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System Services for a 100% Renewable Power System

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GLOBAL PST CONSORTIUM

ESIG 2023 Fall Technical Workshop Session 7: Market Topics, San Diego, October 25th, 2023

Wind in the Electricity Market in Ireland

Mark O'Malley,
Electricity Research Centre, University College Dublin

Paul Smith, EirGrid

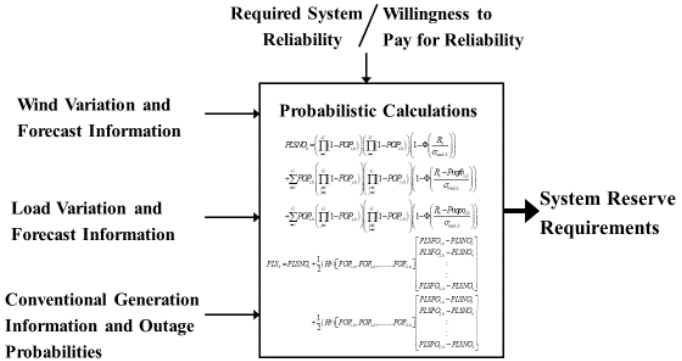
23 Oct 2006 UWIG, Oklahoma City, USA

Impact of wind on generation reserve requirements in Ireland

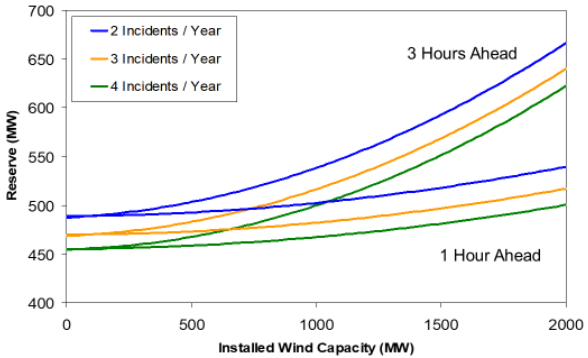
Mark O'Malley, Electricity Research Centre, University College Dublin

25th October 2006
UWIG, Oklahoma City, USA

Outline of Methodology



Operating reserve required



Where we were then	Where we wanted to go
Local	Global
Specific	General
Piecemeal	Holistic
Opaque	Transparent
Expensive & unreliable ?	Cheap & Reliable ?

Doherty, R. and O'Malley, M.J., "A New approach to quantify reserve demand in systems with significant installed wind capacity", IEEE Transactions on Power Systems, Vol. 20, pp. 587 -595, 2005.

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Summary G-PST Research Agenda

Inaugural Research Agenda

Research Program	Description	Number of Questions
Inverter Design	Development of capabilities, **services**, design methodologies and standards for IBRs.	10
Tools and Methods	New tools and methods required to ensure reliability, security, and stability in power systems.	9
Control Room of the Future	Development of new technologies and approaches for enhanced real-time visibility and analysis in power system operator control rooms.	17
Planning	New planning metrics, methods, and tools to capture the characteristics and influence of a changing resource mix.	15
Black Start	Creating new procedures for black starting and restoring a power system with high or 100% IBR penetrations.	1
Services	Quantifying the technical service requirements required of future power system to maintain the supply-demand balance reliably and at least cost.	7

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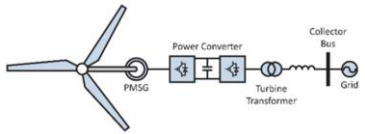
Balance supply and demand at minimum cost and acceptable reliability

Cost reliability trade off

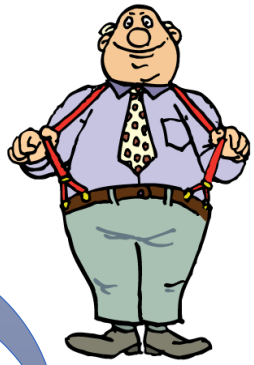


Type IV

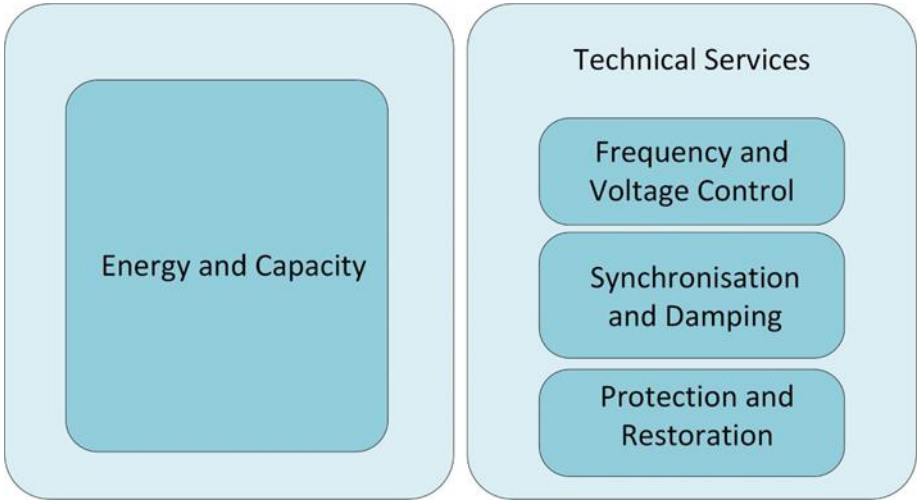
Reliability/Technical

Where we are now	Where we want to go
Local	Global
Specific	General
Piecemeal	Holistic
Opaque	Transparent
Expensive & unreliable	Cheap & Reliable

Minimization of cost

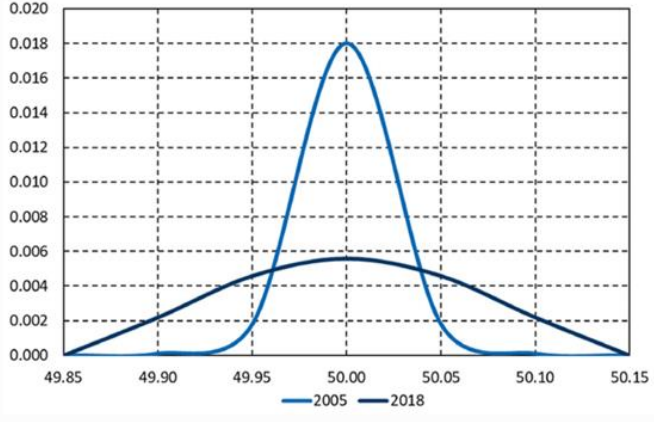


IBRs replacing Synchronous Machines



Fast Frequency Response

Figure 1: Frequency distribution within the normal frequency operating band in the NEM (2005 Snapshot vs. 2018 Snapshot)



Source: AEMO, Removal of disincentives to the provision of primary frequency response during normal operating conditions — Electricity rule change proposal, 1 July 2019, p.14.

Very Fast FCAS Market Commencement

On the 15 July 2021, the AEMC made a final rule to introduce two new market ancillary services in the NEM under the existing Frequency Control Ancillary Services (FCAS) arrangements, the very fast raise and very fast lower FCAS markets.

Following consultation with stakeholders and work undertaken by AEMO, the very fast raise and very fast lower FCAS markets opened **on Monday 9 October 2023 at 1.00pm (Market Time).**

Very Fast FCAS Market Commencement – Go for Monday 9 October 2023

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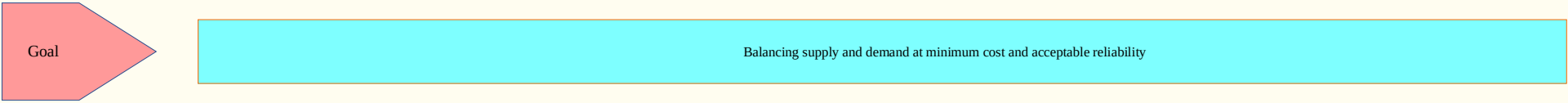
Framework: Primary layer



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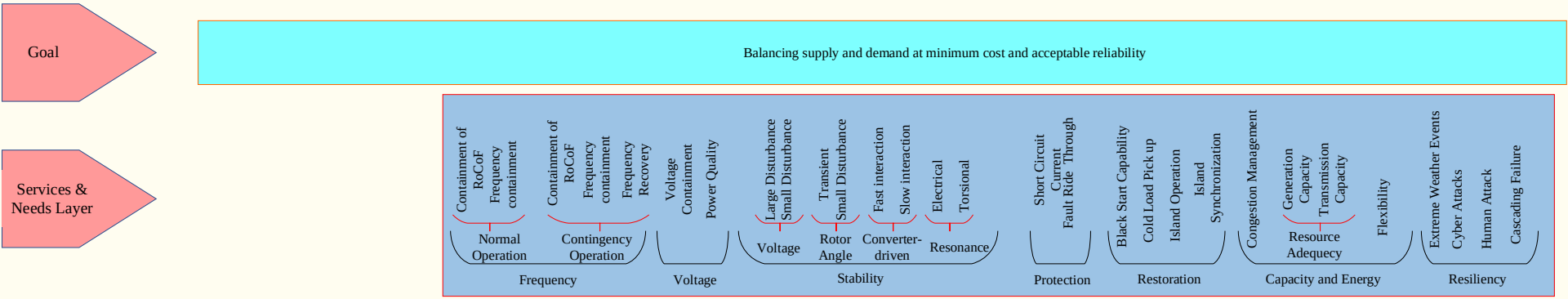
Framework: Services and needs layer



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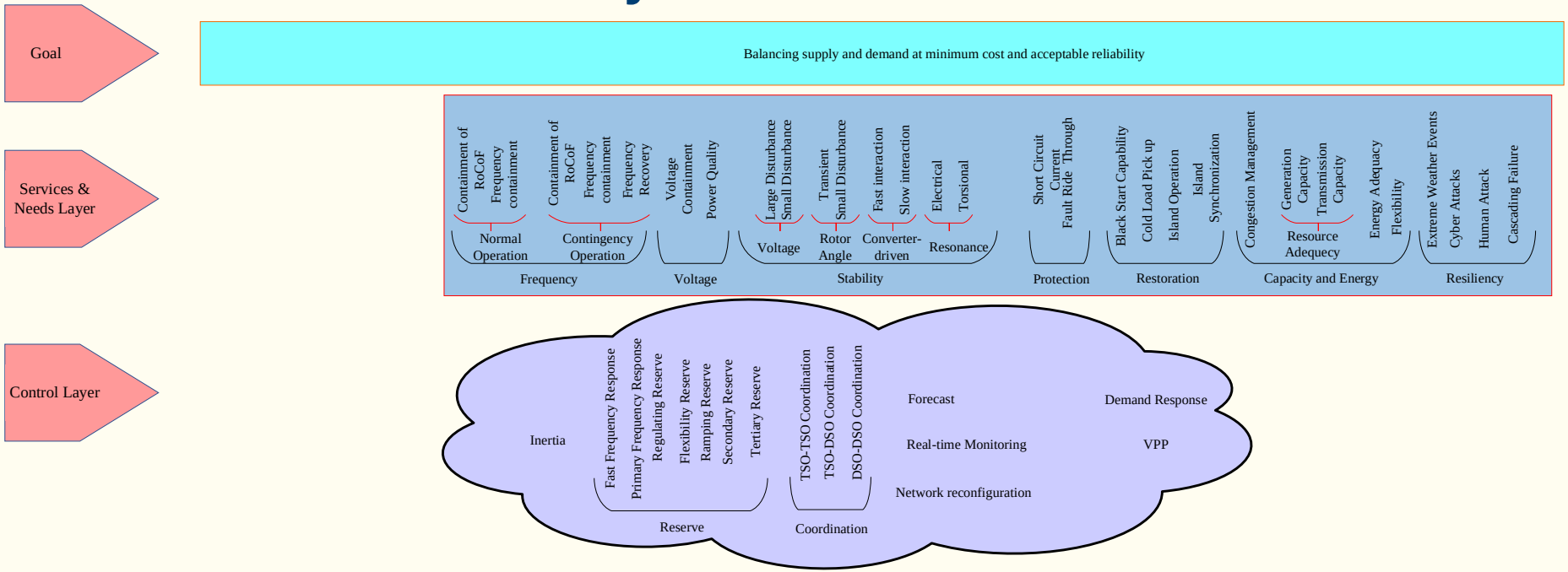
Framework: Control layer



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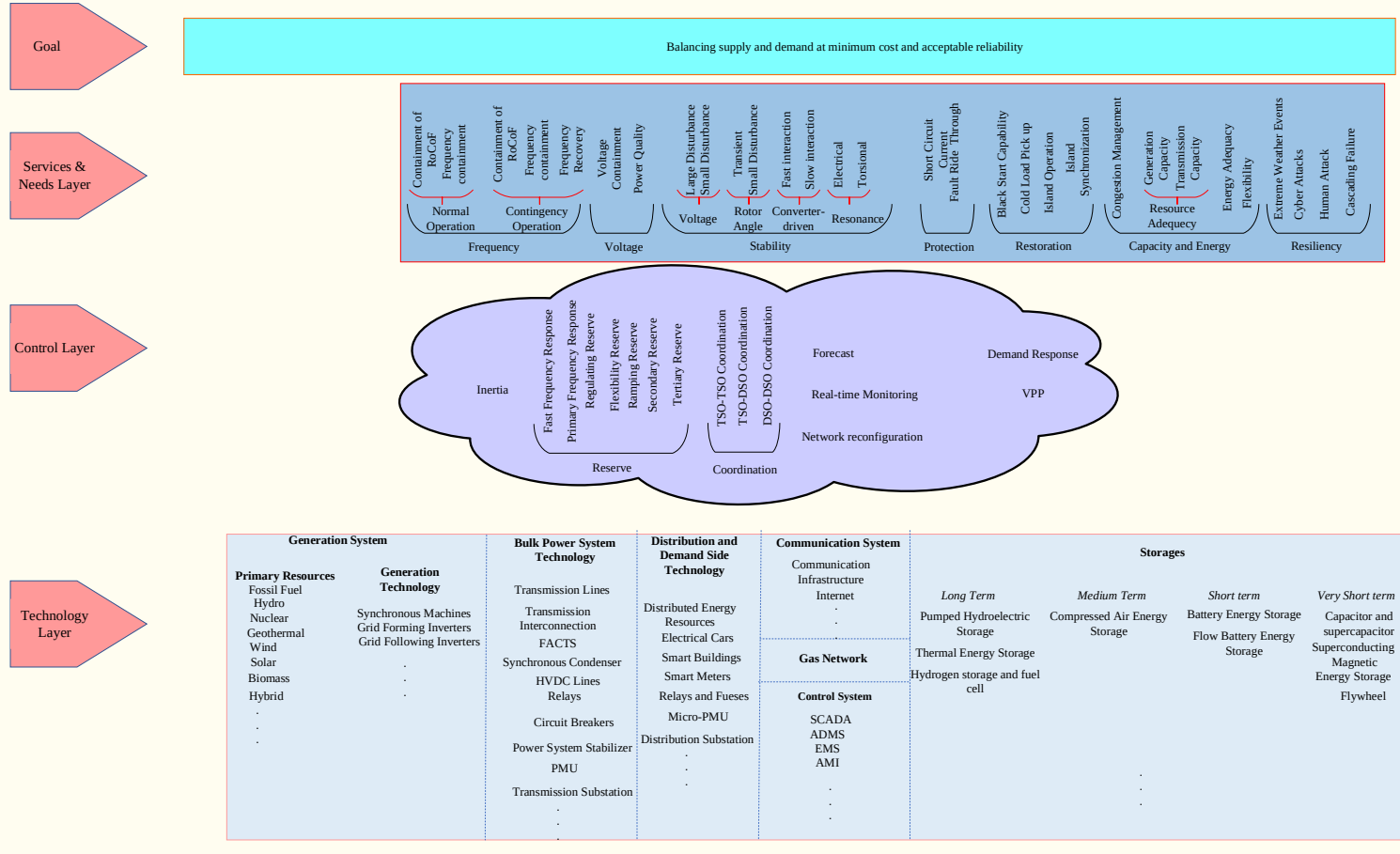
Framework: Technology layer



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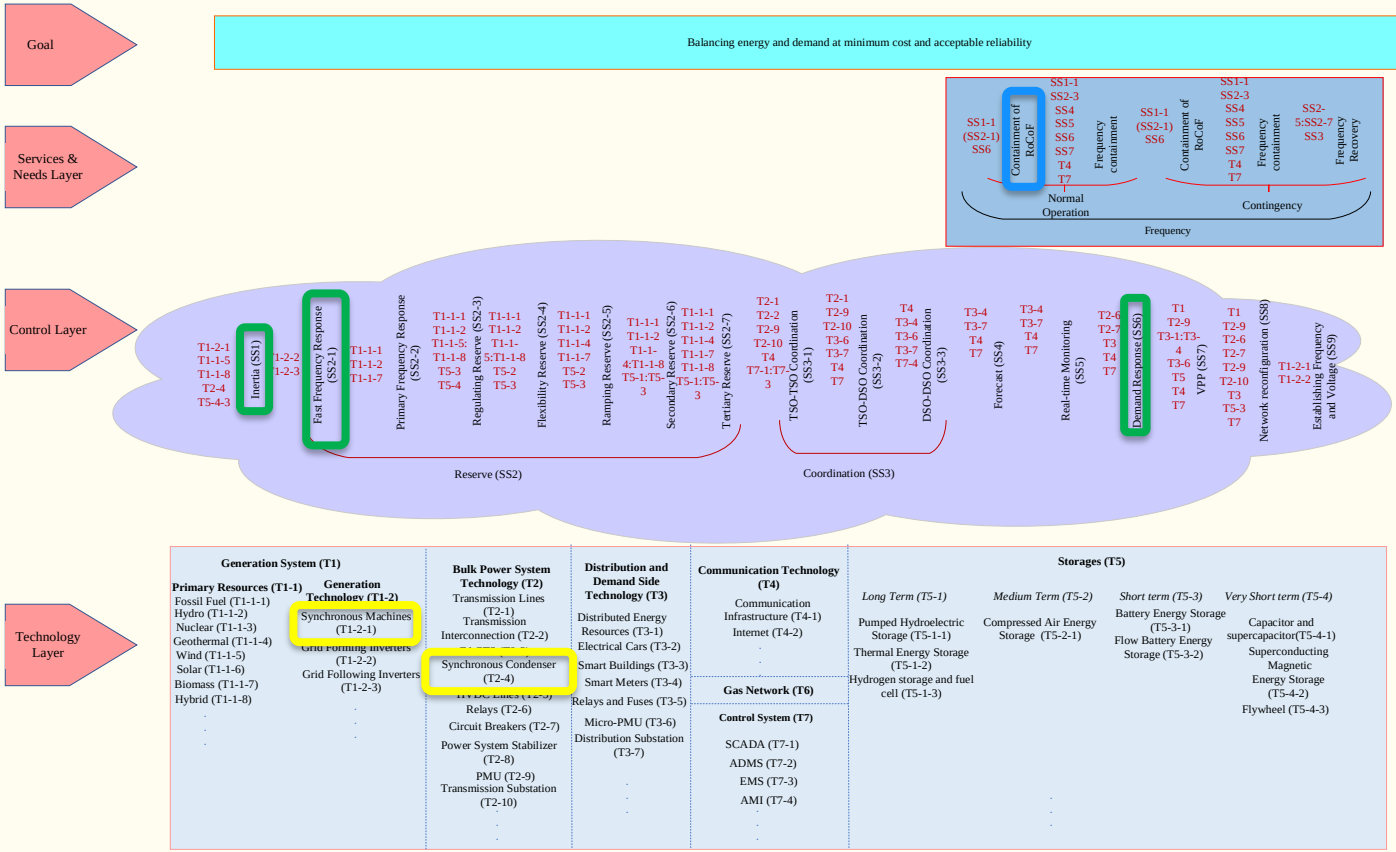
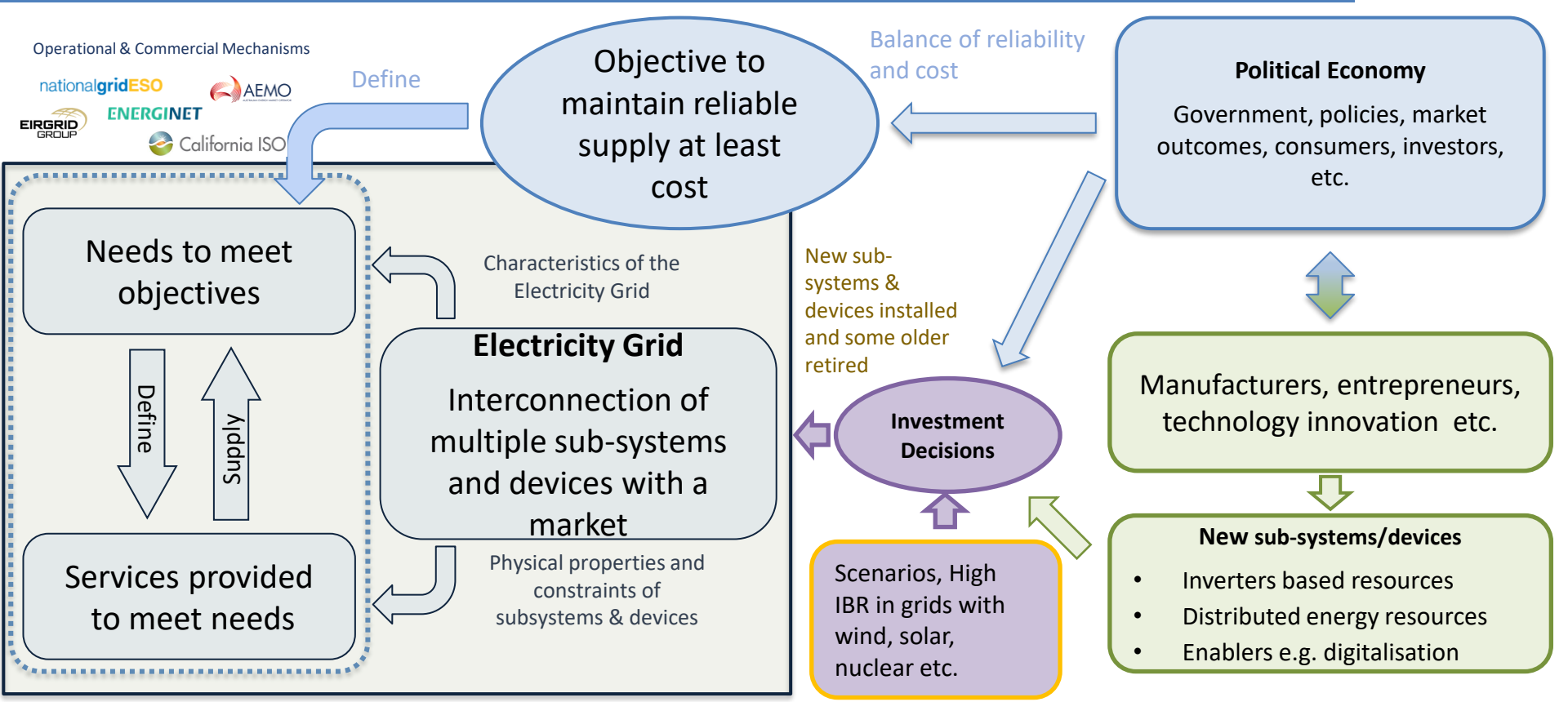
Framework example- Containment of RoCoF



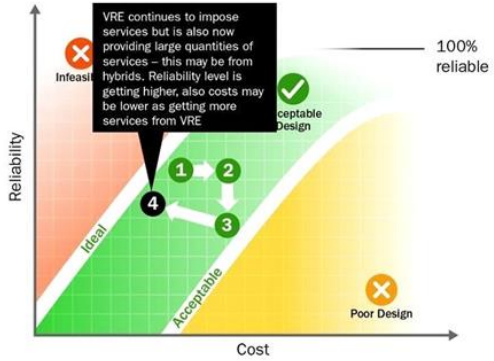
Bring it all together Institutionally for Transformation of the Global Power System



Framework needs much more work

A

B



D

C

O'Malley et al., "Grand challenges of Wind Energy Science – Meeting the needs and services of the power system", Wind Energy Science, in review.

Conclusion

- Significant detailed system level work needed to gain generalisable insights (ongoing)
- Managing needs and services due to IBRs replacing SMs we to have a rigorous process/methodology
- Need a framework to do this ?
- Have made a start – more to be done

Acknowledgements & Further Reading

- Leverhulme Trust International Professorship

Further Reading

- https://globalpst.org/
- https://www.esig.energy/