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ORIGIN and Beyond

Edward Owens and Andrew Peacock

School of Energy, Geoscience, Infrastructure and Society

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Current Energy Issues include

Resource depletion

Ongoing concerns over climate change

Intermittent generation

Electric cars may significantly increase demand for electricity

Fuel poverty

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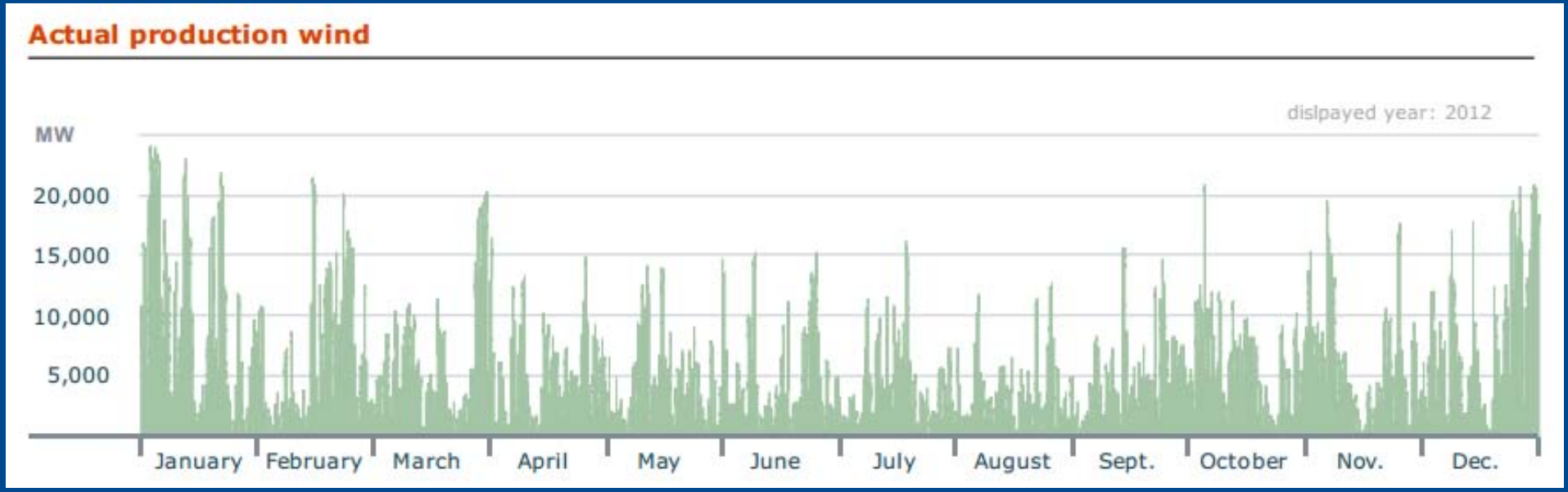
German Wind Generation 2012 – Capacity Factor = 18%



http://theenergycollective.com/schalk-cloete/259876/intermittent-renewables-and-electricity-markets

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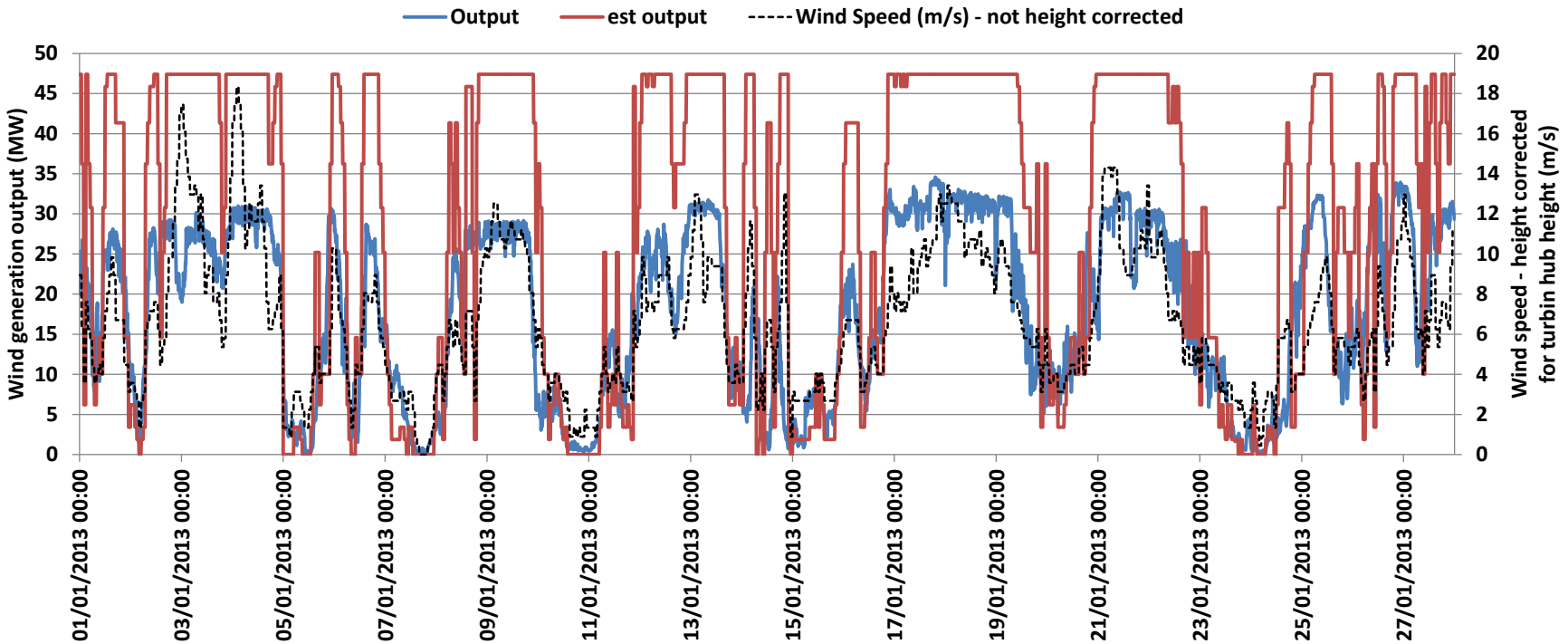
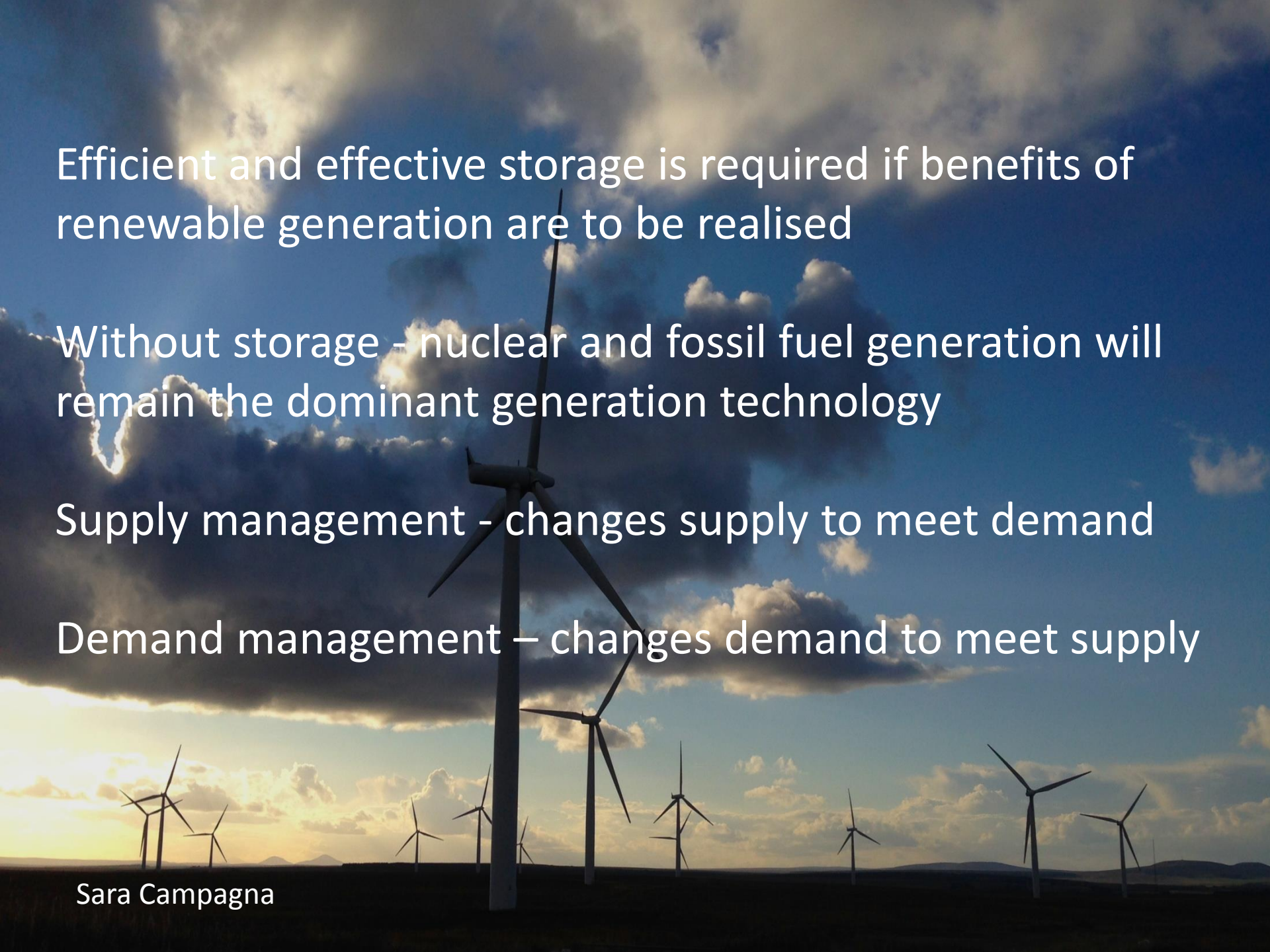
Grid Curtailment / Too much wind



Orkney January 2013



Efficient and effective storage is required if benefits of renewable generation are to be realised

Without storage - nuclear and fossil fuel generation will remain the dominant generation technology

Supply management - changes supply to meet demand

Demand management – changes demand to meet supply

Sara Campagna

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ORIGIN – The Concept

- Begins with our national obsession – the weather

www.radioaustralia.net.au/

http://gowerkitecentre.org.uk/wind_forecast.cfm

https://dqbasmyouzti2.cloudfront.net/

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An accurate local weather forecast enables us to forecast

- Wind Generation
- Solar Generation
- Demand for Energy

http://knxtoday.com/2013/10/2380/case-study-a-wooden-house-with-a-gira-knx-brain-dachau-germany.html

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ORIGIN Forecast

- Wind
- Temperature
- Cloud Cover
- Energy Demand
- Hence predict Demand Shifting Opportunities
- At a local / community level

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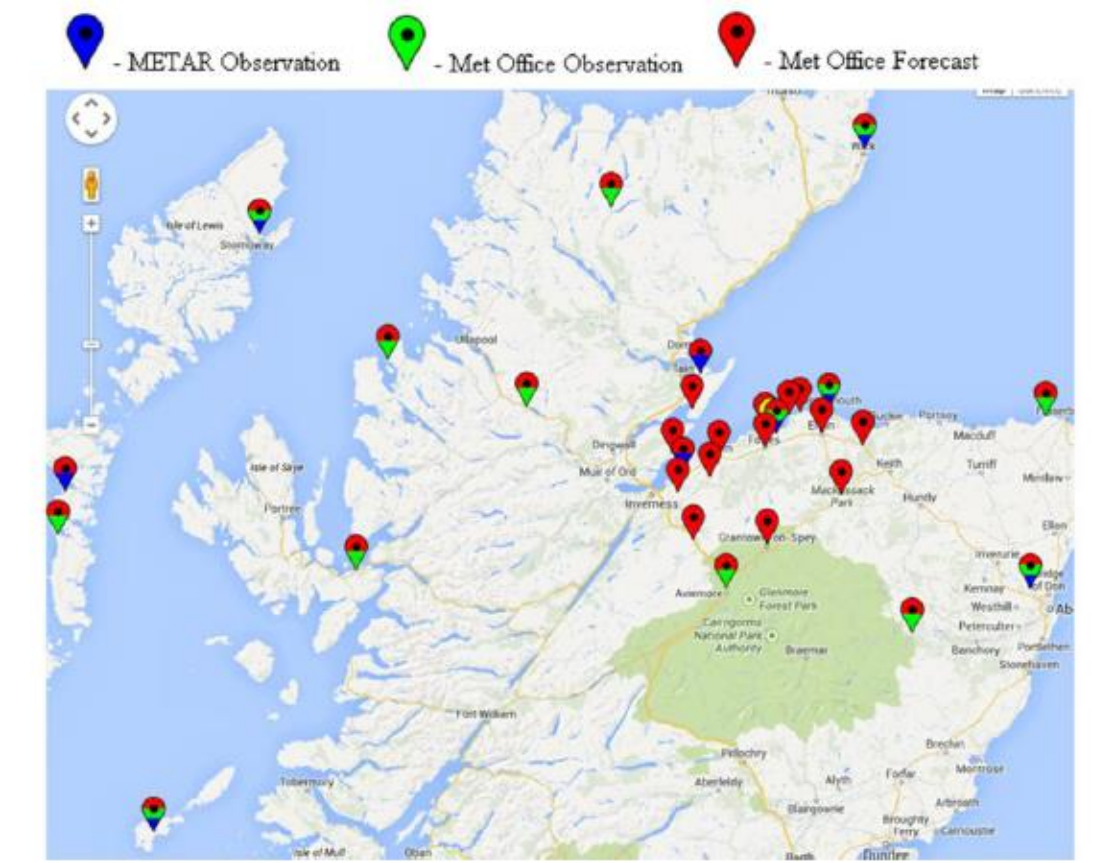
ORIGIN concept



- Captures web enabled observations and forecasts for c37 sites around Findhorn
- Every hour predicts next 48 hours weather at hourly precision
- Highly localised weather forecasting

Corne et al, Heriot Watt University

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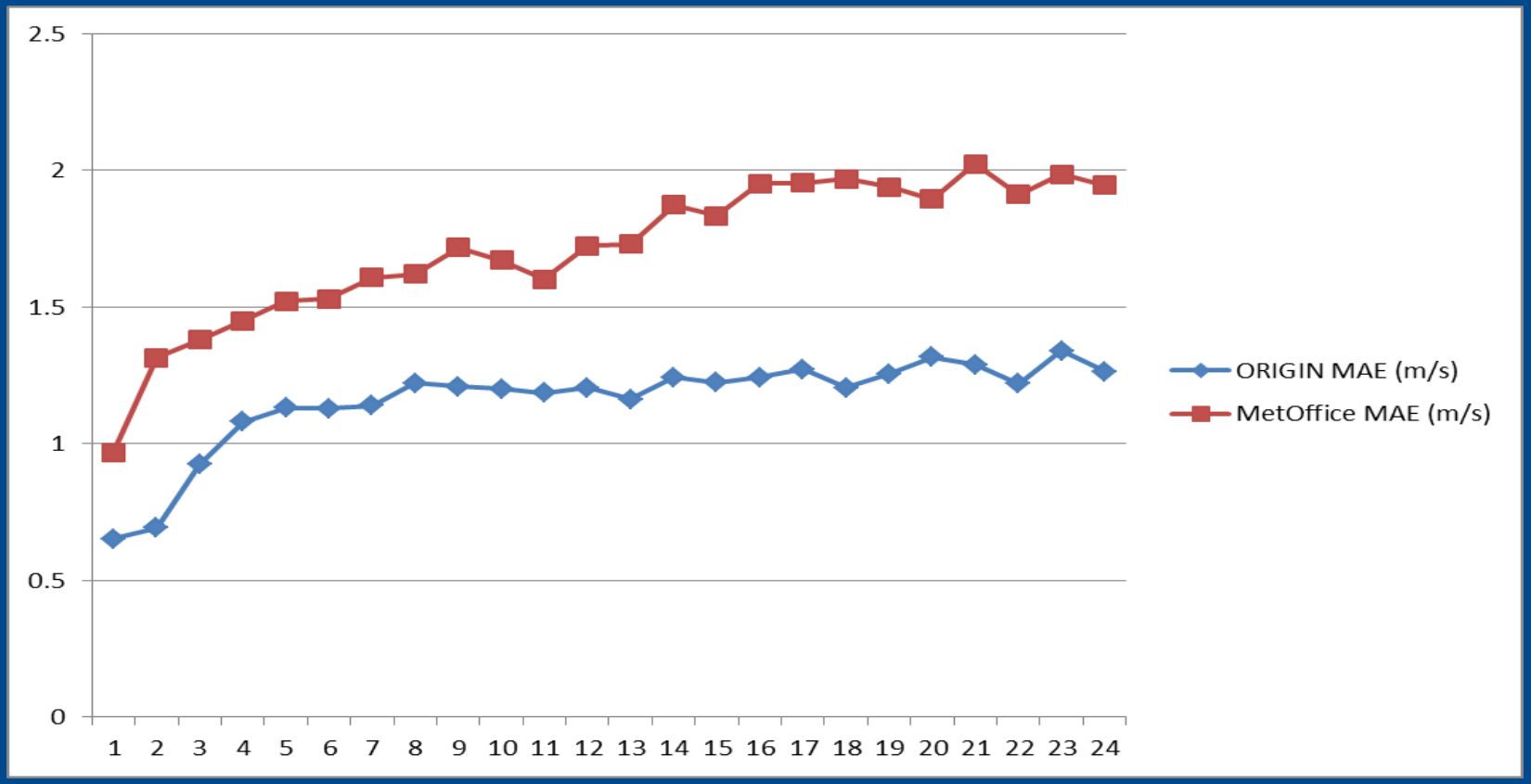

MetOffice forecast errors (in m/s, showing mean absolute error) vs ORIGIN error, for forecasting wind speed at Findhorn
Horizontal axis is 'hours ahead'.

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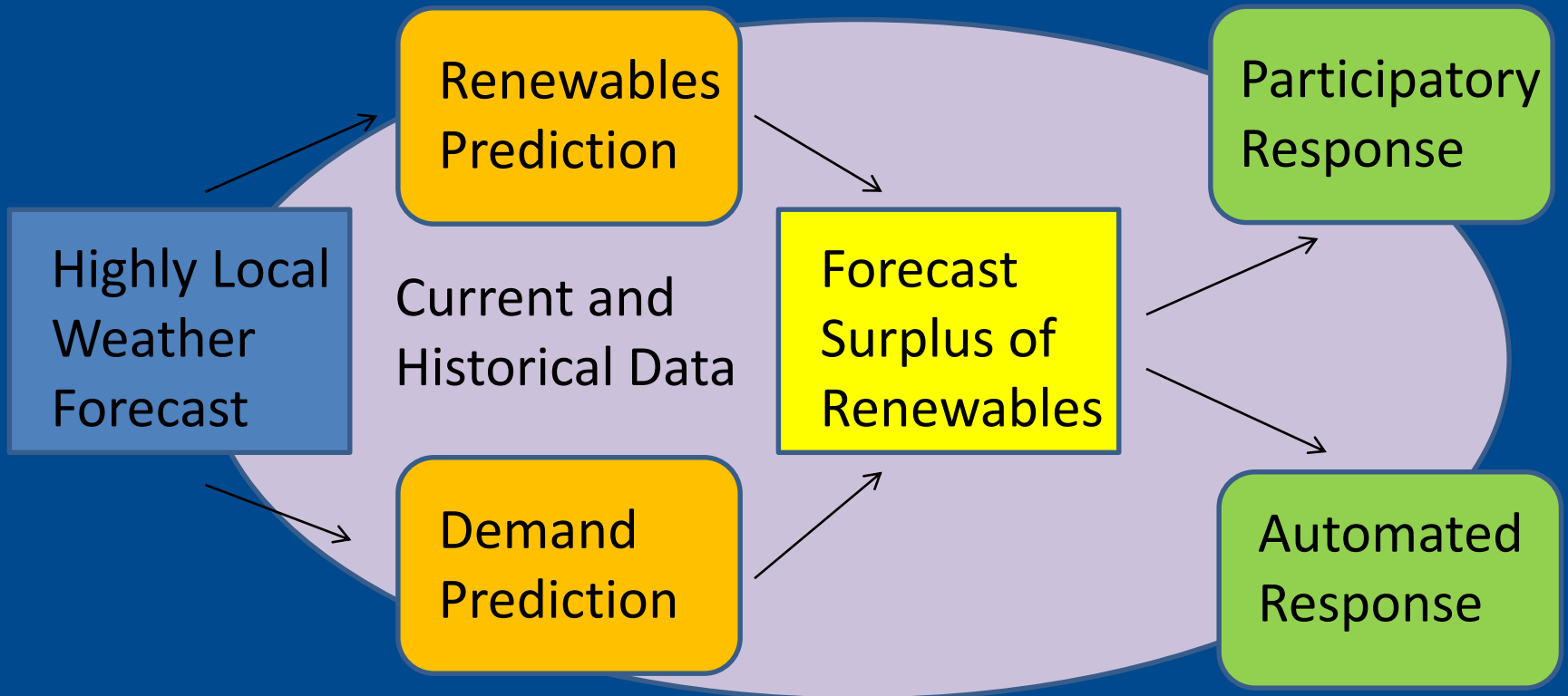
ORIGIN concept

Orchestration algorithm



See Ya Later | MailChimp | ORIGIN UI | https://www.alumni.hw.a

origin-concept.eu/portal/index.html#/dashboard

ORIGIN concept

Feedback Form

If you have any comments please send them through the feedback form on the top right corner

Findhorn

Buildings list | Dashboard | Monitoring

L.K.Bryden
Project Manager

Home > Findhorn > Dashboard

Findhorn dashboard

Yesterday | Monthly | Since Origin

+ Add Gadget

Energy Clock

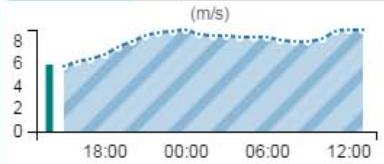
Weather Forecast

6 °C

Last reading
Wednesday 14:40pm

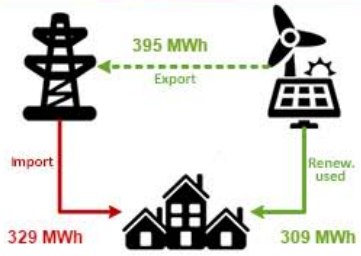
Solar: 128 W/m2
Wind: 5.7 m/s S
At.Pressure: 1006 hPa
Humidity: 71 %
Precipitation:-

Wind | Temperature | Clouds



Availability

Energy Balance



Total Consumption: 638 MWh

Generated Energy Used: 44%

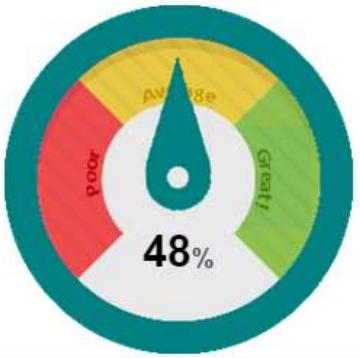
CO2 Savings

Emissions: 117.3 TCO2

Saved by Green Energy: 111.3 TCO2

49%
CO2 Savings

Green-o-meter



Recomms: following that, it looks like 26/02/2015, 14:00, will be promising.

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Customised feedback is important!

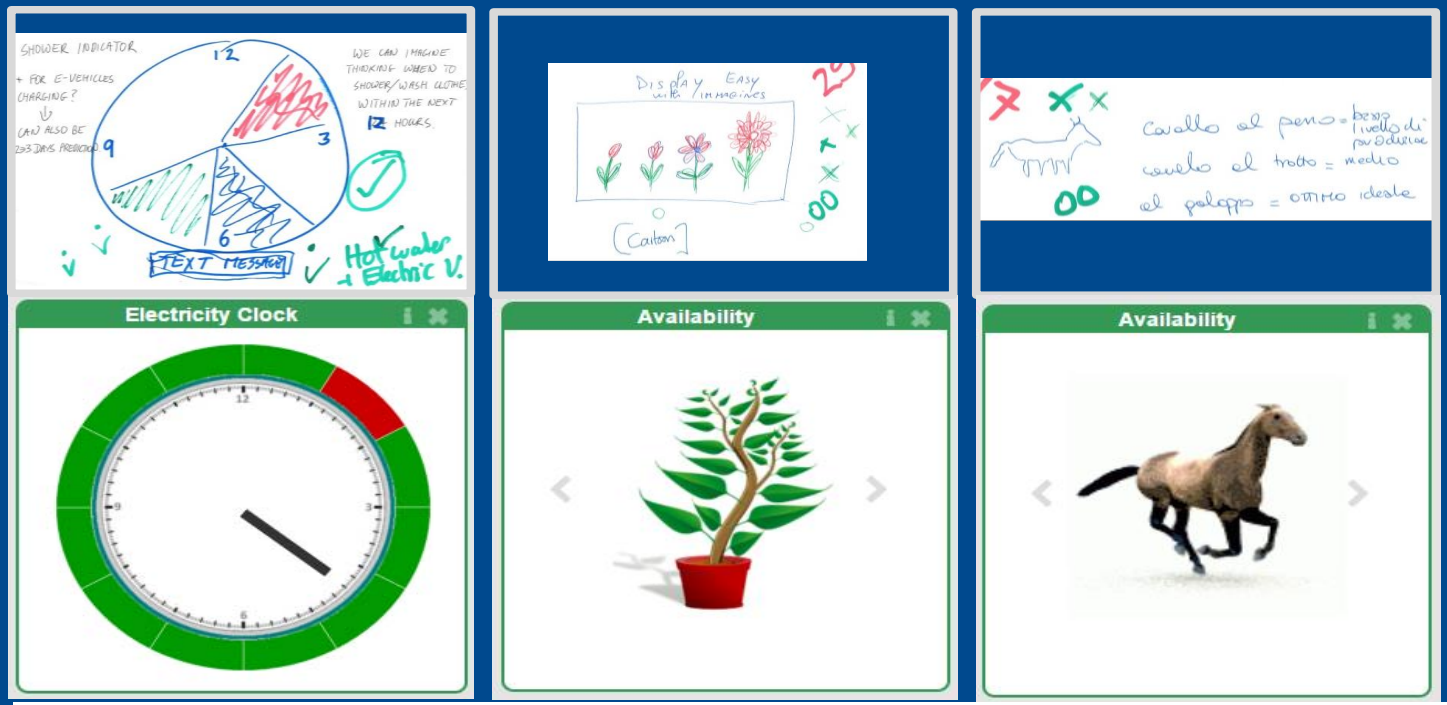

Figure 2.4: How input from the community participatory design workshops was translated by the design team to create the ORIGIN UI.

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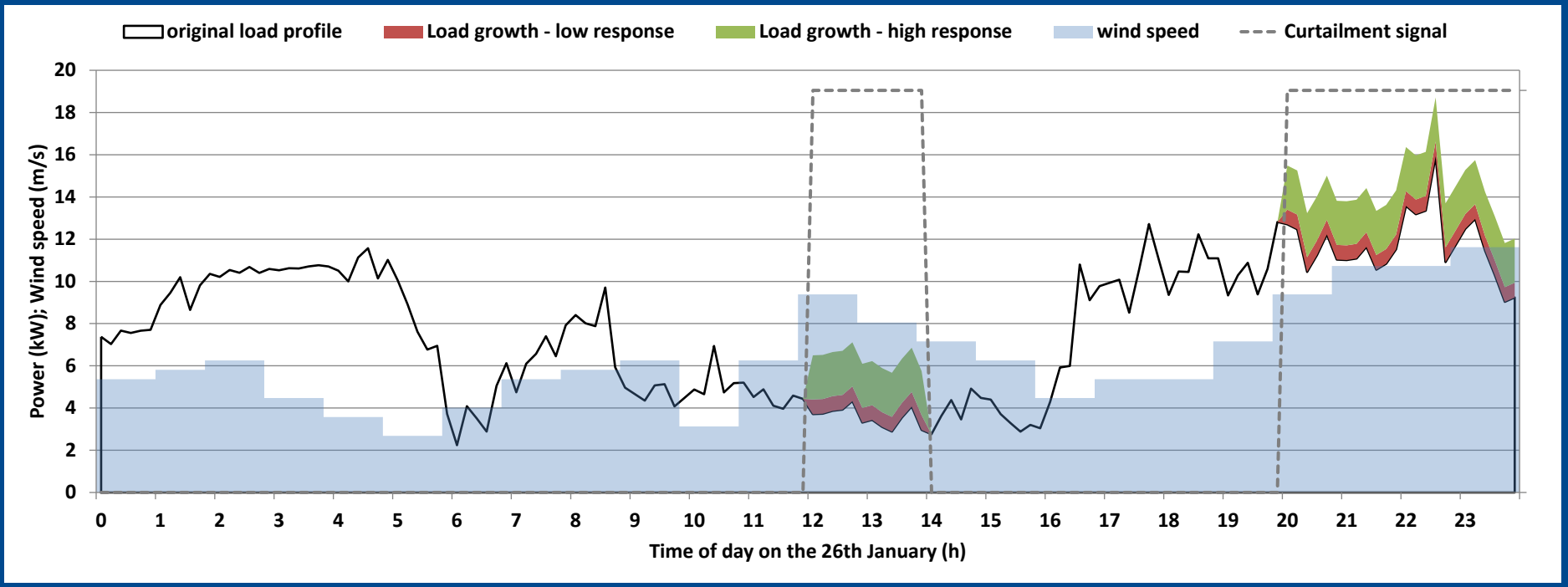
Moving Demand to Meet Supply



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- Changing the way we sell electricity would help – variable tariffs
- 5p when the wind blows – 15p when it doesn't - would guarantee a response from the public
- Truly smart meters enable time of day billing and make this possible
- New business models would be needed
- However people tend to revert to their norm after initial period of enthusiasm. - with the exception of enthusiasts – gamification

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So what did ORIGIN find?

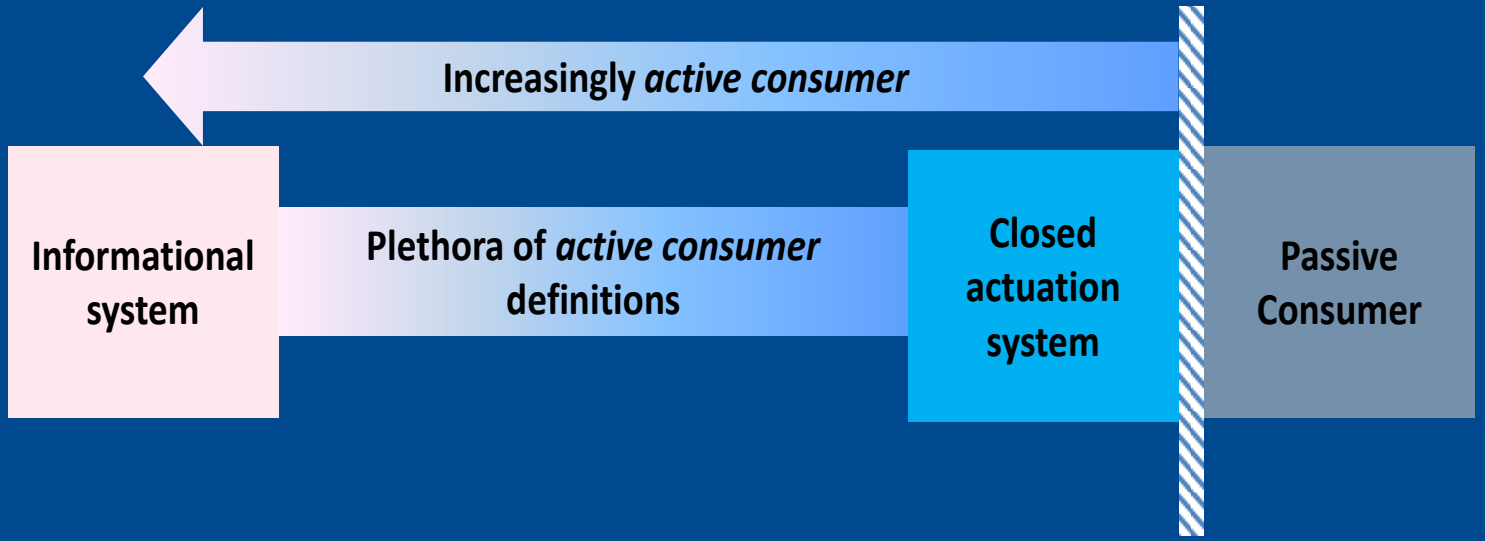

Figure 2.1: Boundaries of active consumer participation in a demand response system

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Demand response project	Type of response	Percentage increase in use of Community Renewables	GHG Emissions Savings / $kgCO_2e$ per annum
Building electricity demand (Italy)	Informational – feedback (Measured)	3%	374
Total Demand Response (Italy)		3%	374
Improved micro-grid control (Portugal)	Modelled Actuation	22%	5,400
Electric Vehicle Charging (Portugal)	Modelled Actuation	10%	1,250
Total Potential Demand Response (Portugal)		32%	6,650
Household electrical demand (Findhorn)	Informational – incentivised	5.8%	12,900
Household thermal demand (Findhorn)	Actuated (Modelled)	11%	24,400
Community electrical demand (Findhorn)	Informational - with feedback (Measured)	2.5%	5,500
Total Response with tariff incentive (Findhorn)		16.8%	37,300

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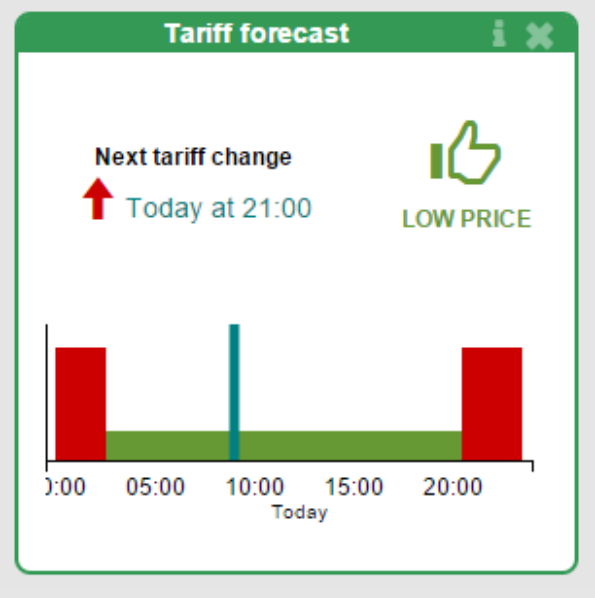
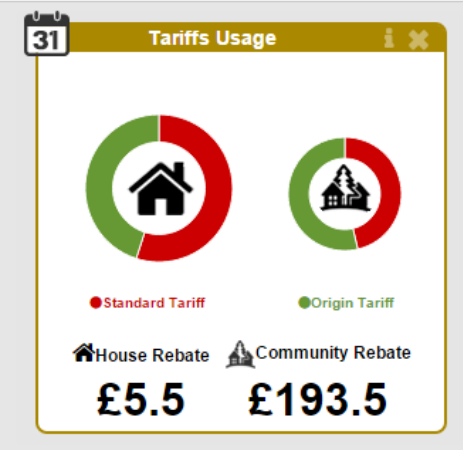
Scenario	Simple Monitoring	Advanced Monitoring	Informational	Automatic Actuation
Informational Demand Response	X		X	
Actuated Demand Response		X	X	X

Scenario	Deployment Difficulty	Cost	Effectiveness
Informational Demand Response	Easy	Medium	Medium
Actuated Demand Response	Medium / Hard	Medium / High	Excellent

Dynamic Wind Tariff field trial





- New tariff covering 24 hour period from 00h00 to 23h59 issued each day at 17h00
- Tariff based on forecasted availability of surplus power from the community owned wind park
- Std tariff = 17p/kWh, low tariff = 4.2p/kWh
- Tariff was a rebate scheme
- 40 participants – trial ran for circa 9 months

Response – all participants

Bars show response that was statistically significant

Line shows the distribution of tariff periods throughout the day

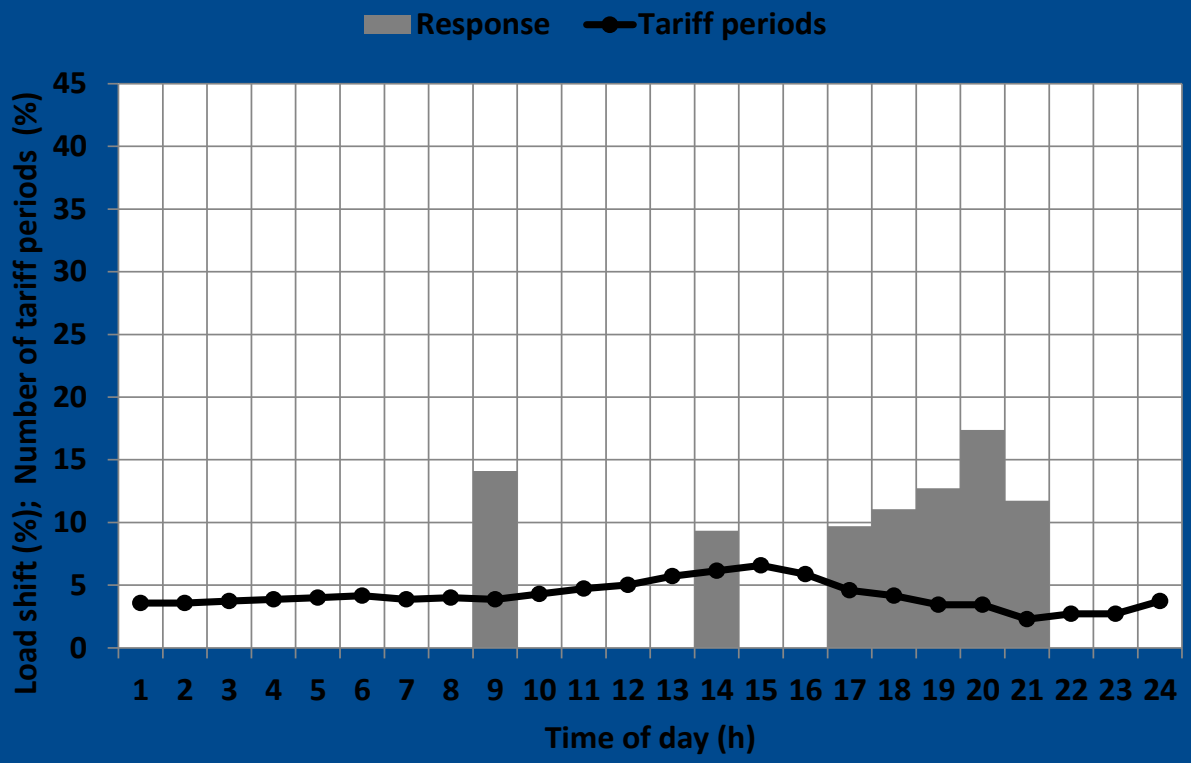


Figure 5: Demand response disaggregated by time of day

DR in individual households

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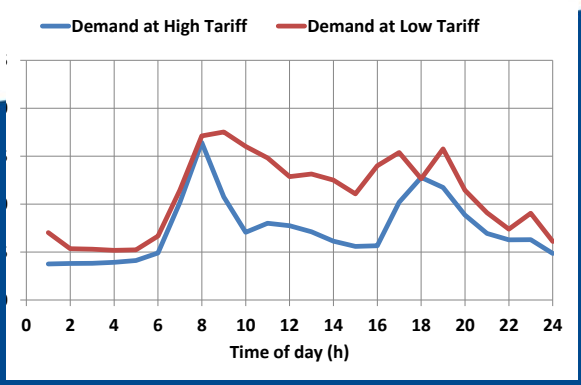
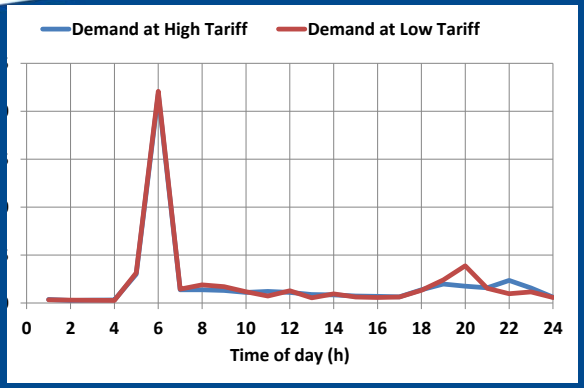
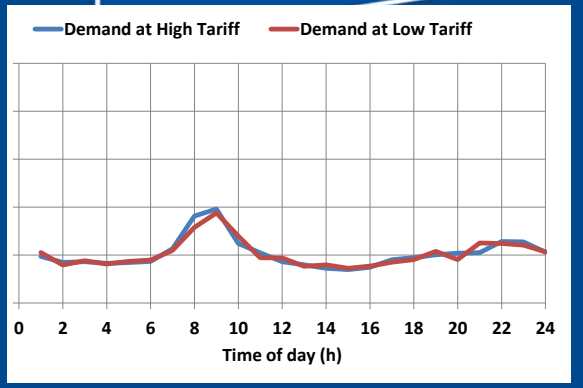


My love for you has become a pleasurable obsession, and I tune into you several times each day.

Please give me at least a little GREEN everyday to retain my playful energies – but as a tease never give me a GREEN for a full 24 hours – to keep me on my toes.



ORIGIN is an exciting initiative that I would like to engage in…
I try to live lightly and consistently. I have a kettle, washing machine, computer and sound system.
.



I have not engaged with you. When I am spending my time in my home with you, I might as long as the whole process and you does not become militant.

I sometimes am only home for a few hours a day & need to do what I need to do, regardless of you. I wish you success.

DR among motivated participants

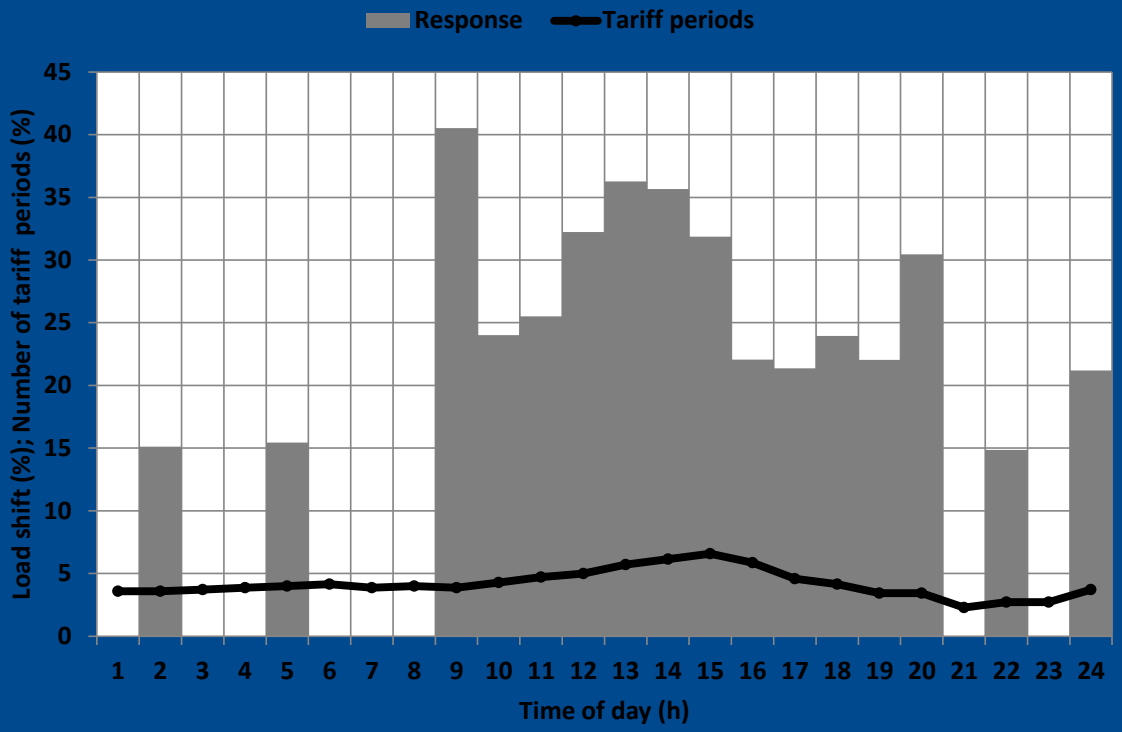


Figure 7: Average demand response of continuously active participants disaggregated by time of day

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ORIGIN Innovations/Outputs

- Automated Forecast Informed Vehicle Charging System (AVC):
- Residential Heating Control (RHC):
- Heat Pump Control (HPC):
- District Heating Optimisation (DHO):
- Thermal Storage Optimisation (TSO):
- Accurate Localised Weather Forecasting (AWF):
- Socially Inclusive Energy Tariffs (SET):
- Energy User Interface (UI):

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After ORIGIN – what's next?

- Can we change how we sell electricity from passive to active consumption?
- What business models might this realise?
- Demand response through variable tariffs and participation of end users

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After ORIGIN – what's next?

- Intergas Combi Compact ECO RF 30: £1600

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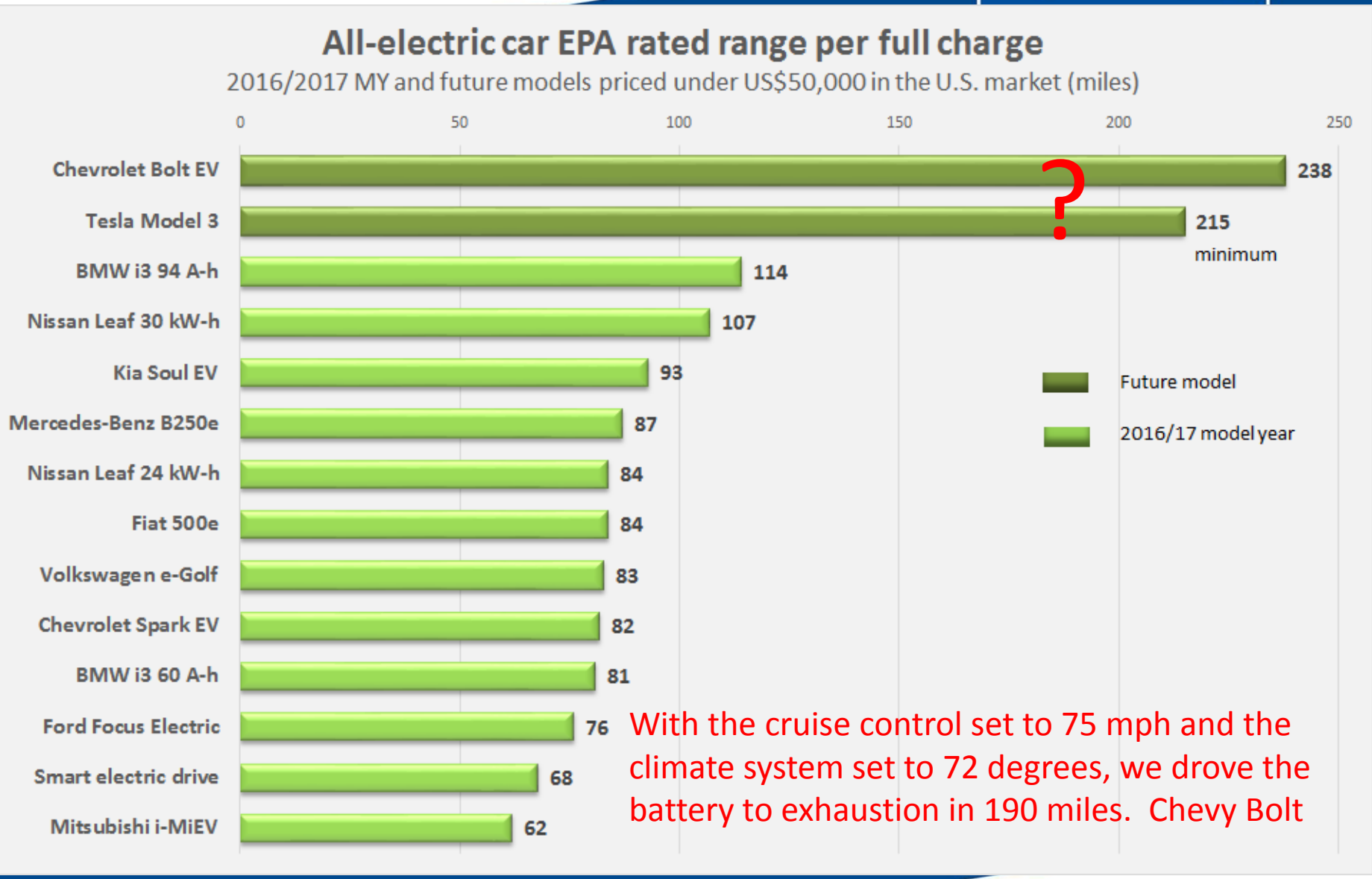

With the cruise control set to 75 mph and the climate system set to 72 degrees, we drove the battery to exhaustion in 190 miles. Chevy Bolt

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New (and exciting) Projects

- SMART Fintry (LECF Project)
- COSY (Findhorn)– Occupancy informed energy control
- Community based nursing services – can they be provided via electric vehicles without compromising patient care?

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- “Ruggedised” SMART Cities award
- Battery storage in social housing
- Wheatley Group, Glasgow City Council

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SCORE India (Innovate UK)

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Dr Edward Hugh Owens
Dr Andrew Peacock

- School or Energy, Geoscience, Infrastructure and Society
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