Rigorous and Comprehensive Energy Analysis: Essential for Commercial Sector EEO Success

Energy Efficiency Opportunities Workshop, Sydney 2010

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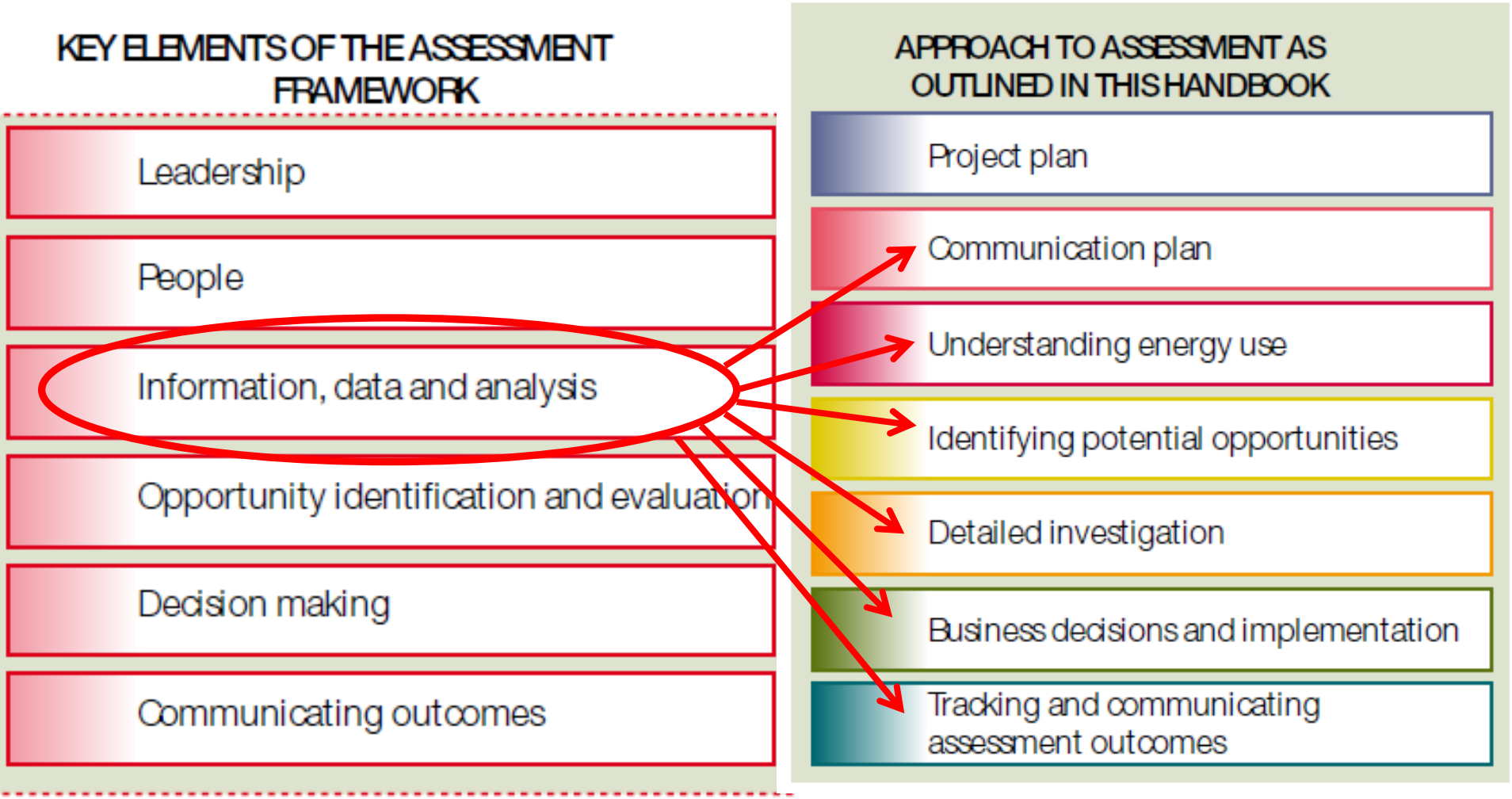
Key Element 3 – Information, data and analysis. INTENT:

- Sufficient data, in suitable forms, is used to quantify and understand energy use, identify and quantify energy saving opportunities, and to track performance and outcomes (where actions are implemented)

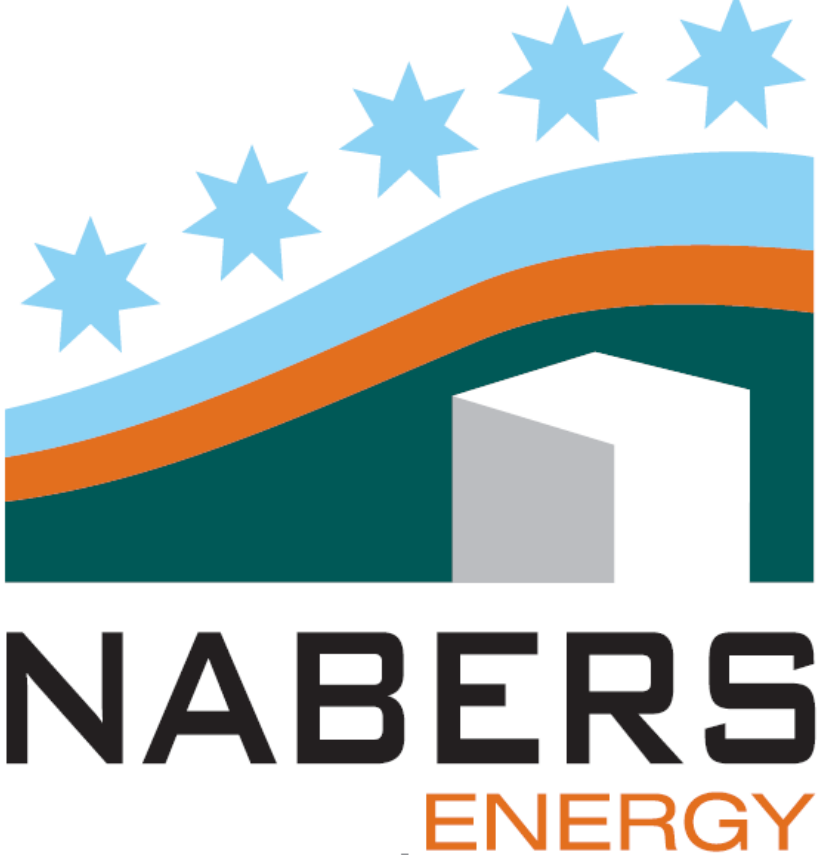
- Energy data is analysed from different perspectives to understand relationships between activity and consumption, and to identify energy efficiency opportunities

Shift from technical to organisational focus

From EEO *Assessment Handbook* (p.10)



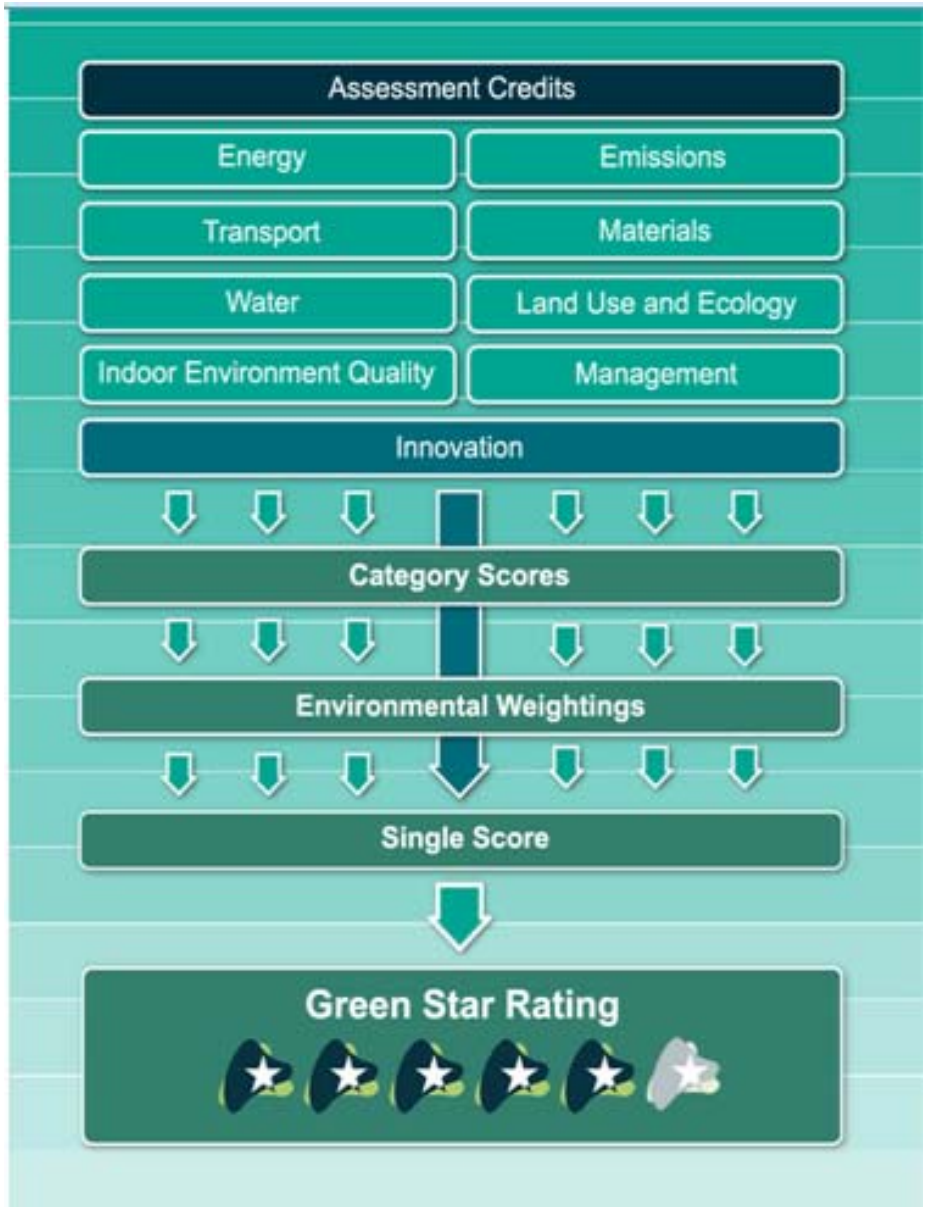
Verification requires evidence that key processes have been pursued – that key *Intents* in guidelines have been satisfied



NABERS (National Australian Built Environment Rating System – thanks to Robert Vale!)

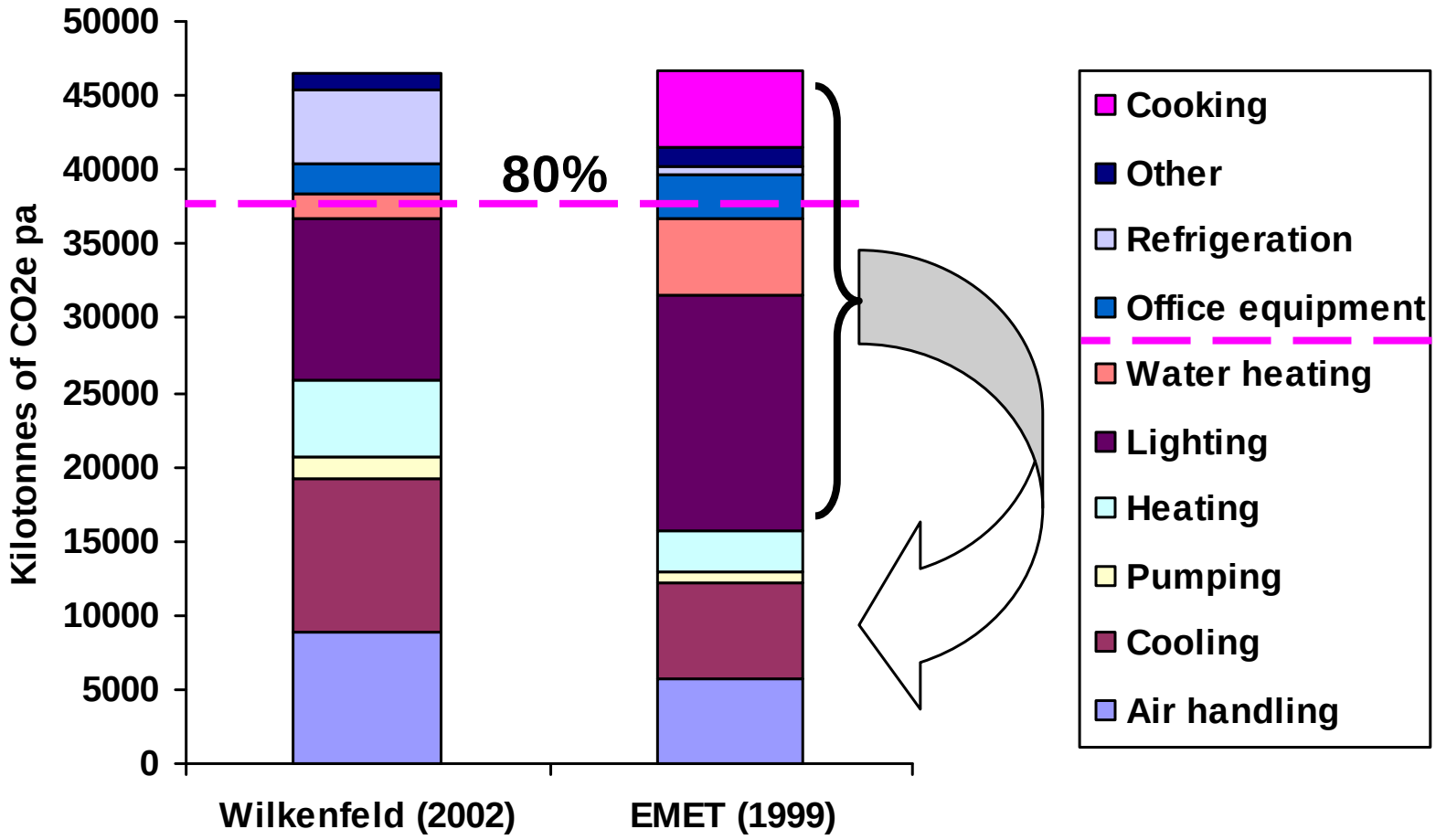
- Originally ABGR – Australian Building Greenhouse Rating Scheme
- Launched 1999 in NSW
- For existing office buildings, based on annual energy use (normalised)
- For new office buildings uses modelling, includes Commitment Agreement
- Being extended to other building types
- Basis for non-residential Mandatory Disclosure regulations from 2010

Green Star Rating: issues covered and base building greenhouse design ratings (Office V3)



Predicted Greenhouse Gas Emissions (kg CO_2-e/m^2/annum)	Points Awarded
110	Conditional Req't
95	1
90	2
85	3
80	4
75	5
70	6
65	7
60	8
55	9
50	10
45	11
40	12
35	13
30	14
25	15
20	16
15	17
10	18
5	19
0	20

Commercial sector ghgs…. Complex interactive effects between activities



Why be obsessive?

- Commercial buildings not very energy-intensive:
  - Eg cut lights by 1 watt/sqm + 1 hour/day = 7% saved
  - So ‘little things’ matter and sloppiness hurts
- Paying other people’s bills?
- Many subtle energy wasters/savers, eg:
  - Lights and equipment left on, standby waste, poor zoning
  - H&C ‘fighting’ each other, interactive effects, re-heat
  - Distribution waste – HW ring mains, ducts, fans, pumps
  - Air leakage and fixed air supply volumes
  - Some suppliers don’t have good data(!) or think ‘systems’
- Multiple benefits – productivity, complaints, rent...

Impact of features on commercial building energy performance (NABERS Rating)

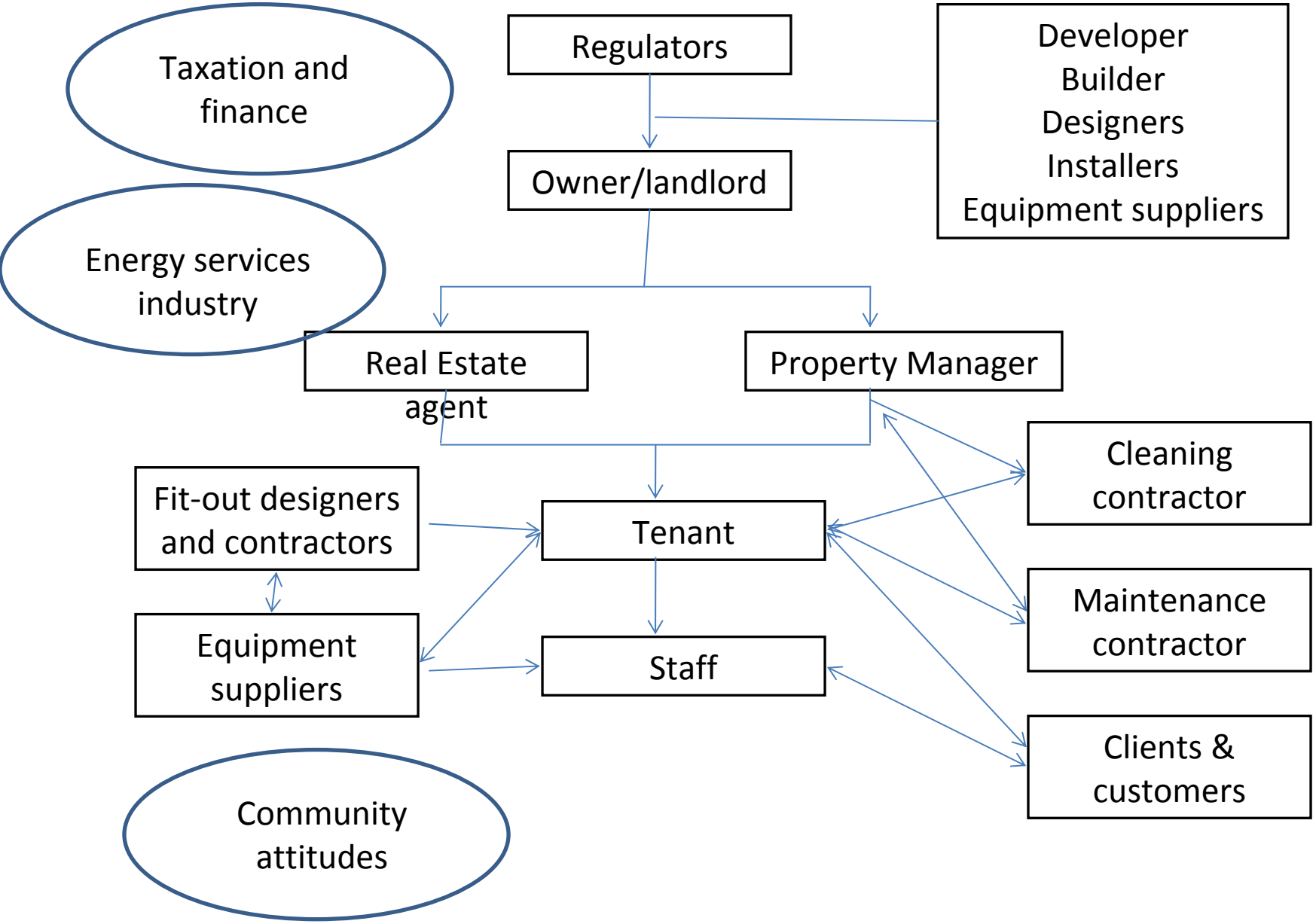
(from Warren Centre Low Energy High Rise Project)

- Technology
  - +0.6* economy cycle
  - +1.4* good facade and services technologies
  - +0.6* incremental investment in efficiency

Efficiency is about a lot more than technology or 'freezing in the dark'

- Management, skills
  - +1.3* management at least partially in-sourced
  - +0.9* all managers (portfolio, asset, bldg) feel able to influence efficiency
  - +0.5* disclose NABERS rating to tenants
  - +0.4* incentives/penalties for maintenance contractors
  - +0.5* efficiency training program
  - +1.3* bldg manager skilled in energy efficiency

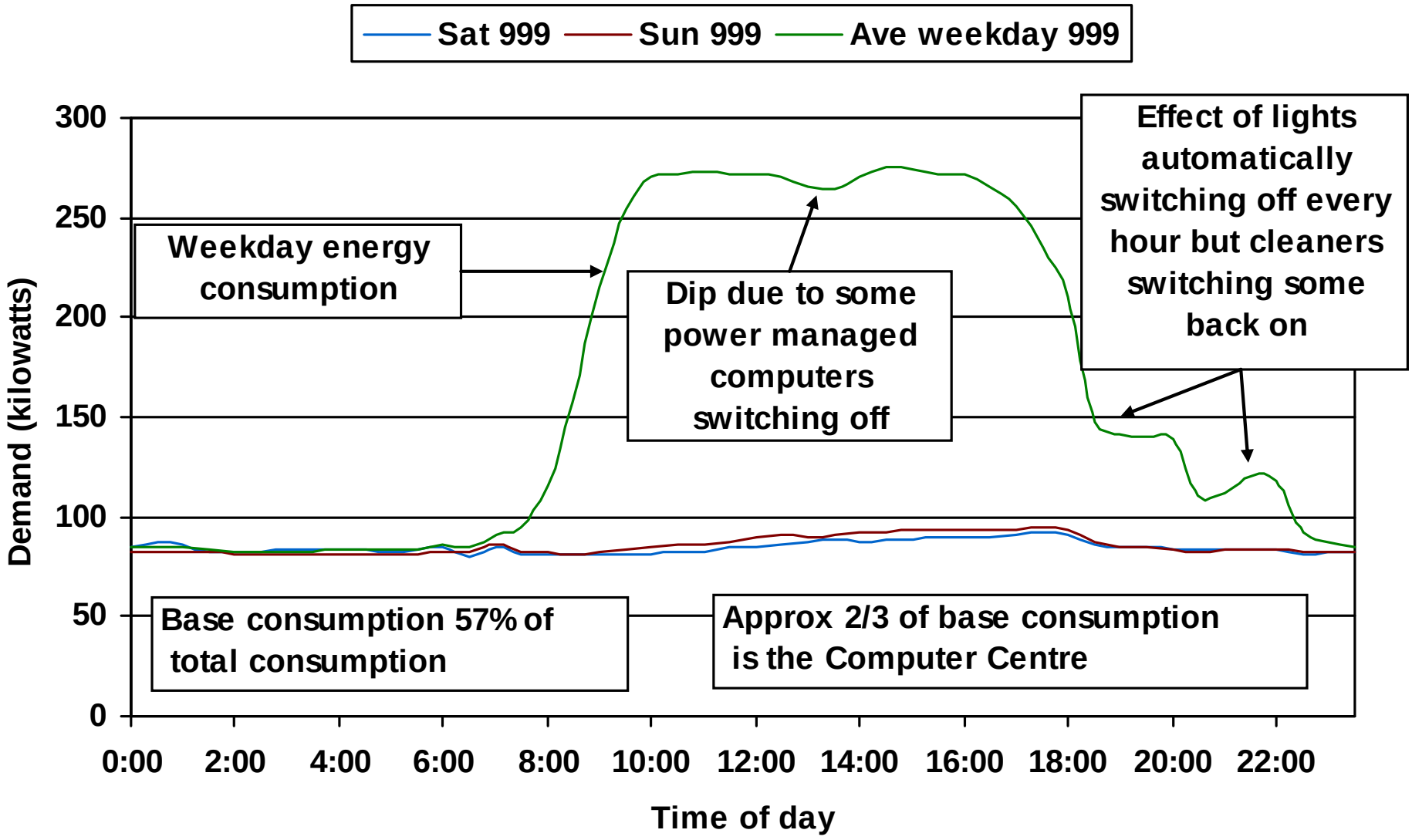
Buildings: the chains of influence – who to engage?



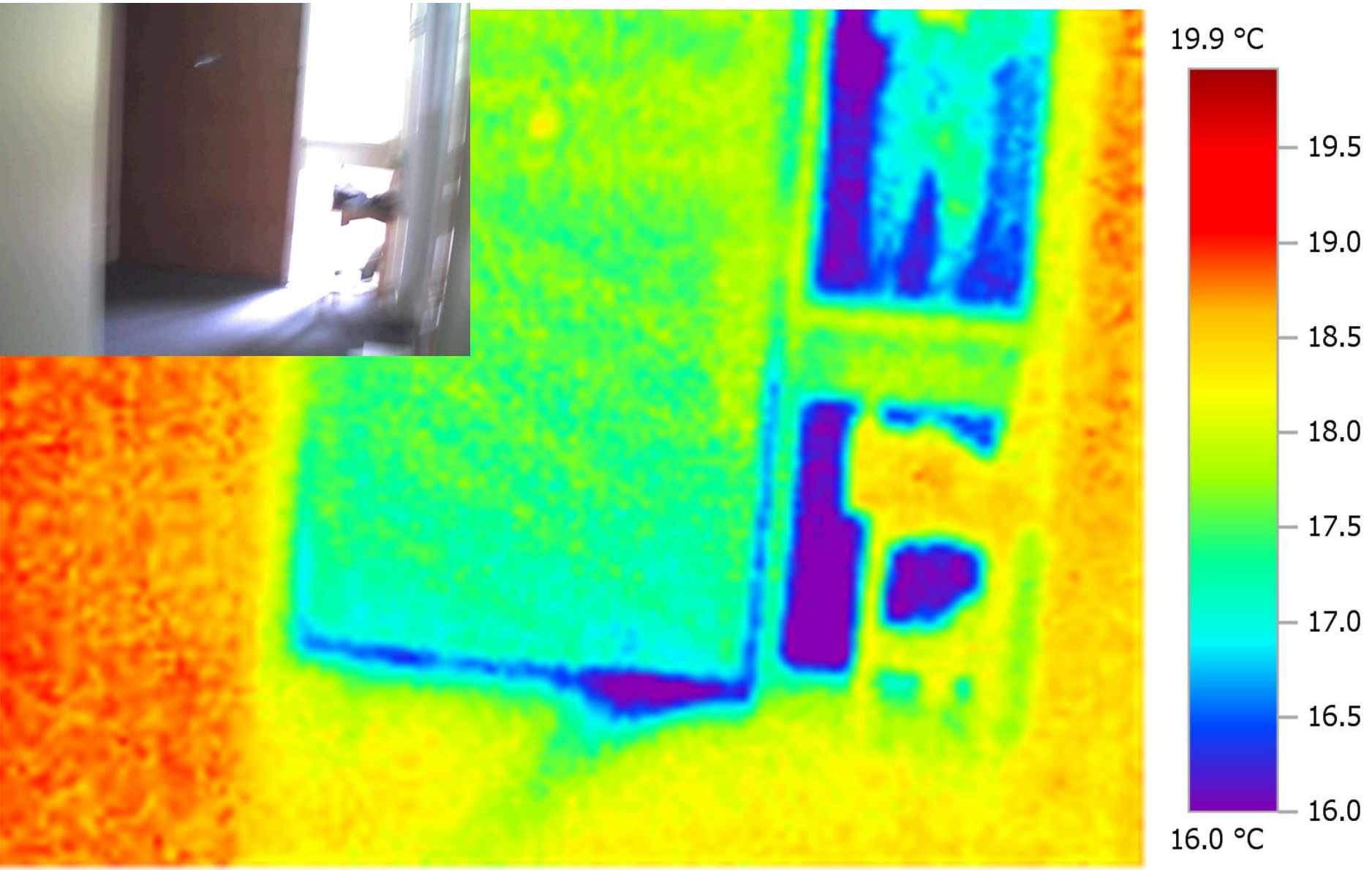
Options for building understanding of energy use

- Measurement, monitoring and benchmarking – services provided compared against energy use
- Diagnostic tools – eg thermal imaging, air leakage testing
- Liaison with suppliers, specialists, advisers, contractors
- Literature review
- Technical analysis, modelling and estimation
- Statistical analysis
- Consult occupants
- Review contracts, leases, procurement rules, etc
- Systems thinking (technical, people, legal, contracts etc)
- Each provides some insights and raises questions for further analysis/measurement

Monitoring matters! Load profiles provide useful information: example of daily load profile for an office. What would be an 'ideal' profile?

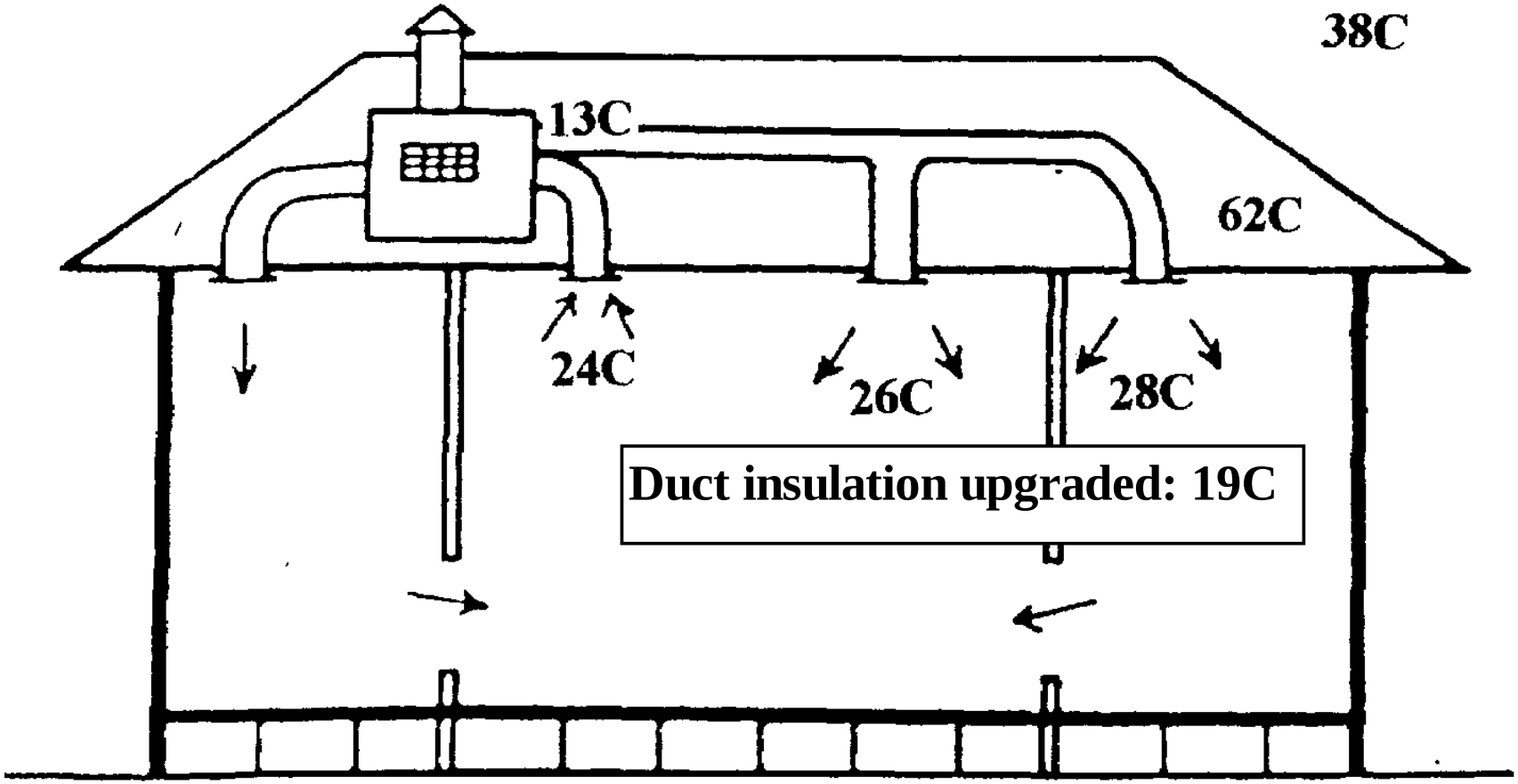


Front door and window showing lower section: more air leaks under bottom of door, despite a draughtstrip being fitted.



The detail matters: effect of dark roof with inadequate insulation combined with poorly insulated, leaky ducts in the hot roof space. Insulation of internal ceiling also critical to limit heat flow,

Measurement of temperature drop proved losses



Y	Energy Consumption kWh pa	Correlation Results
x_1	Selling Area	Positive Correlation
x_2	kWh/m^2	Inter-correlation
x_3	Building Type	Correlation
x_4	Trading Hours	Small correlation
x_5	Age of Building	Negative correlation
x_6	In Store Bakery	Insufficient data
x_7	Average Weekly customer count	Negative factor
x_8	Refrigeration length – cool with no doors	Positive Correlation
x_9	Refrigeration length – frozen with doors	Positive Correlation
x_{10}	Refrigeration volume – cool with no doors	Positive Correlation
x_{11}	Refrigeration volume – frozen with doors	Positive Correlation
x_{12}	Refrigeration Breakdown Costs	Positive Correlation
x_{13}	Back of house cool room volume	Positive Correlation
x_{14}	Back of house Freezer cool room volume	Positive Correlation
x_{15}	Ceiling height	Positive
x_{16}	On-site Meat Room	Low correlation
x_{17}	Airlock at Entrance	Positive Correlation
x_{18}	Lighting Type	Negative correlation

Big Switch Projects Supermarket Multiple Regression Factors – preliminary outcomes

$$Y = c_0 + c_1x_1 + c_2 x_2 + \ldots c_kx_k + u.$$

Outcome showing major variables – 76% of variation

$$Yp = 771244 + 558\,x_1 + 852\,x_{10} + 922\,x_{11} - 719103\,x_{17}$$

Where Yp = Predicted Energy Consumption (kWh pa)

x_1 = Selling Area (m^2)

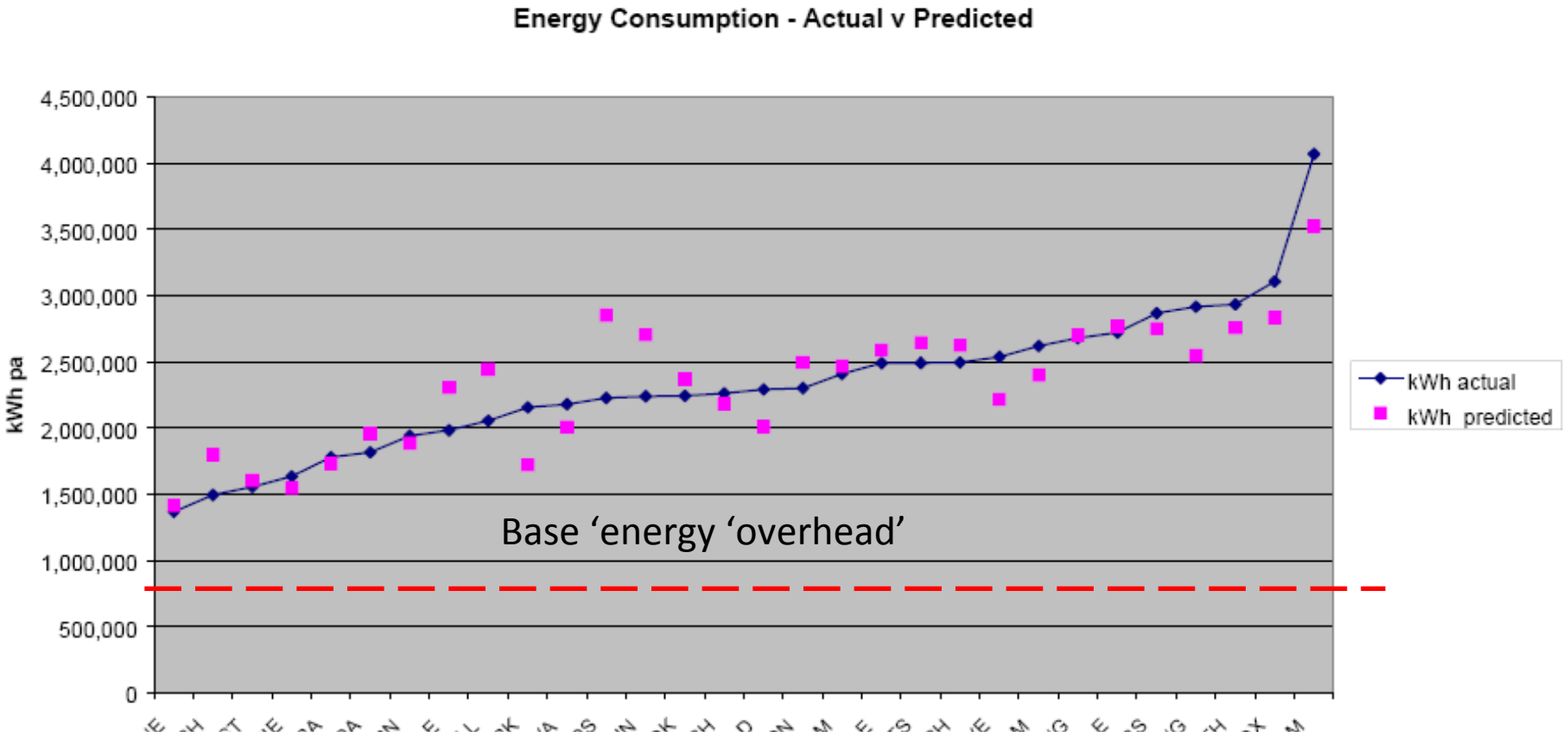
x_{10} = Refrigeration volume – cool with no doors

x_{11} = Refrigeration volume – frozen with doors

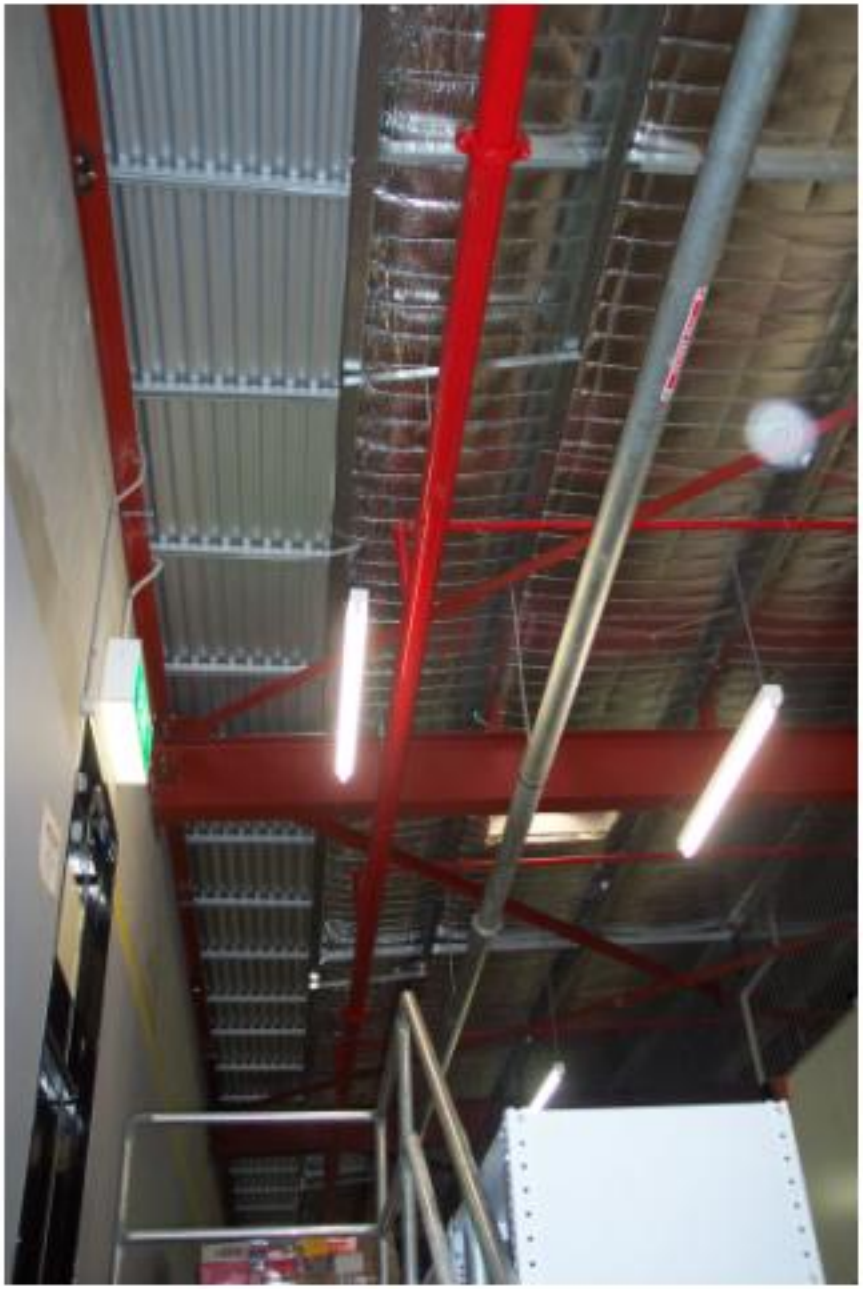
x_{17} = Air-lock Entrance

But what questions does this raise?

Actual vs predicted consumption using Regression equation – look at ‘high’ and ‘low’



Store sites (similar climates)

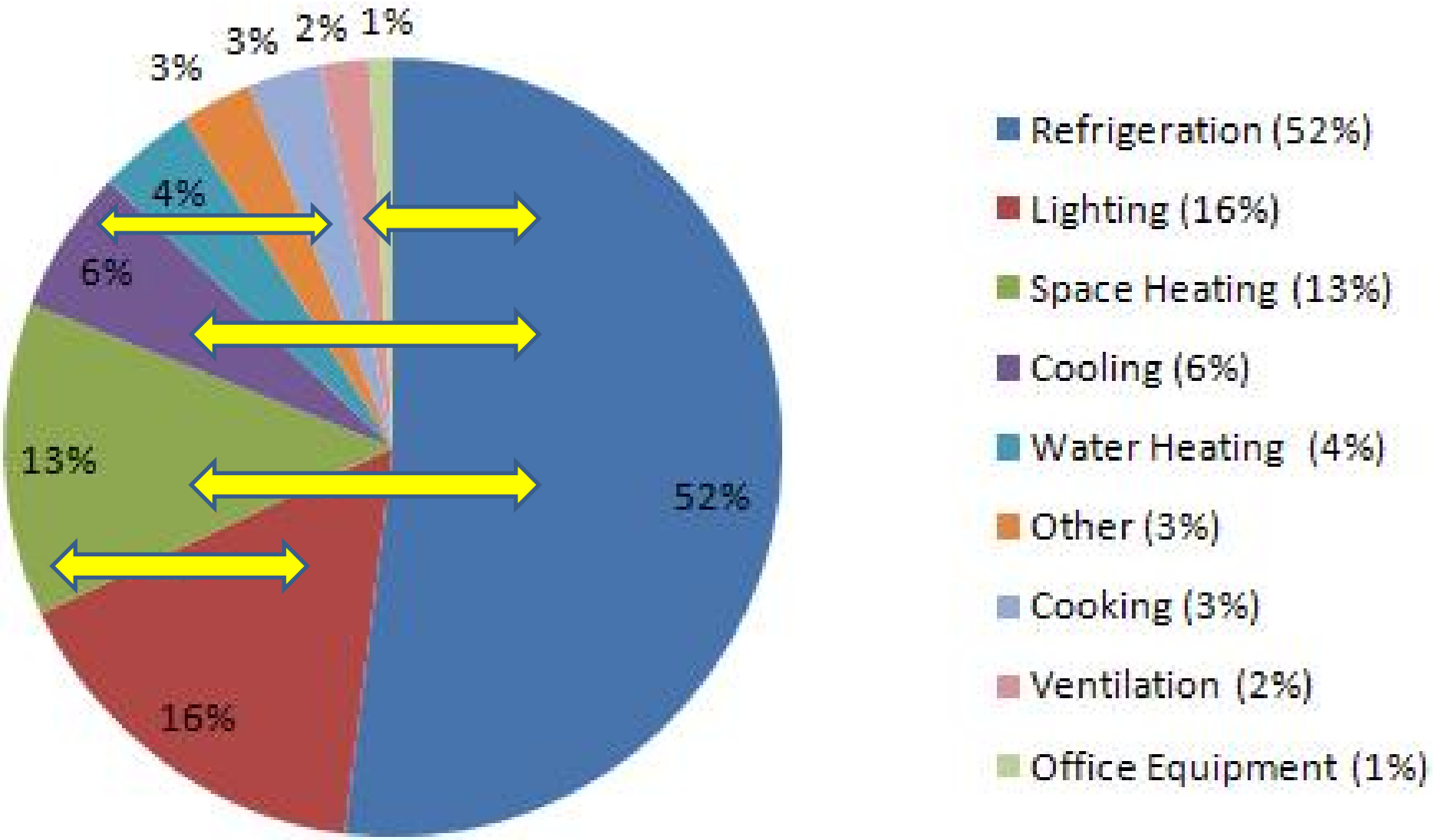


Uninsulated box gutter – heat gain 150 watts/square metre.

If insulated, gain would be 15 watts

And air leakage around edges of wall/gutter and gutter/roof

Supermarket energy use – complex interactive effects highlight need for systems thinking and modelling



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