

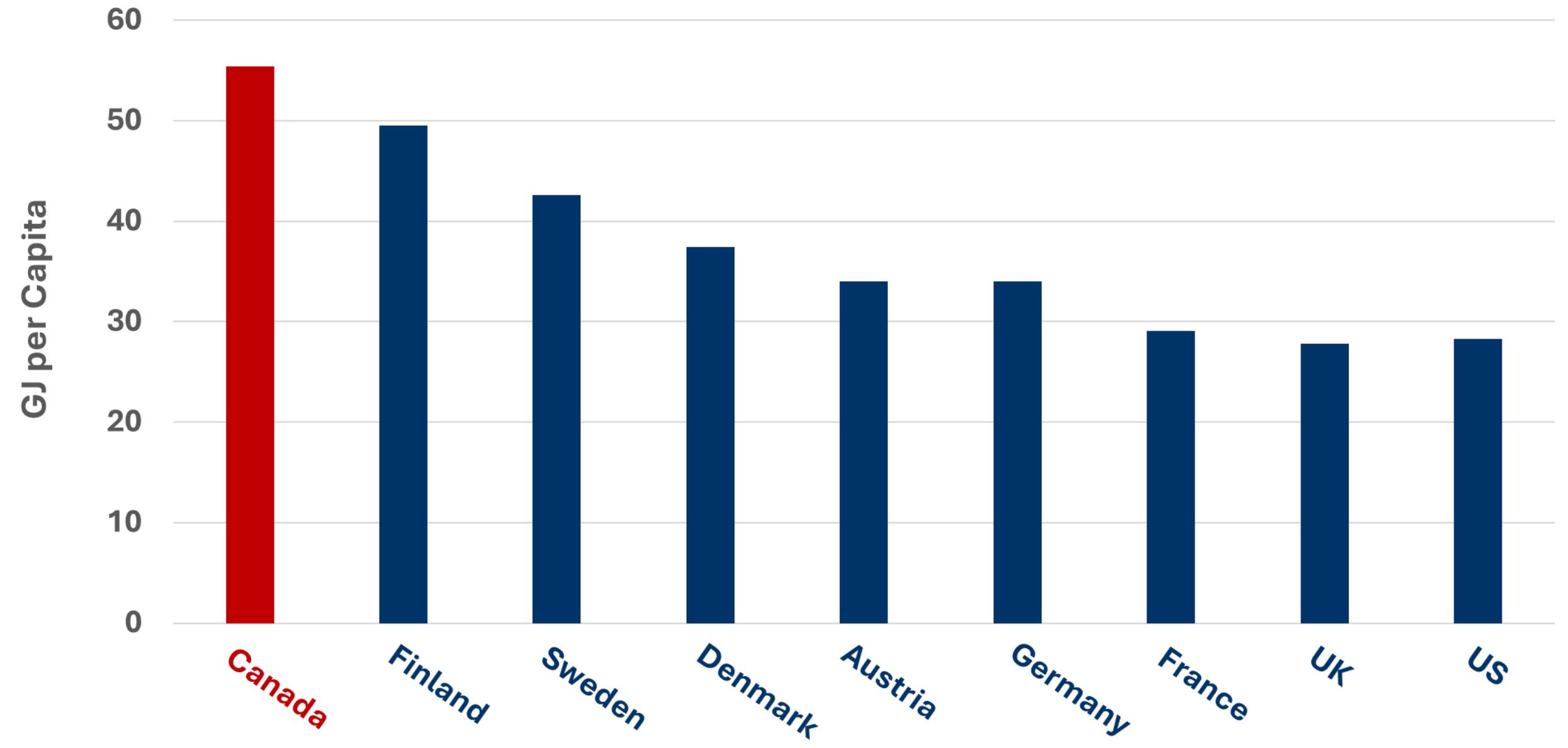
# District Heating in the Arctic

*Critical Infrastructure for Energy Security,  
Adaptability, and New Pellet Demand*

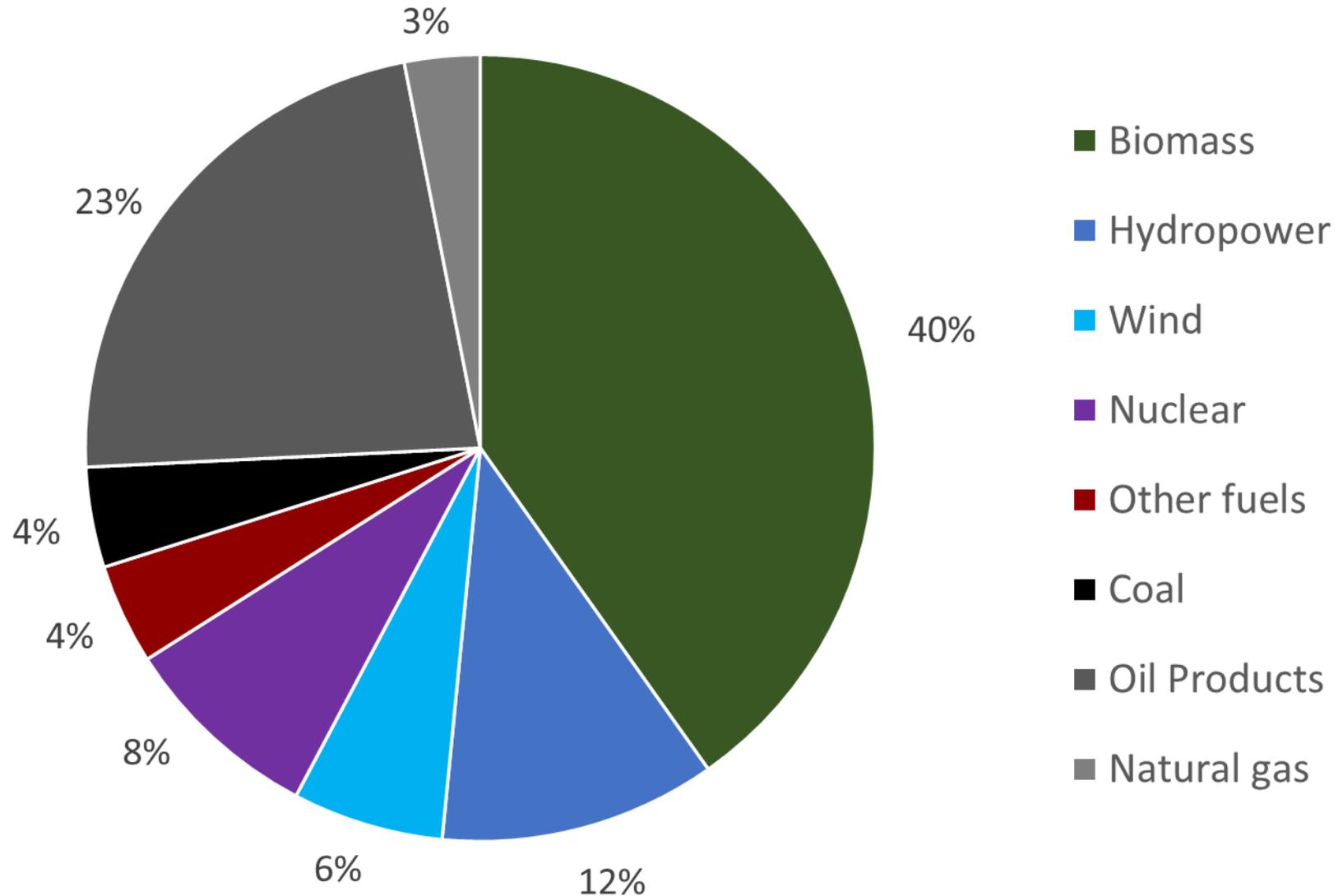
# Key Points

1. District heating is fuel flexible infrastructure
2. District heating is not appropriate everywhere
  - *Individual building solutions can be superior*
3. District heating in the Arctic is high capital cost, but so is fuel
4. There is a reason Arctic communities have developed DH systems
5. Canada can learn from Greenland (Denmark) & Svalbard (Norway)
6. Canada can be a (biomass) fuel exporter to improve energy security
7. Biomass + district heating is powerful, but also consider individually
  - District heating using wasted heat from diesel generators
  - Pellet supply for individual building heat

# Building Space and Hot Water Demand

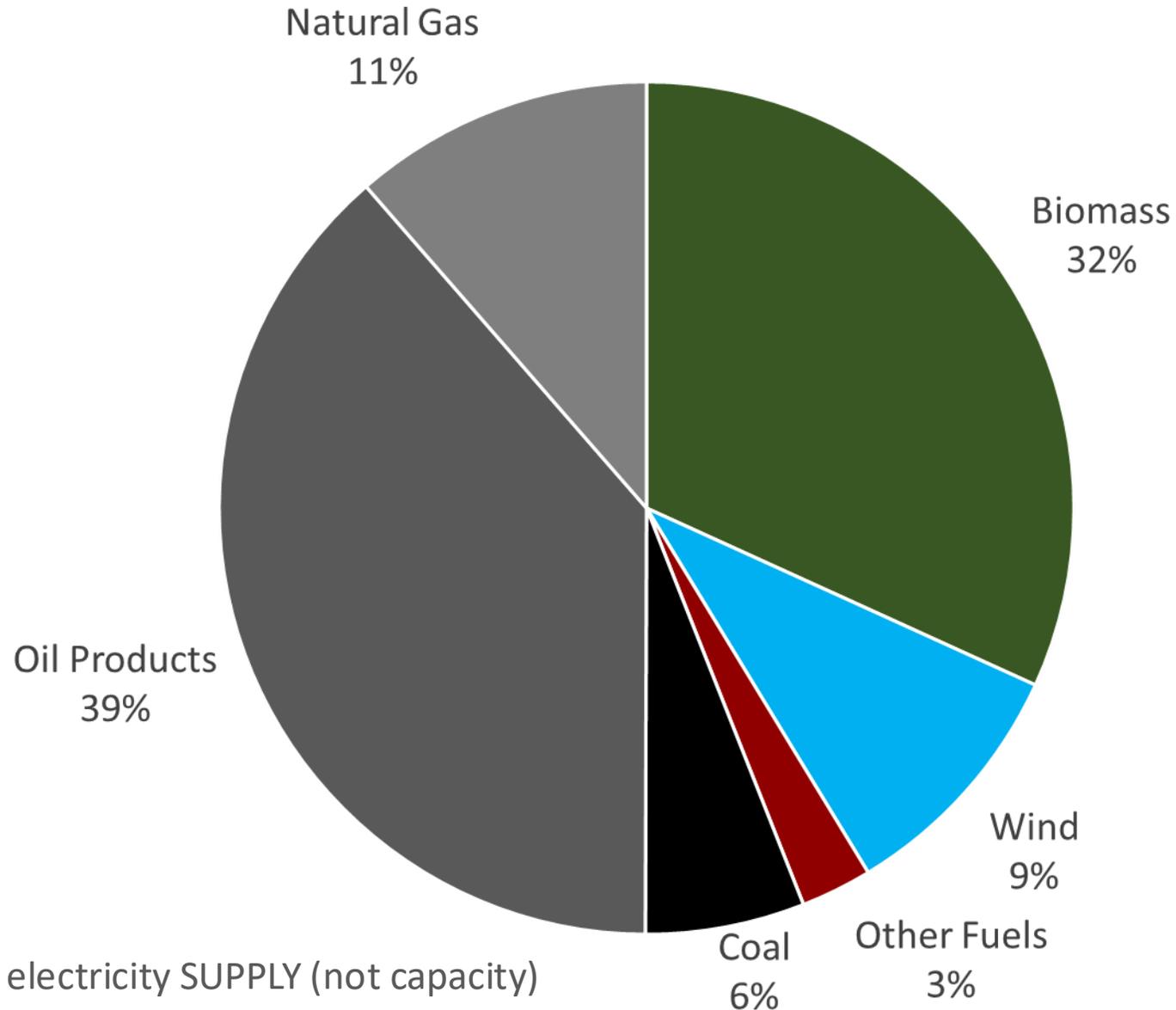


# Energy Consumption in Sweden



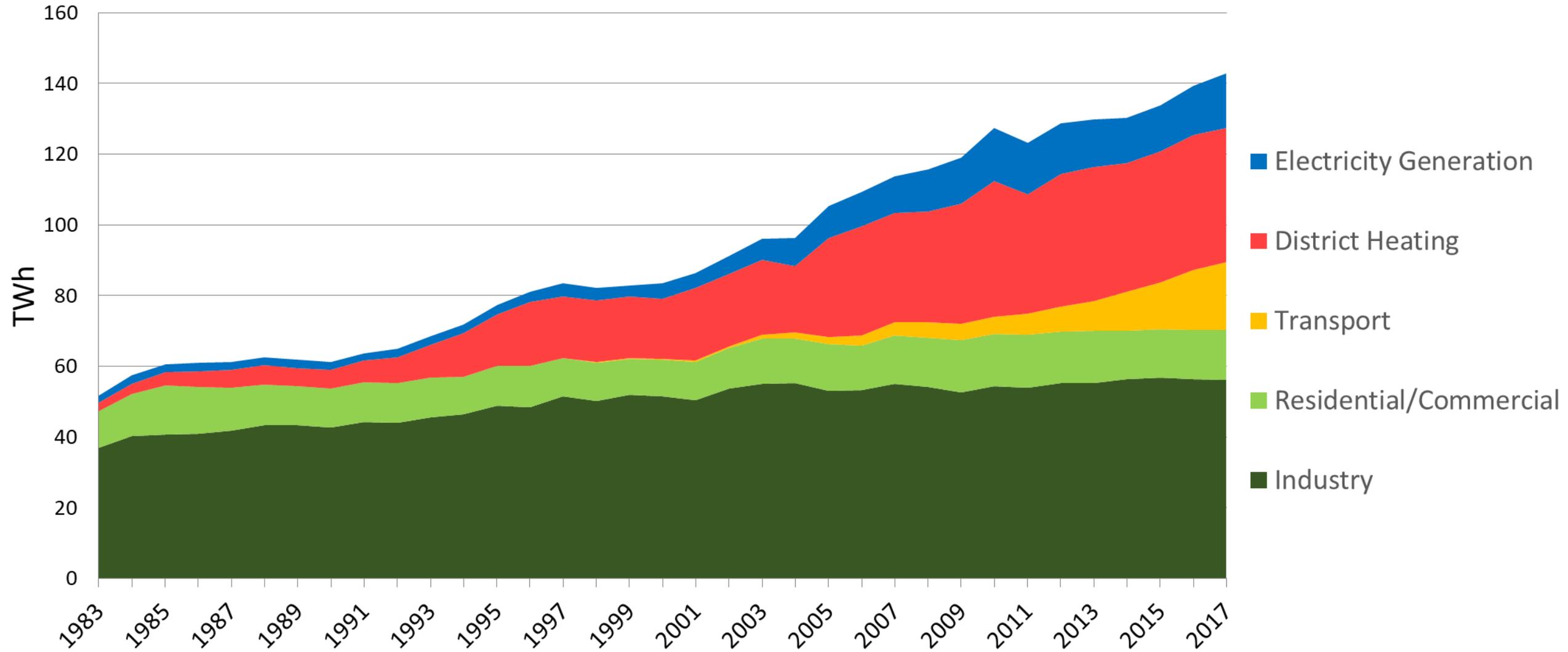
- 58% renewable energy, 65% non-emitting

# Energy Consumption in Denmark

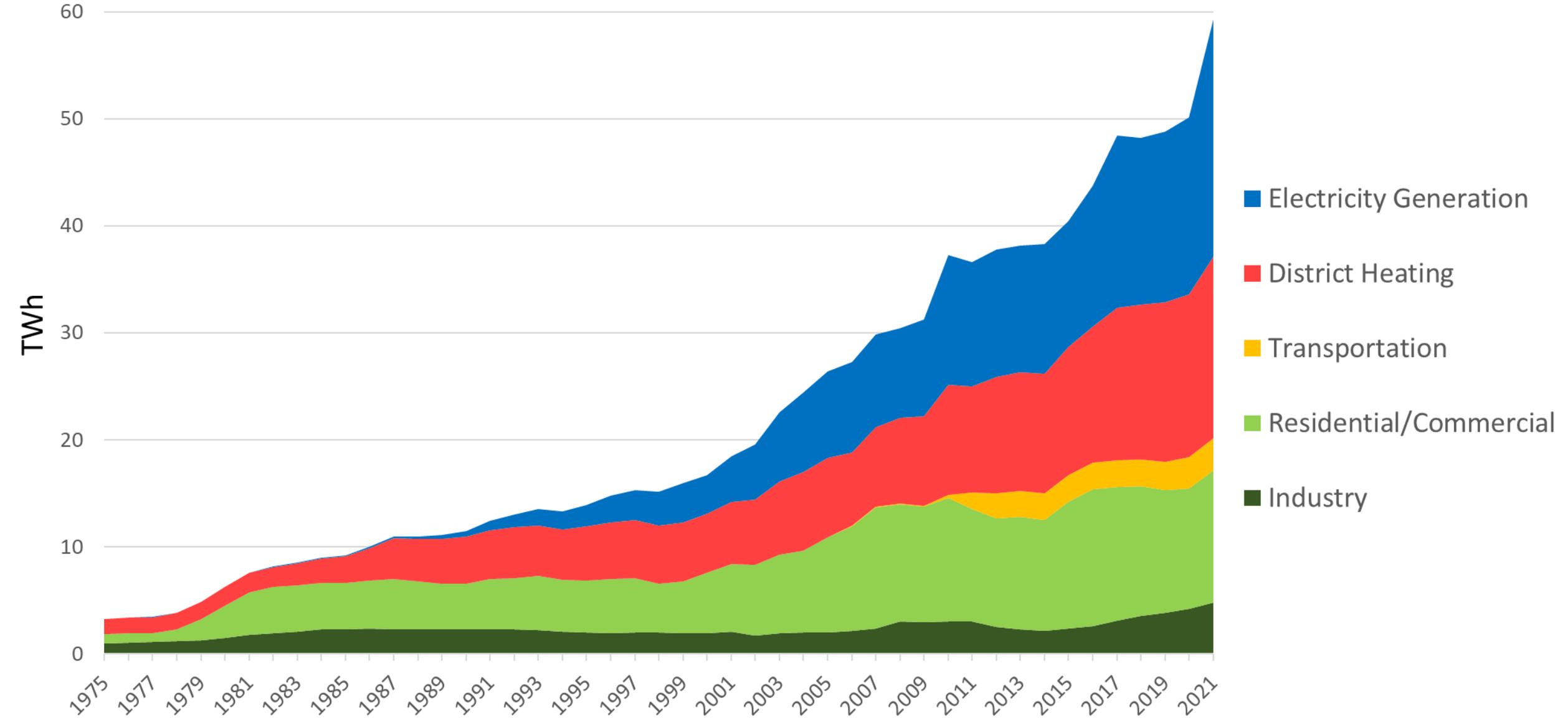


- Wind provides 50% of electricity SUPPLY (not capacity)

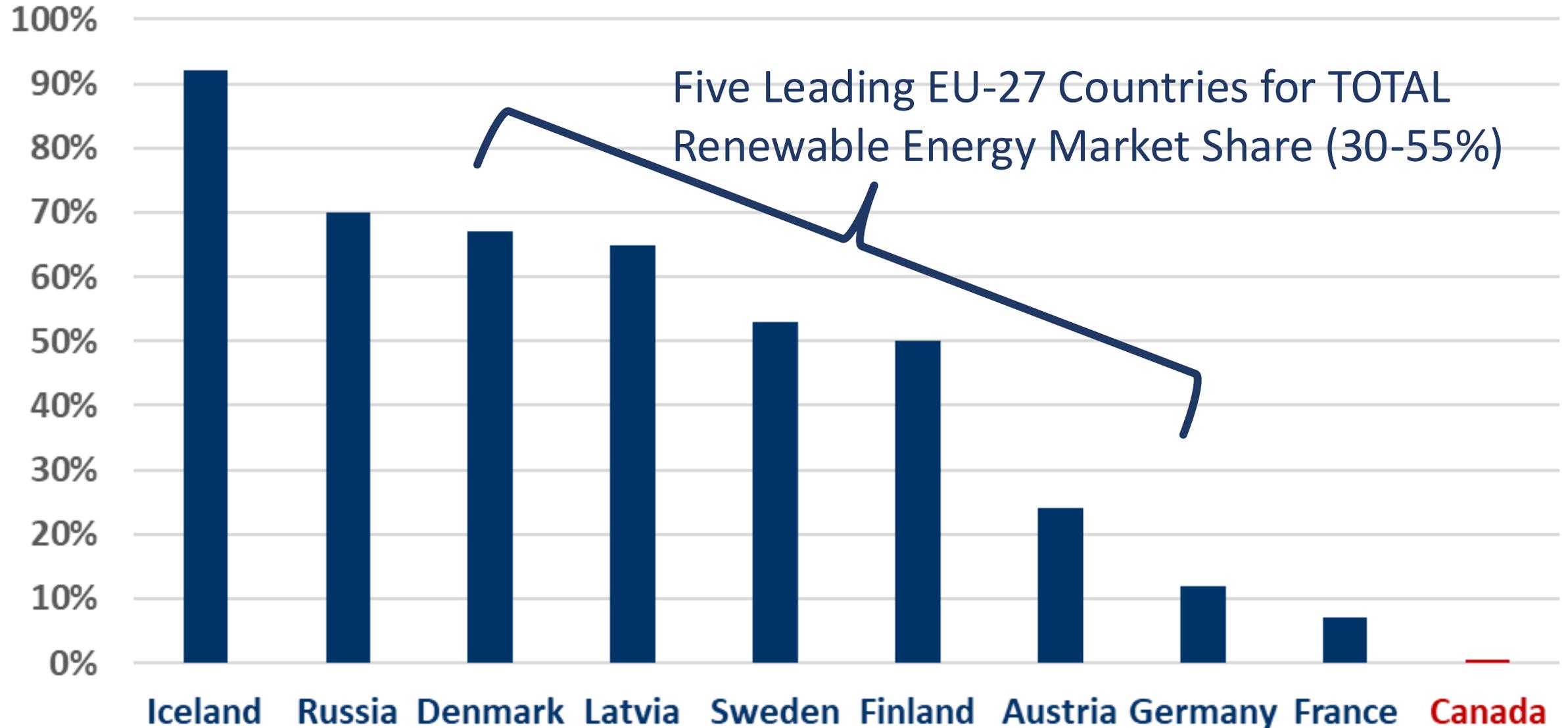
# Bioenergy Demand in Sweden



# Bioenergy Demand in Denmark

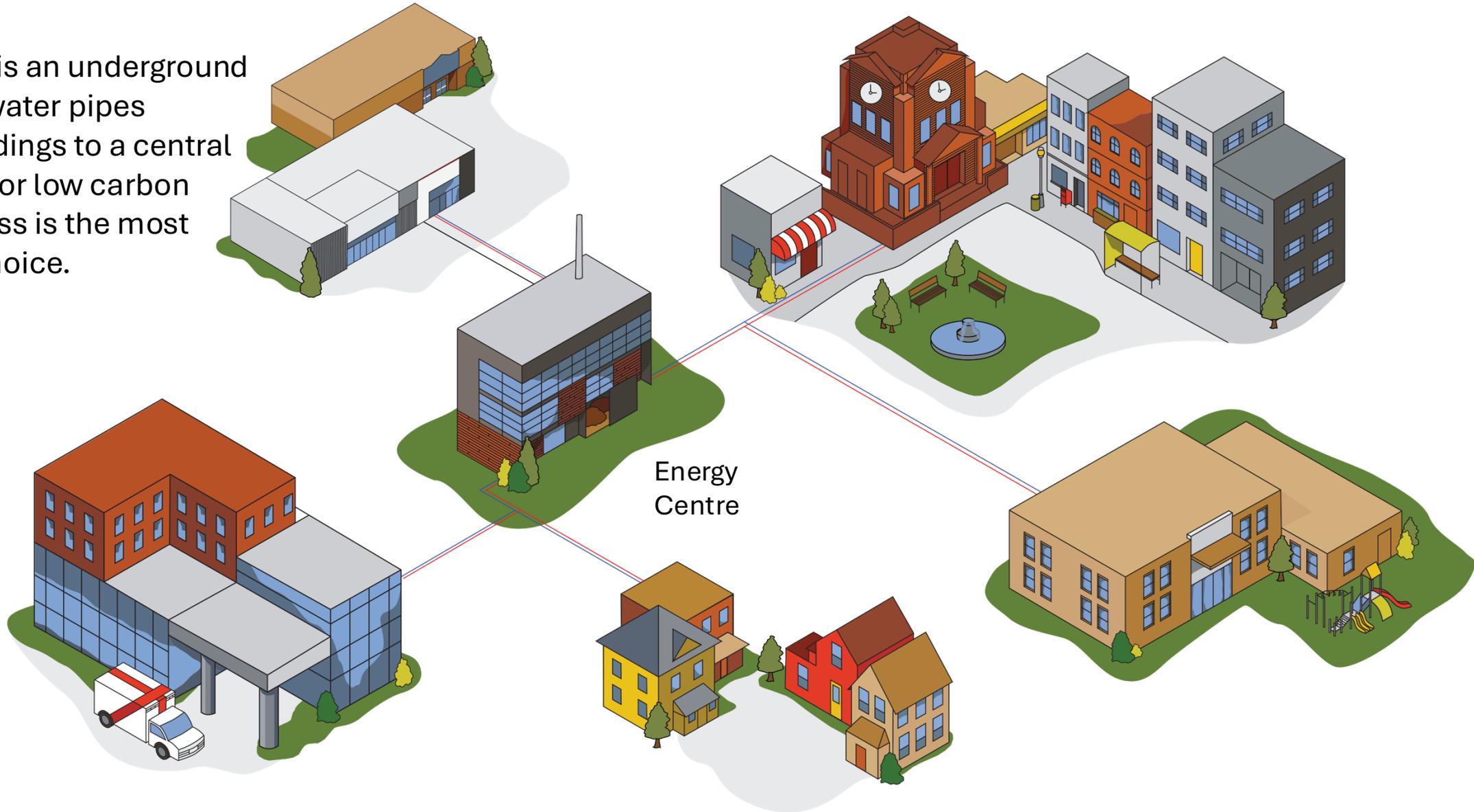


# Population Served by Heat Networks

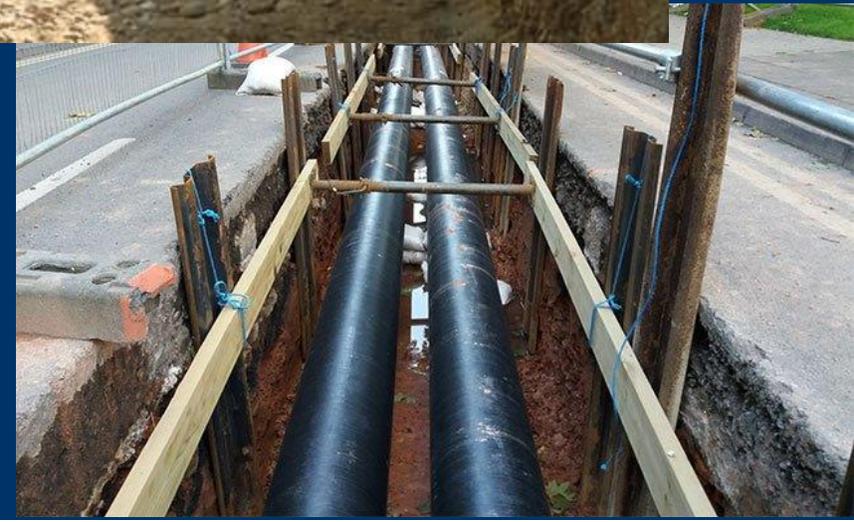


# What is District Heating?

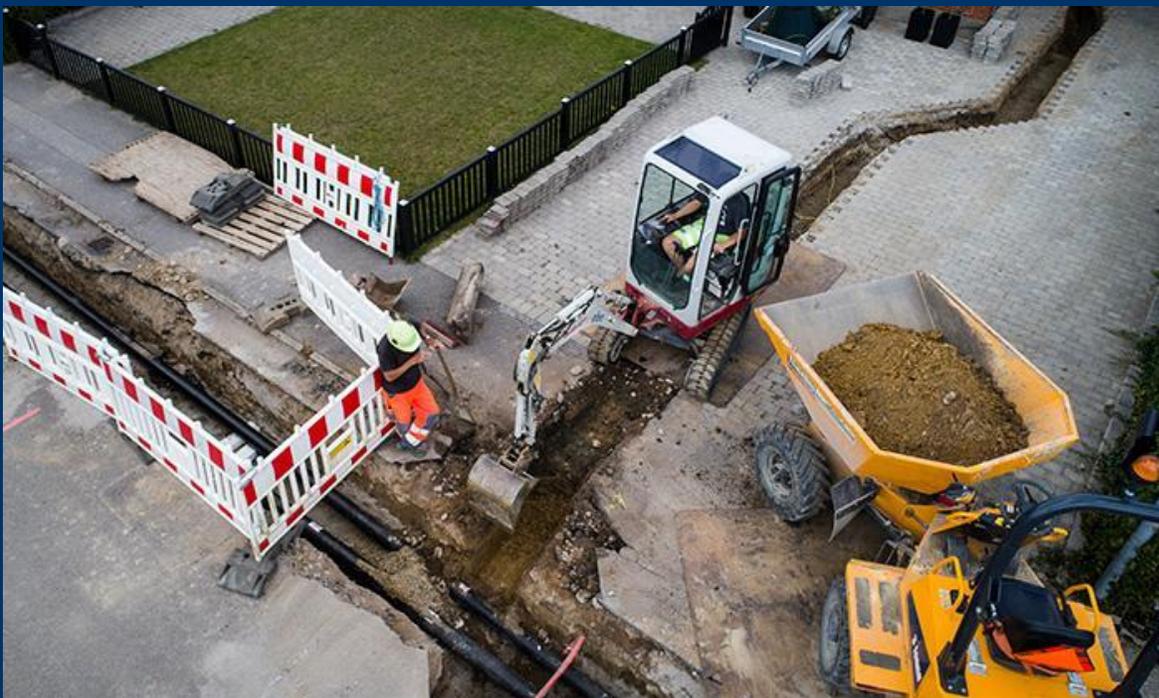
District heating is an underground network of hot water pipes connecting buildings to a central energy facility. For low carbon systems, biomass is the most common fuel choice.



# Transmission Pipes



# Distribution Pipes





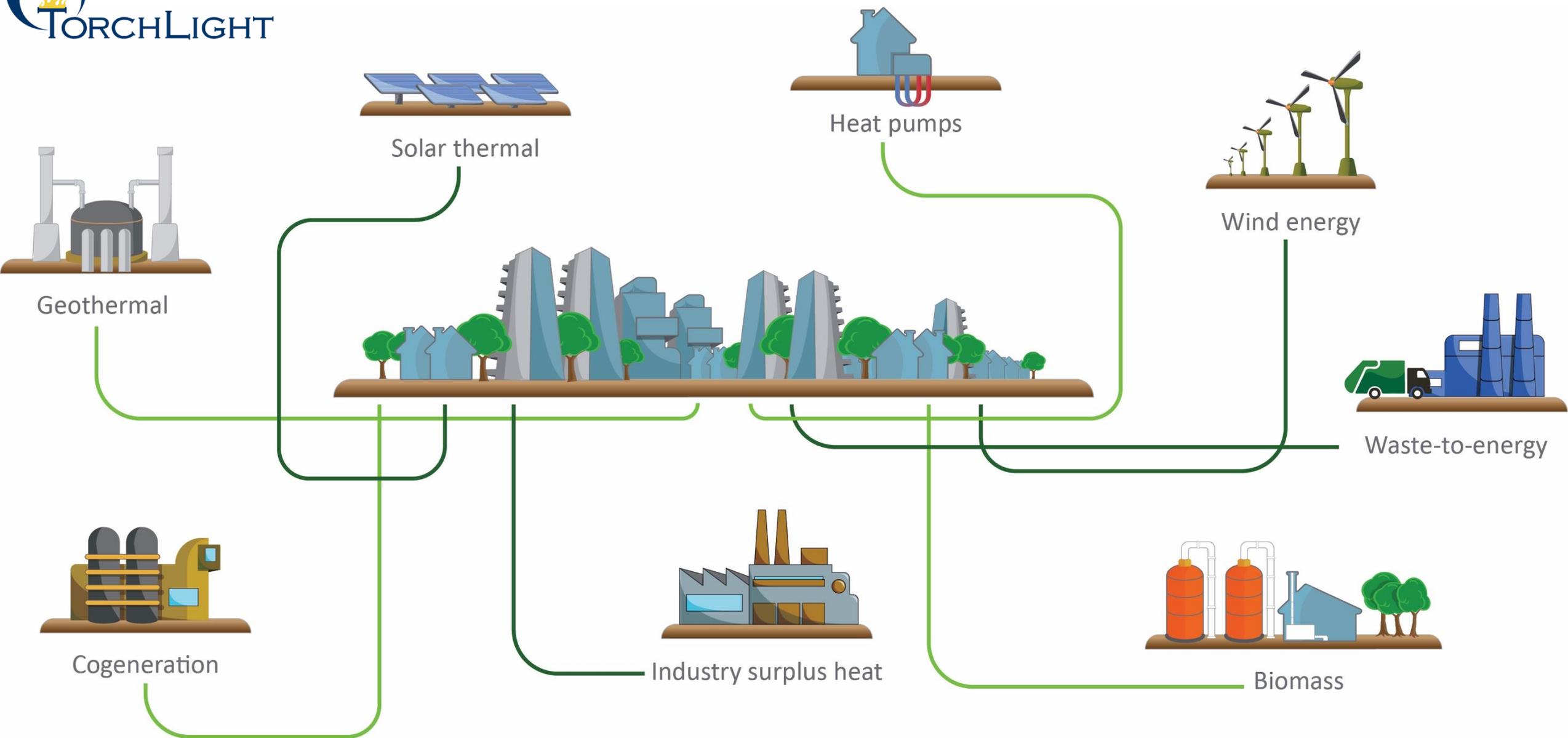


# Heat Transfer/Interface Unit

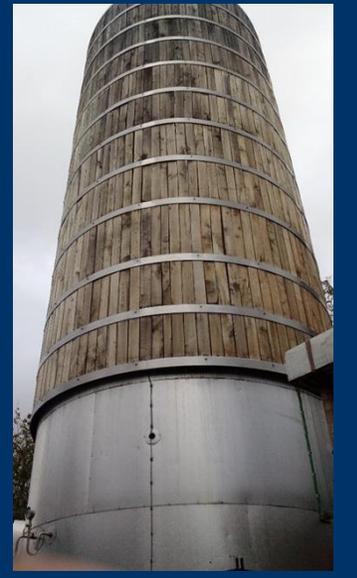


# Heat Transfer/Interface Unit

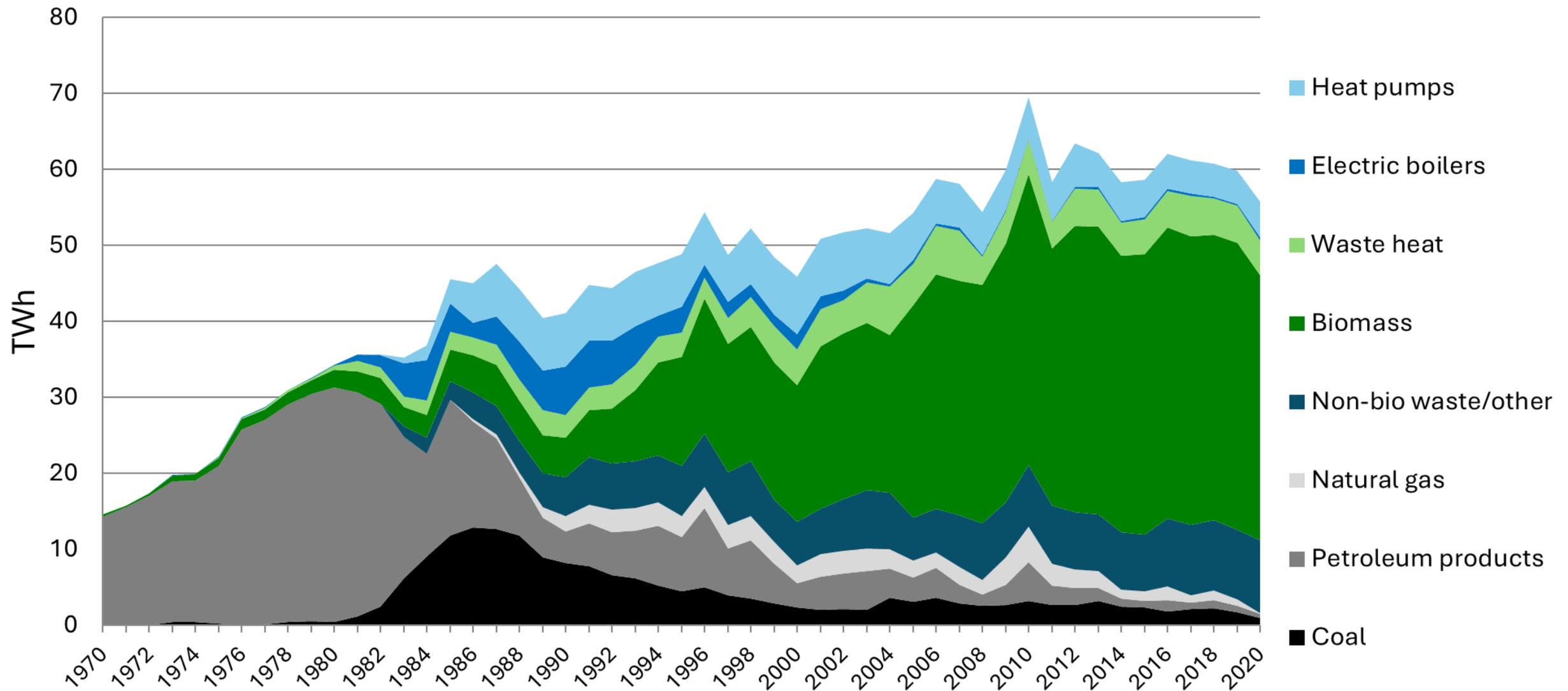




# Thermal Energy Storage



# Sweden District Energy by Fuel



# Arctic District Heating Examples

# Svalbard



# Longyearbyen, Svalbard



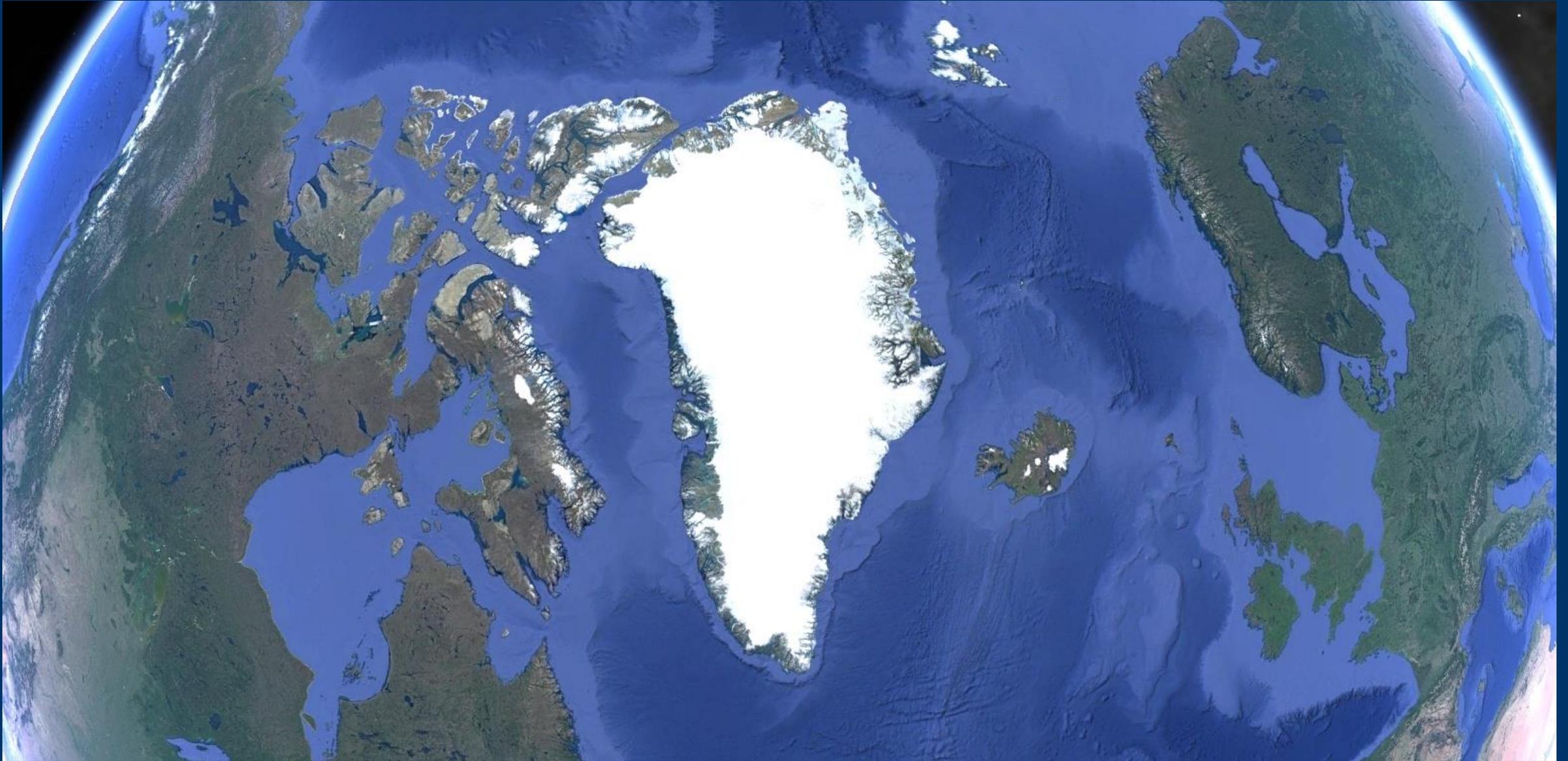
# Longyearbyen, Svalbard



# Svalbard District Heating

- Main community is Longyearbyen (1,750 residents)
- Community-wide, above ground district heating system
- Coal-fired combined heat and power plant (8 MW<sub>e</sub>/20 MW<sub>th</sub>)
- Current plant constructed in 1982, coal is local fuel
- 100 years of coal providing heat and power
- Coal use ended in 2025 to meet Norway's coal transition goals
- C\$30 M CapEx to switch to diesel
- Diesel supposed to be stopgap before renewables
- Must purchase diesel on open market – much higher cost

# Greenland



# Greenland

- 16 district heating systems, 23 district heating plants
- State energy company: Nukissiorfiit
- Heat recovery from diesel generators, oil boilers, electric boilers, waste-to-energy
- Combination with hydropower to address seasonality
- New combined heat and power waste-to-energy plants built in Nuuk and Sisimiut
  - Both 8.2 MW<sub>th</sub>; Nuuk has ORC (350 kW<sub>e</sub>)
  - Almost all heat for Sisimiut, 10% for Nuuk
- Waste is negative cost fuel
- WtE: Huge environmental & cost benefits
- Good marine infrastructure (unlike Canada)



# Ilulissat, Greenland



- Population of ~4,700
- 22.5 MW<sub>e</sub> hydropower plant **BUT** heat distributed by DH network

# Nanortalik, Greenland

- Population of ~1,100
- District heating supply: diesel generator heat recovery + oil
- No hydropower
- Potential for wood pellets?



Stay Tuned!

Lessons from Two Projects

*Inuvik, NT & New Glasgow, NS*

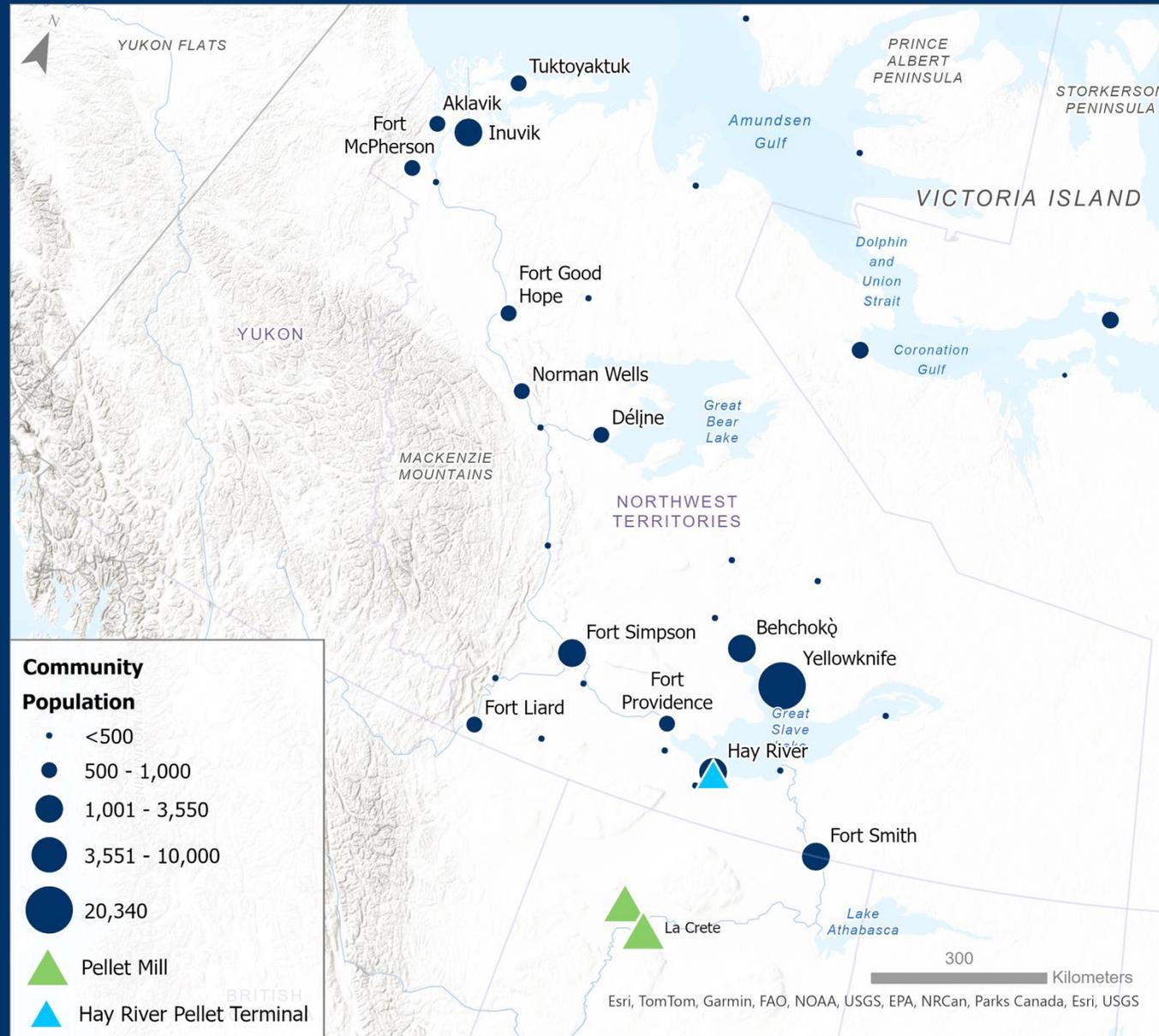
# Arctic Pellet Network

*Leveraging Existing Arctic District Heating Infrastructure and Canadian Ports*

# Concept

- Three primary pellet supply chains to deliver pellets from southern producers
- Pellets could be used in CHP & heat-only boilers connected to existing/new DH systems
- Pellets could be used in individual buildings/homes (boilers, stoves)
- Displacing oil and diesel
- Considerations:
  - Pellets have higher bulk density than diesel or heavy oil; transport cost high
  - Greater storage (volume) capacity required per unit energy
  - Pellets can be handled by hand for residential consumers (e.g., bags)
  - Standard shipping containers can be used for storage
  - Pellet vs. diesel spills – no comparison

# Great Slave Lake/Mackenzie



# Hudson Bay





# Where to Start?

- Infrastructure is essential!
- Greenland communities, Longyearbyen, and Iqaluit have ports
- Ports allow for delivery of pellets in containers, supersacks
- Potential small-scale bulk delivery?
- Summer sealift, Canadian-style:
  - Very difficult and expensive for pellets
  - Many containers needed



# Ilulissat, Greenland



# Greenland Ports



Qasigiannuit

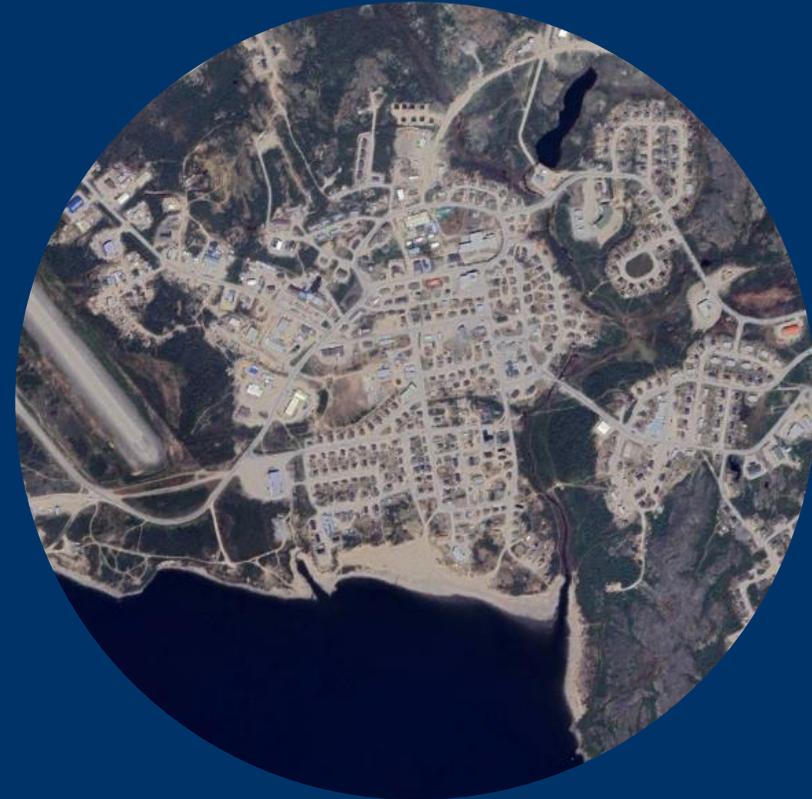


Sisimiut

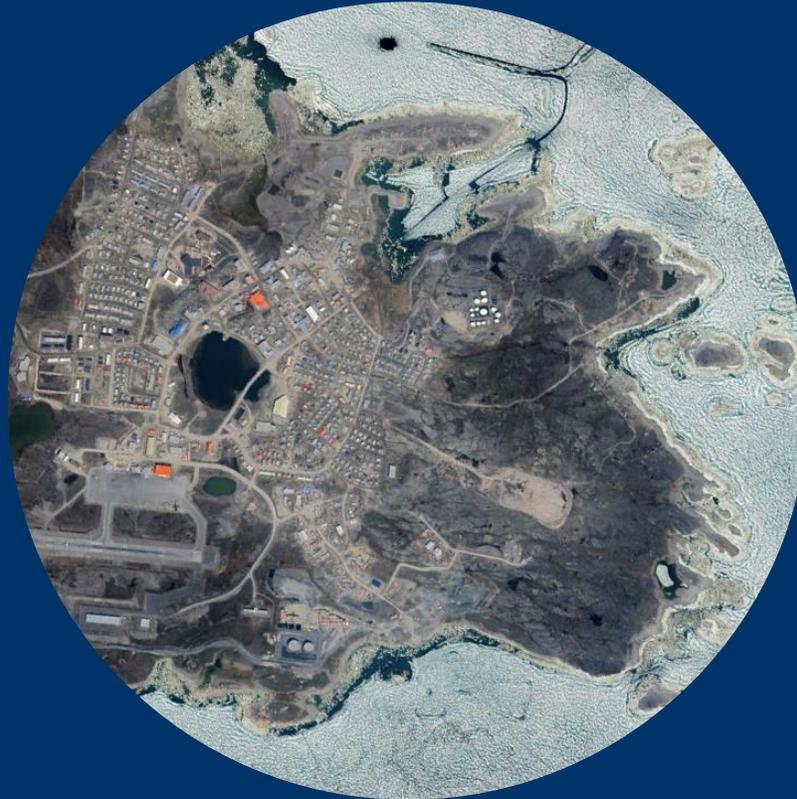


Nuuk

# Canada – No Ports



Kuujuaq, QC  
Pop: 2,900



Rankin Inlet, NU  
Pop: 2,900



Kangiqsujaq, QC  
Pop: 900

# Conclusions

- Arctic district heating is proven and attractive
- District heating enables fuel flexibility and thermal energy storage
- Enables increased penetration of intermittent renewables (e.g., wind)
- Integrate electrical and thermal grids – go beyond small systems (e.g, Iqaluit)
- Wood pellets with CHP can be an economically attractive option
- Big challenge in Eastern Arctic: getting pellets from ship to shore.  
INFRASTRUCTURE!
- Solid waste-to-energy is lowest cost fuel option & deals with waste issues
- Start by shipping pellets to Greenland or Svalbard

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