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Performance x Design

NIA Fall Summit - 2025

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→ Design-Build, Decarbonization, and the Future of Mechanical Insulation

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Agenda

1. Welcome & Framing
2. The Design-Build Shift
3. The Hidden ROI of Insulation
4. Decarbonization Imperative
5. Data Centers & Emerging Trends
6. Partnership & Innovation
7. The Road Ahead
8. Q&A

65%

Rise in Global Building Energy Demand by 2050

37%

Global CO_2 Emissions from Built Environment

30-40%

Building Energy Used by Mechanical Systems

10-30%

Energy Savings Potential When Properly Insulated

$20B

Saved for Every 1% of Mechanical Efficiency Gain

105MMT

of CO_2 Avoided Annually by Maintaining/Optimizing Mechanical Insulation in the US

The Design-Build Shift

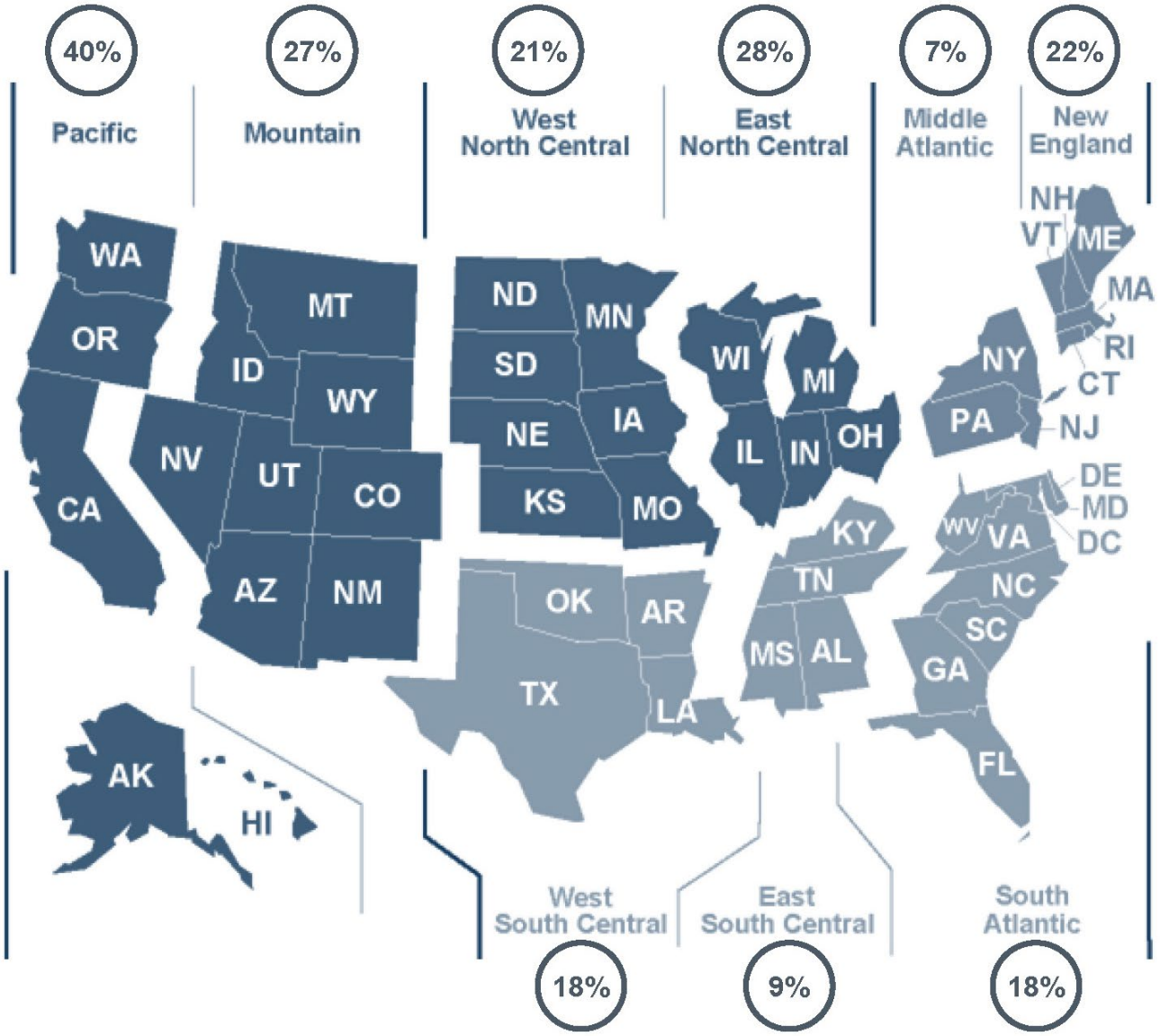
The Design-Build Shift

Nearly **50%** of U.S. construction spending by 2028 ($2.6T) will be **Design-Build** projects.

Projects using DB are delivered **102% faster** than traditional DBB/CMR.

7.6% annual growth from 2021-2025, delivering **$406 billion** in construction across all segments.

Current growth in design-build construction is **34%**.



Why It Matters Now

In traditional DBB, insulation is often a line-item decided after design

Too late to impact performance

In DB, performance criteria (energy, EUI, decarbonization) are baked in early

Mechanical Systems decisions define the carbon profile

When insulation experts are engaged early:

- Specifications improve
- Systems are optimized for efficiency, maintainability, and cost
- They can influence whole-building energy models and LCA inputs

Missed collaboration = missed savings and higher carbon footprint

Retrofit insulation fixes cost up to 3-5x more than integrating during design

The Spec Challenge

Many mechanical insulation specs are decades old, copy-pasted, or reference outdated standards (pre-ASHRAE 90.1-2016).

- **Under-insulated systems** = wasted energy and higher emissions
- **Incompatible materials** = moisture, mold, and corrosion under insulation (CUI)
- **Ambiguity** = lowest-bid mentality instead of performance-based results

Design-Build gives us a reset button – a chance to co-author smarter, performance-based specs.

Rewrite the playbook to align cost, carbon, and constructability.

What you can do:

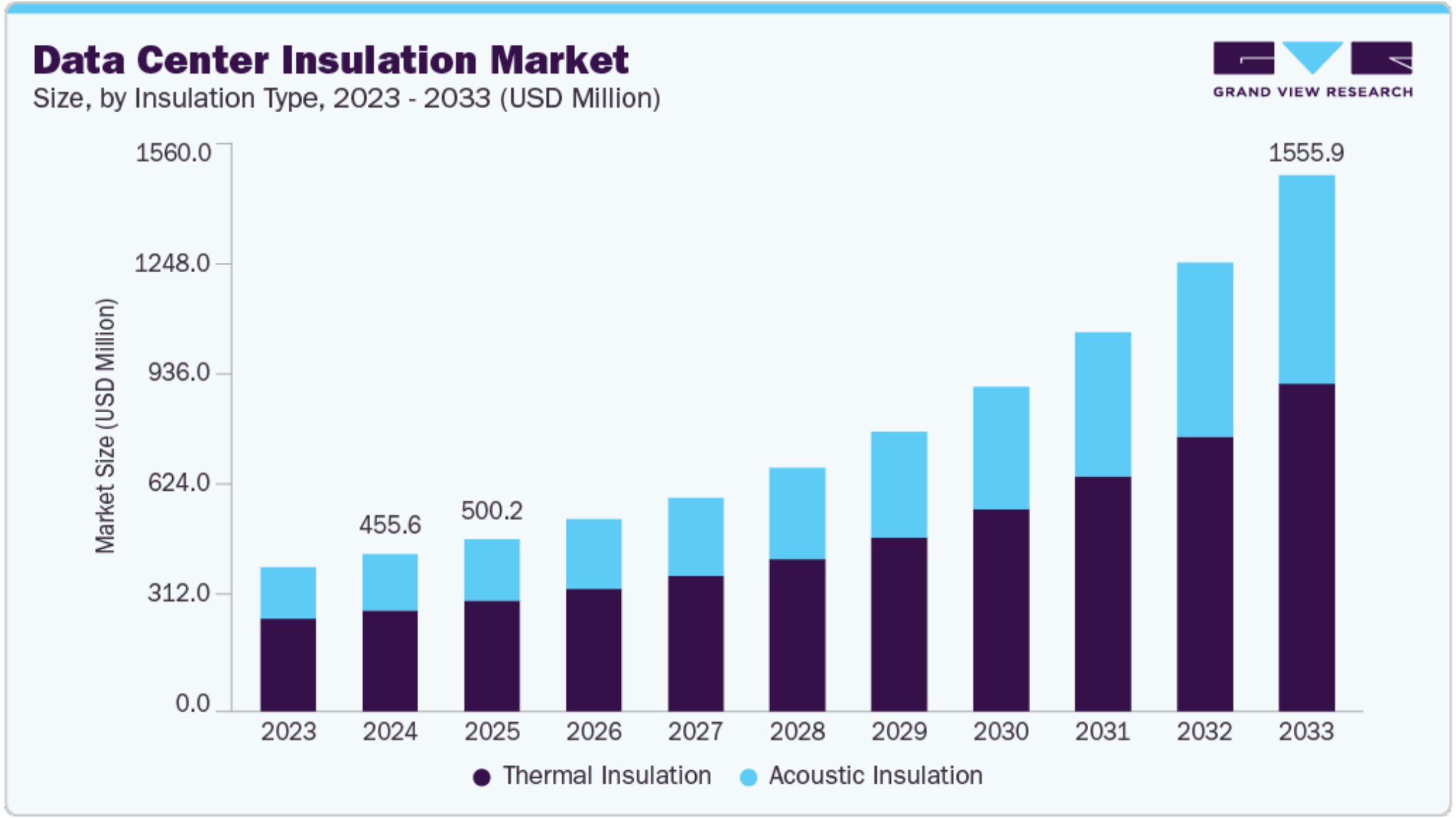
- **Audit and modernize specs:** Identify outdated references and embed ASHRAE 90.1-2022, ASTM, and IECC 2024 updates.
- **Collaborate early:** Bring engineers, contractors, and insulation experts together to define verified performance targets.
- **Leverage NIA standards** (in development): The upcoming NIA framework will establish consistent performance and quality benchmarks across the industry.
- **Educate the end user**: Position insulation as a measurable decarbonization and risk mitigation tool — not a hidden line item.

The Hidden ROI of Insulation

→ 6-24 Month Payback

→ 20-30% Loss

→ 500x Energy Return



→ $455-$1.55B Market Growth

→ 40-60% Cooling Load

→ ROI Beyond Energy

Decarbonization Imperative

Verified Performance: The Next Frontier

Why It Matters

- Energy and carbon savings remain assumed without verification
- Closes the loop between design assumptions and results
- Hidden losses equal uncounted emissions and missed savings
- Verification protects ROI and ensures persistent efficiency

Performance Pathway

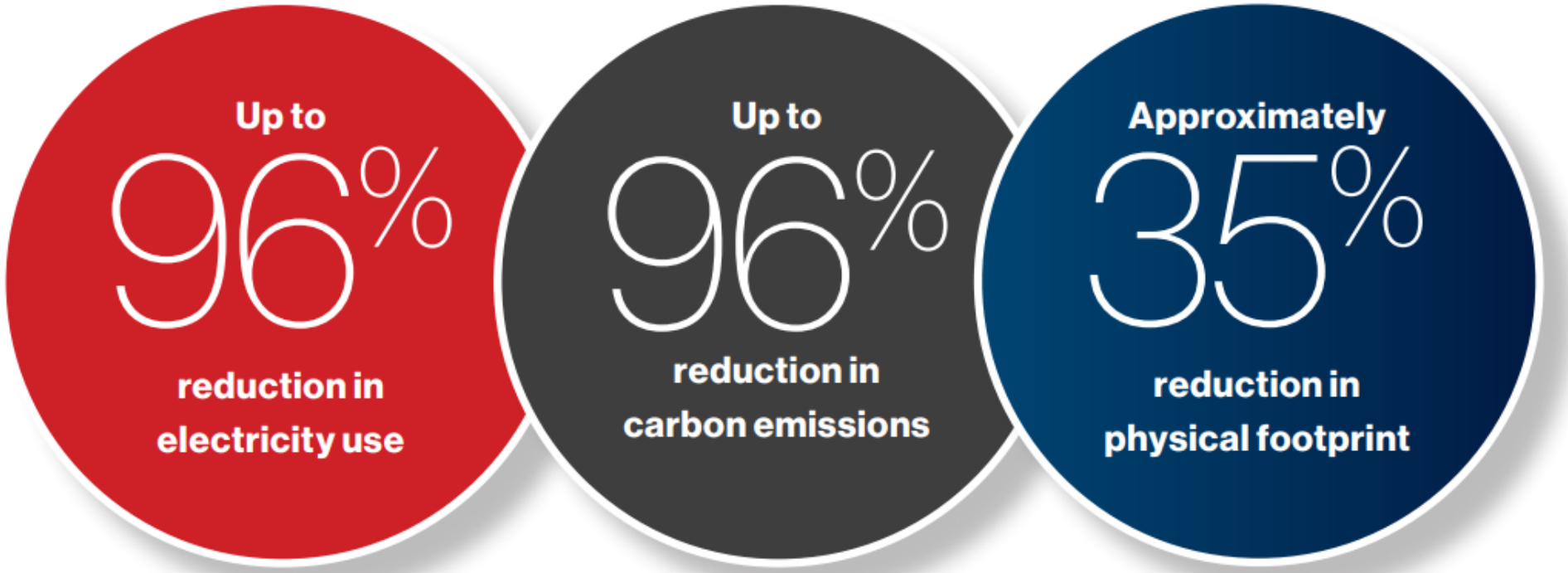
The Road Ahead

- Establishes a trusted data framework
- Supports ESG disclosures
- Positions insulation as a quantifiable sustainability solution
- Positions insulation as a measurable decarbonization tool
- Creates pathways for innovation and digital integration (AI, IoT, etc.)

Design Variables that Drive Carbon

Variable	Key Effect	Quantitative Impact
 **ΔT Temperature Differential**	Higher temperature differentials exponentially increase losses — insulation thickness and conductivity are critical.	↑ ΔT = ↑ Energy Loss
 **λ Thermal Conductivity**	Typical range 0.025–0.045 W/m·K; each 0.005 improvement = ~1–2% energy gain.	↓ 0.005 λ = ~2% Efficiency Gain
 **Continuity**	Discontinuities at flanges, valves, supports can raise system losses.	+15–25% System Loss if Untreated
 **Moisture Barrier Integrity**	Water ingress increases λ by 50–70%, nullifying design intent.	+50–70% λ Increase if Compromised
 **Maintenance Factor**	Degraded insulation creates “carbon leakage”; regular thermal audits sustain performance.	Ongoing audits = steady carbon profile

Potential impacts of decarbonization projects



Source: Compiled by MIT Technology Review Insights, based on data from "7 Ways to Reduce Your CO2 Footprint and Save Money," Hitachi Vantara, February 22, 2023

Data Centers & Emerging Trends

Growth & Scale

Industry Scale

- Global Data Center Energy Use ~ 3-4% of all electricity
- Typical Hyperscale site = tens of thousands of linear feet of insulated piping and ductwork, some up to 30 inches in diameter

Mission Critical

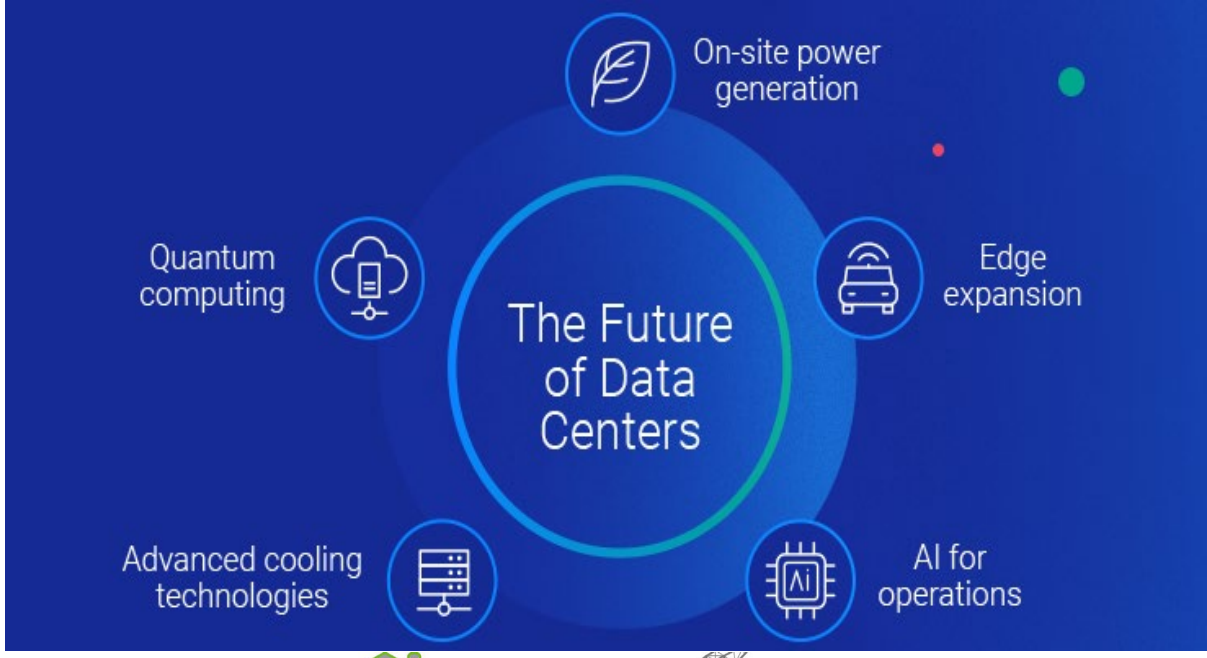
- Thermal Precision
- Condensation Control
- Efficiency/Longevity

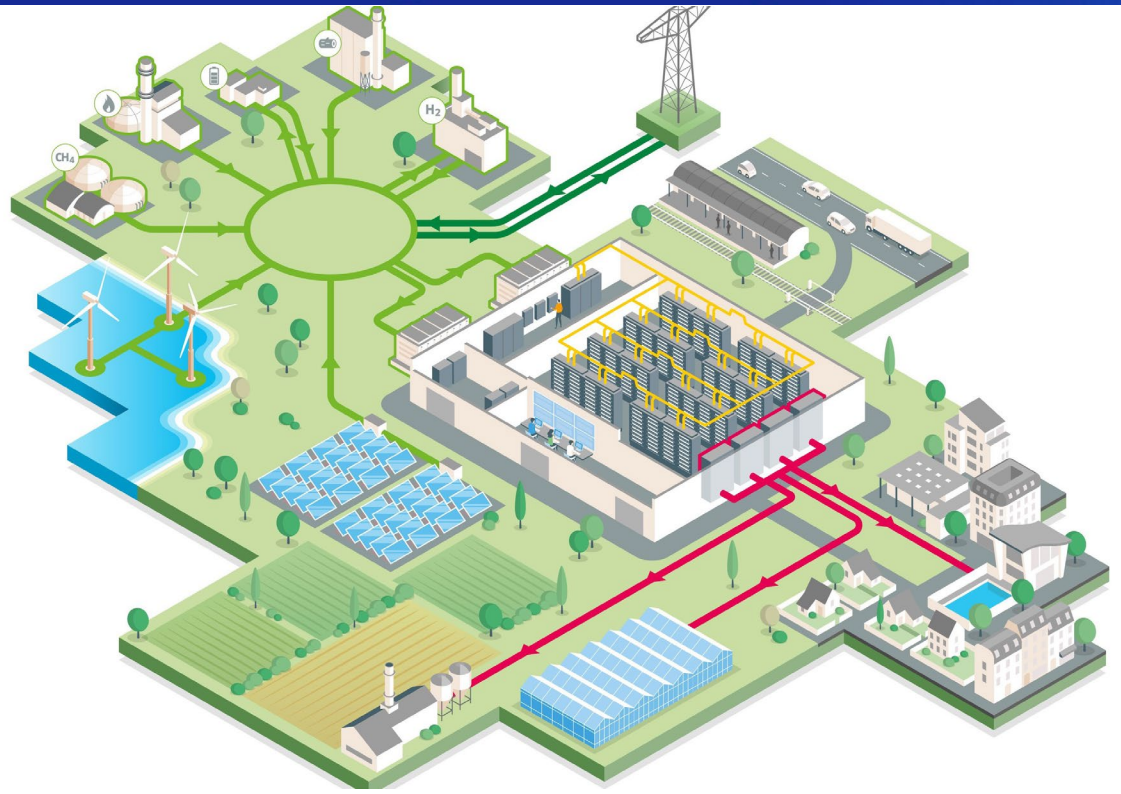
Design-Build Implications

- Prefabricated mechanical skids require early insulation design and QA/QC. Insulation logistics (storage, staging, sequencing) are now a construction-schedule driver/critical path item
- Owners expect documented performance

Trends:

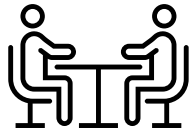
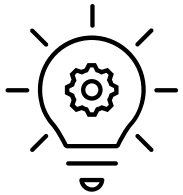
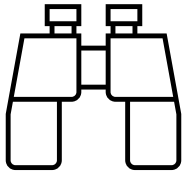
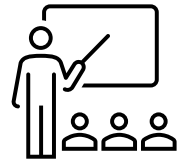
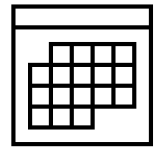
1. Digital Integration
    1. BIM & Digital Twins
    2. AI & Sensors
2. Decarbonization Alignment
    1. Owners Want Measurable Results
    2. Material Transparency
3. Evolving Project Delivery
    1. Design-Build Collaboration
    2. Off-Site Fabrication
    3. Lifecycle Thinking





Partnership & Innovation

Partnerships

Partner Early

Innovate Smarter

Shared Vision

Educate Upstream

Long Term

The Road Ahead

The Road Ahead: Industry and Innovation Shifts

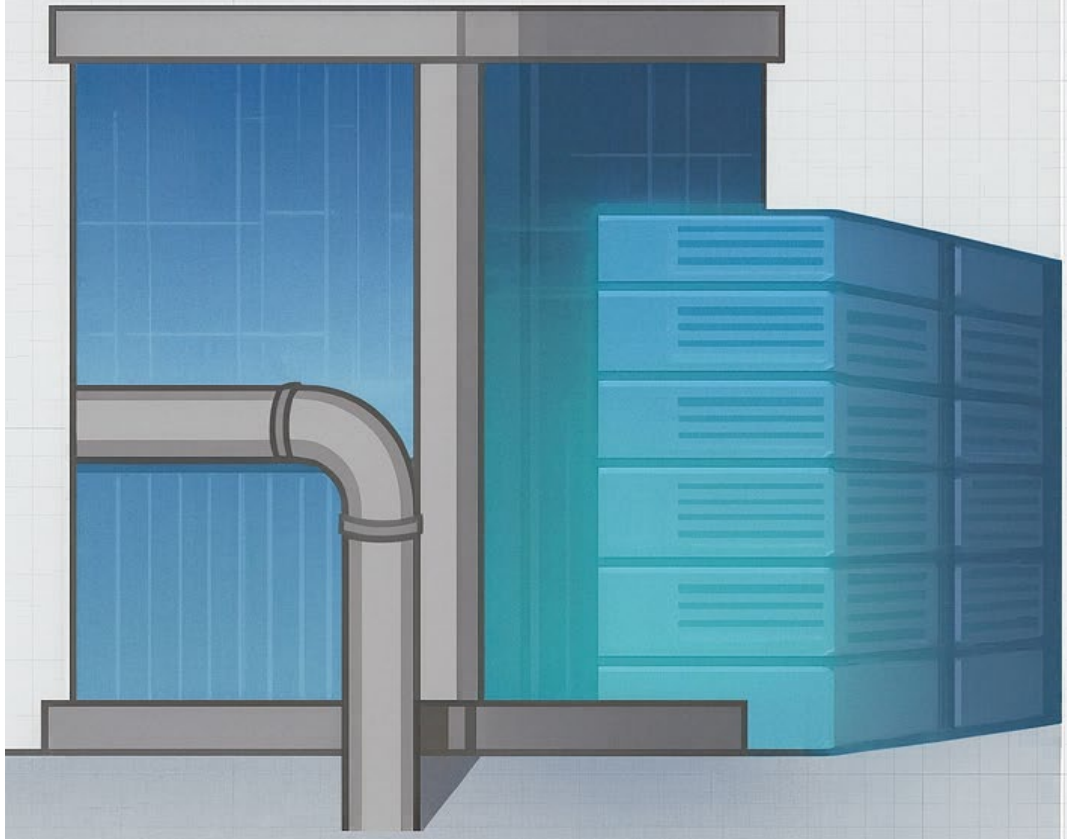
1. The Industry Is Changing Fast

- Codes and standards shifting from energy efficiency ⟶ carbon performance
- ASHRAE 90.1-2022, 90.4, and IECC 2024 now embed thermal continuity and verified R-values
- The SEC Climate Rule and Federal Mandates require Scope 1 & 2 emissions – insulation directly affects both. Owners are embedding carbon-intensity targets in procurement.

2. The Next Wave: Data + AI

- BIM & Digital Twins are adding insulation layers for thermal & carbon modeling
- AI-driven facility analytics track temperature deltas, moisture intrusion, and detect degradation automatically
- “Smart specs” are emerging – AI-assisted specification tools that identify missing criteria and model performance outcomes

The Future?



What This Means for You

→ From unseen material to measurable performance.

1 Insulation = Measurable Performance

Once invisible, insulation performance now feeds **energy models,** digital twins, and ESG metrics. It's a **quantifiable asset**

2 Data is the New Differentiator

Those who can translate field performance into **carbon and energy data** will drive future design-build partnerships and win procurement decisions.

3 The Next Advantage: Literacy + Collaboration

Teams that combine **material expertise** with **data literacy** and cross-trade collaboration will define the next generation of "smart"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