

Achieving A Sustainable Future Together: Vicinity Energy's Decarbonization Plan and Progress

DEP Climate Change Advisory Committee
December 14, 2021

Vicinity Introduction

How Vicinity District Energy Works

Vicinity's district energy system tackles global energy problems on a local level, with local resources, providing highly reliable energy solutions while reducing carbon footprint in communities.

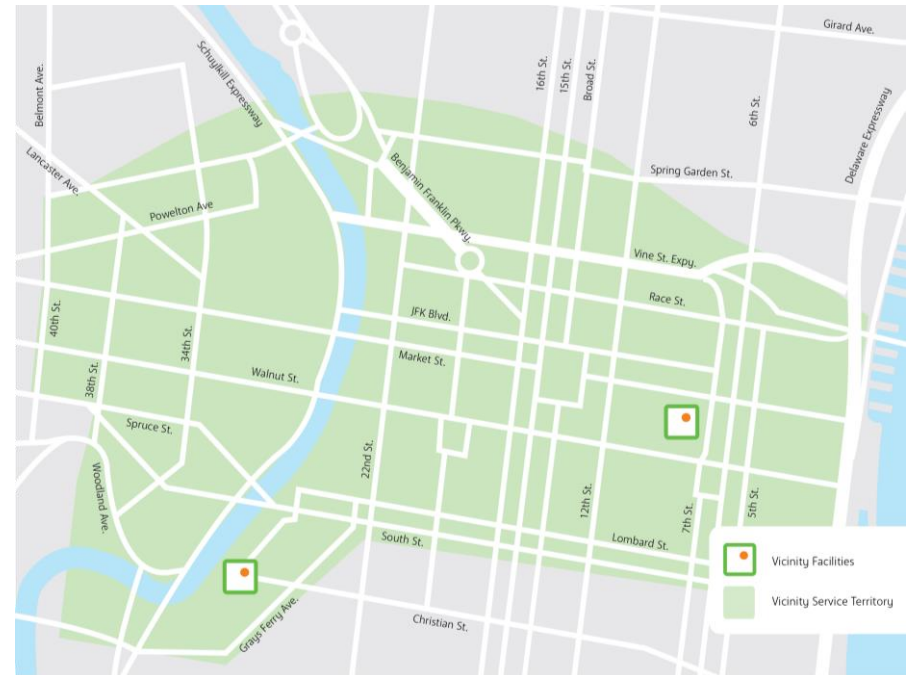


Steam, hot water and chilled water are produced centrally and then distributed through our vast underground network directly to buildings and campuses, **eliminating the need for onsite boiler and chiller plants in individual buildings.**

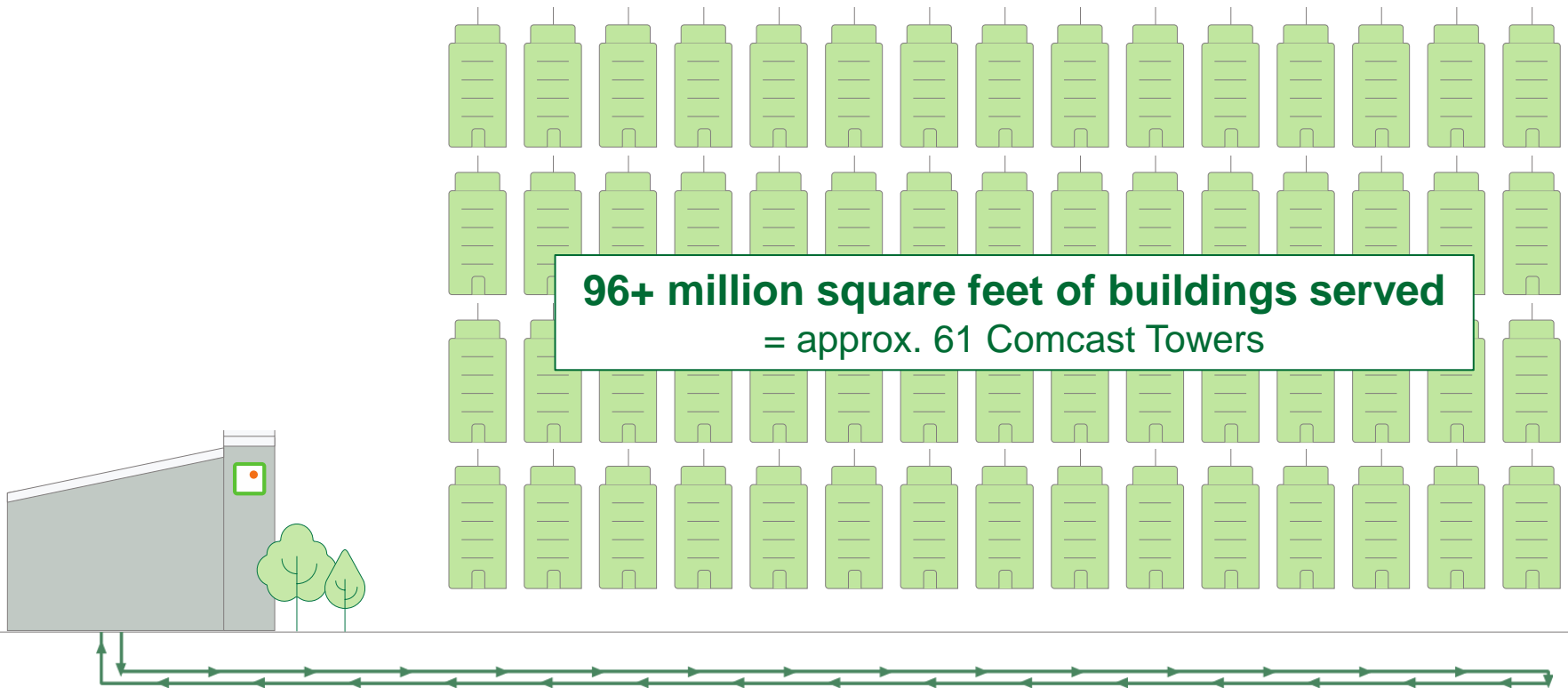
The Philadelphia District Energy Network

District energy **removes over 300,000 short tons** of carbon emissions annually from the City of Philadelphia

- **170MW of combined heat and power (CHP) capacity**
- **96+ million square feet of commercial space served**
 - Universities
 - Life Sciences
 - Hospitals
 - Commercial facilities
 - Municipal
- 400 buildings
- 41-miles of underground piping distribution for steam
- 2,000 lineal feet of supply and return chilled-water pipe
- Integrating biogenic fuels in 2021 and exploring new technologies to achieve net zero carbon



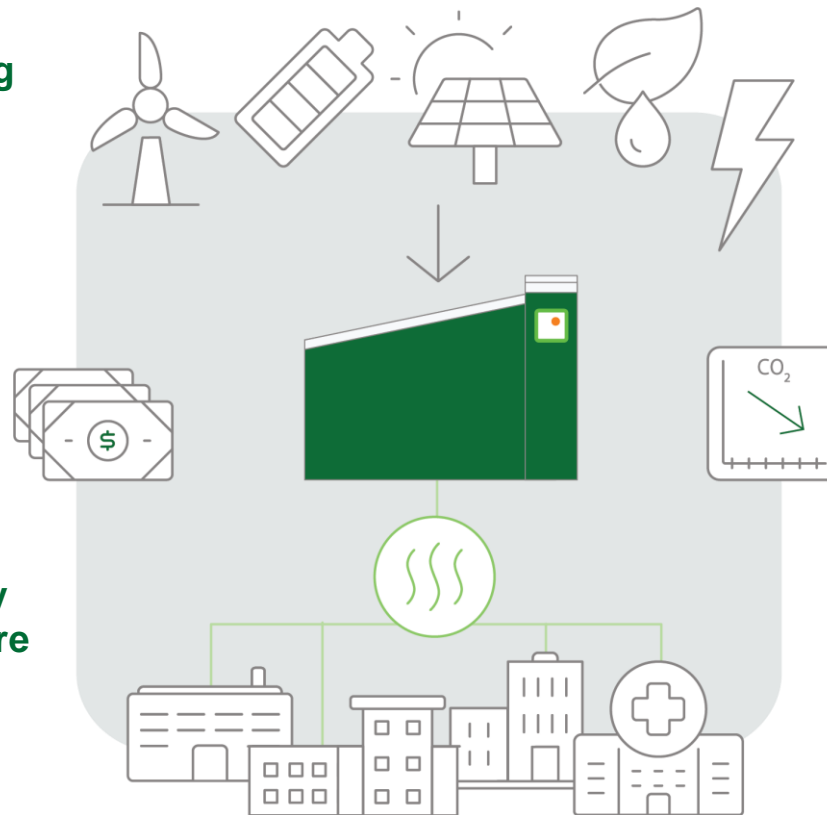
Major Hospitals, Campuses, Life Sciences, Hotels, Commercial Real Estate and City Buildings in Philadelphia Choose District Energy



Plug and Play for Large-scale Decarbonization in Philadelphia

Plug and Play – existing 41-mile infrastructure for a low-cost, **ready to use**, solution for organizations to meet the City’s climate goals

Save Money – no costly retrofits or infrastructure upgrades to meet new “greening” regulations

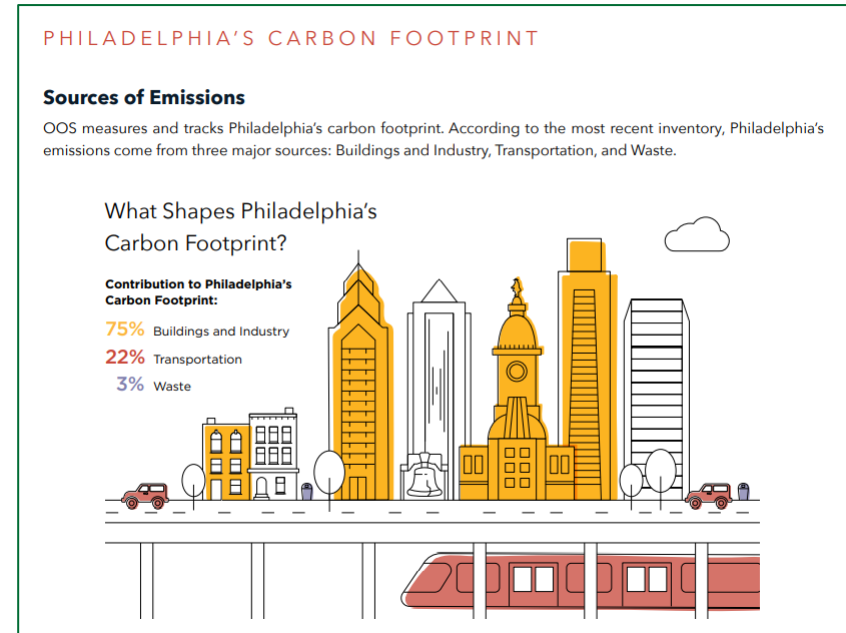


A History of Change – adaptable fuel sources to decarbonize such as biogenic fuels, electrification, industrial-scale heat pumps, hydrogen and long-term battery storage for carbon dispatch

Resilient and Reliable – technology and systems provide **99.99% reliable distribution** with multiple redundancies in place for a climate uncertain future

District Energy directly addresses the largest source of carbon emissions in Philadelphia

- 75% of Philadelphia's carbon emissions are from buildings and industry
- Vicinity reduces the carbon footprint of nearly **100 million square feet** of building space...and growing
- **Over 1.5M metric tons of carbon reduction since 2014, the equivalent of removing 65,000¹ cars from the road every year**
- 90% of Philadelphia's steam produced by highly efficient CHP with very low carbon content relative to alternatives
- Avoids more than **300,000 tons of CO₂** emissions annually when compared to conventional means of heating and cooling buildings.

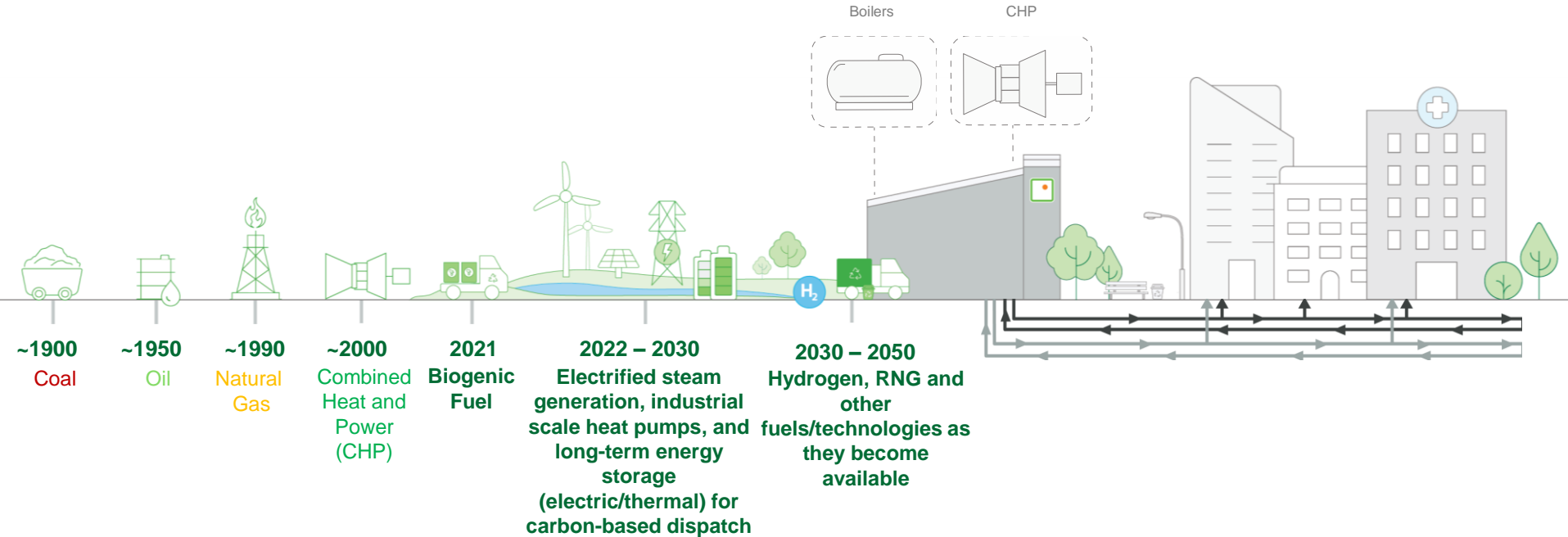


Source: Philadelphia Climate Action Playbook, January 2021, page 13

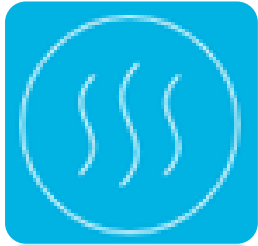
**Vicinity Energy's
Decarbonization Plan and
Progress: Net Zero Carbon
by 2050**

Leveraging Existing Infrastructure, New Technologies and Renewable Energy Sources to Decarbonize the Building-energy Sector

Vicinity Energy has a 100-year history of greening and is aggressively pursuing innovative technologies to achieve **net zero carbon emissions by 2050 or sooner**.



Vicinity Energy: The 4 Pillars of our Net Zero Carbon Roadmap



“Green Steam”

Systems fed with low carbon, CHP green steam



Agile Operations & Fuel Flexibility

Able to apply the latest fuel and technology innovations to our portfolio, impacting environmental justice communities



Investments in Efficiency

Constantly improving efficiency of our systems and investing alongside our customers

Vicinity has invested \$300M in our Grays Ferry facility to-date.



Reliability and Resiliency

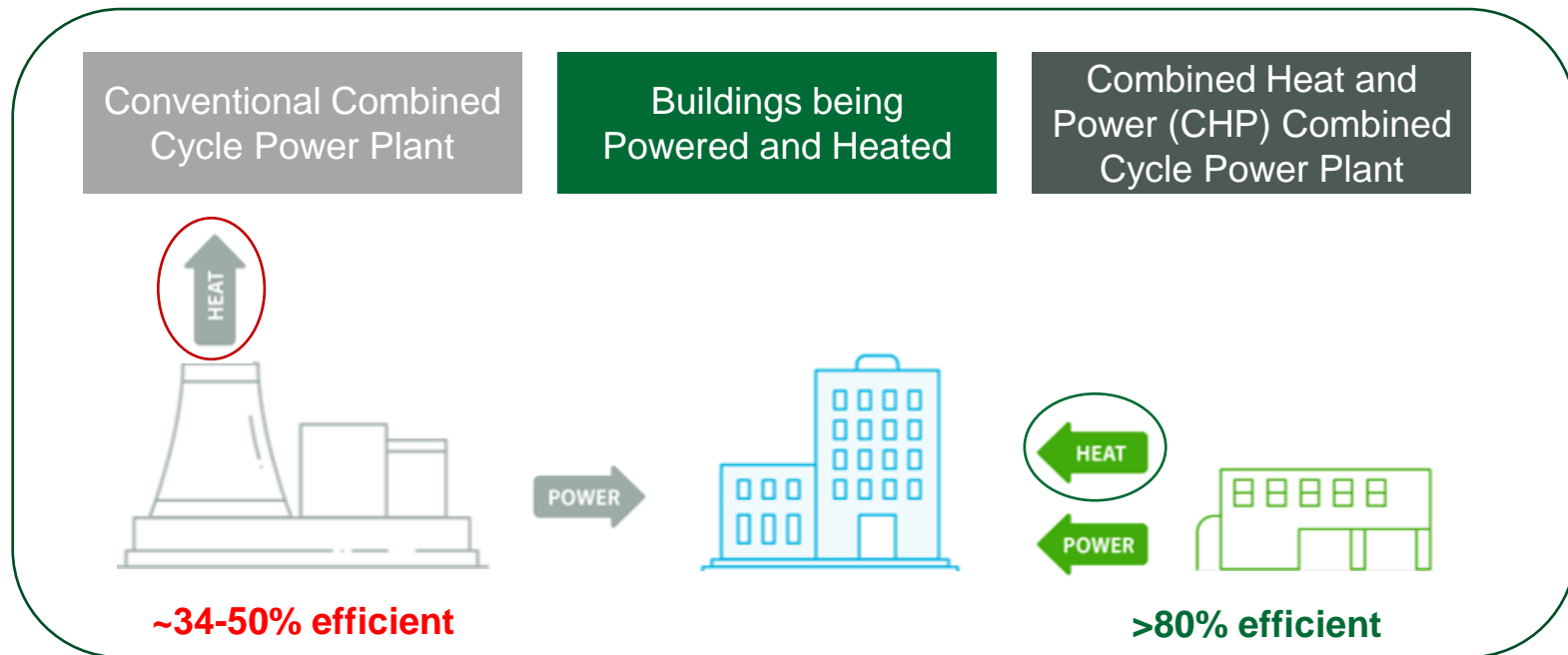
Delivers 99.99% reliable clean energy to our customers 24/7/365

Combined Heat and Power (CHP) Plants Heat Buildings with Energy Discarded by Conventional Power Plants



“Green Steam”

CHP’s simultaneous production of power and heat consumes less fuel than if produced separately and is significantly more efficient, resulting in substantially lower carbon emissions.



*Cogeneration will continue **to reduce carbon emissions through 2050** in Philadelphia by displacing fossil fuel generation resources running on the margin in grid operations*

*As long as there are fossil fuel load following resources on the grid, natural gas-fired cogeneration will **always result in less carbon emissions than separate heat and power***

2021 Partnership: Vicinity and Lifecycle Renewables

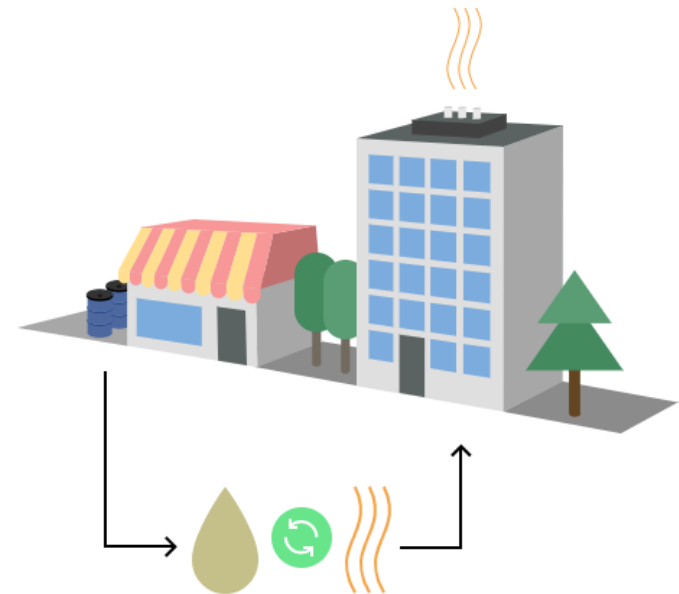


Agile Operations
& Fuel Flexibility

Vicinity partnered with Lifecycle Renewables in Philadelphia to purchase **600,000 gallons** of used cooking oil annually

Benefits of the Partnership:

- LR100 has the lowest carbon footprint of any commercially available biofuel
- Introduces a circular solution that repurposes and recycles fuels
- Reduces greenhouse gas emissions by over 80% and reduces particulate matter emissions by 10 times
- Keeps waste out of the municipal wastewater systems and landfills



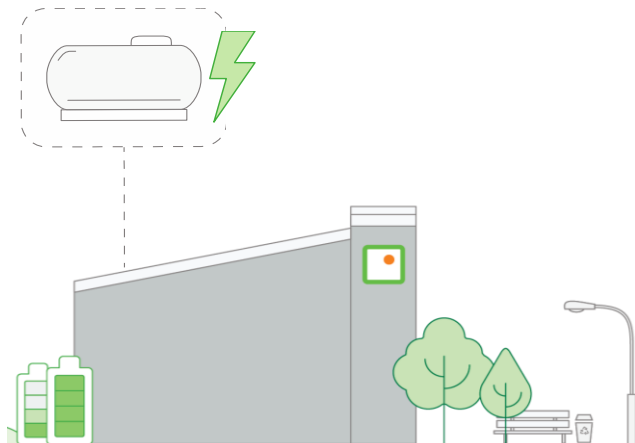
Looking Forward: Introducing New, Cleaner Fuels, including Electrification



Agile Operations
& Fuel Flexibility

Electrification: Leveraging the increase of renewables and our incredibly valuable district energy assets to accelerate decarbonization

Electric Boilers



- Leveraging well established technologies to convert electricity into steam (industrial scale electric boilers)
- Capitalizing on the flexibility of our existing assets that **connect to the electric transmission system today**
- Ready to take advantage of the **future economics of renewable electricity** to introduce green electrons to our fuel mix
- **Exploiting the agility of district energy to decarbonize**, easily “flipping the switch” to greener fuels
- We can electrify at our central plant and **customers require zero otherwise costly building modifications**

Philadelphia Reverse Osmosis Water Project

Vicinity has started construction of a Reverse Osmosis plant to utilize water from the Schuylkill River to feed our steam generating assets



**Investments in
Efficiency**

Benefits

- Sources water directly from the Schuylkill River without pre-treatment
- River water can be blended with condensate and city water to control solids
- Reduction of sewer discharge by 75%
- Conserves 630 million gallons of potable water per year
- Reduce harsh water treatment chemicals by 65%
- All equipment to be in existing building, no new land development required



Introducing Large Scale Industrial Heat Pumps to Further Decarbonize



Investments in Efficiency

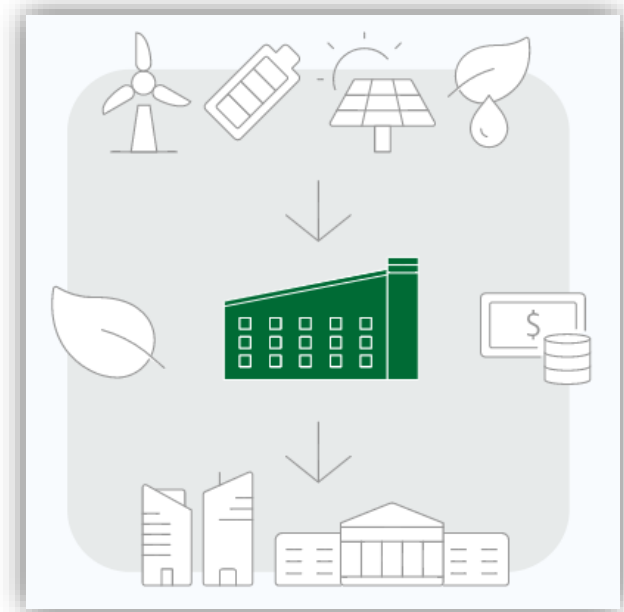


- Large scale, industrial heat pumps developed in Europe
 - Malmö, Sweden – 40 MW
 - Drammen, Norway – 15 MW
- Vicinity is exploring the installation of industrial scale heat pumps at its sites in Philadelphia, PA and Cambridge, MA
- Uses CHP generated electricity to extract energy from river sources to preheat feedwater back to the CHP
- Dramatic reduction in carbon intensity of CHP steam cycle (~10%) ... 20-30k tons of CO₂ annually
- Utilizing “exotic” refrigerants (e.g., hexane, pentane) that are well suited for our regulated industrial facility... but unlikely to be permitted in commercial facilities due to their hazardous nature
- These carbon benefits immediately benefit all of our district energy customers

Vicinity's Growth Potential and Expansion Capability is Vast

Growth of the district energy steam loop is one of Pennsylvania's most effective tools to meet its carbon emissions reduction goals.

- Vicinity has a mandate for growth with access to capital for expanding our positive environmental impact
- Our installed capacity today is 2x our current peak load
- We could conceivably add every large building in Center City to our steam loop
- **For every 1 million square feet added to the district energy system, carbon emissions avoided are 3,417 to 4,960 short tons per year**
- Growth of district energy fed by increased use of CHP, ***directly supports the achievement of the State's climate action plan***



Questions?

Appendix

Vicinity's Clean Energy Roadmap: Net Zero Carbon Emissions by 2050

2020 – 2030

- **Introduce net zero carbon biofuels** to offset fossil fuels in demand peaking boilers through targeted dispatch and long-term fuel supply contracts. Monitor the economics of renewable natural gas (RNG) at scale.
- **Enhance our operations** with battery storage, green roofing and stormwater recapture
- **Install electric boilers** to leverage renewable resources to support CO2 based dispatch
- **Improve our operational efficiency** through optimization projects
- **Engineer micro-grid solutions** that employ biofuel capable combined heat and power (CHP) systems with proven resiliency
- **Dispatch cogeneration plants** to reduce carbon footprint; reusing all waste heat for maximum efficiency. Work with original equipment manufacturers (OEMs) to introduce biofuels to combustion turbine & heat recovery boilers
- **Expand our district energy system** into new neighborhoods so more communities benefit from our clean energy solutions for heating and cooling.
- **Continue and expand our sustainable water practices**, including condensate recovery and reuse
- **Purchase renewable electricity for “house loads”**, the power required to run our plant and auxiliaries

2030 – 2040

- **Decarbonize fossil fuel use from the district system** by expanding green fuel supply sources and electrification to take advantage of the progressively greener electric grid supply represented by offshore wind and hydroelectric imports
- **Implement new technologies** on a large-scale to include hydrogen, RNG, batteries and heat pumps
- **Introduce additional sustainable water practices** to include full system condensate recovery and reuse
- **Continue to invest in our system** to expand to new areas and achieve even greater energy efficiency

2040 – 2050

- **Continue to innovate and drive the implementation** of new economically viable green technologies
- **Eliminate burning of methane** from the fuel source mix
- **Adapt to the ongoing evolution** in energy
- **Continue to invest in our system** to expand to new areas and achieve even greater energy efficiency

Thomas Jefferson University Hospitals in Philadelphia, Pennsylvania



Project Facts:

- **925** hospital beds
- **30-year** contract
- **7,000 tons** of chilled water production
- **6 buildings** served
- **1.5M+ square feet** served
- **2,000 lineal feet** of supply and return chilled-water pipe

- With a \$24 million capital cost, Vicinity designed, financed and built a central chilled water plant to supply cooling to Thomas Jefferson University Hospitals (TJU) campus.
- As the institution sought to grow and renew its utility infrastructure, it also required a financing solution to advance these capital improvements.
- With Vicinity's financing, engineering and project development support, the institution developed a new central chilled water plant without the upfront capital expense that would have been incurred from self-development.
- Vicinity continues to operate the 7,000-ton chilled water plant under a 30-year contract term.
- Vicinity's long-term partnership enables the institution to focus on its research efforts and providing quality clinical care to its patients.

Wistar Institute in Philadelphia, Pennsylvania



Project Facts:

- **20-year** contract
- **10,000 lb/hr** steam demand
- **89,700 sq ft** tower expansion
- **22,000 sq ft** vivarium
- **46 labs**

- Located in University City, Wistar is a world leader in early-stage discovery science in the areas of cancer, immunology and infectious disease.
- Although Wistar planned to renovate and expand their research and development space in 2012, the biomedical company faced a challenge in its limited footprint.
- Via a 20-year long-term steam contract with Vicinity, Wistar ultimately expanded their site and maximized their research and development space.
- Wistar's construction schedule was very accelerated, but Vicinity was able to accommodate the rapid schedule: Wistar was interconnected through a temporary interconnection to allow for its existing boiler plant to be demolished until the permanent routing became available.
- Wistar's permanent interconnection is served through a cooperative agreement with Penn: Vicinity operates and maintains Penn's 11-mile steam distribution network, providing reliable and resilient energy service to the Institute.

University of Pennsylvania in Philadelphia, Pennsylvania

By leveraging cogenerated “green steam”, Penn has reduced its carbon footprint by 172,000 metric tons – the equivalent of taking 28,000 cars off the road per year.



Project Facts:

- **260-acre campus served**
- **220 buildings** served
- **11-mile distribution network**
- **10,000-tons** of steam-driven chilled water
- **172,000 metric tons** of carbon reduced
- **20-year** energy service contract

- Most systems on Penn’s campus that require thermal energy – heating, cooling, hot and chilled water, lab equipment and humidifiers – are supplied by Vicinity’s district energy system.
- In 2013, Vicinity completed a \$60 million investment in its Philadelphia network, converting it to 100 percent ‘green steam’ (through its CHP technology, an expansion of the regional natural gas pipeline and the installation of two new and efficient rapid response boilers).
- These improvements are not only helping Penn meet its aggressive GHG emission targets but have also greatly improved the overall efficiency of steam service for Penn and the central business and university city districts of Philadelphia.
- Combined heat and power (CHP) is an innovative environmental solution that recaptures heat that was previously lost to the environment, using advanced cogeneration technology.
- Vicinity’s multi-million-dollar investment in its energy infrastructure increases efficiency and reduces annual GHG emissions by the equivalent of removing 70,000 cars from the streets annually.
- With Penn’s efforts to improve sustainability and conservation on its campus, combined with its use of ‘green steam,’ Penn has already reduced its total campus carbon emissions by 18 percent as of 2014.

2 Liberty Place Philadelphia, Pennsylvania



Project Facts:

- **1.2M** square feet
 - **36 floors** of commercial office space
 - **26 floors** of luxury residential space
 - **3rd tallest** building in downtown Philadelphia
- Vicinity teams provide heating and domestic hot water with cogenerated district steam at 2 Liberty Place in Philadelphia, a well-known building in the area.
 - The building was experiencing heating reliability issues and leaning on six 20-year-old electric boilers. Vicinity already provided steam to the first three floors. The condos are luxury units and reliability is critical. The plant normally operates in parallel with Con Edison.
 - After economic and technical review, the customer chose district steam with the installation of Maxi-Therm units.
 - With this approach, there are lower maintenance and energy costs, a 10-12% improvement in efficiency versus a traditional steam system, lower capital costs with the elimination of in-building boilers, elimination of the need for vents/chimney space, and added space to their mechanical room..
 - Vicinity made a capital contribution to the project with benefits like cost savings, reliability, risk, carbon and space.