

Still Plenty of Room at the Bottom

A Mesh Microgrid and Microclimate for Nalanda University

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The job of clever people is to ask complex questions. The job remarkably clever people is to ask deceptively simple ones.

1. Does the developing world need a grid to develop?
2. If not, can we learn something about modernizing our own?

dbHMS was founded in 2002 on the principles of integrated project delivery and high performance design

A Studio Culture

Design Studio

Sustainable Planning Studio

High Performance Studio

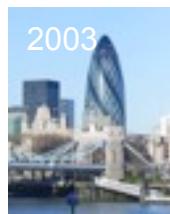
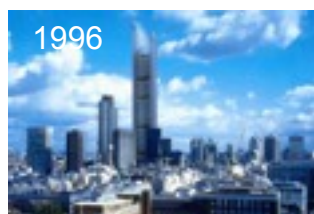
Commissioning Studio



New Residents Per Hour

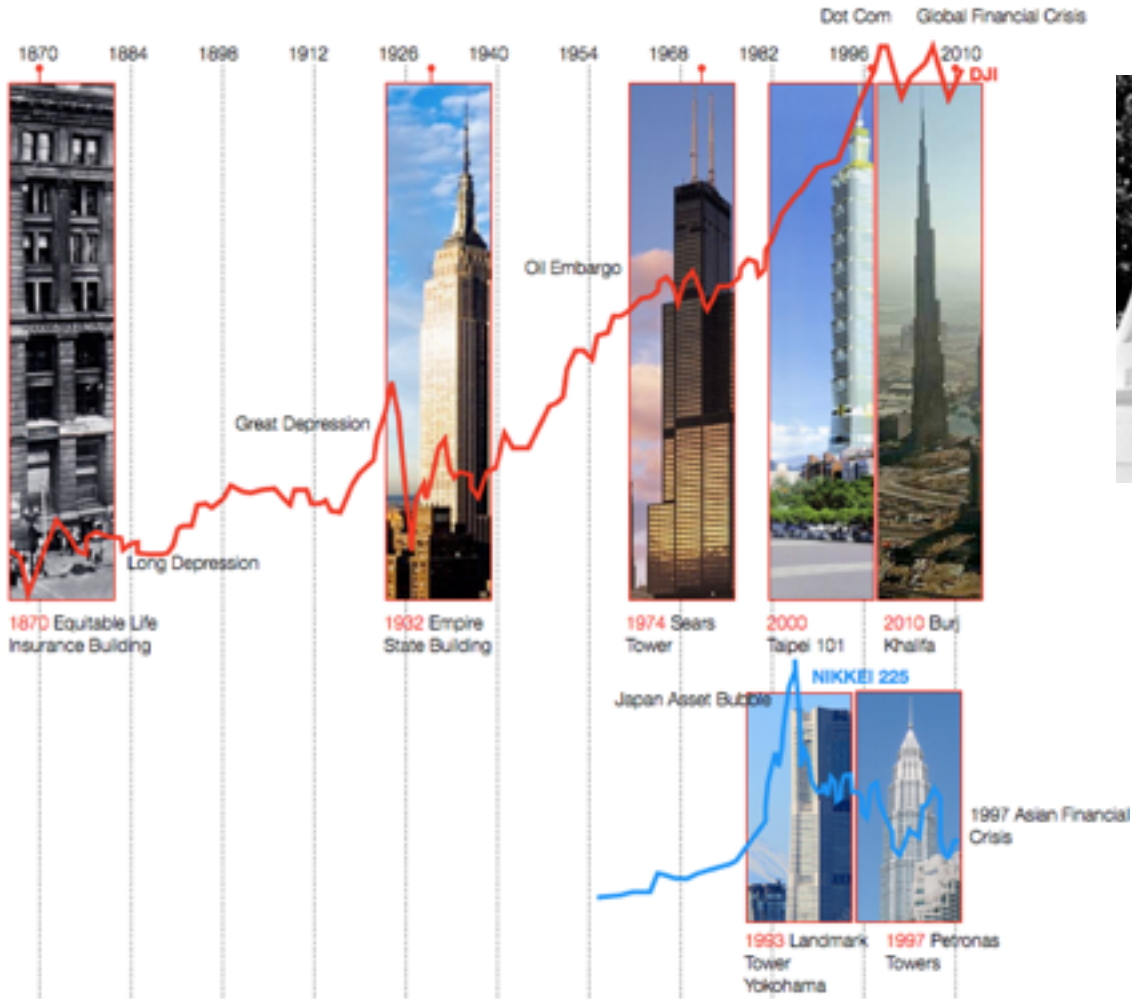


95% of future urban growth will occur in Africa and Asia
 On average they will consume 2x as much energy
 On average they will make 6x as much money



350 Million moved into a city in Asia in the same time, that would have required about 76,000 Gehrkins

This is not the seventies.

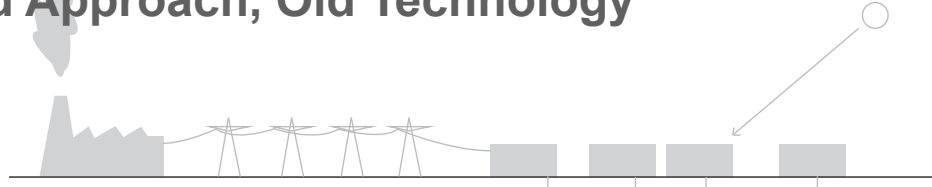


Fuel Cell 7.5 \$/watt
Photovoltaics 6-7 \$/watt
Nuclear 6-7 \$/watt
Coal 2.3-3.7 \$/watt
Wind 2-3 \$/watt
Natural Gas 1.50 \$/watt

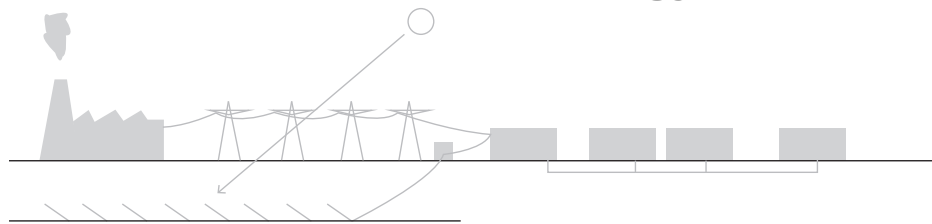
Knowledge = Power; Speed = Knowledge; Speed = Power

University as a Power Plant

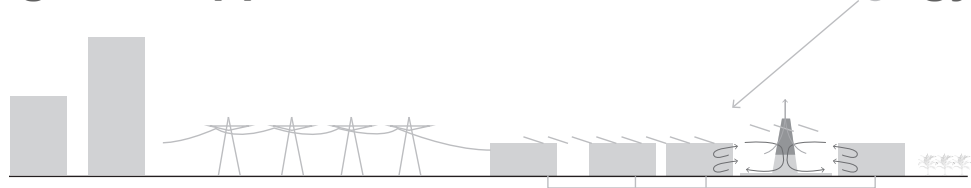
Old Approach, Old Technology



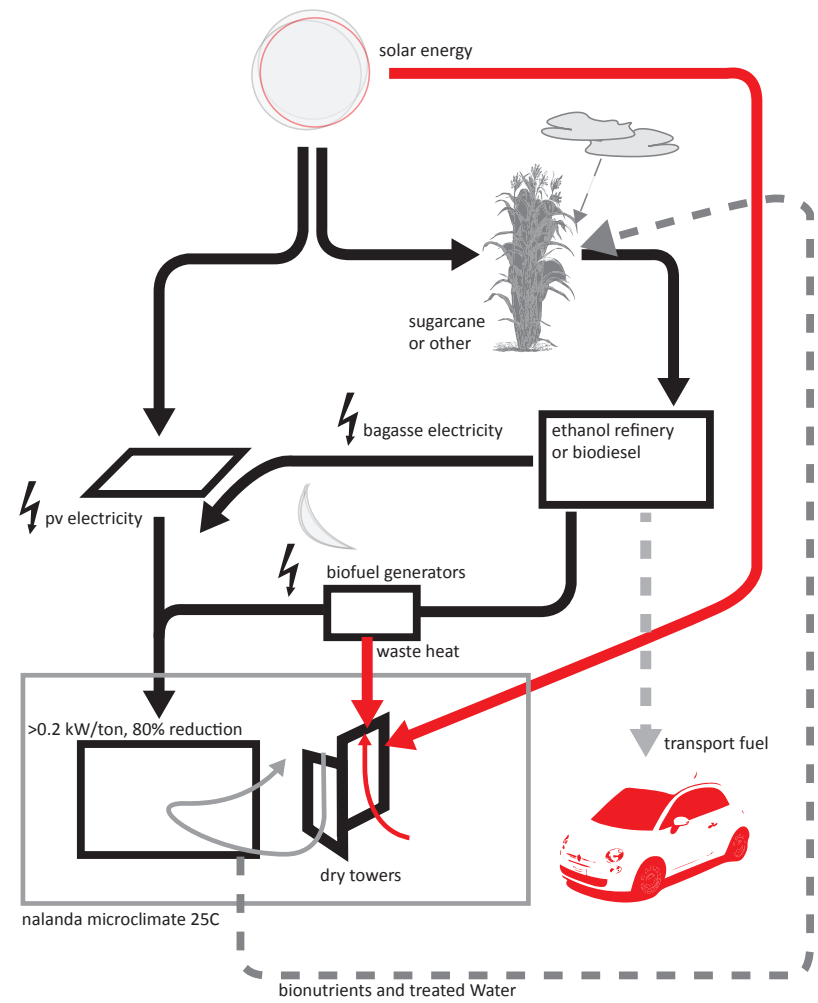
Old Approach, Newer Technology



Integrated Approach, Transitional Technology



For the oldest university, fifth century CE



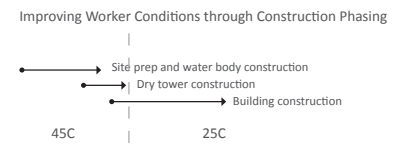
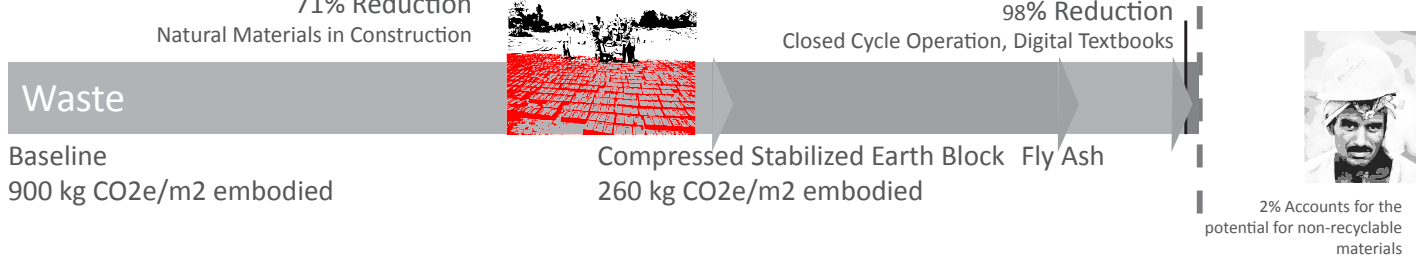
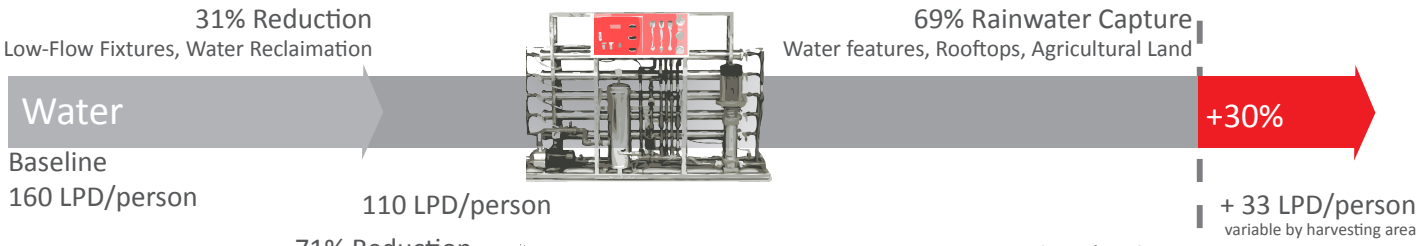
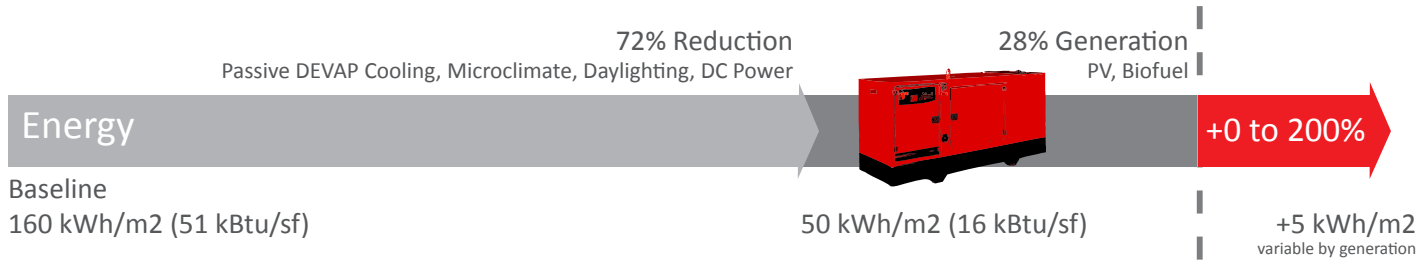


OVERALL STRATEGY

PASSIVE OVER ACTIVE, RESILIENCY OVER STRENGTH, MODULAR,
EXPANDABLE, SIMPLE, EFFICIENT AND APPROPRIATE TO PLACE

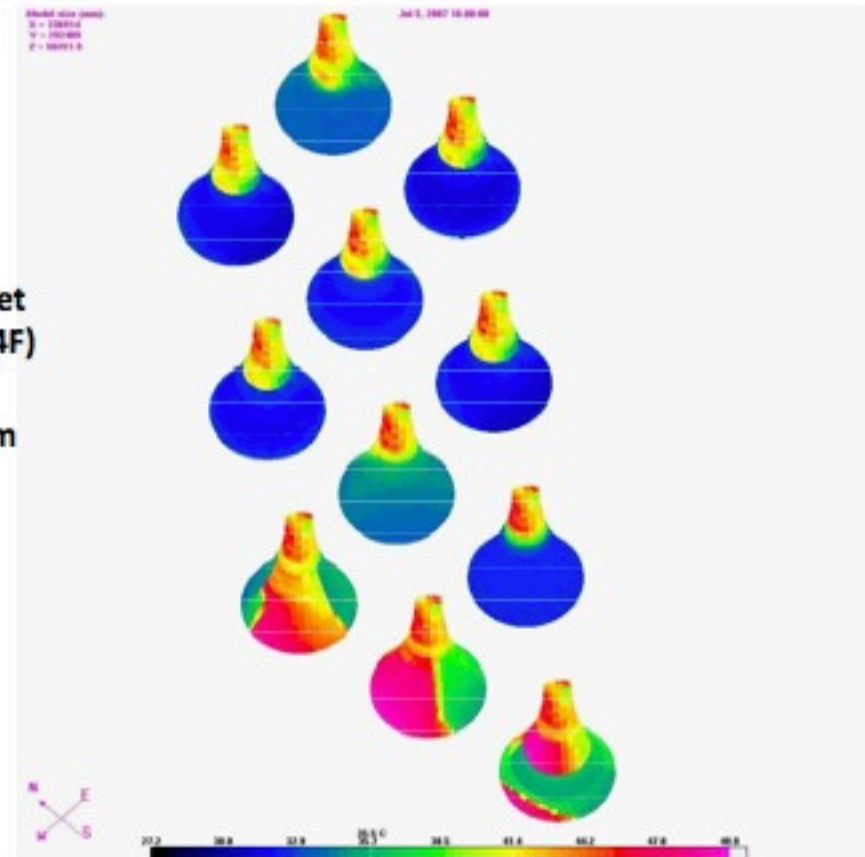
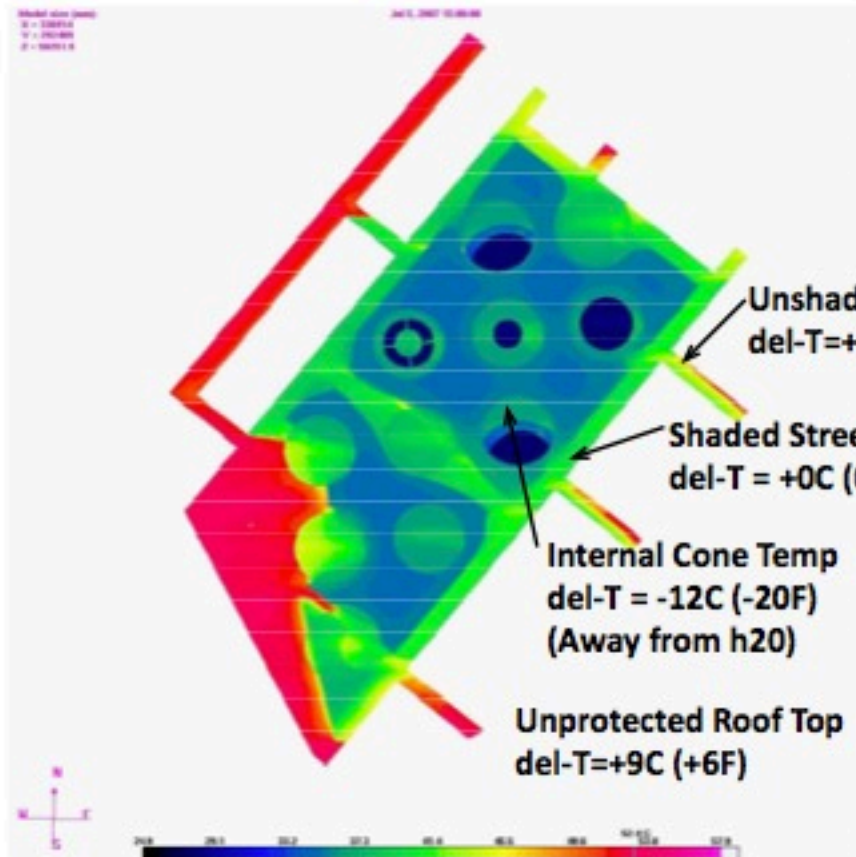
1. Smart Energy Storage
2. Balanced Energy
3. DEVAP Cooling
4. Microclimate
5. Modular Power
6. Water Exchange
7. Natural Materials
8. Closed Cycle Operations

Triple Net-Zero

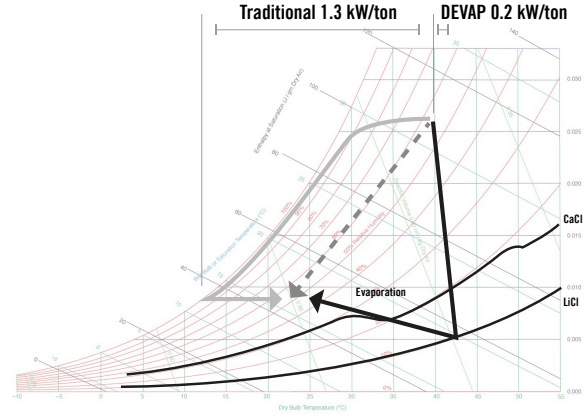
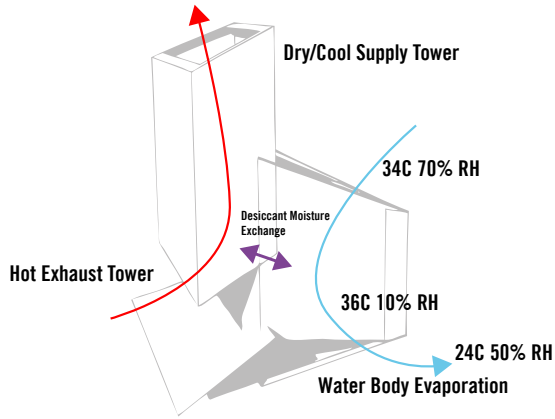


- 90% Spaces that meet ASHRAE Std 55 comfort 85% of the year and increase ventilation by at least 10% over Std 62.1
- 5% Improvement on CIE Maximum illuminance for light pollution reduction
- 30/40db Night/Day sound level in residential areas
- 65% Parking utilized by shared or ultra-low emission vehicles
- 100% Materials compliant with to be developed banned list considering toxicity, VOCs and Carbon
- 80% Floor area has a daylight factor >2.5
- 90% Reduction in refrigerants, principal dehumidification with non-toxic LiCl

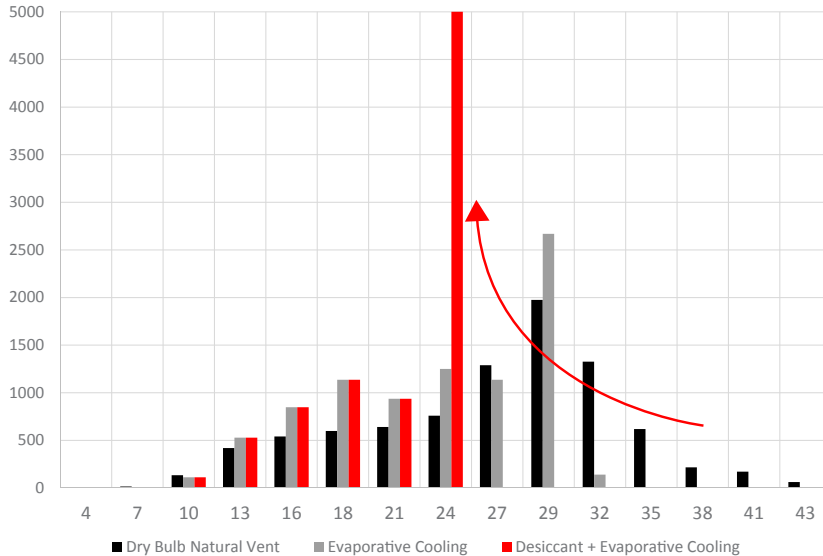
Lessons Learned from Masdar



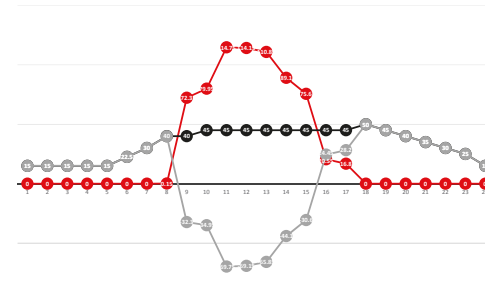
Dry-Cool Towers



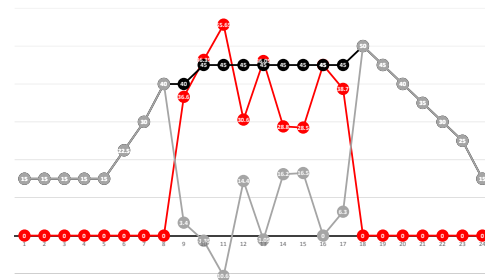
ANNUAL TEMPERATURE DISTRIBUTION



TYPICAL DAY (Wh/m²)



CLOUDY DAY (Wh/m²)



Key Statistics

Energy balance is net-zero at a 1:4 ratio, PV:NFA

Domestic water balance is net zero at a 2:1 ratio, Site Collection:NFA

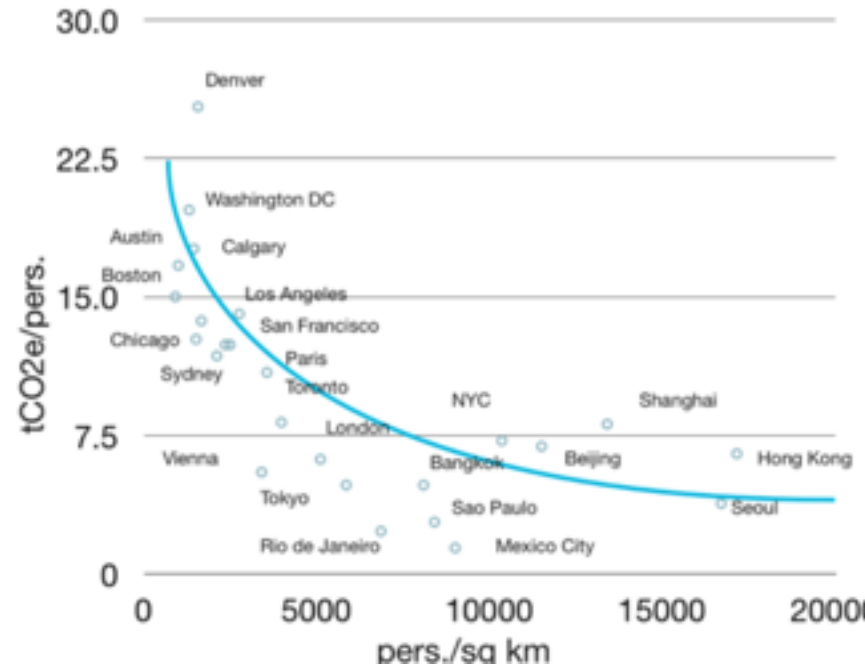
Carbon Abatement is 1200 kgCO₂e/Yr per Person (3 Years to Carbon Neutral)

On-site electricity is worth 14000 Rs./Yr (\$260) per person (+1000 Rs. (\$18) Carbon Credits)

Capital cost of Hybrid PV-Biofuel System is estimated at 220,000 (\$4080) Rs/ person (11 Yr ROI)

25 Year Return 2600 Lakh Rs. (\$4.9M) vs. 1250 Lakh Rs. (\$2.3M) anticipated tuition 2500 students

Moderation is a fatal thing. Nothing succeeds like excess.



AIA 2030 and Energy Codes are Targeting NZE
 Yet with Current Technology NZE is limited to 3-4 stories??

Final Provocative Thoughts

<< 50% Buildings are Modeled

1. Ditch prescriptive code

No financial mechanisms other than first cost

2. Incentivize Investment , ie FAR bonuses

3. Decouple operation and maintenance costs through service models

Little Performance Based Competition

4. Integrated project delivery

5. Progressive carbon based land and building transaction tax





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