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discussion paper



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Transitions of the energy sector in Egypt, Brazil and Germany – a comparison of the interplay between government, the private sector and civil society

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Abstract

Transition of the energy sector encompassing a shift to renewable energy use, higher energy efficiency and a decline of overall energy demand is one of the major goals regarding climate protection and transformation towards sustainability. Analyses of socio-technical changes in early industrialised countries point out that this kind of technological shift has to be accompanied by social and institutional innovation processes. In this context the interplay of government, the private sector and civil society seems to be crucial for far reaching transitions. The formation of advocacy coalitions, the openness of political opportunity structures and an appropriate policy mix are highlighted as important elements for this interplay. This article analyses transitions of the energy sector in Egypt, Brazil and Germany which represent three countries with significant differences concerning their natural resource basis and stages of societal and economic development. It shows that these differences play an important role for the main energy trajectory the countries are pursuing and characteristics of the interplay between government, private sector and civil society.

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1. Introduction

A sustainable transition of the energy sector is on the global agenda especially in the context of climate protection goals. Shifting from the use of fossil to renewable energy (RE) is one of the major elements of this transition accompanied by an increase of energy efficiency and a reduction of the overall energy demand (International Bank for Reconstruction and Development 2017).

Studies on the introduction of new technologies point out that successful transitions are not only determined by technical characteristics but are also the outcome of social and institutional innovation processes (Soule, Olzak 2004). In several analyses of energy transitions in different early industrialised countries the interplay between government, the private sector and civil society actors is highlighted to be a crucial element (Jacobsson, Lauber 2006; Mautz 2007; Kamp 2008). This article wants to take up these insights and compare the role of the three actor groups – government, private sector and civil society – and their interplay in energy transition processes in Germany, Brazil and Egypt.

Egypt, Brazil and Germany represent three countries with significant differences concerning their framework conditions and their stages of societal and economic development. Germany can be characterised as an early industrialised country with resource intensive ways of production and consumption. During the last decades it has undergone a rather far reaching transition of the energy sector. Economic growth has been low during the last years and national energy demand has slightly decreased. Brazil represents an emerging country which has passed through a phase of considerable economic growth from the mid-1990s till 2013 (The World Bank, Annual GDP Growth (%)), resulting in higher incomes and growing middle classes which adapt more resource intensive lifestyles. Egypt represents a late industrialised country with a high share of low income groups despite economic growth since the 1990s (The World Bank, Annual GDP Growth (%)). Population growth, economic development and rise of middle classes have led to a fast growing energy demand in Brazil and Egypt (The World Bank, Energy Use (kg of oil equivalent per capita)).

Energy transition processes in these countries and collaboration of the different stakeholder groups, their roles and functions within the change processes are supposed to be very different. Illustrating the different stakeholder interactions, this article wants to contribute towards a better understanding of the dynamics of transition processes under different context conditions.

The article is structured as follows: Chapter 2 presents insights about the role of different stakeholder groups and central categories for the analysis of their interplay, which were mostly won in early industrialised countries. Chapter 3 gives an overview of the performance of crucial economic and ecologic indicators and developments in the energy sector in the three countries. Chapter 4 outlines changes in the energy sector and the role of the three

stakeholder groups in each country. The discussion (chapter 5) compares energy transition dynamics of the three countries referring to the analytical categories won from literature review.

The article draws on secondary content analysis of existing publications on the development of the energy sector of the three countries, taking into account scientific analyses as well as reports from governmental institutions and national as well as international organisations dealing with energy transitions. While the changes of the energy sector in Germany are described very well and have been analysed from different perspectives, this is less the case for Brazil and Egypt (Alden 2004). Information is fragmented and many times not available in English. As far as we know, no comprehensive socio-technical analysis on changes of the energy sector in these countries has been carried out.

2. Theoretical Background: The role of government, private sector and civil society actors for energy transitions

Regarding the **role of government**, there is plenty of evidence that governmental steering and regulation has a high impact on environmental and/or technical innovations as e.g. the development of RE (Mautz 2007; Blazejczak et al. 1999; IÖW 2001; Huber 2005). Authors point out that an appropriate – and also flexible – **policy mix** of several complementary measures is necessary. Important elements are alterations in science, technology and educational policies (Jacobsson, Lauber 2006) and institutional changes to generate markets. Moreover, the significance of providing ‘protected spaces’ for new technologies is pointed out, which may serve as a ‘nursing market’ where learning processes can take place and the price as well as performance of the technology can improve (Markard, Truffer 2006; Ericsson 1989; Kemp et al. 1998). Subsidies as e.g. feed-in-tariffs can serve as support for market formation (Kamp 2008).

Analysing the role of national governments it has to be considered that they are influenced by **international regulation** on EU or global level. Since the mid-1990s international agreements on sustainable development and prevention of climate change have won importance resulting also in economic incentives as the Clean Development Mechanism. Additionally, international regulation or funding bodies play a major role in influencing national policies. For example, the EU decided 1997 that all members should gradually liberalise their electricity markets during the next years (Kemfert 2004). Late industrialised countries in Africa or Latin America who were dependent on international funding bodies as the World Bank or the International Monetary Fund were urged by these organisations to reduce or abolish subsidies and privatise the national energy sector (Hall, Nguyen 2017).

Regarding the **role of the private sector**, the **entry of new firms** is mentioned as an important element for successful transition processes by

Jacobsson & Lauber (Jacobsson, Lauber 2006). Each entering firm enriches the development of the sector with new knowledge, capital and further resources. Newcomers try out new combinations, fill existing gaps or respond to novel demands. This way further formation of knowledge is enhanced by specialisation and the accumulation of experience.

The **role of non-governmental organisations** and social movements for socio-technical transitions has been discussed by several scholars. Studies have shown that social movement organisations can have a direct influence on public policies by engaging in lobbying and protest activities and indirectly by changing public preferences and shaping public opinion (Cress, Snow 2000; Andrews 2001; Burstein, Linton 2002).

Regarding the **interplay** between social movements and industry some authors claim that NGOs impact the ***institutionalisation of specific "field frames"***, which results in the development of economic activities such as the recycling industry (Lounsbury et al. 2003) or the RE industry (Sine, Lee 2009). The perception of social and economic opportunities of entrepreneurs in certain industrial sectors can be shaped by civil society activities as well as entrepreneurial motivation to exploit these opportunities. NGOs can also contribute to consumer demand for "clean" energy for example by organising campaigns against "dirty" fossil energy and by spreading information about the environmental advantages of RE (Vasi 2009). ***Openness of the political opportunity structures*** seems to be a crucial point for the possible influence of social movements (Vasi 2009). Movement mobilisation and policy outcomes are for example influenced by the presence of elite allies, or by changes in the level of elite receptivity to protests and their willingness to repress protests (Andrews 2001; Kriesi et al. 1995; Soule, Olzak 2004). Additionally, political factors, such as the ***level of democratisation*** influence the level of civil society engagement (Smith, Wiest 2005; Dalton 2005).

Several authors refer to the importance of ***broad advocacy coalitions*** made up of a variety of different actors sharing a similar set of beliefs (Mautz 2007; Kamp 2008; Jacobsson, Lauber 2006). These actors engage in wider political debates in order to gain influence over institutions and to promote the perception that a certain technology is an answer to broader policy interests. (Jacobsson, Lauber 2006). Kamp (Kamp 2008) stresses that advocacy coalitions are necessary to pave the way for a new technology within the incumbent regime which is difficult because of self-interests, path dependencies due to taken investments, existing regulations and routines. Different actors such as researchers, technicians, manufacturers, different types of users, or protagonists of civil society organisations can be part of these advocacy coalitions (Mautz 2007). Besides these categories which describe the role of the different stakeholder groups and their interplay, Kamp stresses the importance of the ***availability of natural resources*** as a basis for the respective energy supply system (Kamp 2008).

The central categories for the analysis of the role of the three actor groups and their interplay are summarised in table 1.

Table 1: Categories for the analysis of the role of the three actor groups and their interplay in sustainable energy transitions

Government	Private Sector
<ul style="list-style-type: none"> - appropriate and flexible policy mix: - alterations in science, technology and educational policies - institutional changes to generate markets - alterations of the planning law - influence of international regulation 	<ul style="list-style-type: none"> - entry of new firms
	<p>Civil Society Actors</p> <ul style="list-style-type: none"> - lobbying and protest: - influence on public policies - shaping public opinion
Interplay between the actor groups	
<ul style="list-style-type: none"> - institutionalisation of specific "field frames" by NGOs (influence on enterprises and consumers) - openness of the political opportunity structures for social movements - political support for certain industrial sectors (e.g. subsidies, feed-in-tariff) - broad advocacy coalitions 	
Further important categories	
<ul style="list-style-type: none"> - energy resource base - level of democratization 	

These insights regarding the role of the three actor groups as well as the interplay between them were mainly won in analyses of transition processes in early industrialised countries as UK, Germany, Netherlands, Denmark, and the US. This article explores whether these categories prove to be helpful for the comparison of energy transitions in an early industrialised, an emerging and a late industrialised country.

3. Overview of sustainability related trends in Germany, Brazil and Egypt

Brazil, Egypt and Germany are in different stages of their economic and social development which has to be taken into account when looking at sustainability trends. Germany can be characterised as an early industrialised social market economy with a stagnating population (Worldometers, Germany Population) and low rates of annual GDP growth in the last decades (1.4% between 1990 and 2016) (AGBE 2017). In contrast, Brazil and Egypt show a rapid growth of population¹ and significant rates of annual GDP

¹ Brazil had a population growth of 11% between 2000 and 2010 (Pottmaier et al. 2013) with yearly growth rates between 1,2 and 1,3% (The World Bank, Population Growth (annual %)). Egypt's population has almost doubled since the 1980s with yearly growth rates between 1.8 and 2.7% (Worldometers, Egypt Population).

growth², at least in years with political stability (The World Bank, Population Growth (annual %)). However, average GDP/capita of both countries still is much lower than in Germany, reaching around \$US 3,500 in Egypt, \$US 8,650 in Brazil compared to \$US 41,930 in Germany (data from 2016) (The World Bank, GDP per Capita). Even though politics of the Brazilian Workers' Party led to a certain rise of the middle class and improvements for low income groups, the Gini index which indicates the degree of social inequality still remains very high (53 in the year 2013 compared to 60 in the year 1993). In Egypt, social inequality has been lower than in Brazil with a Gini index of 30 in 1996. However, between 1996 and 2000 the Gini index increased (to 33) and only improved in a very slow rate till 2008 (reaching 31). The protests which led to the end of the Egyptian autocratic regime in the year 2011 were fueled by discontent of the low income groups who were not benefiting adequately from economic growth in the 2000s (Tinoco 2013).

The three countries have adopted sustainability goals in their national politics to a different extent. The German government has launched a National Sustainability Strategy in the year 2002 with a broad range of ecological and social goals (Federal Government of Germany). While there has been progress in some fields (e.g. increase of the percentage of RE supply) other indicators do not show any improvement (e.g. in the fields of mobility, biodiversity).

The Egyptian government has set up a sustainable development strategy in the year 2014 until the year 2030. It aims at achieving development in several areas (e.g. health, education, energy and environment) through the cooperation of public sector, private sector and civil society (Ministry of Planning 2015). Egypt is also taking part in efforts towards "regional integration" related to RE in the African continent (Saadi et al. 2015), due to the growing importance of clean forms of energy deployment in Africa (Hancock 2015).

In 2011, the Brazilian government introduced the Action Plan for Sustainable Production and Consumption (APSPC) which is an outcome of Brazil's accession to the Marrakesh Process created 2007 by the United Nations Environment Program (UNEP) to implement the commitments of the Johannesburg World Conference on Sustainable Development 2002 (ME 2014). APSPC complements the goals of the National Plan on Climate Change (PNMC), launched in 2009, which focuses on reducing greenhouse gas emissions (ME 2012).

Regarding sustainability performance, CO₂-emissions/capita and year is an indicator which provides an overview about the overall energy intensity of production and consumption in the respective countries. In Germany, a moderate decline can be observed during the last two decades, however still

² Egypt's average annual economic growth rate was above 5 percent between 2000 and 2010 but has slowed down since 2011 due to political instability (The World Bank, GDP per Capita).

remaining on a very high level considering the average amount of 2 t/capita and year the World Climate Council is claiming to be acceptable to prevent severe climate changes (Committee on Climate Change 2014). Up to now, Germany is not reaching its ambitious CO₂ reduction goals. In Brazil and Egypt, emissions/capita and year have been rising since 1991 but are still on a comparably low level (see table 2).

Table 2: CO₂-emissions/capita and year in tons between 1991 and 2010 (Source: (United Nations Statistics Division))

	CO₂-emissions/capita and year (t)		
Year	Germany	Brazil	Egypt
1991	11.48	1.44	1.37
2000	9.94	1.88	2.14
2010	9.04	2.15	2.62

Regarding energy use, overall primary energy consumption in Germany was stable between 1995 and 2005 and has been slowly declining since then (from around 14,500 PJ in 2005 to 13,838 PJ in 2016) (AGBE 2017). Fossil energy consumption is still dominant with a share of 12% from RE in the year 2016 (see table 3). Germany is only producing around 30% of the primary energy it consumes within the country. The mix of nationally produced primary energy has been shifting towards RE during the last decades, reaching 43% in 2016, followed by coal with 42%, gas with 6%, mineral oil 2% and others (e.g. nuclear energy) with 6%. Germany, therefore, is a net importer of fossil energies, which is also favoured by decreasing prices for mineral oil, gas and coal since 2010 (AGBE 2017).

Brazil's primary energy demand continues to grow fast: the average annual growth rate in the years 2000 till 2011 was 3.3%. In 2010, 98% of the households in Brazil benefited from the electric system, with the highest rates in urban areas (99%) and some rural areas especially in the North region with low electrification rates (62%) (MPOG 2011). Due to the growing energy demand, a strong focus on expansion of oil production and carbonisation of the electricity sector can be observed while energy efficiency performance is stagnating (Luomi 2014). This goes along with a significant growth in energy-related greenhouse gas emissions which were responsible for around 30% of Brazil's total emissions in 2014. Brazil's energy production shows a unique pattern with renewables covering 44% of the total primary supply and more than 80% of electricity referring to the year 2016 (see table 3). This is due to the high amount of hydroelectricity and biofuel production. Considering only electricity production, other renewables had a share of 8% (wind 6,9% and solar less than 1%) and nuclear power of 1.3 % in January 2017 (MME 2017a). Despite its fast-growing energy demand, Brazil is approaching self-sufficiency, climbing from 57% in 1980 to 96% in 2011 (IEA 2013a).

Since 2014 energy consumption and CO₂-emissions have decreased due to the political and economic crisis in Brazil.

Egypt is well electrified with 99 percent of households connected to the electricity system. Going along with the rising population, economic development, lifestyle changes and high governmental subsidies, energy consumption has also increased imposing severe threats on the supply system (Hegazy 2015). Referring to the year 2015 Egypt covered 96% of the primary energy demand from fossil and 4% from renewable sources (hydroelectricity, wind, solar) (Ratner 2016) (see table 3).

Table 3 gives an overview of the sources for primary energy consumption in the three countries.

Table 3: Primary energy consumption by source

Sources for primary energy consumption (%) / country	Germany (data from 2016) (AGBE 2017)	Brazil (data from 2016) (MME 2017b)	Egypt (data from 2015) (Ratner 2016)
Oil	34	37	45
natural gas	23	12	50
Coal	25	5	1
Nuclear energy	7	2	-
Renewable Energies (wind, sun, biomass, hydroelectricity)	12	44 (hydro - 12.6 biomass - 17.5 fire wood, charcoal - 8 others - 6.1)	4 (3% hydro-electricity)

Summing up, in all three countries mainstream developments are not indicating a (clear) shift towards sustainable (energy) production and consumption. Even though there are some positive trends in Germany regarding for example the production of renewable energies, the overall resource and energy intensity of production and consumption remains high and transition is going on in a slow pace. Since Brazil and Egypt are in a phase of social and economic development, consumption levels in all areas are increasing, resulting also in a fast growing energy demand.

4. Transitions of the energy sector in Germany, Brazil and Egypt

In the following section, changes in the energy sector of the three countries will be described with a special focus on transitions towards sustainability which encompasses the provision and use of renewable energies (RE), increase of energy efficiency and reduction of the overall level of energy use.

4.1. Transition of the energy sector in Germany

In May 2016, Germany covered for the first time almost 90 percent of its electricity supply with renewable energies (RE) for a period of around one hour (dpa 2016)! Even if this accomplishment was a result of the interplay of several favorable conditions (sunny and windy weather as well as low levels of electricity consumption), it made clear that the visions which had been called utopian several decades ago, could become reality. Transition of the German energy sector from the 1970s up to now can only be explained with closely intertwined developments of civil society, the private sector and governmental regulation which will briefly be presented in the following paragraphs. Figure 1 illustrates the major milestones of changes in the energy sector in Germany between 1970 and 2015.

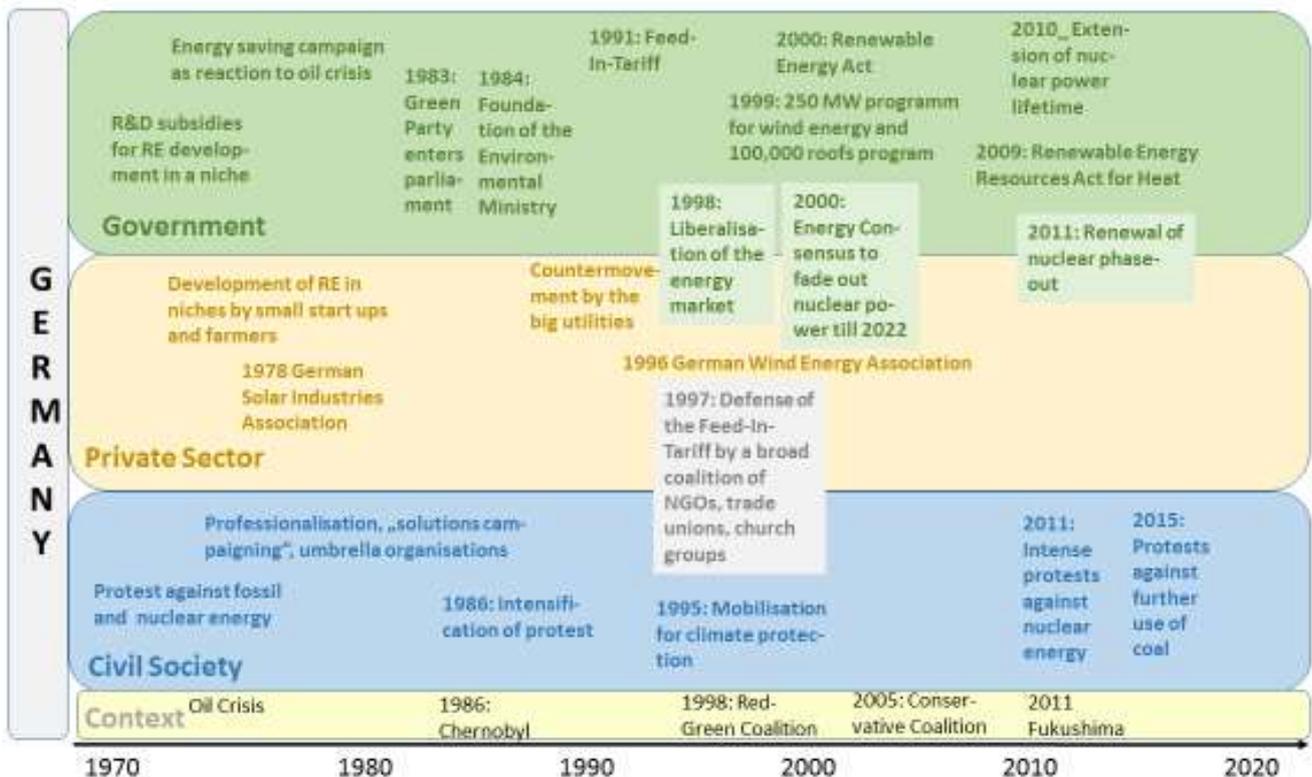


Figure 1: Changes in the energy sector in Germany from 1970 till 2015

Questioning the centralised paradigm of energy supply in a niche (1970s-mid 1980s)

In the 1970s, Europe faced a drastic increase in oil prices (known as “oil crisis”) resulting in policy measures as energy saving campaigns and the desire to increase self-sufficiency. At this time, the German government favored the strategy to increase the supply with nuclear energy, which was compatible with the centralised paradigm (Young, Hager 2011). In the 1970s till mid 1980s governmental support for RE was mainly restricted to R&D funding by the Ministry of Research which allowed universities, alternative research institutes and some firms to experiment with renewables in a niche (Young, Hager 2011). In this period the Ministry of Economics as a very powerful government member continued to favor traditional energy producers and was not interested in expansion of the renewables sector (Lipp 2007).

Fueled by the oil crisis and the nuclear accident of Chernobyl (1986) powerful social movements developed in the 1970s and 1980s (Mautz 2007). The protest did not only address the environmental risks which were linked to traditional energy supply but also targeted state-sponsored industrial projects as symbols of a planning system that ignored civil society concerns (Young, Hager 2011). Citizen activism led to the founding of green and alternative parties and networks of citizen groups throughout West Germany. The four largest environmental organisations showed significant growth during 1980s contributing to the institutionalisation of the environmental movement (Rucht, Roose 2003). 1983 the Green Party entered the national parliament for the first time with an understanding of being the parliamentary arm of the environmental movement (Mez 1987) and aiming for more transparency and openness in policy making.

Regarding the dominant private sector, the major utilities, which enjoyed territorial monopolies on energy supply and especially the nuclear power industry were resistant to alternative energy sources (Toke, Lauber 2007). In this phase, enterprises of the renewable sector (wind and solar energy) were dominated by start-ups, which often originated from actors of the social movements and farmers experimenting with the use of biomass. By end of the 1970’s, the growing number of enterprises in the solar sector began to organise themselves in umbrella organisations as the German Solar Industries Association (1978), and the German Association for the Promotion of Solar Power (1986).

Renewable energies leaving the niche by forming societal coalitions (mid 1980s till end of 1990s)

The environmental movement was not only able to increase awareness about the environmental problems and risks of fossil and nuclear energy production, but also to create the perception that RE could be a workable solution for these problems (Vasi 2009). This was also due to a shift from critical

campaigning to “solutions campaigning” by the major environmental organisations as Greenpeace and Friends of the Earth, who professionalised their work and began to cooperate with science, enterprises and government (Rootes 2003a).

The concept of a feed-in-tariff was not developed by the government but by one of the “counterexpert” scientific institutes that had arisen from the environmental movement (Vasi 2009). An alliance of advocates for RE and organisations representing small solar and hydropower producers as well as politically conservative small wind energy producers proposed the first feed-in-tariff law, which granted access to the grid to renewable energy producers at a fixed price lowering investment risks (Toke 2011). In the year 1991 the government “more or less reluctantly” adopted this measure to promote RE production pressured by the protests after the Chernobyl accident and by organised advocates and their allies in the Bundestag (Jacobsson, Lauber 2006).

The costs of especially wind power began to drop which resulted in a boom in capacity and a boost to manufacturing and employment (Lipp 2007). Surprised by the success of RE, the big utilities began to attack the feed-in-law both politically and in the courts. When the government introduced plans to reduce the feed-in-tariff in 1997, the German Wind Energy association was very successful in mobilising a broad coalition of environmental groups, metalworkers’ union, farm groups and church groups for its defense (Vasi 2009).

Another reason why energy issues were taken up by the media, public authorities and the general public in the early 1990s was the rapid rise of the issue of global climate change to the top of the environmentalist agenda (Vasi 2009). Already 1995, German environmental NGOs launched large campaigns to protect the climate and support of RE which resulted in the collection of 650,000 signatures (Rucht, Roose 2003). Due to the vital role of civil society for putting renewable energies on the agenda, Young and Hager (Young, Hager 2011) stress that “grassroots groups were key to embedding alternative technologies in society *before* there was a federal policy framework” (highlighted by the authors).

Sustainable transition of the energy sector as a national policy strategy (end of 1990s till today)

1998 a coalition of the Social Democratic Party and the Green Party came into power which provided better opportunities for the environmental movement to influence the national energy policy (Young, Hager 2011). 1998 was also the year of the liberalisation of the German energy market which allowed new power providers to go into business. The government supported this development by introducing a “100.000 Roof Program” for solar power in 1999 and by revising the feed-in-law in the year 2000 resulting in the RE Act which expanded the subsidy for renewable energy. Already 1998 the Red-

Green coalition also started talks with the major utilities about future of nuclear energy which resulted in an agreement in the year 2000 to phase out of nuclear energy till the year 2022. However, this agreement was challenged when the coalition of Christian Democrats and the Liberal Party took over power in the year 2005. 2010 the coalition decided to extend the lifetime of German nuclear plants. This decision was accompanied by the largest anti-nuclear demonstration since the 1980s with around 120,000 participants. Societal protests increased after the nuclear accident in Fukushima in the year 2011 which motivated chancellor Merkel to revise former decisions and come back to the phase-out of nuclear power till the year 2022 (Young, Hager 2011). Since then there is a fragile consent in German Politics to gradually increase the share of renewable energies and renounce from nuclear power (this shift of political strategies is called "Energiewende" (energy transition)) but there are different positions regarding the pace and the concrete realisation of these goals. Especially the future role of coal is debated very intensely being – again – accompanied by civil society protest against new investments in coal plants (Deutsche Welle 2016), but also the installation of more wind energy plants and planning further energy networks have been accompanied by protests.

Besides policies for RE, the German government has also been active in supporting energy efficiency measures since 2002 and the cogeneration of heat and power as well as generating heat from RE sources (Adoption of the RE Sources Act for Heat in the year 2009).

4.2. Transition of the Energy Sector in Brazil

Brazil has followed a very specific trajectory in designing its energy supply with a strong focus on hydropower for electricity and biofuel production from alcohol. In the next sections the changes of national policy and technological developments will be described in three phases highlighting the role of government policies, developments in the private sector and civil society activism. The most important milestones are shown in figure 2.

Striving for national independence in energy supply (1950s till mid 1980s)

Brazil has a long history in RE production especially regarding the use of hydropower and the production of biofuel based on ethanol from biomass. While hydropower plants were built on a private basis in the early 1900s, the government started to control this sector after 1930. With the creation of the Water Code in 1934 the government asserted that waterfalls were state properties, and that any private initiative would need a governmental concession to produce hydroelectricity (ABRADEE 2016). The 1950s till 1970s were characterised by intensification of governmental control of the energy sector, nationalisation of foreign energy companies and the creation of state

companies in order to promote national energy independence (Andrade et al. 2009; Malaguti 2009). This process was enforced by the authoritarian military regime which ruled from 1964 to 1985 (Fainguelernt 2016). Starting from the 1950s till today the Brazilian government has invested in very large hydropower plants with capacities up to 14,000 MW. The Itaipu hydropower plant which was inaugurated in 1984 is one of the biggest installations worldwide (Itaipu Binacional 2016).

The 1970s oil crisis also motivated the country to invest in producing fuel based on ethanol (Fainguelernt 2016). In 1975, the National Programme of Alcohol (Proalcool) was created to provide biomass for energy production, especially sugarcane (Departamento de Imprensa Nacional 1975). Proalcool became the largest commercial energy programme using biomass in the world (MME 2007). Ethanol enterprises received up to 80% loans of their industrial costs from the government. In the 1980s, automotive industries started manufacturing cars only moved by ethanol to encourage its use (Vargas 2007).

With the ongoing economic growth in the early 1980s the military Government feared the lack of energy generated by hydropower and wanted to be more independent of coal and oil imports. The government therefore also explored nuclear power as an option and started to build a nuclear power plant (Angra I) in 1986 (Kuramoto, Appoloni 2002).

Concerning solar energy, the Brazilian development of photovoltaic technology began in the 1950s. In the 1970s, the development of photovoltaic technology in Brazil was considered to be equivalent to those in the pioneer countries. In the late 1970s and early 1980s, two factories of crystalline silicon photovoltaic modules were established in Brazil. In 1978, the Brazilian Association of Solar Energy (ABENS) was created and had offices in many Brazilian regional states. However due to a lack of incentives for solar energy production, research groups directed their work to other areas in the 1980s and PV production ceased (CEPEL 2014).

End of the 1970s, when the restrictions of the authoritarian regime (e.g. ban of social manifestations, censorship on media, formation of new parties) were loosened, environmental groups were forming, being part of the re-democratization movement. Energy issues as protest against nuclear energy and large hydropower plants were prominent and resulting in campaigns and manifestations (Alonso et al. 2005; Rosa 2013). In 1982 a protest manifestation with around 3,000 participants took place against the destruction of the natural reserve "Seven Falls" (Sete Quedas) caused by implementation of a huge hydropower plant (Alonso et al. 2005).

Re-democratisation and liberalisation of the energy sector (mid 1980s till 2000)

After a process of "gradual opening" starting 1974, the military authoritarian regime came to an end in the year 1985. The 1980s till 1990s were marked

by severe economic problems which also had an influence on reduced investments in power plants. In the mid-1980s, the government focused on issues of energy conservation and energy efficiency, launching the National Programme for Energy Conservation (Procel) and an Efficiency Labelling Programme (PBE) (Haddad 2005).

1990 was marked by the beginning of the National Privatisation Programme - PND, opening the electricity system to competition and private capital (CEMIG 2012; Kucinski 1995). The privatisation process included the big Federal utilities such as Eletrobras (electricity) as well as most of the regional states' utilities but not the oil industry (Petrobras) (Barros et al. 2012). Main motivation for the privatisation process was the lack of capital for new investments and increase of efficiency. The lack of capital was also caused by holding down electricity tariffs in the 1970s and 1980s, a decision which was abolished in the year 1993 (Kucinski 1995).

In the mid-1990s the government made new efforts to establish solar energy production. In 1994, the Ministry of Mines and Energy created the Programme of Energy Development for States and Municipalities to promote electrification for the rural population, implementing 8,500 photovoltaic systems (CEPEL 2014).

Regarding civil society activities, the country had approximately 400 organised environmental groups in 1985 (Viola 1992) which began to form a stable coalition in crucial political situations. As Alonso et al. (Alonso et al. 2005) elaborate, setting up the Brazilian Constitution in 1988 and the preparation of the UN Conference on Environment and Development in the year 1992 in Rio de Janeiro were two major events which enhanced institutionalisation and professionalisation of the Brazilian environmental movement. The formation of the National Front for Ecologic Action in the year 1987 was the basis to apply direct pressure on parliamentary representatives regarding the inclusion of environmental issues in the new Brazilian Constitution. A broad network of initiatives also succeeded in influencing the Brazilian agenda of the 1992 UN Conference, bringing together the two wings of conservationist and more political socio-environmentalist activists. The establishment of the Ministry for the Environment in the year 1992 showed that environmental issues were gaining importance also in the government.

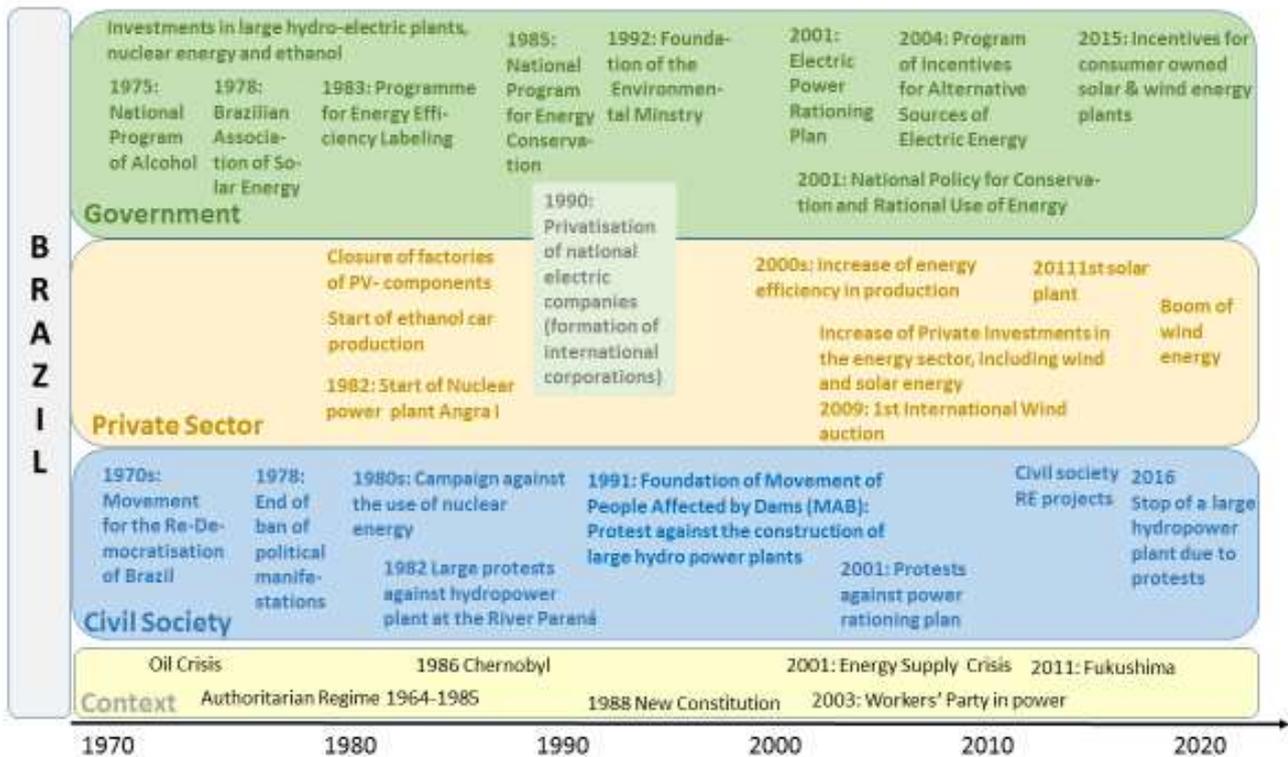


Figure 2: Changes in the Brazilian energy sector from 1970 till 2016

Diversification of the energy mix and involved actors (2001 till today)

Due to insufficient investments and planning as well as a severe drought, the Brazilian dependency on hydropower resulted in an electricity supply crisis in 2001. The government launched an electric power rationing plan with compulsory reduction of 20% in consumption (Tolmasquim 2016; Melo et al. 2011) and increase of the energy tariffs (ILUMINA). These measures were accompanied by intense protests from a broad coalition of civil society organisations, trade unions, industry associations and opposition parties (Alonso et al. 2005).

The energy crisis also led to the launch of several programmes in order to diversify the energy mix in Brazil, increase energy efficiency and reduce energy consumption in industry and the residential sector (Haddad 2005; Scandelari, Cunha 2013). The National Policy for the Conservation and Rational Use of Energy, which was launched in 2001, specified maximum levels of energy consumption as well as minimum levels of energy efficiency for machines and goods (Haddad 2005). Adapting to new energy efficiency standards, the private sector began to change its modes of production (Scandelari, Cunha 2013).

Starting in the early 2000s the energy sector has been divided into regulated and unregulated markets to enable public and private investment (EIA). According to the World Bank (The World Bank, World Development Indicators 2013), private energy investments increased considerably after 2009

compared with the years before (from US\$2bn in the year 2004 to US\$11bn in the year 2009 and US\$31bn in 2012). To guarantee stability for the investments of new generation capacity, large consumers and distributors are obliged to commit themselves to long-term contracts of purchasing electricity. Organised by the Brazilian regulatory agency ANEEL, the agreements are made through auctions (which serve to select the most competitive bids) (Luomi 2014).

Diversification was also supported by the Incentive Program for Alternative Sources of Electric Energy (Proinfa), created in 2004, aiming at an increase of the share of electricity produced from wind, biomass and small hydroelectric plants. Proinfa subsidises technical, economic and socio-environmental planning of initiatives in the RE sector. By now biomass is the second-largest renewable electricity source used in Brazil. Since 2008 the use of biomass has almost doubled and is used especially in co-generation systems in industry and agriculture (UNEP FI 2010). Wind power is the source that grew most in participation in auctions since 2009 and currently is the fastest growing energy source.

The Brazilian government took steps to promote solar energy, creating the Sectoral Energy Fund (CT-ENERG), which increased research and development activities in PV technology. In 2004 the Brazilian Centre for the Development of Photovoltaic Solar Energy (CB-Solar) was created, involving administration, universities and the State Company for Electric Energy. The first photovoltaic plant in Brazil with 1MW was inaugurated in 2011. In the solar sector small scale projects in cooperation of civil society organisations, government bodies and entrepreneurs are more common (CEPEL 2014). International environmental organisations as Greenpeace and WWF promote bottom-up projects. Fostering further decentralised energy production, the Brazilian Ministry of Mines and Energy (MME) launched a programme (ProGD) in the year 2015, providing incentives (e.g. loans) for the production of solar and wind energy directly by the energy consuming unities, including private homes, commerce, industries and the agricultural sector. MME expects that 2.7 million of producer/consumer unities of energy will be generated till 2030, producing 23,500 MW of clean and renewable energy (MME 2015). These policies can be interpreted as first attempts to foster types of energy production which are not part of the paradigm of centralised energy production.

Diversification of electricity supply is also promoted due to severe environmental and social problems which are linked to huge hydropower plants (MAB 2016, WWF-Brazil 2012). The Movement of People Affected by Dams (MAB), which was founded 1991, estimates that – for example - at least 40,000 people were impacted by the construction of the Belo Monte Dam, among them 13,000 indigenous Brazilians natives (MAB 2016). Throughout the last decades there have been numerous protests against the construction of dams, destruction of natural reserves and relocation of the indigenous population. In the year 2016 for the first time the government

cancelled plans to construct a hydro power plant in the Amazonas region due to local and international protest (Greenpeace 2016).

Driven by the system of electricity auctions and the attractiveness of thermal generation plants as a complementary supply, since the early 2000s the share of fossil fuels, and particularly natural gas, in the electricity mix has grown (IEA 2013).

Regarding the transport sector, the percentages of oil and biofuel have – with some fluctuations - stayed almost constant since the 1990s with biofuel covering around 30% of the whole energy supply and oil around 40%. Brazil is close to self-sufficiency in oil production after several decades of government efforts to reduce the dependence of imports (IEA 2013a). Due to better living standards and a long-term policy of privileging transport on roads, demand for transport fuels is growing fast. Transport and oil therefore continue to be the main drivers of Brazil's energy-related growth of GHG emissions (Luomi 2014).

4.3. Transition of the Energy Sector in Egypt

Once an exporter of oil and gas, Egypt has difficulties to satisfy its own energy needs in the last decades facing enormous challenges due to rapid growth of energy consumption and political instability. Consistent with the global trend toward adopting clean energy, there have been first efforts to reduce the dependency on fossil energy sources and diversify the energy mix by adopting a higher share of renewable energies. In the following section, changes in the energy sector will be described in three phases. Figure 3 gives an overview about the changes in the Egyptian energy sector from 1970 till now.

Nationalised and export oriented energy sector (1960s till 1990)

Egyptian Energy production and consumption has been dominated largely by fossil fuels, encompassing oil and natural gas. Egypt had a rather significant level of oil exports in the 1980s and 1990s with a peak in the mid-1990s (AfDB 2012). Since the oil crisis in 1973 many developing countries have explored for oil to assure self-sufficiency but also to gain foreign exchange revenue. The Egyptian oil output sector has quadrupled between 1970 and 1980 with respective growth of export volumes and real revenues. Despite the rise of income by exporting oil, Egypt was facing high foreign debts of approximately \$US 40 billion (Choucri et al. 1990). Extraction of oil – and since the 1980s of gas - was explored in joint ventures with British Petroleum (BP) at a very early stage, starting in the year 1965 via the foundation of the Gulf of Suez Petroleum Company (GUPCO) (BP).

Energy prices were subsidised over a long period of time. Already president Nasser initiated subsidies on food as a measure against poverty which have expanded to energy, transport and public utilities over the years (McDermott 2012). In the energy sector the subsidies led to very low levels of energy efficiency in industry and waste of energy by industry and high-end energy

users (Hegazy 2015). Pressured by the International Monetary Fund and the World Bank, president Sadat tried to reduce subsidies in the year 1977 resulting in the nationwide "Bread Riots" which forced the government to re-install them (McDermott 2012).

Regarding the electricity sector, the generation and distribution of electricity was carried out exclusively by private companies when electricity was first introduced in Egypt in 1893. Generation, transmission, and distribution of electricity were nationalised in the year 1962, resulting in the government as sole owner and operator of all electrical companies. The electricity authorities were converted several times resulting in the Egypt Electricity Authority (EEA) which was founded in 1976 (EgyptEra (n.d.)a).

In the 1950s till 1980s hydropower played a major role in electricity generation in Egypt. Under the autocratic rules of Gamal Abdel Nasser (1954-1970) and Anwar Sadat (1971-1981) big hydroelectric plants were constructed. The Aswan High Dam was primarily constructed to prevent floods and improve drought management. Negative impacts were that over 100,000 people had to be relocated and that archaeological sites were submerged. Inauguration of the Aswan High Dam hydropower plant in 1967 was followed by the construction of three other big dams in the period between 1985-2008. In 1980 hydropower still represented 50% of Egyptian electricity capacity. Due to the vast increase of electricity demand and a shift towards use of gas, it lost importance in the following decades, by now covering only around 11% of the total electricity demand (EgyptEra (n.d.)b).

There was already some interest in other RE in the late 1970s resulting in signed agreements to test potential for RE use. In 1986, the New and Renewable Energy Authority (NREA) was established as the main authority responsible for evaluating RE sources and introducing technology options through pilot projects and studies. 1991 NREA started assessing the RE potential to issue a solar and wind atlas (Georgy, Soliman 2007).

After the Chernobyl accident, several environmental organisations were founded mainly by academics of the middle class, the biggest being the National Association for the Protection of the Environment (NAPOE). NAPOE saw its tasks in raising governance and population awareness for environmental issues. Since several ministers and governors were members of NAPOE it had some influence on policy making. The Egyptian Green Party was formed in 1990 after a petition at the constitutional court. Due to little finances and restricted leeway for political activities (bureaucratic authorisation of manifestations) it was not very influential (El-Bahay 1998).

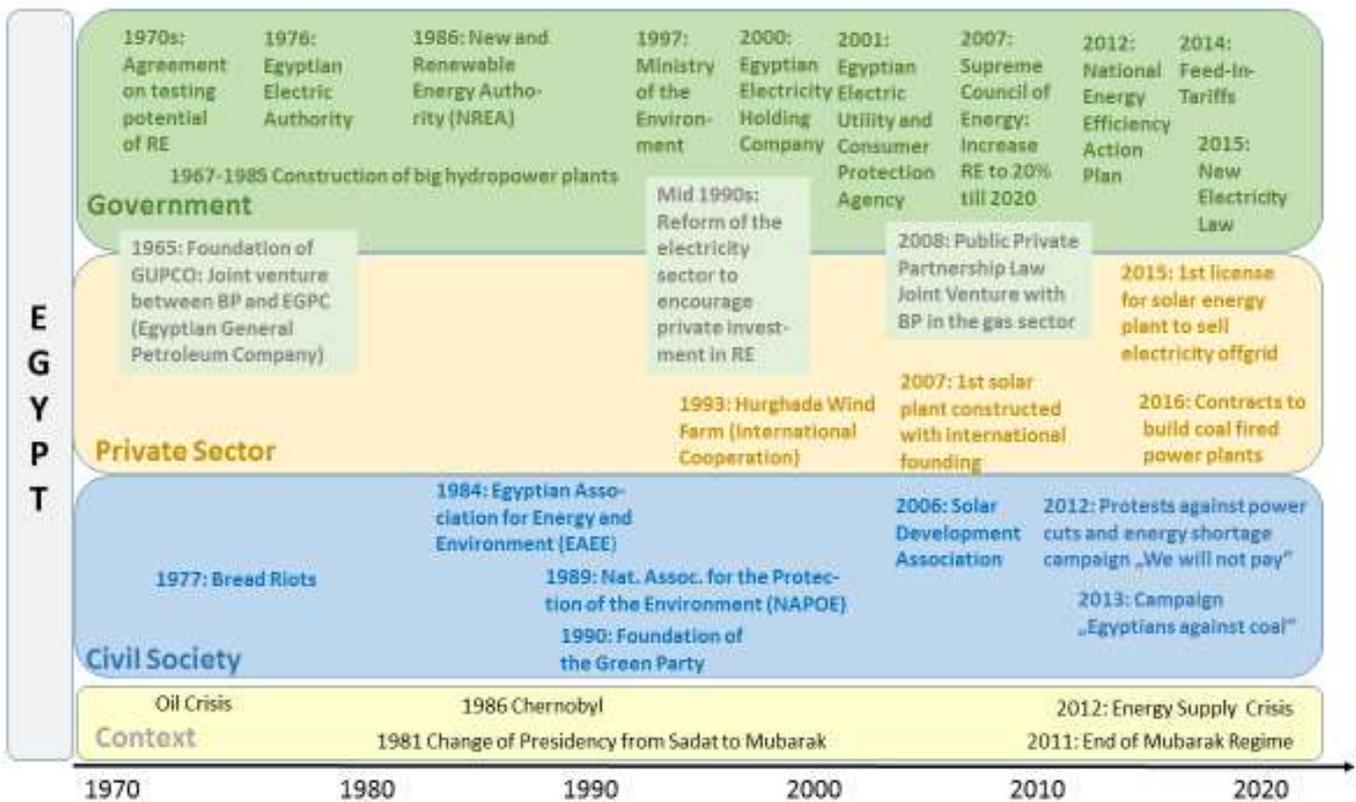


Figure 3: Changes in the Egyptian energy sector between 1970 and 2016

Liberalisation of the energy sector (1991 till mid 2000s)

Since 1991, the Egyptian government under the autocratic leadership of Hosni Mubarak has started economic reforms to reduce the size of the public sector and strengthen the role of the private sector. In the period between 1996 and 2000, several laws and presidential decrees were launched with the aim to re-organise and regulate the growing electrical industry. In 1996, local and foreign investors were permitted to construct, operate, and maintain utilities for electricity generation. In 1997, the Electric Utility and Consumer Protection Regulatory Agency was established with the responsibility of regulating and supervising the relation between the associated electric utilities (EgyptEra (n.d.)c). In 2000 the former EEA was replaced by the Egyptian Electricity Holding Company EEHC which reorganised the management of the Egyptian electricity sector resulting in separate companies for hydroelectric and thermal power production as well as electricity transmission and distribution (EgyptEra (n.d.)a). Additionally, three privately owned independent power producers (IPPs) started operations in 2002 and 2003 with power purchasing agreements for 20 years with EEHC (AfDB 2012).

The peak of the Egyptian oil production was in the mid-1990s. Depletion of the existing oil fields would have needed major investments which were not undertaken. Combined with a rise of domestic consumption, Egypt changed

from being an oil exporter to being a net oil importer (Hegazy 2015). Higher energy needs could partly be compensated by the use of domestic natural gas. Since the early 2000s, Egypt has developed to be an important producer and exporter of natural gas via joint venture with BP. To save crude oil for exports, Egypt turned to gas for the domestic market, mostly to supply heavy industries and electric power plants (Hegazy 2015).

Since the early 2000s, Egypt was successful in reducing power outage rates and durations as well losses of the distribution system indicating that distribution companies have improved their performance in the last decade. However, the current supply security is very low with a reduction of the power system's generation reserve capacity from 20% in the early 2000s to 10% by the 2010s. During the annual periods of peak demand, the Egyptian power system therefore is significantly less able to avoid power shortages (Vagliasindi, Besant-Jones 2013).

Since beginning of the 2000s several governmental organisations were established to endorse RE development. Early industrialised countries, including Germany, Denmark, Spain and Japan, supported RE development in Egypt through offering financing facilities and technological transfer (Georgy, Soliman 2007). Early wind farms were state-owned by NREA including Hurghada which started operations in 1993. Between 2000 till 2008 a series of wind farms were established in Zafarana through collaboration with European countries and Japan (NREA 2011).

Increasing efficiency and diversification of the energy mix (2007 till today)

The privatisation and diversification strategy has been enforced by the government since 2007. In this year, the Supreme Council for Energy (SCE) published a strategy for increasing the share of RE to 20% by 2020, including a 12% contribution from wind energy (Crocker 2013). The strategy stresses the potential of private investments in RE generation which goes in line with the general orientation of the government which crystallised in the issuance of the public-private partnership law in 2008 (AfDB 2012).

The urgent need for increasing energy efficiency and diversification of the energy sector became even more significant with the energy crisis of 2012 when domestic energy demands exceeded supply. The crisis was attributed to growing consumption rates and economic developments, declining investments in oil and gas sectors owing to political instability and poor strategic planning for managing demands (Park 2015). It resulted in an increase of oil and gas imports to meet energy shortages as well as outage power cuts (Kingsley 2014) which were accompanied by severe civil society protests (Hegazy 2015).

The modification of energy regulation led to more private investments in the fossil energy as well as in the RE sector. In 2008 the Egyptian government

and BP Egypt established the Pharaonic Petroleum Company (PhPC) as a joint venture to enhance the business with natural gas. BP has been exploring the Nile Delta as well as the Western Desert and found new reserves in the years 2011 and 2015 (BP). There have also been new oil discoveries in the last years, maintaining a stable level of exploration. However, since the country's debts are partly paid with the export of crude oil, the output of the refineries declined by almost 28% between 2009 and 2013 (Hegazy 2015).

Regarding renewable energies, the government launched a feed-in tariff scheme in the year 2014. Governmental policies include paying set tariffs for RE, and Build-Own-Operate and Build-Operate-Transfer tenders for more competitive bidding by developers. As incentives it includes exemptions from customs and sales taxes on all RE equipment as well as allocating land to private companies working in wind and solar fields. These policies result in an attraction of local and international investors as well as funding institutions to participate in solar and wind projects (NREA (n.d.)a).

Another critical milestone of the energy reform is the issuance of the electricity law in the year 2015. The new law allows for the private sector to participate in the production and sale of electricity limiting the governmental monopoly to the transfer of electricity (EgyptEra (n.d.)d). As an outcome of this law, Karm solar company was granted the first license to produce and sell electricity off-grid from solar energy to private sector companies with a capacity of 1 MW (Knight 2015). To achieve the set target of increasing the share of RE, several wind and solar projects are under development often in cooperation with western countries or international organisations (AfDB 2012). To expand solar energy generation, several loans are offered from financial institutions to the Egyptian government including the World Bank and African Development Bank (NREA (n.d.)b). The first solar plant was constructed at Kuraymat starting in the year 2010 through an international grant from Global Environment Facility (GEF) (AfDB 2012).

Besides wind and solar energy Egypt is also exploring the potential for nuclear energy. Egypt's nuclear plans were put on hold after the accident in Chernobyl in the year 1986. In 2015, Egypt signed an agreement with Russia on building a 4,800 MW nuclear power plant at El Daaba (Eleiba 2015).

Egypt is also extending its use of coal. In April 2014, the government agreed to the use of coal for industrial purposes, facilitating producers to start the conversion of their facilities. In May 2015, the Industrial Development Authority announced that the majority of cement plants (90%) have decided to shift to coal use to be able to increase their production. In the years before the cement industry was confronted with a limited provision with natural gas forcing them to reduce its output (Oxford Business Group). The decision to allow imports of coal was very controversial, facing protests from civil society as well as opposition of the Environmental Minister of this period Laila Iskandar (Masr 2015).

Besides diversifying energy sources, the government is also attempting to adjust low energy prices and increase the motivation for energy efficiency. In 2013, the Egyptian government spent 7 per cent of the GDP on subsidies for fuel. In combination with the economic crisis these costs have contributed to the growing deficit, which reached about 12 per cent of GDP in 2013 (Energypedia 2015). In order to alleviate this burden, electricity prices were increased in the year 2014 as part of a five-year plan which aims to start generating profits from electricity, which was at that time sold for less than half of its production costs (Energypedia 2015; Reuters 2014).

5. Discussion

In this section we want to compare the changes of the energy sector in the three countries mainly focusing on the role of the three actor groups and their interplay. We will draw on categories elaborated in chapter 2.

Availability of resources

One point which seems to be of crucial importance for the respective structure of the energy sector is the availability of national energy resources. Regarding national fossil resources, Germany could only rely on coal, which was getting in the focus of critical environmental debates about "Waldsterben" caused by acid rain. Motivated by the oil crisis in the 1970s, the German government aimed for a higher independence from oil imports, at first favoring nuclear power as "clean energy". Only the ongoing protests and the nuclear accident in Chernobyl led to a gradual shift towards biomass, wind and solar energy as RE resources. In comparison, Egypt was a net exporter of oil and gas for a long period of time and can still rely on these fossil resources for self-supply. Additionally, it had – equally as Brazil – favourable conditions to use hydropower as a main source for electricity production. Brazil also has oil and gas reserves which are used to cover the national demand. The government decided in an early stage to explore the potential of using hydropower and focused on the use of biomass for fuel production. Brazil has been the only country which has consequently established bio-ethanol production while other countries as the US failed in realising similar plans. In contrast, the considerable natural potentials for wind and solar energy use in Brazil and Egypt have only recently been started to be exploited.

This comparison shows that the three countries were to a different extent confronted with pressure to explore alternative energy sources beyond fossil energies and were able to explore different natural potentials. The availability of natural resources is also discussed in literature comparing e.g. the different development of the Dutch and the Danish energy sector. While the Netherlands could partly rely on national gas fields, this was not the case in Denmark which started earlier in supporting the development of the wind energy sector (Kamp 2008).

The role of government

In Brazil as well as in Egypt there was early support for research and development regarding the potential of solar energy in the 1970s, quite comparable to Germany. Egypt and Brazil supported R&D activities regarding solar and wind energy in an early stage (1970s) but unlike Germany they did not complement it with further measures of protecting technology development in niches or policies for market formation. Only in the 2000s feed-in-tariffs and incentives for the production of solar and wind energy were introduced. In contrast, Brazil put a strong emphasis on R&D and market creation for biofuel production from ethanol and closely linked technical developments in the automobile sector in the 1970s and 1980s up till today.

Also compared to other European countries it seems that Germany is one of the countries which followed the goal of establishing a RE sector rather consequently with a well-balanced policy mix and regular adaptations of the regulative frame (Mautz 2007). Taking a closer look however, it gets rather clear that the policy design continuously was an issue of political conflict and negotiation with several moments of policies (as e.g. the fade out of nuclear power) being revised due to pressure from big energy utilities and differing interests between the ministry for environment on the one side and for economics on the other side (Lipp 2007).

The main priority in Egypt and Brazil was to meet the fast growing energy demand. During the autocratic regimes energy was highly subsidised. Keeping the costs for a basic supply with food, energy and public services relatively low, was part of the stabilisation strategy of these regimes. These subsidies were important from a social perspective but they promoted waste of energy and did not support efforts for higher energy efficiency in industry (Luomi 2014; Hegazy 2015). In both countries social protests linked to energy crises played an important role for the start of democratisation processes.

Brazil and Egypt also show similar patterns of nationalising the energy sector in the 1960s and 1970s followed by a gradual opening of the markets for private capital in the 1990s. Also in Germany liberalisation of the energy market took place end of the 1990s which, however, only slowly – and due to measures of market formation for renewable energies and other regulatory measures – led to an entry of new companies on the market. Privatisation and liberalisation of the electricity and/ or the energy sector as a whole in the three countries are part of a global trend at the end of the 20th century.

Besides global tendencies of liberalisation there are other international regulations all three countries are embedded in and affected by to some extent. The United Nations Framework Convention on Climate Change (UNFCCC) was the basis for several international Climate Conferences and the ratification of the Kyoto Protocol by almost 200 countries. This protocol encompasses mandatory goals for global CO₂-reduction and reduction goals

for all the states which ratified the protocol (including Germany, Brazil and Egypt). The Clean Development Mechanisms (CDM) offers options for emerging and late industrialised countries to get support for the development of their RE sector. Studies show, however, that accompanying frame work conditions as abolishing subsidies for fossil energies, opening the energy markets and removing institutional barriers for the dissemination of renewables are necessary for an effective cooperation in this field. Since the mid-2000s Brazil and Egypt have benefitted from international capital for the production of renewable energies based on the CDM (Sterk et al. 2007).

The role of the private sector

Since the provision of energy is part of the basic services – as provision with water, education and health facilities - the development of the private sector in this field is mostly closely linked to national and international political strategies. For a long time, early industrialised countries followed the paradigm of a centralised energy supply, guaranteed by big state owned utilities. Via colonial politics this paradigm was also exported to Latin America, Asia and Africa. Linked to the rise of neoliberalism a global shift towards privatisation of major infrastructure systems (energy, water, transport) took place at the beginning of the 1990s. At first this process favoured existing big utilities and only gradually allowed the entrance of new actors. By now many of the major energy providers are operating on a multinational scale.

Comparing the three countries, only in Germany the dominant paradigm was challenged by a radical new paradigm of decentralised energy supply organised by a multitude of actors linked to more democratic forms of planning and implementing technology. Protection of environment and climate were the guiding principles of this movement which was the basis for the foundation of start-ups in the wind and solar sector and energy cooperatives. Even if the idea of decentralisation has lost its importance in the 2000s with the implementation of bigger wind, solar and bioenergy parks, it cannot be overseen that the number of energy providing facilities has risen to a great extent since the 1990s. The aspect of democratisation is best expressed by the fact that by 2017 over 800 citizen cooperatives for renewable energies have been founded in Germany (Bundesgeschäftsstelle Energiegenossenschaften), stressing the point that technical innovations are often linked to social innovations.

The situation in Brazil and Egypt was quite different since the production of RE - in Brazil as well as in Egypt via huge hydropower plants and in Brazil additionally via the production of biofuel – was initiated by the government and implemented in partnerships with big (partly multinational) companies, following the centralised paradigm. In contrast to Germany the basis for these technological developments was not a holistic vision of a sustainable, more emancipatory, technological trajectory. Both technologies are linked to severe sustainability problems as destruction of natural biodiversity and relocation of natives in the case of hydropower and social and ecological

problems of intensive monoculture in the case of biofuel. In Brazil the path of using sugarcane from large scale agriculture met the interests of powerful land owners and the sugar and ethanol industry linked to them. Aggressive lobbying by the agribusiness sector can clearly be detected in governmental policies and investments through the decades (e.g. the 30's, 70's, and 80's) (Leme 2004; Oliveira 2002).

The increase of wind and solar energy plants in Egypt and Brazil since the 2000s followed another pattern than in Germany. The companies are often based on multinational corporations and install wind or solar parks of considerable size. In contrast to the small German start-ups which still had to develop the technologies, companies in Brazil and Egypt were able to take up existing mature technologies. International and national climate goals play a certain role for fostering the wind and solar sector but also the motive to diversify energy production and to ensure security of energy supply. In contrast to Germany, the alternative paradigm of decentralised – more emancipatory - energy production does not seem to be of major importance in Brazil and in Egypt. Since 2010 activities in small niches have been started in Brazil, often initiated by international NGOs, which support decentralised energy supply by private homes or small companies, mostly in remote rural areas.

The role of civil society

As described in section 4.1 many of the German governmental and entrepreneurial actions taken in the energy sector originate from a powerful environmental civil society movement which goes back to the 1970s and 1980s. The continuous discursive process included protest in form of manifestations, campaigns and blockades (e.g. of transports with nuclear material) and lobbying. Rootes (Rootes 2004) points out that “the balance of environmental movement actions has shifted from highly visible protests to lobbying and ‘constructive engagement’ with governments and corporations, much of which is publicly invisible but which, no less than more public forms of protest, established economic and social relationships and cultural understandings”. The close link between the social movement and innovative economic developments as cooperatives and start-ups of solar and wind production was already described in the former section. Another example is that Greenpeace, one of the major German environmental NGOs was one of the first providers of “green electricity” in 1999.

In Brazil planning and construction of big hydropower and nuclear plants were also accompanied by civil society protests. In 2016, the Movement of People Affected by Dams (MAB) succeeded for the first time to stop the construction of a big hydropower plant. Alonso et al. (Alonso et al. 2005) point out that also in Brazil the movement changed their strategy from organising public protests to preference for lobbying through professional associations, often combined with scientific expertise. In Egypt bigger civil society protests so far mainly focused on social issues (“bread riots”, protests against the

reduction of subsidies and power cuts). The protests “Egyptians against coal” in 2013 which were mainly motivated by the fear of health risks, indicate a shift of perspective of civil society engagement, which might be linked to the rise of the middle classes. Prior research also shows that Egyptians are aware of environmental problems, yet a “brown agenda” (e.g. issues of poverty and pollution in cities) dominates rather than a “green agenda” (e.g. issues of global warming) (Alden 2004). Regarding Brazil and Egypt it is important to consider that the development of civil society organisations was limited by the autocratic regimes in both countries, in Brazil till the beginning of the 1980s, in Egypt till 2011.

Interplay between the stakeholder groups

In Germany advocacy coalitions of NGOs with a broad range of societal actors as scientists, entrepreneurs and delegates from parliament were of vital importance for a transition towards a more sustainable energy sector (Kamp 2008; Young, Hager 2011). As described above, environmental groups have undergone a process of institutionalisation by getting more specialised and professional and shifting towards less confrontational tactics in collaborating with governments and businesses (Rootes 2003; Bosso 2004). Many environmental NGOs began to cooperate with scientists, lawyers, and professionals, and focused on activities as lobbying and taking controversial issues to court. Progressive actors within different institutions could rely on public mobilisation in crucial situations as e.g. attempts to abolish the feed-in-tariff, the revision of the nuclear phase out etc. (Vasi 2009). Several studies have shown that the strength of supportive social movement organisations has an impact on decisions of policy makers on the local level but also at the state and national levels (Cress, Snow 2002; Andrews 2001; Soule, Olzak 2004).

On the other side one has to attest a certain openness of the German political opportunity structures which – even if sometimes with a long time lag – reacted for example to the growing opposition to nuclear power. The nuclear accidents Chernobyl and Fukushima played an important role as political windows of opportunity for more radical changes. However - as the comparison with other European countries which did not take similar measures shows – those changes were only possible at that moment of time because the ground for the technological shift had already been prepared.

For Brazil Alonso et al. (Alonso et al. 2005) describe growing permeability of political and administrative institutions to demands of civil society organisations during the process of re-democratisation, including environmental issues. During mobilisation for the Constituent Assembly the strategy of the National Front for Ecological Action was to influence representatives directly by offering visits to conservation areas. Following this strategy, it was supported by liberal and conservative representatives regarding some topics which were integrated in the environmental chapter of the 1988 Constitution (e.g. protection measures for the rain forest and

genetic diversity, environmental education, environmental impact assessment for economic activities, including the site of nuclear plants). Concerning energy issues it seems however, that the movement did not succeed in shifting from a protesting mode to a strategic vision – and respective allies - how the rising energy demand could be met in alternative ways.

Alonso et al. (Alonso et al. 2005) point out that the conservationist wing of the environmental movement which was focusing on protection of flora and fauna could more easily find allies in the phase of setting up the new constitution and environmental legislation. The fact that the more progressive socio-environmental wing which was posing fundamental questions of the capitalistic system lost importance in this phase, might explain why more progressive positions which could have been the basis for a more radical paradigm shift regarding energy provision played a minor role.

In the first years the Workers' Party was in office (beginning of the 2000s), activists collaborated intensely with the federal administration, with the hope that those participatory innovations that the Workers' Party had carried out on a local level during the previous decade, would be scaled up. However, after some years, many activists distanced themselves from the Workers' Party due to corruption scandals and a conservative economic policy. The last years of the Lula and especially of the Rouseff Presidency showed an environmental rollback in favor of economic development. Milestones are the alteration of the Forest Code (due to pressure from the agribusiness) which was quite successful in protecting rainforests, permission to build 30 new big hydroelectric dams till 2020, and changes to the Mining Code authorising mining on federally protected indigenous lands (Hurwitz 2012). So far there are no signs that environmental issues will be put higher on the agenda by the conservationist presidency which took over power in 2016.

Since civil society organisations are still rather weak in Egypt, so far there have been no advocacy coalitions pushing environmental issues. The introduction of the use of coal which was accompanied by civil society protests had the potential for this kind of collaboration since the environmental minister of this time also voted against this political measure. However, it seems at this point of time, the social movement was not influential enough to be able to support environmental and health concerns in the face of strong economic interests.

Conclusion

Since the 1970s, the energy sectors in the three countries have undergone considerable transitions. While some of the changes – as the trend towards privatisation of the energy sector – are following a global trend, all countries show special features which are linked to their natural resource base and characteristics of their political, economic and social development as the level of democratisation as well as growth of population and industry. Traditionally,

the national governments were responsible for energy provision, resulting in strongly regulated, centrally organised energy sectors which were based on fossil fuels or – as in the case of Egypt and Brazil - on large scale hydropower and biomass use. This centralised paradigm was only questioned in Germany by a strong civil society movement which succeeded in building advocacy coalitions supporting a shift towards a more decentralised energy supply based on RE sources as wind, sun and biomass. This shift was only possible through a – partly highly contested - policy mix which supported the development and market access of a new economic sector. In Brazil and Egypt changes towards diversification of the energy mix were motivated by international regulation and funding options as well as the objective to be able to deal with the growing energy demand.

The analyses of energy transitions in the three countries confirm that the development of technical trajectories can only be understood by considering political and socio-economic context conditions as a policy lever. The role of the three stakeholder groups – government, private and civil society actors – in this kind of processes has been confirmed. However, influence of civil society depends on the openness of the political system and the successful formation of coalitions of interest.

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