

# EXPLORING THE MARKET FOR DEMAND-SIDE RESPONSE

MPhil in Technology Policy - Final Group Project  
EPRG Spring Seminar  
13 May 2016



## Project team

### MPhil in Technology Policy Students

- Kathryn Dingle
- Jorge Jaramillo
- Omair Khalid
- Ermeena Malik
- Kunal Mandalia
- Philip White

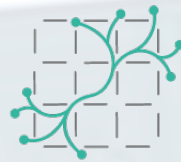
### Advisors

- Lewis Dale
  - Regulatory Strategy Manager, National Grid
- David Reiner
  - Assistant Director, EPRG



Demand-side response is hard to miss at the moment...

**ofgem** Making a positive difference for energy consumers



Living Grid



Creating the right environment for demand-side response

CEER 2015 ANNUAL CONFERENCE

Unlocking energy market flexibility and demand-side response

## Towards a Smart Energy System

DSR Event 2016  
Demand-Side Response  
Thursday 8th September 2016 / Banking Hall, London, UK

HOUSES OF PARLIAMENT  
PARLIAMENTARY OFFICE OF SCIENCE & TECHNOLOGY

### Electricity Demand-Side Response

POSTNOTE  
Number 452 January 2014



**Overview**

■ Electricity demand and supply both fluctuate throughout the day. Some fluctuations are predicted, such as a peak in demand in the

Commons Select Committee



### Electricity demand-side measures

Inquiry status: Oral evidence concluded

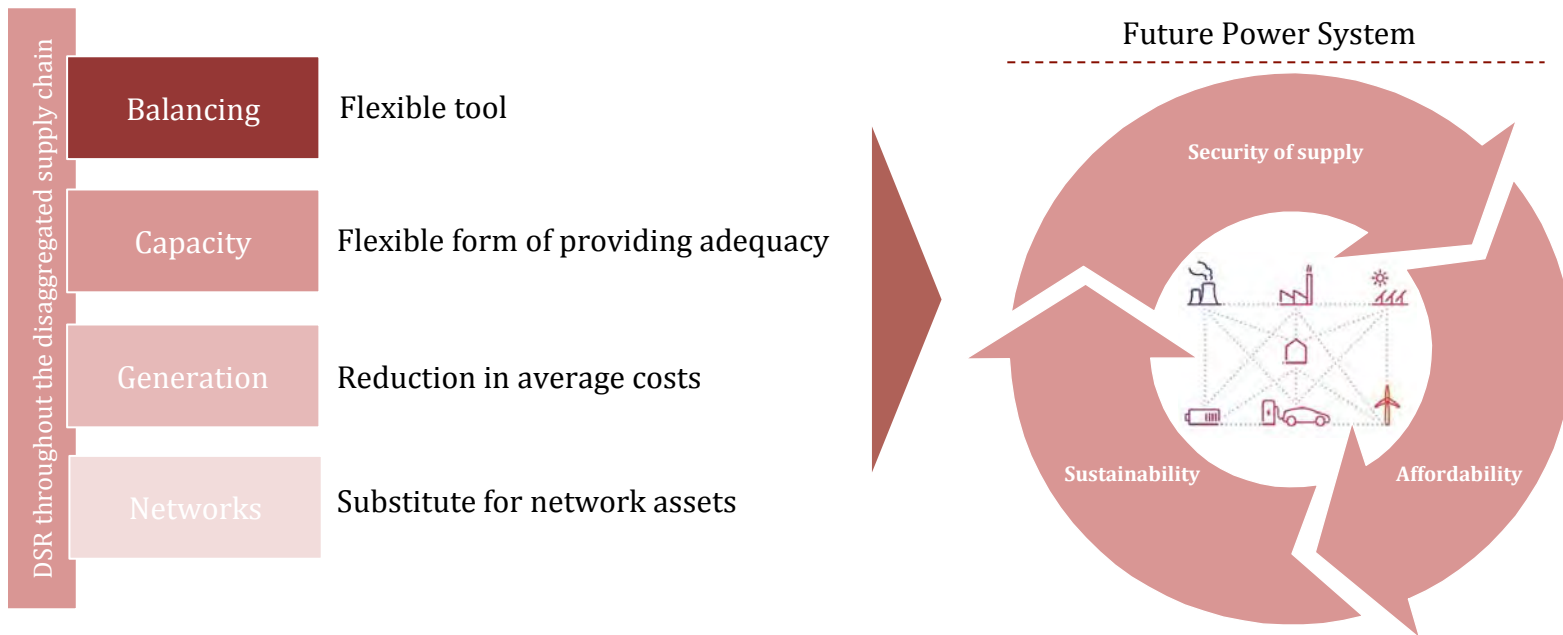
Closure of coal and oil power stations, along with wider changes to the electricity mix over the next decade, are predicted to increase risks to the UK's electricity security of supply. This problem can be addressed by, increasing the supply of electricity by building new power plant or importing it from abroad via interconnectors or, reducing the demand for electricity. This reduction in demand can be temporary (known as

...but for good reason!

## Definition of DSR

*“**Actions** by customers to **change the amount** of electricity they take **off the grid** at **particular times** in response to a **signal**”*

## Value creation



Source: Ofgem (2013) *Creating the right environment for demand-side response*



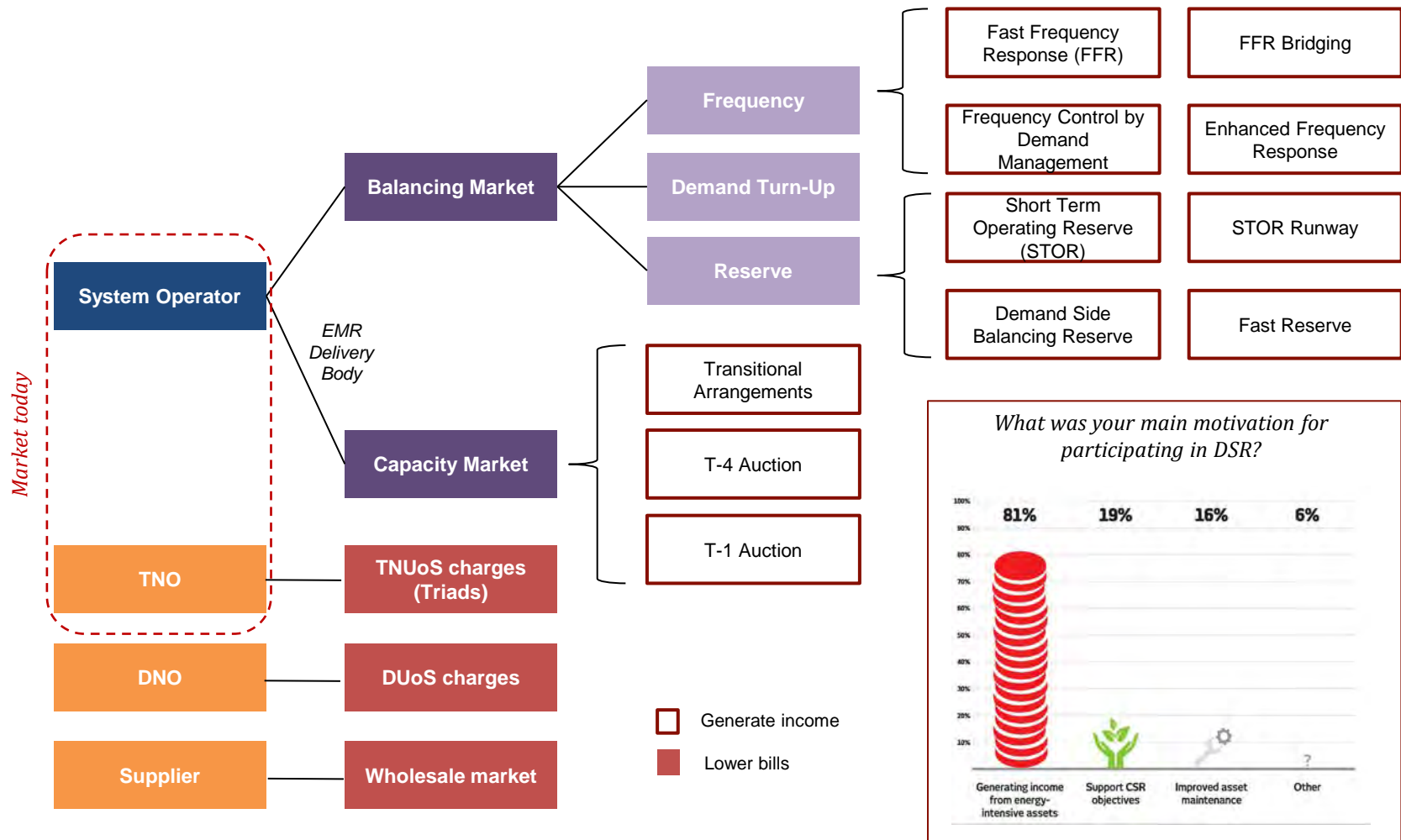
# There are five potential sources of DSR in the UK

Source of DSR	Type of resource
Distributed generation	Distribution connected: <ul style="list-style-type: none"> <li>▪ Conventional generation</li> <li>▪ Renewable generation</li> <li>▪ CHP generation</li> </ul>
I&C Back-up generation	Pre-existing emergency back up generators
I+C demand led DSR	Reducing or shifting demand e.g. HVAC etc
Domestic demand led DSR	Reducing or shifting demand e.g. storage heaters
DNO Smart Grid technologies	Electrical energy storage and voltage control

Market today

Source: DECC-commissioned Frontier Economics (2015) *Future Potential for DSR in GB*

# Providers can access the market through numerous routes...



Source: National Grid; Ofgem; Open Energi (2015) Demand Side Response Report

...either directly or through an aggregator

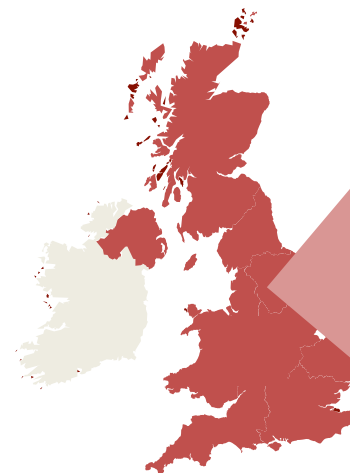
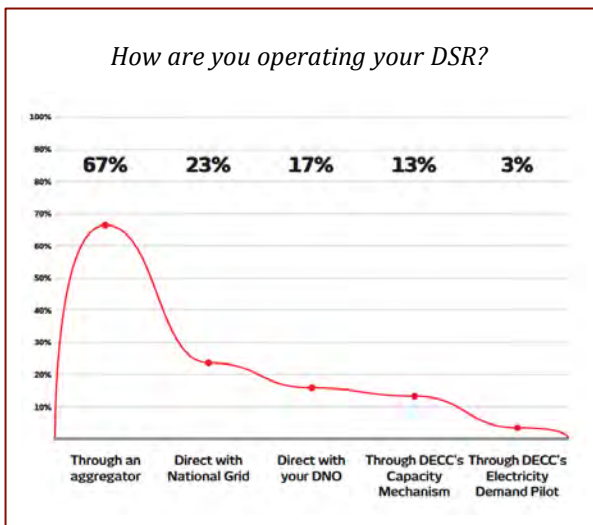
## Aggregators

Aggregators “co-ordinate end-users offering small amounts of DSR and combine these to offer into specific routes to market”

Direct vs. aggregator decision largely based on whether business meets product requirements and has management capacity

Standard business model is revenue splitting (*typically 70% client / 30% aggregator*)

- Key variables are: % split of revenues, installation costs, and penalty handling



Source: POST (2014) *Electricity Demand Side Response*; Open Energi (2015) *Demand Side Response Report*



# UK market in practice today

- Market emerged in mid-2000s
- Historically, STOR has been largest programme
  - Rapid product expansion in recent years
- Frequency most profitable product today
  - The faster response the more lucrative
- Current market dominated by large I&C customers and embedded generation doing diesel generation and Triad load shedding
  - Little “true” DSR
- National Grid the dominant contractor
  - Limited opportunities at DSO level
  - Wholesale market only accessible through suppliers, who are slow to uptake
- Aggregators the largest providers
- Confusion and challenges abound...

Scale of National Grid contracting (*estimates*)

Market	Product	DSR contracted (MW/year)
Balancing	STOR	1750
	STOR Runway	200
	Demand Turn Up	300
	DSBR	515
	Fast Reserve	280
	FFR and Bridging	200
	FCDM	150-200
	EFR	TBD
Capacity	Main	2014: 175 2015: 450
	TA	2016: 500
Network	Triad avoidance	1800

Source: National Grid (2016); Curtis, M. (2015) *Overview of the UK Demand Response Market*; Sustainability First (2016) *Demand-Side Response Market Snapshot*





## Current barriers to DSR are well known and being “worked through” ...

### Regulatory

- Product terms and conditions
  - e.g. minimum size, response time and availability requirements
- Capacity Mechanism rules
  - Contract length (1 year vs. 15 for generation)
  - Exclusivity between CM and TA
- Half hourly settlement

### Commercial

- Commercial viability needs greater:
  - Long-term certainty and stability to build confidence and justify investment
  - Stronger financial incentives and pricing signals
  - Flexibility of product design (e.g. for aggregators to maturity match)
  - Ability to stack products

### Cultural/Institutional

- Education and simplification needed:
  - Lack of customer awareness, especially amongst smaller energy customers
  - Better and more clear promotion needed
  - Initial engagement/trust difficult
  - Confusing to navigate schemes
  - Time-consuming

### Technological

- Specialist technology required which is not compatible with some customers
- Lessons learnt from Smart Meter Rollout
- Baseline measurement issue

Source: Element Energy (2012); Ofgem (2013, 2015); National Grid (2016); Sustainability First (2016); Utility Week (2015)



## ...but longer-term challenges remain

### ▪ **Sustainability of the aggregator business model**

- Has unprofitable revenue sharing precedent been set?
- What will be the impact of embedded benefit review, resolution of BM-party imbalance charging issue?
- Is the market big enough for everyone? Will it cannibalise itself (e.g. STOR price)?
- Can the business models scale and/or diversify? What is cost trajectory when expanding to SMEs?
- Will I&C customers no longer need an aggregator when awareness improves?
- Is “true” demand response, where government now focusing efforts, profitable? Existent?

### ▪ **Emergence of other providers**

- Will VIUs overcome the inherent DSR/generation conflict? Will imbalance charging changes play a role?
- Are potential profits enough to make it worthwhile?

### ▪ **Emergence of other sources of DSR and routes to market**

- How will domestic DSR evolve?
- Will the DNO route to market be commercially successful?
- What is the future interaction between DNO and SO in DSR?
- What is the future of Triads?

### ▪ **Risk of political interference**

## Our initial conclusions on the UK DSR market

- Stick > Carrot
- Confusing!
- Limited profit opportunity
  - Aggregators loss making
- Genuine commitment to build the market from most stakeholders...
  - ...but it's not easy!
  - Classic case of innovation vs. legacy market structure

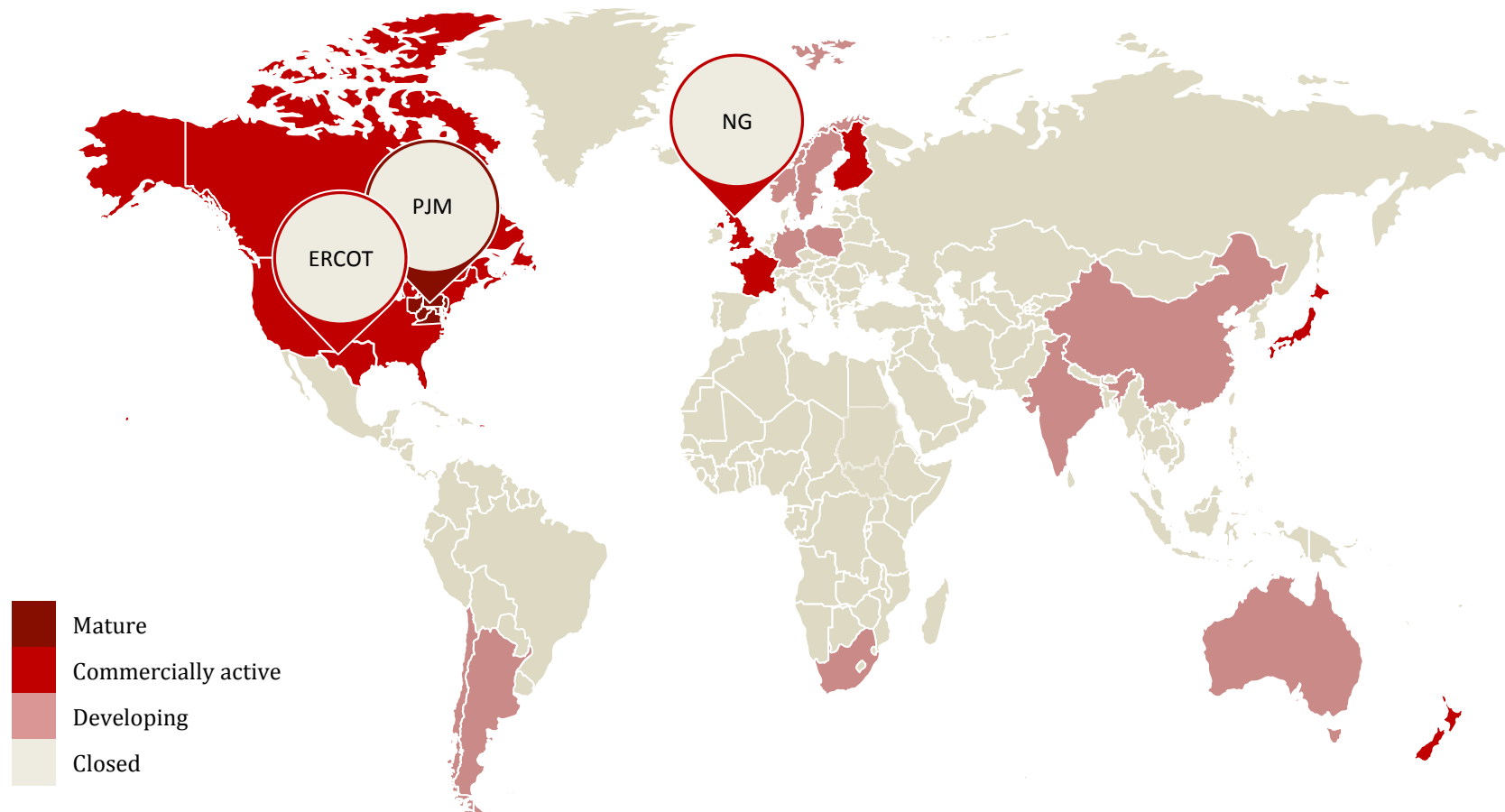
*“Great Britain (GB) was the first country to open several of its markets to consumer participation in Europe.... **However, unfortunately in recent years it seems that the stakeholder process between providers, DECC and Ofgem has not been as effective as would be expected in a mature market.** As a result, measurement, baseline, bidding and many other procedural and operational requirements are inappropriate for demand-side resources, noticeably reducing the number of demand-side MWs in the system (even as national capacity continues to decline). Therefore, **though the markets remain open in name, the actual results are worse in 2015 than in 2013-14. If the trend continues the UK will no longer be a viable market for demand response providers.**”*



Source: SEDC (2015) *Mapping Demand Response in Europe Today*



We looked globally for inspiration of where the UK may go from here

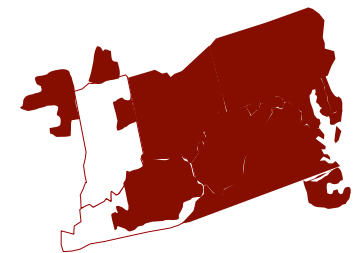


Source: SEDC (2015) *Mapping Demand Response in Europe Today*; Transpower (2016); MaRS (2015) *National profiles*; METI (2015)



## ERCOT and PJM in the US provide interesting case studies

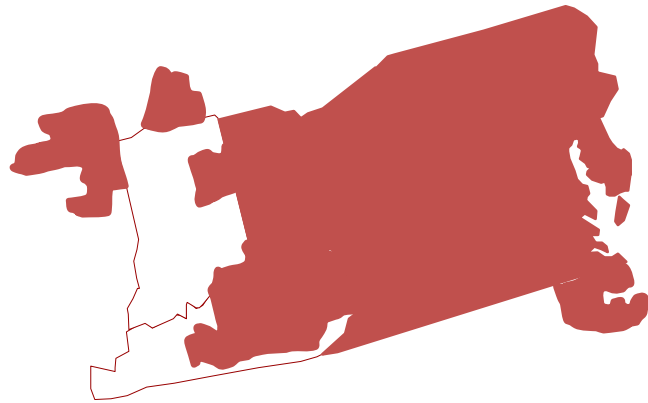
	ERCOT	National Grid	PJM
Capacity	74 GW	80 GW	184 GW
Peak Demand	68 GW	63 GW	165 GW
Population	23 million	57 million	61 million
DSR Capacity	2.1 GW	2.3 GW	15 GW*
DSR as % of Peak	3.2%	3.6%	9.1%



Source: National Grid (2005); ERCOT (2012); FERC (2015); POST (2014);\*Base Residual Auction for DR: PJM Auction Results (2016)



## PJM is a good example of DSR Integration



Liberal Market

- De-regulated with FERC as regulator.
- Manages grid reliability and wholesale electricity market across 13+ states

Functioning Capacity Market

- First Auction commenced in 2007
- Ensures long-term price signals to retain investment and generation

Successful DSR Saturation

- From less than 2% peak load in 2007/8 to > 7% in 2015/2016

Source: IEA Security Advisory Panel (2014)



# How does this compare to the SO in the UK?

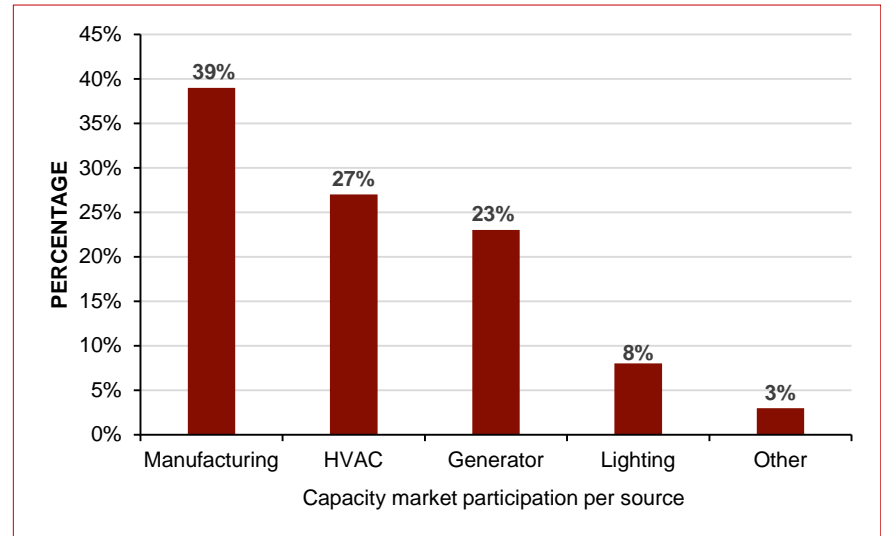
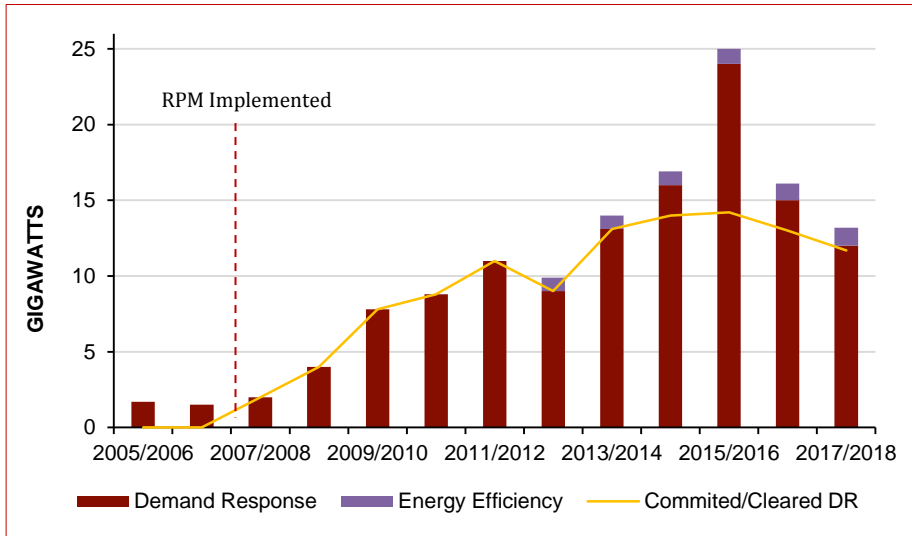
	Capacity	Frequency	Reserve
PJM	<ul style="list-style-type: none"> <li>T-3 Auction</li> <li>3 Incremental Auctions</li> </ul>	<ul style="list-style-type: none"> <li>Regulation Market</li> </ul>	<ul style="list-style-type: none"> <li>Synchronized Reserve</li> </ul>
National Grid	<ul style="list-style-type: none"> <li>Transitional Arrangements</li> <li>T-4 Auction</li> <li>T-1 Auction</li> </ul>	<ul style="list-style-type: none"> <li>Fast Frequency Response (FFR)</li> <li>FFR Bridging</li> <li>Frequency Control Demand Management</li> <li>Enhanced Frequency Response</li> </ul>	<ul style="list-style-type: none"> <li>Short Term Operating Reserve (STOR)</li> <li>STOR Runway</li> <li>Demand Side Balancing Reserve</li> <li>Fast Reserve</li> </ul>

## Key Takeaways

- Resource adequacy achieved through capacity market
- National Grid has developed specific products for DR participation

Source: National Grid; PJM

# The state of the Capacity Market in PJM



## DSR Capacity Market Contribution

- Capacity Market payments account for ~\$800 million.
- Over 12 GW in Capacity Market
- Aggregators account for 82% of demand response activities in PJM
- Over 80 third-party aggregators in PJM

Source: The Brattle Group (2013); PJM Market Activity Report (2016)





## What is the outlook for the Balancing Market in PJM?

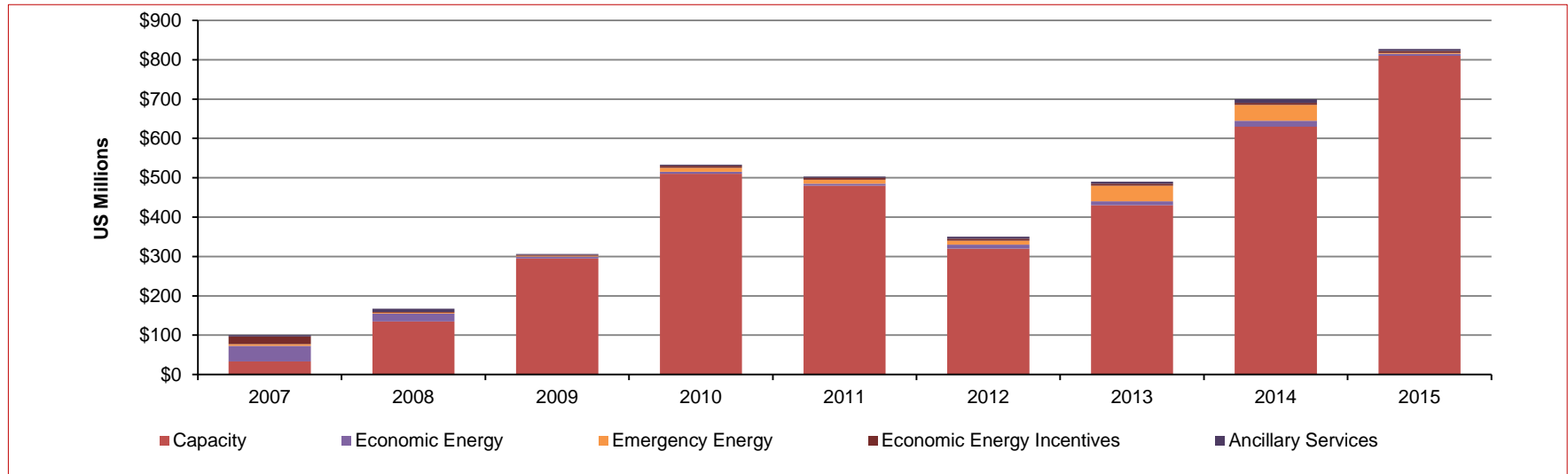
### Key Takeaways in the Balancing Market

- Monthly avg. 457 MW in Synchronous Reserves
- Monthly avg. 16 MW used for Frequency Regulation
- Minimum 100 kW Participation for DSR to play in Balancing Services
- Market based mechanisms for procuring Synchronized Reserve
- Regulation Services are performance based - i.e. More flexible delivery
- Product definition allows for demand-side flexibility
- Registration process streamlined and transparent through software infrastructure

Source: PJM Market Activity Report (2016)



## What can we learn from PJM?



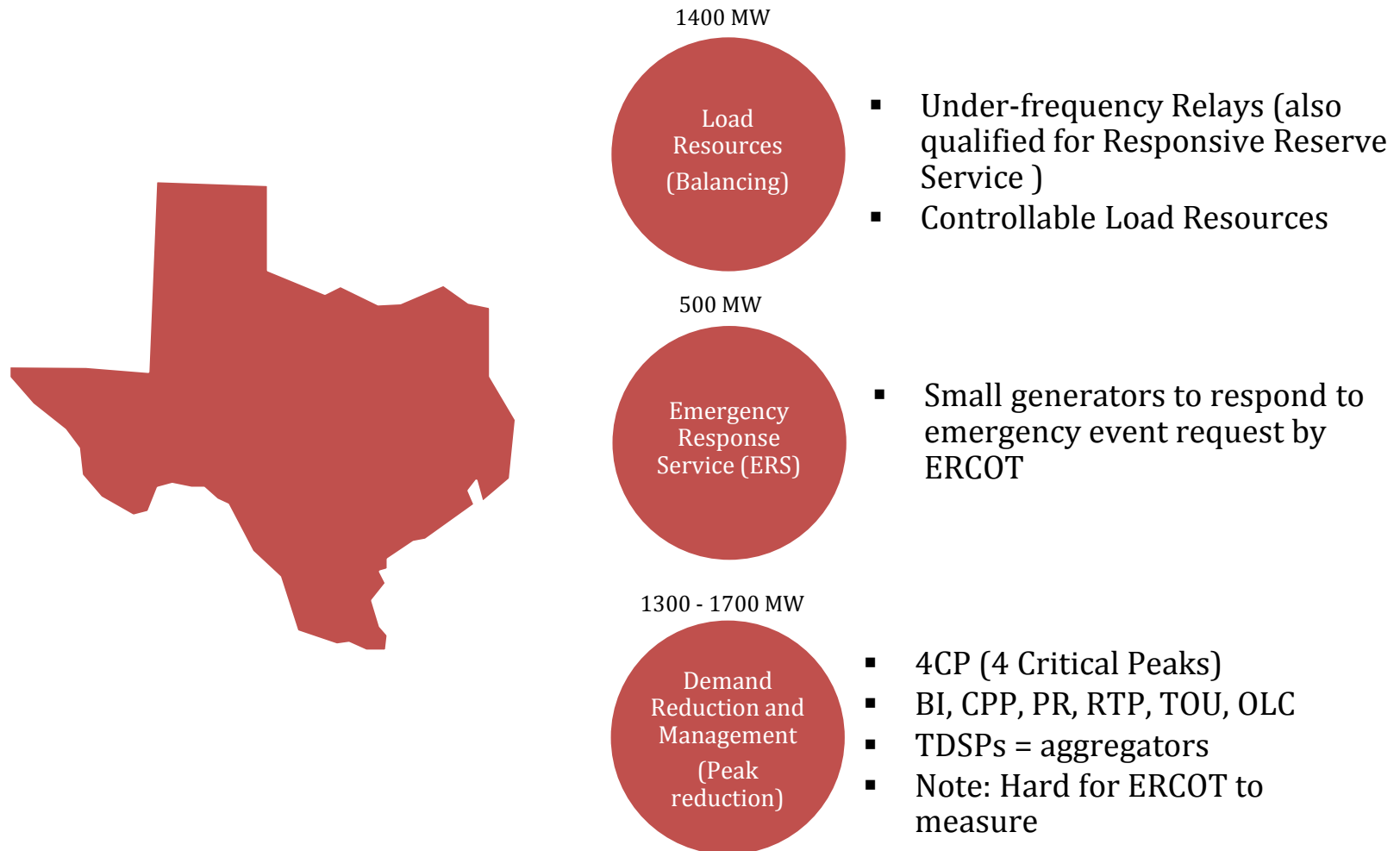
### Key Takeaways

- Most of the money is in the Capacity Market right now
- Aggregators focusing on specific aspects to drive value
- But DSR is saturating now requiring innovation
- Contribution of DSR in Balancing Services previously limited but now increasing

Source: PJM Market Activity Report (2016); Synapse Energy Economics (2013)



# ERCOT DSR: Market in Practice



Source: ERCOT (2015)



## ERCOT DSR: Barriers and Successes

### ▪ Barriers

- Low market prices
- Scarcity Pricing is unpredictable
- Lack of Capacity Market, but by choice?
- Expansion difficult
- Residential markets untapped
- Uninformed customers

### ▪ Successes

- In the reserves services, ERCOT has been procuring 50% from Demand Side
- Potential higher--limited due to cap of 50 million USD
- ERCOT proves to be good case study for balancing market improvement

#### *Bottom Line:*

*Policy changes or an increase in energy prices need to happen to get ERCOT on par with top performers in capacity markets. More analysis needed to determine successes in balancing market*

Source: External survey/interview; Brattle (2012); Walton (2015); Tweed (2015)



## A global survey of “best practices” for DSR offers important lessons

### DSR participates in both ‘Energy Only’ and ‘Energy + Capacity’ Market designs

#### ▪ **Market access**

- DSR participation in all markets (Balancing, Capacity & Energy)
- Delivery and performance rules suited to DSR
- Standard, simple product portfolio
- Viable aggregation system

#### ▪ **Pricing and evaluation**

- Compensation at fair market value
- Effective baseline assessment
- Fair penalties for non-compliance
- Streamline payment arrangements

Source: RAP (2013) *Effective Mechanisms to Increase the Use of Demand-Side Resources*; SEDC (2014) *The Ten Rules for Successful Demand Response*; Lawrence Berkeley National Laboratory (2012) *Addressing Energy Demand through Demand Response: International Experiences and Practices*; ENTSOE (2015) *Market design for demand side response*



## Our initial conclusions on what drives growth in DSR



Capacity Market **...is key!**

### In addition to:

- Participation rules
- Compensation levels
- Product design
- Enabling infrastructure
- Information flow and engagement with stakeholders



We will test the conclusion along the following lines of enquiry

- **Does the CM hypothesis apply to the UK?**
  - Is there a market where DSR has been successful without a CM?
  - Is there something about the nature of the UK market that means 'Energy Only' markets are big enough to support DSR on their own?
  - Are legacy business models in the UK so unsustainable that even with a CM it will not be enough?

# Questions, Feedback, and Comments

EPRG Spring Seminar  
13 May 2016