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Context and community renewable energy development in Western Australia: towards effective policy and practice

Emilia Lawonski[1*], Nicole Hodgson[1] and Jonathan Whale[2]

[1] Sustainability, School of Business and Governance, Murdoch University, Western Australia
[2] Energy Studies, School of Engineering and Information Technology, Murdoch University, Western Australia

*Corresponding author: emilia_lawonski@fastmail.com.au

Abstract
Community renewable energy projects are contributing diverse sustainability benefits in a transforming energy landscape, but in Western Australia, projects are few and far between and the state is being left behind in national policy discussions. Drawing upon a socio-technical framework which conceptualises the context of innovation journeys according to patterns in the context, we investigate Western Australia and its major electricity network as a site for community-driven renewable energy development. Our case-study analysis suggests that project development in Western Australia to date has survived in niche pockets, which have been unusually conducive to community energy development, in a context otherwise riddled with political, technical, and regulatory hurdles.

Keywords: Community renewable energy, Western Australia, Distributed generation

1. Introduction
Community renewable energy (CRE) projects differ from traditional energy generation models. These projects are exemplified by an approach to development that encourages open participation by local community members, and creates positive shared outcomes for their communities (Walker & Devine-Wright, 2008). This form of renewable energy development has made notable contributions to the clean energy transition in countries such as Scotland, Denmark and Germany (Bomberg & McEwen, 2012). While currently less than twenty Australian CRE groups are generating energy (Embark, n.d.), there is growing momentum spurred on by an increasingly active community of practitioners, lobby groups and activists, CRE support groups, and enthusiasts. There is also increasing interest in the political sphere as CRE makes its way onto the agendas of governments and major political parties at the state and national level. CRE research and strategy development in Australia has so far focused predominantly on project development issues in the context of the National Electricity Market (NEM), the largest interconnected grid in the country that connects states in the east of Australia (see for example Ison et al., 2012; C4CE, 2015; Mey, 2016). The government funded National Community Energy Strategy discusses key policy and regulatory reform mechanisms relevant to the NEM, while omitting the regulatory and market regime of Western Australia's South West Interconnected System (SWIS) (C4CE, 2015). Although generalisations about CRE development have been made based on prior research, it is not a given that these findings can be readily extended to all Australian contexts. Given the growing interest in CRE in government and politics nationally, policy development requires inputs from a variety of Australian contexts. This paper fills an empirical gap by investigating the context of the SWIS in Western Australia (WA). The SWIS is the second largest electricity network and market in Australia and in contrast to the NEM, is isolated from all other Australian states and has its own unique regulatory regime and market mechanisms[1]. As such it can be expected that CRE projects in WA's south west face a set of distinct conditions that warrant investigation. This paper uses case studies of CRE projects from the geographic region covered by the SWIS to investigate how context has influenced CRE development; exploring the interplay of contextual influences upon CRE development in this setting. The findings suggest that CRE development in Western Australia's south west has survived in niche pockets, which have been unusually conducive to project development in a context otherwise riddled with hurdles of a political, technical and regulatory nature.

[1] An Electricity Market Review was launched by the WA Minister for Energy in Early 2014. As a result a series of reforms to the market and network were proposed. A package of Bills to transfer regulation of the SWIS network to the national electricity regulatory framework is currently on hold (Public Utilities Office, 2017a).

2. Case studies and methodology

A multiple-case study design (Yin, 2014) is used, drawing on four projects located in a geographic area covered by the SWIS network in WA. Through an initial desktop study three community labeled wind generation projects in the SWIS were identified: Denmark Community Windfarm (DCW), the only case-study that is both operational and has strong community credentials; Fremantle Community Wind Farm (FCWF), which is not operational and facing a major hurdle in gaining land access; and the Mt Barker Community Windfarm (MBCW), which is an operational community-scaled wind farm but does not have as strong community credentials as DCW and FCWF. MBCW was included to provide further insights into the issues facing community-scaled projects in the SWIS, and also as a contrasting case. The final case study, the Guildford Energy (GE) solar project, provides insights into a fledgling group struggling with early-stage project development issues and at a much smaller scale than the other case studies. Key case study information is presented in Table 1.

Table 1 – Overview of case study information

	DCW	**FCWF**	**GE**	**MBCW**
Size	2 x 800 kW wind turbines. Maximum output registered at 1.44 MW.	Proposal to build eight to twelve wind turbines. Total output 6.4 MW to 9.6 MW.	Proposed 20-25 kW solar PV pilot project followed by 200 kW PV installation.	Three 800 kW wind turbines. Maximum capacity registered at 2.43 MW.
Cost	Approx. $5.8m AUD.	Estimated at $16-18m AUD for eight turbines.	Unknown (project abandoned late 2014).	Approx. $8.5m AUD.
Location	Rezoned reserve at Wilson Head. Approx. 9km south of Denmark townsite, Great Southern Region, WA.	Rous Head at Fremantle Port. Fremantle, Perth Metropolitan Region, WA.	Guildford, Perth Metropolitan Region, WA. Intention to utilise local factory roof/s, and a local pub for the pilot.	Private sheep farm 4km north of Mt Barker, Great Southern Region, WA.
Status	Operational since February 2013.	Seeking land access.	Project abandoned late 2014.	Operational since April 2011.

This research builds upon Walker and Devine-Wright's (2008) two-dimensional process and outcome framework that conceptualises CRE as a form of renewable energy development which employs open and participatory development *processes* and results in local and collective *outcomes* for their communities (Walker & Devine-Wright, 2008). We developed a series of indicators to systematically analyse the social processes and outcomes of each project to ascertain the community value arising from each approach. A differentiation between this approach and Walker and Devine-Wright's conceptualisation (2008) is the consideration of project scale, which coupled with a project's location, can imply who benefits with regards to energy generated and consumed (Hicks & Ison, 2011). Our analysis draws upon a theoretical framework which conceptualises contextual influences on socio-technical innovation. Rip (2012) builds on the socio-technical transition literature (see Geels, 2005), reframing the multilevel perspective on socio-technical transitions, identifying "general patterns and structures in the context" that exert an influence on project dynamics (2012). The context interacts with project development journeys across three socio-technical layers: niches, provide breathing room for 'radical innovations' by forming 'protected spaces' for experimentation; regimes give the context rules and structuration; and the landscape, comprises social, economic, environmental and material aspects at the macro-level of society, where influences tend to be more indirect (Geels, 2005); and create a "backdrop of opportunities and constraints" (Rip, 2012). This framework is used to investigate contextual influences on both the social processes and outcomes of CRE project development, and on those influences that have other material effects such as those which influence how or if a project physically eventuates in a given context. The study uses a combination of interview data corroborated with documents and a thematic network analysis approach (Attride-Stirling, 2001).

3. Findings and analysis

In 2003 WA led the way in CRE development in Australia with the forming of the pioneering DCW project. Since then only a few CRE projects have emerged in the state, with a majority of projects located in NSW and Victoria (C4CE, 2015). Context has played a part in influencing the project development approaches of our case studies, which demonstrate the community value of CRE projects (Walker & Devine-Wright, 2008). The results in Tables 2 and 3 show that against a set of process and outcome indicators distilled from the data, the development approaches of DCW, FCWF, and GE are significantly community based, indicating socially transformative development approaches. MBCW is only loosely community based; having little community involvement in project development, and the financial benefits, while to some extent local, are not widely distributed throughout the community.

Table 2 – Indicators of open and participatory project development processes across case studies

Processes	**DCW**	**FCWF**	**GE**	**MBCW**
The Vision	Concept emerged from local community; led by core group of prominent locals.	Concept emerged from Fremantle locals passionate about renewable energy.	Concept emerged from Transition Town enthusiasts living in and around Guildford.	Initiated by Perth based renewable energy consultancy.
Community engagement	Broad engagement included workshops, school engagement, site visits and bus tours to Albany Wind Farm.	Extensive engagement through public meetings, workshops, presentations, stalls, events & social media.	Community co-design workshops, presentations and discussions. Leaflet drop.	Local stalls and newspaper advertisement.
Community Participation	Core group of locals volunteer. Local supporters demonstrate their support publicly. Locals invest.	Core project team and supportive community members volunteer, attend events and donate funds.	Core group of local Transition Town enthusiasts volunteer their time, skills and resources.	Little interest in participation and investment from local community. Hundreds attend official opening.
Legal Structure	i) Not-for-profit entity. ii) Public company $500 min. investment.	Co-operative with one vote per member investor.	Transition Town Action Group with no formal structure.	Private company.

Table 3 – Indicators of local and collective project outcomes across case studies

Outcomes	**DCW**	**FCWF**	**GE**	**MBCW**
Community Fund	Community fund of 200,000 one dollar shares to DCW Inc.	Community fund to be established from percent of profits.	Model involved fund for investing in community projects.	No community fund.
Investment Structure	Public company. Local advertising kept investment mostly in the local community (116 shareholders).	Registered co-op limits investment to WA, (option to register in other states). Local investment sought.	Project model involves local community investment (investment model not yet determined).	Private company model comprising twelve investors with ties to the local area.
Other local financial benefits	Locals employed in all project phases. DCW Inc. issued $27, 000 in grants to date + further $20,000 to distribute.	Intention to employ local people. Tourism potential hoped to contribute to economic revitalisation.	Intent to partner with local installer. Intent for local businesses to benefit from cheaper electricity.	Land leased from local farmer. Some local employment during construction.
Capacity building and education	Lessons shared with other groups. New local projects funded.	Locals learn to build a wind farm through project participation.	Core group gained knowledge about regulations and market.	Development experience benefited DCW.
Energy outcomes and scale	Improved local power quality. Approx 30% of local load met[2].	Project scale approximately matches load of Fremantle Port.	PV to offset energy purchased from grid by local businesses.	Scaled to local load. Power sold to state owned retailer.

[2] Early intention was to more closely match Denmark's energy needs with a 2.4 MW wind farm, however after conducting technical studies, the network operator limited the project to 1.44 MW.

3.1 Niche influences: local contexts as CRE Incubators

The analysis did not identify any niches in the strict sense of *actively constructed* spaces that support and protect novel developments (see Geels, 2005). Instead certain localities possessed combinations of characteristics more likely to lead to the development of successful CRE projects. In other words these localities exhibited niche-like behaviour for the purposes of CRE development; albeit the niche conditions were established incidentally. In Denmark, features of the local historical, physical and social context interacted to create a supportive niche for the emergence of a grassroots, community owned wind farm. A DCW director described the town of Denmark as an "incubator" for CRE development, with "a reputation for at least thirty years of being a green town", "visionary can-do people", and the right "physical environment" for a wind farm; emphasising that at the time such a project "wouldn't have happened in most other places in this state" (Interview, DCW 'D2', 2014). A community member described Denmark's interest in sustainability leadership: "there's all sorts of elements of people [who live in Denmark] wanting to show what the future more sustainable lifestyle looks like" (Interview, Denmark Community Member, 2014). The impetus for DCW was about building Denmark's capacity to continue to build on its sustainability leadership: "driven by the community wanting to take charge of energy consumption in such a way that it actually fed back profit back into this community in order to grow our capacity to do more of the same" (Interview, Denmark Community Member, 2014). This is reflected in the community ownership model and Community Sustainable Living Fund, which reinvests project dividends into the community via grants to local community enterprises. In contrast to DCW, while Mt Barker had the right physical characteristics to support the development of a community-scaled wind farm, it lacked those key historical and social features of the local context that drove Denmark to establish a strongly community driven project. Approximately 60 km from Denmark, Mt Barker had a location with a sufficient wind resource and in close proximity to a power distribution line. Those involved in the development of MBCW characterised the town as a "conservative community", which did not show interest in being involved in the project (MBCW 'MB1', 2014). The local attitude appeared to be "great idea, just go away and do it" (MBCW 'MB2', 2014). The developer's perception of the community's attitude of "that's a good idea but don't ask us for any money" influenced the project not to pursue a strongly community-based approach: "it's not that we didn't market for it; there was no evidence that people would actually come in and do that [invest in the wind farm]" (MBCW 'MB1', 2014).

Like the town of Denmark, Fremantle also possesses key niche-like characteristics that have coincided to create the impetus and opportunity for a community owned wind farm development in the port city. The proposed site of the wind farm at Fremantle Port is an iconic location with a proven wind resource, and, being at a major port, is near transmission lines. Like Denmark, Fremantle has a reputation for its sustainably-minded local and progressive community: "the City has a proud tradition of social justice and innovation in environmental management and sustainability (Pettit 2009, 49). For example: "People [that live in Fremantle] are interested in community gardens … [and] renewable energy" (Interview, FCWF 'F1', 2014). As a result FCWF has experienced significant community support ranging from local people volunteering their time and participating at events, to public support from Fremantle's 'green' mayor, and the Maritime Union of Australia, which voted unanimously in favour of the project in a meeting with 700 members (Maritime Union of Australia, 2012). For Guildford Energy, a protected space for conceptual project development emerged through social networks associated with the Transition Town movement. Local Transition Town events were the catalyst for project formation via the coming-together of like-minded individuals, however the niche did not extend beyond this loose social network and was not enough to sustain project development activities against the challenging backdrop of the socio-technical regime of the SWIS.

3.1.2 Macro-protected spaces

In addition to the above incubator characteristics, DCW, MBCW and FCWF experienced circumstances that provided economic protection for project development; afforded by macro-protected spaces reliant on external conditions. If niche conditions depend on a macro-protected space, such as a supportive policy or agreement, and the macro-protected space becomes unstable, the niche will be exposed (see Rip, 2012). A commercial wind development was proposed at Fremantle Port as early as 1997, and received planning approval from the WA Planning Commission in 2002 (Pacific

Hydro, 2003), but never came to fruition due to disagreement around commercial terms for electricity purchase by the Fremantle Port Authority (FPA) (Fremantle Wind Farm, 2016). Project development work completed at the time, including wind monitoring data, geotechnical drilling, grid connection studies and environmental studies, which demonstrate the feasibility of a wind farm at the site, is available to the FCWF project proponents through an agreement with the initial developers. Access to this work, worth over $500, 000 is extremely valuable to the FCWF project, because as emphasised by a director: "We can never do a project like this somewhere else, because we'd have to pay that five hundred grand for that work to be done" (Interview, FCWF 'F2', 2014). The agreement to acquire this work has created a macro-protected space for a wind farm at that particular site, without which the project would not exist.

A federal grant through the Renewable Remote Power Generation Program (RRPGP) was made available to applicants in 2006 to cover up to 50% of the capital costs of renewable energy projects in remote areas. WA was the only state to extend funding to grid-connected projects. The grant criteria limited applications to medium-sized (30 kW – 2 MW) projects located within specific local government shires, and preferenced fringe of grid areas within the SWIS, for which projects could demonstrate potential for improved local power quality and reduced transmission losses (Sustainable Energy Development Office, 2006). DCW fit these specific criteria as an edge-of-grid town with significant power quality issues and large transmission losses, eventually securing a grant of $2.49m. MBCW secured the grant for $4.2m as it was within a listed shire, despite not having power quality issues, or being under 2 MW. The grant was only ever made available for one round of successful applicants who applied in 2006, highlighting the intermittency of policy and the vulnerability of reliance upon macro-protected spaces. As will be seen in section 3.2, reliance on the grant also left DCW vulnerable to changing political circumstances.

3.2 Socio-technical regime interactions

3.2.1 Regime decision-making processes

The major hurdle for FCWF is gaining land access at the proposed site at Fremantle Port, owned by the WA Government and managed by the FPA, which refuses to lease the land. FCWF has thus embarked on a community engagement campaign to influence the FPA to allow the lease. A director stated: "It's almost become a community engagement campaign, more than a wind farm development, which fits with the community ownership model anyway, so that's great. We're building up this head of pressure of people that actually want it to go ahead" (Interview, FCWF 'F3', 2014). The strategy includes demonstrating community support to compel the state government to direct the FPA to approve the lease. Engagement with the Barnett Government, in office in WA between September 2008 and March 2017, proved fruitless and land access was further complicated by a bill introduced before state parliament in May 2016 to privatise the port, a move opposed by the then state opposition.

Similarly, over the course of its ten year development, DCW contended with challenges related to changing local, state and federal governments with shifting policy and funding priorities. DCW engaged regularly with elected members: "we had to re-educate all those three levels of government every time there was an election because every time you'd get a whole bunch of people coming in who knew nothing about it…a pretty major logistics exercise and it took a lot of energy" (Interview, DCW 'D2', 2014). A local opposition group, the South Coast Landscape Guardians, gained the support of local councillors and the Federal Minister for the Environment, Ian Campbell, who announced that the project had divided the Denmark community and later refused to approve the RRPGP grant. In 2005 the local council voted against a town planning scheme amendment to accommodate the wind farm on the 'A' Class Reserve "in order to preserve the amenity and landscape values of Wilson Head", and voted against the excision of the Wind Energy Facility zone even after the council's 2008 Community Survey demonstrated 70% support for the wind farm (Shire of Denmark, 2008). The amendment was a crucial step in securing land access from the state government, so the wind farm committee worked to convince supportive individuals to stand for council: "we actually got a majority of councillors that were in support of the project, and that's through being proactive; we had to get people to stand for council that were pro wind farm" (Interview, DCW 'D1', 2014). The new council composition voted

in favour of the excision, which was subsequently approved by state parliament. Timing was crucial due to a caveat with a deadline placed on the grant, making funding subject to the excision.

3.2.2 Network access and connection

A common thread throughout the interviews was the opinion that dealing with the state network operator with regards to gaining network access and connection is extremely difficult and expensive. A senior electrical engineer stated that the network operator has "some of the most onerous rules in the world...you'll have to do things here that you wouldn't be required to do in Europe for instance...Their engineers I'd say have got a fairly low level of understanding of inverter connected generation...so what they don't understand they throw the rule book at" (Interview, Senior Electrical Engineer, 2014). A DCW director described the network operator as "incredibly obstructive. They'd get us to do studies that we would pay for and they would come back and say 'that didn't work, do you want to do another study?'...that went on three times" (Interview, DCW 'D3', 2014). A FCWF director also described the process as being "set up for project proponents with deep pockets...that fits in pretty well with...all that [project development] work being done before [by the original commercial developer] and us being able to benefit from that" (Interview, FCWF 'F3', 2014). The high cost of undertaking network studies to determine if a project can access the network and at what size is a major risk for CRE projects in the SWIS. GE's community solar project design was underpinned by advice disseminated by a CRE support organisation based in the eastern states of Australia; and the model was based on conditions in the NEM. The GE project group lost confidence in its model; "we found out it wasn't quite that simple" (Interview, GE 'G1', 2014). A significant reason being difficulties associated with network access: "Particularly once we found out that [the network operator] Western Power puts a lot more constraints on you if you're installing anything over 30 kW" (Interview, GE 'G1', 2014).

The cost of physically connecting to the network can also be significant in the SWIS as discovered by DCW, who were required to pay to replace the existing aerial distribution line which was deemed inadequate, and to underground a major portion of the new power line along a snaking road reserve and up to the wind farm; a distance of 1.5km, which was "extremely expensive" (SkyFarming, 2014). Despite there being two turbines at a combined rating of 1.6 MW, the wind farm output was limited by the network operator to 1.44 MW due to the risk of voltage rise issues (SkyFarming, 2014), thus reducing the potential economic output of the wind farm. For the above reasons (and more) the chosen site was described by a DCW director as "fraught": "if the government had paid generators one or two cents more per kWh we wouldn't have put it there – it was the only site that would work if we got a pittance for our energy" (Interview, DCW 'D3', 2014).

3.2.3 Power sales and lack of retail contestability

Customers in the SWIS consuming less than 50 MWh per year are unable to choose their electricity retailer. As a FCWF director noted, the absence of full retail contestability in the SWIS stops the project from "supplying energy to co-operative members" (Interview, FCWF 'F1', 2014). Another director added that "if we could sell power to households it would be easier to get a community project away, because people really do want that; they really do want to be able to buy power from the wind farm" (Interview, FCWF 'F3', 2014). Both DCW and MBCW sell their power to the state-owned retailer via power purchase agreements. For GE, the ability to sell its solar power to the businesses on which it was planning to install its solar systems became prohibitively complex. Without an electricity retail license GE would not be allowed to sell power directly to businesses, unless it was able to obtain an exemption from the *Electricity Industry Act 2004* (Interview, GE, 'G1' & 'G2', 2014). Furthermore, customers under the contestability threshold would not be able to choose GE as their retailer. In August 2016 a new licence exemption framework for solar power purchase agreements (Solar PPAs) was introduced by the WA State Government (Public Utilities Office, 2017b). This new framework should provide greater clarity for future projects modelled on a Solar PPA arrangement.

3.3 Landscape constraints

The network infrastructure of the SWIS can be seen as a component of the socio-technical landscape; an "obligatory passage point" physically enabling and constraining the transport of energy through the network (see Rip, 2012). As shown in section 3.2.2 DCW had no choice but to pay to physically

augment the network to enable electricity to be transported to energy consumers. In parts of the SWIS the distribution network has reached capacity: for example in the Wheatbelt region "capacity restraints in the distribution network are inhibiting the development of energy generation" to the extent that "Small scale renewable distributed generation is likely to be restricted to off-grid installations as the capacity of the local power distribution network limits their ability to feed power back into the grid" (Wheatbelt Development Commission, 2014).

4. Discussion and conclusions

This research demonstrates that CRE development in the context of the SWIS has survived under a set of very specific conditions. Particular local niche-like conditions have driven and sustained a handful of CRE projects within a socio-technical regime designed around an incumbent centralised generation model built heavily on large-scale fossil fuel generation plant owned by both the state and private corporations. The socio-technical regime faced by CRE projects in this context presents hurdles and constraints of a technical, regulatory, and political nature. Macro-protected spaces have been crucial to project success; created by short-lived programs that enabled government grants for capital works to be allocated to DCW and MBCW based on an exclusive set of conditions. Similarly, an agreement between FCWF and a commercial wind developer enabling the group to access previously completed development work at the proposed wind farm site provides a macro-protected space that makes the project economically viable. The findings indicate that while supportive local niches can sustain project activity over extended periods of time, instability in the policy sphere and resistance from within the socio-technical regime can cause significant difficulties and delays for CRE projects in the SWIS. These difficulties are highlighted by the contrasting experiences of projects proposed on state owned versus private land. DCW and FCWF have experienced immense difficulty seeking approvals to build on state land, facing opposition from government ministers, and for FCWF opposition from a state enterprise. Located on private land, MBCW gained planning approval relatively easily and did not face local opposition. This also helps explain why despite significant community support for DCW and niche-like conditions for a CRE project in the town of Denmark, a small opposition group to the wind farm gained political traction, in the otherwise progressive, 'green' town, as the project was proposed on a crown reserve valued by locals. Local opposition in Denmark is in line with Bomberg and McEwen's (2012) findings that a sense of place and belonging based on a 'shared geographic space' can be both a driver for CRE development, and a motivator for active opposition.

Faced with significant difficulties stemming from the regime layer of the context, CRE actors in the SWIS have not been passive actors constrained by their environment. To the contrary, the project actors we interviewed have navigated and 'stretched' the context (Rip, 2012) with the support of their communities, by engaging with socio-technical regime stakeholders and in the case of DCW even physically augmenting the socio-technical landscape of the SWIS network infrastructure, at great cost, to accommodate their project vision. For the GE solar project, the complex regulatory regime became an unsurpassable barrier to further project development, and is a warning sign to new projects to be cautious of project models established in contexts outside the technical and regulatory jurisdictions of the SWIS, and investigate how the context may impact the project before becoming invested in a particular project design. It is clear that the SWIS regime in its current form, including its interconnectedness with the broader WA and national contexts, is not an accommodating place for CRE development. There are however signs that the SWIS is changing and may present opportunities for new CRE projects to arise. For example, the network operator is pursuing a renewable micro-grid to address power reliability issues in the edge-of-grid town of Kalbarri, stating that its engagement process "canvassed the level of support for a community-owned solution", although later resolving that the community preferred a solution led and managed by the network operator (Western Power, 2016). With reliability issues and capacity constraints facing many parts of the SWIS network, win-win solutions like edge-of-grid DCW and community micro-grids have the potential to benefit communities *and* the network. If further benefits of CRE are to eventuate in WA, ongoing CRE strategy and policy development at the national level must explicitly consider the nuances of the SWIS and WA separately to the NEM; tailoring specific strategies for this context. Accordingly, CRE development in the SWIS would benefit from targeted policy development at the state government level, based on an understanding of the intertwining contextual influences that affect CRE projects.

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