Transforming Delhi's Power Grid

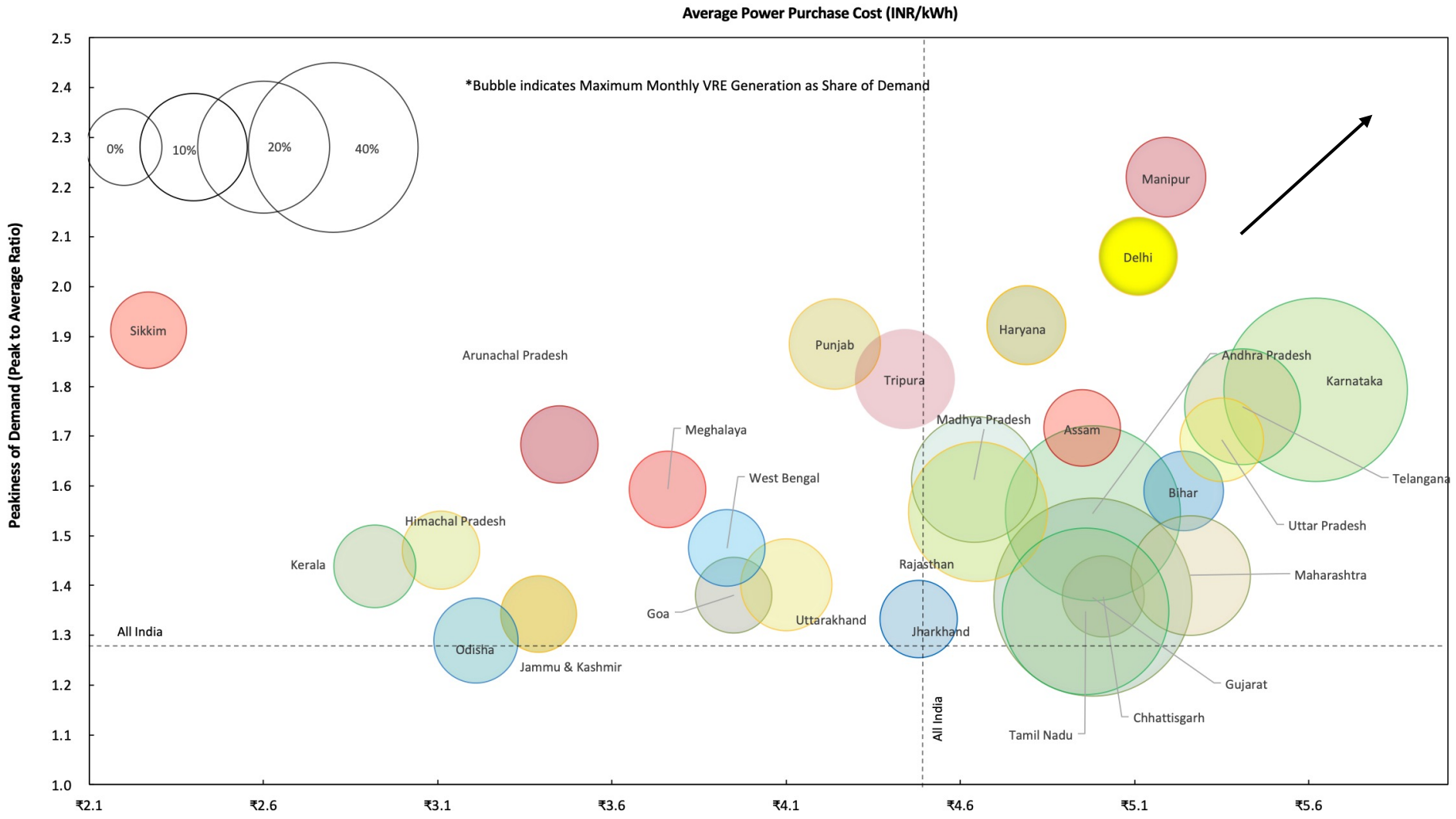
A Guide to Enhancing Grid Flexibility

Arjun Gupta
Jagabanta Ningthoujam

BSES

RMI
ENERGY. TRANSFORMED.

Unmanaged load and RE generation growth will result in higher cost of power procurement

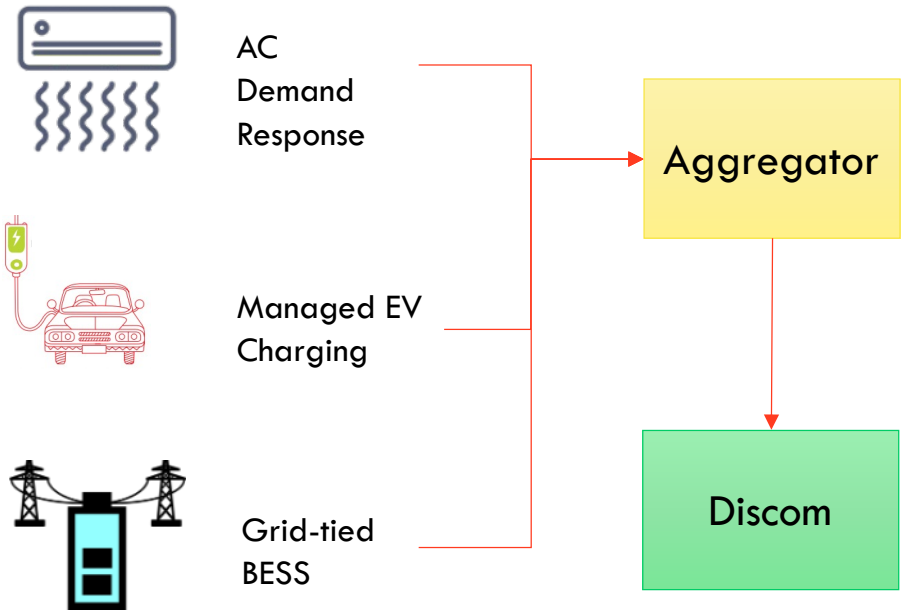


Delhi has one of the highest peak-to-average demand ratios in India which is contributing to steep power procurement costs in the State.

Developing Grid Flexibility Readiness Guides for Delhi

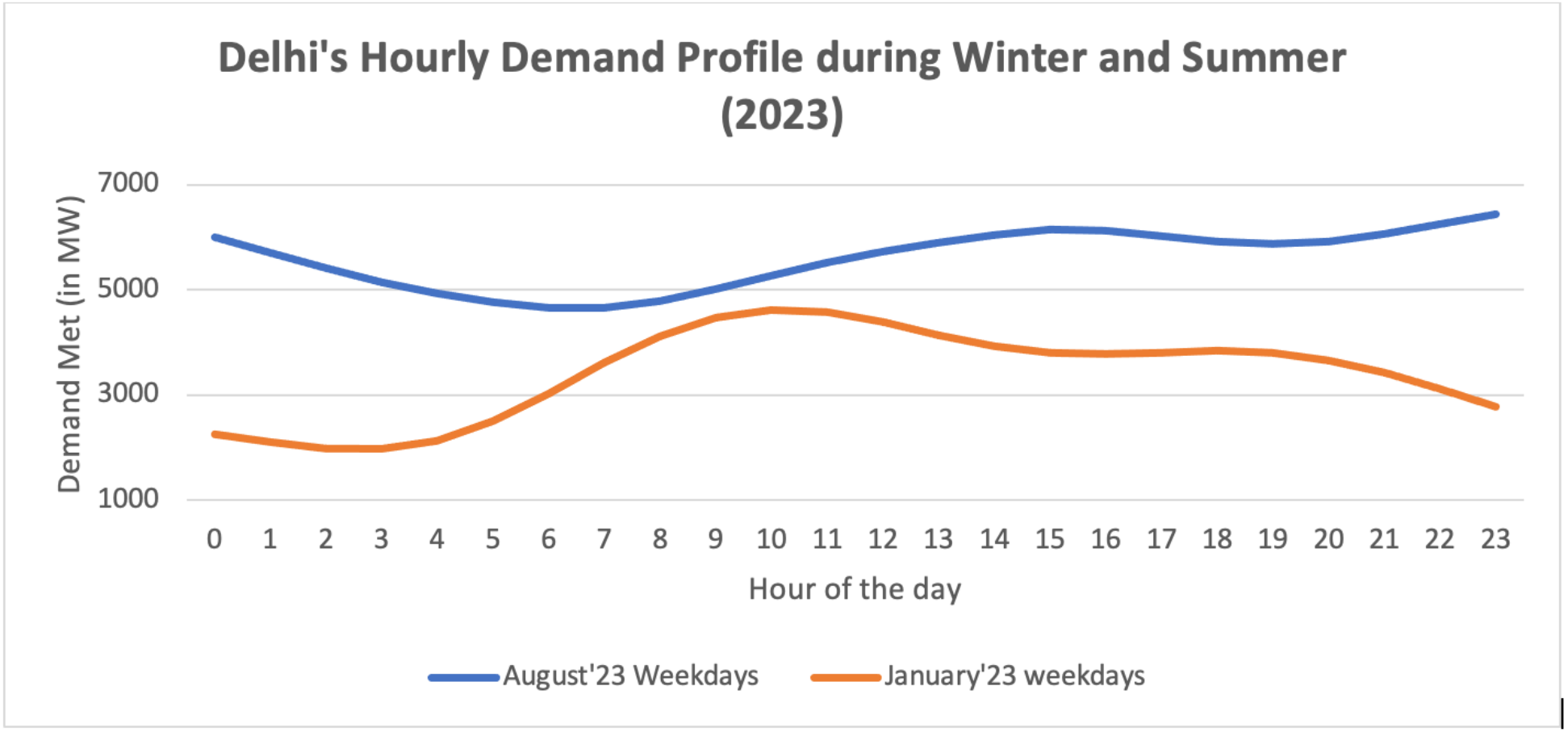
RMI partnered with BSES to create a Grid Flexibility Readiness Guide to enable demand side flexibility measures like Demand Response, Managed Charging of EV's to mitigate the rising peak demand in Delhi. The study focussed on the following key pillars -

- Impact of Cooling, EV and E-Bus penetration on Delhi's peak demands till 2030.
- Impact of demand drivers on Delhi's electricity supply and distribution infrastructure.
- Developing the economic value streams and cost-benefit analysis of the proposed demand flexibility measures.
- Developing the value of introducing a Virtual Power Plant in Delhi that stacks the benefits of multiple grid flexibility measures.
- Critical Enablers needed to scale the proposed measures.



Delhi's Electricity Demand and Supply Considerations

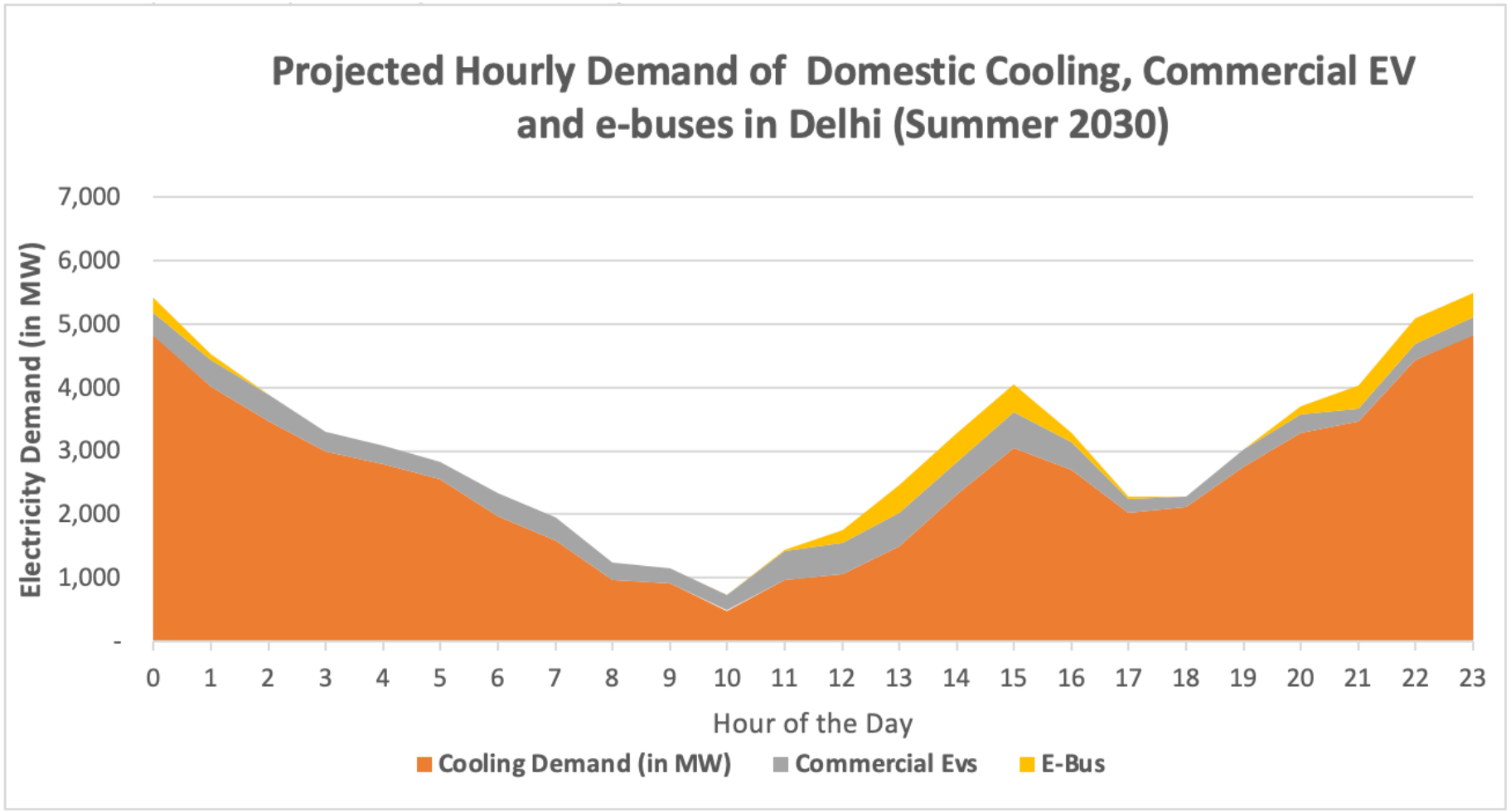
Demand for Flexibility in Delhi is rising due to seasonal swings



Source: RMI analysis of IITK energy data portal [15]

- Delhi experiences two peak periods during the summer months and demand is consistently greater than 5000 MW across the day
- Demand during winter months remains lower than 5000 MW during the winter months with just one peak period during the mornings

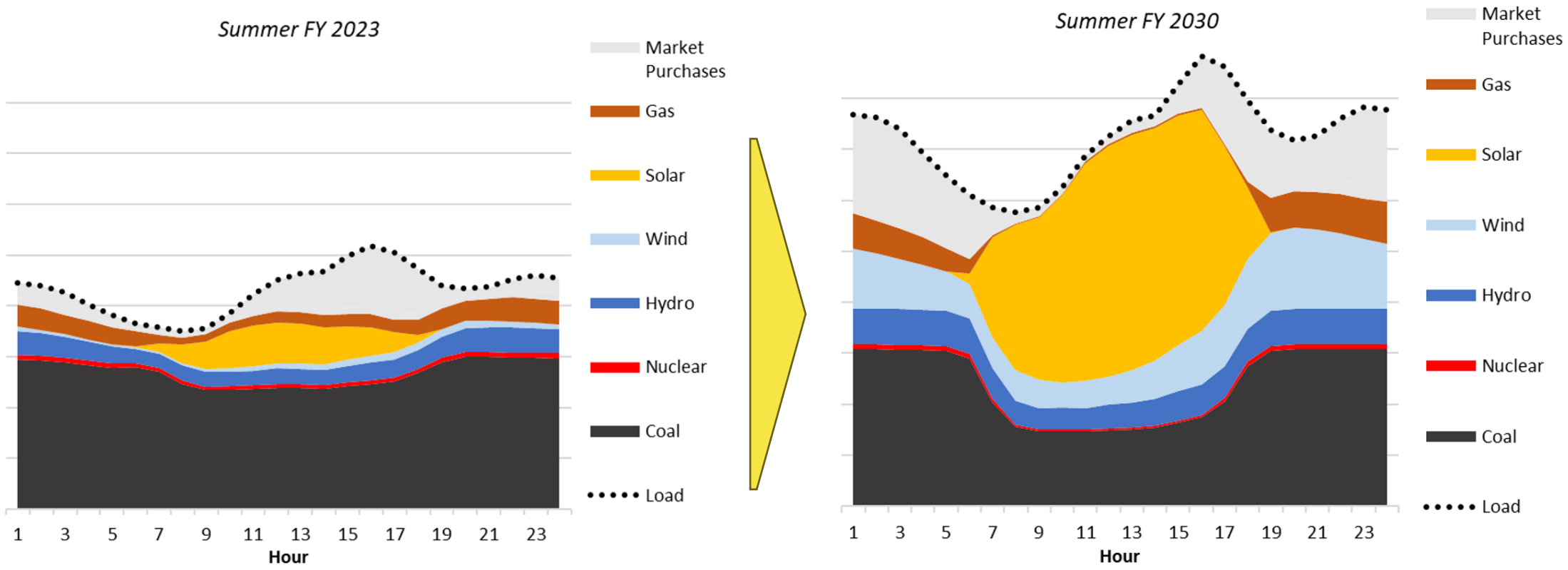
Domestic Cooling and EV's Will Drive Delhi's Future Peak Demand



- Domestic cooling accounts for 40% of Delhi's peak summer demand.
- Cooling could account for close to 5000 MW of Delhi's peak demand by 2030.
- E-bus and commercial 4-wheeler EV charging could further contribute almost a 1000 MW of peak demand by 2030. This demand coincides with the existing night peaks in Delhi during the summer months leading to sharper peaks in the future.

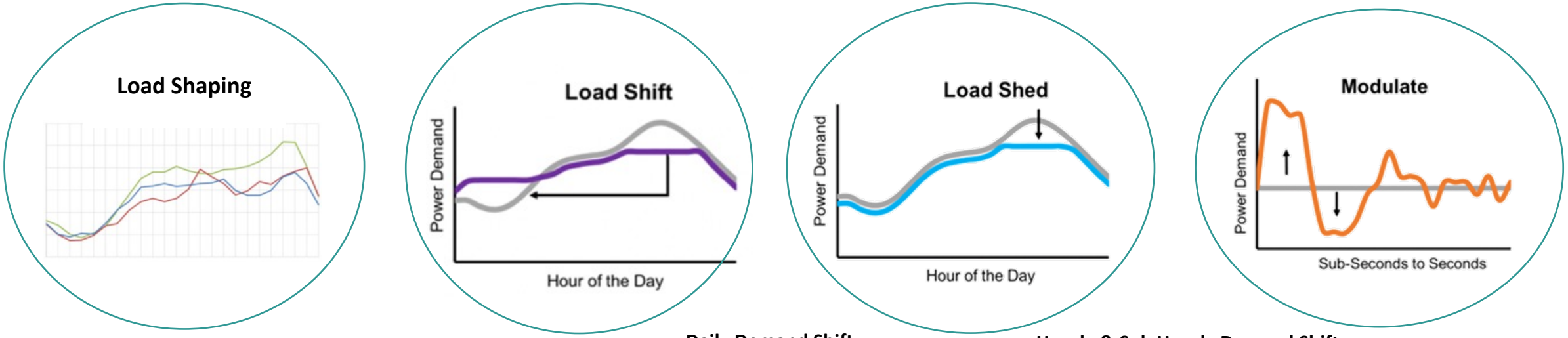
Source: RMI analysis

Delhi's Peak Demand is met with Gas & Market Purchases (Summer)



- Lack of RE generation during the night hours leads to the deployment of expensive gas generators and market-based purchases to meet demand during peak hours.
- Despite gas generators meeting only ~ **8%** of the annual electricity demand, they accounted for **about 25% of** the annual power procurement costs of BSES.

Demand Side Grid Flexibility Measures Can Mitigate Delhi's Peaks



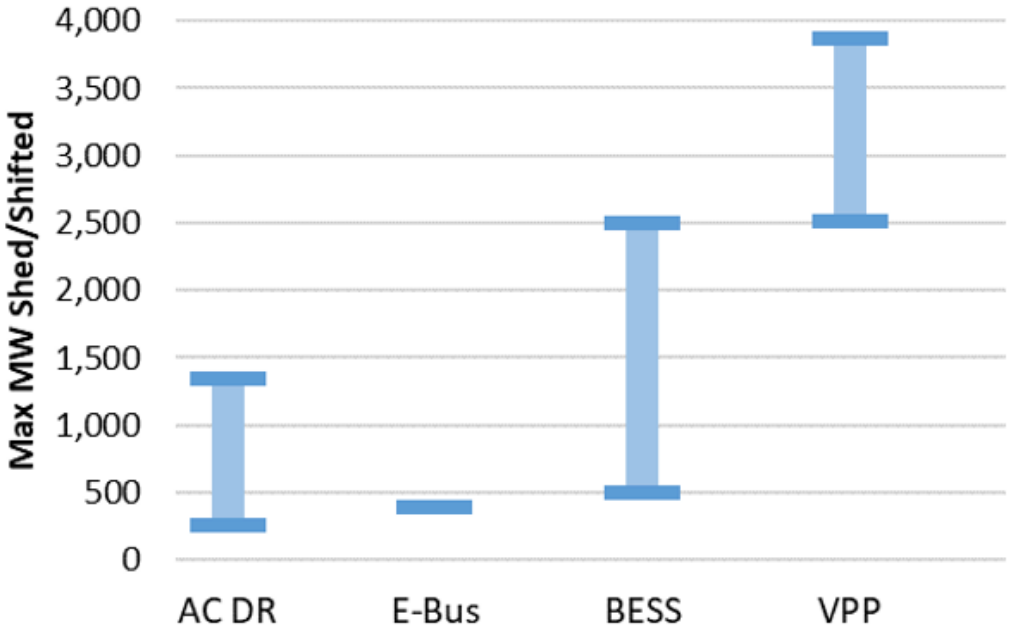
Seasonal Demand Shift **Daily Demand Shift** **Hourly & Sub Hourly Demand Shift**

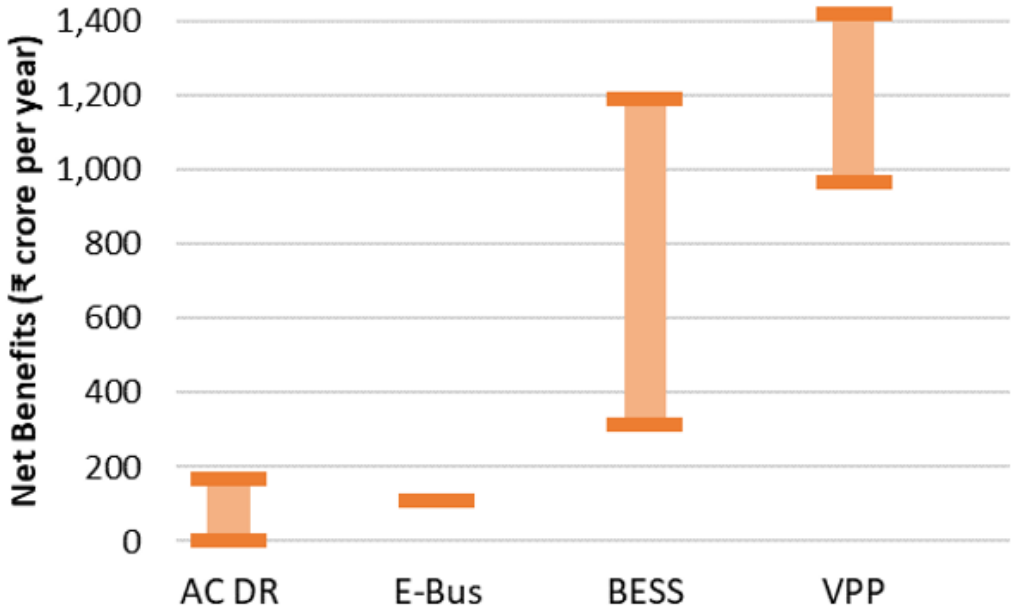
Lower level of granularity and control needed → Higher level of granularity and control needed

Grid Flex Levers in Delhi	AC based Demand Response	Managed EV Charging	Battery Storage	VPP
	enables Load Shedding	enables Load Shifting	enables Load Shifting	enables Load Shifting + Shedding
Avoided Energy Benefits	Mid Potential	Mid Potential	High Potential	High Potential
Avoided Generation Capacity Benefits	Mid Potential	Low Potential	Mid Potential	High Potential
Distribution Deferral Benefits	Mid Potential	Low Potential	Mid Potential	Mid Potential
Deployment Costs	Medium	Low	High	High

Impact of Grid Flexibility Levers in Delhi

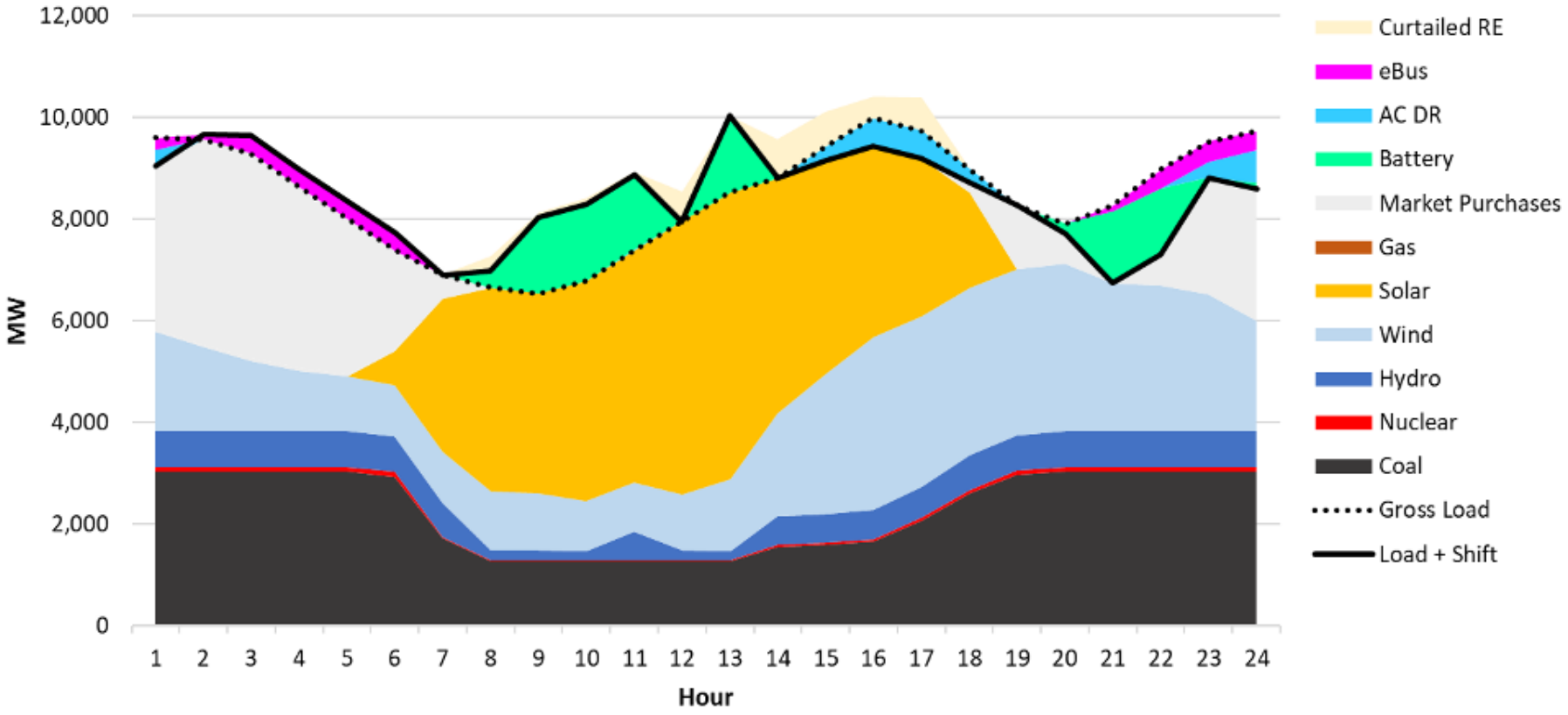
Grid flexibility measures can unlock ₹ 1400 cr of net savings for Discoms by 2030





- Grid flexibility measures provide peak shaving benefits based on the participation rate of consumers in AC DR programs, the number of e-buses that can charge during off-peak hours and the quantum of BESS that is deployed in Delhi.
- The net financial savings are accrued based on the energy cost savings, distribution deferral savings and avoided generation capacity savings minus the costs involved in establishing grid flexibility in Delhi.

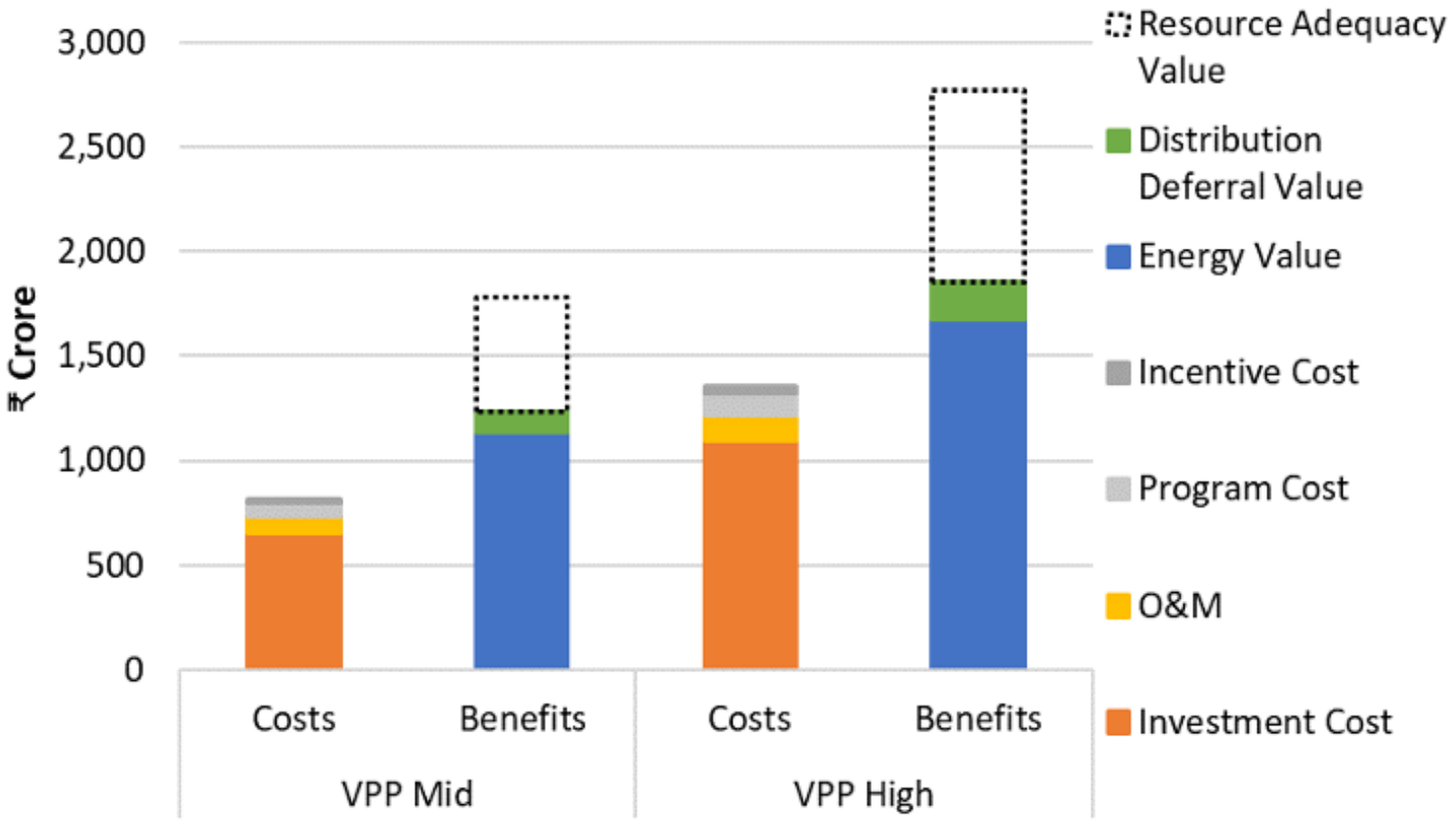
Grid flexibility measures can mitigate up to 4000 MW of peak demand in Delhi by 2030



- Grid flexibility measures complement each other across the day to mitigate Delhi's peak demand effectively.
- Aggregating these measures under a Virtual Power Plant framework (VPP) can enable peak shavings of 2500 – 3800 MW in Delhi by 2030.

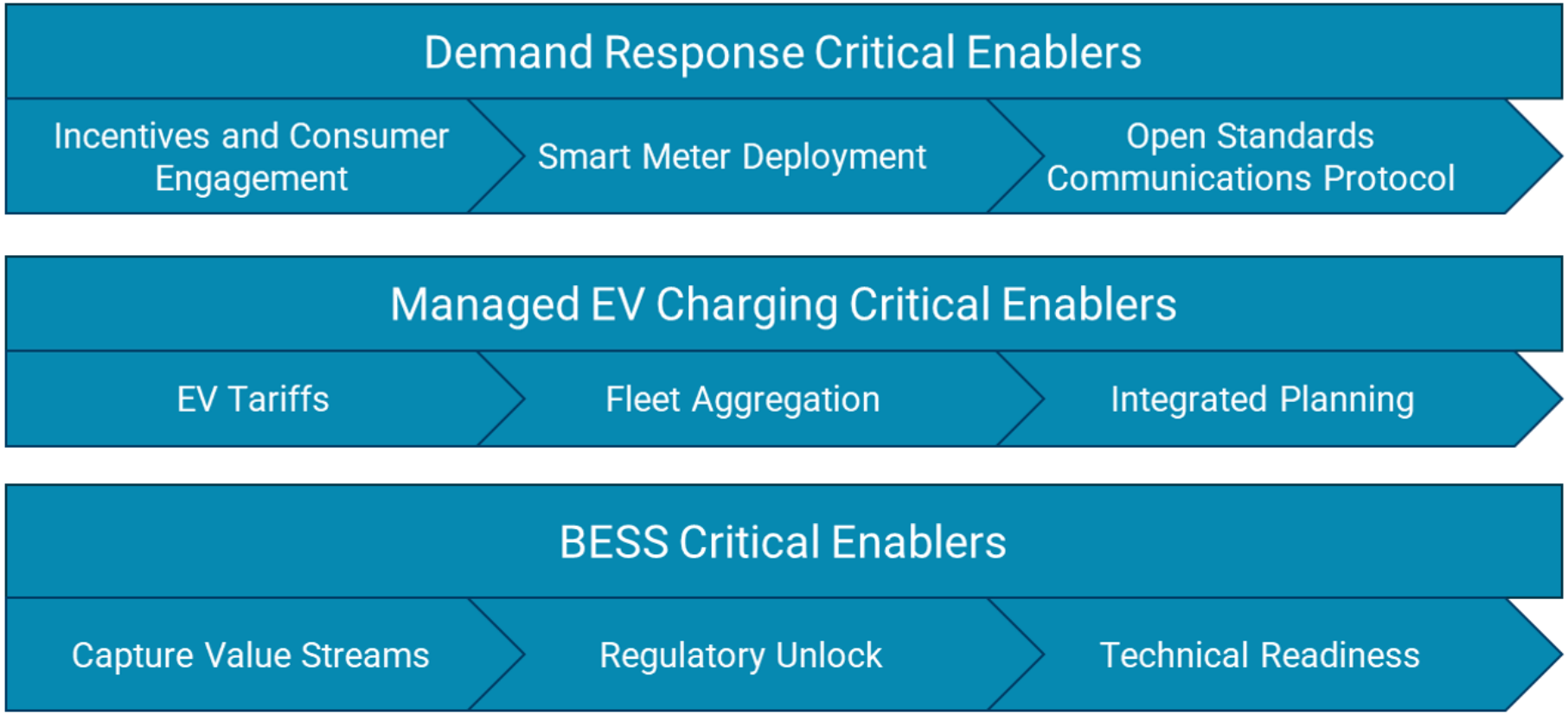
Source: RMI analysis.

The economic benefits outweighs the costs of establishing a VPP in Delhi by 2030



- The monetary benefits of grid flexibility measures in our analysis outweigh the costs largely due to the energy value savings coupled with distribution deferral savings.
- If these measures are provided a RA value through obviating the need for building new capacity (to meet planning reserve margin) coupled with an affixed capacity accreditation value for each measure, the benefits are found to be significantly higher.

Critical Enablers for Grid Flexibility



Source: RMI

RECOMMENDATIONS

Recommendations

- Based on the DR pilots conducted so far in Delhi, Discoms can develop a a comprehensive cost-benefit assessment of DR programs. This assessment can be shared with State & Central regulators to enable regulations which can help shape a large-scale and long-term DR program. Iterative changes can be made to the programme based on participant and working group feedback.

- ADR will require a large push for AMI implementation and smart devices – primarily smart meters and smart switches for ACs. ADR pilots can be conducted with existing consumers who possess smart meters in Delhi already to assess the potential benefits of ADR. This can also help develop a comprehensive cost-benefit assessment for deploying AMI.

- There is an opportunity for shifting the charging of E-buses and EV's during the night off-peak hours. EV-owners and E-bus operators have the potential to accrue economic benefits in the form of rebates offered on EV tariffs during off-peak hours in Delhi. Pilots around smart charging of EV's and managed charging of E-buses can help identify the overall costs and benefits available to all stakeholder groups involved. This can help shape future regulations for managed charging.

Recommendations

- Priority should be given to assessing the value of distribution-sited BESS projects in parts of the distribution grid that require significant upgrades. Based on the few pilots that have already taken place, focusing on conducting a thorough M&V will enable learnings to be extracted and socialised. These learnings will inform the best practices and encourage scaling of distribution-sited BESS projects.
- Given the distributed nature of grid flexibility measures, the role of an aggregator that interacts with consumers, discoms and grid operators is critical. Aggregator based models can be piloted in regulatory sandbox environments. Lessons learnt from these models can help shape regulations that enable aggregators as grid participants who can provide grid flexibility services. This can also help set the foundation of virtual power plants in India.
- State Regulators can roll out resource adequacy guidelines where capacity accreditation is specified for grid flexibility resources. This can can boost the economic viability of the proposed resources.

THANK YOU