WASHINGTON STATE ENERGY STRATEGY – HYDROGEN USAGE

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Prepared for:

Washington State Department of Commerce

Clean Energy Transition Institute

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DATA REQUESTED

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- Hydrogen demand by end use sector in Washington
  - Hydrogen consumed in the economy to produce useful work, such as in fuel cell vehicles and producing chemicals
- Hydrogen converted to synthetic fuels to satisfy Washington fuel demand
  - Conversion of hydrogen to other forms of fuel for consumption by end uses
  - Differentiated by hydrogen produced out-of-state versus in-state
- Electricity demand from hydrogen production serving Washington end use hydrogen and synthetic fuel demand
  - How much electricity is required to produce hydrogen?
  - Differentiated by hydrogen produced out-of-state versus in-state

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RESULTS

HYDROGEN END USE DEMAND BY SECTOR

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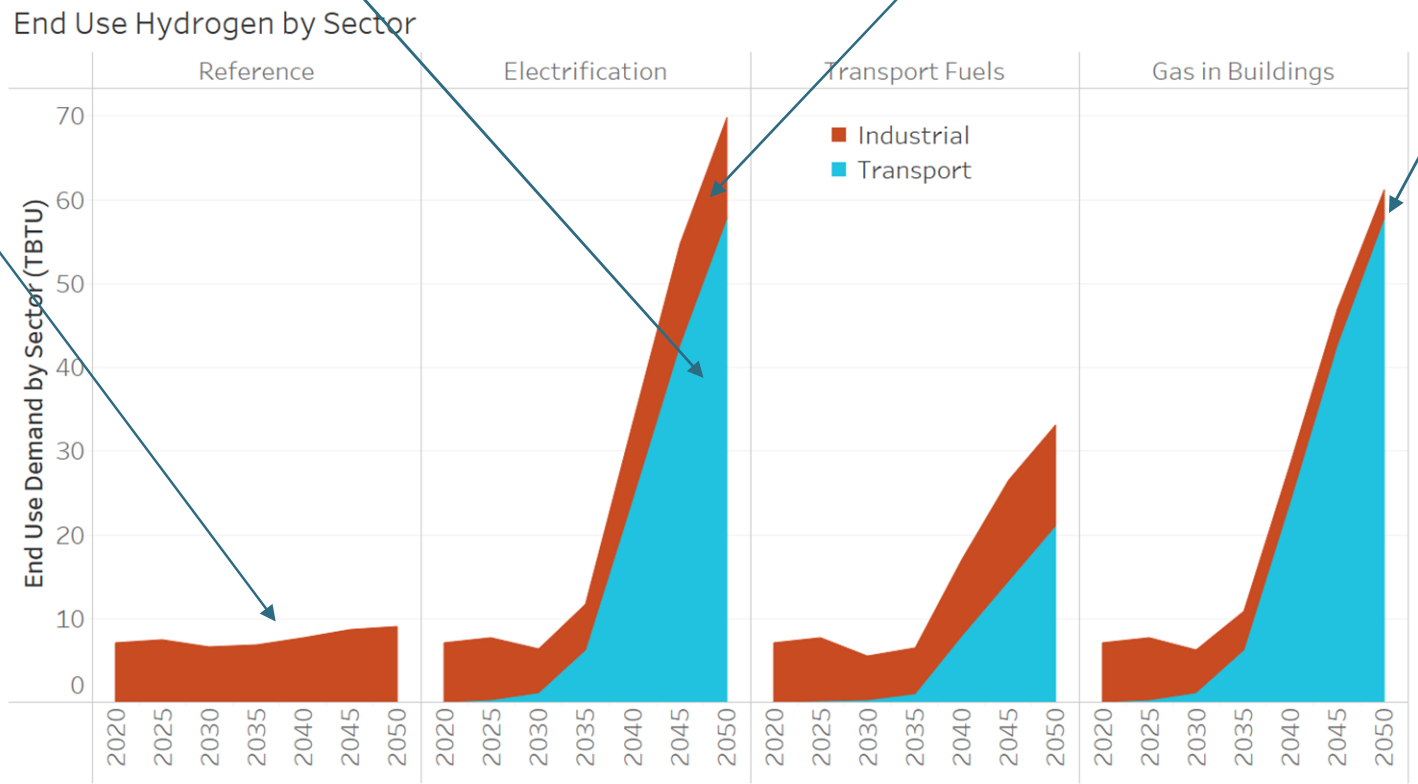
Demand from industrial sector only in Reference, similar to today

Large growth in hydrogen demand for transport in Electrification Scenario

Less demand in refining but more in industrial heating applications

Natural gas in industrial heat not replaced with H2 in Gas in Buildings



HYDROGEN END USE DEMAND BY SUBSECTOR

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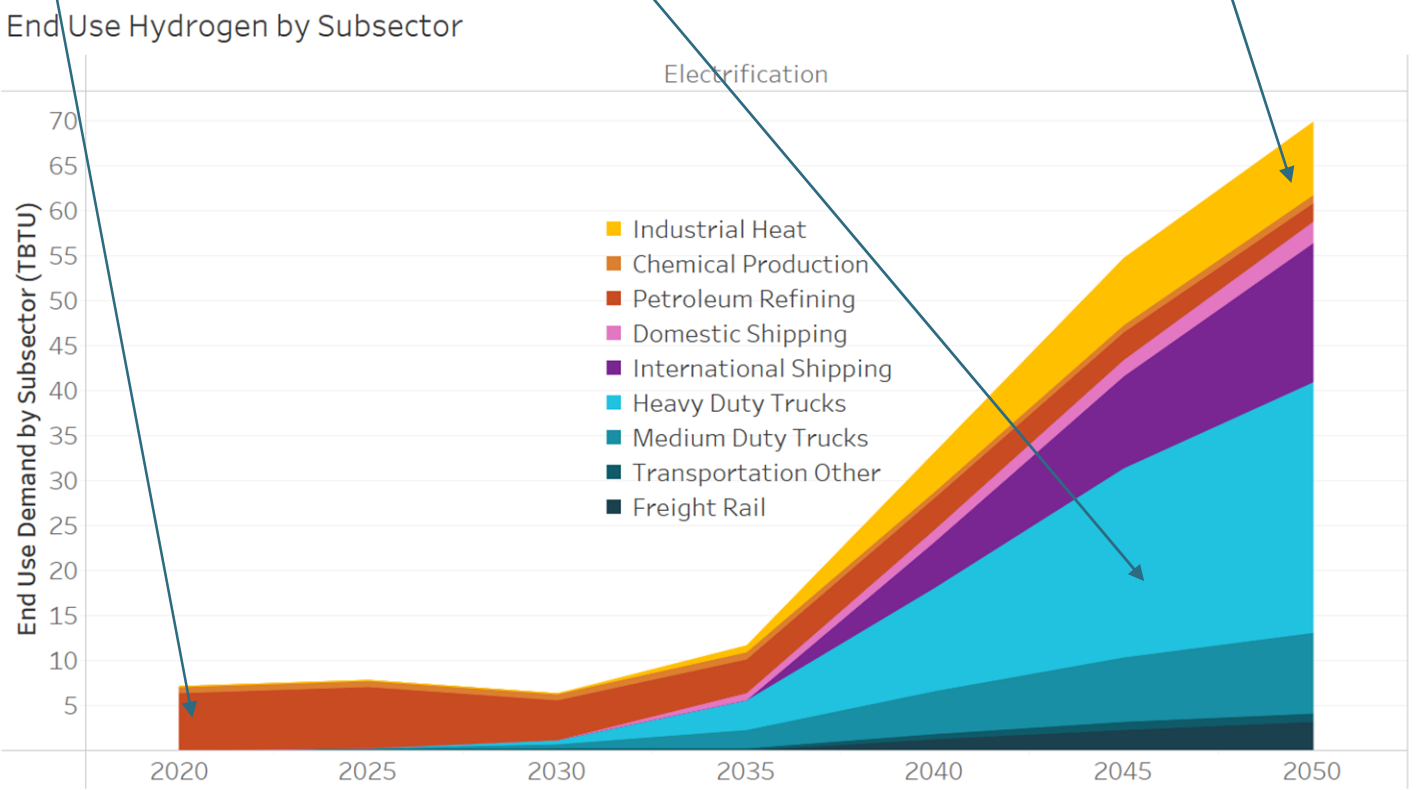
2020 hydrogen demand in petroleum refining and bulk chemicals

H2 consumption grows in transport subsectors in Electrification Scenario

Some H2 assumed in heat, displacing gas in high temp applications



- Electrification Scenario assumptions just one pathway
  - Future H2 consumption may look significantly different
  - Applications in transport and industrial heat are currently nascent and will depend on technology development
- Cost competition between hydrogen and electrification in these sectors will determine future adoption

HYDROGEN CONSUMED DIRECTLY IN WASHINGTON

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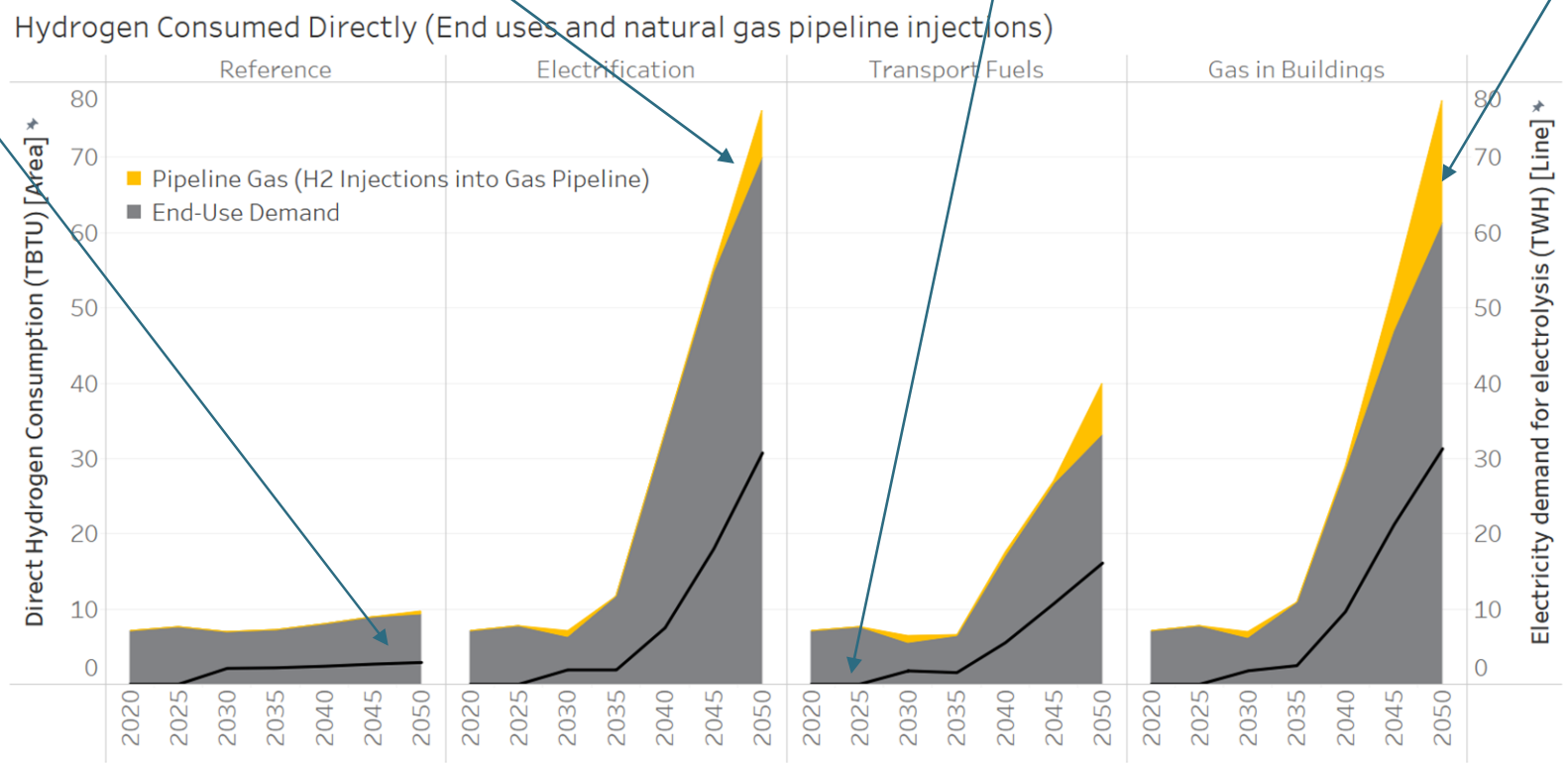
Grey end use demand consumption shown on previous slide

Additional WA hydrogen consumption through pipeline gas injections

Hydrogen in 2020 from reformation transitioning to electrolysis

Increased H2 injections in Gas in Buildings due to greater gas demand



HYDROGEN USED TO PRODUCE SYNTHETIC FUELS

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No synthetic fuels consumed in WA in the Reference Scenario

Majority of H2 for synthetic fuels produced out of state

Greater out of state electricity consumption for H2 than in WA

Larger H2 demands in Transport Fuels to displace fossil in transport