GAS BALANCING, MARKETS AND THE SYSTEM OPERATOR

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Jornada Tecnica
Bogota, March 29th

INITIAL PROPOSITIONS

- GAS BALANCING INVOLVES THE WHOLE SYSTEM

- ON-THE-DAY GAS BALANCING MARKETS ARE A SMALL PART OF THE WHOLE SYSTEM

- ON-THE-DAY MARKETS WILL NOT SOLVE BALANCING PROBLEMS WHICH ARE SYSTEMIC IN ORIGIN

ORGANISATION OF PRESENTATION

- BALANCING REQUIREMENTS: THE IMPORTANCE OF OWNERSHIP STRUCTURE
- THE BALANCING PROCESS AND MARKETS
- ON-THE-DAY BALANCING AND THE OCM
- THE SYSTEM OPERATOR AND BALANCING

Balancing Requirements:

the Importance of Ownership Structure

In the Beginning there was State Ownership of Gas Transmission, Distribution, Storage and some Upstream Production

Sources of Balancing Uncertainty:

The Weather

Breakdowns

Available Responses:

Monopoly Administration of Production and Storage Assets (via both ownership and contractual arrangements)

Then there was Privatised Monopoly

Sources of Balancing Uncertainty:

The Weather

Breakdowns

Available Responses:

Monopoly Administration of Production and Storage Assets (via both ownership and contractual arrangements)

Then there was Liberalisation with Internal Unbundling (Production and Supply Separated from Networks by placing them in Separate Business Units)

Sources of Balancing Uncertainty:

The Weather

Breakdowns

Available Responses:

Monopoly Administration of Production and Storage Assets (via both ownership and contractual arrangements)

Then there was Liberalisation with Ownership Unbundling (*Ownership* of Production and Supply separated from Networks)

Sources of Balancing Uncertainty:

The Weather (impact increases)

Breakdowns (impacts increase)

System De-integration

Available Responses:

Network Monopoly *Management* of System (Operations and Governance)

Then there was Liberalisation with Ownership Unbundling (Production and Supply separated from Networks) and Supply Competition

Sources of Balancing Uncertainty:

The Weather (impact increases)

Breakdowns (impacts increase)

System De-integration

Multiple Suppliers/Shippers

Customer Switching

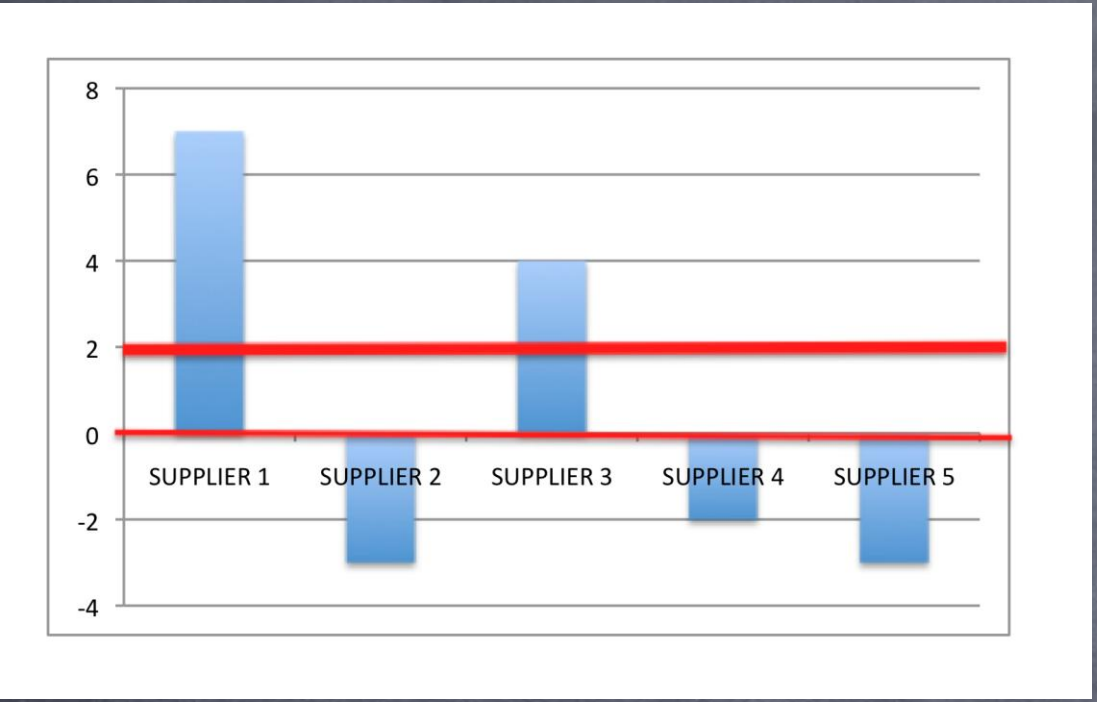
Upstream Contracts and Associated Gas

Customer Dependence on Gas (especially Generators)

Available Responses:

Network Monopoly *Management* of System (Operations and Governance) and On-the-Day Markets (motive to reduce costs but also facilitated inter-shipper balancing transactions independent of system operator)

SYSTEM BALANCING AND SHIPPER/SUPPLIER BALANCING



Suppliers' Balance (individual Suppliers' anticipated Customer requirements) does not imply System Balance (Actual Customer requirements)

Possibilities:

Supplier Balance = System Balance (very unlikely, graph thin red line)

Supplier Balance > System Balance

Supplier Balance < System Balance (graph thick red line)

CONCLUSIONS (1)

Balancing Requirements

f(W,B,OC,SC,UC,GP)

where W=Weather

B=Breakdowns

OC=Ownership Complexity

SC=Supply Competition

UC=Upstream Contracts

GP=Generators' Portfolios

THE BALANCING PROCESS AND MARKETS

Reminder: System Balancing is Ultimately Physical (from changes in Production or Storage)

F(Pr,S,Fl)

Where Pr=Proximity of Supply Reserve

S=Size of Supply Reserve

Fl=Flexibility of Supply Reserve

Supply Reserve=Production and/or Storage and Linepack

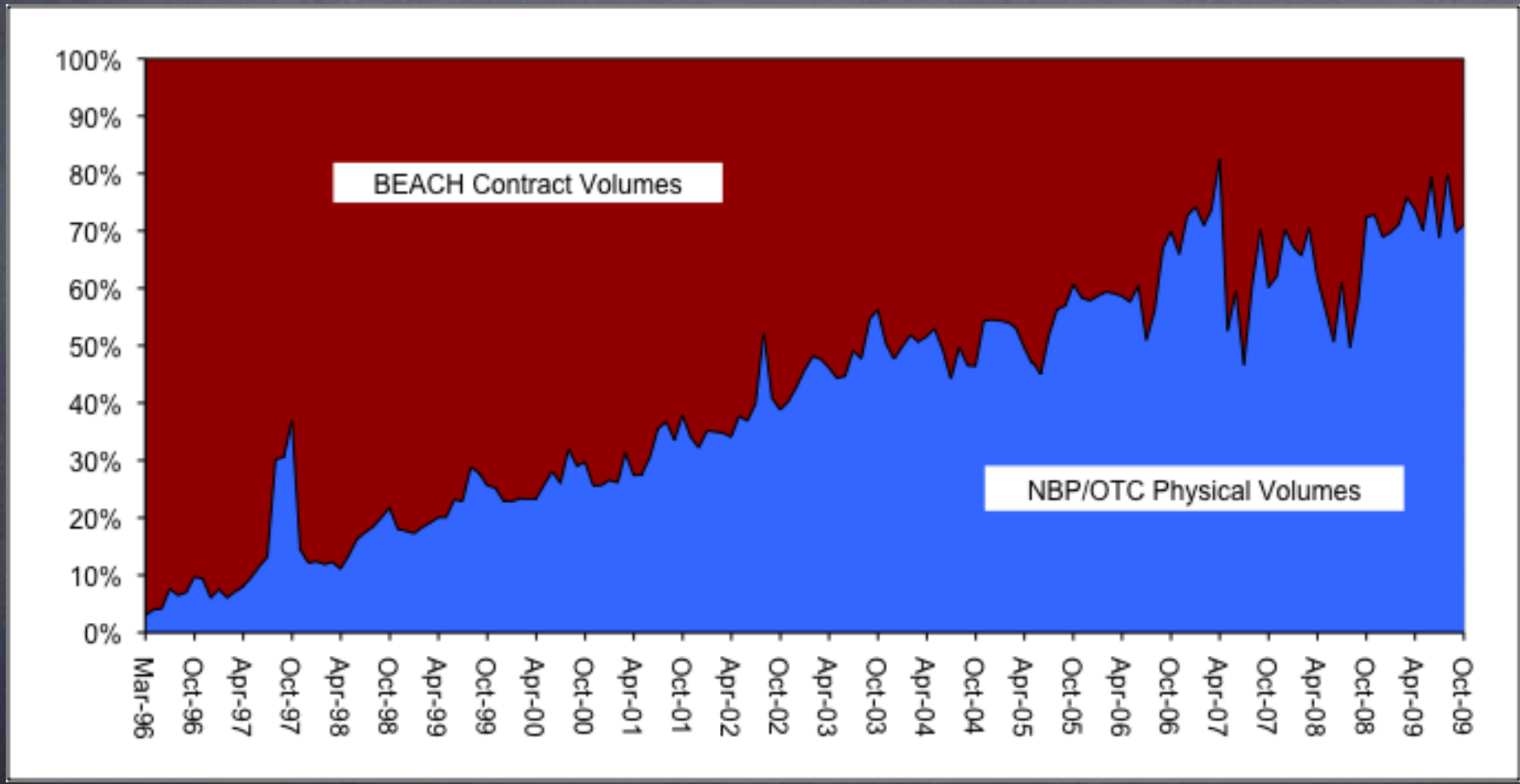
Markets cannot change these physical aspects of the gas supply chain. Markets may allow the physical configuration of supply to work more effectively. However, they may also make them work less effectively at higher cost. Markets can induce a demand-side response, but this may not be desirable.

GAS BALANCING AND CONTRACTING TOWARDS THE ‘GAS DAY’ (Gas Delivery)

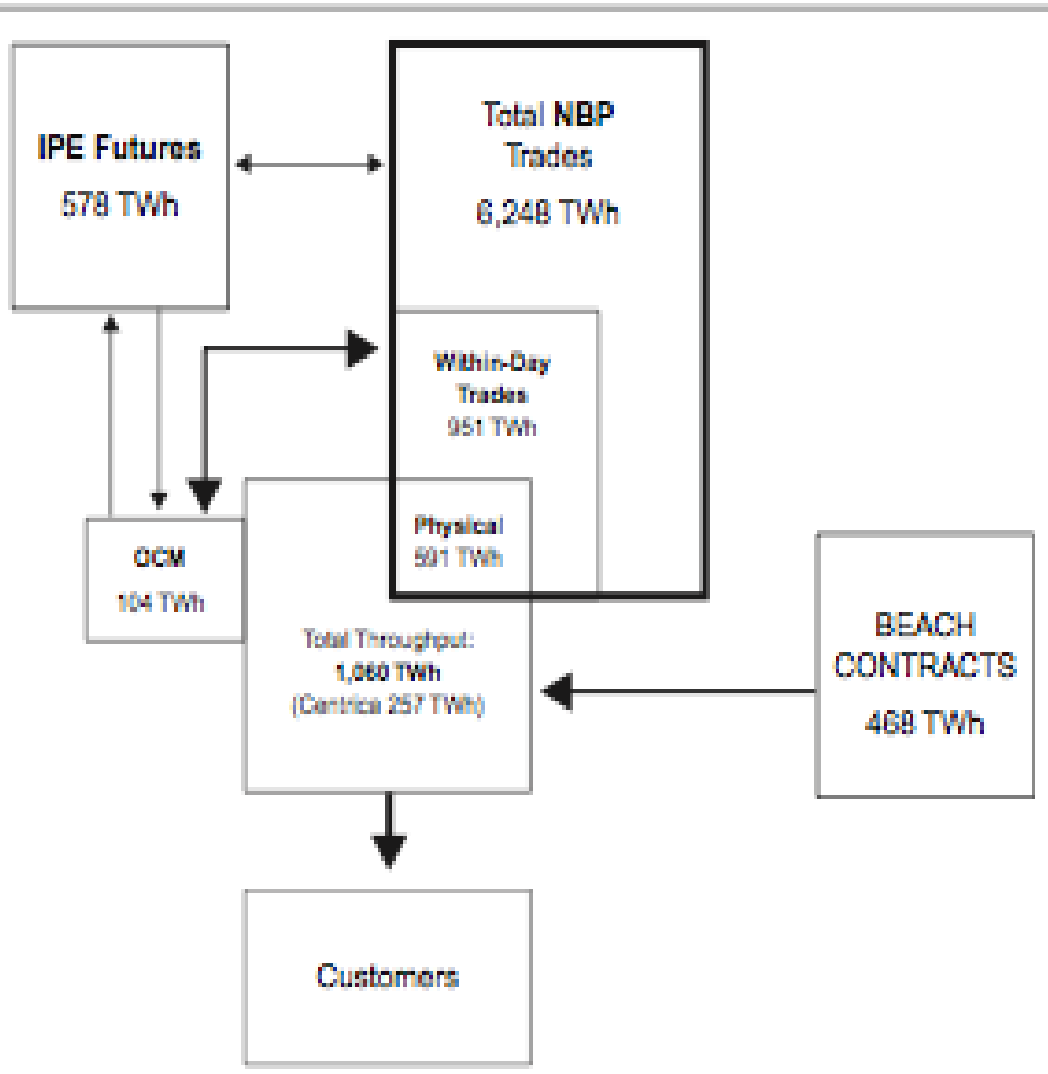
The success of On-the-Day markets is critically dependent on the performance of markets before the day.

PAST	OLD-STYLE LONG-TERM CONTRACTS (Beach Delivery, Oil and Producer Price Indexed)
	NEW-STYLE LONG-TERM CONTRACTS (NBP Delivery, wholly or partially Gas-Indexed)
	MONTHS OUT CONTRACTS
	GAS Day minus one Purchases (D-1)
GAS DELIVERY DAY	DELIVERY under PAST CONTRACTS + SPOT PURCHASES and SALES: Within-Day (On-the-Day-for-the-Day): OTC Prompt Desk and OCM. CONTRACTING for FUTURE DELIVERIES: OTC Forward Desk and Bilateral Contracts.
FUTURE UP TO 2 YEARS OUT: OTC FORWARD DESK	SAP-priced (OCM System Average Price)
	MONTH minus one (M-1)-priced
	MEDIUM-TERM CONTRACT (wholly Gas-Indexed)
FUTURE BEYOND 2 YEARS OUT: BILATERAL CONTRACTS	NEW-STYLE LONG-TERM CONTRACTS (NBP Delivery, wholly or partially Gas-Indexed)
	CONTINUING OLD-STYLE LONG-TERM (Beach Delivery, Oil and Producer Price Indexed)

The Overall Development of Gas Markets in the UK



The Relative Size of Different Gas Markets in the UK (2004)



NBP Physical Trades as % of Total NBP Trades = 9.5%

NBP Deliveries as % of Total Deliveries = 55.8%

OCM as % of Throughput = 9.8%

OCM as % of Total (NBP + OCM) Within-Day Trades = 9.8%

IPE as % of Throughput = 54.5%

Centrica (British Gas) as % of Throughput = 24.2%

Growth of Markets since 2004 (to 2009)

- Throughput down 6%

- NBP Trades up 81%

- APX-Endex, the OCM operator, has expanded its range of products since 2004 to include Day-Ahead, and its volumes have grown by 50% to about 150 billion TWh (2009)

- However, ICE, the Futures Exchange has also expanded its product range and increased gas volumes by 330%, indicating a change in the importance of exchange-traded vs OTC traded gas (from 9% to 22% of trades – 2009, although does include some European trading). Gain relative to the OCM to be expected because Month-Ahead and Day-Ahead are the most important contracts.

- Trading still dominated by OTC trades

CONCLUSIONS (2)

- System Balancing is ultimately physical
- System Balancing for the day begins long in advance and moves through a series of contractual phases
- The most important short-term markets are Month-ahead and Day-ahead (Shipper/Suppliers seek to avoid on-the-day trading)
- Most trading is ‘paper’ and via the OTC
- Contracts specifying delivery to a National Balancing Point, do not automatically also imply that this gas has been traded on short-term markets
- If a portfolio of markets does not exist and/or their liquidity is low then this would exert pressure on an isolated On-the-Day exchange, with price volatility a likely result

GAS BALANCING AND THE OCM (On-the-Day Commodity Market)

European Union Level: General Principles (1)

"Balancing rules shall be designed in a fair, non- discriminatory and transparent manner and shall be based on objective criteria. Balancing rules shall reflect genuine system needs taking into account the resources available to the transmission system operator."

Article 7 of Regulation 1775/2005

European Union Level: General Principles (3)

"Imbalance charges shall be cost-reflective to the extent possible, whilst providing appropriate incentives on network users to balance their input and offtake of gas. They shall avoid cross-subsidisation between network users and shall not hamper the entry of new market entrants.

Article 7 of Regulation 1775/2005

UK Practice

Rules established via the Network Code which is managed by the Joint Office of Gas Transporters (different from the System Operator which is National Grid Gas)

Advance Flow and Offtake Nominations up until end of day before Gas Delivery Day

Use of Trading Exchange (the OCM) to price Within-day trades which are used to correct Shipper Imbalances

Incentives to Shippers to avoid Imbalances (System Marginal Price Buy for Cashout; Unauthorised Gas Flows)

System Operator Revenue Neutral and Incentivised to intervene at lowest cost while not compromising system safety (linepack deterioration)

OCM Prices used in Balancing: Negative Imbalance (System Operator has to sell to Shipper)

the "**System Marginal Buy Price" is the greater of:**

(i) the System Average Price plus 0.0287 pence/kWh; and

(ii) the price in pence/kWh which (subject to Section D4.1.4, 4.1.5(a)) is equal to the highest Balancing Action Offer Price in relation to a Market Balancing Action taken for that Day;

Uniform Network Code, Transportation Principal Document, Section F, February 2011

OCM Prices used in Balancing: Positive Imbalance (System Operator buys from shipper)

the "**System Marginal Sell Price" is the lesser of:**
(i)the System Average Price less 0.0324 pence/kWh; and
(ii)the price in pence/kWh which (subject to Section D4.1.4, 4.1.5(b) and 4.1.7) is equal to the lowest Balancing Action Offer Price in relation to a Market Balancing Action taken for that Day;

Note the incentive not to oversupply as well as undersupply

Uniform Network Code, Transportation Principal Document, Section F, February 2011)

System Average Price (SAP)

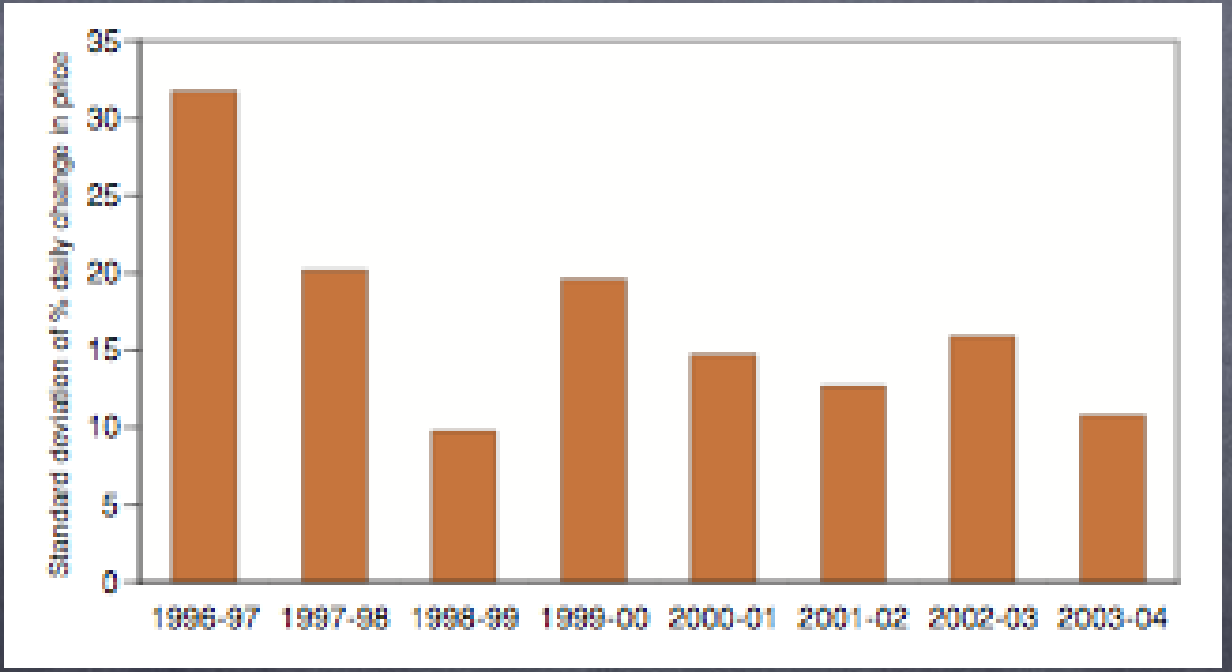
the "**System Average Price" for a Day is (subject to Section D4.1.4 and 4.1.6) the price in pence/kWh calculated as the sum of all Balancing Transaction Charges divided by the sum of the Market Transaction Quantities and Non-Trading System Transaction Quantities for all Balancing Transactions respectively effected in respect of that Day**

(and for the avoidance of doubt on a Day on which National Grid NTS takes no Market Balancing Action the System Marginal Buy Price and the System Marginal Sell Price shall be the System Average Price).

Uniform Network Code, Transportation Principal Document, Section F, February 2011)

History

The OCM originally replaced the 'Flexibility Mechanism' under which all trading was with the System Operator (as the Electricity Balancing Mechanism still is). Prices were initially volatile (more than for other markets) but then it settled down:

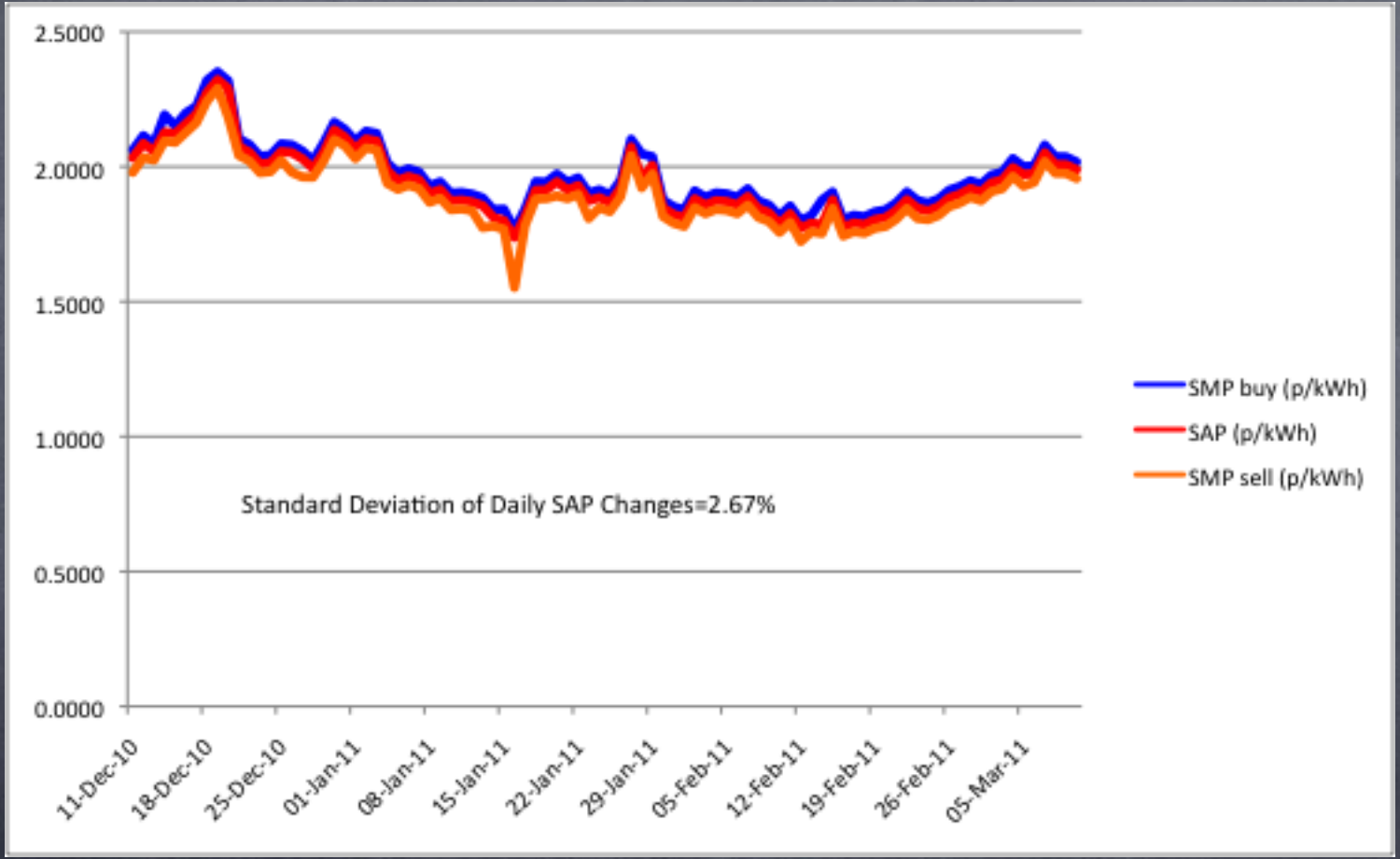


SAP – own calculations from *Gas Prices in the UK*

Notes: Behaviour of OTC Within-day was similar; Use of SMP and SAP transferred directly from the Flexibility Mechanism

Last Three Months

During cold winter months OCM prices have shown little volatility



Own calculations

OCM Mainly Trades Titles

Three On-the-Day (within-day) products are traded on the OCM: Locational (to ease constraints at specific locations), Physical (for physical delivery) and Title (changes of title to gas scheduled for delivery). The majority of trades on the OCM are Title.

Implications?

Main Market Participants

Banks and funds J.Aron(GoldmanSachs), Barcap, BNP, Calyon, Centaurus, Citadel, Citibank, Credit Suisse, Deutsche, Elliott Advisors, Macquarie, Merrill Lynch, JP Morgan, Morgan Stanley, Nomura, Tudor	Producers BG Group, BP, Conoco, ENI, ExxonMobil, Gazprom(GM&T), Shell, Statoil, Total
End-users Accord(Centrica), EDF Energy, Eon, RWE, Scottish Power, Scottish & Southern, Smartest, Wingas (UK)	Proprietary Traders EDF Trading, Gunvor, Hetco, Koch, Mercuria, Noble, Vitol

Source: Patrick Heather, OIES

CONCLUSIONS (3)

- The original motive for establishing the UK's On-the-day exchange was the cost of the System Operator's bilateral trades with Shipper/Suppliers (under the 'Flexibility Mechanism')

- The use of SMP and SAP were not an invention of the OCM, they originated under the Flexibility Mechanism

- After a volatile beginning OCM trading settled down

- OCM trading mainly for titles of gas already scheduled for shipment (i.e. it is not for additional gas to balance the system)

- OTC 'Within-day' trading probably still more important, but the prices in both markets track each other

- The participation of non-gas organisations adds to liquidity but can also result in speculation affecting prices

THE SYSTEM OPERATOR AND BALANCING

The System Operator in the UK

- This is National Grid which also operates the Electricity Grid

- Operation is separate from governance because while National Grid owns all the UK's transmission network, it does not own all the Distribution network

- Governance (management of the Network Code) is by the Joint Office of Gas Transporters

- National Grid's System Operator function is regulated under a different price control ('SO' regulation) from its transportation function ('TO' regulation)

Balancing Tools Directly Available to System Operator

- Allowing ‘linepack’ to vary within safe limits
- Storage withdrawals and injections (including its own, pre-booked ‘Operating Margins’ storage for use in emergencies)
- OCM interventions (signals for Production ‘swing’ and Storage activity)
- Capacity buy-back (to overcome locational constraints)
- Declaration of a ‘Gas Balancing Alert’ (accompanied by interruptions)

Triggers for Intervention

System Monitoring

Safety Monitors

Prevailing View

Current Gas Day : Monday, 14/03/2011

Previous | Welcome to National Grid | Next

Alert Status

	Today 14/03/2011	Tomorrow 15/03/2011
GBA	NONE	NONE
Trigger (mscm)	449.80	455.20

Forecast

Graph

Demand (mscm)

Forecast Demand	300.4 (16:01)	288.2 (13:04)
Seasonal Normal Demand	333.6	332.6

Supply (mscm/d)

Forecast Flow	290.0 (16:00)
Physical Flow	302.1 (16:00)

Linepack (mscm)

PCLP	337.3 (16:01)

Likelihood to Interrupt

Long Term Demand

System Entry Point Flow Data

Forecast Map

Demand | Supply

Actual Map

Demand | Supply

Forecast Annual Peak Demand 514 mscm

Real Time Flow Data

ANS Messages

NONE

Actual

Demand (mscm) Graph — 13/03/2011

Actual Demand	270
Seasonal Normal Demand	319
Actual CWV	7
CWV Seasonal Normal	7

Supply (mscm) Graph — 12/03/2011

Beach including Norway	211
LNG Imports	41
Interconnectors	17
Storage	4

Linepack (mscm) Graph — 14/03/2011

Opening	347.7

EOD Export Physical Flows (mscm) — 13/03/2011

Bacton	0
Moffat	18

Storage Stock Levels (GWh) Graph

	13/03/2011	14/03/2011
Short	356	432
Medium	2,450	2,481
Long	7,777	7,822

Actual Storage Stock (GWh) Graph

Aggregate LNG Importation Stock (GWh) Graph

13/03/2011	14/03/2011
4,549	5,804

Price Graph — 13/03/2011

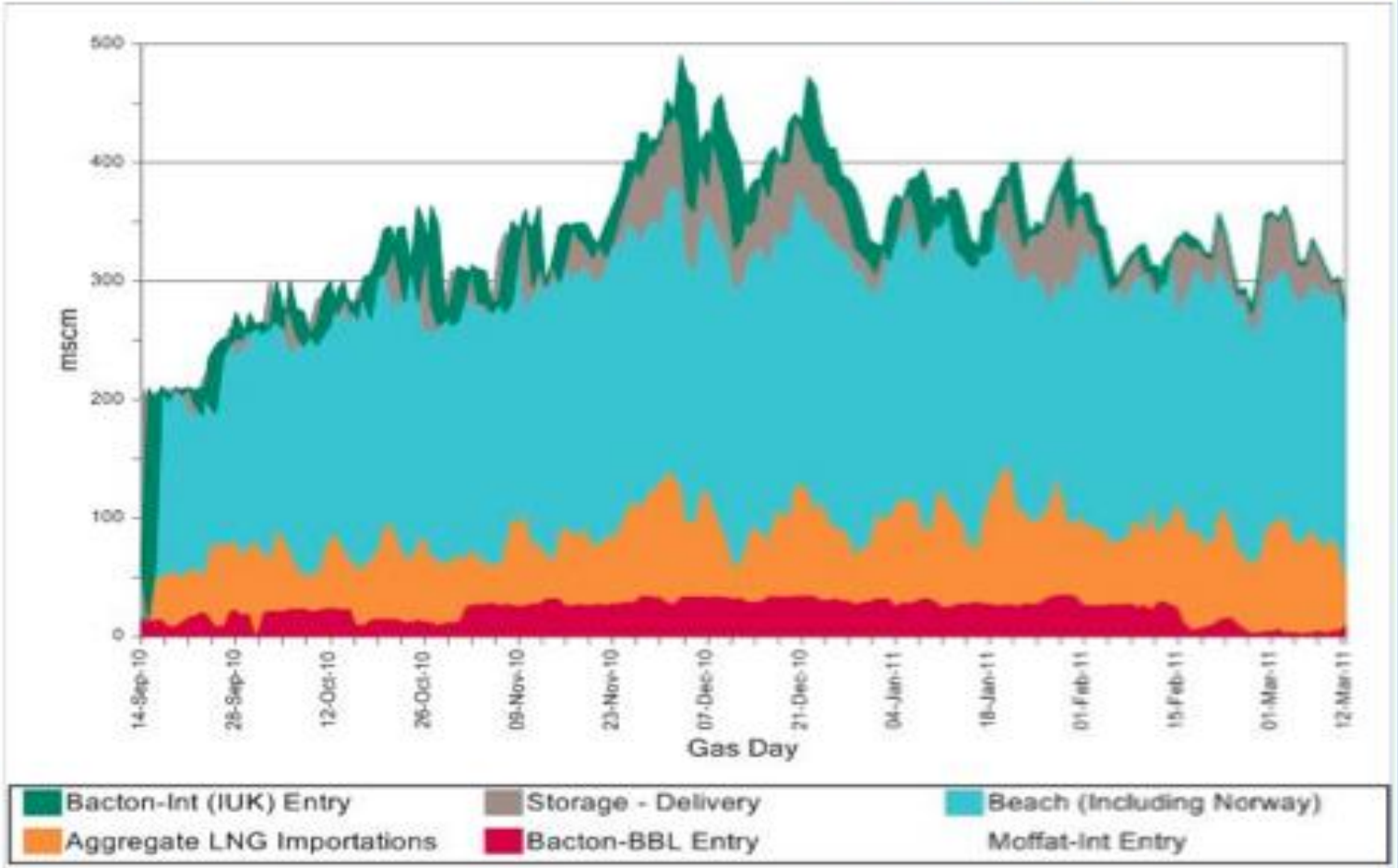
	SAP	SMP Buy	SMP Sell	7 day Avg
p/kWh	2.0804	2.1221	2.0870	2.0198
p/therm	61.35	62.16	60.40	59.19

National Grid publishes data in UK standard units. Conversion factors are provided in the "Help" menu.

Graph : Supply Graph

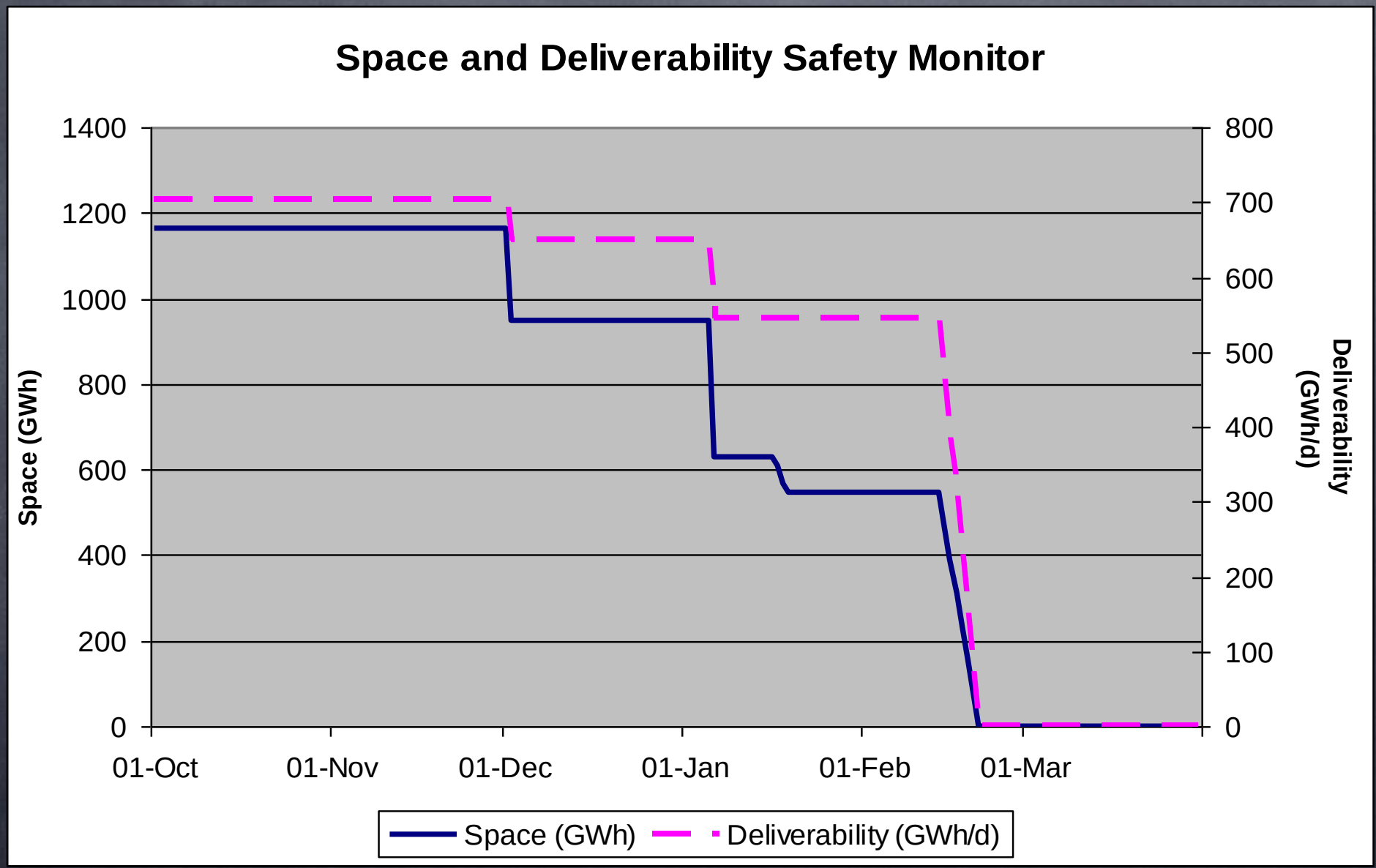
Back to Prevailing View

<< Previous Season || Next Season >>



<< Previous Season || Next Season >>

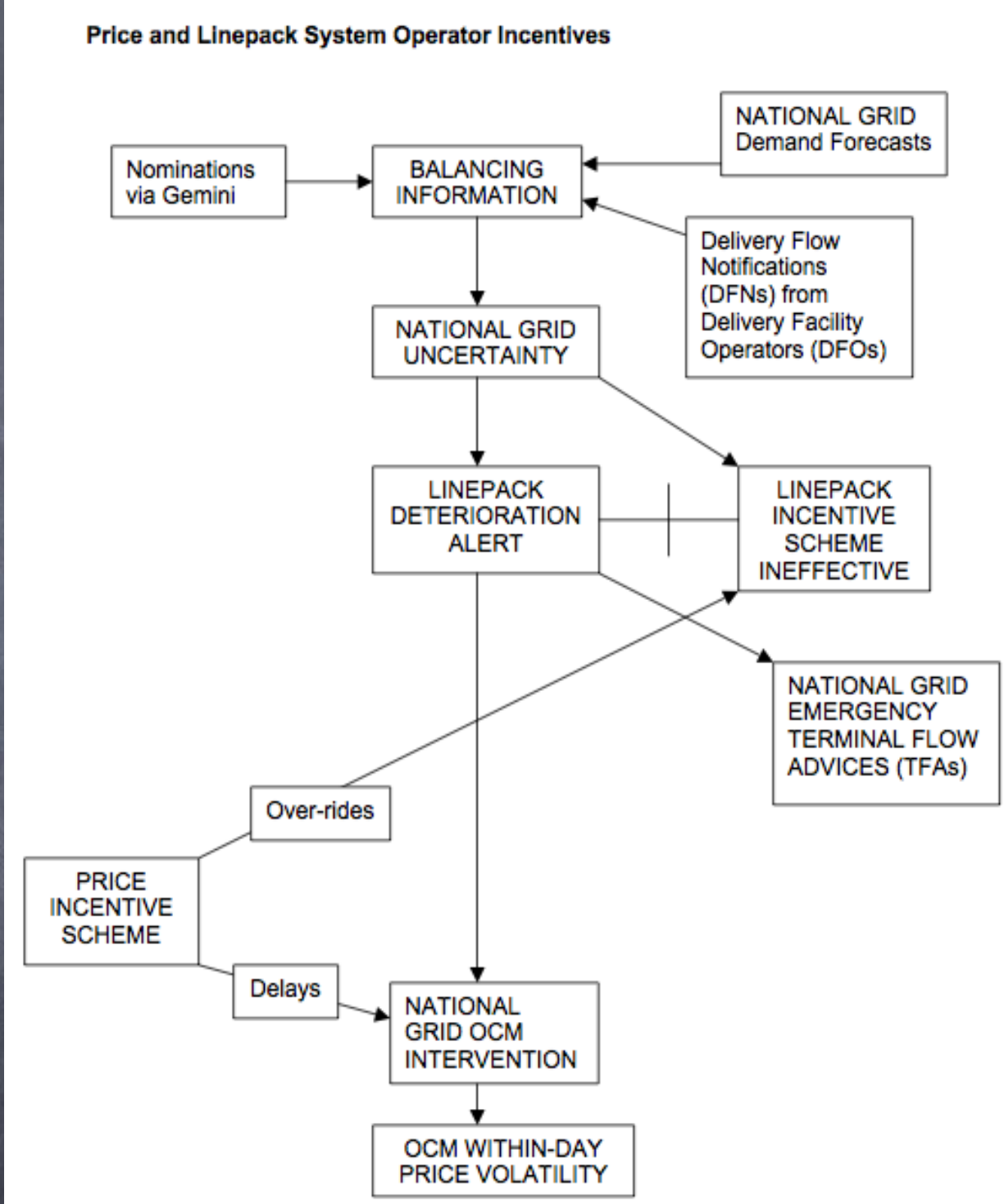
Storage Safety Monitors February 2011



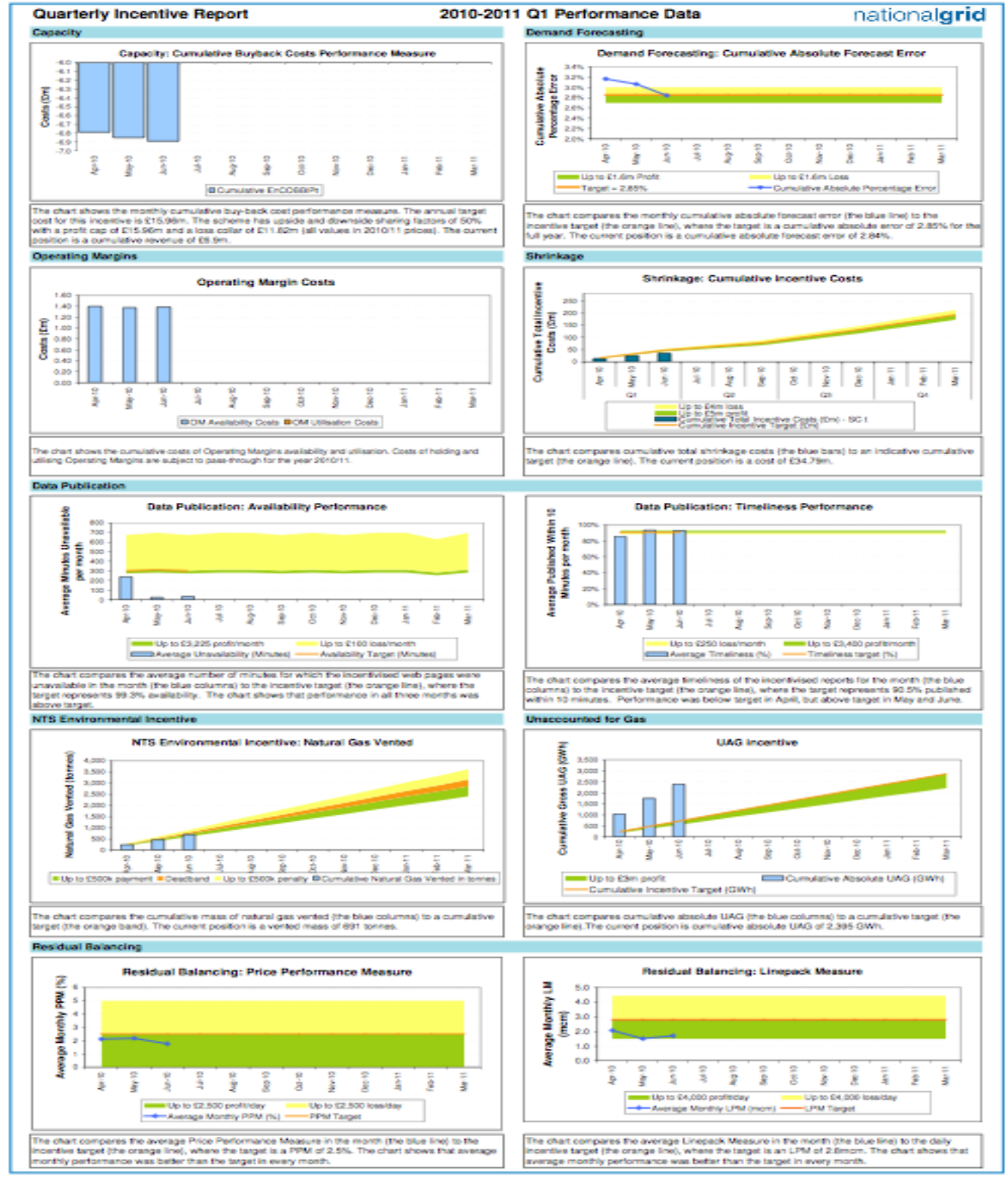
7 System Operator Incentives

- Demand Forecasting (error under 2.85%)
- Operating Margins (procurement scrutiny)
- Environmental (target for gas vented from compressors)
- Data Publication (99.3% availability, 90.5% of hourly updates with 10 minutes of the start of the hour)
- Residual Balancing (intervention price and linepack maintenance incentives, ‘capped and collared’)
- Shrinkage (own-use and unbilled gas)
- Unaccounted for Gas (upside only, capped)

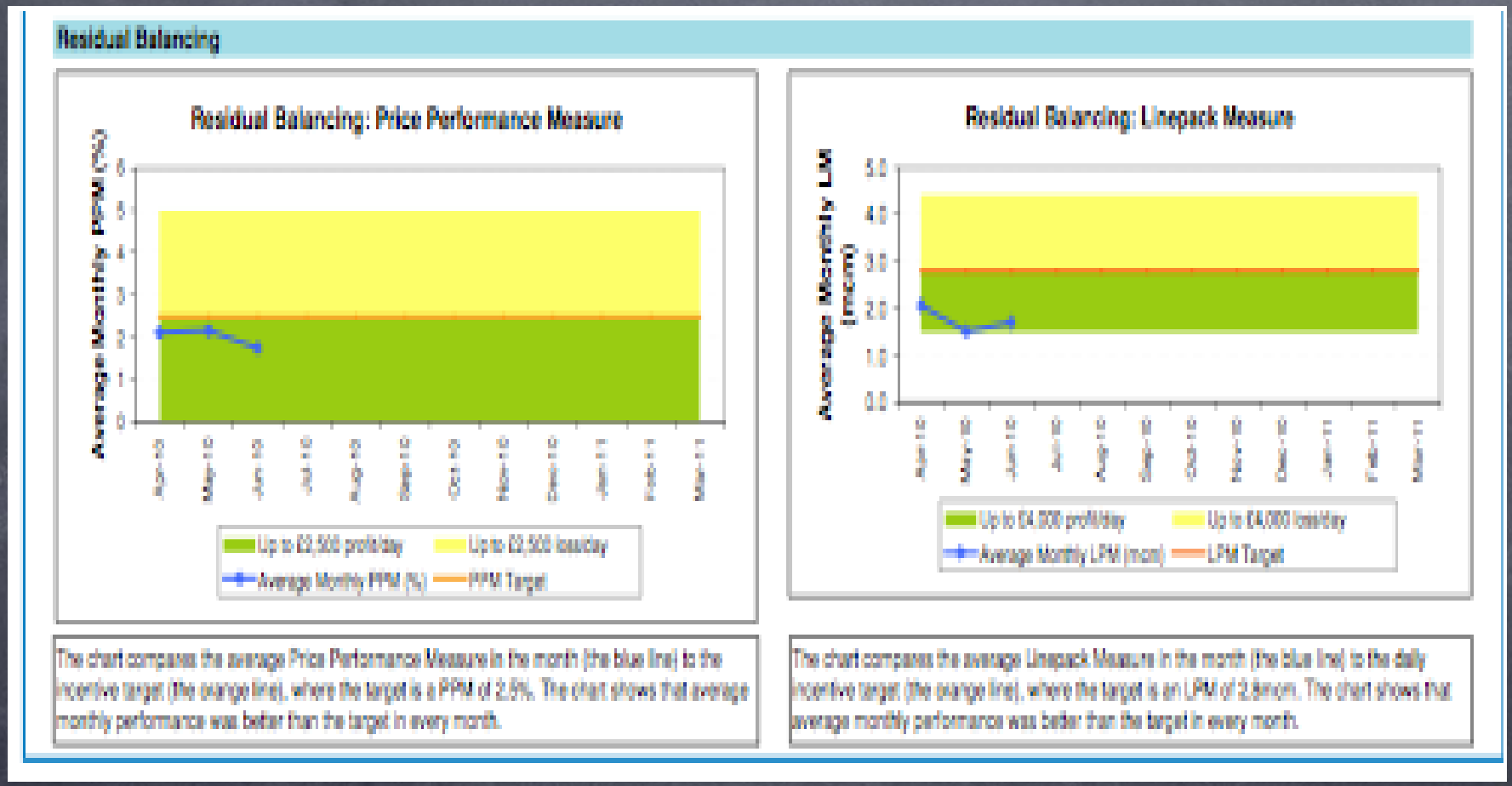
Potential Contradictions between Residual Balancing Incentives



Performance of Incentives Q1, 2010-2011 (summary of National Grid's Quarterly Incentive Report)



Price and Linepack Performance



Source and Scale of Incentive Revenues

◎ Cost recovered from Shippers via the System Operator (SO) Commodity Charge

◎ In the financial year 2009-10, incentive income amounted to only 2% of total revenues derived from the SO Commodity Charge

CONCLUSIONS (4)

- Governance has to be separated from system operation if there are multiple owners of a network (long-distance, high pressure Transport + short-distance low pressure Distribution)

- A single system operator is required in Transportation (to which Distribution is subordinate). This can be difficult to implement if there are multiple owners of Transportation

- System Operators require a safety framework within which to operate

- The existence of the OCM alone did not itself assure low cost balancing – a System Operator incentive scheme was also required

- The behaviour of OCM prices and incentive schemes can be compromised by Shipper/Supplier manipulation of the market (Deliveries different from Nominations – ‘Unauthorised Gas’)

CONCLUSIONS

Liberalised Ownership Structure: system deintegration (coordination problems); supply competition (demand uncertainty)

Use of Markets: a variety of contracts with high liquidity is essential to avoid price volatility; if there are system problems markets will price them; if there is contract indexation to short-term markets the impact will be large; no such thing as a ‘spot market’; OTC still dominant.

On-the Day Commodity Markets: original motivation was to reduce costs of balancing; success depends on the size and variety of before the day contracts; initial volatility which reduces over time is to be expected; how would it work in the context of a market dominated by ‘point-to-point’ contracts?

System Operator: should be separated from system governance; an OCM can subject to manipulation by Shipper/Suppliers which also affects the outcomes of System Operator incentives