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Keywords

governance, local, cities, retrofitting, australia, sydney

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Retrofitting Cities: Local Governance in Sydney, Australia

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Abstract

Transforming cities to a lower carbon future is one of the key challenges of contemporary urban governance. Retrofitting the city – or modifying existing urban infrastructures, buildings and daily life to suit different energy sources and different expectations of energy consumption – is essential to this transformation. In urban studies, little focus has yet been applied to the shape and character of urban governance frameworks and mechanisms required to successfully retrofit cities. In this paper we address this lacuna by exploring the logics, practices and dynamics of retrofitting governance in the Australian city. Using a governmentality perspective, the paper identifies the involvements of different scales of government in retrofitting policies and mechanisms and connections between them. Based on a unique survey of carbon reduction initiatives involving government, business and community actors across Australia's capital cities, we outline the types of retrofitting solutions being proposed and enacted. Using a focus on local initiatives from Sydney, Australia's largest city, the paper documents four key techniques through which retrofitting is being governed – self-governing, holistic, facilitative and educative. The findings suggest that governance gaps remain in attending to the daily life of technologies and the materiality of daily life.

Introduction

Cities are critical to transitions to low carbon futures, not only because of the large and growing global urban population but also because global resource consumption is concentrated in cities (Gossop, 2011:208; Hodson, Marvin, Robinson, & Swilling, 2012; Monstadt, 2007). Ensuring that new urban spaces, such as new housing or new city precincts, are low or zero carbon is central to these transitions (Hodson & Marvin, 2010). Equally important to reducing urban carbon consumption is the retrofitting of existing urban planning frameworks and imaginaries, infrastructure, built form and patterns of daily life (Eames & Dixon, 2012; Pincetl, 2012). Retrofitting involves the modification of what already exists in cities: altering the ways in which existing buildings are heated and cooled, diverting households, businesses and organisations toward renewable sources of energy rather than fossil fuels, encouraging the take up of energy efficient appliances, altering urban infrastructures of energy and transport provision toward renewable sources.

Retrofitting is both a social and a technological challenge. Technologically, it involves the installation of a diverse range of new or upgraded zero or low carbon technologies to the existing urban fabric. These include, often in combination, new forms of building insulation to minimise heat transfer between the inside and outside of buildings, more efficient lighting and heating (e.g. heat pump rather than electric hot water systems) and micro-generation of energy supply. Retrofitting technologies can be applied at a number of scales. These include individual buildings, clusters of buildings, precincts, entire local authority areas, or supra-urban systems of energy infrastructure. In the Australian case, for example, where 60% of carbon emissions are generated by energy use and 75% of electricity generation is coal-fired (Australian Government, 2011), micro (ie individual building) installation of solar PV is the most common retrofitting technology. Retrofitting is also a social process in which technologies are adopted, accommodated and altered by urban actors. The behaviours and choices of individuals have a potentially profound impact on the effectiveness of technologies. For example, a recent Cambridge study suggested that attention to behaviour change can double the energy savings of retrofitting (Markusson, Ishii, & Stephens, 2011).

Surprisingly, given the importance of retrofitting to the achievement of low carbon cities, and the voluminous literature on urban carbon governance (Bulkeley & Castan Broto, 2013; Rice, 2010; While, Jonas, & Gibbs, 2010), explicit focus on enabling retrofitting through governance is rare. There is some analysis of programs that encourage retrofitting at household or building scales (see Deakin, Campbell, & Reid, 2012; Ghosh & Head, 2009; Kelly, 2009; Sunikka-Blank, Chen, Britnell, & Dantsiou, 2012), but little consideration of what institutions and mechanisms might best enhance cities' capacities to adopt retrofitting technologies and behaviours. This paper hence provides a theoretical framework for understanding the governance of urban retrofitting as well as empirical answers to the question of the character of retrofitting governance. Specifically, we develop and implement a framework for understanding the governance of urban retrofitting that considers the assemblage of institutions, materials, agencies and mechanisms that might enable the transformation of cities. This framework is outlined in the first section. The paper then explicates retrofitting governance through the example of cities across Australia, beginning with an overview of the governance of urban retrofitting from the perspective of state and national policies in the second section. Here, despite the absence of a holistic vision for retrofitting urban environments, we document a patchwork of programs, policies and interventions that attempt to retrofit existing urban infrastructures for a carbon-constrained future. The third section presents a more detailed examination of retrofit governance at the 'sub' urban scale, using an audit of local scale retrofitting initiatives in Australia's largest city – Sydney – to develop a typology of means or techniques through which retrofitting is governed. We conclude with an analysis of the limitations of retrofitting governance as currently practised.

Governing Urban Retrofit

Our purpose in this section is to provide the conceptual tools to understand how and by whom retrofitting is governed in the city. We start with the notion that retrofitting is a socio-technical process. By this we mean that retrofitting not only

requires the application of technologies, but also the adoption and accommodation of these technologies across diverse sites and spheres. Conceived in this manner, retrofitting raises questions not only of technological performance and individual behaviour, but also of the means through which the co-production of socio-technical systems is fostered and directed. Coupled with the diversity of sites (e.g buildings, infrastructure systems) and actors (e.g. businesses, individuals, NGOs) through which retrofitting occurs, we hence turn to three dimensions of urban carbon governance to frame an understanding of retrofit.

First, we consider governance as multi-scalar: institutions governing carbon in the city encompass and exceed the urban scale, folding into and through each other in complex ways (Betsill & Bulkeley, 2006). There is therefore no one centre of governance as such, but rather the governing of retrofit takes place through shifting constellations. Actions of transnational networks have shaped urban responses to climate change, for example, as have national scale policies. The diverse initiatives of local authorities are also critical: urban authorities have driven emissions reduction and low carbon transitions through a diverse array of action (Betsill & Bulkeley, 2007; Hoffmann, 2011). Thus in what follows we highlight multi-scale responses to the retrofitting challenge.

Second, urban carbon governance is carried out by both state and non-state institutions. Divisions between public/private authority in urban governance are being reconfigured, as boundaries between public and private authority are reconfigured, including local forms of authority (M^cGuirk & Dowling, 2009; Schroeder & Lovell, 2011). In other words, governing is a dispersed form of rule that cuts across conventional public/private spheres. Governing occurs through an assemblage or alignment of diverse actors, interests and institutions as well as materials, artefacts, that enable programmatic aims to be achieved (Li, 2007). In the case of retrofitting, recent work has suggested that considerable effort is required to assemble institutions capable and willing to implement retrofitting, and that the motivations of these institutions are often divergent (Deakin, et al., 2012; Schiellerup & Gwilliam, 2009). Extending this idea, we suggest that the task of retrofitting governance is to orchestrate a supportive policy framework in which builders,

energy retailers, appliance and car manufacturers, infrastructure providers and householders may consider and embrace the possibilities for retrofitting. In simple terms this means that retrofitting technologies need to be taken up by, and are also mediated by, two central groups of stakeholders: those responsible for building the city (builders, developers, landlords, homeowners, governments) and also those that inhabit these spaces (residents, building tenants, workers, organisations, members of the public etc.). In our empirical analysis we are hence alert to this 'dispersed nature of rule' (Ekers and Loftus, 2008: 703) being enacted in pursuing retrofitting objectives.

Third, building upon insights that have been highly productive for understanding urban responses to climate change, governance is enacted through the 'conduct of conduct' (in relation to climate governance see Keskitalo, Juhola, & Westerhoff, 2012). By this is meant that shaping how an issue is framed, its objects or materials aligned and, crucially, its subjects and their practices enrolled are central to governing (Paterson & Strippel, 2010; Whitehead, 2009). In relation to retrofitting there are two key targets of this 'conduct of conduct': those shaping urban infrastructures and built environments and those who inhabit them. The first relates to the systems of provision that shape cities; entities responsible for generating the provision of retrofitting materials and technologies, supporting the development of markets, technologies, business models, skills, expertise and so on. Retrofitting, therefore, requires changes in conduct within the 'systems of provision' that shape urban sociotechnical systems. The second target relates to the adoption and accommodation of these new and upgraded technologies into the routines and cultures of daily life (Glad, 2012); the adoption of new behaviours and shifts in behavioural norms or hegemonies. This in turn means that the governing of behaviour change is critical in retrofitting just as it is in diverse other fields of low carbon transitions (Hargreaves, 2011). Here, the governance challenge for retrofitting is to encourage individual householders, workers and organisations not only to retrofit their respective spaces materially (dwellings, commercial buildings, vehicles), but also to accommodate and embrace retrofitting technologies into daily practices of residents, organisations, workers, and travellers. Of most interest in this

paper are the specific mechanisms and techniques through which conduct is shaped (Dean 1999; Li 2007). We know from studies of other dimensions of urban carbon governance that these may be mandatory standards and regulation, but can also be voluntary agreements, education packages, subsidies and other indirect measures (see Tambach, Hasselaar, & Itard, 2010). The question of which mechanism prevail in the governance of retrofitting remains.

In what follows we use this framework to capture the multi-scalar, multi institutional and multi-mechanism dimensions of governing retrofit. Whilst principally interested in local-scale governance, we see this as constituted by actors at local and non-local scales. We are also alert to the importance of context in shaping governance limits and possibilities, and attend specifically the broader Australian context in the next section. We conceive of governance as occurring through both state and non-state actors, as well as partnerships. And finally, we are interested in the mechanisms and techniques of governance as a means through which conduct is ‘conducted’. These conceptual tools, as the analysis will show, bring to the fore both the potential and pitfalls of governing retrofit.

Positioning Retrofit in Australia’s Multilevel Climate Governance Context

In terms of state institutions, three ‘levels’ of government shape Australian cities: national, state and local. Across the first two of these, the profile of retrofitting is currently riding high. An array of policies and programs seek to encourage and instigate retrofitting practices across the city. Table 1 presents a schematic summary of these policies and programs in terms of their focus (who/what) and mechanisms (how), which we summarise here. In terms of focus, suites of programs are directed at five distinguishable sectors that encompass the city both as corporate and ‘everyday’ space: the energy sector; government; community organisations and not-for-profits; householders/residential building owners; and businesses (both large and small-to-medium). The most common focus is government—initiatives to support the retrofitting of government buildings and operations. Least common are programs that target energy supply infrastructure. Each of the remaining three

foci—other community organisations and non-profits, households and businesses—are of equal prevalence, though are governed in different ways. Collectively, these programs drive the installation of retrofitting technologies.

Across both federal and state programs governing at a distance is most prevalent, manifest in programs that set the framework for the supply and demand of renewable energy and thus seek to encourage the uptake of renewable energy retrofit technologies across all sectors. For example the Federal Government's Renewable Energy Targets policy sets the framework for the supply and demand of renewable energy, requiring energy retailers to provide 20% of their energy through renewables. This means of governing retrofit is aimed predominantly at shaping a new system for the provision of retrofit and deploys target-setting and monitoring as techniques of 'performance', which also include various forms of calculation, target-setting, and audit and that are regarded as central to the workings of advanced liberal government (Dean, 1999). The array of concrete initiatives that fall under the umbrella of these policies use a number of mechanisms: regulation (via mandatory measures and marketised mechanisms); grants, rebates and subsidies; rating systems; targeted information and advice services; voluntary agreements; and funding for projects that demonstrate retrofitting processes and outcomes. Such techniques include those of 'performance' but also of what has been termed techniques of 'agency', through which new forms of conduct and subjectivity are enabled and sustained and which include mechanisms to enrol participation, material artefacts that script new practices, forms of partnership and so on (Bulkeley, Watson, & Hudson, 2007). Performance standards for building and appliances and grants to install retrofits in non-residential buildings are the most widely deployed, reflecting the mix of attempts to govern both directly and 'at a distance'. Though not widely deployed, subsidies primarily fund the development of information and advice services to underpin the installation of retrofitting technologies and wider energy efficiency measures. Several of these include subsidised audit services, whereby measurement becomes a first step towards mobilising retrofit for energy efficiency. Retrofitting the system of provision is hence

governed predominantly through acting at a distance and with a reliance on information provision.

Equally important are the multitude of grant schemes that fund the retrofitting of government buildings. For instance, in 2012, the NSW government announced a program of investing \$6.4m to retrofit 150 of its buildings (e.g. ambulance stations, courthouses, motor registries, police stations, hospitals and train stations) for energy efficiency. Community organizations and Not-for-Profits are also primarily governed through installation grants working across diverse aspects of the built environment. For instance, the Federal Government's Community Energy Efficiency Program in 2012 and 2013 provided co-funding for 63 retrofitting projects across the local government and Not-for-Profit sectors (eg organisational premises, public facilities, street lighting). Grant funding is a technique that both demands particular forms of performance, conforming with program goals, auditing the results of investment, and demonstrating improved performance, but also enables new forms of social and material agency.

Programs that seek to influence retrofitting in households and businesses use an array of mechanisms. Comparatively, programs directed to the business sector and the householders/residential building owner sector—while they focus heavily on non-residential and residential buildings respectively—cover the full range of governance techniques from installation grants to information and advice services, rebates for specific technologies, regulation and funded demonstration projects. Notably, both federal and state governments have programs targeted specifically at low-income householders, recognising the specific retrofit and energy efficiency challenges such households face.

TABLE 1: Summary of key federal and state policies and programs governing retrofit in Sydney

Policy Mechanism	Retrofit focus	Federal Policy Example*	NSW Policy Example*
Strategy/Policy framework	Framing/vision	National Energy Efficiency Strategy	NSW Sustainability Policy
Grants	Government and other public buildings and operations	Local Government Energy Efficiency Program National Solar Schools Program Green Precincts Fund Community Energy Efficiency Program	School Energy Efficiency Program Public Facilities programs
Grants	Energy supply		NSW Greenhouse Gas Abatement Scheme
Grants	Commercial sector buildings	Clean Business Australia	
Grants	Residential buildings	Low Income Energy Efficiency Program	
Grants	Workforce (trades)		NSW Energy Efficiency Training Program
Regulation/standards	Energy supply; energy retailers	Renewable Energy Targets (RET)	NSW Greenhouse Gas Abatement Scheme NSW Energy Savings Scheme
Regulation/standards	Buildings	Building Code of Australia	BASIX National Australian Built Environment Rating System
Regulation/standards	Government and other public buildings and operations	Energy Efficiency in Government Operations	
Regulation/standards	Commercial sector buildings		Energy Savings Action Plans

Information	Residential buildings	Your Home	Home Power Savings Program Energy Efficiency Community Awareness Program
Information	Cars		NSW Fleetwise Partnership
Demonstration	'The City'	Solar Cities SmartGrid Smart City	
Rebate/subsidy	Residential buildings	Renewable Energy Bonus Scheme: Solar Hot Water Rebate	NSW Home Savers
Rebate/subsidy	Commercial buildings		Energy Efficiency for Small Business Program Energy Saver
Rebate/subsidy	Cars		LPG Gas vehicle conversion
Market	Buildings	Environmental Upgrade Agreements	NSW Solar bonus

Source: Authors' compilation of key state and federal energy and climate change policies with retrofitting components, November 20

* Empty cells indicate no equivalent policy

One final observation can be made about the general policy and program context. Several federally-supported programs encourage cross-sectoral collaboration and partnerships, especially involving local governments (eg Low Income Energy Efficiency Program, Smart Grid Smart City, Environmental Upgrade Agreements). This technique for developing new forms of agency reflects both the increasingly routinized nature of public/private governance configurations and the recently expanded willingness to recognise local governments' role beyond the traditional expectation that they would manage behaviour change and awareness campaigns. This is evidenced in federal support for the production of local government toolkits and adaptation action plans, the establishment of the Australia Council of Local Government (2008) to 'hear from and talk to all levels of government' (Pillora, 2010), and the development of funding programs that directly address local governments (see Table 1).

In short, state and national government involvement in governing retrofit has two key characteristics. First, and specifically in relation to the socio-technical nature of retrofit, is the relative lack of engagement directly with the social practices of energy consumption. By far the majority of policies are targeted at the installation of more energy efficient technologies and renewable energy sources: providing rebates to install solar PV, grants to retrofit buildings, information programs to purchase environmental offsets for fleet vehicles. With rare exceptions, such as mandatory environmental standards for residential renovations, *direct* engagement with the use and integration of retrofitted technologies into patterns of daily life is not constructed as being within the remit of state or federal government. Second is the indirect nature of much of this involvement: with few exceptions outside the regulation of the energy sector and government itself, policies engage soft measures to enable or encourage retrofitting rather than hard measures to mandate it. Moreover, these are overwhelmingly policies that require multi-institutional cooperation across states or partnerships with local governments and community organisations. The state and federal approach to retrofitting Australian cities can be succinctly summarised as 'governing at a distance'. We can see in retrofit, in other words, Australia's highly contested climate politics being played out (Howarth & Foxall, 2010; Jones, 2012). Equally intriguing though, is the governing occurring at the local scale, to which we now turn.

Governing Retrofit at the Local Scale in the Australian City: The Case of Sydney

Local scale retrofitting governance in Australia is certainly imagined within and conditioned by these federal and state scales, as suggested by the plethora of grants available. Yet local governance with some independence from state and federal parameters is also feasible and, indeed, is evident within Australian cities . Thus in 2011/2012 we carried out a survey of carbon abatement initiatives across the domains of energy infrastructure, buildings and transport being undertaken at the local scale across all seven of Australia's state and territory capital cities (Sydney, Brisbane, Canberra, Darwin, Adelaide, Melbourne, Hobart and Perth). Importantly, this survey encompassed not just explicit carbon abatement strategies, but also interventions and initiatives that indirectly targeted carbon abatement – such as environmental education programs that incorporate reductions in energy use. Given our resources, it was not possible to survey each local jurisdiction in the capital cities. Instead, a sample of approximately a third of local government areas in these cities was surveyed, encompassing a theoretically informed selection of small and large, CBD, inner and mid city, and outer suburban jurisdictions. The audit started with websites of local governments, known not-for-private and community organisations, and documented private sector interventions, and then snowballed out from these to identify less visible interventions. This approach resulted in the identification of 896 initiatives related to buildings, transport and energy infrastructure, of which one-third had a retrofitting component. Then, using a framework developed by Castan Broto and Bulkeley (2013), we classified these according to who initiated/participated, the focus of the initiative, the mechanisms through which it was undertaken, its target audiences and its funding. We draw from the Sydney initiatives documented in the audit to capture retrofitting governance at the local scale.

Table 2: Detailed Characteristics of Local Retrofitting Initiatives in Sydney, 2012

	Energy Infrastructure		Buildings		Transport		Total %
	#	% of 24	#	% of 77	#	% of 2	% of 103
Total initiatives	24	100.00	77	100.00	2	100.00	100
Target audience							
Own organization/personnel	23	95.8	19	24.7	2	100	42.7
Residential building/household/travellers	1	4.2	42	54.5	2	100	43.7
Business tenant	0	0	26	33.8	0	0	25.2
Landlords	n/a	n/a	3	3.9	n/a	n/a	0
Schools	0	0	1	1.3	n/a	n/a	0
Focus							
Technical	23	95.9	72	93.5	2	100.0	94.1
Social	5	20.8	52	67.5	0	0	55.3
Mechanism							
Regulation	5	20.8	14	13.6	0	0	18.4
Market	1	4.2	23	22.3	0	0	23.3
Enabling	22	91.7	75	97.4	2	100	96.1
Provision	11	45.8	30	38.9	0	0.0	39.8
Institutions – Initiator							
Local government	24	100	56	72.7	2	100	79.6
Private sector	0	0	9	11.7	0	0	8.7
NGO/community	0	0	11	14.3	0	0	10.7
Federal/state	0	0	7	9.1			
Institutions – Partner							
None	15	62.5	29	37.6	1	50	43.7
Federal government	0	0	5	6.49	1	50	0
State government	0	0	16	20.78	0	0.0	0.2
Local government	7	29.1	29	37.6	0	0.0	34.9
NGO/community	0	0	11	14.3	0	0.0	0.1
Corporation	4	16.7	21	27.3	0	0.0	24.2

Source: Authors' survey, 2011/2012

Of the 278 initiatives identified in Sydney, 103 had a retrofitting component (see Table 2). Mirroring the state and national policy context, these initiatives can generally be described as intentional but small-scale retrofitting interventions, with an absence of holistic visions for retrofitting the city. Turning first to the institutions of retrofitting governance, we found

that most were initiated by local government (70%), principally acting alone (47 %), though occasionally using funding from other sources. The other 30% were initiated by a diverse group, of which the private and Non-for-Profit sectors were the most active, with minimal direct federal and state government involvement as instigators of initiatives. The retrofitting of transport (e.g. the conversion of existing vehicles to alternative fuels) is marked by its relative absence (just two initiatives); with most local retrofitting governance instead focusing on residential, commercial or public buildings. Thus most prevalent in terms of a material focus was retrofitting energy provision at the building scale, typified by installing devices that enable individual buildings to be powered from renewables or lower carbon sources. Technologically, there was an overwhelming focus on microgeneration in the form of the installation of solar PV, and on energy efficiency through the conversion of lighting, heating and cooling to more energy efficient forms (LED, gas, solar). Compared to state and federal policies, these initiatives have an equal focus on the initiating organisation and residential buildings/households (43 and 44 % respectively) and are less likely to address retrofitting by businesses or of business premises. Initiatives were much more likely to use enabling mechanisms such as the provision of advice, audits and information, suggesting a predominance of governing at a distance.

It is these techniques through which governing retrofit is pursued that are the focus of the rest of this paper, given their importance in the 'conduct of conduct'. For these purposes, we classify each initiative in terms of a four-fold typology (Table 3). The categories of the typology are not mutually exclusive: though all initiatives fall into one of these categories; some fit into two or more. We describe and analyse these techniques in what follows.

Table 3 Techniques for Locally Governing Urban Retrofitting in Australia

TECHNIQUE	FOCUS	MATERIALS	INSTITUTIONS	MECHANISMS
Holistic	Built environment structure of provision	Micro-generation Solar PV Cycling infrastructure	Whole-of-government; large-scale partnerships	Multiple: demonstration, provision, regulation, grants, education
Self governance	Own institution: built form, employee activities	Solar PV, LED lighting, insulation	Single organisation; funding from national and state governments	Financial: subsidies, grants
Facilitative	Businesses, households, schools, other organisations	Lighting, heating and cooling systems	Local government as broker	Financial; Education; Ratings
Educative	Activities of households, businesses in utilising retrofit technologies	Lighting, Solar PV, insulation	Local government	Information provision; engagement; demonstration

Holistic retrofitting is a technique that tackles retrofitting in a coordinated and multidimensional manner. It pertains to large-scale programs to retrofit the energy infrastructure, travel patterns and building fabric of a particular geographical area (e.g. a local government area), most often as part of a clearly articulated retrofitting vision. These are rare in urban Australia, and are thus far confined to the well-resourced CBDs of Sydney, or federally-funded programs like Solar Cities or Smart Grid Smart City.¹ Unlike the more narrowly-focused initiatives in the other elements of the typology, these initiatives focus on retrofitting the wider energy infrastructure in combination with retrofitting individual buildings. They do so through facilitation, direct intervention, as well as through widespread

education and demonstration. Interestingly, the use of strong regulatory measures is rare even across these schemes with wide ambition. Australian cities have not, for example, restricted cars from their city centres nor have they mandated building energy performance for existing buildings.

The City of Sydney's Sydney 2030 programme is illustrative here (see: <http://www.sydney2030.com.au/>). Following a comprehensive visioning and strategic planning process, the City (an area encompassing the CBD and immediate surrounds) developed a strategic plan that prioritised sustainability, in which initiatives targeting the retrofitting of diverse sectors (transport, energy, buildings) were introduced across the city. As befits the term holistic, the City of Sydney example involves a broad spectrum of governance mechanisms, as well as a multi-dimensional focus across residents, businesses, transport and infrastructure. These include a business-coordinated retrofitting of commercial buildings, a plan to move city buildings off the coal-fired statewide electricity grid and onto a city-scale trigeneration system, the conversion of road space to cycling paths, as well as the conversion of council vehicle fleets, lighting and buildings to low or zero carbon energy sources. Such holistic governance, though politically and popularly contested, is underpinned by a strongly articulated vision matched by political and economic resources to bring the vision to fruition. It is also connected to the City of Sydney's economic strategy to be identified as 'green and global' (Acuto, 2012).

Retrofitting through *self-governance* in the form of retrofitting an organisation's own assets is our second mode of governance. This includes the retrofitting of public buildings like council offices, local-government-owned swimming pools, libraries, or the headquarters of non-government organisations. About 40 % of retrofitting interventions were of this type, suggesting that local authorities in Australia have a most pronounced capacity to act with respect to their own organisation. Self governance sees various adaptations to buildings made to reduce carbon footprints, including installation of insulation, or solar PV and changes in lighting. Beyond individual buildings this also includes the conversion of systems of street lighting to LED and the conversion of council car fleets to non-gasoline fuels. Specific examples are numerous and are found extensively within and beyond Sydney; buildings retrofitted in this way can be found in almost every Australian local government area. Funding via the federal and state grant programs outlined in the previous section is

critical to self-governance. The Blue Mountains Sustainable Precinct, for example, involved local government using federal funding to install solar PV on an iconic tourist centre, whilst a number of inner city councils used various grant schemes to retrofit the lighting, heating and cooling systems of their swimming pools, parks and community centres. In this mode, local institutions are principally enacting an authority and capacity to govern the consumption of energy in their own buildings, though primarily through application of energy efficient or renewable technologies rather than a concerted focus on behaviour. Self-governance can, nonetheless, have an educative component, in that many of these buildings are also used to demonstrate low carbon living to a broader audience. The Blue Mountains Sustainable Precinct, for instance, includes prominent explanatory panels outside the retrofitted buildings with the intent of making the retrofit visible to the many visitors to the site.

Governing retrofit in an *educative* mode is by far the most common strategy both across our sample nationally and in Sydney. This emphasis no doubt stems from local governments' long term environmental education focus as well as the assumption that correcting the 'information deficit' is key to changing energy-related behaviour (Shove, 2010). Thus our audit captured myriad initiatives that aimed to inspire, inform and educate households and businesses about retrofitting their premises and to integrate retrofit technologies into their daily lives. A wide range of educative strategies is evident, with information provision through leaflets, websites and newsletters most prevalent. A number of organisations, for instance, use a commercially produced 'Sustainable Living Guide' in which households are informed about the carbon-reduction benefits of installing newer energy efficient appliances as well as insulation. Local governments also run workshops for residents to see retrofitting technologies in practice. For example, the Treading Lightly initiative, which operates collectively across several Sydney local governments, consists of 6-monthly blocks of weekly workshops primarily targeting local householders and focusing on domestic and household activities. There are also a number of 'demonstration homes' established in council-owned premises that take such workshops one step further, demonstrating retrofitting *in situ*. Even here though, there remains limited engagement with 'living with retrofit'. In these sites, an 'ideal' retrofitted home is presented for residents to see and touch, and gauge its viability in their own lives. The focus is on encouraging the update of

technologies rather than their use. Information provision, toolkits, and workshops all facilitate, encourage, and inform rather than mandate. Thus governing retrofit in an educative mode shapes conduct indirectly.

Closely related though different is retrofitting through facilitative techniques, in which local governments *facilitate* or *broker* the retrofitting activities of local businesses, organisations (e.g. schools) and households through a combination of education, provision and access to funding. Local governments (and sometimes Not-for-Profits or private sector actors) facilitate access to grants, audits and bulk purchase schemes to enable households etc to decarbonise their buildings through retrofitting measures. Here, local agencies (government, non-government and commercial) use publicity and access to knowledge, programmes and other schemes to attempt to shape conduct so as to initiate retrofitting, primarily at the building scale. Local agencies connect businesses and households with the practicalities and materials of retrofitting. An example here is Auburn and Parramatta's Streamline Your Business program in which the local authority provides a business with access to an on-site energy assessment and a tailored Energy Action Plan detailing how they can save energy, including through retrofitting technologies. A program with wider geographical reach is CitySwitch, a national local government-commercial tenant partnership that includes four local authorities in Sydney. The program explicitly works with commercial tenants in the geographical areas to provide information, tailored advice and implementation plans on reducing their carbon footprint, including a strong emphasis on retrofit. Local government involvement is essential: facilitating access to organisations, assisting in the hosting of events and administering associated grant programs.

Conclusion

In this paper we have demonstrated that the governance challenge of transitioning cities to low carbon futures through retrofitting is being addressed at all scales of government in Australia, through a proliferation of initiatives and by a variety of actors. Governance is multi-level, to be sure, with federal and state policies and programs shaping the structure of provision and conditioning the local delivery of retrofitting initiatives. However, ongoing political debates about climate change in Australia have produced a reticence in federal and state level responses, thus it is at the local scale that the greatest willingness and capacity to

govern retrofit is found. In terms of multiscale understandings of urban carbon governance, then, the paper confirms the importance of the local scale. The fourfold typology of retrofitting mechanisms, however, suggests that the local scale may not be as experimental as others have suggested (see Hoffman 2011). Separately and collectively governing retrofit in educative, holistic, facilitative and self-governing ways largely eschew direct intervention in favour of 'at-a-distance' techniques that render the issue and its solutions visible to a broad audience. Thus the potential of local scale retrofitting governance in Australia is yet to be fully realised.

This potential is also not yet fully realised because of poor alignment between the technological and social dimensions of retrofitting. In short, where the system of provision is being directed towards retrofitting, the intended subjectivities and practices are scarcely taken into account and hence fail to materialise. Likewise, interventions to create new subjects and practices (e.g. through education) are not supported by systems of provision in which these subjects could act. In conclusion, we see, at all scales in Australian cities but particularly at the local, a vibrant assemblage of institutions and mechanisms to induce retrofitting installation conduct. However, there is less evidence of a capacity to govern the imbrication of these technologies into the fabric of daily life (Moloney, Horne, & Fien, 2010). Significant further work – both research and policy – is thus required on the assemblages of social, technical and political systems required to more comprehensively retrofit the city.

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¹ Federally-funded cross-sectoral programs that fund and instigate alterations to energy supply, building design and household/business interactions with energy (e.g. through smart metering or solar PV installations).