The Role of Infrastructure Finance for Renewable Energy Infrastructure Project Development

Praveen Ashok Kumar,
Lebogang Mahlare

Abstract
Assessing how infrastructure projects create an environment for growth

Contents

Glossary

DBOO	Design-Build-Own-Operate
ESG	Environment, Society and Corporate Governance
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GWh	Gigawatt hour
kWh	Kilowatt hour
IPP	Independent Power Producers
PPA	Power Purchase Agreement
PPP	Public-Private Partnerships
RE	Renewable Energy
SPV	Special Purpose Vehicle
WTE	Waste-to-Energy
HCEI	Hawaii Clean Energy Initiative
HSEO	Hawaii State Energy Office
ESSF	Energy Security Special Fund
HRS	Hawaii Revised Statutes

List of Figures

List of Tables

1 Introduction

Cities around the world have grown to house half of the world's population, and by 2050, urban populations are expected to rise by as much as 70%. Currently, cities are responsible for more than two-thirds of global energy use, and considering rapid urbanisation, energy demands and the ability to deploy capital present a host of challenges to economic development. Current urbanization patterns from geopolitical shifts, changing environmental climates, constrained economic environments present a host of global trends that are leading to voluntary and involuntary migration of people to cities. This migration thus leads to burdened infrastructure which radiates many dynamic spokes: transportation, water and sanitation, healthcare and many other issues. These areas all crucially interface with the energy sector and require adequate strategies, management and financing vehicles to ensure their consistent and equitable delivery. Thus, in the advent of a rapidly changing global landscape, increasing pressures on the energy sector naturally spurs a convergence of the physical world to meet energy investment, policy, governance as well as engagements in the public and private sector.

As with many challenges, opportunities emerge to redefine standards of social, environmental and economic importance. 195 countries adopted the first universal climate change agreement COP21 with the pressing need to mitigate climate change. The availability of funding in different political landscapes has become a critical issue as well as the need to find new models that allow key stakeholders in both the private and public domain to collaborate. Economic growth requires investment in infrastructure to spur increased economic activity, and so energy infrastructure development becomes more pivotal. The World Economic Forum estimates the global demand for infrastructure at $4 trillion in annual expenditure where current investment is at $3 trillion, creating a global infrastructure gap of $1trillion a year. For cities to meet the needs of its citizens, a significant amount of capital is required to fill funding gaps for these services, particularly in poorer countries.

This project will thus aim to assess the role that infrastructure finance plays on the development of renewable energy infrastructure across the triple bottom line namely: society, environment and economy. Views across market structure, governance, public-private partnerships, environmental impact, social impact, and infrastructure will be assessed, as well as the risks that arise in its deployment. The investigation will require a wide-geographical spread of cities as well as comparing their differing socio-economic standing. The Cities of Berlin (Germany), Sao Paulo (Brazil), Sydney (Australia), Los Angeles (United States), Hawaii (United States of America) & Manila (Philippines) have been chosen for this study.

The findings reveal that the developing countries exhibited energy shortages, financing challenges in the ability to attract capital and have limitations in local domestic capital. This is due largely to political unrest, lack of adequate regulatory oversight and the inability to overcome capital hurdles attributed to the risk of investing in those countries. Moreover, regional development banks as well as multi-lateral organisations such as the International Finance Corporations, dominate in the financing of infrastructure. In terms of energy provision, grid-scale, centralised distribution is characteristic of developing nations, however underdeveloped, over decentralised models, and often governed by state and federal legislation objectives. In developed nations, financial and energy markets are very advanced, tend to be liberalized and well-regulated. Together with this, policy objectives at the federal and state level provide financial incentives to drive renewable energy technology's success in their cities. Understanding all stakeholders means to assess their roles in the infrastructure development and how it ultimately benefits the consumer, as they are the most important stakeholder, since they are the people who drive all projects success as the buyers of the electricity that make the entire operations feasible.

1.1 Problem Identification

The following problems were identified in the ability to develop renewable energy projects:

- ***Governance:*** Urban expansion increases the demand for energy services and thus governments need to have sound city strategies and public services management capabilities to inform the successful energy supply they envision. Regulatory environments either promote or diminish investor confidence, thus this is a challenge to cities.
- ***Infrastructure Finance:*** The availability of funding sources is a challenge as well as the ability to deploy the investment capital from the different sources in the world after exogenous shocks in global markets (financial crisis) with fiscally constrained government budgets, in tough economic climates globally.
    - ***Access to finance:*** Different financing vehicles have different investment criteria by country risk profile, energy technology type and region
    - ***Mandate:*** Different financing vehicles have different investment mandates: developmental or profit; thus an environmental scan across regulatory etc.
- ***Public-Private Partnerships:*** Different models of public-private collaboration optimize or impede how energy services are provided as well as how infrastructure financing is conducted. These models tend to differ in developing versus developed countries, and also in the disparities in public services management models. These all necessitate the manner in which financing is disbursed and thus how economic development targets are met.
- **Environmental Impact:** Financing new infrastructure to meet growing demands results in the degradation of natural capital. A challenge cities are facing is in the need to plan projects in light of increasing pressures from the global community for environmental conservation and energy efficiency. Some cities have ratified proposals such as the *UN Principles of Responsible Investing, COP21* amongst others, in developing energy infrastructure.
- ***Societal Impact:*** The impact to society is not always measurable, however there is increasing pressure to establish metrics that distinctly measure how society is impacted by the development of infrastructure e.g. increased access, social welfare etc. This might be better observed on a case by case basis.
- ***Economic Impact:*** It follows that growth in energy necessitates economic development, however, it is worth exploring whether this is always beneficial or if it in fact can have adverse effects on the economy. Suitability of energy infrastructure can also present negative economic impacts too. Financial providers are also dictating terms of financing particular technologies over others. It begs the questions of suitability, and whether these yield suitable and economically beneficial impacts.
- ***Risk:*** There are a number of potential risks that governments, private sector and all stakeholders face. These present a challenge on how capital is deployed. Projects need to present internal rates of return that overcome capital hurdles as investors require investment returns commensurate with the level of risk. These will therefore be identified regionally in the different cities as well as the solutions on how they can be mitigated.

1.2 Definitions

For the purpose of this project, the following definitions will be used:

"Climate Neutral: A city can be regarded as 'climate-neutral' if its greenhouse gas emissions can keep global warming below the threshold of 2°C – assuming a world population of 9 billion people by 2050, each endowed with the same per-capita emission rights of 2 metric tonnes of CO_2 equivalents (life-cycle based)."

"***Developed countries*** (industrial countries, industrially advanced countries): High-income countries, in which most people have a high standard of living. Sometimes also defined as countries with a large stock of physical capital, in which most people undertake highly specialized activities. Developed countries may also include middle-income countries with transition economies, because these countries are highly industrialized."

*"**Developing countries:*** According to the World Bank classification, countries with low or middle levels of GNP per capita are classified as developing countries. Several countries with transition economies are sometimes grouped with developing countries based on their low or middle levels of per capita income, and sometimes with developed countries based on their high industrialization. More than 80 percent of the world's population lives in the more than 100 developing countries."

*"**Economic development:*** Qualitative change and restructuring in a country's economy in connection with technological and social progress. The main indicator of economic development is increasing GNP per capita (or GDP per capita), reflecting an increase in the economic productivity and average material wellbeing of a country's population. Economic development is closely linked with economic growth."

*"**Economic growth.*** Quantitative change or expansion in a country's economy. Economic growth is conventionally measured as the percentage increase in gross domestic product (GDP) or gross national product (GNP) during one year. Economic growth comes in two forms: an economy can either grow "extensively" by using more resources (such as physical, human, or natural capital) or "intensively" by using the same amount of resources more efficiently (productively)."

Energy efficiency: Using less energy input to deliver the same level of service

Infrastructure: A nation's critical infrastructure provides the essential services that underpin its society and serve as the backbone of that nation's economy, security and health. These can range from water, energy, transport, emergency services, healthcare, information technology, waste, financial, communications sectors.

Infrastructure Gap: Infrastructure gaps are usually quantified by estimating the existing capital stock and comparing it to a benchmark, typically based on the country's development level.

1.3 What is Renewable Energy Finance?

Renewable Energy finance is quite broadly understood to be defined by market participant, policy incentive, money flows and innovative ways of structuring renewable energy finance for the ultimate benefit of the society. Though the cost of many forms of renewable energy has fallen e.g Solar PV, Wind technologies prices have diminished greatly but still sometimes are prohibitive in constrained municipal budgets. Policy is crucial to fill grant financial incentives, investors are required (and need to be attracted by this incentive), adequate capital needs to reach the project and ultimately consumers need to benefit from the renewable energy technology. With growing trends, more and more people are becoming aware of the cost of climate change and are adovating for green technology. Across the world, renewable energy is gaining prominence for a number of reasons, developing countries are growing increasingly more reliant on it to meet energy demands, traditional fossil fuels are a source of pollution and new climate change mitigation strategies are being incorporated in cities. Thus renewable energy investments are different from historical, conventional electricity investments, and these different characteristics need to be integrated with the existing industry and market structures.

2 Selected Cities

The selected cities were chosen from a list of developed vs developing countries. They are all at different stages of development and offer different learnings in differing economic, social and political and environmental contexts. The below figures 1 and 2 illustrate the financial flows by region in the world by renewable energy investment. As observed in the graph. In the last year (2015), the different incremental increases in investment motivate the city analysis showing mostly growing trends in renewable energy investment.

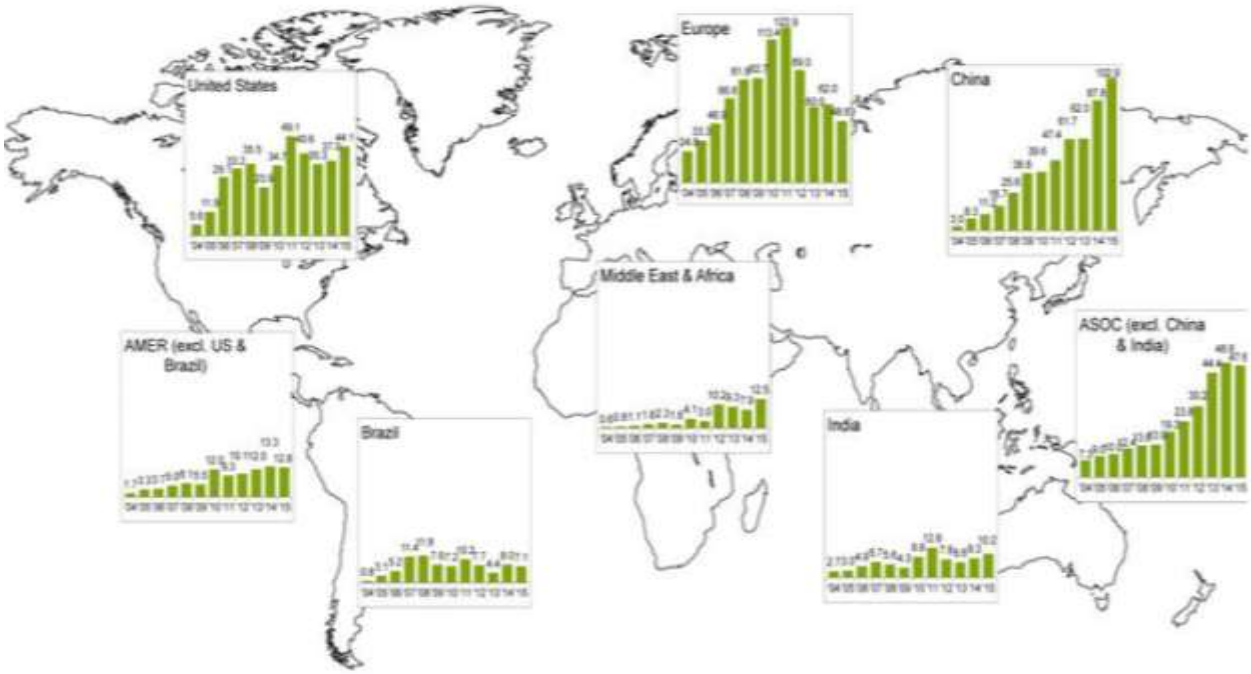

Figure 1 Investments in Renewable Energy, (Source: UNEP, Bloomberg New Energy Finance, 2016)

Figure 2 Cities with renewable energy power policies by type, 2016

Table 1 List of Cities by GDP, Population & GDP/Capita

City	GDP	Population	GDP/Capita
1. Berlin	$ 142bn	3.6m	$40 00
2. São Paulo	$ 220bn	11.3m	$18 487
3. Manila	$57.33bn	12.9m	$2765 (country)
4. Sydney	$337.45bn	4.3m	$40 100
5. Los Angeles	$789.7bn	4.0m	$59 092
6. Hawaii	$70.49m	1.43m	$49 479

3 Berlin - Germany

Figure 3 Map of Berlin (Google Maps)

- Location: Northeast Germany
- Total Area: 887 km^2
- GDP: $142bn
- GDP/Capita: $40 000
- Population: 3.6 million
- Population density: 4 000/km^2
- Major Economic Sectors:
  - Commerce
  - Trade and services

3.1 General Information

Berlin, a city-state, is a world class city with a complex and developed renewable energy market. It has for a long time promoted sustainability in energy and developed as a prosperous city that has efficiently and effectively delivered its services to its citizens. The energy policy in Berlin is premised on three goals, namely, “security, supply and economic efficiency and environmental – and climate friendly energy”.

The financing for most of the energy projects in Germany are funded by their local city governments either through the funds from their treasury or by sourcing loans from local banks. The federally owned KfW Bank Group plays a pivotal role in providing credit facilities for investments in renewable energy projects in Germany and (around the world). When it came to 2010, households invested the largest share from renewables at 37%, utilities, banks, and other investors all contributed about 25%, farmers invested about 20%, and industry and commerce invested the remaining 16%. Small-scale renewable projects, such as residential solar photovoltaic installations, dominated overall renewable energy investment, representing 75% of all investment in renewable energy, while large-scale projects accounted for the remaining 25%.

3.2 Rationale for Selecting City

The fall of the Berlin Wall in 1991 marked a change in energy provision between East and West Berlin. For 29 years, thereafter, the city spent billions into developing energy infrastructure and bridging East and West Germany energy gaps. With its robust ambitions for environmental protection, the City aims to be carbon neutral by 2050. The city has already managed to reduce its carbon emissions from 29.3 metric tons to 21.3 metric tons in 2020, achieved by a decreasing energy consumption significant renewable energy build. This will be conducted through demand side and supply side efficiency. Demand-side (prevent and reduce power and heat consumption around the city) and supply-side (use renewable technologies more efficiently across: biomass, biogas, photovoltaics, solar thermal, wind and geothermal energy). This provides an interesting landscape for further investigation of renewable energy finance.

The current energy architecture in Berlin is illustrated below:

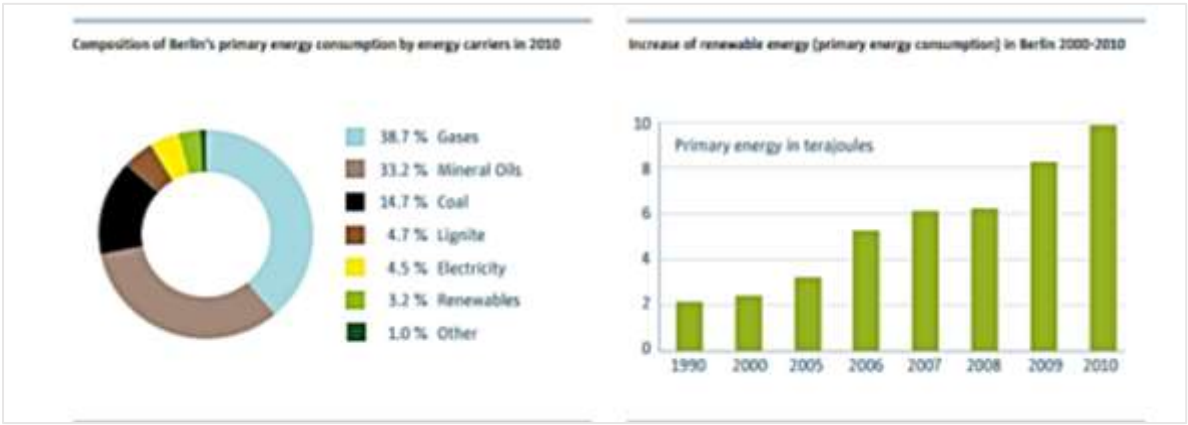

Figure 4 Berlin’s energy matrix and associated energy consumption

- In 1997, Germany’s energy sector was privatized and sold municipal infrastructure and services, Bewag, to the Swedish power company Valtenfall. The municipality sold a majority share to private investors out of a desire to raise its overall income.

- In 2000, the German government and the German nuclear power industry agreed to phase out all nuclear power plants by 2021 and that by 2050, 80% of the country's energy demands will be met by alternative energy sources. 2010.
- The national government also committed reduction in CO_2 emissions to 40% below 1990 levels by 2020 and to 80% below 1990 levels by 2050.

These commitments at national level have trickled down to Berlin and are reinforced in the city's strategies for 2050. The case that makes Berlin compelling is grounded in its robust and dynamic energy market. It has launched several great initiatives worth noting and also a pioneer in benchmarks for energy efficiency. In Berlin, The bulk of private sector investment results from corporate investors (€22bn/$22.96bn) for the energy sector which is estimated to contribute about 95% of climate finance in the country.

3.3 Case Study: Renewable Energy Development

Berlin has set out to achieve ambitious, yet possible, climate neutral goals. The overall long-term vision for the city is to reduce emissions, have diversified energy through a range of initiatives that will ultimately lead to it being carbon neutral. Berlin has set its path towards this goal by providing Renewable Energy investment, favourable regulatory policies and financial & policy incentives to the developers and investors alike.

3.4 Urban Infrastructure Challenges Identified

The City aims to be carbon neutral by 2050. To achieve this, the city has to taken several measures which will be challenging, some of which are listed below:

- **Political will:** The German Federal Government has envisioned an energy future where the country cuts 80% of GHG compared to 1990 levels and 80% of electricity supply should contribute 80% of this by 2050. What is challenging is that Berlin has "here is also no strategic coordination between the different Senate Departments when it comes to climate and energy policy". This means that there is little incentive for the party to overcome implement their climate policy effectively.
- **Intermittency in the energy market**: Unless consumers are seamlessly able to adapt their energy usage to follow energy supply or new technologies emerge such as energy storage, consumers will reject the technology. Large quantities of renewable energy generation is intermittent and will lead to an energy system that in some hours has too much energy supply, while in others expensive plant may be needed to meet demand
- **Mismatch in policy**: Local government has perceived the national framework in favour of liberalised energy markets as inadequately designed to adapt electricity distribution grids to the challenges of the Energiewende (energy turn) – the Federal Government legislation and thus become impediments to overall investment and innovation at the local level.
- **Changing energy mix:** The share of renewable energies in power generation is required to rise from: 1.2% (2005) to 17.8% (2020). The change in energy mix will increase the share of biomass used both in district heating and local heat production gradually over the years till 2020. This would be a challenge to achieve.
- **CO_2 reductions strategy implementation:** Significant reductions in CO_2 will be required to change of energy sources from coal and fuel oil to natural gas and bio-natural gas and by an extension of the highly efficient local combined heat and power generation (CHP) as per the city strategy, the policies of Berlin have been criticised by the 'Green Party' as sometimes

living policy without adequate deployment thus the governmental challenges persist in translating policy to action.

- Private household energy consumption is required to drop by 8%, and modernisation of buildings is required at a rate of 0.7 to 2% for improved energy efficient buildings along with new financing instruments for building owners are also required to implement energy efficient and cleaner energy alternatives.

3.5 Governance, Decision Making & Stakeholder Interests

Generally, all stakeholders are consumers, service providers, developers of projects, distributors of energy, regulators in the state, lenders (banks and other financial institutions) as well suppliers of services (engineering and procurement for operations and maintenance) as well as the local government.

- **The City of Berlin:** The Berlin Energy Agency organises retrofits for large public and commercial buildings with the aim of realising energy savings from costs reduced. This is achieved through the installation of automatic control engineering systems, heating control systems, lighting systems, ventilation and air conditioning systems.
- **Berlin Energy Agency**:
- **Berlin Energie:**
- **Berlin Department for Finance**: Evaluates bids for energy proposed by the genera
- **Distribution System Operator**:

3.6 Public Policy Objectives, Regulatory Framework and Performance Measures

Policy directs the promotion of renewable energy through two predominant methods:

- Price-based schemes: feed-in tariffs (investors receive a fixed price for renewable power generation/kWh in a designated time period)
- Quantity-based schemes: tendering system (these use an auction to determine the required remuneration level required)

Overall policy presiding over finance in the sector can be illustrated by:

SECTOR		POLICY
ENERGY	Renewable Energy Act (*EEG*)	Introduced a Feed-in Tariff, a leading incentive for private sector investment in renewables. Importantly, it also obliges the network operator to 1) connect renewable energy sources, and 2) accept the resulting energy generated.
	Power Grid Expansion Act (*EnLAG*)	Identifies and helps facilitate investment into critical electricity infrastructure projects. Under development is a so-called "one-stop-shop" for approval and permitting processes of infrastructure investment.
	Network Development Plan (*Netzentwicklungsplan*)	A coordinated effort between the four German transmission system operators (TSOs) to organize grid investments over the next ten years, estimated at around EUR 20 billion in total.
INDUSTRY	Ecological tax reform	Encourages emission reduction measures via energy prices.[a]
	Tax exemptions and reductions (*Spitzenausgleich*)	Requires a mandatory implementation of energy management systems and a sector average reduction of energy intensity by an annual 1.3% as a precondition for tax exemptions/reductions (under discussion)[b] (compare, for example, Bauchmüller 2012; Vorholz 2012).
	EU Emissions Trading Scheme	Encourages emission reduction measures via carbon prices.
BUILDINGS	The Energy Savings Ordinance (*EnEv 2009*)	Demands minimum energy performance standards for buildings.
	Regulation for Renewable Energy in the Heat Sector (*EEWärmeG*)	Demands a minimum share of thermal energy from renewable sources.
TRANSPORT	EU CO_2 targets for cars	Prescribe relative emissions intensity for car manufacturers, combined with penalties.[c]

Figure 5 Renewable Energy policies that enable projects to come forward.

Financial incentives form a backbone to driving renewable energy finance development. It can be seen in figure 5 policy, there are presiding legislation that are renewable energy specific and help guide renewable energy investment. Other financial instruments include:

- **Feed-in tariff**: Feed-in electricity tariffs (FiT) have been introduced to encourage the use of new energy technologies such as wind, solar, hydro and other renewable energy. FiT system combined with a guaranteed right of access to the grid for renewable energy projects, this applies for 20 years as well as the year for commissioning. Since 2014, feed-in tariffs ranged from 3.33 ¢/kWh for hydropower over 50 MW, 12.88 ¢/kWh (17.3 ¢/kWh) for solar installations on buildings up to 30 kW and 19 ¢/kWh for offshore wind

Other initiatives:

- The model called "Berlin Energy Saving Partnership" (ESP) was developed by the City of Berlin along with the Berlin Energy Agency for the efficient refurbishment of public and private buildings with the advantage of no financial obligation to the owner of the building. The model aims to upgrade buildings to deliver savings in CO2 redsuctions and also generate energy savings in energy use.
- An accredited Energy Service Company (ESCO), which is to be determined through tendering, finances and implements appropriate energy saving investments to achieve pre-defined energy and cost reductions.

3.6.1 Policy on Climate change

Legislation informing Berlin's renewable energy generation targets are the 'Energy Transition' policies directed by the Ministry of Economic Affairs and Energy:

Table 2 The Energy of the Future, Federal Commitments to 'Energy Transition'

Target	**2014**	**2020**	**2030**	**2040**	**2050**
Greenhouse gas emissions (base year 1990)	−27.0%	−40%	−55%	−70%	−80 to −95%
Renewable energy share of gross final energy consumption	13.5%	18%	30%	45%	60%
Renewable energy share of gross electricity consumption	27.4%	35%	50%	65%	80%
Primary energy consumption (base year 2008)	−8.7%	−20%	NA	NA	−50%
Gross electricity consumption (base year 2008)	−4.6%	−10%	NA	NA	−25%

These above targets have also been set out in the Berlin Turnaround Act, adopted on 17th March 2016. The *Climate-Neutral Berlin 2050,* has also been pivotal towards carbon reductions listed in the above table. The Berlin Energy and Climate Protection Programme (BEK) will translate the above goals into practice.

3.7 Energy Finance

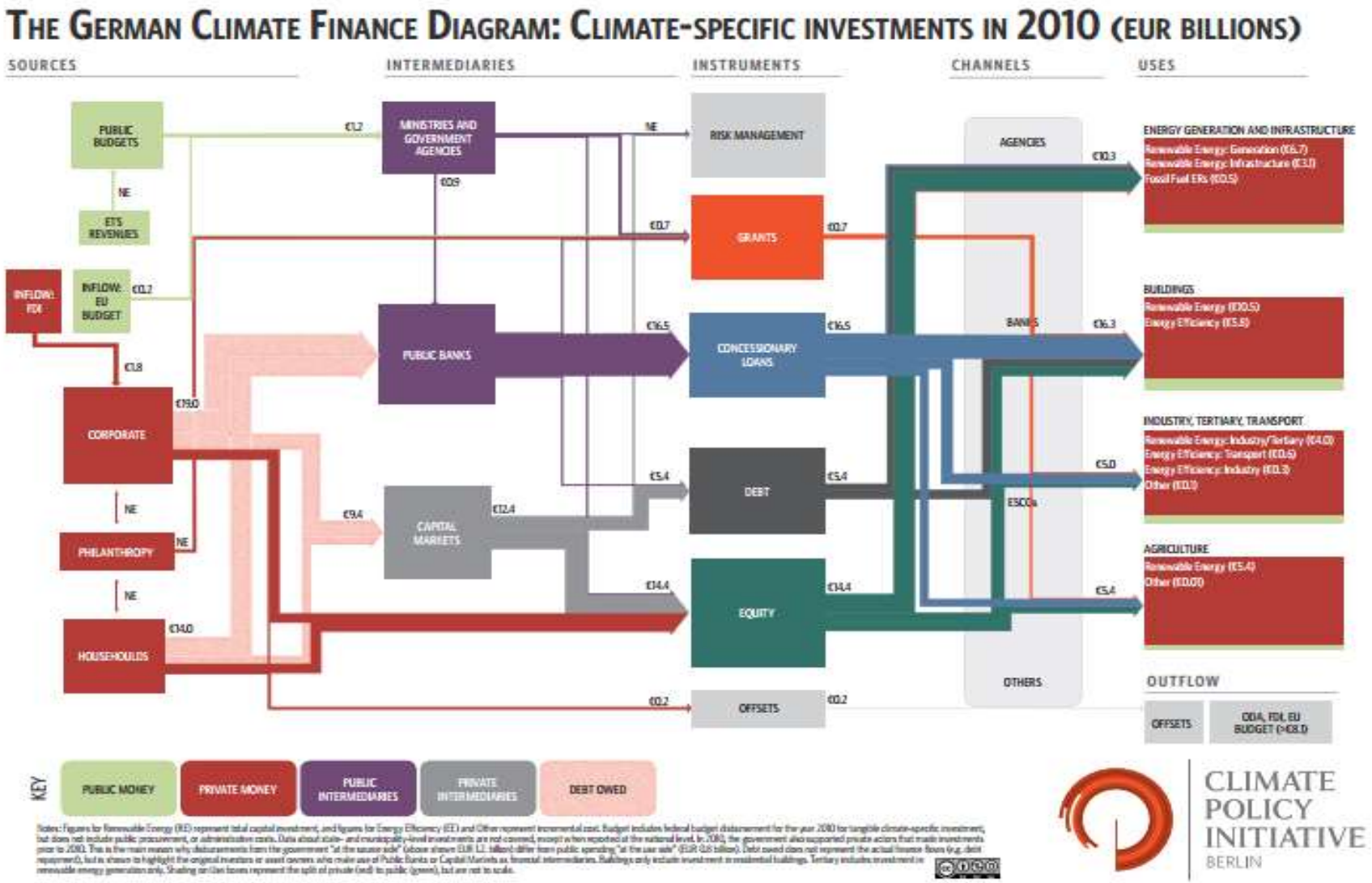

Figure 6 the flow of funds in the German economy towards buildings, industry, and agriculture (Source: The Climate Policy Initiative – Berlin

The investment flows in figure 5 indicated above illustrate the flows of funds generated by households, public money and private capital towards renewable energy. As can be seen all stakeholders effectively play a role in delivering financial flows to the renewable energy assets. The private sector is the most important investor in renewable energy finance.

In the State of Berlin, low cost finance are generally characterised into three:

Types of Finance for Renewable Projects (source: Climate Policy Initiative – Germany)	
Short-term finance	Covers early stage, higher risk, and often higher return, segments of a project lifecycle including project development, construction and project commissioning. This capital is provided by project developers, utility companies, and banks.
Long-term debt	Can bring in lower cost capital, generally supplied by banks or other financial institutions through project finance, or through loans or bonds to utilities, developers, companies, households or other long term equity investors.
Long-term-equity	Is provided by the long term owners of the projects that may include utilities, developers, financial institutions, landowners, or energy consumers among others

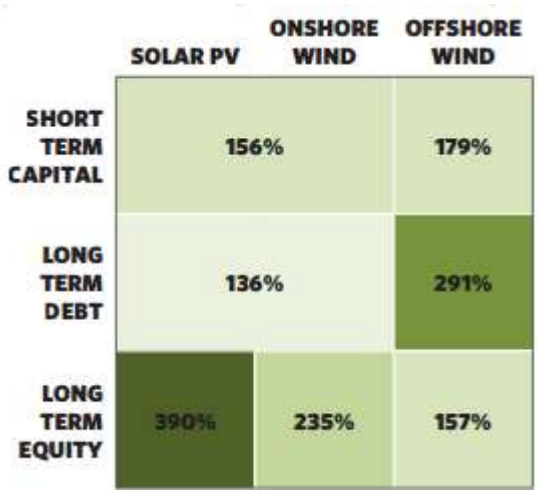

Figure 7 Types of finance and their proportions

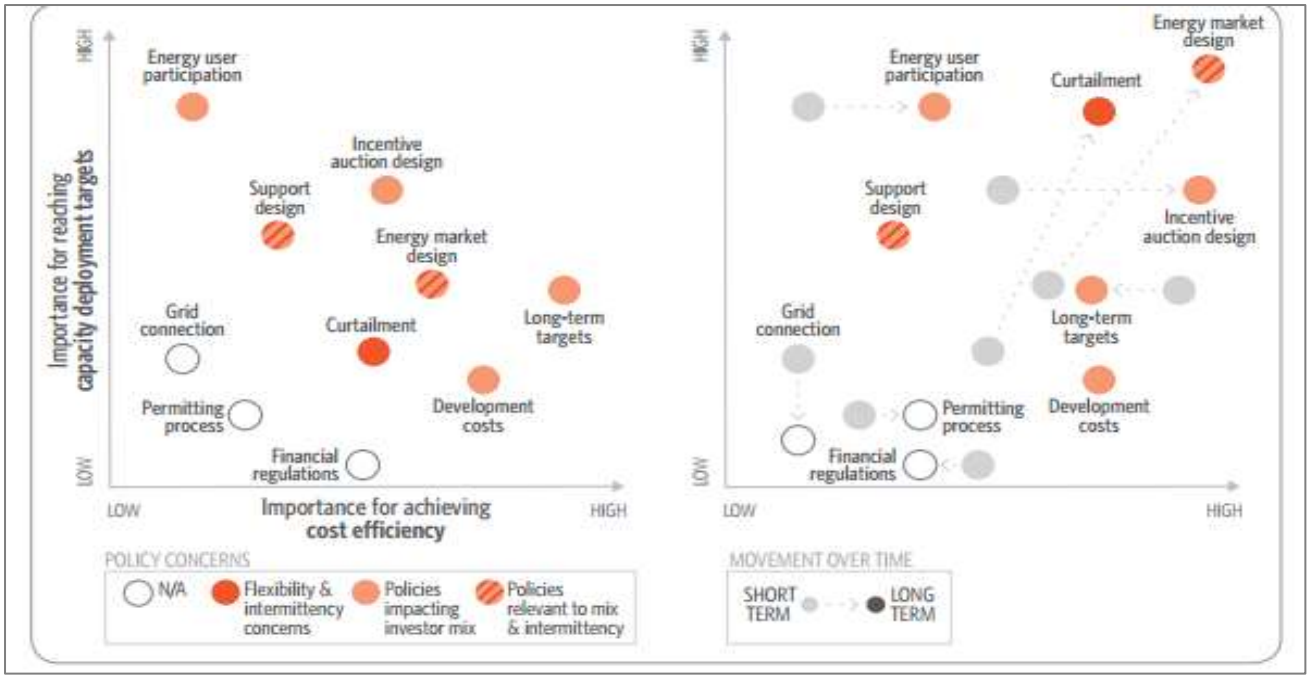

Figure 8 Key policy impacts on investment

Figure 8 highlights the importance of having renewables in investment. It takes into consideration the key elements such as grid connection, permitting, financial regulation, customer and an array of support needed for this deployment. As can be seen, relevant policies form a concern in the State given the risk of political incongruence in the Berlin Senate. Thus, it is important to understand why in this state, which issues impact the level of investment for the cities.

Through the aforementioned Berlin Energy Savings partnership, already 1,300 buildings have been upgraded, therefore CO_2 reductions of nearly 64 000 tpa (average saving of CO_2 emissions of 27.3 %) since its launch. This has amounted in total generated savings of €10.5m or 26% of usual energy costs. The Energy Savings Co has already invested about €44.4m in this program to bring this program to success.

In 2012, €787m (66% of the total commitments in the energy sector) were granted for renewable energies within the scope of financial cooperation with developing nations. The KfW development bank is counted among the world's largest financiers for renewable energies in developing countries.

Local city governments usually fund energy projects through the funds from their treasury or by sourcing loans from local banks. Apart from the local Governments there are also other financing methods that are deployed.

Other financing vehicles:

- The German development bank KfW programmes help finance renewables in the:
  - Federal Bank KfW Bank Group is the German development bank. It is 80% owned by the Federal government with 20% remainder being owned by the States of Germany. It provides a cheap way to fund capital projects due to its tax-exempt status and ability to lend at rates lower than commercial banks

- Direct loans under a banking consortium, with KfW contributing 50% to the financing of projects
- Financing composed of a loan through a bank € 25m up to €100m per project

- European Regional Development Fund: funds that contribute to smart, sustainable and inclusive growth in European Union regions and cities.
- International Finance Corporation - World Bank Group
- Local banks: local banks provide loans to private people and entrepreneurs
- Other means of financing existing plants have been through leasing plants, this has been used my governments to preserve their balance sheet.

Investment hurdles

There are barriers to investment in relatively untapped energy. These relate to investment risk relate to green investments being a relatively new territory with little experience in financing nascent technologies.

3.8 Public-Private Partnerships

The Energy Saving Partnership between the Berlin Energy Agency and the Berlin Senate Department for Urban Development and the Environment provides a key model for energy performance contracting in the public sector. It aims to optimize energy within building structures, and real estate blocks. Private sector providers will be contracted to refinance this initiative from the savings incurred through energy savings. “The basic principle is quite simple: a private specialised energy service company – the so-called contractor – brings his know-how and the necessary financial means into the project”.

The contractor is responsible for the performance of the technical systems and consequently any risks due in case of a system’s break down. “He also guarantees the client a minimum level of targeted energy savings and consequently carries the risk of refinancing, hence full payment is just gained by reaching the energy saving guarantee”.

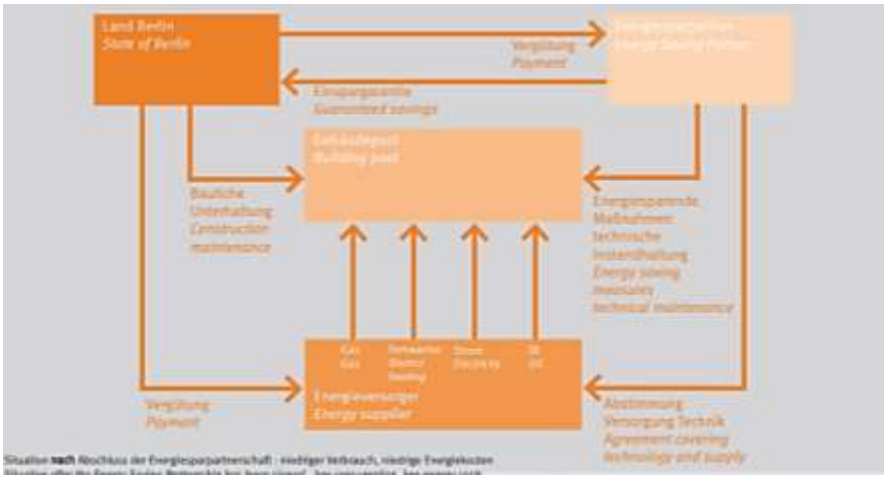

Figure 9 Energy Saving Partnership - low consumption, low energy costs

There have been several initiatives in Berlin that have shown the model for PPPs to be successful. Some of them include:

Project	Solar Energy Generation - Municipal (2002)
Structure	Public Private Partnerships
Nature of project	The Berlin Municipality initiated the Solar Roof Initiative to motivate to drive solar power plants by private investors. Approximately 80 buildings' roof space (schools, buildings, complexes)
Objectives	Reduce GHG and harvest solar energy from the idle roof area on 6000 buildings.
Policy and Incentives	Feed-in tariffs for renewables. Allowing electricity generated by solar power plants more economically viable increased participation from private investors.
Positive Aspects	By using a PPP financing structure the municipality transferred the financing of the construction material and of the technical knowledge to private investors

Thus this particular initiative indicates the success of the project due to PPP model and how effective financial incentives can allow for renewable energy success.

3.9 Alternative Strategies under consideration

Berlin's alternative energy is the framework for their energy provision, therefore how they will deal with the intermittency of the power will require new strategies in the new clean energy outlook. This means that back-up generation will likely include some fossil fuels e.g using gas or a new investment into the highly cost prohibitive battery storage. Alternative storage mechansism are being considered: Mechanical (flywheels), Electrical (capacitors), Chemical (batteries and fuel cells), Gravitational (pumped-hydro) and Elastic (compressed air).

Green Bonds are emerging as a creative mechanism to also finance renewable energy. KfW directly allows for financing of renewable energy projects investors to benefit from the extending lines of credit and ensuring available bonds, whilst simultaneously supporting climate and environmental protection. This means that the State could also be a direct beneficiary of the initiative in future given that

3.10 Impacts Assessment

- Society: Civic engagement to promote energy efficiency and savings is done with citizens to promote energy conservation and the ability to conserve energy
    - Tax incentives given for renewable energy reduce tax bills for customers who benefit overall
- Environment: Berlin's Greenhouse gas emissions consist of 98% CO_2, the carbon neutrality will require urban carbon dioxide emissions being limited to 4.4 million tonnes by 2050.

Further investigation from retail financing and grants will be investigated to see the effects and benefits to the consumer. This will speak to the economics of city retail prices and how they benefit consumers of this energy

Risk

- **Price Risk:** Renewable generation in Germany is usually paid a fixed price tariff for each unit produced and so is relatively unaffected by price fluctuations. With a guaranteed price, both debt and equity investors see renewable energy as low risk.

- **Regulatory risk**: there is a risk that the ambitious targets of the State will be hampered by the issue of intermittency. Others hail and it and other critics say that it could result in making energy prices too volatile.
- **Uncertainty** can create gaps between project budgets and obtainable revenues in projects with long lead times, depending on who invests, the risk could be high if there is a bidding to construction phase required for the bid (pre-feasibility costs and bidding in auctions for energy prices comes at a cost). This ultimately increases the risk of investment.
- **Flexible grid:** Germany must meet the challenge of creating electricity system flexibility to facilitate integration of renewable energy without imposing unmanageable risks on renewable energy investors

4 Sao Paolo – Brazil

- Location: Southeast region of Brazil
- Total Area: 7 994km^2
- Urbanized area: 1 522 km^2
- GDP: $220 billion (12.26% of Brazilian GDP)
- GDP/Capita: $18 487
- Economic growth: 4.2%pa
- Population: 11.3 million
- Major Economic Sectors:
    - Manufacturing
    - Financial Services

Figure 10 São Paulo, Brazil (Google Maps)

4.1 General Information

São Paulo is Brazil's richest city, the 10th richest city in the world and has the largest economy in the southern hemisphere. Regionally, São Paulo has considerable hydroelectric power stations, a substantial amount of capacity to produce ethanol from sugarcane, the reuse of methane from landfill gas, and ample hydrocarbon reserves across the region. The country overall has undergone a significant political regime change, political protests due infrastructure inadequacies, an electricity crisis in 2001 due to over-reliance on renewable infrastructure (hydropower) coinciding with a drop in rainfall and as such, national and the local government of Sao Paulo aggressively started supporting biomass and wind as alternatives to the power sector; coupled with robust carbon emissions mitigation commitments, almost 45% (compared to São Paulo's 55%) of its primary energy demand is catered for by renewable energy, hydropower accounting for at least 80% of that domestic electricity generation.

Public Infrastructure spending at different tiers of government in-country has not been in line with economic growth over the past few decades. This has resulted in large infrastructure gaps commensurate with a large decline in infrastructure investment as a percentage of GDP. This decline has been largely due a decline in public infrastructure spending, and a steady but stagnant private sector investment. A further look into public spending reveals that at different levels of government, most infrastructure investment occurs at state and municipal levels. This provides a basis for our

investigation to understand the role that the government plays at national, state and municipal level in creating an enabling environment for this infrastructure development to take place.

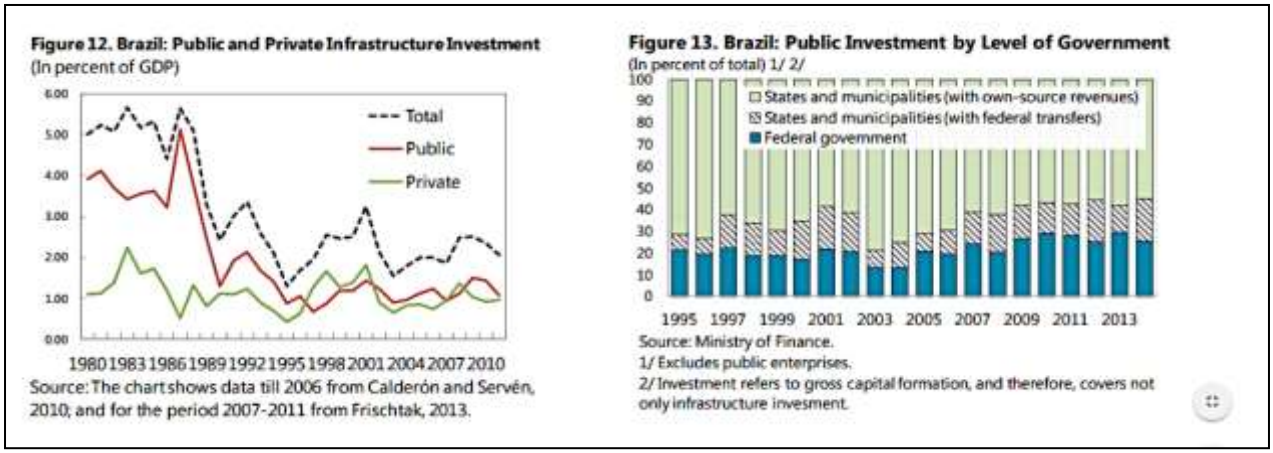

Figure 11 Brazil Public-Private Infrastructure Spending

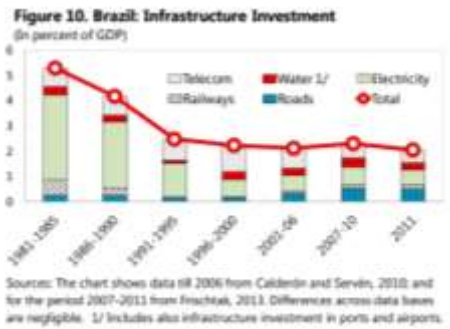

Figure 12 Brazil Infrastructure Investment by Sector

Figure 8 also illustrates the sharp decline of electricity investment as a percentage of GDP over three decades.

The sector forms a fundamental part of the economy and thus requires understanding potential limitations that the state (and relevant cities) face in financing energy projects.

4.2 Rationale for Selecting City

São Paulo has had associated increase in population density accompanied by a corresponding increase in electricity demand, adding intense strain on energy infrastructure. Thus, much like many growing cities, it requires pressing mitigations for energy security. Hydroelectric power, which forms the backbone of its renewable energy generation, has not proportionally grown to meet increasing demand. Thus, through targeted efforts, the city's policies and financing landscape aims to incorporate the increase in traditional renewables (e.g. solar and wind energy) and also explore alternatives such as bioelectricity (biomass to generate electricity). There have been several initiatives proposed such as feed-in tariffs, preferential financing mechanisms for renewable projects as well dedicated funds that make direct investments in renewable energy. Other programmes range from subsidies and tax incentives for renewables, some of which have seen success and others have failed.

São Paulo forms an interesting case for the study as the city is traditionally dependent on renewable energy. In line with this, it has a relatively low per capita GHG footprint among global cities (1.5 tonnes CO_2e per capita compared to Washington DC's 19.7 per capita). The City has also earmarked a strategy to increase distributed generation closer to consumer centres in an aim to reduce its dependency of importing energy from other regions of the country, thus improving energy security fpr the city.

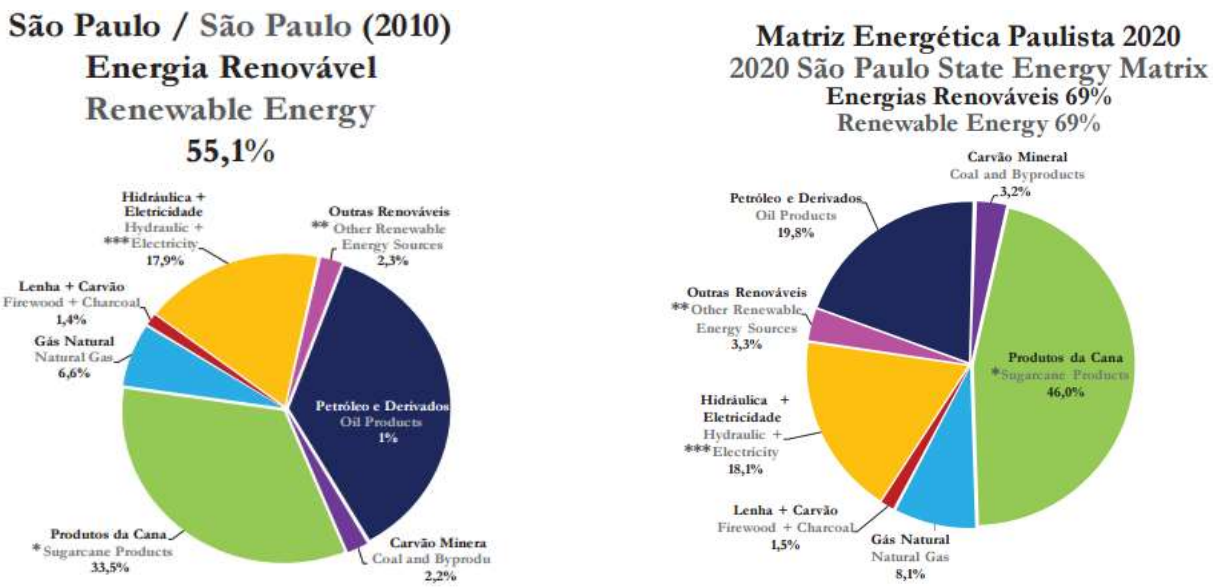

Figure 13 Energy Matrix 2010 and 2020 São Paulo, (Source: São Paulo State Energy Plan 2020)

The installed electrical capacity in Brazil amounts to 125GW. São Paulo's energy is approximately 16% of that, at approximately 23GW.

4.3 Case Study: Renewable Energy Development

Brazil, and by extension, São Paulo's energy mix has historically been one of the least carbon-intensive counties of any major economy. It was historically publicly managed until the 1990s, under the President Fernando Cardoso regime, where the country underwent market liberalisation of the energy sector. The first reform in 1995 opened up the market to incorporate private players.

4.4 Urban Infrastructure Challenges Identified:

The State of São Paulo's Energy Plan articulates some robust energy investment plans, however, there are a number of challenges the sector faces:

- **Water shortages:** Severe water shortages have hurt Sao Paulo that relies on such a significant amount of energy to generate hydroelectricity. In recent news, the Financial Time's February 11th 2015 article: "The worst hit São Paulo reservoir system is Cantareira. Set in hills near the city's international airport, this serves 6.2m people in the metropolis's central and surrounding areas. But it is operating at just 6.1 per cent of its capacity — including reserves that usually are not tapped."
- ***Regulatory*:**
    - ***Licencing***: The State has outlined that licencing practices for projects are cumbersome and serve as hurdles to new renewable energy investment thus has highlighted a need to adopt simplified environmental licencing practices required to fund projects.
    - ***Tax:*** There is a need for projects to receive investment tax incentives for the implementation of assets or through the renewable of production assets. This could boost private sector involvement for the sector.
    - ***Environment:*** The regulatory environment and tariff conditions are also challenging in Sao Paulo, to adequately allow for investments in the retrofit of hydroelectric power plants in the State, thus making it difficult for projects to gain adequate investment.

- ***Scarce information*:** Information on several factors that impact on projects range from: time to completion of projections, project delays, interruptions, etc. This limits investor visibility on historical processes, regulation and risks, and increases overall costs of capital (increased required rates on return) due to excess uncertainty.
- ***Transmission Access:*** There is a case that a utility-scale project is facing difficulty to transport energy produced to the Sao Paulo region due to a lack of transmission capacity.

4.5 Governance Decision Making & Stakeholders Interests

Decision-making power in a city is key to achieving the mandates set out in energy policy and planning. Interestingly, São Paulo is one of the largest economies in the world and, does not have legislative authority over energy. Figure 10 illustrates the Regulatory Structure for the Brazil Energy Sector informing the State's role in energy provision. Table 3 indicates the powers of the State in the energy sector. The State government of São Paulo is headed by the governor of São Paulo, under him are 39 Municipal Governments.

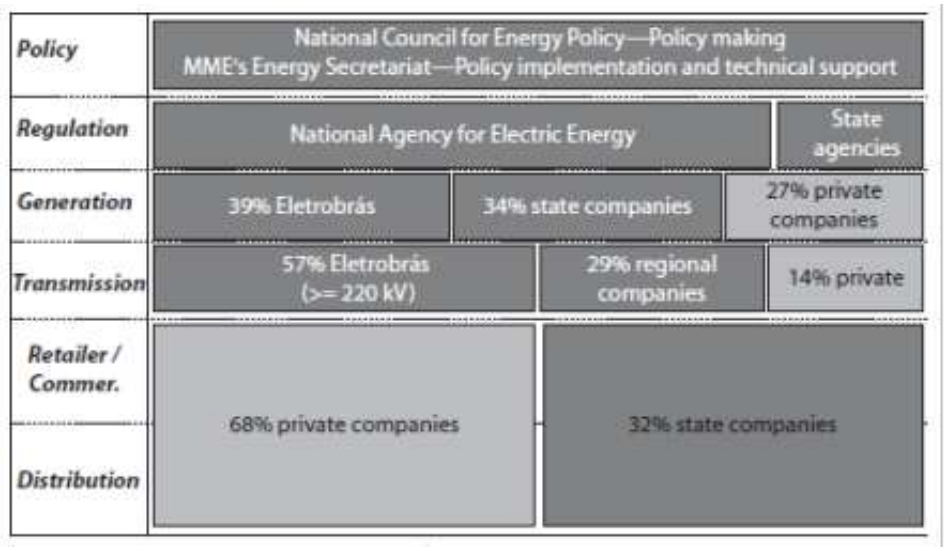

Figure 14 Power Sector Structure in Brazil (Source ECOFYS, 2016)

Table 3 State Wide Executive Powers for Energy Regulation (Source: Power to Act, The Climate Group 2016)

Power	Action	Detail	Source
Executive power over state governance (Derived from the Brazilian Constitution)	Statewide energy efficiency target for industry (non-binding)	Energy efficiency gain of 5% in the industrial sector by 2020	São Paulo State Energy Plan
	Statewide energy efficiency target for the residential, commercial and public sectors (non-binding)	Energy efficiency gain of 5% in the industrial sector by 2020	São Paulo State Energy Plan
	Increase public awareness of energy efficiency	Campaigns, school programs, and professional training courses on energy efficiency for students, professionals, and the public	São Paulo State Energy Plan
	Invest in R&D for energy efficiency technologies	Support R&D centers and equipment production for energy efficiency	São Paulo State Energy Plan
	Adopt voluntary GHG reporting for industry	Voluntary GHG reporting for energy intensive industries with over 7,000 participants	São Paulo State Environmental Protection Agency

The National Plan thus forms the backbone of all city master planning, thus the State uses its power to support national efforts through actions and State Agencies.

National Government Departments

- **The National Council for Energy Policy (CNPE):** The highest-level body in charge of setting energy policy in Brazil
- **The Ministry of Mines and Energy (MME):** Overall policymaking responsibility for the electricity sector
- **National Agency of Electricity (ANEEL)**: Regulates and controls electricity generation, transmission and distribution to compliance with legislation

Local Government Departments

- **Empresa Metropolitana de Aguas e Energia (Metropolitan Company of Water and Energy):** is a state – owned entity of the state of São Paulo
- **São Paulo State Council of Energy Policy (CEPE):** Led and managed by Secretary of Energy José Aníba. They formally launched the city strategy on energy and is in charge of energy policy in general and overall energy management. Renewable energy is administered in the Renewable Energy Division of the Energy Secretariat of the State of São Paulo
- **São Paulo State Environmental Protection Agency:** The agency **(CETESB)** is responsible for issuing environmental permits and for monitoring and enforcing compliance with pollution laws in the State. The agency adopted a voluntary GHG reporting program for industries that are energy intensive. This initiative has 7000 participants.
- **São Paulo State Sanitation and Energy Regulatory Agency (ARSESP):** The agency organises public hearings and consultation, and has an ombudsperson for any disputes. They are the regulator for gas, electricity and water supply and sanitation regulator.

Financial stakeholders

- **Brazil Development Bank**
- **Sao Paulo State**
- **Ministry of Mines and Energy**

Private Companies

- Centrais Elétricas Brasileirdas (Eletrobrás) generates and transmits approximately 60% of Brazil's electric supply.
- **Companhia de Transmissão de Energia Elétrica Paulista** (CTEEP) transmission system operators of electric power grid main private concessionaire of the transmission of electrical energy, for transmission of 30% of all electricity produced in Brazil, and about 100% of the State of São Paulo

4.6 Public Policy Objectives, Regulatory Framework & Performance Measure and Indicators

4.6.1 State Policy on Finances, Energy Generation and Environmental Impact

Energy Finance Programs and Policies

- **The Growth Acceleration Program (PAC)**: This is a targeted program that promotes social, urban, logistics, and energy infrastructure projects in the country, thus contributing to accelerated sustainable development. The Federal government acknowledged the need to attract more private investment and subsequently launched the infrastructure programme, to increase government and private investment to $500bn. This plan aims to accelerate economic growth for the country looking at infrastructure as an asset class.
    - State and municipal governments receive loans and grants from the fund to fulfil their Municipal energy directives.
- **Feed-in Tariff**: A feed-in tariff in 2001 was proposed but yielded no contracts.
- **Net metering program (December 2015)** (Sistema de Compensação de Energia) allows small-scale power generators of up to a capacity of 5 MW to offset their electricity bills with credits from the energy they provide to the grid.
    - Earned credits amongst customers can be distributed among different accounts, e.g on a commercial property or a residential apartment building.
    - Allows for the net-metering credits obtained and not used by a generating facility to offset the excess energy consumption of other sites provided that (i) both sites are serviced by the same distribution concessionaire; and (ii) ownership of both sites is the same
- **Tax incentives:** Import tax exemptions for wind and solar equipment range from 2-10%, so long as there is no equivalent local production.
- **Sao Paulo State tax initiatives** give exemptions for wind and solar energy (including water heating and water pumping) valid until 2021.
- **Social Housing e (Minha Casa Minha Vida):** State tax (ICMS) exemptions for wind and solar energy (including water heating and water pumping) and promote the installation of solar heaters, solar PV and wind power microgeneration in sites of common use of all housing complexes funded with public resources. Initially envisaged for one year, the exemptions have been extended from the launch year, spending R $ 328.1 billion in projects. requires new residential, commercial and industrial buildings to install solar water heating systems (SWH) to cover at least 40% of the energy used for water heating.

Grid access policies:

- Transmission and distribution tariff discounts: 50% across wind, solar, hydropower, biomass

Energy Generation

- The national pla: ***Ten Year Energy Expansion Plan (PDEE)*** aims to boost renewable energy country-wide in the decade 2010 – 2020.
- ***The São Paulo Energy Plan – PPE 2020*****:** São Paulo has set its goals on achieving 69% of its total electrical generation from renewable energy sources by 2020 from 55% today. In terms of usage, because São Paulo is heavily reliant on imported energy from other regions, thus underpinning this strategy will mandate more distributed generation at consumer centres.
- ***The Solar Ordinance of São Paulo*****:** requires new residential, commercial and industrial buildings to install solar water heating systems to cater to at least 40% of the energy used for heating water. It is a municipal directive that is in-line with national energy framework. This policy has had the benefit of creating savings among stakeholders producing a reduction in the production costs of solar water heating systems (SWH)

Environmental Impact

- ***State Policy on Climate Change (SPCC):*** This plan is informed by the National Plan on Climate Change, which includes a proposed target for the reduction of national electricity consumption by 10%. The São Paulo policy, aims to implement programs and plans aimed at a reduction of 20% in CO_2e by 2020 through specific objectives:

  Transport Sector

  - 90% of new flex-fuel vehicles fuelling with ethanol 90% of the time (bioethanol).
  - Maintenance of the blend mandate anhydrous ethanol (99.5% pure ethanol and 0.5% water) in gasoline.

  Industrial Sector

  - Explore programs that could result in energy efficiency gain of 5%.

  For the Residential, Commercial and Public Sectors

  - Employ energy strategies in building practice to achieve energy efficiency gain of 10%.

Social Impact:

- **Energy Security:** São Paulo State's increased electrical energy demand increased significantly with population increases and thus the strengthening of electrical energy supply is needed to avoid rolling blackouts throughout the city. This has a huge social burden and impedes society's ability to function optimally. Thus, through the promotion of distributed generation systems, integrated management and infrastructure sharing (transport, energy, communication etc.), energy transmission and distribution can be optimised. This is outlined as an overarching objective to ensure energy security and avoid future crises.

4.7 Alternative Strategies under Consideration

The Brazilian Federation of Banks and the UN Environmental Programme have launched the scaling up green bond markets for sustainable development as a new mechanism of finance in Brazil whilst also highlighting Sao Paulo's innovation in providing Solar PV grid connections for farmers. The public sector and private sector will collaborate to stimulate private sector market development for green bonds. Bonds serve as a financing tool for infrastructure projects, providing a potentially low cost and long-term source of capital. Having gone through the severe drought, the state could see massive investment in water resilient infrastructure for hydroelectric power as well as spur other sectors in a low carbon future.

This also touches on PPPs for renewable energy finance.

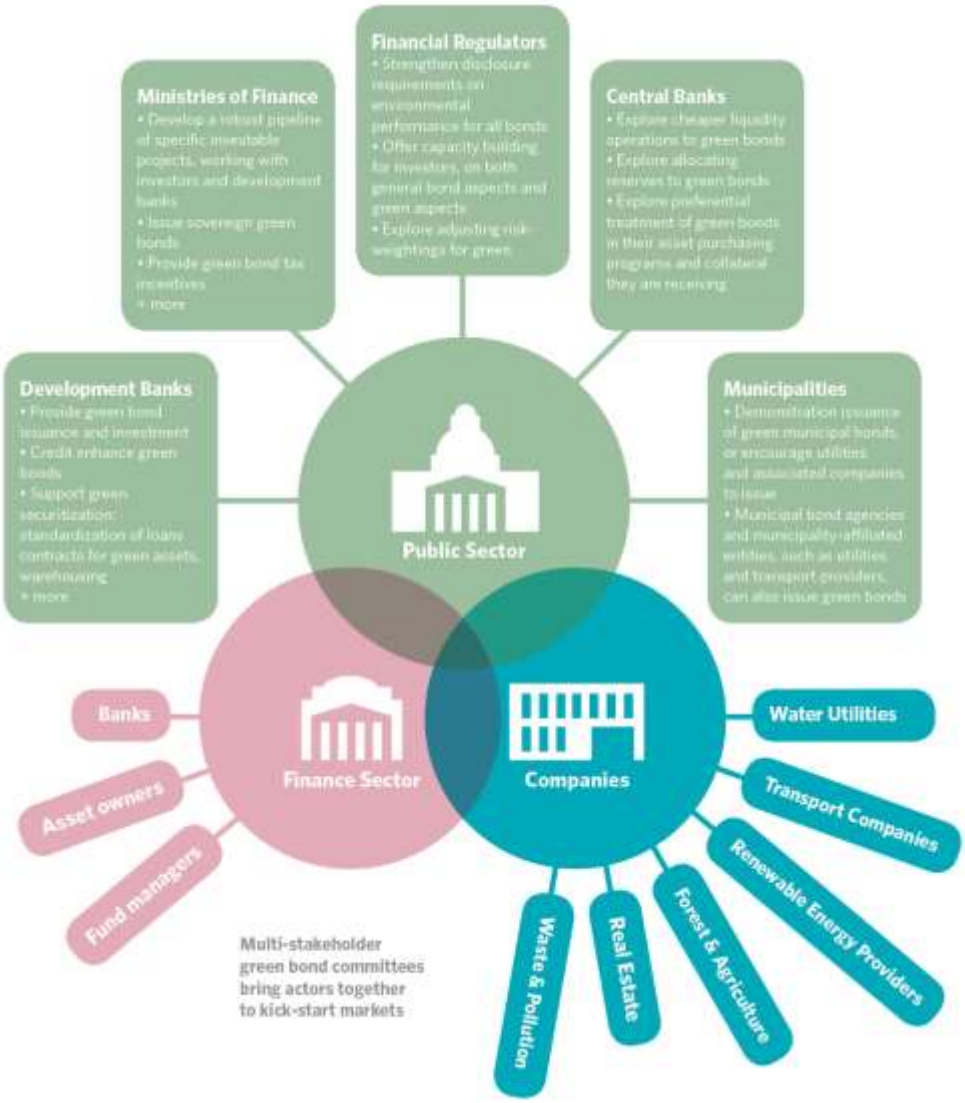

Figure 15 UNEP/Brazilian Federation of Banks Conference on Green Bonds , 2015

4.8 Energy Finance

Private infrastructure financing is plays a significant role in Sao Paulo's economy, usually infrastructure is financed from different sources.

Infrastructure finance availability has been conducted by:

- Public Funds through the **Growth Acceleration Program**
- **Brazilian Development Bank (BNDES):** provides low-interest financing for renewable energy projects that meet local content requirements – depending on what the local content is, they provide different financing amounts for the development of renewable energy infrastructure.
    - **BNDES PROINFA (Programme of Incentives for Alternative Electricity Sources):** offers favourable financing conditions to project developers, offering up to 70% of the total investment cost; the structure of loans also allow for BNDES to receive direct payment from the government PPA initially, with project owners and investors then receiving the residual after the loan quota. The program benefits wind energy, PCHs (i.e., hydroelectric plants of up to 30 MW) and biomass projects.

    - **BNDES Finem program:** aims to finance renewable projects greater than R$ 20 million (US$7m) at interest rates ranging from 1.9% to 6.36% above inflation, p.a and also financing projects improving the efficiency of the grid.
    - **BNDES Financing:** Prorenova programme for new sugarcane plantations. With total funding of BRL4m, the programme finances up to 90% of all programmes to boost bioethanol sector.
- **Energy Development Fund (CDE):** The program is funded by levies from electricity prices and supports the share of electrical energy generated by the enterprises.
    - The program has certain requirements in order to qualify for funding, requesting a minimum 60% local content of the project be sourced in the country, at a maximum limit of 20% in each state.
    - The programme is operated by Electrobrás, which buys energy at preferential prices, giving Power Purchase Agreements for 20 years. The BNDES could finance up to 70% of capital costs (excluding site acquisition and imported goods and services) at the basic national interest rate (TJLP) plus 1.9% premium and up to 1.5% of risk premium.
- **Brazil Northeast Bank (BNB)**
    - Brazil Northeast Bank: Grants soft loans for large projects and more favourable interest rates.

Other agencies funding renewable projects in Sao Paulo but not limited to the region and funding Brazilian projects overall include: International Finance Corporation – World Bank Group, Inter-American Development Bank and the Japan International Cooperation Agency.

Intermittency: Whilst the government is looking to finance renewable energy generation, contingent on its strategy being successful requires a diverse energy mix that allows for a strong, reliable baseload and that also accommodates intermittent renewables. In an uncertain regulatory environment, this become.

4.9 Public-Private Partnerships

Sao Paulo's PPPs are mostly design-build arrangements. Several public-private partnerships have been sponsored related to transmission lines or new hydropower plants. Private sector involvement has gained prominence in the state to avoid corruption and thus government takes on more a role to provide concessions for renewable energy build.

The launch of the Green Bond initiative will hightlight Sao Paulo's new

The country overall awards contracts to project developers through awarding competitive bidding contracts. These are awarded Power Purchase Agreements of up to 20 years. These schemes for technology specific auctions were introduced in 2007 for biomass and small hydro, 2009 for wind energy. The price of electricity ceiling is set by the Ministry of Mines and Energy and is required to have bidders bid lower to provide energy and sign 20 year PPAs with distribution companies mandated to purchase power via these auctions. Energy providers also have to have a net worth of 10% of the projects estimated cost. Recent renewable energy finance in solar energy between public and private sector have awarded these bids in renewable-only agreements:

- October 2014 auction (solar-only): over 1 GW awarded — 31 projects to start supplying energy on Oct. 1, 2017 — at an average price of R$ 220/MWh ($55/MWh).

- August 2015 auction (solar-only): over 830 MW awarded — 30 projects to start supplying energy on Aug. 1, 2017 — at an average price of R$ 301/MWh ($75/MWh).
- November 2015 auction (solar and wind): over 920 GW awarded — 33 solar power projects to start supplying energy on Nov. 1, 2018 — at an average price of R$ 297/MWh ($74/MWh).

4.10 Impact Assessment: Environmental Impact, Societal and Economic Impact

Climate Change

The State Policy on Climate Change (PEMC) established a 20% reduction of CO_2 emissions in São Paulo State by 2020 (2005 baseline). This translates to a reduction from the 2005 figure of 88 844 Gigagrams CO_2 to the 71 075Gg by 2020. In respect of the energy sector, 95% of GGF emissions are CO_2 with 58% of all emission being due to the transportation sector and 28% due to the industrial sector. This analysis corresponds to the energy types being consumed in the State from which major sources of CO_2 emissions come: diesel oil, natural gas, gasoline and fuel oil altogether correspond to 85% of CO_2 (2010 estimate) in the energy sector of the State.

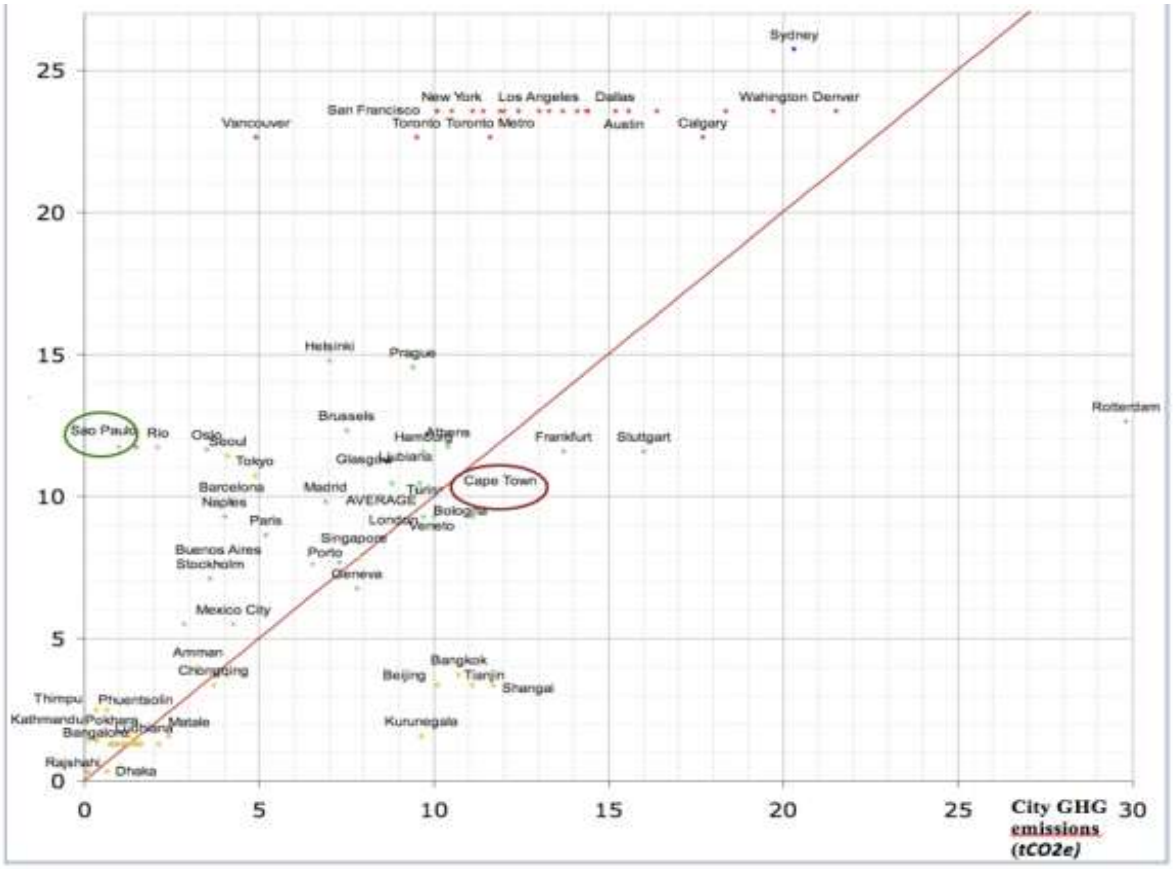

Figure 1 - Overview of Cities' and Countries' Carbon Footprint. Created by authors, using data from Hoornweg et al., 2011.

Figure 16 Overview of Cities' and Countries' Carbon Footprints (Source: The Relative Carbon Footprint of Cities, UNEP 2013)

Whilst it boasts renewable energy generation (largely because of its dependence on hydropower), more extreme global weather patterns have made periods between rainy seasons drier than expected, causing energy shortages in the state.

Social Impact

Energy security has been a contentious social issue in the region due to the cities' over-reliance on hydroelectric power. Thus increasing renewable energy investment needs to also account for a sustainable baseload through the investment of renewables. The sector will also naturally increase the number of people employed in the sector, increase renewable energy penetration and consequently increase the productivity of the city. Literature states the difficulty in measuring direct economic growth, although there is consensus in knowing this relationship is positive.

Economic Impact

The mandatory local content policies that are set by the State are such that about 60% of all manufacturing and services for the projects be locally sourced and 20% sourced from each state. This allows for the local industries to remain competitive and also advance their business in R&D and experience in the sector.

4.11 Risks

Electricity Security

Sao Paulo's electricity generation and transmission is part of a single line interconnected grid network connecting the North and South of the country, 85% of which being from hydropower generation, thus with the increase in

Penalties and Termination of contracts

At times when projects are delayed, they tend to go into cost overruns, thus if a project is delayed by more than a year, the contract can be terminated without justification from the State. This is a burden to investors as at times, project costs are due to the public entities and their inefficient processes (licencing procedures) and dissuades investors when wanting to invest in a project.

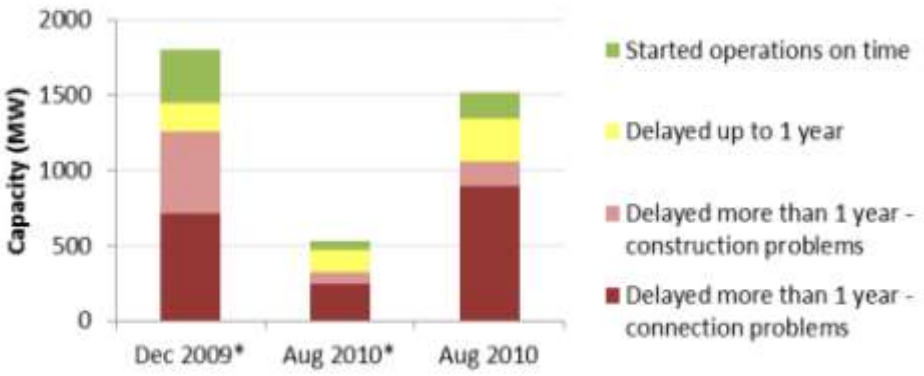

Figure 17 Status of Projects that Auctioned in the first Three Brazil Wind Auctions

Regulatory Uncertainty: Increase regulatory uncertainty increases the risk to private companies and their ability to provide affordable capital.

Political Unrest and Economic impact

Recent issues of social unrest has caused interruptions in the city, coupled with credit downgrading of major companies. Understanding this context will allow for better understanding of the cost of deploying capital in São Paulo.

4.12 Technology Solutions Used

São Paulo is rich in rainfall and in biomass capacity; it has been hailed as the country's greatest potential for bioelectricity. Emergent fuels for electrical generation such as biomass from sugarcane have prompted feasibility studies in this field. Coined 'bioelectricity', 10 692 GWh of electricity was generation in 2010, 5760 GWh of which was used as output for the national electrical system.
Investment into bioelectricity is a Sao Paulo strategy to also reduce dependence on hydro which was caused many widespread strained power rationing.

Over and above the proposed policies above, actions and other measures will be aimed at adopting and *optimising* the State's Energy Matrix on the basis of investing in bioelectricity (biomass to electricity), wind and solar energy:

- **Biomass from sugarcane** is the main funding strategy for electricity generation for *new renewable* sources. The generation of electricity from biomass will be achieved through a program for boiler retrofit and investments in replacement of boilers from electrical energy generation $1300/kW.
- **Wind Energy:** With respect to wind energy, São Paulo feasibility studies show that 4.7GW of generation is implementable with an energy conversion to 13 TWh/year. The policy aims to exploit these this potential through further investment in wind energy. Interestingly, in recent interview in November 2016, the Secretary of Energy and Mines for the State of São Paulo contradicted this potential, stating "There is little wind energy potential in São Paulo, so we are not working to harness this small potential in São Paulo." Alternatively, the city will however, support the wind turbine manufacturing industry more robustly.
- **Solar Energy:** Solar Energy in São Paulo State's Energy Plan presents an amount of 512TWh/year potential from solar irradiance mapping. The policy aims to inform the increase in the nature of these projects.
- **Biogas:** Biogas from organic waste (landfills, forestry and agricultural waste) represents 2600MW in capacity, plans to exploit this as an alternative fuel are underway for the State.
- **Hydroelectric power:** The State of São Paulo already has a significant contribution of energy coming from hydroelectric power, further investment in hydro will expand this power sector by 3700MW.
    - **Natural Gas:** Even though natural gas is not a renewable energy, its introduction will help the city transition to more renewable energy generation in coming years.
- Through public funds, the State aims to also promote solar heater installation, solar PV and wind power microgeneration for housing complexes for multiple use.

4.13 Lessons Learned

Any infrastructure investment is ultimately paid for by the users and taxpayers. Revenue collection from usage goes to the special purpose vehicle for which government provides the concession, and/or subsidy.

Regulatory Uncertainty: Increased costs of capital due to regulatory uncertainty increases the risk to private companies. Therefore the strength of contracts should be designed such that they are not easily renegotiated and clear regulatory frameworks are understood by all stakeholders.

5 Hawaii - United States

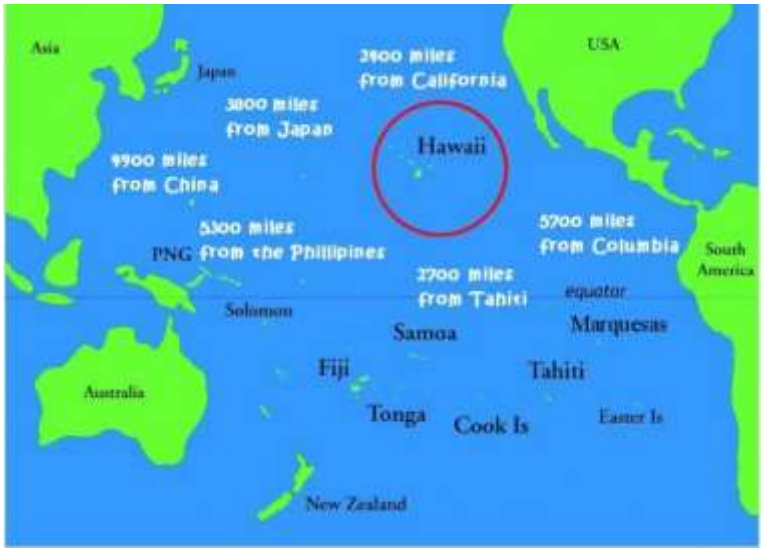

Figure 1 Hawaii Islands, USA

- Location: Southwest region of USA
- Total Area: 28,311 km^2
- GDP: $70.485bn (Hawaii State)
- GDP/Capita: $49 479
- Economic growth: 1.2% p.a
- Population: 1.43m
- Major Economic Sectors:
  - Tourism
  - Agriculture

5.1 General Information

Hawaii is an island state of the United States located in the central Pacific Ocean. Hawaii islands do not have natural reserves of oil and coal, making them completely dependent on imported gasoline for their fuel requirements. Hawaii Islands rely more than 90% on imported oil to fulfil their primary energy requirements with more than 75% of electricity generated from oil compared to an average of 1% in the whole of the United States.

5.2 Rationale for Selecting City

Being heavily reliant on imported petroleum makes the state vulnerable to fluctuating petroleum prices, thus the energy finance in Hawaii is highly unstable. Hawaii is a very ideal playground for testing out a renewable energy generation market as there is very scanty natural resources and the price of fuel in Hawaii is very high due to its reliance on imported fuel. Hawaii has recently started to invest on the renewable energy sector and aims to become a 100% self-sustaining state by use of renewable energy by 2045.

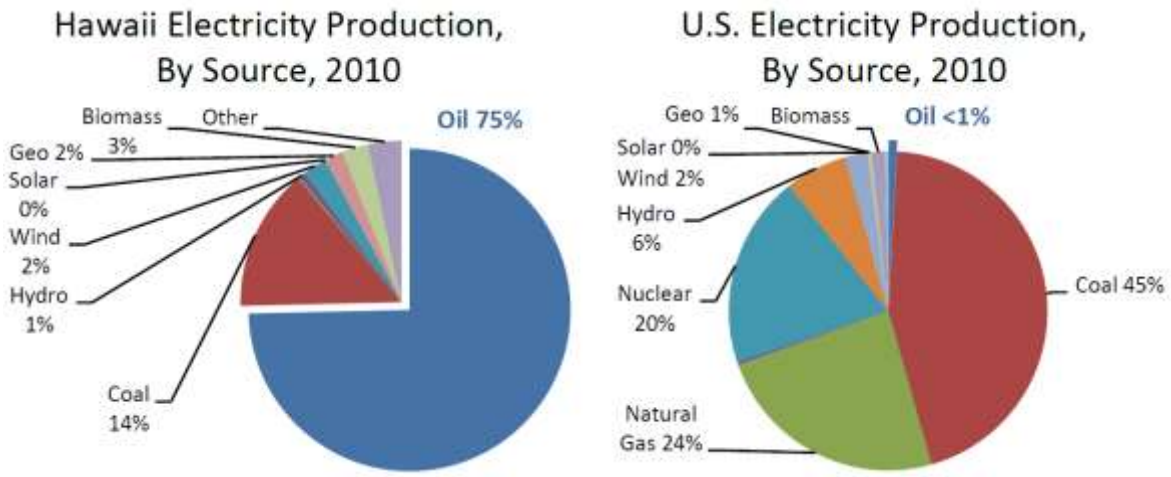

Figure 18 Hawaii Energy Mix compared to the United States

5.3 Urban Infrastructure System Challenges Identified:

To Achieve the offset of generating a 100% power from renewable energy by 2045, there is a requirement of very high inflow of finance into the renewable energy sector in Hawaii. In order to achieve Hawaii Clean Energy Initiative (HCEI), over $15 billion in investment capital would be required. Also, minimizing the cost of capital is critical to managing cost impacts to ratepayers, so there is always a trade-off between the investment made and the tax collected which limits the flow of funding from the government for the R.E. Projects. Clean energy infrastructure requires significant upfront capital investments and many of today's clean energy financing products only serve those who can afford the large upfront costs or have the financial ability to access credit, creating an underserved market, reducing the competition and making it highly difficult for small players to enter into the market.

5.4 Governance Decision Making & Stakeholders' Interests:

Hawaii State Energy Office is the prime authority holding responsibility for Renewable Energy projects in Hawaii. The State of Hawaii has a bold energy agenda to achieve 100 percent clean energy by the year 2045. Along with reducing the islands' dependency on fossil fuels and increasing efficiency measures, the clean energy plan is also contributing to the state's economic growth.
The Hawaii State Energy Office is leading the charge and has embarked on a strategic plan to position Hawaii as a proving ground for clean energy technologies and accelerate our transformation to a clean energy economy.

HSEO is supported primarily by the Energy Security Special Fund (ESSF), established under Section 201-12.8, HRS. The ESSF receives 15 cents of the tax on each barrel of petroleum product sold by a distributor to any retail dealer or end user of petroleum products, other than a refiner. In the fiscal year ended June 30, 2015, the ESSF revenues were $3,708,195, down from $3,719,218 in the preceding fiscal year. To address the reduced revenues from the Environmental Response, Energy, and Food Security Tax over the last several years, Act 185, SLH 2015 imposed the tax on fossil fuel in addition to the tax on petroleum products. The ESSF will receive 14.3 percent of the tax on fossil fuel sold by a distributor to any retail dealer or end user, other than a refiner. The allocation of the Environmental Response, Energy, and Food Security Tax to the ESSF is critical for supporting the Hawaii Clean Energy Initiative, given Hawaii's aggressive goal to reach 100 percent renewable energy by 2045. Federal funding from the USDOE and other federal agencies supplements the HSEO's ESSF funding. The USDOE's State Energy Program provides an annual formula allocation of approximately $280,000. HSEO actively researches and pursues federal funding opportunities that align with its objectives. In fiscal year 2015, DBEDT issued $150 million in Green Energy Market Securitization Bonds 2014 Series A. They are designated as Green Bonds because the proceeds fund renewable energy and energy efficiency projects. Proceeds were deposited into the Hawaii Green Infrastructure Special Fund, which was administered by HSEO through June 30, 2015. As of July 1, 2015, this special fund is administered by the Hawaii Green Infrastructure Authority.

HAWAII STATE ENERGY OFFICE BUDGET			
	FY2015 ACTUAL		
	PERSONAL SERVICES	OTHER CURRENT EXPENSES	TOTAL
Energy Security Special Fund	$3,375,833	$1,236,006	$4,611,839
Hawaii Green Infrastructure Special Fund	$192,627	$143,705,712	$143,898,339
Hawaii Green Infrastructure Bond Fund	$0	$1,693,357	$1,693,357
Federal & Other Funds	$0	$1,618,905	$1,618,905
Total	**$3,568,460**	**$148,253,980**	**$151,822,440**
	FY2016 BUDGETED		
	PERSONAL SERVICES	OTHER CURRENT EXPENSES	TOTAL
Energy Security Special Fund	$3,852,677	$1,689,780	$5,542,457
Hawaii Green Infrastructure Bond Fund	$0	$50,000,000	$50,000,000
General Funds		$222,974	$222,974
Federal Funds	$0	$1,500,000	$1,500,000
Total	**$3,852,677**	**$53,412,754**	**$57,265,431**

Figure 19 Hawaii State Energy Office Budget

5.5 Public Policy Objectives, Regulatory Framework & Performance Measures / Indicators

Hawaii's energy policy aims at deploying cost effective investments in clean energy production and management for promoting Hawaii's energy security. The government of Hawaii has aligned governmental regulations and policies for investment in the renewable sources of energy such as geothermal, solar, wind and hydro energy. To achieve this the Hawaii Government has introduced several incentives to the residents for increasing the use of renewable energy:

Renewable Portfolio Standard	▸ 40% by 2030; all electric utilities ▸ The energy savings from the use of energy efficiency technologies or renewables to displace or offset electricity demand can be used toward annual compliance until 2015 ▸ Existing renewables may be used toward compliance ▸ The Public Utilities Commission (PUC) can establish standards for each utility that identify what portion of the RPS should be met by specific technologies
Net Metering	▸ All utilities ▸ Net excess generation credited to customer's next bill at retail rate, granted to utility at end of 12-month billing cycle ▸ 100 kW system capacity limit; aggregate capacity limit of 15% per circuit distribution threshold for distributed generation
Interconnection Standards	▸ Investor-owned utilities ▸ No system capacity limit specified; net metering not required ▸ External disconnect switch required
Tax Incentives	**Solar and Wind Energy Credit** *(Personal or Corporate)*: ▸ 20% of the cost of equipment and installation of a wind system ▸ 35% of the cost of equipment and installation of a solar energy system ▸ Maximum rebate varies by technology and property type ▸ If reduced amount exceeds customer's tax liability, taxpayer may reduce eligible credit amount by 30% and be refunded excess credit **Ethanol Production Incentive:** For 30% of a production facility's nameplate capacity
Feed-in Tariff	▸ Solar, wind, biomass, geothermal, waste energy, ocean, and hydropower are eligible ▸ Qualified projects receive a fixed rate over a 20-year contract ▸ Three tiers for rates, differentiated by technology and system size ▸ Offered by three investor-owned utilities: HECO, MECO, and HELCO
Public Benefits Fund	▸ All utilities, excluding KIUC, collect surcharge on customers' utility bills ▸ July 2013-June 2014 budget: $21.9m in direct incentives
Green Infrastructure Bonds	▸ The Department of Business, Economic Development, and Tourism can issue bonds to secure low-cost financing for clean energy measures ▸ Proceeds used to fund the on-bill financing program, and bondholders are repaid with funds collected through the public benefits fund
Loans	**Farm and Aquaculture Alternative Energy Loan** ▸ For farmers and aquaculturists, to provide up to 85% of PV, hydro, wind, biogas, or biofuel project costs (max of $1.5m), for a loan term of up to 40 years ▸ 3% interest rate for agriculture, 5% for aquaculture
Rebates	**Solar Water Heater (SWH) Rebate** ▸ Residential customers eligible for a one-time rebate of $750 ▸ Residential utility customers in certain counties can choose between a direct, upfront rebate of $1,000 or a $1,000 interest-rate buydown ▸ Commercial customers may receive custom incentives

Figure 20 Energy Policy of Hawaii

A vision for a clean energy future must be paired with a resolute push for policies and regulations that counteract inertia, encourage progress and eliminate obstacles. The state's profound ambition for energy independence is to work with the utilities and regulatory bodies to reshape energy policy that will turn vision into reality. In addition to the epochal 100 percent RPS legislation that is driving all of Hawaii's clean energy efforts, HSEO, DBEDT and other state agencies worked in the areas of policy and regulation to:

• Make it easier for residents to take advantage of clean energy.

• Establish energy equilibrium at state bodies like the University of Hawaii, which will generate as much or more energy as they use.
• Encourage Hawaii's utilities to plan effectively for a clean energy future, modernize grids, integrate renewable energy and attain sustainable and secure generation and distribution.
• Enable hydrogen-based energy.
• Advance the feasibility of owning and operating an electric vehicle (EV). These and many more achievements have thrust the state into the forefront of global clean energy leaders and drawn the attention of national energy policymakers, who are looking to Hawaii to show America the way to a clean energy future.

Hawaii has made great ground in increasing the amount of locally produced renewable energy. With a goal to generate 100 percent clean energy by 2045, the state will continue to:

- Align government regulations and policies with clean energy goals
- Facilitate processes for developing renewable energy
- Deploy renewable generation and grid infrastructure
- Explore next generation technologies and new applications of existing technologies.

The objective of the government will be to harness the complete scope of renewable energy potential. Hawaii, being an Island state, has a plenty of renewable energy potential from solar, wind, hydro, bioenergy, geothermal, ocean water and wave energy and hydrogen sources.

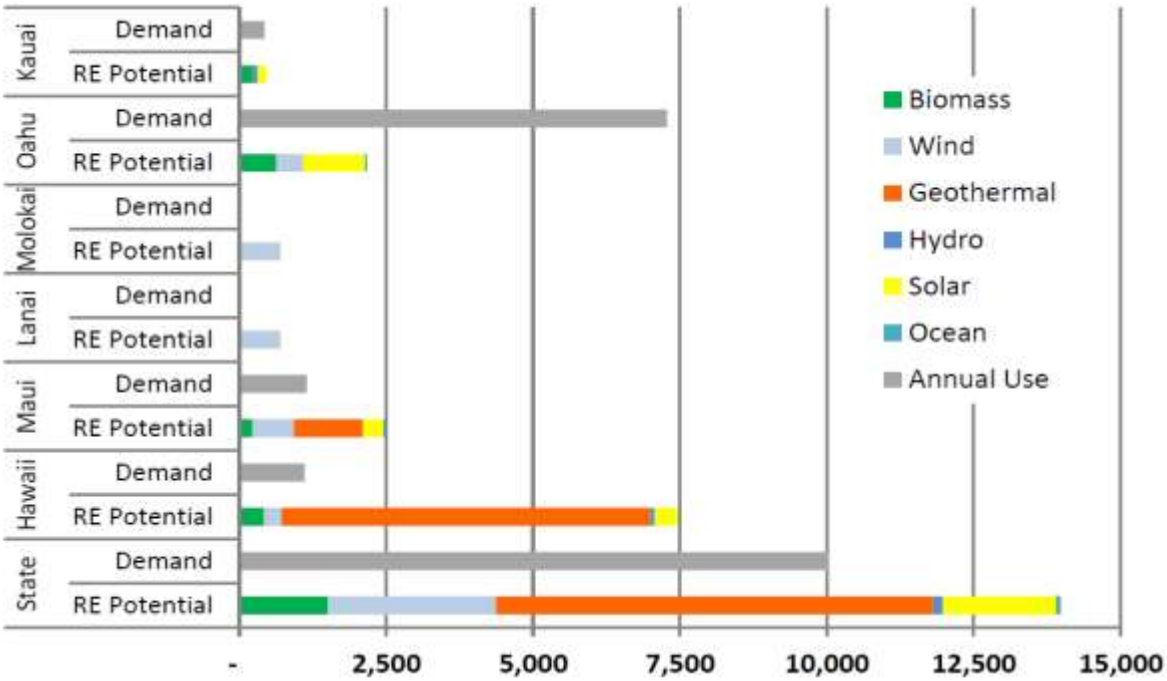

Figure 21 Renewable Energy Demand vs Potential (source)

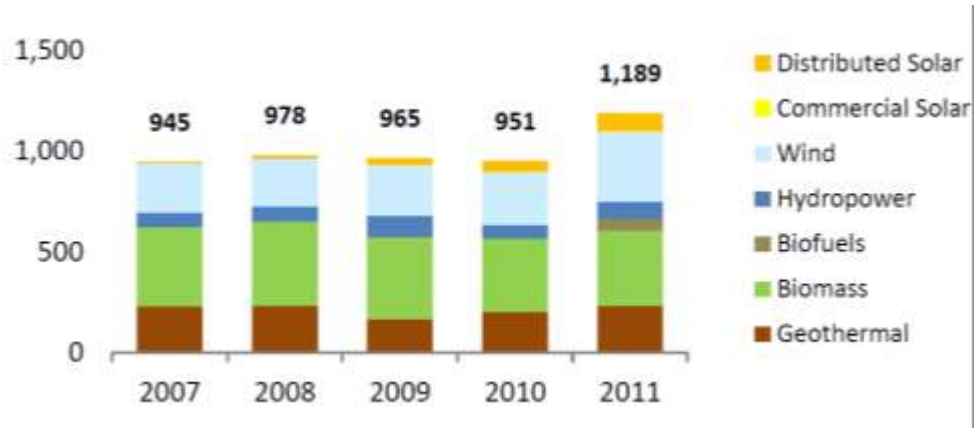

Figure 22 Renewable Energy Generation in GWh

5.6 Alternative Strategies under consideration – Energy Assurance and Security In Hawaii

The Hawaii State Energy Office (HSEO) leads the state government's effort to ensure a secure and reliable energy infrastructure in the contemporary energy environment. As the designated agency for energy, HSEO works closely with many government and industry emergency management and security partners to lower vulnerabilities, deter threats, minimize the consequences of energy disruptions, and enhance recovery of Hawaii's energy systems.

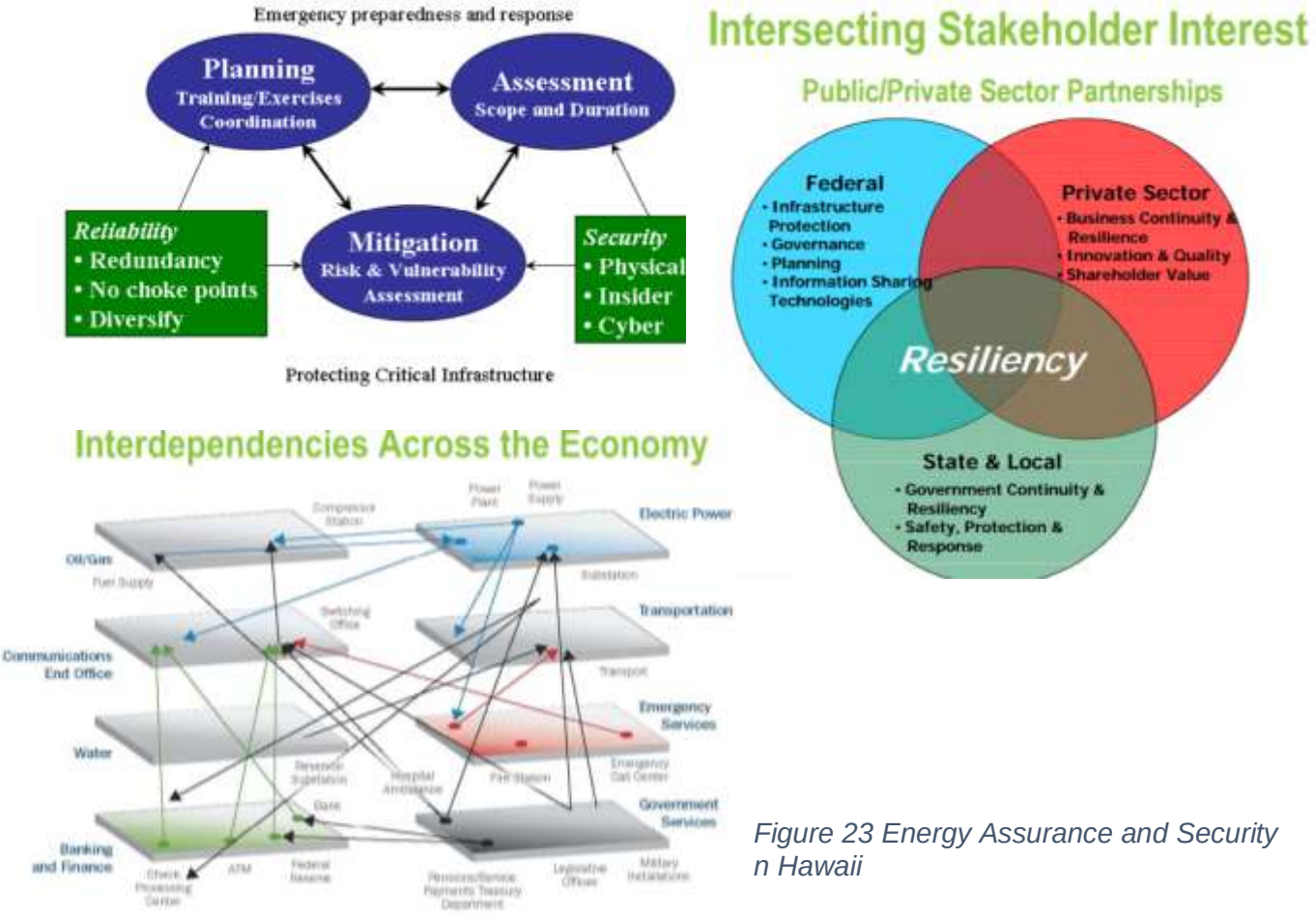

Figure 23 Energy Assurance and Security n Hawaii

5.7 Financing for Renewable Energy Projects:

Due to the rapid increase in the interest in Citizens of Hawaii in R.E. there have been multiple avenues of Financial investments sprouting out in Hawaii:

1) Hawaii Angels (Private Equity)
Angel investors are high net-worth individuals who make equity investments in entrepreneurial businesses. Individual members have invested more than $30 million in various companies and have played a significant role in Hawaii's start-up community. Members often mentor entrepreneurs and provide new companies with valuable business advice and important contacts. The group typically invests in seed and start-up companies.

2) Hawaii Venture Capital Association
Venture capital is a subset of private equity and is popular among new companies or ventures with limited operating history, which cannot raise funds by issuing debt. Most venture capital comes from a group of wealthy investors, investment banks and other financial institutions that pool such investments or partnerships. The Hawaii Venture Capital Association was founded in 1988 to serve as the nexus for entrepreneurship, capital formation and networking.

3) Commercial Scale Renewable Energy Investment Firms
The following list represents a sample of local and mainland investment firms that engage in renewable energy project finance, investment and consulting services for commercial scale projects in a variety of technologies. Certain solar installers also offer solar financing via power purchase agreements or other arrangements for non-profit and for-profit entities.

- Bonterra Solar
- Capital Technology Inc.
- Distributed Energy Partners
- GE Energy Capital
- Greenpower Capital
- Island Pacific Energy
- KAS Consulting Group
- Kairos Energy Capital
- Sunetric

4) Financial Institutions
Conventional lending institutions offer an array of debt instruments from business loans to credit lines that can often compliment the overall financing profile of renewable energy companies that have an established business record or other means of establishing collateral. A Few of the Institutions that have been engaged in this program are:

- American Savings Bank
- Bank of Hawaii
- Central Pacific Bank
- Finance Factors, Ltd.
- First Hawaiian Bank
- Hawaii National Bank
- Ohana Pacific Bank
- Pacific Rim Bank

- Territorial Savings Bank

Green Infrastructure Loan Program: In this financial model that has been adopted by Hawaii, a loan would be provided to the consumer to purchase and install a clean and efficient energy equipment. Apart from this the government has introduced a bond financing scheme wherein the consumers are imposed a dedicated green infrastructure surcharge in their monthly bills and they are issued a bond. This fund generated is utilised for clean energy and efficiency programs. This is the first time these funds have been used as credit enhancement for a bond issuance It is expected that this finance model will enable consumers having low credit score to receive financial support and remove barriers to deploying clean energy projects by accessing low cost utility tariff financed bonds that are sold to private investors such as pension funds.

5.7.1.1 Companies in Hawaii offering benefits of the scheme:

Energy Finance Solutions: As a part of the Green Energy Market Securitization Program, the company offers financing for residence to purchase a Solar Photovoltaic System. They offer up to a 100% finance cost with zero down payment and over a 20 Year fixed rate loan term for an interest rate of only 5.99%.

Hawaii Energy Connection: Through their Kumukit savings scheme, the company offers a comprehensive investment strategy wherein the consumer could start savings on interest from Day-1. The Surcharge amount would be invested in the scheme and there would be an estimated ROI of 7.5% in addition to a bonus. This plan also offers a zero-down payment, low interest rates and long repayment period.

5.8 State-Wide Incentives:

State-wide incentives in Hawaii have driven renewable energy deployment

Corporate Tax Credit for Solar and Wind Energy: The Hawaii Energy Tax Credits allow individuals or corporations to claim an income tax credit of 20% of the cost of equipment and installation of a wind system and 35% of the cost of equipment and installation of a solar thermal or photovoltaic (PV) system.

Performance-Based Incentive: Renewable energy technologies in Hawaii are eligible for feed-in tariff for a contract period of 20 Years.

Property Tax Incentive: The alternative energy property installed on a building, property, or land is exempt from property taxes for 25 years.

General Excise Tax Exemption: Wind energy producers may be eligible for a 100% general excise tax exemption as well as reductions in state income taxes in exchange for demonstrated job growth

5.9 Federal Incentives:

Business Energy Investment Tax Credit & Renewable Energy Production Tax Credit: This allows is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year.

Corporate Depreciation: The businesses may recover investments in renewable energy in certain property through depreciation deductions over a period of five years.

5.10 PPP Model:

A Public Private Partnership model has been made between the state of Hawaii, Panasonic Eco Solutions, and Coronal Group LLC for a $100M in solar photovoltaic (PV) financing. The partnership as a part of Hawaii's Green Energy Market Securitization Program (GEMS), was put together by Clean Power Finance (CPF), a financial services and software provider for the solar industry, and aims to provide significant electric bill savings to underserved non-profits and businesses in Hawaii.

Non-profits in Hawaii that have previously found it difficult to finance a solar PV system now have another option for solar financing, under Hawaii's Green Energy Market Securitization (GEMS) program and an innovative public-private partnership.
Under the GEMS financing program, non-profits can prepay a power purchase agreement (PPA) for a solar PV system, essentially allowing them to lock in their electricity costs for the next 20 years at a significant discount. Because non-profits are not able to take advantage of either state or federal tax credits that can lower the cost of a solar power system, this program can let non-profits still reap the benefits of solar through lower electricity rates. Through this partnership, Coronal and Panasonic will provide engineering, procurement, and construction services to Hawaiian solar installers, as well as tax equity, while CPF will work with the state to manage capital deployment and provide underwriting services to the project. The GEMS program, which uses rate reduction bonds to finance solar projects, is the first of its kind in the US, and maximizes the economies of scale through leveraging a large pool of municipal bond capital to reduce financing costs for clean energy through reduced overhead expenses.

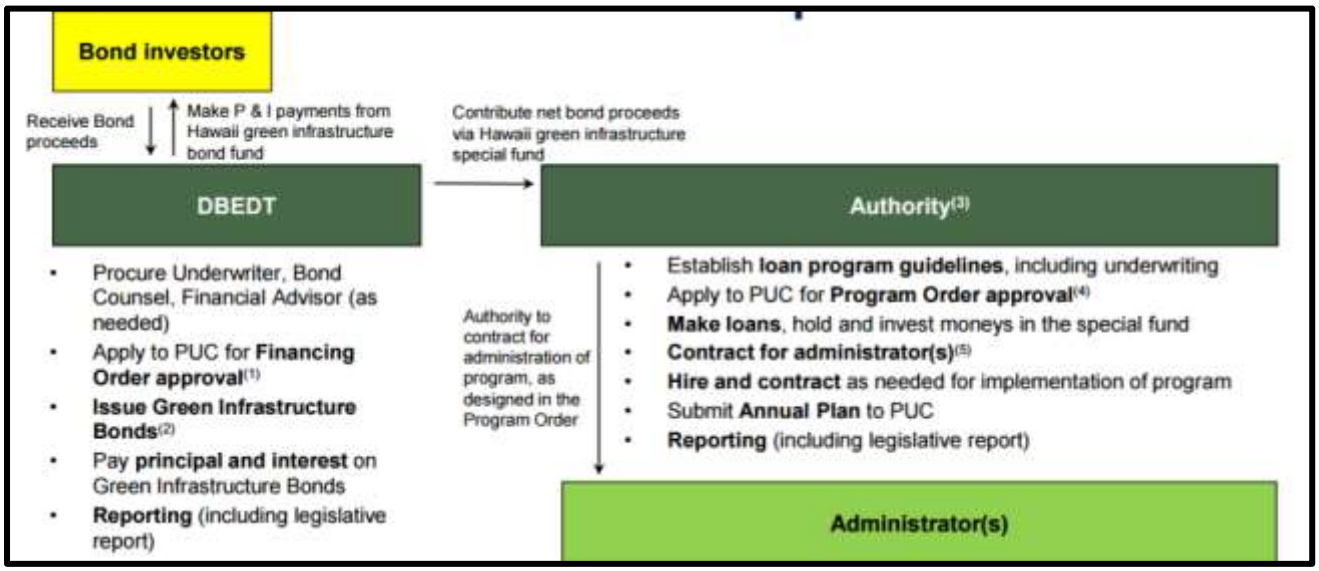

Figure 24 GEMS Scheme Structure

5.11 Impact Assessment

Given the region's excessive use of oil and fossil fuel technology, the region's carbon footprint per capita is comparable with some of the world's largest. Below are the impact assessment of Hawaii Island region:

Environmental Impacts:

It is critical to assess the environmental impact of Renewable Energy projects prior to making investment in the project. Renewable Energy is a very environmental friendly measure however there may be a few measures that could be considered that could further improvise the quality of production and transmission of renewable power.

The ultimate purpose of any Clean Energy project is to reduce the Carbon footprint and to increase the efficiency of generation and distribution of power. But at the rate at which the solar panels are growing in Hawaii, it really raises a concern on the manufacturing process of Panels which is a very non-environment friendly procedure that leaves out a lot of residual waste.

Societal Impact:

Even though the Renewable energy may be highly beneficial for the neighboring society there are still a lot of concerning issues that have to be assessed before the initialization of the project. When development of geothermal energy was first proposed on Hawaii Island, some who opposed the project cited cultural concerns stemming from Hawaiian beliefs in Pele, the volcano goddess believed to be responsible for the formation of the Hawaiian Islands. Other concerns were expressed about the health effects of hydrogen sulphide emissions from geothermal projects and that development and operations, such as well drilling, could be noisy and disruptive. Some people also expressed concerns about the slight possibility that injection wells might contaminate drinking water sources.

When Hawaiian Electric proposed building a wind farm on the ridge above the Kahe power plant in Leeward Oahu is 2005, nearby residents raised many concerns. These included aesthetics, impact on property values and the chance that wind farm construction might disrupt traditional Hawaiian archaeological and burial sites or bring more human traffic to the area.

Economic Impact:

Renewable Energy projects require very high initial capital investment at the beginning of the beginning of the project that may require collaborative efforts from the local government and private players to initiate a project. Hawaii has the highest electricity rates in the country and rooftop solar penetration has moved so rapidly, Hawaii's utilities are now grappling with both technical and economic challenges that mainland utilities have yet to fully face. Due to this shift of energy generation from Non-Renewable to Renewable resources there is a huge economic impact.

4.12 Risks in Renewable Energy Financing:

Much of the dramatic growth of the clean energy industry over the past 15 years has relied on grants, incentives, rebates, policy initiatives, and technical support from state and municipal clean energy programs. But continued growth will be limited as long as it relies primarily on deep public subsidy. This basic issue hits at both the federal and state level. At the federal level, the country has begun to see a dramatic decline of federal support for clean energy, as more than seventy-five percent of federal program dollars for clean energy are coming to an end.

5.13 Technology Solutions and their Assessment: Implementation of Smart Grids:

Smart Grid projects are in rapid initiation phase in the Hawaii Islands and the utilities in Hawaii are eager to invest in Smart Grid Projects. Over $57 million has been invested in Smart Grid demonstration projects in Hawaii. They have identified three key parameters in the smart grid that they plan to focus initially

- Smart Meters
  - Provide timely and more detailed energy usage information
  - Allow for time of use rates
- Energy Storage
  - Allows for increased renewable energy penetration
  - Stabilizes grid by conditioning power and smoothing fluctuations
- Demand Response--managing electricity use in response to available supply
  - Reduces the need for spinning reserves
  - Reduces the amount of oil imported

	Oahu	Hawaii	Maui	Lanai	Molokai	Kauai
Total Capacity (MW)	**1672**	**270**	**261**	**9.3**	**11.8**	**128**
Percent of Statewide Capacity	71.1%	11.5%	11.1%	0.4%	0.5%	5.4%
Net peak demand (MW)	1216	203	204	5.4	6.3	78
Total Reserves (MW)	456	67	57	3.9	5.5	50

Table 4 Peak Electricity Demand and Total Generation Capacity

There are huge investments made in the smart Grid sector across the globe and also the Department of Energy of the United States has allocated $3.4 billion in grants for smart grid projects & grid upgrades in recent years.

Figure 25 Worldwide Smart Grid Market

There are currently five ongoing Smart Grid Projects in Hawaii:

Name	Description	Key Companies	Location
DOE Renewable and Distributed Systems Integration (RDSI) Maui Smart Grid Demonstration Project	Develop a distribution management system that aggregates distributed generation, energy storage, and demand response technologies with $7 million in DOE funds and $8 million in industry funds.[6]	HNEI, HECO/MECO, General Electric, First Wind	Maui Meadows, Wailea
Japan U.S. Island Grid Project	Develop advanced technologies that automate EV charging and demand response to allow more renewable energy on the grid. NEDO will invest $37 million in the project.[7]	NEDO, Hitachi, Mizuho, Cyber-Defense, US DOE, NREL, HECO/MECO, HNEI, MEDB, & Maui County	Kihei, Maui
KIUC Smart Grid Demonstration	Installation of advanced metering infrastructure (AMI) and other smart grid technologies for grid management and energy efficiency information. Total cost of around $11 million for 33,000 meters in five years.[8]	KIUC, U.S. DOE	Kauai
Honeywell Fast Demand Response	Industrial and Commercial programs available for designating non-essential facilities that can be turned off during critical energy situations with ten minutes notice or less.[9]	HECO, Honeywell	Oahu
Korea-Oahu Smart Grid Demonstration	Gov. Neil Abercrombie signed a letter of intent with officials from South Korea to develop a micro smart grid demonstration project in Hawaii.[10]	Korea Smart Grid Institute, LG Electronics, Nara Controls, Hyosung, KT, Royal Hawaiian, Moana Surfrider, Sheraton Waikiki	Oahu

Table 5 Smart Grid Projects in Hawaii

5.14 Lessons Learned:

Hawaii has been heavily dependent on imported petroleum for energy and investment on renewable energy would be an economically profitable and technically feasible solution, The strategy of providing subsidies for renewable energy investment and financing of such products have had a very welcoming effect. If the governmental policies are to be maintained flexible the same way it is maintained, we could expect even further investment and development in Hawaii region. This could make a paving way for Hawaii to achieve becoming a 100% self-sustaining state by use of renewable energy by 2045.

6 Manila - Philippines

- Location: Northwest Philippines
- Total Area: 1474.82 km^2
- GDP: 57.33 billion
- GDP/Capita: $8,000
- Economic growth: 5.6%pa
- Population: 12.9 million
- Major Economic Sectors:
  - Tourism
  - Banking & Finance

Figure 26 Manila, Philippines

6.1 General Information:

Manila is the capital and second-most populous city of the Philippines. With the city population exceeding 1.7 million, all cramped in an area under just 43 sq.km., it is the most densely populated city in the world with a whopping 41,515 people per square kilometre. The Philippines is a group of islands, and Manila occupies a central location along the Pacific trade routes. Being at the cross-roads of many an Asian culture. Manila is also crisscrossed by several seismic faults which make it extremely prone to earthquakes and is subsequently ranked the second riskiest capital to live in. This makes it a very interesting study to see how renewable energy finance would impact a developing high seismic activity capital city.

6.2 Rationale for Selecting City

The Philippines possesses very limited fossil fuel resources and thus has to look at renewable sources for its energy demands. Fortunately, it has an abundance of renewable energy sources which make up over 30 percent of power generation. The Philippines was the first country in Southeast Asia to deploy solar and wind technologies at large. It is the second largest producer of geothermal energy in the world. Not only is it a world leader in renewable energy technology, it is one of the more ambitious countries in this sector. Looking at the levels of investment in these projects as of 2010, the Philippines is set out to triple its share of renewable energy by 2030. The Philippines is committed to reducing costs, as it has one of Asia's highest electricity rates, owing in part, to expensive fossil fuel imports.

5.3 Urban Infrastructure System Challenges Identified:

Philippines being a developing nation and having abundant potential for renewable energy utilization is seen as one of the ideal test market for implementation of Renewable Energy in Asia. RE development is faced with a number of regulatory barriers. For instance, while the Renewable Energy Act of 2008 provides for non-fiscal incentives like FIT, it was only in July 2012, almost four years after the enactment of the Renewable Energy Act, that the FIT rates were issued. Although the issuance

of FIT rates by the Energy Regulatory Commission (ERC) was and is regarded as a very significant move towards the promotion and development of RE, it was not without challenges. The approved rates were lower than what the National Renewable Energy Board (NREB) proposed. As the FIT will be the key determinant of a RE project's economic viability, it remains to be seen how it will impact the RE industry. The final rules and regulations concerning the FIT system are yet to be implemented. Other mechanisms, as provided in the Renewable Energy Act, namely RPS, net metering, RE market, green energy options, interconnection with the grid, priority dispatch, and RE trust fund are needed to be put in place to further attract investors. Putting all these mechanisms in place is not an easy undertaking

Another issue concerning the RE industry is the need for developing local technologies. The costs of RE will remain high if the country continues to depend on imported technology. Other issues include lack of public awareness of the benefits of the RE projects (socioenvironmental concerns) and absence of commercially viable market for RE systems. These issues are in an unclear ground that makes it challenging for private firms to invest in the RE Sector.

5.4 Governance Decision Making & Stakeholders' Interests:

Energy is globally recognized as indispensable to a country's economic growth. This vital role of energy is embedded in the country's energy policy, where the national government views energy as the country's driver to global competitiveness and is instrumental in reducing poverty and promoting social equity.

Sitting at the helm and driving the country towards achieving the abovementioned goal is the Department of Energy (DOE), the policy maker of the energy sector. It is mandated by the Republic Act (RA) No. 7638 (Department of Energy Act of 1992) 'to prepare, integrate, coordinate, supervise and control all plans, programs, projects and activities of the Government relative to energy exploration, development, utilization, distribution and conservation'. Assisting the DOE to meet these tasks are affiliated energy agencies that comprise the 'Energy Family':

- **Philippine National Oil Company (PNOC):** the government institution in the exploration, development and utilization of indigenous energy sources.
- **National Power Corporatdon (NPC):** the state-owned generation company.
- **National Transmission Corporation (TransCo).** Owned by PSALM, TransCo was formed to absorb the NPC's power transmission functions.
- **Power Sector Assets and Liabilities and Management (PSALM) Corporation:** in charge of the sale and privatization of the NPC's generation assets.
- **National Electrification Administration (NEA):** the lead agency for providing electricity in the countryside.

The Energy Regulatory Commission (ERC) stands independent, by virtue of its being a quasi-judicial regulatory body. It is responsible for setting rates, promulgating and enforcing rules and guidelines, resolving cases and disputes and penalizing market abuse. With the enactment of RA 9136 in 2001, the ERC replaced the old Energy Regulatory Board (ERB) that used to regulate power and oil prices.

As the country's energy sector has evolved with the introduction of new reforms, new players are emerging: congressional oversight bodies have been created to monitor implementation of reforms in aid of legislation; the creation of a wholesale electricity spot market (WESM) necessitated the creation of a Philippine Electricity Market Corporation (PEMC); consumer groups and civil society

organizations (CSOs) have proven to be a formidable voice in prompting the government to act on increases in oil and electricity rates.

5.5 Public Policy Objectives, Regulatory Framework & Performance Measures / Indicators

The Philippines has put an energy policy framework in place that aims to adopt clean energy. The policy seeks to encourage the exploration and development of renewable energy resources and increase investment in clean energy projects. The result would be reduced energy costs, reduced dependence on fossil fuels, reduced impact on global climate change and ultimately, energy self-reliance. To achieve this, the Philippines government has introduced the following mechanisms.

- **Lowering Investment Costs:** The government aims to reduce investment costs by providing several fiscal incentives. Income tax amendment, tax credits, holidays, exemptions, and cash incentives is offered to increase spending on equipment and adoption of clean energy technology.
- **National Renewable Energy Program:** The program aims to increase Renewable energy capacity by 200% within 2030. By means of this program, the Philippines aims to become number one in geothermal and wind energy production and also to expand their capacity of hydro, biomass solar and ocean energy.
- **Renewable Portfolio Standard (RPS):** Subject to the Department of Energy's finalization, this policy aims to enforce a mandatory percentage utilization of RE Generation system in on-grid systems.
- **Feed-in Tariff (FIT):** The Feed-in-Tariff aims to prioritize connection to the grid and also the purchase, transmission, and payment by grid operators. This would be in compliance with RPS norms.
- **Net Metering:** This policy aims to provide the framework for the effective sales and delivery of user-generated renewable energy to the grid.
- **Green Energy Option:** This policy subject to the Department of Energy's finalization, aims to enable the option for an end-user to purchase electricity generated exclusively using renewable energy facilities.

National Renewable Energy Program (NREP):
Under the state's National Renewable Energy Program (NREP), the DOE seeks to increase the RE-power based capacity of the country to 15,304 MW by year 2030, or three times the 2010 capacity-level. On a per technology basis, the NREP seeks a 75% increase in geothermal capacity, 160% increase in hydropower capacity, 277 MW additional capacity in biomass power, wind power "grid parity" with the commissioning of 2,345 MW additional wind capacity, an additional 248 MW of solar power capacity (plus an "aspirational" solar target of 1,528 MW of additional capacity), and to developing the first ocean energy facility for the country. As a critical milestone to meeting these targets, 2,155 MW of additional capacity must be installed by 2015, according to the NREP.

Energy Plan 2012-2030:
The Energy Plan 2012-2030, which the DOE launched in December 2012, lays down the roadmap for future demand and capacity addition plans. As per the plan, the current installed capacity in the country of about 16,250 MW is expected to go up to 25,800 MW (an increase of about 60% by 2030). Specifically, the objectives of the Plan are as follows:

- expand energy access
- promote a low-carbon economy
- climate-proof the energy sector
- develop regional energy plans
- promote investments in the energy sector
- identify and implement energy sector reforms.

These policy objectives are supported by specific quantifiable targets to be achieved by the end of 2030, the most prominent of which include:

- triple renewable energy capacity by 2030;
- achieve 90% household electrification by 2017 and 100% energisation at “sitio” level (an administrative-territorial category in the Philippines) by 2015;
- have 30% of all public utility vehicles running on alternative fuels;
- implement a higher blend of biofuels; and,
- achieve 10% energy savings on total energy demand

The Philippines Department of Energy has put forward long-term energy plan targets through its National Renewable Energy Program, aiming to triple its renewable energy capacity base to 15,304 MW by 2030. More specifically, these targets are differentiated by technology, and include hydro (8,724 MW), geothermal (3,461 MW) and wind (2,378 MW). This would signify an increase in renewable energy capacity of 9, 865.3 MW, increasing the total shares of hydro by 5,394.1 MW, geothermal by 1,495 MW, and wind by 2,345 MW, based on 2010 figures.

The Philippines has implemented minimum energy performance standards for air conditioners, compact fluorescent lamps, and linear fluorescent lamps, and plans to expand the capacities for testing laboratories for televisions, washing machines, and refrigerating equipment. Various initiatives related to energy savings in the residential and commercial sectors have been successful; examples include the ADB-led phase-out of incandescent lamps, the IFC-supported efficient lighting initiative program, the GEF/UNDP-supported efficient lighting market transformation program, and the government energy management program.

The passage of the Biofuels Act of 2006 (RA 9367), was a major policy leap toward harnessing the economy’s domestic alternative energy resources.

The introduction of alternative fuels in the Philippines provides a feasible option for minimizing the effects of continuous increases in the price of crude oil in the world market, and of worsening environmental conditions. In implementing the Act, the DOE, under its Biofuels Programme, accredited a total of 13 biofuel producers (nine for biodiesel and four for bioethanol) in 2011.

The biofuels programme of the Philippines hopes to create market awareness for alternative energy projects in collaboration with various industry stakeholders. In addition, as the transport sector accounts for the greatest share of demand in the economy’s total consumption, it plans to pursue

efforts to forge partnerships with academic and research institutions to conduct on-road performance and durability tests for a higher biofuel blend for vehicles.

Resources	Awarded Projects with Service Contracts *(Pre-development)*	Projects Certified as Ready for Construction *(Shovel Ready)*	Completed Projects
	Capacity (MW)	Capacity (MW)	Capacity (MW)
Hydro			27
Wind	1,024	431	394
Solar	681	524	500
Biomass		24	94
TOTAL	**1,705**	**979**	**1,015**

Table 6 Renewable Energy Projects under FIT System Philippines

Fuel Type	Installed Capacity (MW)			Total	% of Total
	Luzon	Visayas	Mindanao		
Coal	4,671	806	232	5,709	31.8%
Oil based	2,033	670	773	3,476	19.4%
Natural Gas	2,861	1		2,862	16.0%
Geothermal	844	965	108	1,917	10.7%
Hydro	2,471	11	1,061	3,543	19.7%
Solar		22	1	23	0.1%
Wind	283			283	1.6%
Biomass	50	44	36	130	0.7%
Total	**13,213**	**2,519**	**2,211**	**17,943**	**100.0%**

Table 7 Installed Capacity of Power Plants in Philippines

5.6 Energy Financing & Public-Private Partnership:

The Philippines has been experiencing rising power demand and costs alongside increasing power shortages and an increased climate vulnerability. A lack of available finance and financial institution capacity for renewable energy and efficiency projects has compounded the country's vulnerability and energy challenges. The Sustainable Energy Finance (SEF) Program is the first of its kind in the Philippines, and is expected to continue paving the way for private sector investments in renewable energy projects. The Philippine's SEF, under implementation by the International Finance Corporation (IFC), encompasses both an advisory and an investment component to help boost renewable and energy efficient projects in the private sector. The program enables the Philippines to continue to reduce Green House gases emissions, improve energy security, and boost economic development in the country. The SEF Program addresses existing market barriers through both advisory services and investment, as a means to catalyse market transformation. The Philippine's private banks are supported through capacity-building, technical evaluation, and product development to help finance

RE and EE projects**.** The program's technical assistance package and risk-sharing facility model is highly replicable and tailored to each bank. The country's SEF Program has enabled investments in 66 sustainable energy projects, which are expected to cut CO_2 emissions by more than 740,000 tons per annum. The IFC program, with Clean Technology Fund (CTF) resources, has helped client banks identify and develop nearly 300 energy projects in their pipeline, 87 of which were financed by private banks. Nearly 100GW of electricity and 843.6GW generated renewable energy per annum have been saved as a result of the SEF program. Beneficiaries of the program include banks and financial institutions that invest in RE/EE projects, private sector investors, and the overall population of the Philippines, as reduced emissions of greenhouse gases and other conventional pollutants improve the quality of life. The program is expected to have a trickle-down effect on poverty reduction.

Clean Technology Fund:

Philippines, as a developing nation has taken a many initiatives and has devised a special financial instrument – The Climate Investment Funds. It is designed to support low-carbon and climate-resilient development through scaled-up financing channelled through the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and World Bank Group.

The Climate Investment Funds are allocated for primarily for the following Projects:

Strategic Climate Fund (SCF):
The Strategic Climate Fund (SCF) is one of the two funds of the Climate Investment Funds. It serves as an overarching framework to support three targeted programs with dedicated funding to pilot new approaches with potential for scaled-up, transformational action aimed at a specific climate change challenge or sectoral response.

The SCF is an umbrella vehicle for the receipt of donor funds and disbursements to specific funds and programmes aimed at piloting new development approaches or scaling up activities aimed a specific climate change challenge or sectoral response. There are three funds under the SCF framework: The Pilot Program for Climate Resilience (PPCR), the Forest Investment Program (FIP) and the Program for Scaling Up Renewable Energy in Low Income Countries (SREP).

Clean Technology Fund (CTF):
The Clean Technology Fund (CTF), is the other Climate Investment Funds, promotes scaled-up financing for demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse gas emissions savings. With the electric power industry generation, transmission and distribution fully owned and operated by the private sector, there is little room for large public investment in the energy sector. This is especially true for the fcmgeneration subsector, as incentives under the Renewable Energy Act of 2008 have stimulated significant interest in expanded renewable energy capacity.

Under the revised Country Investment Plan (CIP), the Government proposes to use CTF resources in support of cleaner and more energy efficient transport through an Energy Efficient Electric Vehicles (EEEVs) Project, while continuing renewable energy promotion through a revised Solar Energy Development Project.

The revised Solar Energy Development Project, as proposed, plans to transform the solar rooftop market and to create a new market for solar charging for e-vehicles without direct public subsidies. These interventions would be outside of the new feed-in tariff (and its 50 MW cap) while also supporting the development of net metering in the country. It is estimated that this can be accomplished through an investment of roughly $100 million, requiring only $20 million in CTF resources. This takes account of the new solar feed-in tariff1 having created large interest from the private sector for investments of as much as 300 MW.

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Electric Vehicles (ADB)	Solar Energy Development (ADB)	Total
CTF	75	50	105[a]	20[a]	250
GoP / DBP	180	50	99	20	349
IBRD Loans	250	260	0	0	510
IFC Loans	250	0	0	0	250
ADB Loans	0	0	300	80	380
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing (AFD loans)	0	245	0	0	245
Total	**1,505**	**605**	**504**	**120**	**2,734**

Figure 27 Financial Planning for CTF (source)

ADB - Asian Development Bank, AFD - Agence Franciaise de Developpement, CTF - Clean Technology Fund, DBP - Development Bank of the Philippines, EE=energy efficiency, GoP - Government of the Philippines, IBRD - International Bank for Reconstruction and Development, IFC - International Finance Corporation, RE - renewable energy, WBG - World Bank Group.

5.7 Alternative Strategies under consideration: Equity Financing for Renewable energy Projects

Equity (shares of stock) can be used to raise capital for a project or company. As opposed to debt finance, an equity investor has the right to play an active role in making decisions related to a particular project. The investor's stake in a company is represented by shares which give the shareholder residual ownership of the assets and earnings of a company but only after all other obligations to holders of debt and preferred stock are met. This is considered a high-risk financial vehicle and therefore the expected rate of return is very high (usually greater than 20%). Equity in a project could be between 20 to 40% of the project depending on the specific arrangements. Possible sources of equity financing include joint venture partnerships, equity investment funds, pension funds, and venture capital.

5.8 Impact Assessment:

Environmental Impact Assessment:

Figure 28 Marginal Cost Abatement Curve

Project siting, design, construction, operation and decommissioning of the projects create potential environmental issues. Projects whose potential environmental impacts are varying depending on the scale of the project but expected to be mostly moderate, temporary and localized.

Setting up of renewable energy generally requires large areas of land which may result in loss of environment. There is also a cost for carbon footprint that has to be assessed before funding for a project.

Economic Impact Assessment:

It is important to assess the economic damage caused due to implementation of a renewable energy project in a developing country like Philippines. There might be a huge impact on the jobs and life standards of people working in the non-renewable sector. Also, the cost of generation of renewable energy is high compare to the non-renewable energy. Even though the government may provide subsidies to bring the cost to a comparable level, the government finally loads back the subsidy value to the citizens of the country.

Societal Impact Assessment:

There could be a plenty of Social issues that might arise due to the implementation of a renewable energy project in Manila. Manila being under a high seismic zone has to be very sensitively reviewed before implementation of a project. Apart from this there could be several other societal impacts due to renewable energy projects of which a few are listed below:

- Forced population displacement and impoverishment
- Boomtown formation around major constructions
- Downstream unanticipated changes in agro-production systems; and
- Loss of cultural heritage assets

5.9 Technology Solutions and their Assessment: Variable Renewable Energy (vRE) Grid Integration

There are Several Technological Challenges that have to be addressed for successful implementation of the system. So, it is essential to rightly address these issues and derive a conclusion. A few of the challenges are listed below:

Grid Parity: In majority of the cases generating energy from renewable energy is much more expensive than the conventional non-renewable energy generation.

Utilization: This is one of the major issues that is faced in the energy sector wherein renewable energy facilities can be considered either peak load or base load for the market. The flexibility of the facility as also the matching of resource availability to power usage are relevant factors but the ultimate viability is dependent on the cost-benefit calculation.

Resource availability vs Grid availability: In a number of countries the existing grid is overloaded and cannot be utilised for the peaks and troughs generated by renewable energy power source. This necessitates strengthening of the existing grid before such renewable sources can be tapped on a large scale basis. In other situations, transmission lines do not exist in the vicinity of the resource and hundreds of kilometres of lines may need to be developed to evacuate power. This can then cause a conundrum for financiers as to which comes first: the financing of the power lines, or the financing of the generating facility. In such situations intervention by public bodies are typically required to support the financing of say the transmission lines, with a guarantee of availability when the generation facility is complete.

Variable Renewable Energy (VRE) Grid Integration:

One of the major challenges for a renewable energy source is the intermittent characteristic that they follow. For renewable energy sources, such as Solar, Wind or Geo-Thermal, it is not possible to expect a standard output value at all times as the input is not controllable. Hence it is very much essential to integrate the variable renewable energy sources to the grid. This could also help tackle the above listed challenges and help in balancing of the grid.

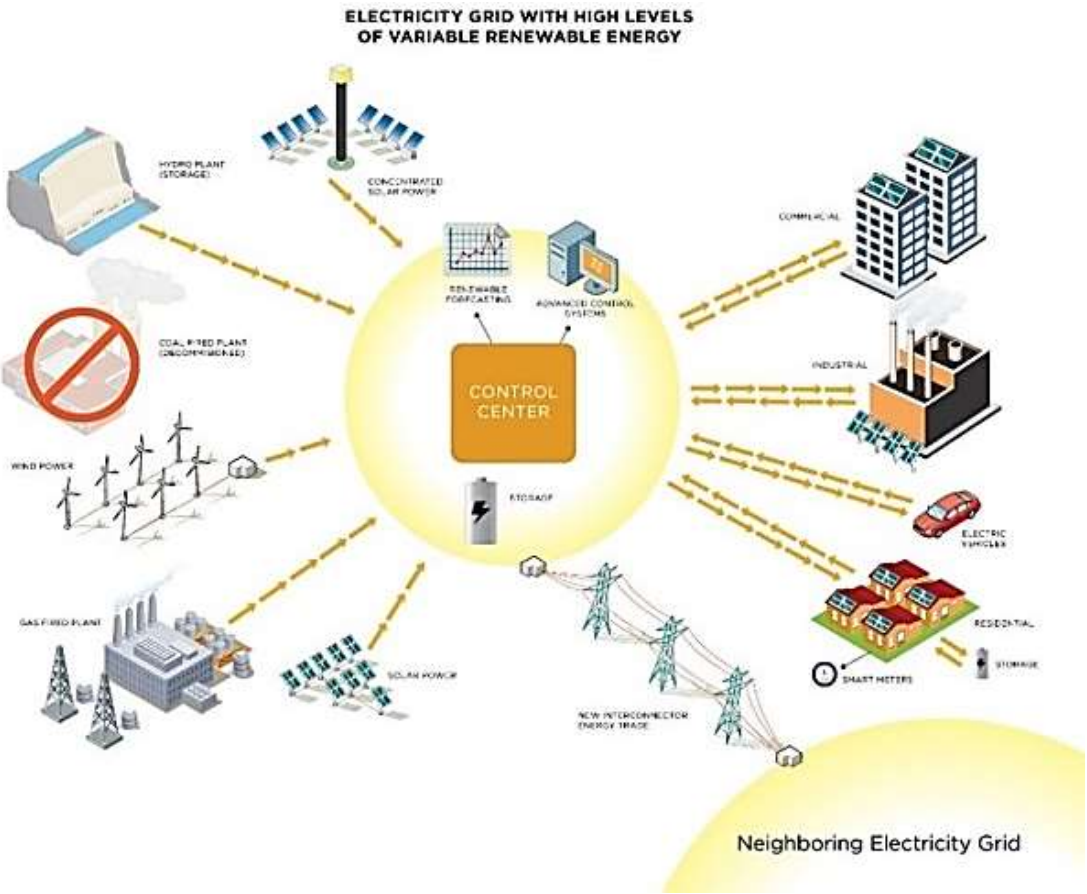

Figure 29 Variable Renewable Energy Grid Integration

7 Los Angeles – United States of America

- Location- Western side of USA
- Total area- 1,302 km^2
- Population- 3.8 million
- GDP- $789.7 billion
- GDP per Capita- $59 092
- Major Economic Sector
    - Trade
    - Commerce and services
    - Entertainment

Figure 30 Map of Los Angeles

7.1 Introduction

Los Angeles is one of the most populous city in the US with the population of the 3.8 million. This might be the reason for LA having the highest energy consumer among the US. LA imports more energy than any other state than US. Due to the high-energy rates, conservation policy, mild weather LA has the lowest per capita energy use in US.

7.2 Rationale for Selecting City

LA has the largest amount of distributed generation capacity amongst the counties in California. The largest solar plant in world having a capacity of 579 MW is being built in Los Angeles as a part of Solar Star Project. The LA Government has envisioned 2035 general plan and Renewable Energy Ordinance (REO) which is guide to future development and progress of renewable projects within LA county. Besides this Los Angeles Department of Water and Power (LADWP) develop plan for going 100% renewables including outline and resource allocation to archive goal. Government is also taking initiative to combat climate change including switching to LED lighting, cleaning up the port of Los Angeles, introducing electrical vehicles, investing in efficiency, and eliminating the use of coal by 2025 making it a very active clean environmental city making it an ideal city to study about renewable energy projects as per the Los Angeles Department of Water and Power (LADWP)'s report 51 % energy generation is based on coal. Second source is a natural gas it's about 26%. Overall renewable energy share has increased from 1.6% in 2003 to 20% by 2010. Among the renewables wind energy contributes highest about 8.2% follows the small hydro 7.1%, Biogas 3.7%, Geothermal 0.9% and Solar is about 0.2% by 2010. As per the Energy Information Administration (EIA) transportation consume about 39% energy followed by industrial 24%, Residential 19% and Commercial 18%. To support the growth of the sector, the state introduced and developed many policies, such as its 33% renewable portfolio standard. Through this political and geographic advantage California leads the nation in generation capacity from geothermal, biomass, solar PV, and solar thermal electric projects, while placing second in wind and hydropower generation capacity.

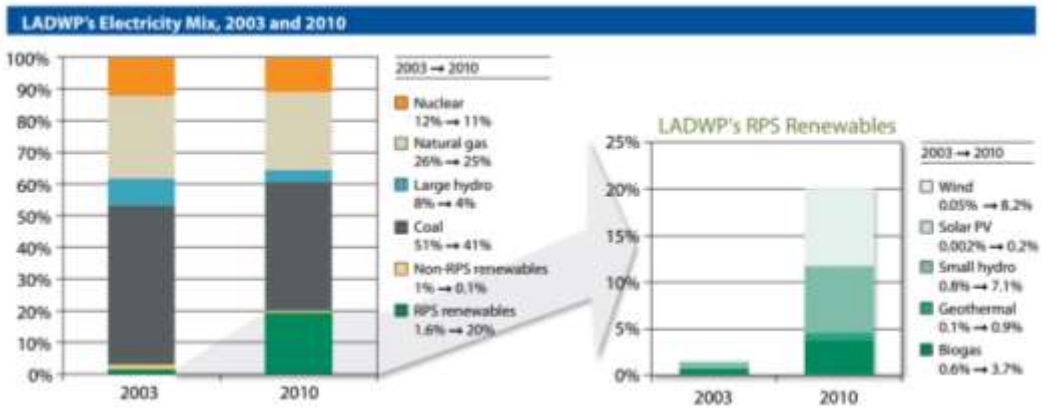

Figure 31 Los Angeles Energy Mix

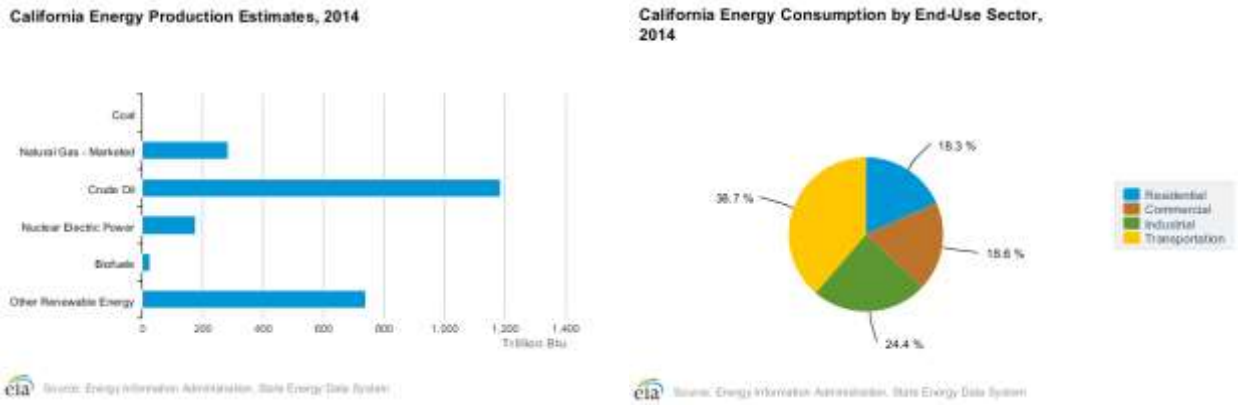

Figure 32 California Energy Mix

7.3 Urban Infrastructure System Challenges Identify

Renewable energy financing in Los Angeles is a major challenge for completion of projects due to Less-established renewable power developers Especially those with smaller projects, could have more difficulty attracting needed financial capital and completing their projects. Development of projects relying on newer or innovative technologies that lack extensive operational track records may be slowed because many tax equity investors are highly averse to technology risk. Projects relying on tax equity financing likely will be more expensive to develop because of the transaction costs and potentially higher yields required to attract tax equity capital.

7.4 Government Decision Making & Stakeholder's Interests

The main stockholder for Los Angeles's power system reliability is Los Angeles Department of Water and Power (LADWP). LADWP maintains ownership and operation of many of its electricity generation, transmission, and distribution assets. LADWP currently assists 1.4 million electric service connections in the greater Los Angeles area. Business and industry within the City of Los Angeles consume about 70 percent of the electricity provided to customers, while residential customers account for consumption of the remaining 30 percent.

For Renewable and Distributed energy sources include purchases from the Pleasant Valley Wind Project located near Evanston, Wyoming; digester gas (generated by the anaerobic breakdown of organic waste) at the Hyperion Treatment Plant used at LADWP's Scattergood Generating Station; LADWP-owned solar photovoltaic arrays in the Los Angeles area; landfill gas purchased from Bradley, Penrose and Lopez Canyon; and LADWP-installed fuel cells.

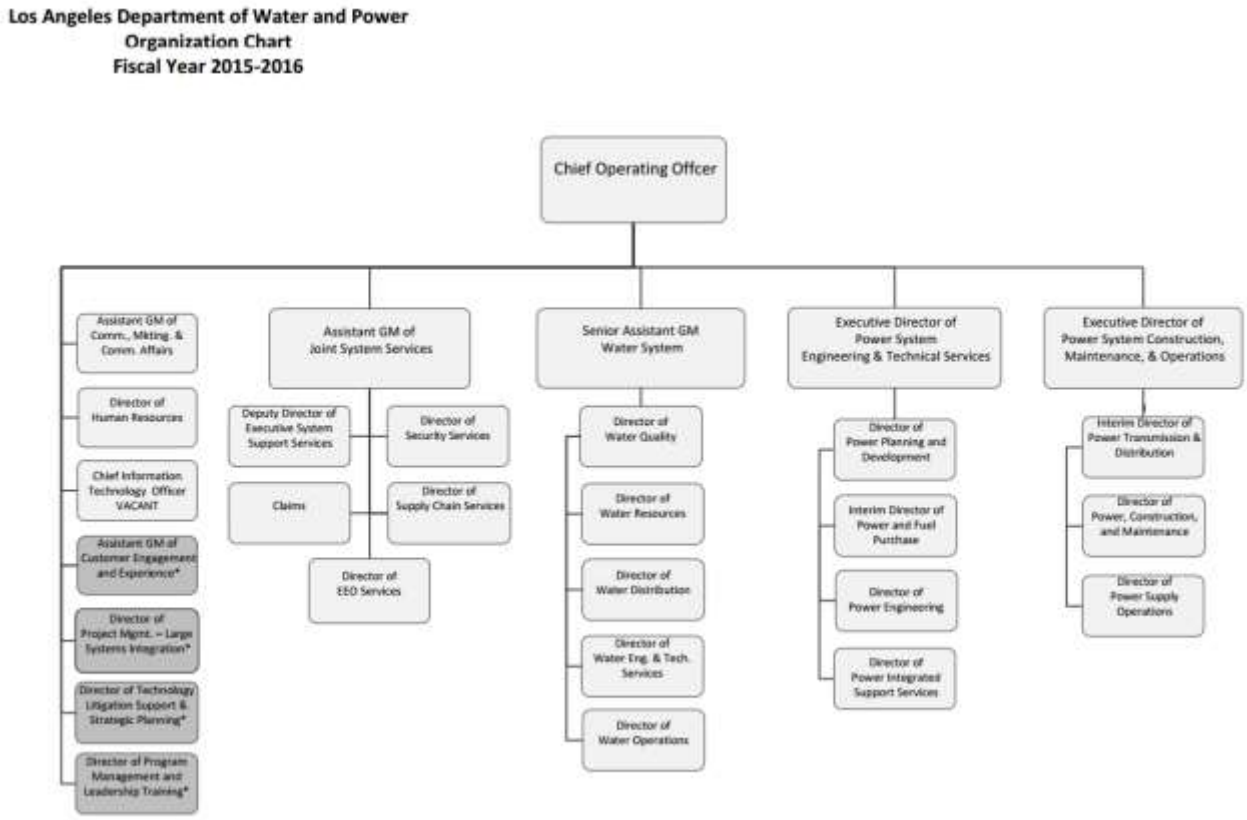

Figure 33 LADWP Organization Chart

Besides than LADWP there are some other stockholder which are taking interest in investing in renewable energy sector. Recently, the California Energy Commission and the Department of the Navy signed a Memorandum of Understanding (MOU) that will help the state and the Navy and Marine Corps continue to operate on the cutting edge of technology by pursuing innovative renewable energy initiatives.

There was an Energy Efficiency Partnership between Investor owned utility and California community College for encourage energy efficiency investments and foster best practices in the California Community College System. The state's four investor-owned utilities (IOUs), including Pacific Gas & Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), and San Diego Gas & Electric (SDG&E), have partnered with the California Community College (CCC) Chancellor's Office and the CCC Districts to provide technical assistance, financial incentives, and project support for energy efficiency improvements to the CCC system state-wide.

7.5 Government Initiatives and Policy

Local Government Policies

LADWP develop policies regarding following area

- Expand local PV development programs
- Implement community solar & virtual net metering
- Accelerate permitting and adoption of rooftop PV
- Enhance energy storage
- Develop grid-tied backup solar and modernize Los Angeles's energy grid
- Lead by example with solar installations on new and existing City projects
- Measure and prepare for citywide climate action

- De-carbonize LA's electrical grid
- Reduce individual and citywide energy consumption through education and retrofitting
- Leverage local expertise to develop and support climate-change related technologies
- Lead national initiatives and international efforts to establish binding climate agreements

State Government Policy

Renewable Portfolio Standard

- 33% by 2020 (midterm targets of 20% by December 31, 2013 and 25% by December 31, 2016); all electric utilities
- Tradable renewable energy credits are capped at 10% for the requirement by 2017
- State wise target of 1,325 MW of energy storage procured by 2020, installed by 2024

Net Metering

- All utilities except LADWP 4 System capacity limit of 1 MW for most systems, or up to 5 MW for university or local government systems; aggregate capacity limit of 5% of customer peak demand
- Net excess generation (NEG) credited to customer's next bill at retail rate; at end of 12-months, may be rolled over indefinitely or purchased by utility
- Customers own RECs for system, but not RECs for NEG purchased by utility
- Virtual net metering allowed for multi-tenant properties, and meter aggregation allowed for governments and businesses with multiple meters

Interconnection Standards

- Investor-owned utilities (IOUs)
- No limit specified, net metering not required

Governments Initiatives regarding Renewables

Go Solar California! Campaign

- Goal to install 3,000 MW of solar power capacity by end of 2016 and 585 million terms of solar hot water systems by end of 2017; state-wide budget of $3.6bn
- For IOU service territories
- As of Q1 2014, 2,139 MW of solar capacity had been installed

California Solar Initiative (CSI):

- For all systems in IOU areas except new homes
- PV and solar thermal electric rebates; solar hot water rebates; single and multi-family affordable homes rebates; research grants (funding for some programs exhausted)
- PV incentive offered as a one-time payment based on expected performance or as a monthly payment based on production 4 Operated by California Public Utilities Commission

New Solar Homes Partnership (NSHP):

- Offers incentives for solar PV on new homes to support home builders
- Operated by California Energy Commission

Self-Generation Incentive Program:

- For systems 30 kW or larger: 50% incentive received upfront and 50% received based on kWh production over first five years
- For systems under 30 kW, 100% paid upfront

- Maximum: lesser of $5m or 60% of eligible project costs (up to 3 MW)
- For wind, waste heat, energy storage, biogas, CHP, and fuel cell systems

Renewable Market Adjusting Tariff (Re MAT):

- Replaced state's existing feed-in tariff in July 2013
- Project size cap of 3 MW; state wise program cap of 750 MW
- Pricing adjusts based on demand

7.6 Financing Strategies

Los Angeles County Property Assessed Clean Energy (PACE) Financing Strategy

PACE program is an economic system which is strategy for a rise or create a fund for projects like energy efficiency, water efficiency and renewable energy building upgrades. PACE programme capitals up to 100% of the installed cost with low interest rate. This program accepted in 2008 and Assembly Bill 811 allowed cities and counties to found PACE financing for commercial offices, apartment buildings of five or more parts, schools and non-profits, industrial facilities, hotels, and retail/restaurant uses. Los Angeles has 80 contributing cities.

Qualified building upgrades through PACE include high efficiency lighting, HVAC equipment, cooling towers, high performance windows, fuel cells, solar thermal/PV, high efficiency plumbing fixtures, and smart irrigation systems. The aids of financing through the PACE program include the opportunity for building owners to spread the cost of upgrades over a longer period, rise property value and rent potential, and decrease financial risk through low interest rates and the exceptional structuring of the PACE loan system.

Utility Rebates and Incentives

Energy services offer a variety of rebates and incentives for residential and commercial customers. DSIRE allows California energy customers to filter incentives and policies based on type (rebate, tax credit, grant, green building incentive, etc.), The LADWP offers rebates and education for a range of energy efficient appliances, building products, and solar systems. Additionally, LADWP delivers custom-tailored commercial and industrial incentives for lighting, air conditioning, and refrigeration efficiency upgrades.

State Rebates and Incentives

Bright Schools Program

Directed by the California Energy Commission (CEC), the Bright Schools Program assists California schools in their efforts for energy efficiency schemes. This capital helps contributors identify the most cost-effective energy saving opportunities for their existing facilities. K-12 schools as well as community colleges can apply for technical help in the form of present facilities energy audits, review of proposals, developing performance specifications, and more.

Energy Partnership Program

Managed by the California Energy Commission (CEC), the Energy Partnership Program supports California cities, counties, special districts, public hospitals, and public care facilities in their efforts for energy efficiency projects. This capital helps contributors identify the most cost-effective energy saving chances for new and current facilities. The Energy Partnership Program can offer technical assistance early in the design stage for new buildings to more exceed the least energy savings from Title 24. For existing facilities, applicants can apply for technical assistance in conducting energy audits, reviewing proposals, developing performance specifications, and more.

CEC Energy Efficiency Financing

Since 1979, the Energy Conservation Assistance Act (ECAA) has granted more than $330 million in loans to over 800 units in the State of California. The California Energy Commission (CEC) bids low- or no-interest loans for energy efficiency projects to local governments, schools, special districts, and public healthcare facilities.
Projects with proven energy and/or cost savings are eligible. Examples of projects include:

- Lighting system upgrades
- Pumps and motors
- Streetlights and LED traffic signals
- Energy management systems and equipment controls
- Building insulation
- Energy generation including renewable and combined heat and power projects
- Heating, ventilation, and air conditioning equipment
- Water and waste water treatment equipment

7.7 Technological Solution

Smart Grid Regional Demonstration Program

Los Angeles Department of Water and Power (LADWP) is collaborating with a consortium of research institutions to grow new Smart Grid technologies, quantify costs and benefits, authorise new models, and create models to be altered countrywide. The project consists of four broad initiatives, including

- **Demand Response (DR):** make an integrated demonstration of Smart Grid operations and technology as applied to DR. Test bed sites will investigate a full range of user environments: residential, commercial, light industrial, and institutional
- **Electric Vehicle (EV)** Combination into the LADWP Grid: validate parts such as smart charging and battery aggregation; renewables and EV battery integration; an active microgrid; demonstration of a ride/car share program at LADWP; and EV test bed sites at USC and UCLA
- **Customer Behaviour:** validate a wide-ranging set of studies and focused reviews related to the impact of Smart Grid communications systems and methods on buyer usage; energy savings from using Smart Grid enabled interfaces; pricing options and programs; and actual messaging and incentives regarding electric vehicles
- **Next-Generation Cyber Security:** validate technologies to show grid flexibility against physical and cyber-attack, an operational testing approach for components & installed systems, and redefine the security perimeter to address Smart Grid technologies to the meter in residential and commercial sites.

Goals/Objectives

- Decrease in consumer electric costs
- Decrease in power interruption costs
- Reduction in peak power loads
- Improve grid resilience against cyber-attack and system integrity

Key Milestones

- Complete Smart Grid Final Design (March 2012)
- Complete Smart Grid Demo Installation/Construction (December 2013)
- Operations start (January 2014)
- Complete Demo Operations Phase (scheduled – September 2015)

Benefits

- Electricity costs reduced
- Lower peak demand
- Greenhouse gas emissions decreased
- Energy security strengthened

7.8 Performance Measures and Statistics

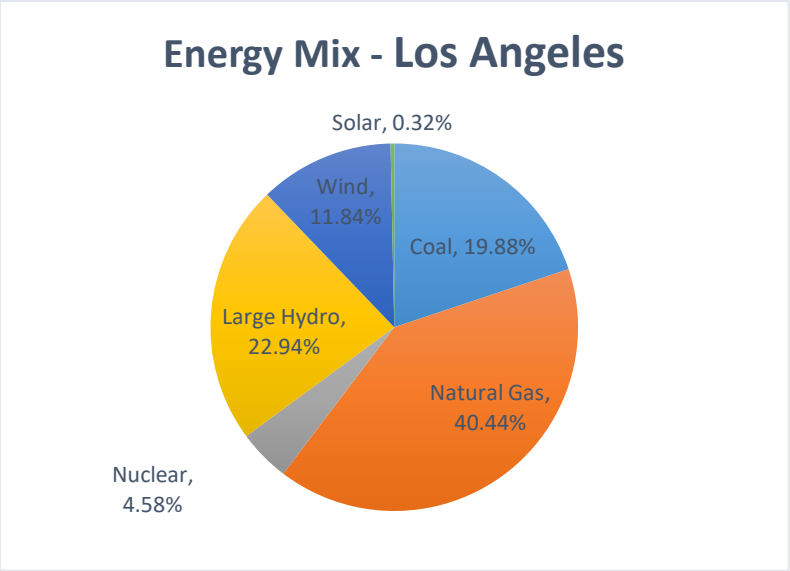

Figure 34 Energy Mix (EIA)

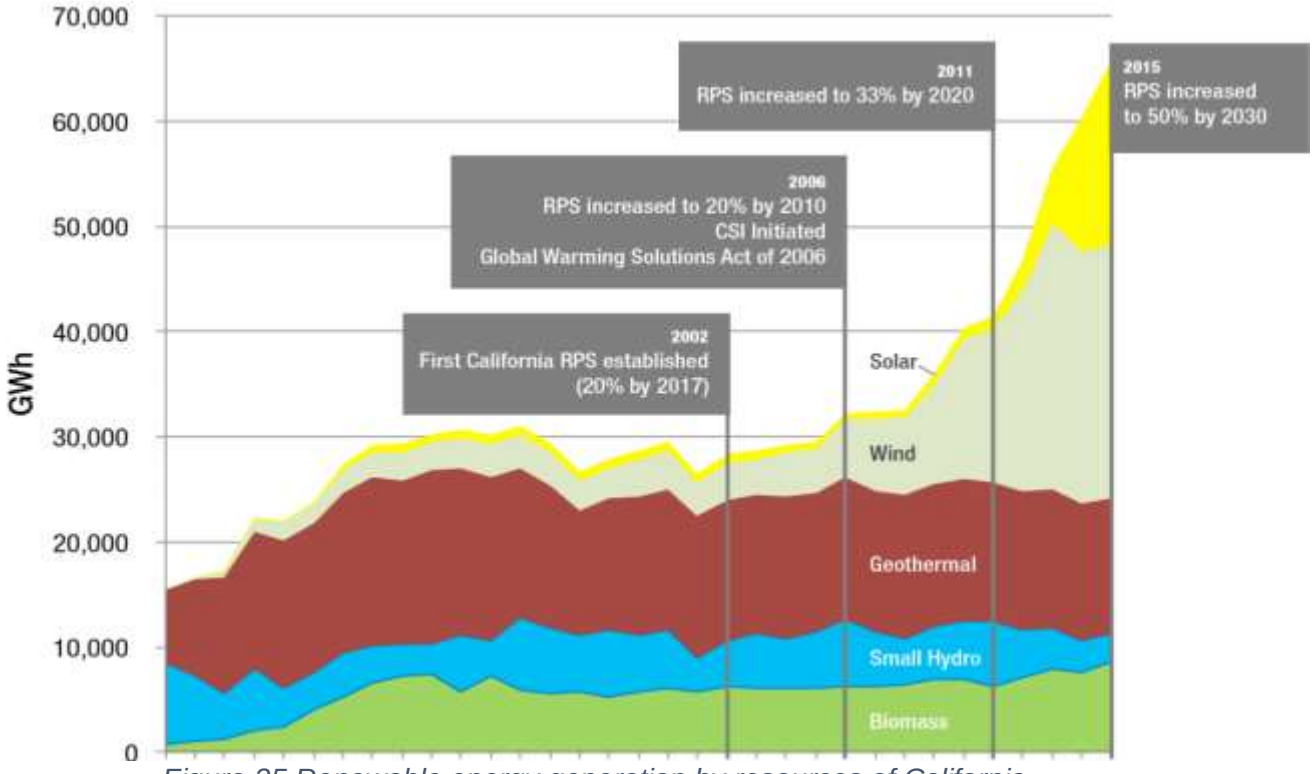

Figure 35 Renewable energy generation by resources of California

As per the above energy mix graph we get idea of Los Angeles sources of energy. There are about 60% energy production by Coal and Natural Gases and other 40% from renewable sources. Renewable Energy generation graph shows the significant growth of the all the source of renewables which sign of also increase demand and project of renewable energy in Los Angeles county.

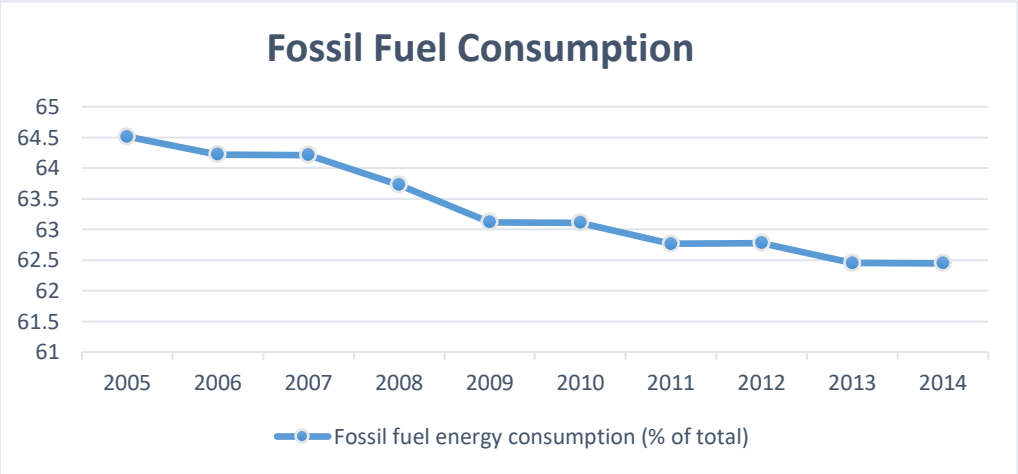

Figure 36 Fossil Fuel Consumption (World Bank Data)

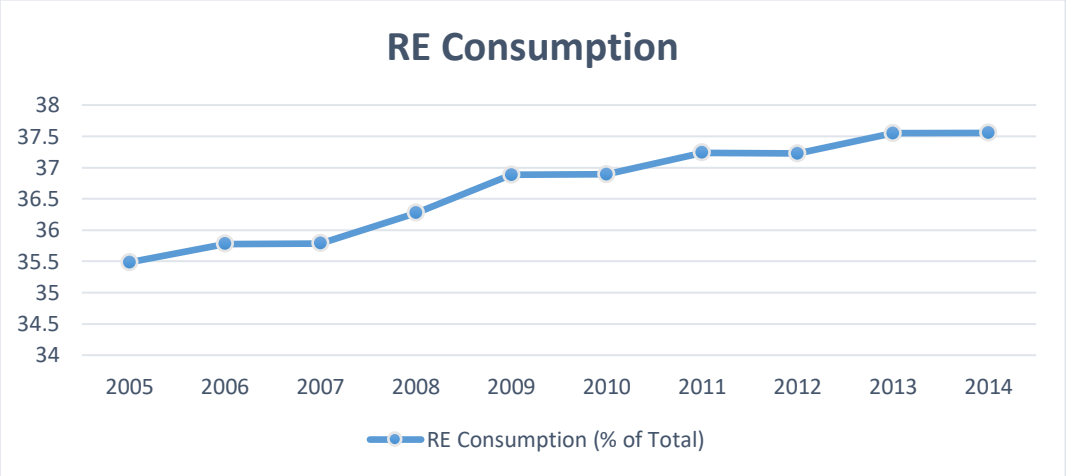

Figure 37 RE Consumption (World Bank Data)

Through the comparison between Fossil fuel and RE consumption data for Los Angeles shows that in fossil fuel consumption decrease drastically with the increase in renewable energy generation. Fossil fuel decrease by 2% over the 10 years' time line and renewables took over fossil fuel over these years.

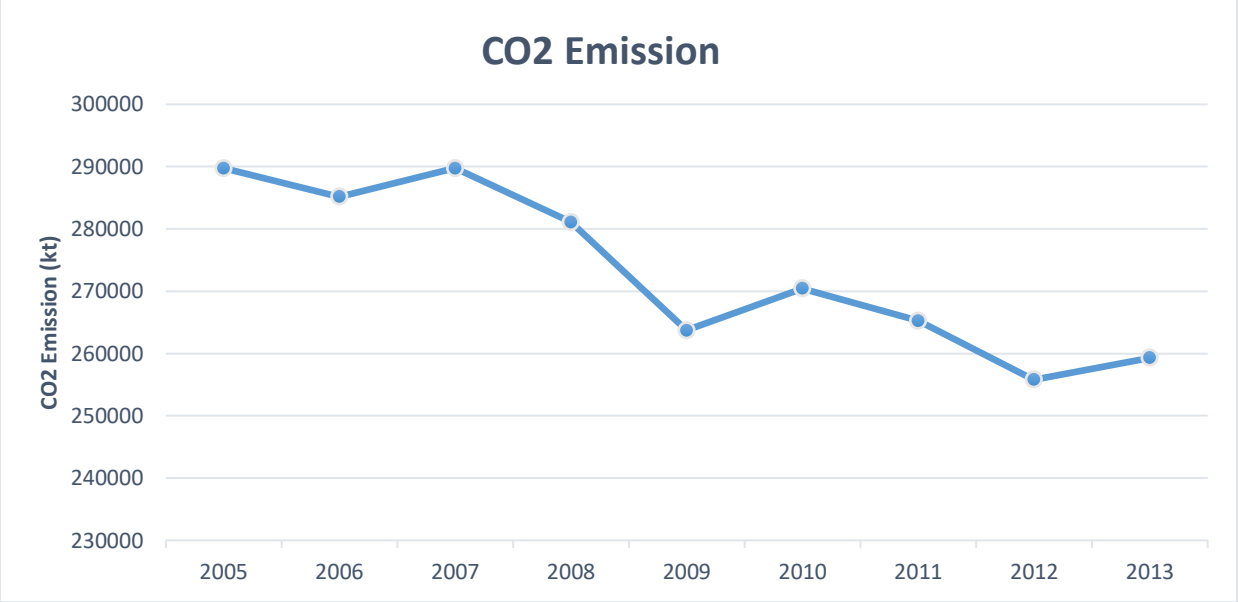

Figure 38 CO2 Emission (World Bank Data)

Over last 10 years use of fossil fuel decrease in Los Angeles county which also affect the change environmentally CO2 emission of these region is also drastically decrease over this years which is apparently good effect of usage of renewable.

7.9 Own Assessment of the Case Study

Los Angeles is amongst the most populous city among the USA and energy crises and increase in carbon footprint is also challenges for the LA county. These challenges inspired them to innovate and create opportunity through these regions. The results of this feasibility study show that it is possible to achieve the Los Angeles County's renewable energy needs by using of the region's accessible renewable energy resources. When we analyse past and current situation of Los Angeles it shows drastic change in their energy sector specifically increment of renewable energy production. In my suggestion throughout these years Los Angeles achieve economic stability as well as environmentally suitability and keep forwarding to achieve their 2050 targets. Today Los Angeles approach towards these challenges is integrated and very effective which is appropriate example for many other cities which facing the same challenges.

8 Sydney - Australia

- Location - East coast of Australia
- Total area - 12 367 km²
- Population - 4.3 million
- Population density - 400/km²
- GDP - $337.45 billion
- GDP per Capita - $40100
- Major Economic Sector
- Finance and Insurance Industry
- Professional and Business Services

8.1 Introduction

Sydney is state capital of the New South West and one of the most populous cities in Australia. Energy is essential for the economic development and environmental sustainability. 80% of the region's energy requirements are generated from coal. In 2014, 10.8% out of total electricity generation was from renewable energy sources. Solar, wind and biomass resources have increasingly been developed over the past six years. Wind generation in the state amounts to 975 GWh of electricity, and solar PV systems, 1,456 GWh. Over 1,030 GWh of electricity was also generated from bagasse, landfill and other bioenergy sources.

8.2 Rationale for Selecting City

Sydney local government area (LGA) developed a master plan for sustainable Sydney for 2030 in which they set a target to reduce carbon emissions by 70% across the entire local area by 2030 as compare to 2006 levels. Because 80% of emissions is come for centralised power generation which primary sources is coal. In that master plan, local government also set target to meet the 100% electricity demand by 2030. Among this local electricity demand they plan to generate 30% by renewables and other 70% by trigeneration by 2030. Tri-generation is the production of electricity, heat and cooling in the one process Sydney is generally self-sufficient when it comes to energy, meeting about 90% of its electrical power demand; neighbouring states of Victoria and Queensland outsource the remaining electricity. Coal fulfils the majority of Sydney's primary energy demand as around 80% of all power generation is based on coal; natural gas comprises 6% to 7% with the residual being renewables. New South West has a strong focus on Renewable Energy, boasting some of the best solar resources in the world. The drier areas have high average global solar irradiance and are ideal environments for large-scale solar systems. Same for the other renewables. Renewable energy is not new to Sydney. Sydney has been using renewable energy since 1796, for example wind power was used to grind wheat for flour and construct wind mill in that area all the way from Rocks to Parramatta up river. As per the records and investigation there are sufficient renewable energy resources within 250km of the city to meet the City of Sydney's 30% renewable electricity target. Renewable electricity for the City's planned trigeneration network could supply 100% of buildings energy needs in the City of Sydney by 2030. Trigeneration is a combine process of heating cooling and Energy generation.

Goals set by Sydney local government

- By 2030, renewable electricity generation can provide 30% of electricity used in the City of Sydney.
- Up to 18% of the City's electricity demand can be met from renewable electricity generation within the local government area.
- At least 12% of the City's electricity demand can be met from renewable electricity generation within 250km of the local government area.
- Renewable gases can replace 100% of the natural gas used to supply the City's planned trigeneration network.
- Renewable energy can reduce greenhouse gas emissions across the entire local government area by 37.5% based on 2006 levels. 6 Renewable electricity and renewable gas can provide 100% of the city's electricity, heating and cooling requirements.

8.3 Urban Infrastructure System Challenges Identify

Sydney's ability to achieve its renewable energy target has been vulnerable in recent years by excess supply and falling demand in the wholesale electricity market and political uncertainty regarding incentives for renewable generation. Financial barriers relate to the need for and ability to raise open capital, the ability to source and access capital (for reasonable cost), the relationship between rising costs and decreasing capacity, and the need for investment certainty. Financier inexperience with renewable technologies and project innovation can result in high transaction costs and make risk assessment difficult. Further, costs associated with managing generation and grid integration are often necessary. These costs arise due to the need to connect to established legacy networks that are not designed to connect intermittent distributed generation originally built using public funds. Generally, these adaptation costs are borne privately but provide no additional revenue stream. The RET, Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC) currently operate to help overcome these barriers in different ways. Their success is limited particularly regional and remote areas which face additional financial and non-financial barriers that change risk profiles and require more innovation.

8.4 Government Decision Making & Stakeholder's Interests

There main two energy for energy sector in the Australia one is The Australian Energy Regulator (AER) and other is the Australian Renewable Energy Agency (ARENA).

The Australian Energy Regulator (AER) regulates energy markets and networks under national energy market legislation and rules. Its functions, which mostly relate to energy markets in eastern and southern Australia, include:

- monitoring wholesale electricity and gas markets to ensure energy businesses comply with the legislation and rules, and taking enforcement action where necessary
- setting the amount of revenue that network businesses can recover from customers for using networks (electricity poles and wires and gas pipelines) that transport energy
- regulating retail energy markets in Queensland, New South Wales, South Australia, Tasmania (electricity only) and the Australian Capital Territory
- publishing information on energy markets, including the annual State of the energy market report, to assist participants and the wider community.

The ACR operates under Competition and Consumer Act 2010. The AER may make decisions in relation to its functions under the National Electricity Law, National Gas Law, and National Energy Retail Law. It can seek an order from the Federal Court that a person is in breach of a relevant energy law.

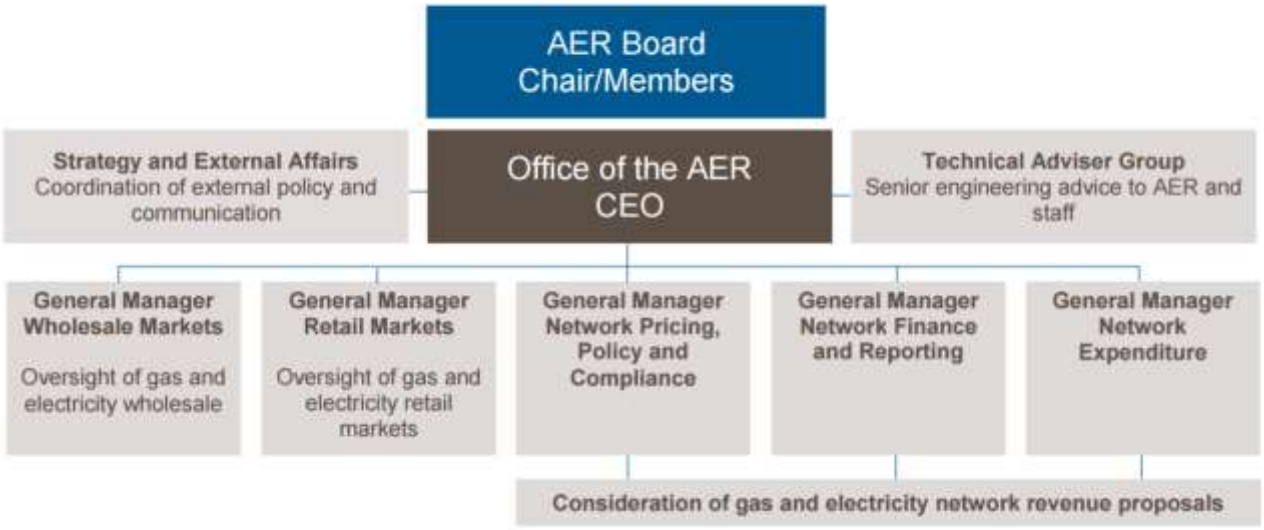

Figure 39 ACR Organization Chart

The Australian Renewable Energy Agency (ARENA)'s mission is for a society that is increasingly powered by renewable energy. ARENA's two objectives are to improve the affordability and increase the use of renewable energy across Australia. It undertakes this by funding renewable energy projects, supporting research and development activities and supporting activities that capture and share knowledge. The agency has committed more than 230 projects, studies, scholarships, and fellowships that are helping reduce the cost and increase the use of renewable energy in Australia. ARENA's grant funding is enshrined in the ARENA Act 2011, which currently provides the agency with more than $2 billion USD in funding to invest in supporting renewable energy projects until the year 2022.

For Renewables, there are many other stakeholders to support the renewable energy sector
The South-East Region for Renewable Energy Excellence (SERREE), through its industry cluster initiative, provides the broader context for facilitating collaboration between industry, research and training, communities, and government.

Universities and research institutes, such as the Australian National University's Energy Change Institute, will contribute to identifying a longer-term strategic vision of the energy industry, build productive research and education partnerships to create value for business, and build the innovation capacity of local researchers, educators, and businesses.

Canberra Institute of Technology will grow as Australia's premier skills centre for renewable energy training, driven by industry needs and with a strong focus on attracting national and international students.

CBR Innovation Network provides business planning and commercial readiness services to new and emerging Canberra-based technology ventures.

Local business will help to inform near-term industry-specific market needs, and form research and collaboration partnerships to develop innovative, export-oriented products and services for market.

National and international businesses will collaborate with local researchers and businesses, inform near-term industry-specific market needs, and provide markets for innovative products and services.

Investors will collaborate with government and business to finance the development of new products and services with a national and international export market focus.

8.5 Government Initiatives and Policy Objectives

The Emissions Reduction Fund (ERF)

The ERF worth $ 1.85 billion USD is the key climate policy of the Federal government. It aims to reduce household and organisations' GHG emissions using positive incentives (or subsidies) by auction process. The government imposes a hidden maximum bid price above which it will not pay for any projects and commits to purchasing 80% of the volume of emissions below the maximum bid price for each auction. If successful at the auction, carbon credits are paid at the bid price. Successful projects are selected solely on whether they have the lowest bid price. This policy is likely to direct emission reduction strategies to least cost projects and favour smaller incremental changes (e.g. forestry and replacement of lights in industrial buildings, existing) over more capital intensive (and expensive) projects.

The underlying objective is to help Australia "meet its emissions reduction target of five percent below 2000 levels by 2020" [47] through a scheme that enables the cheapest emissions reduction methods thereby reducing costs and increasing productivity. A non-exhaustive list of projects covered by the ERF include

- Improvements in energy efficiency
- Reductions in electricity generator emissions (e.g. Via technological improvement)
- Capturing landfill gas
- Reducing waste coal mine gas
- Reforestation and revegetation
- Improving agricultural soils

Carbon pricing

The carbon pricing scheme introduced by the previous Labour government was designed to internalise carbon costs for major polluters. One of the primary election platforms for the current Federal government was removal of carbon pricing which occurred in 2014. Accordingly, there is no longer a price on carbon in Australia except that which is provided via the ERF. However, other measures that formed part of that scheme (including ARENA and the CEFC) have not been removed, yet. Hostility to pricing carbon in some parts of the Australian electorate means that in the absence of political leadership (or a global agreement) a carbon trading scheme or tax is unlikely in the short term.

The Australian Renewable Energy Agency (ARENA)

Basically, ARENA's role is to improve competitiveness of renewables, and increase renewable energy supply. It is technology uncertain and focused on eroding technological and commercialisation barriers and knowledge sharing. The Australian government has committed to closing ARENA but has so far been prevented from doing so by the senate. Anyhow its pending demise, it continues to assess and fund projects and has shown it will continue to do so until it is closed. The government has dedicated to honouring funds owed by ARENA at the time of its repeal. ARENA performs a permitting role for projects and initiatives facing technical or commercialisation challenges that prevent market support. It tends to focus on commercialising technology rather than approaches.

The Clean Energy Finance Corporation (CEFC)

The CEFC is a government funded financier created to help overcome financing challenges associated with clean energy development (including renewable energy and low emissions technologies) though it does cooperate with ARENA. It is focused on providing finance at a concessional rate for clean energy projects that have a positive rate of return. The concession depends on external benefits provided by the project and can take the form of lower costs, higher risk, or longer duration. As at 30 June 2014, the CEFC had a portfolio of $931 million USD for total project value of more than $3.2 billion USD. The CEFC provides an important pathway through the financial barriers associated with accessing capital particularly for large scale renewable energy deployment. Uncertainty surrounding its future is not conducive to further renewable energy deployment, particularly for larger systems.

The Renewable Energy Target (RET)

The RET aims to reduce GHG emissions from electricity generation by providing certificates for renewable energy generation. Small systems are provided with upfront payments while large systems are provided with certificates based on MWh generated. Liable entities (generally electricity retailers) must purchase a specified number of certificates. This policy has played a key role in facilitating renewable energy deployment and reducing emissions in Australia.

- It provides an incentive for investment in renewable energy generation that is not necessary to meet demand, and which is not viable without the RET subsidy.
- Incumbent generators, electricity retailers and consumers fund the RET via a cross-subsidy.
- Its impact on electricity prices is small (and downward)
- Given changes in the electricity environment, approximately $13 billion of large scale generation will be developed that is not required
- The cost to the community of the RET is too high given the availability of alternative (lower cost) emission abatement alternatives

The RET has played a key role in facilitating Australia's renewable energy deployment. If the reduced RET target becomes effective, it will help reduce uncertainty by providing a floor target that is unlikely to be reduced in the future. Uncertainty surrounding the RET has contributed to significant reduction in renewable energy investment particularly for large-scale systems and it remains to be seen how the industry responds in the future.

Tariff policies and Feed in Tariffs (FiTs)

Tariff policies are a State and Territory responsibility. Household FiTs have generally been reduced across all States and Territories and are now generally low (e.g. ~$0.06-$0.07/kWh) relative to electricity tariffs (~$0.24-0.30/kWh) with few exceptions. The value of household PV exported to the grid is uncertain due to information asymmetry about network impacts and capacity to offset wholesale

prices. However, in New South Wales, it is estimated at between $0.049-0.093/kWh (median $0.056/kWh) based on the estimated wholesale electricity costs. The tariff policy context in Australia is important. Uniform tariff policies are generally used. These have significant distributional impacts, particularly in regional areas where supply costs can be much higher than tariff rates. Tariff reform is increasingly on the policy agenda and is likely to see a trend towards higher fixed connection charges, and lower variable costs to reflect distribution network costs.

Policy instrument	In Existence?	Comments
Emissions Reduction Fund	Yes	The ERF is a recent policy initiative designed to encourage least cost investment abatement. However, it is unlikely to directly support the renewables sector.
Carbon pricing Scheme	No	The scheme was repealed in 2014. A price on carbon is unlikely in the short term.
ARENA	Yes	The future of ARENA is uncertain. The Federal government has committed to its closure but has so far been prevented by the Senate. If closed, the government will honour existing funding obligation
CEFC	Yes	The future of the CEFC is uncertain. The Federal government has committed to its closure but has so far been prevented by the Senate. If closed, the government will honour existing funding obligations
Renewable Energy Target (RET)	Yes	The RET is likely to be in 2015 from 41,000 gigawatt hours by 2020 to 33,000 gigawatt hours in 2020, biannual reviews will also be removed
Electricity Tariffs	Yes	FiTs still exist in Australia though they vary significantly between States and Territories (and even within them). Tariff reform is increasingly on the agenda.

Table 8 Key Renewable energy policy and their status

Beside than these New south west and Sydney local government also follow these key policies and support and develop their own.

- Applying the New South West Renewable Energy Action Plan (New South West Government 2013) (REAP) to rise renewable generation in New South West and help meet the national Renewable Energy Target (RET) at least cost to the energy consumer and with maximum welfares to the state
- Founding the Renewable Energy Advocate – a position that acts as a single, cross government, point of contact for industry – helping address network, planning and financial constraints faced by renewable energy advocates
- Reiterating its support (during the 2014 review) for the Australian Government's 2014 RET of 41 000 MWh of renewable generation by 2020
- Dealing the National Green Power Accreditation Program (NGPSG 2015), which helps residential and business electricity users acquisition renewable energy – in 2014 sales in New South West stood at 377 GWh, about 30% of the total
- On-going to support solar feed-in-tariffs (in line with annual IPART determinations)

- Inspecting ways to provide a sustainable and predictable future for the solar industry supporting the Regional Clean Energy Program (RCEP), which is helping groups with the local development of renewable energy resources – both by development public engagement and awareness-raising with respect to large-scale growths, as well as helping societies use renewable energy sources to produce their own electricity locally.

8.6 Financial Initiatives

The large-scale projects that were effectively funded in 2015 were primarily onshore wind and solar PV projects. The current development of those technologies has resulted in levelized costs of electricity (LCOE) which are now cheap with traditional fossil-fuel generators. The Australian Power Generation Technology Report (November 2015) concludes that wind power is the lowest cost renewable technology currently available – with USD $75 per MWh with comparable to integrated gasification combined cycle coal plants and forecasts that in the next 15 years to 2030, the capital costs for solar PV plants will reduce by 35-50%.

Public Private Partnership Model

Funding for the large scale renewable project done in several different ways - by government investment vehicles, investment by large generators and retailers and by an innovative agglomerated purchasing vehicle.

- In March 2016, the Australian Government generate the $1 billion USD Clean Energy Innovation Fund, which is to be managed by Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA).
- In April 2016 CEFC and Palisade Investment Partners announced a strategy with an objective of accelerating the delivery of $1 billion USD in Australian renewable energy projects. The strategy involves funds managed by Palisade and is aimed at obtaining institutional investment in renewable energy at an earlier stage of project development
- In February 2016, AGL Energy established an investment vehicle, the Powering Australian Renewables Fund (PAR Fund) to entice investors to contribute to a pool of ~$2-3 billion USD for investment in large scale renewable projects. AGL has committed to invest $200 million and it will seek partners to contribute $400 to $700 million USD equity.
- Also in February 2016, Origin Energy notified the market of their intent to assist in pushing additional renewable energy projects through the pipeline in order to meet their respective RET. Key to their ambitions will be the commissioning of the Darling Downs 200MW Solar PV plant in Queensland in respect of which Origin has sought funding from ARENA.
- The Melbourne Renewable Energy Project comprises a consortium of businesses, universities, cultural institutions, and local councils led by Melbourne City Council who seek to drive investment in renewable energy by committing to the group or joint purchase of 120GWh per annum of energy from a new utility scale renewable energy system connected to the NEM. The consortium's intention is to generate 25% of Melbourne's electricity from renewable energy by 2018 with the objective of becoming carbon neutral by 2020.

These recent market signals demonstrate that businesses and governments alike are aware of the investment impasse. Factoring in project build times of 14 to 24 months, significant financing will

need to be unlocked in the short term to enable the construction of the 6,000MW of renewable energy capacity and meet the RET deadline by 2020

Other than this government also establish some incentive related programs to encourage consumer for renewable energy.

Renewable Energy Certificates

Fossil fuel generation has economy capital and fuel costs. It accepts government subsidies, and has a governing framework that supports large scale fossil fuel power stations on a national grid. This governing framework generates regulatory barriers to minor scale distributed renewable energy technologies which makes it difficult for renewable energy technology to compete on cost alone.

Feed-In Tariffs

A well-made feed-in tariff can fast expand the uptake of renewable energy technologies at a marginal cost to society, as seen by the massive uptake of solar and renewable gases in Germany which has resulted in lower overall bills in part due to the merit order effect whereby network peak events (when energy prices are highest), are minimised

Removal of the Regulatory Barriers to Renewable Energy

Distributed renewable energy technologies such as building integrated solar PV and supply connected onshore wind energy and precinct scale renewal supplied by renewable gases could be cost viable now if the governing barriers to distributed energy were removed negating the need for feed-in tariffs for these early skills.

Rebates

The Australian Government provided a rebate program that offered up to USD $5,800 rebates for installing solar panels on homes and community use buildings (other than schools), through the Solar Homes and Communities Plan.

Mandatory renewable energy target

In 2001, the Australian government presented a compulsory renewable energy target (MRET) planned to ensure renewable energy obtains a 20% share of electricity supply in Australia by 2020. The MRET will rise from 9,500 gigawatt-hours to 45,000 gigawatt-hours by 2020. The scheme lasts until 2030.

Subsidy funding

The Solar Flagships program sets apart $1.6 billion USD for solar power over a period of six years. The government funding is for 4 new solar plants that produce coal plant scale power (in total up to 1000 MW - coal plants typically produce 500 to 2,000 MW). This subsidy would need additional funding from the plant builders and/or operators. As a comparison Abengoa Solar, a company currently constructing solar thermal plants, put the cost of a 300 MW plant at 1.25 billion USD in 2007. In 2009, the Arizona state government announced a 200 MW plant for $1 billion US dollars.

8.7 Technological Solution

The following projects are examples of innovations around Sydney in the renewable energy domain

Solar Photovoltaics - Sydney Town Hall

Sydney Town Hall is an architectural and historic icon. The building is heritage listed so, the photovoltaics (PV) design was sympathetically designed to the Town Hall's form and character.

Capacity: 48kW
Annual output: 60MWh pa
Solar panels: 240
Annual saving: 62.4 tonnes CO_2

Solar Photovoltaics-Sydney Theatre Company

Sydney's Wharf Theatre has installed nearly 2 000 solar panels that cover the entire roof. This is enough energy to power 70% of the theatre's energy demands, along with practical electricity saving measures.

Capacity: 384kWp
Annual Output: 530MWh pa
Solar panels: 1,906 solar panels
Annual saving: 562 tonnes CO_2

8.8 Solar Thermal Hot Water, Redfern Community Centre, Sydney

The City of Sydney Council has installed solar thermal hot water systems on many of its Council owned buildings in the city. The solar thermal evacuated tube solar pre-heat systems are an Australian invention. The systems can be installed on residential and commercial buildings and are easy to retrofit to existing hot water systems on building.

Capacity: 315 litres triple 4.8kW
Collector Area: 8.5 m2
Hot water storage: 945 litres
Daily hot water usage: 1,000 litres at 50ºC
Energy saving: 42,015MJ pa gas & 11.7MWh pa electricity
Annual saving: 12.4 tonnes CO_2

8.9 Micro Wind Turbine, Inmark Tower, Sydney

Micro wind turbines can be installed on buildings both vertically and horizontally. Inmark Tower at 710 George Street in the centre of Sydney was the first urban wind turbine installed in the City of Sydney

LGA. It has a vertical axis turbine. The building is a 35-storey high rise residential with retail and commercial space. A frame around the turbine is a visual aesthetic and not a feature of the turbine

Capacity: 4kW
Start-up wind speed: 3–5 m/s
Shut off wind speed: 25 m/s
Annual output: 11MWh pa
Annual saving: 11.6 tonnes CO_2

8.10 Renewable Energy Sector Development Strategies

Invest in large-scale renewables Continue to support investment in large-scale solar and wind power towards the full achievement of 90% renewable energy

Action

- Start process to award up to 50 MW to solar energy developers under the government's next generation solar initiative.
- Award up to 1 MW for community solar.
- Progress further wind energy capacity releases building on the 200 MW wind auction process.

Facilitate battery storage Facilitate local research and investment into battery storage as an important Solar industry

- Facilitate a national test facility for battery storage technologies in Canberra with trades training and tertiary research integration.
- Work towards the integration of energy storage at (or associated with) a large-scale solar facility in the ACT.
- Support the deployment of household-scale battery storage on the ACT distribution network.

Facilitate research partnerships

Facilitate productive partnerships between battery storage, solar and wind energy developers and local research, education, and trades training institutions, building institutional recognition and capacity

Support small business innovation

Leverage a range of funding sources to support innovation and growth of local small businesses which can address the needs of solar, wind and energy storage industries

8.11 Performance Measures and Statistics

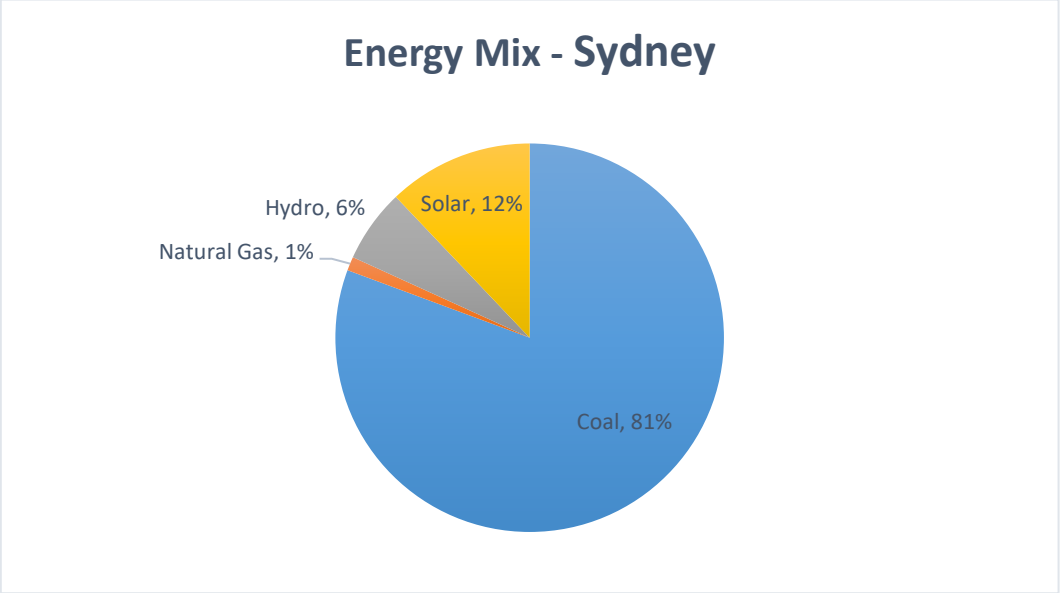

Figure 40 Energy Mix Sydney

As per the above energy mix graph we get idea of Sydney sources of energy. There are about 80% energy production by Coal and Natural Gases and other 20% from renewable sources.

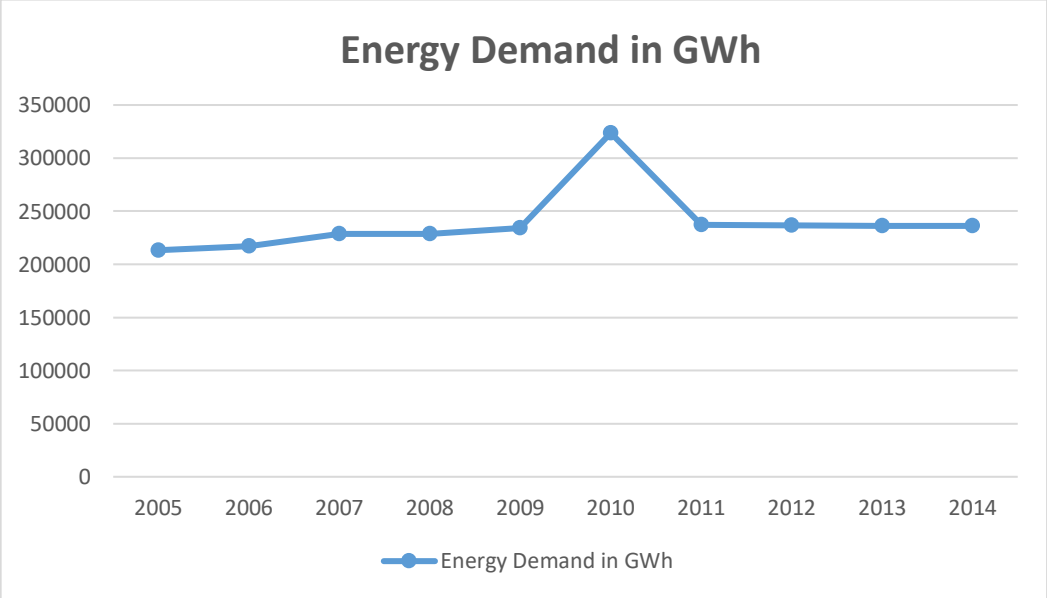

Figure 41 Energy Demand in GWh (World Bank Data)

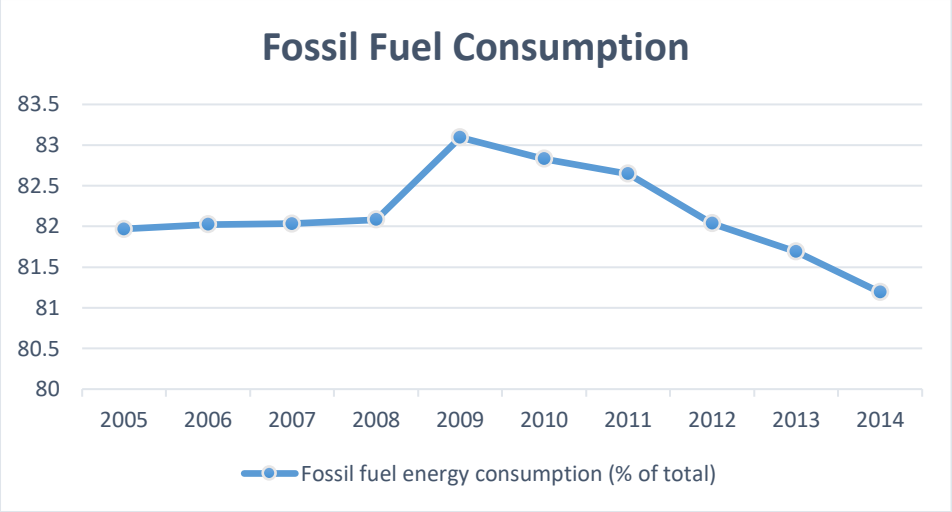

Figure 42 Fossil Fuel Consumption (World Bank Data)

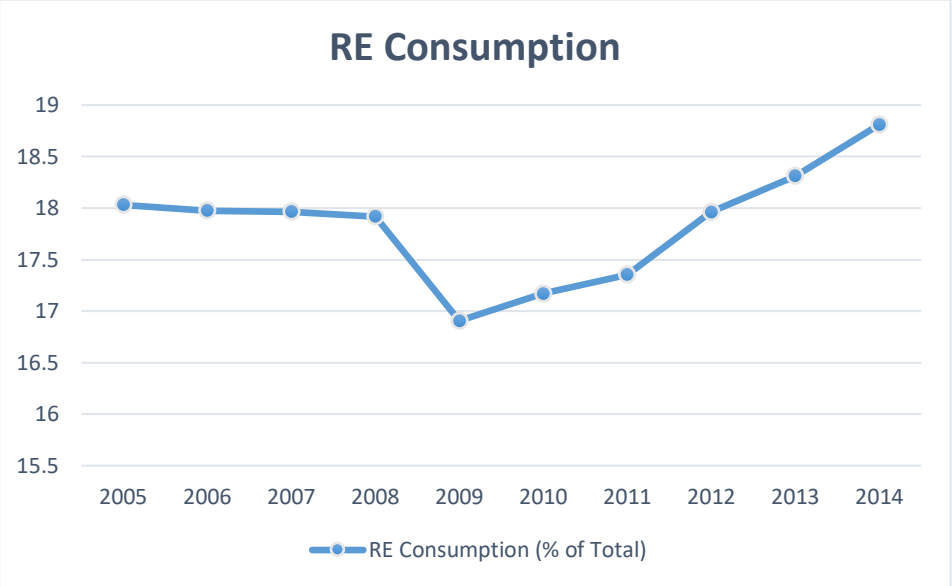

Figure 43 RE Consumption (World Bank Data)

Through the comparison between Fossil fuel and RE consumption data for Sydney shows that in fossil fuel consumption decrease significantly. It also shows the increment in renewable energy generation over these years. Fossil fuel decrease by 1% over the 10 years' time. In 2009 world master games held in Sydney so power demand increase to cope up with these demand usages of fossil fuel increase.

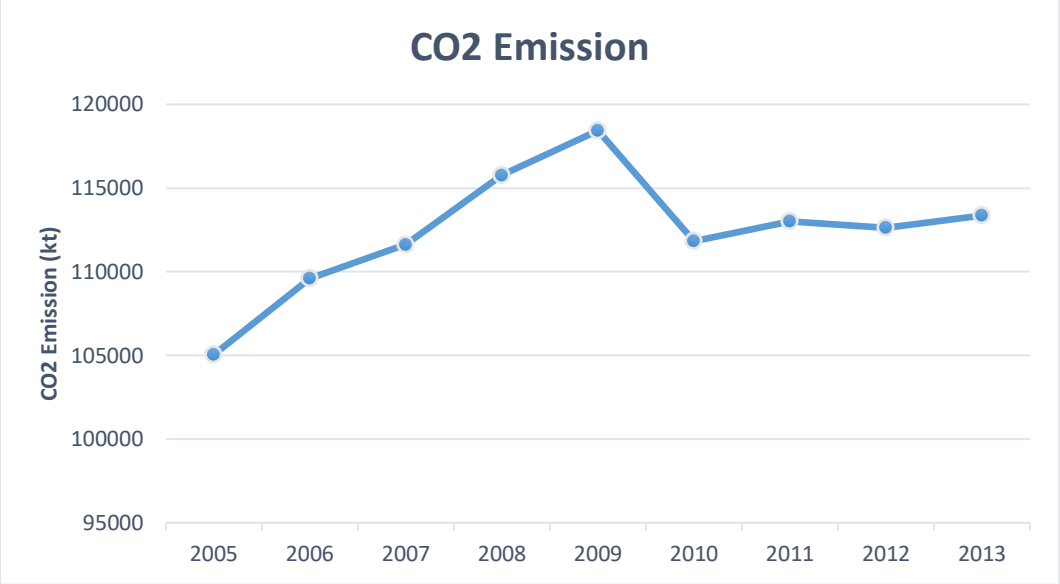

Figure 44 CO2 Emission (World Bank Data)

As above graph shows emission decrease in Sydney over 10 years of time. There is one hike show in graph between 2009 and 2010 at these same year fossil fuel consumption is also at their peak and then decrease as increase pf the renewables generation which also effective for CO2 emission.

8.12 Own Assessment of the Case Study

Sydney is a one of the most expensive city in the world and hub of many industry like tourism and financial service. Energy demand is also high and increase year by years so it is really changing thing for government to cope op with the energy demand. Most of the energy come from the coal based power plant so it's very challenging situation to convert into complete renewables. Although local government develop master plan for renewable energy in which they commit by 2030 they produced 30% by renewables. They already took many initiatives to reach their goal. Technological solution provided by government is unique and worthy which indicted they follow right track to complete their targets. Sydney faced challenging situation in energy demand but its dedication towards the renewables was appreciated. Other cities should be learned from these examples.

8.13 Data for Performance Assessment

The analysis where individual data was sourced can generally be found in the City sections, however, in order to compare data across the cities, it was necessary to compare different metrics across the cities to better understand renewable energy infrastructure finance.

It has already been determined that the role of infrastructure finance requires multi-stakeholder analysis and understanding of institutional settings to better understand the landscape for its operation. In order to have consistent data for the cities, comparing their relative size compared of GDP to see if there is a direct relationship between the size of the economy

	Sydney	Los Angels	Berlin	Hawaii	Sao Paulo	Manila
GDP For Cities billion USD	400.9	930.82	129.77	70.845	568	108.03
	2015	2015	2015	2015	2015	2015
	Australia	**USA**	**Germany**	**USA**	**Brazil**	**Philippines**
GDP For Country billion USD	1339.54	17947	3355.77	17947	1774.72	291.97
	2015	2015	2015	2015	2015	2015
Ratio	**0.30**	**0.05**	**0.04**	**0.004**	**0.32**	**0.37**

8.14 International Governance Surrounding Renewable Energy Infrastructure

The United Nations and the World Bank have set out governance requirements which measure 'responsible' investing across ESG principles. Financial institutions (regional banks, commercial banks, development banks, private funds) from around the world can be signatories of this and adhere to them. These are:

- **UN Principles of Responsible Investing:** United Nations Environment Programme Finance Initiative and the UN Global Compact as a framework for improving the analysis of ESG issues in the investment process and to aid companies in the exercise of responsible ownership practices
- **Equator Principles:** Risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in project finance.
- **UN FCCC:** The twenty-second session of the Conference of the Parties (COP 22), the twelfth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP 12), and the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.
- **Cities 40:** C40 is a network of the world's megacities committed to addressing climate change.

Governance Frameworks, governance and regulatory policies	Brazil	Australia	Philippines	United States	Germany
UN Principles for Responsible Investing	Y	Y	N	Y	Y
UN Equator Principles	N	Y	N	Y	Y
UN FCCC	N	Y	N	Y	Y
Cities 40	y	y	y	y	Y

Table 9 Governance Frameworks and regulatory policies

Y – Country is a member and of the Policy
N – Country is a Non-Member of the Policy

It is evident from above that the developed countries have stronger mitigation policies for Climate change impact. This means that they have better awareness on the benefits of the renewable energy resources and making more investments in the field of renewable energy.

8.15 Renewable Energy Consumption across cities

Consumption patterns across the different cities is indicative of general progress of RE amongst the cities. Over the last few years, despite some of the policies proposed, a % change in Sao Paulo has diminished slightly, a relatively fat Manila and general increasing trends for the rest.

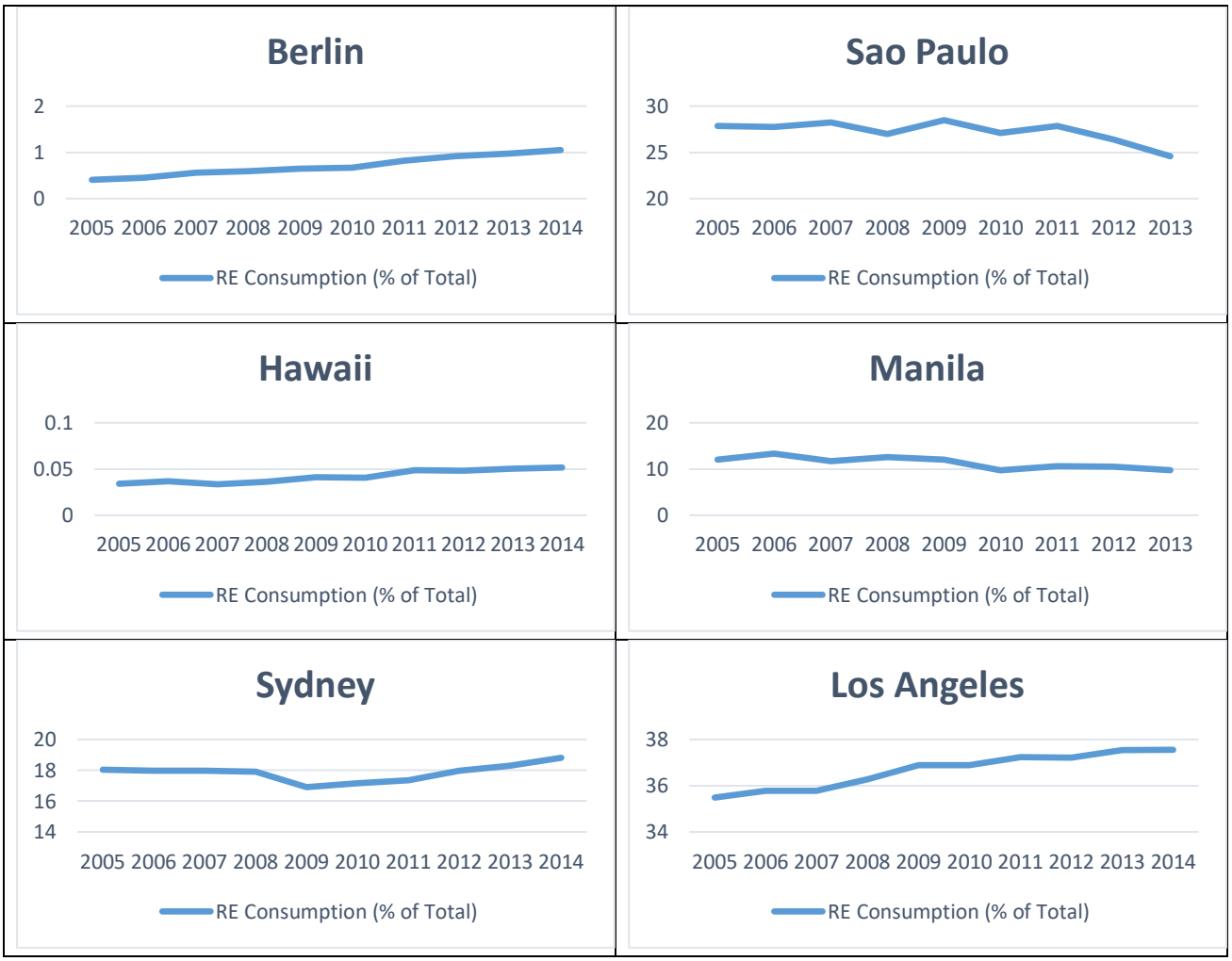

Figure 45 Renewable energy Consumption (Source: World Bank Data)

8.16 Fossil Fuel Energy Consumption (as % of Total)

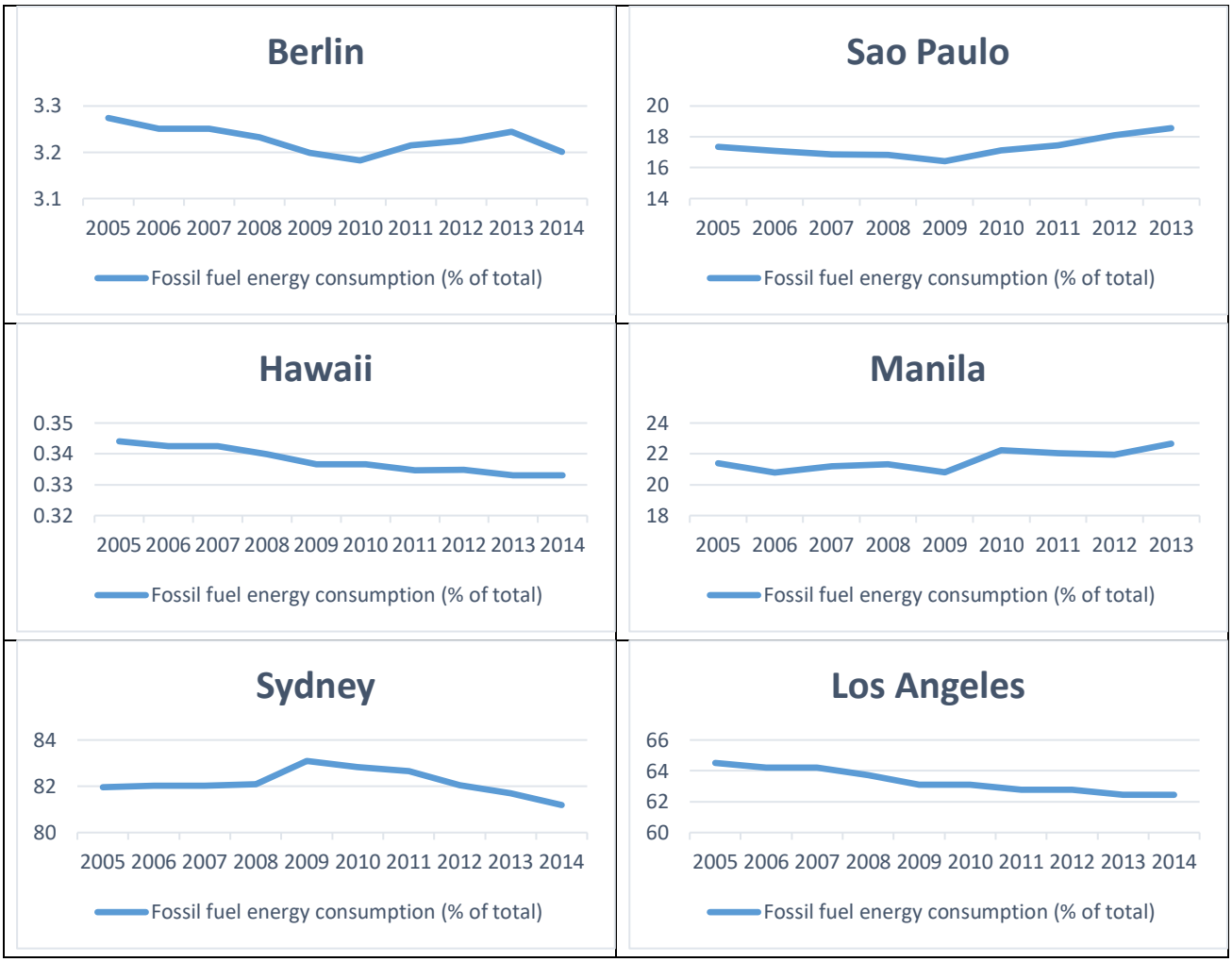

Figure 46 Energy Consumption from Fossil Fuels

It is observed from the above analysis that there is a downward trend in the renewable energy consumed in the developed country cities of United States, Australia and Germany and there is a upward trend in Philippines and Brazil.

This fall in renewable energy consumption in Sao Paulo and Manila indicates that there is less investment and focus on the renewable energy projects in the respective countries. Also, the increase in fossil fuel consumption may mean higher rate of industrialisation leading to higher energy use and hence increase in fossil fuel consumption. Hence it is a very wise strategy to invest in renewable energy power sources especially in developing cities so that the development of the city could be complemented by the development of the renewable energy sector in the respective country.

8.17 Investment flows

Whilst FDI is not a measure of investment into the sector, understanding the political and financial dynamics that have also shown confidence in to the cities has shown volatility in 2008 (understandably, given that that was the year of the financial crisis), followed by market recovery where countries have shown positive investment flows. Different cities have experienced different socio-economic dynamics and thus single answers alone can not inform the trends. What it does indicate, however, is a marked increase in most cities in financial flows into the countries. This shows

the environment for investment. More noticeably in Sao Paulo who's market recovery has been strong after droughts and political upheaval, thus able to attract more investment. Similarly, Hawaii can not be observed under the same analysis given that it contributes very little to the GDP of the United States.

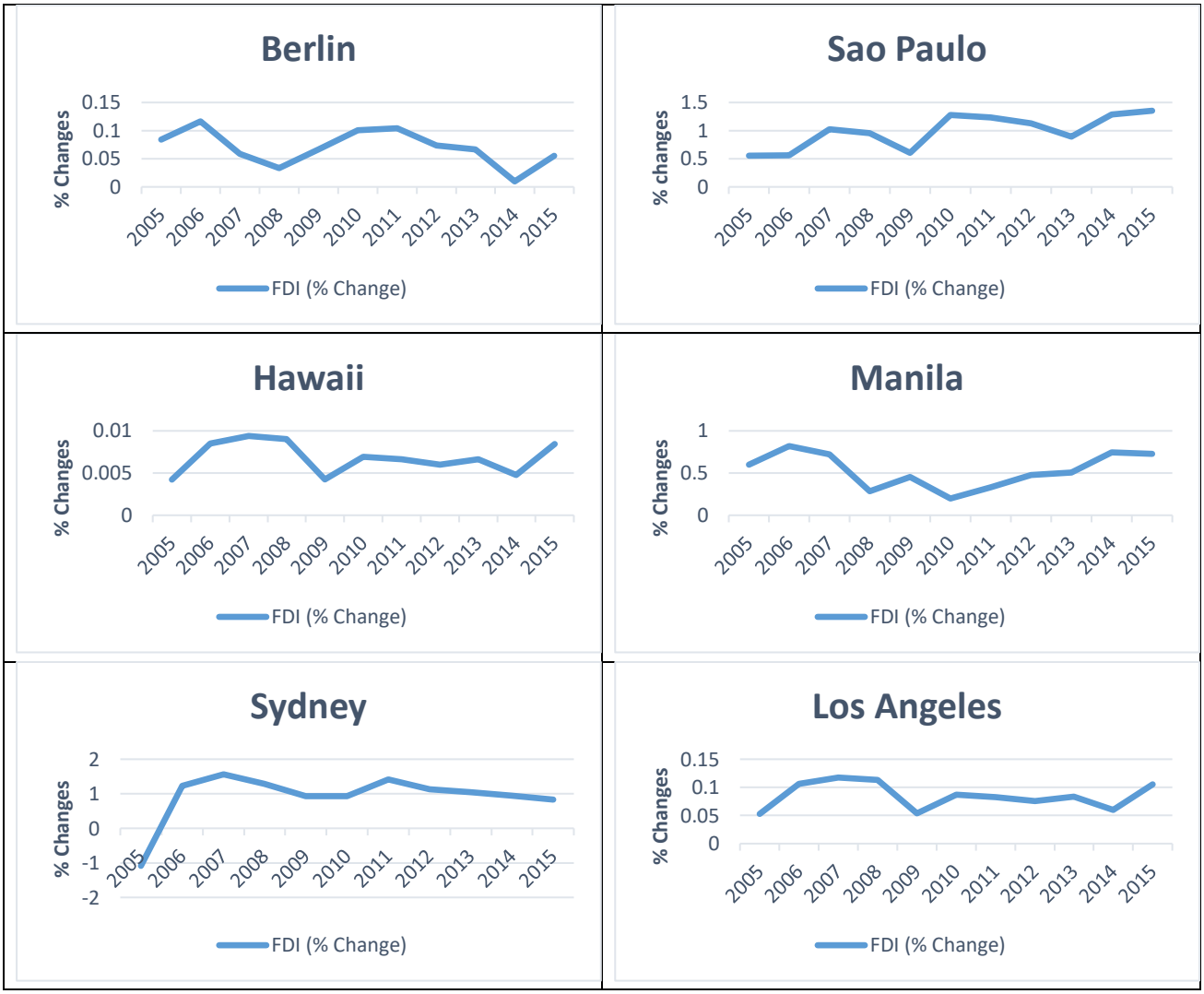

Figure 47 Foreign Direct Investment Flow in % change (World Bank Data) ~GDPcity/GDPcountry proxy was used to determine

There has also been a shift in renewable energy investment from developed to developing regions and that has not been surprising. Naturally with the demand for energy increasing the world over, more nations find themselves planning renewable energy infrastructure as part of their build. Moreover, the trends in renewable energy investment by region indicate solar power and wind generation as favourable technologies for deployment.

Category / Year / Unit	2004 $bn	2005 $bn	2006 $bn	2007 $bn	2008 $bn	2009 $bn	2010 $bn	2011 $bn	2012 $bn	2013 $bn	2014 $bn	2015 $bn	2014-15 Growth %	2004-15 CAGR %
1 Total Investment														
1.1 New investment	46.6	72.8	112.0	154.0	182.2	178.7	239.2	278.5	257.3	234.0	273.0	285.9	5%	18%
1.2 Total transactions	55.5	99.1	147.9	212.7	241.6	242.9	297.6	352.0	324.9	301.1	360.4	379.8	5%	19%
2 New Investment by Value Chain														
2.1 Technology development														
2.1.1 Venture capital	0.4	0.6	1.2	2.1	3.2	1.6	2.5	2.5	2.4	0.8	1.0	1.3	36%	13%
2.1.2 Government R&D	1.9	2.0	2.2	2.7	2.8	5.4	4.9	4.8	4.7	5.2	4.5	4.4	-3%	8%
2.1.3 Corporate RD&D	3.2	2.9	3.1	3.5	4.0	4.1	4.2	5.1	5.0	6.6	4.5	4.7	3%	3%
2.2 Equipment Manufacturing														
2.2.1 Private equity expansion capital	0.3	1.0	3.1	3.6	6.7	2.9	5.4	2.4	1.6	1.4	1.6	2.1	32%	18%
2.2.2 Public markets	0.3	3.6	9.3	21.4	10.9	12.9	11.2	10.0	3.8	10.1	16.2	12.8	-21%	42%
2.3 Projects														
2.3.1 Asset finance	32.0	52.6	84.5	109.8	135.8	120.2	152.9	181.4	163.3	158.0	188.4	199.0	6%	18%
Of which re-invested equity	0.0	0.1	0.7	3.2	3.6	1.9	4.4	3.4	2.8	1.9	3.7	5.8	59%	-
2.3.3 Small distributed capacity	8.5	10.2	9.4	14.1	22.3	33.5	62.6	75.7	79.3	53.9	60.4	67.4	12%	21%
Total Financial Investment	32.9	57.6	97.3	133.7	153.1	135.7	167.5	192.8	168.3	168.4	203.6	209.4	3%	18%
Gov't R&D, corporate RD&D, small projects	13.6	15.2	14.7	20.3	29.1	43.0	71.7	85.7	89.0	65.6	69.5	76.5	10%	17%
Total New Investment	46.6	72.8	112.0	154.0	182.2	178.7	239.2	278.5	257.3	234.0	273.0	285.9	5%	18%
3 M&A Transactions														
3.1 Private equity buy-outs	0.8	3.7	1.9	3.6	5.1	2.2	1.9	3.0	3.3	0.5	2.6	3.5	36%	14%
3.2 Public markets investor exits	0.4	2.4	2.7	4.0	0.9	2.5	4.9	0.2	0.4	1.7	1.8	1.8	1%	16%
3.3 Corporate M&A	2.4	7.6	11.9	20.4	16.9	21.8	19.4	29.7	10.2	16.3	11.8	19.2	63%	21%
3.4 Project acquistion & refinancing	5.3	12.5	19.5	30.7	36.4	37.7	32.3	40.6	53.7	48.6	71.2	69.3	-3%	26%
4 New Investment by Sector														
4.1 Wind	19.0	29.0	39.8	61.2	75.4	79.8	98.7	84.2	81.9	90.6	105.7	109.6	4%	17%
4.2 Solar	11.9	16.1	22.2	38.9	61.6	64.4	103.7	154.8	146.2	119.1	143.8	161.0	12%	27%
4.3 Biofuels	4.0	9.6	28.2	28.3	18.5	10.4	10.1	10.3	7.2	5.7	4.7	3.1	-35%	-2%
4.4 Biomass & w-t-e	7.7	9.7	11.9	16.2	17.1	14.7	15.7	18.0	13.5	10.5	10.4	6.0	-42%	-2%
4.5 Small hydro	2.6	7.3	7.6	6.7	7.6	6.2	7.9	7.2	6.4	5.5	5.5	3.9	-29%	4%
4.6 Geothermal	1.2	1.0	1.5	1.9	1.7	2.9	2.8	3.7	1.8	2.4	2.6	2.0	-23%	5%
4.7 Marine	0.0	0.1	0.9	0.8	0.2	0.3	0.3	0.3	0.3	0.2	0.4	0.2	-42%	14%
Total	46.6	72.8	112.0	154.0	182.2	178.7	239.2	278.5	257.3	234.0	273.0	285.9	5%	18%
5 New Investment by Geography														
5.1 United States	5.6	11.9	29.1	33.2	35.5	23.9	34.7	49.1	40.6	35.3	37.0	44.1	19%	21%
5.2 Brazil	0.8	3.1	5.2	11.4	11.8	7.9	7.2	10.2	7.7	4.4	8.0	7.1	-10%	21%
5.3 AMER (excl. US & Brazil)	1.7	3.3	3.7	5.0	6.1	5.5	12.0	9.3	10.1	12.0	13.3	12.8	-3%	20%
5.4 Europe	24.8	33.3	46.9	66.8	81.8	82.7	113.4	122.9	89.0	60.0	62.0	48.8	-21%	6%
5.5 Middle East & Africa	0.6	0.8	1.1	1.8	2.3	1.6	4.1	3.0	10.2	9.3	7.9	12.5	58%	32%
5.6 China	3.0	8.3	11.2	16.7	25.6	38.8	39.6	47.4	61.7	62.0	87.8	102.9	17%	38%
5.7 India	2.7	3.0	4.9	6.7	5.6	4.3	8.8	12.8	7.8	6.6	8.3	10.2	22%	13%
5.8 ASOC (excl. China & India)	7.3	9.0	10.0	12.4	13.6	13.9	19.3	23.8	30.2	44.4	48.8	47.6	-2%	19%
Total	46.6	72.8	112.0	154.0	182.2	178.7	239.2	278.5	257.3	234.0	273.0	285.9	5%	18%

Figure 48 Global Trends in Renewable Energy Investment 2016 Data Table, $Bn [2]

Figure 49 indicates a significant increase in the level of investment in wind and solar generation over the last decade. Wind investment has grown by 17%, compared to 27%. In addition, regionally, the growth in Brazil and United States have grown by 21% in new investment into renewables.

As can also be observed, Debt is the main component of large scale renewable energy projects, particularly those that are utility-scale generation.

From these lessons we can learn that the renewable energy landscape will be transformed over time.

- Climate actions will motivate the surge of new renewable build
- The falling costs of renewable energy technology makes it more affordable
- Infrastructure as an asset class has gained overall prominence and offers private investment returns in a rapidly evolving financial landscape
- The emergence of new financial mechanisms e.g. green bonds as well as renewable energy credits, incentives and others make this a landscape likely to see continued interest.

8.18 Changing Energy Matrix

The current Energy Mix of all the selected cities is shown

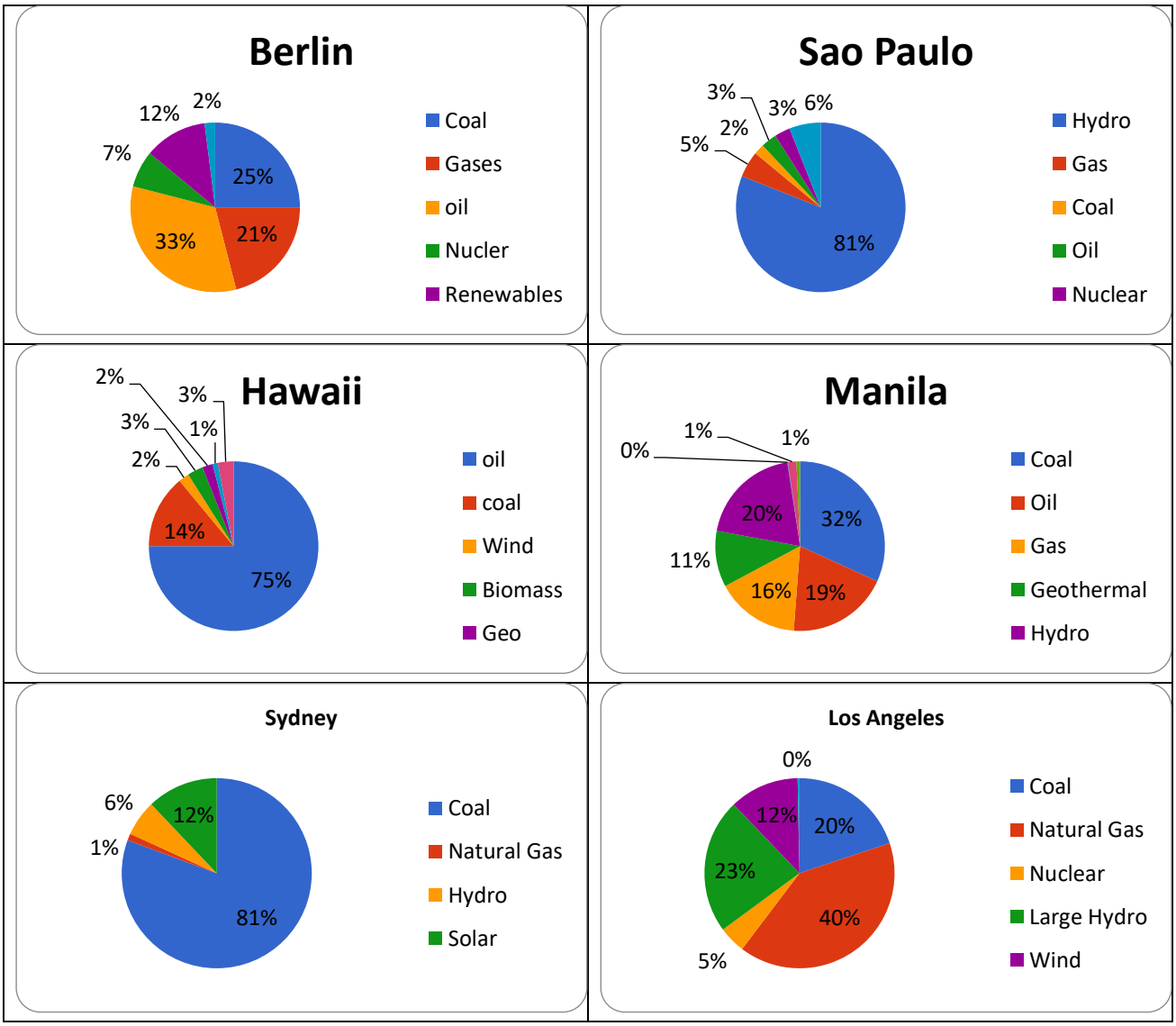

Figure 49 Energy Mix

8.19 The Evolution of the Market

- Market liberalisation is often accompanied by policy incentives that grant financial incentives for new technology. Tax incentives (and their duration) will be evaluated across the different States that the cities are housed as these ultimately impact on energy prices, which in turn impact on revenues collected by projects

(comment)

	High Income			Upper Middle Income	Lower Middle Income
	Australia	Germany	United States	Brazil	Philippines
Renewable energy targets	R	B	R*	R	B
Regulatory Policies					
Feed-in tariff/ premium payment	A	R	A	x	R
Electric utility quota obligation/RPS	B	x	R*	x	B
Net meatering/ net billing	x	x	R*	R	B
Transport obligtion/mandate	A	R	R	R	B
Heat obligation/mandate	A	B	A	A	x
Tradable REC	B	x	A	x	x
Tendering	N	N	x	N	B
Fascal Incentives and Public Financing					
Capital subsidy, grant or rebate	B	B	B	x	B
Investment or production tax credits	x	B	R	B	B
Reductions in sales, energy , VAT or other t	x	B	B	R	B
Energy production payment	x	x	x	x	B
Public investment, loans or grants	R	B	R	B	B

R	REVISED (one or more policies of this type)
A	Existing Sub-National (but no national)
B	Existing National (could also inlude subnational)
N	New (one or more policies of this type)
R*	REVISED Sub National

Figure 50 Regulatory Policies

8.20 Societal benefits

(comment)

- Infrastructure projects not only provide employment opportunities in construction phases, but also in the negotiated deals with financial institutions and contractors alike. PPPs in developing countries can also take on additional developmental requirements
    - Local content policies: sourcing certain construction materials from the local country and as such improving local industrial activity
    - Local Community Trusts: governments have also made it a requirement for banks and equity investors to create trusts for surrounding communities affected by the construction of this infrastructure, this enables them to benefit from the project financially for its entire project life. This tends to happen in far less developed cities, where there are surrounding communities however, still worth the investigation.

8.21 Environment

- Different cities are signatories of various protocols, governance frameworks and therefore understanding the assessment criteria for these will be critical.

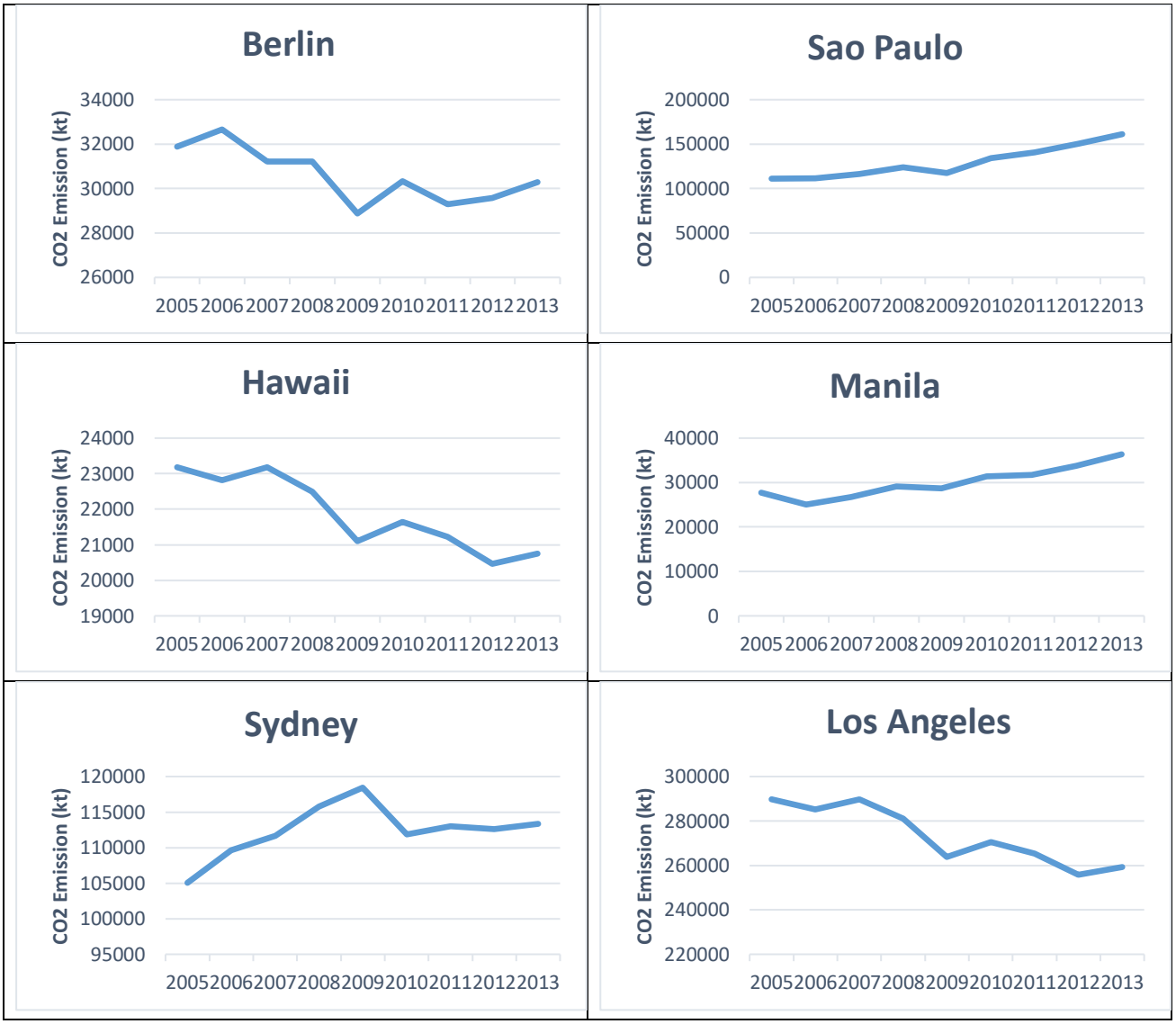

Figure 51 CO2 Emission

8.22 Public Private Partnerships

(lessons learned)

Public-private partnerships have seen increased prevalence the world-over as all cities aim to deliver services equitably, reliably and at a sustained quality. This means that private sector involvement has taken on many forms in energy provision.

- *Design, Build, operate:* contract is awarded for the full scope of the public facility with ownership remaining with the municipality.
- *Build, Own, operate:* a contractor undertakes the public facility without transferring ownership to the municipality.
- *Build, Operate, Transfer:* private partner builds a facility to meet the public sector's specifications and operates for a predetermined amount of time.

Figure 52 Foreign Fund Flow into Projects

9 Lessons Learned through comparison

9.1 Developing nations

The selected developing countries cities can be characterized by persistent energy shortages, financing challenges and/or political unrest. These tend to have a limiting factor to attracting infrastructure investment where commercial bank lending is limited. The hurdle to overcome prevailing risks in politics, low sovereign credit ratings, and political instability requires large multilaterals to aid in provide cheaper sources of capital through either debt or equity financing as well as aiding governments improve regulatory environments for more private sector involvement. Regional banks, although not present in all nations, also play an effective vehicle of finance in bridging energy infrastructure gaps on a developmental basis. Developing countries also tend to have market structures differ in development and often tend to have state-owned/driven entities managing energy provision.

9.2 Developed Nations

In more developed economies, we find that markets are less monopolised by state owned entities and have diverse competitive markets where both private and public sectors come together. Most developed nations' market structures are liberalized and offer federal and state tax incentives for producing cleaner fuel, promoting the development of new energy technologies. Many developed nations also boast robust energy strategies from both demand-side and supply-side management, from reduced consumption to more efficient generation methods. Increased commitments to overall carbon reduction also spurs innovation as some developed nations strive towards carbon neutrality. A leader in this is Germany, where the country is decommissioning *all* its nuclear plants and increasing renewable energy on a diverse and mass basis. Financing energy in these countries spreads across public funds (federal and state) as well as private funds from development banks, commercial banks and private fund initiatives. Risks of projects are mainly attributed to nascent technologies finance and thus technology failures are a (mitigatable) risk.

9.3 Public Private Partnerships

The role PPPs can not be ignored as more investment capital emerging from private sector becomes more significant, so does the need to have better collaboration. It was observed that in cities with low regulation, cost of investing is traditionally higher. Well-regulated economies, with strong incentive schemes allowed for the partnerships to be more successful. Renewable energy is getting a lot of attention and thus governments in developing countries cities need to allow for efficient and transparent processes whereas in developed countries, where more robust energy commitments are robust, there needs to be less intermittency risk as well as an adaptable strategy that can accommodate new innovations such as battery storage. Investment flows are still seen to hunt down renewable project and thus the collaboration between government and private investment will still be seen in the world going forward.

9.4 Risk Assessment

Services: Investors tend to be more nervous when investing in countries that have strong local content policies (requirements to adopt local companies and their services in renewable projects), the adoption of these requires investors to have trust in local manufacturing and services given that they have to operate for 20 years or so.

Construction - Cost of completion will be fundamental to the financial viability of any project as the financial assumptions and ratios are always dependent on the assumed cost of construction of the project. The lenders will need some mechanism to manage the risk if the project company's cost of completion increases as compared with that anticipated at financial close.

Performance - The lenders will want to ensure that completion requires the works to be in a good condition for operation. Since the revenues are secured by the level of operation of renewable projects. This is fundamental to all cities and state policies

PPA: power purchase agreements need to be available and secured with a reputable state government simply because there are risks revenues security. If renewables fail to generate at the optimal level, governments tend to bear the risk of this. Allowing the contracts signed to cater for this allows for better management to all stakeholders.

Price risk: the consumers are ultimately affected by any renewable energy investment. In developed cities, deregulated markets mean that prices fluctuate by demand and supply. This means security of price needs to be monitored when fiscal incentives expire.

Policy change/political risk: New government administrations such as USA's President – elect Donald Trump, could repeal important policy such as the Clean Power Plan. This could have damaging impacts on the planet as a whole.

9.5 Investing for Economic Impact across Environment, Society and Corporate Governance

The private sectors are constantly engaged in being signatories for economic impact. Governance frameworks developed by the United Nations as well as the World Bank, IFC have incorporated:

- **UN Principles of Responsible Investing:** United Nations Environment Programme Finance Initiative and the UN Global Compact as a framework for improving the analysis of ESG issues in the investment process and to aid companies in the exercise of responsible ownership practices
- **Equator Principles:** risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in project finance
- **Nations** have also ratified the following commitments to overall climate change:
    - COP21, Kyoto Protocol, Copenhagen Accord

A growing list of private companies in each country will be investigated to see which cities and companies within these cities have committed to the above in 'Impact Assessments' per the criteria stipulated in these documents.

Investing in renewable energy generation has been widely hailed as a means of increasing energy security, diversifying energy mixes in line with climate change commitments and boosting economic growth. Increasingly, more and more investment flows are attracted to infrastructure as an asset class, not surprisingly energy infrastructure for its demand to meet societal needs, its potential to yield sure positive investment returns and it as a fundamental driver of economic growth. Its regional contexts make for interesting observations as governments adopt international policies and directives in their

regional settings and further deploy renewable energy as a means of addressing some of their social concerns.

The institutional settings with which these energy projects occur are impacted by regulator settings, risk of investment in those nations and of course the security of demand. Investors have ranged from institutional investors across multilateral agencies, regional development banks, government public funds and an array of private investment all participating in energy infrastructure investment. Naturally, multilateral agencies have a developmental mandate, larger, superior balance sheets to most governments can generate positive investment flows at lower required rates of return. This means that they can absorb more risky investments than private investors too. MLA's also play a role not only in providing financing for energy infrastructure, but also at times a dual mandate of improving institutional infrastructure through pressures to improve regulatory and governance. Private investment, naturally with a profit mandate, has greater desire for higher returns on investment and thus more stringent standards for investment. This means that they have more stringent investment criteria but also consequently drive efficiencies in construction and management of these energy projects.

In conclusion, renewable energy plays a fundamental role in the advancement of economies, their transition to cleaner energy and mitigation climate change. Energy infrastructure is also an attractive and secure asset class, thus offering investment returns to investors who are also tending more towards developmental agendas in their governance.

Bibliography

1. WBG, “Beyond Economic Growth Student Book,” The World Bank Group, [Online]. Available: http://www.worldbank.org/depweb/english/beyond/global/glossary.html. [Accessed 10 October 2016].
2. DHS, “Critical Infrastructure Sectors,” Homeland Security, [Online]. Available: https://www.dhs.gov/critical-infrastructure-sectors. [Accessed 10 October 2016].
3. Senate Department for Urban Development and the Environment, “Climate-Neutral Berlin 2050: Recommendations for a Berlin Energy and Climate Protection Programme,” Senate Department for Urban Development and the Environment, Berlin, 2016.
4. R. Buehler, A. Jungjohann, M. Keeley and M. Mehling, “How Germany Became Europe’s Green Leader: A Look at Four Decades of Sustainable Policymaking,” Solutions, October 2011. [Online]. Available: http://thesolutionsjournal.org/node/981. [Accessed 25 October 2016].
5. BIK, “Berlin Climate Protection Infromation Office,” Federal State of Berlin, Berlin, 2015.
6. BNA, “Performance Contracting: Energy Saving Partnership, A Berlin Success Model,” Federal State of Berlin, Berlin, 2015.
7. IEA, “Brazil (Partner country),” International Energy Agency, 2015. [Online]. Available: https://www.iea.org/countries/non-membercountries/brazil/. [Accessed 16 October 2016].
8. M. L. Bucalem, “Sustainable Urban Development of Sao Paulo: Challenges and Opportunities,” Prefeitura de Sao Paulo: Desenvolvimento Urbano, Sao Paulo, 2012.
9. R. H. Pereira, “Looking a Decade Ahead: Electrical Power Generation in Brazil,” General Electric, 03 November 2014. [Online]. Available: http://www.geglobalresearch.com/blog/looking-decade-ahead-electrical-power-generation-brazil. [Accessed 2016 October 2016].
10. Governo Do Estado de Sao Paulo, “The electricity in the State,” Government of the State of Sao Paulo: Secretary of Energy and Mining, [Online]. Available: http://www.energia.sp.gov.br/energia-eletrica/energia-eletrica-no-estado/. [Accessed 16 October 2016].
11. M. Garcia-Escribano, C. Goes and I. Karpowicz, “Filling the Gap: Infrastructure Investment in Brazil,” International Monetary Fund, 2015.
12. EIG, “Brazil’s Energy and Infrastructure Landscape - A White Paper,” EIG Global Energy Partners, Washington DC, 2014.
13. Enerdata, “São Paulo State adopts energy strategy by 2020 (Brazil),” Enerdata, 22 July 2013. [Online]. Available: http://www.enerdata.net/enerdatauk/press-and-publication/energy-news-001/sao-paulo-state-adopts-energy-strategy-2020-brazil_20991.html. [Accessed 16 October 2016].
14. G. Coleman, A. Kontesi, X. Li, A. Masliah, D. Renwick, L. Torà and L. Vargas, “Building Successful Public-Private Partnerships in Sao Paulo's Transportation Sector,” Columbia University School of International and Public Affairs, New York, 2013.

15. W. contributors, “Hawaii,” Wikipedia, The Free Encyclopedia, 19 October 2016. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Special:CiteThisPage&page=Hawaii&id=745163793. [Accessed 19 October 2016].
16. WEF, “Inspiring Future Cities & Urban Services: Shaping the Future of Urban Development & Services Initiative,” World Economic Forum, Geneva, 2016.
17. WEF, “Risk Mitigation Instruments in Infrastructure Gap Assessment,” World Economic Forum, Geneva, 2016.
18. WBG, “Global Economic Prospects: Divergences and Risks,” World Bank Group, 2016.
19. “Sao Paulo,” Bookings and city guide, [Online]. Available: http://www.sao-paulo.com/. [Accessed 4 October 2016].
20. IBGE, “Cidades,” Instituto Brasileiro de Geografia e Estatística, [Online]. Available: http://www.ibge.gov.br/english/default.php. [Accessed 4 October 2016].
21. H. Lim, “Infrastructure Development in Singapore,” Singapore Institute of International Affairs, Singapore, 2008.
22. “Singapore Climate Close Up,” C40 Cities Climate Leadership Group, Singapore, 2015.
23. APEC, “Infrastructure Public-Private Partnership Case Studies of APEC Member Economies,” Asia-Pacific Economic Cooperation, Beijing, 2014.
24. C. S. Pianesi, “A New Model to Chip Away at the Infrastructure Financing Gap: Brazil Leads the Way,” The World Bank Group, 12 May 2014. [Online]. Available: http://blogs.worldbank.org/psd/new-model-chip-away-infrastructure-financing-gap-brazil-leads-way. [Accessed 16 October 2016].
25. WBG, “Open Energy Data Assessment Nairobi, Kenya,” World Bank, Washington, 2015.
26. EPA, “New South Wales State of the Environment - Economics and the Environment,” Environment Protection Authority, Sydney, 2014.
27. EIA, “Today In Energy,” 25 October 2016. [Online]. Available: http://www.eia.gov/todayinenergy/detail.php?id=28492. [Accessed 25 October 2016].
28. Asian Development Bank. Proceedings of the Regional Workshop on Solar Power Generation Using Photovoltaic Technology. Manila: n.p., 1996.
29. Adriano, J. (2009) ‘China, Philippines Stoke Island Tensions’, *Asia Times Online*, March. Available from: http://www.atimes.com/atimes/Southeast_Asia/KC27Ae02.html [Accessed 20 March 2010].
30. Agcaoili, L. (2011) ‘Aquino Admin to Post Highest Growth Average of 5.3%– ING’, *The Philippine Star*, 28 January.
31. Appenzeller, T. (2004) ‘The End of Cheap Oil’, *National Geographic*, **205** (6), pp. 80–109.
32. ADB (2009) ‘ADB Projects in the Philippines’ (as of 31 July 2009,).
33. ADB and APEC (2009) *Energy Outlook*. Manila: Asian Development Bank.
34. “ECONOMICS AND THE ENVIORNMENT,” New South Wales State of the Environment, 2015.
35. P. M. Jr, “A Struggle between Coal and Renewable Energy in the Philippines,” 17 6 2016. [Online]. Available: https://us.boell.org/2016/06/17/struggle-between-coal-and-renewable-energy-philippines. [Accessed 26 10 2016].

36. R. Gregory, “Germany-Freiburg-Green city,” [Online]. Available: http://www.ecotippingpoints.org/our-stories/indepth/germany-freiburg-sustainability-transportation-energy-green-economy.html. [Accessed 26 10 2016].
37. “US energy Information Administration,” EIA, [Online]. Available: http://www.eia.gov/state/?sid=HI#tabs-4. [Accessed 26 10 2016].
38. “Renewable Energy in The Philippnes,” [Online]. Available: http://climate-journal.asia/renewable-energy-in-the-philippines/. [Accessed 26 10 2016].
39. “Renewable Energy in California,” ACORE, 2014.
40. “Map of Renewable Energy Resource of NSW,” Department of Industry NSW, 2016.
41. “Lessons in Renewable Energy Planning,” World Resource Institute, [Online]. Available: http://www.wri.org/blog/2013/06/4-lessons-renewable-energy-planning-philippine-experience. [Accessed 26 10 2016].
42. DOE (2009) ‘Rising to the Challenge of Energy Security’, *2009 Energy Sector Accomplishment Report [online]*. Available from: http://www.doe.gov.ph/EnergyAccReport/default.htm [Accessed 9 April 2010].
43. DOE-EECD (2010) ‘Summary of Awarded RE Contracts as of 29 March 2010,
44. “Hawaii State Energy Office,” State of Hawaii, [Online]. Available: http://energy.hawaii.gov/resources/dashboard-statistics. [Accessed 26 10 2016].
45. “Hawaii Energy Connection,” Kumukit, [Online]. Available: http://www.hawaiienergyconnection.com/hawaii/residential/finance.html. [Accessed 26 10 2016].
46. “Hawaii Energy - Technial Reference Manual,” Hawaii, 2014.
47. “Hawaii Energy,” [Online]. Available: https://hawaiienergy.com/about/get-the-facts. [Accessed 26 10 2016].
48. “Energy in Developing Countries,” University of Oxford, [Online]. Available: http://www.energy.ox.ac.uk/wordpress/energy-in-developing-countries/. [Accessed 26 10 2016].
49. “Energy in California,” Wikipedia, the free encyclopedia, [Online]. Available: https://en.wikipedia.org/wiki/Energy_in_California. [Accessed 26 Oct 2016].
50. “Energy Finiance Services,” [Online]. Available: http://www.energyfinancesolutions.com/forhomeowners-hawaii-gems-financing-for-solar-projects. [Accessed 26 10 2016].
51. Rubric, J. (2010) ‘Philippines’ Power at a Crisis Point’, *Asia Times Online*, 10 April. Available from: http://www.atimes.com/atimes/Southeast_Asia/LD10Ae01.html [Accessed 16 April 2010].
52. World Bank (1994) *Philippines Power Sector Study, Structural Framework for the Power Sector*. East Asia & Pacific Regional Office: World Bank, Industry and Energy Operations Division.
53. “Encyclopedia.com,” [Online]. Available: http://www.encyclopedia.com/places/united-states-and-canada/us-political-geography/hawaii. [Accessed 26 10 2016].
54. Anonuevo, E. P. C. (2010) ‘Renewable Energy to Raise Meralco Bills’, *The Manila Times*, 26 March [online].
55. ASEAN Secretariat (2002) ‘ASEAN and China Sign Declaration on the Code of Conduct in the South China Sea’, *ASEAN News Release*, Jakarta, Indonesia [online]. Available from: http://www.aseansec.org/13166.htm [Accessed 17 August 2011].

56. Bacon, R. W. and Besant-Jones, J. (2001) 'Global Electric Power Reform, Privatization, and Liberalization of the Electric Power Industry in Developing Countries', *Annual Review of Energy and the Environment* [online], **26**, pp. 331–359. Available from: http://rru.worldbank.org/Documents/PapersLinks/567.pdf [Accessed 29 September 2010].
57. "Department of Indunstry," Gorvenment of NSW, [Online]. Available: http://www.resourcesandenergy.nsw.gov.au/energy-consumers/sustainable-energy/renewable-energy-action-plan. [Accessed 26 10 2016].
58. Barcelona, R. (2002) 'Power Shortcut, Why We Are Where We Are', *Staff Memo* , University of Asia and the Pacific.
59. BBC News (2008) 'Oil Hits New High on Iran Fears', *BBC News Online*, 11 July. Available from: http://newsvote.bbc.co.uk/2/hi/business/7501939.stm [Accessed 4 July 2010].
60. Bunye, P. (2010) 'Opportunities and Challenges for Renewable Energy Debt in RP', *Business Mirror*, 30 March, p. A6.
61. "CLEAN ENERGY ACCESS IN Develping Countary," World Resources Institute.
62. "California," Wikipedia, the free encyclopedia, [Online]. Available: https://en.wikipedia.org/wiki/California. [Accessed 26 Oct 2016].
63. *Clean Energy Regulator, Emissions Reduction Fund: auction guidelines, C.E. Regulator, Editor. 2015, Commonwealth of Australia: Canberra.*
64. *Clean Energy Regulator. Emissions Reduction Fund. 2015 06/03/2015]; Available from: http://www.cleanenergyregulator.gov.au/Emissions-Reduction-Fund/Pages/default.aspx.*
65. *Commonwealth of Australia, Emissions Reduction Fund White Paper. 2014, Commonwealth of Australia: Canberra*
66. *G Hunt MP, Carbon Farming Initiative Amendment Bill 2014, Explanatory Memoranda, P.o. Australia, Editor. 2014, Commonwealth Government of Australia: Canberra.*
67. *Clean Energy Regulator. Auction results: April 2015. 2015 09/05/2015 21/05/2015]; Available from: http://www.cleanenergyregulator.gov.au/ERF/Published-information/auction-results/auction-results-april-2015.*
68. *Clean Energy Regulator. Carbon Abatement Contracts table. 2015 15/05/2015 21/05/2015]; Available from: http://www.cleanenergyregulator.gov.au/ERF/Published - information/auction-results/auction-results-april-2015/Carbon-Abatement-Contracts-table*
69. https://www.dlapiper.com/en/australia/insights/publications/2016/05/investment-trends-in-renewable-energy-in-australia/
70. *Department of Environment. Emissions Reduction Fund. 2015 06/03/2015]; Available from: http://www.environment.gov.au/climate-change/emissions-reduction-fund.*