



Carnarvon DER Trials Update – ESCI-KSP Submission

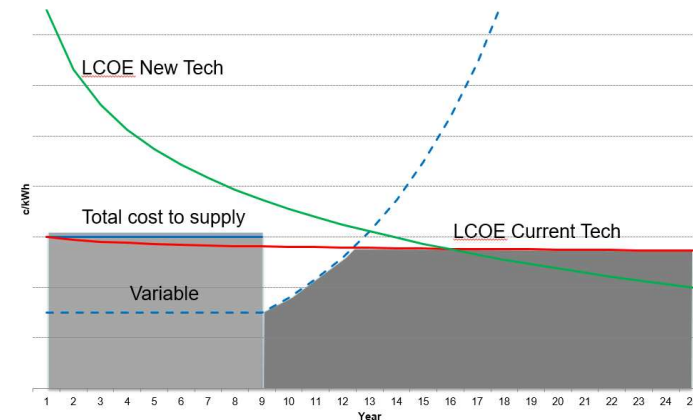
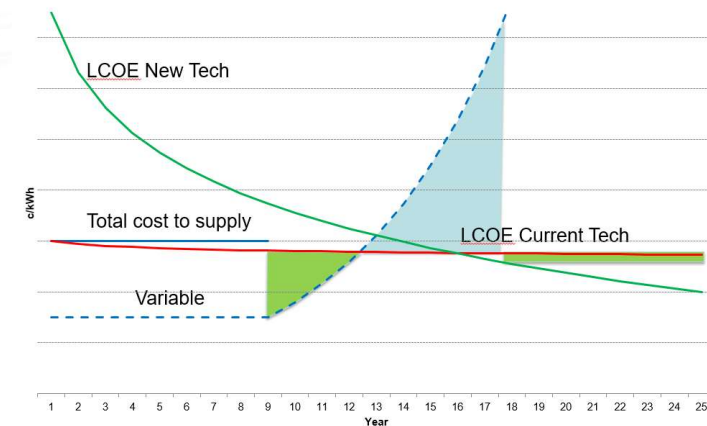
@May 2018

David Edwards

Blueprints

- Long range forecasting for all 38 networks
- Analysis of ongoing CAPEX, OPEX
- Overlaid with learning curves on PV, Energy Storage and cost of data
- Economics improved with high penetration DER
- Identification of challenges to:
 - Power system engineering
 - Operational practices
 - Commercial model
- Established a development pathway to a high penetration DER future
- Business model transition from predominantly centralised to predominantly de-centralised model
- Retention of customer choice
- Open up Hosting Capacity targets

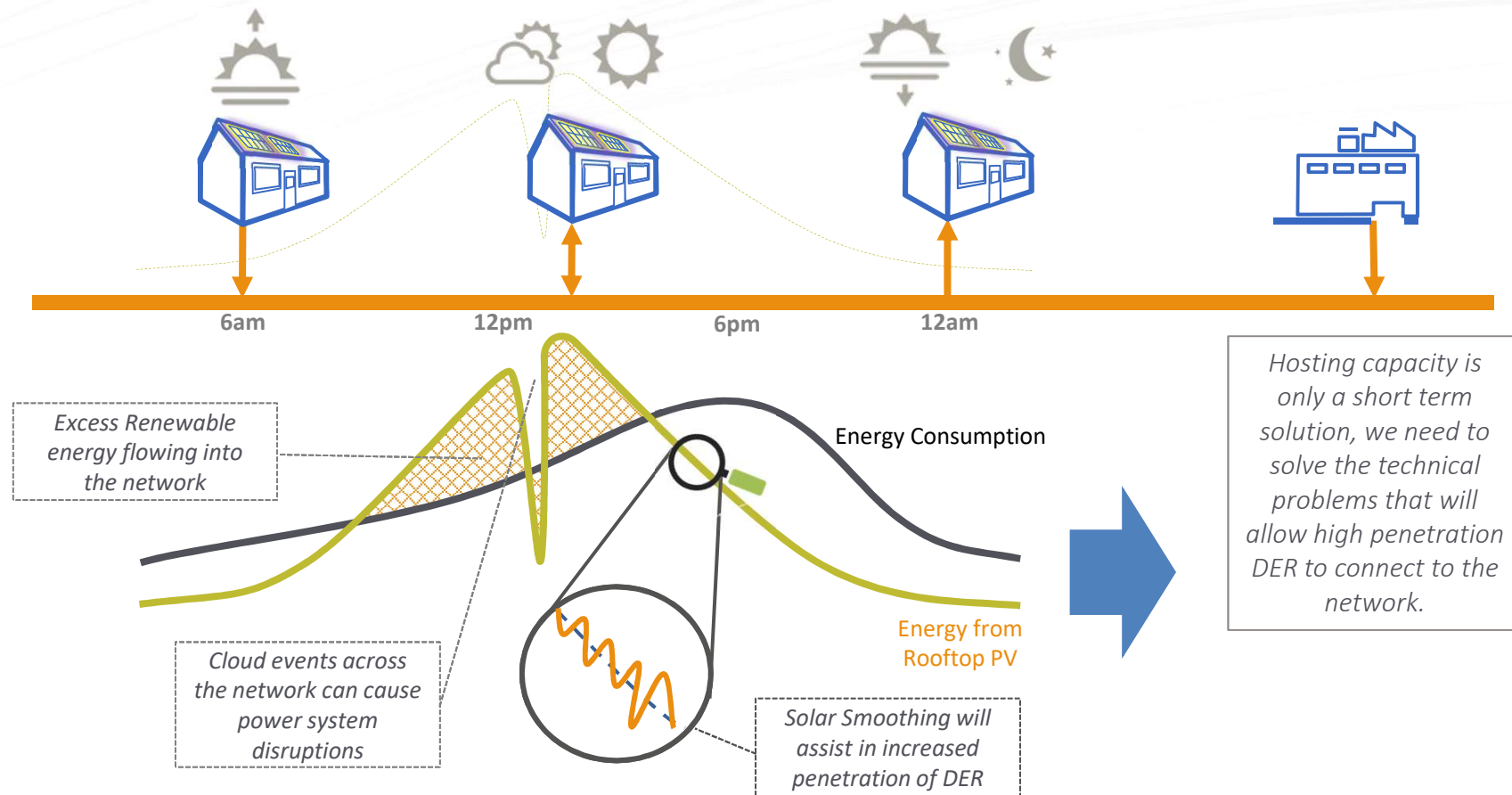
HORIZON
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Visibility & Control

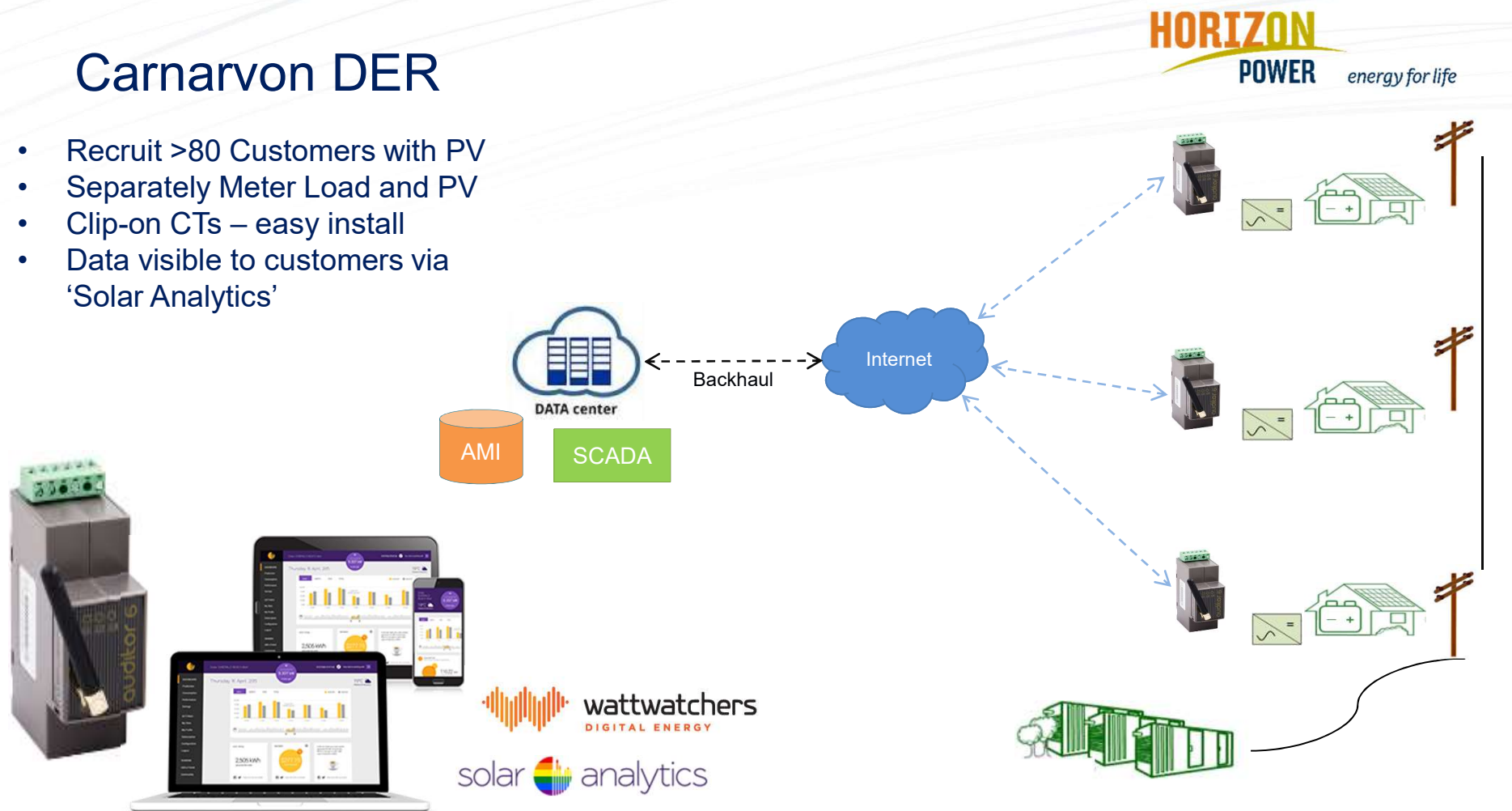
- We have seen distributed generation growing to become the largest generator on the network completely changing network load profiles as we have known them for the last 100 years.
- Distributed energy storage will grow and completely change network load profiles as we know them today.
- The bulk of energy dispatch on the network will come from non-industrial standard consumer grade electronics
- This dispatch will not be secured by a 10 year power purchase agreement with all the certainties we favour
 - No step in rights
 - No liquidated damages
 - No dispatch profile guarantee
 - No spinning reserve limits
 - No SCADA visibility or control
 - Dealing with small companies 'Startups'
- How do we address these challenges?
- How do we embrace the uncertainty and still preserve system stability, power quality and reliability?
- What methods can we use to de-risk this future state?
- We will not find the answer to these questions in the way we have done business over the last century

Visibility & Control



Carnarvon DER

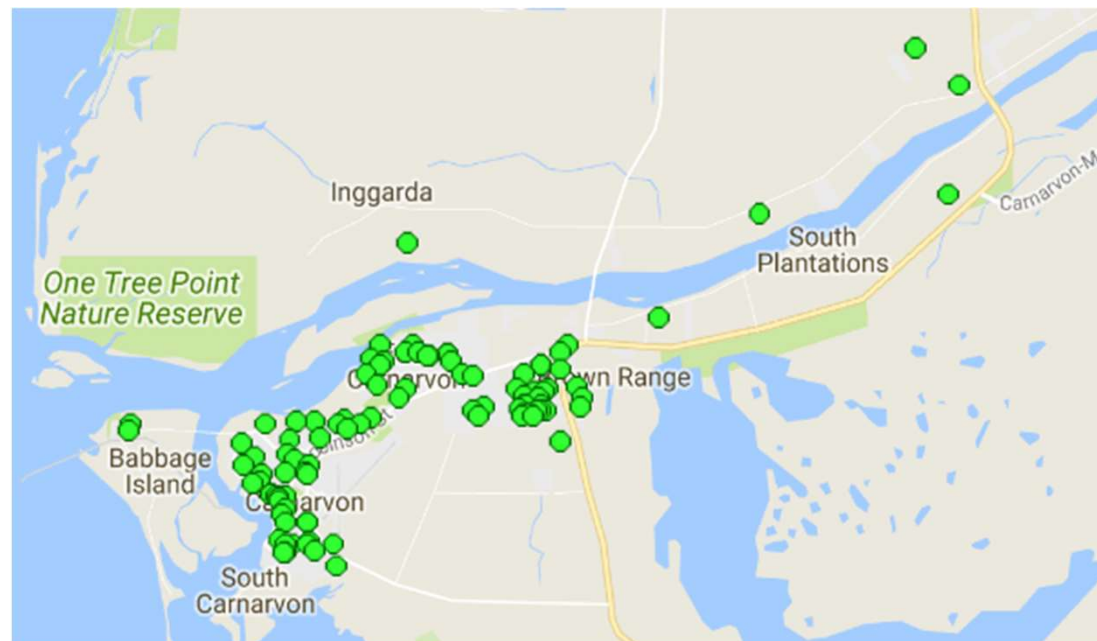
- Recruit >80 Customers with PV
- Separately Meter Load and PV
- Clip-on CTs – easy install
- Data visible to customers via 'Solar Analytics'



WattWatchers Installations

- 59 Residential and Commercial sites so far...
- Some sites with multiple PV systems
- Some sites with PV systems remote from the residence
- 108 Watt watchers installed
- Good geographic spread from East to West
- Best possible geographic spread from South to North (prevailing winds)

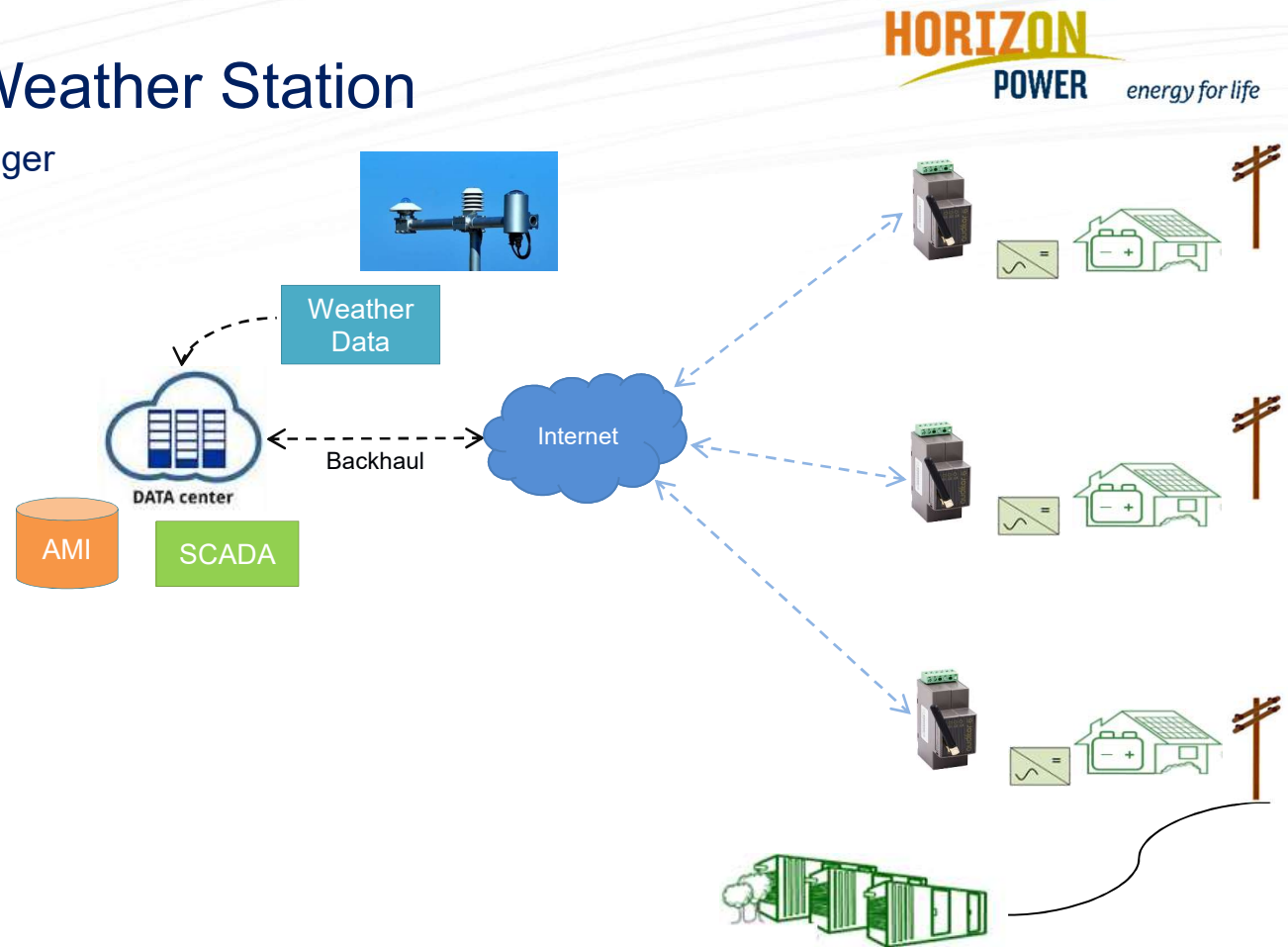
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Skycamera & Weather Station

- Fulcrum 3D - 360° Sky Imager
- Temperature & Humidity
- Wind speed & Direction
- Solar Insolation
- Barometric Pressure

Fulcrum 3D
precision sensing

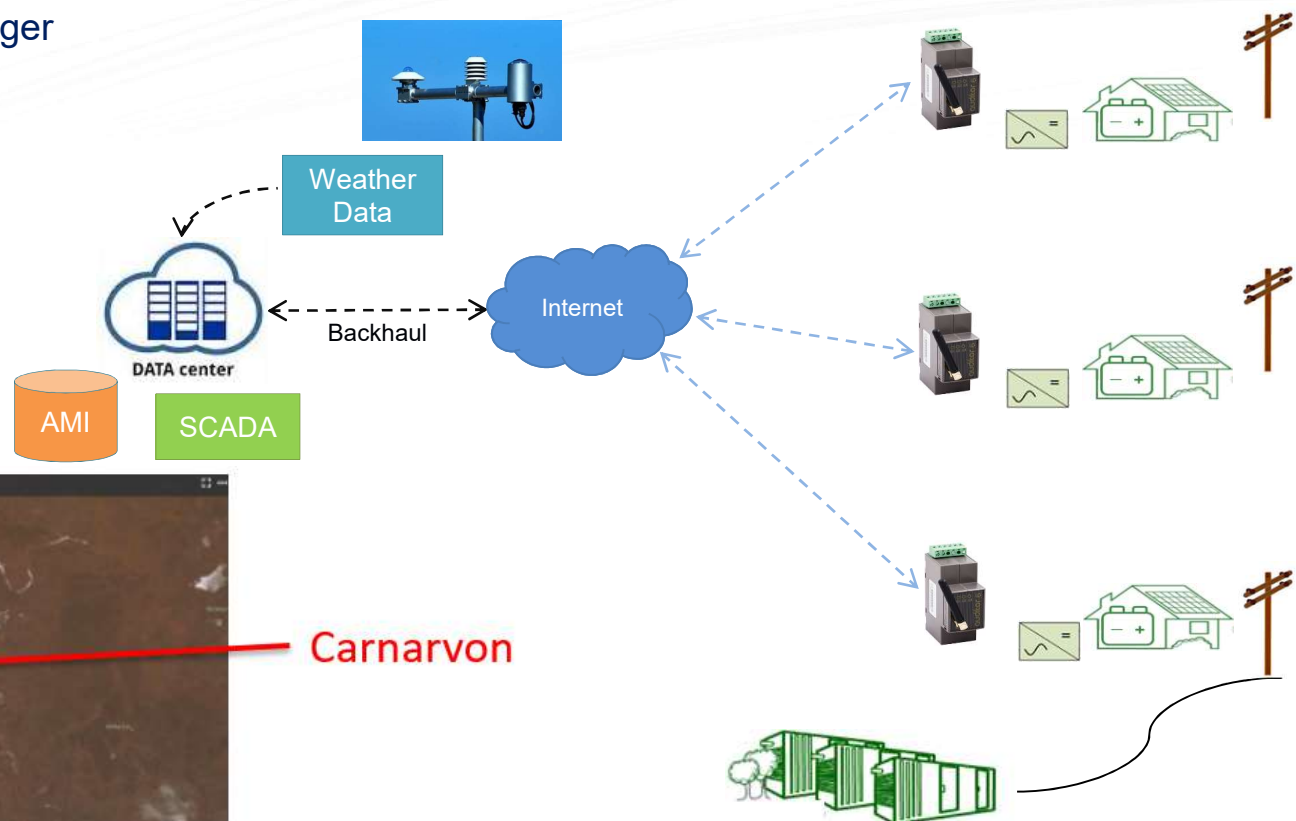


Skycamera & Weather Station

- Fulcrum 3D - 360° Sky Imager
- Temperature & Humidity
- Wind speed & Direction
- Solar Insolation
- Barometric Pressure
- Solcast Forecast Input



Carnarvon



Monitor & Control of PV & Energy Storage

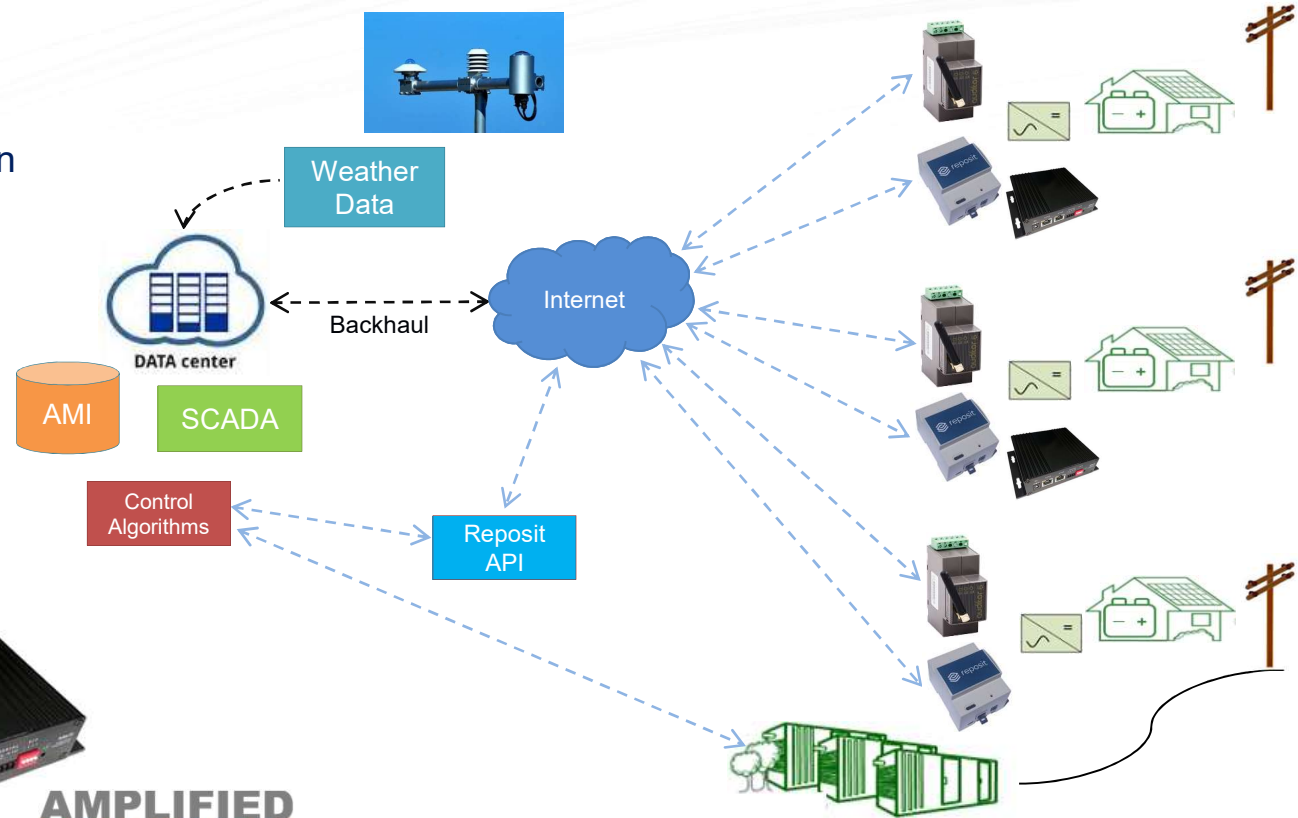
- Feed-in Management
- Demand Side Mechanism
- Ancillary Services
- Energy Storage Optimisation
- Sunspec Support

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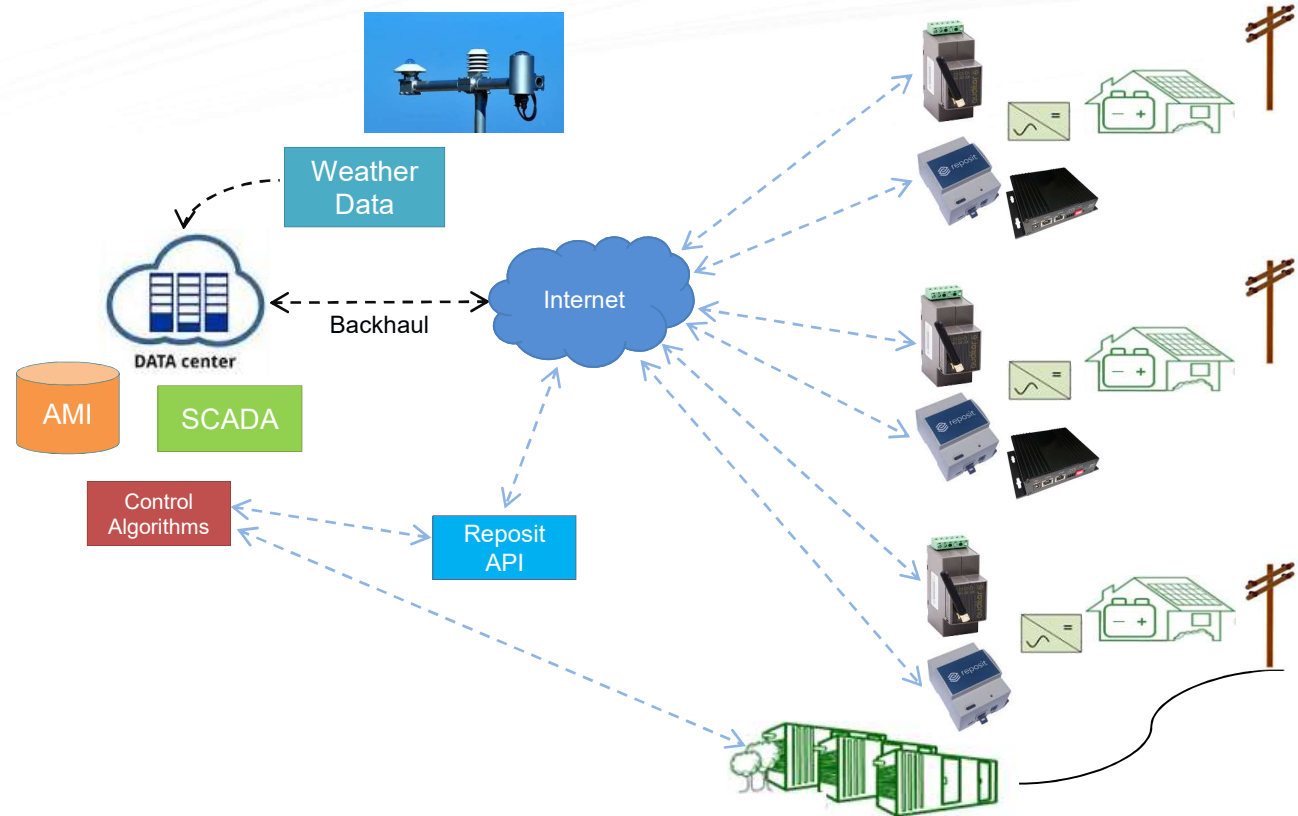


AMPLIFIED
ENGINEERING



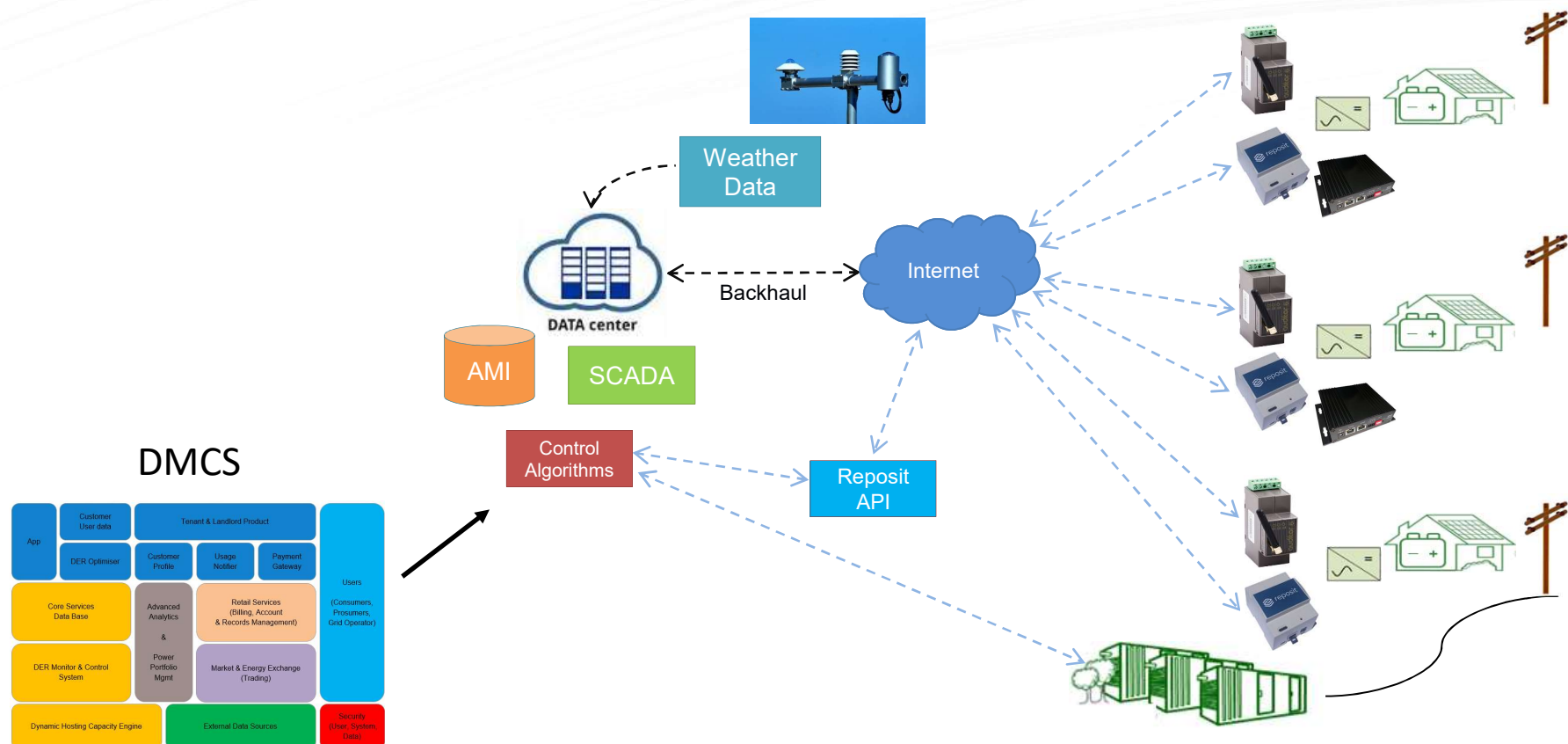
Monitor & Control of PV & Energy Storage

- 10 Customers – PV/Battery system + Reposit Box
- 6 Customers – Inverter upgrade + Reposit Box
- Commercial Buildings
- Police & Justice Centre
- Solex Solar Farm



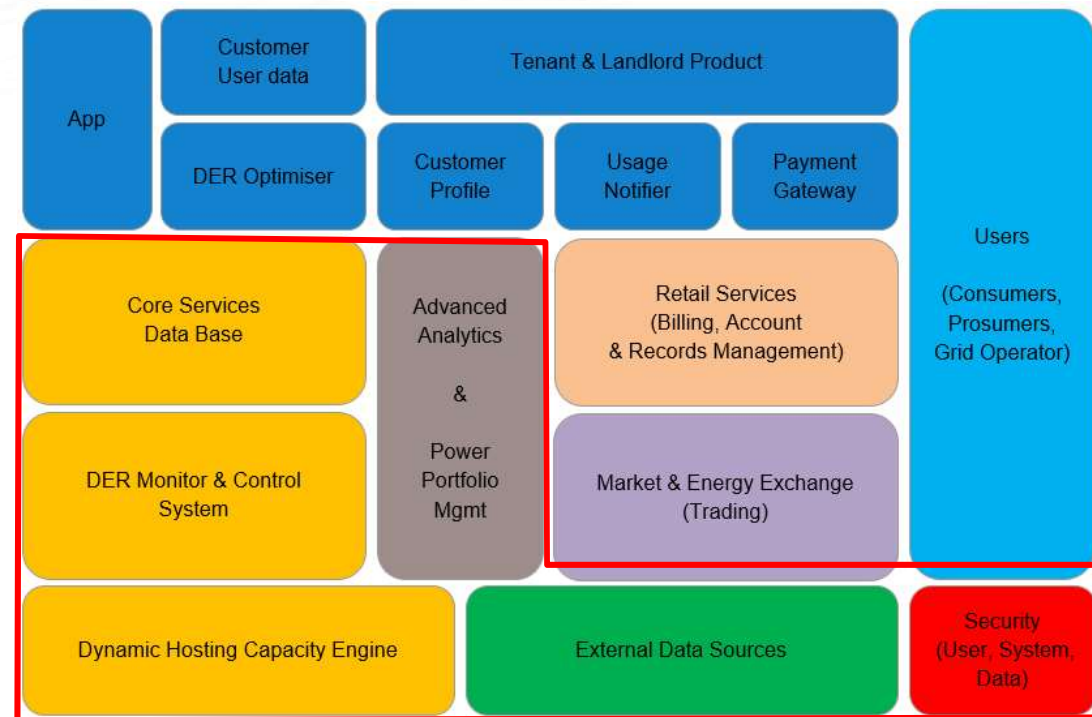
DER Monitor & Control System

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DMCS Application Stack

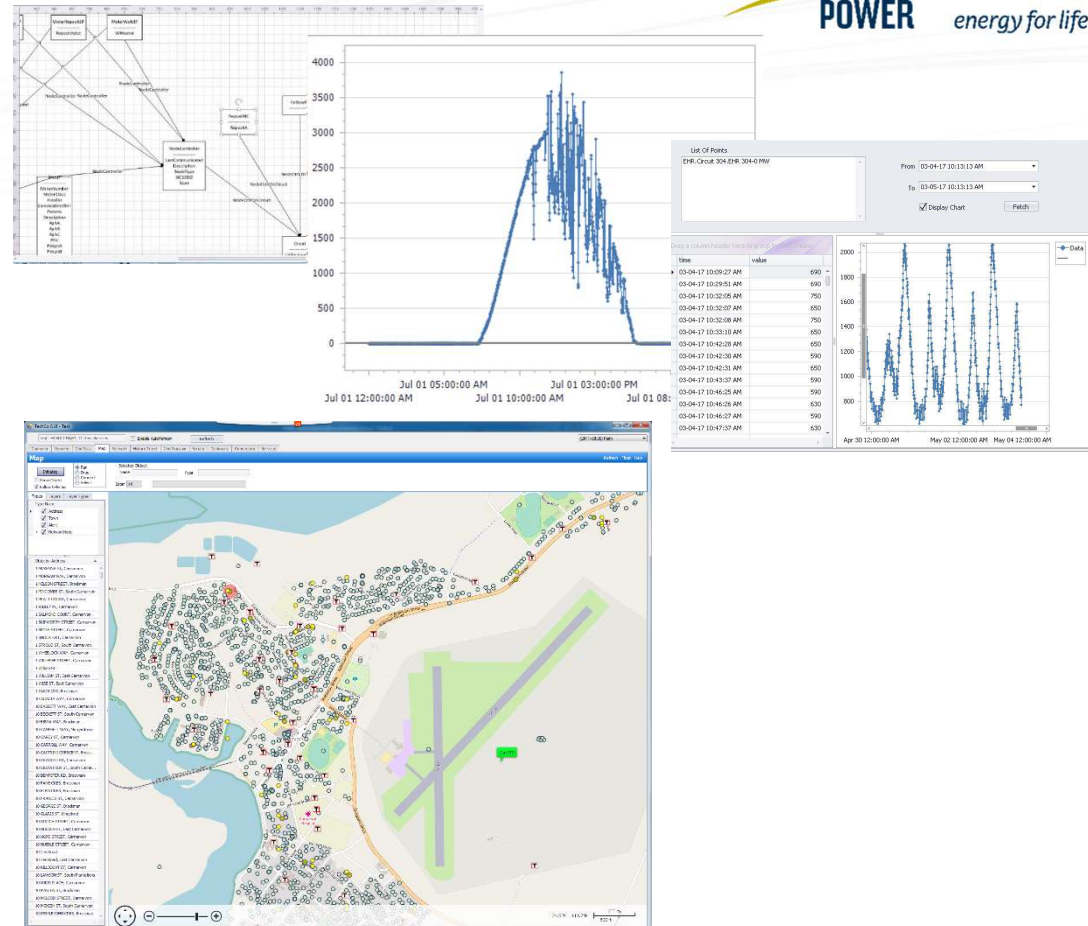
- Flexible and modular architecture
- DER and Grid Integration
- Ancillary & Grid Services
- Advanced Analytics & Power Portfolio Management
- Energy Exchange (Trading)
- Retail Services (Billing, Accounts & Records)
- Profiles for different platform users
- Flexible suite of Customer facing products



Core Services

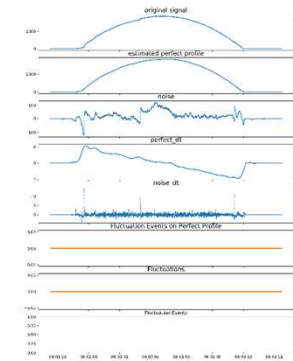
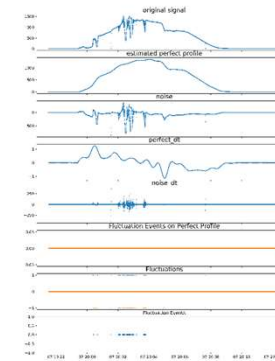
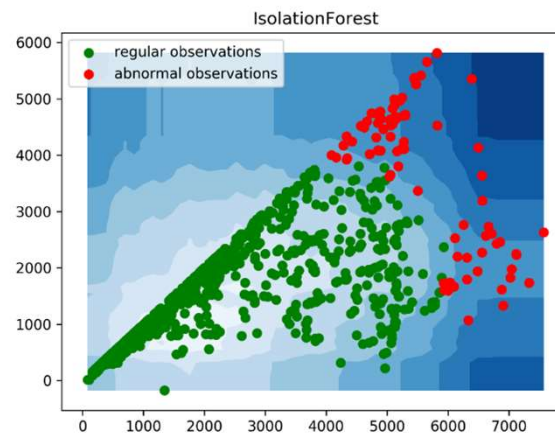
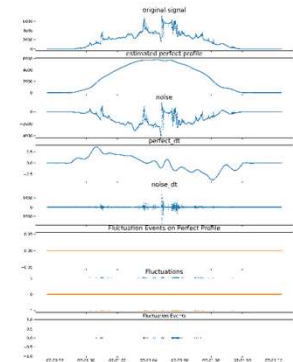
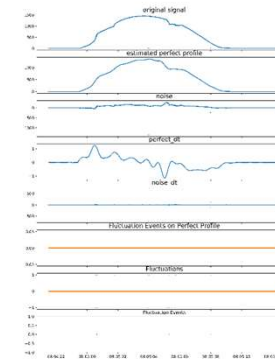
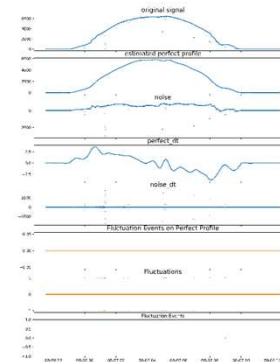
- PV Production Data from Reposit
 - Advanced Meter Infrastructure Data
 - Forecasting Data from Solcast
 - Meteorological Data from Weather Station
 - Power Station SCADA
-
- All data has a geospatial reference
 - Curates the co-incident set of time stamped data (currently 17 Bn Points)
 - Cleans, filters and prepares the data for machine learning

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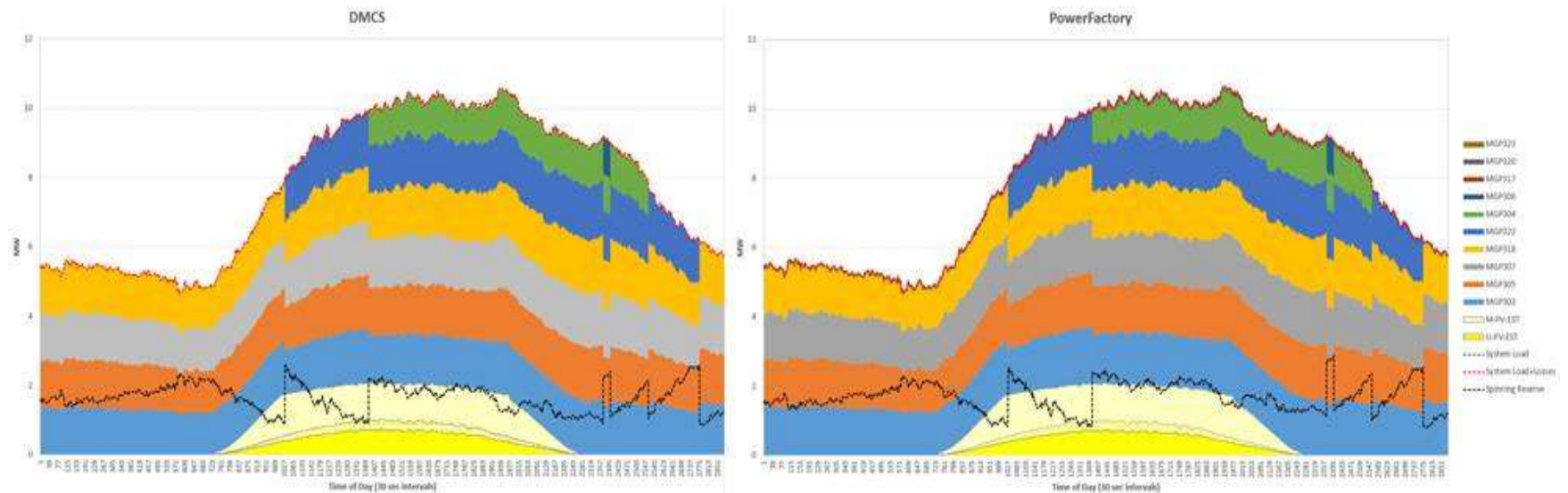
Advanced Analytics

- Impact of cloud events on multiple PV systems spread across the distribution system
- Unsupervised machine learning of the Fluctuation factor
- Unsupervised machine learning of the Diversity factor
- Relationship between weather, load and RE production



DER Monitor & Control System

- DER Monitor & Control Simulation
- Calculates the dynamic hosting capacity
- Network Risk Simulation
- Scenario Simulation
- Predictive Simulation
- Visualisation and Analytics



Virtual Power Plant

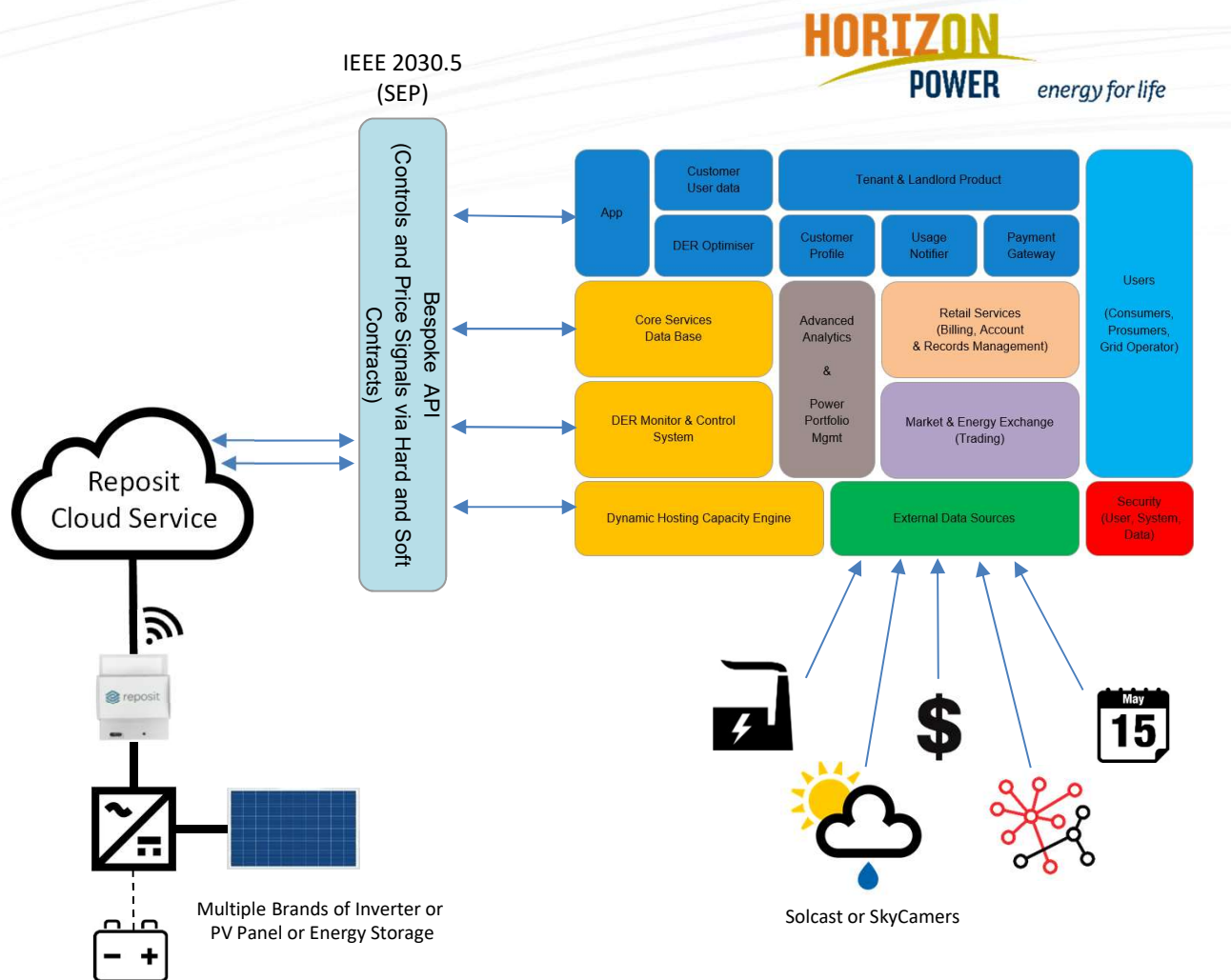
Aggregated DER are grouped into Virtual Power Plants (VPP) which are managed en-mass by the Reposit Cloud Service.

Customers are assigned to a VPP when they connect their DER through the conventional approvals process.

VPPs can be reconfigured at any time by Horizon Power through the Reposit VPP dash Board.

VPPs can be assigned per town, per feeder, per street or per contract (individual).

All settings relating to VPPs are adjustable at any time through the Reposit VPP dash board.



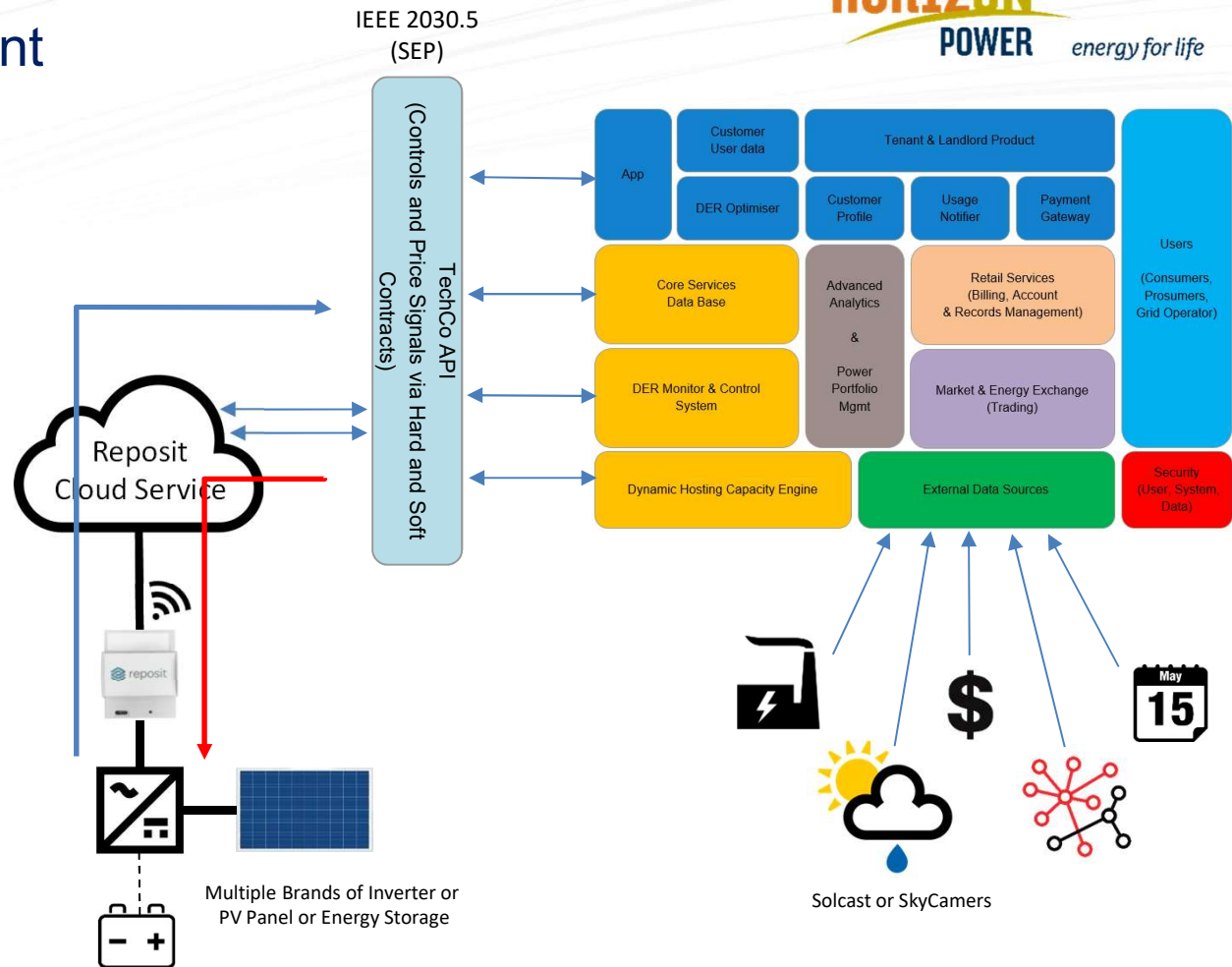
Feed-in Management

Monitor: Operational data is passed from the DER via the Reposit Cloud service and API to the DMCS. This builds a view of operation we call 'Grid Awareness'

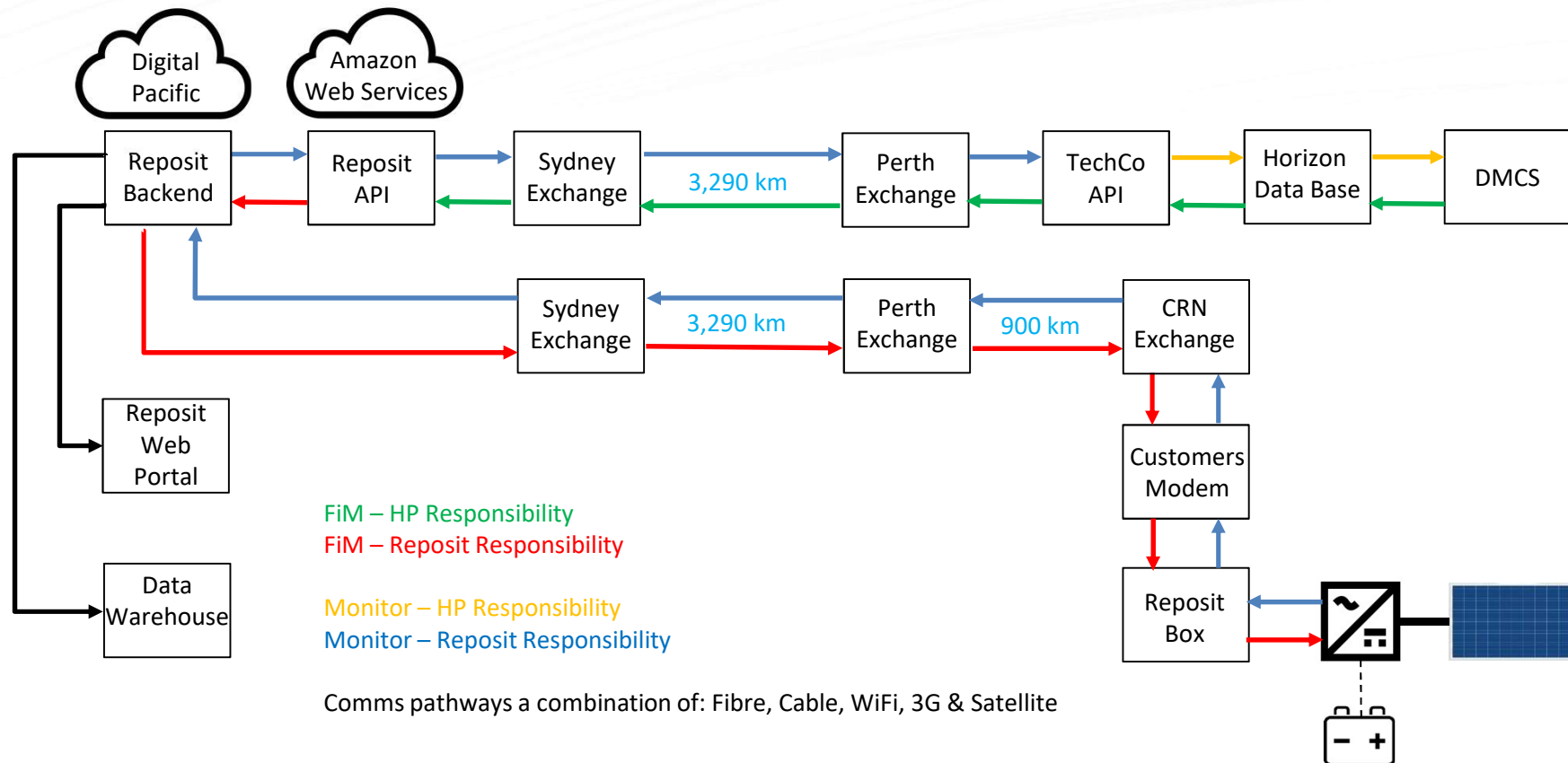
The DMCS monitors the external inputs

The DMCS makes the best decision possible using data inputs and predictive analytics

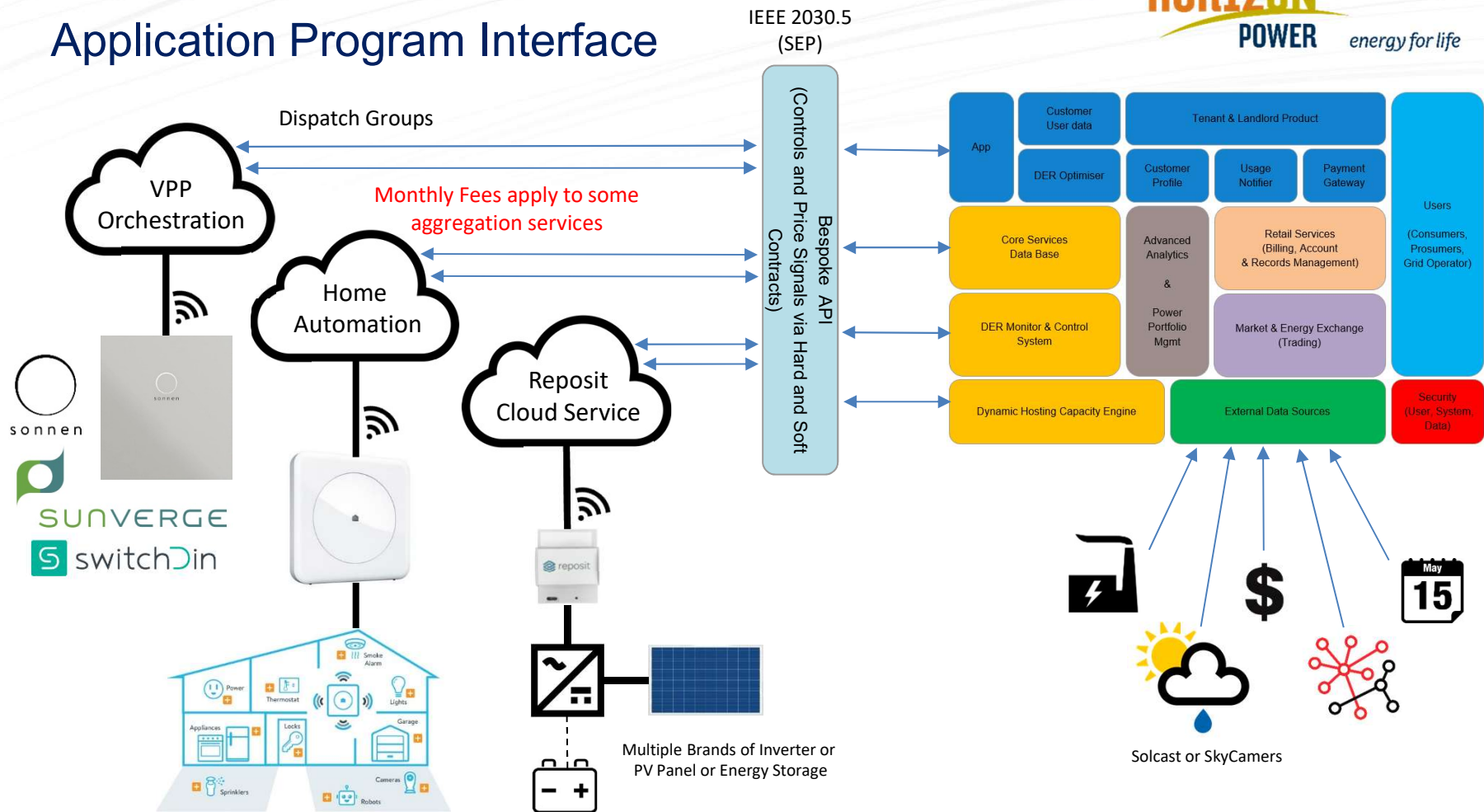
Control: The DMCS instructs the Reposit Cloud service to control the VPP. Reposit is responsible for procuring the required outcome via the VPP and the number of individual DER systems available to the VPP at that time.



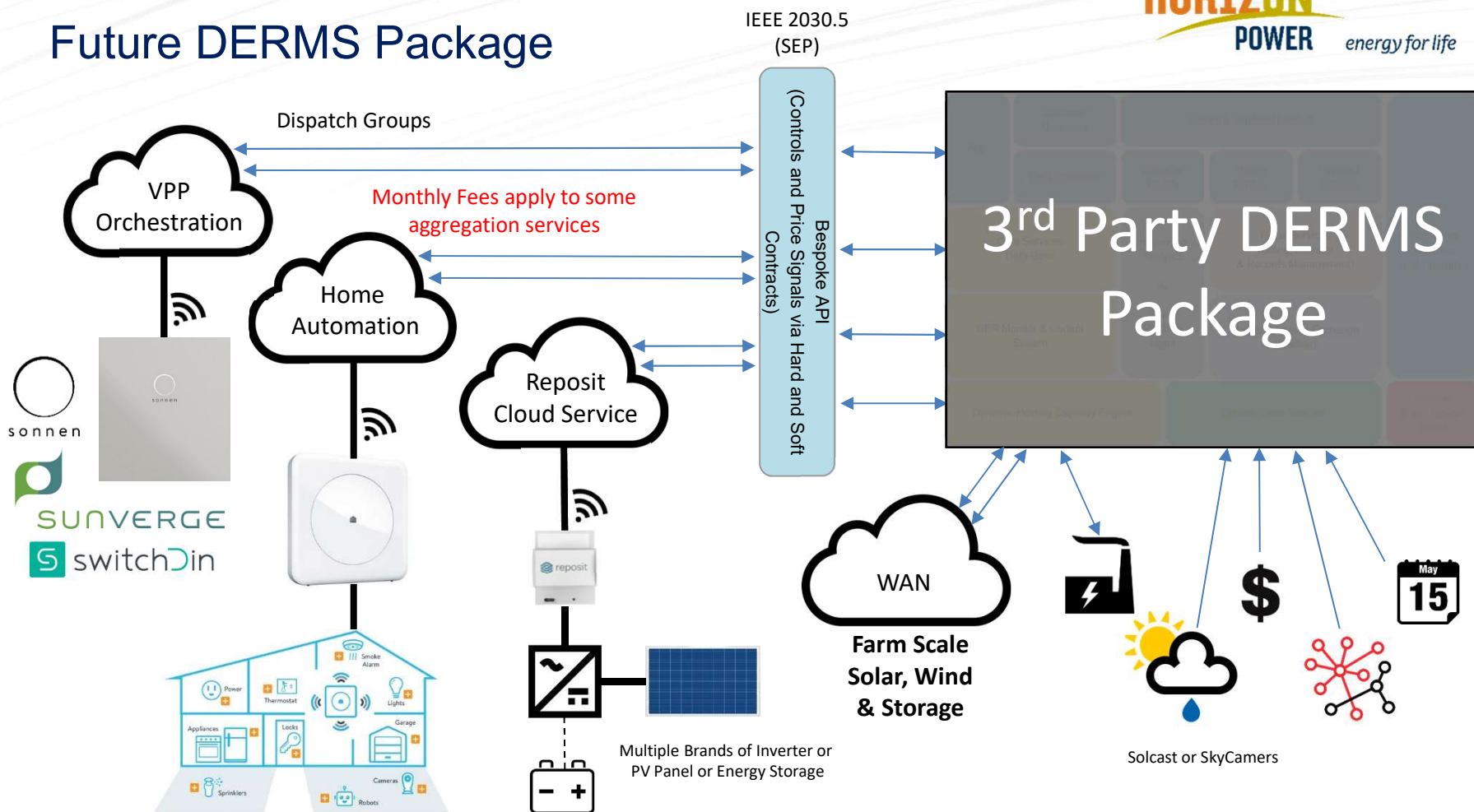
Feed-in Management



Application Program Interface



Future DERMS Package



Problems or Opportunities?

Engineers

- Controlling network connected capacity via the Internet
- Handing control of that capacity to a third party
- The third party is using a cloud service....in Sydney...
- Third party uses the customers internet connection

Customers

- Customer agreements – what's wrong with my existing bill?
- Boundaries of control – you want to control my PV...are you out of your mind
- Warranties and liabilities – you damaged my battery
- Data ownership – this is my data I own it
- IP ownership – you're making money out of my data
- Metering challenges – that tiny thing is not a real meter
- Broadband availability – I need to patch my what?
- Broadband congestion – you mucked up Game of Thrones
- Cyber Security – what exactly do you mean by Malware?



ARENA

Australian Government

Australian Renewable
Energy Agency

The Carnarvon DER Trial Activities received funding from
ARENA as part of ARENA's Advancing Renewables Fund.



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