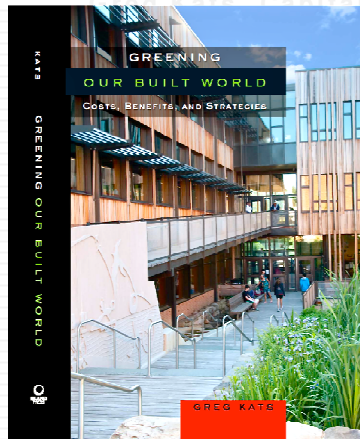


**UNEP-SBCI  
June 2012**

**The Economics of Green Buildings and Green Cities**



**Shanghai**

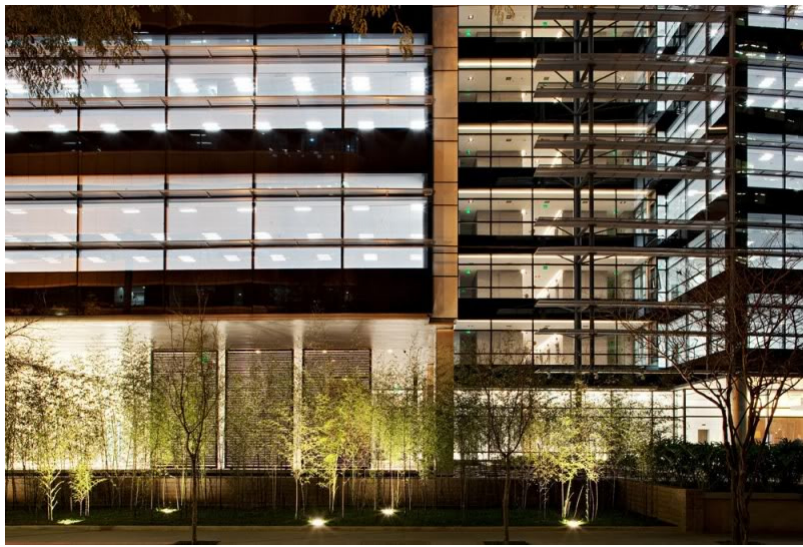
**1989**



**2010**

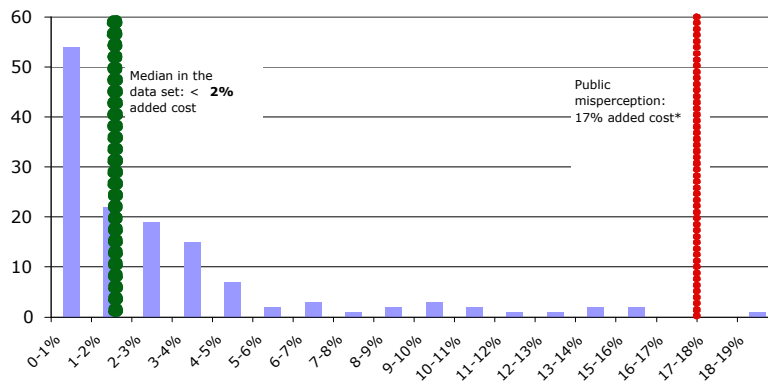


# Jatoba commercial building LEED Gold, São Paulo



## Big Perception Gap on Cost Effectiveness of Green Design

**Additional cost to build green:  
Evidence from 146 green buildings**

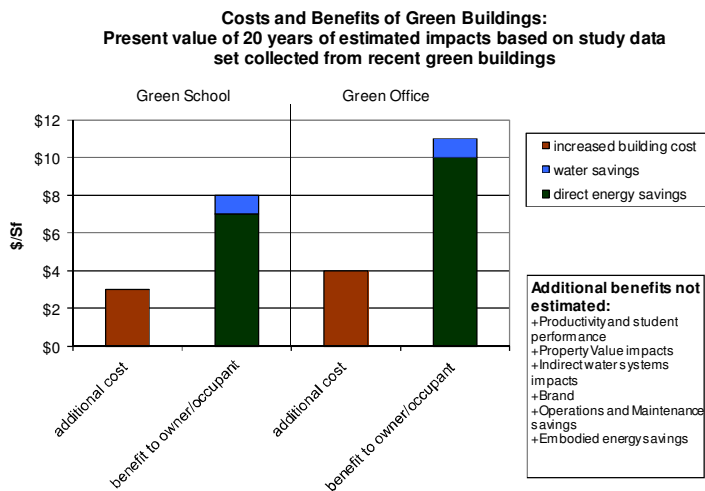


\*2007 opinion survey by World Business Council for Sustainable Development

**Range of reported premiums**

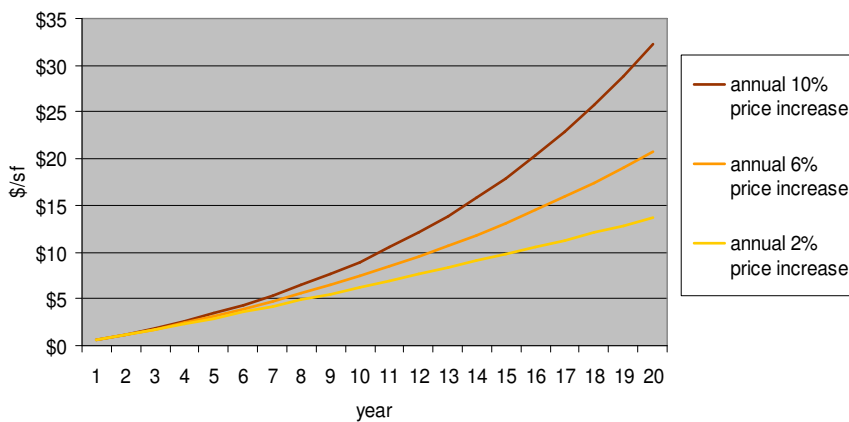
## Costs and Benefits: utility savings only

Source: Greening Our Built World (Island Press, 2010)

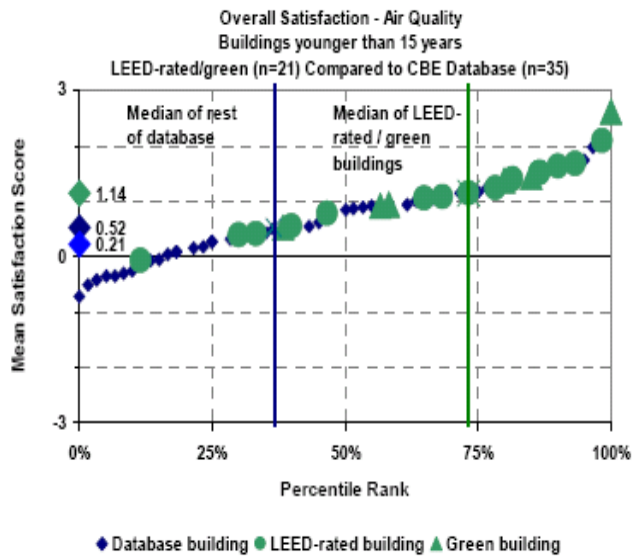


## Green/efficiency = risk reduction

**Cumulative energy savings in green offices**



Green = increased tenant satisfaction



Abbaszadeh, S., L. Zagreus, D. Lehrner and C. Huizenga, 2006. [Occupant Satisfaction with Indoor Environmental Quality in Green Buildings](#). *Proceedings, Healthy Buildings 2006*, Vol. III, 365-370, Lisbon, Portugal, June.

## Health & Learning Benefits of Green Schools

Increased Learning, Productivity & Performance (3%)

Increased Future Earnings of Students (1.4%)

Reduced Asthma (25%)

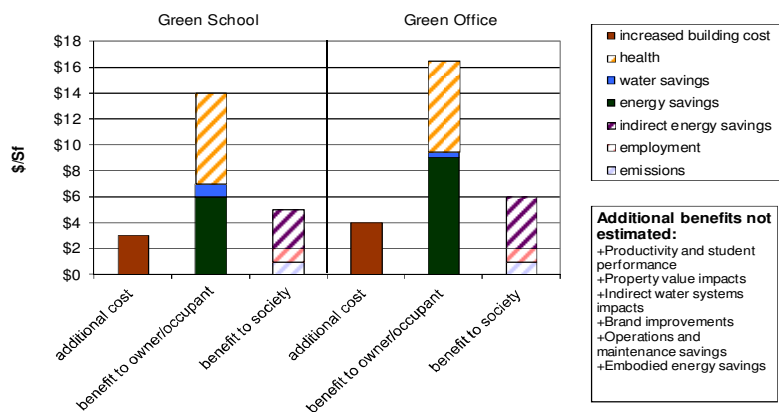
Reduced Colds and Flu (15%)

Reduced Teacher Turnover (3%)

Source: Greening Our Built World (Island Press, 2010)

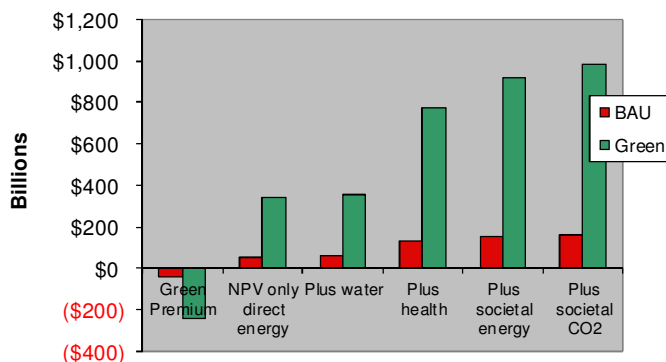
## Costs and Benefits of Green Buildings

**Costs and Benefits of Green Buildings: Present value of 20 years of estimated impacts based on study data set and synthesis of relevant research\***

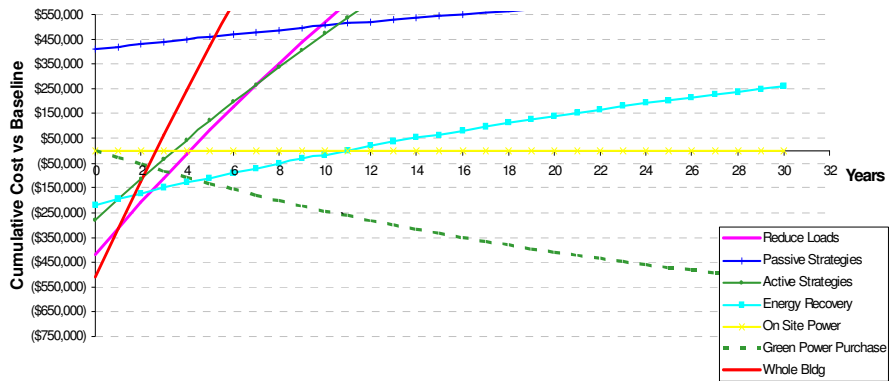


## Greening = Wealth and Jobs Creation

**NPV of Net Benefits of BAU and Green**



## Whole building integrated upgrade Source: ARUP/Stanford



## Green Building Benefits: Increased Rent, Sales & Occupancy

| 1 <sup>st</sup> Quarter 2008 | Non-LEED | LEED Certified Offices | Difference | % Change |
|------------------------------|----------|------------------------|------------|----------|
| Occupancy rates              | 88%      | 92%                    | 4%         | 5%       |
| Rent (\$/SF)                 | \$31     | \$42                   | \$11       | 35%      |
| Property value (\$/SF)       | \$267    | \$438                  | \$171      | 64%      |

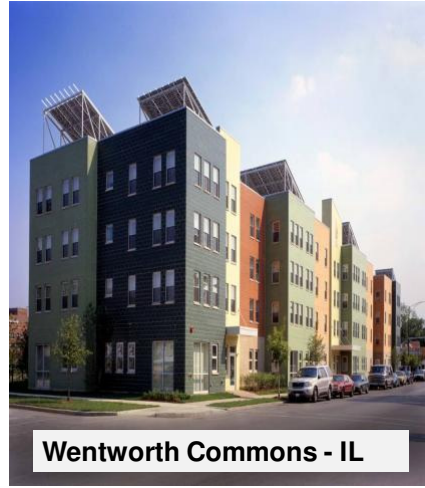
| 1 <sup>st</sup> Quarter 2008 | Non-Energy star | Energy Star Offices | Difference | % Change |
|------------------------------|-----------------|---------------------|------------|----------|
| Occupancy Rates              | 88%             | 92%                 | 4%         | 5%       |
| Rent (\$/SF)                 | \$28            | \$31                | \$3        | 11%      |
| Sale Price (\$/SF)           | \$227           | \$288               | \$61       | 27%      |

Source: CoStar

## All Building Types are Greening



Comcast Building



Wentworth Commons - IL

## Brand Impact of Greening

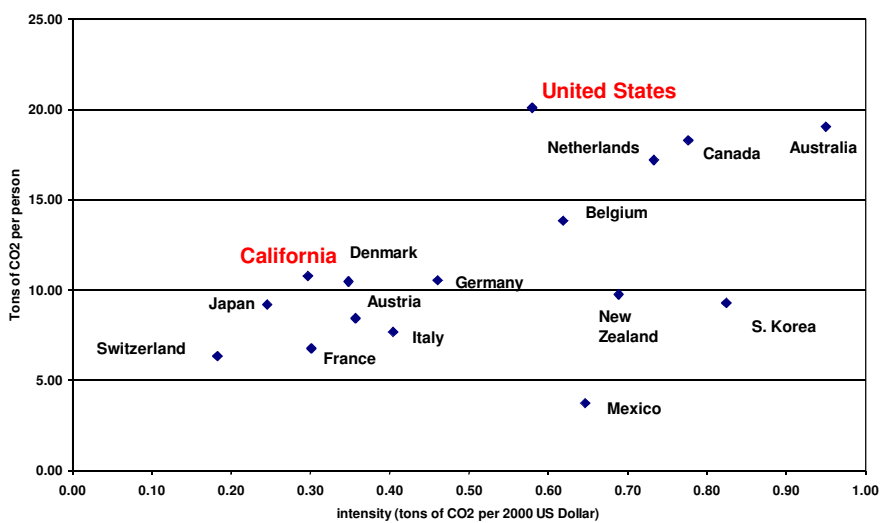
Greening impacts: three Sources of Brand Equity

- Increased brand awareness (e.g., free media exposure)
- Greater preference due to specific attributes (e.g., better IEQ)
- General non-attribute preference (e.g., association with quality, lower risk)... AAA rating
  
- LEED > Zero net energy > living buildings

# Pearl River Tower, Guangzhou

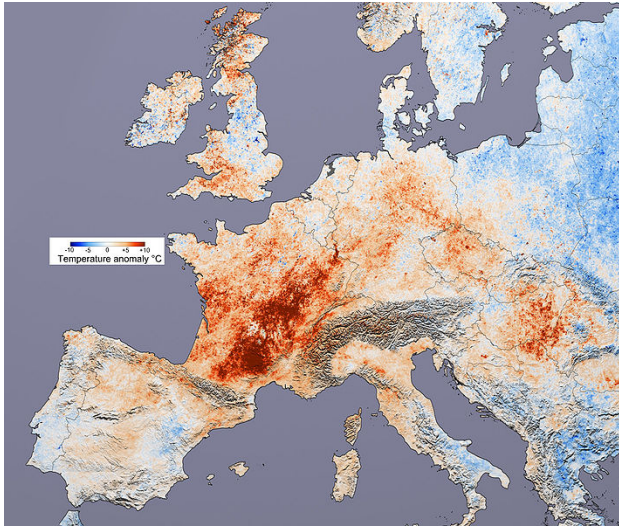


### Carbon Dioxide Intensity and Per Capita CO2 Emissions (Fossil Fuel Combustion Only)





**Aug 2003: European heat wave**  
 Temperature anomalies reached 10 °C  
 52,000 Europeans died



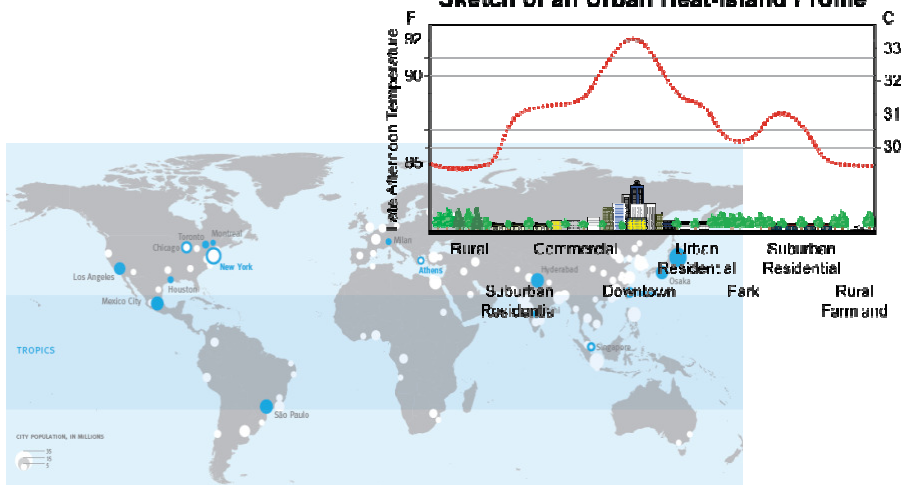
| Country               | Fatalities    |
|-----------------------|---------------|
| Italy                 | 18,257        |
| France                | 14,802        |
| Germany               | 7,000         |
| Spain                 | 4,130         |
| England & Wales       | 2,139         |
| Portugal              | 2,099         |
| Smaller countries     | 4,025         |
| <b>Total of above</b> | <b>52,452</b> |

<http://earthobservatory.nasa.gov/IOTD/view.php?id=3714>

**Cool Cities: GCCA Network**

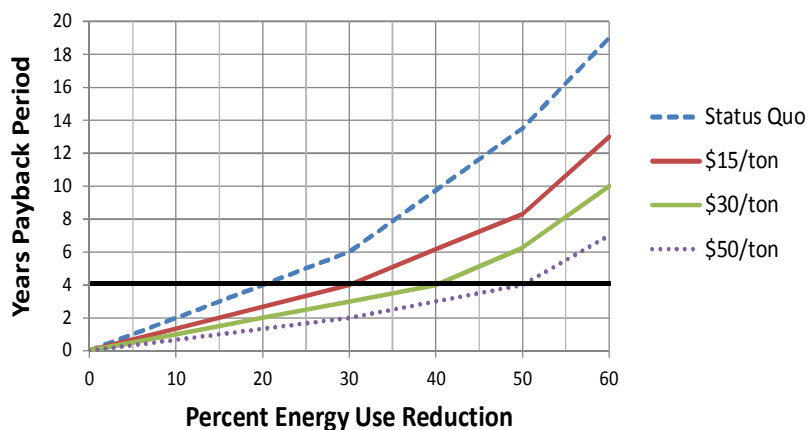
[www.globalcoolcities.org](http://www.globalcoolcities.org)

**Sketch of an Urban Heat-Island Profile**



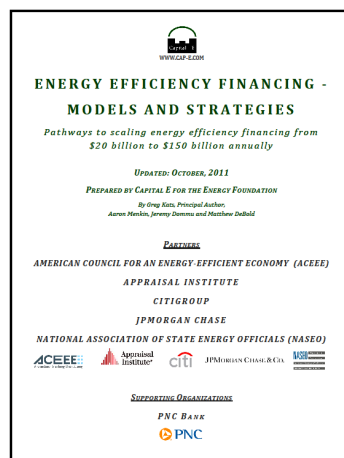
## Rewarding energy efficiency and green design for emissions reductions benefits

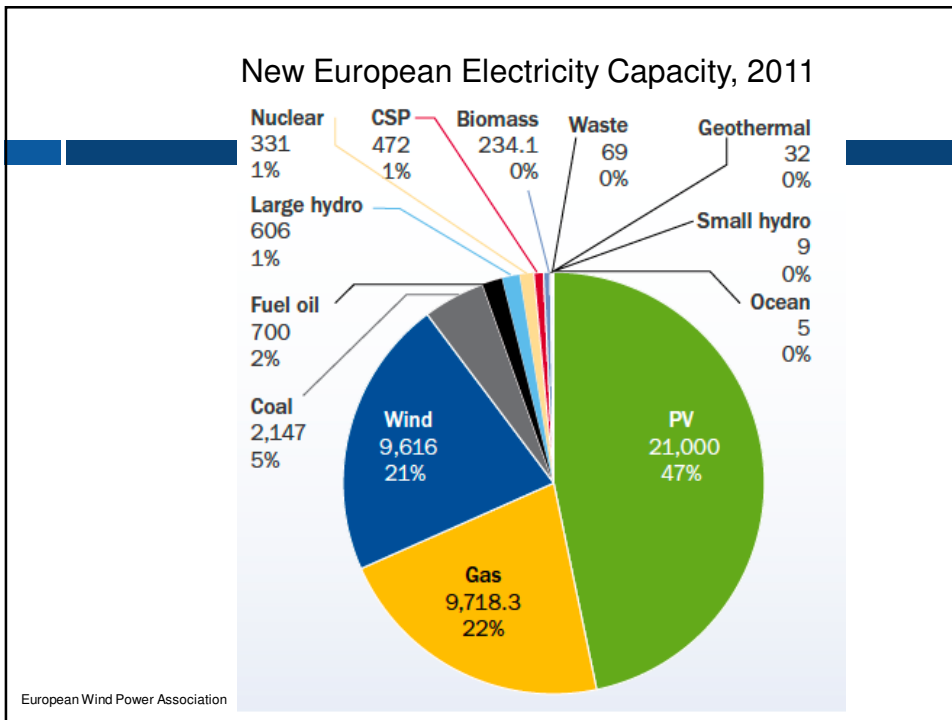
### CO<sub>2</sub> to EE Model: Illustrative Impact



## New EE Finance, Service Models

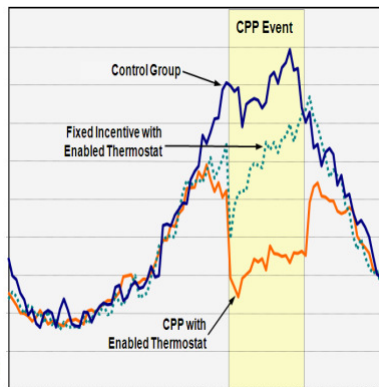
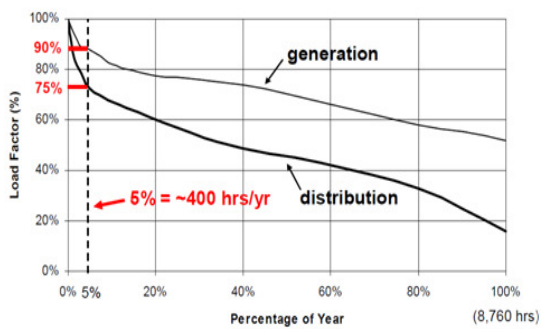
- Smart EE reshapes load far more cheaply than hard storage
- Extend PV Power Purchase Agreement (PPA) ownership models:
  - eliminates up front costs
    - EE, solar thermal, gshp
- SaaS business model
  - Cloud based, V Low capital costs
    - Building IQ
- Cooperative consumption
  - BetterWorkplace
- EE through social media platforms
  - MyEnergy
- U Military: Security driven
  - Zero net energy bases, green buildings





## Reducing Peaking Power and T&D can achieve huge savings

Hourly Loads as a fraction of Peak



## Net Zero Building

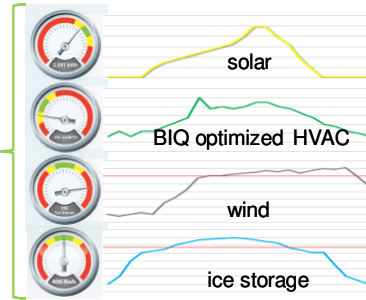
By load shifting and intelligently adjusting interior temperatures, BuildingIQ optimizes HVAC operations, balancing :

- reduced energy usage/cost
- maintained or improved occupant comfort
- maximized DR event performance



In net zero buildings this strategy:

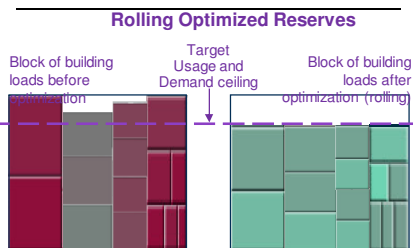
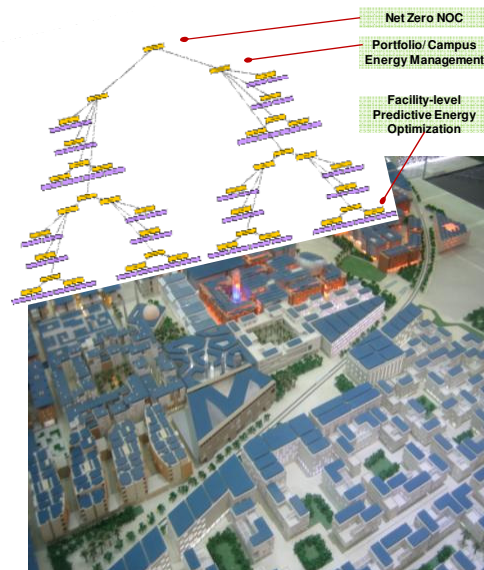
- uses the building's thermal mass as energy storage to balance renewable sources
- forecasts and adjusts timing of peak HVAC loads to match renewable power supply



## Levelized District Optimization

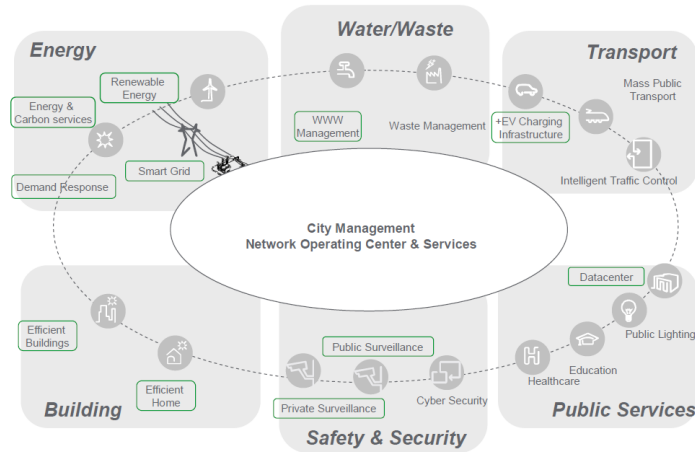
Use predictive energy optimization in 2 ways:

- **At District Level:** predicts and analyzes DR capacity and energy storage capacity to aggregate
- **At Facilities level: BuildingIQ:** provide operational and analytical oversight on entire portfolio and campus – from predictive, real-time, historical perspectives.

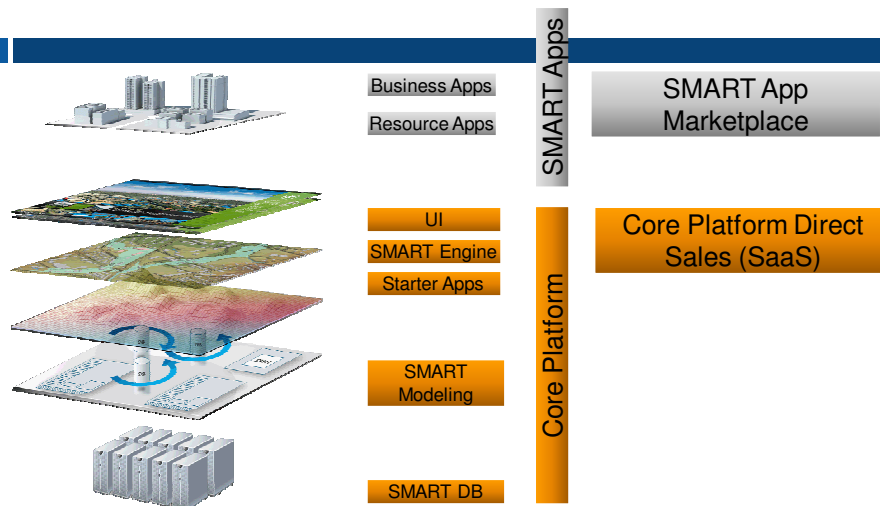


Smart Cities: Large increase in potential savings, but large increase in complexity (slide source: Schneider)

A Smart City is a system of systems



Data Management key to Green Cities eg Screampoint



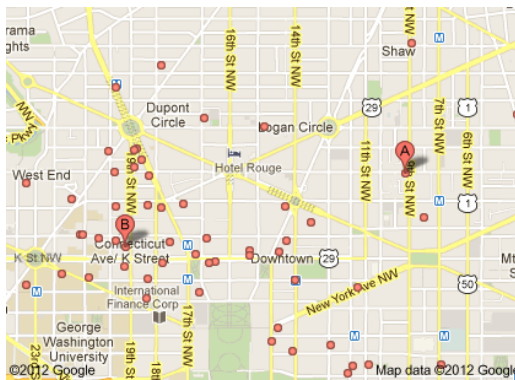
# Green > Quality + Healthy > Better Brand

Cities can drive green at negative costs  
 Web enables shift from waste/water expansion + disposal to waste/water reduction

DC Green

Rationale:

- Employment
- Cost effective
- Brand Benefits



## Green Building Performance Database:

[www.gbdata.org](http://www.gbdata.org)

Thank you!

- [www.globalcoolcities.org](http://www.globalcoolcities.org)
- [www.cap-e.com](http://www.cap-e.com)
- [gkats@cap-e.com](mailto:gkats@cap-e.com)
- [gbdata.org](http://gbdata.org)

