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Carbon profiles of remote Australian Indigenous communities: A base for opportunities

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HIGHLIGHTS

- We model carbon profiles of two remote Aboriginal communities.
- Community carbon profiles were lower than the Australian average.
- We compare stationary energy with a 72-community sample average.
- Low-carbon communities are possible with renewable energy systems.
- Building design and energy source can impact significantly on emissions.

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ABSTRACT

A decision-making model was constructed to assist remote Australian Indigenous communities select appropriate climate change mitigation programs. The Resilient Community and Livelihood Asset Integration Model (ReCLAIM) comprises six steps that focus on community assets and aspirations. The second of these steps is to determine the baseline carbon profiles of communities based on six sources of carbon emissions: materials, construction processes, stationary energy, transport, water systems and waste. The methodology employed an annualised lifecycle analysis of housing materials and construction, and an annual inventory of other emission sources. Profiles were calculated for two remote communities and compared to the Australian average and also average electricity consumption by remote communities in the Northern Territory.

The results, expressed in tonnes of carbon dioxide equivalent (tCO_2-e), showed that average household carbon profiles of the two communities (6.3 and 4.1 tCO_2-e/capita/yr) were generally lower than the Australian average (7.3 tCO_2-e/capita/yr). The stationary energy results revealed that infrastructure and building design could raise fuel consumption and costs, and therefore carbon emissions, despite modest lifestyles. The carbon emission categories differed between the two communities highlighting the need for an individualised approach to understanding the drivers of carbon emissions and mitigation responses.

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1. Introduction

The advent of climate change has seen an on-going concern with carbon management on a global scale. This has prompted a range of responses at the international, national, community and organisational level. The United Nations Framework Convention on Climate Change (UNFCCC) came into force in 1994, with its Kyoto Protocol (KP) (United Nations, 1998) negotiated in 1997. The KP and its extension, the "Doha Amendment" (United Nations, 2012) require the reporting and target setting of carbon emissions by ratifying parties. The KP has created carbon reduction or mitigation mechanisms including the Clean Development Mechanism (CDM) and Joint Implementation (JI) to provide funding for projects in developing and developed countries and international emissions trading. Climate change mitigation responses include both legislative and voluntary approaches at national, community and organisational levels such as renewable energy targets, promotion of energy efficiency, behaviour change programs, and carbon-offset programs (Moloney et al., 2010).

Locally, in Australia, it would appear likely that carbon management activities could provide a range of opportunities for

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remote Indigenous communities, particularly given their wealth of knowledge in natural resource management (Barnsley and Nailsma, 2009). Financial opportunities are of particular interest, as Indigenous Australians are currently economically disadvantaged, earning an average of $465 per week in 2012–13, which is just over half the weekly wage of non-Indigenous residents, and only 48% of labour force age are employed (SCRGSP, 2014).

To date their carbon management opportunities have mainly focussed on broad land management activities (Heckbert et al., 2009, 2008; Russell-Smith et al., 2009), however the potential for energy efficiency and renewable energy projects are also discussed by Barnsley and Nailsma (2009). This paper explores those mitigation opportunities in relation to settlement areas of remote communities in more detail.

Central to these mitigation approaches is the need to measure the emissions and removals related to the applicable entity, activity or object, and a number of guidelines have been produced to prescribe or assist with calculations (see Greenhouse Gas Protocol, 2004, 2014; IPCC, 2006). Therefore, a robust carbon accounting method is required to determine the baseline carbon emissions, the emission reductions related to interventions and resulting emissions or targets. Firstly, for clarity, the terms "carbon profile" and "carbon accounting" are used here to include greenhouse gas emissions and removals, expressed in carbon dioxide equivalents (CO_2-e).

1.1. Carbon profiles in Australia

Based on 2012 national inventory data, Australia's greenhouse gas emissions per capita are estimated to be approximately 24 t CO_2-e/yr, which is almost twice the OECD average (~12.5 t CO_2-e/yr) (OECD, 2014). The nation is one of the highest per capita carbon emitters in the world. In addition to its resource economy, it is heavily reliant on coal-fired power stations (Garnaut, 2008), has high automobile dependence (Newman and Kenworthy, 1999) and has energy intensive buildings and housing (ASBEC, 2008). This would indicate that activities in the residential sector would also be expected to have high carbon emissions.

Carbon profile calculations can differ significantly depending on the boundary and method used (Ramaswami et al., 2008). A study by Fuller and Treloar (2004), based on operating and embodied energy in the home and travel to work energy, calculated that a typical professional couple household would produce approximately 17 t CO_2-e/yr or 8.5 t CO_2-e/capita/yr. A broader consumption-based study by Lenzen and Peters (2010) of high-income professionals, with one or no children, in the cities of Melbourne and Sydney, estimated approximately 80 t CO_2-e/yr per household. Assuming household occupancy rates of about 2.6 persons (Australian Bureau of Statistics, 2013a) this would equate to approximately 31 t CO_2-e/capita/yr.

Carbon profiles of remote Indigenous communities, which include Aboriginal and Torres Strait Islander communities, have not yet been quantified. This is possibly due to residents comprising less than 1% of the Australian population (ABS, 2007) and therefore not being expected to contribute significantly to emission inventories. However, Wood and Garnett (2009) published an assessment of ecological footprints (EF) comparing Indigenous and non-Indigenous populations in the Northern Territory with reference to remoteness. The results, reported in global hectares (gha), showed a significantly lower average footprint per capita for Indigenous people (~6.2 gha) compared to non-Indigenous (~9 gha), with those in remote areas having the lowest (~5.8 gha). They largely attributed these results to Indigenous poverty and noted the challenge of improving living standards without commensurate ecological footprint (or carbon emission) increases. Therefore, calculating emissions at source will assist with an understanding of the extent to which lower carbon profiles are directly related to energy poverty, and whether improving sustainability of infrastructure can contribute to economic development in remote communities. Identifying sources will also determine whether the lower footprint results are replicable in other non-Indigenous communities.

Previous research with remote communities found that a range of concerns, such as poverty, health and the maintenance of traditional knowledge, were deemed to be "interconnected and overwhelming in comparison to climate change" (Petheram et al., 2010, p. 687). Therefore, these more important aspects need to be taken into consideration when compiling and analysing profiles and considering policy implications.

1.2. This research

The focus of the research was the development and testing of a decision-making model: the Resilient Community and Livelihood Asset Integration Model (ReCLAIM). This model aims to empower remote communities to select carbon mitigation programs that build on their existing assets and align with their development goals. The model consists of six interrelated steps:

1. Asset and goal identification with community,
2. Baseline energy and carbon emission profile,
3. Carbon management strategy selection by community,
4. Modelling of selections,
5. Modelled results presented to community for final selection, and
6. Implementation plan.

These steps also allow for policy implications to be elucidated.

The baseline energy and carbon profile of communities was included within the model to help direct programs for asset implementation. It also allowed significant sources of emissions to be identified, relevant reduction mechanisms to be ascertained (if appropriate), and the impact of mitigation programs to be subsequently measured. It was intended that identified mitigation programs could potentially produce carbon credits for trading purposes. While the focus here is on mitigation strategies, adaptation benefits (reductions in vulnerability to climate change impacts) can be concurrently realised (IPCC, 2007).

This paper discusses only the baseline energy and carbon profile (Step Two) of the ReCLAIM model. Six key sources of carbon emissions: materials and construction process, stationary energy, transport, water systems and waste were identified for inclusion in the carbon profile. These six emission sources focus on the buildings, infrastructure and network mobility aspects of settlements rather than personal daily consumption choices. These sources were also the focus of the broader Decarbonising Cities and Regions Project, within which this project was situated, which encompasses four settlement types: urban fringe development (greenfield), urban redevelopment (brownfield), mining camps, and remote Indigenous communities. An overview of that project and an assessment of suitable lifecycle analysis software tools for embodied energy and carbon in settlement structures, including *eTool* (Haynes and Bruce, 2011), which is utilised in this research, is described further in Beattie et al. (2012). It should be noted that as actual data had not been collected at the time of writing the Beattie et al. (2012) paper, only a hypothetical example of a remote community was presented. Further consideration of Indigenous community carbon profiles, including land use, land use change and forestry is included in Stewart et al. (2011). The methodology discussed in this paper to collect, analyse and combine data for the six emission sources is guided by literature review of methods outlined in Section 3.

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