Indonesia Solar City Guidebook

Sustainable urban planning and design for Local Governments

Prepared under the project:

Local Renewables: South-south cooperation between cities in India, Indonesia and South Africa

May 2013

Prepared by:

ICLEI – SEA

in partnership with

ICLEI – South Asia

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Disclosure Page

ICLEI – Local Governments for Sustainability

ICLEI - Local Governments for Sustainability is the world's leading association of cities and local governments dedicated to sustainable development. ICLEI is a powerful movement of 12 mega-cities, 100 super-cities and urban regions, 450 large cities as well as 450 small and medium-sized cities and towns in 84 countries. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level. Our basic premise is that locally designed initiatives can provide an effective and cost-efficient way to achieve local, national, and global sustainability objectives.

The ICLEI Southeast Asia Secretariat[1] collaborates closely with the global ICLEI network and other regional offices around the world, in sharing tools, materials, strategies and good practices specifically designed and implemented at the local level. ICLEI Southeast Asia's key environmental work streams within the Secretariat include Energy and Climate Change, Disaster Risk Reduction, Water and Sanitation, Urban Biodiversity and Integrated Urban Planning.

Renewable Energy and Energy Efficiency Partnership (REEEP)

Renewable Energy and Energy Efficiency Partnership (REEEP) is an active global partnership that structures policy initiatives for clean energy markets and facilitates financing for sustainable energy projects. The Partnership was established alongside the 2002 World Summit on Sustainable Development in Johannesburg. Over its ten-year lifespan, REEEP has established itself as a vocal champion for clean energy – energy efficiency and renewable energy – punching above its weight in three ways: by funding innovative projects, by providing internet-based information resources, and by supporting clean energy stakeholders.The organisation is now comprised of 400 partners including 45 governments as well as a range of private companies and international organisations. Some 5200 individuals are also registered as Friends of REEEP.

[1] http://archive.iclei.org/index.php?id=586

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Contents

List of Tables

List of Figures

Terms, Abbreviations and Acronyms:

BAU	Business As Usual
BAPPENAS	Badan Perencaan Pembangunan National (National Development Planning Agency)
BPS	Badan Pusat Statistik (Statistics Indonesia)
CH_4	Methane
CDM	Clean Development Mechanisms
CDP	Carbon Disclosure Report
CO_2	Carbon Dioxide
COP17	17th Conference of the Parties
CFL	Compact Florescent Light
DEPSOS	Departemen Sosial (Department of Social Affair)
DFIs	Development Finance Institutions
DNPI	Dewan Nasional Perubahan Iklim (The National Council for Climate Change)
ECC	Energy Efficiency Certificates
EE	Energy efficiency
EIB	European Investment Bank
ESCo	Energy Service Company
eCO_2	Equivalent Carbon Dioxide
G-20	The Group of Twenty
GDP	Gross Domestic Product
GE	General Electric
GEEREF	Global Energy Efficiency and Renewable Energy Fund
Gg	Giga gram
GHG	Greenhouse Gases
GIZ	Die Deutsche Gesellschaft für Internationale Zusammenarbeit
GoI	Government of Indonesia
$GtCO_2$	Giga-tons of carbon dioxide
$GtCO_2eq$	Giga-tons carbon dioxide equivalent
HEAT +	Harmonised Energy Analysis Tool Plus
HTF	Heat-Transfer Fluid
ICLEI	ICLEI – Local Governments for Sustainability
ICLEI AS	ICLEI – Local Governments for Sustainability – Africa Secretariat
ICLEI SA	ICLEI – Local Governments for Sustainability – South Asia
ICLEI SEA	ICLEI – Local Governments for Sustainability – South East Asia
IDPs	Integrated Development Plans
IEA	International Energy Agency
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
ICCS	Integrated Climate Change Strategy
INCAS	Indonesia National Carbon Accounting System
Indef	Institute for Development Economics and Finance

IPCC	Intergovernmental Panel on Climate Change
ISCI	First International Solar Cities Initiative
JICA	Japan International Cooperation Agency
Kg	Kilogram
kL	Kilo Litre
kHz	Kilo Hertz
km	kilometre
km^2	kilometre squared
kT/yr	Kilo Tonnes per Year
kW	Kilo Watts
kWe	Kilo Watts Equivalent
kWh	Kilo watt-hour
kWp	Kilo Watt Peak
L	Litre
LGs	Local Governments
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
LR	Local Renewables
LRI	Local Renewables Initiative
LPG	Liquefied Petroleum
LULUCF	Land Use, Land Use Change and Forestry
MEMR	Ministry of Energy and Mineral Resources
MoF	Ministry of Finance
Mt	Metric tonnes
Mtoe	Million tonnes of oil equivalent
MU	million units
MW	Mega Watt
MWe	Mega Watt Equivalent
MWh	Mega Watt-hour
MWP	Mega Watt Peak
NAMA	Nationally Appropriate Mitigation Action
NAP	National Action Plan for Climate Change
NGHGI	The National Green House Gas Inventory
NGO	Non-governmental Organisation
NO_2	Nitrogen Dioxide
PAKLIM	Policy Advise for Enviroment and Climate Change
Permen	Peraturan Menteri (Ministrial Regulation)
PLN	Perusahaan Listrik Negara (Indonesia State Owned Electricity Company)
PNG	Piped Natural Gas
PPP	Public Private Partnership
PV	Photovoltaic
RAN-GRK	Rencana Aksi Nasional – Gas Rumah Kaca (National Action Plan for GHG)
R&D	Research and Development
RE	Renewable Energy
REEEP	Renewable Energy and Energy Efficiency Partnership

RPJMN	Rencana Pembangunan Jangka Menengah Nasional
SA	South Africa
SNI	Standar Nasional Indonesia (National Standard of Indonesia)
SWH	Solar Water Heater
T/yr	Tonnes per year
TAR	Third Assessment Report
Te Co_2	Tonnes of Equivalent Carbon Dioxide
TNA	Technology Needs Assessment
ULBs	Urban Local Bodies
UNFCCC	United Nations Framework on Climate Change
UU	Undang-undang (Law)
W	Watt
Wh	Watt-hour
WRM	Water Resources Management

Preface

The Local Renewables Initiative and Network

With the Local Renewables (LR) Initiative, ICLEI – Local Governments for Sustainability supports and strengthens local governments in their generation and supply of renewable energy (RE) and implementation of energy efficiency (EE) in the urban activities/services. The focus is on the roles and responsibilities of local governments as a driving force for innovation and investment in their communities. The LR initiative consists of a worldwide network of cities.

The aims of the initiative are to:

- increase the sharing of knowledge of locally sustainable energy
- initiate and empower model communities worldwide
- transfer knowledge from cities with recognized expertise
- facilitate networking among local governments internationally

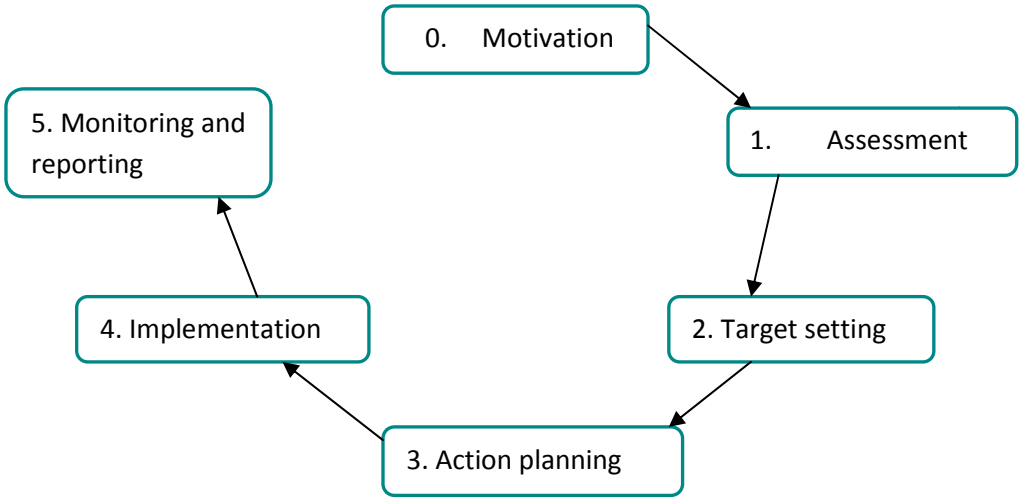
The term 'Local Renewables' attempts to bring into focus the symbiotic relationship between energy efficiency and renewable energy, with an emphasis on local level action.

The LR initiative has received support from cities and organizations around the world to enable the issue of renewable energy and energy efficiency at the local level to be advanced and to allow cities to learn from one another.

About the project 'Local Renewables: South-south cooperation between cities in India, Indonesia and South Africa'

The current project 'Local Renewables: South-south cooperation between cities in India, Indonesia and South Africa' is funded by the Renewable Energy and Energy Efficiency Partnership (REEEP). The project aims to develop two model LR communities, one in Ekurhuleni Metropolitan Municipality in South Africa, and the other in Yogyakarta City in Indonesia while providing both with guidance from Coimbatore City in India, an advanced LR city through its participation in anLR project from 2008 to 2010, and to facilitate the adoption of similar initiatives in other South African and Indonesian local governments.

The project, which ran from October 2011 to June 2013, enabled the cities of Ekurhuleni and Yogyakarta to undergo and implement the LR milestone process (depicted below).



About the Solar City Guidebook for Indonesia

A landmark achievement of the LR initiative was the input and influence towards the development of the national level Solar Cities programme in India. This large scale national level programme in India, helmed by the Indian Ministry of New and Renewable Energy, aims to help develop a targeted 60 'solar cities' in the country. The Solar Cities programme has many components in line with the Local Renewables programme. Thus, a project that began with 3 cities in India spread its influence to a total of 60 to date.

Through this present project, ICLEI aims to create such an impetus in the two countries of Indonesia and South Africa through the preparation of a Solar City Guidebook. Based on a similar guide developed by ICLEI South Asia for the Indian Solar Cities programme, these country-specific solar city guidebooks aim to make the case for increasing the number of cities adopting local renewables in South Africa and Indonesia. In India, the local level programme encouraged the national government to undertake a countrywide rollout. It is hoped that the Indonesia guidebook may serve as the first impetus for a similar up-scaling in Indonesia.

Executive Summary

The Indonesia Solar City Guidebook is intended to serve as an informing document for readers to learn about the various aspects involved in a Solar City, including relevant international developments, technical terms and processes. It is intended to serve as a useful resource for Indonesian local governments when embarking upon a programme to increase the uptake of renewable energy and energy efficiency at the local level.

Beginning with an overview of the global energy scenario, the introductory section provides the basic context to the guidebook and illustrates the renewable energy scenarios and energy efficiency initiatives from a global and Indonesian perspective. Chapter two outlines the obligations pertinent in Indonesia for local climate action, from national goals to provincial commitments and targets.

Chapter three unfolds and describes the evolution of the solar city concept, international solar city initiatives and ICLEI's Local Renewable initiative and network. A section herein, focus on the solar city programme inIndia, Indonesia and South Africa related to its objectives, targets and guidelines, making the case for the motivations of developing a solar city programme in Indonesia. The fourth chapter outlines the key steps of such a programme at the city level. Thissection provides solar cities case studies and best practices from around the world, examples of similar programmes, and typical activities conducted through them.

The fifth chapter provides an overview of the various technology, systems and device options which would aid the uptake of renewable energy and energy efficiency at the local level. The final chapter concludes by providing information on the local level implementation strategy that would be required to put in place for a solar city programme and possible international financing options and mechanisms that could be usedto implement physical projects on the ground.

This guide aims to serve as an introduction to the specific energy reduction strategies in local government climate change, energy and sustainability strategiesfor:

- City governments and decision makers
- Professional and institutional groups involved in renewable energy and energy efficiency
- Private organizations and companies interested in investing in renewable energy and energy efficiency projects at the local level

Chapter 1: Introduction

The global climate is controlled by complex interactions between marine and terrestrial systems. These interactions generate a variety of climatic variables across different regions and exert significant influence on day-to-day variations at the global, regional and local levels. Climate change is defined by the International Panel for Climate Change (IPCC) as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (IPCC, 2007). Climate change may be a result of natural internal processes, external forces or from anthropogenic changes such as increased carbon dioxide (CO_2) emissions. However the United Nations Framework Convention on Climate Change (UNFCCC) makes a clear division between anthropogenic causes that alter the composition of the atmosphere and the natural causes attributing to climate variability. Climate change, as defined by the UNFCCC, is any 'change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and is in addition to natural climate variability over comparable time periods' (IPCC, 2001) and the IPCC (2007) concur that anthropogenic forcing is a major driver.

Repercussions of climate change are expected to be global and across physical, social, ecological and economic dimensions. While several direct and indirect effects of changing climate are anticipated globally, their intensities are expected to be greater in the developing world mainly because of the low level of resilience and preparedness in these parts of the world, especially Asia. While the basic science of climate change is well-founded and scientifically substantiated, the science related to predicting the eventual impacts remains uncertain because of the complexity of earth's natural systems. Strong evidence exists to prove that anthropogenic causes have resulted in increased level of greenhouse gasses in turn resulting in global temperature rise, consequences of which will be highly pervasive (IPCC 2007).

As an issue that is interrelated with several other global challenges like urbanization, rising population and global economic and energy crisis; climate change will have significant influence on political and social developments challenges in different parts of the world and Indonesia is no exception.

Under climate change, Indonesia is predicted to experience temperature increases of approximately 0.8°C by 2030. Moreover, rainfall patterns are predicted to change, with the rainy season ending earlier and the length of the rainy season becoming shorter. Climate change affects all economic sectors, but the agricultural sector is generally the hardest hit in terms of the number of poor affected. (IFPRI 2011)[2]

Growing energy use has a direct impact on global and local environments. Vehicular and industrial emissions are the main sources responsible for deteriorationof air quality in cities. Apart from environmental impacts of increased energy use, energy security concerns are becoming central issues in several developed and developing countries. Rapid depletion of fossil fuels has forced the world to seriously begin to consider exploring possibilities and alternativesfor harnessing the renewable energy resources and implementing energy efficient techniques.

[2] http://www.ifpri.org/sites/default/files/publications/ifpridp01148.pdf

Government policies and regulations play a key role in transforming energy markets towards greater adoption of renewable energy and energy efficiency. A vast array of proven renewable technologies is readily availableat a marketable and affordable price. Despite the relative abundance of natural resources such as sunshine, wind, water and underground thermal heat, these non-diminishing resources are yet to be fullyexplored.

International perspective of climate change and energy

As urban population, economic activity and wealth increase, urban energy use is projected to grow rapidly. Currently the world is host to approximately seven billion (2013) people (U.S. Census Bureau, 2013), more than half of who live in urban centres. It is projected that by 2030, cities will house 60% of the world's population – equivalent to the total global population in 1987 (Nigel Jollands, IEA). According to the 2010 census the total population of Indonesia is 237.5 million people, about a half whom, or 118 million people, live in urban areas. This implies that urban development will become a more pressing issue in the country. As the cities grow, development issues will be raisedsuch as traffic congestion, slums and crime, and also the broader context of socio-economic and political dynamics, as well as energy and resources.

Annual total greenhouse gas (GHG) emissions arising from the global energy sector continue to increase. Combustion of fossil fuels continues to dominate a global energy market that is striving to meet the ever-increasing demand for heat, electricity and transport fuels. GHG emissions from fossil fuels have increased each year since the IPCC 2001 Third Assessment Report (TAR) (IPCC, 2001), despite greater deployment of low- and zero-carbon technologies, (particularly those utilizing renewable energy); the implementation of various policy support mechanisms by many states and countries; the advent of carbon trading in some regions, and a substantial increase in world energy commodity prices. Without the near-term introduction of supportive and effective policy actions by governments, energy-related GHG emissions, mainly from fossil fuel combustion, are projected to rise by over 50% from 26.1 $GtCO_2eq$ (7.1 GtC) in 2004 to 37–40 $GtCO_2$ (10.1–10.9 GtC) by 2030. Mitigation has therefore become even more challenging (IPCC, 2007) for emerging economies.

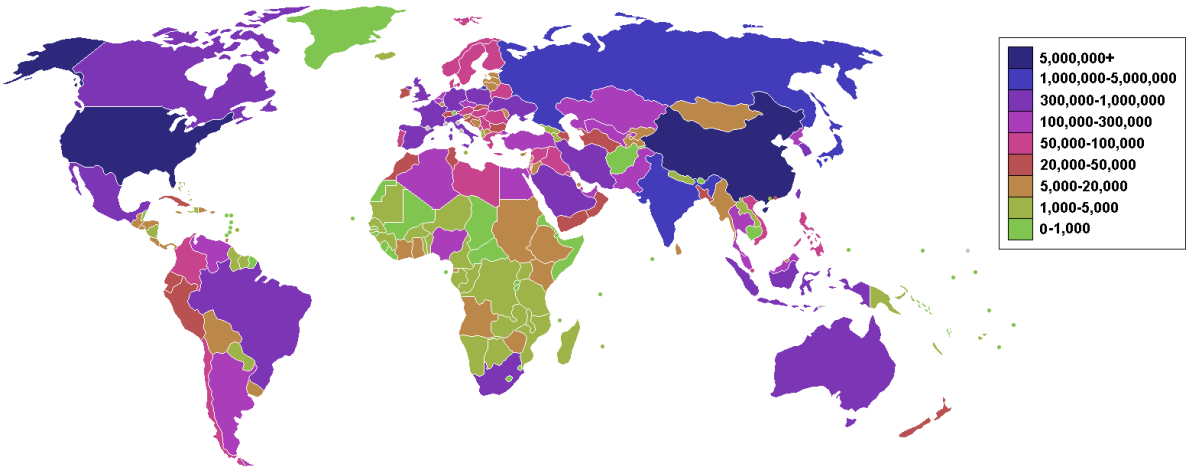


Figure 1: World map in proportion to the global distribution of GHG emissions and responsible geographical areas.[3]

Climate change threatens to undermine many of the development objectives of the countries in the rest of the developing world, in particularly in the areas of water, energy, health and agriculture. In order to allow low carbon, resource efficient and sustainable economic development in the developing world, a climate change agreement requires nations from both the developing and developedcountries to take ownership and comply with international obligations. Globally the IPCC states that emission reductions by 2100 between 60% to 80% from 1990 levels must be achieved. The burden sharing between nations of this target is the subject of international negotiations.

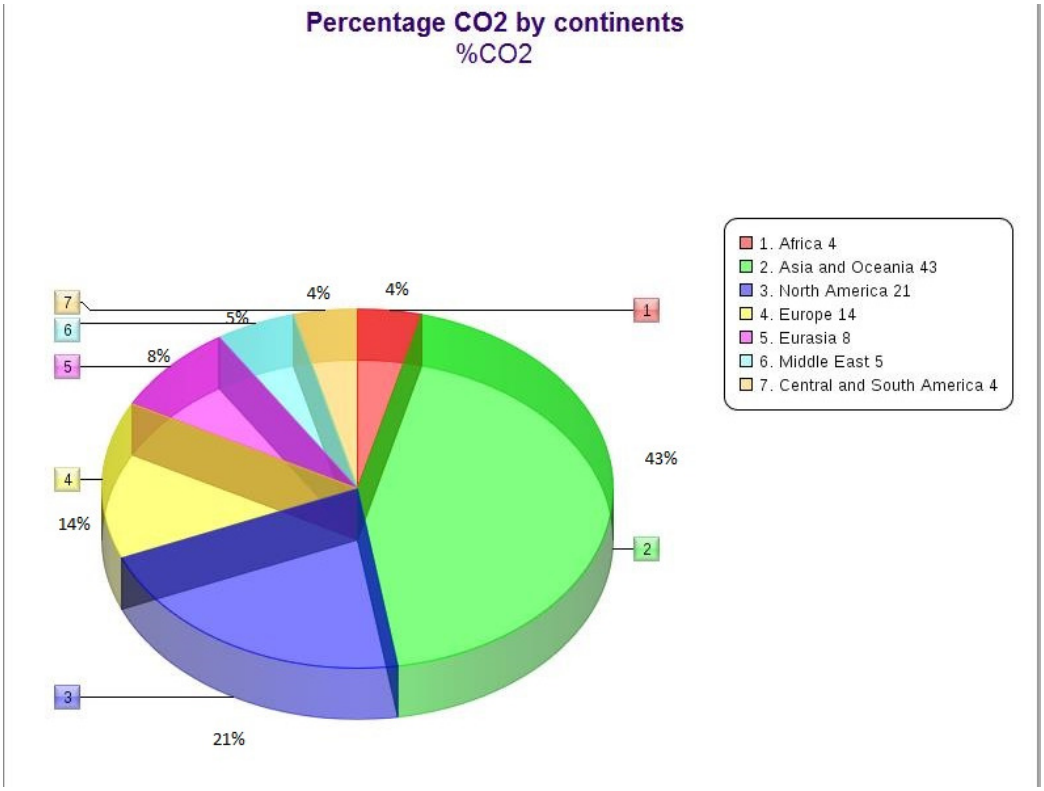


Figure 2: Global distribution of carbon dioxide emitted into the atmosphere.

[3] http://upload.wikimedia.org/wikipedia/commons/d/d1/Countries_by_carbon_dioxide_emissions_world_map_deobfuscated.png

A significant proportion of world's energy is consumed by the ever growing engines of social, economic and technological advancement called cities. As vital centres of global development and innovation, cities themselves hold the key to resolution of some of their own problems. Fuelled by fossils, urban development has attracted unbridled population growth and resource use, resulting in ever increasing resource constraints for further development and the cumulative population suffers tremendously.

Indonesia perspective on energy and climate change

Indonesia is located between 6°08' North and 11°15' South latitude, and from 94°45' to 141°05'East longitude. The country covers 1,910,931 Km^2. It has five large islands (Sumatra, Java,Kalimantan, Sulawesi and Irian Jaya) and about 13,667 small islands, of which over half (56%) ofwhich are nameless, and only 7% permanently inhabited.Extensive coastal plainsand mountain areas of 1,000 metres above sea level are characteristics of Sumatra, Kalimantanand Irian Jaya. Of the 200 million ha of land territory, about 50 million ha is devoted to variousagricultural activities. There is nearly 20 million ha of arable land, of which about 40% is wetland(rice fields), 40% is dry land, and 15% is shifting cultivation. Since 2005, the Republic of Indonesiahas been divided administratively into 33 provinces (Statistic Indonesia - BPS, 2012)

Figure 3 Map of Indonesia

The country's population is the fourth most populous nation in the world, following China,India and the United States. The population grew from 119 million in 1971 to 219 million in2005. While the growth rate is slowing down from 1.49% (1990–2000) to become 1.34% (2001–2005), it is projected that Indonesia's population will reach 300 million in 2030.

Figure 4: Urban population (% of total) in Indonesia. Source: Trading Economics[4])

Poverty remains a challenge, while unemployment and underemployment are still relatively high. In the Mid-Term National Development Plan (RPJMN[5]) 2004–2009, it was targeted that poverty and unemployment would be about 5.1% and 8.2% respectively. Recent report from Statistic Indonesia (BPS) stated that the number of unemployment by February 2008 reached 8.46% or about 9.43 million people. However, based on the projection of the Institute for Development Economics and Finance (Indef), due to current economic crisis the number of poor and unemployed in 2008 may increase to 9.5% and 16.3% respectively (Depsos[6], 2009).

Indonesia's GDP is approximately US$ 175 billion in 2008, in which trade (16.7%), manufacturing (28%), agriculture (15.4%), and services (10.17%) are the main contributors. Earnings from exports were about US$ 69 billion (primarily oil and gas, textiles, appliances, coal, copper), while imports accounted for about US$ 44.8 billions (primarily food, chemicals, capitals and consumer goods). GDP growth has increased steadily since 1998, reaching 6.3% in 2007 thus bringing per capita GDP to around US$ 2,000, which is considerably higher than the pre-crisis level (around US$1,000). The role of non-oil and gas sectors has become more significant since the Asian Financial Crisis (AFC); the oil and gas sectors' contribution to the economy decreased, as indicated by the negative growth rates for the whole period, except in the year 2000. Among the non-oil and gas sectors, agriculture has played an important role. It is the sector least aff ected by the AFC and in fact helped the recovery of Indonesian economy after the crisis. This was due to its role as "the employer of last resort" and its substantial increases in exports[7]

[4] Trading Economics website as http://www.tradingeconomics.com/indonesia/population, accessed on Dec 16th 2013

[5] RPJMN stands for *"Rencana Pembangunan Jangka Menengah Nasional"*

[6] DEPSOS: Ministry of Social Affair of Indonesia

[7] Indonesia Second National Communication Under The United Nations Framework Convention on Climate Change (UNFCCC)

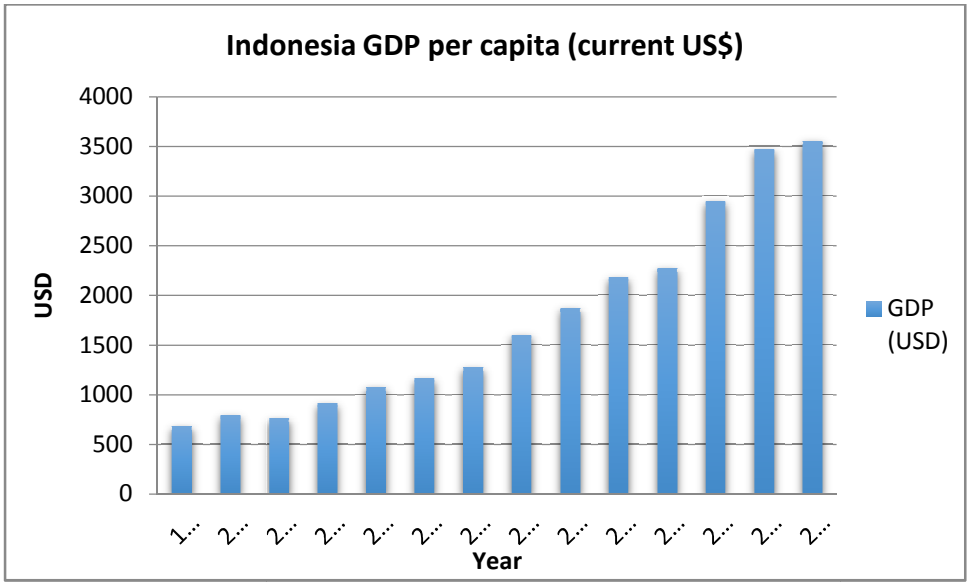


Figure 5GDP Indonesia[8] 1999 –2012

Energy

Indonesia's energy demand remains highly dependent on fossil fuels, although there is a huge potential for renewable energy (RE) to play a larger role in the energy mix. Formuch of Indonesia, with its relatively isolated islands and regions, provision of basicenergy needs by RE is an appropriate option. The GoI Energy Management Blueprint[9] 2005-2025projects that the share of RE in the primary energy supply will grow from the 4.3% in year 2005 to 17% in 2025, with RE playing an increasingly important role, particularly forgeothermal and biofuels.

The GOI is commended for its efforts to shift policy to accelerate the penetrationof RE technologies into the marketplace and to create jobs and generate income byusing locally available energy sources. However, the great challenge now is to introducecost-effective incentives that will attract the necessary investments and bringsustainability to the deployment of RE technology. This would be another task fora Directorate General of Energy Efficiency, Conservation and Renewable Energy inthe Ministry of Energy and Mineral Resources.

Keys to sustainability in the deployment of RE technology are the removal ofsubsidies in fossil fuel retail pricing and electricity tariffs, and the establishment of aregulatory framework that will provide incentives and clarity to investors on issue related to the bidding procedure for new projects and the ongoing taxation and REfeed-in tariffs. This is equally applicable to all REtechnologies and the incremental costs of these RE systems should be reflected inthe tariff to the local electricity consumer rather than recovered from the governmentbudget.

[8] World bank website, GDP Indonesia accessed on Dec 18th 2013, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries/ID?page=2&display=default

[9] Ministry of Energy and Mineral website, accessed on Dec 18t 2013, as http://esdm.go.id/publikasi/lainlain/doc_download/714-blue-print-pengelolaan-energi-nasional-pen.html

Indonesia's Commitment for Climate Change

At the G-20 meeting in Pittsburgh and at UNFCCC COP15 in Copenhagen in 2009, the President of the Republic of Indonesia committed to achieve the target of 26% reduction in carbon emissions from a Business As Usual (BAU) scenario by 2020. Further emissions reductions of up to 41% are expected to be implemented with international support. These commitments were submitted as Indonesia's nationally appropriate mitigationactions to the UNFCCC in January 2010.

This is fully in line with Indonesia's continued efforts to implement its target under theClimate Change Convention and contribute to a global mitigation effort in accordancewith the principles and provision of the Convention. Furthermore, the Government ofIndonesia has developed a national policy framework and action on climate change. Toadvance and promote the effort nationally, the Government of Indonesia (GoI) enactedthe Presidential Regulation No. 61 – the National Action Plan for GHG emission reduction(Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca, henceforth RAN-GRK) on 20September 2011.

Table 1Allocation of emission reduction target per sector in 2020 (tCO2e)

Sectors	Target of Reduction (tCO2e)	
	26%	41%
Forestry and Peat Land	672,000,000	1,039,000,000
Agriculture	8,000,000	11,000,000
Energy and Transport	36,000,000	56,000,000
Industry	1,000,000	5,000,000
Waste	48,000,000	78,000,000
Total	767,000,000	1,189,000,000

Based on this framework, all 33 provinces in Indonesia was expected to form the local action plan in accordance with national target.

Indonesia's Carbon Story

Indonesia is also among the world's largest emitters of greenhouse gases (GHGs), with land use change and deforestation the largest contributor to GHG emissions. Energy-related emissions are dominated by industry, power, and transport sectors and the energy sector is the third largest source of CO_2 emissions.

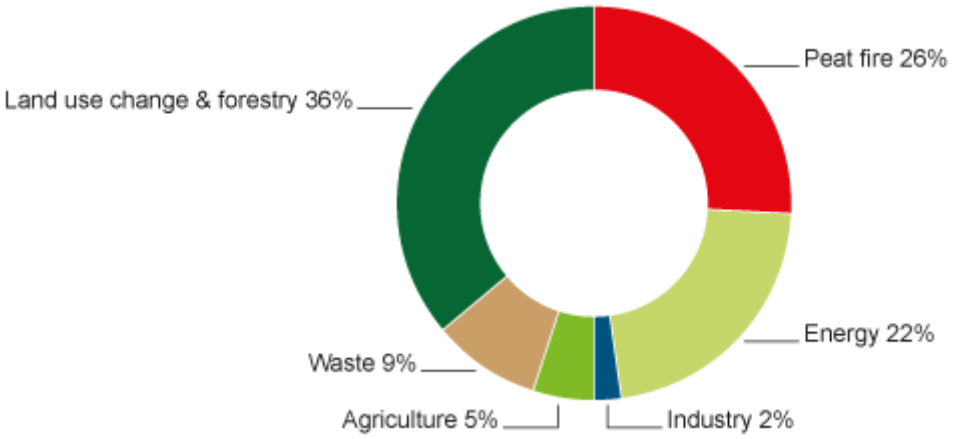


Figure 6 Indonesia's emissions profile[10]

Indonesia has abundant primary energy resources that are utilized to meet domestic demand and export requirements in the form of oil, liquefied natural gas (LNG), and coal. Coal is Indonesia's largest fossil fuel resource, with proven reserves of 5,300 million tons of lignite and sub-bituminous coal located predominantly in Sumatra and Kalimantan. The Indonesian Government plans to rapidly expand the domestic use of coal for electricity generation. In the foreseeable future, power generation and industrial use will continue to dominate coal utilization[11].

Indonesia also has substantial renewable energy resources. Historically, while the focus has been on export revenue, since early this decade, there has been a rapid re-orientation by the Indonesian Government towards meeting its domestic energy needs.

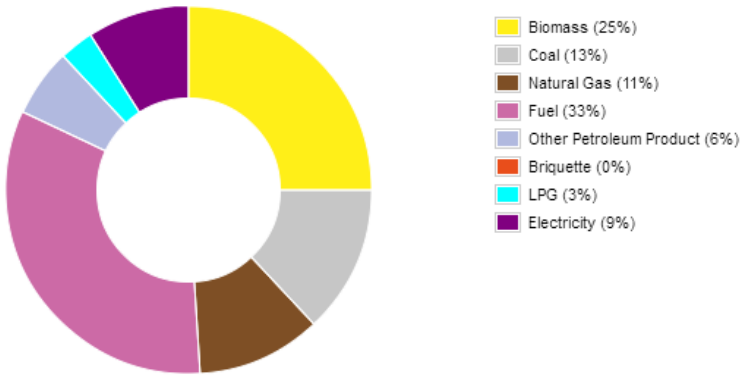


Figure 7 Indonesia's energy consumption by type in 2011[12]

[10]Clean Technology Fund Investment Plan for Indonesia, 2010

[11]US Aid, 2008, Indonesia Energy Assessment

[12] Handbook of Energy & Economic Statistics of Indonesia, Ministry of Energy and Mineral Resources (Indonesia) 2012

Since 2007, the climate change development in Indonesia gathered significant momentum when Indonesia hosted the 13th COP of the UNFCCC in Bali. Indonesiaestablished several institutions and enacted several policy documents and relatedregulations to address climate change. The National Council for Climate Change (DewanNasional Perubahan Iklim, henceforth DNPI) was formed in 2008 and acts as the nationalfocal point for climate change issues discussed in international forum. Subsequently, theGoI mainstreamed climate change activities into the National Medium-Term DevelopmentPlan 2009-2014 (RPJMN)and established a national trust fund (ICCTF) to finance climate change activities. At theend of 2009, Indonesia announced its voluntary commitment to mitigation followed bythe issuance of Presidential Regulation No. 61/2011 on the National Action Plan to reduceGHG emissions

The National Greenhouse Gases Inventory (NGHGI) was estimated using Tier 1 and Tier 2 of the2006 IPCC Reporting Guidelines and the IPCC GPG for LULUCF. In 2000, total GHG emissions for the four main greenhouse gases (CO2, CH4, N2O, PFC) without LULUCF (LUCF and peat fires) reached 56,728.78 Gg CO2equivalent. With the inclusion of LULUCF, total net GHG emissions from Indonesia increase significantly to about 1,377,982.95 Gg CO2e. The GHG emissions (in CO2 equivalent) were distributed unevenly amongst the three gases recorded, i.e. net CO2 totalled 1,112,878.82 Gg, representing 80.8% of the National GHG emissions; methane (CH4) totalled 236,617.97 Gg (CO2equivalent) or 17.2%; and nitrous oxide (N2O) totalled 28,341.02 Gg (CO2equivalent) or 2.0%. The main contributing sectors were Land Use Change and Forestry, followed by energy, peat fire related emissions, waste, agricultural and industry.

Table 2 Summary of GHG emissions from 2000-2005 from all sectors (in Gg CO2e)[13]

Source	2000	2001	2002	2003	2004	2005
Energy	280,937.58	306,774.25	327,910.62	333,950.21	372,123.28	369,799.88
Industrial Process	43,043.52	49,810.15	43,716.26	47,901.63	47,985.20	48,733.38
Agriculture	75,419.73	77,500.80	77,029.94	79,828.80	77,862.54	80,179.31
LUCF	649,254.17	560,546.00	1,287,494.79	345,489.33	617,423.23	674,828.00
Peat Fire	172,000.00	194,000.00	678,000.00	246,000.00	440,000.00	451,000.00
Waste	157,327.96	160,817.76	162,800.37	164,073.89	165,798.82	166,831.32
Total with LUCF & peat fire	1,377,982.95	1,349,448.96	2,576,951.98	1,217,243.86	1,721,193.07	1,791,371.89
Total without LUCF & peat fire	556,728.78	594,902.96	611,457.19	625,754.53	663,769.84	665,543.89

Indonesia Energy Sector

Indonesia is endowed with substantial energy resources that include both fossil fuels as well as a variety of RE resources. From the early days of independence until the late 1990s, Indonesia was a

[13] Indonesia Second National Communication Under The United Nations Framework Convention on Climate Change (UNFCCC)

major crude oil producer and exporter. Given this abundance, domestic consumption of petroleum products in the country was heavily subsidized, which also led to the development of the power generation subsector largely based on diesel and other petroleum-based fuels. By the 1990s, the crude oil reserve base was in decline and the Asian Financial Crisis contributed to the cessation of investments in new exploration as well as increasing the country's refining capacity. As a result, Indonesia has become a net oil importer. During this period, Indonesia also began to diversify its energy mix by developing its high quality coal reserves as well as its natural gas resources, which were being increasingly used for power generation. There was also a modest, yet significant, expansion of RE that included geothermal and hydro power. Despite this effort, Indonesia was unable to significantly reduce its dependence on petroleum-based fuels. The transportation sector continued to grow increasing its utilization of fuel while natural gas for domestic power generation became scarce since significant amounts were earmarked for exports.

Indonesia was at the epicentre of the Asian Financial Crisis in the late 1990s and its economy was badly affected and contracted significantly in its aftermath. As a result, there was excess power generation capacity in the country as the new millennium began. However, Indonesia has seen steady economic growth since, and the country's power sector has struggled to keep up with the high electricity demand growth triggered by the recovery. The financial position of the national power company (PLN), already weakened by the crisis, and further deteriorated due to the dramatic increase of oil prices on the international market from 2002 to 2008. PLN struggled to invest, requiring growing subsidies to maintain operations in a system that was still highly dependent on petroleum products where declining domestic production was being met with increasing levels of imports. Private sector investments also came to a halt during this period. Current power supplies barely keep up with demand which is increasing at around 8 percent per year, and brownouts and load shedding have become commonplace affecting economic growth and even ordinary consumers. PLN has estimated that some 2,500 MW of new power generation capacity is required each year in order to meet the growing demand. In 2006, the GoI devised the first "Fast-Track" program for the construction of 10,000 MW of coal-based power generation plants by PLN, which was viewed as the only readily available solution for utilizing abundant domestic coal resources to displace high-cost generation units in an affordable manner. This decision, along with existing heavy use of diesel, will further increase the country's dependence on fossil fuels, exacerbating local and global environmental impacts: an additional 10,000 MW of coal-fired power will add an estimated 55 million tons of CO2 per year. Overall, estimates suggest that if this trend were to continue, it would result in a manifold increase in CO2 emissions from the power sector over the next two decades.

In late 2008 GOI continued to expand its power generation capacity in order to keep up with demand by launching a Second Fast-Track Program to construct another 10,000 MW of capacity in which 60 percent will be comprised of RE, with geothermal accounting for about 4,800 MW and hydropower accounting for most of the other RE capacity. Geothermal power is one of the best options to diversify Indonesia's energy mix. It is a base load generation technology not subject to the intermittency and variability of most renewable electricity sources. As an indigenous energy source, it will also enhance the country's energy security and serve as a natural hedge against the volatility of fossil-based commodity prices. As such, geothermal can directly displace coal-fired power generation. In addition, hydro power and biomass at various scalesprovide a useful opportunity to utilize local resources for grid-based power as well as foroff-grid solutions to increase rural electricity access that will contribute towardsalleviating poverty and improving people's quality of living.

The GOI has been reviewing electricity pricing and subsidy policies, since substantial economic distortions remain. Although some reforms have taken place, the aim is to further rationalize energy sector pricing, improving the targeting of subsidies to poor consumers, and promoting reforms necessary for the long term sustainable development of the energy sector. Energy subsidies still make up a substantial portion of the state budget. Since PLN continues to rely on petroleum-based fuels for a large part of their power generation, the increased international oil prices have driven their cost of supply from about US$0.06/kilowatt-hour (kWh) in 2004 to about US$0.12/kWh by 2008 (JICA 2009[14]) . Since these price increases were not passed through at the retail level to consumers, PLN required a subsidy of US$6.5 billion in 2008 to cover the resulting losses. Fuel subsidies represent an even higher cost to the Government budget, although the GOI has eliminated them for some sectors such as power, industry and specific categories of transport. As a result, the prospects for EE have improved, and opportunities will continue to get better as prices are further reformed and distortions are removed. Improved utilization of energy will not only make Indonesia economically more competitive, but also help reduce the strain on the power sector and reduce the burden on the national budget. Therefore, further rationalizing fuel pricing and subsidy policies remain an imperative for improving efficiencies, minimizing price shocks, and ensuring that the vulnerable are protected.

The GOI has also made strides to improve the policy environment so that reforms can take hold. The recently enacted Energy Law[15] (UU 30/2007) and the Electricity Law[16] (UU 30/2009) provide a renewed legal framework for the overall energy sector, with emphasis on economic sustainability, energy security, and environmental conservation. The Energy Law places high priority on development of domestic resources, including RE. The Electricity Law defines the regulatory and institutional framework for the power sector going forward, and is expected to further encourage RE and EE. Therefore, the energy sector is at a crossroads where, with continued reforms and appropriate interventions, it can move towards greater efficiency in a climate friendly manner while protecting the poor.

[14] "Study on Energy Conservation and Efficiency Improvement in The Republic of Indonesia, Final Report Summary;" August 2009

[15] http://esdm.go.id/regulasi/uu/doc_download/4-undang-undang-nomor-30-tahun-2007.html

[16] http://esdm.go.id/regulasi/uu/doc_download/977-undang-undang-nomor-30-tahun-2009.html

Integrated Climate Change Strategy in Yogyakarta

Yogyakarta, as the capital city of Yogyakarta Special Region Province, has developed rapidly in all sectors. In recent times, a spurt in the growth of population and business activities has been witnessed, as a consequence of Yogyakarta being a cultural and tourism hub for foreign and local tourists, and as a centre for education city. People from smaller neighbouring cities come to Yogyakarta to study or to make a living in the city.

The growth of population and development of urban activities needs a commensurate increase in supporting infrastructure, such as water supply and sanitation systems. Intensive groundwater withdrawal in this city without sufficient recharge of groundwater affects the groundwater supply balance from time to time, indicated by a decreasing in groundwater levels (decrease in potential energy) and a reduction in groundwater supply capacity (decrease in quantity).

Increasing population density and insufficiently treated domestic wastewater coupled with the sandy nature of the local soil, contribute to deteriorating groundwater quality. This is indicated by increasing faecal coliform content in groundwater wells in the urban area.

Figure 8a and 8b geographically illustrates Yogyakarta Province

Yogyakarta province borders on the districts of Sleman and Bantul. The city lies approximately 114 m above sea level and is divided into 14 sub-districts over an area of 32.5 km2.

The average annual rainfall reaches 2.012 mm/year, with 119 rainy days, an average temperature of 27 degrees Celsius and an average humidity of 24%. During rainy season, the south-west wind brings relatively wet air, whereas during dry season, south-easterly winds bring dry air with a wind velocity of 5-16 knots/hour. In 2010, the total population reached 456,915 inhabitants with a population density of 14.58 inhabitants per km2 and a population growth of 0.1%. The city's gross domestic product (GDP) depends mainly on the secondary and tertiary sectors such as hotels and restaurants (25.06%); services (21.8%); transportation and communication (18.32%); financial services and leasing (14.03%) and the processing industry (11.67%).

In 2010, the government of Yogyakarta launched its cooperation with GIZ PAKLIM to develop an Integrated City Climate Strategy (ICCS). Based on data from 2009, the government sector generates approximately 9.490 tCO2e of GHG emissions – mainly produced by street lighting (82%), followed by the government vehicle fleet (15.7%), and energy use in government buildings (2.4%). In comparison, the community sector generates approximately 927,911 tCO2e of GHG emissions produced by settlements (39.6%), followed by transportation (22.2%), the commercial sector (17.7%), waste (17.1%), and the industrial sector (3.4%). Yogyakarta's ICCS formulates action plans and strategies that can support the target of decreasing projected GHG emissions by 15% by 2020.

To counter the impacts of climate change, mitigation and adaptation actions will be targeted at reducing the risk of dengue fever, twisters (stormy weather), river floods, droughts, and extreme temperatures (heat waves). All climate change action plans will be formulated along eight strategies to combat dengue fever, improve the dissemination of climate change information, improve water resource management (WRM), minimize the negative impacts of extreme temperatures, improve the energy efficiency of buildings and street lighting as well as in the industrial sector, improve transport management and integrated waste management.

http://www.paklim.org/about/climate-change-strategies-in-cities-2/yogyakarta/#sthash.88OZlDeN.dpuf

Chapter 2:National and Sub-national Obligations

Indonesia Government plays a major role in climate change mitigation in cities. The policies and strategies emerging fromthe Indonesiagovernment recognise that cities are major GHG emitters and are vulnerable to the impacts of climate change. For Indonesia to achieve reduction targets mitigation of 26% below BAU level by 2020 through domestic eff orts and the target of 41% reduction to be reached with international support, there is a need for cities to play a pivotal role in the attainment of these goals as they are the hubs of carbon intensive activities and focusing on cities provides the highest emissions reduction impacts. In way to achieve the reduction target, Provincial and Local governments are encouraged to take action in managing land utilization, improvement of agriculture practice, introduction of integrated waste management and conservation of energy.

The following section identifies legislation at the National and Provincial levels, from which cities should align local efforts with higher level obligations, while the Indonesia nation as a whole can collaborate on joint efforts to build and work towards a healthier and sustainable future.

The Development of Climate Change Policy in Indonesia

Indonesia's National Council on Climate Change, which has 17 Ministers and is chaired by the President, is in charge of coordinating Indonesia's climate change policies and international positions. The Council is supported by several Working Groups, including on mitigation, and transfer oftechnology.

Indonesia is developing a strategic, multi-year policy and investment program for low-carbon growth, as outlined in the National Action Plan for Climate Change (NAP 2007) and the Development Planning Response to Climate Change (2008).

In Indonesia, many of the key initiatives are embodied in decrees rather than legislation, and passed by Ministries rather than Parliament. In late 2011, President Susilo Bambang Yudhoyono approved a decree that obligates Indonesia to cut its emissions by 26 per cent below unchecked levels by 2020, and by 41 per cent if the country can secure international funding.

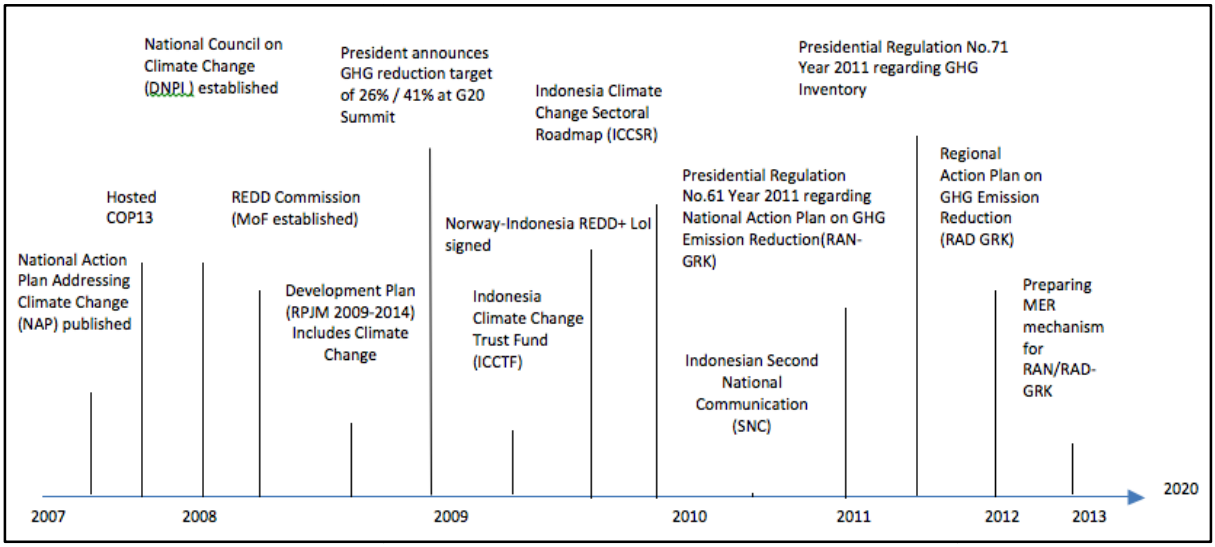


Figure 9 Indonesia Climate Change Development histories

Indonesia's National Action Plan (NAP) to Combat Climate Change

Indonesia does not have any obligation to reduce its greenhouse gas emissions; however, it has demonstrated interests in playing an active role in the global efforts to tackle climate change. The NAP, which was released in November 2007, is a dynamic instrument to serve as guidance to various domestic institutions in carrying out a coordinated and integrated effort to address climate change. In the area of mitigation, the NAP identifies energy and land use change and forestry as key priorities where Indonesia will seek international cooperation and funding to support its effort. In the energy sector, the NAP establishes an emissions reduction target of 30 percent from BAU during the period 2012–2025, and a 50 percent reduction from BAU during the period 2025–2050. The three main priorities areas of focus are diversification toward renewable energy sources, improving energy efficiency in industrial sectors, and implementation of cleaner energy technologies. Under adaptation, the NAP aims to target a range of key areas, including climate information forecasting to manage risk; agricultural intensification and irrigation technologies; water resources management improvements; energy and water saving technologies in the industry sector; and health sector improvements to prevent disease, identify impacts, and utilize natural medicinal plants.

The NAP also focuses strongly on the need for institutional capacity building and for harmonization and revision of the regulatory policy framework for sustainable development management. The NAP outlines existing climate change response actions, including ratification of international agreements, creation of domestic institutions, passage of laws and regulations in the energy, minerals, and forestry sectors, and implementing programs to improve energy use, address forest and land fires, combat illegal deforestation, improve management of peat land, address flooding issues and conduct integrated coastal zone management. To implement the actions outlined in the NAP, Indonesia plans to utilize domestic public finance through new mechanisms and fiscal instruments; develop approaches for technology transfer from developed countries; and increase international support for its development priorities.

INDONESIA's PRIORITY SECTORS FOR GHG EMISSION REDUCTION

The NAP (2007) provides analyses of GHG emissions and a comprehensiveassessment and program for both adaptationand mitigation. Mitigation targets for energyrelatedemissions include a 30 percent reduction from BAU during the period 2012–2025,and a 50 percent reduction from BAU during the period 2025–2050. Indonesia's TNA[17]report (2009) includes energy **modelling**, technology assessments and cost estimateswhich indicate that over 30 percent GHG reductions are technologically feasible by 2025**.** Emission reductions would be achieved through acceleration andexpansion of a combination of a broad spectrum of demand- and supply-side EE,accelerated development of RE systems, development of clean-coal plants, anddeployment of carbon capture and storage from fossil-fuel power plants.

Based on technology and cost analyses presented in the 2009 TNA report, GHGreduction priorities are in industrial EE, EE and RE in the power sector, and cleanertransport. This is also substantiated

[17]TNA: Technology Needs Assessment onClimate Change Mitigation (Climate Investment Fund – 2010)

by a recent draft marginal abatement cost curve presented by the National Climate Change Committee in 2009, in which it highlights the ranking of costs andabatement potentials of mitigation options in the power sector, as the following: (i) EEand conservation, particularly industrial end-use efficiency; and (ii) RE,primarilygeothermal, hydropower, and biomass. The third option, which is proposed for a secondphase investment if Clean Technology Fund funding is forthcoming, (iv) cleaner transport.

Indonesia's most recent policy document on climate change is the Second National Communication under the UNFCCC (November 2009)[18]. The Communication reports that energy is the largest non-land use source of emissions, growing from 333,540 Gg CO2 in 2000 to 395,990 Gg CO2 in 2005 which represents a 25 percent increase. The Communication further notes that, with RE and EE measures, emissions from the energy sector could be reduced by 2020 in a range between 35 and 40 percent compared with the BAU scenario[19]. Mitigation options include increased power generation from new/renewable energy sources such as geothermal and increased EE in the transportation, industry and residential/commercial sectors.

Indonesia has also recently issued its Green Paper on Economic and Fiscal PolicyOptions for Climate Change Mitigation (Ministry of Finance, November 2009). For theenergy sector, it proposes to: (i) impose a carbon tax/levy on fossil fuel combustioncoupled with access to international markets, facilitated by negotiation of a "no-lose"target, and (ii) introduce complementary measures to incentivize EE and deployment oflow-emission technology, exemplified by a specific geothermal policy strategy.

The identified GHG reduction priorities are being translated into actions(investments, programs and policies) through the following vehicles:

- NAP – the NAP (2007) calls for a range of mitigation actions in the energy sector revolving around energy efficiency and renewable energy. These were translated into a set of initial investments for 2008-09 by BAPPENAS through the RPJM (2008).
- Climate Change Roadmap – reducing carbon emissions from the energy and forestry sectors are pillars of the roadmap that seeks to bridge the period between the NAP and the National Medium-Term Development Program 2010-2014.
- Presidential commitment – the President of Indonesia has recently committed to significant reductions in future GHG emissions. He has asked that nearly half of these reductions come from the energy sector and by reducing waste. The Government is currently formulating its proposals for achieving these targets.

Beyond these specific actions, Indonesia has put forward three consistent development and climate change messages: (i) climate change cannot be addressed at theexpense of the poor; (ii) climate investments must be consistent with development goals;and (iii) climate assistance must be on top of past development assistance commitments.

[18] http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf

[19] Average value of historical emission [Year 2000 – 2005]

Indonesia plans to improve emission estimates, particularly from LULUCF and peat lands in the next National GHG Inventory. At present, activities undertaken by the Ministry of Forestry and Ministry of Agriculture to improve emission estimates from peat lands are the following:

a. The Ministry of Agriculture (through the National Research Consortium for Climate Variability and Climate Change) is conducting studies to develop emissions factors from peat lands under different usage scenarios in Central Kalimantan. The Ministry of Agriculturewill also expand this study to other provinces and request support from internationalagencies. Additional surveys to improve data on peat depth (particularly in Papua) are alsobeing planned. It is expected that the funding allocated for the 3rd National Communicationcan provide additional support for the studies.
b. The Ministry of Forestry is improving the emission sink factors from forests and emissionfactors from fi re (both in mineral soils and peat land). The programme is being undertakenthrough the INCAS (Indonesian National Carbon Accounting System) and other relevantresearch programmes under the MoF and partners.
c. The state Ministry of Environment is conducting a pilot study on Peatland Management,including calculation of GHG emissions from peat lands in West Kalimantan and RiauProvince.
d. A detailed analysis commissioned by Indonesia's National Development Planning Agency(BAPPENAS) is also commissioning a detail analysis on peat land emission and projectionas well as mitigation strategies. The analysis is undertaken by a multi-disciplinary team ofIndonesian scientists, economists and legal specialists.

Chapter 3: Evolution of the Solar City Concept

With rapid urbanization and concentration of economic activities in urban areas, cities have emerged as large consumers of energy and resources. With the coming of age position taken towards better and greener cities led to the development of many concepts for sustainable city development, and one of which was the concept of a Solar Cities.

Initiatives began in the form of networks made up of cities, sometimes coordinated by national or regional governments that worked on creation of policy and enabling market mechanisms along with strong awareness generation for the local adoption of renewable energy. Some of the initialgroups that joined this movement included the Brundtland City Energy Network formed in 1999, the European Green Cities Network in 1996, Energie Cites Association [Energie C].

The First International Solar Cities Initiative (ISCI) World Congress was held in Daegu, South Korea, November 14-18 2004. At this Congress, 19 cities from around the world presented their policies and programs for incorporating renewable energy and other clean energy forms into urban development.

"The term 'solar (and sustainable) cities' is a broad term that can encapsulatemany different initiatives, activities, and technologies. Generally, it implies renewable energy, energy efficiency, sustainable transport options, new urban planning methods or goals, architectural innovation, and environmental health.

Definitions of "solar cities" by the International Solar Cities Initiative and the European Solar Cities Initiative also include a "climate-stabilization" aspect, whereby cities responsibly set per-capita targets for future *greenhouse-gas emissions at levels consistent with stabilizing future levels of atmospheric carbondioxide and other greenhouse gases."*

Eric Martinot (www.martinot.info)

City solutions range from solar photovoltaic panels to offshore wind farms, to a concentrating of solar power towers. Environmental auditing, smart metering and certification are other strategic solutionsthat are employed in several cities around the world. All of these initiatives are supported in all such cities by strong awareness raising and promotional activities.

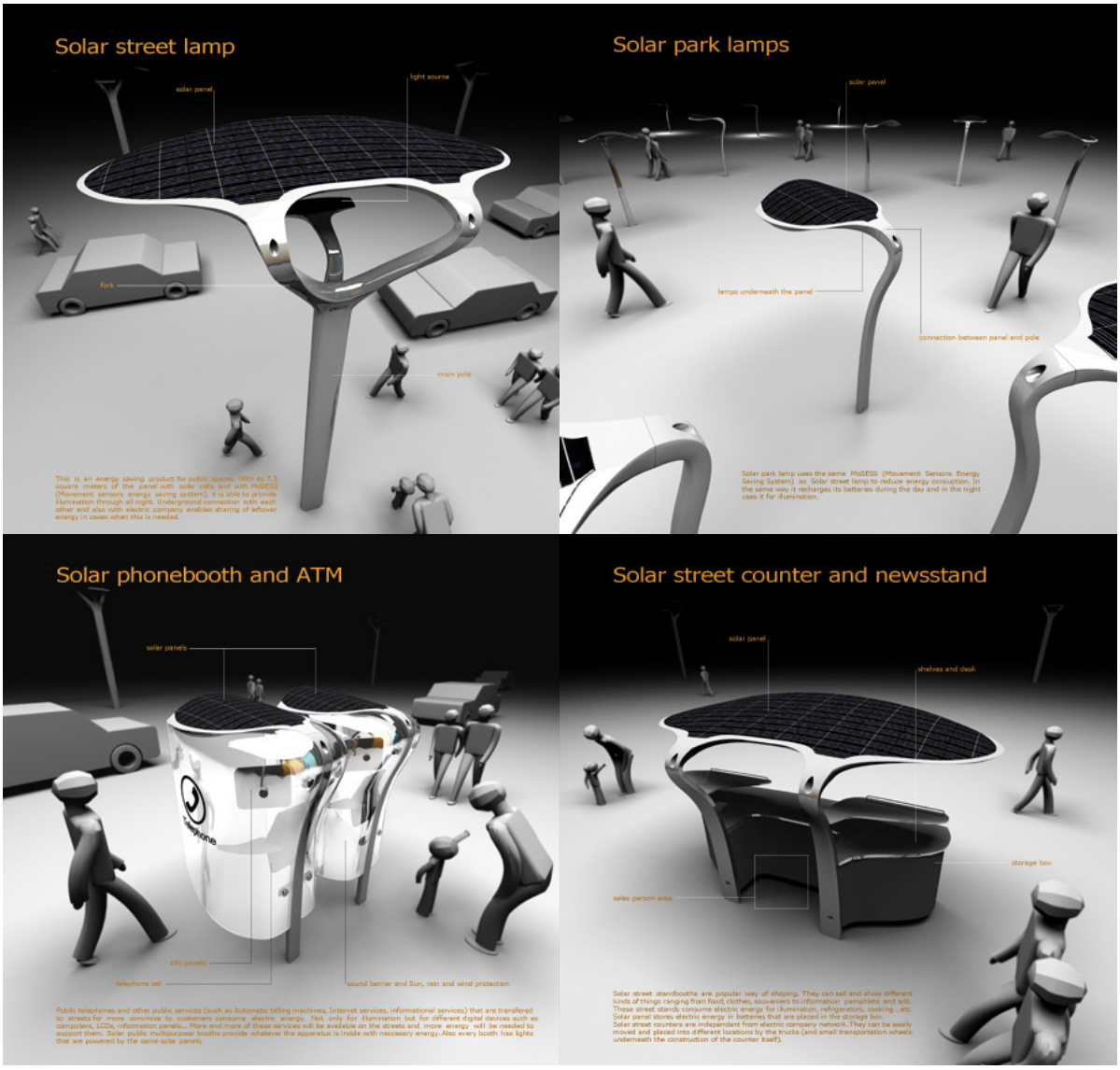


Figure 10: Solar city initiatives by Nikola Knezevic

Features of international solar city programs

The tables below providenine case studies of international solar city programs, in summary the Program names are listed below:

1. 100,000 Rooftops Solar Power Program (Germany)
2. Solar Cities (Australia)
3. Development of Solar Cities (India)
4. Solar America Communities (America)
5. European Solar Cities
6. Freiburg Solar City (Germany)
7. SolarCity Linz (Austria)
8. Solar City Daegu (SCD) 2050 (South Korea)
9. Solar Cities in China (China)

S. no.	Particulars	Description
1	Name of Program	100,000 Rooftops Solar Power Program (Germany)
2	Instating agency	German Federal Government
3	Timeline	1999 to 2004
4	Scope	Country-wide initiative to install solar panels on 100,000 rooftops with cumulative increase over the program duration. Anyone with a south facing and adequate roof area was eligible for the program
5	Motivation	Increasing the renewable energy share in the country's energy mix and to decrease dependence on fossil fuels. Emission reduction commitment under Kyoto protocol was also a factor. Other aims/objectives were to: • Address energy issues independent of nuclear energy • Gain experience with solar installations • Make new housing compatible with renewable electricity generation needs
6	Approach	Interested home owners and institutions applied for the loan from the total funding earmarked by the Federal Government at $500 million. 10-year low interest loans were sanctioned to the applicants who were to contract solar PV companies and installers for installation based on their individual home requirements. The loan precluded any down payments or interest for the first two years and the installation was subsidized to roughly about 20% of its total value.
7	Impact	• Successful installation of solar panels on 100,000 rooftops in the country • The program significantly increased the share of solar energy use in Germany with 130 MW installed until 2000 and significant capacity increments expected thereafter. • Increase in the mass manufacture capability of German solar panel manufacturers • Increased public interest, awareness in solar energy eventually stimulating consumer usage of solar energy • Continued and reliable dependence on solar energy in domestic and industrial sectors continues making 20% of German energy needs renewable energy dependant
8	Sources	http://www.a1solar.co.uk/german_rooftop_program.html http://thebreakthrough.org/blog/2009/04/soaking_up_the_sun_solar_power.shtml

S. no.	Particulars	Description
1	Name of Program	'Solar Cities' (Australia)
2	Instating agency	German Federal Government
3	Timeline	2004 and on going
4	Scope	Australian Government in partnership with the community and industry is set to trail a range of products and services under real-world conditions in seven cities across the country.
5	Motivation	The government intends to reduce household energy bills and limiting and deferring upgrade to electricity infrastructure by leveraging solar energy towards urban self-sufficiency.
6	Approach	Seven cities Adelaide, Alice Springs, Blacktown, Central Victoria, Moreland, Perth and Townsville were developed as Solar Cities with financial and technical assistance from the Government. The program is aimed at monitoring and rewarding the households that use energy wisely, implement solar technologies and engage in actively reducing their emissions. The review would entail benefits like tax cuts, higher family benefits, higher pension and allowances.
7	Impact	• The program ties in with other climate change mitigation and low carbon initiatives of the Australian government • The success of the 'Solar Cities' program has helped instigating the National Solar Schools Program which is a country-wide initiative and has recently added 784 more schools to about 3000 existing ones. The schools are being given grants of up to $50,000. The program began on 13th Feb 2012 and will last for a year. • Among other achievements some were: ✓ Two 300 kW PV parks in Bendigo and Ballarat ✓ Australia's largest roof-mounted solar system (at the time of installation)—a 305 kW PV system at Crowne Plaza in Alice Springs
8	Sources	http://www.cleanenergyfuture.gov.au/solar-cities-a-catalyst-for-change/ http://www.cleanenergyfuture.gov.au/more-schools-to-go-solar/

S. no.	Particulars	Description
1	Name of Program	'Development of Solar Cities' (India)
2	Instating agency	Central Government of India, through the Ministry of New and Renewable Energy (MNRE)
3	Timeline	2008 and on going
4	Scope	MNRE is targeting 60 cities to be developed as Solar Cities out of which 31 have been given in-principle approval for development into solar cities. The program is administered by Central government designated State-level nodal agencies and will include a set of activities to be mandatorily undertaken in efforts to plan for a10% reduction in conventional energy demand over the next 5 years.
5	Motivation	Burgeoning cityscapes and rapid urbanization are increasing the energy demand on already energy-strained Indian cities. As a means of developing Indian cities as self-sustaining energy hubs, the program aims at introducing renewable energy and energy efficiency initiatives through comprehensive planning, implementable activities and increasing local capacity building
6	Approach	MNRE undertook a novel approach in implementation of the program: • The cities are invited to sign-up for the program based on the guidelines issued by MNRE • The cities then prepare a Master Plan through MNRE authorized consultants outlining the activities and plan of action • Upon approval of the Master Plan, the city Corporations implement the pilot projects and set the solar city development in motion • Funding for the program is subsidized by the MNRE and the cities are developed as pilot cities and model cities for demonstration of success • Each solar city is directed to establish a dedicated solar city cell which will serve as the nodal point for all activities taking place under the program
7	Impact	• Solar Cities program has imparted State and local level autonomy to undertake renewable energy and energy efficiency initiatives which are best suited to local conditions • In principle approval has been issued to 48 cities out of which 37 cities have had their Master Plan sanctioned • Seven cities have already started executing the Master Plans and out of Rs. 17.23 crore earmarked for 37 cities, Rs. 2.75 has been released for utilization to nodal agencies/municipal corporations • The project will be expanded over the next few years with learning taking place from its initial phases.
8	Sources	*mnre.gov.in/file-manager/UserFiles/solar_city_guidelines.pdf* http://www.mnre.gov.in/schemes/decentralized-systems/solar-cities/

S. no.	Particulars	Description
1	Name of Program	'Solar America Communities' (America)
2	Instating agency	Department of Energy, Government of USA
3	Timeline	2007 to 2008; Scaled up in 2010
4	Scope	The program was aimed at increasing the federal-local partnerships and development of feasible solutions in 25 cities in the country. The program also involved capacity building and training local government staff to facilitate development of Solar America communities. The program guidance and capacity building initiatives were also scaled-up in 2010 with an aim to be expanded to reach up to 5,000 local governments supported by a funding of $10 million over 5 years.
5	Motivation	The program was aimed at increasing widespread, large-scale adoption of solar across America by making solar energy systems cost-competitive with other forms of energy by the end of the decade.
6	Approach	Within each of the 25 cities, the following activities facilitated the project execution: • Instatement of a Solar Advisory committee and local solar coordinator. • Preparation of targets based on survey of city inhabitants and identification of local barriers • Guidance and training of local governments in solar policy and regulations, financial initiatives and workforce training
7	Impact	Besides successfully creating jobs and awareness of the program in American cities, the program has increased the public-private partnerships. Funding from DOE's Solar America Initiative of approximately $150 million for 13 solar technology development projects has been earmarked to advance the commercial competitiveness of solar electricity and to bring down the costs of Solar PV.
8	Sources	http://solaramericacommunities.energy.gov/ http://www.good.is/post/for-more-solar-energy-occupy-rooftops/ http://www.icleiusa.org/news/press-room/press-releases/department-of-energy-selects-iclei-to-accelerate-solar-adoption

S. no.	Particulars	Description
1	Name of Program	European Solar Cities
2	Instating agency	European Union
3	Timeline	Non-specific timeframes
4	Scope	The European Solar Cities initiative is a diversified mandate committed by the EU to render financial and organizational support such initiatives across Europe.
5	Motivation	Within a larger aim towards emissions reduction and climate change mitigation, the European Solar Cities initiative is motivated towards: ✓ Mobilizing stakeholders ✓ Increasing communication between cities ✓ Integrating cities especially from the Eastern Europe in Solar City development ✓ Maintaining a repository of information for activities under the Solar City development mandate
6	Approach	European Union under its climate change mitigation framework has committed to co-fund, support and partly administer projects that leverage solar power for empowerment of cities to generate renewable energy. Some examples of the programs supported by the EU are: ✓ Multiplying Sustainable Energy Communities (MUSEC) ✓ Concerto Initiative ✓ European Solar Cities Initiative (ESCi) ✓ Desertec
7	Impact	EU has committed to an independent economy-wide emissions reduction target of 20% by 2020, compared with 1990 levels. In line with this commitment, each of the EU member country is increasing the use of solar and other renewable forms of energy through city level initiatives co-funded by the EU. Until Dec 2010, the total installed solar PV capacity was 29.32 GW_p.
8	Sources	http://www.eurobserv-er.org/pdf/baro202.pdf https://www.ises.org/ises.nsf/f3e5b699aa79d0cfc12568b3002334da/eba26afbc357097ac1256d73004be5ea?OpenDocument http://concerto.eu/concerto/about-concerto http://www.musecenergy.eu/web/project.html

S. no.	Particulars	Description
1	Name of Program	Freiburg Solar City (Germany),
2	Instating agency	Freiburg Local Government
3	Timeline	Non-specific timeframes
4	Scope	Working within their jurisdictional boundaries, Freiburg has introduced interventions in domestic, commercial, industrial and municipal sectors through systematic initiatives in the areas of transport, waste
5	Motivation	Driven by the city's energy policy based on energy conservation, the use of new technologies and the use of renewable energy sources, the city has resolved further to reduce emissions through calls for initiatives in the areas of transport, waste and industrial production, as well as energy
6	Approach	In Freiburg, the on-going solar city development is progressive and is not defined by timelines. The approach followed in this case is to introduce sustainable and eco-friendly measures (as explained above) through ordinances and government orders. Similar model of policy direction has been adopted by other European cities like Madrid, Pamplona, Sevilla, and Conil.
7	Impact	Freiburg has successfully reached a total installed solar PV capacity of 3.2 MW earlier than most European cities producing 3 million kWh per year for use in the grid. In addition, the city has introduced SWH systems and Solar Thermal systems for use in community swimming pools. Such ordinances and policies for environmentally conscious development have proved to be an asset for the city of Freiburg. Furthermore. The city aims to reduce its dependence on nuclear energy and increase use of renewable forms of energy.
8	Sources	http://www.solarregion.freiburg.de/solarregion/freiburg_solar_city.php

S. no.	Particulars	Description
1	Name of Program	SolarCity Linz (Austria)
2	Instating agency	EU and Local Government (Linz)
3	Timeline	Non-specific timeframes
4	Scope	Urban housing design and planning in Linz and the housing policy has been aligned for sustainable and environmentally conscious development.
5	Motivation	Besides the requirement of housing for a large section of city inhabitants, the program is motivated towards providing energy efficient living arrangements which stems from avoiding the use of fossil fuels and energy conservation.
6	Approach	Linz city government has developed sustainable urban spaces and housing projects. The project has satiated the rising housing needs of the inhabitants and also proved beneficial for future urban development projects through restructuring of outmoded housing policies.
7	Impact	The project began in early 90's and has succeeded in reducing housing investments through use of district heating systems and SWH etc. In addition, waste water management and its reuse for agricultural purposes have been successfully implemented. About 1300 housing apartments were built in the pilot phase and the urban and infrastructural development policies in Linz have been since restructured for sustainable urban development.
8	Sources	http://www.linz.at/english/life/3199.asp

S. no.	Particulars	Description
1	Name of Program	Solar City Daegu (SCD) 2050 (South Korea)
2	Instating agency	Daegu Local Government
3	Timeline	Near-term project
4	Scope	The project is intended to develop and promote new and renewable energy industries within its borders and thereby increase 5% of its renewable energy use.
5	Motivation	The project is intended to increase, besides the share of renewable energy in the country's energy mix, community participation, real energy transition and spread of renewable energy projects in Asia.
6	Approach	The Solar City Daegu 2050 is a comprehensive city wide program composed of several initiatives including Green Villages, Solar Schools and Solar Villages. The project considers urban and peri-urban development through targeted programs which offer spill over benefits for further project promulgation.
7	Impact	Until 2006, the renewable energy development driven under the project has been successful in installing 4,412 at 35 sites and 170kW solar power generation facilities in 75 general households. The project also covered public places, precincts and community halls in addition to parking spaces and bus stops for solar PV installations.
8	Sources	http://www.world-renewable-energy-forum.org/2004/download/Kim.pdf http://www.ceep.udel.edu/publications/sustainabledevelopment/publications/2006_sd_BSTS_solar_cities_Daegu_2050_project.pdf

S. no.	Particulars	Description
1	Name of Program	Solar Cities in China (China)
2	Instating agency	Beijing Municipal Commission of Development and Reform
3	Timeline	Non-specific
4	Scope	Cities in China are heading towards extensive solar deployment in alignment with National solar development policy.
5	Motivation	Chinese renewable energy investments peaked in 2011 and increasing the share of renewable energy share in the country's energy mix, Chinese government is targeting renewable energy use in cities as a method to abate the impending energy crisis due to rising fossil fuel costs and its huge population.
6	Approach	The government has instated the development of solar energy through establishment of 6 major "Golden Sunlight Projects" which include 20,000 kW rooftop solar photovoltaic (PV) power generation project, a 50,000 kW on-grid solar power station demonstration project. Several similar such demonstration projects have been planned across the country and are intended to have a positive effect on global perception of Chinese clean technologies but also accelerate the country's solar development.
7	Impact	The project has been touted to increase Chinese share in global renewable energy percentage with total solar energy power generation capacity at 70 MW. The projections indicate that increase in capacity will even hit 300 MW by 2020. Beijing is thought to be the first solar city in China, heading to the target of being the largest solar market throughout the world. Beijing's solar development policies have been emulated at other cities like Dezhou, Rizhou, Kunming and others.
8	Sources	http://www.chinasolarcity.cn/Html/dezhou/index.html http://inhabitat.com/rizhao-the-sunshine-city/ http://www.gokunming.com/en/blog/item/295/kunming_named_chinas_solar_city

ICLEI Local Renewables Network

With the Local Renewables Initiative (LRI), ICLEI – Local Governments for Sustainability supports and strengthens the role of local governments that promote the generation and supply of renewable energy and energy efficiency in the urban environment. The focus is on the roles and responsibilities of local governments as a driving force for innovation and investment in their communities.

The focus on local government adoption and promotion of renewable energy and energy efficiency is because local governments play a key role in promoting sustainable energy at a community level. They have a political mandate to govern and guide their communities, provide services and manage municipal assets. They have legislative and purchasing power that they can use to implement change in their own operations and in the wider community. Local governments can further play a role as a model in their region or country, showing how policies and local actions can be shaped to guide communities in the transition to a sustainable energy future.

Leading cities cooperate in the global Local Renewables Network, share their expertise and experience on Renewable Energy and Energy Efficiency. The Network is open to cities and towns around the world that have either already shown exemplary activities to strengthen renewable and sustainable energy at the local level (LR) and/or are developing themselves into model LR communities. The network started with cities in Europe, India and Brazil. The initial funders of this network are GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) and GOF (UK Global Opportunity Fund) through the British Embassy in Brazil.

The Network aims to link three types of communities:

Model communities: Local governments that are selected and in the process of becoming sustained and sound LR Model Communities, benefiting from support through a project.

Resource Communities: Local governments that already have comprehensive integrated strategies and actions in place addressing sustainable energy, in particular focusing on RE and EE, providing advice to model communities and benefiting from the exchange.

Network Communities: Local governments that are linked to a current LR project and are committed to promoting the initiative and learning from the Model Communities in each country or region but do not have the full financial benefits of a current project.

Figure 11: ICLEI's Local Renewables Network consisting of three types of communities:Model, Resource and Network Communities

Chapter 4: Development and Implementation of a Solar Cityin Indonesia

Motivation for 'Solar City' Program in Indonesia

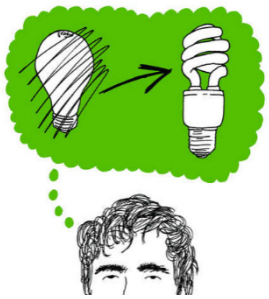
Indonesiagovernments are consistently improve development of electricity generation from renewable source locally.. The program called "Energy Development Programme in Integrated Urban and Rural Independent Energy Independent[20]". Inline with that program, It is necessary that local governments formalize their strategies and policies in-line with National and Provincial legislation in the aim to reduce energy demand and supply and increase and promote the use of renewable and energy efficient technologies. The goal of the Solar City program is to promote the use of renewable energy in urban areas by providing support to municipalities for preparation and implementation of a road map to develop their cities as Solar Cities. The objectives of this initiative are:

- To enable/empower urban Local Governments (LGs) to address energy challenges at the city - level;
- To provide a framework and support to prepare a master plan including assessment of current energy situation, future demand and action plans;
- To build capacity in the Urban Local Bodies (ULBs) and to create awareness amongst all sections of civil society;
- To involve various stakeholders in the planning process;
- To oversee the implementation of sustainable energy options through public - private partnerships.

Activities towards the development of a Solar City

1. Institutional:

a. Technical Assistance, Service Delivery and Information Dissemination



A technical officer, energy champion,within the city plays a critical role in obtaining interest, political buy-in and technical support at the city level. The champion will be required to lead the community into a behavioural change and new approach, from business-as-usual to an innovative way of thinking towards low carbon development from the house hold level to large industrial development. The champion mandate will be to facilitate the Solar City process and should be able to deliver quick and efficient technical assistance for the better understanding of RE and EE technologies, scientific concepts and equipment handling and usage. The technical assistance could be in the form of technical documents, vocal discourse, brochures and pamphlets.

[20]http://www.esdm.go.id/siaran-pers/55-siaran-pers/2710-pengembangan-energi-di-kota-terpadu-mandiri-dan-desa-mandiri-energi-di-kawasan-transmigrasi.html?tmpl=component&print=1&page=

Roles and Responsibilities:

- Contact point within local authority for all stakeholderson matters concerning energy and climate change;
- Keep informed of related international, national and local current affairs;
- Co-ordinate related projects and campaigns;
- Facilitate and mainstream energy and climate change policies and strategies across all local government department.

b. Establish a Stakeholder Committee

The Solar City Stakeholder Committee is a very integral component for the development of the Solar City process. The purpose of establishing an internalstakeholder committee is to ensure the parallel set up of a local site for exchange and collection of relevant data for sustenance, promotion and awareness generation of renewable energy and energy efficiency at the local level. The stakeholder committee will be the focal point and a critical player for implementation of the solar city development.

A "Solar City Stakeholders Committee" will be set up for advisory support involving representation from elected representatives in the municipal bodies, local research and academic institutions, resident welfare associations, industries and corporate organizations, NGOs, State Nodal Agencies and other relevant stakeholder

The stakeholder committee will be established within the municipality and will function under the full administration of the local government. The City Manager which will be the highest level authorizing personnel with a senior technical officer at the level of executive engineer or project manager whom will facilitate the process, activities and implementation. The officer in-charge will prepare all strategy and functioning modalities of the stakeholder committee, facilitate and support day-to-day activities, documentation, communication and every other activity under stakeholder committee. The stakeholder committee will provide technical guidance, expertise and financial analyses of projects for potential investors, individualsand companies.

Roles and responsibilities:

- Provide input and agree upon stakeholder committee terms of reference;
- Commit to terms of reference obligation;
- Be in attendance to all stakeholder committee meetings;
- Actively participate and provide best knowledgeable experience and expertise to agenda items and assignments;
- Be diligent and punctual on assigned portfolios or duties;
- Support and advocate the stakeholder committee within other networks.

2. Baseline Study and City Energy Profile

a. Baseline Study

A baseline study is required to link and incorporate all international, regional and national conventions, strategies, laws and climate related targets and action plans to the local government's core service delivery and plans. The city's planning and decision makers needs to ensure that these components are well aligned with the city's short-, medium- and long term plans and strategies to incorporate all the sectors and strive towards achieving an holistic approach towards city management.

b. City Energy Profile (GHG Inventory)

An important component towards the development of a Solar City is the understanding of the cities energy patterns and profile. Before the drafting of a city's master plan or/and action plan it is vital to undertake an energy audit, also known as a GHG inventory. For this activity it is important to consult the Stakeholder Committee established to provide an overview of the energy consumption consumed by the urban area. The respective Stakeholder Committee members will be able to identify all relevant energy consumption sources within the urban jurisdiction. It is recommended that data is collected and assigned to one of two modules: the governmental energy consumption and the community energy consumption.

Based on the collected secondary and primary data, an energy baseline would be prepared for each municipal sector. The secondary data should be collected for thepast 5 years, which provides a baseline and illustrates trends to inform more accurate projections of total and sectoral energy/emissions on current and future growth rates.

Accurate data is essential for energy planning and because the pool of data sources is large and often sources are scattered, it is not easy for the technical officer to collect all the data in a limited time period. In order to facilitate data collection, it is advisable that the technical officer within the local governments to schedule and facilitate meetings (or inception workshop) of all concerned departments/institutions at the beginning of the project. In such a meeting the technical officer can present on the data requirements and the local government can identify the correct agencies that would be the appropriate source for respective data. Local government departments and the Solar City Stakeholder Committee should assist with disseminating appropriate data request letters to all concerned agencies introducing the project, with a request for providing the respective data.

Data on energy consumption (electricity, petroleum products, coal and biomass) should be collected from residential, commercial, industrial and local governmental sectors (Waste, Transport, Waste Water, Water, Electricity and street lighting). Residential sector includes residential households and residential housing complex, while commercial sector includes all offices, shops, shopping centres,

multiplexes, hotels, restaurants, advertisement bill boards and institutional/government buildings include hospitals, schools, colleges, churches, hostels, jails, government offices, etc.

The major sources of energy for both residential and commercial sector are electricity and Liquid Petroleum Gas (LPG). In addition, a variety of fossil fuels may be used for power back-up e.g. diesel generators. In some cases, biomass fuels are also used for cooking and water heating.

The industrial sector includes all industries that fall within the municipal jurisdiction. Other than the electricity as an energy source, other fuels that are used within the Indonesian context include petroleum products (diesel, natural gas, naphtha and furnace oil), wood, coal and biomass

Municipal sector includes municipal services (water pumping, street lighting, sewage treatment). The main source of energy here would also be electricity.

A few steps to undertake to assist with the data collection:

- Assess the city boundary or jurisdiction;
- Identify types of energy used within the city;
- Identify key energy users within the city (i.e. Industry, Commercial, Transport, Residential);
- Separate the list of energy users into the two modules: Government and Community;
- Develop a data sheet form of the data required for each module;
- Schedule individual meetings with key stakeholders whom may assist with the data collection. Provide the data sheet for energy users to complete.
- Gather electronic data systematically and store data within a suitable GHG energy tool;
- Once all the required data is collected undertake the necessary calculations, accounting and reporting.

HEAT (Harmonised Energy Analysis Tool) Plus

HEAT+ is ICLEI's newest software tool designed to help local governments reap the benefits of reducing greenhouse gas emissions and common air pollutants—such as CO2, NOx, SOx, CH4, CO, and VOC—and the benefits are significant. Save money. Improve air quality. Mitigate global warming. Protect public health.

For the first time ever, cities using HEAT+ can compare "apples to apples" and benchmark emissions levels against local, state, national, provincial, and international standards. Anyone interested in translating energy use, transportation demand, and waste activities into emissions data can use HEAT+ to

- Inventory and forecast emissions
- Prepare Action Plans
- Track commitments
- Measure progress against targets
- Inform policy decisions
- Determine Priorities
- Quantify progress, and
- Report results

ICLEI Local Governments for Sustainability

HEAT+ is the only web-based product of its kind, offering secure data storage, a global data bank, comprehensive technical support, and accessibility 24 hours a day, 7 days a week. A variety of software packages are available.

Website:http://heat.iclei.org/heatplusv4/index.aspx

3. Policy and Strategy Development

Once the energy audit and the necessary inventory and city energy profile reports are complete, use the results and outputs to assist with the understanding and prioritizing of the critical energy issues for each of the modules and sectors.

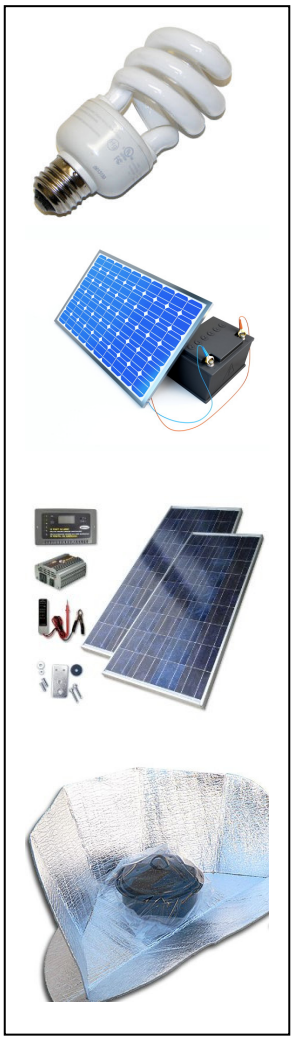
A draft Action Plan should be the first step towards the development of the City Level Renewable Energy Master Plan. The Master Plan should provide a complete sector-wise base-line energy utilization and GHG emissions in the city. It should further provide total and sector-wise projections for energy demand and supply for a required period. Year-wise targets for energy conservation, renewable energy addition and GHG abatement along with the action plan for implementation will be clearly highlightedwithin the Master Plan.

Potential sources of funding from respective organizations (both public and private) for providing financial support should be identified. The Master Plan should set clear and realistic targets and goals for energy reduction; local reduction targets should be in-line with national targets; annual targets should be realistic however ambitious in order to achieve beyond long term reduction goals; recording of energy saving interventions from energy efficiency measures and generation from renewable energy installations should be reported and accounted for annually.

Activities to undertake towards the development of a 5-10 year Master Plan

a. Energy Demand Forecasting for next 10 years

This step involves predicting the energy demand for the period of 5-10 years. To estimate the energy demand, the growth in energy use of different sectors needs to be established. These growth rates are established based on immediate past trends and future growth plans. Based on the past time-series data and information on growth plans, growth rate in energy demand for different sectors can be estimated. These growth rates are used for making future projection of energy demand in each sector for the next 5-10 years.



b. Sector wise Renewable Energy Strategies

A renewable energy resource assessment should be undertaken in order to identify the potential renewable energy sources and opportunities within the city. This would include assessment of solar radiation, wind power density and availability, biomass resources and municipal/industrial wastes. The next step would be listing of all potential renewable energy technology options. An indicative list of renewable energy technologies/systems is discussed in the chapter 5.

c. Sector wise Energy Efficiency Strategy

While renewable energy technologies would provide clean energy, EE and DSM measures would help in reducing the energy demand. An indicative list of EE and DSM measures that can be introduced in different sectors – residential, commercial, and industrial and municipal is discussed in chapter 5. A sector-wise techno-economic analysis of potential energy efficiency and DSM measures should be carried out.

d. Stakeholders Consultations

Stakeholders' consultation is a very important step in the preparations and development of the master plan. Several external stakeholders' consultations are suggested such 1) as an initial inception meeting to introduce the project and present the data requirements, 2) one immediately after the analysis of sector-wise energy audit outputs; and 3) one towards the end to discuss the draft master plan. The participants can include elected representatives including external experts from, local research and academic institutions, resident welfare associations, industries and corporate organizations, ESCos, RE manufacturing industries, NGOs, SNA, etc. Stakeholders committee formed as part of the Solar City process should be consulted on all developments and processes.

Recommended outlines of a Master Plan

1. Projection for energy demand and supply for 10 years
   - Sector wise
   - Total
2. Base line of energy utilization & GHG emissions
   - Residential
   - Commercial/ Industrial
   - Industrial
   - Municipal Services
   - GHG emission
3. Renewable Energy Strategy
   - Renewable Energy Resource Assessment
   - RE Strategy for Residential Sector
   - RE Strategy for Commercial and Institutional Sector
   - RE Strategy for Industrial Sector
   - RE Strategy for Municipal Sector
4. Energy Efficiency Strategy
   - EE Strategy for Residential Sector
   - EE Strategy for Commercial and Institutional Sector
   - EE Strategy for Industrial Sector
   - EE Strategy for Municipal Sector

5. Year-wise goals of savings in conservation energy through demand side management & supply side measures based on Renewables.

6. Action Plan for achieving the set goals & expected GHG abatements. This will include capacity building and awareness generation.

7. Budget estimates and potential sources of funding from respective sources (both public and private)

4. Activities to implement at the local level

a. Solar City Resource Centre

One of the on-ground projects that can be easily implemented is a Solar City Resource Centre. Development of a local Resource Center is a space within the city's governmental buildings, which is easily accessible to the general public and end users to showcase local initiatives and products informing the community about RE and EE innovations. The location is of vital importance as it will be a means to easier and quicker dissemination of knowledge and information to a wider scale of audience. Examples of locations are within education and awareness centres, city libraries or accessible municipal buildings.

All technological options available under RE and EE should be displayed within a space to showcase and promote such technologies; this space is given the proposed name, Solar City Resource Centre within the Solar City Program.

It is a resource base of information and physical exhibition of models related to RE and EE techniques.
The information promoted within this space should include:

- Available RE/EE techniques in the region
- Feasibility analysis of each technique
- Technology suitable for a particular client considering his/her requirements and budget
- Required capital
- Sources of funding
- List of manufacturers of RE/EE equipment in that region
- List of consultants in that region
- City implementation projects and description of each
- City Energy Plan and related policies and strategies

Connecting People with Energy through the Resource Centre
The target audience for the Solar City Resource Centre is:

- Municipal Corporations/departments
- Local Utilities, Local Business
- Developers of Large Scale Construction projects
- Architects, city planners
- International and local organisations
- City residents and resident welfare associations

Indian Case Study: Capacity Building within the Solar City Program

Under the Local Renewables Model Communities Network project funded by GTZ, ICLEI-SA has conceptualized and assisted in establishment of the Renewable Energy & Energy Efficiency Resource Centreswithin **Bhubaneswar**, **Nagpur** and **Coimbatore**.Other well established Resource Centres are Freiburg, Bonn and Vaxjo(under the International Network of EuropeanProgramme); Betim (Brazilian Solar City Program) cities, which form part of ICLEI International Training Centre, ICLEI European Secretariat and ICLEI US offices respectively.

The Resource Centres are strategically located in all four of these cities whereby the general public is able to view the material as any given time. In Bhubaneswar, at the entrance lobby of the Corporation building; in Nagpur, at the Citizens Facility Centre in the Corporation premises; and in Coimbatore, the Resource Centres is located adjacent to the Citizen's Service Centre in the Corporation premises.

RE and EE equipment manufacturers have shown positive interest and support towards these Resource Centres in the respective cities. At present, Gayatri Solar and Tata BP Solar have exhibited their equipment and information materials at the Bhubaneswar Resource Centre whereas in Nagpur Tata BP Solar is now associated with the Resource Centre. Resource Centres in the cities are receiving encouraging response (in terms of number of people visiting) from the citizens as well as Corporation officials. These Resource Centres continuously undergo efforts to update and include new technologies within the centres.

- School children and students

Programmes and Activities for the Resource Centre

- Display and demonstration of RE and EE equipment
- Conceptualize various campaigns, workshops, seminars, panel discussions, meetings, and exhibitions targeting RE and EE promotion awareness generation and voluntary adoption of technology measures by individuals, communities, associations, and institutions. These programmes should ensure the active participation of local residents, private players, ESCos, local/state RE and EE manufacturing companies, etc
- Provide and produce all resources for promotional and awareness generation activities like reports, booklets, equipment brochures, pamphlets, posters, banners and related matter
- Maintain all records of activities charted in monthly activity target list. Usage of proper detailed documentation methodology should be a priority. Monthly and yearly data should be recorded both in soft and hard copies
- A target list of potential stakeholders, private partners, ESCos or RE and EE manufacturing companies should be made updated every two month to involve them as partners/members/funding sources for the sustainability and promotional activities of the Solar City Resource Centre

Coimbatore Resource Centre

Established under the Local Renewables Model Community Project, Coimbatore Resource Centre has served as a one-stop outreach, awareness and information provider for renewable energy and energy efficiency projects, products and related financing options available.

As a model community, Coimbatore city Corporation has been instrumental in execution of a number of activities in the city with the logistical and organisational support rendered through the Resource Centre.

As an indicator of success under the project, Coimbatore Resource Centre has and continues to assume the following roles:

- Comprehensive resource base for information on renewable energy and energy efficiency projects/products
- Platform for outreach to target audience which include local entrepreneurs, schools, Corporations of other cities, Architects and urban planners, local utilities and generally anyone interested in green initiatives
- Administrates the action plans and annual activity plans which fall under the purview of RE and EE initiatives taking place in the city
- Ensures provision of logistical and organisational support in implementation and subsequent monitoring of the projects

b. Communication, Education and Public Awareness (CEPA)

Awareness, Publicity and Capacity Building

Awareness and Publicity Programmes are encouraged to provide awareness among target audiences within the city pertaining to the financial benefits and incentive of renewable energy technologies and devices. Under these programmes, information on technological developments, financial benefits and cost savings from RE system and EE measures, government initiatives and incentives for such devices/measures, availability, price should be disseminated through various media platforms. The following activities are proposed for creation of awareness and publicity.

Publicity through electronic media

- Production and telecast of documentary films, short duration films, TV spots/advertisements through local TV networks;
- Production and broadcast of radio sponsored programmes, radio spots/jingles and Radio Talks etc. through local FM channels

i. Print Media/Publication

- Advertisements in colour and black & white in newspapers/magazines/journals etc.
- Printing of booklets, folders, brochures, posters, calendars and newsletters.
- Develop educational programs and workshops on energy efficiency, distributed generation, and renewable energy systems in buildings for homeowners, businesses, government staff, and those in the building industries.

ii. Exhibitions, Outdoor Publicity, Campaign

- Use of Exhibitions and Outdoor Publicity activities like hoardings, kiosks, bus panels, bus-stop shelters, wall paintings, computerized animation display systems, etc. in the city.
- Display and demonstration of RE and EE equipment in the Solar City Resource Centre.
- Organizing runs, debates, seminars, quiz, drawing, model making, poster, essay and slogan writing competitions among others for school children and others;
- Promotion and publicity of RE and EE by displaying models and posters and related printed media in different public places, institutions/organizations, hospitals and bus stands.
- Encourage maximum participation by residents and business owners in the local authority's energy efficiency programs through marketing and education exercises.
- Educate government purchasing agents in each city departments regarding the benefits of Energy Star rated equipment, including the cost savings to the city.
- Encourage community input on strategies for improving energy efficiency in building.

iii. Workshops and Seminars

It is proposed to organize workshops and seminars on specific technologies for targeted audiences from residential, commercial, institutional, industrial and municipal sectors.

iv. Training and Education Programs

The key areas of training should be prioritized such as technical, management or general. Crucial aspects which should be addressed primarily at this stage for the development of the Solar City

Resource Centre to be well suited for a range of activities (training, exhibition, workshops) should be addressed or undertaken:

- User-needs and resource assessments and feasibility studies.
- Renewable energy project design including the economical and financial aspects;
- Renewable energy project management;
- Operation, maintenance and monitoring of RE and EE systems

v. Creating a Web Portal

Portals could be created by the City within the Energy Department website page to provide citizens access to RE and EE technologies, and activities occurring in and around the area. Instant access to technological options available to end-users, their capital cost, returns on investment and other useful information through this mode of knowledge exchange which is a quick and easy communication mode for generating awareness and sensitizing the general public. Creating an interactive website exclusively for "Solar City" for awareness campaigns, information sharing and support to the users will be a useful tool.

vi. Demonstration projects

The technical feasibility and economic viability of solar technology can be addressed by implementing a number of demonstration projects, such as solar hot water heating system for hospitals, hotels and catering services could be implemented. Others include solar industrial process heat in the drying, food and textile industries. Dissemination activities can be carried out using information materials such as leaflets, posters, videos and media advertisements. These projects will further provide a wider level of acceptance and better understanding of the technology and the benefits of such devices. The demonstration projects will also in paving the way forward and providing first hand experiences for improvements in the training and skills of the stakeholders as well as increased efforts in research and development activities.

Indicative measures to be taken by Cities towards the develop of a 'Solar City'

Some of the measures that can be adopted by city governments while developing their city/ town as a solar city are:

Indonesia Government's involvement and support for the oversight of implementation of the strategies in the local authorities' Master plan during 5-10 years (financial value if any). The concerned local government is encouraged to send proposals with the budget to respective provincial, national department as well as to private sectorsto support the project planning and implementation process.

Annual Budget from National Government for RE and EE programmes and projects at the local level.

Development of "Solar City Stakeholder Committee" for the sustainability of the Solar City Programme initiatives is encouraged. Solar City Cell consisting of the stakeholder committee and resource centre (further details can be found in Chapter 4) The solar city cell is an essential tool for planning, implementation of strategies, raising awareness, capacity building, involving private partners, and major stakeholders (architects, engineers, builders & developers, financial institutions, NGOs, technical institutions, manufactures/suppliers).

Awareness generation: each Province in Indonesia is encouraged to promote RE and EE through the Solar City Resource Centre, awareness campaigns, publications and through relevant media channels to capacitate the public on RE and EE innovations that can be implemented at the local level (such as workshops/ seminars/ training / publications/ awareness campaigns etc.).

A timely audit of government and public sector shouldbe scheduled and measures taken for ensuring conservation of energy.

Local authorities are encouraged to promote energy efficiency within each sector drafting and developing bye-laws for municipal sectors.

Government orders can be issued for construction of energy efficient buildings at the most within government/public sectors, in accordance with any feasible green building codes like GBCSA)

Solar water heating could be made a mandatory bye-law for buildings (old/new) within the municipality jurisdiction, especially in buildings of special category like hotels, hospitals, hostels etc.

Compliance with Municipal Solid Waste regulations and efforts to recycle, re-use and reduce solid waste. Maximum efforts should be taken up to implement waste to energy projects.

The municipalitiesshould ensure energy conservation in street lights/garden lights, traffic lights, hoardings and roadside blinkers by replacing old inefficient lights and light fittings with more energy efficient, EElabelled appliances.

There is a very urgent need for municipal resource mobilization in terms of manpower, infrastructure for monitoring, documentation and information sharing towards achieving the success of implementing the master plan.

Initiatives and motivation is required to amass funds from private partners, national governments, international organisations and other funding organizations for implementation of solar city strategies and action plans.

The City manager should successfully ensure the implementation progress and achievement of Solar City targets.

Chapter 5: Indicative RE and EE solutions

This chapter describes different renewable energy devices/systems that can help to bring about reduction in consumption of conventional energy. Thesefollowing devices described in this section are commercially available and are useful for urban area application.

Energy Efficient devices

Home Appliances

Labelling Appliances

Government of Indonesia through National Standard Agency has introduced SNI 04-6958-2003 about Utilization of Electricity for Household Appliances – Labelling of Energy Rating based on Australian Standard AS 2575.1-1989 and New Zealand Standard NZA 6205.1-1989.

So far, Ministry of Energy and Mineral Resources has issued one regulation which is Permen ESM No. 06 of 2011 that govern labelling procedure for self-ballasted lamp while labelling for refrigerator and air conditioning is under development.

Energy Star Appliances

Energy Star is an international standard for energy efficient consumer products originated in the United States of America. Devices carrying the Energy Star service mark, such as computer products, kitchen appliances, buildings and other products, generally use 20%–30% less energy than required by federal standards. Devices range from home, business and industrial products which can be purchased in big retailer such us Electronic City, Electronic Solution, Carrefour

Energy Switch

Energy Saving With Changing Behaviour (Energy Switch) is a program supported by Ministry of Energy and Mineral Resources to help organization saving their energy by change the behaviour. The saving potential is around 5-12% through energy efficiency behaviour such us scheduling energy use, setting the right temperature, unplug appliance when not in use and energy saving campaign

There are 6 steps to implement Energy Switch which are (1) Getting top management commitment; (2) Energy Situation Audit; (3) Planning; (4) Implementation; (5) Evaluation; (6) Maintaining Energy Saving Behavoir.

As pilot projects, MEMR in a collaboration with Energy Efficiency and Conservation Clearing House Indonesia has choosen 10 organizations to participate in Energy Switch program as follow: (1) Yayasan Indecon; (2) Sampoerna School of Business; (3) Malioboro Mall Yogjakarta; (4) Ibis Hotel Yogjakarta; (5) PT Nutrifood Indonesia; (6) PT Body Shop Indonesia; (7) PT LEN Industri (8) Ministry of Teleccomunication and Informatic; (9) PT DHL Indonesia; (10) PT ISBG Communication

Lighting

LED lights

Light-emitting diodes (LEDs) in comparison to incandescent bulbs are 8 times more efficient and twice as efficient to the florescent bulbs. LEDs are widely used in many appliances and are recommended as the household lighting due to the energy efficiency capacity. The initial cost of the bulbs is higher compared to the incandescent and florescent light bulbs; however LEDs have a longer life span, generate very little heat, have low sensitivity levels to shocks and varying temperatures and generally produce a brighter light.

Cost: Variation in cost subject to make, type, producer and wattage.

Suppliers: Global producer like Philips, Osram, GE, Panasonic and other companies sell their product through grocery, electrical shop and supermarket. Please read product packaging for further information to suit your needs.

Compact Florescent Lights

Compact Florescent Light (CFL) bulbs are electrode tubes containing argon and mercury vapour which by excitement by the atoms within the tubes creates light within the ultraviolet range. The CFL bulbs produce less heat to generate light and therefore are more energy efficient than incandescent bulbs. A 15-watt florescent light bulb produces the same amount of light as a 60-watt incandescent, therefore saving energy and money. CFL bulbs are safer to operate and can also reduce energy costs associated with cooling homes and offices.

Ministry of Energy and Mineral Resources in cooperation with PT Carrefour Indonesia has established Green Retailer to sell CFL and LED with instalment payment.[21] The purpose of these initiatives is to fasten the replacement of incandescent with more efficient lamp.

Cost: Variation in cost subject to make, type, producer and wattage.

Suppliers: Global producer like Philips, Osram, GE and other companies sell their product through grocery, electrical shop and supermarket. Please read product packaging for further information to suit your needs.

Water Dispenser

Water dispenser plays a important roles in the house hold to provide standby hot water and the demand for this appliances is increasing 30% annually, Generally, water dispenser designed to accommodate one bottle either in the top or in the bottom depend on practicality to the user.

Recently, Japanese water dispenser launched new technology with double bottle which claimed reduce the energy consumption around 30%. The product is accepted by the market and they are selling around 10, 000 units per month.

Typical product specifications are:

- 30% saving from insulation technology
- Power for heating 320 Watt
- Power for Cooling 70 watt
- 100% stainless steel

[21] http://www.ebtke.esdm.go.id/id/energi/konservasi-energi/237-peresmian-green-retail-pertama-di-indonesia.html

Cost : IDR 2,000,000 – IDR 2,500,000

Suppliers: Sanken, Denpoo,

Table 3: Average saving that could be used with various energy efficient devices. The table below makes several comparisons between non-efficient devices versus energy efficient devices and provides potential annual savings.

Electrical Device	Product Power (W)	Power Consumption (kWh)	Electricity Tariff = 979per kWh] (IDR)	Amount used per day [xhr](hr)	Amount used per month [xhr each day for xdays]	Monthly Use	Monthly Savings	Amount used per year [20*12=240]	Yearly Savings
Normal Appliance	**1000**	**1**	**979**	**24**	**720**	704,880		8,458,560	
Star Energy Appliance	**750**	**0.75**	**743**	**24**	**720**	528,660	176,220	6,343,920	2,114,640
Candescent bulb	**60**	**0.06**	**59**	**4**	**120**	7,049		84,586	
CFL bulb	**15**	**0.015**	**15**	**4**	**120**	1,762	5,287	21,146	63,439
Candescent bulb	**60**	**0.06**	**59**	**4**	**120**	7,049		84,586	
LED bulb	**8**	**0.008**	**8**	**4**	**120**	940	6,109	11,278	73,308*
CFL bulb	**15**	**0.015**	**15**	**4**	**120**	1,762		21,146	
LED bulb	**8**	**0.008**	**8**	**4**	**120**	940	822	11,278	9,868*
Single Bottle Dispenser	**400**	**0.04**	**392**	**2**	**60**	23,496		281,952	
Double Bottle Dispenser	**320**	**0.032**	**313**	**2**	**60**	18,797	4,699	8,458,560	56,390**

*annual saving per light bulb subject to tariff rates.

** assumed 2 hours of heating and 22 hours of standby

Water Saving

Heating household water contributes to about 40% of all household electricity consumed. Showering with a high efficiency showerhead can save more than half of this energy (and much water) to the advantage of the householder, the environment and under energy and water shortage circumstances, of the supplying utility. An energy and water-saving showerhead typically has a flow rate of less than 10 litres per minute, compared with a conventional showerhead which has a flow rate of between 15-25 litres per minute. There are two types of showerheads that are water and energy efficient, Aerators and laminar flow. Aerator showerheads mix air with water, forming a misty spray while laminar-flow showerheads form individual streams of water.

Cost: IDR 400,000 – IDR 2,500,000

Energy Savings: See the text box for calculations on savings per month and per year.

Water Heating

Geyser thermostat

A Geyser thermostat is a heating element within the geyser that maintains the water temperature to a pre-set temperature. Most home geysers are in Indonesia set to a temperature of 75 degrees Celsius, once this temperature is met, the element switches off. An effective method to reduce electricity usage and save household energy is by reducing the thermostat in a range of 35 – 75 degrees Celsius and by set the temperature to a minimum of 65 degrees Celsius this action can reduce electricity consumption by 14%. [22].

Cost: no cost, only saving.

Energy Saving: An average household with a 100L geyser can achieve a monthly energy saving of 278 kWh and IDR 272,906 on cost of energy if a thermostat temperature is reduced from 75 to 65C.. See calculations below in Table 2, for further household savings.

Note: Hands on technical tips can be sourced from the internet or your local plumber to assist with the setting of the geyser thermostat.

[22] http://linggojati.com/?ForceFlash=true#/submenu/Electric-Water-Heater.html

Table 4: Energy and Water Saving Calculations

Normal Shower head uses on average 20L per minute. *Efficient Shower Head* uses on average 10L per minute, which is half that of a normal shower head.	
Geyser Specifications for an average household: 2kW, 100L, thermostat 70C **Savings with an Efficient Showerhead:**	Geyser Specifications: 2kW, 100L, thermostat 60C **Savings with a thermostat:**
Water has a heat capacity of 4.1813 joules to heat one gram by one degree C. 1 litre is 1000 grams. For the purposes of this example, the geyser tank has a capacity of 100L. As a hundred litres is 100 000 grams of water, it takes 4.1813J * 100 000 = 418130 joules to heat this amount by one degree Celsius. A joule is equivalent to 1 watt-second, therefore 418130 joules is 418130/3600 = 116.15Wh. If the thermostat of the household geyser is **75C**, the energy needed to heat 100L of water is 116.15*75 = 8711.25.5Wh If the voltage of the device is 2000W (2kW), then it would take 8711.25Wh/2000 = 4.35 hours to heat the 100L geyser tank to 75C. The electricity tariff/rate of Indonesia in 2013for household at 1300 VA installed power is IDR 979 per kWh, therefore the cost to heat 100L tank to 75C is (8711.25/1000)kWh*IDR 979 per kWh = IDR 8528 By using an energy and water saving shower head a household can save IDR 1,556,360 IDR 8528/2*365) per year on electricity. <u>Water saving:</u> If a household has four people, each take a shower twice a day for 10 minutes, by using a normal shower head, the consumption of water per month would be as follows: 4people*10minutes*20L/minute*2 a day*30 days a month = 48000L = 48kL Water Tariff in Jakarta is on average IDR 7,300 per kL. An efficient shower head uses half the amount of water than a normal showerhead, therefore saving IDR 175,200 (24kL*IDR 7,300) per month, which is an annual saving of IDR 2,102,400	Water has a heat capacity of 4.1813 joules to heat one gram by one degree C. 1 litre is 1000 grams. For the purposes of this example, the geyser tank has a capacity of 100L. 4.1813 joules*100 000=418130 joules A joule is equivalent to 1 watt-second, therefore 418130/3600 = 116.15Wh. If the thermostat of the household geyser is **65C**, the energy needed to heat 100L of water is 116.15*65 =7550 Wh The electricity tariff/rate of Indonesia in 2013for household at 1300 VA installed power isIDR 979 per kWh, therefore (7550/1000)kWh*IDR 979/kWh = IDR 7391R By changing the thermostat of the water geyser by 10C, a household can save IDR 1,137 (IDR 8528 – IDR 7391) per 100L heating to 65C rather 75C. The annual saving is, assuming a household consumes only 100L for showering per day, is IDR 415,045 (IDR 1,137*365). If an efficient shower head is used, water consumed is: 4people*10minutes*10L/minute*2 a day*30 days a month = 24000L = 24kL Savings on heating a tank of 100L is IDR 1,137; therefore monthly savings on the electricity consumption on heating 24000L is IDR 272,906 (24000/100*IDR 1,137). The total amount of water and electricity saving per month using energy efficient devices amounts to an estimate of **IDR 448,106** (IDR 175,200 + IDR 272,906), which is an annual saving of **IDR 5,377,272** per year.

Reduce your individual CO2 emissions – use public transport

Making use of public transports helps the environment considerably. Approximately 20% of the total carbon dioxide emitted globally is as a direct result of transport (land, air and sea) of which land transport accounts for 80% (ScienceDaily, 2009). Sustainable transportation solutions can achieve 30-50% (Litman, 2011) emission reductions while helping to address problems such as traffic congestion, accidents and inadequate mobility for non-drivers, and supporting economic development. By taking advantage of public transport options (train, bus, car sharing) a reduction in emissions can be as much as 10-30% of an individual's annual carbon footprint (Litman, 2011).

For driving tips that will reduce your carbon footprint visit: Green Fleet at http://www.greenfleet.com.au/Global/Individuals/index.aspx

Renewable Energy devices

Photovoltaic

Photovoltaic (**PV**) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. The photovoltaic effect is the creation of voltage or electric current in a material upon exposure to light. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. Materials presently used for photovoltaic's include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenite/sulphide. Dhttp://en.wikipedia.org/wiki/Photovoltaics - cite_note-jac-0ue to the growing demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years (Jacobson, 2009).

Lighting

Solar Bottle Bulb

Solar Bottle Bulbs are an easy and effective lighting solution for low cost housing in pro-poor areas. The name comes the concept from which it is made, of which is an empty 1.5 litre plastic bottle. The content of the bottle includes liquid bleach and purified water. The Solar Bottle Bulb can be used as an alternative electric powered light bulb placed within a rooftop that is exposed to sunlight on the outside. Although this intervention is only useful during daytime, its luminance is able to produce as much light as a 50W incandescent bulb.

Cost: minimal

Materials needed: plastic bottle, roof sheet material, purified water, chlorine and a rubber sealant.

Portable Solar Light and Charger

There are many solar kits available on the market that offers a small portable solar panel, LED lamp and a battery for storing renewable solar energy. The solar energy is sufficient energy to supply 4 to 6 hours of light to a LED lamp on high and low settings respectively. The kit also provides cellphone chargers and adaptors that are suitable for most cellphone types.

Cost: IDR 200,000 – IDR 300,000

Supplier: PT Sinar Arona Jaya Perkasa, Phone: (021) 619-4277, email: cs@aronastores.com, website: http://www.aronastores.com/

Solar Street Light

Solar street lights work on the principle of the photovoltaic cell or solar cell which absorb energy from the sun during daylight. The solar cell converts solar energy to electrical energy which is stored within a battery. The solar lamp draws the current from this battery and requires no other wiring or energy from alternative sources. Solar street lights are currently manufactured in Indonesia, the supplier list can be seen below.

Solar lighting can make use of three types of bulbs; sodium vapour, LED and induction technology lighting. Additional benefits of using solar street lighting, other than being low cost and making use of renewable energy sources, LED solar lighting is long lasting and can be used for

approximately 20 years without replacement, uses a lower voltage to produce a brighter light and the thin-film solar panel is highly durable to high temperatures and hail stones.

Cost: varying on prices, dependent on quantity and type.

Suggested Suppliers:

PT Sinar Arona Jaya Perkasa, Phone: +6221619-4277, email: cs@aronastores.com , website: http://www.aronastores.com/

PT. Adyawinsa Electrical and Power, phone: +62 2189841301, email: cs-adyasolar@adyawinsa.com, website: http://adyawinsa.com

PT LEN Industri (Persero), Phone: +62225202682, email: marketing@len.co.id, website: www.len.co.id

PT Surya Perkasa, Phone: +6221629 0801, email: djunaidi@suryaperkasa.com, website: http://www.suryaperkasa.com

PT Active Life, phone: +6221-54353165, email: sales@solarwerkindo.com, website: http://www.solarwerkindo.com

Cooking

Parabolic Cookers

Parabolic cookers are energy efficient devices that require no other energy resources except solar energy. A parabolic cooker is designed as a large spherical curvature dish that focuses sunrays inwards which heats the focus point, such as a pot of water or food. The parabolic cooker is able to cook food at the same rate as a conventional oven and boil a litre of water in 15 minutes. These cookers are considered to be a better alternative for outdoor cooking and camping as they require no firewood, gas or electricity.

Cost: IDR250,000 (small) – IDR 3000,000 (large).

Energy Saving: (Power output: 500 watts (small) – 2000watts (large)).

Solar Box Cooker and Oven

A solar box cooker (similar to the parabolic cooker principles) is a box with reflective lining material that absorbs and reflects the sun's rays and directs it within the box which converts into heat energy. This heat energy is then able to purify and boil water, cook and bake food and sterilize various instruments.

Box Cookers cook meals with performance varying between half as fast as conventional ovens to almost the same speed.

Cost: IDR 4,200,000

Supplier: **SunFire Solutions**, Tele: +27 (0) 11 624 2432; email: crosby@sunfire.co.za , website: www.sunfire.co.za

Water Heating

Solar Water System

Solar water heating systems absorb solar radiation, which then transfers heat directly to an interior space or storage device and thus distributes the heat. Solar water heating systems are the most commonly used household water heating alternative.Solar water systems save households 40 - 60% of their energy bill paying themselves back within 3 years. Indonesia is located in equator (Latitudes 6oN and 11oS)with abundant direct sunlight which makes it feasible to make use of the solar opportunities for free energy.

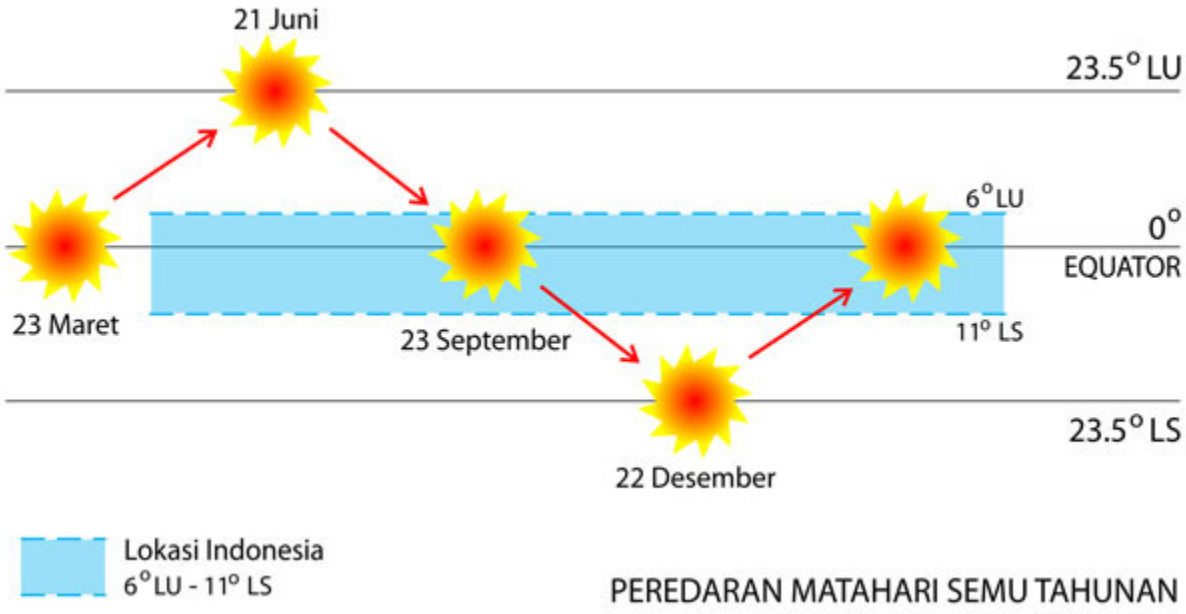


Figure 12: Cycle of the sun in Indonesia in yearly basis

Solar Water Systems are available in many designs and makes and are manufactured locally in Indonesia. There are three main solar water systems available on the market, which are:

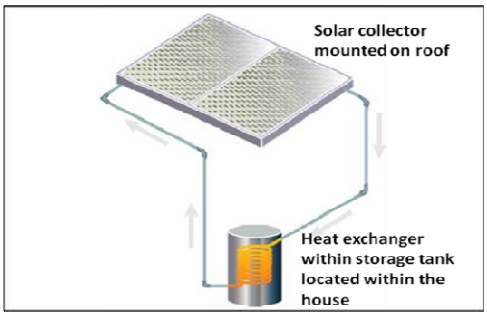
1. Thermosyphon SWH systems

The **thermosyphon** is a simple, efficient, reliable and low maintenance system in hot and moderate climates, often referred to as a passive heat exchange. The installation costs are minimal and require no pumps or special control devices, however a controller can be used to monitor the water temperature and switch the element on at a pre-programmed time. A collector mounting system and an insulated storage tank are mounted on a roof (facing north in the southern hemisphere), the open pipe system allows hot water to rise through the top of the collector into the storage tank through the natural convection principal.

2. Split Pressurized SWH systems

The split pressurized SWH system is simiar design and priciple to that of the thermosyphon system, the difference is that the collector and tank are seperated. The storage tank can be located anywhere in the house and the existing geysors can be retrofitted to allow for solar water heating using a conversion kit.The roof mounted collector is located on a north facing roof allowing optimal radiation and absorbtion.

3. Indirect SWH systems



Indirect or closed systems do not heat the water directly rather they use fluid with a low-freezing point to absorb radiant energy from the sun. This system uses heat exchanger that separates the potable water from the fluid, known as the 'heat-transfer fluid' (HTF), that circulates through the collector. The two most common HTFs are water and an antifreeze/water mix that typically uses non-toxic propylene glycol. After being heated in the panels, the HTF travels to the heat exchanger, where the heat is transferred to the potable water. This system is slightly more expensive the the other two, however indirect systems offer freeze and overheating protection.

Cost: Cost of each system is dependent on size, type and make of the solar heating system, therefore it is recommended that one should apply for a series of quotes with various suppliers, rebates from Eskom are available and should be considered as a saving option.

Energy Saving:Solar Water Systems save households 40 - 60% of their energy bill paying themselves back within a 3 year period.

Supplier:

PT Wijaya Karya Intrade Energi, Phone: +6221 85916633, Email: info@wikaenergi.com, Website: www.wikaenergi.com

PT Inti Sarana Adi Sejahtera, +6221 66607588,email: info@intisolar.com, website: http://www.intisolar.com

Potential Photovoltaic Plants in Indonesia

Ministry of Energy and Mineral Resources has issued ministerial regulation on PV Power Plant Tariff No. 13 of 2013. As the continuation to these initiatives, MEMR also has released 140 MW quotas to be tendered in 80 locations.

Figure 13: Quota Map of PV Plants in 80 Locations 2013. Source: http://energy-indonesia.com/03dge/0130913fit.pdf

1. Aceh (4MW)
2. North Sumatera (2MW)
3. Riau (8.5MW)
4. West Sumatera (2MW)
5. Bangka Belitung (13MW)
6. Bengkulu (1MW)
7. West Kalimantan (9MW)
8. South Kalimantan (2MW)
9. Central Kalimantan (2MW)
10. East Kalimantan (2.5MW)
11. East Java (4MW)
12. West Nusa Tenggara (17MW)13. East Nusa Tenggara (14MW)
14. Gorontalo (2MW)
15. Central Sulawesi (2MW)
16. East Sulawesi (1MW)
17. North Sulawesi (4MW)
18. Southeast Sulawesi (14 MW)
19. North Maluku (7.5MW)
20. Maluku (10.5MW)
21. Papua (14.5 MW)
22. West Papua (5MW)

Wind Energy

Wind power involves converting wind energy into electricity by using wind turbines. A wind turbine is composed of 3 propellers-like blades called a rotor, which is attached to a tall tower. On average wind towers are about 20m high to reach the strongest winds.

Indonesia has potential of 9.29 GW and out of it only 0.0006 GW that has been utilized therefore in the Blue Print of National Energy Management 2006 – 2025 based on Presidential Regulation No. 5 of 2006, the government sets out a vision, policy, goals and objectives for promoting and implementing renewable energy in the country. In order to meet the long term goals of renewable energy, government set target to utilize 5% of geothermal and biofuel and also 5% of utilization of renewable source. Specifically for wind power, government has set the target to utilize 255 MW power which 25 MW is off grid power and 230 of on grid power.

Both private sector and government institution has measured the potential of wind power in more than 150 locations and as the result

- There are 19 locations with average wind speed > 5 m/s and power > 150 watt/m2 in 30 meters above ground
- There are 35 locations with average wind speed > 5 m/s and power > 150 watt/m2 in 50 meters above ground

The major challenge to develop these sites remains connection to the national grid and reaching agreement with the major off-taker with regard to price and general support of the industry.

Figure 14: Wind Turbines combine with Solar PV located on Pandansimo Baru, Yogjakarta

Tidal Energy/ Ocean Current Energy

Tidal energy is the power achieved by capturing the energy contained in moving water in tides and open ocean currents. Tidal power is classified as a renewable energy source, because tides are caused by the orbital mechanics of the solar system and are considered inexhaustible. Tidal power has great potential for future power and electricity generation because of the essentially inexhaustible amount of energy contained in these rotational systems.

Indonesia as a country has large potential in generating electricity through this mechanism as it offers a large coastline with many bays and lagoons which can be used to generate tidal energy. There are many large cities that are located on the coast and would benefit greatly from this kind of power generation.

So far, development of tidal power still in small scale pilot project (10 KW) in Baron Beach or Nusa Penida Beach which designed by T-Files research team comprised of Institut Teknologi Bandung students[23].

Geothermal energy

Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

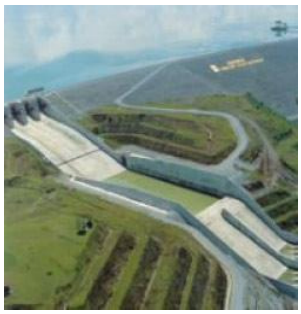
Wells can be drilled into underground reservoirs for the generation of electricity. Some geothermal power plants use the steam from a reservoir to power a turbine/generator, while others use the hot water to boil a working fluid that vaporizes and then turns a turbine. Hot water near the surface of Earth can be used directly for heat. Direct-use applications include heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes such as pasteurizing milk

Indonesia has potential of 219 million Barrel of Oil Equivalent (BOE) or about 27 GW geothermal energy while is only 1226 MW is utilizing so far. In away to speed up the development, in July 2012, the government raised the feed-in-tariff for geothermal power plants from 9.7 US cents per kilowatt-hour (kWh) to between 10 to 17 cents per kWh. The prices vary from one region to another, depending on the availability of infrastructure and potential geothermal reserves where a power plant operates. For example, the price in Sumatra is 10 cents per kWh, Java 11 cents and Papua 17 cents. Recently, there is new proposal from GoI to adjust the feed in tariff where the new pricing

[23] http://www.bbc.co.uk/indonesia/majalah/2013/03/130326_iptek_itb_tenagaarus.shtml

would be based on a power plant's capacity and enthalpy, or heat content.In the capacity category, power plants will be divided into five groups: over 55 MW, between 20-55 MW,between 10-20 MW, between 5-10 MW and under 5 MW.A power plant with low-medium enthalpy lower than 225 degrees Celsius, depending on the capacity of the power plant, will have a ceiling price range from 17 to 30 US cents per kWh and that of high enthalpy from 11 to 28 cents per kWh.

Hydro power plants



Hydro-power or water power is power derived from the energy of falling water and running water, which may be harnessed for useful purposes. Kinetic energy of flowing water (when it moves from higher potential to lower potential) rotates the blades/propellers of turbine, which rotates the axle. The axle has a coil which is placed between the magnets. When the coils rotate in magnetic field it induces them in the coil due to change in flux. Hence, kinetic energy of flowing water is converted to electrical energy.

Until September 2013, Indonesia has utilized 5,711 MW of large scale hydro power and around 230 MW of micro/minihidro out of 76.67 GW potential sources. GoI also has introduced feed in tariff for micro/minihydro based on MEMR Regulation No. 4 of 2012 while the price is vary from one region to other region. For instance the price in Java and Bali in IDR 656; Sumatera and Sulawesi IDR 787. Since the regulation is not really attractive to developer then this regulation is on process to be revised24.

[24] http://energy-indonesia.com/03dge/0130913fit.pdf

Chapter6: International financing mechanisms

International financing options and related mechanisms

Leveraging international finance is one of the crucial and decisive steps in accomplishment of sound and feasible energy conservation and renewable energy generation projects. Based on the activities to be undertaken in the purview of the project, financing varies in tune with factors like scale, technology employed, economic feasibility and the institutional set up in support of the project. Due to the fact that renewable energy projects have long gestation periods and the returns are usually envisioned with long term perspectives, financing these projects require high initial capital withlong term investment. In addition to private capital markets, international bi-lateral or multi-lateral support comes into play to sustain local renewable energy and energy efficiency projects.

International donor organizations such as United Nations, World Bank, European Commission, and REEEPhave endeavoured to unlock the collaborative funding potential for renewable energy and energy conservation projects. Some of these international financing options for renewable energy (RE) and energy efficiency (EE) projects are enlisted here along with explanation of their funding mechanism.

1. Green or Clean Energy Bonds and Investment Services

Clean Renewable Energy bonds are unique lending mechanisms for public entities investing in renewable energy projects. Local authorities and implementing agencies issue financial bonds to the public and receive interest free capital. Bond holders are either compensated through the payment of interest or tax credits. This mechanism is viable only if the investing agency is large enough to attract the requisite number of investors. Internationally, these bonds are issued by globally operative banks such as European Investment Bank (EIB), governmental bodies or groups of governments. Bonds offer tax holidays and rebates and are funded via international capital markets, in the case of EIB, additionally through its Green Bond instrument. EIB issues 'Climate Awareness Bonds' to finance projects within the fields of renewable energy and energy efficiency. Issuance of bonds precedes the acquisition of a reasonable credit rating for the project through credit agencies like CRISIL, CARE etc. This requires robust project planning including comprehensive analysis of associated risks and forecast of financial resources over the course of the project.

International Finance Corporation (IFC), the financing arm of World Bank also has a number of financing products and investment services under its funding portfolio. IFC mainly aims at promoting sustainable enterprises, encouraging entrepreneurship, and mobilizing resources that would not otherwise be available. These funds can be leveraged by encouraging entrepreneurial organizations to invest in renewable energy and energy efficiency projects.

2. Carbon Finance

As one of the popular options for Carbon finance,Clean Development Mechanism (CDM) offers an international platform for trading Carbon emission reductions through exchange of Certified Emission Reduction certificates (CERs) between countries. Once registered, the

project is monitored for the actual emission reductions annually and CERs generated thereof are exchanged to receive funding.

ICLEI in partnership with UN Habitat have published a tool in 2012 specifically focusing on *'Making Carbon Markets Work for Cities: A Guide for Cities in Developing Countries'*, which seeks to enhance the capacity of local government officials to initiate, develop and manage GHG reduction projects, and to get the carbon financing they need.

3. Public Finance Mechanisms

Some funding bodies like Global Energy Efficiency and Renewable Energy Fund (GEEREF), which are collaborative multi-lateral investment agencies, focus on renewable energy and energy efficiency projects and invest in private equity funds specializing in equity finance for SMEs. Availing these funds entails a track record of RE and EE projects which have not just been financially but also environmentally sustainable. Direct financing isn't possible with this funding option but can be deemed as a sustainable one as it targets financing the local small and medium RE and EE industry.

Alternatively, leveraging the private capital market through commercial loans is a viable option and helps the local governments fund projects. . In considering a project for commercial bank financing, banks assess the local authority's cash flow and financial viability. Where the credit worthiness of the local authority is in question, a credit guarantee may be required, which could be provided either through the state/province or a third party.

A more self-reliant means of funding local projects is through the self-financing model wherein the local authorities fund renewable energy implementation through granted municipal funds or taxes collected by the local authority. Special investment funds for renewable energy projects may also be set up in conjunction with the state/provincial government. Tax and tariff collections could also be used to self-finance these projects. Factoring in investment recovery is critical, as failure to recover costs directly impacts utility earnings and viability of the investment; also sending a discouraging message for further investments.

4. Energy Certificates

Renewable Energy Certificates (REC) and Energy Efficiency Certificates (EEC) are also a secure means of availing funding by presenting the energy generation/savings potential of the projects. Tradable certificates for every basic unit of energy generated (1 MWh) from RE projects or saved under EE projects can be exchanged for funds in national or international markets. Basically meant to be an easy method of reducing emissions for countries lacking RE potential or lacking the infrastructure to do so, the REC and EEC mechanism enables revenue flow fairly easily by trading the benefits obtained from the projects. Once the REC or EEC has been sold, it ceases to be accounted as an emission reduction achieved under the inventory of the entity which has sold the certificate.

Other funding options may by availed through Regional Development Banks (like Asian Development Bank for the Asian and South Asian region), Development Finance Institutions (DFIs) etc.

5. Nationally Appropriate Mitigation Action (NAMA) Facility

During the climate negotiations in Doha, Qatar, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Department of Energy and Climate Change (DECC) of the United Kingdom (UK) launched €70 million of funding called "NAMA Facility" to support partner countries to implement ambitious action against climate change

The NAMA Facility is designed to support developing countries that show strong leadership in tackling climate change and want to implement transformational Nationally Appropriate Mitigating Actions (NAMA). Transformational NAMAs are projects, policies, or programmes that shift a whole technology or sector in a country onto a low-carbon development trajectory. Developing countries are preparing NAMAs as part of their national strategies.

However, it is difficult to access finance through existing commercial and public channels to finance implementation, particularly for the most innovative NAMAs. By applying a competitive selection process the Facility will improve the value for money and quality of NAMAs and enable their implementation. It is intended that the Facility will support investments across a range of countries and sectors with grant funding as well as loan finance.

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