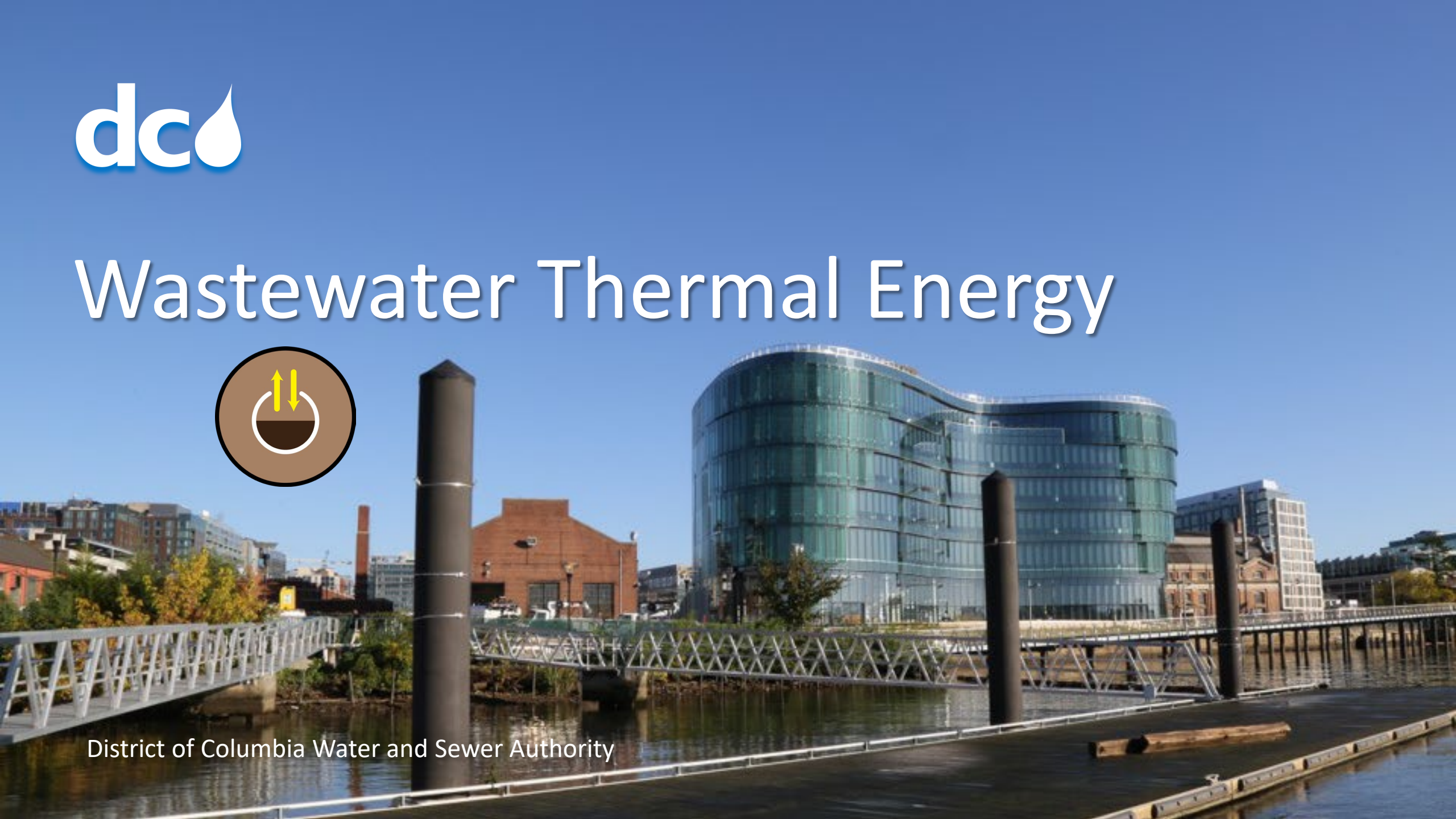
Wastewater Thermal Energy



District of Columbia Water and Sewer Authority

Disclaimer

DC Water is a nonprofit governmental authority that acts in the interests of its ratepayers in the District of Columbia, Maryland, and Virginia.

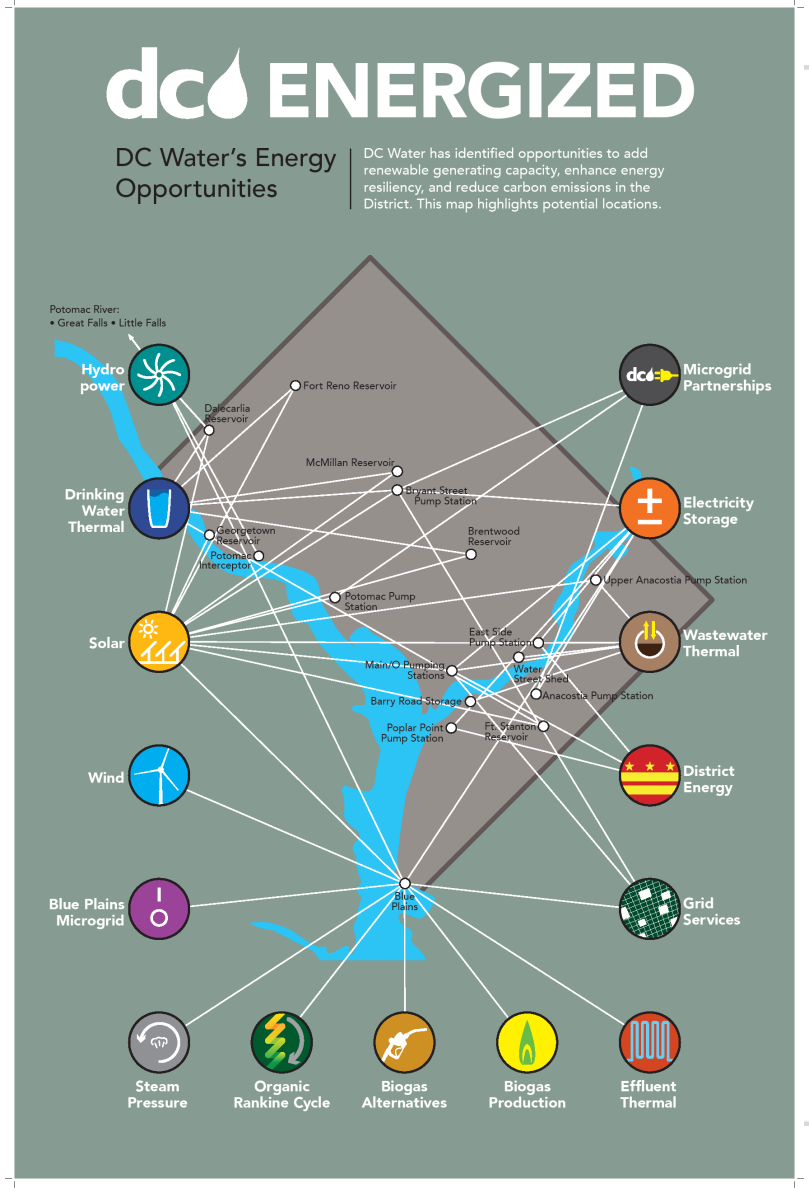
DC Water does not endorse, recommend, or suggest use of any product or purchase from any vendor.

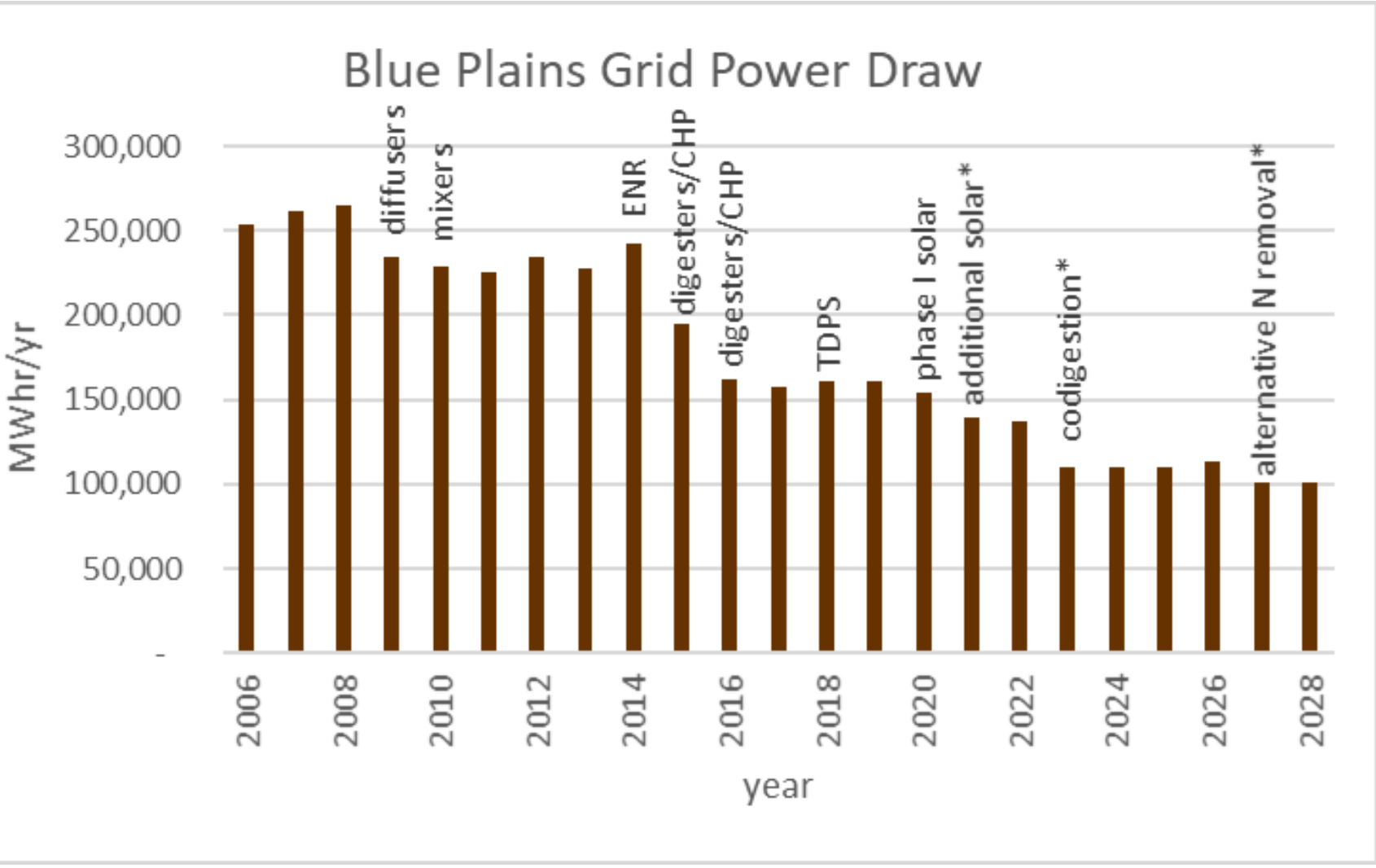
Information presented today reflects DC Water's interest in the concepts of wastewater thermal energy and district energy and their potential value to our ratepayers, and DC Water's analysis and experience to date.

DC Water

- One of nation's largest utilities
  - 1,200 employees
  - $640 million annual operating budget
  - 2.2 million people served
  - 32 MW average power usage
- Drinking water purchased from Washington Aqueduct (USACE)
- Water distribution and wastewater collection for District of Columbia
- Wastewater treatment for DC region
- Independent, nonprofit governmental Authority – Act of Congress 1996
- Excellent performance record

DC Water Energized



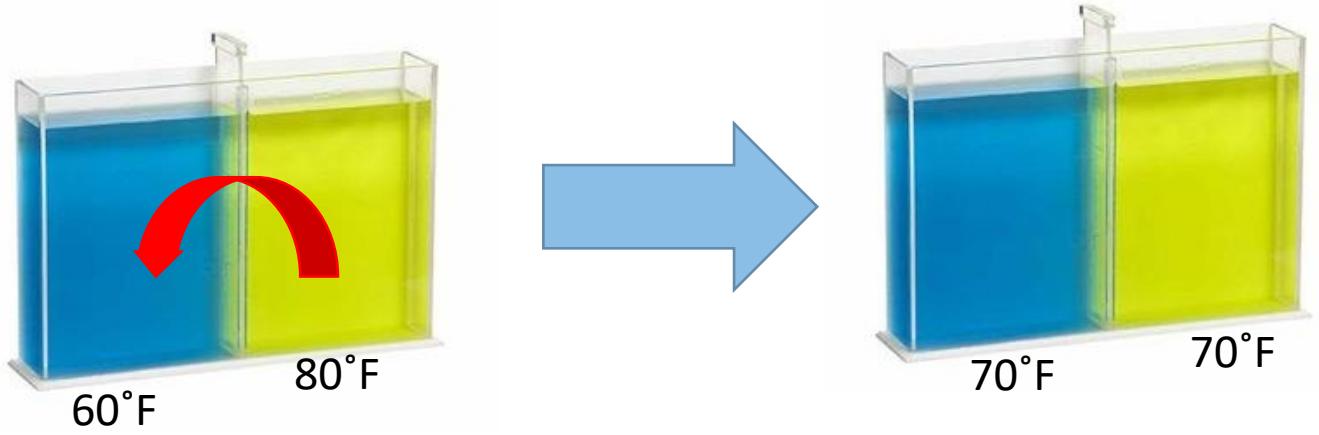


Why Wastewater Thermal?

1. Generate Revenue

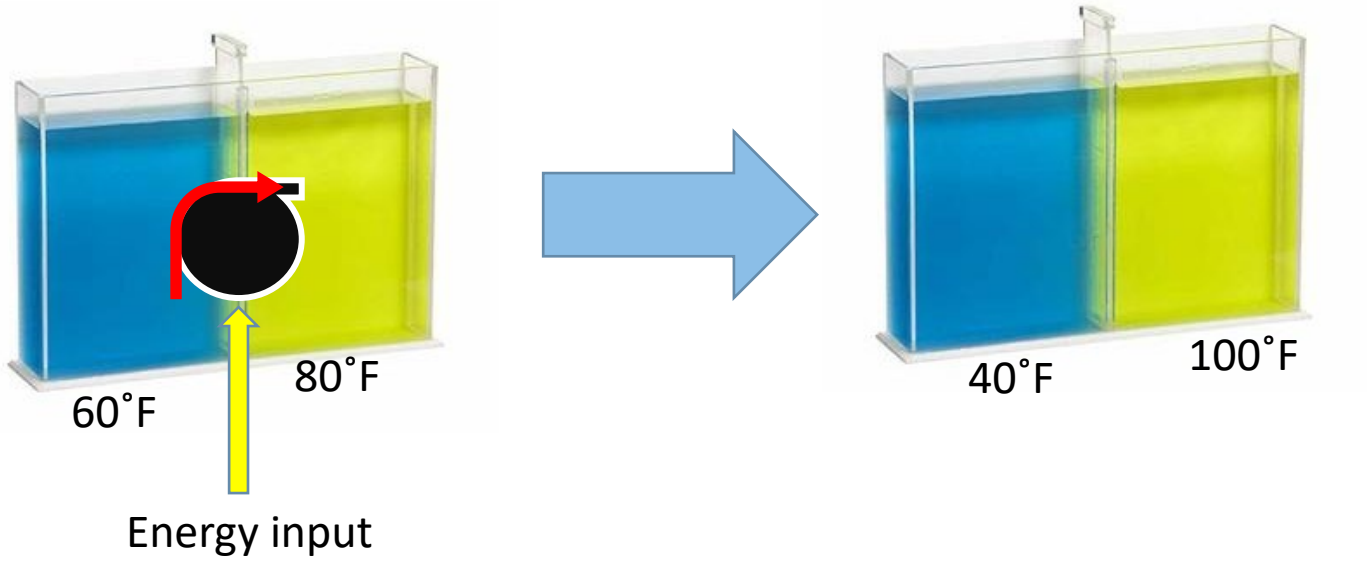
$

Thermodynamics and Heat Pumps



Final temperature depends on:

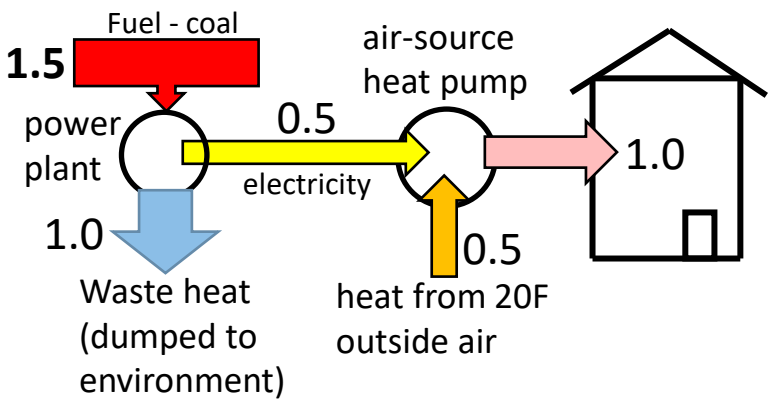
- Type of liquid (heat capacity)
- Volume in each chamber
- Initial temperature

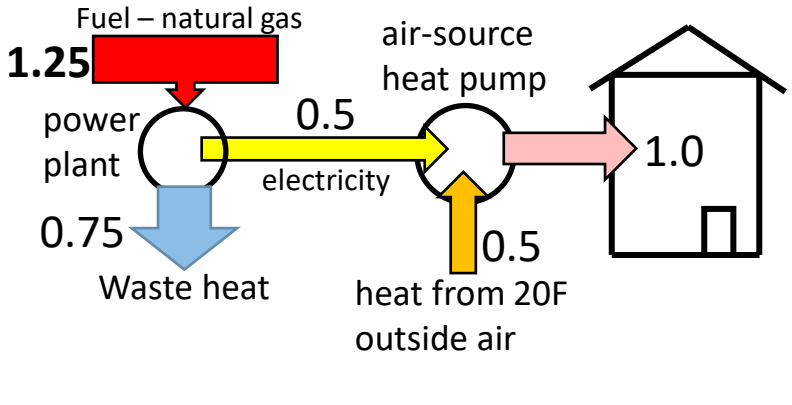


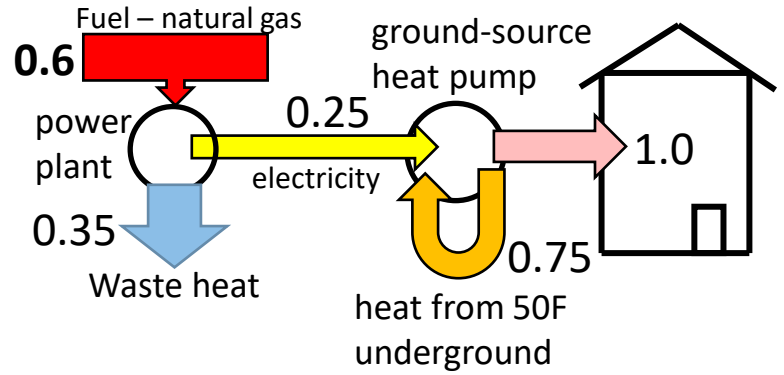
Energy input required depends on:

- Type of liquid
- Volume in second chamber
- Final temperature(s)
- Difference in initial temperatures

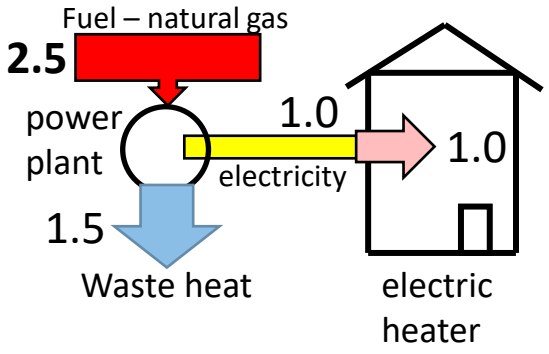
Efficiency of Heat Pumps

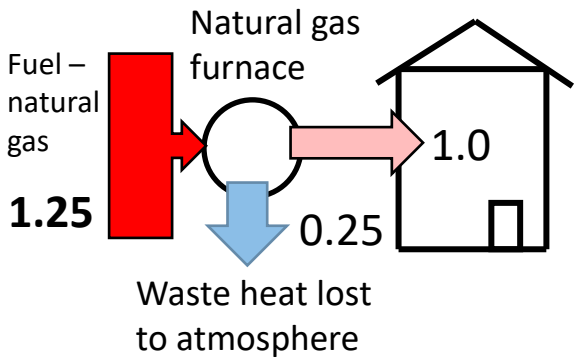


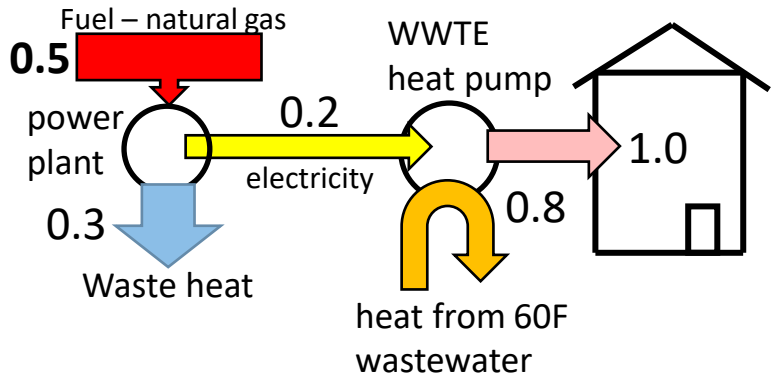




How much fuel is needed to deliver 1 unit of heat to a building?







Potential Benefits

Economic

- No furnace, no cooling tower
- High efficiency heat transfer: COP up to 8
- Operational savings of up to 80%

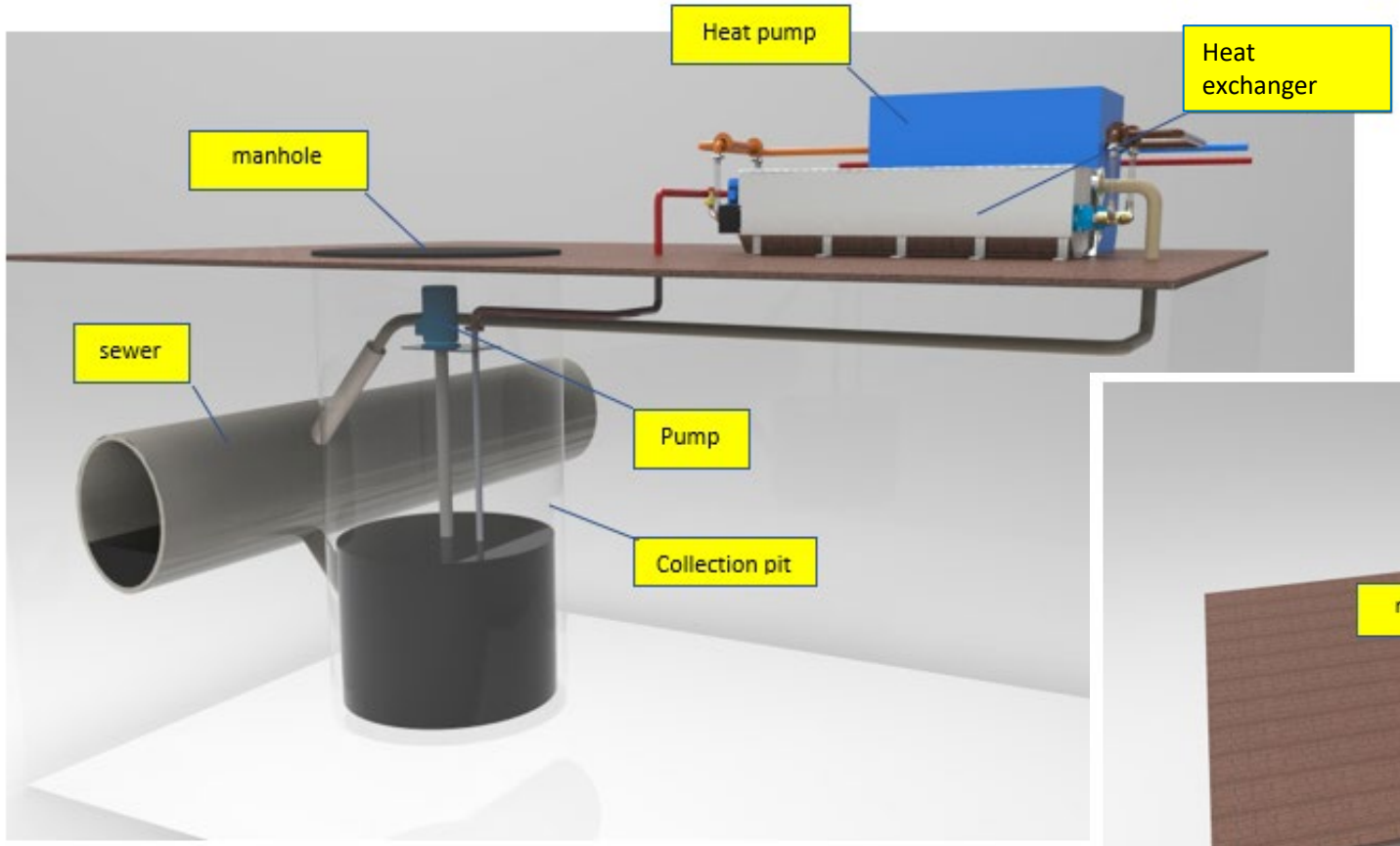
Environmental

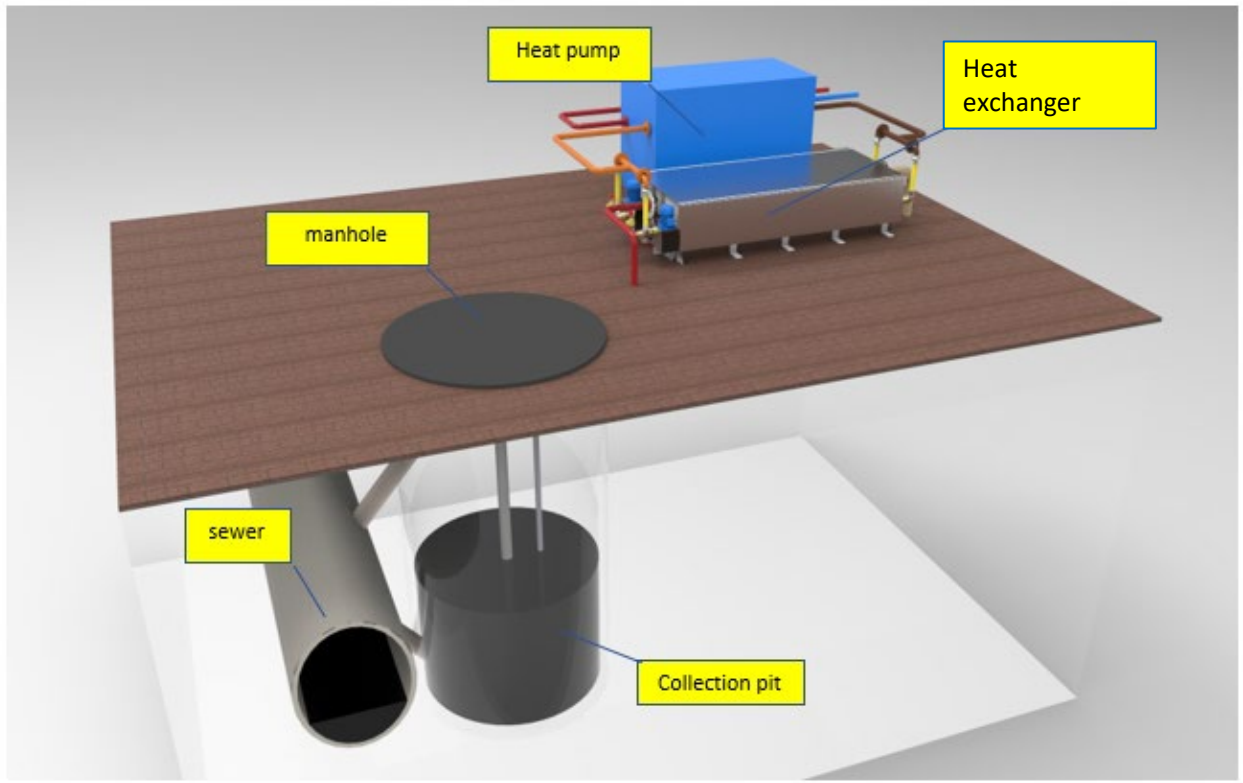
- Reduced energy consumption
- Switch from direct-fossil-fired to electric grid for heat
- Eliminates consumptive fresh water use for cooling

Development

- Rooftop space: extra apartments, pool, etc.
- Simplified maintenance

How It Works





Schematic credit: Pozzi Leopoldo srl

Wastewater Thermal Energy – Buildings in Operation

American Geophysical Union

DC Water Headquarters

Photo credits: American Geophysical Union, DC Water

DC Water – AGU Covenant

Attached to Property

- Will survive transfer or sale
- Allows connection to sewer main
- 20 year duration
- Maintenance: all at AGU's cost; DC Water will keep inlet open

DC Water

- Access to sewage
- No redesign of sewage system to reduce flow
- Resumption of flow as fast as possible in event of disruption
- No upstream connections with negative impact

AGU

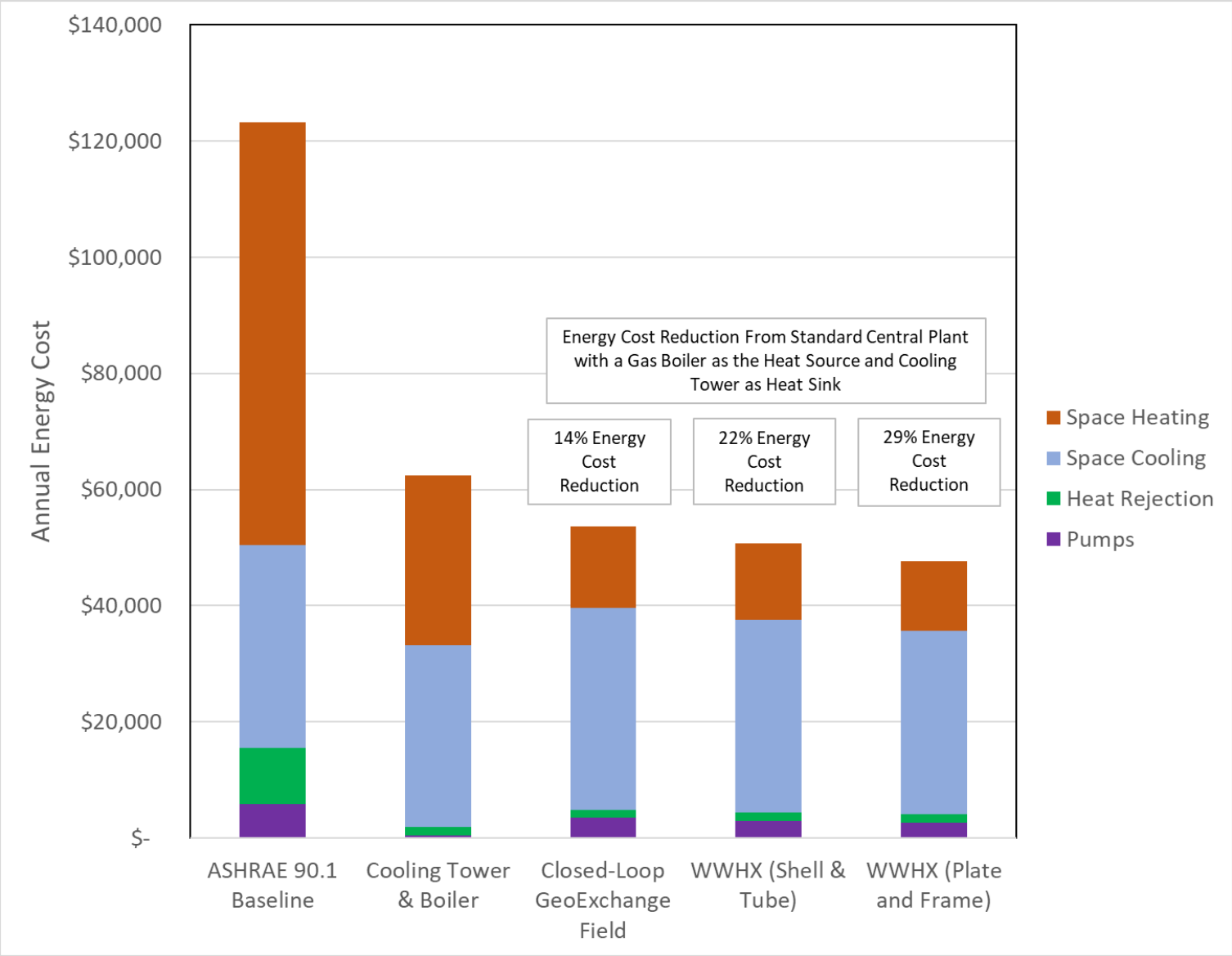
- Submit all design, construction, and operational plans for approval
- Operate system only within parameters submitted
- No inlet or outlet of material (closed system)
- No disruption of flow in main

DC Water Headquarters

- Completed 2018
- Houses admin/public functions of DC Water
- Built on top of sewage pump station
- 150,000 square feet

HQO Efficiency

Design choices cut energy cost in **half** from already energy-efficient code requirements



With wastewater as the heat source/sink, energy cost dropped an **additional 29%**

And- the building could be **fully electrified** even where a geothermal field was impossible

Resource Size

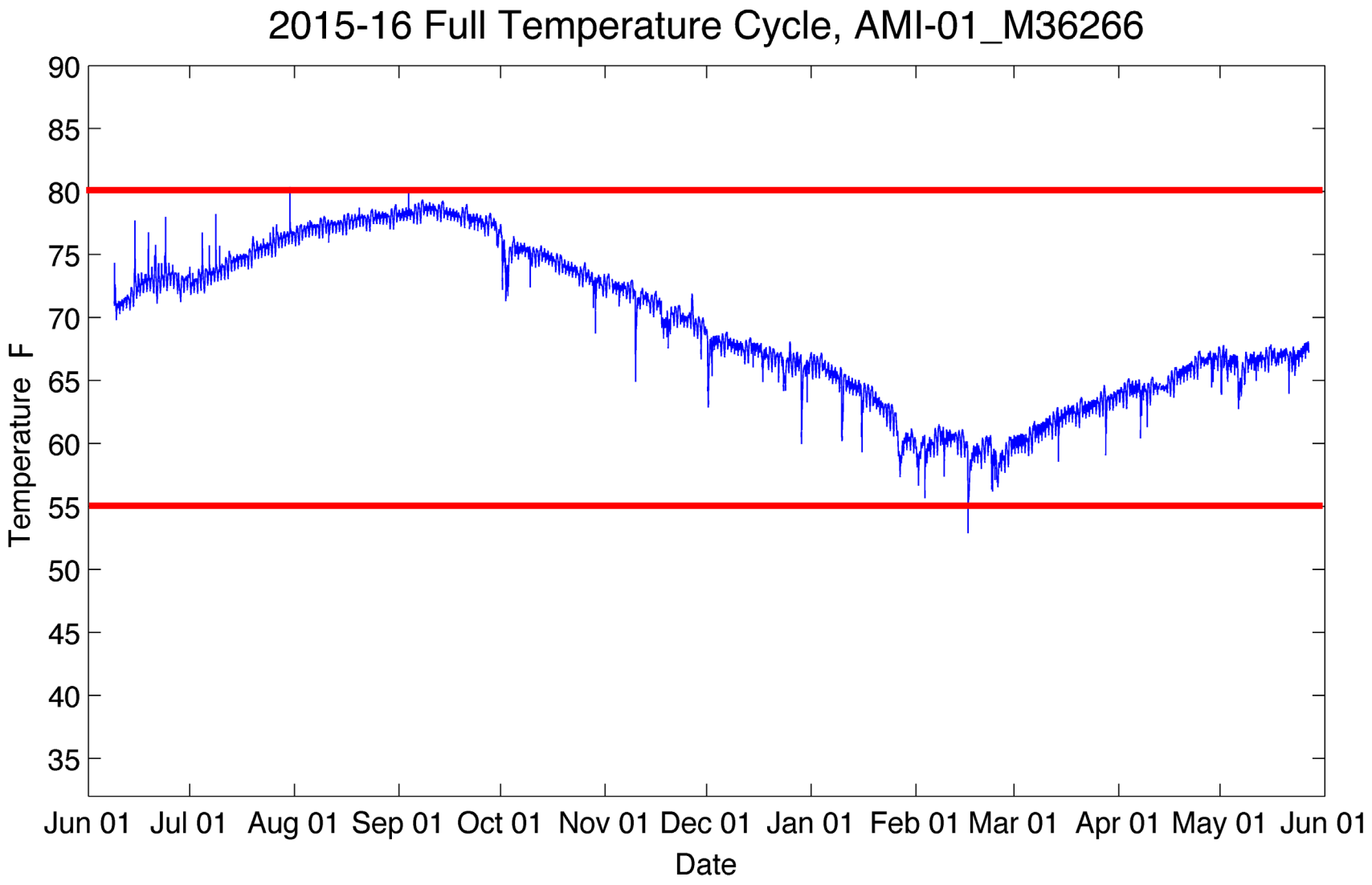
Each 1,000,000 gallons/day yields ~1 MW thermal energy

which equals

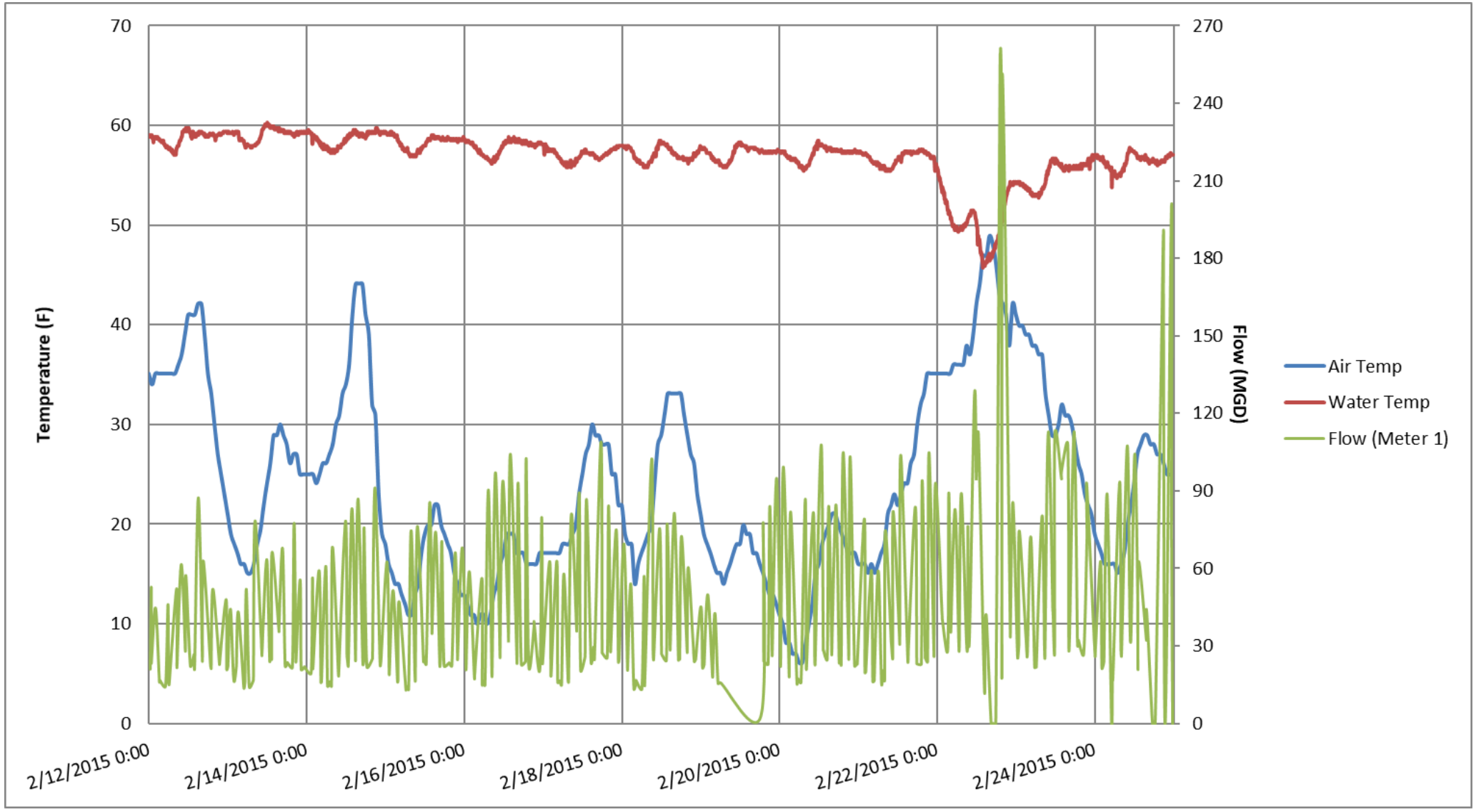
100 MW for each 1,000,000 people

In DC, that's 200 MW, or at least **25,000,000 square feet** of conditioning

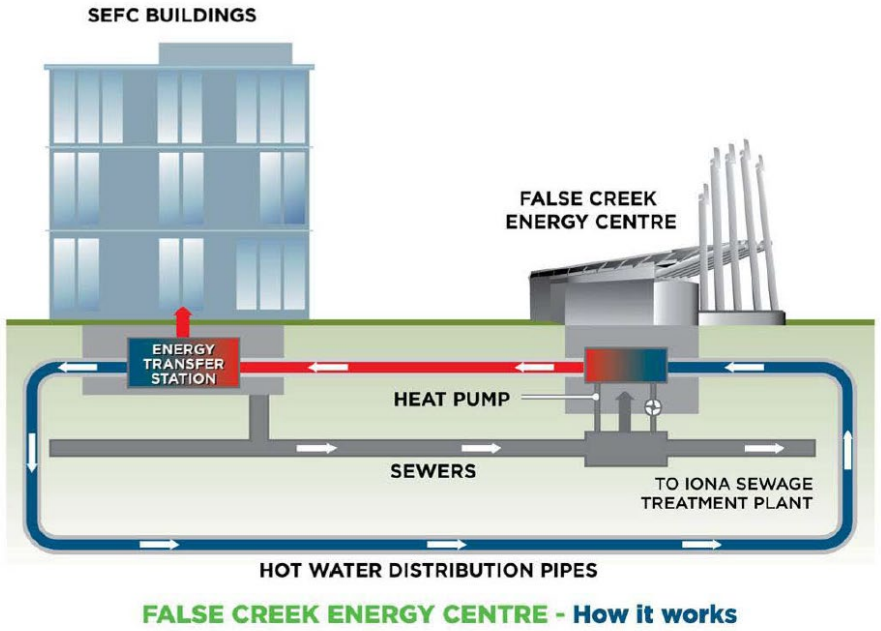
Plus, potentially more energy at the treatment plant – up to 3-4x



Impact of Rain and Snow



District Energy



FALSE CREEK ENERGY CENTRE - How it works

CITY OF VANCOUVER

Advantages of District Energy

- Reduced necessary capacity due to noncoincident peak loads
- Easier integration of thermal storage
- Capture of reverse-season sources (eg, datacenters)
- Shoulder-season thermal circulation
- Easier integration of renewables
- No need to match supply and demand at each point
- Professional operators
- Professional maintenance
- Reduced in-building equipment frees space

Organizational Elements

- Who pays for, builds, and owns the central system?
  - DC Water
  - Developer/developer instrument
  - Third-party
- Who operates and maintains the system?
  - DC Water can, but doesn't have to
- What regulations would apply?
- What is the legal relationship between the properties and the system?
- DOEE and PSC views

Wastewater Thermal Energy – To The Future

Valsana Hotel in Arosa, Switzerland uses a combination of wastewater and geothermal for 100% of its heat.

In Denver, a 250-acre development will get 90% of its thermal energy from the sewer underneath.

Maryland made wastewater thermal energy eligible for renewable energy credits in 2021.

SE False Creek, in Vancouver, Canada, is an entire neighborhood heated by wastewater.

King County, Washington is working with private partners to develop WWTE systems.

Photo credits: Valsana and New York Times

Additional Resources and References

- Water Research Foundation 4788: State of the Science and Issues Related to Heat Recovery from Wastewater (2019)
- Water Research Foundation 4843: Integrating Sewage Thermal Energy Use (STEU) and Other Emerging Water-Energy-Waste Technologies into Decentralized/Distributed Systems (2022)
- Denver projects: Jim McQuarrie (Jim.McQuarrie@tetratech.com)
- City of Philadelphia: Paul Kohl (Paul.Kohl@Phila.gov)
- HQO Design: Don Posson (Don.Posson@smithgroup.com)
- RPS Legislation: D.C. Act 21-466 (2016), Maryland HB0561 (2021)
- DC Public Service Commission RFP No. PSC-22-06 (proposals in review)
- International District Energy Association (www.districtenergy.org)

Q&A

Saul Kinter

Business Development Program Manager
Department of Resource Recovery
DC Water
saul.kinter@dcwater.com