WISEWOOD ENERGY

# BIOMASS ENERGY FOR THE OSU-CASCADES CAMPUS

## PRELIMINARY ANALYSIS


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Wisewood Energy


**OSU-C Biomass Advisory Meeting**

May 10, 2017

# ABOUT WISEWOOD ENERGY

## Our Mission

We outfit communities and businesses with state-of-the-art biomass energy systems that strengthen local economies, lower heating costs and promote environmental stewardship

Technology in Service of Community and Environment

# OUTLINE

- Project background
- District energy model
- Emissions and air quality
- Central Utility Plant
- Next steps
- Community scale biomass examples
- Group discussion

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# PROJECT BACKGROUND

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- **OSU-C begins master campus planning** with the Long Range Development Planning (LRDP) team
- **OSU-C receives funds from 2016 USDA Wood Innovations Funding** to study biomass feasibility alongside master planning
- **OSU-C retains Wisewood Energy** to provide biomass analysis for realistic campus scenarios
- **LRPD team develops five energy efficiency scenarios**, and recommends biomass central heating
- **Wisewood Energy uses LRPD data** to conduct biomass analysis

# ENERGY TECHNOLOGIES CONSIDERED

## Thermal Energy Sources

| OPTION | EVALUATED? |
|---|---|
| Natural gas | No: Fossil fuel based |
| Biomass | Yes |
| Biomass with Geoexchange | Yes |
| Geoexchange without biomass | No: Heating/cooling loads unbalanced, ground temperature issues, not cost effective |
| Geoexchange with air ource heat pumps | No: Heat pumps increase need for PV |

Table adapted from PAE Engineers.

# ENERGY TECHNOLOGIES CONSIDERED

## Electrical Energy Sources

| OPTION | EVALUATED? |
|---|---|
| Wind | No: Inadequate wind resources, higher maintenance needs, intermittent generation |
| Photovoltaic | Yes |
| Biomass with Cogeneration | No: Consider for future |

Table adapted from PAE Engineers.

# LRDP ENERGY SCENARIOS

| SCENARIO | DESCRIPTION | CAMPUS EUI (KBTU/SF/YR) | GEOTHERMAL | BIOMASS | ANNUAL HEAT DEMAND |
|---|---|---|---|---|---|
| **GOOD** | Biomass central heat<br>Distributed cooling<br>Buildings designed to code | 79 | No | Yes | 62.7 MMBtu |
| **BETTER** | Biomass central heat<br>Distributed cooling<br>Buildings exceed code | 56 | No | Yes | 48.0 MMBtu |
| **BETTER PLUS** | Biomass and geoexchange<br>central heating and cooling<br>Buildings exceed code | 49 | Yes | Yes | 48.0 MMBtu |
| **BEST** | Biomass central heat<br>Distributed cooling<br>Buildings passive as applicable | 38 | No | Yes | 29.5 MMBtu |
| **BEST PLUS** | Biomass and geoexchange<br>central heating and cooling<br>Buildings passive as applicable | 33 | Yes | Yes | 29.5 MMBtu |

Table adapted from PAE Engineers.

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## Biomass Energy for the OSU-C Campus

# DISTRICT ENERGY MODEL

# BIOMASS SYSTEM SIZING

- **Determine optimum biomass boiler size** for efficiency and effectiveness
- **Design biomass for full campus buildout**; realistic construction would be in phases
- **100% biomass heating** in Good Scenario
- **70% biomass heating, 30% geoexchange** heating (100% geoexchange cooling) in Best Plus

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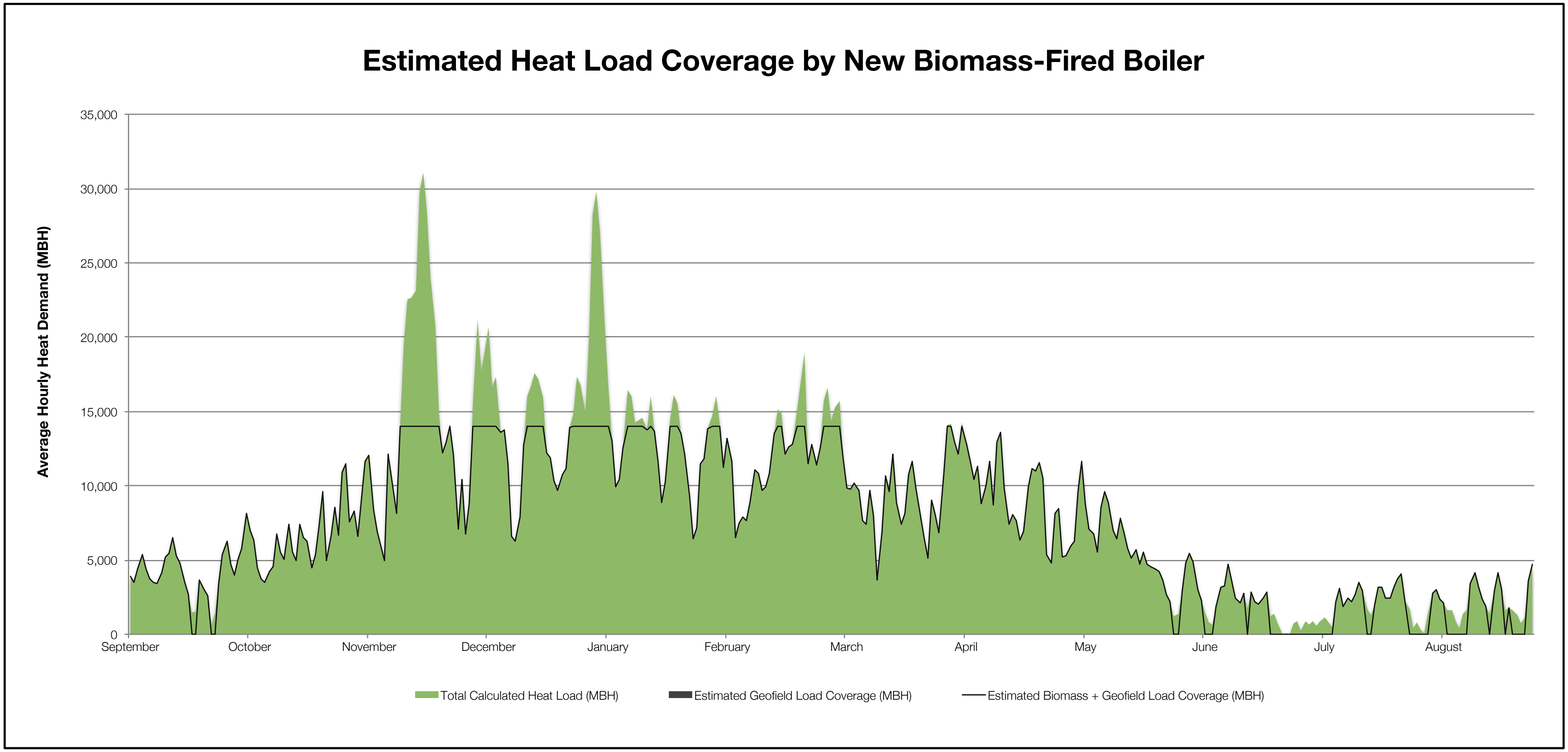
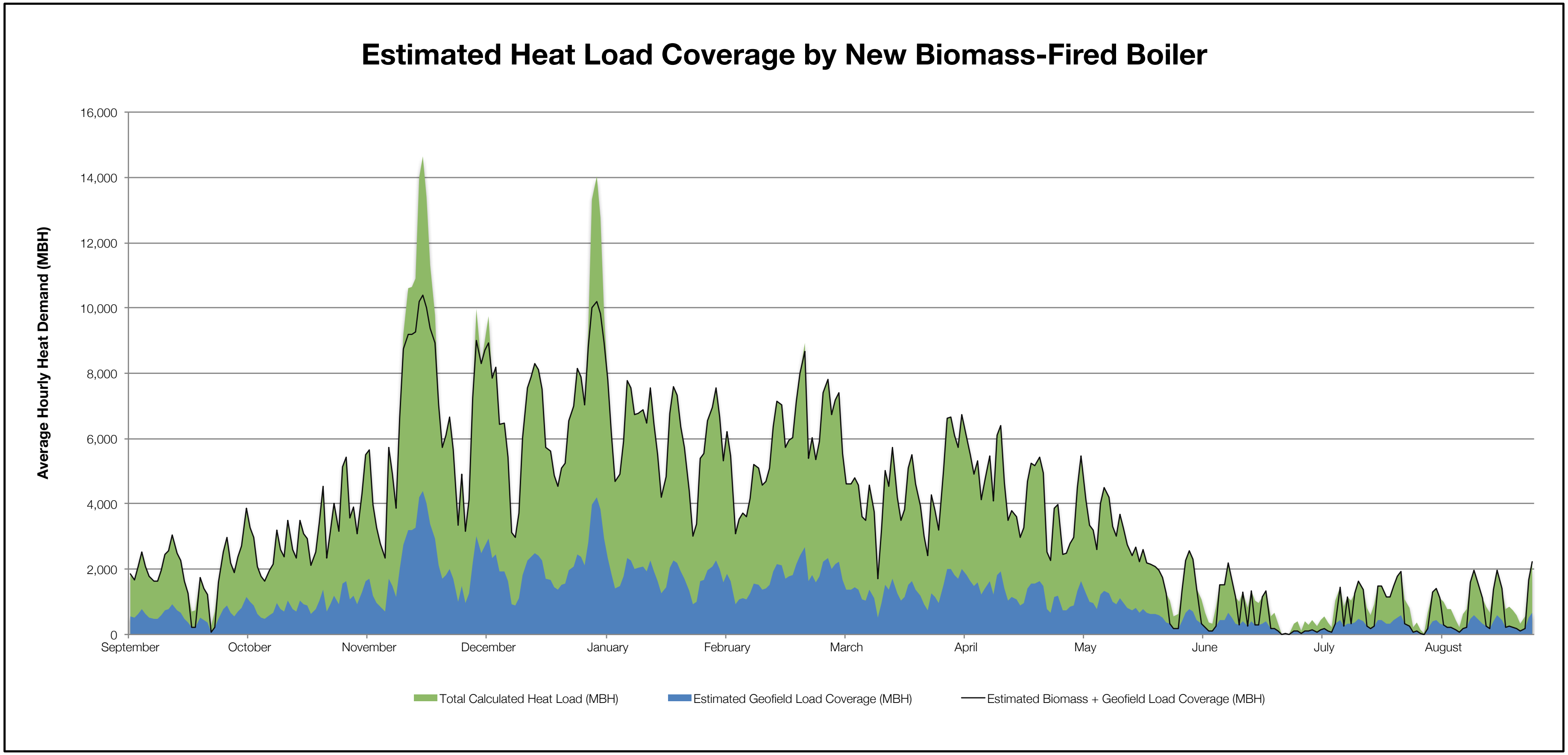
# BIOMASS HEAT LOAD: GOOD SCENARIO



# BIOMASS HEAT LOAD: BEST PLUS SCENARIO



# GOOD AND BEST PLUS SUMMARY

| | GOOD | BEST PLUS |
|---|---|---|
| BOILER OUTPUT (MBH) | 14,000 | 6,000 |
| NON-GEOFIELD HEAT LOAD COVERED BY BIOMASS | 90% | 94% |
| FUEL CONSUMPTION (GT/YR)* | 5,300 | 1,600 |
| CUP FOOTPRINT (SQ FT)** | 11,400 | 8,900 |
| ON-SITE STORAGE | 196 tons | 60 tons |
| FUEL DELIVERIES | 1 - 10x per week | ≤1 - 3x per week |

*Assumes 35% moisture content wood fuel
**Footprint includes fuel storage

# FUEL COST COMPARISON

| FUEL SOURCE | NATURAL GAS BAU GOOD SCENARIO | BIOMASS GOOD SCENARIO | NATURAL GAS BAU BEST PLUS SCENARIO | BIOMASS BEST PLUS SCENARIO |
|---|---|---|---|---|
| NATURAL GAS | $502,000 | $48,000 | $148,000 | $9,000 |
| BIOMASS | | $134,000 | | $41,000 |
| ELECTRICITY | $2,000 | $50,000 | $1,000 | $22,000 |
| TOTAL | **$504,000** | **$232,000** | **$149,000** | **$72,000** |

**Savings from BAU: ~$272,000**

**Savings from BAU: ~$77,000**

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# FUEL CONSUMPTION AND SUPPLY

- 1,600 – 5,300 GT/yr, 35% moisture content
- Boiler able to utilize material up to 55% moisture content, <4" particle size
- Unlocks most readily available, inexpensive fuel
- Recent study determined up to 280,000 GT/yr biomass available in Jefferson, Crook, Deschutes County
- Common practices for biomass residual remaining from management activities include burning, mastication, and leaving on-site

# CARBON IMPACTS

- Biomass considered carbon neutral in the UN and European Union
- Carbon impacts of biomass depend on site-specific characteristics
  - Feedstock and alternative fate
  - Management practices
  - Energy technology
  - Displaced fuel

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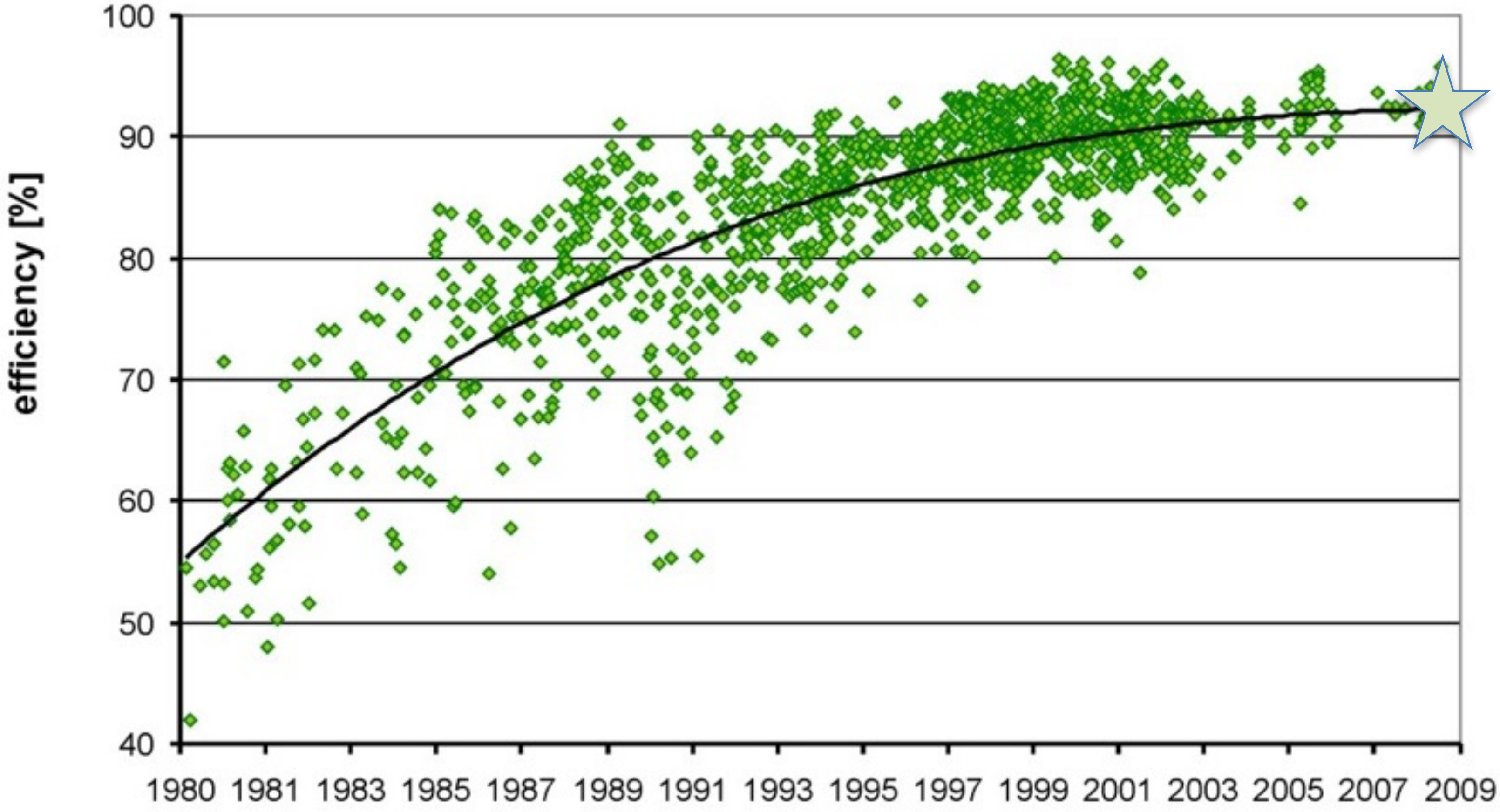
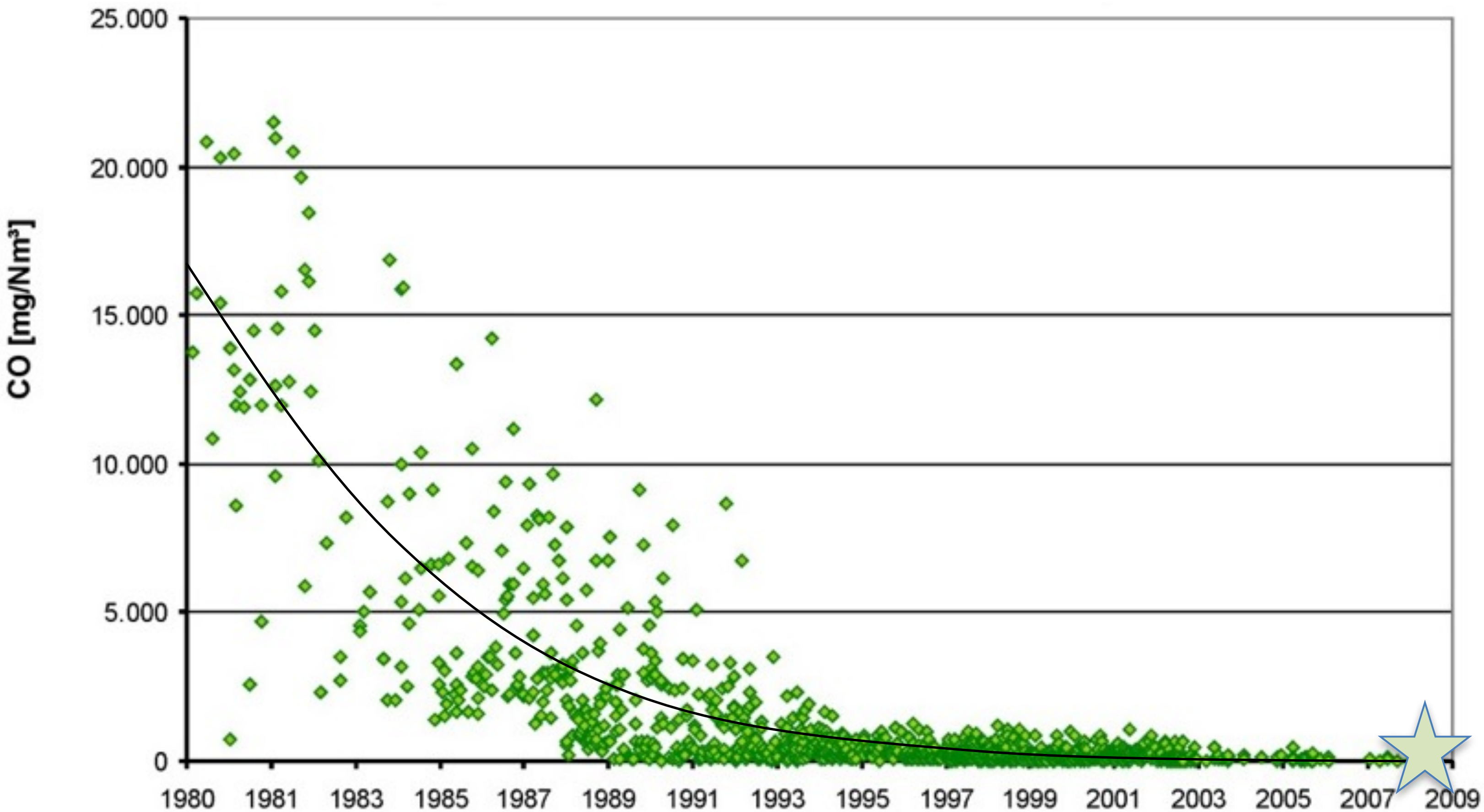
# EMISSIONS AND AIR QUALITY

# EFFICIENT




Development of emissions of Austrian Biomass Boilers, measured by the federal agency for agricultural engineering Wieselburg (BLT)

# CLEAN

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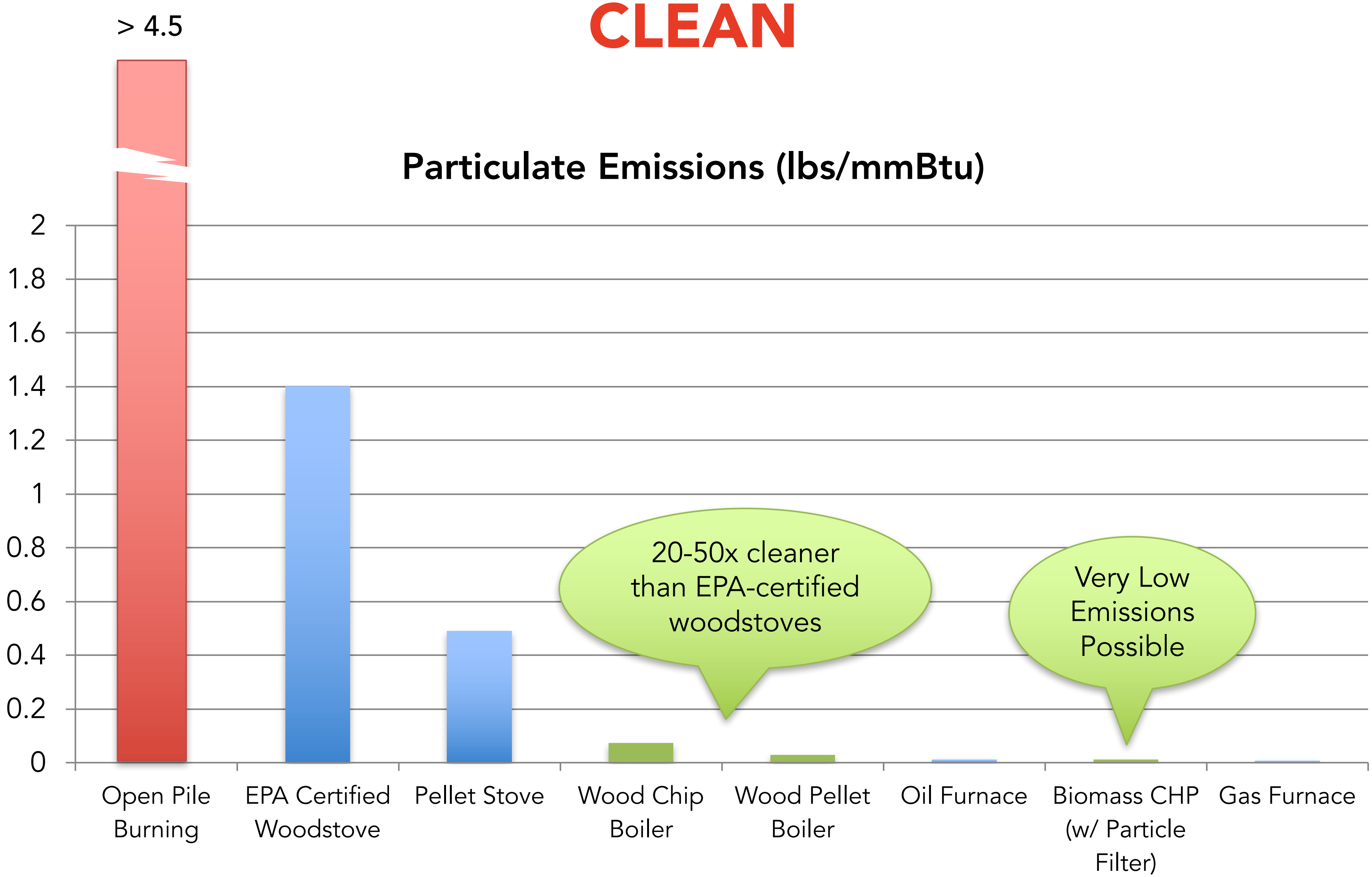

> 4.5
Particulate Emissions (lbs/mmBtu)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20-50x cleaner than EPA-certified woodstoves
Very Low Emissions Possible
Open Pile Burning
EPA Certified Woodstove
Pellet Stove
Wood Chip Boiler
Wood Pellet Boiler
Oil Furnace
Biomass CHP (w/ Particle Filter)
Gas Furnace

# EMISSION CONTROLS FOR OSU-C

- Dynamic feedback from oxygen and temperature sensors in the combustion chamber and flue gas stream to optimize combustion
- Multi-cyclone array
- Electrostatic precipitator

# ESTIMATED EMISSIONS

| EMISSION | GOOD (TONS/YR) | BEST PLUS (TONS/YR) |
|---|---|---|
| **CARBON MONOXIDE (CO)** | 0.899 | 0.276 |
| **NITROGEN OXIDES (NOX)** | 6.301 | 1.932 |
| **PARTICULATE MATTER (PM)** | 0.281 | 0.086 |
| **VOLATILE ORGANIC COMPOUNDS (VOC)** | 0.112 | 0.034 |
| **TOTAL** | **7.593** | **2.329** |

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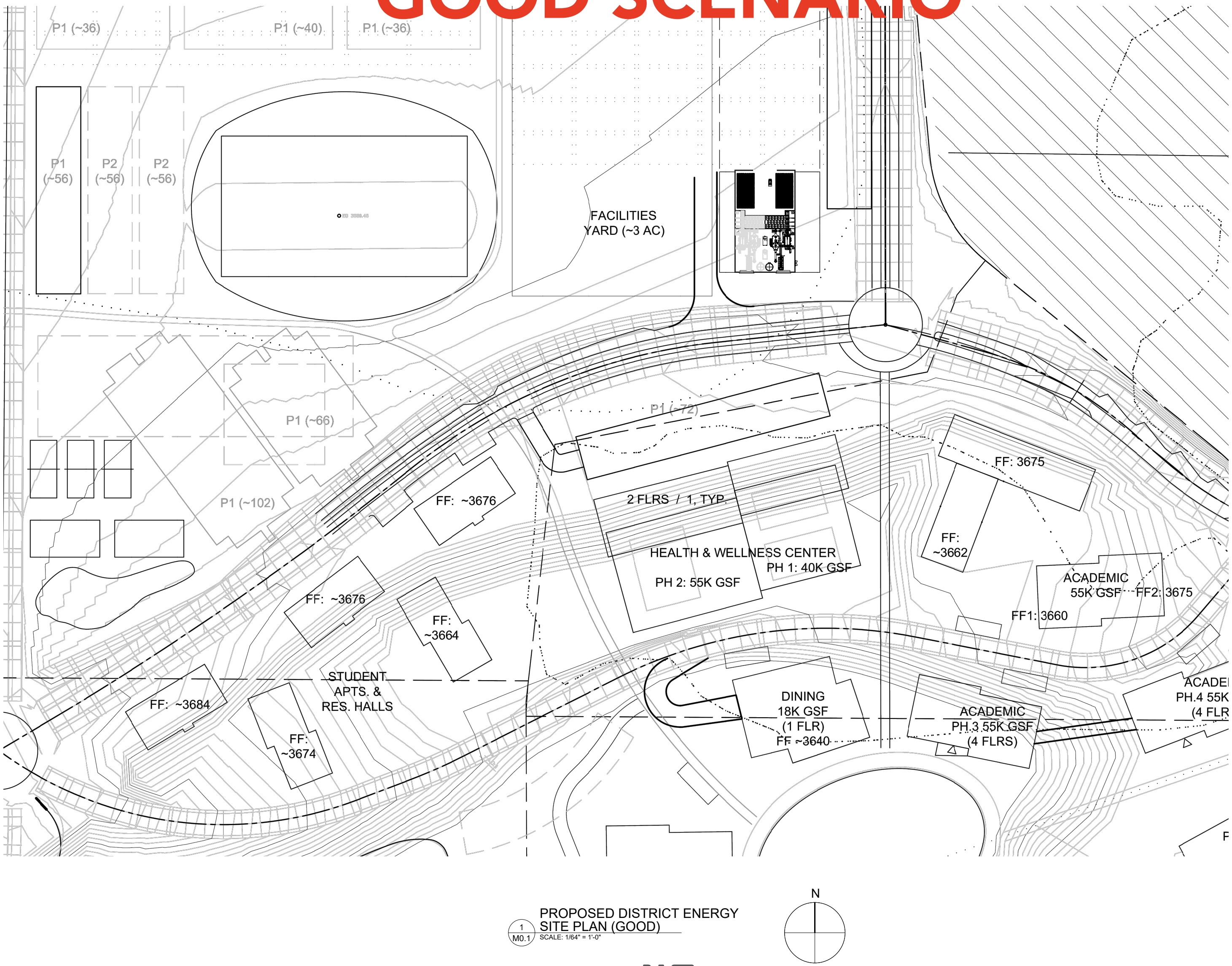
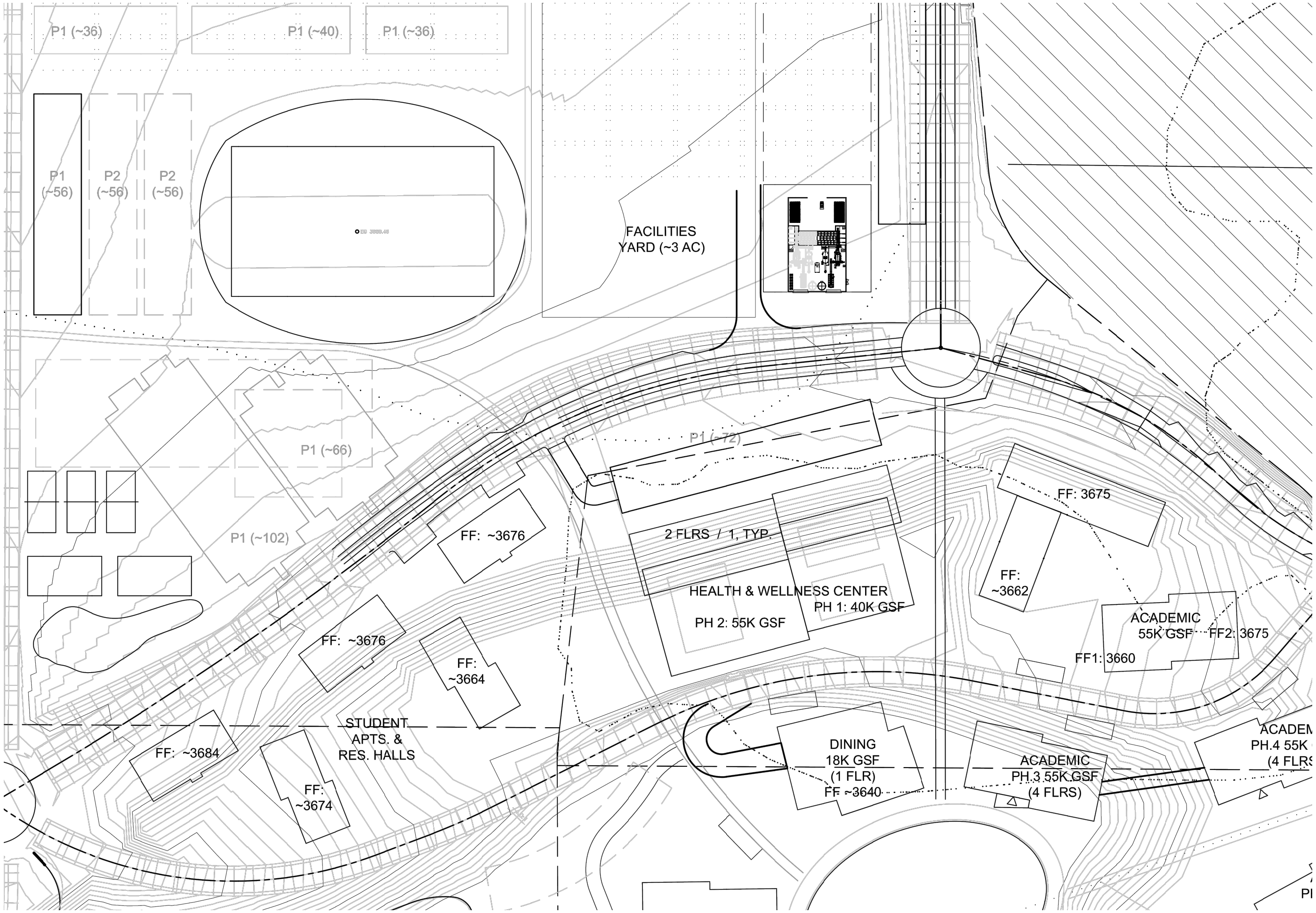
# CENTRAL UTILITY PLANT

# PRELIMINARY SITE PLAN: GOOD SCENARIO



# PRELIMINARY SITE PLAN: BEST PLUS SCENARIO




PROPOSED DISTRICT ENERGY SITE PLAN (BEST PLUS)
1 M0.1
SCALE: 1/64" = 1'-0"

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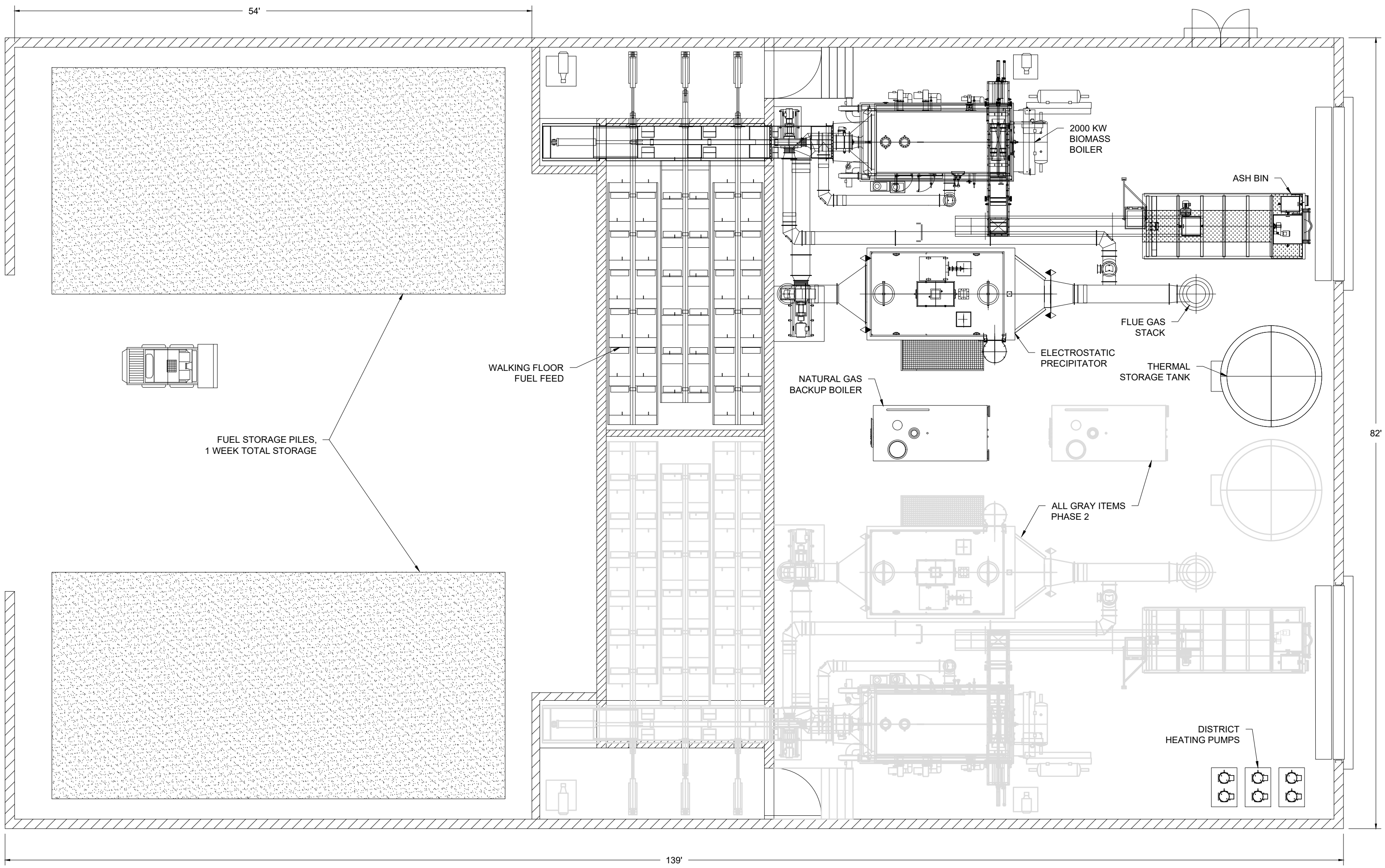
# PRELIMINARY MECHANICAL PLAN: GOOD SCENARIO

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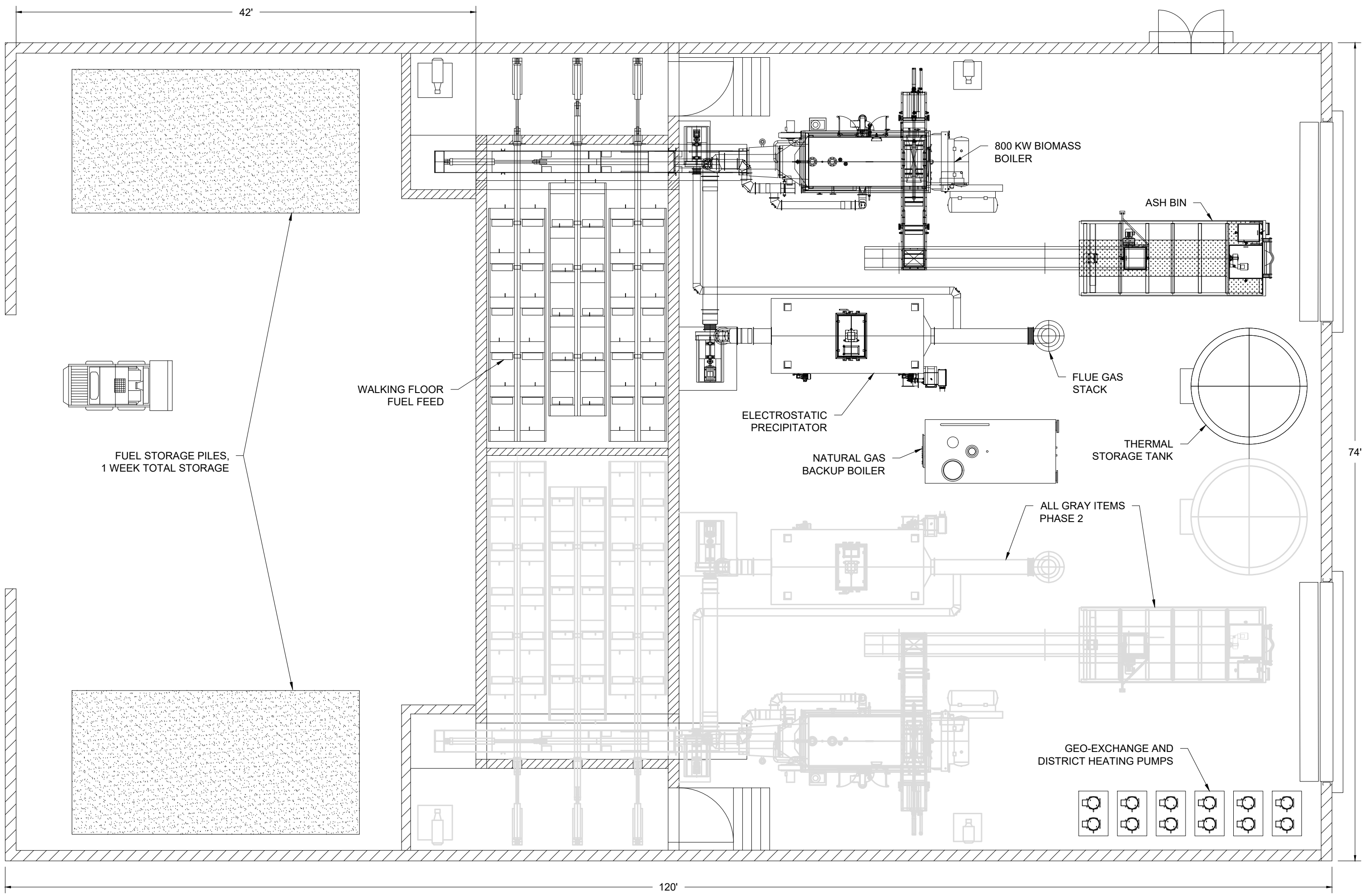
# PRELIMINARY MECHANICAL PLAN: BEST PLUS SCENARIO



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Community Scale Biomass

# PROJECT EXAMPLES


# KETCHIKAN INTERNATIONAL AIRPORT

Pellet Boiler in Ketchikan, Alaska

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# HARNEY COMMUNITY ENERGY

Wood Chip District Heating in Burns, Oregon

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Biowärme Haus i. E.

# NEXT STEPS

- Incorporate feedback from biomass advisory meeting
- Meet with ODEQ to discuss air quality and emissions
- Incorporate final LRDP master planning documentation

# THANK YOU!

WISEWOOD ENERGY

Technology in Service of Community and Environment


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# DISCUSSION QUESTIONS

## Forest Health and Management

- What are the current and future forest management policies related to woody biomass harvesting to promote forest health and management?

## Air Quality

- What are current air quality standards/regulations for biomass emissions and what, if any, are health implications? How does this compare to other emission sources?

## Carbon

- Will open pile burning continue to be part of forest management practices in the area? What is an appropriate life-cycle framework to discuss carbon?