



Governance for regenerative and decarbonised eco-city regions



Jessica Bunning*

Curtin University Sustainability Policy Institute (CUSP), 3 Pakenham St, Fremantle 6160, Australia

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ABSTRACT

Today, world's city populations are growing at an unprecedented rate. Old centralised, city infrastructure networks are under pressure to support the production, distribution and consumption of city resources. New distributed, low and zero carbon infrastructure options are required to reduce global carbon emissions and pollution, and improve the efficient distribution of energy, water and waste products and services. Similarly, new strategies to manage these infrastructure systems are required. Outdated political, economic, and social barriers need to be reviewed to allow city precincts to succeed in reducing their carbon footprint, improve people's lifestyles, and live more harmoniously within the means of the Planet. This paper seeks to uncover some of the barriers, as well as the opportunities that exist for the process of decarbonising cities to succeed. The paper through a series of interviews with professionals from all different sectors of society, aims to shed some light on some of the key issues surrounding the topic of governance and decarbonised, urban development. The work also highlights some emerging business models that demonstrate the type of governance structures that can support decarbonised development within cities and regions.

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1. Introduction

The world's cities are growing increasingly larger, transforming into megacities, hosting the densest populations that history has ever known. To support these thriving megalopolises the efficient productivity of resources is required and a resiliency in the distribution of power, water and waste products and services is needed that is more in sync with the environment. Outdated, carbon intensive, city infrastructure systems are struggling to keep up with the pace at which our cities are growing, plus they are contributing to rising global carbon emissions [1]. Humans need a new approach, a new way of thinking, and a new way of looking at how our cities are designed, built and powered. Similarly, city infrastructure systems require new management strategies that support low and zero technology aimed to enhance people's lifestyles and create a cleaner Planet. An opportunity exists to re-imagine, reinvent and reinvest in our cities to restore the Earth's natural balance and ensure a future whereby our children can proudly take over its stewardship [2,3].

This process of namely, 'decarbonisation' will involve redeveloping each urban precinct step by step with a lower carbon

footprint. Decarbonising cities requires all socio-political, economic, environment, business and education sectors joining forces to collaborate, share ideas, methods, knowledge and expertise. The urban and climate change challenge will not be solved with one quick fix. Offering up complex, location specific problems, solutions need to be found through communal and creative problem solving at the finer, precinct-scale level. If the world is to make the transition to a 'green' economy, based on a circular flow of resources, then all of society affected by this change should contribute to its transformation to ensure a smooth transition [4].

2. Governance for decarbonised development

2.1. Community stakeholder engagement

Enough talking about sustainability issues has transpired over recent decades; now it is time for greater action. People are ready to move forward from discussing ambitious carbon mitigating strategies to actually following through with carbon reductions and realising decarbonised development within their precincts. An increasing unease over soaring carbon emissions, energy and water security, negligent waste disposal, and rising utility bills has incited a greater interest from communities in the management of their local resources [5]. Parallel to this rising community concern, is municipalities are being given greater autonomy and

* Tel.: +61 434 417 380; fax: +61 89 266 903.

E-mail address: jessbunning@hotmail.com.

responsibility for the planning and design of their precincts. Because local authorities are not always provided the financial or technical means to accomplish high sustainability goals, building partnerships with the private sector, and civic society is fundamental to strengthening their capacity for delivering decarbonised development [4,6].

The emerging precinct scale market for innovative low and zero carbon development is prompting councils, private enterprises and developers, citizens, banks and other organisations to adopt new roles, and form new governance structures encompassing a diversity of community stakeholders [7]. Traditional consumers are becoming producers and providers of local power, water and waste services run by new types of utility partnerships [4,8]. Municipalities are evolving from facilitators of decarbonised development to in some cases, active participators in the construction, operation and management of low or zero carbon district schemes [9,10]. This escalated participation and vested interest from communities in sharing responsibility and investment in the stewardship of their local resources, raises the likelihood that precinct infrastructure systems built to improve resource efficiency will be better managed in the long-term.

2.2. Improved governance structures

Advanced state-of-the-art technology to reduce carbon emissions in the built environment exists today; however, the question of how to bring it all together still evokes a sense of uncertainty among local government and developers [11]. More clarity is required on: how to manage these new systems; what type of partnerships work; and who should partake and be accountable for their functioning. Much debate surrounds the word governance and its role in decarbonised development. Now more transparency is needed on the type of business models, financial mechanisms, technical tools, and collective intelligence for unravelling solutions for 21st Century urban and climate change challenges.

This paper aims to firstly uncover some of the barriers whether political, economic, social, real or perceived that impede the rate at which decarbonised development is taking place in our society. Secondly, it aims to reveal some opportunities emerging that demonstrate obstacles being overcome with a little intelligibility and creative thinking outside 'the box'. Finally, certain governance models will showcase how renewable energy and low carbon energy district schemes can be managed under an effective governance structure.

3. Methodology

This research was carried out over a period of six months involving interviewing a large range of different people associated with the development industry. They were contacted via email, telephone or in person at meetings and invited to participate in an interview regarding the barriers and opportunities to decentralised, district low and zero carbon energy, water and waste schemes. The people were chosen on the basis of their knowledge and expertise in this field. Various materials were used to seek out candidates including: databases, magazines, newspapers, and by attending various networking events. Out of the 50 people asked to take part in the interviews 95% accepted. This demonstrated an overwhelming high degree of interest from the candidates to 'tell their story', assist with research in the area and be open to criticism. The interviewees ranged from large governmental bodies, state and local government officials, utilities, private companies, associations, Non-Governmental Organisations (NGOs), and various professionals from legal, environmental, and socio-political, economic and cultural organisations to academics.

The interviews were usually recorded using an iPhone microphone app, and were mostly conducted in person face to face or over the phone. In some circumstances the interviews were completed by responding to a series of questions over email. The interviews were fairly informal, taking place over a coffee, and lasting for approximately 30 minutes. The questions were tailored to suit the interviewee, so none were identical. Quite a bit of research was carried out on the interviewee and their organisation beforehand, to prepare appropriate questions that would fit the expertise of the interviewee, in order to extract relevant information in the interview that matched their expertise. For instance, there was no point in discussing with a high level government official in water the impacts and trade-offs of renewable energy schemes. It was better to be quite precise and focused in the questions rather than broad and general. This allowed the interviewee to provide quality knowledge that would otherwise be lost in general conversation about rather broad topics. The more concise the questions were the more informative was the answer. All the interviews were professionally transcribed.

3.1. Aim

The aim of the interviews was to gain greater in-depth understanding of the challenges that people in the development industry are struggling with at this moment of time and transition. It was important to obtain a wide range of viewpoints to provide a balance and objective account of the current debate around centralised and decentralised low and zero carbon infrastructure schemes. Interestingly, it was often towards the end of the interview, that the interviewees started to really open up and provide very insightful information regarding their circumstance and view of the issues surrounding low carbon development.

This information under normal circumstances would be quite difficult to acquire, as a lot of knowledge of business structures and models, remains in-house and not published in public material. Although, the interviews were largely conducted with Australians, regarding issues in Australia, they are also indicative of issues that many other countries are struggling with grasping. The interviewees' voices – their arguments, perceptions, opinions, doubts, fears, hopes and success stories are woven throughout this paper like a patch work quilt, under principle themes that were identified from analysing the interviews as a whole. For the purposes of this paper, not all of the interviews could be presented and the focus remains largely on energy low and zero carbon, district schemes.

4. Value networks theory

A value networks framework is where designated roles are assigned like in any ecosystem, but rather than an environmental one, this is in an economic system. The framework involves the relationship manager, the brand builder, the solutions integrator and the component provider roles all joining together to deliver an outcome for the community. Steve Lennon from ARUP suggests that this is also a general way to consider the individual but key pieces involved in creating a decentralised energy solution [13].

The key to this framework, which can be likened to any decentralised system, is determining where is the 'value' accrued to in the network, and a lot of that value is derived and based on where is the market power. According to the theory this 'value' should come down to the systems 'relative value add' to what the overall network is offering the end customer in any kind of share market that involves a producer. This framework provides just a simple way to begin thinking about the necessary bargain that should be getting struck by the participatory entities in the value

network relative to their contribution to the sum of value it can deliver to the customer. So, in applying this to a decentralised energy solution, whether this type of framework takes the shape of a Public Private Partnership agreement or a Community-owned model, some ‘body’ or person is always going to be playing one of these roles [12].

5. Results

5.1. A governance framework for decarbonised development

Transitions in development are occurring with communities across the globe increasingly driving innovation, manifesting a wave of change and pressurising governments to open doors and allow new ‘green’ inventions to rise. Many legislative, regulatory and policy hurdles that have impeded the rate, at which carbon mitigation can take place, are now under scrutiny, examination and review. A new governance framework is called for that embraces and provides clear pathways for catalyzing low and zero carbon, sustainable urban development.

5.1.1. Dissolving political barriers

5.1.1.1. A policy shift. A policy shift if required in Australia, to encourage innovation in distributed, low and zero carbon infrastructure systems [13]. Governments need to deeply consider the type of policy frameworks that will encourage investment in distributed low carbon schemes [12]. These policies should cover all generators and retailers, including small to large scale, and base load generators, because essentially the issues and barriers such as, for gas, solar and biomass generators tend to be the same regardless of the kind of project [12].

5.1.1.2. Political will. It imperative that the governance settings are right, and the State government expresses the political will, becoming a willing player in understanding the opportunities, examining statutory and regulatory barriers and determining their role in amending those barriers to deliver outcomes [13]. Mark Batty [13] from the Western Australian Local Government Association (WALGA) insists, “if you want to build a sustainable city or a sustainable town, you’re either using your regulatory and statutory and policy legal’s to facilitate it or to hinder it. So the government’s got to determine what it wants to do.” He argues that it is not the developer’s space because they are willing to innovate and get a competitive edge. The challenge Mr Batty insists is “getting the policy settings, the government settings and the regulatory settings right to help facilitate, while still providing a measure of risk management [13].”

5.1.1.3. Euphemistic whole government approach. An euphemistic whole government approach is required that ensures the bureaucrats and policy makers work across government rather than only within their area of expertise to reach a broader sustainability outcome [13]. In the meantime, in the absence of a supportive regulatory, and stakeholder environment, development will be inclined to take the path of least resistance to achieve the kind of step change that centralised infrastructure represent [14].

5.1.2. Removing economic barriers

5.1.2.1. Sharing costs and risks. Greater attention should be given to issues surrounding the cost of innovation for decarbonised development. This applies to all countries, whereby governments need to determine whether the underwriting, or the sharing of risk between community benefit and private benefit is appropriate. The benefits of decarbonised development attributed to the developer and broader community must be examined to decide whether

there is an upfront opportunity risk or cost that should be in part met through some kind of incentivisation by governments [13].

5.1.2.2. Incentivising innovation. More thought is needed on the type of policy levers available to provide an incentive, whether it is tax breaks, or underwriting some start up costs, or a large infrastructure grant project or program. It is essential that governments analyze their role in stimulating some of that innovation other than to as Mr Batty from WALGA claims “sit back and say, well we didn’t back it up economically, we haven’t assisted at all, we’ve got our regulatory requirements and that’s it [13].”

5.1.3. Illuminating social barriers

Within local government context, there is always a political barrier surrounding distributed systems, in terms of people’s perceptions of whether or not there is going to be a problem. Even if there are no legitimate technical issues, lack of knowledge, information and perceptions will act as barriers to its implementation. These are social barriers in terms of perception as opposed to talking about simply regulatory ones [14]. The governance regulatory and political framework in Australia is always playing catch up, as it is typically risk adverse, such as the health sector [14].

On the other hand like the developers, local government has been by convergence working towards similar kinds of review and “modernisation” of the regulatory and legislative frameworks to try and facilitate sustainable enterprises [13]. Government entities, such as Western Power are a very diverse operation with a lot of employers “chipping away at those rules” and saying, this is what smart grids look like and this is how to plug in electric vehicles and this is the standard for solar panels that supports the notion that electricity has to run through big, fat wires [15]. So, the issue in Australia is that everyone is looking at decarbonising but there is just not a free and open and contestable market around this concept yet [13].

5.2. An open and contestable market for decarbonised infrastructure

Historically in the western world where electricity markets have come from, after the Second World War, the majority markets became state owned; especially in Europe, Australia, New Zealand, Japan, and Korea, countries were capital scarce, and as power is typically viewed as an essential service, and essential to industry, governments concluded they should own it, and provide it as a service to develop the economy [12]. Similarly, Western Australia lacked an open electricity market. People could only purchase power from either the retail company Synergy or from Western Power, and if a business owned a generator it still had to sell that power to Western Power [16].

Today, as the world’s economies are maturing, people are questioning whether the government should own the infrastructure. Western Australia for example, now has a regulated electricity power, allowing generators to sell their power to any retailer, wholesaler or buyer [16]. Various models around the world have demonstrated that power can be delivered better and more efficiently, if there is a competitive open market [4]. Better outcomes can be delivered because a choice for consumers exists, with private industry generating the best solutions technically, technologically, and environmentally. Whereas, governments on the other hand, grow into big monopolies and bureaucratic organisations, which may have been necessary in a developing economy, but as society becomes a more mature economy - electricity markets tend to work better [12].

5.3. Investment in modelling and systems thinking

Cities were never designed, built and managed with the same insight we now have into the complexity of the Earth's ecosystem, including its fragile balance and vulnerability to human impact. Essentially the current state of our world's cities is comparable to a series of accidents occurring over many decades [12]. Similarly, most of the infrastructure regulations and legislation and ideas of how to manage a network were created last century and in many cases, early last century [15].

Taking an incremental approach will not allow us to unwind the decades of consequences intended or otherwise that have led us to where we are. Stephen Lennon [12] from ARUP quoted Einstein infamously saying, "the level of thinking that got us into this mess will not get us out of it". We can apply this message to today's climate change and urban challenges. Mr Lennon believes a strong investment is needed into the modelling and systems thinking required that can help illuminate the city system we've now got and give us the opportunity to design our way out of it, towards a greater more sustainable future [12]. The challenge for renewable energy producers for instance, is to start thinking outside the box, in terms of being like a mobile phone or internet market, in terms of how the energy market will evolve in the long-term [15].

5.4. Business models for decarbonised development

It is imperative at the beginning of a project that creative discussion and thought be given to intelligently finding solutions that side steps present obstacles, inherent in out-dated socio-economic and political frameworks that are yet to catch up. Equally important is spending time examining how all the various technology options will be integrated and managed with a business model that ensures a win–win scenario for all stakeholders.

5.4.1. Creating the proper context and conditions

Typically people invest ninety percent of their work into the content and design of solutions for low carbon, sustainable, urban development, including engineering aspects, leaving only ten percent for creatively shaping the proper context and conditions necessary to support and realize the success of their projects. It is not easy to manifest this latter fifty percent as capital by nature is typically very impatient; with no time to wait for obstacle and dramas and regulatory change [12].

This is a large reason why in the past, many highly creative, ambitious, sustainability projects have simply dissolved into mere paperwork before they have ever got out of the boardroom. People have been deterred by the political, economic or social hurdles, which incur additional time, work, hassle and money to overcome.

5.4.2. Developing correct business models

Developing the correct business models to support decarbonised development needs to be at the top of the agenda because the policy makers, energy providers, and government who ultimately make a decision on the go ahead for a project, are interested in the business model and how it will stack up financially [17]. Business models need to ensure a steady return on investment is guaranteed to all people involved and affected by the project – which is relevant to Value Networks Theory ensuring all 'values' in the network chain are understood and met.

A very coordinated approach is required to overcome often-complicated policies. Different people are needed to tackle policy issues, the business model and the partners within the project and different people for working with the community and entering the community 'buy in' for this [17].

5.5. Role of local government

The role of local government in global decarbonised development is still partly undefined and questions of whether the local authority should take the lead in this space conjure up much debate. Likewise, in Australia, the definition of the role of local government is still emerging. Some view it as leaning towards more of a facilitative role, to facilitate communities to acquire a broader understanding of sustainability issues [18]. There is the perception that governments need to understand their role and be prepared to play a part in delivering more sustainable communities.

5.5.1. Local government facilitator of innovation

With any decarbonised development project, local government firstly needs to decide whether they are pursuing a model to become an energy utility, or if they are creating the impetus by letting contracts for example to some entity to build a cogeneration facility, from which to purchase energy. The latter is a set of commercial imperatives to allow private enterprise to supply what is needed for the precinct. The City of Sydney chose to avoid becoming a power generator in the business of energy generation, so they let a tender, which AGL won, and contracted them to be responsible for building the power. Commercial incentives should be put into the marketplace to allow commercial solutions to come forward and competitively [15]. Ray Wills insists that:

"I'm less comfortable with the notion that local government might become an energy generator because as a government they've got no reason. They're not going to go out and buy wheat farms to grow wheat, they're not going to take the wheat and crush it into flour, they're not going to make the flour and put it into bread, they're not going to take the bread and start a bakery. They'll compete with all their private industry interests so why would they go and build a power station to create electricity to sell a commodity? It's not their fundamental role in life [15]."

5.5.2. Local government in the businesses of decarbonised development

There is high level of investment and co-operation between the private sector and government, state and local, in many jurisdictions around the world to help facilitate communities. However, current restrictions in Western Australia's legislation prevent local governments from forming joint ventures with the private sector or to operate a company as essentially for profit businesses [18]. Originally, this rule was established to avoid local authorities getting into any commercial difficulties [14]. Today, an enquiry is underway to ascertain whether this rule is limiting government's ability for innovation. If a 'Bill' for subsidiary is passed it will enable local authorities to create trading enterprises, which could facilitate decarbonised development [14].

5.5.2.1. Council controlled organisations. Other countries have more enabling regulations around how local authorities can be organised. Local authorities can have trading enterprises to run waste management or water utilities, for example. Some municipalities can focus on being urban regenerative and have the ability to create business structures to support its implementation [14]. Auckland City Council has at least seven council controlled organisations that are demonstrative of current best practice of shared service agreements for sustainability. Council controlled organisations have fit for purpose directors on their boards who have the necessary knowledge, skills, experience, and qualifications for making informed decisions. Other local councils might have councillors who are extremely community minded with a great

passion for their community but lack the necessary knowledge, skills and understanding of how a sophisticated business model should work [18]. One way the local government reform in Western Australia aims to improve the capacity of local government is by amalgamating its local councils, which is hoped to streamline vision and strategies.

6. Emerging governance models for decarbonising cities

The following models demonstrate some ways that local government, developers, businesses and communities are forming partnerships, which aim to build their financial, technical capacity and the necessary knowledge, skills and expertise to implement decarbonised development throughout their precincts.

6.1. Joint venture partnership

A Joint Venture Partnership (JPV) involves the supplier of the low or zero carbon equipment entering into a joint venture. Usually, for example in Australia windmills are either French or German owned and the JPV assist with payment for the equipment through a lease over time [17]. This kind of model can side step economic barriers associated with high head works costs, which is the upfront infrastructure challenge to provide the incentive for innovations to occur [13].

6.1.1. JPV for regional decarbonised development

Although some overseas companies view the Perth market as too small and carrying too high a risk to ensure the economies of scale for a JPV to succeed, when they can alternately direct their businesses to emerging opportunities throughout Asia [17]. Considerable potential for JPVs does exist throughout regional Western Australia under the super towns' government policy, focused on decentralising, and building up regional centres for employment and development [13]. These regional towns, typically fringe of the energy grid could be used as pilot projects for taking communities off the grid or conversely becoming a strong contributor to the grid at the network point. New infrastructure is already required to accommodate rising regional populations for example in Katanning, so an ideal opportunity exists to integrate sustainable solutions such as, using feedstock after harvest to feed a cogen or trigeneration plant within already planned greenfield development. This issue raises questions around where is the best place to initiate decentralised infrastructure and where is it really needed in which area. This can become a question of geography that is one of the main drivers for decentralised development [13].

6.2. Public private partnership

A Public Private Partnership (PPP) is a long-term partnership typically between a government or quasi-government and a private sector consortium. It is emerging as a favourable alternative for hospital, university campus precincts or private developments with the sufficient critical mass of residential, commercial or mixed to install a co or trigeneration facility, but lacking relevant technical expertise in house necessary for procuring, installing, operating and maintaining the scheme [19]. A high risk exists over the capacity for local governments to determine, underwrite, manage and finance these large, sometimes costly industrial processes, such as waste to energy schemes [4]. Engaging a suitable qualified and experienced private sector proponent to take on these tasks can alleviate some of this risk. A PPP usually involves the enterprise bearing the upfront capital costs of procuring and installing the plant, which is ideal for a university lacking spare cash to invest in these types of projects, as opposed to maintaining the critical and

core infrastructure for teaching and research. In return for that upfront capital outlay, the operator seeks a guaranteed income stream over a long-term to get a suitable return on its investment both in the capital and the provision of its services and maintenance. The public entity is able to pass the technical risk on to the private sector that is best able to manage and deliver optimal solutions. The governance framework and duration is determined by the financial modelling on the investment required to guarantee an income stream that justifies the initial investment and lifespan of the capital works, whether it's a building or a piece of plant equipment. Running a competitive procurement process is believed to improve the chances of obtaining the best value and outcome from the private sector, which is imperative for governments, quasi-governments or universities with little money to spend or waste [19].

In the case of the PPP for the Fiona Stanley Hospital trigeneration scheme in Western Australia, when procuring the plant rather than building in performance criteria about the quality and maintainability of the equipment, the contractor obtained a price for its maintenance over five years with renewable options. This ensured a bid from a supplier that included the original cost of the capital equipment, plus a contracted cost for its long-term maintenance. Although some technical issues were experienced in getting the plant integrated into the control system, they had no real major hurdles with actually installing the trigeneration facility because they had the state backing their financing and a strong government commitment to meeting environmental targets [20].

6.3. Co-operative

Energy co-operatives are membership based organisations, whereby like democratised companies, people pay their membership and everyone has voting rights, rather than solely a board of directors making decisions [17]. The model allows a diverse range of government, private sector or community members to join together, have a voice, create and work on a project and become stakeholders. Energy co-operatives have a legal status and are a common tool in most Western economies in Australia they allow community groups to seek treasury funds from the government on a low interest or no interest loan, with only taxes to achieve an outcome. The co-operatives take on the risk and management of the project but they receive a government guaranteed loan that avoids having to approach a bank and justify the project, the State takes on some risk because it is a loan but that would apply equally with a wind farm [15].

6.4. Community-owned

The community-owned model is a similar to a standard proprietary limited company, but the people are shareholders. A company is set up and the shareholders are the individual community members and organisations who have raised the money to build the wind farm. Since the community owns the project and a bulk of its company's shares there is considerable pressure on the government to change whatever policy is needed. It also builds other revenue sources for the community through returns generated, creating multiple benefits. In the case of the Hepburn Community Wind farm, it generates electricity for the community then sells the energy back to the grid, therefore creating a return, which is invested back into the community. The dividend return is split between the community project, and as a dividend back to the shareholders who are community people [17].

Similarly, in Fremantle, a wind farm is being launched to supply renewable energy to the city. A standard propriety limited company with sponsorship from Fremantle residents and equity/debt

financing from corporate sponsors has been established. This model allows community members to raise money to build the wind farm and also to become shareholders of the company. Because the wind farm company will be allowed to sell excess energy to nearby locals, it will create a return that will then be invested back into community projects and provide a dividend to community shareholders and investors. The company has coordinated a range of specialists to tackle policy issues, create the business model, establish partnerships and work with the community to ensure the most efficient management and development of the project [17].

6.5. Municipally-owned

The City of Kuopio in Finland has a series of municipal owned companies. In the city centre a municipal power plant company produces electricity from local peat material, and hot water for the district heating system, to cover the whole city. The municipal company has its own board of directors and elected members by the city council, which includes private enterprises. The company is funded in part by the municipal budget, and in part by private markets, it has its own capital, infrastructure, and investments in the economy [21]. The municipal company of electricity and central heating has one branch that is responsible for the power plant; another that is in charge of buying and selling electricity; and a third branch is accountable for sales and purchases of hot water for the district heating system [21]. Municipal companies can obtain loans from the municipalities for investments, and to sustain their businesses if private markets are too expensive. In return, the municipal energy company provides a part of their profit to the municipal budget, and towards investment in municipal services [21].

6.6. Independent power producer

Independent Power Producers (IPPs) are private thus, not government owned. IPPs involve a private consortium of developers driving the project's development. Once the project is de-risked, guaranteeing a steady rate of return, it can attract large long-term investors, such as superannuation funds to secure the upfront capital. IPPs typically will launch a bid for tenders to select private utilities. Together with the private consortium and investors a Special Purpose Vehicle (SPV), subsidiary company is set up to run the IPP. The investors receive a portion (e.g. 80%) of the project's returns over a period of 20–30 years and the private consortium receive perhaps 20%, hypothetically speaking. Later, once the project has been successfully running for a while it can be launched on the stock market to attract shareholders [22].

One crucial criteria for an IPP's success is it is imperative that the initial shareholders or investors jointly decide at the outset of the project, who will be responsible for what task; how will they take it from a concept to reality; and importantly how they will acquire finances for design, planning and enabling works [23]. Because many IPPs require a considerable amount of work to find parties actually willing to enter into long-term contracts, a lot of them rely on banks. Consequently, the IPPs need to have strong financial situations from the start to be acceptable to the banks [23].

7. Conclusions

More guidance is needed on the business models, financial mechanisms and technical tools that can guarantee the effective operation and management of new 'smart' city, decarbonised infrastructure systems that will shape the ultimate transition of our society towards a 'green' economy. Many socio-cultural, political

and economic barriers exist for establishing less carbon intensive, district schemes, since traditional centralised systems are still naturally favoured by outdated governance legislation aimed to support them in the past. What is needed are new rules, regulations, policies and legislation that cross over to allow decentralised, low and zero carbon technologies an opportunity to enter into the energy market for urban development and associated infrastructure.

Through a series of interviews this paper has sought to uncover some of the barriers that are impeding the implementation of district low and renewable energy schemes. It has identified some of the governance strategies that various utilities, organisations, enterprises and community have applied to avoid certain obstacles, and create new pathways for decarbonised development. The governance models demonstrate that there are various options for managing these systems emerging. Yet, despite the range of models, currently no one overriding model exists, rather the choice depends on the local context and circumstances, whether one particular model will be more applicable than another. Further research is required into the kind of governance models that are more appropriate for certain environmental, economic, and socio-political conditions. This information will allow people to better identify and clarify from the beginning of a project, which model is better suited to pursue, given their type of local situation.

Conflict of interest

The authors declare no conflict of interest.

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