Retrofitting for Peak Demand Load Reduction

How can retrofitting strategies be conceptualised into simple principles?

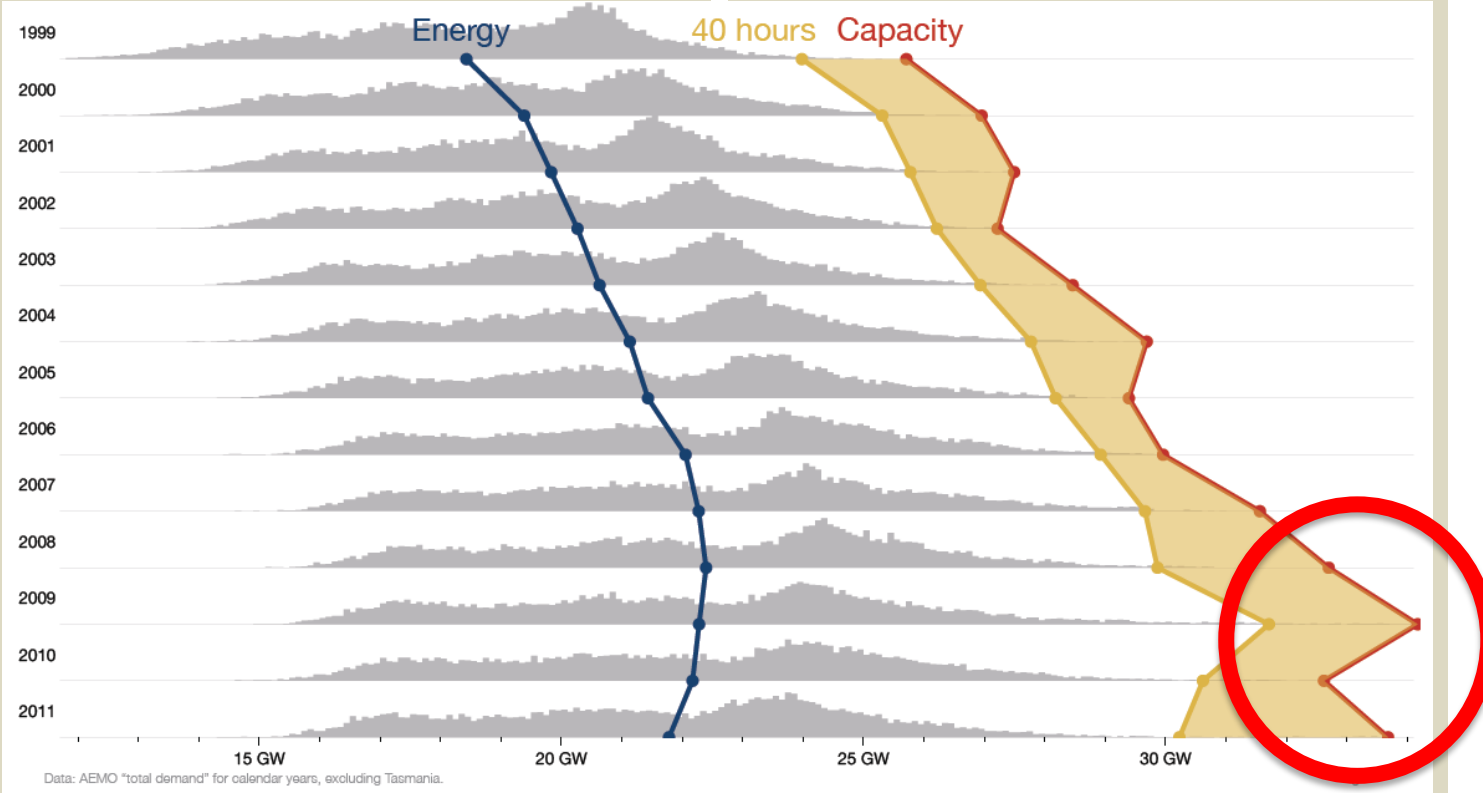
1. INTRODUCTION

Improvements to the existing building stock needs changes in either the design process of buildings and its procurements.

A first step is to consider strategies for reducing operational energy and peak loads, therefore carbon emissions, which would be by achieved by breaking down the energy use, and also by using a bioclimatic approach in planning.

Nearly 80% of the energy used in office buildings is for lighting and conditioning purposes, hence considerable savings in energy savings would be possible if regarding bioclimatic issues.

Considering that peak energy demand is hardly achieved by existing plants due to the ever increasing energy demand of constructions and industries, the reduction of peak loads is therefore the more economically viable approach and retrofitting of existing buildings holds a key for sustaining the current power infrastructure.



Brochure authors
Mark. B. Luther, Ass. Professor, School of Architecture and Building, Deakin University, Victoria, Australia

Contact: mark.luther@deakin.edu.au

UPGRADE Solutions & IEA SHC Task 47
Renovation of Non-Residential Buildings towards Sustainable Standards

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

DEAKIN UNIVERSITY

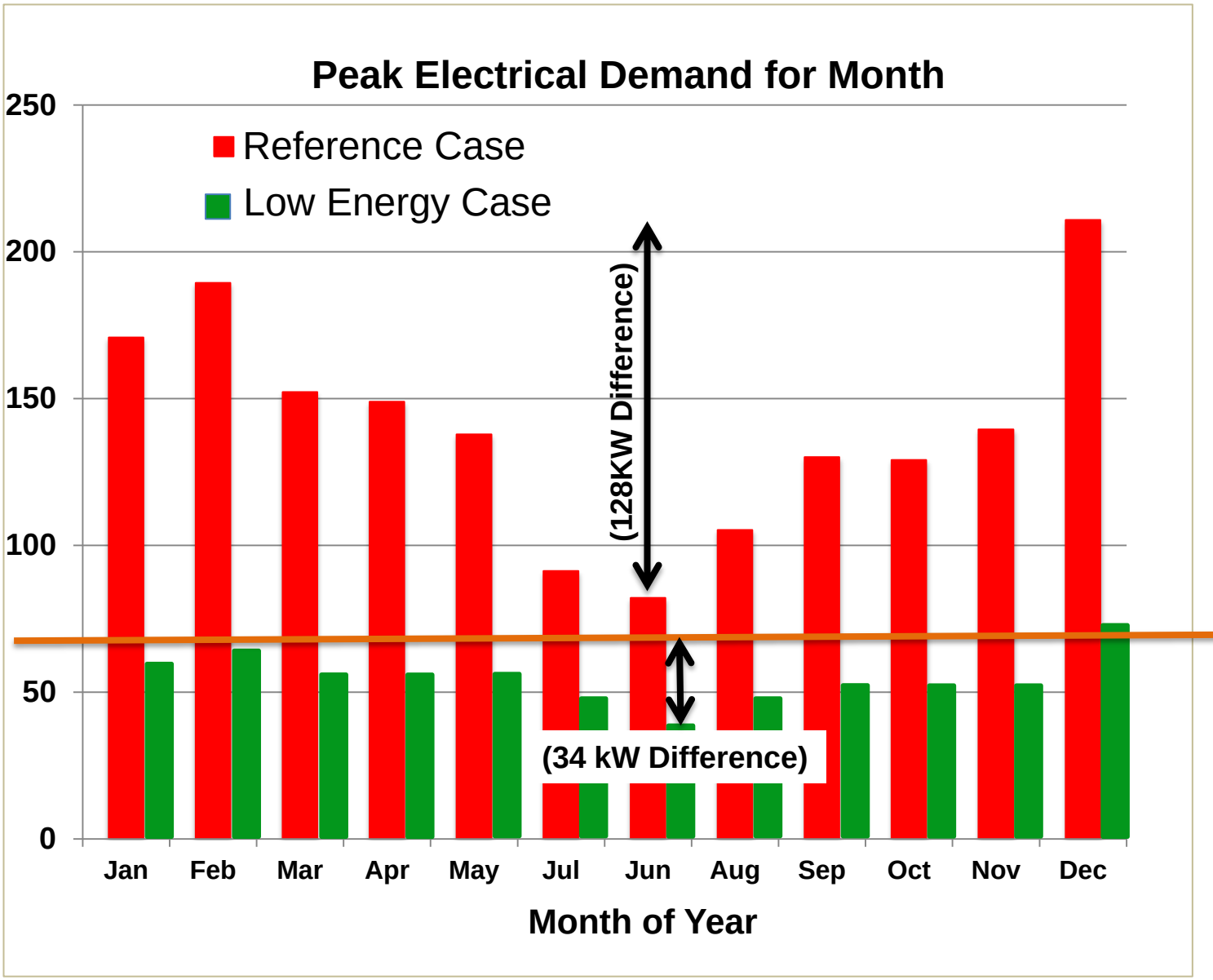
2. REDUCING THE PEAK ENERGY DEMAND (PED)

Once recognised the period and demand of a the peak load in a project, its mechanical equipment, their maintenance and period of use can be reduced considerably.
A bioclimatic approach strategy to reduce the energy demand through a *balanced peak demand,* can also lower:

- Capital expenditure in equipment
- Maintenance costs
- Effective controlled interior environment

A MONTHLY MAXIMUM PEAK DEMAND LOAD REDUCTION IN kWh
Electricity cost is based on peak demand rate for the whole year, therefore if the demand for peak energy is less, a lower demand charge rate could be applied.

A REDUCED VARIANCE IN MONTHLY PEAK DEMAND LOADS
If the cost of electricity is based on peak demand rate for an entire year, then the user pays a peak demand privilege for the period, which will apply penalties if used over a certain amount in monthly peaks.
A controlled demand will offer a smoother energy cycle, more predictable control expectancies, and easy detection of discrepancies, if they occur.



3. A STAGED APPROACH TO REDUCING ENERGY PEAK LOAD

Step-by-step methodology for integrating bioclimatic principles and innovative conditioning strategies. To yield a positive result the approach for conditioning a building should consider: the site, orientation, building form and materials.

i. Site potentials

i. Passive solar design

i. Insulated and airtight building envelope

i. Passive pre-conditioning methods in fabric

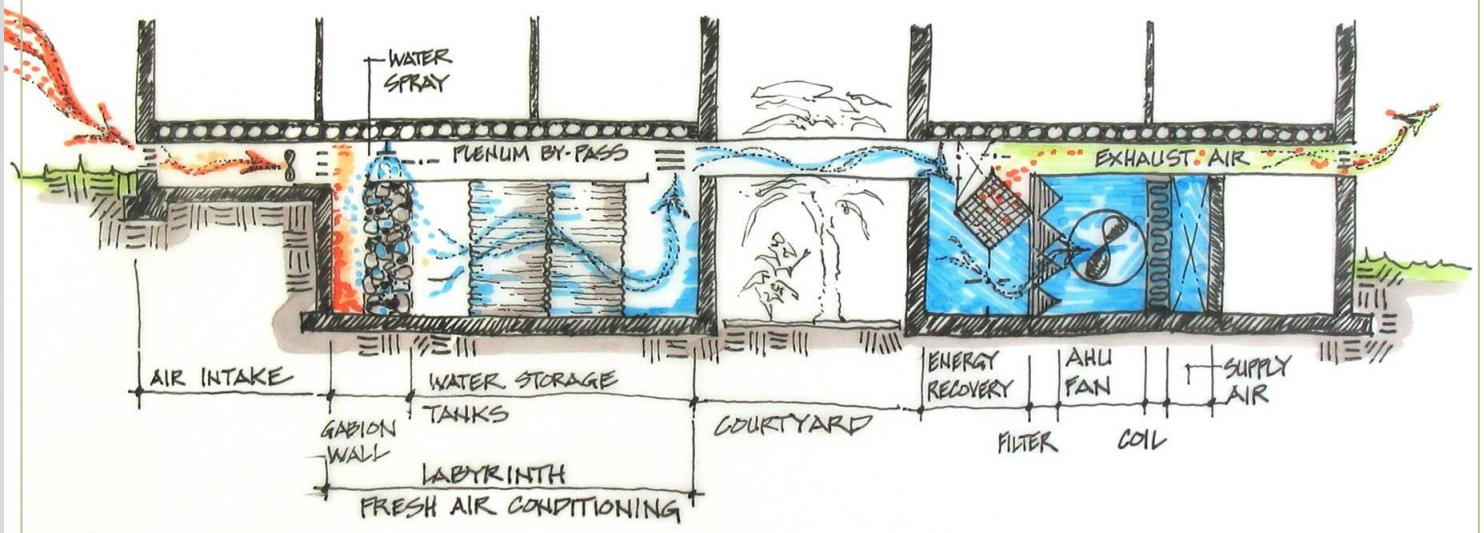
i. By-pass fresh air intake (economy cycle)

i. Energy recovery system

i. Other solar thermal mechanical processes

i. Energy efficient mechanical services

i. Optimised control and building management system



4. A CHECKLIST OF ENERGY-EFFICIENT STRATEGIES

Energy efficient strategies can be hierarchized according to their level of contribution in performance, for a particular project.

Variable temperature conditioning set-point
Program setting to adaptive comfort models.

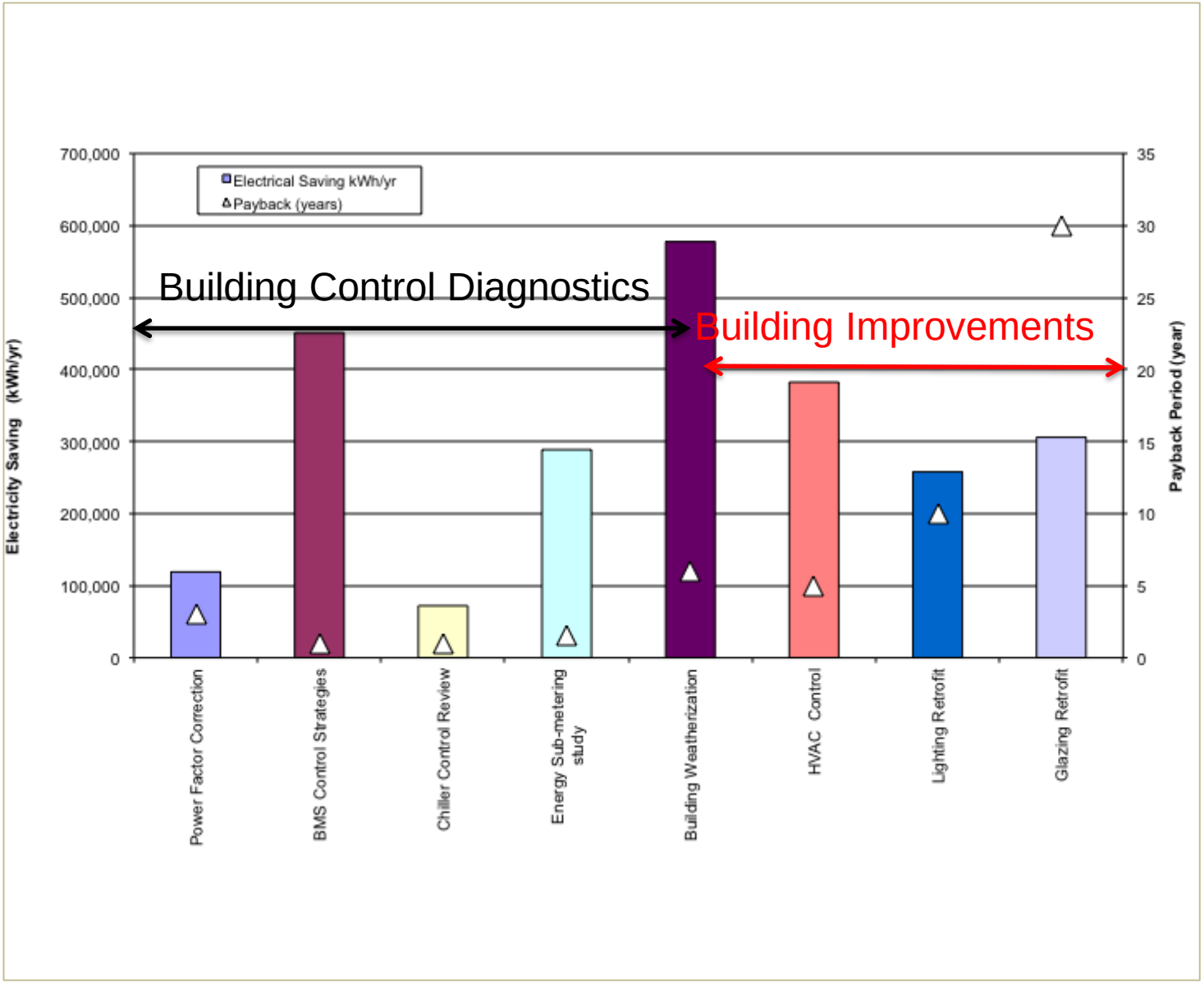
Building air leakage control
A tighter building envelope results in a more controlled indoor environment, even in warmer climates.

Ducting leakages
Prevent energy losses through duct-work.

High efficiency HVAC control systems
In either Coefficient Of Performance (COP) and/ or Building Management Systems (BMS).

Economiser-cycle ventilation control
Avoid overuse of air conditioning when not needed.

Energy efficient lights
Efficacy of the light source (lumens/watts) and distribution effectiveness.



Daylighting
Is only effective if artficial light is dimmable, when natural light is available.
Another key factor is the control of desired levels of light.

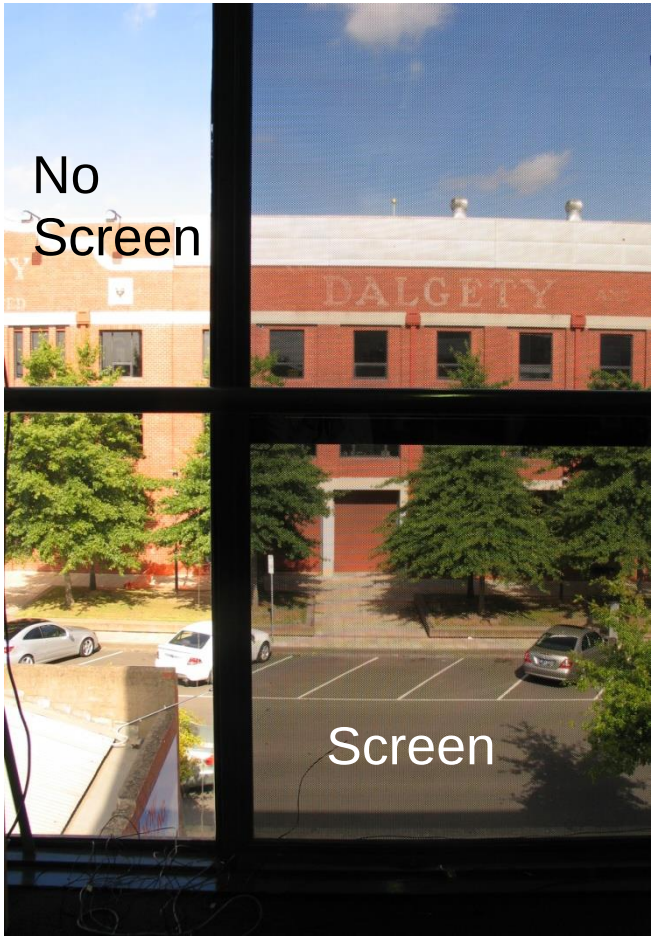
Glass FaÇade Improvements
Links glass selection to daylighting and benefits from incorporating insulation in the building fabric.

Shading Systems
A clever shading system should allow for visibility, diffuse light and block unwanted solar gains.

Insulation

Thermal Mass and Storage
Can be provided also detached from the building structure and compatible with lightweight construction systems.

Passive Solar Conditioning
By either direct and indirect systems, such as glazed areas to allow sun penetration and indirect systems like solar hot water collectors.



Visibility

The existing single glazed heat absorbing glass façade system, under a measured peak load hour, transmits and releases **45 kW** into the office.

The proposed addition of the external screen to this façade reduces this peak load to **7 kW**.

6. PRO-ACTIVE VS REACTIVE BUILDINGS

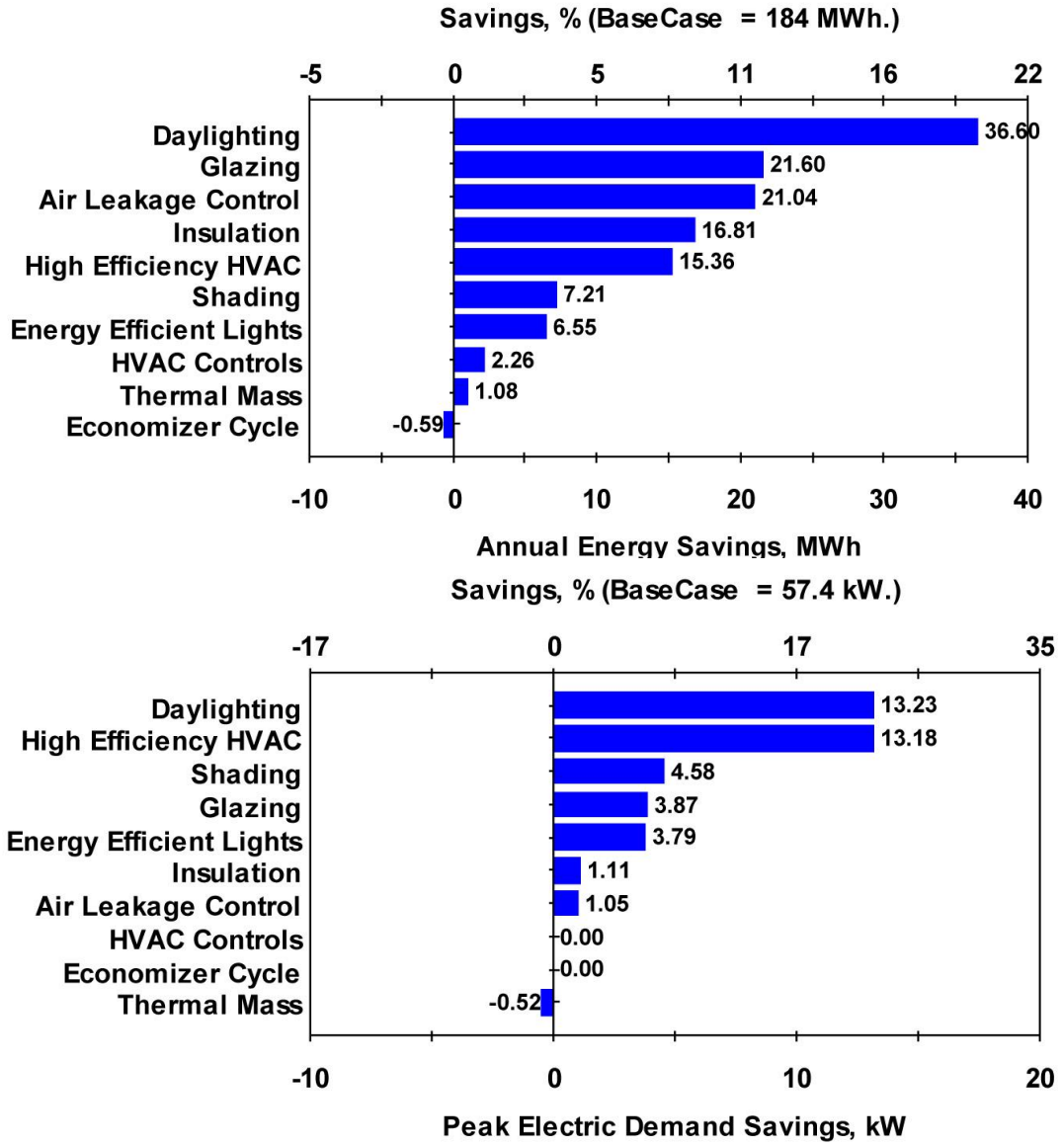
Rank the different strategies previously provided for a particular building regarding its:

- Type,
- Design and
- Climate region.

The figure shows an example in Melbourne, Australia.

Strategies can be ranked in a different ways, according to the characterization on energy efficiency.

A bioclimatic approach aims for smarter building conditioning considerations, beyond the single day requirements, and a proactive implemetation of several energy-efficient strategies, like the ones listed before.



7. CARBON TAX INCENTIVE FOR RETROFITTING

Australian Office Buildings need for ranking their CO2 emissions and energy consumption, through the Commercial Building Disclosure (CBD) programme.

Carbon taxes pushes owners and developers to seek for solutions for retrofitting buildings, which gives the highest opportunity to reduce GHG emissions according to IPCC report 2007.

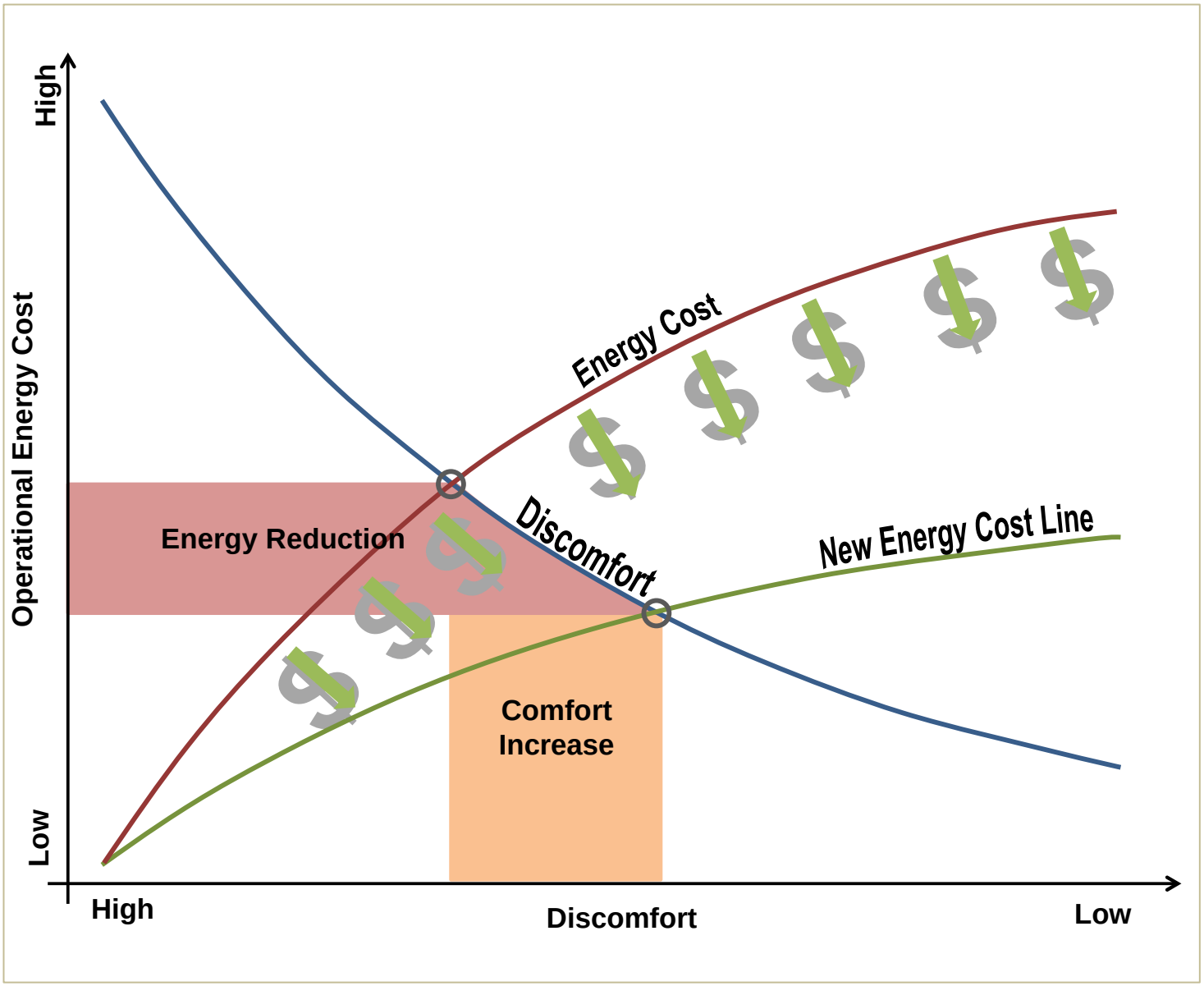
A key for Australia is to find ways to reduce energy consumption and GHG emissions.

What is need to be done?

- The creation of a standard for retrofitting procedures.
- A methodology to rank the solutions.
- Existing Energy Audit standard does not consider life-cycle costs in benefits like: comfort, spatial gains (area) and operational time reduction of HVAC systems.

Implications on a emissions trading scheme

- High performing buildings would accumulate credits.



8. CONCLUSION

The key factors to act upon a bioclimatic conditioning and control are:

- Awareness of our environmental conditions.
- Provide information for Building control systems.
- Utilize latest achievements in communication technology to allow systems to be actively and directly connected to the online world, allowing to;
- Respond immediately upon the information received from building control systems.