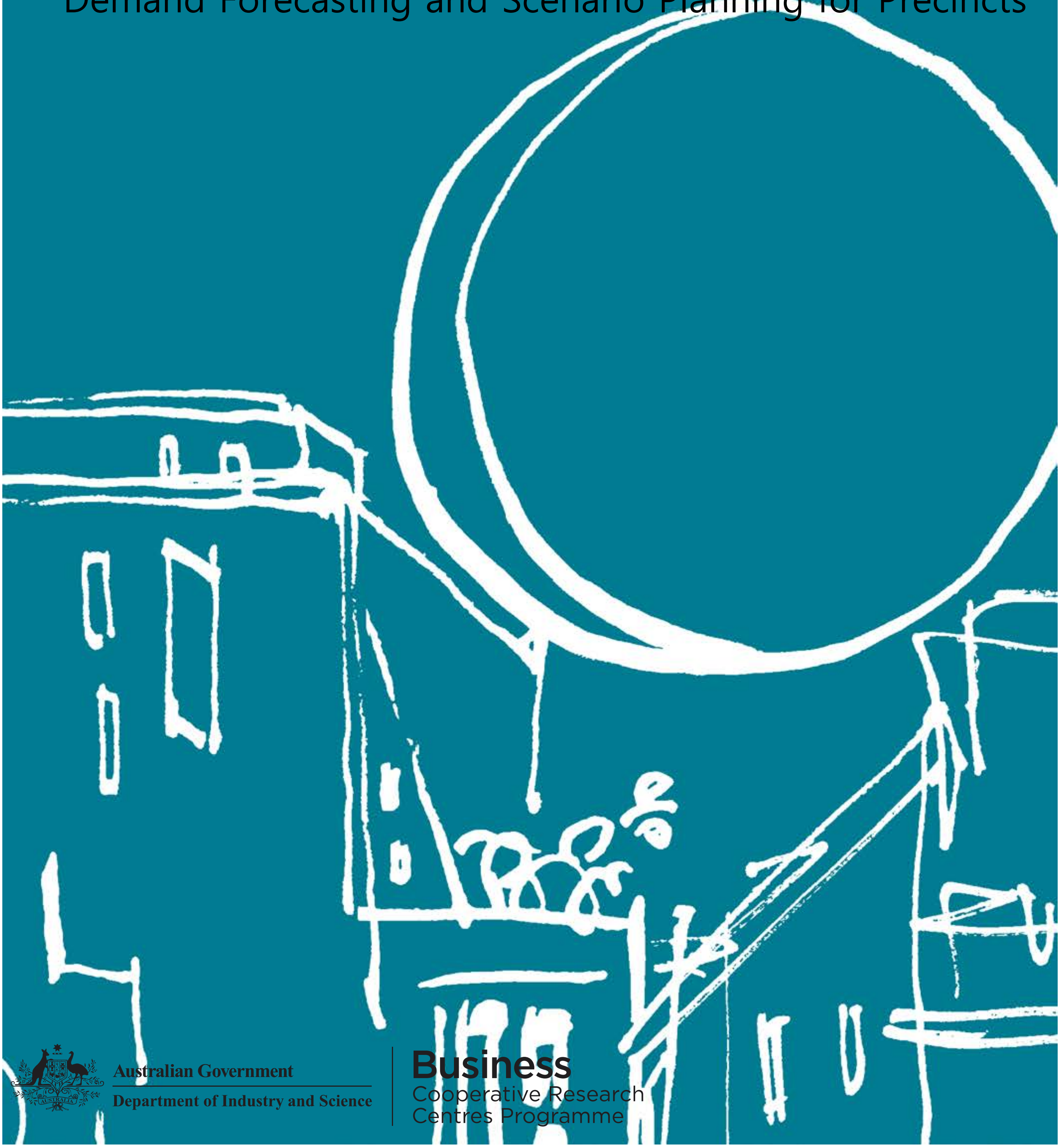
LOW CARBON LIVING CRC

PROJECT WORKSHOP NO.1
Initial Workshop Summary Report

Integrated Energy, Transport, Waste and Water (ETWW) Demand Forecasting and Scenario Planning for Precincts



Australian Government
Department of Industry and Science

Business
Cooperative Research
Centres Programme

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INTRODUCTION

The following is a summary of the workshop presentations, discussions and of the workgroup sessions for the CRC-LCL's project on ETWW conducted Friday 1st February 2013, 10:00 – 16:30 at Room C4-16 at the University of South Australia's City East Campus, chaired by Liz Ampt.

This project for the CRC for Low Carbon Living is designed to develop a shared platform for integrated ETWW (energy, transport, waste and water) demand forecasting and scenario planning for ETWW under low carbon futures, focusing on gaps, synergies, alternative approaches and required research directions. It will include a series of facilitated national workshops on demand forecasting for ETWW utilities and services and on scenario generation and appraisal. The aim is to seek the development of integrated tools for demand forecasting and scenario evaluation covering ETWW with identified commonalities in data requirements and model formulation. It will first (Phase 1) develop an integrated framework for demand forecasting that will then be fully developed and implemented in Phase 2. A method for including the impacts of household behaviour change in demand forecasting will be a major component of the framework. In this way overall carbon impacts of urban developments or redevelopments can be assessed effectively and efficiently.

The first of these facilitated national workshops on demand forecasting was hosted by The University of South Australia at their City East campus on Friday 1st February 2013. Running from 10:00am to 4:30pm, the workshop invited representatives from the project partner organisations with presentations from a selection of these as well as CRC-LCL and project leaders. Attendees also contributed to workgroup sessions with a range of topics and issues relative to the project discussed and presented. The following report is a summary and synthesis of this workshop containing the following elements:

- Introductory ETWW project information
- Presentations on CRC-LCL and the ETWW project
- Presentations by key researchers and industry
- Workgroup discussions and synthesis of outcomes
- What's next?

PRESENTATIONS

CRC for Low Carbon Living Overview – A presentation by Prof. Deo Prasad

The CRC-LCL builds upon expertise in sustainable urban design, solar energy, energy efficiency, built environment, decision support software tools and community engagement. It is dedicated to engaging multidisciplinary expertise, existing technology development, social research and national benchmark software tools. Three research programs reflect the three key research areas related to delivering a low carbon built environment. Programs areas are:

- Program 1: Integrated Building Systems
- Program 2: Low Carbon Precincts
- Program 3: Engaged Communities

Program areas look to making low carbon buildings affordable, low carbon infrastructure desirable and informing and empowering decision makers. A multidisciplinary approach will enable sustainability with a low-carbon metric as well as sustained change, developing policies based on evidence. Programs are end-user driven allowing for tools that are widely and publicly available to drive policy and design.

More information on the CRC for Low Carbon Living is available from their website: http://www.lowcarbonlivingcrc.com.au/

Program 2: Low Carbon Precincts Overview – A presentation by Prof P.W. Newton

Research Program 2 of the CRC will develop new knowledge and tools that enable the design of, and stimulate the market for, low carbon infrastructure at the precinct scale. This will facilitate property developers and local government partners providing low carbon infrastructure development as well as redevelopment and retrofitting at the planning point of delivery. The structure for the program is indicated below.

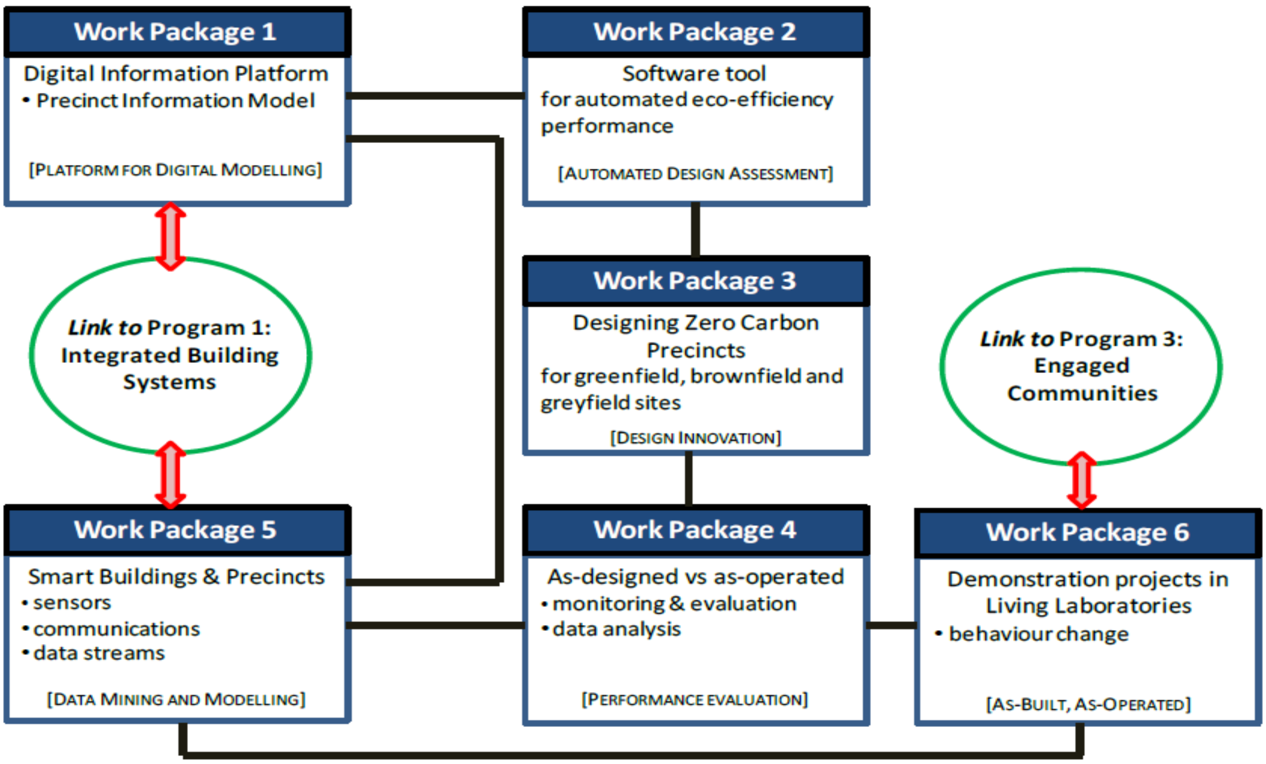

Figure 1: Research Program 2 Structure

The program 2 structure is based on six connected work packages, which also link to the other programs in the CRC. Activity areas included in Program 2 (and projects within these) consist of the following:

Activity 1: Digital Information Platform:

- Project: Scoping study for precinct design assessment tools (Module 1: PIM)

The following illustration of the Scale of 'Things' (Source: UrbanIT, after Andreas Kohlhaas) is used to demonstrate the location of precinct scale design assessment relative to other scales of assessment.

Considerations for interfacing existing Precinct Tools (such as PrecinX, MUtopia and others) with PIM is represented in Figure 2.

Activity 2: Performance Assessment & Demand Forecasting for Precincts

- Project: Scoping study for precinct design assessment tools (Module 2,3: Assessment methods, databases)
- Project: Integrated energy, transport, waste and water demand forecasting and scenario planning for precincts

The arena of precinct design assessment including relationships between framework, assessment and rating is illustrated in Figure 3.

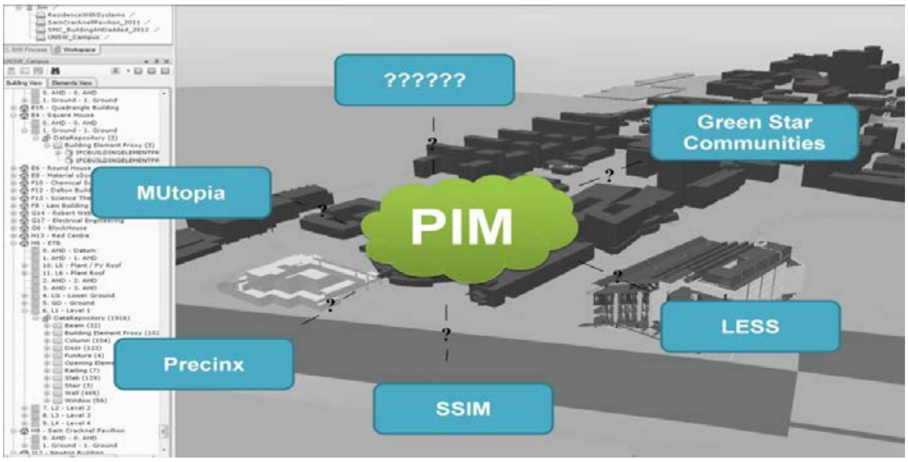

Figure 2: Considerations for interfacing existing Precinct Tools with PIM

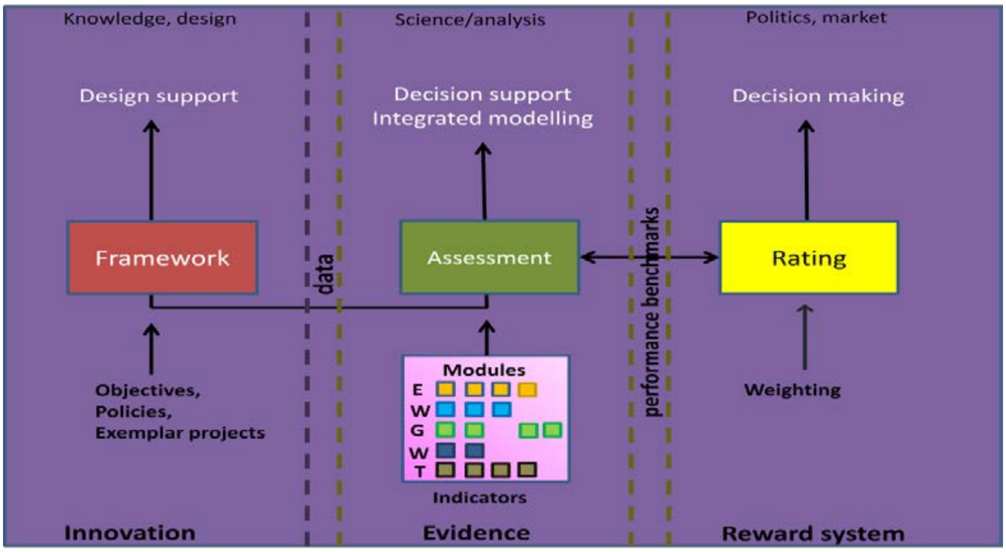

Figure 3: The arena of precinct design assessment

Activity 3: Design Innovation

- Project: Low carbon precincts – international review of best practice policy and practice
- Project: Design interventions for urban heat islands
- Project: Visions and Pathways 2050: Scenarios, Visions and Pathways for a Low Carbon Built Environment (Joint with program 3)

Activity 4: Performance Evaluation (precincts as operated)

- [Living laboratories/ Joint with program 3]

Activity 5: Data Mining and Modelling

- Project: Joint CRC/AURIN project on integrated energy/water database for Sydney (+ consumption models; Jevons effect
- Project: Health co-benefits calculator
- Project: Carbon metrics for the built environment (cross program)

The CRC Studies of Socio-Technical Innovation in Program 2 contains 3 time horizons as illustrated in the Figure 4.

Precinct demand forecasting largely within horizon 2: implementable over the next 3-10 years.

Discussions that arose from this presentation posed the question is the 'Program Framework' appropriate and what other 'precinct' issues/topics are not covered yet?

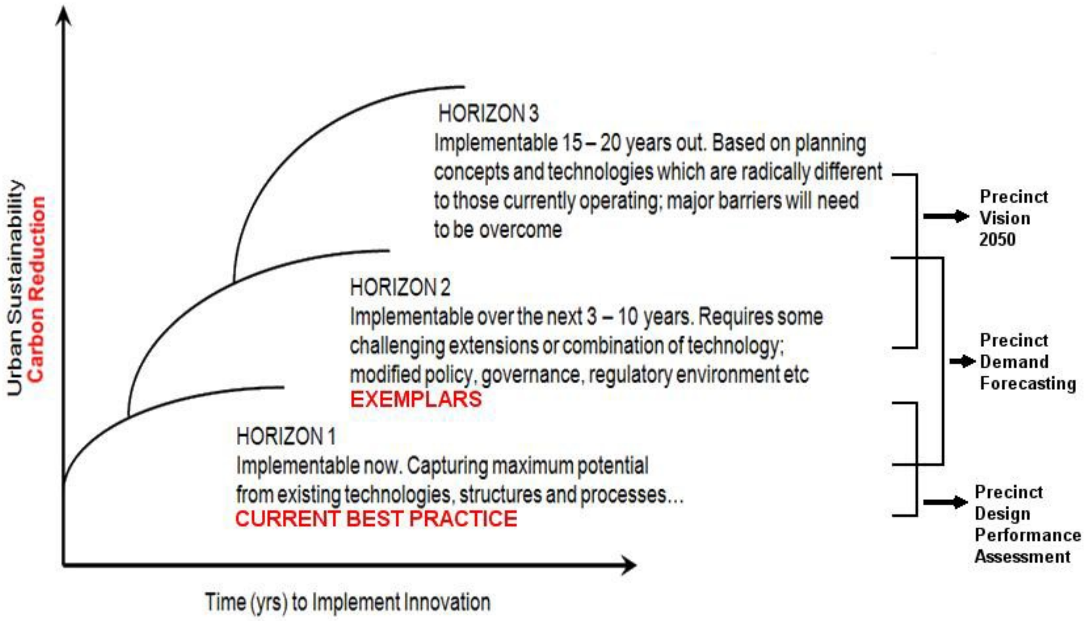

Figure 4: Time horizons of the CRC Studies of Socio-Technical Innovation in Program 2

ETWW Project Overview – A presentation by Prof. M.A.P. Taylor

The ETWW project exists in work package 2 of the CRC program 2 and has the following project partners:

- UniSA
- CSIRO
- UNSW
- SA DPTI
- Renewal SA
- SA Water
- Sydney Water
- AECOM

Project objectives are:

- Develop a method for the simultaneous estimation of the demands for energy, travel, water and waste
  - (initially) at residential household level
  - including carbon impacts
- Include the impacts of voluntary behaviour change by households
- Implement a tool for planners and developers
  - to estimate demands in the planning, design and evaluation of residential developments

It is anticipated that this will present challenges to develop a tool for use by practitioners (industry and community).

The project is to extend over 3 years with 2 project phases (1 year + 2 years) and a $0.962M cash budget (+ $1.266M in kind). The core team consists of:

- 1 project leader (Prof. Michael Taylor)
- 4 key researchers (Prof. Steffen Lehmann, Dr. Adam Berry, Dr. Rocco Zito, A/Prof Tommy Wiedmann)
- 1 postdoctoral fellow (Dr Nicholas Holyoak)
- 4 PhD students (TBA)
- project steering committee (partner and other organisation representatives)

Project outputs include an integrated framework for demand forecasting, to be developed, tested and implemented. This will result in an integrated demand estimation tool designed for use by practitioners and tested by them, which estimates carbon performance, accounts for behaviour change programs, includes different forecasting time horizons and includes interaction effects between demands.

Figure 5 shows a timeline of the expected tasks and milestones for the duration of the project.

Project steering committee meetings are to be held every 6 months. After the initial workshop, others will be held to consider the ETWW forecasting research synthesis, framework and specification. Finally, a national symposium will be held close to the conclusion of the project.

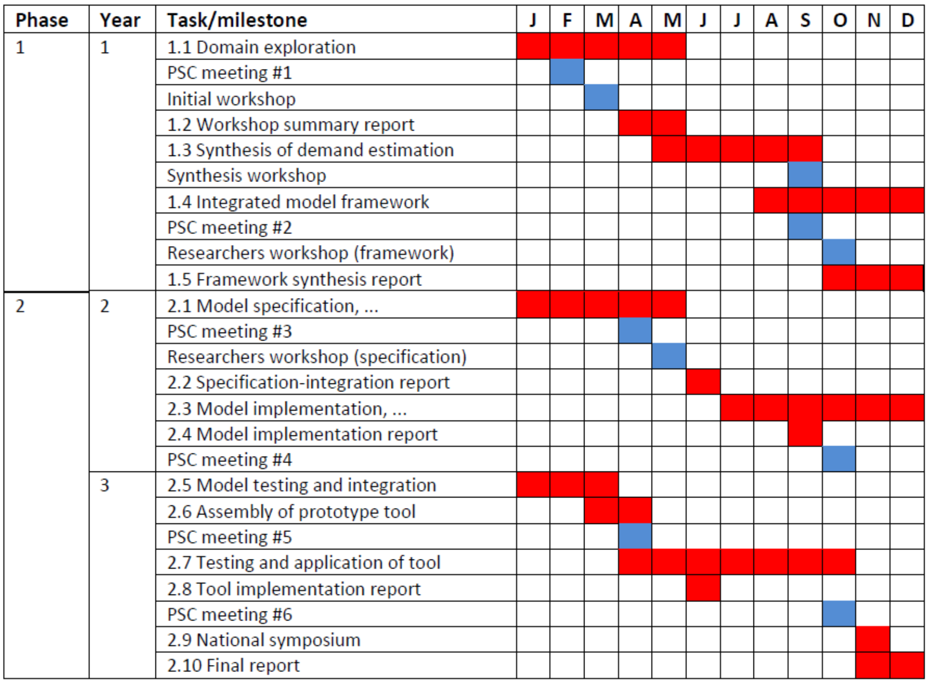

Figure 5: Expected tasks and milestones for the duration of the project

Energy Demand Forecasting – A presentation by Dr. Adam Berry, (CSIRO)

A copy of the full presentation is available in Appendix A and in summary:

- Modelling and forecasting energy is becoming rapidly more complicated due to the rise of intermittent renewables, the growth of demand-side provisions, bi-directional power-flow and the likely arrival of EVs and other distributed storage.
- There is very little public data available that accurately captures the topology, impedance and behaviour of Australia's electricity and distribution low-voltage networks, nor is there much in the way of detailed analysis of demand-side load management/behaviour change initiatives.
- CSIRO is looking to improve the quality and availability of data with the National Feeder Taxonomy Study, Solar Cities and Solar Intermittency programmes, which mine data about the electricity distribution network, demand-side intervention initiatives and solar energy variability
- CSIRO has solar and load forecasting technologies that are suitable for short-term (<hours) forecasting of demand and tools for optimising the layout of networks and estimating EV & solar uptake.

Following the presentation, discussion was on:

- The ability of energy models to forecast precinct demographic changes eg. double in house numbers? This was considered unlikely at this stage due to data restrictions and very little known about voltage distribution.
- Caution must be taken with assuming transferability of models between locations.
- Models need to provide multiple and diverse products such as and other energy uses beyond electricity (eg. gas) and consider non-residential users in a precinct.

Transport Demand Forecasting - A presentation by Dr. Nicholas Holyoak, (UniSA)

A copy of the full presentation is available in Appendix B and in summary:

- Presentation summarised approaches to forecasting transport behaviour patterns for present and future years using modelling approaches.
- Overall, travel demands for a population are estimated from socio-demographic and land use data and assigned to the transport network supply.
- Modelling commonly occurs at macro (national/state), meso (metropolitan) or micro (intersection) scales with meso suggested as potentially most appropriate for this project.
- Transport forecasting is well researched and utilised in practice with much scope for including behavioural components.
- Key input data includes population and household profile info, employment and education data and transport system operation data.
- Key outputs include network travel patterns, emission and energy consumption estimates
- GIS data representation is heavily utilised for this and potentially other modelling realms.

Following the presentation, discussion was on:

- It was noted that transport modelling tools used are sophisticated and based on many years of developments.
- Although a 'meso' level model was suggested for being most appropriate at this stage, more micro-level models may also have an application.

Economy-Wide Life-Cycle Accounting and Water Demand Forecasting - A presentation by A/Prof Tommy Wiedmann, (UNSW)

A copy of the full presentation is available in Appendix C and in summary:

- Economy-wide life-cycle accounting based on environmental input-output analysis provides a comprehensive modelling framework for economy-environment interactions.
- Energy, transport, water and waste are represented in such a framework in the form of economic sectors, (annual) environmental flows
- Overall carbon outcomes can be quantified from a production (direct) and consumption (embodied / footprint) perspective
- Trade-offs and nexuses can be evaluated quantitatively and in the context of the Australian economy
- The current Industrial Ecology Virtual Laboratory (IE Lab) project is currently building up an environmental input-output framework for Australia with a sector resolution of ~1300 and spatial resolution of ~2000 (suburb level)
- Key input data for water demand scenarios include population growth, demographic changes, consumption patterns / lifestyles, uptake of water efficiency measures and water recycling initiatives and climate change. The rebound effect should be taken into account.
- The water supply side also has important implications for the overall carbon outcome of future water demand scenarios
- Quantified scenario variables from water demand model (and other models) can be used to project full IE Lab framework to future years, allowing the calculation of economy-wide carbon outcomes.

Waste Demand Forecasting - A presentation by Prof Steffen Lehmann, (UniSA)

A copy of the full presentation is available in Appendix D and in summary:

- Presentation summarised approaches to forecasting waste demand and estimation methods
- Using the waste hierarchy, a focus must be on reducing/avoiding the creation of waste
- Circular material flows (looping material cycle) include maximised reuse and recycling; but recycling alone will not be enough
- Organic waste offers particular opportunities for composting, biomass and fertiliser production
- Samples were given for landfill/incineration/recycling and recovery/composting figures of a series of countries and for Adelaide
- A typical process of forecasting (future capacity requirements) was presented, comparing three methods of demand forecasting
- A list of existing tools and their foci was presented; Adelaide waste facts were presented
- It was obvious that the waste domain has its particular challenges and demand forecasting must go beyond weight, volume and diversion rate
- Future consumption and behaviour change patterns will have a significant impact
- Lifecycle approaches and embodied energy are significant
- Different types of waste streams and linkages to other domains (e.g. waste water) need to be integrated
- New waste types, such as e-waste or new construction components, create new challenges
- Each city will need to define its particular solutions, this means: the tool will need to be calibrated and fine-tuned

Following the presentation, discussion was on:

- This project component has two PhD students that will be involved and seeking 1 more
- What about waste water and waste energy? There will be important aspects to each project element that will cross the boundaries.

The Practitioner's View - A presentation by Mr Phil Donaldson, (Renewal SA)

A copy of the full presentation is available in Appendix E and in summary:

- Why the need for ETWW demand forecasting– driving affordable outcomes, consistent metrics, policy, combined approach
- What we do now – range of current software tools including PrecinX
- Lochiel Park - ecological footprint calculations
- Tonsley Park redevelopment – integrated energy, water and waste management, requires tri-gen plant and energy transfer stations, renewable energy and storage, retic system, smart building control integration
- PrecinX: software tool integrating onsite energy, embodied CO_2, potable water, transport, housing diversity and stormwater modules. Outputs KPI's of greenhouse gases, potable water, total affordability and vehicle hours travelled. Applied to infill and fringe case studies and presents a comparative analysis of development scenario planning using key metrics.
- Tools: needs include common metrics, to take note of industry needs, present scenario sensitivity, incorporate benchmarks with links to existing databases and assessment processes. Also behaviour change capabilities, be easy to use, understand the market and avoid re-inventing the wheel.

Following the presentation, discussion was on:

- Will developers see the benefits? Will they use the tool that gives them their most preferred/best answer? Developers attitudes are changing over time and decisions are made based on conversations based on initiatives
- It will be useful to identify the stakeholder and end-user need with respect to the modelling tools – therefore a need to contact them exists.

WORKGROUP DISCUSSIONS

Following on from the presentations and discussions, the workshop participants were divided into 3 workgroups (of approx 6 members each) and given approximately 1 hour to discuss 6 topics associated with the ETWW project. Following this workgroup session, representatives presented their respective group's outcomes. Groups were structured as follows:

Table 1: Workshop group members

Group 'A'	Group 'B'	Group 'C'
Phil Donaldson	Nick Thomas	Michelle Philip
Rocco Zito	Nick Holyoak	Michael Taylor
Kate Beatty	Adam Berry	Tommy Wiedmann
John Devlin	Ivan Iankov	Jason Ting
Steffen Lehmann	Peter Newton	Atiq Zaman

During this session, discussions were to centre around six core questions. These questions and the combined outcomes from all groups are presented in the following sections.

Discussion topic 1: What definitions need to be considered?

Considerations that were identified by the workshop groups had much common ground with some topics identified by more than one group. Where this occurs, the number of groups that have identified this issue is provided in brackets. The definitions that need consideration were identified as:

- Precinct (3): 'Green Star Communities', link to PIM project, aggregation flexibility, scale can vary but covers a mix of users/building types, landmark that links surrounding land uses, boundaries can by physical eg. major roads or social
- Time frames/horizons (2): dependant of client base and their requirements, closely linked to forecasting, providing and managing/operating infrastructure and services
- Forecasting scenarios (2): what and how, scenario analysis and policy drivers, succinct detail, how receptive and how dynamic eg. policy, climate, technology
- Low carbon living (2): low carbon, metrics of definition, lifestyle – personal - behaviours
- End user (2): government, developer, policy, utilities (Stakeholders), Community, builder, consumer, developer, tool benefits, users, open source, regulators
- Waste: water, energy, nutrient, time
- Base-unit of analysis
- Demand: specific/different definitions for ETWW, Waste in particular is different - more likely a supply, seasonal variations
- Behaviour change: voluntary, compulsory, incentives – relationship of all to industry transformation – personal / precinct development
- Incremental change versus transformational change
- Forecasting parameters: is mean enough or range/distribution (and consequence of system failure)

There is a need to define what is meant by a 'precinct', not only in terms of the physical aspects and spatial scale but also consider data needs associated with modelling, the low carbon living elements within it and who will be involved in the assessment of these. At this stage the required definitions relate to establishing the broad forecast model parameters such as base units and behavioural inclusions.

Discussion topic 2: What are the main synergies that you can see from today?

Workgroups were held after the presentations and discussions form CRC and partner organisations, providing participants with an insight into the dimensions of the forecasting issues related to energy, transport waste and water. As workgroups they then had the opportunity to identify general common ground and interactions of model forecasting. The identified issues extend beyond the forecast model development itself.

- Data (2): level of data consistent – household data, climate data; Data bases, storage and recall, operational scale – opportunity for "platform widget", demographic base of models – everyone uses ABS
- PrecinX (2): ETWW
- Expense: Commercial – Affordability
- Energy: Across all areas
- Complexity: simple resilience
- Adaptable: regenerative opportunities
- Pollution/Hazard/Safety
- Localisation: Reduce all domains

This discussion topic also gave rise to some additional questions posed by the groups relating to the level of relationships between ETWW and the modelling approach. Network based modelling across areas – network based approach is a common element? Or is this a supply chain approach?

Possible synergies seen in the data used in the modelling processes with the PrecinX model viewed as a tool that should be recognised and investigated further.

Discussion topic 3: What are the main gaps that need addressing?

To complement the previous discussion topic, workgroup members had the opportunity to note areas that need addressing in terms of gaps and shortfalls. This topic received more attention than the previous in terms of provided answers with some common to the previous (eg. the issue of data). Again, the issues extend beyond the forecast model itself.

- Data (3): Getting the data – 'Design Data Protocol', consistency of input data, how ETWW uses data – is ABS data inputs the same as transport energy, cross elasticity between the 'silos', measurement of performance – data capture, what and from where?
- Time (2): Time/resources/people allocated in project – eg. energy experts, time frame –model scale, how fine/coarse, need to identify reach
- Waste informatics (modelling)
- Evaluation
- Retrofitting – Access? and invisibility and scale
- Prioritise demand scenarios – future
- Pricing and sensitivity analysis – capability
- Impact analysis (intended consequences)
- Life cycle boundaries
- Energy – includes all types eg. gas

The importance of data emphasised as groups identify aspects that will need to be addressed relating to availability, types and applicability. Identifying modelling and analysis capabilities and establishing research timeframes and resources is also needed.

Discussion topic 4: Creating an integrated model – what alternative approaches can you think of [to those you currently work with]?

Due to time constraints, only 2 groups suggested alternative approaches and other considerations.

- Trust modelling of industry: get the first cut - look
- Don't re-invent the world
- Outputs: test, valuable, reliability of tests
- Activity based model of personal scale
- Distills down to a common carbon metric: Consider 1. Focus is a precinct performance. 2. What is the most suitable way to present forecast results eg. transport – is it probability distribution of trip length?

- Also: Elasticities (economic) of the demands and cross-elasticities between the demands

Discussion topic 5: List potential interactions between areas (e.g. if i reduce car use by staying at home, there'll be additional energy used and different use of water and considerations of waste).

This topic was addressed in different ways by the groups, who have suggested specific interactions, and other considerations beyond these. Rather than provide detail on potential interactions between areas, one group noted that it is very important to identify and clearly define interactions and interaction boundaries while asking which are 'important' and to prioritise these.

- Reducing car use – work from home, increase in energy use
- Car fleets – reduce carbon – newer cars, fleet change over – wasting embedded energy
- Energy used in providing water at point of consumption
- For precinct, energy and water use in precinct (household?) by time of day given travel by household members (therefore times individuals are in the precinct – activity modelling etc.)
- Waste disposal has transport component and an energy component
- Waste water
- Opportunity analysis –
- Connections to outside the precinct
- Multiplier effects of solutions - opportunities
- Employment/productivity/food – supply chain, lifestyle, community connections

As there are many specific examples of interactions, this is a topic that will need further consideration in terms of what interactions are to be recognised and how these will be represented in the forecast modelling process. This is especially important to deliver an integrated ETWW modelling approach.

Discussion topic 6: How will we retain interest/enthusiasm amongst the group?

Groups offered a range of suggestions to this last topic, largely focussed around structured communication with opportunities for non-structured interaction. It was largely seen as the responsibility of the research leaders to initiate with the opportunity for all involved organisations (and beyond) to participate.

- Digital
- Shared data store
- Email updates
- Online forum/discussion board for researchers
- Newsletter on project updates – key researchers
- User forums to get feedback and inform stakeholders
- Opportunity for research forums – PhD's
- Regular exchange of progress and events, outcomes – key researchers
- Non-CRC participants – board, team leaders
- Joint papers
- Common areas for interaction,
- Wine and beer – program leaders
- Encourage external and practitioner inputs

Responses to this topic indicate that it is an important aspect that can be achieved through various interaction methods at varying levels of complexity and resources. The use of electronic means is encouraged to increase the ease of the communication process.

Additional discussions...

In addition to the topic-led issues, the workgroups also identified other research items considered worthy of mention, which included:

- Peer review outside CRC
- CRC journey over the coming years – what is the narrative? Can we make it exciting, colourful and artistic?
- Raising the profile of this project and project group – articles (eg. based on the first workshop, birth of CRC) should be distributed to networks
- Capacity building of industry and PhD's – upskilling mulit-dimensional analysis of developing ecological engineers
- Celebrate!

WHAT'S NEXT?

The next stage of the research is to develop a synthesis of demand estimation, a process that will (in the first instance) require researchers and other relevant parties provide comment and suggestions based on this report. This report (and other developed materials) should be communicated beyond the CRC participants, a process that will be assisted by the use of the CRC LCL website.

In terms of defining a forecast model framework, a literature review can summarise the key content relevant to the ETWW fields. It will therefore be essential to identify a collection of core or foundation literature on demand forecasting approaches for all parties to review.

At this stage of the research it is also important to raising the profile of this project, not only to inform but to promote interaction with potential contributors within the existing research organisations and beyond. This process will be helped by activities such as the development of communication channels and electronic resources or 'common areas' for literature, data sources and updates.

APPENDIX A: ENERGY DEMAND FORECASTING PRESENTATION

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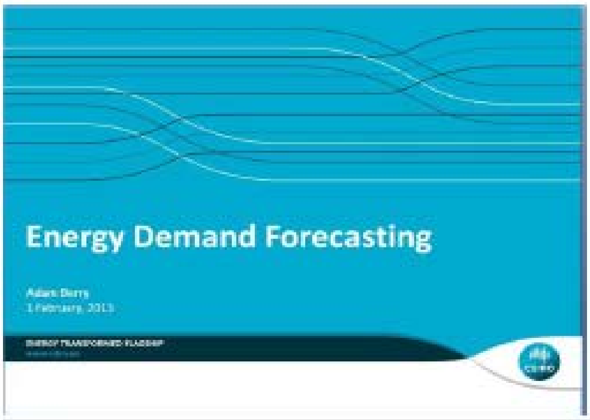

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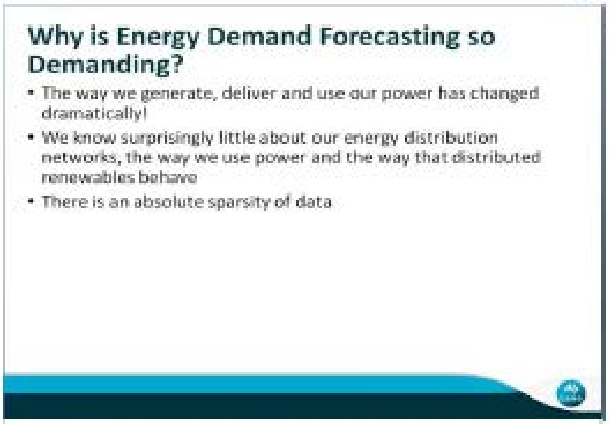

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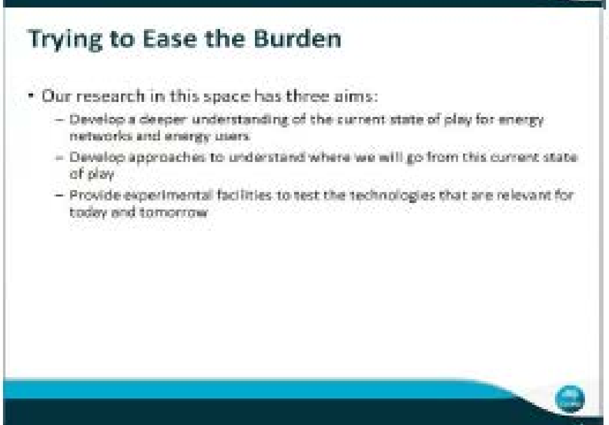

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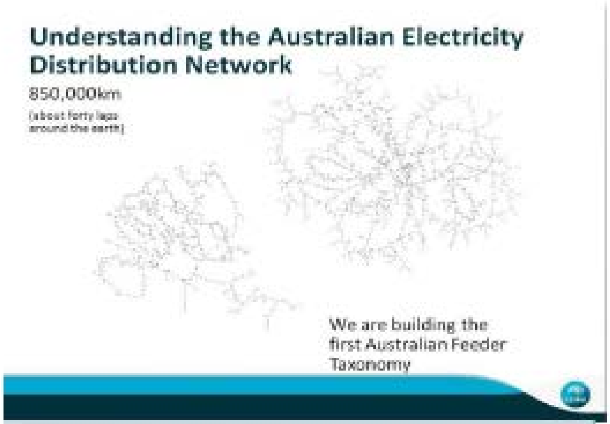

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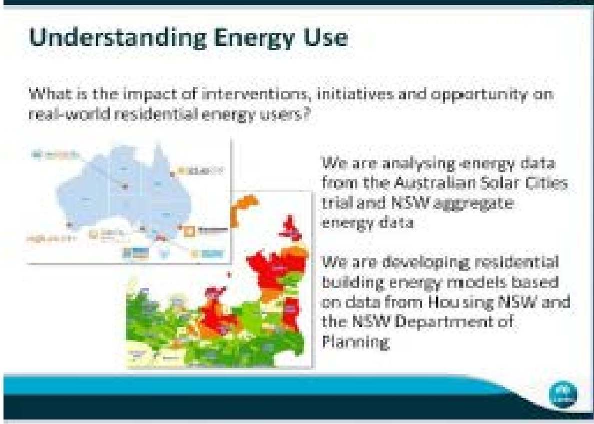

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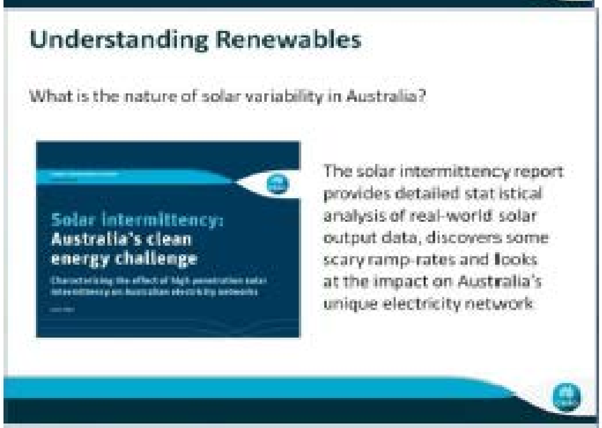

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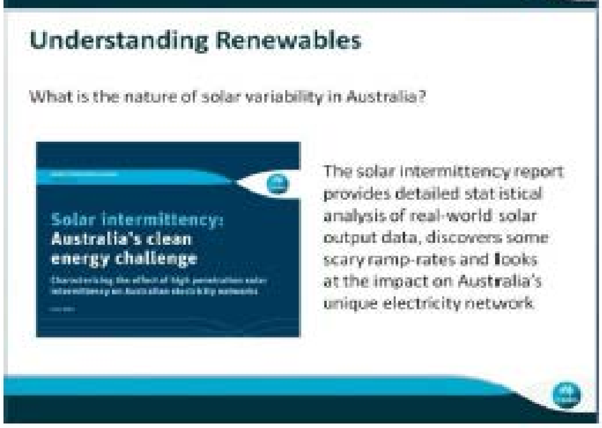

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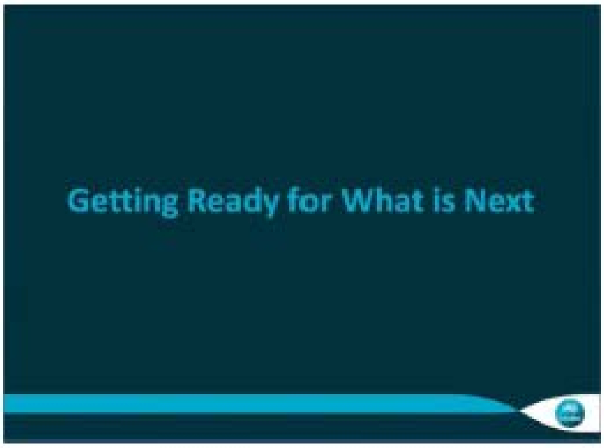

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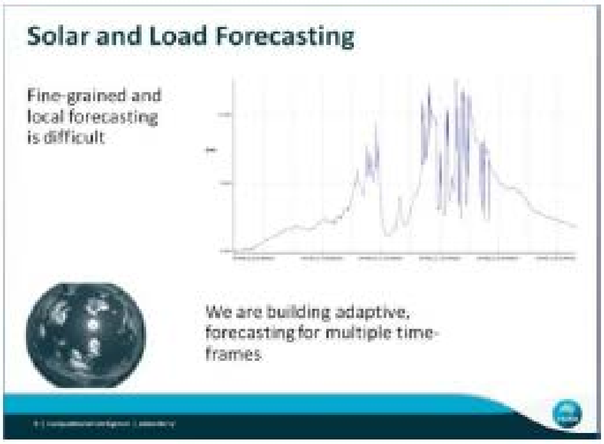

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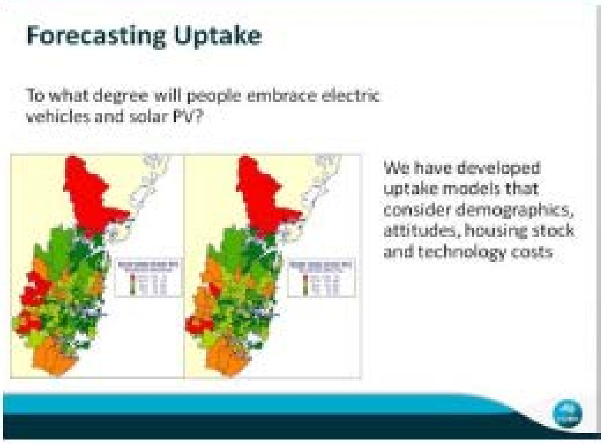

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APPENDIX B: TRANSPORT DEMAND FORECASTING PRESENTATION

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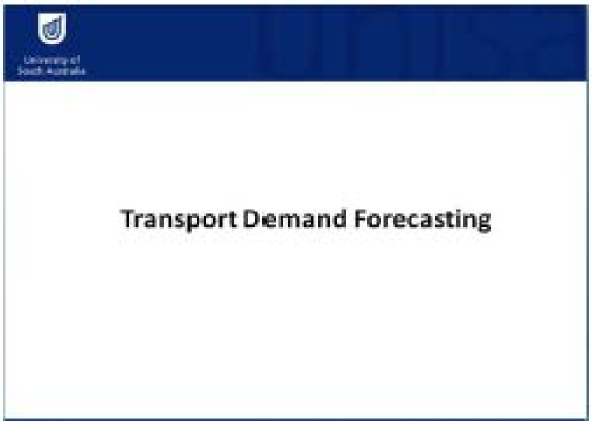

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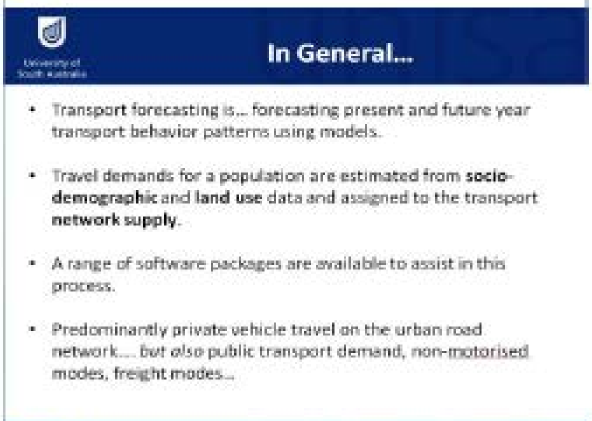

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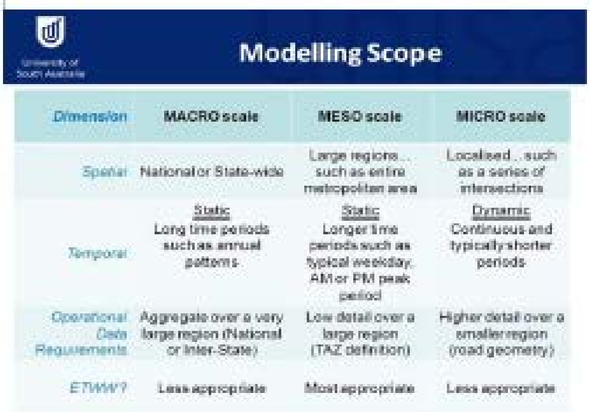

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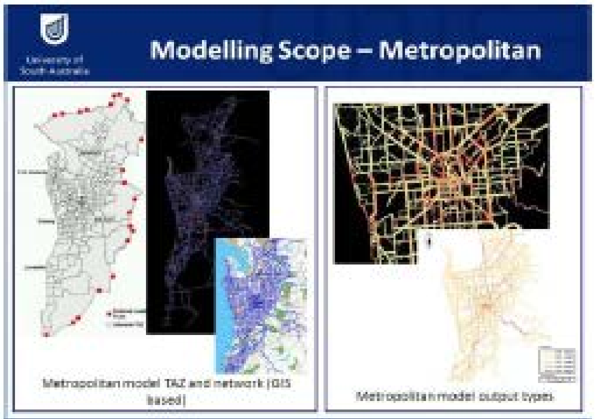

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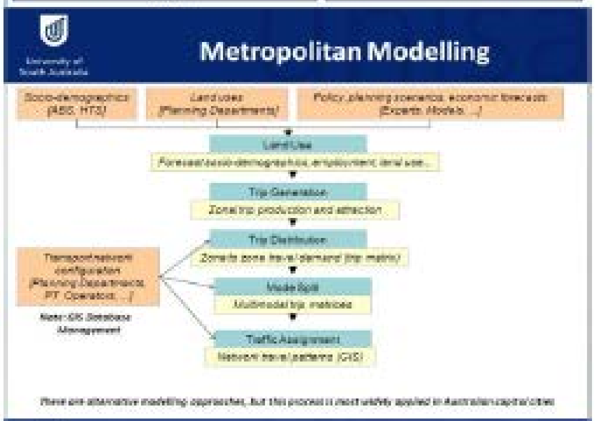

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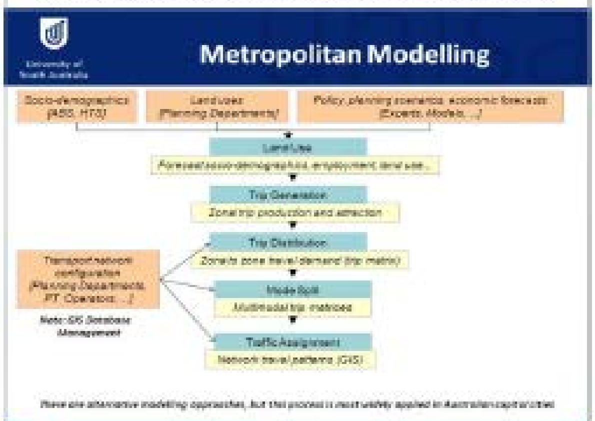

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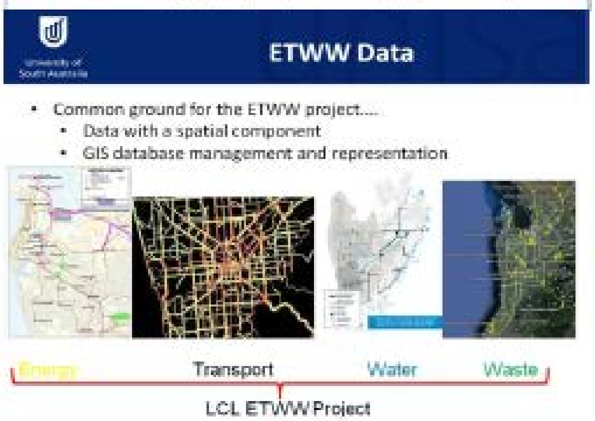

APPENDIX C: ECONOMY-WIDE LIFE-CYCLE ACCOUNTING AND WATER DEMAND FORECASTING PRESENTATION

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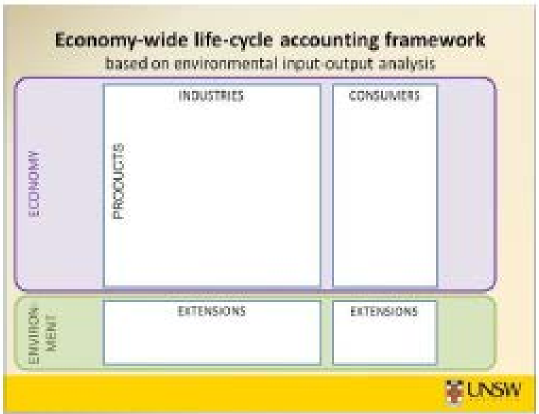

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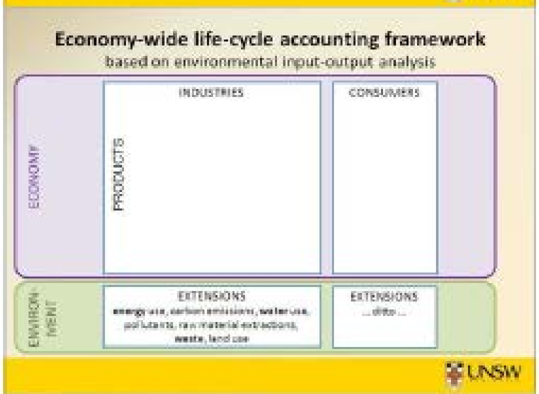

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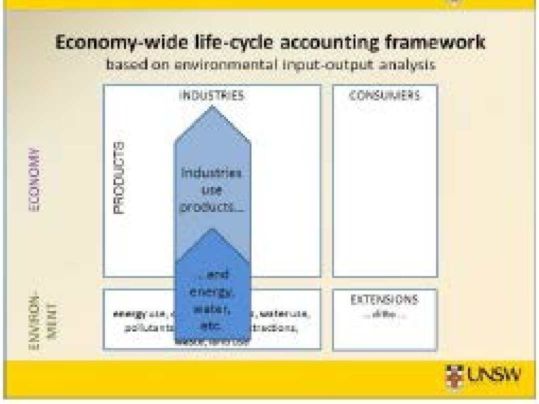

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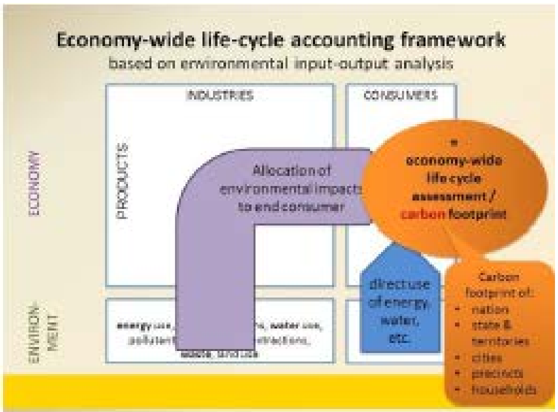

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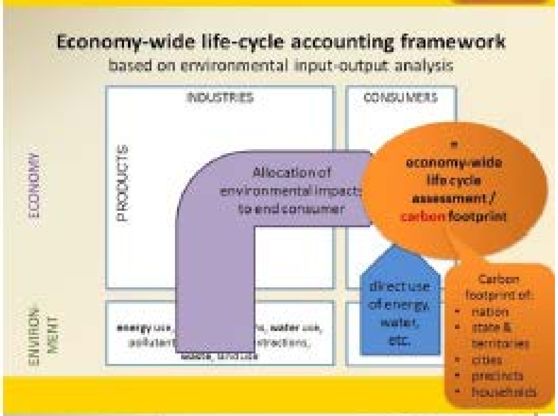

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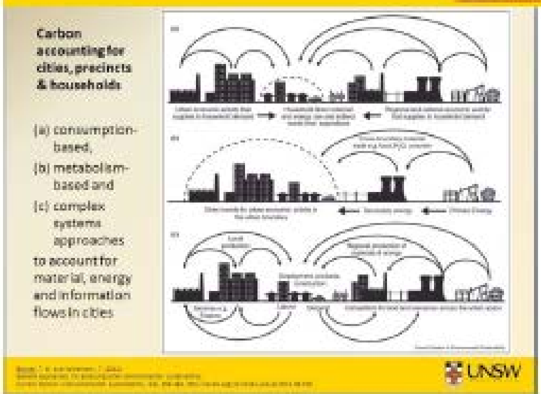

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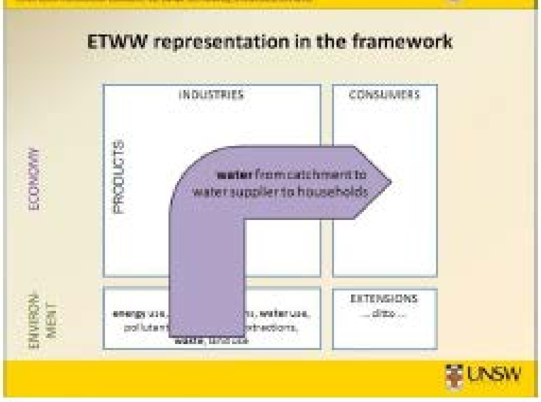

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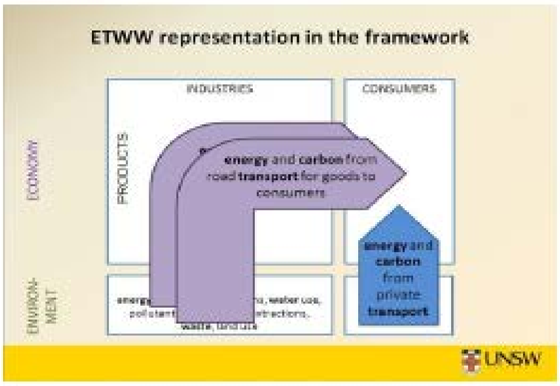

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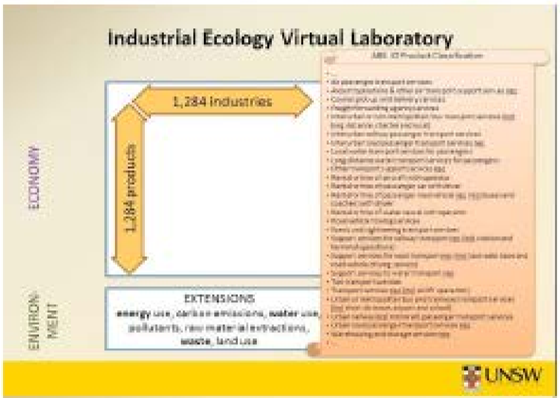

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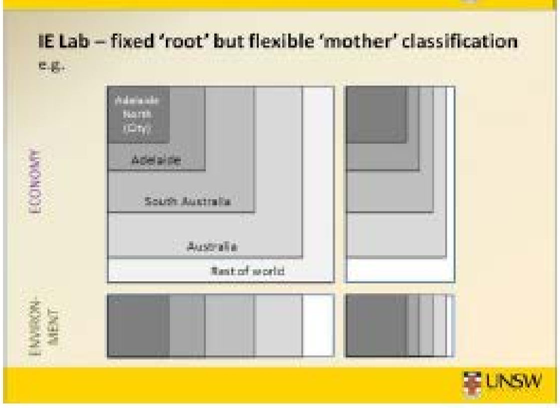

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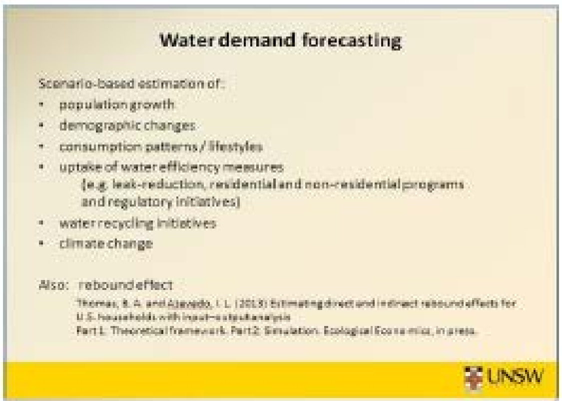

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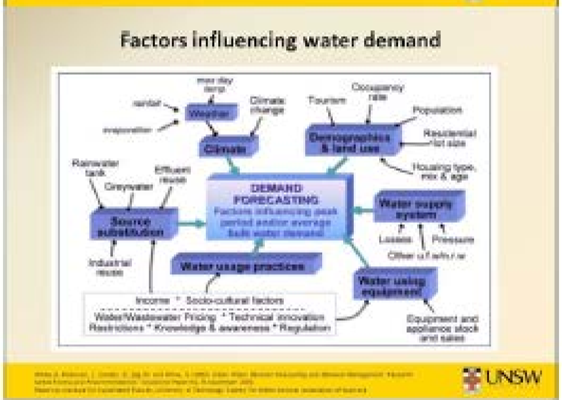

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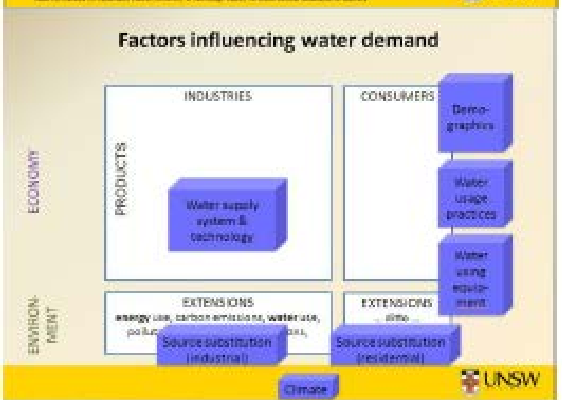

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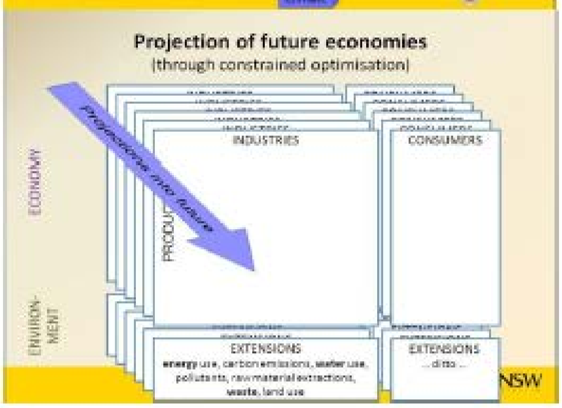

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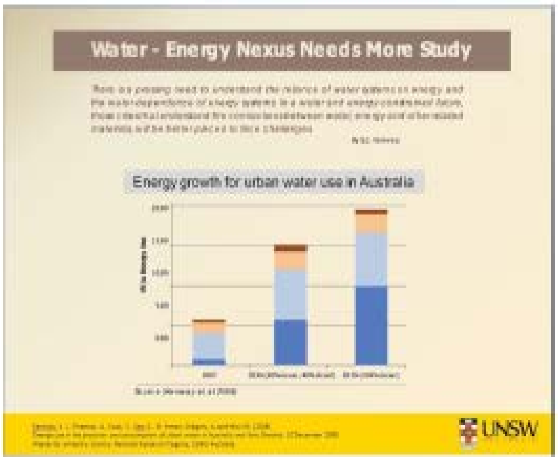

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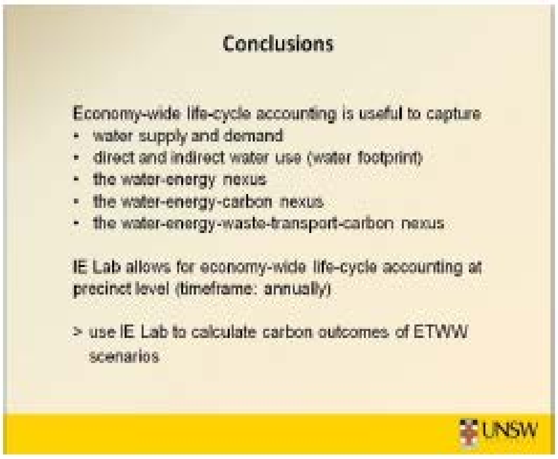

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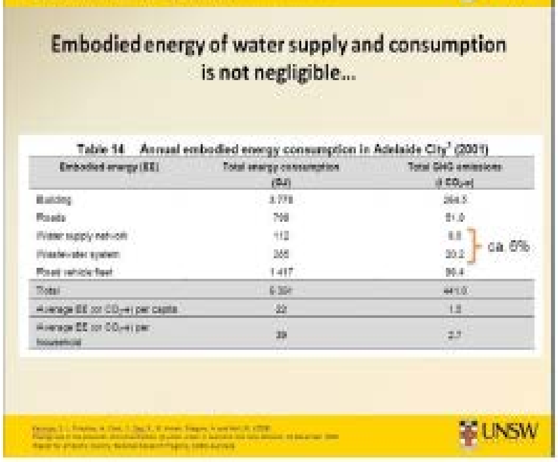

Embodied energy (EE)	Total energy consumption (GJ)	Total GHG emissions (t CO_2-e)
Building	3 778	264.5
Roads	798	51.0
Water supply network	112	8.8
Wastewater system	265	20.2
Road vehicle fleet	1 417	96.4
Total	6 304	441.0
Average EE (or CO_2-e) per capita	22	1.5
Average EE (or CO_2-e) per household	39	2.7

APPENDIX D: WASTE DEMAND FORECASTING PRESENTATION

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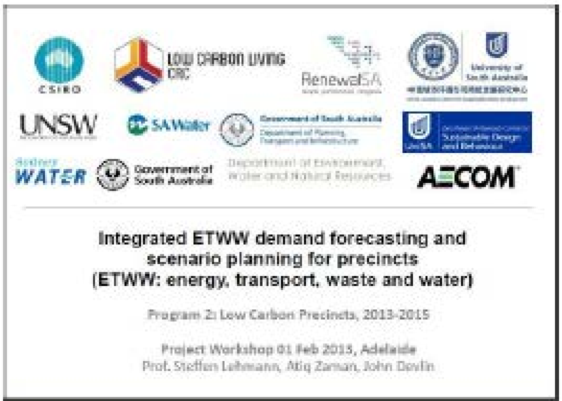

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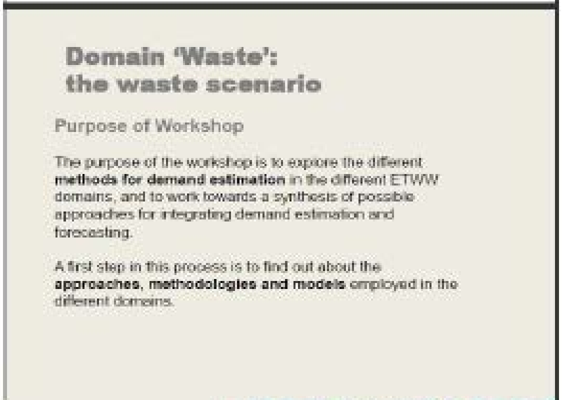

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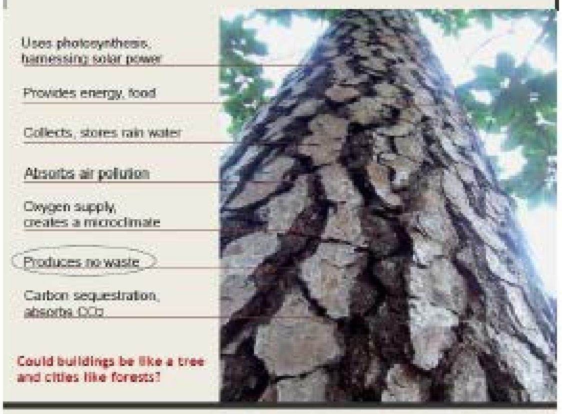

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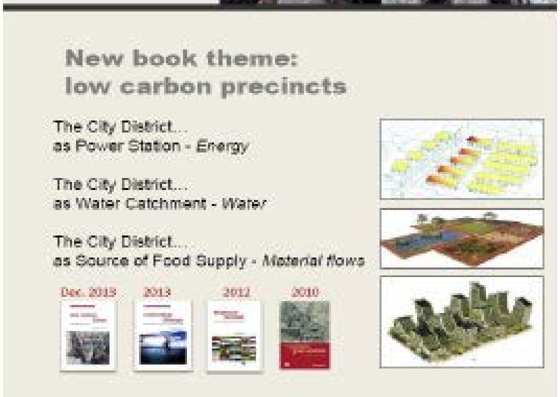

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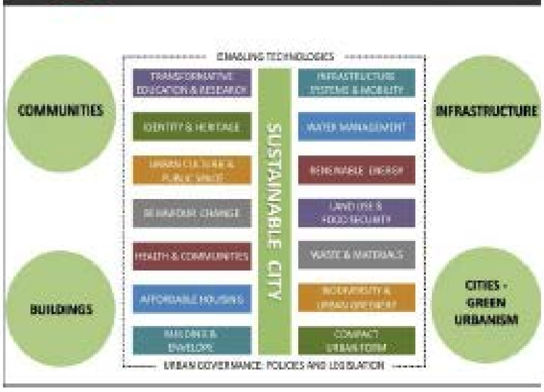

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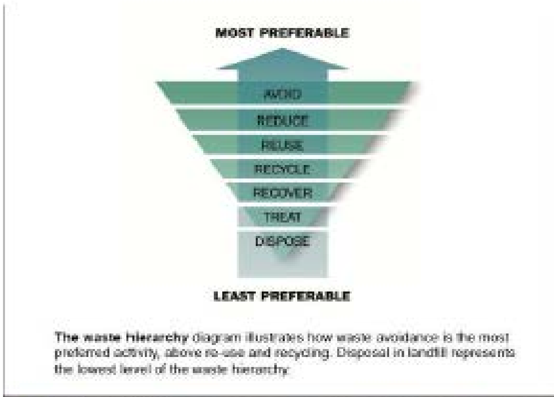

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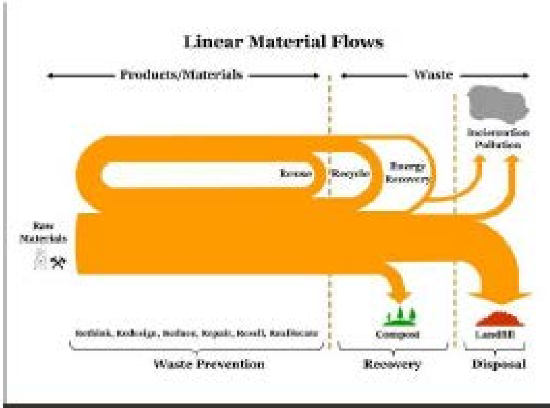

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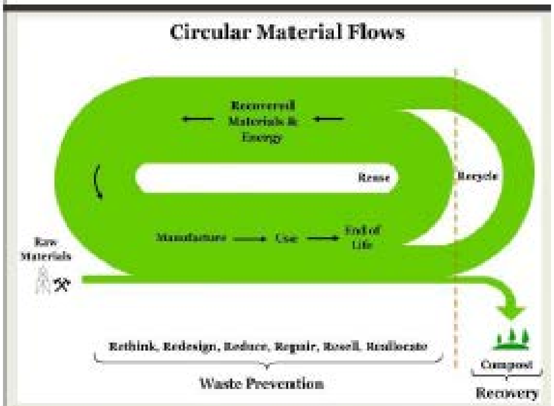

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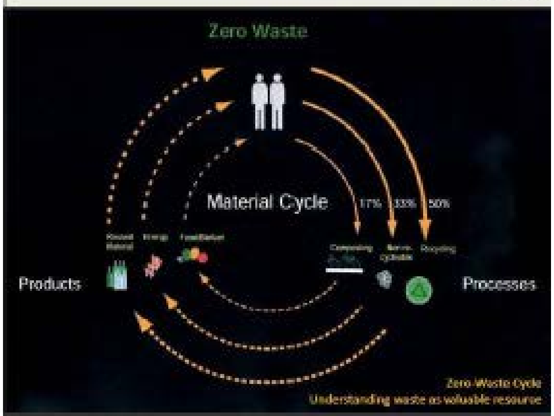

Slide 12

In the available literature, a recommended split for a city (here a typical developed city in Germany) can be found where no **MSW waste** goes to landfill:

- Recycling and re-using waste: *min. 60 per cent and more recommendable (70-90 per cent recycling target),*
- Composting of organic waste (biomass): *around 30 per cent recommendable,*
- Incineration of residual waste (waste-to-energy): *generally to be avoided, maximum 10 per cent only for waste that cannot be recovered/recycled.*
- No landfill: *0 per cent*

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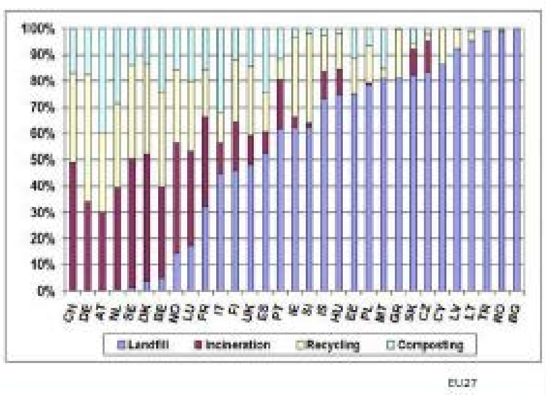

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Definition: demand forecasting

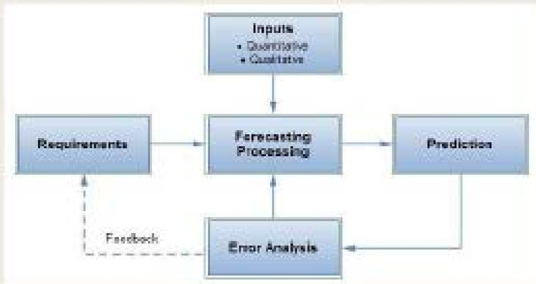
Demand forecasting is a proven method in urban planning used for making planning and infrastructure design decisions based on **future capacity requirements**.

It is the activity of estimating the quantity of a service or product that future residents (consumers) will require.

Demand forecasting involves both informal methods, such as educated guesses, and quantitative methods, such as the use of historical or current data and statistics.

Slide 15

Forecasting: Typical process



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Demand Forecasting: methods

DEMAND FORECASTING METHODS

Qualitative Method (Judgemental)	Combined Method (Judgemental and Statistical)	Quantitative Method (Numerical and Statistical)
Survey Executive jury method Sale force composite Delphi	Artificial Intelligence Methods - Artificial neural networks - Expert/Group method of data handling - Support /believe vector machines System Dynamic (Causal loop system)	Casual forecasting - Regression analysis - Econometric models - Input-Output models Time series - Trend/ Pattern analysis - Regression analysis - Exploratory analysis

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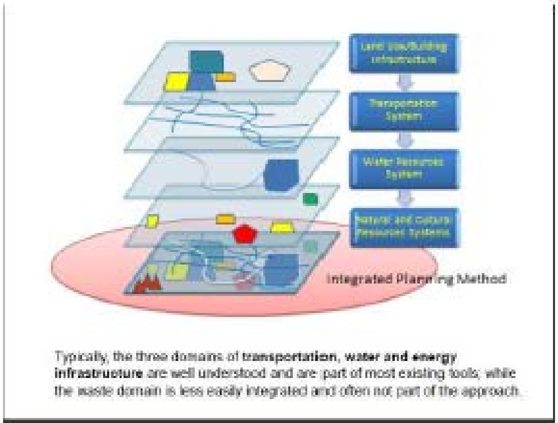

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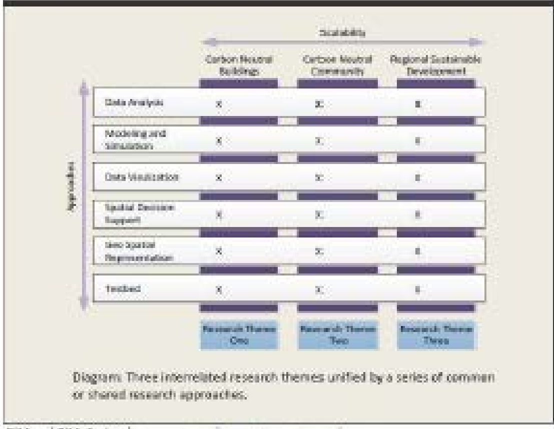

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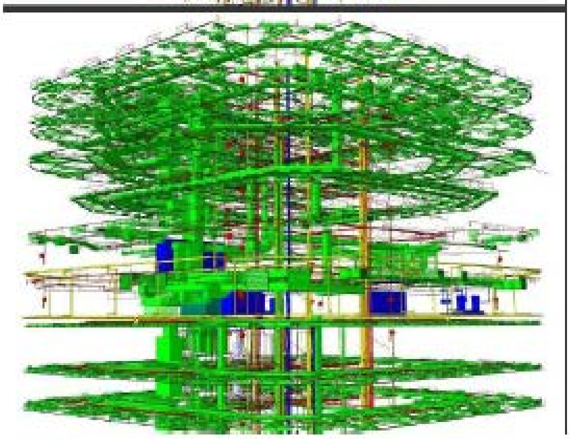

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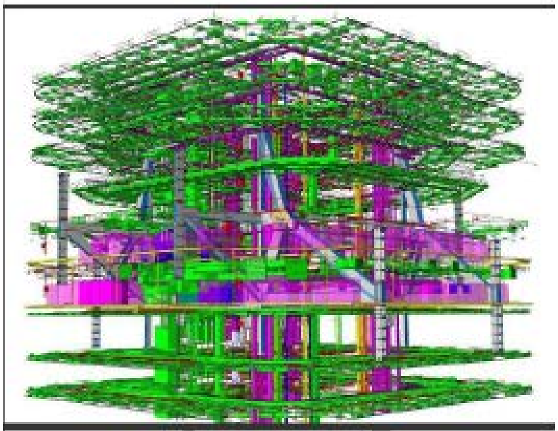

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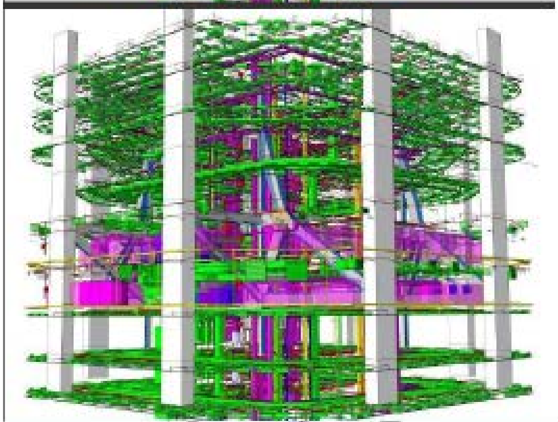

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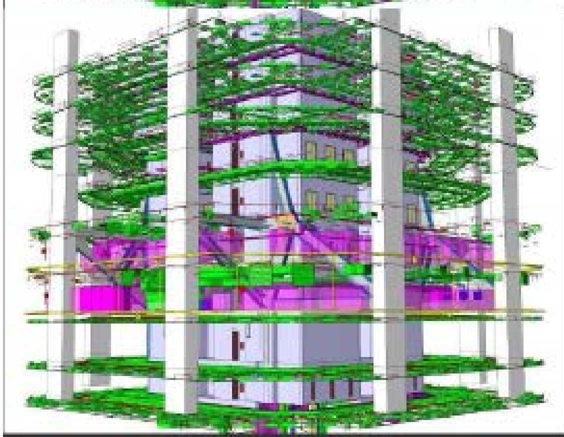

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Existing tools and their use

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NABERS OFFICE waste	Australia	Office Building	X	X	√	X
EnviroDevelopment (UDIA)	Australia	Multi-residential Development	√	√	X	X
SMARTWaste	UK	Development Site Waste Management	√	√	X	X
GreenStar	Australia		√	√	X	X
Wrap Net Waste Tool	UK	Building Waste	X	√	√	√
[illegible]	USA	Municipal Solid Waste	X	X	√	√

Slide 26

Performance metrics and parameters

Current methods of ***quantitative waste and material flow estimation*** use the weight of waste generated as a unit to quantify different scenarios.

Forecasting this amount and its impact is largely based on the following indicators…

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Performance metrics and parameters

(1) **total amount/weight**: kilogram of MSW waste per capita, (e.g. 2kg p. cap. p. day),

(2) **volume and weight per cubic metre of the particular mix (content type)**: every substance will have a different weight to volume conversion factor. One cubic meter of water weighs 1000kg or 1 ton, but other materials will weigh different, e.g. wet food waste),

(3) **diversion rate:** this is the current diversion from landfill rate and rate of resource recovery, current recycling and re-use rate in percentage terms, (e.g. 66% diversion rate),

(4) **socio-economic context**: current and future consumption patterns, changes in affluence of residents and population growth (in $/GDP per capita, driving the growth rate of waste generation, 3-year or 10-year time frame? E.g. $40k pa in 2013, $50k pa in 2015)

Slide 28

Performance metrics and parameters

(5) **behaviour change**: expected household behaviour change towards waste avoidance,

(6) **infrastructure**: implications of policy/legislation, supply chain and waste disposal,

(7) **treatment**: complexity of treatment / recovery,

(8) **energy**: amount of embodied energy in KCal,

(9) **environmental impact**: how hazardous it is,

(10) **transport**: distance to treatment/recycling centre

(11) **time horizon**: are we looking at 5 hours, 5 months or 5 years?

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Consumption

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Australia:
6 per cent growth of waste p.a

2012: 43 mill tonnes waste

2020: 80 mill. tonnes waste

Slide 31

Demand estimation: waste domain

What is the situation **in Australia** in general and what are reasonable targets?

The total MSW waste generated by 20 mill. Australians was:

2007: 44 million tonnes, of which recycled: 52 per cent

2020 forecast: 80 million tonnes (this seems unavoidable, given the current growth rate), of which to be recycled: min. 80 per cent (recommended target).

Slide 32

Australia: the waste facts

Per capita, **Australians** generated around **2,080 kg p. capita pa** (2.08 tonnes) of total waste (all waste streams together) in 2006-2007 (this includes around 750 kg MSW per capita p.a.).

This is around 5.7 kg per day, among the highest figures worldwide (Wilson et al, 2012).

The official waste generation per capita figure for **South Australia**, for 2006-2007, was **2.1 kilograms of MSW** per person p. day.

It's likely that the real figure is actually higher (getting reliable data is a constant challenge in the waste sector).

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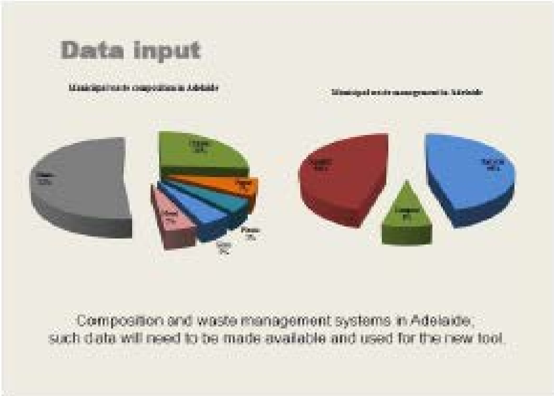

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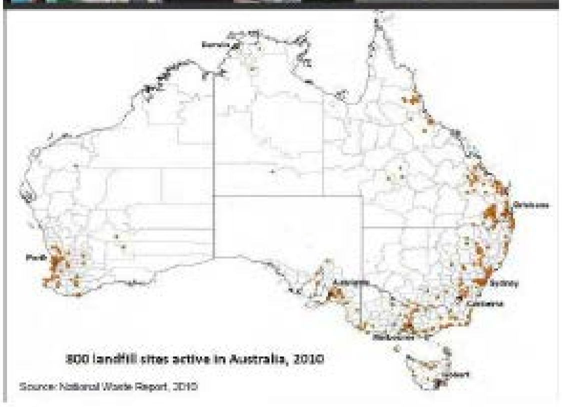

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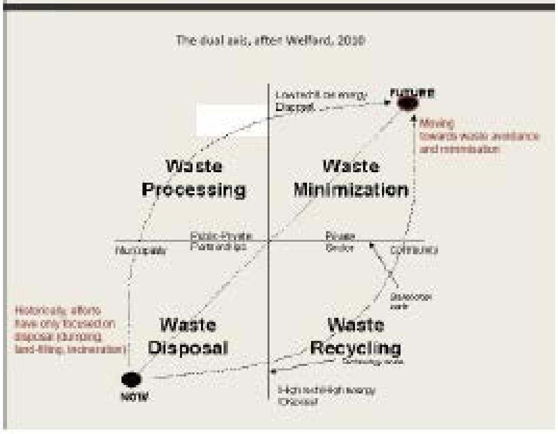

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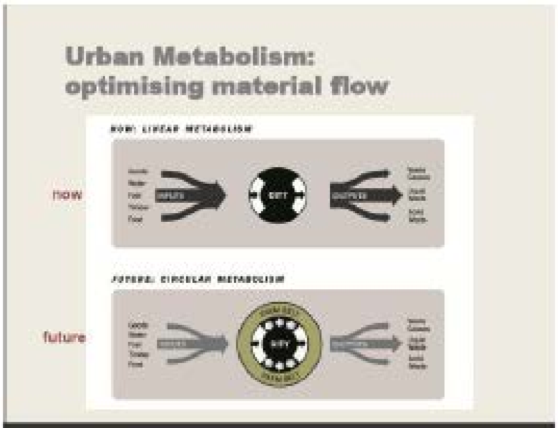

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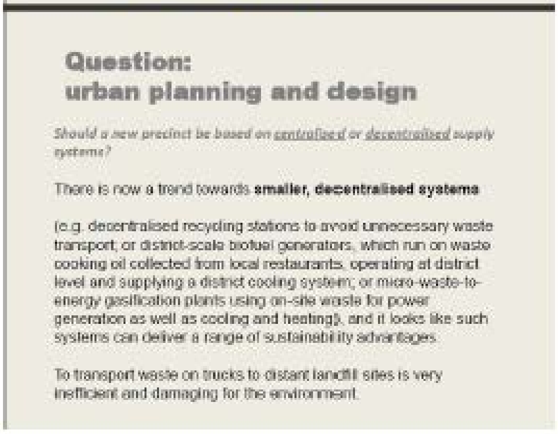


Slide 49

Methodology: practical considerations

How often should the waste be measured?
- Daily, weekly, monthly, seasonally…

Where should the waste be measured?
- At each bin, household bin, street level, precinct level…

Within what boundaries should waste be considered?
- Impacts of commuting and remote consumption/pollution…

How should the waste be measured?
- Self-assessed, on the trucks, at landfill, RFID tracking…

Whose performance are we measuring?
- The building, the people, their lifestyles, the urban design, the city…

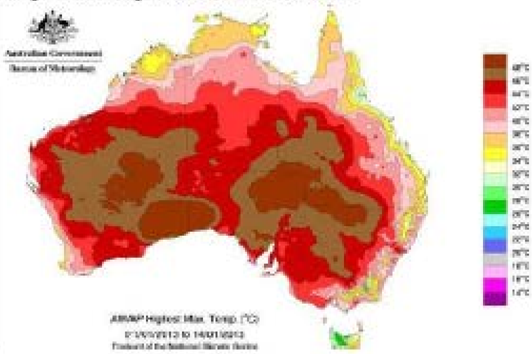
What aspects of the waste are most important?
- Volume, weight, expense, hazardousness, complexity, scarcity…

Why do we want to forecast the demand of waste services?
- Do we want to meet demand, or change the demand? **We want to move towards lower demand and a low carbon future…**

Slide 50

CRC Project in Program 2: Urban micro climate – Heat stress

Mitigation strategies for urban heat islands



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Discussion

APPENDIX E: A PRACTITIONERS VIEW PRESENTATION

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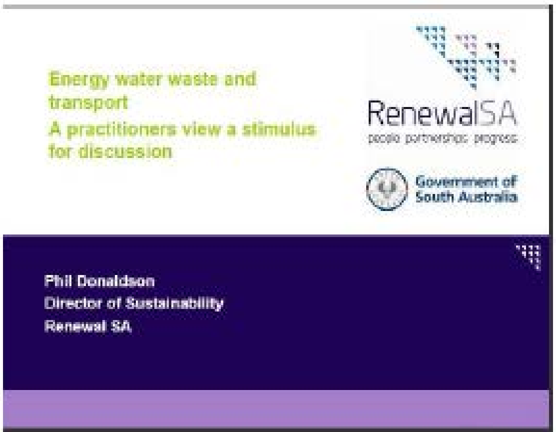

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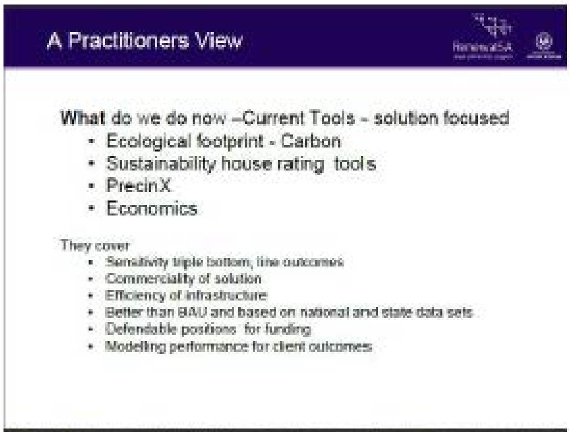

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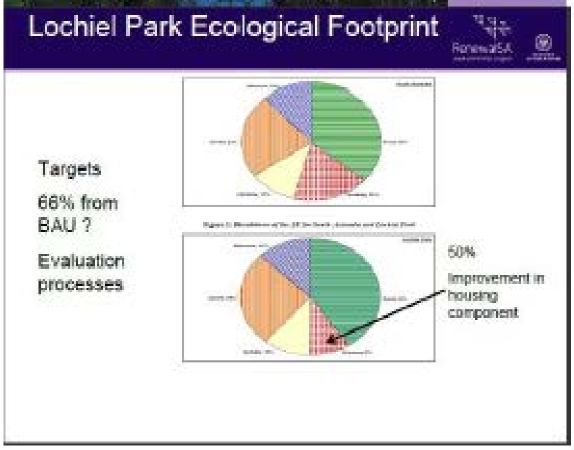

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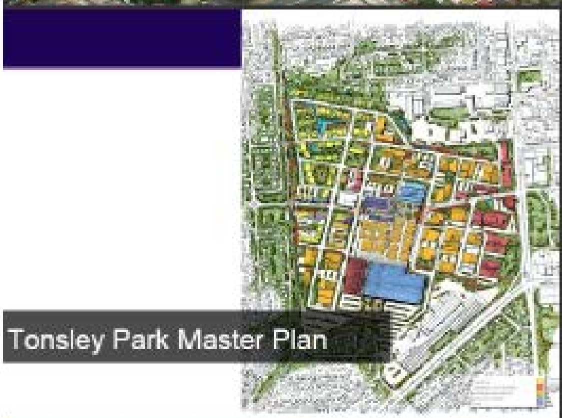

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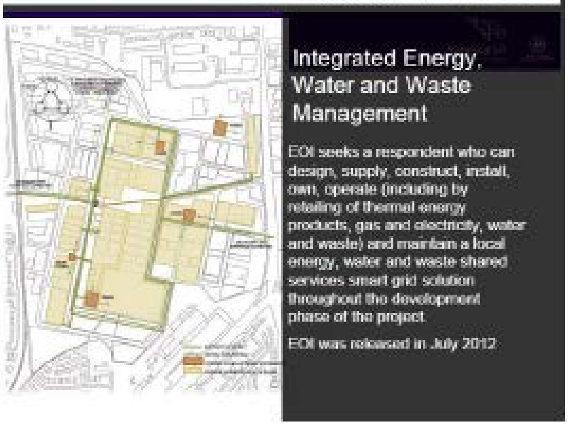

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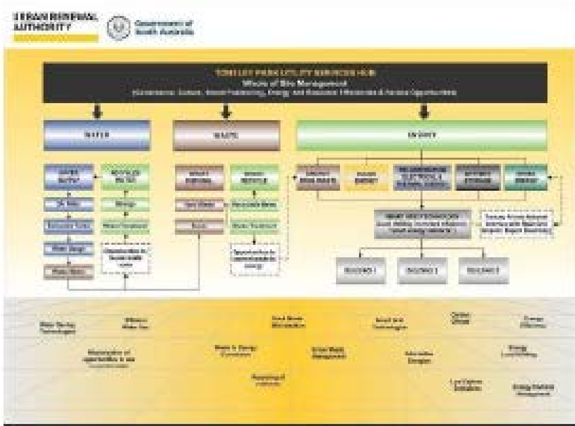

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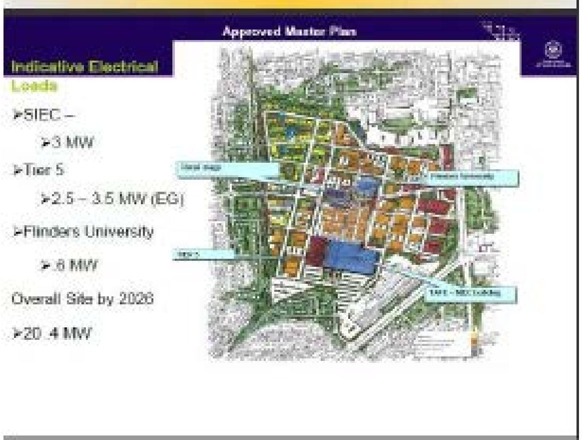

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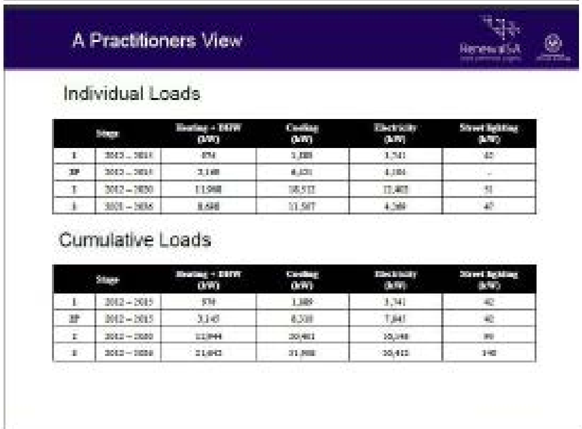

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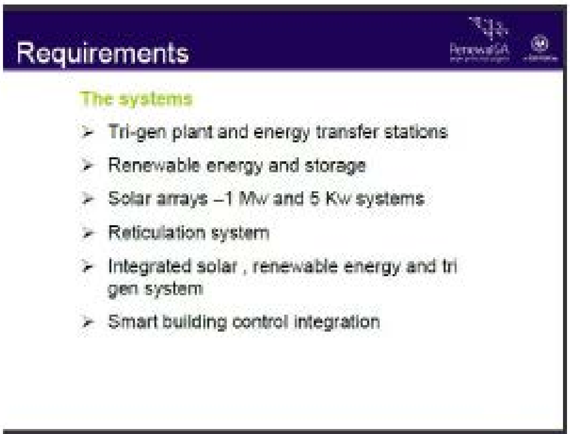

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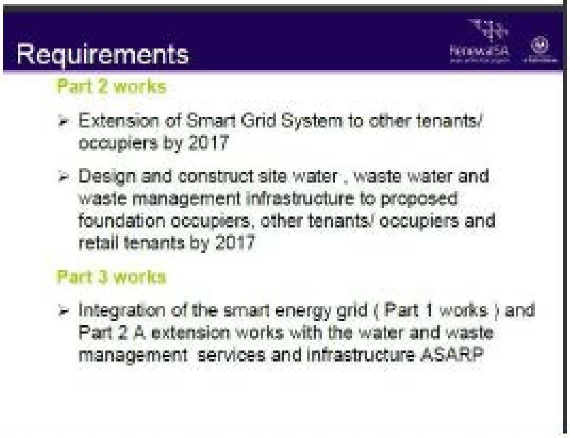

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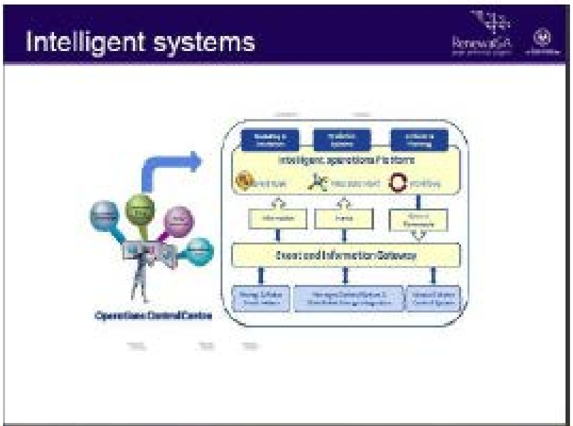

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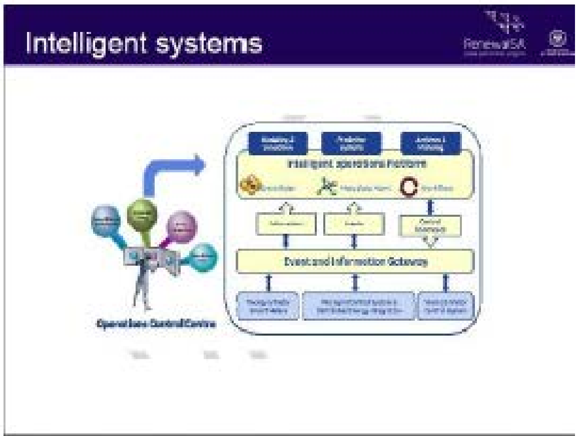

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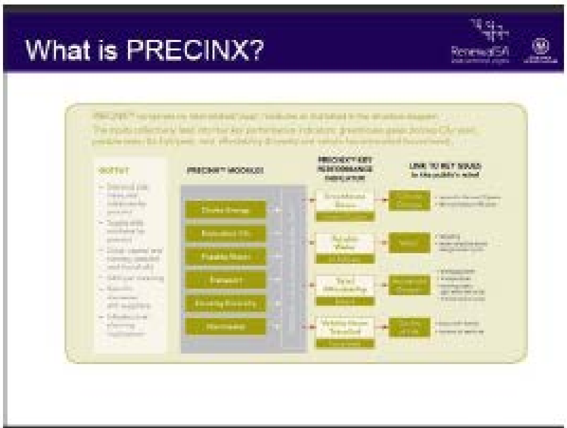

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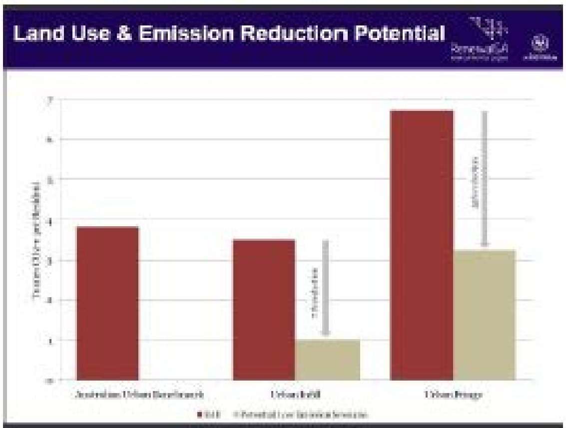

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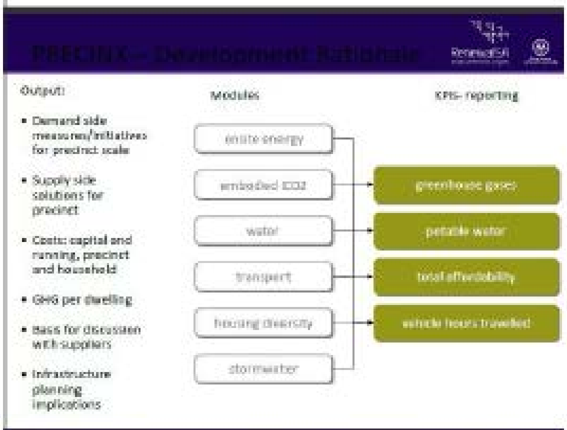

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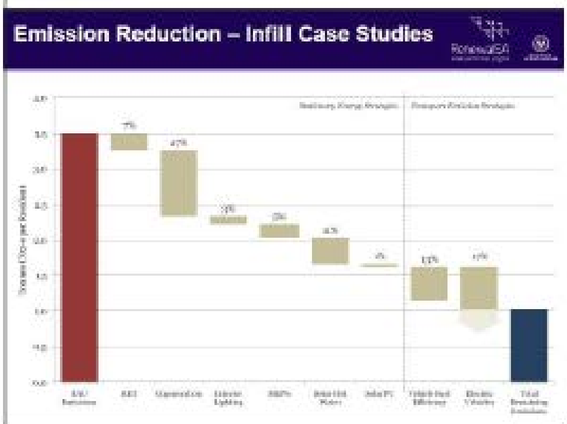

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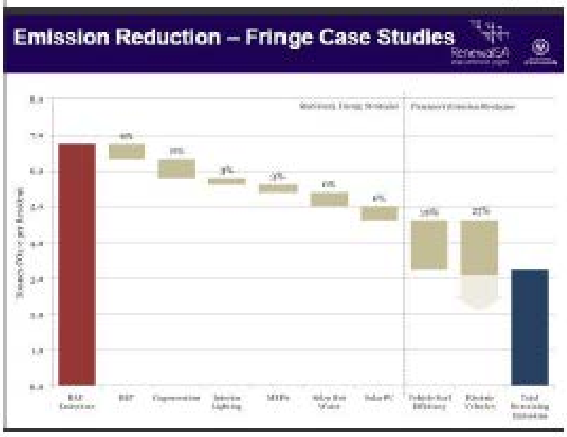

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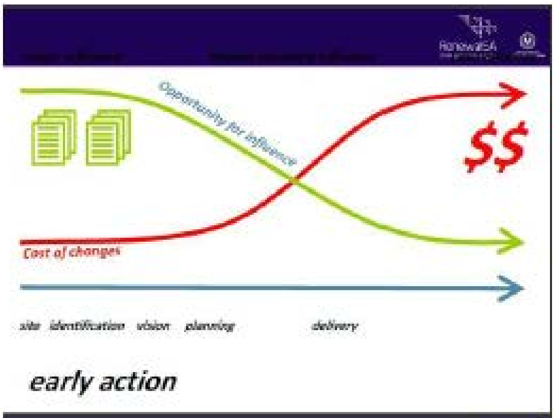

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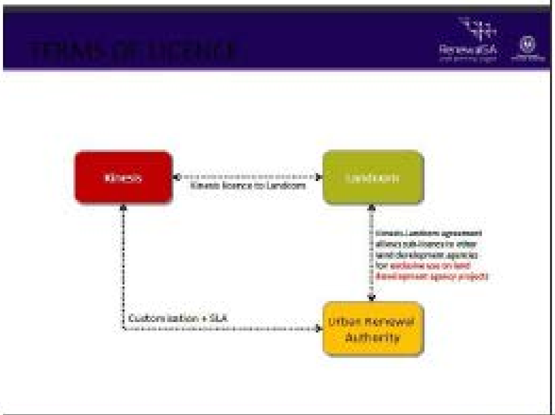

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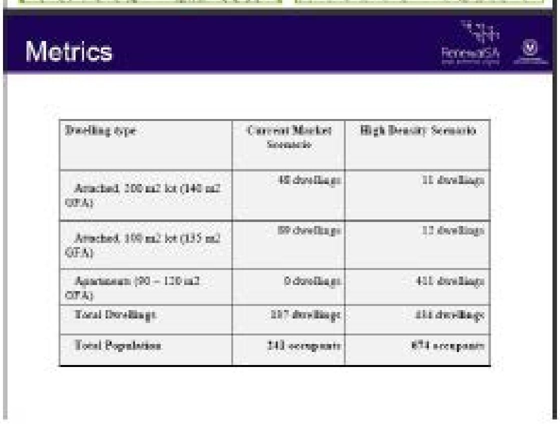

Dwelling type	Current Market Scenario	High Density Scenario
Attached, 200 m2 lot (140 m2 GFA)	48 dwellings	11 dwellings
Attached, 100 m2 lot (135 m2 GFA)	89 dwellings	12 dwellings
Apartments (90 – 120 m2 GFA)	0 dwellings	411 dwellings
Total Dwellings	137 dwellings	434 dwellings
Total Population	243 occupants	874 occupants

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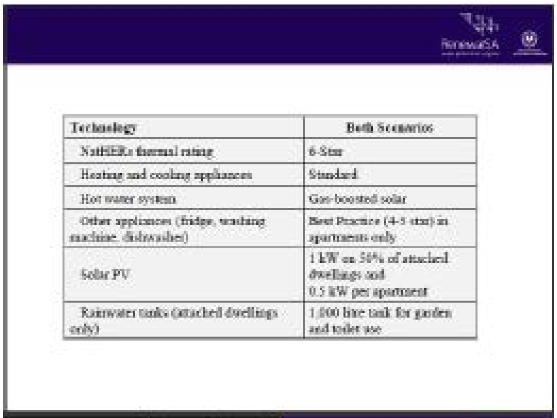

Technology	Both Scenarios
NatHERs thermal rating	6-Star
Heating and cooling appliances	Standard
Hot water system	Gas-boosted solar
Other appliances (fridge, washing machine, dishwasher)	Best Practice (4-5 star) in apartments only
Solar PV	1 kW on 50% of attached dwellings and 0.5 kW per apartment
Rainwater tanks (attached dwellings only)	1,000 litre tank for garden and toilet use

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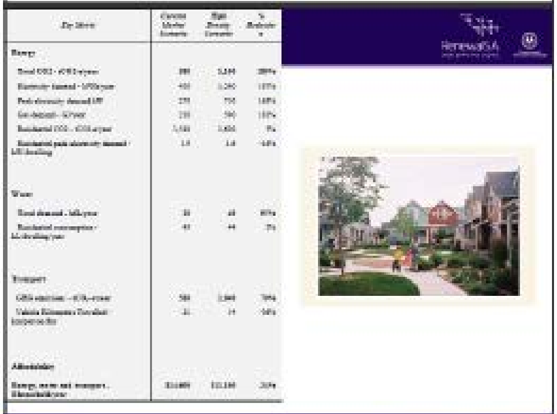

Key Metric	Current Market Scenario	High Density Scenario	% Reduction
Energy			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Water			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Transport			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Affordability			
[illegible]	[illegible]	[illegible]	[illegible]

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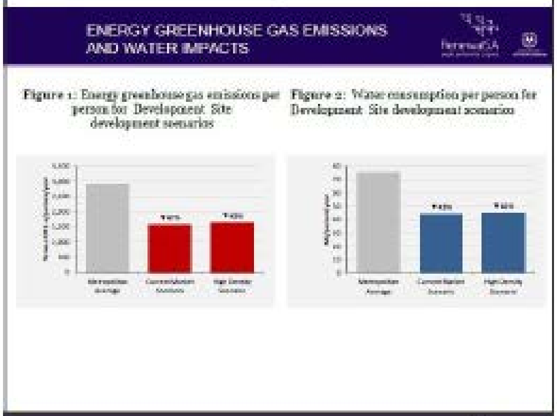

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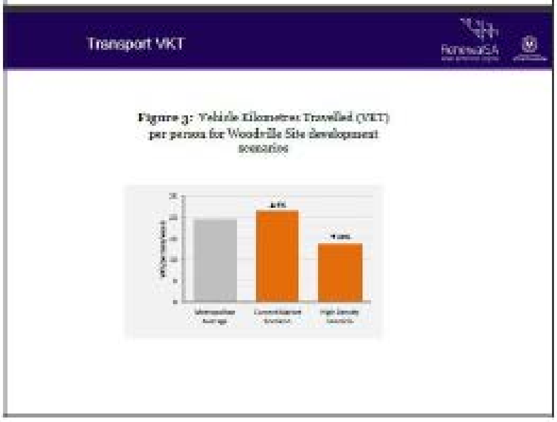

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Reconciling commercial and sustainability tensions for low carbon living

Adopting a systems approach
- Planning and designing at a precinct, neighbourhood and building scale. based on evidence – agreed metrics
- Assessing feasibility of projects and initiatives that includes triple bottom line assessment.
- Adopting whole of life cycle costing approaches.
- Assessing alternative and integrated sources of water , energy and waste infrastructure models (TRANSPORT)

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A Practitioners View

Tool - Needs

Able to provide common metrics that can inform multiple uses in other tools - collaboration not competition

Must link and take note of industry needs re realities of planning and development

Sensitivity to different scenarios and have scalability

Must have benchmarks across a range of development and building types

Must link to database and assessment processes that enable cumulative pre and post assessment i.e. ability to create evidence of value re GGE avoidance related to scenarios

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A Practitioners View

Tool - Needs

Behaviour change - Industry issues – community

Make it easy
- Seamless –technology as an enabler
- Instant feedback individual
- Instant feedback Precinct scale

•Be clear about materiality issues - value for money options

•Understand market and the development industry – demonstrate pathway – forward

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- Lets not re- invent the wheel
- Provide mechanisms for open sharing and collaboration
- Engage consultant industry
- Marketing benefits though industry partners

RenewalSA people partnerships progress

Government of South Australia

Ground truth across industry who are not necessarily partners