

Energy Sector Reform, Economic Efficiency and Poverty Reduction

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August 2014

Abstract

It has been more than two decades since the widespread initiation of global energy sector reforms and restructuring. However, the empirical evidence on the microeconomic, macroeconomic and quality related performance of reforms across developing countries needs to be examined considering the sizable gap in the energy economics literature. This paper reviews the empirical and theoretical literature on the linkages between energy sector reforms; economic and technical efficiency and poverty reduction. The extent of reforms have varied across developing countries in terms of changes in market structures, the role of the state and the regulation of the sector. Reforms have improved the efficiency and productivity in the sector among many reforming countries. However, the efficiency gains have not always reached the end consumers due to the inability of sector regulators and inadequate regulatory frameworks. Reforms seem to generate poverty alleviation impacts and promote welfare of the poor only when the poor have access to energy. This implies that at a minimum, reforms should be aimed at catering the energy to the poor to produce any significant impacts on poverty reduction. Future studies of reforms can also focus on the welfare analysis of reforms using cost-benefit analysis, which remains largely limited in the context of developing countries.

Keywords: energy, reform, efficiency, poverty

JEL Classification: L52, L92, Q48

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1. Introduction

The energy sector primarily consisting of coal, oil, gas, heat and electricity experienced a major global experiment of introducing market-oriented reforms and restructuring in response to a combination of political, economic and technological factors starting the early 1980s (Ljung, 2007). The reforms aimed at introducing energy policies, legislation, regulations and institutions that would unfetter the monopoly of state-owned utilities and provide opportunities for private actors to participate in a competitive market. Hence, the reforms consisted of both high and low level reform measures.

The high level reforms focussed on introducing competition in the wholesale and retail segments of energy supply, the horizontal unbundling of the incumbents to create viable competitors, the creation of an independent regulatory body and often (but not necessarily always) privatisation. Reforms allowed the corporatisation of the different segments of the energy supply. Reforms also facilitated the vertical separation between the natural monopoly and competitive segments of the vertically integrated energy sectors that were monolithically owned and managed by state governments before reforms. Vertical separation of these distinct activities of the energy supply industry (ESI) was believed to guard against any cross-subsidization between the competitive businesses and regulated businesses of energy supply and discriminatory practices such as denial of access to networks (Joskow, 2006). The degree of vertical separation (or unbundling) varied in terms of functional separation, accounting separation, legal separation and ownership separation.

The introduction of competition in downstream energy sectors such as electricity and gas supply also allowed for competition in upstream gas and coal production sectors, while the increase in energy trading facilitated the introduction of emissions markets (Pollitt, 2012). The low level reforms included aspects of cost-reflective pricing (such as removal of subsidies and subsidies restructuring, tariff liberalisation and price setting), adoption of new energy technology, new financial schemes and community involvement (Prasad, 2008).

Moreover, market driven economic reforms are on-going in many countries while the reform process in the energy sector is regarded as being both possible and inevitable (Erdogdu, 2013a). For example, by the end of 1990s, the majority of OECD countries and over 70 developing and transition countries had taken some steps toward reforming their electricity sector indicating a distinct trend and pace towards the energy sector reform experiment

(Besant-Jones, 2006). However, ample amounts of financial resources and effort have already been spent in energy sector reforms across the reforming countries. It is, therefore, necessary and timely to revisit the experience of the reform process and impacts of market based energy reforms and draw lessons of experience learnt in the aftermath of this on-going reform experiment.

Successful energy reforms should enhance the efficiency of the sector, improve energy service reliability and service quality, reduce the price-cost gap through cost-reflective pricing and increase investments (Newbery, 2002; Jamasb, 2006; Kessides, 2012). Successful energy sector reform should also benefit the poor by providing access to energy services, improvements in cost efficiency, improvements in other services such as health, education and communications; and stimulation of economic development and public sector finances (Davies et al., 2003).

However, an extensive analysis of the impacts of energy sector reforms on several sector specific and macroeconomic dimensions including energy prices, energy supply quality, utility performance, economic growth, social welfare and poverty reduction is missing in the existing energy reform literature. There has also been a renewed interest in the relationships between energy sector reforms, efficiency, growth, and welfare in the light of climate change and energy security concerns. For example, the UK, one of the pioneers of market-based energy reforms, proposed a new electricity market reform since 2010 signalling the desire for significant government intervention in order to meet its climate change objectives (DECC, 2011). The renationalization of energy industries in Latin American countries like Bolivia, Venezuela and the Dominican Republic has also underscored the changing but significant role of the state within the market-based reform model (Balza et al., 2013). Likewise, Argentina, once at the forefront of reform, is systematically undermining the role of markets in the energy sector (Littlechild, 2013).

This paper attempts to bridge the gap in the energy reform literature by reflecting on the process and outcomes of liberal energy sector reforms on micro-macro dimensions and synthesize relevant policy lessons that will be useful for policymakers in (re) formulating the (existing) new energy sector reforms and policies. The paper presents a review of the empirical and theoretical literature on the linkages between energy sector reforms; economic and technical efficiency and poverty reduction in developing countries. In doing so, the chapter aims to clarify the understandings on the context and motivation of energy reforms, review the progress and assess the factors that shape the process and determine the outcomes

of reforms, measure reform performance, unravel the existing hiatus between the theory and practice of energy reforms and reach rigid conclusions on the performance of reforms from a policymaking perspective.

The remainder of the sections are structured as follows. Section 2 discusses the drivers and context pertaining to energy sector reforms. Section 3 highlights the existing experience with energy sector reforms focussing on some examples of reforms failure and success in different countries. Section 4 summarizes the status of energy sector reform in various countries. Section 5 discusses the different methodological approaches to studying the impacts of reforms. Sections 6 and 7 analyses the impacts of energy sector reforms on several industry specific and macroeconomic dimensions. Section 8 synthesizes the reform policy lessons. Section 9 concludes the chapter.

2. Energy Reform Context and Drivers

The energy reform era that intensified during the 1990s needs to be understood within its wider historical (or pre-reform) context. The post-World War II period involved substantial increases in state involvement and state control of the energy sectors as governments longed to bolster economic development and increase energy access. The state-led model was also encouraged by the Cold War superpowers and multilateral development agencies (Williams and Ghanadan, 2006). National oil corporations ran the petroleum industries as the sole importer, refiner and distributor of petroleum products while state-owned vertically integrated utilities generated, transmitted and distributed electricity. However, the specific motives for state involvement and control across different energy sectors varied.

Rising import dependence for oil and gas among the developed countries provided incentives for others to promote state owned national champions in oil and upstream gas as production assets would be secure and favourable terms of trade could be negotiated (Williams, 1981). In the electricity sector, technological change in electricity generation from small scale local production towards large scale thermal and nuclear production needed significant capital financing of risk-taking nature from the state in the wake of rising electricity demand (Chick, 2007). In the coal sector, mine workers in state owned enterprises remained powerful while the oil price spikes encouraged continued support for locally produced fossil fuels instead of using oil in energy production (Pollitt, 2012). In downstream gas markets, the rapid network

extension implied that large state owned gas companies often replaced the local gas systems such as in the UK (Williams, 1981).

The state dominated energy sectors mostly operated under conditions of poor supervision and soft-budget constraints that eventually led to overstaffing, inefficiencies and political interference. For example, the model adopted for the electricity supply industry (ESI) since the Second World War resulted in the use of costly generation technologies, neglect of customer services, economic inefficiency and excess capacity in particular in developed and transition countries (Jamash et al., 2005). The energy sector also became vehicles for political patronage and breeding grounds for corruption (Ljung, 2007). By the 1990s, the performance of the energy sector in developing countries became unsustainable to support economic growth and social development in spite of large foreign development assistance to state-owned utilities in the energy sector during the 1970s and 1980s. The poor performance of the state led vertically integrated sector and its underlying consequences prompted energy sector reforms across both developed and developing countries.

Political ideology based on the faith in market forces and dislike for strong labour unions contributed to energy sector reforms. For example, privatization of state owned energy utilities reinforced the ideology of the Thatcher government and its interest in reducing the costs of domestic coal subsidies in the UK while similar ideological and political explanations can be found in Chile, Norway and New Zealand (Newbery, 2002; Hogan, 2002). Technological progress and development of the highly efficient gas-fired combined coal gas turbines (CCGTs) also provided possibilities to build small generation units in relatively short time with little risk involved. This eliminated the significant entry barriers that had previously existed to entry in power generation and intensified competition in electricity generation.

The liberalisation of the energy sector was strongly encouraged by international financial institutions such as the World Bank and the International Monetary Fund (IMF), which pursued the neoliberal doctrines of the 'Washington Consensus' in their structural adjustment policies (World Bank, 1993; Stiglitz, 2002). For example, the World Bank officially changed its lending policy in 1992 and later followed by the Asian Development Bank (ADB); the European Bank for Reconstruction and Development (EBRD) and the Inter-American Development Bank (IADB) for electricity development from traditional project lending to policy lending. This made energy sector loans to developing countries contingent upon their

willingness to adopt competition and introduce private participation. As such, almost 187 billion US dollars of private capital flowed into the economy of 76 developing countries during the 1990s (Beder, 2005).

Economic theory also played a key role in shaping energy sector reforms. The theoretical arguments for efficiency improvements dominated the motives for privatisation and adopting market-oriented reforms. It was believed that a combination of privatization, regulatory reform and liberalisation enhances economic efficiency and improves service standards in all energy sectors (Megginson and Netter, 2001; Pollitt, 2002). The paradigm shift in terms of the way the energy facilities are owned, operated and financed allowed expanding the scope for competition in energy markets. The creation of wholesale markets for electricity and gas in Chile, UK and Norway further reinforced this view.

However, improvement in efficiency was not the sole reason for undertaking large-scale privatisation of the energy sector. The oil shocks of the 1970s led to serious fiscal and monetary concerns in developing economies due to large foreign debts, budget deficits and soaring inflation. For example, loans for energy sector development accounted for 25% of total developing country public sector foreign debt during the 1980s (Jhirad, 1990). Reducing public spending and increasing private capital flows by undertaking structural adjustment programs was the only viable solution to overcome the macroeconomic crisis in developing countries. The privatisation of state led utilities that were operating under financial stress provided options for raising capital to the government and alongside reducing its Public Sector Borrowing Requirement (PSBR). Bolivia including other Latin American countries (LACs), Ghana and the transition economies (which includes the countries belonging to the former Soviet Union) are examples of energy sector privatization in the context of large debt crisis. Interestingly, privatisation in the LACs proceeded at such a speed that they contributed to about 40% of the total value of energy privatizations in the world during the 1990s (Gabriele, 2004).

Table 1 summarizes the energy sector drivers and external drivers (factors outside the energy sector) that contributed to the adoption of liberalised energy reforms in developed and developing countries. The specific motives for energy sector reforms often varied between developing and developed countries while external drivers played a key role in shaping energy sector reforms.

Table 1: Drivers of energy sector reforms

Energy sector drivers	External drivers
<i>Developed countries:</i> excess capacity, use of costly generation technologies, economic inefficiency, growing consumer demands for cheap energy <i>Developing countries:</i> burden of energy subsidies, low service quality, high energy losses, poor service coverage, capacity shortage and energy sector investment constraints	a) <i>Political and economic ideology</i>: faith on the forces of market, competition and privatization b) <i>Technological innovation</i>: such as the development of CCGTs c) <i>Macroeconomic events</i>: such as the post-Soviet economic transition (1989), Latin American debt crisis (1980s), Asian financial crisis (1997-1998) d) <i>Capital raising options</i>: privatization of state owned energy assets e) <i>OECD energy deregulation</i>: creation of new energy multinationals looking for new investment opportunities f) <i>Lending policies</i>: such as those of the World Bank and IMF with strings attached g) <i>National economic reform context</i>: as a result of economic crisis and structural adjustment programs

Source: Authors

3. The Reform Experience - Mixed Evidence

Energy sector reforms became a global trend during the 1990s. The 'standard textbook model', which was first applied to the power sector reforms in Chile in 1982, became the standard model for energy sector reforms. The standard model for electricity reform involved the following reform sequence and steps: i) establishment of the electricity market regulator at the start, ii) corporatization of state-owned enterprise, iii) law for electricity sector liberalization, iv) unbundling (or vertical separation) of the main segments, v) incentive regulation of electricity networks, vi) establishment of a wholesale electricity market, vii) privatization and viii) introduction of independent power producers (IPPs).

However, the sectors' resource endowment, initial structure, size, and institutional strength differed across the reforming countries. Also, the design, scope, and implementation of reforms varied across countries. Inevitably, these factors came to play an important role in the

performance and relative success of market-oriented reforms. Hence, generic market-based reforms may be suitably applicable across all energy sectors.

The *initial sector structure* defines the starting point of the reform process and is a given factor implying the importance of envisaging appropriate structure from the start of the reform process (Jamash et al., 2005). For example, the transition countries inherited the features of the command economy on to the energy sector, which led to politically determined energy prices, excess capacity, while exhibiting high levels of electrification at the start of economic liberalisation. Furthermore, most transition countries adopted market-oriented energy reforms but many of these did not create suitable institutions such as effective sector regulators to support the market driven energy sector reforms (Nepal and Jamash, 2012a).

The *institutional factors* refer to sector and economy level legal and regulatory framework that influence and support the continuity of the reform process in the energy sector. The reforms and regulation of the energy sector in developing countries tend to suffer from low levels of institutional environment in terms of limited regulatory capacity, limited accountability, limited commitment and limited fiscal efficiency (Laffont, 2005). The weak institutional environment implies that reforms and regulation of the energy sector can be ineffective. Regulation can become prone to political capture becoming a tool of self-interest within the government or ruling elite (Stiglitz, 1998). In contrast, developed countries tend to have or able to create more robust institutional framework and arrangements due to their high institutional endowment. This implies that implementing reforms and regulation of the energy sector is comparatively easier and feasible in developed economies.

The *size of the energy sector* can influence the reform capabilities and reform options of individual reforming countries. It is not clear if the smaller energy systems in developing countries require or benefit from vertical separation and third-party access. For example, the scope for competition may be limited implying that, in small energy systems; the benefits of adopting liberal reform package may be small in relation to the costs.

Despite these notable differences, energy sector reforms have been globally pursued under varying initial conditions. Some have had relative success while many have not lived up to the ambitions and expectations after more than two decades of reforms. For example, existing market driven reforms among OECD countries like Chile, Norway and Sweden appears to be performing well as compared to the UK, once considered as a successful model of electricity

reforms. In contrast, the inability to attract private investments in the power sector in Sub-Saharan African countries like Uganda and Zambia remains a disappointment. Reforms are still progressing in some countries while they have halted and remain incomplete in others (Nepal and Jamasb, 2013). Some countries (such as in Latin America) have made relatively advanced transition to the market in the energy sector while some (such as China, Russia, South Africa) are caught between the state and the market where the state still plays a dominant role in energy sector operation and management (Nepal, 2013; Erdogdu, 2013a). The evolving nature of the energy supply industry coupled with the underlying climate change and energy security objectives have also fuelled some elements of policy uncertainty in energy sector reforms. For example, the UK electricity market is characterized by the active government involvement in detailed market design due to challenging targets for renewables and carbon coupled with security of supply concerns and the prospect of retail market regulation that can virtually eliminate competition (Littlechild, 2013).

Chile was the first country in the world to implement a comprehensive modern day reform of its electricity sector. The establishment of the National Energy Commission in 1978 marked the first episode of reform followed by the formulation of the Electricity Act in 1982. This allowed for the vertical restructuring beginning in 1981 with large scale privatisation of the electricity sector in 1986. The performance of the Chilean electricity utilities before 1978 was disappointing with the two largest utilities, Endesa and Chilectra, making a loss of 4.3 and 3.2% on equity respectively. However, the performance of the electricity sector since 1982 has been remarkable as investments in generation and transmission grew, average industrial and residential prices for electricity fell, marked improvements in financial performance of the sector after privatisation, superb efficiency improvements, expansion in rural electrification and improvements in quality of supply. GDP grew by 7% per annum during the process of privatization while inflation declined steadily. The removal of constraints on new investment and capital meant that the state-run companies operating under the same conditions as private companies performed better after privatisation. As of today, the electricity markets continue to develop in Chile along with Colombia and Peru.

Source: Pollitt (2004), Littlechild (2013)

Norway was one of the first countries to deregulate and liberalise its electricity sector in Europe following the new Energy Act in 1990. The reform elements initially involved establishing a voluntary spot market for wholesale electricity trade, vertical separation in legal terms of the state-owned and vertically integrated company Statkraft and economic regulation of network companies. However, the

market liberalisation reform occurred without changes in ownership unlike the UK as privatisation of the energy sector was politically unacceptable. In 1996, a common Norwegian-Swedish power market was established as the first intercountry integrated power market in the world. In 1997 fees for consumer switching was eliminated while the Norwegian Competition Authority introduced a price information system in order to boost retail market transparency. Today, Norway has competitive and transparent wholesale and retail markets for electricity. The six years after deregulation also witnessed production capacity in Norwegian hydro plants exceeding demand. The incentive regulation of the network companies had led to efficient outcomes. As such, the country participates in the world's largest joint wholesale electricity.

Source: Askim and Claes (2011)

Box 1: Electricity reforms in Chile and Norway

The 'BRICS' countries comprising of Brazil, Russia, India, China and South Africa provide mixed evidence on the features and success of reforms in the electricity sector. The BRICS countries are interesting for studying reforms as they represent almost 3 billion populations with a combined nominal Gross Domestic Product (GDP) of around 16 trillion US dollars and combined 4 trillion US dollars of foreign reserves (IMF, 2013a). These countries are distinguished by their large, fast-growing economies while being located in different continents (South America, Asia, Eurasia and Africa).

Brazil reformed its electricity sector with the main objective of increasing competition and investment and private capital through privatisation, and has been relatively successful. The successful but radical and deep electricity reforms in Chile and Argentina motivated Brazil to adopt a rather cautious approach in reforming its power sector although the country undertook some privatisations before the establishment of the sector regulator which is generally not advisable.

Brazil is the third largest energy market in the Americas, after the United States and Canada and has the largest, and growing, power sector in Latin America. Electricity consumption growth rates have fluctuated at around 5% per year, demanding the entrance of an average of 3GW generation capacity every year. The entire electricity sector was reformed in the late 1990s, the aftermath of which continues to drive reform, innovation and opportunity in the sector. Brazil has made significant progress on its transformational journey away from having an inefficient and underinvested state-owned electricity sector on the brink of collapse, and can today show its achievements in having

unprecedented levels of competition in its electricity sector. Electrification rate is 98.3% in Brazil. That all of this has come in such a short period of time is impressive: today the electricity sector offers investors a dynamic market which would have been a closed shop a little over a decade ago. Brazil also has a transparent electricity tariff determination process. Renewable energy sources play a major role in the Brazilian electricity sector as 90% of electricity produced comes from hydroelectric power plants.

Source: Woolf et al. (2010)

Box 2: Electricity reforms in Brazil

Russia, on the other hand, is in the process of adopting one of the most ambitious electricity reform programs. While past achievements of reforms have also been impressive by international standards, the outcome remains uncertain (IEA, 2013). One of the key messages from the reforms in the Russian ESI is that restructuring and market liberalisation of a large-scale industry is feasible on both economic and political grounds. It should be noted that Russia enjoys considerable energy resource endowments.

The Russian electricity supply industry has undergone a series of radical reforms in the last twenty years. The Russian case consists essentially of two reforms: transformation from a planned system into a state-owned monopoly in the early 1990s, followed by monopoly restructuring, together with market liberalisation, in 2003-2011. The electricity price liberalisation commenced in 2007 with increasing intensity of annual price liberalization. It was planned to reach full liberalization by 2011 but this has not been achieved. The degree of liberalization is uncertain because of intense price regulation and a highly concentrated market. The first reform consisted mostly of emergency measures in a fast-transforming environment in the transition towards a market economy and was therefore unlikely to produce satisfactory results. By contrast, the second reform relied extensively on international experience and reform templates, and appears to have created a viable industry structure and reasonable market design, although some policy decisions such as increased regulation and further consolidation may have undermined some of the early-stage achievements. The main target of adding new generation capacities and avoiding electricity shortages has been achieved after reforms. The quality of regulation and competition and the handling of the heat sector remain key major challenges.

Source: Chernenko (2013)

Box 3: Electricity reforms in Russia

India, belonging to the South Asia region initiated power sector reforms already in 1991, often under external lending agency pressures. The reform progress has been difficult, limited, and largely unsuccessful and slow so far and is affected by the instability of rule-makers, poor overall acceptance, slow adaptation and poor transition management (Bhattacharya, 2007). Political instability and policy uncertainty have halted and stalled the electricity reform process across developing countries in South-Asia. The problems of stalled reforms and policy discontinuity are even acute for developing countries with small electricity systems reeling under political instability such as in Nepal (see Nepal and Jamasb, 2012b). In Japan, reform is still under consideration while reforms seem frustrated in Korea.

India started power sector reforms in 1991 as a response to the political and economic crisis due to overall opening of the economy by allowing the independent power producers to enter the sector. Large deficits and inadequate capital reinvestment led the sector to technical and financial problems at the time of initial reforms in 1991. The sector was plagued with commercial losses and growing subsidy burden. The next stage of reform introduced the single buyer model at the state level with the introduction of independent regulation in 1997. The Electricity Act 2003 was eventually enacted and provided a more flexible approach to power management by de-licensing generation except hydro, separating the competitive and monopoly segments and allowing wholesale and retail trading with multiple licensing at the transmission and distribution level. However, the evidence of reform success is not encouraging and the need for reforms based on competition, privatisation and regulation is questionable. On-going power theft, economy level corruption, and an artificially decreased pricing structure have made it nearly impossible for the state utilities in India to improve power service. Average transmission and distribution losses are well above 35% of power generation. Power shortages still prevail while 289 million people (25% of total population) lacked access to electricity in 2009. There are individual differences across the states while there is also a high share of self-generation across individual states. However, there seem to be some progress in the development of renewable energy sources in India.

Source: Joseph (2010), Sen and Jamasb (2013)

Box 4: Electricity reforms in India

China started to reform its electricity sector in 1985 when investments in electricity generation were made open to local governments, foreign companies and private investors. In 1997, the modern enterprise system replaced the former central planning system while China had a significant electricity reform in 2002 that reflected the electricity reform model adopted

by the European Union. The reforms have been successful in improving electricity access as 99.7% of people have access to electricity in China. However, the dual role of government in the energy sector, the inheritance of the energy sector business from a highly centralized planned economy, and the coal-intensive nature of power generation, has undermined many reform aspects of the evolution of China's power sector (Ma and He, 2008). The power sector reforms still remain slow and vapid in China. For example, electricity prices, including on-grid electricity tariffs, are still fully regulated by the government.

The stipulation of Electrical Law in 1996 was one of the key milestones in the legislative development of China's power sector. The law set the principle of a centralised electricity pricing policy and tariff-setting and required that electricity tariffs reflect the fair sharing of project costs and promote power sector development. The law also paved the way for the formation of the State Power Corporation (SPC) in 1997 and has been regarded as one of the most important reform measures implemented in the Chinese power sector. Another major reform was initiated in December, 2002 with the State Council's issuance of the 'Plan of Electric Industry Reform' (SC2002 No. 5). The SPC was dismantled and its assets were divided into 11 newly established corporations, including five generation companies, two grid companies, five independent power producers and four technical and engineering service corporations. However, the introduction of economic incentives and 'cost plus' pricing principles in the power sector has resulted in allocative inefficiency, high electricity costs and suboptimal capacity expansion although the growth of the power sector has been promoted. The concerns on social stability and economic growth have prevented the government from significant changes on electricity pricing. The consequences have been a series of conflicts and reform timetables in the power industry have not been followed. The government still intends to maintain control over the power industry which is delaying the pace of restructuring of the sector. The old traditional methods of administrative regulation and price control are still in place.

Source: Ma (2011)

Box 5: Electricity reforms in China

Likewise, electricity reforms in South Africa have been largely based on home grown ideas even though the 'standard model' of restructuring based on unbundling, competition and privatisation was seriously considered but later rejected. International reform drives only played a minor role in the South African power sector reform. On the other hand, understanding the process and outcomes of power reforms in South Africa is crucial for the Sub-Saharan Africa region facing chronic power problems, including insufficient generation

capacity, low connectivity, poor reliability, and high costs, all of which have constrained economic development in the region (Eberhard and Shkaratan, 2012).

There has been vigorous debate about restructuring the large electricity industry of South Africa based on the standard reform model for more than two decades, but the plans have not been implemented. The key reform steps in 1990s involved rationalisation of the distribution sector including funded electrification programmes; establishment of an independent energy regulator; corporatisation of Eskom which was established as a public utility by the government of South Africa in accordance with the Electricity Act (1922) and managed liberalisation of the electricity sector involving lots of planning. The corporatized, commercially run state-owned Eskom has been able to access private capital and has delivered low prices, reliable supply and increased access. The electrification rate doubled after 1993. However, more than 12 million of the population still lacked electricity access in 2009. There are also current concerns with underinvestment in the distribution sector resulting in deteriorating quality of supply. Rising demand growth for electricity and deterrence of investment given the monopoly status of Eskom imply that capacity shortages are inevitable. Historical analysis of Eskom also reveals that state-owned enterprises tend to make hugely inefficient investments. A draft legislation (ISMO bill) aimed at removing Eskom's monopoly over the generation and transmission of electricity was submitted to the parliament in 2012 but is still under review. The bill aims at creating an independent, state-owned entity, to encourage competition by introducing independent power producers into the market and make the sector more cost-effective. .

Source: Eberhard (2007), Minister of Energy (2011).

Box 6: Electricity reforms in South Africa

In Ghana, electricity reform began in 1993 in response to the supply shortage due to rising demand in the face of drought (Opum and Turkson, 2000). The cabinet opened a comprehensive restructuring plan to reform the electricity in adherence to the standard reform model in 1997. However, the reforms were never implemented due to opposition as the Volta River Authority (VRA), a state enterprise, argued unbundling would weaken its competitive advantage in the West Africa Power Pool. In Thailand, the Parliament authorized the initial steps of reforms in 1992 but the 'Privatization Master Plan' in the wake of 1997 financial crisis did not receive any parliamentary approval (SEPC, 1998). The California crisis coupled with the change in government in 2001 eventually halted the liberalization of the Thai electricity industry.

On the contrary, power sector reform in Fiji achieved some success in recent years despite political obstacles and is considered as a successful model of power sector reform for other Pacific Small Island Developing States (SIDS) (Dornan, 2014). The reform of the electricity sector between 1996-2013 lead to reduced power losses, improvements in productivity and increment in electricity tariffs to better reflect costs despite difficult political environment. Table 2 summarizes the power sector reform experience among selected cases in a power sector reform matrix.

Table 2: Power Sector Reform Matrix

<i>Country</i>	<i>Primary factors for reform</i>	<i>Key milestones of the reform process</i>	<i>Main outcomes</i>	<i>Limitation/Challenges</i>
India	economic openness to foreign investment, poor performance of state-owned electric utilities	IPP entry in 1991, introduction of independent regulation in 2003, Electricity Reform Act enacted in 2003	eleven states undergone full functional unbundling, five state adopted partial unbundling, 12 states have independent regulator but no structural change, two states Orissa and Delhi have regulator, full unbundling and privatised distribution	success of reform no encouraging, questionable outcomes base d on competition and privatisation, technical losses above 35% of power generation, power theft on-going, state-level corruption, subsidised tariffs
Thailand	supply shortages, government's massive debt, Asian financial crisis	1992 Electricity Law, IPP Law 1996, approval of independent regulator establishment in 1999, abandonment of price based pool in 2003, privatisation postponement in 2004, establishment of energy regulatory board in 2008	electricity market reforms remain inactive, uneconomic tariff structure which is disadvantageous to consumers, regulation ad incentive schemes do not promote efficiency but favour the state enterprises	political turmoil affecting reform implementation, regulatory institutions remain weak and not independent, state enterprises are favoured, promoting market competition difficult
Ghana	supply shortages, external lending policy, fiscal crisis, lack of investment, poorly performing distribution sector	World Bank requires reform as loan conditions in 1994, 1997 restructuring and privatization plan, regulator formed, IPPs introduced in 1998, reforms shelved by	reforms stalled, structure of the sector has not changed much, VRA mostly operating under financial losses, distribution losses remain high, tariff	regulator not independent from political interference, no standard form of PPA in the market, competing pressures to keep

		parliament in 2001, VRA unbundled in 2008	setting not economic and eroding the long term viability of utilities	consumer tariffs low hampering the establishment of cost-reflective tariff
Fiji	fiscal problems, donors lending policy	1996 Public Enterprise Act, functional separation in 1998, internal reform again started in 2002, tariffs increase by independent regulator in 2005	productivity improvements, system losses reduced from 18% to 10%, tariff collection rates increased, more authority and discretion to independent regulators	true independence and effectiveness of the regulator remains questionable, unstable political environment can lead to low private sector involvement
Brazil	poor performance of state-owned utilities, demonstrations effects from Chile and Argentina	launched radical electricity sector reforms in 1996, privatisation began since 1995, creation of independent regulators in 1998, short term wholesale market created between 1995 and 2003, long term contracts model replaced the previous wholesale market between 2004 and 2005	increasing reverting to central planning, competition has improved in the sector, auction process in transmission provide competition and incentives for investors, distribution companies procure electricity at competitive price	excessive reliance on hydro can lead to energy crisis in the face of rising demand as in 2001-2002, decarbonisation a challenge when already dominated by hydro, attracting private investments a necessary condition for the growth of the sector
China	electricity reforms pursued as a part of wider liberal economic reforms	corporatisation and commercialisation of sector in 1998, 1999 bidding by power generators, separation of generation from transmission and distribution in 2002, creation of state electricity regulatory commission in 2002, scheme for power price reform in 2003	overall reforms postponed, industry restructuring not accompanied by the introduction of competitive markets, entrenched interests have obstructed further reform, generating capacity doubled between 2002 and 2007	future of power sector reform uncertain, political will be important in moving forward with stalled reforms, institutions such as legal system and capital markets remain immature to support competitive markets
Russia	electricity reforms pursued as a part of wider liberal economic reforms after Soviet-Union break up	establishment of joint stock company for electricity in 1992, reform principles adopted in 2001, regulatory	reforms stalled, lack of insufficient investments for system modernization and low carbon	blackouts in 2002 highlighted fragility of the system, destruction of hydropower plant

		framework of the reform established in 2003, gradual transition towards free market pricing in 2003, privatisation of quasi- monopolist in 2008, free market pricing in theory in 2011	generation capacity, electricity pricing controlled by government for social equity concerns	in 2008 highlighted the need for system modernisation, market pricing only in theory as government actively monitors electricity prices
South Africa	democratic revolution of 1994, poor performance of state-owned utilities, new international thinking	creation of an independent regulator in 1995, White Paper on Energy Policy published in 1998, announcement of no unbundling of the incumbent in 2004, White Paper on renewable energy published in 2003	overall reluctance to reform, post 1990 performance saw improvements in quality and security of supply, rapid progress in extending electricity access, prices low by international standards and below cost-recovery levels	urgent need for capacity expansion as capacity is tight, pricing principles of efficiency and cost-reflectivity necessary, transparency in subsidy programme needed

The introduction of the market-oriented reform model in the power sector provided impetus to introduce reforms in other energy sectors such as natural gas, coal and oil. In addition, gas, coal and oil are both end economic products as well as a fuel for generating electricity. Hence, reforms in power sector responded to reforms in other energy sectors such as coal, oil, gas and heat. For example, reforms in the Brazilian natural gas industry followed the basic template of institutional reforms implemented in electricity and gas sectors of the EU countries (Oliveira and Marreco, 2006). The aspects of gas industry reforms in Brazil is also important from international perspective considering the use of natural gas to generate electricity, the process of regional gas integration and the use of natural gas to replace other carbon intensive fossil fuels. Likewise, the gas market reforms in Turkey were mooted with views to strengthen the market integration among the neighbouring countries. External drivers such as import dependence and supply vulnerabilities also played a major role in the reforming the Turkish natural gas market (OECD, 2002). However, the reform has not worked out as expected due to the incumbent's dominant role (monopoly power) in the market and the absence of an independent transmission system. This presents a setback for the Turkish economy whose natural gas consumption depends heavily on imports.

Brazil initiated reforms in its natural gas sector in 1995 when two Constitutional amendments were passed in Congress that allowed the monopoly (the government) to contract out the petroleum

activities to private companies and also allowed state governments to grant concessions to investor-owned gas distribution utilities. The petroleum law was enacted in 1997 that established a new structure for the oil and natural gas sectors and separated the transportation segment from other activities of the natural gas chain. The National Petroleum Agency was also established to regulate, contract and monitor economic activities inherent to petroleum, natural gas and biofuels industries. The focus of reforms shifted to strengthening the planning role of the Ministry of Mines and Energy in the energy sector as a whole with the change in Federal Government in 2003. The Brazilian gas industry witnessed growth after reforms in terms of increased national production and increased investments in the sector since the market opening. Imports from Bolivia and Argentina have also increased but transmission bottlenecks and lack of investments in networks can be a concern for the longer term regional integration.

Source: Mathias and Szklo (2007)

The Turkish natural gas industry was state owned and vertically integrated during the 1980s and the 1990s. The legal structure of the natural gas market was reformed in 2001 as a part of energy market restructuring with a new law aimed at gradual liberalization and vertical separation in the market. The new law aimed at establishing a legal framework for developing a fair, transparent and competitive natural gas market through unbundling and eliminating the monopolistic structure in the market. The Energy Market Regulatory Authority (EMRA) acts as the sole authority and describes the procedures for regulations in the energy market. However, the legal reform and the regulatory agency have not established a market structure that reinforces and promotes a liberal market. The market is still dominated by the incumbent and is constrained from competition. Efficiency considerations in the sector have also taken a backseat while the natural gas supply has not been sufficiently diversified and is prone to external shock. The sector also lacks necessary storage facilities.

Source: Cetin and Oguz (2007)

Box 7: Natural gas sector reforms in Brazil and Turkey

In the oil sector, the state has been playing a dominant role in the ownership and management across many oil rich developing countries. Hence, there is a general reluctance to undertake market-oriented oil sector reforms. However, the inefficiency in state ownership and management resulting to poor sector performance has persuaded reforms in those countries that underwent reforms. The oil industries of Nigeria and Mexico are the recent examples of state-owned enterprises poised for major reforms. Nigeria is Africa's biggest oil producer

while Mexico is the ninth largest oil producer in the world. Mexico remarkably decided to end a 75 year state oil monopoly open the sector to foreign investors. The reform of the energy sector in Mexico is expected to increase the GDP growth rate by 1% (Blanco, 2013). In Russia, a three-stage plan was announced to reform the oil industry in 1992, which involved full privatisation of the oil companies on the final stage (Berkowitz and Semikolenova, 2006). However, the privatization process remain partial and limited with the government obtaining ownership in several companies and also maintaining full control over the transport of oil and gas.

Nigeria nationalised its oil industry with the establishment of the Nigerian Nation Oil Corporation in 1971. The Nigerian National Petroleum Corporation (NNPC) replaced the Nigerian National Oil Corporation in 1997. The Petroleum Act (1969) and the NNPC Act (1997) have been the defining pieces of legislation in the Nigerian oil sector. These acts remain old and often designed for the industry at its infancy. The Oil and Gas Sector Reform Implementation Committee (OGIC) was established in 2000 in an attempt to restructure the oil and gas industry. Reforms were inevitable as the industry has been badly run for years with falling production, lost revenues and export earnings, erratic regulation, theft and corruption. The OGIC prepared the Petroleum Industry Bill (PIB) in 2008 and the bill was finally passed after 5 years of wait. The success of this reform will be gauged with time.

Source: Hogan Lovells (2012)

Mexico's Congress approved a bill to end a 75-year state monopoly and generate as much as 20 billion US dollars of additional foreign investment in a year. This is considered as the nation's most significant economic reform since the North American Free Trade Agreement. The bill will allow multinationals oil companies to develop the largest unexplored crude oil area in the Arctic Circle. Producers will be offered production sharing contracts or licences. The reform is expected to boost foreign investment, stimulate economic growth, increase the availability of energy at more affordable prices for Mexicans and increase oil and gas production. The bill also aims at undertaking some institutional changes as the Pemex board will be trimmed to 10 from 15 and will consist of five government members including the energy minister as board president and five professional advisors. Time will tell how successful these reform initiatives will be in the Mexican oil sector.

Source: Bloomberg (2013)

Box 8: Oil sector reforms in Brazil and Turkey

In the mining industries, the reforms in Colombia seem successful. Colombia is the fourth largest exporter of coal in the world and the nation undertook some mining reforms including the restructuring of the coal sector and changing legislation. The favourable government policies towards foreign investment has rapidly expanded the Colombian mining industry whose contribution to the national GDP stood at 2.3% in 2012 (Reuters, 2011). The world's largest coal producers, China, also initiated some market-based reforms in the coal sector including the deregulation of the coal prices. China has a largely market-driven mining sector. However, the results of coal price liberalisation are mixed in China and can be partly attributed to the stalled or slow reforms in the electricity sector.

Since 1940, the Mines and Energy Ministry has been the main mining authority with the legal capacity to regulate mining activities in accordance with the laws issued by the Congress in Colombia. In 2011, the government undertook a reform of the state bodies regulating and controlling mining activities including the modification of the mining law. The reforms involved market-based restructuring of the Colombian mining sector. Industry deregulation, tax law reforms and special incentives for foreign direct investments were created. The Colombian law also maintains that foreign individuals and corporations who act as mining concessionaries have the same rights as Colombian individuals and corporations. These reforms and policies have contributed to rising foreign direct investments in the mining sector while exports from mining industry in Colombia exceeded 14.8 billion US dollars in 2012.

Source: Martinez, Bejarano and Cardenas (2013)

Market reform for Coal in China began in the 1980s. In 1983, the Chinese government implemented a dual price scheme where the coal producers were allowed to sell excess coal output at higher administratively –set prices. China also began to allow local governments and private entities to invest in coal mining. China's central government stopped setting prices for non-electricity related coal in 1993, but continued to convene annual contract meetings for major coal and power companies, issuing a reference price for electricity related coal for each year until 2001. Coal prices have increased steadily in China since 1990. Increased coal prices, along with fixed electricity prices, make coal fired power unprofitable in China and have sometimes resulted in power shortages. The rising coal prices have also encouraged cheap coal imports squeezing the margins for domestic coal producers.

Source: Yang, Xuan and Jackson (2012)

Box 9: Coal sector reforms in Colombia and China

District heating is a significant energy sector in most transition economies. For example, the heat sector covered 60% of heating and hot water needs in transition economies in 2004 (IEA, 2004). The heat sector experienced reforms as other energy sectors during the 1990s. However, competition in the sector remains weak in many developing countries while the ownership is confined to the state and municipalities. This is in contrast to developed countries like Denmark and Finland where competition in the sector is strong and private sector participation is also possible. For example, in Lithuania, the price regulation in the heat sector is based on a cost-plus approach and some forms of incentive regulation with the use of benchmarking. The proper regulation of the Lithuanian district-heating sector encouraged the reduction of measured heat transmission losses from 32.3% in 1996 to 15.7% in 2009 (Lukosevicious and Werring, 2011). However, many transition countries such as Lithuania are poised to undergo a comprehensive heat sector reforms in the future.

District heating has an approximately 68% market share in the Lithuanian heat market. The 1997 separation of district heating from the Lithuanian Energy led to the creation of six regional and 13 municipal district heating companies. Municipal companies are regulated by the municipalities, which include price fixing as well while the national Control Commission regulates regional companies for Energy Prices and Energy Activities. However, the state will support initiatives aimed at increasing the heat consumption efficiency, utilization of waste energy potential and the use of biomass. By the year 2020 the target for decrease in households' and public buildings' heating consumption is 30–40%. Compared to 2011, it will allow saving annually as much as 2 to 3 TWh of heat. The district heating will be restructured in compliance with principles of the third EU Energy Package, as well as by ensuring provisions for arrangement of activity of heat production and transmission enterprises substantiated by fair and efficient competition. The transparent activity of heat production and transmission enterprises and their control will ensure heat supply services at the least prices.

Source: Ministry of Energy of the Republic of Lithuania (2012)

Box 10: Heat sector reforms in Lithuania

A number of developing countries around the world have also undertaken reforms on energy subsidies in the transition towards establishing market prices. Some subsidies reforms have been successful, for example, in countries like Chile (early 1990s), Philippines (1996 and

2001) and Uganda (1999) while the reforms have been unsuccessful in countries like Bolivia (2010), Mauritania (2008) and Indonesia (2003). Subsidies reforms have been partially successful in countries like Iran (2010), Nigeria (2011/2012) and Niger (2011).

In 2010, Bolivia removed fuel subsidies, lifting a price freeze that had been in place for six years in an effort to curtail the widespread smuggling of artificially low-priced diesel and gasoline to neighbouring countries. The removals of the subsidy took Bolivians by surprise as it instantly increased prices by over 80%. Transport and teacher unions went on strike. Thousands of demonstrators marched in major cities. The public backlash led to a rapid reinstatement of subsidies by the government.

In December 2010, Iran became the first major oil-exporting country to enact large subsidy cuts as a result of the sanctions over its nuclear programme, which put its finances under pressure. The reforms cut fuel and electricity subsidies on the supply side and shifted its focus to the demand side. The legislature approved raising fuel prices while compensating citizens with monthly cash payments while a public relations campaign delivered the message that subsidies promote waste and social injustice, as poorest citizens do not benefit. Riots never materialized and the price increases removed 50-60 billion US dollars in fuel subsidies, distributed at least 30 billion US dollars in cash to citizens. The reform is expected to improve Iran's medium-term outlook by rationalizing domestic energy use, increasing export revenues and strengthening overall competitiveness.

Chile's energy reforms focus on the demand side of its energy sector. While there is an excise tax on transport fuels, there is an explicit government policy to reduce price volatility for consumers of transport fuels through a Consumer's Protection System. Chile still has some fuel subsidies but transparency has helped the public to understand price fluctuations and pave the way for liberalization of the domestic fuel markets. The subsidiary role of the state in the electricity sector is one of the key lessons for countries undergoing reform.

Source: World Economic Forum (2013)

Box 8: Examples of energy subsidies reforms

4. Energy Sector Reform Elements and Status

The successful application of the 'standard reform model' in Chile (1982), UK (1990) and Norway (1991) encouraged many developed and developing countries to adopt similar models in their energy sectors. The model brought about a fundamental paradigm shift in terms of energy sector market structures, the role of the state, and the regulation of the energy sector. Privatization of the state-owned energy assets was often pursued within the 'standard reform model' context. For example, Norway successfully implemented the standard model in the electricity without privatizing the state-owned and municipality and country owned utilities demonstrating that privatisation is not a pre-requisite for reforms and the answer is in effective market structure, competition, and network regulation (Bye and Hope, 2005).

4.1. Market Structure

The design of energy market structures is crucial as they produce a major effect in shaping all other key decisions, including the design of the contracts between the government, the consumers and the private sector as well as the decisions on energy prices (ESMAP, 2011). Energy market structure has a strong influence on whether and to what extent the energy sector reforms can achieve improvements in performance. Creating competitive wholesale and retail energy markets by undertaking vertical separation were the eventual underlying aims behind energy market restructuring.

However, the merits of vertical separation need to be gauged against the merits of vertical integration. This is because important technological aspects of energy supply often favors the vertical integration between different supply stages resulting in vertical economies of scope. For example, the benefits of vertical integration in network industries can arise due to coordination economies, market risk economies (including hold-up risks), and specialization economies (Joskow, 2007). Thus, the choice between a vertically integrated energy market structure and unbundling can be between the economies of coordination and scope versus the possible increases in transaction costs and the potential efficiency gains from competition and increased efficiency resulting from unbundling (Kessides, 2004). The efficiency gains from effective competition (productive and allocative) in conjunction with the distributional equity concerns needs to be carefully weighed against the benefits of economies of vertical integration in restructuring energy sectors from an economic welfare perspective.

4.2. The Role of the State

The importance of energy to economic development in developing countries led to increased state involvement among post-war governments. The standard model of vertically integrated state-owned and centrally planned energy supply industries were replicated throughout the developing world (Newbery, 2002). However, majority of the state-owned monopolies operated with weak supervision and soft-budget constraints that created economic inefficiencies. Hence, a first wave of reform in the 1970s and 1980s were attempted to improve the performance of the energy sector while maintaining public ownership (Vagliasindi, 2013). However, these attempts to reform the state-owned monopolies in developing economies primarily failed.

A second wave of reforms swept the energy sectors of developing countries in the early 1990s. These reforms were aimed at expanding the scope for competition in the energy sectors either through ‘competition in the market’ or ‘competition for the market’ (Ljung, 2007). Hence, both domestic firms and multinational corporations could participate in the energy sector as private actors. As a result, there was a big push for privatisation and the use of Public-Private Partnerships (PPPs) in the energy sector (Vagliasindi, 2013). For example, the PPS already represented a major share in electricity generation and distribution in middle-income countries by 2004 (Estache and Goicoechea, 2005). The contract model of PPPs that dominated the energy sector generally involved the service contracts, management contracts, lease contracts, concession contracts and divestitures.

Under service contracts, the public enterprise employed a private contractor to undertake specific functions while the management contracts provided full responsibility to the private contractor. Lease contracts involved the private contractor paying a predetermined lease fee while the state continued to be owner of the assets but transferred responsibility to the private concessionaire under concessions contracts. For example, concessions contracts was a popular model to involve private sector participation in the water and sewerage sectors, transport sector and some segments of the energy sector in Latin America (Guasch, Laffont and Straub, 2006). Divestiture implies full ownership of the energy assets to the private sector, which in turn assumes full responsibility for capital investment, daily operations and maintenance.

Competition also inevitably meant some reduction in the state ownership, as private sector can freely participate in the wholesale markets and take market share from incumbents

(Pollitt, 2012). Hence, the role of the state is changing from the sole owner and energy service provider to that of a policymaker and regulator. The state still plays an active role in the energy affairs of developing countries while its role may increase with increasing concerns regarding energy security and climate change objectives.

For example, a renationalization trend of energy industries has gained support in some countries in Latin America. The performance of market-oriented energy reforms (structural changes in ownership and institutional frameworks) has received strong criticisms in countries such as Bolivia, Venezuela and the Dominican Republic (Balza, Jimenez and Mercado, 2013). Bolivia renationalized its electricity sector in 2008 by introducing reforms aimed at establishing state control and renationalised most of the transmission and distribution segments in 2012. Venezuela started the renationalisation process in 2007 by nationalising its main energy company. The Dominican Republic also started renationalising its electricity sector since 2000. Rejections of utility privatisation were also experienced in Mexico (1999), Brazil (1998) and Thailand (1999).

4.3. Regulation of the Energy Sector

The market-oriented reforms were followed by the need to create strong and effective new institutions in the form of independent energy sector regulatory agencies. The separation of the natural monopoly segments of energy supply from the competitive segments and privatisation placed much emphasis on economic regulation to ensure that public interests are properly reflected in terms of service quality, network access and tariffs while all generators have equitable access to the grid and consumers. The perverse incentives created by the cost-of-service regulation in terms gold-plated spending (see Averch and Johnson, 1962) implied that incentive regulation was encouraged to improve cost efficiency in energy networks. It was assumed that incentive regulation of the monopoly energy networks would mimic the outcomes of a competitive market (Littlechild, 1992).

The experience with economic regulation of energy networks via incentive regulation in developed economies has been positive with significant improvements in cost efficiency (Helm, 2009). However, one of the major regulatory failings, even in developed economies, has been the inability of the regulator to pass the efficiency gains in the sector to end consumers (Newbery, 2004). The failure of energy liberalisation to deliver for the poor together with poor governance and corruption led to rising public opposition to privatisation

in Latin America (Roland, 2008). The cost of independent regulation in vertically integrated small energy systems can also be significant compared to the benefits (Kessides, 2004). As such, independent regulation remains a major challenge for developed as well as many developing countries.

Regulation cannot be considered independent in many developing countries given the political nature and terms of regulatory appointment, public source of funding of the regulatory body and low participation of the politically unaffiliated regulators in designing regulatory content such as tariff methodology (Stern, 1997). Developing economies are also challenged by inadequate technical capacity, lack of necessary experience and skilled human resources, institutional illegitimacy and democratic illegitimacy to make independent regulation feasible (Dubash and Rao, 2008; Pollitt and Stern, 2010). Regulatory and competition agencies in developing countries are hampered by the absence of well-developed accounting and auditing systems (Estache and Trujillo, 2003). The lack of constitutional control of the government and the lack of some degree of ability to enter into long-term contracts have also hindered effective public utility regulation in developing countries (Laffont, 2005). For example, the absence of a proper regulatory framework in place prior to any contractual agreements led to the renegotiation of many concessions contracts in Latin America (Guasch, Laffont and Straub, 2006).

The limited capacity of the regulatory agency and the state remains a challenge in managing and balancing multiple forms of engagement with diverse stakeholders in developing countries (Dubash and Morgan, 2012). As such, regulation may seem to be much important to be left alone to the regulators in developing countries as there is a risk of ‘regulatory capture’ by vested interests resulting in outright corruption. However, evidence suggests that effective regulation can lead to gains in economic performance from privatisation and competition in developing countries (Zhang, Parker and Kirkpatrick, 2008).

4.4. Status of Reform in the Power Sector

After more than two decades of electricity sector reforms, the status of power sector reform remains varied in developing countries. Five basic models of organizational arrangements and modes of interaction can be observed across the developing countries that reflects varying degree of competition and government control in the power sector (Ljung, 2007).

They are a) a vertically integrated mostly state-owned monopoly where the state handled all generation, transmission and distribution; b) a vertically integrated single buyer where the state-owned, vertically integrated utility buys electricity from the IPPs often by entering into long-term power purchase agreements (PPAs); c) a single buyer in an unbundled system where the monolithic state owned utility is vertically separated into competitive (generation and retail) and natural monopoly segments (transmission and distribution) while a central dispatch company purchases the wholesale power from the generators under long-term PPAs; d) cost-based wholesale competition where the system operator dispatches the power plants based on the marginal cost and e) bid-based wholesale competition where price is determined based on the market forces of demand and supply irrespective of the marginal cost of supply.

The single buyer model dominates most of the electricity sectors in Asia, Africa and some transition countries as observed in Table 3. Some of the transition countries are also operating as a vertically integrated monopoly despite experiencing economy wide market-based reforms in the 1990s. The present state and progress of power sector reforms in the transition countries is reminiscent of the fact that the collapse of central planning was not by choice but rather a consequence of dysfunctional political and economic system of yesteryears (Nepal and Jamasb, 2012a). In contrast, most of the countries in Latin America have competitive wholesale arrangements and made considerable reforms have been carried out with adherence to the standard reform model.

The generation segment of the ESI has undergone privatization in many developing countries while the network segments remain publicly owned. In Latin America privatisation of the ESI has been largely pursued in Latin America while IPPs are now a large market in Asia, particularly in China, Indonesia, the Philippines, India, Pakistan, Malaysia and Thailand under a single buyer model. The significant public ownership (and involvement) corresponds to inadequate legislation and no independency of regulators in developing countries. The inadequacy of legislation can also be observed in those countries that have undertaken the privatization of the electricity network segments such as Brazil, Cameroon and Ivory Coast. Overall, many developing countries are still a distant away from the full adoption of liberalized standard model in their power sector and are by and large in transition from state control to markets.

Table 3: Reform status of electricity sector in selected countries

Market Structure		Private Ownership and Involvement		Regulation	
China, Thailand, Vietnam, Nepal, Sri Lanka, Burkina Faso, Nigeria, Ivory Coast, Zimbabwe, Senegal, Morocco, Tunisia	<i>monolithic single buyer</i>	China, Malaysia, Philippines, Thailand, Vietnam, Nepal, Lithuania, Turkey, Russia, Nicaragua, Colombia, Bolivia, Argentina, Brazil, Peru, Chile, Tunisia, Morocco, Kenya, Zimbabwe, Ivory Coast, Uganda, Nigeria, Ghana, Cameroon, Bangladesh, Sri Lanka, India, Pakistan	<i>generation</i>	Malaysia, Philippines, Thailand, Pakistan, Bangladesh, Nepal Cameroon, Nigeria, Uganda, Ivory Coast, Senegal, Kenya, Argentina, Bolivia, Chile, Peru, Brazil, Nicaragua, Colombia, Russia, Turkey, Azerbaijan, Kyrgyzstan	<i>independent regulators exists</i>
Malaysia, Philippines, Pakistan, Bangladesh, Ghana, Uganda, Kenya, Turkey, Lithuania	<i>unbundled single buyer</i>	Cameroon, Ivory Coast, Argentina, Bolivia, Brazil, Chile, Peru, Nicaragua, Colombia, Russia, Lithuania	<i>transmission</i>		

South Korea, Cameroon, Uzbekistan, Turkmenistan, Tajikistan, Azerbaijan, Kyrgyzstan	<i>monopoly</i>	Philippines, Pakistan, Cameroon, Uganda, Ivory Coast, Morocco, Chile, Brazil, Peru, Argentina, Bolivia, Nicaragua, Colombia, Russia, Lithuania, Turkey, Azerbaijan	<i>distribution</i>		
Argentina, Bolivia, Brazil, Chile, Colombia, Peru, Nicaragua, Russia	<i>wholesale competition</i>				

Source: Adapted from Ljung (2007) and authors' compilation

4.5. Status of Reform in the Oil and Gas Sector

The oil and gas supply industry comprises different segments. The upstream oil and gas sector includes the exploitation, exploration and production (E&P), discovery and recovery of crude oil and natural gas. The downstream sector includes the refining of crude oil and gas, selling arrangements such as the storage, wholesale and retail distribution of petroleum products and the transmission and distribution of natural gas. There is a strong interaction between the upstream and downstream sectors as in the electricity sector where good performance of the competitive segments depends on the good performance of the regulated network segments (Joskow, 2008). The different activities in oil and gas supply provide varying scope for competition to be introduced.

The oil industries of the majority of oil producing developing countries are run by National Oil Corporations (NOCs). The government usually controls 100% of the shares although there is some privatisation in the Latin American oil sector. The joint ventures market model dominates the upstream activities while the state oil company is often a mandatory partner in the joint venture. The joint venture model has proven to be successful in attracting capital for oil development in developing countries such as Ghana and Nigeria. However, the heavy involvement of the state has undermined the issue of independent regulation in oil sector reforms.

The highly capital intensive refining activity has also undergone divestitures in countries belonging to central Asia and South Asia such as India. Trade openness and allowing free imports of petroleum products has also been one of the most important reforms in the oil

sector of developing countries. Table 4 below reports the status of oil sector reforms in some selected countries around the world.

Table 4: Status of oil sector reform in selected countries

<i>Country</i>	<i>Corporate organisation/ establishment</i>	<i>Ownership</i>	<i>Regulation</i>	<i>Competition</i>	<i>Joint ventures</i>	<i>Trade Openness</i>
Sudan	Sudapet / (1997)	100% shares government controlled	no independent regulatory body	limited competition	limited participation	No
South Africa	PetroSA / formed in 2002 as a merger of three entities	100% shares government controlled	no independent regulatory body	upstream, midstream and down stream open to foreign competitors	upstream venture arrangements successful	Yes
Ghana	GNPC/ (1983)	100% shares government controlled	GNPC regulates upstream while NPA regulates downstream	healthy downstream competition	only a handful of non-NOC participants in upstream sector	Yes
Nigeria	NNPC (1977)	100% shares government controlled	Petroleum Product Pricing Regulatory Agency manages downstream oil	permits issued to build several private refineries	upstream venture arrangements successful	Yes
India	ONGC/ (1994)	government owned but partially	DGH, independent regulator	vigorous competition in upstream and downstream,	several foreign and domestic	Yes

		privatized		private refineries for export	alliances	
Saudi Arabia	Saudi Aramco/ (1933)	100% shares government controlled	no independent regulatory body	non-Aramco participants in refining, petrochemicals and product marketing	numerous joint ventures in upstream	Yes
Brazil	Petrobras/ (1953)	government owned but partially privatized	ANP regulates the upstream sector	numerous non-Petrobras participants in upstream	numerous joint ventures in upstream	Yes
China	CNOOC/ (1982)	100% government owned	entrusted to various government entities	downstream competition not applicable for CNOOC	numerous foreign and domestic alliances	Yes

Source: Adapted from the World Bank (2008)

In the upstream gas sector, liberalisation has involved part privatisation of state owned companies even though state ownership remains dominant in many developing countries. Trade liberalisation and the possibility to imports have fuelled upstream competition. The transmission and distribution pipelines remain privatised to some extent among most countries in Latin America. In the downstream gas supply, reforms have meant some privatisation or the introduction of new private entrants and the structural reform of national industries to create competitive wholesale and retail markets with regulated non-discriminatory third party access to monopoly transmission and distribution networks (Pollitt, 2012). Table 5 below provides the status of gas sector reforms among selected countries of the Asia-Pacific region.

Table 5: Status of gas sector reform in selected countries

<i>Countries</i>	<i>Upstream ownership</i>	<i>Upstream competition</i>	<i>Transmission ownership</i>	<i>Third-Party access</i>	<i>Downstream ownership</i>	<i>Downstream competition</i>
Chile	partially privatised	heavy import dependence	transmission partially privatised, distribution fully privatised	unclear	2 subsidiaries of GASCO and 2 other private companies	in the interface of competition versus regional monopolies
China	state-owned	state domination, LNG	state owns about 80% of pipeline	probably not	owned and managed by local	price controlled by the

		imports began in 2006	network		governments	government
Indonesia	state-owned	participation of 6 international companies	55% government owned	yes	state-owned company has 93% share of distribution	98.7 % of customers of the incumbent are industrial
Malaysia	wholly state-owned	no	government owned	no	Gas Malaysia is the sole provider of gas to non-power sector	No
Peru	domestic and private companies	yes	regulated third party access for one transmission line	yes	Suez group is the only licensee distributor supplying Lima	No
Philippines	Small but rapidly growing sector	no	not applicable	no	not applicable	not applicable
Russia	Gazprom owned 38% by state	not much	Gazprom controls the pipeline network	no	Gazprom	No

Source: Adapted from Dee (2011)

4.6. Status of Reform in the Coal Sector

Market-oriented reforms in the coal sector have involved the running down of subsidised coal production in many high cost countries such as Poland, with some privatisation of coal assets (Zientra, 2009; Pollitt, 2012). However, the reforms in the coal sector reflect the reforms in the electricity sectors, as coal is largely an input for producing electricity. For example, the coal market in China opened up at the end of 2002, and controls on coal prices were released (Ma, 2011). Nonetheless, the coal sectors in the developing countries remain state-owned although the introduction of market-oriented reforms has led to significant increase in world coal trade.

For example, the Coal Mines Act of 1973 brought the coal mining industry under public sector ownership and management. Economic liberalisation meant the amendment of the Coal Mines Act in 1993 and 1996 that allowed captive mining by the private sector for power generation and other purposes (Lahiri-Dutt, 2007). However, the private sector plays a very

limited role in the Indian coal industry. The central and state governments regulate the coal sector in India as per the national institution. Likewise, in China, the coal industry remains the most important and also the most market-driven energy sector. China liberalized the coal prices for the Major State Coalmines in 1993 (except for coal used for electricity generation and agricultural use) in the transition towards a socialist market economy (Wu, 2005). Since then, the coal prices in china have risen above the average costs of production which has helped the state coal companies to recover their debt while maintaining coal production under the control of tight price regulation (Peng, 2009).

The reform status in the Chinese coal sector indicates a market-based system where the Major State Coalmines were transferred from central to local governments based on decentralization. Table 6 shows the current status and trend of coal institutions' evolution in the largest single consumer of coal in the world. The first period of economic reforms (1949-1978) involved adopting the original Soviet-style institutions of the coal sector into the Chinese economy. The second period of reforms (1979-1992) involved introducing a market system into the economy while the third reform period (1993-current) focused on establishing and deepening a market-based system in the Chinese coal sector.

Table 6: Trend and status of coal sector reform in China

	<i>1949-1978</i>	<i>1979-1992</i>	<i>1993-current</i>
Administration	central agency	central and local governments	local governments after 1998 except Shenhua, China Coal and Yimin
Finance	state budget	state budget switching to state loan	state creditor switching to shareholder
Pricing	state regulated and below cost recovery level	two –track system (different price for coal used for electricity production)	relaxed

Source: Adapted from Peng (2009)

4.7 Status of Reform in the Heat Sector

The policy sequencing in heat sector reforms have involved the following: i) establishing an independent regulator, ii) setting up social support programmes in eliminating direct heat production subsidies, iii) insisting on good payment discipline through legislation and enforcement, iv) meter requirements at the interface with all buildings and large consumers,

v) developing policies to promote demand-side energy efficiency, vi) establishing conditions for full cost recovery, vii) removing barriers to unregulated wholesale competition and viii) involving private sector through privatisation or public-private partnerships (IEA, 2004). However, reforms have often been initiated without any legislations or regulation. For example, Denmark had a well-defined national district heating policy while Finland did not have national heating legislation or regulations.

The heat sector plays a significant role among the transition economies. These countries adopted different pathways in reforming the heat sector. For example, Russia has the largest and oldest district heating system in the world characterized by centralized heat production and distribution through heat networks in contrast to heating with decentralized boilers (Boute, 2012). Hence, the Russian heating sector requires creating an adequate regulatory framework that contributes to the transfer of capital and energy efficient technology while the traditional cost-plus approach to tariff setting is not ensuring the financial viability of energy efficiency investments in the Russian heat sector. China, on the other hand, embarked on heat sector reforms since 2003 with the government setting out a clear reform agenda on district heating. However, the heat sector remains a concern due to dispersed enforcement and inconsistent application of sector reform guidance (including two part heat tariffs), overlapping responsibilities and coordination difficulties, lack of sufficient institutional capacity and resources to carry out regulatory functions, lack of transparency in decision making, reporting and information seeking and challenges to monitoring and ensuring compliance (ESMAP, 2012).

Table 7 provides some status of heat reforms in the some selected countries. Several transition countries such as Lithuania, Estonia, Czech Republic, Hungary and Poland had already introduced some forms of incentive regulation in the heat sector before 2004 (IEA, 2004). The current regulatory approach remains weak coupled with legal basis based on stat orders and rules while competition in the district-heating sector are rare across many transition economies (Lukosevicius and Werring, 2011).

Table 7: Status of heat sector reform in selected countries

<i>Countries</i>	<i>Tariffs Regulated</i>	<i>Cost recovery</i>	<i>Multi-utilities participation</i>	<i>Heat source competition</i>	<i>Regulation of wholesale competition</i>
Kazakhstan	yes	no	no	limited	no

Russia	yes	no	yes	no	no
Lithuania	yes	not always	no	yes	yes
Ukraine	yes	not always	yes	limited	no
Latvia	yes	not always	no	yes	yes
Korea	yes	yes	no	no	n.a.
Poland	yes	not always	no	yes	yes

Source: Adapted from IEA (2004), (Lukosevicius and Werring, 2011)

and authors' own compilation

5. Assessing the Reform Impacts

The guiding economic principle behind undertaking an economic reform is based on whether the reform adopted engenders a net positive impact on socio-economic welfare. This implies that a social-cost benefit analysis (SCBA) prior to reform is a pre-requisite to assess the social effectiveness and welfare implications of reforms. A SCBA considers energy reforms and restructuring as an investment and compares the costs of investment with the benefit which is the change in actual and projected performance relative to a defined counterfactual of what would have happened in the absence of reforms and restructuring (Jones et al., 1990). Hence, a SCBA estimates the overall welfare impact of energy sector reforms and distribution of welfare among government, consumers and private investors. However, governments do not necessarily perform social-cost benefit analysis prior to reform and tend to rely on less formal types of assessment (Jamash, Newbery and Pollitt, 2005).

On the other hand, energy sector reforms are multi-dimensional activities with many interacting factors and a variety of impacts that a SCBA may inadequately (or cannot) capture. Assessing the effectiveness of energy reforms can be complex as it includes different interrelated steps and can occur in different forms or models in a dynamic process (Pollitt, 2009). Hence, there exist other important applicable approaches to analyse energy sector reforms and can be classified into four major categories: econometric studies, efficiency and productivity analysis, macro studies and individual and comparative case studies (Nepal, 2013).

Econometric studies can suitably analyse well-defined issues and hypothesis tests through statistical analysis of reform determinants and performance. These studies are used to examine the drivers of energy reforms and to quantify the effect of various reforms on the energy sector performance indicators. Performance metric regressions based on cross-section, panel data econometrics and time-series econometrics are applied for this purpose. Statistical tests to assess the significant differences in the performance metrics before and after reforms are often carried out by conducting a t-test. However, a t-test for significant performance differences cannot control for the effects of other variables as in a multivariable regression analysis.

Efficiency and productivity analyses are desirable for assessing the effectiveness with which inputs are transformed into outputs, relative to best practice. These studies rely on parametric and non-parametric method in measuring productivity and efficiency. Parametric methods of efficiency analysis use specified functional forms of production or cost functions and apply econometric techniques. Typical parametric methods include regression analysis and stochastic frontier analysis (SFA). In contrary, non-parametric methods use mathematical programming techniques and do not require specification of production or cost functions. Data Envelopment Analysis (DEA) is a commonly used non-parametric method that evaluates the performance of an agent relative to the frontier. Frontier methodologies do not assume that all economic agents are technically efficient and hence measure efficiency as the distance to the frontier by constructing a cost or production function. Therefore, each individual agent is benchmarked against the best practice, also known as benchmarking (Jamasb and Pollitt, 2000). Efficiency and productivity studies also reduce the need for rigorous data and especially when the data is hard to collect.

Macro studies of reforms estimate their impacts using general equilibrium models of the economy. These studies involve the use of general equilibrium models in assessing the quantitative impacts of energy reforms on the economy. The computable general equilibrium (CGE) models use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors pertaining to energy reforms. The advantage of the reform studies based on CGE modelling is that these studies attempt to model the interaction effects of sector reform with non-reforming sectors and calculate the aggregate welfare effect directly.

Single or multi-country *case studies* are desirable when in-depth investigation or qualitative analysis is needed. These studies are useful when qualitative aspects of energy sector reforms

such as regulation and conflict resolution and reform dynamics such as the implementation process are crucial factors in assessing the efficacy of electricity sector reforms and processes (Jamash et al., 2005). This is because these factors are inherently difficult to capture through statistical methods. Case studies can examine the issues that do not easily lend themselves to rigorous quantitative analysis or could not be analysed due to lack of comprehensive data (Jamash, Newbery and Pollitt, 2005). Hence, analysis based on case studies can also overcome the issues associated with model specification and accuracy of variables in representing the relevant aspect of reform. Case studies involving single or multiple countries have been a popular technique to study the process and outcomes of energy sector reforms in many developing and developed countries.

For example, Jamash et al. (2005) provided a detailed literature survey of empirical evidence on determinants and performance of electricity sector reform in developing countries by studying different studies based on econometric evidence, efficiency and productivity analysis, macro evidence and case studies. In this report, we provide a detailed literature review of empirical evidence on the performance of energy sector reform in developing countries even though the dominant focus of the existing literature is on power sector reforms. Market-oriented energy sector reforms, when implemented properly, should engender positive impacts on efficiency and other performance measures of the energy industry with desirable macroeconomic consequences. Reforms are expected to lead to cost-reflective energy pricing and the curtailment of energy subsidies while reducing the price-cost margin. Reforms should also enhance the technical, operational (including improved access to energy) and economic efficiency of the sector. The importance of energy as a production input and necessary final consumption good imply that energy reforms should be conducive towards economic growth and poverty reduction. Hence, the impacts of energy sectors reforms can be studied as industry specific impacts (encompassing energy prices/subsidies and technical/economic/operational efficiency) and macroeconomic impacts (economic growth, poverty reduction, welfare enhancement).

6. Microeconomic and Quality Related Impacts of Reforms

This section reviews the relevant literature analysing the impacts of energy sector reforms on several dimensions pertaining to the microeconomics of energy industry including energy prices and subsidies, economic efficiency and quality dimensions such as operational

efficiency. The market-driven nature of reforms and the reliance on the competitive forces of the market and price signals was expected to lower electricity costs and retail prices while improving the overall efficiency of the sector (Joskow, 1998). High electricity prices and inflation coupled increasing debt burden often due to rising government subsidies to maintain artificially low electricity prices in many countries may have proven to be important drivers of electricity reforms.

6.1. Impacts of reforms on energy prices and subsidies

Market-oriented reforms should drive cost efficiency and lead to the realization of cost-reflective energy prices. Reforms were expected to establish the primacy of pricing mechanism in the energy industry by fostering competition and leading to improved efficiency and lower energy prices (Yang and Sharma, 2012). The short-run effects of reforms were to encourage market participants with the lowest costs to operate in the market while discouraging (or forcing out) those that cannot profitably participate at the prevailing market prices (Fan, 2007). The long run effects would encourage entry by new actors in energy markets by providing better incentives so that new entrants with more efficient technologies would create additional downward pressure on energy prices (Newbery, 2000). Hence, sector reforms are expected to lead to lower energy price-cost margins coupled with cost-reflective prices as reforms move energy prices towards their long-run marginal costs (LRMC).

However, there is no clear consensus regarding the evidence of reforms on energy price impacts in developing countries. The evidence tends to vary across different developing regions while the impacts of different reform steps on energy prices also seem to differ. As such, the evidence does not support the hypothesis in all cases. Three studies by Nagayama (2007, 2009) and Erdogdu (2011) are of notable importance in assessing the reform impacts on prices at the global level. For example, the impacts of various reform steps such as the introduction of foreign IPPs, privatization and unbundling of the electricity sector produced no significant impacts on electricity prices of developing Asian and LACs (Nagayama, 2007). Regulatory institutions in developing countries are often found to be not independent implying that political interference prevents energy prices from being-cost reflective. The overall results in Nagayama (2007) show that the introduction of foreign IPPs, privatization and introducing retail competition lowered electricity prices in some regions and not all

developing countries. Country level corruption on contracts granted to the IPPs also prevented the reforms from producing their intended effects in developing countries such as in Southeast Asia (Henisz and Zelner, 2002).

Higher electricity prices also provided impetus to adopt liberal electricity reforms in developing countries of both Asia and those of the former Soviet Union and Eastern Europe and had an impact on the transition of the market structure from a monopoly model to a wholesale/retail competition model (Nagayama, 2009). The analysis showed that cross-subsidies declined with the progress in the adoption of the liberalization models in Asian developing countries. In Latin America, the impact of liberalization on electricity prices is mixed as liberalization models progressed. The wholesale and retail prices have often risen due to unbundling and privatization in order to assure profit to private investors consisting mostly of the multi-nation corporations. The results suggest the need in developing countries to be careful regarding the choice of appropriate liberalization model.

The effects of energy sector reform on energy price cost-margin and cross subsidy levels can be different between industrial and residential consumers across both developing and developed countries. Participation of IPPs in the wholesale market and existence of wholesale markets seems to decrease industrial price-cost margin in the developing countries of America while the existence of wholesale markets raised the industrial price-cost margin for all other developing countries (Erdogdu, 2011). Likewise, the establishment of wholesale electricity markets had a downward effect on the residential price-cost margins in developing countries apart from the developing countries in America. Unbundling, with privatization, also led to a decreasing effect on residential price-cost margins in developing countries in America. However, the creation of electricity sector regulators raised the cross-subsidy levels in other developing countries except in Latin America. The evidences point that each of the main reform steps can produce diverse impacts on the price-cost margins and cross-subsidy levels across different countries.

The price impact of reforms has been less frequently studied on a regional basis when the focus of most research to date has been at the utility level. India provides an interesting case to assess the regional outcomes of energy sector reforms considering the different states sharing a common economic and political system. Sen and Jamasb (2012) analyse the impacts of individual reform measures on key economic and power sector variables for different Indian states and showed that the average price of electricity was unaffected by reforms while passing of tariff order in different states as a mechanism to correct price

distortions significantly lowered the industrial price of electricity. Tariff order also rationalized electricity pricing by lowering the cross-subsidies between industrial and residential customers while unbundling significantly lowered the cross-subsidy between industrial and agricultural customers. In the state of Orissa, the average electricity tariff increased from 1991 to 2001 but remained constant from 2001 to 2009 (Kundu and Mishra, 2011). However, the price of electricity sharply increased particularly for agricultural customers after reforms due to the abolishment of government subsidies coupled with the initial costs of sector restructuring. These studies confirm that reform outcomes in developing countries can be adverse during the initial stages of reforms.

In Latin America, the change in regulatory regime from cost-based to price-caps did not produce clear pattern of electricity price development although the changes in ownership and regulatory regime in the electricity distribution sector led to a decline in the final price in general (Estache and Rossi, 2005). The price fall, however, did not match the corresponding productivity gains. However, a recent study by Balza, Jimenez and Mercado (2013) documented that an increase in cumulative private investment by 1 percent led to a 0.015 percent reduction in electricity prices across Latin America. The quality of regulation in reforming countries also significantly reduced the electricity prices. In Peru, the restructuring and privatization of the electricity distribution market led to price increases for consumers (Anaya, 2010). In Argentina, the wholesale electricity prices as well as the real average tariffs fell from the 1992 levels as a result of increased competition due to industry restructuring and privatization even though the price froze in the wake of an economic crisis in 2002 due to the devaluation of the national currency (Haselip and Potter, 2010). Average node prices for electricity also declined in Chile from the 1982 levels with the implementation of reforms while prices reduced by 30% in Argentina (Pollitt, 2004). Nonetheless, assessing the causal effect of the price fall for low-income groups is complicated in Chile as targeted subsidies and electrification policies can also produce the effect rather than strictly privatization (Paredes, 2001). In Colombia, prices reduced by 20% (Ayala and Millan, 2003). However, the evidence is contrasting for Turkey where power distribution privatization did not yield the expected retail price declines within the initial years of reforms program as wholesale tariffs exhibited a reduction in the rate of 10% while retail tariffs showed an increase of 5.9% (Karahan and Toptas, 2013).

Similarly, in Africa, electricity prices have been generally high before and after reforms. However, the high prices do not cover the full costs due to distorted pricing mechanisms even

after reforms. The average power tariff in Sub-Saharan Africa is about the twice the tariff in other parts of the developing world even though countries like Angola, Malawi, South Africa, Zambia and Zimbabwe have maintained highly subsidized low prices below the cost levels (Eberhard et al. 2011). Reforms also had no impact on the electricity prices of South Asian countries like Nepal, Bangladesh and Pakistan where electricity prices are not cost-reflective and politically determined (Bhattacharya, 2007). Electricity prices continue to be below the cost recovery levels giving rise to high commercial losses among the transition countries such as Georgia, Moldova, Ukraine and the Commonwealth of Independent States (CIS) since reforms started in the early 1990s (Kennedy, 2003). The difficulty of the socially vulnerable consumers to absorb further price increases (low affordability) has often prevented pursuing tariff reforms in many transition countries (Fankhauser and Tepic, 2007). In Turkey, the introduction of a tariff system reflecting costs differently affected the production and consumer prices of electricity. The effect on consumer prices was slightly lesser than for producer prices (Akkemik, 2011).

The empirical literature assessing the impacts of energy reforms on the prices of coal, heat, oil and gas in developing countries is scarce. However, the impacts of reforms on gas prices has been analysed with regards to developed economies. For example, ownership unbundling had no impact on natural gas end-user prices in OECD economies while legal unbundling reduced the prices significantly (Growitsch and Stronzik, 2014). Privatization led to higher prices contrary to decreasing end-user prices as shown in an earlier study. In terms of coal prices, China experienced a rapid increase with the adoption of market-oriented reforms as coal prices became more cost-reflective of the actual resource and production costs after reforms (He et al., 2011). Heat prices in transition economies continued to be regulated after the reforms but regulated prices may not always be at cost recovery levels and hence not cost-reflective (IEA, 2004).

Table 8: Reforms and Energy Prices

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Nagayama (2007)	econometric	global	panel data: 83 countries (26 developed); 1985-2002	ordinary least squares, fixed effects, random effects	neither unbundling nor introduction of a wholesale pool market on their own necessarily reduces the

					electricity prices; unbundling may work to reduce prices when coexistent with an independent regulator
Nagayama (2009)	econometric	global	panel data: 78 developing, developed and transition countries; 1985-2003	ordered response, fixed effects, random effects	higher electricity price drive liberalisation; liberalisation models does not necessarily reduce electricity price
Erdogdu (2011)	econometric	global	panel data: 63 developed and developing countries, 1982-2009	fixed effects, random effects	no uniform pattern for the impact of reforms process as a whole on price-cost margins and cross-subsidy levels; different impact of different reform steps
Sen and Jamasb (2012)	econometric	India	panel data: 19 Indian states, 1991-2007	bias corrected fixed effects	political economy factors giving rise to adverse outcomes in the initial stages of reforms
Kundu and Mishra (2011)	econometric	Indian state of Orissa	survey based approach	partial least squares	some consumers group benefited (such as industrial) while some lost (such as agricultural)
Estache and Rossi (2004)	econometric	Latin America	distribution companies of 14 countries,	correlation	fall in prices in general did not match the productivity gains
Balza, Jimenez and Mercado (2013)	econometric	Latin America	panel data: 18 countries, 1971-2010	generalised least squares	no robust results in terms of privatisation and end-user-prices; strong and robust association between regulatory quality and electricity prices
Anaya (2010)	cost-benefit analysis	Peru	electricity distribution companies (privatised and non privatised)	single country	privatisation contributed to price increase

Haselip and Potter (2010)	case study	Argentina	power sector indicators	single country	reforms led to price decline until macroeconomic crisis
Pollitt (2004)	case study	Chile	power sector indicators	single country	average node prices declined after reforms
Karahan and Toptas (2013)	case study	Turkey	power sector indicators	single country	no reduction in retail electricity prices after reforms
Eberhard et al. (2011)	Case study	Africa	power sector indicators	multi-country	eliminating pricing inefficiencies can close the funding gap in the power sector
Bhattacharya (2007)	Case study	South Asia	power sector indicators	multi-country	reform undertaken produced no significant results, electricity prices still highly subsidised
He et al. (2011)	Macro study	China	coal and electricity prices	CGE modelling	coal price increase caused a rise in the costs of electric power industry while the influence gradually descended with increases in coal price
IEA (2004)	Case study	Transition economies	district heating indicators	multi-country	heat prices are still regulated in these countries even after reforms
Kennedy (2003)	Case study	Transition economies	power sector indicators	multi-country	implementation of reform should be enhanced to improve reform performance
Fankhauser and Tepic (2007)	Case study	Transition economies	affordability indicators for utilities	multi country	level of tariffs needed for cost recovery bear important affordability consequences
Akkemik (2011)	Case study	Turkey	macro and micro variables with focus on energy producing sectors	single country; social accounting matrix	cost reflective electricity tariff affect consumers prices slightly less than producer prices

6.2. Impacts of reforms on quality of service and access

One of the principal aims in most reforming countries was to enhance the quality of energy supply (Joskow, 1998; Briceno-Garmendia et al., 2004). Reforms were expected to enhance energy production, lead to efficient utilisation of existing capacities and add new capacities by attracting investments and reduce energy losses. The participation of the private sector in energy production/generation implied that reforms were expected to enhance the access to energy. Hence, in developing countries, reforms were often advocated with the belief that they would accelerate access to the poor (Sinha, 2003). The evidence is encouraging with regards to reforms enhancing several quality related performance indicators but not conclusive in terms of accelerating energy access to the poor.

Studies on the impact of reform in developing countries have found that competition, high quality regulatory governance and regulatory law appear to bring about positive results for service penetration, generation capacity expansion and utilization of generation capacity (Cubbin and Stern, 2004; Zhang et al., 2008). The interaction of different reform components seem important as privatization and the introduction of competition combined with the existence of independent regulatory agencies contributed to an increase in electricity generation capacity (Cubbin and Stern, 2006). The sequencing of reform measures proved to be crucial as developing countries that established an independent regulatory authority and introduced competition before privatisation gained in terms of higher electricity generation and higher generation capacity (Zhang et al., 2005). Liberalization process has contributed to increases in electricity self-sufficiency such as reserve margins (Erdogdu, 2014).

However, the effects of reforms on quality and access have differed across different development regions as showed by Nagayama (2010). The introduction of foreign IPPs when coexistent with independent regulators and unbundling on its own increased per capita generation capacity in Asian developing countries while the establishment of an independent regulator produced an opposite effect. The per capita generation capacity increased among the LACs with the introduction of wholesale power market and power exchange. The reform impacts have triggered different impacts on electricity transmission and distribution (T&D) losses (Nagayama, 2010). The introduction of foreign IPPs decreased T&D losses in Asian developing countries while it had the opposite effect in Latin America along with the establishment of an independent sector regulator. The introduction of wholesale power

market increased T&D losses in Asian developing countries as the amount of power traded increased..

In the transition countries, reforms in the electricity sector on its own did not produce any significant effect on per capita installed electricity capacity, T&D losses and per capita electricity production (Nepal and Jamasb, 2012a). On the other hand, private sector investments contributed to a decline in electricity losses in Latin America (Balza, Jimenez and Mercado, 2013). Technical and non-technical losses fell sharply from above 20% in 1992 to just above 10% in 2007 in Argentina (Pollitt, 2008). The number of minutes of supply interruption per year fell to 2.1 in 2003 from 9.6 in 1997 in Chile while distribution losses fell from 19.8% in 1987 to 5.6% in 2003 (Pollitt, 2004). Generation capacity also increased in many LACs except Brazil post reforms (Millan, 2005).

Reforms triggered different impacts on the plant load factor, T&D losses and gross electricity generation among the Indian states (Sen and Jamasb, 2012). Unbundling and tariff orders had a positive and significant effect on plant load factors. Introduction of independent regulation, unbundling and privatisation of distribution segment contributed to increases in T&D losses. Gross electricity generation in India increased with the introduction of the IPPs while privatisation of the distribution segment led to declines in electricity generation. In Nepal and other South Asian countries, electricity losses are still persistent around 25% even after more than two decades of power sector reforms (Nepal and Jamasb, 2012b). The average level of T&D losses in Sub-Saharan Africa was around 27.5% in 2009 although the system losses substantially ranges from 14.5% in Angola to 68% in Swaziland (ESMAP, 2009). Reforms have also been unable to reduce electricity theft in most regions of the developing world considering that the quality of governance such as effective accountability, political stability, and government effectiveness and corruption control can reduce energy theft in developing countries (Smith, 2004).

The international experience with electricity restructuring, privatisation and liberalisation has exposed the vulnerabilities in electricity supply in various countries (Hall, 1999). For example, the end of 1997 saw repeated power cuts in Rio de Janeiro, Brazil followed by Buenos Aires, Argentina where a 10 day blackout occurred in 1999 while India experienced the largest blackout in 2012. These supply vulnerabilities coincide with the decline in private investments in the electricity industries of developing countries with the progress in reforms (Erdogdu, 2014). In addition, the progress toward energy sector reform coincides with reduced government support for different research and development (R&D) activities that

potentially threaten the sustainable efficiency improvements in the energy industry (Erdogdu, 2013b).

Energy reforms in developing countries were often mooted with a view to increase the access to energy across all segments of the population. The evidence of success, nonetheless, is scarce. There is also limited systematic information about the impact of energy sector reform on all sources of energy utilised or potentially utilised by the poor (Prasad, 2008). The introduction of market-based reforms has affected the institutional and financing arrangements for rural energy access placing considerable constraints towards the rate of rural electrification and affordability of energy (Haanyika, 2006). For example, the Indian state of Orissa, which underwent a deep reform program, experienced a decline in the electrification rate after reforms (Sihag, 2007). The unaffordability of electricity by the poor also imply that any reform initiatives aimed at intensifying rural electrification has little impact in improving the energy access of the poor (Bhattacharya, 2006). Moreover, market liberalisation accelerated the availability of gas and kerosene in Senegal although the Sub-Saharan Africa consists of the world's ten least electrified countries in the world (Prasad, 2008). Electricity access in Sub-Saharan Africa ranges from 100% in Mauritius to 3% in Burundi while the region has the lowest access levels of 31% compared to other developing regions (Prasad, 2011).

Evidence from Latin America suggests that private sector investments, improvements in regulatory quality and overall institutional reforms significantly improved the electricity coverage in the region (Balza, Jimenez and Mercado, 2013). Electricity coverage has been a notable success in South America after reforms where the post-reform electrification levels have considerably increased from the pre-reform levels (Kozulj and Di Sbroiavacca, 2004). For example, the post-reform electrification rates in Argentina, Peru and El Salvador respectively increased to 95, 72 and 76% from the respective pre-reform rates of 91, 38 and 62%. The number of households without electricity supply in Chile decreased to 14% in 2002 from 62% in 1982 after reforms (Pollitt, 2004).

Table 9: Reforms and Energy Quality/Access

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Cubbin and	econometric	global	panel data: 28 developing	OLS, fixed	regulatory law and governance positively

Stern (2004)			countries; 1980-2001	effects	related to higher per capita electricity generation and capacity
Cubbin and Stern (2006)	econometric	global	panel data: 28 developing countries; 1980-2001	fixed effects, error correction models	regulatory law and governance positively related to higher per capita electricity capacity controlling for privatization and competition
Zhang, Parker and Kirkpatrick (2005)	econometric	global	panel data: 25 developing countries, 1985-2001	fixed effects	independent regulation and competition before privatisation important for higher electricity generation and capacity
Zhang, Parker and Kirkpatrick (2008)	econometric	global	panel data: 51 developing countries, 1985-2000	fixed effects	on their own privatisation and regulation do not lead to obvious gains in economic performance
Erdogdu (2014)	econometric	global	panel data: 55 developed and developing countries, 1975-2010	fixed effects, random effects	reform progress led to higher levels of electricity supply self-sufficiency
Nagayama (2010)	econometric	global	panel data: 86 developed and developing countries, 1985-2006	fixed effects	IPPs, unbundling, regulatory agency and creating wholesale markets reduced transmission and distribution losses
Nepal and Jamasb (2012a)	case study	Nepal	power sector indicators	single country	electricity losses in South-Asia including Nepal still remain high, capacity and power shortages prevail
Nepal and Jamasb (2012b)	econometric	Transition economies	panel data: 27 countries, 1990-2010	bias corrected fixed effects	power sector reform on its own did not produce any

					significant impacts on T&D losses
ESMAP (2009)	case study	Sub-Saharan Africa	power sector indicators	multi country	high number of outages per year and long delays with electrical connections
Pollitt (2008)	case study	Argentina	power sector indicators	single country	reforms successful in improving quality prior to the collapse of Argentine peso
Millan (2005)	case study	Latin America	power sector indicators	multi country	generation capacity expanded vigorously except in Brazil after reforms
Smith (2004)	case study/econometric	global	102 countries: electricity losses, governance indicators for 1980 and 2000	correlation/ multi country	losses have increased in many developing countries after reforms
Hall (1999)	case study	global	power sector indicators	multi-country	reforms have coincided with rising power cuts and blackouts
Erdogdu (2013b)	econometric	global	panel data: 27 countries, 1974-2008	fixed effects; random effects	reform progress led to decline in R&D investments
Prasad (2008)	case study	Africa	energy sector indicators	multi-country	energy reforms only impacts access when adjusted to local conditions of the poor
Kozulj and Sbroiavacca (2004)	case study	Latin America	power sector indicators	multi-country	electrification levels increased after reforms

6.3. Impacts of reforms on productivity and efficiency

The changes in energy market structures together with changes in the role of the state and regulation of the sector were aimed at improving utility efficiency and productivity levels through the introduction of competition (Wolfram, 1999). The evidence of reforms in improving efficiency and productivity in the energy sector is positive especially in Latin

America, which also remains the most studied region. However, efficiency and productivity impacts of reforms remain least studied in South Asia and Africa. There are only few studies analysing utility efficiency and reforms at the global levels.

The existing global evidence suggests that privatisation does not lower costs in the short run for the industry once allowance is made for ownership while government interference with investments decisions lead to increased costs (Pollitt, 1995). Changes in ownership did not automatically resolve efficiency problems in the absence of competition among the least developed countries where significant efficiency gaps persisted between small scale and large scale electricity providers (Yunos and Hawdon, 1997).

In South America, there was no evidence of catching up effects in technical efficiency between 1994-1997 with partial evidence that suggests that countries, which reformed their electricity sector, had a better performance than those, which did not reform (Rodriguez-Pardina and Rossi, 2000). Although technical efficiency among the major electricity distribution companies in South America marginally improved between 1994-2001, the results suggested considerable scope for improving efficiency among the firms (Estache, Rossi and Ruzzier, 2004). The increments in productivity seem to be in line with the degree of incentives built in regulation while private companies under rate of return regulation exhibited similar labour productivity as public firms (Estache and Rossi, 2005).

The efficiency of the Argentine gas distribution sector improved after privatisation with significant catching up effect and a shift in the frontier (Rossi, 2001). The labour productivity in the electricity distribution experienced an increase after reforms in Argentina (Pollitt, 2008). Labour productivity in electricity distribution also increased in Chile since the privatisation of leading companies (Fischer, Gutierrez and Serra, 2003). The incorporation of distribution value added (VAD) in the tariff fixation processes of the electrical power distribution contributed to driving the efficiency of the distribution sector in Chile (Sanhueza, Rudnick and Lagunas, 2004). In Brazil, privatisation had no statistically significant impact with operating expenditures as input but technically efficiency dropped when considering total expenditures (Motta, 2004). This makes case for including capital costs in any benchmarking exercise. Overall, the reform processes as well as the incentives generated in the reform process in Brazil do not seem to have led the firms to behave in a more efficient manner between 1998 and 2005 (Ramos-Real et al., 2009).

Bonifaz and Santin (2000) found out that privatised firms did not outperform state enterprises arguing that privatisation did not lead to an improvement in terms of efficiency among Peruvian electricity distribution companies. The post reform experience suggested insufficient evidence for technical change or significant savings associated with technological improvements in the sector (Bonifaz and Rodriguez, 2001). Improvements in efficiency and productivity of electricity distribution in Peru have occurred with the adoption of regulatory reforms in the Peruvian electricity sector although privatisation proved to be advantageous only in the initial years after the reform (Perez-Reyes and Tovar, 2010). There seem to be a positive relationship between the restructuring and reforms of the electricity distribution sector and enhancement of productivity in Peru (Perez-Reyes and Tovar, 2009). Management practices seem to be important in the Peruvian electricity distribution due to which private utilities are less inefficient than public utilities (Bonifaz and Jaramillo, 2010).

In Colombia, reforms of the 1990s seem to have improved the average efficiency levels of electricity distribution with regulatory policy engendering a positive effect while ownership producing no conclusive effect (Pombo and Ramirez, 2002a). Technological improvements and regulatory policy had had positive effect on average efficiency but the divide between good performers and bad performers increased after reforms (Pombo and Ramirez, 2002b). Mello and Espinoza (2004) found no significant changes in the productivity levels among the 20 distribution companies between 1993-2003 although environmental variables mattered significantly. In contrary, Pombo and Taborda (2006) showed that plant efficiency and productivity increased after the regulatory reform of 1994 although the efficiency of distribution companies did not improve after the reforms. Nonetheless, the Colombian electricity distribution exhibits high inefficiency persistence and heterogeneity among firms (Galan and Pollitt, 2014). Rural companies and firms with small customers seem to have experienced the largest efficiency gains over the fifteen years after the reforms.

In Africa, the results obtained from the efficiency analysis of the Ivory Coast electricity companies could not reject the hypothesis of a significant performance improvement in post-privatisation period while the technical efficiency measures have behaved irregularly since privatisation (Plane, 1999). Meanwhile, Estache et al. (2008) attempted at documenting efficiency levels in Africa's electricity firms based on a sample of 12 operators providing services in the 12 country members of the Southern Africa Power Pool. The study relied on the DEA decomposition technique to estimate the changes in total factor productivity (TFP).

The results showed comparable levels of efficiency and performance levels in the region while finding no clear correlation of efficiency improvements with the adoption of reforms.

A number of studies have also focussed on efficiency and productivity analysis of electricity reforms in the transition countries. The efficiency analysis based on the Ukrainian privately and publicly-owned firms in the context of a new regulatory authority and distribution utility privatisations suggested that privately-owned firms responded to policies and incentives associated with reducing commercial and non-commercial network losses than publicly owned firms (Berg et al., 2005). In Poland, technical efficiency among the electricity distribution companies increased during the transition process while allocative efficiency deteriorated (Cullman and von Hirschhausen, 2008a). The cross-country level analysis suggested that the Polish distribution companies were marginally inefficient while the Czech Republic featured the highest efficiency (Cullman and von Hirschhausen, 2008b). Slovakia and Hungary occupied the middle range. This implies that privatization had a positive effect on technical efficiency in all four countries. The average efficiency of thermal generation plants also grew in China as autonomy from the central government was one of the important determinants of efficiency (Lam and Shiu, 2004). China also experienced an improvement in the operating efficiency of the coal mining companies from 2001 to 2010 even though technical efficiency remained relatively low and unstable (Zhao et al., 2011). However, the efficiency analysis of Turkish gas distribution found public firms managing costs more efficiently than private firms (Erturk and Turut-Asik, 2011). In electricity distribution, private distributors had better technical scale efficiency on average in Turkey during the early years of reforms (Bagdadioglu et al., 1996; Celen, 2013).

A limited number of studies have been carried out to assess the efficiency and productivity of electricity reforms in developing Asian countries. The performance and efficiency analysis of Indian electricity generation companies supported the government policy of unbundling the Indian power sector while state owned companies appeared inefficient (Jain, Thakur and Shandilya, 2010). However, electricity privatisation brought about different impacts among employees productivity in the state of Orissa as some employees felt benefits while others did not (Kundu and Mishra, 2012). In contrast, technical performance in the Thai electricity industry was found to be mainly driven by technological improvements as industry reform had insignificant impact on productivity (Wattana and Sharma, 2011). In the Philippines, productivity in the sector did not improve significantly despite reforms being instituted in 2001 (Bautista et al., 2011). Similarly, the empirical analysis by Nakano and Managi (2008)

showed that regulatory reforms have contributed to productivity growth in the steam power-generation sector in Japan for the period 1978-2003. Deregulation of the Japanese electric power industry also contributed to productivity growth (Goto and Sueyoshi, 2009). In China, unbundling of the integrated electricity utility-the State Power Corporation (SPC) boosted the productivity and operational efficiency among the large coal-fired power plants controlling for substantial heterogeneity in the technical profile of the plants (Zhao and Ma, 2013).

Table 10: Reforms and Efficiency and Productivity

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Pollitt (1995)	non-parametric	global	768 thermal plants from 14 countries including South Africa and Thailand	DEA with 2 nd stage regressions /Tobit	privatisation did not lower costs in the short run, government interference with investment increase costs
Yunos and Hawdon (1997)	non-parametric	least developing countries	cross-section generation data for 27 countries, panel of electricity generating utilities from Malaysia, Thailand and the UK for 1975-1990	DEA	changes in ownership do not resolve efficiency problems in the absence of competition, efficiency gaps between small scale and large scale providers
Rodriguez-Pardina and Rossi (2000)	parametric	South America	30 electricity distribution companies from 10 countries 1994-1998	stochastic production function	partial evidence of reformers performing better than non-reformers

Estache, Rossi and Ruzzier (2004)	parametric/ non-parametric	Latin America	84 electricity distribution companies 1994-2001	stochastic cost function, DEA, labor requirement function	technical efficiency marginally improved but scope for efficiency improvement exists
Estache and Rossi (2005)	parametric	Latin America	127 distribution companies 1994-2001	stochastic production function/labor requirement function	incentives in embedded in regulation crucial for productivity increases
Rossi (2001)	parametric	Argentina	panel of 8 gas distribution companies 1970-1995	stochastic production frontier	major efficiency improvements during the period
Sanhueza, Rudnick and Lagunas (2004)	non-parametric	Chile	35 distribution companies for the year 2000	DEA	incorporating distribution VAD led to improvements in efficiency
Motta (2004)	parametric/non-parametric	Brazil	distribution companies 1994 and 2000	DEA/Stochastic production frontier	Privatisation has no effect on operating cost efficiency, makes case for including capital costs in benchmarking
Ramos-Real et al. (2009)	non-parametric	Brazil	panel of 18 distribution companies from 1998-2005	DEA	incentives generated in the reforms process incapable of making firms behave in more efficient manner
Bonifaz and Santin (2000)	non-parametric	Peru	panel of 19 distribution operators 1995-1998	DEA with 2 nd stage regressions	privatisation did not lead to an improvement in terms of efficiency
Bonifaz and Jaramillo (2010)	parametric	Peru	panel of 19 distribution companies for the period 2000-2008	stochastic cost frontier	private utilities are less inefficient than public utilities due to better management practices
Perez-Reyes and Tovar (2009)	non-parametric	Peru	14 distribution companies for the period 1996-	DEA	reforms led to improvements in efficiency and

			2006		productivity
Perez-Reyes and Tovar (2010)	parametric	Peru	14 distribution companies between 1996 and 2006	distance function	incentives lead by the reform process made firms more efficient
Pombo and Ramirez (2002a)	non-parametric	Colombia	panel of 33 distribution companies from 1988-2000	DEA with 2 nd stage regression	reforms improved average efficiency levels
Pombo and Ramirez (2002b)	non-parametric	Colombia	panel of 33 generation and 12 distribution companies 1988-2000	DEA with 2 nd stage regression	technology improvements and regulatory policy had positive effect on average efficiency levels
Mello and Espinoza (2004)	parametric	Colombia	panel of 20 distribution companies 1999-2003	Free Disposal Hall	environmental variables mattered significantly
Galan and Pollitt (2014)	parametric	Colombia	panel of 21 electricity distribution firms for the period 1998-2012	dynamic SFA model	increases in efficiency among rural firms only manifested during the last five years driven by improvements in service quality and energy losses occurred
Plane (1999)	parametric	Ivory Coast	time-series from 1959-1995	stochastic production function	significant but irregular gains from the privatization of management
Estache, Tovar and Trujillo (2008)	non-parametric	Southern African countries	12 operators of 12 different countries, 1998-2005	DEA	no clear correlation between adoption of reforms and improvements in efficiency
Berg, Lin and Tsaplin (2005)	parametric/non-parametric	Ukraine	24 distribution companies, 1998-2002	stochastic production frontier/DEA	private operators responded well to incentives than public operators, perverse regulation worsens incentives
Cullman and von	parametric/non	Poland	32 distribution companies	DEA/SFA	technical efficiency

Hirschhausen (2008a)	-parametric		between 1997 to 2002		improved with reforms but allocative efficiency deteriorated
Cullman and von Hirschhausen (2008b)	non-parametric	Poland, Czech Republic, Slovakia, Hungary	47 Eastern European regional companies, 37 German companies	DEA/Free Disposal Hall	Czech Republic and Slovakia feature the highest efficiency, privatisation had a positive effect in all countries
Lam and Shiu (2004)	non-parametric	China	panel of 30 municipal autonomous regions and provincial thermal generation plants 1995-1996	DEA with 2 nd stage regressions	average efficiency increased at 2%
Zhao, Li and Zhang (2011)	non-parametric	China	11 coal companies, 2001-2010	DEA	efficiencies improved though technical efficiency is low and unstable
Bagdadioglu, Price and Weyman Jones (1996)	non-parametric	Turkey	cross section of 70 distribution operators in 1991	DEA	Private operators are more efficient than public operators
Celen (2013)	non-parametric	Turkey	21 companies for the period 2002-2009	DEA with 2 nd stage regression/ Tobit	private ownership positively affect efficiencies
Erturk and Turut-Asik (2011)	non-parametric	Turkey	38 gas distribution companies, 2008	DEA	public firms are more cost efficient than private firms
Jain, Thakur and Shandilya (2010)	parametric/non-parametric	India	30 state –owned utilities for the year 2007-2008	DEA/SFA	unbundling drives efficiency in electricity generation
Wattana and Sharma (2011)	non-parametric	Thailand	Thai electric industry, time series data from 1980-2006	DEA	industry reforms not significant in driving efficiency
Bautista, Agnes and Valderrama	non-parametric	Philippines	120 electric cooperatives, 2001 to 2006	DEA	reforms did not drive productivity in the sector

(2011)					
Nakano and Managi (2008)	parametric/ non-parametric	Japan	10 companies, 1965-2003	DEA/ generalised method of moments	regulatory reforms have contributed to productivity growth in the steam power-generation
Goto and Sueyoshi (2009)	parametric	Japan	annual observations in 9 companies from 1983-2003	multi-product translog cost function, random effects maximum likelihood estimator	improvements in productivity growth after deregulation
Pombo and Taborda (2006)	non-parametric	Colombia	12 electricity distribution companies from 1985 to 2001	DEA	profitability, partial input productivity, and output improved; plant efficiency and productivity increased after the reform
Zhao and Ma (2013)	non-parametric	China	balanced panel: 34 large power plants for the period 1997-2010	DEA	Operation efficiency improved on average, unbundling boosted productivity

7. Macroeconomic Impacts of Reforms

In this section, we review the relevant literature analysing the impacts of energy sector reforms on several macroeconomic dimensions such as economic welfare, economic growth and poverty reduction. The crucial role of the energy sector in the economic growth plan and policies across all developing countries imply that reforms implemented in the energy sector should generate positive impacts in promoting economic welfare, economic growth and alleviating poverty. However, economic welfare and economic growth does not wholly capture the distributional impacts of reforms that bear several equity repercussions. Hence,

we separate the poverty alleviation impacts of reforms from economic welfare to the extent possible.

7.1. Impacts of reforms on economic welfare

The welfare studies of reforms measure the economy-wide welfare impact of undertaking reforms and also the associated individual effect among different actors such as the customers, producers and the government. Social cost-benefit analysis (SCBA) is typically used for this purpose. A comprehensive SCBA can also capture the distribution of welfare among different actors in assessing the winners and losers of reforms and to what extent (Jones, Tandon and Vogelsang, 1990). Only a few studies have assessed the efficacy of energy reforms and restructuring using SCBA in developing countries with most studies undertaken in the Latin American context.

Galal et al. (1994) estimated that the privatisation of the Chilean distribution and generation companies in one of the first and most comprehensive studies of welfare implications of reforms. The privatisation of the Chilean electricity companies (an electricity distribution and a power generation) led to a permanent gain in social welfare equivalent to 2.1% of 1986 sales value. However, the gains were achieved at a fiscal loss and two-thirds of the aggregate gains went to foreign shareholders. In Brazil, the privatisation of the electricity distribution market during the period 1995-2000 when approximately 60% of privatisation occurred created a one-off gain equal to 2.5% of national GDP while producers gain around two-thirds of the benefits (Mota, 2003). Consumers could have benefited more from privatisation since the start the presence of tougher regulation. The economic welfare impacts of partial privatisation and restructuring of the Peruvian electricity market also proved worthwhile as the gains amounted to 542 million US dollars in 2007 prices (Anaya, 2010). The distributional gains suggested that government and producers benefited the most from welfare gains while consumers benefited the least.

Similarly, Toba (2007) studied the welfare impacts of introduction of private sector participation into the Philippine electricity generation sector, through liberalization of the market for IPPs during the power crisis of 1990-1993. The introduction of IPPs presented significant gains contributing to resolving the crisis and promoting economic and social development while consumers and investors were net gainers. However, only about one quarter of the total private investors' gain is transferred to the domestic investors, as most of

the investors are assumed to be foreigners. The largest portion of the net benefit equivalent to a net present value of 10.4 billion US dollars (in 1999 prices) was distributed to consumers while both domestic and foreign investors also gained. The government was the loser. In Israel, Tisher et al. (2006) undertook a cost-benefit analysis summarizing the government's reform plan using an unregulated regime as the counterfactual. The results suggested that following the government's reform plan will only yield a small net benefit even when carried out flawlessly relative to the regulated regime. The reforms will also lead to large increases in electricity producer profit and government tax receipts at the expense of the electricity consumers. As such, a less-than-perfect transition to competition could easily preclude the potential gain of the government plan.

Table 11: Reforms and Economic Welfare

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Galal et al. (1994)	multi-country case studies	global	public enterprises divestitures in UK, Chile, Malaysia and Mexico; analyses the privatisation of the power sector in Chile	social cost-benefit analysis	privatisation when combined with proper regulatory framework can be welfare enhancing, private ownership improves efficiency of generation, promote profit maximisation and increases the value of regulation
Mota (2003)	single country case study	Brazil	privatisation of electricity distribution and supply businesses between 1995-2000	social cost-benefit analysis	economic welfare (net benefits) was significant but most of it went to the producers; consumers could have benefited more from privatisation in the presence of tougher regulation
Anaya (2010)	single country case study	Peru	privatisation of electricity	social cost-benefit	privatisation was worthwhile in terms

			distribution companies: Electrolima and Electro Sur Medio	analysis	of social welfare, government and producers benefited the most while consumers the least due to price increases
Toba (2007)	single country case study	Philippines	liberalisation of the electricity generation sector between 1990-1993	social cost-benefit analysis	consumers and investors were net gainers while the government lost, reform with private sector participation increased economic welfare
Tishler et al. (2006)	single country case study	Israel	in accordance to the 2003 Israeli government announcement to undertake a comprehensive reform of the electricity sector based on the standard reform model	cost-benefit analysis	the reform plan will only yield a small net benefit even when carried out flawlessly, will increase the profit for producers and tax receipts for the government at the expense of customers, performance-based regulation of the sector thereby is desirable

7.2. Impacts of reforms on economic growth

The energy sector operates within the wider economic system and hence is vital to the functioning of the economy. For example, it has been empirically shown in the Indian context that the stock of electricity infrastructure makes a positive and significant contribution to its industrial economic output (Sen and Jamasb, 2012). Therefore, any structural and institutional changes brought about by reforming the energy sector is capable of producing lasting impact on the economy. Furthermore, the impact of the quality of institutions on per capita GDP as an indicator of economic growth is well emphasized in the economic growth literature (Easterly and Levine, 2002; Rodrik, Subramaniam and Trebbi, 2004, Acemoglu and Robinson, 2010).

Empirical evidence also suggests a strong positive link between regulatory quality in all economic sectors and economic performance such as economic growth in developing countries (Jalilian, Kirkpatrick and Parker, 2007). Energy reforms can stimulate economic growth by improving access to energy and energy consumption (Ozturk, 2010). However, only a few studies have directly examined whether energy sector reforms serve as the determinants of economic growth where per capita GDP and overall employment are used as an indicators of economic growth.

Chisari, Estache and Romero (1999) estimated the macroeconomic effects of the privatisation and regulation of utilities including the energy sector that began since 1989 in Argentina. The privatisation of electricity generation and distribution and gas all had positive effect on GDP. The privatisation of the gas sector had the greatest effect on GDP amounting to 0.31% rise in GDP in the presence of good regulation. Privatisation of energy utilities also did not contribute to the dramatic rise in unemployment in Argentina between 1993 and 1995. The fiscal consequences of privatisation and regulation of infrastructure utilities including energy in Argentina suggested that the country gained more in macroeconomic terms from the net present value of subsidy cuts (Benitez et al., 2001). Nepal and Jamasb (2012a) showed that electricity reforms on its own did not produce any significant impacts on per capita GDP of the transition countries. However, the returns to per capita GDP from power sector reforms was maximised when the interaction between electricity reforms and other macro level reforms were considered. In China, the effects of an electricity price increase are capable of producing an adverse influence on GDP (He et al. 2010). For example, a 20% hike in electricity price is capable of shrinking the national GDP by 43%. Hence, adjustment in electricity prices in accordance to the coal price owing to effective electricity market liberalisation can produce a contractionary effect on economic growth in China.

Lin and Jiang (2011) estimated the macroeconomic impact of removing energy subsidies in China. The results suggested negative impacts on macroeconomic variables such as economic growth although removing energy subsidies can result in a significant fall in energy demand and emissions. Removal of energy subsidies removal would also hamper the competitiveness of the Chinese economy alongside reducing the economic output (Lin and Li, 2012). Similar results were experienced in Egypt where removing price-distorting subsidies for oil products produced contractionary outcomes across all macroeconomic closures including economic growth (Lofgren, 1995). In contrary, a study by Saunders and Schneider (2000) using the Global Trade and Environment Model (GTEM) estimated that those developing and

transition countries undertaking subsidies removal would face a 0.5% increase in GDP in 2010. Reallocating the resources freed up by energy subsidies removal to more productive public spending can help boost economic growth over the long run (IMF, 2013b).

Table 12: Reforms and Economic Growth

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Chisari, Estache and Romero (1999)	macro study	Argentina	performance data before and after privatisation of the argentine utilities	CGE model	privatisation resulted in different kinds of efficiency gains with significant macroeconomic benefits, privatisation not the cause for rising unemployment
Lin and Jiang (2011)	macro study	China	energy subsidies, energy use, energy demand/supply fundamental, emissions	CGE model	removing energy subsidies resulting in negative macroeconomic impacts such as GDP
Lin and Li (2012)	macro study	China	energy subsidies, macroeconomic variables	CGE model	subsidies removal will lead to fall in output and reduced competitiveness
Lofgren (1995)	macro study	Egypt	subsidies, macroeconomic variables	CGE model	removing oil subsidies lead to economic contractions
Saunders and Schneider (2000)	macro study	global	energy consumption, energy prices and subsidies, economic outputs	GTEM	subsidies removal contributes to long-run GDP growth
IMF (2013)	case study	global	energy and economy level data	multi-country	subsidies removal boost economic growth in the long run
Benitez, Chisari and Estache (2001)	macro study	Argentina	privatisation, fiscal reforms and regulation data	CGE	country gained more from subsidy cuts and reforms and privatisation of energy

					utilities not be blamed for increased unemployment
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7.3. Impacts of reforms on poverty alleviation

The literature analysing the direct empirical evidence between on energy-poverty linkages is relatively scarce (Estache et al., 2002). Nonetheless, existing literature on infrastructure reforms and poverty linkages shows that policy changes to improve the level and quality of infrastructure in developing countries can engender poverty reduction by improving health and educational outcomes (Estache and Fay, 1995; Brenneman and Kerf, 2002). Hence, energy sector reforms aimed at improving the stock and access to energy infrastructures matters most to the poorest being one of the determinants of economic growth. However, the impacts of energy reforms and changes in poverty rates and income distribution have not been systematically analysed while existing empirical studies are also limited. On the other hand, studies such by Victor (2005) found no inherent connection between energy markets reforms and the promotion of welfare for the poorest households although energy and development are correlated.

The extent to which energy sector reform affects poor people at a basic level depends on their ability to access energy. For example, energy poor also tend to be income poor as evidenced from India establishing a clear link between income poverty and energy poverty (Khandker, Barnes, Samad, 2012a). Rural electrification also helped reduce poverty in India even though the larger share of benefits accrued to wealthier rural households (Khandker et al., 2012). In addition, grid electrification in Bangladesh generated significant positive impacts on household income, expenditure and education where the household gain in total income due to electrification was around 21 percent, with a 1.5 percentage point reduction in poverty per year (Khandker et al., 2012b). Similarly, access to communal grid electricity generated externality benefits for the poor than the rich in Vietnam while access to household electricity benefited the rich than poor questioning the rural electrification's long term benefits for the overall rural economy (Khandker, Barnes and Samad, 2013).

The efficiency gains from privatisation of energy utilities in Argentina accrued mostly to high-income classes, while gains from the effective regulation of newly privatized utilities accrued mainly to low-income classes (Chisari, Estache and Romero, 1999). All income

groups benefited from reforms while the distribution of income also improved (Navajas, 2000). In general, incidences of final electricity price fall were experienced post reforms in Latin America although the price fall did not translate into increased affordability and access to electricity to the masses. For example, the operators and the state shared most of the gains in the form of rents and higher tax revenue (Estache and Rossi, 2004). In Peru, electricity consumers, which constitute the majority of the population, benefited the least from reforms as welfare gains were offset by increases in prices (Anaya, 2010). Nonetheless, the welfare consequences of getting connected to electricity networks are high.

In the African context, Boccanfuso, Estache and Savard (2009a) explored the distributional effects of pricing reform in the electricity sector of Senegal. The analysis found that increases in power prices bear little direct impact on most poor households as only few poor households are connected to network while only few of the households only benefit from network extensions. Compensating measures such as cash transfer in the face of electricity price increase slightly decreases income inequality between poor and rich households. Similar effects were observed regarding the distributional and poverty-related effects of price reform in the electricity sector of Mali, a poor country in West Africa (Boccanfuso, Estache and Savard, 2009b). The increase in electricity prices did not affect poverty directly as very few poor households are connected to the electricity grid while households also decrease their electricity consumption when price rises. Unlike in Senegal, compensating measures such as cash transfer after price rise did not help the low-income households losing from pricing reform. Based on the broad trends of energy reforms across the African countries, Clark et al. (2005) show that the impacts of reforms on the poor are neither direct nor inevitable.

Betily, Movchan and Pugachov (2013) analysed the poverty and welfare impacts of increased natural gas prices in Ukraine. Their analysis suggested that increases in gas prices result in welfare losses across all household categories, with a more profound impact on urban households, as they are the largest consumer. As such, social welfare programs should be targeted at the poorest households to alleviate the adverse poverty impacts of an increase in gas prices. In Malaysia, the amount of government subsidy is directly linked to the fuel oil prices. Hence, pricing reforms in the form of subsidy removal can potentially lead to significant falls in income of rural households leading to rising poverty levels among the rural households when compared to urban households (Solaymani et al., 2013). Likewise, evidences from the impacts of energy infrastructure investments in India and Thailand

suggested strong links between investments in energy infrastructure and rural poverty reduction while the effects were not strongly felt in China (ADB, 2005).

Table 13: Reforms and Poverty Reduction

<i>Study</i>	<i>Approach</i>	<i>Region</i>	<i>Data</i>	<i>Method</i>	<i>Policy impacts and relevance</i>
Victor (2005)	case study	global	energy sector indicators	multi-country	energy access and development correlated; link between reforms and poverty reduction complex and non-inherent
Khandker, Barnes and Samad (2012a)	econometric	India	cross-sectional survey data for households in 2005	probit estimates	energy poverty and income poverty are directly linked to each other
Khandker, Barnes and Samad (2012b)	econometric	Bangladesh	cross-sectional survey data for households in 2005	propensity score matching	electrification led to household gains in income and poverty reduction
Khandker et al. (2012)	econometric	India	cross-sectional survey data for households in 2005	maximum likelihood probit model	rural electrification also helped reduce poverty; larger share of benefits accrued to wealthier rural households
Boccanfuso, Estache and Savard (2009a)	macro study	Senegal	macro –micro variables between 1995 to 2001	CGE model	direct price effects are weaker than general equilibrium effects on poverty and inequality
Boccanfuso, Estache and Savard (2009b)	macro study	Mali	macro –micro variables	CGE model	direct price increases have a minimal effect on poverty and inequality, whereas the general equilibrium effects of such increases are quite strong and negative
Clark et al. (2005)	case study	Africa	energy sector indicators, macro	multi-country	impacts of reforms on the poor are neither

			variables		direct nor inevitable
Betily, Movchan and Pugachov (2013)	macro study	Ukraine	household survey data for 2009	CGE model	increases in gas prices result in welfare losses across all household categories, with a more profound impact on urban households
Solaymani, Kari and Zakaria(2013)	macro study	Malaysia	time series macro and micro data	CGE model	subsidy removal can potentially lead to significant falls in income of rural households leading to rising poverty levels among the rural households
ADB (2005)	case study	Asia	macro-micro data	multi-country	strong links between investments in energy infrastructure and rural poverty reduction in Thailand and India
Estache, Foster and Wodon (2002)	case study	Latin America	macro-micro variables	multi-country	evidence of reforms on poverty reduction is scarce; hence the analysis remain incomplete

8. Discussions and Policy Implications

A review of the limited literature and evidence on the impacts of energy sectors reforms suggests a growing trend in this research area among developing and transition countries. However, most of the reform literature focuses on the electricity sector. The existing reform studies have used both quantitative and qualitative techniques to assess the impact of reforms with no strict preference over one another. Latin America remains the most studied region in the reform literature for two major reasons: a) being one of the pioneers of the market-driven energy reforms and b) the ability of the Latin American Association of Energy Regulators to generate comparable data.

The reform studies have analysed one or many dimensions of reforms involving changes in energy market structures, regulation of the sector and changing role of the state on several

industry specific micro and economy specific macro variables. The evidence on the performance of reforms remains mixed in developing countries for varied reasons. For example, the mixed results indicate that reforms have not progressed, stalled or recently initiated to produce the intended economic effects in many developing countries. Additionally, even if reforms have advanced, they remain so only in theory such that existing reform practices are incapable of producing real impacts. The reform measures among selective samples may also be inadequate to recognize significant effects while undertaking quantitative (mostly econometric) studies.

Moreover, the mixed results and evidence also reflects the difficulty of undertaking any empirical studies on the performance and determinants of energy reforms. The reliability of econometric results analysing the effects of reforms often hinges on the availability of a data sample that captures a mix of reform experiences. Energy reforms and performance data tend to suffer from endogeneity and simultaneity bias. Establishing the effects of reforms typically involve correcting for country or utility specific factors other than reforms but robust evidences are neither guaranteed nor certain. This is because of reforms being multi-dimensional involves a number of simultaneous inter-related steps affected by a vector of political, economic and institutional factors that are difficult to quantify. These factors make it difficult to isolate the effects of particular reform steps or interaction of different reform steps on specific reform outcomes.

The issue of cost-reflective pricing remains at the heart of the success or failure of the reforms. Reforms led to cost-reflective electricity pricing in some countries in Latin America by decreasing the price-cost margin. In the absence of market power abuse and exercise, reforms also led a decline in average wholesale energy prices but not necessarily the retail prices. Privatisation, however, raised the energy prices allowing the governments and producers to gain from the price rise while affecting the consumers. The existence of an independent regulator and institutional quality seem to facilitate the transition to cost-reflective energy pricing and mitigate any adverse impacts of price increases. ***Hence, energy price adjustments should be undertaken before privatisation rather than after privatisation to minimise the tension between economic efficiency and equity if privatisation of the energy companies is considered as an option for reform in developing countries.*** The existence of cross-subsidies and subsidies for rural electrification in developing countries implies that it is also hard to separate the price only impacts of reforms.

In many developing countries, reforms have led to improvements in operational efficiency of the sector by minimising energy losses, increasing energy production and energy capacities. For example, the liberalised electricity market model in South America has been relatively successful in attracting investments in generation than the dominant single-buyer model in South Asia. However, energy theft still remains common in developing and transition countries despite reforms. This implies that ***establishing social legitimacy and public acceptance of reforms are crucial in tackling the traditional problems of non-commercial energy losses (energy theft) and non-payment of energy in developing countries.*** One possible way to increase the social legitimacy and public acceptance of reforms is by implementing reform programs that adequately reflect the local economic, political and social conditions rather than solely relying on international reform ideologies.

The issue of service quality is mostly associated with the access to energy in developing countries with reforms generating varying impacts. For example, the adoption of market-based reforms in Latin America coincided with an expansion in rural electricity access programmes as opposed to countries in South Asia and Sub-Saharan Africa where the lack of electricity access in rural areas remains a national problem. In contrary, South Africa achieved higher electrification without implementing the textbook reform model. The evidence suggests that ***reforms, if undertaken, alone cannot solve the problems of inadequate access to energy in developing countries in the absence of other complementary socio-economic arrangements.*** The existence of side arrangements implies that it is hard to measure the direct impacts of reforms on rural energy access. Nonetheless, reforms have helped exposing the issue of inadequate rural energy access as major impediments to socio-economic progress in developing countries.

Reforms (mainly privatisation and regulation) seem to have largely improved the cost efficiency of energy utilities in many developing countries. Energy sectors in these countries witnessed major efficiency gains. In that sense, reforms seem to have fulfilled one of its major objectives. However, the gains have not trickled down to the end-users of energy. Evidence suggests that consumers benefited from efficiency gains from privatisation in the presence of a good regulatory body while regulators with perverse incentives exacerbated the matter. The inability of the sector regulators to transfer the efficiency gains achieved through reforms to end users through market-based instruments (such as incentive regulation) has led to reforms being unpopular and negative. From a consumer-welfare perspective, the lessons

of experience suggest ***the need to create an independent and competent regulatory body before privatisation of energy utilities.***

Reforms, if carried out properly, enhance economic welfare as documented from the lessons of experience. However, reforms alone are incapable of creating an equitable distribution of welfare among different income groups. The welfare gains from privatisation mostly went to both domestic and foreign-owned producers in many instances. Experiences document that the welfare gains from privatisation would have benefited consumers more in the presence of a tougher regulation. The ***importance of a proper regulatory framework in maintaining a balance between welfare maximisation and equity considerations is paramount*** in developing countries.

The impact of energy sector reforms on economic growth is positive. This is not surprising when macroeconomic condition have often catapulted energy reform in many developing countries. Privatisation, if pursued with economic motives, seems to be conducive in macroeconomic terms. However, removal of energy subsidies seems to generate contractionary effects on the economy in the short-run although the long-term effects are positive. Hence, ***energy subsidies reform in developing countries should be appropriately phased, well targeted and transparent while the corresponding prices increases should be sequential and not abrupt*** to maintain economic growth both in the short-term and long run.

The link between energy sector reforms and poverty reduction remain in-direct, complex and hard to quantify. Evidence suggests a correlation between energy access and development in developing countries implying that reforms affect poverty in developing countries through access to energy. For example, the access to electricity in rural Bangladesh increased the welfare of the poor and helped reduce poverty as well. This implies that at a minimum, ***reforms should be aimed at catering the energy to the poor to produce any significant impacts on poverty reduction*** in developing countries. This indeed is a major challenge considering the costs involved in expanding energy access. For example, it is estimated that the investment cost of providing electricity to Sub-Saharan Africa over a 10-year period is between 160 and 215 billion U.S. dollars (Rosnes and Vennemo, 2012). At the same time, it also provides an opportunity to reform the lives of the poor and establish the legacy of market driven reforms in developing countries.

9. Conclusions

This chapter reviewed the empirical and theoretical literature on the linkages between energy sector reforms; economic and technical efficiency and poverty reduction in developing countries. The chapter achieved so by understanding the context and motivation of energy reforms, reviewing the progress and assessing the factors that shaped the outcomes of reforms, measuring reform performance, exploring the theory and practice of energy reforms and formulating policy lessons based on the performance of reforms in developing countries. The extent of reforms have varied across developing countries in terms of changes in market structures, the role of the state and the regulation of the sector.

Existing literature suggests that assessing the impacts of energy reforms have heavily focussed on measuring the operational and economic efficiency and productivity impacts of reforms. However, the literature studying the macro linkages of reforms seems scarce. The impact of reforms on the poor is also limited and hard to quantify. Hence, examining the impact of energy sector reforms on factors directly affecting the poor people was a challenge of the study. The incompleteness of reforms and the interplay among several indirect factors (such as economic, political and institutional) compounds the challenge of properly measuring the reform impacts of individual reform steps.

Overall, the literature is evident that reforms have improved the efficiency and productivity in the sector although the efficiency gains may not always reach the end consumers. The existence an independent regulatory body with tougher regulation is necessary in developing countries to transfer the efficiency gains to the customers and ensure that not only producers and the government benefits from privatisation. Reforms seem to generate poverty alleviation impacts only when the poor have access to energy. This implies that reforms should be localised with a view to meet the energy needs of the poor, which can potentially enhance the welfare of the poor. However, there is a consensus in the literature that the regulatory framework at disposal and the nature of regulation is crucial in balancing the tension between economic efficiency and equity impacts of reforms.

We also found several caveats in the existing reform literature which future research can potentially aim at. The welfare analysis of reforms using cost-benefit analysis remains limited in the context of developing countries. The impacts of reforms on energy network investments are also unclear and under-studied. The competitiveness of wholesale markets and market power issues also remains to be studied in developing countries in the aftermath of reforms. The existing literature on the empirical evidence of reforms focuses mostly on the

electricity sector. Similar studies should be extended to other energy sectors such as coal, oil and gas by facilitating information and data sharing among the energy regulators.

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