

# Energy Decarbonization Blueprint

June 2026



# Speaker

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Willdan*



# California Energy Design Assistance

CaliforniaEDA.com



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## Technical Assistance

Whole building  
decarbonization analysis  
during  
early design



## Final Analysis

Verification of savings at  
construction completion



## Earn

Long term carbon savings  
and incentives from  
partnering utilities

*Optimize Carbon Savings on Your Next New Construction or  
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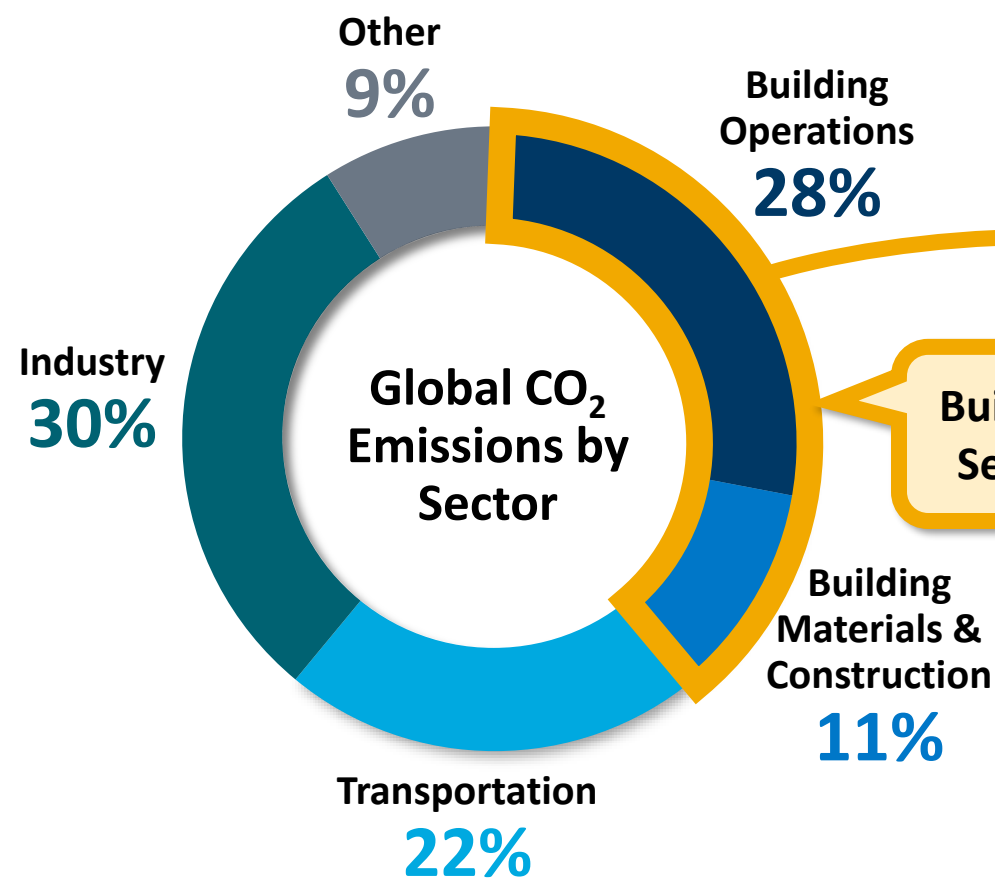
# Abstract and Learning Objectives

Utilizing **four case studies**, this course explores how to create a new blueprint for energy decarbonization that aligns with the changing electric grid. An overview of energy infrastructure changes that are taking place in the state of California will be provided alongside how these changes impact the types of building systems being considered for a multi-family building, a school, a healthcare project, and an office building. The course will explore the carbon impacts of each case study both today and in the future as the electric grid continues to decarbonize utilizing expected average carbon emissions for 2030 and 2050.

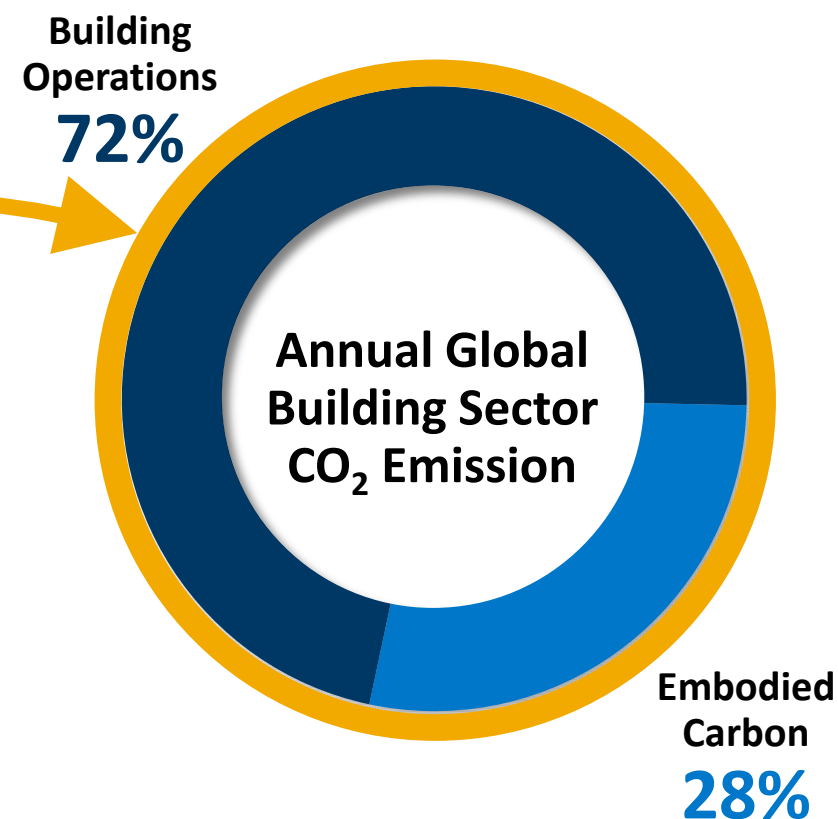
## Learning Objectives:

1. Identify how the decarbonization of the CA electric grid impacts the built environment
2. Describe challenges and opportunities in decarbonizing typical project types from an energy standpoint
3. Describe the difference in decarbonization impacts between today's grid and the expected grid in 2030 and 2050
4. Create an energy decarbonization blueprint for your firms' projects

# Buildings' Contribution to Carbon Emissions



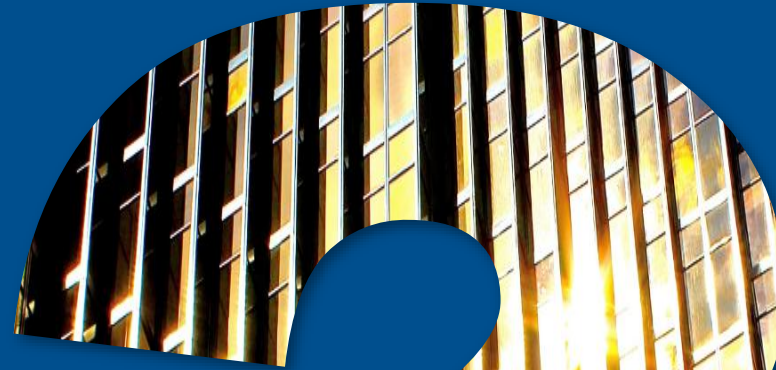
Source: Architecture 2030, Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017



Source: Architecture 2030, EPA International Energy Outlook

# Architects Value Sustainable Design But...

- Clients aren't interested or asking for it
- Budgets are too tight
- Developers don't care about ongoing maintenance and energy costs
- Paybacks are too long
- Timeline is too short to consider options
- Contractors or Facility Managers aren't comfortable with it
- Measures just get removed in value engineering
- Not in our scope of work
- It's the engineer's problem to solve
- Not required by code



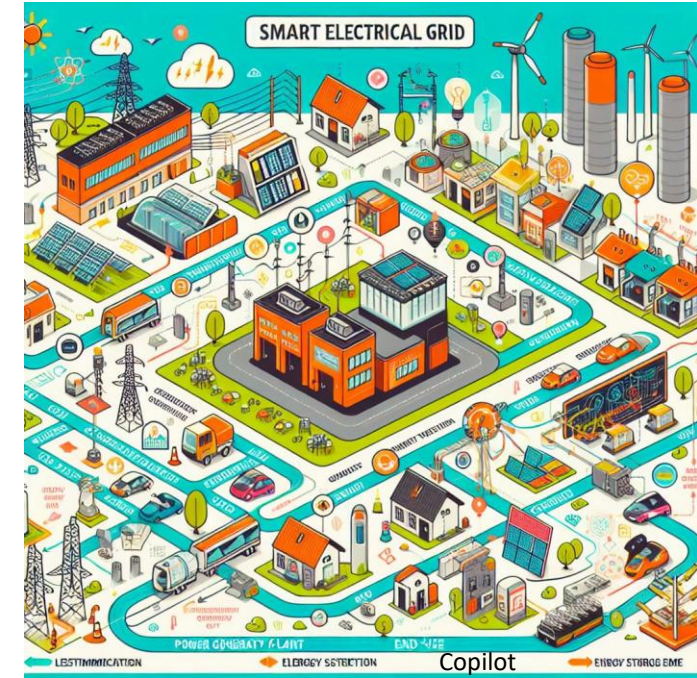
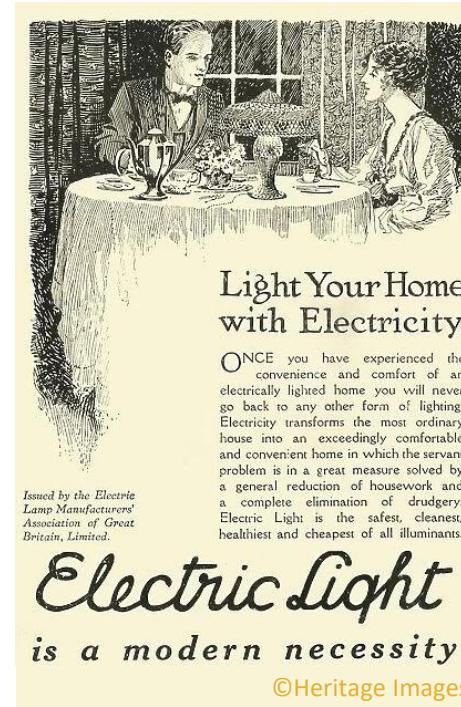
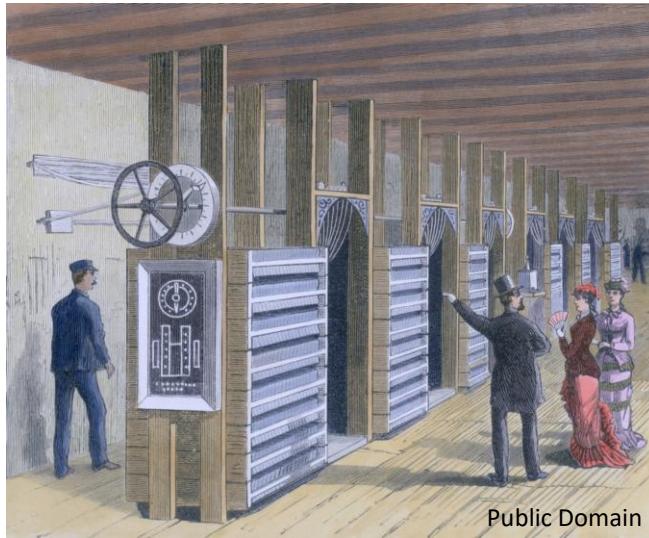
# Buildings with high operating carbon

- Slow the transition to clean energy
- Are less adaptable and resilient, causing...
  - Faster depreciation
  - Decreased profits
- Vulnerable to future policy changes
  - Higher utility rates
  - Carbon taxes
- Potential to become stranded assets





# Electricity as a power source is relatively young



Late 1800s:  
Electricity is a  
luxury for the  
privileged few

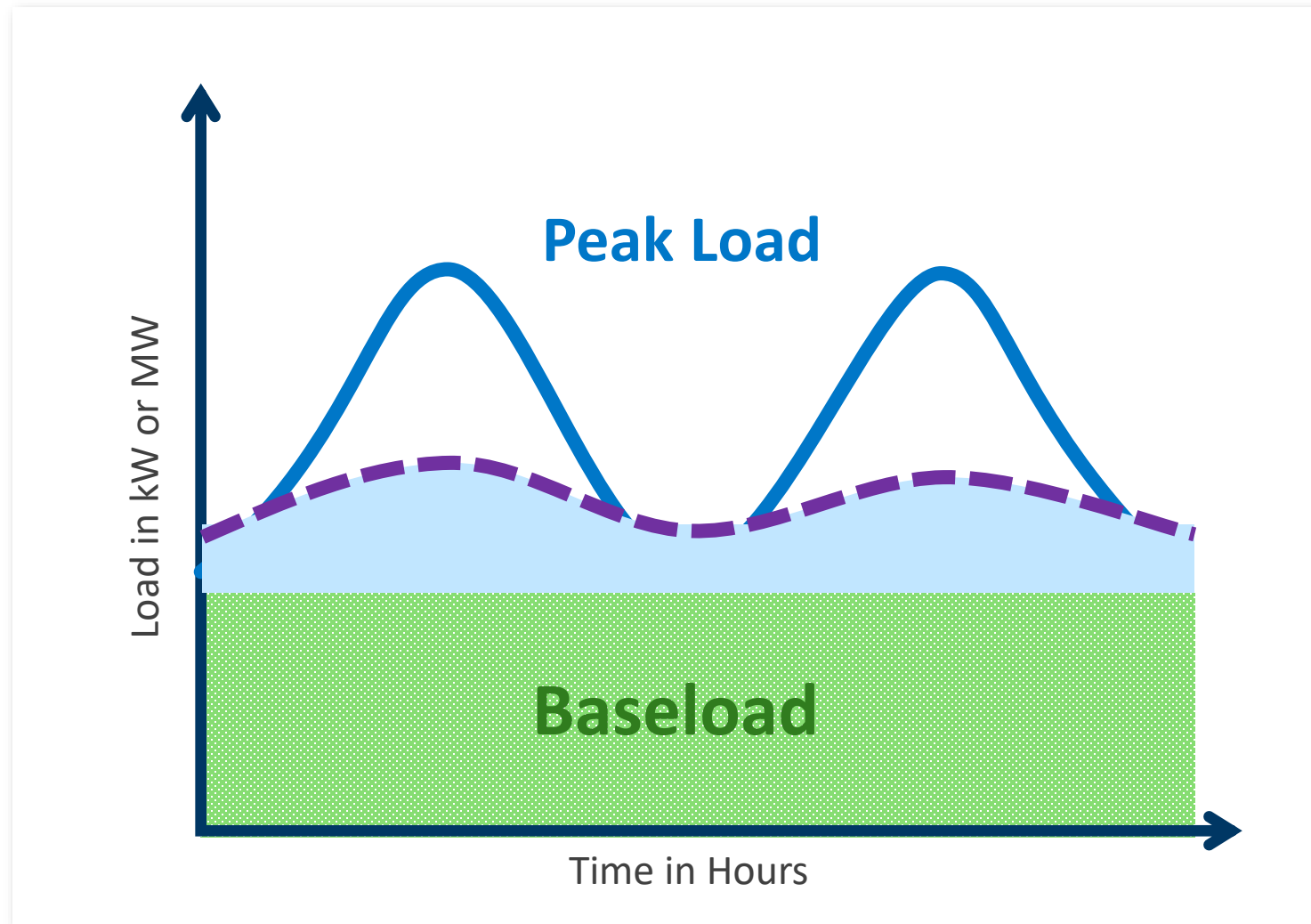
In 1925, only  
50% of homes  
had electricity

1938: "Electricity is a  
modern necessity of life."  
(Franklin Roosevelt, at Rural  
Electrification Administration  
celebration)

Electricity becomes  
affordable, reliable,  
and accessible

Electricity is  
fundamental  
human right

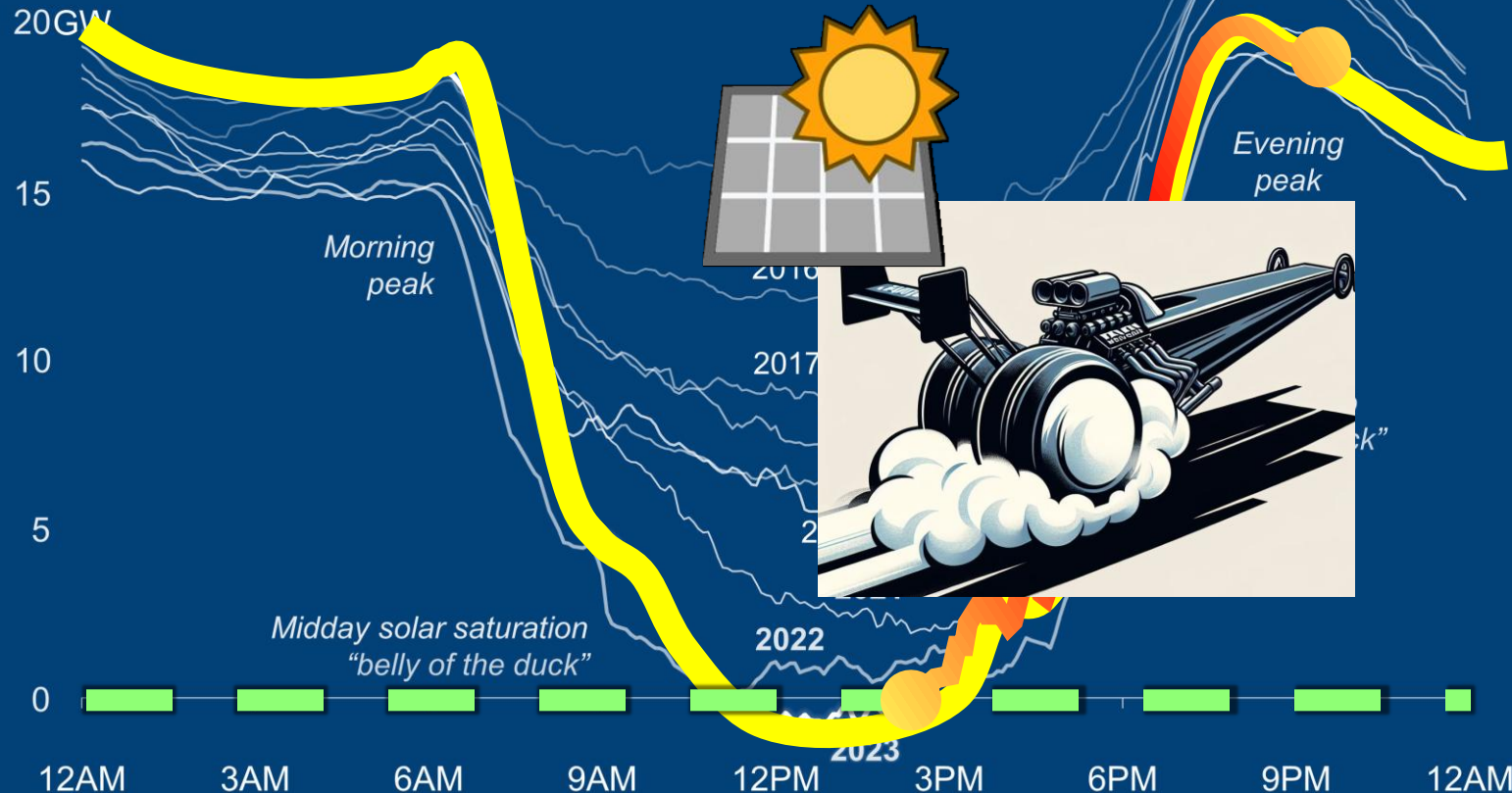
# Electricity Production



# Widespread Solar Impact on Grid

## California's duck curve hits record lows

Lowest minimum net load day each year in CAISO, 2015-2023



Source: CAISO | @BPBartholomew

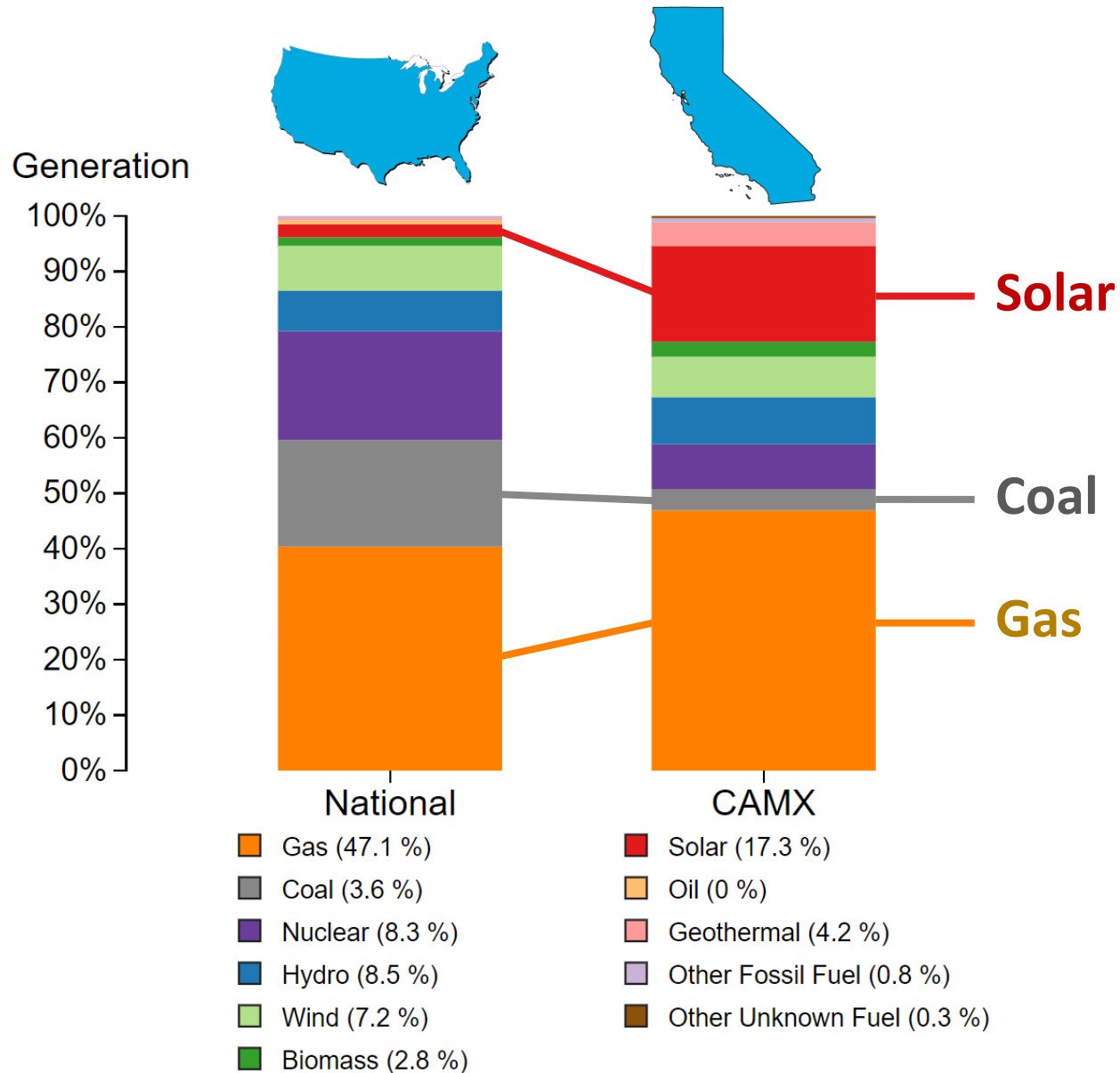
Note: Net load shown is demand minus utility-scale wind and solar

The Merit Order

- Significant reduction in net demand during the day
- Steep ramp-up of demand between 4 pm and 7 pm

Variable renewable production needs to be balanced with dispatchable power or demand.

# California's Grid Mix in 2020



- Compared to National Average
  - More renewables
  - Much less coal
  - More natural gas
- Grid continues to decarbonize with non-dispatchable solar and wind
- Duck curve is going to continue to grow

# Electric Grid is Getting Cleaner

- Reduction in coal power plants replaced with renewables and natural gas plants
- California Public Utility Commission retired subsidies on new natural gas connections
- States and local governments encouraging all-electric power in new buildings
- Renewables have become more cost effective
- Utility grade battery storage



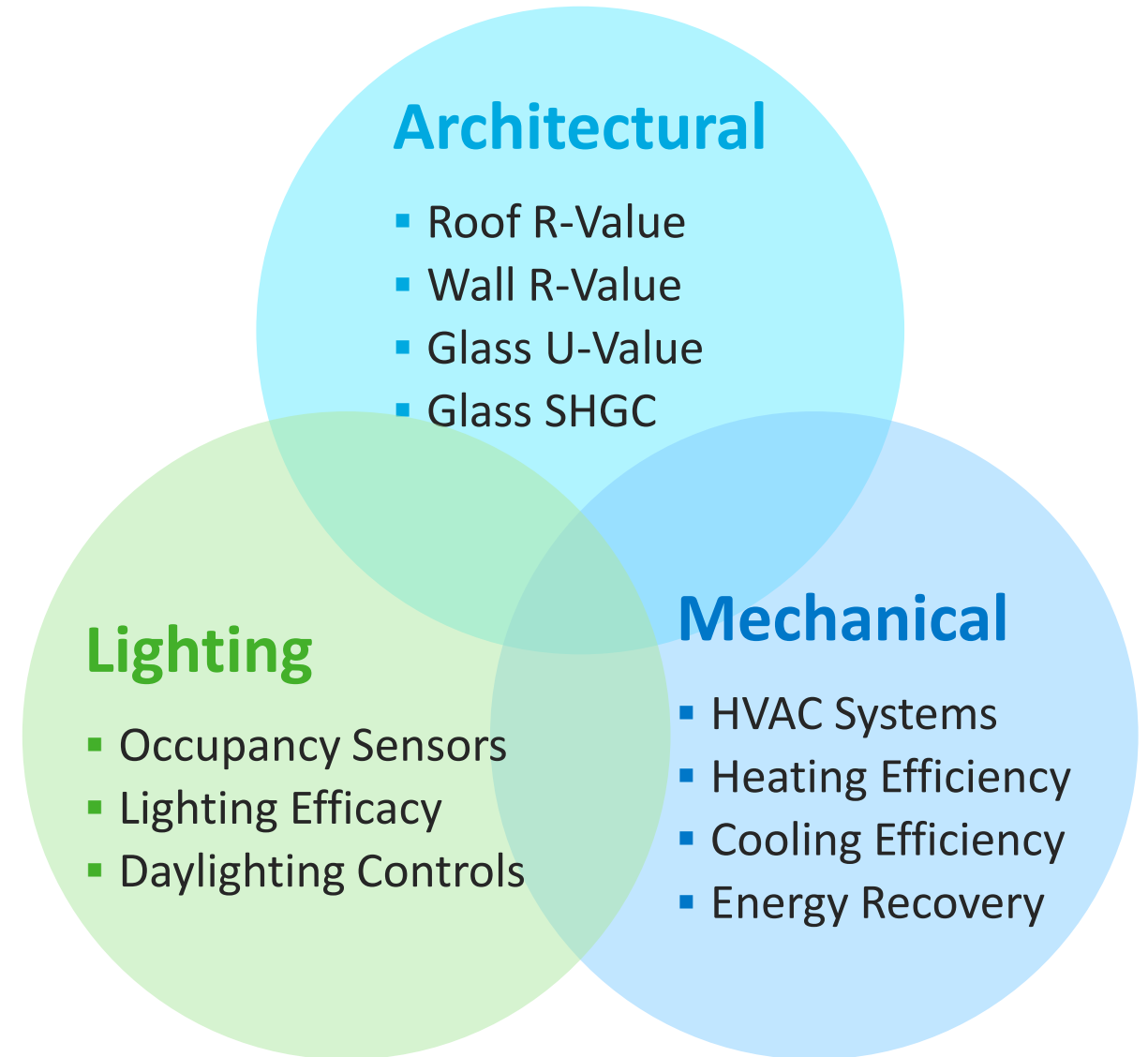
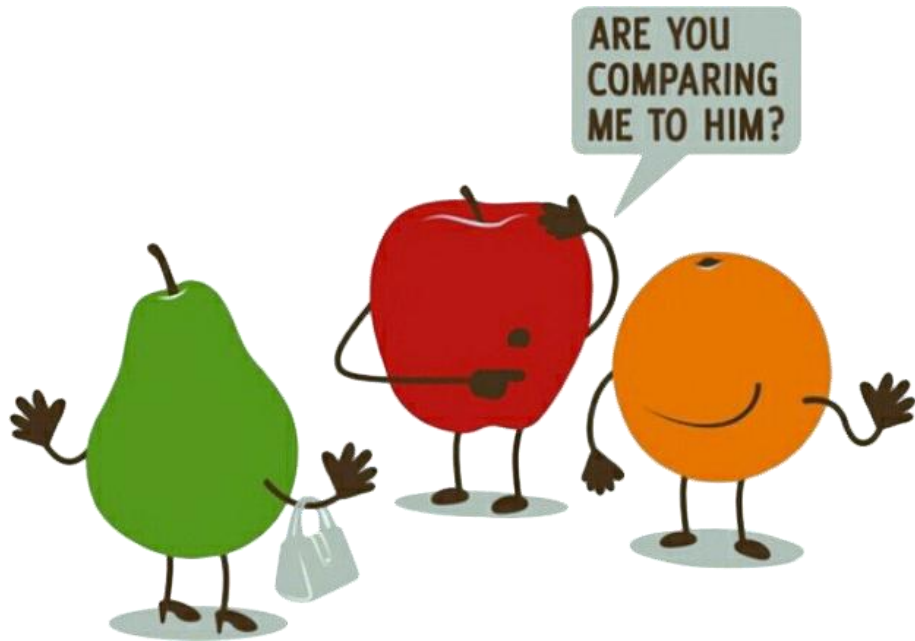
# Demand Response and Time-of-Use Rate Structures

- **Demand Response:**  
Financial incentives to reduce energy consumption during peak incidents
- **Time-of-Use Rate Structure:**  
Rate per kilowatt hour changes throughout the day



# Variables Impacting Energy Analysis Results

- Climate
- Building type/function
- Building form/size
- Window to wall area ratio
- Hours of operation/usage



# Building Decarbonization Toolkit

## Heat Pumps



- High efficiency air source heat pumps
- High efficiency ground coupled heat pumps

## VRF Systems



- Variable refrigerant flow
- Simultaneous heating and cooling

## Water Heating



- Heat pump water heater

## Kitchen Equipment



- Electric fryer
- Electric ovens
- Electric griddle
- Induction Cooktops

**Low Global Warming Potential (GWP) Refrigerants**

# Recap - Rules Of Thumb *Alone* Won't Solve This Challenge

- 1 Electricity is a relatively young technology
- 2 The energy grid is continuously evolving
- 3 Our current structure is not a sustainable business model and rates keep changing
- 4 There are too many variables that impact carbon impact in a building for a one-size-fits-all solution
- 5 Building system technology keeps evolving and improving

# Decarbonization Methodology

# Energy Modeling Tool Advancement



**Faster**



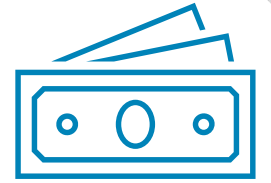
**Accurate**



**Versatile**

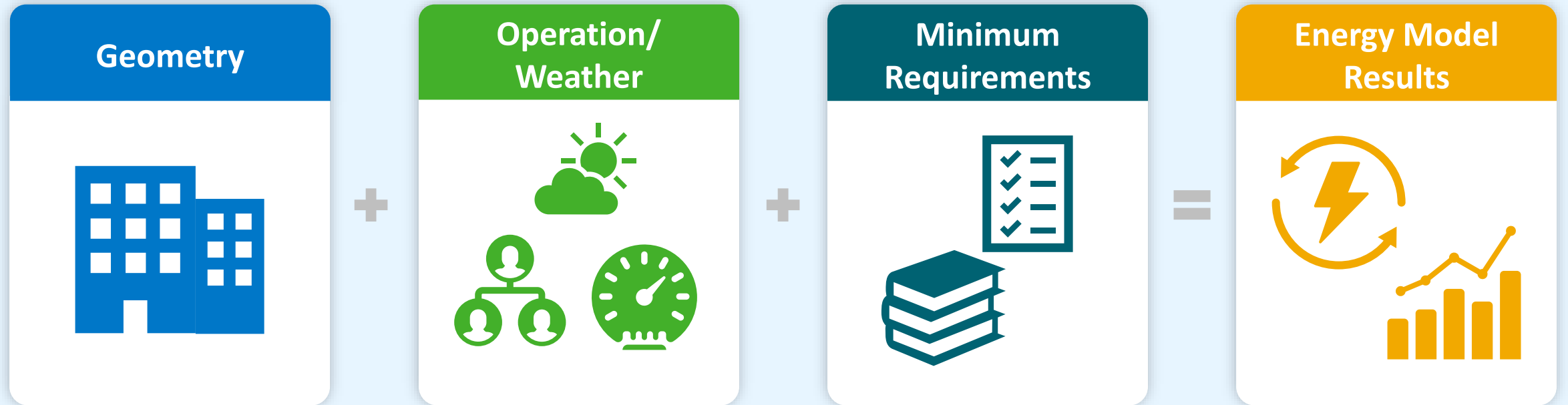


**Easier**

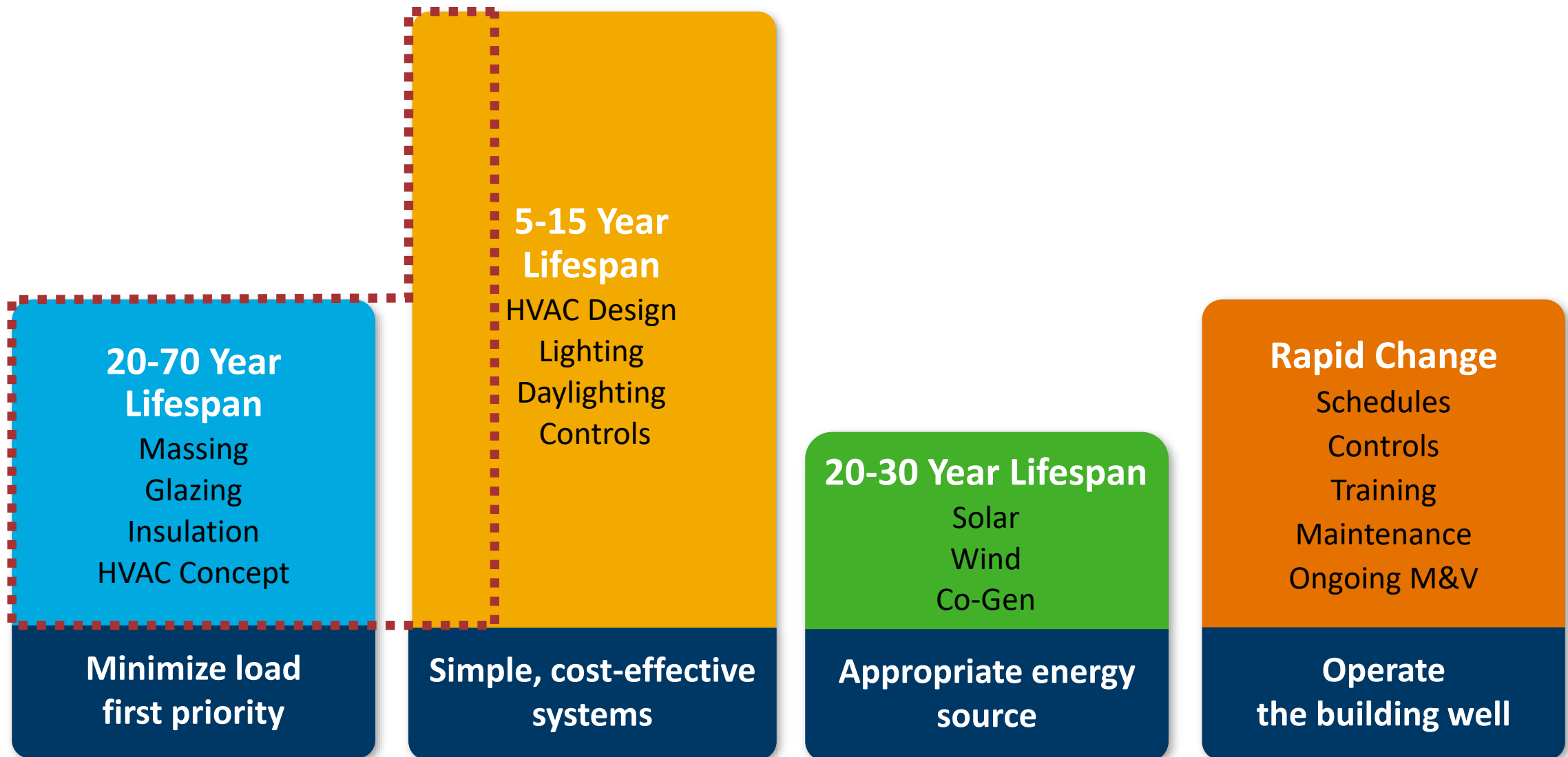


**Affordable**

# Comparative Analysis



# The Method: Start Early, Stay at It



# Case Studies

# Case Study Building Types

Apartment



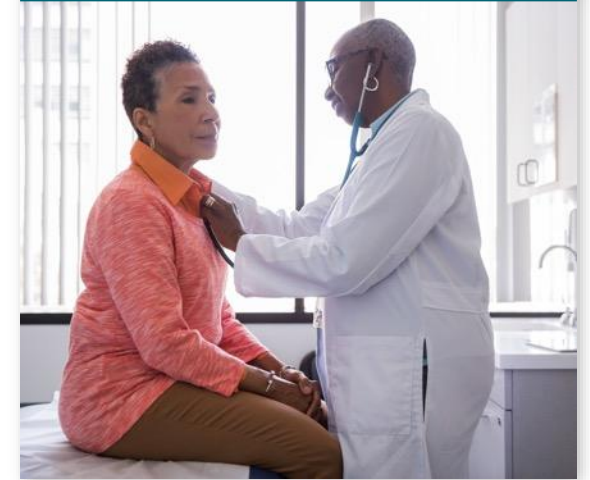
School



Office



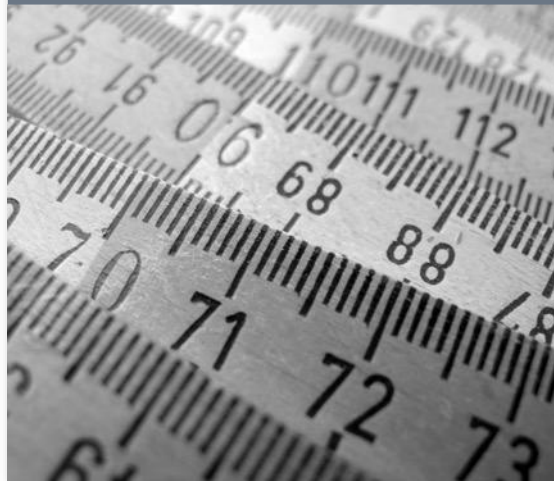
Clinic



Typical Space Types



100,000 SF Program



Typical Hours of Operation



# Case Study Locations

San Jose



Los Angeles



# Mechanical Systems for Case Studies



## Natural Gas

- Gas fired Vertical Terminal Air Conditioners in apartments with packaged rooftop units for common spaces
- VAV System with Air Cooled Chiller and Gas Boiler
- Gas fired water heaters



## All-Electric

- Air Source Heat Pumps with electric back up
- Electric resistance water heaters



## Sustainable

- Ground coupled water loop heat pumps
- Heat pump water heaters

# System Assumptions



## Mechanical Assumptions

- **Chiller:** 1.12 kW/ton
- **Condensing Boiler:** 95% efficient
- **Gas furnace:** 95% efficient
- **DX cooling:** 12.1 EER
- **Air Source Heat Pump:** 12.1 EER/ 3.63 COP
- **Water Loop Heat Pump:** 16.9 EER/ 3.84 COP
- Demand control ventilation included where applicable



## Architectural Assumptions

- Slightly above code minimums
- Aluminum windows with slightly above code minimums for U-factor and Solar heat gain coefficient
- Vinyl windows in apartments

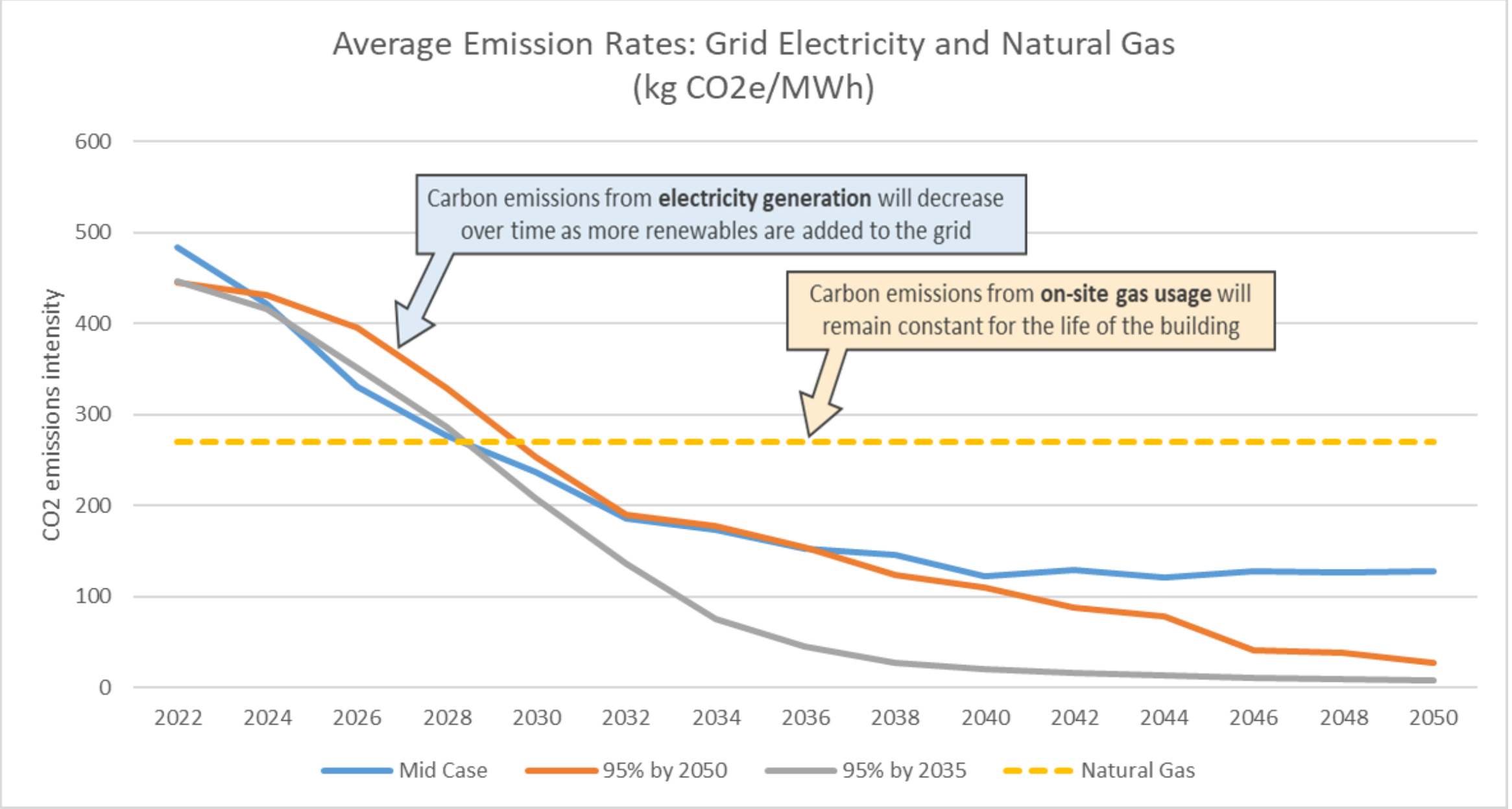


## Lighting Assumptions

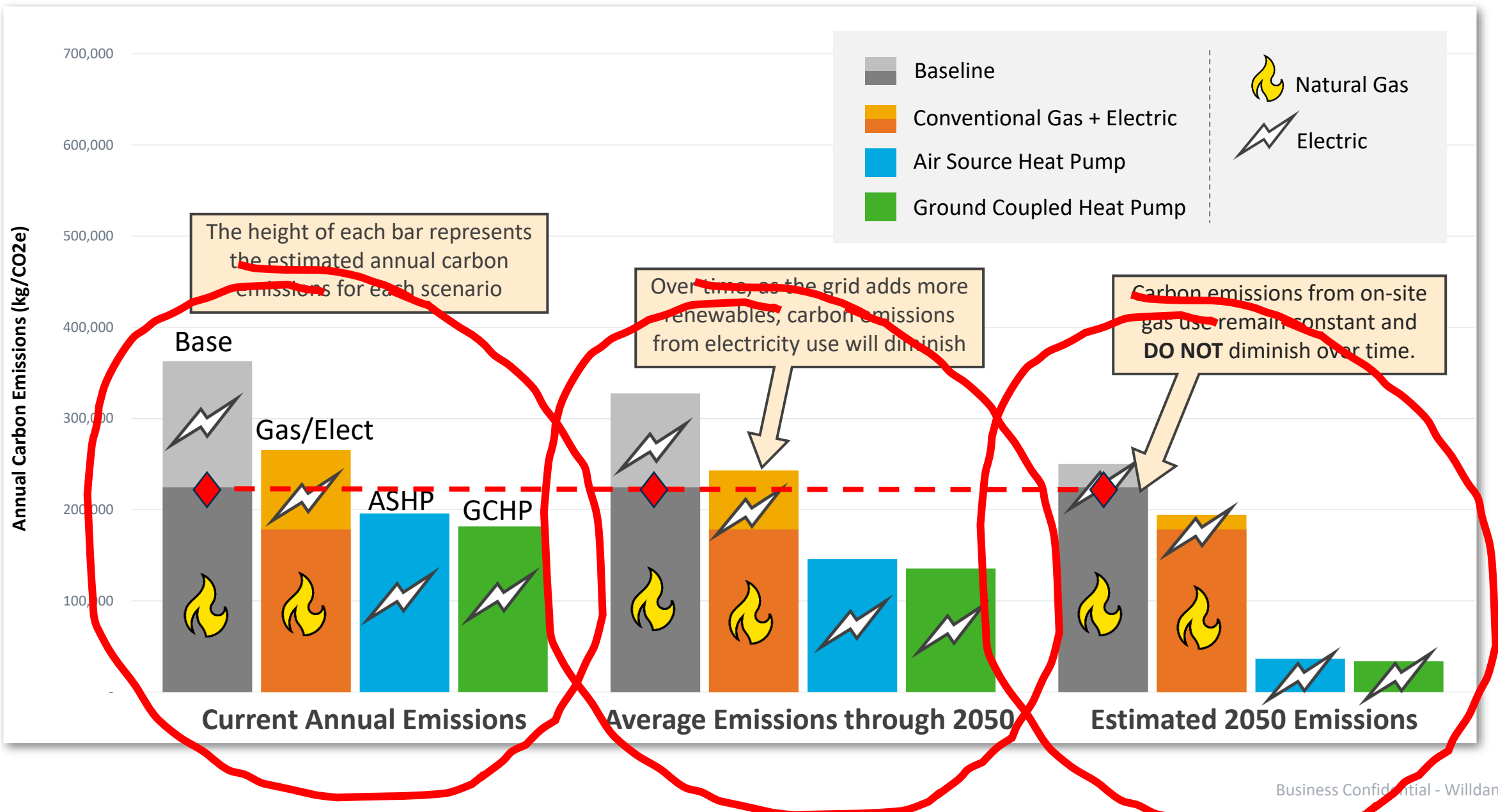
- LED Lights throughout
- Lighting controls as required by code

# Carbon Impact by Fuel Type and System

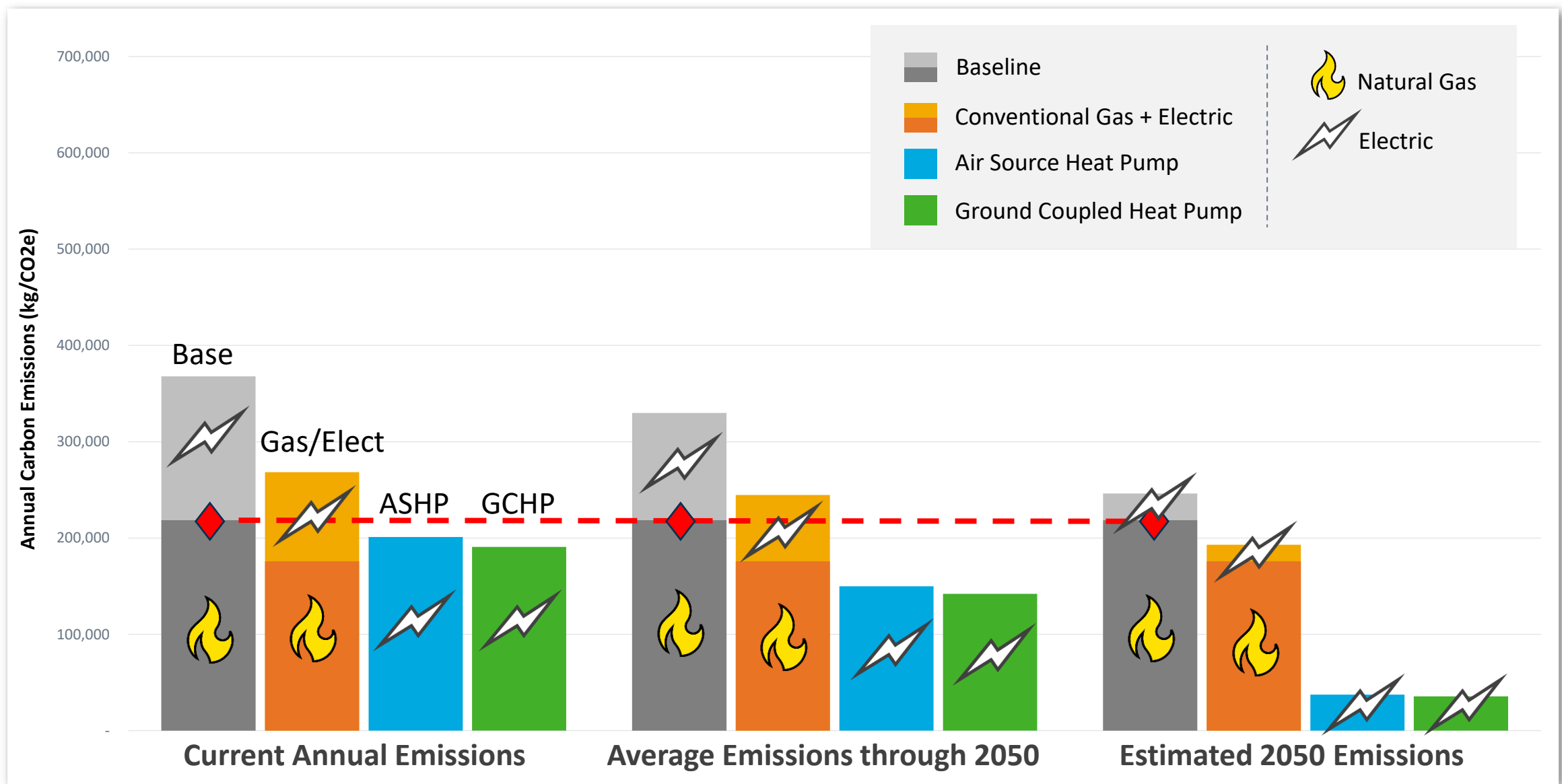
# Carbon Emission Projections Through 2050



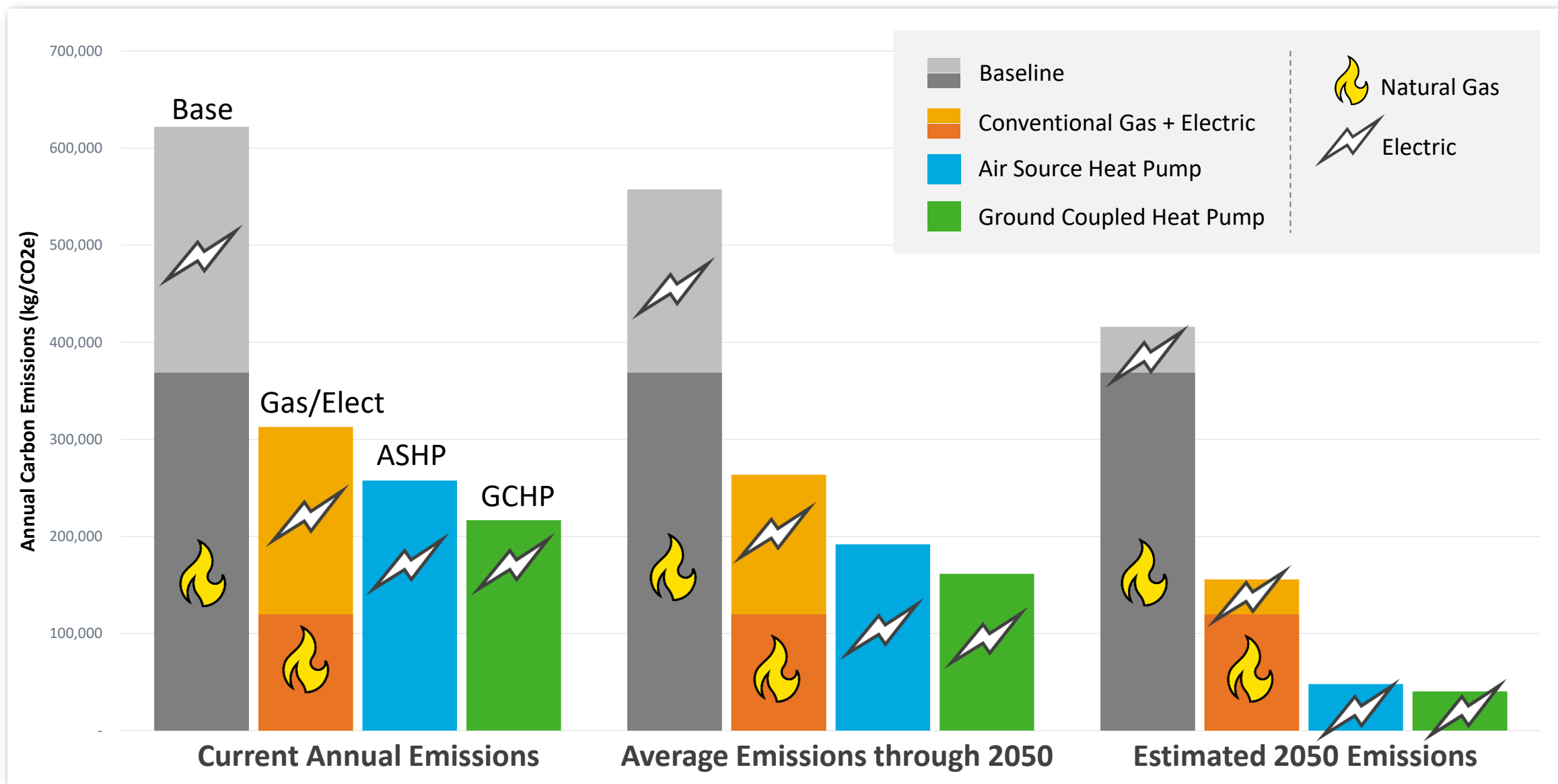
# Annual Carbon Emissions by Energy Source - Multifamily (NorCal)



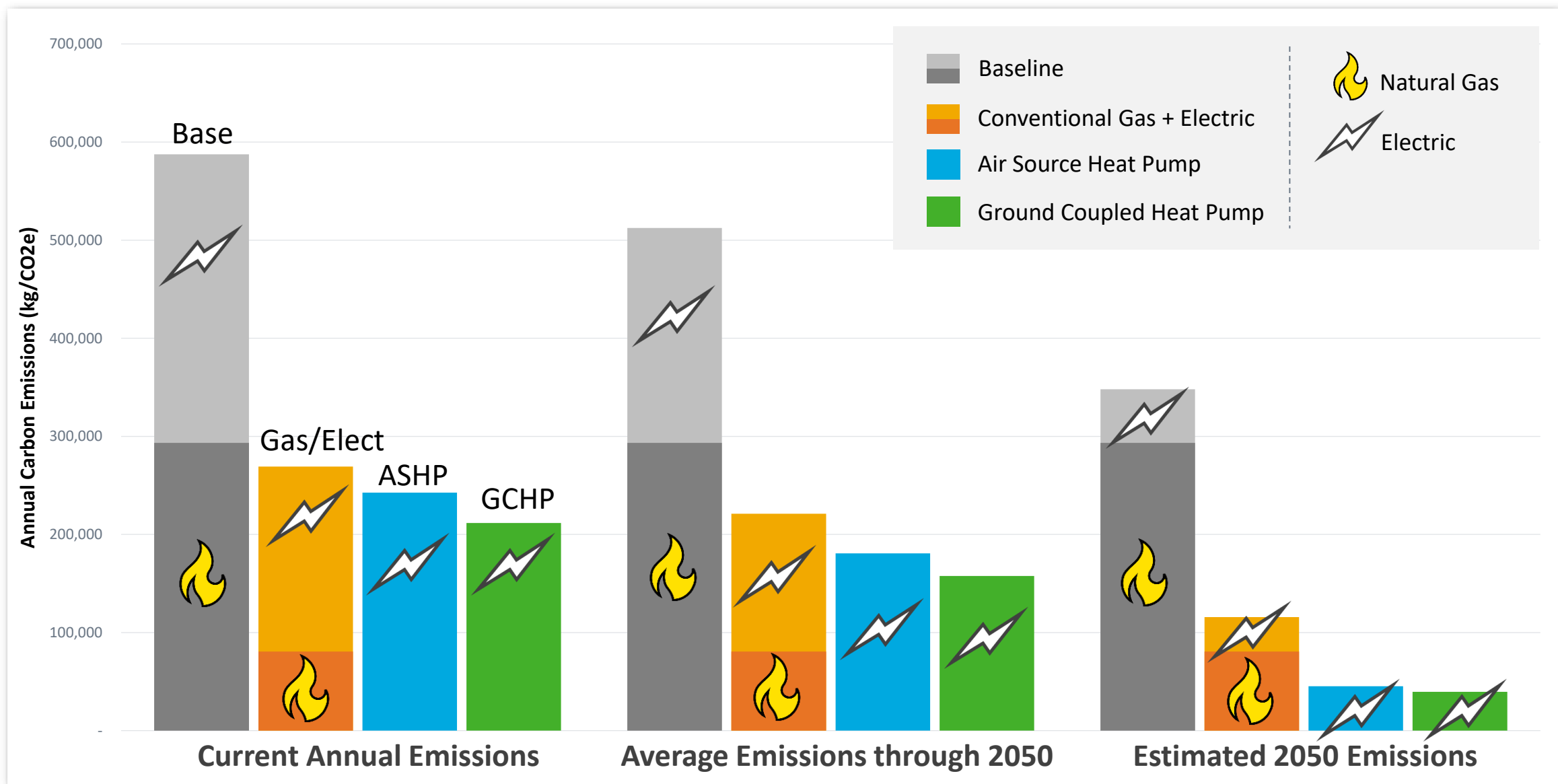
# Annual Carbon Emissions by Energy Source - Multifamily (SoCal)



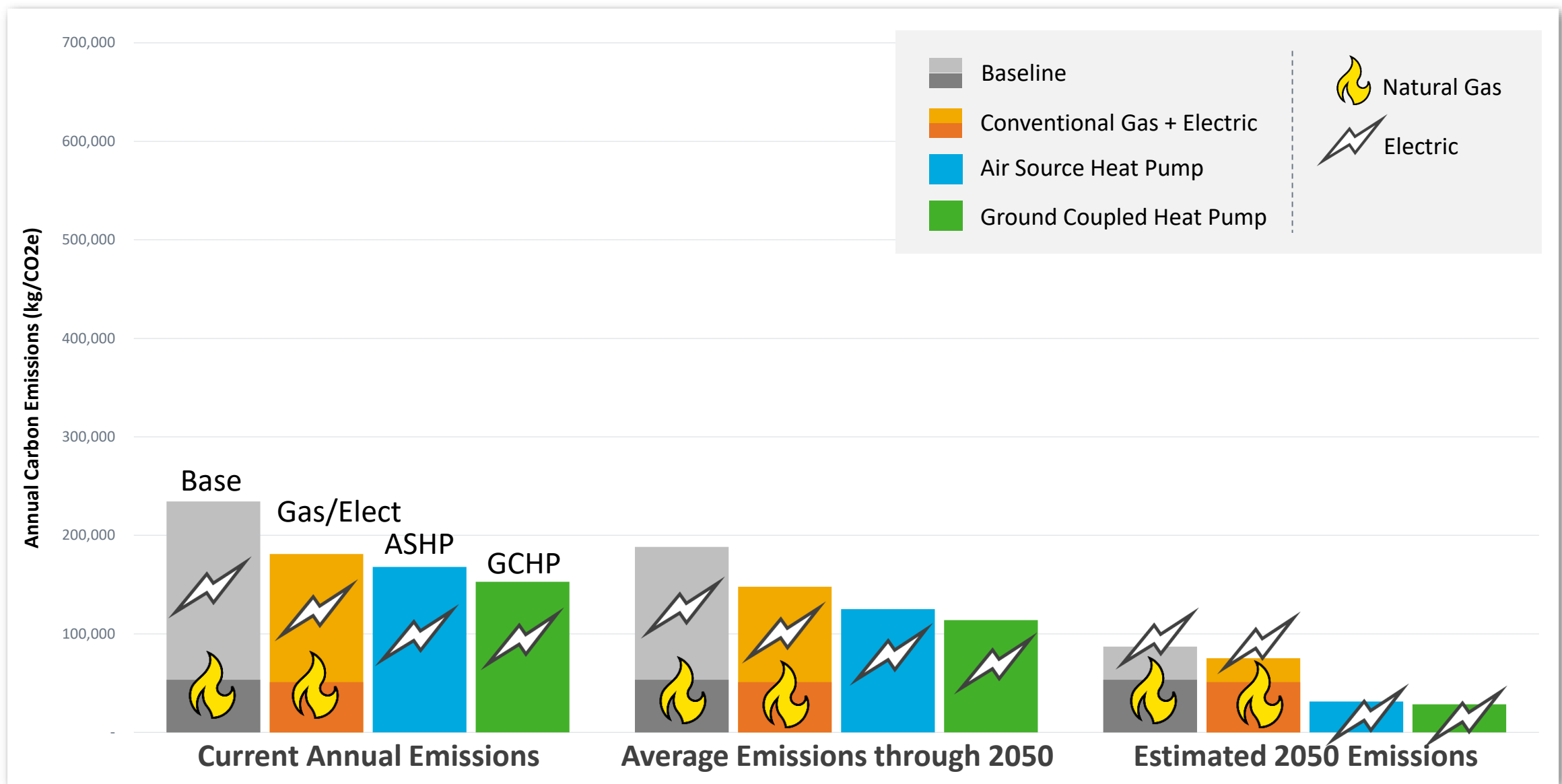
# Annual Carbon Emissions by Energy Source - K12 (NorCal)



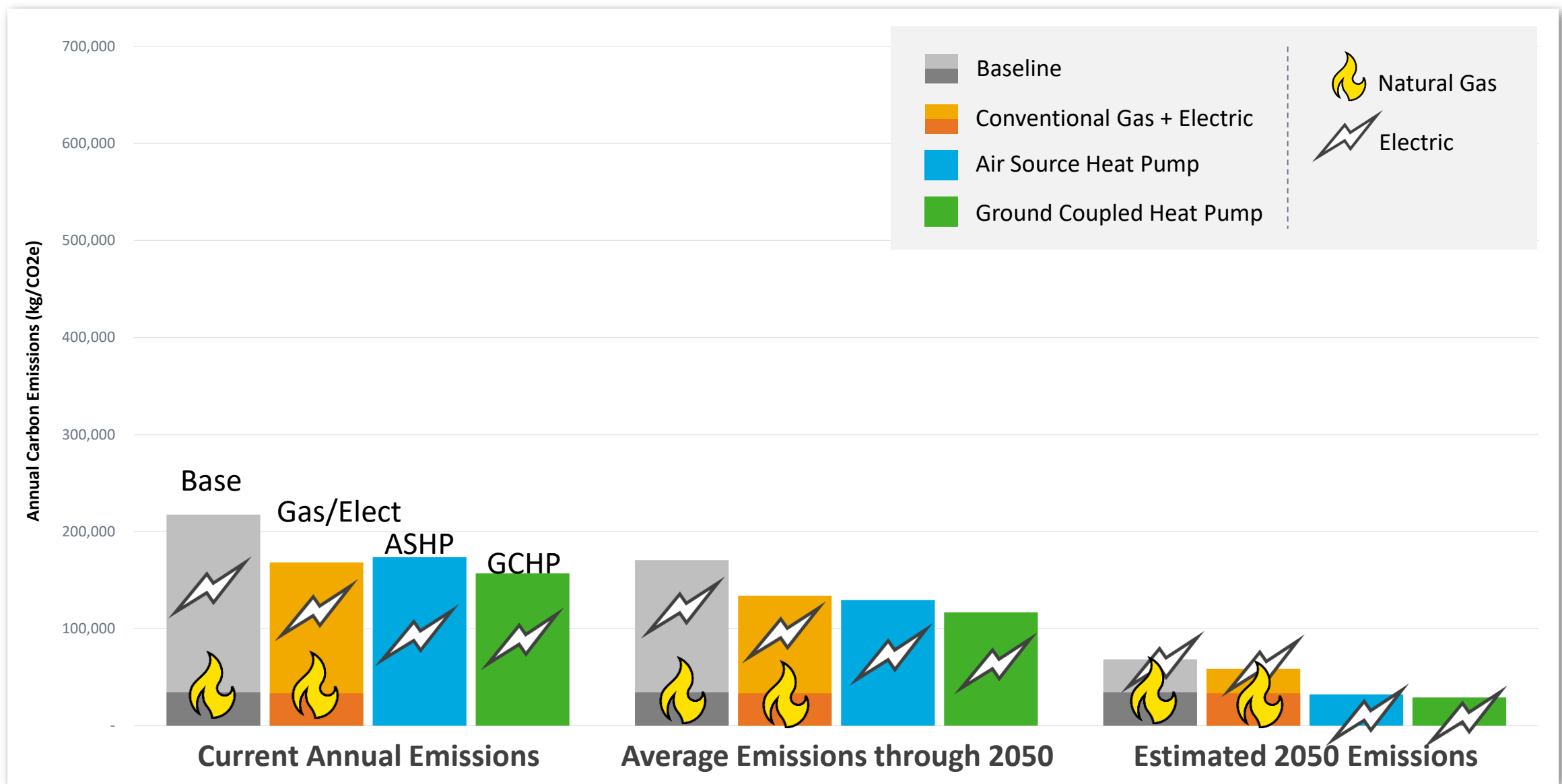
# Annual Carbon Emissions by Energy Source - K12 (SoCal)



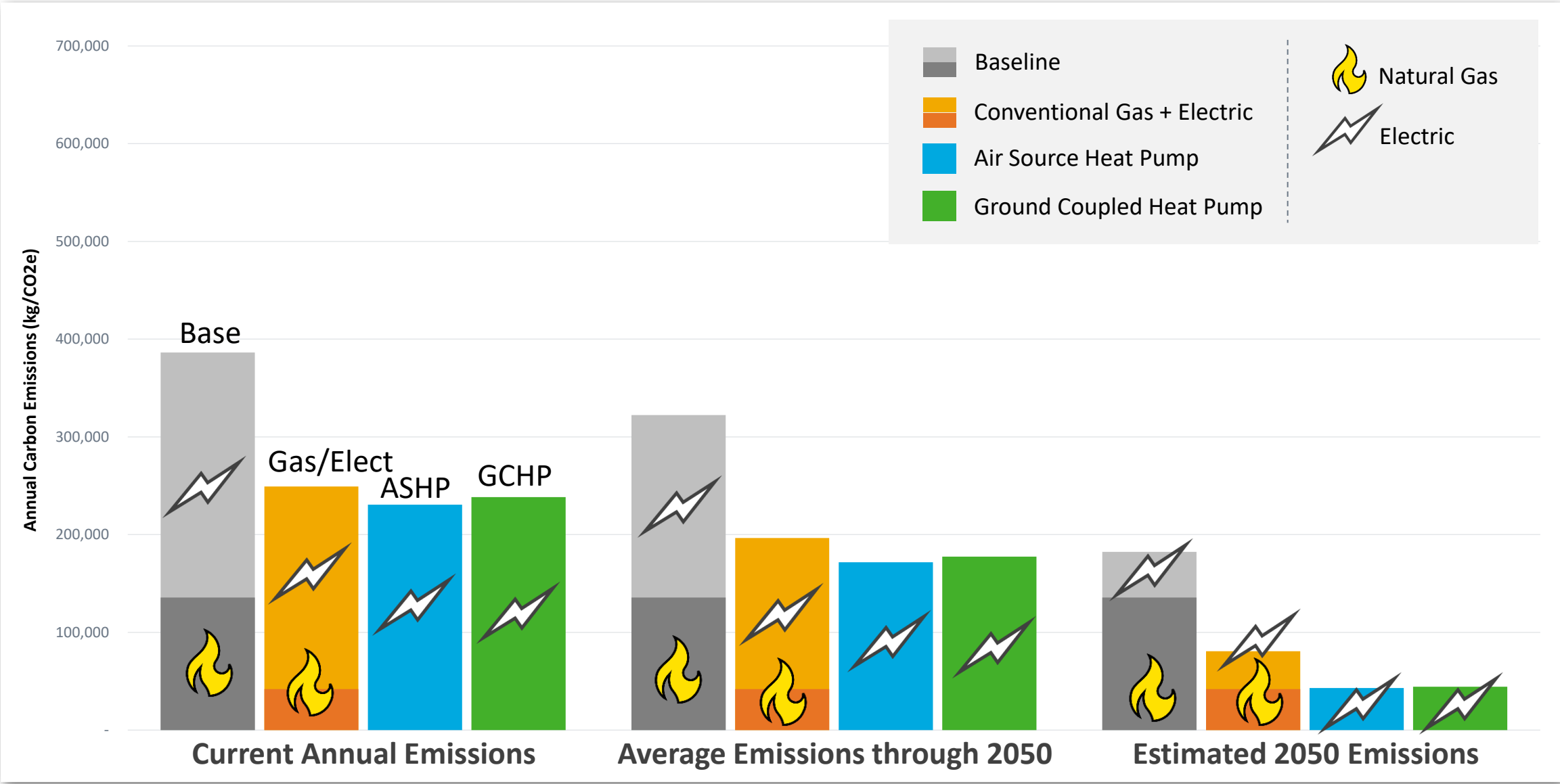
# Annual Carbon Emissions by Energy Source - Office (NorCal)



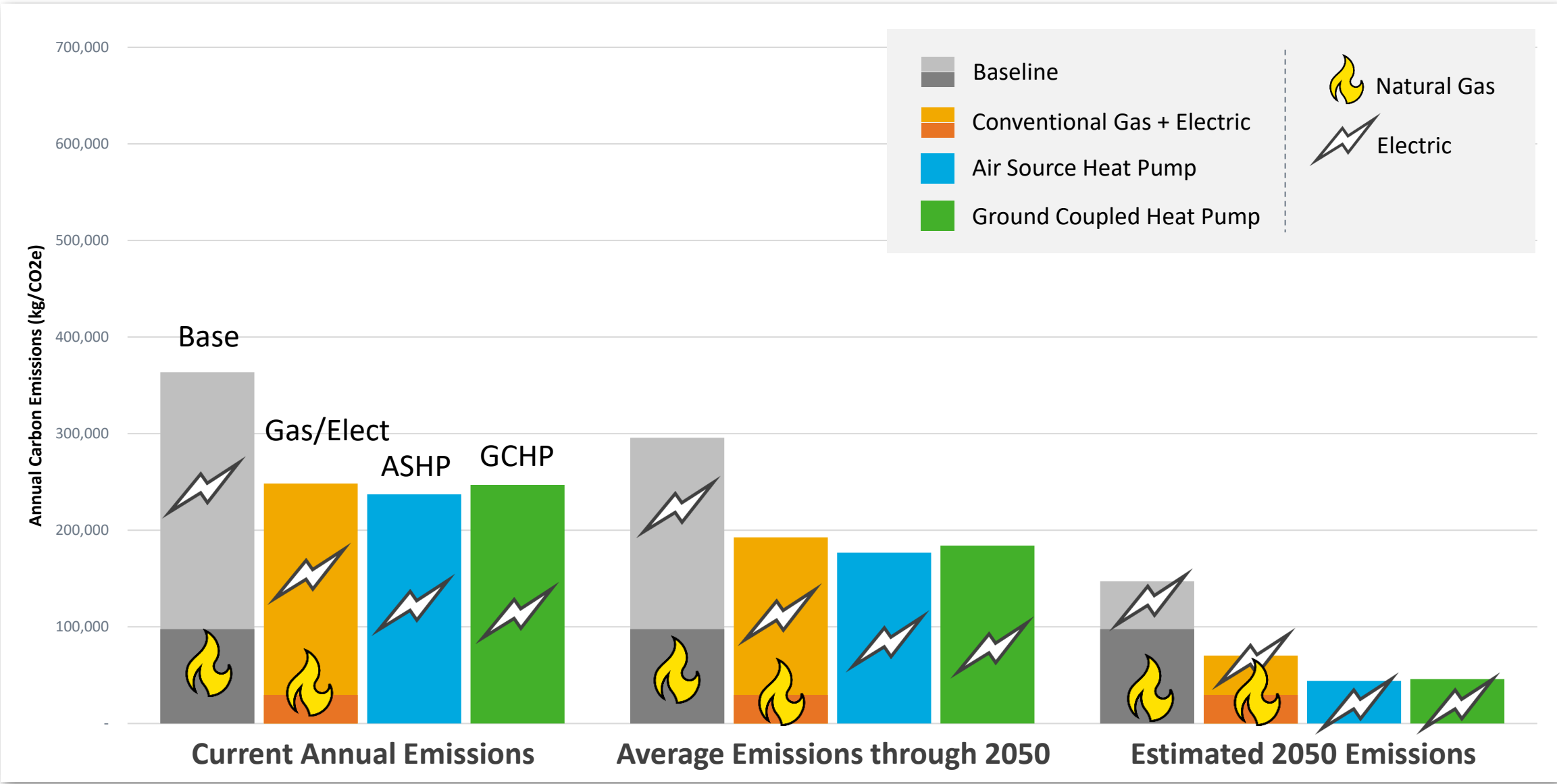
# Annual Carbon Emissions by Energy Source – Office (SoCal)



# Annual Carbon Emissions by Energy Source – Healthcare Clinic(NorCal)



# Annual Carbon Emissions by Energy Source – Healthcare Clinic(SoCal)



# Key Takeaways



Installing natural gas equipment in new buildings locks in those carbon emissions for the life of the equipment



The electric grid is getting cleaner each year - which has a profound impact on carbon emissions of the built environment



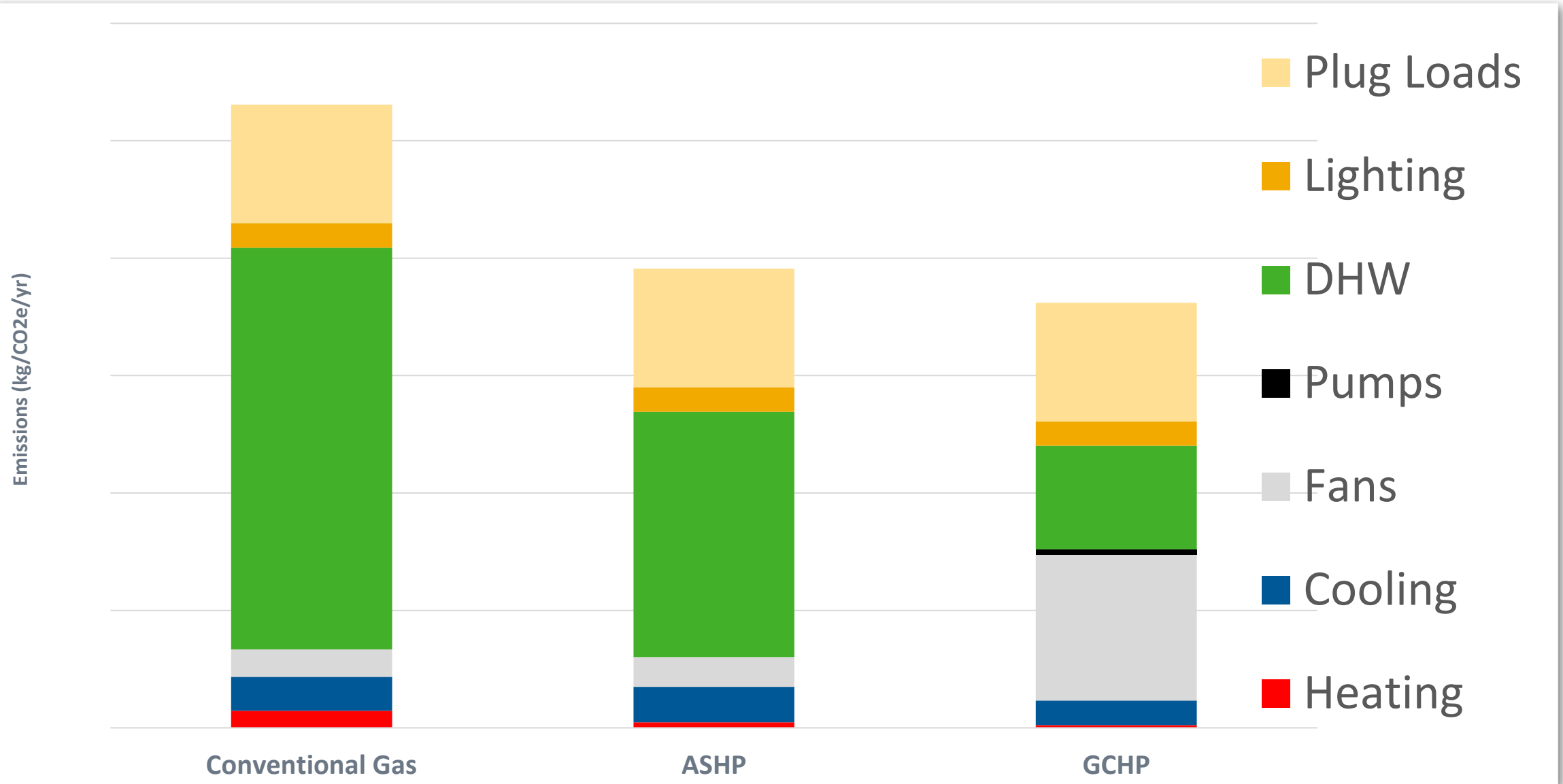
Installing efficient electric equipment will allow the building to decarbonize along with the electrical grid



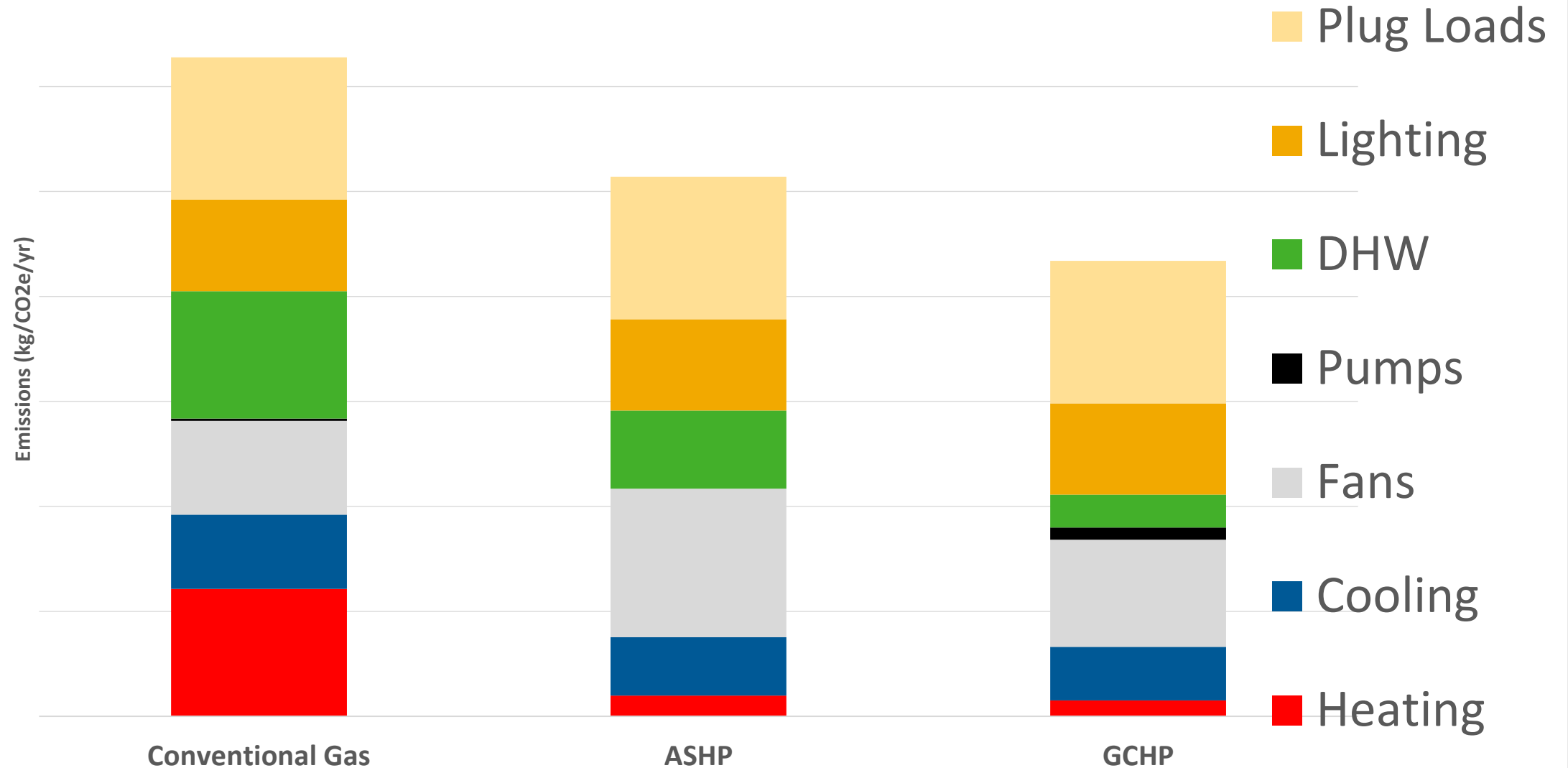
Electrifying buildings is key to decarbonizing the built environment

# Carbon by End Use

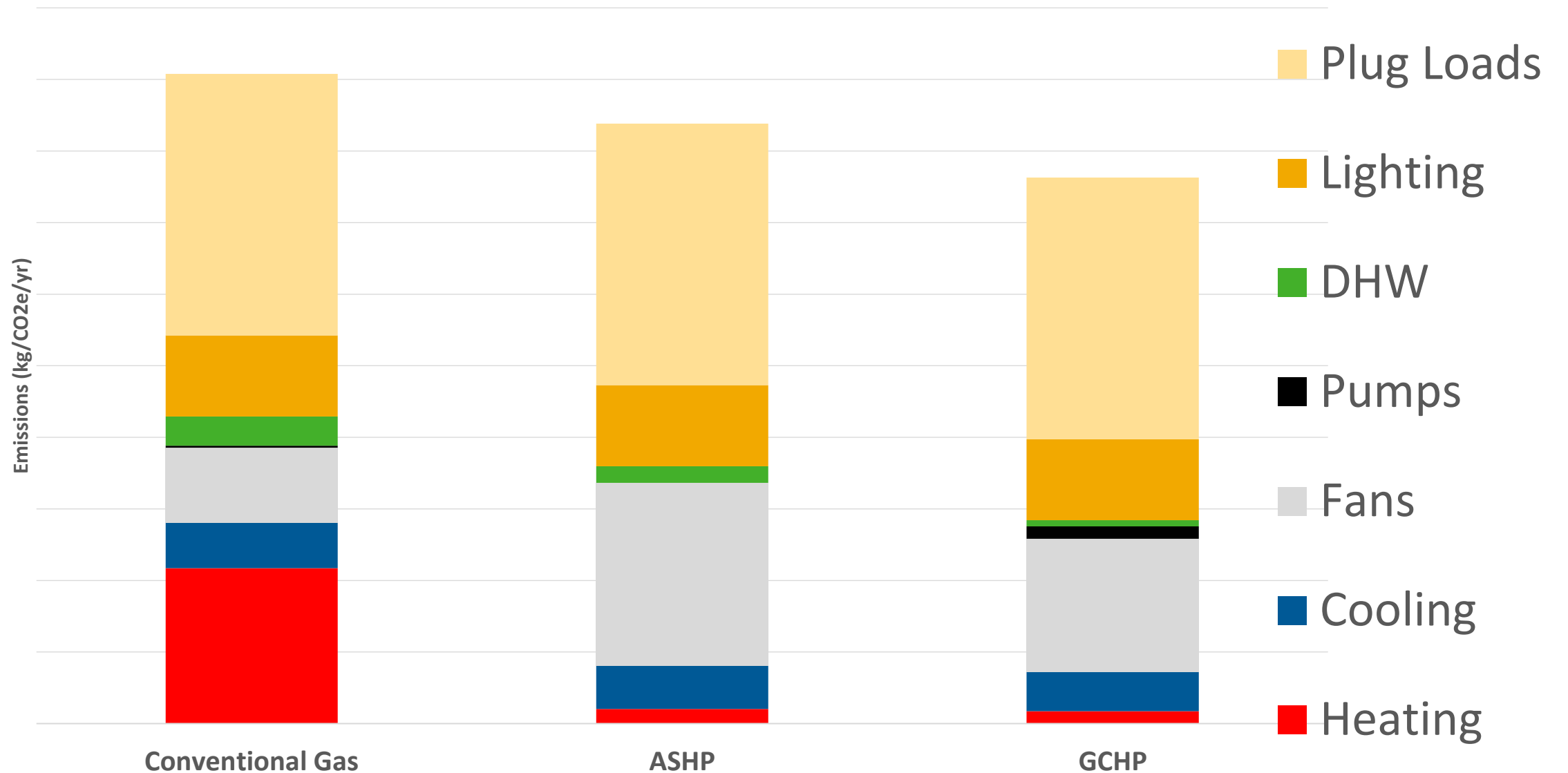
# 2026 Carbon Emissions by End Use - Multifamily (NorCal)



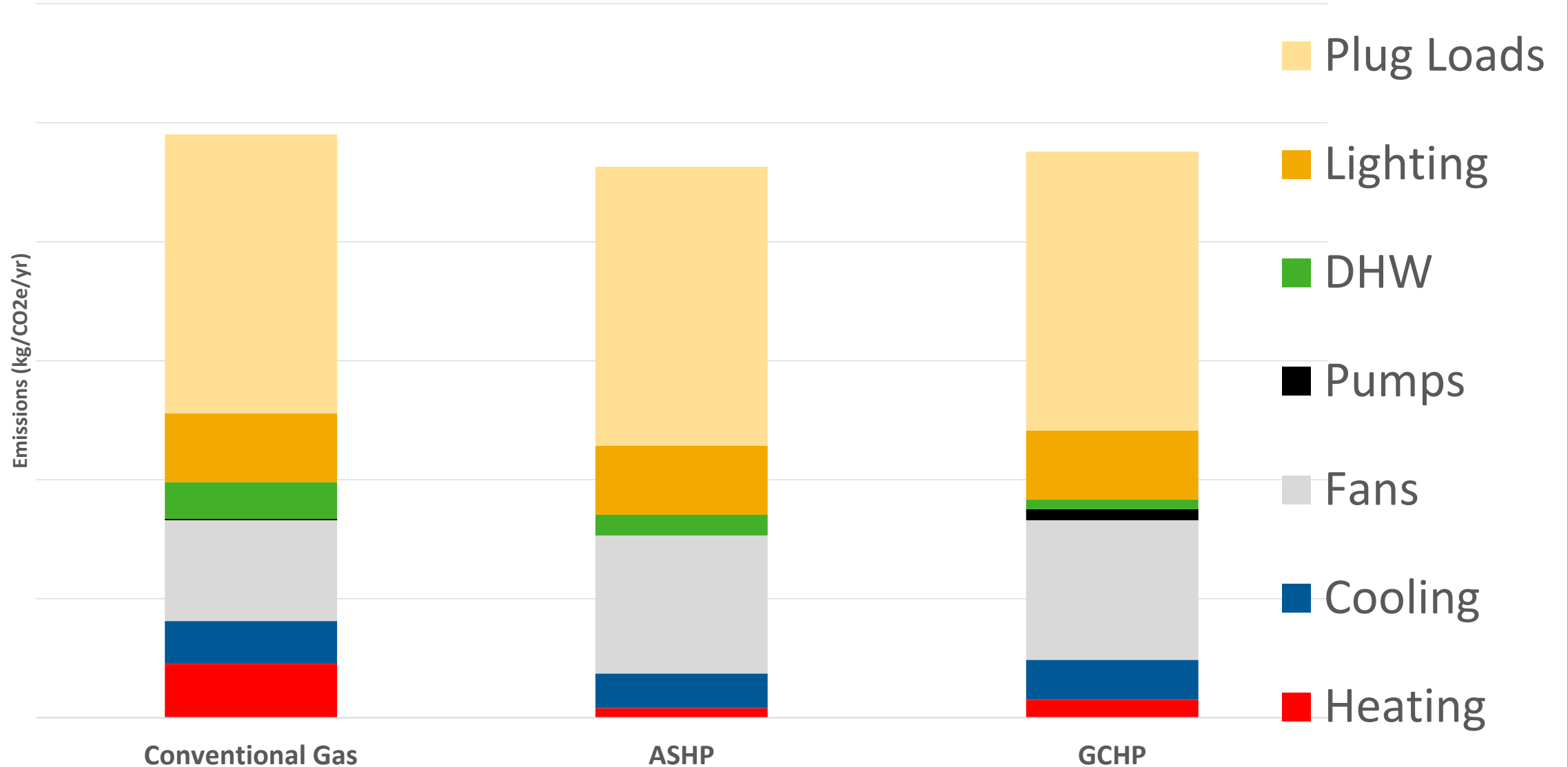
# 2026 Carbon Emissions by End Use - K12 (NorCal)



# 2026 Carbon Emissions by End Use - Office (NorCal)



# 2026 Carbon Emissions by End Use - Healthcare (NorCal)



# Key Takeaways



Water heating is the biggest carbon usage in apartments and school facilities



Plug loads and fan energy in offices and healthcare are opportunities for carbon reduction



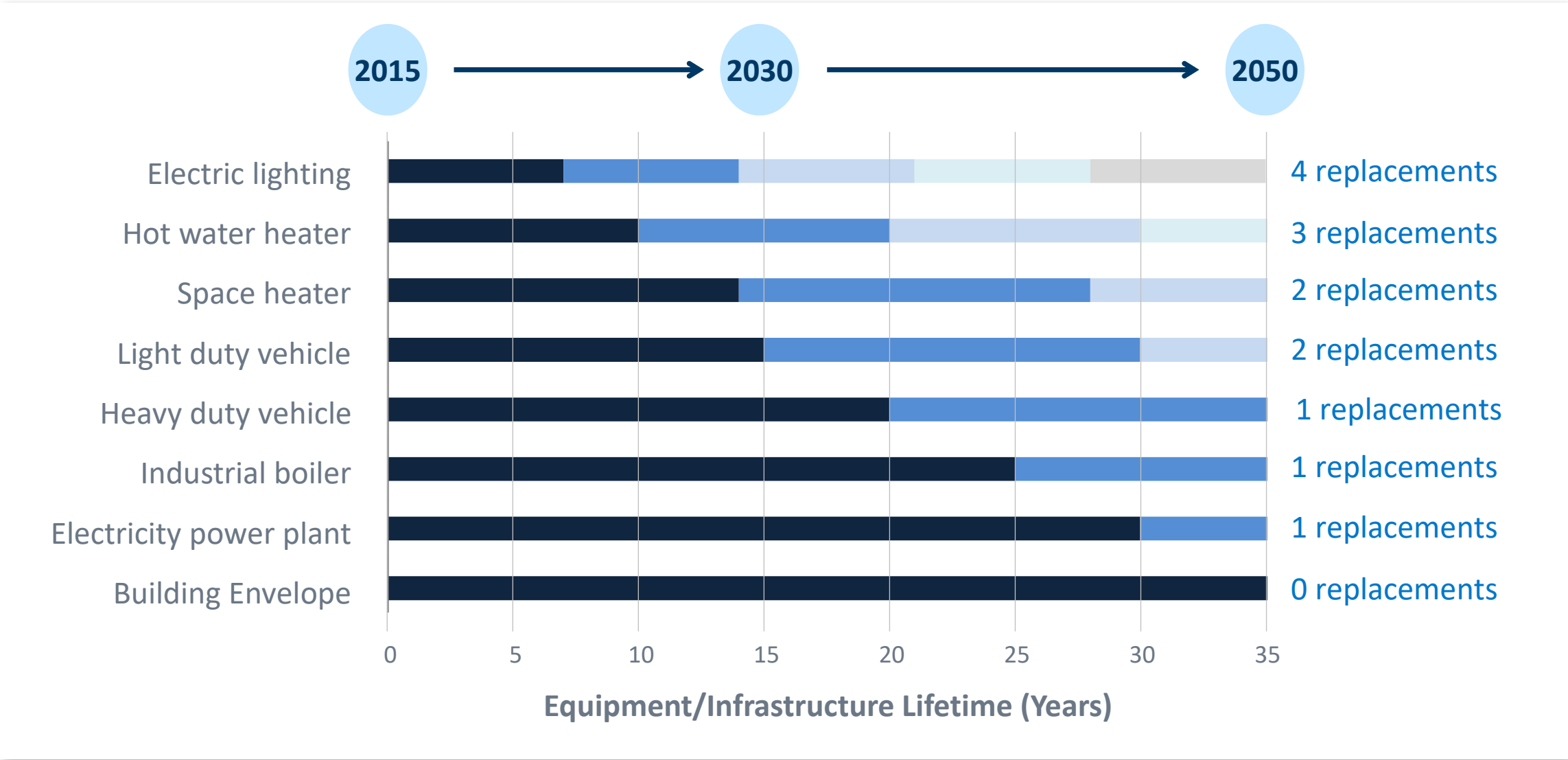
Minimal savings impact is left from lighting -- LEDs have made electric lights very efficient



In the next 5 years 460 Million Square Feet of new construction apartments are expected to be built in California

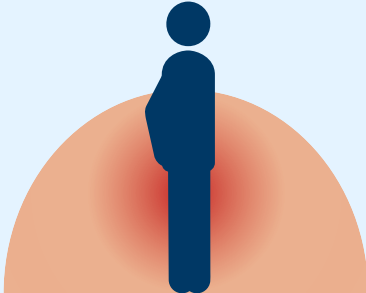
# Other Considerations

# Equipment Life



# Internal Loads – Occupant Activity

Building types house different activities that influence heating and cooling loads

|             |  |  |  |  |  |
|-------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Activity    | Sleeping                                                                          | Sitting                                                                            | Standing                                                                            | Walking                                                                             | Exercise                                                                            |
| Heat Output | 76W                                                                               | 103W                                                                               | 126W                                                                                | 212W                                                                                | 370W                                                                                |

# Key Takeaways



Building envelope impacts heating and cooling loads and has a life-long impact on carbon reduction



Additional carbon reductions can be found by balancing envelope strategies, building systems, and project budget/goals



More carbon reductions can be found when we analyze impacts of internal loads



Decarbonization analysis can help identify areas where additional savings can be found

# Conclusions and Discussion

# Key Takeaways



The landscape of power generation is changing and contributes significantly to carbon reduction.



Utilize energy modeling to explore load balancing and carbon emissions.



Assess carbon reduction, with today's and future emission rates, to design buildings for the future.



Make a commitment to include low carbon design strategies in the development of every project.

# Thank you!



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