To: Karl Scholz, President

From: Thermal Transition Taskforce

Date: Feb. 5, 2024

RE: Recommendation & Report

This document provides background, findings, and recommendations of the Thermal Transition Taskforce, a group charted by former Interim President Philips in Fall of 2022 to develop a recommendation on the best means for the University of Oregon to recapitalize its campus heating infrastructure over the long-term to reduce its greenhouse gas emissions while balancing various constraints and risks. Below you will find the Taskforce's findings, and unanimous consensus recommendations for immediate actions and subsequent analysis as well notes on options which we did not believe made sense for the university to pursue at this time, but that had support from various campus and community groups. Appended to this transmission you will find a staff report outlining the extensive due diligence by the taskforce, its public outreach efforts, and various consultant reports which served as the basis for the financial and operational review of the workgroup.

Process:

The Taskforce first met in late fall 2022 and continued meeting through January 2024. During that time, it met either as a full workgroup or in various subgroups analyzing in detail specific issues related to our existing natural gas and steam heat distribution system, energy markets, regulatory and other issues. The taskforce focused on our primary responsibility which was to:

> *Recommend to the president a long-term plan to support the recapitalization of the University's campus heating infrastructure that is in alignment with our values and responsibility as prudent stakeholders with a long-term view, these include balancing;*
>
> - *reduction of greenhouse gas emissions,*
> - *assessment of technical feasibility risk,*
> - *resiliency of campus heat production to market and natural hazards,*
> - *limited disruption to student campus experience, and*
> - *maintenance of appropriate fiscal stewardship.*

These balancing principles were used as guides as we settled on a final recommendation. The Taskforce was thoughtful and intentional throughout its analytical process, members engaged in candid and open discussion and brought in their lived and professional experiences and expertise as well as their best understanding of campus constituent opinions.

During the process the Taskforce heard from technical experts, senior executives at relevant utilities, non-governmental organizations and government agency representatives to understand energy markets, production, distribution and the regulatory/policy landscape. As information became available the Taskforce engaged in extensive public outreach. This included six public forums, numerous class presentations, and hosting a public survey process with questions geared towards the specific issues at play for the Taskforce at that time. Specific takeaways from these public outreach events, and particularly from students, that were impactful to the Taskforce's deliberations and our eventual recommendation were as follows:

- Inaction or relying primarily on state or federal regulatory structures for decarbonization were not acceptable and that the university should be an active agent in its own decarbonization efforts.
- Reducing greenhouse gas emissions from the campus heating system was of keen interest to students, yet there was reluctance to pay for these efforts with student tuition. Therefore, reducing or minimizing the direct cost of such efforts was important.
- Acting in a concrete way now and realizing greenhouse gas reductions in the short-term was critical.

The Taskforce included members who initially expressed divergent preferred outcomes and objective functions. However as greater levels of clarity were established through the due diligence process, a consensus opinion formed. The findings and recommendation included in this document are a unanimous consensus of the Taskforce and are what we believe is the best step forward at this time to accomplish the specific remit of the Taskforce.

Taskforce Findings:

It is critical for the University of Oregon to begin the transition away from using fossil fuels to heat the Eugene campus. This will not happen in one step, and the Taskforce has developed a set of findings and recommendations, outlined below, that we believe are the most effective means of transitioning our campus from a predominantly fossil fuel-based heating system to an electrical source over time.

The Taskforce finds that:

1. Business as usual, or maintaining our existing heating system as is, is not acceptable going forward and that electrifying heat generation is likely to be the best pathway towards lowering greenhouse gas emissions from the campus heating system.
2. The university should take practicable steps to ensure that it is directionally consistent with climate science and relevant climate commitments at the local, state, national and international levels.
3. These commitments, and our understanding of climate science indicate that time is of the essence, and efforts that reduce greenhouse gas emissions in the near-term are more valuable than emissions reductions further out.
4. Concrete on-site actions by the university are critical to prepare it for forthcoming transitions in the energy markets and policy landscape. Carbon offsets may have cost advantages compared to infrastructure investments, but they would not fulfill the Taskforce charter as they would not improve the efficiency of the institution's heating system or help position it to respond to changing energy markets and policy landscapes.
5. Though there may be uncertainties around specific laws or regulations at the state or national level, there is likely to be ongoing and intensifying efforts to increase the cost of natural gas and decrease its availability. The University of Oregon should prepare itself by transitioning its heating system, at least partially, to electricity which will require a larger budget commitment for energy.
6. Completing a steam to hot-water conversion of the campus heat distribution system at this time is not advisable as the speed to implementation is likely to be over a decade in length, the costs are exorbitant, and the campus and in-building disruptions are likely to have significant impact to the education, research and public service missions of the university.
7. The amount of research and experimentation activity in industrial-scale heat production technology spurred by recently enacted legislation at the federal level (Inflation Reduction Act of 2022) has meaningfully increased the probability of technological innovation in steam heat generation.

Recommendation:

The Taskforce has developed the recommendation articulated below in alignment with the findings established above, the due diligence conducted over the past year by the Taskforce, and multiple years of administrative and consultant analysis. The recommended first step is

expected to immediately reduce estimated annual heating emissions by approximately 45%, is in line with the student requests[1] in 2019 to then President Schill which initiated much of the University of Oregon's CAP 2 process, and will position the UO to be directionally consistent with emissions reduction targets set by the International Panel on Climate Change (IPCC 2023), the U.S. pledge pursuant to the Paris Climate Agreement (2021), the State of Oregon's greenhouse gas reduction goals (EO 20-04), Oregon's Climate Protection Plan (CPP), and the City of Eugene's Community Climate Action Plan 2.0 (CAP 2.0). This change will re-assert UO's leadership on climate change, reduce UO's exposure to regulatory uncertainty, improve its resiliency to natural disasters, and position the university for possible future investments.

This recommendation reflects the Taskforce's best understanding of established and emerging climate science, regional energy policy, energy markets, and energy technologies, developed through a thorough due diligence process which relied on many University of Oregon as well as external experts and market participants. The Taskforce recognizes that the recurring incremental costs associated with any option, including the least cost alternative, are large relative to recurring budgets for critical operations with the university and in particular when compared to the historical $2 million dollars allocated to new strategic investments made on an annual basis.

Specifically, the Taskforce recommends two separate, but essential and intertwined actions:

1: Install 8MW Electrode Boiler (Option 2B) as Quickly as is Practicable. This option is expected to achieve the following:

- Shift 54% of steam heating from natural gas to electricity.
- Provide the fastest emissions reduction available to the university, as its implementation timeline is estimated to be within two to three years and requires limited supplemental infrastructure improvements.
- Reduces heating related greenhouse gas emissions up to 45% per year once operational.
- Provide a flexible foundation for a second phase thermal systems decarbonization plan which will take more time and analysis to implement. An 8 MW electric boiler can be:

[1] https://cpfm.uoregon.edu/sites/default/files/studentletter_cap2.pdf

    - Combined with a second electrode boiler to further reduce dependence on fossil fuels and reduce emissions, or
    - Re-purposed to provide clean peak heating, which means it can supplement a transition from a steam to hot water distribution system such as heat recovery chillers, geo-exchange and/or other steam-based heat production systems if such technologies mature over the coming years.
- Provide the least costly alternative available to the university and analyzed by the Taskforce.

2: Further decarbonization

An 8 MW Electrode Boiler (Option 2B) is a first step in realizing long-term decarbonization goals, not the final step. The Taskforce recommends that the President charge the Office of Sustainability with leading an intentional process of assessing next steps in decarbonizing the university's district heating system. This process should include annual public reporting to the President, Board of Trustees and campus communities through the Climate Action Plan 3 (CAP 3) scheduled for adoption during Spring 2024 and continuing for five years. Specifically, the Office of Sustainability should evaluate whether:

- Implementation of an 8 MW Electrode Boiler creates new opportunities by integrating thermal or electrical storage systems (batteries) that reduce demand during peak hours. These were not evaluated or studied by the Taskforce but may further reduce emissions and save money.
- Developments in emerging technologies, regulatory changes, federal and state climate/decarbonization incentives related to heat production or distribution systems like those found at the University of Oregon, that individually or in concert with each other, may be sufficient to prompt additional investments in greenhouse gas reductions.

Notes on other options:

The following options were considered in detail. The Taskforce does not recommend pursuing these options at this time for various reasons which are articulated below. Additional analysis can be found in the appended staff and consulting reports.

Business as Usual

- University of Oregon's primary heating system consists of two large natural gas (diesel backup) boilers one 60 klb/hour boiler and one 65 klb/hour boiler. Steam produced by the boilers is distributed via a network of steam pipes located underground that connect to the vast majority of campus buildings.
- This heating system currently releases just under than 25,000 tons of carbon dioxide into the atmosphere annually.
- Though this system is relatively inexpensive to operate, the Task Force recommends transitioning away from this heating system over time due its reliance on fossil fuels and resulting emissions.

18 MW Electrode Boiler ("Option 2A")

- Option 2A fully commits the university to a technology that may not be optimum over time due to its expense and efficiency characteristics. Efficiency in operations of electrical equipment will become increasingly important as more industries and individuals who currently utilize natural gas or other fossil fuels electrify and increase demand for electricity.
- An investment in Option 2A now may become a "stranded asset" in the medium- to long-term if other, more efficient, technology develops for generating heat at temperatures required for a steam heat distribution system in later years.
- The Taskforce believes it is advisable to make a first step towards electrification and then evaluate developments in the energy markets, industrial scale heating technology, the regulatory and governmental incentive fields.

Heat Pump Chillers ("Option 3") and Geo-exchange ("Option 4").

- The steam to hot-water conversion required by Option 3 and Option 4 consists of six two-year phases – if construction goes according to plan. Because of this the university would not see meaningful greenhouse gas emissions reductions for a prolonged period of time, which will hinder the institution's ability to reduce emissions as soon as possible.
- The campus and in-building conversion costs for a steam to hot-water distribution system are two to three times more expensive than was initially projected by the AEI report (2022).
- The campus and in-building disruption associated with the steam to hot-water conversion will be substantially more disruptive to mission critical education, research

and public service operations than originally understood or estimated. This disruption to normal operations for all or nearly all members of the campus community may be more than they can be reasonably bear.

- Steam to hot-water conversion is an “all-in” decision that, given the very large capital expenditures and associated debt cost, may force the institution to make significant cuts in education, research and public services or see dramatic increases in costs to students without direct state funding for the project that may negatively impact enrollment and affordability for at least the next 40 years.
- The debt funding necessary to accomplish Options 3 and 4 may not be available in financial markets or may be sufficiently costly that it is for all practical purposes unattainable because the project is not associated with any new revenues or sufficient cost savings to justify it on economic terms.
- The federal government has not yet clarified if steam to hot-water conversions, such as those contemplated by the Taskforce, would be eligible for significant incentives under the Inflation Reduction Act.
- Recent technology developments, still in early stages, suggest that a hot-water conversion may not be necessary to achieve our long-term decarbonization goals. The UO should allow these developments time to mature.

Additional Information:

- Given the information available to the Taskforce, Option 2A is in all cases more appealing in comparison to Options 3 or 4 because of their operational disruption and extremely high cost on an absolute and relative bases in terms of an emissions reduction, annual and aggregate net-present value cost.

Estimated Total Project Costs and Marginal Annual Costs:

	BAU	BAU (with CPP)	Option 2a (18MW)	Option 2b (8MW)	Option 3	Option 4
Capital Construction Costs (Present Value, Financed)	$105,000,000	$105,000,000	$179,300,000	$147,300,000	$1,096,800,000	$1,174,100,000
IRA Benefit (Present Value)	$0	$0	$0	$0	-$3,400,000	-$27,200,000
Marginal Cost vs BAU	-	$0	$74,300,000	$42,300,000	$991,800,000	$1,069,100,000
Operating and Maintenance Costs (Present Value, Cumulative)	$1,657,000,000	$1,699,600,000	$2,020,800,000	$1,864,500,000	$1,599,700,000	$1,596,900,000
Marginal Cost vs BAU	-	$42,600,000	$363,800,000	$207,500,000	-$57,300,000	-$60,100,000
Total Option Cost (Present Value, Financed)	$1,762,000,000	$1,804,600,000	$2,200,100,000	$2,011,800,000	$2,696,500,000	$2,771,000,000
Total Marginal Cost vs BAU	-	$42,600,000	$438,100,000	$249,800,000	$934,500,000	$1,009,000,000
2038 Annual Operating + Maint + Debt Service (Present Value)	$27,500,000	$28,200,000	$35,600,000	$31,800,000	$66,300,000	$69,900,000
2085 Annual Operating + Maint + Debt Service (Present Value)	$29,900,000	$30,600,000	$35,600,000	$33,200,000	$28,000,000	$27,700,000
Total Cumulative Emissions (2025-2085, MTCO2e)	1,686,000	774,000	438,000	978,000	805,000	529,000
Cumulative Emissions Reduction (2025-2085, MTCO2e)	-	(912,000)	(1,248,000)	(708,000)	(881,000)	(1,157,000)
Cumulative Emissions Reduction (%) (vs BAU)	-	54%	74%	42%	52%	69%
Cost per MTCO2e Reduction (Present Value)	-	$47	$351	$353	$1,061	$872

Annual Costs in 2028	BAU	BAU w/ CPP	Option 2a	Option 2b
2028 Nominal Value	$23,200,000	$23,500,000	$32,700,000	$28,400,000
Marginal cost vs BAU		$300,000	$9,500,000	$5,200,000
Present Value	$20,000,000	$37,500,000	$28,200,000	$24,500,000
Marginal cost vs BAU		$17,500,000	$8,200,000	$4,500,000

Annual Costs in 2038	BAU	BAU w/ CPP	Option 3	Option 4
2038 Nominal Value	$42,800,000	$43,900,000	$103,300,000	$108,800,000
Marginal cost vs BAU		$1,100,000	$60,500,000	$66,000,000
Present Value	$27,500,000	$28,200,000	$66,300,000	$69,900,000
Marginal cost vs BAU		$700,000	$38,800,000	$42,400,000

Thermal Transition Taskforce Membership:

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