Energy Wastage and Recovery Options in Buildings

WEBINAR SAARC ENERGY CENTRE

23/06/2020

Dr. Mohammad Adil

Deputy Director

www.CIBEA.com.pk

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Today!

- Introduction
- Building Energy Wastage
- CIBEA's study on Building Energy Wastage in Peshawar City.
- Use of Building Information Modelling in Energy wastage control.

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Our team at **CIBEA.com.pk**

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Building Team of **CIBEA.com.pk**

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Trainee Engineer

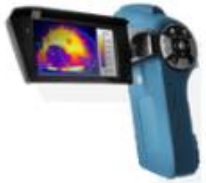
Engr. Inam Ullah
Trainee Engineer

Engr. Adeed Khan
Building Performance Analyst

Equipment at CIBEA

11. Blowerdoor

1. Energy Analyzer (KW, KVA, PF, Harmoics)



2. Thermal Imager Baltech TR-0120

3. Anemometer EXTECHAN 340

4. Anenometer Dwyer VT-200

5. Video Boroscope EXTECH BR 250-4

6. Laser Range Finder

7. Moisture Humidity Meter EXTECH MO 295

8. IR Thermometer Fluke 572-2

9. Laser Distance Meter Fluke 419 D

10. Flue Gas Analyzer Testo 320

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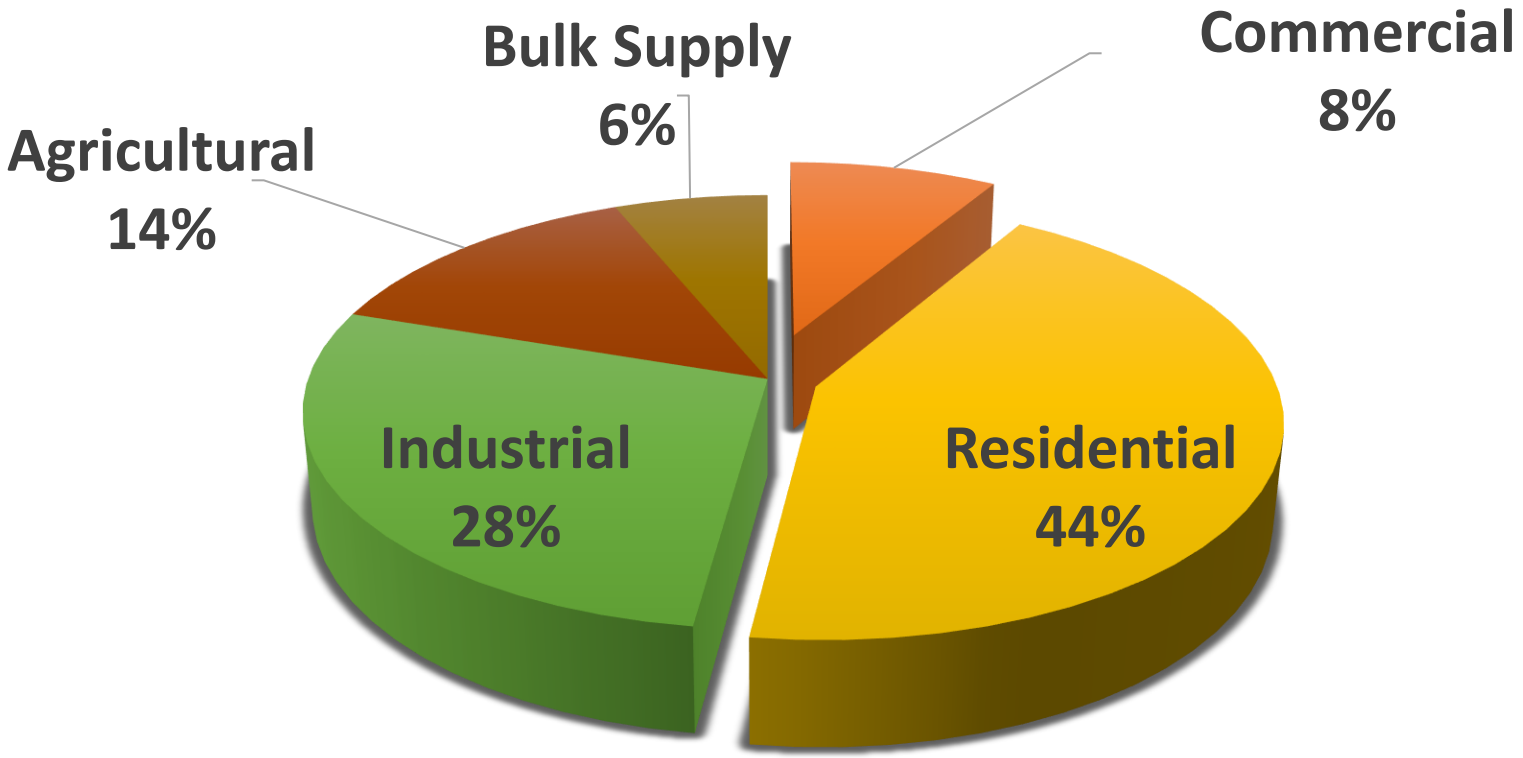
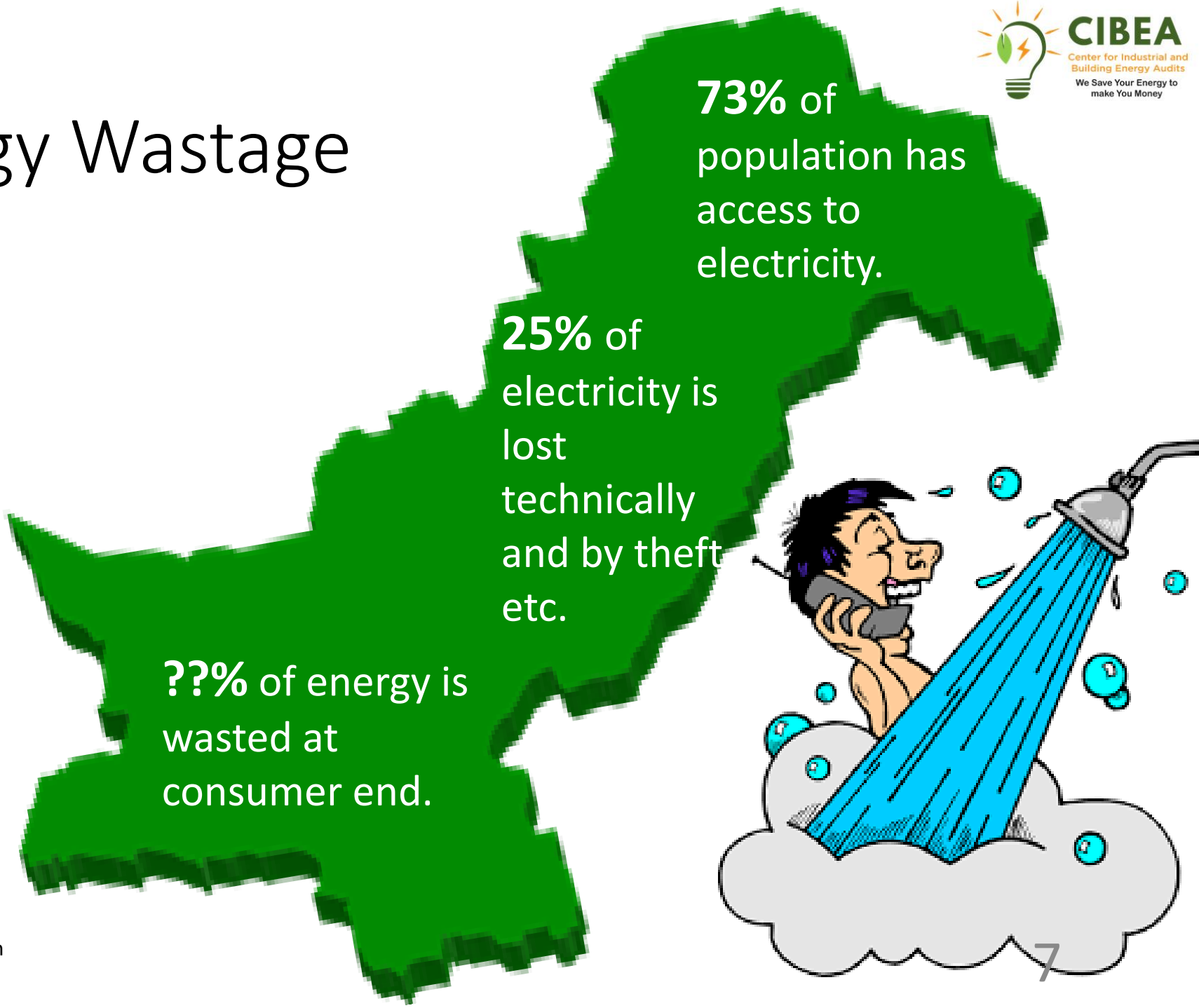
Sector-wise Energy Consumption in Pakistan



https://www.researchgate.net/publication/262937628_Smart_Grids_An_approach_to_integrate_the_Renewable_Energies_and_Efficiently_Manage_the_Energy_System_of_Pakistan

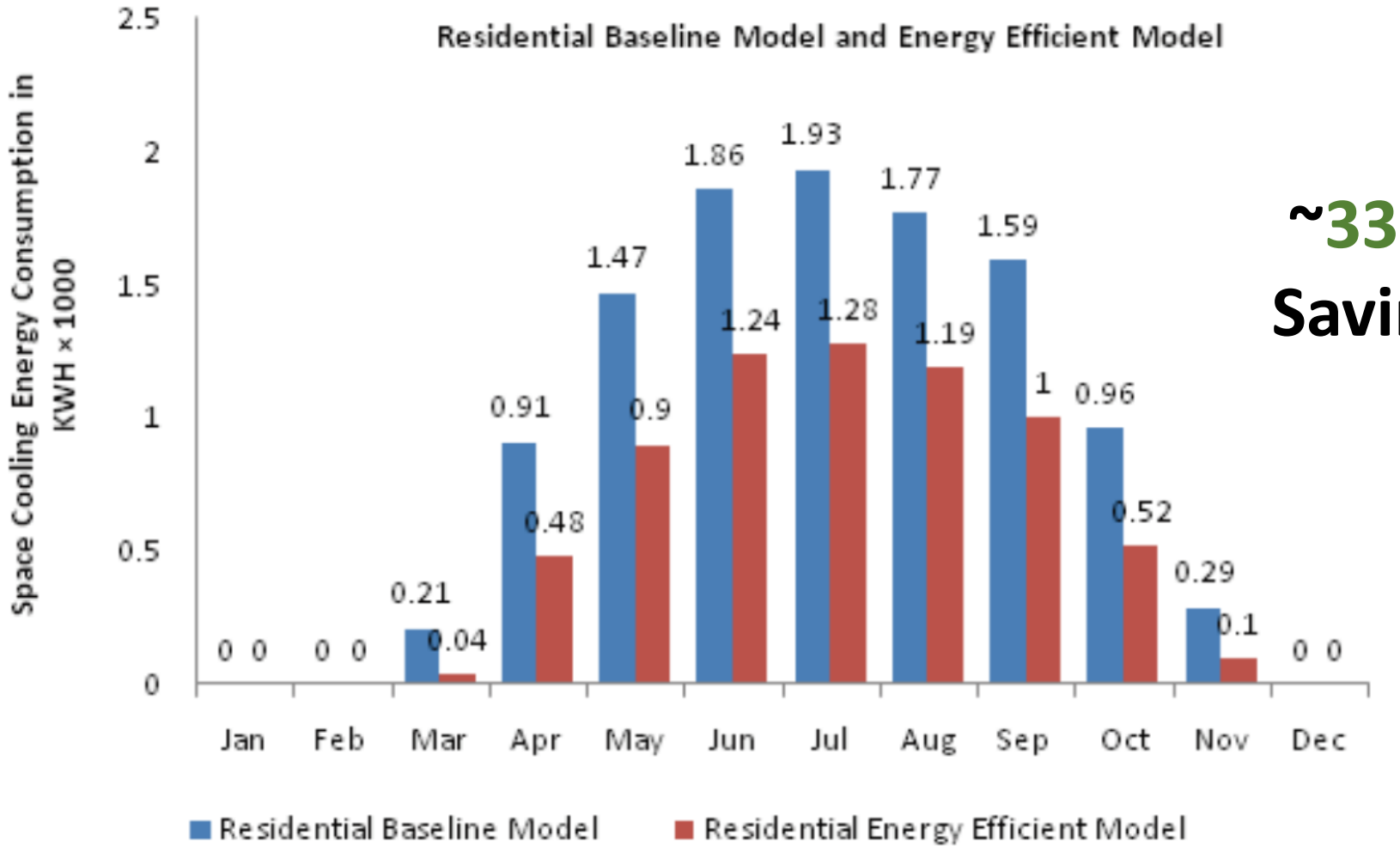
Building Energy Wastage

In Pakistan,



https://energypedia.info/wiki/Pakistan_Energy_Situation

Energy Saving with Energy Efficient Equipment

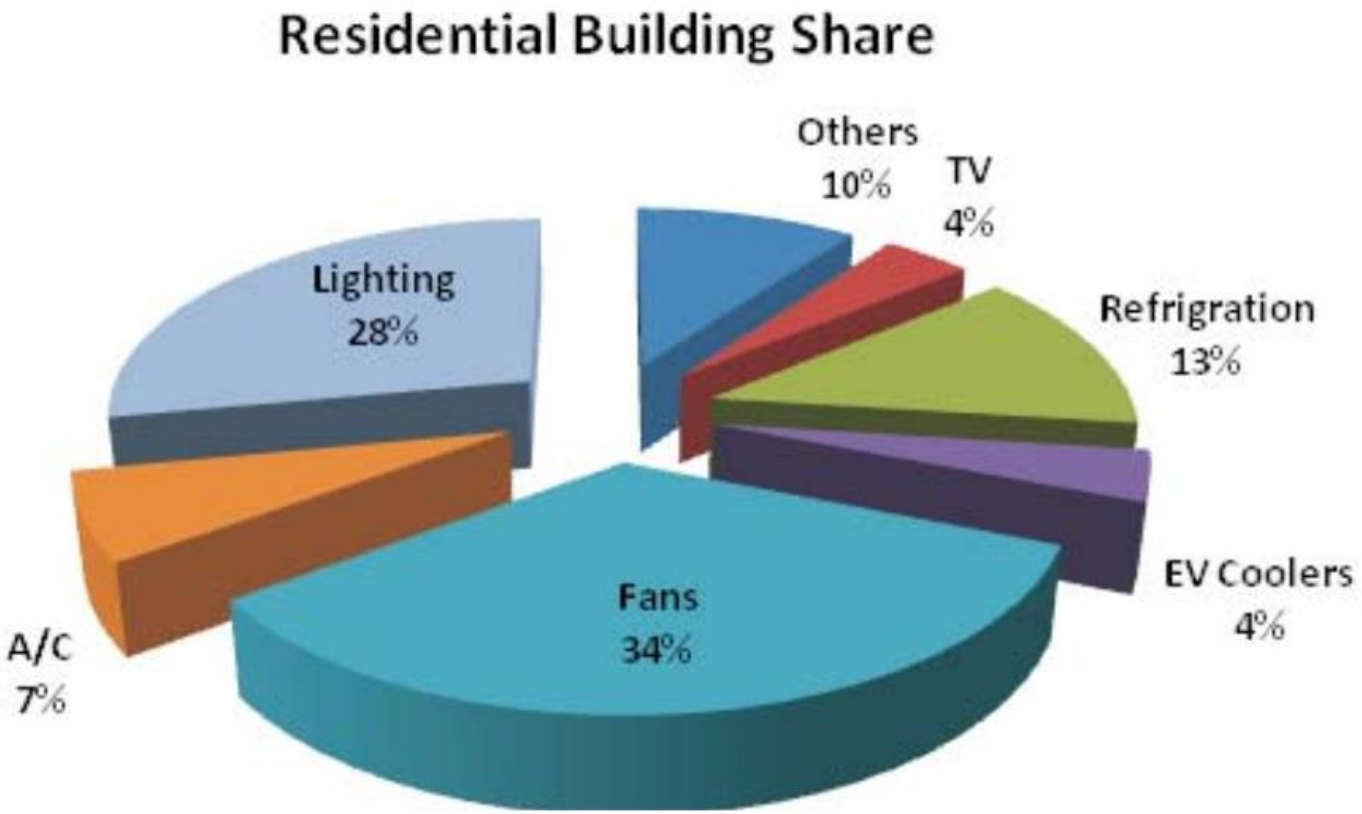


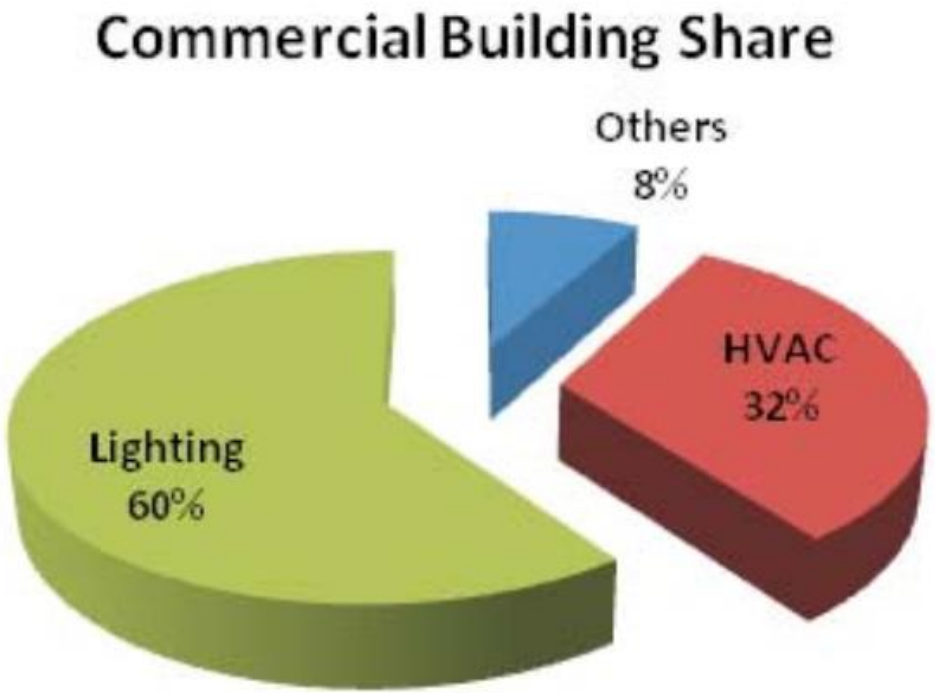
~33%

Saving

Energy Efficient Residential Buildings in Pakistan Article in Energy & Environment · July 2014 DOI: 10.1260/0958-305X.25.5.991
Khurshid Ahmad, Amer Farhan Rafique, Saeed Badshah

Energy Consumption in Buildings





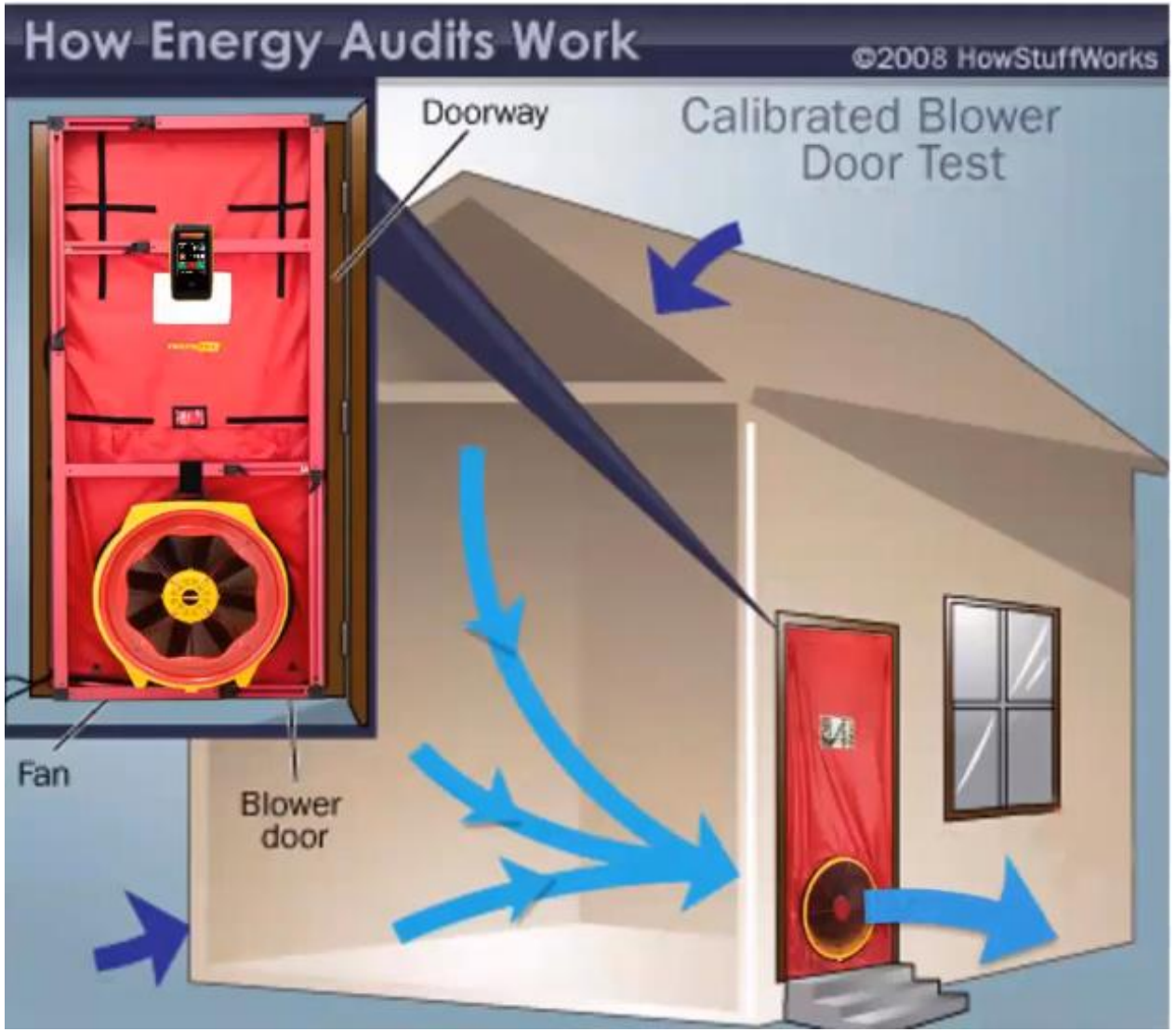
The Bureau of Energy Efficiency (BEE), 2008

Question remains!

- **How much energy is wasted in/by building (design)?**

Consuming this wasted energy will reduce demand on providers.

Blowerdoor Test



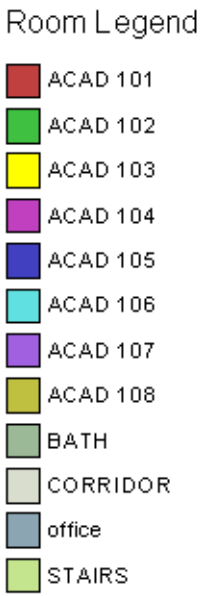
Blowerdoor Test

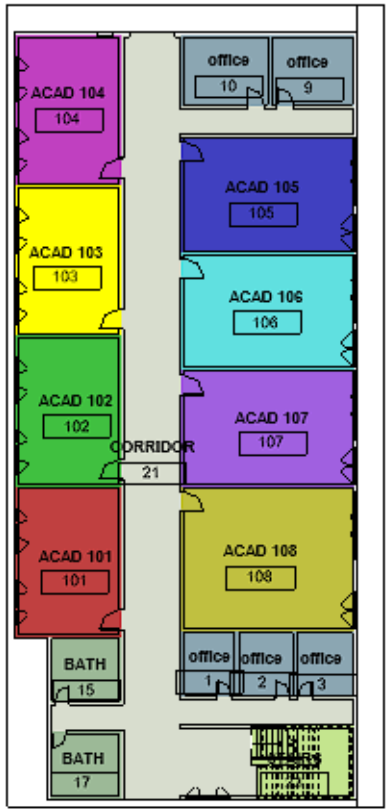
Team CIBEA setting the blowerdoor equipment

Taking depressurization readings

Blowerdoor Test Commercial Building A

Rooms Layout





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Blowerdoor Test Commercial Building A

Room #	Airflow at 50 pa,cfm @50	Air changes at 50 pa, n50 (/h at 50 pa)	Effective leakage area at 4 pa (cm^2)	Equivalent leakage area at 10 pa(cm^2)	LEED permeability at 4 pa (cm^2/100m^2)	Volume (m^3)	Floor area (m^2)	Enclosure area (m^2)
ACAD 101*	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 102	875.1	11.94	319.5	594.5	199.1	126.5	41.4	160.4
ACAD 103	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 104*	1267.5	17.02	512	918.5	319	126.5	41.4	160.4
ACAD 105	998.79	10.19	321.7	626.5	158.4	166.6	56.1	203.1
ACAD 106*	1157	11.8	364.9	716.1	179.7	166.6	56.1	203.1
ACAD 107	1171.5	11.78	468.5	843.5	230.5	166.6	56.1	203.1
ACAD 108	1157	11.8	364.9	716.1	179.7	166.6	56.1	203.1
ACAD 201*	1116.7	15	444.1	801.2	276.8	126.5	41.4	160.4
ACAD 202*	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 203	1116.7	15	444.1	801.2	276.8	126.5	41.4	160.4
ACAD 204	1267.5	17.02	512	918.5	319	126.5	41.4	160.4
ACAD 205*	998.79	10.19	321.7	626.5	158.4	166.6	56.1	203.1
ACAD 206	1344.3	13.71	349.7	735.9	172.2	166.6	56.1	203.1
ACAD 207*	1171.5	11.78	468.5	843.5	230.5	166.6	56.1	203.1
ACAD 208	1200.1	12.24	488.5	873.9	240.5	166.6	56.1	203.1

* Values are not measured but are taken from similar room's data

FROM BLOWERDOOR TEST

- **ACH @ 50** PASCAL = 13.2
- LBL N Factor = 9.71
- n ACH =1.36

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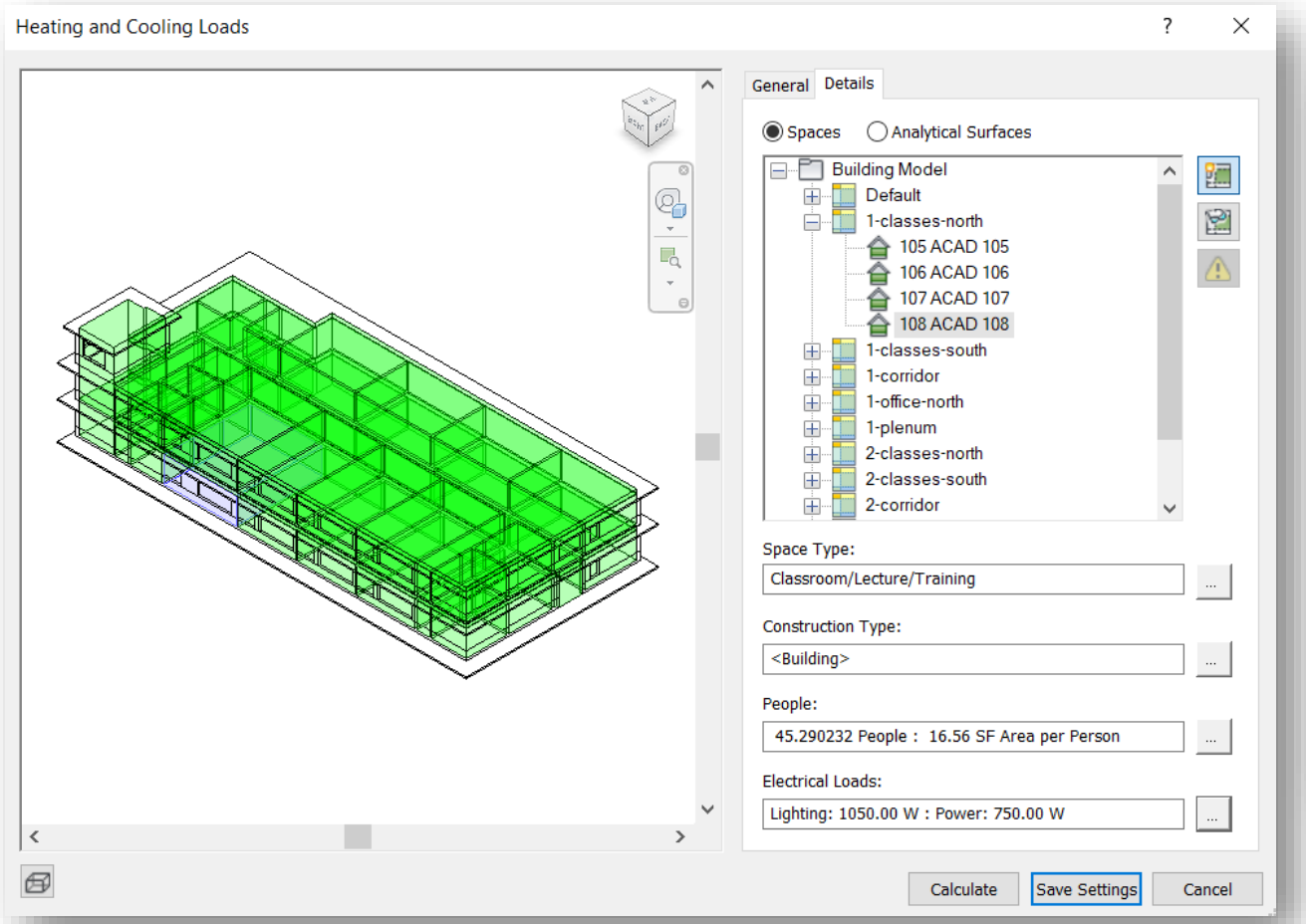
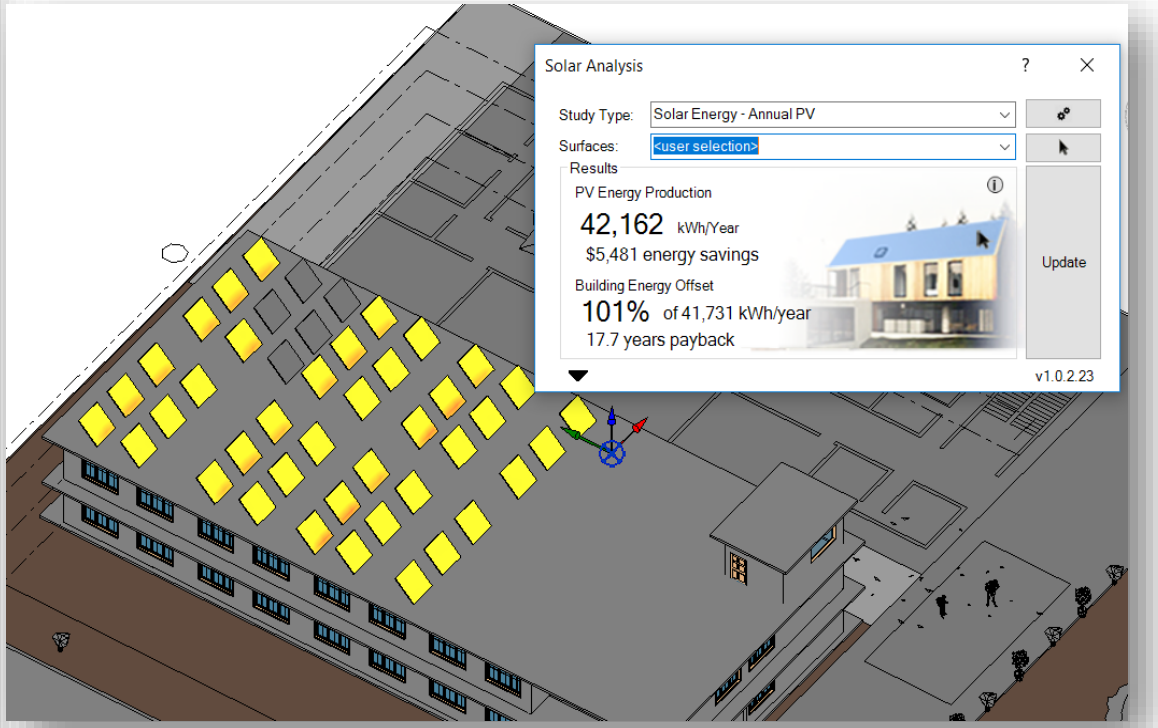
BIM Model of Commercial Building A





Blowerdoor Test Commercial Building A

Comparison of heating and cooling load for 1.36 and 0.5 ACH

HEATING AND COOLING LOAD FOR 1.36 ACH	
Peak Cooling Total Load (Btu/h)	413,147.4
Peak Cooling Airflow (CFM)	12,290
Peak Heating Load (Btu/h)	111,755.3
Peak Heating Airflow (CFM)	2,361

HEATING AND COOLING LOAD FOR 0.52 ACH	
Peak Cooling Total Load (Btu/h)	366,606.1
Peak Cooling Airflow (CFM)	12,222
Peak Heating Load (Btu/h)	75,991.4
Peak Heating Airflow (CFM)	2,158

Average ACH @ 50 pa = 13.21
Which when Converted to Natural ACH becomes 1.36

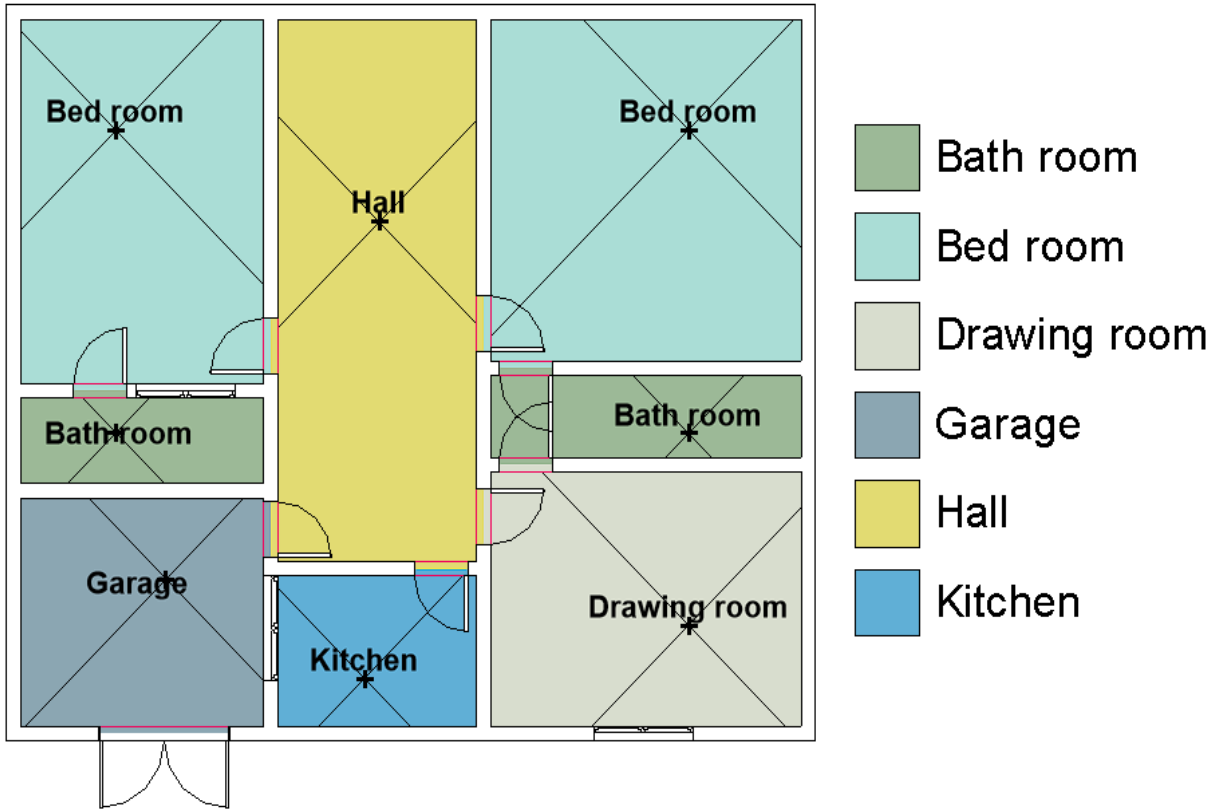
Similarly,
Natural ACH = 0.52
Which when Converted to ACH @ 50 pa becomes 5 ACH

If we make the rooms air tight and reduce ACH @ 50 pa from 13.21 to 5 ACH the peak heating and cooling loads reduces.

Difference in peak Cooling load = **46541.3 (btu/h)**

Difference in peak Heating load = **35763.9 (btu/h)**

Blowerdoor Test Residential Building B



FROM BLOWERDOOR TEST

- **ACH @ 50** PASCAL = 34
- LBL N Factor = 14.28
- n ACH =2.38

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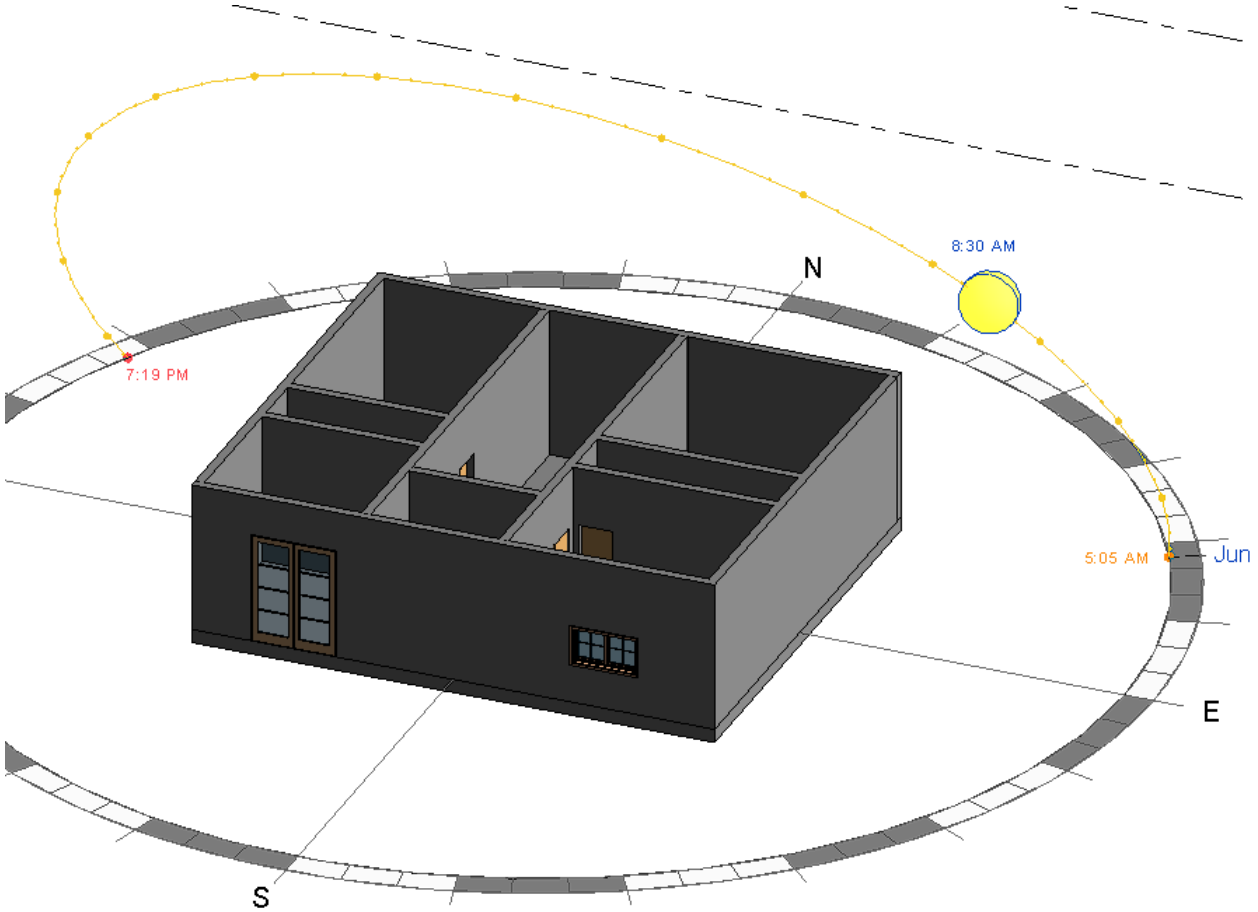
BIM Model in Revit and Energy Analysis



Blowerdoor Test Residential Building A

Comparison of heating and cooling load for 2.38 and 0.5 ACH

HEATING AND COOLING LOAD FOR 2.38 ACH	
Peak Cooling Total Load (Btu/h)	**18,330.4**
Peak Cooling Airflow (CFM)	452
Peak Heating Load (Btu/h)	**15,855.7**
Peak Heating Airflow (CFM)	483

HEATING AND COOLING LOAD FOR 0.52 ACH	
Peak Cooling Total Load (Btu/h)	**13,396.2**
Peak Cooling Airflow (CFM)	452
Peak Heating Load (Btu/h)	**10,067.6**
Peak Heating Airflow (CFM)	454

ACH @ 50 pa = 34 which when Converted to Natural ACH becomes 2.38

Similarly,
Natural ACH = 0.52
Which when Converted to ACH @ 50 pa becomes 7 ACH

If we make the rooms airtight and reduce ACH @ 50 pa from 34 to 5 ACH the peak heating and cooling loads reduces.

Difference in peak Cooling load = **4934.2 (btu/h)**

Difference in peak Heating load = **3328.6 (btu/h)**

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Finally

RESIDENTIAL BUILDINGS

- The reduction in cooling load due to infiltration control is around **25 %** of the total cooling load.

- And the reduction in heating load is around **21%** of total heating load.

COMMERCIAL BUILDINGS

- The reduction in cooling load due to infiltration control is around **12 %** of the total cooling load.
- And the reduction in heating load is around **32%** of total heating load.

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BIM+ BLOOWER DOOR Audit

Is a possible way of reducing **12-32%** of energy wastage *in heating and cooling*

or

7-17% *reduction of the total energy demand* in all sectors combined.

THANK YOU

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Any Questions

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