# Urban Sustainable Energy Policies and Programs: An Overview

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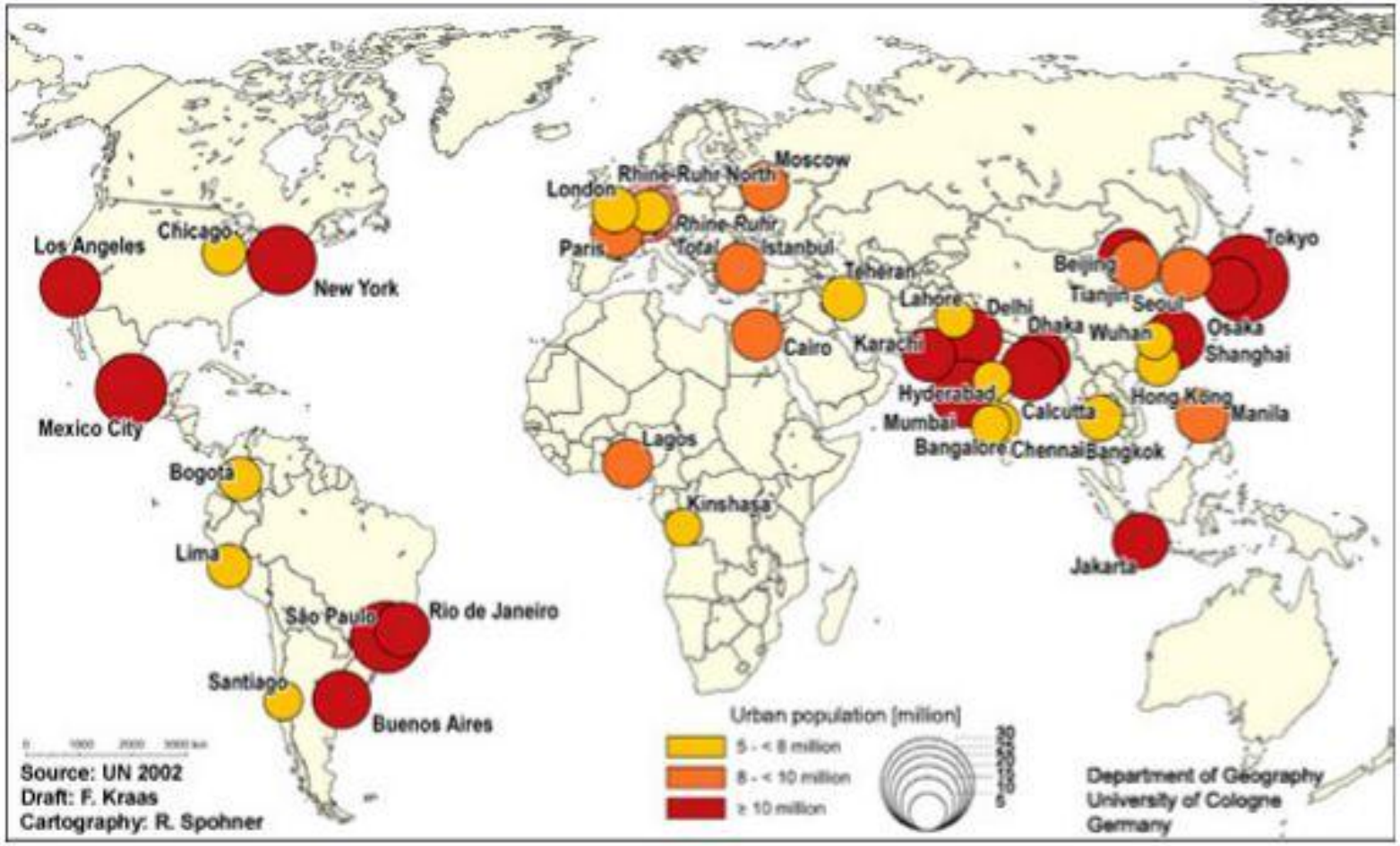
# Overview

- Motivation and Rationale
- Opportunities
- Drivers of Change
- Challenges
- Approaches and Methods
- Tools
- Actions

# Motivation - Cities are the growth engines of a nation

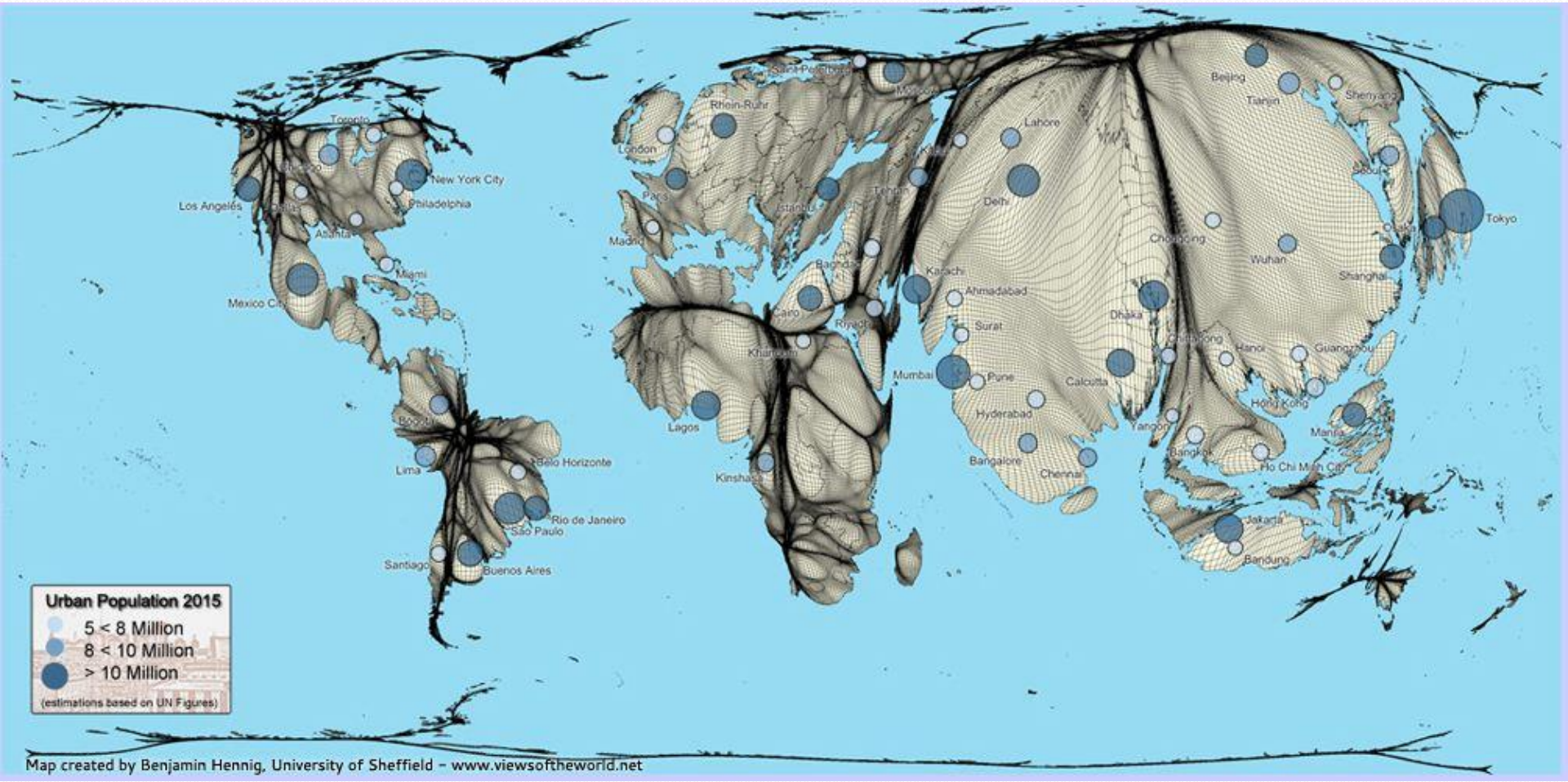
- In 1850 only 2% of the world population lived in cities
- By 2000 47% of the world population lived in cities
- Globalization & Urbanization
  - Global players / trade volume increase
  - 2030: 60% of population in cities
  - High density living demands for new patterns in infrastructure areas
- Climate Change
  - Cities responsible for 75% of greenhouse gas emissions
  - Need for resource efficiency and environmental care

# Global Population in Urban Areas in 2015



# Global Population in Urban Areas in 2015:

## *Population-weighted view*

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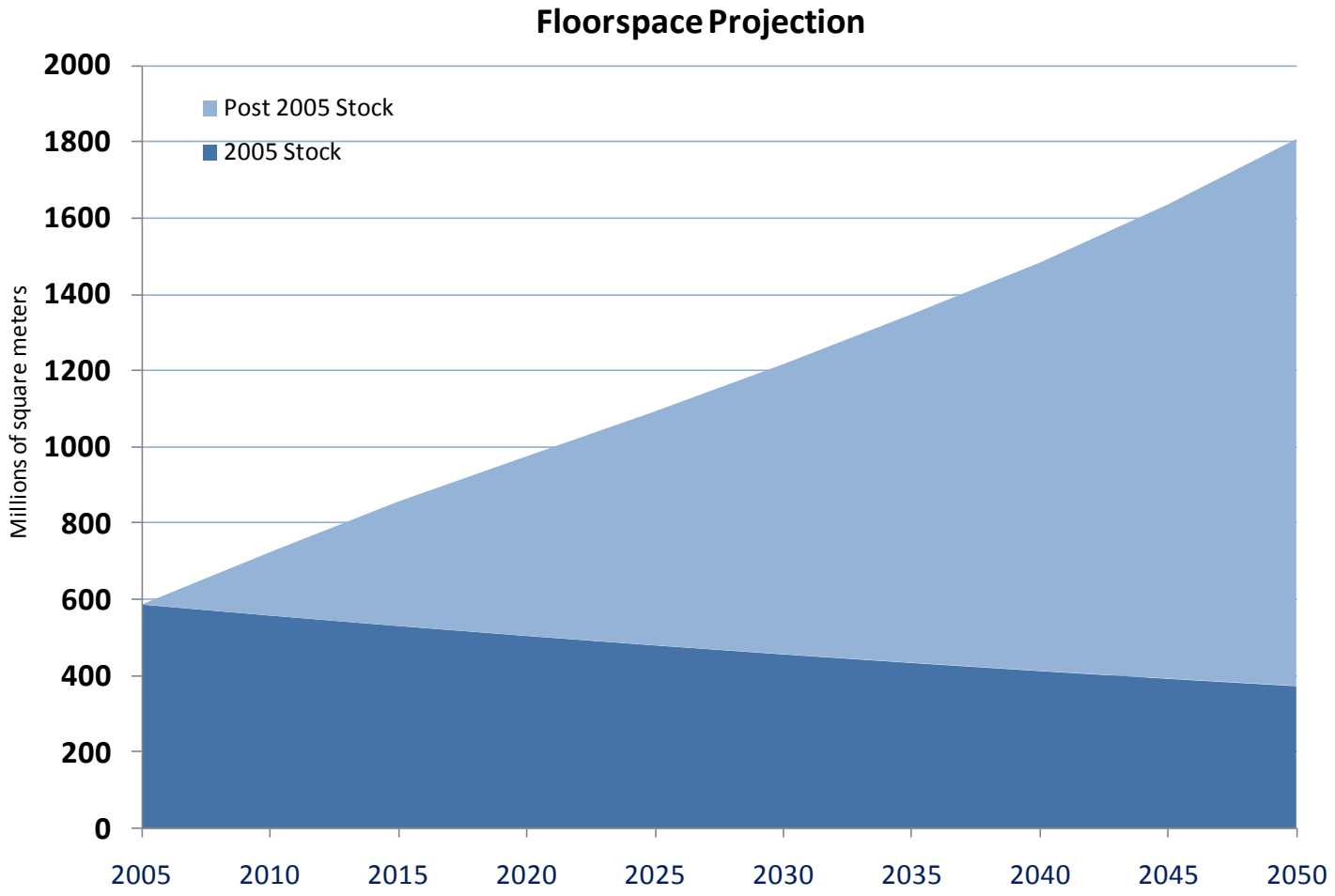
# Opportunities

- Significant investment in infrastructure over the next 20 years
- New construction – what you build today will last for the next 5 decades

accelerate solutions to climate change and water management by providing relevant information for business, policy and investment decisions

# New Construction –
## India Commercial Sector

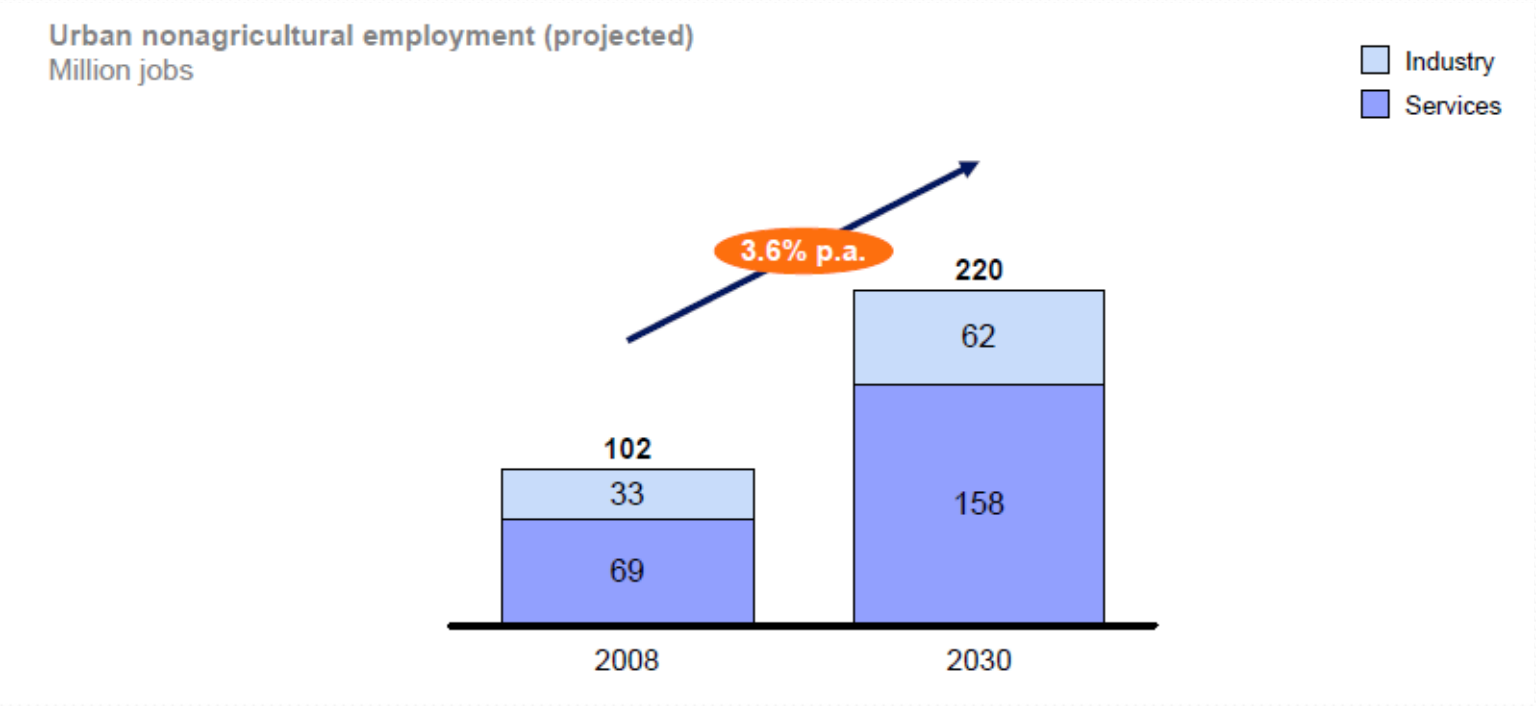



**Source**: LBNL estimates 2010

# Drivers of Change

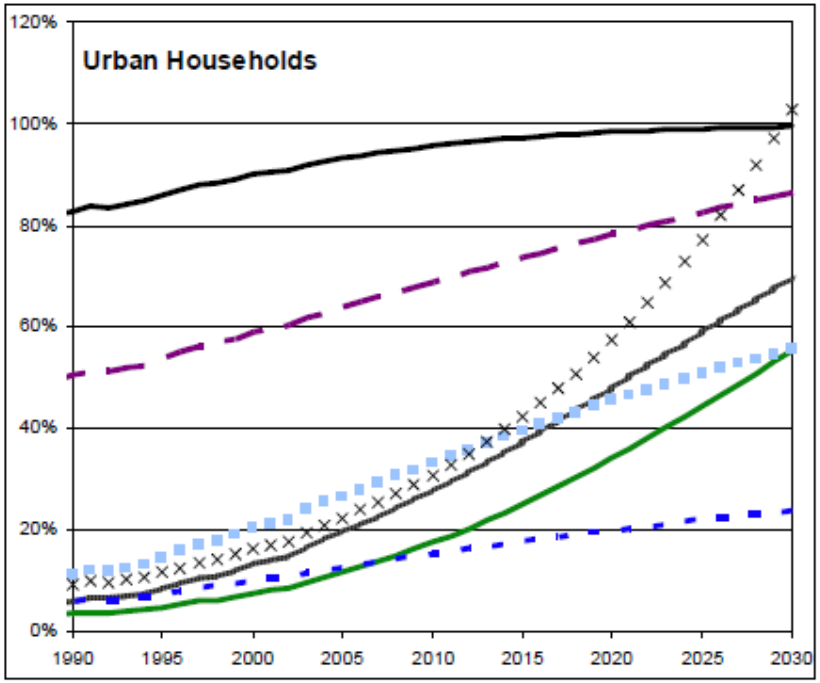
- Population and Demographics
- Economic opportunity
- Changing lifestyle and ownership patterns
- Institutional Capacity and governance
- Energy availability, accessibility, and acceptability
  - Changes in fuel mix between urban and rural

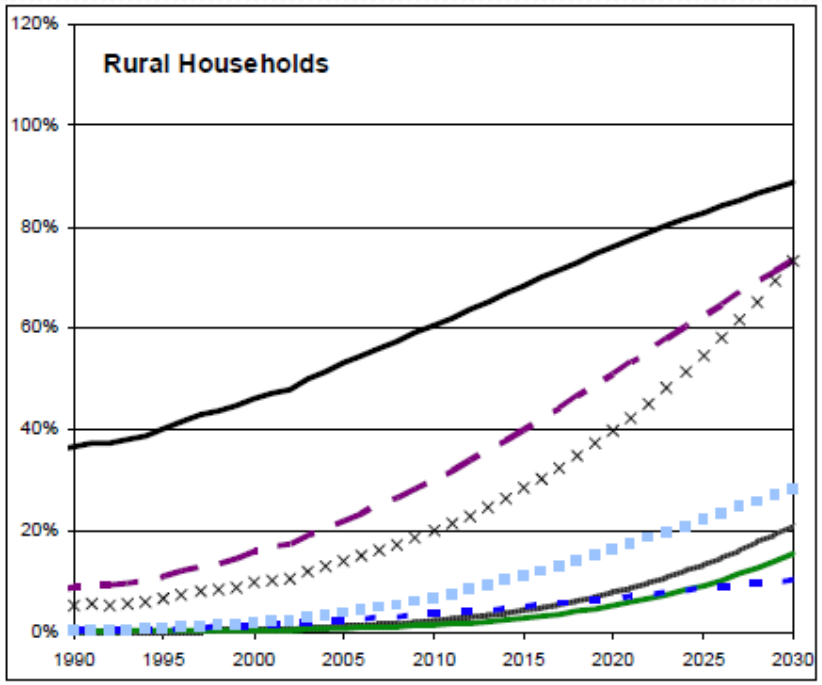
# Economic Opportunity – India Example




**Source**: Urbanization Model, McKinsey

# Ownership Patterns

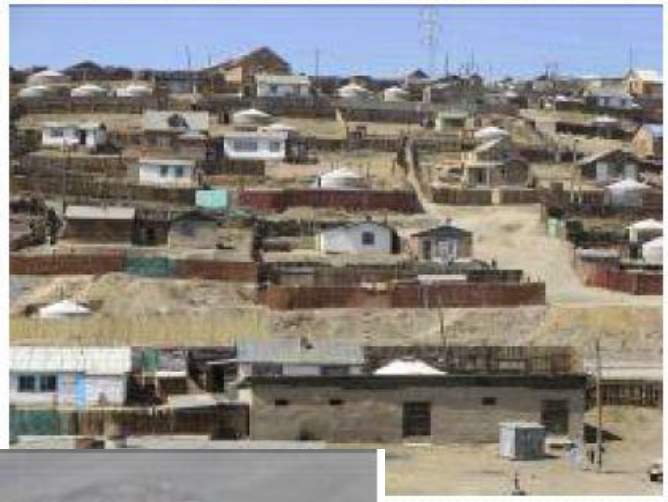



Electrification
TV
Refrigerator
WH
WM
AC
Others

**Source**: LBNL's saturation curves for India

# Urban vs. Rural Fuel Choices – The Mongolian Case



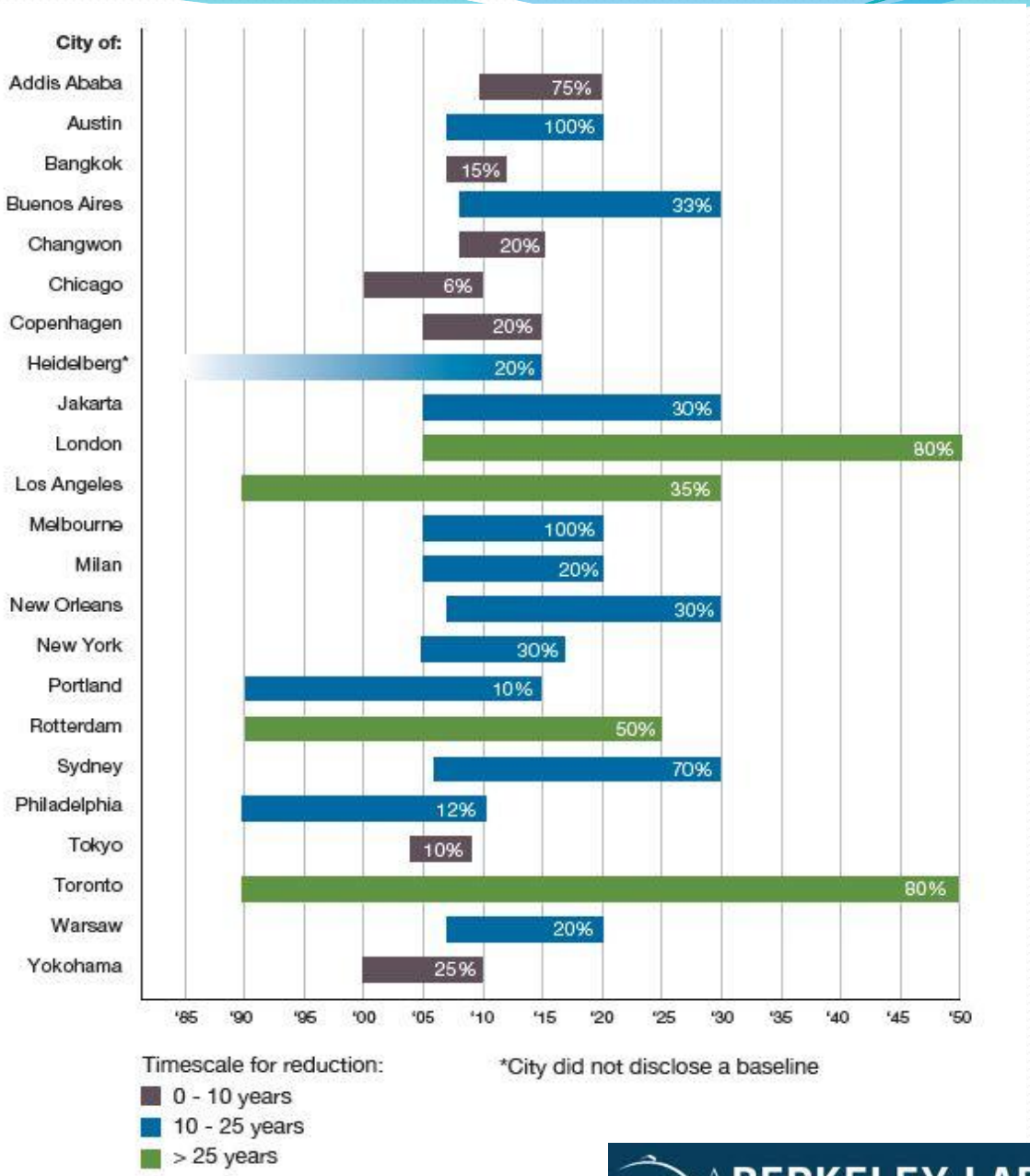
# Challenges

- Increasing urban poor – squatter settlements
  - Pressure on existing infrastructure
- Urban sprawl – overloading ecological footprint
  - Increased demand on private modes of transportation
  - Cost of infrastructure increases
  - Quality of life issues
- Institutions for planning and governance
  - Urban environmental problems are largely the result of lack of proper management, planning and absence of coherent urban policies

# Approaches & Methods

- Benchmarking for key indicators – World Bank, ADB
  - Quick estimates for action in key areas
- Actions through Carbon footprinting – ICLEI (HEAT)
  - Cities for Climate Protection (CCP)
  - Helps set reduction goals and identify actions
- Roadmapping through forecasting and prioritizing – LBNL (CITEA), McKinsey
  - Comprehensive for prioritizing actions for critical impact in key sectors

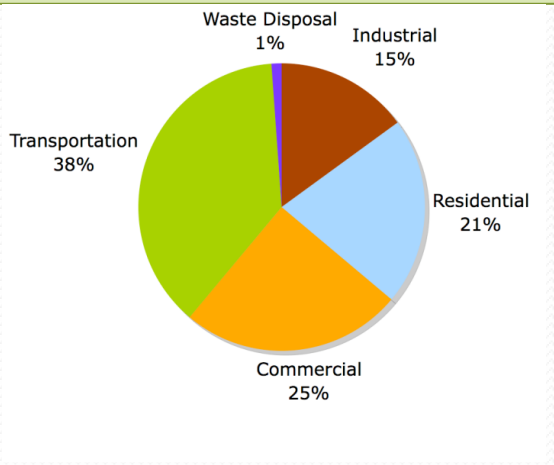
# City government operations emission reduction targets, by city

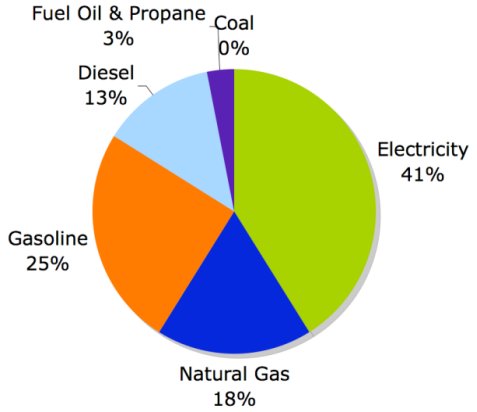



**Source**: CDP Cities 2011

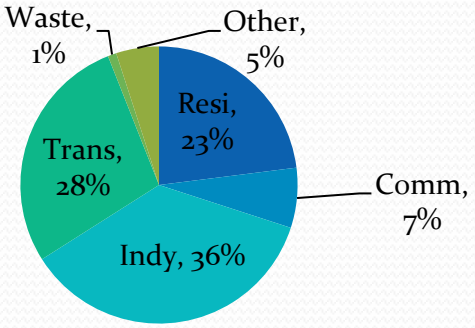
# Developing a climate action plan Step 1: Emissions Inventory

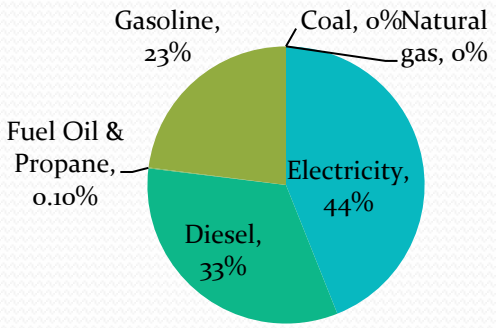
## GHG Emissions Inventory for Portland, Oregon by Sector and by Fuel Source




## GHG Emissions Inventory for a Typical Indian City by Sector and by Fuel Source



# Tools for Assessment, Actions, and Roadmapping

- Benchmarking tools
- Comprehensive assessment and action oriented tools
- Online Tools for Emissions Inventory and Target Setting
  - Clean-Air Cool-Planet. Community Toolkit (NH).
  - ICLEI USA. "Community Greenhouse Gas Inventory Methodology for Bay Area Local Governments."
  - Natural Capitalism Solutions. "Climate Protection Manual."
  City Action Plans; State Action Plans

# LBNL Approach

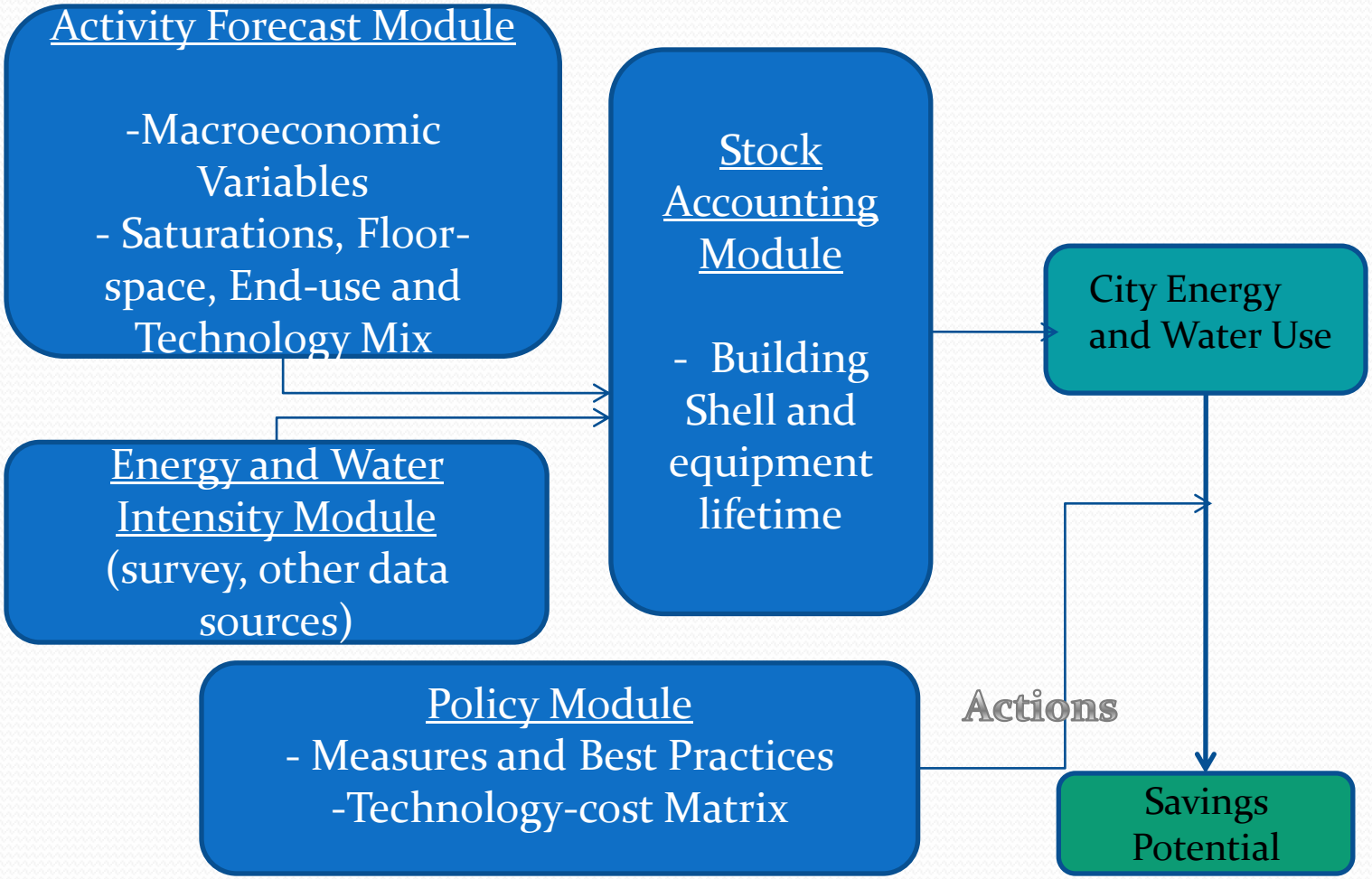
- Comprehensive analytical basis for prioritizing actions
  - Bottom-up demand forecast driven by macro-economic parameters
  - Technology-policy menu for impact assessment
- City selection and stakeholder engagement
- Criteria for city selection
  - Proactive Mayor/Commissioner –local champion
  - Potential for implementation
  - Availability of credible data
  - Tier 2/3 emerging growth centers
- Leveraging Opportunities with other ongoing initiatives

# How does roadmapping for sustainability work?

A comprehensive approach for conducting assessment of energy and water use in cities to identify and prioritize sectors, and suggest specific efficiency interventions with 3 principal components

- A city-level energy and water baselining tool with forecasts for the next two plan periods
- A process for prioritizing sectors that offer the greatest EE and WE potential
- A 'scenario-builder' of available efficiency measures
  - Identifies areas where city authorities will have significant impact
  - Produces estimates for savings potential
  - Allows roadmapping through prioritization of measures

# City Implementation Tool for Environmental Actions (CITEA)

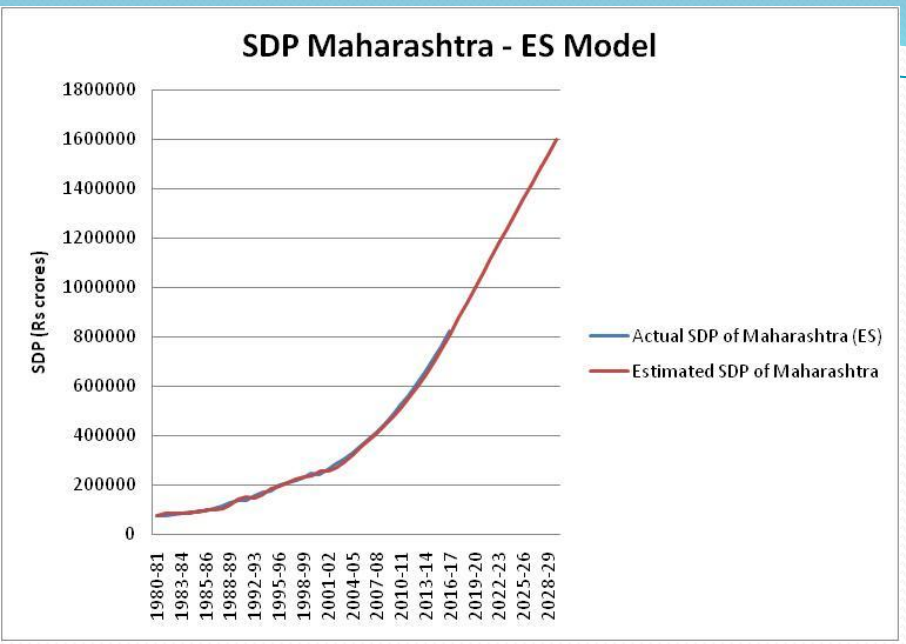


# Key Drivers of the Tool

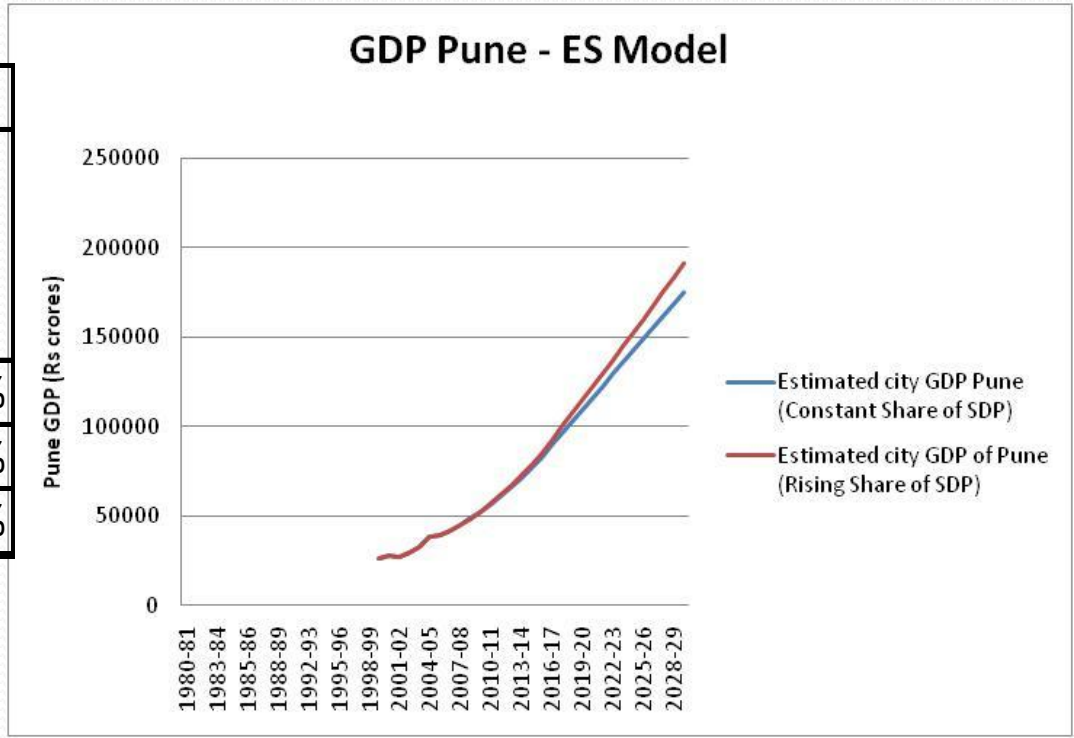
- GDP/Income Forecasts
- Population and Urbanization levels
- Equipment and Appliance Saturations
- Estimates of Baseline Efficiencies
- Efficiency Cost Curves
- Building Stock Assessment

# Forecasting Income: Economic Activity at City Level

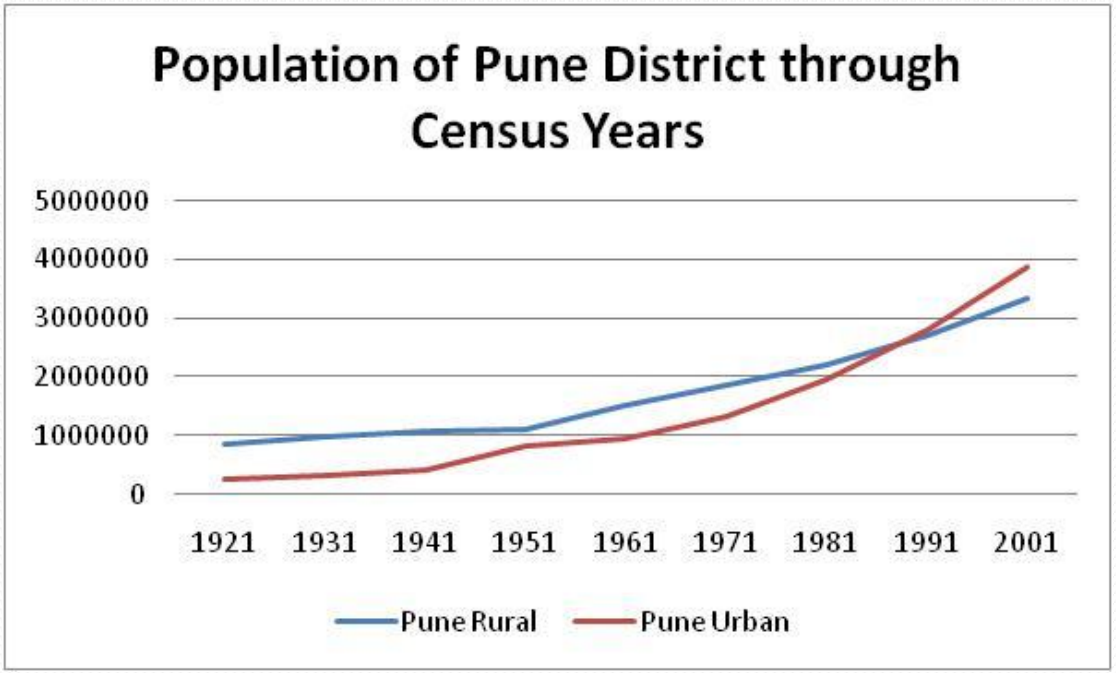
- **Level** and **composition** of economic activity drives demand by inducing production and income effects
  - Higher levels of production/ value added steer (derived) demand for key inputs – energy, water, transportation, and other services -- through a series of input-output linkages
  - Higher incomes enhances (final) demand for commodities - positive income effects for normal goods




| Estimated compound annual rates of growth | | | |
|---|---|---|---|
| | SDP Maharashtra - ES Model | City GDP (constant share) | City GDP - rising share |
| 2000-10 | 7.2% | 7.2% | 7.2% |
| 2010-20 | 7.7% | 7.7% | 8.1% |
| 2020-30 | 5% | 5% | 5.3% |



# Population and urbanization

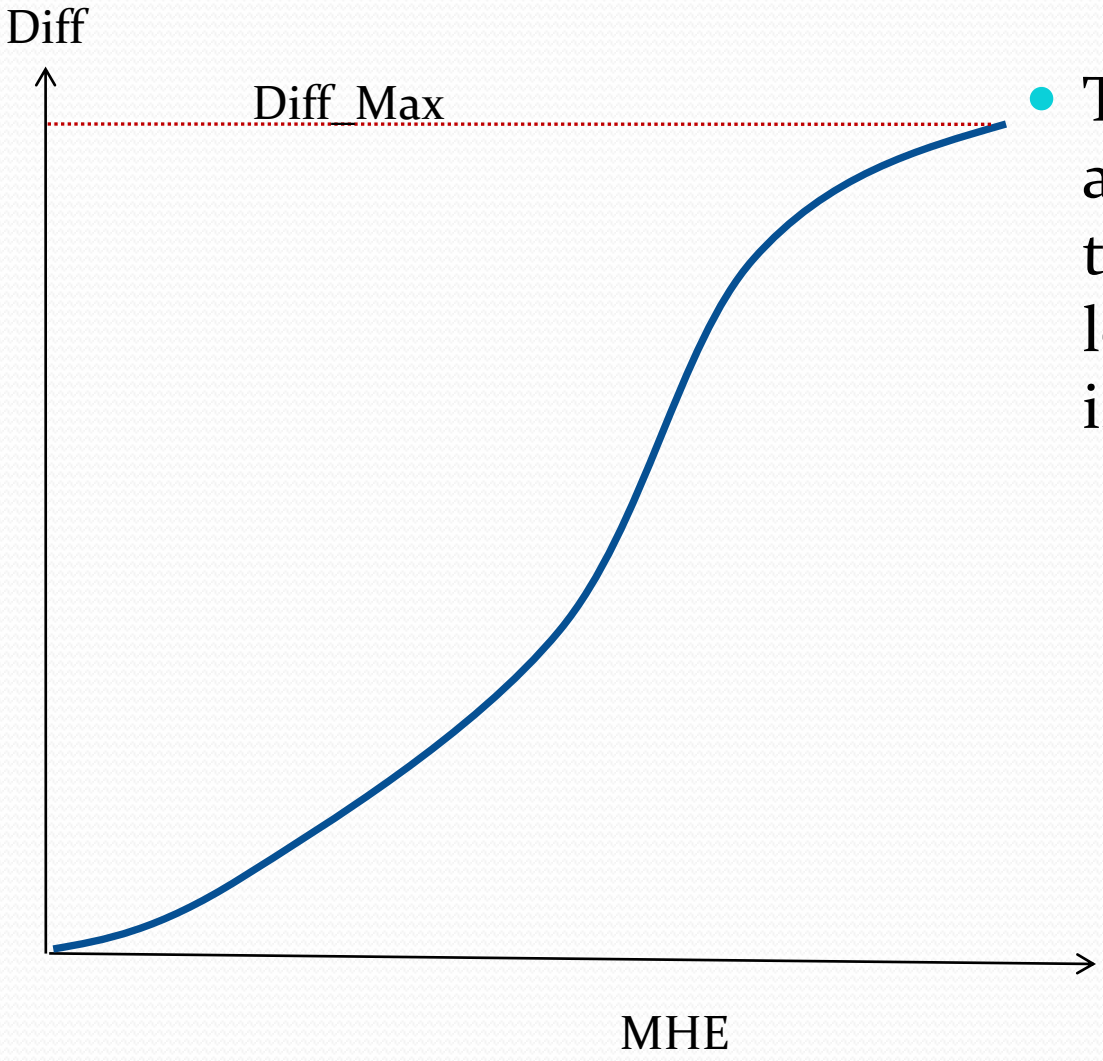



- The population share of Pune district rises marginally in State (6% to 7%)
- Urban population increase over 1971-2001 much faster (2.7% p.a.) as compared to rural (1.5% p.a.).
- Such high rates of urban population growth put stress on urban facilities and infrastructure

# Equipment and appliance saturation

- As part of the end-use bottom up approach to predicting energy demand in households, appliance ownership is explained by
  - Household monthly expenditure
  - Household size
  - Index of inequality
  - Time trend
- City level estimation proposed by utilizing various rounds of NSS Household Survey Dataset

# Saturation curve



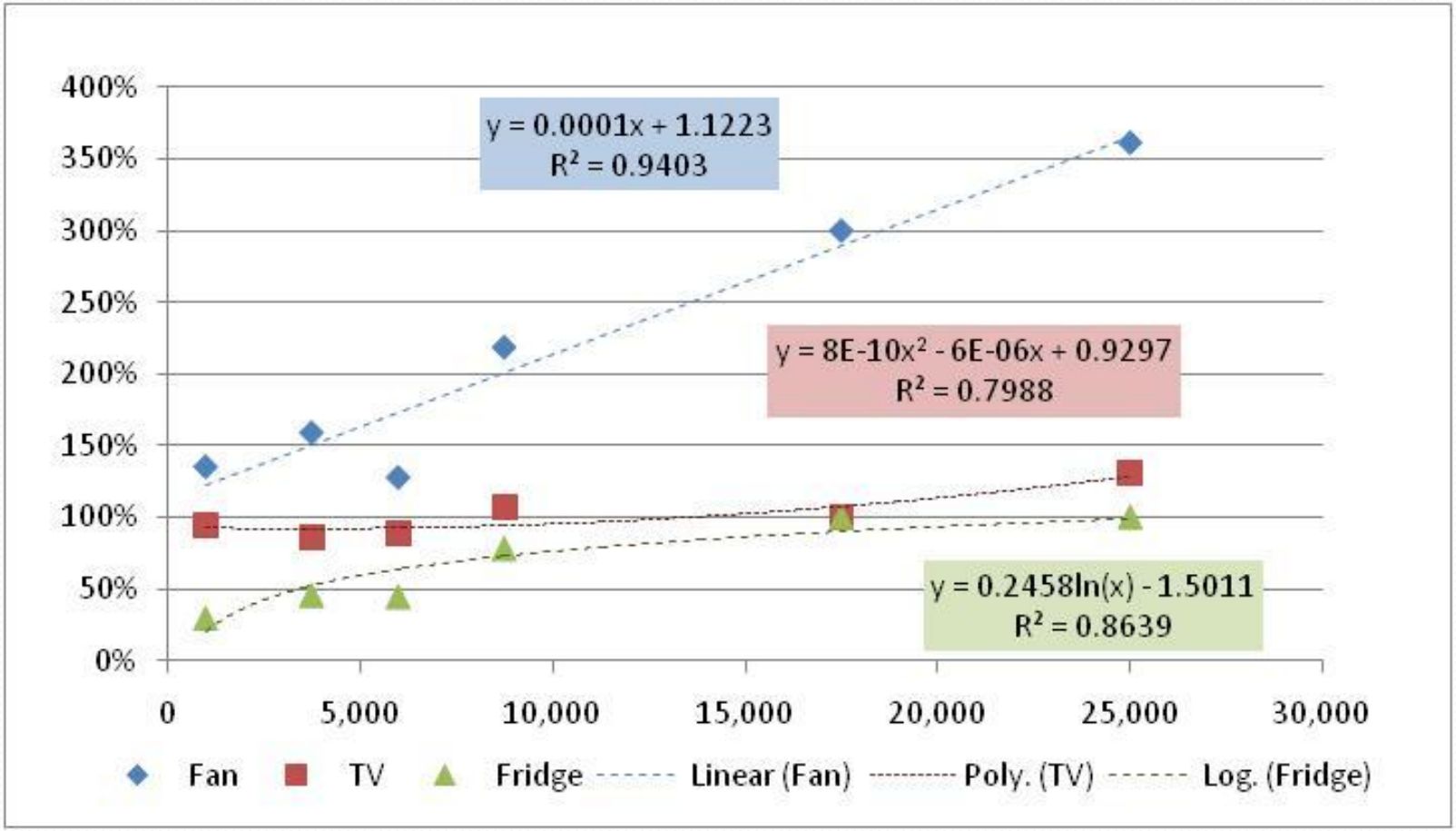

- The diffusion of appliances postulated to follow an S-shaped or logistic growth s.t. there is
  - an initial faster rate of appliance diffusion,
  - an inflexion point,
  - a slower rate of appliance penetration later

# Tool Overview

## 6 Sectors

| Sectors | Agent and Activity | Main disaggregation |
|---|---|---|
| Residential | Households and Equipment ownership | Slum and other urban areas |
| Commercial | Square meter of building | Building type: hotel, retail, schools, etc. |
| Transport | Number of Vehicles | Modes |
| Water | Households and economic activity | Sector of activity |
| Waste | Households and economic activity | Sector of activity |
| Public/Street Lighting | Road Length (# Lamps) | Traffic zones |

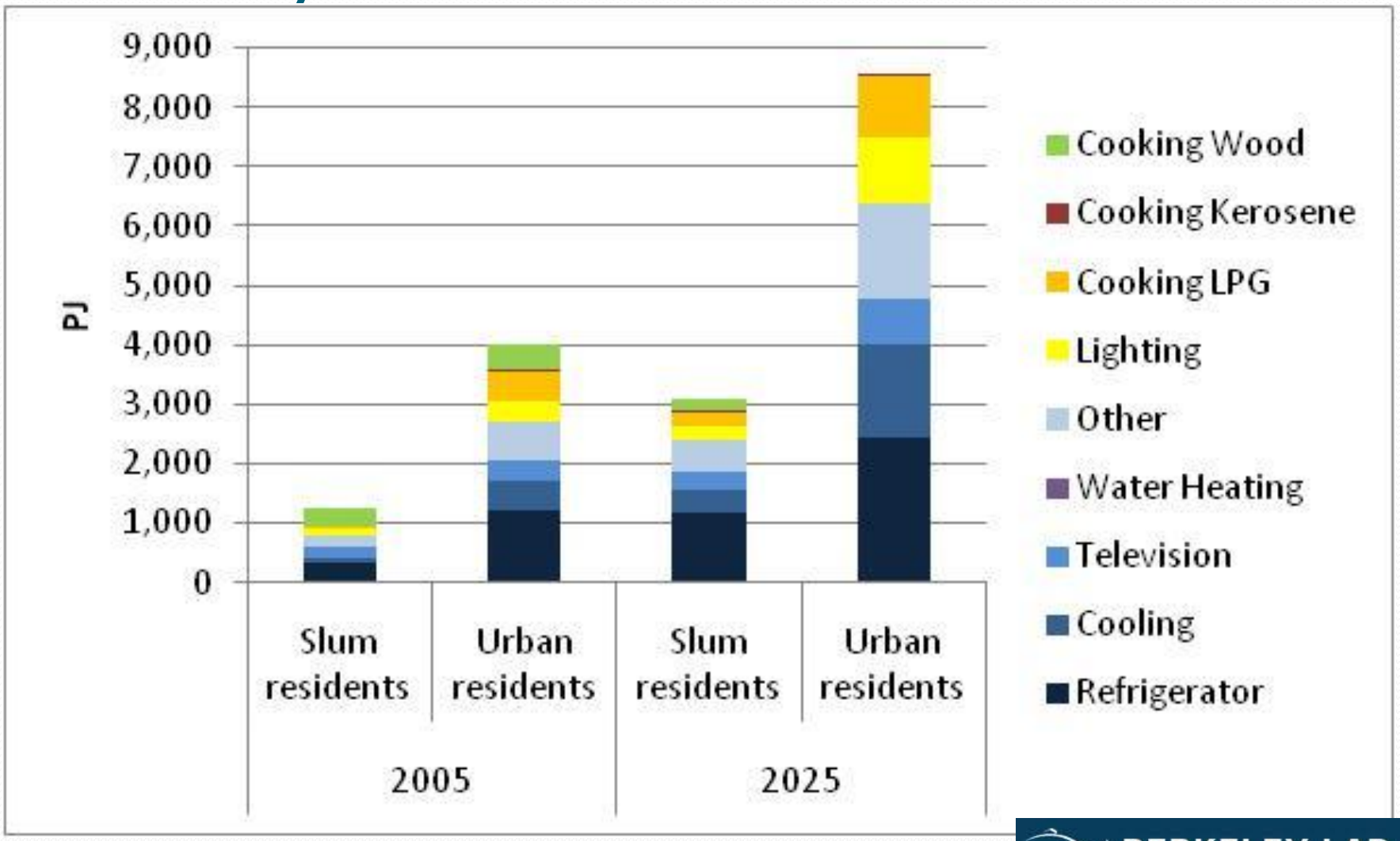
# Residential: Saturation



# Tool Outputs

- Estimates cost of implementation
- Resource Savings Impacts (energy, water, fuelwood)
- Pollution Reduction Impacts ($CO_2$, NOx, PM10)
- Waste Reduction Impacts
- Prioritized set of actions

# Residential:Baseline (Preliminary Results)



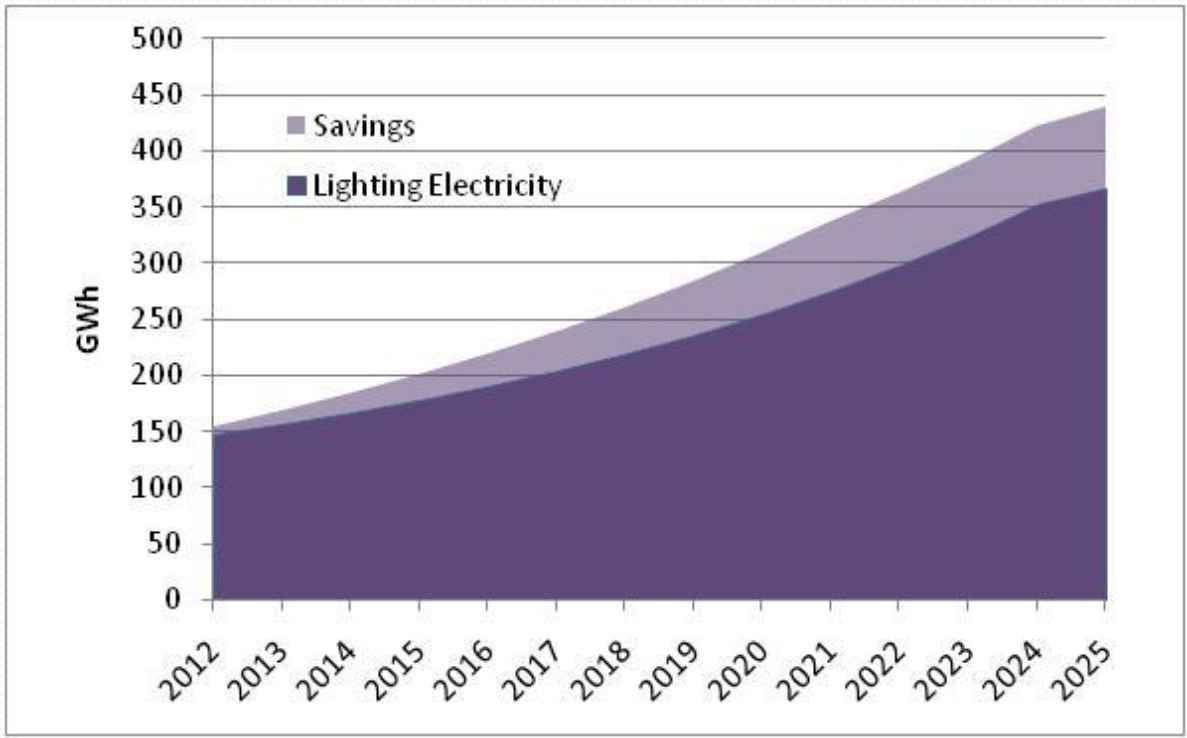
# Residential: Measures Considered

- Replacement of Fluorescent T12 lamps with T8 and T5
- Promoting Fluorescent lamps T5 instead of T12 or T8
- CFL replacement for all incandescent
- Incandescent phase out
- Moving from baseline efficiency to 4 star or higher for refrigerators
- Cool roofs
- Kerosene to LPG for Domestic
- Wood to LPG for Domestic
- Improving Cookstove Eff
- Smokeless biomass cookstoves
- Low flow showerheads
- Replacement with solar water heating
- Efficiency measures for Washing Machine
- Grey water use

# Residential: Measure Example (Preliminary Results)

- Existing stock of T12 replacement with T8 or T5 by 2021
- T12 phase out

| | |
|---|---|
| Electricity savings | 44 GWh |
| % of total Residential electricity | 3% |
| $CO_2$ savings | 40 $ktCO_2$ |
| % of total Residential | 1% |



# Commercial Sector

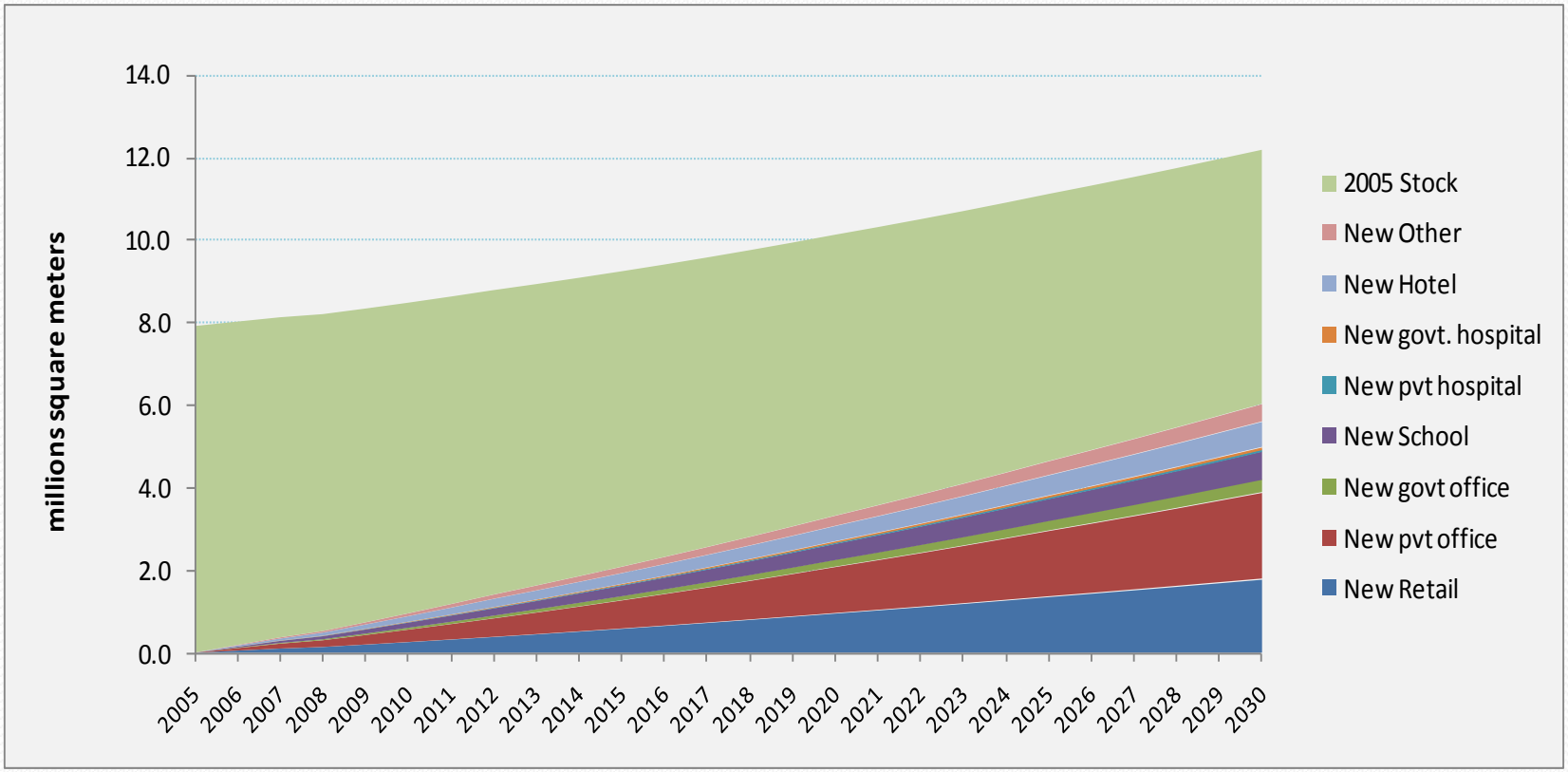
Three principal components of energy use estimates –

1. Building Stock Assessment (by building/activity type)
2. Energy Use Intensity (by building/activity type)
3. End-use level breakdown of energy use (lighting, cooling, fans, other)

Drills down to the end-use level, where specific policy can be assessed

- HVAC – Equipment types and market shares for specific buildings by activity type
- Lighting – Based on lighting power density observed in buildings by activity type
- Water use
- Waste Generation

# Preliminary Findings – Building Stock Assessment



# Potential Measures in the Commercial Buildings Sector

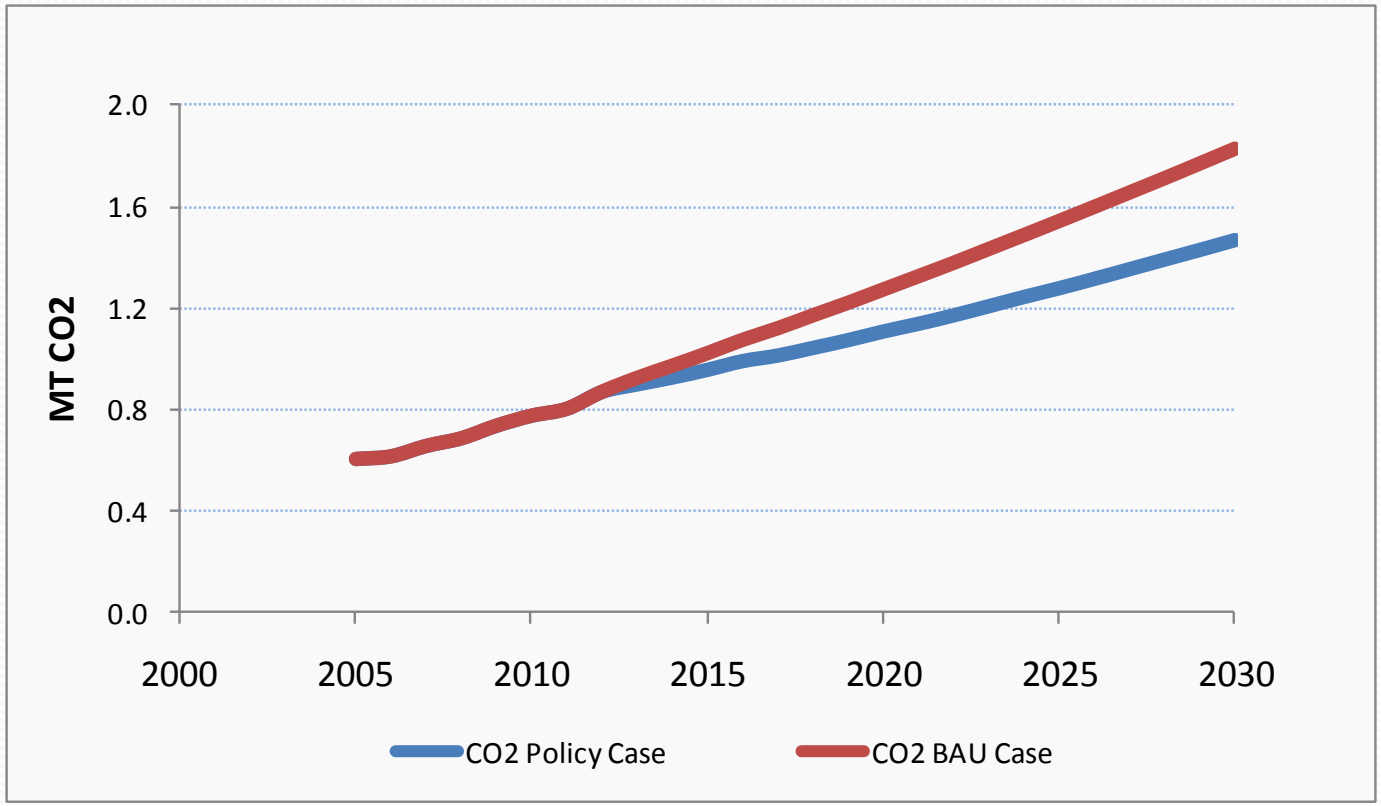
**Space Cooling**

- Cool Roofs
- Other HVAC efficiency measures
- Energy efficient windows and insulation
- ECBC implementation in all buildings

**Lighting**

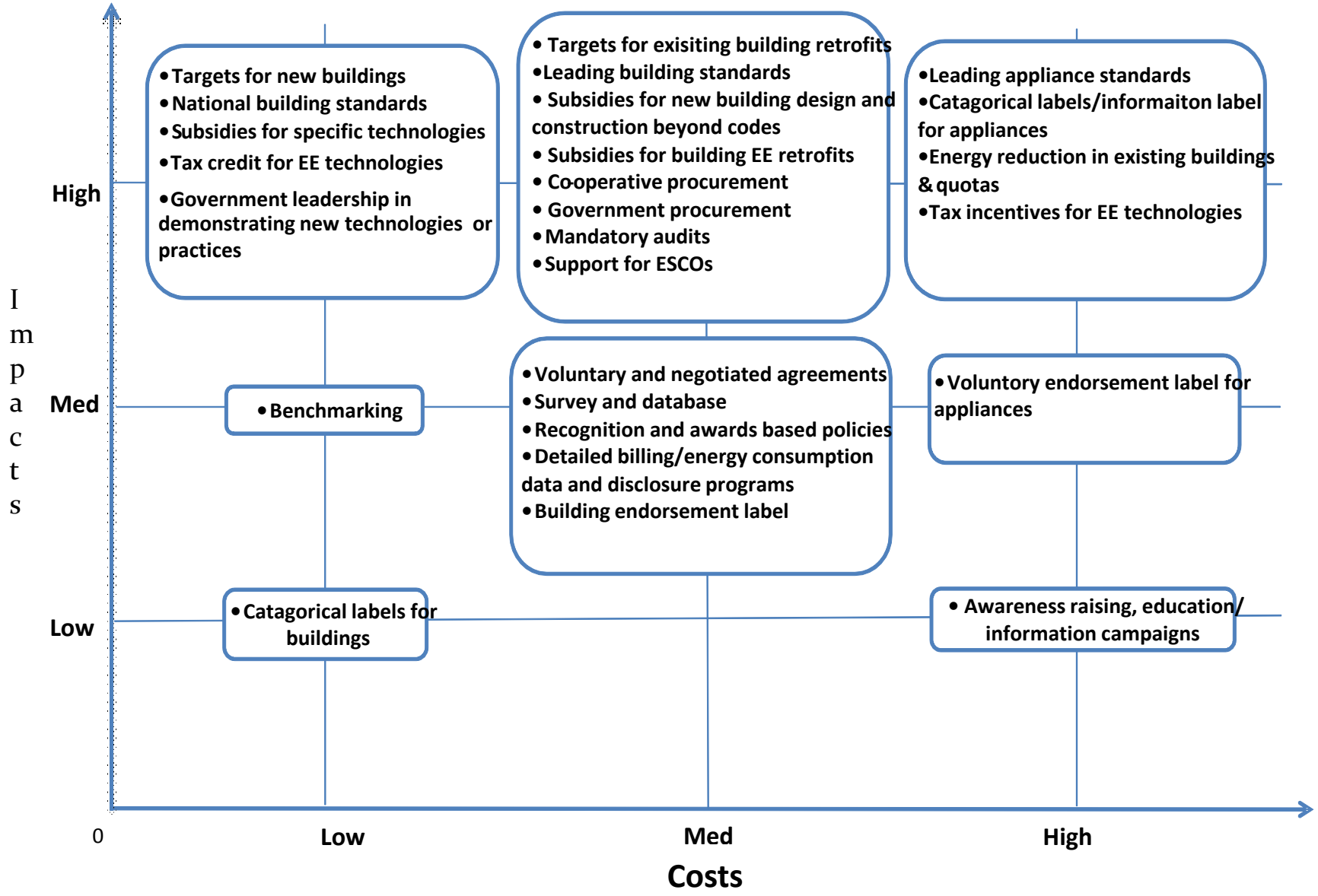
- Replacement of T12 and T8 Lamps by T5s
- ECBC implementation in all or PSU buildings
- LED lighting for exterior areas
- Installation of sensors to reduce the "on" time

# Potential $CO_2$ reduction from Building Code Implementation in Commercial Buildings Pune




- A potential reduction of ~15% by 2020 and 25% by 2030 for an 80% adoption rate

# Developing Low Carbon Climate Action Plan at the City Level
## Policy Mechanism Selection –Building Sector Example



# Key discussion points for the ASEAN member countries

- Sustainability can mean many things – can we discuss some objectives that ASEAN member cities would like to consider under this?
- Some cities (Vancouver, Melbourne) and even countries (Denmark) have a zero-net-energy target. Is this even possible?
- What regional networks exist for cooperating on SUE planning? How are these being used now?
- What is the advantage of a sustainable urban energy policy over a national energy policy?
  - Often energy is a state priority and not so much a city level priority; are there alternatives you can think of that might provide a leverage to accomplish the carbon targets?
- Are methods in use by the C40 broadly transferrable to the ASEAN region?
- Some of the cities have been working with ICLEI on implementing local Agenda 21; are there lessons from that experience that could be utilized for the ASEAN region as a whole?
- What role do cities perceive for donors and multilaterals?
- Does the responsibility for urban planning currently reside with the City Government? How could the current urban planning incorporate sustainable energy planning within the planning process?
- What are some of the limitations of political leadership in sustainable urban energy?