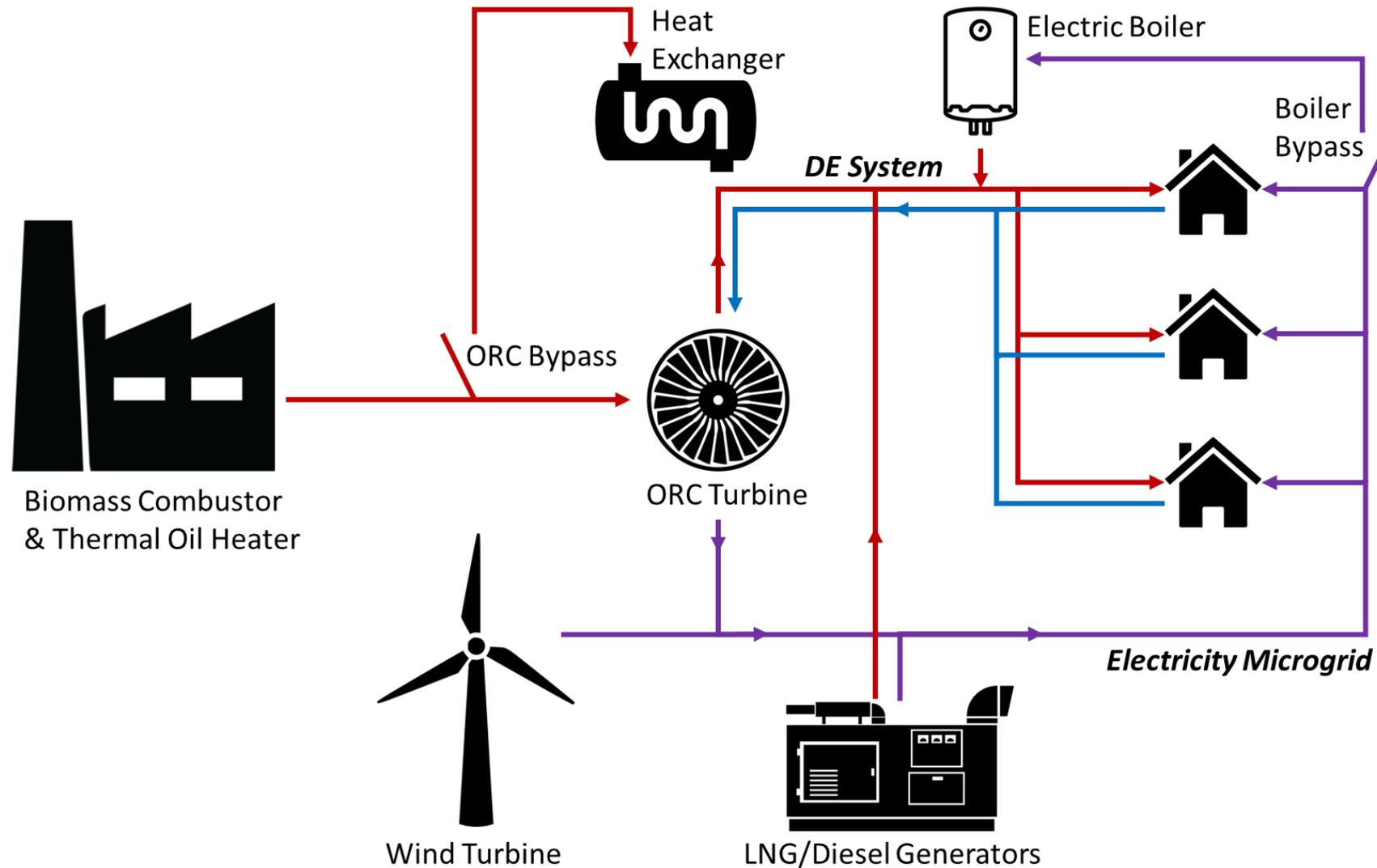
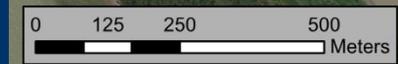
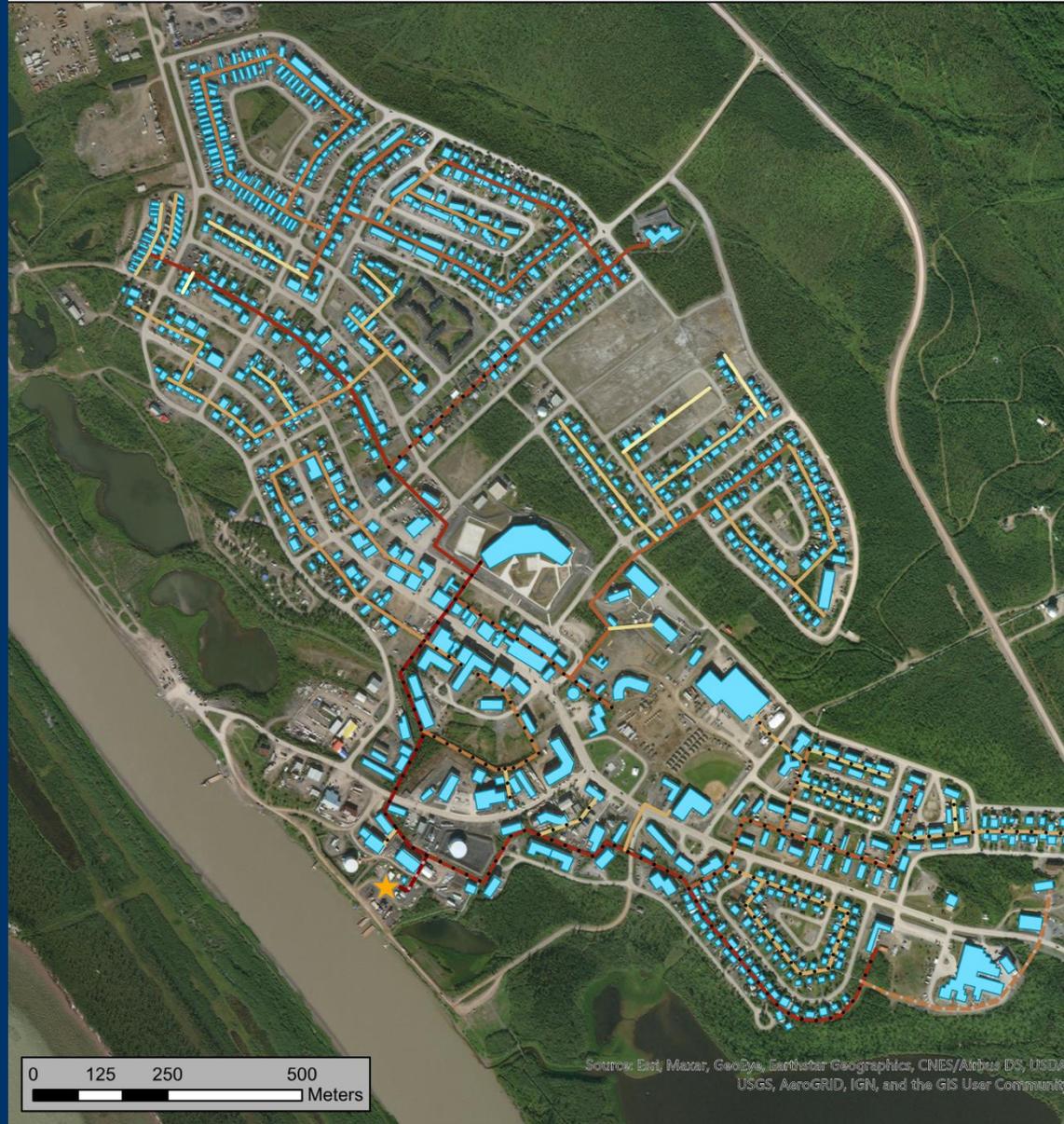


Lessons from Two Projects

Inuvik, NT & New Glasgow, NS

- Prefeasibility study on community-wide district heating system for Nihtat Energy
- Comparison of biomass fuel options
 - Pellets by truck
 - Pellets by barge – container vs bulk
 - Chips by barge
- For community-wide system with biomass CHP
 - Bulk pellets by barge with substantial storage – if water levels allow
 - Winter trucking as necessary
- Opportunity to increase wind power generation with thermal storage
- Use of Organic Rankine Cycle to assist with grid frequency modulation
- Substantial cost savings for both electricity & heat, despite very high capital cost





Pipe Diameter (DN mm)			
32	80	150	300
50	100	200	400
65	125	250	450

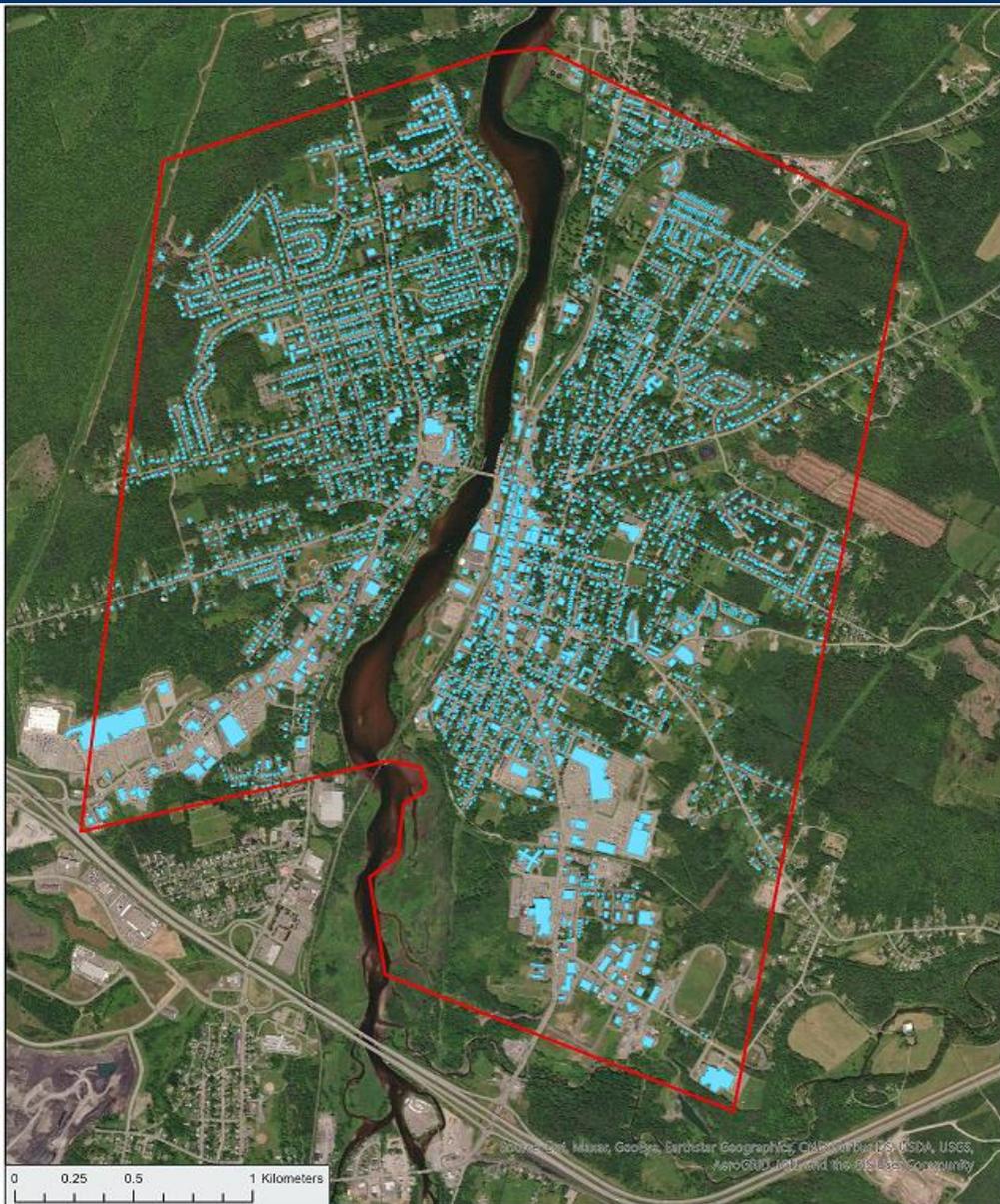
- ★ Energy Center
- No utilidor
- - - Old utilidor
- Solid line indicates new utilidor



- Co-generation of heat and power results in large cost savings
 - District heating network necessary to utilize heat
- Investment in infrastructure leads to long-term cost savings
 - BAU is low CapEx but high operating cost
 - Large annual cash drain
- District heating allows for thermal storage
 - 'Overbuild' generation with low OpEx renewables
- Alternative thermal storage consideration: sand battery?
- ORC allows for flexibility of generation
 - Lower electrical efficiency than steam, but ok if not wasting heat (DH, storage)
 - ORC too low efficiency for electricity without heat use



New Glasgow District Energy



- Feasibility study for community-wide district heating system
- Central biomass CHP plant
- Study led by TorchLight in collaboration with Town of New Glasgow, Rathco ENG, ACFOR, and FNSWO
- Funding from Natural Resources Canada (& TNG)
- Master plan, zoned build-out
- Pipes, in-building connections, energy centres
- Fuel supply plan
- Utility plan – ownership, financing, operation, etc.
- Municipality vs. co-op vs. P3 vs. private
- Extensive community engagement

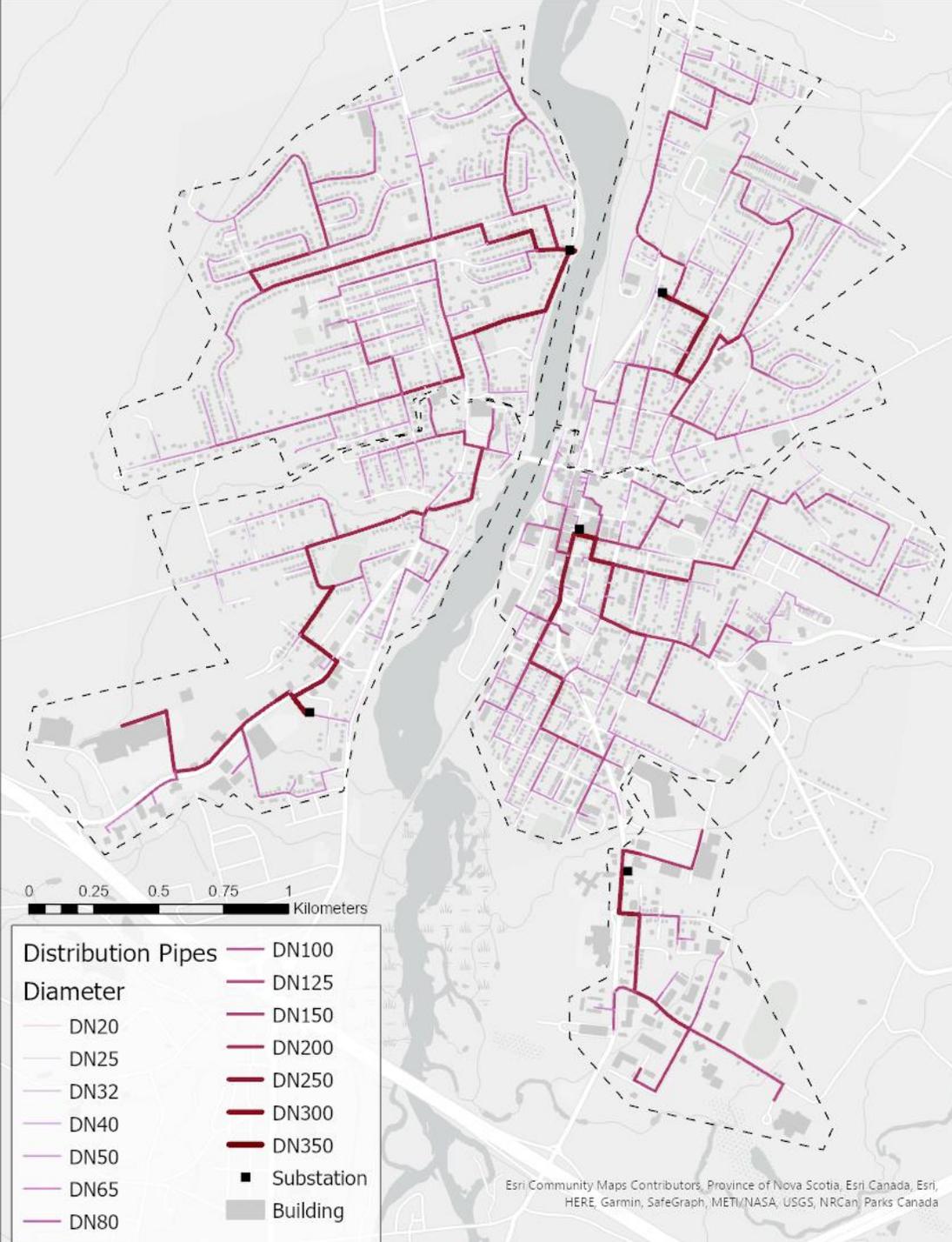
- Community-wide network – everyone benefits
- Heat supply must be substantially lower cost than all alternatives
- Scale biomass CHP to town heat demand
- Support ecological forestry and sustainable forest management
- Align with goals of GoC and GoNS

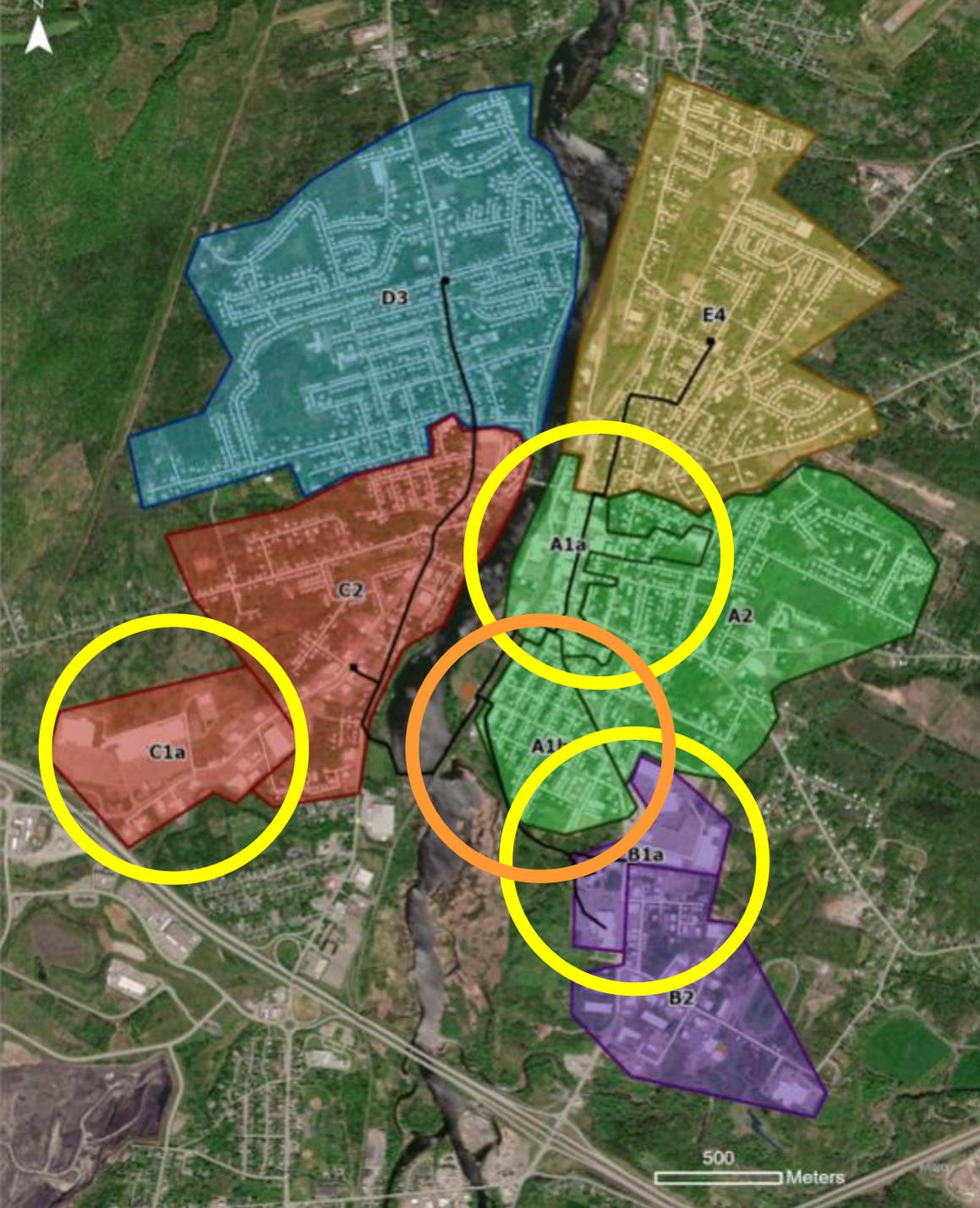
Energy Source	Price	\$/GJ Heat
Heating Oil	\$1.50/L	\$60
Electricity	\$0.19/kWh	\$53
Heat Pump*	\$0.086/kWh	\$24
Natural Gas	\$22/GJ	\$26
Wood Biomass**	\$75/tonne	\$9
Wood Biomass CHP	\$75/tonne	\$1

*Assumes COP of 2.2 including electric DHW

**Heat-only

- Pipe size dictated by connected loads (buildings)
- Must be able to meet peak demands (space & DHW)
- Transmission pipes & distribution pipes
- Layout impacted by location of energy centre(s)





Zone	Peak Heat Load (MW _{th})
A	20
B	11
C	12
D	15
E	12
Total	70

For reference:

- Dalhousie Truro: 8 MW_{th}
- Kraft pulp mill: >300 MW_{th}
- Enwave Toronto: 600 MW_{th}
- Stockholm Exergi: 4,000 MW_{th}

170,000-200,000 MWh/yr @ \$150/MWh
 = \$25-30 M/yr in building heat expenditures



Scale: 16.7 MW_e (power only)
13.3 MW_e/26.0 MW_{th} (CHP)

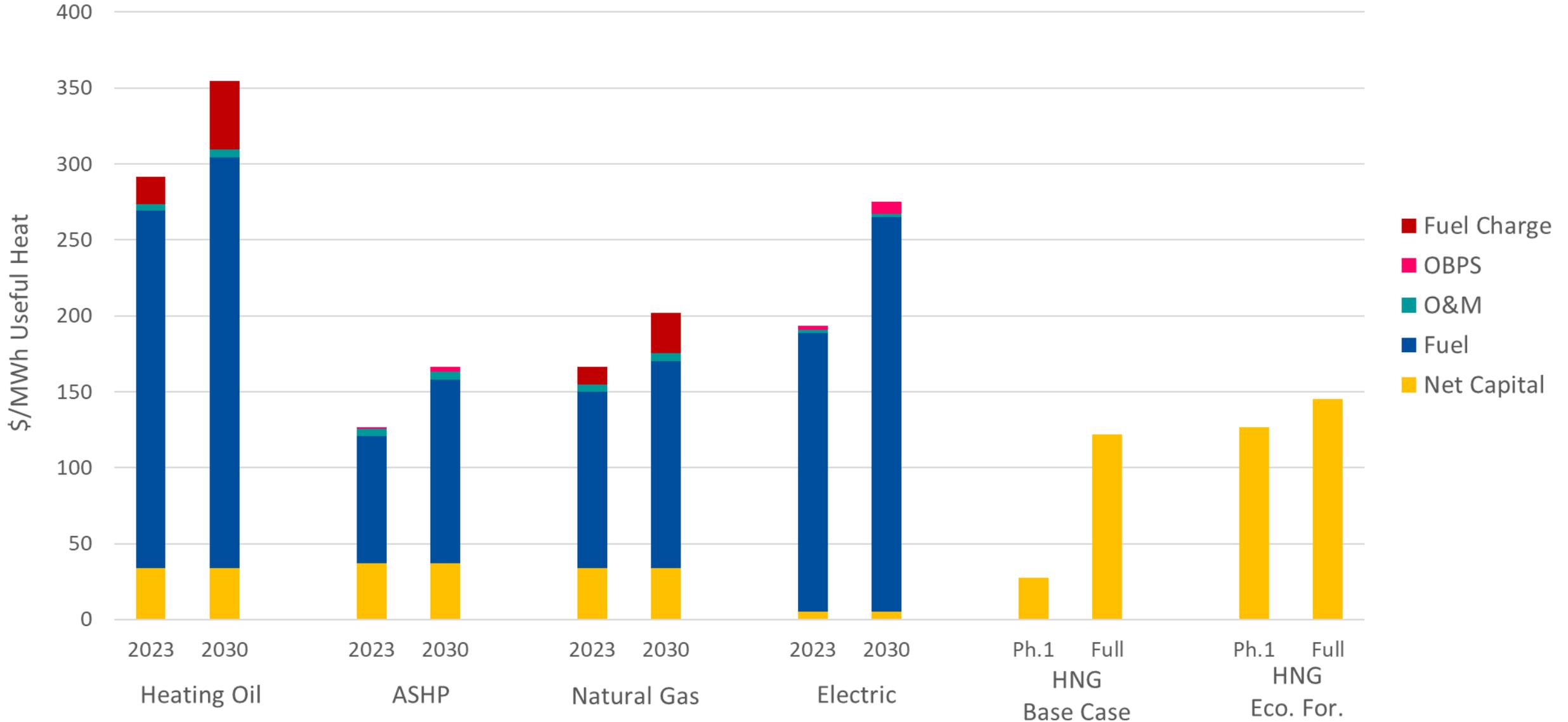
Very low emissions bubbling fluidized bed

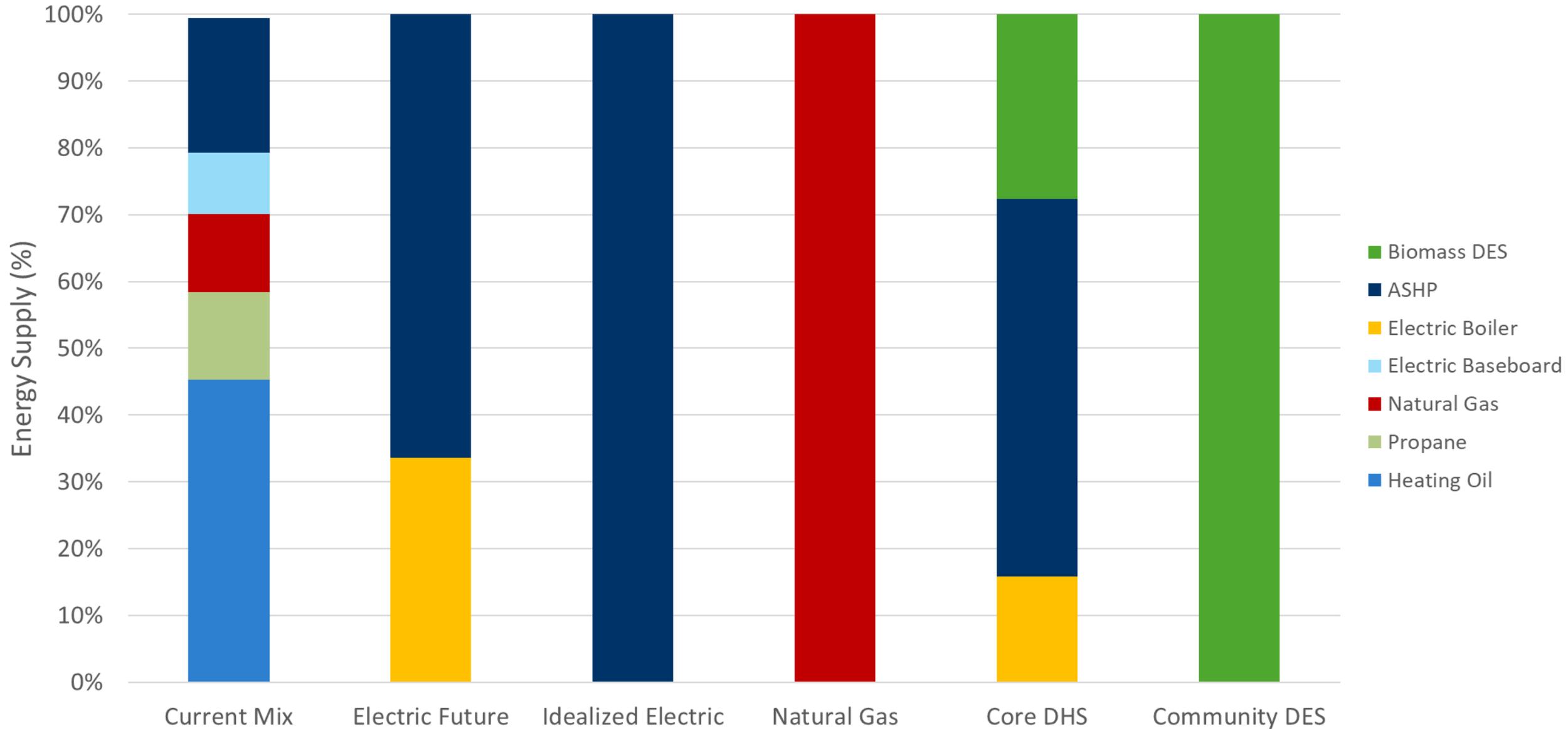
Fuel Demand: 70,000-95,000 bdt/yr

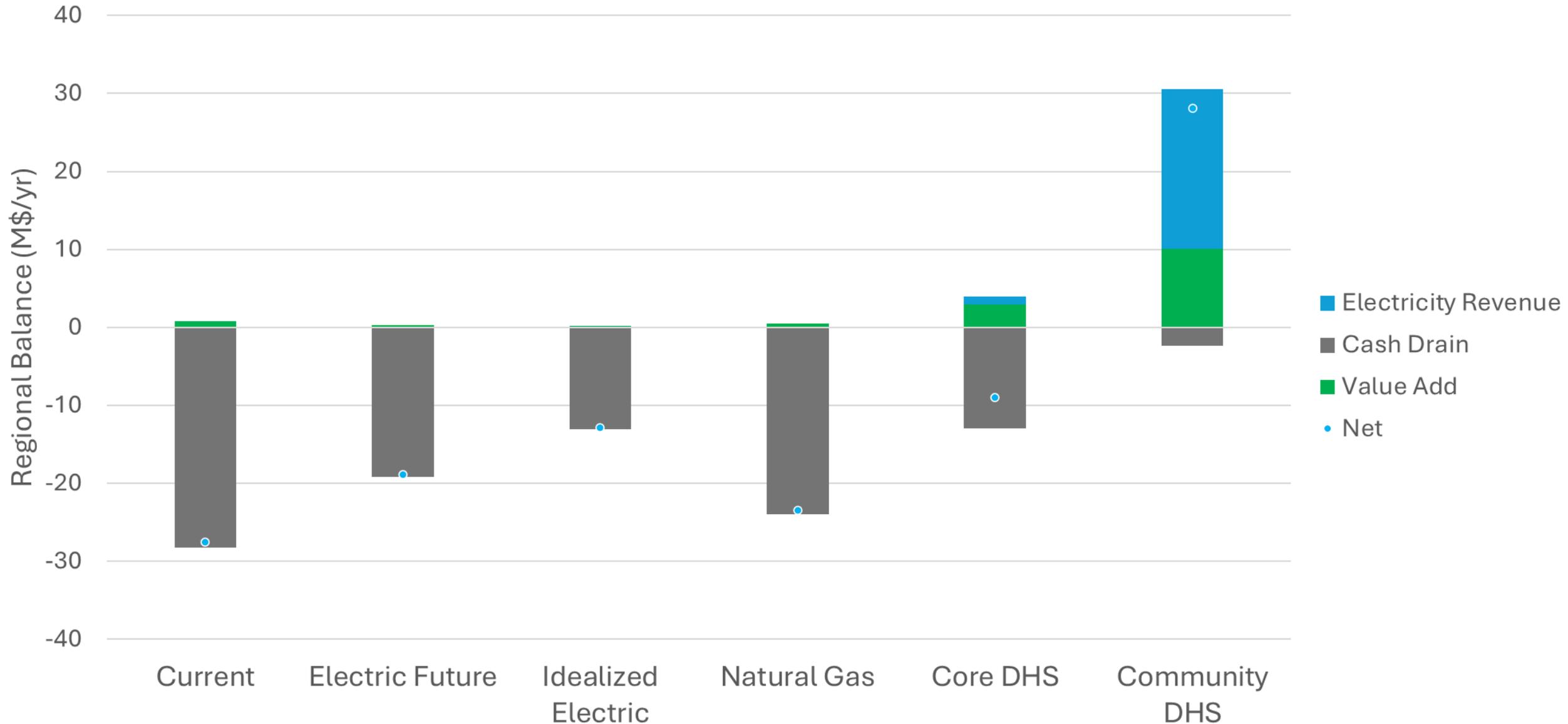
1 truck every 45 minutes in 12 hour day

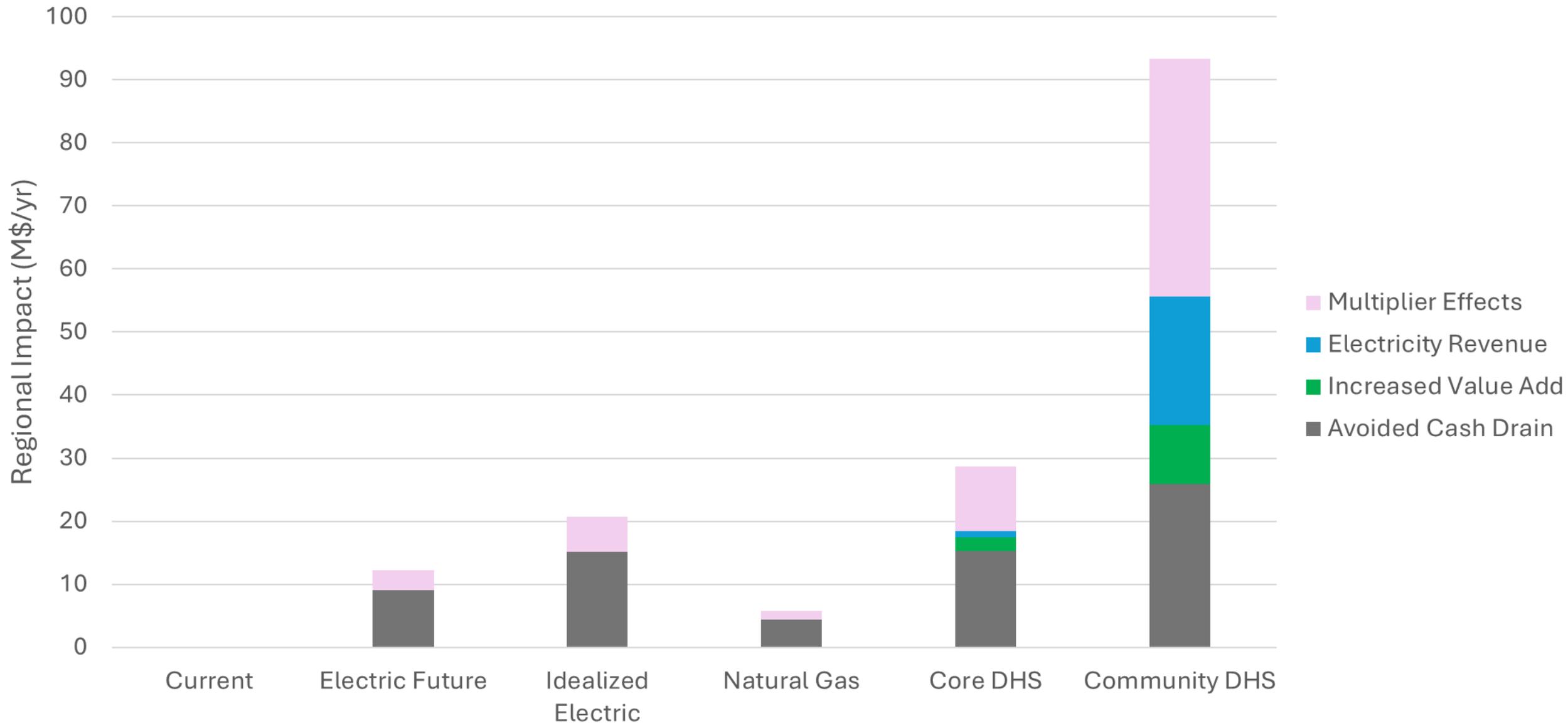
10-13% of Northern Pulp Mill demand

Cost of Heat (Residential)









- CHP is required to make low density district heating economic
 - Electricity revenue lowers net cost of heat supply to network
- Other studies (e.g., Quesnel, BC) show other sources not competitive for DH
 - Heat pumps (industrial, geo) – electricity consumer, not producer
 - Bioheat alone – pipe CapEx hard to justify; go individual building
- Thermal storage important for plant operations & energy efficiency
- Steam generation preferred if electricity high value (but ORC simpler in North)
- Enthusiastic municipal support necessary for advancement
- Multiple pathways to municipal ownership without municipal investment/debt