



**REGEN**  
Sustainable Power Solutions  
**POWER**

11th ASIA-PACIFIC  
MINERAL RESOURCE  
EXHIBITION & CONFERENCE 2016

# Innovative Solar Diesel Hybrid Systems

Prof Chem Nayar



# Presentation : Outline

- ❑ Introduction
- ❑ Conventional Solar Diesel Hybrid Systems- Case Studies
- ❑ Hybridgen –Variable Speed Generator
  - ❑ Mining Accommodation
  - ❑ Water Pumping
  - ❑ Drinking Water Solutions
  - ❑ Communication



# My background



- BSc Elect Engg , MTech ( IIT Kanpur), PhD ( Wind Power), Uni. of Western Australia
- Professor of Electrical and Renewable Energy Engineering, Curtin University till Dec 2011; now Emeritus Professor .
- 111 “ Project Distinguished Professor Hefei University,
- Visiting Professor China University of Mining and Technology , United Arab Emirates University, Chiang Mai University ( Thailand)
- Chairman, Regen Group Pty Ltd, Australia
- Director, Radiant Solar , Hyderabad, India
- Asian Development Consultant on Renewable Energy
- Supervised /supervising 25 PhDs, 300 research papers, 8 million in research grants



- **Winner of Sustainable Energy Industry Excellence Award 2011 : (1) The Ambassador Award and (2) Product and Technology Award for variable speed diesel generator (Hybridgen)**
- **Australian Power Engineering Committee “ Lifetime Career Achievement Award” , 2012**
- **Fellow of Australian Solar Council**





# CURTIN UNIVERSIY



- Approx 60,000 students (39,000 EFTSL); 27% of students are international
- 7<sup>th</sup> largest university in Australia
- Approx 4000 equivalent full-time staff\*\*; largest single-site employer in WA.

- Destination of Choice for WA University applicants with 47% domestic market share\*
- Major campuses in Perth, Kalgoorlie, Singapore and Malaysia

(\* Source: Office of Strategy and Planning, TISC First Preferences 2015)

\*\* Source: Curtin University office of Strategy and Planning, Snapshot taken 31 March 2014)





# REGEN

Sustainable Power Solutions **POWER**

## RESIDENTIAL SOLAR SYSTEMS



## COMMERCIAL SOLAR SYSTEMS



## OFF-GRID SYSTEMS



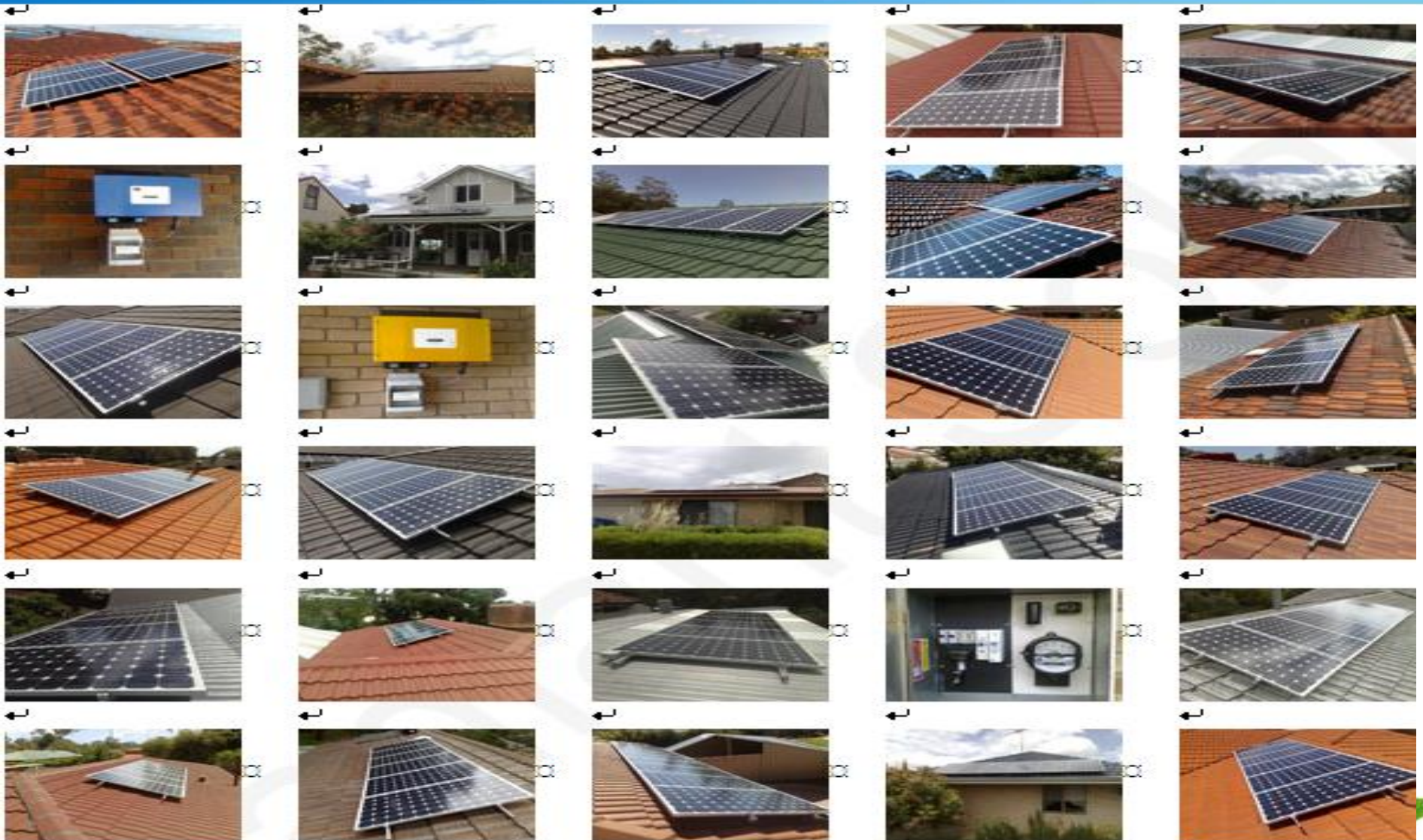
## PRODUCTS



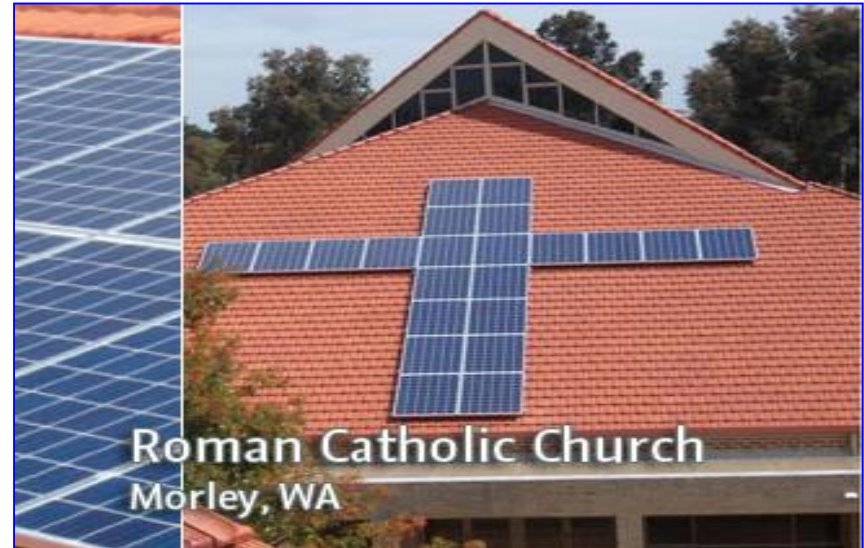
## STORAGE













# Commercial Solar PV Installations- 100kW, Sydney



- Rated as “Above and Beyond Standards” by GSES in the “The Good, The Bad and The Ugly presentation”, Clean Energy Council Conf., 2013





# 5MW Solar Farm Project in Setiu, Terengganu, Malaysia (Consultant)

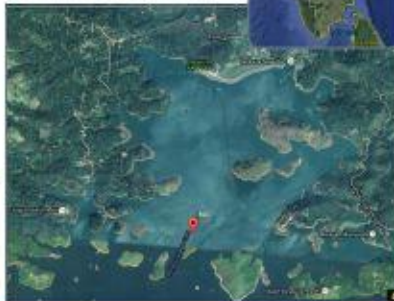




## 500kW FLOATING SOLAR POWER PLANT

Kerala, India

Kerala State with large stretches of water bodies has huge potential for floating photovoltaic systems. The Kerala State Electricity Board Ltd (KSEBL) has awarded a 500 kWp Floating Grid Interactive Solar Photovoltaic Power Project in the Banasurasagar dam in Wayanad to a consortium led by Adtech Systems Ltd, a Thiruvananthapuram based company. The other members of the implementing consortium are Hyderabad based Radiant Solar Pvt Ltd, Floatels India Pvt Ltd and Regen Power Pty Ltd, an Australian renewable energy company based in Western Australia.



10kW Floating Solar Power Plant installed in Banasurasagar

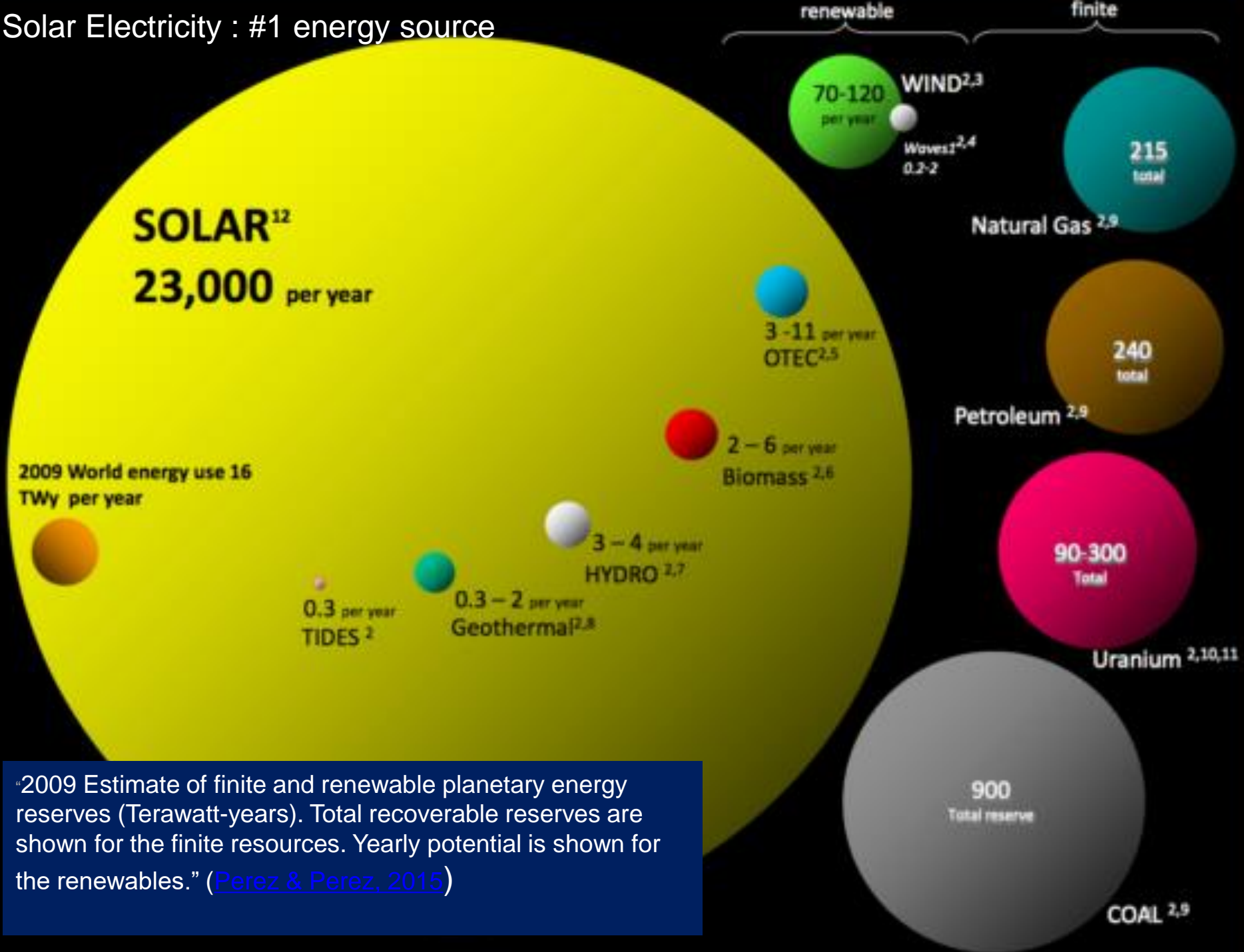


Experimental 5kW system for National Thermal Corporation, India





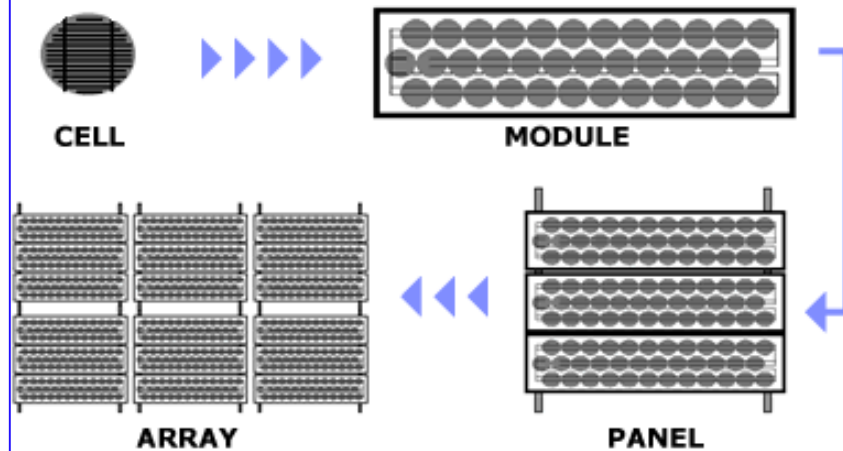
# Solar Electricity : #1 energy source





<b>Cells</b>	Semiconductor device that converts sunlight into direct current (DC) electricity
<b>Modules</b>	PV modules consist of PV cell circuits sealed in an environmentally protective laminate and are the fundamental building block of PV systems
<b>String</b>	Is a set of series connected Modules designed to produce a nominal working voltage whilst ensuring the it doesn't exceed $V_{max}$ and $V_{min}$ at $T_{min}$ and $T_{max}$ respectively
<b>Panels</b>	PV panels include one or more PV modules assembled as a pre-wired, field-installable unit
<b>Array</b>	A PV array is the complete power-generating unit, consisting of any number of PV modules and panels
<b>Balance of System</b>	Power conditioning unit ( inverter/charge controller) ,Frames, cables, connectors, trackers, instruments etc

## From Cell to Array





## **Benefits :**

- Established technology for remote area power generation
- Portable
- Modular
- Many mines have short life time-Generators can be on leasing terms
- Mining companies can go for Power Purchase Agreement

Energy costs can account for around 30 per cent of expenditure for remote area and off-grid miners, which rely on diesel-fired generators and face the additional burden of transport costs for fuel.



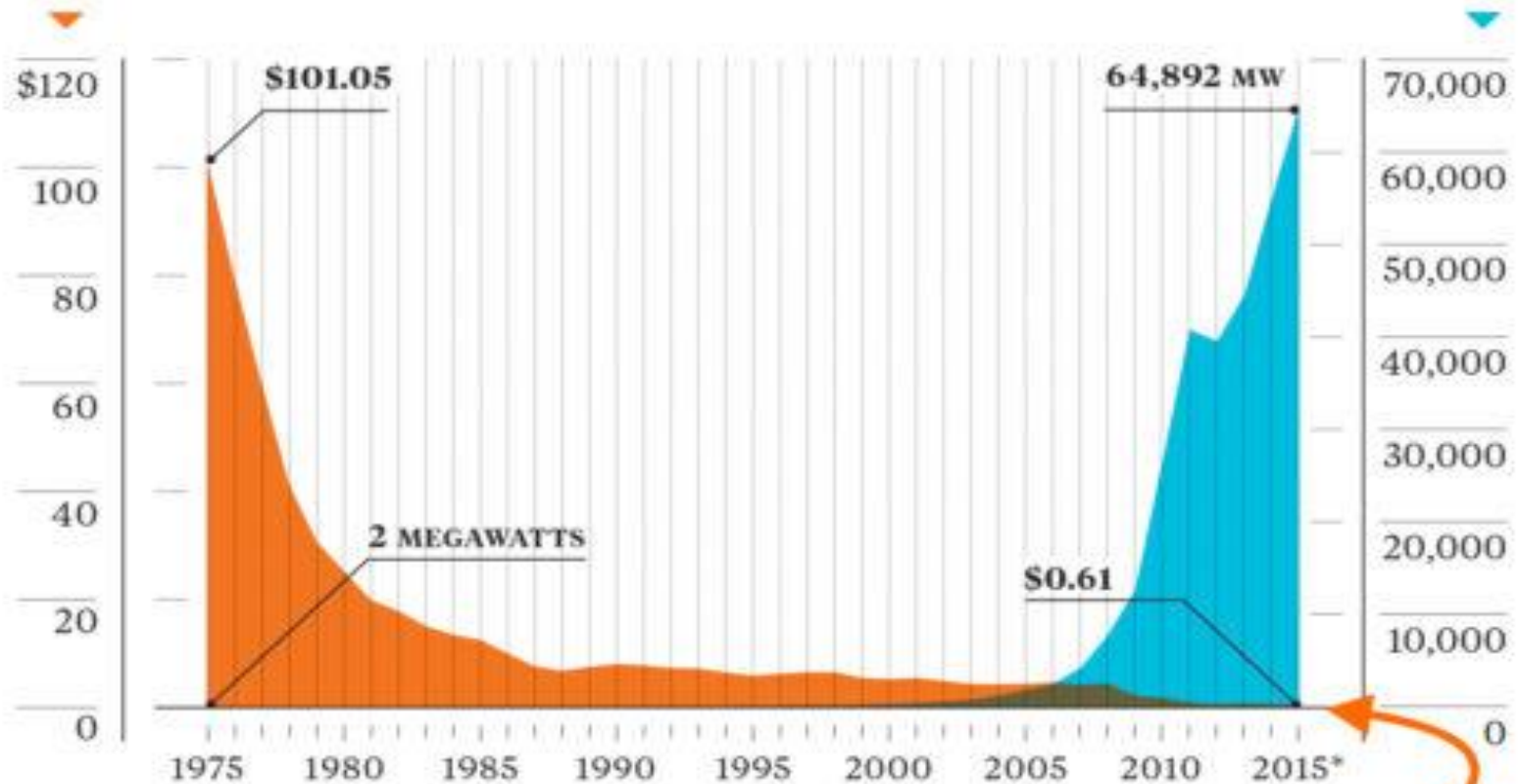


# Solar on Fire

As prices have dropped, installations have skyrocketed.

Price of a solar panel per watt

Global solar panel installations

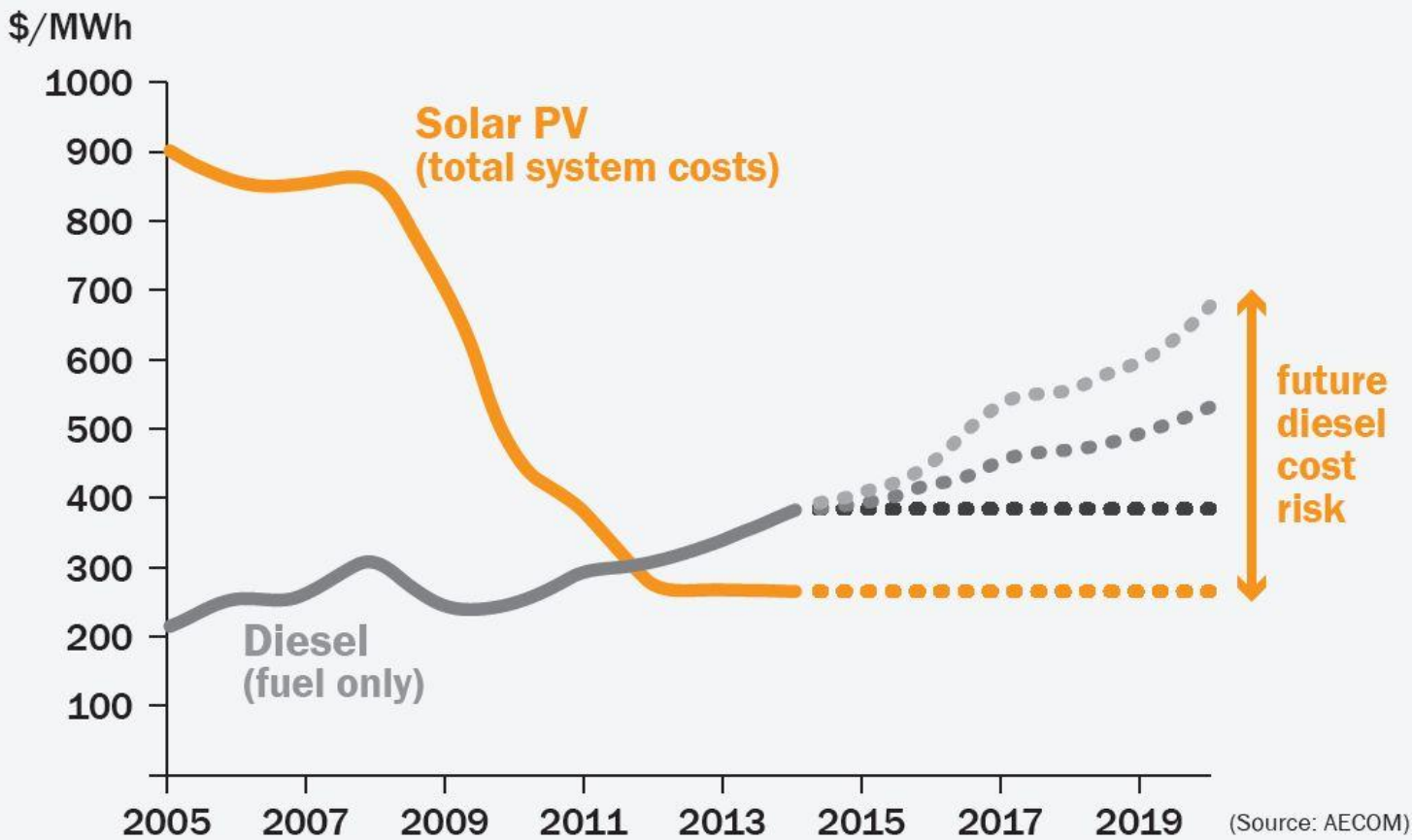


\*Estimate. Sources: Bloomberg, Earth Policy Institute, [www.earth-policy.org](http://www.earth-policy.org)

**Down to \$0.447 in August 2016**



# Solar-Diesel



Energy costs can be 30% of the expenditure With Diesel Generator only



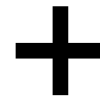


## Examples of self generated power use in mining:

- Accommodation
- Equipment Drive
- Lighting
- Water Pumping / Water Treatment
- Communications

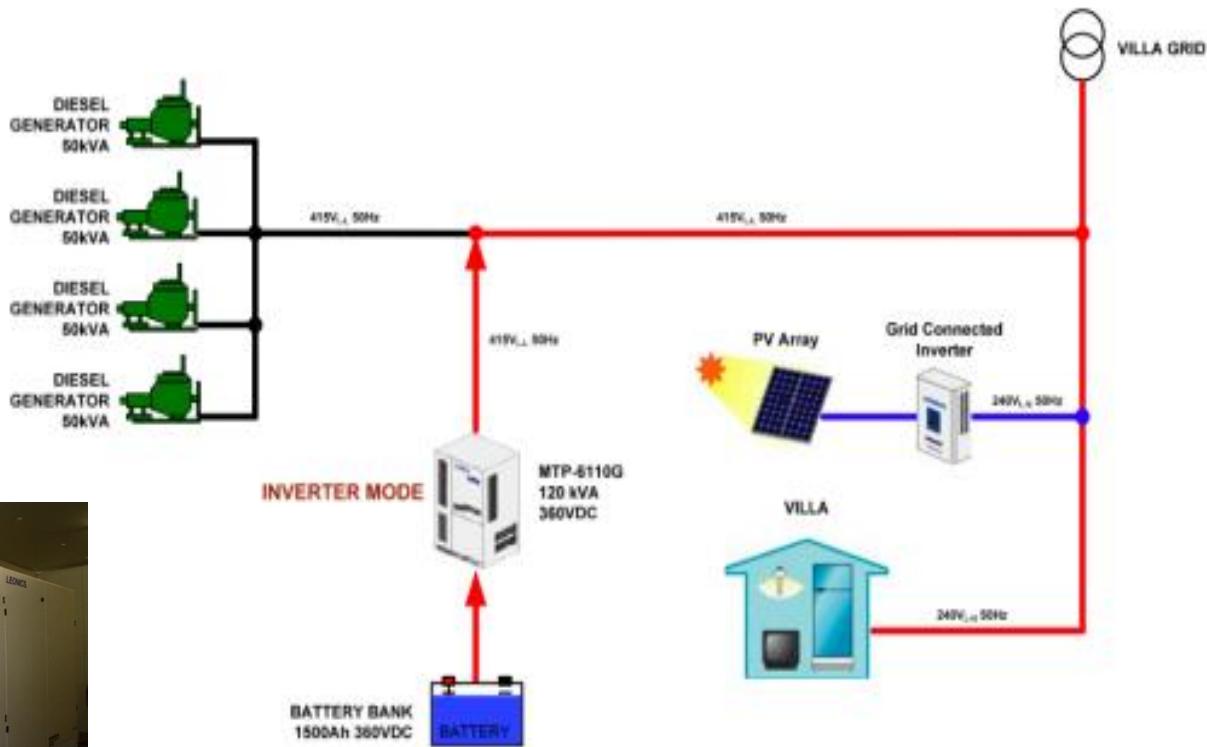


# Solar/Diesel Hybrid Systems













# 40kW PV Solar System

Our Commitment to Sustainability



System Size: 40kW

Generating Since: 01 Nov 2015

## TOTAL ENERGY GENERATED TO-DATE

ENERGY GENERATION

**11372.17**

kWH

AVERAGE GENERATION

**140.4**

kWH / Day

ENERGY CONSUMPTION

**37916**

kWH

AVERAGE CONSUMPTION

**468.1**

kWH / Day

TOTAL CO2 OFFSET TO-DATE  
EQUALS

**28**



TREES SAVED

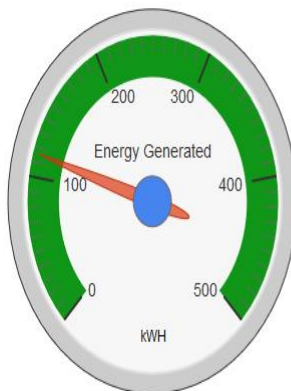
TOTAL ENERGY GENERATED  
TO-DATE EQUALS

**9098**



KG OF CO2 SAVED

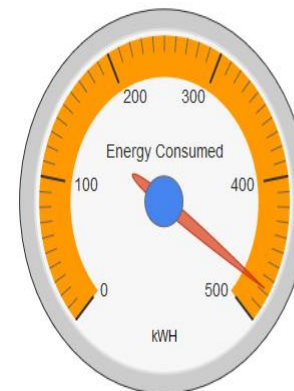
## TODAY'S ENERGY GENERATION



ENERGY GENERATED TODAY

**115.73**

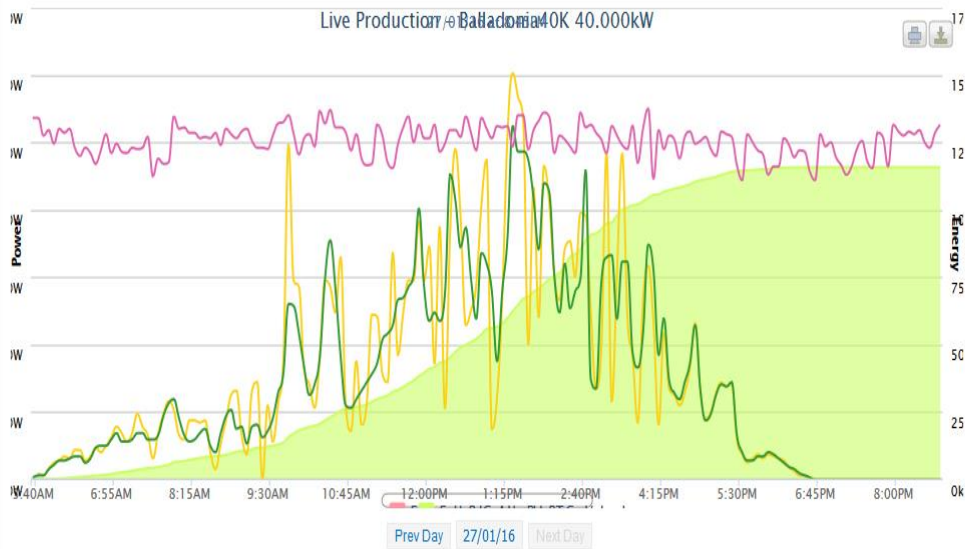
kWH



ENERGY CONSUMED TODAY

**477.66**


kWH





### International Patent : PCT/AU2011/001068 , Power Management System and method for optimising fuel consumption.

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 (19) World Intellectual Property Organization  
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(25) Filing Language:  
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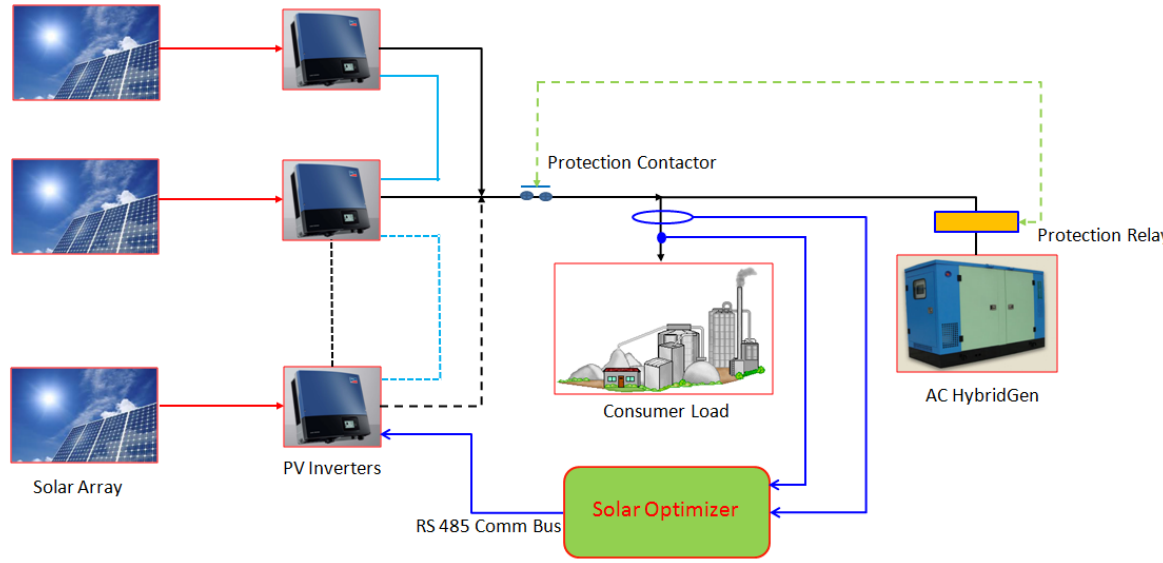
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AU, AC, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EG, ES, FI, GB, GD, GE, GL, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published: — with international search report (Art. 21(3))







# 15kW Solar Hybrid System







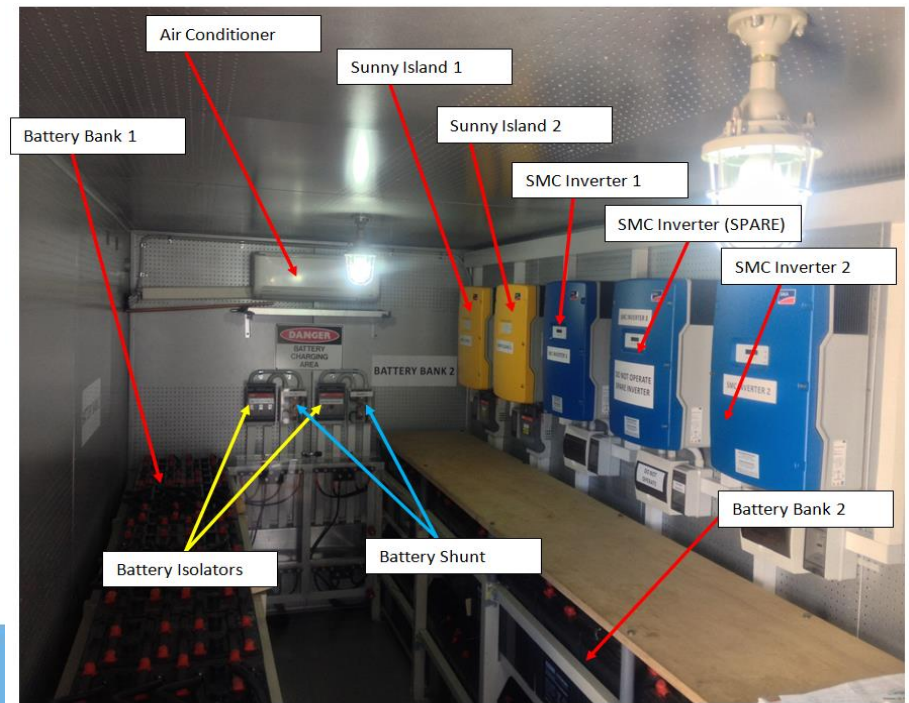




# 15kW Variable Speed Generator supplied to Curtin



# Case Study: Containerised Solar Hybrid System for BC Iron Nullagine in Western Australia

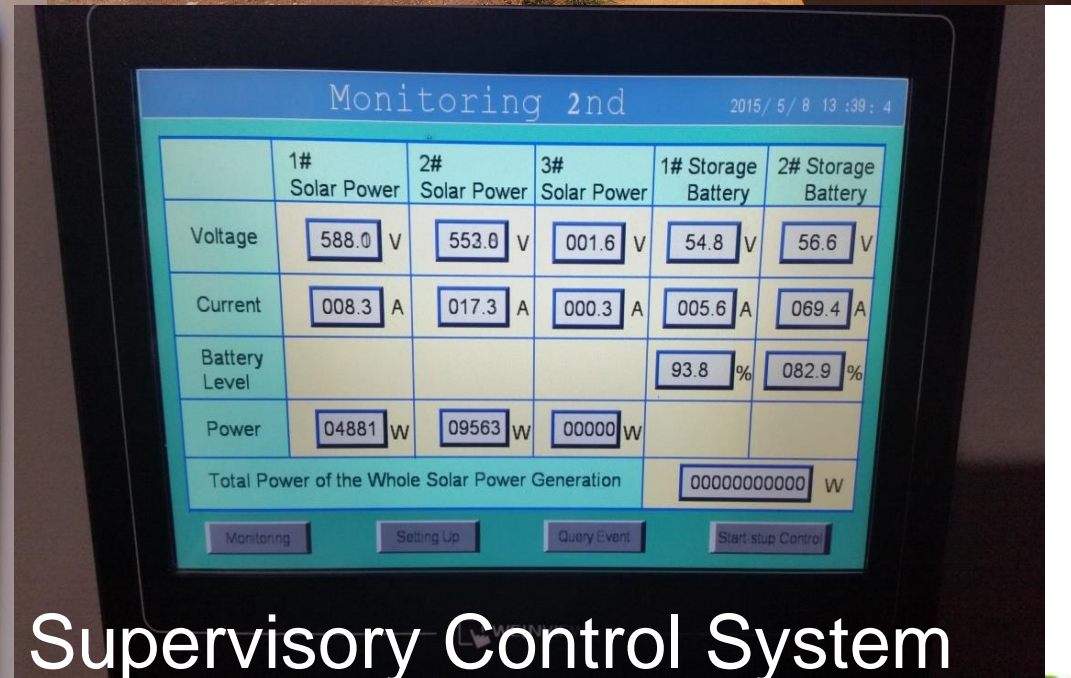
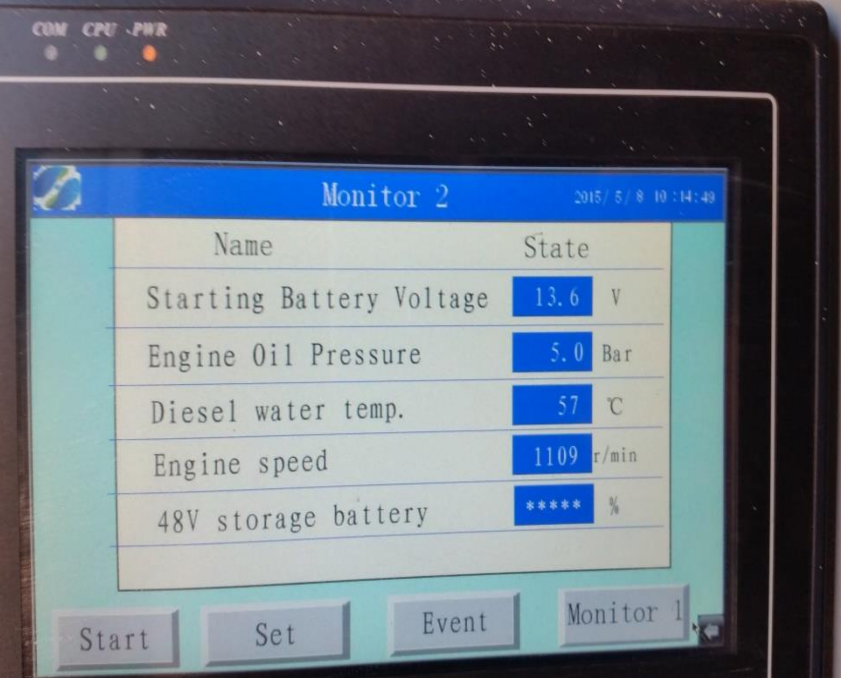




# Major components and control







# Supervisory Control System









# Solar tracking PV array at Mt Cattlin, Ravensthorpe, Western Australia







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**Chairman & Managing Director**





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