



Toward a More Sustainable Global Built Environment

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Demand Surge for Construction During Next Decade

- Demographers consistently predict around one billion additional inhabitants of our planet in the next decade
- Architecture, Engineering and Construction (AEC) create the fixed, physical wealth of nations
 - ▮ Providing basic housing and infrastructure for these people is estimated to cost between \$3-\$10 trillion!
 - ▮ Deferred maintenance needs for infrastructure in the developed world will also cost several trillions!
- Why should we be concerned about this demand surge in construction worldwide?



The Built Environment Interacts with the Natural Environment

- The built environment impacts the natural environment directly — e.g., dams, irrigation canals, roads, harbors, ...
- The built environment also impacts the natural environment in a variety of indirect ways
 - ▮ Buildings consume ~ 50% of energy
 - ▮ Construction materials (cement, asphalt, steel,...) contain large amounts of embedded carbon
 - ▮ New construction and demolition generate solid, liquid and gaseous waste streams that impact landfills, surface and groundwater, and air quality
 - ▮ Urban land-use planning has substantial effects on infrastructure efficiency, transportation and human health



Barriers to Sustainable Development of B.E.

- Industry Fragmentation
 - ▮ Vertical and horizontal fragmentation of the industry distort/remove life-cycle perspectives & incentives
 - Office developer minimizes investment in land and construction
 - Designer designs to code
 - Builder builds to design specs
 - User rents space from developer “triple-net”—pays own utilities
 - Rent and utilities are a small part of total cost for commercial users

- Sequential, Paper-based Processes
 - ▮ Balkanization of issues—no tradeoffs
 - ▮ Technical and economic concerns get prioritized over environmental and social justice concerns in early decisions

- Limitations of Tools for Analysis and Integration
 - ▮ Discipline-oriented tools
 - ▮ No shared data models → do not facilitate integration
 - ▮ Not visual enough to engage “illiterate” stakeholders



Barriers to SDBE in Developing Countries

- Large informal economies → lack of public funds for infrastructure
 - ▮ Governments encouraged by multilateral lenders to privatize development of infrastructure
 - ▮ Popular pushback against some kinds of privatization
 - Citizens in Asia and Latin America oppose privatized water supply, power, natural resource extraction (especially of mineral and energy resources)
- Lack of “institutional capacity” to manage infrastructure
- Corruption siphons off value from public works projects
- Lending covenants may lock in inefficient project delivery systems, e.g., design-bid-build



Barriers to SDBE in Developed Countries

- High transaction costs of fragmented construction industry
 - ▮ Each player provides minimum acceptable scope
 - ▮ Lump sum contracting and subcontracting creates huge transaction costs
 - ▮ Systemic innovations are slow to diffuse
- Externalities not given weight in decisions, except when incorporated in codes/regulations
 - ▮ Build to code (ref. “The Good Company” article)
 - ▮ Building codes are heavily biased toward life-safety, not life-cycle economics — much less ecology, equity



Current Construction Practices are Not Sustainable

- Why should we care about the coming boom in construction?

Developing the volume of buildings and infrastructure that will be urgently needed over the next decade using current approaches is unsustainable, and will have severe negative impacts on the natural environment!



Increasing Social and Political Pressures for More Sustainable Development

- NGOs promoting sustainable development worldwide
 - ▮ “Transparency International” highlighting corruption
 - ▮ Environmental and social justice NGOs applying “naming and shaming” pressure on politically sensitive multilaterals
 - e.g., see the “Triple Bottom Line” mission statement of the IFC
 - ▮ Triple bottom line assessment spreading to private investors
 - “Equator Principles” adopted by 25 financial institutions from 14 countries for > 75% of all built environment project financing worldwide
- Consumers driving “Green Branding” in developed world
 - ▮ Hybrid automobiles
 - ▮ Environmentally certified products
 - ▮ LEED certified buildings (and similar certifications in Europe)
 - ▮ Flow: *Europe* → *N. America* → *Latin America* → *Australia* → *Asia* → *Africa*

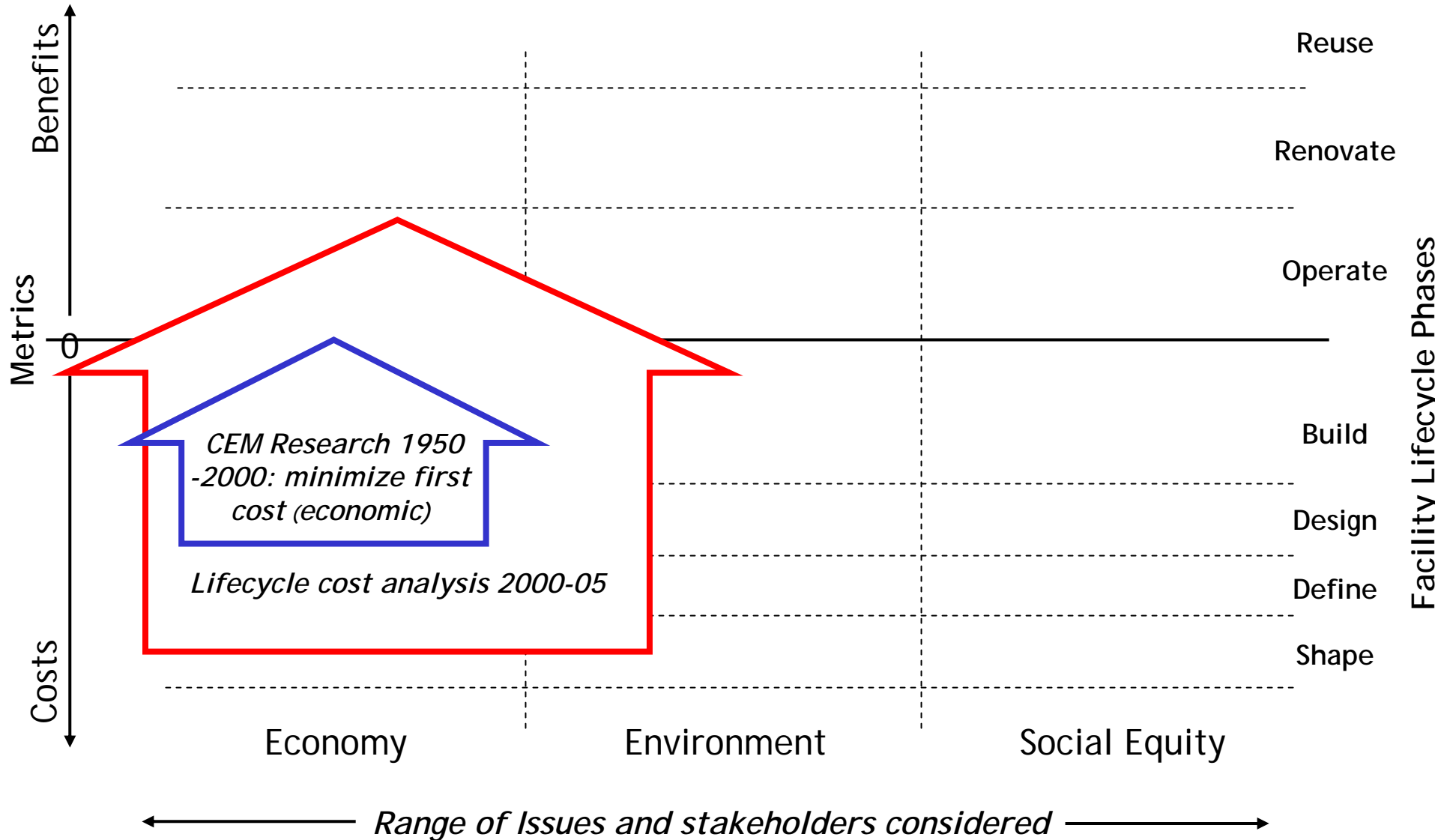


Stanford's Response to this Challenge

- Sustainability thrust of CEE department
 - /// ~~Civil and Environmental Engineers~~ →
 - /// “Sustainable Civil Engineers”
- The Sustainable Built Environment Thrust
 - /// Combine resources and activities of several existing CEE centers
 - ***Collaboratory for Research on Global Projects (CRGP)***
 - ***Center for Integrated Facility Engineering (CIFE)***
 - ***Project-Based Learning Laboratory (PBL)***
 - ***John Blume Earthquake Engineering Research Center***
 - /// Draw in additional faculty from CEE, Earth Sciences, Natural Sciences, Social Sciences, Law, Business, Medicine...
 - /// Launch new academic programs
 - Interdisciplinary doctoral program modeled after IPERS
 - New MS program in Sustainable Development of the Built Environment
 - New undergraduate Interdisciplinary Major on SDBE

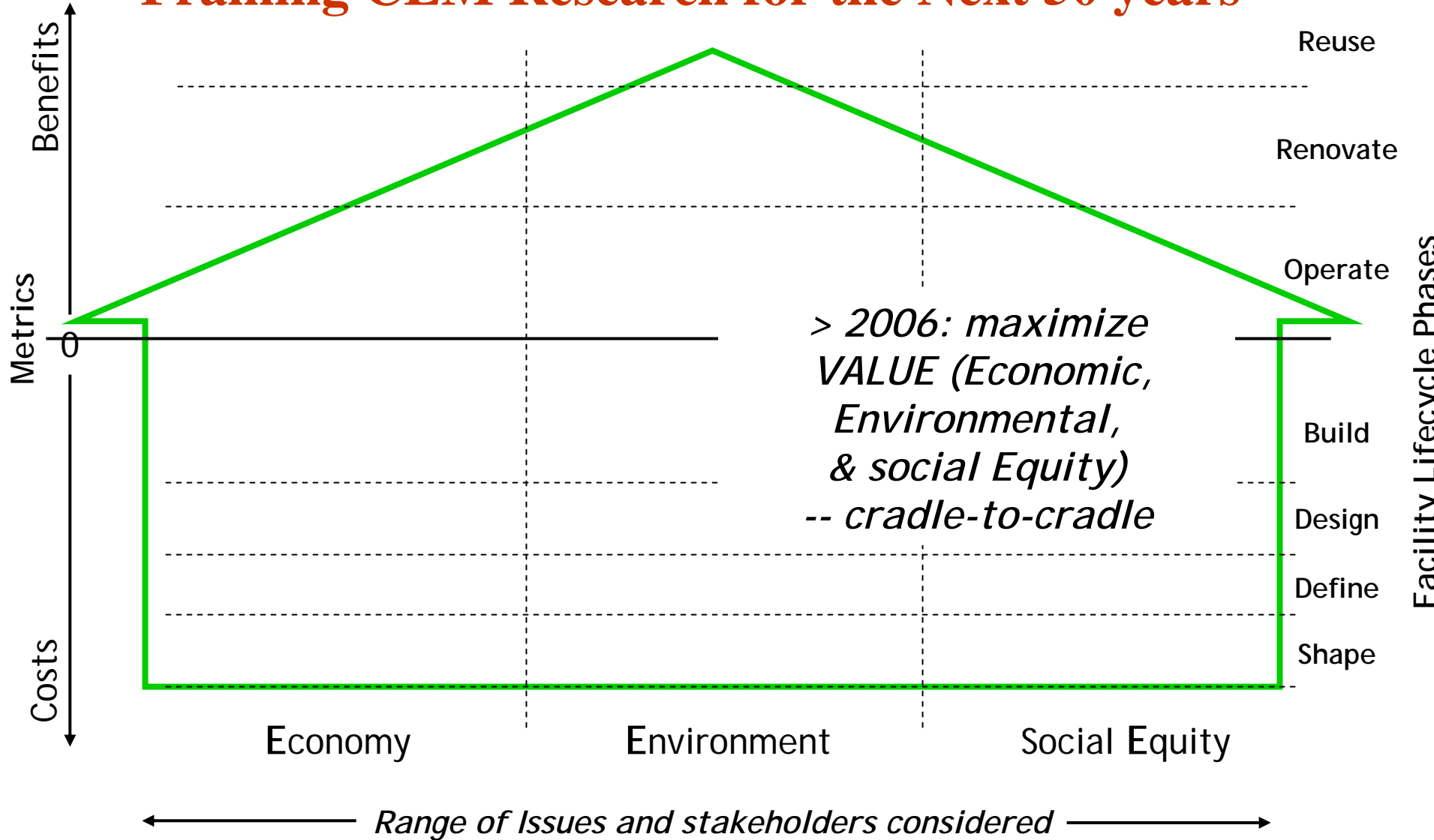


CEM Research in the First 50 Years





Framing CEM Research for the Next 50 years





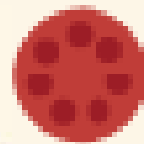
Mission of SBE

- SBE will equip leaders in government and industry with *frameworks*, *tools*, *strategies* and *policies* to develop the built environment in more sustainable ways:
 - ▮ **Frameworks** to understand impacts on sustainability
 - ▮ **Tools** for construction professionals to analyze the lifecycle, triple bottom line outcomes of projects
 - ▮ **Strategies** for companies to address existing barriers to sustainable development worldwide
 - ▮ **Policies** for governments and multilateral lending agencies to finance, procure and regulate construction in more sustainable ways

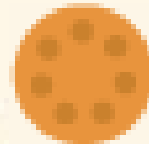


THE WOODS INSTITUTE

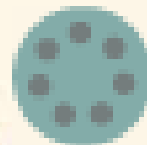
> Overview



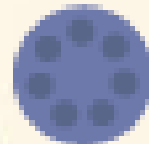
Energy
& Climate



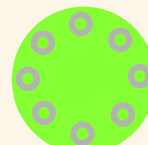
Land Use
& Conservation



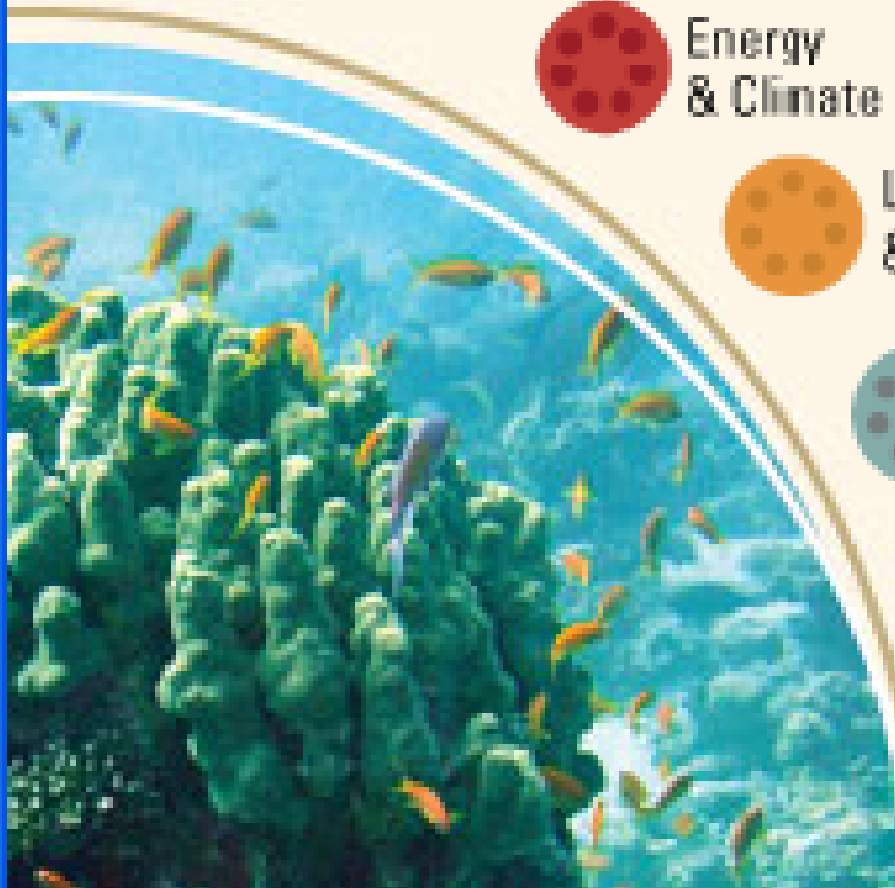
Oceans
& Estuaries



Fresh
Water



Built
Environment





Possible Research Themes

- **Sustainable Buildings**
 - ▣ **Potential Collaborators:** CEE (incl. CEM, DCI, SEG, green architecture, EES, EFM, E&A), MS&E, ME...
 - ▣ **Sub-themes:** energy use; water (re)use; indoor air quality; sustainable building materials; construction methods; multi-hazards; performance-based design...

- **Sustainable Infrastructure**
 - ▣ **Potential Collaborators:** CEE, MS&E, Sociology, Economics, Law, Business, Political Science, global collaboratory partners...
 - ▣ **Sub-themes:** governance; financing; natural capital; design; construction; supporting operations and maintenance; resiliency against hazards; ...

- **Sustainable Cities**
 - ▣ **Potential Collaborators:** CEE, Earth Systems, Lane Institute for the American West, Medicine/Public Health , global collaboratory partners...
 - ▣ **Sub-themes:** new approaches and tools to plan sustainable cities; cross-cultural issues in planning cities, distributed infrastructure for water treatment, energy generation...



Status of SBE

- Several cross-disciplinary research collaborations already funded or in review
 - ▮ Initial seed research grant involving CEE, sociology and law on role of NGOs in global infrastructure projects funded by FSI
 - ▮ Large proposal involving CEE and Earth Sciences on using GIS and 4D modeling approaches to guide urban development submitted to Qatar Free Zone
- Launching a Collaboration within WIE
 - ▮ Town Hall Meeting (April 2007)
 - ▮ Campus-Wide Seminar Series (Spring and Autumn 2007)
 - ▮ Seed Research Grants (Early 2008)
- Coordinated SBE fund-raising about to begin



Discussion

