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Biomass CHP for Northern & Remote Communities:

CHP Test Program at CanmetENERGY-Ottawa

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Natural Resources Canada




Alaska –Yukon Wood Energy Conference, 2019

Canada

About CanmetENERGY-Ottawa (CE-O)

CanmetENERGY is the science and technology branch of Natural Resources Canada and operates three CanmetENERGY labs across Canada with over 450 scientists, engineers and technicians

Work With Industry To Develop Cleaner, More Energy-efficient Biomass Conversion Processes

Bioenergy Program at CE-O

Increased utilization of biomass will allow Canadian industries to lower their carbon footprint while using secure, local, sustainable resources. Communities also derive economic and employment benefits from increased use of local resources. CE-O advances these national interests through innovation on conversion of biomass for energy and production of solid, liquid, and gaseous fuels.

Federal Initiatives to Reduce Reliance on Diesel for Northern & Remote Communities

Budget 2016 announced, starting in 2016-2017:

- $10.7 million over two years to implement renewable energy projects in off-grid Indigenous and northern communities that rely on diesel and other fossil fuels to generate heat and power.

Budget 2017 announced, starting in 2018-2019:

- $53.5 million over ten years to implement renewable energy projects in off-grid Indigenous and northern communities that rely on diesel and other fossil fuels to generate heat and power.

IMPACT CANADA

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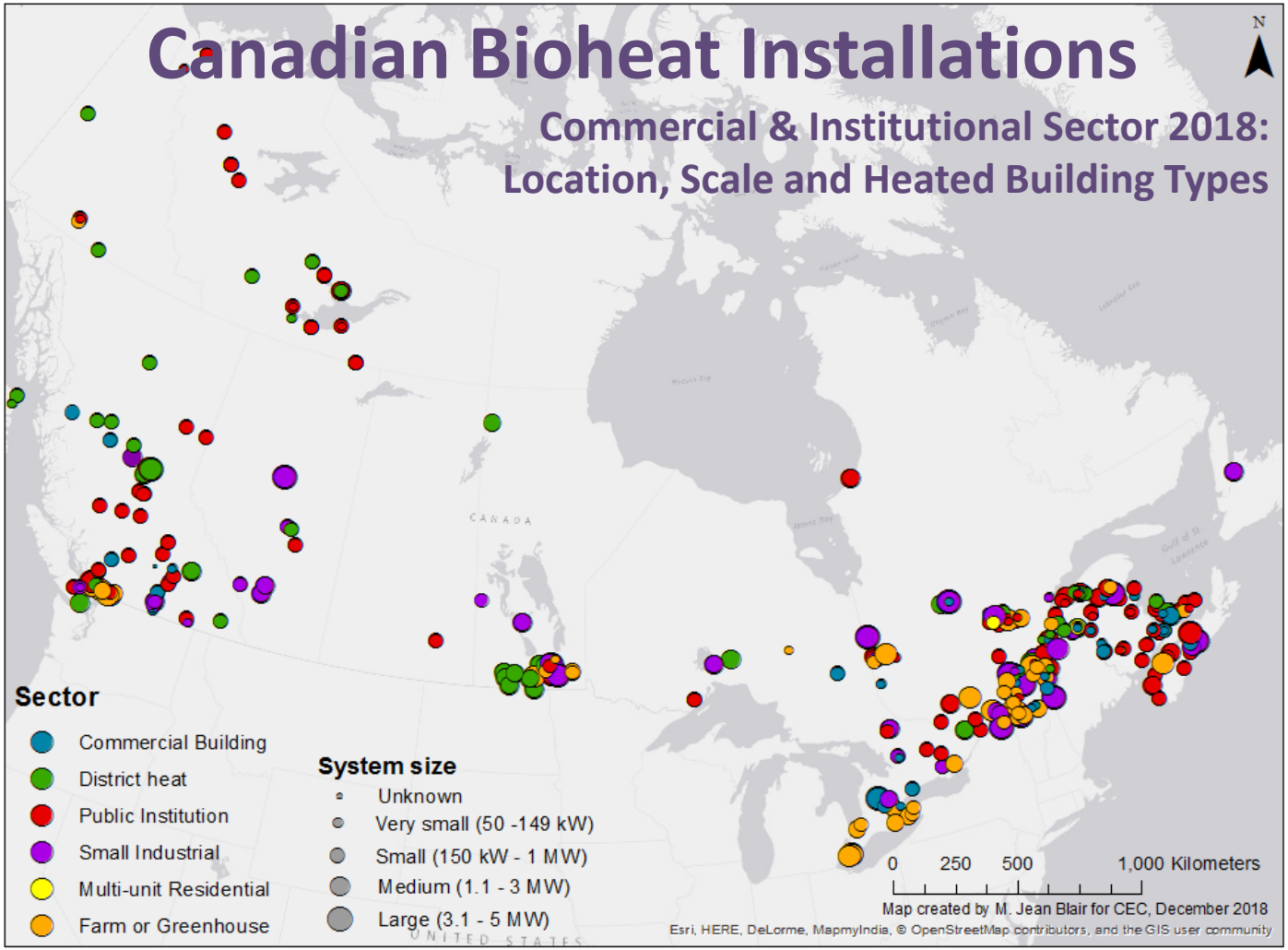
Canadian Bioheat Installations

Commercial & Institutional Sector 2018: Location, Scale and Heated Building Types

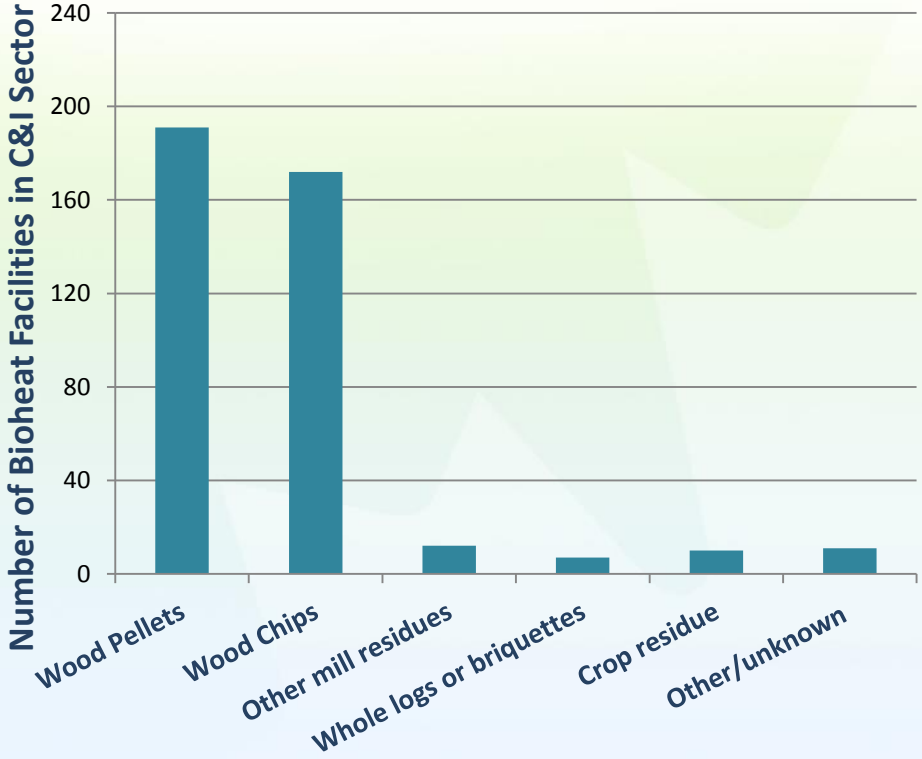


Small Biomass CHP Installations in Canadian North

Biomass CHP – Borealis / Kwadacha FN, BC

Bioheat and future home of Biomass CHP, Teslin T'lingit FN, Yukon

Wood Chips – As a fuel



New document by Canadian TC238 – Solid Biofuels (CSA)

SPE 2254 – Guide to Wood Chip Fuel: Characteristics, Supply, Storage and Procurement

Expected publishing date of late spring 2019

CE-O Initiatives:

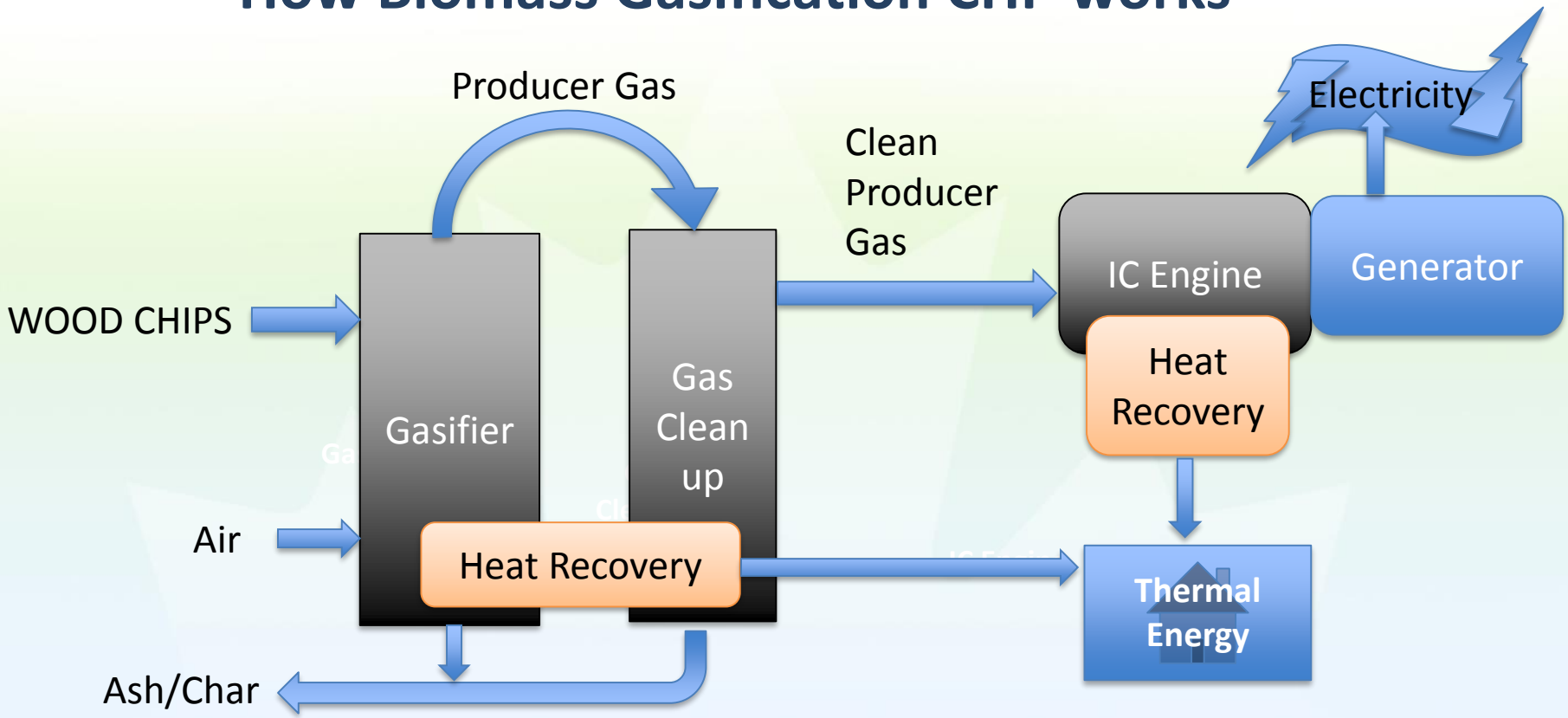
Identification and Assessment of Optimal Pathways to Produce Bioenergy for Heat and Power in Northern and Remote Communities

- Techno-economic analyses (TEA) reports - bioenergy pathways; review of best available technologies (BAT) and gaps hindering deployment of cost effective solutions.
- Preparation of Best Practices Guide (s) on how to select and implement bioenergy projects
- Additional R&D activities as identified through the TEAs:
  - gasification based CHP (Volter Project) [years 3 and 4]
  - Fuel cell applications [year 4 only]

Gasification Based CHP Verification at CE-O

- Verification of system performance for Volter 40 Indoor (2017)
- Assessment and documentation of operational issues including effect of variation in fuel specifications;
- Assessment of ancillary equipment requirements
- Environmental performance (Emissions Testing)
- Disposal of residues / consumables
- Health and Safety Issues

How Biomass Gasification CHP works



Installation Considerations at CE-O:

- Building to house the CHP system
  - Electrical connections
  - Fuel storage
  - compressed air at 80 psi
  - Ash bin
  - Exhaust pipe
- Connections
  - Heating - hydronic piping system
  - Power - existing low voltage grid (480V, 3 ph, 60 Hz)
- Health & Safety protocols and controls
  - Fire, possible toxic gas

Performance Test Matrix

- **Wood Species: Hardwood and Softwood**

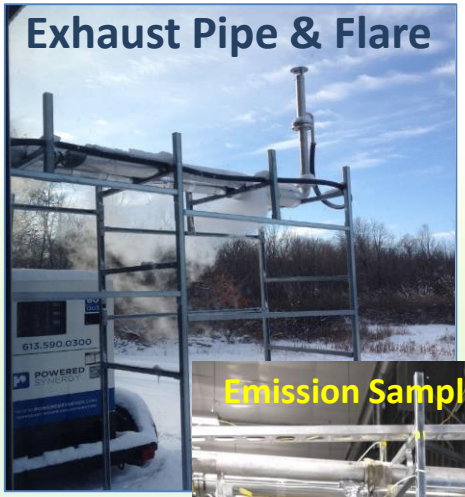
  To spec, i.e. dry (<15%) and uniform size and shape]
- **Wood Chip Quality:**

  Variation in moisture content & size distribution
- **Firing Rate :**

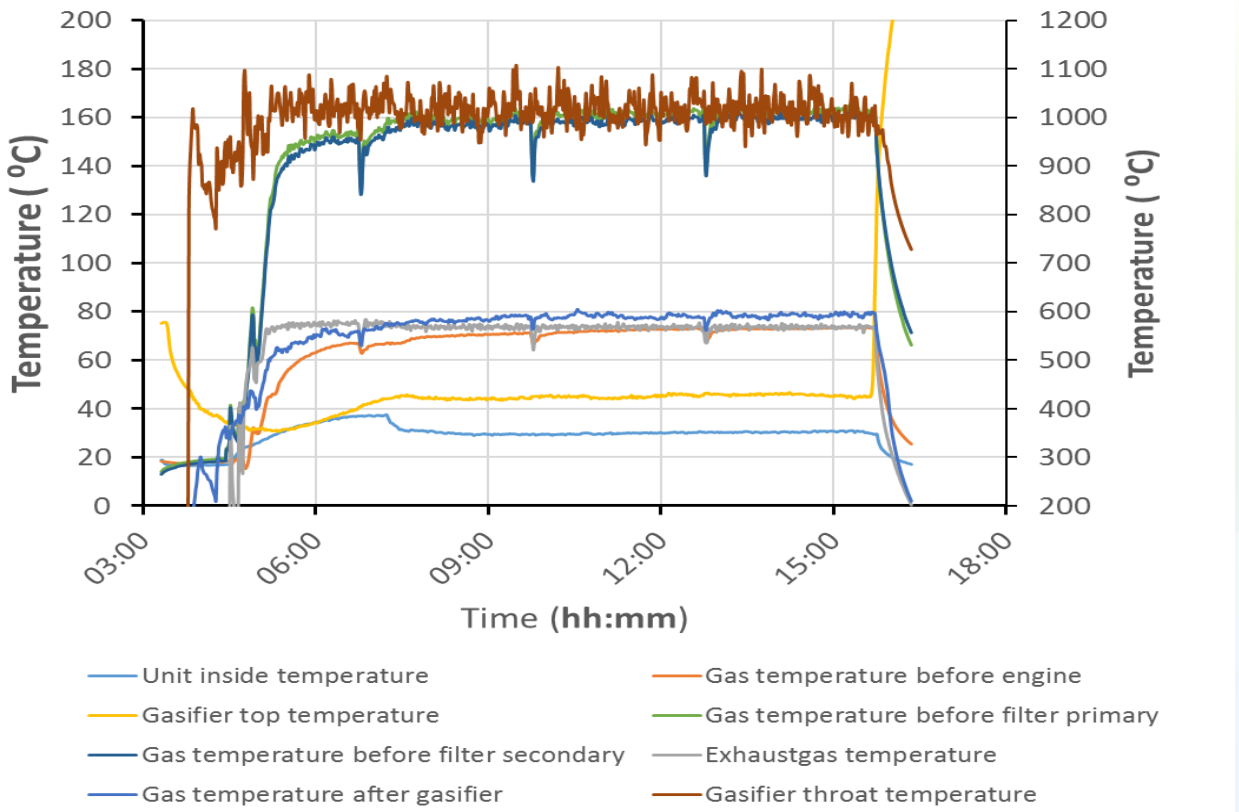
  Nominal load and partial load (30%)
- **Emissions Profile:**

  Flue Gas : CEM and FT-ir (O2, CO2, CO, H2O, NOx, SO2, Methane) , Methane & non-Methane HC, TPM, condensables,

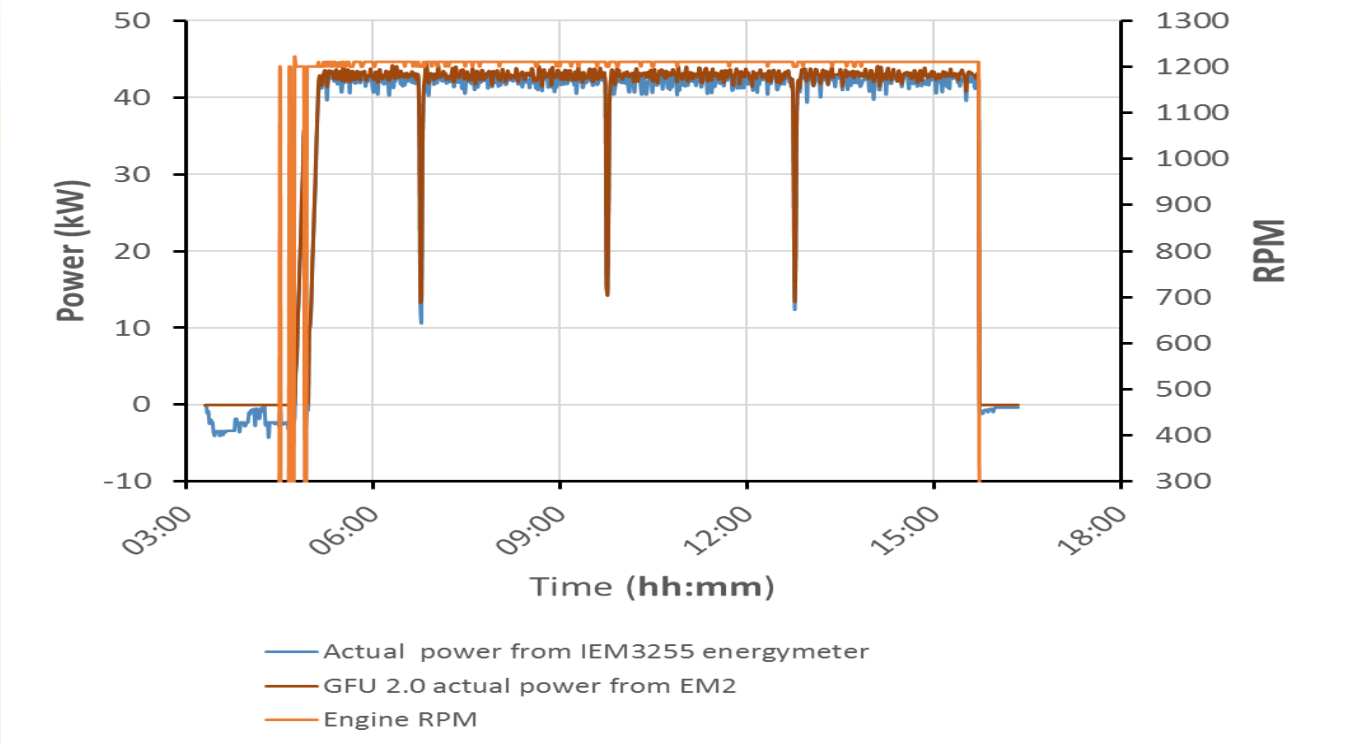
  Producer Gas: Chromatographic analysis, gravimetric Tar



Steady State Operation



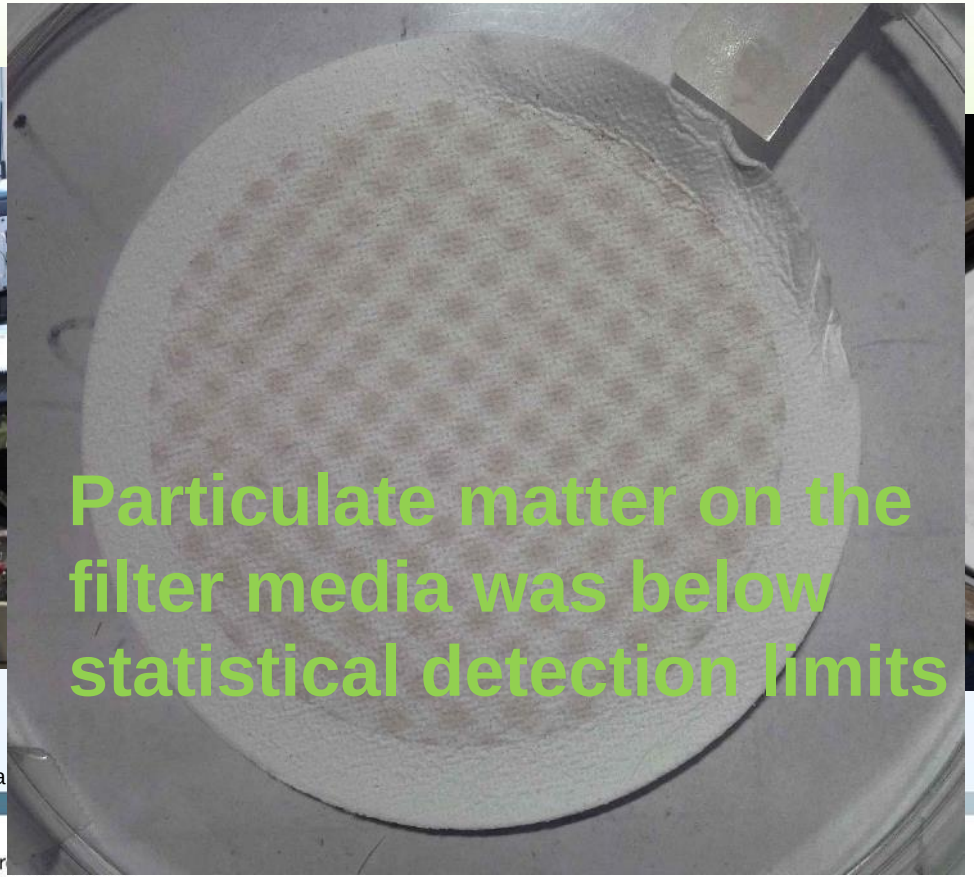
Electrical Output



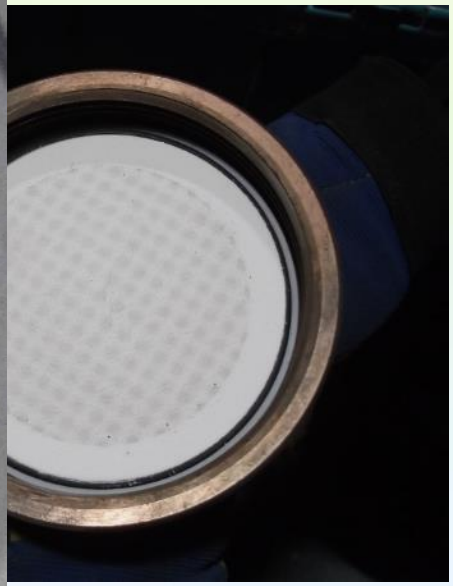
Engine Emission Data

Wood Species	Moisture (wt%)	Electrical Output (%)	Duration (hours)	Total Mass in (kg)	Average NOx (ppm, dry)	Average SOx (ppm, dry)	Average CO (ppm, dry)	Average CO2 (vol%, dry)	Average O2 (vol%, dry)
HW	6.0	100	30.5	977.0	1505.5	4.9	102.4	18.1	1.7
SW	8.9	100	14.5	464.5	1132.4	4.1	152.8	17.9	1.9
HW	15.5	100	8.9	323.7	836.9	4.5	155.4	19.2	1.7
SW	8.0	30	8.4	137.2	201.6	5.3	34.5	18.8	2.0

Engine Emissions



Particulate matter on the filter media was below statistical detection limits



Key Observations

- Operation is highly automated and performs well with minor deviations (demonstrated relatively high availability)
- Maintaining fuel quality within specs **is absolutely CRITICAL**
- Engine emissions are very low for CO, THC and particulate but higher for NOx
- Configuration tested at CE-O requires grid connection for start up
- CE-O observed optimal operation when unit operated at constant heat and power load.

Safe, Reliable and Efficient CHP Operation Needs ……

- Well established and functioning fuel supply chain
- Wood chips meeting specs
- Trained operator with strong technical knowledge

- increase confidence and knowledge for regulations – Grid connection, environmental compliance

CE-O Other Initiatives on Bioenergy for North

- Capacity Building
  - with Regional Colleges (BIOCOMM –colleges network), manufacturers and communities
  - Technical training & curriculum development
- Solid Biofuel Standards
- Liquid Biofuels in Diesel Engines

Acknowledgements

CE-O Project Team

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Engineering Services

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PERD &EIP Funding Programs

CanmetENERGY

Leadership in ecoInnovation

Thanks for your attention,

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