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Session: Smart Grids for Smart Cities

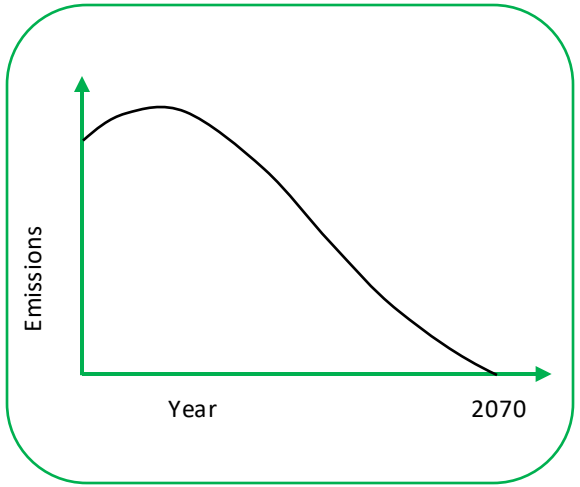
Integrated Resource Planning for Renewables and Green Hydrogen Modelling

Presented By

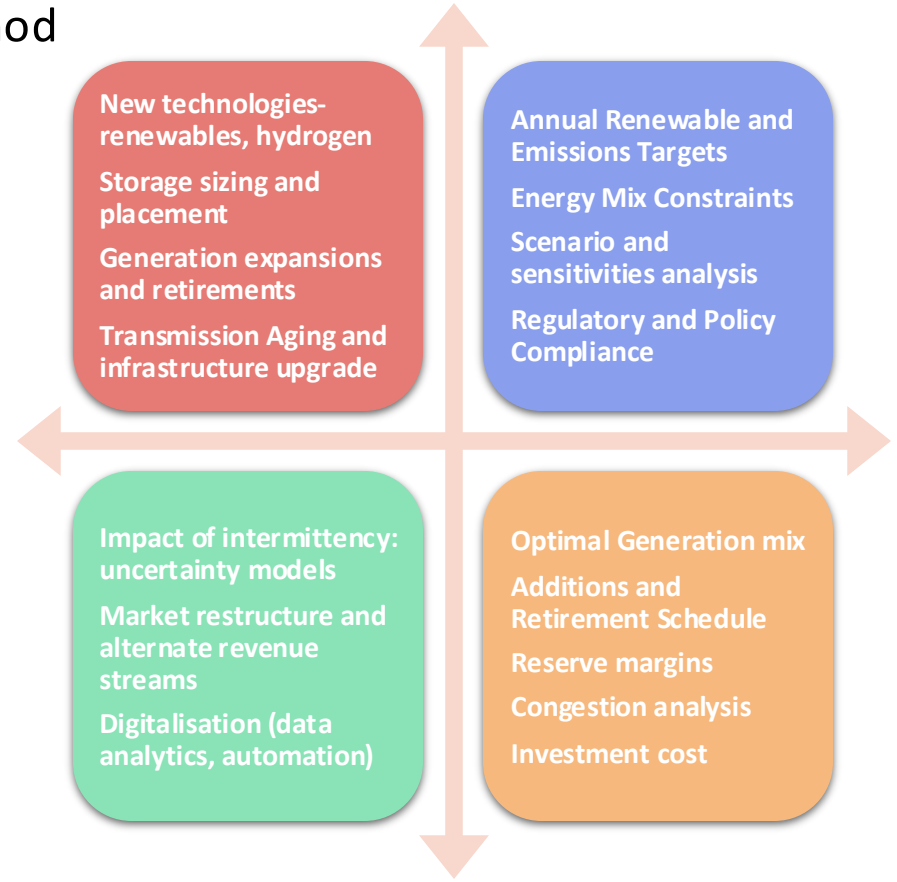
Aditi Narang, Energy Market Analyst, Energy Exemplar

Introduction

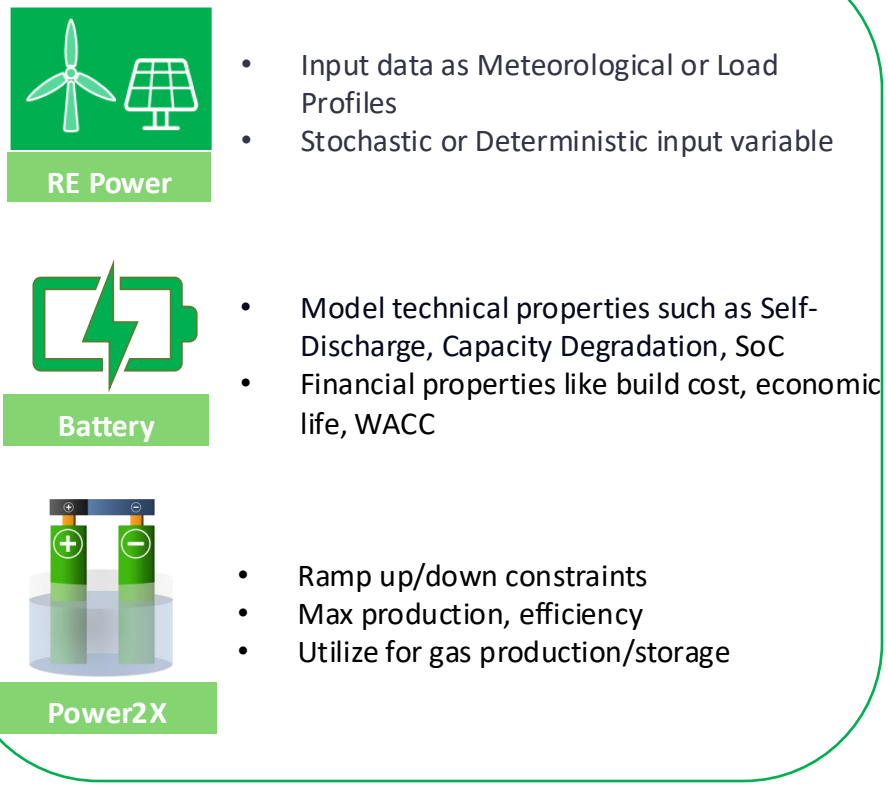
- Energy Systems are undergoing major transformation
- **India's target for 2030: 50% of installed capacity is renewable**
- **Net Zero emissions Target by 2070**
- New technology adoption and penetration
- Need for a holistic planning method



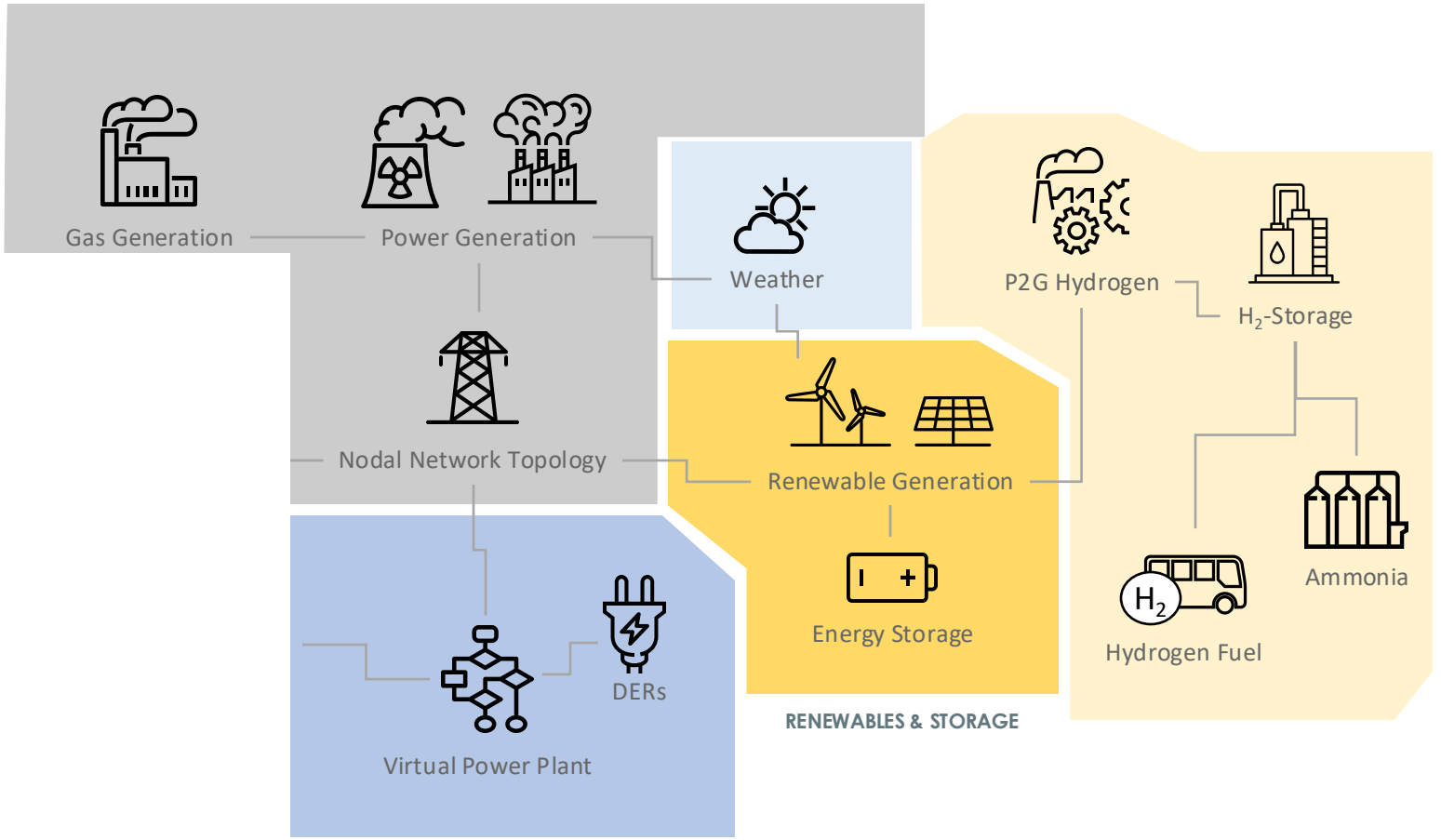
Integrated Resource Planning (IRP): Optimal investment plan for cleaner, reliable, cost-effective energy system



Modelling IRP: Single Unified Energy System



Sector coupling, Co-optimization & Integration of Green Fuels



Key Asset Investment Questions

Which technology should be built/retired?

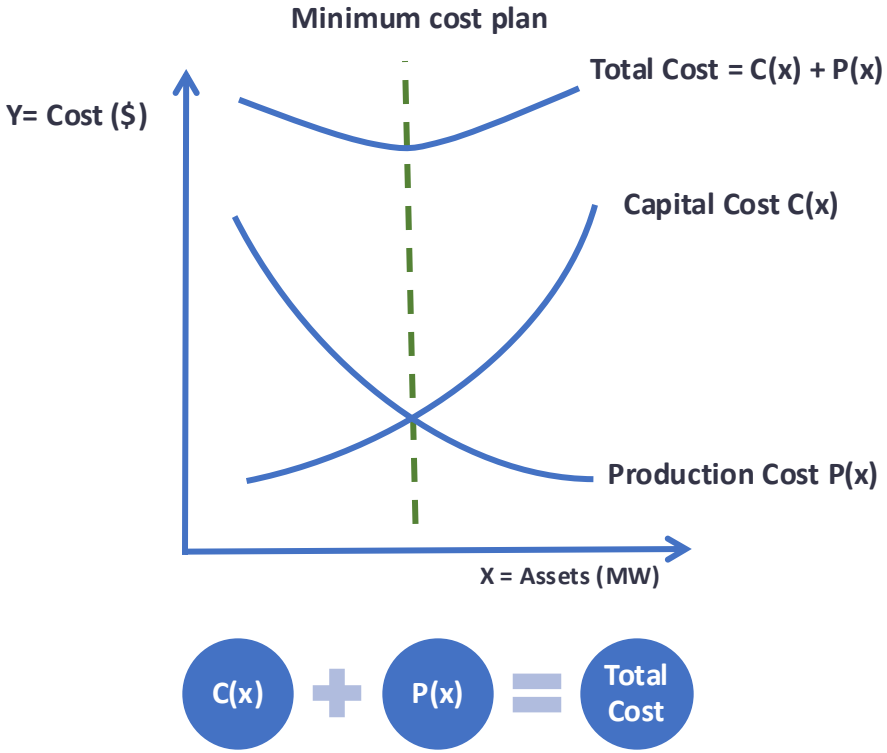
How much capacity is optimal for the system?

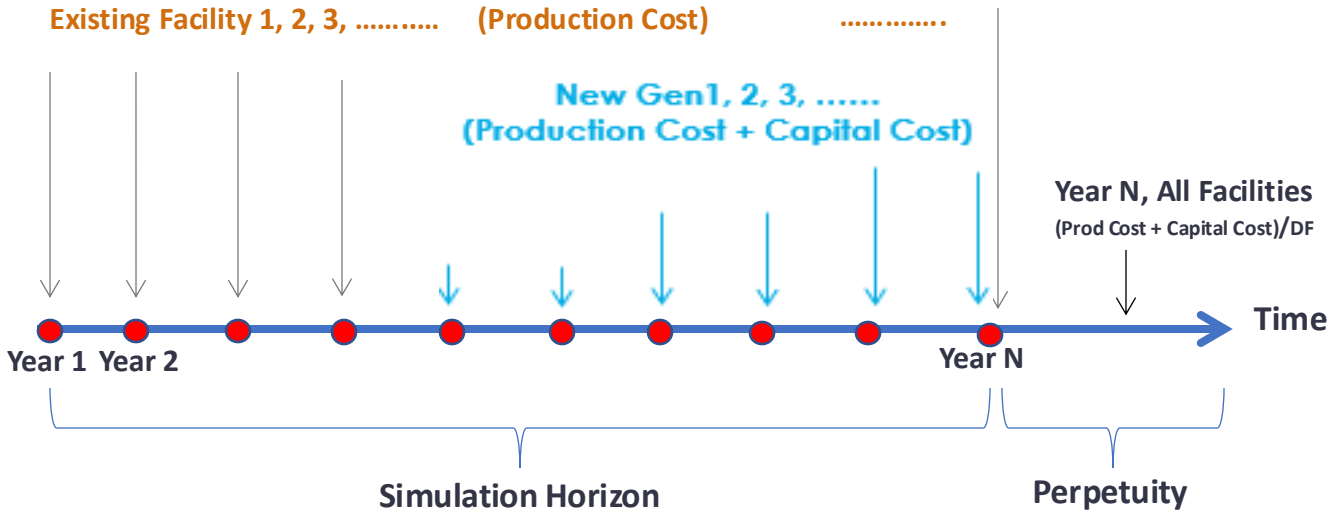
When should the capacity be available?

Where is the asset most needed across the grid?

Optimizing Long-Term Plans

Encompasses system expansion planning and transmission expansion planning





Objective: Minimize the total cost of the system (production + capital) formulated as **Mixed-Integer Problem**

IRP Application: Renewables, Green Hydrogen and Ammonia Modelling and Sizing

Generator	FiscalYear	Build (MW)	Retire (MW)	Net Build (MW)
Solar1	2025	405.98	0.00	405.98
Solar2	2025	475.00	0.00	475.00
Wind1	2025	1,165.00	0.00	1,165.00
Wind2	2025	1,200.00	0.00	1,200.00
System	2025	3,245.98	0.00	3,245.98

Battery	FiscalYear	Build (MW)	Retire (MW)	Net Build (MW)
BESS 4h	2025	9.00	0.00	9.00

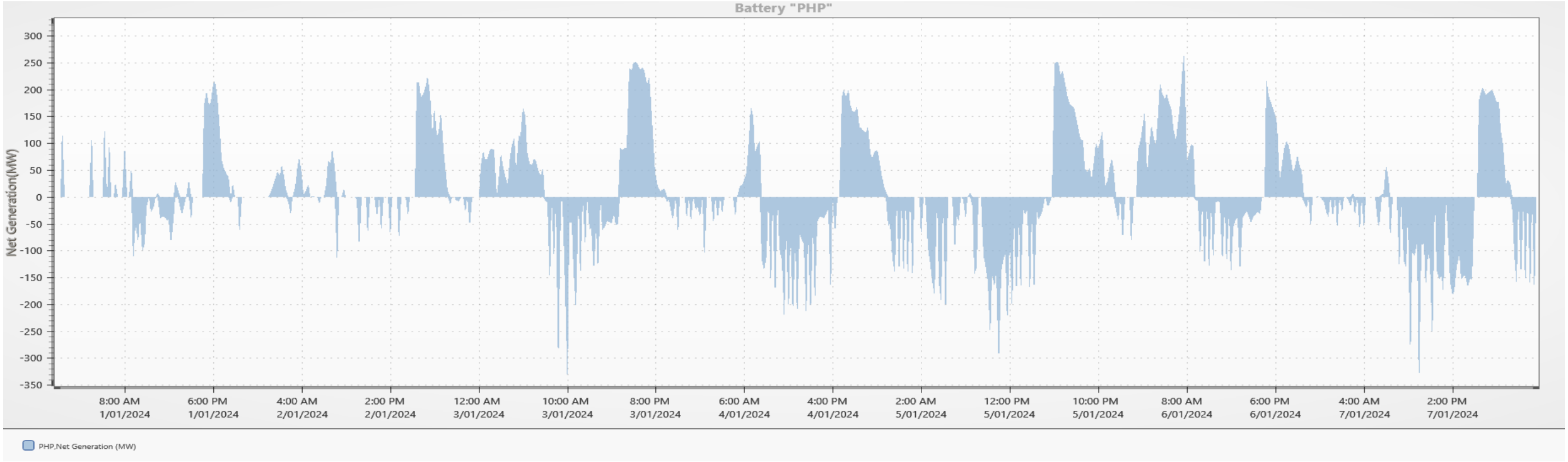
Power2X	FiscalYear	Build (MW)	Retire (MW)	Net Build (MW)
P2X_Electrolyser	2025	830.00	0.00	830.00
Export to Demand 01	2025	10.00		
Rail Wagon Aux 3	2025	10.00		
Rail Wagon Aux 5	2025	10.00		
Road Tanker Aux 2	2025	10.00		
Road Tanker Aux 4	2025	10.00		

Gas Plant	FiscalYear	Build (TJ)	Retire (TJ)	Net Build (TJ)
NH3 Plant	2025	0.20	0.00	0.20

Gas Storage Expansion Summary:

Gas Storage	FiscalYear	Net Build (TJ)
H2 Storage	2025	0.08

Renewables and Storage Operation



Key Takeaways

- Renewables, Hydrogen and Ammonia in the existing network: **Integrated Power and Gas System Modelling and Co-optimization**
- **Modelling regulatory and policy compliance**: renewable energy targets, emission targets and reliability measures
- **Optimal sizing and placement** for future expansion and investment planning
- Modelling of **uncertainties for risk mitigation** and informed strategic decisions
- **Optimal system operation** and storage resource allocation

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THANK YOU

For discussions/queries email: ***aditi.narang@energyexemplar.com***