



Case Studies of Net Zero Energy Districts

Asia Clean Energy Forum

ROCKY MOUNTAIN INSTITUTE

Transforming global energy use to create a clean, prosperous, and secure low-carbon future.

June 2020

About Rocky Mountain Institute

37 Years of Global Energy Expertise and Impact

Focused on the transition toward a distributed, clean, and resilient energy future

220 FULL-TIME STAFF



Best-in-class experts from across the energy industry guided by co-founder Amory Lovins

7 LOCATIONS



6 Offices: Basalt & Boulder, CO; New York City; San Francisco; Washington, D.C.; Beijing, China; plus a sister organization in India

\$52 MILLION BUDGET



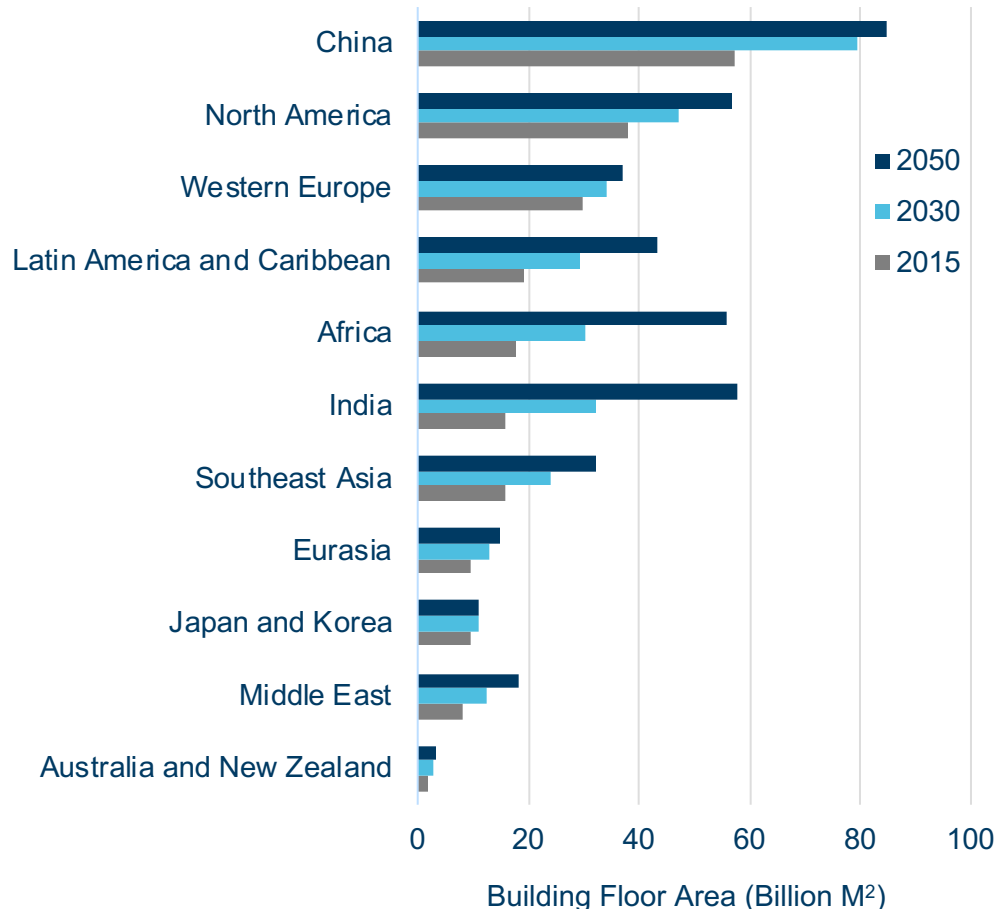
75% of revenue from philanthropy, 25% from collaboration

LARGE ECOSYSTEM OF PARTNERS



Addressing energy use in growing urban areas is critical to limiting global warming

Projected growth in building floor area globally
from 2015 to 2050 by region
(billion m²)



According to the UN, **the population of urban areas could increase by as many as 2.5 billion people by 2050**, with close to 90% of the increase taking place in Asia and Africa.

To support this growth in population, the world is projected to **add approximately 200 billion m² of buildings by 2050**, or an area nearly equal to the current global building stock. This is the equivalent of adding an entire New York City to the planet every 10 days for the next 30 years.

Buildings currently use over **200 quadrillion BTUs of energy every year and are responsible for nearly 40% of GHG emissions annually**

The role for net zero buildings and districts in achieving 2030 and 2050 energy and emission targets

Net zero energy buildings, though critical, are not sufficient on their own.

To address this issue – we must first expand our lens and make the problem bigger.

The challenge of the coming decades will be to create clean, healthy, and economically vibrant communities in all types of climates and economies. This means addressing;

- Public health
- Pollution
- Economic development
- Congestion



RMI works on innovative district-scale zero energy projects to demonstrate high-quality, low-carbon urban design

Hazelwood Green
Pittsburgh, USA



0.75 KM²

550,000 M² OF BUILDINGS

**~7000 JOBS CREATED &
6,000 RESIDENTS**

**TARGETING NEAR NET
ZERO ENERGY STATUS**

Meishan “Port+Industry+City”
Ningbo, China



330 KM²

**12.6 MILLION M² OF
BUILDINGS**

300,000 PEOPLE

**775,000 MT CO₂ ANNUAL
REDUCTION IN 2030**

70% REDUCTION

Palava
Dombivli, India



20 KM²

**9 MILLION M² OF
BUILDINGS
(PHASE II OF III)**

500,000 PEOPLE

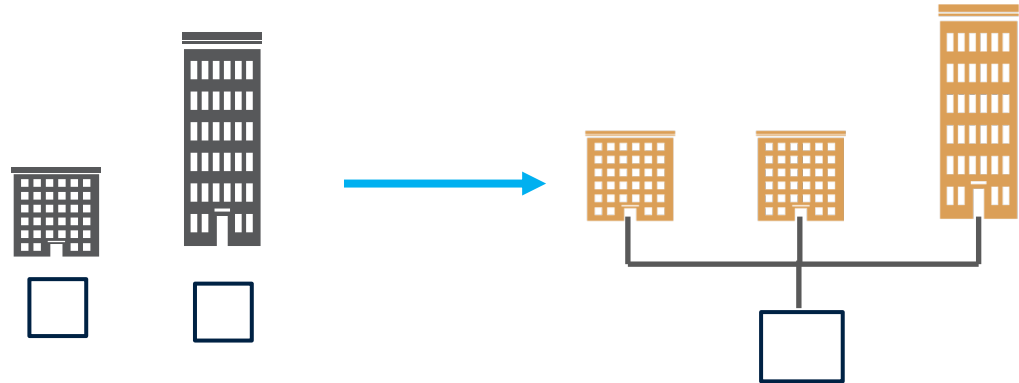
**930 GWh/Year ENERGY
SAVINGS**

**260,000 MTCO₂ ANNUAL
REDUCTION IN 2030**

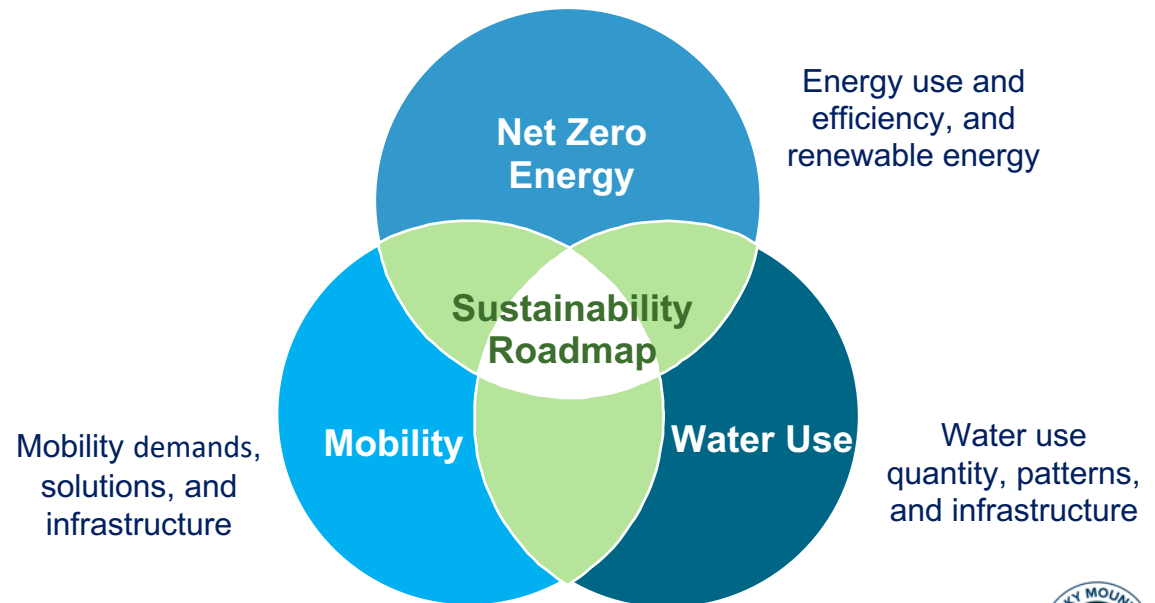
RMI's approach to net zero design

RMI's approach focuses on expanding the boundaries of the “problem” to identify and drive integrated solutions.

Expanding the boundaries from **individual buildings** to a **focus on districts** unlocks new opportunities.



Similarly, taking an **integrative approach to sustainability design and planning** presents new opportunities and high impact outcomes.



Integrating proven and innovative technologies to achieve zero energy goals

Efficient Buildings and Districts

- Improved envelope performance
- Passive design techniques
- Efficient appliances
- Cooling load reductions
- HVAC control strategies
- Optimize day lighting and glare reduction
- Behavioral programs

Clean Energy Generation

- Central Plant / District cooling
- Rooftop PV plants
- Open access contracts
- Ground mount PV plants
- Vertical and carport PV potential
- LNG terminal regasification cooling load recycling
- Biogas recycling

Clean and Efficient Mobility Solutions

- Electric bikes, cars, buses, and freight delivery vehicles
- Vehicle light weighting
- Green commuting
- Non-motorized transport network
- Driverless container trucks
- Electrified cranes
- Mobility awareness and education programs

Digital and Smart Technologies

- Smart meters
- Integrated smart building controls and technologies
- Advanced demand response
- 5G infrastructure
- Automated and smart charging
- Automated and autonomous vehicle technologies

Design and technology to address cooling demand in residential buildings

In India, RMI modeled the impact of different design and building technologies to improve the cooling demand of residential buildings.

Passive Design

Optimize building design to maximize passive cooling, including natural ventilation and cross ventilation using window placements, louvers, and incorporating architectural features like wing walls and solar chimney.

Improves resident wellbeing and reduce use of cooling equipment.

Insulated Concrete Forms

ICFs provide a high thermal efficiency and limit air infiltration. They support lower labor costs, when installed by an experienced crew.

Peak residential cooling load reduced by 42% and a decrease in cooling kWh by 29%.

Solar Reflective Paints

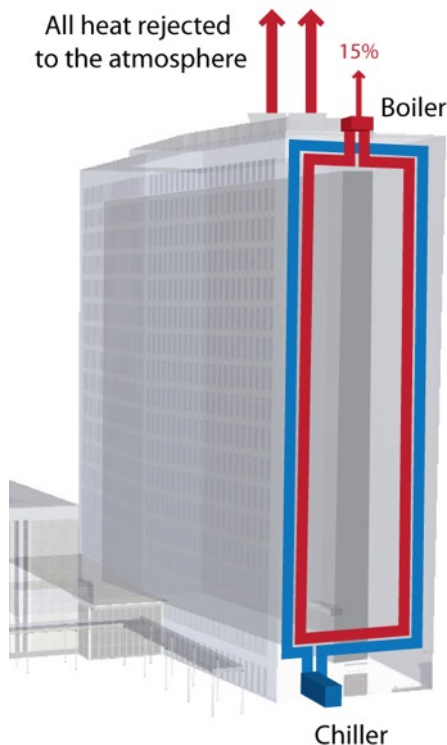
Solar reflective paints help reduce energy absorption from the sun. They are applied to the exterior of buildings to keep buildings cool and improve energy performance. Target a solar reflective index greater than 80.

Peak cooling load is reduced by 8% and a decrease in cooling kWh by 19%. Mitigates urban heat island effect.

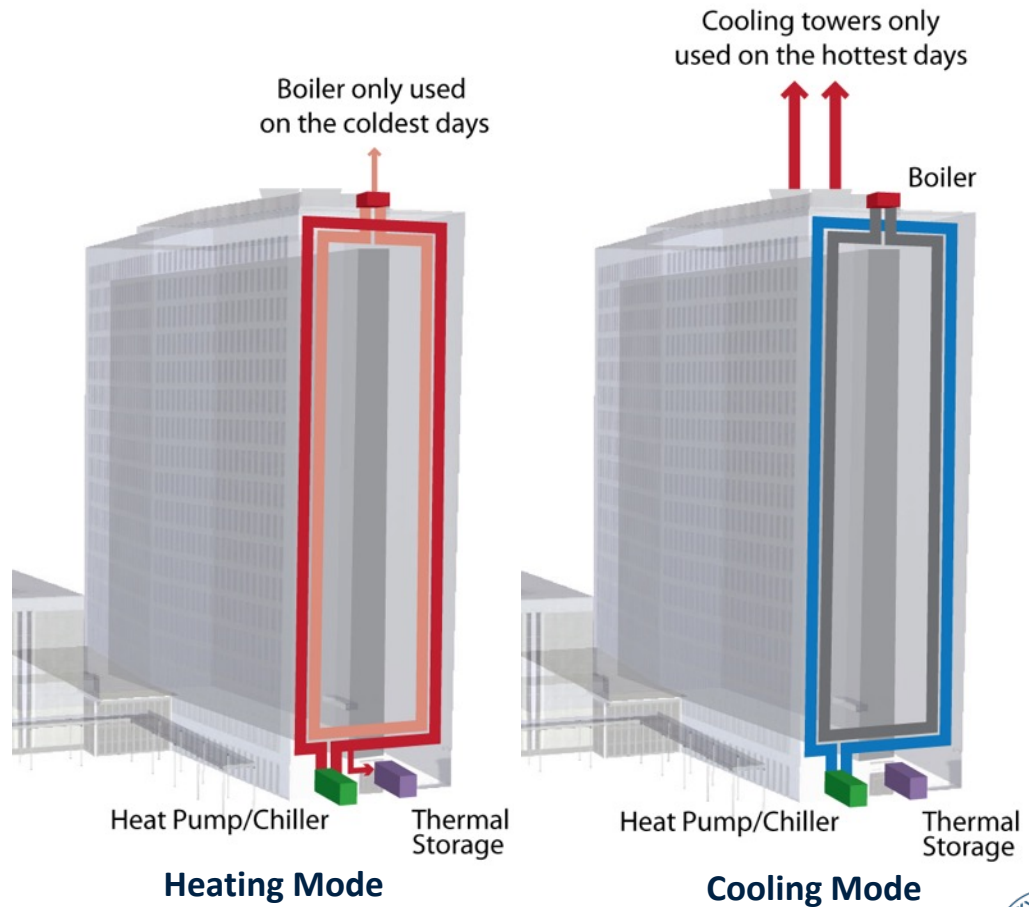
Achieving net zero energy through an integrative approach to district clean energy

Examine the entire system to optimize for all needs – including movement of heat throughout the district

Conventional System Using Boilers and Chillers



Hybrid Heat Pump System (Betterment Option)



Digital and IT technology is enabling and accelerating the clean energy transition

District-scale developments are acting as early adopters and piloting innovative digital and IT technology that can enable the accelerated deployment of clean energy systems.

Building controls and customer platforms

During COVID lockdowns, many buildings are gathering data on energy performance during unoccupied state to improve baseline performance. This can lead to minimizing 'vampire' loads and engaging occupants.

Electric cranes and autonomous/driverless trucks

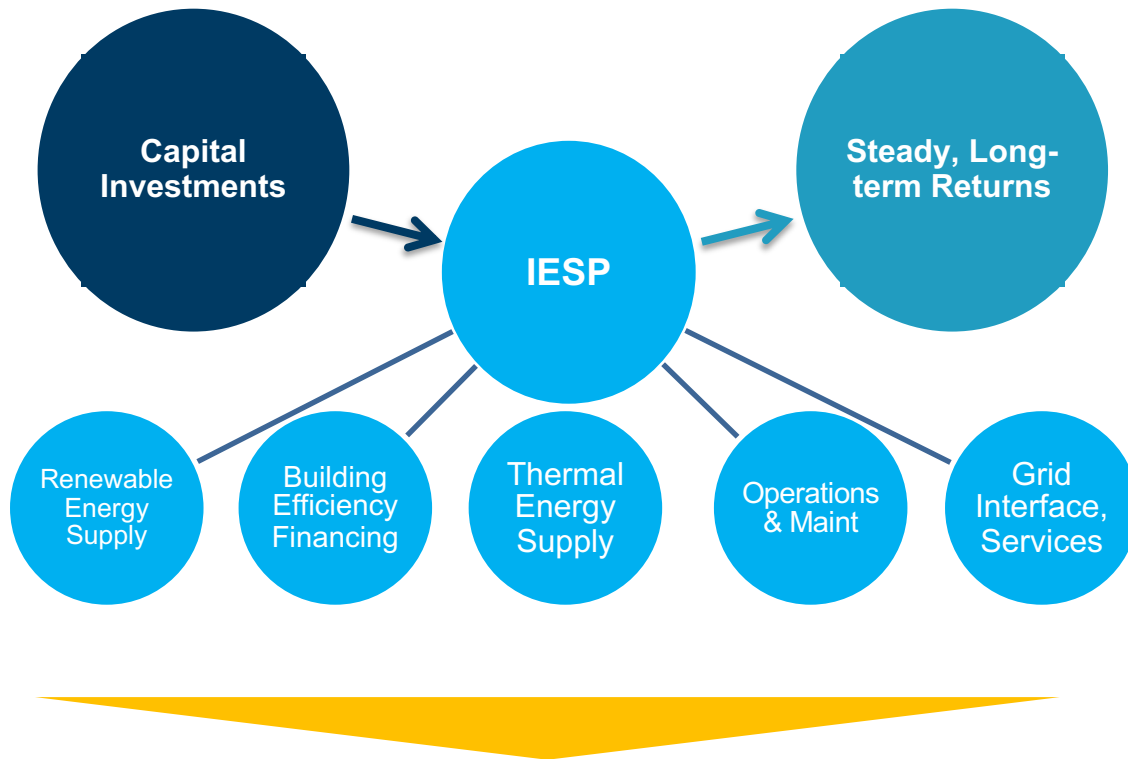
Moving goods and containers frequently requires many diesel-based vehicles, but Singapore and others are leading the way to find efficient and automated solutions

Smart charging to optimize vehicle-grid integration

With increasing shares of electric personal mobility – the grid can benefit from selective charging and price signals. A district offers significant benefits in creating this infrastructure and controls system.

An Integrated Energy Services Provider (IESP) aligns incentives and drives greater investment opportunity

Opportunity for control, optimization, and aligned incentives to maintain system and operate it efficiently



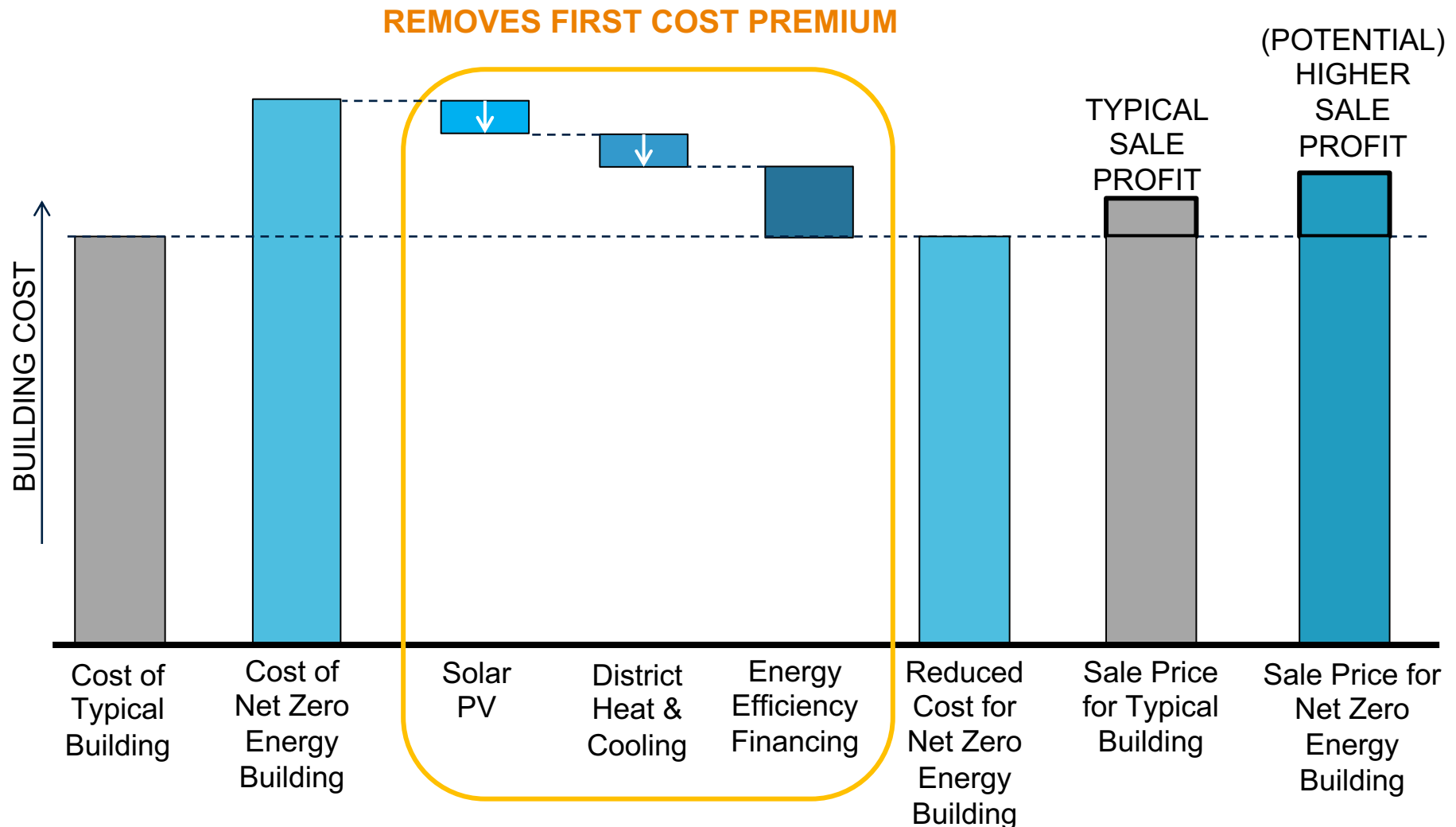
A centralized system can:

1. **Shift upfront capital costs** for heating and cooling equipment to a district energy developer
2. **Provide the basis for on-bill efficiency financing** based on local market circumstances
3. **Facilitate electricity market revenue opportunities** like demand response, frequency regulation, or investment deferral for utility infrastructure
4. **Centralize control** of the site heating and cooling system, and other infrastructure, to provide services such as operations and maintenance

NZE Opportunity:

Integrated energy services provider (IESP) to aggregate site energy services while ensuring that NZE is financially attractive to the project owner and tenants

IESP shifts up front costs from individual buildings to a central entity



Cross-cutting insights and lessons learned

Based on net zero and near net zero district projects, the following key lessons help generate project success and overcome barriers of first cost;

- Define clear goals, involve all stakeholders
- Work backward from the goal, rather than forward from standard design
- Leverage technical synergies, including capturing all heat and coolth and capturing value from waste
- Aggregate and centralize key services, consider CHP and geothermal
- Build the value proposition for service providers
- Build a financially attractive suite of services for developers and tenants



Case study: Empire State Building – Innovative Approaches and Technology

Starting in 2011, improved energy performance more than 40% with a three-year payback. Used technologies such as window remanufacturing and regenerative braking.

Now seeking a next phase of improvement, driven by successful economics and government policy





Thank you!

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To learn more about RMI and our work, please visit www.rmi.org.