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Understanding energy-related regimes: A participatory approach from central Australia

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HIGHLIGHTS

- Energy-related activities and regimes frustrate pro-sustainability action.
- Participatory workshops increased understanding of activities and regimes.
- Workshops used a novel combination of governance and social theories.
- Results justify inclusive dialogue around building energy standards and transport options.

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ABSTRACT

For a particular community, what energy-related innovations constitute no-regrets strategies? We present a methodology to understand how alternative energy consuming activities and policy regimes impact on current and future liveability of socio-culturally diverse communities facing climate change. Our methodology augments the energy policy literature by harnessing three concepts (collaborative governance, innovation and political economic regime of provisioning) to support dialogue around changing energy-related activities. We convened workshops in Alice Springs, Australia to build capability to identify no-regrets energy-related housing or transport activities and strategies. In preparation, we interviewed policy actors and constructed three new housing-related future scenarios. After discussing the scenarios, policy and research actors prioritised five socio-technical activities or strategies. Evaluations indicate participants enjoyed opportunities given by the methodology to have focussed discussions about activities and innovation, while requesting more socially nuanced scenario storylines. We discuss implications for theory and technique development.

1. Introduction

Suites of actions at multiple levels are required to transform energy systems to meet equity, efficiency, and pollution objectives (Pacala and Socolow, 2004; GEA Writing Team et al., 2012). Community-level energy initiatives contribute meaningfully to such portfolios (Mulugetta et al., 2010; Roorda et al., 2012; Ramaswami, 2013; Ryan, 2013). By identifying courses of action that may be socially acceptable, and robust to a variety of plausible changes in energy and social policy at higher levels of governance, scenario methodologies have proven useful in option development (Kok et al., 2007; Næss and Vogel, 2012; Ramaswami et al., 2012; Foran et al., 2013).

One approach to developing multi-faceted energy scenarios is to describe alternative patterns of socio-technical change, drawing on concepts such as transition management and the multilevel perspective on systems of provision (Verbong and Geels, 2007; Foxon et al., 2010; Verbong and Geels, 2010). For instance, the *Transition Pathways to a Low Carbon Economy* project developed three scenarios by which the UK could reduce its greenhouse gas emissions 80% by 2050. A contrasting policy paradigm (market, government, or civil society) informed each scenario and associated modelling (Foxon, 2013). Such whole-of-system, technically oriented scenarios can inform at national-level policy making. However, to support participatory action research on energy systems in specific places, refinements to method are needed. For example, the UK *Thousand Flowers* scenario is based on a homogenous "civil society" policy paradigm (Foxon, 2013), in which citizens, not market or government actors, play a leading role in decisions related to energy systems. Such a scenario however

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Table 1
Types of innovation.Source: Authors, adapted from Seyfang (2009).

	Market-based innovation	Grassroots innovation
Context	Market economy	Social economy
Driving force	Above-market economic returns obtained from possession of an innovation	Various interpretations of social need and affordable functionality
Organisational form	Firms	Very diverse (informal groups, networks, associations)
Resource base	Commercial income	Diverse (grants, voluntary inputs, mutual exchanges, commercial income)

raises questions about how energy-related policies and activities impact on citizens who *differ* with respect to race, cultural values, livelihood aspirations and economic capability (cf. Shove and Walker, 2007). A growing literature exists on methods to facilitate urban sustainability transitions (Vergragt and Brown, 2010; Roorda et al., 2012; Nevens et al., 2013; Ryan, 2013), however issues related to socio-cultural difference do not feature prominently in this literature (cf. Wittmayer et al., 2014).

This paper augments the energy transitions literature by proposing a methodology, informed by critical social science, to assist multi-stakeholder dialogue around energy activities, policies and change. The methodology flows from interest in developing collaborative ways of understanding how alternative energy-related activities and systems impact on the current and future liveability of selected local communities. We use Alice Springs in central Australia, as a case study. Drawing on concepts of grassroots innovation (Seyfang, 2009; Seyfang and Haxeltine, 2012) and also influenced by social practice theory (Shove, 2004; Strengers and Maller, 2011; Shove et al., 2012; Horne et al., 2013), we introduce the concept of "energy-related activity" to catalyse dialogue. To encourage actor reflection around constraints and possibilities for change, we place innovation in a conceptual framework that draws on political economy and collaborative governance. To help assess possibilities for innovation around energy-related activities, we introduce the concept "political economic regime of provisioning" (cf. Foran, 2015) (Section 2). In a collaborative process, participants debated existing energy-related innovations and additional innovations that may be feasible in remote Australia (Section 3). We discuss the methodology's utility in energy policy development in Section 4.

2. Methods

One way to plan for energy futures is to explicitly reflect on what could happen to people and communities under alternative scenarios, taking into account uncertain future levels of factors such as policy commitment, local innovation and economic growth. Remote Australia – an area that covers 85% of the continent but comprises 5.2% of its population – is considered distant from many markets and centres of power (Stafford Smith and Cribb, 2009; Foran et al., 2014).[1] The region's social distance puts a premium on local knowledge and technical and social innovations to address problems that mainstream approaches may fail to resolve. In this context, scenario methods can help explore the fate of a particular issue, geographic region, or policy in a number of alternative future worlds, which can be derived from a common initial scenario framework (Henrichs et al., 2010; Foran et al., 2013). Our methodology makes use of this technique: informed by theories of collaborative governance, we used scenario techniques to explore the fate of innovative energy-related activities in alternative political economic regimes of provisioning.

2.1. Innovation and energy-related activity

By energy-related "activity" we mean a type of action, mediated by use of particular technologies and associated infrastructure, whose status is typically accepted as normal in a particular place and time, or otherwise institutionalized. Such activities are important for energy studies because they involve particular material designs, configurations, and technologies – for example, single family, brick veneer houses in Australia with relatively low insulation (Horne and Hayles, 2008; Wang et al., 2010). Technologies embody assumptions by designers and other authorities about what users need or find appealing. In a political economic context of limited options, their absorption by users locks-in a particular technology, with consequences for energy demand.

Our concept of energy-related activity has been influenced by the social practice literature. A social practice is a emergent entity that results from the integration of (i) practical knowledge (e.g. the knowledge that an architect has about what designs are commercially viable) with (ii) material infrastructures (e.g. timber, brick veneer, sealed roads, central grid-supplied electricity), underpinned by (iii) a combination of common understandings about what constitutes necessity as well as obligation (Shove, 2004; Strengers and Maller, 2011; Shove et al., 2012). Based on this literature, we conceive of energy-related activities as socially constructed and embedded in material artifacts and mental conceptions. However, departing from social practice literature – and instead consistent with literature on political economy (Section 2.2) and on collaborative governance (Section 2.3) – we work with a slightly more optimistic conception of the power of collective action to change some energy-related activities.[2]

By "innovation" around energy-related activity we refer to the process by which activities new to a particular social group are acquired by that group, resulting in novel outcomes (cf. World Bank, 2012). Although market-based, entrepreneurial, and technical images dominate thinking around innovation (cf. Hekkert et al., 2007; Foxon, 2013: 19), market economic logic does not govern provisioning of all goods and services. Grassroots innovation (Seyfang, 2009) 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. In this concept, profit is not primarily appropriated by private actors but "reinvested into the grassroots" (Seyfang, 2009: 63–82; Foran et al., 2014) (Table 1). The value of innovations can be evaluated according to indicators of sustainable consumption, such as: adopting lower carbon lifestyles; local provisioning of

[1] Remoteness in Australia is typically defined based on road distance to service centres with different levels of population (Australian Population and Migration Research Centre, 2015). 2.5% of Australia's population is indigenous (548,365 persons in 2011); 25.6% of the indigenous population lived in remote regions in 2011 (Australian Bureau of Statistics (ABS), 2013a).

[2] Social practice theory is sceptical about the transformative potential of human agency (Sayer, 2013): our departure from its conceptualization of agency is motivated by an interest in participatory and deliberative approaches to formulating energy policy.

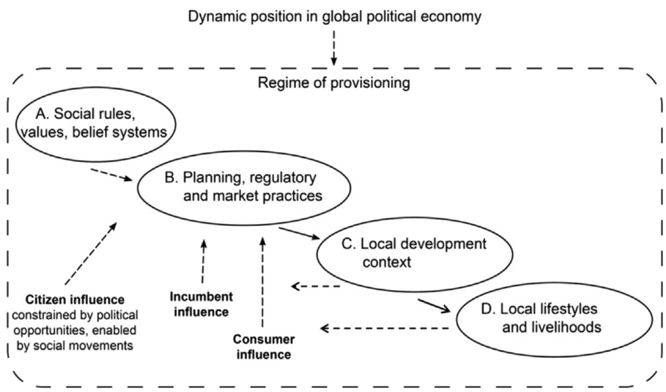

Fig. 1. A political economic regime of provisioning. Source: Adapted from Foran (2015).

energy; and collective action (e.g. initiatives that empower people to learn and engage with policy actors) (Seyfang, 2009).

2.2. Regimes of provisioning

Understanding constraints and possibilities for innovation require us to understand a given energy-related activity (such as speculative, market construction of lightly insulated homes) in a wider social and political economy context which includes assemblages and hierarchies of activities. Synthesising insights from several disciplines, the concept of "political economic regime of provisioning" may be helpful for this purpose (Foran, 2015). A political economic regime of provisioning (Fig. 1) is a social order with the following dimensions:

(1) A multi-level system of mental conceptions and energy-related activities.
(2) Contestation between incumbents and challengers around particular conceptions and activities.
(3) Levels and patterns of energy and resource flows.
(4) Spatially embedded material infrastructure that supports those flows and dominant system beliefs.

(Geels, 2002; Schandl et al., 2009; Foran, 2015)

Such multi-level complexes have previously been described as systems of provision (Reusswig, 2009; Seyfang, 2009; Ryan, 2013). In the socio-technical transitions literature, change is conceived of as a complex, co-evolutionary process involving micro-level variation; macro pressure on mid-level regimes; regime support of particular micro niches; and mutual adaptation between niche and regime (Geels, 2002; Verbong and Geels, 2007). Co-evolutionary models of change usefully emphasise that multiple drivers of change exist, and the profound difficulty, given systems complexity, in steering transitions towards sustainability (Shove and Walker, 2007; Harvey, 2011). However, to the extent that co-evolutionary models are uninformed by concepts of critical political economy, they pay insufficient analytical attention to driving processes such as capitalist accumulation[3], spatially uneven development, and attendant dispossessing impacts on citizens and consumers (Harvey, 2011; Bridge et al., 2013; Foran, 2015).

Insisting on the importance of political economy, we prefer the term "political economic regime of provisioning": a regime is a multi-level field of goal-oriented striving, in which incumbent and challengers have a common understanding of the rules governing their struggle (Ray, 1999; Fligstein and McAdam, 2011; Hess, 2013, 2014; Foran, 2015). Regimes run neither smoothly nor democratically: sharp patterns of inter-group domination and coalition may exist (Wittneben et al., 2012). By referring to the entire multi-level complex as a political economic regime of provisioning, we underscore power asymmetry and embeddedness. We believe that this usage will counter a tendency in the social-technical transitions literature to overemphasise the disruptive potential of niche innovations, and to insufficiently interrogate the redistributions of power entailed in transitions.

2.3. Collaborative governance

Regimes of provisioning persist when particular social understandings and physical infrastructure that support them get reproduced through often taken-for-granted activities. To support actor reflection around particular activities, we used theories of collaborative governance (Ansell and Gash, 2008; Emerson et al., 2012). Collaborative approaches, which contrast to bureaucratic or managerial modes of policy, are initiated by leadership and driven by the recognition of actors that a particular issue is important; is complex and contested; and has interdependencies. Such interdependencies may be between state and non-state actors, as well as between sectors (for example between housing, health and energy policy).

Emerson et al. (2012) proposed that collaborative governance works by generating a virtuous cycle of three micro-social processes: (1) "principled engagement" refers to processes such as reasoned argument and deliberation, aimed at defining problems and finding agreements together. Over time, principled engagement enables, (2) "shared motivation": processes that build trust, mutual recognition of interdependence, internal legitimacy, and shared ownership. Shared motivation, in turn, increases, (3) "capacity for joint action": mobilisation of resources and knowledge, leading via changed institutional arrangements, to outcomes that cannot be accomplished in isolation (e.g. changes to energy usage via changing housing or mobility activities).

In summary, literature on collaborative governance suggests that it is enabled by effective deliberative processes. However, collaborative governance may also require a history of actor frustration with managerial modes of governance to resolve an issue, in which case, significant time is required for collaboration to emerge.

2.4. Application in remote Australia

Of Australia's 32.5 TW h renewable electricity generation in 2012–13 (13% of total generation), more than half (56%) is sourced from large (> 5 MW) hydropower plants (Bahadori et al., 2013; Bureau of Resource and Energy Economics (BREE), 2014: table O). However, interest in the opportunity or challenge posed by wind, solar and other forms of renewable energy is vigorous (Wright and Hearps, 2011; McClean and McHenry, 2014), notwithstanding low levels of electricity demand growth (0.9% p.a.; BREE 2014); reversals in government support for pricing carbon; and contestation over the appropriate level and implementation of mandatory renewable energy targets (Martin and Rice, 2012; Commonwealth of Australia, 2014). Such interest in renewable energy is multi-faceted, reflecting for instance: (1) the popularity of residential-scale renewable energy, resulting from real electricity price increases and feed-in tariff policies in many jurisdictions, (2) the recognition of vulnerability of infrastructure to climate change impacts (Branz Limited, 2007; Wang et al., 2010; Quezada et al., 2014), (3) the salience of climate change mitigation as a political issue in urban settings, resulting in local government initiatives to reduce greenhouse gas emissions and (4) the interest of incumbent as

[3] Specifically, the need to attain a compound rate of growth, leading to proliferation of investment in energy plant and material infrastructure as well as short-lifetime consumer products (Harvey, 2011; Twomey and Gaziulusoy, 2014; Foran, 2015).

well as new electricity actors in strategic foresight, in a context where onsite generation has been significant enough to reduce the rate of growth for centrally supplied electricity (CSIRO, 2013).

However, in conversations around energy, remote Australia still figures mainly as a provider of energy and resources to a global economy (Bureau of Resource and Energy Economics (BREE), 2014). Despite a need to adapt to climate change, and the higher prevalence of Indigenous people with poor human development outcomes (Commonwealth of Australia, 2015), capacities for energy-related pro-poor innovation in remote Australia are not well understood (Maru et al., 2012). Notwithstanding efforts to promote energy efficiency and solar energy in selected local communities (Havas et al., 2015), future energy-related challenges facing remote Australia deserve attention (Maru et al., 2012; Horne et al., 2013). In 2014, we organised two workshops for the purpose of developing a collaborative understanding of how alternative energy-related activities may impact on the future liveability of Alice Springs, Australia, focusing on housing and transport.

We chose Alice Springs, a town with a population of 28,000 (9163 households) and a semi-arid climate, as a site to trial our methodology, based on its relative density of policy and research actors around urban water, energy, and environmental sustainability, compared to other remote towns. Located approximately in the geographic centre of Australia, Alice Springs is >1400 km to a city of $>100,000$ people and functions as a service town for outlying settlements (Havas et al., 2015). Despite rail links to Adelaide and Darwin, petroleum is imported via road and prices are around 15% higher than the national average. A pipeline to Darwin (capital of the Northern Territory) allows centralized, gas-fired electricity generation (100 MW capacity, 55 MW summer peak demand). Indigenous people, generally more economically disadvantaged than the rest of Australian society (Commonwealth of Australia, 2015), comprise 18% of residents.

Notable efforts to innovate around electricity include the Alice Solar City programme (2008–2013), a $A 42 million package which included new solar installations as well as commercial and residential energy efficiency (EE) audits. The residential programme included financial incentive vouchers which allowed homeowners to purchase EE, solar energy technologies, or load management measures (Havas et al., 2015). The residential programme resulted in participation of 2856 households with an estimated annual energy savings of 3.52 GW h (Alice Solar City, 2014). The programme also organised EE retrofits in tenant-occupied Indigenous housing.[4] The Alice Solar City programme was influenced by desertSMART COOLMob, a non-profit, government-supported community-based water and energy efficiency programme that embodies aspects of grassroots innovation, and has published a vision to improve the town's environmental and social sustainability (McClean and McHenry, 2014). Notwithstanding such efforts to innovate, electricity consumption in Alice Springs (137 kWh /household/week) is high compared to the national average (124 kWh/household/week) (Australian Bureau of Statistics (ABS), 2013b), dominated by cooling energy demand, and renewable sources provide only 3% of average annual electricity generation (McClean and McHenry, 2014).

2.4.1. Dialogue workshops

This section details the participatory process we implemented. Comparing alternative participatory designs was beyond the scope of this project. Based on results obtained (Section 3) we consider the process detailed below to be feasible and effective, but do not claim it constitutes an optimal process or one suitable for all contexts. We organised two workshop events designed to build capacity of people in place-based communities to explore the research question italicised below:

> "If the future is uncertain, a strong economy, progressive social attitudes and policy support for energy-related innovations cannot be guaranteed. *In your region, what particular policies and innovations should be promoted as no-regrets strategies, regardless of what the future holds?*"

Face-to-face meetings were chosen as a platform to allow stakeholder discussion and deliberation around the above questions. They were intended as the first round in a sequence of ongoing work, and this paper reports on outcomes of the first-round workshops. We organised separate housing and transport meetings in order to elicit domain-specific insights and experience around energy-related activity. The first-round workshops were not designed as a deliberative jury or otherwise to directly represent community end-users: instead, we sought individuals with expertise on various topics in housing and transport regimes of provisioning.[5] Fifteen individuals[6] from government and private non- and for-profit organisations, with expertise in housing, transport, energy, research, or service delivery, participated in a one-day housing- or transport-oriented discussion. Each workshop had at least two participants with an Indigenous background or significant experience working with Indigenous people. To prepare for the workshops, we conducted a round of 13 semi-structured interviews with policy and practice actors in 2013–14, reviewed relevant literature, constructed a set of three housing-related scenarios and released an online discussion paper (Foran et al., 2014).

After introduction to objectives and key concepts, the workshops included discussion of energy-related housing or transport activities participants had reason to consider innovative, or otherwise meaningful (100 min). To stimulate discussion, we showed a list of potentially relevant activities to the participants, as well as a set of indicators of sustainable consumption (Foran et al., 2014). We invited participants to reflect on the specific circumstances of how an activity they valued was initiated (when, by whom, how), how it was sustained or not, taking into account factors such as advocacy, entrepreneurship, government support and market pull, as well as specific history, geography and dominant values. This was followed by a 40-min presentation of two scenario frameworks: a national-level study (McLennan Magasanik Associates and Strategis Partners, 2009); and a second framework, created by the authors, focussing on housing provision in Alice Springs (Section 2.4.2). We then invited participants to choose one of the two scenario frameworks, and discuss what specific aspects of a future scenario enabled or inhibited an activity (90 min). Participants evaluated the methodology in a concluding 45-min session.

2.4.2. Housing provision scenarios

Residential building energy efficiency in Australia is typically communicated as a value on a scale from 0 to 10 stars on the Nationwide House Energy Rating Scheme scale (NatHERS, 2010). The existing housing stock in Australia has an average rating of 2 stars (Wang et al., 2010). The typical dwelling in Alice Springs in 2002 had a floor area of 135 m^2, is timber-framed and air-conditioned. Forty-two percent of dwellings had some ceiling

[4] In Alice Springs, an important source of indigenous housing consists of approximately 20 "Town Camps" which have evolved from self-built, kin-based settlements into government-supported precincts, housing a population of 2000–3000 tenants and visitors in ~284 houses (Horne et al., 2013).

[5] In the research design, end-user knowledge and perspectives would be sought through subsequent interviews, focus group discussions, informing a second-round workshop (Foran et al., 2014)

[6] Organisers sought and invited a larger number of participants; attendance reflects scheduling conflicts.

insulation; just over a third had wall insulation (Branz Limited, 2007). Assuming a cooling thermostat setting of 26.5 °C, a 2-star house in Alice Springs has been estimated to consume 373 MJ/m^2/yr, of which >70% goes towards cooling. In 2010, the NT Government increased the standard for new homes to 5 stars. Assuming the same cooling thermostat setting, a 5-star house in Alice Springs consumes 143 MJ/m^2/yr, of which 82% is for cooling (Wang et al., 2010). However, considering the significant behavioural assumptions involved, and the fact that NatHERS underestimates cooling demand (Berry and Marker, 2015), energy consumption estimates in this section should be interpreted as relative indicators.[7]

In 2050, houses built in 2000 are 50 years old, reaching the end of their physical lifetime. How they get renovated or rebuilt varies by scenario. Our scenarios imagined housing and urban affairs in Alice Springs in 2050, based on high or low future levels of three uncertain processes: economic growth, policy commitment to energy-efficient building standards, and grassroots innovation (Foran et al., 2014: 25–26). All scenarios assumed an average temperature increase of 2.5 °C and real energy prices doubling by 2050 (CSIRO, 2013). These parameter choices allowed us to focus the discussion on adverse futures. They were also consistent with parameter choices made in an independent modelling-based study of Australian electricity futures (CSIRO, 2013).

(1) The *Isolated* scenario represents a future world in which economic growth is low, grassroots innovation is low and policy commitment to climate-adapted housing is also low. In this future world, 'low' policy commitment means that all new or renovated houses in 2050 must attain an energy efficiency rating equivalent to 7 stars on the NatHERS scale in 2010 (84 MJ/m^2/yr; NatHERS, 2010). In the 2.5 °C warmer climate of 2050, assuming no change in thermostat setting or rebound effect, such houses would require an additional approximately 100 MJ/m^2/yr) for annual heating and cooling (Wang et al., 2010: 1675), making their total consumption 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. Energy costs have increased as a proportion of their household expenses. The slow economy means little competition in the local home building industry. Builders continue to provide houses that are relatively expensive, 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) In the *Bartering* scenario, by contrast, people have come together out of frustration with the conventional economy and housing industry to develop their own low-tech solutions and associated social innovations. In 2050, several hundred houses are built with rammed earth and used tires, and other alternative designs and materials exist. People pool their labour to get houses built. Some of the residences built follow a co-housing model, which features common kitchen and laundry facilities, as well as garden spaces. 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 the *Isolated* scenario.
(3) The *Boosted* scenario is a 2050 world with a stronger economy, clear policy commitment and grassroots innovation. New houses must meet or exceed an energy efficiency rating that is equivalent to 10 stars (in today's terms). The Northern Territory 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 that 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 or water utilities (cf. Earthship Biotecture, 2015). Houses in these estates use passive heating and cooling principles and 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.

3. Results

3.1. Potentially meaningful energy-related activities

After viewing and discussing a matrix of energy-related activities potentially relevant to Alice Springs (Foran et al., 2014), participants considered a subset of 16 activities to be potentially meaningful (Table 2). For example, participants in the transport workshop valued the Centre Bush Bus, a public passenger and freight service (Raicu et al., 2011) and discussed its benefits compared to an uncoordinated series of private and public vehicles providing multiple services to remote communities. In the housing workshop, participants debated the value of "smart" energy metres, and the impact of the Alice Solar City programme. Some considered the latter programme meaningful (e.g. it mobilised a combined investment of $A 60 million in EE and renewable energy and catalysed participation of the state-owned power utility), while others pointed to a potential rebound effect and the increasing penetration of air conditioning activity (Foran et al., 2015b).

The first column in Table 2 provisionally classifies the activities according to relevant level(s) in the regime of provisioning (cf. Fig. 1). After discussing the three alternative housing-related scenarios, participants indicated the italicised subset as no-regrets investments, meaning that they should be pursued irrespective of future levels of economic growth, policy commitment towards energy efficiency standards, and grassroots innovation.

Beyond specific energy-related activities, two cross-cutting themes – flexibility and social inequality – arose during the Alice Springs dialogues.

3.2. Institutional flexibility

Participants argued that solutions will require institutional flexibility, not only technical innovation. Examples discussed included (1) vehicle fleet management systems scaled regionally. Such systems could allow multiple stakeholders to travel more efficiently through vehicle pooling, achieving substantial savings in vehicle capital and operational costs, (2) trials of youth shared housing designed by Centre for Appropriate Technology, and funded by Central Land Council (CLC). In a community development programme, this regional governance organisation explored

7 We thank a reviewer of this paper for emphasising this point.

Table 2
Innovations considered potentially meaningful by participants.Source: Authors. Note: italicised activities regarded as potentially "no-regrets" by participants.

Focal level in regime	Type of innovation	Application
A–B–C–D (Multi-level or cross-cutting)	Institutional	(1) *Culturally appropriate models of innovation (e.g. Central Land Council approach to youth housing)* (2) Active transport (e.g. bicycling, walking) (3) Change Northern Territory administrative year (outdoor work during cooler months saves water and energy)
	Grassroots	(4) *Self-build, community-specified Indigenous housing* (cf. Peter and Ayora 2011) (5) *Recognising and allowing grassroots sustainability innovations to persist*
B (Planning, regulatory and market practices)	System planning	(6) *Multi-user vehicle fleet systems* (7) *Centre Bush Bus: network and operational model* (8) Allow higher density residential dwellings closer to Alice Springs central business district
	Retrofits to increase EE	(9) White roofs, shading, external wall insulation, appropriate use of windows
	Commercial buildings with solar passive design	(10) Green Well Building, Alice Springs (iconic energy- and water-efficient office building completed in 2013)
	Mandatory EE disclosure schemes	(11) Mandatory disclosure of home energy efficiency schemes
C-D (Local context and livelihoods)	Contextually appropriate technology	(12) Bushlight solar and hybrid power systems with management control features (13) Smart water and energy metres
	Awareness raising, education and information campaigns	(14) desertSMART COOLMob (social network around sustainable liveability, based in Alice Springs) (15) Maintenance and recycling system for vehicle parts (16) Information on public transport access

options for youth shared housing in Aboriginal and Torres Strait Islander communities, trialling small shipping containers located under a larger supported roof (Tangentyere Construction, 2013; Centre for Appropriate Technology, 2014).

Potential users, in a process of engagement with architects, exercised a preference to live and sleep outside, using containers for sleeping in colder months. The configuration offers a shaded outdoor space, allowing airflow through the space beneath to aid cooling (Fig. 2). CLC had autonomy to decide how funds would be used, and authority to explore options less restricted by government building standards.

3.3. Social inequality

Workshop participants agreed that Aboriginal and Torres Strait Islander people are not well served by the existing system of housing provision (cf. Fien et al., 2011; Fien and Charlesworth, 2012; Horne et al., 2013). They reported that housing is frequently overcrowded; that appropriately designed aged care residences and high density accommodation for younger people is lacking; and that issues of social exclusion due to possible racism in the private real estate market exist. Some participants suggested that with increasing food and energy costs (and possibly encouraged by policies), more migration from outlying settlements to larger towns would occur. However, the innovative solutions discussed (e.g. modular housing) have a marginal or experimental status at present.

3.4. Workshop evaluation

Participants evaluated the workshops in plenary discussions as well as through a survey. The survey instrument consisted of seven statements designed to correspond to relevant drivers of collaboration (Section 2.3). Responses were based on a Likert scale: 1 = strongly disagree, 5 = strongly agree. Respondents agreed that energy-related issues were complex. They considered

Fig. 2. Example of youth shared housing. Source: Centre for Appropriate Technology.

Table 3
Response to evaluation questions.Source: adapted from Foran et al. (2015b).

Indicator of collaboration	Statement	Average	Min	Max
Mutual understanding	(1) I have a better understanding of how other participants think.	4.0	2	5
Mutual understanding, complexity	(2) Other participants raised many other important goals and policy options.	4.2	3	5
Reasoned argument	(3) The arguments put forward by other participants were reasonable and not simply reflections of their personal or organisational interests.	4.0	3	5
Shared ownership	(4) It is important for me to continue providing inputs into this process, even on topics beyond my agency's mandate.	3.9	2	5
Uncertainty, complexity	(5) We need to take uncertainty in remote Australia's energy-related systems into account more seriously.	4.6	3	5
Complexity, uncertainty	(6) We need to diversify our policy goals and options.	4.7	4	5
Interdependency	(7) In order to improve energy-related liveability, I need to improve my understanding of how my organisation depends on other organisations.	3.9	2	5

contributions made by others to be reasoned, believed in their potential ownership of the process, and recognised their interdependence on others (Table 3).

Participants also evaluated our methodology by commenting vigorously (in plenary discussions) on details of process and content. They noted the absence of particular invitees (e.g. commercial builders). With respect to content, participants commented that the scenario storylines (Section 2.4.2) deserved further social elaboration, in order to adequately visualise and understand the current diversity of lifestyles, associated energy energy-related activities, and modes of innovation. To paraphrase one participant: “Niches exist of people who have built their own humpies [traditional shelters]. People are experimenting with papercrete caravans, hydroponics and earth buildings. These innovators are not waiting for the government to build them a better humpy.”

4. Discussion

Three issues of relevance to energy policy merit discussion: (1) the costs, benefits and challenges of standardizing energy performance of residential building envelopes, (2) the insights gained by situating energy-related activities in regimes of provisioning and (3) refining participatory methods informed by concepts of energy-related activities and regimes.

4.1. Standardizing building envelope performance

Once long-term, life-cycle costs and benefits are taken into account, existing standards for housing building envelopes are inadequate. By 2050, a house built in Alice Springs to a 5-star level will actually perform at a 3-star level or worse. For Darwin, the anticipated impacts of climate change are more severe: a 5-star house in Darwin performs at a 1.5-star level or worse by 2050. In order to perform at a 5-star level in 2050, a house built in Darwin today would need to achieve approximately an 8-star rating (Wang et al., 2010).

Energy standards embodied in Australian building codes suggest that resistance to change can be entrenched: 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). By contrast, other analysts estimate that moving from a 5 star to an 8 star home design[8] 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 (NPVs) compared to a 5-star baseline, across a range of future energy prices and discount rates (Morrissey and Horne, 2011; Morrissey et al., 2013). In Adelaide, a warm temperature climate, positive NPVs across a range of discount rates have been calculated for 7.5-star homes (Berry and Davidson, 2015). Investing in equivalent homes in central Australia may provide similar net benefits. Furthermore, if increased cooling loads resulting from a warming climate are taken into account, net present values would increase beyond those reported by Morrissey et al. (2013). Workshop participants noted that a portion of society could actually afford the higher upfront costs of more energy-efficient housing. This point is significant, because we would expect landlords to fall into the class of building owners who are more able to afford EE upgrades or new highly EE building designs, although under the current housing provisioning regime they are not particularly rewarded to do so (Horne et al., 2013).

With respect to transport, half of the population in remote Australia has access to public transport, compared to 82% in non-remote Australia (Australian Bureau of Statistics 2010). High levels of diesel fuel use have been reported (Green Energy Taskforce 2012), and diesel fuel costs are 20–100% higher in remote Australia (Spandonide, 2014). High transport costs significantly magnify food and other living costs (Litman, 2014). Low income Northern Territory households who rely on remote stores would spend $>33\%$ of their income on a market basket of food, at a cost of 53% more than if purchased from a supermarket in Alice Springs or Darwin (Department of Health [Northern Territory], 2014). Policies to further encourage use of fuel-efficient vehicles and safer, more regular public transport services would enhance self-sufficiency and resilience of remote communities and enterprises.

Socio-cultural diversity however complicates any straightforward shift towards a regime of higher building energy efficiency standards. Cultural diversity and socio-economic inequality means that people have diverse conceptions of what they need, want and are capable of self-provisioning. During the housing workshop, one participant stated that: “People are operating in different modes … 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” (Foran et al., 2015b).

4.2. Activities and regimes

Participants attached importance to innovative activities at multiple levels in a housing or transport regime of provisioning (Table 1). The 16 activities valued fall into three clusters, most obviously (i) development of contextually appropriate technology and end-user education campaigns and (ii) changes to specific planning, regulatory, and market activities. Many of the valued innovations fell into the latter cluster (Fig. 1, level B). By contrast, a third cluster of innovations appears to require significant changes at two or more levels in a regime. For example, innovative, government-subsidised youth shared housing requires funders to

[8] Freney et al. (2012) review conventional and non-conventional building envelope options to achieve an 8 star rating or better.

accept the waiver of customary building standards and possibly external sleeping areas. These changes may challenge prevailing administrative rules and design norms, as well as dominant societal values of what a residence should look like (Fig. 1, A and B).

Specific activities in Table 1 could be supported by a number of different policy approaches, instruments and other collective actions. For example, retrofits to increase energy efficiency could be supported by more stringent building codes (a regulatory approach) as well as by market-based approaches, such as energy performance contracting and fiscal approaches, such as subsidised loans (Ürge-Vorsatz et al., 2012). The "optimal"' package of collective actions to support an innovative activity cannot be predicted – it will depend on what future emerges. However, the further use of scenario-based techniques could inform the discussion about no-regrets policy approaches, instruments and collective actions.

Social practice theory however emphasises that social conventions evolve along with energy-consuming designs and technologies. This implies that we should not expect regulations or market-based instruments alone to transform energy-related activities. It will be necessary to explore how social conventions, e.g. around levels of government regulation or subsidisation have been formed, as a basis for understanding how they might change. Doing so in participatory settings will require refinements to method.

4.3. Reflections on method

Problems with energy-efficient housing provision in the face of long-term warming, on the one hand (Morrissey and Horne, 2011; Morrissey et al., 2013) and systemic underrepresentation of remote issues on the other (Stafford Smith and Cribb, 2009; Altman and Kerins, 2012), indicate weaknesses in Australian energy governance. Meanwhile, consumer interest in onsite solar photovoltaic generation and its implications for Australia's centralized electricity regime, constitute a bottom-up challenge (CSIRO, 2013). Such regime weaknesses and opportunities are unlikely to be unpacked, debated and addressed without local conversation and action. In this regard, we demonstrated that it is possible to begin a conversation around energy futures with a group of actors representing different backgrounds, interests and beliefs. Participants enjoyed the opportunity given by the structured methodology to discuss and debate energy futures issues (Table 3). Groups appeared to appreciate the opportunity to have relatively focussed discussions about energy-related activities and prospects for innovation (cf. more superficial interaction through survey-based research designs).

A participatory approach towards understanding energy-related activities and regimes faces limitations common to all participatory approaches. They are time and labour intensive and notwithstanding their growth in poverty and development work are still, in our opinion, relatively uncommon in Australian energy applications. The cost and relative unfamiliarity of participatory approaches to energy policy formulation translate into additional advocacy requirements with key partners (e.g. funders).

In terms of the specific techniques we applied, readers may ask whether certain inputs provided, such as a list of potentially innovative energy-related activities, biased the results obtained (e.g. by supplying particular ideas). However, participants in this application were professionals with significant disciplinary expertise and social authority, and we have no indication, based on observation and analysis of meeting proceedings (Foran et al., 2015b), that they were constrained or biased by particular workshop inputs.[9] Although we consider the results noteworthy, as the first in a planned sequence of collaborative work, we do not claim they represent formalized governance recommendations.

We invited participants to reflect on how an energy-related activity they valued was initiated, how it was sustained or not, taking into account factors such as advocacy, entrepreneurship, government support and market pull, as well as specific history, geography and dominant values. Given limited time, and occasional gaps in participant knowledge of specific histories of practice, we were pleased with the quality of ensuing discussion. Case studies dedicated to such themes (cf. Vergragt and Brown, 2010) would enhance subsequent participatory workshops.

Current regimes of housing and transport provision are not meeting a socio-culturally diverse set of needs in remote Australia. Scenario-based approaches may help visualise alternative energy-related activities and regimes. Our workshops presented participants with short and relatively simple future snapshot scenarios. In so doing, we sidestepped challenges at two levels: (1) at the regime level, theoretically nuanced storylines of regime development. Social practice theory and socio-technical transitions theory both attach importance to the notion that technology and social convention co-evolve, making alternative regime configurations possible, and necessary for ecological sustainability (Foxon et al., 2010; Næss and Vogel, 2012) and (2) at the experiential level, workshop participants told us that more detailed, authentic representations of diversity would make scenarios more meaningful. With respect to the first challenge, co-evolution informs our scenarios (Section 2.4.2), but deserves more explicit participatory discussion. Interview- and case-study based approaches could meet the second challenge, helping elaborate the housing scenarios with more detailed socio-cultural representations of housing, livelihoods and lifestyles. Notwithstanding such challenges, the workshop findings give confidence that with appropriate participatory design (balancing theoretical nuance and sociological detail) and resourcing, citizens and consumers can gain a more nuanced understanding of energy-related activities and regimes (Foran et al., 2015a).

5. Conclusion and policy implications

A lack of social scientifically detailed, collaborative methods and techniques limits participatory understanding of energy-related activities. Limited understanding of energy-related activities in turn reduces the scope and potential impact of local level energy transition initiatives, relevant to local as well as national energy-related policies. In response, we developed and applied a technique that explores energy-related activities, in a manner sensitive to place-based socio-cultural differences between citizens and between citizens, market and government actors. Our approach offers several conceptual and methodological contributions. We demonstrate the value of the concepts of *grassroots innovation* and *collaborative governance*, concepts which allow people to better understand *political economic regimes of provisioning* in which they are embedded. We used the concepts productively in participatory workshops. Considering three challenging future energy-related scenarios for the town of Alice Springs, participants deliberated on energy-related activities and prospects for innovation, and identified a subset of "no-regrets" activities worth supporting, irrespective of future levels of economic growth, policy commitment towards energy efficiency standards, and grassroots innovation (Table 2).

To support policy formulation around energy-related issues of long-term consequence, better understanding is needed of the value of participatory applications which use concepts (such as "energy-related activity" in this paper) partly influenced by social practice theory (Sayer, 2013). More understanding is needed of

[9] If undue influence is of concern a controlled design application is appropriate. As opposed to a *tabula rasa* design, the discussion inputs were a sign that the research team had also reflected on the issues, conveying respect for the participants and their time.

how scenario storylines involving energy-related activities could improve outcomes for ordinary and marginalised people (cf. Walker, 2013). Through such understanding and participatory action, energy futures work can become less elite-oriented and technologically focussed, and more engaged with the socio-political and cultural forces that influence policy and regime change.

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