MIDDLE EAST METHANOL FORUM

منتدى الشرق الأوسط للميثانول

MEMF

Hosted & Organized by

Qatar Fuel Additives Company Limited (QAFAC)

Methanol Fuel Cells: Powering the World's Future Energy Needs

www.oorjafuelcells.com

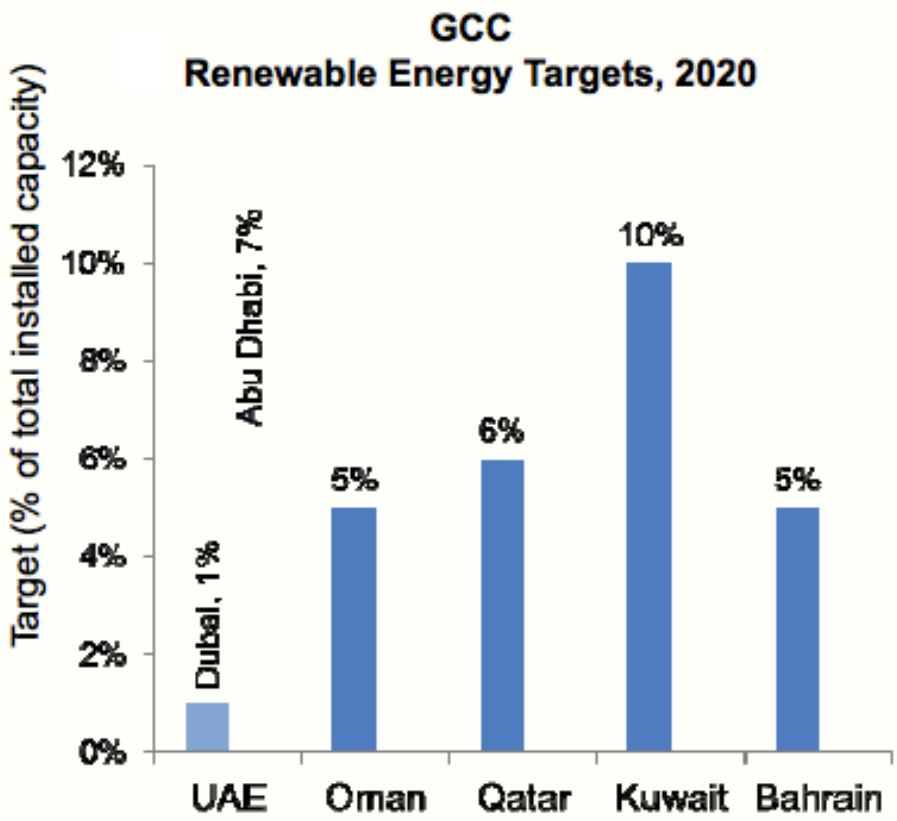
Renewable Energy Targets in the GCC

Deployment of new technologies will enable the region to meet ambitious goals

Dubai: 0.13GW
AUH: 1.5 GW

Oman: 1.25 GW

Qatar: ~1 GW



KSA: 17 GW

Bahrain: 0.25 GW

Kuwait: 2.7 GW

Sources: Frost & Sullivan analysis of stated targets and plans by GCC countries

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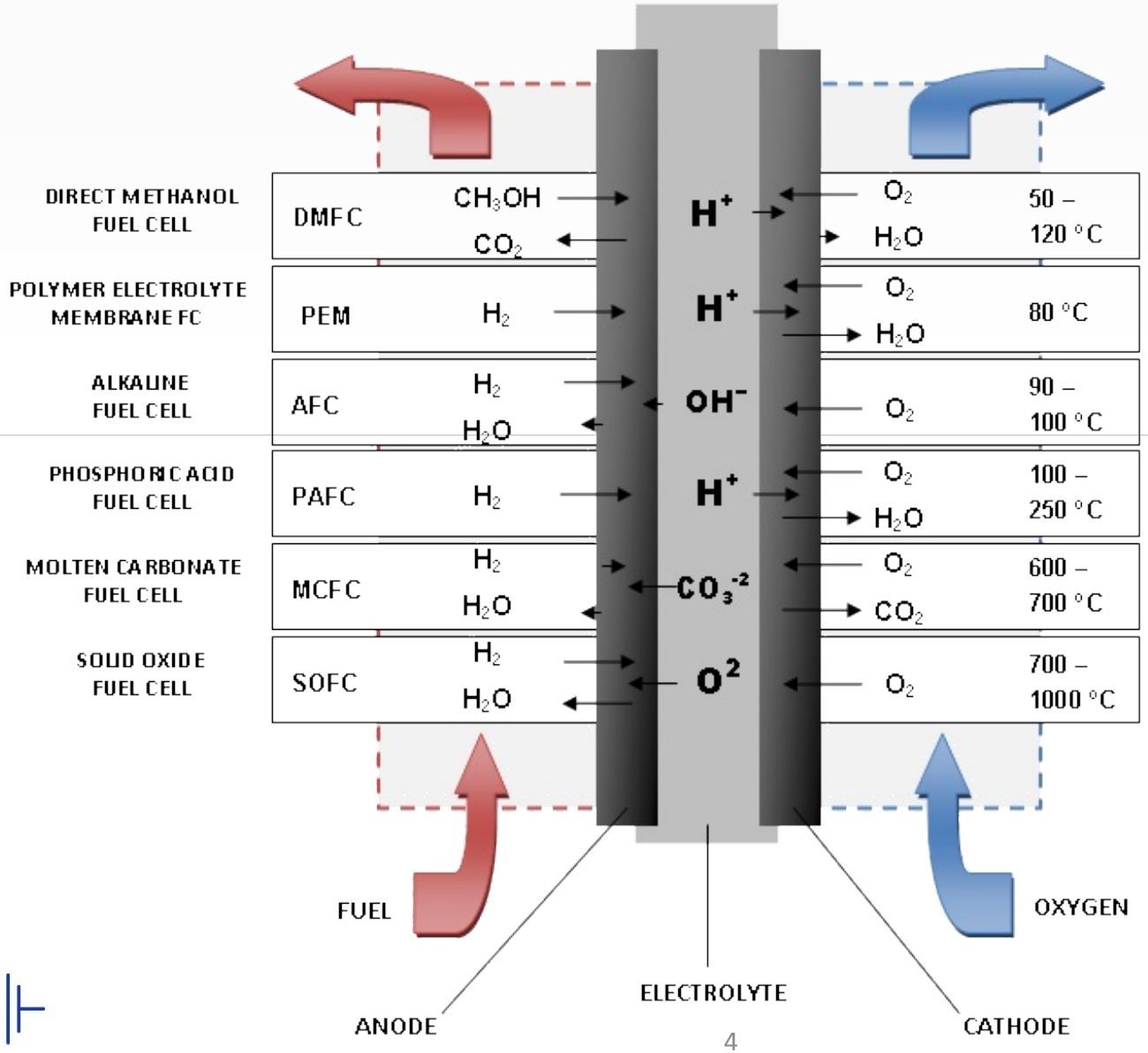
Fuel Cell Technologies



Advantages Methanol vs. Hydrogen

Hydrogen Fuel Cells

6 bottles of Hydrogen enables 33 hours of backup time at 1.5 kW

H_2 is volatile, requires high pressure or cryogenic storage in expensive and heavy to transport containers, and needs pressure reduced for fuel cell needs

Direct Methanol Fuel Cells

1 Drum of Methanol (200 liter) enables 200 hours of backup time at 1.5 kW

CH_3OH delivers efficient energy storage by volume, even compared with compressed H_2 at standard 150 bars

CH_3OH is a user friendly, easily transportable, non-explosive liquid and low cost for stationary or mobile storage

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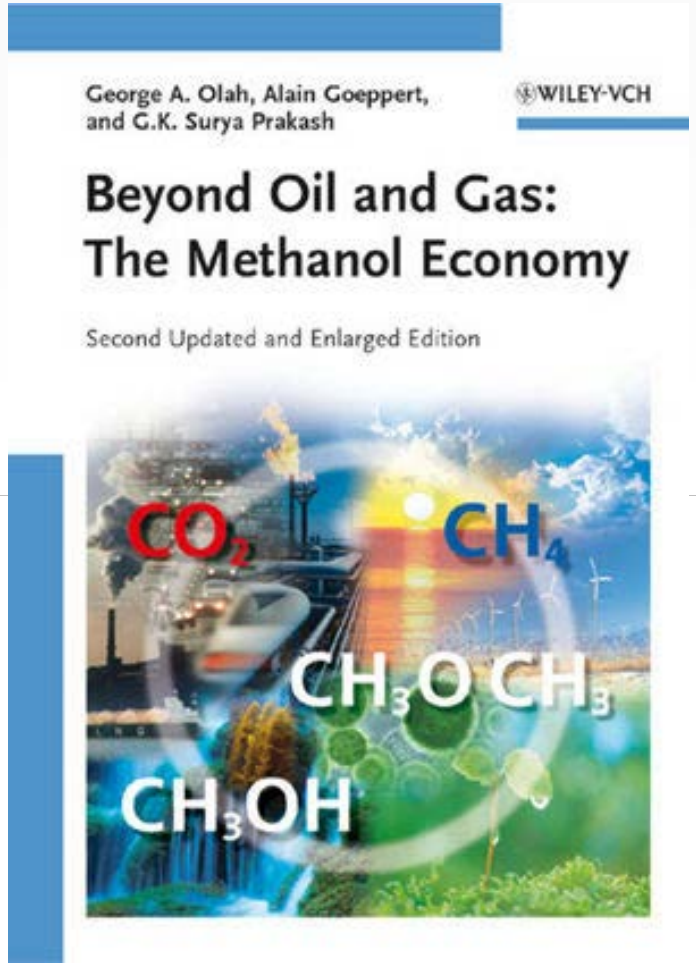
DMFC: Key Enabler of Methanol Economy



Methanol can be made sustainably from:

- Agricultural waste
- Animal waste; e.g. Smithfield Farms hog waste
- Construction waste – lumber, plywood
- Forestry and forestry products waste
- Municipal solid waste; e.g. Enerkem, Edmonton

40 million liters/year from urban garbage

Methanol is available globally used for cooking, heating, lighting, and transportation fuels

Oorja delivers methanol based electrical power for global health, education, economy

Provides enough power to supplement or supplant diesel gensets and batteries in target markets and applications

Miracle Energy on Hand

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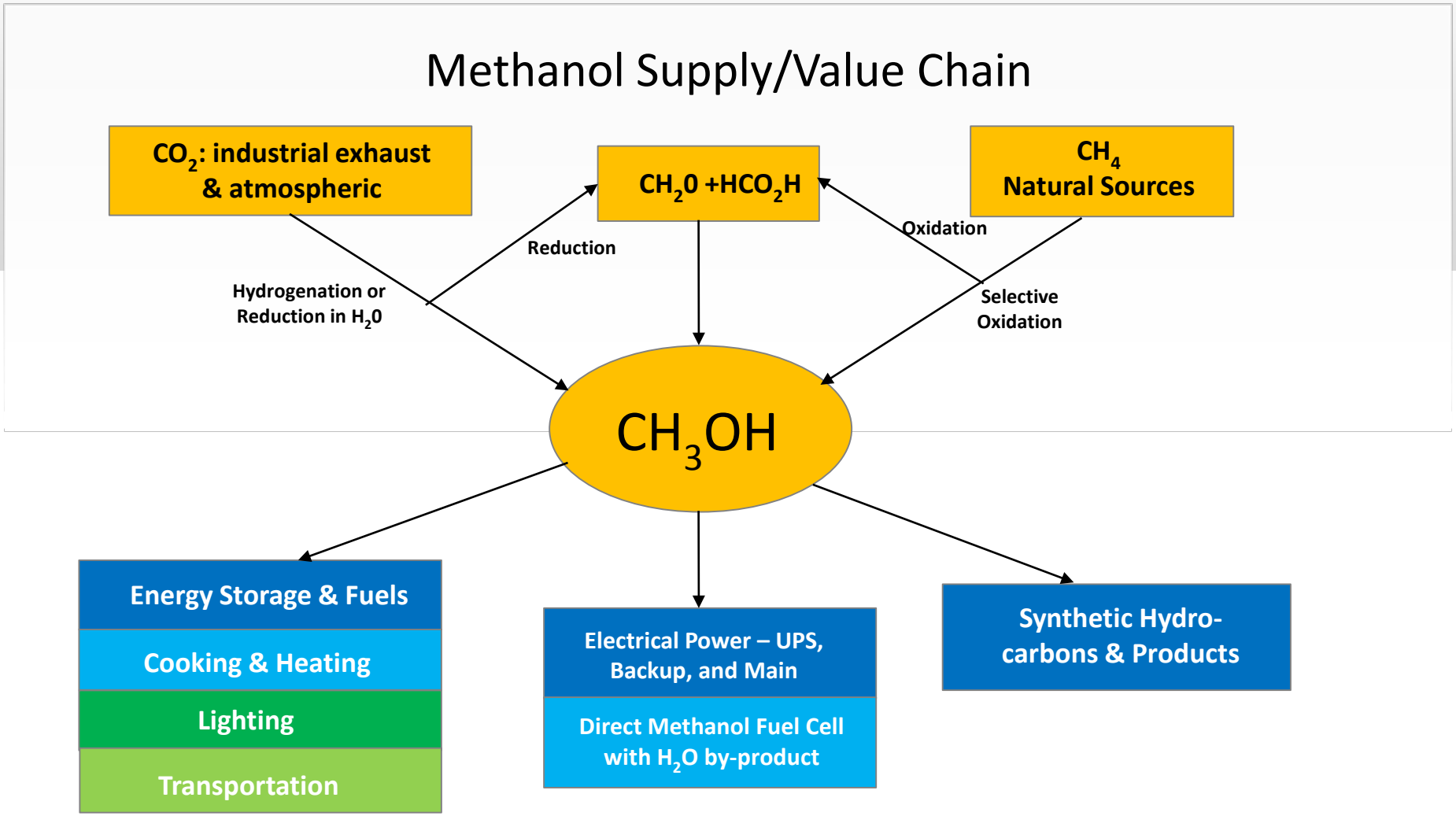

Methanol cooking and heating is especially important for replacement of inside burning of wood, charcoal, coal, etc. which cause serious health problems

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About Oorja

Scalable Direct Methanol Fuel Cells

- 2014 1.5 kW to 5 kW – highest performance DMFC today
- 2015 7.5 kW to 30 kW clusters for backup and remote power
- 2016 100 kW hybrid micro grid systems to MW grid scale systems

Markets 2014 – 2017

- Logistics, extending battery life in e-forklifts, pallet loaders, etc.
- Telecom base stations backup and remote power needs
- Refrigerated Trucks, back up power for other applications
- Nanogrids, Microgrids and Distributed Generation

Drivers 2014 – 2017

- 1 year ROI in 24/7/365 logistics applications versus extra batteries, charging stations, and need for battery replacement
- Methanol fuel cells deliver lower TCO/LCOE than diesel gensets or H2 Fuel Cells in off grid locations, e.g. Telecom base stations
- Growing methanol production from sustainable waste and CO2

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Oorja Products Address Large Global Markets

2015 – 2017 Target Markets

- Materials Handling Equipment (MHE) – Logistics
- Cell Tower Base Station Back Up Power
- Micro Grids and Distributed Energy Generation
- Emergency Power – Lights, Buildings, Shelter

2015 – 2017 Other Markets

- Refrigeration Trucks
- Remote Terminal Units (RTUs)
- High Power Distributed Energy Generation
- High Power Micro Grids

Product Market Road Map: 2015-2017

Product	Watts Power	Markets	Typical Applications
Model S	500	Rural Power	LED, Phone, Laptop
		Mobile Power	Camper, Car, Boat
		Mobile Power	RTU, Pipeline & Ag Pumping
Model III	**1,500**	**Battery Backup Power**	**Class III Forklifts, Pallet Loaders**
			UPS, Emergencies, Traffic Lights
Model IV	5,000–10,000	Battery Backup Power	Class I, Class II Forklifts
		Transport Power	Refrigeration Trucks
Model T	**1,500-9,000**	**Backup Power**	**Telecom Base Stations**
Model M	100,000	Micro-Grid	Remote, Local Power

***2015 products in green, others in design**

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Enabling Power

Model III

Model III on-board battery charger works with most Class III materials handling equipment. Other applications include power for refrigeration while trucks are loading and unloading to reduce noise and pollution.

- Battery Range Extension
- Improved productivity
- Reduced operating costs
- Increased Battery Life
- Increased performance
- No SOx and NOx pollution

Key Features:

- Only commercial direct methanol fuel cell (DMFC) for materials handling and refrigeration truck applications.
- Designed to fit on existing fork lifts and pallet loader vehicles
- Reduces TCO and LCOE for electrical vehicles
- Provides clean, environmentally friendly, quiet operation
- Operates in both indoors and outdoors
- Tolerates deep freezer, dust, rain and airborne particulates operating environments

Technical Highlights

Power	
Maximum Electrical Power	1.5 kW
Voltage Options	24V; 36V; 48V
Idle to Peak Power	10 minutes maximum
Refueling Time	Less than 1 minute
Physical Dimensions	30.5” x 12.75” x 13.5
Weight	170 Lbs (79 Kg)
Operating Temp	-20º C to 45º C
Internal Pressure	Less than 2 psi
Fuel Tank Capacity	12 Liters (run time 12-16 hours)
Ergonomics	
Ease-of-use	Push button operation
Internal Pressure	Less than 2 psi
Fuel	Methanol
Fuel Cell Design	DMFC (Direct Methanol Fuel Cell)
Cooling Method	Air Cooled
Form Factor	Mountable with mounting bracket
Interfaces	Dry contacts, LCD, SIM card, USB, Wireless

DMFCs Reduce High Infrastructure Costs for Powering Materials Handling Forklifts, Pallet Loaders, etc.

Battery Swapping Station

Rapid Charging Station

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Replacing APU's with Clean Quiet Power

Before

After

Backup Power for Telecom Base Station Sites

Replacing Diesel Generators with Direct Methanol Fuel Cells

Diesel Generators

- Maintenance intensive
- Fuel or device theft common
- Inefficient at low/intermittent power
- Noisy and noxious emissions
- High LCOE especially remote and rural sites

- Low maintenance
- No theft threat to fuel or device
- High efficiency keeping batteries at desired state of charge (SOC)
- Quiet with no noxious emissions
- Low LCOE with 1 year payback

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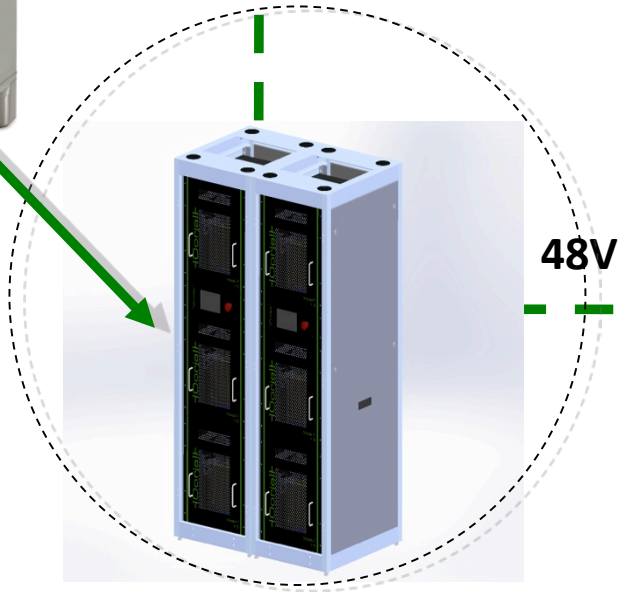
Reliable Operation for Remote Applications

AC Power

Oil and Gas Pipelines



48V DC

Telecom Tower

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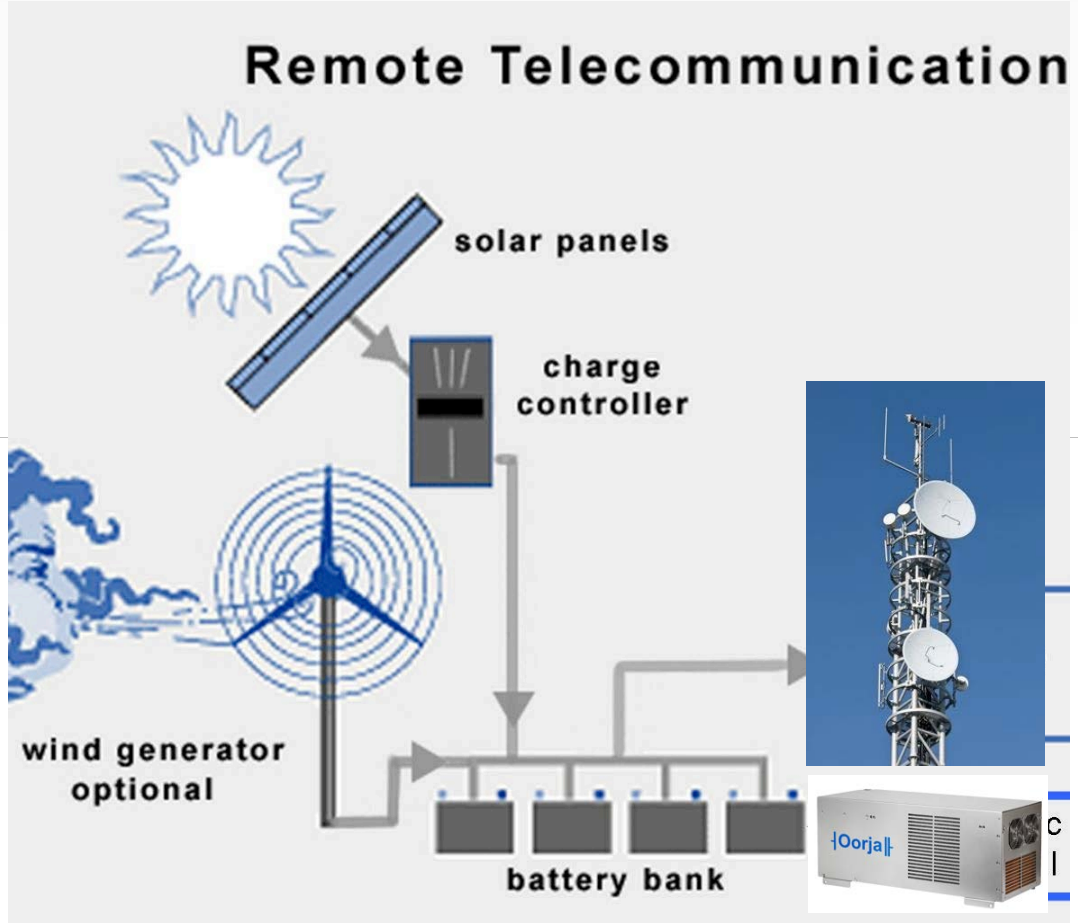
DMFC Micro Grids and Distributed Generation (DG)



- Microgrids are a large and rapidly growing global opportunity
- Power routers can deliver the least expensive green power as available, wind, solar, DMFC
- DMFC enhances energy security, reliability, and avoids transmission CAPEX and electricity line losses
- Market include rural and remote locations, campuses, military bases, science parks, new urban sustainable/green cities and more

85% of Rural Africa Has No Electricity

Demand

Resources

Capital

The World Bank

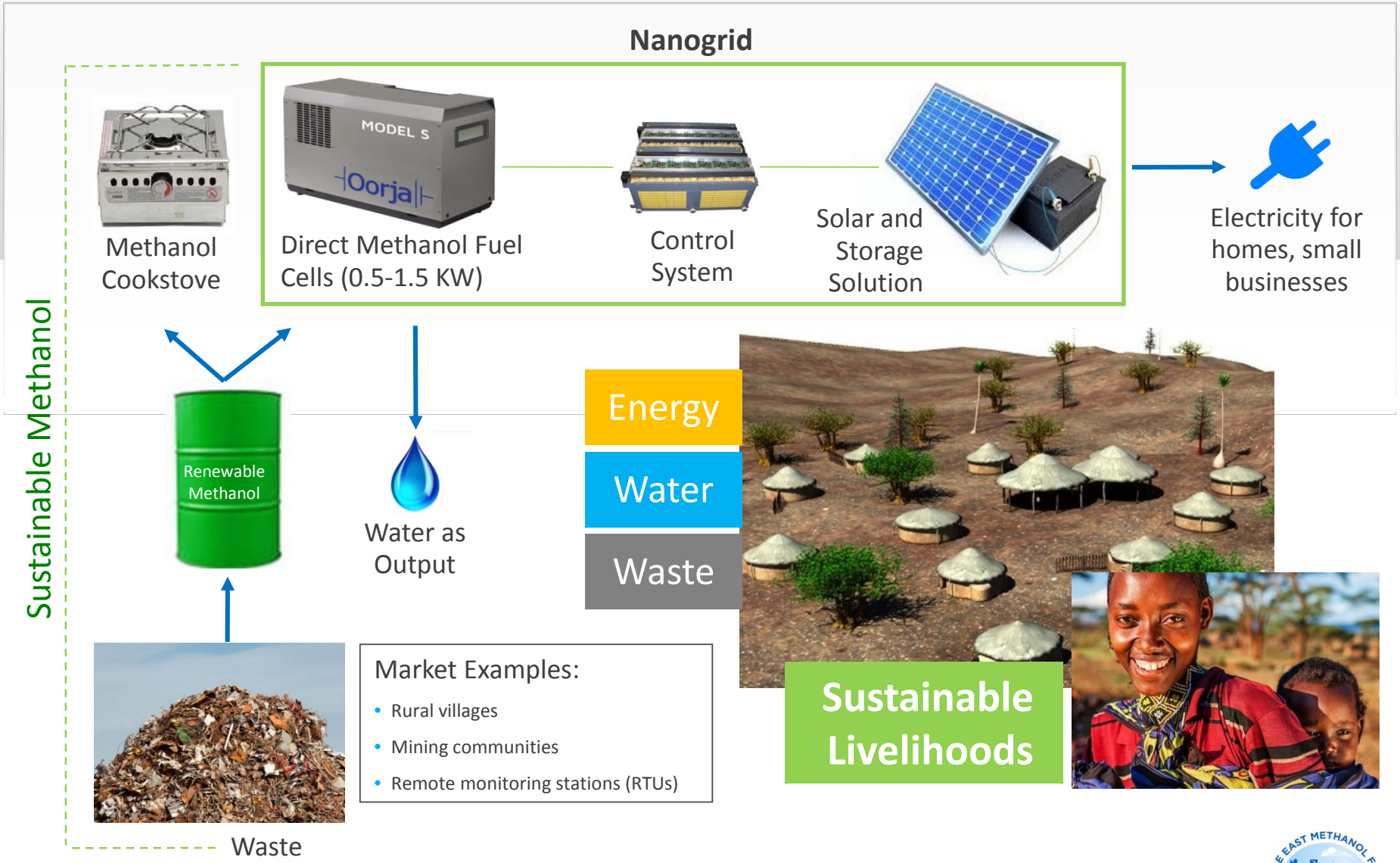
BILL & MELINDA GATES foundati

IFC

USTDA

United States Trade and Develop

Oorja Nano Grid Provides Clean, Reliable, & Renewable Power for Rural & Remote Communities



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Model M: 100 kW – 1 MW (2016 Engineering Release)

- Model M delivers 100 kW power with run time based on fuel supply
- Fuel consumption maximum 100 Liter/Hour in normal operation
- A typical 400 gallon/1,500 liter “Tote” fuel tank enables 15 hours run time
- A typical 100,000 gallon/375,000 liter rail tanker car enables 3,750 hours run time
- Power output of 480 Volts @ 60 Hz, 3 phase, either 3 or 4 wire
- Real time monitoring via wireless interface provided by Oorja and/or micro grid service operator
- Up to 10 units may be connected to deliver 1 MW

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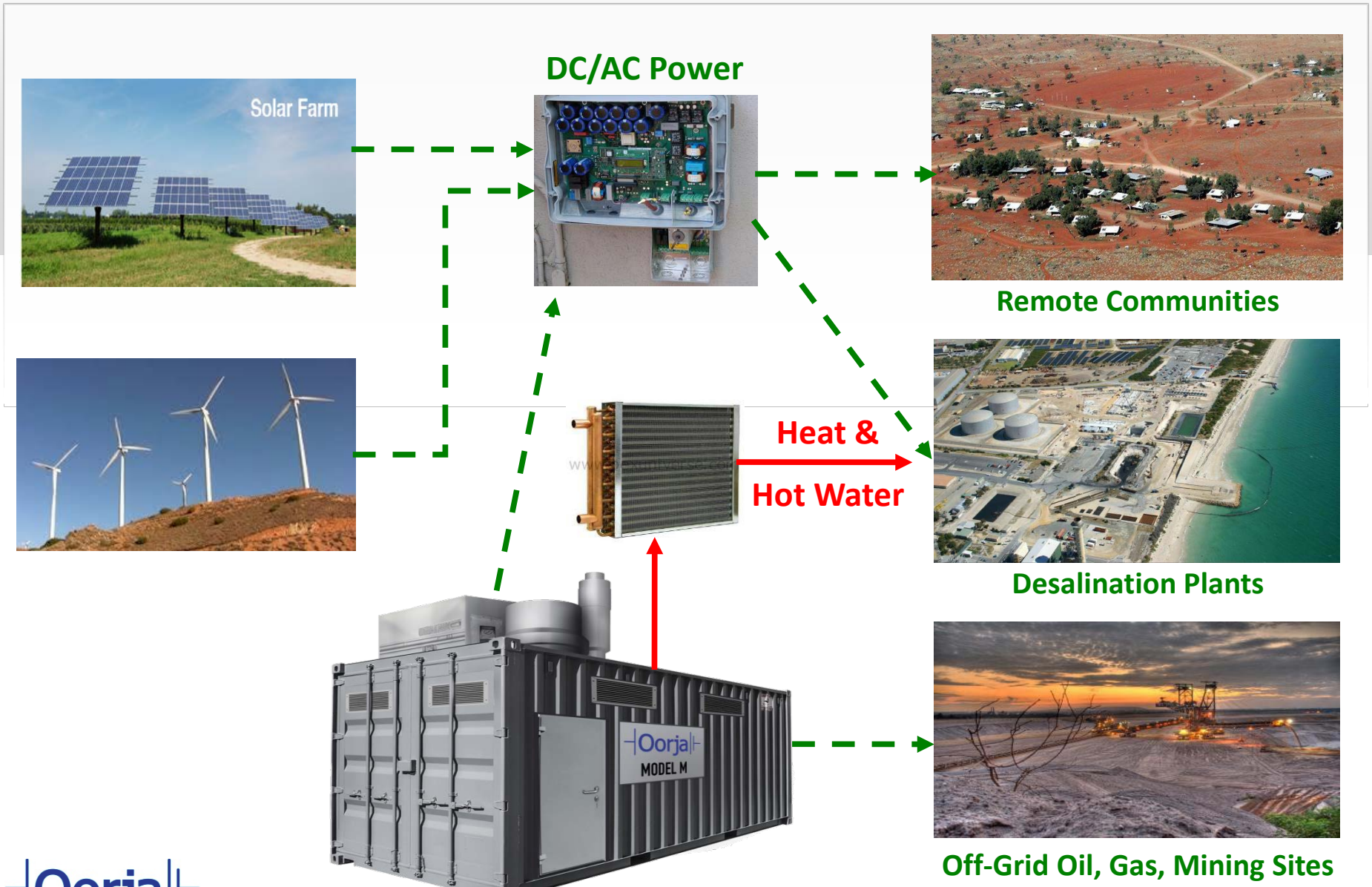
100 kW to Multiple MW Micro Grid Power



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Story of a 1 MW Methanol Power Plant in GCC

15% less carbon emissions than natural gas with no NOx or SOx

7,300 MT Annual Methanol Used

Methanol fuel cells provide a clean, 24/7 distributed power source to meet growing GCC electricity needs

Fuel is initially sourced from traditional feedstock such as natural gas, and transition over time to renewable production

8,200 MT Annual water production

Water output can be repurposed for use in the region

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Customers 2015

China	Microgrids and Telecom Base Station Power
Philippines	Telecom Base Station Power
Japan	Telecom Base Station Power Back Up Power • Emergency Shelters • Traffic Lights Materials Handling Equipment Refrigeration Trucks
U.S.	Materials Handling Equipment Power
Middle East	Hybrid Micro grid 18 kW Power Systems
South Africa	Telecom Base Station Power
Mexico	Telecom Base Station Power

TOYOTA TSUSHO

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Thank You

James H. Boettcher--Chairman of the Board

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