energy currently comes 100% from Diesel Fuel

- Right now, diesel fuel is barged into Arviat and burned in diesel generators in order to create power. Burning diesel creates harmful greenhouse gas emissions contributing to climate change.

- Our vision is to use renewable energy sources, like the sun and the wind, to create clean energy.

- The Hamlet started working with NRStor in late 2016 to design a clean energy solution.

Arviat Clean Microgrid Project

We looked at the energy needs in Arviat and local wind and solar resource to design the project

After many studies, we determined that the best solution for Arviat will include:

200 kW Solar System
Target 2023

1.6 MW Wind Turbines
Target 2023+

2 MW / 2 MWh Battery Energy Storage
Target 2023+

Preliminary analysis shows that over 20 years, this project could:

- Prevent over 160 thousand tonnes of CO_2 from entering the atmosphere
- Avoid burning ~ 30 million litres of diesel fuel

The Hamlet of Arviat will own the project with NRStor and make revenues from it by selling the clean energy to the utility (QEC).

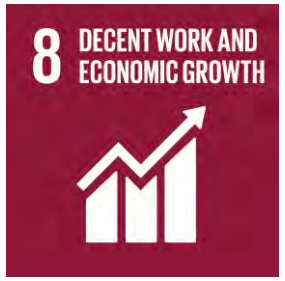
Project Siting

Sites were selected considering technical requirements and local preferences, and are located on Hamlet Lands.

Project Benefits

Environmental Benefits

- Prevent over 160 thousand tonnes of CO_2 from entering the atmosphere
- Avoid burning ~30 million litres of diesel fuel
- Reduce diesel by more than 50%
- Provide Arviat with a reliable and renewable source of energy



Economic Benefits

- Creation of a long-term revenue stream to the Hamlet of Arviat, for reinvestment into the community
- Job and training opportunities directly through the project, especially during construction
- Increase in jobs enabled by the community's project revenues

Social Benefits

- Improved air quality and health benefits of reduced diesel consumption
- Increase in community initiatives enabled by the revenue provided by the project
- Increased understanding of clean energy technologies and clean energy education in the community

Remote Microgrid Project Challenges

Remote microgrid projects come with unique considerations and challenges that must be managed through strong partnerships and a willingness to think creatively.

- Independent Power Producer and PPA model may be new to the region and utility
- Data can be challenging to obtain
- Project Siting can be sensitive and requires robust community involvement and support
  - Wind siting can be limited by proximity to airports, which are present in all remote, fly-in communities. Increased distance from the airport must be weighed against cost of transmission line to connect wind to the microgrid
- Permitting pathways for renewable projects may be unclear and undefined
- Logistics must be managed and may impact project timelines
  - Constrained by the number of barges to a community (i.e. 3 barges a year in Arviat)
- Integration with existing diesel system
  - Diesel equipment may be very old
  - Connection assessments for high penetration of renewables is new for utilities
- Extreme cold weather in the north must be taken into consideration in project design

Example of Community Involvement

We have learned firsthand how local involvement in all aspects of the project makes for stronger outcomes.

- Bird Surveys conducted by local HTO in summer of 2020 were able to move forward as planned, rather than being delayed by the pandemic

Partnerships for Climate Action

Remote microgrid projects require a high level of interface and collaboration between Project Partners and Stakeholders

We believe community-driven projects require:

- Local Involvement and Community Leadership
- Project Partner with Project Development & Financing Experience
- Collaborative Utility with a clear IPP process to make projects a success

Clean Energy Microgrids present an important opportunity for remote communities to gain ownership in their energy systems while reducing dependence on diesel.

As project partners, NRStor can help enable community-led clean energy microgrids to be deployed seamlessly and successfully.

Thank you

L'ᓇ

Matna

"Yesterday is ashes. Tomorrow is green wood. Only today does the fire burn brightly"
-Inuit proverb

Path Forward for Renewables Development in the Beaufort

Grant Sullivan, Nihtat Energy Ltd.

April 27, 2022

Who are the Nihtat Gwich’in?

Nihtat Energy Ltd (NEL)

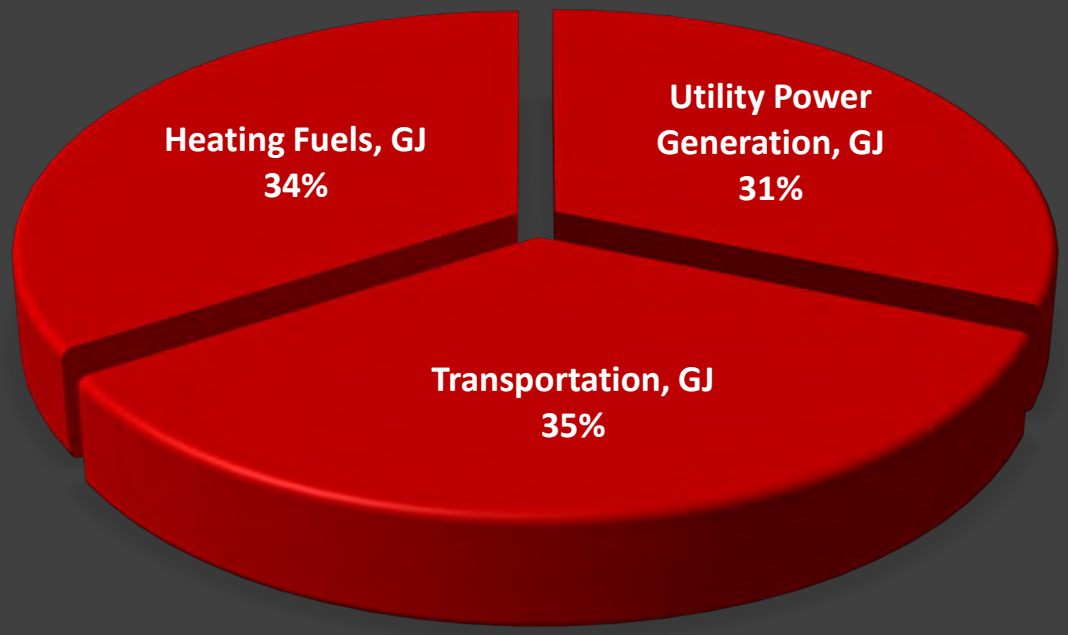
- Northern, Indigenous owned.
- Subsidiary of Nihtat Corporation
- Focused on developing and operating clean energy alternatives.
- Operating in Beaufort Delta region & other areas of northern Canada.

Nihtat Corporation

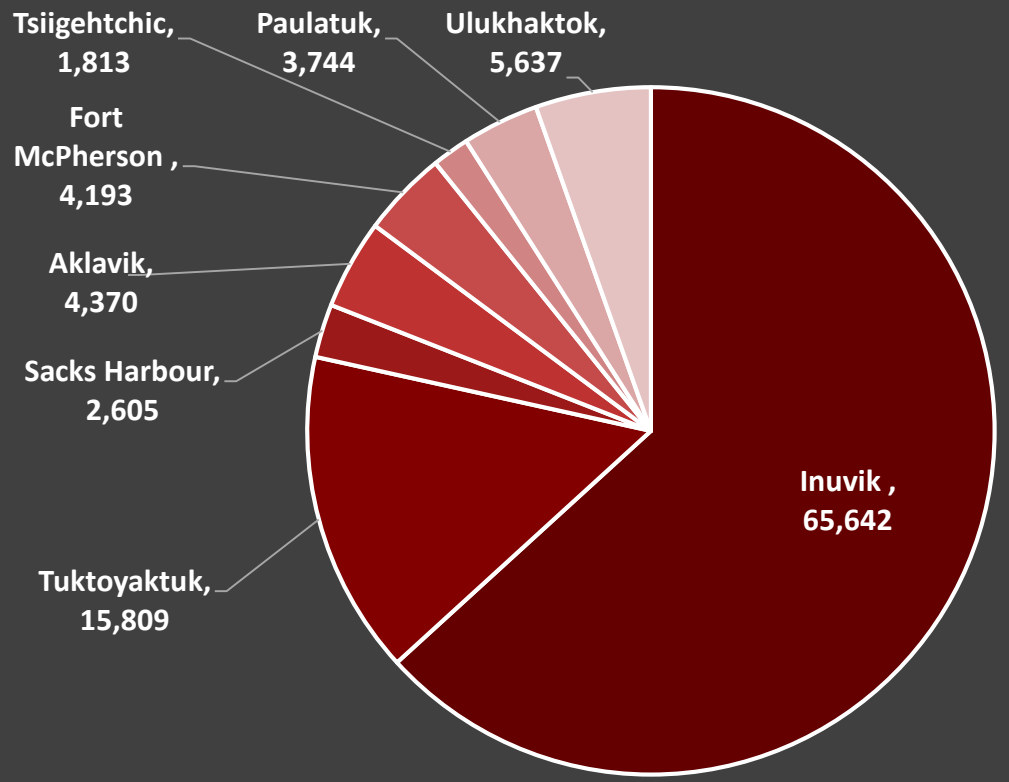
- Wholly owned by the Nihtat Gwich’in Council.
- Located in Inuvik, NWT.

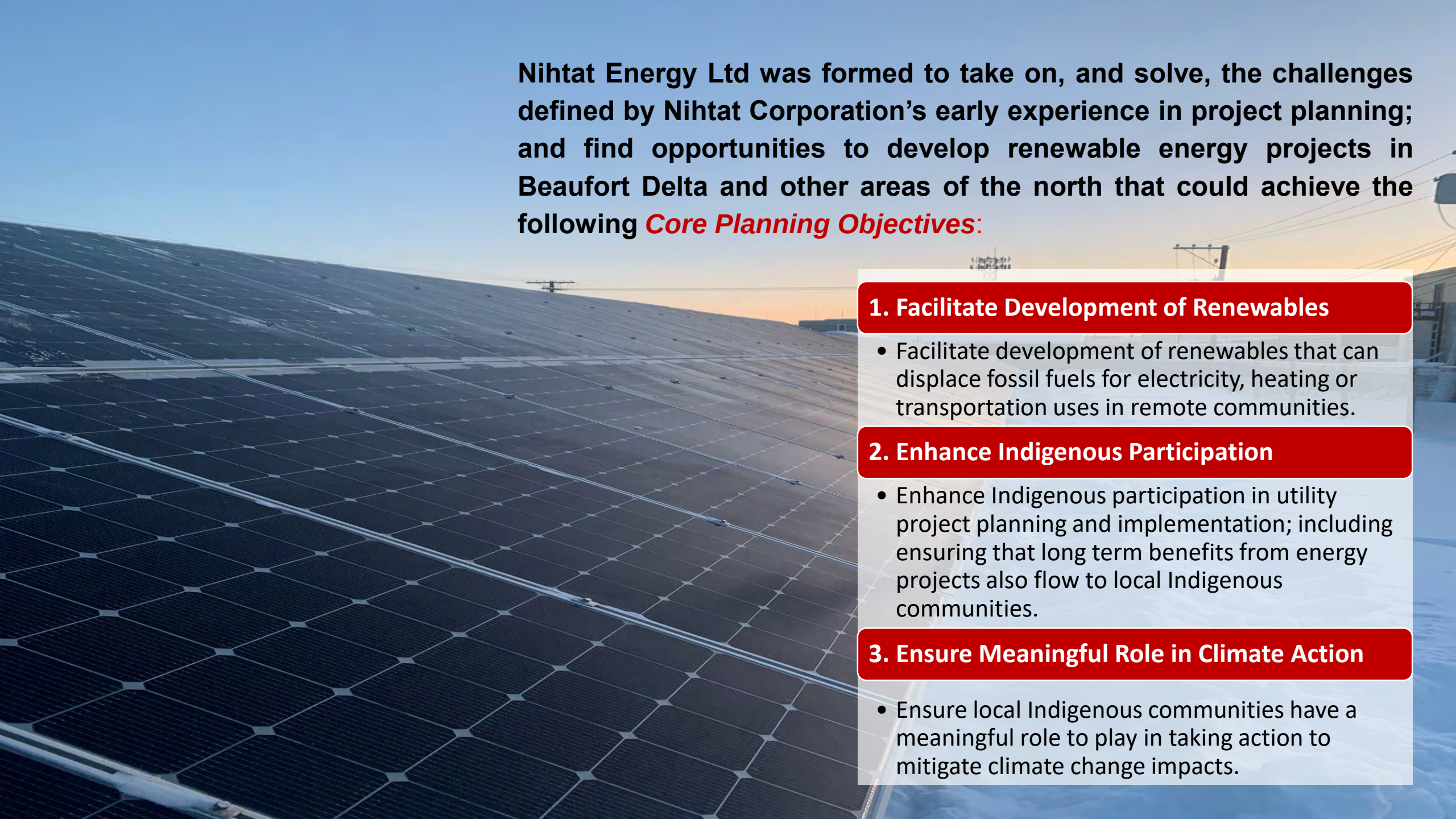
Beaufort Delta Context – Fuel Use

Breakdown of Beaufort Delta Thermal Fuel Use



Beaufort Delta GHG Emissions by Community





Nihtat Energy Ltd was formed to take on, and solve, the challenges defined by Nihtat Corporation's early experience in project planning; and find opportunities to develop renewable energy projects in Beaufort Delta and other areas of the north that could achieve the following *Core Planning Objectives*:

1. Facilitate Development of Renewables

- Facilitate development of renewables that can displace fossil fuels for electricity, heating or transportation uses in remote communities.

2. Enhance Indigenous Participation

- Enhance Indigenous participation in utility project planning and implementation; including ensuring that long term benefits from energy projects also flow to local Indigenous communities.

3. Ensure Meaningful Role in Climate Action

- Ensure local Indigenous communities have a meaningful role to play in taking action to mitigate climate change impacts.

North Mart Inuvik

- 165 kW AC
- 164.5 t/yr GHG emissions reduction

Solar Residential Program

- 214 kW AC
- 154 t/yr GHG emissions reduction

Mackenzie Hotel Inuvik

- 99 kW AC
- 76.5 t/yr GHG emissions reduction

ISSF Project

- 60 kW AC
- 66 t/Yr GHG Emissions reduction

Aklavik IPP

150 kW AC

155 t/yr GHG emissions reduction

Iqaluit North Mart

300 kW AC Installed

297 t/ yr GHG emissions reduction

Inuvik 1 MW Solar

- 1 MW AC
- 784 GHG Emissions Reduction

NEL Installed / Planned Solar in Northern Canada

2019	379 kW AC
2020	99 kW AC
2021	60 kW AC
2022/23	1,450 kW AC
Total	**1,988 kW AC**

Inuvik Wind Hydrogen Project

2020-21

High Penetration Renewables Study

- Confirm initial feasibility of 3.5 MW Wind
- Identified excess electricity

2021

Assess uses for excess electricity

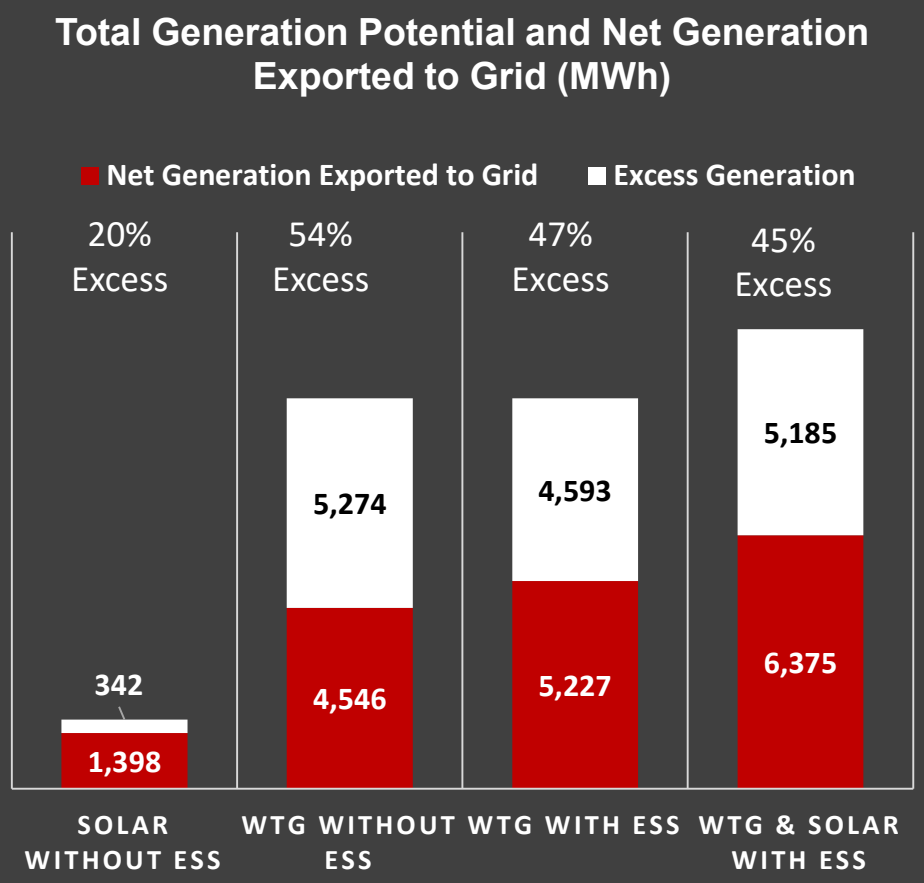
- Hydrogen Feasibility Study
- Initial concept/ scale

2022-23

Wind-Hydrogen Feasibility Study

- Site assessment
- Design
- Business Case
- Agreements
- Engagement

Inuvik Wind-Hydrogen Project



Dempster Highway Electrification Project

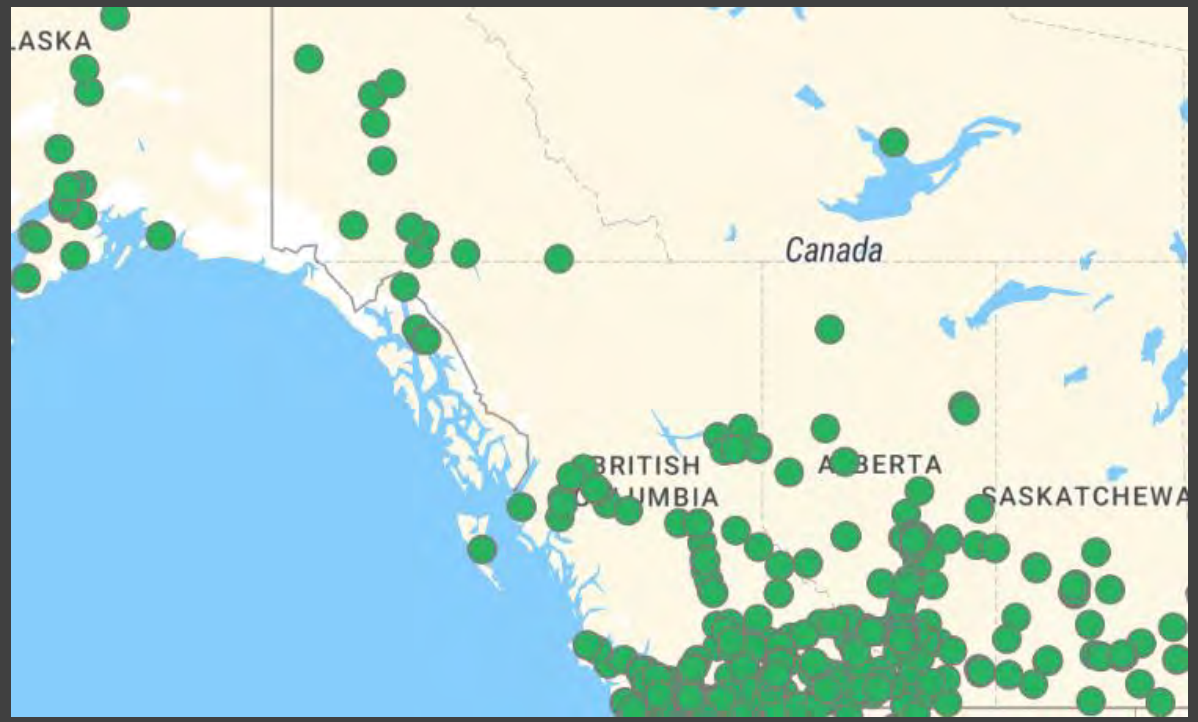
Install EV fast chargers at 6 locations along the Dempster Highway

Link northern Yukon and the Mackenzie Delta region to southern Yukon

Enable electric vehicle corridor from coast to cost to coast across Canada, and above the Arctic Circle

Demonstrate off-grid, lower carbon, EV fast chargers and systems in arctic and sub-artic climates

Map of EV Charging Stations



Barriers to EV adoption in northern Canada

- Geographic distances
- Off-grid nature of communities
- Low population densities

Dempster Highway Electrification Project

Self Contained System

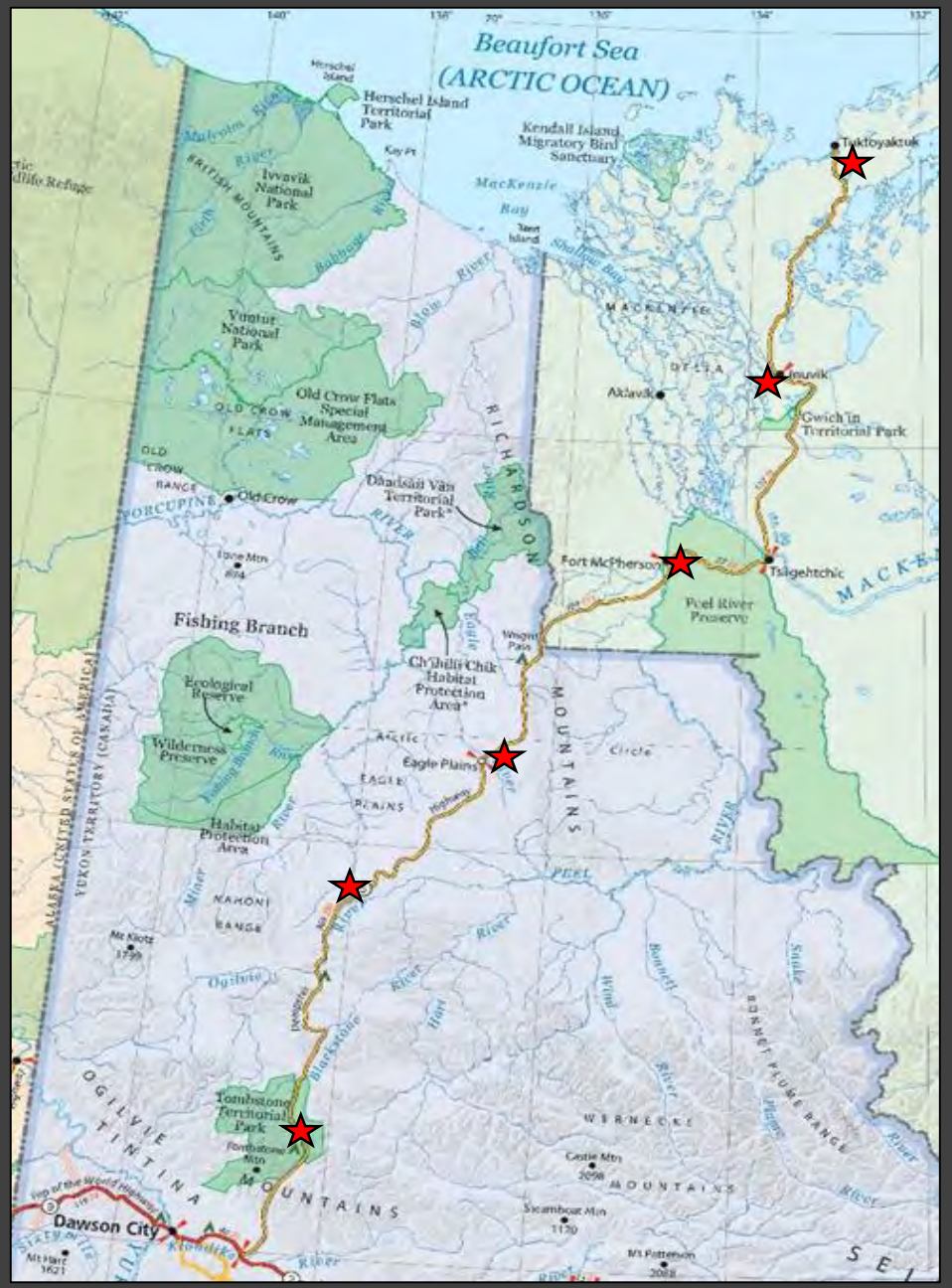
- Autonomous microgrid deployment on remote roads
- Standard 40’ high cube dry ISO container
- Solar array for adjacent to charging station

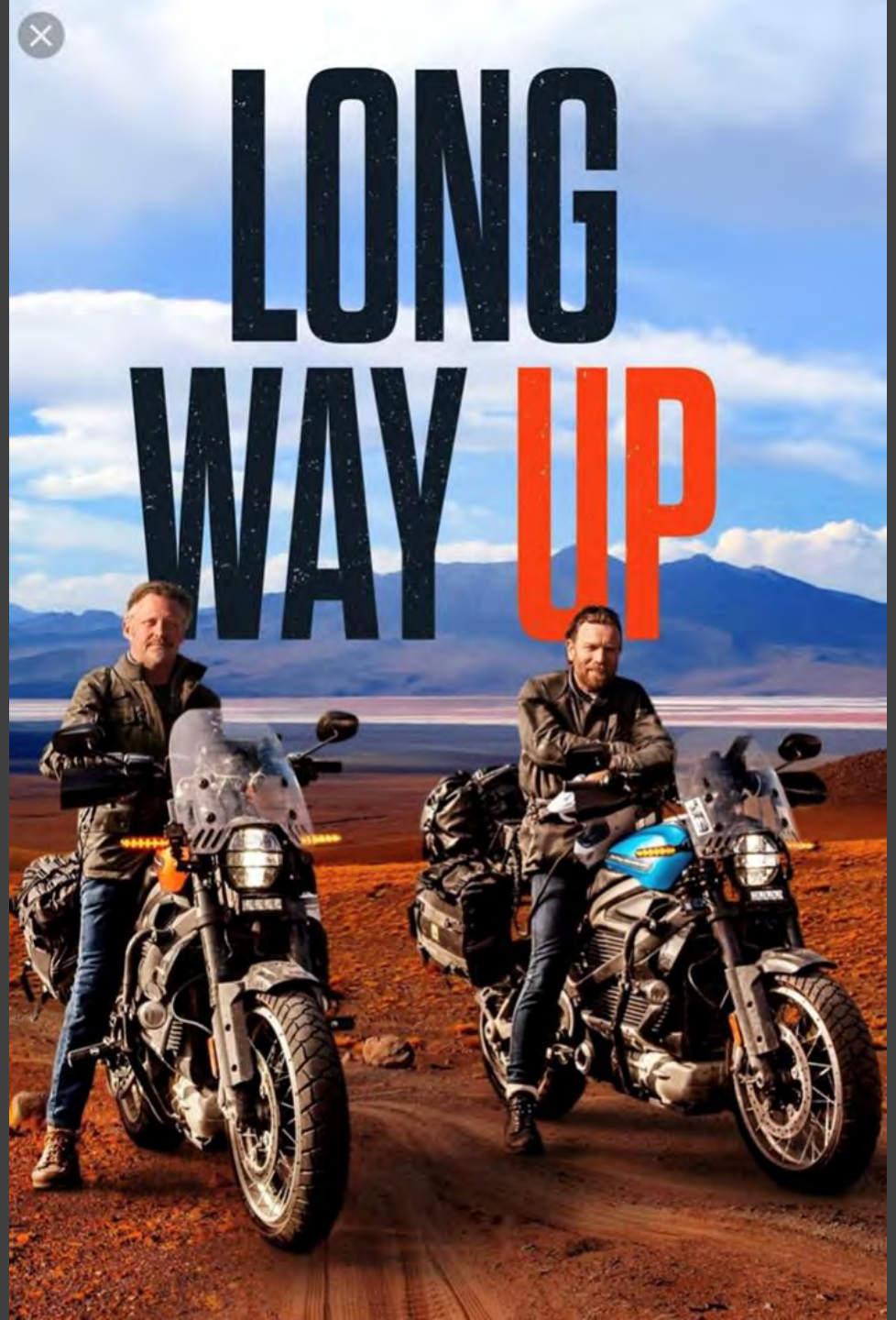
Remote fast charging stations along the Dempster Hwy:

- At km 450 (Yukon/NT border)
- At km 272 (a NWTel site)
- At km 142 (an abandoned quarry with access road)

Regular charging stations in NT:

- Tuktoyaktuk (at NTPC’s plant)
- Inuvik (at NTPC’s plant)
- Fort McPherson (at NTPC’s plant)




LONG
WAY UP

Inuvik Biomass Supply Chain – Bulk Shipment via Barging

Current Biomass Requirement

- Inuvik Biomass heating requirement of 3,000 to 4,000 dry t/year.
- GNWT 40% target for biomass heating use

Supply Chain Costs & Reliability Issues

- Trucked from LaCrete, Alberta (approximately 3,100 km distance)
- Minimal margin below current fossil fuel heating costs
- Winter Road Constraints
- Competing against established fossil fuel supply chains

Inuvik Biomass Supply Chain – Bulk Shipment via Barging

Proposed Approach:

- Truck haul from LaCrete to Hay River;
- Barge haul from Hay River to Inuvik;
- Option for bulk delivery using dedicated barge

Use barge service is currently owned by Marine Transport Services [MTS]

- Summer shipping season five months (June to October).
- Up to 1500 tonnes per barge

Summer 2022

- Barge 1000 tonnes of biomass wood pellets (totes) for winter 2022/23 heating season

2022/23

- Studies to optimize barging supply chain approach
- Work with MTS and GNWT
- Work with local biomass suppliers

2024 onwards

- Optimized long term solution

Thank you

Grant Sullivan
Nihtat Energy Ltd

Tu Deh-Kah GEOTHERMAL

Tu Deh-Kah GEOTHERMAL

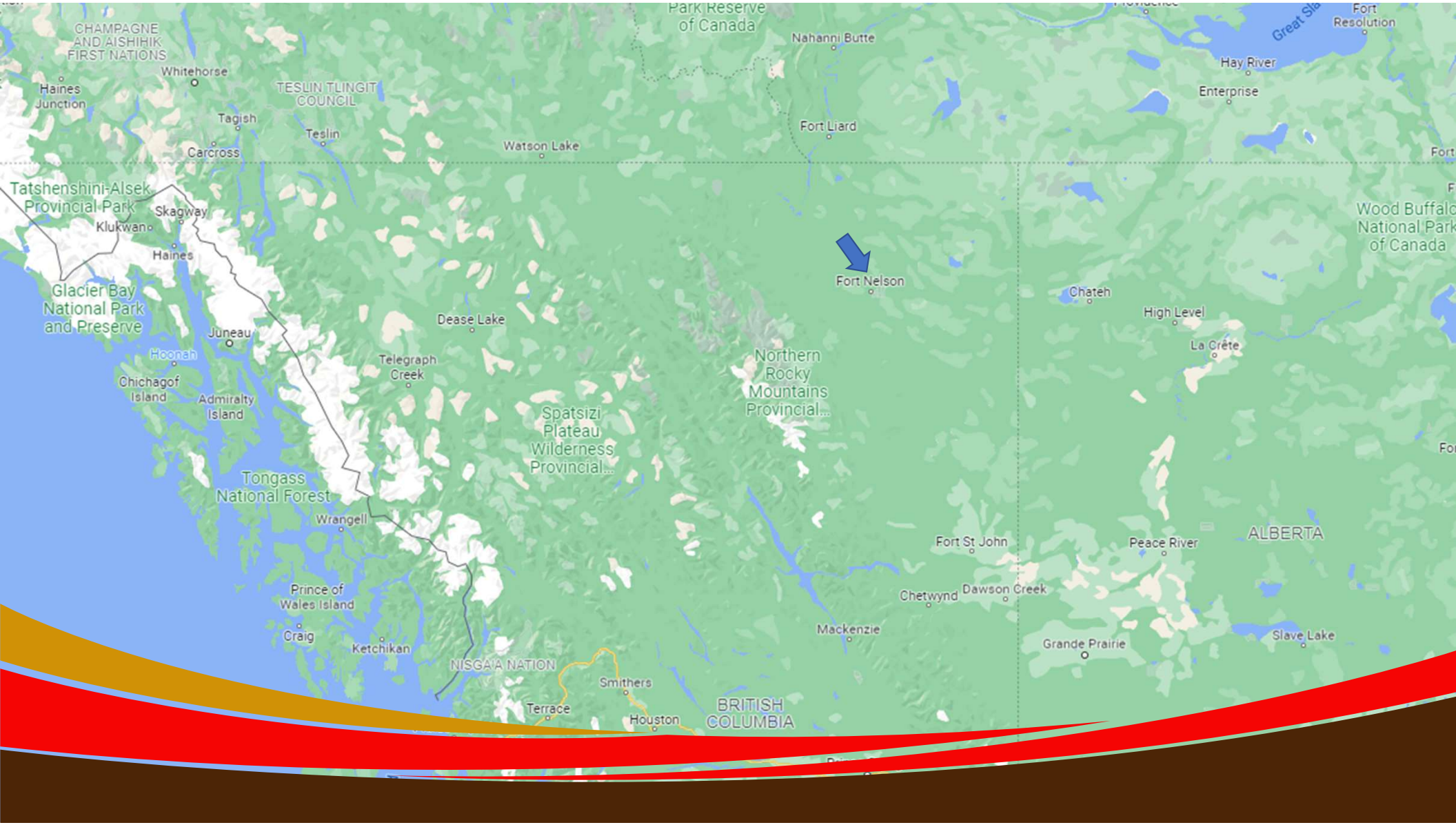
PROJECT UPDATE

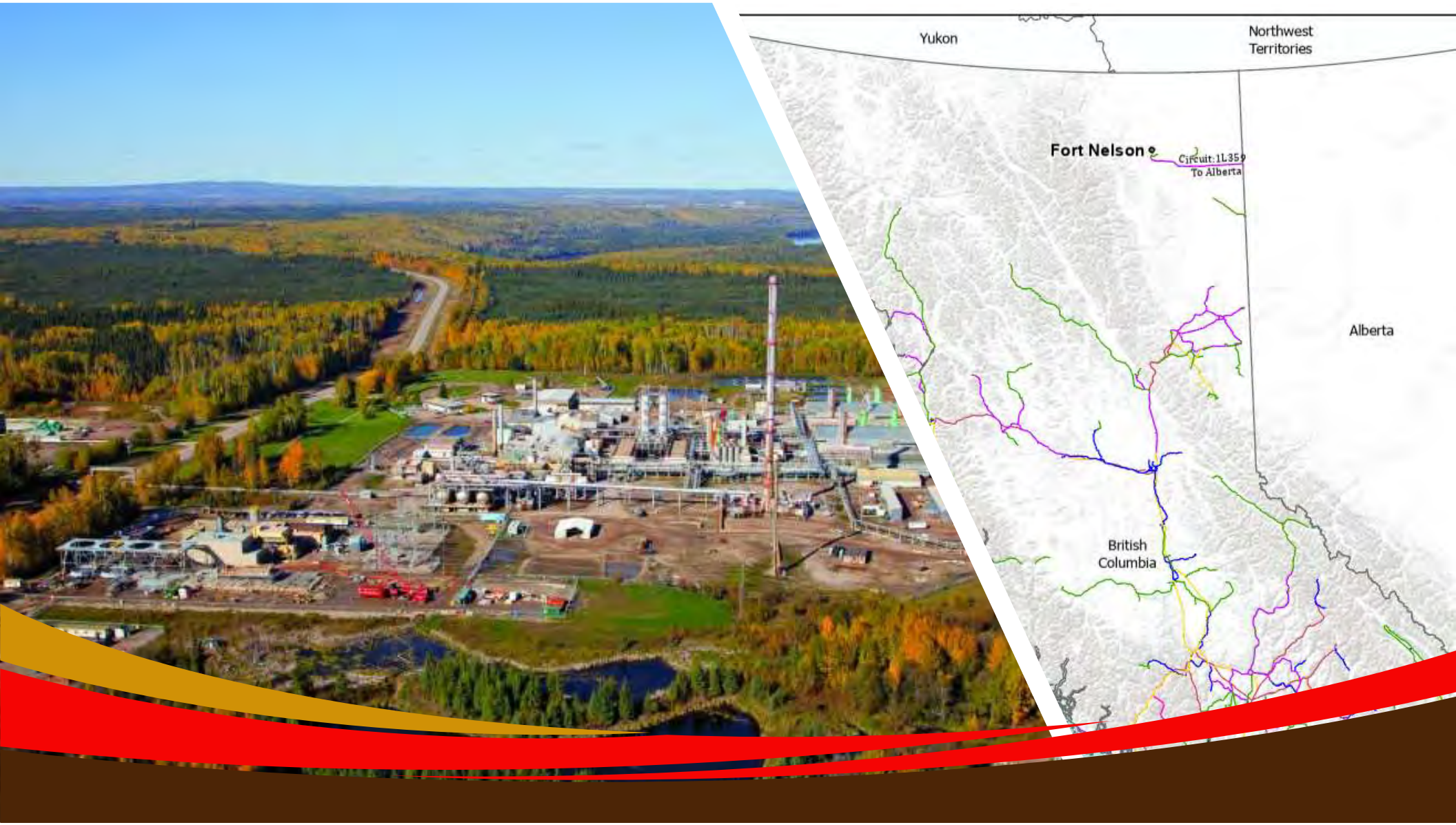
JAMIE CAPOT-BLANC
Project Coordinator


TAKE YOUR PICK
sale
sale
sale


Costly Food
Gauge of global food prices jumped most ever in March, to a new record
FAO Food Price Index
Points
Monthly change for index
Percent
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Source: UN FAO
Bloomberg


FRED
Global price of Energy index
Index 2016 = 100
1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Source: International Monetary Fund
fred.stlouisfed.org


Park Reserve of Canada
Nahanni Butte
Great Sla
Fort Resolution
CHAMPAGNE AND AISHIHIK FIRST NATIONS
Whitehorse
Haines Junction
TESLIN TLINGIT COUNCIL
Hay River
Enterprise
Tagish
Teslin
Fort Liard
Carcross
Watson Lake
Tatshenshini-Alsek Provincial Park
Skagway
Klukwan
Haines
Wood Buffalo National Park of Canada
Fort Nelson
Chateh
Glacier Bay National Park and Preserve
High Level
Dease Lake
Juneau
La Crête
Hoonah
Telegraph Creek
Chichagof Island
Admiralty Island
Northern Rocky Mountains Provincial...
Spatsizi Plateau Wilderness Provincial...
Tongass National Forest
Wrangell
Fort St John
Peace River
ALBERTA
Prince of Wales Island
Chetwynd
Dawson Creek
Craig
Ketchikan
Mackenzie
Slave Lake
Grande Prairie
NISGA'A NATION
Smithers
Terrace
Houston
BRITISH COLUMBIA


Yukon
Northwest
Territories
Fort Nelson
Circuit:1L359
To Alberta
Alberta
British
Columbia

120C

5.6 MW

Rhine Valley, Germany

193C

82 MW

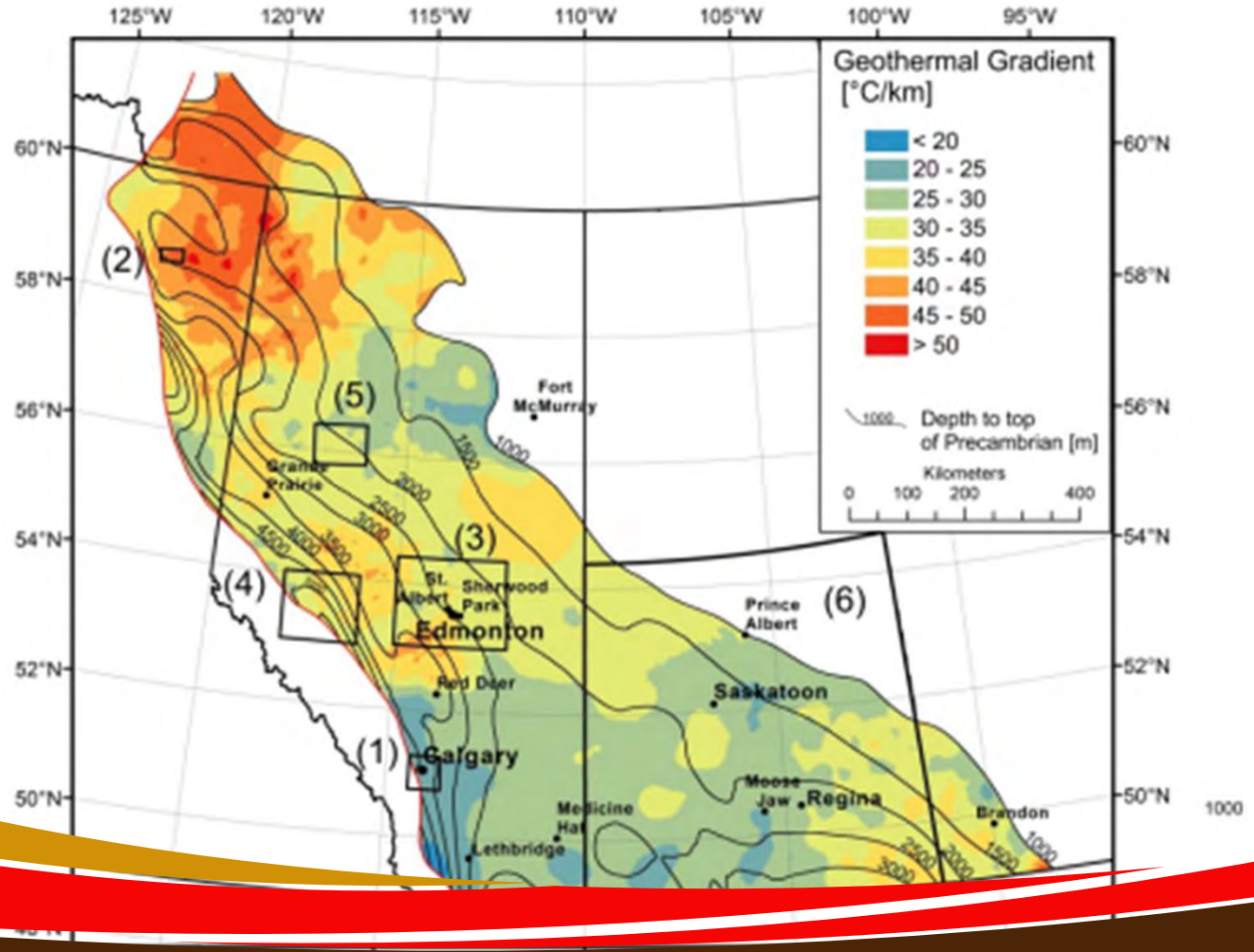
Ngatamariki Power Station, New Zealand

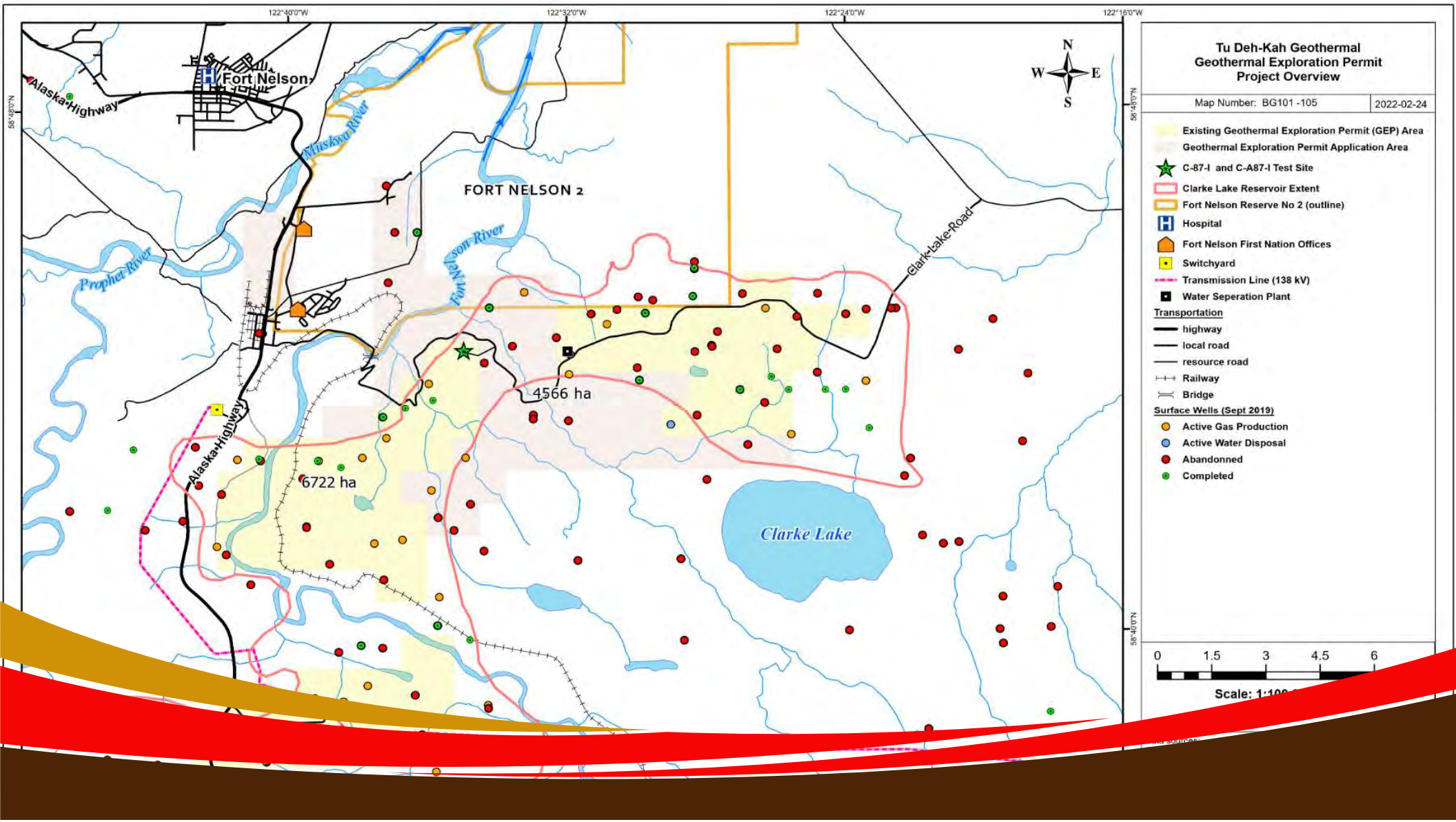
164C

45 MW

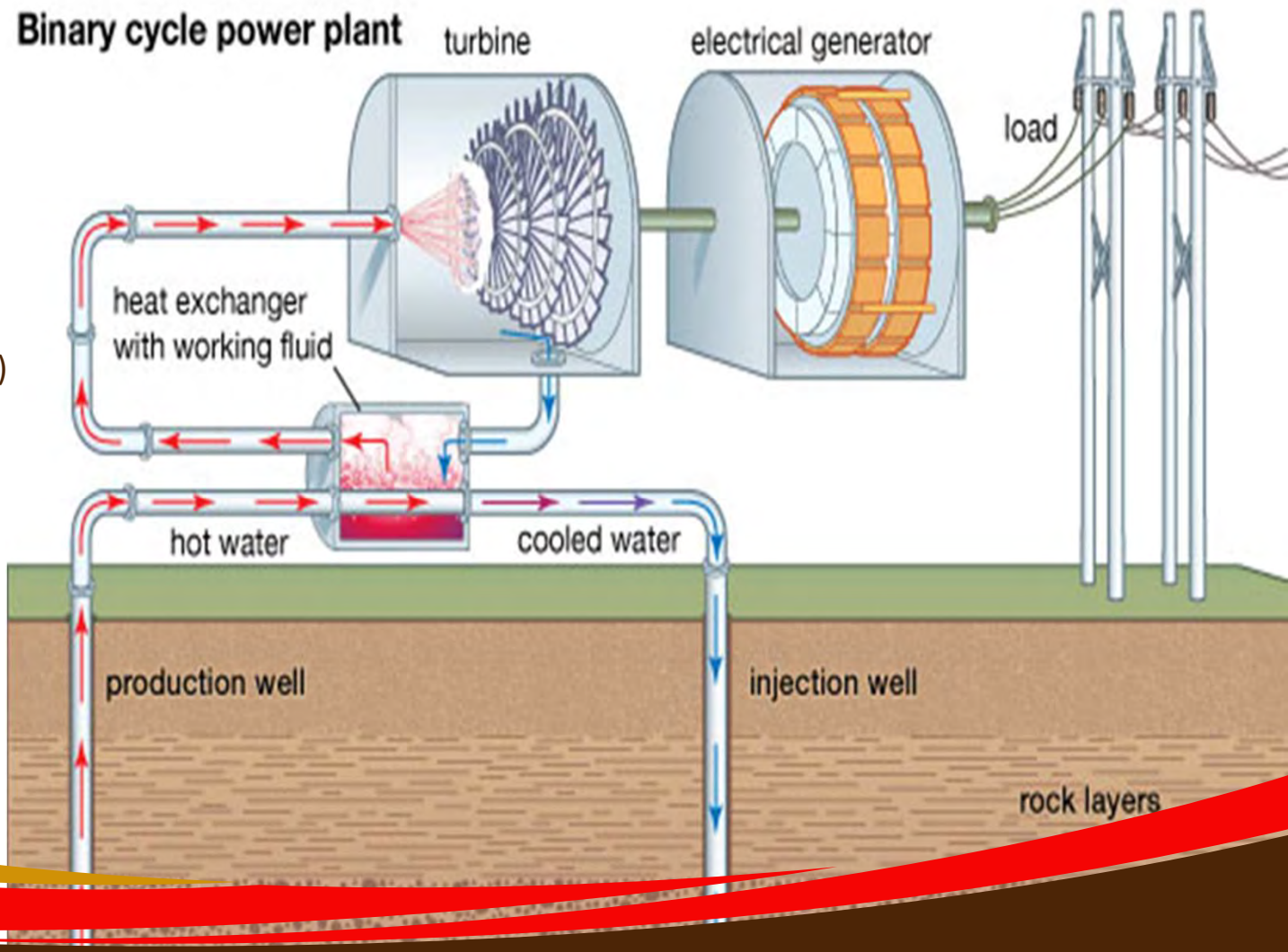
McGuiness Hills, Nevada USA

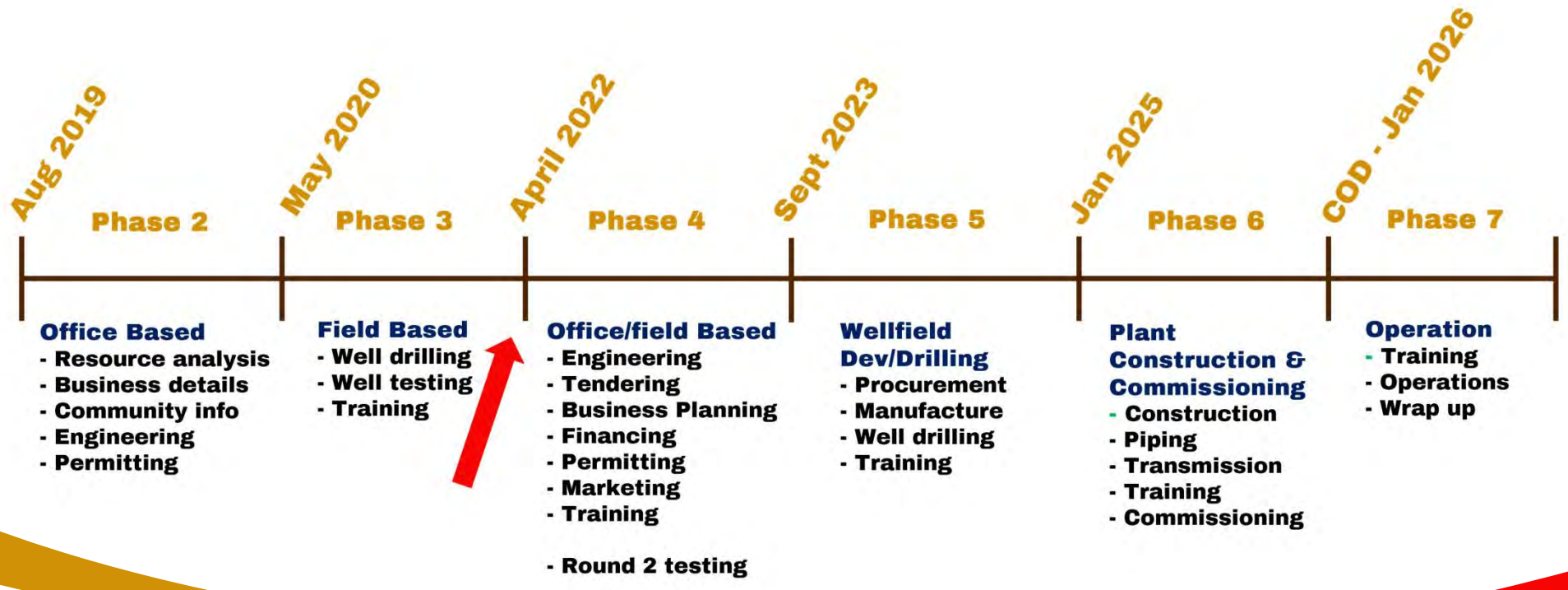
Temperature at Depth and Distribution of
Potential Geothermal Target Formations




122°40'0"W
122°32'0"W
122°24'0"W
122°16'0"W
58°48'0"N
58°40'0"N
Fort Nelson
Alaska Highway
Muskwa River
Prophet River
FORT NELSON 2
Fort Nelson River
Clark Lake Road
4566 ha
6722 ha
Clarke Lake
N
W
E
S
Tu Deh-Kah Geothermal
Geothermal Exploration Permit
Project Overview
Map Number: BG101 -105
2022-02-24
Existing Geothermal Exploration Permit (GEP) Area
Geothermal Exploration Permit Application Area
C-87-I and C-A87-I Test Site
Clarke Lake Reservoir Extent
Fort Nelson Reserve No 2 (outline)
Hospital
Fort Nelson First Nation Offices
Switchyard
Transmission Line (138 kV)
Water Seperation Plant
Transportation
highway
local road
resource road
Railway
Bridge
Surface Wells (Sept 2019)
Active Gas Production
Active Water Disposal
Abandonned
Completed
0
1.5
3
4.5
6
Scale: 1:100

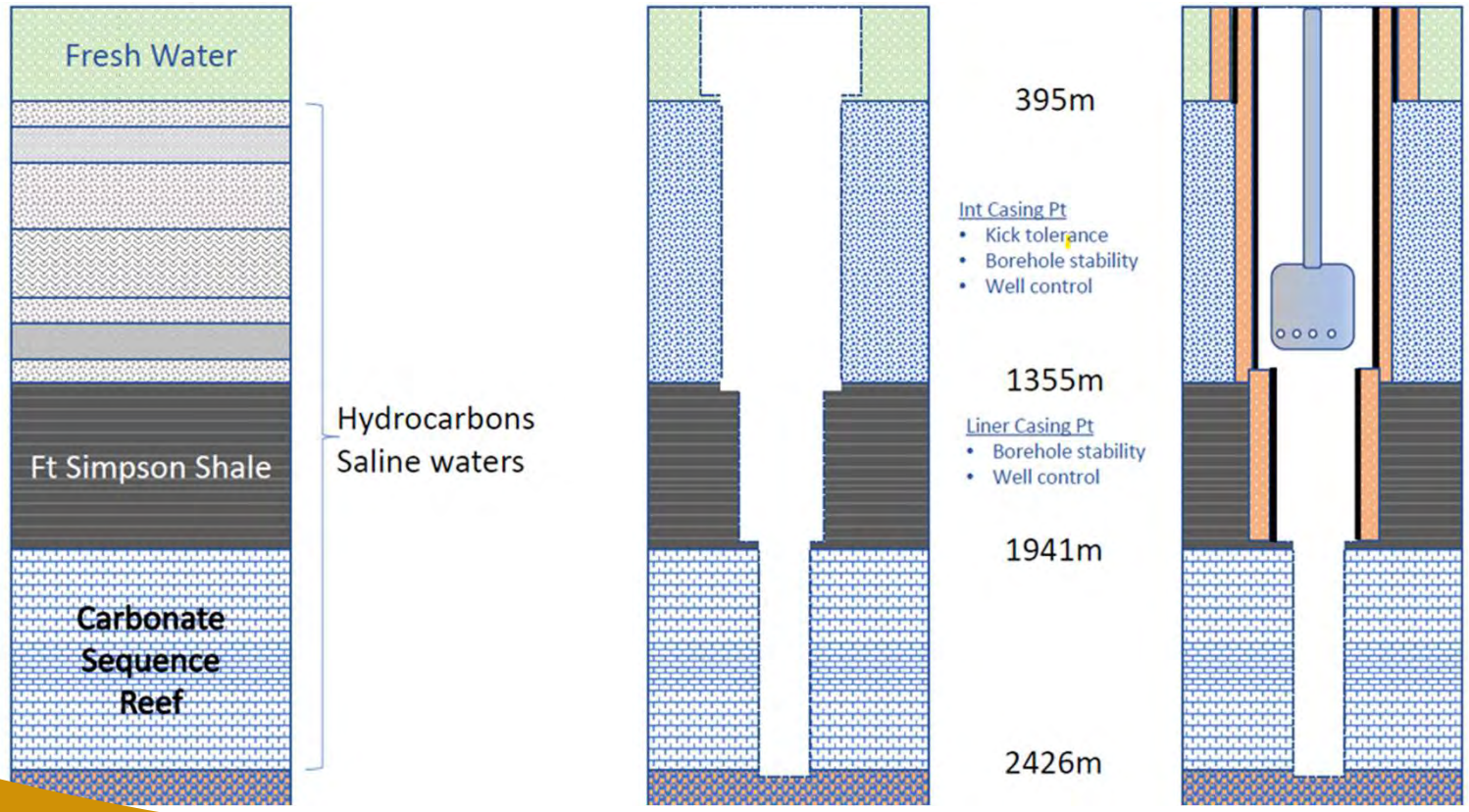
I. Heat
II. Water/fluid
III. Pathways (cracks in rock)




Aug 2019
Phase 2
May 2020
Phase 3
April 2022
Phase 4
Sept 2023
Phase 5
Jan 2025
Phase 6
COD - Jan 2026
Phase 7
Office Based
- Resource analysis
- Business details
- Community info
- Engineering
- Permitting
Field Based
- Well drilling
- Well testing
- Training
Office/field Based
- Engineering
- Tendering
- Business Planning
- Financing
- Permitting
- Marketing
- Training
- Round 2 testing
Wellfield Dev/Drilling
- Procurement
- Manufacture
- Well drilling
- Training
Plant Construction & Commissioning
- Construction
- Piping
- Transmission
- Training
- Commissioning
Operation
- Training
- Operations
- Wrap up

August 2021

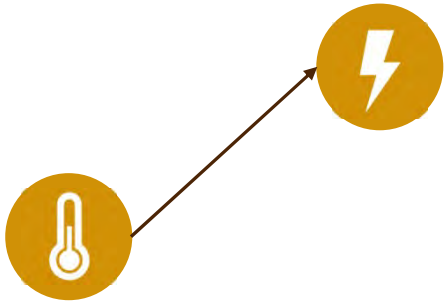

© Katie Huang


Fresh Water
Ft Simpson Shale
Carbonate
Sequence
Reef
Hydrocarbons
Saline waters
395m
Int Casing Pt
• Kick tolerance
• Borehole stability
• Well control
1355m
Liner Casing Pt
• Borehole stability
• Well control
1941m
2426m

WHERE ARE WE GOING?

WHERE ARE WE GOING?

WHERE ARE WE GOING?



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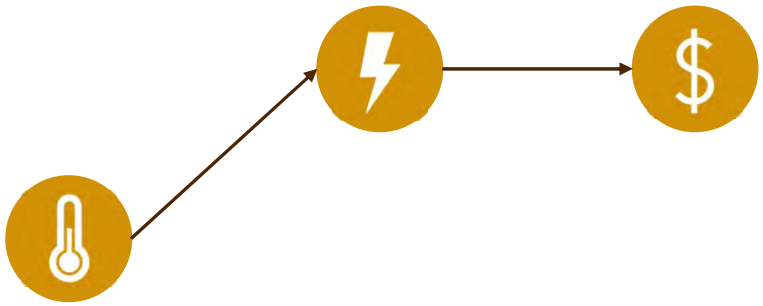

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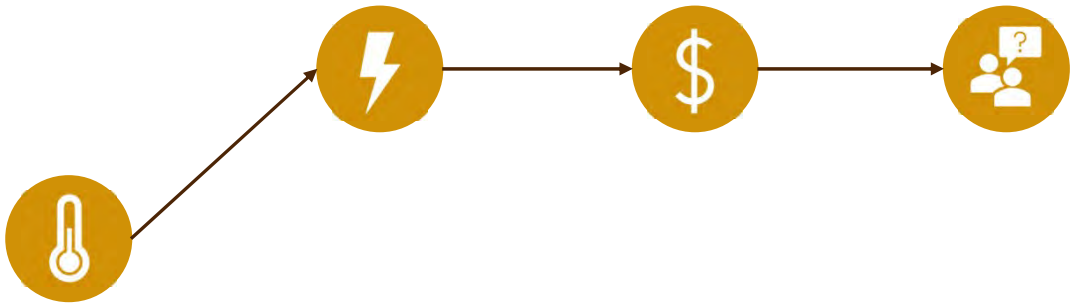

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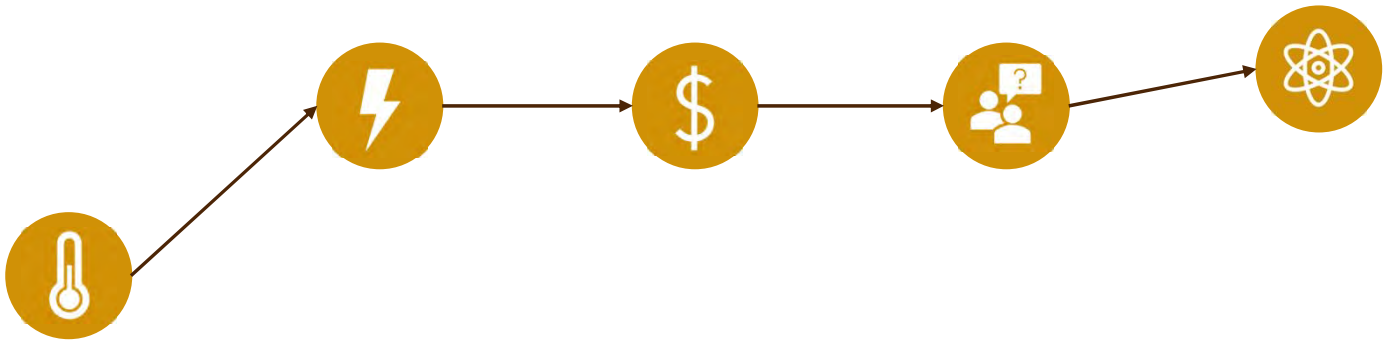

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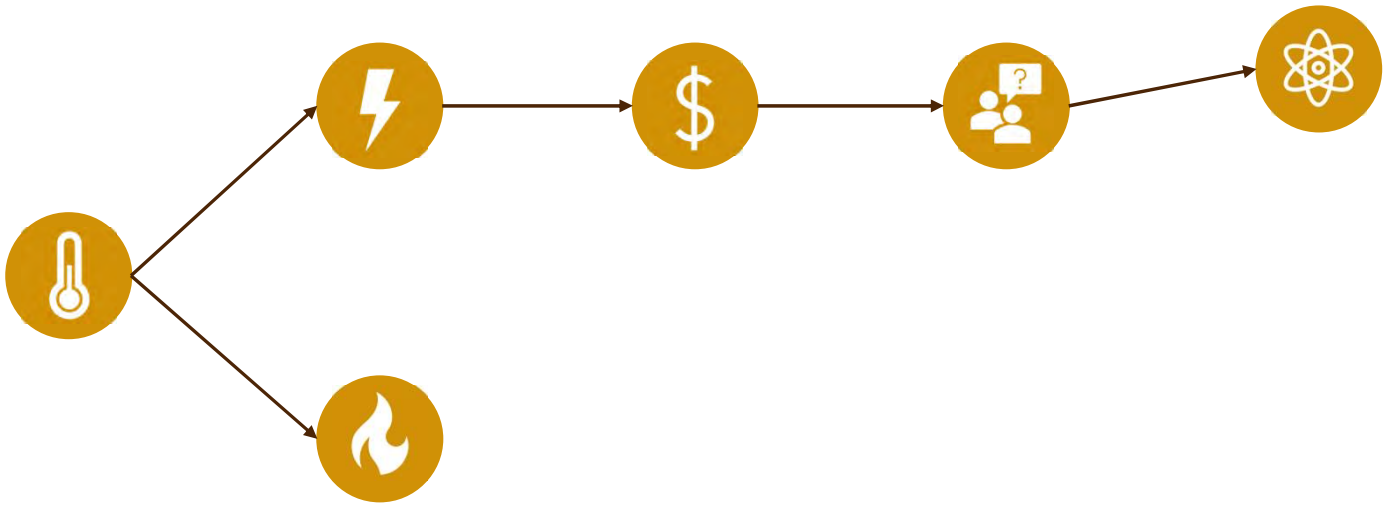

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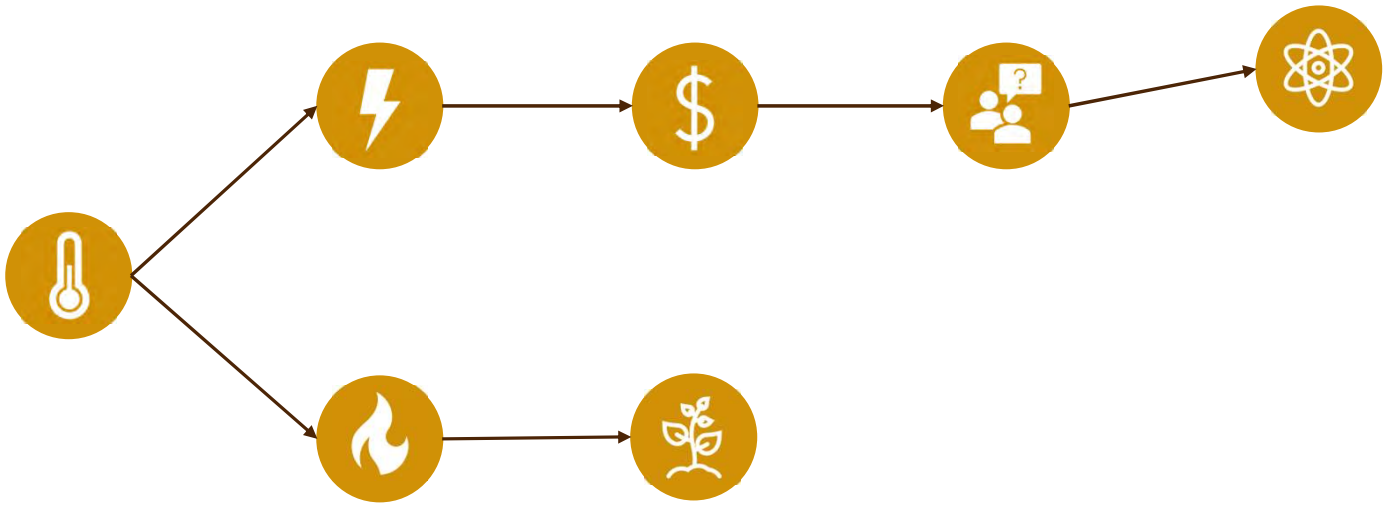

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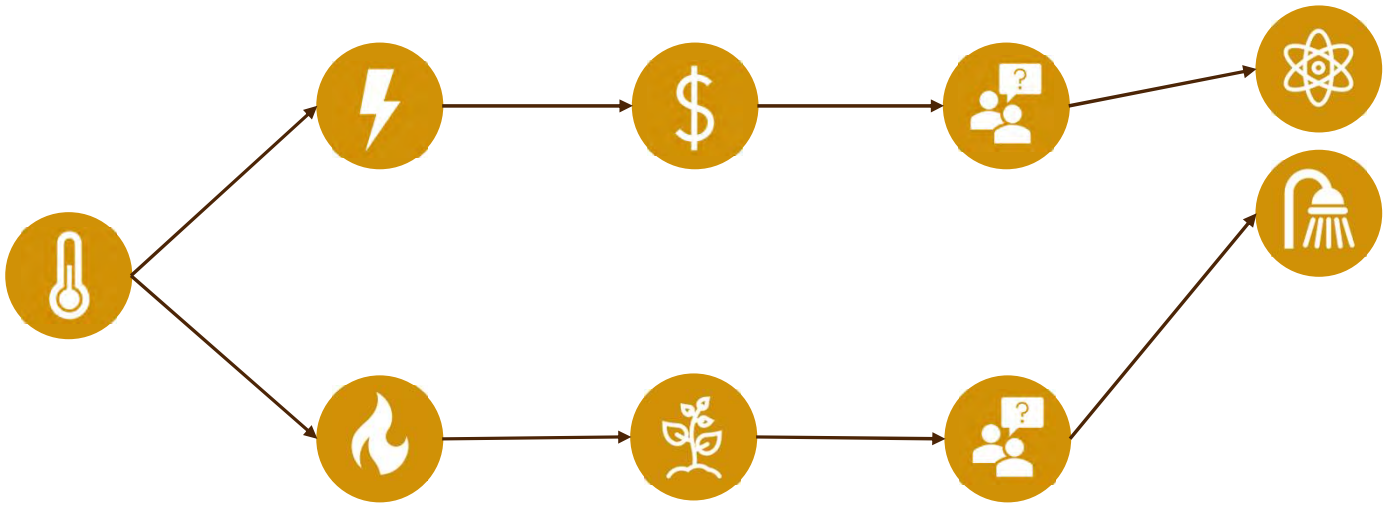

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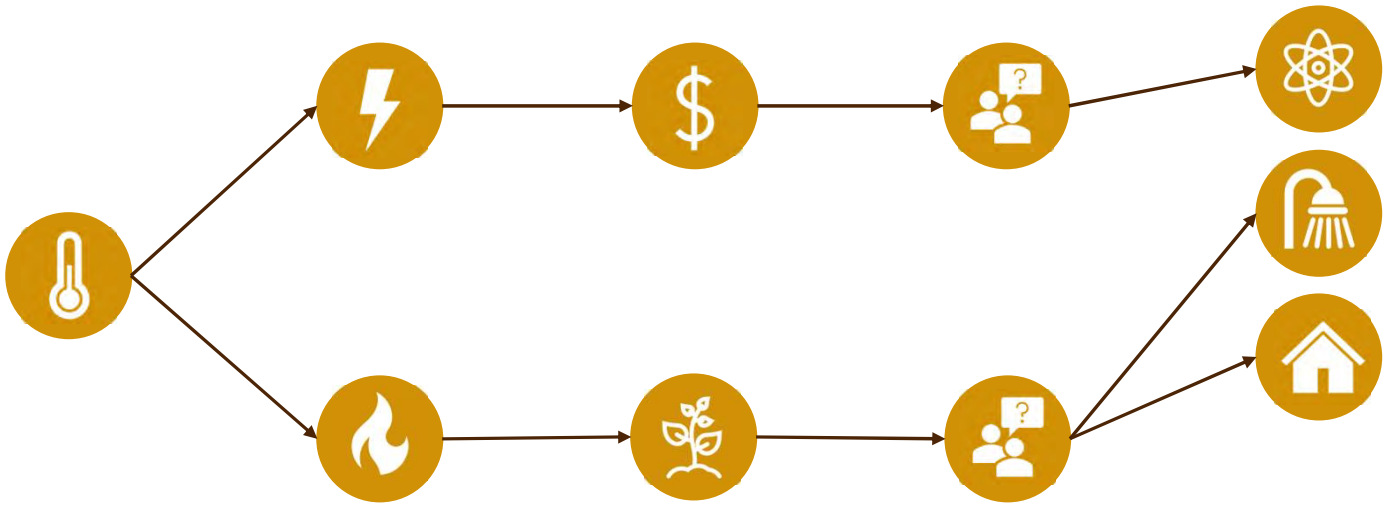

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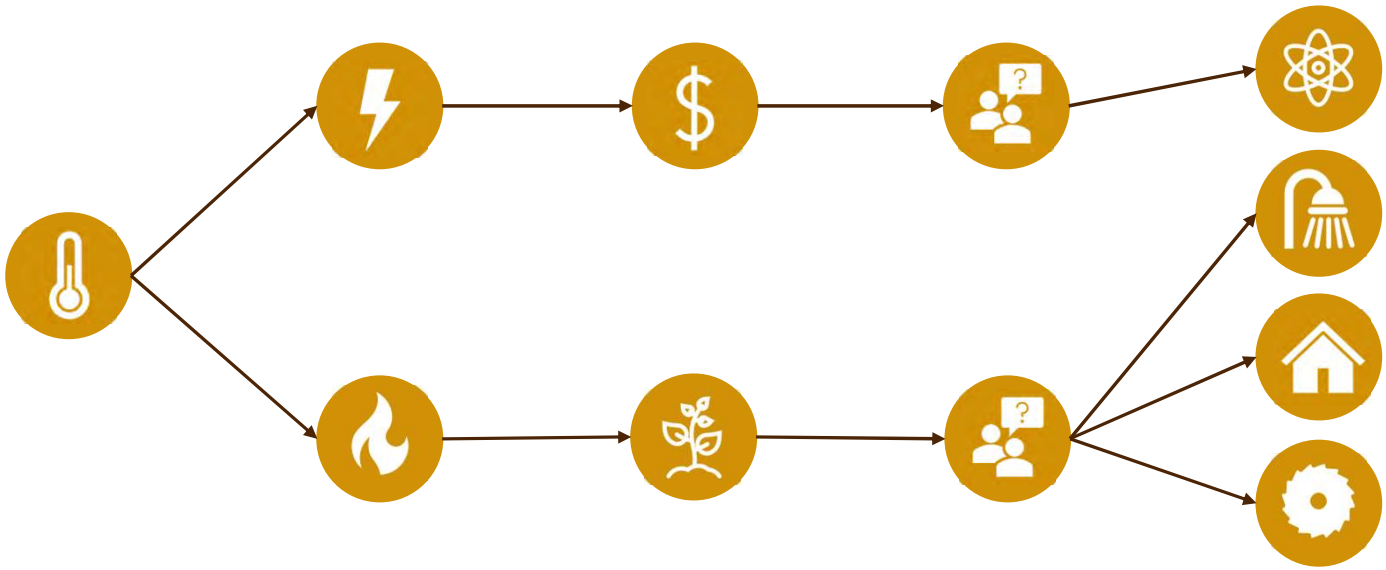

Tu Deh-Kah Geothermal Blessing Ceremony Aug 2021


FORT NELSON FIRST NATION
RESPECTING OUR PAST
SUSTAIN OUR FUTU


Tu Deh-Kah
GEOTHERMAL


Deh Tai
LIMITED PARTNERSHIP