

Design and Development of a Hydrogen Refueling Station

Green Energy
Consulting
April 2, 2003



Prepared by:
Serena Lee, Sarah Wai Sze Li, Patricia Wong
Supervisor: M. Fowler

Project Goals

- Design a hydrogen refueling station to service the “Hydrogen Economy” of the future
- Create a safe, reliable, timely and cost-efficient design that can be easily utilized in the near future to refuel hydrogen-powered fuel cell vehicles

Justification

- Today's vehicles rely on gasoline and diesel to run internal combustible engines which are harmful to urban air quality and global warming
- Future vehicles will likely be powered by hydrogen-powered fuel cells, which require no foreign oil and emit no harmful emissions or greenhouse gases
- Therefore, demand to distribute hydrogen in the community will make the design of a hydrogen refueling station a necessity



Hydrogen Economy



Hydrogen Economy - Current Projects

- President Bush's February 2003 State of the Union Address:
 - proposed an overall \$1.7 billion for fuel cell vehicle and hydrogen fuel R&D over the next 5 years
 - proposal includes \$720 million in new spending, plus \$1 billion already budgeted
- 2 hydrogen refueling stations in Canada (Vancouver)

Hydrogen Car & Refueling Station



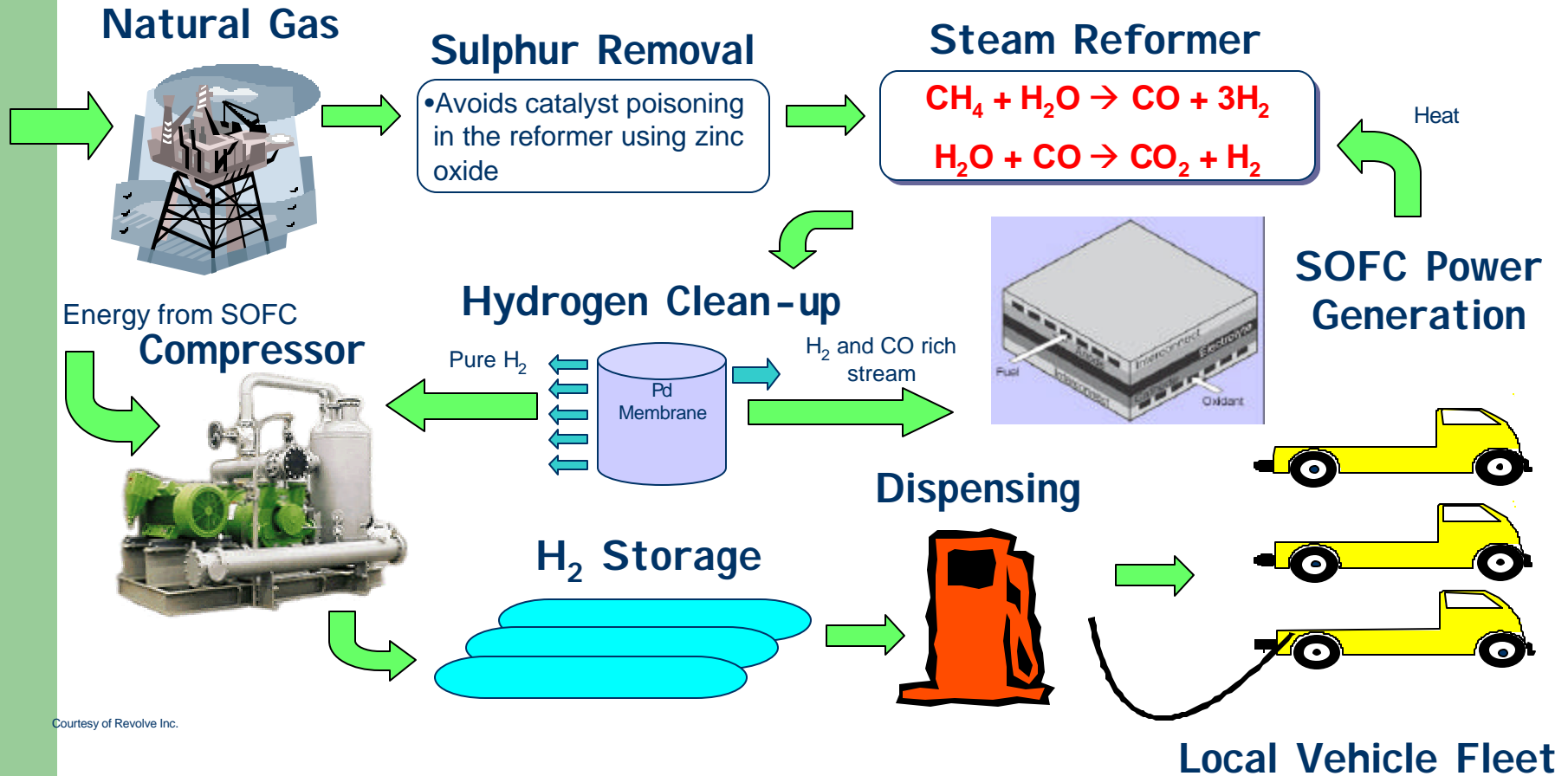
Benefits

- Hydrogen fuel cell-powered vehicles offer the possibility of clean and efficient operation
- World crude oil production is declining: focus will shift to usage of alternative fuel to power vehicles
- Infrastructure to distribute Hydrogen will be the KEY driver in the development of the Hydrogen Economy and related technologies.
- Large-scale design leads to future development opportunities

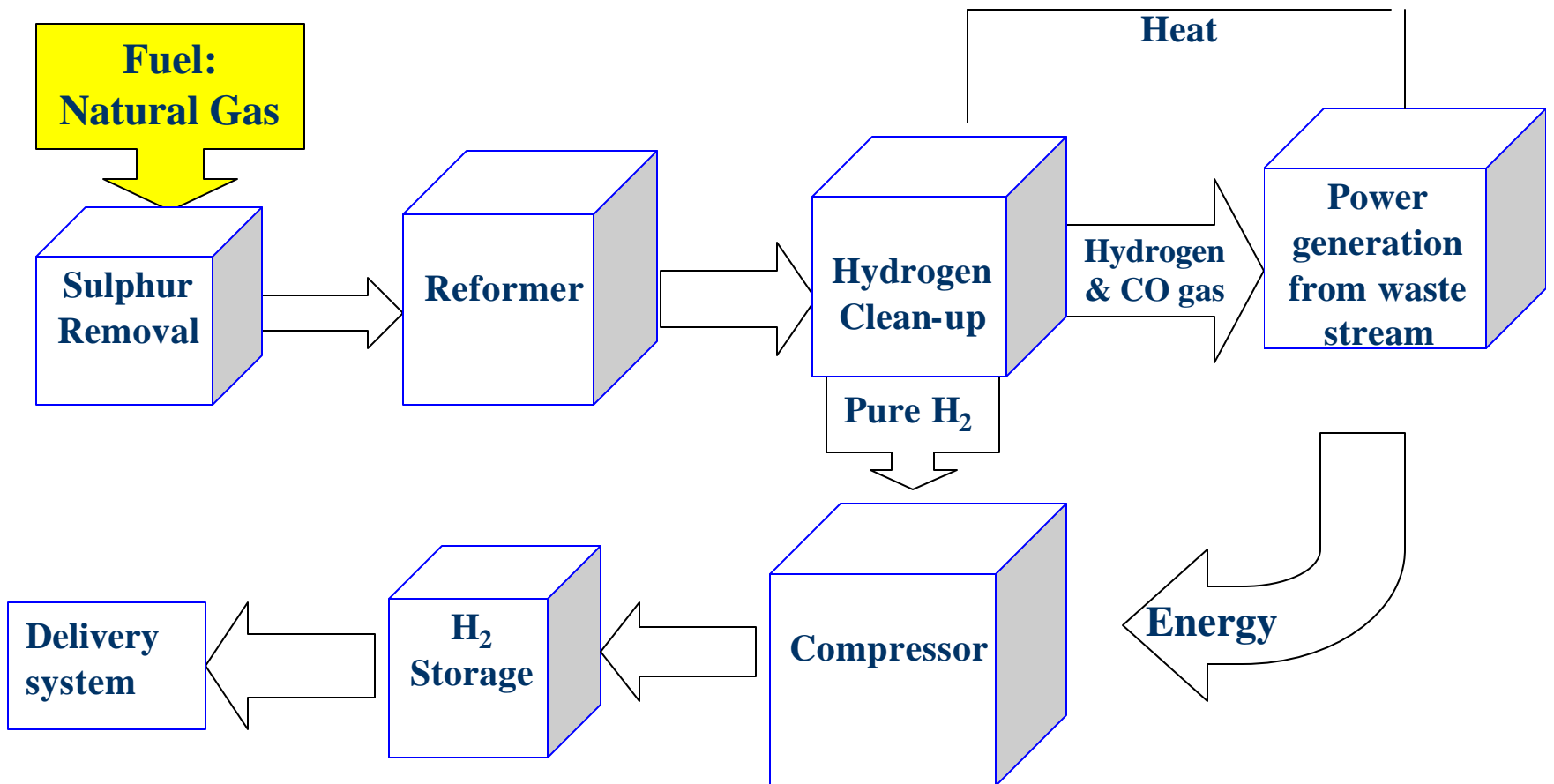
Design Methodology

- Requirements of the Station – Based on Today transportation practices (i.e. 500 refueled serviced per day)
- Evaluation of design options
 - Determine components in station
- Modeling: Using AspenPlus Software
 - Determine station specifications
- Review of Safety and Code Issues:
 - Hydrogen safety
- Challenges

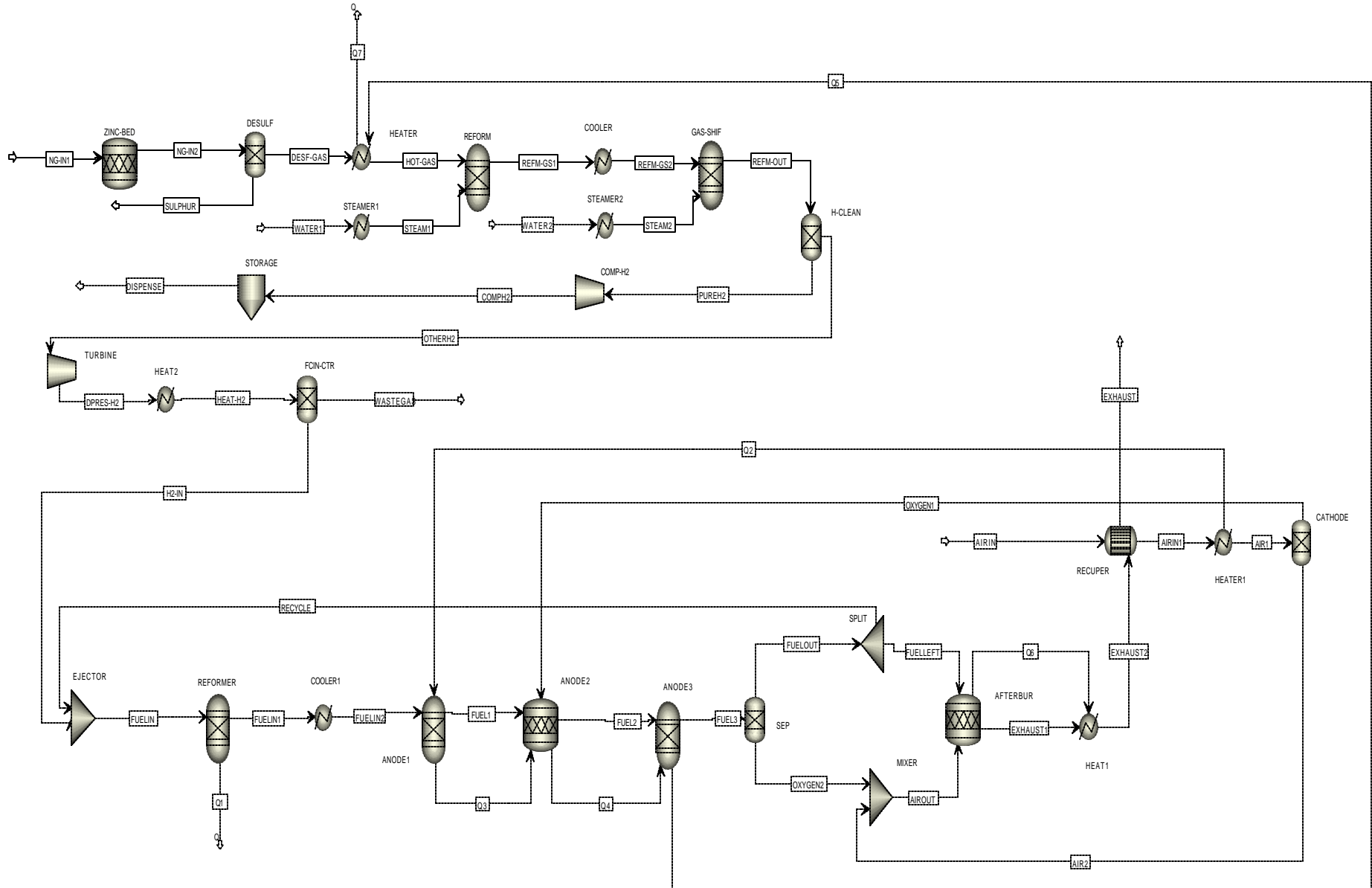
Schematic of Future Hydrogen Refueling Station



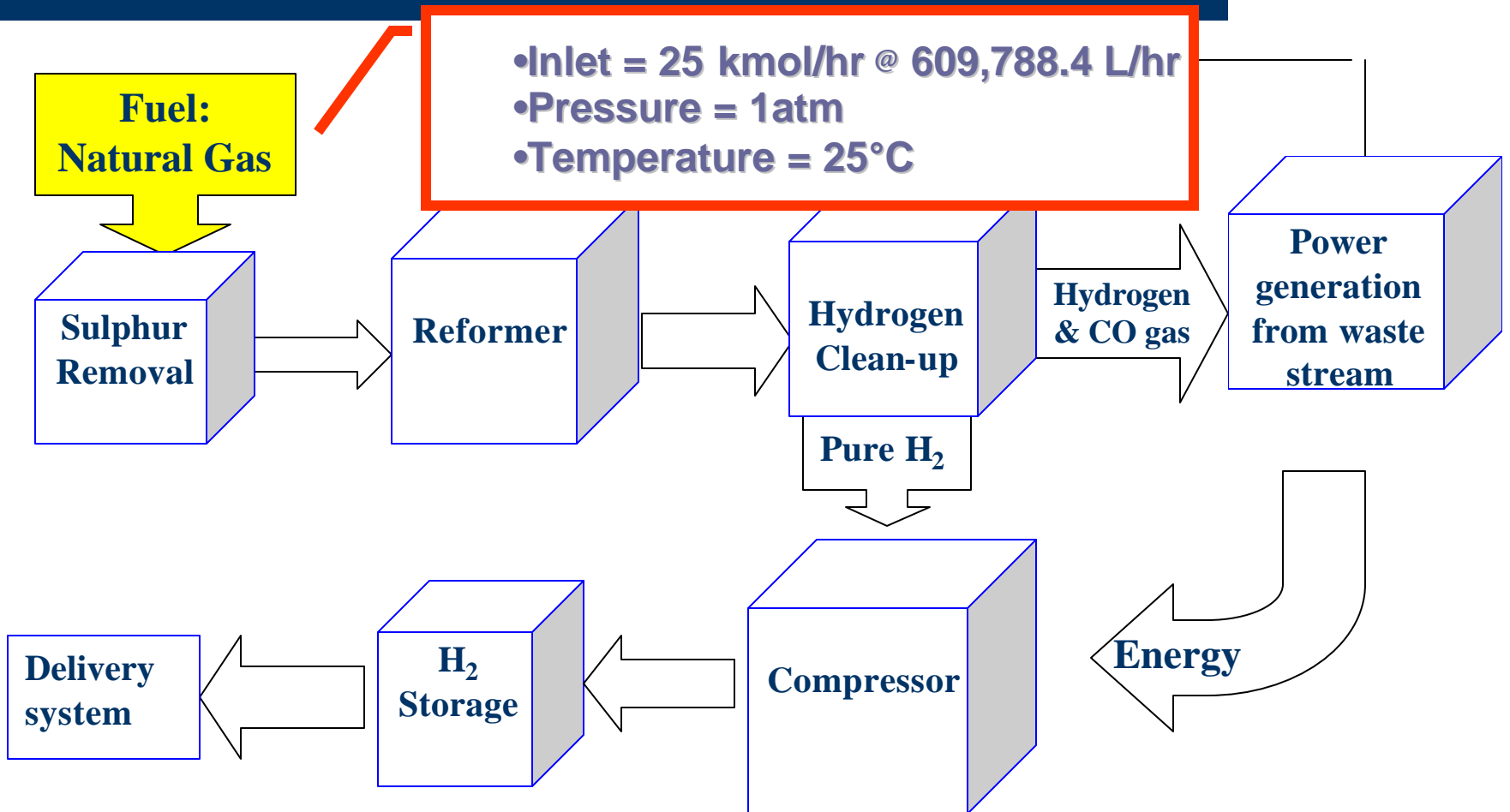
Modeling Results - Station Specifications 1



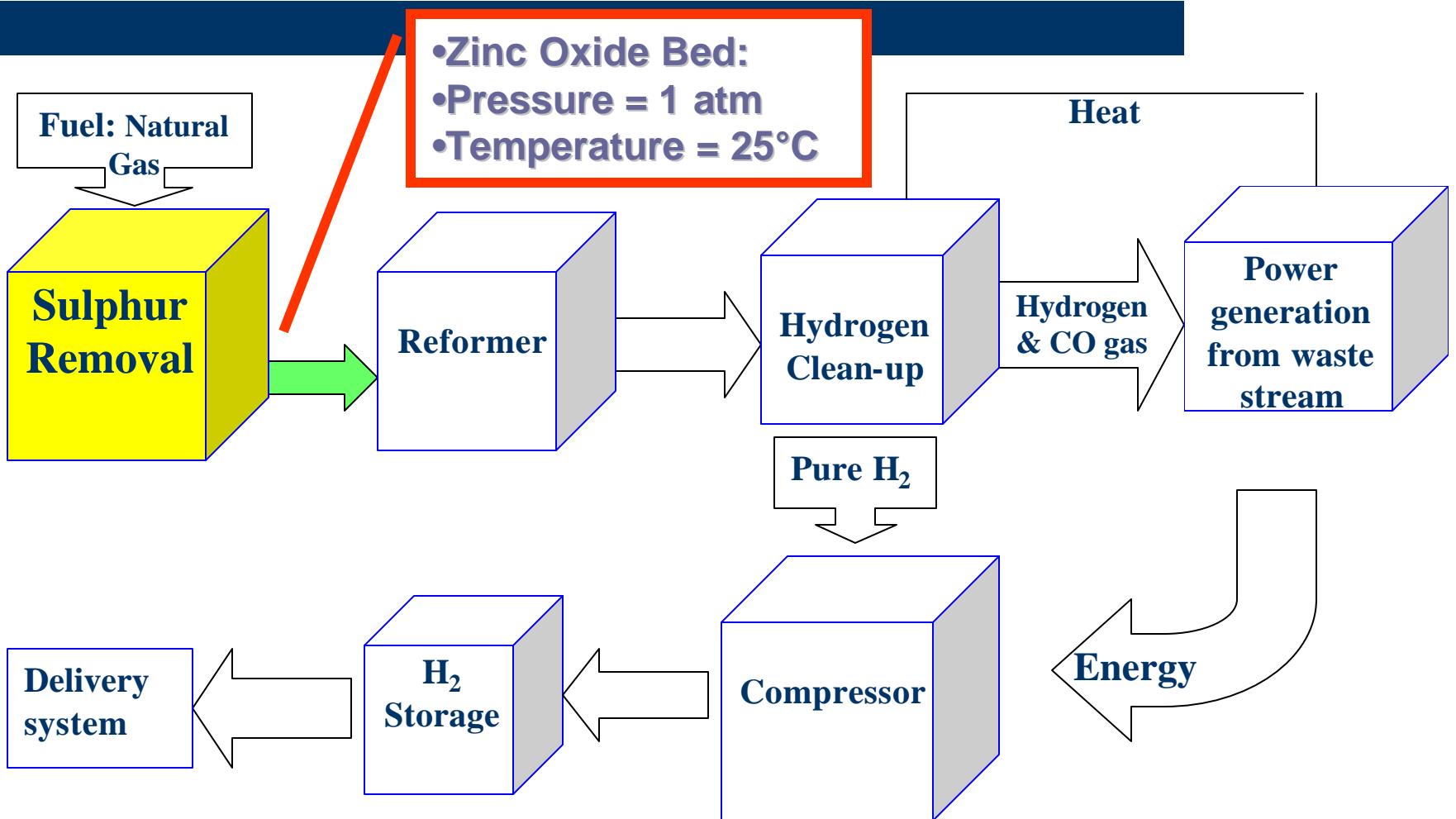
Aspen Modeling - Process Flow Diagram



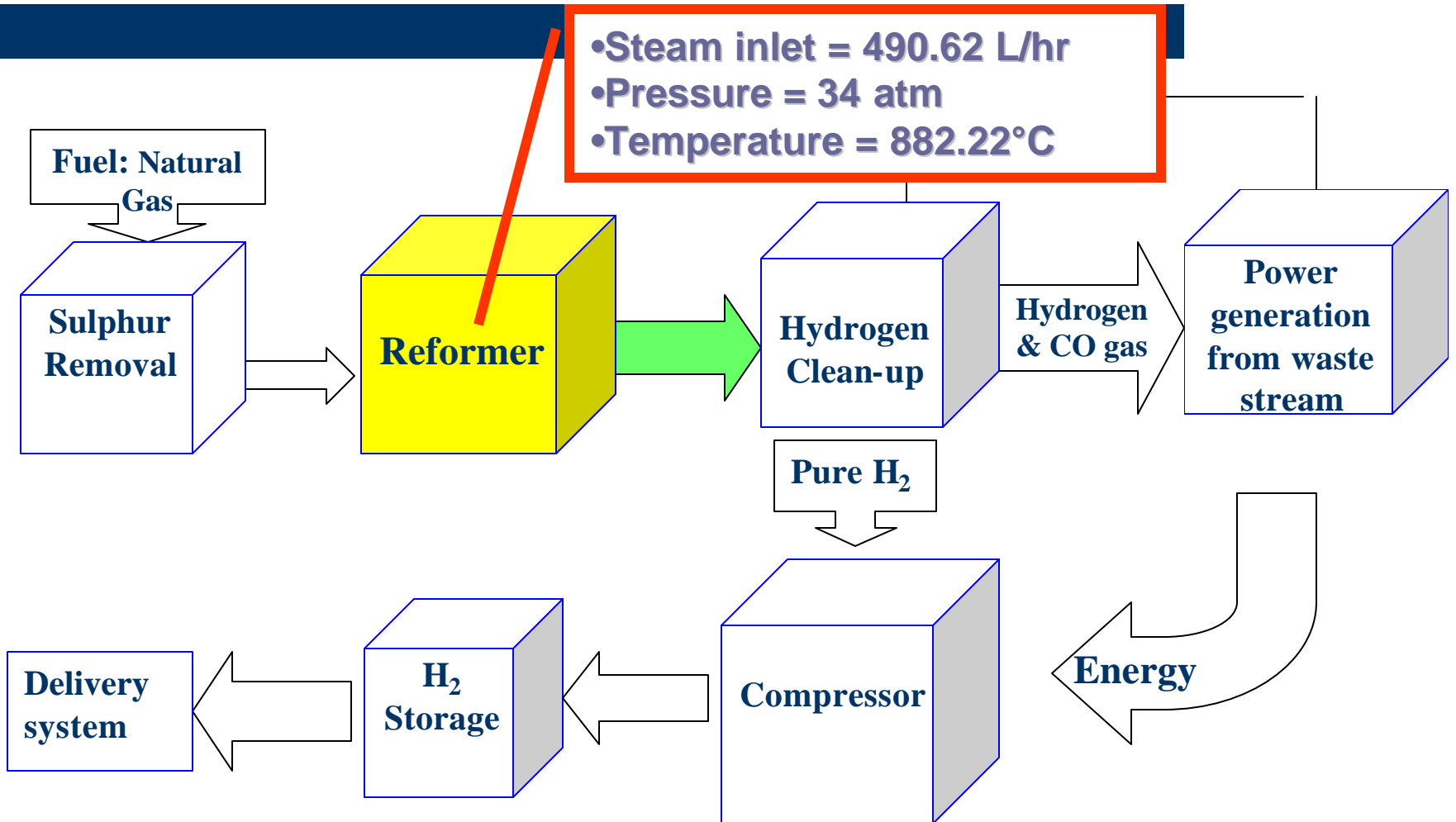
Modeling Results - Station Specifications 1



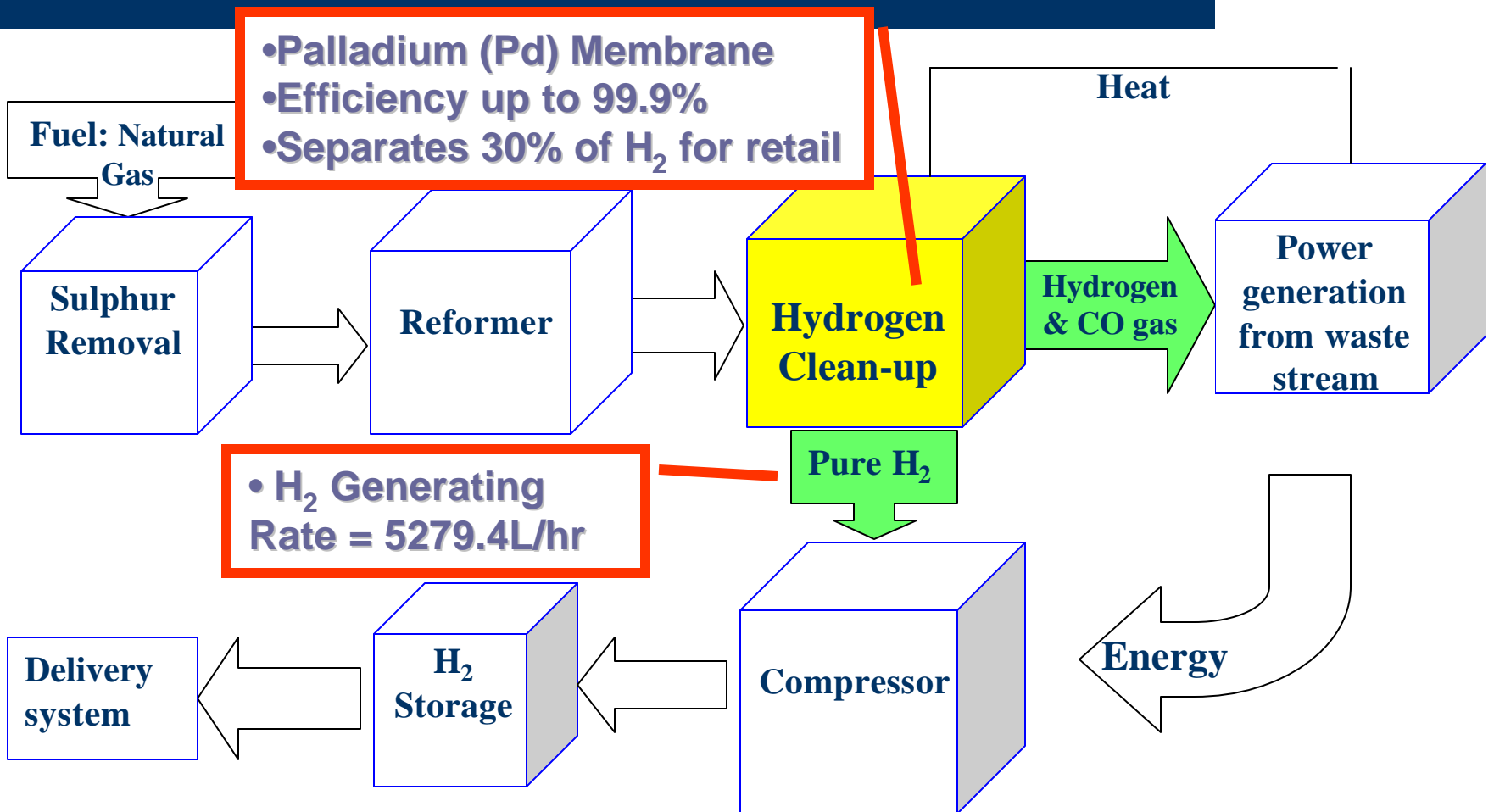
Modeling Results - Station Specifications 2



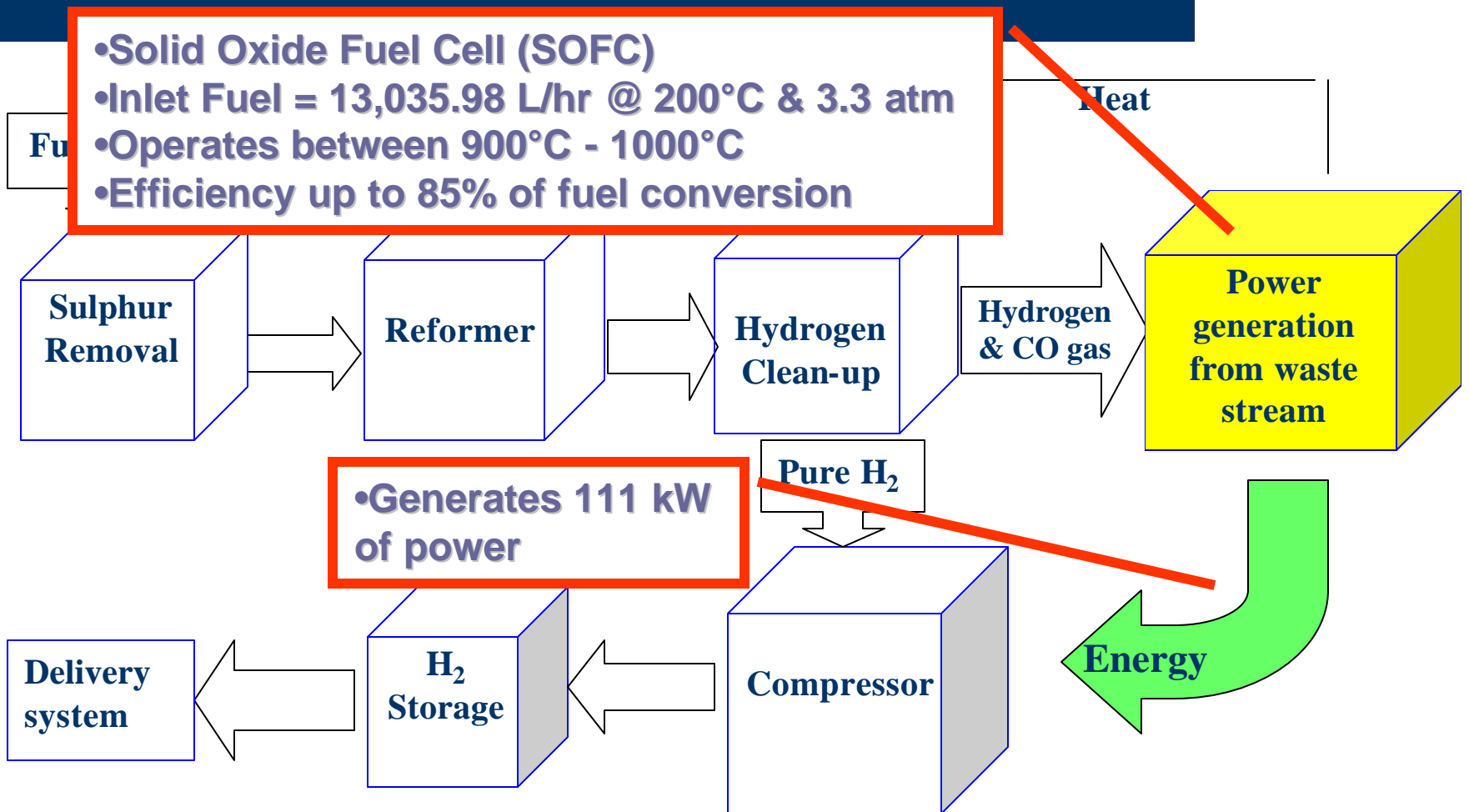
Modeling Results - Station Specifications 3



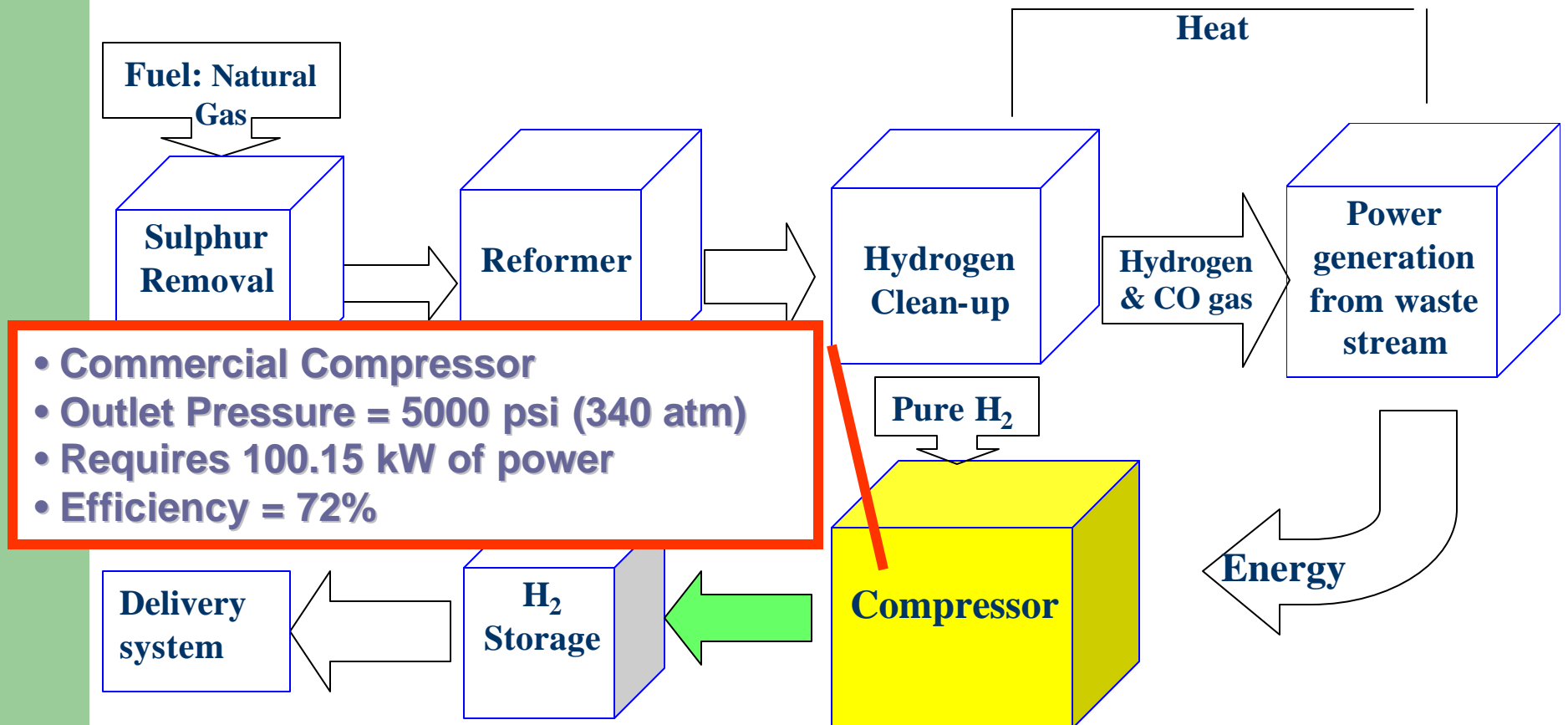
Modeling Results - Station Specifications 4



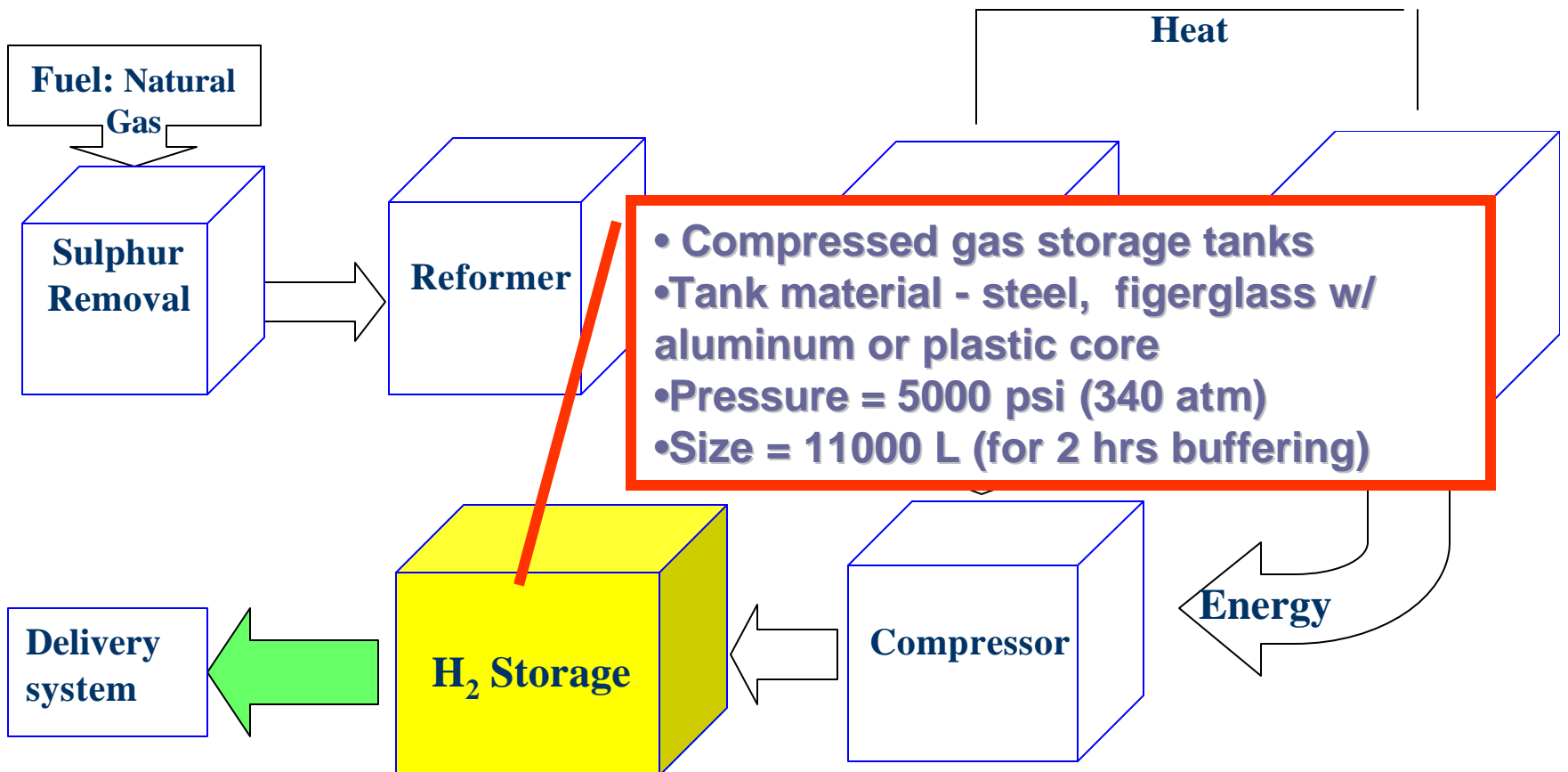
Modeling Results - Station Specifications 5



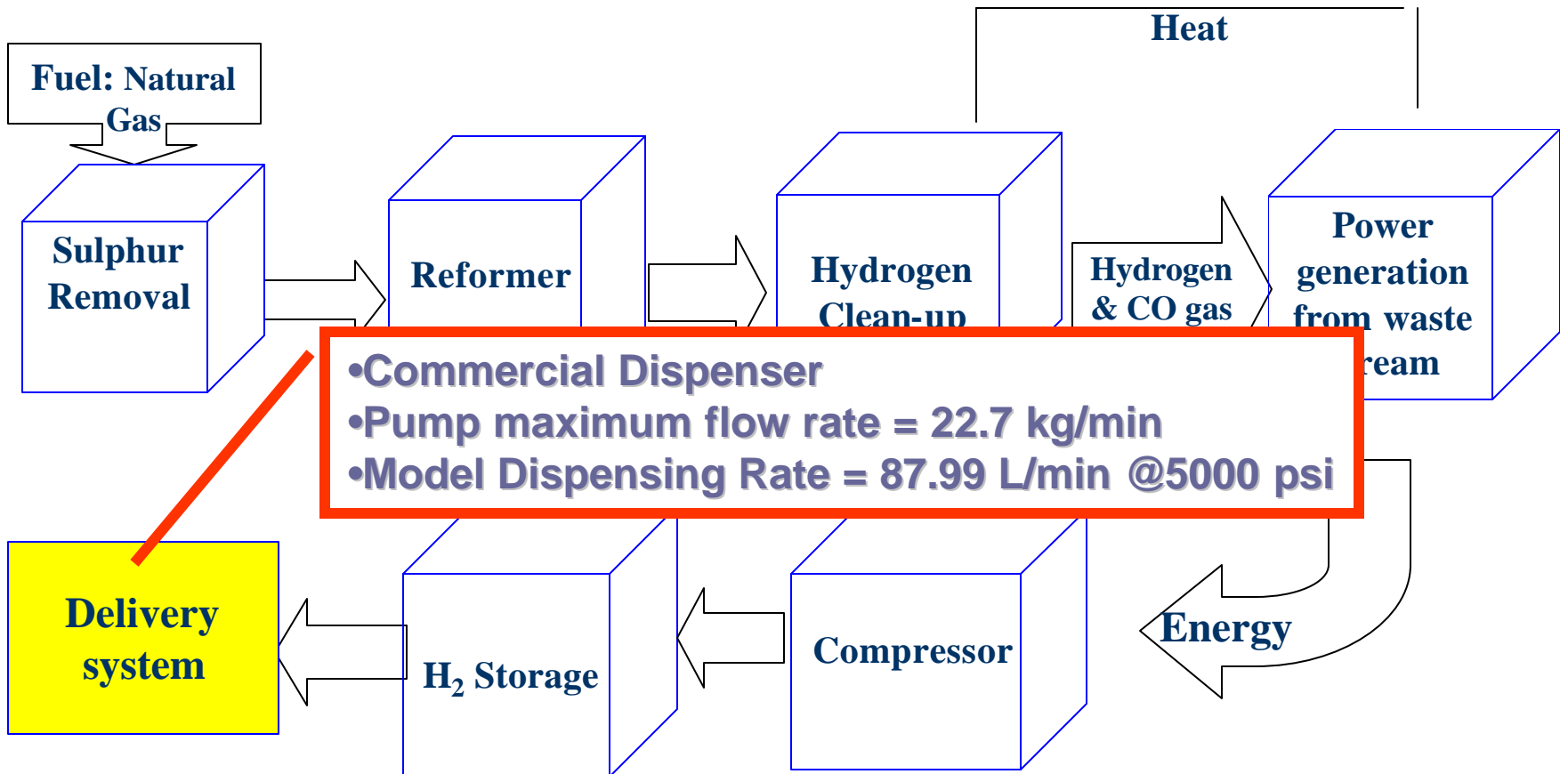
Modeling Results - Station Specifications 6



Modeling Results - Station Specifications 7



Modeling Results - Station Specifications 8



Modeling Results - Station Specifications 9

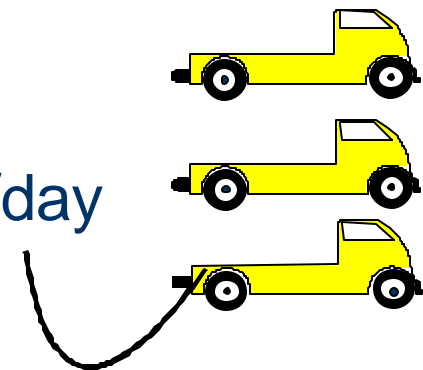
- Retail Station Operating Hours:

- Operating Hours = 20 hrs
- Retail Service from 5 a.m. to 11 p.m.
- Buffer hydrogen generation for storage from 11p.m. to 1a.m.



- Service

- Approximately 950 fuel cell vehicles/day
- Total production = 105,588 L H₂/day
- Refueling time = 1 - 2 min/vehicle



Hydrogen Safety 1

- Public education is required for hydrogen acceptance
- Safety codes are currently being developed in North America for hydrogen storage and delivery
- In Canada, the Canadian Standards Association (CSA) has set standards for the transportation of hydrogen and piping systems

Hydrogen Safety 2

- A hydrogen refuelling station in California follows guidelines set by the National Fire Protection Association (NFPA) and the American Society of Mechanical Engineers (ASME)
- Hydrogen can be safely handled

Challenges

- Due to the current lack of infrastructure, and information for large scale H₂ production, cost of operation cannot be determined at this stage
- ASPEN result needs to be validated due to fuel cell and reformer technology is still new
- Future improvement in reforming technology may lead to design modification



More details here



Summary

- Our aim is to satisfy the inevitable demand for hydrogen fuel by designing a feasible hydrogen refueling station
- We anticipate a future automobile market with near-zero emissions, and our design will enable us to obtain that goal efficiently, reliably and at the lowest possible cost!

Conclusion

- Hydrogen Retail station are possible based on today's societies transportation practices
- A conceptual design of a station indicates that a station can be built base on Natural Gas feed refueling 900 cars a day
- Safety and Environmental regulation are still under development, but issues are resolvable

Questions?

