



System Services International Review

Market Review

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Background to the project

- KEMA was engaged by EirGrid to carry out an international review of the System Services (SS) regimes adopted in a number of international (island) markets.
- This involved an examination of
 - what services were being used;
 - why and how they were deployed; and
 - how the arrangements had evolved during the period that formalised SS measures had been established in the respective liberalised markets. .
- This study will be used to provide an insight into the various options that are in place internationally, the commercial frameworks that support them and their possible suitability for inclusion in the development of SS specific products for use in the SEM.

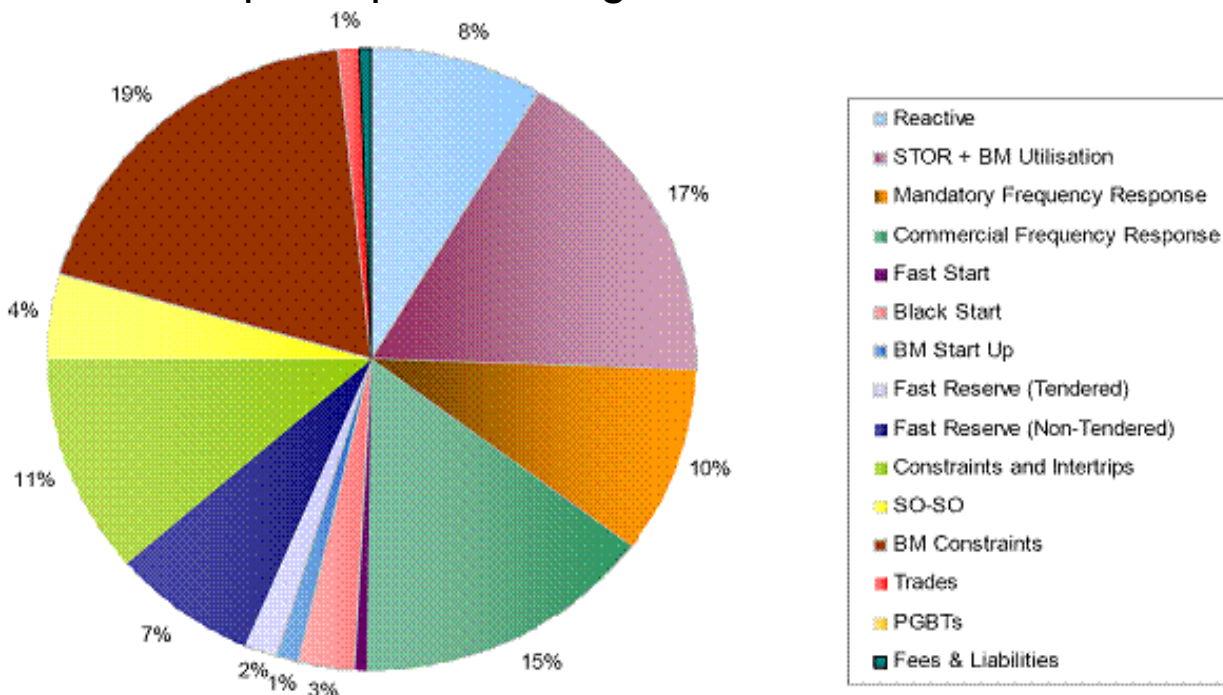
Scope and deliverables of the report

- A country specific review of products and services in Great Britain (GB), New Zealand, Tasmania, Singapore, Spain and Cyprus.
- Key elements include:
 - An investigation into what services are available, whether they are mandated or market driven and how they are procured;
 - A description of the contractual / market arrangements currently in place;
 - An understanding whether minimum generation could be regarded as an explicit service anywhere and/or is it reflected in other SS products;
 - An overview of the supporting commercial arrangements (e.g. balancing mechanism vs gross pool) and the performance incentives that may apply;
 - A summary of applied penalty arrangements where the “causer pays” for services, either explicitly or implicitly; and
 - Market specific revenue assessments i.e. the revenue generated in each case in relation to the overall market revenue.

Great Britain (1/2)

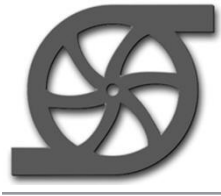


- GB represents a large market relative to the other island markets investigated
- Market supported by a mature set of commercial arrangements aimed at maximising service provision at minimum cost
- Healthy competitive mix of system service providers reflecting the availability of 17 market participants with generation assets over 500MW.



- Mandatory services make up 18.5% of the SS total cost.
- Necessary services consist of Black Start and Fast make up 3.5% of the cost and are agreed under bilateral contracts.
- Almost 78% of the costs are for Commercial Services that assist NG in meeting its licence obligation

Great Britain (2/2)



Future development:

- Increase in variable renewable generation (predominantly wind) creates greater uncertainty
- NG's prediction shows that overall forecast for managing the variability in wind output is ~£286 million by 2020, with the forecast for procuring the full operating reserve requirement forecast to be between £565 million and £945 million.
- DECC anticipates adopting a number of measures to cover that capacity requirement. These include the use of:
 - "Demand-side response"
 - Local generation;
 - Energy storage (although this option is very limited at present); and
 - Interconnection with other grids that may have an excess of capacity at times when GB has a surfeit.



New Zealand

- 2 island markets linked by a 1GW interconnector → great deal of System Service provision to either island is supplied via this link
- Generation dominated by flexible hydro plant, but low availability of many (run-of-river) hydro stations leads to high plant margin
- Significant year on year volatility as weather heavily influences energy prices and costs for the provision of SS.
- Little change since SS introduction in 1996: stability in generation mix and relatively low costs of provision
 - System Services procured:
 - Frequency keeping
 - Instantaneous reserves
 - Over-frequency reserves
 - Voltage support
 - Black start
- Relatively integrated market for energy and system services, with regulation and reserve co-optimised within energy dispatch
- TSO does not need to seek to “pre-empt” behaviour of the energy market to ensure sufficient dynamic capacity is available to meet security needs
- Cost of SS: \$90m annually
- ~1.5% of total sales in the electricity market in New Zealand.



- An island market with a monopoly generator → But Basslink connection with mainland Australia changes the dynamics of islanded operation.
- Basslink can provide >25% of Tasmania electricity demand enabling competition for the provision of system services to be provided by others producers from the mainstream Australian electricity market.
- Very high levels (>95%) of hydro generation
- Of the markets studied, Tasmania had the lowest cost per MWh for system service provision due to island size and the level of hydro generation available
- Principal focus of service provision is on frequency control
- At times all frequency control capability is delivered from mainland Australia which can cause frequency deviations
- Demand is relatively low → need for reactive power is also very low
- In general, costs of provision of services are far lower than for an island of the scale of the SEM

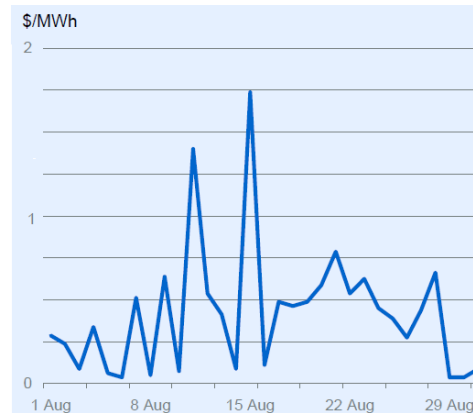
Singapore



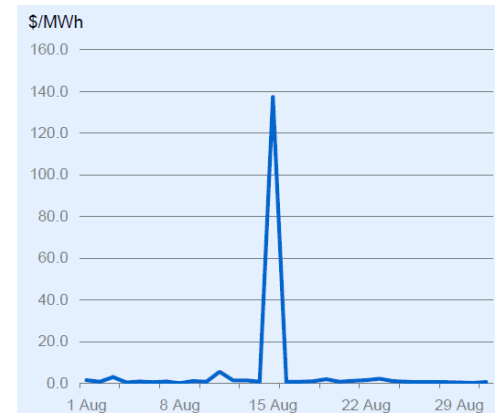
- An isolated system with high single fuel dependency (gas) → very high plant margin. No wind or coal generation
- Reactive Power not a material issue in Singapore due to high co-location of generation and demand but also a small geographic size of the network.
- Reserve and regulation prices are calculated as the shadow price (the cost of the next increment of reserve or regulation that is needed in excess of the demand forecast).
- All providers of reserves and regulation are paid the relevant price for each of the services.

- Most similar to the SEM in terms of market size with some differences:
 - lack of any interconnection;
 - low requirements for reactive power; and
 - high plant margin

Average daily prices for reserves and regulation for Aug 2011



Primary Reserve Price (\$/MWh)	
Monthly Average	0.33
Previous Month	0.53
Change	-36.9%
Max	16.32
Min	0.01



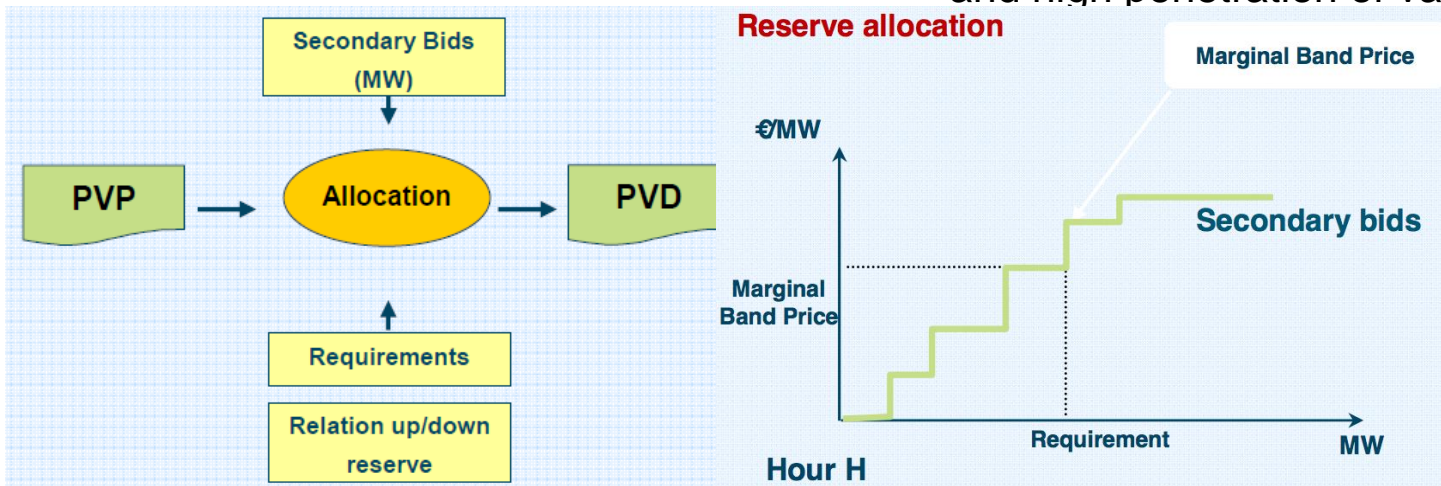
Secondary Reserve Price (\$/MWh)	
Monthly Average	5.66
Previous Month	3.84
Change	47.4%
Max	1410.9399
Min	0.01



- Still a fully monopolistic market with one supplier and one generator.
- Small scale of the market (4.7TWh)
Lack of interconnection
- SS come at a high cost when compared to other markets (no economies of scale).
- All system services costs are recovered from suppliers on a monthly basis
- Market regulation and the approach to system services are much different from the other markets studied in this report
- TSO has calculated that the most cost efficient level of Primary Operating Reserve is 60MW with an annual fuel cost ranging from 8.5 million Euro to 12 million Euro.
- Balancing market covers 2-3% of energy traded through the TSO (estimation from market regulator)



- Peninsular system with limited interconnections and high penetration of variable generation
- Not dominated by any single generation source, but high legacy of hydro and nuclear capacity
- Annual cost SS in 2010 €593.8M representing 10.8% of total revenues in Spanish electricity market
- Primary and secondary regulations provided automatically and tertiary and deviation services provided following manual instruction
- Only service provided on the competitive capacity market is secondary and tertiary control
- Similarities with SEM: limited interconnection and high penetration of variable generation

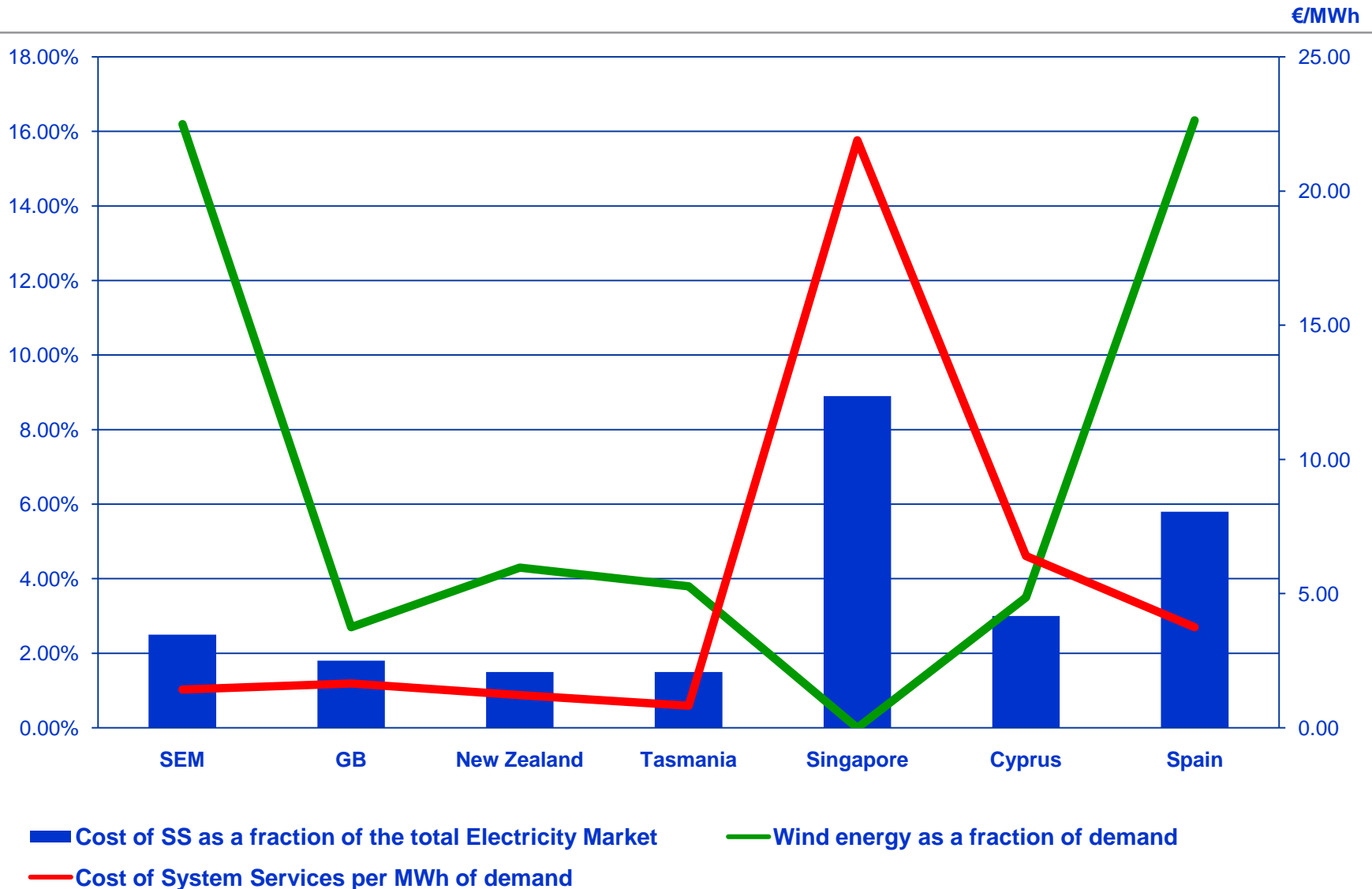


Secondary Regulation Process (Source: Red Electrica de Espana)

Commercial /Regulatory Overview of System Services

	SEM	GB	New Zealand	Tasmania	Singapore	Cyprus	Spain
Mandatory AS	Rules, obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision	Rules obligations, frequency capability and minimum voltage provision
Commercial AS	Primary, Secondary, Tertiary Operating Reserve, Synchronised Replacement Reserve and De-synchronised Replacement Reserve	Black Start; Fast Start; Frequency Response; Enhanced Reactive Service; Fast Reserve; Short Term Operating Reserve; Intertip; Emergency Assistance; Maximum Generation Service	Reserve markets Contracts for Reactive Power and Black Start	Reserve markets Contracts for Reactive Power and Black Start	Reserve markets Contracts for Reactive Power and Black Start	All System Services	Secondary, tertiary regulation, Deviation management Contracts for Reactive Power
Payment for AS	Cost are socialised amongst consumers	Uplift in transmission charges	Reserve SMP Tenders (pays as bid) for other	Reserve SMP Tenders (pays as bid) for other	Regulation and Reserve SMP Tenders (pays as bid) for other	Agreed contract tariff (pay as bid)	Secondary & Tertiary reg: paid by generation and demand units which deviate from program Tenders (pays as bid) for other
Relationship to Energy Market	Regulation and Reserve via co-optimised despatch	Utilisation of some System Services interact with operation of BM (GBSO can forward trade for balancing)	Reserve via co-optimised despatch	Reserve via co-optimised despatch	Regulation and Reserve via co-optimised despatch	Separate	Regulation and Reserve via co-optimised despatch

Comparison of the cost of system services



Comparison of the cost of system services

	SEM	GB	New Zealand	Tasmania	Singapore	Cyprus	Spain
Cost of System Services as a fraction of the total Electricity Market	~2.5%	~1.8%	~1.5%	~1.5%		2-3%	10.80%
Cost of System Services per MWh of demand	€1.43/MWh in 2011	£1.44/MWh 2010/11 c.1.656 Euro/MWh	c.1.217 Euro/MWh	c.0.825 Euro/MWh	c.21.9 Euro/MWh	c.2.75-6.4 Euro/MWh	3.75 Euro/MWh
Cost Recovery	AS payments outside the SEM by the TSOs. Annual payment rates are set, applicable to the calculation of charges.	Via specific charge, BSUoS, levied pro rata on combined MWh of generators and suppliers	Frequency keeping – demand; Reserves, generation and SO (for HVDC); Voltage –zonal distribution	Regulating – causer pays and market customers; Contingency – market generators and customers	Reserve – generators pro rata on MWh Regulation – generators for 5MW per unit then rest on consumers Reactive Power – T connected consumers (minor cost) Black Start – consumers on MWh basis	Paid by consumers Operating reserve pro rata on MWh by settlement period (ii) Rest pro rata on monthly MWh	Market participants and end customer
Cost incentivisation	Market-based costs. Pass-through	AS costs within overall Balancing costs (external and internal to GBSO) subject to overall GBSO BSIS Scheme	Market-based costs. Pass-through	Market-based costs. Pass-through	Market-based costs. Pass-through	Direct regulatory involvement in ASS contract agreement	Market based costs

Conclusions (1/2)

- Mandatory requirements on large generators to provide the necessary key service requirements present in each market
- Most effective markets those where the specific service required can be provided by a number of different participants → rise to active competition
- Only Spain has a significant market share of variable wind generation comparable to that in SEM. At the opposite extreme New Zealand and Tasmania have a majority share of hydro
- System services markets are generally a relatively minor consideration in the context of the broader wholesale energy market.

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Conclusions (2/2)

- Plant margin in SEM appear high, but when adjusted for performance (e.g. intermittency of wind generation and reliability of older fossil fuel plant) it is not as high as in some of the countries examined (e.g. Singapore)
- Interconnected markets do attempt to use the interconnectors to provide system services on a commercial basis GB is looking to develop cross border service provision via interconnectors
- All of the markets essentially socialise the cost recovery for the provision of most system services. New Zealand, Tasmania and Singapore recover reserve costs and some frequency costs from 'causing' generators to incentivise appropriate technical performance (i.e. reliability) due to the impact that poor performance can have on their system;
- Min generation generally is not reflected in any of the markets.

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