

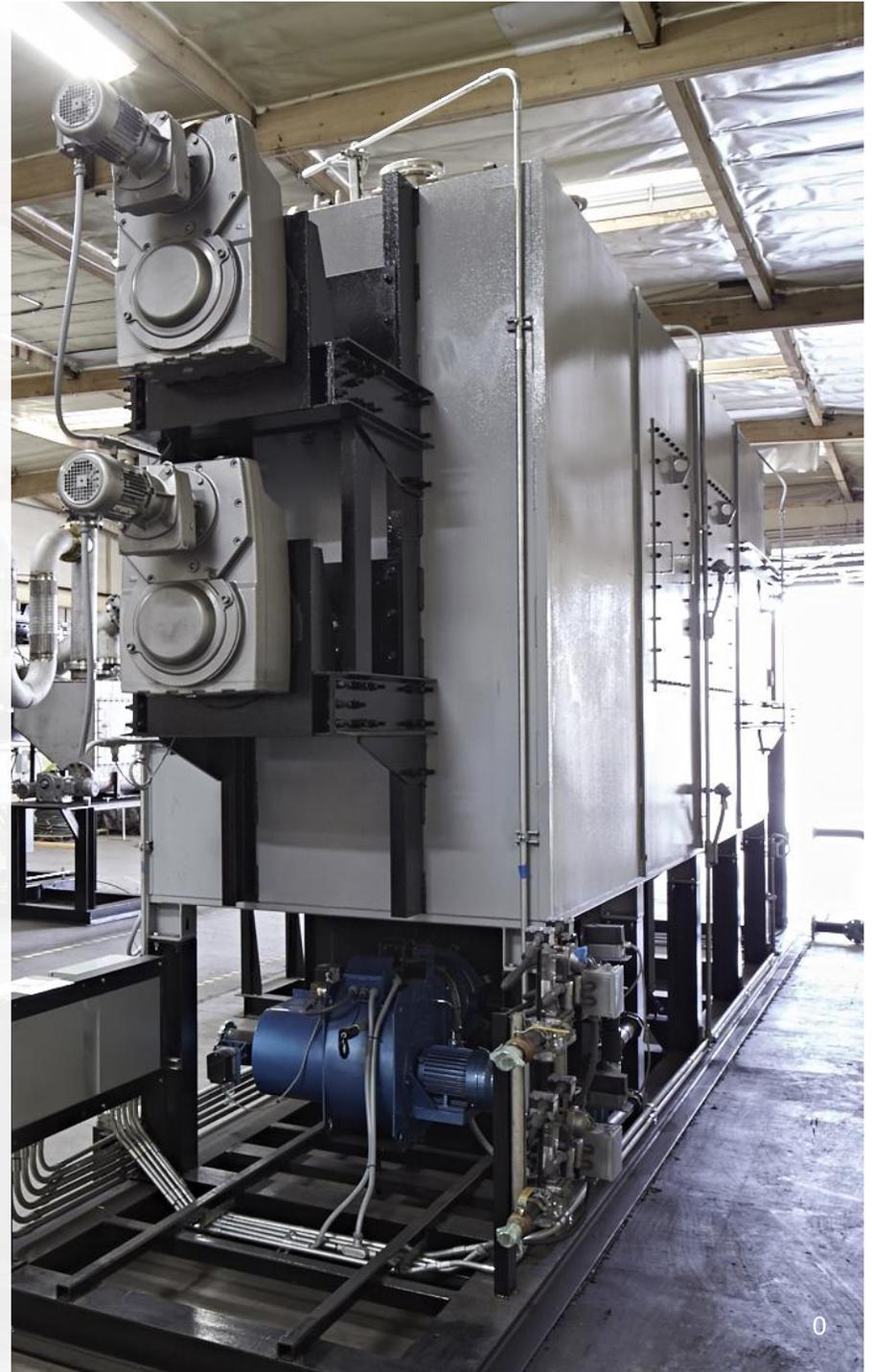
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Infrastructure

*Creating a circular economy
by converting locally
generated waste into biogas,
hydrogen, and carbon char*

Presented to:

**California Bioresources
Alliance**

November 19, 2021



Problem: Traditional waste management practices emit greenhouse gases: CO₂, CH₄, N₂O



Landfilling



Land Application

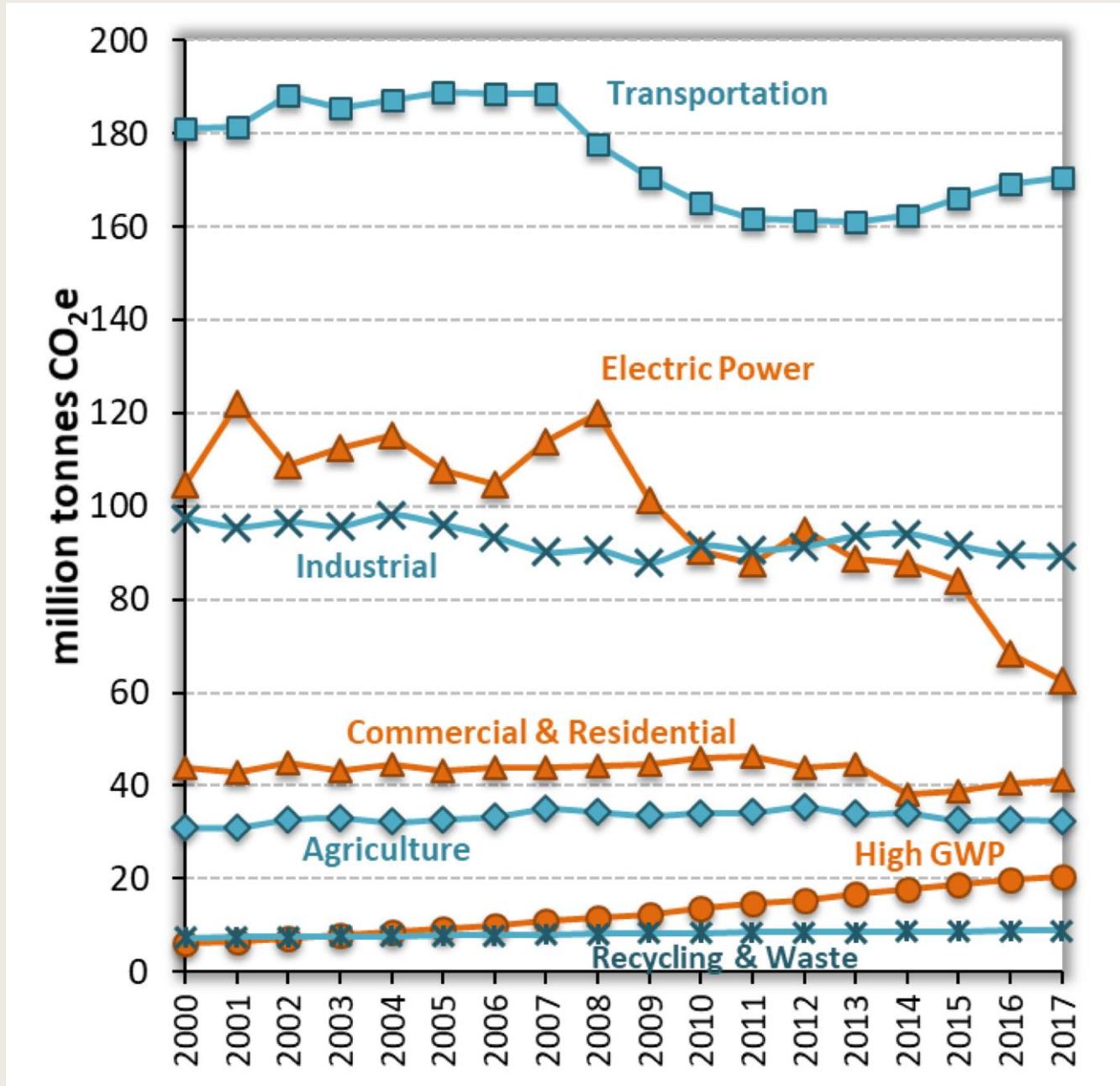


Composting



Incineration

Problem:
 Transportation
 Accounts for
 40% of
 California's GHG
 missions



CARB 2019 Edition, California Greenhouse Gas Emission Inventory:
 2000 – 2017

Solution: Convert "Wastes" into Low Carbon Transportation Fuel



Tree pruning and removal



Biosolids



Nut shells



Green waste



Conversion Technology



Renewable Hydrogen



Lower Carbon Intensity Fuels

Existing Legislation Provides a Push and Pull for this Approach

SB 1383

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Tree pruning and removal



Biosolids



Nut shells



Green waste



Conversion Technology



Renewable Hydrogen

LCFS Credits



Lower Carbon Intensity Fuels

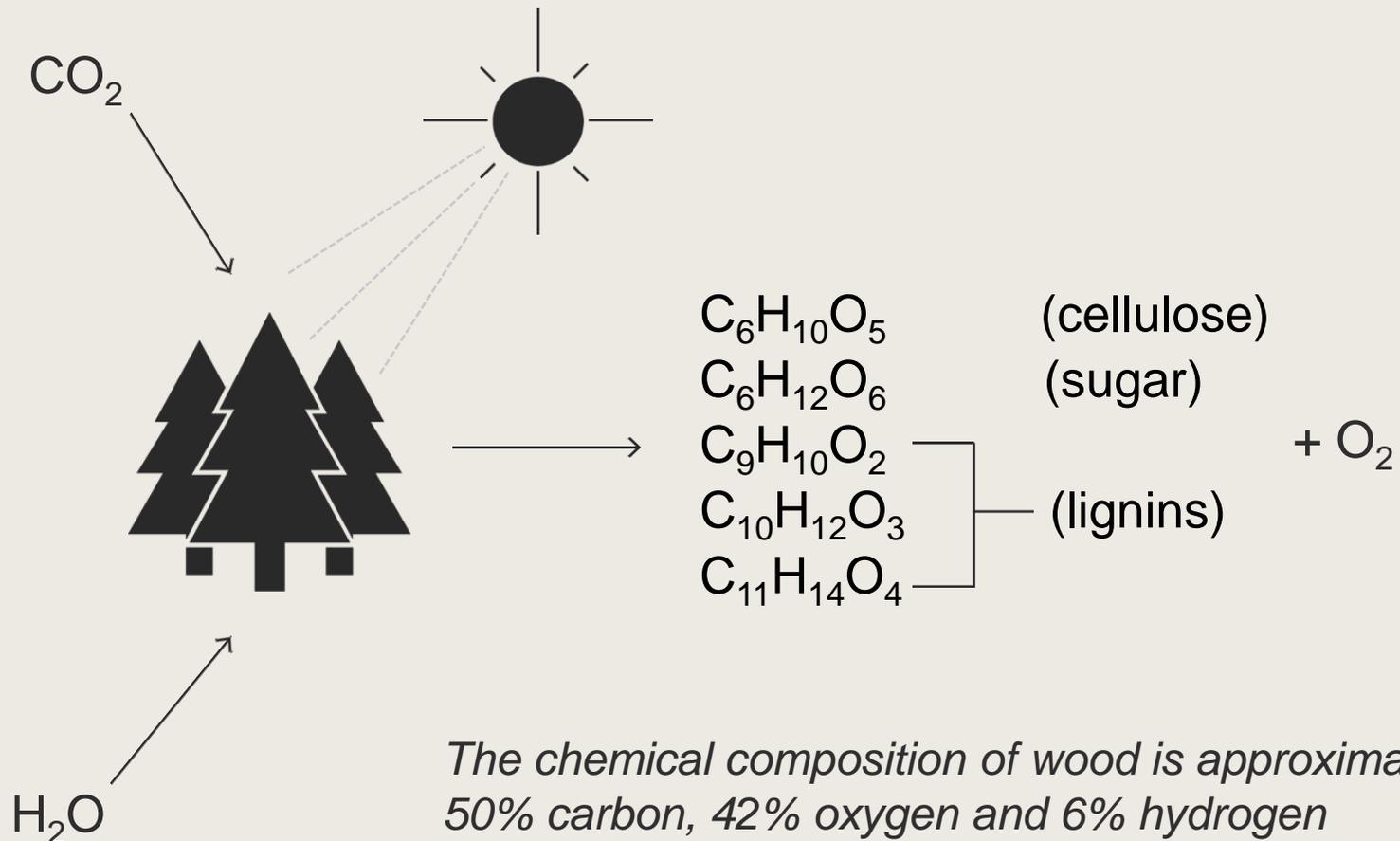
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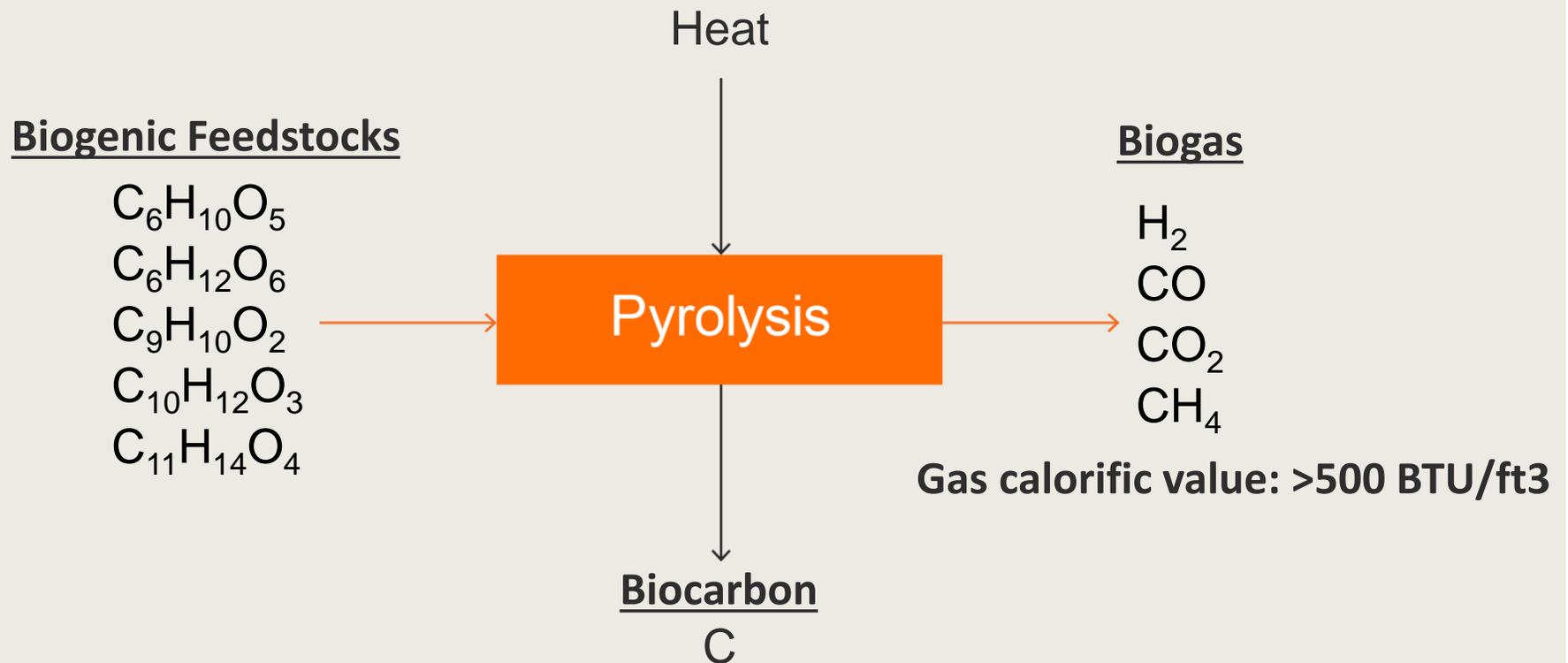
California Generates over 100,000 tons/day of “waste” feedstock that can be converted into energy

Feedstock	Amount Technically Available per Year
Animal Manure	3.4 million BDT
Fats, Oils, and Greases	207,000 tons
Municipal Solid Waste (food, leaves, grass)	1.2 million BDT
Municipal Solid Waste (lignocellulosic fraction)	6.7 million BDT
Agricultural Residue (lignocellulosic fraction)	5.3 million BDT
Forest, Sawmill, Shrub & Chaparral Residues	26.2 million BDT
Total	42.8 million BDT

Biogenic feed originates with the photosynthetic combination of atmospheric CO_2 with H_2O to form a carbohydrate and oxygen



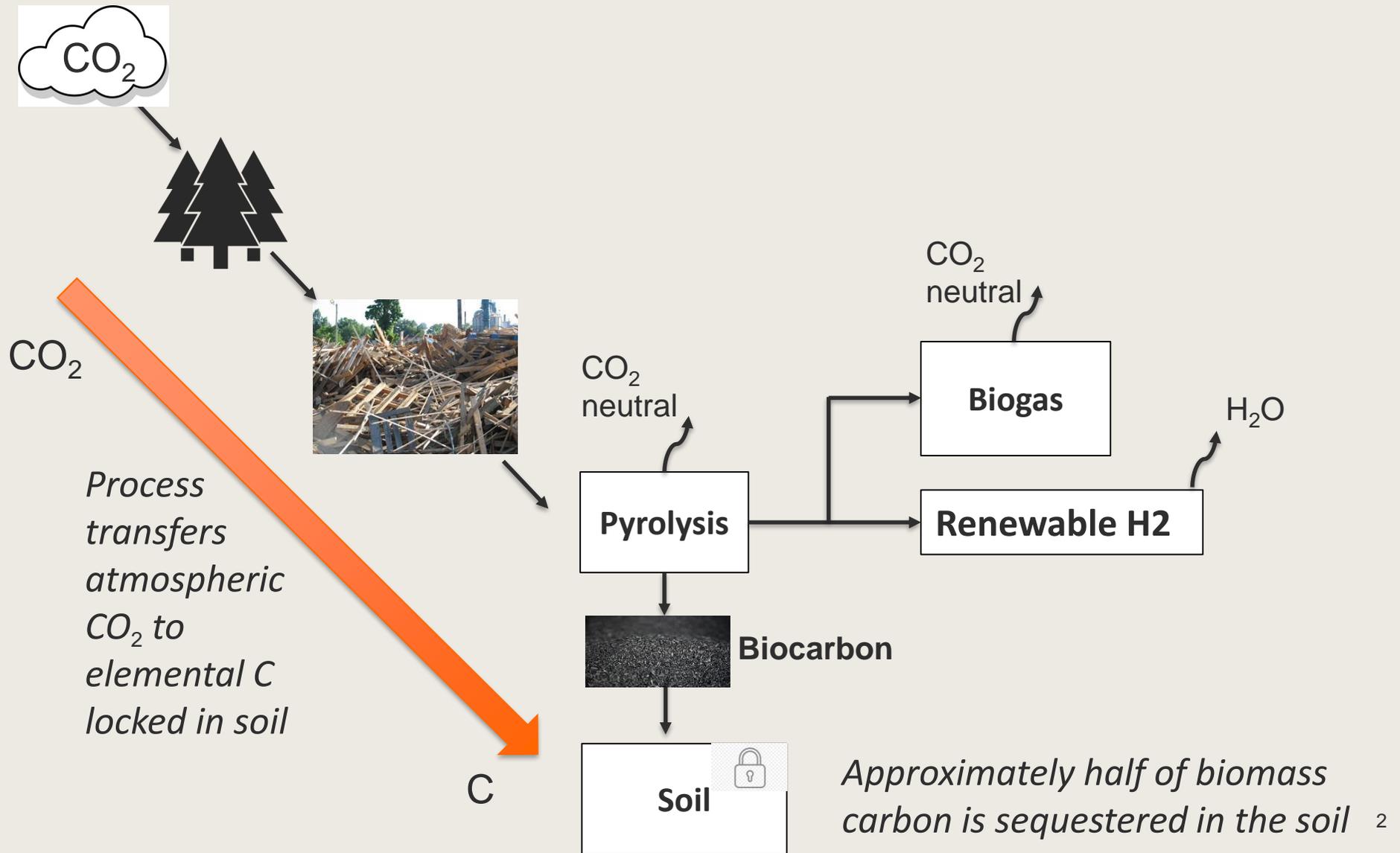
High-temperature “slow” pyrolysis to convert biogenic feed to gasses and carbon



The gas composition and biocarbon (C) properties depend upon feedstock composition, pyrolysis temperature, and gas and solid retention time

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Pyrolysis leverages the ecosystem services of plants to reduce atmospheric carbon (carbon negative process)

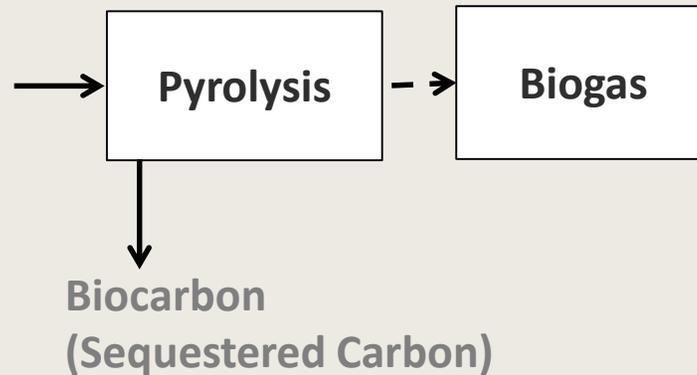


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Starting with Biogas Provides a Flexible Renewable Energy Platform

Biogenic feedstock

Ag Residuals
Demo wood
Biomass from forest
management



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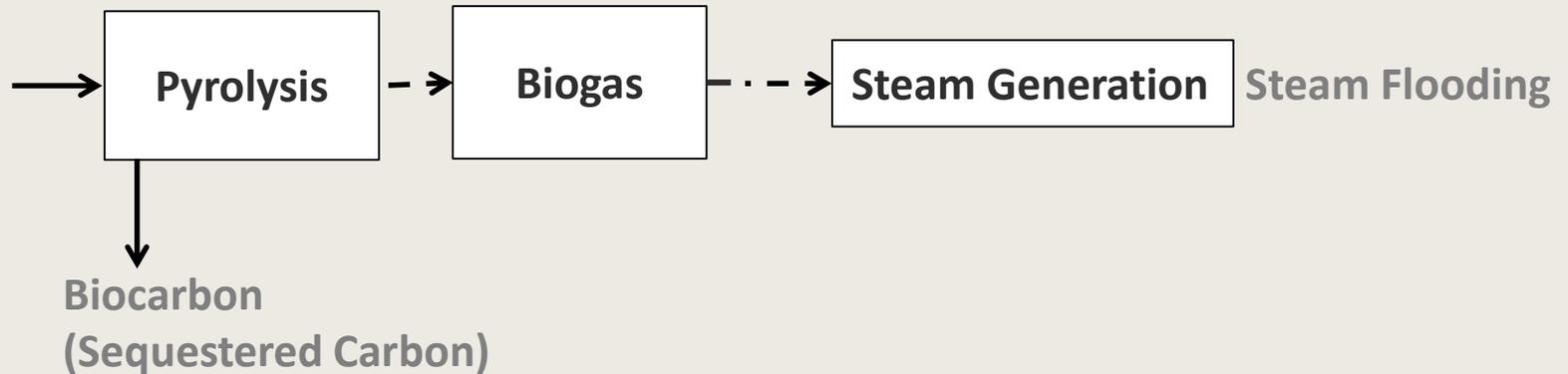
Biogas can replace natural gas used for steam generation, reducing the carbon intensity of produced crude

Biogenic feedstock

Ag Residuals

Demo wood

Biomass from forest
management

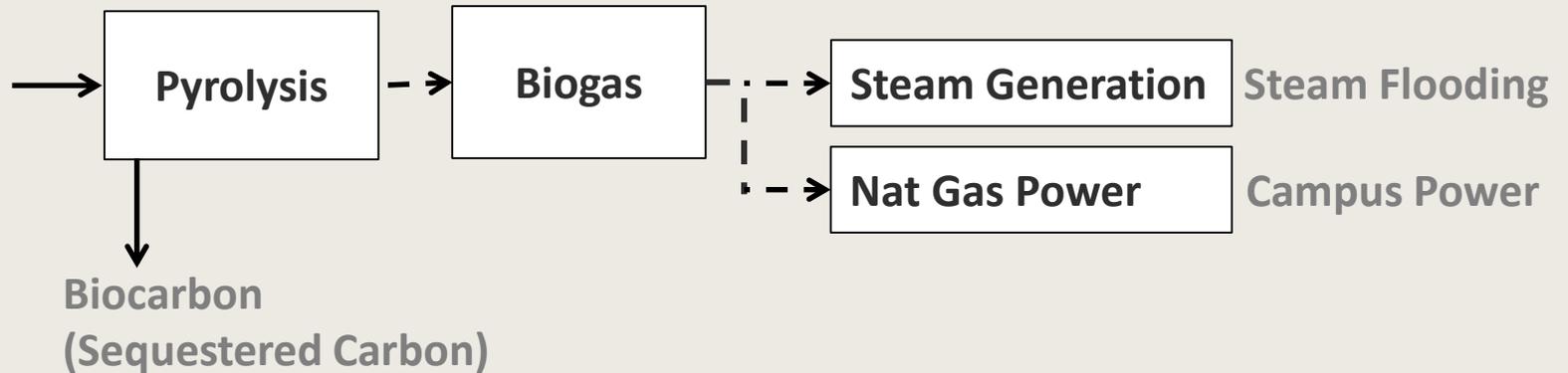


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Or...Biogas Can Replace Natural Gas for Power Generation, Reducing Carbon Intensity of Electricity

Biogenic feedstock

Ag Residuals
Demo wood
Biomass from forest management

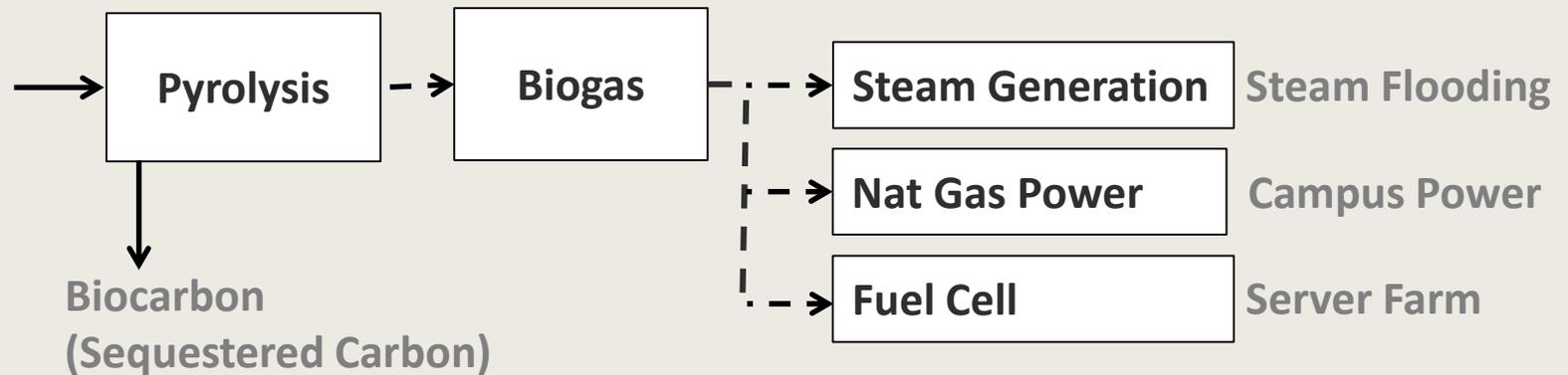


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Or...Biogas Can Replace Natural Gas in Fuel Cells to “Clean the Cloud”

Biogenic feedstock

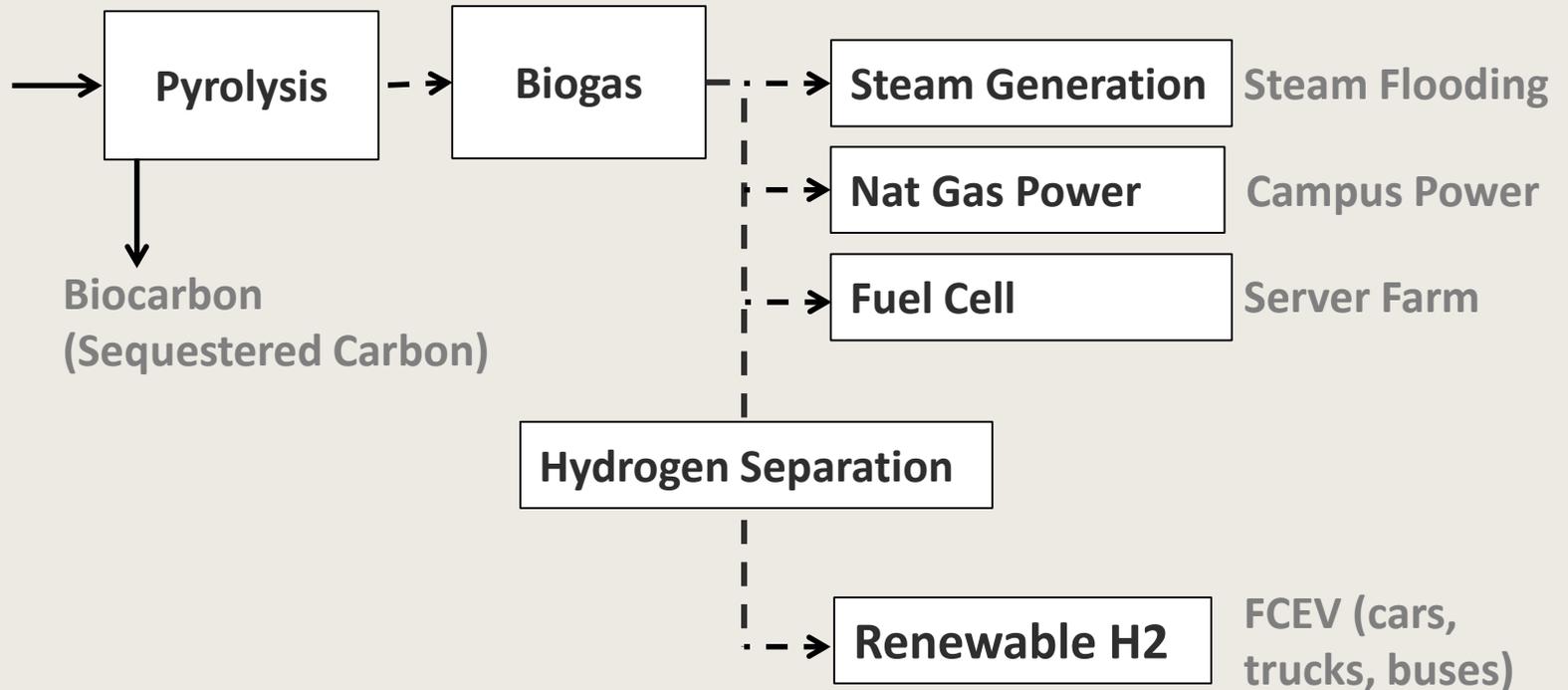
Ag Residuals
Demo wood
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Biogas Can Also Be Upgraded to Renewable Hydrogen for Fuel Cell Electric Cars, Trucks, and Buses

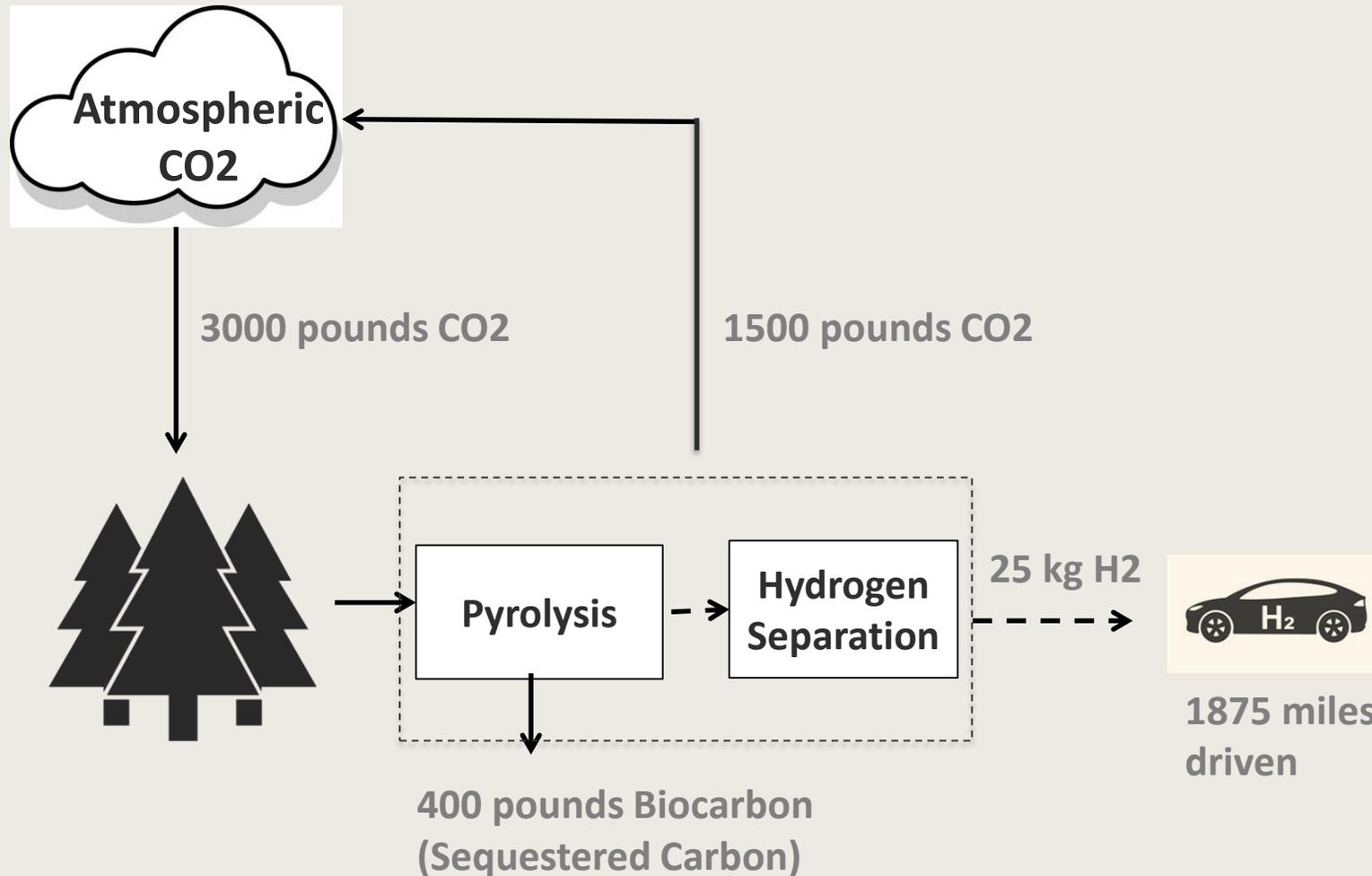
Biogenic feedstock

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This Process Removes One Pound of CO₂ from the Atmosphere for Every Mile Driven Using R-H₂



Elemental Carbon Char Is the Key to Carbon Management



Figure 1: Biochar produced from organic matter. Source: Hans Erken, Flickr.

- Soil Amendment
- Fossil coal substitute for difficult to decarbonize industries

Biocarbon as Soil Amendment Has Many Benefits



Carbon Sequestration

- Reduced Irrigation (less water)
- Improved Nutrient Retention (less fertilizer)
- Reduced Nutrient Runoff (less non-point pollution)
- Enhanced microbial activity (healthier soil)
- Increased yields

Biocarbon Can Substitute for Fossil Coal in Difficult to Decarbonize Industries



California cement manufacturers use 900,000 tons of coal and petroleum coke, which can be replaced with carbon neutral “biocarbon”.

Creating a circular economy by converting locally generated waste into biogas, hydrogen, and biocarbon yields many benefits

1. Reduce GHGs emissions from traditional waste management practices
2. Produce carbon negative transportation fuels
3. Improve agriculture yields using less water
4. Decarbonize difficult to decarbonize industries (Cement manufacturing)

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The Technology Described Is Operating at **Commercial-Scale** in Downtown Los Angeles – ***Contact Kore to Arrange for a Visit***



Project supported technically and financially by:



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