

Fuel Cell Systems as a Back-Up Power Alternative



Green Power For Mobile
Phnom Penh, Cambodia July 2012

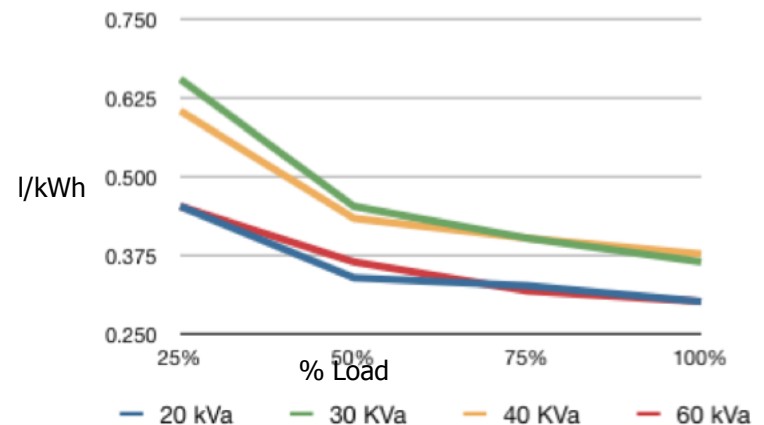


Principle Factors Affecting Site Uptime

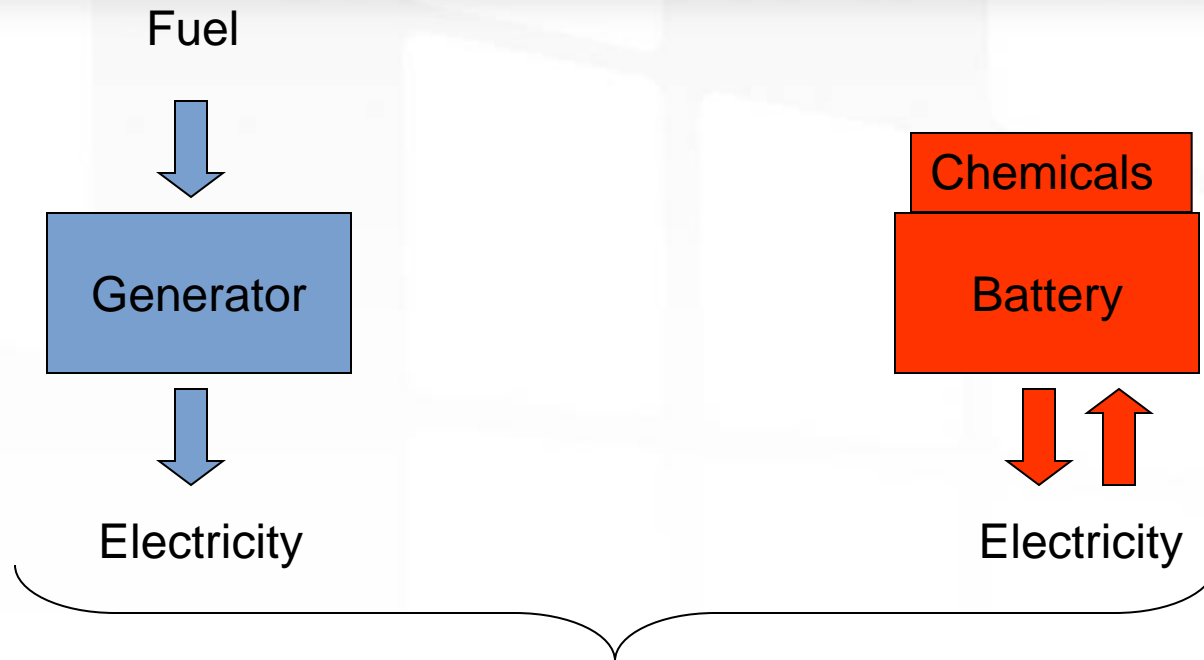
- **Power availability**
 - Mains availability is highly variable but is better closer to urban centers where the grid is more robust and demand is less variable
 - Grid supply is less reliable in some regions of South East Asia
 - Natural disasters affect power distribution and availability
 - Traditionally all sites have back up batteries so they can provide service during short mains outages of a few hours
 - Important sites will be equipped with standby generators or - if they are easily accessible - the facility to connect a mobile unit
- **Community issues:** theft...
- **Maintenance:** human error causes many site failures

On Site Power Generation

- Diesel generators are widely deployed to provide extended backup time on remote sites
- Most operators do not use gen sets < 10 kVa range for two reasons
 - Smaller units aren't designed for continuous duty
 - Over-dimensioning caters for surging loads (like air conditioners)
 - Big units are harder to steal
- The consequent over dimensioning results in big efficiency losses as diesel generators are most efficient at high loads
- Diesel generators are:
 - Heavy
 - Noisy and vibration
 - Polluting
 - *Prone to fuel theft*

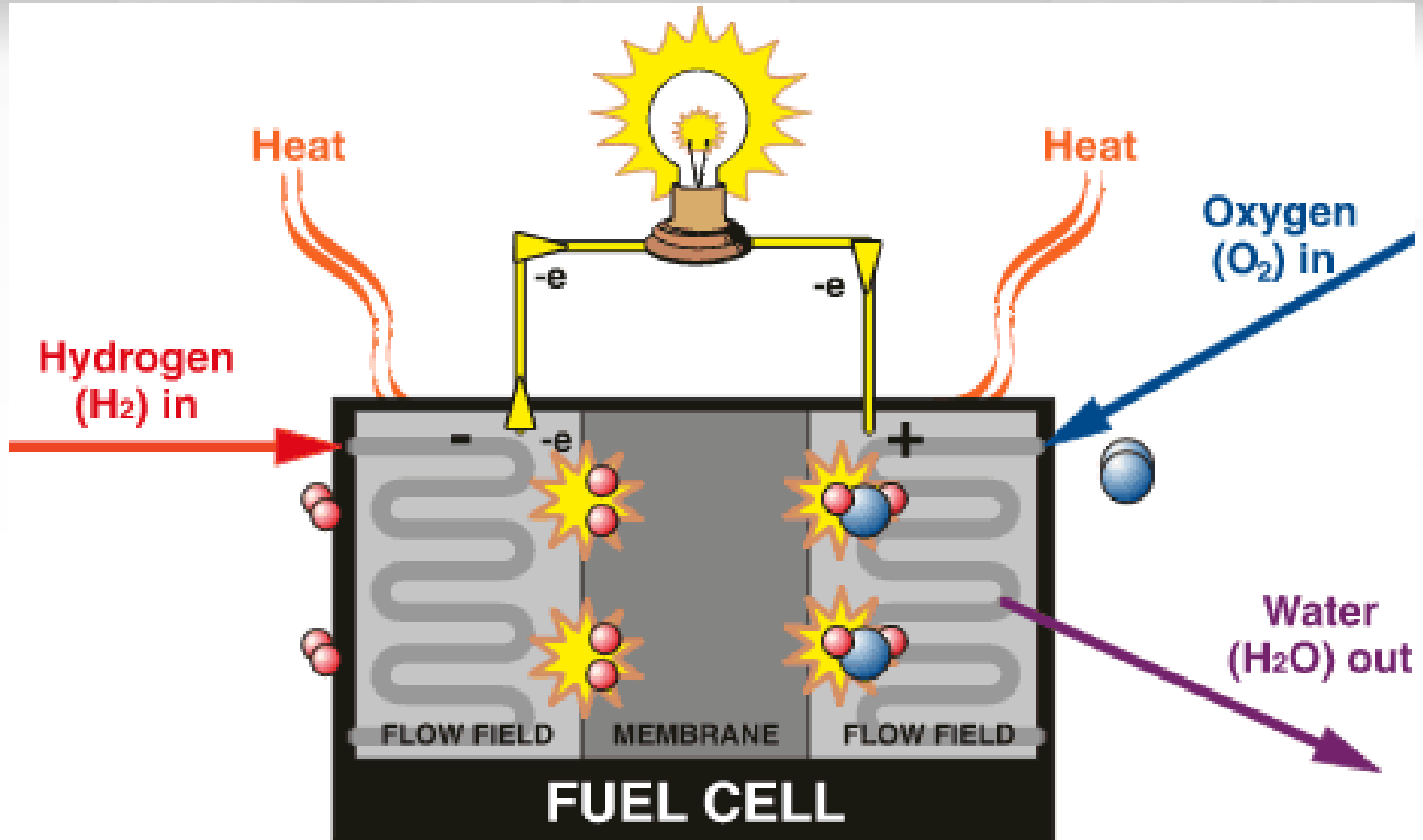


What is a fuel cell?



A fuel cell is an efficient and quiet DC generator which converts chemical energy directly into electricity.

Fuel Cell Technology



What fuel for fuel cell systems?

- PEM fuel cell systems require hydrogen gas to produce electricity
- Hydrogen could be supplied either from industrial hydrogen gas cylinders or generated on site as needed.
- A variety of hydrocarbons (methanol, LPG, natural gas...) could be converted into high purity hydrogen gas using reforming technology
- Today methanol fuel cell systems are commercially available



ElectraGen™ Hydrogen System



ElectraGen™ME Methanol System

What fuel for fuel cell systems?

- PEM fuel cell systems require air and **hydrogen gas** to produce electricity
- Hydrogen could be supplied either from industrial hydrogen gas cylinders or generated on site.
- A variety of hydrocarbons (methanol, LPG, natural gas...) could be converted into high purity hydrogen gas using **reforming** technology
 - C_xH_y or $C_xH_yO \Rightarrow H_2 + CO_2$
- Hydrogen can be produced from water and electricity via **electrolysis**
 - $H_2O + \text{electricity} \Rightarrow H_2 + O_2$

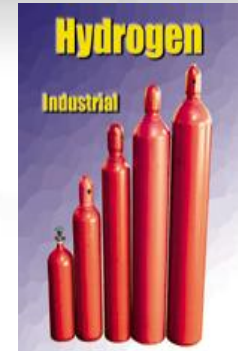
Hydrogen for fuel cell systems



PEM stack

← Hydrogen gas

Industrial gas cylinder
(H_2 storage)



Methanol reformer
LPG reformer
(*On site production on demand*)



Electrolyser
(*On site production + storage*)



Fuel Cell System Value Proposition

Value proposition

- Clean, high efficient, reliable, quiet, easy to site and extended run backup

Competition

- Incumbent backup power technology: generators and batteries

Advantages over incumbent technologies

- Lower lifecycle costs
 - Higher reliability = lower repair costs = improved availability
 - Fewer moving parts = lower maintenance costs
 - Less thefts
- Lower environmental impact (low emission, noise, vibration)
- Operates from -40C to +46C
- Light & compact
- High efficiency and Load following = reduced fuel consumption



Use cases with strong value proposition

- Geographies with poorer grid reliability (100 to 1,000 hours annual grid loss)

Fuel Cell System Value Proposition

How to reduce size of battery bank and, therefore, the cooling load?

Implement Fuel Cell System

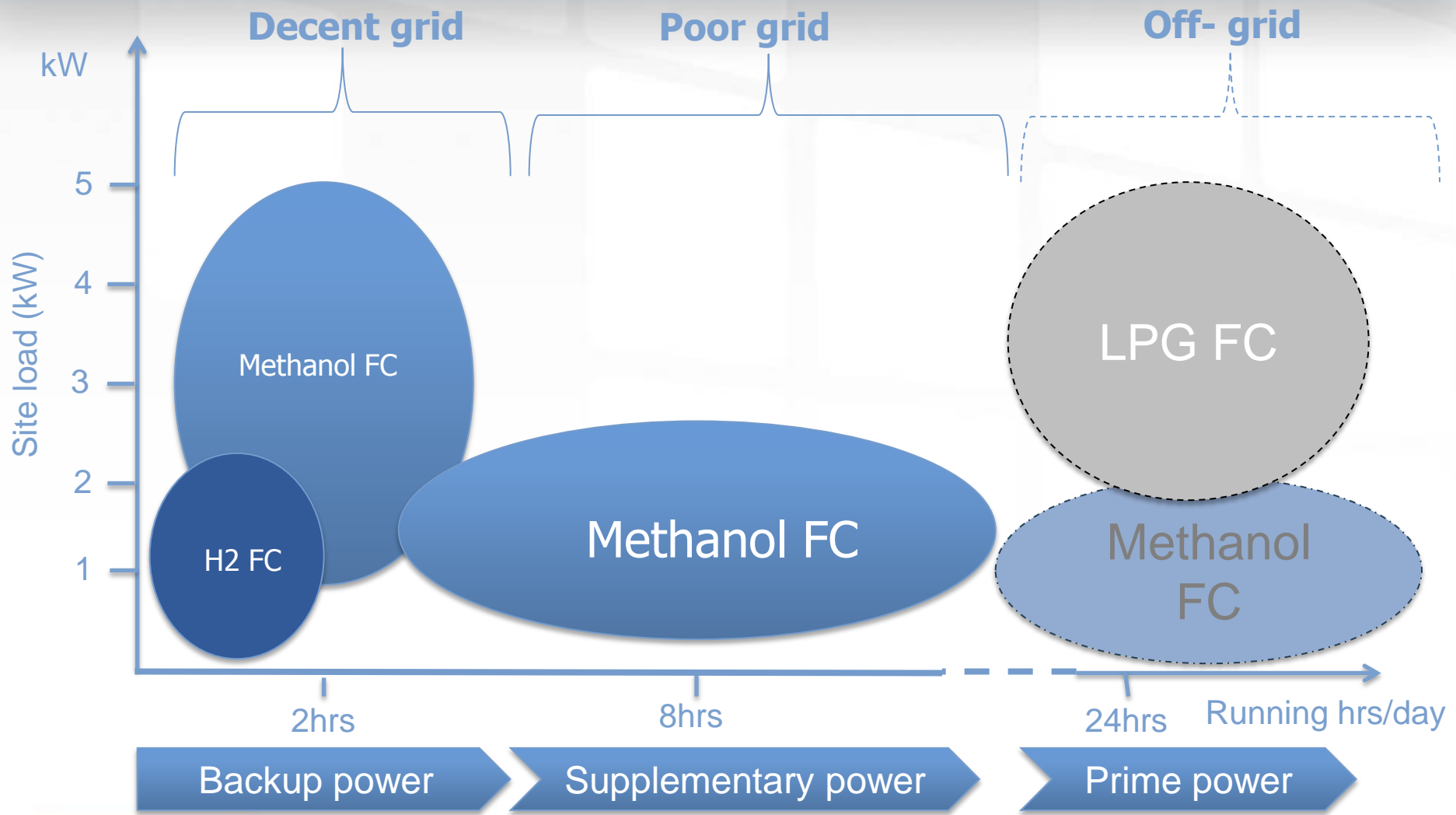
Fuel Cell System:

- Output power designed specifically for telecom sites.
- Efficiently follows the load – no need for large battery banks for cycle charging.
- Starts quickly: fuel cell only needs small battery for start up.
- Enables Free Cooling & DC Cooling solutions
- Small battery enables possibility to use advanced battery technologies which require no cooling
- Long run (several days)



Large battery bank no longer needed, therefore cooling requirement is dramatically reduced.

Applications for Fuel Cell systems



IdaTech Corporate Overview

IdaTech designs and manufactures extended run backup power fuel cell products for telecommunications and other critical applications.



HQ and R&D (USA)



Factory Mexico
Capacity: 5000 units/year



- Founded in 1996 in Bend, Oregon USA
- ISO 9001 certified (HQ and factory)
- 100+ employees
- + 1000 systems deployed worldwide on Telecom sites
- Sales and Service Centers in Germany; South Africa, Malaysia and Mexico

Commercially proven Products

ElectraGen™ H2



ElectraGen™ ME



Fuel:	Hydrogen	HydroPlus™ (Methanol-Water)
Power:	2.5kw or 5kw	2.5kw or 5kw
Voltage:	48 VDC	24 or 48 VDC
Benefits:	Efficient, reliable, quiet & zero emissions	Efficient, reliable, quiet & zero emissions
Application:	Back-up power for telecom	Back-up power for telecom (primary power under development)
Commercial Availability:	Shipping commercially since 2008 Planned to be discontinued as standard product 2012	Shipping commercially since 2010

Commercially proven Products

ReliOn
+ -



alteryg
systems



Dantherm
Power



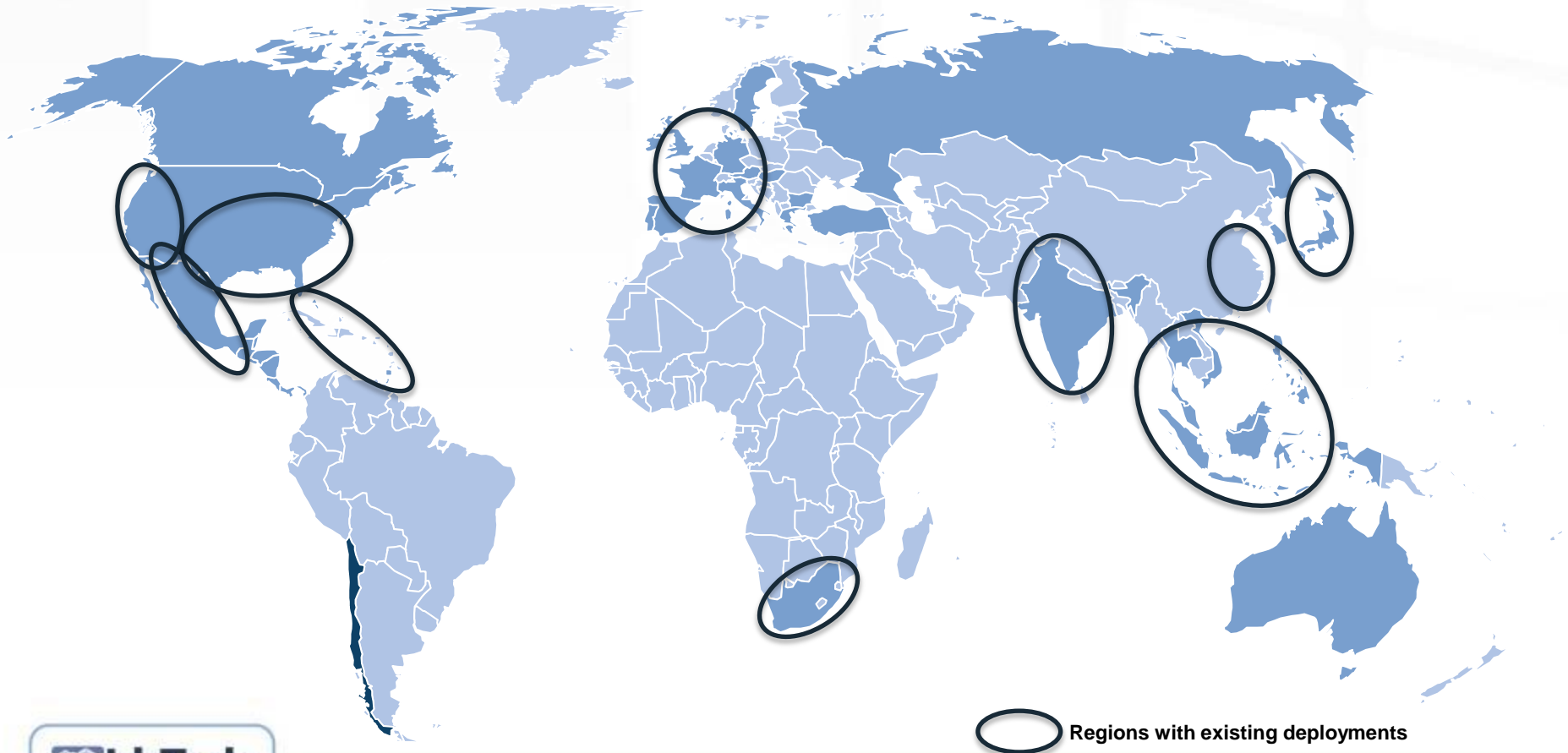
electro
power systems



IdaTech
Power For The Long Run

Fuel Cell System Deployments (Telecom)

Around 3,000+ Systems active on Telecom sites



IdaTech Telecom installations



NTT docomo (Japan)



(South Africa)



telcel (Mexico)



TSTT (Trinidad)



T-Mobile (USA)



(Chile)



IdaTech installations in South East Asia



**5.0 kW
ElectraGen™ ME
(Indonesia)**



**5.0 kW
ElectraGen™ ME
Hub (Indonesia)**



**2.5 kW
ElectraGen™ ME
Hub (Indonesia)**



**ElectraGen™ ME
(Indonesia)**

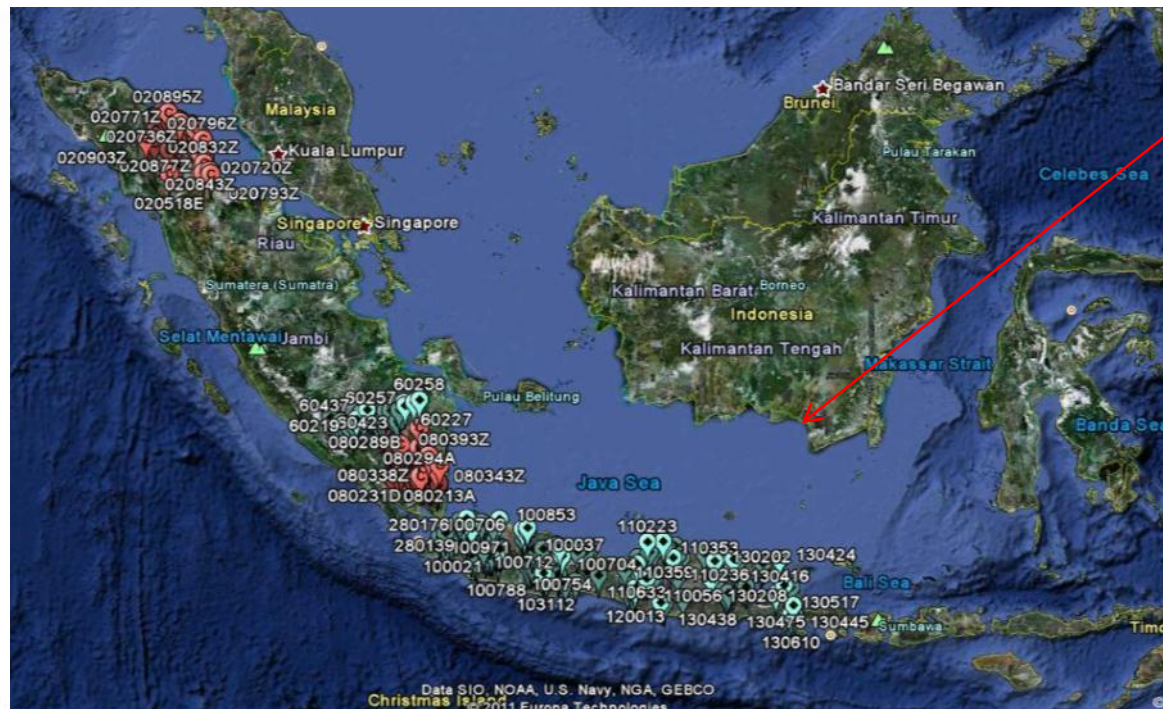


**ElectraGen™ ME
(Indonesia)**



Fuel Cell deployments in Indonesia

- More than 500 fuel cell systems now in operation at Telecom sites
- Additional 250-350 to be installed by the end of 2012
- Commercial deployment with 2 operators
- Field test with 4 other operators => initial deployment (2012)
- Hydrogen & methanol fuel
- Green field sites and rooftop sites (Jakarta)



Fuel Cell deployments in Indonesia

Rooftop Installation in Indonesia



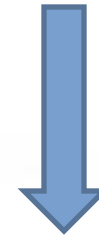
Indonesia HCPT Deployment



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Challenge:

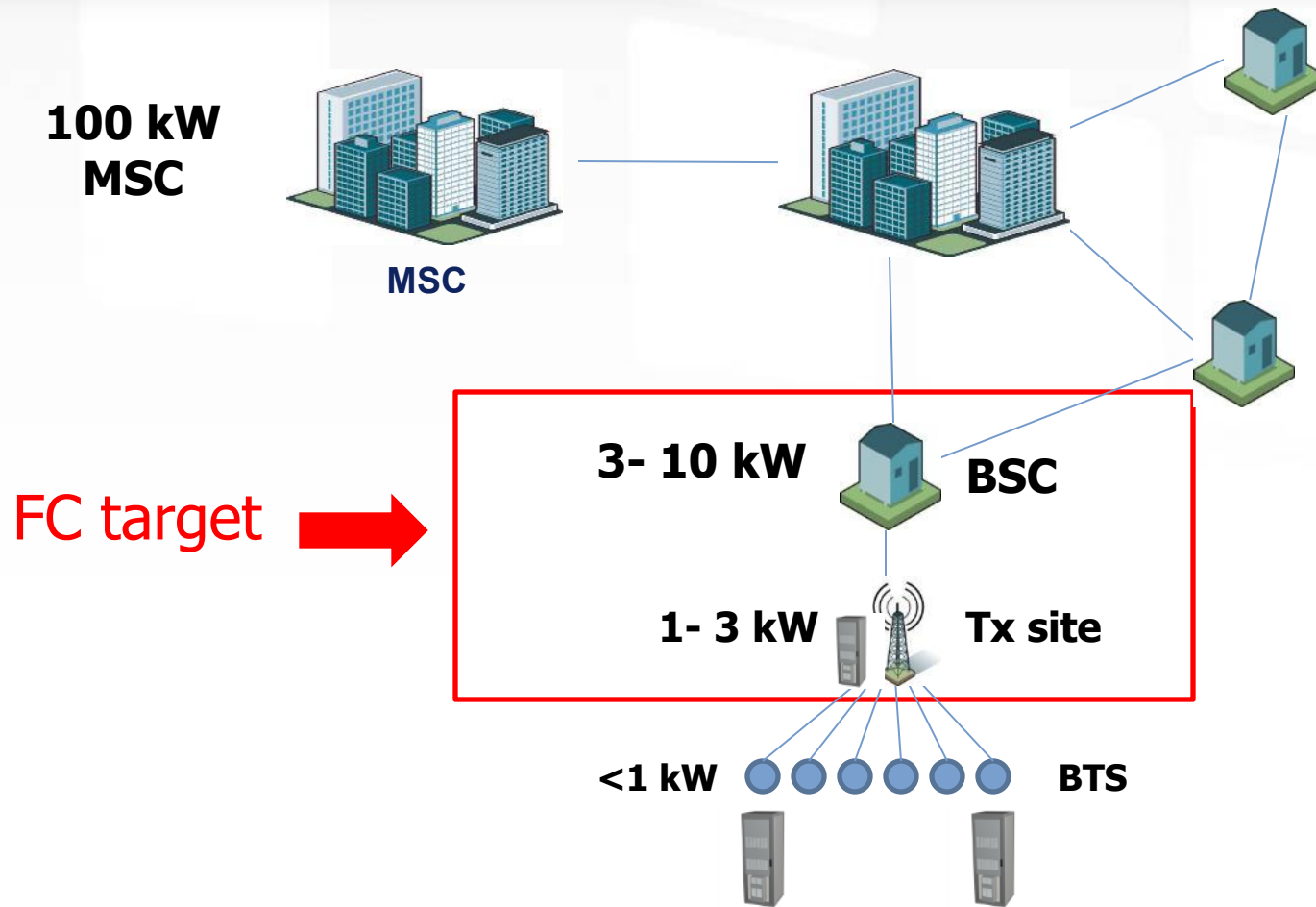
- Poor grid quality (several hrs/week)
- Outdoor BTS (no air conditioner for batteries)
- Diesel & battery theft issues
- Local community issues (generator noise)



Solution:

- 500 fuel cell systems being deployed
- Location: Sumatra and Java
- Load (average): 1-3kW @48Vdc
- Product: 2.5 kW Fuel cell system
- Fuel: Hydrogen gas
- Site autonomy: 6 cylinders (42hrs)

Telecom Network Opportunity



Business Case => Transmission hubs

2 attractive typical sites for fuel cell backup systems:



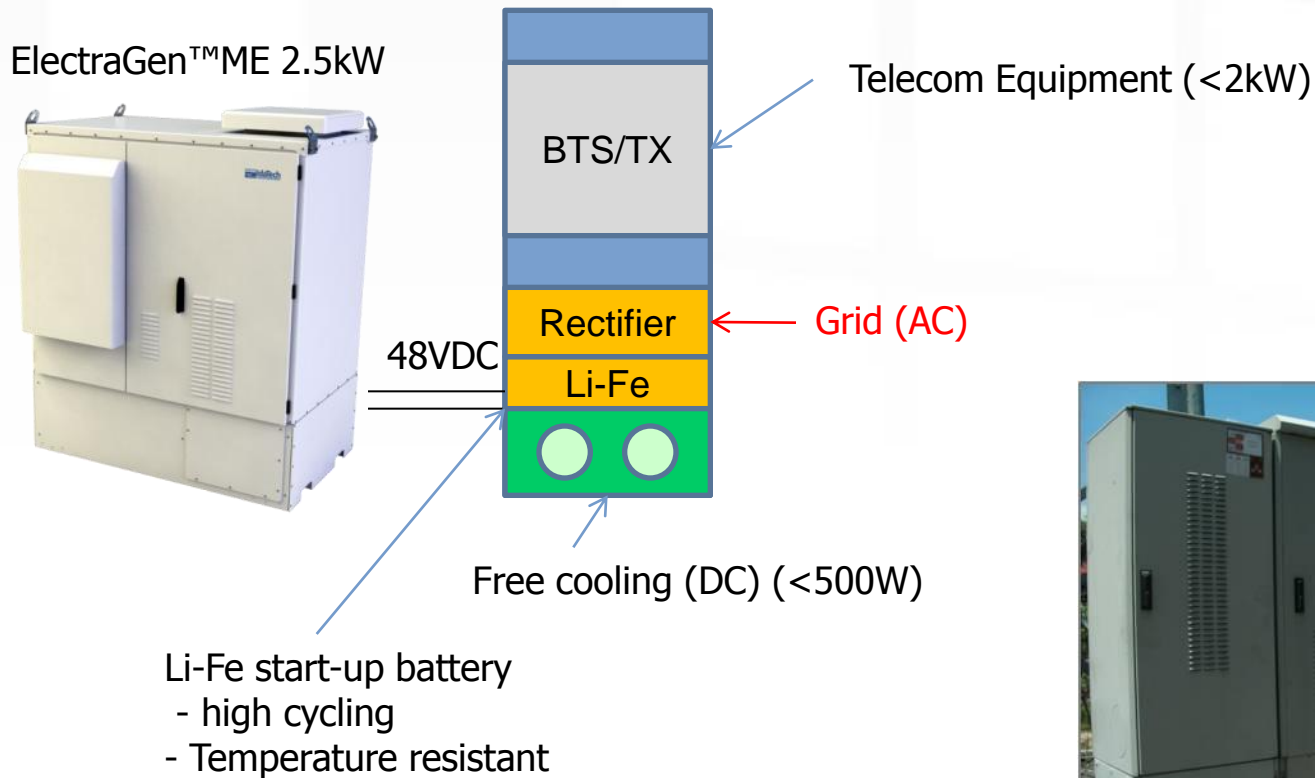
Urban site (high revenue site)
(rooftops...)
DC power: 50A - 100A
Battery back-up: 500AH-1000AH
Not possible to install Genset
Air-con units (2-4KVA)



Poor-grid site (hub, Tx site)
(small shelter/outdoor BTS)
DC power 30 – 80 A
Battery back-up: 200AH-500AH
Genset (15kVA-25KVA)
Air-con units (2-4KVA)

Optimized design for green field sites

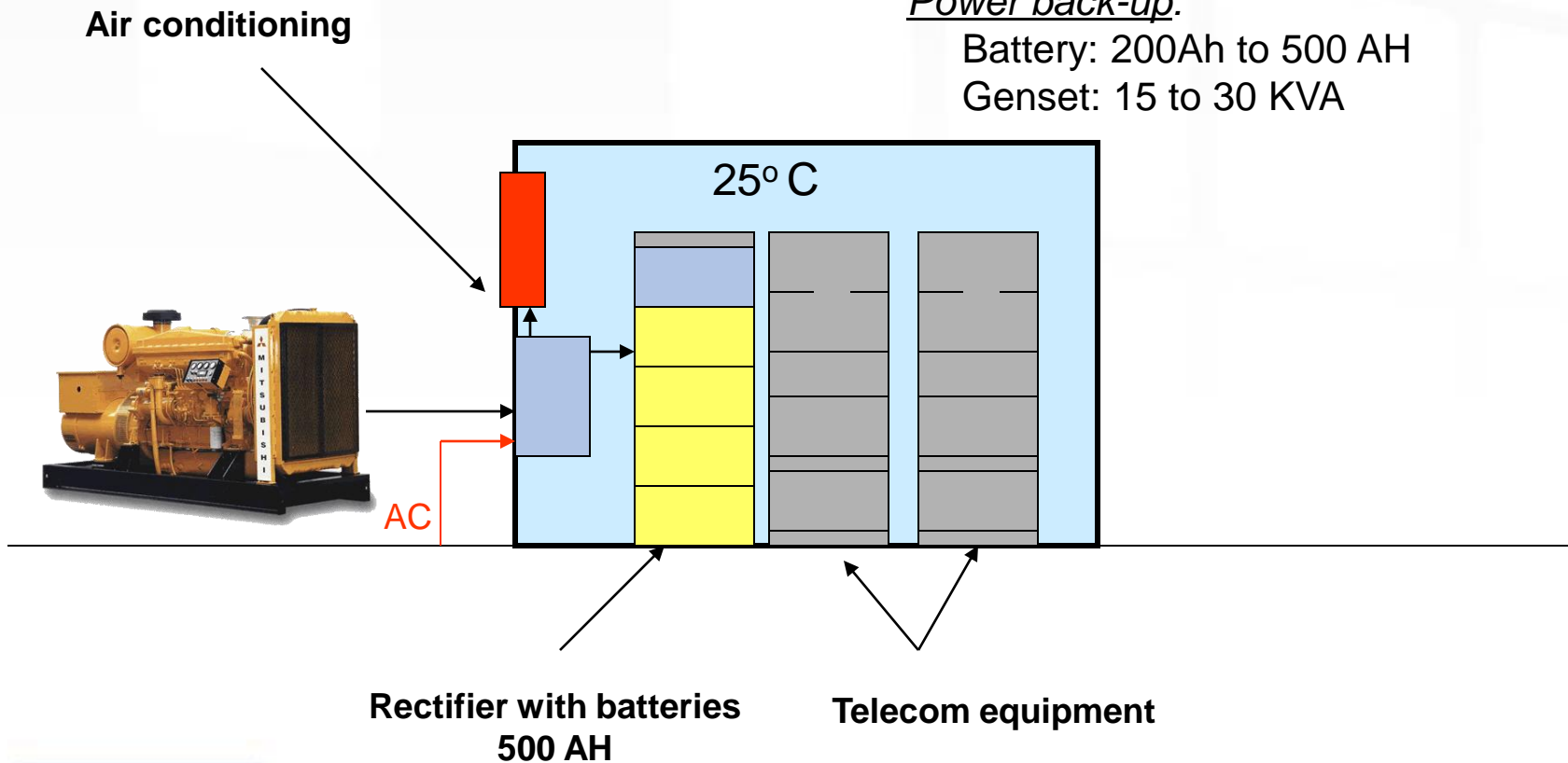
Outdoor BTS



Typical Telecom shelter site

Site Power consumption: 6-8 kVA
Telecom Equipment (DC): 20 to 60A
Other equipment: (lights/modems): < 1 KVA
Air conditioning (AC): 2-4 KVA
Power back-up:

Battery: 200Ah to 500 AH
Genset: 15 to 30 KVA



Fuel Cell Telecom shelter site

Site Power consumption: < 5 kW

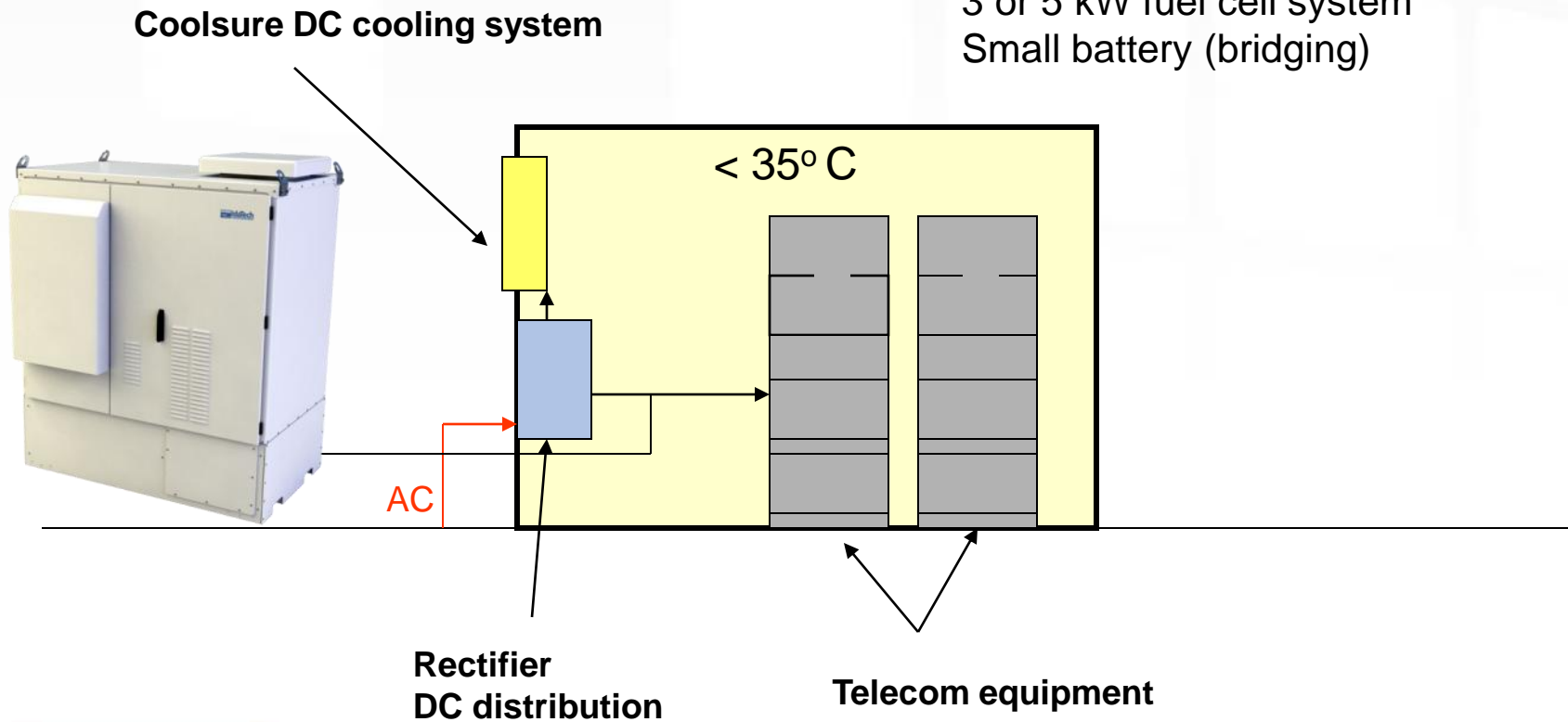
Telecom Equipment (DC): 3 kW

DC air cooling: 1.5 kW

Power back-up:

3 or 5 kW fuel cell system

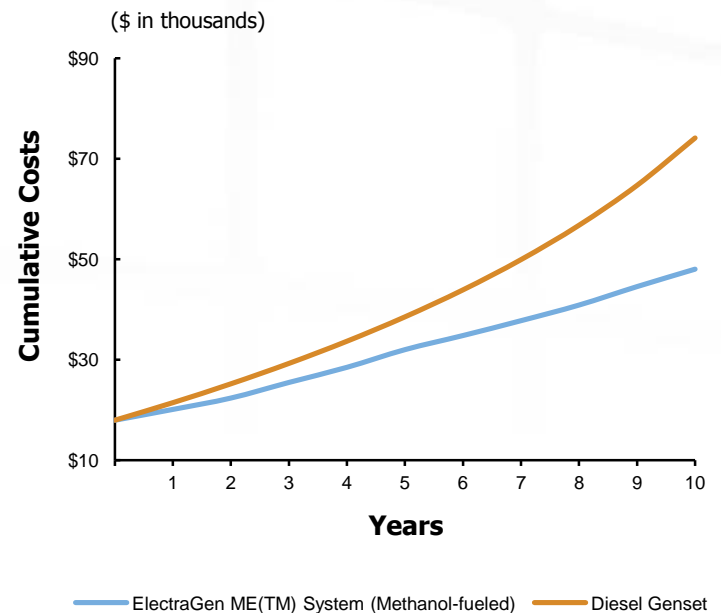
Small battery (bridging)



TCO Analysis

- Up to 20% more efficient
- Cleaner / more environmentally friendly
 - 20% to 50% reduction in CO2
 - > 95% reduction in CO, NOx and Sox
 - Zero particulate matter
- Reduced operating cost
 - Not subject to diesel fuel pilferage
 - Require less repair and maintenance
- More reliable
 - Able to cycle on and off multiple times
 - Run for longer periods of times
- Less noisy and vibrate less during operation
- Renewable Fuels (renewables tax credit)

Total Cost of Ownership Comparison: Diesel Generator & Battery vs IdaTech Fuel Cell



**Strongest value proposition:
Geographies with poorer grid reliability (100-1,000 hours of annual grid loss)**

Operating Cost Reduction

- Fuel Cell = a low maintenance DC generator to replace large batteries & genset
 - saving on battery replacement cost
 - saving on generator maintenance and thefts
 - saving on ATS and genset protection (noise, housing..)
- Reduction of rectifier capacity and redundancy level
- Electrical consumption saving
 - cooling is a very significant part of site power consumption
 - no large battery bank = no need to keep shelter/BTS at 22 C
 - possibility to use DC cooling solutions
- Outdoor installation = more space for revenue generating equipment in shelter
- Higher availability = more revenue per site

Up to 30% in power consumption saving

Fuel theft reduction

- Diesel theft is a major issue for operators in SEA
 - => key driver for some of the Indonesian operators to switch to fuel cell
- Up to 30% of the diesel is stolen (transport, dilution, @ site...)
- Price of diesel is going up in many countries (Indonesia)

- Hydrogen and methanol/water mix have no retail value
- No fuel theft out of the 300+ sites installed in Indonesia for that past 2 years

Other less tangible advantages

- Green power solution: low emission and low noise
- Government incentives and PR opportunities
- Better relationship with local communities
- Less space requirement
- Improved site availability (more revenue per site)



Indonesian ICT Minister visit at HCPT site



Summary

Fuel Cell System	Benefits
Only a small battery for start up of the fuel cell system is required.	Reduced cooling requirement.
Fuel Cell is a DC Generator.	Replace traditional VAC (alternating current) aircon units with DC cooling solution and reduce site power consumption.
Possibility to use lithium batteries.	Eliminate battery air conditioning system entirely. Extended lifetime battery – thousands of cycles possible.
Designed for telecom application with load following and efficient operation over power range.	Efficient operation and lower OPEX. Reduced rectifiers since power surge from AC generator is eliminated.
No market for the fuel, and fuel cell system only works for telecom applications.	Not an object of theft - reduced OPEX.
Light weight, low vibration, low emissions; reduced foot print	Easy to site on roof tops, near residences and businesses, environmentally friendly.
Long autonomy (liquid fuel)	Several days of back-up power

Thank you 
www.idatech.com