



**NUVERA<sup>®</sup>**  
**Fuel Cell Electrification:**  
**What Matters**

Ralph Clague | June 28, 2022



Is An Independent Part of



Nuvera World HQ and Manufacturing Plant  
Greater Boston, Massachusetts



Fuel Cell Durability Test Facility – Osio, Italy



4,000 m² Test Cells & Manufacturing Plant

M-11 Module

E-45

E-60

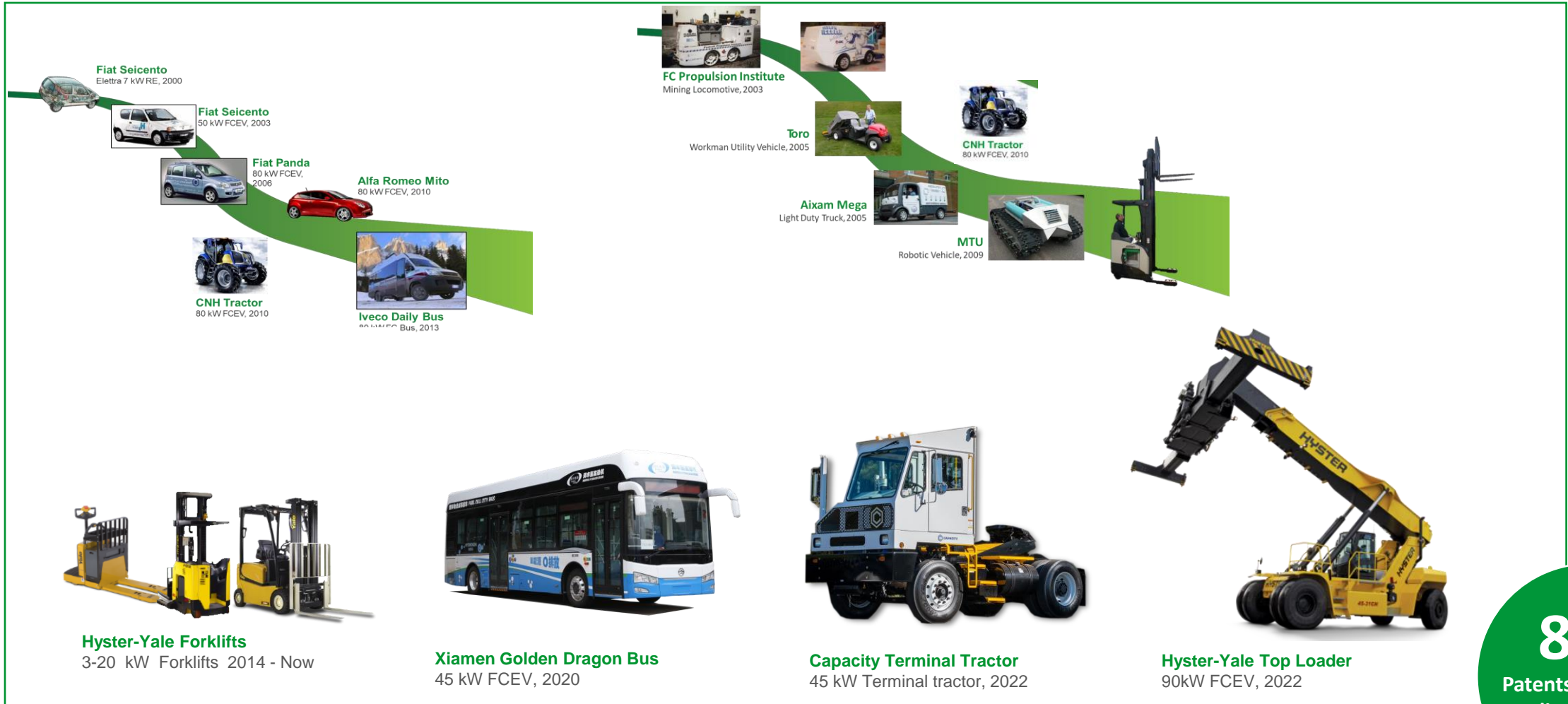
EN-125

**803**  
Patents Granted or Pending Worldwide

Nuvera products are **BUILT FOR WORK**

# 25+ Years of Mobility Experience

## Embedded in High-Performance Nuvera Fuel Cell Power Solutions Provided Today



**803**  
Patents Granted or  
Pending Worldwide

# E-Series Engines for Versatile Applications

## Broad Range of Real-World Use Cases

### On-Road Applications



**7.5t Truck**  
E-45



**10.5m Bus**  
E-45, ZRHE



**Refrigerated Delivery Truck**  
E-60, ZRHE



**Prototype Car**  
E-60

### Other HD Applications



**Stationary Power**  
E-45



**Container Handler**  
2xE-45, HYG



**Port Tractors**  
E-45, Capacity



**Mobile Power Station**  
E-45, Dannar  
E-60, Devinn

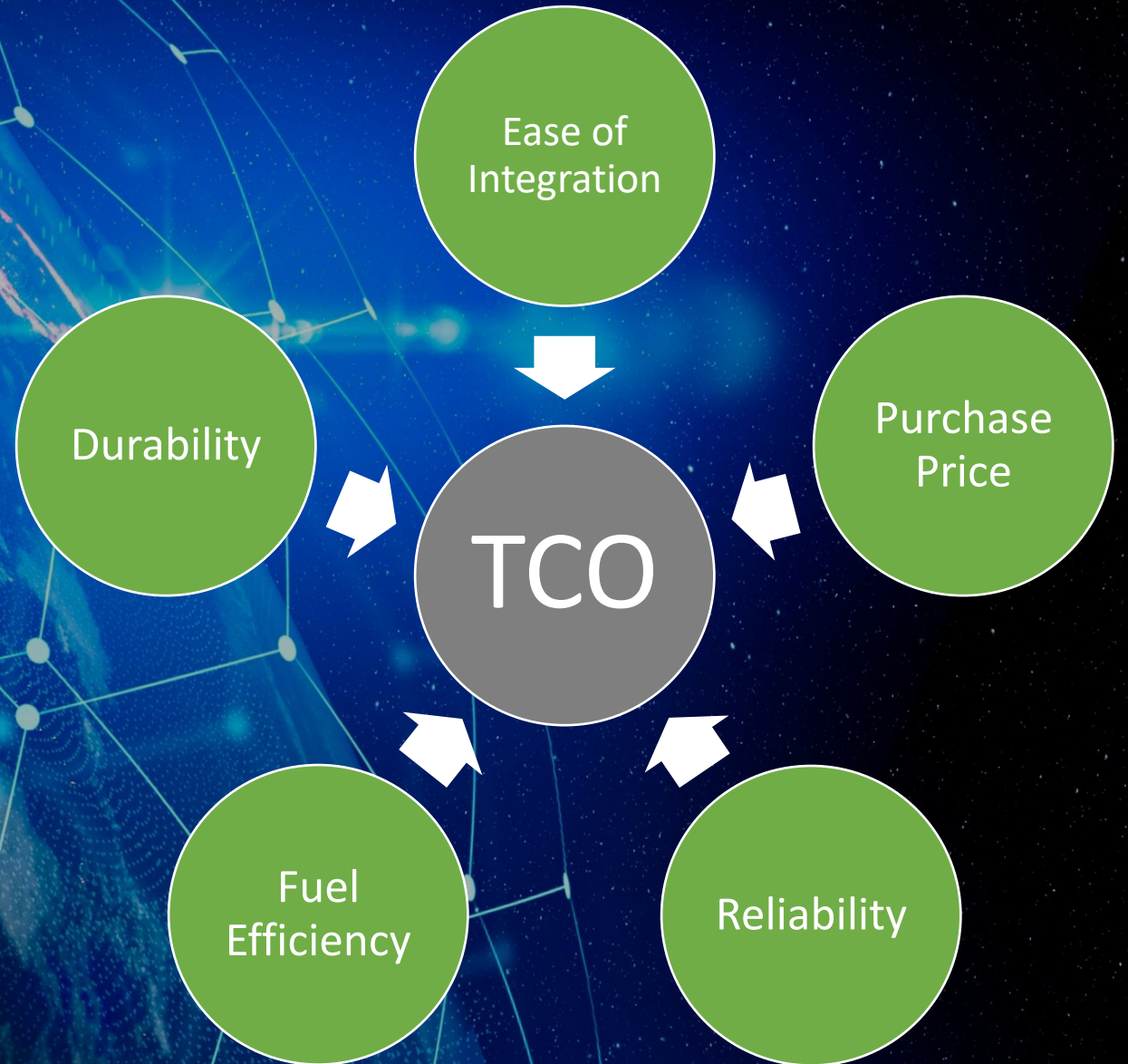


**Reach Stacker**  
2xE-45,  
Hyster Yale



**Port Tractor**  
E-60

# What Matters: Total Cost Of Ownership



# Engine Efficiency → Making Hydrogen Work For You

Application duty cycle critical to understanding cost and lifetime in real-world service

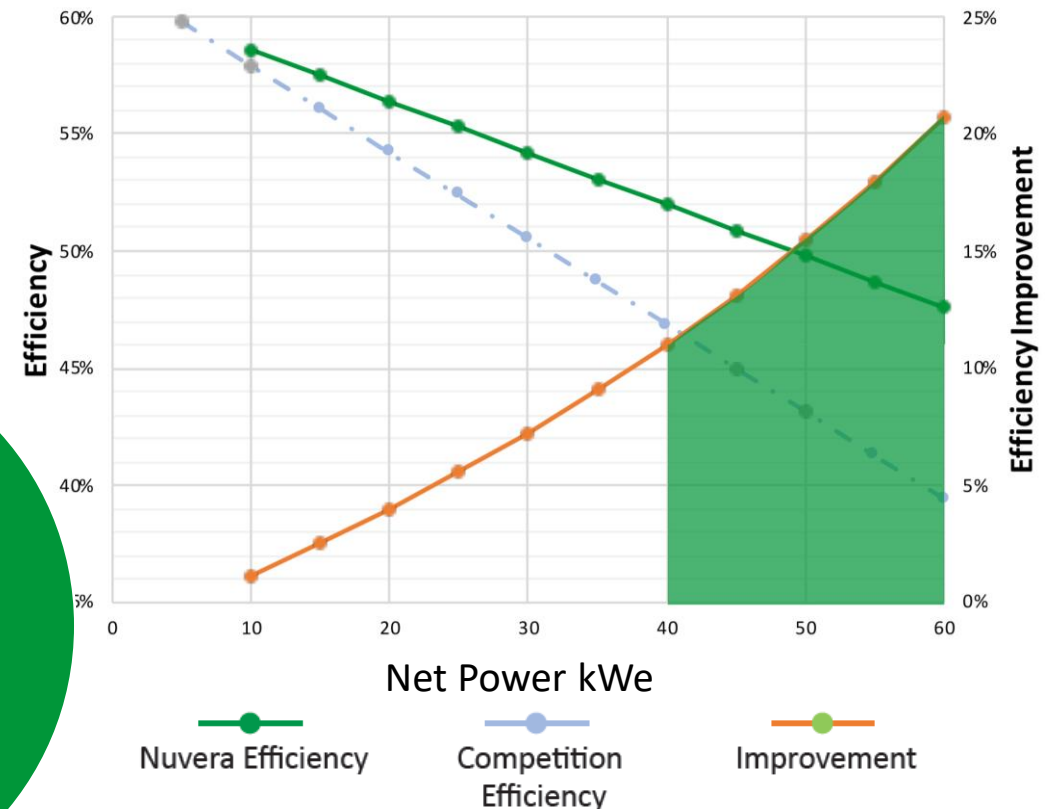
Cost of ownership for fuel cell engine:

- + Upfront **cost of fuel cell engine**
- + Minimum **power requirements for application** over product life
- + **Hydrogen usage**, a function of fuel cell engine **efficiency**
- + **Durability** of Fuel Cell Engine
- + **Service and preventive maintenance** costs

Nuvera provides 20% efficiency benefit where it's needed most – in high-power **WORK ZONE** performance.

## DELIVERY TRUCK CASE STUDY

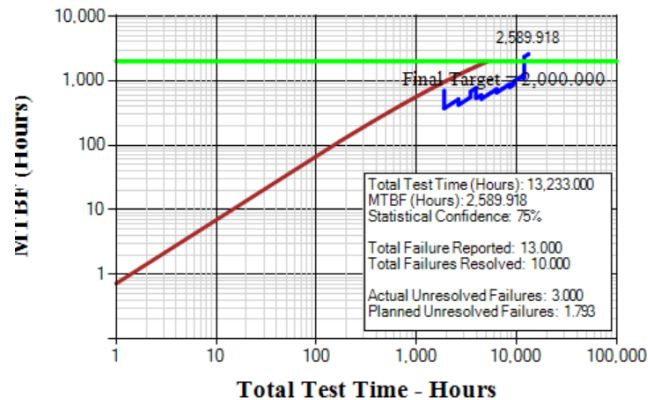
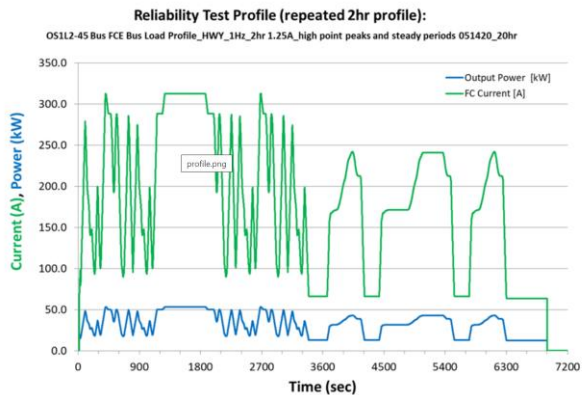
### Efficiency of Nuvera E-60 vs. Competition



# Engine Reliability Testing → More Time At Work



Test Group	Hours	Comments
Verification	12,550	DVP Testing
Phase 1 RG	11,512	2202 hr MTBF
Phase 2 RG	13,233	2589 hr MTBF
	<b>37,295</b>	<b>hours</b>
	30	km/hour
	<b>1,118,850</b>	<b>km equivalent on road</b>



MTBF >2500 Hours → 99% System Availability  
 in Typical Vehicle Application

**NUVERA<sup>®</sup>** 

**Thank You**

**Ralph Clague**

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**Hyster Yale Group**

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