

# Renewable H<sub>2</sub>: Status, Expectations, Recommendations

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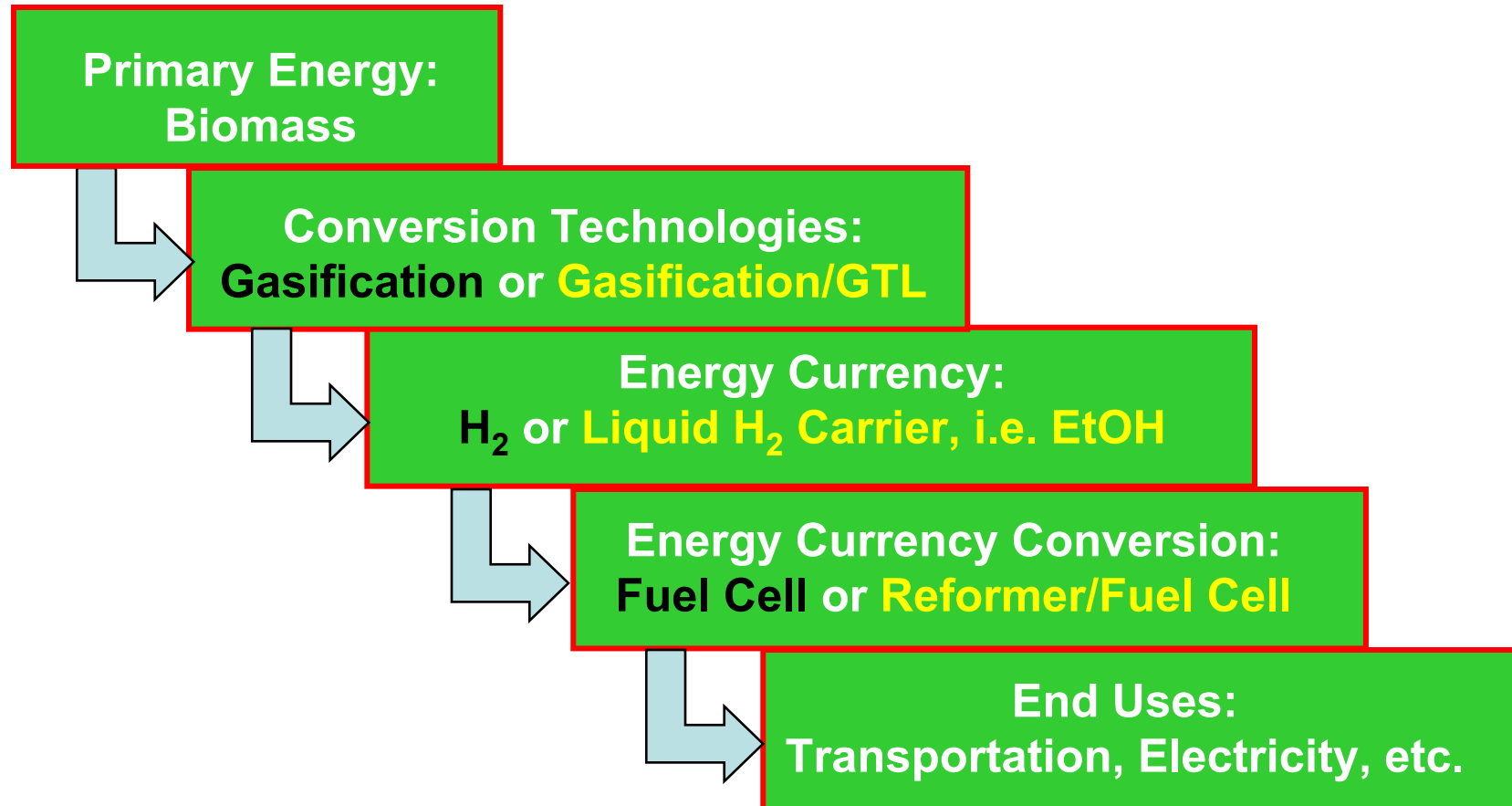
# Renewable Hydrogen

- Technologies and Application/Usage
- Timeline
- Costs: Present and Future Targets
- Barriers/Challenges
- Recommendations



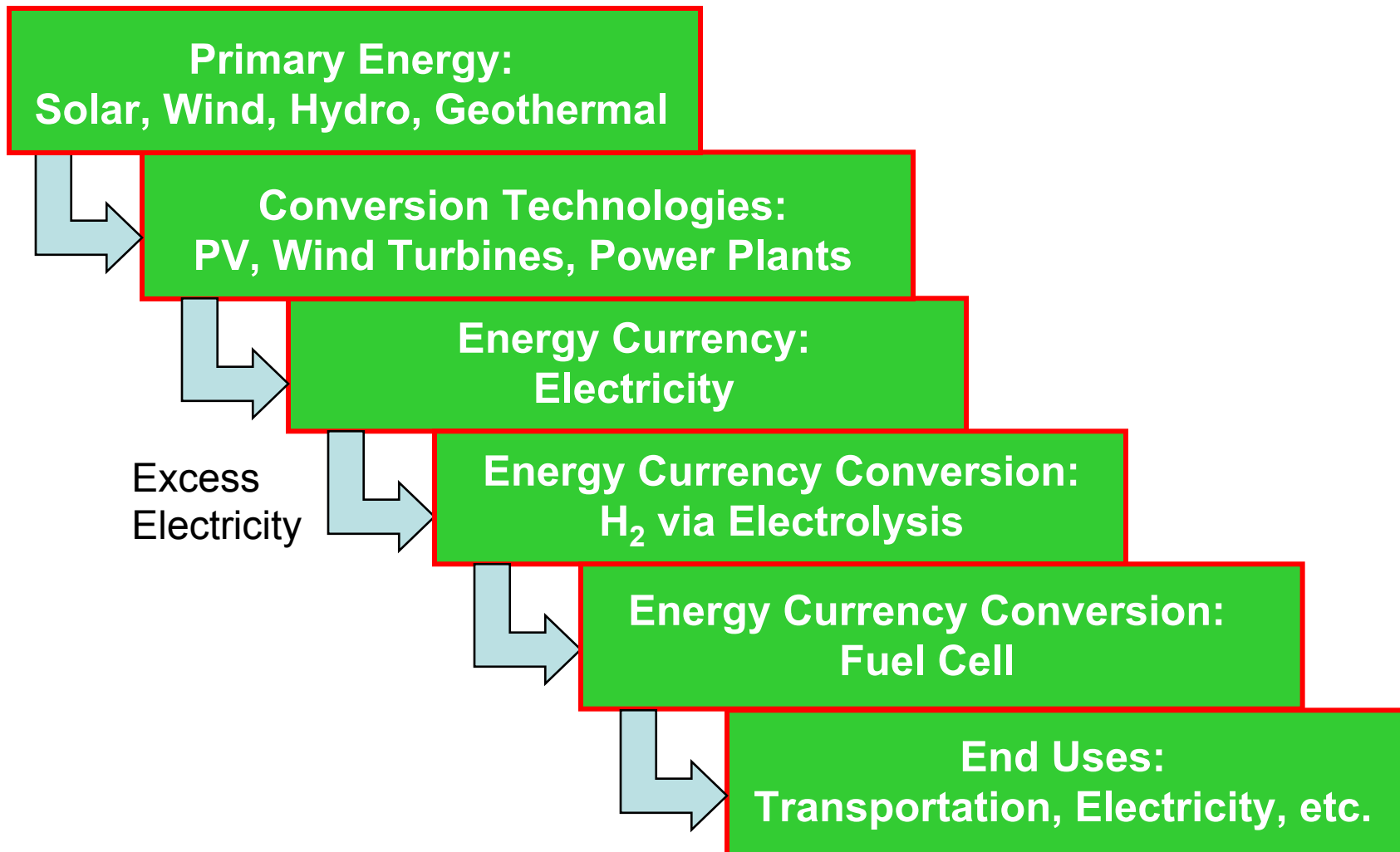
# H<sub>2</sub> Energy Systems

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# H<sub>2</sub> Based Energy Systems

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# H<sub>2</sub> Economy Development Timeline

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- ❖ Research, Development and Demonstration: 2000 to 2030
- ❖ Transition to the Marketplace: 2010 to 2025
- ❖ Expansion of Markets and Infrastructure: 2015 to 2035
- ❖ Realization of the Hydrogen Economy: 2025 and beyond

Source: Hydrogen, Fuel Cells & Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan, US Dept. of Energy



# Hydrogen Pricing

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- ❖ H<sub>2</sub> is currently \$4 to \$5 per kg (On energy basis: 1 kg H<sub>2</sub> ≈ 1 gallon of gasoline)
- ❖ US Dept. of Energy H<sub>2</sub> cost goal for 2015: \$2 to \$3 per gallon of gas equivalent, delivered, untaxed, in 2005 \$'s, independent of production pathway (July 14, 2005)
- ❖ NREL estimate of current H<sub>2</sub> production cost from biomass via gasification, \$1.38 per kg H<sub>2</sub> at plant gate; compression and delivery expected to add \$2 per kg H<sub>2</sub>



# Barriers/Challenges

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## ❖ Technological

- Onboard hydrogen storage for vehicles\*
- Reducing H<sub>2</sub> production and delivery costs\*
- Improving fuel cell performance and reliability while reducing manufacturing costs\*

## ❖ Economic and Institutional

- High risk investment required for H<sub>2</sub> delivery infrastructure\*
- Uniform codes and standards\*
- Public education and outreach\*

\* Current research, development, & demonstration activities in Hawaii



# Hydrogen Recommendations

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- ❖ **Continue to foster an environment that allows Hawaii to actively participate in H<sub>2</sub> research, development & demonstration (RD&D) programs**
- ❖ **Large, federally-funded, RD&D programs often require 50% cost match; availability of state funds for cost match would aid in supporting larger programs**





# References

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<http://www.eere.energy.gov/hydrogenandfuelcells/mypp/>

Biomass to Hydrogen Production Detailed Design and  
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Indirectly-Heated Gasifier. Spath et al. 2005.

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