HKIT Architects - Work Based Learning

Building for the Future

Presented to MLA Students
November 15, 2023

OAKLAND UNIFIED SCHOOL DISTRICT
Community Schools, Thriving Students

Agenda

Establishing Schema

- What is sustainable design? How do we heat and cool buildings?
  a. What do we already know? What do we want to learn?
- How do buildings use energy?
  a. What criteria do architects consider when building something new?
  b. When they are working on an older building?

Highlighting the Design Process

- Pros and cons of different systems

Laying the Foundation for Recommendations

- Needs and opportunities at MLA Maxwell & across Oakland

Norms

- Center Student Voice & Learning
- Be Solution-Oriented
- Consider the whole picture
- Ask questions: all questions are good questions
- Take space, make space

What is sustainable design?

What do we already know?	What do we want to learn?

What is sustainable design?

What do we already know?	What do we want to learn?
In 1987, the United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Natural Cycles How Applied to Built Environment Varies Scales Vary (Family - Building - Neighborhood - City - Region - Nation - World) Resource efficient (water, materials, electricity, air, etc.) Healthy - Offset Energy Use - Carbon	

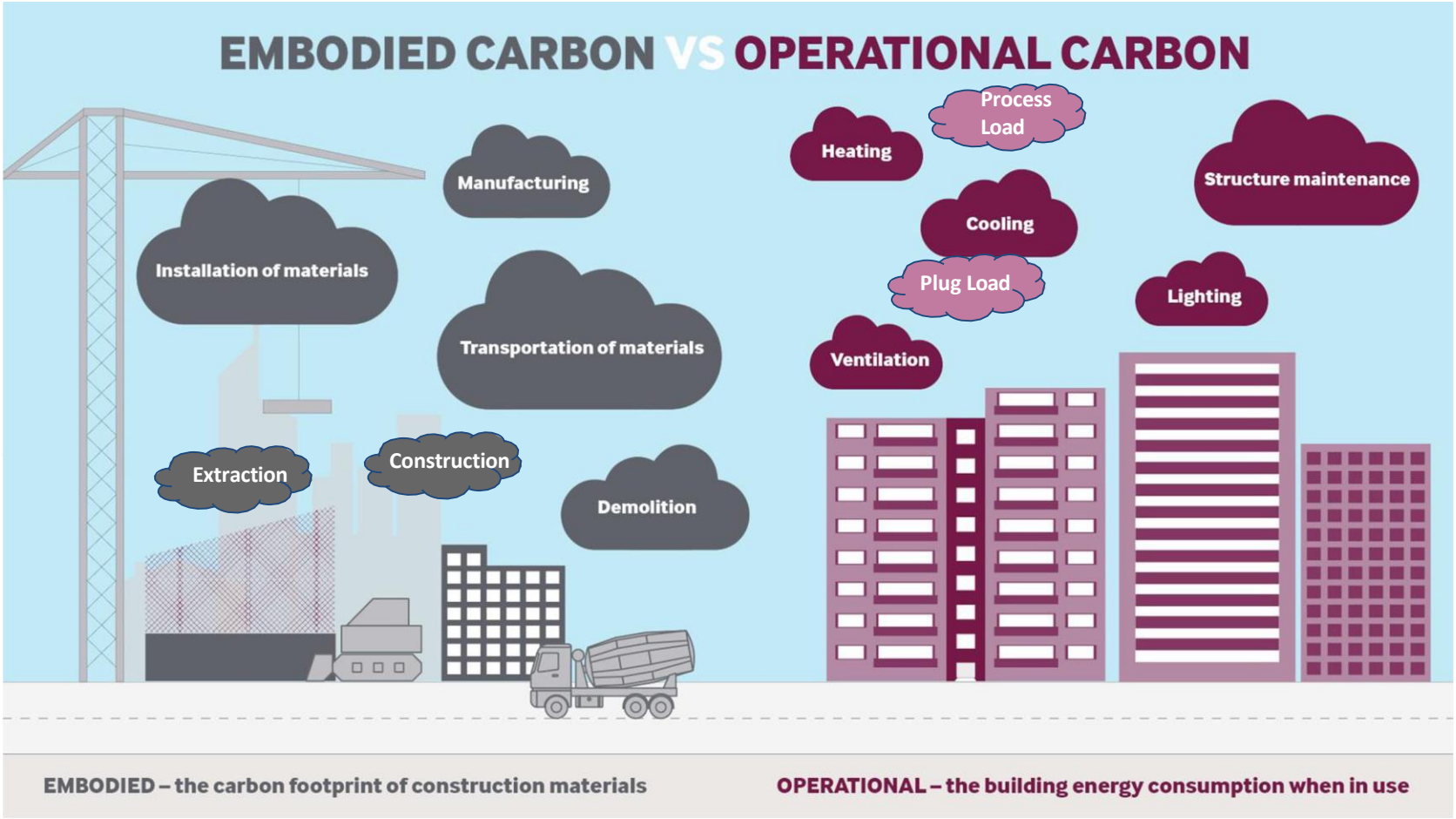
Embodied vs. Operational Carbon

Embodied carbon

Embodied carbon is the amount of carbon emitted during the making of a building's materials and the construction of a building. The extraction of raw materials, the manufacturing and refinement of materials, transportation, installation and disposal of old supplies can all produce embodied carbon emissions. Essentially, embodied carbon is built into the fabric of building.

Operational carbon

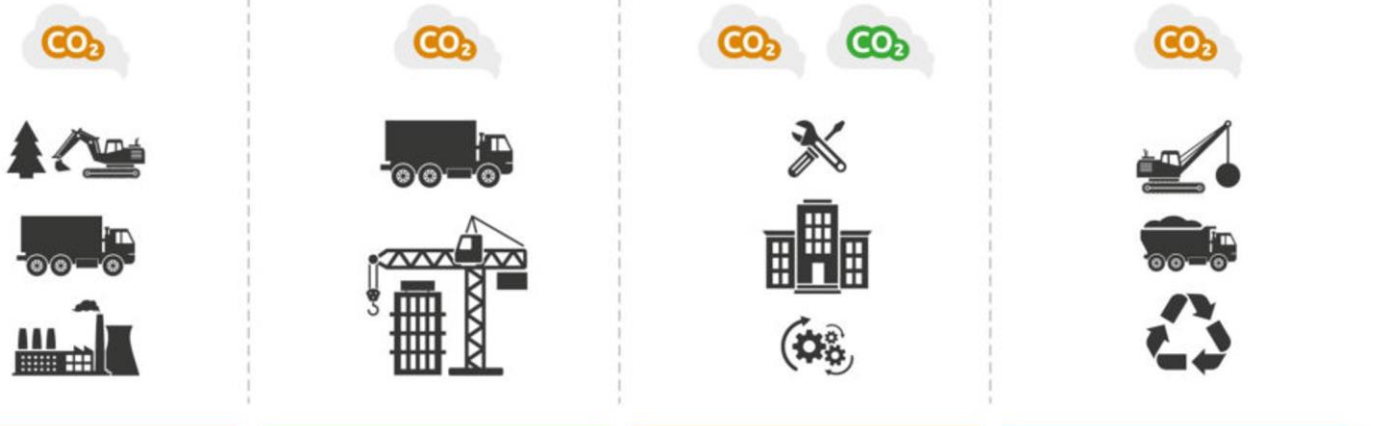
Operational carbon is the amount of carbon emitted once a building is in use. It's easier to measure than embodied carbon and has been a reduction priority for a while now. The aim is to retrofit existing structures and design new buildings with energy efficient practices, passive design and active systems for heating, cooling, etc., but also to shift to electricity as a power source. As well, producing power at the building from renewable energy sources to offset energy use can offset or eliminate operational carbon


EMBODIED CARBON VS OPERATIONAL CARBON
Manufacturing
Installation of materials
Transportation of materials
Extraction
Construction
Demolition
Process Load
Heating
Structure maintenance
Cooling
Plug Load
Lighting
Ventilation
EMBODIED – the carbon footprint of construction materials
OPERATIONAL – the building energy consumption when in use

The four primary stages of 'Embodied' and 'Operational' Carbon across a building's end-to-end life cycle.

CO_2 Embodied Carbon

CO_2 Operational Carbon



Production

- Extract raw materials
- Transportation
- Manufacturing

Construction

- Transportation to site
- Building construction

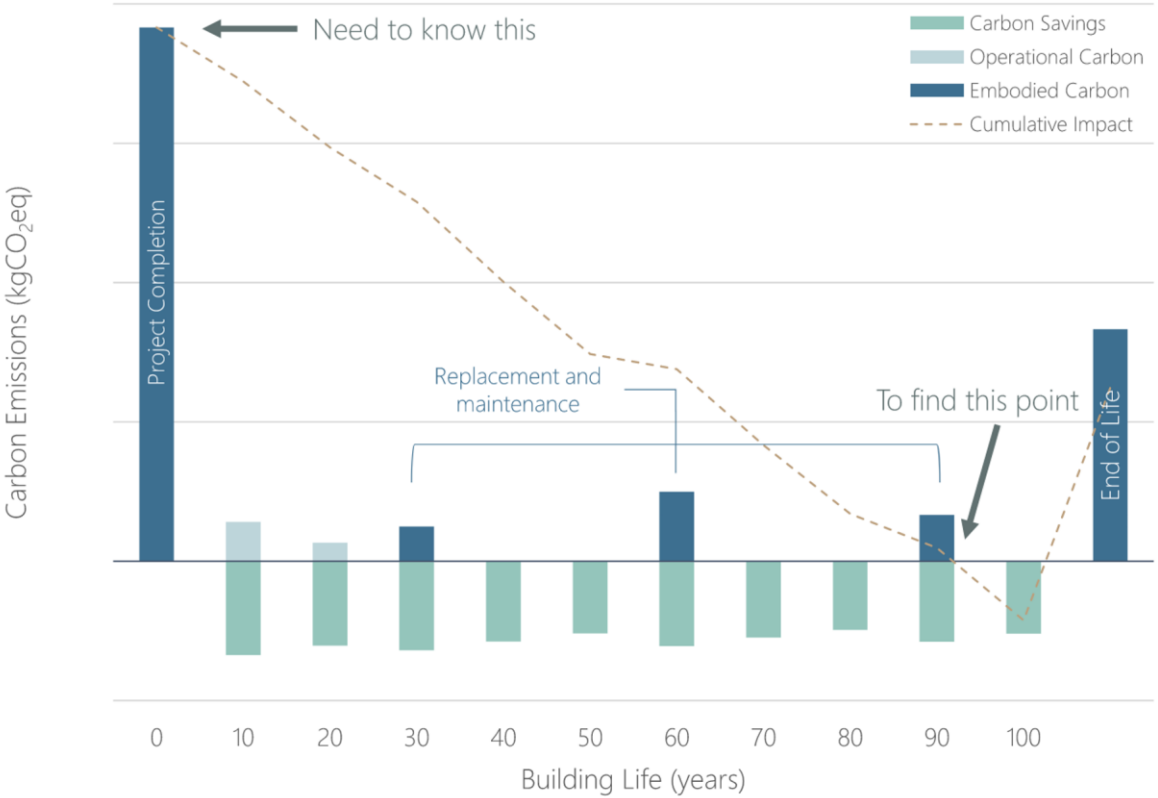
Use

- Maintenance & repair
- Replacement
- Operations

End of Life

- Demolition
- Haul away waste
- Recycling & reuse

BUILDING LIFETIME & THE CARBON "PAYBACK" PERIOD



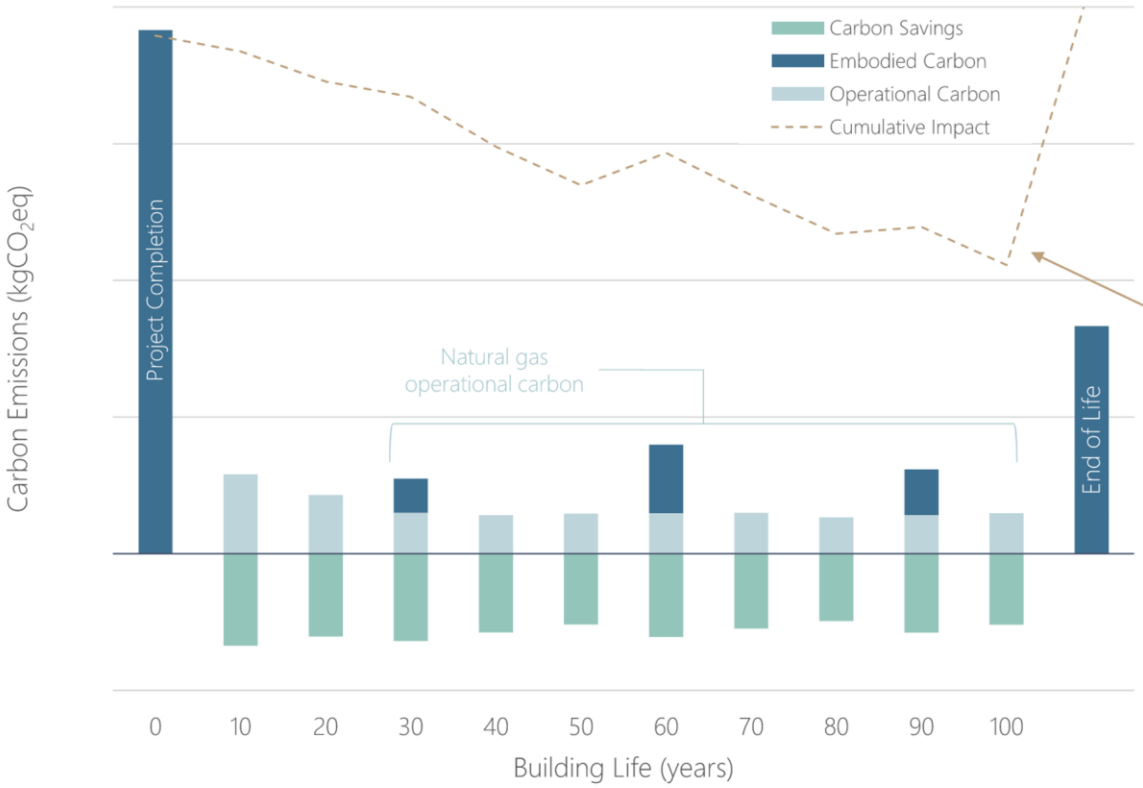
Theoretical project with:

- All-electric building
- On California grid (carbon neutral 2045)
- Modestly-sized PV array

Build lean!

With a carbon neutral grid on the horizon, the amount of initial embodied carbon becomes an even more significant chunk of the impact.

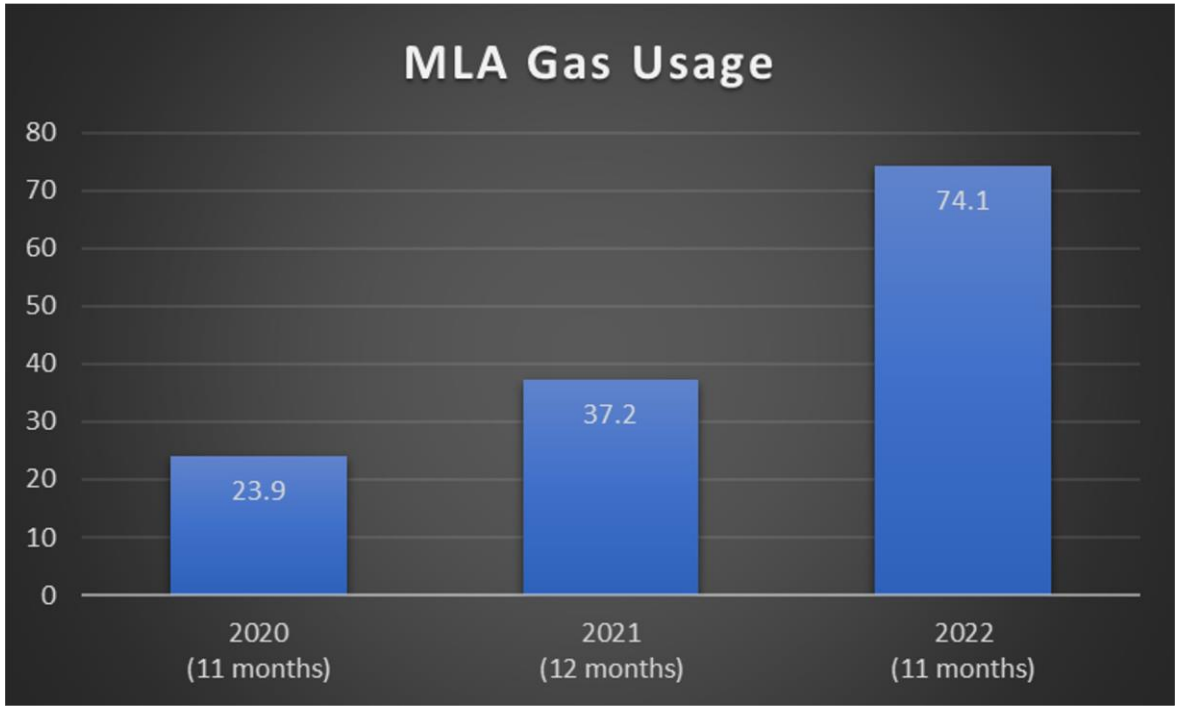
BUILDING LIFETIME & THE CARBON "PAYBACK" PERIOD



Same project, but with mixed electric and natural gas use:

- On California grid (carbon neutral 2045)
- Modestly-sized PV array

Initial cost of carbon may not be ever fully recovered

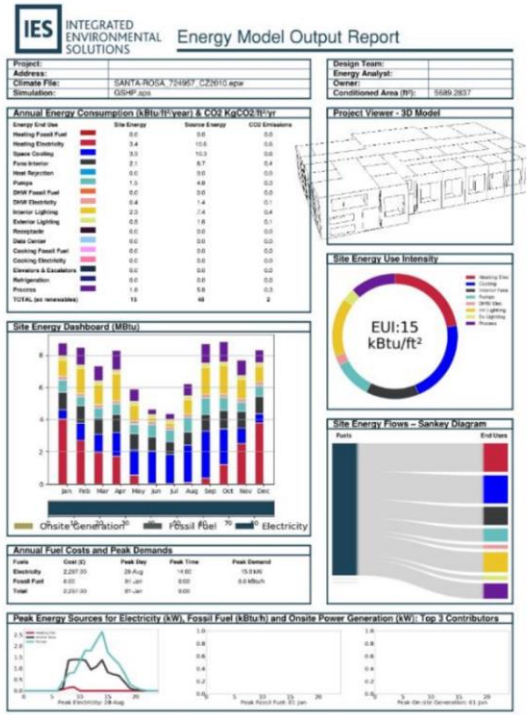

MLA Gas Usage
80
70
60
50
40
30
20
10
0
23.9
37.2
74.1
2020
(11 months)
2021
(12 months)
2022
(11 months)

What are the other systems in a building?

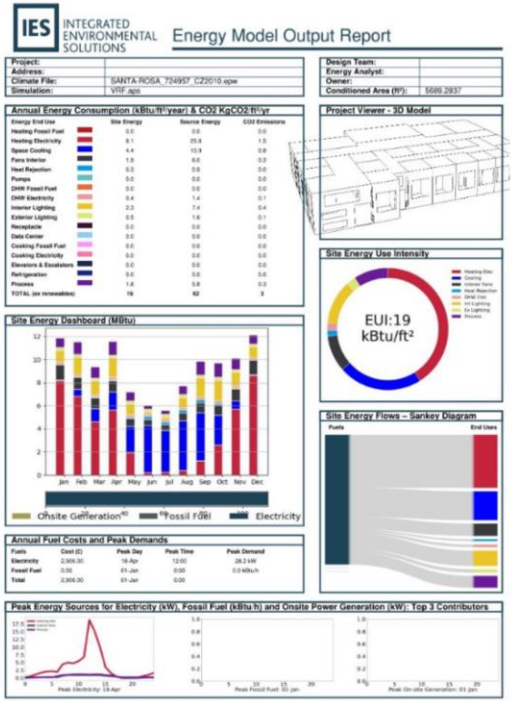
System/Structure	Sustainability Pros	Sustainability Cons

What are the other systems in a building?

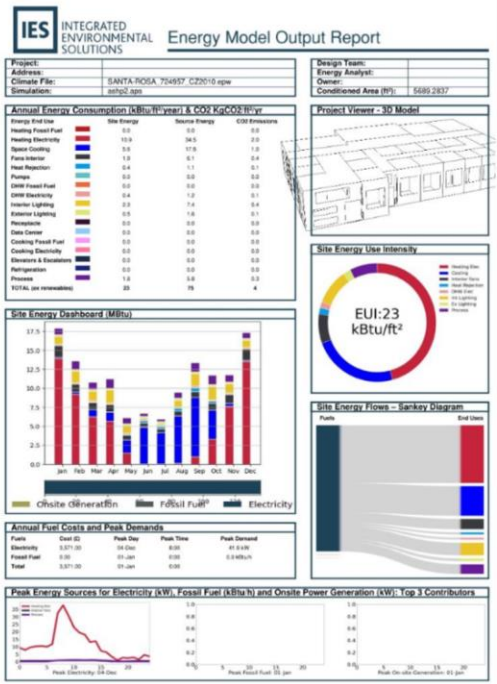
Appendix 1.1 GSHP Energy Model Output Report



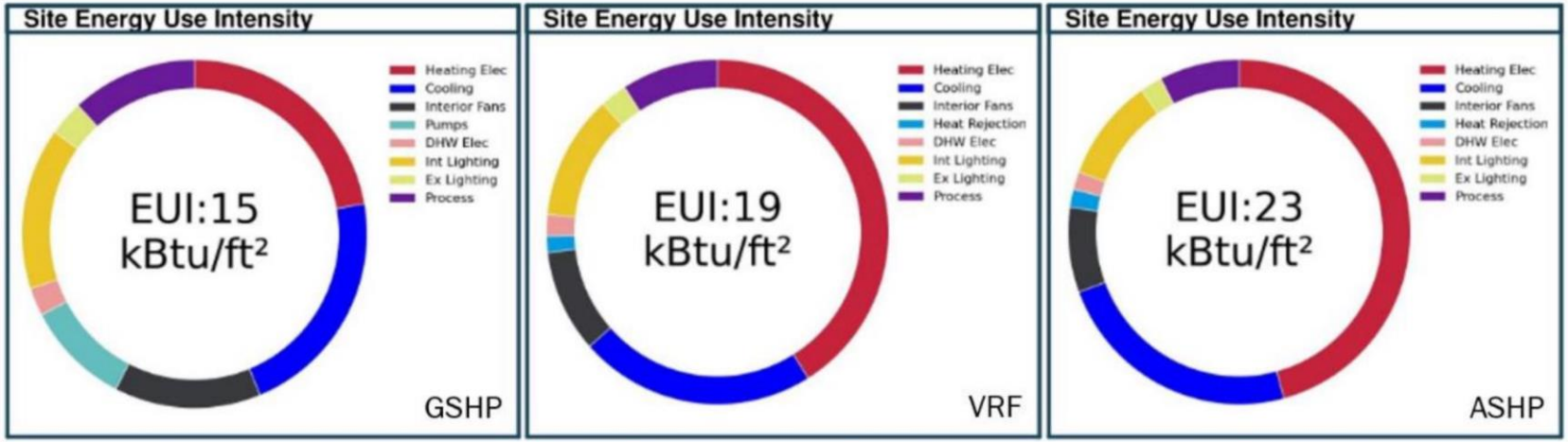
Appendix 1.2 VFF Energy Model Output Report



Appendix 1.3 ASHP Energy Model Output Report

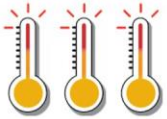


What are the other systems in a building?



What are different ways we can heat or cool buildings?

System/Structure	Pros	Cons

HVAC SYSTEM	TYPE	FUEL SOURCE	GLOBAL WARMING POTENTIAL	ENERGY EFFICIENCY	INSTALL COST	MAINTE-NANCE	CLASSROOM SPACE
1A. HYDRONIC - REUSE EXISTING BOILER							**LIGHT IMPACT** FAN CONVECTOR IN CLASSROOM AT RADIATOR LOCATION, TAKES UP ONE WINDOW
1B. HYDRONIC - HEAT PUMP							**MEDIUM IMPACT** FAN COIL UNIT IN CABINET, TAKES UP ONE WINDOW
2. HEAT PUMP - IN CLASSROOM							**MEDIUM IMPACT** FAN COIL UNIT IN CABINET, TAKES UP ONE WINDOW
3. HEAT PUMP ROOF TOP							**LIGHT IMPACT** NONE AT FIRST FLOOR, SHAFT FOR DUCT WORK AT SECOND FLOOR
4. GROUND SOURCE HEAT PUMP							**MED IMPACT** FAN COIL UNIT IN CABINET, TAKES UP ONE WINDOW
5. CEILING HUNG SPLIT SYSTEM							**NO IMPACT**

Design Criteria for New Buildings & Energy Efficiency

Program - Function - Location - Budget - Schedule - Process

Power Generation - Amount - Fuel Source - Type

Goals - Ratings Systems - Passive (Demand) - Active - Test/Repeat

Design for Daylighting - HVAC Type - Envelope - Test/Repeat

Efficient Lighting, Low Water Use

Needs & Opportunities

What are the opportunities to improve the energy efficiency of our buildings?	What are our options?	What is the need & our responsibility in Oakland?
Whole-school Facilities Projects (e.g. Maxwell, McClymonds, Roosevelt)	• Solar Panels* • Replacement Boilers • Heat Pumps • Window Shades • Window Replacements • Insulation* • Energy Efficient Appliances • LED Lighting * only available for new buildings	**Average age of boilers: 26 yrs** (5 boilers are over 100 years old; 14 are over 50 years old) **Average age of windows: 20 yrs** (4 are over 50 years old) **Average age of lighting: 20 yrs** (2 are over 50 years old)
Annual Deferred Maintenance Projects		
New Federal Funding (rebates in 2-5 years; current $$ removed from other OUSD projects)		

MLA Improvement Project

Option 1 - Modernization: $9.5M Improvements to existing building; PLUS an additional $12.3M Improvements to existing building {Opción 1 - Modernización: Mejoramientos al edificio existente de $9.5M; MÁS inversiones adicionales de $12.5M}

#2 - Middle School: $9.5M Improvements to existing building: PLUS a new 10,000 sq. ft., 2-story classroom building {#2 - Edificio Secundario: Mejoramientos al edificio existente de $9.5M; MÁS un nuevo edificio de dos pisos midiendo 10,000 pies cuadrados}

#3: Multi-Purpose Rm (MPR) Building: $9.5M Improvements to existing building; PLUS new 8,000 sqft MPR bldg {#3: Nuevo Edificio Multipropósito: Mejoramientos al edificio existente de $9.5M; MÁS un nuevo edificio Multipropósito midiendo 8,000 pies cuadrados

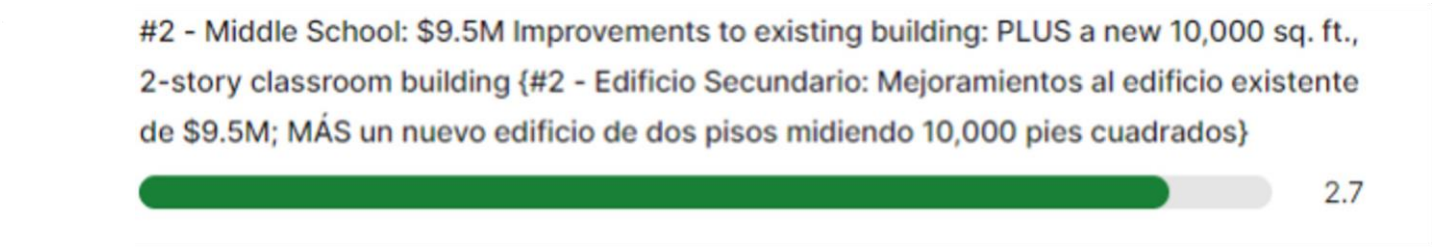
Decision Making Process & Next Steps

Previous Engagements with MLA:

10/5, 10/20 - Families; 11/13 - Staff

Current preference from MLA community:

Option 2 for community (slight preference) & teachers/staff (strong preference)



PAC Meeting Moved: 11/28

Board of Education needs to approve any major budget or project scope changes.


Needs & Opportunities

Why We Should Replace The Gas Boiler At MLA With Heat Pumps

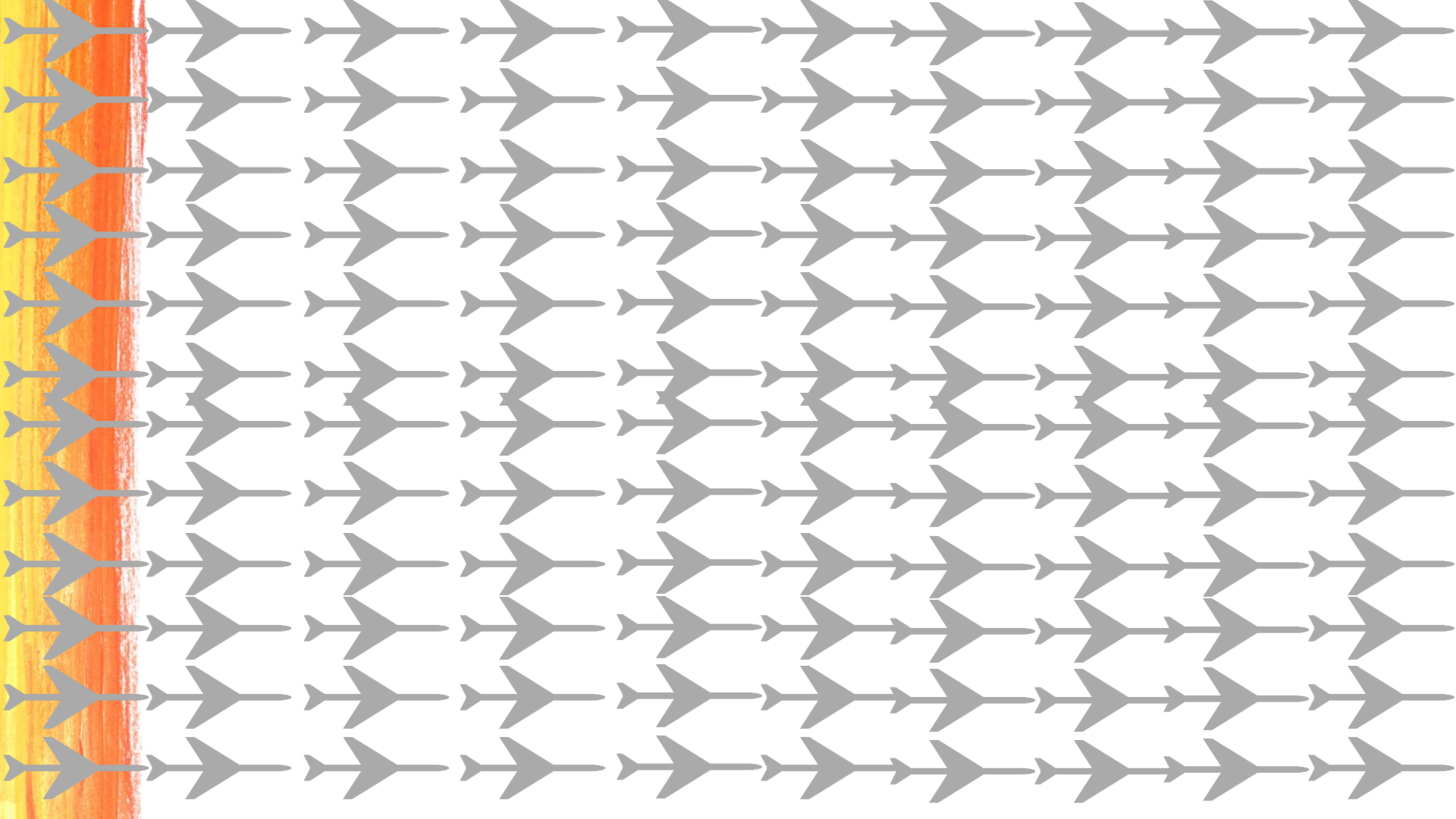
by Augie, and the MLA Youth vs. Apocalypse student Club

The School Board's October 2020 OUSD Climate Emergency Action resolution make 2 commitments

-To Phase out the use of Fossil Fuels district-wide

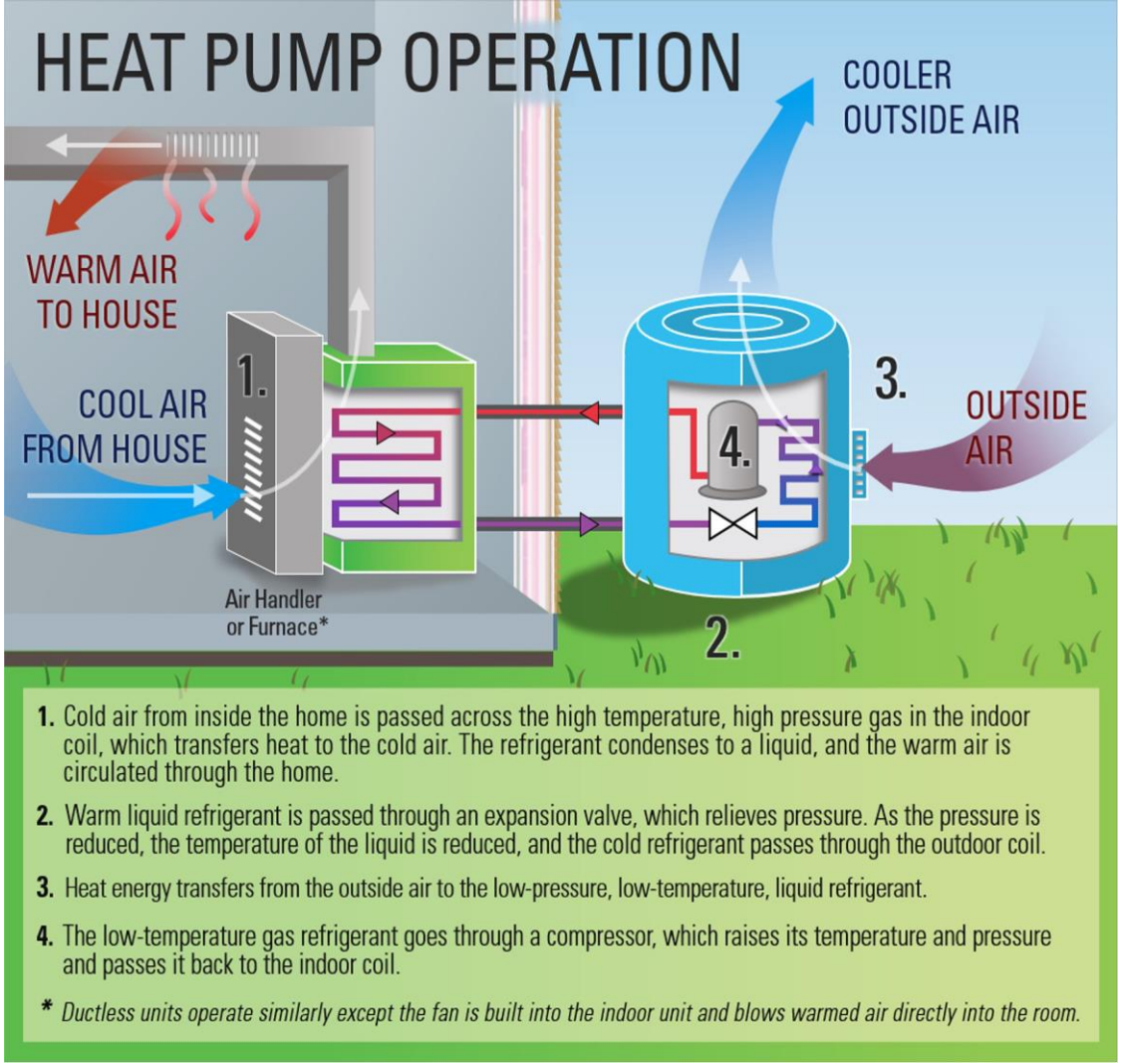
-To achieve 100% Clean Electricity district-wide

The boiler at Maxwell currently produces an estimated 32 metric tons of CO2 every year. That's the same as about 120 transatlantic flights



The solution?

Use some of the Measure Y bond money to install heat pumps to replace the boiler.

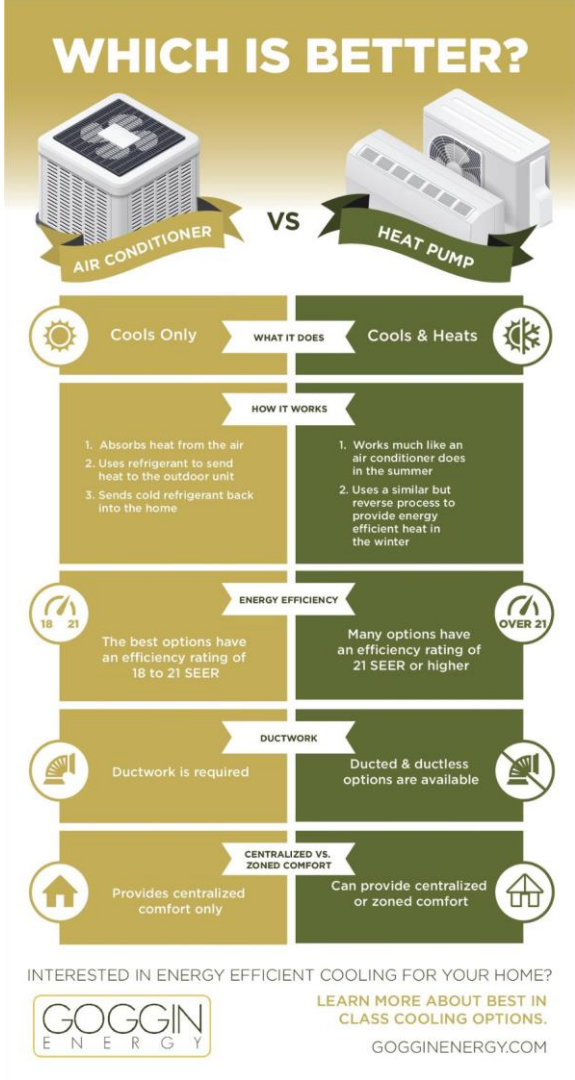


1. Cold air from inside the home is passed across the high temperature, high pressure gas in the indoor coil, which transfers heat to the cold air. The refrigerant condenses to a liquid, and the warm air is circulated through the home.
2. Warm liquid refrigerant is passed through an expansion valve, which relieves pressure. As the pressure is reduced, the temperature of the liquid is reduced, and the cold refrigerant passes through the outdoor coil.
3. Heat energy transfers from the outside air to the low-pressure, low-temperature, liquid refrigerant.
4. The low-temperature gas refrigerant goes through a compressor, which raises its temperature and pressure and passes it back to the indoor coil.

* *Ductless units operate similarly except the fan is built into the indoor unit and blows warmed air directly into the room.*

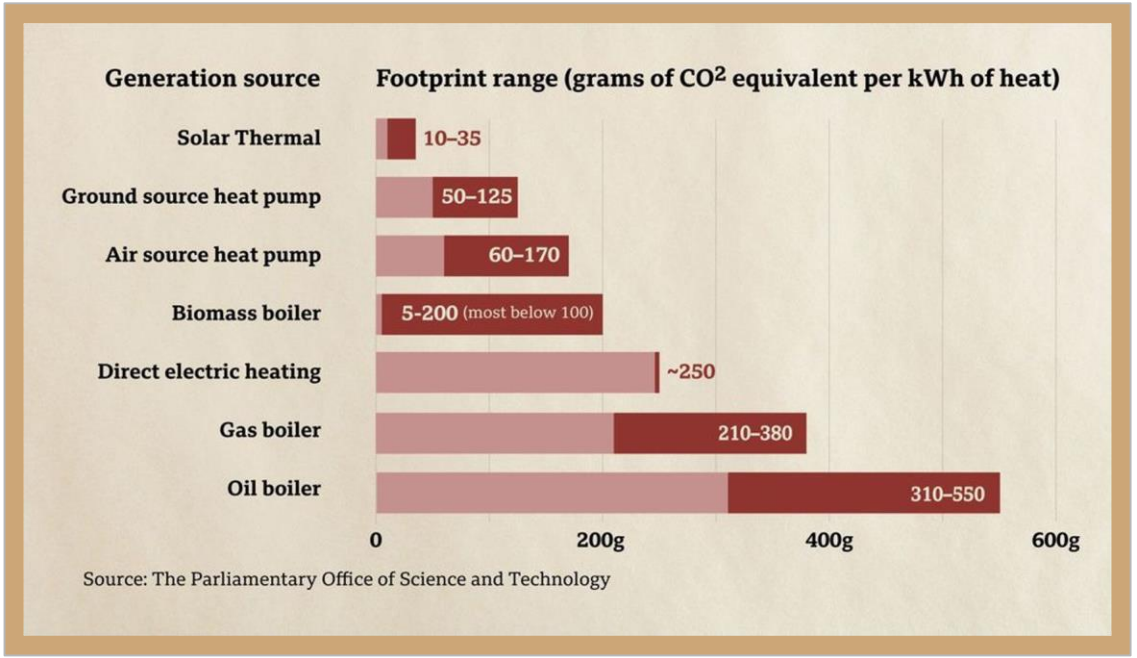
How is a heat pump different from AC?

What is the difference between a heat pumps and AC exactly? A heat pump is basically an air conditioner that works in 2 directions. While essentially identical while cooling, heating is a completely different story. Air conditioners do not provide heating, but heat pumps do. A heat pump works by extracting heat energy from outside air, even in extremely cold temperatures, then transferring the heat inside the home, where it releases the heat into the air. A heat pump can heat and cool, but an air conditioner cannot, which is the main difference between the two. Together, an air conditioner and furnace are a complete heating and cooling system, but with a heat pump you wouldn't need to get two systems.



How is a heat pump better for the environment?

You don't need gas or oil to use a heat pump, as it relies only on electricity, so it makes it better for the environment because it barely leaves a carbon footprint. The gas boiler we currently use burns a lot of gases that produce a lot of greenhouse gases that are very harmful to the environment.



How much would it cost

Here at MLA, we are getting big sum of Measure Y bond money, with $2 million already spent on the ADA ramp. To install a heat pump system, it would take an estimated $3 to $5 million, still leaving a lot of facility upgrade money.

Why should we use heat pumps at MLA?

We should use heat pumps at MLA because:

- They don't require oil or gas to run, just electricity, reducing our use of fossil fuels and shrinking our carbon footprint
- They are able to heat and cool, so you wouldn't need two systems
- Since they basically use air conditioning technology that operates in 2 directions, they typically cost only a little bit more than air conditioners.

The MLA Student Youth vs Apocalypse Club is currently circulating the following petition to ask that the boilers be replaced with heat pumps, which has gotten 9 teacher signatures, almost 100 parent signatures, and around 250 student signatures.

Petition to Ban Fossil Fuels at MLA

Dear MLA and OUSD administration, We the following people ask that you stop using fossil fuels at MLA. Specifically, we request that you replace the gas boiler with electric heat pumps.

We think this is important because:

- Fossil fuels are bad for the environment, causing global warming. We don't want the earth to die.
- When fossil fuels are used or extracted it hurts people living nearby. 90% of people living within one mile of a fossil fuel infrastructure site in CA are People of Color
- Global warming causes more frequent heat waves electric heat pumps can provide air conditioning on hot days, in addition to heat on cold days. Gas boilers only provide heat.

Name	Signature	Grade

Please join the MLA student Youth vs Apocalypse club in calling for the district to shut down fossil fuels at MLA, and replace the gas boiler with heat pumps.

Link to online version of the petition: https://forms.gle/Zcb9bXZYnEmJmnUA9