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Article

Low Carbon Urban Transitioning: From Local Experimentation to Urban Transformation?

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Abstract: Climate change mitigation remains a contested political and policy issue nationally in Australia. Nevertheless, Australian cities have been actively engaging with low carbon policy for well over a decade and numerous actions and programs have resulted. A question arises as to whether such initiatives can amount to a transition; a systemic change from one dominant fossil-fuel based socio-technical regime, to another, fossil-free based socio-technical regime. In this paper, we review the critical literature on low carbon governance and socio-technical transitions and present a set of criteria by which we propose it is possible to assess the emergence of and/or progress towards low carbon urban transition. We then apply this approach to a case study. The paper presents findings from a review of low carbon initiatives in Australia with a particular focus on Melbourne, Victoria exploring the policy context in which these initiatives and responses have emerged, the typical approaches adopted and the implications for urban change and governance. We examine the roles of, and relationships between, different levels of government, climate change alliances, community/environmental organisations and other actors, and assess progress of the urban low carbon transition. In so doing, we identify significant shortcomings and policy disconnects which we argue are limiting progress towards a low carbon future in Victoria.

Keywords: socio-technical transitions; low carbon governance; urban policy

1. Introduction

Since the Rio Earth Summit in 1992 and the United Nations Framework Convention on Climate Change agreement, there has been a proliferation of responses to climate change driven by a wide range of actors from the transnational to the local level. Cities have become key sites of action with city municipal actors and non-government and community based organisations now playing a significant role in carbon reduction initiatives across the world. The momentum at the local scale can in part be explained by a grassroots driven desire to address climate change and its impacts which has contributed to driving local government responses at a community scale. Municipal authorities have also taken the lead in large part as a response to, and indeed an attempt to put pressure on, weak or non-existent climate change policies at a national level [1]. During the early 1990s, action at the municipal level focused around mitigation initiatives and reducing emissions through regulation, planning, transportation, energy provision and waste collection [2]. While initially involving several hundred cities, now thousands of cities are actively pursuing carbon reduction strategies as part of their governing process. Bulkeley and others [2–8] have documented the roles and actions of cities and their community stakeholders in climate change governance over recent decades and highlight the importance of transnational networks and programs including ICLEI's Cities for Climate Protection (CCP) Program and more recently the C40 Cities Climate Leadership Group and the Clinton Climate Initiative, the US Mayors Climate Protection Agreement, and the European Covenant of Mayors, as a significant feature of "the changing climate governance landscape" [2] (p. 546). While local level mitigation efforts in Australia emerged during the 1990s and 2000s, it was not until the late 2000s that a national response to climate change was articulated. Since the emergence and subsequent demise of the national Carbon Pollution Reduction Scheme there has been a shift in focus at lower levels of government towards adaptation planning, reducing vulnerabilities and building resilience to climate change. The recent bushfires in Victoria and floods in Queensland have highlighted the importance of planned adaptation initiatives. Despite the distinct policy focus on adaptation at the Victorian state level, local governments and place-based organisations and coalitions continue to trial new and innovative approaches to carbon mitigation supported largely by Federal government funding. While there are emerging divisions and a lack of clarity between roles and responsibilities across government, there is clear acknowledgment that both mitigation and adaptation initiatives are complementary and necessary in responding to climate change [9].

Within the climate change policy settings in Australia and Victoria, we focus our attention in this paper on the notion of "low carbon urban transitioning". The ontological starting point for this idea is that a shift from a number of local, unconnected actions to a more coordinated set of actions and policy responses across a range of governing scales is a necessary pre-requisite for systemic change. This has profound implications for strategic urban policy making.

International research suggests that "a transition to a 'low carbon' future implies a large-scale reorganization in the way societies produce and use energy" and "cities are critical in this transition because they concentrate social and economic activities that produce climate change related emissions" [4] (p. 1). Transitioning therefore implies significant transformations in the way we design, plan, and construct the infrastructure and urban form that shapes our everyday lives and our capacities to adapt to and mitigate against the impacts of climate change. If we are to see a transition on a large scale this will necessitate a coordinated and integrated approach to policy and governance and an

alignment of goals across land-use, transport and energy infrastructure planning, and in the design and retrofit of buildings and precincts. Low carbon initiatives across the world have been described as a "patchwork mosaic" [10] and questions remain around the extent to which local scale responses have the capacity to drive the types of systemic changes required. There is now a growing body of research analysing and comparing urban responses to climate change and whether the strategic intent of low carbon transitions and experiments can be realised in different urban contexts [4,11–15]. This paper seeks to contribute to this research by examining the types of local carbon initiatives and experiments emerging in Melbourne, the role and capacity of local governments and extent to which strategic urban policy is helping or hindering the process of low carbon transitioning.

First, we situate our research by briefly defining some key concepts including "low carbon urban transitions", "low carbon urbanism" and "low carbon politics" and review some of the theoretical frameworks informing research on low carbon transitions. Second, we present an overview of the climate change policy settings shaping low carbon responses. We then examine the types of low carbon initiatives emerging in Victoria and Melbourne. We highlight the range of scales, approaches and governance dynamics involved in low carbon transitioning and discuss the emerging trends, shortcomings and disconnections in low carbon urban.

2. Low Carbon Urban Transitions: Definitions and Theories

In the Australian policy context, the role of cities and urban policy in low carbon transitioning is not always made explicit. Despite the acknowledged need for cities to reduce GHG emissions, as stated in the National Urban Policy Framework (2011) [16] the Commonwealth plays a limited role in shaping urban policies and strategies. Indeed, this role fluctuates from an interest in coordinated through mechanisms such as COAG, to no discernable role at all, with the recent dissolution of the Major Cities Unit that produce the National Urban Policy. While carbon reduction is a Commonwealth responsibility, urban policy is the domain of State governments who are responsible for developing strategic plans and regulatory frameworks which guide future development.

Despite widespread recognition that the challenges presented by climate change clearly implicate cities and how we transform energy and urban systems, our analysis highlights the disconnections between urban policies and those focused on climate change. To help explore the explicit role of cities and city actors in transitioning, a recently edited book titled "Cities and Low Carbon Transitions" [4], draws contributions from the field of urban studies and technological transitions to help develop some conceptual frameworks and empirical research on how we might understand urban transitions and the multiple scales and actors involved. It is argued that the "sustainable city" agenda of the 1990s has been replaced with a climate change agenda and the emergence of a new "low carbon urban politics" [10]. This new urban politics involves multi-level (national, regional, local) strategies and actors who are placing climate change firmly within the realm of city strategy and urban policy. The climate change agenda implicates all levels of government, however to date the multitude of urban responses at the local scale, while perhaps contributing to a form of "low carbon urbanism" are characteristically "*ad hoc*', …" in most cases, rather than leading to the development of new forms of urban planning, or to systemic efforts to transform urban systems, what is emerging as a result of these efforts is a patchwork mosaic of low carbon urbanisms—each different in their character, politics and possibilities" [2].

Along with a multi-level governance (MLG) approach another useful framework to inform understandings of "transitioning" is the Multi-Level Perspective (MLP). Geels and others have developed the MLP as a framework for analyzing changes in socio-technical systems and includes three scales: (macro) landscape pressures, institutions and norms; (meso) socio-technical regimes which structure the way particular systems operate; and (micro) niche experiments and innovation [17–20]. Landscape pressures, such as political cultures, economic growth, macroeconomic trends, land use, utility infrastructures exert pressures on socio-technical regimes and "create a broader context of opportunities and constraints within which actors and coalitions of actors operate" [21] (p. 479).

"Regimes are seen as socio-technical in that technologies and technological functions co-evolve with social functions and social interests where technological development is seen to be shaped and potentially shaped by a broad constituency of not only technologists and engineers but also policy makers, business interests, NGOs, consumers and so on where the interrelationships of these interests through regulations, policy priorities, consumption patterns, investment decisions, amongst other things, hold together to stabilise socio-technical regimes and their existing trajectories [19] in [21] (p. 479).

The niche level is where experiments and innovations occur and this typically involve small networks of actors developing and learning about new technologies and processes of innovation. Innovations at the niche scale can work upwards to effect change at the regime and landscape level and vice versa. While the MLP is considered a useful approach for understanding the ways in which urban infrastructure networks may be transformed in response to climate change [4] (p. 3), it is criticized for inadequately accounting for the role of cities or how as a framework it contributes to understanding "urban socio-technical transitions" [21] (p. 480). It is argued that within the landscape-regime-niche hierarchy there is a need to better understand the dynamic relationship between innovative activities within cities and wider national and societal transitions and further, that cities cannot be perceived as simply "receiving" transition initiatives but that they can have a role in purposively shaping and innovating transitions [21] (p. 480). Hodson and Marvin highlight the importance of analyzing the mediating roles of "intermediary organisations and contexts" in understanding urban transitions and the need to examine the politics of whose priorities are dominant and what the implications are for urban transitions [22] (p. 422). "The creation of intermediaries is necessary to constitute a space outside of the obduracy of both existing urban governance regimes and existing socio-technical regimes" [23] (p. 482). This approach to understanding low carbon urban transitions provides a useful framework for examining current initiatives and their potential role in transforming urban regimes. It is concerned with the extent to which, in different contexts, the various actors and coalitions involved are actually working towards a "genuine, radical transition" or just continuing to reproduce the status quo [22] (p. 437). Hodson and Marvin argue that researchers need to focus on the "where" of transitions approaches to better understand the various urban contexts which shape and mediate transitions and importantly identify to what extent socio-technical systems and their transition can be governed and configured at the urban scale [21] (p. 485).

Analytical Approach

What emerges from these frameworks (MLG and MLP) is a conceptualization of cities as complex arrangements of socio-technical systems which are comprised of and co-produced by social and technical elements [4]. These elements include technology and materials; technical systems; political and legal institutions; processes of design; and social practices. This challenges the often siloed policy and governing arrangements which separates energy supply from demand and urban form from transport and buildings. While we may be seeing an array of "niche" scale experiments and innovations targeting some of these elements, we are interested in this paper on the extent to which these may be contributing to systemic transitions. These transitions would necessitate multi-level and coordinated governance around a shared vision for a low carbon future. We would expect to see then the emergence of an integrated policy response at the scale of the city involving a metropolitan-wide, long-term strategy, a strong regulatory framework and a set of actions that aim to systematically transform all socio-technical elements comprising the city. In broad terms an integrated urban policy response would be attempting to better link the "disconnected logics of development" [24] (p. 312).

As a starting point for considering the progress of urban low carbon transitions, we pose the following set of criteria (Figure 1) to interrogate "progress towards" such a transition. These have been developed from our review of the literature on low carbon governance summarized above, together with the work of Hodson and Marvin [21–24] and others on urbanism and intermediaries, and the work of Geels [25] and others on the Multi-Level Perspective and socio-technical transitions.

- The landscape: Alignment between international, national and local economic and strategic goals and urban low carbon needs and practices.
- National Policy: Explicit climate change mitigation policy and consistent bi-partisan implementation.
- Urban Policy: Explicit city role, responsibility and resources for climate change mitigation policy and consistent bi-partisan implementation at the city scale.
- Governance: Explicit and articulated framework for multi-level governance of LCUT strategy and actions.
- Intermediaries: Funding for connected, active intermediary organisations to deliver and network LCUT strategy and actions.
- Innovation: Protected spaces, such as funded innovation/demonstration programs to experiment with, test and pre-commercialise/pre-socialise future LCUT socio-technical arrangements.
- Research and learning: Evaluate, monitor and feed back social change, social practices and the uptake and socialization of emerging and dynamic LCUT socio-technical arrangements.

Figure 1. Proposed criteria in assessing the progress of urban low carbon transitions.

3. Multi-Level Governance in Low Carbon Urban Transitioning—the Australian and Victorian Context

3.1. Policy Settings

Under the previous Commonwealth Labor Government's climate change policy framework the overall aim was to reduce the national carbon footprint by 5% below 2000 levels by 2020 through three main avenues: mitigation, adaptation and international engagement, as set out in Securing a Clean Energy Future [26]. The key mitigation measures outlined included establishing a price on carbon and developing an emissions trading scheme (ETS), improving the energy efficiency of businesses and households, achieving renewable energy targets (RET) and improving on data for greenhouse gas emissions. Adaptation measures focused on developing a national adaptation framework, reforms and information and research. The third pillar focused on international engagement which involved participating in United Nations Climate Change forums and developing international partnerships.

At the time of implementation, the carbon price only applied to the top 500 carbon polluters in the country. Despite the limited direct impact of a carbon price, it generated intense political debate over the implications of increased energy prices resulting from a carbon "tax" on the wider community particularly for businesses and low income households. To compensate for the potential increase in fuel costs, the Labor government funded a range of initiatives including energy efficiency measures through Low Carbon Australia Limited (which was formerly the Australian Carbon Trust from 2001). Alongside the package of energy efficiency measures, a renewable energy target was established aiming to ensure that 20 percent of electricity was from renewable energy by 2020. The RET included both large and small scale renewable energy investors. The uptake of small scale renewables has been significant with approximately 1 million households installing solar photo-voltaics and more than 794,345 solar hot water and air source heat pump systems. The RET is currently under review. Another significant national level initiative was mandatory disclosure (*i.e.*, point of sale disclosure of a buildings energy, greenhouse and water performance) which was put forward as part of the National Strategy for Energy Efficiency (2009). While residential mandatory disclosure never eventuated it does apply to commercial buildings.

The introduction of a carbon price was an important initiative nationally and also internationally as a signal of leadership on carbon mitigation. It proved to be too controversial however in the context of an economic downturn and intense political pressure. The Liberal-National Coalition was elected in 2013 with a key platform to "abolish the carbon tax". The current government while resisting international calls to increase the GHG emissions reduction target (currently 5% below 2000 levels by 2020), has replaced the carbon tax with a "Direct Action" policy which through an Emission Reduction Fund ($2.55 billion over four years) will provide financial incentives for polluters to reduce emissions [27]. Under the previous CPRS mechanism, polluters pay for the amount of GHG emissions they generate. Direct Action instead funds projects that will either lower emissions or offset them such as cleaning up power stations, reforestation, carbon capture, *etc.* The process involves businesses competing through a tender process to win contracts for these projects which will be managed by the Clean Energy Regulator.

3.2. Victorian Policy Settings

The relationship between Federal and state level climate change policy creates both a dynamic and unstable context within which niche or local scale climate initiatives emerge. Up until recently at both the Federal and State levels, carbon mitigation was not a priority at either level of government and any focus on climate change was largely concerned with risk minimisation and adaptation planning particularly focusing at the local level. The recent state election in Victoria however, may start to see a strategic state based response to climate change, which has been missing over the past four years. After a review of the Victorian Climate Change Act in 2010, the Liberal-National Coalition government, repealed the GHG emissions reduction target for the state and subsequently all reference to "low carbon" or carbon mitigation was removed from policy discourse. The state bureaucracy and policy settings were a moving feast over recent years with a number of rounds of departmental restructuring and reviews. The Environmental Policy and Climate Change division previously within the Department of Sustainability and Environment which became the Department of Environment and Primary Industries, was disbanded and called Environmental Policy and included a Climate Adaptation Policy team who were responsible for writing the Victorian Climate Adaptation Plan (2013). The state governments funding program, the Sustainability Accord, which has supported local governments and community groups in delivering mitigation projects and other sustainability initiatives became almost singularly focused on funding only adaptation initiatives. Alongside adaptation, resource efficiency, which includes energy efficiency (EE) did remain a concern for government and was included within the "business and innovation" portofolio rather than climate change. Sustainability Victoria (SV), which is the state governments program delivery agency for environmental initiatives, became more narrowly focused around resource efficiency initiatives including retrofitting programs targeting commercial buildings, schools and households through information provision, rebates and incentives. This reduced scope for SV also saw the axing of its "climate communities" program was important in funding a range of local government and community based initiatives.

Over the next four years, under a new Labor government who were elected in Victoria in November 2014, climate change policy is likely to become more prominent as a key policy issue. The Australian Labor Party's (ALP) policy platform states that "Labor will ensure that Victoria is the leading Australian State in dealing with and responding to climate change. This includes focusing on emissions reduction, utilising targets, implementing energy, efficiency measures, creating a Green Jobs Action Plan. Labor is also committed to reduce greenhouse gas emissions over the longer term in line with the science" (ALP 2014: 80, 81). It goes on the list a number of ways that Labor intends to deliver on these objectives including introducing legislation to allow local councils to help finance commercial building energy efficiency measures (similar to the City of Melbourne's 1200 Buildings Initiative); support initiatives to mode-shift transport away from cars; introduce energy efficient urban design; expand programs to reduce demand for energy, and so on. In broad terms, this amounts to a return to climate policy settings that existed under Labor government predecessors including a return to "restore, update and strengthen the Climate Change Act" [28] (p. 82).

Against this backdrop of upheaval and uncertainty at both federal and state levels around climate change policy, there has continued to be a growth in local government and community scale initiatives particularly focusing on energy efficiency, building retrofits, behaviour change programs and renewable

energy projects [15,29]. We turn in the next section to focus on the types of initiatives emerging in Victoria and in particular on local government partnerships and alliances as key intermediaries working across levels of government and municipal boundaries, seeking to build capacities to achieve socio-technical change in their particular regions. Victoria is unique amongst other Australian states in having introduced another tier of regional governance albeit voluntary to address climate change. There are ten regional climate change alliances, involving 70 of a total 79 Victorian councils, each unique in arrangement and function, but significant in driving regional level co-ordination and innovation across the state. The Alliances were initiated by the Regional Partnerships Program as part of the Victorian Greenhouse Strategy released by the state Labor government in 2002. These regional alliances vary in their arrangements and ambitions however they are largely comprised of a council based membership with aims to work in partnership within their regions to improve energy efficiency and the take up of renewable energy as well as work with their communities to become more resilient to climate change [30]. After a review in 2006 the partnerships program was considered a success at building regional alliances and continued to be funded by the Labor state government allowing alliances to focus their efforts on developing greenhouse abatement measures to address their specific needs; building the capacity of local governments, engaging the community and the private sector in greenhouse abatement and partnering with government in the delivery of state and commonwealth greenhouse programs and improve the integration and targeting of government services and programs [30]. These alliances are emerging as important intermediaries in low carbon transitioning in Victoria particularly in driving regional strategy processes, applying for grants and coordinating the implementation of initiatives. They are also acting as lobbyists and advocates for improved data gathering to assist in future planning and assessments and have a role in building knowledge and technical capacities across their member councils and partner organisations. Despite this important governance role, they do not have any formal place within the governing hierarchy and are dependent on local member fees and grants for their continuing work.

3.3. Low Carbon Initiatives in Melbourne, Victoria

This section draws on a desktop review undertaken in 2013 of low carbon policies, strategies and initiatives focusing on Victoria. The review involved an internet search using the terms “low carbon”, “carbon reduction”, “mitigation”, “climate change and urban” and targeted particular government and organisational websites. We gathered over 60 entries, some relating to multiple initiatives. We did not list each local government in Victoria (of which there are 79) but we did include the climate change alliances which incorporate 70 councils. Including all local government initiatives would expand the list significantly. The intention was not to build a comprehensive list but to gather a wide range of data in order to understand the typical responses and approaches adopted by different organisations and levels of government with a particular interest in the socio-technical and spatial dimensions of those initiatives. This resulted in four categories that we would argue fall within the realm of city strategy and urban policy, these include energy infrastructure, urban form and transport, buildings and households (people). We have not attempted to provide percentage breakdowns of initiatives according to each category as this would require further development of the database. This analysis was intended as a mapping exercise to first understand the types of low carbon initiatives emerging and to assist in developing more in-depth

research exploring the extent to which we may be seeing systemic transitioning in the context of Melbourne, Victoria.

In Table 1 we map the policy priorities and a range of actions/initiatives at each level of government according to the four categories. While the national level has been significant up until 2013 in driving action around climate and energy policy broadly, the majority of initiatives emerge at the local/regional and community scales where the responsibility for delivery and implementation clearly lies. As the politics of climate change shifted at the federal and state levels, local governments and communities have continued to pursue often piecemeal and short-term funding, to drive a range of initiatives and local government alliances have emerged as playing a key coordinating role across councils particularly driving regional "zero net emissions strategies", energy efficiency projects (buildings) and community engagement and training (people).

In Table 2, we outline the typical aims and approaches across low carbon initiatives, which target three main areas; energy infrastructure, buildings and people and typically use a combination of techno-efficiency measures, financial/market measures, and behaviour change through information provision and various attempts at persuasion. Energy efficiency and demand management strategies typically employ all of these measures however there is almost consistently a separation between buildings and the people using them. Buildings are assessed according to computer models measuring thermal performance, heating and cooling systems and appliances resulting in technical and product based solutions to improve efficiencies. When people are considered at all, they are encouraged to change their behaviours by taking up a set of actions. These approaches are common across many local and community-driven low carbon initiatives [31]. We argue this indicates a lack of integration of policy and of institutional learning about how systemic change may occur.

In considering the extent to which any of these initiatives may represent a shift in urban socio-technical regimes we can make some observations. Victoria has a number of significant niche scale initiatives that are transforming energy use in their particular contexts, for example, the Hepburn Wind Farm initiative which is the first community-owned wind farm in Australia, and generates enough power to service 2300 households. As a community driven initiative with some funding from the previous state government, it emerged in response to a lack of leadership from both State and local governments [32]. We would also argue that some of the regional climate change alliances are also significant in building regional scale capacity and strategies, which are seeking to challenge existing energy provision regimes, involve multi-pronged strategies in collaboration with a range of actors (e.g., see alliances including NAGA, WAGA, CVGA, SECCCA). The Moreland Energy Foundation (MEFL) is another example of an organisation supported by a local government that is driving innovation in community engagement through multi-cultural initiatives and experimenting and trialling approaches to shift energy use in households and other sectors. The extent to which these place-based and regional scale initiatives can or will drive broad scale urban regime change remains to be seen however, it could be argued that they do represent innovative "niche" scale or experimental responses which explicitly aim to challenge constraints including planning regulations and energy provision. As intermediaries in low carbon transitioning, they have proven to be significant in the Victorian context, in driving action and innovation, building local coalitions, developing skills and capacities of member organisations and securing on-going funding to continue their projects and innovations. That said, they are constrained by short-term funding grants and the dynamic and unstable policy context that supports their work.

Table 1. Multi-level governance and spatial dimensions of low carbon urban initiatives.

Governance and Spatial Scale	**Climate Change and Energy**	**Urban Form and Transport**	**Buildings**	**Households and People**
National	- Carbon price and ETS *(NB. Abolished by Coalition)* - Renewable target (RET) and funding (under review) - Energy Efficiency funding grants	- National Urban Policy Framework - Infrastructure funding	- Rating Schemes - Mandatory Disclosure - Energy Efficiency of commercial buildings - Insulation scheme	- Energy efficiency funding to local and community level groups and businesses - Rebates and incentives
State	- Adaptation framework - Managing risk - Fossil fuels over renewables	- Limited planning regs and policy - Roads over public transport	- Energy efficiency commercial and residential buildings	- Limited community engagement programs
Regional	- Regional Strategies and Collaborations - Mitigation and adaptation measures - Street lighting	- Public transport advocates - Planning reform advocates	- Energy efficiency of council owned buildings, businesses and residential	- Community engagement and information - Household behaviour change - Audit/Retrofit schemes
Local	- Adaptation planning - Energy efficiency - Community leadership	- Implements state level planning policy - Local/precinct design - Local transport planning (cycle/walkability, *etc.*)	- Council buildings energy efficiency retrofitting - Small scale renewable initiatives and precinct dev	- Training and workshops - Energy Efficiency - Auditing - Retrofits - Education - Information
Community groups and other (e.g., advocates, consultancies, social service orgs)	- Range of expertise and agendas - Social welfare agenda—low income households - Consultancies—services to orgs and councils (*i.e.*, carbon accounting, strategies, *etc.*	- Place-based strategies - PT Advocates - Activists - Campaigns	- Innovative designs and experiments	- Auditing - Retrofits - Education - Information Renewables—wind, solar initiatives

Table 2. Low Carbon Initiatives by "Target".

Target	Aims	Approaches/Mechanisms
Energy Infrastructure	- Increase renewable energy (solar PVs, wind, co-generation)	- Project finance/grants - Rebates/feed-in-tariffs - Investment in technologies - Community owned energy - Wind farms - Co-generation projects
Buildings	- Improve energy efficiency and thermal performance of council and community facilities - Improve energy efficiency and thermal performance of new build and commercial blds	- Star rating—building regs. - Financial incentives - Grants - Information and training
People	- Demand management—peak load, *etc.* - Energy efficiency for low income households - Encourage people to live more sustainably (e.g., buy more efficient appliances, use less energy, use car less, *etc.*)	- Community based training and workshops—take up actions - Information provision - Financial incentives (*i.e.*, rebates) - Household auditing and minor retrofitting (e.g., light globe replacement schemes)

In reflecting on the extent to which these initiatives constitute a form of transition in low carbon urban policy, there are some significant gaps. While role of local governments and the coordinating role of local government alliances has been critical in driving climate change responses at the urban scale, there is no metropolitan and state wide policy that can in the words of [24] (p. 312) "better link the 'disconnected logics of development'". Local scale climate change responses which focus around energy efficiency and behavioral change, while important, continue to operate in a piecemeal way and outside the regime governing land use planning, transport and energy infrastructure provision. The latest state government metropolitan strategy, for example, "Plan Melbourne" [33] acknowledges that urban form and transport are important in reducing greenhouse gas emissions and reducing energy consumption, however it offers little in terms of a vision or an approach to urban development that radically alters the current development pathway [33]. As we identified earlier, if we are to see a transition to a low carbon city, we would expect to see through a metropolitan plan some alignment of goals across land-use, transport and energy infrastructure planning, and in the design and retrofit of buildings and precincts. While Plan Melbourne aims to direct future growth towards established areas and create a "20 min city" to reduce car trips, there remains minimal investment in public transport particularly in outer areas where there are little or no services and a continued priority given to road infrastructure. The Plan does include some reference to energy efficiency under Direction 5.7 which aims to: "Reduce energy consumption and transition to clean energy" [33] (p. 129). The Plan appears to emphasise an enabling role for the State government to assist local government and the private sector to implement energy efficiency programs and measures (e.g., similar to the City of Melbourne's 1200 Buildings Program), however the details behind how this will occur are unclear. In the absence of a clear vision and long-term plan for metropolitan growth, initiatives at the local government scale are constrained particularly around driving broad-scale urban policies shaping urban form, densities, design and transport infrastructure.

4. Discussion: From Piecemeal to Strategic Change: Governance and Policy Disconnects

In considering the question of whether we are witnessing broad-scale urban (regime) transformations we have identified some significant shortcomings around governance and leadership as well as policy disconnects which we argue are limiting progress towards a low carbon future in Victoria.

Returning to our seven criteria outlined in Figure 1, the following shortcomings are apparent:

- 1–3: Landscape factors are poorly aligned to low carbon agendas; *climate change policy* is contested, and there is no explicit *city role in climate change action*, amounting to a lack of systematic transitioning and governance. In particular we refer the lack of political leadership and co-ordinating policy at the state government scale and to some extent the national scale in driving more systematic urban retrofitting and urban/transport planning.
- 4: Multi-level and multi-spatial governance strategies are generally lacking, associated with disconnected and conflicting policy settings. For example, energy efficiency agendas at local and state levels conflict with state energy policy which supports the continued growth in the fossil fuel industry, and; sustainable transport policies at local level conflict with continued focus on private transport-led road construction. Across buildings and urban policy there is a disconnection between piecemeal energy efficiency strategies; regulations targeting buildings; urban development policy and planning; and transport policy.

- 5–6: Identifiable, resourced roles, and a "patchwork mosaic" [2] of intermediary organisations/actors with low carbon aims and objectives is largely missing outside local government alliances. Likewise, innovation "niches" for "experiments" with low carbon governance and practice are *ad hoc*.
- 7: Social practices and elements of practices are generally missing in the shadows of policy cast by the dominant hegemonies of technical efficiency, market rationales and human behaviour models. Understanding people and "socio—technical" change does not feature in policy settings or programs. Targeting of people typically through information, training and financial incentives shows limited understanding or capacity to address the factors shaping and constraining people's everyday lives (e.g., technologies, housing, urban form, transport, skills and competencies, meanings and norms). There is also little research understanding or monitoring social change or the social dimensions of attempts at climate mitigation actions, and hence no opportunity to feed this back into policy making or action planning.

Taking each briefly, the first concerns the lack of systematic transitioning and governance to steer broad-scale transformations and the concern that low carbon initiatives are tinkering around the edges. Landscape pressures include a lack of international consensus on climate change policy and carbon markets, and a heightened reliance upon international free-trade and liberalized markets in the face of a global downturn. These have fuelled a roll-back from action on pricing carbon and political contest. In this respect, and not-withstanding the importance of local and regional collaborations, the types of responses in Victoria could be considered piecemeal or patchwork in nature, with no clear metropolitan scale action.

The second issue refers to the lack of coordination across places and governance scales, illustrated by the ongoing commitment from state government's plan to continue our reliance on Victoria's coal based fossil fuel industry to supply our electricity (currently provides 95% of stationary energy in Victoria) reflected in the following statement: "Victoria has one of the world's most extensive brown coal deposits and the Coalition Government is committed to maximising the opportunities to develop this resource in support of economic development, investment and job creation in the Latrobe Valley" [34]. The policy disconnect in carbon and the built environment is also striking. While the building code has established a 6-Star energy rating for new buildings and renovations, Victoria's policies guiding urban growth, densities and sustainable transport provision and systemic urban retrofitting are weak. Even though the latest metropolitan strategy for Melbourne, Plan Melbourne will likely be replaced under the new Labor government, without significant changes to the current planning system governing land-use and a commitment to implement a long term strategy to contain urban growth, invest in public transport and renewable energy then broad-scale low carbon transitioning will remain significantly constrained. Policies and processes for low carbon transitioning involves changing both hard (physical infrastructure) and soft (institutions and processes) systems and means confronting and challenging various forms of "lock-in" that can be embedded within these systems [35]. The legacy of land-use and transport systems already in place presents an enormous challenge to low carbon transitioning.

The third issue concerns the lack of low carbon intermediaries, and lack of structured spaces for experiments in low carbon responses. While there are programs such as the Victorian Energy Efficiency Target (VEET) scheme these are not linked to coherent national policy settings. The stalling of Mandatory

Disclosure is an example of the ad hoc nature of building retrofit policy and the roll-back of structured schemes to support insulation and domestic-level PV systems and feed-in tariffs provide a foundation for intermediaries and niche experiments that resembles quick sand more than it resembles anything upon which to base a business or a long term strategy for building professions, institutions or long term low carbon goals.

The fourth issue concerns the limitations of the socio-technical divide that exists between approaches: techno-efficiency measures and a "rational choice" approach to behaviour change. Energy efficiency focuses largely on technical solutions to reduce energy use (and the financial savings that result) and behaviour change relies upon individuals to take up "actions". While some efficiency gains will be achieved through technical measures, social change framed in this way, will ignore the multitude of ways that unsustainable practices and patterns of development can continue business-as-usual. For example, encouraging people in greenfield areas to reduce their car use is a waste of time if we continue to plan new suburbs with little or no alternative transport options. Likewise, reducing energy use in houses with rapidly increasing floor areas driven by the latest trends in renovations and designs is also challenging. Instead we need a broad understanding of the complex elements comprising our daily practices and target those elements not necessarily the attitudes of individuals.

5. Conclusions—Low Carbon Urban Transition?

The Multi-Level Perspective has its limitations as a tool for understanding socio-technical transitions, but as demonstrated here, it can provide a useful insight when supplemented with ideas of social change, governance processes and, within these, the roles of intermediaries. As a result, in contrast to commentary about progress in greening technologies, the authors conclude that progress of the low carbon transition is minimal and prone to rapid reversal or stalling. Rather than coherent multi-level governance, the low carbon urban transition in Victoria, Australia, is currently characterised by *ad hoc*, divergent actions. The Federal government's role in low carbon urban transitioning has largely manifested through renewable energy initiatives and through grants targeting energy efficiency at the local government and community scale. In the absence of long term bipartisan policy settings, these national initiatives are transient and this has profound implications for low carbon transitioning. The policy landscape is such that the Victorian state government has focused its role on adaptation rather than mitigation, and in energy savings through efficiency rather than carbon reduction. Implementation, such as it is, is delivered through local government.

Multi-spatial governance is emerging in a nascent form via the local government greenhouse alliances, involving coalitions of organisations and actors from the government, business, social services, environmental and research sectors. Through the Federal energy efficiency grants funding process, organisations at local and community scales are enlisted to compete for government funding which to some extent has helped drive coalition building as this is part of the bid process. The emergence of regional climate change alliances in Victoria is, we would argue, a significant feature of this state's "low carbon" policy and is a form of governance that is helping to drive changes at both the niche and to a lesser extent regime scales through energy infrastructure projects, regional scale urban retrofitting and capacity building initiatives. As intermediaries they are contributing to creating spaces outside the obduracy of both existing urban governance and socio-technical regimes.

In terms of the extent to which we might consider the range of low carbon initiatives we have reviewed in Victoria as contributing to a "genuine radical transformation" or reconfiguration in socio-technical systems and urban form, low carbon transitioning is unstable, localised and transitory. Current energy efficiency measures can be described as piecemeal and continued support for fossil fuels and urban policies that prioritise roads over public transport provide for a conflicted low carbon policy framework. This said, we recognise that socio-technical transformations occur over time and there are signs that at the local and regional scales there is a growing capacity and willingness to transform people and places. This initial analysis has opened up a number of important avenues for future research, particularly around the role and significance of regional climate change alliances and similar initiatives globally and the extent to which new informal governing arrangements can transform socio-technical regimes.

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Author Contributions

Both authors co-designed the research, Susie Moloney carried out the research and analysed the data and both co-wrote the paper.

Conflicts of Interest

The authors declare no conflict of interest.

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