Policy Options for Low Carbon Cities

Johor Bahru and Pasir Gudang, Malaysia

Authors:

Andy Gouldson, Sarah Colenbrander and Effie Papargyropoulou

Foreign & Commonwealth Office

Centre for Climate Change Economics and Policy

KeTTHA KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

ISKANDAR MALAYSIA

UNIVERSITY OF LEEDS

UTM UNIVERSITI TEKNOLOGI MALAYSIA

The Economics of Low Carbon Cities

Johor Bahru and Pasir Gudang, Malaysia

Today

15.2% of city-scale GDP leaves the local economy every year through payment of the energy bill. In 2025, energy expenditure will remain substantial at 13.1%.

15.2% of GDP leaks out of the economy

Tomorrow

Investing 0.4% of GDP p.a.

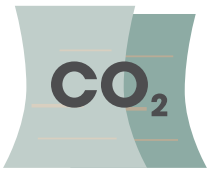
Leads to...

0.4% of GDP could be profitably invested, every year for ten years, to exploit commercially attractive energy efficiency and low carbon opportunities.

- **Energy**
  reductions in the energy bill equalling 1.0% of GDP
- **Financial viability**
  less than two years for measures to pay for themselves
- **Employment**
  more jobs and skills in low carbon goods and services
- **Wider economic benefits**
  energy security, increased competitiveness, extra GDP
- **Wider social benefits**
  reductions in fuel poverty, improvements in health

Potential to reduce CO_2 emissions

2000 — 2025



24.2% CO_2 reduction

After cost-effective investments in the city.

25.1% CO_2 reduction

After cost-effective investments in the electricity sector.

45.4% CO_2 reduction

After cost-neutral investments in the city.

46.6% CO_2 reduction

After cost-neutral investments in the electricity sector.

Contents

Foreword: Iskandar Regional Development Authority

Today, many Asian countries experience leapfrogging urbanisation and industrialisation largely due to increased influx of capital and governments' economic policies. Asia is set to produce more than half of the global population and GHG emissions in 2050, particularly if the business-as-usual model of development continues. Most governments in Asia have made commitments towards reducing their emissions in order to avert the worsening climate change scenarios. One of the means of achieving and translating such commitments is through low carbon society initiatives that are particularly targeted for cities. A number of collaborative research partnerships and dialogues on low carbon society are ongoing such as the 'Low Carbon Society Scenarios for Asian Region', which is the parent publication for this report, and the Low Carbon Asia Research Network (LoCARNet).

The 'Policy Options for Low Carbon Cities' is the latest that involves Iskandar Malaysia, which follows on from 'The Economics of Low Carbon Cities', published in June 2014. This Policy Options report asks the important question of 'What is the best way to shift a city to a more energy efficient, lower carbon development path?'

Iskandar Malaysia, the fastest growing of the five economic regions formed by the Federal Government, is the focus of these two reports. The first report explored the economic case for large-scale low carbon development and investment, and made recommendations on how these can be done. This Policy Options report explores further the policy-making process by examining the governance arrangements between Federal, Regional, State to Local. It also examines in some detail the policy tools and financial mechanisms, some of which draw successful examples from the United Kingdom.

This report is timely as Iskandar Malaysia continues to implement its Low Carbon Society Blueprint programmes, which we started in early 2013, after its global launch at COP18 in Doha, Qatar in November 2012. We see this Policy Options report as providing an important contribution to our Low Carbon Society Blueprint 2025. This report is the product of several months of research in the UK and several days of intense discussions in Malaysia between policy-makers in both Federal and State agencies and researchers from Leeds University, Universiti Teknologi Malaysia, NGOs and IRDA.

The implementation of these two reports will depend largely on behavioural changes by all stakeholders, from the Federal agencies, to the decision-makers, right through to the people on the ground. It requires strong and collaborative commitments between all parties, innovative means of engaging the industry, and the public and practical approaches that can really impact the transition to a low carbon society. I hope, therefore, that stakeholders will read this report and consider how they can proactively implement its many ideas and recommendations in the development of Iskandar Malaysia into a 'strong and sustainable metropolis of international standing'.

My special 'thank you' goes to the University of Leeds, ESRC Centre for Climate Change Economics and Policy for this important report and to the funders, the UK Foreign and Commonwealth Office as well as the British High Commission Malaysia. I would also like to thank KeTTHA, the State Government of Johore, the five local authorities within Iskandar Malaysia (Johor Bahru City Council, Central Johor Bahru Municipal Council, Pasir Gudang Municipal Council, Kulai Municipal Council and Pontian District Council), UTM, MJIIT, SEDA, PAIM, GIZ, CETDEM, WWF-Malaysia, JKR/BSEEP, TrEES and Rhy Synergy for their time and effort in contributing to this report.

Finally my special thanks to IRDA's Environment Division, as well as the various other divisions who contributed their time and effort in making this report possible.

Y.BHG. Datuk Ismail Ibrahim
Chief Executive
Iskander Regional Development Authority

Foreword: British High Commission, Kuala Lumpur

Even in these tough times, moving to a low carbon economy is the right thing to do, for our economies, our societies and our planet. This Policy Options report for a Low Carbon Society targeted for Johor Bahru in the Iskandar Region sets out various policy instruments that could help municipal authorities and regional governments to realise the economically attractive opportunities for climate actions. These options, I hope, will put the Iskandar region on track to meet its long-term commitment to cut its carbon emission intensity by 50% by 2025 (from 2005 levels) – a target which is clearly spelt out in their 2012 Iskandar Low Carbon Society Blueprint.

To be effective on the global scale, climate change requires many localised actions such as in Iskandar; every country and, within it, every region needs to play their respective part. This Policy Option report shows that a groundswell of opinion is developing in Malaysia to tackle rising emissions in cities and emerging economic corridors, which should influence government to tackle climate change. We need to build momentum to achieve a low carbon society post 2020.

Over the next decade or so, we must prepare for the future. The 2020s will require a change of gear. Technologies that are being demonstrated or deployed on a small scale now will need to move towards mass deployment. By 2030, I hope Malaysia will have seized the huge opportunity to deploy innovative policy instruments and green technology for a better future. District cooling may change the way we cool ourselves in the tropics. Electric and energy efficient cars will help to reduce vehicle emissions to less than half today's levels. More investments in new low carbon power stations should be the norm. These approaches are already working in the UK and in a big way – our renewable energy generation now provides almost a fifth of UK's electricity needs, powering the equivalent of 14.5 million homes annually. The UK is one of the most attractive countries in the world for green growth, with almost £37 billion invested in renewable energy since 2010. We lead the world in offshore wind and remain one of the world leaders in marine energy. This brings great opportunities for our businesses, for jobs, and for boosting local economies. In 2013, activity by turnover in the UK's low carbon economy was worth £122 billion and supported over 460,000 jobs, and this has been growing strongly. Malaysia could look to enjoy such a paradigm shift.

The transition to a low carbon economy will require investment. From a Malaysian context, by cooling buildings better, and driving more fuel-efficient cars, energy consumption can be reduced and maximised, offsetting the upfront investment funding needed for low carbon energy. By investing in more diverse energy sources, Malaysia can be less vulnerable to fossil fuel price spikes. And by investing in industries that suit Malaysia's geography and skills, Malaysia will gain a long-term comparative advantage in industries with a big future.

This Policy Option paper shows that moving to a low carbon economy is practical, achievable and desirable. A shift that also supports sustainable economic growth. It will require investment in new ways of generating energy, not a sacrifice in living standards. But turning it into reality will require business, government and the public pulling in the same direction. It will require bold steps. Malaysia faces big choices on infrastructure and investment. I hope over the course of the next few years, Malaysia will make the right choices, the bold choices to forge a new national consensus on low carbon transition. The Iskandar region can be at the forefront of this by taking the lead now. The UK stands ready to help and share our experiences in making this transition in Malaysia. The involvement of British expertise in this project output is a prime example of where we are making a difference locally.

The British High Commission through the SEA Regional Prosperity Fund is delighted to be involved in this timely and far-reaching report. Lastly, my special thanks goes to all the institutional partners and authors who invested their time and effort in completing this report – Iskandar Regional Development Authority (IRDA); Kementerian Tenaga, Teknologi Hijau dan Air (KETTHA); ESRC Centre for Climate Change Economics and Policy (CCCEP), University of Leeds; and Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM).

H.E. Vicki Treadell
British High Commissioner to Malaysia

Introduction

Aims and objectives

What is the best way to shift a city to a more energy efficient, lower carbon development path? Even where there is broad interest in such a transition, there are major obstacles that often prevent cities from acting on such a far-reaching agenda. Focusing on urban Iskandar Malaysia, *Policy Options for a Low Carbon Society: Johor Bahru and Pasir Gudang, Malaysia* considers the ways in which the national government, regional development authorities and local authorities can change the relationship between energy and development in a rapidly growing urban region.

This report draws on *The Economics of Low Carbon Cities: Johor Bahru and Pasir Gudang, Malaysia* (Gouldson et al., 2014a), which explored the economic case for large-scale low carbon investment. Here we aim to further support the policy making process by considering the governance arrangements, policy tools and financing mechanisms that could be adopted in order to exploit the economically attractive low carbon options.

The national and local context

Individual energy consumption is relatively high in Malaysia at 2.63 tonnes of oil equivalent (toe) per capita, compared to other fast-growing high-middle income countries such as China at 1.7, Brazil at 1.37 or Turkey at 1.54 toe. While Malaysia now has the second highest energy demand per capita in Southeast Asia after Brunei, it remains well below the OECD average of 4.28 toe per capita (World Bank, 2014a). The national government has committed to voluntarily reduce the emissions intensity of GDP by up to 40% based on 2005 levels by 2020, conditional on technology transfer and financial support from Annex I countries (Ministry of Natural Resources and Environment, 2010). However, improvements in emission intensity are thus being far outstripped by rapid economic growth, meaning that the absolute level of emissions produced in Malaysia is rising rapidly.

This broader context on energy has substantial implications for urban areas. 73% (21.1 million) of the 29.2 million people of Malaysia live in cities (World Bank, 2014b) and over 90% of national economic activity is conducted in cities (Muller, 2013). Energy consumption and greenhouse gas emissions are therefore likely to be concentrated in cities for the foreseeable future. Although Kuala Lumpur dominates the Malaysian economic landscape – the wider Klang Valley that includes Kuala Lumpur is home to 7.2 million people and produces 38% of national GDP (SPAD, 2013) – 48% of the Malaysian population live in other urban regions, which generate 52% of national GDP. These smaller cities therefore have a critical role to play if the country is to avoid locking into an energy- and carbon-intensive development path.

This analysis focuses on Johor Bahru and Pasir Gudang as examples of smaller Malaysian cities. The cities are located in Iskandar Malaysia, a Special Economic Corridor located in the state of Johor at the southern tip of Peninsular Malaysia. Johor Bahru is the third largest city in Malaysia and serves as an important industrial, logistics and commercial centre. The major industries in the city are plastics manufacturing, electrical and electronic equipment, petrochemical refining and food processing. The main services are wholesale and retail trade, tourism and hospitality, professional and business, transport, medical, educational and financial services (IRDA, 2007).

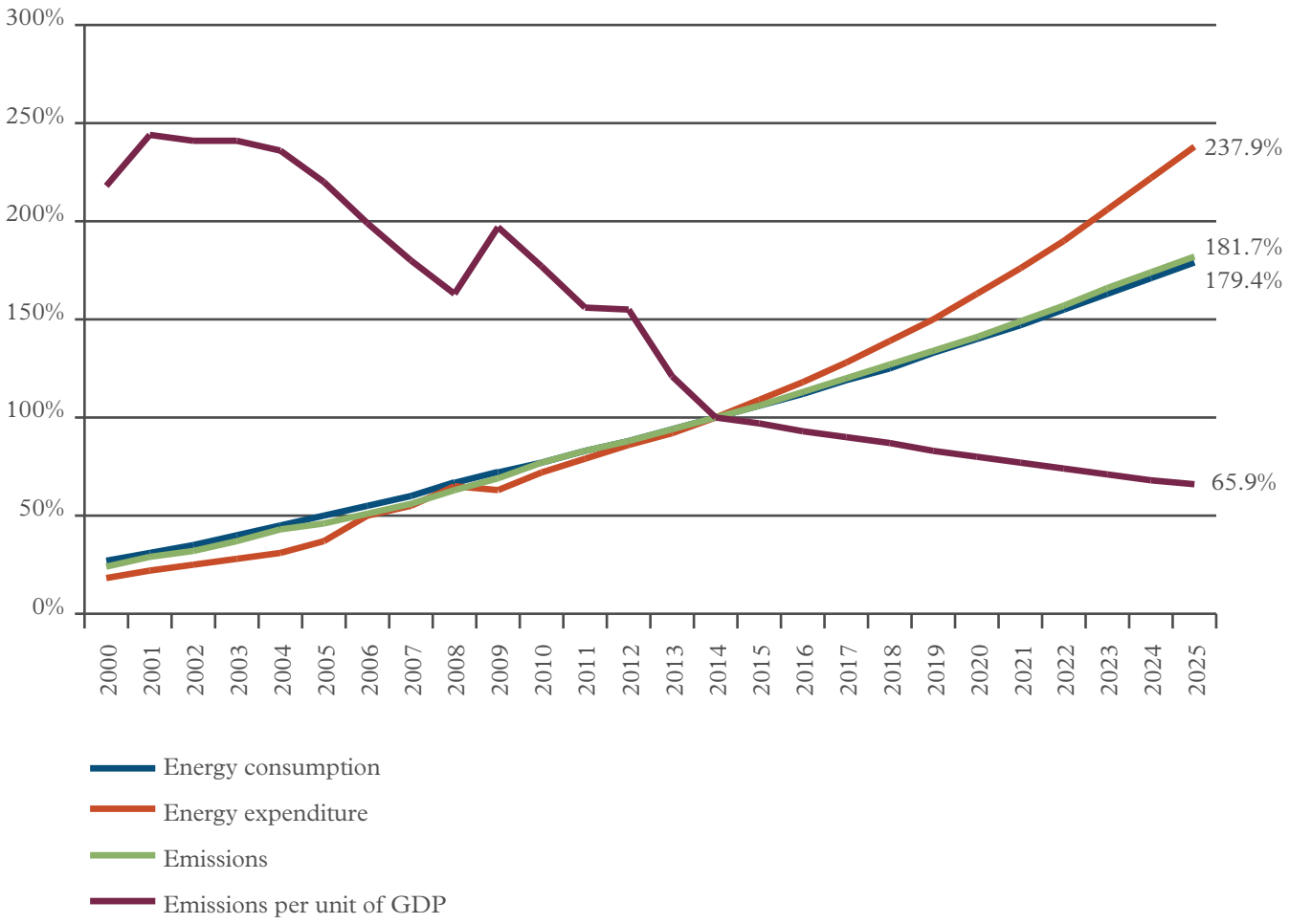
The population of Iskandar Malaysia was 1.4 million in 2005, but is expected to more than double to 3 million by 2025. This planned expansion, combined with a projected economic growth rate of 7-8% per annum (IRDA, 2013), imposes substantial challenges to urban planners. However, the Iskandar Regional Development Authority (IRDA) also recognises that the pace and scale of change offers an opportunity to shift Iskandar Malaysia on to a lower carbon trajectory – if the various levels of government are willing to introduce enabling climate policies and invest in low carbon infrastructure options. *The Low Carbon Society Blueprint for Iskandar Malaysia 2025* (UTM et al., 2013) accordingly calls for a 50% reduction in emission intensity by 2025, relative to a baseline year of 2005.

Opportunities for cost-effective low carbon investment

With the continuation of business as usual trends, total energy consumption, energy expenditure and greenhouse gas emissions in Johor Bahru will increase significantly over the next decade. Total energy consumption is forecast to rise by 79.4% from 59.9 TWh in 2014 to 107.4 TWh in 2025. When combined with increasing real energy prices, this leads total expenditure on energy to increase by 137.9% from MYR 13.5 billion (USD 4.10 billion) in 2014 to a forecast level of MYR 32.5 billion (USD 9.83 billion) in 2025 (see Figure 1).

There is some relative decoupling of economic output and carbon emissions because of energy efficiency improvements in the wider economy. However, economic and population growth outpace these efficiency gains so that carbon emissions attributed to the city are forecast to rise by 81.7% from 21.0 MtCO2-e in 2014 to a forecast level of 38.6 MtCO2-e in 2025 (see Gouldson et al., 2014a).

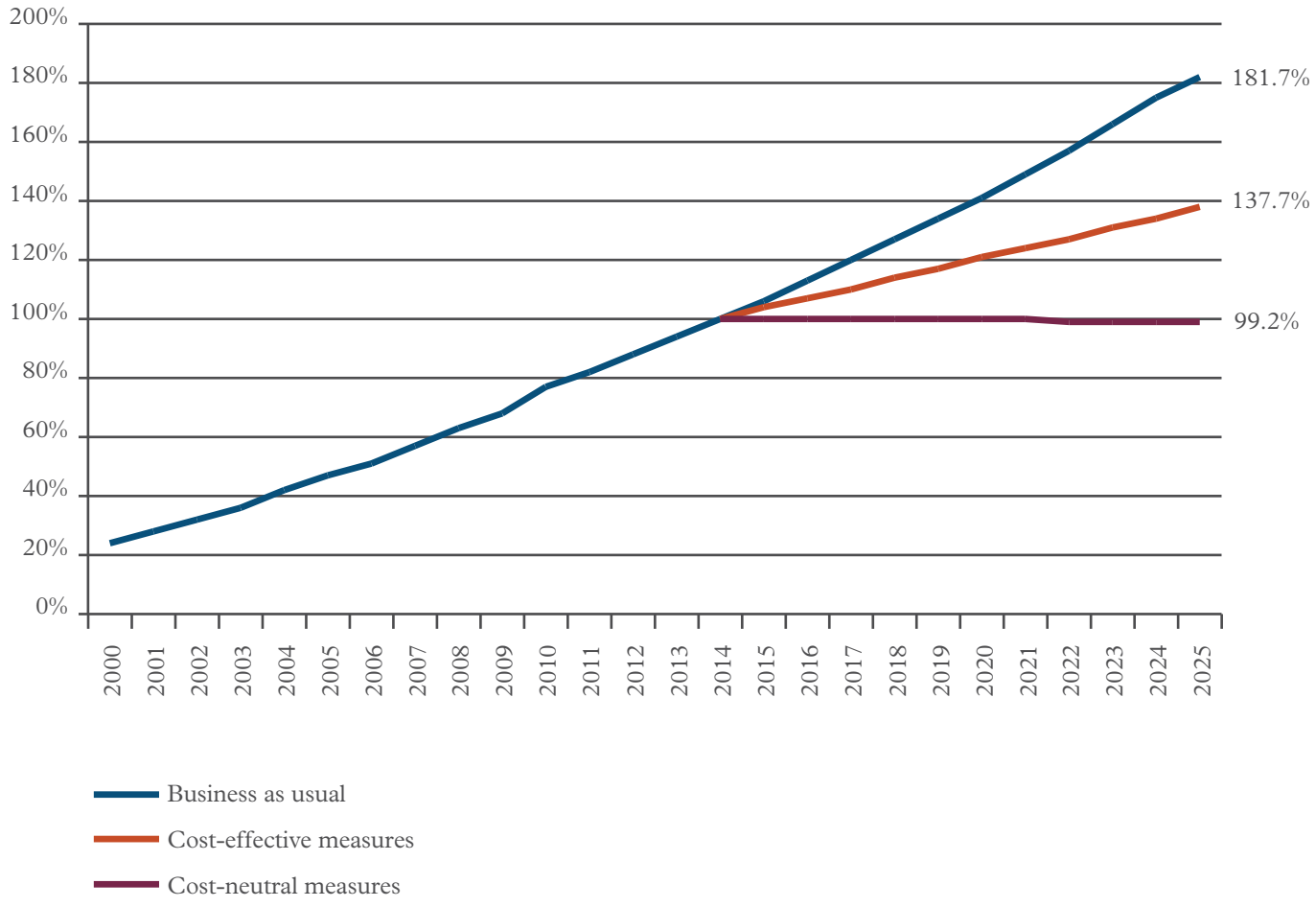
Figure 1. Indexed energy consumption, energy expenditure, carbon emissions and emission intensity of economic activity for the city of Johor Bahru between 2000 and 2025.



The city of Johor Bahru could reduce its carbon emissions by 24.2% by 2025, relative to business as usual levels, through cost-effective investments, i.e. investments that would more than pay for themselves on commercial terms over their lifetime. This would require an investment of MYR 3.33 billion (USD 1.01 billion), generating annual savings of MYR 2.56 billion (USD 0.77 billion) and paying back the investment in 1.3 years. The impact of these investments on carbon emissions at the city scale between 2014 and 2025 is shown in Figure 2. The low carbon measures would continue to generate annual savings throughout their lifetime (see Gouldson et al., 2014a).

The economic and carbon savings from each of the low carbon measures are provided in Gouldson et al. (2014a). These measures span the electricity, commercial, industrial, residential, transport and waste sectors.

Figure 2. Carbon emissions attributed to Johor Bahru under three different investment scenarios, between 2000 and 2025.



Governance Arrangements

The Iskandar Malaysia Context

The context for urban action on climate change is partly determined by policies and mechanisms introduced at higher scales. Specifically, city plans are often adopted to contribute to national climate mitigation strategies or in response to the absence of ambitious national leadership (Schreurs, 2010; Anguelovski and Carmin, 2011; Franzén, 2013). In either case, multi-level governance arrangements are central to enabling urban-level responses to climate change (Betsil and Bulkely, 2006; Corfee-Morlot et al., 2009; OECD, 2010a; Franzén, 2013; Acuto, 2013; Matsumoto et al., 2014). Similarly, implementing mitigation policies may require effective communication and careful coordination among different sectors of government. Improving cross-sectoral governance arrangements can allow cities to combine policy options in a way that maximises synergies while minimising trade-offs (Viguié and Hallegatte, 2012).

To enable the widespread adoption of the economically attractive measures identified in *The Economics of Low Carbon Cities: Johor Bahru and Pasri Gudang, Malaysia*, policy interventions are likely to be needed from national, state and local governments and from policy areas including energy, finance, housing, transport and economic development. Even where a low carbon option falls clearly within the authority of a particular ministry or agency, it is apparent that extensive capacity building will be required at a range of levels and across a number of sectors to deliver the measure effectively. Meeting a target of 100% biofuel in either the transport or industry sector, for instance, would demand effective monitoring and reporting systems throughout the supply chain to ensure that biofuel is produced in a socially and environmentally sustainable way. Effective multi-level governance systems can improve the fit and the interplay among actors and institutions at the national, regional and local levels, enabling cities to undertake more ambitious action on climate change (Paavola et al., 2009; Matsumoto et al., 2014).

So what are the relevant governance arrangements in Malaysia? At a national scale, the *Tenth Malaysia Plan* (2011-2015) establishes or maintains a number of national mitigation programmes. These include a renewable energy target of 985MW by 2015 (5.5% of Malaysia's total electricity generation), facilitated by a feed-in tariff; an energy efficiency target of 4,000ktoe per year by 2015, substantially from more efficient lighting, appliances and buildings; and the construction of energy-from-waste infrastructure (Economic Planning Unit, 2010). In practice, 243MW of renewable energy capacity was installed by 2014 and the Energy Save programme reduced consumption by 306.9GWh or 26.4ktoe. Mitigation measures are therefore largely sectorally focused (Khailani and Perera, 2013) and insignificant relative to, for example, the expansion of installed coal-fired capacity by 3.4GW between 2008 and 2013 (Oh et al, 2014).

The *Eleventh Malaysia Plan* (2016-2020) places more of an emphasis on building resilience to the impacts of climate change. However, low carbon goals include increasing renewable energy installed capacity to 2,080 MW, fostering green markets through green procurement and green building criteria, promoting low carbon mobility through more efficient vehicles and public transport, and improving recycling rates (Economic Planning Unit, 2015). Perhaps more importantly, the Eleventh Malaysia Plan underscores that climate change mitigation and adaptation should be seen as an investment rather than a cost, which marks an important paradigm shift at the national level.

At a local scale, urban development in Malaysia is governed by the Federal Department of Town and County Planning, while most mitigation actions are sectoral and directed by the relevant government agency. Local action plans must align with state and national plans (Khailani and Perera, 2013). We provide a more detailed overview of the multi-level governance arrangements in the buildings, electricity generation and transport sectors below.

These centralised governance structures can limit the scope for climate action led by local authorities or regional governments. Malaysian cities can lack either the capabilities or powers to push forward with climate change mitigation, even when there are significant co-benefits at the local level. They can 'cherry pick' attractive low carbon measures that are relatively simple to implement but their scope to go further is frequently dependent on changes at a higher institutional level. This is because they are operating in a context where national commitments to climate mitigation are weak; where centralised administrative systems limit the scope for local leadership; where the capacities of local government are frequently challenged; and where joined-up thinking across sectors and policy domains is unusual.

These findings suggest a need to establish or strengthen multi-level, cross-sectoral governance arrangements that allow cities to experiment in ways that can enable learning both in the cities themselves and in their wider networks. While this may seem like a fragmented rather than systematic response to climate change, these city-scale initiatives can build expertise in and momentum for climate action in the absence of ambitious national commitments.

Financing Options

The fact that the wide range of economically attractive options have not yet been exploited suggests that there are ongoing barriers to investment. These barriers frequently include lack of knowledge, capacity or finance, particularly as low carbon measures often entail higher upfront costs and longer payback periods, even if they deliver more substantial savings in the long term. Economically attractive low carbon measures can be financed from many sources, including households, firms, commercial banks, institutional investors, public budgets and climate funds (Figure 3). However, national, regional and local governments all have a critical role to play in mobilising private capital. Public policies and resources are often necessary to increase returns, reduce costs, de-risk low-carbon options and close knowledge or capacity gaps to unlock investment in climate mitigation. This is recognised in the *Eleventh Malaysia Pla*n (Economic Planning Unit, 2015), which highlights the role of government in developing sustainable financing mechanisms and creating green markets.

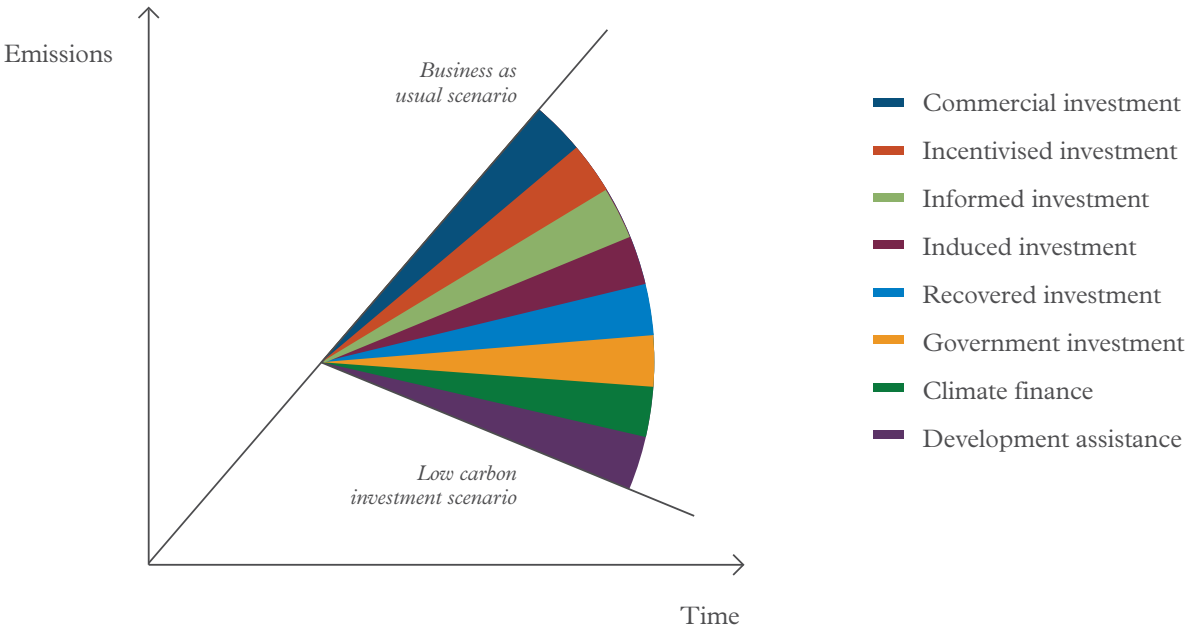
Commercial investment

A significant proportion of the low carbon, climate resilient investment opportunities identified could be attractive enough to secure commercial investments. These are typically the investments with, for example, significant returns, short payback periods and low levels of risk and uncertainty.

Incentivised investment

Where the criteria for commercial investment are not strong enough, government can play a temporary role by offering additional incentives for commercial investment. These can come in the form of, for example, feed-in tariffs for renewables or tax breaks for the purchase of more efficient vehicles. In the short to medium term, incentives can play a crucial role in breaking inertia, building capacities and avoiding 'lock in' to high carbon development paths, but in the longer term, such incentives may not be necessary. The cost of many technologies has fallen substantially over recent decades (for example, see Islam et al., 2013; Timilsina et al., 2012), and breakthroughs are anticipated in others (for example, see Pollet et al., 2012; Stauffer et al., 2011). Such improvements could enhance the economic case for low-carbon investment at scale by creating the conditions for commercial rather than incentivised investment. Policy frameworks and the allocation of public financial resources consequently have a critical role to play to encourage technological substitution as these options become more economic (Kalkuhl et al., 2012; van der Vooren et al., 2012).

Figure 3. Potential sources of investment in cost-effective and cost-neutral low carbon options in developing country cities.



Informed investment

As well as providing additional incentives, government and other actors can help to stimulate investment by raising awareness and providing access to information. Awareness can be increased through broad information campaigns, through initiatives such as the energy labelling of vehicles and appliances, or through assurance schemes that recognise particular suppliers or technologies that meet environmental criteria. Resource-constrained municipal authorities could mobilise behavioural change and investment through informational tools, though a voluntary approach is likely to capture only a fraction of the potential economic and carbon savings.

Induced investment

Governments can require households, firms and other actors to invest in low carbon options. For example, governments can introduce building codes with higher levels of energy efficiency or require for new vehicles to meet tougher emissions limits. With these policies in place, households and firms would provide the additional capital but could expect to quickly recover their investment through lower running costs.

Enabled investment

Government and other actors such as trade bodies can create conditions that are more conducive to investment. They can do this by, for example, building technical capabilities or investment in technology-specific infrastructure (notably for electric vehicles). They can also do this by minimising risks for pioneers, for instance by establishing long-term renewable energy quotas or acting as an anchor client in purchasing particular technologies.

Recovered investment

Governments can make some forms of investment viable through different forms of cost recovery. Investments in state owned or regulated utilities in the electricity or water sectors can be enabled through some forms of 'cost plus pricing'. Infrastructure developments can be financed through initiatives such as tax increment financing (where up-front costs are met through the increases in tax revenue they generate) or through planning gain (where permission to build is given on the condition that new infrastructure is provided). Other investments – for example in establishing urban congestion zones – can be self-financing over time through the revenues they generate.

Recycled investment

Some forms of investment can be funded through the savings that they generate. This model has been the basis for both Energy Service Companies (ESCOs) and retrofit schemes that fund investments in energy efficiency from the savings that these investments make and that the schemes capture and use to service loans and for reinvestment.

Government investment

As the public sector typically owns, uses and controls a very large estate, governments have substantial scope to invest in improving their own energy efficiency. For example, by retrofitting public buildings with insulation, double glazing, solar panels or more efficient lighting, governments can catalyse the development of the skills and supply chains necessary for a local green economy.

Governments can also act as cornerstone clients by establishing green purchasing policies, for example, with respect to public sector electricity consumption.

Climate finance

Support for some forms of low carbon development has been available through the Clean Development Mechanism (CDM), through Joint Implementation (JI) mechanisms and through the voluntary carbon markets. New forms of climate finance are now emerging based on Nationally Appropriate Mitigation Actions (NAMAs) and Nationally Adaptation Programmes of Action (NAPAs). In a relatively wealthy country such as Malaysia, climate finance can play an important role in decarbonising infrastructure investments by paying the incremental costs of less carbon-intensive options.

Development assistance

Multilateral and bilateral agencies are increasingly prioritising low emission options when investing in development, for example, by preferentially supporting public transport over private vehicles and renewable energy technologies over coal-fired power plants. This option is less pertinent in the context of high middle-income countries such as Malaysia.

Policy Options

Here, we consider six different policy instruments that – even in contexts of weak or fragmented national climate policy – could help municipal authorities and regional governments to realise the economically attractive opportunities for climate action. These options span the buildings, electricity generation and transport sectors. We hope that ambitious interventions such as these could help to demonstrate the economic case for climate action and thus begin the transition to lower carbon cities in Malaysia.

1. More Efficient Buildings

Residential and commercial buildings consumed 11.6% of energy in Johor Bahru and Pasir Gudang in 2014, and their share of energy consumption is projected to increase to 14.0% in 2025. Total energy consumption from commercial and public buildings is projected to increase by 49.9% and from residential buildings by 122.0% between 2015 and 2025. This means that improving the efficiency of the building stock can play a significant role in reducing Iskandar Malaysia's energy bills and carbon emissions.

Exploiting these opportunities will require coordination across multiple levels of government. The major actors and existing policies with respect to energy efficiency in the residential, commercial and public sector are outlined in Figure 4.

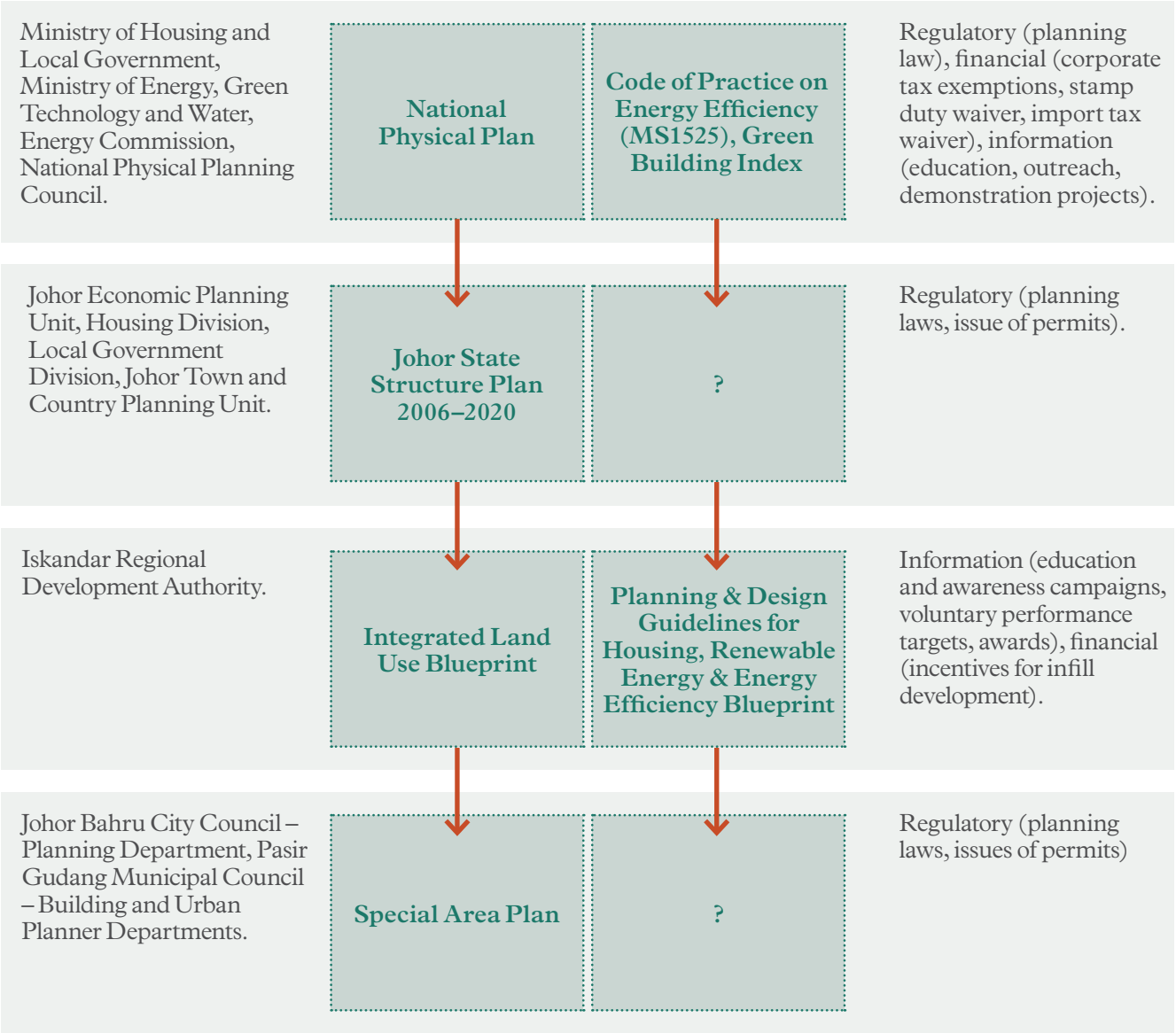
We have identified two policy instruments to capture the economic and environmental benefits of more efficient buildings: a revolving fund model to finance building retrofit and land value taxation to promote compact urban growth.

Table 1. The economic and carbon savings from key measures in the buildings sector.

Measures	Net present value[1] (RM millions)	Carbon savings to 2025 ($ktCO_2$)
Most energy efficient air conditioners	2,505	3,948
Turning up thermostat 1°C	608	1,618
Green building standards in residential sector 20% improvement in energy efficiency	1,784	1,429
Turning off lights for one extra hour per day	232	616
Green building standards in commercial sector 20% improvement in energy efficiency	217	173

1 These calculations of net present value are based on the economic value of low carbon measures over their 15-year (air conditioners) or 40-year (buildings) lifespan, assuming the measures are deployed at a constant rate between 2015 and 2025.

Figure 4. Key actors and policies governing the buildings sector in Johor Bahru and Pasir Gudang. The question marks highlight areas where responsibility is not clearly defined.



Use a revolving fund model to finance greener buildings

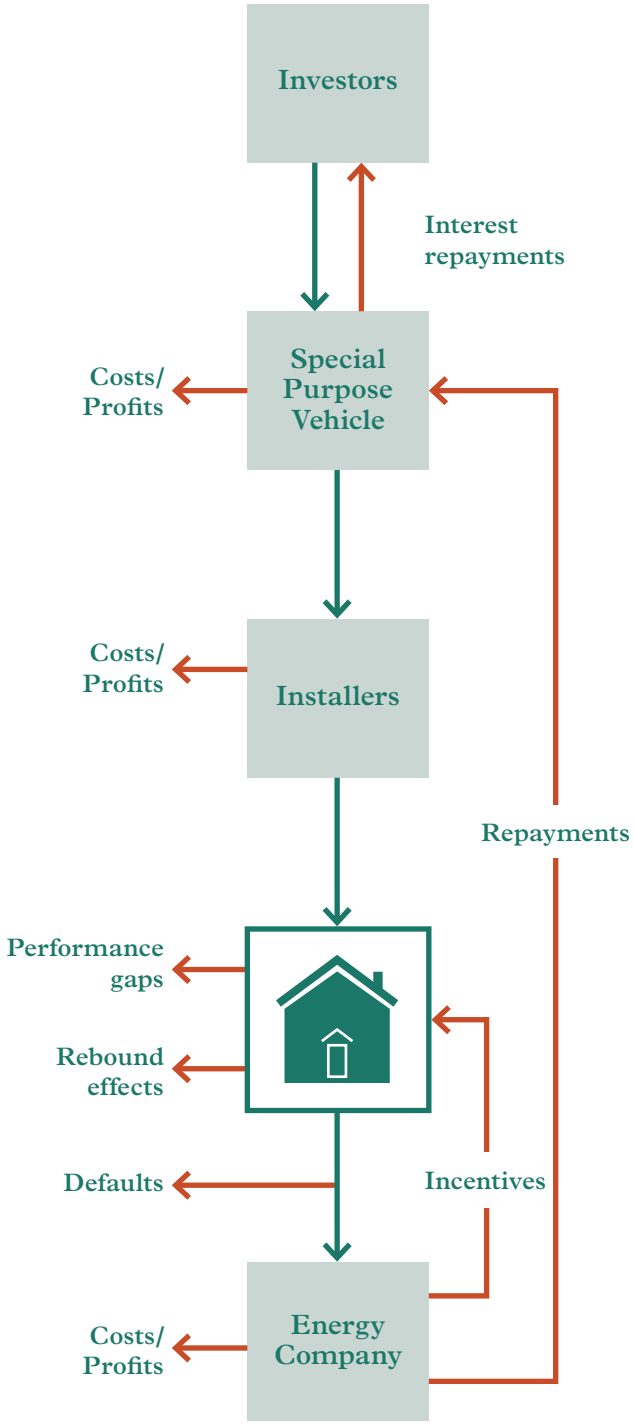
Many potentially attractive energy efficiency investments, such as retrofitting houses to 'passive cooling' levels, do not meet the short-term financial return criteria of businesses, investors, and individuals. With a revolving fund, an extensive buildings retrofit scheme or ambitious green buildings policy could be made cost-effective or at least cost-neutral, albeit with significant up-front investments that would only pay for themselves over an extended period of time.

A revolving fund is a fund where some of the savings from investments are collected and re-invested to either reduce the need for new finance or to increase the impact of limited finance. In this way, the resources in the revolving fund remain available to finance continuing operations because they are replenished through repayments. The up-front investment costs of an ambitious building retrofit programme could be significantly reduced through the creation of a revolving fund.

A good regional example is Thailand's Energy Efficiency Revolving Fund. This is a dedicated credit line to commercial banks for them to fund energy efficiency projects at low interest rates. It was launched in 2003 and ran until 2011. Funds were provided from the Department of Alternative Energy Development and Efficiency at zero interest for loans of USD 3.2 million – USD 12.7 million. Banks on-lent this financing and were allowed to charge interest up to 4% to cover their costs and risk. Once a project was implemented, the borrower repays the loan principal and interest to the bank, which repays the principal to the fund.

A generic model of a revolving fund is illustrated in Figure 5. Different models exist with different roles for public, private or civic actors either as enablers, owners, investors, deliverers or governors. The direct impacts of such funds depend on the ways in which they are applied and governed. The public sector probably has to play a significant enabling role if revolving funds are to be widely adopted – this means providing policy certainty, introducing enabling policies, lowering risk and cost of capital, lengthening time horizons and securing public interest outcomes, among others. However, once established, revolving funds could be financed and run by public, private or civic actors for either private or public benefit.

Figure 5. A generic model of a revolving fund for a domestic building retrofit scheme (Gouldson et al., 2014b).



Increase land value taxation to promote compact urban development

Property value has two elements: the value of land and the value of buildings or other 'improvements' on the land. Taxing the improvements on land, which is part of market value assessment, provides a disincentive to improve that land. In Malaysia, our understanding is that Quit Rent is based on the value of the land and the Assessment Tax is based on the value of the buildings or other improvements. Both land and 'improvements' are taxed at a fairly low rate.

To promote compact urban development in Iskandar Malaysia, the municipal authorities or state government need to disincentivise urban sprawl. Many municipalities around the world use either land value taxation or 'split-rate taxation' (where the land component is taxed more heavily weighted than the buildings) to create financial incentives for constructing higher density buildings and improving underutilised land.

In theory, as the value of the land is taxed more highly than the property, it should increase the capital to land ratio and so incentivise a higher intensity of development (Floater et al., 2014). Specifically, a split-rate taxation system or land value tax encourages landowners to increase the productivity of urban property – for example, by encouraging building upkeep, stimulating construction on vacant land near existing infrastructure and revitalising central city areas by rewarding more productive land use. There is some evidence that land value taxation reduces urban sprawl in the USA (Cho et al., 2011) and China (Li, 2014).

Land value taxation can also help to deter speculation and allow value created by individual labour and capital improvements to be retained by the private sector, increasing net economic efficiency (Crossley et al., 2012). Finally, land value taxes could also provide a stream of new revenue for municipal authorities, which can be used to finance public transport or other infrastructure.

In an Asian context, land value taxation systems have been adopted in Japan, Korea, Taiwan and parts of China. The Philippines has a split-rate property tax, whereby both land and buildings are taxed (Franszen, 2013).

2. Decarbonising Electricity Supply

Malaysia is dramatically increasing its electricity generation in order to support rapid economic growth and meet development targets. The Peninsular Malaysian electricity grid has increased production by 80% between 2000 and 2014, and electricity consumption in this region is expected to increase by 86% or 10.4 TWh between 2014 and 2025.

In 2014, generation for the Peninsular Malaysian grid was 56% coal, 38% natural gas, 6% hydro and 1% diesel generation. Looking forward to 2025, significant investment in natural gas and coal-fired power plants is planned, which will further increase both the absolute level and relative share of fossil fuels in electricity generation. This will lead to an increase in carbon emissions attributed to the electricity generation in Johor Bahru of 90% under business as usual conditions, from 8.94 MtCO2-e to 17.01 MtCO2-e in 2025.

Recent and planned investments in the electricity grid limit the scope to shift significantly towards renewable energy generation. However, many of the electricity generation technologies that are in place now remain relatively inefficient or have high running costs. This provides decision-makers with an opportunity to promote less carbon-intensive options and reduce long-term energy bills.

It is also worth highlighting that energy efficiency is the 'first fuel', i.e. the cheapest and cleanest way of enabling energy supply to meet growing demand.

Cities have relatively limited scope to influence the carbon intensity of the electricity grid on the scale identified in Table 2. However, some options are available which offer significant co-benefits in terms of improving municipal creditworthiness and reducing local energy bills. Here we consider the scope to issue municipal bonds as means to fund renewable energy infrastructure (or other low carbon measures) and to increase the feed-in tariff quota while reducing the tariff.

Issue municipal bonds to finance renewable energy and other low carbon infrastructure

In Malaysia, as in most countries, municipal budgets are usually sufficient to cover a city's operating costs but not to finance large capital expenditures in, for example solar farms or waste-to-energy infrastructure. One way for local governments to raise the necessary levels of investment is to engage with domestic and international financial markets (Farvacque-Vitkovic, 2014). This requires municipal authorities to either (1) identify 'bankable' projects to bring to market investors, i.e. projects that are sufficiently robust and have appropriate risk management systems and a favourable rate of return, or (2) to improve their creditworthiness enough to reduce the cost of borrowing. The World Bank suggests that investing US$1 in improving the creditworthiness of cities can leverage more than US$100 in private finance for low carbon urban infrastructure (World Bank, 2013). In both cases, developing a pipeline of projects is an important step for a city.

Here we will focus on municipal bonds, or debt securities issued by a local or state government to finance capital expenditure. Municipal bonds may be issued to fund a specific project such as a power plant, railway or waste incinerator, or to fund a series of infrastructure projects. In either case, the capital assets underwrite the bond. Bonds appeal to institutional investors because they offer longer-term maturities, lower risk and steady yields, as well as overcoming barriers such as transaction costs and investment scale (Floater et al., 2014). Bonds appeal to municipalities because they offer a means to unlock private finance for urban infrastructure investments, usually more cheaply than bank credit by two or three percentage points (Freire, 2014).

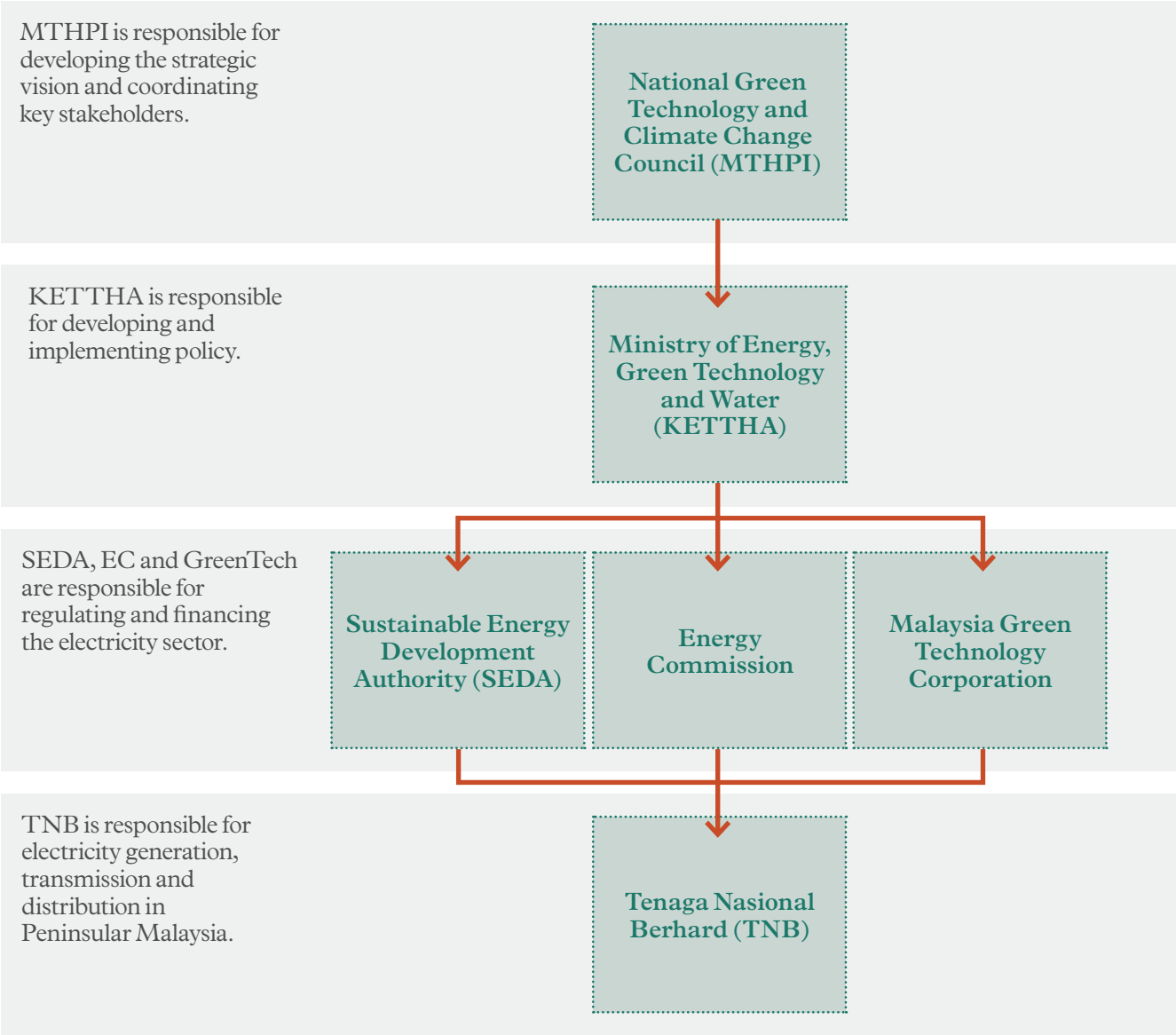
Municipal bonds were pioneered by New York (USA) over two hundred years ago (Godfrey and Currie, 2013). Today, this financing method has been adopted by cities as diverse as Rio de Janeiro (Brazil), Ahmedabad (India), Jakarta (Indonesia), Aguascalientes (Mexico) and Dakar (Senegal). More recently, Johannesburg (South Africa) pioneered a green municipal bond, i.e. where the revenues raised are dedicated to financing green infrastructure, in this case hybrid buses, biogas energy and rooftop solar water heaters among other measures (Floater et al., 2014). Johannesburg has been followed by Gothenburg (Sweden) and Spokane (USA). Meanwhile, Pasir Gudang was one of the first local authorities in the world to issue Islamic or sukuk municipal bonds, raising RM 80 million in 2005.

Table 2. The economic and carbon savings from key measures in the electricity sector.

Measures	Net present value[2] (USD millions)	Carbon savings to 2025 ($ktCO_2$)
Coal retrofit (8.1GW)	-5,543	32,550
Natural gas replaced by solar PV (2GW)	1,415	10,173
Energy-from-waste (combined heat and power)	504	8,359
Diesel replaced by solar PV (1.2GW)	1,423	5,181
Residential solar PV panels (20MW by 2025)	786	3,423

2 These calculations of net present value are based on the economic value of low carbon measures over their lifetime, assuming constant deployment between 2015 and 2025.

Figure 6. Key actors and policies governing electricity generation in Malaysia.



The many large-scale, economically attractive opportunities identified in Iskandar Malaysia suggest that there are opportunities to issue revenue or special purpose municipal bonds, which are secured by the anticipated revenue from the project being financed. For example, the construction of a solar farm could be financed by the sale of electricity. Renewable energy generation investments offer a good strategy to improve the creditworthiness of a local government in international financial markets: there is more certainty about returns and payback periods than most infrastructure options (particularly if coupled with a power purchase agreement) and there is often substantial goodwill and demand for climate-friendly investments.

Reform the feed-in tariff to incentivise private investment in renewable energy

Feed-in tariffs are widely used financing instruments to increase returns to and reduce risks for renewable energy investors. In Malaysia, the Sustainable Energy Development Authority (SEDA) currently administers a feed-in tariff (FiT) that obliges electricity distribution companies to buy electricity generated from approved renewable resources at a specified rate and for a specific duration. This programme has contributed to a substantial expansion of solar photovoltaic installed capacity: 194.04MW have been approved for the FiT as of May 2015 (SEDA, 2015).

However, this is a small fraction of Malaysia's solar potential. The country has an average solar radiation of 400-600MJ/m^2 per month (Mekhilef et al., 2012) and the payback period for rooftop solar is 1.6-2.2 years (Wong et al., 2015). There is therefore immense scope to increase the share of electricity generated from solar power in an economically attractive way. This would slash energy bills for households and firms, and increase the city's economic resilience by reducing exposure to volatile fossil fuel prices. There is also a wider economic case to support the domestic solar industry. Malaysia is the third largest producer of solar equipment in the world. International companies including FirstSolar, Panasonic, SunEdison, Hanwha Q Cells, Solexel and SunPower all have solar panel factories in Malaysia (Bradsher, 2014). Increasing local demand for rooftop solar PV offers a means to further strengthen this industry and create even more local jobs.

Various measures could be adopted to promote renewables more effectively. SEDA could increase the quota for FiT-eligible solar projects, but reduce the value of the FiT. With the substantial global fall in the cost of solar modules (FS-UNEP Centre and BNEF, 2014), solar panels in Malaysia are economically attractive with much lower subsidies. This should help scale up deployment. The Iskandar Regional Development Authority and similar bodies could provide targeted training to local banks, focusing on the project and FiT approval process, solar technologies and business models. There may be scope for collaboration with the Japanese government and universities here, as Japan has achieved extraordinary rates of solar uptake over recent years (FS-UNEP Centre and BNEF, 2014). And municipal authorities could install solar PV panels on the roofs of public buildings. This will help to stimulate the development of the necessary skills and supply chains, while reducing public expenditure on energy use.

3. Low Carbon Transport

Transport consumed 43.4% of energy in Johor Bahru and Pasir Gudang in 2014, and total energy consumption is projected to increase by 49.9% between 2015 and 2025. The energy bill for the transport sector also reached an immense RM 7.19 billion in 2014, which equates to 53.1% of the city's total energy bill. This means that investing in low carbon transport systems can play a significant role in reducing Iskandar Malaysia's energy bills and carbon emissions.

Table 3. The economic and carbon savings from key measures in the transport sector.

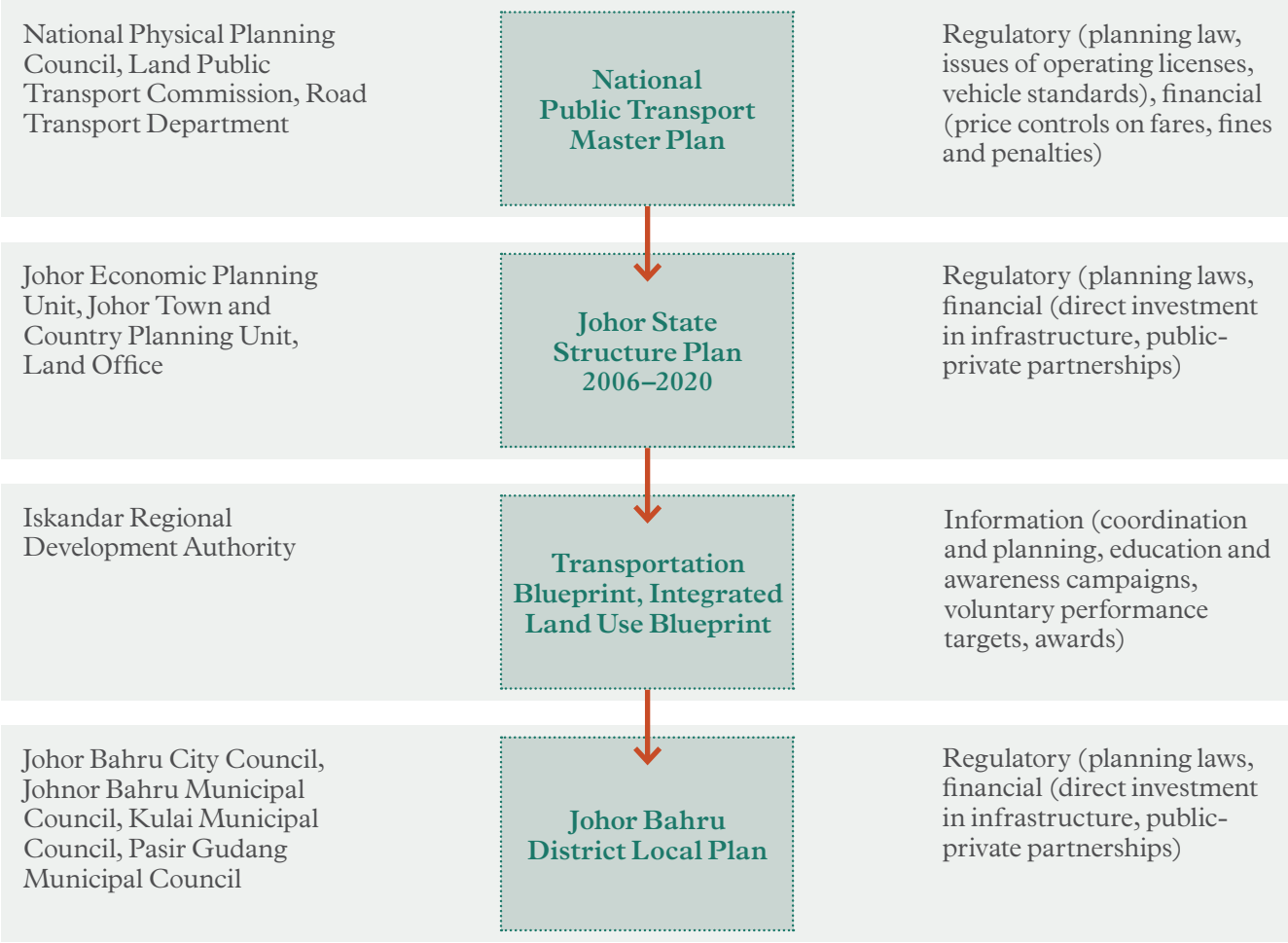
Measures	Net present value[3] (RM millions)	Carbon savings to 2025 ($ktCO_2$)
Hybrid private cars		
— with current tax incentive	23,804	15,051
— without current tax incentive	9,983	12,060
Euro IV vehicle standards		
— with sales tax relief	8,753	9,169
— without sales tax relief	-604	4,093
LRT (50km)	**-3,332**	**2,749**
Parking demand management	**1,113**	**1,407**

To exploit these opportunities will require coordination across multiple levels of government. The major actors and existing policies with respect to energy efficiency in the residential, commercial and public sector are outlined in Figure 7. It is apparent that municipal authorities have particularly significant powers to act on transport.

We have identified congestion pricing and the creation of an integrated transport authority as the two most promising strategies to mobilise large-scale investment in mass transit systems.

3 These calculations of net present value are based on the economic value of low carbon measures deployed between 2015 and 2025. They assume a 30-year lifespan for the LRT and a 15-year lifespan for vehicles.

Figure 7. Key actors and policies governing the transport sector in Malaysia.



Create an integrated municipal transport authority to coordinate planning and financing

Urban transport brings with it a level of complexity not found in other transport sectors such as railways, roads or inland waterways, given the number of possible modes in the city. Administrative fragmentation can obstruct effective land use planning and transport infrastructure investment, and therefore poses a particularly significant barrier to more cost-effective and equitable accessibility in cities (UN HABITAT 2013; OECD, 2014a).

An effective solution is to create a single integrated transport authority for the city region (Floater et al., 2014). Evidence shows that the initiation of city-wide transport authorities can bring with them a number of co-benefits, including a 9% reduction in reported levels of particulate matter and 13% improvement in public satisfaction with transport systems (OECD, 2014a). This has been demonstrated at a national level in Malaysia, with the creation of the national Land Public Transport Commission (SPAD). This resolved the previous challenge of coordinating among some ten different authorities including the Ministry of Transport, Ministry of Entrepreneur and Cooperative Development, Ministry of Tourism, Ministry of Works and the Economic Planning Unit.

Municipal governments often do not have sufficient capacity or incentive to coordinate across a metropolitan area on long-term planning and on expansion plans (OECD, 2014b). While the five municipal authorities of Johor Bahru have completed a pioneering collaborative Local Plan, an integrated transport authority could help to secure investment and would facilitate successful implementation. The national government of Malaysia, the state government of Johor or the Iskandar Regional Development Authority may therefore need to encourage or require more ambitious metropolitan coordination across the five city councils in Iskandar Malaysia. Higher levels of government can also provide incentives for metropolitan governance, or can empower integrated transport authorities with authority over land-use management or an ability to leverage dedicated funding sources.

In the case of Johor Bahru, for example, an integrated transport authority could be responsible for the implementation of the Johor Bahru Local Plan, which includes:

1. Planning and construction of the three proposed Bus Rapid Transport lines (Johor Bahru – Skudai, Johor Bahru – Johor Jaya and Johor Bahru – Nusajaya);
2. Parking demand management policies, including park-and-ride systems around the BRT lines;
3. Construction of cycling lanes to link residential areas to green space and commercial areas; and
4. Creation and enforcement of pedestrian zones areas in downtown areas.

Introduce congestion pricing to encourage use of public and non-motorised transport modes

Congestion pricing is a travel demand policy where vehicles are charged for access to roadways at specific times. It was first implemented in Singapore in 1975. Cities around the world have followed its example, achieving major reductions in congestion, including London, Stockholm and Milan. Major cities currently considering or developing congestion charge programmes include New York, Beijing and Bogota (EMBARQ, 2014).

In the first three years of its implementation, the London congestion charge reduced vehicle traffic by 16%, traffic delays by 26% and journey times by 14% (Leape, 2006) with minimal impacts on local business. Particulate matter and nitrous oxide emissions have been reduced by 12%, leading to an increase in life expectancy of 1.83 years for every 1,000 people living within the congestion charge zone (Tonne et al., 2008).

In addition to these social impacts, congestion charging programmes have also shown to be an effective means of raising capital for further transport investments. Congestion charge programmes raise £253 million in net revenue each year in London (Transport for London, 2014), more than $90 million in Stockholm (Eliasson, 2008), $125 million in Singapore, and more than $20 million in Milan (Sustainable Cities Collective, 2014). Therefore, for example, the municipal authorities in Johor Bahru and Pasir Gudang could use the revenue from congestion pricing schemes to fund the proposed expansion of the BRT system or the construction of segregated cycling and pedestrian infrastructure.

Congestion tolls are not a single answer to congestion, nor are they without challenges in implementation. Congestion charging programmes require substantial upfront investments. Capital costs range from the tens to hundreds of millions and operational costs range from 15-30% of revenue (OECD, 2010b). Congestion charging programmes also have the potential to disadvantage poorer residents if alternative transport options are not available, emphasising the need for complementary transport investments. Further, congestion charges can be challenging to implement politically. On this last issue, however, evidence from surveys in London and Stockholm have found that opposition to congestion charges fell 32% and 16% one year after the schemes were implemented, suggesting that congestion charges can achieve wide public acceptance when effectively implemented (Ahmed, 2011; Eliasson, 2008).

Conclusions

Malaysian cities such as Johor Bahru and Pasir Gudang have a wide range of economically attractive low carbon measures available to them. These investments could cover their lifetime costs and generate a real return above 5% – as well as cutting energy bills and improving economic competitiveness across the country.

There are two ongoing obstacles to effectively exploiting these opportunities.

Firstly, the multi-level governance arrangements are currently fragmented and centralised. This hinders effective action on climate change at a local scale. Our analysis suggests a need to improve the coordination among different levels and sectors of government, so that cities can undertake sustainability experiments such as municipal green building standards or congestion pricing. These can build capabilities and public support, and can be replicated elsewhere in Malaysia if successful.

Secondly, low carbon measures often entail higher upfront costs and can sometimes have longer payback periods than higher carbon alternatives. Households, firms and local governments will often require enabling policy frameworks and innovative financing mechanisms to act – such as revolving funds or congestion pricing. In the absence of ambitious national climate commitments, local governments need to be empowered with the resources and capacities to pilot these kinds of initiatives. If necessary, international actors can provide crucial technical assistance and catalytic funding.

We hope that by providing evidence on the scale and composition of these opportunities, this report will help to build political commitment and institutional capacities for change. We also hope this report will help Johor Bahru and Pasir Gudang to implement the enabling policies, develop the business models and secure the investments needed to pursue climate action at the city scale.

Finally, we would like to reiterate that economics is not the only discipline that has something useful to say on the transition to a low carbon society. A wider analysis should also consider issues relating to the equity, inclusivity and broader sustainability of the different pathways towards a low carbon society in Malaysian cities.

References

Acuto M. 2013. *City Leadership in Global Governance*. Global Governance. 19(3) 481-498.

Ahmed B. 2011. *Manchester congestion charge scheme: A review.* Journal of Civil Engineering and Construction Technology. 2(11).

Anguelovski I, Carmin JA. 2011. *Something borrowed, everything new: innovation and institutionalization in urban climate governance. Current Opinion in Environmental Sustainability.* 3(3) 169-175.

Betsil M, Bulkely H. 2006. *Cities and the Multilevel Governance of Global Climate Change*. Global Governance. 12(2) 141-159.

Bradsher K. 2014. *Solar Rises in Malaysia During Trade Wars Over Panels.* New York Times (11/12/2014). Available from: http://www.nytimes.com/2014/12/12/business/energy-environment/solar-rises-in-malaysia-during-trade-wars-over-panels.html?_r=0

Cho S-H, Kim SG, Roberts RK. 2009. *Measuring the effects of a land value tax on land development*. Applied Spatial Analysis and Policy. 4(1) 45-64.

Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M., Cochran, I., Robert, A., Teasdale, P-J. (2009) *Cities, Climate Change and Multi-Level Governance, OECD Environment Working Papers,* Organisation for Economic Cooperation and Development, Paris.

Crossley D, Brennan M, Baker G. 2012. *Smart Growth. A Guide to Urban Planning in Texas Communities*. Available from: https://journals.tdl.org/txplanningguide/index.php/tpg/article/download/21/17

Economic Planning Unit. 2010. *Tenth Malaysia Plan 2011–2015*. Prime Minister's Department, Government of Malaysia. Available from: https://www.pmo.gov.my/dokumenattached/RMK/RMK10_Eds.pdf

Economic Planning Unit. 2015. *Eleventh Malaysia Plan 2011–2015.* Prime Minister's Department, Government of Malaysia. Available from: http://www.micci.com/downloads/11MP.pdf

Eliasson J. 2008. *Lessons from the Stockholm congestion charging trial.* Transport Policy. 15(6) 395-404.

EMBARQ. 2013. F*inancing Needs for Sustainable Transport Systems for the 21st Century.* World Resources Institute (WRI) Center for Sustainable Transport. Background paper presented at the 7th Regional Environmentally Sustainable Transport Forum in Asia, 23-25 April 2013, Bali, Indonesia.

Farvacque-Vitkovic CD. 2014. *"Introduction"*. In Farvacque-Vitkovic CD, Kopanyi, M. (eds). *Municipal Finances: A Handbook for Local Governments*. World Bank. Washington, D.C.

Floater G, Rode P, Friedel B, Robert A. 2014. *Steering Urban Growth: Governance, Policy and Finance*. New Climate Economy Cities Paper 02. LSE Cities. London School of Economics and Political Science.

Franszen R. 2013. *Property Taxation in Developing Countries. 8th Mass Appraisal Valuation Symposium Durban, South Africa*. In Floater G, Rode P, Friedel B, Robert A. 2014. *Steering Urban Growth: Governance, Policy and Finance. New Climate Economy Cities Paper 02*. LSE Cities. London School of Economics and Political Science.

Franzén, M. (2013) *Local Governments as Nodes for Greenhouse Gas Abatement: Climate Change Governance in Multi-Level Frameworks, European Journal of Sustainable Development*, 2, pp361-372.

Freire ME. 2014. *"Managing external resources."* In CD Farvacque-Vitkovic and M Kopanyi. (eds). *Municipal Finances: A Handbook for Local Governments*. World Bank. Washington, D.C.

FS-UNEP Centre, BNEF. 2014. *Global Trends in Renewable Energy Investment 2014*. Frankfurt School-United Nations Environment Programme Collaborating Centre for Climate and Sustainable Energy Finance, Bloomberg New Energy Finance. Frankfurt. Available from: http://fs-unep-centre.org/system/files/globaltrendsreport2014.pdf

Godfrey J, Currie PE. 2013. T*he importance of, and outlook for, municipal bonds and public power.* The Electricity Journal. 26(6) 65-73 doi:10.1016/j.tej.2013.06.001.

Gouldson A, Colenbrander S, Sudmant A, Papargyropoulou E. 2014a. *The Economics of Low Carbon Cities: Johor Bahru and Pasir Gudang, Malaysia*. The Centre for Low Carbon Futures. Available from: http://www.climatesmartcities.org/sites/default/files/4336%20Malaysia%20Report%20v5.pdf

Gouldson A, Kerr N, Millward-Hopkins JT, Freeman M, Topi C. 2014b. *Innovative Financing Models for Low Carbon Transitions: Exploring the case for revolving funds for domestic energy efficiency programmes.* European Union FP7 Financialisation, Economy, Society and Sustainable Development (FESSUD). iBUILD working paper 6. Available from: https://research.ncl.ac.uk/media/sites/researchwebsites/ibuild/WP6.pdf

IRDA. 2007. *Iskandar Malaysia Comprehensive Development Plan.* Iskandar Regional Development Authority. Johor Bahru. Available from: http://www.iskandarmalaysia.com.my/comprehensive-development-plan-cdp

IRDA. 2013. *What is Iskandar Malaysia: Facts & Figures.* Iskandar Regional Development Authority. Johor Bahru. Available from: http://www.iskandarmalaysia.com.my/what-is-iskandar-malaysia-fact-figures

Khailani DK, Perera R. 2013. *Mainstreaming disaster resilience attributes in local development plans for the adaptation to climate change induced flooding: A study based on the local plan of Shah Alam City, Malaysia*. Land Use Policy. 30(1) 615-627.

Leape, J. 2006. *The London congestion charge*, Journal of Economic Perspectives. 20(4): 157-176. doi:10.1257/jep.20.4.157.

Li J. 2014. *Property tax reform and urban sprawl – Evidence from provincial data in China*. International Conference on Management Science & Engineering (ICMSE). 2061-2066 doi:10.1109/ICMSE.2014.6930489.

Matsumoto, T., Nutall, C., Bathan, G., Gouldson A., Laloe, F., Pathak, M., Robert, A., and Welch, D. (2014) *'National and Sub-National Integration' in Green Growth in Practice: Lessons from Country Experiences,* Global Green Growth Institute, European Climate Foundation and Climate and Development Knowledge Network.

Mekhilef S, Safari A, Mustaffa WES, Saidur R, Omar R, Younis MAA. 2012. *Solar energy in Malaysia: Current state and prospects*. Renewable and Sustainable Energy Reviews. 16. 386-396. doi:10.1016/j.rser.2011.08.003.

Ministry of Natural Resources and Environment. 2010. S*econd National Communication to the UNFCCC.* Government of Malaysia. Available from: http://www.nre.gov.my/Malay/Alam-Sekitar/Documents/Penerbitan/SECOND%20NATIONAL%20COMMUNICATION%20TO%20THE%20UNFCCC%20%28NC2%29.pdf

Muller, S., 2013. *Urbanization, Infrastructure and Economic Growth In Southeast Asia*. Institute for Sustainable Communities. Available from: http://www.iscvt.org/news/urbanization-infrastructure-and-economic-growth-in-asia/

OECD. 2010a. *Cities and Climate Change*. Organisation for Economic Cooperation and Development (OECD). Paris. Available from: http://www.oecd.org/gov/citiesandclimatechange.htm

OECD. 2010b. *Implementing Congestion Charges. Round Table 147*. International Transport Forum, Organisation for Economic Cooperation and Development (OECD). Paris. Available from: http://www.internationaltransportforum.org/jtrc/discussionpapers/DP201012.pdf

OECD. 2014. *What Makes Cities More Productive? Evidence on the Role of Urban Governance from 5 OECD Countries.* Organisation for Economic Cooperation and Development (OECD). Paris. Available from: http://www.oecd-ilibrary.org/docserver/download/5jz432cf2d8p.pdf?expires=1425045909&id=id&accname=guest&checksum=CEE64950528F4F1C104E58BD0DF62B90

OECD. 2014b. *"A National Strategy for Cities: Taking Ownership of Urban Policy"* in OECD Regional Outlook 2014: *Regions and Cities: Where Policies and People Meet*. Organisation for Economic Cooperation and Development (OECD). Paris. Available from: http://www.oecd.org/fr/regional/oecd-regional-outlook-2014-9789264201415-en.htm

Oh TH, Lalchand G, Chua SC. 2014. *Juggling act of electricity demand and supply in Peninsular Malaysia: Energy efficiency, renewable energy or nuclear?* Renewable and Sustainable Energy Reviews. 37 809-821.

Paavola J, Gouldson A, Kluvankova-Oravska T. 2009. *Institutions, Ecosystems and the Interplay of Actors, Scales, Frameworks and Regimes in the Governance of Biodiversity.* Environmental Policy and Governance. 19(3) 148-158.

Purvis N, Jones A, Springer C. 2014. *Retrofitting Coal-Fired Power Plants in Middle-Income Countries: What Role for the World Bank?* The Brookings Institution. Available from: http://www.brookings.edu/~/media/research/files/papers/2014/07/coal-fired-power-plants-middle-income-countries-world-bank-purvis/retrofitting-coalfired-power-plants--final.pdf

Schreurs M. 2010. *Multi-level Governance and Global Climate Change in East Asia*. Asian Economic Policy Review. 5(1) 81-105.

SEDA. 2015. *Operational Plants*. Sustainable Energy Development Authority. Malaysia. Available from: http://seda.gov.my/?omaneg=00010100000001010101000010000010000000000000000000&s=539

SPAD. 2013. *Land Public Transport Master Plan,* Land Public Transport Commission. Available from: http://eps.mbpj.gov.my/SlideT

Sustainable Cities Collective. 2014. *Congestion Charging: Does it work?* Available from: http://sustainablecitiescollective.com/162696/congestion-pricing

Tonne, C., Beevers, S., Armstrong, B., Kelly, F. and Wilkinson, P., 2008. *Air pollution and mortality benefits of the London Congestion Charge: spatial and socioeconomic inequalities*. Occupational and Environmental Medicine 65(9) 620-627 DOI:10.1136/oem.2007.036533.

Transport for London. 2014. *Annual Report and Statement of Accounts*. London. Available from: https://www.tfl.gov.uk/cdn/static/cms/documents/annual-report-2013-14.pdf

UTM, IRDA, Kyoto University, Okayama University, National Institute for Environmental Studies. 2013. *Low Carbon Society Blueprint for Iskandar Malaysia 2025*. 2nd Ed., Johor Bahru: UTM-Low Carbon Asia Research Centre. Available from: http://www.utm.my/partners/satreps-lcs/publications/

Viguié V, Hallegatte S. 2012. *Trade-offs and synergies in urban climate policies*. Nature Climate Change. 2 334–337 doi:10.1038/nclimate1434

Wong SL, Ngadi N, Abdullah TAT, Inuwa IM. 2015. *Recent advances of feed-in tariff in Malaysia*. Renewable and Sustainable Energy Reviews. 41 42–52 doi:10.1016/j.rser.2014.08/006.

World Bank. 2013. *Financing Sustainable Cities: How We're Helping Africa's Cities Raise Their Credit Ratings*. Available from: http://www.worldbank.org/en/news/feature/2013/10/24/financing-sustainable-cities-africa-creditworthy.

World Bank. 2014a. *Energy use (kg of oil equivalent per capita)*. Available from: http://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE

World Bank. 2014b. *Urban population (% of total)*. Washington DC, USA. Available from: http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

Appendix A: Workshop participants

Organisation	Name	Position
Majlis Perbandaran Johor Bahru Tengah (MPJBT)	Noor Azlan Bin Mohammad	Penolong Pegawai Perancang
Majlis Perbandaran Johor Bahru Tengah (MPJBT)	Md. Naharudin bin Md. Alimi	Penolong Pegawai Senibina
Majlis Perbandaran Johor Bahru Tengah (MPJBT)	Mohd Faizal Unisham bin Mohd Zuri	Penolong Pegawai Senibina
Perbadanan Pengangkutan Awam Iskandar Malaysia (PAIM)	Syed Haszanoraimy bin Syed Hassan	Associate GIS, Data Management
Perbadanan Pengangkutan Awam Iskandar Malaysia (PAIM)	Abdul Rauf bin Md Sanuri	Associate, Planning Policy
Centre for Environment, Technology & Development, Malaysia (CETDEM)	Gurmit Singh	Chairman
Iskandar Regional Development Authority (IRDA)	Boyd Dionysius Joeman	Acting Head, Environment
Iskandar Regional Development Authority (IRDA)	Choo Hui Hong	Associate, Environment
Iskandar Regional Development Authority (IRDA)	Kamisah Mohd Ghazali	Senior Vice President, Economics & Investment
Iskandar Regional Development Authority (IRDA)	Fadzil Abdul Hamid	Assistant Vice President, Economics & Investment
Rhy Synergy Sdn Bhd	Datuk Hj Yusra bin Sabar	Chairman
Rhy Synergy Sdn Bhd	Rashdan bin Rashid	Managing Director

Organisation	Name	Position
Rhy Synergy Sdn Bhd	Muhamad Nurazmi Bin Abas	Executive Director (Business Development & Operation)
Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)	Hezlen Sali	
Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)	Jeyashri Kisna	Programme Coordinator (Cities, Environment and Transport)
WWF-Malaysia	Phubalan Karunakaran	Team Leader, Earth Hour City Challenge
BSEEP Project	Kevin Hor	National Project Manager and Component 3 Consultant
Sustainable Energy Development Authority (SEDA)	Steve Anthony Lojuntin	Deputy Director
The Energy Commission	Azimah Abdul Aziz	Senior Analyst
Treat Every Environment Special (TrEES)	Christa Hashim	Director
Universiti Teknologi Malaysia	Dr. Irina Safitri Zen	Research Fellow/ Head of Sustainability Unit
Universiti Teknologi Malaysia	Ho Wai Shin	Senior Lecturer
Universiti Teknologi Malaysia	Dr. Pramila Tamunaidu	Senior Lecturer
Universiti Teknologi Malaysia	Dr. Rory Padfield	Senior Lecturer
BSEEP Project	Deep Kumar	Project Executive
British High Commission	Muru Loganathan	Climate Change and Energy Attache
Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA)	Prakash A/L Nagalingam	Ketua Penolong Setiausaha

The Climate Smart Cities Programme
www.climatesmartcities.org

The study has been conducted as part of the Climate Smart Cities programme that has been underway since 2009. The programme is led by Professor Andy Gouldson at the University of Leeds with support from the ESRC Centre for Climate Change Economics and Policy.

The intellectual property rights for the methodology and approach applied in this report are retained by the University of Leeds. The University of Leeds does not accept any responsibility for the ways in which the report or the data are used.

Acknowledgements

This individual study has been supported by the UK Foreign and Commonwealth Office through the British High Commission in Kuala Lumpur. It has also been supported by the ESRC Centre for Climate Change Economics and Policy and the University of Leeds.

This individual study has been conducted and this report is authored by Andy Gouldson, Sarah Colenbrander and Effie Papargyropoulou.

Foreign & Commonwealth Office

Centre for Climate Change Economics and Policy

ISKANDAR MALAYSIA

KeTTHA KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

UNIVERSITY OF LEEDS

UTM UNIVERSITI TEKNOLOGI MALAYSIA

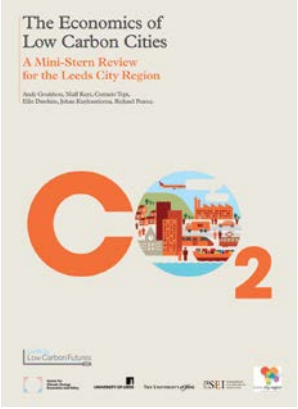
Climate Smart Cities
www.climatesmartcities.org

Kolkata, India

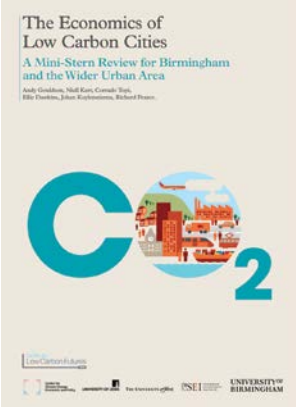
Lima-Callao, Peru

Palembang, Indonesia

Johor Bahru, Malaysia

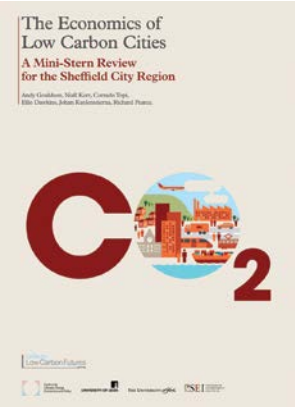


Leeds City Region



Birmingham and the Wider Urban Area

The Humber



Sheffield City Region

Project Director:

Prof Andy Gouldson
a.gouldson@leeds.ac.uk

UNIVERSITY OF LEEDS

Project Manager:

Sarah Colenbrander
s.colenbrander@leeds.ac.uk

UNIVERSITY OF LEEDS

In-country lead:

Boyd Joeman
boyd@irda.com.my

ISKANDAR MALAYSIA