



**Sustainable
Built Environment**
National Research Centre

**Retrofitting public buildings for energy and water efficiency
(SBEnrc Project 1.43) – 2016/17 Finished Project**

**Resilient buildings: Informing maintenance for long-term
sustainability (SBEnrc Project 1.53) – Current 2017/18 Project**

**IoT Smart Building Systems
Digital multi-utility management – Emerging area**

**Prof. Rodney Stewart
Cities Research Institute, Griffith University**

Retrofitting public buildings for energy and water efficiency

Project 1.43

2016/17 Finished Project

Project Leader: Prof. Patrick Zou, Swinburne



aurecon



Project team



Prof. Patrick Zou
Project Leader, SUT

Prof. Rodney
Stewart, *GU*

Dr Morshed
Alam, *SUT*

Dr Edoardo
Bertone, *GU*

Dr Oz Sahin,
GU

Project steering group



Mr Chris Buntine
*Project steering group (PSG)
Chair, ESD Leader, Built
Environment, Aurecon*

Mr Evan Blair
*Industry Partner
Principal Project officer
Building Industry & Policy
(HPW), QLD Department of
Housing and Public Works*

Mr Chris Buntine
*ESD Leader, Built
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Ms Carolyn Marshall
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WA Department of Finance,
Principal Architect, Building
Management & Works*

Mr Dan Ellis-Jones
*Industry Partner
WA Department of Commerce,
Building Commission* 3

Persuasion for *Project 1.43*

- Federal, state and local governments occupy more than 25% of the commercial building stock
- Around \$1 billion per year is spent by the Australian Government for water/energy use annually
- Opportunities for low-cost water and energy retrofits that can significantly reduce resource demand, ongoing utility costs and environmental impacts
- Building retrofit projects are challenging to plan, finance, procure, audit and reliably return capital
- But, some governments internationally and within Australia have had varied success at building retrofit programs

Government retrofit programs are not new But are rarely ongoing..... Why?

	VIC – GGB/EGB	NSW - GREP	SA - GBEEI	WA-ESG	QLD-CSB
Mandate	Yes*	Yes	Yes	No	No
Input target	Yes	Yes	Yes	No	No
Output target	No	Yes	Yes	Yes	Yes
Facilitation team	Yes	Yes	Yes	Yes	Yes
Procurement	EPC & equivalent process	EPC & equivalent process	EPC & equivalent process	No particular procurement model	No particular procurement model
Pre-qualified ESCO	Yes	Yes	Yes	No	No
Government finance	Available**	Available	Available	Available	Available

**mandatory during 2009-2013, **was not available during EGB scheme*

Why is there a 'valley of death' for retrofit programs?



Lessons learned

Highly successful retrofit programs in Germany, USA, UK and China incorporating many of these 6 elements

Bridge is only as strong as the weakest element

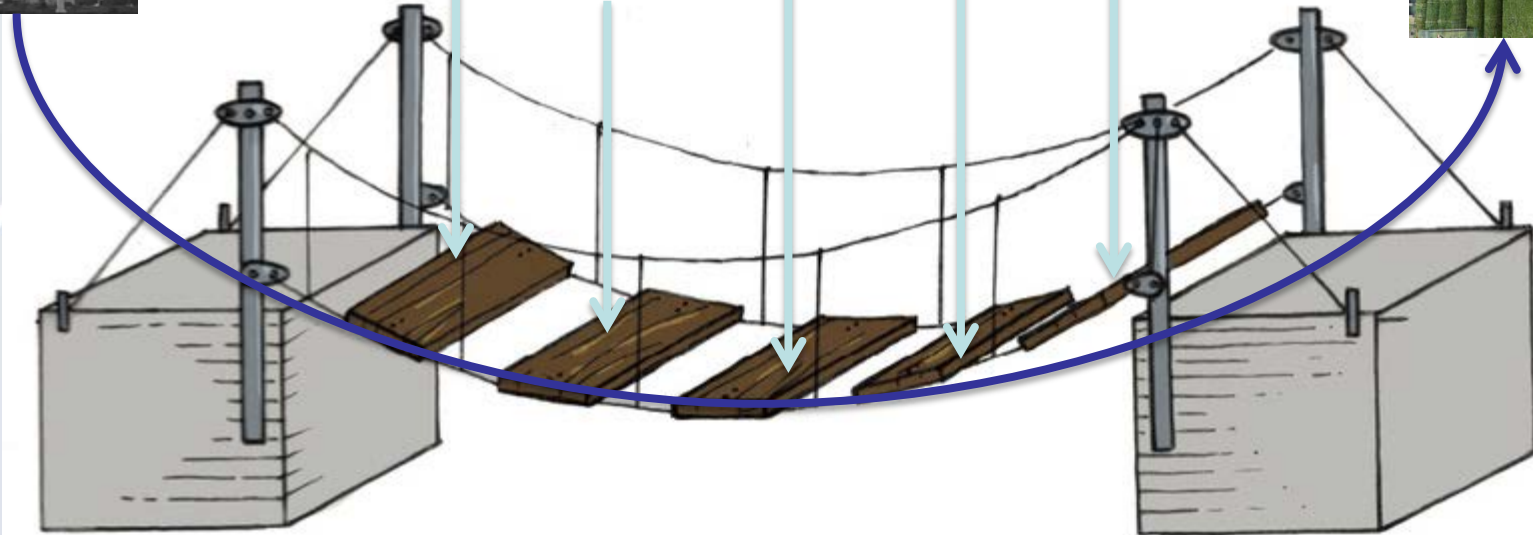


*Building
efficiency
assessment*

*Retrofit
options,
guidelines*

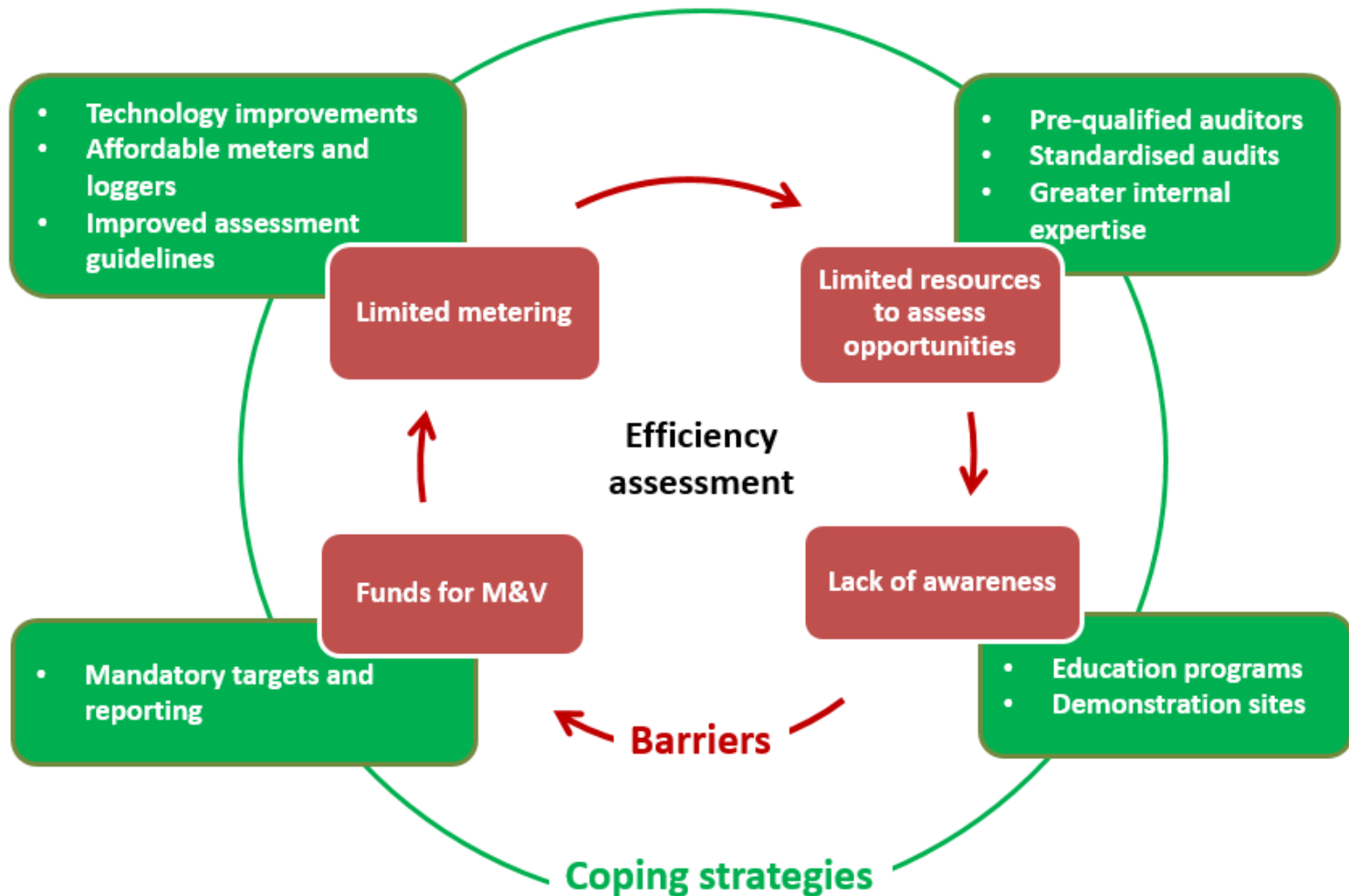
*Post retrofit
M&V*

*Procurement
Financing*



Barriers and coping strategies

Comprehensive building efficiency assessment



Barriers and coping strategies

Available ongoing financing

Financing

Barriers

Lack of knowledge in business case development

No dedicated funding

Limitations in borrowing from private sector

Split incentives

Associated risks

Coping Strategies

- Support from facilitation team
- Sharing information between agencies
- Streamline process for business case development

- Policies targeting budget support
- Retrofitting funding rules from Treasury
- Use Revolving Loan Fund (RLF) and Green Bonds

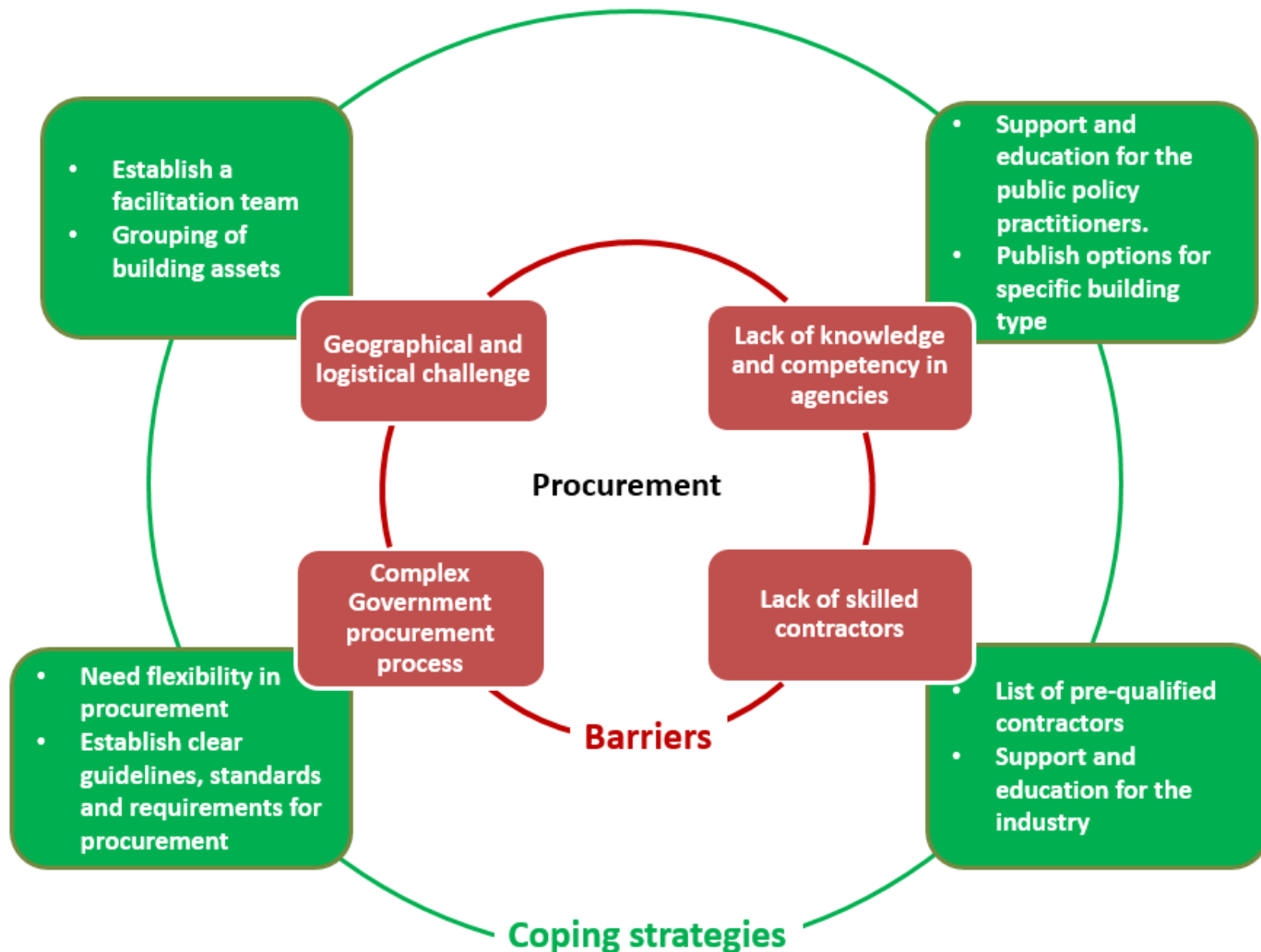
Establish relevant funding schemes

Mechanism to keep savings in the departments/agencies

Use EPC

Barriers and coping strategies

Suitable procurement model



Barriers and coping strategies

Education to raise awareness

Raising awareness through education

Barriers

Negative perception

Not core business

Lack of desire-if voluntary

Coping Strategies

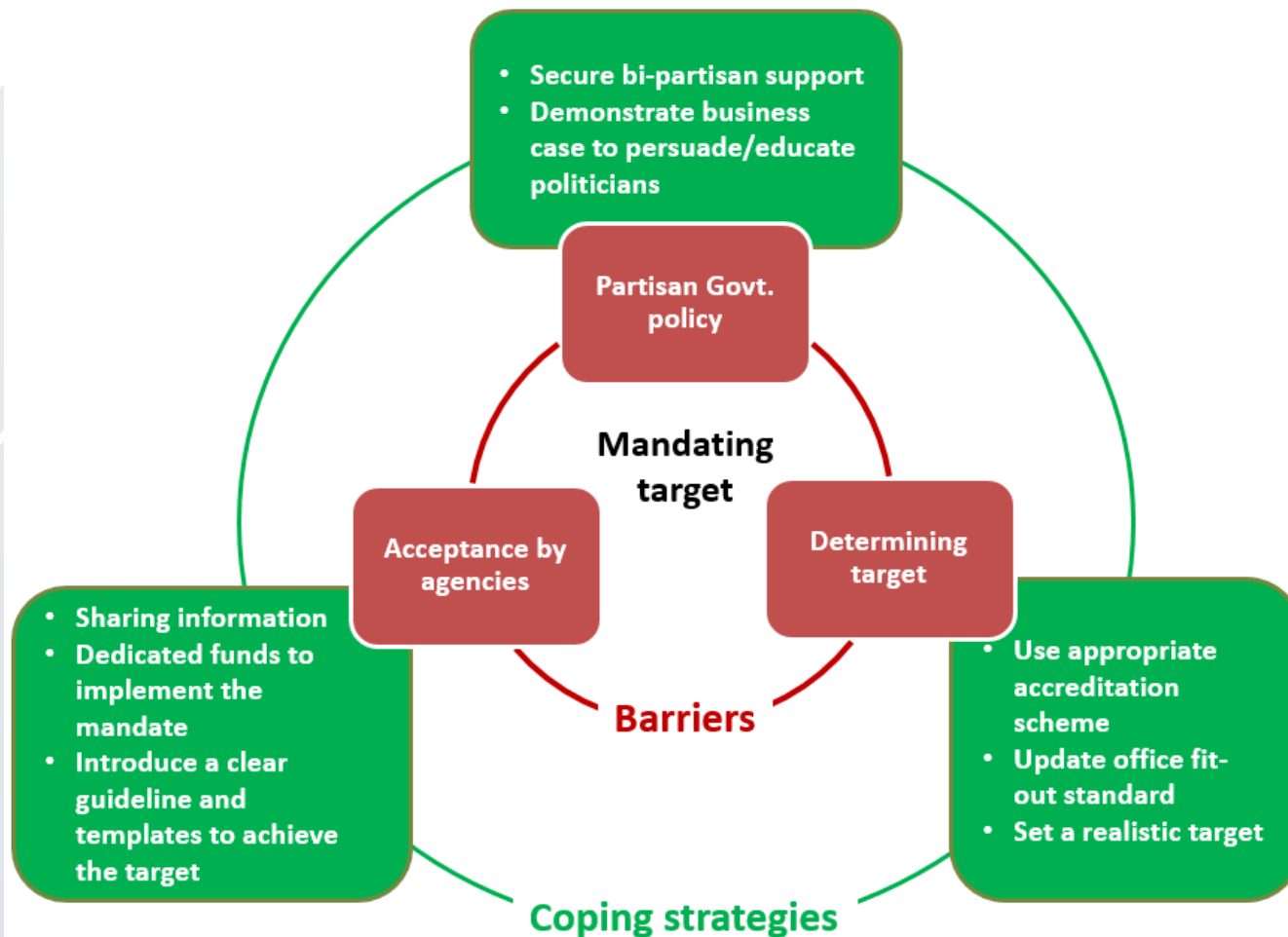
- Demonstrate potential savings
- Government supported awareness training program.
- Develop website with educational information

- Need mandates to make it priority
- High level management engagement

- Reward Performance
- Peer pressure through mandatory reporting

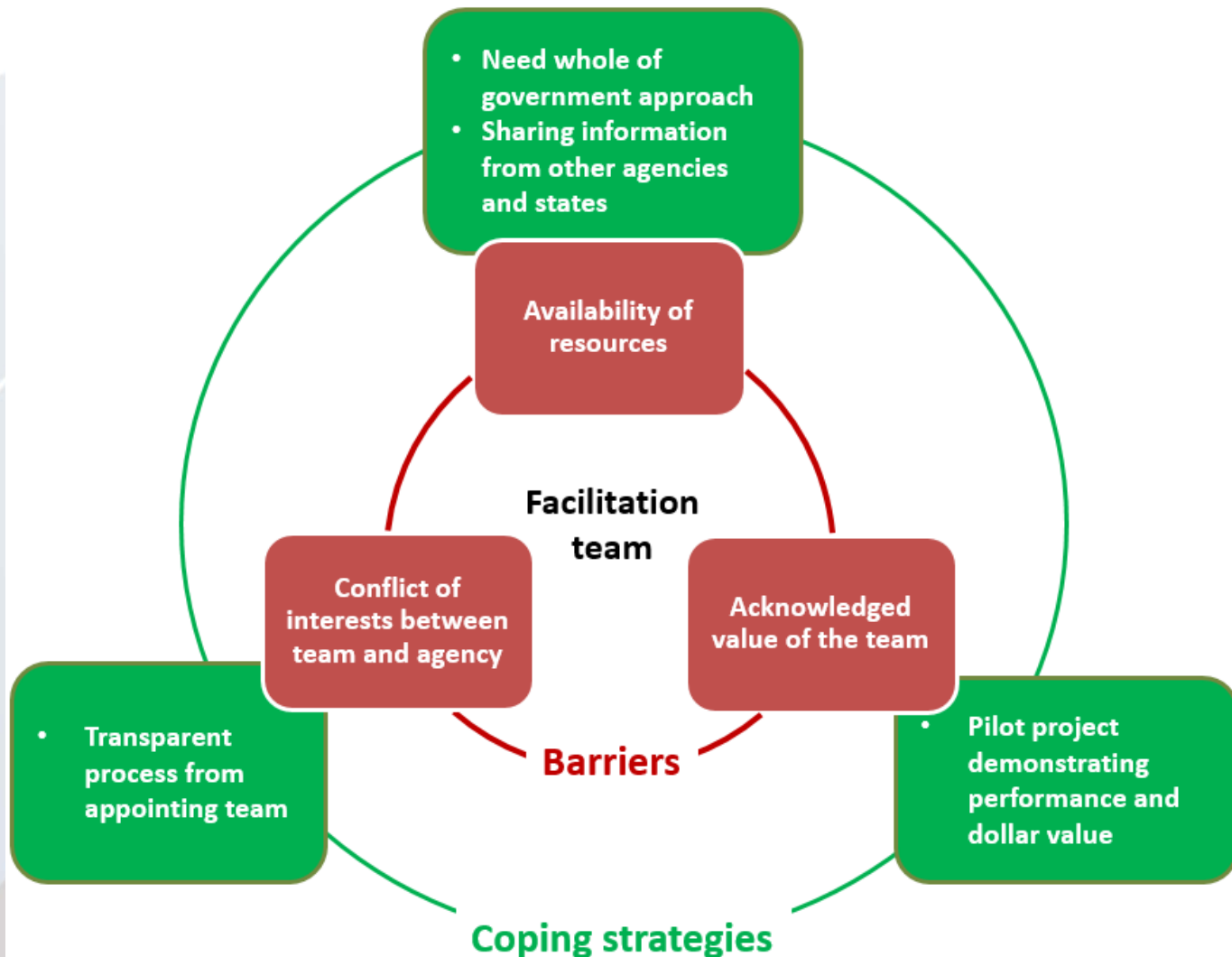
Barriers and coping strategies

Mandating a target



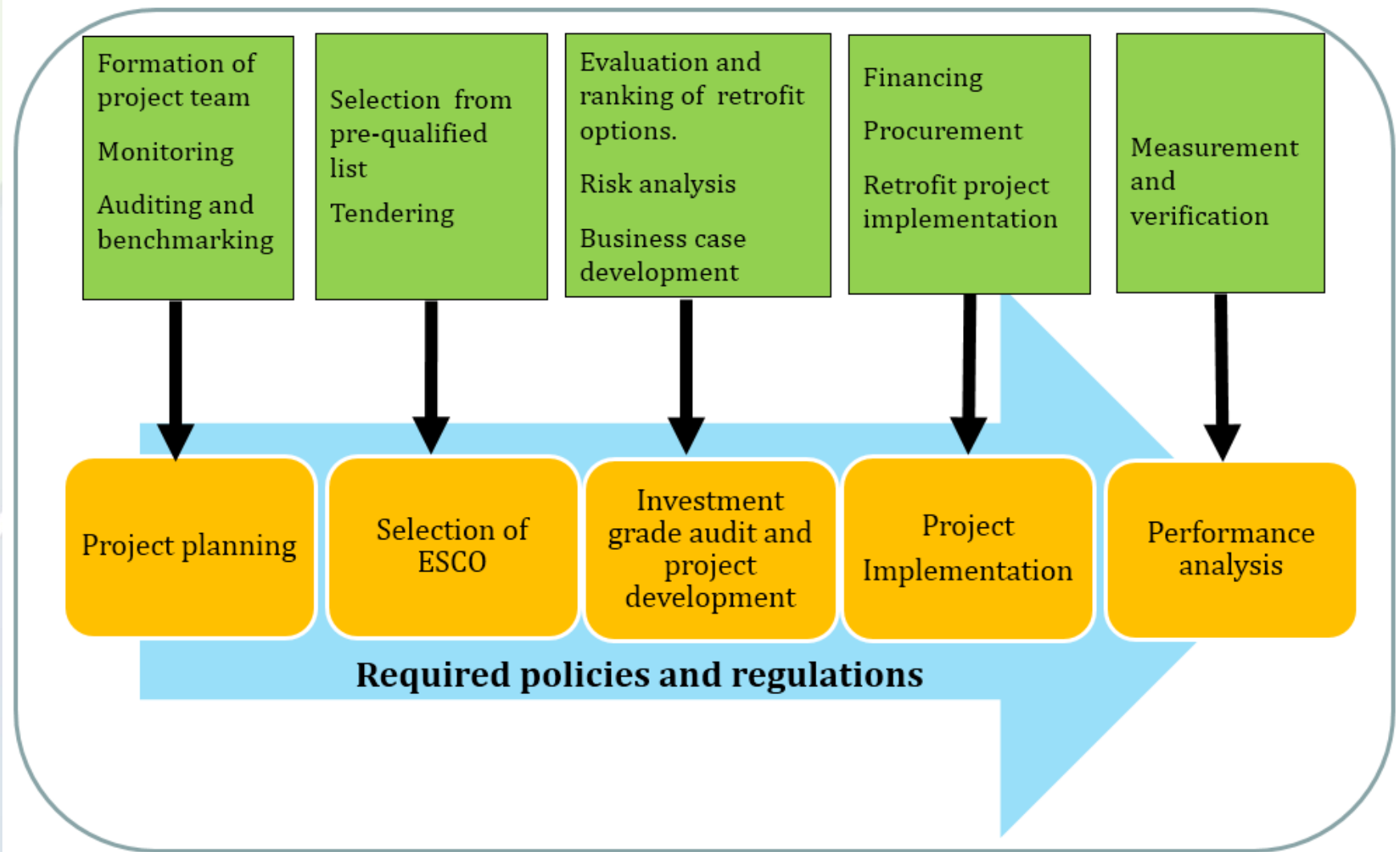
Barriers and coping strategies

Facilitation team establishment



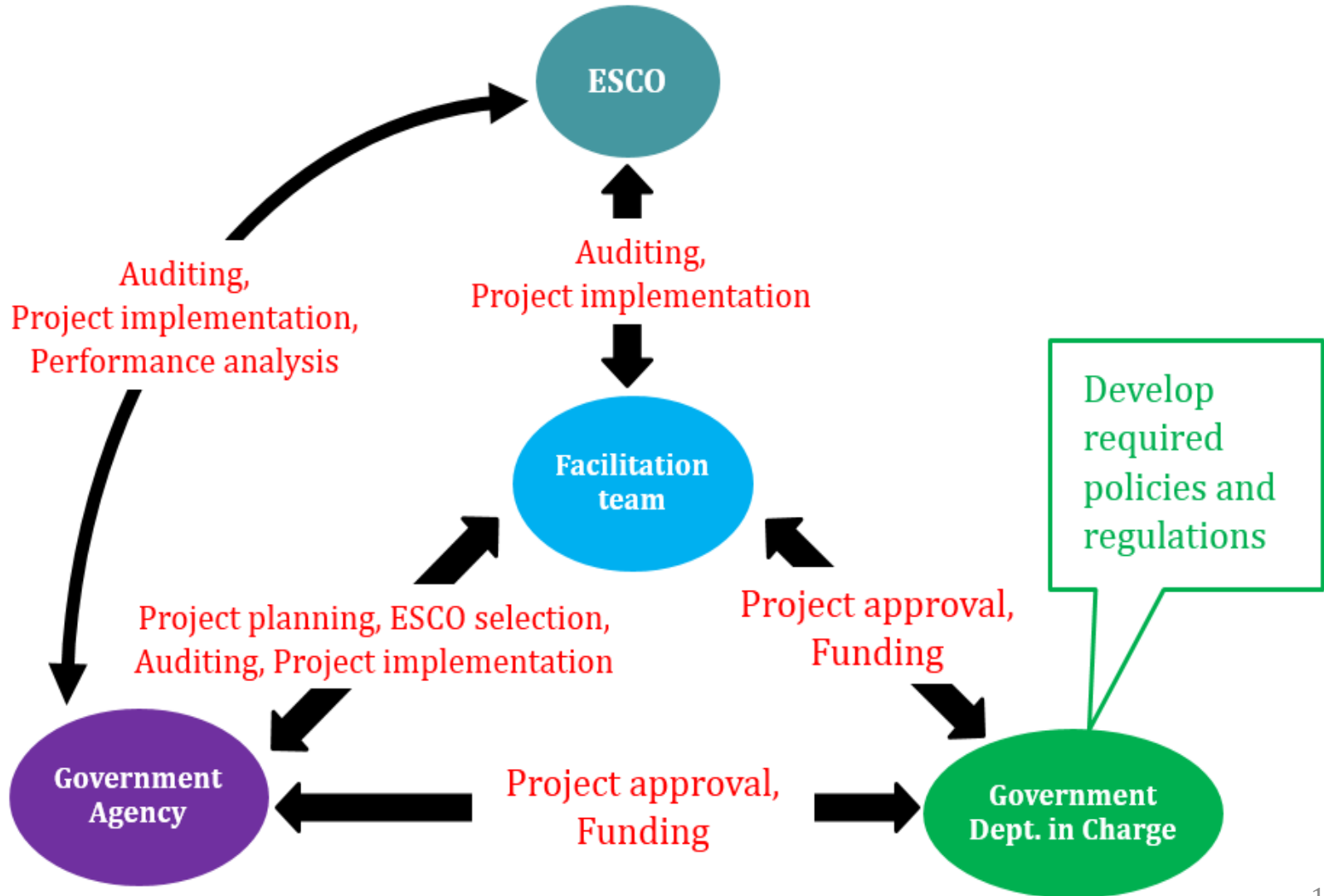
Project Deliverable

Public building retrofitting guidelines



Project Deliverable

Retrofit Program - Implementation pathway

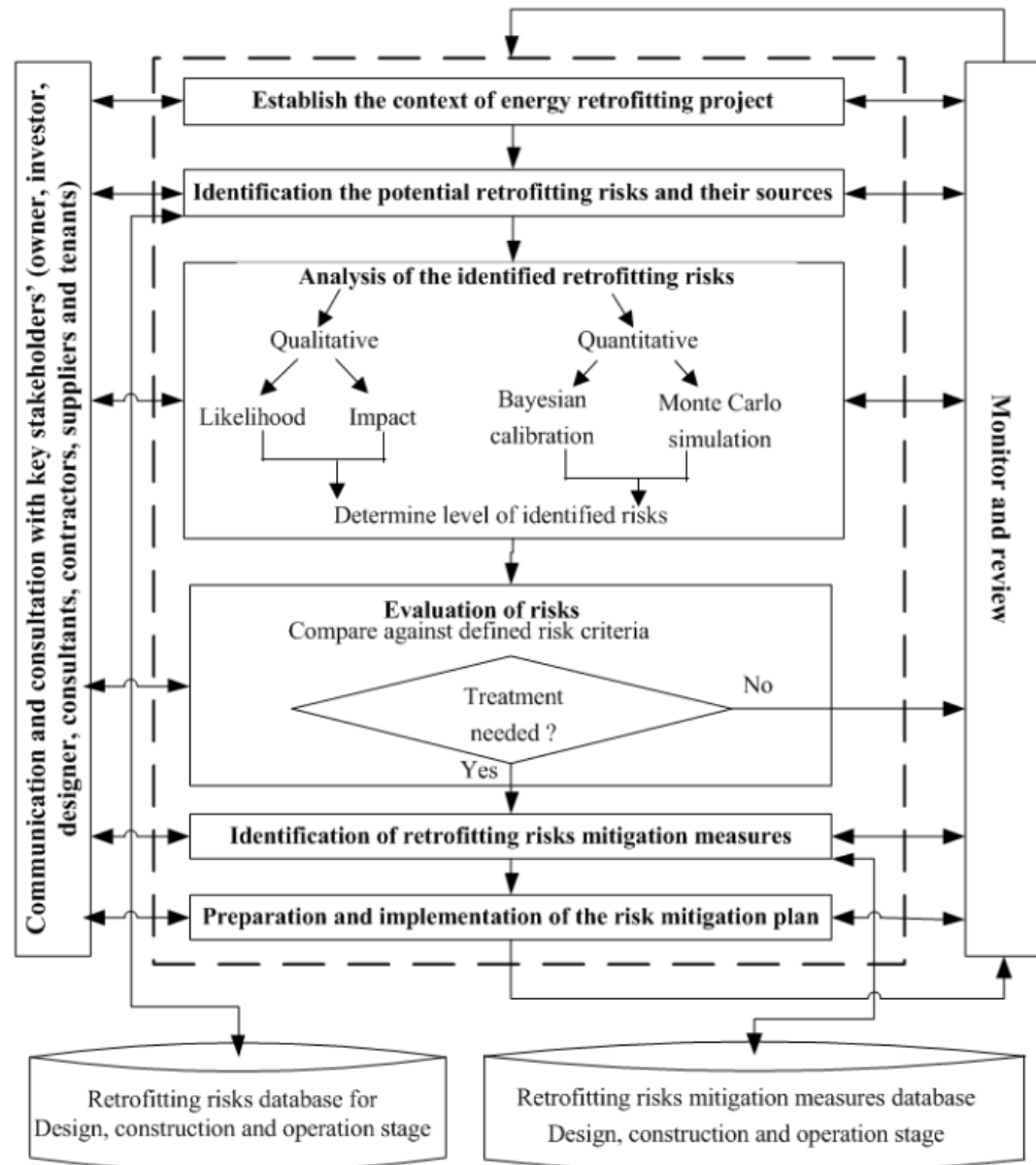


Project Deliverable

Risk management framework

RISKS

- Financial
- Market
- Economic
- Legislative
- Social
- Project design
- Industry
- Technological
- Installation
- Operational
- Measurement
- Verification



Resilient buildings: Informing maintenance for long-term sustainability

Project 1.53

2017/18 Project

Project Leader: Dr. Lam Pham

Swinburne University

***Preventative maintenance also considering betterment options is the
missing link to improving building resilience***

Project participants

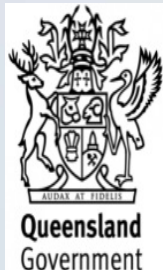
Chair: Graeme Newton

University

- Swinburne University of Technology
- Griffith University

Industry

- Queensland Dept. of Housing and Public Works
- Western Australia Government (various depts.)
- BGC Residential
- Aurecon
- NSW Land and Housing Corporation



Conference Host



Persuasion for project

- Extreme events (e.g. cyclones, bushfire, flash floods) cause considerable damage to buildings and incur repair costs
- Non-structural failure of certain weak building elements (e.g. roof sheeting fixings) leads to costly damage (e.g. water ingress)
– *prevention less costly than repair in many cases*
- Existing building inspection & maintenance largely unregulated, and where undertaken has limited focus on resilience
- Building inspectors review public buildings on a predefined basis; however, consideration for extreme event vulnerability and resilience hardening is not adequately considered
- Opportunity to improve current regulatory and non-regulatory regime for resilience related maintenance (both the private residential and public sectors)

Planned project deliverables

The overall project has the following scope:

- Resilience for **high winds** (Griffith – Rodney lead);
- Resilience for **flash floods** (Swinburne - Pallone lead), and
- Resilience for **bush fire** (Swinburne - Lam lead)

Each sub-project produces linked reports related to the three core deliverables:

Deliverable 1: Current state of knowledge: existing preventative maintenance practice, failures due to lack of maintenance etc. for the relevant extreme event.

Deliverable 2: Identification of critical preventative maintenance issues for the relevant extreme event (including inventory of vulnerable building stock typologies).

Deliverable 3: Implementation strategies – regulatory and non-regulatory means (i.e. policy/practice recommendations for governments, building asset managers and owners, insurance institutions, etc.)

Cyclone damage is substantial

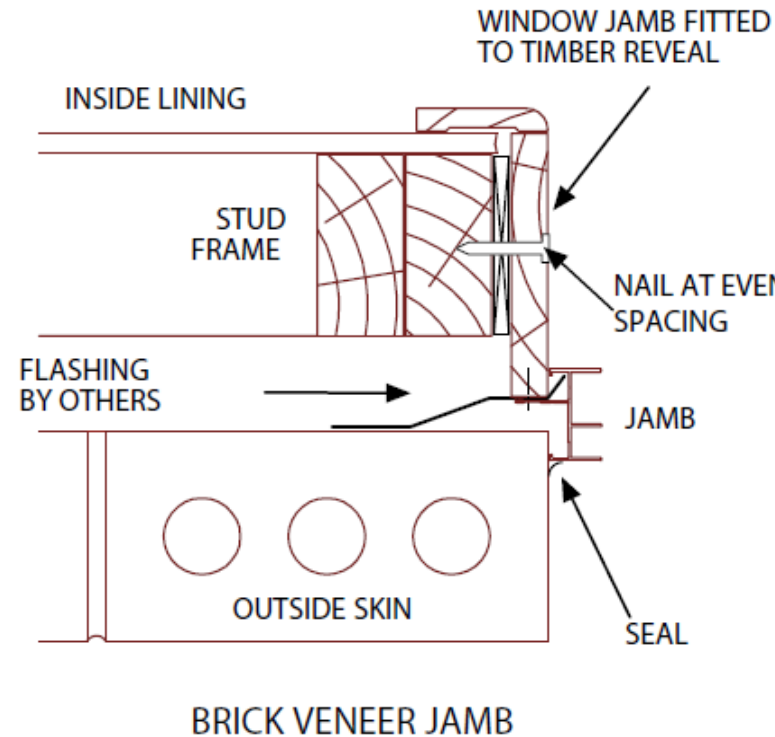
State	Event Name	Event Date	Estimated Loss Value (2015)
QLD, NSW	Cyclone Debbie	March 2017	\$1,403,000,000*
NSW, QLD, VIC, TAS	East Coast Low	June 2016	\$421,696,229
NSW	East Coast Low	April 2015	\$949,615,700
QLD	Severe Tropical Cyclone Marcia	February 2015	\$544,163,458
VIC	Melbourne Severe Storm	February 2011	\$526,651,637
QLD	Cyclone Yasi	February 2011	\$1,531,573,196
QLD	Cyclone Tasha	December 2010	\$393,000,000
NSW	East Coast Low	June 2007	\$1,675,000,000
QLD	Cyclone Larry	March 2006	\$799,000,000
QLD	Cyclone Justin	March 1997	\$650,000,000
NSW	Sydney Region Storms	January 1991	\$625,000,000
WA	Cyclone Joan	December 1975	\$398,000,000
NT	Cyclone Tracy	December 1974	\$4,090,000,000
QLD	Cyclone Althea	December 1971	\$648,000,000
QLD	Cyclone Ada	January 1970	\$1,001,000,000
QLD	Cyclone Dinah	January 1967	\$877,700,000

*Original estimated insurance loss value

Source: <http://www.icadataglobe.com/access-catastrophe-data/>

Wind-driven rain and public housing envelope (GU package)

- Improving resilience of public housing to non-structural damage from wind-driven rain due to extreme weather events (i.e. cyclone and severe storms)
- Focus on resilient design and enhanced construction inspection; specifically waterproofing standards of the building envelope (**AS4654**), windows and doors (**AS2047**) and Masonry (**AS4773**)
- In-depth inspection for building envelopes in regions vulnerable to cyclones (checklists)



This manufacturer certifies that this product was designed to conform with AS2047. The design performance has been verified by a NATA accredited test laboratory. This manufacturer is a member of the AWA Accreditation Program.

ACCREDITED MEMBER No. AWA 123

XYZ

YOUR COMPANY LOGO

DESIGN PERFORMANCE

N2 SLS 400 Pa
ULS 900 Pa

Water Resistance
150 Pa

ENERGY RATED

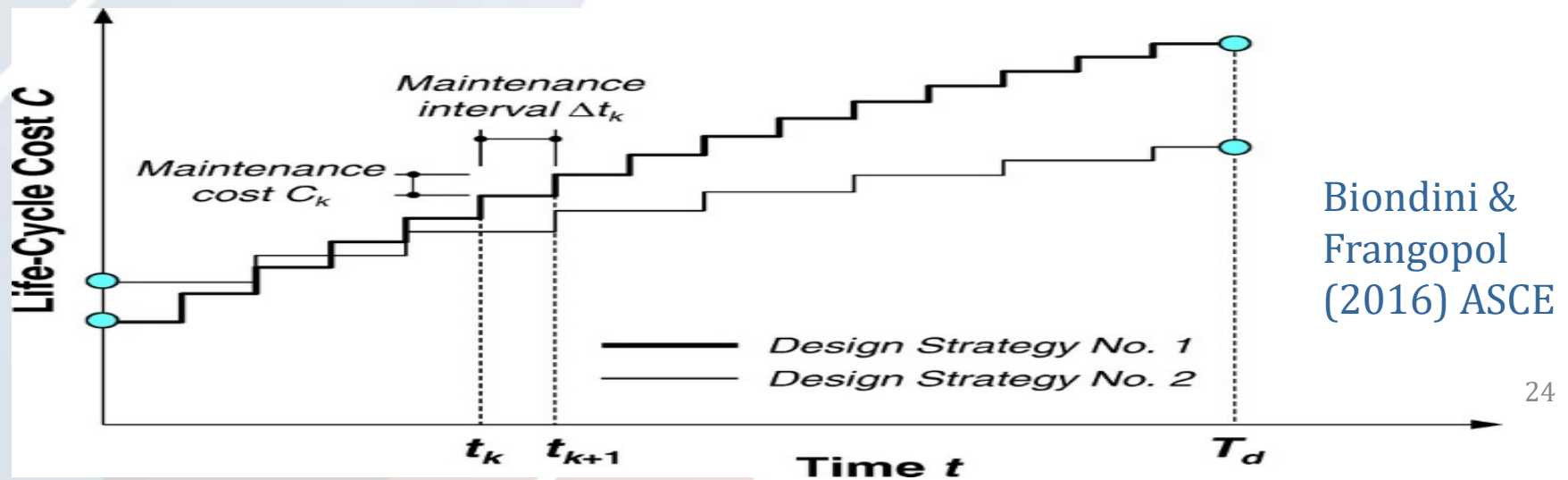


Window and roof failure modes

Building elements	Failure Modes	Damage through components
Window	Material / design	through louvre windows
		through undamaged windows
		through open gaps between sashes, frames and through seals
		through worn or damaged window seals
		around flashings, through linings
		through weep holes, gaps and around seals
	Bad installation / material/ design	through the window frame
Roof	Material / design	eaves, gutter, gables
	Bad installation / material/ design	under flashings, gutters, eaves lining

Hardening options – low hanging fruit

- Focused on recommending some hardening opportunities that represent the best life cycle cost-benefit (e.g. window/door specification and inspection) for low density public housing
- Estimate life cycle cost for scenario of reduced incidence of non-structural wind and water ingress related damage due to extreme wind events for both the recommended strategies and BAU approach
- Determine the life cycle cost-benefit of the proposed resilience hardening strategy for critical building components in regions vulnerable to extreme wind events





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Emerging project area

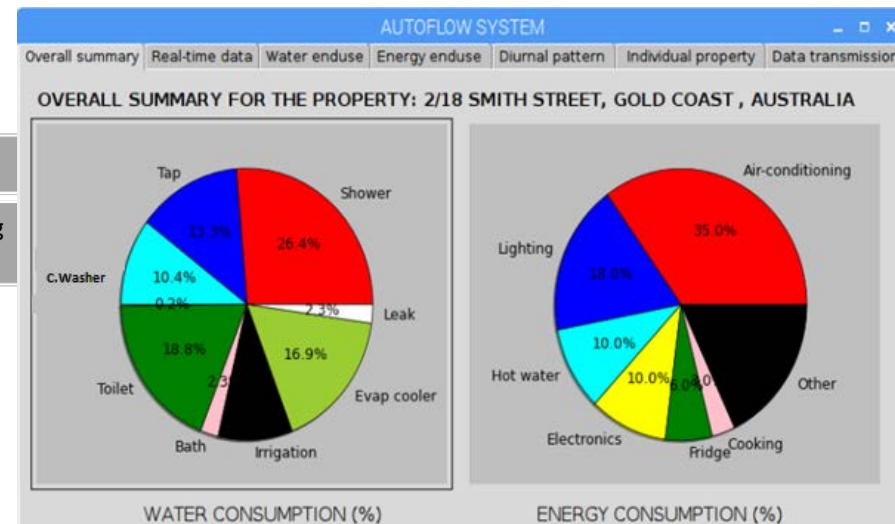
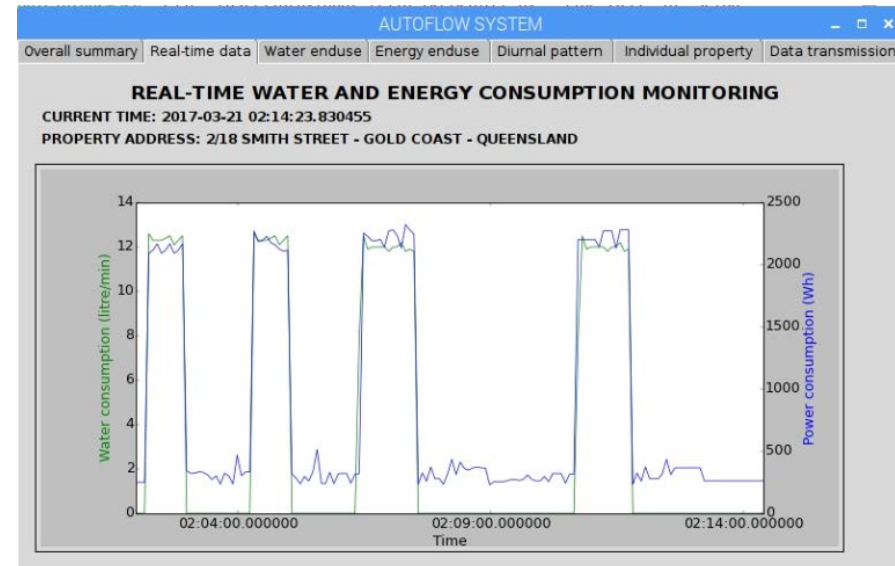
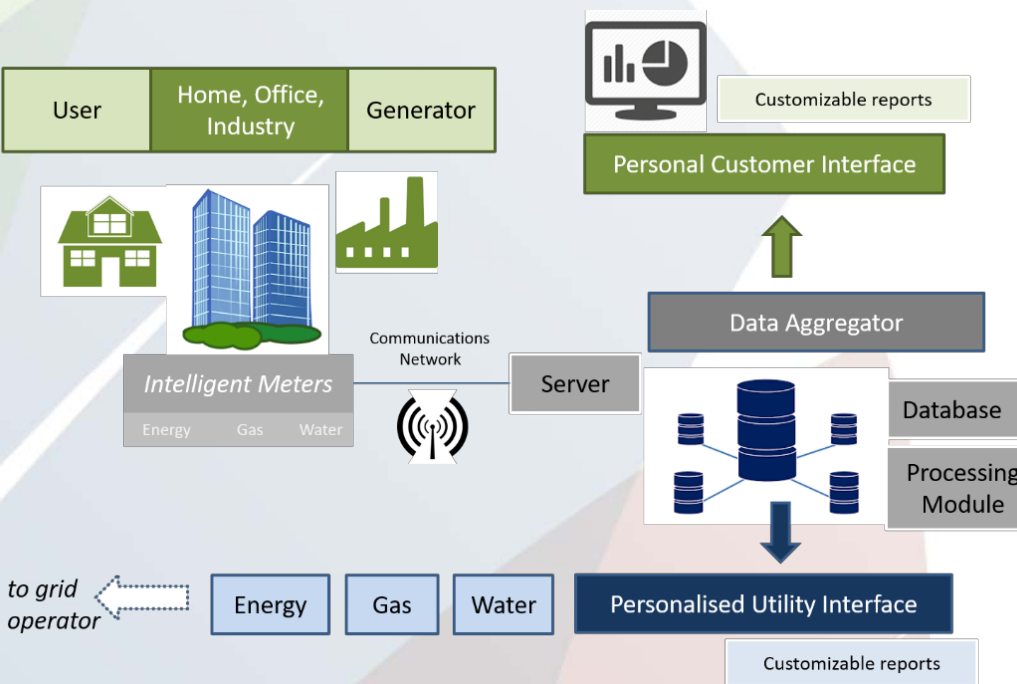
IoT Smart Building Systems

Digital multi-utility management

Prof. Rodney Stewart

Automated building energy and water management through intelligent sensor technology and big data analytics

Unlocking the water-energy nexus



Big data analytics example

'Big data' from intelligent metering must be supported by good analytics to be useful

Water end use data accessible anywhere

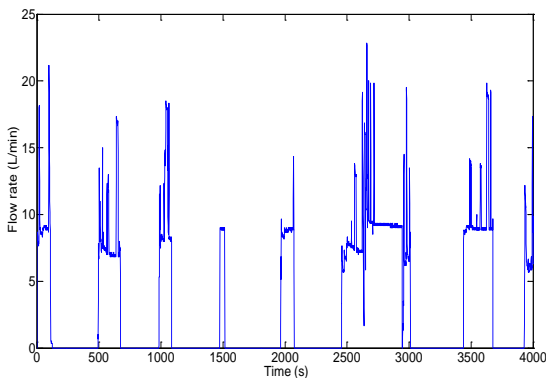


More informative web portals for utilities and customers



Intelligent meter

Meter software can autonomously categorise water consumption



Flow signature patterns

HMM
DTW
ANN
Etc.



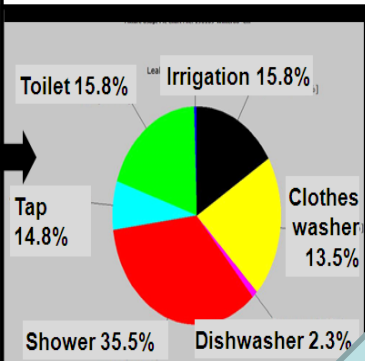
WATER BUSINESS X: INTELLIGENT METERING SYSTEM Log out

Welcome: 5 Smith Street, Brisbane, Queensland

Please make a selection

- My Usage and Budget
- Comparative Usage
- Rebate Schemes
- Water End Use Reports **→**
- Reduce Your Consumption
- View / Pay Bills
- Leak alerts
- Contacts

Day - 19 October 2012, Water Consumption End Use Report



Fixture Category	Water Usage (L/hh/d)	Percent (%)
Leak	15.28	2.92
Toilet	83.08	15.87
Clothes washer	70.59	13.49
Shower	186.21	35.58
Dishwasher	12.20	2.33
Irrigation	77.52	14.81
Tap	78.54	15.01
Total	523.42	100

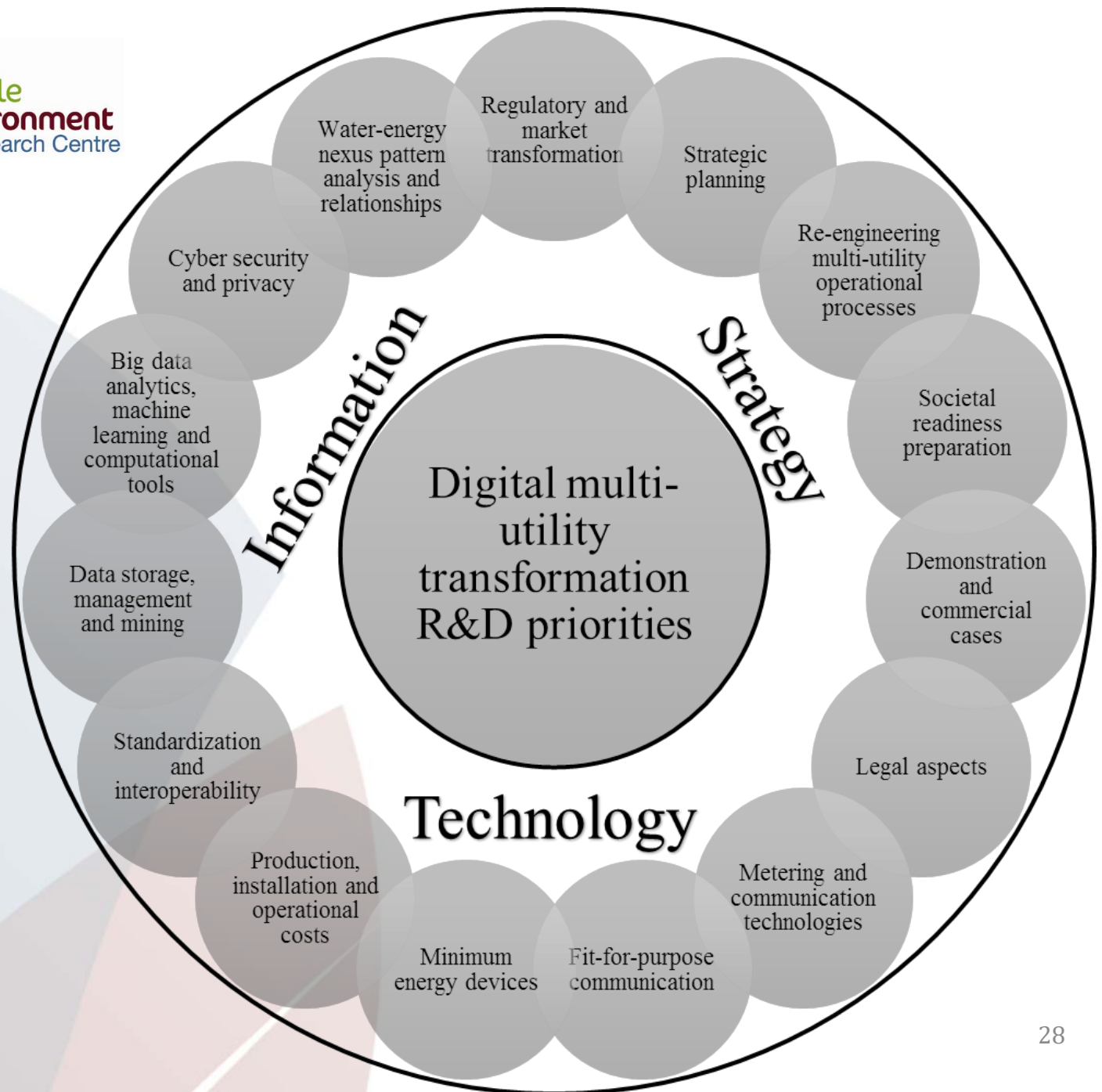
Quick Summary: My Usage

Target Usage Per Day: 480 L/hh/d Yesterdays Usage: 496 L/hh/d
 Yesterdays Average Daily Household Consumption: 510 L/hh/d
 Last Weeks Average Daily Household Consumption: 472 L/hh/d

Consumption broken into end use categories



R&D Roadmap



Acknowledgements

- We would like to acknowledge the **Sustainable Built Environment National Research Centre (SBEnc)** and its partners for funding Projects 1.43 and 1.53.
- We also acknowledge the valuable support provided by members of the project steering group.
- We acknowledge the support of industry partner personnel that aided certain stages of the project (e.g. workshop participants).

Thank you!

Any questions?