

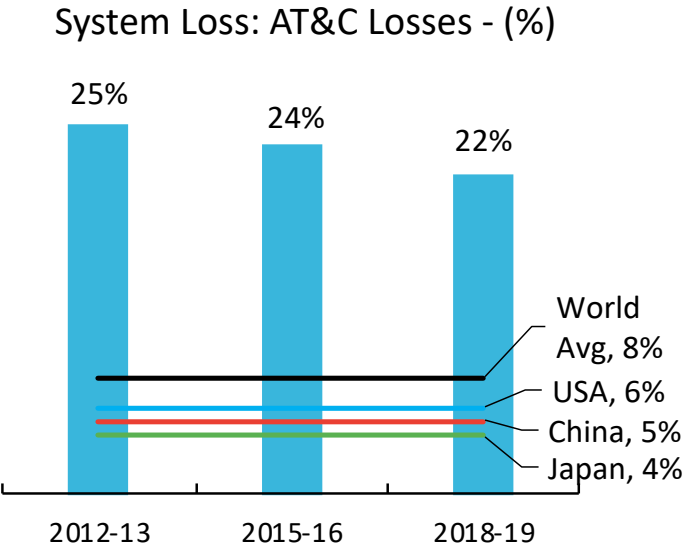
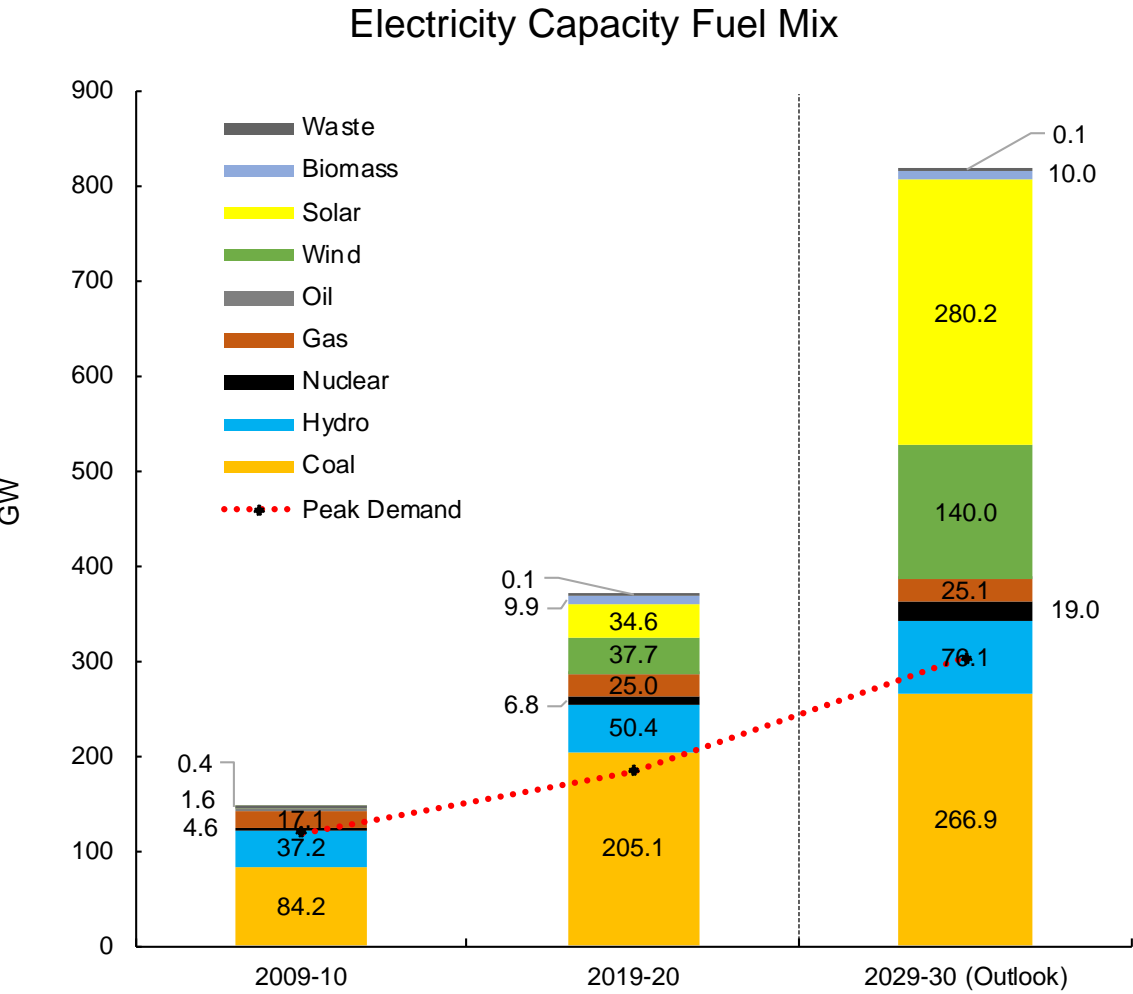


Power Through: A Climate Resilient Future

Jagabanta Ningthoujam

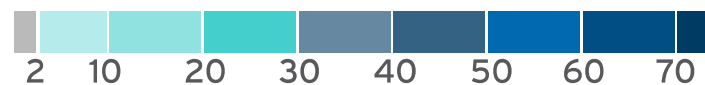


Indian Power Sector at a Glance



What does climate risk look like for India?

Annual probability of a lethal heat wave, %

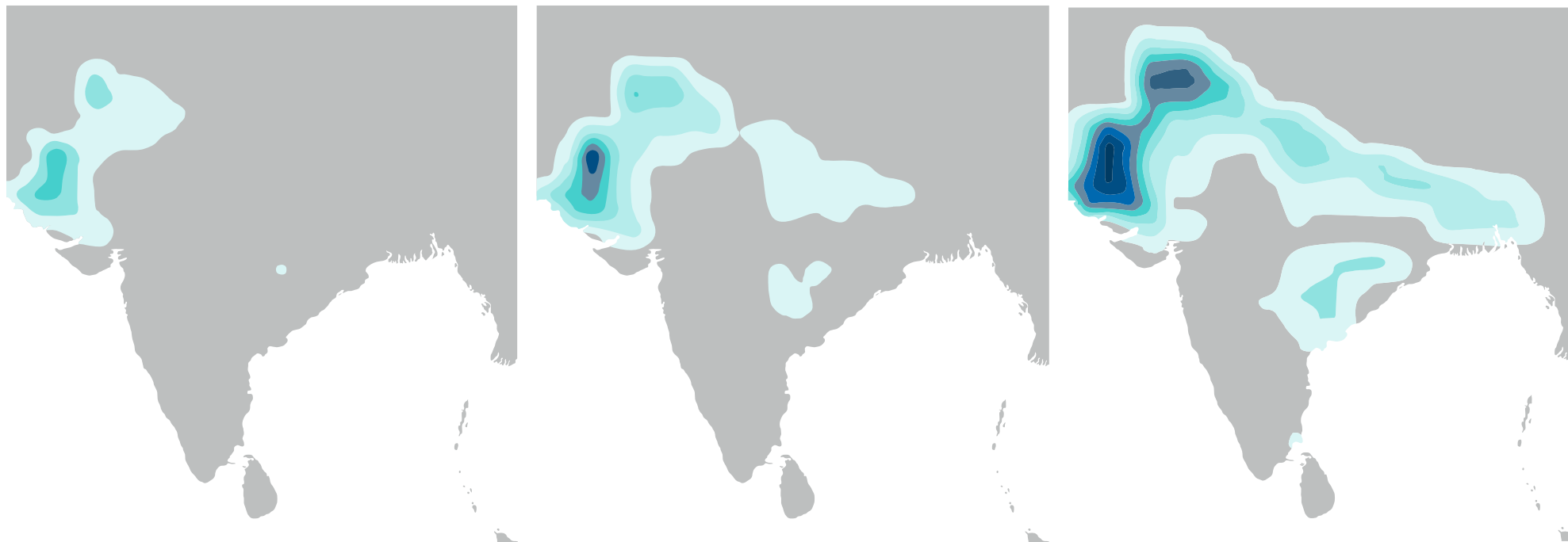


Today

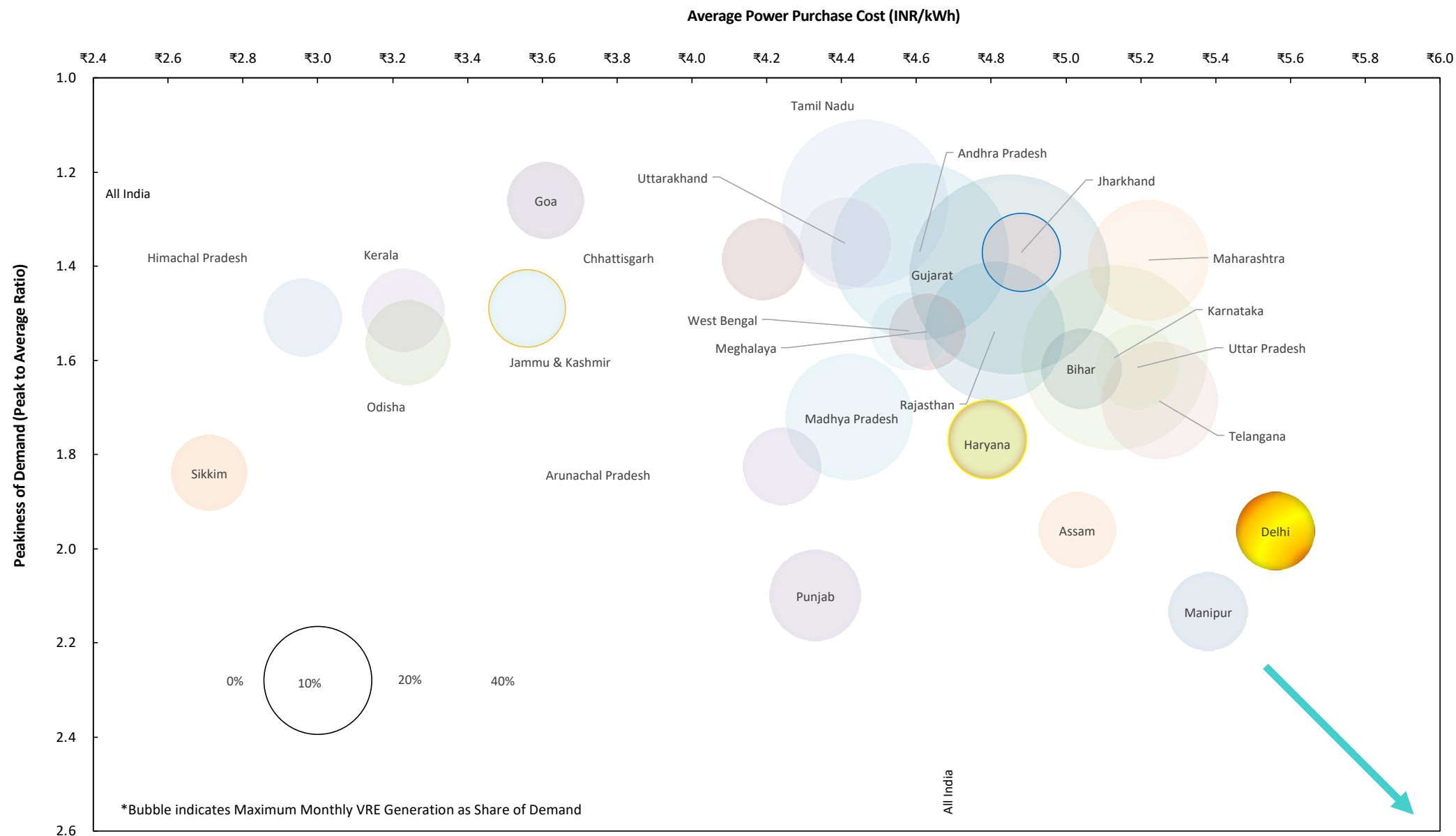
2030

2050

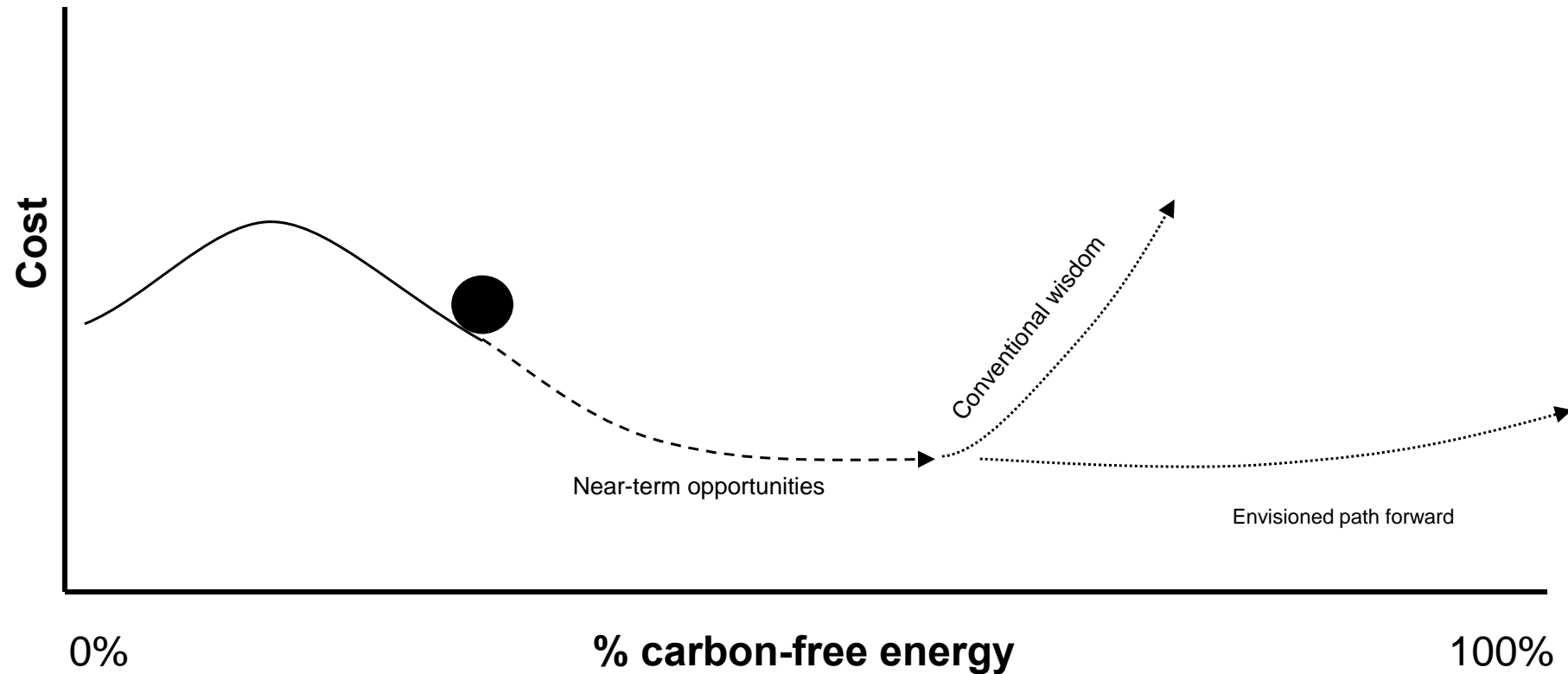
Based on RCP 8.5



Heat, peak power and cost of power procurement



Not accounting for climate risks can impose unforeseen financial burden on the pursuit of clean energy transition

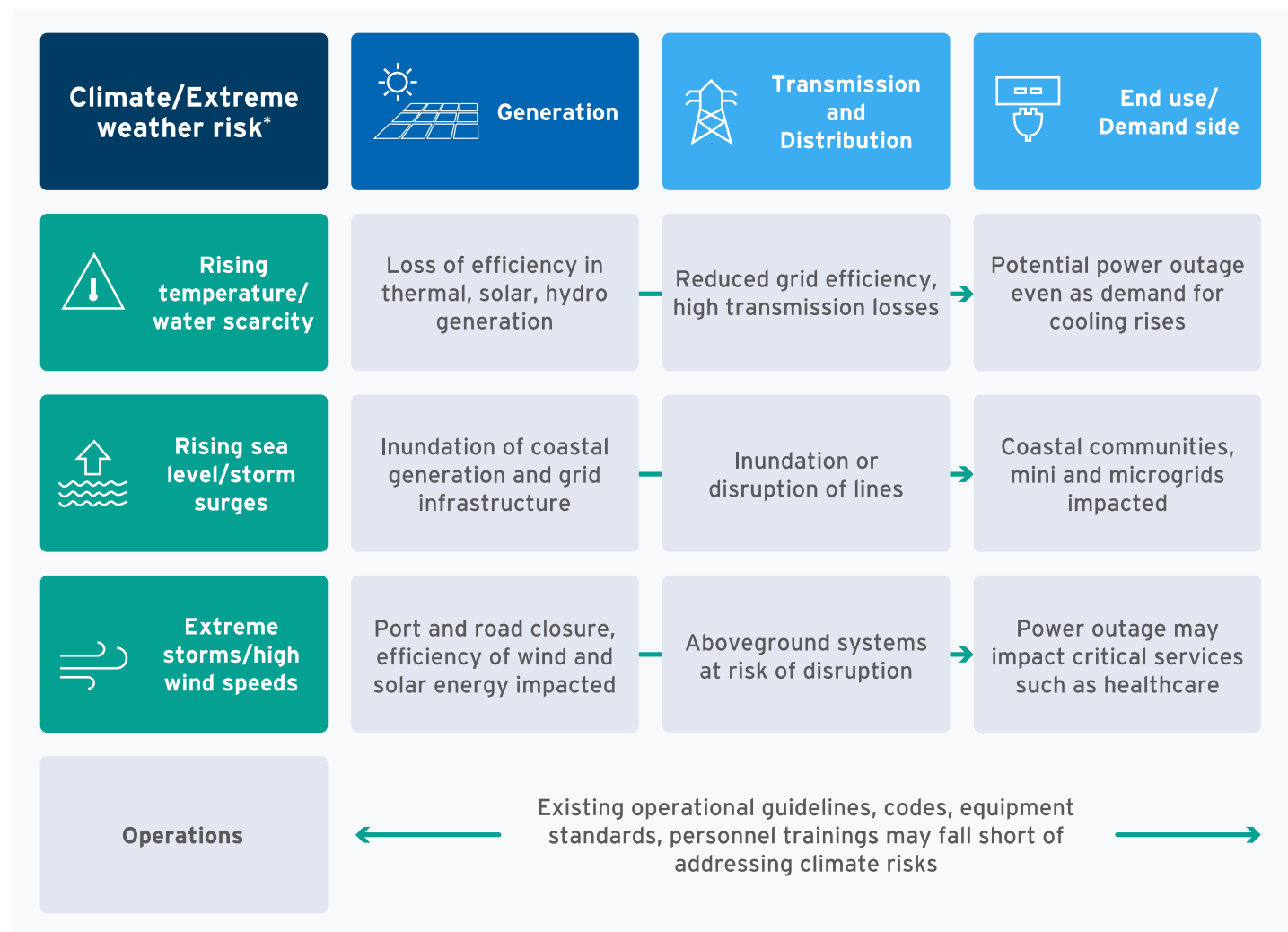


Source: RMI

Resilience is the ability to plan for, adapt to, learn and recover from adverse events over time

What does climate risk look like for the power sector?

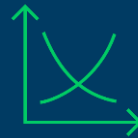
- Uncertain and evolving nature of long-term climate risks
- Changing and unpredictable nature of supply and demand
- Centralization of risk on the power grid
- Cascading impact on external sectors



Examples of extreme weather impact on power sector in India



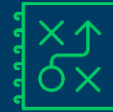
Rising intensity of floods



Weather related demand fluctuation



Variable wind speed



Weather related unpredictability of RE generation



Cyclones

What encapsulates power sector resilience?

Before the Fact

- Awareness
- Plan & invest for resilience
- Improve demand-side applications
- Upgrade equipment standards
- Improve communication standards
- Access to infrastructure/resilience insurance

After the Fact

- Disaster response
- Access to finance
- Framework for quick restoration & recovery



**Data on
long-term
climate risks**



**Finance and
insurance
instruments**

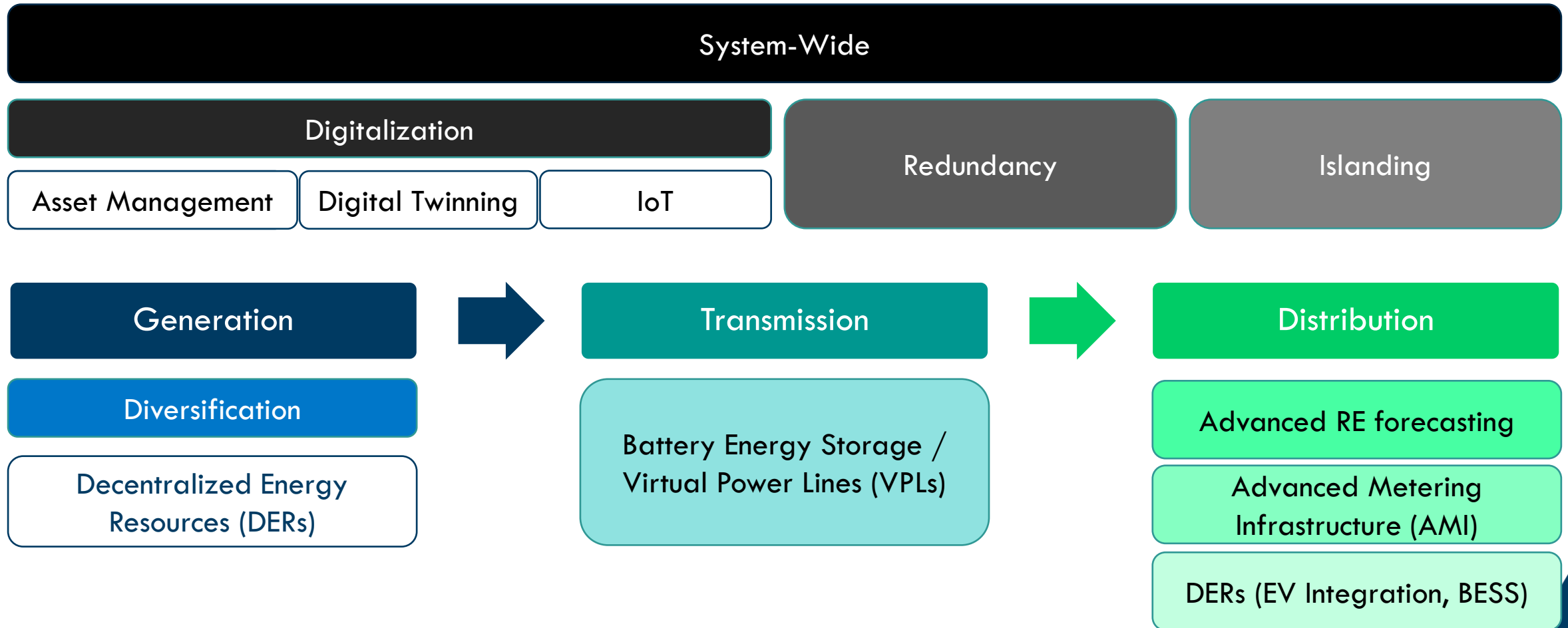


**Adopting
technological
interventions**

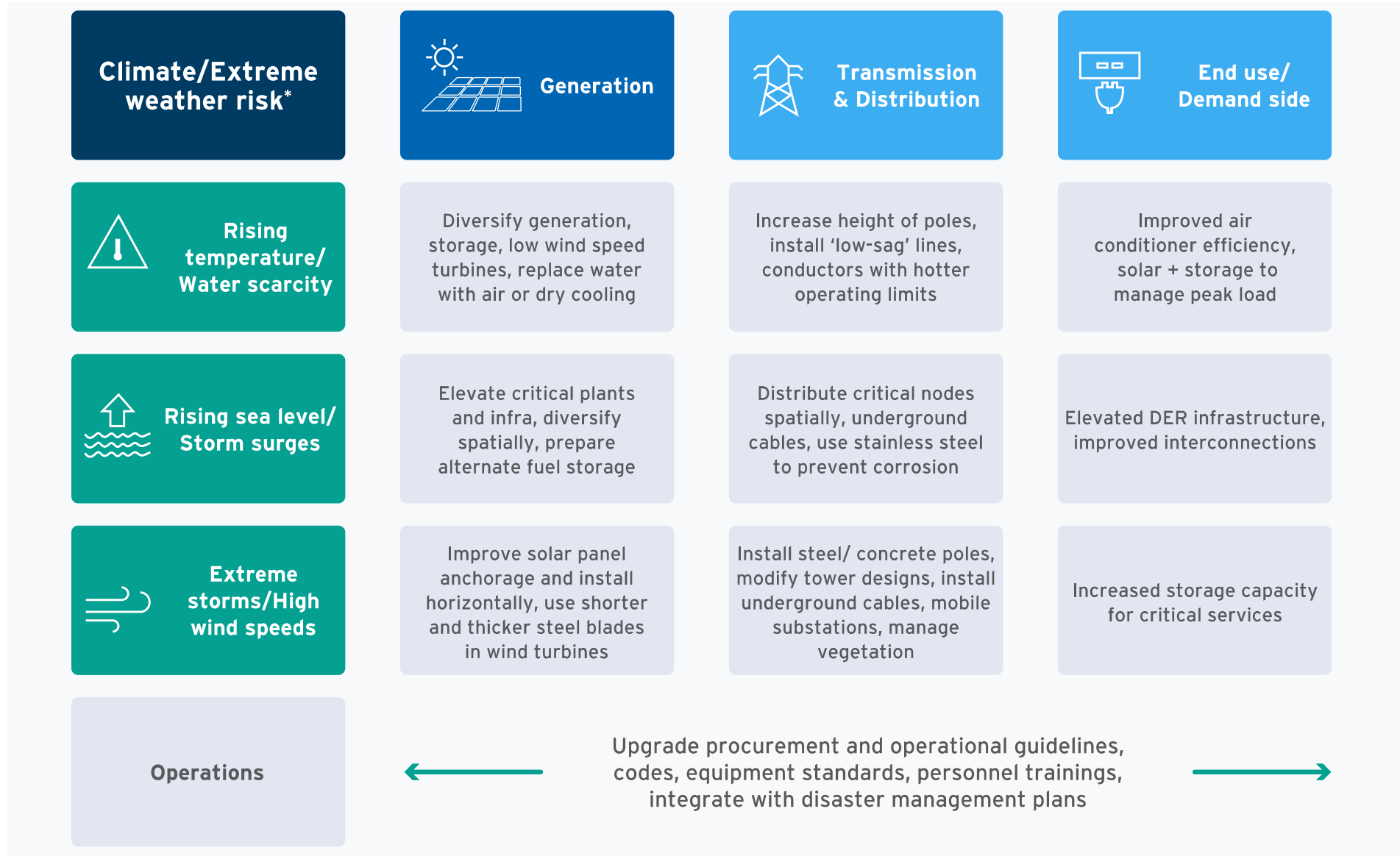


**Policy, governance
and regulatory
measures**

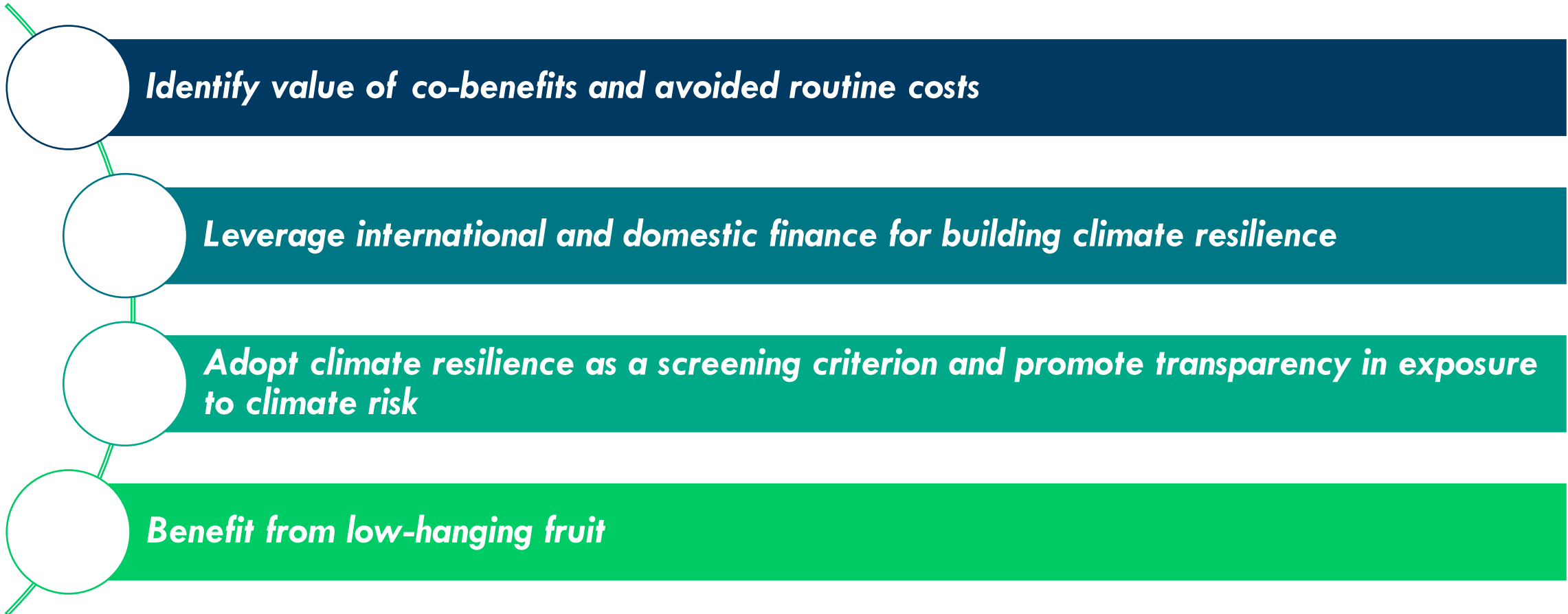
Adopting Technology Interventions



Snapshot of mitigation options for power sector infrastructure in the face of extreme weather impact



Financing Power Sector Resilience



Key Takeaways

- Mainstream resilience thinking into planning, governance, regulations, and operations frameworks in the sector
- No one-size-fits-all solution
- The right data and technology are crucial for preparing and responding to both near-term and long-term climate risks
- Explore different routes to attracting finance and investments for power sector resilience
- Power sector resilience is intrinsic to India's energy transition – in ensuring that power infrastructure investments are effective, in enabling a nimble and flexible electricity system, in safeguarding development goals and supporting critical services before, during, and after a disruption



THANK YOU

Approaches of Leveraging Demand Side Flexibility for Resilience through Communities in the US

Dr. Martha Symko-Davies
Sept 30, 2022

Businesses and communities are pursuing ambitious clean energy initiatives to mitigate environmental and economic risks and address system inequities.



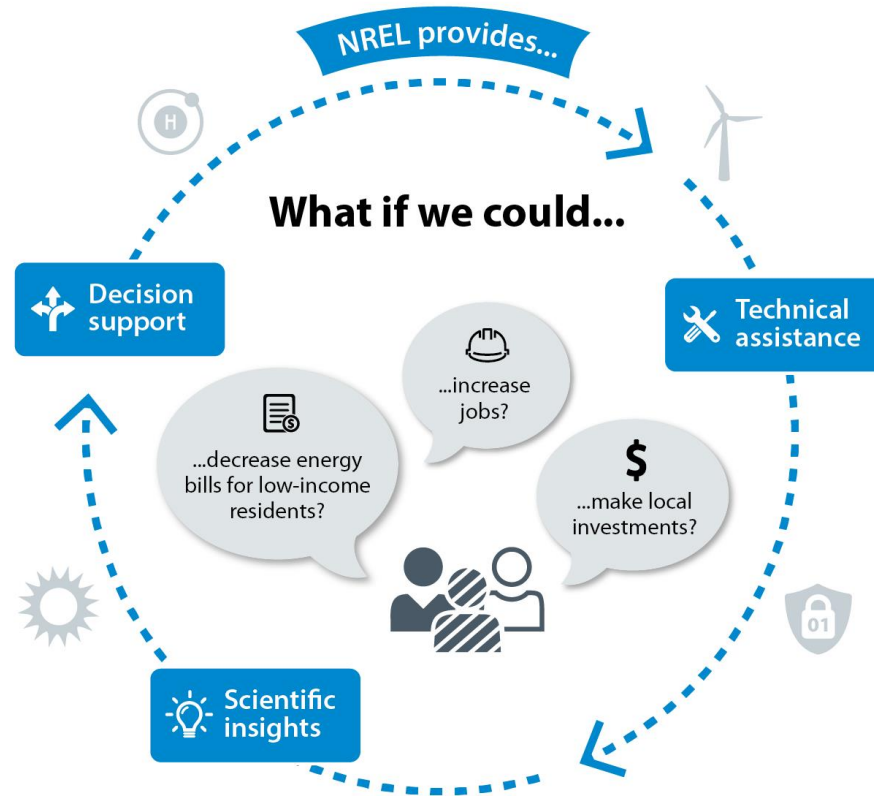
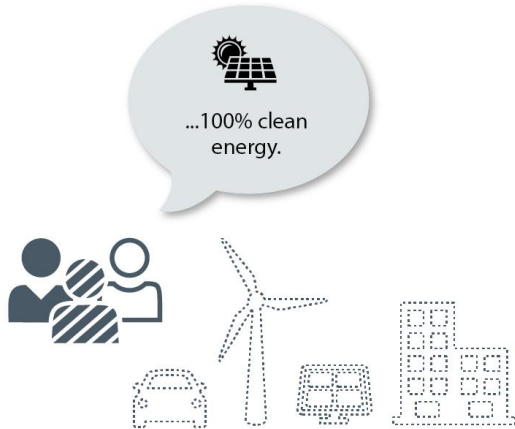
LA100 team at Pine Tree Wind and Solar Farm, California

To move from **ambitions to actions**, communities often need **in-depth energy-sector expertise and insight**.

As a U.S. Department of Energy (DOE) research lab, **NREL offers unbiased, best-in-class analysis and modeling capabilities** supported by **decades of scientific and applied research, expertise, and partnerships**.

Illuminate pathways to clean, affordable, equitable, secure, and resilient energy systems

Our ambition is...



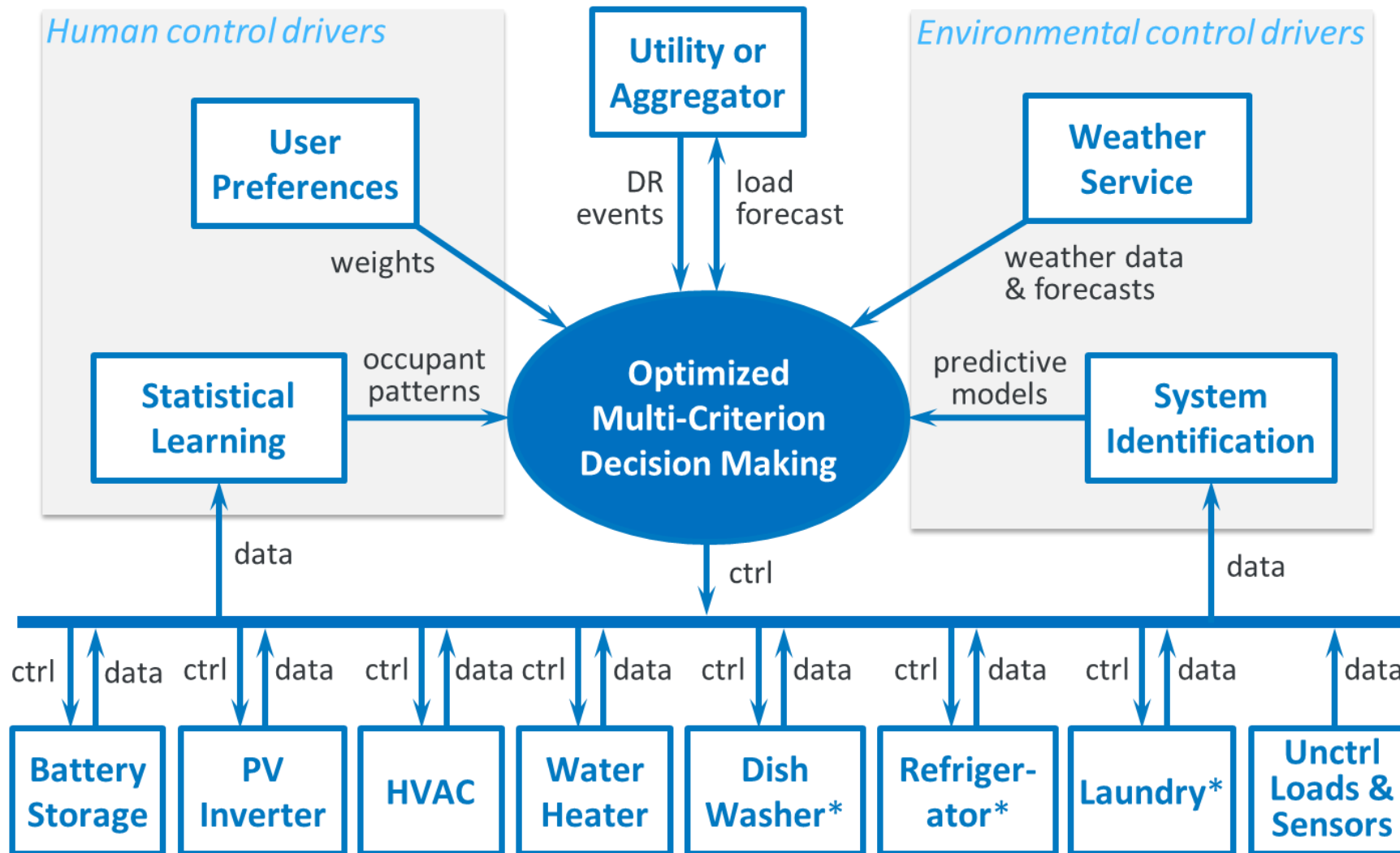
Now we can take action to...



Opportunity to develop new foundational AI approaches with innovative problem formulations that address needs of all communities for resilience and equity.

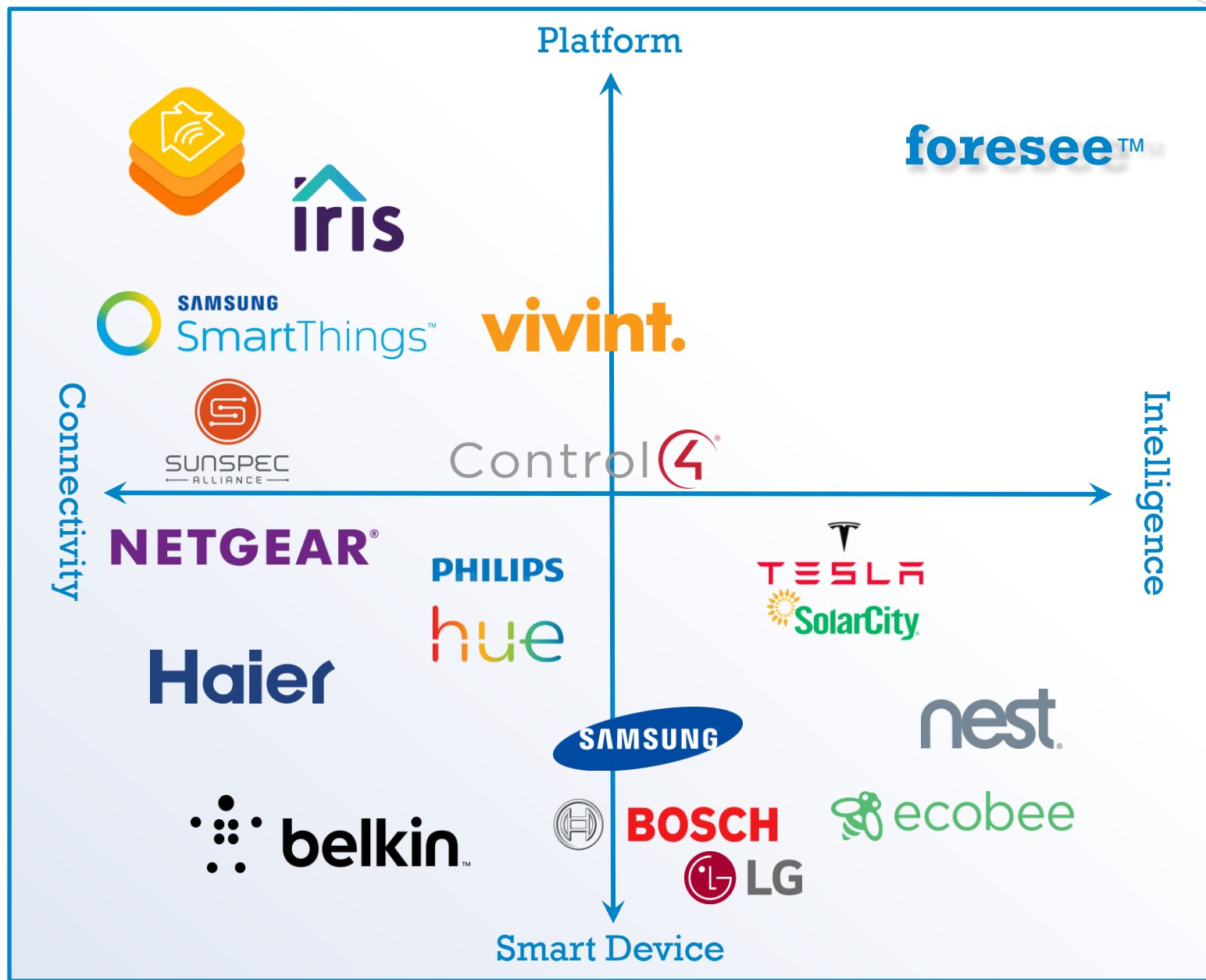


Control Architecture



*: Not included in the current project

Landscape Home Energy Management Concierge



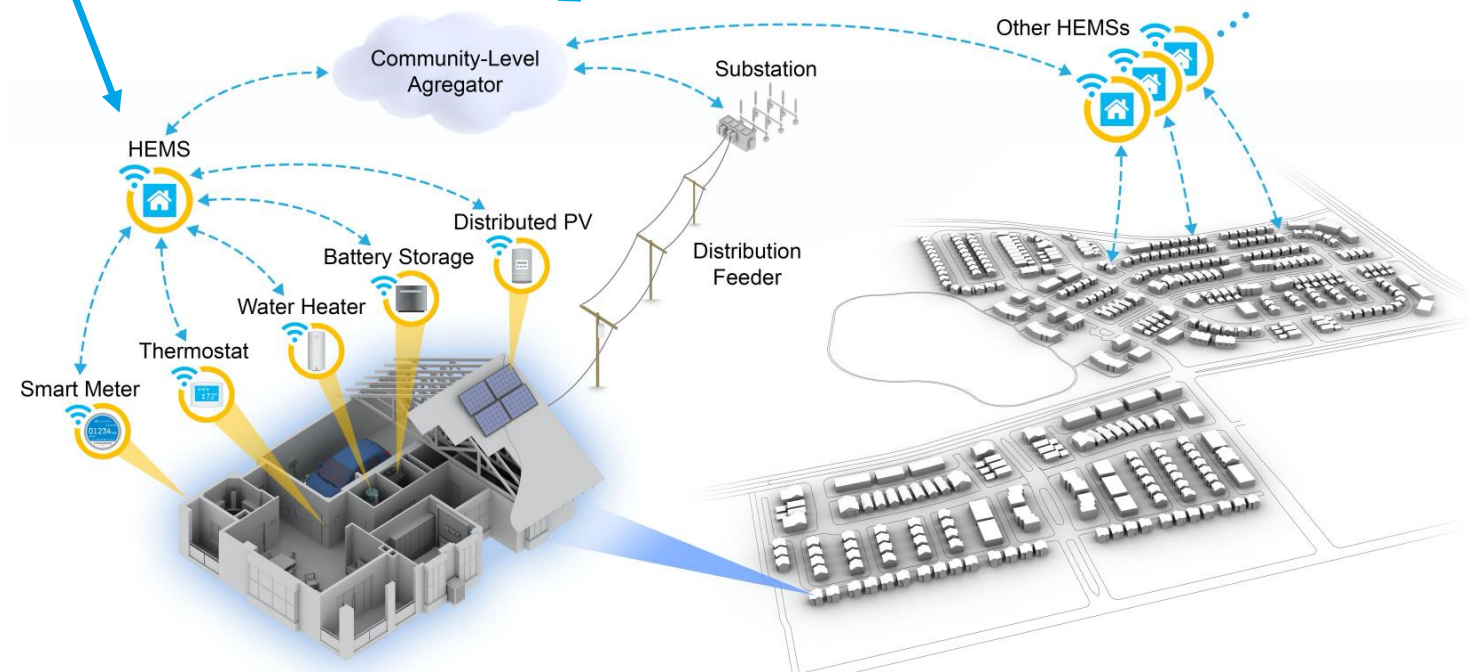
Coordinated home energy management can enable a “smart community”

- Deploying home energy management system can help homeowners reduce energy use, save utility bills, and ensure thermal comfort
- Coordinated control of homes can help utilities improve demand flexibility, host more renewables on the grid, defer infrastructure upgrade, and improve grid reliability and resilience

Home Energy Management System (HEMS) + Community Aggregator

HEMS: Manage the behind-the-meter devices on behalf of the homeowners

Aggregator: Coordinate homes in a community and respond to utility control



NREL's Smart Home Technologies to Help Habitat Homeowners at Basalt Vista – Better Comfort & Resilience, Lower Cost & Carbon

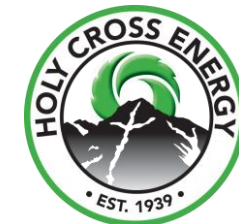
AI-Driven Smart Community Control for Accelerating PV Adoption & Enhancing Grid Resilience (funded by DOE)

- Goal: Develop and validate a community-scale solution to resolve crucial distribution grid issues from PV and increase load flexibility
- Advanced control technology coordinating the behind-the-meter resources at the home- and community-levels.
- Provide a cost-effective and scalable solution to address distribution grid issues arising from high-penetration PV.



Significance & Impact (“so what”)

- Boost the benefits of affordable housing for local school district staff by enhancing comfort and resilience while reducing utility bills and carbon emissions
- Provide a scalable non-wire alternative to utilities to interconnect future net zero energy communities



Example: Supporting resilience in vulnerable communities



Community priorities

Remote, island, and islanded community energy and infrastructure challenges, values, and goals



Partnership approach

Deep energy-sector experience, expertise of the national labs + local, trusted stakeholder organizations



Energy assessment and planning

Provide resources and on-the-ground support



Resilient energy systems

Knowledge sharing → lessons learned, use cases → identified responsive technology needs