



Clean Hydrogen for Industrial Decarbonization

PICG Built Environment Workshop

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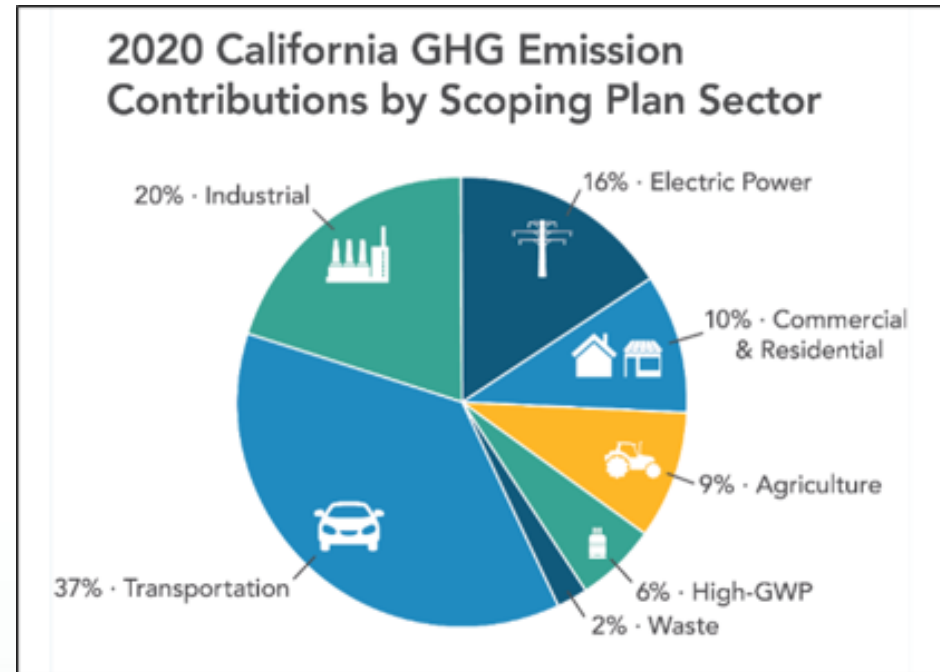
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Industrial Decarbonization with Clean Hydrogen

- Industry is a major GHG emissions contributor
- > 60% of process heat from gas
- Challenging to decarbonize
- Clean hydrogen (H₂) could be a promising decarbonization pathway for high temperature processes





Possible California Industries with Hydrogen Potential

- **Cement** – CA is one of the largest producers and users of cement
 - Production of cement emits over 9 million MT of CO₂ annually
 - Requires very high temperatures of over 2600 degrees F
 - H₂ could mitigate the energy-related 40% of cement production emissions.
- **Glass** – CA produces container glass and flat glass
 - Requires high temperatures over 2500 degrees F
 - Some flat glass manufacturers investigating use of hydrogen blends in glass kilns
 - In CA, flat glass manufacturing already uses H₂ in tin baths
- **Electronics Manufacturing**
 - Uses H₂ for non-combustion purposes, such as for annealing (as a heat transfer mechanism), epitaxy (as a reducing agent), deposition (direct incorporation of H₂ into thin films), and stabilizing (as a chemical additive)
- **Metals**
 - Reheating furnaces operate at temperatures over 2000 degrees F



Potential Issues and R&D Needed

- **Challenges**
 - Air emissions
 - Combustion characteristics and flame controls
 - Impact on existing equipment
 - Heat transfer potential
 - Safety
 - Costs and availability including production, delivery and storage
- **CEC's R&D activities**
 - H2 blend impacts on large commercial and industrial equipment
 - Characterization study on industrial H2 clusters
 - Assessing H2's role in California's electric sector, including cross-sector impacts and benefits