Use of torrefied wood pellets to heat buildings in East Canada's Northern communities.

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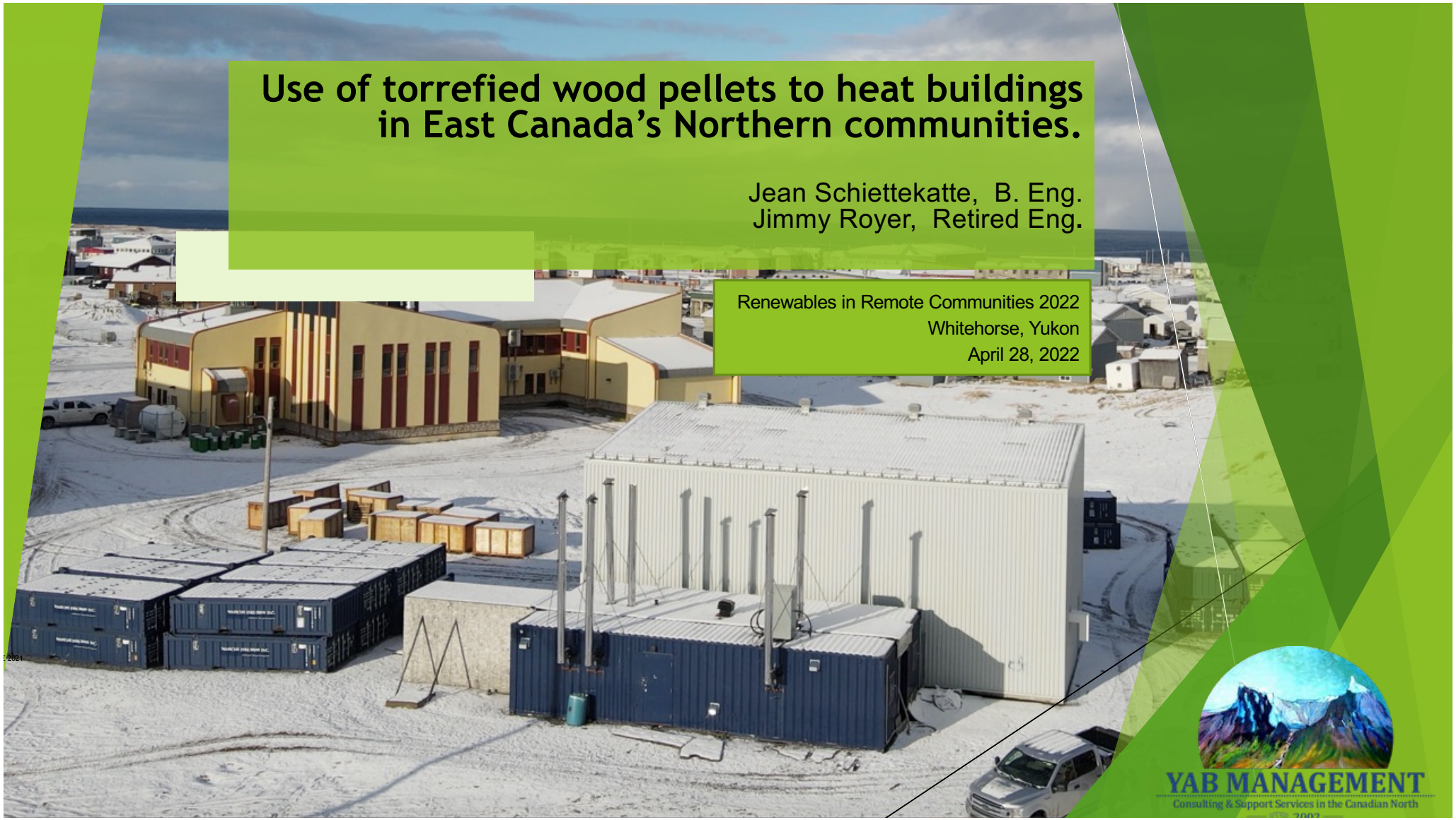

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CONTENT

1. Summary of situation
2. The wood pellet solution
3. Producing the pellets
4. Transporting the Pellets
5. Examples from WFN Community
    1. Heating the WFN Arena
    2. Heating the new urbanisation
6. Conclusions

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1. Summary of Situation

Heating buildings in the North is very costly

a. Cost of fuel
b. Transportation of fuel
c. GHG emissions
d. Environmental risks

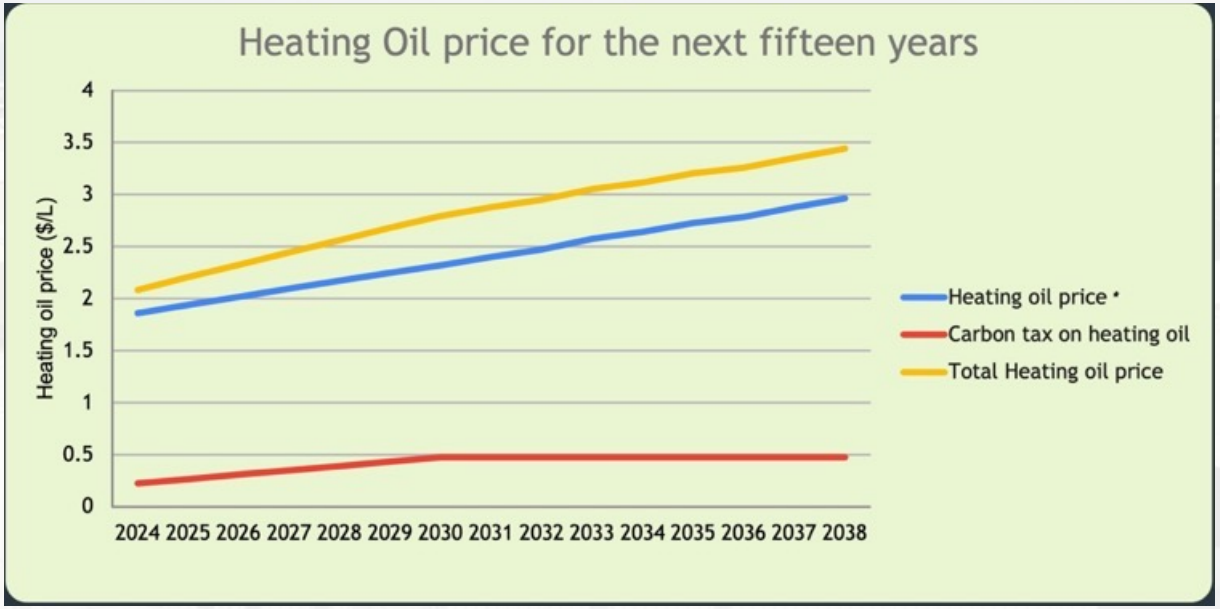
1. Summary of Situation: Cost

1. Fuel Costs are skyrocketing:
    1. impact of new Carbon Tax
    2. Impact of international situation
2. Transportation Infrastructure

Heating with Electricity

1. Electricity is produced from diesel gensets with poor electrical efficiency

1 Summary of Situation: Cost



By 2030, CARBON TAX will Increase oil price by almost 0.50 $/l or 25% of actual cost. Price will likely reach well over 3 $/l.
However, in Quebec, GHG emissions are regulated by a carbon market.

*Hydro-Québec forecast

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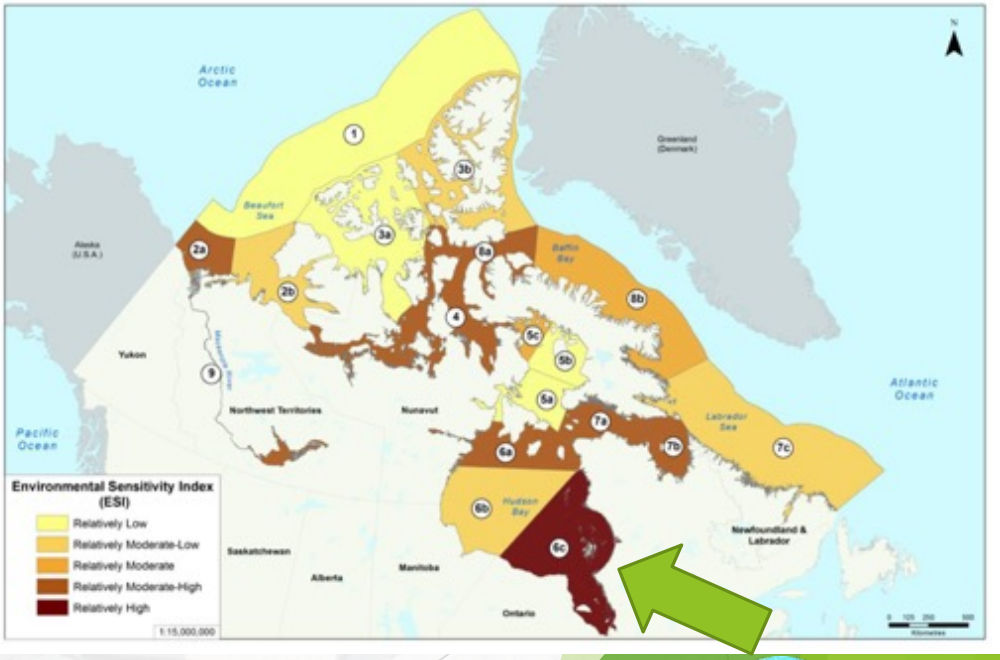
1. Summary of Situation: Environmental Risks

RISK OF FUEL SPILL AT SEA: POTENTIAL IMPORTANT IMPACT FOR WHAPMAGOOSTUI



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1. Summary of Situation: Environmental Risks

Diesel spills often unreported, unknown

Governments are trying to reduce diesel use, in large part due to their desire to lower emissions. But a lot of that diesel never even makes it to the generators; instead, it spills out into the environment from storage tanks, or from the trucks, pipelines and ships that deliver it to the communities.

More than 9.1 million litres of diesel has been spilled in the Northwest Territories and Nunavut since the 1970s. More than half of the leaks are from trucks and storage tanks.

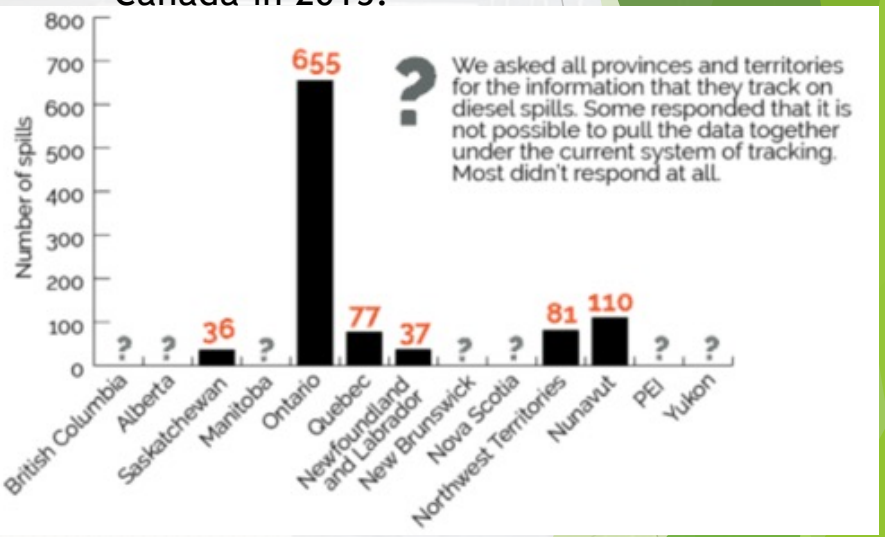
In Yukon, those numbers are vague at best. The government knows a lot of diesel has ended up in the environment, but has a hard time pinning down the exact number due to historically lax reporting. Looking at what records are available, government analysts came up with a total of at least 219,000 litres, but say that is definitely an underestimate.

"A large amount of the fuel spilled over the last 40 years is unreported, and frankly unknown," says Cedric Schilder, environmental protection analyst for the Yukon government. "There was a whole period of time where it was pretty cowboy."

All the diesel in Yukon needs to be trucked in one load at a time; there are no ports or pipelines connecting the territory to the south.

So it's not surprising that when it does make it to its destination, diesel produces the most expensive power in Canada.

How many land spills in North of Canada in 2015?



NEED FOR A SOLUTION TO LOCAL POLLUTION RISK OF WATER TABLE WITH FUEL

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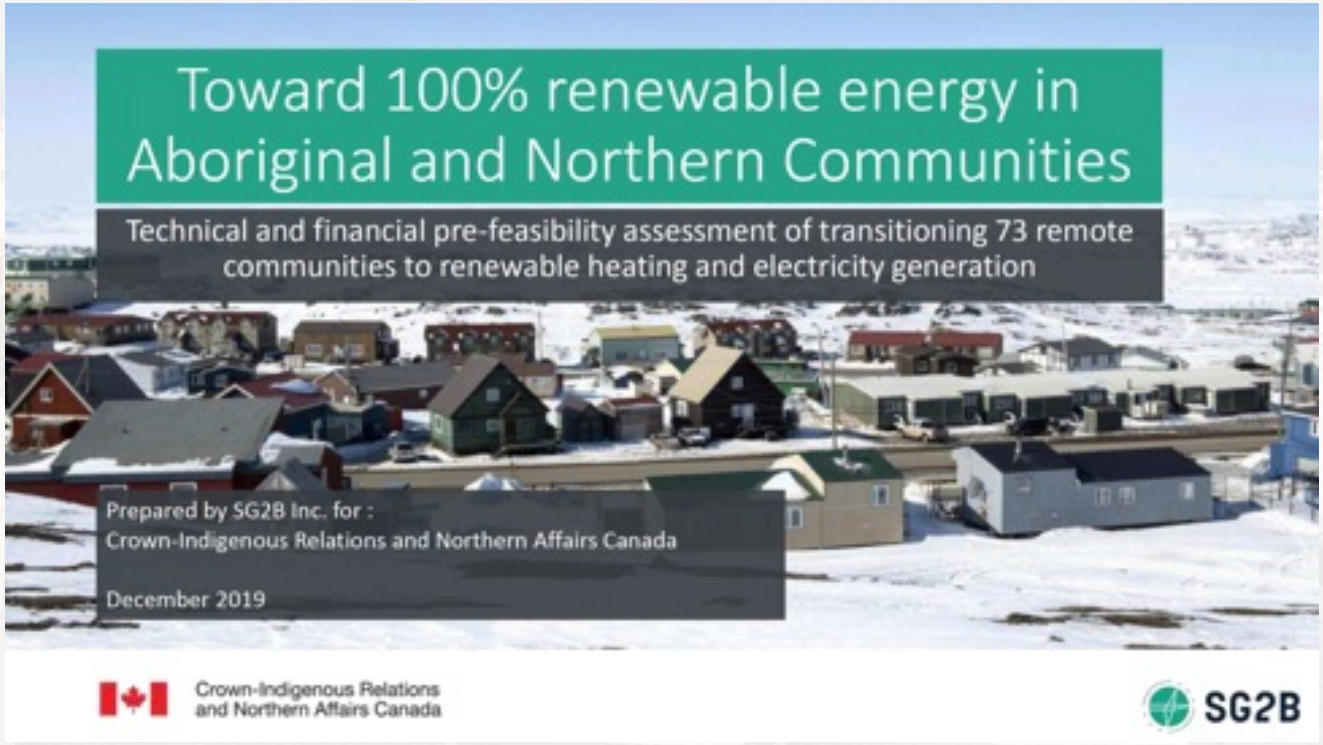
2. The wood pellet solution



Following the SG2B assessment, an analysis of biomass needs of existing buildings of Whapmagoostui / Kuujjuaraapik and the new Whapmagoostui Urbanization was made;

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2. The wood pellet solution

Biomass scenarios in each Nunavik village.

In 2034	*Unit*	Akulivik	Aupaluk	Ivujivik	Kangiqsualujjuaq	Kangiqsujuaq	Kangirsuk	Kuujjuaq	Kuujjuarapik	Puvirnituq	Quaqtaq	Salluit	Tasiujaq	Umiujaq	Whapmagoostui	Nunavik without Inukjuak + Whapmagoostui
BAU scenario - Heating oil need	*L*	1,126,243	447,701	739,107	1,278,747	1,561,744	1,213,150	6,722,283	1,370,624	3,070,553	904,848	2,487,924	623,179	688,830	1,561,038	23,795,969
Biomass Solution - Biomass need	*ton*	2,076	830	1,365	2,354	2,878	2,237	12,412	2,513	5,644	1,669	4,589	1,151	1,270	2,880	43,867
Biomass Solution - GHG avoided	*tonCO2*	3,144	1,249	2,063	3,570	4,360	3,387	18,761	3,829	8,575	2,526	6,945	1,739	1,923	4,357	66,428

Nunavik without Inukjuak + Whapmagoostui	*Unit / Year*	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
BAU scenario - Heating oil need	*L*	20,504,207	20,811,770	21,123,947	21,440,806	21,762,418	22,088,854	22,420,187	22,756,490	23,097,837	23,444,305	23,795,969
Biomass Solution - Biomass need	*ton*	3,780	7,673	11,682	15,810	20,059	24,432	28,932	33,561	38,322	43,219	43,867
Biomass Solution - GHG avoided	*tonCO2eq*	57,274	58,129	58,997	59,878	60,772	61,679	62,600	63,535	64,483	65,446	66,428

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3. Producing the pellets

What is the best type of Pellets for the North?

From large plants in Bécancour to small plants in Amos

3. Producing the pellets

1. Standard pellet

- The standard pellet is a small cylinder of compressed wood that is generally made from sawdust and / or wood shavings. There are various producers in Quebec.
- These products are finely grounded and compressed in the pelletizing equipment to achieve a density greater than 650 kg / m³ (H^0 <10% [7]) regardless of the species of the original wood.
- This product is not hydrophobic and is sensitive to moisture. There were many issues during trials in winter condition in Whapmagoostui.

3. Producing the pellets

2. Torrefied and CHAR Pellets (Black pellets)

- Both Torrefied and CHAR pellets are similar in dimension to the standard pellets except that the biomass is treated before being compressed in the pelletizing equipment.

- The Torrefied and CHAR pellet treatment brings the grounded wood at a high temperature in the virtual absence of oxygen. The treatments are different but their effect is to remove water and some volatile compounds and produce a wood biomass that is concentrated and hydrophobic giving the product great stability under reasonable conditions of transport and storage).

- Black pellets have densities similar to the standard pellets, but their calorific value are higher (10 to 15%) depending on the moisture content of each product.

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3. Producing the pellets

Actual torrefied pellets producers in Québec

- AIREX is the main producer in Québec with a proven technology ;
- Actual supplier of Whapmagoostui ;
- Actual cost of production in Bécancour = 240 $/Ton ;
- Small plant (+10 000 Tons / year) = + 380 $/Ton ;

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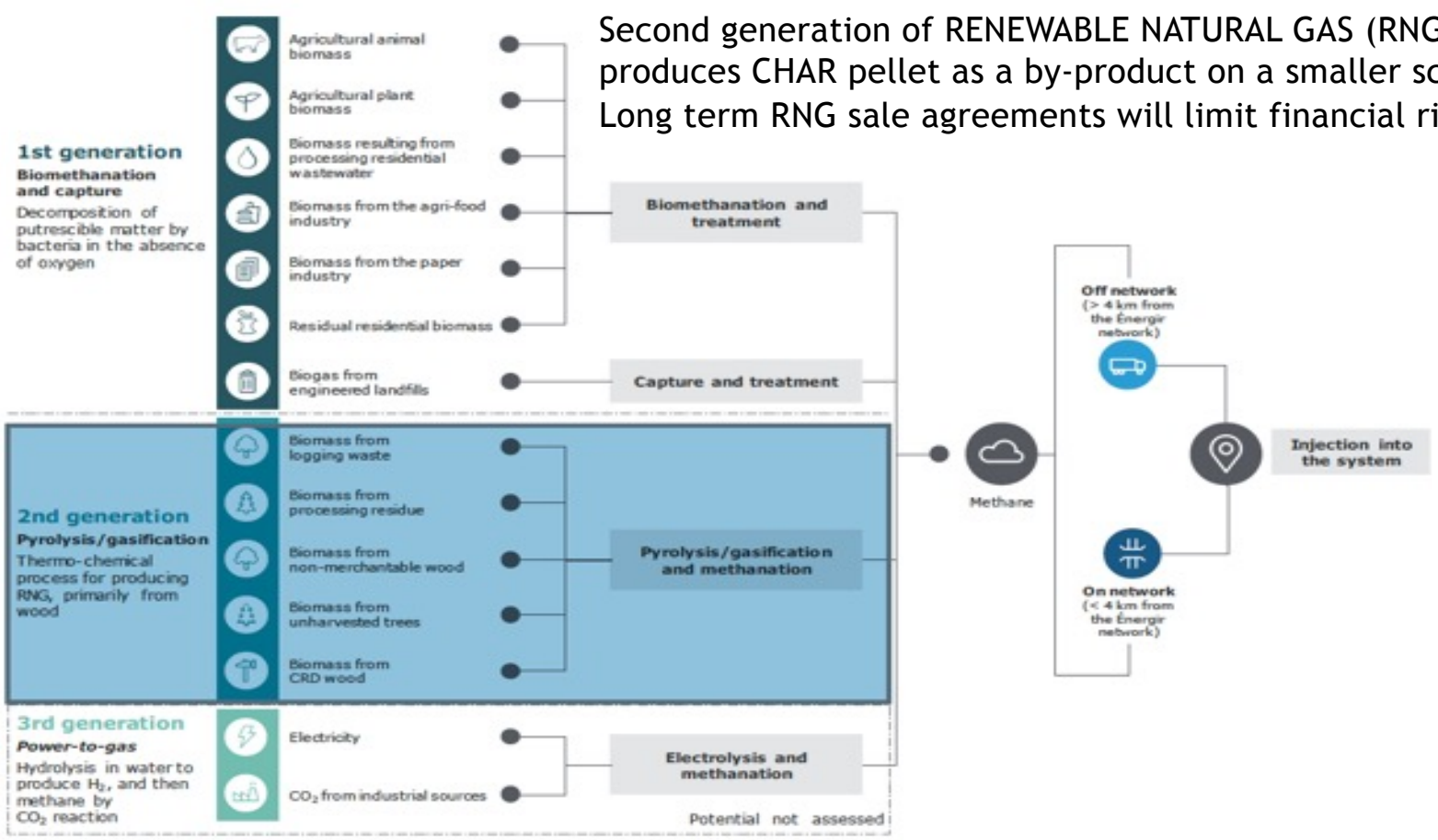
3. Producing the pellets

New generation of CHAR pellets

Second generation of RENEWABLE NATURAL GAS (RNG) from wood also produces CHAR pellet as a by-product on a smaller scale (<4000 Tons/year). Long term RNG sale agreements will limit financial risks (2/3 of revenues).



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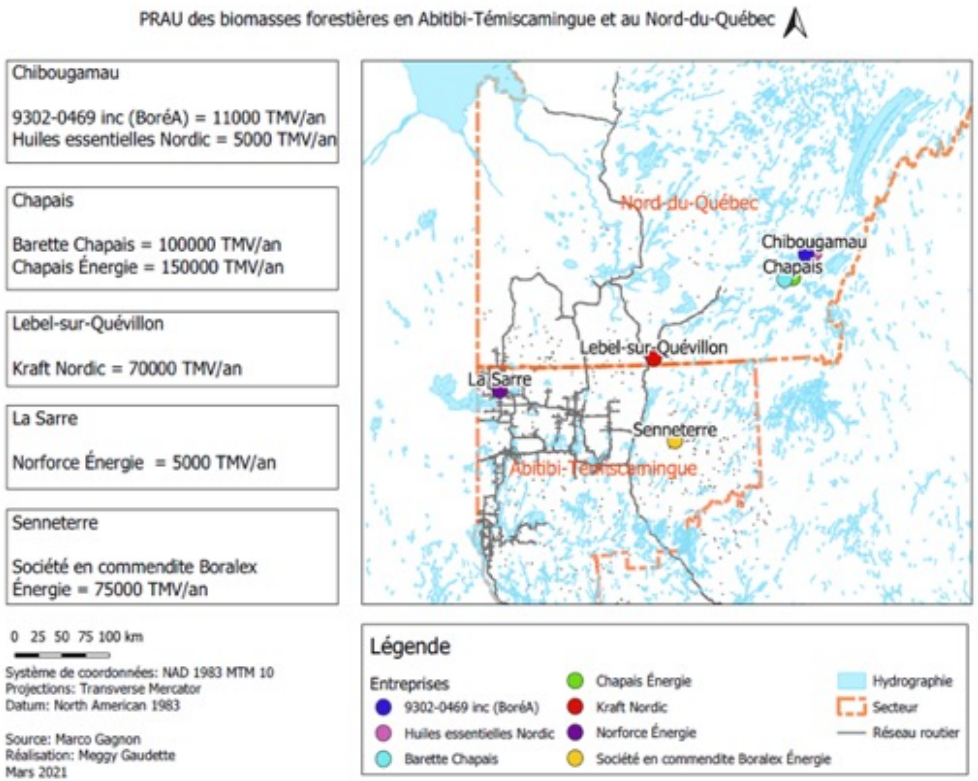
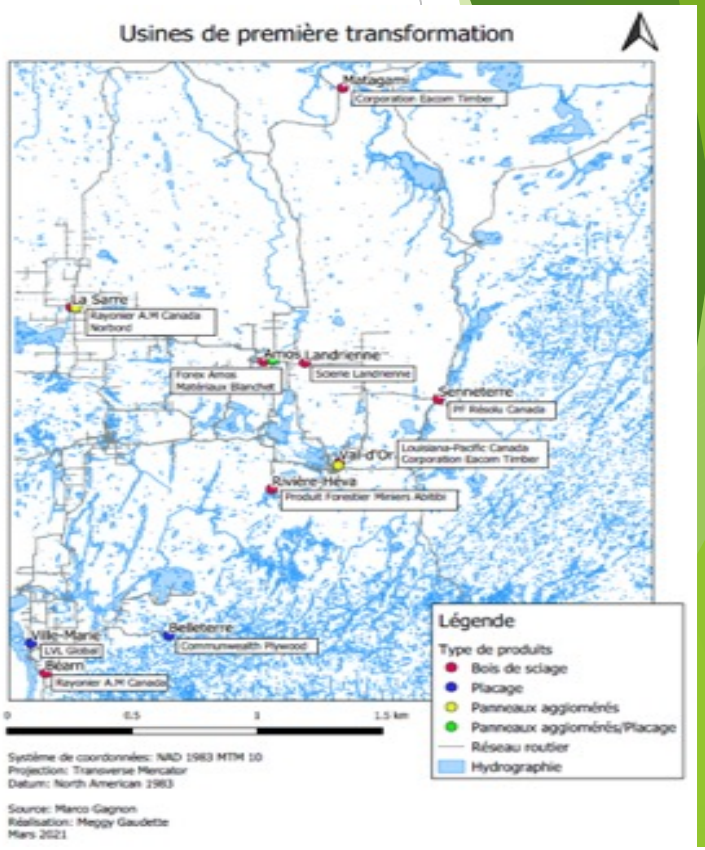
4. Producing the pellets





4. Transporting the pellets

From Amos to NUNAVIK by roads, barges and ships

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4. Transporting the pellets

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4. Transporting the pellets

Sealink
or
Road and Barge

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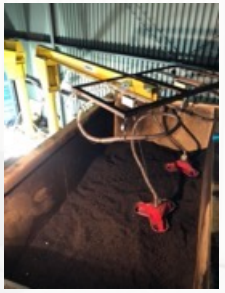
5. Examples from Whapmagoostui First Nation (WFN) Community

Production
Pellet

Transport

Storage container

Mole feeding &
Weekly storage

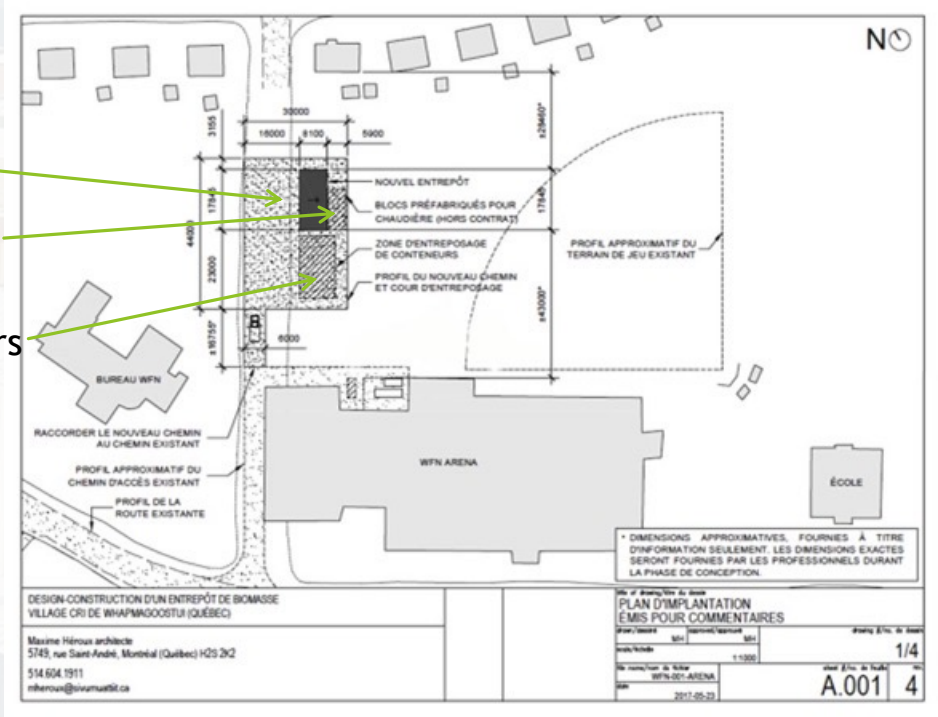


Daily storage

Boiler

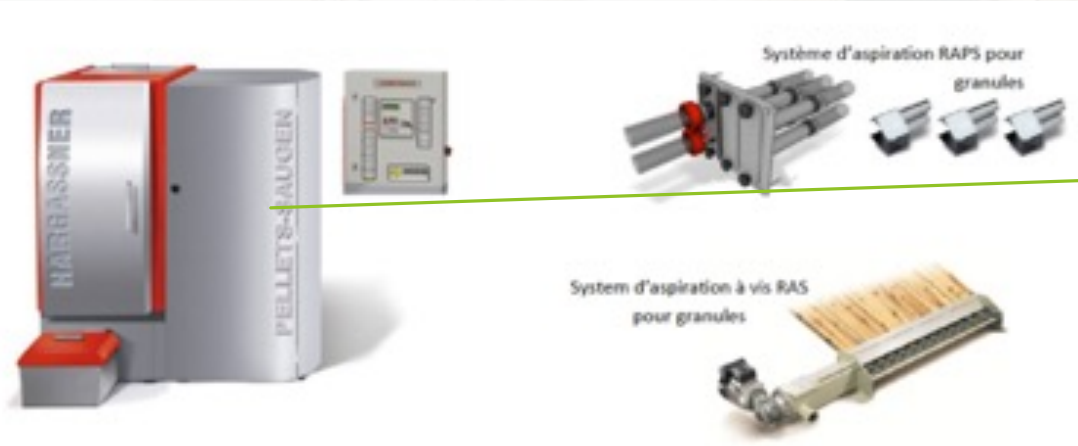
5.1: Heating the WFN Arena. TECHNOLOGY

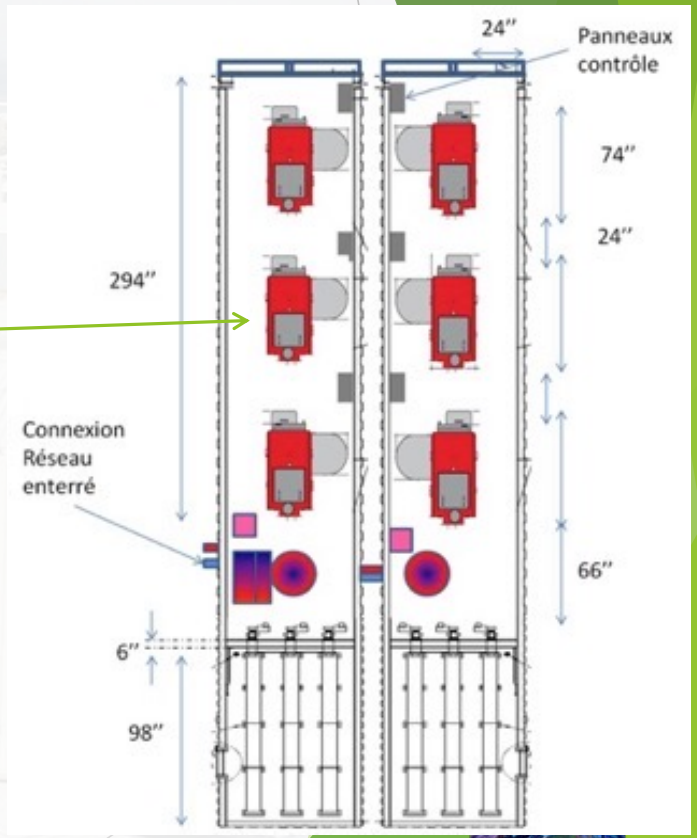
1. Warehouse
2. Biomass boilers
3. Storage containers



5.1: Heating the WFN Arena. TECHNOLOGY

2 Containers with 3 units of 105 KW

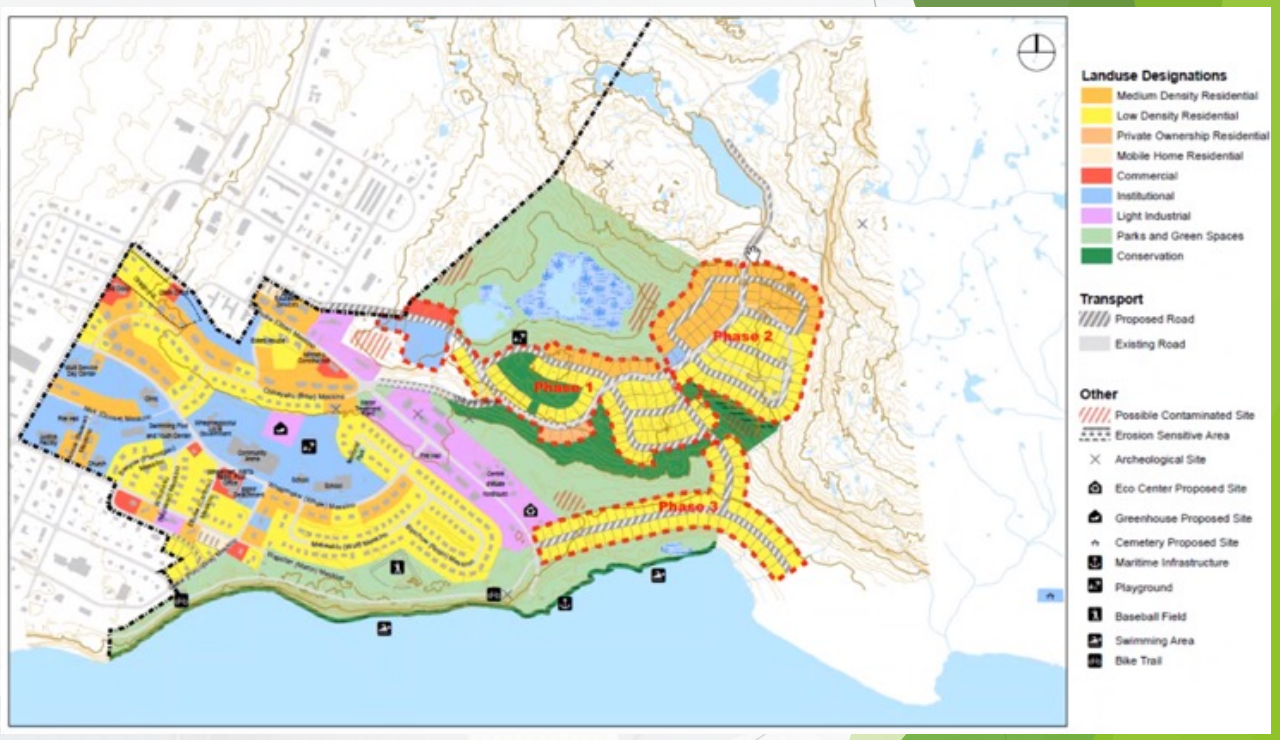




5.2: Heating the WFN new urbanisation

New urbanisation

- Most communities in the north have a housing crisis;
- Centralized heating system are very adapted for these new needs like it was done in Ouje-Bougoumou;
- Excess supply of energy from others renewables (i.e. Wind) can be easily integrated to supply heat in theses networks;
- Distributed heating system would be used in existing the urbanisations.



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5.2: Heating the WFN new urbanisation

Existing Urbanisation

- Heating and hot water needs: ≈ 26 GWh ≈ 6,400 tonnes of biomass;
- Maximum demand: ≈ 11 MW;
- Recoverable heat emissions from the diesel power plant: ≈ 14.8 GWh;
- Maximum demand with heat recovery: ≈ 8 MW;
- **There is a strong potential for biomass cogeneration.**

5.2: Heating the WFN new urbanisation

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New urbanisation

	Units	Total	Phase 1	Phase 2	Phase 3
Low density housing	Number	176	60	50	65
Mid density housing	Number	64	12	52	0
Low density private house	Number	5	5	0	0
Commercial	Number	2	0	2	0
Annual Biomass need (80% efficiency)	Tonnes	2 169	609	1 080	407

Phase 1

Phase 2

Phase 3

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6. CONCLUSIONS

1. Heating with black pellets is more cost effective than diesel

- The study on the optimization of the supply system of torrefied pellets for heating the community of Whapmagoostui has shown that the use of torrefied pellets is more profitable than the use of diesel from the economic and environmental point of views;
- Challenges remains with the low level CO_2 tax in Quebec;
- Potential conversion of all the heating systems in Nunavik would allow substantial annual savings (without CAPEX cost):

	Annual Total Cost	GHG (tonCO_2eq)	Ressources
BAU scenario - Diesel	$74,145,710	66,474	23,795,969 L
Biomass Solution	$41,311,699	46	43,867 tons
ANNUAL SAVINGS	$32,834,011	66,428	

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6. CONCLUSIONS

2. Short-term scenario with black pellets

- Considering that one ton of torrefied pellet is equivalent to 510 liters of diesel, we can conclude that it costs 19% more to use diesel than to opt for implementation of the 1C scenario where torrefied pellets are produced in Bécancour and shipped to Whapmagoostui.

- The torrefied pellet option represents an annual savings of $ 954 in heating costs for each home in Whapmagoostui currently heated with diesel.

➢ **Scénario 1-C – Sealift from Bécancour**

794$

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6. CONCLUSIONS

3. Medium and Long term scenarios with black pellets

- In the medium term (5-10 years), several opportunities in terms of supply scenarios make the use of black pellets even more economical than diesel including its transportation (Scenarios 4-H). Diesel would then be 29% more expensive.

- The production of CHAR pellets in Abitibi Temiscamingue integrates very well with the production of second generation RNG. An expanded gas network to Waswanipi could also provide a new, even more profitable source of supply.

➢ **Scénario 4 - H - New barge**

715 $

- In the long term (+10 years), the option of pellet transportation by airship also appears very promising.

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Meegwetch!
Thanks!
Nakurmik!

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