

## **California's decarbonization targets and beyond: Decentralized Waste to Hydrogen solutions**

# California Target

Renewable electricity  
electrolysis and conventional  
biofuels are fully carbon  
neutral.

Good !!

Hydrogen (or Power) from  
Biomass and Waste:  
Effectively remove carbon  
from the atmosphere by  
combining conversion stations  
with CCS technology.

Much better !!

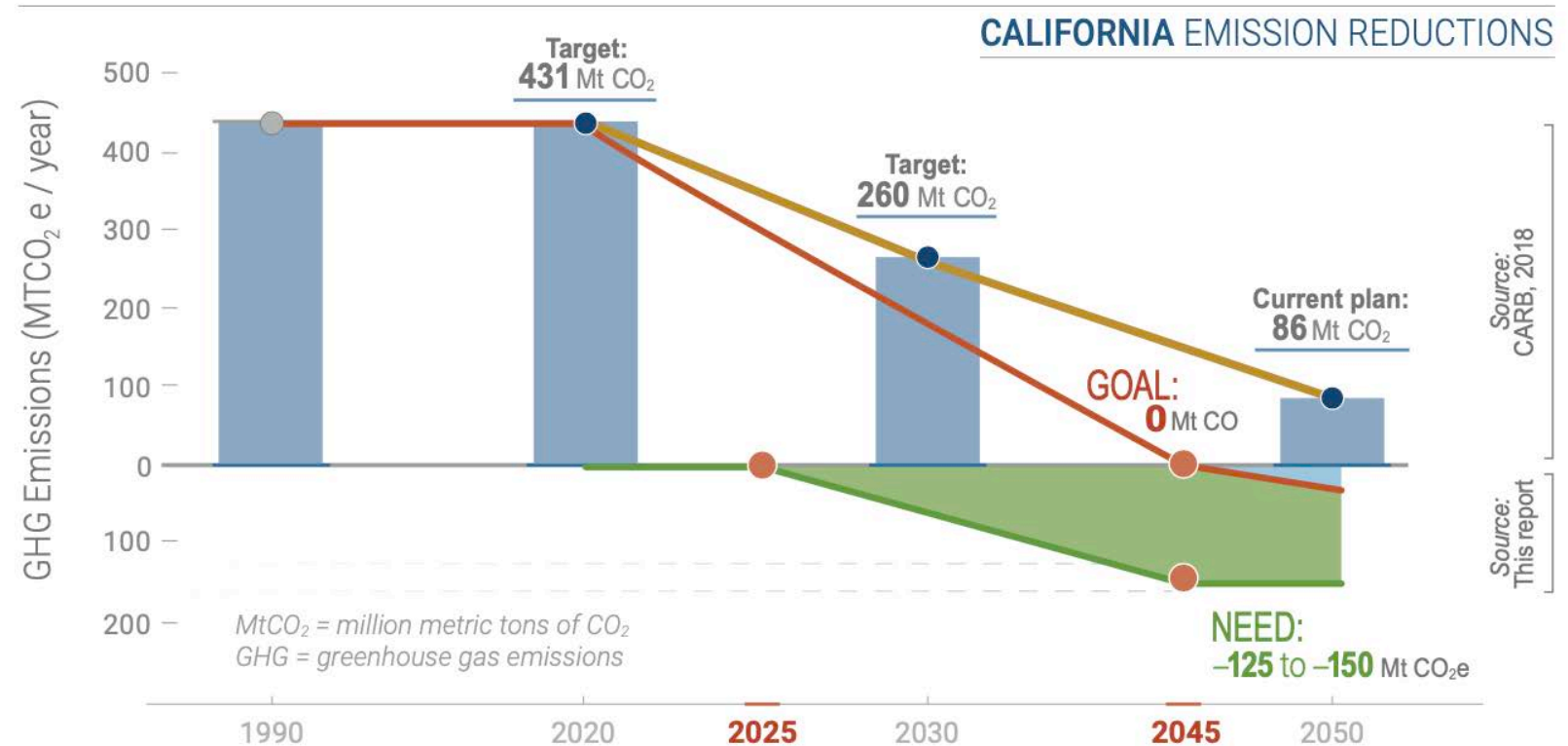


Figure ES-1. Goals of California's emissions plan extrapolated to 2045 (CARB, 2017) with negative emissions estimates from this report.

- Landfilled MSW: 40 MMT
- Crop residue: 9 MMT
- But also:
  - 170 million trees
  - Other dry biomass
  - Non-recycled plastic and paper
  - Upcoming bioplastics



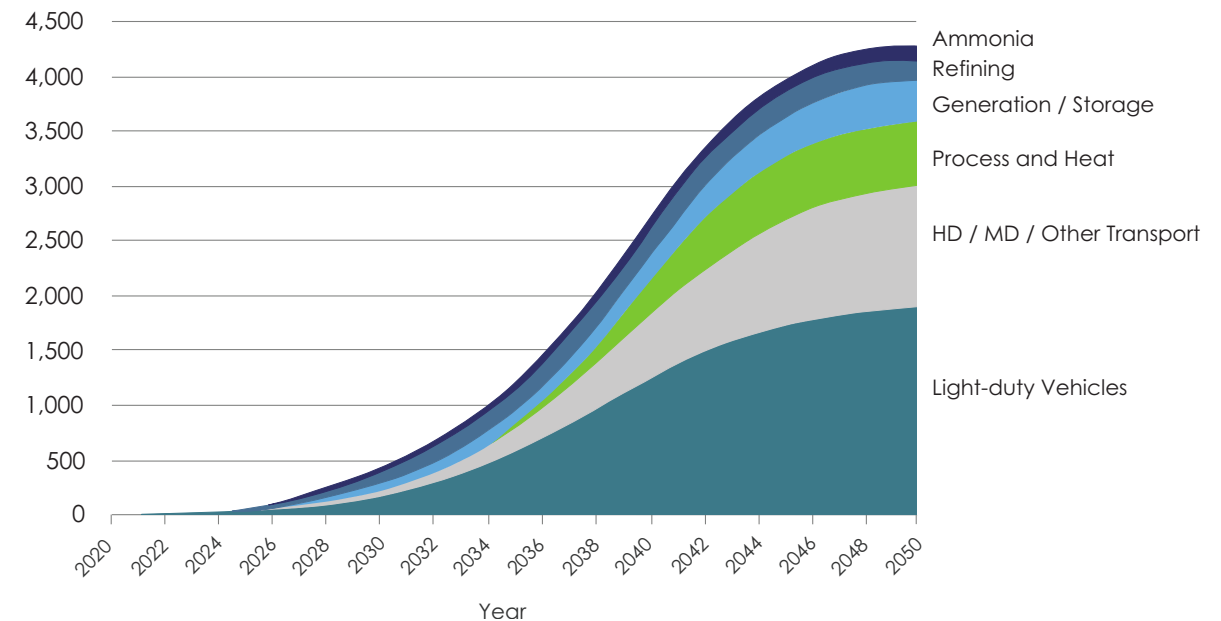


# ... and hydrogen is coming

## Not “if”, but “when”

- California expected to reach 500,000 T H<sub>2</sub> demand by 2030, 4 MT in 2050
- Public transportation projects, automotive manufacturers, heavy duty vehicles...

MILLION KILOGRAMS H<sub>2</sub> DEMAND



# Renewable hydrogen production pathways

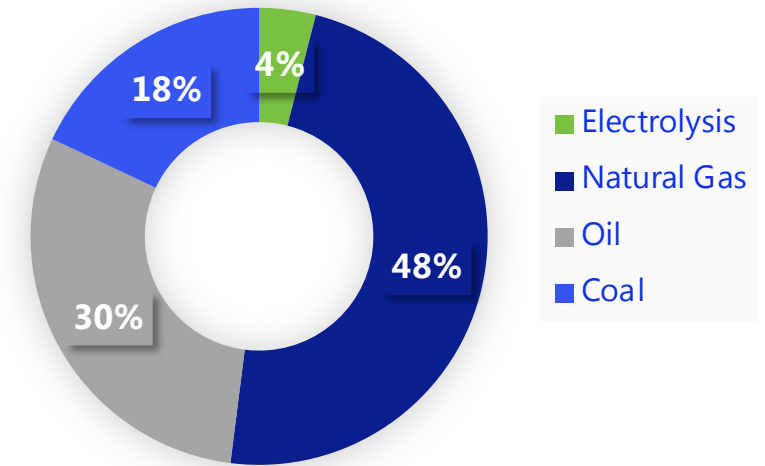
## Current world production: 50 M Tons per year

- Mostly used for crude oil refining or ammonia production
- Overwhelmingly fossil source  
(not unlike the power that charges our “clean” BEVs)

## Electrolysis powered by renewables

- The most widely acknowledged  $\text{RH}_2$  production solution
- A long road, just to cover the current production needs.
  - Need to reach a higher RE ratio
  - Cover added demand from BEV
  - Then produce hydrogen for the clean transportation needs ?

Hydrogen Production Source (Mt)



# Biomass: the third pathway

- **Billion-Ton Report - U.S. DoE & Oak Ridge National Lab**
  - Paves the way for hydrogen production:
    - 1 billion ton biomass = 50 M tons  $H_2$ ,
    - 50 M tons of  $H_2$  contains enough energy to replace 90% of U.S. annual gas consumption of 3.4 billion barrels
- **What about California:**
  - 49 MMT MSW and Crop is 2.5 MT  $H_2$
  - 63% of the expected  $H_2$  demand in 2050
  - 66 MT biogenic  $CO_2$  out of our atmosphere per year

## Improving Waste management, producing clean Hydrogen

- Predictable, continuous and creatively solve another major environmental issue
- Small size distributed systems improve waste logistics and provide a clean decentralized conversion of waste to energy.
- Cleaner than incineration, addresses landfill diversion mandates

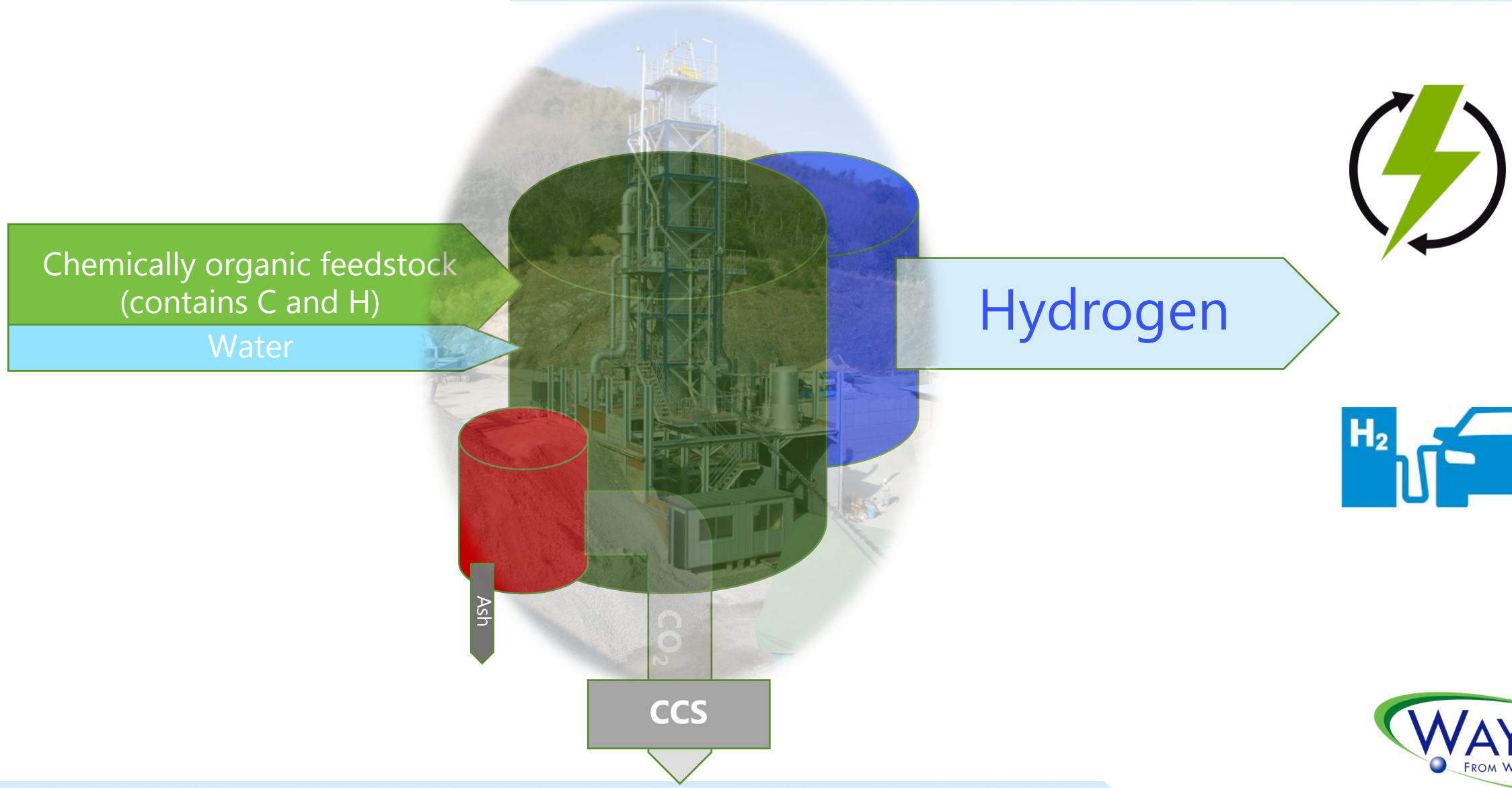


## Our solution, engineered, refined and enhanced in Japan

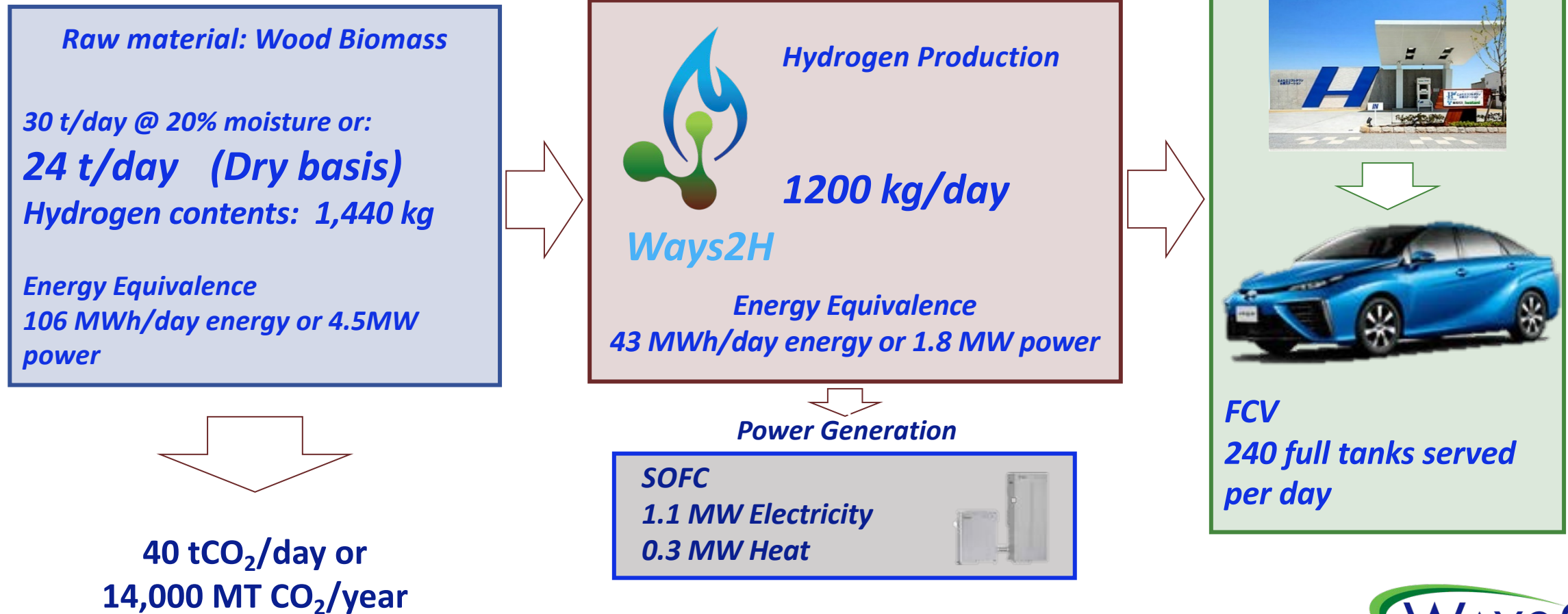
- Developed by Japan Blue Energy Co.
- Organic waste, including plastics, into hydrogen
- Over 16 years development, 3 generations of test size units built, tested and enhanced
- 4th generation currently in operation in Joso, Japan, treating sewage sludge and other waste streams
- Small to medium size, truly decentralized solutions to optimize feedstock or hydrogen logistics
  - 1 t/day capacity transportable solution
  - Stationary 24 t/day standard design.







# Project Case Study: 2 Output Options



## Ways2H systems produce renewable hydrogen from waste biomass

- Engineering
- Construction
- Commercial Development
- Joint venture: Clean Energy Enterprises & Japan Blue Energy Co.
- Headquarters in Long Beach, CA

## Decentralized energy production

- 8 to 48 tons/day waste processing
- 300 KW to 2 MW power stations, 300 kg to 2 tons H<sub>2</sub>/day

## Systems available now







**WAYS2H**  
FROM WASTE TO HYDROGEN

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