

Existing and Future 'Low Carbon' Hydrogen Fuel Sources

Air Products and Chemicals
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Agenda

- Who is Air Products?
- Hydrogen Infrastructure Today
- The Future of Hydrogen Infrastructure
- Key Messages

Leadership in Hydrogen Fuel Infrastructure

- World's largest producer of merchant hydrogen ~50% share
- Active since 1993
 - Built over 85 hydrogen station projects
 - Over 72,000 fuelings
 - In 15 countries
- Strong and broad IP position and responsible for many firsts:
 - Energy Park
 - 350 bar
 - 700 bar
 - Class1 Div1 dispenser
 - CA Hydrogen Highway
 - Over 50 fueling patents



Steam Methane Reformer



Delivered Hydrogen



Gas Pipeline

Liquid Tank Trailer



Gas Tube Trailer

Gas Cylinders



Hydrogen Facts

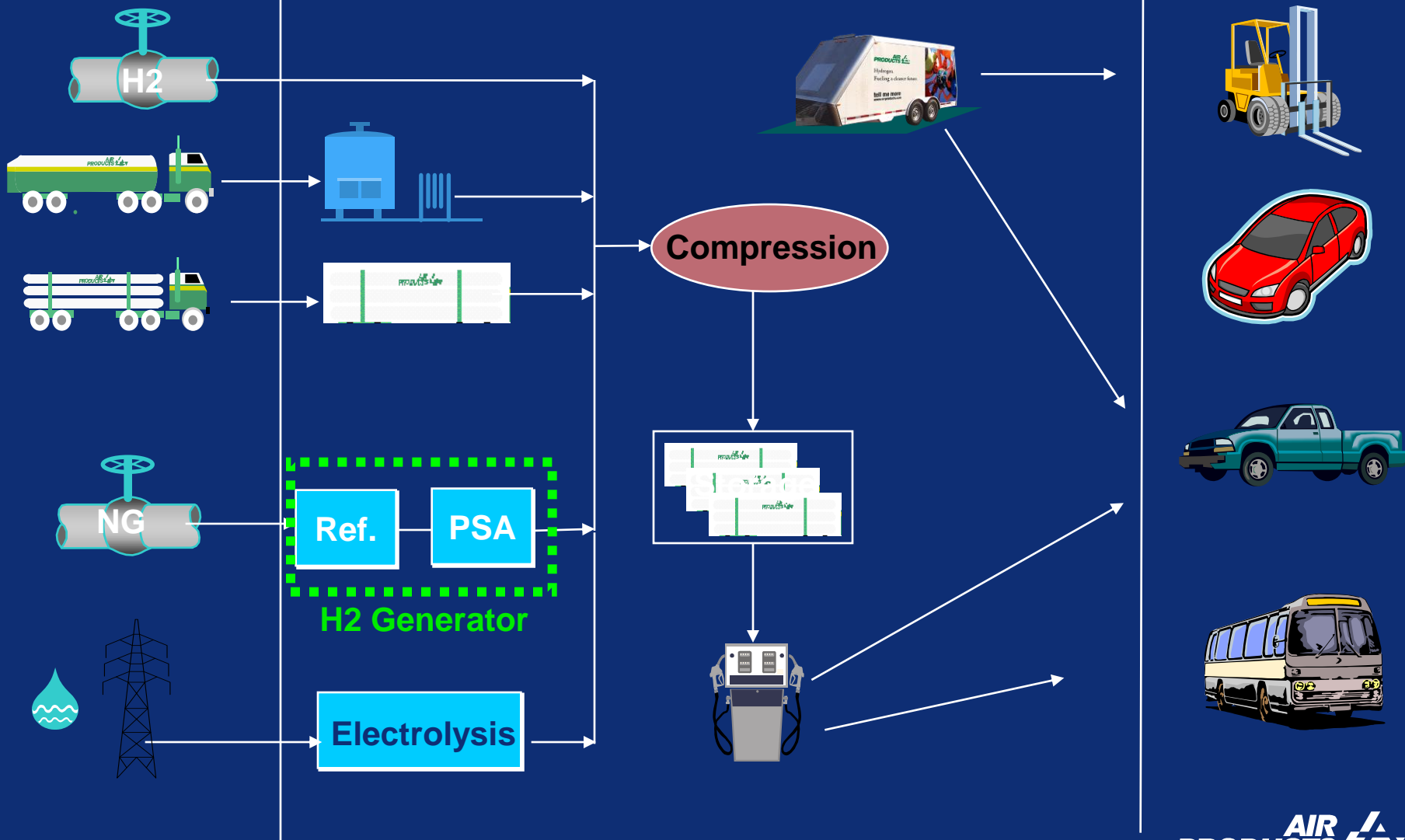
- AP total capacity could support 7-8 million vehicles if used only for vehicle fueling.
 - Excess capacity in CA and TX could support 100,000+ vehicles
- AP's daily production equals:
 - 4.6 million kg/day
 - 1,316 liquid H2 trailers/day
 - 11,335 gaseous H2 tube trailers/day
- AP continues to build plants:
 - 2006, 6 plants, 450 MM scfd
 - 2008, 1 plant, 100 MM scf
 - 236,000 kg/day, 68 LHY trailers, 584 tube trailers
- Hydrogen is also used in glass, steel, foods, pharmaceuticals and electronics. We touch it everyday !

H2 Sourcing for Fueling Stations

Feedstocks

Fueling Station

Vehicles



Infrastructure Transition

- Provide technologies which have utility today while positioning for the future
- Focus on a regional model with abundant H2 and population.
- Focus on mass transit in other urban areas.
- ★ *Future Hydrogen Infrastructure will include:*
 - *Pipeline delivered hydrogen similar to NG*
 - *Multiple feed sources of hydrogen from:*
 - *Biomass*
 - *Geothermal*
 - *Wind*
 - *Solar*
 - *Nuclear*
 - *Coal*
 - *Methane reforming*
 - *Delivered or distributed product in the outlying areas*



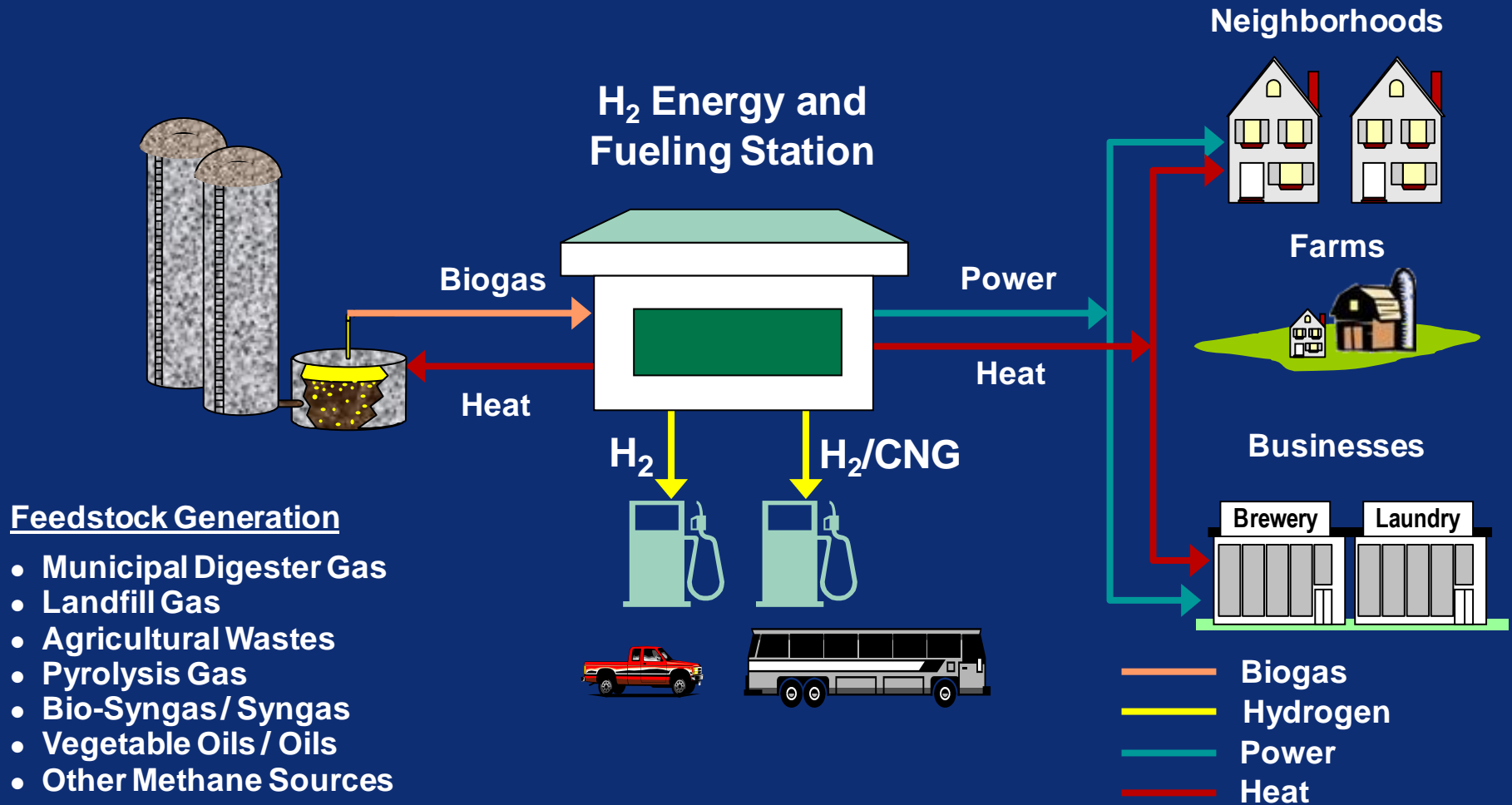
Renewable H2 Fueling Projects



Renewable Hydrogen Challenges

- Location of the renewable energy/feedstocks relative to the demand for hydrogen
- Cost and efficiency as compared to current H₂ production methods
- Reliability/Availability of the resource

Hydrogen Energy Station Vision - High-Efficiency and Renewable



Renewable Hydrogen Energy Station

- Feedstock Flexibility - Targets **Renewables**
- Reduced Emissions
 - No Combustion (Virtually No NO_x, SO_x)
 - Reduced or No GHG Footprint
- Ultra High Efficiency
 - Venting or Flaring: 0%
 - Generators: 17%
 - H₂ Production + PEM Fuel Cells: 25%
 - RHES: 70+%
- Green Power + Green Hydrogen
- Co-Production Improves Economics vs. Stand-Alone H₂ Fueling Stations
- Sustainable!

Key Messages

- Hydrogen is here today. Thousands of customers purchase hydrogen via pipelines, trucks, cylinders and onsite generation.
- Greenhouse gas emissions can be significantly reduced with H₂ “Classic” when used in a fuel cell vehicle (50% reduction, wells-to-wheels)
- Hydrogen will come from a variety of feedstocks in the future, including cost competitive, renewable methods of production.

Thank you

tell me more

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