

Hydrogen Energy:

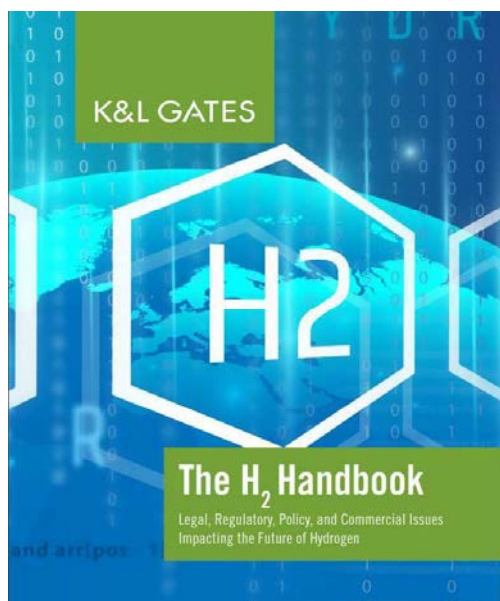
Unique Considerations for Hydrogen Projects

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Producing Hydrogen



Production Methods

- Steam reformation (SMR)
 - Natural gas or landfill gas
- Autothermal reformation
 - Natural gas or landfill gas
- Electrolysis
 - Low temperature (uses electricity)
 - High temperature (electricity and heat)

Onsite vs. Offsite

- Electrolyzers are modular and have a small footprint providing flexibility as to size and location
- SMR typically requires utility-scale investments
- Hydrogen hubs can serve as both onsite and offsite suppliers

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Using Hydrogen

Industrial processes

- Refining Petroleum
- Producing Fertilizer
- Chemical Production
- Food Processing

Wholesale/retail market supply

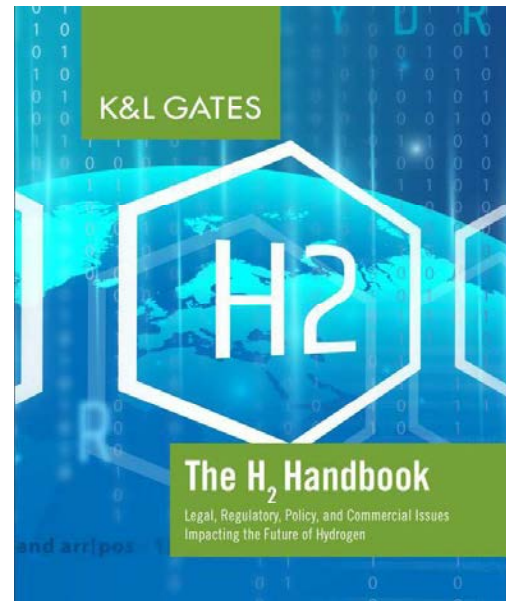
Transportation fuel

Natural gas blending

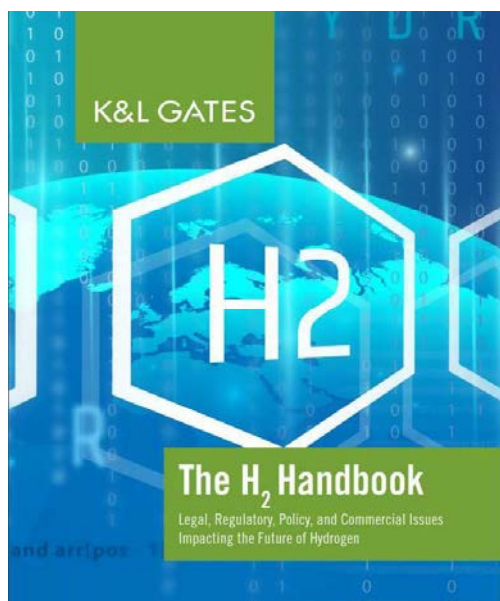
Electricity generation

Electricity storage

Gas turbine fuel



Onsite Electrolytic Hydrogen Projects



Siting is on Customer Premises

Lease vs. License

Feedstock

Onsite Storage

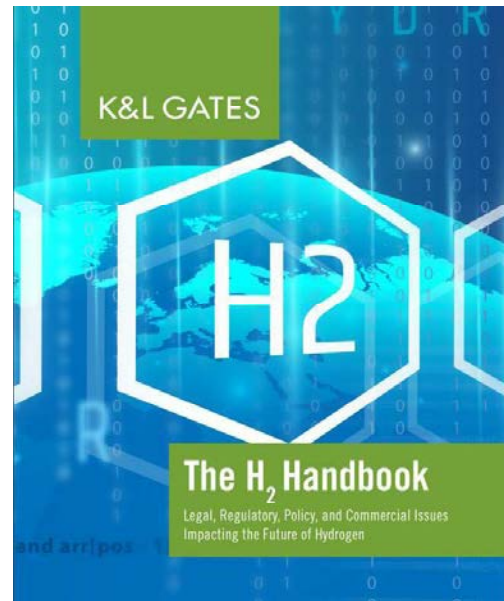
Delivery Point

Fully Wrapped vs. Partial Wrapped Contracts

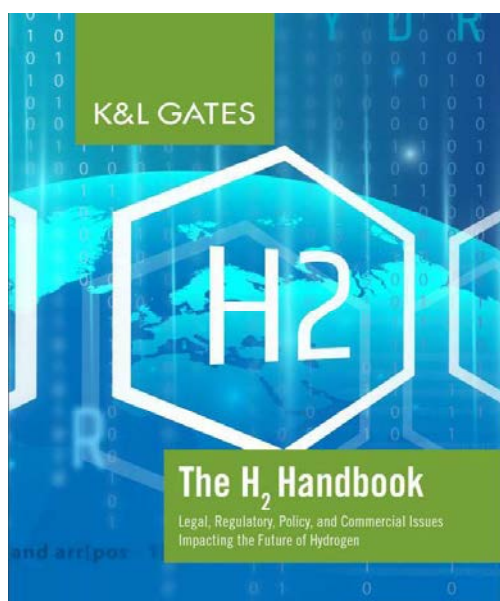
Onsite Hydrogen Projects: Power Supply

Low-emission resources

- Types:
 - Renewables (solar, wind, geothermal, hydro)
 - Nuclear
 - Fossil fuels or biomass with CCS
- Co-located
 - PPA, Lease, or Build-Transfer/EPC Agreements
- Grid Power + RECs
 - Virtual Power Purchase Agreements (VPPAs)



Onsite Hydrogen Projects: Water Supply



Water Specifications

- testing and certification as to quality

Water Scarcity - allocation of risks

- Supplier wants:
 - Unqualified responsibility by Customer to supply full water requirements on demand
- Customer wants:
 - Change in Law Provisions addressing government-imposed water restrictions
 - Force Majeure Provisions that cover water shortfall

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