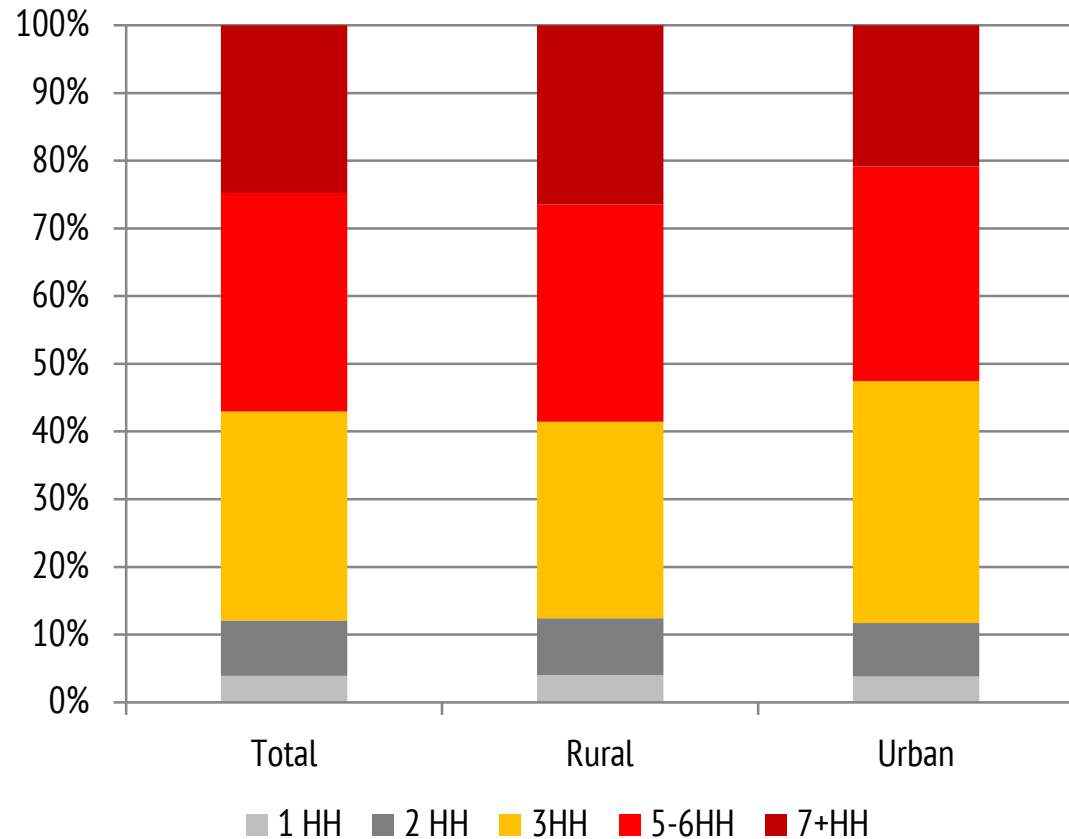


# Housing: Comfort: Energy

# Context



**Population: 1237 Million (313.9)**

**Households: 220 Million (120.7)**

**Avg. Household size: 5.3 (2.6)**

**8k Towns and 600k Villages**

**Avg. house hold energy consumption per year  
900 kWh/year**

**833M (69%) in Rural India**

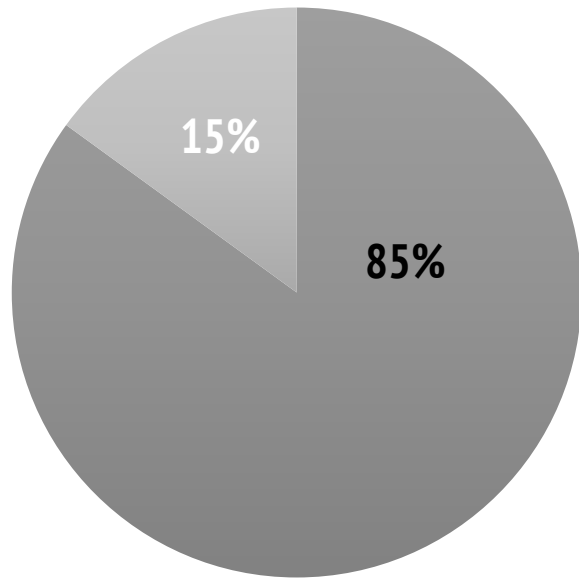
**377M (31%) in Urban India**

*Source: Census India 2011*

# Context: Power cuts summer 2016

City	Avg Temp Degree C	Peak Demand MW	Peak Supply MW	Power Cuts Hrs.
Srinagar	28	822	750	10
Raipur	41	410 (375)	410	14-16
Kolkata	35	1986 (1865)	1986	No Scheduled
Patna	40	2400 (2200)	1900	3-5
Bhopal	45	330 (280)	330	No Scheduled
Mumbai	32	3365 (3212)	As per Demand	No
Ahmedabad	39	1534 (1372)	As per Demand	No

Source: Indian Express, Sunday , June 1, 2016



**Sector-wise Floor  
Space Area by 2050**

- Residential
- Commercial

## Residential Energy Consumption

34% Fans

28% Lighting

7% Air Conditioning

4% Evaporative Cooler

13% Refrigerator

4% Television

10% others

**73%**

**27%**



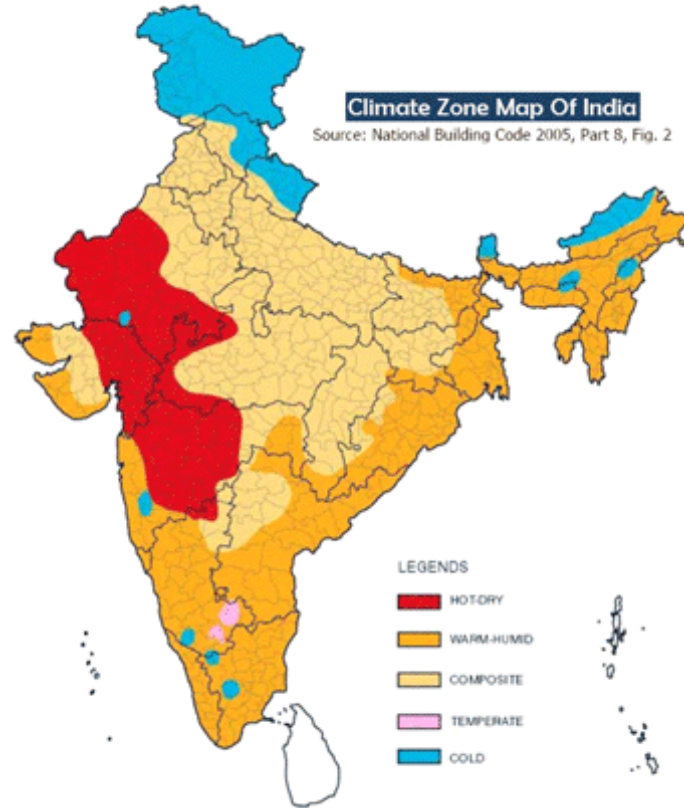
- Building Codes for Commercial Buildings: ECBC and For Residential ECBC – R
- “Housing for All” – GoI
- Residential Energy can be managed by S & L program
- ‘Lock In’ period of new residential construction

# GBPN – CEPT Study



- How much Energy India's residential sector consume
- What should we focus on
  - Buildings or
  - Appliances or
  - Behaviour or
  - Everything?
- Should we rely on Market or Codes

# Methodology: Field Study



- Four Cities – in Four Climate Zone
- Ahmedabad – Hot and Dry (CDD 3441 – HDD 131)
- New Delhi – Composite (CDD 2928 – HDD 429)
- Mumbai – Warm and Humid (CDD 3567 – HDD 0)
- Pune – Moderate (CDD 2485 – HDD 175)

About 1000 households – 250 per Climate Zone

# Methodology: Field Study



- Housing Typology
  - Ground + 3
  - Ground + 12
  - Row houses – Tenements
  - Independent Bungalows
- Family of 2 to 7
- Various neighborhoods



# Methodology: Field Study

તમારું વીજળી બિલ સમજો.

ST00041

S.L. PATEL  
HOUSE NO. 1  
SECUNDER STREET,  
N.P. CANAL,  
SURAT.

**torrent**  
**POWER**  
TORNENT POWER LIMITED  
Tornent House, Sector-10, Gurgaon, Haryana, India - 122002  
T. 011-26100000, F. 011-26100001, E. info@torrentpower.com

**YOUR ELECTRICITY BILL - MAR-2012**

Service number / સેવા નંબર  
50029773

Net Payable amount / જે ચૂકવવા માટે  
**Rs. 22,483.00**

Bill due date / બિલ ચૂકવવાની તારીખ  
**31-03-2012**

Particulars / વસ્તુ	Amount / રકમ
Total energy charges (0.00-0.00) / જે ચૂકવવા માટે	1872.25
Delivery Payment Charges / ડેલિવરી ચાર્જ	20.41
Other taxes / અન્ય ટેક્સ	0.00
Stand-by duty / સ્ટાન્ડ-બાય ડયુટી	949.21
Current bill amount / વર્તમાન બિલ રકમ	4271.87
Previous bill / પાછલા બિલ	16208.00
C / F amount / સેવા નંબર	-0.04
Net Payable amount / જે ચૂકવવા માટે	22483.00

**METER & BILLING DETAILS / મીટર અને બિલની વિગતો**

Type / વસ્તુ	Value / મૂલ્ય
Meter no / મીટર નંબર	63000670
Present reading / વર્તમાન રીડિંગ	479054
Final reading / અંતિમ રીડિંગ	477071
Multiplying factor / મલ્ટિપ્લિયિંગ ફેક્ટર	1.00
Units consumed / વપરાયેલ યુનિટ્સ	964
Stand-by duty / સ્ટાન્ડ-બાય ડયુટી	949.21
Lighting / લાઇટિંગ	0.00
Fans / ફેન્સ	0.00
Appliances / એપ્લાયન્સ	0.00
Other / અન્ય	0.00
Total / કુલ	964

**CONSUMPTION INFORMATION / ઇલેક્ટ્રિકલ વપરાશ**

Category / વર્ગ	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11	Jan 12	Feb 12	Mar 12
Lighting / લાઇટિંગ	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Fans / ફેન્સ	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Appliances / એપ્લાયન્સ	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Other / અન્ય	100	100	100	100	100	100	100	100	100	100	100	100	100	100

24x7 call center facility, JUST DIAL, 103203. Obtain Power, Meter, Bill, New Application information and complaint registration.

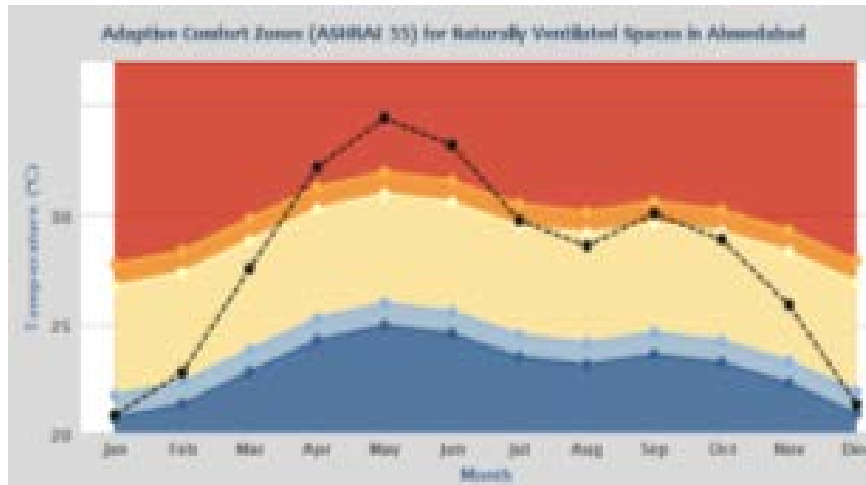
Please attach this coupon with cheque for payment and drop box.

Bill Month: March 2012  
Cycle End No: 27000001  
Service No: 50029773  
Net Amount: 22483.00

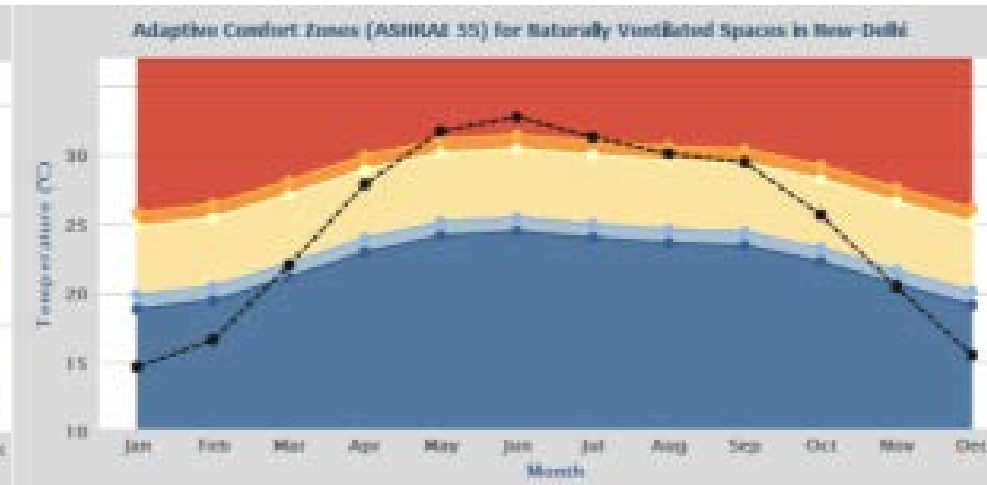
Due Date: 31-03-2012  
Security Deposit Required Amt: 2700.00

- Built-up / carpet / super built - up area
- Construction characteristics
- Building Type - *Common Load, Lifts, Water Pumps*
- Floor Plans – Number of bed rooms
- Family profile
- Location, Number and rating of appliances
  - Appliances operation pattern
- **Connected Load & Bills of One / Two years**

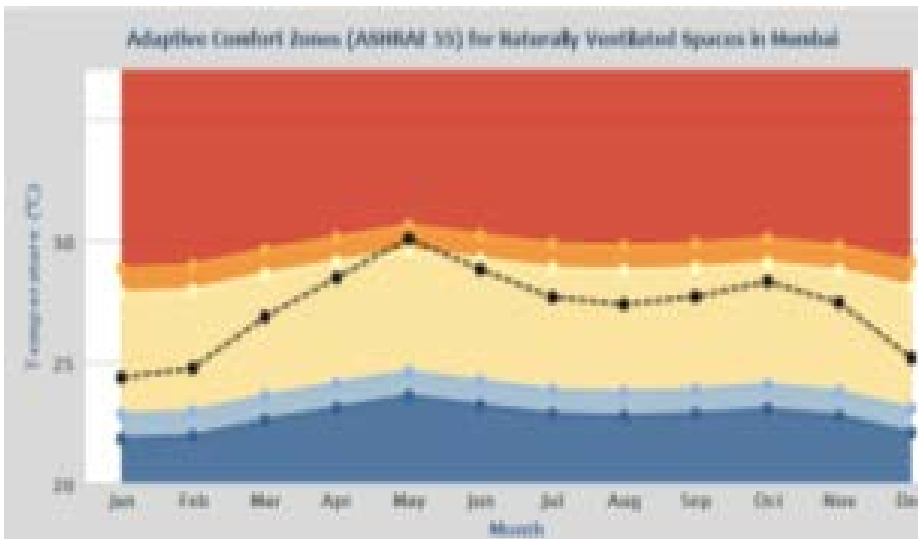
# Methodology: Comfort Hours (ASHRAE 2010 Adaptive Model)



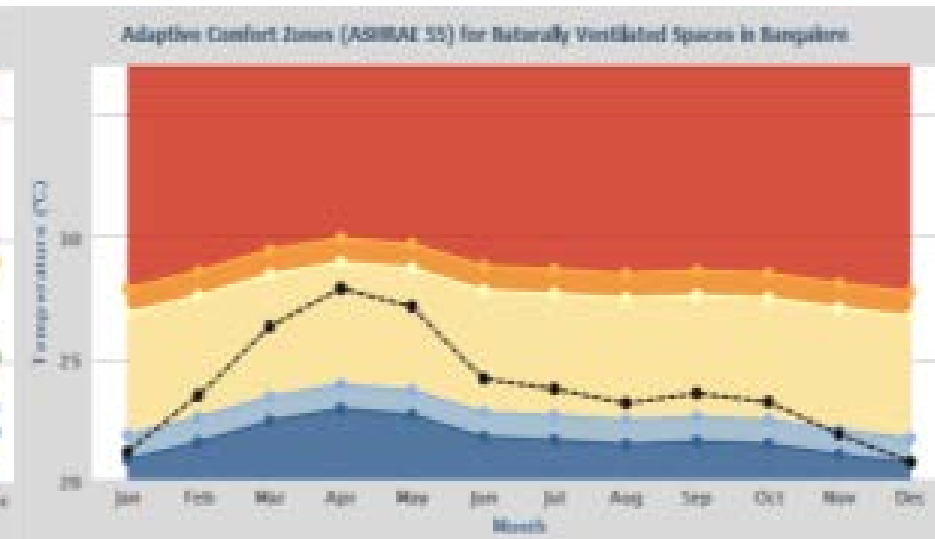
Ahmedabad



New Delhi

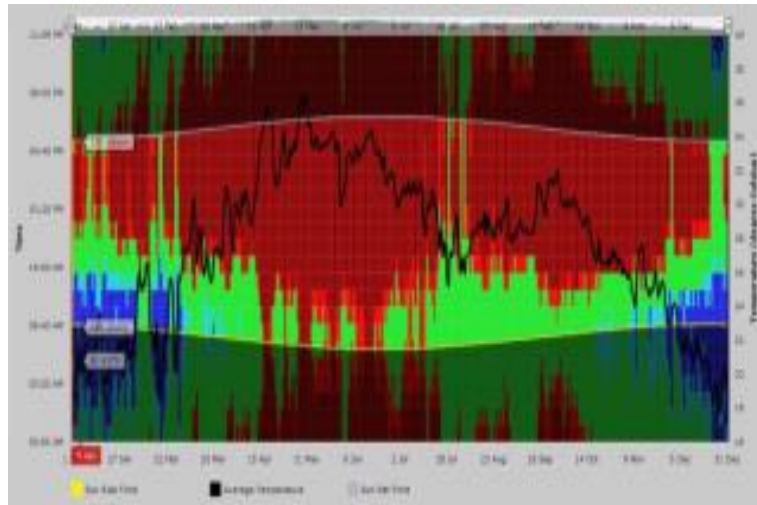


Mumbai

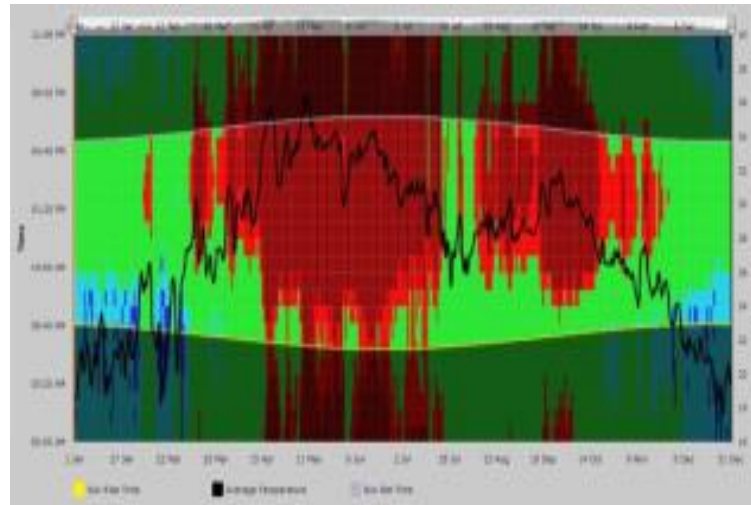


Pune

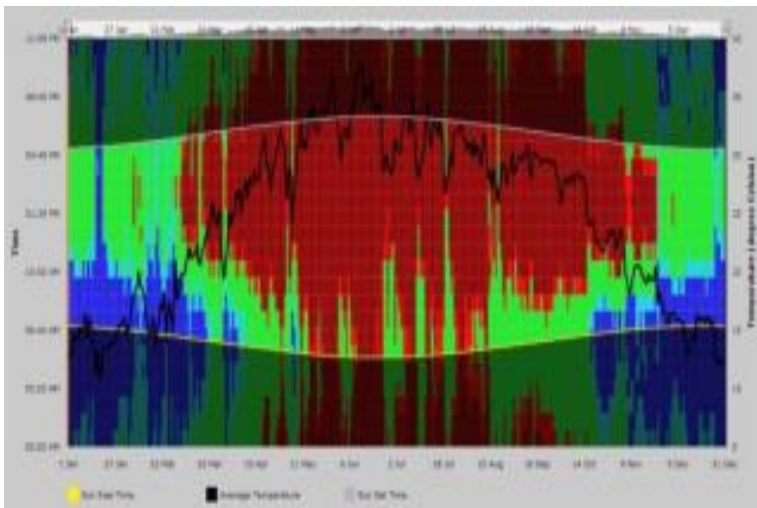
# Methodology: Comfort Hours: Indoors



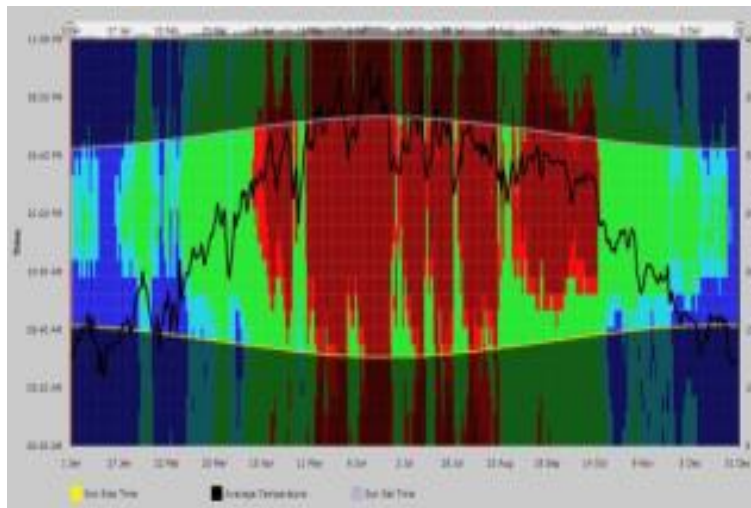
Uncomfortable cold 80% adaptive low 90% adaptive 90% adaptive high Uncomfortable high



Ahmedabad



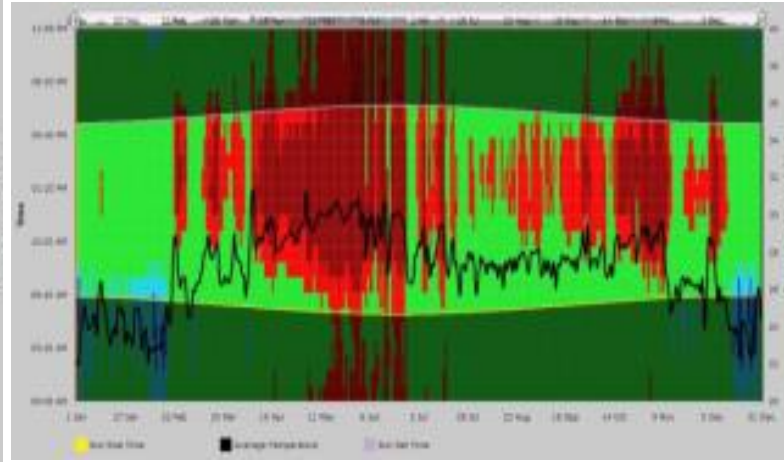
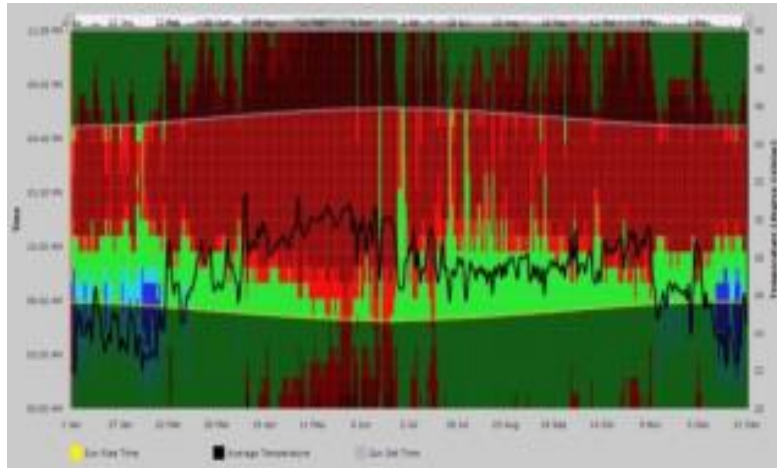
BAU - Residence



New Delhi

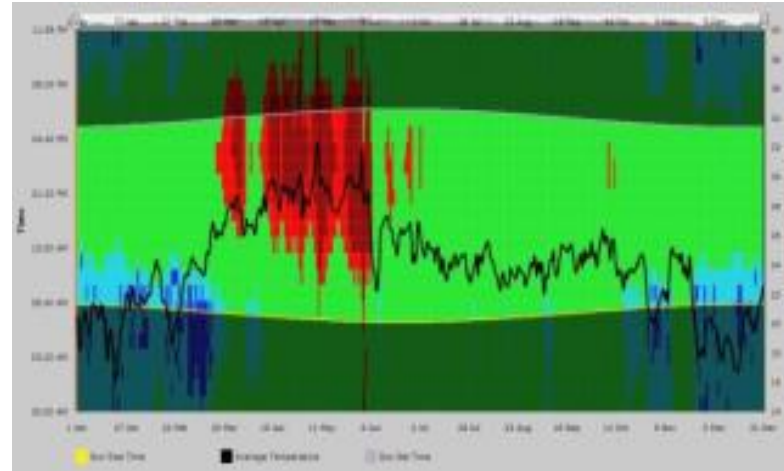
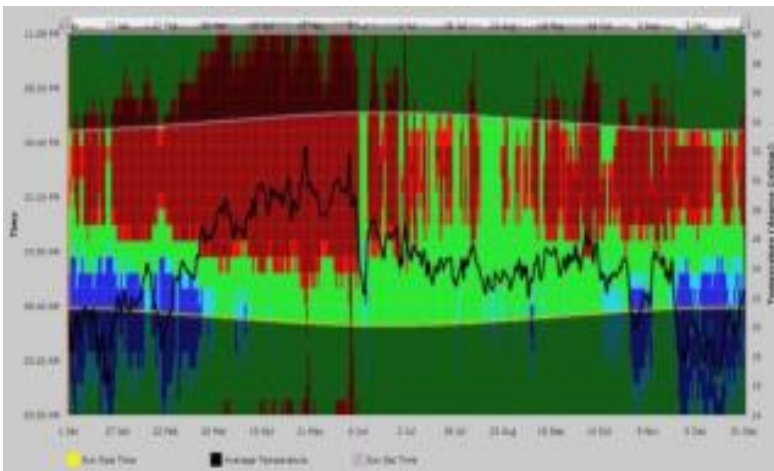
ECBC - Residence

# Methodology: Comfort Hours: Indoors



Mumbai

Uncomfortable cold    80% adaptive low    90% adaptive    90% adaptive high    Uncomfortable high

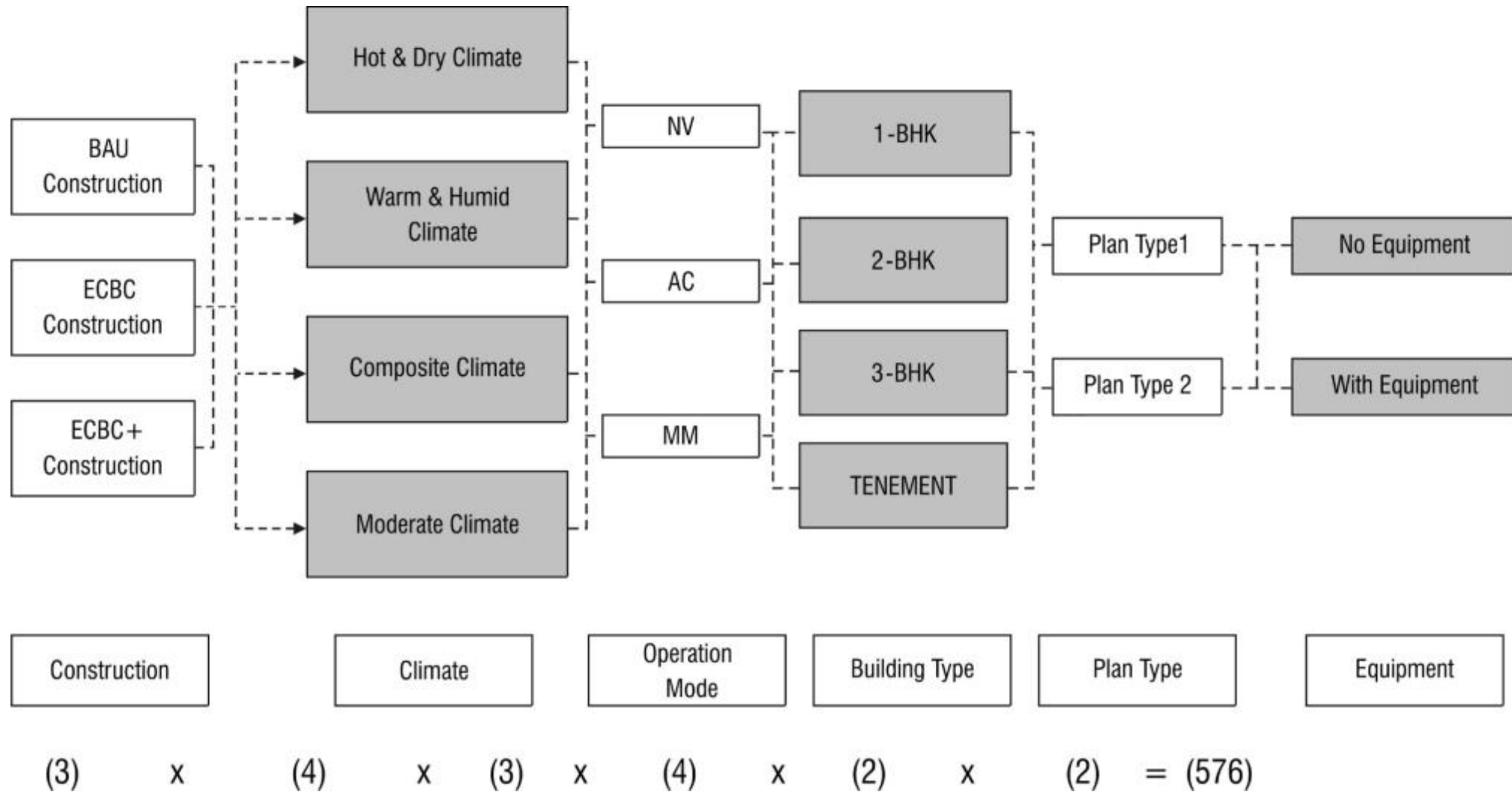


Pune

BAU - Residence

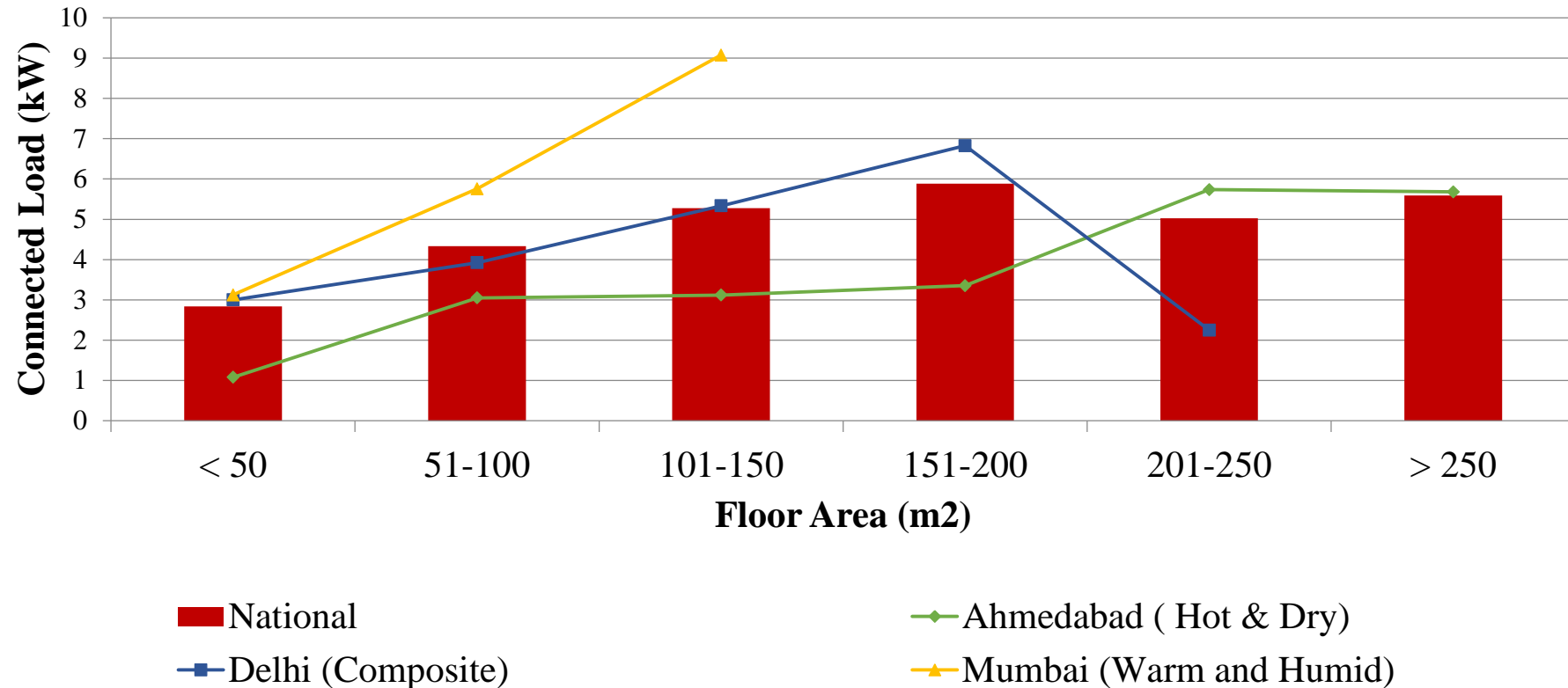
ECBC - Residence

# Methodology: Simulation Run Chart



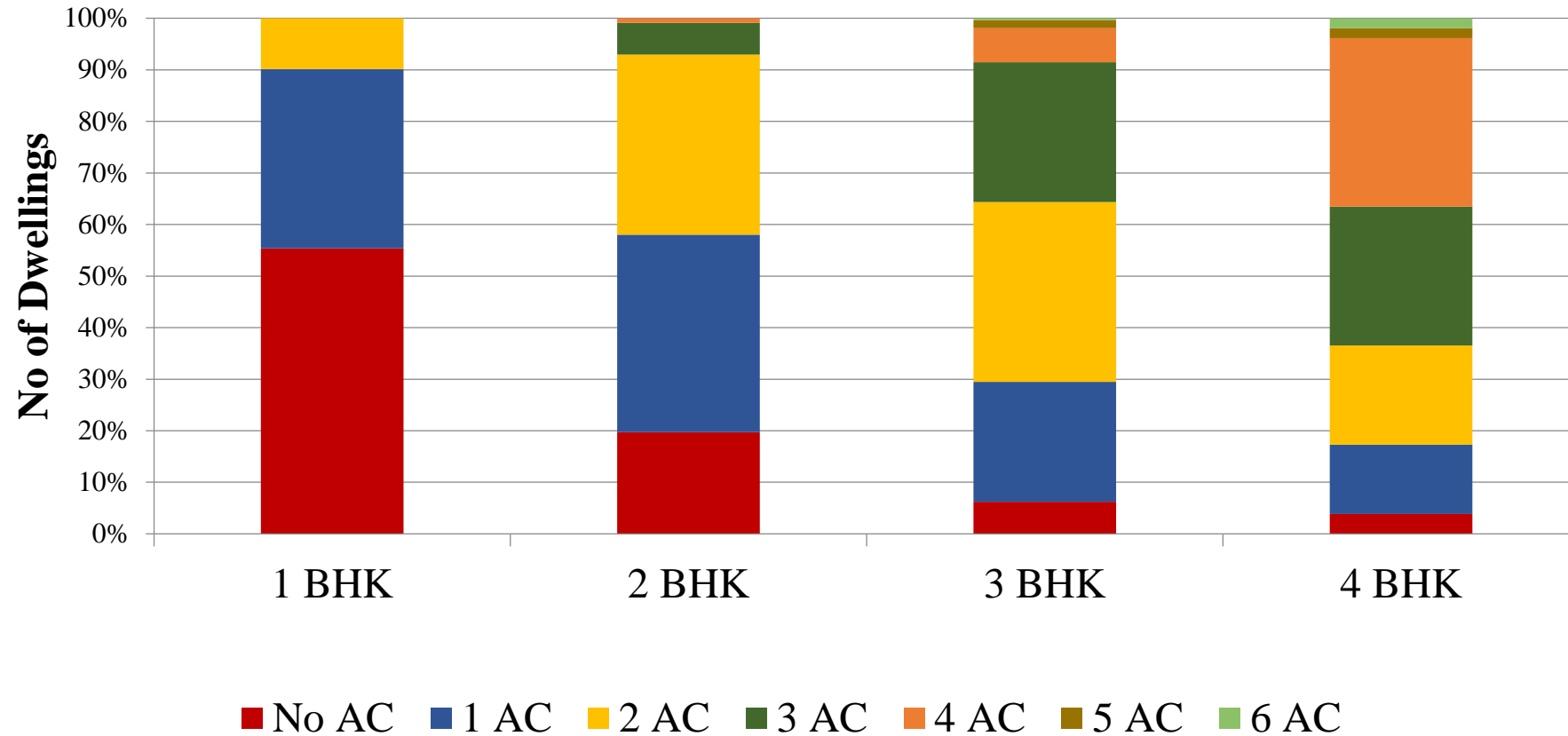
# Observations and Analysis

## Connected Load versus Floor Area

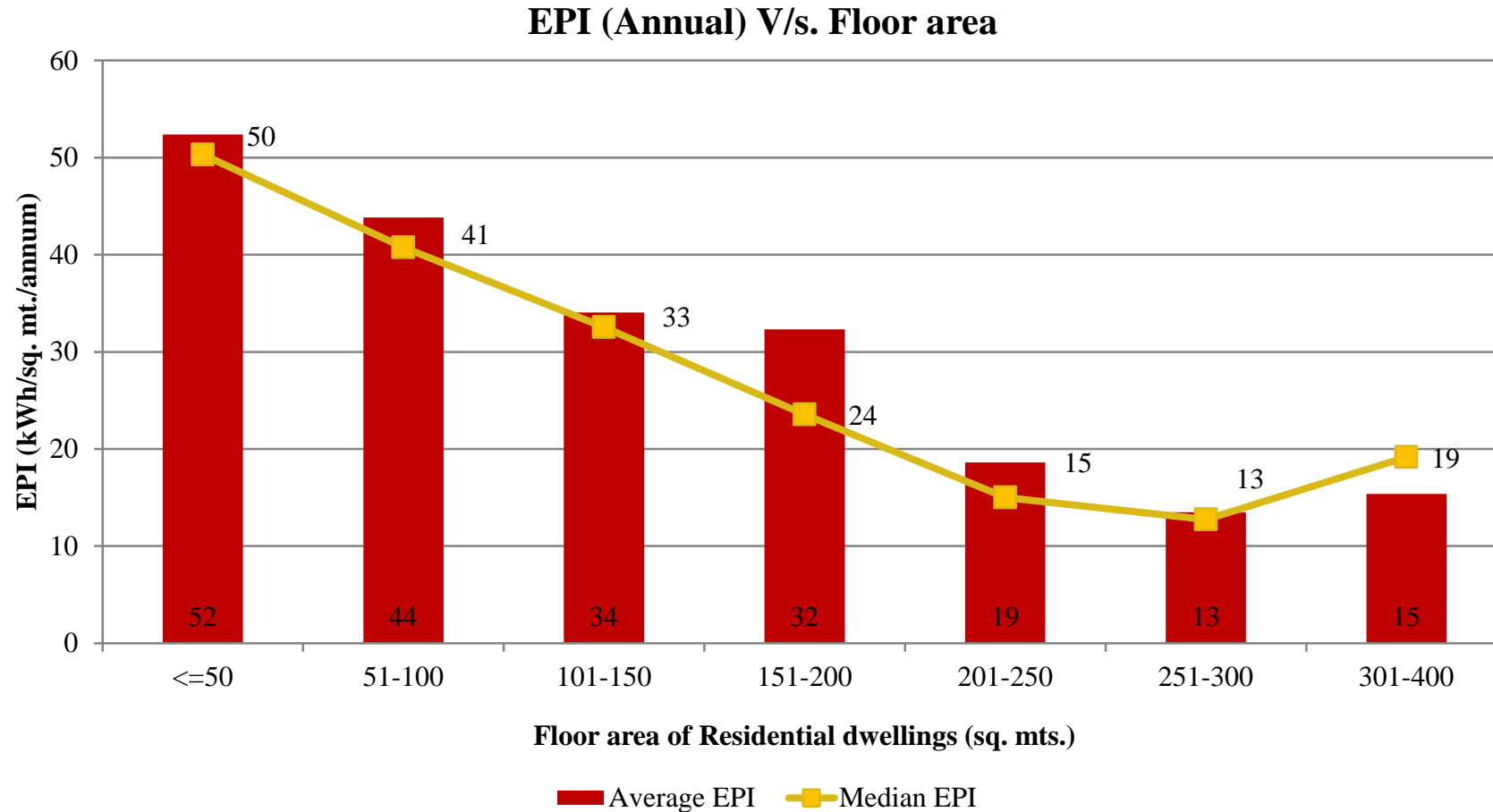


# Observations and Analysis

## Air Conditiners and Bedroom Distribution

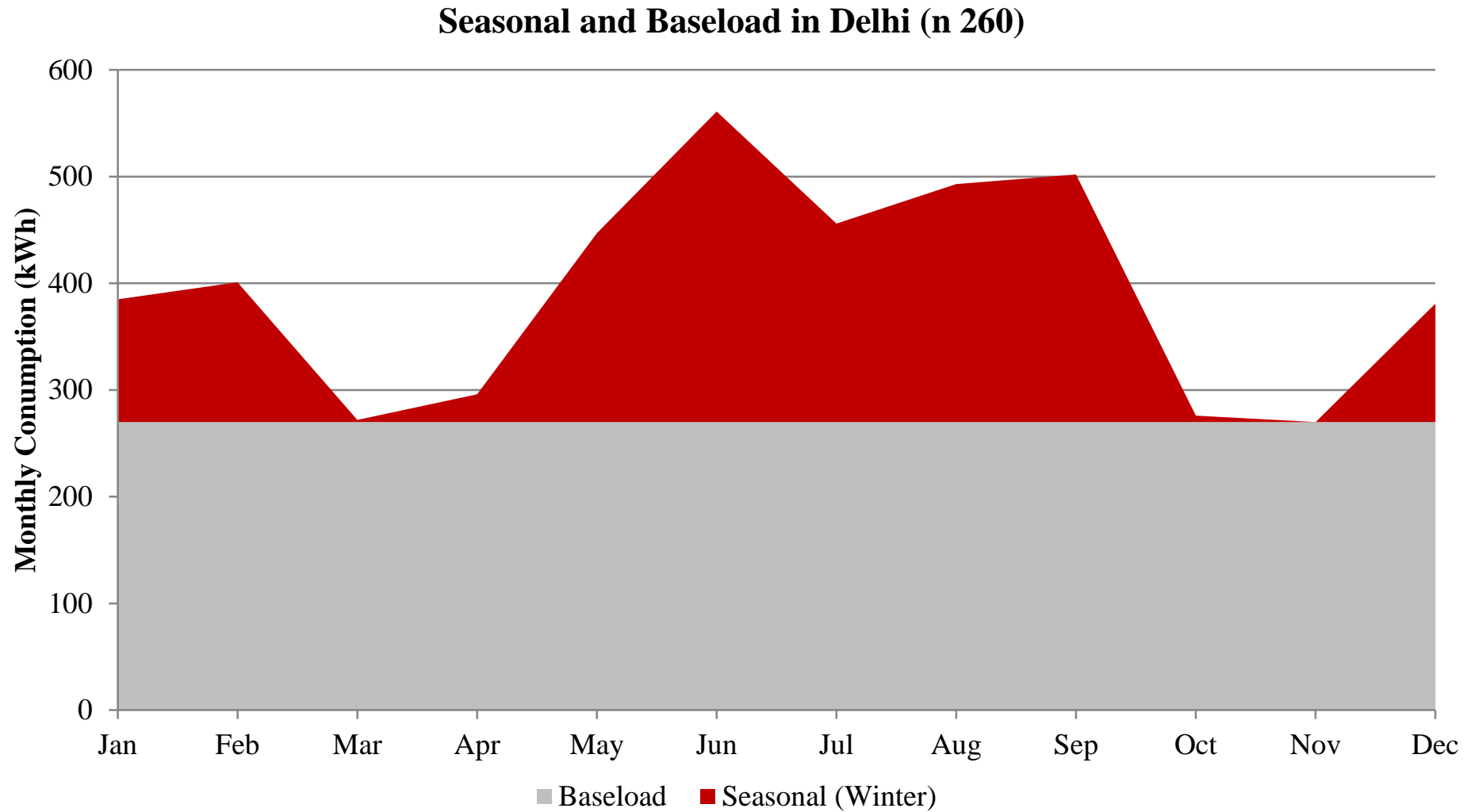


# Observations and Analysis

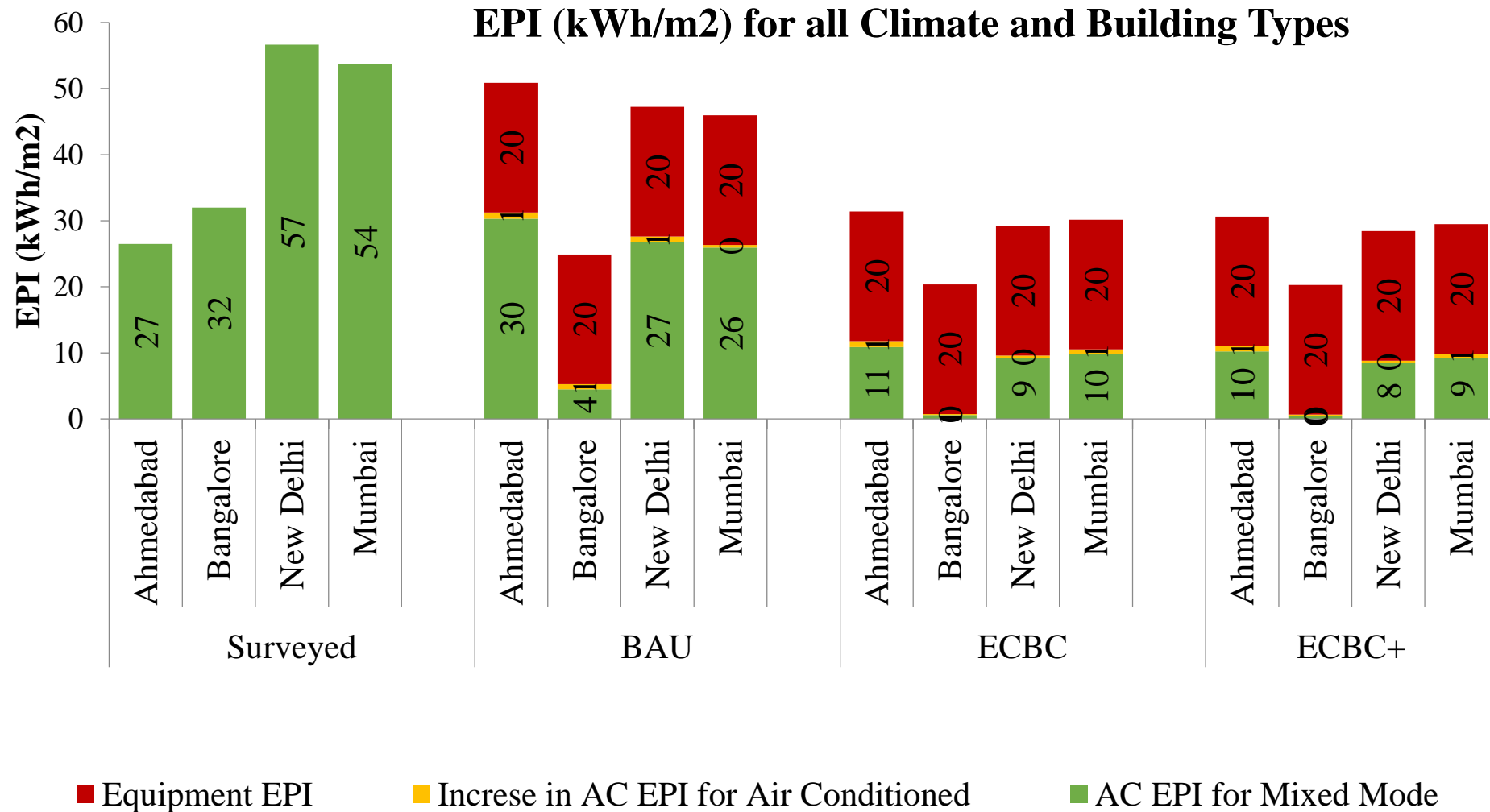




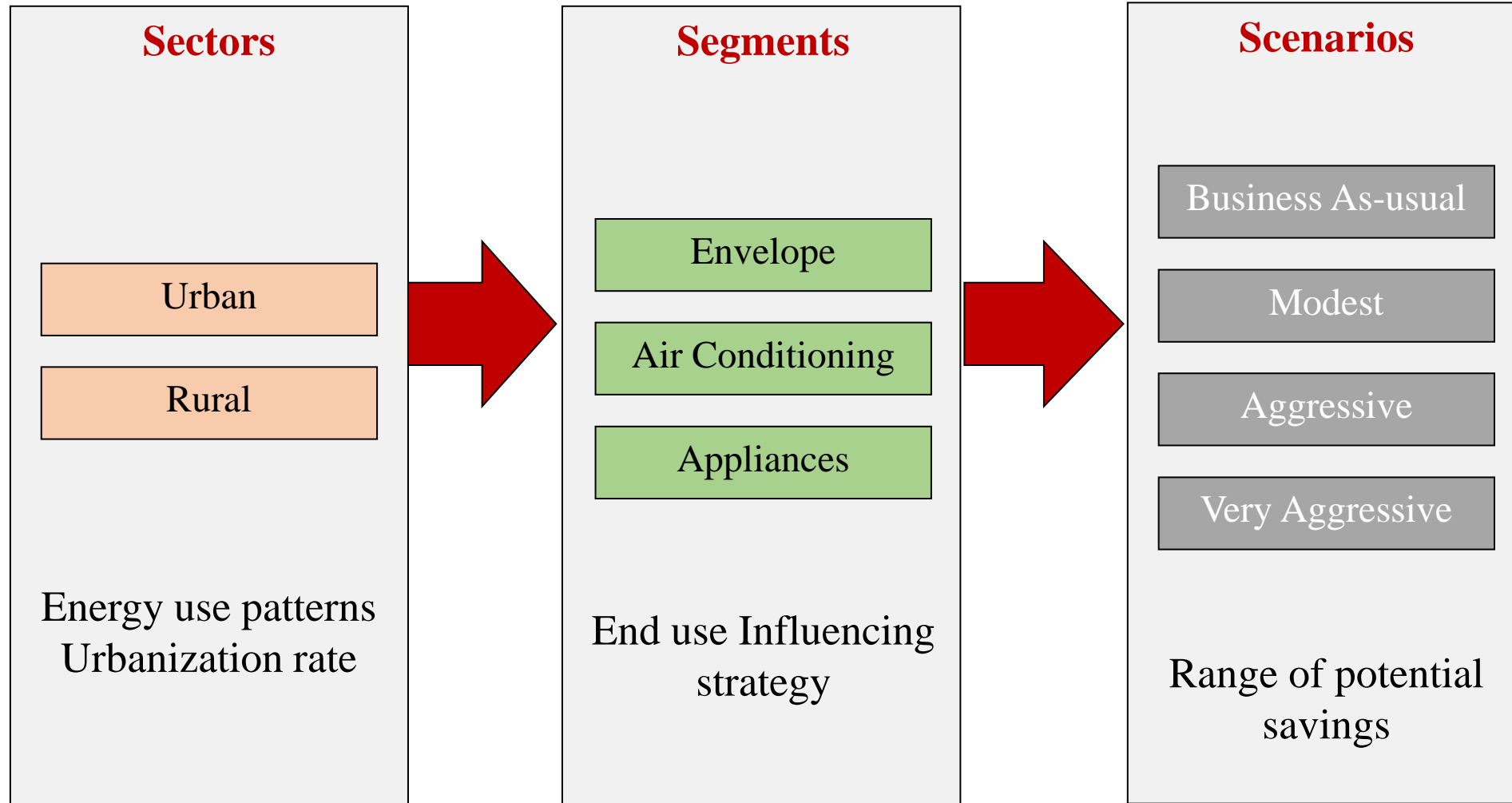
# Observations and Analysis



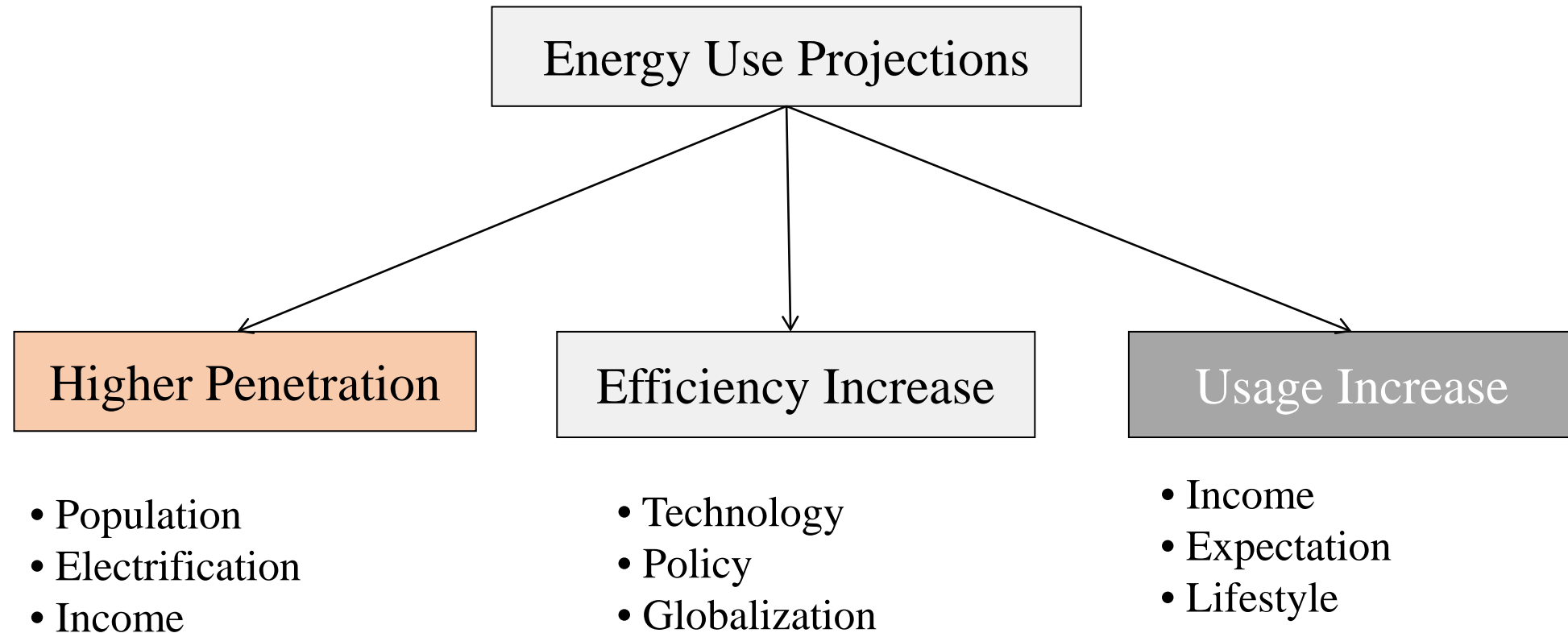
# Observations and Analysis



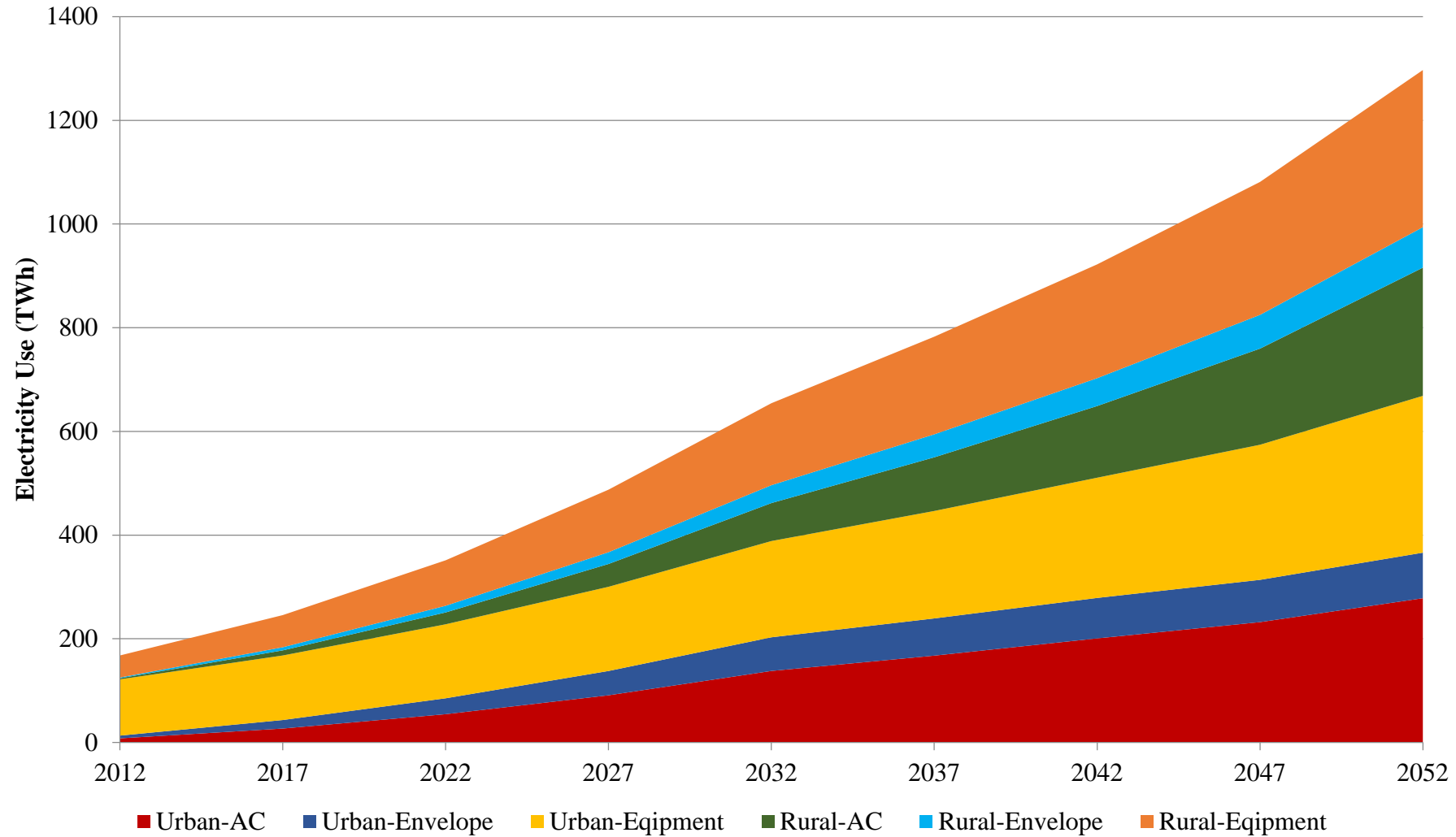
# Projections



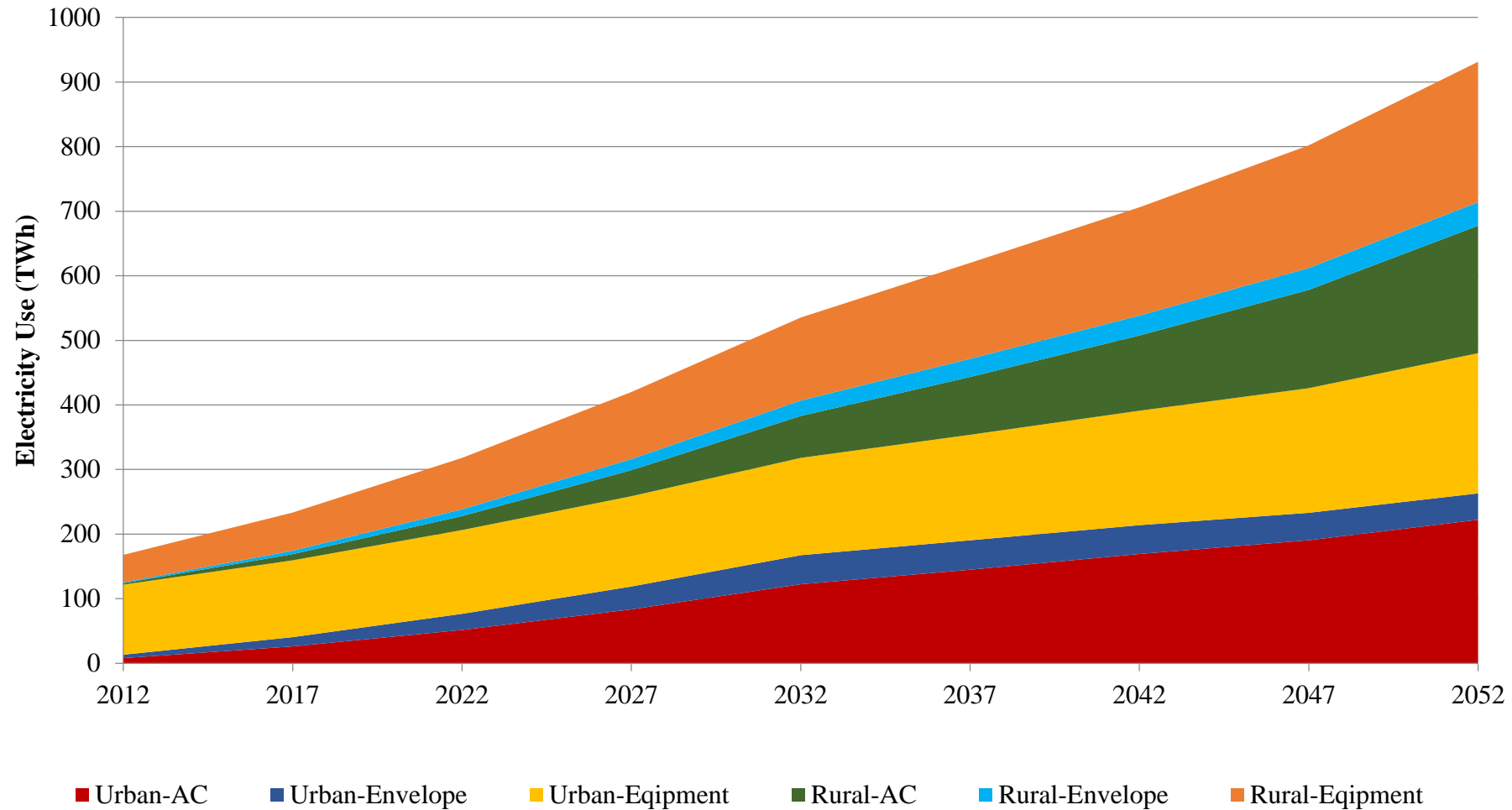
# Projections



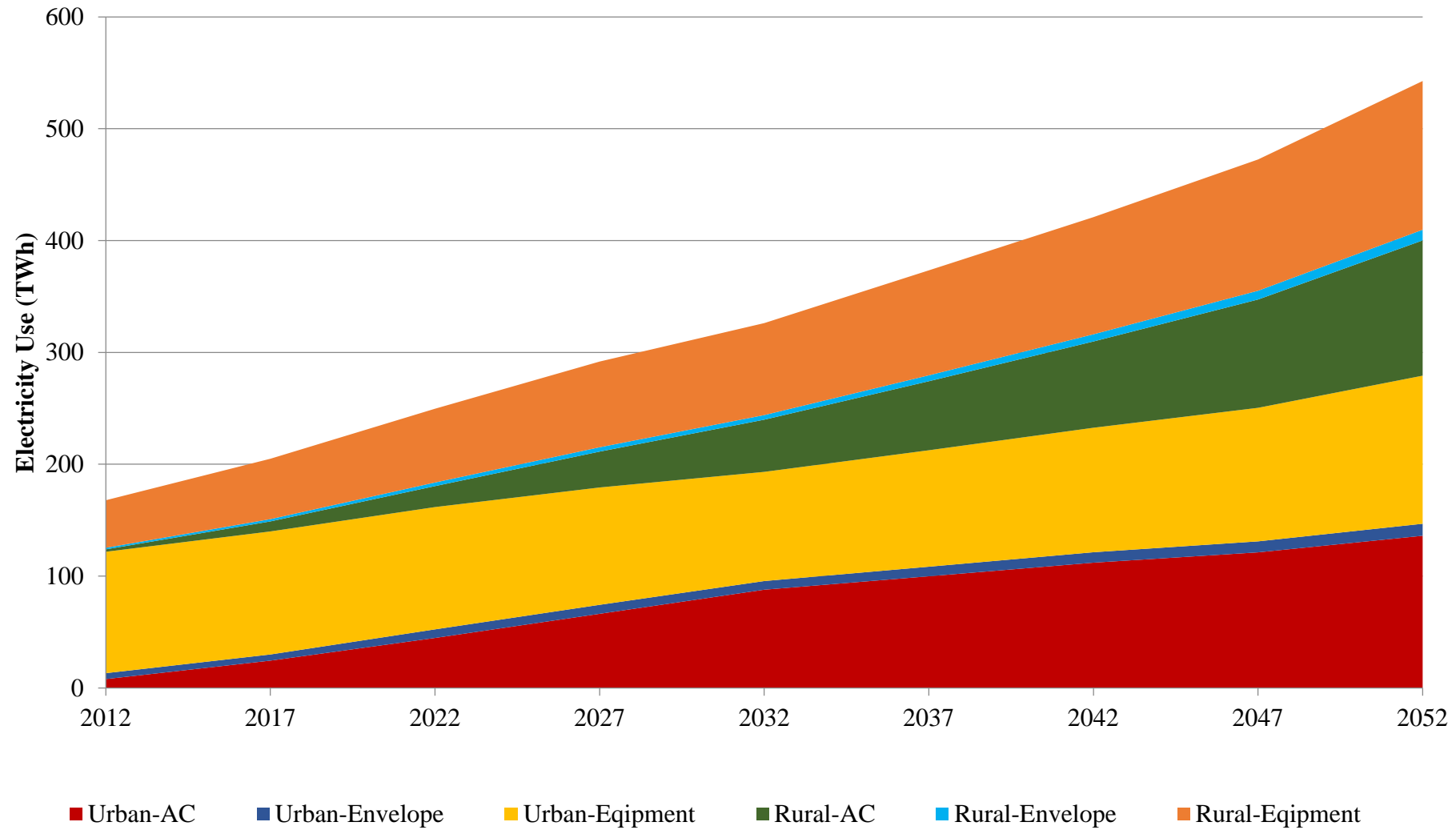
# Projections: BAU Scenarios



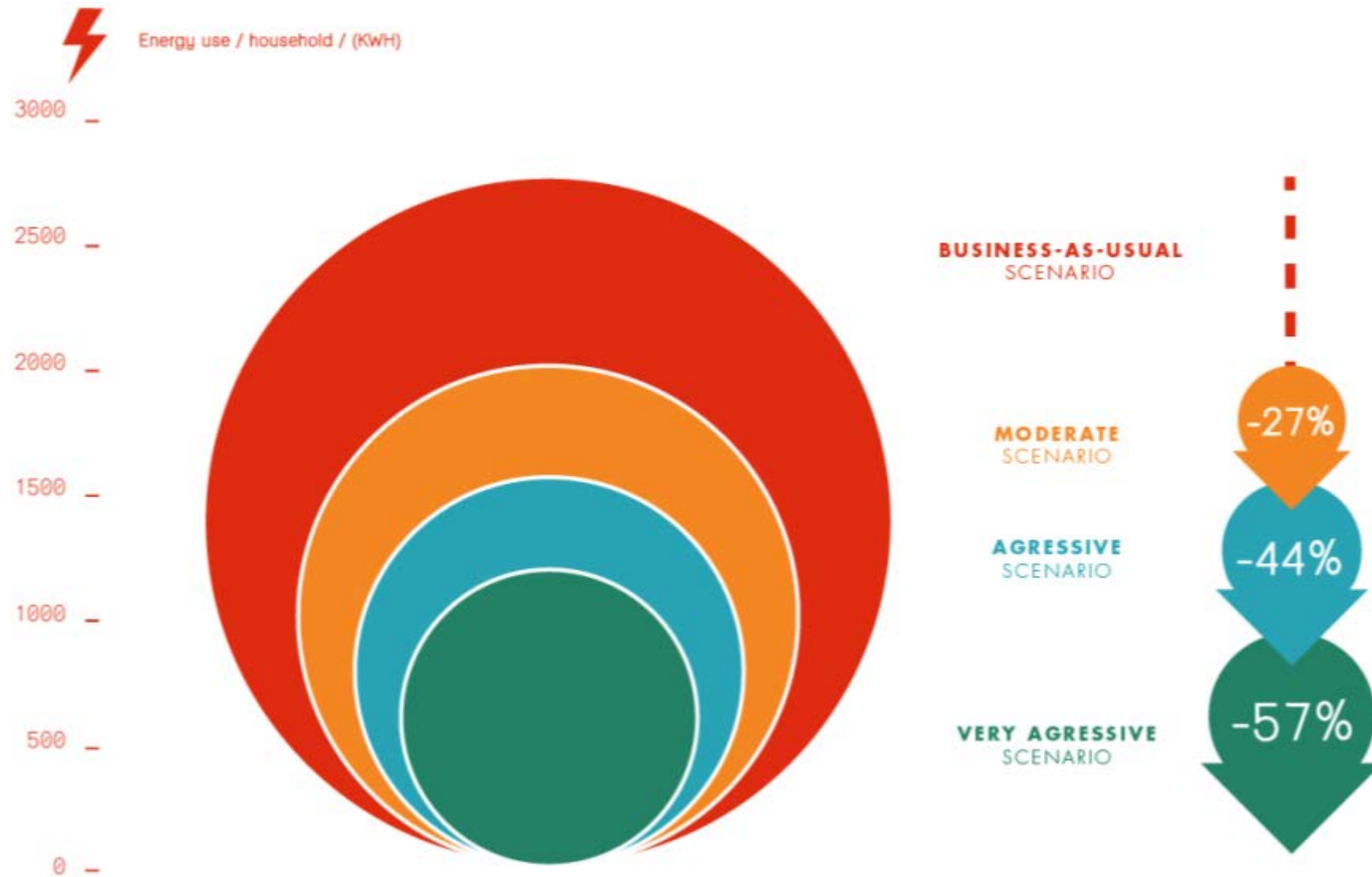
# Projections: Moderate scenario



# Projections: Very aggressive scenario



# Four Possible Scenarios





# THANK YOU

