NERA
ECONOMIC CONSULTING

1961 ▪ 50th ANNIVERSARY ▪ 2011

Balancing the System in 2050: Policy Challenges

EPRG/NERA Winter Seminar 2012

Richard Druce
Senior Consultant

Cambridge
December 2012

Insight in Economics™

Overview

NERA
ECONOMIC CONSULTING

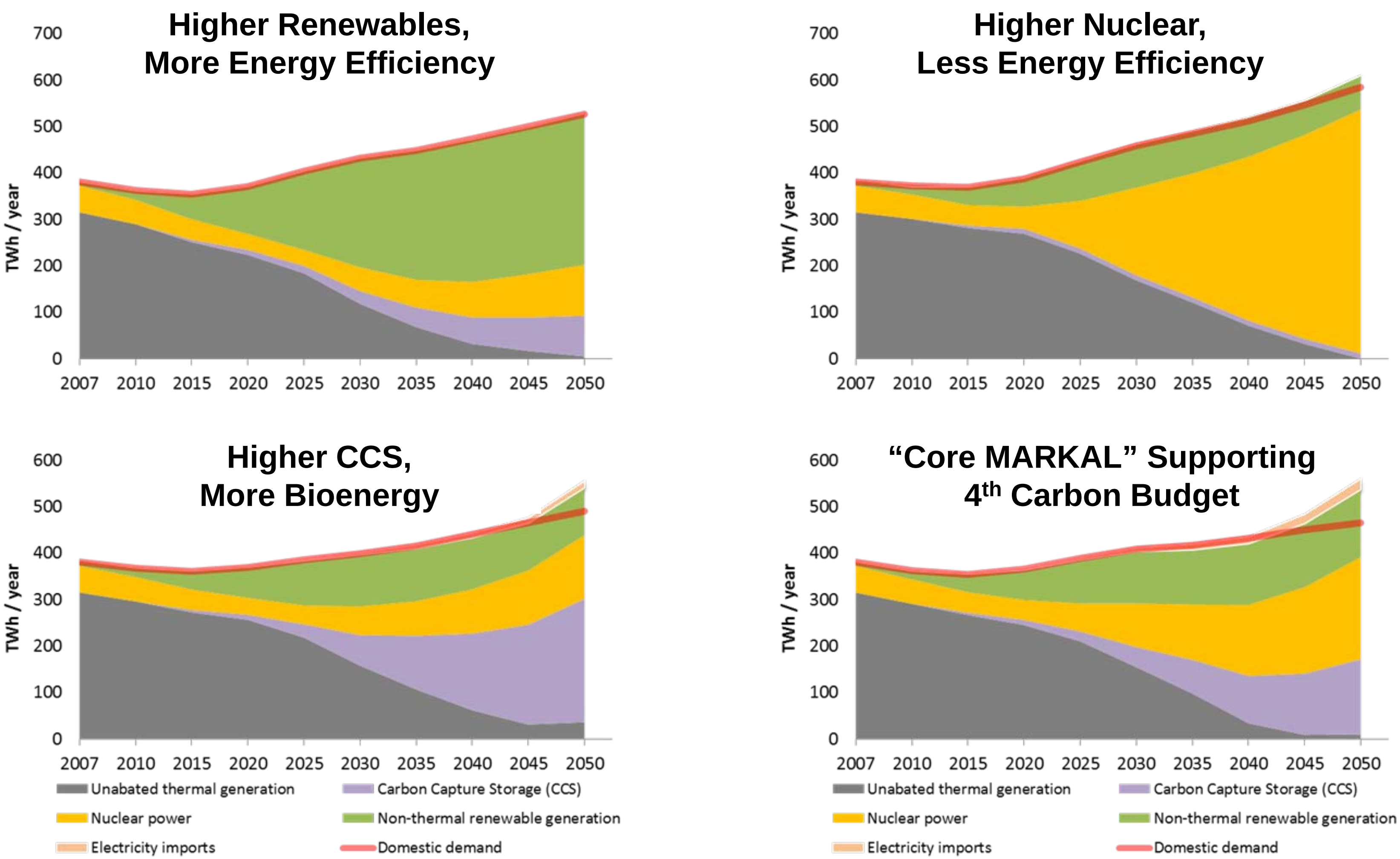
- Policy background on the “balancing challenge” under DECC’s “pathways”
- Meeting the balancing challenge
  – What are the real-life constraints likely to hinder system balancing?
  – What policy measures can support the efficient deployment of balancing technologies?

NERA
ECONOMIC CONSULTING

System Balancing in Long-Term Energy “Pathways”

The Carbon Plan sets out long-term plans to de-carbonise the power sector

NERA ECONOMIC CONSULTING

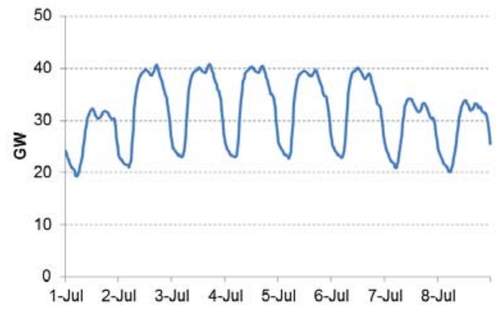


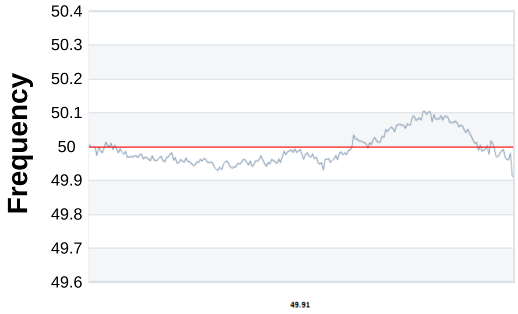
Several “pathways” match TWh of electricity demand to TWh of electricity generation

Source: NERA analysis using DECC’s “2050 Pathways Calculator”

"System balancing" is matching energy supply in TWh to demand at all times

(Half) hour to (half) hour balancing	Equating demand and supply over the year: *Demand*$_h$ = *Supply*$_h$ *For all hours h = 1 … 8760*
Moving energy to where it is needed	T&D reinforcements; Interconnection
Ensuring system security in real time	Resolution of imbalances sub (half-) hour; Ancillary services (reserve, response, etc)



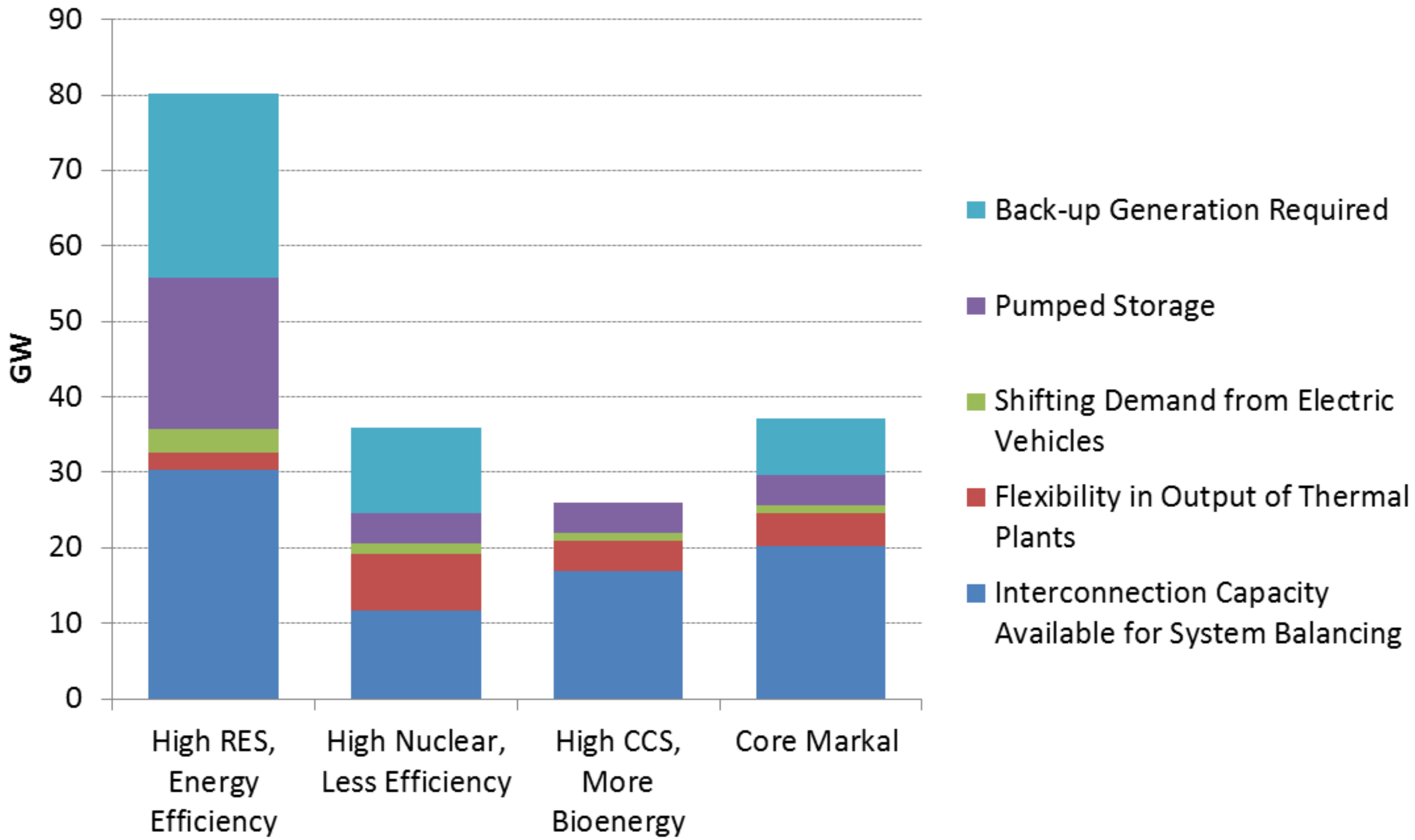


Data sources: National Grid website

The Pathways *assume* additional capacity exists to balance the system

NERA
ECONOMIC CONSULTING

- Mix of interconnection, DSR, storage and back-up generation to meet demand during 5 days of cold, low wind conditions



Source: NERA analysis using DECC's "2050 Pathways Calculator"

Imperial's model optimises deployment of balancing technologies in each Pathway

NERA ECONOMIC CONSULTING

Modelled Deployment of Balancing Technologies *	High RES, High Efficiency	High Nuclear, Lower Efficiency	High CCS, More Bioenergy	Core Markal
Flexible Generation	29-98 GW	11-70 GW	25-90 GW	13-63 GW
Storage	21-23 GW	28-29 GW	11-14 GW	14-15 GW
Interconnection	7-35 GW	15-61 GW	1-38 GW	9-36 GW

** Modelled deployment in a range of scenarios on cost/performance of new technologies, reserve policies, conditions in neighbouring markets, etc*

The optimal level of balancing technology deployment is <u>highly uncertain</u>

Source: NERA/Imperial, Understanding the Balancing Challenge, August 2012

The challenge of defining the "balancing challenge"

- Imperial's model quantifies "the balancing challenge" as defined by DECC:

  "the savings in UK electricity system costs that can be achieved through the adoption of alternative balancing options over the period to 2050" *

- The policy challenge is creating market, regulatory and institutional arrangements to incentivise the efficient deployment of both conventional and alternative balancing options

* DECC, Electricity System: Assessment of Future Challenges – Annex, 9 August 2012, page 85

NERA
ECONOMIC CONSULTING

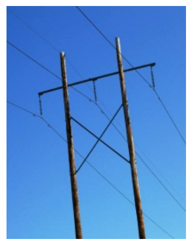
Meeting the Balancing Challenge

Identifying conditions for efficient deployment requires an analysis of incentives

Storage and DSR enable arbitrage between low and high price periods, and may affect network charges

Generation | **Transmission** | **Distribution** | **Consumers**

Flexible generators are more likely to capture high energy and ancillary service prices than less flexible alternatives



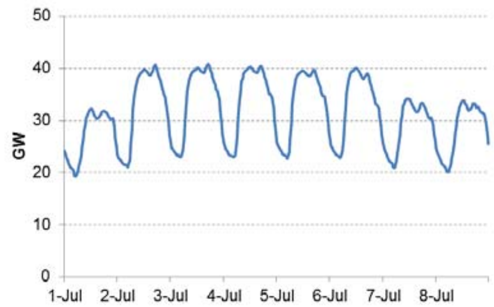
Interconnector owners profit from the value of price arbitrage, and may sell capacity to facilitate reserve sharing

Signaling the marginal value of balancing assets will promote efficient deployment

NERA
ECONOMIC CONSULTING

(Half) hour to (half) hour balancing

- Energy (& capacity) pricing signaling the marginal cost (value) of energy

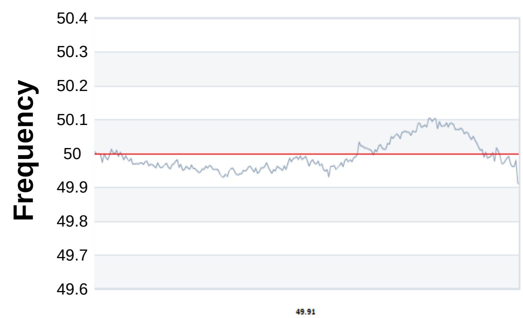


Moving energy to where it is needed

- Locational pricing of energy, reflecting marginal costs
- Network charges signaling marginal costs/benefits

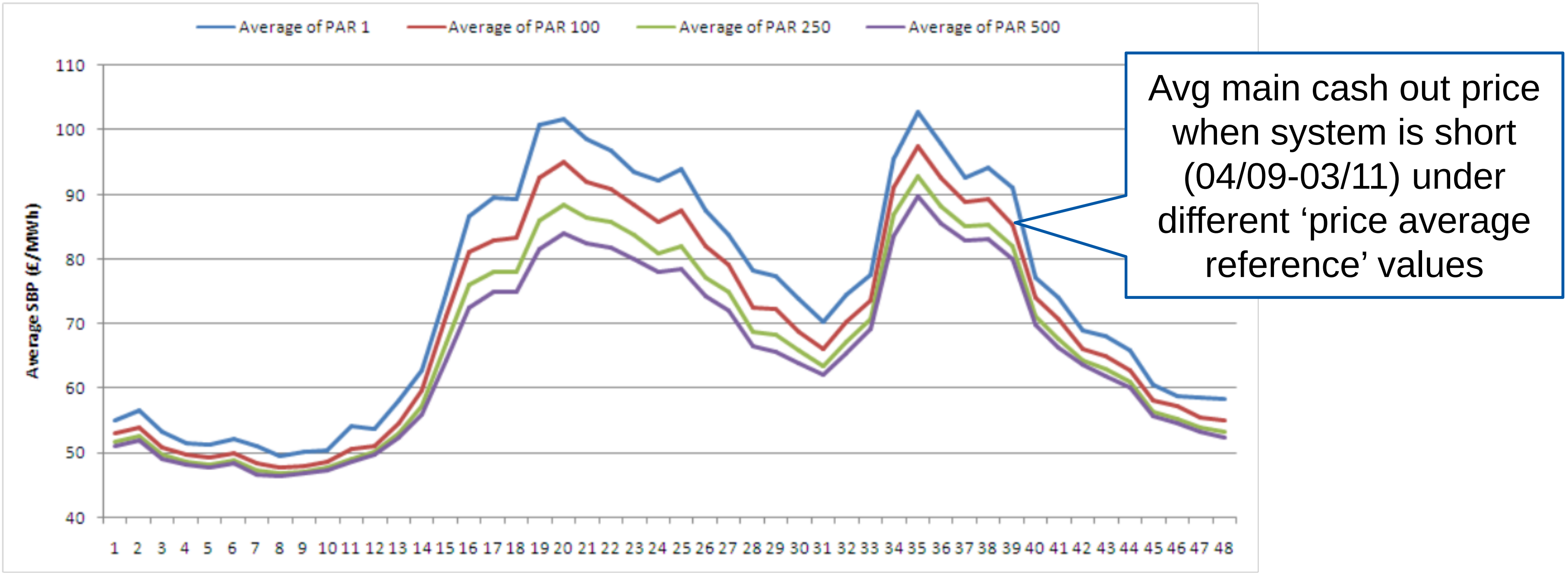
Ensuring system security in real time

- Ancillary service markets signaling marginal value of each reserve/response product



Administered constraints on prices dilute the value of balancing capacity

- Examples from GB market:
  - 500 MWh averaging rule for calculating “marginal” balancing prices
  - Under pricing of SO balancing actions



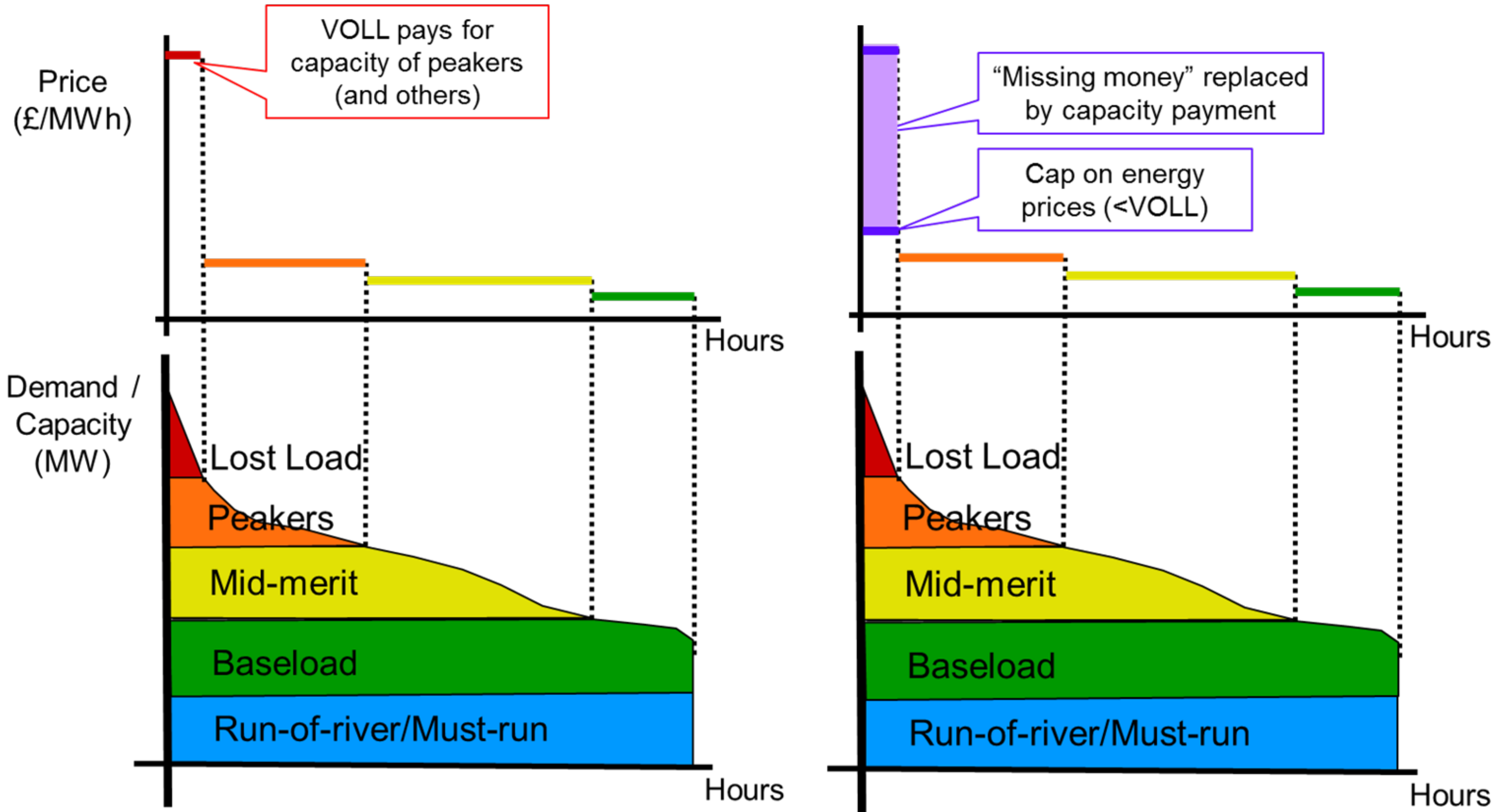
The Electricity Balancing SCR may reform these features of BETTA

Source: *Ofgem Electricity Balancing SCR Initial Consultation, 1 August 2012*

A capacity mechanism may mitigate effects of constrained peak energy prices

NERA ECONOMIC CONSULTING

- As well as administered rules that restrict peak prices, other (e.g. political) factors may prevent price spikes



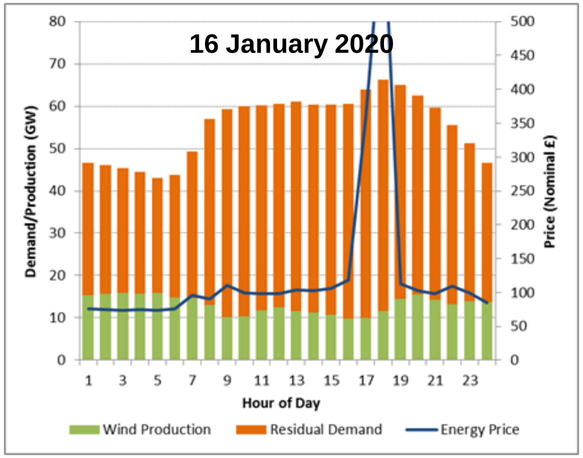
In wind-dominated systems, price spikes can occur outside peak hours

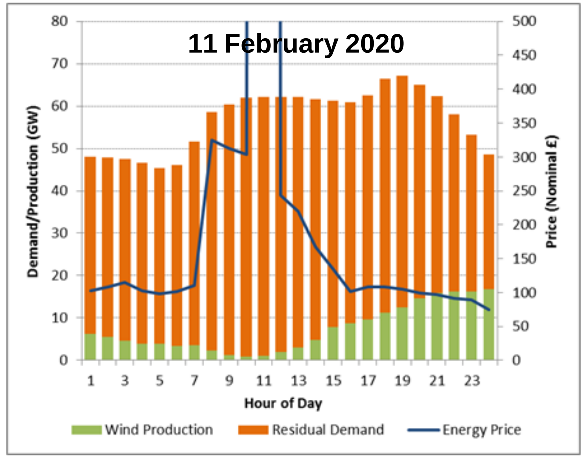
NERA
ECONOMIC CONSULTING

As at present, prices tend to be high in winter peaks, spiking occasionally, with lower prices in summer

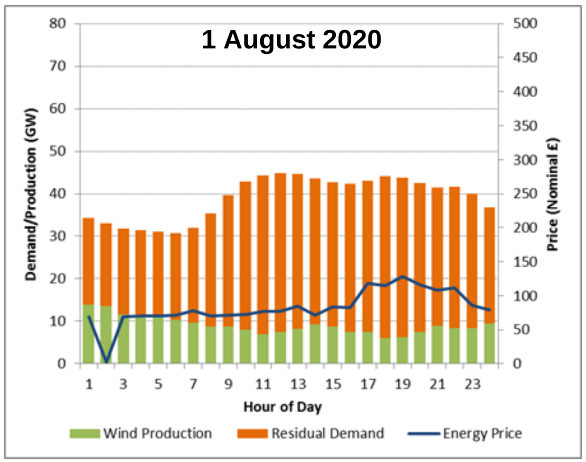
But periods of low wind production can cause price spikes at all times of the year

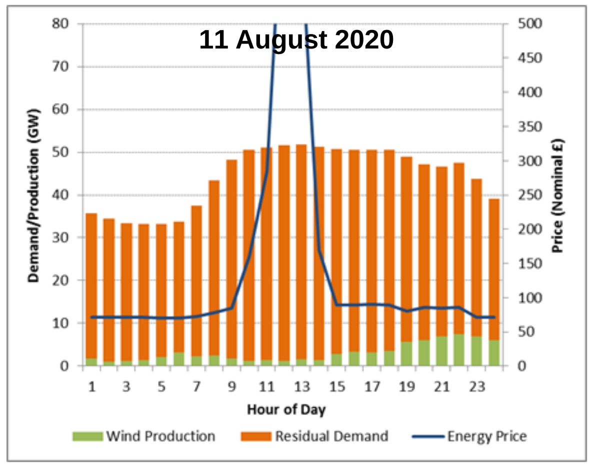
Modelled Prices on Illustrative Winter Days in 2020





Modelled Prices on Illustrative Summer Days in 2020





Source: *Recent NERA modelling work in the GB market*

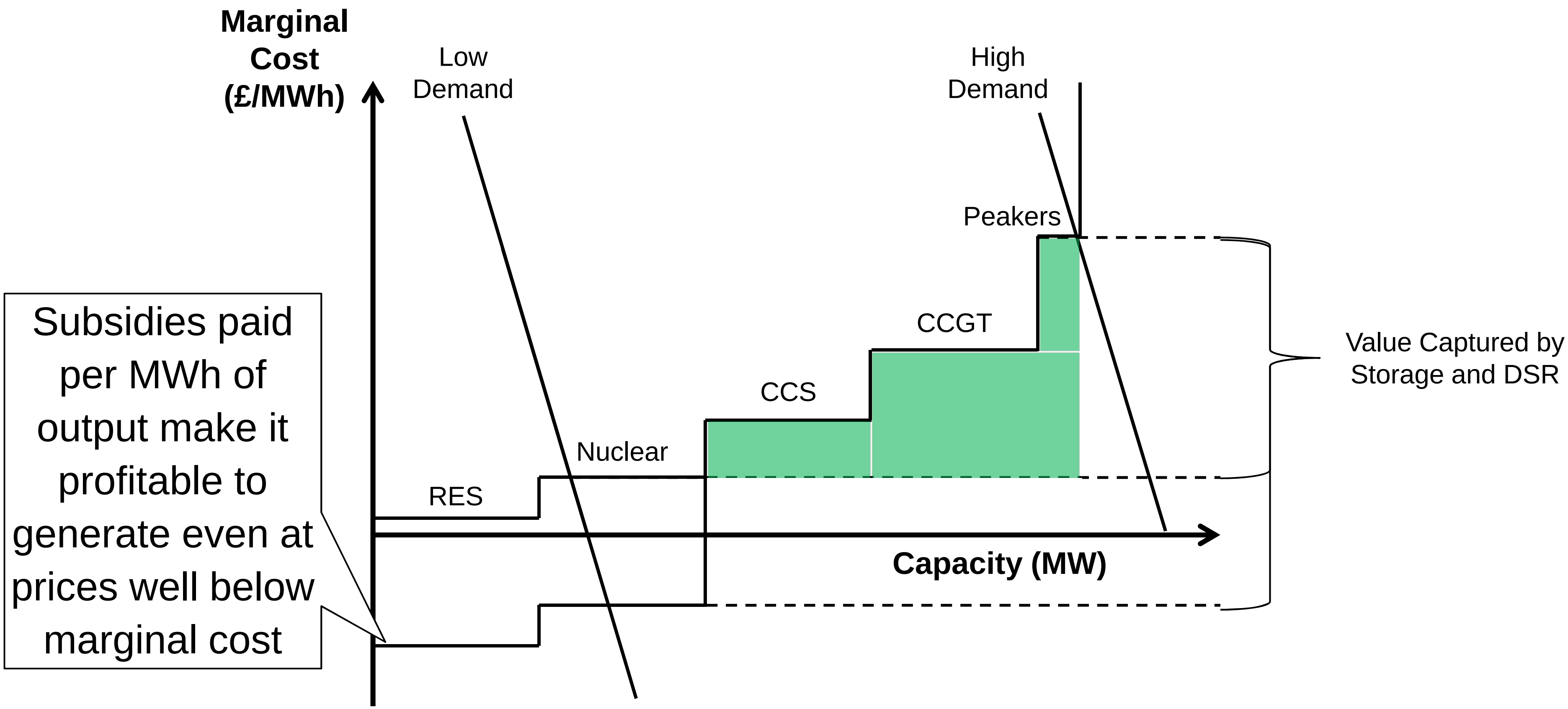
Balancing an intermittent power system creates challenges for CPM design

NERA ECONOMIC CONSULTING

Developments		Challenges for CPM Design
Periods of scarcity (and price spikes) will become less predictable, and may only be captured by more flexible units	→	Defining eligible availability and calibrating penalty mechanisms to replace “missing money”
Non-generation solutions can substitute for generation capacity	→	Defining the capacity target, and facilitating participation in capacity tenders by DSR
Increased regional integration and greater interconnection	→	Allowing holders of interconnector capacity to participate in tenders

Energy-based low carbon subsidies may exaggerate the value of balancing technologies

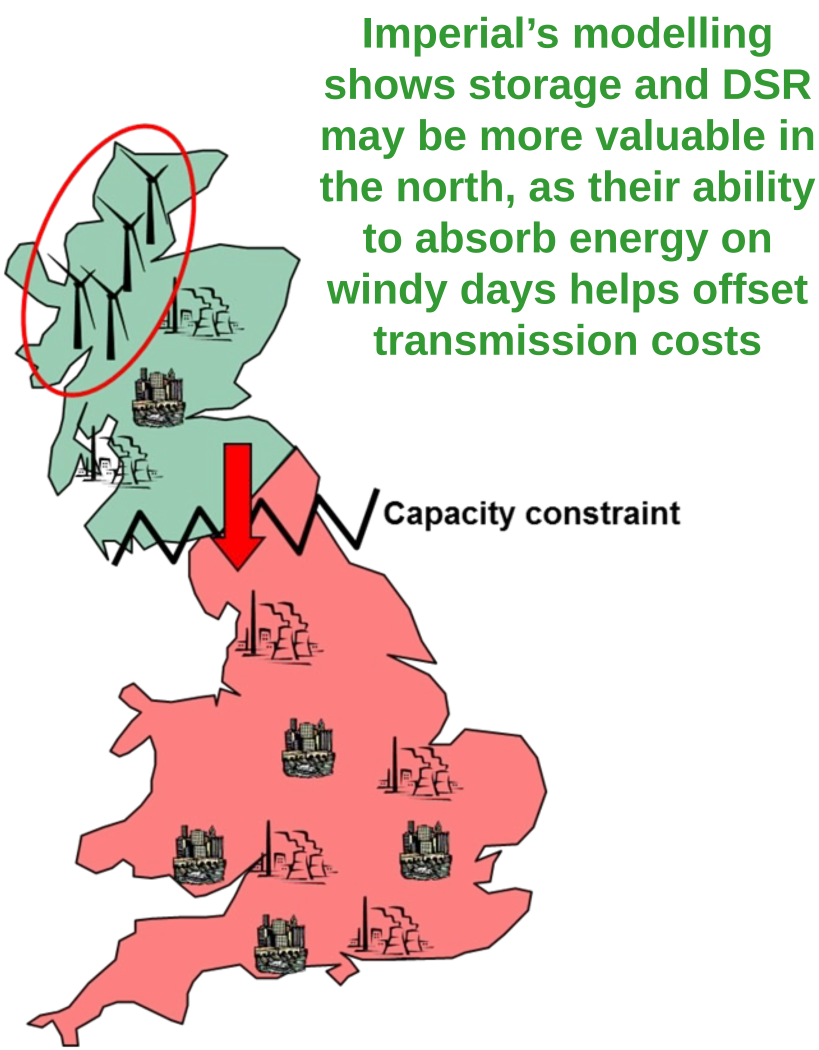
NERA ECONOMIC CONSULTING



Possible solutions include capacity-based subsidies, or linking subsidies to expected output

Locational price signals may help maximise the benefits of alternative balancing technologies

NERA ECONOMIC CONSULTING



- BETTA is a national energy market, conveying limited locational price signals
- Some reform programmes may alter this:
  - **Project TramsiT:** Examining generation transmission charges, but reform of demand charges would be needed to signal value provided by storage/DSR
  - **EU Target Model:** CACM Network Code may require market splitting, providing regional price signals
  - **Regional capacity prices?**

Source: *Framework Guidelines on CACM, ACER, 29 July 2011*

DSR and storage could cut DNO reinforcements by up to £3bn/yr in 2050*

NERA ECONOMIC CONSULTING

- Efficient deployment of balancing technologies may require that DNOs reflect (avoided) capacity costs in tariffs
  - Only larger customers are exposed to the marginal cost of DNO capacity
  - Little (or no) geographic variation in small users' tariffs within DNOs
- Challenge for RIIO-ED1 is to promote an efficient trade-off between "smart" technologies and reinforcement

Tariff Component from CDCM	***Units***	***Restrictions***
One, two or three unit rates	p/kWh	No more than two unit rates for non half hourly settled demand
Fixed charge	p/day	Not for unmetered supplies
Capacity charge	p/kVA/day	Half hourly settled demand tariffs only
Reactive power charge	p/kVArh	Half hourly settled tariffs only

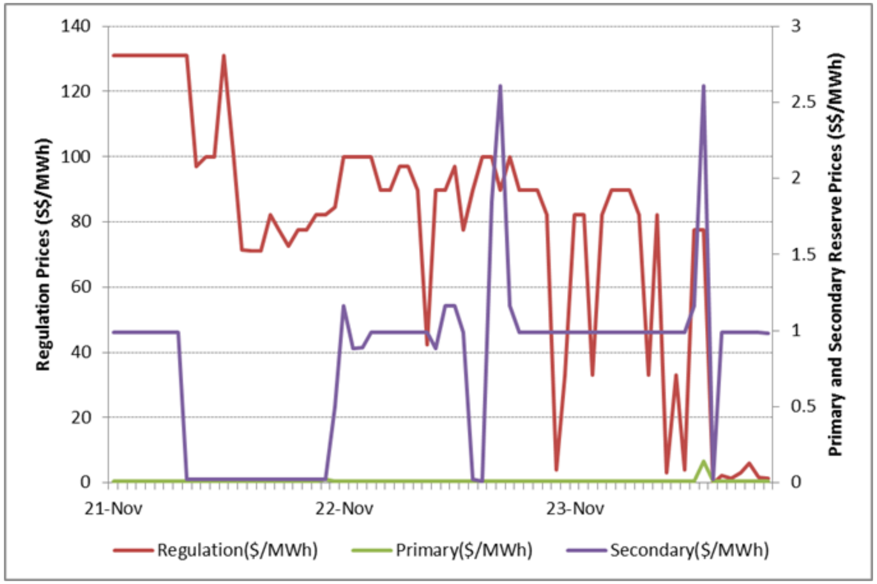
Source: Distribution Connection and Use of System Agreement (v5.4), Schedule 16, Table 1

** Figure based on Imperial modelling work.*

Balancing technologies will also be required for real time balancing

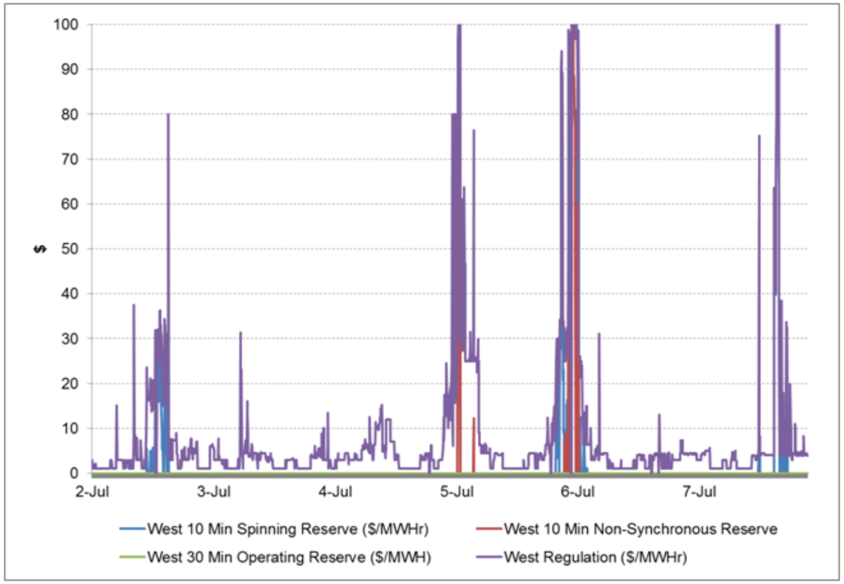
- Achieving an efficient allocation of capacity between reserve and ancillary services will help balance the system at least cost
  - Requires signals of the marginal value of providing ancillary services
  - Real time ancillary service markets would help

Reserve and Regulation Pricing in the Singaporean Market



Source: Energy Market Company of Singapore Website

Reserve and Regulation Pricing in the New York Market



Source: NY ISO Website

Conclusions

Conclusions

NERA ECONOMIC CONSULTING

- The costs and constraints involved in system balancing are, rightly, receiving increasing attention from policymakers
- The main "balancing challenge" will be implementing policies to encourage and efficient deployment of balancing technologies
- Efficient pricing of energy and ancillary services, and cost reflective network charging, will help meet this challenge

NERA
ECONOMIC CONSULTING

1961 ■ 50th ANNIVERSARY ■ 2011

Contact Us

Richard Druce

Senior Consultant
NERA—London
+44 20 7659 8540
richard.druce@nera.com