Power Plant Decarbonization

ENERGY RENEWAL PROGRAM

April 2025

UNIVERSITY of WASHINGTON

Power Plant Decarbonization

The University of Washington is undertaking a groundbreaking effort to fully decarbonize the energy system of its Seattle campus, transforming how we heat, cool and power our buildings.

At the core of this initiative is the significant upgrade to the UW Power Plant, which currently depends on aging, inefficient infrastructure that burns natural gas to produce steam for heating. By transforming to cleaner, more efficient energy infrastructure, UW is aligning its daily operations with its long-standing sustainability values.

Power Plant Decarbonization

In 2024, a comprehensive decarbonization plan was completed, outlining the following steps needed to upgrade systems, reduce emissions and secure funding.

This work is critical in reducing carbon emissions and transition the UW to 100% clean energy, an effort motivated by regulatory requirements and the shared commitment of both faculty and students to ensure the UW is a leader in campus sustainability.

Power Plant Decarbonization

Setting the Stage

1. We are the second largest public carbon emitter in the state of Washington,
2. The power plant is 93% of our direct carbon emissions,
3. At the core of our plan is a switch from combustion boilers to moving energy with heat pumps, which means we will no longer be burning natural gas for heat but instead using clean electricity,
4. Heat thrown away into the air and sewer could displace ~70% of our natural gas.

Power Plant Decarbonization

Why we need to decarbonize

5. Investing in the decarbonization of the plant is a smart investment in a clean energy alternative that also adds resiliency and increases our capacity for cutting edge research,
6. Decarbonizing the power plant is a capital-intensive project, with significant energy savings, and increased resiliency for UW's mission and services,
7. Doing nothing will be riskier than decarbonizing, because UW needs to add electrical capacity to continue with innovative research, and because UW's energy systems would still be dependent upon fossil fuels.

Power Plant Decarbonization

What's Next

8. We have an implementation plan, 47 projects over 14 years,
9. We can and will coordinate this infrastructure project with other campus retrofits, such as where we do have to dig for new piping, we have aligned with ADA improvements,
10. 75% of the new hot water pipes can fit in our tunnels (minimizing disruptions), and
11. The first 10 projects totaling $292M have been submitted to the state legislature.
12. We are encouraging the state to allocate proceeds from the CCA to fund this effort.
13. The sewer and lake portions of the project lend themselves to private partnerships.

Power Plant Decarbonization

Executive summary of the key steps to decarbonize the power plant

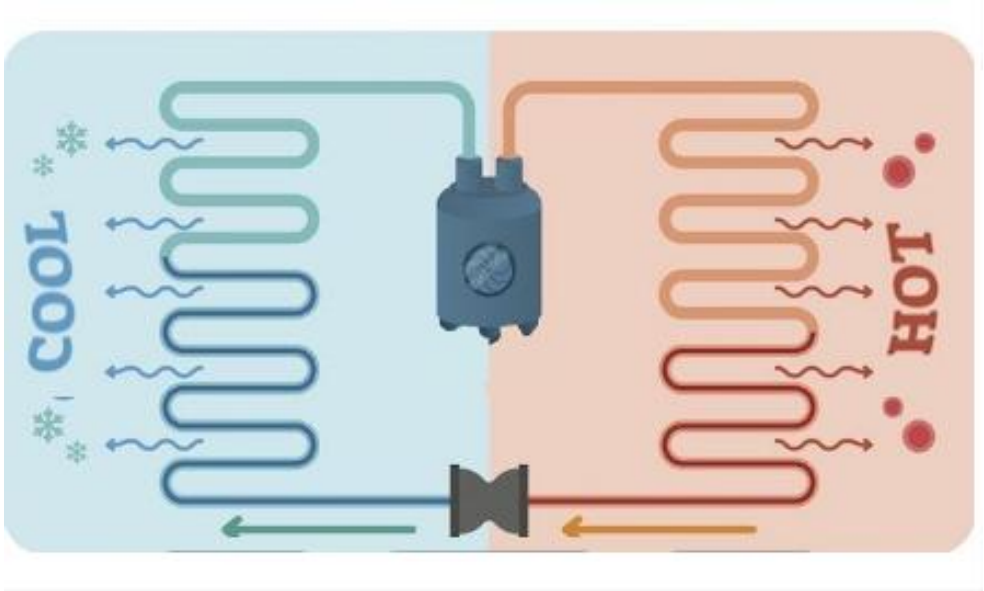
1. Switch from combustion boilers to moving energy with heat pumps
2. Maximize the efficiency of the heat pumps
3. Build a new electrical substation for capacity & reliability
4. Add thermal storage for resiliency & to optimize heat pump performance
5. Address process-based steam loads
6. Convert the campus steam distribution system to hot water
7. Make heat from the cooling system the primary source of heating
8. Connect all cooling systems to the central system
9. Tap the King County wastewater system as a secondary source of heating
10. Access Lake Washington for both heating and cooling
11. Retain the three most efficient boilers as an emergency back-up for cold winter days

Power Plant Decarbonization – Technology Advances

Energy cannot be created or destroyed – but it can move!

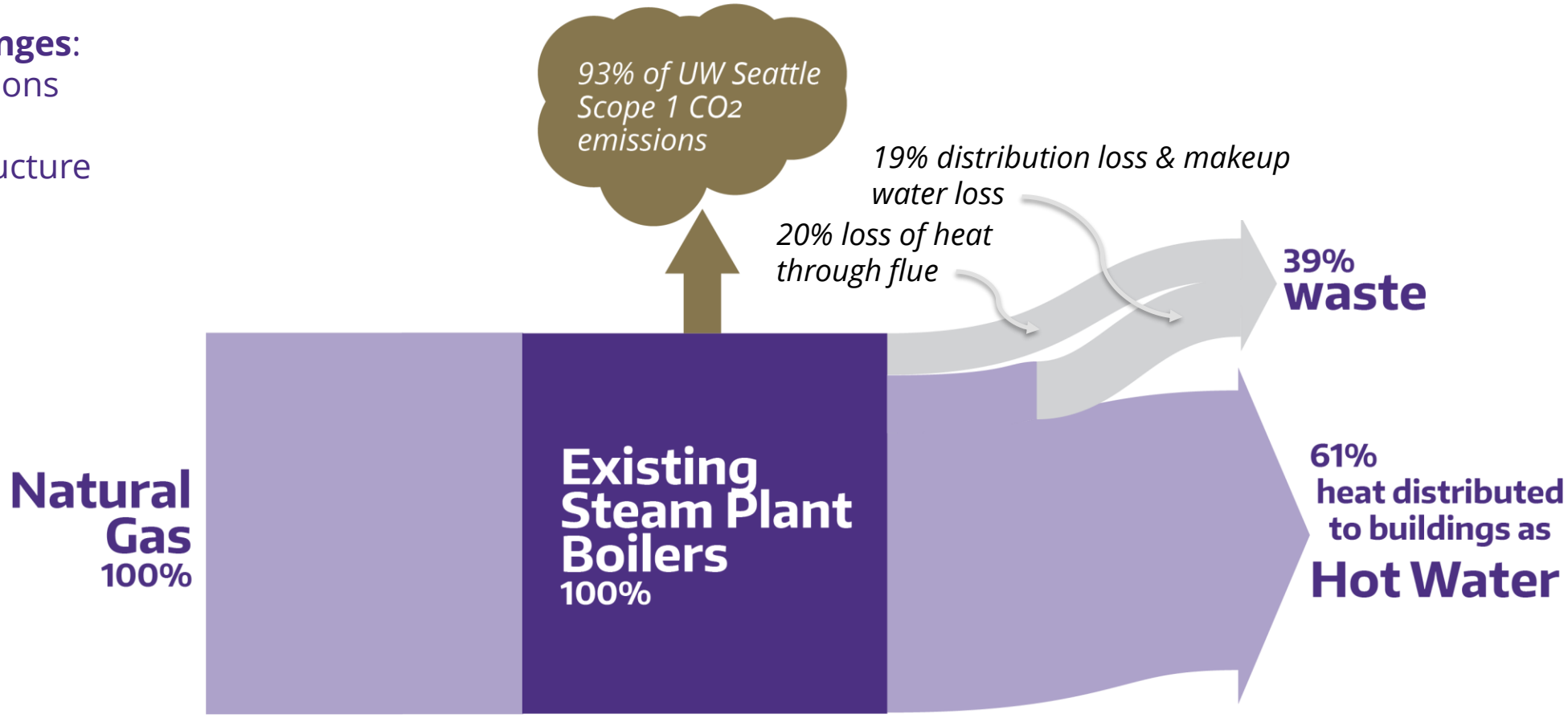
Now: Energy from combustion (boilers)

Next: Energy transfer (heat pumps)



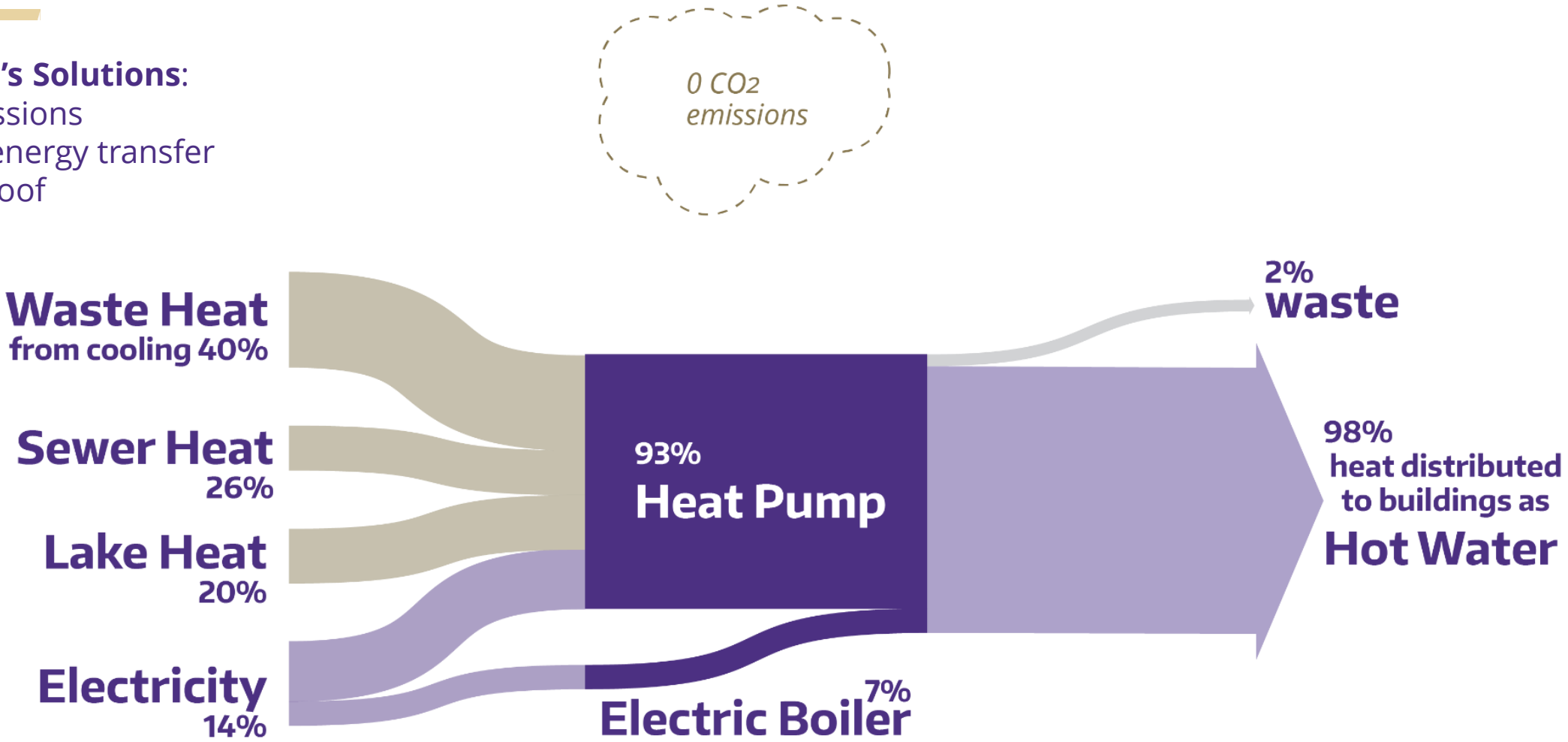
Power Plant Decarbonization – Efficiency Gain

Today's Challenges:
- Carbon emissions
- Inefficiency
- Aging Infrastructure



Power Plant Decarbonization – Efficiency Gain

Tomorrow's Solutions:
- Zero emissions
- Efficient energy transfer
- Future proof

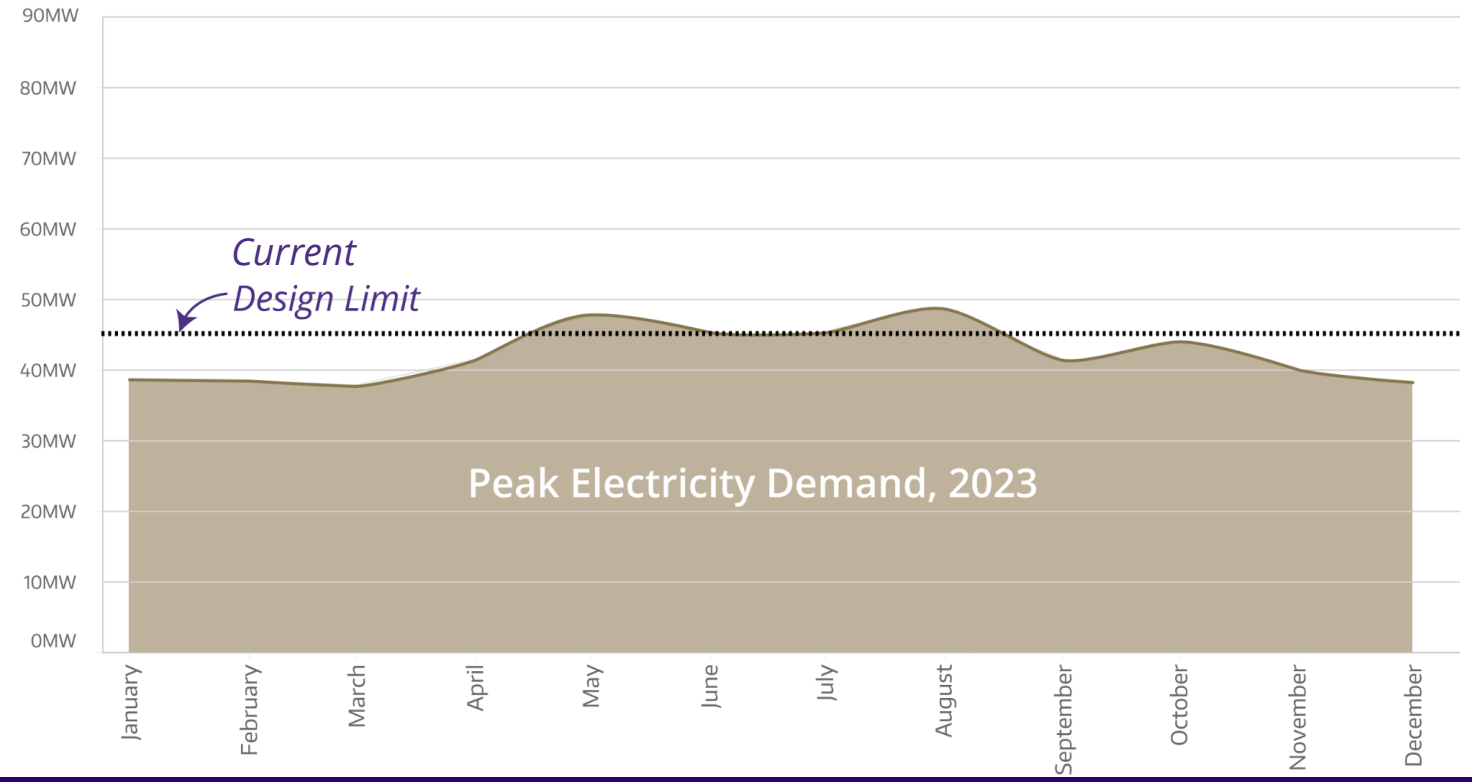


Electrification – Current electricity condition

Today's challenges:

Our electrical load is taxing our power delivery infrastructure.

We are experiencing voltage sags which can compromise electronic research and medical equipment.

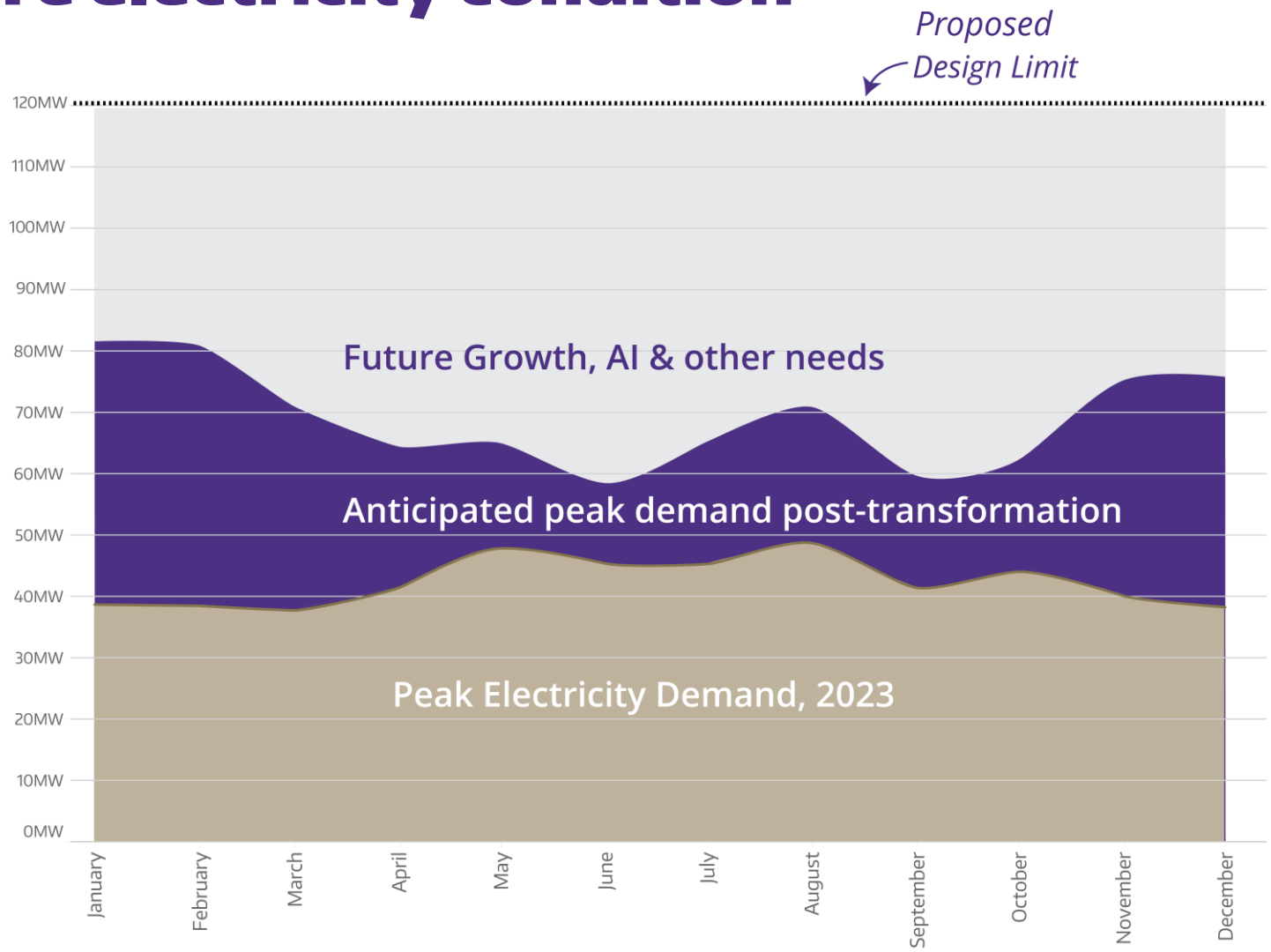


Electrification – Future electricity condition

A new substation dedicated to the UW will provide the reliable, high-quality power we need.

Two strategic benefits to the new UW Substation:

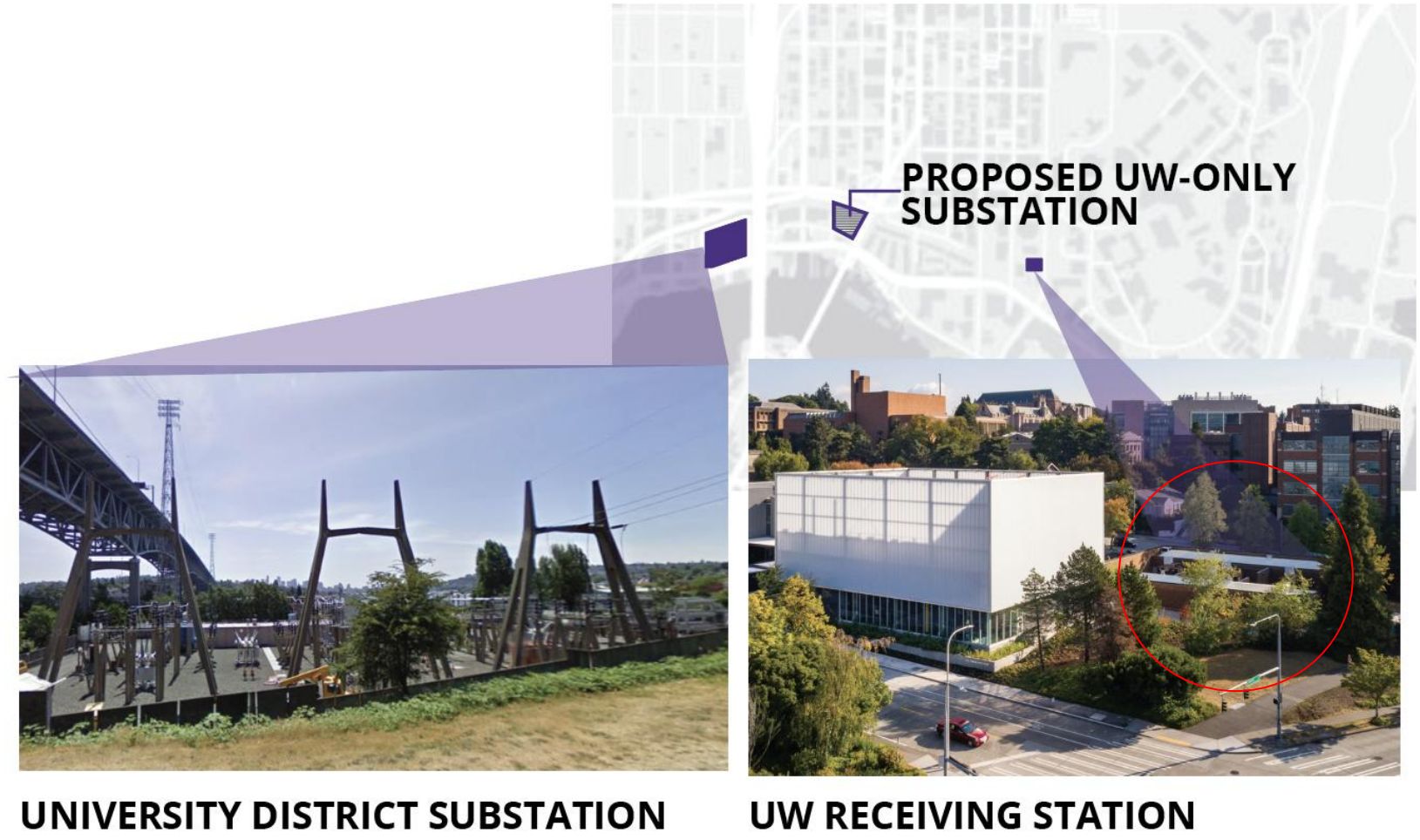
1. Mitigates present risk exposure to voltage sags.
2. Can be sized to meet future growth for the next 50+ years.



Electrification – Build a new electrical substation

A new substation dedicated to the UW will provide the reliable, high-quality power we need.

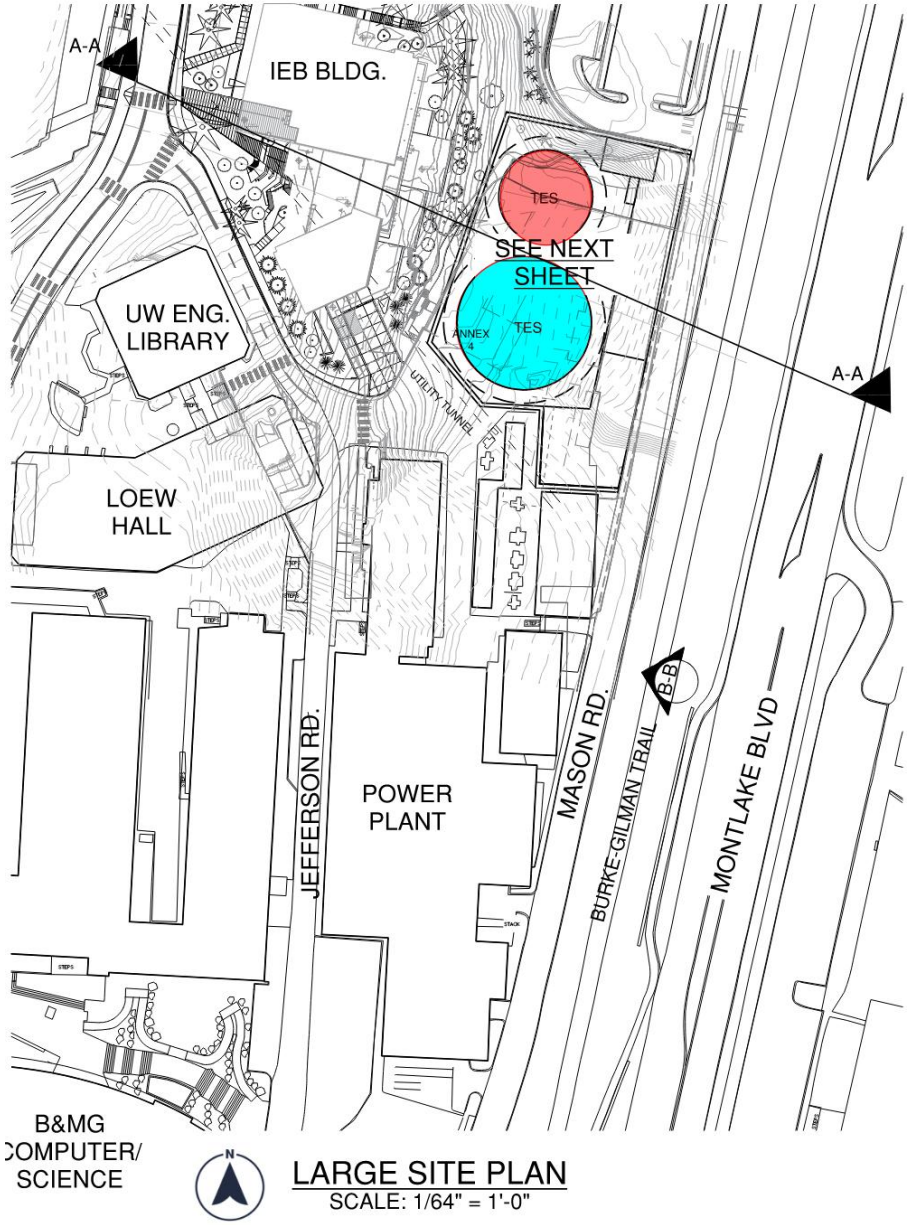
We are in discussions/ partnership with Seattle City Light on optimizing ownership and project funding.



Efficiency Gain

Thermal energy storage tanks are large water batteries that serve multiple purposes:

- They adjust for variations in the energy demand from the campus which improves performance and useful life of the heat pumps,
- The tanks provide resiliency during power outages,
- Allow energy to be stored when the electrical demand is low,
- The storage tanks can also be used for electrical peak demand management.



Energy Distribution

Convert to Hot Water

The distribution system from the central plants to campus buildings:

- 16 miles of hot water pipes to replace steam pipes
- 4 miles of chilled water pipes upsized and added

Maximize the re-use of the existing utility tunnel system:

- We can put 75% of these new pipes in existing tunnels
- To complete the system, we will need 1,500 linear feet of new tunnel in West Campus
- Remaining 25% will be direct bury piping coordinated with ADA improvements

Energy Transfer at Buildings

Convert to Hot Water

We will replace steam heat exchangers with hot water heat exchangers in 150 buildings:


Architecture Hall

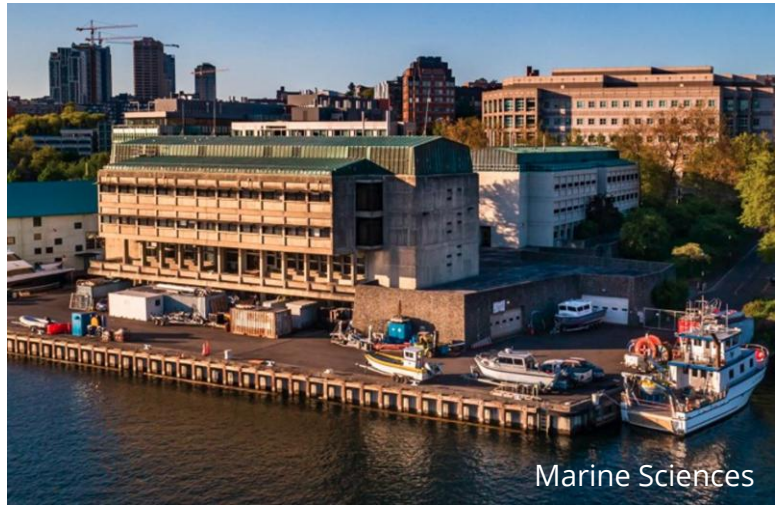
33% simple

- New heat exchanger


Chemistry Building

45% moderate

- New heat exchanger
- New pump
- New hot water coil


Marine Sciences

22% complex

- New heat exchanger
- New pump
- New hot water coil
- New hot water radiators

Sources of Energy Transfer

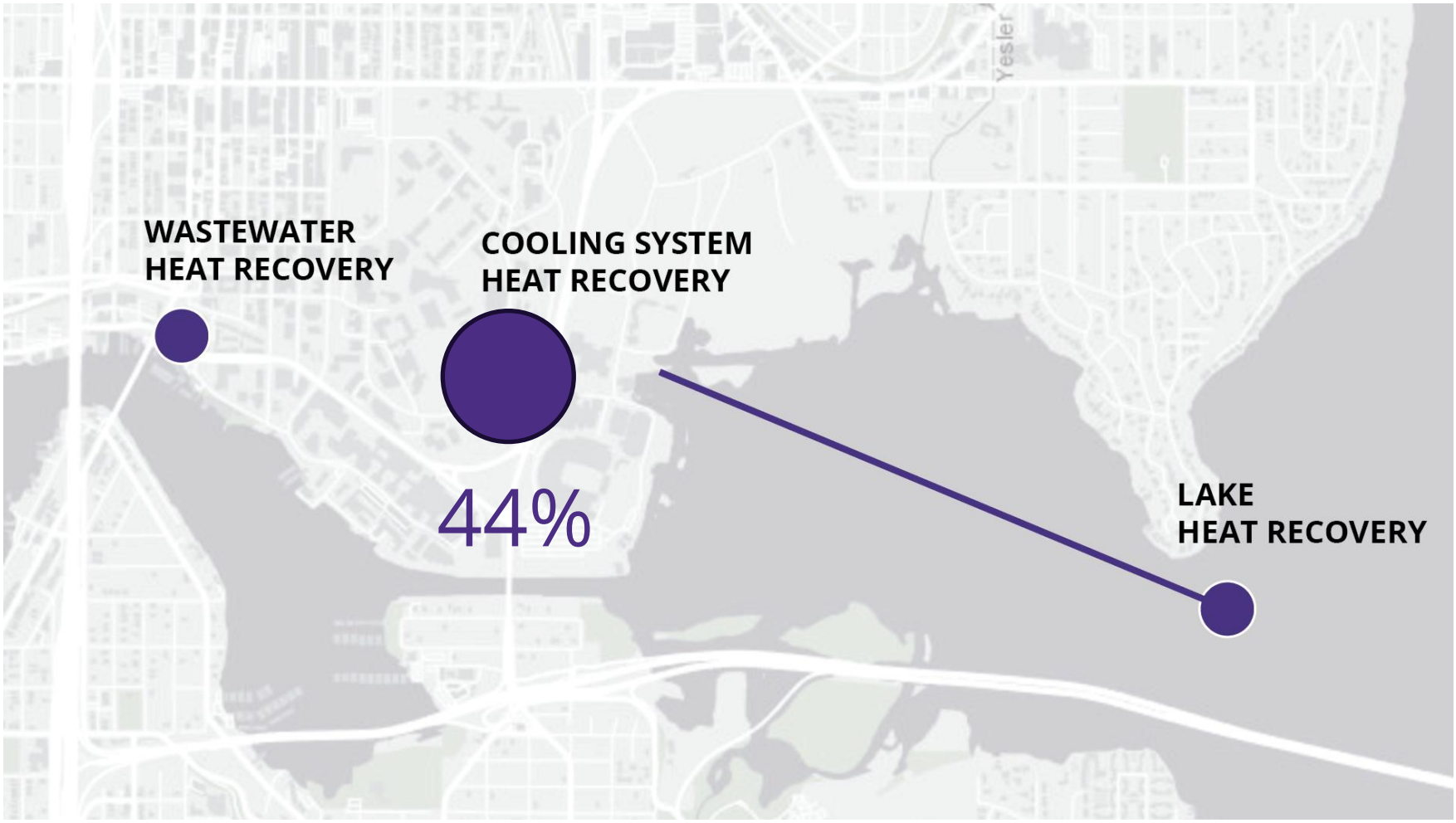
Use heat extracted from our buildings

Move energy via chilled water and hot water systems

Centralize cooling

Other sources required in winter:

- Sewer heat recovery
- Lake interface



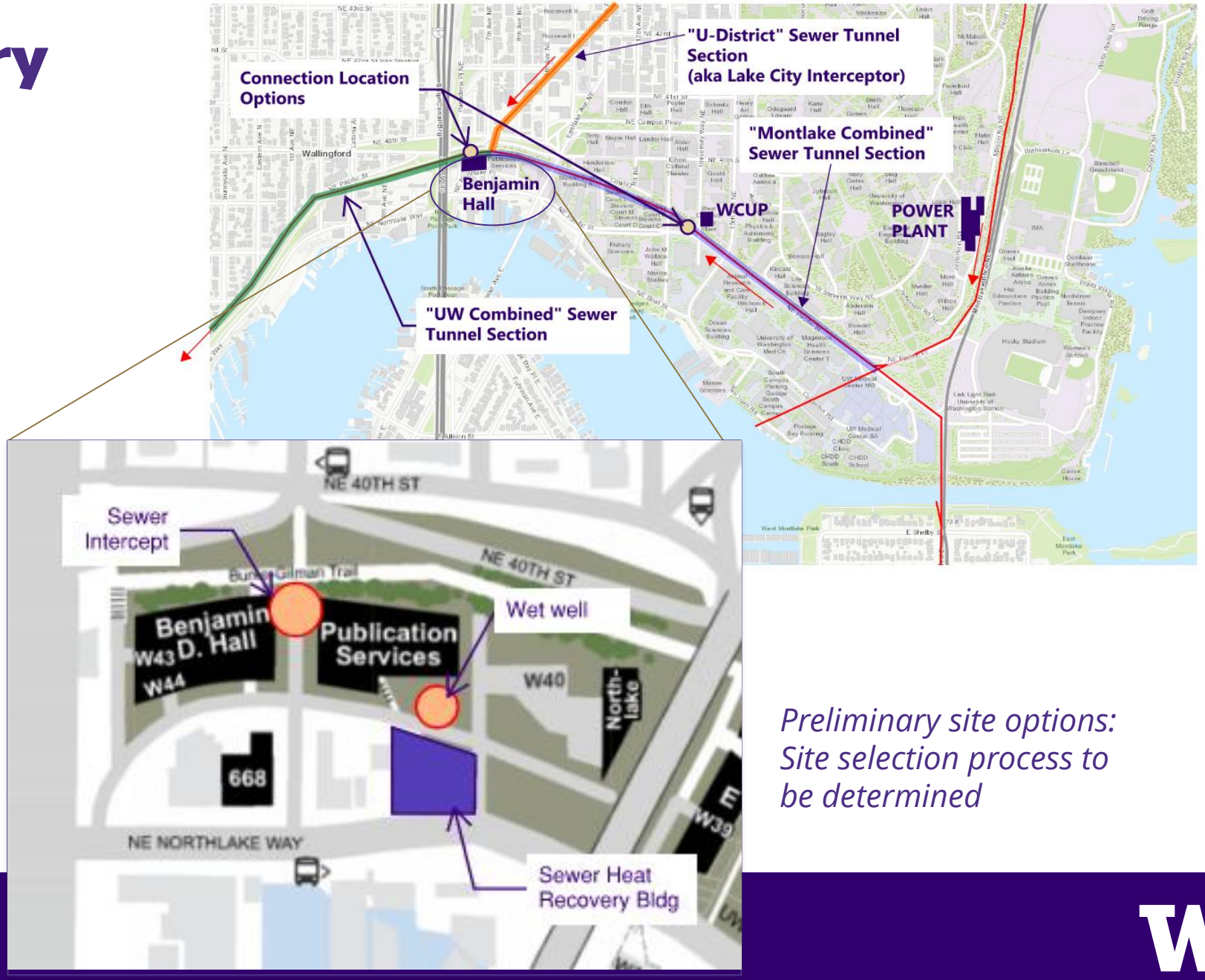
Sewer Heat Recovery

Engage the King County pilot program to recover heat from 50°F -70°F sewer water.

High efficiencies of sewer heat recovery offset electricity & sewer energy charges.

Sewer heat recovery can supply **26% of campus heating** and displace 10% of our current fossil fuel use.

King County Sewer - Heat Recovery Opportunity Map



Preliminary site options: Site selection process to be determined

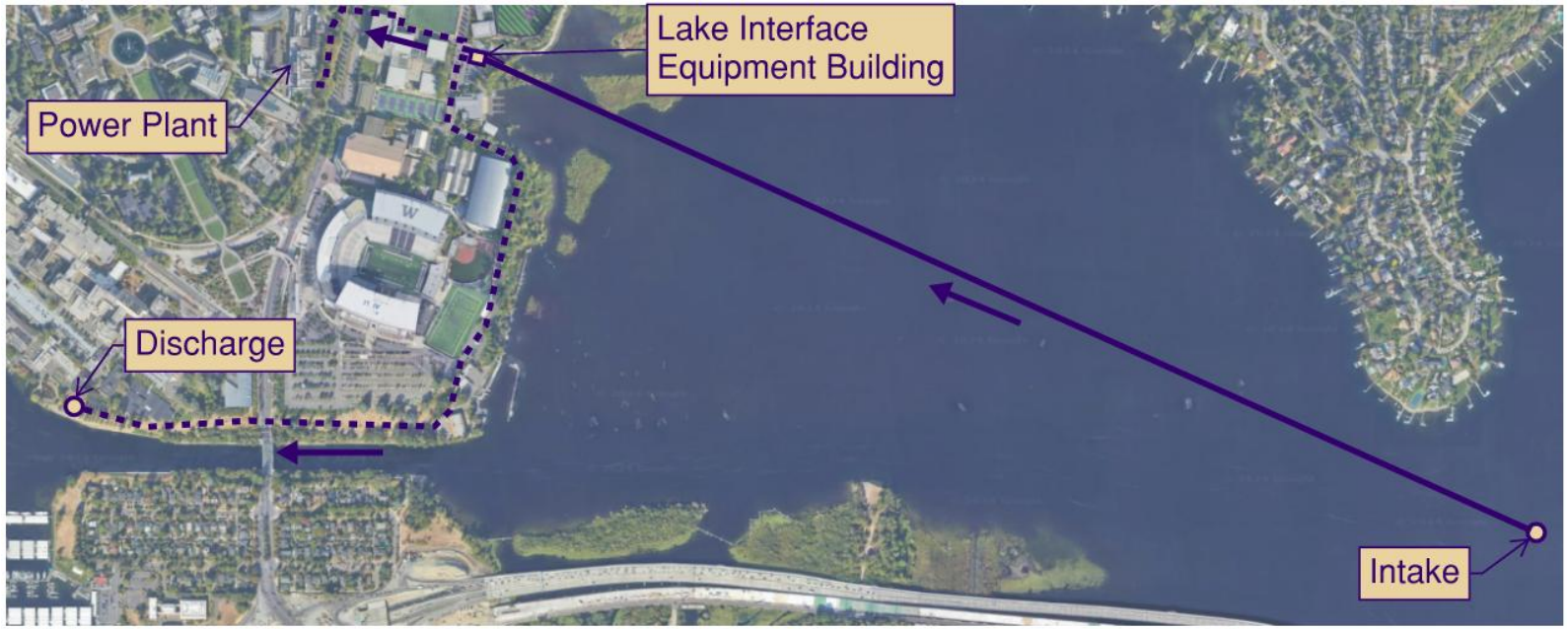
Lake Interface

New building for heat recovery equipment – 1-story 2,000 sq ft facility near Husky Ballpark / Conibear Shellhouse

Buried piping between new building and Power Plant

Heat recovery chillers added to the Power Plant

Submerged piping through Union Bay to Lake Washington (intake) ~1.2 miles



Improve Building Efficiency

In parallel to power plant improvements, target energy intensive spaces to improve building efficiency:

- Focus on labs that typically use 3-5 times more energy than classrooms
- Upgrade building controls to reduce nighttime air changes
- Recover waste heat from year-round cooling
- Improve steam systems for autoclaves and glass wash

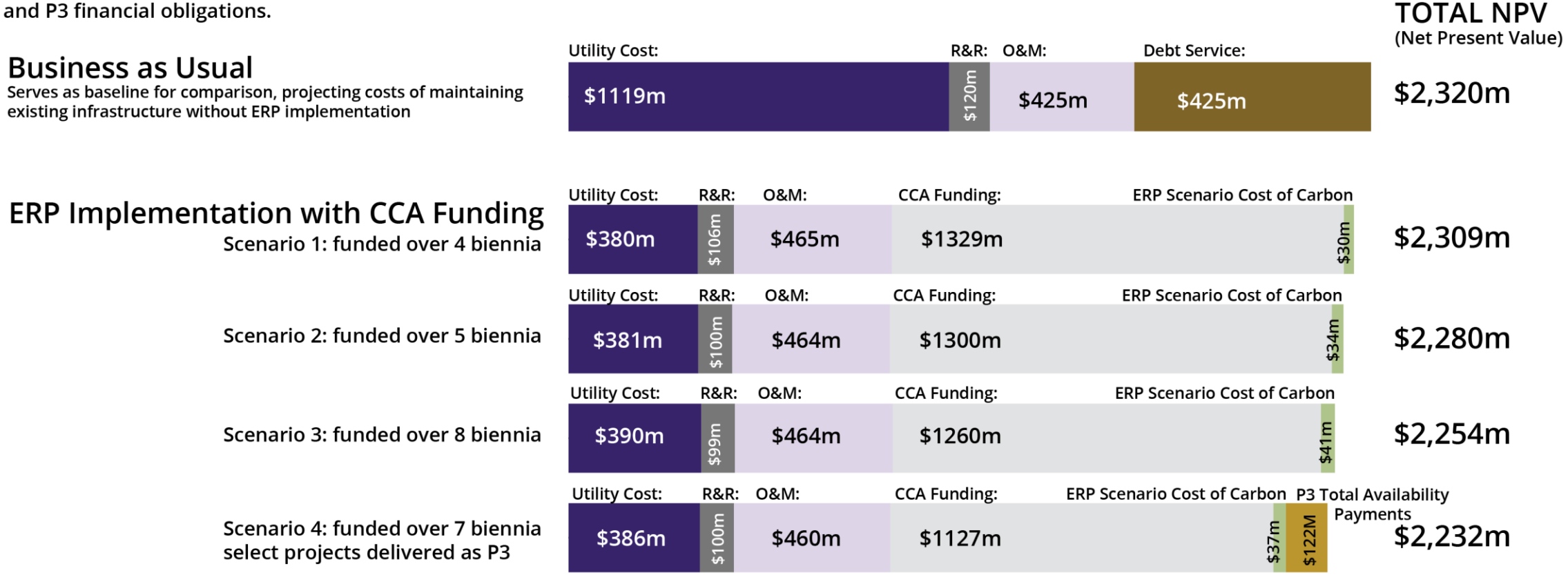
Power Plant Decarbonization

Total Project Cost (2024 dollars) = $1,600 million

Cost (2024 $'s)	Category	
$1,193 million	**Decarbonization**	Primarily focused on plant heating systems, distribution, and building conversions
$180 million	**Public-Private Partnership Opportunities**	Energy sources: Sewer heat recovery and Lake Interface
$49 million	**Electrical System Upgrades**	New electrical substation and distribution
$178 million	**Climate Adaptation**	Additional cooling systems and distribution
$1,600 million	**Total**	

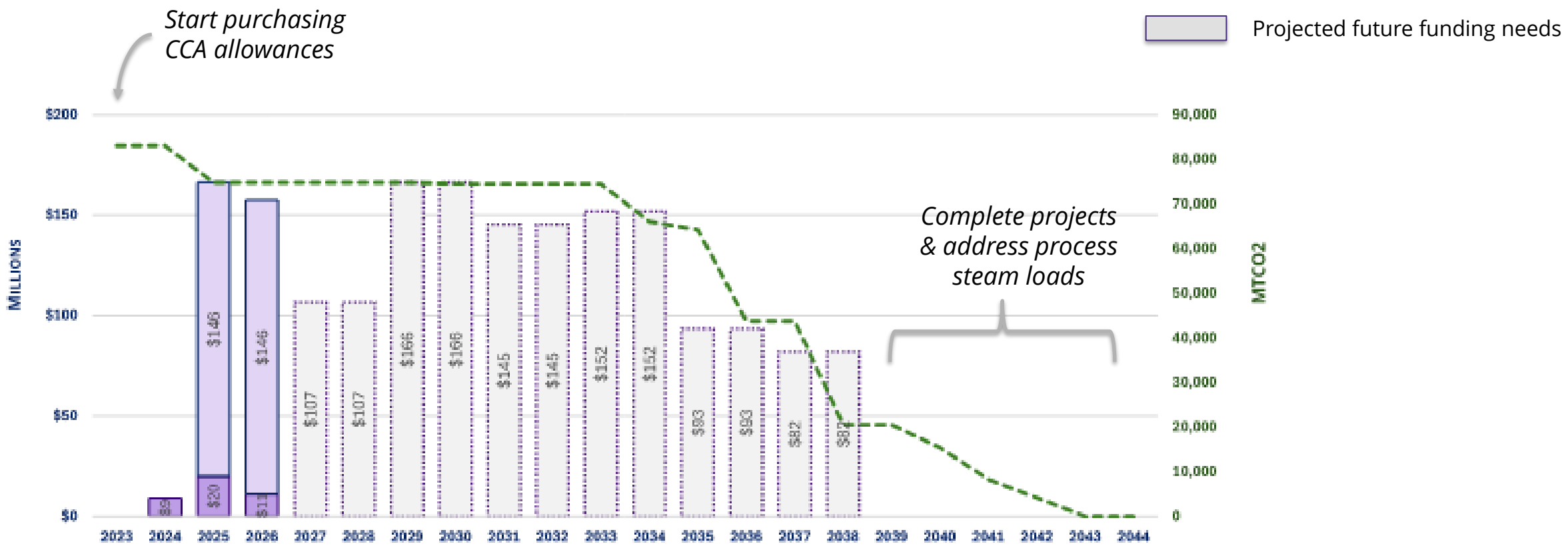
Power Plant Decarbonization

The NPV analysis considers the present value of each scenario cashflows, inclusive of: utility costs, operation and maintenance costs, lifecycle repair and replacement costs, University debt service costs, State CCA fundings, and any applicable regulatory costs of carbon costs and P3 financial obligations.



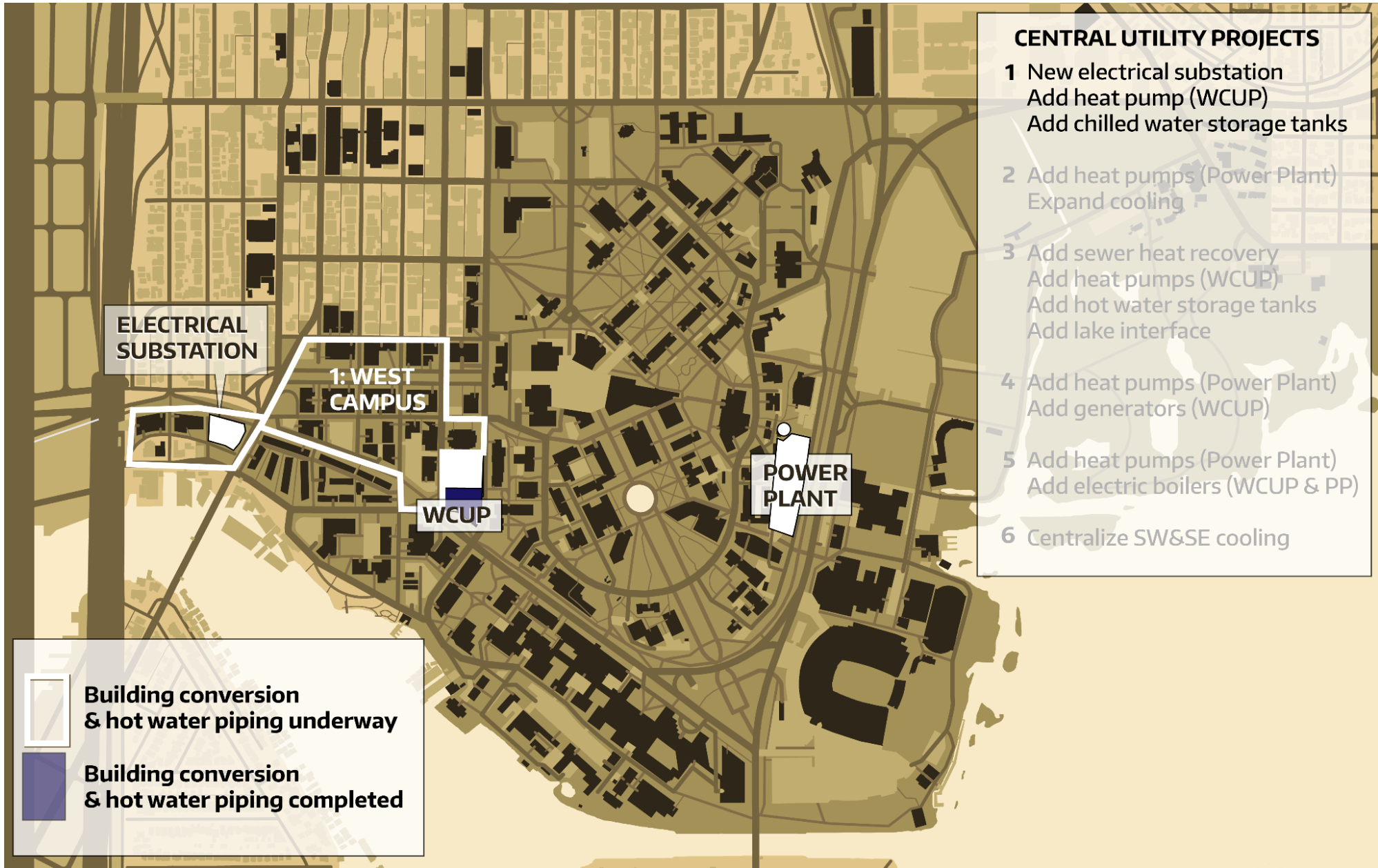
Power Plant Decarbonization

Annual capital investment & CO2 emission reductions



Timeline

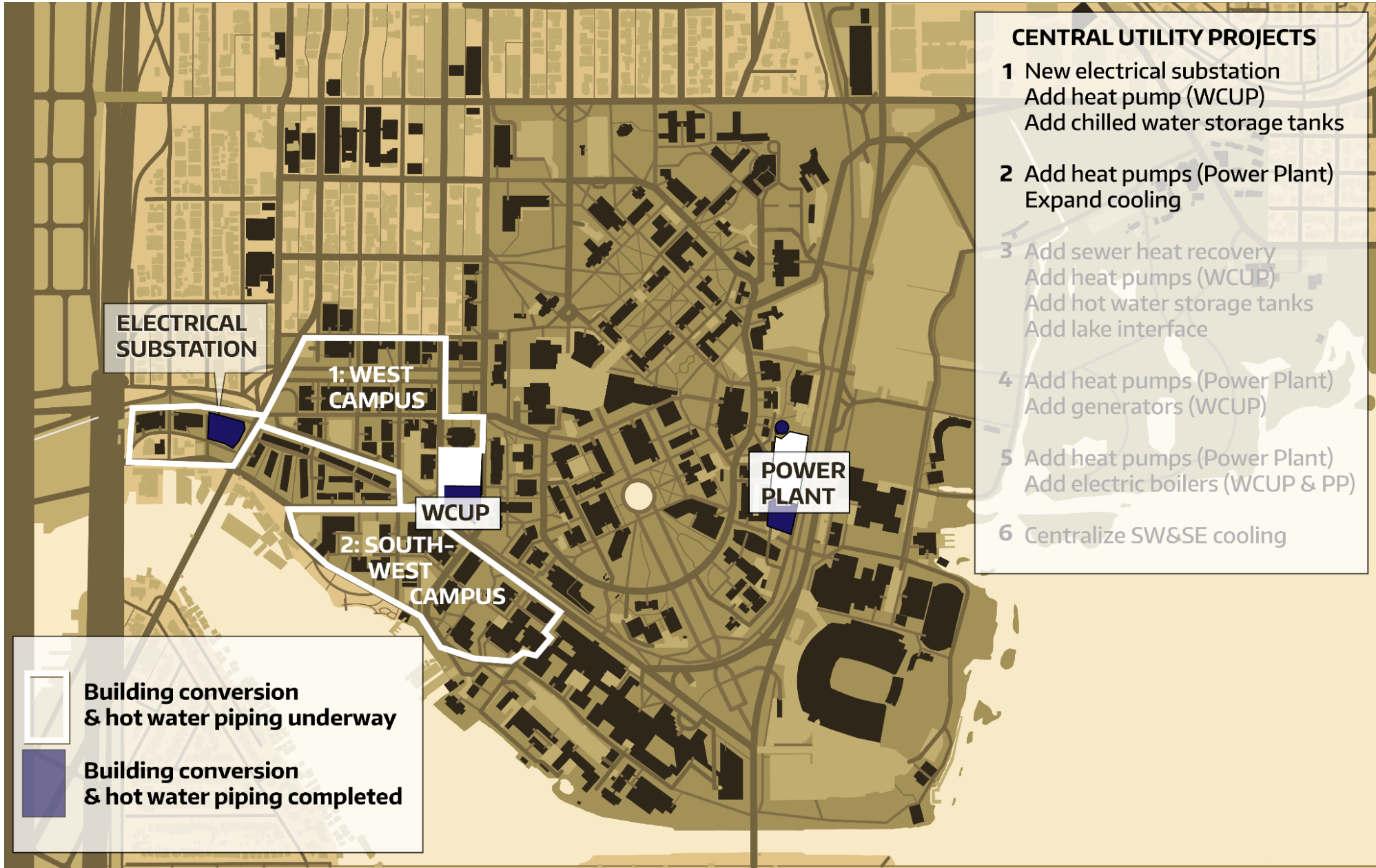
2025



Timeline

2025

2027

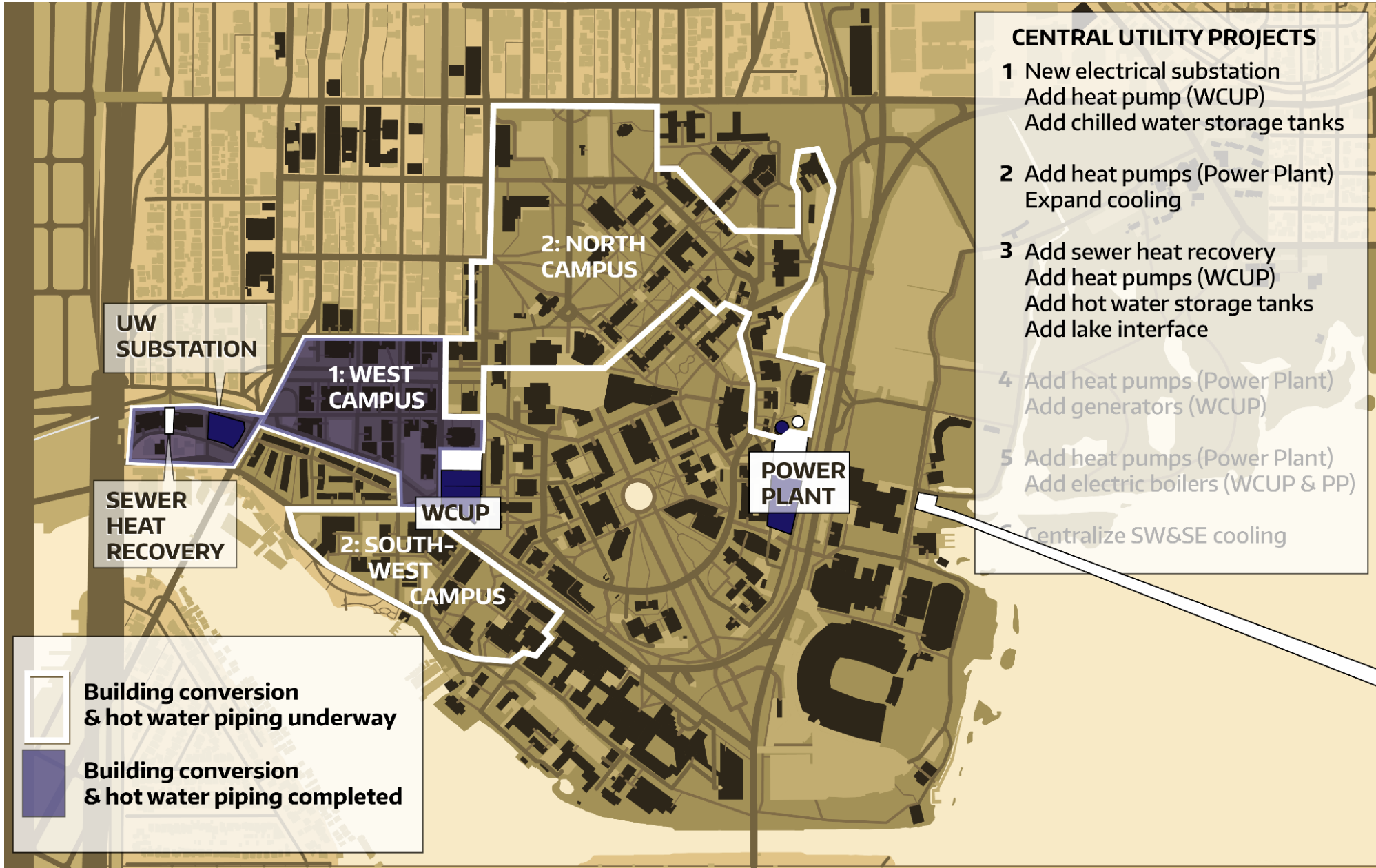


Timeline

2025

2027

2029



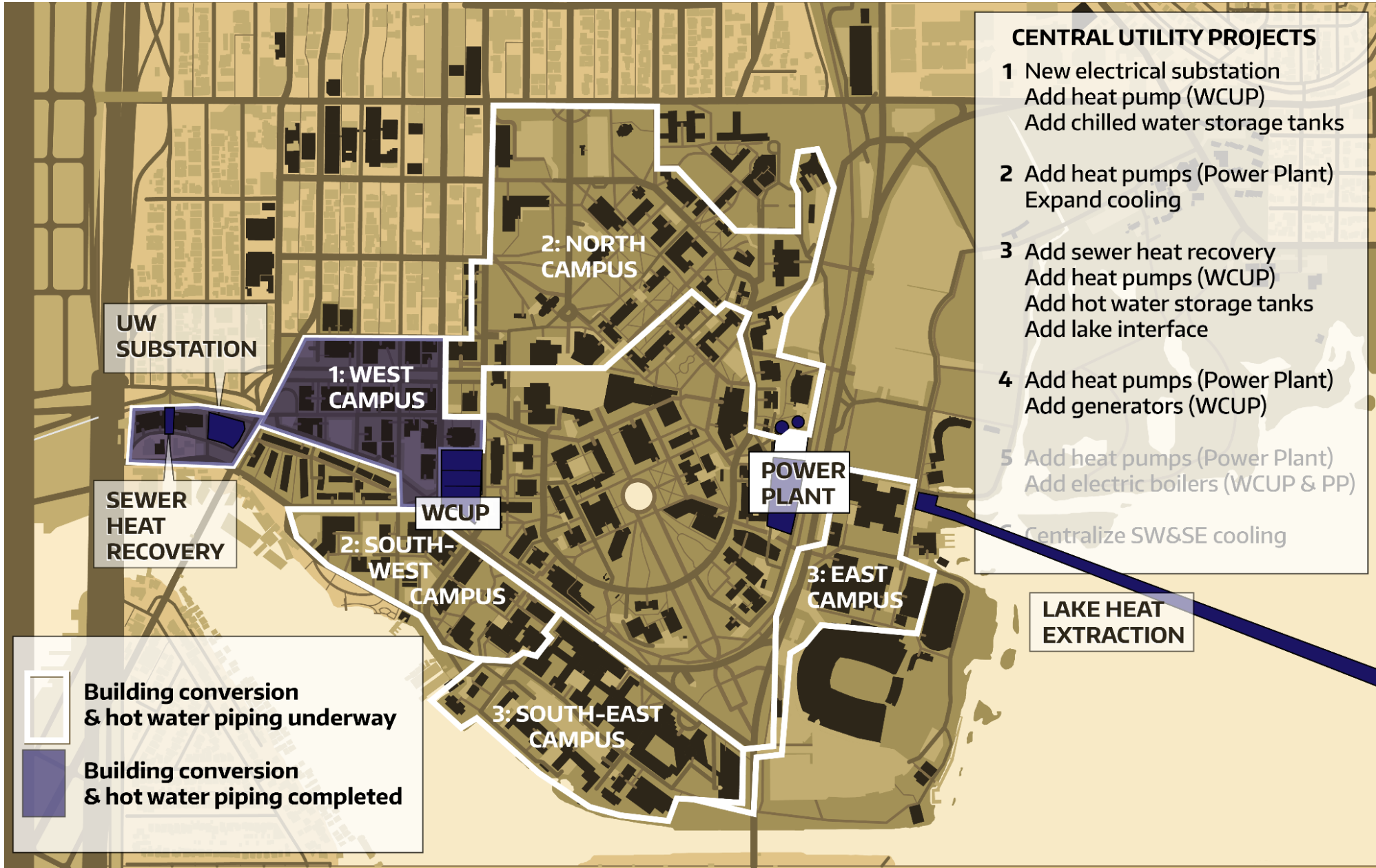
Timeline

2025

2027

2029

2031



Timeline

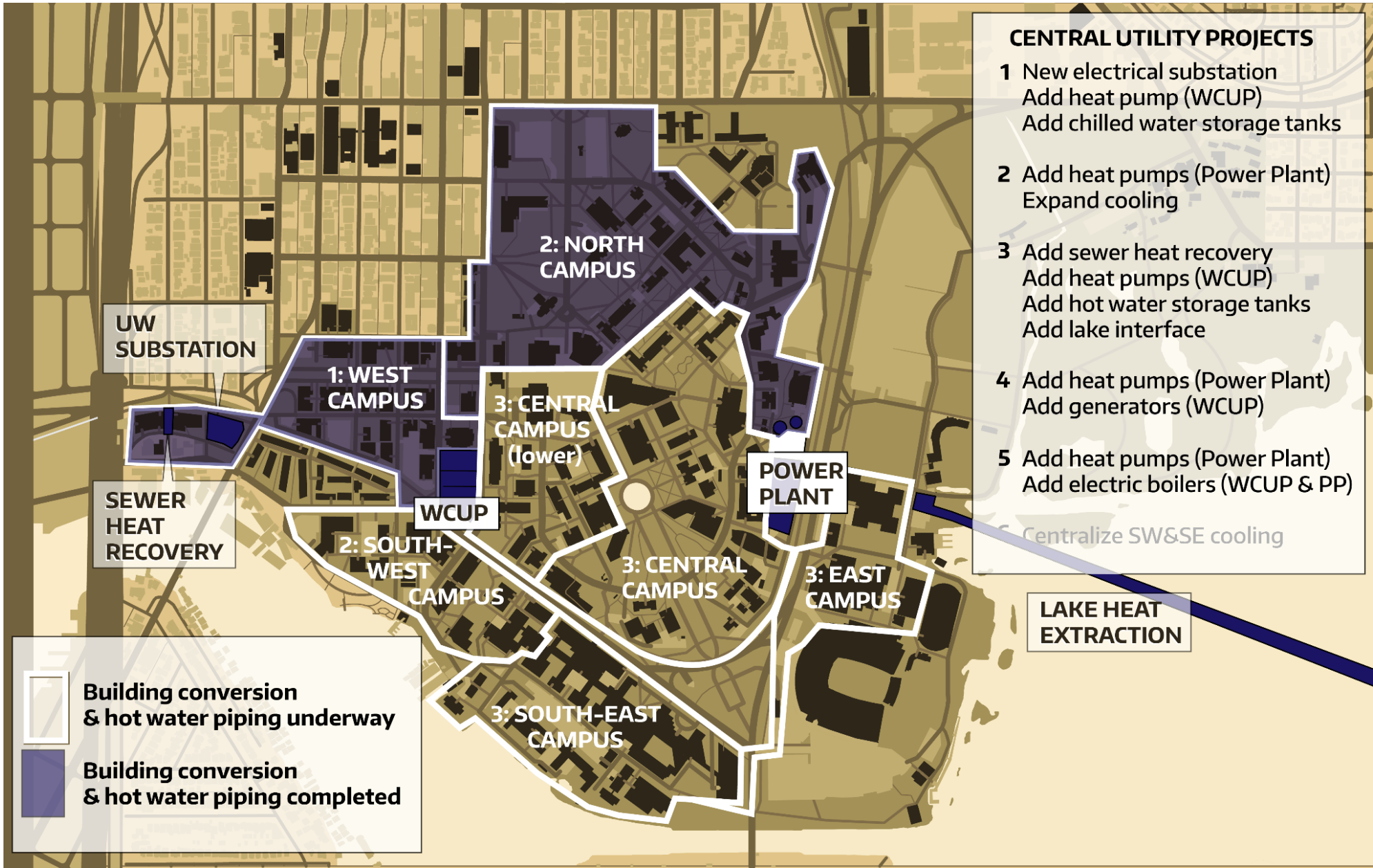
2025

2027

2029

2031

2033



Timeline

2025

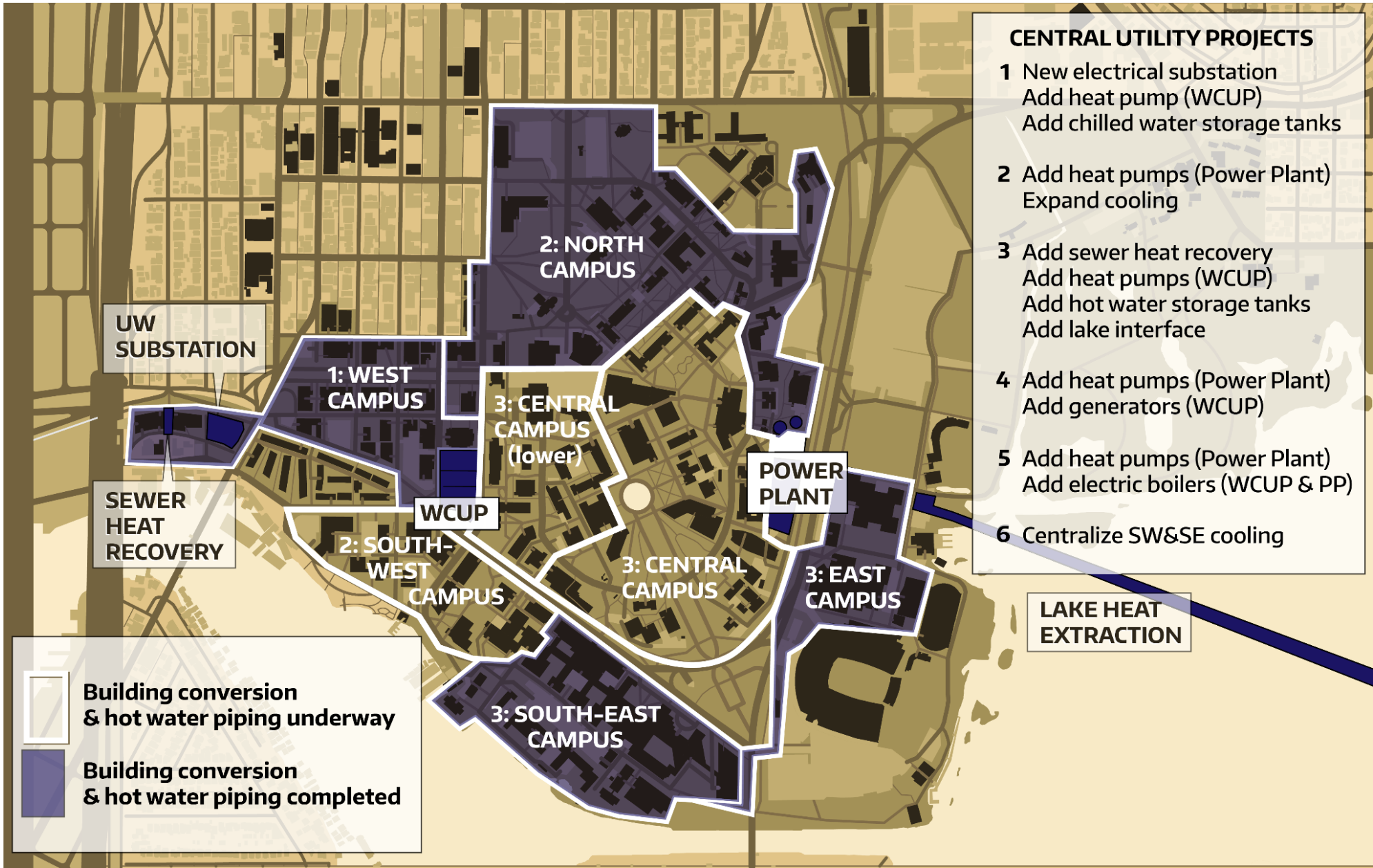
2027

2029

2031

2033

2035



Timeline

2025

2027

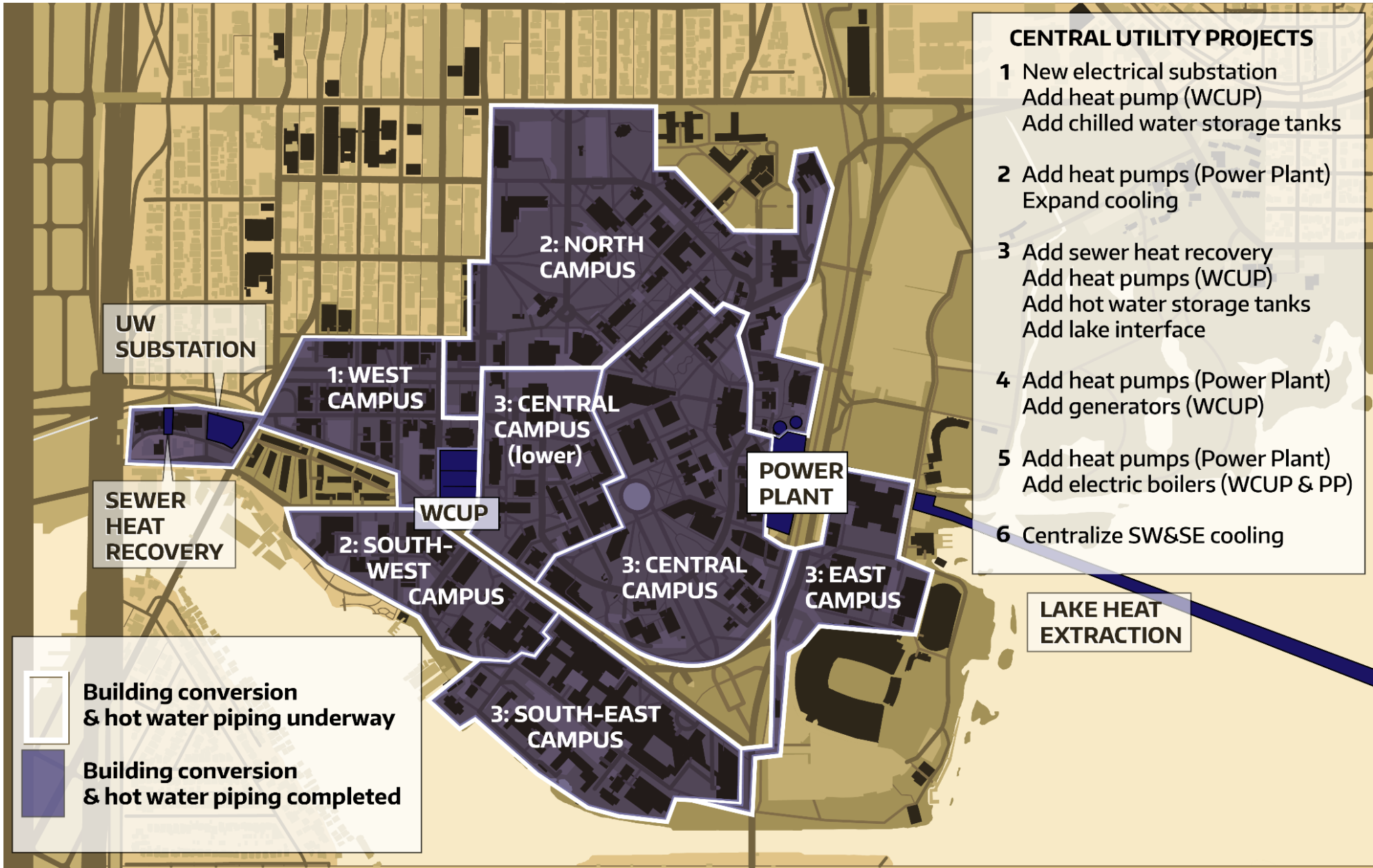
2029

2031

2033

2035

2037



Next Steps

- Advocacy to secure $292.6M for ‘25-’27 funding request to legislature
- Become one of 3 pilot projects for King County wastewater energy transfer
- Advance Lake Interface agency outreach and permitting process
- Advance UW substation negotiations with Seattle City Light