





# **WHY BIOENERGY?**

- Climate Change
- Air Quality
- Landfill reduction
- Renewable power
- Low carbon fuel
- Local energy supplies
- Community resilience

# Climate Priorities

IPCC: We have 12 years left to reduce climate pollution or face catastrophic changes

ARB: SLCP Reduction and carbon sequestration are the only way to immediately reverse climate change and its impacts

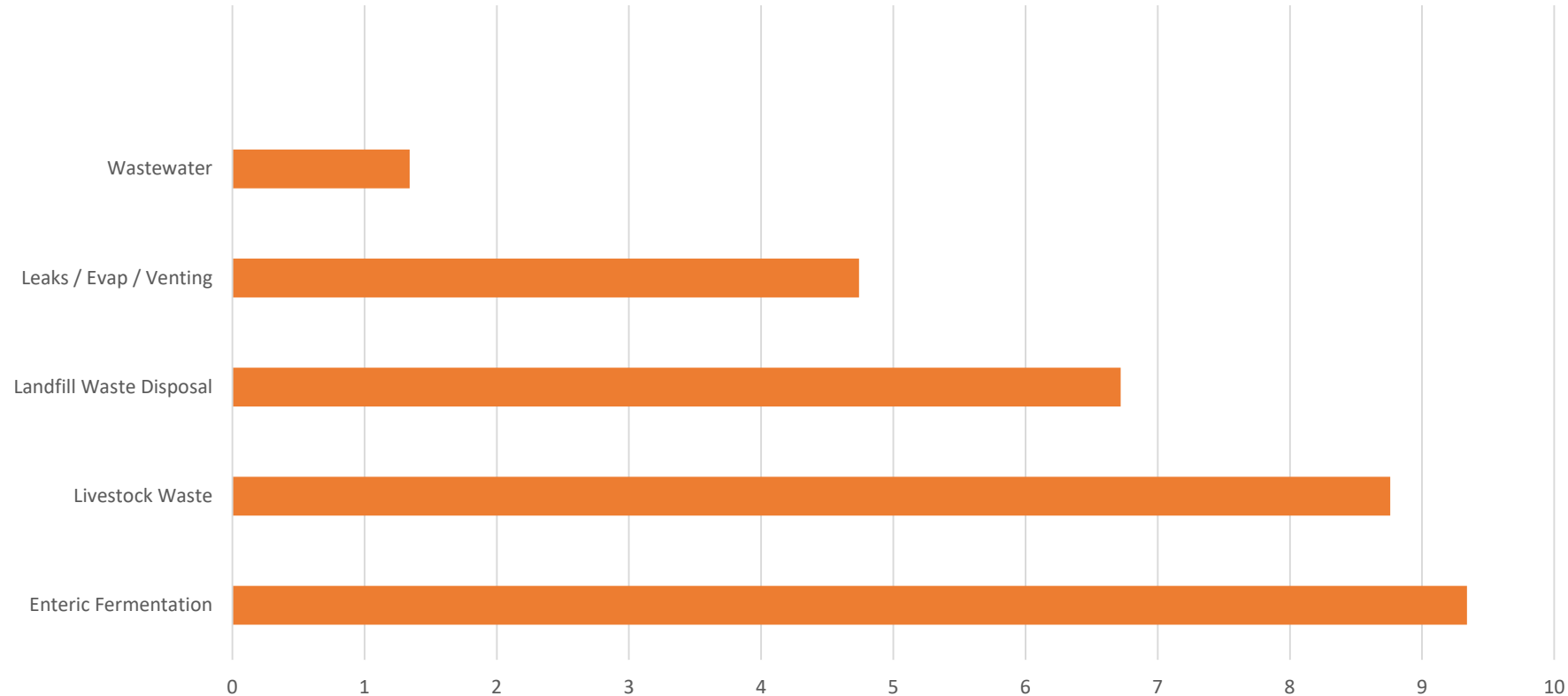
SLCP's are much more damaging than CO<sub>2</sub>



## Organic Waste and Methane

- Methane = 72x more damage to climate than CO<sub>2</sub>
- Organic Waste = 4 of 5 biggest sources in CA

California's Top 5 Methane Sources



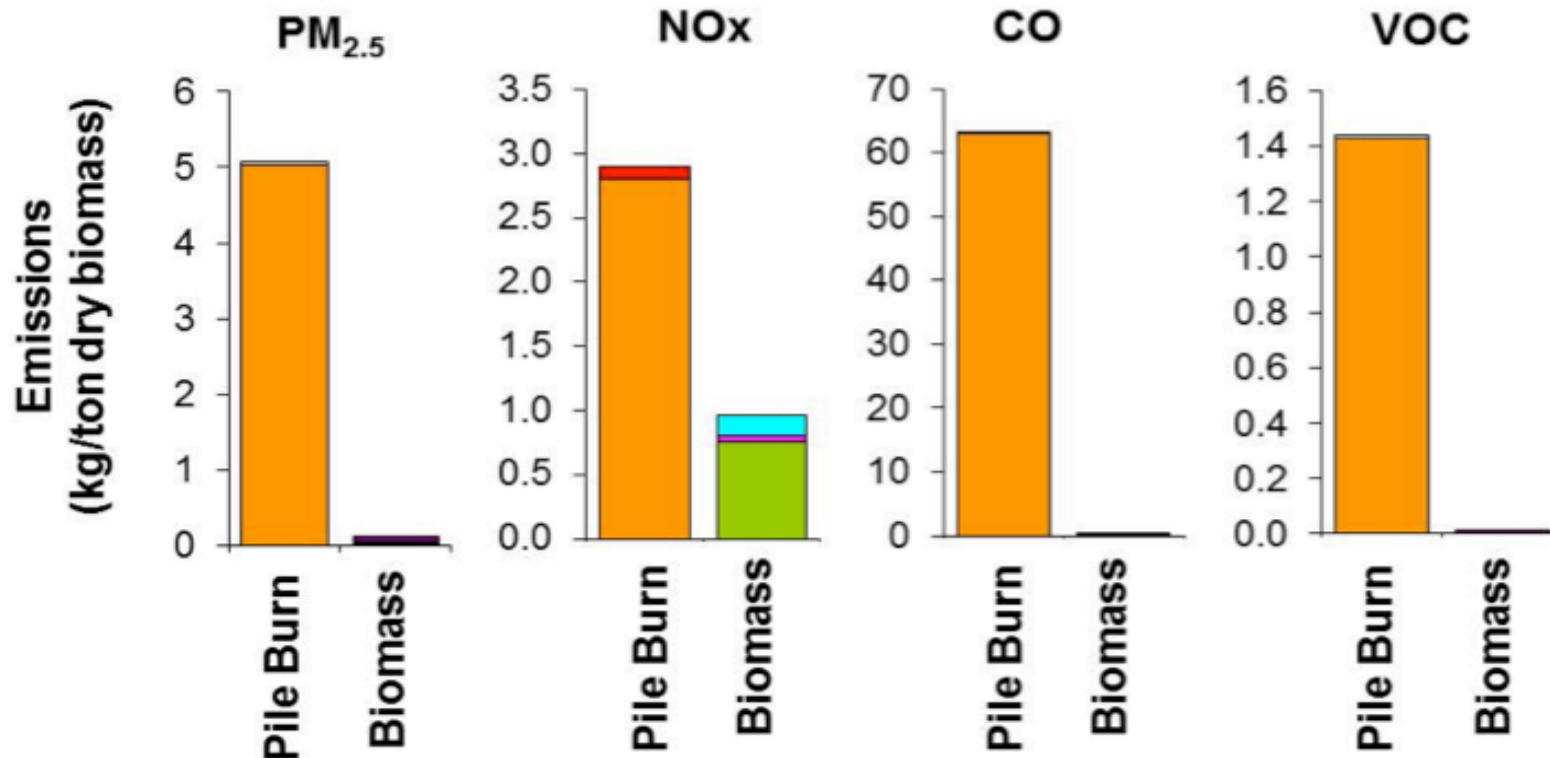
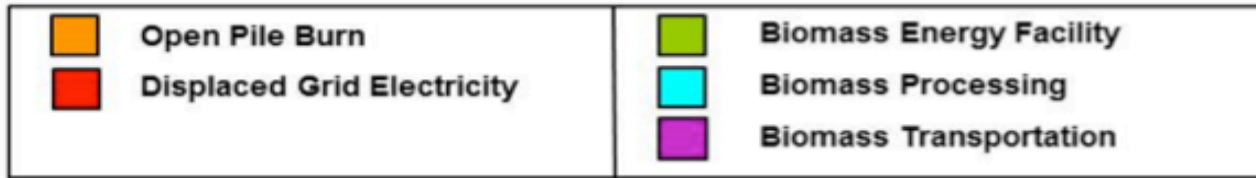
# LifeCycle Carbon Intensity of Fuels (grams CO<sub>2</sub>e / MJ)

<b>Diesel</b>	102
<b>Gasoline</b>	100
<b>Corn ethanol</b>	34-75
<b>Natural Gas</b>	68
<b>Fuel Cell (non-renewable hydrogen)</b>	39
<b>Electric vehicles (CA power grid)</b>	31
<b>Biodiesel</b>	9 to 50
<b>Landfill Biogas</b>	11 to 40
<b>Biogas from forest waste</b>	14
<b>Wastewater Biogas (large facilities)</b>	8 - 30
<b>Biogas from Diverted Food and Green Waste</b>	-15 to -31
<b>Dairy Biogas</b>	- 276









## Biomass Reduces:

- PM<sub>2.5</sub> and black carbon by 99%
- Methane and other VOC's by 95-99%
- NO<sub>x</sub> by 40-70%.



# Putting Food / Agricultural Waste to Work



- Distributed scale gasification
- Walnut shells used to produce heat and power needed for shelling, drying and packaging the nuts
- Meets the most stringent NOx standards in the U.S.
- Gasification probably destroys PFAS chemicals – need research on this

# Importance of Biogas to Replace Diesel

- Diesel trucks = largest source of air pollution in San Joaquin Valley and South Coast Air Districts
- Diesel causes ½ of smog and toxic air contaminants in SJV
- Near-zero emission trucks can cut NOx and TAC's 90-95%



# Need to Put Organic Waste to Use

- SB 1383 (Lara, 2016) requires:
  - ✓ 40% reduction in methane emissions and anthropogenic black carbon
  - ✓ 75% reduction in organic landfill waste by 2025  
(15 million tons of diverted organic waste / year)

Draft regs - <https://www.calrecycle.ca.gov/Laws/Rulemaking/SLCP/>





# Bioenergy + Compost or Biochar = Greatest Benefits

- OR Department of Environmental Quality – Bioenergy + compost provides 3.5 times greater GHG reductions than compost alone

<https://www.oregon.gov/deq/FilterDocs/FoodWasteStudyReport.pdf>





# Importance of Bioenergy for Reliability

- NAS – Need bioenergy to get to 100% renewables
- Former DOE Secretary Moniz – Need bioenergy for reliability
- Bioenergy can provide flexible generation power, energy storage
- Bioenergy can provide locally energy supplies

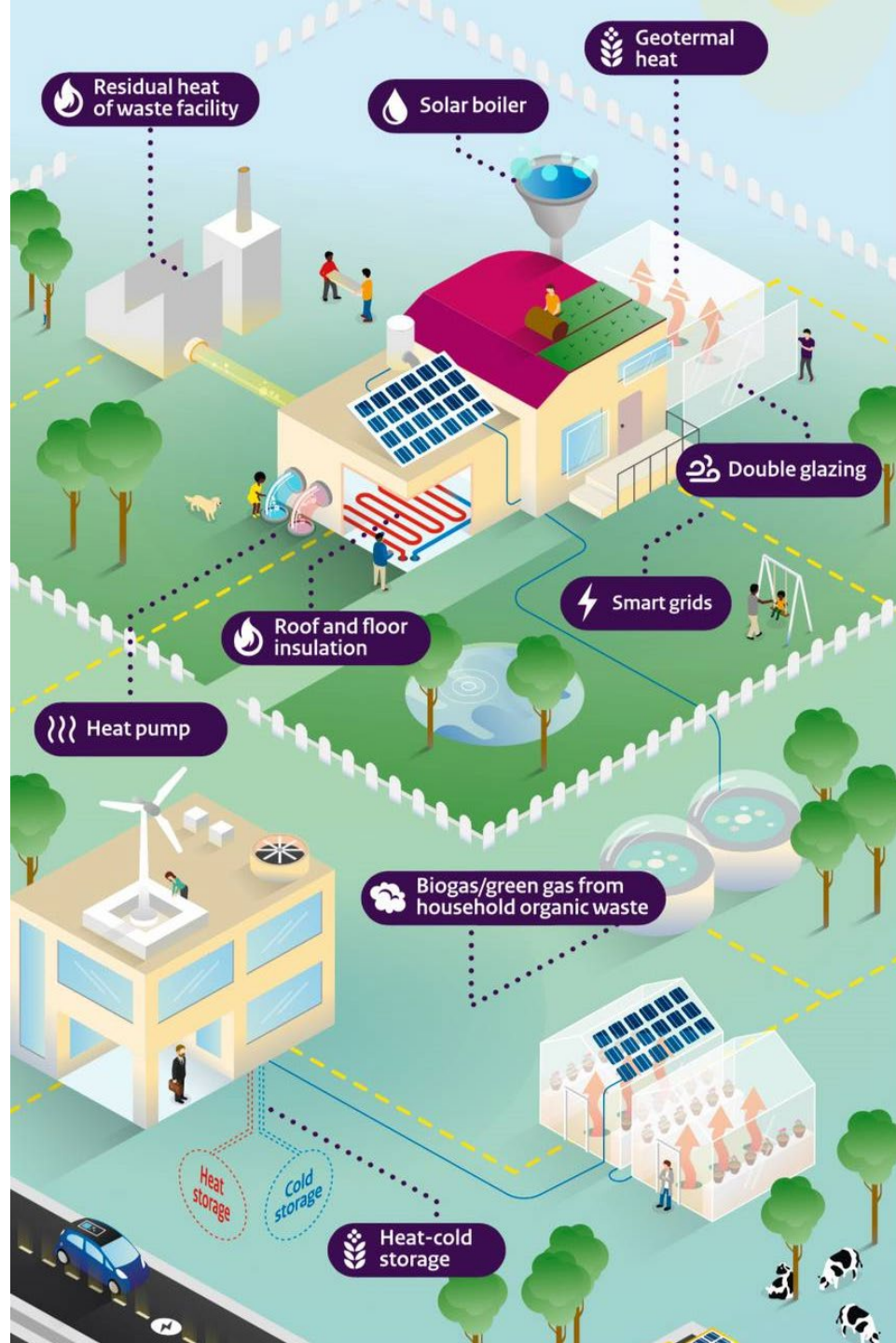






Biogas can Provide Locally Sourced,  
Carbon Negative Generation and Storage





























## Next Steps – Research Needs

- How to maximize GHG/SLCP reductions from food/ag waste
- Emissions from compost versus bioenergy
- Can gasification eliminate PFAS chemicals
- Highest and best uses of biochar
- Technologies to eliminate bioenergy emissions
- Technologies to upgrade biogas (incl. CO<sub>2</sub> removal)

# THANK YOU

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**Bioenergy**  
Association of  
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