Decarbonizing Minnesota’s Natural Gas End Uses

Meeting 5

April 10th, 2020
Via Zoom
AGENDA

9:00  Welcome and Introductions
9:15  Presentation and Q&A: The Promise and Potential of EE in Decarbonizing Minnesota’s Natural Gas End-Uses
10:00 Discussion on Energy Efficiency
10:45 BREAK
11:00 Overview of District Energy Systems in Minnesota
11:05 Presentation and Q&A: The Promise and Potential of Geothermal Technology in Decarbonizing Minnesota’s Natural Gas End-Uses Discussion
11:35 Discussion on Geothermal Technologies
12:00 LUNCH
1:00  Presentation and Q&A: District Energy Systems in Minnesota
1:30  Discussion on Geothermal Technologies
2:30  ADJOURN
Presentation and Q&A: The Promise and Potential of EE in Decarbonizing Minnesota’s Natural Gas End-Uses

Carl Nelson and Jon Blaufuss, Center for Energy and Environment
Decarbonizing Minnesota's Natural Gas End Uses (Meeting #5)

Insights from the 2020-2029 Minnesota Energy Efficiency Potential Study

Date: Friday, April 10, 2020 (9:15 AM – 10:45 AM)
Minnesota Energy Efficiency Potential Study: 2020–2029

Carl Nelson
Director of Program Development
Center for Energy and Environment
cnelson@mncee.org

Jon Blaufuss
Program Coordinator
Center for Energy and Environment
jblaufuss@mncee.org
Today’s Agenda

Background on Potential Study (Carl)
Methodology (Carl)
Results (Jon)
Program & Policy Recommendations (Jon)
Q & A
Background
1980: PUC directed to initiate a pilot to demonstrate the “feasibility” of investments in EE.

1983: Utilities with revenues greater than $50 million were required to operate at least 1 conservation program. Required “significant” investment.

1989: All Public utilities were required to operate conservation improvement programs. Oversight transferred from PUC, low-income requirements added.

1991: A specific level of spending was required (1.5% electric, 0.5% gas) & munis and coops were included.


2010: 1.5% Savings Goal for Utilities takes Effect

2017: Munis and Coops meeting a specific threshold exempted from CIP.
Utility Mix in MN – Natural Gas
MN EE Achievements – Natural Gas
## Cost of Efficiency in MN

<table>
<thead>
<tr>
<th>State</th>
<th>ACEEE Ranking</th>
<th>Electric spending ($/kWh)</th>
<th>Gas spending ($/therm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>1</td>
<td>$0.34</td>
<td>$7.39</td>
</tr>
<tr>
<td>California</td>
<td>2</td>
<td>$0.35</td>
<td>$6.02</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>3</td>
<td>$0.37</td>
<td>$5.89</td>
</tr>
<tr>
<td>Vermont</td>
<td>4</td>
<td>$0.39</td>
<td>$3.68</td>
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<tr>
<td>Oregon</td>
<td>5</td>
<td>$0.29</td>
<td>$3.56</td>
</tr>
<tr>
<td>Connecticut</td>
<td>6</td>
<td>$0.43</td>
<td>$6.17</td>
</tr>
<tr>
<td>Washington</td>
<td>7</td>
<td>$0.21</td>
<td>$3.83</td>
</tr>
<tr>
<td>New York</td>
<td>7</td>
<td>$0.27</td>
<td>$5.12</td>
</tr>
<tr>
<td>Minnesota</td>
<td>9</td>
<td>$0.19</td>
<td>$1.76</td>
</tr>
<tr>
<td>Maryland</td>
<td>10</td>
<td>$0.33</td>
<td>$9.88</td>
</tr>
</tbody>
</table>
Goals of Study

• Estimate statewide electric and natural gas energy efficiency for 2020-2029
• Produce actionable resources
• Engage stakeholders
Methodology
Types of Energy Efficiency Potential

- **Maximum Achievable**: Subset that is achievable considering market barriers, given the aggressive incentives and idealized programs
  - Rebates set at 100%
  - Technology adoption at theoretical maximum

- **Program Potential**: Subset of achievable, given constrained incentives (50%) and program budgets
High Level Methodology Overview

INPUTS
- Sales, demographics, end-use data
- Measure attributes: costs, savings, load shapes
- Avoided costs: energy, capacity, transmission & distribution, emissions
- Market barriers, technology adoption trends

STEP 1
- Forecast and disaggregate the baseline energy load

STEP 2
- Characterize the efficiency measures

STEP 3
- Screen measures for cost-effectiveness

STEP 4
- Estimate program budgets and measure penetrations

STEP 5
- Calculate total savings and net benefits

OUTPUTS
- Technical potential
- Economical potential
- Program potential
- Total savings, costs and benefits
Societal Cost Test Used for Screening

Utility Cost Test
- Value of avoided energy & capacity
- Cost of incentives & program administration

Societal Cost Test
- Value of avoided emissions
- Customer cost to install efficiency measures
Results
Results – Gas Utilities
Results – Gas Incremental by Year

- Max Achievable
- Program
Results – Gas Potential by End Use

Cumulative annual 2029 savings

Program potential scenario
## Results – Gas Top Five Residential Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cumulative 2029 Energy Savings (Dth, thousands)</th>
<th>Percent of Total Residential Energy Savings Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensing furnace</td>
<td>5,200</td>
<td>28%</td>
</tr>
<tr>
<td>Tier 1-3 thermostat</td>
<td>4,600</td>
<td>25%</td>
</tr>
<tr>
<td>Attic insulation &amp; air sealing</td>
<td>2,300</td>
<td>12%</td>
</tr>
<tr>
<td>Boiler</td>
<td>1,900</td>
<td>10%</td>
</tr>
<tr>
<td>Aerosol envelope sealing</td>
<td>1,100</td>
<td>6%</td>
</tr>
</tbody>
</table>
### Results – Gas Top Five Commercial Measures

<table>
<thead>
<tr>
<th>Energy recovery ventilator</th>
<th>Demand control ventilation</th>
<th>Boilers</th>
<th>Condensing furnaces</th>
<th>Smart thermostat</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Energy recovery ventilator" /></td>
<td><img src="image2.png" alt="Demand control ventilation" /></td>
<td><img src="image3.png" alt="Boilers" /></td>
<td><img src="image4.png" alt="Condensing furnaces" /></td>
<td><img src="image5.png" alt="Smart thermostat" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cumulative 2029 energy savings (Dth, thousands)</th>
<th>3,600</th>
<th>2,900</th>
<th>2,600</th>
<th>2,500</th>
<th>2,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of total commercial energy savings potential</td>
<td>16%</td>
<td>13%</td>
<td>12%</td>
<td>11%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Results – Gas Potential by Segment

Cumulative Savings, % of Total, 2029
Program Findings and Recommendations
Current MN Utility Program Findings

Minnesota has a strong foundation of effective CIP programs

• Minnesota currently has some of the lowest cost and best performing programs in the country

• Utilities in Minnesota – both IOUs and COUs – have been proactive in designing and implementing comprehensive, effective, and innovative program models

Partnerships have helped increase program effectiveness

• Deep relationships with trade allies have helped utilities deliver programs

• Smaller utilities face additional challenges in implementing programs, but the most successful COU programs involve cooperation among utilities

• Some utilities have achieved enhanced performance through joint natural gas-electric programs
Sources of Natural Gas Potential

- Residential: 40% (Space Heating 85%, Water Heating 11%, System Efficiency 4%)
- Commercial & Industrial: 60% (Space Heating 65%, System Efficiency 17%, Process Heating 13%, Cooking 3%, Other 1%, Water Heating 1%)

The majority of natural gas potential is currently used for space heating in the residential sector, while the commercial and industrial sectors utilize it for space heating, system efficiency, process heating, cooking, and other purposes, with system efficiency being a significant contributor in both sectors.
Smart Thermostats Grow in Importance

Measure categories within gas space heating end use
Program Recommendations

Recommendations for Utility Programs:

• Continue to test promising new approaches.

• Offer comprehensive program designs for larger and harder-to-reach customers.

• Develop upstream incentives and associated program support in selected markets.

• Incorporate operational savings into commercial and industrial programs.

• Employ segment-specific strategies to reach customers.

• Deepen trade ally engagement and training efforts.

• Incorporate AMI-enabled capabilities into programmatic strategies.

• Leverage interest by local governments in energy efficiency.

Coordination among Utilities:

• More systematically share best practices and program successes.

• Coordinate more closely on trade ally outreach and training.

• Work further towards coordinated and/or joint implementation of programs.
## Workforce Impacts

### Jobs supported

<table>
<thead>
<tr>
<th>Direct job type</th>
<th>Expected job-years</th>
<th>% of total job-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC technicians</td>
<td>10,500</td>
<td>21%</td>
</tr>
<tr>
<td>Electricians</td>
<td>5,100</td>
<td>10%</td>
</tr>
<tr>
<td>Insulation installers</td>
<td>2,200</td>
<td>5%</td>
</tr>
<tr>
<td>Mechanical engineers</td>
<td>2,100</td>
<td>4%</td>
</tr>
<tr>
<td>Architects</td>
<td>2,000</td>
<td>4%</td>
</tr>
<tr>
<td>Plumbers, pipefitters</td>
<td>1,800</td>
<td>4%</td>
</tr>
<tr>
<td>Retail salespersons</td>
<td>1,400</td>
<td>3%</td>
</tr>
<tr>
<td>Weatherization technicians</td>
<td>1,100</td>
<td>2%</td>
</tr>
<tr>
<td>Stationary engineers and boiler operators</td>
<td>700</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>3,500</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Total direct job-years</strong></td>
<td><strong>30,400</strong></td>
<td><strong>62%</strong></td>
</tr>
<tr>
<td><strong>Indirect job-years</strong></td>
<td><strong>18,900</strong></td>
<td><strong>38%</strong></td>
</tr>
<tr>
<td><strong>TOTAL JOB-YEARS</strong></td>
<td><strong>49,300</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

$6,657,000,000

2020-2029 incremental costs of MN utility-driven energy efficiency investments under program achievable scenario
Website: www.mncee.org/mnpotentialstudy/home/
Study Appendices

A) Methodology and Data Sources
B) Detailed Model Results
C) Energy Efficiency Measures
D) Behavioral Measures and Approaches
E) Load Management and Demand-Response
F) Low-Income Sector Market Study
G) Rural Utility and Agriculture Sector Market Study
H) Small Commercial Market Sector Study
I) Energy Efficiency Program Benchmarking Report
J) Residential Buildings Primary Data Collection Report
J-2) Residential phone survey data and statistics workbook

K) Commercial Large Buildings Primary Data Collection Report
L) Trade Ally Survey Report
L-2) Trade Ally Survey Interview Scripts
M) Minnesota HVAC Sales Data Report
N) Advisory Committee Membership and Policy Comments
O) Review of Past Minnesota Energy Efficiency Potential Studies
P) Analysis of Workforce Impacts of Modeled Energy Efficiency Programs
Utility Reporting Tools

The utility reporting tool enables results of the potential study to be examined in more granular detail, including by:

- Individual utility (Both electric and natural gas)
- Building segment
- End use
- Measure

Website: https://www.mncee.org/mnpotentialstudy/reporting-tools/
Questions?

Minnesota Energy Efficiency Potential Study: 2020–2029

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Presentation and Q&A: The Promise and Potential of Geothermal Technology in Decarbonizing Minnesota’s Natural Gas End-Uses Discussion

Audrey Schulman and Zeyneb Magavi, Home Energy Efficiency Team
The GeoMicroDistrict

A Novel Path to Building Electrification

Putnam Foundation

Barr Foundation
To cut carbon emissions NOW by driving systems change.
Unrepaired Natural Gas Leaks
Worcester, MA
Next 5 years of pipe replacement work plans (utility reported)
Cost: $100,000
4 Homes
➢ Don’t work everywhere
➢ Large burden on electric grid, especially during winter
➢ Inequity of access
➢ Requires collapse of gas industry
Design Principles

➢ Safe
➢ Renewable & Resilient & Reliable
➢ Low cost for consumers
➢ Workers keep their jobs
➢ Minimal legislative & regulatory change
➢ Equitable & Scalable & Adaptable
The GeoMicroDistrict

Service to Customer

Thermal Loop

Vertical Borehole Array
Ground Source Heat Pump
Feasibility Study

Prototype street segments created

Low density residential

Medium density residential

Medium density mixed-use

High density mixed-use
Annual Heating & Cooling Loads

- Low Density Residential: 81% Heating, 19% Cooling
- Medium Density Residential: 75% Heating, 25% Cooling
- Medium Density Mixed-Use: 42% Heating, 58% Cooling
- High Density Mixed-Use: 52% Heating, 48% Cooling
Technical Feasibility per Street Segment

The ability to meet energy demand through boreholes in the street only

- Low Density Residential: 100%
- Medium Density Residential: 92%
- Medium Density Mixed-Use: 100%
- High Density Mixed-Use: 34%
Comparison of Energy Prices

Source: BuroHappold analysis; U.S. EIA
Annual Greenhouse Gas Emissions

- Existing
- GeoMicroDistrict in 2020
- GeoMicroDistrict in 2050
The HEET Grid
The Towerside Project

Photo: Towersidemsp.org
Just water is in the pipe.
Efficiency: Economies of Scale
Efficiency:
Energy Diversity
Borehole Thermal Energy Storage (BTES)

15°
### CASE STUDY

**2006**
- 3,500 students
- 6 new buildings planned
- Installed first geothermal shared loop

**2019**
- 4X the students
- 3x the buildings
- Geo loop connects 16 buildings
- Expansion continues

Courtesy of The GreyEdge Group® & IGSHPA
Before:

• ~ 3,400 tons
• 14.5mm gallons/yr
• 784 kW

After:

• 750 tons
• 4.5mm gallons/yr
• 185 kW

Courtesy of The GreyEdge Group© & IGSHPA
Thermal Management: Bonuses!

Prewarmed Irrigation Water

Melted Snow on Sidewalks

Courtesy of The GreyEdge Group® & IGSHPA
Energy & Money Savings

System cost (post rebates): $8 Million

Energy savings: $1 Million/yr

Courtesy of The GreyEdge Group© & IGSHPA
Eversource Gas President announcing GeoMicroDistrict Pilots in MA.
Research & Evaluation Team

- MIT Sloan School, System Dynamics
- Harvard T.H. Chan School of Public Health, C-CHANGE Institute
- BuroHappold Engineering
- Massachusetts DEP (Department of Environmental Protection)
- Berkeley National Lab, Earth and Environmental Science
- University of California, Berkeley, Civil & Environmental Engineering
- National Renewable Energy Laboratories
- Massachusetts CEC (Clean Energy Center)
- The Grey Edge Group
Taste the Future

and transition to a clean energy home
The F.U.T.U.R.E. Act (H.2849/S.1940)

An Act For a Utility Transition to Using Renewable Energy

- Gas Companies permitted to bill for BTUs
- Permits utility-scale renewable thermal
- Limits gas pipe depreciation past 2050
- Creates Renewable Thermal Credit Market
- Path to 100% Renewable Thermal by 2050
What can Minnesota do?

➢ Create a path to renewable thermal for gas distribution utilities
➢ Move away from investment in new gas infrastructure
➢ Redirect investment to thermal resource infrastructure
➢ Map your thermal wealth (available sources and sinks)
➢ Pilot GeoMicroDistricts in strategic locations to seed expansion
GeoMicroDistrict by HEET is licensed under a Creative Commons Attribution 4.0 International License.
"Go. Evolve. Don't worry about us."
Problems with Gas
Problems with Gas
Heat pumps aren’t new technology.

They contain fluid that works like a sponge for heat.

When they expand, they absorb heat.

When compressed they “reject” heat.
Annual Heating & Cooling Loads

- Low Density Residential: 81% Heating, 19% Cooling
- Medium Density Residential: 75% Heating, 25% Cooling
- Medium Density Mixed-Use: 42% Heating, 58% Cooling
- High Density Mixed-Use: 52% Heating, 48% Cooling
Heat Exchange
Connects to your existing system

Heat exchanger → Water pump → Radiator

Heat exchanger → Air handler → Vent
Temperature Control
Site Selection Strategy

Expansion Sites

Potential site
Installation Begins

18” HDPE single pipe carries ambient temperature water around the campus.

Distributed mechanical rooms creates resilience: redundant pumping.

Courtesy of The GreyEdge Group® & IGSHPA
Other Possibilities

2008 Olympic Media Center, Qingdao, China

- 600 refrigeration tons
- Heat pumps
- Energy source: seawater (mechanicals under dock)
Lotte Tower, Korea

- Briefly the tallest building in the world
- 123-story mixed-use building
- 1,100 boreholes under building footprint, 600 feet deep
- Waste energy from municipal and waste water
- > 70% of total thermal load
Other Possibilities:

Drilling Technology for Tight Spaces

Drill rig < 6’ tall

Drills holes 600’ deep

Waste Disposal

Courtesy of The GreyEdge Group© & IGSHPA
‘Taste the Future’ Events
My Future Ready Wish List

- Heat/AC
  - Cold-temperature Heat Pump. Model: __________________________
- Hot Water
- Cooking
  - Induction Range. Model: ________________________________
- Dryer
  - Electric Dryer (Heat Pump). Model: __________________________
- Fireplace
  - Wood or electric insert. Model: ______________________________

Remember the terms “Heat Pump” and “Induction” are your secrets to efficiency.
<table>
<thead>
<tr>
<th>Time</th>
<th>Agenda Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
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<td>Minnesota’s Natural Gas End-Uses</td>
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<tr>
<td>10:00</td>
<td>Discussion on Energy Efficiency</td>
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<td>10:45</td>
<td>BREAK</td>
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<tr>
<td>11:00</td>
<td>Overview of District Energy Systems in Minnesota</td>
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<tr>
<td>11:05</td>
<td>Presentation and Q&amp;A: The Promise and Potential of Geothermal Technology</td>
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<td>Discussion on Geothermal Technologies</td>
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<td>1:05</td>
<td>Presentation and Q&amp;A: District Energy Systems in Minnesota</td>
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<td>1:30</td>
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</tr>
<tr>
<td>2:30</td>
<td>ADJOURN</td>
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</table>
Presentation and Q&A: District Energy Systems in Minnesota

Nina Axelson, Ever-Green Energy
District Energy Decarbonization Trends
Emerging Opportunities for Geoexchange and Beneficial Electrification

Nina Axelson
VP, Sustainability and Outreach
nina.axelson@ever-greenenergy.com
Community Scale Energy Systems

Underground network of pipes aggregate heating and cooling needs

Aggregated thermal loads allows application of technologies and fuels not feasible for individual buildings

Increases fuel flexibility, rate stability, and reliability
Integration & Renewables

Carbon/GHG Reduction

Source: Aalborg University and Danfoss District Energy, 2014
Renewable Thermal

Geoexchange Systems Utilizing Geothermal, Sewer, Solar, and Storage
Geothermal District Systems

Closed Loop Systems

Horizontal

Vertical

Pond/Lake

Underground pipes circulate liquid that is heated or cooled by the earth. The liquid is then transferred via an exchanger to heat or cool the structure.

Source: SaveOnEnergy.com
Drake Landing Solar Community in Alberta, Canada
Detached garages with solar collectors on the roofs

Solar collector loop

Energy Centre with short-term thermal storage tanks (STTS)

District heating loop (below grade) connects to homes in community

Borehole seasonal thermal storage (long-term) (BTES)

Two-story single-family homes
Sapperton District Energy System – Sewer Exchange (British Columbia, Canada)
False Creek Energy Centre in Vancouver, BC, Canada
Modernizing and Decarbonizing Existing Systems
District Energy St. Paul

35% CO2 reduction between 2005 and 2018
70% anticipated after coal retirement
(2019 and 2020 data pending)
Oberlin College

**Carbon Dioxide Emissions**
*(As Metric Tons CO2)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric</th>
<th>Natural Gas Other</th>
<th>Natural Gas Central Plant</th>
<th>Coal</th>
<th>Total CO2</th>
<th>2007 Baseline</th>
<th>% Reduction (2007 Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>20,720</td>
<td>4,693</td>
<td>710</td>
<td>18,570</td>
<td>44,693</td>
<td>44,693</td>
<td>0%</td>
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<tr>
<td>2013</td>
<td>2,777</td>
<td>2,516</td>
<td>3,943</td>
<td>12,054</td>
<td>21,288</td>
<td>44,693</td>
<td>52%</td>
</tr>
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<td>2014</td>
<td>2,790</td>
<td>2,333</td>
<td>3,347</td>
<td>13,934</td>
<td>22,404</td>
<td>44,693</td>
<td>50%</td>
</tr>
<tr>
<td>2015</td>
<td>3,030</td>
<td>2,493</td>
<td>8,933</td>
<td>0</td>
<td>14,456</td>
<td>44,693</td>
<td>68%</td>
</tr>
<tr>
<td>2020</td>
<td>2,450</td>
<td>1,082</td>
<td>191</td>
<td>0</td>
<td>3,724</td>
<td>44,693</td>
<td>92%</td>
</tr>
<tr>
<td>2025</td>
<td>2,450</td>
<td>1,082</td>
<td>191</td>
<td>0</td>
<td>3,724</td>
<td>44,693</td>
<td>92%</td>
</tr>
</tbody>
</table>

Additional steps need to be taken to eliminate these remaining carbon emissions.
Roadmap to Carbon Neutrality Campus Program

- Geoexchange
- Hot Water Distribution
- Biofuel
- Waste Heat Recovery
- Waste Heat Recovery
New Community Development Systems
Net Zero Aspirations
Towerside Innovation District
Vision for an Adaptable Energy System
ATES is an open-loop geothermal technology. It relies on temperate water in the aquifer that can be used to heat buildings in the winter and as a loop to remove heat from buildings in the summer.

Bores are drilled into the aquifer to interface with the temperate water source.

Then a secondary water loop carries that water to buildings in supply/return pipes underground.

Once the water reaches the buildings, a heat exchanger is used to heat or cool the building loop.
Rice Creek Commons
Energy Master Plan
(as presented in 2015)
Groundwater Treatment Station

2 MGD pumping for 25-30 years minimum
Thermal energy transfer substation
Provide heating and cooling to residential neighborhoods
Avoid natural gas infrastructure
Micro-hydro electrical offset for pumping
70% Reduction in CO2 Emissions

<table>
<thead>
<tr>
<th></th>
<th>Traditional Scenario Annual CO² Emissions</th>
<th>Recommended Scenarios Annual CO² Emissions</th>
<th>Annual CO² Reductions</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>7,524 tons</td>
<td>0 tons</td>
<td>7,524 tons</td>
<td>100%</td>
</tr>
<tr>
<td>CHP</td>
<td>3,581 tons</td>
<td>2,905 tons</td>
<td>676 tons</td>
<td>19%</td>
</tr>
<tr>
<td>Low Temp District Energy</td>
<td>1,057 tons</td>
<td>747 tons</td>
<td>310 tons</td>
<td>29%</td>
</tr>
<tr>
<td>Totals</td>
<td>12,162 tons</td>
<td>3,652 tons</td>
<td>8,510 tons</td>
<td>70%</td>
</tr>
</tbody>
</table>

Equivalent of removing over 1,600 automobiles off the road annually.
Mission Rock in San Francisco, California
Mission Rock Development

28-acre site owned by the SF Port Authority

3.5 million square feet of mixed-use development

San Francisco Giants as the Master Developer

Ever-Green Energy as the developer, operator, and manager of the district energy system
Mission Rock Development Goals

ECODISTRICT GOALS

**ENERGY**
20-26% better than ASHRAE 90.1-2010
- Central Energy Plant for heating, cooling, and hot water
- Tenant sub-metering and real time information
- Tenant commitments to reduced plug-loads

**WATER**
Zero potable water use for non-potable applications
- 33-47% Reduction in GHG emissions
- Water efficient fixtures
- Centralized graywater system
- Potential for bay source cooling

**WASTE**
25-50% increase in waste diversion over SF baseline
- User education to increase waste separation
- Source control programs to limit sale of landfill materials

**TRANSPORTATION**
7% Reduction in carbon emissions from automobile use
- Improved transit services
- Improved bike facilities and network
- Improved walking connections and experience
- TMPs
SAVING 2.5 MILLION GALLONS OF WATER/YEAR

BAU: 2.5 million gallons/year
DE: 0 million gallons/year

SAVING 490,000 GALLONS OF SEWAGE/YEAR

BAU: 490,000 gallons/year
DE: 0 million gallons/year

SAVING 30,000 MMBtu OF NATURAL GAS/YEAR

BAU: 30,000 MMBtu/year
DE: 8 MMBtu/year

Total CO2 Savings 1,600 Tons

BAU = Business as Usual with individual generation in each building; DE = District Energy
Key Enablers for Renewable/Carbon-Free Thermal

Policy Measures
- Integration into Renewable Portfolio Standards
- Renewable thermal credits
- Carbon pricing
- Sales tax exemptions and rebates
- Financing incentives

14 states have integrated renewable thermal standards in their RPS

It is critical that any stimulus or Green New Deal packages include funding for renewable or carbon-free thermal technologies.
Symbiotic Integrated Systems
41% of U.S. Primary Energy

Decarbonizing Minnesota’s Natural Gas End Uses

Meeting 5

April 10th, 2020
Via Zoom