

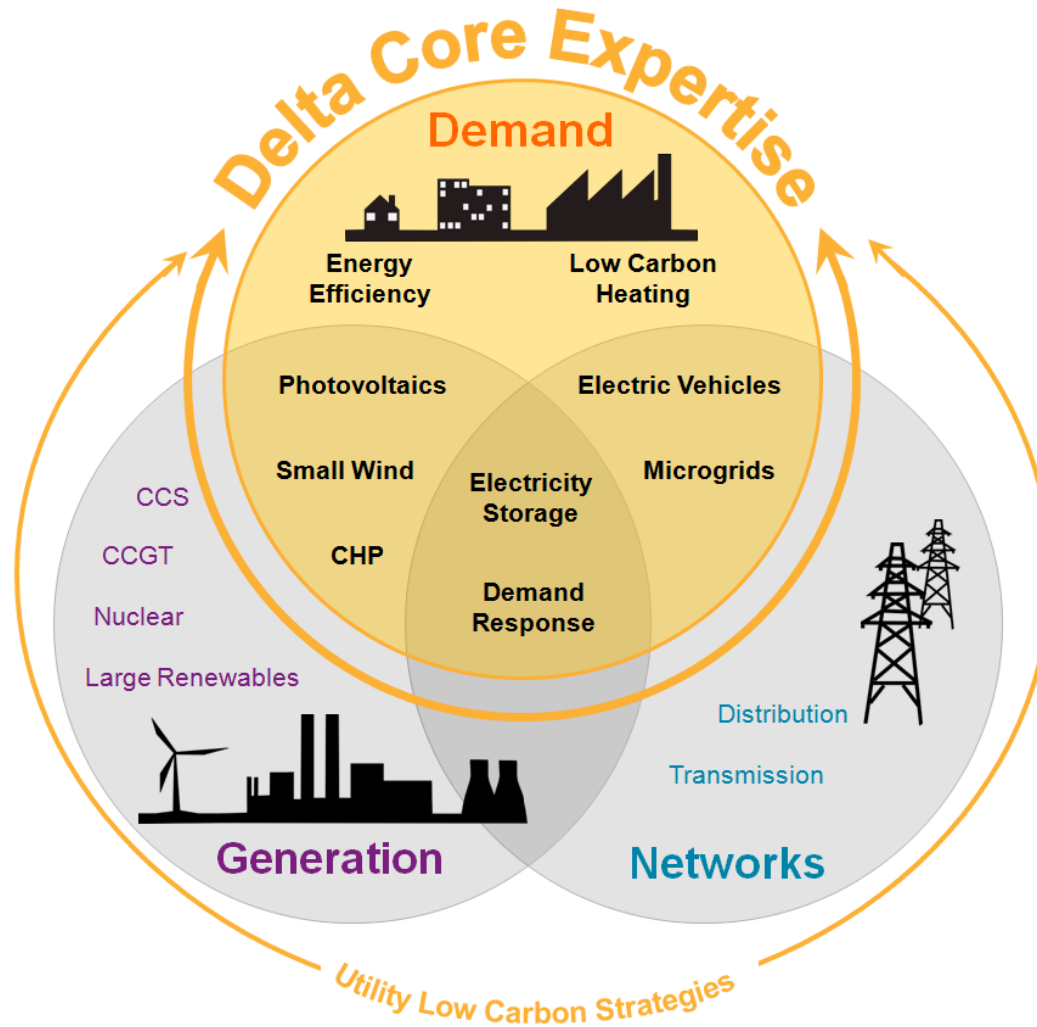
# How can Electricity Storage Enable the Rollout of UK DE Systems?

Distributed Energy Systems  
17 November 2009

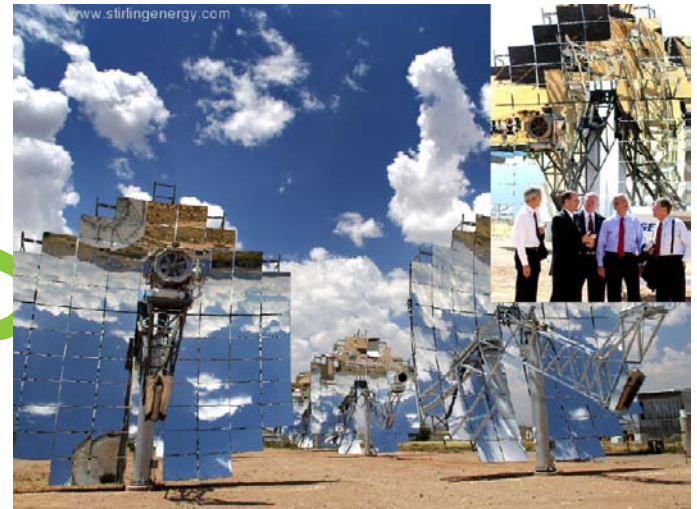
Cian McLeavey-Reville  
Delta Energy and Environment



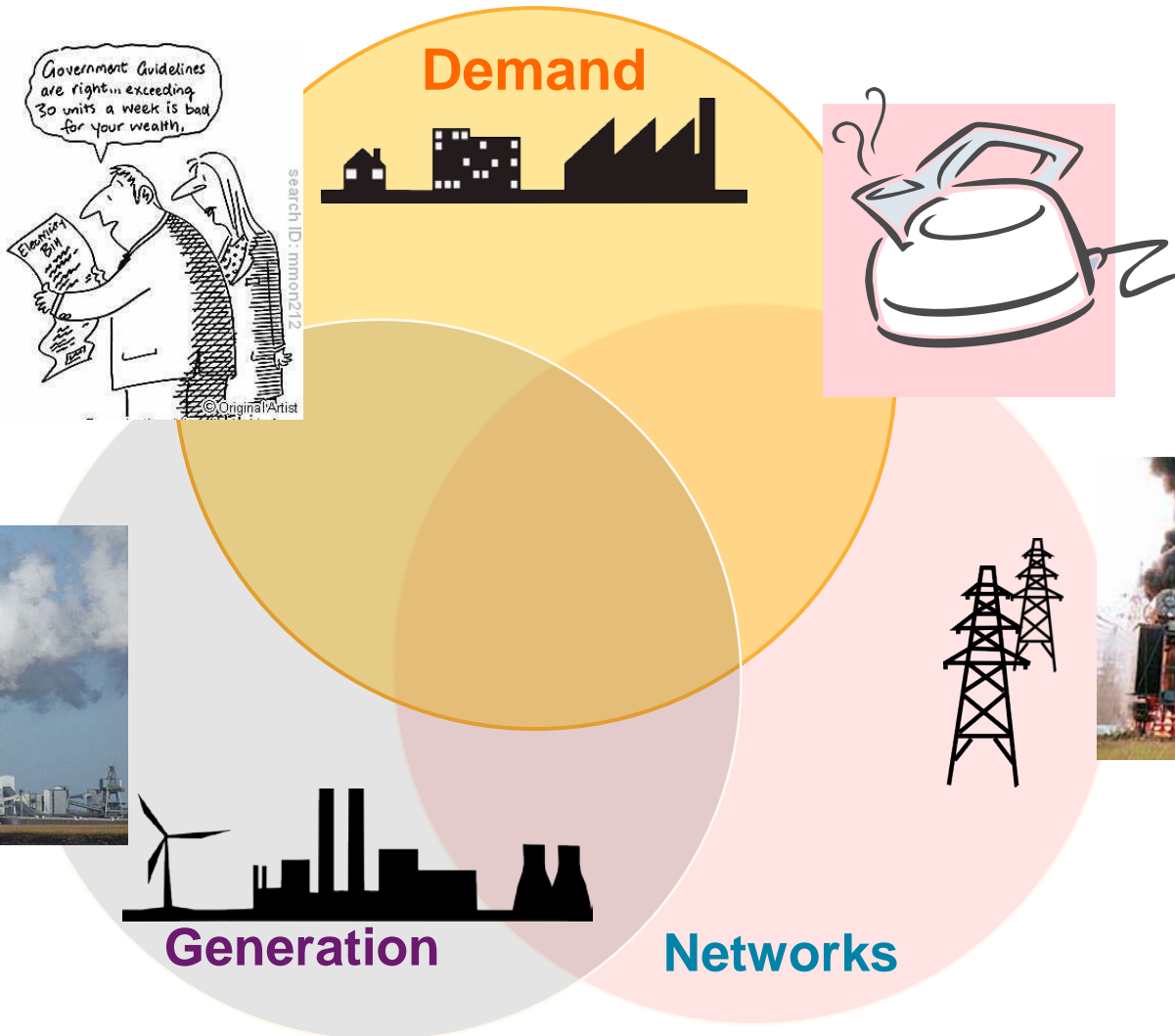
- ▶ 1. About Delta
- ▶ 2. The Zero Carbon Future
- ▶ 3. Today's Power System
- ▶ 4. The Future Generation Mix
- ▶ 5. Distributed Energy Systems
- ▶ 6. Storage in DE Systems
- ▶ 7. EVs – The Game Changer
- ▶ 8. Challenges for Storage



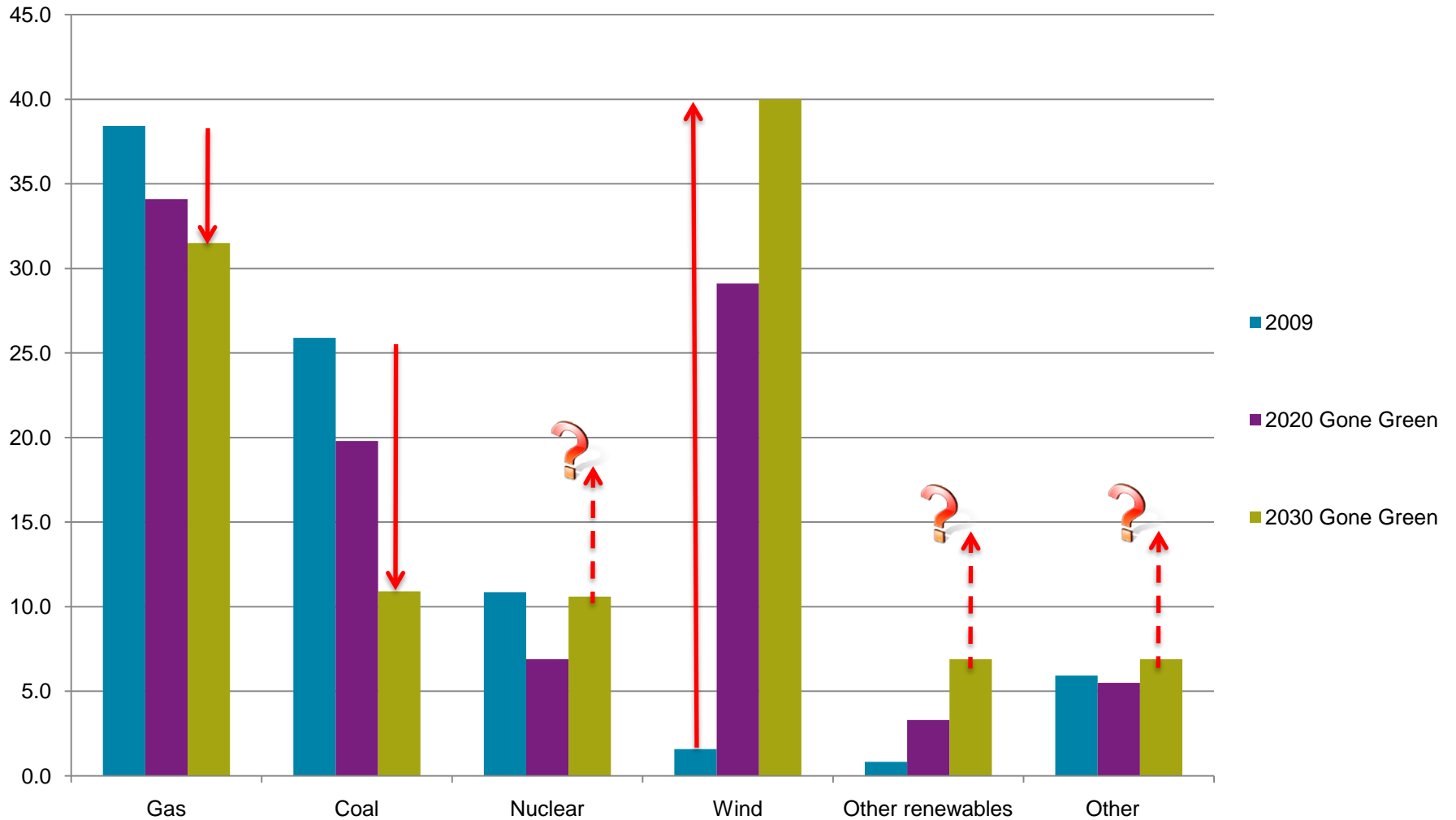
# A Zero Carbon Future



# Today's Power System

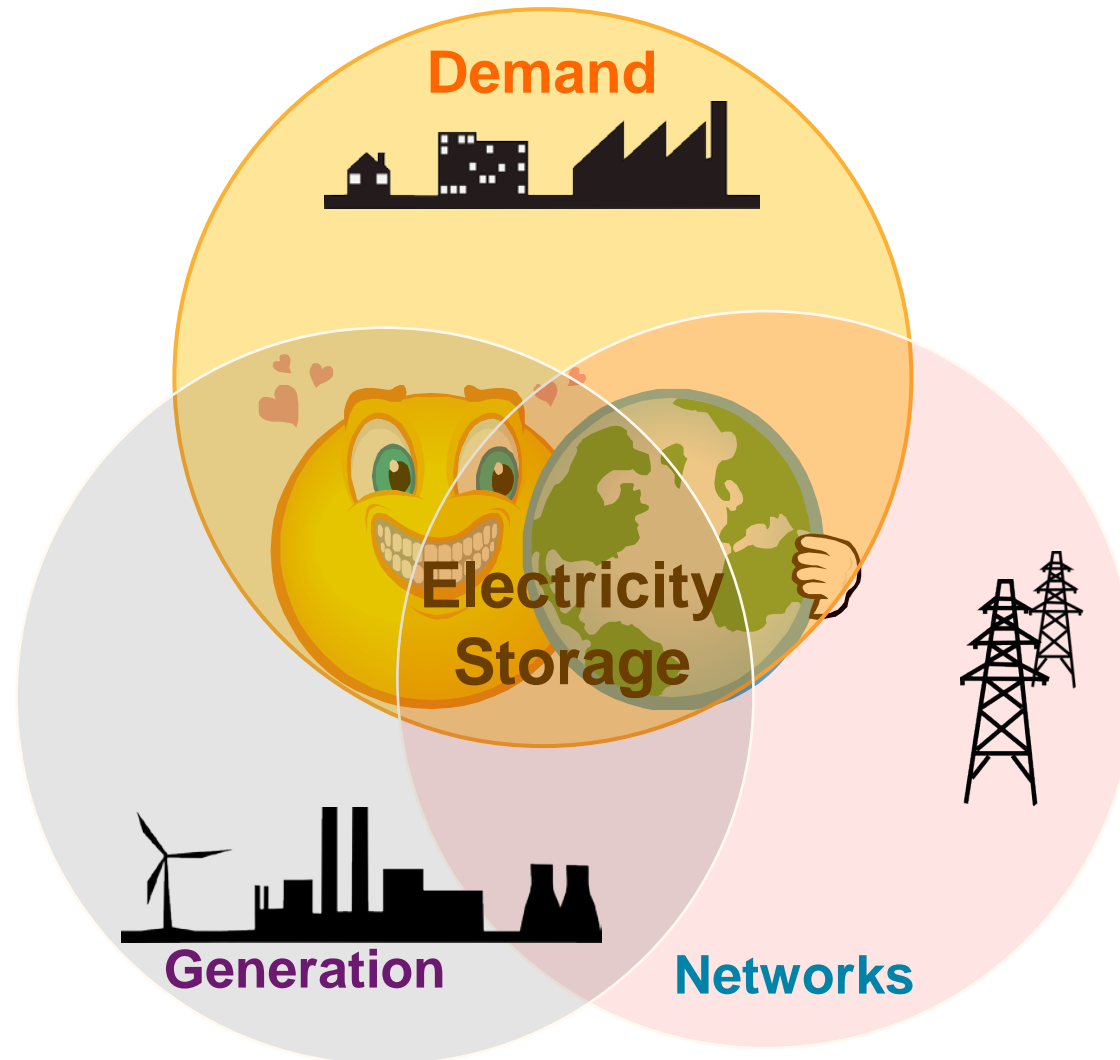


# Future Generation Mix

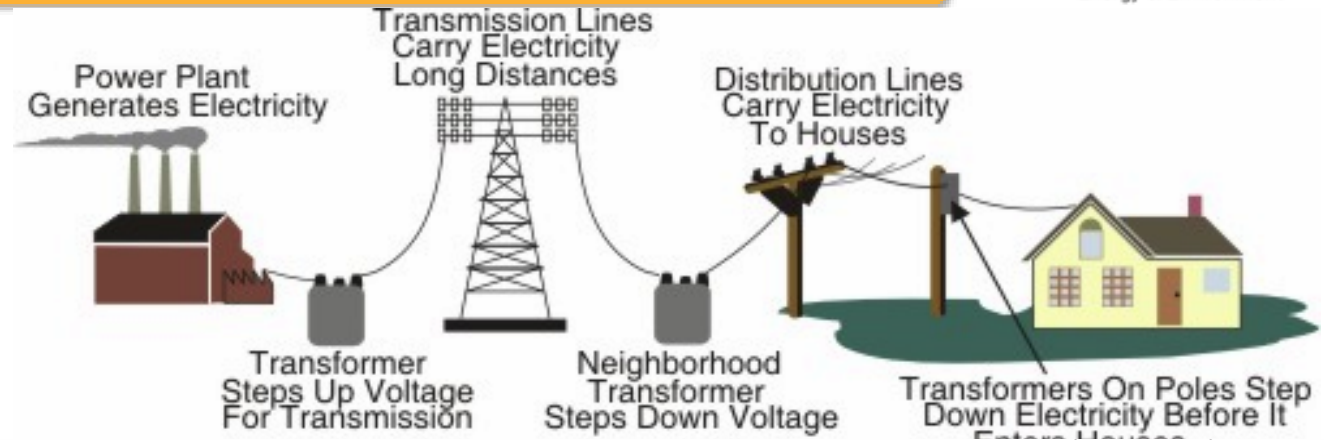


DECC, ESNB, 2009

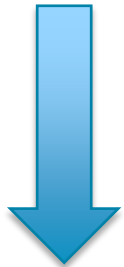
# Storage Sits in the Middle



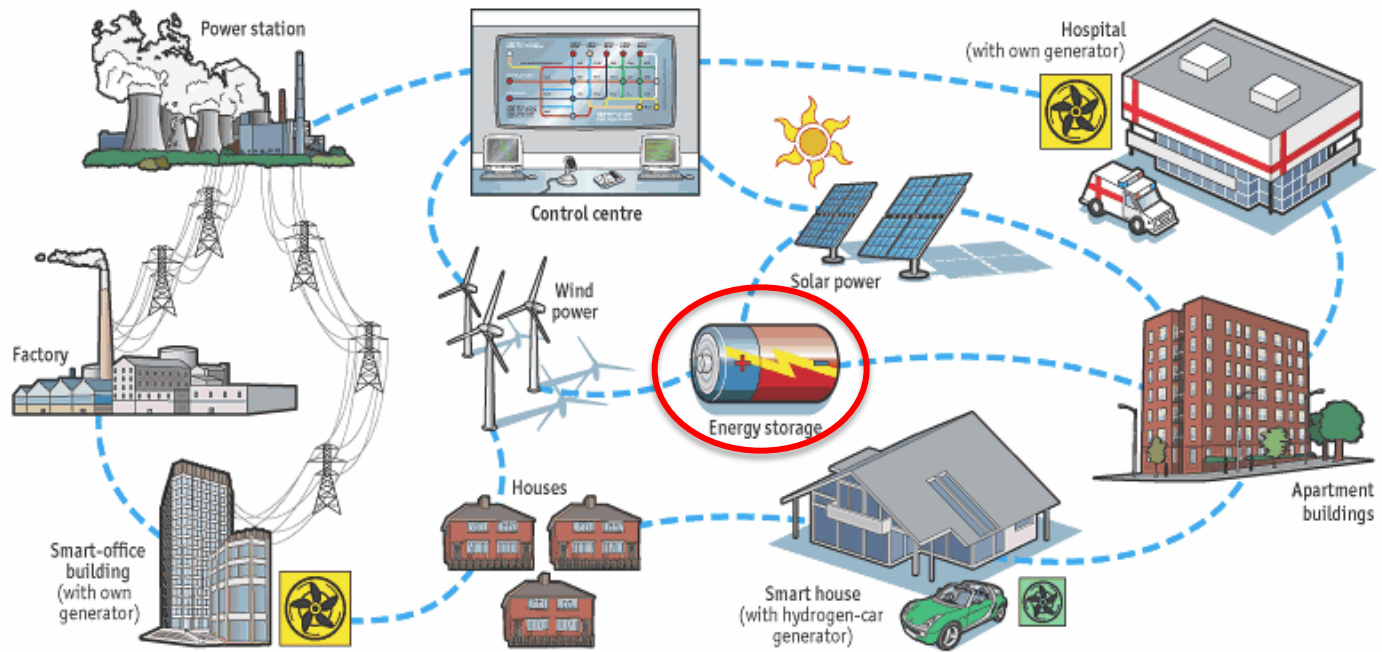
# Distributed Energy Systems



- Traditional



- Smart, low-carbon & distributed



Sources: The Economist; ABB

Commercialised	In Development
Pumped Hydro	Adiabatic Compressed Air
Compressed Air	Innovative Pumped Hydro
Lead Acid	Advanced Lead Acid
Sodium Sulphur Battery – NGK	Other Flow Batteries – Deeya, Plurion...
Vanadium Redox Flow Battery – VRB Power	Ultracapacitors
Zinc Bromine Flow Battery – ZBB Energy, Premium Power	SMES
High Speed Flywheel – Beacon Power	Large Scale Thermal - Isentropic
Lithium-Ion – A123, Altairnano, SAFT...	

## Commercialised

Pumped Hydro

Compressed Air

Lead Acid

Sodium Sulphur Battery – NGK

Vanadium Redox Flow Battery – VRB  
Power

Zinc Bromine Flow Battery – ZBB Energy,  
Premium Power

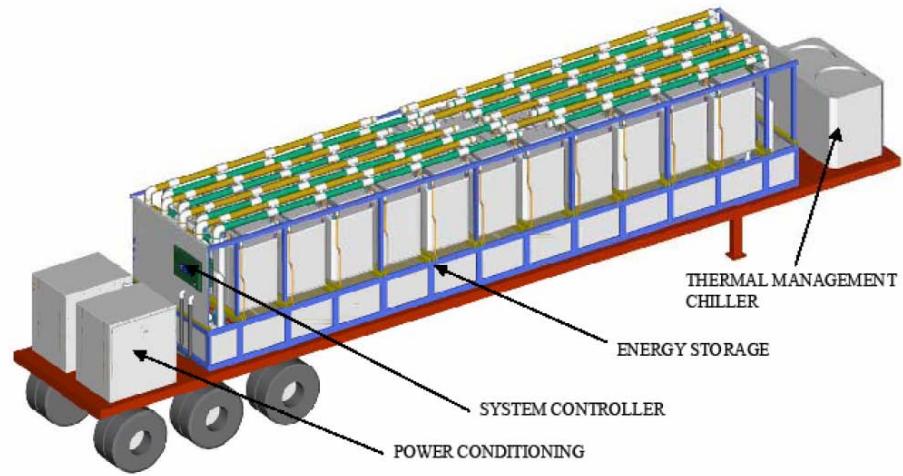
High Speed Flywheel – Beacon Power

Lithium-Ion – A123, Altairnano, SAFT...

## In Development



Commercialised	In Development
<p>Pumped Hydro</p> <p>Compressed Air</p> <p>Lead Acid</p> <p>Sodium Sulphur Battery – NGK</p> <p>Vanadium Redox Flow Battery – VRB Power</p> <p>Zinc Bromine Flow Battery – ZBB Energy Premium Power</p> <p>High Speed Flywheel – Beacon Power</p> <p>Lithium-Ion – A123, Altairnano, SAFT.</p>	<p>Adiabatic Compressed Air</p> <p>Innovative Pumped Hydro</p>



## Commercialised

## In Development

Pumped Hydro

Compressed Air

Lead Acid

Sodium Sulphur Battery – NGK

Vanadium Redox Flow Battery – VRB  
Power

Zinc Bromine Flow Battery – ZBB Energy,  
Premium Power

High Speed Flywheel – Beacon Power

Lithium-Ion – A123, Altairnano, SAFT...



## Commercialised

## In Development

Pumped Hydro

Compressed Air

Lead Acid

Sodium Sulphur Battery – NGK

Vanadium Redox Flow Battery – VR  
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Premium Power

High Speed Flywheel – Beacon Power

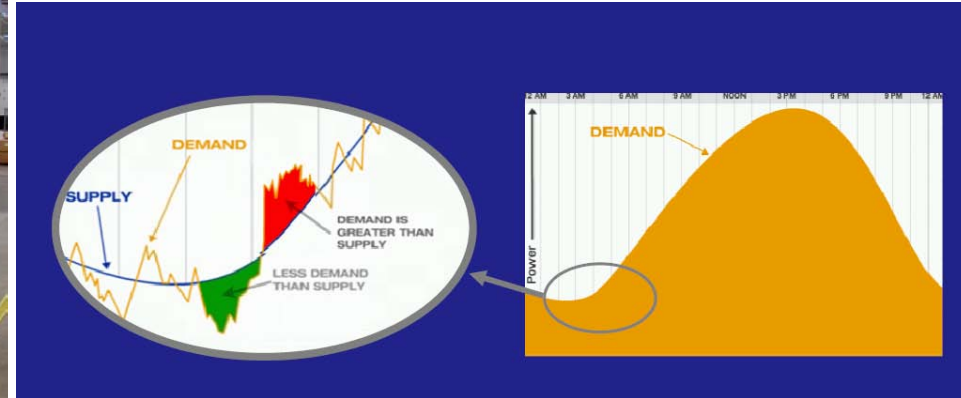
Lithium-Ion – A123, Altairnano, SAFT...





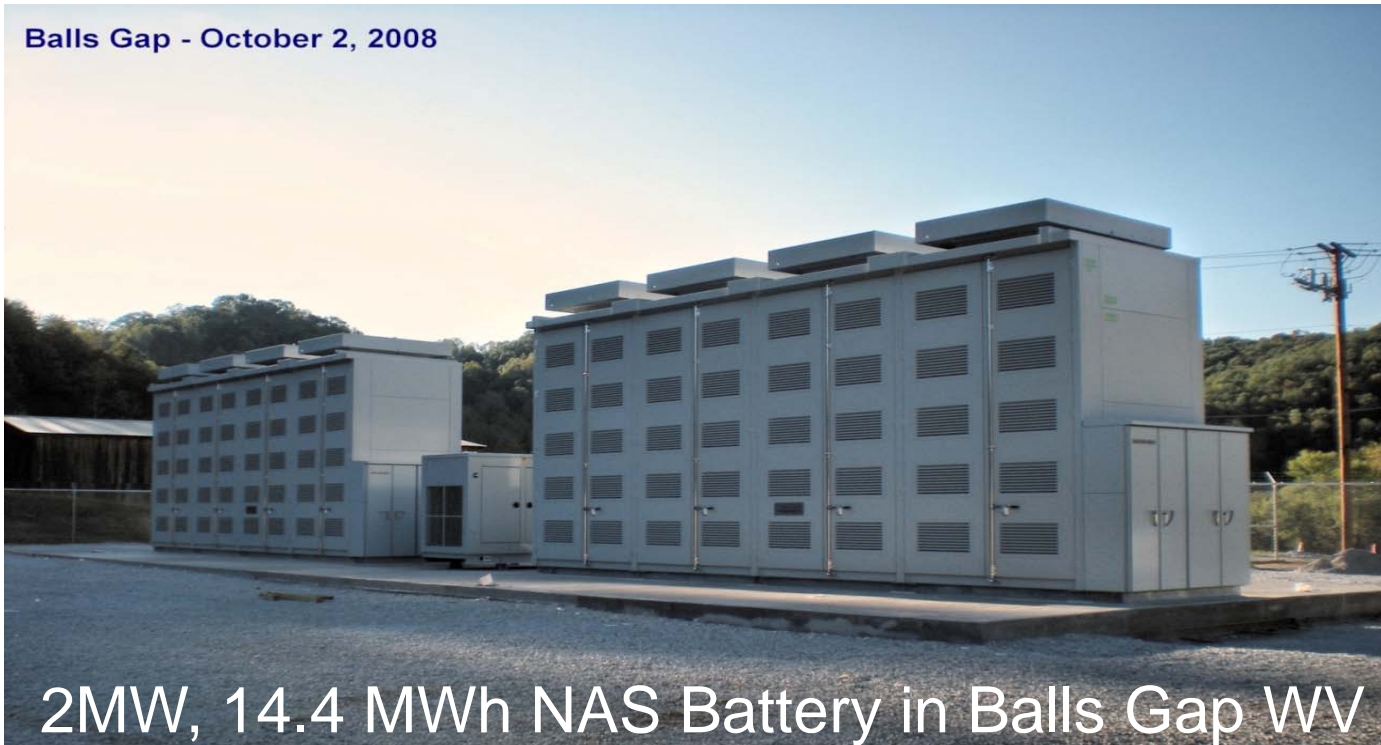
- Japan Wind Development Company
- 34 MW Nas, 51 MW wind
- Electricity sold directly to the market
  - Output predicted 48 hours in advance
  - Guaranteed €0.15/kWh + market price

# Storage Enables DE Systems - Generation



- Beacon Power
- 1<sup>st</sup> 2 of 5 MW in New England ISO
  - Providing frequency regulation
  - 20 MW plant planned for NY
    - \$69 million investment, \$10 million annual revenue
    - \$43 million loan guarantee approved, construction started

Balls Gap - October 2, 2008



2MW, 14.4 MWh NaS Battery in Balls Gap WV

- American Electric Power
- 2 MW NaS
  - Defer investment in distribution line for 2-3 years
  - Improve service reliability on rural feeder, with dynamic islanding

# Storage Enables DE Systems - Demand



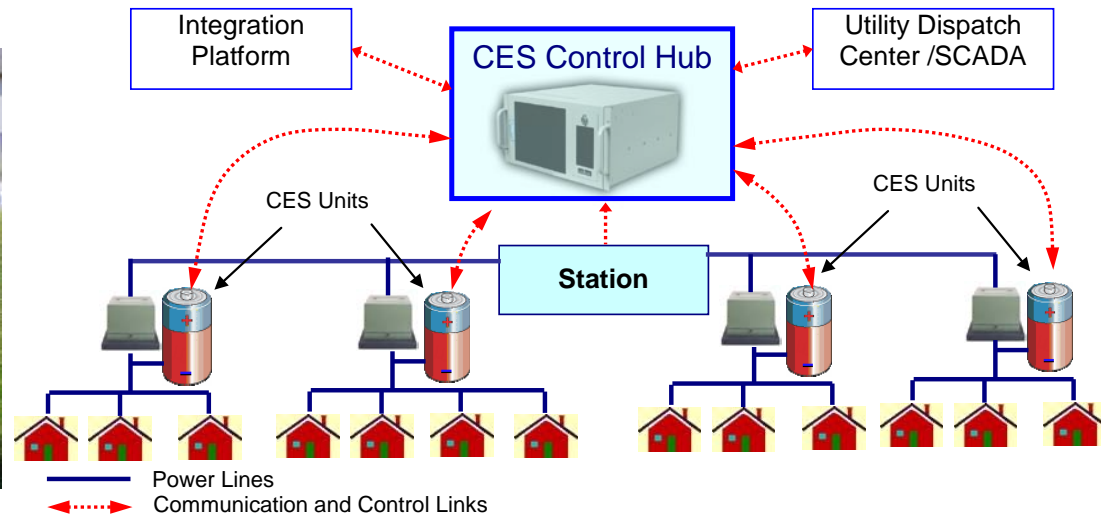
- New York Power Authority
- 1.2 MW NaS to charge compressors
- Annual savings
  - \$46,000 – power rates
  - \$220,000 – labour costs (night shift)

Tariff (Time)	Energy (\$/kWh)	Demand (\$/kW/month)
Off-peak (00:00 – 07:00)	\$0.0440	\$ -
Peak June – Sep, Mon - Sat (10:00 – 22:00)	\$0.0762	\$34.350
Intermediate (All other)	\$0.0737	\$3.420

# Community Storage – The Ultimate Storage Location?



AEP, 2009

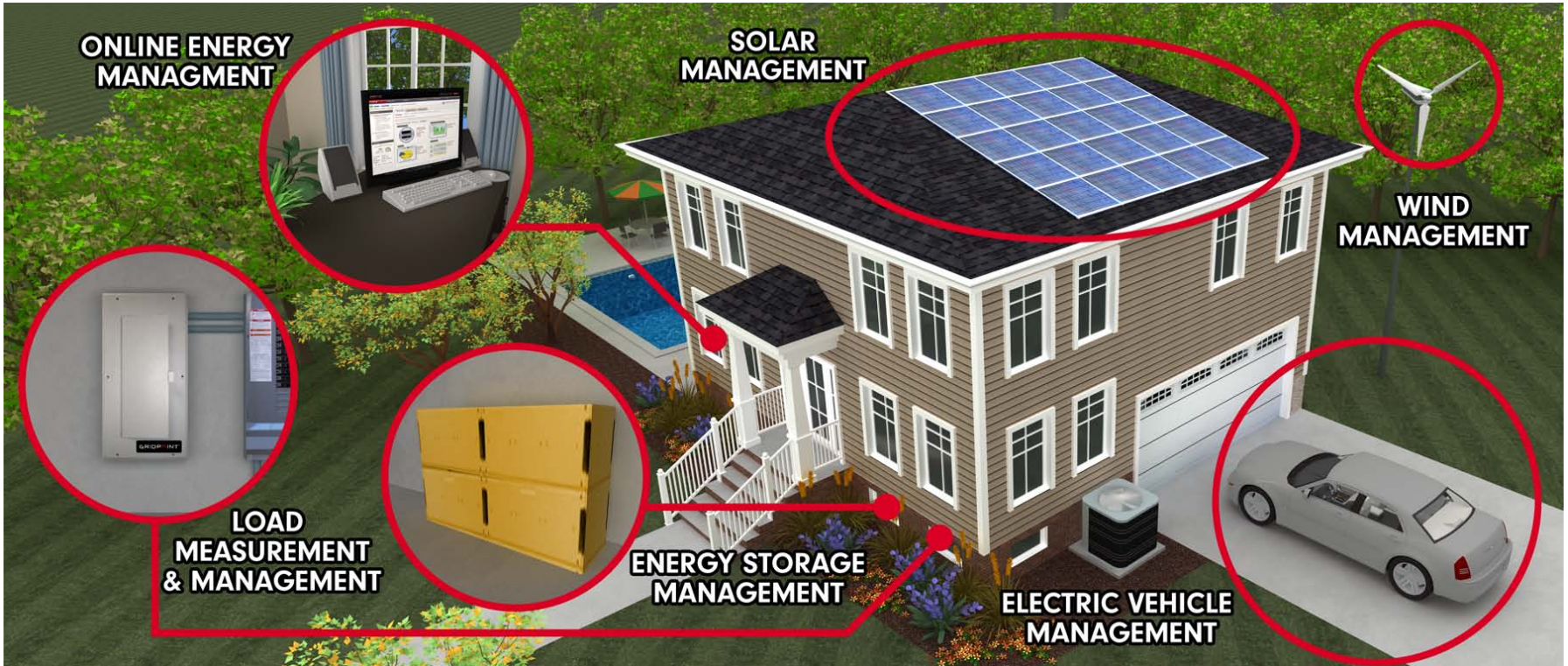


## Benefits:

- 1) Backup power for local houses
- 2) Ancillary services through aggregation
- 3) Manage customer DG
- 4) Voltage correction
- 5) Shift demand

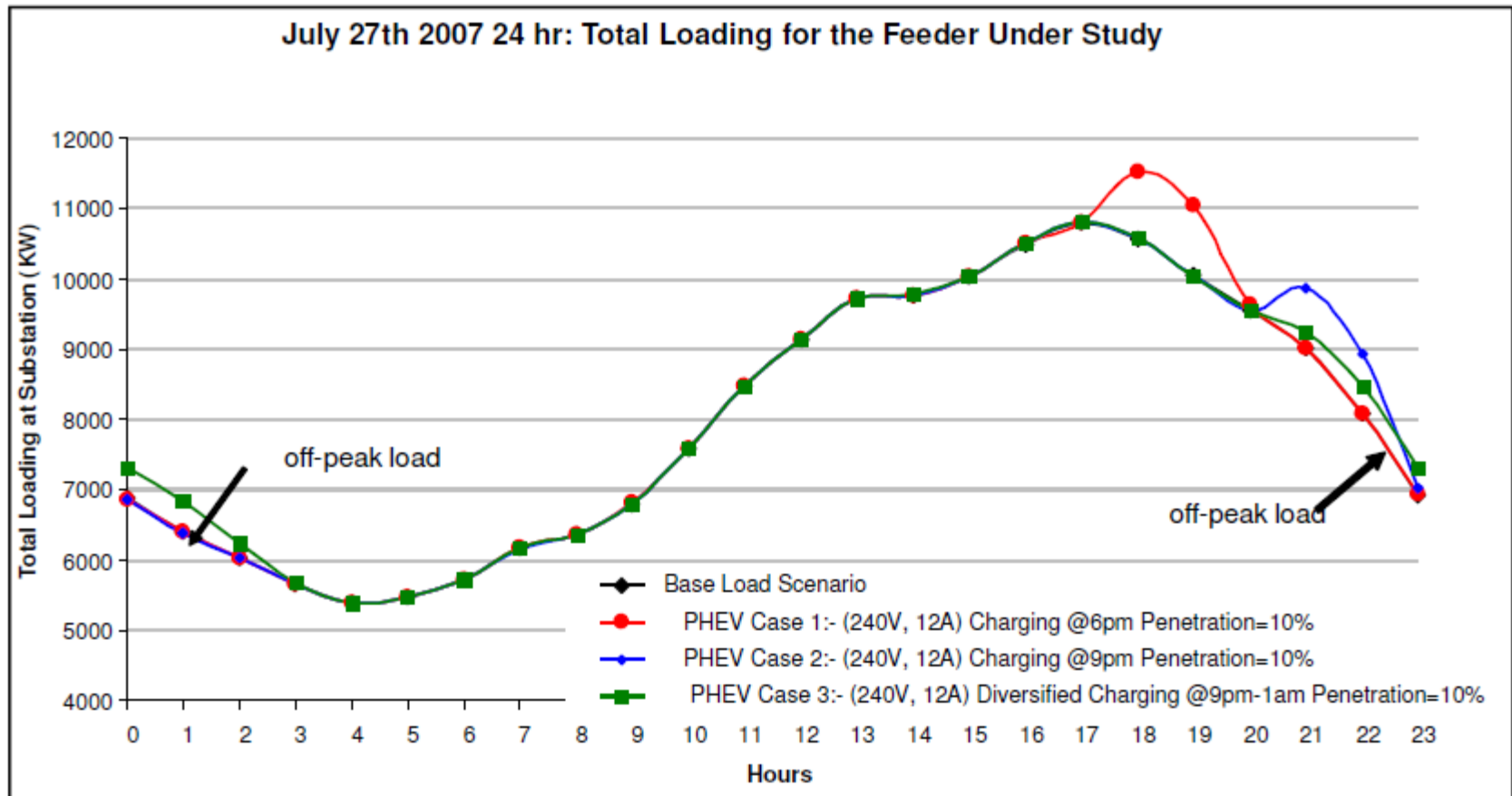
Addressing  
generation,  
networks and  
demand

# Electric Vehicles – The Game Changer



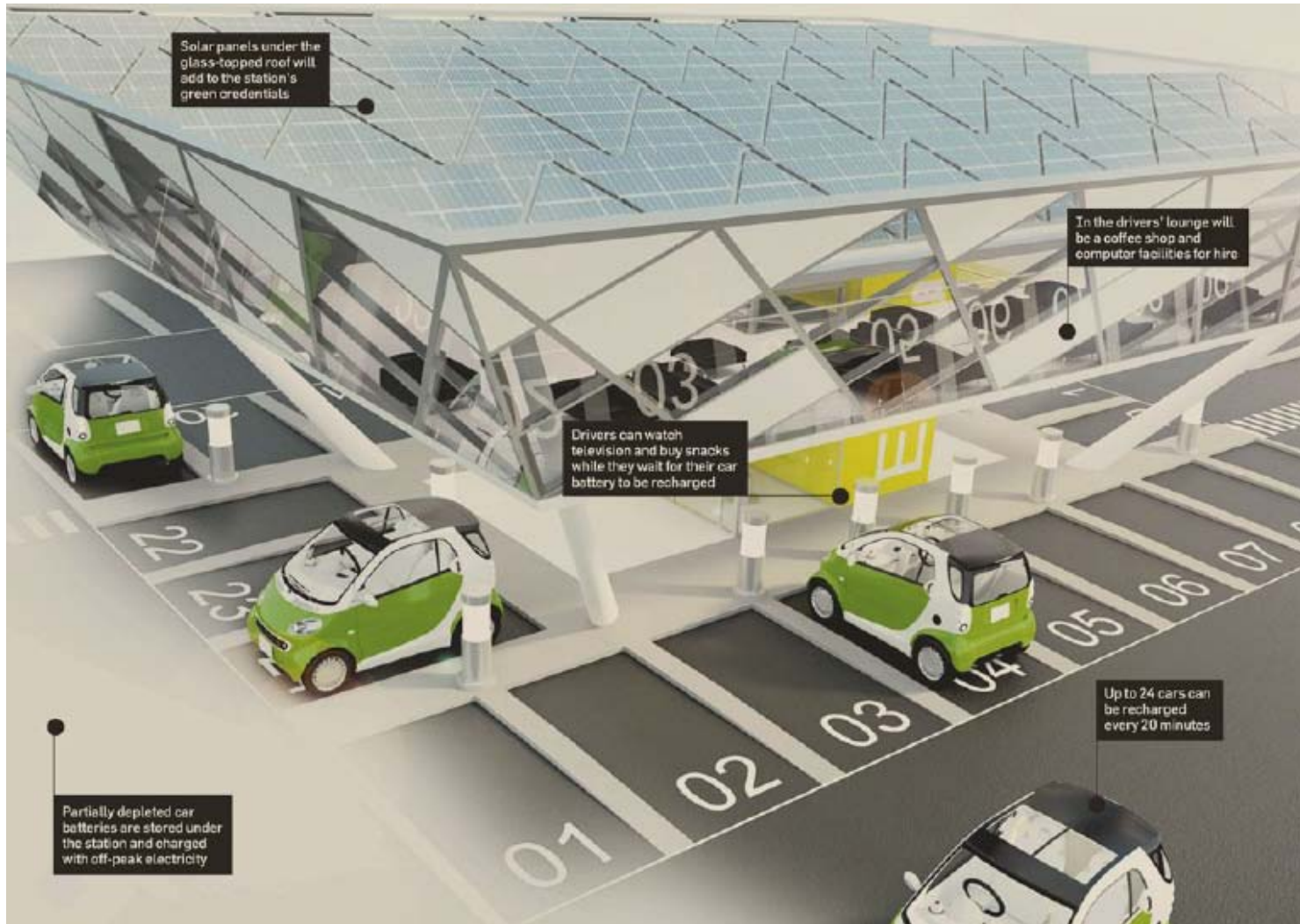
Gridpoint, 2009

# Electric Vehicles – Problem if Ignored



EPRI, 2009

# Electric Vehicles – EVOasis



EVOasis, 2009

- Technology
- Cost
  - ▶ Scale, competition, EV market
  - ▶ Incentives
- Regulation...

# Unbundled – Where does storage fit?

**Demand**



**Generation**



**Networks**

# Regulation – Has Bred DNO Dinosaurs?



## Low Carbon Networks Fund

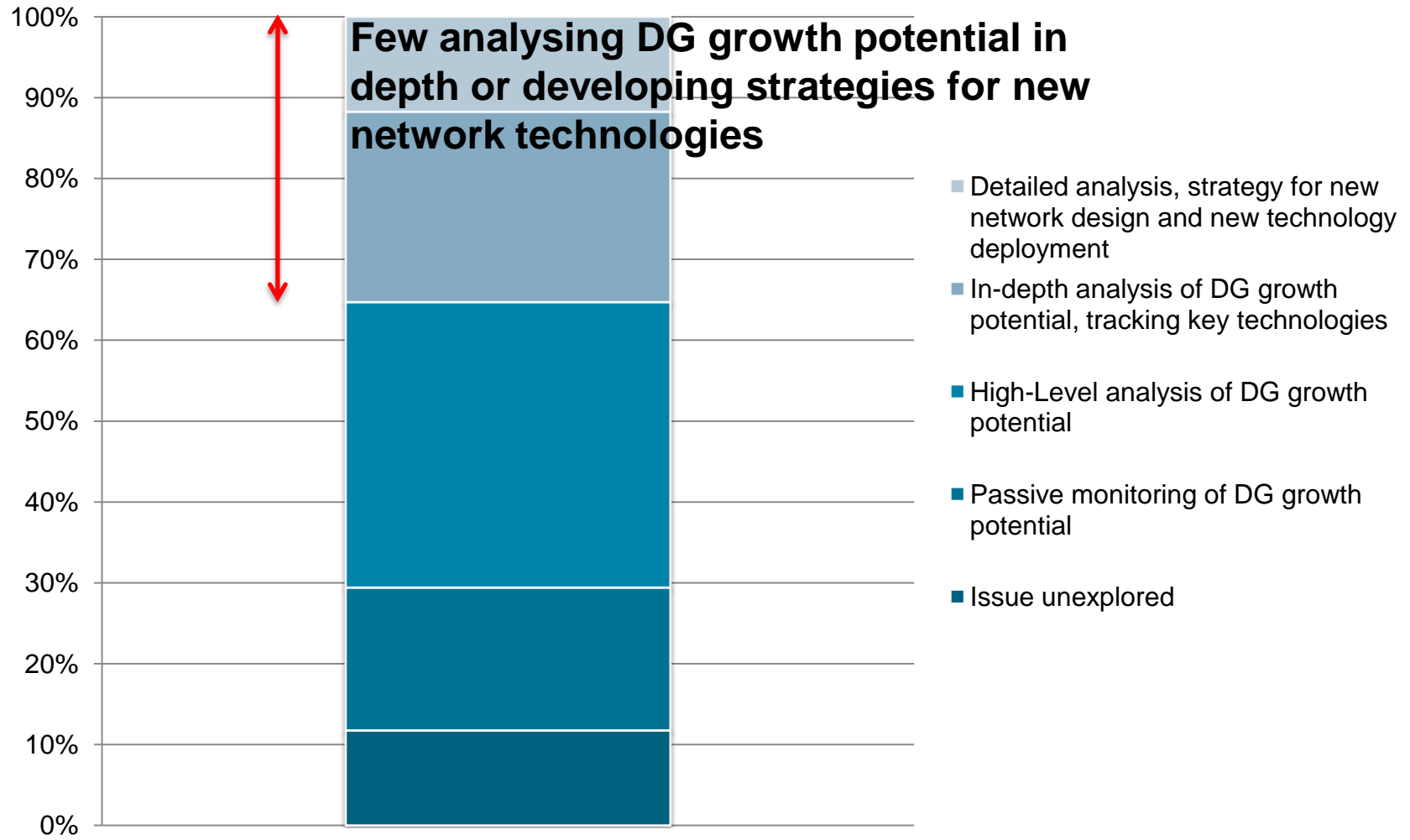
- £500 million for DNOs to trial advanced network technology



## Price Control Review:

- Cut investment by 17%

# Regulation – Has Bred DNO Dinosaurs?



Delta and Accenture, 2009

- Zero-carbon affects the entire power system, not just generation
- The pinch point for DE is the distribution network
- Electricity storage enables low-carbon distributed energy systems, EVs may be game changers
- Regulation makes it difficult for the full benefits of storage to be realised
- DNOs tend to be risk-averse due to the way they are regulated
- Storage is not the only solution!

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