

NZW South East Asia Center For Innovation in the Built Environment (SEIBE)

A Preliminary Blueprint

December 7, 2022

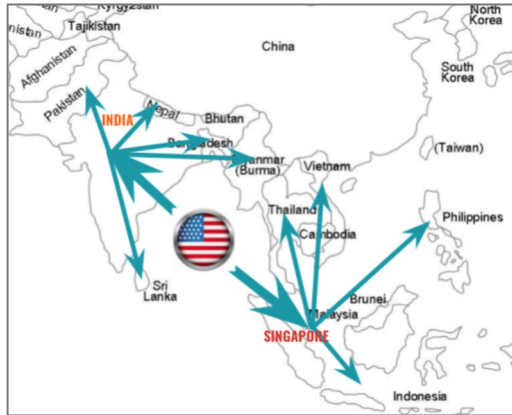
Nan Zhou, Reshma Singh, Carolyn Szum, Mary Ann Piette

Center for Innovation in the Built Environment (CIBE)

Build a foundation of knowledge, technologies, tools, human capabilities, and relationships to position the U.S. and Indo-Pacific for a net zero carbon built environment promoting equitable wellness and resilience.

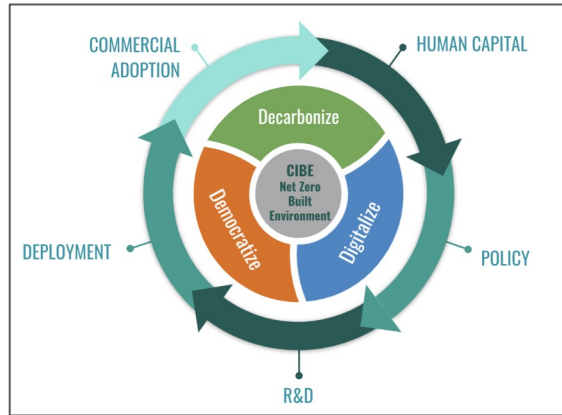
STRATEGIC GEOGRAPHY

U.S. hubs with regional dispersion in India (South Asia) and Singapore (ASEAN)

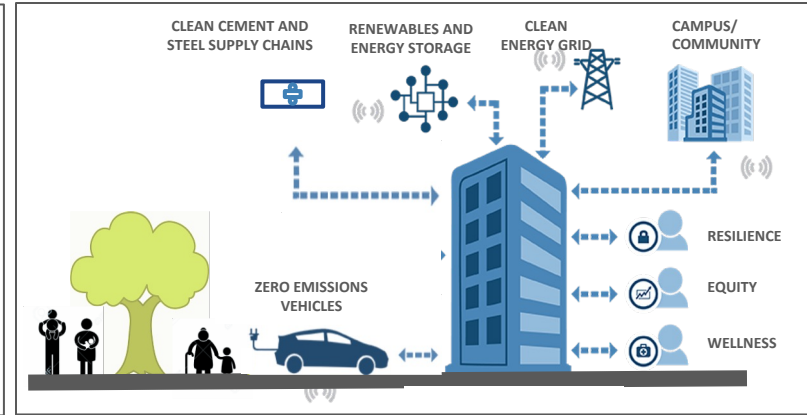


INCLUSIVE STAKEHOLDER FRAMEWORK

Three drivers and five levers, Decarbonize, Digitalize, Democratize



BUILT ENVIRONMENT: BUILDING-COMMUNITY-GRID SCALES
Energy equipment, renewables, vehicles, and storage that are inherently integrated with houses and buildings



Benefits to U.S. Govt

Mission-oriented science and innovation underscoring climate-diplomacy

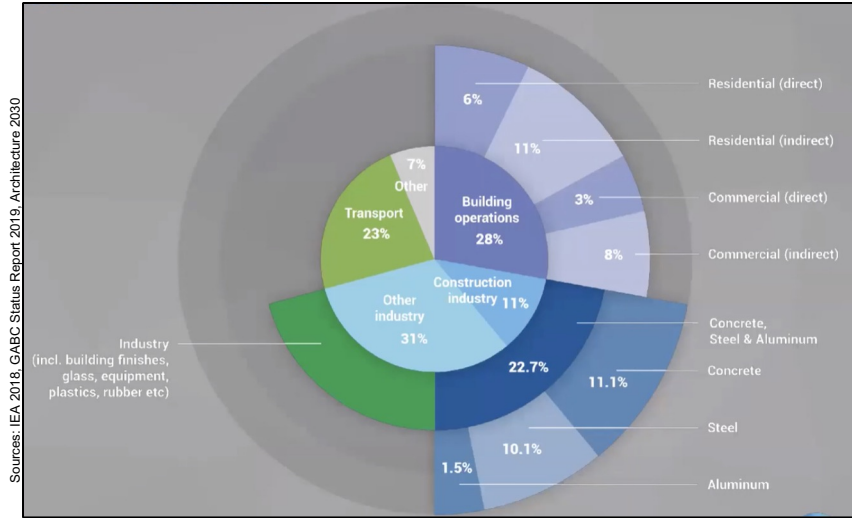
Benefits to U.S. Industry

Accelerated, scaled adoption of U.S. products and services in emerging markets

Benefits to U.S. Buildings Sector

Reverse innovation through cost-effective co-development and test bedding

The Intersection of Buildings and Industry: Illustrative Examples



Energy emissions account for 79% of GHG emissions

- 39% relate to the energy needed for our built environment
- Significant leapfrog opportunity: Building lifetime is 50-100 years; half of the buildings standing in 2050 yet to be built
- Growing demand for building materials in emerging markets

Buildings are greatest users of toughest-to-abate sectors (cement steel) that requires a range of RD&D and commercial adoption-relevant industrial interventions

- Technologies: e.g., prefab, alternative cements, green H2
- Measures e.g. recycled waste
- Practices, e.g. extending building lifetime

Berkeley Lab expertise can enable

- Techno-economic modeling, analysis, roadmaps
- Standards, codes, and policy development
- Pilot demonstrations with green procurement of appropriate materials and technologies

New Administration Climate Change Agenda on Indo-Pacific

- Executive Order *Tackling the Climate Crisis at Home and Abroad* positions climate as central to U.S. foreign policy and national security.
- Indo-Pacific is front and center of U.S. international agenda.
 - Accounts for ~60% of total global growth in primary energy demand by 2040.
 - Requires \$1 trillion annual investment in energy infrastructure.
- U.S.-Indo-Pacific collaboration priorities are climate mitigation, adaptation, resilience, technology, capacity-building, and climate finance
- The built environment in the Indo-Pacific is a historic impact opportunity for swift climate action, and for access to significant emerging markets to scale U.S. innovation.



How can we work together to achieve the greatest impact?

How can we leverage and build upon past work?

How can we use a dispersion effect, with hubs South East Asia (Singapore)?

Key Program Drivers

U.S.-Singapore Climate Partnership



- Support **climate technology R&D** and regional **clean energy infrastructure development**
- **Mobilize private capital** for climate change mitigation.¹

SEA countries joining NZW



- Singapore, Thailand joined NZW at COP 27
- Indonesia is already in NZW, and Vietnam is in process

SEA Requests for U.S. Collaboration



- Data infrastructure for building EE
- ESCO sector development
- Mobilize private capital for building EE
- RDD-CA of low carbon cooling solutions
- Harmonized building codes and certification
- Analysis of economic benefits of building EE²

1. Fact Sheet: Strengthening the U.S.-Singapore Strategic Partnership. August 23. Accessed September 10, 2021.
2. Lister, Mark, Anna Mowat, Peter du Pont, Nan Zhou, and Carolyn Szum. 2020. "Analysis and Assessment of the Existing Landscape and Opportunities for Building Energy Efficiency in Selected Countries in Asia." Berkeley: LBNL.

Key Program Drivers

Push from U.S. Industry

Seek to leverage earlier DOE successful bilateral program models, research and industry consortium, and help establish SIIBE in the South East Asia region.

Aim to accelerate the domestic and international market demand of advanced, commercially available, and competitive U.S. building energy technologies.



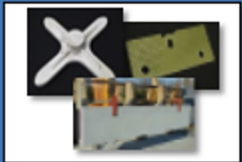


CERC-BEE Program



Vision: To build a foundation of knowledge, technologies, tools, human capabilities, and relationships to position the United States and China for a future with very low-energy buildings resulting in very low CO₂ emissions.

Elements	Description
Presidential Initiative	■ Initiated at the presidential level in 2009 (CERC 1.0), renewed in 2014 (CERC 2.0).
Clear Vision	■ Accelerate adoption of very low energy buildings and net zero energy buildings (NZEB).
Shared Investment	■ \$100M+ , ten-year program with shared investment from U.S. and Chinese governments and industry.
Strong Engagement	■ Over 230 researchers from 75 U.S. and Chinese partner organizations in academia, non-profit, and the for-profit private sector working on technology innovation, evaluation, and real-building field validation.
Focused Research	■ High-impact, integrated, cutting-edge cost-shared, bilateral projects.
Substantial Outcomes	■ 8 commercial products; 12 patent applications/invention disclosures; 18 copyrighted software tools; 33 codes/standards/policies; and 82 peer-reviewed publications.
10 Awards for Innovation	■ 2013, 2016, 2020 R&D 100 Awards , 2016 Gold Edison Award , 2018 Best of Design Award for Digital Fabrication, 2019 Keeling Curve Prize Honorable Mention, 2019 HIVE 50 Award , 2020 LBNL Tech Transfer , 2021 EarthX E-Capital Summit Semi-Finalist.
Demonstrations	■ 5-8 low-energy, high-performance buildings or NZEB in different climate zones.
Intellectual Property (IP) Protection	■ Strong, flexible, multi-level IP protection framework: CERC Protocol, Technology Management Plan, TMP Letter of Endorsement
Industry Cost share	■ U.S. industry exceeded 1:1 cost-share commitment, providing \$1.40 for every \$1.00 invested by DOE
CO ₂ Impact	■ 100 million tons CO₂ reduction per year by 2025 (~11% reduction by 2050 against business as usual).



12 Invention Disclosures and Patents Filed



10 Awards for R&D



Tech Demo: Brooklyn, NY - Next-Generation Precast Concrete Walls





U.S. Industry Testimonials



Johnson
Controls

- **“Participation gives us access to leading researchers...which leverages the investments we are making in innovation through our significant in-kind contributions.”** *Clay Nesler, former Vice President, Global Energy and Sustainability, Johnson Controls*



DOW

- **“We value access to world class research Institutes as well as shared building science with our Chinese counterparts and U.S. Industrial Board Members.”** *Greg Bergtold, former Global Advocacy Director, Dow Building & Construction*



PCI
Precast/Prestressed
Concrete Institute

- **“We see great value in results that will benefit the industry and the built environment...We could not ask for a better collaborative environment.”** *Roger J. Becker, P.E., S.E., Vice President Technical Services, Precast/Prestressed Concrete Institute*



United
Technologies
Building & Industrial Systems

- **“The technical breadth and depth of the CERC-BEE research teams is allowing us to explore solutions that would not be able to carry out on our own.”** *Dr. Murilo W. Bonilha, General Manager, United Technologies Research Center (China)*



LUMENCACHE

- **“The CERC-BEE program provides the opportunity to demonstrate the diverse capabilities of the platform over time, and engage multiple technology partners.”** *Derek Cowburn, CEO, LumenCache, Inc.*



U.S.- India CBERD Program

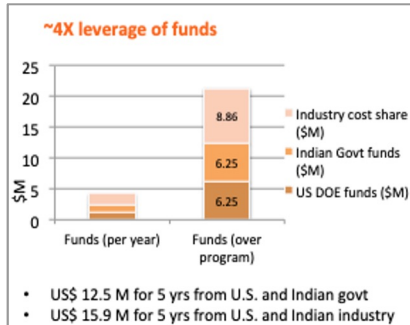
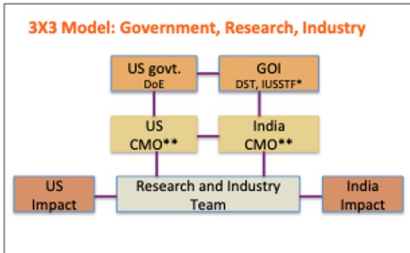
www.cberd.org



Accelerating building energy innovation through a robust bilateral public-private partnership



Our Industry Partners:

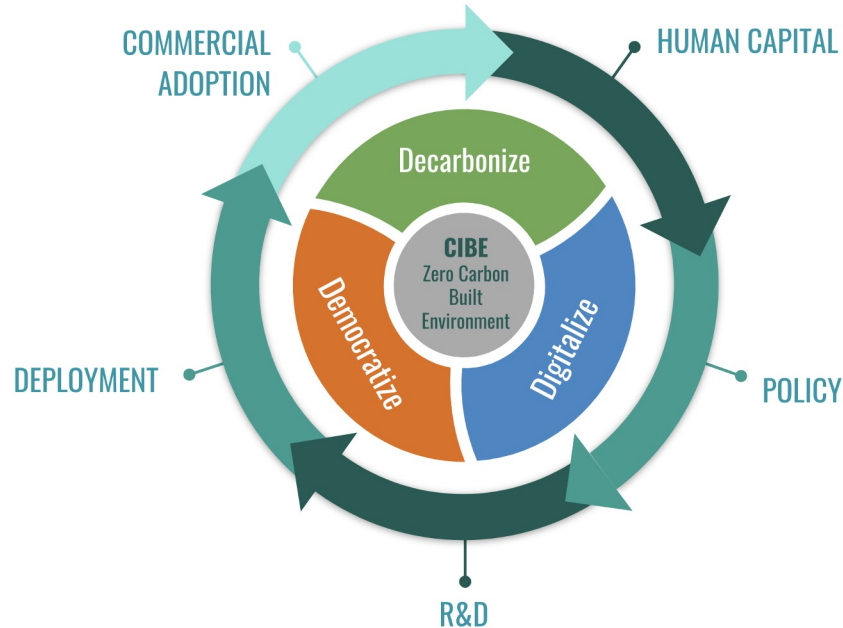


Elements	Description
Presidential	<ul style="list-style-type: none"> Presidential building energy initiative, conducted during 2013-2018
Clear Vision	<ul style="list-style-type: none"> Enhanced ties between U.S.-India trifecta: Govt., Academia, Industry Outcome-based R&D to drive cost-effective tools and technologies
Shared Investment	<ul style="list-style-type: none"> \$28M, 5-year program, shared government- industry investment 4X leverage of USG funding
Strong Engagement	<ul style="list-style-type: none"> 12 U.S. companies and 20 career scientists & 50 researchers on technology innovation, evaluation, demonstrations and field validation
R&D Focus	<ul style="list-style-type: none"> High-impact, integrated, cutting-edge, cost-shared, bilateral projects
Significant Outcomes	<ul style="list-style-type: none"> 7 Product prototypes, 5 Software tools, and 100+ Peer-reviewed publications 40 Researcher Exchanges, new BHAVAN Fellowship
Policy impact	<ul style="list-style-type: none"> Adoption of R&D into India's Energy Conservation Building Code
Demos/ test-beds	<ul style="list-style-type: none"> 7 Demonstrations in buildings and 14 test beds or major apparatus across climate zones
Powerful Platform	<ul style="list-style-type: none"> Prominent players, 100+ S&T staff, 11 R&D organizations, 30 cost-share industry partners

Vision, Goals, Governance, and Implementation Framework

Program Vision

To build a foundation of knowledge, technologies, tools, human capabilities, and relationships to position the United States and Indo-Pacific for a net zero carbon built environment promoting equitable wellness and resilience.



Proposed Outcomes

A suite of **pre-competitive R&D/pre-commercial technology** and **innovative policy/market solutions** that when **combined with commercial technologies and deployed at scale**, have the technical feasibility to achieve the following outcomes in the U.S. and Indo-Pacific:

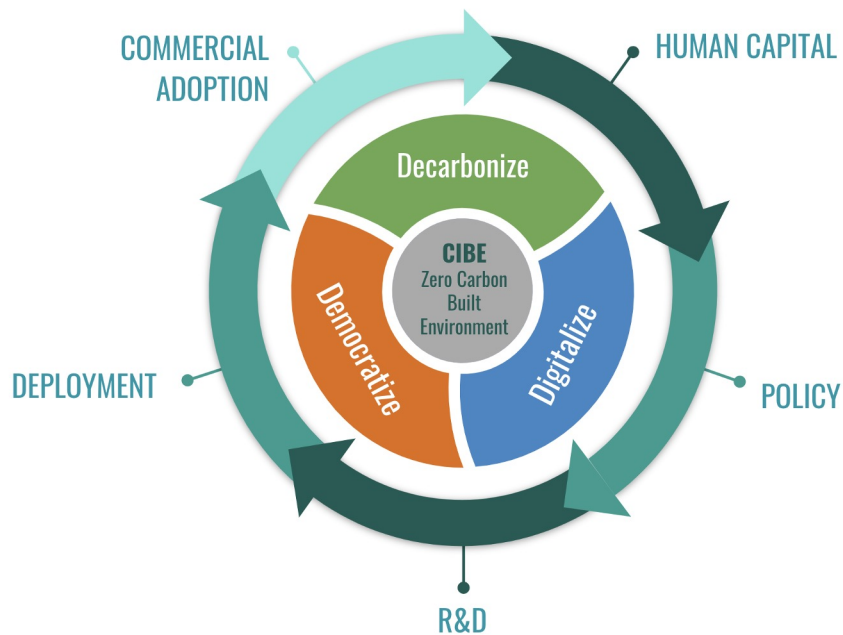
- All new public buildings to be net zero carbon operations by 2030.
- All new commercial buildings to be net zero carbon operations by 2035.
- All new buildings to achieve a 50% reduction in embodied carbon emissions by 2035.
- All new residential buildings to be net zero carbon operations by 2040.
- 80% of existing buildings to be net zero carbon operations by 2050.

Proposed Outputs

- **R&D:** Patents, invention disclosures, copyrighted software, high-impact publications, etc.
- **Policy and Regulatory:** Roadmaps, policies, standards, guidebooks, etc.
- **Deployment:** focused on integrated/systems-level solution demonstrations such as:
 - Net zero carbon building/community (building-to-grid) demonstration
 - Net zero carbon stock/portfolio demonstration
- **Commercial Adoption:** Commercialization plans for pre-competitive technologies and adoption plans for innovative policy/market mechanisms.
- **Human Capital:** Human resources to facilitate a just energy transition through skills building (e.g., training, workshops).

SEIBE RDD-CA Focus Areas

Research, Development, Deployment, and Commercial Adoption



“3D” Vision for a net zero carbon built environment promoting equitable wellness+resilience

DECARBONIZE

Radically reduce emissions
for a zero-carbon built
environment



DEMOCRATIZE

Provide equitable wellness in a
resilient living environment

DIGITALIZE

Smartly connect buildings, distributed energy
resources, people, and organizations

*Developed with leading U.S. and Indian government and industry experts during BIGathon Roundtables, 2020
<https://www.buildinginnovationguide.com/bigathon-1>

Decarbonize

Radically reduce emissions for a zero-carbon built environment



- **Reduce embodied carbon**

Target: 50% reduction from current industry standards in new construction by 2035

- Low embodied biogenic, remedial, vernacular, circular, carbon-sequestering, high-performance alternatives to steel and cement
- Rapid, modularized/prefab durable, disaster-resilient, energy efficient assemblies
- Technologies and processes for circular integration

- **Reduce operational carbon**

Target EUI $\leq 50 \text{ kWh/m}^2/\text{yr}^*$ (~66% reduction in energy use from baseline through EE) and renewable energy for remaining ~33% grid energy use, by 2050

- Low-emission cooling and dehumidification, encompassing passive+active
 - Reduce external heat gains
 - Enhance personal comfort
 - Removal/control of indoor sensible and latent heat



Democratize:

Provide equitable comfort and wellness for all in a resilient, healthy environment



- **Healthier environments**

- Ventilation/filtration+energy efficient equipment
- Health and environment safe materials (e.g. Low volatile organic compounds, non-endocrine-disrupting materials, etc.)
- Thermal comfort and wellness technologies: Inside the building (energy/wellness technologies), Whole building (passive and active systems), Community level (urban heat/pollution mitigation)



- **Equitable Resilience**

- Improve access to low-carbon and resilient energy for all communities
- Enhance hard infrastructure, and nature-based infrastructure
- Technologies to counter urban heat, pollution, and provide enhanced durability to natural disasters



- **Advance sustainable behaviors and capacity building services**

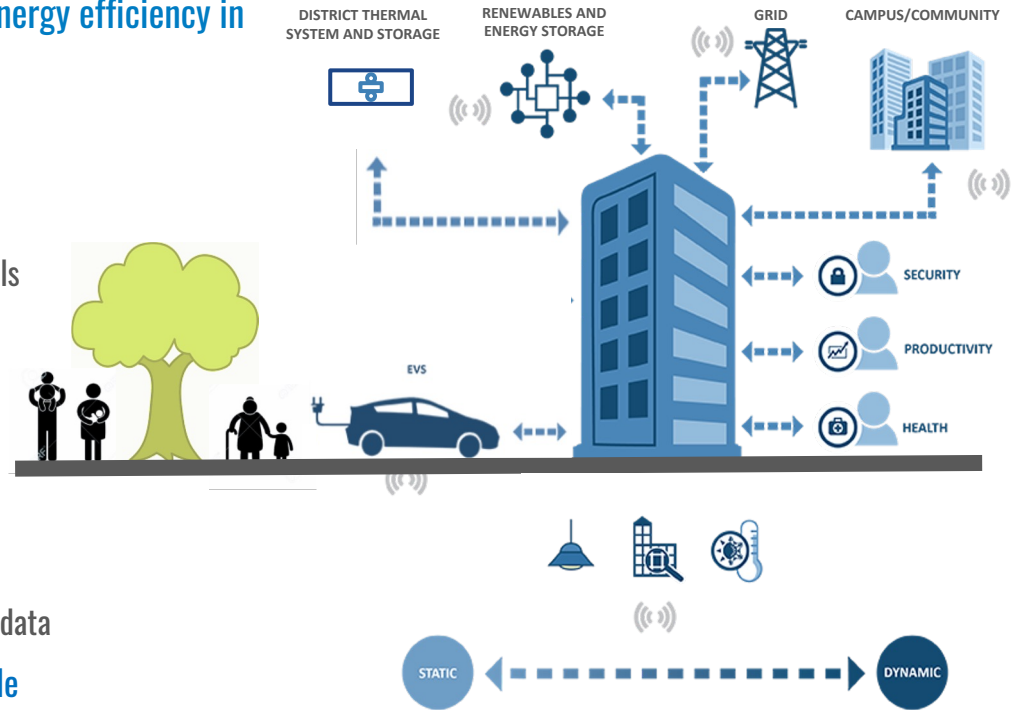
Digitalize

Smart platforms unifying renewables + energy efficiency



Target: Triple energy savings through demand flexibility and energy efficiency in buildings by 2035, relative to 2020 levels

- Digitalize the building lifecycle
- Digital design and construction, digital supply chains
- Smart equipment, building, and community scale sensors and controls
- Advanced data analytics
- Building-to-grid load flexibility
- Integration of building, renewables/ thermal and electrochemical batteries/electric vehicle /grid
- Harness unique regional contexts
- Machine learning on building and urban image/text/novel sources of data
- Digitization and scientific scrutiny of traditional climate-suitable



methods/ materials

Deployment and Commercial Adoption Cross-Cut

Rationale

“The CERC-BEE scope of work facilitated breakthroughs in 3D printing, precast concrete, and self-healing sealants because **it encouraged us to go out into the field and do application and demonstration.** A lot was learned on the job sites which led to a next-generation of products.”

DuPont's Global Advocacy & Strategic Partnerships Director, Jeff Hansbro

“**Singapore companies want to see their technologies in demonstration buildings,** so this is extremely relevant.” Singapore BCA

“**India is keen on U.S. technology transfer and financing.**” India BIGathon Roundtable stakeholder

Possibilities

- Net zero carbon building/community demonstration project
- Net zero carbon stock/portfolio demonstration project

Priorities

- Integrated/system-level solutions
- Disruptive, scalable, cost-effective
- U.S. and Indo-Pacific locations

Policy and Markets Cross-Cut

Rationale

“There needs to be **more aggressive building code progression.**”

DuPont's Global Advocacy & Strategic Partnerships Director, Jeff Hansbro

“Building energy performance **benchmarking systems are needed** to demonstrate the performance levels that are feasible so appropriate codes can be set.”

LumenCache's CEO, Derek Cowburn

“Policy is an area that the U.S. and Singapore should work together on - **particularly sustainable finance**, which is mentioned in the U.S.-Singapore Climate Partnership.”

Singapore BCA

“The real estate industry represents **40% natural resource use, 40% waste, 35% GHG emissions** in India. The important drivers are increasing awareness and **changing consumer preference**, improving affordability and economics, **government push and policy support**, and health benefits”

India BIGathon Roundtable stakeholder

4 Policy Priorities Identified in Scoping

- **Building energy codes and standards** (mutual recognition/harmonization).
- **Market transformation policies/tools** (e.g., certification, benchmarking, transparency, building performance standards).
- **Technology performance testing standards and protocols** (e.g., low embodied carbon construction materials).
- **Mobilization of private capital.**

Policy and Markets Cross-Cut: Illustrative Activities



Guidebooks

Best practices in building technology

E.g. Open-access digital guidebook of building science-based (U.S.) technologies and services relevant to the target region.



Market Adoption Programs

Skill-building for stakeholders to support adoption of emerging technologies.

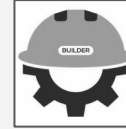
E.g. Program for smart energy analytics through technical/procurement assistance, demonstrations, and policy influence.



Building Sector Data Frameworks

Building energy performance database taxonomy and structure.

E.g. Adapt from DOE's BEDES and BPD to support data exchange and comparative analysis.



Workforce Development

Exposure on CIBE solutions to technical and policy/advocacy pipelines.

E.g. through academic, technical, and vocational pipelines for upskilling energy services workforce.



Digitized Supply Chains

Digital design, fabrication, construction, asset delivery and management.

E.g. Digitized regional supply chains for new construction for U.S. technologies and solutions; overcome supply chain disruptions.

SEIBE RDD-CA Strategy

R&D

Decarbonize, e.g.

Breakthrough, low-embodied, circular materials with rapid, resilient assemblies

Low-emission cooling and dehumidification harnessing passive + active solutions

R&D

Democratize, e.g.

Super-efficient, cost-effective, scalable filtration, cleaning, and ventilation methods

Solutions to mitigate pollution and urban heat island

R&D

Digitalize: e.g.

Leapfrog tech for integrated building-to-(micro) grid
Advanced urban data analytics

Low-cost, smart sensors/controls for occupant behavior
Direct current (DC) equipment

Scientific scrutiny of traditional building methods

Deployment and Commercial Adoption

Demonstrations for Net Zero e.g.:

- (1) building/community scale showcasing pre-commercial tech and solutions
- (2) Stock/portfolio scale showcasing commercially available tech and solutions

Policy/Markets:

- (1) Guidebooks, (2) Market Adoption Programs, (3) Building Sector Data Frameworks, (4) Stakeholder/Workforce Development, (5) Digital Supply chains

Benefits to U.S. Govt

Mission-oriented science and innovation underscoring climate-based diplomacy

Benefits to U.S. Industry

Accelerated and scaled traction in emerging markets for new construction and retrofit products and services; leading to clean jobs in the U.S.

Benefits to U.S. Buildings Sector

Reverse innovation through cost-effective co-development and test bedding

SG
*

cross-cut

Building Upon Earlier Successful Programs and Teams

- From strictly bilateral to regional hubs and dispersion for greater market access.
- From purely “Buildings energy efficiency” to “Buildings-to-grid”, distributed energy resources in the built environment for integrated net zero carbon impact
- From purely cutting-edge R&D to RDD-CA (Research, Development, Deployment, and Commercial Adoption) to prime the pump for climate and market impact.

Intellectual Property (IP) Protection

Technology Management Plan (TMP)

- Provides a clear understanding of IP principles and administrative procedures before work begins.
- Enhances protection for IP rights with endorsements by governments.
- Means for negotiating terms and conditions.
- Pathways for dispute resolution.

TMP Letters of Endorsement

- To ensure legal enforceability, the corresponding government ministries formally agree to and endorse the TMP.



*Researchers' Guide to
Intellectual Property and
Technology Transfer*



<https://cerceee.lbl.gov/intellectual-property>

Benefits to the United States

1. **Deliver rapid science and technology gains** in fields like artificial intelligence (AI) through government-research-industry-academic partnerships.
2. **Accelerate American innovation** to bolster and build critical clean energy supply chains in the United States and **strengthen American manufacturing**.
3. Support U.S. firms in supplying low-carbon solutions to the Indo-Pacific to **spur U.S. industry, jobs, and competitiveness**, and **make America the world leader in clean energy technologies**.
4. Advance toward a 100% clean energy U.S. economy with net zero emissions and **zero net carbon buildings at zero net cost, including carbon-neutral construction materials**, by 2050.

The White House. 2021a. *A Letter to Dr. Eric S. Lander, the President's Science Advisor and nominee as Director of the Office of Science and Technology Policy*. January 20. Accessed August 20, 2021.

—. 2021b. *Biden-Harris Administration Launches American Innovation Effort to Create Jobs and Tackle the Climate Crisis*. February 11. Accessed August 20, 2021.

—. 2021c. *Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government*. January 27. Accessed August 20, 2021.

Proposed Impacts

CO₂ Reduction



Innovation



Commercialization



International Collaboration



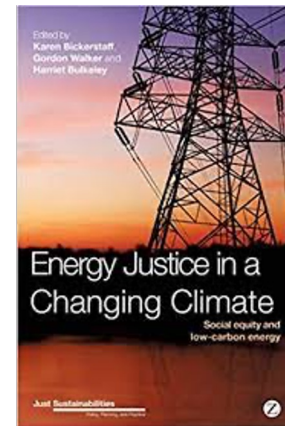
Industry Involvement



Technology Cost Reduction



Energy Justice



Thank You

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Next Steps

Appendix India

Appendix: Additional Information on India



India is at a tipping point... a primary cause is the built environment

Biggest producer of embodied carbon emissions from buildings by 2050

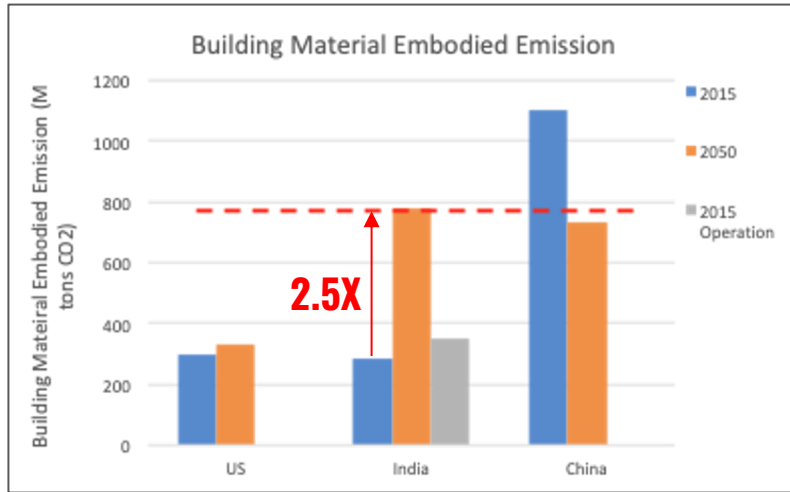


Fig 1 Projected buildings' embodied carbon emissions: U.S., India, China [1] [4]

Addition of massive new footprint with exploding energy use intensity and operational emissions

Reference:

1. Stephane la Rue du Can et. al. Modeling India's energy future using a bottom-up approach, Applied Energy, Volume 238, 15 March 2019, Pages 1108-1125
2. ACEE, 2019, Building Stock Modeling - Key Enabler for Driving Energy Efficiency At National Level.
3. Zhou et. al. 2018. Scenarios of energy efficiency and CO₂ emissions reduction potential in the buildings sector in China to year 2050. Nature Energy volume 3,2018)
4. IEA. India Energy Outlook, 2021

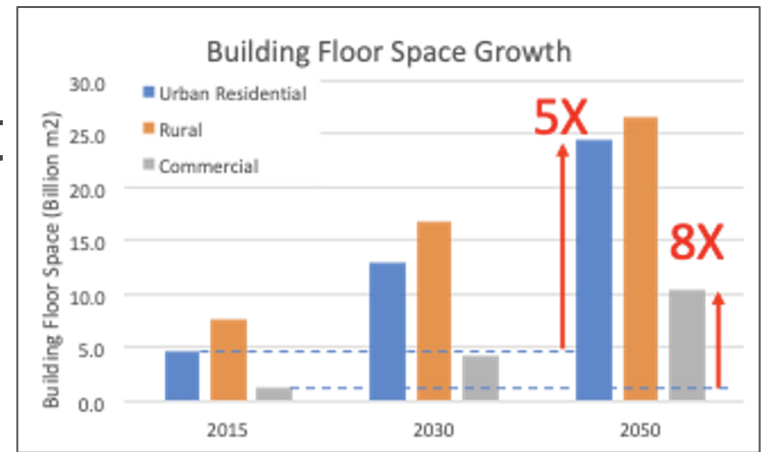


Fig 2: India: Floor space growth from 2015 – 2050 [1], [2], [3] [4]

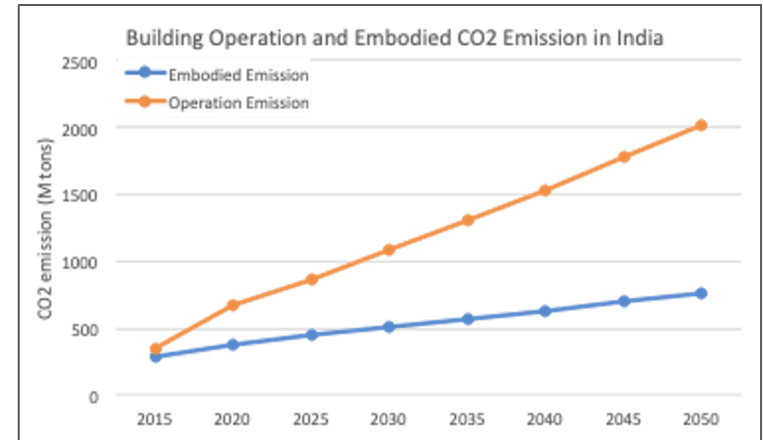
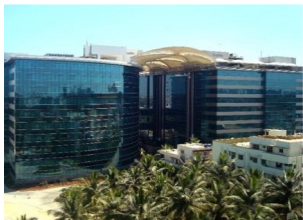


Fig 3: India: Buildings emissions growth from 2015 – 2050

Problem/Opportunity



>2X

3X

>50% of the floor area (by 2050) yet to be built



~130M sick

Unhealthy buildings
Class A buildings: 300kWh/m²/yr; primary emphasis on renewables



~3X

Rapid urbanization

India ranked 89th in the world for climate preparedness



~3X

Energy intensity
>10x growth in ACs by 2040



~

Extreme events

Indoor and outdoor air quality frequently inadequate

The built environment in India is a **historic impact opportunity** for

- Swift climate action
- Equitable access to wellness and resilience
- Significant emerging markets to scale innovation

Trends/barriers* for net zero buildings

- Lack of commitment from manufacturers
- Limited net zero pledges

Passive and fragmented stakeholder ecosystem

38% global GHG emissions

- Buildings are highest GHG emitting sector (including scope 1,2,3)

Explosive growth in building stock

- Proj. 38 Billion m2 by 2037
- Materials use growth Cement 3.5X, Steel 5X by 2050

Barriers

Slow market uptake of low-carbon strategies

- Composite cement 1% of product mix
- Standards for material testing TBD

Increasing embodied emissions share

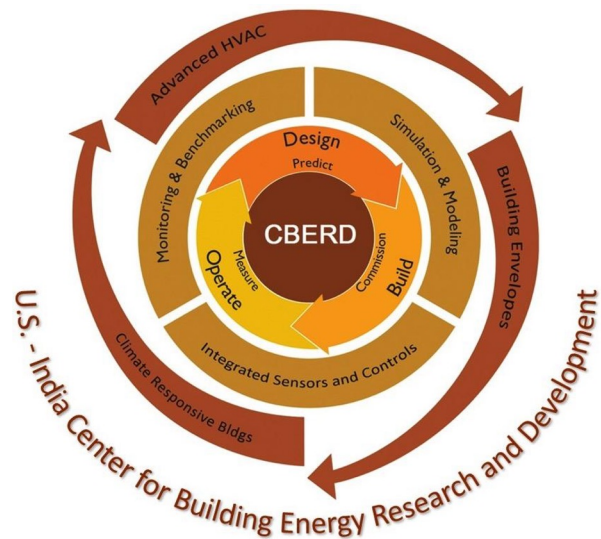
Uni-dimensional policy approach

- Current policies focus only on operational emissions (ECBC, ENS, PAT, S&L)
- No policy push on embodied emissions or resilience

- Largest emitter of embodied carbon, proj. to consume remaining Carbon budget

* Adapted from Alliance for an Energy Efficient Economy

How U.S.-India partnerships can provide value



(2013-18)

www.cberd.org

11 institutional partners



U.S. Research Partners	Indian Research Partners
BERKELEY LAB OAK RIDGE Carnegie Mellon University Rensselaer	CEPT UNIVERSITY IIT, HYDERABAD IIT MADRAS IIT BOMBAY IIT KHARAGPUR CSIR

34 industry and civil-society partners

Building Information Technology	Building Physical Systems	Collaboration and Deployment
Infosys Schneider Electric PHILIPS Honeywell Autodesk nLighted SYNAPSENSE	BOIL SINTEX DELPHI AIS PLUS [®] NeoSilica Skys shade SAINT-GOBAIN Lighting Science Oorja	Nexant NRDC GINGER THE FERN green spaces CITY OF SAN JOSE Lighting Society of India BAPVC REIL

CBERD Innovation Pipeline



Development and Demonstrations



Schneider Electric



SAINT-GOBAIN



Traditional Indoor Unit

DELPHI

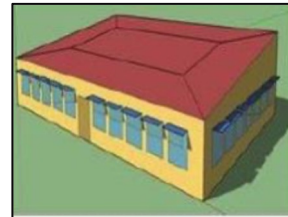


Honeywell

Market Stimulation



Workforce exposure and test-beds



Science-based policy shaping

Ecosystem Adoption

A&E practitioners



Equipment/
Technology
industry



Developers

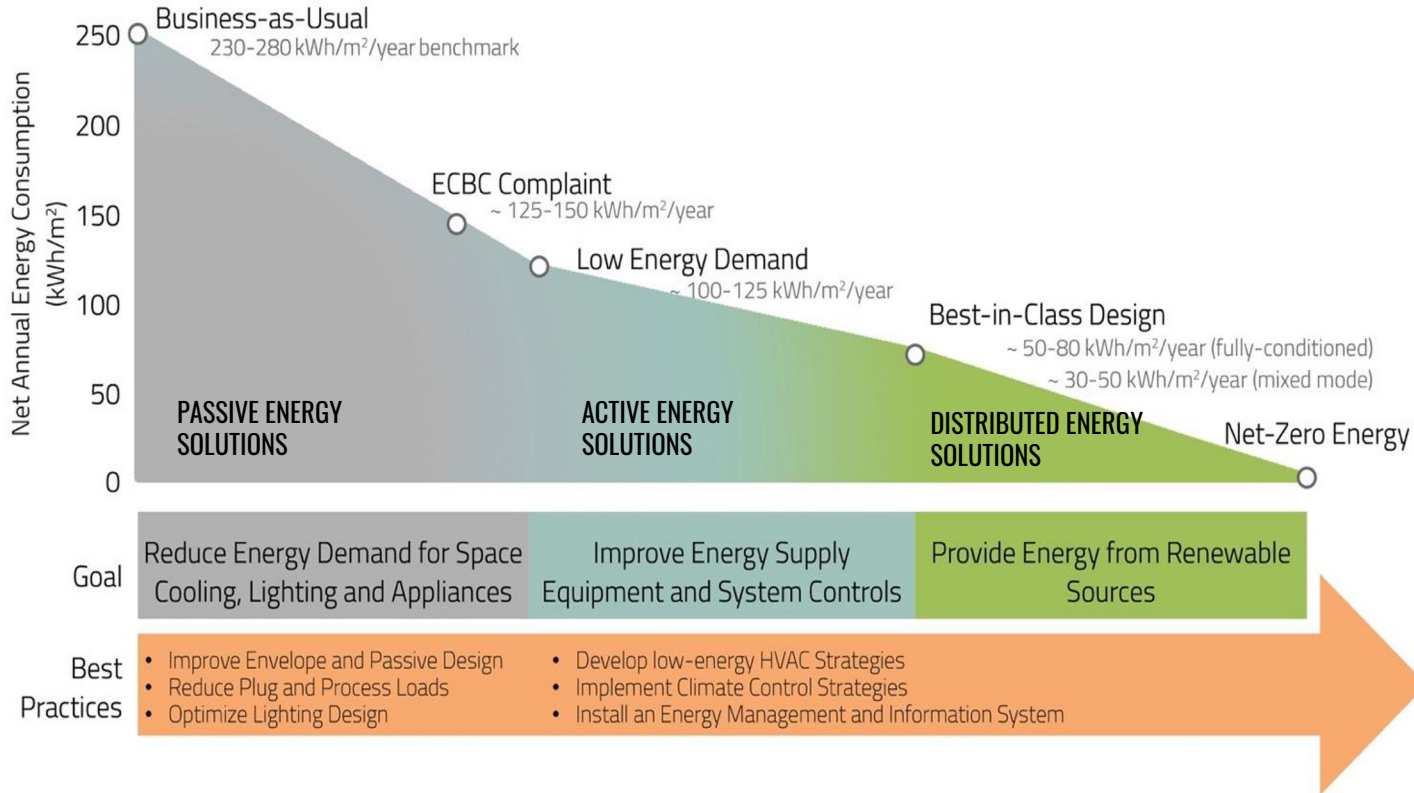


Policy and
Regulatory
institutions



Deployment

Technologies to attain net zero energy buildings

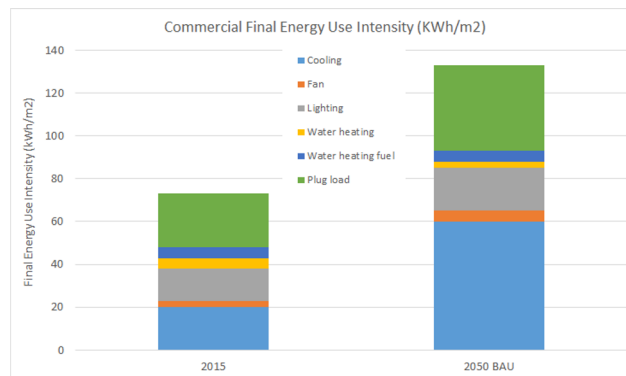
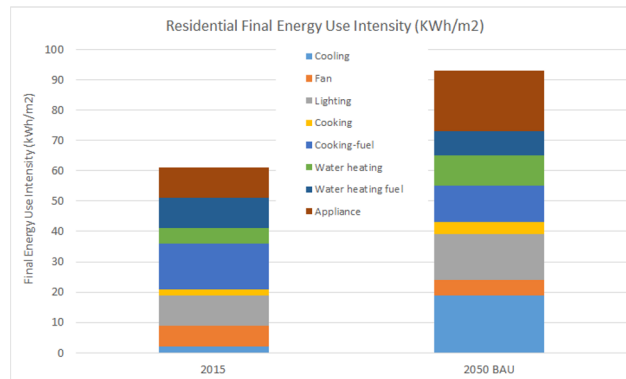
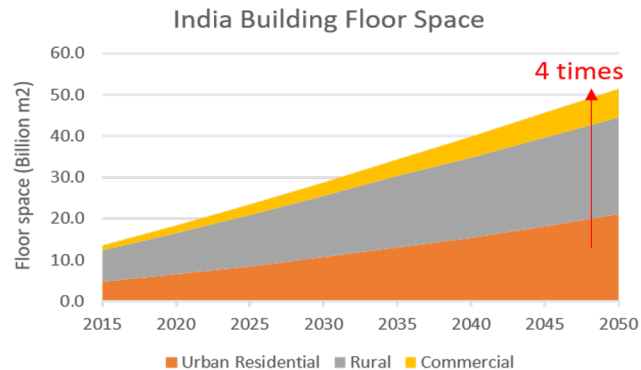


Efficiency

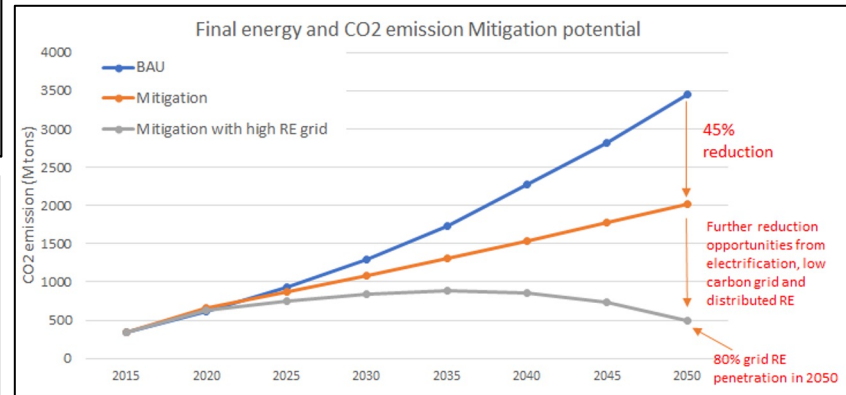
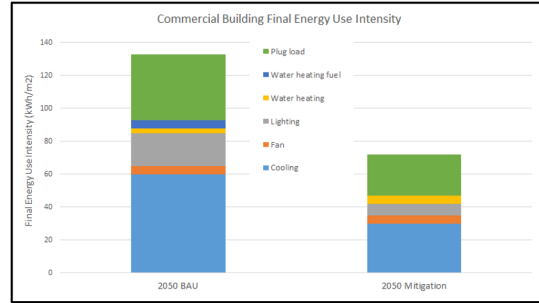
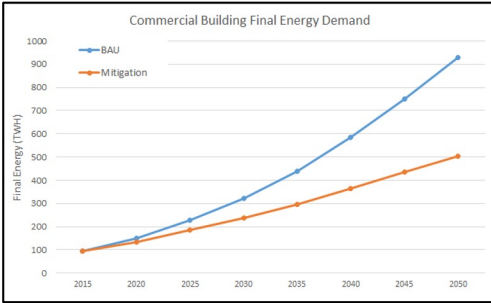
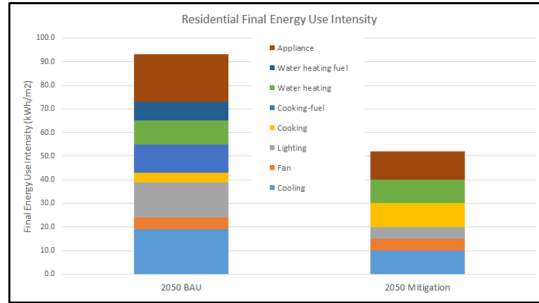
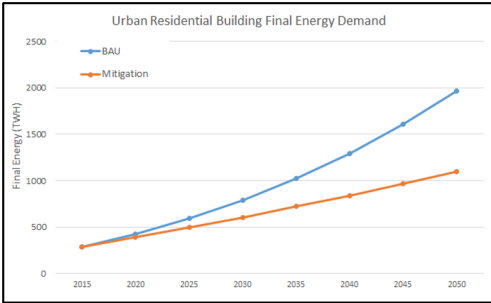
Reduces energy need by 60-70%

Renewables

Only 30% capital investment now needed

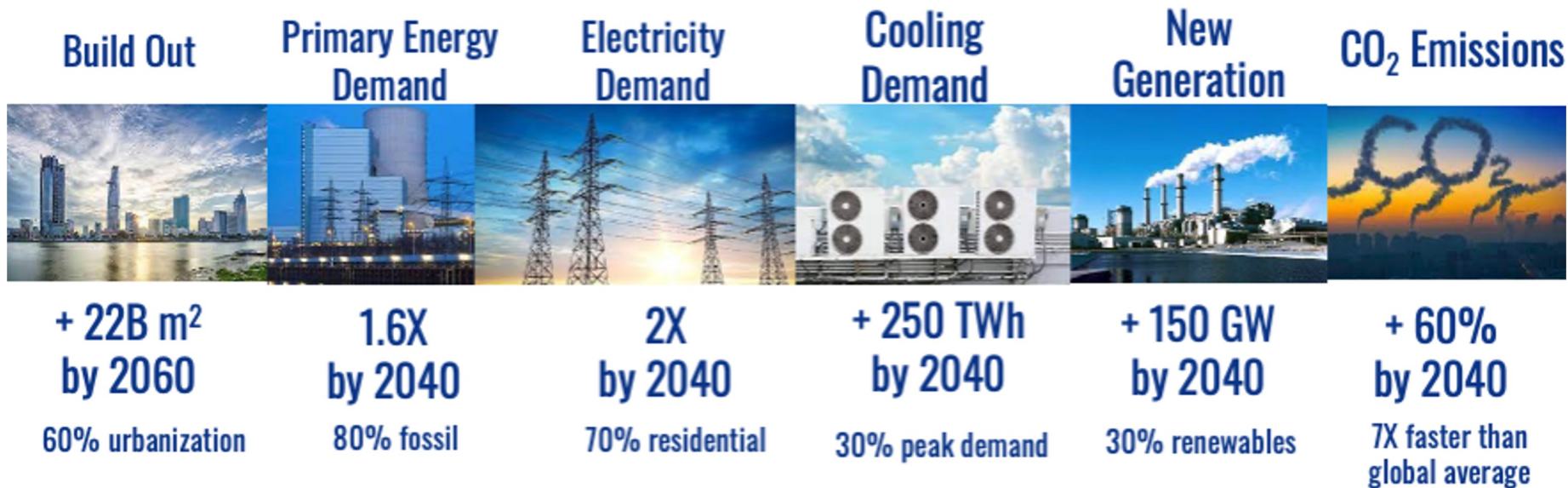


Technical Mitigation Potential



Appendix ASEAN

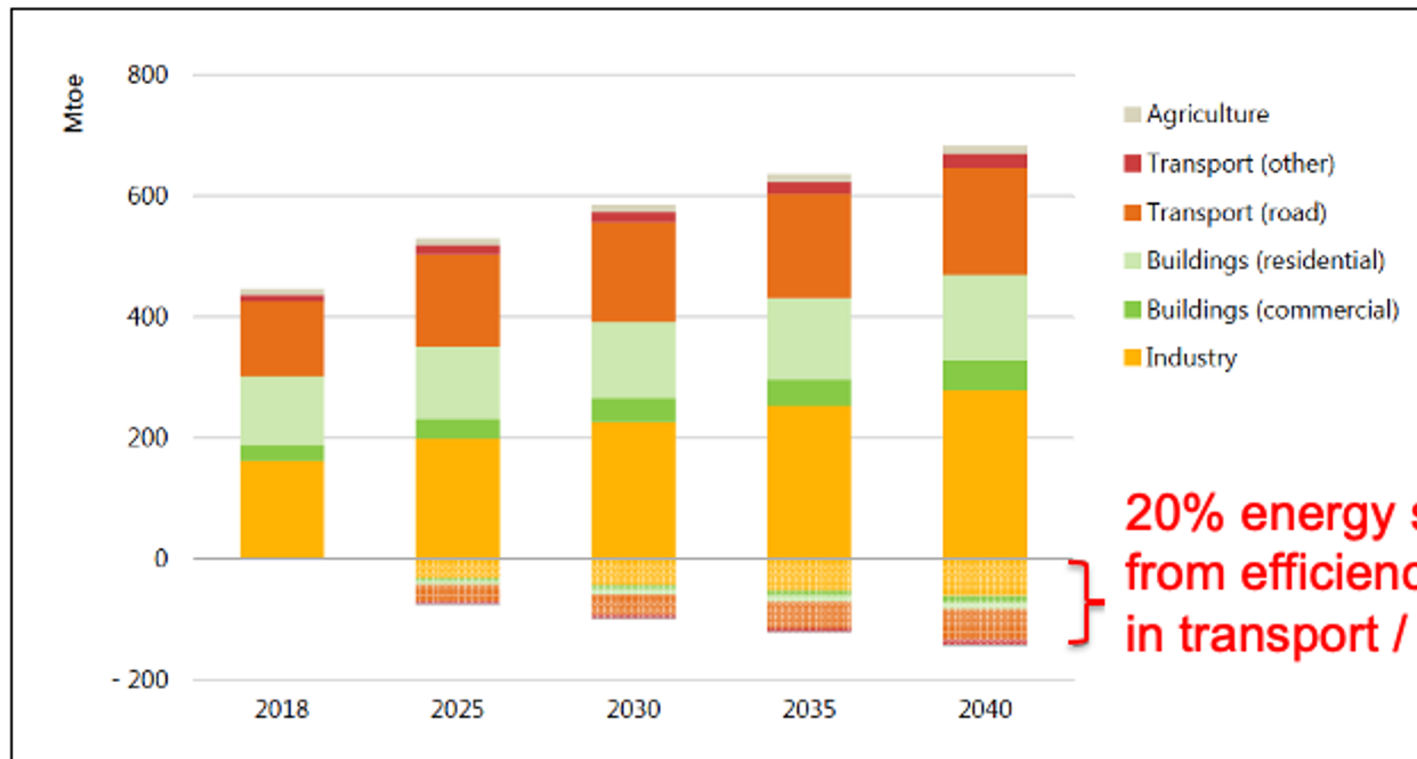
ASEAN Problem / Opportunity



Target Countries in ASEAN

Indonesia | the Philippines | Thailand | Vietnam | Malaysia
comprise 89% of ASEAN's energy demand

Current ASEAN Energy Efficiency Policy is Insufficient



20% energy savings from efficiency, mostly in transport / industry.

Singapore: Global Innovation Hub for Smart and Sustainable Built Environment



1. Digitalization

- Advanced data analytics (e.g., digital twins) and AI techniques.
- Open/universal data management platforms/applications.
- Smart sensors, controls, and solutions to influence occupant behavior.
- Digital design/construction.

2. Materials / Assembly

- 3D printing and modular assembly.

3. Zero Energy (ZE) / Positive Energy (PE) Buildings

- Push the boundaries to 80% EE improvement in buildings cost-effectively.
- Develop disruptive technologies.
- Cost reduction for mass adoption in the market.
- Building to grid integration (e.g., building-EV-RE-energy storage).

4. Health

- Bio-aerosol transmission reduction.

5. Active Cooling Efficiency

- Non-compressor A/C.
- Desiccant membrane A/C.
- Hybrid cooling solutions.

6. Passive Cooling Efficiency

- Wind-driven natural ventilation.
- Cool paints.
- Insulated glazing.

7. Policy

- Finance, codes, demos.

U.S.-Singapore Partnerships on Climate, Growth, Innovation

On August 23, 2021, the Biden Administration announced the launch of several new partnerships with Singapore. Of relevance to CIBE are the following:

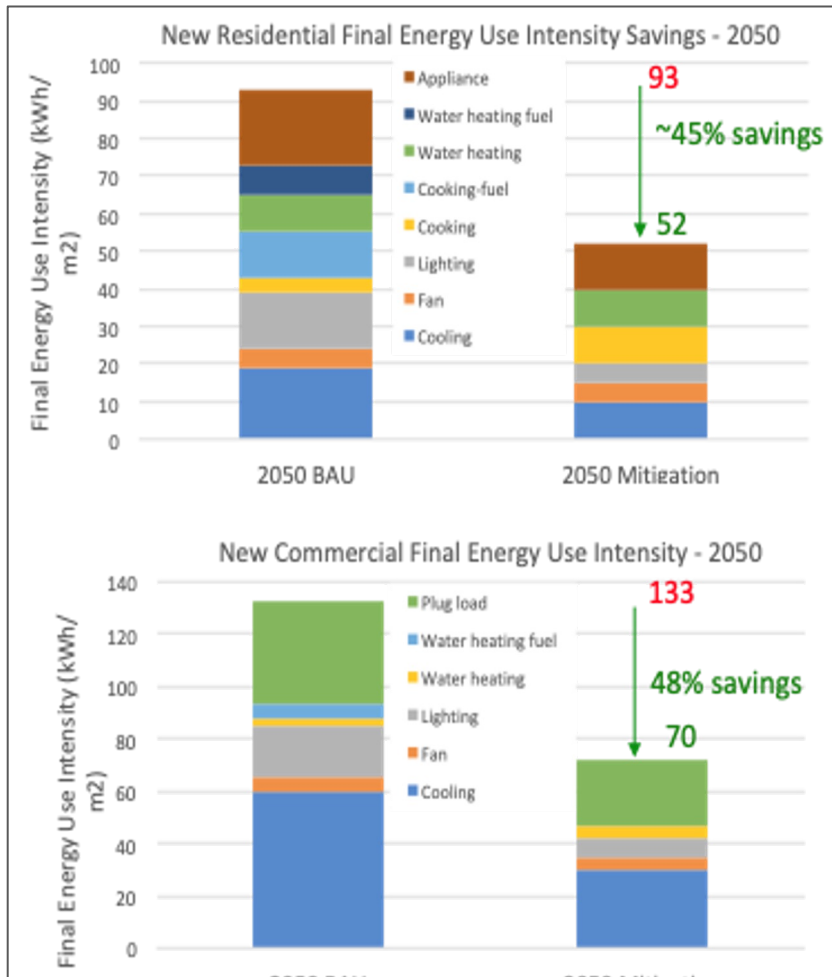
The “[U.S.-Singapore Climate Partnership](#),” through which both countries intend to work together to develop high-quality climate standards and **increase regional ambition on sustainable finance**, collaborate on financial sector climate and environmental risk management, **support climate technology R&D and regional clean energy infrastructure development**, improve sustainability of ports and shipping, and **mobilize private climate capital for climate mitigation** and adaptation. To launch the Climate Partnership, experts from the **Departments of Commerce, Energy, Transportation, and Treasury** will undertake bilateral consultations with their counterparts in Singapore to develop standards and a medium-term program of work

The “[U.S.-Singapore Partnership for Growth and Innovation](#),” through which the U.S. Department of Commerce and Singapore Ministry of Trade and Industry will strengthen U.S.-Singapore trade and investment collaboration starting with four pillars: digital economy; **energy and environmental technologies**; advanced manufacturing, and healthcare. Through this partnership, the United States and Singapore will address immediate and long-term challenges that face both of our economies, including the need to enhance supply chain resilience. **This partnership is designed to promote inclusive economic growth, innovation and entrepreneurship, and shared**

^p The White House. 2021e. *Fact Sheet: Strengthening the U.S.-Singapore Strategic Partnership*. August 23. Accessed September 10, 2021.

Additional Slides

Mitigation potential



Side by side

Key Program Drivers

U.S.-India Strategic Clean Energy Partnership



Under the SCEP, the United States and India agreed to collaborate on:

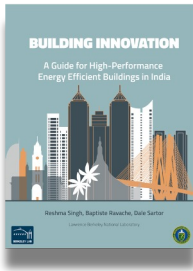
1. Five pillars, three of which are relevant to the CIBE Blueprint: **(1) Power and Energy Efficiency;** **(2) Renewable Energy;** (3) Responsible Oil and Gas; (4) **Sustainable Growth;** and (5) Emerging Fuels.
2. Cutting edge research and development through the longstanding **U.S.-India Partnership to Advance Clean Energy-Research (PACE-R)**, prioritizing research on emerging clean energy technologies.

India Requests for U.S. Collaboration



South Asian Times

DOE Deputy Secretary David Turk in New Delhi on Sep 15, 2021



www.buildinginnovationguide.com

The BIGathon Program, for a \$35-50 Billion Indian Green Building Market



Policy advocacy
*Easy to use guide for energy conservation building code compliance, and beyond
BIGathon's discussion on decarbonization of buildings is important for the Bureau of Energy Efficiency. 50% of India's NDC targets can be achieved by energy efficiency alone.
Saurabh Diddi, Director, Bureau of Energy Efficiency, Ministry of Power, Government of India



Market advocacy
*Evidence-based best practices for high performance buildings
"BIG provides guidelines on how innovation can drive sustainability. BMC definitely wants to design buildings better, and also incentivize through a property tax regime that ensures that they are sustainably operated" Praveen Pardeshi, Chief, Bombay Municipal Corporation



Technology transfer pathways
*Showcases U.S. technology and service providers
"Berkeley Lab has played a key role in shaping Infosys' energy efficiency strategy, helping us leapfrog in our journey to become carbon neutral." Swapnil Joshi, Smart Spaces & Sustainability, Infosys India

Knowledge and skill-building workshops
*Insights for Facility Managers and the Architectural/Engineering/developer community
"I really welcome the Building Innovation Guide - ...green buildings represent a \$35-50 Billion market opportunity in India." Sujata Saunik, Addl Chief Secretary, Government of Maharashtra

CIBE Proposed Governance Structure and Implementation Framework

