Africa Spectrum

Manyuchi, Albert Edgar (2016),
Foreign Direct Investment and the Transfer of Technologies to Angola’s Energy Sector, in: *Africa Spectrum*, 51, 1, 55–83.

URN: http://nbn-resolving.org/urn/resolver.pl?urn:nbn:de:gbv:18-4-9227

ISSN: 1868-6869 (online), ISSN: 0002-0397 (print)

Foreign Direct Investment and the Transfer of Technologies to Angola's Energy Sector

Albert Edgar Manyuchi

Abstract: The relationship between foreign direct investment (FDI) and the transfer of technology is undergoing a great deal of academic scrutiny and policy analysis. A growing body of literature shows that FDI can be a channel by which to transfer and/or acquire technology; however, there is a paucity of empirical studies on this as it relates to African economies. This article seeks to fill some of that gap by focusing on how FDI inflows are contributing to the transfer of technologies specifically into Angola's energy sector. The analysis is based on qualitative research conducted in Angola in 2014 and reveals that energy production and distribution-technology infrastructure, including machinery and human skills, have been developed largely through FDI inflows. There is, however, no evidence that this FDI has enlarged Angola's endogenous scientific and technological research capabilities in the energy sector; therefore, policies that promote these capabilities, especially manufacturing capabilities, should be introduced.

■ Manuscript received 26 August 2015; accepted 7 March 2016

Keywords: Angola, international economic relations, energy industry, energy resources, foreign direct investments, technology transfer

Albert Edgar Manyuchi is a final-year DPhil student in International Relations at the University of Pretoria and works as a national surveillance coordinator with the Anova Health Institute.
E-mail: <manyuchi@anovahealth.co.za>

Countries around the world have different and unevenly distributed technological capabilities, which are defined as “the hardware of production (knowledge about machines and processes) and software (skills, knowledge, and procedures of performing practical tasks)” (Wangwe 1979: 3). It may be asserted that economic differences between industrialised (developed) and poor, underdeveloped countries may largely be accounted for by technology. Indeed, what separates developed from developing countries

> is not just a gap in resources but a gap in knowledge, which is why investments in education and technology – largely from government – are so important. (Stiglitz 2006: 28)

The technology gap between countries may be narrowed or even closed through a variety of means, including technology transfer through foreign direct investment (FDI). Until recently, the direction of FDI flows and technology transfer was mainly from the industrialised North to the developing South. However, this is now changing as some countries in the South are becoming major sources of FDI and new technologies (Bell 1990; UNCTAD 2014a).

There is little empirical research on the relationship between FDI and technology transfer in developing countries (UNCTAD 2010); but, as Zarsky (2005) notes, inward FDI (IFDI) in Africa has been on the rise, and Ajayi (2006) observes that FDI inflows to African countries between 1980 and 1999 grew by over 218 per cent, whilst overall inflows from 1970 to 2010 escalated by over 4,000 per cent.

The increased inflows of FDI to Africa have traditionally been directed at the extractive or natural-resources sectors (UNCTAD 2014a) and only more recently to the services and manufacturing sectors (UNCTAD 2015). This rise in FDI inflows may largely be accounted for by a wide range of policies and regulations that have been introduced in many African countries, as well as agencies that have been established over the last three decades or so, all geared towards attracting foreign investment (Mugabe 2005). Now, most African countries have national investment agencies and legislation exclusively dedicated to promoting or attracting FDI. However, some of these measures are not explicitly aimed at promoting technology-based FDI, but rather directed towards attracting financial capital. Clearly, FDI inflows can be important sources of hardware and software technologies and can contribute to the development of national scientific and organisational capabilities (Diyamett and Mutambla 2015; Anyangah 2010; Chowla 2005; Sawada 2005; World

Bank 1993). In fact, FDI is critical for growing African economies and stimulating human development on the continent.

This article attempts to determine whether increased FDI into Angola's energy sector has indeed led to the transfer of technologies. As Table 1 indicates, Angola (whose economy is largely based on energy) was the top recipient of FDI among five leading African countries between 2000 and 2008.

Table 1. Ranking of Top 5 African FDI Recipients and Share of Inflows, 2000–2008

Rankings	Country	Average (in million USD)
1	Angola	6,631.5
2	Egypt	4,586.5
3	Nigeria	4,529.1
4	South Africa	3,510.3
5	Morocco	1,812.6

Source: UNCTAD 2010.

In 2014, Angola attracted USD 16 billion in FDI, mainly targeting the oil and gas subsectors. According to Fingar (2015), Angola was second only to Egypt in terms of level of capital investment among the top FDI recipient African countries in 2014 (presented in Table 2).

Table 2. Top 5 FDI Destination Countries in Africa by Capital Investment, 2014

Rankings	Country	Capital investment (in billion USD)
1	Egypt	18
2	Angola	16
3	Nigeria	11
4	Mozambique	9
5	Morocco	5

Source: Fingar 2015.

Although Angola has made significant economic strides after the 29-year-long civil war came to an end in 2002, many Angolans in urban and rural areas are still living in poverty (Jover et al. 2012). In terms of political and social features, the country has a high rate of youth unemployment, a relatively uneducated adult population, high levels of private sector and government corruption, a primarily low-skilled labour force, limited and expensive health services, limited democratic space for citizenry, and a ruling elite that stifles opposition and dissenting voices (Muzima and Mendy 2015). Economically, the country is heavily reliant on the proceeds from oil and gas (Vargas Murgui 2014). Since 2003, the government has attempted to diversify the economy by supporting other sectors such as mining, retailing, agriculture, infrastructure development, and telecommunications (Kiala and Ngwenya 2011).

The Angolan government has instituted a number of policy and institutional reforms to attract FDI inflows because it generally believes that FDI is an essential ingredient for economic growth, diversification, and industrialisation. Table 3 shows the actual inflows of FDI to non-energy sectors of the economy between January 2003 and May 2015.

Table 3. Top 10 Angolan Sectors Receiving FDI (Jan 2003 – May 2015)

Sector	Capital expenditure (in million USD)	Number of projects
Real estate	4,137.72	2
Financial services	1,241.90	129
Building and construction materials	1,197.00	11
Beverages	841.20	20
Communications	559.01	13
Business services	220.40	4
Metals	487.77	8
Hotels and tourism	477.20	6
Food and tobacco	401.30	12

Source: Mouzinho 2015.

Nonetheless, there is no readily available information on the technologies carried through FDI inflows to these sectors, but there is anecdotal information for some key projects. An example of an FDI key project in diamond mining is the Sociedade Mineira de Catoca (Catoca Mining Society), whose shareholders include Empresa Nacional de Diamantes de Angola (Endiama), Alrosa, Odebrecht, and Daumonty Financing Company BV. In this venture, whilst Alrosa transfers technologies for diamond exploration and mining from Russia, know-how technologies are transferred through training in diamond cutting and polishing at a school in Surat, India. In the automobile sector, a key project is the motor vehicle assembly plant located in the Viana industrial zone, which is a result of a partnership between China's Dongfeng, Japan's Nissan, and

Angola's CGS. The two transnational corporations (TNCs) provide the equipment and know-how to the local firm.

FDI inflows to Angola are important in closing the technology gap that separates Angola from not only developed countries but also other developing countries with similar GDPs. This study examines the nature of national policies and the institutions established by the Angolan government to attract FDI into the energy sector, and whether these policies and institutions promote transfer of hardware and software technologies. The key research question is: Is increased FDI flow into Angola's energy sector associated with the transfer of technologies, and has it resulted in such transfers?

The remainder of the article is structured as follows. The second section spells out the conceptual framework used in the analysis, defining the concept of technology transfer and describing the main channels or avenues for the transfer of technology; key factors influencing technology transfer through FDI are outlined. The third section deals with the methodology underpinning the analysis, and the fourth and fifth sections summarise the main findings emanating from this research.[1]

Conceptual Framework

The Concept of Technology Transfer

The term "technology transfer" may be defined as the process involving the non-linear transfer of hardware, scientific knowledge, and skills from one entity to another (Ramanathan 1994; Souder, Nashar, and Padmanabhan 1990). It may take place domestically from one firm/company or sector to another, such as in the case of transfer of biotechnologies within Argentina's biotechnology sector (UNCTAD 2014b), and/or across national borders – from one country to another. International technology transfer is often associated with the movement of machinery or equipment between countries, often from a developed to a developing country – for example, the transfer of Japanese rail technology by Kawasaki to China, and the transfer of vehicle-manufacturing technology from the United States' Ford Motor Company to a Chinese automobile producer, Chang'an Motors (Atkinson and Ezell 2012). But as Derakhshani (1984) notes, technology transfer is largely about "the acquisition, development, and utilisation of technological knowledge by a country other

1 I would like to acknowledge my DPhil supervisors, Prof. John Ouma Mugabe and Dr. Yolanda Kemp-Spies, and my many interviewees in Angola.

than that in which this knowledge originated." The definition also emphasises the transfer of knowledge "through education and training, which could include training on how to effectively manage technological processes and change" (Jafarieh 2001: 13). In addition, technology transfer encompasses "technological capacity-building, which includes knowledge and skills that firms need in order to acquire, assimilate, use, adapt, change, and create technology" (UNCTAD 1997: 4).

Bell (1990) and Mansfield (1982) developed typologies of transferrable technologies. Mansfield distinguishes between material transfers, design transfers, and capacity transfers, whilst Bell highlights the nature of transferrable technologies as flows A, B, and C. These are presented in Table 4 below as a classification of transferrable technologies.

The typologies by Bell and Mansfield are quite compelling in their explanation of technology transfer through FDI in both greenfield and brownfield enterprises. These typologies enable us to unpack the main argument, which is that not all technologies are uniformly and holistically transferrable; some components or elements of technologies are more easily transferrable than others. Looking at the energy sector, for example, the three "flows" of technologies transmitted through FDI flows may be analysed. In cases where the host country has absorption capacity, an advanced national technological, industrial, and educational infrastructure, and explicit technological promotion policies, it is possible that all these different "flows" would be transferred. But in cases where a number of these factors are inadequate or lacking, some technological components would be more easily transferrable than others.

The Transfer of Technologies through FDI

The inflows of FDI to host countries can be resource-seeking, market-seeking, efficiency-seeking, and strategic-asset-seeking and may target new projects (greenfield investments) or existing entities (brownfield investments) (Ajala 2010; Dunning and Lundan 2008). Also, the factors that determine whether FDI inflows are technology-carrying are the conditions in the home and host country, and the volumes and quality of FDI involved.

Table 4. Classification of Transferrable Technologies

Key variables	Flow A material transfers	Flow B design transfers	Flow C capacity transfers
Main concern	Capital goods	Skills and know-how for production	Knowledge and expertise for generating and managing technical change and changing technical systems
Type of technology transferred	Hardware, machinery, equipment, materials, final products, components, parts, and turnkey plants	Paper- and people-embodied technologies: people-embodied technology includes skills training and the know-how required to operate and maintain new or improved production facilities; paper-embodied technology comes in the form of manuals, schedules, flow charts, operating procedures, maintenance, repair procedures, blueprints, designs, basic information, data, and guidelines	Know-why technology: skills and software
Outcomes of transfers	Commencement, maintenance, or enhancement of production	Skills, know-how, and services that affect production	Modification of existing systems; delivery of new products and systems
Involvement of recipients	Usually passive and inactive	Active	Very active
Examples	Sasol (South Africa) can transfer plant and equipment that transforms gas to liquid to its subsidiary in Mozambique, which enables Mozambique to exploit gas reserves once the assembling and installation of equipment is completed	Sasol (South Africa) can transfer plant designs to a subsidiary in Qatar, which enables Qatar to develop a similar plant based on the designs provided	A TNC can provide some information on the use of, and problems with, fuel cells in its plants; the subsidiary is then in a position to analyse the information provided and innovatively apply this knowledge to enhance the quality of fuel cells in its firm

The desire to exploit mineral resources embedded in resource-seeking FDI inflows to Africa has led to a number of investments in the energy sector, such as the construction of power stations. For example, Alrosa of Russia developed Hydro Chikappa 1 in Angola in order to provide a reliable electricity supply for its mining operations. Also, in some cases FDI flows into the energy sector have been motivated by the availability of markets. For example, investments by South Africa's Eskom Holdings into Eskom Uganda Ltd were largely based on the guarantees of a market inside Uganda for the power this subsidiary company would be producing. A strategic-asset-seeking objective may likewise be the reason for inflows of FDI into the energy sector – as in the case of various investments made by PetroSA.

Inward flows of FDI may be technology-carrying through vertical linkages – both backward and forward ones. Backward linkages involve the transfer of technologies between a TNC and suppliers of products and services inside a host country. Through training, TNCs may build the capacity of local suppliers so as to meet the required product-quality and volumes. For example, Glencore (a TNC with subsidiaries in South Africa) trained domestic coal-supplying firms, enabling them to meet their contractual requirements with Eskom Holdings. Backward linkages exist when TNCs find markets for local suppliers and provide them with further training in order to meet these market requirements. This may promote increased export capacity for local host-country firms. For example, inflows of FDI have capacitated Makomo Resources (Pvt) Ltd of Zimbabwe to meet its contractual obligation to supply 60,000 tons of coal to the Hwange Thermal Power Station every month, and have facilitated the company's export of coking coal and surplus coal to regional and international markets.

Technology transfer through forward linkages occurs when TNCs interact with buyers who are either consumers or other firms using their intermediate products in their own production processes (Diyamett and Mutambla 2015). Ultimately, this results in buyers delivering high-quality products and services to domestic markets at reasonable and cheaper prices. Factors such as the size of the host-country market, the quality of intermediate goods, the technological capabilities of local firms, and the absorption capacities of domestic firms to a large extent determine whether technologies are transmitted through forward linkages.

In addition to vertical linkages, FDI may also carry technology by way of horizontal linkages. In such cases, FDI develops local technological capabilities through demonstration, competition, imitation, and labour migration (Diyamett and Mutambla 2015). Whereas the demonstration effect occurs when host-country firms update their technologies as a result of witnessing the superior technologies possessed and utilised by TNCs, imitation happens when local firms modernise their technologies by replicating the technologies of TNCs (Saggi 2000). And in response to domestic firms updating to TNC technologies, TNCs usually upgrade their own technologies to a higher level to retain their competitive advantage. The ensuing competition has the potential to lead to greater spill-over effects, and domestic firms with lesser technological capabilities may well be crowded out by such TNCs (Wang and Blomström 1992).

In the energy sector in Africa, the demonstration effect is limited to certain countries that have permitted the use of off-grid and decentralised power-generation and power-transmission solutions, although these solutions may still be in their embryonic stages. Most African countries, such as Zimbabwe, South Africa, and Zambia, still zealously retain national and regional electricity grids that are run by monopolistic, national entities not affected by competition; therefore, the state entities have no incentive to enhance their power-generation or power-transmission capabilities. This limits the extent to which technology transfer through the demonstration effect can take place.

Technologies can also be transferred through labour migration, especially when TNC employees leave to work for domestic firms or establish their own companies. Although labour migration is generally an important channel for transferring technology, many local employees are unable to launch their own companies because of the high up-front costs associated with energy-sector projects. Furthermore, TNCs usually provide favourable employment packages to host-country employees, which often prevent them from moving on to domestic firms.

Technology transfer through FDI may occur when TNCs relocate their research and experimental development (R&D) units to host countries. It is natural for TNCs to try to gain access to local markets. By locating an R&D unit in a host country, TNCs can easily gain access to local knowledge and modify their products and services to meet local conditions. However, most R&D activities of TNCs are still located in home countries rather than in host countries. Thus, R&D continues to be one of the least internationalised activities of TNCs (UNCTAD 2005; Reger 2004; Patel and Pavitt 1991). Blomström and Kokko (1998) suggest that there is a considerable degree of R&D activity that takes place in host countries, especially through the activities of TNC affiliates. However, empirical evidence from the energy sectors in South Africa, Uganda, and Mozambique indicates that most TNCs engaged in these countries have not relocated their R&D activities to their local subsidiaries. Hence, technology transfer through the relocation by TNCs of their R&D facilities may be rather limited in the context of the energy sector in Africa.

Methodological Aspects

This is a policy-science study that aims to deal with practical problems and policy effects grounded in a given contextual reality, hence the use of a research question and a conceptual framework to guide analysis. A case-study methodology espoused by Yin (2009) was utilised to determine the occurrence of the transfer of technologies through FDI to Angola's energy sector. This was purposely done for two reasons: first, the country's energy sector is heavily dependent on FDI inflows; second, efforts by the government to modernise the energy sector have been central to attracting FDI inflows. The approach to the analysis is qualitative and descriptive, while secondary and primary data sources are utilised.

Secondary data was gathered through a review of existing literature, including company investment reports and government reports on energy-sector TNCs investing in Angola. Data collection mainly involved writing to, or directly calling on and asking for data and information from, consultants, companies, and government employees. Since there was not a great volume of existing secondary literature which could be gathered and utilised for this research endeavour, primary data sources had to be accessed in order to provide the complementary material.

Primary data was collected through interview questionnaires that were administered to representatives from the government, the private sector, and civil society at both the national and international level. Initial interviewees in these three categories were purposely selected, and snowball sampling was employed to identify other possible interviewees. The use of the snowball technique was inevitable: as Angola's energy sector is highly securitised, the permission to carry out the research was only obtainable through referrals. A total of 57 in-depth interviews were conducted with interviewees with knowledge on FDI inflows to Angola, Angola's energy sector, and technology transfer through FDI flows to the energy sector. In terms of data-processing for secondary material, theme-based summary sheets of triangulated, archived data were analysed by reviewers who pointed to gaps in the data, conflicting data, and areas in which a saturation point had not yet been reached. In the case of unsaturated data areas, these were stressed during the interview process. Data from interviews were manually analysed through note-taking during all discussions (subsequently classified thematically and summarised) and mined from e-mail correspondence. Furthermore, Atlas.ti software and Microsoft Excel spreadsheets were also used for data analysis.

The selection of case studies for this research may be considered to suffer from the typical weaknesses of non-probability samples: limitation with regard to generalisation, and the potential for bias arising from the use of snowballing techniques. However, wherever the investigation generalises findings, the specific conditions underlying such generalisations are outlined. With regard to potential biases, the fact that the research triangulates various data sources mitigates any biases.

The Results

An Overview of Angola's Energy Sector

The energy sector is a priority sector for the government of Angola and most of the operations are controlled directly by the presidency and a few delegated officials, mainly from the security sector. The energy sector provides the greatest amount of revenue to the state. Angola's energy sector is composed of many subsectors, including oil and gas, renewable and non-renewable, alternative energy, and power (electricity) generation and transmission. These subsectors have various supply and consumption chains, and are associated with various enterprises. The International Energy Agency (2012) observes that to meet off-grid heating and cooking needs in 2012, 49 per cent of Angolans used traditional solid biomass and waste, which consists of wood, charcoal, manure, and crop residues, while 40 per cent used petroleum, 6 per cent hydropower, and 4 per cent natural gas.

Recently, there have been increased investments in renewables, such as wind and solar energy. However, these projects have not yet begun to supply power to consumers, but solar (photovoltaic) projects have already started powering rural communities and rural service centres and providers such as health facilities and schools, as off-grid, small-scale solutions.

FDI Inflows to Angola's Energy Sector

Although Angola was mainly an agriculture-based economy during the colonial period, it has now become heavily dependent on proceeds from the energy sector. This dependency has in a way stalled diversification of the economy.

Table 5. FDI Oil-Producing Projects in Angola

Operator	Partners	Location	Projects
Exxon-Mobil	BP, Eni, Statoil	Block 15 Deepwater	Kizomba A (Hungo, Chocalho, Marimba) Kizomba B (Kizomba, Dikanza) Kizomba C (Mondo, Saxi Batuque) Kizomba Satellites Project (Clochas, Mavacola)
Chevron	Sonangol, Total, Eni	Block 0 – Area A Offshore	Takula, Malongo, Mafumeira Norte
		Block 0 – Area B Offshore	Bomboco, Kokongo, Lomba, N'Dola, Sanha
		Block 0 – Area B Offshore	Nemba, Tombua, Landana
	Eni, Sonangol, Total, Galp Energia, Inpex	Block 14 Deepwater	Kuito, BBLT (Benguela, Belize, Lobito, Tomboco)
BP	Sonangol Sinopec International (SSI)	Block 18 Deepwater	Greater Plutonio (Plutonio, Galio, Cromio, Paladop, Cobalto)
	Statoil, Sonangol, Marathon, SSI	Block 31 Ultra-deepwater	PSVM (Plutão, Saturno, Vênus, Marte)
Total	Statoil, ExxonMobil, BP	Block 17 Deepwater	Dalia Pazflor (Perpetua, Zinia, Hortensia, Acacia) Girassol, Jasmin, Rosa CLOV (Cravo, Lirio, Orquidea, Violeta)
Eni	Sonangol, SSI, Falcon	Block 15/06 Deepwater	West Hub
Pluspetrol	Sonangol, Force Petroleum, Cubapetroleo	Block 123-5 Cabinda Onshore	Cabinda C (South)
Somoil	Chevron, Sonangol	Onshore	Soyo

Table 5 (continued)

Sonangol	Total, Chevron, Petrobras, Somoil, Kotoil, Poliedro, BTG Pactual	Block 2/85 Offshore	Lombo East
	Total, Eni, Inpex, Mitsui, Naftagas, Naftaplin, Mitsubishi, Somoil, Svenska, New Bright International Development	Block 3 Offshore	Palanca, Cobo, Pambi, Oombo, Nunce Sul
	Statoil, Somoil, Angola Consulting Resources	Block 4/05 Deepwater	Gimboa
Chevron	Sonangol, Total, Eni	Block 0 Offshore	Mafumeira Sul
Chevron	Total E&P Congo, Angola Block 14 BV, Eni, Sonangol P&P, SNPC, GALP	Block 14 Deepwater	Lianzi Field
Exxon-Mobil	BP, Eni, Statoil Angola	Block 15 Sub-sea	Kizomba Satellites Phase II

Source: Adapted from U.S. Energy Information Administration 2015.

Mouzinho (2015) reports that from January 2003 to May 2015, approximately 32 greenfield projects worth a total of approximately USD 65.6 billion in coal, oil, and natural gas were opened in Angola; this is 16 times higher than the investment volumes made in the second-ranked real-estate sector. The oil and gas subsector has historically received the lion's share of FDI flows to the energy sector. Current oil-producing projects arising from FDI are presented in Table 5.

Aside from FDI to the oil and gas subsectors, there have also been direct investments into other subsectors, as indicated in Table 6.

Generally, FDI into the energy sector in Angola can be regarded from the vantage point of two different periods – prior to and after 2004. An interviewee from the Angola National Private Investment Agency (ANIP) stated,

> The civil war ended in 2002. The government quickly moved to focus on development, and among the key sectors to be modernised was the energy sector. Several actors were approached between 2002 and 2003. A breakthrough came in late 2004 by way of a Chinese loan and direct investments. We can, therefore, see the era before 2004 as an era where not much was done to attract

IFDI to the energy sector, and the period post-2004 as a period of sudden increase[s] in direct investments. (14 July 2014)

The key differences in terms of FDI inflows to the energy sector in Angola during the pre-2004 and post-2004 periods are presented in Table 7.

Table 6. Some Key FDI into Non-Oil and Gas Energy Subsectors

Operator	Energy subsector	Partners	Location	Project focus
BIOCOM	Bioenergy	Sonangol, Odebrecht, Damer Industria SA	Malanje Province	Bioenergy from sugarcane
Hydro Chikapa 1	Hydropower	Alrosa, ENE	Lunda Sul Province	Hydropower from Chikapa River
Angola Liquefied Natural Gas (LNG) Project	Bioenergy	Chevron, Sonangol, Total, Eni	Zaire Province	LNG production
Fortune CP	Solar	Government of Angola	Huíla Province	Solar projects for health centres, community centres, and educational facilities
Proef	Bioenergy	Sonangol	Zaire Province	Bioenergy from sugarcane

Since 2004, Angola's energy sector has received direct investment flows targeting more greenfield projects than brownfield enterprises. Greenfield energy projects have been initiated with the active involvement of state-owned enterprises (SOEs), such as Sonangol in oil and gas and Empresa Nacional de Electricidade de Angola (ENE) in the power subsector. In this regard, a useful frame of reference in examining FDI inflows to greenfield enterprises in the energy sector is the project cycle, comprised of the phases of exploration, project construction or development, and project operations or production.

Table 7. Differences in FDI to the Energy Sector, Pre-2004 and Post-2004

Key variables	FDI flows to Angola's energy sector, pre-2004	FDI flows to Angola's energy sector, post-2004
Sources of FDI	Mainly from developed countries, such as the US, UK, France, Spain, Italy, and The Netherlands	From both developed and developing countries, such as China, Argentina, and Brazil
Concentration of FDI in the sector	Direct investments were mainly into oil and gas	Diversifying from oil and gas to include renewables, alternative energy sources, and non-renewables
Policy framework	State-centred delivery of energy to consumers through the national grid, and very little participation from independent power producers	Reforms now underway to open up the space to independent power producers, and the promotion of off-grid, decentralised energy solutions
Role of the state in projects	Owns all energy projects through equity shares	Creates the framework for various stakeholders to operate, and only gets involved in some projects of strategic importance to the country

In the exploration phase, activity in the oil and gas subsector involves the Angolan government, through the Ministry of Petroleum (MINPET) and Sonangol, working closely with a TNC in exploring the feasibility and profitability of investing in a proposed project. During this phase, MINPET and Sonangol are the contracting parties to, or the approving agencies for, a submission made by the TNC. As exploration activities generally involve huge capital investments, they are mainly financed by the government or an interested TNC; financial institutions come on board when the project has proven bankability. In Angola, exploration activities are mainly in onshore and offshore oil and gas fields. As such, Sonangol and SSI have conducted exploration activities in the Cabinda North Block, whilst the Cabinda South Block was initially explored by the Australian Roc Oil Company, later taken over by Pluspetrol Angola, a subsidiary of the Argentinian group, Pluspetrol, with Sonangol and Cubapetroleo as partners.

The second stage is the project development or construction phase. This stage usually commences when the exploration phase has proven the project viable and profitable. An ideal greenfield energy-sector FDI-based project would have project owners (TNCs with more than a 10 per cent equity share); engineering, procurement, and construction management (EPCM) firms; project funders; and training and advisory services firms (TASFs). Projects in the oil and gas sector in Angola engage several international firms through the ownership of shares in a single project or a number of projects. For example, in the Biocom Bio-Energy Project, a 40 per cent equity share is owned by the Brazilian firm Odebrecht, another 40 per cent by the Angolan company Damer Industria SA, and 20 per cent by the state-run petroleum company Sonangol Holdings EP. This project aims to generate an expected 30 million litres of ethanol, 250 tons of sugar, and 160,000 megawatt-hours of electricity per year. Similarly, the Hydro Chikapa 1 Project involves FDI by the Alrosa group of Russia, which owns a 55 per cent equity share in the power-generating company Hydrochicapa SARL, with the remaining 45 per cent share held by ENE. And, in the case of the Angola Liquefied Natural Gas Project, several TNCs partnered up in March 2002, signing an agreement by whose terms Chevron and Sonangol hold 36.4 per cent and 22.8 per cent equity shares, respectively, whilst Total, BP and Eni are allocated 13.6 per cent shares each. Thus, Chevron and Sonangol are the project's core leaders. In all these examples, TNCs have more than a 10 per cent equity share – hence, their investments qualify as FDI.

In addition to project owners, greenfield FDI energy-sector projects also need EPCM firms. These are international and local companies contracted by project owners to construct and develop a project. Due to the complexity of most greenfield projects in Angola, EPCMs have primarily been large TNCs from developed countries – such as the United States, the United Kingdom, Spain, Italy, Denmark, Sweden, and Germany – and from the developing (emerging) world – such as China, Brazil, Argentina, and South Africa – with very limited involvement of domestic or local companies. EPCM firms in Angola's energy sector include Odebrecht Oil and Gas, Andrade Gutierrez, Queiroz Galvão, Camargo Corrêa, and ConocoPhillips. These EPCMs sometimes contract original equipment manufacturers (OEMs) or their designated local dealers (such as BarloWorld Equipamentos Angola) to supply the necessary tools and implements.

Greenfield FDI energy-sector projects also require project funders. These are banks and financial institutions that provide funding to project owners for construction and development. Much of the project capital comes from the United States, the United Kingdom, China, Russia, and Brazil. Other project funders include Standard Chartered Bank UK, Standard Bank de Angola, the African Development Bank (AfDB), and the Development Bank of Southern Africa (DBSA).

Last, TASFs engaged by both project owners and EPCMs provide services associated with safety, health, and the environment (SHE); environmental impact assessments; and legal and financial services. An example of a TASF that has conducted several energy-sector projects for government and the private sector in Angola is the Portuguese company Consultores de Engenharia e Ambiente SA.

During the final project operations or production phase, a management structure conducts the day-to-day running of operations. Whereas the activity of an EPCM is limited to maintenance, repairs, and troubleshooting of technical problems encountered during production, TASFs continue to provide various services associated with production and SHE. At this stage, compliance with legislation and policies concerning the training of staff and SHE, amongst others, is also of paramount importance.

FDI Inflows and the Transfer of Technologies

The research has found that FDI into greenfield projects in oil and gas in Angola has primarily brought in hardware and equipment, enabling the exploitation of these strategic resources, delivering oil and gas (through pipelines) to local refineries, constructing and expanding local refineries, and exporting oil and gas to regional and international markets. Thus, machinery and hardware underpin the entire oil and gas value chain, and appropriate technologies are supplied by OEMs with subsidiaries located inside Angola. Hence, most of the machinery and hardware used in the oil and gas industries come into the country through FDI activities and licensing and import agreements.

Like most greenfield energy-sector projects in Angola, FDI through the Angola LNG Project facilitated the transfer of hardware and machinery (equipment) – in this case to the oil and gas subsector. In fact, "the transfer of hardware and machinery was non-existent before the advent of the Angola LNG Project" (Interview with a Ministry of Energy and Water [MINEA] official, 14 July 2014). Equipment transferred included those installed in the plant and associated with pipelines transporting gas from oil wells to the works factory. Plant construction technology was licensed to Angola LNG by ConocoPhillips, an internationally renowned LNG technology-designing firm, and the construction of the plant was performed by Bechtel, an EPCM company, using the ConocoPhillips optimised cascade process. Thus, the technology transfer involved the transmission of a complicated and integrated engineering system, which consists of gas-inlet facilities, process units, an acid-gas removal unit, a dehydration unit, mercury removal beds, a liquefaction unit, an LPG/condensate separation or stabilisation unit, a flare and blow-down system, a 25 megawatt electrical power-generation gas-turbine-based unit, and a product storage unit catering for LNG, Liquefied Petroleum Gas (LPG), propane, butane, and condensate.

Similarly, FDI to Angola's energy sector has also been a catalyst for the transfer of machinery and hardware into bioenergy projects, such as the Biocom Project. In an interview on 15 July 2014, a Sonangol official commented that "the success of the Biocom Project is due to the transfer of machinery and hardware. In fact, all components for the project came from Brazil, which is a leading country in this [kind of] technology."

In the power subsector, the main technologies transferred through FDI are also hardware and machinery. For example, the Hydro Chikapa 1 Project was designed by Russia's Alrosa Yakutniproalmaz Institute and constructed by Alrosa-Vneshstroy Ltd, with equipment and workers coming primarily from Russia. The main purpose of this 16 megawatt project was to generate power for Alrosa's mining activities.

The primary reason why the international transfer of hardware and machinery occurs through FDI inflows to the oil and gas industries and to the power subsector is that Angola lacks domestic capabilities to manufacture such equipment. As a MINPET official stated,

> We, like many developing countries, are still importing or buying basic things, because we do not have the industry to manufacture products locally. We buy and import electric bulbs at the moment; think of a time when we will be able to manufacture components for a power plant or an oil rig. (Interview, 14 July 2014)

Whereas the transfer of machinery and hardware through FDI to oil and gas, and to the power and bioenergy subsectors, can be demonstrated empirically without any difficulty, the transfer of technology in the form of designs or blueprints cannot be so easily identified. A MINEA official pointed out,

> There is no project [for which] we have been given all the designs by the developers. Design transfer is possible in an academic sense, but in practice it means the developer may go out of business. (Interview, 14 July 2014)

Indeed, blueprints for the Hydro Chikapa 1 Project remained in the hands of the project owner, Alrosa; the designs for the Biocom Project are held by Odebrecht; and in the Angola LNG Project, a licensing agreement allows the appropriate technologies to be used, but Bechtel (the EPCM firm) controls access to the designs.

The transfer of technology through knowledge in the form of know-how is a quite recent phenomenon occurring through new forms of FDI inflows to renewables. However, investments into renewables have not reached a stage where large-scale machinery and hardware are required, as most projects are still in the feasibility or exploratory stages. For example, much work on huge wind and solar-energy projects are still in the mapping and planning phases. In these cases, knowledge-transfer is taking place through the passing on of skills on project design by international companies to the few Angolan technicians and engineers who are brought on during the exploration phase and take part in feasibility studies. Once this stage is completed, according to a MINEA official,

> we would expect IFDI to concentrate on the transfer of hardware and machinery required for production – and these transferred capabilities may sometimes become redundant. (Interview with a MINEA Official, 14 July 2014)

There is some evidence of technology transfer or knowledge transfer occurring through training aimed at creating supply-chain linkages, specifically in the oil and gas industries. Angola's local content laws have promoted training institutions and programmes for capacity building in local firms so as to empower them to become suppliers to TNCs. Current training programmes focus on financials, business management, and the bidding process for open tenders. Several locally owned Angolan firms have participated in these training programmes, subsequently establishing supply links with TNCs, especially in the oil and gas subsector. These capacity-building training programmes have mainly been offered by international NGOs, with financial support from TNCs. Hence, there is some transfer of technology in the form of knowledge transfer.

Another dimension of the transfer of knowledge is demonstrated by the Angola LNG Project. In this case, the transfer of know-how is an ongoing process, premised on the training of Angolan personnel for employment. Knowledge transfer was of crucial importance since Angola had no previous experience with an LNG plant. The country also had very few local workers with the necessary experience and skills for employment in this kind of greenfield project. The shortage of skilled labour is illustrated by the fact that this project employed between 3,000 and 5,000 non-permanent workers during its construction phase. Nearly all members of the local workforce (about 50 percent of the total workforce) were engaged in low-level menial tasks, with a very small portion working in a supervisory capacity, and only a tiny handful occupying technical positions. Expatriates, most from India, Brazil, Europe, and North America, constituted the other 50 per cent of non-permanent employees, and they worked mainly as supervisors, technical personnel, and managers, with only a few in menial jobs.

Knowledge transfer in the LNG project involved the training of Angolans in the technical and engineering facets of the project, commencing during the construction phase of the plant. Selected personnel had to undergo three years of training in Angola and abroad, mostly in Europe and the United States. The first cohort of 50 Angolans started training in the technical aspects of LNG technology in 2009. A similar number was enrolled in 2010 and again in 2011. In order to enhance knowledge transfer, a training agreement was signed with India to transfer LNG skills to Angolans through local training and the exchange of personnel between Angola and India.

But the impact of knowledge transfer through training has not yet been evaluated. When the project commenced production in 2013, there were approximately 500 permanent employees. Very few of the permanent staff complement are Angolans, and most of them work in lower-level jobs. The difficulty in determining the outcomes of knowledge transfer through training is that recruitment to work in managerial positions is highly politicised, and persons that are connected to the political elite are employed in these positions. Although Angola has a policy of "Angolanisation," which stipulates that TNCs should employ a ratio of 30 per cent expatriates to 70 per cent Angolans, this policy was waived as part of the incentive package given to investors by the government.

There is also evidence of the transfer of know-how to local firms, especially when these companies are engaged as service providers to TNCs. For example, the Angola LNG and Biocom projects have promoted supply-chain technology transfer in indirect support areas, such as those associated with providing catering, cleaning, and hospitality services; safety clothing; and footwear. This means that the services that most contracted domestic firms provide to TNCs in the Angolan energy sector are not directly related to manufacturing, engineering, or core business. Many domestic companies do not succeed in penetrating and providing core services to TNCs, simply because contractual agreements between project owners, EPCMs and OEMs state that repairs and maintenance of plants and original equipment remain their preserve – which, to a very large extent, excludes the participation of local industries in supplying direct production-related services. Moreover, TNCs usually streamline the number of their suppliers and prefer to use a single firm to conduct a variety of services, benefitting them in terms of administrating, making service payments, and supervising deliverables. But, a few domestic firms that did manage to secure direct production-related services are those providing welding, metal fabrication, and electrical-installation services under the close supervision of OEMs or EPCMs.

Whilst there are some supply-chain linkages between domestic firms and TNCs in Angola's energy sector, a close scrutiny of those linkages indicates that domestic companies lack the manufacturing capabilities to provide direct services to the core business of TNCs. Hence, it is necessary to develop manufacturing capabilities and capacities among domestic firms, which will require a closer interface between local content laws and industrial policies, and closer interaction between the institutions that develop and manage these policies – in particular, MINPET, Sonangol, and the Ministry of Industry.

Linkages between TNCs and domestic firms based on distribution chains are very limited, because of the monopolistic control of the supply chain by state-owned Sonangol, which has created several subsidiary companies to facilitate distribution of oil and gas products in Angola. Similarly, in the power subsector, ENE is a monopolistic entity that controls the supply of electricity and, thus, limits value chains that could have been created from distribution.

The research has also found that the transfer of managerial capacities through FDI to the energy sector in Angola has been quite limited. Since the energy sector in Angola is in its embryonic stages, we found that most of the managerial staff running subsidiaries of TNCs as well as FDI-based projects in the country are experienced expatriates. Foreign firms and their subsidiaries have not fully complied with the Angolanisation policy and local content requirements, and managerial positions have remained in the hands of experienced foreigners.

Furthermore, the transfer of technologies by energy-sector TNCs through the establishment of R&D facilities inside Angola is, for all intents and purposes, non-existent. Although there are some R&D facilities operating at universities and other private institutions, these are not R&D facilities specific to the energy sector. Thus, as part of their corporate social responsibility obligations, TNCs and their subsidiaries have provided funding to universities and private institutions for research that indirectly impacts their activities. Most energy-sector TNCs have kept R&D and innovation activities located at the parent company or in the home country. Thus, FDI to the energy sector in Angola has not prompted local R&D activities by TNC subsidiaries, or the transfer of R&D activities from TNC home countries to Angola.

The research further found that FDI inflows from both the developed and advanced developing countries have been pivotal in transferring machinery and hardware to Angola's energy sector. For instance, the transfer of technology through the Angola LNG project mainly involved developed countries and firms in Europe and America. In the case of the Biocom Project, Brazilian firms were involved. Firms from the UK such as Fortune FC have been involved in photovoltaic projects in Angola, and Spanish companies are involved in wind energy. Therefore, whether a country is developed or not may not be a key issue in terms of transfer of technologies; rather, the mastery of a given technology and the ability to favourably share it with a host country through channels such as FDI may be more salient.

Discussion

The results show that the government of Angola is actively involved in the energy sector – the main source of state revenue. State entities actively mobilise FDI to the sector as well as direct FDI inflows towards desired national socio-economic outcomes. Therefore, FDI inflows to the country's energy sector are politicised and politically directed. Nevertheless, our key finding is that although FDI inflows to Angola's energy sector do transfer technologies, they do not transfer them holistically and uniformly. Some technologies are more easily transferrable than others. The research findings clearly demonstrate a hierarchy with regard to transferrable technologies through FDI to the energy sector in Angola. Across the subsectors, the technologies most often transferred are in the form of machinery and hardware (equipment) – which constitutes Flow A and material transfer in the respective typologies of Bell and Mansfield. There are two main reasons that these technologies are transferred more often. First, inflows of FDI to Angola's energy sector are mainly into greenfield investments: the machinery and hardware that form the lifeblood of a project. Studies done by Urban et al. (2015) and Im (2010) also found that FDI inflows mostly transfer hardware technologies necessary for the existence of the projects.

Second, Angola lacks the endogenous technological capabilities to manufacture and assemble the essential machinery and hardware for energy-sector projects. Consequently, without any endogenous technological capabilities, certain countries, Angola in particular, are highly dependent on external sources of technology, including transfers through FDI. As Fabayo observes,

> the incapability of the African continent, like the other developing regions of the world, to source needed, modern technological resources for development and the environment locally, has made dependence on offshore sources inevitable. (Fabayo 1996: 358)

The second tier in the hierarchy of transferrable technologies is know-how, especially in the form of people-embodied knowledge. The research confirmed the transfer of knowledge through various training programmes that are conducted inside and outside of Angola. In fact, the training of Angolans is obligatory, and national legislation and policies such as Angolanisation, along with Decree 20/82 and Law 17/09 ("Mandatory Hiring and Training of Angolan Citizens"), require that direct investors have a minimum of 70 per cent Angolan nationals employed in their companies and that work-visa applications for expatriate staff be regulated and approved for a certain time period only, allowing them to train Angolan counterparts to take over their positions. There are also some incentives for training local Angolans enshrined in Decree 14/10, entitled "Fund for Training and Development of Human Resources," which imposes a training tax of 0.5 per cent levied by the government on TNCs and from which companies may deduct training expenses. Further incentives are to be found in the Oil Customs Law (11/04), which has provisions for the exemption from import duties of equipment for training purposes, and which imposes a tariff protection on the domestic market. These incentives are catalytic in the transfer of know-how through training.

The least transferred technologies through FDI to the energy sector in the hierarchy of transferrable technologies, and when the typologies of Bell and Mansfield are adopted, are design transfer and capacity transfer, or: Flow C technologies. Across the subsectors it has been demonstrated that TNCs fiercely guard their designs and, therefore, do not provide these to host countries. Another reason that has not been mentioned explicitly is that the transfer of paper-embodied technologies is limited, because the official language of Angola is Portuguese, whilst a number of energy-sector TNCs come from either English-speaking countries or China. Thus, there is a definite language barrier, and for paper-embodied technologies to be transferred to Angolans there is an obvious need for translation services into Portuguese.

It has been demonstrated that managerial skills, as well as know-why technologies that are critical in effecting systems change, are in the hands of EPCMs, which are usually TNCs. There has been a limited transfer of these technologies to the host country. Clearly, the non-transfer of managerial skills and know-why technologies hampers Angola's ability to make modifications to acquired technologies. Thus, Angola needs to build infrastructure that would ensure the development of more quality human capital, allowing TNCs to place these people in positions that would enable them to make systems changes.

The research has also demonstrated the development of supply-chain linkages in the energy sector. But, what has been clear is that these linkages are not coupled to the core business of TNCs, but rather to secondary activities. This is happening despite the country's Oil Activities Law 10/04, which stipulates that investors must give preference to local suppliers, especially when their services are slightly more expensive (by up to 10 per cent) than those provided by foreign suppliers. This indicates that local laws should be strengthened in order to ensure that domestic companies provide services related to the core business of TNCs.

The research has also shown that forward linkages are quite minimal because of the pervasive presence of SOEs in distribution activities. There is a clear need to explore whether such state interventions are necessary and beneficial to the country, and to entrepreneurs and consumers. However, the present study did not look into this aspect; thus, this may be an area for future research endeavours.

The finding that a number of developed- and developing-country firms are involved in energy-sector projects in Angola may mean that transfer of technology may not be so much of a question of developed vs. developing country but more an issue of how a given country masters a certain technology, including its capability to share it with other countries. For example, Brazil's mastery of bioenergy enabled it to invest in Angola. Similar findings were made by Urban et al. (2015) on Chinese dam-building capabilities. This calls for countries to scout technology masters that would enable them to achieve their desired development trajectory. Although we found that developing-country investors are involved in Angola, whether these investors promote better and holistic transfer of technologies in comparison to those from the developed countries demands further research.

Conclusion

FDI is an important source of technology transfer to African economies, in particular to the energy sector. As this research has shown, with well-crafted national policies and institutional arrangements FDI helps to build technological capabilities. This research has also demonstrated that whereas the transfer of machinery and hardware (equipment) and of people-embodied know-how (the development of local technical expertise, especially through training) has taken place, there is no empirical evidence that FDI has stimulated or produced the transfer of design and know-why technologies (organisational and managerial skills). Moreover, there is no evidence of labour migration from TNCs to domestic firms (or through ex-employees of TNCs forming new firms), and thus no evidence of subsequent transfer of technologies through this channel, because of both high upfront costs associated with energy projects and better employee incentives provided by energy-sector TNCs. Finally, a key factor impeding the transfer of technologies to Angola's energy sector is weak endogenous scientific and technological capabilities. Domestic or local R&D capabilities are underdeveloped and there is, therefore, very limited knowledge production. Policies that promote these should be introduced.

References

Ajala, Babatunde Oluwagbemiga (2010), *Gearing FDI towards Sustainable Development in Nigeria: The Role of the WTO TRIMS Agreement*, LLM dissertation, Faculty of Law, University of Pretoria.

Ajayi, S. Ibi (2006), *FDI and Economic Development in Africa*, paper presented at the AfDB/AERC international conference on "Accelerating Africa's Development Five Years into the Twenty-First Century", Tunis, 22–24 November.

Anyangah, Joshua Okeyo (2010), Financing Investment in Environmentally Sound Technologies: Foreign Direct Investment versus Foreign Debt Finance, in: *Resource and Energy Economics*, 32, 3, 456–475.

Atkinson, Robert D., and Stephen Ezell (2012), *Innovation Economics: The Race for Global Advantage*, New Haven: Yale University Press.

Bell, M. (1990), *Continuing Industrialisation, Climate Change, and International Technology Transfer*, report prepared in collaboration with the Resource Policy Group, Oslo, Norway, Brighton: University of Sussex, Science Policy Research Unit.

Blomström, Magnus, and Ari Kokko (1998), Multinational Corporations and Spill-Overs, in: *Journal of Economic Surveys*, 12, 3, 247–277.

Chowla, Peter (2005), *Comparing Naughty BITs: Assessing the Developmental Impact of Variation in Bilateral Investment Treaties*, DESTIN Working Paper Series, 05-67, London: London School of Economics and Political Science, Development Studies Institute.

Derakhshani, Shidan (1984), Factors Affecting Success in International Transfers of Technology: A Synthesis, and a Test of a New Contingency Model, in: *The Developing Economies*, 22, 1, 27–47.

Diyamett, Bitrina, and Musambya Mutambla (2015), Foreign Direct Investment and Local Technological Capabilities in Least Developed Countries: Some Evidence from the Tanzanian Manufacturing Sector, in: *African Journal of Science, Technology, Innovation and Development*, 6, 5, 401–414.

Dunning, John H., and Sarianna M. Lundan (2008), *Multinational Enterprises and the Global Economy*, London: Edward Elgar Publishing.

Fabayo, J. A. (1996), Technological Dependence in Africa: Its Nature, Causes, Consequences and Policy Derivatives, in: *Technovation*, 16, 7, 357–370.

Fingar, Courtney (2015), *Foreign Direct Investment in Africa Surges*, online: <www.ft.com/intl/cms/s/0/79ee41b6-fd84-11e4-b824-00144feab dc0.htm> (31 March 2016).

Im, Sok Saing (2010), Review: Research, Knowledge Transfer and Capacity Building Programs Related to Hydropower Development in Cambodia, in: Norwegian Water Resources and Energy Directorate (NVE), *Water and Energy: Sustainable Development of Hydropower Involving the Private Sector in Research Collaboration in the Lower Mekong Region. Final Report*, online: <http://splash-era.net/downloads/mekong_re port_part2.pdf> (15 September 2014).

International Energy Agency (IEA), Beta (2012), *Angola: Indicators for 2012*, online: <https://www.iea.org/statistics/statisticssearch/report/?year =2012&country=Angola&product=Indicators> (3 December 2015).

Jafarieh, Hamid (2001), *Technology Transfer to Developing Countries: A Quantitative Approach*, PhD thesis, Salford: University of Salford.

Jover, Estefanía, Anthony Lopes Pintos, and Alexandra Marchand (2012), *Angola Private Sector: Country Profile*, Luanda: African Development Bank, Angola Field Office.

Kiala, Carine, and Nomfundo Ngwenya (2011), *Angola's Strategic Co-operation with the BRIC Countries*, SAIIA Occasional Paper, 85, Johannesburg: South African Institute of International Affairs (SAIIA).

Mansfield, Edwin (1982), Technology Transfer, Innovation and Public Policy, in: Devendra Sahal (ed.), *The Transfer and Utilization of Technical Knowledge*, Lexington, Mass.: Lexington Books.

Mouzinho, Aurea (2015), *The Oil Factor: Contextualising FDI and Private Investment Policy in Angola*, a presentation on SADC investment policy and regional integration, Johannesburg: South African Institute of International Affairs (SAIIA).

Mugabe, John (2005), Governing Foreign Direct Investment in Sub-Saharan Africa: Policies and Practices Reconsidered, in: Lyuba

Zarsky (ed.), *International Investment for Sustainable Development: Balancing Rights and Rewards*, London: Earthscan.

Muzima, Joel Daniel, and Fernanda Ramalho Mendy (2015), *African Economic Outlook: Angola 2015*, Luanda: AfDB, OECD, UNDP, online: <www.africaneconomicoutlook.org/fileadmin/uploads/aeo/2015/CN_data/CN_Long_EN/Angola_GB_2015.pdf> (3 February 2016).

Patel, Pari, and Keith Pavitt (1991), Large Firms in the Production of the World's Technology: An Important Case of "Non-Globalisation", in: *Journal of International Business Studies*, 22, 1–21.

Ramanathan, K. (1994), The Polytrophic Components of Manufacturing Technology, in: *Technological Forecasting and Social Change*, 46, 221–258.

Reger, Guido (2004), Coordinating Globally Dispersed Research Centres of Excellence: The Case of Philips Electronics, *Journal of International Management*, 10, 1, 51–76.

Saggi, Kamal (2000), *Trade, Foreign Direct Investment, and International Technology Transfer: A Survey*, Policy Research Working Paper Series, 2349, Washington, DC: The World Bank.

Sawada, Naotaka (2005), *The Economic Impacts of Technology Transfer and Spillovers through Foreign Direct Investment in Developing Countries*, PhD thesis, Manoa: University of Hawaii.

Souder, Wm. E., Ahmed S. Nashar, and Venkatesh Padmanabhan (1990), A Guide to the Best Technology Transfer Practices, in: *The Journal of Technology Transfer*, Winter-Spring, 5–16.

Stiglitz, Joseph (2006), *Making Globalization Work: The Next Steps to Global Justice*, London: Allen Lane.

The World Bank (1993), *Foreign Direct Investment: Benefits beyond Insurance* Development Brief, 14, Washington, DC: The World Bank.

United Nations Conference on Trade and Development (UNCTAD) (1997), *Positive Measures to Promote Sustainable Development, Particularly in Meeting the Objectives of Multilateral Environmental Agreements*, Geneva: United Nations.

United Nations Conference on Trade and Development (UNCTAD) (2005), *Economic Development in Africa: Rethinking the Role of Foreign Direct Investment*, New York, NY: United Nations.

United Nations Conference on Trade and Development (UNCTAD) (2010), *Foreign Direct Investment, the Transfer and Diffusion of Technology, and Sustainable Development*, Geneva: United Nations.

United Nations Conference on Trade and Development (UNCTAD) (2014a), *World Investment Report, 2014: Investing in the SDGs – An Action Plan*, New York, Geneva: United Nations.

United Nations Conference on Trade and Development (UNCTAD) (2014b), *Studies in Technology Transfer: Selected Cases from Argentina, China, South Africa and Taiwan Province of China*, New York, Geneva: United Nations.

United Nations Conference on Trade and Development (UNCTAD) (2015), *World Investment Report: Reforming International Investment Governance*, New York, Geneva: United Nations.

Urban, Frauke, Giuseppina Siciliano, Kim Sour, Pich Dara Lonn, May Tan-Mullins, and Grace Mang (2015), South–South Technology Transfer of Low-Carbon Innovation: Large Chinese Hydropower Dams in Cambodia, in: *Sustainable Development,* 23, 4, 232–244.

U.S. Energy Information Administration (EIA), Beta (2015), *Angola*, online: <https://www.eia.gov/beta/international/analysis.cfm?iso=AGO> (3 February 2016).

Vargas Murgui, Monica (2014), *FDI and Development: Desk-Study on the Impact of Chinese Foreign Direct Investment (FDI) Has in Angola's Socio-Economic Development*, Barcelona: Universitat Autònoma de Barcelona.

Wang, Jian-Ye, and Magnus Blomström (1992), Foreign Investment and Technology Transfer: A Simple Modell, in: *European Economic Review*, 36, 1, 137–155.

Wangwe, S. M. (1979), Transfer of Technology: Issues and Policies, in: *Utafiti*, 4, 1, 3–13.

Yin, Robert K. (2009), *Case Study Research: Design and Methods*, Los Angeles, CA: Sage.

Zarsky, Lyuba (ed.) (2005), *International Investment for Sustainable Development: Balancing Rights and Rewards*. London: Earthscan.

Ausländische Direktinvestitionen und Technologietransfer im angolanischen Energiesektor

Zusammenfassung: Dem Zusammenhang von ausländischen Direktinvestionen (Foreign Direct Investment, FDI) und Technologietransfer wird sowohl in der Forschung als auch in der politischen Analyse große Bedeutung zugeschrieben. Zahlreiche Veröffentlichungen belegen, dass FDI den Transfer von und/oder den Zugang zu Technologien erleichtert. Allerdings gibt es zu wenige empirische Studien, die diesen Zusammenhang in Bezug auf die Wirtschaft afrikanischer Staaten untersuchen. Der Autor will diese Lücke zu einem kleinen Teil schließen, indem er die Bedeutung des Technologietransfers durch den Zufluss von FDI im Energiesektor Angolas ermittelt. Seine Analyse basiert auf qualitativer Forschung in Angola im Jahr 2014. Er zeigt auf, dass sich die Erzeugung von Energie(trägern) und die Verteilungsinfrastruktur – maschinelle Ausrüstung und Qualifizierung – durch den Zufluss von FDI erheblich entwickeln konnten. Allerdings gebe es keinen Beleg dafür, dass dieser Zufluss die endogenen wissenschaftlichen und technologischen Forschungspotenziale im angolanischen Energiesektor gefördert hat. Der Autor empfiehlt politische Maßnahmen zur Förderung dieser Fähigkeiten, insbesondere im Bereich der Produktion.

Schlagwörter: Angola, Internationale Wirtschaftsbeziehungen, Energiewirtschaft, Energieträger/Energiequellen, Direktinvestition, Technologietransfer