



A conversation about energy futures for remote Australian communities – theory and detailed workshop findings

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Shortened forms

ALEC	Arid Lands Environment Centre
CAT	Centre for Appropriate Technology
CCS	Carbon Capture and Storage
CEFC	Clean Energy Finance Corporation
CLC	Central Land Council
DKA	Desert Knowledge Australia
NatHERS	Nationwide House Energy Rating Scheme
PWC	Power and Water Corporation
RE	renewable energy
RET	Renewable Energy Target

1. Introduction

Over the next several decades Australia will face energy-related challenges and opportunities. Anticipated challenges include commodity price increases (such as the 2014 increase in the natural gas price) and temperature extremes that will require more energy to cope with them (such as heat waves in Central Australia). Yet we can expect opportunities for improved energy systems, such as an increasing participation of rooftop solar consumers, affordability of renewable energy as well as technological improvements in energy use for transport and appliances. Many such challenges and opportunities remain poorly understood at the level of specific regions and communities, such as for remote Australia. Taking into account future uncertainties, this research sought to develop a collaborative understanding of how alternative energy-related practices may impact on the future liveability of selected communities in remote Australia, focusing on housing and transport. By collaborative understanding, we mean understanding that emerges from a participatory research process.

We developed a methodology that is effective in assisting a range of planners, policymakers and community representatives working in cross-cultural settings in remote Australia to collaborate around issues related to energy futures. Through the collaborative process, participants identified existing energy-related innovations in remote Australia and, together with the researchers, explored additional innovations that may be feasible so that efforts to enhance the future energy systems in remote Australia are well informed of existing and possible options. The research also produced consensus-based policy recommendations.

This paper contains lightly edited notes that summarise discussions during two workshops, focused on housing and transport respectively, conducted in May 2014 (see Foran et al. 2015, p. 10 for the workshop agenda). It integrates material used to stimulate discussion at the workshops, as well as preliminary interpretations by the research team. A final section places the May 2014 workshops into the wider context of conversations in Australia around climate adaptation and energy futures.

The workshops had the following specific objectives:

1. To understand participants' thoughts and preferences with respect to energy-related housing and transport practices that are important for remote Australia (both in the present and considering a set of future scenarios)
2. To learn more about participants' experiences related to the above topics
3. To seek content and process recommendations that might support ongoing dialogue and collaboration among interested participants (including processes appropriate for smaller remote communities).

The workshop invited designers, builders, planners, policy advisors and residents interested in long-term planning and policymaking processes for housing. The aim was to begin a structured conversation that may help people in remote Australian communities better understand, and prepare for, future challenges and opportunities at the interface between housing and energy and between transport and energy.

Sections 2 to 6 of this document summarise issues and discussion based on the 13 May 2014 housing workshop. Section 7 summarises discussion from the 15 May transport workshop.

2. Exploring energy-related practices and innovations: presentation and discussion

2.1 Summary of presentation

The workshop was framed by a set of concepts that are embedded in, or may be useful to address, the project's research questions (see Figure 1) and its purpose statement, which was:

Taking into account future uncertainties, we want to develop a collaborative understanding of how alternative energy-related practices may impact on the future liveability of selected communities in remote Australia, focusing on housing, enterprises and mobility.

The concepts introduced included:

- practices, including alternative or innovative practices
- innovation
- societal arrangements (regimes) for provision of goods such as housing and electricity
- alternative futures.

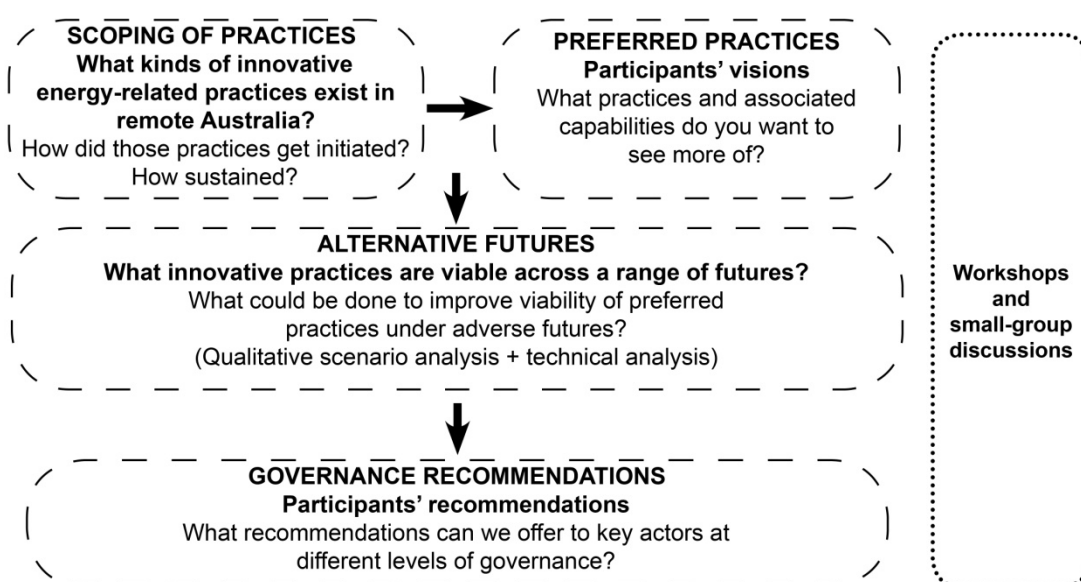


Figure 1: Project design

Source: Editors

Practices: The project seeks to improve understanding about the history and future prospects of meaningful, inspiring and innovative practices. By ‘practices’, we mean the combination of common understandings (e.g. what is a need, what is a luxury), material infrastructures (e.g. timber, brick veneer, sealed roads, central grid-supplied electricity) and practical knowledge (e.g. the knowledge that an architect has about what designs will or will not be commercially viable) (Strengers & Maller 2011).

Innovation: Innovation often gets confused with invention. An ‘invention’ refers essentially to the discovery or creation of something new to the world, for example, a new technical or scientific idea or concept. ‘Innovation’, by contrast, focuses on discovery or learning that is new to a particular group of people (World Bank 2012). Innovation is particularly relevant to remote Australia because the region is distant from many markets and centres of power and possibly from dominant rules and practices. This puts

a premium on local technical and social innovations to address problems that mainstream approaches may fail to resolve (Stafford Smith and Cribb 2009).

Many examples of innovative practices exist in remote Australia (see Table A 1 in Appendix A). These include installation of solar photovoltaic (PV) systems through Alice Solar City initiative; energy efficiency and thermal comfort retrofitting for housing led by Tangentyere Housing; Bushlight's community energy planning methods and renewable energy systems; and the 'Earthship' self-build housing movement, which originated in New Mexico. We noted that the self-build housing movement and voluntary social networks (such as networks of Aboriginal Art Centres, e.g. Figure 5) are examples of 'grassroots innovation', which is not fundamentally driven by profit-seeking but rather by voluntary exchanges based on particular ideals or interpretations. In concrete terms, this involves voluntary exchanges of labour, knowledge and services, often centred on a particular community of place, in whose economic and social wellbeing residents choose to invest. We flagged our interest in learning more about cases of grassroots innovation in remote Australia. How have grassroots sustainability innovations emerged; how are they sustained? We showed a diagram from Hekkert et al. (2007) that proposes a general model of market-oriented innovation (Figure 2). The diagram has two feedback loops, a left-hand loop involving practice development and diffusion through networks and a right-hand loop involving policy advocacy leading to market formation. The project sought to understand the extent to which this conceptualisation captures the dynamics of grassroots sustainability innovation.

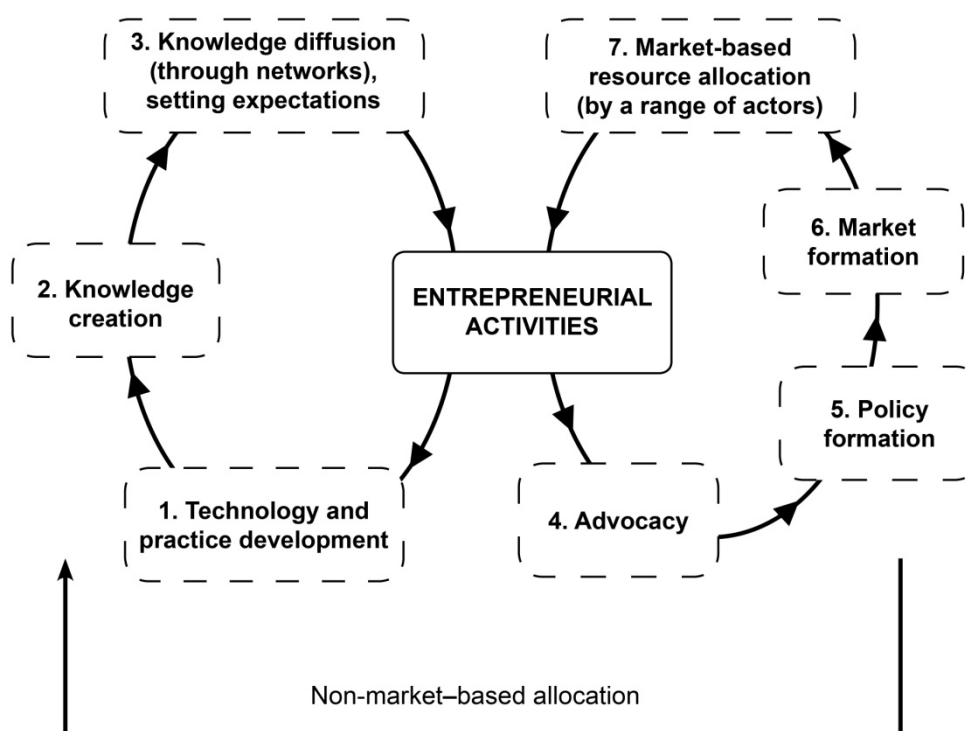


Figure 2: One perspective on entrepreneurial dynamics

Source: Authors, adapted from Hekkert et al. (2007)

Regime of provisioning: When we talk about energy systems (or food, water or housing, for that matter) people commonly talk about markets (e.g. the National Electricity Market) and they talk about supply chains. In this project we use a more general framework, which we call a regime of provisioning (Figure 3), which can be understood as the societal arrangements for provision of a particular good, such as housing or electricity (Foran 2015). We used this framework to help understand:

- how technology, organisations and labour power are socially organised to construct particular kinds of dwellings
- similarly, how energy is socially and technically sourced and transformed to get from the source to the home.

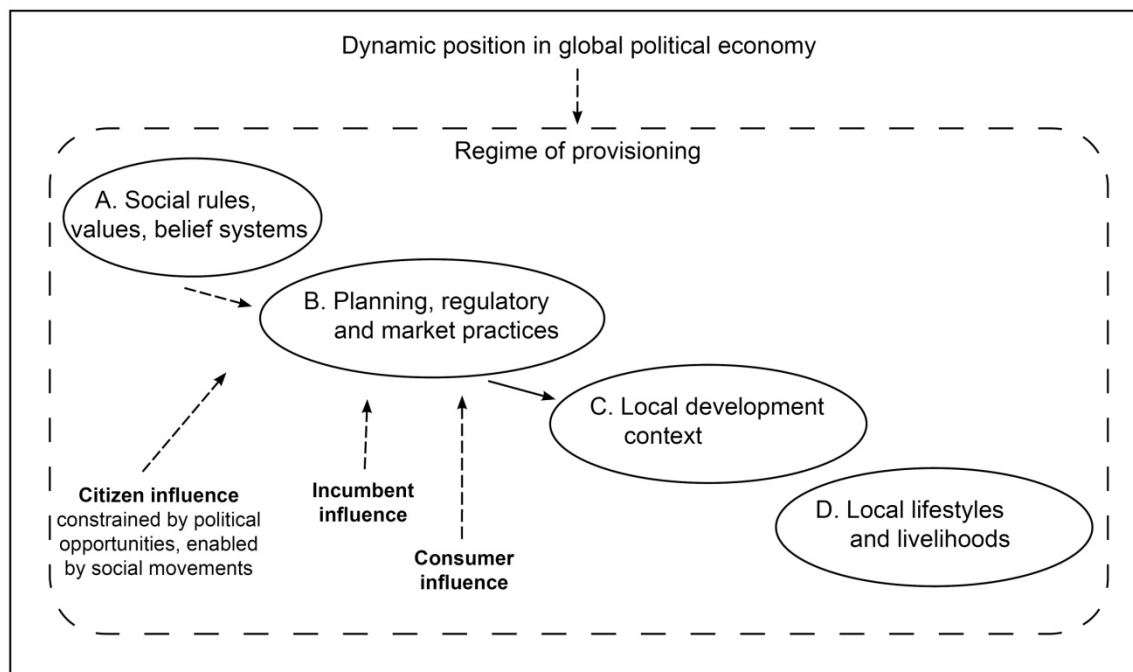


Figure 3: Regime of provisioning

Source: Authors

The top left-hand side of Figure 3 represents generalised values and beliefs in a society. For example, in Australia (and other affluent societies) individual privacy and convenience are highly valued, influencing the popularity of low-density settlements dominated by single homes, and automobile transport (Filion 2010). The middle of the figure emphasises sector-specific rules and processes, for example, urban planning processes, housing energy efficiency standards (e.g. NatHERS) and business models, such as the rate-based model for regulated energy organisations (where an organisation is allowed a particular rate of return on approved investments, such as poles and wires).

These practices resonate with more generalised values. Regimes thus have a considerable amount of structure and path dependency. However, they evolve as forces from the global or national economy, as well as having society impact on them. For example, they evolve under the strategic influence of local business and political leaders, consumers and citizens.

Alternative futures: There are two complementary but distinct ways to think about how the future may unfold: through visioning and through structured scenario-building approaches. By ‘visioning’, we refer to imagined future outcomes that people attach importance to. People regard some of these outcomes (e.g. objectives, aspirations, goals) positively and wish to see them realised. A vision can also include outcomes that people explicitly wish to avoid (Figures 4–5).

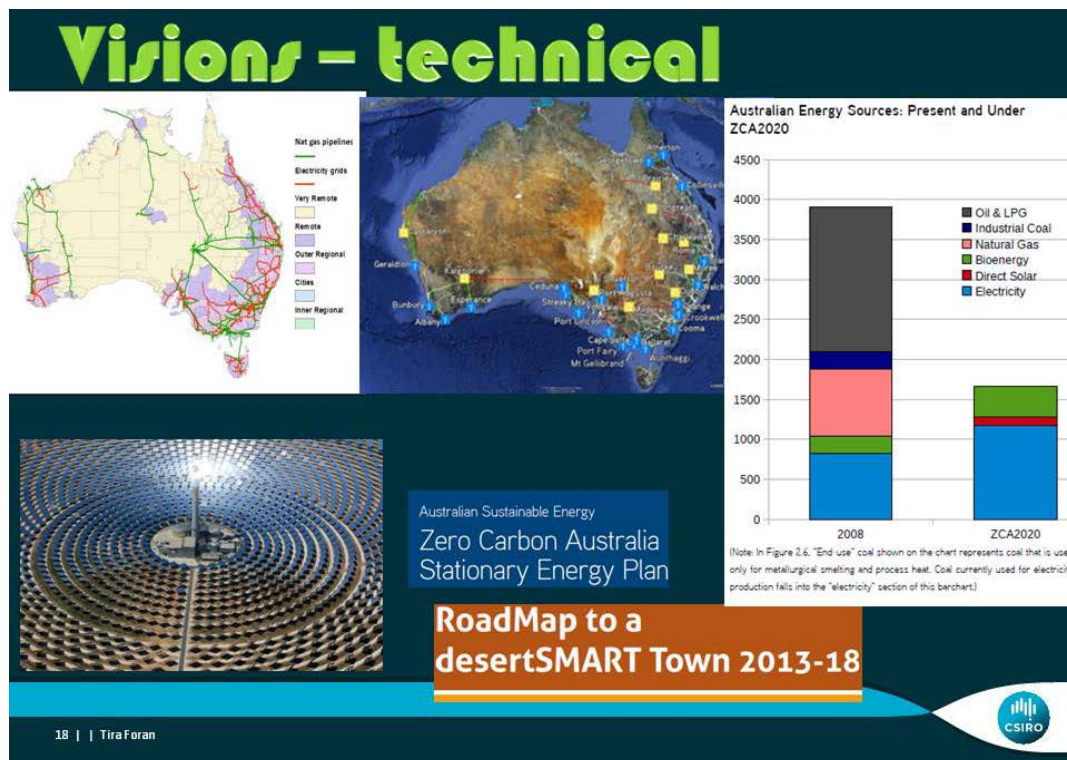


Figure 4: Examples of technically oriented visions

Source: Authors, based on images: Top left from Foran et al. (2014); 'RoadMap to a desertSMART Town 2013-18' from Wright & Hearps (2011), rest from McClean & McHenry (2014)



Figure 5: Examples of socially oriented visions

Source: Authors, based on images (clockwise from top left: DesertSMART CoolMob; NT Arts Infrastructure Projects, Munupi Arts visit (August 2009); Social network, Lejano, Ingram & Ingram (2013); Warakurna Art Centre (T. Acker)

A scenario can be defined as plausible and often simplified descriptions of how the future may unfold based on a coherent set of assumptions about key driving forces, their relationships and their implications (Henrichs et al. 2010, p. 152). Driving forces are issues or factors that have an influence on the system and that are usually out of the short-term control of the scenario builder. Once a set of outcomes (e.g. levels of a particular indicator) has been chosen for a number of critical ‘driving forces’, the framework of a future world exists. Scenario builders can then create storylines that explore in more detail what life looks like in a particular framework (Foran et al. 2013).

Scenario thinking is a craft as much as a science. The idea is not to predict the future, but to learn from the contrast between different imagined future worlds. Some of the learning could involve practices (things that make sense to do) regardless of what future holds. People involved in scenario approaches could also be learning about each other’s values and beliefs.

Examples of technically oriented energy visions include Zero Carbon Australia (Wright & Hearps 2011) and desertSMART COOLmob’s *RoadMap to a desertSMART Town 2013–18* (McClean & McHenry 2014). *RoadMap*, for instance, envisions that 100% of electricity in Alice Springs is generated from clean, renewable resources. A proportion of electricity generation is distributed (from community-based or individual systems). At the same time, all residents in Alice Springs – including vulnerable people and those on low incomes – can afford electricity for basic needs.

We also emphasise the importance of creating social visions as suggested by networks of Aboriginal and Torres Strait Islander community artists.

2.2 Summary of discussion

This section provides an initial analysis of the multi-topic discussion that flowed from the opening presentation. We interpreted the discussion according to the dynamics of innovation (Figure 2) and the different components of the regime of provisioning (Figure 3).

Table 1: First plenary discussion: summary and initial interpretation

Topic / Summary of discussion	Research team interpretation
Dynamics of change and stability	
<i>Regulation is the wrong place for driving innovation.</i>	Regulation reflects the outcome of contestation between incumbent actors and challengers, such as consumer organisations or citizen advocacy. Figure 2 argues that advocacy and practice development drive innovation. Figure 3 reminds us that dominant conventions limit change.
<i>Information about energy consumption should be available when buying and selling a house; having informed consumers is an ideal of capitalism. Hoping that if people see that if operational energy costs of house A are greater than house B, we will start to get change. That’s a role for regulation: requiring that information be available.</i>	This statement is a thoughtful example of policy advocacy.
Collaborative governance: tensions and prospects	
<i>With respect to ‘collaboration’: need Commonwealth and Territory governments to be part. We have elements that are going in completely different directions. Need government decision makers here at the table.</i> <i>It’s very easy for like-minded people to agree and collaborate.</i>	Collaborative dialogue requires willingness to listen to argument and reach a mutual understanding. Can this project encourage incumbent actors to engage in dialogue around, for example, the need for stronger regulation

Topic / Summary of discussion	Research team interpretation
<i>Where are the builders and real estate agents? Not surprising they are not here.</i> <i>Builders, product manufacturers, and renewable energy agents also need to increase their awareness (not just the consumer).</i> <i>The future is something quite different. The other stakeholders not here are completely stuck in the mundane and have no time to think about futures.</i> <i>We need to challenge this model of the greedy developer. Development has to survive as a commercial entity; there is a crop of younger developers who are interested in sustainable design; there are other ways to bring people into dialogue.</i> <i>Housing issues are big in the NT; recommendations to 'policy' makers is one path to impact, but other paths exist. We want to address the big picture questions and challenges, but they can't (all) be addressed at the same scale. Perhaps the objective should be to inform a small community.</i>	around energy efficiency? Are the drivers of collaboration (see above) present at this point in time? A historical understanding of policy formulation around building standards in NT would be helpful. More reflection is needed on the project's path to impact, including what level/s of governance to focus on.
Affordability	
<i>A portion of the market in Alice Springs could afford higher upfront costs (for climate-adapted housing). Politicians want to keep housing costs down to keep it affordable. Bottom line is the cost of housing now. For commercial buildings it's different: upfront cost is not the largest cost, that's maintenance. Education and awareness raising are important.</i>	This statement reminds us of the importance of social values: here the value is affordability in the present day.
<i>Increased cost of energy could be a driver of sustainability. Long-term processes, such as the impact of increased tariffs by Power and Water Corporation (PWC) will change real costs. The 2014 Federal budget speech (coincidentally delivered on 13 May after the workshop) matters less by comparison.</i> <i>Budget could prove to be a really good catalyst for innovation if it is austere.</i> <i>In the last couple of years, government speak has shifted from price parity to price reflective of energy costs in remote Australia. Need to take into account equity issues.</i>	These statements reflect the fact that tensions exist between different spheres of the political economy (e.g. between cost of housing and energy relative to wages; between the natural environment, which is warming, and mental conceptions of how to provision energy efficiently). Such tensions put pressure on a particular regime of provisioning to evolve.
Meeting diverse needs and aspirations, especially for Aboriginal and Torres Strait Islander people	
<i>What about Aboriginal and Torres Strait Islander people – how are they being understood? Our model of knowledge making needs to actually result in collaborative understanding. Need to go beyond a particular knowledge paradigm. How to create different kinds of spaces?</i>	Conventional modes of research with Aboriginal and Torres Strait Islander people may not be sufficient to deliver the sophisticated mutual understandings required.
<i>Aboriginal and Torres Strait Islander people may move into town because it's so expensive to live out bush. Food, fuel and power are already expensive. So why build housing out bush? There are plans to build more housing in town, where there's housing overcrowding already.</i> <i>But where is the promised housing development in town? (One is going ahead via private means.)</i> <i>Different groups have different cultural preferences for housing. For example, in one community, young folk like living together in a dorm situation. In another, they like living together in separate family groups.</i> <i>Engagement and consultation have been done. What other ways are there to engage the different groups, ways that work for them? They may not be prepared to sit around the table in this format. Small group follow-up?</i>	At what point will cost of living pressures out bush put pressure on the urban housing regime in Alice Springs to evolve? How adequate is the private sector development for meeting the needs of Aboriginal and Torres Strait Islander people? What changes are needed in order for the housing regime to deliver more diversity in dwelling forms? One objective of the project is to develop more effective collaborative research techniques.

Topic / Summary of discussion	Research team interpretation
Specific meaningful practices, behaviour and lifestyles	
<i>Retrofitting is important, and there's lots of potential to improve our understanding of it.</i> <i>How a user operates and interacts with a house matters; we cannot assume a house designed to be cool will be operated according to design.</i> <i>What level of intervention should be made once the house is up and running?</i> <i>Different social constructions of liveability exist and aspirations matter, yet conventional images of housing dominate.</i>	Perhaps our understanding is less developed because retrofitting, although a large industry, has less media visibility and public status compared to new home construction. Example of a potential regime failure, where people are losing energy, perhaps as a result of the strength of dominant values (freedom, privacy)? Reminder of importance of social values.

Source: Editors, based on plenary discussion

3. Energy-related housing practices that support liveability

The goal of this session was to identify practices that workshop participants considered meaningful and to document the reasoning and discussion around such practices. The discussions were held in groups of 5–6 people to encourage participation. To stimulate the discussion, we first circulated a list of potentially innovative practices to the participants, as well as a set of indicators of sustainable consumption (see Tables A 1 and A 2 in Appendix A). We asked people to nominate additional practices if they wished, then to take turns discussing why a particular practice is meaningful. We then asked groups to focus on a subset of practices to discuss in more detail. Participants were invited to consider questions such as: How and when was the practice initiated? Who was involved? How was it sustained? What was the importance of advocacy, entrepreneurship, government support and market pull? We found that the number of relevant questions exceeded the capacity of a small discussion group to address them in the allotted time. For valued practices, this indicates a need for follow-up interviews with expert informants.

Table 2: Practices considered meaningful

Practice	Reason it's considered meaningful	Issues
COOLmob (a social network example of a grass-roots innovative practice)	Long-running liveability program that influenced the Alice Solar City initiative Notes: Started 2001 as an initiative of Arid Lands Environment Centre (ALEC) and Desert Knowledge Australia (DKA) with Federal Government money, then NT Government (from 2002) has continued to this financial year. Initially concerned with energy and water, then it expanded to include food and community development 2006 – Energy auditing service available via Alice Solar City Has received targeted grants for RoadMap, bike riding, composting, low-income energy efficiency	COOLmob has struggled to retain core funding
RoadMap to a desertSMART Town 2013–18 (McClean and McHenry 2014)	Because it's a collective vision and people can achieve it It picked up on issues for which no-one had responsibility in 2005; now somebody does. Comes out as: 'Well, why can't we do it here?' Often a challenge, because it has to be government-led (who in government leads?) and then the standard questions come up Cost–benefit analysis, time frame [*]	Uncertain how strongly the RoadMap is supported by key organisations and within community [*]

Practice	Reason it's considered meaningful	Issues
Alice Solar City	Mobilisation of resources (\$60 M between Federal, State and private sector partners, ended 30/6/13) Increased the profile of PV stations (e.g. Uterne)	Potential rebound effect in power consumption Lack of strong vision to continue program, despite efforts to lobby government to continue funding. Tail-end funding is needed to work on scaling out, innovation
Increasing residential density closer to central business district (CBD)	Reduce transport energy consumption Increase efficiency of urban space Affordability [*] Granny flats offer a detached dwelling option	Access to open space for residents in high-density housing
Bushlight (an institutional example of an innovative practice)	A response to a very specific need Innovative in that it can occur through constraints Familiar The awareness generated	Uncertainty about ongoing funding
Energy and water efficiency retrofits and awareness	Smart water meters (a program of Power and Water Corporation) and energy meters (trial component of Alice Solar City [ASC]) Water meters important because of prevalence of leaks in system; identifies where leaks are occurring Power cards increase end-user awareness (a component of Tangentyere Council's energy efficiency [EE] retrofit project funded by ASC)	Efficiency does not necessarily mean low cost Technical capacity: few contractors Scaling issues with political decisions made in large scales [*] Lack of local regulation based on practicality; just guidelines (governance type in NT) [*] Some disputes over retrofit priorities
Behavioural changes	Some people joined ASC and got a solar split system; by contrast, other practices led to not needing the split system, e.g. painted roof white, installed blinds, used windows appropriately [*]	Importance of practical knowledge and interest as a prerequisite for change [*]
White roofs (ALEC)	Practice should (in theory) reduce energy consumption	Very difficult to evaluate impacts; peoples' perceptions differ from evaluation of subsidy cost recovery models Implies specific behaviour
Adelaide House	Stone building with passive cooling design Does not need cooling in summer Summer cooling is independent of occupant behaviour	Historical building – stone/brick construction is very labour intensive compared with current practice in Central Australia
Green Well Building (Government) Sue Dugdale	Inspiring: 5-star energy rating was achieved mostly through passive means	
Publicly accessible buildings providing cooling	Equitable and efficient way to provide thermal comfort	Participants thought the concept interesting but worried about implications (e.g. retail centres)
The research approach used for Staying Cool (Horne et al. 2013)	The research captures and is based on everyday practice. Research was conducted in very remote communities and findings are authentic. The research process was attuned to understanding peoples' behaviour through understanding their own underlying rationales	

Practice	Reason it's considered meaningful	Issues
Programs of the NT that enable Aboriginal and Torres Strait Islander people to organise themselves in ways that work for them, in terms of their own identity	Interculturally recognisable and provide legitimacy in both worlds Social acceptance is a key motivator, and the converse is also true, e.g. housing style/type Success is dependent on the person who does the intercultural brokerage work and the social process by which it's made meaningful, e.g. some excellent CDEP examples	How innovation arrives is critical to how it's picked up, e.g. 'God dropped a building' doesn't work because there's no ownership. Maybe the reaction changes over time though?

Source: Editors, based on group discussions

[*] a topic that deserves follow-up enquiry

3.1 Notes from discussion

1. **Alice Solar City initiative:** Some considered the ASC program meaningful (e.g. it mobilised \$60 million); others thought that the big idea or the 'alluring scheme' was not enough; people also needed to change habits. ASC led to an increase in PV installation, which resulted in a rebound effect (electricity consumption increased); this is a perverse outcome. Electricity consumption has also increased due to increased air-conditioner penetration; the ASC program – at best – would have moderated the rate of increase.

Other group members felt the initiative was still important because of context: power tariff increase in last 12 months; some signals of increasing off-peak consumption; PWC according to some group members has previously been a sceptic of grid-connected solar PV (citing its recent investment in gas turbines¹).[*]²

Related practices people wanted to explore: how building owners could become electricity generators; how to lower restrictions on decentralised power; and water treatment.

2. **Denser development (e.g. townhouses)** Background: some hotels/motels have been converted to residential living. This makes sense, in order to increase residential living in Alice Springs CBD and affordable accommodation in town. Example was given of a 75-home scheme that included design to optimise the site, providing open space amenities.
3. **Kilgariff sub-division:** Initially this was identified as an eco-suburb with features involving use of recycled water, with potential for promoting new ways of living with higher energy and water efficiency.
However, when built, block sizes were large (~900 m²) which was framed as 'meeting market demand'. Recycled water was used for irrigation but not delivered to house blocks. The division is low density and distant from services (power, water, sewer).
4. **Innovation and diffusion:** Timing is important; people are more receptive to a new practice in one context than in another. Take advantage of changes in the context that lead to people becoming more receptive. There needs to be a focus on how an innovation radiates/percolates between people who are innovating and their networks. Scale: it's small, incremental, behavioural.
5. There is a need for **alternative housing models for Aboriginal and Torres Strait Islander people**, partly to meet demand from people moving to town. Models that are available are town camps and

¹ In October 2014, Indigenous Essential Services (subsidiary of PWC) was awarded \$55 million by the Australian Renewable Energy Authority and NT Government to install PV systems in 30 remote (off-grid) communities.

² [*] a topic that deserves follow-up enquiry

detached houses for suburban middle class. Models that are not available are denser housing, aged care for communities, larger open living areas (kitchen, dining and living areas important) and humpies. Context matters: issues of segregation and failures in the real estate market were flagged.[*] Generational differences also matter: younger people may be open to denser accommodation such as flats; however, affordability is key. Older people prefer extended family groups. Younger people's voices are more evident than those of older people. Understanding how and why people use space is important: in Arnhem Land, sitting outside is also about seeing the world go past (i.e. not just about keeping cool). Need to cater for high population mobility across Central Australia. Modularising is an option, but a feasible implementation model doesn't currently exist (e.g. container housing [*]).

4. Energy-related futures for Australia: presentation and discussion

4.1 Summary of presentation

The presentation began with a summary of existing energy-related visions (Table A 3 in Appendix A). We then introduced the uncertain driving forces that were used to motivate two separate energy scenario studies conducted in Australia (Figure 6).

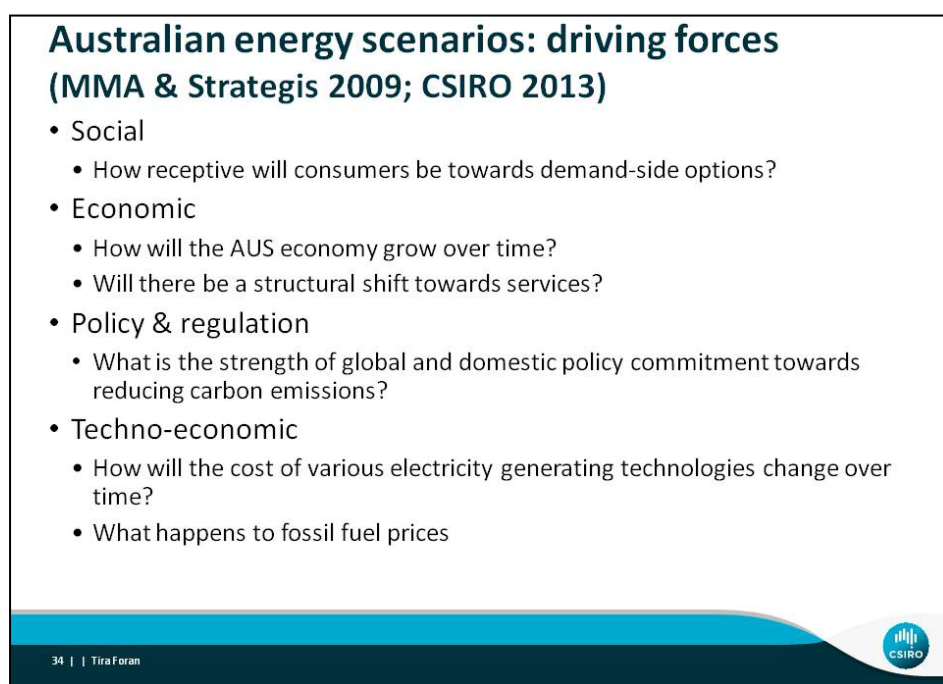


Figure 6: Driving forces in two Australian energy scenario studies

Source: Authors

We showed participants the framework used in the study by MMA & Strategis (2009). We then introduced a simple set of driving forces and a framework to explore housing system futures in Alice Springs:

- Social: what are the prospects for grassroots innovation? LOW vs. HIGH
- Economic: how will the national and local economy grow over time? LOW vs. MODERATE

- Policy and regulation: What is the strength of national and local policy commitment towards energy-efficient building standards? LOW vs. HIGH

We then showed how this combination of three driving forces can produce eight distinct scenarios, and we suggested that looking at a subset of contrasting scenarios provides insight into the importance of distinct driving forces, such as grassroots innovation.

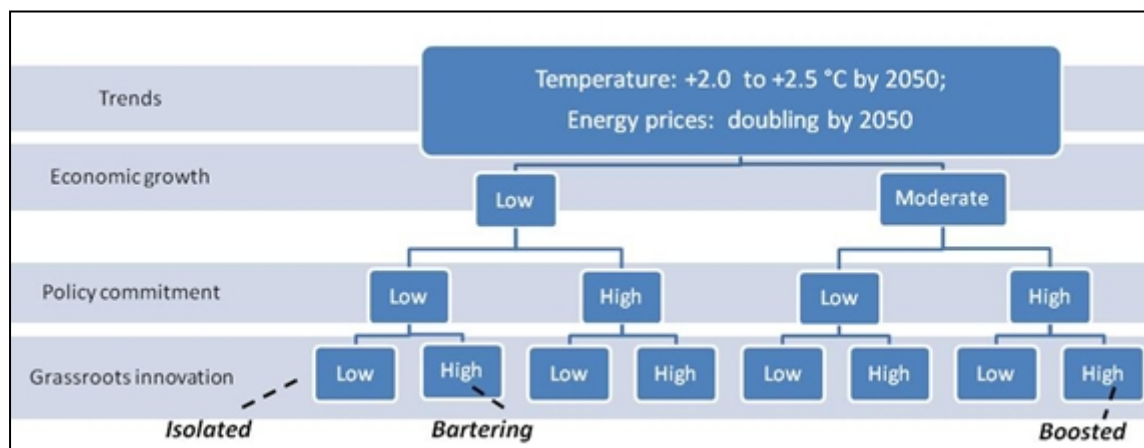


Figure 7: A scenario framework for housing design futures

Note: energy price increases based on CSIRO (2013)³

Source: Research team

In this framework, ‘policy commitment’ refers to the level of support for climate-adapted housing design as expressed in various rules (legislation, regulations, standards) as well as financial incentives associated with such policies. ‘Grassroots innovation’ refers to solutions not organised through commercial markets or government, but through bottom-up, community-based initiatives. Such innovation is driven by particular social values, which may include localisation (increased self-reliance), community building and environmental sustainability (e.g. through reduced carbon and water consumption).

Storylines: In 2050, houses built in 2000 are fifty years old, reaching the end of their physical lifetime. How they get renovated or rebuilt varies by scenario, with eight scenarios possible. In this framework, values such as ‘high’, ‘low’ and ‘moderate’ describe conditions in Alice Springs in the year 2050. To visualise three possible scenarios:

1. **Isolated** represents a future microcosm in which economic growth is slow, grassroots innovation is low and policy commitment to climate-adapted housing is also low. In this future world, imagine that ‘low’ policy commitment means that all new or renovated houses in 2050 must attain an energy efficiency rating that is equivalent to 7 stars in 2010 terms (84 MJ/m²/yr; NatHERS 2010). In today’s climate such a rating might be achieved by installing R2.0 insulation to external wall cavities, R4.0 insulation to the ceiling, R1.5 insulation to the floor edges and weather strips or seals to windows. However, in the 2.5°C warmer climate of 2050, such houses require an additional approximately 100 MJ/m²/yr for annual heating and cooling (Wang et al. 2010), making their total consumption (182

³ In 2012, the average household regulated tariff was approximately 25 c/kWh (2013 AUD). In the CSIRO (2013) scenarios, this increases to approximately 30 c/kWh in 2030 and 48–50 c/kWh in 2050 (CSIRO 2013, Fig. 22). Precisely how big the increase is depends on assumptions about self-generation. In some scenarios, the assumed 37% increase in real wages is not enough to offset increases in electricity bills (CSIRO 2013, p. 46).

MJ/m²/yr) equivalent to the performance of a 4–4.5 star house today.

Low grassroots innovation means that few people have the knowledge and networks to access alternative housing designs that may be more affordable and comfortable. The slow economy means little competition in the local home-building industry. Builders continue to provide houses that are relatively expensive and often poorly constructed and that require air conditioning. Lack of support for expanded community cooling facilities puts pressure on existing libraries, swimming pools and shopping centres. Social conflicts and tensions are managed with a reactive, law-and-order approach, and the town's public image is poor.

2. **Bartering**, by contrast, presents a microcosm in which people have come together out of frustration with the conventional economy and the housing industry to develop their own low-tech solutions and associated social innovations. In 2050, several hundred houses built with alternative designs and materials (rammed earth, used tires) exist. People pool their labour to get houses built. Some of the residences that are built follow a co-housing model, which features common kitchen and laundry facilities, as well as garden space. The houses built are not always compliant with building codes and Council regulations, but the poor economy means that the will to enforce such regulations varies according to the government in office. Lack of policy commitment, however, means that private and public housing tenants continue to suffer thermal stress. The interiors of conventional homes are frequently uninhabitable for low-income tenants, putting a premium on shaded outdoors spaces. Social tensions are similar to **Isolated**.
3. In 2050, a stronger economy, clear policy commitment and grassroots innovation feature in the world of **Boosted**. New houses must meet an energy efficiency rating that is equivalent to 10 stars (in today's terms). The NT Government supports a sophisticated home energy audit service and offers a generous rebate scheme for energy efficiency renovations based on audit recommendations. It offers zero interest loans, which are repaid through consumer power bills or employee direct debit arrangements. High grassroots innovation and policy support for such innovation mean that two new residential estates have even been developed with no centrally supplied power utilities. Houses in these estates are designed to use passive heating and cooling principles; they generate all of their power requirements using solar PV panels. Notwithstanding the above social and technical changes, however, everyday life presents many challenges for people unable to access the services provided by housing innovation networks.

4.2 Household model

David Fleming showed work in progress around a spreadsheet tool to analyse energy-related expenses as a share of household income. The purpose of the tool is to explore the impact on average household budgets of changes to energy prices, on the one hand, and changes to incomes, on the other hand, under different future scenarios. This can be explored over time and across the different regions of Australia.

Energy-related expenses include fuel for operating vehicles and dwelling-related energy (gas and electricity tariffs). They also include capital equipment expenses. The work in progress has focused on operational energy expenses. Household income data were sourced from the Australian Bureau of Statistics (ABS) and petrol prices from the Australian Automobile Association. In 2011, median income in very remote regions of Australia was 25% lower than in cities, while average petrol prices were 8.6% higher (Fleming 2014, Slide 7).

Comparing Very Remote, Remote, and Outer Regional Australia, results (from the ABS Household Energy Consumption Survey [HECS]) show that median household energy consumption is highest in Very Remote regions, followed by Outer Regional, followed by Remote (ibid. Slide 9).

4.3 Plenary discussion

- The HECS survey shows increasing onsite generation in Very Remote zones; non-generating households have decreased their electricity consumption in the period 2010–2012
- There has been a significant increase in onsite generation in the period 2010–2012 in all regions
- Energy for pumping water should also be considered as part of household energy; also, air travel should be considered as it is ~10% of income and ~20% of household energy
- High energy consumption, e.g. 24 kWh/day, is observed in Alice Springs. Incomes are higher too.
- PWC has annual household electricity consumption data on their website.

5. Implications of alternative futures for innovative energy related practices

The purpose of this experimental session was to understand how alternative futures might impact on practices previously identified by participants as meaningful (see section 3). They were then invited to choose at least one of the future storylines, either from MMA & Strategis (2009 and described in Appendix A, Table A 4) or the housing futures draft storylines created by the research team. Participants were invited to discuss questions such as:

- In futures that appear favourable (or unfavourable) to a practice, what specific aspects of that future are favourable (or unfavourable)?
- What is the scope of the practice in terms of geographic scope, and in terms of organisational/institutional support?
- For valued practices, what could be done to improve viability?
- In a given future world, do tensions or contradictions exist that allow niches for alternative practices to emerge?

5.1 Group A Discussion

MMA & Strategis (2009) scenarios	Scenario 2 (Population increase, higher income, lower investment in renewable energy)	Scenario 4 (Lower income, higher oil gas prices)
Energy retrofit	Viable as economic growth and population growth, Western-style attitudes and increased need for energy and consumerism. Energy retrofits mean more efficient use of energy per household, but bigger costs.	Similar to present situation. Less viable as economic growth is low. Lower impact because of high upfront costs. Less subsidies, less retrofit. Favours more innovation in a low-tech way. People are more progressive, so awareness is important. Building codes are essential. Opportunity for educational interventions. Favourable for cooling centres.

5.2 Group B Discussion

1. Some participants were critical of the approach towards discussing the future of innovative practices. All scenarios presented, including grassroots innovation, are ‘whitefella’ scenarios. What would an Aboriginal and Torres Strait Islander model of innovation look like? Research team should sit down with small communities, taking a community-building approach. Need culturally appropriate models of innovation, practice and engagement in Aboriginal and Torres Strait Islander communities. At the same time, need a multicultural/multistakeholder perspective (e.g. Alice Springs population comprises 20% Aboriginal and Torres Strait Islander people; 20% Indian and African people).
2. Local grassroots innovators exist, for example, people experimenting with papercrete-insulated caravans. The story of rammed earth houses hasn’t been documented properly. Several more and less successful attempts at innovation were noted (e.g. in Utopia): contact local experts.
3. In order to get grassroots innovation, need policy support. Service delivery not viable without government support: ‘We’re a government town.’ ‘Isolated’ scenario (Figure 7 above) will eventuate if government support declines. We need to move from ‘Isolated’ to ‘Boosted’ scenario. Need to delve into microprocess issues of how to get more policy support, more funding support.
4. Desert Knowledge Precinct could be a site for demonstration buildings with comparative data on performance, as well as labour hours and other inputs. This could be the basis of a sustainable buildings network. People could visit the site to learn more about the science. Some feel the DKP vision has not been funded adequately. Want a tangible demonstration centre.
5. Discussion of Danielle Every’s flat-pack (‘IKEA’) housing research project in Ceduna and Yalata. Project began with an interest in ‘co-design’ and evolved into research that looks at current housing needs, lifestage, usefulness, in-migration from bush, other infrastructure and visioning (including employment). The project has evolved into an exploration, based on ethnographic research, of housing and housing-related financing options.

In summary, participants in this group had contrasting perspectives on sustaining local innovation: ‘Isolated’ and ‘Bartering’ scenarios (Figure 7 above) were seen as unstable. Need government/policy support (e.g. low economic growth; high policy commitment; high grassroots innovation). A program of community-owned solar farms, funded from mining royalties, is an example of an initiative requiring high levels of government/policy support. On the other hand, small niches exist (e.g. self-build humpies, papercrete-insulated caravans, hydroponics, earth buildings). As one participant put it: ‘Innovators exist who are not waiting for the government to build them a better humpy.’ Need culturally appropriate models of innovation, practice and engagement in Aboriginal and Torres Strait Islander communities.

5.3 Group C Discussion

Smart energy (and water) meters

The discussion was focused on what would encourage the installation of smart energy meters and the use of the data they generated. High energy costs were seen as an incentive to the householder to install and use a smart meter but as a disincentive⁴ to an energy supplier, which relies on energy sales for income. Creative solutions are needed for decoupling retailer income from supply, such as distributed, household-scale generation, with reuse/recycling of the infrastructure (e.g. solar panels) via a supplier. For smart

⁴ There are many considerations involved with the use of smart meters, as they also give energy providers better scope to manage the supply of power to individual households and record power usage from offsite.

meters to be used by householders, the data would need to be easily accessible and meaningful. Provision of de-identified data for comparison with neighbours' use was seen as a potential means of influencing energy use. It was pointed out that the WaterSmart program started as a grass-roots initiative and was then picked up by governments. Smart energy meters were seen as unviable in a scenario with low policy commitment to energy efficiency.

An example of maladaptive coupling between energy use and supplier income was given in the case of Territory Housing. Currently, Territory Housing is paying PWC to provide resources (water and energy), without measuring and fixing leaks. In other words, the government is paying itself to use resources inefficiently. Water-use efficiency (stopping leakage of water and energy wasted in extra pumping) would benefit Territory Housing by reducing its costs but would reduce PWC's income. When PWC Water has to pump extra water to compensate for leaks in the water system, it is also paying PWC for the energy required to pump the extra water. Financial transfers are therefore occurring within PWC, between the water and the energy branches, and within government, between PWC and Territory Housing.

Aboriginal and Torres Strait Islander housing: self-build, community-specified

Two examples were given where Aboriginal housing had been developed according to the requirements expressed by Aboriginal people. Self-build Aboriginal housing is a relatively marginal practice, very individual-driven. Money and energy are saved via recycling existing materials. The Central Land Council (CLC) and Centre for Appropriate Technology (CAT) are experimenting with shelters for young people, based on small containers under a second roof, with plenty of deck space where most of the residents prefer to sleep. The money was set aside by the CLC specifically for infrastructure purposes. This model enables the flexibility to generate options that fit with the expressed requirements of Aboriginal people. Participants felt that this flexibility is lost under a government policy environment or within building control zones. It was felt that a risk-management or a minimum standards approach was more appropriate in Aboriginal and Torres Strait Islander communities than a more comprehensive standards-based approach, although that did raise the question of who would accept the risk.[*]⁵ The policy focus on standards, such as building codes, was also questioned, with the observation that building use is also important and an important avenue for grass-roots innovation. However, at present the policy environment is not equipped to learn from and respond to behavioural adaptation (either positive or problematic) arising from the application of building standards. It was also acknowledged that application of standards was reinforced through pressure on government, when 'people down South come screaming about providing sub-standard housing'.

Based on this discussion, Aboriginal housing more aligned with Aboriginal ways of living in remote communities may be more feasible in a policy environment with a low commitment to energy-efficient building standards.

For government to support funding that is more under local control and less top-down, trust and maturity are needed. These can develop over time with listening, letting go of control and pursuing a long-term goal of working together rather than government just providing a solution. An example given of the latter, illustrating its limitations, was contracts for solar installations in remote communities being let to component providers who were cheaper because they can sell items over the phone; but they did not understand why they needed to travel out to communities.

⁵ [*] a topic that deserves follow-up enquiry

5.4 Final plenary discussion

The final plenary discussion focused on the high socio-economic and cultural diversity in the region and what that meant in terms of responding to the questions being asked in the research. For example:

- Many different family models exist, including individuals supporting their remote extended families with food and money, singles and sharing; therefore variable housing models exist. There are such diverse modes of innovation, e.g. leaving a settlement and going bush. Different scenarios are very different for different people. Therefore, there is a need to conduct research in ways that different people can relate to.
- People are operating in different modes. For example, some are disconnected from society, whereas some are knowledgeable, getting all the sustainability incentives and benefits available. Many are in between, with a high proportion of income spent on food. Thus, the social diversity observable today provides glimpses into the future worlds explored briefly in the workshops.
- Not many people identify with the mean values in the ABS HECS data (see section 4.2) as the data presented do not pick up the range of variability.

From this discussion, we can see that innovations that matter to people depend on their different lifeways. There is a need to understand energy-related practices by lifeway. The scenarios in their present form may not be helpful because participants cannot relate to them yet. A more effective scenario approach might incorporate an exploration with participants of what particular scenarios might mean for different lifeways, so that the consequences for particular practices of importance for a given lifeway became apparent during the discussion.

6. Feedback about the project

The purpose of this session was to invite comments on the project's proposed design (Figure 1) as well as any other suggestions to improve research impact.

Table 3: Final plenary discussion – summary and initial interpretation

Topic / Summary of discussion	Research team interpretation
Governance	
Policy is not just government. Think in terms of advice and recommendations – then can access all people. Government has lots more than one tier. Hard work is required to identify where recommendations are most aptly framed. Important to develop policies that are going to be applied – not politicised. Industry associations – real estate, industry – a number of us are involved in examples of that. Need to push this up to the broader policy environment. Think of Real Estate Institute of NT and similar associations. I'm cynical about the process of going from generating information to policy recommendations. Policy leads to top-down commands in some organisations. There's a loss in translation in both directions. Need to have multiple discussions/stages and at different scales: continuous and ongoing discussion with policymakers. Don't stop at a second workshop for policy. Try to hold a third workshop for smaller-scale practice issues.	Statements reflect slightly different conceptualisations of how to steer or guide social systems. Reminder about the need to understand appropriate levels of governance as well as to engage with non-government policy actors and networks.
Resources, Capacity, Accessibility	
How do we better equip local organisations? What do you do if there is no	One contribution the project could make is to make the

Topic / Summary of discussion	Research team interpretation
money? Research has to be accessible to people, people in certain roles, e.g. CEOs of small companies, NGOs, store owners, people out bush. If it is aimed at policymakers, will get a policymaker response. If it is aimed at people, then it becomes an active research project that goes along. Want stuff that comes out of the workshops to be able to be used, e.g. tools in housing and energy innovation.	concepts of innovation, collaborative governance and regime of provisioning more accessible, so that people could use them to identify opportunities for networking, entrepreneurship and advocacy.
Research gaps	
We're millions of miles away from a highly energy-efficient building. This is a practical question and a research question. There hasn't been the basic building research to have a good (building) structure. Lack of highly energy-efficient building, despite the other stuff, such as solar PV.	We suspect that the lack of highly energy-efficient buildings in Central Australia reflects a particular building regime, as opposed to lack of applied knowledge.

Source: Editors, based on plenary discussion

7. Transport workshop

The transport workshop held on 15 May 2014 was a smaller event than the housing workshop, in part because potential participants were already planning to attend a transport conference the following week in Alice Springs. It followed a similar agenda to the housing workshop⁶ with the exception that the whole meeting was conducted in a plenary format.

The discussion after the opening presentation touched on the following points:

- First, the connection between sealing roads and economic development: Policymakers understand that sealing roads is a form of economic development, allowing increased tourism, mining and exploration, and access for Aboriginal and Torres Strait Islander communities. Forty years ago, only a dirt road connected Alice Springs from Adelaide. Since the road was improved, the population of Alice Springs has grown from 8000 to 28,000 people. Improved roads lower the cost of imports and exports. One of the NT Government's next goals is a sealed road to King's Canyon to increase tourism.
- Second, the per capita cost of improved roads: A current estimate is that 10 kilometres of sealed road costs about \$1M. Economic development also includes increased expectations, in the minds of the residents of smaller remote communities, for comparable levels of police, education and health services as elsewhere.

7.1 Transport-related practices

Participants attached value to the Centre Bush Bus and spent time discussing its multiple influences and the benefits compared to an uncoordinated series of private and public vehicles providing multiple services to remote communities. Participants also attached great value to the DriveSafe Remote program (2012–present), which provides mobile private and commercial driver test and licensing, registration and inspection services. As an area where more innovation is needed, participants discussed how increased bulk fuel storage capacity at pastoral properties made it possible to reduce the frequency of fuel deliveries. Delivering the same total volume by large-volume road train costs less to the property owner than more frequent, smaller volume deliveries. However, the weight of the road train (and/or the number of heavy wheels) reduces road quality.

⁶ Including presentations by the research team (see sections 2 and 4 above).

Participants also discussed how tightened child safety standards were leading to a phasing out of the fuel efficient multi-passenger vehicles, such as the troop carrier, in favour of smaller vehicles, such as the station wagon. The discussion also touched on drivers of mobility for Aboriginal and Torres Strait Islander people, one of which is the need to access adequate health and education services. One participant attributed inadequate service delivery in remote communities to lack of participatory design and consultation between service providers, elders and young people. Other drivers of mobility that were briefly touched on were housing problems and hunger. To the extent it could deliver adequate aged care, jobs and education, the NT Growth Towns strategy was regarded positively.

Table 4: Examples of meaningful transport-related practices

Issues	Specific points	Innovative practices	Additional examples of innovations
Poor rationalisation of transport between transport needs and infrastructures and services	Sealing a road increases access (on average by a factor of ten). Key for development. However, increased competition from decreased costs meant that local production was less competitive Heavy transport use is intensive and potentially damaging. Ten triple-axle trucks in one day = two years of normal use	The Centre Bush Bus as a subsidised trunk service for passengers, (refrigerated) freight, and mail, with feeder roads. Improved reliability and safety and increased cost-effectiveness NT Action Group (~2004) studied a pilot project for two years. Influenced by Bus Bee in the Anangu Pitjantjatjara Lands (SA) Political intervention and local stakeholder involvement. Engagement was a major factor of success	New infrastructures and services with participation of CDEP in the building process[*] Weight restriction for freight
Communities are increasingly reliant on resource towns to source both transport services and services requiring transport	Cattle stations in the 1970s used to have 40 employees on site; they have fewer than four now Central Land Council with 100+ vehicles managed from Alice Springs	Logistics/storage Mobile services (the Purple Bus for mobile dialysis) Community self-sufficiency with multifunctional activities interacting with local economy[*] Territory Growth Towns policy (top-down decentralisation, policy aiming to redistribute resources and population to larger Aboriginal and Torres Strait Islander settlements with private home ownership and business development)	Bulk storing of goods and fuels Decentralised services (aged-care services on-country with associated co-benefits)[*] Fixing cars with parts available in-situ in workshops with local coordination[*]
Urban public transport – social relations	Aboriginal people did not feel welcome on town buses, used more expensive taxis and minibuses	Bus shelters near town camps (ideally <= 400 m from patrons) and improved driver training. Community outreach and consultation	
Safety issues and access to transport	Very high rate of casualty and transport-related imprisonment People used to jump in the back of a truck	DriveSafe Remote Carpooling ('Chuckin in')	Access to Country programs New type of up-front 'chuck-in' system to fund travelling [*]

Note: Points marked * are areas that deserve to be explored in more detail.

Source: Editors, based on plenary discussion.

7.2 Implications of alternative futures for innovative energy-related practices

This session explored the viability of particular meaningful practices under alternative futures. Table 5 summarises the discussion, which focused on the Bush Bus program. The table shows eight alternative scenarios based on three variables: rate of grassroots innovation, rate of economic growth and level of policy support. Each could take high vs. low levels in the future. Notably, in the high innovation scenarios, participants associated innovation with competition for services provided by Bush Bus, that is, the emergence of alternative services and businesses. Under Scenario 1 (low grassroots innovation, low economic growth and low support for transport policy), participants thought that the cost of transport would be prohibitive, pushing people who had travelled to larger towns to remain there. One way to carry the discussion forward is to explore the implications of each scenario. Thus, in Scenario 1, one implication is that the disadvantaged population in service centres would grow, requiring a range of affordable services to maintain their status and life outcomes. Similarly, the connection between grassroots innovation and alternatives to Bush Bus (e.g. Scenario 8) could be elaborated.

Table 5: Imagined future scenarios for the Centre Bush Bus

Low grassroots innovation	Low transport policy support	High transport policy support
Low economic growth	Scenario 1: Decrease Fewer services, less demand and people come back to town (Compare to Isolated housing scenario in section 4)	Scenario 3: Growth More services, low demand but monopoly
High economic growth	Scenario 2: Thriving Fewer services, but strong demand and monopoly	Scenario 4: Thriving More services, strong demand and monopoly
High innovation		
Low economic growth	Scenario 5: Decrease Fewer services, less demand and very intense competition	Scenario 7: Decrease More services, low demand and competition
High economic growth	Scenario 6: Vulnerable Fewer services, strong demand, competition	Scenario 8: Growth More services, strong demand but competition (Compare to Boosted housing scenario in section 4)

Source: Editors, based on plenary discussion

The participants also briefly discussed the future viability of the NT Growth Towns policy, specifically the implications of low innovation, low growth and low transport policy support (Scenario 1) vs. its high innovation, high growth and high policy support counterpart (Scenario 8). Participants thought that removing transport policies that subsidised current fuels and technologies would make the Growth Towns policy less viable, because the costs of infrastructure provision and transport would be prohibitive. The Growth Towns policy was seen as more viable under Scenario 8, but participants were uncertain as to whether people in smaller remote communities would chose to relocate to the promoted Growth Towns.

In addition to the scenario-based assessment of viability, participants briefly discussed a wide array of technical, institutional and social innovations. One example of an institutional innovation proposed was to begin the administrative (financial) year in January. Because of the lead time in tendering and contracting

projects, this would mean that road works projects would run over the cooler winter months, saving considerable water and energy (noting that 2–3 million litres of water is used on a five kilometre road section).

Participants briefly discussed active transport (cycling) and the viability of solar-powered electric buses and other alternative energy sources for urban use. They considered fossil fuel prices as an important factor influencing transition away from current technologies. They also briefly discussed pre-colonial Aboriginal and Torres Strait Islander mobility and livelihoods, the knowledge of which could be adaptive across a range of uncertain futures. As one participant put it:

You know all this sustainable living and energy-efficient stuff is always about creating more growth in one area to make this country a better place. Why isn't anybody moving around anymore? Indigenous people have been doing it for so long. They're still doing it now ... Kids could use this [Indigenous] knowledge later on ... what happens when everything falls to pieces? What happens when there's no fuel left? What happens when there's nobody farming down there anymore? What happens when there's no computers? Oh my God. No telephones ... Where do you go from there?

Participants also valued the contemporary use of communications technologies to maintain and revitalise language and culture, for example, remote production and access to self-produced video narratives.

In terms of lessons learnt, the research team was reminded that the connections (synergies and tensions) between grassroots innovation and Aboriginal and Torres Strait Islander knowledge deserve to be better understood. From a methods perspective, the research team learned that it was possible to have a time-efficient, initial dialogue around practices and uncertain futures, in a setting where participants had limited exposure to scenario-based techniques.

8. Conclusion

In this section we situate the May 2014 workshops into a context of conversations and debates in Australia around climate adaptation and energy futures. Facing higher energy prices and climate change, a great need – and potential – exists to provide people in remote Australia with buildings that are more comfortable and energy efficient. The existing building stock, on average, performs at 2 stars (Branz Limited 2007). Because they do not yet anticipate future impacts of climate change or possible impacts of carbon policy, existing building energy codes serve Australia poorly (Wang et al. 2010, Strengers and Maller 2011, Morrissey et al. 2013). By 2050, 5-star houses in Darwin and Alice Springs will require, respectively, about 72% and 101% more energy than they do today (Figure 8).

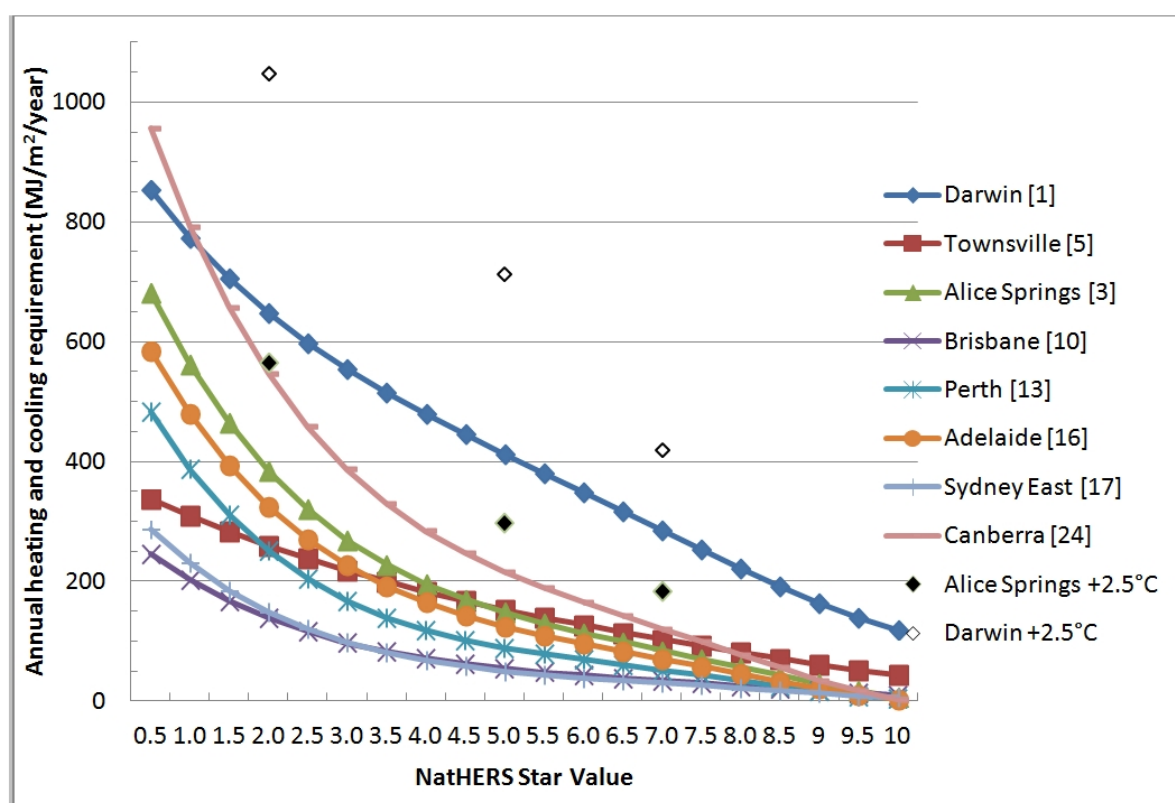


Figure 8: Annual heating and cooling requirements corresponding to Australian house energy ratings by city and climate zone

Note: number in brackets refers to NatHERS climate zone

Source: Authors, based on NatHERS (2010); and Wang et al. (2010) for +2.5°C

Energy-planning principles that emphasise integration of demand- and supply-side resources are relevant in responding to such challenges (GEA Writing Team et al. 2012). Such principles emphasise the importance of first investing where the costs of providing energy services is lowest, which is almost invariably on the demand-side, with end-use energy efficiency. Conceptual frameworks that allow energy-related policy to be unpacked also have a role to play. Energy policy is inherently multidimensional. The longstanding focus of policy has been on security of supply, access at affordable prices and – to a lesser extent – on economically efficient use of energy. In recent years, some analysts have called for the concept of energy security to broaden to include attributes or values such as environmental sustainability, long-term sustainability, resilience and governance (reviewed in Foran 2013, and Figure 9 below).

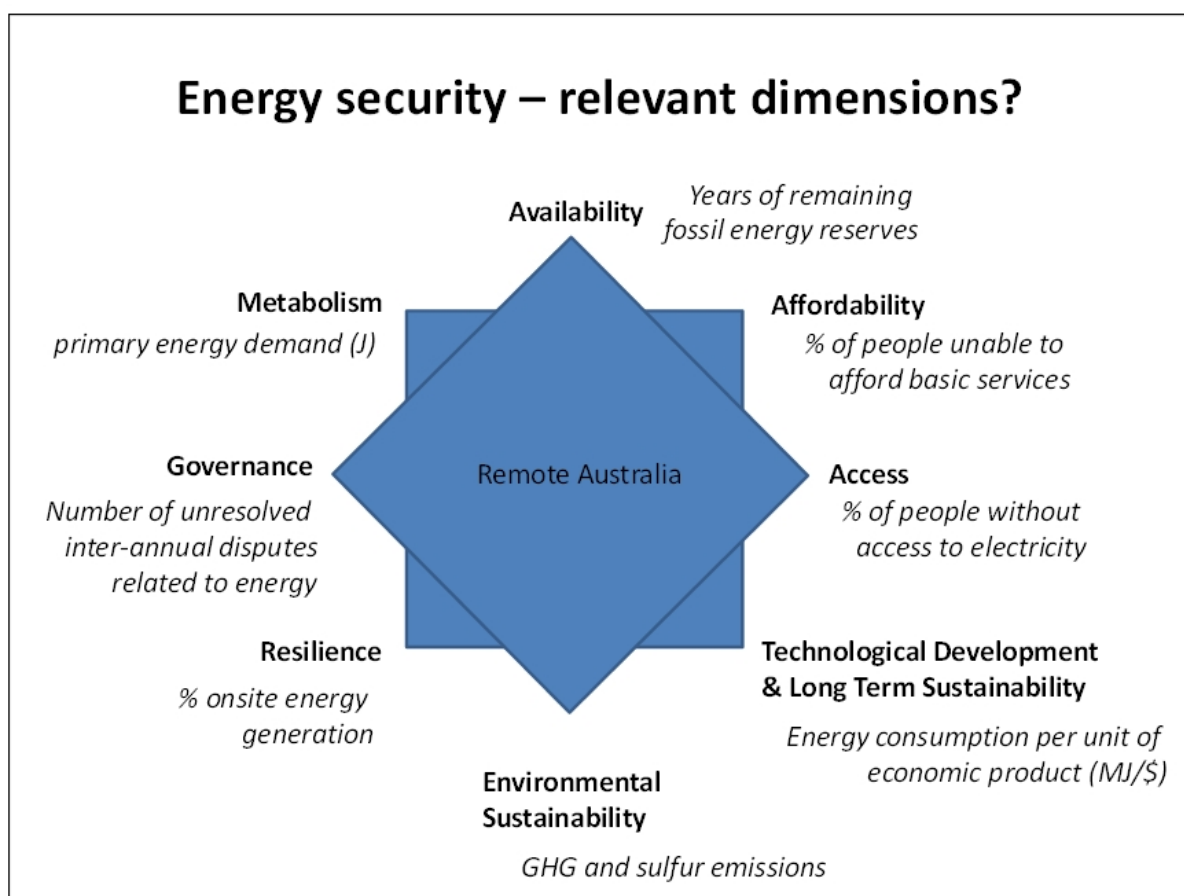


Figure 9: A multi-dimensional approach to energy security

Note: Examples of metrics shown in italics

Source: Authors, based on (Foran 2013)

Using mixed qualitative, participatory and quantitative methods, it is possible to track what may happen to these dimensions under contrasting energy futures. The alternative housing futures shared and discussed during the workshops (section 4) contribute to this kind of analysis.

However, the fundamental problem is not lack of principles, relevant frameworks or evidence of innovative practices. As these proceedings show, markets serving remote Australia fail to provide many relevant social and technical innovations. The limited availability of energy efficiency advisory services – to say nothing of energy performance contracting – is a case in point.

One (pluralist) model of purposive social change is that civic society (communities and NGOs) needs to express their preferences or values – that is, what matters to them and ought to matter to others. Governments and businesses will respond by creating opportunities, perhaps through dedicated pilot-scale resources. Stakeholders should then collaborate to try to attain virtuous feedbacks. An example of such collaboration is between private building owners, the City of Melbourne and Australia's Clean Energy Finance Corporation (CEFC). The City of Melbourne and CEFC provide low-cost financing for building energy-efficient retrofits that will contribute towards the City's ambitious target of zero net carbon emissions by 2020.

However, the energy standards embodied in Australian building codes show that resistance to change can be deep seated. Builders and regulators commonly state that increasing energy-efficiency performance will increase the upfront cost of a home, for example by \$5000–\$10,000 to move from 5 stars to 6 stars (Clune

et al. 2012). However, other analysts estimate that moving from a 5-star to an 8-star home design will increase average costs by less than \$10,000, while increasing energy efficiency by 65% (Morrissey et al. 2013, Tables 2 and 3). Analysis for a cool, temperate climate such as Melbourne shows that investing in high efficiency (8 star) homes yields net positive present values (a measure of benefit to cost) compared to a 5-star baseline (Morrissey and Horne 2011, Morrissey et al. 2013). This finding holds across a range of future energy prices and discount rates. We would expect that investing in 8-star homes in central Australia would provide similar net benefits. Moreover, the analysis by Morrissey et al. (2013) did not include increased cooling loads resulting from a warming climate. Once climate change is taken into account, net present values would increase beyond those reported by Morrissey et al. (2013). Once long-term, life-cycle costs and benefits are taken into account, the existing housing regime is inadequate.

The weakness of current regulatory settings and the thinness of current market solutions mean that voluntary, grassroots innovative networks become all the more important. However, our understanding of how innovations emerge from – or are embedded in – particular social contexts, such as particular networks of architects and builders, remains limited. This limited understanding means that often we do not know how to transfer an innovative practice that works in a particular location to another location. The energy futures project thus far has emphasised the importance of creating spaces for different actors to meet and exchange understandings of how innovative practices work in remote Australia.

Appendix A: Workshop handouts

Table A 1: Innovative, energy-related practices relevant to remote Australia

Proponent	Type of practice / Details	References
	Energy technology and systems	
Federal Government	Low income energy efficiency program (LIEEP)	Interview I (10/10/13)
Northern Territory Government	Increased residential building energy efficiency performance requirements (May 2010: shift from 3.5-star to 5-star equivalent rating for new homes and extensions; apartments/flats move from no requirement to 3.5-star equivalent)	NT Government (2010)
Tangentyere Council	Energy efficiency retrofits to 61 houses in 12 Alice Springs Town Camps. Results: Indoor temperatures up to 7°C below shaded air temperature with relatively minor passive modifications: roof insulation, insulated shade walls, pergola extensions, window coverings, sealed cornice and wall junctions	Tangentyere Design (2013) Tangentyere Council (2011) Interview G (10/10/13)
Bushlight	Remote area power supply system featuring reliable and durable solar PV. Approximately 90 systems installed. Design includes one essential electric circuit (fridge, one light, one fan) designed to run continuously on renewable energy (RE) Community and household planning and costing service, methodology around what users want to do with electrical power	Stafford Smith & Cribb (2009, p. 114) Interview I (10/10/13)
Alice Springs Town Council	Alice Solar Cities Program helped to increase the number of residential rooftop solar PV systems from 2 to 444 between 2008 and 2012, at a cost of around \$9000 per household (after subsidies and credits). Main determinants of early adopters of PV (277 households) were house style and level of education	Havas et al. (2012)
New South Wales	Time-varying pricing ('dynamic peak pricing'): 10–40 times increase in price of electricity relative to off-peak rate for up to four hours duration. Result: peak load reductions of approximately 30%	Newsham and Bowker (2010) Strengers (2010)
Horizon Power (Utility owned by WA Government)	Location-specific solar feed-in tariffs (exceed state tariff of 8c/kWh) reflect cost of delivering energy to remote locations; people in more remote areas (where it is more expensive to supply electricity) receive up to 50c/kWh for their solar feed-in	Energy Matters (2012)
	Building design and collective practices	
Community arts centres	Cooling centres – use of community arts centre as cooling hubs	Interview C (7/10/13)
	Precinct or town planning practices	
Earthship World Community, New Mexico, USA	A residential community, on 600 acres, of 120 planned homes constructed from rammed earth and recycled materials. Promoted as 'world's first sub-division approved without utilities'.	Seyfang (2009) www.earthship.com
	End-user social practices	
	Staying cool by sitting outside buildings in shade	Horne et al. (2013)
	Water management	
Alice Springs Town Council	Managed aquifer recharge scheme uses treated sewage water for irrigation; up to 600 ML/y stored in aquifer	Stafford Smith & Cribb (2009, p. 117)

Proponent	Type of practice / Details	References
	Transport	
Central Australia	The Centre Bush Bus: The bus services over 35 remote communities in Central Australia, and more than 1 million kilometres are travelled annually.	http://centrebushbus.com.au/
World/Australia	Several examples of vehicle pooling/community transport, based on the principle of operating under-used vehicles and matching vehicle sizes to local needs. Carpooling is a common practice in numerous very remote communities at an informal level.	http://www.cto.org.au/
Adelaide City Council	Tindo Bus (a result of the Adelaide Solar City program) carbon neutral electric bus recharged by 100% solar PV electricity.	http://www.adelaidecitycouncil.com/environment/energy/tindo-solar-bus/

Source: Foran et al. (2014)

Table A 2: Indicators of sustainable consumption

Indicator	Descriptions	Examples
1. Localisation	Contributing to more self-reliant local economies Increasing local economic linkages Reducing length of supply chain	Self-provisioning / local provisioning of food, housing, energy
2. Reducing ecological and social footprint	Shifting consumption to reduce negative impacts on others Reducing energy and resource use	Adopting lower-carbon lifestyles; Voluntary simplicity
3. Community building	Nurturing inclusive and cohesive communities Effective support networks	desertSMART COOLmob http://desertsmartcoolmob.org/ Social networks around green building, permaculture
4. Collective action	Collaboration leading to greater empowerment of people in systems of production and consumption	Local organisations and initiatives that offer spaces or platforms for learning, collaboration, and engagement with government and other actors in policy processes Carpooling systems that use governmental and non-governmental organisation fleets
5. Building new systems of provision	Developing new sets of beliefs, values and technical rules that are more sustainable (e.g. more localised, lower footprint, pro-community)	Gaining institutional acceptance of alternative housing, alternative food distribution and local currency systems

Source: adapted from Seyfang (2009)

Table A 3: Examples of energy-related visions

Proponent	Vision
Zero Carbon Australia 2020 Stationary Energy Plan (Wright & Hearps 2011)	- An ambitious plan to transform the Australian energy sector into a 100% renewable energy (RE) system in ten years (2011–2020) for a cost of approximately \$370 billion - Costs (including return on assets) could be covered by a tariff increase of 6.5c/kWh by 2020 60% of electricity to be generated from concentrating solar power (with molten salt storage), 40% from wind and 2% from hydropower and crop-waste biomass during extended periods of concurrent low solar and wind availability - A new national grid to be formed by connecting three existing large grids: National Electricity Market, South West Interconnected System and North West Interconnected System - Northern Territory grids also transform to 100% RE, but remain isolated

Proponent	Vision
desertSMART COOLmob (McClean & McHenry 2014)	• 100% of electricity in Alice Springs is generated from clean, renewable resources • Distributed generation (high percentage of users generate their own electricity from community-based or individual systems) • All residents in Alice Springs can afford electricity for basic needs, including vulnerable people and those on low incomes
Australian PV Association (Lovegrove et al. 2012)	• By 2020, Alice Springs and Central Australia have developed into a world-leading solar energy centre: high levels of solar energy deployment, test and demonstration facilities, high levels of community support and engagement, best-practice financial and market mechanisms for solar, energy efficiency and demand-side management.
NT Government, (Green Energy Taskforce 2011) Australian Government (Commonwealth of Australia 2014)	• 20% of electricity demand to be met by renewable and low emission sources by 2020 • A similar target has been established at the national level (41,000 GWh by 2020, plus small-scale solar generation) – to be achieved through the Renewable Energy Target (RET) scheme, which obliges wholesalers and some generators to purchase renewable energy certificates from approved providers (e.g. large- and small-scale renewable power systems)
Pittock (2011, n.d.)	• Remote Australia is self-sufficient in RE • Large-scale renewable-powered electricity exported to national grid • Use of solar energy to produce ammonia as a transport fuel • Remote communities and regional towns benefit from construction, maintenance and other associated economic development
Various (De Graaf & Batker 2011, Schor 2010, Seyfang 2009)	• Liveability is maintained and enhanced through social innovations that are provided by voluntary social networks • Production of housing, food, energy is more distributed • People may work fewer hours in the formal market economy and instead invest more time in building human and social capital needed for climate-adapted housing and food provisioning. • Schor (2010) refers to this as 'plenitude'. Seyfang (2009) terms it 'New Economics'.
Innovative and energy efficient housing provision	• By 2050, houses are designed and built using passive cooling and heating principles and achieve a minimum energy efficiency rating of 10 stars. Two new residential estates in Alice Springs developed that do not require centrally supplied power

Table A 4: Key dimensions of MMA & Strategis (2009) energy scenarios

Driver	Scenario 1 (Fast rate of change)	Scenario 2 (An uncertain world)	Scenario 3 (A decentralised world)	Scenario 4 (Oil shock and adaptation)	Scenario 5 (Slow rate of change)
Common trends	Above-average temperatures, more frequent, prolonged droughts; enhanced Renewable Energy Targets for electricity sector				
1. Economic growth	High	High	Medium	Low	Low (mixed)
2. Population growth	High	High	Medium	Medium	Low
3. Global carbon policy	Strong (≤450 ppm)	Weak (≤550 ppm)	Strong (≤500 ppm)	Moderate (≤500 ppm)	Weak (≤550 ppm)
4. Centralised supply-side response	Strong	Strong	Weak	Moderate (renewable)	Moderate
5. Decentralised supply-side response	Strong	Weak	Strong	Weak	Weak
6. Demand-side response	Strong	Weak	Strong	Weak	Weak
User attitudes	Progressive Support high resource and energy efficiency	Consumerist Conservative	Very progressive	Progressive	Conservative
Oil and gas prices	High	Moderate oil, low gas	Moderate	Very high	Moderate oil, low gas

Notes: 'ppm' refers to assumed target in year 2050, for CO₂ equivalent atmospheric concentration in parts per million

Source: Authors, adopted from MMA & Strategis (2009)

Adapted from MMA & Strategis (2009): Future Developments in the Stationary Energy Sector. Scenarios for the Stationary Energy Sector, 2030

- **Scenario 1 (Fast rate of change):** The Australian energy sector transforms rapidly to meet strong global emissions reductions targets. Strong investment in demonstration projects has lowered the cost of both renewable and fossil-based technologies (i.e. Carbon Capture and Storage [CCS]). Geothermal, solar thermal and wind operate on a large scale, as well as coal-fired CCS plants. Consumer response to demand-side technologies (e.g. smart meters and tariffs based on time and season of use) are very positive, and large improvements in energy efficiency result, in part because of high density housing designs (which in turn support cogeneration technologies).
- **Scenario 2 (An uncertain world):** Despite strong economic growth, uncertainty in carbon policy results in lower and uneven government support for technology R&D. Solar thermal technology is supported, but support for other new technologies is weak, resulting only in incremental changes in technology. Social attitudes are conservative and consumerist.
- **Scenario 3 (A decentralised world):** This scenario is very similar to Scenario 1, except that the cost of geothermal and CCS technologies has not lowered, despite government support. In order to meet strong emissions reductions commitments, decentralised and renewable solutions become even stronger in importance than in Scenario 1. Rooftop solar PV and solar water heaters are commonly installed, as are demand-side management technologies such as time-based tariffs, switches that shut off appliances during periods of peak usage and appliances that are programmed to run during off-peak periods.

- **Scenario 4 (Oil shock and adaptation):** This scenario features very high domestic prices for oil and gas, resulting from constraints on the development of global hydrocarbon reserves and sluggish economic growth. In common with Scenario 3, CCS technology is not viable, leading to increased reliance on centrally supplied geothermal and wind technology. However, in contrast to Scenarios 1 and 3, despite progressive attitudes, the weak economy makes many demand-side technologies, rooftop solar PV and solar water heaters relatively unaffordable. Users face high bills and cut back on power consumption unassisted by sophisticated technologies.
- **Scenario 5 (Slow rate of change):** This scenario is essentially the inverse of Scenario 1: in the absence of a strong global carbon policy and facing low economic growth (including the decline of energy-intensive manufacturing), the energy sector transforms only slowly.

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