Session 2 - Technology

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www.hvm-uk.com

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Agenda

- Demand-Side Management
  - the key to the Smart Grid
- Case Studies
- Smart Metering and AMI
  - DCC & Interoperability
- Distributed Generation
  - Alan South – Solar Century
- Renewables and Storage, markets and intermittency
  - Graham Ford – Mansion Partners

Demand-Side Management

DSM - What is it ?

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- **Loads**
  - **Domestic**
    - **Fridges**
    - **Air Conditioning (AC)**
    - **Air-Source Heat Pump (ASHP)**
    - **Electric Vehicle (EV)**
  - **Industrial**
    - **Chillers**
    - **Air Conditioning**
    - **Combined Heat and Power (CHP)**
    - **Big machinery**

DSM – Why do it ?

DSM – Why do it ?

- **Demand Reduction**
- **Peak Shifting**
- **Peak Lopping**
- **Trough Filling**
- **Short-Term Operating Reserve (STOR)**
- **Trading**

DSM – How to do it ?

DSM – How to do it ?

- **Frequency Control**
- **Remote Control**
- **Virtual Power Plant (VPP)**

DSM – The Future

DSM – The Future

- **Micro-Generation Integration (PV)**
- **Storage – domestic, community, grid**
- **Smart Appliances**
- **Dynamic Markets and Settlement**

Case Studies

Pacific Northwest National Laboratory

- What's smart?
  - Smart appliances, meters, and sensors adjust consumption dynamically based on usage
- Objectives:
  1. Manage the transmission constraint on the Olympic Peninsula.
  2. Manage peak load on distribution feeders to avoid the need for local capacity expansion.
  3. Provide ancillary services, such as spinning and non-spinning reserves, voltage support, and reducing cold-load pickup, by delaying restart after an outage.
  4. Minimize power purchases and maximize power sales to wholesale markets in the Western Interconnection, and minimizing a distribution utility's peak demand charges for power purchased from Bonneville Power Administration.
- Smarter Outcomes
  - 10% lower electricity bills
  - 50% reduction short-term peak loads
  - $70B projected savings though better use of existing infrastructure


GoodWatts: Thermostat Status - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address Go Links
GRIDWISE
GoodWatts™
Welcome,
16:56 PDT, Mon, May 8, 2006
Home | Help | Contact | Logoff: jbrous
Devices | Config Alerts | System Data | Cancel Curtailment | Account Notes
GoodWatts
- Homeowner -
Device Control
Heat Pump
Garage
Whole House Meter
Water Heater
Dryer
Scheduling
Thermostats
EM Switches
Occupancy Modes
Reports
Daily Temperature
Monthly Temperature
Daily Electrical
Monthly Consumption
Yearly Graph
Daily Profile
Alerts
Config Data
Thermostat Name: Heat Pump
71°F
AUTO
Cool: 94
Stage 1 OFF
Heat: 69
Stage 1 OFF
Aux Heat OFF
Home
Change System Mode
Change Fan Mode
Override Temperature
Override Occupancy
Cancel Override
Cancel Curtailment
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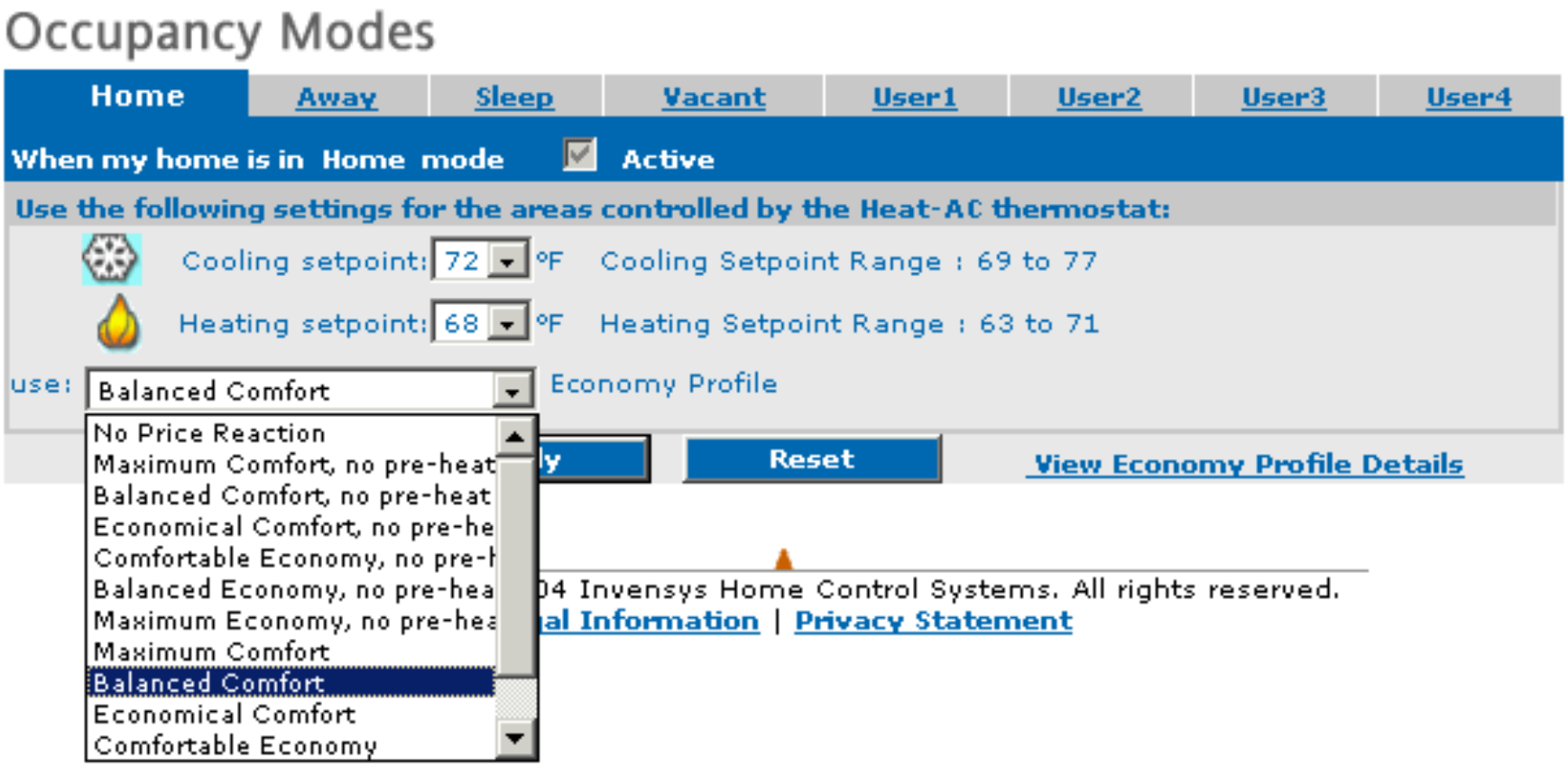
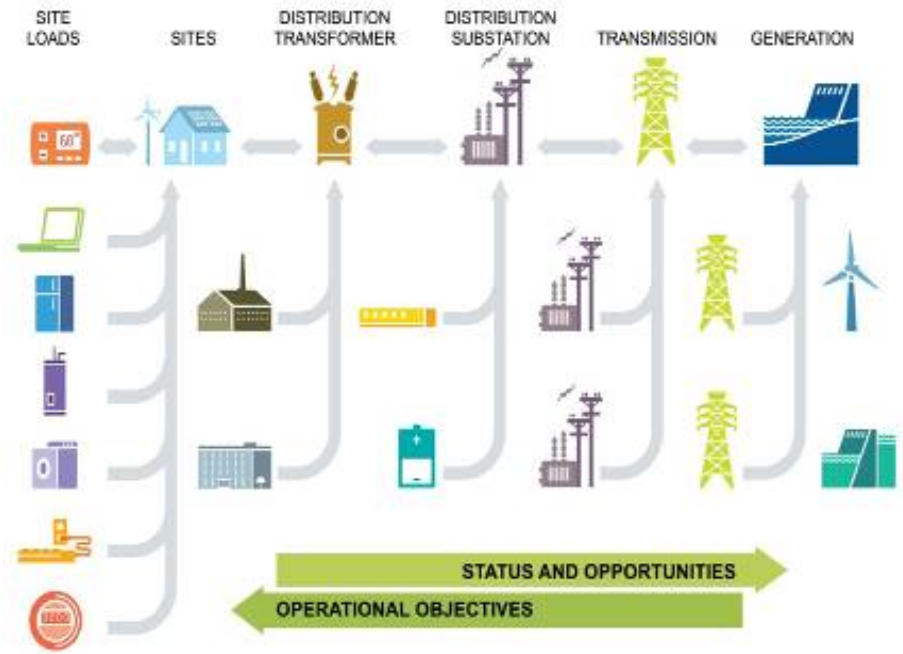
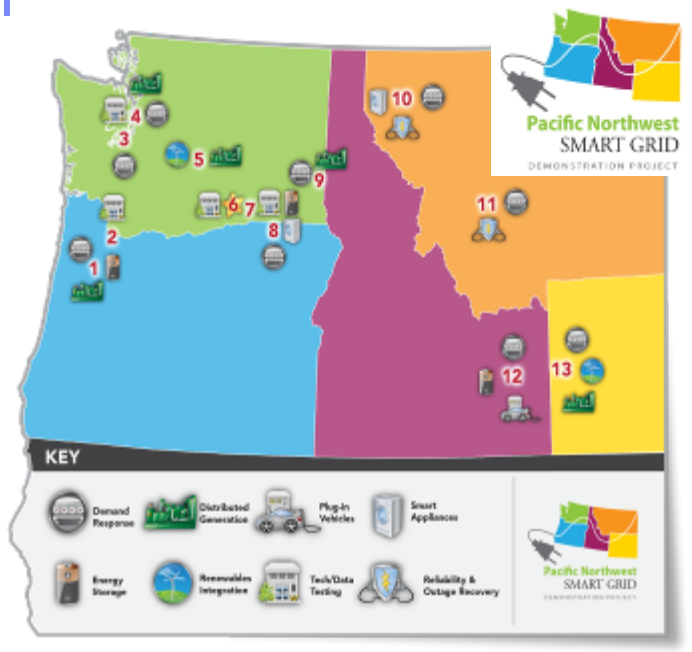
Adjusting the Thermostat Economy Profile



Pacific North West Transactive Control

- $180m US Federal Government sponsored programme
- 5 states, 60,000 premises, countless appliances & devices
- Developing ‘transactive control’ capabilities at scale, to:
  - Manage peak demand
  - Facilitate renewable resources
  - Address constrained resources
  - Improve system reliability and efficiency
  - Select economical resources to optimise the system





- A highly distributed solution for managing responsive energy assets on an electric grid
- Aggregation of power & signals occurs through a hierarchy of interfaces
- Enables a ‘market’ of micro-bidding devices to establish optimal power supply and demand conditions.
- Algorithms defining cost-based economic signals drive a distributed control system signal

Bornholm Island: balancing wind energy with demand

- **EDISON** - 50 EVs on the island used as storage batteries for excess wind energy. When the wind blew the cars charged, when the wind died down, the cars provided extra capacity to the grid

- **EcoGrid EU** – New project to balance load using dishwashers, heat pumps and electric water heaters, as well as the EV batteries, to store excess energy in 2,000 homes on the island
  - Total budget €21m in a large scale demonstration of a real-time market place for distributed energy
  - Controlling a *real* power system with more than 50 % renewable energy

EcoGrid eu
www.eu-ecogrid.net

CO-FUNDED BY THE EUROPEAN UNION

SEVENTH FRAMEWORK PROGRAMME

Nevada Energy Cool Share Program

The Need

- Automated control of high demand appliances to reduce load during periods of high demand
- Cool Share helps customers save money whilst helping NV Energy maintain a stable energy supply during energy peaks.
- 50,000 households participating in Cool Share play a critical role in maintaining reliable power supplies during the summer, reducing environmental impact
- In 2012 Cool Share customers saved 140 Megawatts of electricity – equivalent to the energy consumed by 19,000 homes

Energy Rebate Calculation

Energy Saved (kWh) X Real-time Energy Rate ($/kWh) = Energy Rebate

The Approach

- Participants get a Digital Control Unit (DCU) or a programmable thermostat (PCT) through which NVE initiates energy events during peak periods.
- Sends signal to PCT or DCU and setpoint temperature is increased 4F during the energy event. With a DCU, the signal tells the compressors in the air conditioner to cycle on and off during the energy event.
- House temperature may rise a little, but most Cool Share customers say they never even notice the change.
- Can override the energy event, but not participating reduces the annual Cool Share rebate.

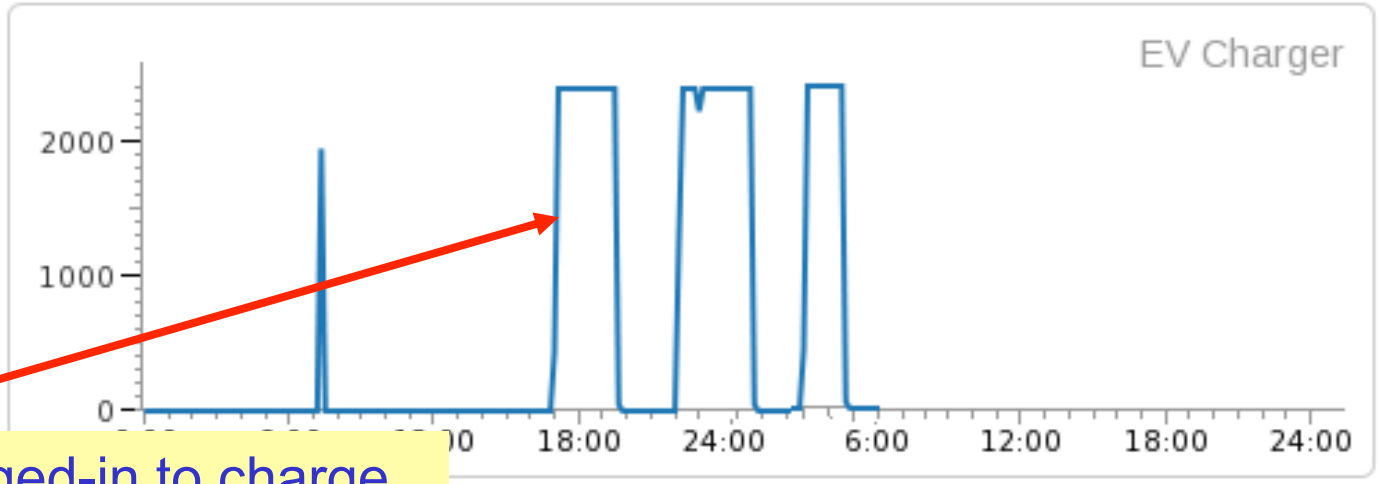
NVEnergy

Localised domestic demand management

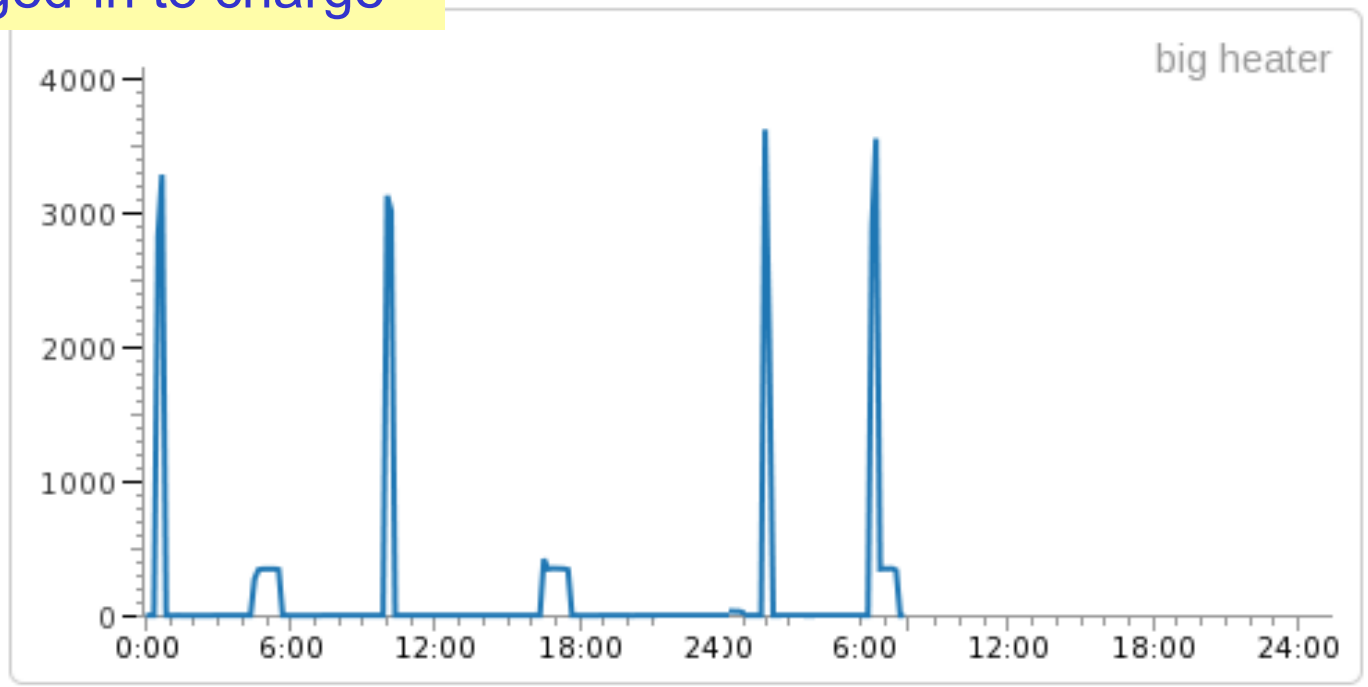

CF-965-EN
F
79

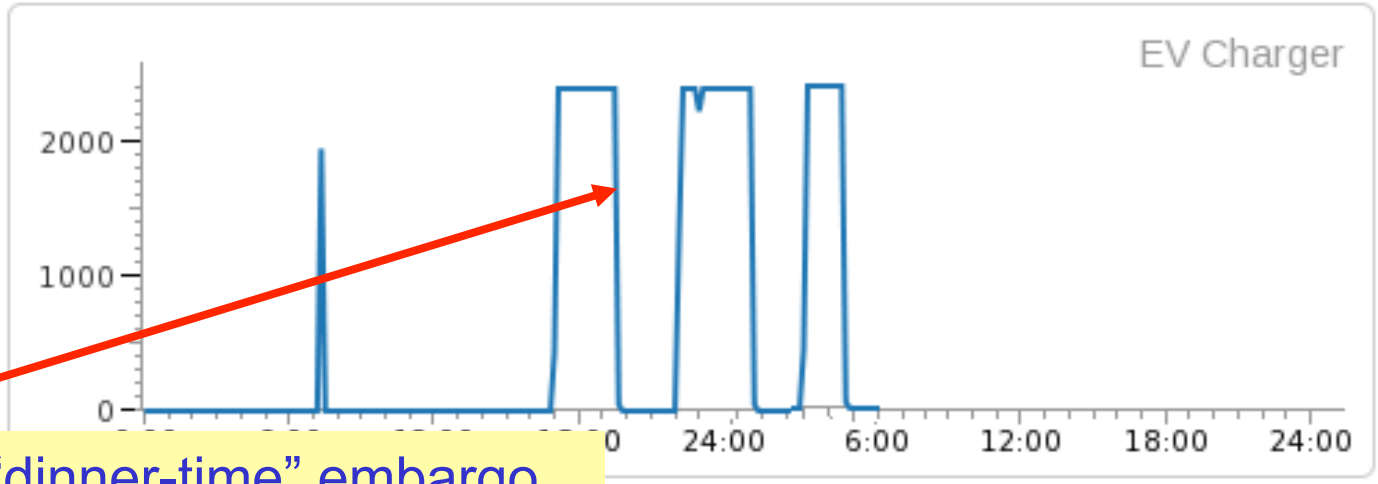

zero emission


RE-HEATABLE

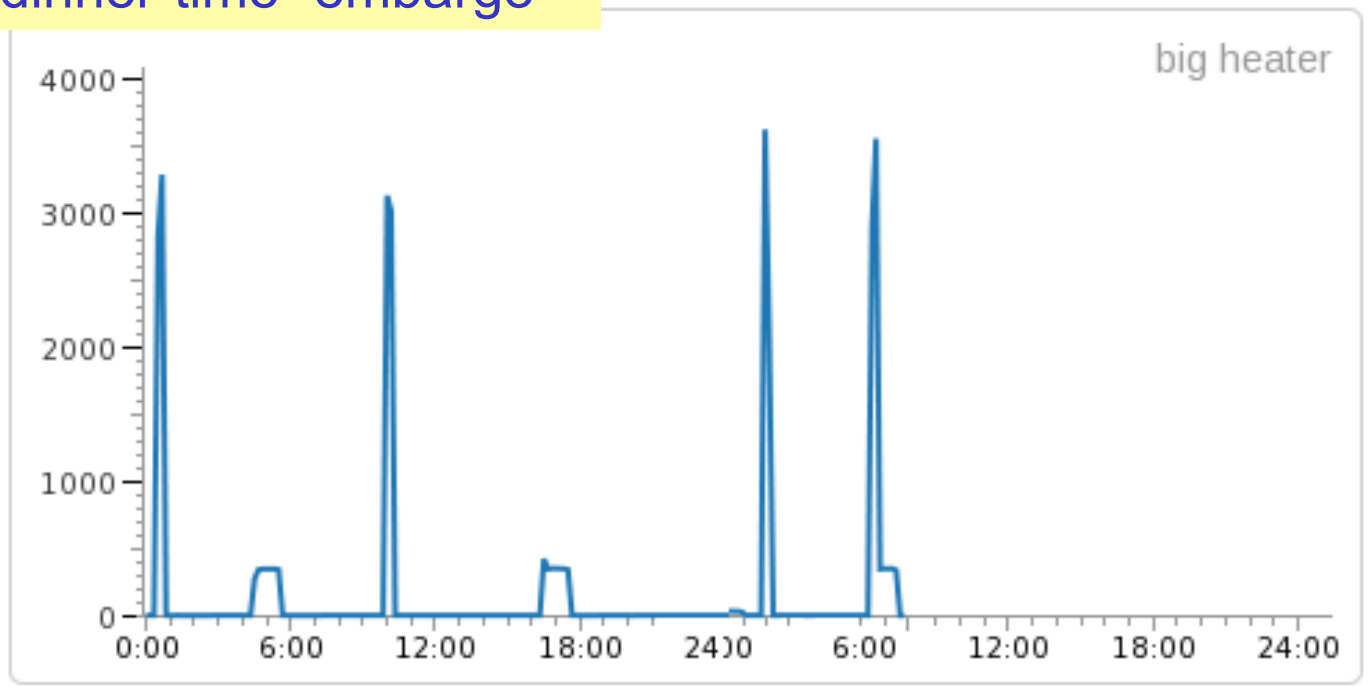


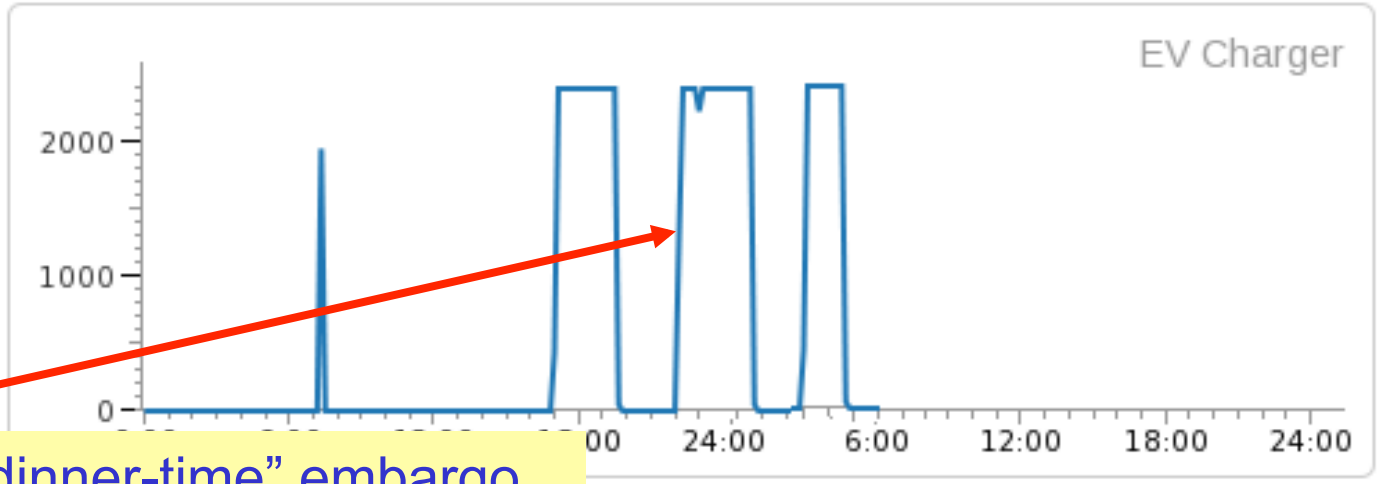
EV plugged-in to charge



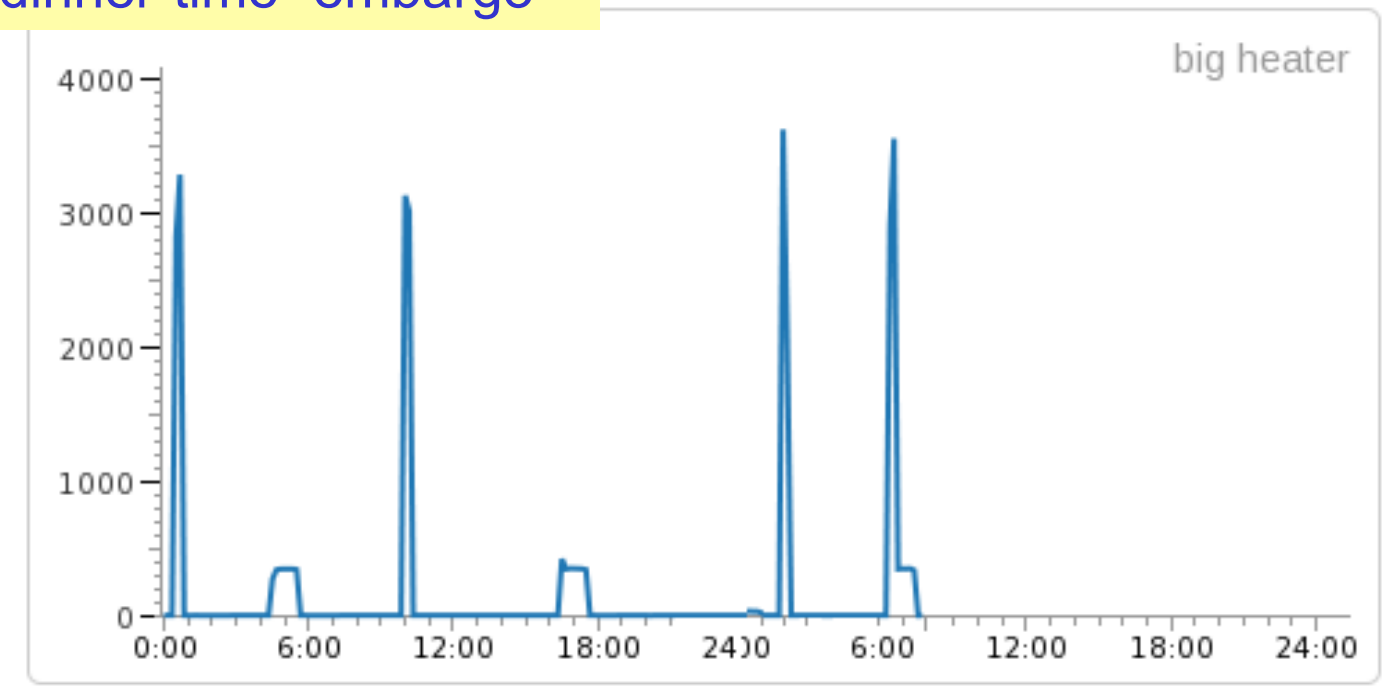


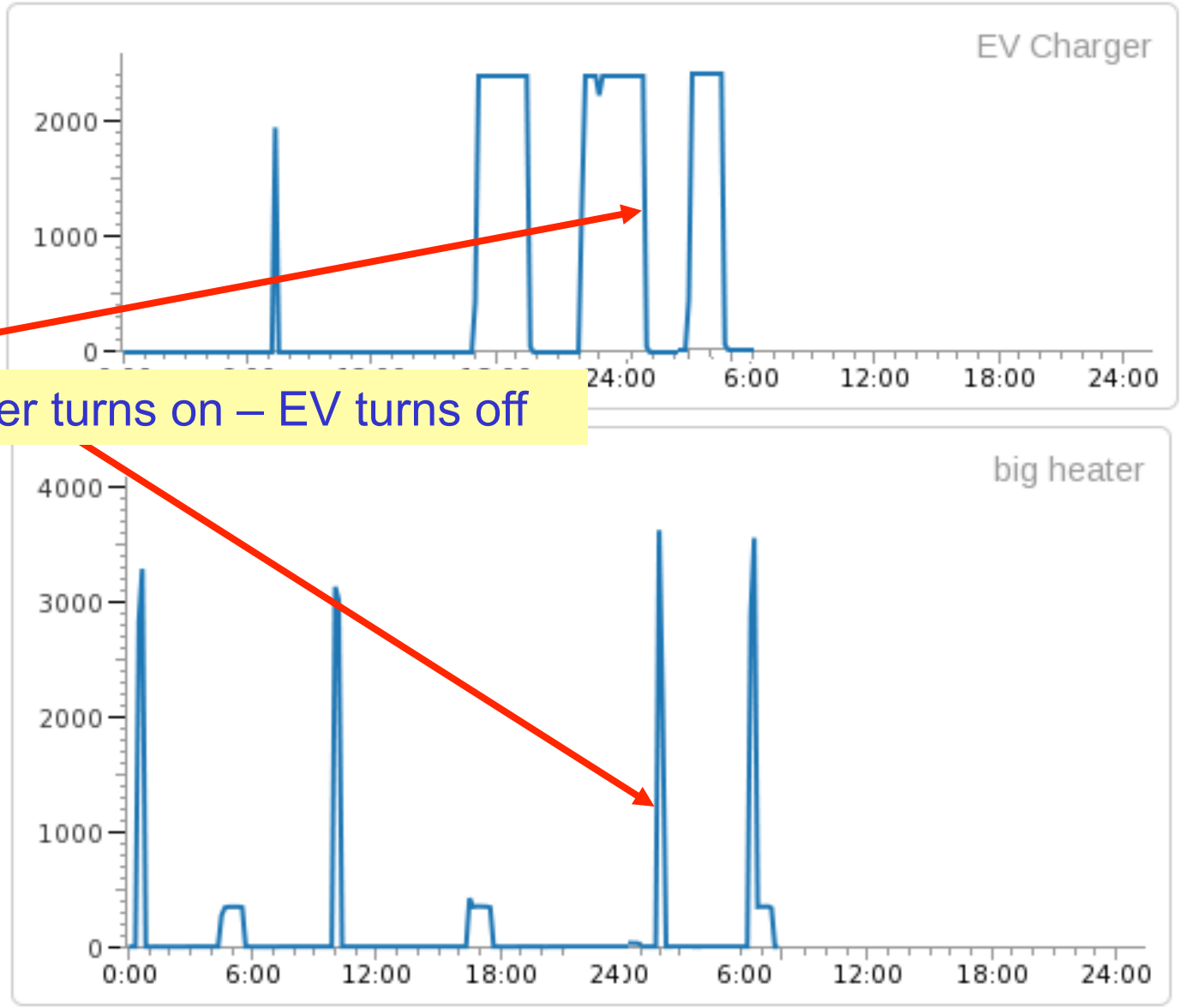
Start of “dinner-time” embargo



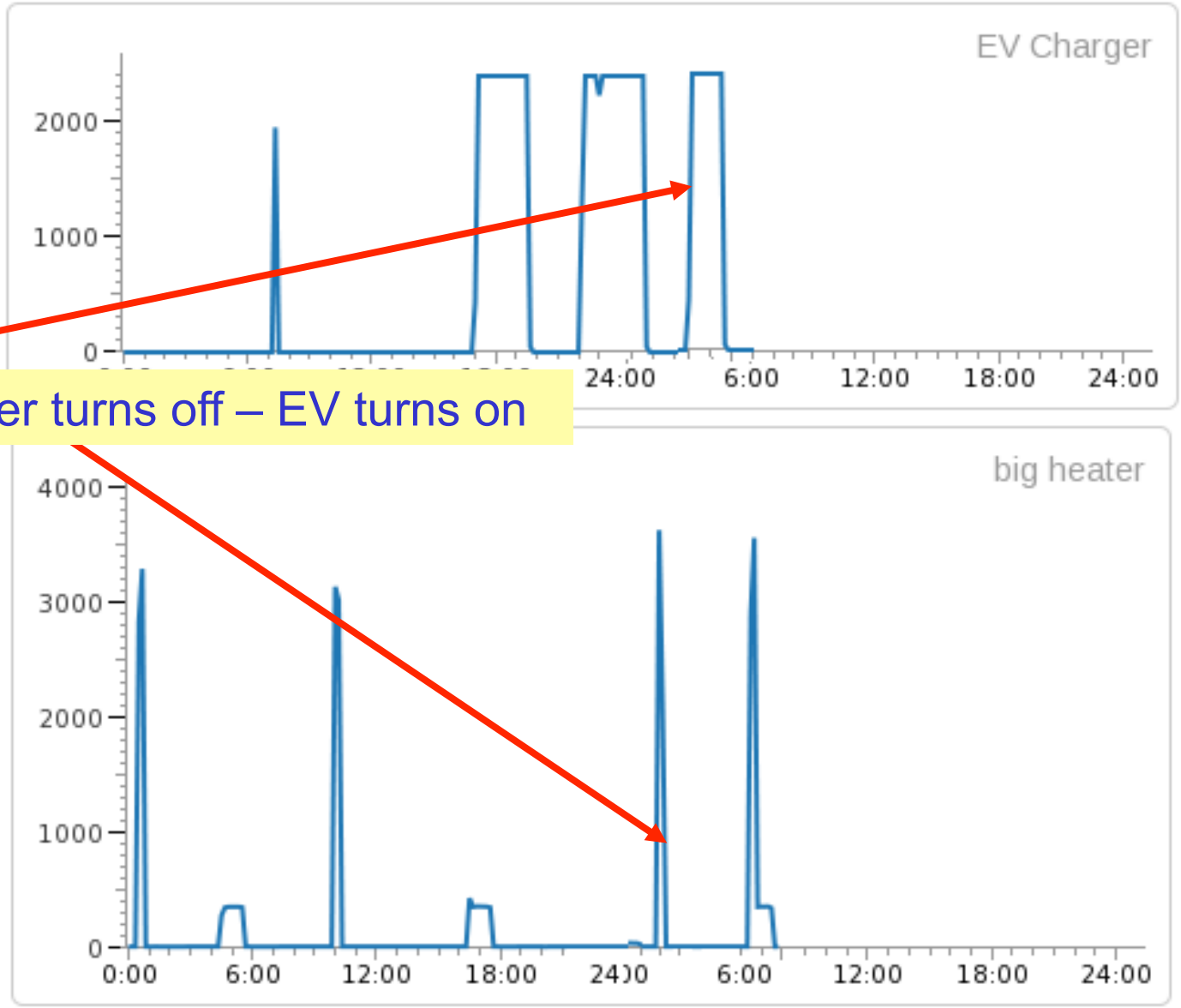


End of “dinner-time” embargo

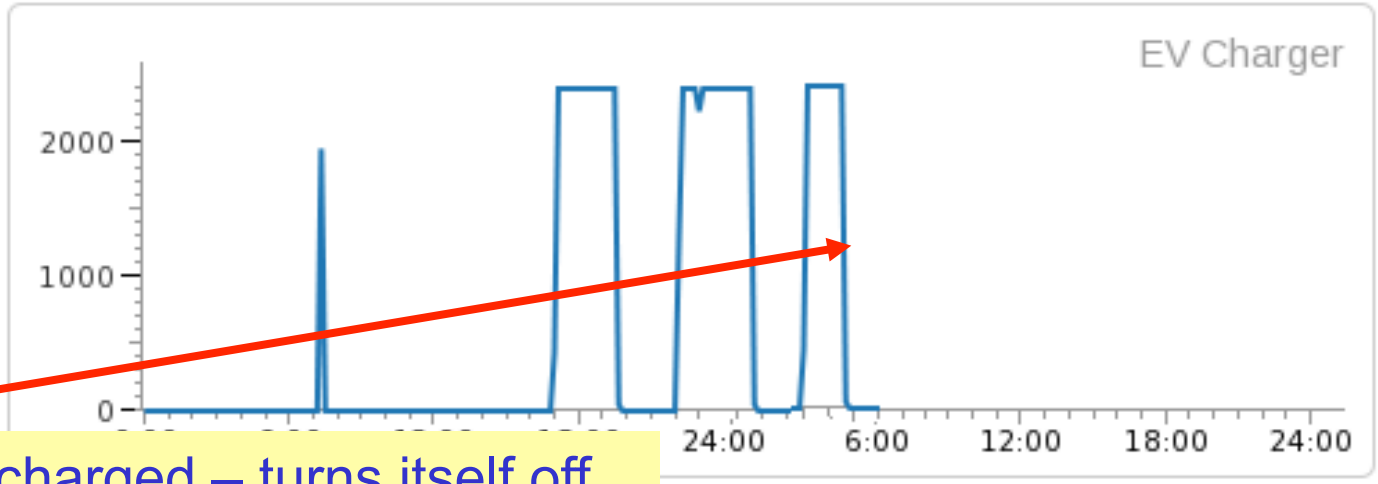




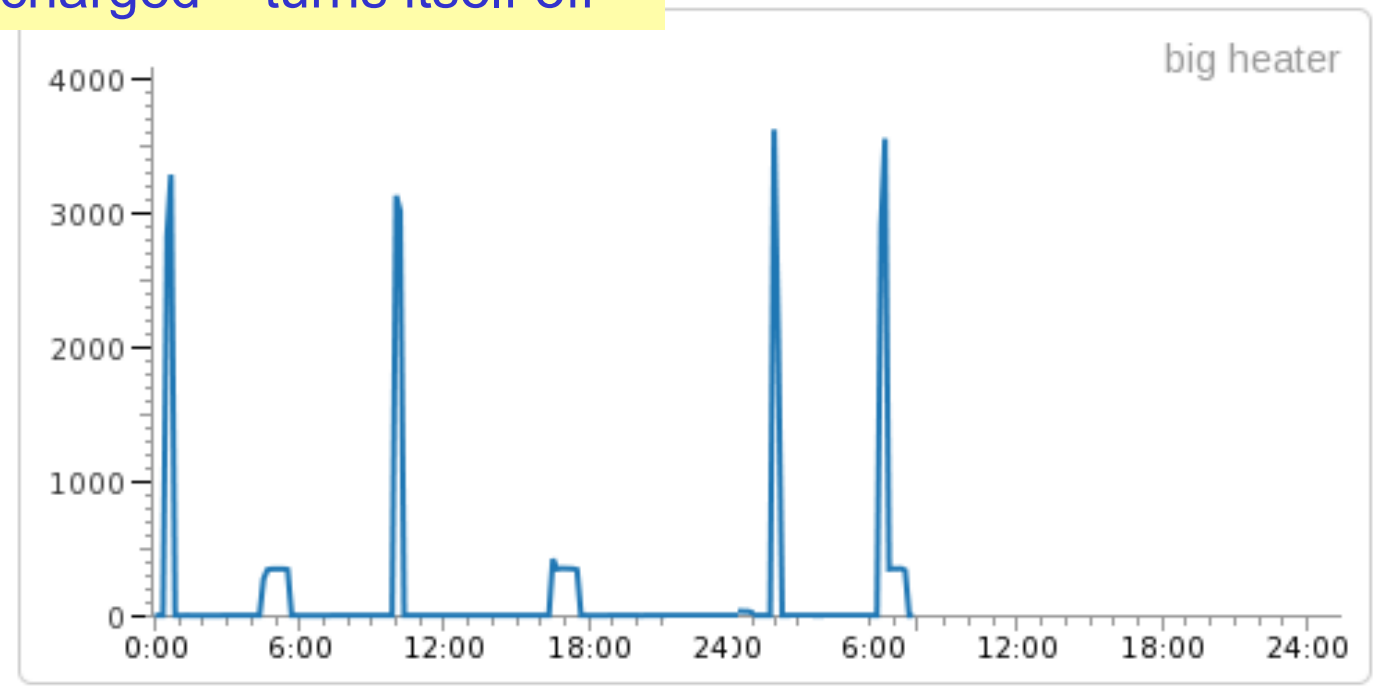
Big heater turns on – EV turns off



Big heater turns off – EV turns on



EV fully charged – turns itself off



Remote demand management

Remote control of EV charging

ecoisland
The hub of a sustainable future

Remote control of EV charging

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The hub of a sustainable future

Remote control of EV charging

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Demand-management event

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The hub of a sustainable future

Demand-management event

Cooling Fan

Table Lamp

Electric Heater

Electric Vehicle

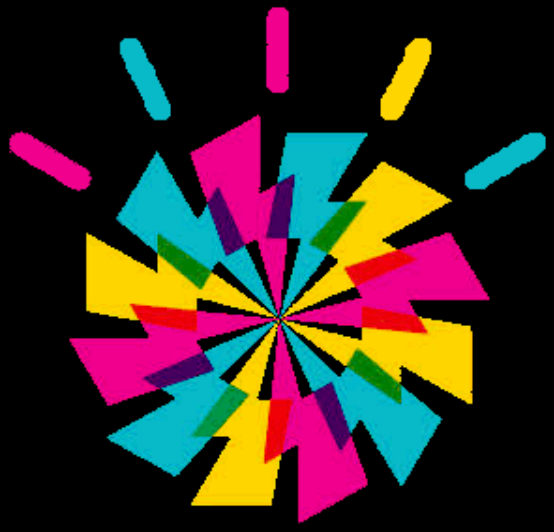
ON ON ON ON

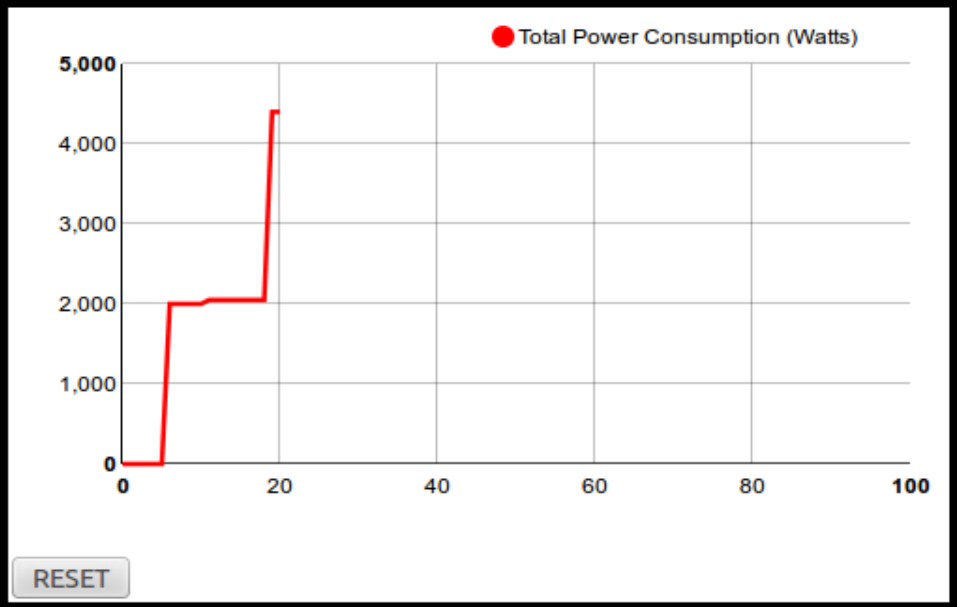
OFF OFF OFF OFF

IBM

Power Consumption

4400 W





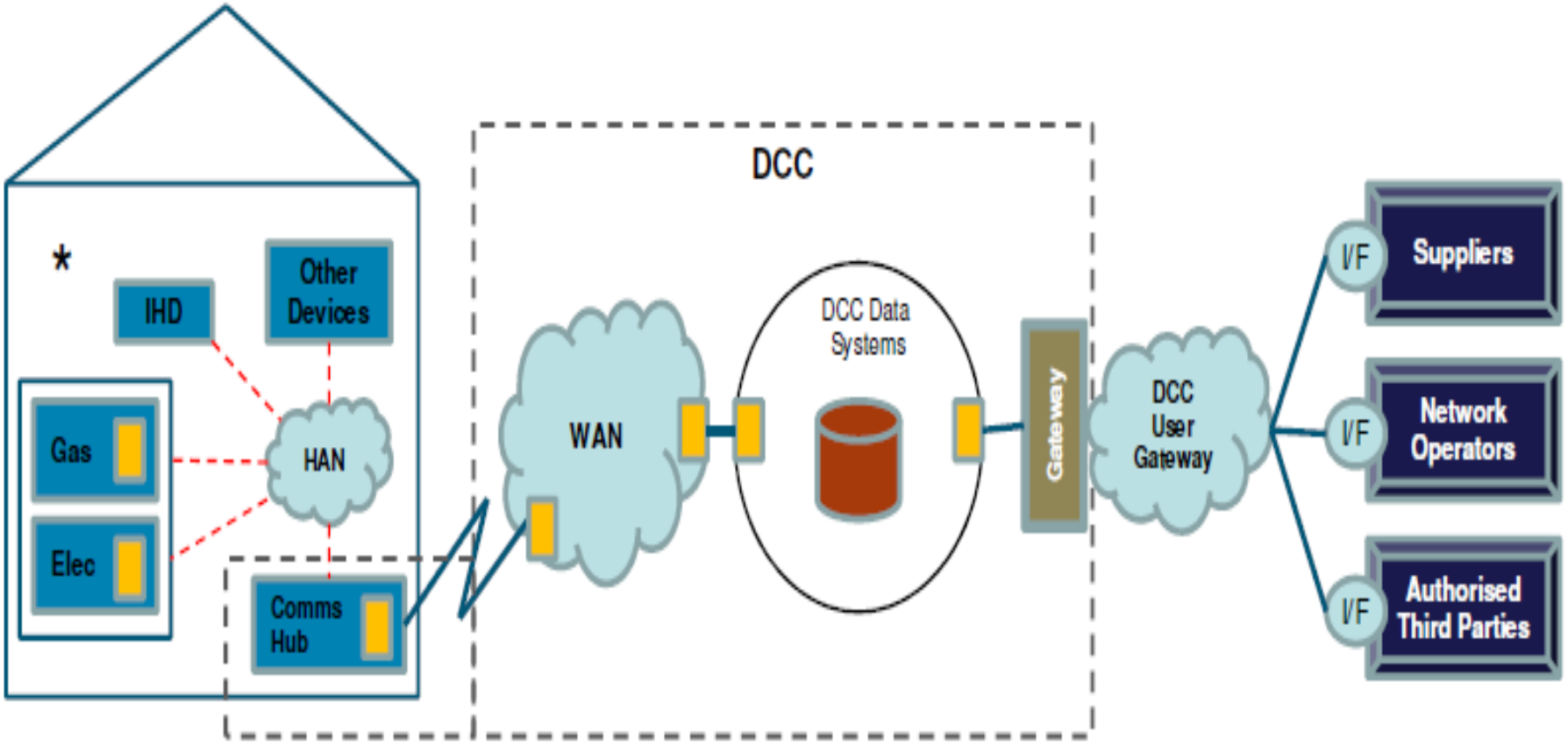
Smart Metering and AMI
DCC & Interoperability

Smart Metering vs AMI/AMR

UK Smart Metering Infrastructure Programme

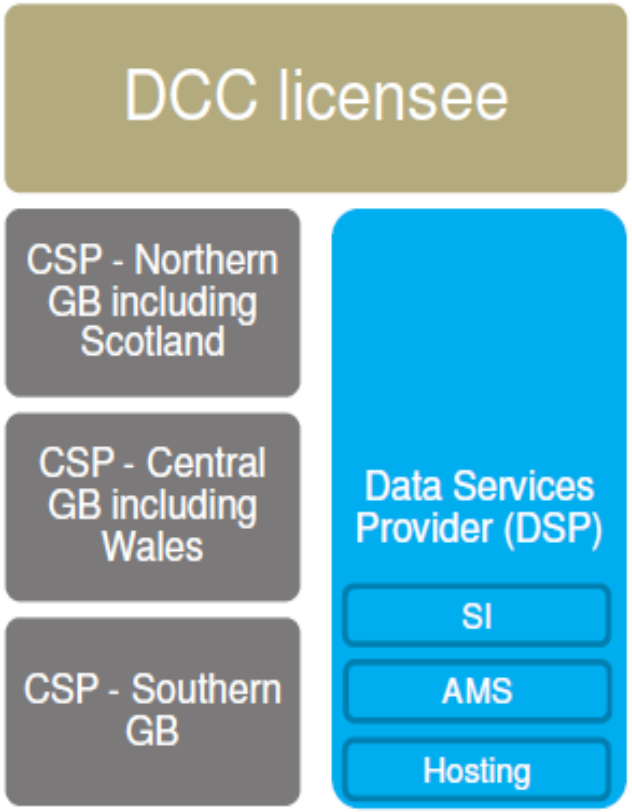
- **DCC, DSP, CSP, DSU, ATP, SEC**

The UK Government has mandated deployment of 53 million electricity and gas smart meters by the end of 2019

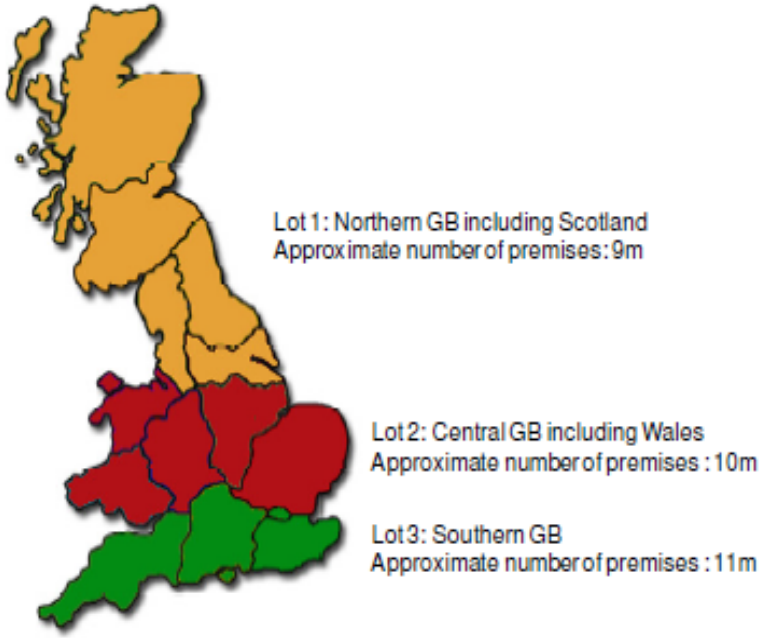


DECC DCC Procurement model

DCC business model

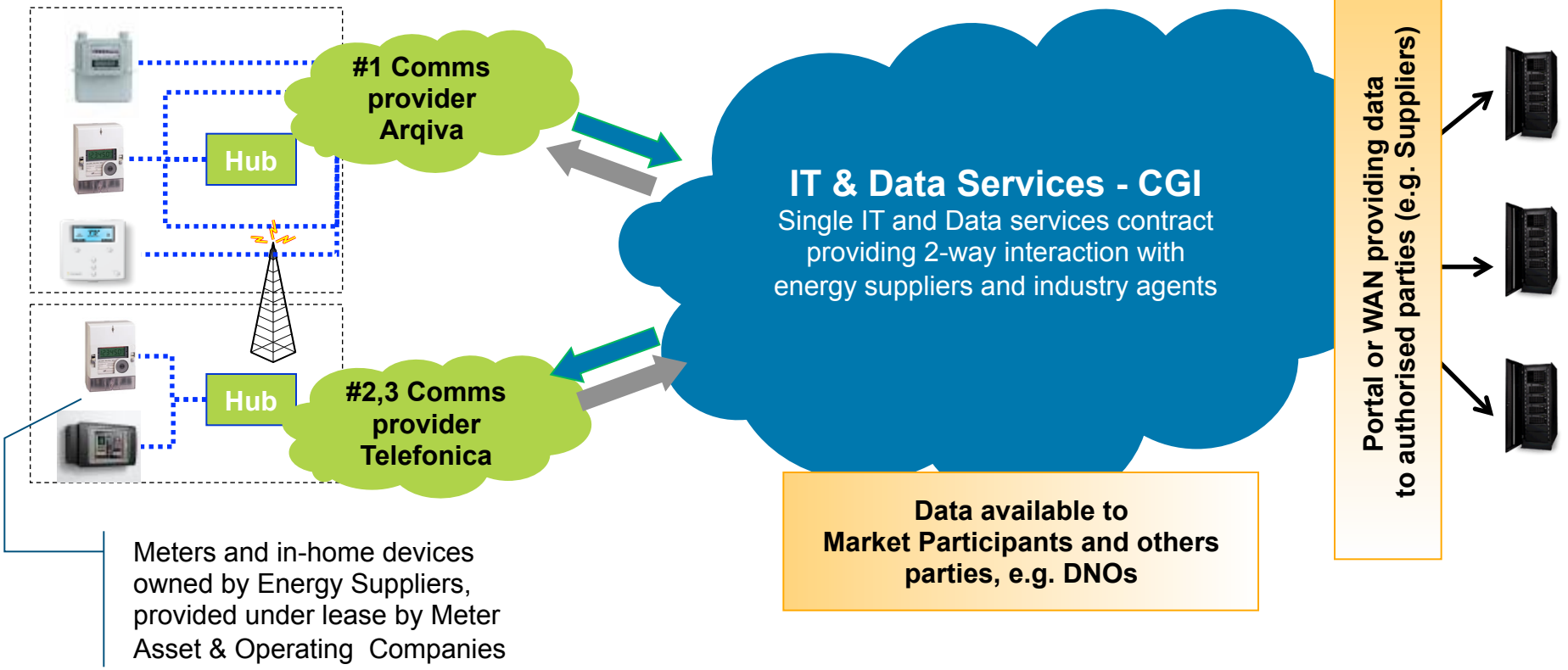


Communications services regional lots



Data & Communications Company - Capita

New regulated Agent providing central communications & data management services to industry



DECC
SMIP
SSWG
SMETS
DLMS
GBCS
CESG
SMKI
OMG!

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Distributed Generation

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Solar Century

Renewables and Storage, markets and intermittency

Graham Ford

Mansion Partners