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Low-Carbon Technology Transfer in Indonesia

An exploration into actors, questions and potential requests to the Climate Technology Centre and Network

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Preface

This SFF-project is financed by the Study Expert Fund provided by the German Federal Ministry for Economic Cooperation and Development (BMZ) and aims to develop technology-specific strategies to support a climate-friendly technology transfer in Indonesia. Based on a detailed analysis of actors, as well as on existing experience of GIZ in related projects in the areas of climate policy, energy efficiency, renewable energy and technology facilitation, the current state of development and level of diffusion of selected climate protection technologies is examined.

This report was developed in close cooperation with the Indonesian Council on Climate Change (DNPI) as national designated unit (National Designated Entity - NDE) to the UNFCCC Climate Technology Centre and Network (CTCN). It shall serve as a basis for the selection and in-depth assessment of low-carbon technology fields in need for further capacity development through the CTCN.

Jakarta, January 2015

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Acronyms and organisation websites

Acronym	Name	Website
ADB	Asian Development Bank	http://www.adb.org/countries/indonesia/main
AfD	Agence francaise de Developpement (French Development Agency)	http://www.afd.fr/lang/en/home/pays/asie/geo-asie/indonesie/afd-en-indonesie
BAPPENAS	National Development Board	www.bappenas.go.id
BAT	Best Available Technology	
BKPM	Capital Investment Coordinating Board (Badan Penanaman Koordinasi Penanaman Modal)	http://www.bkpm.go.id/
SKK Migas	SKK Migas: upstream regulator	http://www.skkmigas.go.id
BPPT	Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknology)	http://www.bppt.go.id/
BPS	Central Agency of Statistics (Badan Pusat Statistik)	http://www.bps.go.id/
CASINDO	Capacity Developing and Strengthening for energy policy formulation and implementation of sustainable energy projects in Indonesia (a project)	www.casindo.info
CDM	Clean Development Mechanism: UNFCCC Kyoto Protocol project-based carbon trading mechanism for developing countries	http://cdm.unfccc.int
CER	Certified Emission Reduction in the CDM. One CER is 1 tCO_2.	
CTCN	Climate Technology Centre and Network	www.ctc-n.org
DEN	National Energy Council (Dewan Energi Nasional)	http://www.den.go.id/index.php
DJK	Directorate General of Electricity	https://www.djk.esdm.go.id
DNPI	National Council on Climate Change (Dewan Nasional Perubahan Iklim)	http://dnpi.go.id/portal/en/
DRN	National Research Council (Dewan Riset Nasional)	http://drn.go.id/
EBTKE	DG New Renewable Energy and Energy Conservation	http://www.ebtke.esdm.go.id
EECCHI	Energy efficiency and Conservation Clearing House Indonesia	www.energyefficiencyindonesia.info
ESDM	See MEMR	

Hivos	Dutch development organisation active in energy	www.hivos.org
ICCTF	Indonesian Climate Change Trust Fund	http://www.icctf.or.id/
IEA	International Energy Agency	www.iea.org
IGES	Institute for Global Environment Studies	www.iges.or.jp
IP	Indonesia Power	www.indonesiapower.co.id
IPB	Bogor Agricultural University (Institut Pertanian Bogor)	http://ipb.ac.id/
IPCC	Intergovernmental Panel on Climate Change	www.ipcc.ch
ITB	Institute Technology of Bandung (Indonesia)	http://www.itb.ac.id/
JICA	Japan International Cooperation Agency	http://www.jica.go.jp/indonesia/english/
MEMR	Ministry of Energy and Mineral Resources (= Kementerian Energi & Sumber Daya Mineral)	www.esdm.go.id
MOF	Ministry of Finance	www.depkeu.go.id
MSOE	Ministry of State-Owned Enterprises	www.bumn-ri.com
NAMA	Nationally Appropriate Mitigation Action	More information: http://unfccc.int/cooperation_support/nama/items/7476.php
PJB	Pembangkit Jawa-Bali	www.ptpjb.com
PLN	Perusahaan Listrik Negara	http://www.pln.co.id/
PTNTP	PT Nusantara Turbin and Propulsi: a cooperation between NTP and BPPT supported by the Indonesian Department of Industry and Commerce	http://www.umcntp.co.id/
PTZI	PT Zug Industry:manufacturing cooperation	http://zug-power.com/
RBCS	Regenerative Burner Combustion System	
RI	Rekayasa Industry	www.rekayasa.com
RL	Richcore Lifesciences	www.richcoreindia.com
UNDP	United Nations Development Programme	www.undp.org
UNEP	United Nations Environment Programme	www.unep.org
UNFCCC	United Nations Framework Convention on Climate Change	www.unfccc.int

Executive Summary

With the aim of assisting Indonesia with identifying the most appropriate requests to the newly formed UNFCCC Climate Technology Centre and Network (CTCN), this report reviews the current state of low-carbon technology, collects stakeholder views and, based on criteria, arrives at technology lines and a list of recommendations for possible requests.

While this report was finalised, the ministerial structure of the Government of Indonesia was changed. Amongst other developments, it was announced that the National Council on Climate Change (DNPI) will be integrated as a secretariat in the new Ministry of Environment and Forestry. In addition, the Agency for the Assessment and Application of Technology (BPPT) will act as the CTCN focal point.

Indonesia 's reliance on agriculture, mining and services leaves room for more localisation of low-carbon technology. Most low-carbon technology in Indonesia is imported from abroad, with a limited role for local manufacturers and low input from local knowledge and maintenance providers. If this situation would change through the transfer of more innovation capabilities along with the hardware technology, the Indonesian economy could diversify away from exploitation of natural resources, lower costs, raise locally added value and create more employment. In some low-carbon sectors, such as small-scale hydropower, a good basis exists, but in others, local capabilities are limited. In general, and not only specifically for low-carbon technology, the level and quality of education and the research sector and the amount of skilled workers will need to increase to reap the benefits.

Stakeholders are well-aligned on the grounds on which requests to the CTCN should be evaluated. Criteria identified by stakeholders for CTCN requests include greenhouse gas reduction potential, other environmental benefits, sectoral development potential (added value to Indonesia, short and long term), innovation capabilities, social sustainability, replicability, cost effectiveness, market readiness or commercial maturity, ease of implementation and monitoring.

Promising sectors and technologies include bio-energy (in particular waste to energy applications including those related to the palm oil industry) as well as hydropower (in particular off-grid, small-scale hydropower). In addition, several energy efficiency technologies (in particular Regenerative Burner Combustion Systems, cement slag re-use and energy efficiency in buildings) have potential in greenhouse gas emission reductions and could be suitable for CTCN requests. Other technologies evaluated include solar PV, CO_2 capture and storage, wind energy and geothermal energy have large potentials in Indonesia but met few of the criteria.

Awareness of the possibilities of the CTCN among Indonesian stakeholders is low. It is therefore recommended that the CTCN focal point sets up an awareness campaign, encourages Indonesian stakeholders to become members of the Climate Technology Network, and involves CTCN staff and Indonesian CTN members in relevant activities.

Indonesia's requests to the CTCN are recommended to build on local needs, possibilities and potentials for low-carbon technologies. The impacts of relatively small requests such as those that can be submitted to the CTCN will be greatest if they are linked with national strategies, NAMAs, existing needs as identified by the Technology Needs Assessment and technologies that have much local potential. It is recommended that the

CTCN is requested to fill specific gaps where much could be achieved with limited but smart investments.

Deeper and more productive cooperation between the public and private sector could contribute to value-added low-carbon technology transfer. Examples of possibilities include co-funding schemes for Energy Service Companies (ESCOs), technology cooperation in the cement sector with ITB and other research institutions, collaborations with industrialized country government to set up a facility for twinning between R&D institutions in the field of technological capabilities, and business development or climate innovation centre, such as a local climate technology business incubator, where business cases for potential technology transfer can be developed.

The timing needs to be right. It is advisable to look for the right request at the right moment just as much as to whether the technology meets national criteria. Depending on the timing, R&D collaborations to improve or enable existing foreign technologies, and on-the-job training and skill development with companies abroad could be part of the requests to the CTCN.

Further possible requests related to capacity development include more high-quality, consistent laboratories that meet international standards for testing and certification schemes, improved project development, risk assessment and English language skills, and information on Best Available Technology: In Indonesia, it is difficult to find out what the Best Available Technology (BAT) is for a specific problem.

Finally, availability of reliable data on energy use, potentials, costs and mapping would be beneficial. Although the situation is improving, Indonesia experiences a dearth of basic data on energy. Different sources provide different estimates, even of current energy use. The projections of energy use, costs of energy technology and potentials of low-carbon technology are difficult to find and hard to rely on.

Indonesia could benefit from the CTCN. However, the local circumstances matter tremendously to the success of the CTCN request. Eventually, the usefulness of the CTCN to Indonesia depends as much on Indonesia as on the quality of the CTCN response.

1. Introduction

1.1. Context

To prevent dangerous global climate change, countries around the world will have to reduce their emissions, either in absolute numbers or compared to a baseline in the coming decades (IPCC, 2014). For emerging economies with a large population below the poverty line this is a considerable challenge. Indonesia is one of such countries: it has a population of 250 million, and an economy that has been growing at between 5 and 7% annually over the past years (World Bank, 2014). Indonesia has other challenges as well: its economy leans heavily on mining and agriculture, while a partial shift to manufacturing and services would add more value and would deplete natural resources less quickly. The considerable role Indonesia plays in fossil fuels is demonstrated by its position as the fifth-largest coal producer and the largest net coal exporter of the world.

In combination with effective green policies, economic development and growth in Indonesia could be consistent with achieving climate change goals. In addition to the energy and industry sectors, in Indonesia the forestry and land use sector is of great importance to preventing dangerous global climate change, which has its own set of challenges. Such green growth however requires a huge effort of government, consumers, companies and knowledge institutions. Low-carbon technologies need to be implemented.

At this point, many technologies, including low-carbon technology, in Indonesia still need to be imported. The capabilities to use such technology locally are well developed, but capabilities to repair, maintain and manufacture spare parts in Indonesia is often limited. In addition, if technologies need to be adapted to specific Indonesian circumstances, or need to be improved through innovation, Indonesian stakeholders often rely on foreign knowledge and companies. Foreign research institutions are often involved to supply specific technical knowledge, finance, and project development skills, which adds to the costs. If this situation continues, the Indonesian economy will be unable to capitalise on its potential for green growth. It is also unlikely that the potential for green growth will be used to the full extent if the local economy reaps only a small and low-value part of the earning potential.

It is against this background that the United Nations Framework Convention on Climate Change (UNFCCC) has founded a Technology Mechanism at its 16th Conference of Parties (COP16) in 2010 in Cancun, Mexico. The Technology Mechanism and in particular its Climate Technology Centre and Network (CTCN) are mandated to aim to facilitate enhanced action on nationally determined technology development and transfer (UNFCCC, 2010: p18-20). A National Designated Entity (NDE) in a developing country can submit requests for technology assistance, which the Climate Technology Centre, a small office in Copenhagen, will then make sure are fulfilled through its global consortium of development agencies and research institutions, or through procurement in the Climate Technology Network (CTN), which the CTCN aims to develop into a globally distributed and locally knowledgeable pool of knowledge and skills in the field of climate-friendly technology – both adaptation and mitigation.

1.2. Objective, questions and outline

For Indonesia, it is an open question which requests for the CTCN would deliver most value to the country. The overall aims of the "LCTT Indonesia" project, set up by the National Council on Climate Change (DNPI) of Indonesia and GIZ, are to identify possible and relevant Indonesian requests to the CTCN, and to assist the NDE in Indonesia with clarifying the organization of technology transfer as part of the national climate mitigation policy framework. To help meet these aims, this report gives an overview of low-carbon technology transfer already happening in the energy sector in Indonesia. In this report, technology transfer includes hardware, but also capabilities and institutional arrangements associated with installations and equipment. Low-carbon technology includes all technologies that reduce carbon emissions significantly compared to currently used energy supply or demand technology.

This report answers the following questions around the current situation, based on the results of a round of interviews among stakeholders in the low-carbon energy sector in Indonesia and a workshop:

1. Which are the most important stakeholders in the low-carbon energy technology sector? In which sectors and technologies does the greatest potential for low-carbon development and technology transfer reside? (section 2)
2. What are stakeholders views on low-carbon technology transfer opportunities and challenges in Indonesia? (section 3)
3. What are good criteria for selecting potential requests to the CTCN and which technology lines might be most beneficial for Indonesia? (section 4)

Finally, section 5 concludes and provides recommendations for DNPI.

1.3. Method

For the work, a mapping of stakeholders was made based on around 25 in-depth interviews with actors from the private sector, from various relevant ministries in the Indonesian government, research institutions and donor agencies active in the country. In addition, a workshop was held on November 4th, 2014, to present the aims of the CTCN, to explain DNPI's vision of low-carbon technology transfer and that of several other relevant government bodies, and to start discussions on what would be criteria for CTCN requests by Indonesia. Through discussion with DNPI, the results are elaborated into the conclusions and recommendations.

While this report was finalised, the structure of the Government of Indonesia was changed. Amongst other developments, it was announced that the DNPI will be integrated as a secretariat in the new Ministry of Environment and Forestry. In addition, the Agency for the Assessment and Application of Technology (BPPT) will act as the CTCN focal point.

2. Characterisation of the Indonesian energy sector and low-carbon technology

Indonesia is a large lower middle-income country: in 2013, it had some 250 million people, a GDP of USD 868 billion and poverty rate of ca. 11%, according to national poverty lines (World Bank, 2014). Water supply and electricity access is around 70 to 75% (ESDM, 2013). Over the past years, the annual growth rate of the Indonesian economy has been gradually declining from around 7% to roughly 5% (World Bank, 2014). In terms of economic development, Indonesia is outperforming most other lower middle-income countries in the region, such as Vietnam or Lao, but is generally showing slower progress than other countries in South-East Asia, such as Thailand, Malaysia or China.

This section will discuss Indonesia's energy and low-carbon development characteristics based on energy statistics, the actor landscape, and current regulation and policy. The final section will provide a future lookout.

2.1. General characteristics of Indonesia's energy sector

According to the International Energy Agency (IEA, 2013a), Indonesia's total primary energy supply (TPES) in 2011 was 209 MTOE, up from 35 MTOE in 1971 and 155 MTOE in 2000 (see figure 2.1). This is about 1.6% of the world TPES. Given Indonesia's higher shares of both world population (3.5%) and its lower share in world GDP (0.8%), Indonesia can be characterised as a low but not very energy-efficient energy user.

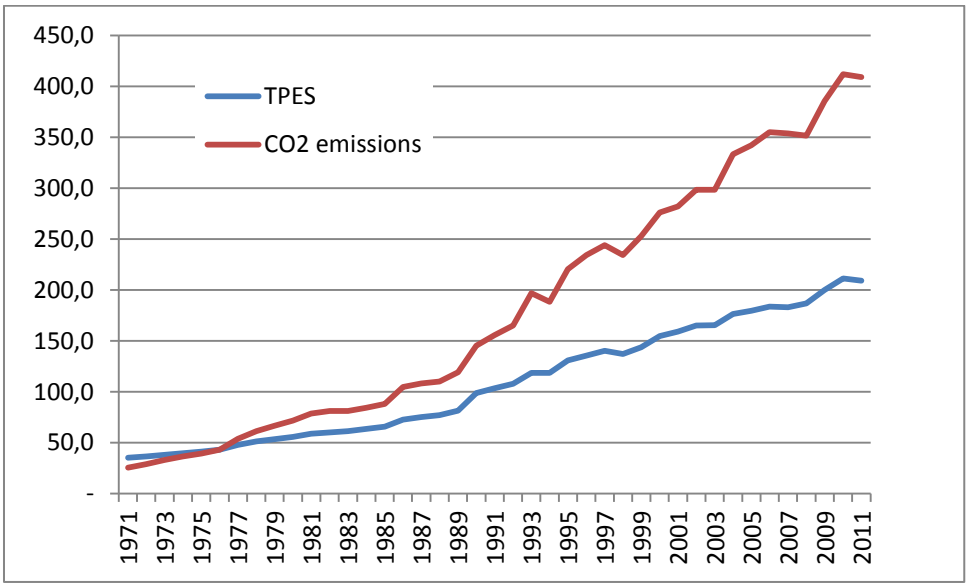

Figure 2.1: Indonesia's total primary energy supply (MTOE, blue line) and energy-related CO_2 emissions (red line, $MtCO_2$) from 1971 – 2011 (according to IEA, 2013a).

In addition to the IEA number, the Indonesian Ministry of Energy and Mineral Resources reports energy data in its Handbook of Energy and Economic Statistics (ESDM, 2013). It reports a primary energy supply number of 1237 million barrels of oil equivalent for 2011, which corresponds to around 173 MTOE, some 17% lower than the IEA number. There are also differences (albeit smaller ones) in population numbers. The difference in energy data may be attributed to different data collection methods.

Figure 2.1 also shows Indonesia's development of energy-related CO_2 emissions (excluding land use and non-CO_2 greenhouse gases), which have shown a steeper increase than energy use.

On the global energy markets, Indonesia is a major player: it is the world's fourth largest coal producer and the world's first largest coal exporter (IEA, 2013b). Indonesia still has over 28 billion tonnes of coal in reserves, mainly in Kalimantan and Sumatera (ESDM, 2013), while it is currently producing less than 500 million tonnes per year (IEA, 2013b). Indonesia is also a significant gas producer (IEA, 2013; ESDM, 2013). All in all, Indonesia exports 86% of the coal it produces, and it exports almost half of its produced natural gas (IEA, 2013b). As Indonesia is a net importer of oil, it was about 50% self-sufficient in 2011 (IEA, 2013b).

Over the past decades, Indonesia's energy intensity of income has been decreasing, while the CO_2 intensity of the energy mix has been increasing (Figure 2.2). These developments reflect the greater formalisation of Indonesia's energy economy: on the one hand autonomous improvements in energy efficiency take place as the added value per unit of energy increases, while on the other hand the use of CO_2-intensive fuels such as coal and oil increases.

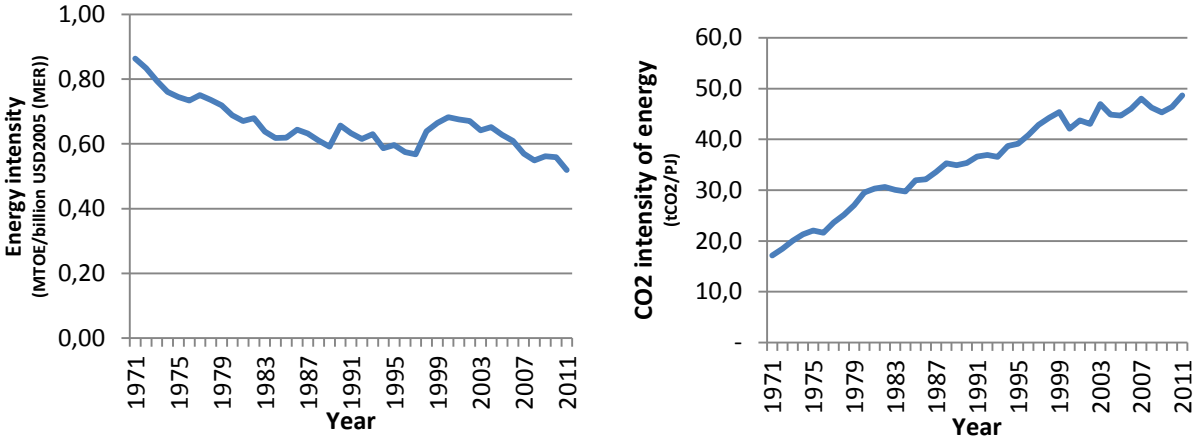

Figure 2.2: Development of Indonesia's energy intensity of GDP (left) and the CO_2 intensity of its energy mix (right) from 1971 – 2011 (IEA, 2013a).

Indonesia's energy supply mix consists for some 95% of fossil fuels (KESDM, 2010). Most of the renewable energy used is bioenergy. In addition, hydropower and geothermal energy contribute significantly.

Indonesia's energy use grows quickly in transportation and residential energy use, both by around 10% between 2010 and 2011 according to the IEA (2012; 2013a). In terms of industry, Indonesia's economy relies heavily on mining and agriculture. Manufacturing energy use seems to have decreased slightly between 2010 and 2011 (IEA, 2012; 2013a). This is not fully consistent with what MEMR reports, which indicates an increase in the household sector of only a few percent per year.

The IEA also reports on Indonesia's CO_2 emissions by sector in 2011 (see figure 2.3). Construction and manufacturing industries made up over one third of total CO_2 emissions, and transportation more than a quarter. In the IEA numbers, almost 80% of residential CO_2 emissions are due to electricity use (IEA, 2013a).

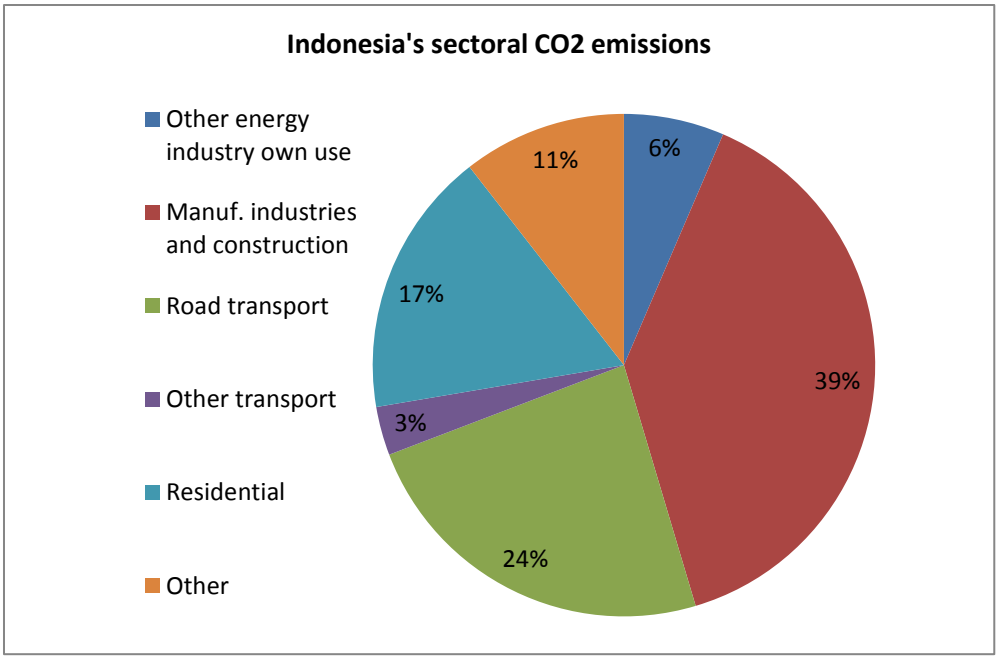

Figure 2.3: CO_2 emissions by demand sector in Indonesia in 2011. Electricity and heat make up 32% of CO_2 emissions, but are allocated to the demand sectors in this graph (IEA, 2013a). The "Other" section includes commercial buildings.

2.2. Actors and their roles in energy supply energy efficiency and other low-carbon technology

The Indonesian energy and low-carbon technology landscape is vast with a myriad of different organisations working on various aspects of a low-carbon future. For low-carbon technology, this intersects with the larger technology sector, which encompasses various business-to-business interactions. This section outlines the roles and main stakeholders in the low-carbon technology and energy landscape, and their interlinkages, in Indonesia. For the purpose of this report, stakeholders and their roles in the low-carbon energy landscape have been organised loosely according to the demarcation given in the Indonesia's Technology Needs Assessment on Climate Change Mitigation (Republic of Indonesia, 2012a: 8; 2012b: 10-11).

2.2.1. Government ministries

The Indonesian Ministerial landscape consists of ministries such as the Ministry of Finance, the Ministry of Energy and Mineral Resources, and sectoral or line ministries like Ministry of Transport, Industry etc. In addition, there are coordinating bodies like BAPPENAS (the Ministry of national development planning). For low-carbon technology the following have a key role to play:

The Ministry of Energy and Mineral Resources (MEMR) governs the energy sector and has effectively become the responsible agency for formulating and implementing policies in all energy-related sectors, including oil, gas, coal, and electric power. MEMR also oversees state-owned energy-related companies such as Pertamina (see below). It is also in charge of providing data and analysis related to energy sector development and conducting surveying

and research into energy and mineral resources (IISD, 2012). Various directorates exist which are of relevance to the scope of this report, including:

- Directorate General of New Renewable Energy and Energy Conservation (DG NREEC) was established in 2010 to formulate and implement policies and technical aspects of the new and renewable energy as well as energy conservation. On similar lines the Director of Energy Conservation, Director of Geothermal, Director of Various New and Renewable Energy and Director of Bio-energy were set up and tasked. DG NREEC sets the feed in tariff which is prioritized by fuel type, in which wind, solar and mini-hydro is given priority over oil, coal and gas. Biomass fuel, including vegetable and animal waste, is given second priority (Forsyth, 2003).

- Directorate General of Electricity (DGE) acts as the chief regulator of the sector, being responsible for the drafting of legislation for electricity and energy utilisation, its standards, guidelines, criteria, procedures, implementation, co-ordination, enforcement and compliance. The central government sets the tariffs, sale price and fee for transmission line (IUPTL- Izin Usaha Penyediaan Tenaga Listrik is a license provided to IPPs) with approval from the parliament, whereas the same process is carried out on regional level by Pemda, the provincial government.

Other directorates include Directorate of Oil and Gas and Directorate General of Mineral and Coal. (APEC, 2013)

The electricity sector, in particular through the national electricity company PLN (see below) is also dependent on the administrative decisions by the Ministry of State-Owned Enterprises (MSOE), the Ministry of Finance (MOF) and the National Development Board (BAPPENAS). While BAPPENAS is not involved directly in the implementation of energy regulation, it influences the direction of energy policy and it safeguards alignment of energy policy with broader economic plans and regulations. BAPPENAS sets out the plan for energy development to be carried out by MEMR (IISD and TKN 2012). National climate change policy is coordinated by BAPPENAS (planning) and the newly merged Ministry of Environment and Forestry (Monitoring, Reporting and Verification). The MSOE oversees the shareholder interest of the state in PLN, the national, state-owned electricity company, while the MOF is responsible for allocating government subsidies and loans to the electricity sector including the PLN.

Line ministries are relevant since technologies fall under sectors such as those outlined in the TNA document which would require coordination and cooperation from Ministry of Transport, newly merged Ministry of Public Works and Housing (Kemen PU dan Perumahan Rakyat), newly merged Ministry of Environment and Forestry, Ministry of Agriculture, Ministry of Industry, Waste, Ministry of Marine and Fishery and Ministry of Research and Technology.

Indonesia is a large nation of many islands, each of which has their own specific energy challenges. Local and regional governments therefore play an important role in the implementation of energy policy: they develop relevant regulations and issue permits. They may also introduce their own, sub-national promotional strategies. Some local governments provide schemes to simplify administrative procedures related to project development.

2.2.2. State-owned companies and government agencies

Perusahaan Listrik Negara (PLN) is a government-owned limited liability company with two wholly owned subsidiaries: Pembangkit Jawa-Bali (PJB) and Indonesia Power (IP). Apart from sharing the generation business with the IPPs and cooperatives, PLN is the sole buyer and seller of electricity in the power market, currently purchasing approximately 80% of the power produced by the IPPs. Natural gas transmission and distribution activities are carried out by a state-owned utility, Perusahaan Gas Negara (PGN). PLN used to have a monopoly on supplying and distributing to end customers, but now is only authorized to licence for providing electricity for public use (IUPTL) may be granted to (among others) private business entities, subject to a 'right of first priority' provided to state-owned companies (i.e. PLN).

Pertamina, Indonesia's national oil company, is also a state-owned enterprise. In addition to its upstream activities, Pertamina operates nearly all of Indonesia's refinery capacity, procures crude and products imports, and supplies products to the domestic market. While Pertamina's monopoly in the retail market ended in 2004, the company continued to be the sole distributor for subsidized fuels until early 2010. With the December 2010 decision to gradually remove fuel subsidies for private vehicles, Pertamina now competes more directly with product retailers. Its responsibilities now include liberalisation of the upstream and downstream oil sectors.

SKK Migas, formerly BP Migas, acts as upstream regulator and BPH Migas as downstream regulator. The Ministry of Energy and Mineral Resources is responsible for entering into PSCs, while BP Migas serves as the upstream regulator that manages and implements these agreements.

Local or government owned financial institution also contribute to providing finance to Geothermal and other renewable energy projects at attractive rates, encouraging uptake of renewables like PIP and PT SMI. Under the recent ministerial reform, the PIP has been merged and is now housed within PT SMI (PT Sarana Multi Infrastruktur) and MSOE, which finances infrastructure development. (http://www.ptsmi.co.id/).

The National Energy Council, DEN(Dewan Energi Nasional) is created as the consequence of a mandate in the Energy Law[1]. The tasks of DEN are to draft the National Energy Policy, to be endorsed and promulgated by the government, with due consent of parliament (the DPR), to draft the National Energy Master Plan (RUEN, Rencana Umum Energi Nasional), to declare measures to resolve the conditions of energy crisis and energy emergency, and provide guidance and management on the implementation of cross-sectoral policies on energy. DEN establishes the National Energy Policy (KEN) which includes achieving energy elasticity to GDP of less than one by year 2025 and as per the latest Government Regulation (PP) No 79/2014 sets the New and RE target as 23% by 2025 and 31% by 2050. DEN is also considering CCD as an effective and desirable technology for Indonesia due to geographical characteristics, in particular a scenario of implementing CCS from 2017 or 2022 (Ministry of Environment,2010).

Government R&D agencies National Research Council (DRN, Dewan Riset Nasional) and the Agency for the Assessment and Application of Technology (BPPT, Badan Pengkajian

[1] It is a national, independent and permanent body

dan Penerapan Teknology) are also important governmental actors. Research in Indonesia is coordinated by the DRN, which is chaired by the state Minister of Research and Technology. Institutions conducting Research & Development (R&D) on energy include the BPPT; research institutions under the Ministry of Energy and Mineral Resources working on oil and gas, coal, geothermal, and renewable energy; and research centres in universities and technical institutions.[2] Indonesia has a broad range of R&D into new and renewable energy technology (such as solar, small-scale wind power and hydropower) and technologies that use biomass and plant-based oils as fuels. Research in this area is directed in many cases at applications in rural development. In 2009, Indonesia spent 0.08% of Research and Development Budget for the energy sector, whereas the complete R&D budget is 1% of GDP. However, the master plan – MP3EI proposes to establish an R&D fund equal to about 1% of the GDP until 2014, with a gradual increase in funds to 3% of the GDP by 2025 (APCTT-UNESCAP, 2014).

BPPT has overseen much research, development and demonstration of indigenous renewable energy such as, for example, a USD 7 million ocean and wave technology project on the southern coast of Java near Yogyakarta (Forsyth, 2003). BPPT performs technology assessments and demonstrations, undertakes energy modelling (using Markal, a bottom-up, technology-rich energy optimisation model) (IEA, 2008) and analysis to inform national policymakers, and works with the private sector and other government agencies to transfer technologies to the marketplace.

Specialised government agencies EECCHI, BKPM and DNPI: Energy efficiency and Conservation Clearing House Indonesia (EECCHI) is a service facility under the Directorate General of New Renewable Energy and Energy Conservation of MEMR that aims to promote energy saving and energy efficiency in Indonesia. Capital Investment Coordinating Board (Badan Penanaman Koordinasi Penanaman Modal, BKPM), the agency in charge of investment licensing and regulation, screens the applications of foreign and domestic investors. This would include the payments for technology imports of cross-border technology inflows into Indonesia (Indonesian Institute of Sciences, 2001). BKPM has a centralized and online platform to issue permits and licenses related to investment in RE and Energy Conservation, The MEMR itself has an agency for Education and Training called Pusdiklat KEBTKE which provides capacity building and training for the energy sector (IEA, 2008). Statistics are obtained from the Central Agency of Statistics (Badan Pusat Statistik, BPS), BKPM, and the Bank of Indonesia and the Handbook of Energy Statistics published on ESDM's website (Indonesian Institute of Sciences, 2001).

Last but not least, the National Council on Climate Change of Indonesia (DNPI) is the focal point to the UNFCCC for climate change policy. It has a technology transfer working group which also feed into the negotiations on the mitigation track for the UNFCCC. It is the National Designated Entity for technology transfer proposals for submissions to the CTCN. Under the new government, DNPI will be housed in the newly merged Ministry of Environment and Forestry.

[2] Universities and research institutions are detailed under the research/academic organisation section.

2.2.3. Civil society and international NGOs

NGOs go about expressing concerns over government initiatives in at least four ways: (1) undertaking projects on public education/awareness, either in support of or opposition to official initiatives; (2) empowering the people to generate their own energy resources, such as creating micro-hydro projects; (3) taking on a watchdog role with regard to government policies; and (4) engaging in advocacy by assisting the government in amending certain energy policies. According to general observation and interviews, most NGOs involved in the Indonesian energy sector are research-oriented (Alexandra , 2012).

Some of the key Indonesian NGOs working on low carbon technology landscape are the Institute for Essential Services Reform (IESR)[3], a network of NGOs (since 2001) provides policy suggestions on promoting transparency and accountability in the Indonesian energy sector and recently focused on community level Renewable Energy. A collaborative effort on energy alternatives involves several NGOs—comprising Sawit Watch, Kehati, the Social and Economic Research Institute (INRISE), Media Indonesia Group together with the Bogor Agriculture University —has focused on technical innovation and, in 2006, it led to the release of a report on developing palm oil as a bio fuel in Indonesia. Likewise, Yayasan Lembaga Konsumen Indonesia (YLKI, the Indonesia Consumer Association), provides the public with arguments for supporting an increase in the electricity tariff (Forsyth, 2003). Yayasan Pelangi has partnered with a foundation within the Institut Bisnis dan Ekonomi Kerakyatan (IBEKA, an economic and business institute) to develop micro-hydropower projects in Aceh and South Sulawesi. Its members also train local communities to operate these facilities. In addition, Yayasan Pelangi collaborates with Yayasan Dian Desa, which specialises in educating local people and businesses to build energy-efficient wood-stoves and kitchens. Yayasan Pelangi's latest project assesses the potential for biogas production in the Tangerang regency, following a request from the local government. Tri Mumpuni Iskandar,is a well-known social entrepreneur and Magsaysay Award winner and the director of the People Centred Business and Economic Institute (IBEKA), which has lead the way in developing small hydropower projects.

An example of an international NGOs in low-carbon technology is Winrock International, a US-headquartered non-profit which has been involved in installing ten wind turbines of between 10 and 1.5kW in small rural villages in Eastern Indonesia for water pumping and power generation, using imported technology from Bergey Windpower of the United States including creation of new governance systems (or "distributed utilities") to ensure technical maintenance and financial cost recovery. Local utilities were created through building a tri-partite agreement between Winrock, the new utility (commonly the village committee), and a local NGO. Each was assigned duties concerning finance, training, and maintenance, which enabled each party to ensure the utility was performing its duties. The Power Switch Campaign[4], launched by WWF Indonesia, was active in Jakarta between 2003 and 2007 as part of a worldwide campaign on energy efficiency. WWF Indonesia is also currently implementing empowerment programmes in certain areas of Kalimantan (Borneo) in collaboration with the local government, assisting communities in assessing their region's potential for various types of renewable energy (Forsyth, 2003). More recently, WWF is

[3] Interviews with UNDP

[4] A poll conducted by the newspaper Kompas in early July 2005 indicated significant public commitment to save energy. Around 71.7 % said that they had reduced their use of electricity, including for lighting purposes, while 34.4 % indicated that they had minimised the use of LPG for cooking.

working with OJK related to financing of renewable energy. Hivos, a Dutch development organisation, is a player in the energy landscape and has already managed a program supported by another international NGO -SNV installed 10,000 Biogas in Indonesia with 90% operating fully[5] [6]. More recently, it has signed an agreement to provide 100% renewable energy for the island of Sumba, Indonesia (Hivos website, 2014). More recently SNV with the financial support of EEP Indonesia, has implemented an introductory project to deliver ten Medium Scale Biogas Digesters in Pulang Pisau, Central Kalimantan.

This is however not necessarily representative of NGOs and civil society members working in the field in Indonesia as these vary project by project, at different points of time and as per location within Indonesia and which depend on various funding sources and intervention strategies.

2.2.4. Research and academic organisations

The Indonesian Institute for Energy Economics (IIEE) produces publications (both digital and print), campaigns and empowerment projects to disseminate and implement their research. It publishes the Indonesian Energy Economics Review (IEER) which offers analyses relating to energy security (IEER 2006, pp. 48–49). For example, volume II of the IEER, published in 2007, discusses domestic energy supply and demand, as well as how the attempt to achieve energy security should go hand in hand with sustainable development. IIEE is currently creating an energy database to support the IIEEM which is an integrated model that incorporates environmental considerations into an optimal energy use analysis that will be made available to the public (Alexandra , 2012). More recently they have been involved in improving Indonesian Integrated Energy and Environmental Modelling (IIEEM) with JICA, and various studies on barriers in production of low-carbon technologies, an inventory of electricity subsidies in Indonesia, study on renewable energy development policy, energy efficiency policy and the development of Biomass Energy power plant in Munduk, Bali in cooperation with amongst others.

The ASEAN Center for Energy[7] promotes the development of energy in a sustainable fashion, and integrates the energy production and power generation capacities of all members (REEEP, 2012). They also work on the ASEAN Energy Database, ASEAN Energy Business forum and a renewable energy support program for ASEAN among other initiatives.

The Indonesian Institute of Sciences (LIPI) is a non-departmental research institution directly responsible to the President of Indonesia. It conducts strategic and fundamental research in science and technology with a focus on sustainable development. Hence, the LIPI energy focus is on new and renewable energy technologies (IEA, 2008).

In order to develop competitive local industries and innovative 'technopreneurs' to found and lead those industries, four leading universities have equipped themselves with technology commercialization activities. The universities include University of Indonesia (UI), University of Gajah Mada (UGM), the Bogor Agricultural University (IPB), and the Bandung Institute of Technology (ITB). In the cases of IPB and ITB for example, an intellectual property Rights (IPR) office has also been established. In IPB, ITB and UGM, business incubators to assist

[5] Interviews with IIEE
[6] Interview with UNDP representative
[7] http://www.aseanenergy.org/

students, alumni and staff in starting their own business have been set up. Additionally, UI in 2007 started realizing its long-term vision of developing science parks aimed at integrating research, development and commercialization activities. (IGES, 2010) Other universities working on low-carbon technology transfer in Indonesia include Gadjah Mada University (UGM), University of Pelita Harapan (UPH, more law and legal side), Surabaya Institute of Technology (ITS) in Surabaya, Surya University, Swiss-German University and CASINDO DETC University in Bandung. They provide training, research support and educate the next generation of expertise.

Several Indonesian research organisations participated in the CASINDO programme (2009-2011), which provided assistance by educating and training policymakers and by developing institutional capacity needed for the implementation of sustainable energy projects in five Indonesian regions. It also helped develop energy-related master and technical school curricula. CASINDO was implemented by a consortium consisting of the Energy research Centre of the Netherlands (ECN, who are also working intensively with DG NREEC)., responsible for the co-ordination, the Technical University of Eindhoven, ETC Nederland, the Ministry of Energy and Mineral Resources and its regional branches (called DINAS Energi[8]), two national research and training institutes (ITB and TEDC) and universities from the five regions are participating.

IPB has a special climate change wing called Centre for Climate Risk and Opportunity Management in Southeast Asia Pacific (CCROM). Related to low-carbon energy, IPB held a Dialogue between Policy-makers and Researchers: Demands and Roles of Research on Sustainable Low-Carbon Development and Green Growth from Policy Perspective on 16 February, 2010. More lately, they are involved in the climate village initiative, national climate leadership program (2013) and carbon accounting (2014).

2.2.5. Private sector including business associations

The extensive private sector relevant to low-carbon technology transfer in Indonesia is discussed in six categories: business-to-business transfers through business-to-business interactions, business associations, technology providers, local manufacturers and consulting companies.

Business to Business Technology Transfer: much low-carbon technology transfer in Indonesia can be traced back to business-to-business through the Kyoto Protocol's Clean Development Mechanism (CDM). But technology transfer existed even before that in the form of Joint Ventures. For instance, the PT Asahan Aluminum smelting works in northern Sumatra, which is a Japanese–Indonesian joint venture that has constructed two hydropower plants of 268MW and 317MW on the Asahan River. In southern Sulawesi, a similar Canadian–Indonesian joint venture built a 165MW hydropower plant on the Larona River to service a local nickel plant (Forsyth, 2003). Another example is General Electric, which licensed technology to the Universal Maintenance Center (UMC), a workshop owned by PT Dirgantara Industries (previously known as PT Industri Pesawat Terbang N Nusantara, the Indonesian aircraft industry) (Soekarno and Damayanti, 2009).

[8] Each province has a DINAS Energi. More information on the one on Jakarta, for instance, can be found here: http://disperindgi.jakarta.go.id/

Business associations: Usually, private sector approaches the government through associations of industry players. They help in lobbying and becoming the core interface between private sector and the government. Examples include the US Export Council for Renewable Energy and the Environmental Business Support Foundation of Jakarta (Forsyth, 2003), the Indonesian Association of Bioenergy Scientist and Technologist IKABI, the Indonesian Biofuel Expert Association (IABI), Indonesian Biodiesel Forum (FBI), Indonesian Solar Energy Engineering Association (IATESI), Nuclear Power Experts Association (KATN), Indonesian Renewable Energy Society (METI), Indonesian Wind Energy Society (MEAI), Indonesian Palm Oil Board (DMSI), Indonesian Biogas Community (MBI), Community for Energy and Environment (MPEL), Indonesian Association of Energy Conservation (APKEINDO), Indonesian Lamp Manufacturers Association (APERLINDO), Indonesian Electronics Association (Gabel), Indonesian Electrical Industry Luminaries Association (AILKI), Energy Conservation Expert (HAKE), Indonesian Building Utility & Building Physics Engineers Association (IAFBI), Energy Saving Society Forum (FKMHE), Indonesia Low Carbon Business forum (ALBI), Green Building Council Indonesia (GBCI), Environmental Business Development Foundation, Indonesia National Committee – World Energy Council (KNI-WEC) (Government of Indonesia, 2012b Pg:10), Indonesian Business Council For Sustainable Development (IBCFSD) (APEC,2013), ASI, APKI- pulp and paper, Indonesia Geothermal Association (INAGA) - Asosiasi Panasbumi Indonesia (API) (Indonesia Geothermal Association), Indonesian Textile Association- API [9], APROBI[10], Wilmar, GAIKINDO for automobiles, GAPKI-Indonesian Palm oil Association and the Indonesia Solid Waste Association (INSWA) and newly founded APLIBI (Asosiasi Penghasil Listrik Berbasis Bioenergi Indonesia).

Foreign and Indonesian private companies which provide technology or have technology transfer projects include Honda, Siemens, Holcim, Indocement and Medco. Medco for instance, is actively involved in renewable energy development, production and promotion even though PT Medco Energi Internasional Tbk (MedcoEnergi) is a publicly-listed Indonesian company majorly focusing on oil and gas. MedcoPower is developing mini-hydro and geothermal power plants in Sarulla in North Sumatra and Ijen in East Java and is planning for the development of the Sarulla Geothermal Power Plant Project 3 x 110 MW, 2 x 55 MW in Ijen, following a geology & geophysics study. Medco also develops bio energy and has an ethanol production with capacity of 180 kL per day in Kotabumi, Lampung Province which was later sold to another entity(APCTT-UNESCAP (2010). The factory was designed to use various raw materials for ethanol production while cassava as major raw material.

Local manufacturers of turbines, boilers, palm oil mills include PT Yudistira Energy (invests in oil and gas, bioethanol, and energy sectors in Indonesia and internationally), P.T. Pasadena Engineering (Engineering, Procurement and Construction Company which focus on Renewable energy and Environment Projects, e.g. Bioethanol, Biodiesel, Biogas, Biomass Gasification, Plasma Technology for Water treatment, etc.), PT Nusantara Turbin and Propulsi (a cooperation between NTP and BPPT supported by the Indonesian Department of

[9] Interviews with Ministry of Industry stakeholders

[10] APROBI is an association of private business entities, some of which have established biofuel plants and links to oil palm growers. In 2007, 5 of the 22 APROBI members had biofuel processing facilities, with a total installed capacity of 1.1 million tonnes per year. Unfortunately, only 15% of the capacity was being used due to limited domestic demand and supplies.---- CIFOR, Working Paper 62 2011, Caroko et al Policy and institutional frameworks for the development of palm oil–based biodiesel in Indonesia

Industry and Commerce that develops and manufactures steam turbines with capacities from 450 kW to 4 MW), PT Zug Industry (boiler manufacturers and power plant contractors through cooperation with partners in Germany and China etc). Usually their only interactions with government are on fiscal incentives and regulations.

Local manufacturers are looking for independent expert opinion on technology, hence a clearing house may be useful[11]. Mapping of bioenergy and PV potentials for diesel substitutions has been done by GIZ for such manufacturers[12]. Tri Mumpuni's lead social enterprise IBEKA[13] and Rekayasa Industry[14] are firms which have technology transfer projects. Rekayasa is a state-owned engineering company that deals with engineering and construction big factories in the country and abroad such as urea fertilizer, geothermal facilities, etc. Since a few years, the company actively expanded its business and offers consultation and service in constructing bio-diesel processing plant (APCTT-UNESCAP, 2010). Other firms identified in this space worth noting are: PT Cerah Sempurna Asia Indonesia, PT Gerbang Multindo Nusantara Asia Indonesia, PT Solar Power Indonesia Asia Indonesia and PT Sudimara Energi Surya Asia Indonesia (ADB, 2010: 99).

Consulting groups include PT Energy Nusantara, PT Energy Management (provides operational development services), PEN consultants and PT Pelangi Energi Abadi Citra Enviro (PEACE) and usually provide technical assistance. Examples include a World Bank-sponsored study on energy use and GHG inventory by PT Pelangi Energi Abadi Citra Enviro (PEACE), an Indonesian consulting group, and others in 2007.

In addition, a host of private hedge funds are looking to invest in green technology. Cleantech Capital Group, Cleantech Venture Network and Greentech Media usually publishes analysis and monitors investments in green technology by venture capitalist firms. Some notable corporate venture capital companies making equity investments in green technology companies are[15]: Clean Technology Venture Capital - Expansion Capital Partners LLC (http://www.expansioncapital.com/index.php), IKEA GreenTech AB (http://www.greentechab.com/company), Kirkpatrick, SJF Ventures- North Carolina, Sequoia Capital (https://www.sequoiacap.com/us/about/dentmakers), Virgin Green Fund, Zouk Ventures, Renewable Ventures, Blue Hill Partners, Echoing Green, DBL ventures, boutique funds like Rockport Capital Partners and SAIL Venture Partners, Global venture funds like 3i and Draper Fisher Jurvetson have also added investments in green technology to their portfolios. In 2006, Kleiner Perkins Caufield & Byers, one of the largest VCs in the U.S., launched a USD 100 million "Greentech Initiative" as part of its USD 600 million 12th fund. To date, investment in Indonesia has not yet picked up for green technologies but is rather extensive for social media and e-commerce ventures.

Examples of ventures funded : Nest raised USD 80 million to develop thermostats that learn the energy consumption patterns and adjust heating and cooling accordingly, India-based Richcore Lifesciences, which produces enzymes for biofuel production and raised USD 54 million (Forbes, 2013).

[11] Interview with METI representative
[12] Interview with LCORE team, GiZ
[13] Interview with IIEE
[14] Interview with ITB University Professor
[15] A full list of firms can be found here : http://www.boogar.com/resources/venturecapital/clean_tech.htm

2.2.6. Multilateral banks and funds

There are several initiatives that are in the form of financial assistance or to tackle financial barriers to the uptake of clean energy technology. One of the key funds that seeks to promote scaled up financing for demonstration, deployment and transfer of low carbon technology is the Clean Technology Fund. Indonesia currently has one project approved by the CTF Trust Fund Committee: Indonesia Geothermal Clean Energy Investment Project, being undertaken with the IBRD. This project was approved for USD 125 million of CTF funding in December 2010[vii]. Other projects in the pipeline under Indonesia's investment plan include energy efficiency projects (ADB and IFC) and geothermal (ADB, IFC, IBRD).

Another one is the Clean Energy Financing Partnership Facility (CEFPF) which was established and administered by the Asian Development Bank (ADB), which focuses on promoting the deployment of new, more efficient and less polluting supply and end-use technologies. Eligible projects include those focused on biomass, biofuel and biogas, rural electrification and energy access, energy efficiency and clean energy power generation, transmission and distribution, amongst others. The fund's resources are also used to support policy, institutional and regulatory reforms that encourage clean energy development. For example the Pilot Project for Efficient Lighting, approved in 2009, focused on demonstrating the use of energy efficient lighting. Meanwhile the Indonesia Eximbank Capacity Building Programme, which received USD 1.1 million of CEFPF funding in 2010, sought to address inadequacies in the financing model for clean energy in Indonesia's commercial banking sector while improving the capacity of financial institutions to provide advisory and financial services for energy efficiency technologies (Arghajata, GreenWorksAsia, 2011). The GEF Trust Fund has supported projects in Indonesia mostly with a renewable energy focus, but funding has also been secured for energy efficiency and sustainable transport activities.

Other funds that also contribute are the Indonesia Climate Change Trust fund and market based funding mechanisms such as the CDM. Although please note that these are broader funds and not solely targeted towards clean energy technology initiatives.

Amongst Banks, the World Bank, ADB, IFC and KfW work on energy efficiency, geothermal etc., but mostly to assist in financing and related processes. The finance for technology transfer is a focus area of the ADB. ADB has already worked on proposed idea of a virtual hub - marketplace for Low Carbon Technologies with corresponding LCT research network and forum (ADB, 2010). They identified main channels of technology transfer and identified two potential markets for technology transfer) the transfer of goods/services from manufacturers/service providers to end-users of LCTs (which we refer to as the "end-user market"); and 2) the transfer of the ability to produce the good/service (referred to as the "IP market") (ADB, 2010)[16]. UNEP's end-user Finance for Access to Clean Energy Technologies (FACET). Programme helps overcome financial barriers to using such technologies. This initiative aims to motivate domestic banks to provide loans for small-scale clean energy applications in Southeast Asia.

[16] Likely participants in such a market place would be Supply side: 2nd Tier technology firms seeking to expand, Start Ups looking for Capital, Innovative design house or universities/national labs, MNCs with non-core technologies, Demand side: Existing LCT players looking to improve their technology portfolios, manufacturing powerhouses looking to enter a new market, technology SMEs looking to enter an adjacent market.

2.2.7. International organisations and donor agencies

International organisations and donor agencies active in Indonesia on low-carbon technology transfer include JICA, GIZ, GGGI, DANIDA, EEP Finland, USAID - Indonesia clean energy program and millennium green prosperity program and AfD. This also includes IRENA other relevant international commissions such as the International Energy Agency (IEA) and sector-specific agencies like Global Wind Energy Council (GWEC), Wind International and the World Wind Energy Association (WWEA). Table 3.1 provides an overview of donors active in Indonesia in low-carbon technology transfer and the activities they focus on.

Table 2.1 overview of donors active in Indonesia in low-carbon technology transfer and their activities.

Donor	Summary of relevant activities
Ministry of Environment Japan	Working on the TNA (Technology Needs Assessment) review and quick study on national technology transfer under the Climate Technology Centre and Network (CTCN) mechanism. This is scheduled for January with comments from DNPI, UNEP and Ministry of Environment., is part of a commissioned work from the Ministry of Environment Japan (MOEJ).
JICA	In 2010, JICA implemented a study for Indonesia's policy reform to promote private enterprises to take part in developing abundant geothermal energy. A geothermal power plant has been constructed in South Sumatra Province and connected to the power grid in Lumat Balai. (Kawamura, 2012)
GIZ	LCORE – Promotion of least cost renewables in Indonesia and GIZ PAKLIM and Ministry of Industry collaboration on various projects for Green Industry/technology are amongst more relevant activities for the scope of this report. Green Chillers Project for NAMA development.
DANIDA	EE clearing house, Establishing ESCOs and audits, Wind Energy Map, pilot projects to localise and contextualise work in local setting. Waste to Energy with Holcim.
Agence francaise de Developpement (AfD)	Green line of credit for RE and EE projects to banks with public leading banks, usually work a lot with PLN, EE study in cement study.
Global Green Growth Institute (GGGI)	Works with ESDM on technology mapping, identify technology, deployment, market, policy and barriers and build a business case for investors in green technologies.
Asian Development Bank (ADB)	CCS pilot project with JICA, geothermal regional study Indonesia, Vietnam, etc., macroeconomic assessment of energy sector, integration and interconnections with PLN, EE audit reports with ESDM.
United Nations Development Programme (UNDP)	Working on TT project with BPPT micro turbines cogeneration with Capstone, Energy efficiency lamps and labelling, BRESL

United States (USAID)	Some related work on adaptation technologies especially in the Marine sector and scheduled technology transfer assistance for the upcoming green prosperity project

2.2.8. Interlinkages and collaboration between actors

The previous sectors demonstrate that the low-carbon technology landscape in Indonesia is extensive and complex. It needs to be very diverse to reflect the cultural and insular diversity of the country of Indonesia. Many actors have ongoing collaborations, of which numerous examples are listed in this section. However, despite occasional collaborations, the connections between private and public entities are not as strong and common as in other countries. Stronger ties and more interaction are likely to lead to greater capacity and mutual learning, better alignment of private entity strategies with government and public priorities and eventually to more low-carbon technology transfer. In some cases, anti-corruption legislation complicates technology cooperation between companies and government, as assets and grants cannot be transferred easily (outcome of the DNPI/GIZ workshop). The examples briefly discussed in this section provide a start of strengthening such much-needed collaboration.

For example, the first TNA assessment has been conducted in 2009 in association with the Ministry of Environment (now, in 2015, Ministry of Environment and Forestry) . It also has a collaboration with Panasonic on Energy Efficiency and has been working on criteria for green boiler, already made a scoring tool.[17] The Ministry of Industry collaborates with ESDM on development of bio-jet fuel [18], and with Adidas, Siemens, cement companies on energy efficiency. Government officials, especially from the Ministry of Energy and Parliament, have taken to occasionally inviting NGOs for ad-hoc public consultations and hearings when formulating new regulations, particularly during emergencies (Alexandra , 2012). MEMR has indicated a vision of how actors could collaborate in Indonesia, which is depicted in figure 2.4.

[17] Ministry of Industry Representative Interview
[18] ESDM Bioenergy Directorate interview

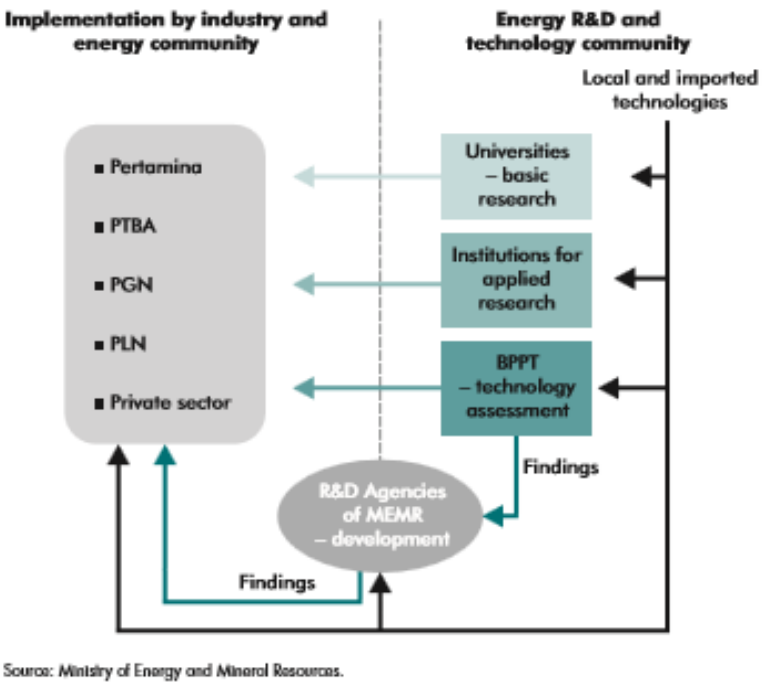

Figure 2.4 MEMR's view on collaboration and linkages between Indonesian research, industry and government actors.

BPPT works with METI on process of selection of technologies for Best Available Technologies[19], on R&D with Bioenergi and ESDM[20] and works with UNDP on introducing micro turbine cogeneration for EE funded by GEF under TT umbrella[21]. BPPT also supported the TNA review process in 2012. The technology for PLN power plants in Banten and Surabaya came from the Netherlands and BPPT has been involved with ITB to understand coal-based steam turbines. This project has been postponed due to unsatisfactory operational maintenance and service from original Chinese coal technology provider.[22]

For technology transfer in agricultural technology, e.g. for biomass production, the central government and local authority liaises with students of university for working on the field lab to test the technology along with the research centres in participatory program formulation, e.g. on assessment and dissemination (OECD,2011). CASINDO DETC University in Bandung have an ongoing wind power project providing training services, vocational training and developing curriculum related to low-carbon technology[23]. IIEE is currently working with DANIDA on renewable energy for two institutions in Semarang on solar and wind to help the district government with legal, project management, finance, integrated training for developer. IPB University is developing algae streams by extracting from oil in a project with the Bioenergy Directorate at ESDM.[24] In March 2014, LIPI researchers conducted a National Stakeholder Workshop on Accessible and Affordable Sustainable Energy Options with the Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) New Delhi, India. The

[19] Interview with METI representative
[20] Interview with Bioenergy Directorate, ESDM
[21] Interviews with UNDP.
[22] Interview with ITB representative
[23] Interview with UNDP representative
[24] Interview with Bioenergy Directorate, ESDM.

Swiss-German university department energy department is also working on technology transfer with a German company. Previously, ITB has worked with TERI in India on technology transfer (in 2009). Further, ITB is involved in a program on CCS with Kyoto University, ITB, Pertamina and Government of Indonesia in an ADB project with a Japanese technology provider. It goes beyond implementation of technology, designing process, and selecting technology. Technical assistance is provided by Japanese institutions. This project started in 2013.[25]

In the private sector, Honda has advanced technology in solar PV and provides tools and training and knowledge transfer to Indonesian researchers and universities as also SMA. Siemens and Schneider conduct technology transfer for generators, but have not yet claimed the low-carbon energy domain. They provide equipment as well as training to university students close to the plant established. For example, Siemens as part of the know-how and technology transfer, launched the "Welding Technology and Non-Destructive Test Training Center" in December 2014 for manufacturing of complex, high-quality components in core competence areas like Machining, LEAN Production, and Project Management. In 2013, Siemens Indonesia has donated training equipment to Politeknik Krakatau's Electricity Laboratory and Mechanical Workshop in Cilegon, Banten.[26] Bruchner and Tiss is a German company that transfers technology in combined heat and power project to Indonesia[27]. APROBI works on second-generation biomass with Pertamina[28] and Indonesian cement company ASI. The Pertamina Foundation is conducting training of trainers with IIEE for 10 schools in the field of micro hydro-electricity.

DANIDA implements a waste to energy project with Holcim, Wind Energy Mapping with EBTKE the EE clearing house and ESCO development. EEP Finland works on electricity from waste biomass in rural areas with local NGOs like IIEE (EEP Finland). Amongst upcoming projects, Danida and ECN aim to set up a renewable energy clearing house and USAID will expand the Indonesian Clean Energy Program further to the Green Prosperity Project. DANIDA also collaborates with IIEE to give trainings and technical assistance for wind mapping and energy projects. GIZ is working with the ASEAN Energy center on trainings in the Hydro power competence center in Bandung.[29] GIZ is also working on best available technology – while manufacturing micro hydro power turbines, trained local turbine manufacturers – in Sulawesi and Bandung.

2.3. Regulation and policy in energy supply, energy efficiency and other low-carbon technology

Indonesia has enacted Energy Law No. 30 of 2007 as the key regulation for national energy policy. This law allowed the creation of a National Energy Council with duties to design and formulate national energy policy in the area of conservation energy and diversification, to decide measures to manage energy crises and emergencies, and to monitor the implementation of energy policy that is cross-sectoral in nature. The senior management of

[25] Interview with ITB representative.
[26] http://www.siemens.asia/id/en/press/Press-Releases/Siemens_Cilegon_Factory_is_committed_to_boost_local_manufacturing.aspx
[27] GiZ wanted to show BtoB savings that will happen after installation but faced a challenge to get baseline data.- Nanda GiZ 06.11 <NS: please revise this source reference> DONE
[28] Interview with Bionergy Directorate , ESDM
[29] Interview with LCORE team GIZ

the National Energy Council is constituted from the Chairman (President of the Republic of Indonesia), Vice-Chairman (Vice President of the Republic of Indonesia), and Executive Chairman (Minister of Energy). The members of the Council will be seven representatives from the ministries directly responsible for supplying, transporting, distributing and utilizing energy; and eight representatives from stakeholders. Ministerial members will be appointed by the President and the others will be selected by the House of Representatives (Tumiran, 2014).

Based on Government Regulation No 79 of 2014 about National Energy Policy 2013 – 2050, the key objectives of the present energy policy are:

- To supply primary energy 400 MTOE by 2025 and 1000 MTOE by 2050; energy per capita 1.4 TOE by 2025 and 3.2 TOE by 2050
- Development of capacity power plant 115 GW by 2025 and 430 GW by 2050; utilization of electricity per capita 2500 kWh by 2025 and 7000 kWh by 2050
- To reduce energy elasticity to below 1 by 2025; and to reduce intensity of energy final 1 percent per year until 2025
- To reach electrification ratio 85% by 2015 and about 100% by 2020

This regulation also set target regarding the energy mix milestone as shown in Figure 2.5.

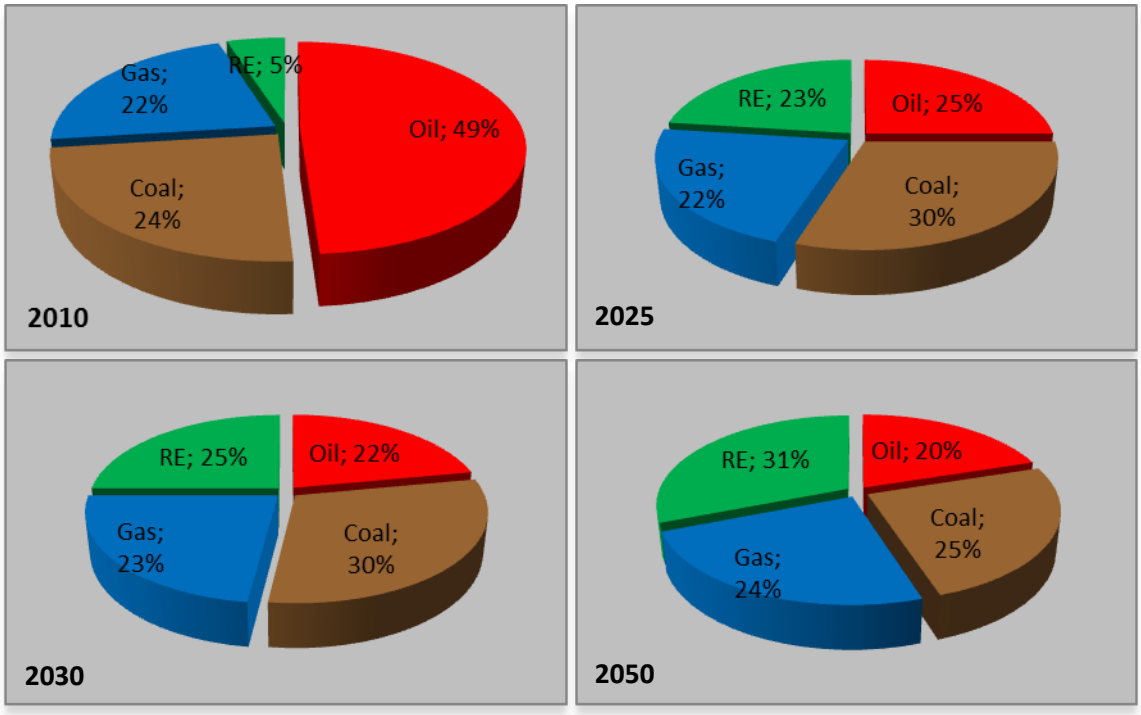

Figure 2.5: Vision of the Indonesian energy mix in 2025, 2030 and 2050 (Source: Government of Indonesia: Government regulation No 79, 2014).

2.3.1. Energy Conservation

Energy conservation is related to increasing the efficiency of energy use on supply and utilization side of the energy value chain, such as sectors of industry, transportation, household and commercial. Government Regulation No 79 of 2014 about National Energy Policy 2013 – 2050 has set a target of a 1% per year reduction in energy intensity and

reaches energy elasticity to below 1 by 2025. The conservation activity is supported by several regulations:

- Government Regulation No.70/2009 concerning on Energy Conservation which regulates about parties responsibilities (government, local government, business sector, and community), area of conservation activity which is supply of energy, utilization of energy and conservation for energy resources.
- Presidential Instruction No. 13/2011 concerning on Energy and Water saving mainly in the government institution. The targets for this instruction are: reduction of the electricity consumption 20%, water consumption 10% and water saving 10% compare to the average of six months utilization before the instruction issued.
- Ministry of EMR Regulation No. 13/2012 concerning on Electricity usage saving. This regulation is the implementation guideline of Presidential Instruction No. 13/2011 to reduce 20% of electricity consumption. The efficiency activities were done in the area of air conditioning, lighting and supporting equipment. The target should be reached after 6 months of the implementation
- Ministry of EMR Regulation No. 14/2012 concerning on Energy management for user of more than 6000 ton fuel equivalent per year. This regulation explained about energy management which covers activities such as appointment of energy manager, development of conservation plan, periodic energy audit and implementation of audit recommendation, and reporting to government.
- Ministry of EMR Regulation No. 15/2012 concerning on Water Usage Saving. This regulation is the implementation guideline to reduce 10% of water consumption in the government building 6 months after the implementation.
- Ministry of EMR Regulation No. 01/2013 concerning on Control of Subsidized Fuel Utilization which regulates the limitation of gasoline RON 88 utilization for government vehicle and subsidized gas oil for truck with more than four wheels to transport the product of mining, plantation and forestry.
- Ministry Of EMR Decree No. 4051K/07/MEM/2013 concerning on Four Energy Targets (Catur Dharma Energi) which are 1) increase oil and gas production, 2) reduce import of oil fuel, 3) development of renewable energy and 4) energy saving.

Ministry of Energy and Mineral resources have set 5 programs (KESDM, 2014a) to implement the energy conservation which is:

1. Energy saving campaign
2. Standard, labelling and define minimum energy performance standard for house hold equipment such as air conditioning and refrigerator
3. Energy manager and auditor
4. Partnership program
5. Implementation SNI: ISO 50001

The implementation of energy conservation is in line with mitigation target in the energy sector. Total emission reduction target from the energy sector 32.8 million tCO2e and out of it around 22.20 million tCO2e should be achieved from energy conservation activity through the programs (KESDM, 2014b):

1. Energy management in energy intensive industry target 10.16 million tCO2e and until 2013 the achievement 309,911 tCO2e

2. Partnership in energy conservation target 2.11 million tCO2e and until 2013 the achievement 781,400 tCO2e
3. Energy efficient appliances target 10.02 million tCO2e and until 2013 the achievement 1,384,236 tCO2e
4. Implementation of Presidential Instruction No. 13/ 2011 on Energy and Water Saving as part of the target from energy conservation until 2013 is 23,316 tCO2e

2.3.2. Energy supply diversification

Energy diversification is targeted to increase the portion of renewable and new energy in the national energy mix on the supply side. Indonesia has considerable potential for a number of new and renewable energy sources however the installed capacity/resources ration is less than 10% except small hydropower of which currently some 30 is used (see table 2.2).

Table 2.2. Renewable energy mapping, resources and implementation levels in Indonesia (Sources: compilation based on Synthesis Report of KESDM, 2013; GIZ, 2012; Wibowo, 2014)

No	Renewable Energy	Resources (R)	Installed Capacity (I)	I/R Ratio
1	Hydropower	75,670 MW	5,771 MW	7.62%
2	Mini- and micro hydro	769.69 MW	230 MW	29.90%
3	Geothermal	28,543 MW	1,228 MW	4.30%
4	Bioenergy (biomass, biogas and municipal waste)	32,654 MW	1,716 MW	5.25%
5	Solar Energy	4.80 kWh/m^2 /day	27.23 MW	
6	Wind Power	3 – 6 m/s	1.87 MW	

The main ones, i.e. bioenergy, geothermal energy, mini-hydro and solar energy, are discussed here.

Bioenergy

In Indonesia, products of bioenergy are developed in the form of biofuel (liquid), biogas, bio-solids (bio-briquettes, pellets) and bio-electricity. Development of each type of bioenergy mostly has been driven by Government Policy to achieve the target 10% contribution for energy mix by 2015 and 14% by 2050. The objectives of bioenergy development policy are:

1. To increase the use of biofuel as the substitution for fossil fuel
2. To contribute to the national economy through development of bioenergy industries
3. Utilization of organic waste as a source of energy
4. Development of biomass-based power plants
5. To increase sustainability of bioenergy supply through development of energy farm

Government has issued several regulations to achieve the objectives:

- Presidential Instruction No. 1/2006 about supply and utilization of biofuel as other fuel
- Ministry of EMR Decree No. 20/2014 concerning supply, utilization and trade system of biofuel as other fuel

- Ministry of EMR Decree No. 19/2013 about supply of electricity based on Bioenergy
- Ministry of EMR Decree No. 27/2014 about power purchase from Biomass Power Plant and Biogas Power Plant

Geothermal

The key regulation for geothermal development in Indonesia is Law No. 27 Year 2003 which governs about the 5 (five) stages in utilizing geothermal energy. The stages are preliminary survey, exploration, feasibility studies, exploitation and utilization. The government will involve in the two early stages and after that the interested party continues with the remaining stages on a commercial basis. The interested party should get the geothermal exploitation licenses (IUP) with limitation as follow:

(i) Exploration phase, valid of 3 (three) years which can be extended 2 (two) times for a period of one year each.
(ii) Feasibility study stage, valid for a maximum of 2 (two) years since the exploration time period is ended.
(iii) Exploitation phase, valid for a maximum period of 30 years after exploration has ceased and can be extended for 20 (twenty) years for each extension.

The Minister Regulation of MEMR No. 17/2014 requires PLN to purchase electricity generated from geothermal power plants operated by independent power producers (IPP) holding electricity supply business licenses (IUPTL), and steam for the purpose of generating electricity from the holders of geothermal exploitation licenses (IUP). The purchase price for electricity is negotiable but cannot be higher than the relevant ceiling price set out in the New Regulation. The purchase price is dependent on the area where the power plant is located and the commercial operation date (COD), subject to approval from the Minister.

Mini Hydro

The promotion and development of hydro-energy in Indonesia is already farther along compared to other renewable energy sources. The government encourages the use of electricity from hydro power through investment by cooperatives and other private actors, and has provided incentives for the utilization of hydropower through a feed in tariff (FIT) system for on-grid hydro power plant under the Minister Regulation of MEMR No. 12/2014 and 22/2014.

The government is also supporting the implementation of off-grid mini hydro for power in remote areas and villages through the program “Listrik Pedesaan” (Electricity for Villages). This program is funded by Special Allocation Fund on an annual basis and the latest program is regulated by Minister Regulation of MEMR No. 3/2014. The fund is available for development of off-grid new mini hydro power, rehabilitation of off grid existing mini hydro power and off-grid centralized solar power, improvement of services and coverage of electricity distribution, development of off-grid centralized solar power and biogas for household purposes.

Solar Power

Indonesia has abundant resources of solar energy which is suitable to use in small islands, remote areas, and border areas where there are no existing electricity installations. In 2013, the Government issued the Minister of Energy and Mineral Resources Decree No. 17 Year

2013 on the Purchase of Electricity by PT PLN (Persero) from Solar Power Plant which regulates power purchase prices of solar power plant with ceiling prices mechanism, and also provides incentives to encourage the use of local contents.

The tariff levels will be based on ceiling price of 25 cent USD /kWh (using modules with local content < 40%, i.e. considered as imported modules) and 30 cent USD/kWh (using modules with local content ≥ 40%). The application for the ceiling price will be done through a bidding process based on certain quota determined by Director General of NRE&EC which is 140 MW in 82 locations. The first round of bidding has been done in 11 locations. Seven locations have been awarded. The participation of the local manufacturers is significant such as PT LEN Industri which won in Kupang, Nusa Tenggara Timur and Adyawinsa which won the Gorontalo location.

2.4. International instruments

To strengthen national action, Indonesia is involved in a number of initiatives supporting its climate targets, including looking into implementing Nationally Appropriate Mitigation Actions (NAMAs), for which GIZ provides technical and institutional assistance, the Indonesian Climate Change Trust Fund (ICCTF) and initiatives around forestry and land-use (including REDD). In addition, Indonesia has been active in the Clean Development Mechanism (CDM).

According to the UNEP/Risoe Centre CDM pipeline (URC, 2014), Indonesia hosts 2,3% of all Asian CDM projects and 1,6% of all Certified Emission Reductions (CERs, the emissions credits in the CDM) generated in Asia. With that, Indonesia features in the top-5 of CDM host countries in Asia and globally (with China and India dominating the portfolio). Most projects in Indonesia are in the waste sector (methane recovery and landfill gas) and in the renewable energy sector (biomass energy, geothermal and hydropower). As the price of CERs has dropped dramatically over the past five years, it is not expected that Indonesia (or other countries) will benefit much from the CDM anymore.

NAMAs (UNFCCC, 2010) are an UNFCCC instrument that aims to facilitate developing countries to undertake those mitigation policies, measures or other actions that are considered in the national interest. Most NAMAs are undertaken unilaterally, but several others are supported and in the future they might even be “credited” – i.e., able to generate carbon credits. In the case of Indonesia, most NAMAs under development are supported NAMAs, meaning that some kind of international assistance is used to help formulate or implement the action. Indonesia aims to make use of NAMAs to help achieve its greenhouse gas reduction targets (see section 2.5). It currently has one NAMA in the implementation phase (Sustainable Urban Transport Programme) and nine under development, in energy supply, industry, buildings and waste (NAMA Database, 2014).

In addition to NAMAs, the Government of Indonesia has set up an ICCTF, “to pool and coordinate funds from various sources such as international donors and the private sector, to finance Indonesia’s climate change policies and programs” (ICCTF, 2014). Primary priority areas for mitigation of the ICCTF are energy and mining and forestry. It has two relevant windows for climate change mitigation: Land-based mitigation and energy. Current contributors to the ICCTF are Australia, Denmark and the United Kingdom (ICCTF, 2014; interview DANIDA).

2.5. Future expectations

The Government of Indonesia aims to both reduce Indonesia's energy intensity by 1% annually until 2050, diversify its energy mix to reach roughly 25% renewable energy in the mix by 2030 and over 30% in 2050 (Government regulation No 79, 2014), reduce greenhouse gas emissions by 26 to 41% in 2020 compared to a business as usual scenario (the higher number being dependent on international assistance).

Whether these targets will be achieved for the energy sector will depend to a large degree on the activity of the actors listed in section 2.2 and the government programmes, policies and regulations as discussed in section 2.3. In addition, the Government of Indonesia has established (Helmy, 2013):

- Presidential Regulation No. 61/2011 on National Action Plan on Emission Reduction Plan (RAN-GRK) covering 70 programs in 5 sectors
- Regional Action Plan on Emission Reduction at Provincial levels (RAD-GRK) covering 32 provinces out of 33 provinces (Province of North Kalimantan was established in 2013)

It is currently unclear if the current government actions listed in section 2.3 actually will add up to Indonesia's emission reduction pledge.

3. Stakeholder views on low-carbon technology transfer in the Indonesian energy sector

In this section, the results of an extensive stakeholder consultation on views on technology transfer are reported. Section 3.1 explains the sources of information and section 3.2 provides an anonymised and summarised version of the results. Section 3.3 draws some conclusions on what this means for the CTCN.

3.1. Approach

3.1.1. Workshop

On November 4th, 2014, a workshop was held by the National Council on Climate Change (DNPI) and GIZ to discuss the approach of DNPI to the CTCN, to introduce the GIZ Low-Carbon Technology Transfer in Indonesia project, to inform the participants of the background and workings of the CTCN and to invite viewpoints from ministries on various technology groups, and on criteria for selection of priority technology lines.

The agenda of the workshop can be found in Annex A.

3.1.2. Interviews

Twenty semi-structured interviews and meetings were conducted to provide more detailed information on the CTCN and to collect viewpoints on the actor landscape around technology transfer, what barriers tend to occur, what could be done to overcome them, whether the CTCN could play a role and in which sectors and for which technologies that would be most

helpful, and how in the longer term local innovation capabilities in Indonesia could be built. Table 3.1 gives an overview of the persons and organisations that were interviewed.

The questions that were discussed in the meetings included:

1) How does low-carbon technology transfer in the energy sector in Indonesia manifest itself most clearly (sector, example of a project or investment)?
2) What are the most important actors in the low-carbon energy technology sector in Indonesia?
3) What key capabilities for low-carbon technology are abundant and scarce in Indonesia?
4) What criteria should be used for selecting low-carbon technology priorities?
5) Please indicate what would be valuable actions to enhance low-carbon technology transfer in Indonesia. What type of technical assistance would be most effective?
6) Which low-carbon energy technology sector(s) in Indonesia should be given priority for technology transfer assistance, and why?

Table 3.1: Overview of interviews conducted for the project. All interviews were held face to face, with the exception of the interview with IIEE, UI, ITB and ANJ Group, which were held by phone.

#	**Institution**	**Type**	**Name interviewee**	**Date (2014)**
1	IGES Jakarta Support Desk	Research / donor	Muchamad Muchtar	29/10; 4/11
2	GGGI	Donor	Guilia Sartori	30/10
3	University of Indonesia (UI)	Research / education	Dr. Triarko Nurlambang	30/10, 13/11
4	Indonesian Institute for Energy Economics (IIEE)	Research	Rachmat Sugandi Hamdani	30/10
5	DANIDA	Donor	Peter Oksen, Trine Bargsteen	31/10
6	METI/SouthPole	Industry	Paul Butar Butar	31/10
7	Sewatama	Industry	Stefanus Johan	3/11
8	UNDP	Donor / UN	Verania Andria	4/11
9	ESDM / Konservasi Energi	Government	Ibu Maritje Hutapea, Harris Yahya	5/11
10	ESDM / Bio Energi	Government	Edi Wibowo	5/11
11	GIZ	Development Agency	Rudolf Rauch, Rafael Wiese	5/11
12	ADB	Finance / MDB	Maura Lillis	5/11
13	Energy Nusantara	Industry	Mohamad Aminuddin, Benny	6/11
14	AFD	Finance / Donor	Ghislain de Valon, Andre Hue	6/11
15	BPPT	Research / Government	Joko PS, Joko P, Rudi	6/11
16	GIZ	Development agency	Anandita Laksmi	6/11
17	Ministry of Industry	Government	Ngakan Timur	6/11

			Antara, Ibu Emi	
18	ANJ Group	Industry	Thomas Wagner	7/11
19	ITB, Bandung	Research/University	Dr Retno Dewi	14/11

3.2. Summary of interview results

Section 2.2 contains an extensive discussion of the actors in the low-carbon technology sector of Indonesia, partly based on literature and internet research and partly on information provided through the interviews and in the DNPI/GIZ workshop. The sections here summarise the results of section where needed, and adds observations from the interviews, where possible with examples.

3.2.1. Characterisation of the low-carbon technology transfer sector

Indonesia has an active private sector, but its private sector is essentially a follower of what is offered by foreign companies in terms of low-carbon technology. It may be a consequence of such an attitude, aimed at selling natural resources and trading goods rather than manufacturing and own knowledge and skills. Through developing those aspects, value could be added to Indonesia's abundant natural resources, and it could make technology cheaper and more available for Indonesian consumers and companies. The Indonesian economy relies heavily on agriculture and mining, and increasingly services, and the added value, employment and economic development benefits for many of Indonesia's products and resources are obtained in other countries.

It became evident from the stakeholder analysis that stakeholders are generally focussed on their own field. This applies to governmental entities, research organisations and companies. Collaboration only seems to be done if the benefits for both sides are so obvious that otherwise the core business cannot be implemented. In addition, research links to private sector and government are limited. Furthermore, the level of higher education was perceived by some stakeholders as a barrier to deeper collaboration on low-carbon technology with local companies and other stakeholders.

Almost all actors were aware of the existence and tasks of the National Council on Climate Change (DNPI), in particular its role as the focal point to the UNFCCC. However, very few of them were aware of the CTCN, the relationship of CTCN to a NDE, and that the NDE is located at DNPI.

In the interviews, we did not speak to local government officials. However, it is clear that in a country that – rightfully – has decentralised many decisions, local government (in provinces and municipalities) is key, also for low-carbon technology transfer. Further work could go further into these actors, perhaps based on the selection of the technology lines.

3.2.2. Characterisation of current technology transfer

Currently, according to the interviews, in Indonesia most technology transfer is done through a pure business-to-business transaction. This was also the case under the CDM. Along with such a transaction of equipment, only a short training for operational skills is usually provided. This practice seems to have consequences for how many actors consider technology transfer in Indonesia: the thought that technology transfer could involve more

than very basic operational skills is not something that is brought up spontaneously in the interviews, with a few exceptions. Most actors did see the value of a broader technology transfer strategy as beneficial after it was suggested.

What is generally not provided in technology-transfer type of transactions are the following aspects:

- Maintenance, repair, improvement and alignment skills: the ability to not just operate but also maintain for long-term use, the ability to repair the equipment if something breaks, and the ability to improve the operations of the equipment based on experience.
- Manufacturing of spare parts: spare parts often need to be imported from abroad and take a long time to get delivered, or add to the investment costs as they need to be kept in storage just in case. The manufacturing of such spare parts is generally not overly complicated and could be done in Indonesia, reducing costs and delivery times.
- Manufacturing of equipment in Indonesia: even if for many technologies this is a long-term prospect, specific investments in human skills and R&D would need to be done now if this is ever going to become reality. Even international technology transfer funding programmes seem to have limited attention to this key aspect of technology transfer.

In the interviews, different experts gave many examples that demonstrated that foreign companies were reluctant to transfer key skills to Indonesian counterparts. This resulted in the supply of “black box technology” that for local users was impossible to open, repair or improve upon.

Another topic that was addressed in interviews was the issue of intellectual property rights (IPR), and the extent to which those form a barrier to low-carbon technology transfer. The first observation is that there is a lack of clarity of the meaning of the IPR. Initially, several actors indicated that IPR is a problem, but when asked how, it turned out that not so much the formal protection of intellectual property in low-carbon technology is key, but the issues flagged before: that foreign producers are reluctant to share competitive skills with local partners and protective of crucial knowledge.

A point that was consistently brought up in the interviews was the fuel and electricity subsidies in Indonesia, which stifle innovation, damage the competitiveness of already expensive renewable energy and hurt the viability of energy efficiency measures that with unsubsidised energy prices would be economically viable. From this perspective, it is hoped that the new government, which has announced plans to reduce the energy subsidies, is successful.

What did work well, according to many interviewees, was the Indonesian policy of tax exemptions for importing foreign clean technology equipment. The procedures are relatively straightforward and it significantly increases the access to low-carbon technology.

3.2.3. Promising technologies and sectors

From the discussions with stakeholders, the technologies and sectors of solar PV, regenerative burner combustion systems, bioenergy, waste-to-energy (biogas), hydropower,

geothermal energy, carbon dioxide capture and geological storage, reuse of slag in cement production, rural electrification and energy efficiency in buildings were mentioned. It is remarkable that technologies in the transportation sector are not mentioned, given the fast rising emissions there and the presence of the only NAMA under implementation in Indonesia in that sector. A brief discussion of the technologies mentioned follows:

- Solar PV: Solar PV conditions in Indonesia are not among the world's best, but there is a significant potential, also in off-grid situations. The sector is already relatively developed, it is unclear what requests to the CTCN would add to the existing developments.
- Regenerative Burner Combustion System: RBCS implementation will be very helpful for energy efficiency in large furnaces (such as in steel production) and reduce emissions.
- Bioenergy, which in Indonesia has many applications:
    - Biogas, in particular bio-digester for waste management (waste to energy)
    - Use of Palm Oil Mill Effluents (POME) to generate biogas and electricity has a large potential in Indonesia and could make the palm oil sector more sustainable in multiple ways. However, the location of the POME plants is often remote from electricity users.
- Hydropower: Has a large potential in Indonesia, but deployment is slow, in part because of technological barriers related to maintenance, repair and innovation capabilities. There is some local capacity to manufacture mini- and micro-hydro turbines in Indonesia and to provide the civil and electrical engineering work. This therefore seems like an obvious sector to see what the CTCN could do to facilitate further increase of local content and deployment.
- Geothermal energy: Indonesia has much potential for geothermal energy. However, the sector is already relatively developed, and the barriers seem to be in order areas than those where the CTCN could make difference.
- Carbon dioxide capture and geological storage (CCS): mentioned by a limited number of actors. There are several sectors in Indonesia (related to gas production and refining) where CCS could play a role but capabilities are limited. Some foreign oil companies are involved and are building capacity with Pertamina, in particular for the possibility of enhancing the recovery of oil through injection of CO_2, while simultaneously permanently storing CO_2. CCS was exclusively mentioned by foreign stakeholders such as donors and multilateral banks.
- Reuse of slag in cement kilns: significant greenhouse gas emission reductions, straightforward technology. Barriers mainly relate to governmental regulation; unclear what the CTCN would add to this technology.
- Energy efficiency in buildings: Indonesia is experiencing a building boom and the efficiency potential – for insulation or cooling appliance use – for both new and existing buildings in industrial, commercial and residential areas is by far not depleted.
- Wind energy: there is some potential in Indonesia, but wind speeds are generally relatively low and compared to other low-carbon technology, the potential is limited. Indonesia has no industry to speak of in the field of wind energy; current implementation is through foreign suppliers and with foreign knowledge (although trainings and university curricula are under development; see section 2).

Table 3.2 summarises the maturity of technologies and sectors, and potential and very preliminary contributions of the CTCN.

Table 3.2 Possible technologies and sectors for CTCN proposals.

Technology/sector	Maturity in Indonesia	Potential role of CTCN
Solar PV	Significant potential, also off-grid. Relatively developed sector and local capacity	Supporting local PV assembly industries
Regenerative Burner Combustion System (RBCS)	Limited capacity but large potential for energy saving	Capacity building, research for local adaptation of technology, preparing a financial mechanism for implementation
Bioenergy	Both in biogas and POME large potential, some local capability	Further development of local capabilities
Hydropower	Large potential, diffusion going slowly, local sector is well developed but practical skills in off-grid situations limited and rotating parts of large-scale hydro still coming from abroad	Further development of user capabilities and assistance to strengthen the manufacturing sector, including towards rotating parts.
Geothermal energy	Large potential, mostly developed by foreign actors in combination with Indonesian companies	Barriers mostly social as well as financial and related to electricity subsidies.
CO_2 capture and storage	Recognised potential in Indonesia, especially in industry. Relatively expensive with limited co-benefits, except perhaps in Enhanced Oil Recovery (EOR). Very limited capabilities in Indonesia but capacity building ongoing	Potentially add onto existing efforts by ADB and foreign oil companies in the field of EOR, but not much synergy with local efforts. Financial barriers will continue to play a role
Reuse of steel slag in cement production	Mature and good potential. Government regulation might be needed	Unclear
Energy efficiency in buildings	Large potential, MEMR standards and regulations are implemented to a limited extent	Assistance on standard and regulatory development and planning on how to enforce and implement them
Wind energy	Wind regime in Indonesia is not very favourable (wind speeds generally low) but could be useful in specific locations	Assistance in mapping of potential, adaptation of technology to low wind speeds, policy planning

3.3. How do the stakeholders fit into the CTCN framework?

Assuming below is the rough process of accessing benefits of the CTCN. After mapping the stakeholders (this report) and selecting potential technology lines, proposals for the CTCN can be developed by the stakeholders. The NDE will screen, select and submit the selected proposals to the CTCN. The outcomes can then be linked to the network (Climate Technology Network) of experts both in Indonesia and abroad. After requests are implemented, the CTCN will monitor and evaluate the implementation from the international perspective. However, also the NDE could conduct a local evaluation.

For the CTCN to work well within Indonesia, it is important that Indonesian actors become members of the Climate Technology Network. Currently, only BPPT is a CTN member. The NDE could play a role in promoting CTN membership among Indonesian stakeholders.

Table 3.3 summarises what different stakeholders could do and how it would fit the CTCN framework.

Table 3.3: Summary of stakeholder actions and fit with the CTCN.

Stakeholder	Possible action	Fit with the CTCN framework
DNPI- amidst changing priorities of the government it has the capacity to compose proposals for CTCN. [30]	Mapping stakeholders, structure of decision making for TT, priorities, compiling of proposals, input for steering committee meetings	Throughout from inception, proposal development to uptake screening and selection, submitting to CTCN, constant supplementary form of support. Acts as liaison agency between Technology Centre and Network and local stakeholders in implementing technology transfer[31]
Steering committee (formed by DNPI)	Receive proposals and decide what proposals sent to CTCN	Proposal selection
Government Ministries, Line Ministries: Ministries of Transport, Industry,	Send proposals, support proposal development and other stakeholders	Proposal development, technical assistance and support for implementation

[30] Also maybe needs PR communication and outreach strategy for CTCN among regional stakeholders within Indonesia to increase buy in, this can mitigate high risk

[31] Farhan Helmy - Indonesia Journey Low Carbon Development

Agriculture etc.		
Government agencies and state-owned companies	Support for regulation, giving research input and coordination.	Linking with network of experts[32]
Civil society and international NGOs	Help with increasing buy in, socialisation of technology, connecting with local context.	Stakeholder mapping, proposal development, linking with network of experts, technical assistance.
Research and academic institutions	Potentially could be added to research network/experts as they have conducted institutionalised TT.	Proposal development Linking with network of experts Technical assistance
Private sector and business	Works with research stakeholders to submit proposal	Proposal development
Multilateral financiers	Works with stakeholders to co-fund activities , assess feasibilities.	Proposal development, technical assistance, monitoring and evaluation.
International organisations and donor agencies	Provide synergies to already existing technology transfer projects and assistance.	Proposal development with other stakeholders, co-funding opportunities, technical assistance

4. Criteria for selecting technology lines

The interviews yielded a rich array of criteria for requests to the CTCN. They are summarised in the following list in no particular order:

1. Greenhouse gas reduction potential: What is the national potential for greenhouse gas emission reduction? What is the short-term (2020 pledges) and long-term (2050 goals) contribution to governmental objectives?
2. Other environmental benefits: Would the technology lead to reduction of other environmental problems, such as those related to air pollution, noise, water use and pollution, or waste management?
3. Sectoral development potential (added value to Indonesia, short and long term): Is it a possibility that Indonesia develops own manufacturing capacity or deploy economic activities that add more value to its natural resources?
4. Innovation capabilities: Is there currently a basis of technological capabilities that can be enhanced to develop the capabilities in Indonesia to innovate on existing technology?
5. Social sustainability: Would the technology line and request add to better worker's conditions, good jobs, poverty reduction and general resilience of the vulnerable?

[32] They are officially listed as the partner for CTCN from Indonesia

6. Replicability: Can the technology be replicated in other parts of Indonesia or perhaps of South-East Asia?
7. Cost-effectiveness, business friendliness and investor risk perception: Are investors and business actors seeing opportunities in the technology to develop into a commercially attractive investment? Are the financial, technical and other risks manageable?
8. Market readiness or commercial maturity: are the technologies associated with the technology line mature enough to be close to commercial operation? Is there still potential for incremental improvement?
9. Ease of implementation: Can other barriers to implementation, such as cultural or religious objections, public acceptance, be limited? Is the roll-out of policies and measures politically and institutionally feasible?
10. Monitoring: Can the results of the technology development and transfer be monitored through a limited list of data and indicators that are easy to collect?

5. Conclusions and recommendations

5.1. Recommendations for two emerging low-carbon energy technology lines

Indonesia has potential to make CTCN requests in a diversity of technologies and sectors, as summarised in Table 3.2. Applying the criteria mentioned by the stakeholders in chapter 4, in terms of greenhouse gas reduction potential, current sectoral development, innovation capabilities and market readiness, it seems that bio-energy (in particular waste to energy applications including those related to the palm oil industry) as well as hydropower are the most promising technology lines. These technology lines also build on Indonesia's NAMA activities.

In addition, specifically mentioned energy efficiency technologies (RBCS, cement slag re-use and energy efficiency in buildings) have potential in greenhouse gas emission reductions and could be suitable for CTCN requests, however, they have a lower potential in terms of local innovation capabilities and sectoral development. On the other hand, their cost effectiveness is relatively high and NAMAs in the cement and building sectors are under development.

5.2. Recommendations on private sector collaboration and engagement

Some interviewees noticed that technology transfer and capability building could be strengthened in Indonesia by improved links between the private and the public sector. A number of suggestions for the public sector were noted:

- Cooperation with Energy Service Companies (ESCOs) could be done through co-funding schemes for increased uptake of climate friendly technologies by the private sector
- In the cement sector, there is already willingness to act[33]. Technology cooperation could be developed with ITB and other institutions, and the sector could be involved in the next review of the TNA.

[33] Ibu retno, ITB 14.11 Should be forum with industry associations.

- Work together with industrialized country government to set up a facility for twinning between R&D institutions in the field of technological capabilities. Examples already exist in Indonesia.
- Setting up a business development centre[34] that provides financing to a climate innovation centre, such as a local climate technology business incubator where business cases for potential technology transfer can be developed[35].

5.3. Recommendations for DNPI proposals for CTCN

The complex actor landscape and the observation that technology transfer that goes beyond transfer of hardware and operational skills and builds manufacturing or innovation capabilities is rare in Indonesia, give rise to some further contemplation of what CTCN requests DNPI should try to initiate along with its actors. We summarise our findings in ten key recommendations for DNPI:

1. Embedding of CTCN requests in existing initiatives: CTCN requests are too small and limited in scope to by themselves lead to transformative change. Although intended to make a difference, the CTCN itself does not believe its work could do this alone. CTCN requests could add to other, new or existing initiatives by providing benefits in terms of longer-term capability development, with R&D institutions, government or the private sector. It is recommended to connect CTCN requests tightly with government policies, and international instruments like the ICCTF, NAMAs and other (financing) instruments.

2. CTCN awareness raising: awareness on the CTCN is still very low in Indonesia, even in Jakarta. The best requests are those that are made by private and public stakeholders active in the field, but they may not be aware that they can make requests. An outreach and consultation effort by DNPI could therefore be deployed.

3. Improve public-private cooperation: Public-private cooperation is good in some areas but limited in others. In those areas, a CTCN request for an R&D cooperation between a public body, a university and private companies could be a constructive way of bringing together private sector and public sector organisations in a situation where their interests are fully aligned.

4. Timing beats technology: although this analysis has yielded two technology lines as the most promising, whether a request through the CTCN is effective and successful, depends also on whether the timing is right for the specific request. It is advisable to look for the right request at the right moment just as much as to whether the technology meets national criteria.

5. R&D collaborations to improve or enable existing foreign technologies: In some cases, technology transfer in Indonesia happens mostly in a business-to-business way with relatively limited regard for local suitability and potential for improvement. R&D collaborations where foreign knowledge is combined with local knowledge can do much to help resolve such problems. Moreover, engaging local research institutions increases innovation skills locally as well as project management capabilities.

[34] METI 31.10
[35] GGGI Giulia 30.10

6. Testing and certification: Indonesia would be assisted with more high-quality, consistent laboratories that meet international standards for testing and certification schemes. Several stakeholders from the private sector, in particular technology users, addressed the importance of testing and high-quality laboratories with certified, reliable outcomes.

7. On-the-job training and skill development with companies abroad: Several stakeholders, in particular from the private sector, highlighted the importance of on-the-job training in foreign companies to develop skills as to how to operate a plant most efficiently and how to repair and make replacement parts. These are skills that cannot be taught in writing, in a one-off workshop or a week-long training, but that are transferred by collaboration and practice.

8. Project development, risk assessment and English language skills: The interest of financiers in investing in companies and low-carbon technologies in Indonesia could be greatly enhanced if proposals for projects by project developers were improved. Communication with foreign commercial financiers would improve with more widely spread English language skills. Proper (financial) risk assessment skills are also needed.

9. Information on Best Available Technology: In Indonesia, it is difficult to find out what the Best Available Technology (BAT) is for a specific problem. Providing reliable and independent information on this (and making it widely known where this information can be found) could lead to deployment of more efficient and higher-quality technology.

10. Availability of reliable data on energy use, potentials, costs and mapping: Although the situation is improving, Indonesia experiences a dearth of basic data on energy. Different sources provide different estimates, even of current energy use. The projections of energy use, costs of energy technology and potentials of low-carbon technology are difficult to find and hard to rely on.

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Annex A: Workshop agenda

Time	Topic
9:00-9:15	**Opening** Mrs. Amanda Katili Niode, Head of Secretariat, National Council on Climate Change
9:15 –9:30	**Steps to develop proposals to the Climate Technology Centre and Network (CTCN) on capacity building for low-carbon technology transfer** Mrs. Widiatmini, Technology Transfer WG, DNPI
9:30 – 9:45	**Brief presentation on LCTT SFF project** Philipp Munzinger, GIZ manager project on low-carbon technology transfer
9:45 – 10:15	**Low-carbon technology transfer in Indonesia and the CTCN** **Approach of scoping analysis** Heleen de Coninck, Radboud University and GIZ consultant on Technology Transfer
10:15 – 10:30	**Coffee break**
10:30 – 11:45	**Three presentations on selected technology fields around a specific low-carbon technology** Mr. Harris (Energy Conservation), Mr. Abdih (New and various energy), Mr. Edi Wibowo (Bioenergy)
11:45 – 12:30	**Discussion guided by questions**, including: - Stakeholder views on key players in the low-carbon energy sector - Stakeholder views on criteria for selection of technology lines
12:30 – 13:30	**Closing and lunch** Philipp Munzinger, GIZ manager project on low-carbon technology transfer