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Fuel Cell 2.0 - Oorja Delivers

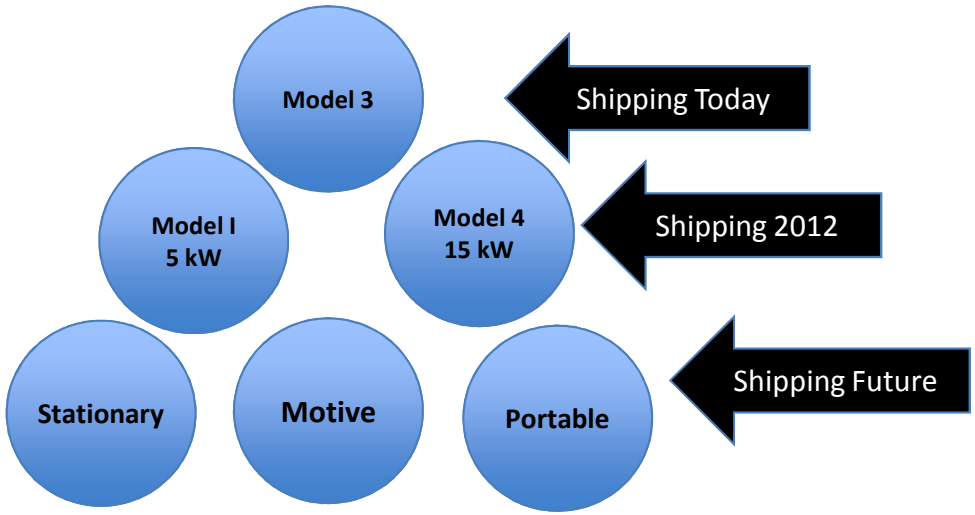
Attribute	Fuel Cell 1.0 had Challenges	Fuel Cell 2.0 Oorja Delivers
Technology:	**Distribution:** no solution **Storage**: partial solutions **Fuel Cells:** uneconomical	✓ **Distribution:** methanol – 15 BG/Y ✓ **Storage:** energy dense liquid ✓ **Fuel cells**: 50x more powerful
Market:	**Customers:** automotive and consumer electronics **Size:** large but technology didn't deliver	**Customers:** repeat commercial volume orders **Size:** $5 billion addressable today, going to $30+ billion with cost reduction
Economics:	**Gross margin:** negative **Fuel Infrastructure:** high cost **Customer paybacks:** multi year	**Gross margin:** Positive **Fuel Infrastructure:** low cost **Customer paybacks:** 12 month

Delivering Commercial Product NOW

Product	Year	Description	Advantages
Model 3	2008	The OorjaPac™ Model 3 is a 1.5kW liquid fuel cell that operates as an on-board battery charger	• Refuels in less than 1 minute • Eliminates grid-charging of battery • Prolongs the life of the battery

Scalable Technology Architecture Delivers Watts to Kilowatts Serving Many Applications

Classic Crossing the Chasm Product Strategy



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Commercial Facts for OorjaPac Model 3

- Shipped 500+ Systems in 3 years
- Backlog of 200+ Systems
- Multiple Repeat Purchase Orders
- Annual Production Capacity of 650 Systems
- Deployed 75 units under DOE's Market Transformation Program

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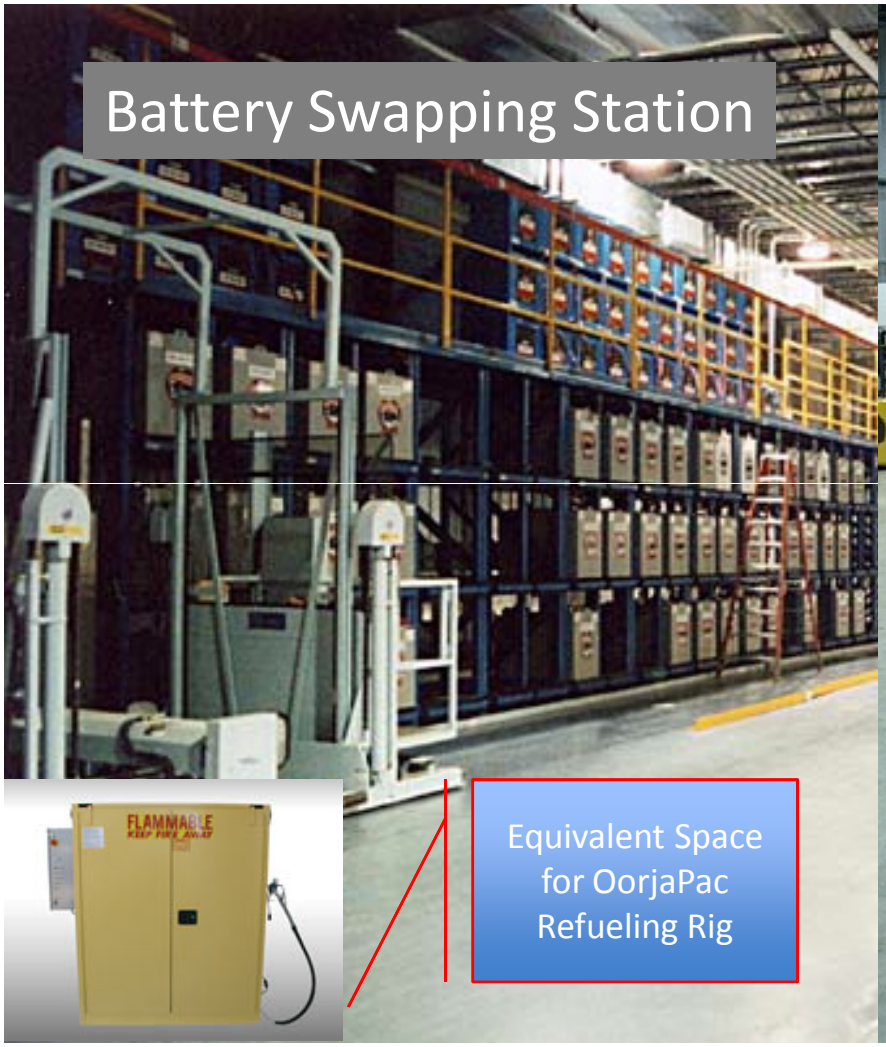
Current Solutions Expensive Infrastructure



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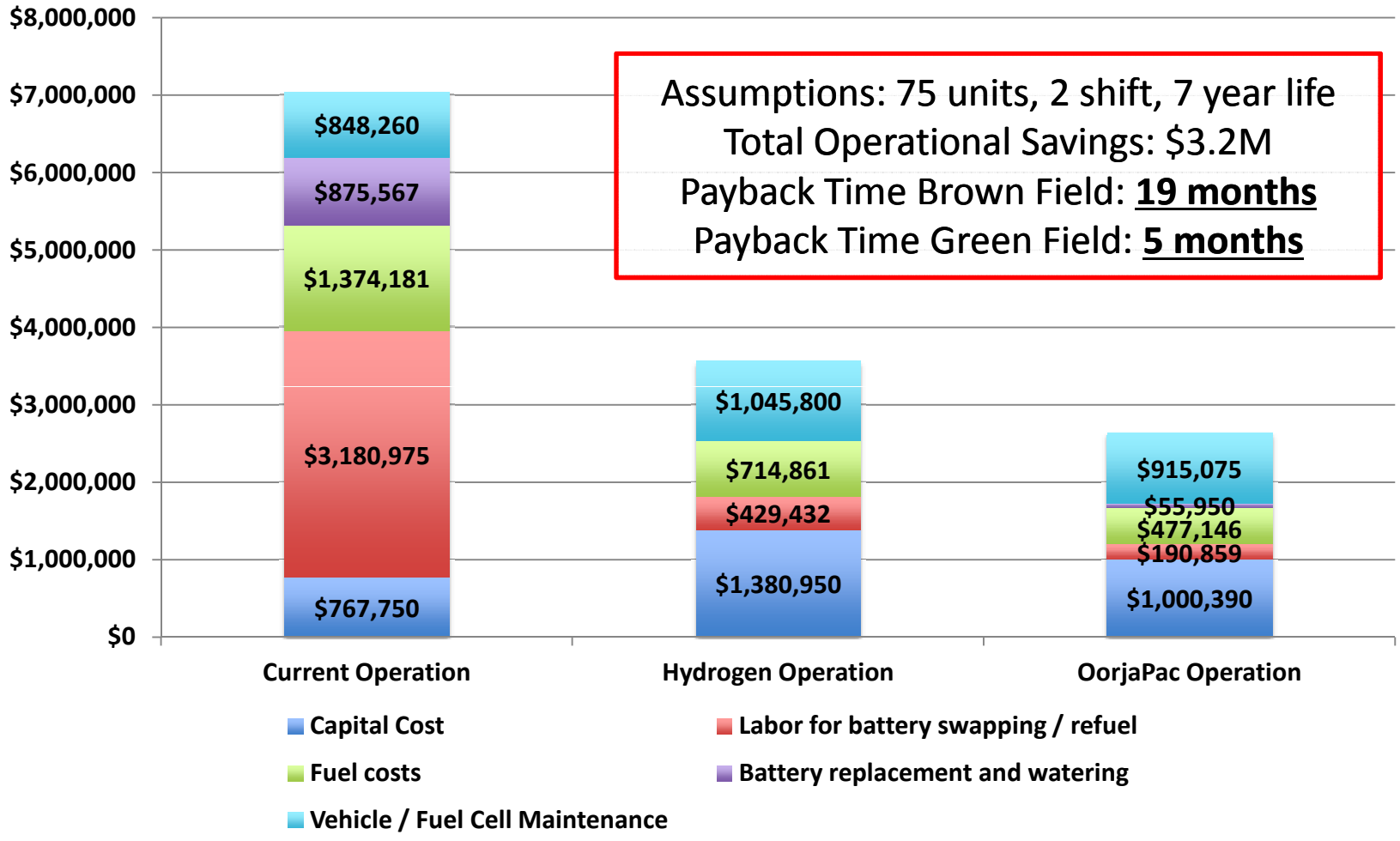
OorjaPac saves OpEx and CapEx

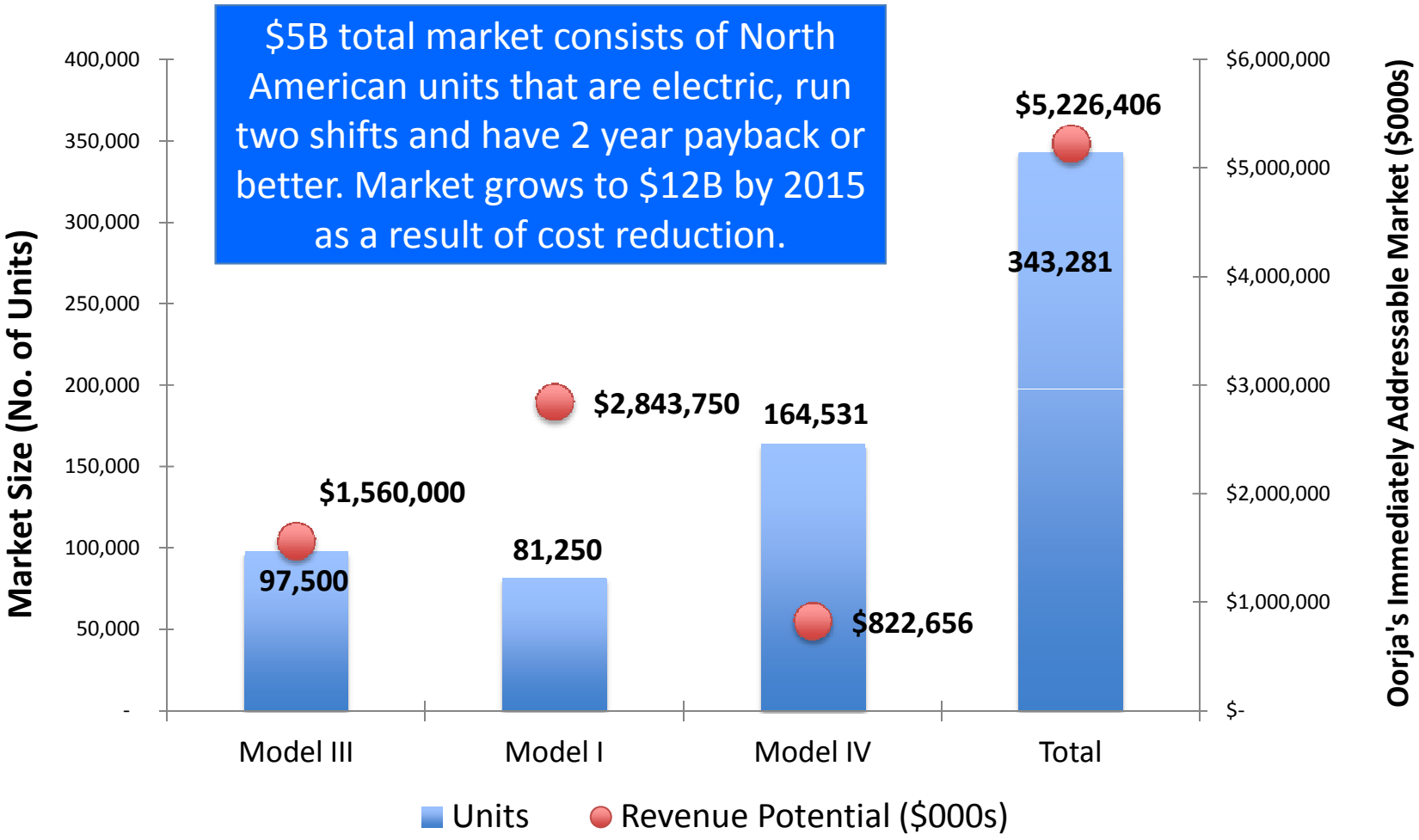
Parameters	Conventional Charging of Lead Acid battery	Rapid Charging of Lead Acid Battery	Hydrogen Fuel Cells	Methanol Fuel Cells-OorjaPac
Runtime between Charges or Refueling	4-5 hrs	3 hrs	8-12 hrs	**15-16 hrs**
Total Downtime per Day for Battery Swap or Battery Charge or Refuel	30-45 mins	20-30 mins	4-8 min	**1-2 min**
Battery Life	3-5 years	2-3 years	NA	**6-7 years**
TCO per MHE per Year (7 Year life)	$7,600	$6,900	$6,500	**$3,700**
Infrastructure Cost (New installation)	$0.5 Million	$0.2-0.5 Million	$0.3-0.5 Million	**$15,000**

Payback as Low as 5 Months



Assumptions: 75 units, 2 shift, 7 year life
Total Operational Savings: $3.2M
Payback Time Brown Field: **19 months**
Payback Time Green Field: **5 months**

$5Billion Highly Qualified Market



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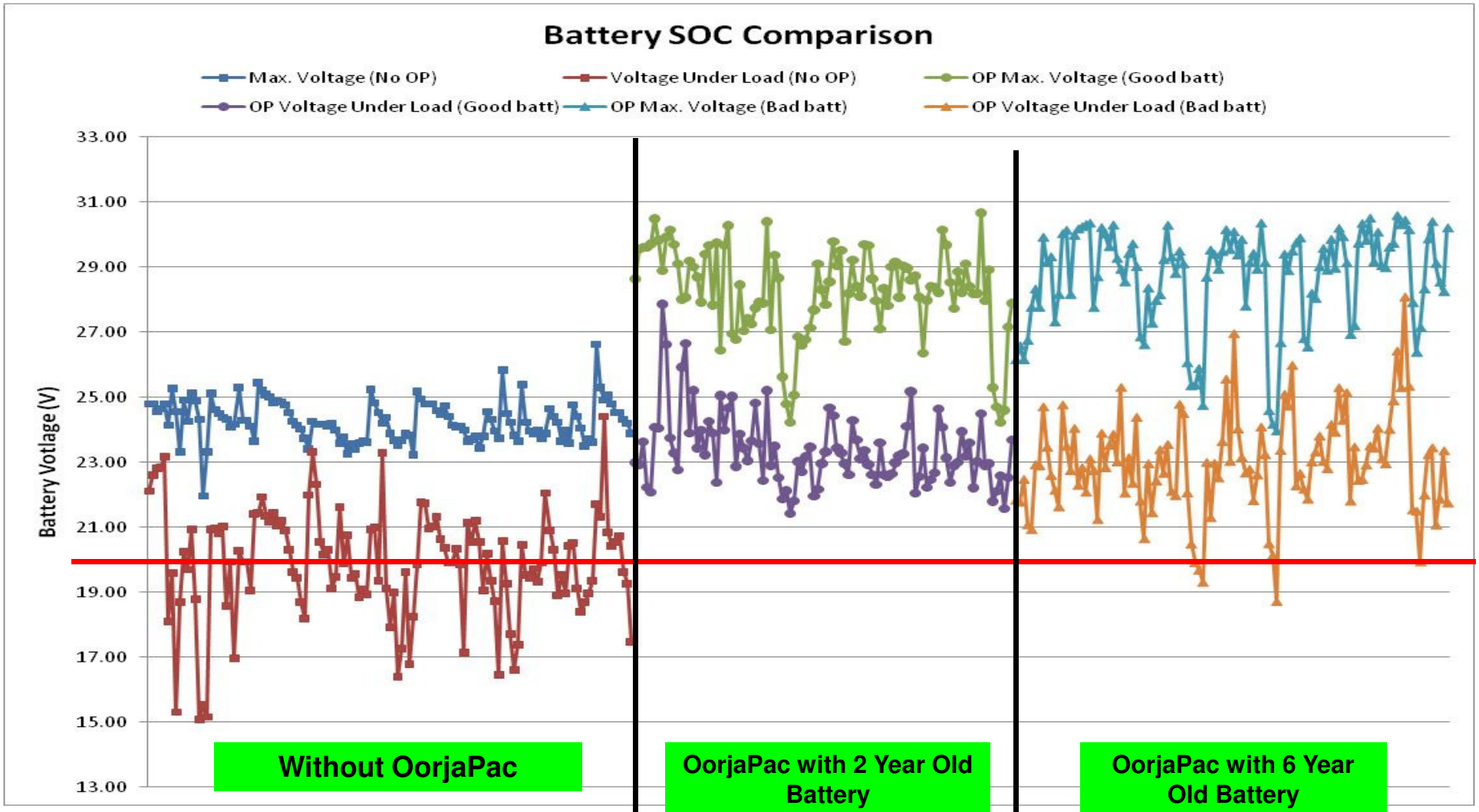
OorjaPac Extends the Battery Life



Note: Data normalized to 1 wk (6 days)

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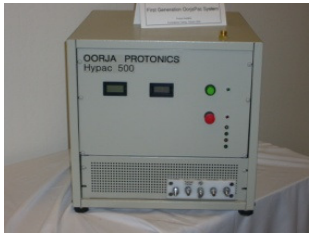
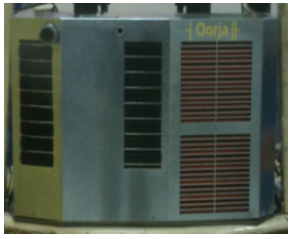
Oorja's Commercial Success

Oorja Dominates High-Power DMFC Evolution since 2006





	2006-'07	2007-'08	2008-'09	2009-'11
System Power Output	0.5 kW	1.2 kW	1.5 kW	1.5 kW 4.5 kW
Stack Life (Hrs)	500	1800	4500	8000
System Power Density (W/liter)	2.9	12.0	17.5	26.3
Technology Challenges Addressed	• Methanol X-over	• Anode Stability • Power Density	• MEA Durability • Fuel Efficiency	•Catalyst Loading •Water Neutral

Wide Breadth of Oorja's DMFC Technology

	Samsung	SFC	Oorja	Comments
Nominal Power (W)	25	250	1500 and 4500	18X higher
Key Application	Military portable	mobile and portable	Forklift and Backup Power	
Output current (A)	1	20	62.5	3X higher
System Power Density (W-Hr/liter)	153	185	231(Model 3) 268 (Model 1)	1.5X
Stack Life (Hrs)	---	5000	8000	1.6X
Core Technology	-System integration	-System integration	-MEA Design -Stack Design -Water Management -Thermal Mgmt - System Integration	- Power Scalability -Wide Design Capability

Samsung

SFC

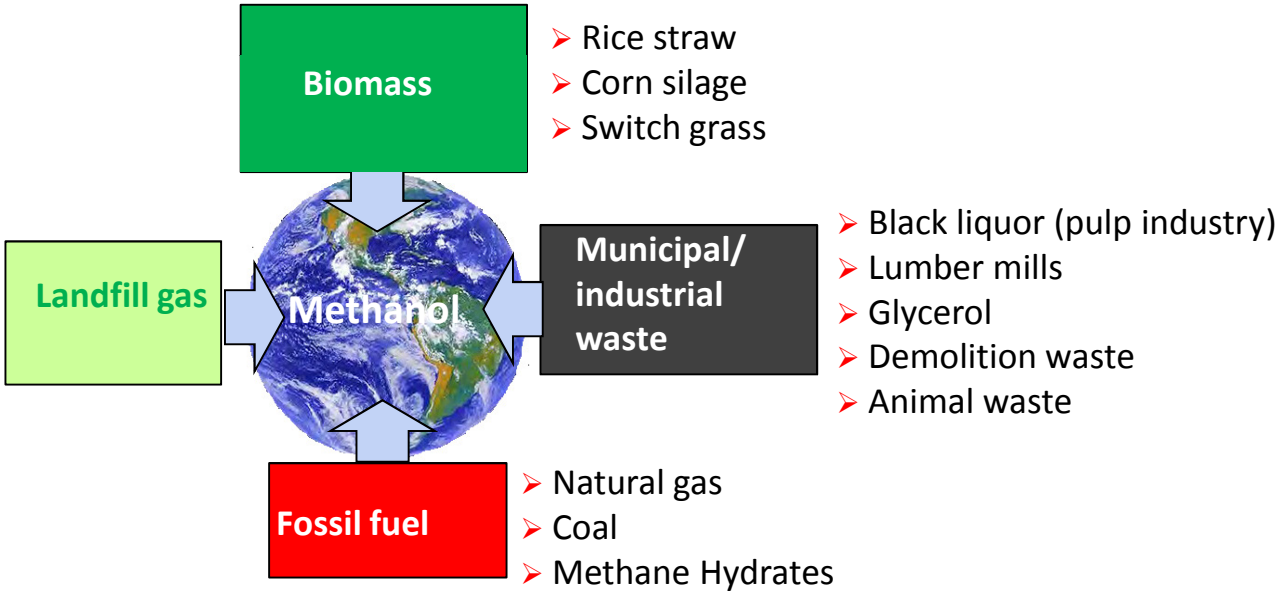
Oorja

Oorja's Total Addressable Market is $30 Billion

	Off Grid Power	Backup/UPS	Transportation		Portable
			Auxiliary Power Units	Range Extenders	
< 1 kW	•Off Grid Village power •Pumps				•Emergency backup •Soldier Power
1-10 kW	•Agriculture •BTS (Single&Dual) •Hybrid (FC+PV) units	•Power substation •Telecom Tower •Mission critical	•Defense	•Forklifts •2-3 Wheelers	
10-25 kW		•Commercial office	•Trucks & Buses	•Agriculture •Fleet Vehicle (Public Transport)	

Why Methanol?

- Industrially produced from natural gas,
  - coal (reducing NOx, SOx)
- Ideal liquid energy from waste,
  - biomass (GHG reduction)
- Non-explosive, low flammability
- Decreased dependence on oil
- Methanol economy (Nobel Laureate Dr. George Olah)



Oorja-A Compelling Story

Technologically Superior

- 50x Power
- Scalable
- Ubiquitous Fuel

Repeat Volume Sales

- Traction in $5B Market
- Tier 1 Customer Sales
- Increasing Sales Volume

Financially Compelling

- Breakeven Gross Margins
- Capital Efficient
- Best Payback