Retrofitting Public Building for Energy and Water efficiency: Guidelines, Financing and Risks

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SBEnrc Project Partners

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Presentation outlines

1. Introduction: Background and research needs
2. Project aims and objectives
3. Retrofitting guidelines
4. Financing mechanism
5. Managing the risks
6. Future work


SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

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Introduction: The Needs

1. Globally the building sector accounts for:
    1. 40% energy consumption
    2. 25% water consumptions,
    3. 30% CO2 emissions.

2. Energy efficiency of buildings is a key component of reducing energy and water use and achieving the emission reduction target set by international protocols.

3. The market for green retrofitting is growing worldwide
    1. $80.3 billion US dollar in 2011
    2. $151.8 billion by 2020.
    3. In U.S., market for green renovation was $2.1 billion/year in 2009, and grew over $6 billion a year by 2013.

4. In Melbourne in last 5 years, 37% of commercial buildings were retrofitted:
    1. average cost of retrofitting ($343,000/building) and
    2. 12% of those over $1 million/building.

Introduction: background

- The building sector accounts for 40% of the global energy/water consumptions, and contributes up to 30% of global greenhouse gas emissions.

- Energy and water efficiency of buildings is a key component of reducing global energy use and achieving the emission reduction target set by international protocols.

- The federal and state governments occupy more than 25% of the commercial building stock in Australia.

- The Australian Government spends well over $450 million a year on energy and water. If the Government upgrades the efficiency of the buildings that it owns or occupies, it will

  - *Deliver well over $2 billion in operational savings over 25 years.*
  - *Reduce energy use from government buildings by 25 to 50 percent and water use by around 10 to 20 percent.*

Introduction: the needs to retrofit

- EEGO in Australia requires that all government office buildings should have minimum NABERS energy 4.5 star rating.
- The Chinese Government issued regulations which requires a 10%-20% reduction (depending on floor area) of energy consumption per m^2 for public buildings by 2015.
- The UK government made a commitment to upgrade the energy efficiency of 7.0 million British homes by 2020 to reduce carbon emissions by 29%.
- Energy Policy Act 2005 in USA requires that all existing buildings must reduce energy consumption 30% by 2015, compared with 2003 levels.
- There are a number of policies with the requirement of reducing energy consumption and emission but lack of a comprehensive retrofitting strategy is hindering the process.

Project Aims and Objectives

- The aim of this research project is to propose a comprehensive guidelines and financing mechanism to guide the building retrofitting process efficiently and cost-effectively. Specific objectives are to:

  - *Identify potential barriers to the uptake of energy/water efficiency retrofitting.*
  - *Evaluate national and international building retrofitting guidelines.*
  - *Propose new retrofit guideline based on the understanding from potential barriers, existing guidelines, and research progress.*
  - *Explore national and international financing mechanism*
  - *Determine the best financing mechanism for public building retrofitting*

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Different Levels of Retrofitting

Level 1 - Existing Building Commissioning	• Up to 25% Energy Savings • Can be achieved with minimal risk and capital outlay by improving building operation and maintenance procedure
Level 2 - Standard Retrofit	• 25-45% Energy Savings • Component level replacement levels of existing equipment for improved energy efficiency.
Level 3 - Deep Retrofit	• Over 45% energy savings • An integrated whole building approach is used for energy savings. For example, combination of building envelope upgrade with lighting and mechanical system upgrade.

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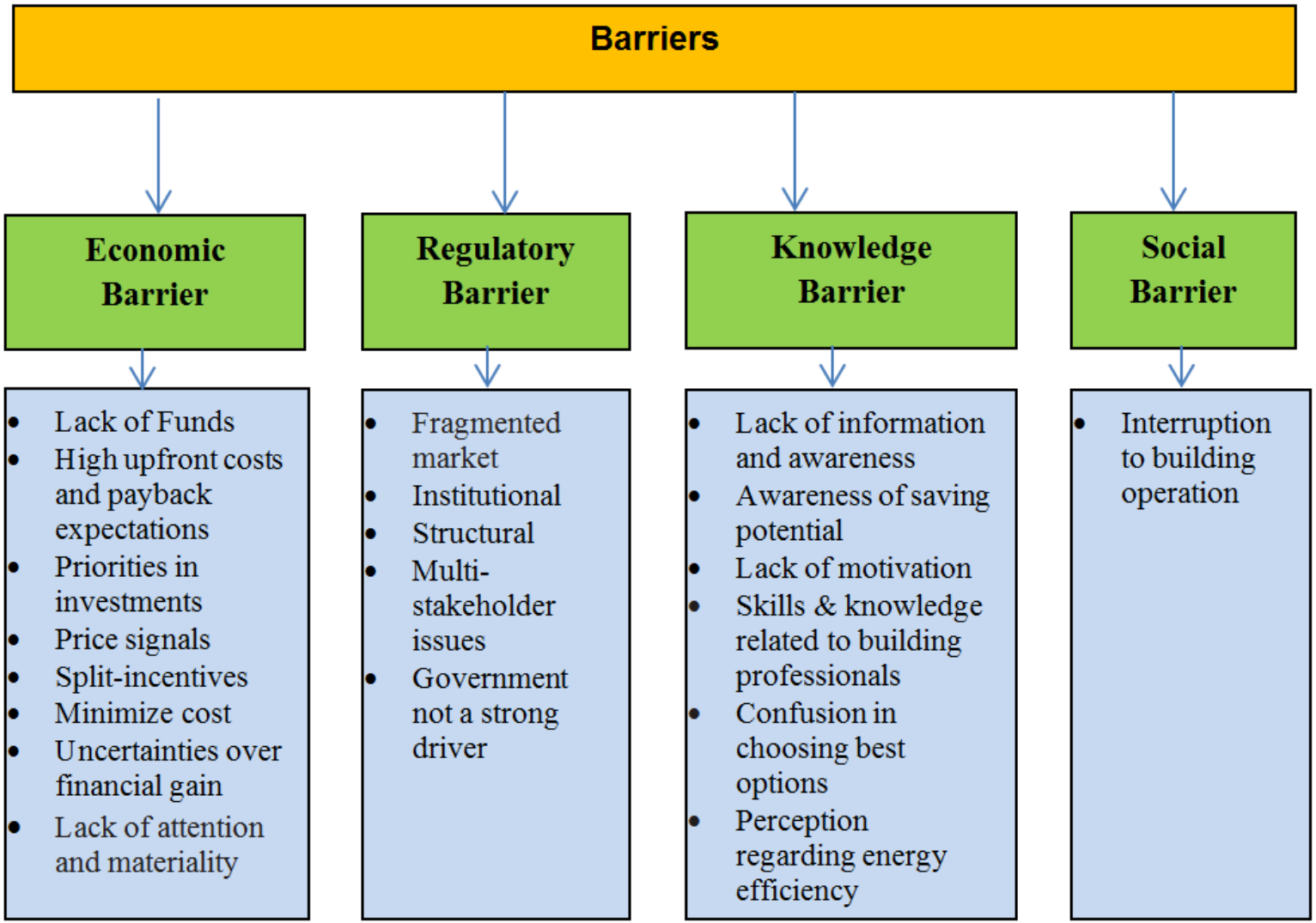
Barriers to implementing retrofitting



Barriers in public building retrofitting

- The implemented strategy to improve the energy efficiency of buildings occupied by government agencies is largely ineffective mainly because of the following barriers:

  - **Lack of information and guidelines -** The government agencies are generally unfamiliar with the process of improving energy and water efficiency and need guidance.

  - **Lack of finance –** The government agencies does not have access to sufficient capital to pay for the upfront cost of building retrofitting project

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Part 1: Retrofitting Guidelines

Overview of Current Interntional Guidelines

- Available building retrofitting guidelines can be divided in two categories:
  - National level building retrofitting strategy
  - Individual building retrofitting guideline
- The *national level* building *retrofitting strategies* can assist the governments in establishing long-term strategies to stimulate the building renovation rates and achieve the national energy efficiency as well as emission reduction target.
- The *individual building retrofitting guideline* includes necessary steps required to retrofit an individual building for energy and water efficiency (focus of this research project)

National level building retrofitting strategy: EU

European Commission suggested that building renovation strategy should address the following issues:

- Provide an overview of the national building stock based, as appropriate, on statistical sampling.
- Identify cost-effective approaches to renovations relevant to the building type and climatic zone
- Provide information on policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations- **Analyse existing policies, potential barriers for uptake of energy efficiency measures**

National level building retrofitting strategy: EU

- Demonstrate a forward-looking perspective to guide investment decisions of individual organisations, the construction industry and financial institutions.

a) Quantify total annual investment requirements, mapped out over the period to 2050, in order to deliver the identified renovation opportunities.
b) Identify existing sources of funding for building energy renovation:
c) Analyse barriers to investment.
d) Identify possible funding sources and mechanisms to meet the identified investment profile

- Provide an evidence-based estimate of expected energy savings and wider benefits.

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National level building retrofitting strategy: EU

Building Performance Institute Europe (BPIE)

Key phases in the development of a renovation strategy:

National level building retrofitting strategy: EU

Phase 1: Identifying Key Stakeholders & Information Sources

A strategy development team needs to be pulled together to include input from representatives of Government ministries with responsibility for policy on energy, the building sector (including housing/communities), regions, industry, finance and the economy. Input from external stakeholders such as sectoral experts, the finance community and representative industry bodies will also be invaluable within the project team.

Phase 2: Technical and Economic Appraisal

In this phase, the technical potential for improving the energy performance of the building stock is determined and the range of renovation options appraised and costed.

Phase 3: Policy Appraisal

The purpose of the policy appraisal phase is, firstly, to review in some detail the current policy landscape affecting building renovation, and secondly, to identify the changes to policies and additional policies that will be necessary to unleash the building renovation market.

National level building retrofitting strategy: EU

Phase 4: Drafting & Consulting on The Renovation Strategy

This phase brings together the technical and economic appraisal undertaken in phase 2 with the review of policy options in phase 3 **in order to generate a range of possible future pathways or roadmaps for the long term renovation of the national building stock**. Depending on the timing and strength of different policy levers, different rates of renovation can be modelled and the resulting investment and benefits horizons profiled and quantified.

Phase 5: Finalisation, Publication & Delivery

At this stage, the national renovation strategy is published by the governments and steps are taken to mobilise the necessary resources to implement the strategy.

National level building retrofitting strategy: EU

European insulation Manufacturers Association(Eurima)

Eight key elements of a building renovation roadmap are:

1. High-level of ambition
2. Clear and ambitious targets
3. Support and collaborative involvement from all levels of Government, market actors and stakeholder parties
4. Flexible but focused iterative development
5. Take a holistic approach, addressing the whole building stock
6. Integrate energy performance with broader societal goals
7. Include flexible, creative thinking, beyond what has been tried before
8. Inclusion of financial support, consumer education, and organisational support

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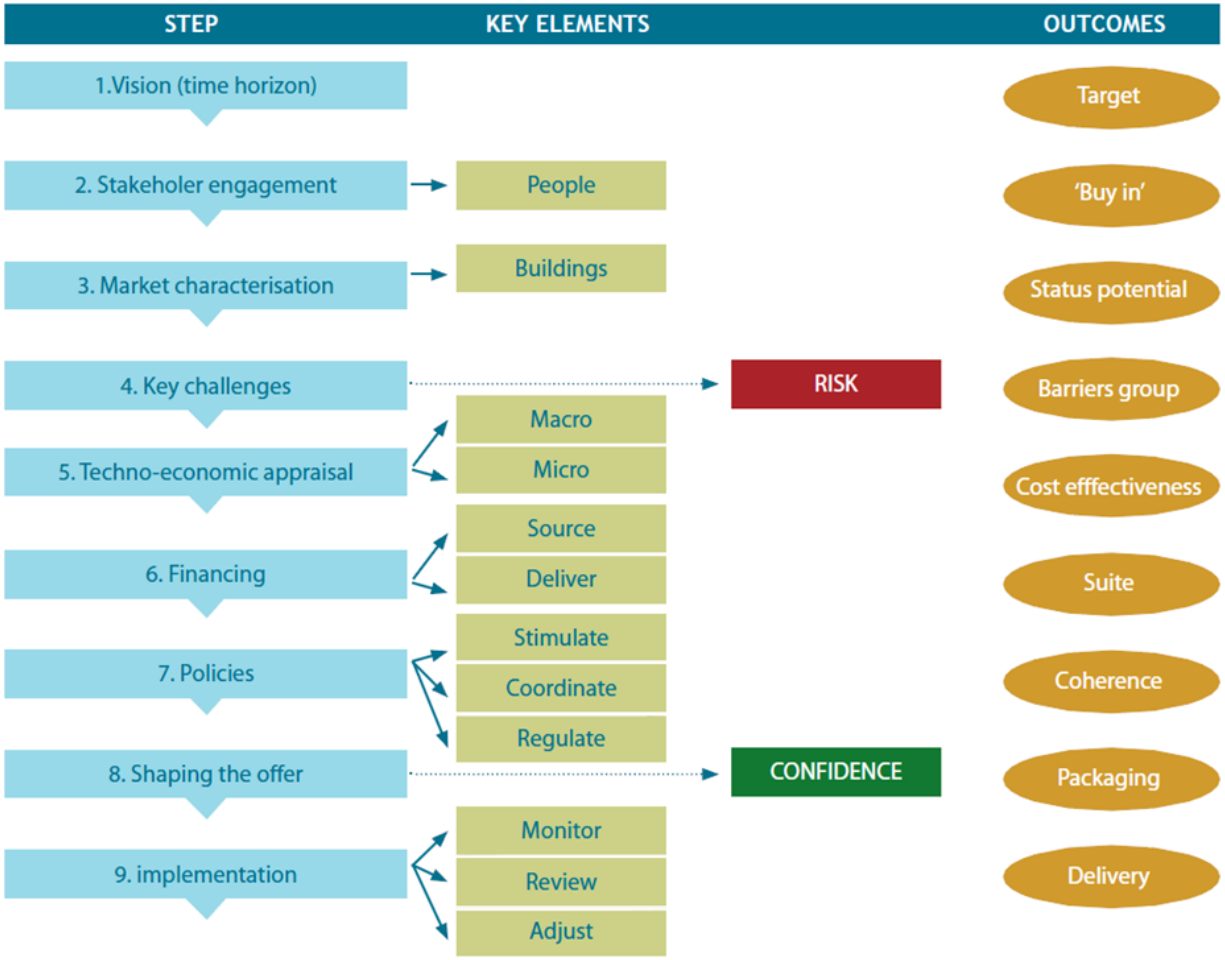
National level building retrofitting strategy: EU

Joint Working Group (EPBD, EED and RES)



Retrofitting Guidelines: EU Joint Working Group

1. **Vision and time horizon**: Issues and questions to consider in setting a vision and time horizon for the long term strategy, and associated targets and milestones.

2. **Stakeholder engagement**: Issues and questions to consider in securing stakeholder engagement, understanding, alignment and commitment.

3. **Market characterisation**: Issues and questions to consider in segmenting, profiling and seeking to understand the marketplace of existing buildings, their owners/ occupiers/ investors, in order to identify the potential for energy performance improvement.

4. **Key barriers and challenges**: Issues and questions to consider in assessing and overcoming key challenges and barriers to mobilisation of this sector.

Retrofitting Guidelines – EU Joint Working Group

5. **Techno-economic appraisal**: Issues and questions to consider in assessing the technical, economic and other costs and benefits of building energy renovation, from individual investor, national exchequer and societal perspectives. This includes tackling of constraints and conflicts.

6. **Financing:** Issues and questions to consider in quantifying, sourcing, designing and delivering the necessary finance, and in managing risk.

7. **Policy measures**: Issues and questions to consider in assessing options and formulating policies to stimulate, coordinate and regulate large scale delivery of quality renovation activity.

8. **Shaping the offer – growing market confidence:** Issues and questions to consider in developing actions to create investor trust and confidence across the market segments.

9. **Implementation:** Issues and questions to consider in the process of mobilising the full breadth and depth of action for effective delivery in the short term and on the long term vision

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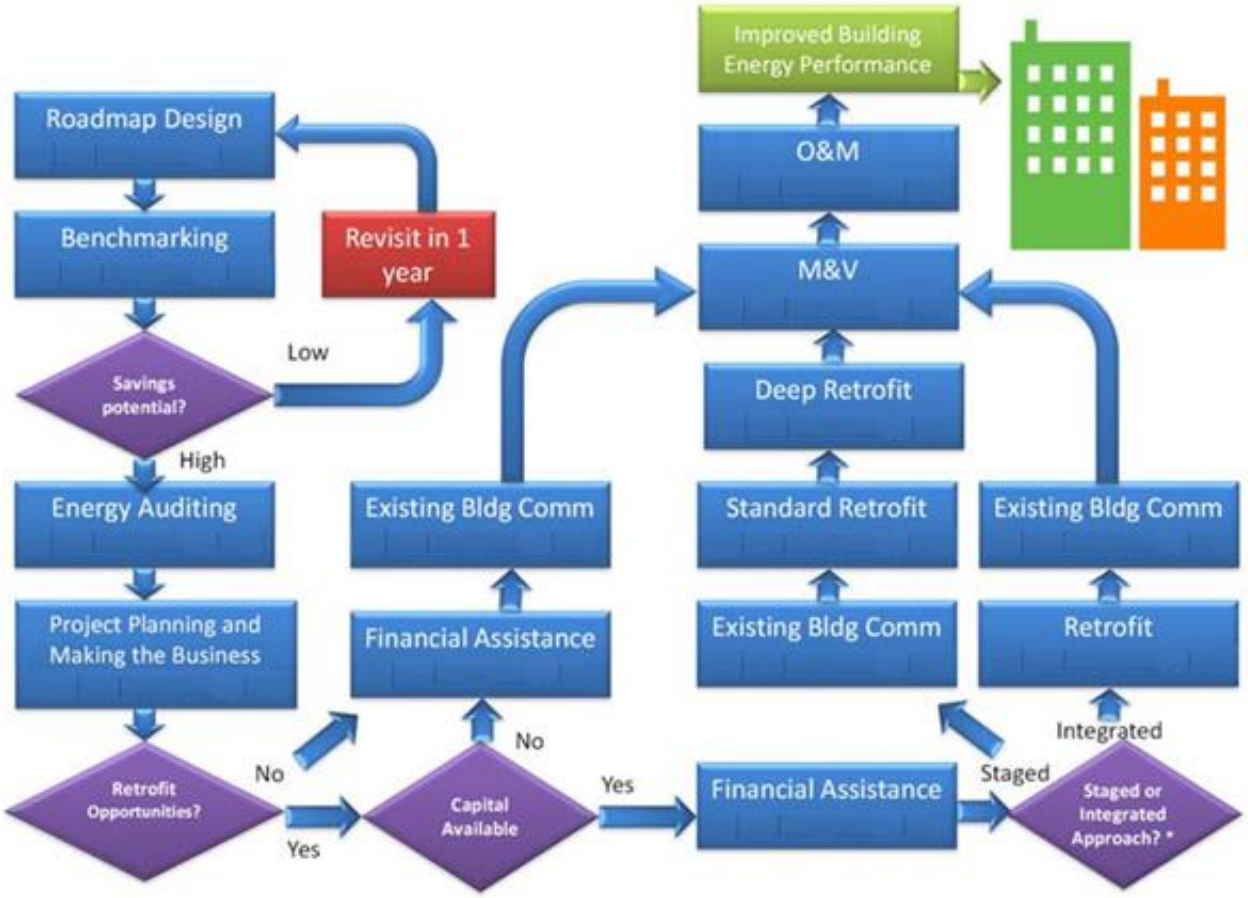
Individual Building Retrofitting Guidelines

USA guideline



Individual Building Retrofitting Guidelines: **USA**

Roadmap Design: This section discusses how an organization can find and deliver on energy-saving opportunities. It begins with a commitment and goal setting, creating action plan, evaluating financing options and incentives, implementing upgrades and measuring progress.

Benchmarking: Calculating an energy performance metric for a building and comparing it with similar buildings provides a hint at the opportunity for upgrades in the building.

Energy Audits: Provides an understanding of a building's energy performance and energy saving opportunities through an investigation of the current equipment, operations, and building energy use patterns. It can be performed with varying levels of rigor and expense.

Project Planning and Making Business Case: Once benchmarking and audits have revealed the opportunities for performance improvements, a strategy (staged or integrated) can be designed for achieving high performance buildings. With many variables at play, such as age and condition of equipment, the timing and coordination of upgrades are important considerations.

A business case is developed considering energy and non-energy benefits of upgrade, cost-benefit analysis and available financial assistance. Finally, levels of energy efficiency upgrade to be implemented is decided based on the business case analysis.

Individual building Retrofitting Guidelines

Techno-economic appraisal: **USA**

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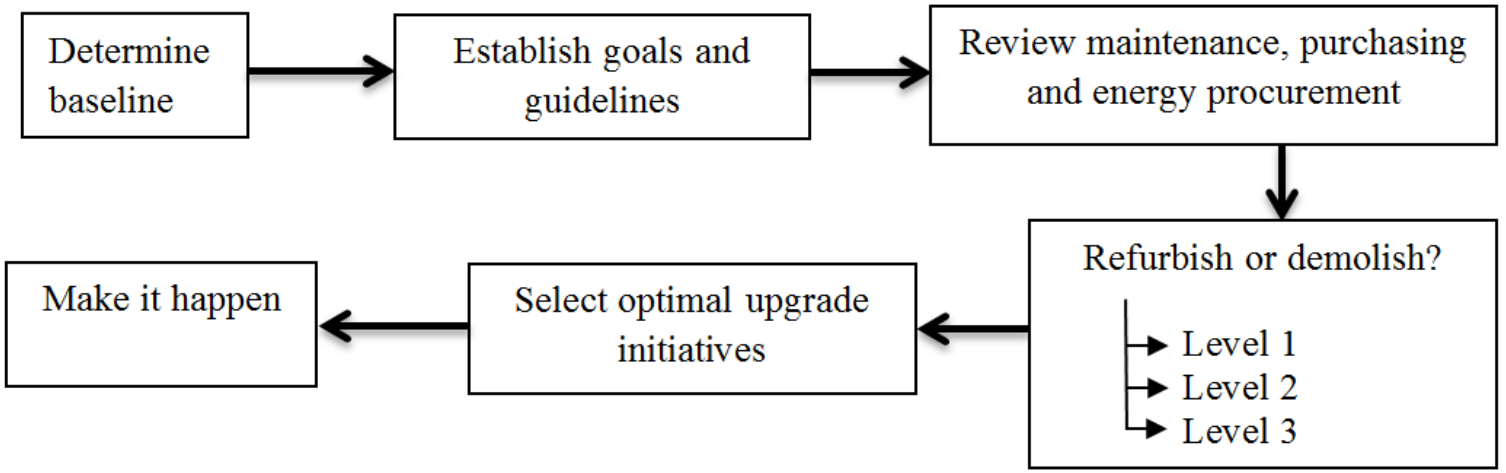
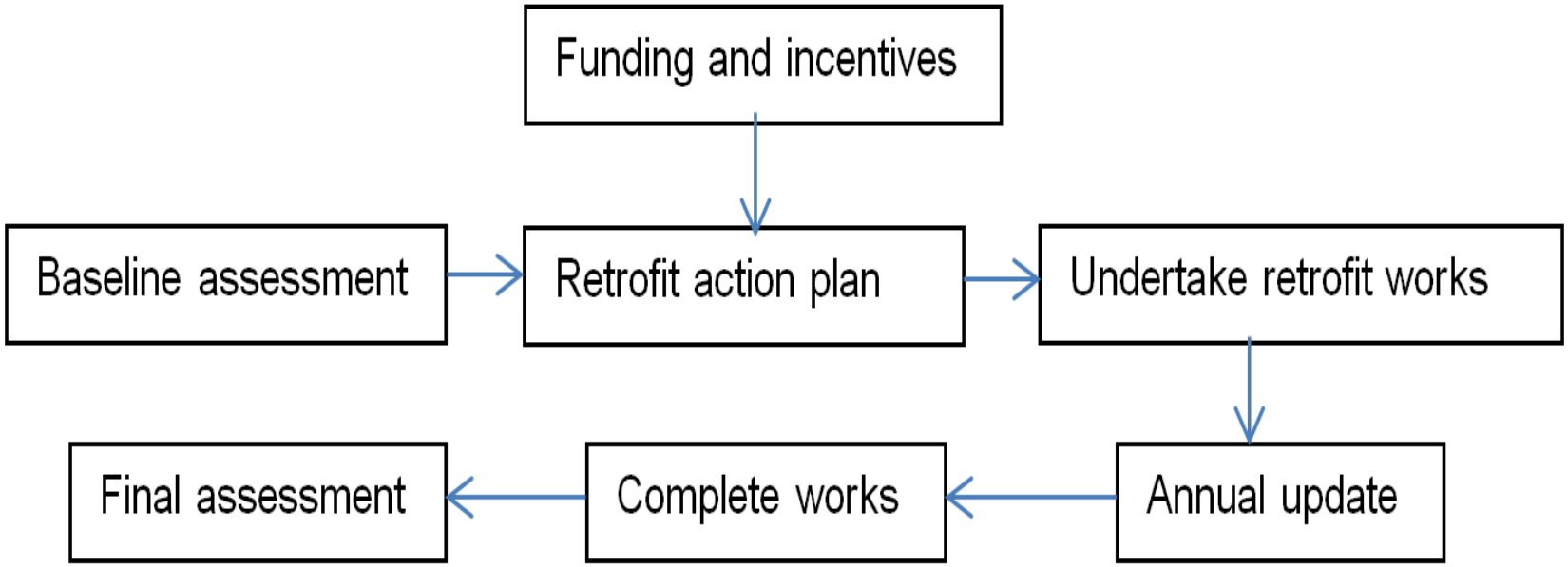
Individual building Retrofitting Guidelines: Australia

(developed by Property Council of Australia and ARUP)



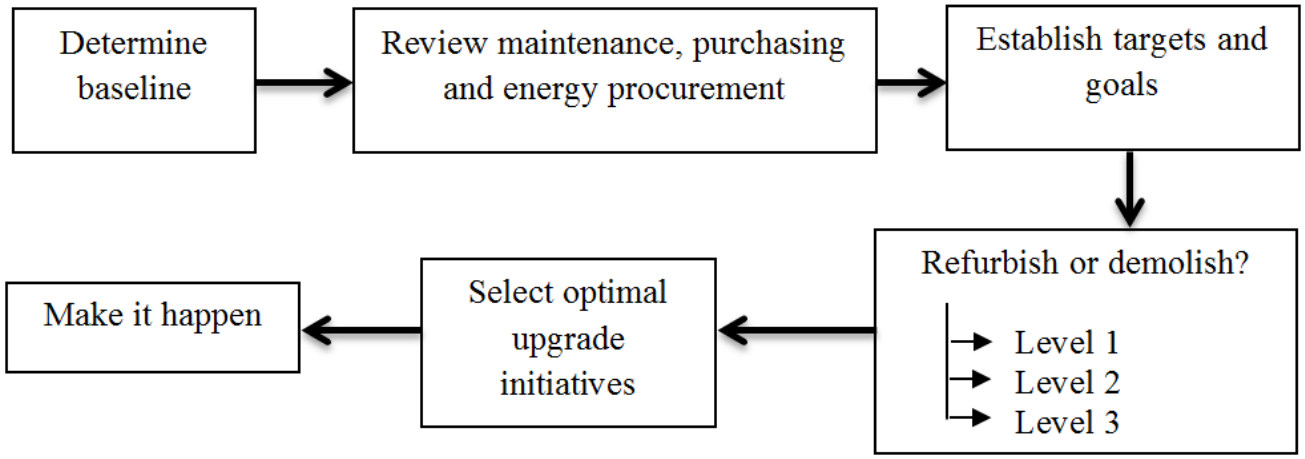
Individual building Retrofitting Guidelines: Australia

City of Melbourne's 1200 building retrofitting process



Individual building Retrofitting Guidelines: Singapore

developed by Building and Construction Authority Singapore and ARUP



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Individual building Retrofitting Guidelines: UK

developed by ARUP

Step #1 Determine your baseline and appropriate level of refurbishment

Step #2 Review your building maintenance, housekeeping and energy purchasing

Step #3 Establish your targets and goals

Step #4 Select your optimal upgrade initiatives

Step #5 Make your survival strategy happen

Individual building Retrofitting Guidelines: UK (developed by ARUP)

- Two assessment criteria: **building performance** and **building condition**.
- Then level of refurbishment is determined using the following table.

BUILDING PERFORMANCE	BUILDING CONDITION				
	EXCELLENT	GOOD	POOR	VERY POOR
EXCELLENT	Maintain	Level 1	Level 2	Level 3
GOOD	Level 1	Level 2	Level 3	Level 3
POOR	Level 2	Level 3	Level 3	Level 4
VERY POOR	Level 3	Level 3	Level 4	Level 5

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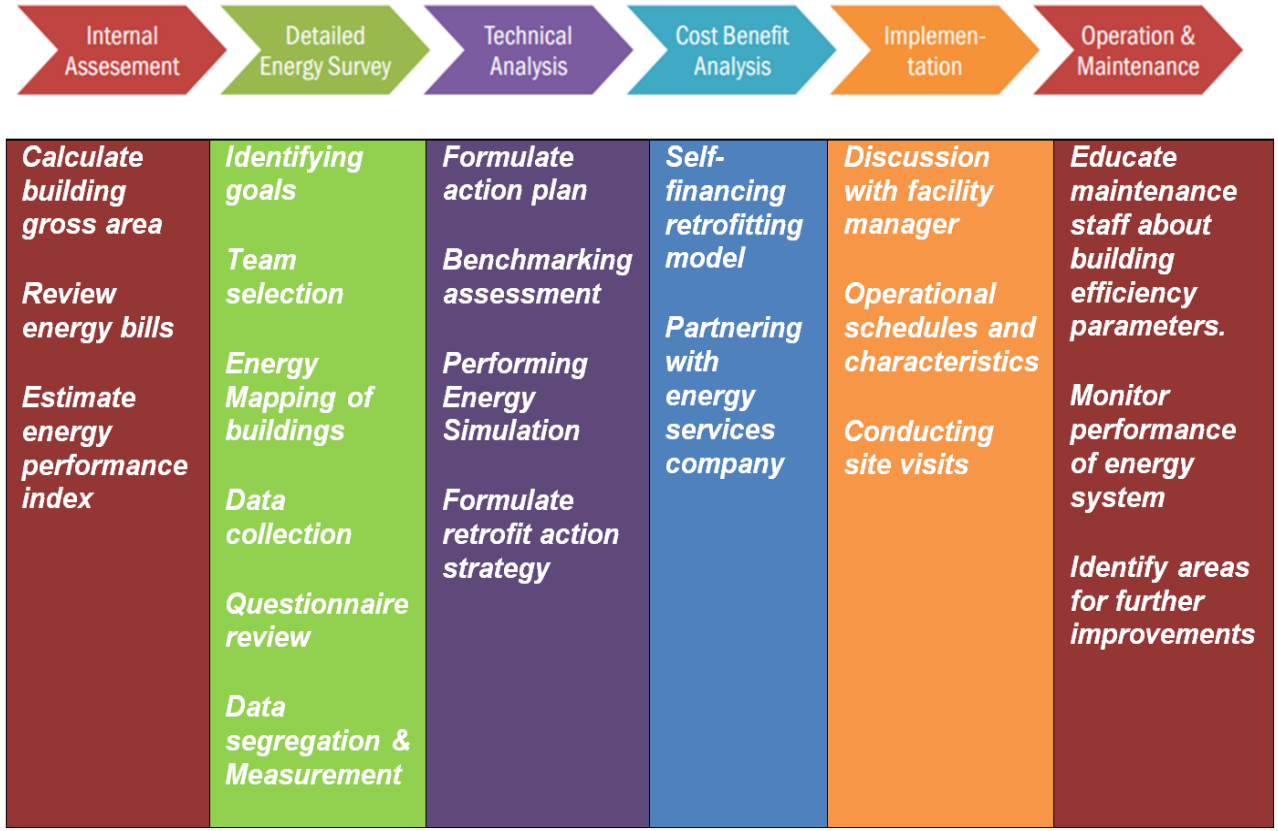
Individual building Retrofitting Guidelines: India



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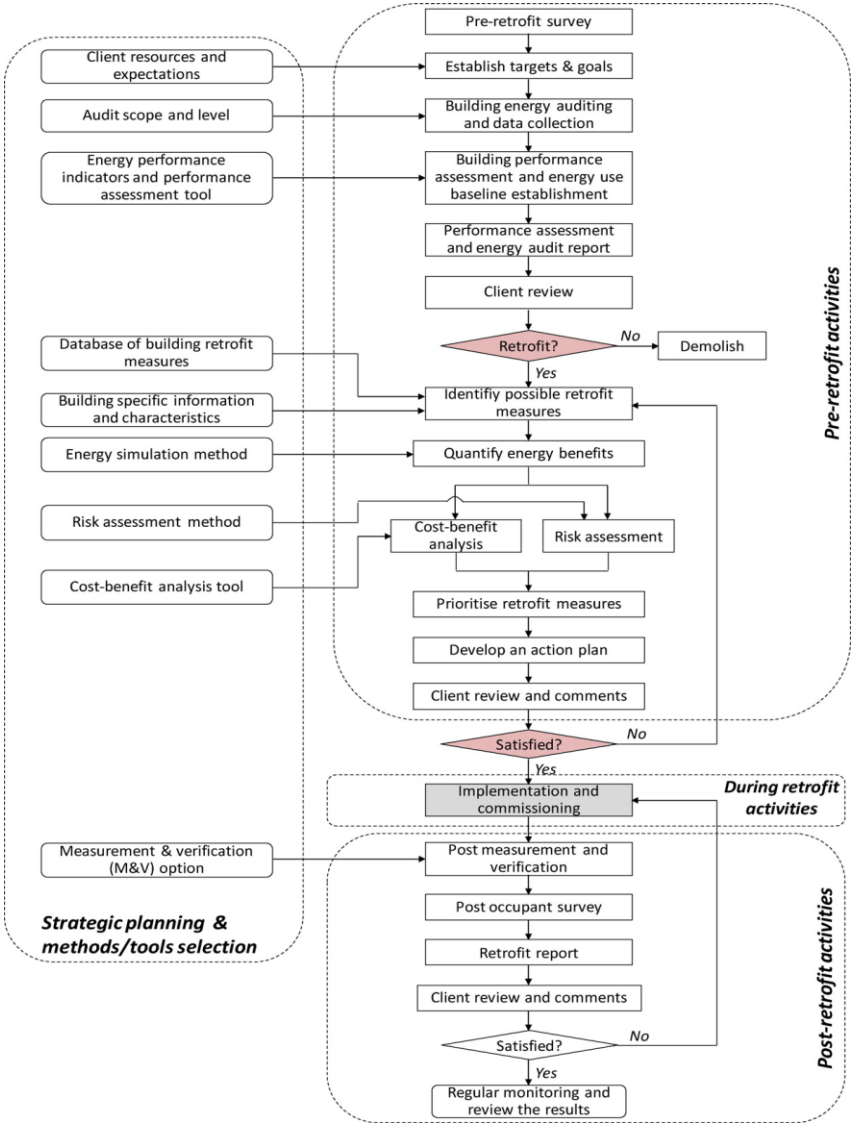
Retrofitting guidelines from research



Source: Ma et al. Energy and Buildings, 2012. 55: p. 889-902

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Benchmarking of guidelines

Guideline components	USA	UK (by ARUP)	Singapore (by ARUP)	Australia (by ARUP)	Australia (City of Melbourne 1200 Buildings retrofitting Program)	India	Research (Ma et al 2012)
Baseline assessment	√	√	√	√	√	√	√
Energy Audit	√	√	√	√	√	√	√
Project planning • ***Establish targets*** • ***Analyse potential barriers and challenges***	√	√	√	√	√	√	√
Exploration of retrofit measures • ***Level 1*** • ***Level 2*** • ***Level 3***	√	√	√	√	√	√[2]	√[2]
Making business case of retrofit	√	√	√	√		√	√
Risk analysis							√
Selection of optimum retrofit measures	√[1]	√[1]	√[1]	√[1]		√[1]	√
Financing	√				√		
Implementation	√	√	√	√	√	√	√
Measurement and Verification	√				√		√
Operation and maintenance	√				√	√	√

[1]Without considering risks, [2] did not divide retrofit measures into different levels.

Benchmarking of guidelines

Guideline components	USA	UK (by ARUP)	Singapore (by ARUP)	Australia (by ARUP)	Australia (City of Melbourne 1200 Buildings retrofitting Program)	India	Research (Ma et al 2012)
Baseline assessment	√	√	√	√	√	√	√
Energy Audit	√	√	√	√	√	√	√
Project planning • *Establish targets* • *Analyse potential barriers and challenges*	√	√	√	√	√	√	√
Exploration of retrofit measures • *Level 1* • *Level 2* • *Level 3*	√	√	√	√	√	√[2]	√[2]
Making business case of retrofit	√	√	√	√		√	√
Risk Analysis							√
Selection of optimum retrofit measures	√[1]	√[1]	√[1]	√[1]		√[1]	√
Financing	√				√		
Implementation	√	√	√	√	√	√	√
Measurement and Verification	√				√		√
Operation and maintenance	√				√	√	√

[1]Without considering risks, [2] did not divide retrofit measures into different levels.

Needs for a new guideline from government perspective

- The retrofitting guidelines, that have been discussed so far, were mainly developed from the perspective of an engineer/assessor/contractor.

- In this research, a guideline is proposed from the perspective of government for improving the energy and water efficiency of government buildings.

Proposed Guidelines

Public Building Retrofitting Guideline			
	Retrofitting steps	**Policies/Regulations**	**Responsible parties/ Pathway**
1	**Establish the target.**	-A policy to upgrade Energy and water efficiency to minimum Standard. Existing similar policy is *Energy efficiency in Govt. operations* -A mandate to implement the policy within an agreed timeframe. Existing similar policies are *Greener Govt. Buildings program of Victoria* and *NSW Govt. resource efficiency policy*.	-Government Internal organisation.
2	**Assess baseline**	-A framework to help the government agencies in undertaking the assessment. For example Energy efficiency specialist team in *NSW Energy Efficiency Government Program.* -A policy to engage the pre-qualified energy service companies (ESCO). The *Efficient government building program guidelines* of VIC and *Energy Efficiency Government Program* of NSW includes the requirement of a prequalified assessors, contractors, and ESCOs.	-Government internal organisation or external private companies. -The government should establish energy efficiency facilitation team (Follow VIC and NSW Govt. plan). The responsible person of each government agency should contact the energy efficiency facilitation team. Or Provide necessary training to that responsible person to manage the retrofitting process. -The government should develop a list of qualified external companies.
3	**Conduct energy and water audit**		
4	**Explore possible retrofit measures**		
5	**Make business case of retrofit**		
6	**Analyse risks**		
7	**Identify optimum retrofit measures**		

Proposed Guidelines

Public Building Retrofitting Guideline			
	Retrofitting steps	**Policies/Regulations**	**Responsible parties/ Pathway**
8	**Organize the finance**	-Develop funding policies to bear the retrofitting cost. Examples of some funding mechanism include *-Sustainable Melbourne Fund* *-Energy Performance contracting (Used by VIC Govt.)* *-Environmental upgrade agreement* *-Emission reduction fund* *-Clean energy financial corporation* *- The Victorian Energy Efficiency Target (VEET) scheme* *-Green Deal (UK)*	- Government internal organisation or external private companies. -If funded by the private companies, select the suitable funding mechanism.
9	**Implement the selected retrofit packages**	-Policies to manage retrofit implementation process including: *-engaging suppliers* *-engaging a skilled contractor* *-managing the tenants.* *-obtaining planning or building permits if necessary*	-Government internal organisation or external private companies.
10	**Commission the building**		-Government internal organisation or external private companies. -Contact independent building commissioning agent to commission the building

Proposed Guidelines

Public Building Retrofitting Guideline			
	Retrofitting steps	**Policies/Regulations**	**Responsible parties/ Pathway**
11	**Operation and maintenance of the retrofitted buildings**	Some existing maintenance and operation guidelines are - *Guide to Best Practice Maintenance & Operation of HVAC Systems for Energy Efficiency from* Council of Australian Governments (COAG) National Strategy on Energy Efficiency - *The Measures HVAC high-efficiency systems strategy* prepared for the Equipment Energy Efficiency Committee under the auspices of the Australian and New Zealand Ministerial Council for Energy.	-Facilities department of retrofitted building. -Adopt a maintenance strategy for the building based on available best practice guidelines
12	**Measurement and verification of the retrofitted buildings**	Some existing measurement and verification guidelines are - *International Performance Measurement and Verification Protocol (IPMVP)* -*ASHRAE Guideline 14* - *A Best Practice Guide to Measurement and Verification of Energy Savings* by The Australasian Energy Performance Contracting Association.	- Facilities department of a retrofitted building or external private companies. -Develop a measurement and verification plan to track the energy and water savings using best practice guideline. -Report the achieved energy and water savings annually.

Conclusion – Part 1

- Barriers to the uptake of retrofitting can be categorized into Economic, Regulatory, Knowledge and Social barriers.

- Review of existing guidelines revealed that all of them are missing important steps: **Risk Analysis** and **Financing Mechanism** in building retrofitting process.

- Existing researches have shown the importance of a risk assessment in building retrofitting process, yet none of the currently available retrofitting guidelines have incorporated it.

- The proposed new retrofitting includes probabilistic analysis of costs of savings to consider all potential risks in a retrofitting project

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Part 2: Financing Mechanism

Part 2 Contents

- Introduction
- Current limitations
- Financial mechanism – some options
- Best international examples (regulation+finance)
- Conclusions
- References

Introduction

- Reduction of 30/40% in energy/water consumptions are often achievable in buildings [1]
- In Australia, Governments occupy over 25% of the commercial building stock; the majority of public buildings were designed with limited consideration for energy and water efficiency. Thus around $1 billion per year is spent by the Government for water/energy use [2]
- In NSW only, up to $99 million in total economic activity could be realised by 2020 with the building energy efficiency market [3]
- However, public buildings are retrofitted to a very low rate [4] this is due mainly to lack of adequate financial frameworks. A full list of current challenges is presented in the next slide

Research gaps

1. Lack of knowledge
   - no reliable information on costs and benefits
   - shortage of technical skills
   - risk aversion
2. Modelling challenges
   - often not clear evidence of the cost-effectiveness of a retrofit project to support capital investment;
   - failure in considering all the costs, benefits and uncertainties of a retrofit project, as well as the effects of bundled alternatives, and the water/energy nexus
3. Financing and market challenges
   - high upfront costs
   - split incentives issues
   - no long-term financing at a moderate costs
   - unattractive financial returns
4. Regulatory deficiencies
   - general lack of national commitment
   - lengthy internal procedures
   - lack of mandatory efficiency standards
   - multiple professions involved in the decision process
   - lack of clear identification of professional roles involved
   - lack of regulated, effective M&V

Main financial challenges

Split incentive issue

- The owner pays for an upgrade whose savings will be benefitted by the tenants [5]

- This rarely happens, as the interest of the owner is to minimise the capital cost of the building (with little regard for energy savings) while the tenants want to maximise the energy efficiency to reduce energy costs [6].

Lack of capital investment/high upfront cost

- Proved to be a main limitation for larger implementation of retrofitting projects [7,8]
- In any economic sector, initial costs, rather then operating costs, are emphasised. This leads to the adoption of energy-inefficient systems [9]
- High initial capital investment, the long payback period and the often unclear division of benefits among stakeholders pose limitation to the expansion of this market [7, 10]

There is a clear need of favorable financing mechanisms and regulatory frameworks to overcome the above limitations

Financial mechanisms – some options

• On-bill recovery	UK
• Utility Energy Service Contract (UESC)	USA
• Environmental Upgrade Agreements	AU
• Energy Performance Contracts (EPCs)	USA, AU, UK
• Revolving loan funds	USA
• Loan Loss Reserve Funds	USA
• Interest Rate Buy-Downs	USA
• Climate Bonds	USA
• Insurance involvement	

On-bill recovery

- Landlords pay for the energy improvements on their utility bills [8, 11]
- This avoids the high upfront costs
- Since the energy bills are supposed to be lower due to the energy upgrade, the savings can compensate the extra costs and thus not affecting the landlord pockets at all.
- This is very important as many owners are averse to taking loans or risks in general [8]
- Green Deal: example of "on-bill recovery" financing mechanism: loan paid back through surcharges on electricity bill. Applied by a number of local UK City Councils (e.g. Birmingham) [12]

Utility Energy Service Contract (UESC)

- Used in the United States
- Agreement between a Government agency and an energy/water supplier which provides technical services and upfront payment of a retrofit project [13]
- Agency will pay back through extra fees in the bills

→ similar to on-bill recovery

→ More than 1,800 projects, ranging from small single-measure to large comprehensive projects, have been reported.

Environmental Upgrade Agreements

- Agreement between a property owner, a bank and local government that facilitates a building upgrade to improve energy efficiency.
- Once qualified for retrofitting, the upfront costs are paid by the financial institution. Owner/tenants pay back through additional Council fees
- Building owners can also pass part of the environmental upgrade charge to the building tenants.
- Helps with split incentives issue
- Used in Australia (e.g. NSW, Melbourne)

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Energy Performance Contracts (EPCs)

- Commonly used financing method in the commercial building sector.
- Energy service companies (ESCOs) implement a project to deliver energy efficiency, and uses the stream of income from the cost savings, to repay the costs of the project
- Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected.
- EPC is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information.

Energy Performance Contracts (EPCs)

Contracting models

Shared savings: Under a *shared savings* contract the cost savings are split for a pre-determined length of time in accordance with a pre-arranged percentage: there is no ‘standard’ split as this depends on the cost of the project, the length of the contract and the risks taken by the ESCO and the consumer.

Guaranteed savings: Under a guaranteed savings contract the ESCO guarantees a certain level of energy savings and in this way shields the client from any performance risk. Under a guaranteed savings contract the ESCO takes over the entire performance and design risk; for this reason it is unlikely to be willing to further assume credit risk. Consequently customers are financed directly by banks or by a financing agency.

Revolving loan funds

- Borrowers (e.g. ESCO) will repay the loan through achieved cost-savings [16]
- The money will be returned to the fund to make additional loans

→ ongoing financial tool that continuously increase due to the paid interests

- Typically lower interest rates and financial procurement costs than traditional financing, making it more competitive.
- These funds can provide financing to entities which otherwise would have issues to qualify for credit [16]
- Possible increase in scope of the project, due to a shorter payback period, which can lead to increased savings [16]
- Successfully applied in several US states.
- By joint marketing with ESCO, revolving loan funds can increase the interest in ESPC [16]

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Interest Rate Buy-Downs

- The bank receives a payment(s) from a third party organization, which effectively subsidizes the borrower's loan costs.
- The borrower gains the benefit of a lower interest, which saves him or her a considerable amount of money on the cost of the total retrofit loan
- With a subsidized loan, a borrower is more inclined to undertake needed retrofit work on a home or building.
- Example: AlabamaSAVES™ program (http://www.alabamasaves.com/Overview.aspx)

Climate Bonds

- Fixed-income financial instruments issued by the governments to raise finance for climate-related projects
- Low-risk, government-backed, → traditionally attractive for institutional and retail investors [17]

- An example is provided by the *Property Assessed Clean Energy (PACE)* Bonds issued by *US municipalities* to provide property owners with low-interest finance for long-term energy efficiency and renewable energy improvements. The investment will be paid back through additions in the property rates. These are lower than the energy savings thus mitigating the cash flow upon households. [17]

- Possible legislative barriers to be applied in other countries, such as Australia, whose local councils cannot issue bonds.

Loan Loss Reserve Funds

- Pool of funds made available to the bank for the specific purpose of covering defaults on a particular class of loans.

- The loan loss reserve fund acts as an internal insurance fund against potentially failed water and energy efficiency loans.

a type of loan that financial institutions
tend to be suspicious of, and less inclined to offer,
out of fear that a disproportionate number will default.

- Example: AlabamaSAVES™ program
(http://www.alabamasaves.com/Overview.aspx)

Role of insurances

- Insurance products are also spreading out as a financial mean to manage risks.
- For instance, the energy savings insurance guarantees that payments are made to the lender, in case the expected energy savings are not reached.
- It can also result in lower financial costs [18]
- A potential market of $1 billion/year was identified [19]

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Some international examples

- Need for regulatory frameworks, integrating a number of financing options, in order to promote the acceleration of the retrofitting rate

- International examples: Germany, UK, USA, China

- Australian examples: Melbourne 1200 Buildings Programme, Victoria's Efficient Government Buildings Program

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Overview of best international practices

- GERMANY [20]

➢ has one of the most ambitious programs of energy conservation in Europe.

➢ New jobs: 500,000 in renewable energy and 900,000 in retrofitting (2006-2011).

➢ Financing: Public investment bank (KfW) offers a special fund in order to promote energy efficiency projects

Three pillars:

1. A clear, legal framework and tight regulation at federal level;
2. Strong financial incentives through subsidies and loans, via a public investment bank;
3. Campaigns to change behaviour.

Overview of best international practices

- UNITED KINGDOM

- Green Investment Bank: Government agency, seeded with public funds, with a number of financing mechanism available, in order to accelerate investment in low carbon assets; it aims at leveraging significant private capital with a mix of targeted direct and indirect financing mechanism [17]

- Green Deal: example of "on-bill recovery" financing mechanism: loan paid back through surcharges on electricity bill. Applied by a number of local City Councils (e.g. Birmingham) [12]

- London's RE:FIT program: it aims to retrofit 40% of public buildings by 2025; different financing options such as bank loans or public funds, with the work carried out by ESCOs [21]

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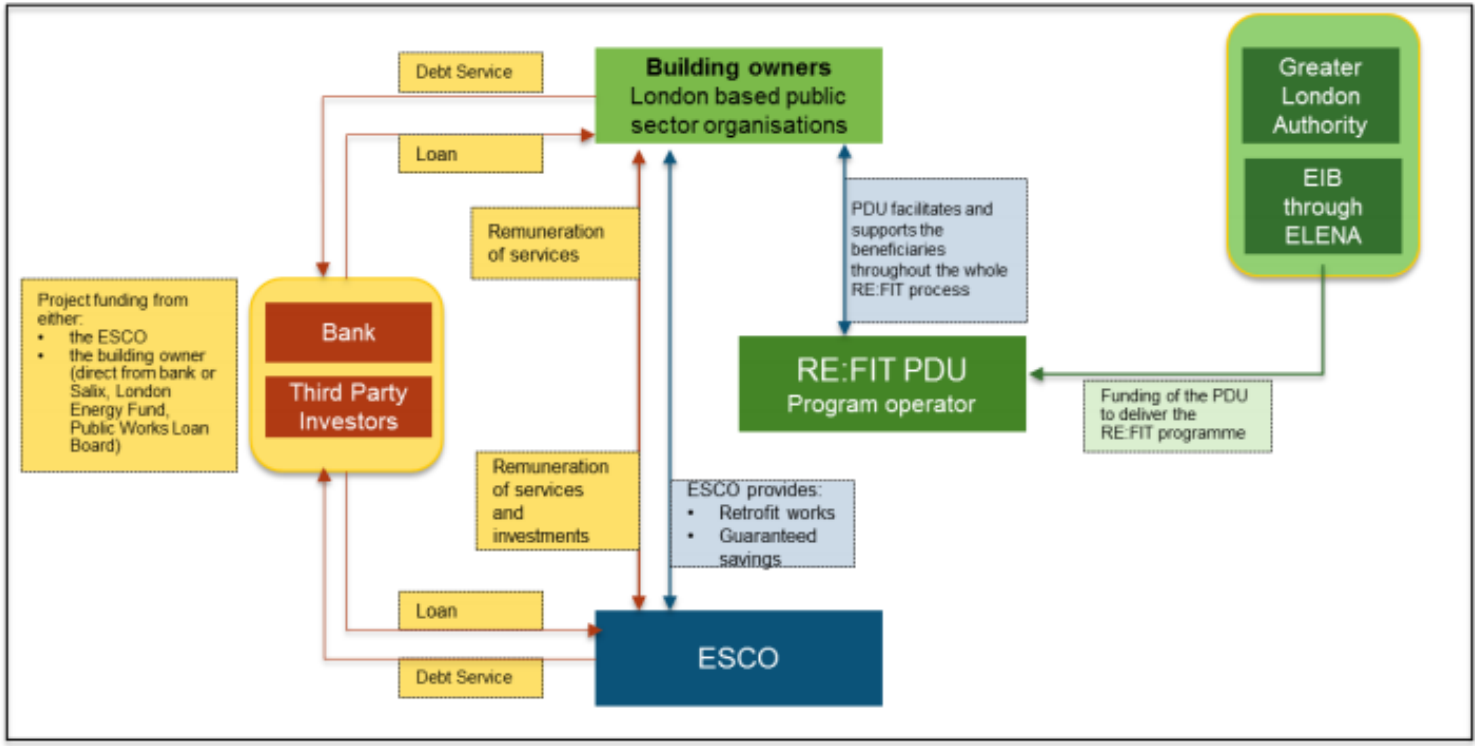
Overview of best international practices

London's RE:FIT program

Simplified the procurement process by providing pre-negotiated, contracts that can be used with a group of 12 pre-qualified ESCOs. Here the building owner only needs to run a mini competition to select the ESCO



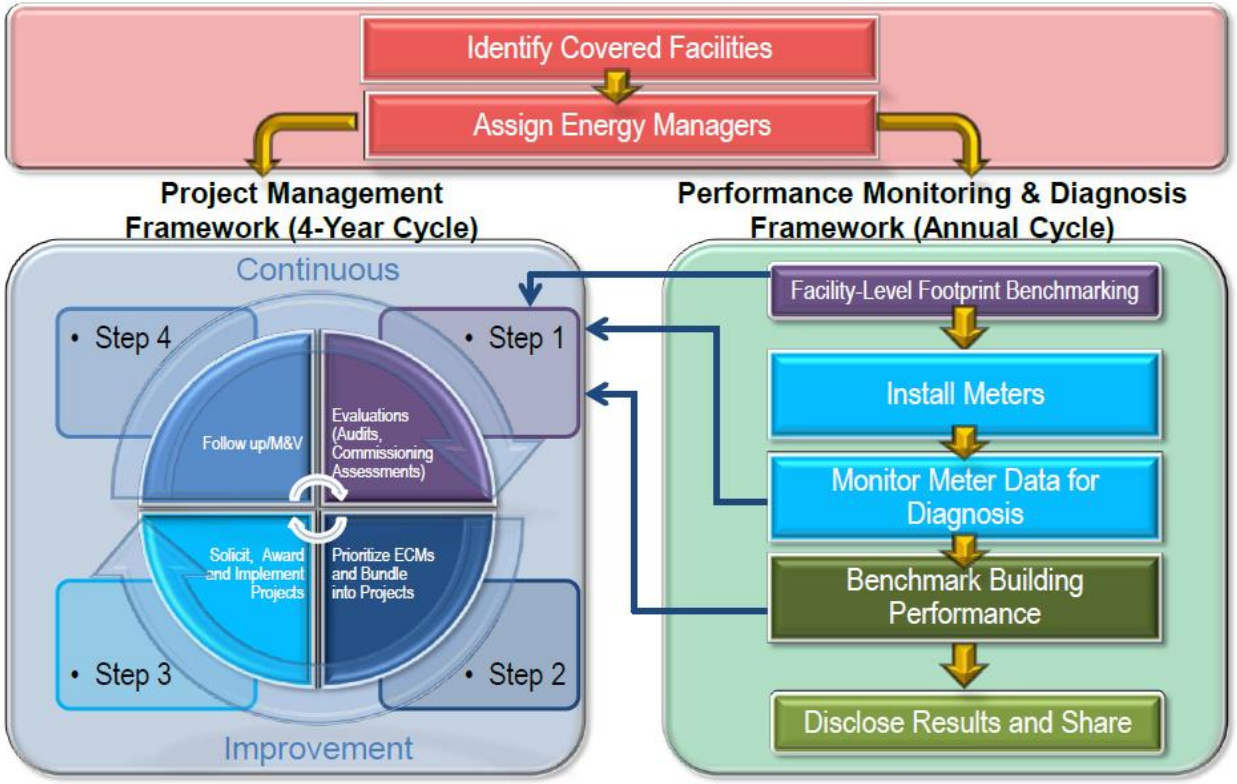
Overview of best international practices

USA: comprehensive approach for deploying energy and water efficiency and conservation measures (ECMs) in Federal buildings and monitoring project and building performance (US Energy Independence and Security Act of 2007)

Two general frameworks:

1) Energy and Water Efficiency Project Management

2) Performance Monitoring Framework



Overview of best international practices

CHINA

- To overcome the split incentive issue, demonstration projects to show the benefits of retrofitting upgrades [10]

- As a consequence, in few areas of China, buildings owners and tenants started to share the cost of energy retrofit [10]

→ Energy and water savings knowledge should be popularised among the consumers through public education [10]

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Melbourne “1200 Buildings Programme”

- Replacing a broken asset was the most common reason to retrofit (39 %) followed by minimising energy consumption (31 %) and attracting tenants (21%).
- 52% of respondents saw retrofitting as an investment and 28% saw retrofitting as a cost.
- 28 % of respondents indicated that the “split incentive” was a barrier to retrofitting.
- 35 % of respondents indicated that access to finance was a barrier to retrofitting.
- Retrofit rate: 5-7%

(1200 Buildings Melbourne Retrofit Survey 2013)

Victoria's Efficient Government Buildings Program

- Invested $134 million in upgrades to 389 government buildings since 2009
- Over 15 years, these projects are estimated to achieve cost savings of $335 million, resulting in a positive net present value of $107 million and the annual avoidance of 134,000 tons of greenhouse gas (GHG) emissions (a 5.1 % saving on total government building emissions).
- The majority of these savings have been achieved through EPC.
- EPC here aims to achieve a 7-year simple payback period for all projects, i.e. projects must pay for themselves with the savings achieved over 7 years.

- However, EPCs are **not suitable for all facilities** and are typically only used for **large and/or complex buildings**, e.g. hospitals, TAFEs, large office buildings, sporting complexes, etc.
- For smaller sites such as schools (<1 Gwh per year), alternative approaches may be preferable as there is no interest from EPCs

http://www.procurement.vic.gov.au/State-Purchase-Contracts/Energy-Performance-Contracting#WhatIsAnEPC

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General recommendations

- Uncertainty regarding what constitutes success, as well as the long term cost effectiveness of various approaches. Geographic, demographic, and programmatic differences frequently cloud the ability to make comparisons across programs [24]

- A revolving loan fund, couple with ESCOs, seems the most suitable option for Australia, but mainly for large complex buildings

- Also, an EUA system such as in Melbourne could be improved and expanded (education, awareness-raising)

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General recommendations

- Create a system with **multiple** financing mechanisms available, following examples of Germany and UK.

- This system should be applied at a national scale, thus unifying the current existing schemes

- The financing options must be embedded in a comprehensive regulatory framework, which includes e.g. better regulated M&V: this can reduce uncertainties and increase insurance involvement
- Energy and water should be both evaluated :

EPC → EWPC

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Revolving loan fund system recently explored for other sectors

RLF+ESCOs → more potential to develop a specialised technical group of professionals, and thus more job opportunities

$50m 'investment-banking style' unit to fund transport projects

Malcolm Turnbull says 'innovative' new unit will 'broker investment in landmark projects' – part of his vision for 30-minute commutes for all workers

Malcolm Turnbull's new 'innovative financing unit' will devise funding deals for multibillion-dollar transport projects. Photograph: Glenn Hunt/EPA

Malcolm Turnbull is promising an investment-banking style "innovative financing unit" to devise funding deals for multibillion-dollar transport projects as part of a grand plan to reduce commuting time and make Australian cities more liveable.

The financing unit would include bureaucrats and secondees from the private sector and would have the job of finding ways to pay for priority projects identified by Infrastructure Australia. They could include public/private partnerships, government borrowings or "value capture" - using some of the land value increases fuelled by a new project, like a rail line, to pay for its construction.

Financial modelling Objectives

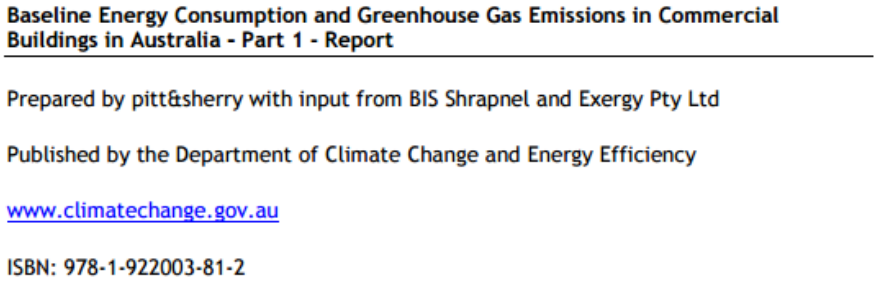
- Estimation of willingness to retrofit under different scenarios (e.g. financial mechanisms, area, etc.)
- Estimation of long-term energy, water and carbon savings

Retrofitting rate estimation

- Challenge: not only technical assessment. Retrofit option must also have financial/implementation attractiveness → Difficult to estimate

- **Bayesian Networks**: probabilistic model allowing for integration of quantitative and qualitative data

Data collection



Baseline Energy Consumption and Greenhouse Gas Emissions in Commercial Buildings in Australia - Part 1 - Report

Prepared by pitt&sherry with input from BIS Shrapnel and Exergy Pty Ltd

Published by the Department of Climate Change and Energy Efficiency

www.climatechange.gov.au

ISBN: 978-1-922003-81-2

- Building stock data
- Energy consumption

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Home > Hospitals & health services > Planning and infrastructure > Sustainability > Water > Water consumption

Water consumption and benchmarks

Key messages

- Water efficiency benchmarks allow organisations to measure how well they are managing their water consumption.
- Water consumption in Victorian public hospitals decreased by 14.3 per cent from 2005-06 to 2014-15.

Analysing water usage and developing water-efficiency benchmarks allows health services to measure how well they are managing their water consumption.

Water use trends in Victorian public health services

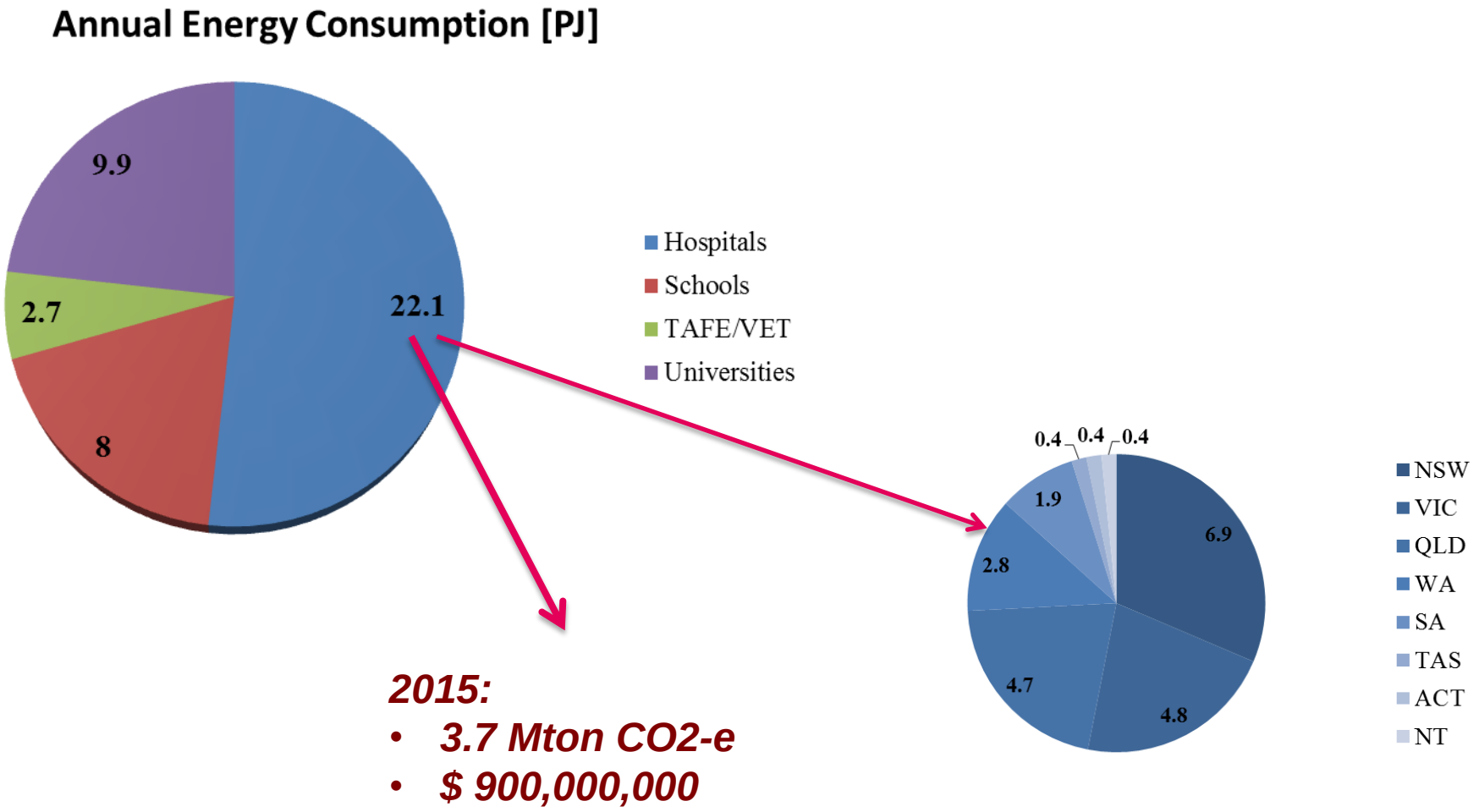
Water consumption in Victorian public hospitals decreased by 14.3 per cent from 2005-06 to 2014-15. From 2010-11 to 2014-15 total water use increased by 9 per cent. This increase could be attributed to a combination of the easing of water restrictions, hotter weather (for example increased irrigation of landscaped areas and increased demand for water-based cooling) and/or water leaks.

Portfolio water consumption

6
5

- Water consumption

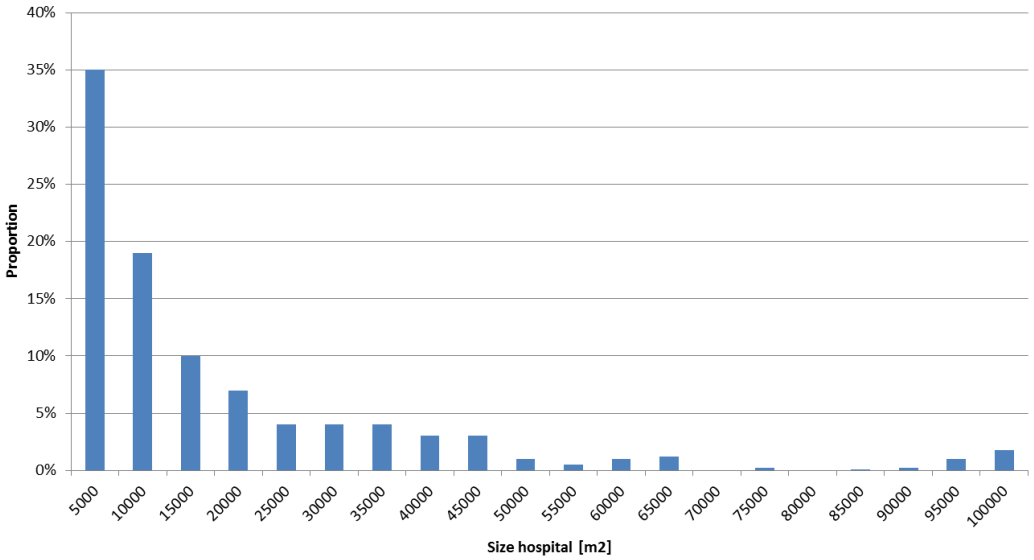
Energy consumption

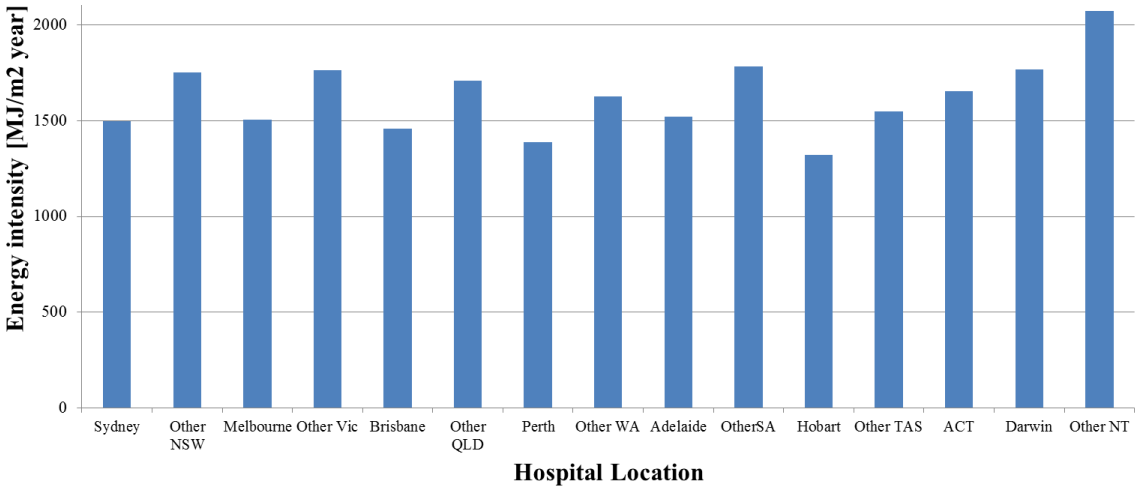


2015:

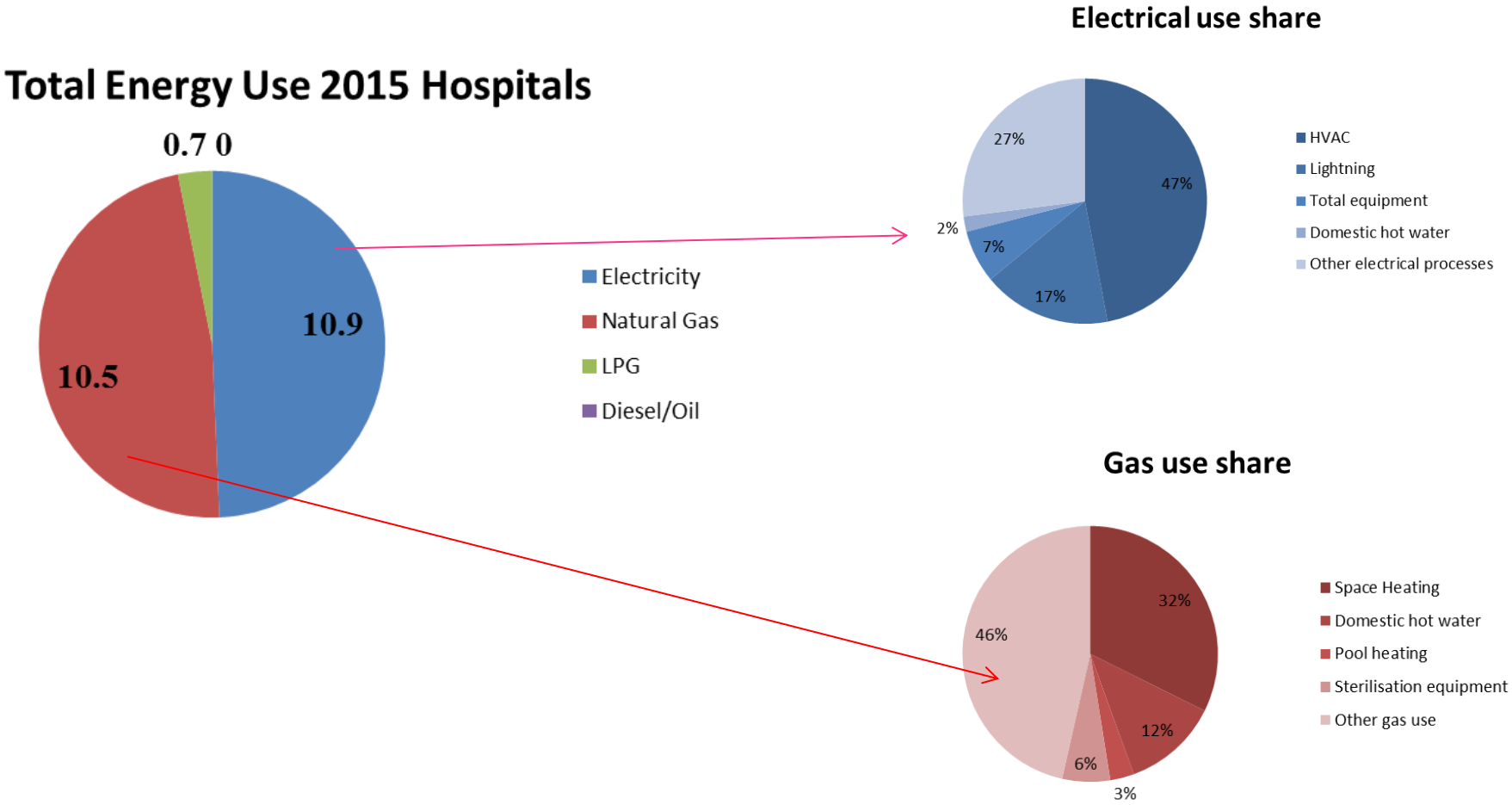
- ***3.7 Mton CO2-e***
- ***$ 900,000,000***

Hospitals Data analysis





Hospital Energy consumption breakdown



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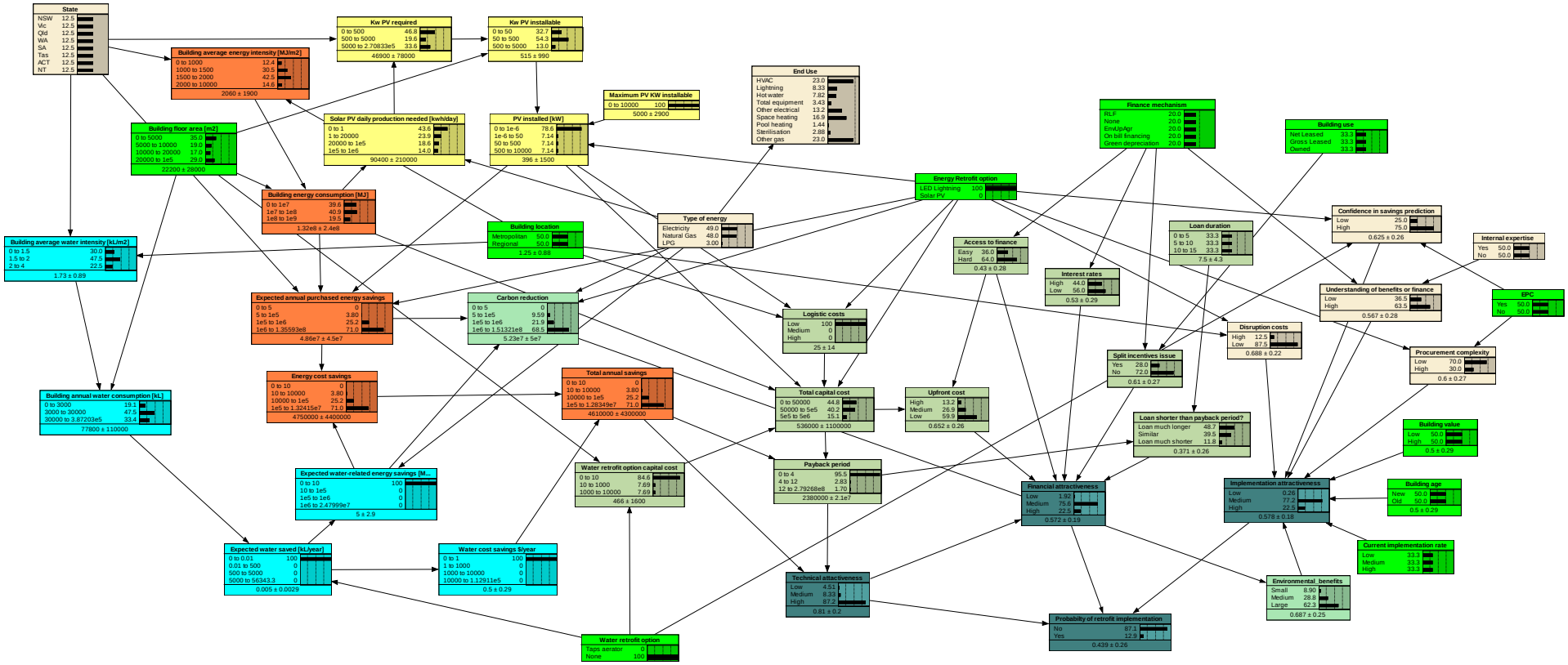
Bayesian network development



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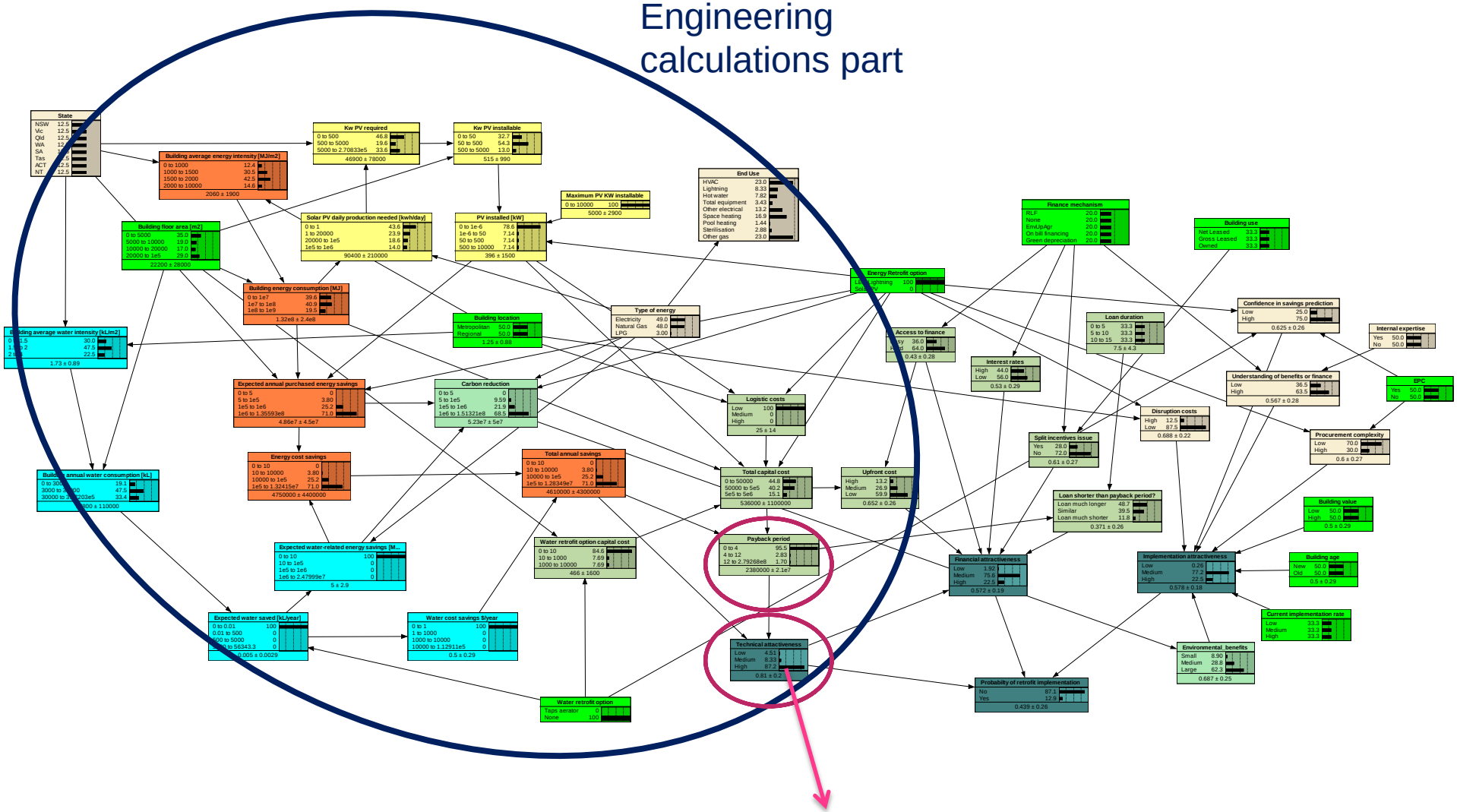
Bayesian network development

Engineering calculations part



Technical attractiveness

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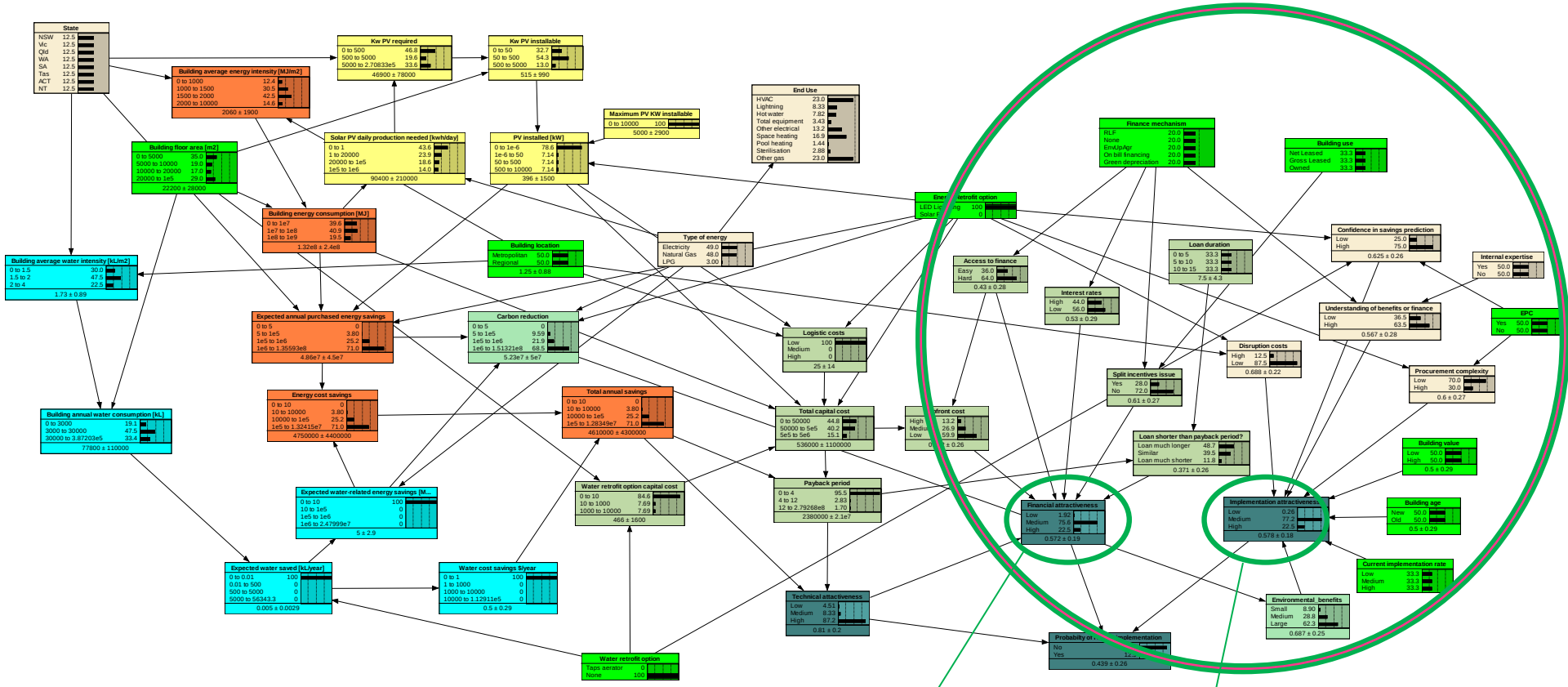
Bayesian network development

Qualitative considerations



Financial attractiveness

Implementation attractiveness

Scenarios analysis

- Technical attr.
- Financial attr.
- Implementation attr.

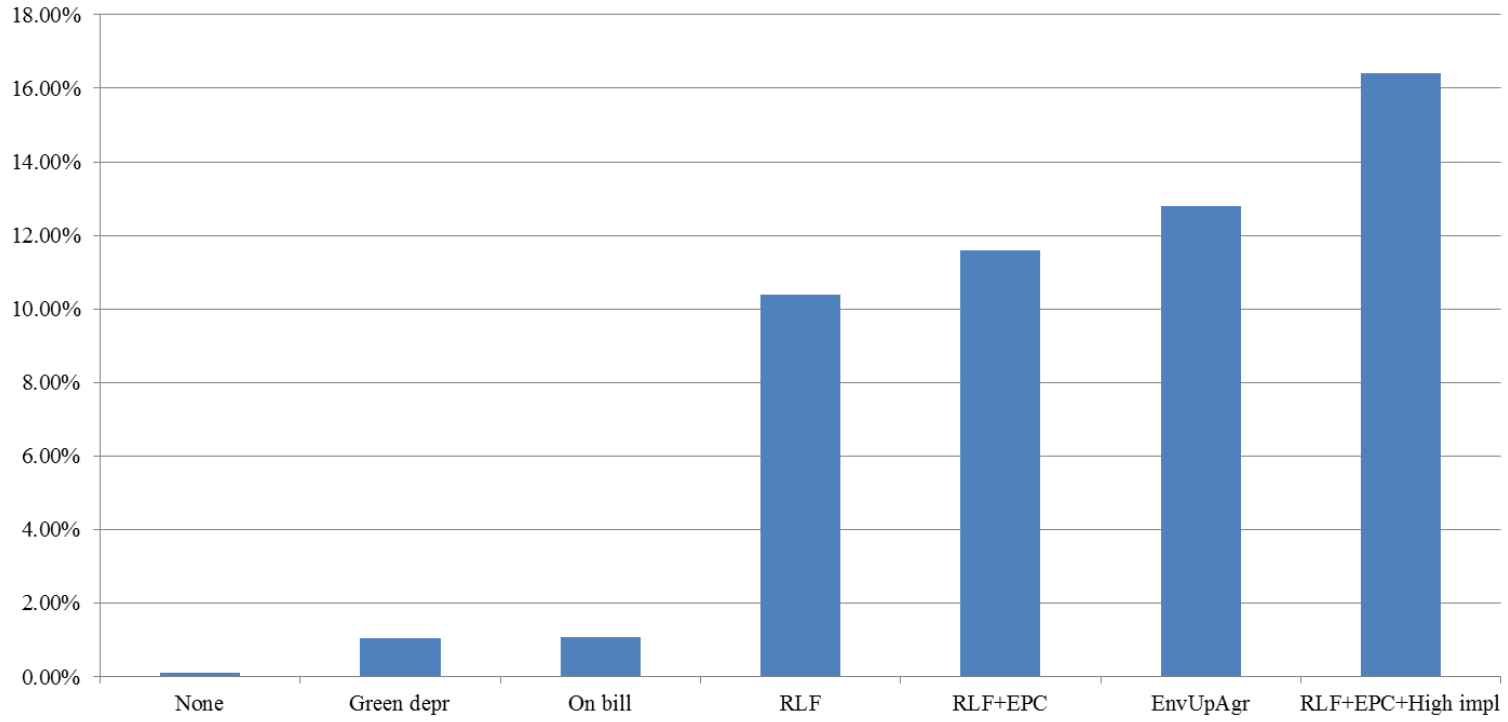
} Willingness to retrofit

Scenarios:

1. *Financial mechanism* (None, RLF, EUA, On-bill, Green depreciation)
2. *Retrofit option* (Energy: Solar PV, LED lights; Water: taps aerators)
3. *Energy performance contractors* (Yes/No)
4. *Area* (State, Metropolitan/Regional)
5. *Current implementation rate* (High/Low)
6. *Building type* (**Hospitals**, Schools, TAFE/Uni)

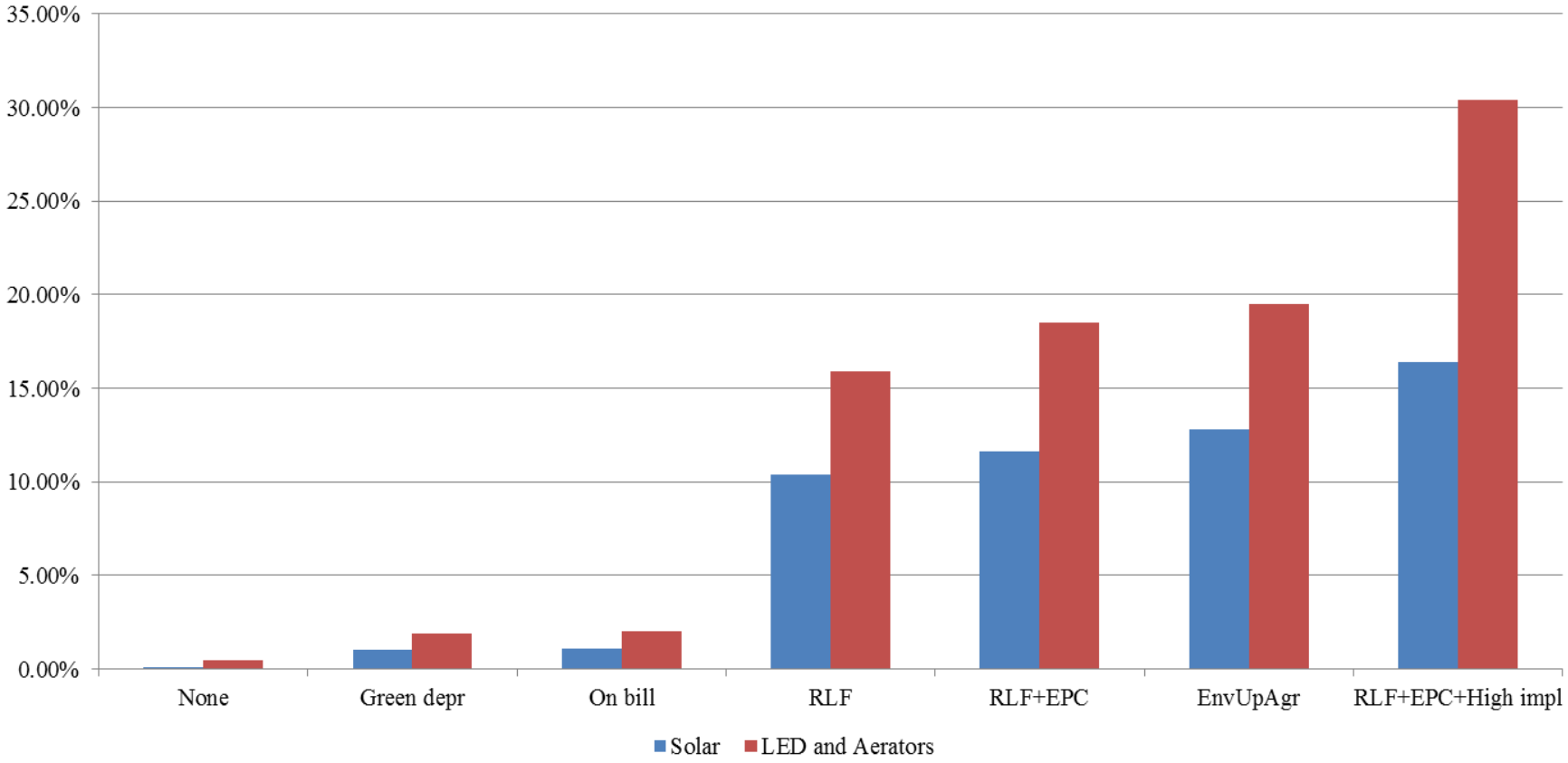
(Some) Results

Common inputs:
Area: metro national
Retrofit option: Solar PV



(Some) Results

Common inputs:
Area: metro national
Retrofit option: LED+aerators



Modelling part 2

- Objective: how many buildings can actually retrofit (and what are the savings) given certain initial fund, interest rates, loan duration?

→Long-term temporal assessment and optimisation of RLF features

→*Systems dynamics* our model choice

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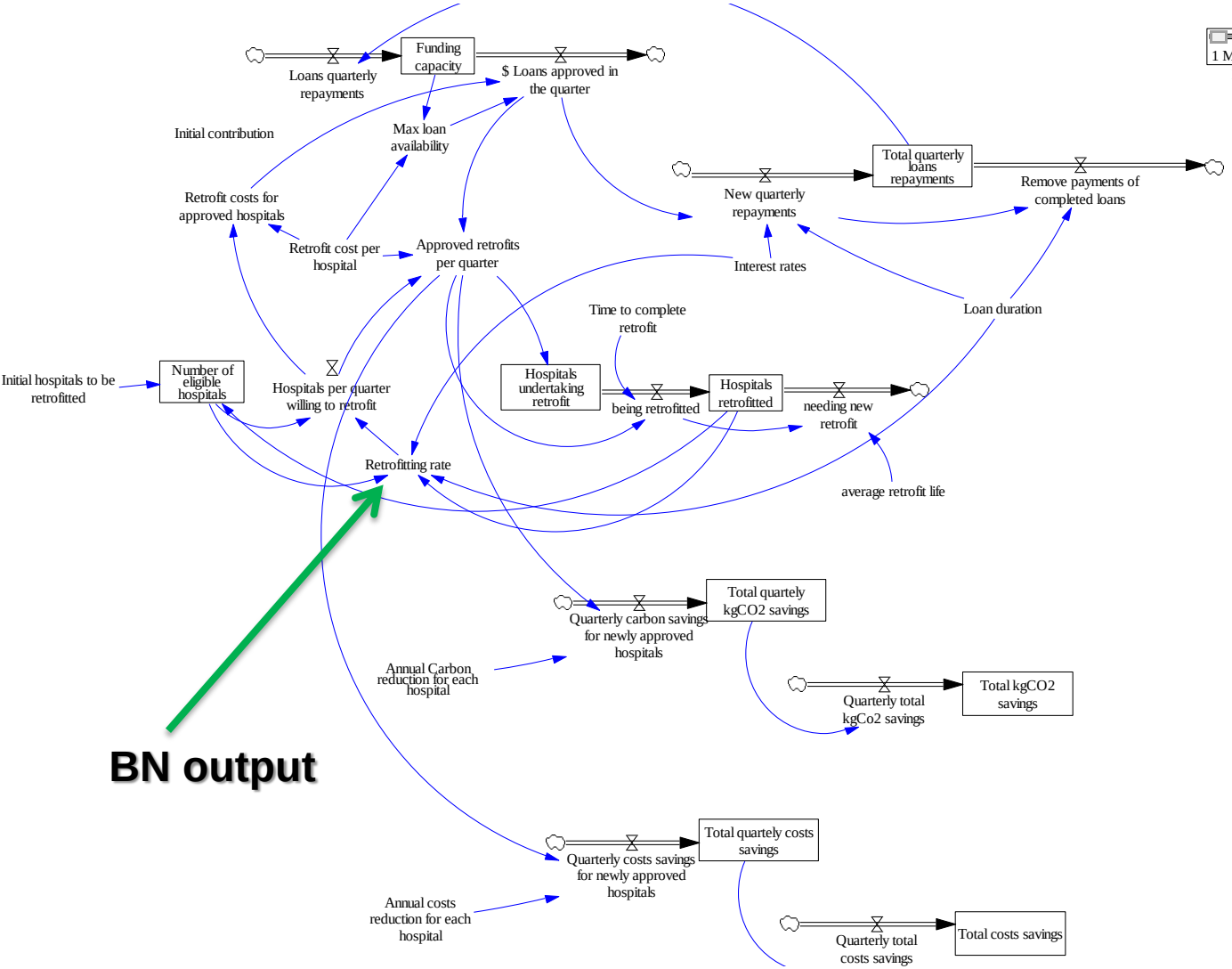
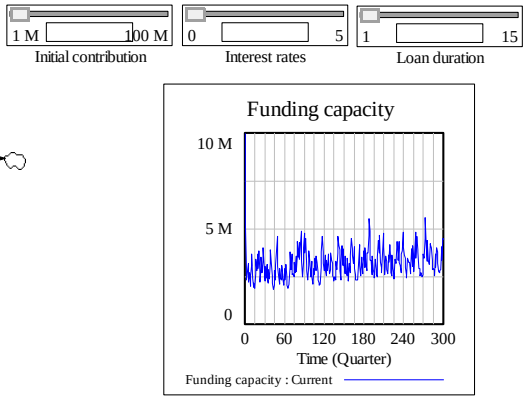
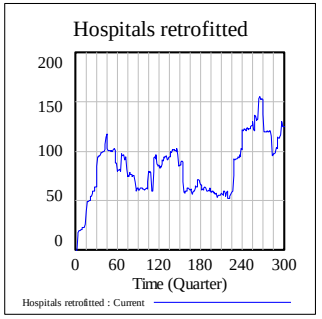
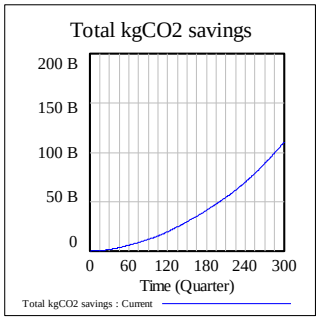
Systems dynamics model









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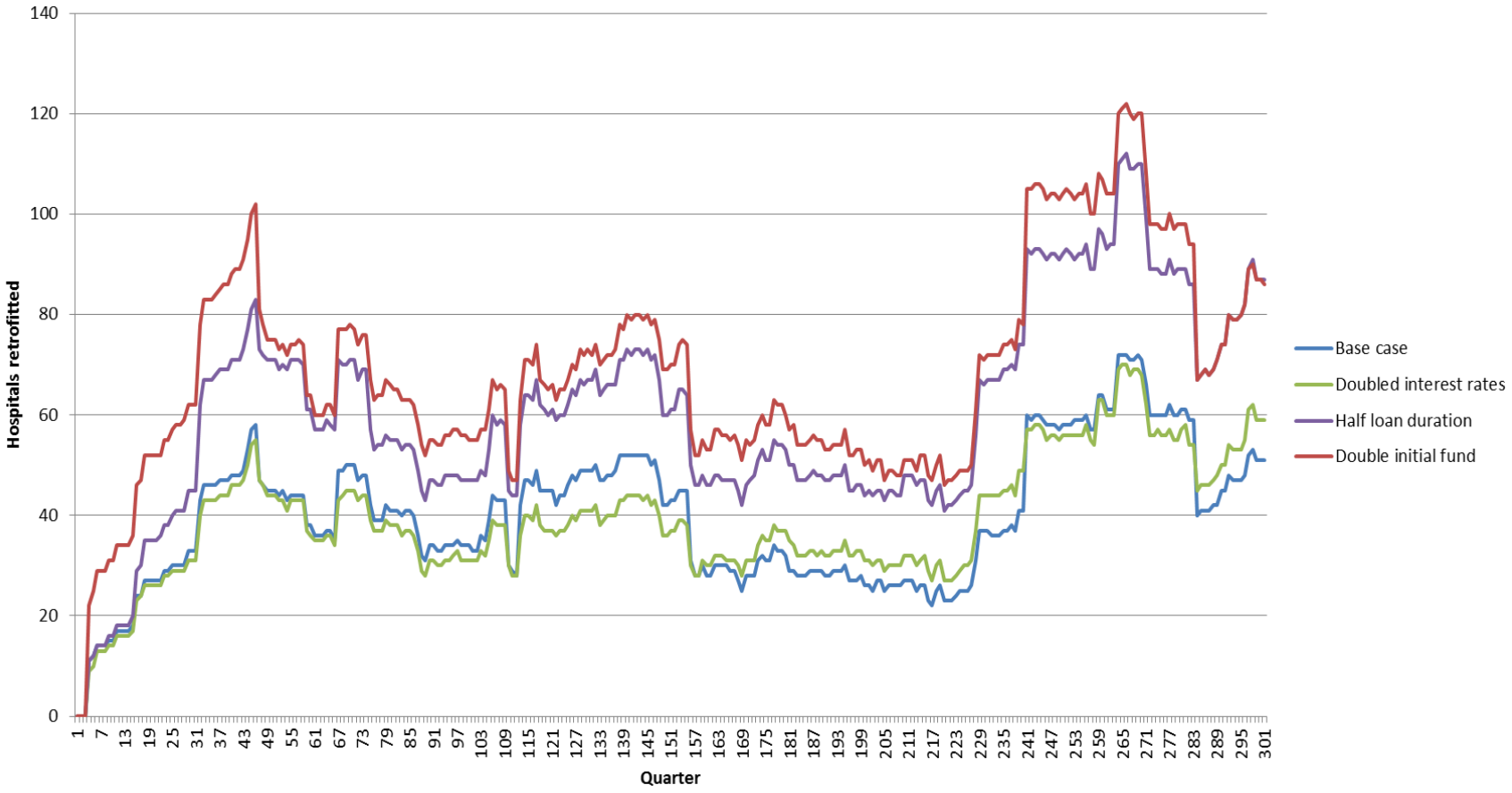
Results

Solar



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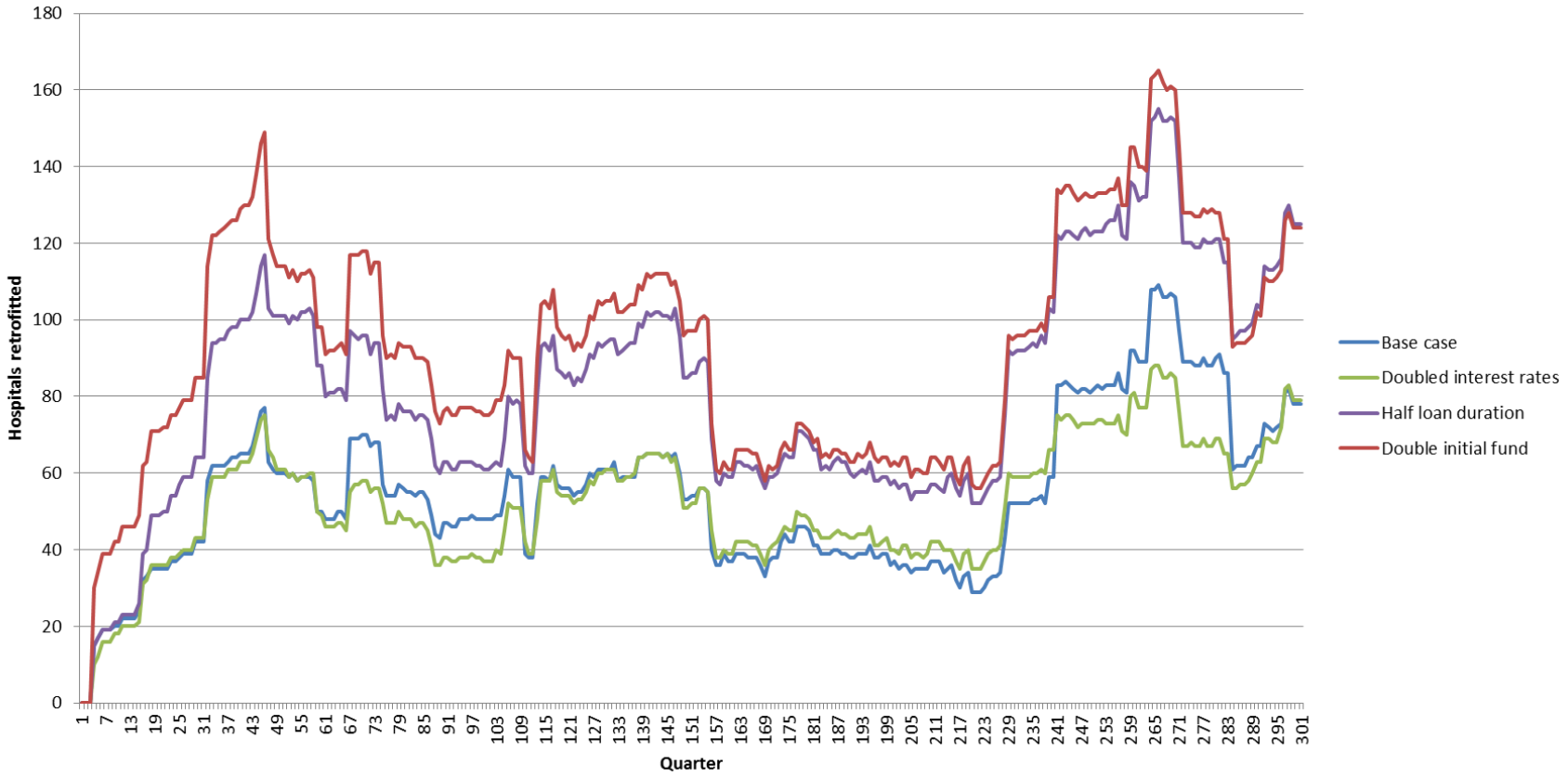
Results

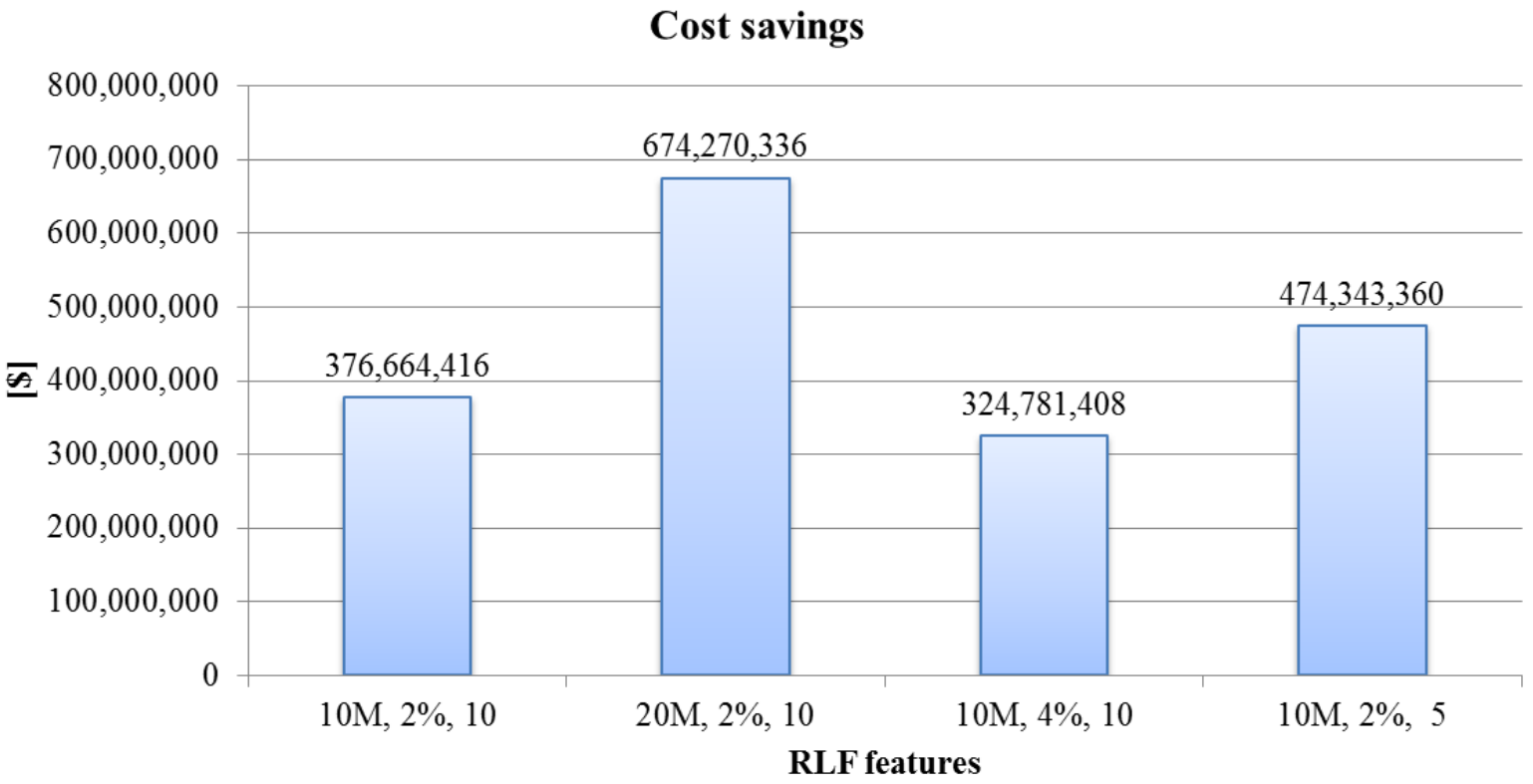
LED lights and tap aerators



Results

20-year projections

Revolving loan funds and EPC for solar panels retrofit in Australian hospitals



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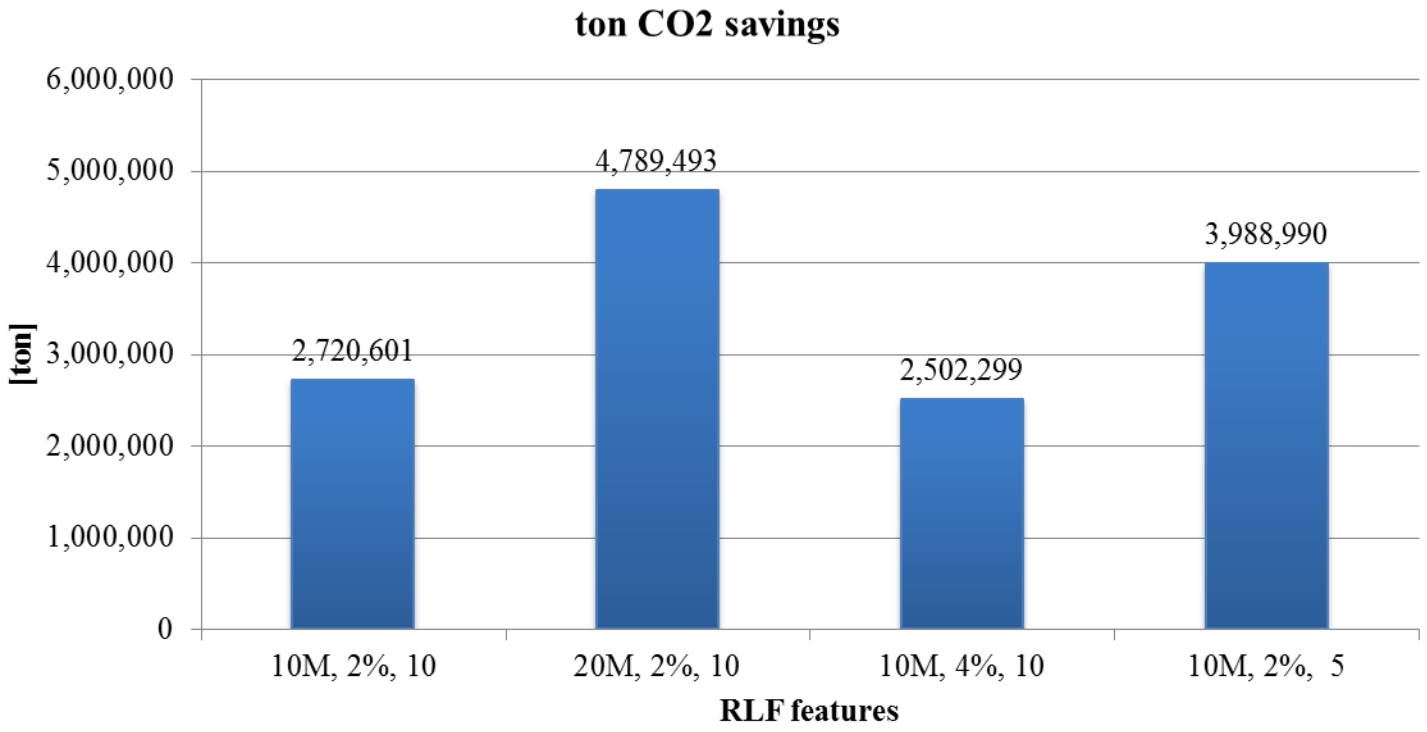
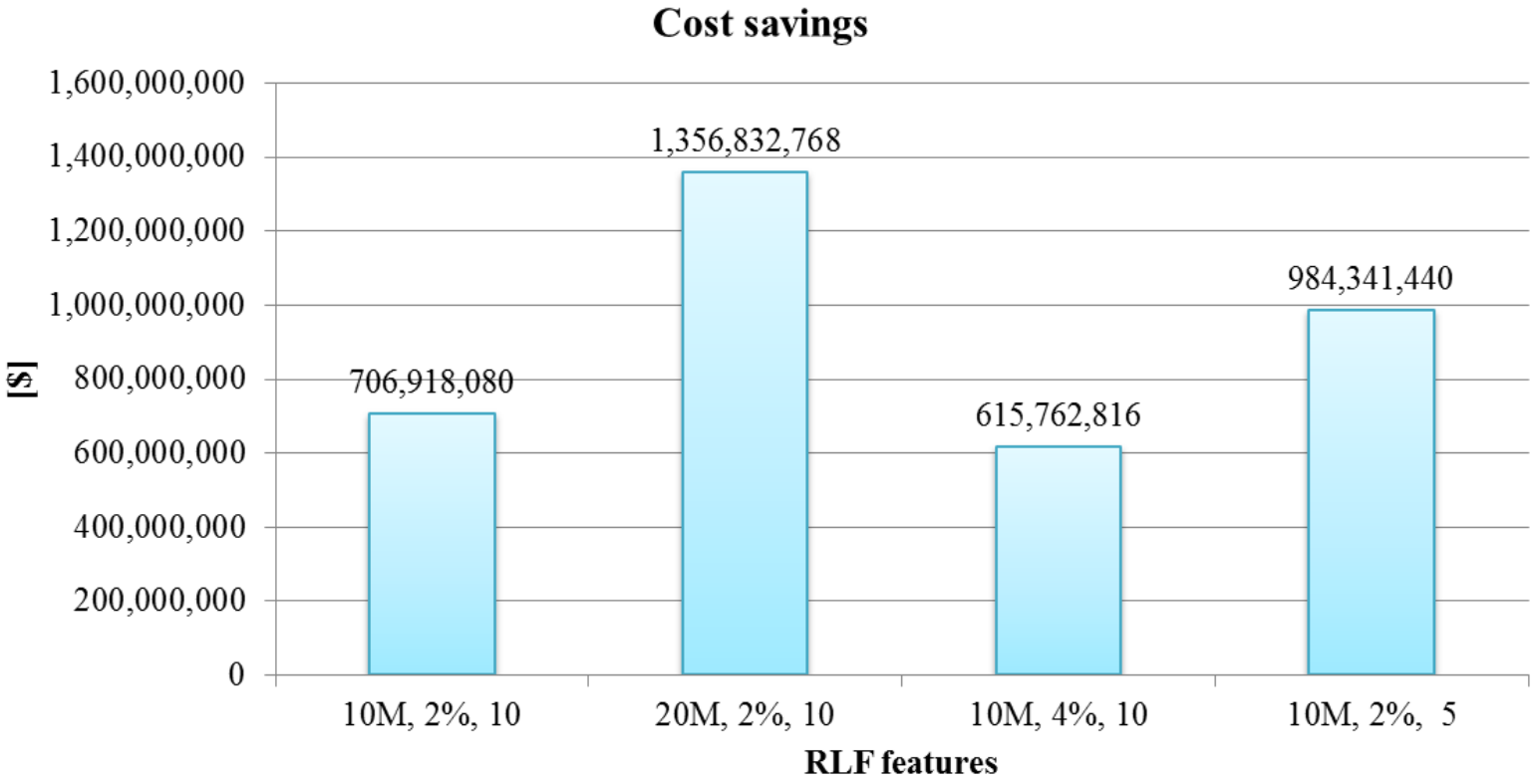


Results

20-year projections

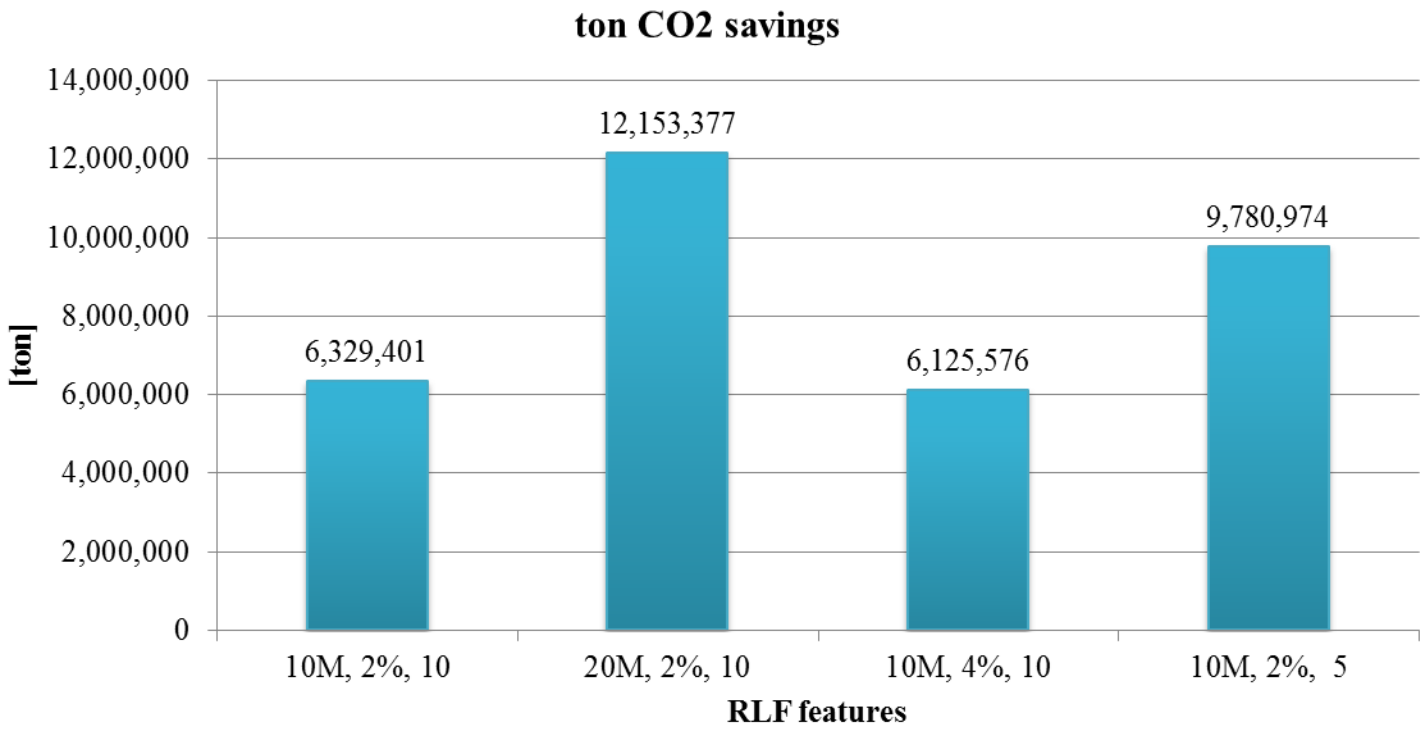
Revolving loan funds and EPC for LED lights + tap aerators retrofit in Australian hospitals



Results

20-year projections

Revolving loan funds and EPC for LED lights + tap aerators retrofit in Australian hospitals



Conclusions-Part 2

- Bayesian Network model allows for estimation of effect of different factors (geographical, financial..) on willingness to retrofit
- **Revolving loan fund + EPC** would lead to highest willingness to retrofit (in line with current best practices)
- SD model can assist in optimising features (e.g. interest rate, duration, initial budget) of a RLF
- Savings of over **$600 million** and **6 MtonCO_2** can be achieved in 20 years with a **$10m** initial fund
- **Employment creation** (e.g. EPC) would add $$ benefit

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Part 3: Managing the Risks

(refer to separate file)

Acknowledgement

The authors would like to acknowledge Sustainable Built Environment national research centre (SBEnrc) for providing research funding for this project 1.43 “Retrofitting Public Buildings for Energy and Water Efficiency”.

Call for contribution and participation

- We are looking for retrofitting project to conduct case study
- We welcome your comments, contribution and participation in this project.

- Contacts: Professor Patrick Zou
  - pwzou@swin.edu.au
  - Tel 0392143781

- Thank you!