HYDROVERT

Developing zero emissions mobility solutions using hydrogen fuel cells

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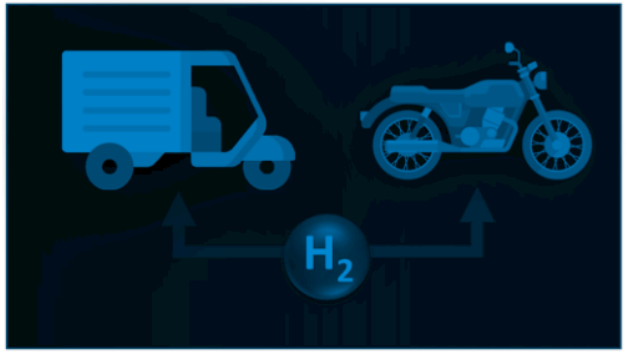
About Hydrovert

Hydrovert Energy is a Pune based startup in the energy domain.

We are developing zero emissions mobility solutions using hydrogen fuel cells.

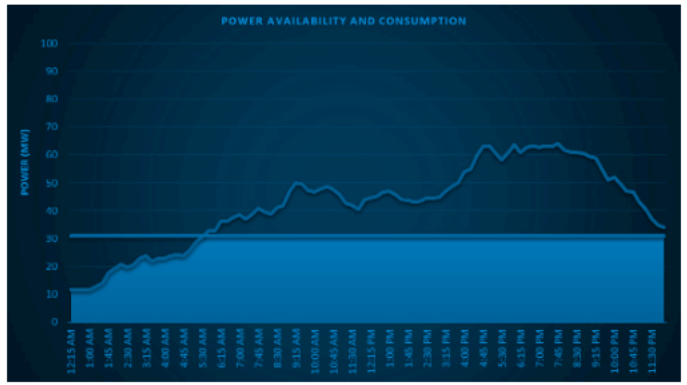
Product



At Hydrovert Energy, we are developing hydrogen fuel cell powered drivetrains for zero emissions vehicles (ZEVs). Our primary focus is on the small vehicle segment which includes 2Ws, 3Ws and small sized boats for leisure applications. Fuel cell powered drivetrains enable an unparalleled driving range to all vehicles while offering a quick 3 minute refueling time.

Dr. Satyajit Phadke

Tools



Whether your green hydrogen requirements are big or small, our easy to use tools can help you visualize how to size your RE Power, Electrolyzers and Hydrogen Storage.

Launch PESSET

Supriya Patwardhan

What are we developing?

Hydrogen Fuel Cell Powered Drivetrains

- We are developing a drivetrain for 2-wheelers (motorcycles)
- The drivetrain can be adopted for 3-wheelers, AGVs, boats and stationary power generation with minimal variation.
- Hydrogen powered drivetrains offers advantages of long endurance and quick refueling for all applications.

3-Wheelers 100 km → 400+ km

AGVs 2 h → 8 h

Electric Boats 10 km → 50+ km

Stationary Power Generation As per fuel availability

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Who are we developing for?

Market Opportunity

Our primary target market is last mile delivery companies such as Amazon, Swiggy, Dunzo, Postal services and others.

Over the last 2 years, last mile delivery services have grown substantially and all the major companies have announced expansion in their fleet for the next 5 years.

- Swiggy promised to cover 8 lakh kms/day through EVs by 2025.
- Flipkart has announced that it will add more than 25,000 electric delivery vehicles to its fleet by 2030
- Zomato said it will adopt 100% EVs for the delivery for the delivery fleet by 2030.
- Amazon has announced, it will add more than 10,000EVs to its delivery fleet in India as part of its global electric vehicle fleet strategy.

Why are we aiming for 250+ km driving range?

- 3-minute full tank refueling
- One refueling point serves 20 vehicles per hour
- Opportunity charging not required (any time of day)

Last mile delivery personnel using 2-wheelers drive 160-180 km per day. We want to develop a range anxiety free solution for this application.

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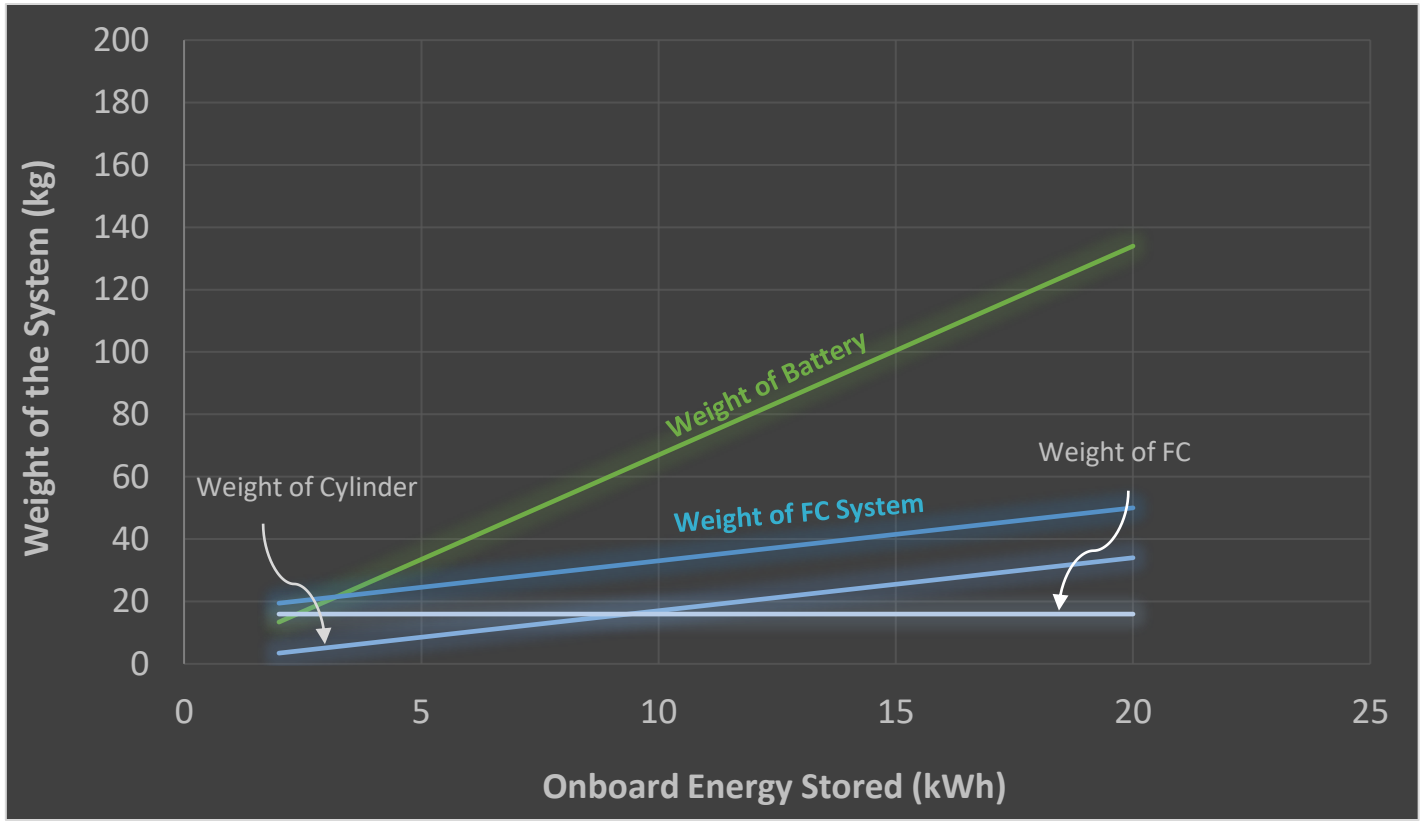
How does PEM Fuel Cell Technology make this possible?



Stored energy (kWh) is increased by simply increasing the onboard stored hydrogen (size of the cylinder) leading to only a marginal weight increase.

Power rating of system = 4 kW

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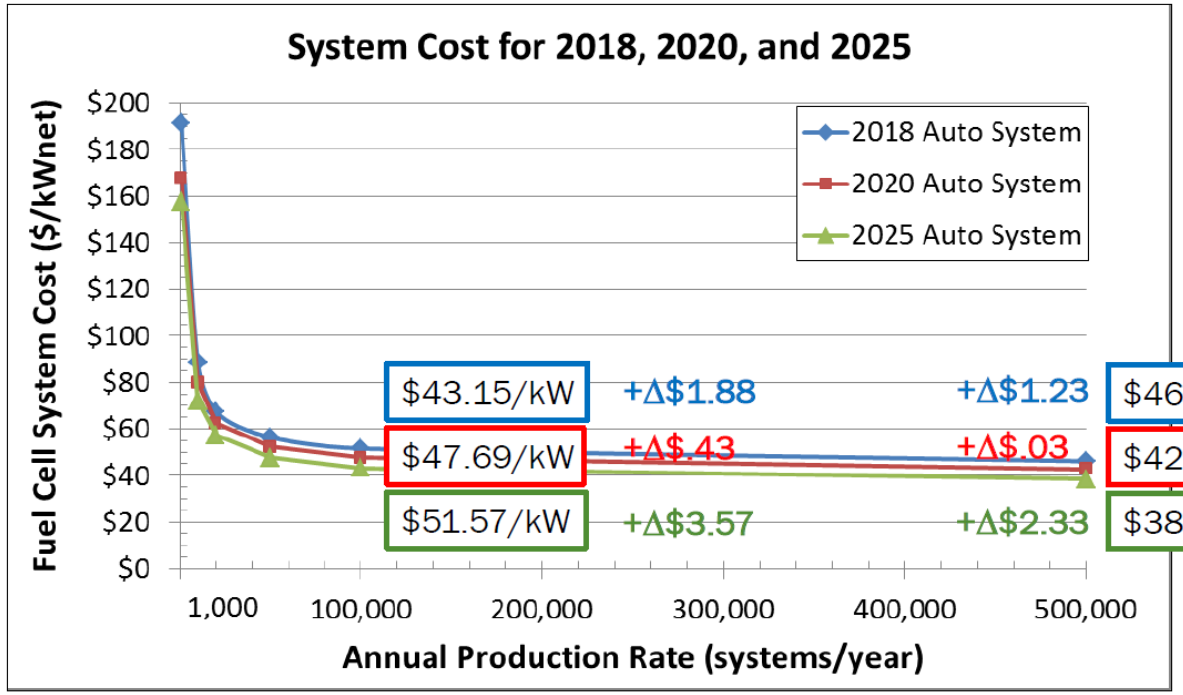
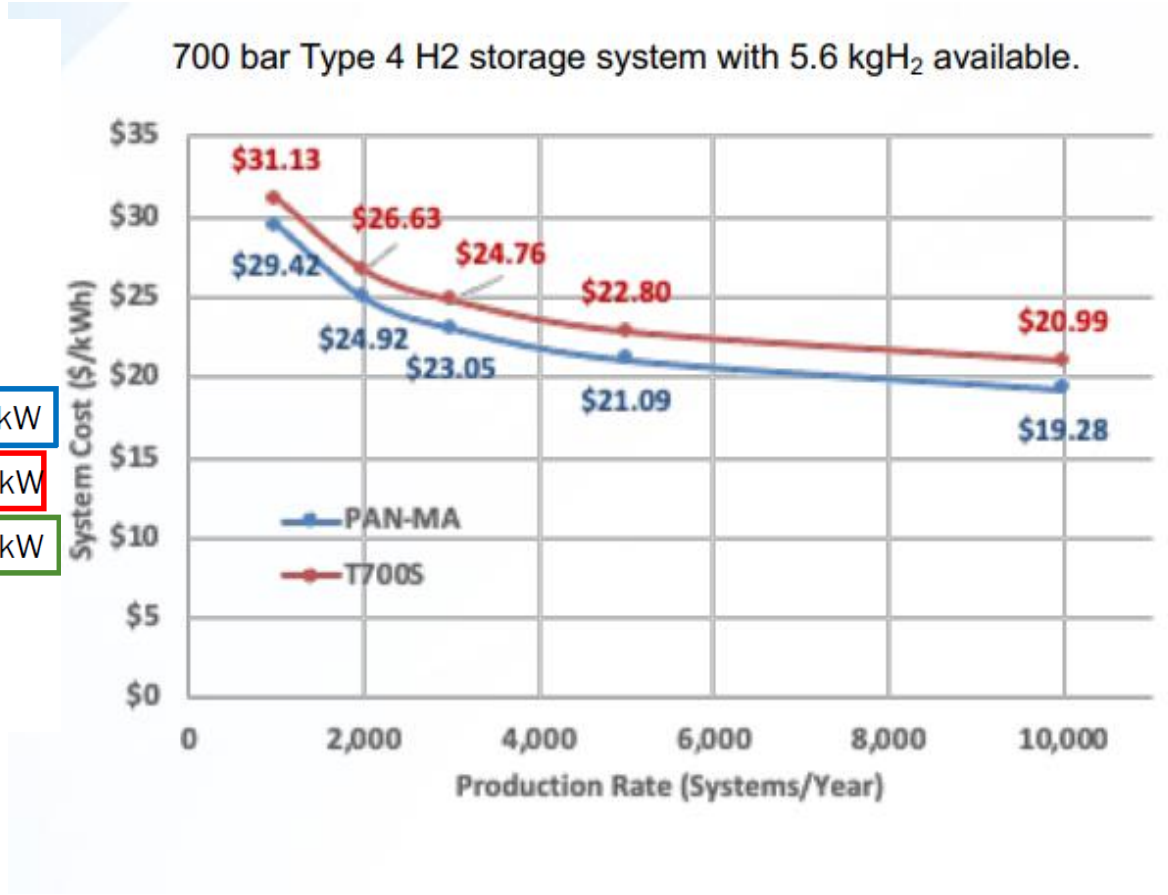
What cost reductions are expected in Fuel Cells?





At a large manufacturing scale:

- Projected cost of PEMFCs = 50 USD/kW
- Projected cost of H2 storage = 20 USD/kWh

The estimated cost of a 2 kW, 6 kWh system required for 2-wheelers is < INR 40,000 (USD 500).

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Source: Hydrogen Storage Cost Analysis, Cassidy Houchins, Brian D. James, Yaset Acevedo, 7 June 2021, US-DOE

Source: 2018 Cost Projections of PEM Fuel Cell Systems for Automobiles and Medium-Duty Vehicles Brian James, Strategic Analysis Inc., April 25, 2018, (US-DOE)

Current Status

Awards

- Supported by **NCL Venture Center**
- Awarded **Nidhi Prayas** Grant in July 2022
- Awarded **Startup India Seed** Grant in Jan 2023
- Awarded **Cummins CSR** Grant in May 2023
- Awarded **RM Tulpule Charitable Trust Grant** in June 2023

Patents

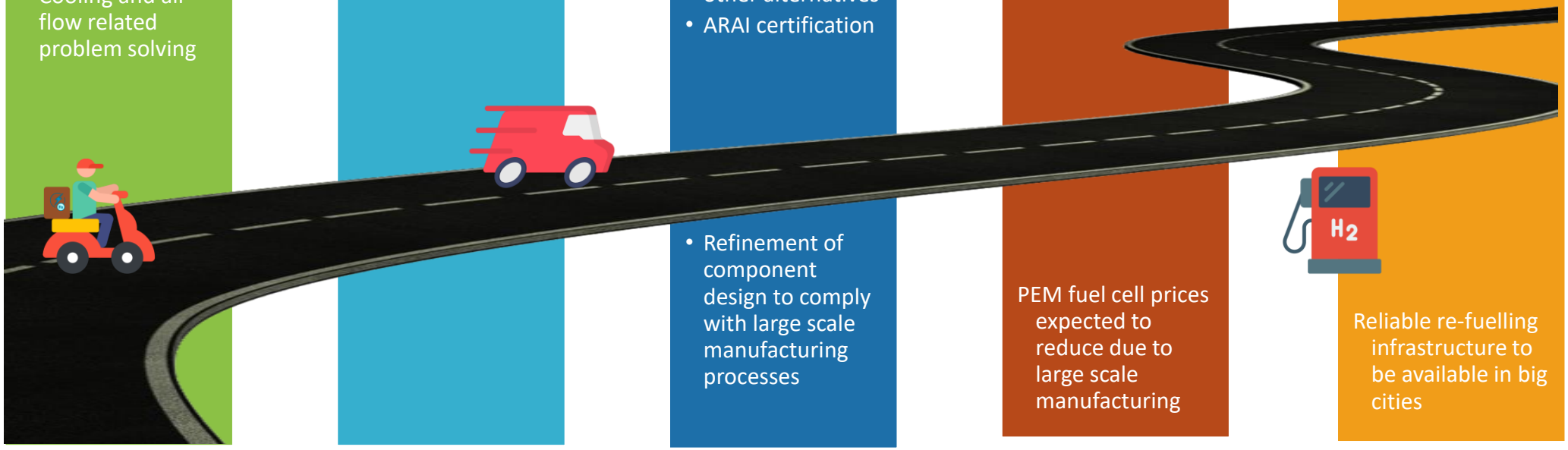
- 2 Provisional patents filed in India

Current status

- First running POC complete for 2-wheeler
- Currently developing an advanced prototype 2-wheeler (motorcycle)

Our 1st Proof Of Concept prototype

Roadmap



2023

2W Prototype

- Sizing of components (motor, fuel cell, battery, tank)
- Automations related to refueling
- H2 consumption optimization
- Cooling and air flow related problem solving

TRL = 6

2024

3W Prototype

- Sizing of components (motor, fuel cell, battery, tank)
- Integration challenges related to 3W solved

TRL = 6

2025

Testing and Validation

- Testing of individual system components (road ruggedness)
- On road testing and validation of performance metrics with other alternatives
- ARAI certification
- Refinement of component design to comply with large scale manufacturing processes

TRL = 7

2026

Pilot scale production

- Setup of small manufacturing plant
- Roll out 5-10 vehicles for demonstration to some select customers and get feedback

PEM fuel cell prices expected to reduce due to large scale manufacturing

TRL = 8

2027

Scale-up of manufacturing

- Setup of manufacturing plant

Reliable re-fuelling infrastructure to be available in big cities

TRL = 9

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Simplifying Adoption of Green Hydrogen for Industrial Decarbonization

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Incorporating GH2 in Industrial Processes

Evaluating de-carbonization potential of H2

- What is the type of fuel being used currently?
- What are the process requirements?
- Is hydrogen also required as a feedstock?

Optimum Design of the System

- RE power availability profile and cost?
- Is H2 blending possible into the current fuel?
- Partial or complete de-carbonization?
- Effect of seasonal variations on the process?

Overall Economics and Implementation Strategy

- Is H2 blending possible into the current fuel?
- Cost of green hydrogen produced?

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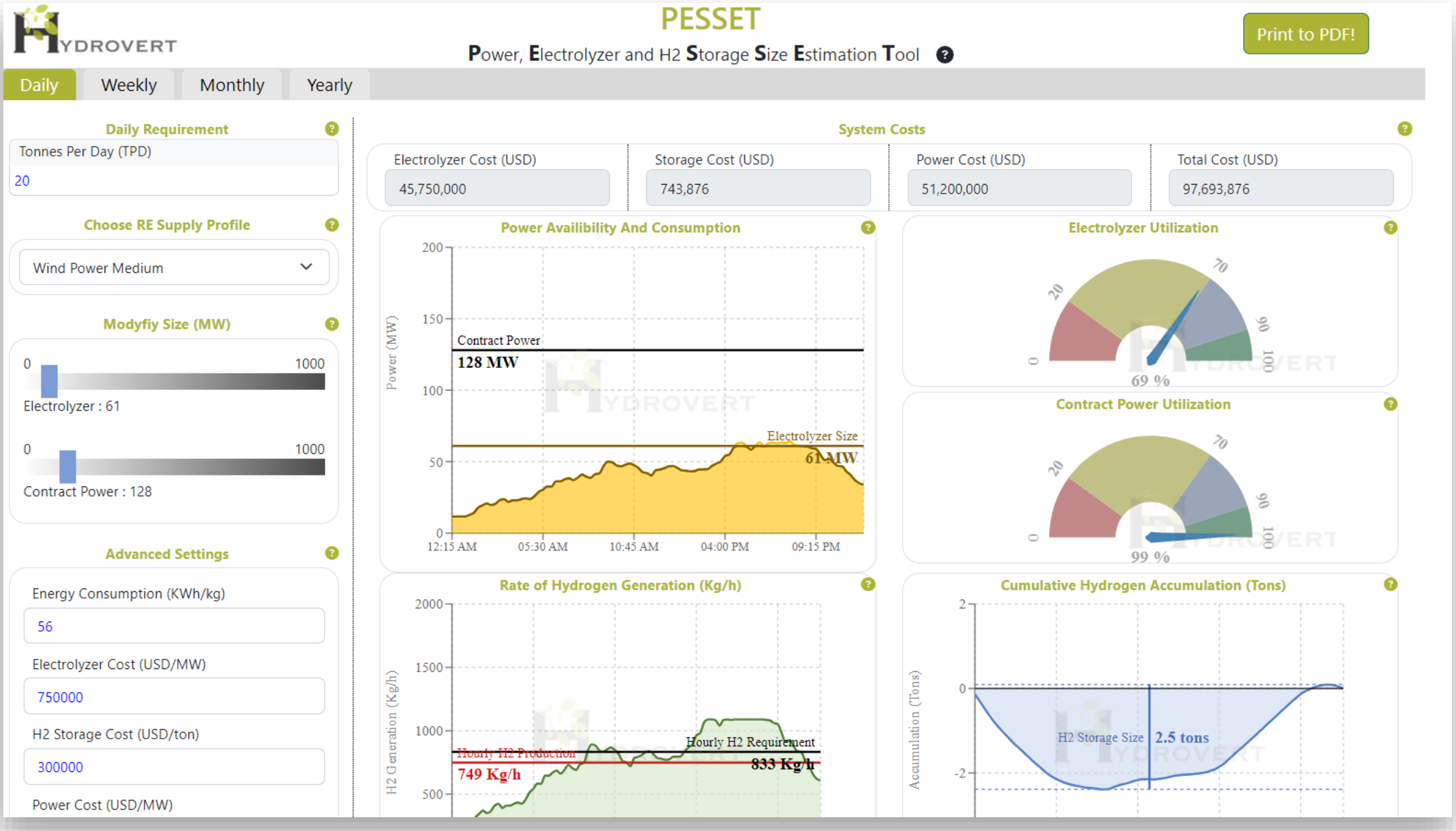
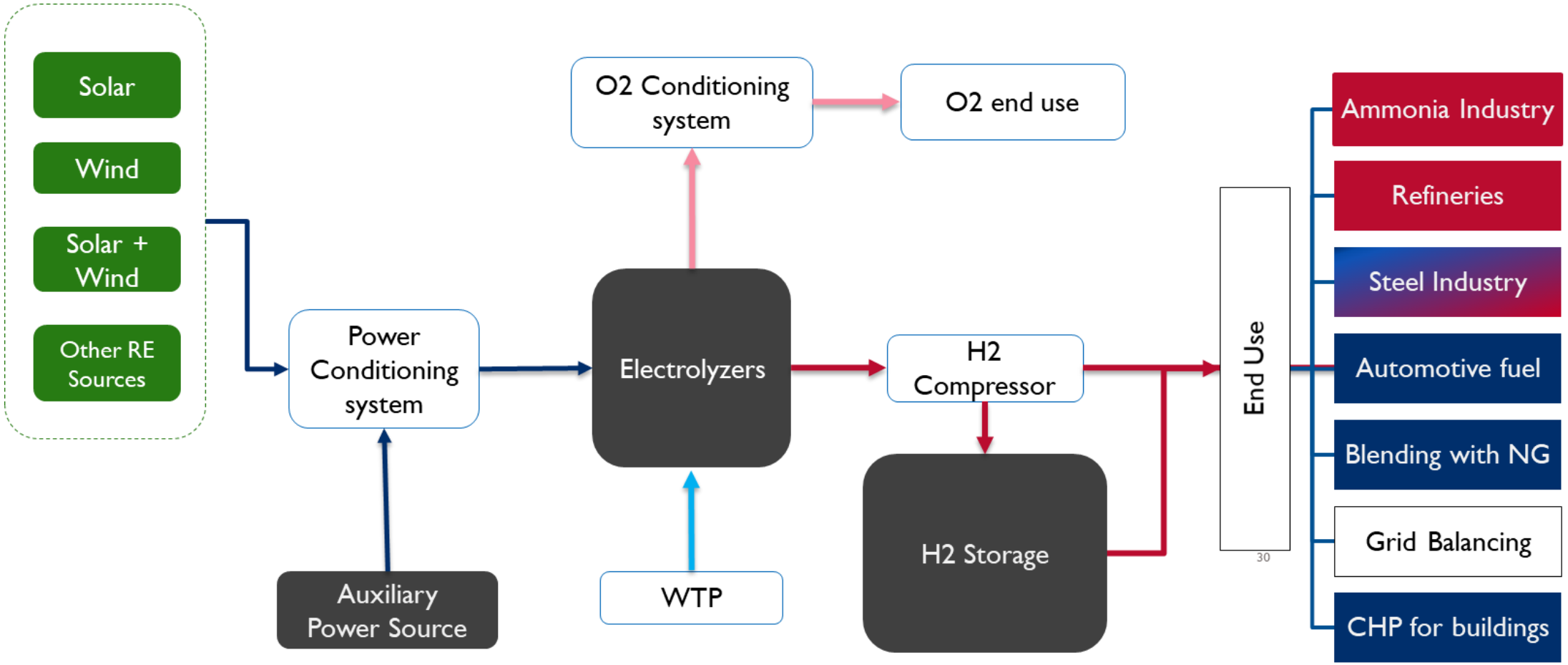


Incorporating GH2 in Industrial Processes



Optimization Strategy for System Design

Capital costs

$$C_{SYS} = C_{EZ} + C_{CP} + C_{H2STORAGE}$$

- Minimization of size (MW)
- Maximization of utilization

INR/MW

- Account for daily variations
- Account for seasonal variations
- Resiliency of system

INR/ton

- Minimization of size (MW)
- Maximization of utilization

INR/MW

Operating costs

Energy consumption per unit H2 produced

MWh / ton
kWh / kg

PEM, Alkaline, SOEC

50-55

55-60

37-40

Electricity tariff

INR/kWh

Fixed or Variable

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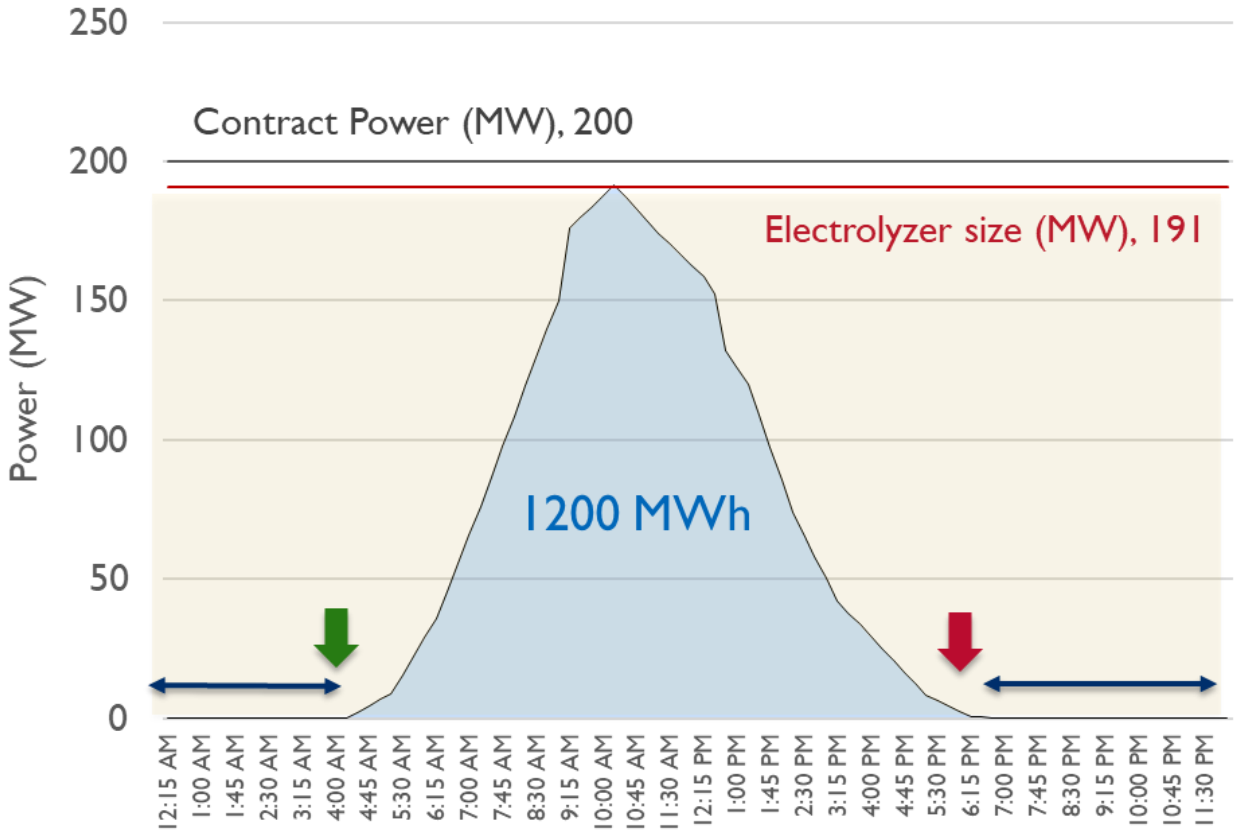
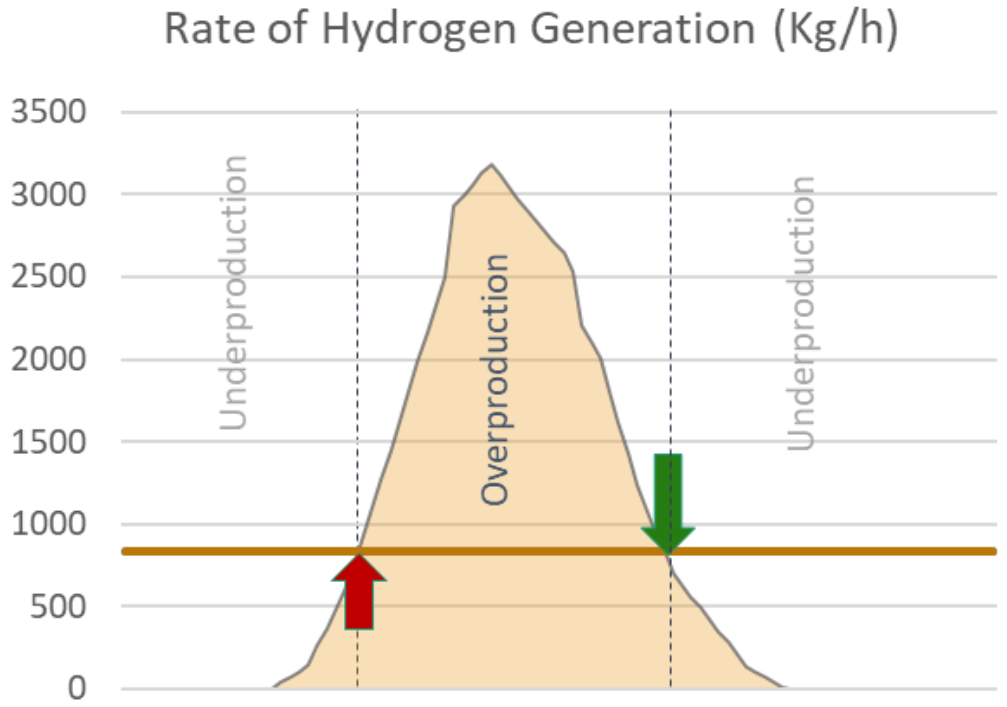
Estimating Storage Requirement





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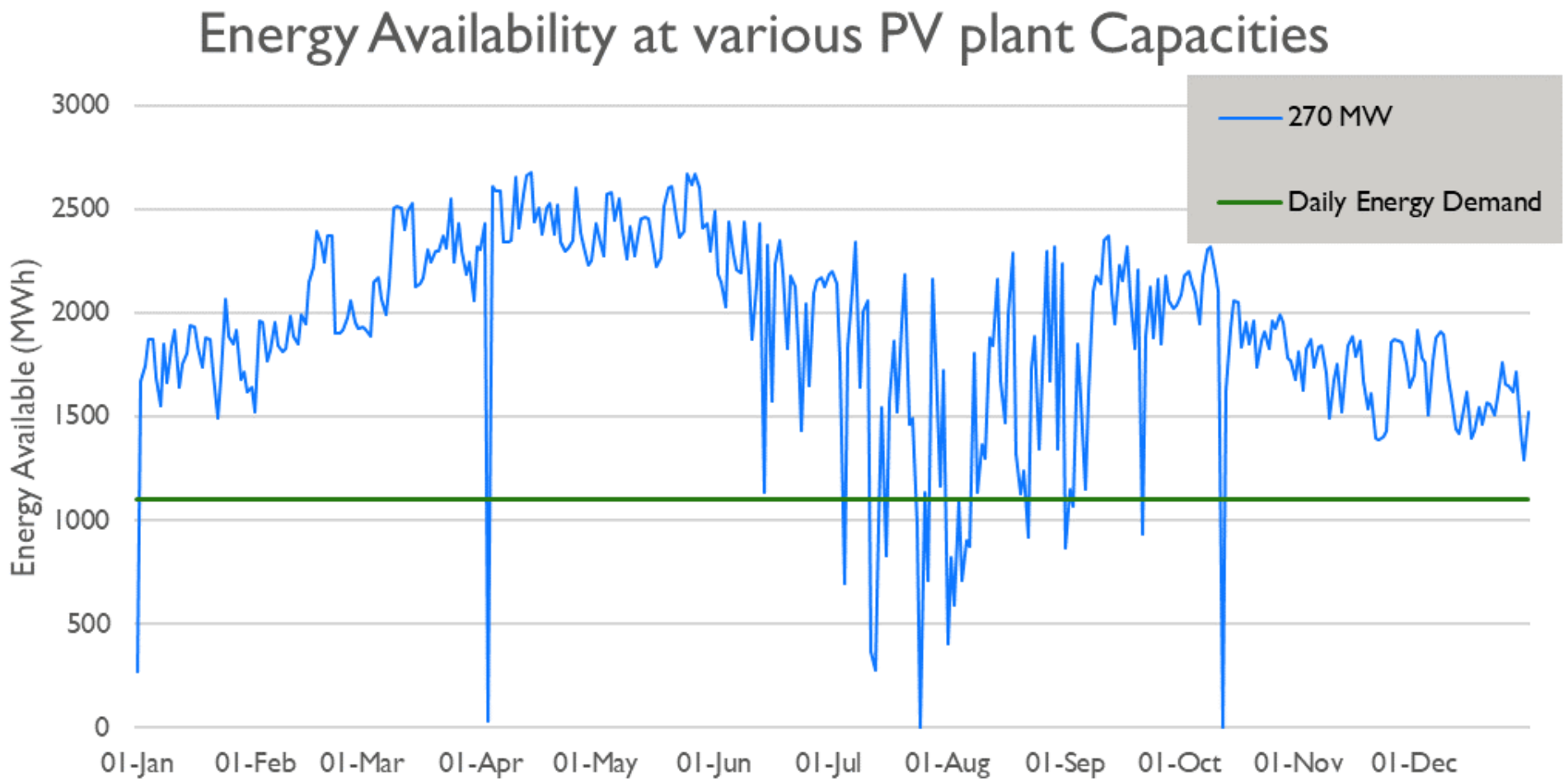
Effect of Seasonal Variations



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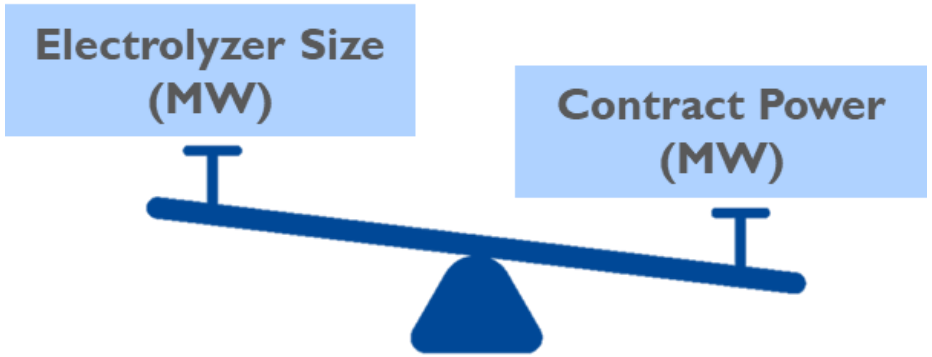
Tradeoff: Minimum H2 storage vs. System resiliency

- Contract Power size and electrolyzer size are inversely related

- Increasing the electrolyzer size (MW) leads to higher costs and lower utilization
  - Lower resiliency
  - Increased costs

- Increasing contract power (MW)
  - Improved resiliency
  - Lower number of days of under-production
  - Increased cost, lower utilization



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