ESTABLISHING COMMERCIAL FUEL CELL NETWORK

A CASCADIANT EXPERIENCE

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Wuhan University of Technology CHINA

Establishing Commercial Fuel Cell Network

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Cascadiant Company Profile

- Headquartered in Singapore and founded in 2010, Cascadiant is a green energy solutions integrator (SI) and managed energy service provider with project offices (Australia, Indonesia, Pakistan, Myanmar and Vietnam)
- Our corporate mission is to provide turnkey, highly reliable green power and clean energy solutions. By integrating the very latest in green technologies Cascadiant reduces an operator's carbon footprint as well as immediately lowers overall operating costs associated with power
- Cascadiant has implemented and manages more stationary fuel cell sites than any other company
- Commercial projects in 6 countries: Indonesia, Australia, Vietnam, Israel, Pakistan, and Nigeria

2010 BUSINESS ACHIEVEMENT AWARD WINNER

RED HERRING 100 WINNER ASIA

businessGreen leaders awards 2011

Top Channel Partner IdaTech 2011

RED HERRING WINNER 100 GLOBAL

2012 BALLARD Partner of the Year

PROJECT EverGreen Because Green Matters

2013 BALLARD Partner of the Year

We're Told The Paradigm Finally Shifted

- "Clean energy technologies have arrived"
- "Electric drive train vehicles will see mass adoption"
- The "smart-grid" will allow for integration of a wide range of new clean and green technologies

- "Electric and hydrogen mobility is on the next and near horizon"
- "Peak oil is here and oil consumption will start to decline

Vision

"WE MUST SHOW THE WORLD IT IS POSSIBLE TO CURE THE GLOBAL ECONOMY AND SAVE THE PLANET AT THE SAME TIME"

"WE NEED ALL CLEAN ENERGY OPTIONS TO MEET ECONOMIC, ENVIRONMENTAL, NATIONAL AND ENERGY SECURITY NEEDS"

G-20 Leaders Summit
25th September 2009, Pittsburgh, PA, USA

Oversold, Overpromised, Under Delivered

"What you do speaks so loudly that I cannot hear your words"

Ralph Waldo Emerson

"Get your facts first, then you can distort them as you please"

"It's easier to fool people than to convince them that they have been fooled"

Mark Twain

"Just because I don't care doesn't mean I don't understand"

Homer Simpson

Operator Power Challenges

TELCO Snapshot - Global and Significant Problem

- Global communications sector emissions are expected to triple from 0.50 billion tons CO_2 in 2002 to over 1.5 billion tons CO_2 by 2020 and growing to more than 5% of the world's total emissions from human activity
- Each back-up generator running 40 hours a month equals over 1 car's CO_2 and each off grid site using generators emits the CO_2 of more than 20 cars
- Replacing the 1,000,000 off grid sites using generators added in just the last 3 years with the green alternatives would be equivalent to:
  - Taking over 20 million cars off the road
  - Planting over 100 million acres of trees
  - Abating more than 100 million tons of CO_2
- ASEAN and ME/A spend over $3B deploying lead acid batteries each year
  - UNICEF 2010 report attributed lead contaminated water the single largest contributor to stunted cognitive development in Asian children
  - Improper disposal of VRLA batteries sighted as a significant contributor
  - Improper safety precautions in the lead recycling process reduces a worker's life expectancy by 9 to 12 years
- Operators using ozone depleting AC comfort air conditioners consume an average 40% more energy than needed to cool indoor sites resulting in excess power being consumed, greater grid demand and a larger carbon footprint

Indonesia Mobile Telecom Operators Power Challenges

Indonesian telecom operators have deployed over 130,000 cell sites to provide cellular coverage to approximately 225M customers with over 350M subscriptions – nearly 130% penetration

Indonesian power grid is unreliable resulting in required backup generators at over 15% of all sites – currently there are ~16,000 diesel generators deployed for back-up and an additional 7,000 for off-grid sites

Diesel gensets are deployed at sites that are either "critical" hub sites or high revenue sites with very unreliable or no grid connection

Expansion of data/fiber networks driving requirement for greater back-up power generation to support increased reliability demands

Mobile telecom network expansions will continue in coming years

- 40,000 new sites across all telecom operators over next 24 months
- Continued deployment of 3G and increased deployment of 4G LTE
- Improved network quality and availability demands
- Increased requirement for backup generation when PLN grid connection fails

Operator Energy Challenges

- Unpredictable Costs
  - Fuel
  - Resources
  - Travel
  - Spares
- Unstable Availability
  - Genset SLA Far Below Equipment SLA Causing Significant Decrease In Network SLA
  - Impacted By Factors Outside Operator Control
  - Grid Outages Becoming Worse As Electricity Demand Continues to Grow
- Additional Repair Costs
  - GenSet Overhaul
  - Stolen Parts
  - Fouled Systems Due to Tainted Fuel
- Fuel Supply
  - Theft Throughout Ecosystem
  - Local Community Issues

Revenue Loss Due to Low SLA

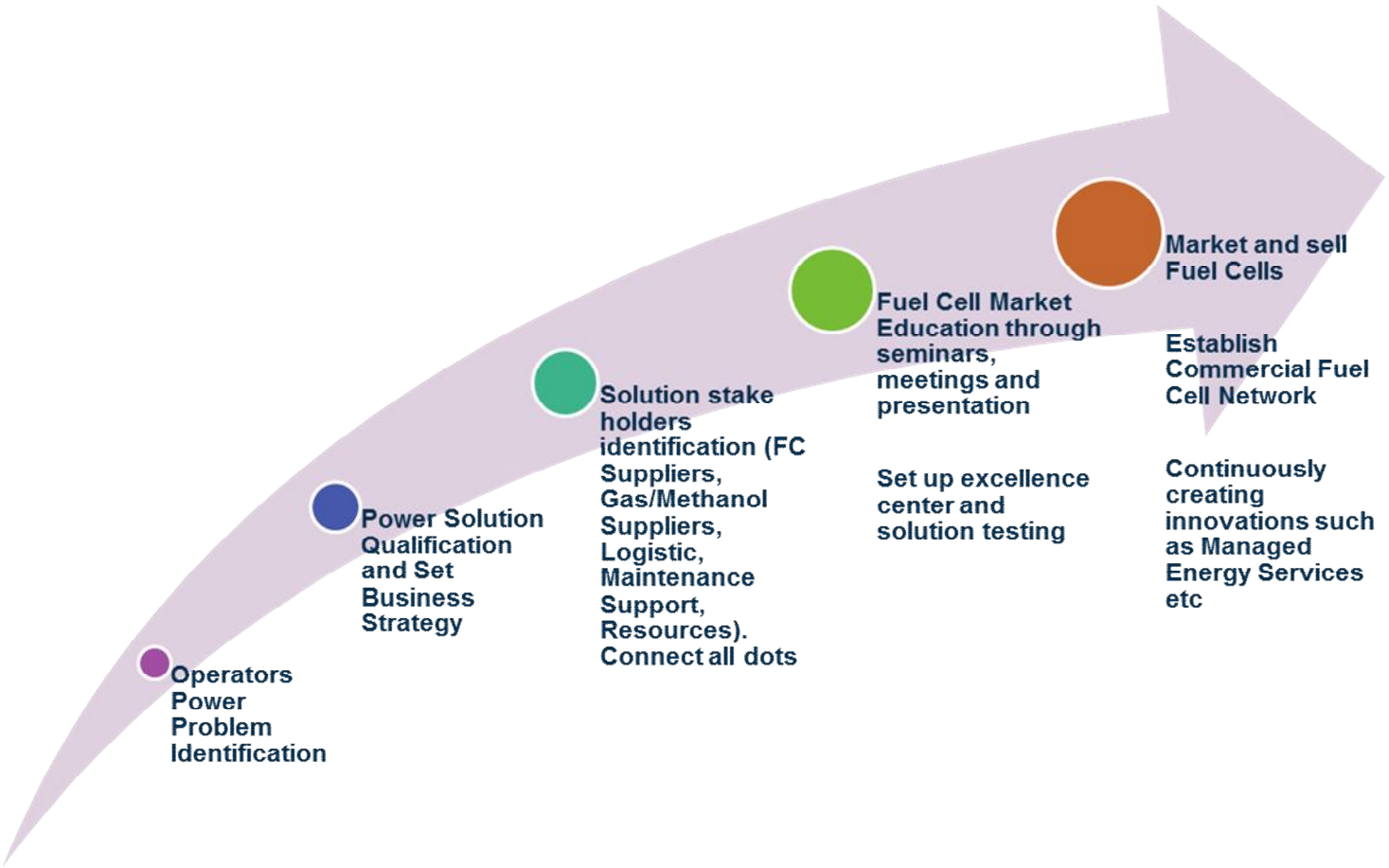
- The following table illustrates the ***significant monthly lost revenue*** that operators experience by deploying diesel generators that perform well below the 99% SLA

SLA	Monthly Hours Outage	Site Rev/Hr. $10	Site Rev/Hr. $15	Site Rev/Hr. $25	Site Rev/Hr. $50	Site Rev/Hr. $100	Site Rev/Hr. $150	Site Rev/Hr. $200
98%	14	$140	$210	$350	$700	$1,400	$2,100	$2,800
97%	21	$210	$315	$525	$1,050	$2,100	$3,150	$4,200
96%	29	$290	$435	$725	$1,450	$2,900	$4,350	$5,800
95%	36	$360	$540	$900	$1,800	$3,600	$5,400	$7,200
90%	72	$720	$1080	$1,800	$3,600	$7,200	$10,800	$14,400
85%	108	$1,080	$1,620	$2,700	$5,400	$10,800	$16,200	$21,600

- Back-up power is typically deployed at the highest value sites generating revenue from both mobile usage and transmission traffic and those associated with HUB sites where even a small outage can have a significant impact on multiple sites and large amounts of revenue.

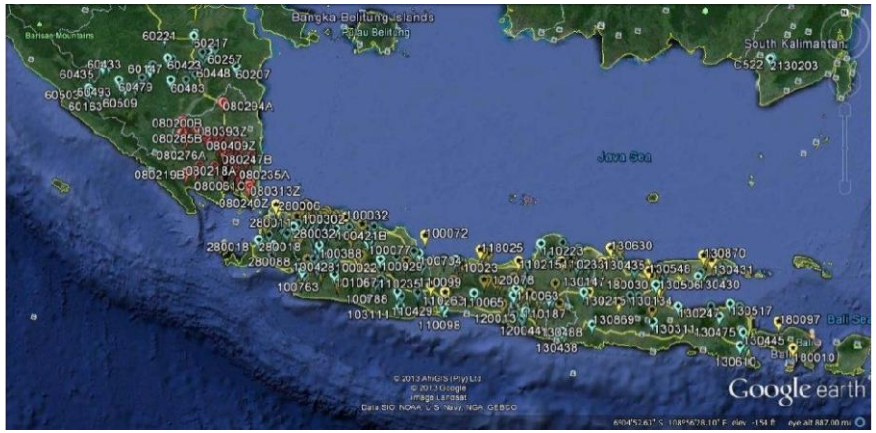
CASCADIANT EXPERIENCE

Making Commercial Fuel Cell Network Possible



Cascadiant In Fuel Cell Industry

- Cascadiant is a world leader in the deployment and management of Fuel Cells and Power Systems
- Cascadiant innovated the Managed Energy Service (MES) to offset the higher upfront cost associated with Fuel Cells
- Nearly 900 Fuel Cells deployed in Indonesia, Timor Leste, Pakistan, Myanmar and Vietnam
  - Hydrogen and Methanol Systems
- Largest customer base in Indonesia
  - H3I largest customer with ~500 systems and 5 Year MES Agreement



Cascadiant Experience Timeline 2008-2011

2008

- Started the Fuel Cell market education in Indonesia

2009

- Setup Customer Experience Center in Jakarta
- Conducted the First Fuel Cell Seminar for all operators
- Recieved the 1st contract for Hydrogen Fuel Cell Deployment for 108 Units

2010

- Completed 108 Fuel Cells Roll-out in Sumatera
- Completed the Methanol based Fuel Cell Trial For Axis
- Recieved the 2nd contract for Hydrogen Fuel Cell Deployment for 154 Units

2011

- Completed 154 Fuel Cells Roll-out in Java and South Sumatera
- Received contracts for Methanol based Fuel Cells From Axis and Bakrie Telecom
- ME Fuel Cell deployment in Botabek (Axis)
- ME Fuel Cell deployment in Padang (Bakrie Telecom)
- ME Fuel Cell Trial in Depok (XL Axiata)
- ME Fuel Cell Trial in Lampung (HCPT))
- Prime Power Methanol based Fuel Cell Trial in Balikpapan (Telkomsel)
- Prime Power LPG based Fuel Cell Trial in Balikpapan (Telkomsel)

Cascadiant Experience Timeline 2012 - 2015

2012

- Contract Awarded for Methanol Fuel Cell for XL
- Contract Awarded for Managed Energy Services for Telin
- Design Fuel Cell Solar Hybrid Solution

2013

- Completed Managed Energy Services roll out phase 1 for Telkomcel
- Completed Remote Monitoring Software Development
- Completed External tank design and testing
- Awarded by GSMA to Conduct Power Optimization Project in Pakistan

2014

- Completed Managed Energy Services roll out using methanol based Fuel Cell for Hutch
- Completed Managed Energy Services roll out phase 2 for Telkomcel

2015

- Completed Managed Energy Services roll out using methanol based Fuel Cell for Telkomsel
- In the process for auditing power solution for the 3rd largest Indonesian Operator
- Fuel Cell recondition and relocation for XL/Huawei
- Implemented Fuel Cell backup Solution for BPPT Data Center

CASCADIANT INNOVATION

Standalone Tank Solution

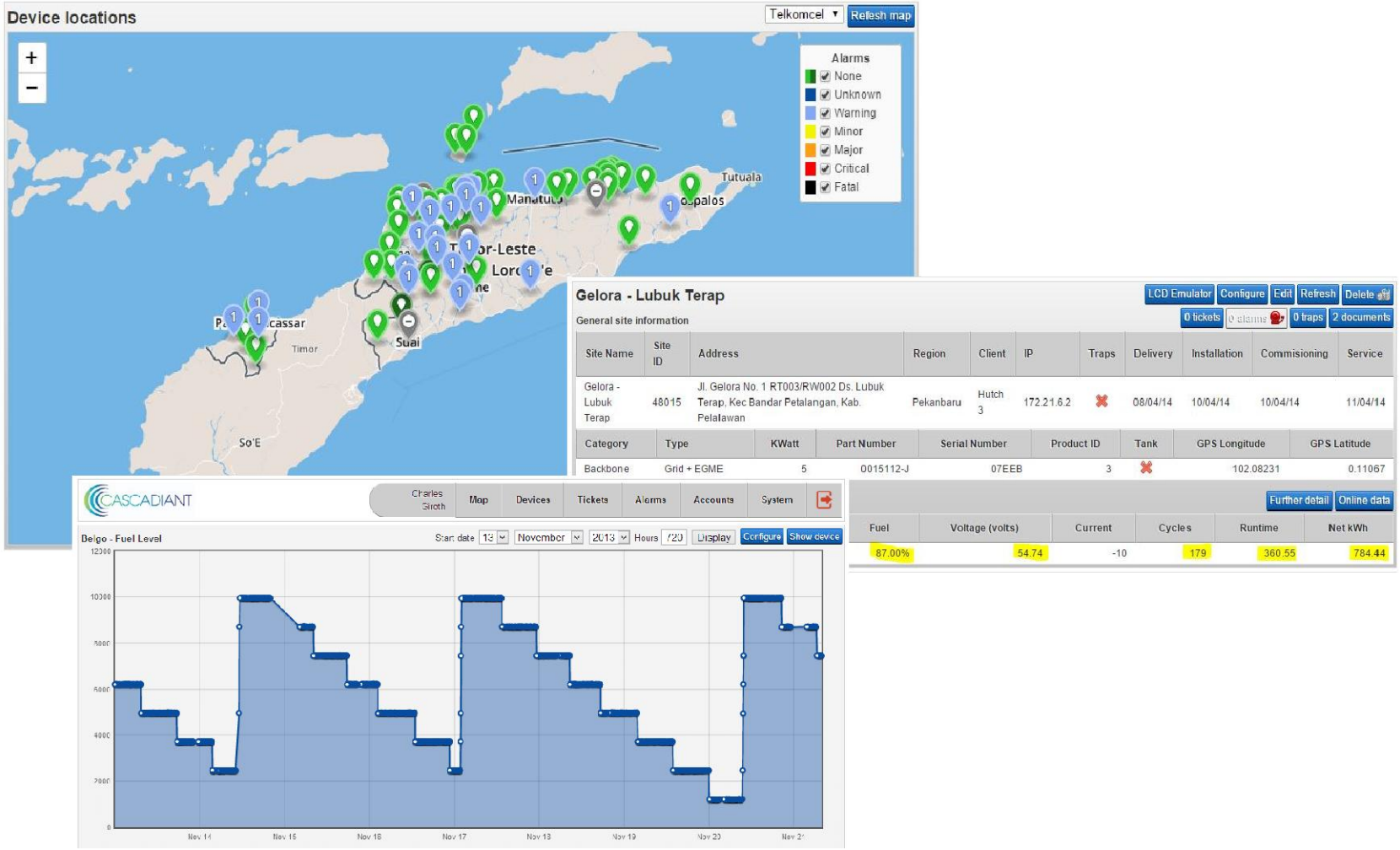
•First company to integrate a 2,000 liter standalone tank solution

Fuel Cell PV Hybrid Solution

•First company to integrate Fuel Cell and PV into an off-grid solution

Fuel Cell Power Management System

•First company to integrate Fuel Cell Software to Power Management Software



Collaboration With GSMA

Selected by GSMA to conduct the second Mobile Energy Efficiency Optimization (MEEO) study highlighting Fuel Cells

Middle (Punjab) – Lahore, Tehsil and MianChannu – 5 Sites

Figure 3 Map of Middle Pakistan – Site Locations

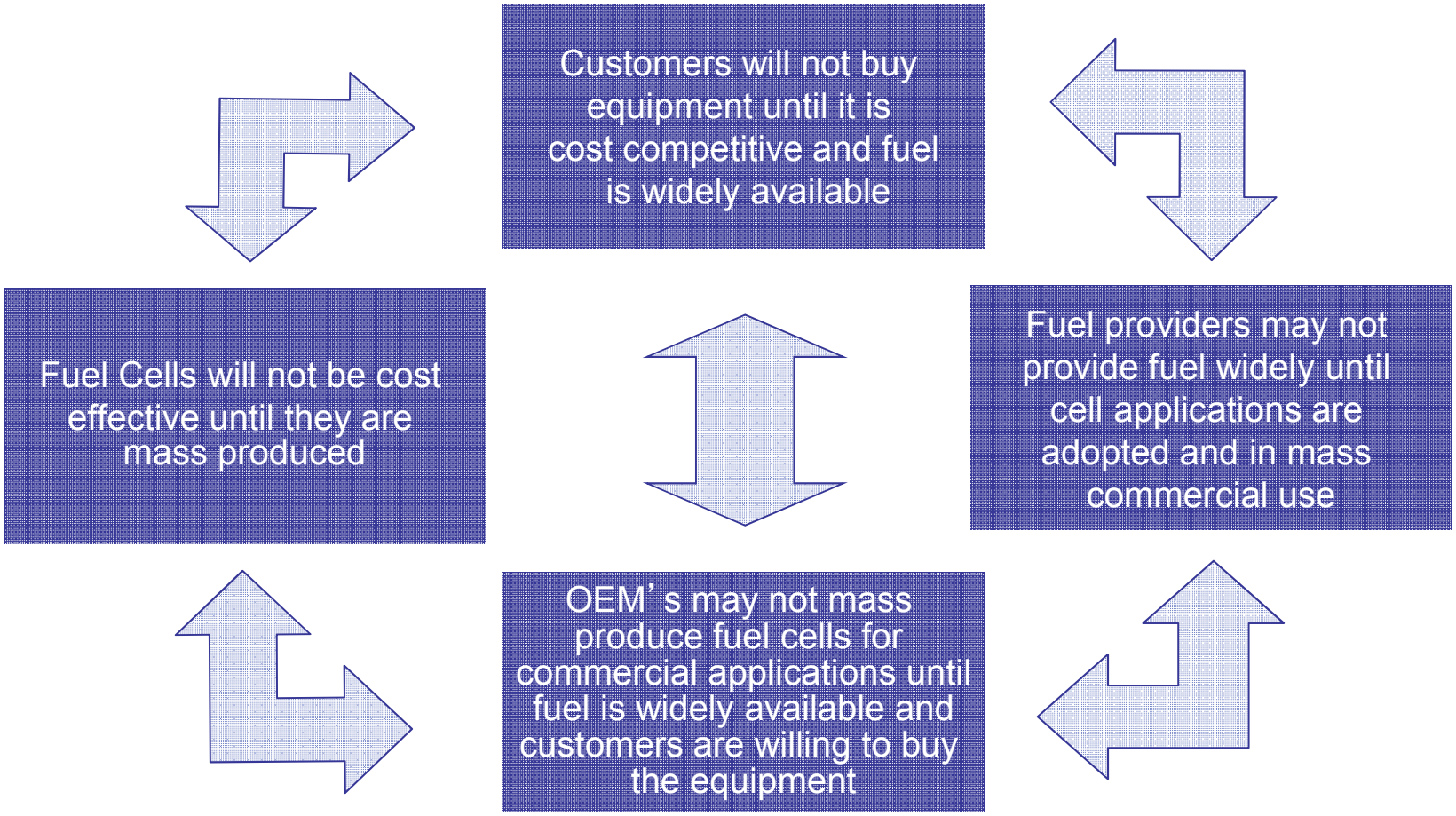
North – Islamabad and Rawalpindi – 3 Sites

Figure 4 Map of North Pakistan – Site Locations

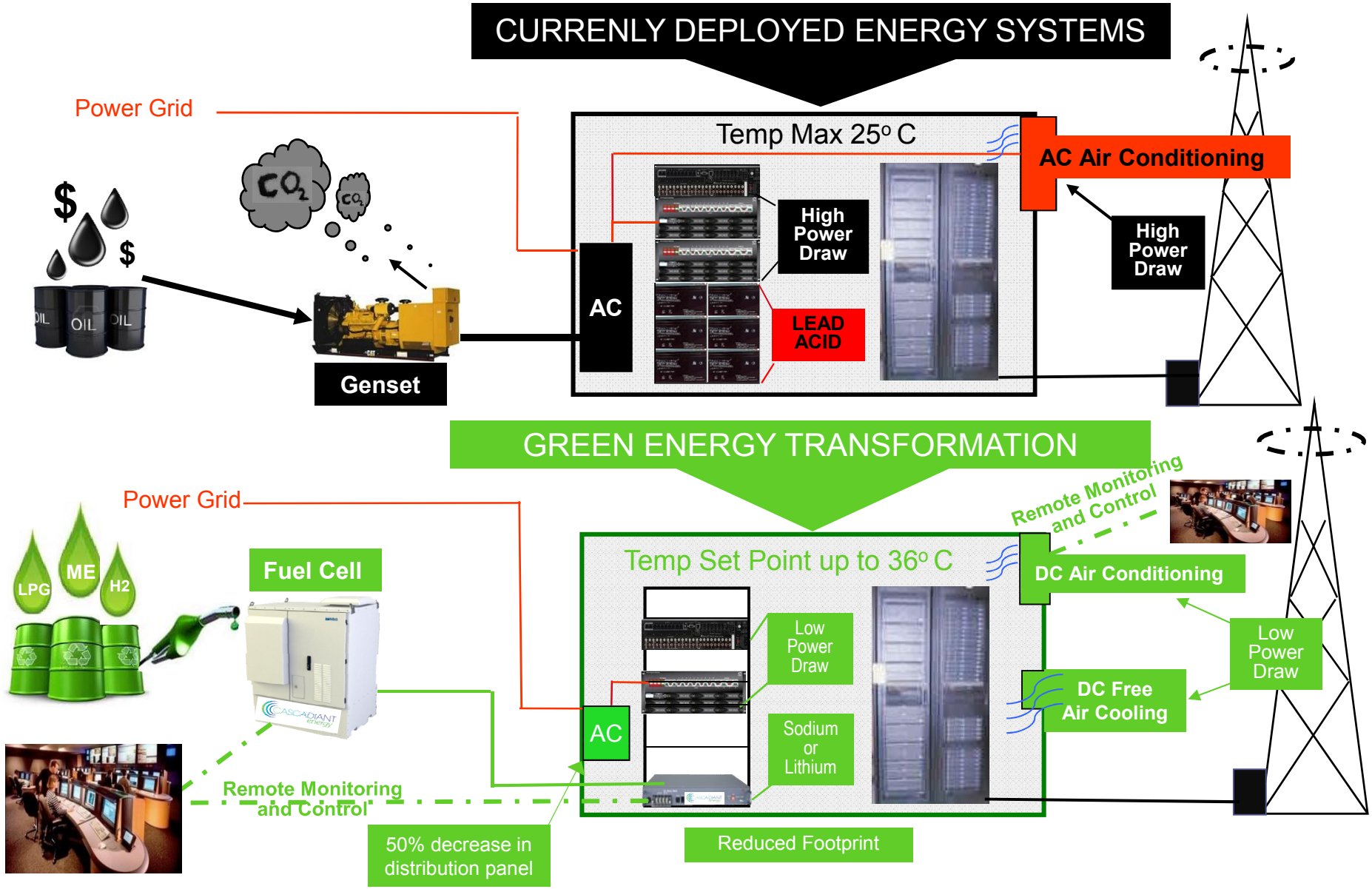
Market Transition

It Is A Complex Transition

- Compelling New Technologies = Radical Change and Market Disruption
- Long Wavelength and Uncertain End-State Hamper Investment And Adoption
- "Governments Are Talking But Users Are Balking"
- Alliances And Commitment Between All Parties Critical



Green Energy Replacement For Back-Up Power



END USER REQUIREMENTS

Solutions Objectives

- Site Availability
  - Increase Network SLA
  - Increase Per Site Revenue
  - Increase Customer Satisfaction and Retention
- Predictable Costs
  - Focus On Fixing Maintenance Costs Over A Longer Term
  - Lower Per Site Energy Usage and Costs
- Guarantee Fuel
  - Supply
  - Cost
- Outsource Services
  - Move Staff And Operational Infrastructure
- Shift CAPEX
  - Decrease Or Eliminate CAPEX For Back Up Power
  - Decrease Or Eliminate CAPEX For Spare Parts
- Corporate Social Responsibility Commitment
  - Green Energy Alternative
  - Move To Domestic Fuel Sources To Eliminate Imports

Telco Customers Additional Wish List

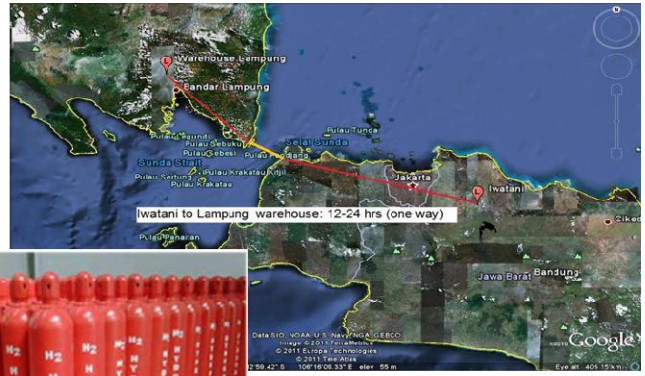
Below are the wish list that Cascadiant collected from various customers

- Cost Competitive to traditional backup power solution
- Short startup time (less bridging battery, or build in bridging energy)
- Longer components run hours such as stack, reformer, pump, etc
- Able to handle more cycles
- Smaller Foot Print
- Able to supply different voltages at the same time 28VDC and 48VDC
- Able to supply power to multiple DC buses
- To be used as Main Power
- High tolerance on fuel specification
- Cost effective Hydrogen production on site

SUPPORTING FACILITIES

Guaranteed Fuel Supply

- Fuel availability is the main concern of a cellular operator. While diesel is available everywhere hydrogen and methanol are only available in certain places.
- Hydrogen cylinders refilling station is usually centralized closer to industrial area whereas telecommunication cell sites are scattered around the places.



Typical Cascadiant Fueling Network

KEY DATA POINTS

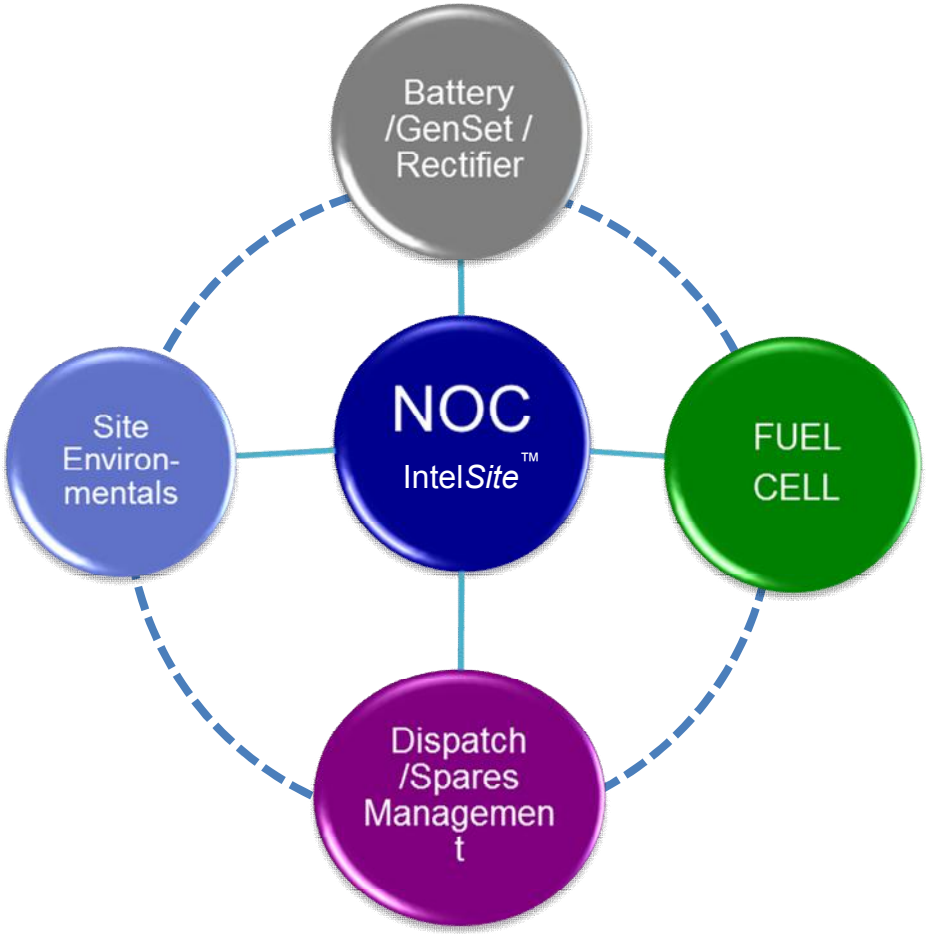
- Multiple Methanol / HydroPlus Suppliers
- Multiple Main Fuel Storage Warehouses
- Distributed Fuel and Spares depots
- Distributed Field Service Offices

Common Infrastructure

Common Infrastructure such as roads play important role for Fuel Cells Deployment and Operation.

Proven Network Support Capability

- Cascadiant will deploy a Network Operation Center (NOC) in Dhaka. The NOC is a 7/24 information and communication center that connects all facets of the Cascadiant power solution
- Monitors and controls how much energy is available and required within each site
- Intelligently optimizes which element can and should be charged or utilized and at what rates to ensure optimal performance and availability
- Dispatches field service and fuel delivery as required
- Monitors individual, customer defined data points per site



24hr NOC and Help Desk

- Remotely monitors all deployed systems
- Coordinates fuel dispatch
- Coordinates field engineering dispatch
- Interface with operator's NOC
- Interface with Tier 3 OEM's service and engineering organizations

Full Certification and Training Program of All Staff

Cascadiant in conjunction with our technology partners fully certifies all field engineering and NOC staff. Each employee experiences a combination of class room training and hands-on experience that will equip all resources with an excellent combination of theory and practical knowledge of the system

- **Gold Trained and Certified**
  - Connections, Fueling and Energizing
  - Installation/Commissioning / ATP
  - Preventive Maintenance
  - Remote Monitoring and Support
- **Platinum Trained and Certified**
  - Functional Trouble Shooting
  - Major components diagnostics and repair
  - In-depth process and module fundamental's
  - 400 Hours of on-the-job supervised training
- **Expert Trained and Certified**
  - Gold and Platinum Certified
  - Data retrieval and and full system analysis
  - Stack replacement and re-build
  - Reformer replacement
  - System optimization
  - 1040 hours of job supervised experience

Regulatory Frameworks

In the developing countries such as Indonesia, the regulatory frame works sometimes are formulated later after a technology is being adopted including Fuel Cell.

Various standards and codes are now being proposed and formulated by four stakeholders: Regulatory Bodies, Experts Panel/Researchers, Producers/SI, and Consumers.

Below are the standards and codes that are being proposed to the Indonesian government for discussion or adoption:

- IEC 62282-3-1 Stationary Fuel Cell Power Systems – Safety
- IEC 62282-3-2 Stationary Fuel Cell Power Systems - Performance test methods
- IEC 62282-3-3 Stationary Fuel Cell Power Systems – Installation
- Hydrogen Quality Standard for Energy
- ISO 15916 Basic Consideration for the safety of hydrogen systems
- Safety standard for Fuel Cell/Hydrogen Vehicle
- ANSI/CSA FC 1-2004 Leakage test
- NFPA 70 Installation
- ASHRAE Ventilation System
- **…others**

Thank You