Smart sustainable campus
Powered by Data, Driven by Technology, & Sustained by Profits
Smart Cities: The Opportunity

• Over 60% of India of 2030 is not yet built
• Massive urbanization, over 590 million people will live in cities by 2030
• Improve quality of life
• Improve productivity of people
• Improve public safety & security, disaster management
• Reduce wastage and improve resource consumption efficiency

Source: McKinsey report on India
Key attributes of smart Campuses/ Future cities

Unreasonable goals
- Strong leadership
- 4X improvement

Design
- Disruptive technology
- Inter-connected

Operations
- Data driven
- Analytics

Behavior
- Awareness & education
- Changes in consumption patterns
Impact of efficient design at Infosys - Growth from 2008 to 2014

- Increase in no. of employees in India: 100%
- Absolute Increase in energy: 13%
- 663 Million units (kWh) avoided
- 0.56 Million Tons of CO$_2$ emissions avoided
- 80 Million USD spend on electricity avoided
## Smart by design - What is possible? Standard Vs. efficient design

<table>
<thead>
<tr>
<th>Performance metric</th>
<th>Standard design*</th>
<th>Efficient design*</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building energy consumption</td>
<td>250 kWh/m²/year</td>
<td>75 kWh/m²/year</td>
<td>70%</td>
</tr>
<tr>
<td>Lighting design</td>
<td>1.2 W/sqft</td>
<td>0.48 W/sqft</td>
<td>60%</td>
</tr>
<tr>
<td>Air-conditioning design (Reduction in heat load)</td>
<td>300 sqft per TR</td>
<td>750 sqft per TR</td>
<td>60%</td>
</tr>
<tr>
<td>Total building electrical design**</td>
<td>8 W/sqft</td>
<td>3.5 W/sqft</td>
<td>56%</td>
</tr>
</tbody>
</table>

* Average for commercial office buildings (incl. lights, AC, computers, miscellaneous)
** Total electrical load for commercial office buildings including chiller plant
4X optimization strategy

HVAC Optimization

- Reduce Heat Gain
- Energy simulation
- Efficient heat transfer mechanism
- Efficient system
- Equipment configuration
- Efficient equipment
- Control strategy
- Continuous monitoring
Envelope: insulation + Smart windows

- Restricted external heat gain in building to less than 30 W/m²
  - Wall insulation with R value of 15
  - Roof insulation with R value of 16
  - Double glazed unit with argon gas to achieve R value of 5.5
  - Low SHGC of 0.2 with low e glass
  - Window-wall ratio < 30%

5 times more efficient
Infosys: 90% of occupied space should be naturally lit

Daylight panel

Vision panel

Light shelves for deeper penetration of day light

Glare free design without blinds
Impact of day lighting

Improves:
- Employee health
- Employee productivity
- Provides pleasant work space
Efficient heat transfer mode and medium

Water has 3400 times higher heat carrying capacity than air for the same volume.

Pumping cost is 7.5 times lower with water as a medium of heat transfer.
Radiant cooling retrofit
Retrofit of Mechanical systems
Retrofits: 30% IRR on retrofit projects

Cumulative reduction in connected load in MW

<table>
<thead>
<tr>
<th>Year</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2.4</td>
</tr>
<tr>
<td>2012</td>
<td>9</td>
</tr>
<tr>
<td>2013</td>
<td>12.6</td>
</tr>
<tr>
<td>2014</td>
<td>19.2</td>
</tr>
</tbody>
</table>
Re-engineering of chiller plants

- Reduction in energy 30%
- Reduction in no. of equipment 45%
- Reduction in space 25%

Conversion of chilled water pumping system from primary-secondary to variable primary
Replacement of electric heaters with heat pumps

- 3.5 times more efficient than electric heating
- 4 MW of connected load reduced across Infosys campuses

Air source heat pump, draws heat from atmosphere

- 1kW electricity → Electric water heater → 0.95 kW of heating
- 1kW electricity → Heat pump → 3.5 kW of heating
White roofs for existing buildings

• Reduces building heat gain and urban heat island effect
• 26 lac sqft area covered with white roof across Infosys campuses
• Reduces heat ingress and hence cooling load
• Over 2000 street light retrofits at Infosys
• High pressure sodium vapor luminaire of 250 W replaced with 90 W LED.
• Migrated from yellow light to white light for improved night vision
• Dimmable, schedulable, motion based activation
UPS system retrofits – 30% IRR

- Reduced installed UPS capacity from 13.5 MW to 7.8 MW (Reduction of 5.7 MW)
- Replaced standalone UPS systems with modular type high efficiency UPS
- 15% improvement in UPS efficiency. Reduction in no. of UPS and UPS AMC costs.
Smart Operations
Central command center

Command center at Infosys Bangalore to monitor, manage and optimize resources usage
Data driven building operations

- Energy saving algorithms optimize operation
- Continuous measurement and verification
- Improves indoor air quality, employee comfort and productivity
- 15% reduction in energy as compared to standard buildings

Example of demand controlled ventilation. Building only uses as much fresh air as required based on CO2 sensing.
Provides data to optimize future building designs

<table>
<thead>
<tr>
<th>Equipments</th>
<th>Inst. watt / Sqft</th>
<th>Current Year Peak Value</th>
<th>Current Year Peak Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC - High Side</td>
<td>0.03</td>
<td>1.16</td>
<td>7:39 AM 4/9/2012</td>
</tr>
<tr>
<td>HVAC - Low Side</td>
<td>0.04</td>
<td>0.30</td>
<td>8:05 AM 3/10/2012</td>
</tr>
<tr>
<td>HVAC - CRITICAL</td>
<td>0.07</td>
<td>0.22</td>
<td>6:10 PM 28/10/2012</td>
</tr>
<tr>
<td>Lighting</td>
<td>0.13</td>
<td>0.20</td>
<td>6:37 PM 6/11/2012</td>
</tr>
<tr>
<td>Fans</td>
<td>0.03</td>
<td>0.05</td>
<td>10:13 AM 7/8/2012</td>
</tr>
<tr>
<td>Raw Power</td>
<td>0.04</td>
<td>0.12</td>
<td>6:06 PM 27/10/2012</td>
</tr>
<tr>
<td>UPS - Work Station</td>
<td>0.56</td>
<td>0.70</td>
<td>3:16 PM 25/9/2012</td>
</tr>
<tr>
<td>UPS - Server</td>
<td>0.03</td>
<td>0.04</td>
<td>9:49 AM 16/11/2012</td>
</tr>
<tr>
<td>Misc.</td>
<td>0.00</td>
<td>0.85</td>
<td>1:45 PM 11/10/2012</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.95</strong></td>
<td><strong>2.32</strong></td>
<td><strong>12:32 PM 27/11/2012</strong></td>
</tr>
</tbody>
</table>

- Standard building designed at 8 W/sqft
- Efficient building designed at 3.5 W/sqft
- Efficient building operating at less than 2.5 W/sqft
Renewable energy and smart grids in smart campuses (cities)
Infosys: Solar Goals: 200 MW by 2017

- Karnataka has excellent policy to promote solar
- Utility scale and rooftop solar
- Solar is profitable
  - Cost INR 6 Cr/MW
  - ROI in 7 years
- Demystifying solar by publishing live data
- Access to solar parks and evacuation infrastructure
- National Labs for testing solar
- Ground level weather data
Electricity generation: Unleash the power of corporate funds

– Increase demand: Utility scale
  • Have a 2020 goal for corporates
  • SPO for all corporates who consume more than 100,000 units a month.
  • SPO for all SEZ developers as their unit holders are getting tax breaks
  • Make RPO implementation more effective and more ambitious
  • Increase the RPO on solar, as many states have achieved their wind targets

– Increase demand: Roof Top Solar
  • Allow net metering
  • Allow Solar funding as part of home loan
Thank You