Energy Poverty in the Arab World: The Case of Yemen

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Executive Summary

The twin challenges of securing energy supplies and tackling climate change have dominated the international energy agenda in the last few decades. An often neglected, but equally important, challenge is ensuring access for billions of people to modern forms of energy such as electricity and liquid fuels. Current estimates indicate that more than 1.5 billion people in the developing world have no access to electricity, while 2.5 billion people rely on traditional biomass and 0.4 billion rely on coal for heating and cooking.

While much of the emphasis of the literature on energy poverty is on the prevalence of the phenomenon in sub-Saharan Africa and South Asia, little has been written about energy poverty in the Arab world. Traditionally having being seen as one of the world's most energy rich regions, the Arab world has in recent years often been overlooked as a region which suffers severely from energy poverty itself. In 2002, about 65 million people in the Arab world had no access to electricity, and an additional 60 million were severely undersupplied in both urban and rural areas. While the region can reflect on some important achievements in terms of electrification rates, these rates vary considerably – between 100 per cent in some countries such as Kuwait, to 7.7 per cent in Comoros, Djibouti, Mauritania, and Somalia. In terms of cooking and heating, almost one-fifth of the Arab population rely on non-commercial fuels like wood, dung, and agricultural residues, particularly in Comoros, Djibouti, Sudan, Yemen, and Somalia but also in Algeria, Egypt, Morocco, and Syria.

This study fills a gap in the existing literature by looking at the case of prevailing energy poverty in Yemen, one of the poorest countries in the Arab world. Yemen's energy poverty is widespread and severe, particularly among the country's rural population and the poor which, according to the most recent data, comprise nearly half of the population. Energy poverty expresses itself in the lack of access to sufficient energy for cooking, lighting, heating, and cooling at the household level, as well as by many public service providers such as hospitals, health centres, schools, and mosques. It also consists of lack of access to better quality fuels – such as LPG for household use and electricity for lighting – which provide safer, cleaner, and more efficient energy than many traditional fuels. Particularly appalling in Yemen is the low rate of electrification, with nearly half the population lacking access to electricity. Businesses and industries also suffer from this situation, which makes energy poverty effectively a

problem for Yemen's entire economy – a paradox given that Yemen is an energy exporter of both natural gas and crude oil.

The main causes of energy poverty presented in this report are complex, but it appears evident that widespread total poverty levels in Yemen comprise perhaps the most critical cause of energy poverty. The complete range of factors that determine fuel access and fuel choice includes the following: household income, by determining the amount of money a household can spend on purchased energy; availability of necessary infrastructure and other incentive structures to make use of more costly forms of energy; fuel price and the cost of the necessary equipment to use the fuel; and individual household preference. The combination of these factors explains why Yemen's pattern of energy use does not involve am automatic move along the energy ladder – the full replacement of inferior, traditional fuels by more modern, more efficient fuels alongside income growth. Rather, most fuels tend to be used to some extent in all income groups, but the amount used as a share of total consumption differs.

Yet, energy poverty must not only be seen as a symptom of income poverty. Energy access, both to sufficient quantities and to higher quality fuels and electricity, must also be seen as a necessary condition for human development, and hence poverty alleviation. Hence, a two-way relationship can be observed between human development and energy access, where sufficient access to modern forms of energy to a large extent condition progress in poverty alleviation – such as universal access to sufficient levels of nutrition, basic health care, and education, and to means of communication with the outside world. Alleviating energy poverty must hence be seen as a critical step towards achieving the UN Millennium Development Goals to which Yemen subscribed.

This report looks also at the issue of pricing energy in Yemen, and the impact of the government's substantial subsidies on liquid fuels and electricity. The report finds that, in light of the size of energy subsidies in Yemen, the continued widespread observation of energy poverty suggests that energy subsidies have not helped improve energy availability in Yemen over the years, especially in terms of improving access to electricity. In fact, one could argue that subsidies may have limited investment in infrastructure and diverted funds away from key sectors, such as health and education, which are essential for poverty eradication. Care must be taken, however, with demands for a quick and total elimination of these subsidies. Fuel subsidies in particular have become the most important social safety net

for the poor, and hence any removal of subsidies must be accompanied by corresponding expansions of other forms of social welfare, in order to prevent increasing the incidence of poverty, and to avoid severing the poorest people's access to energy.

Introduction

The twin challenges of securing energy supplies and tackling climate change have dominated the international energy agenda in the last few decades, especially in OECD countries. An often neglected but equally important challenge is the ensuring of access for billions of people to modern forms of energy such as electricity and liquid fuels. Current estimates indicate that more than 1.5 billion people in the developing world have no access to electricity, while 2.5 billion people rely on traditional biomass and 0.4 billion rely on coal for heating and cooking.[1] Almost one third of all energy consumed in developing countries derives from traditional biofuels.[2] Many studies predict that in the absence of aggressive international and domestic policies to tackle the problem, energy poverty will remain widespread for many years to come.[3]

The gravity of the energy poverty problem in many developing countries, which has recently been described by the IEA as 'shameful and unacceptable',[4] has elevated the issue of energy access in international policy circles. The Riyadh Declaration of the Heads of State and Government of Member Countries of the Organization of the Petroleum Exporting Countries (OPEC) in November 2007 recognized that 'energy is essential for poverty eradication, sustainable development and the achievement of the Millennium Development Goals'.[5] The leaders of the Group of Eight (G8), meeting in L'Aquila, Italy in 2009, emphasized the importance of access to modern energy services which 'is essential for human and social development, and for the achievement of the Millennium Development Goals (MDGs)' pointing out that 'energy access and availability are tightly interlinked with the improvement of living conditions, both in rural and urban areas, providing for cleaner water, more effective sanitation and health services, better education systems and other essential services. Moreover, energy input for productive uses is crucial for job creation and income generation'.[6] In the 12th International Energy Forum meeting, held in Cancun, Mexico in March 2010, the Energy Ministers concluded that the 'fight against energy poverty has been

[1] IEA/UNDP/UNIDO (2010).
[2] Barnes and Floor (1996).
[3] The IEA, UNDP, and UNIDO project that by 2030 1.2 billion people will still lack access to electricity, with the bulk of these people living in sub Saharan Africa, India, and other developing Asian countries (excludes Asia) while the number of people relying on traditional biomass is projected to increase to 2.8 billion people. IEA/UNDP/UNIDO (2010).
[4] IEA/UNDP/UNIDO (2010), 8.
[5] The Third Summit of Heads of State and Government of OPEC Member Countries (2007).
[6] G8 (2000).

unsuccessful so far ... a situation which inhibits social, human and economic development', recommending that the objective of energy poverty reduction be added to the MDGs.[7]

While much of the emphasis of the literature relating to energy poverty is on the prevalence of the phenomenon in sub-Saharan Africa and South Asia,[8] little has been written about energy poverty in the Arab world. Traditionally being seen as one of the world's most energy rich regions, the Arab world has, in recent years, often been overlooked as a region which itself suffers severely from energy poverty.[9] In 2002, about 65 million people in the Arab world had no access to electricity, and an additional 60 million were severely undersupplied in both urban and rural areas. While the region can reflect on some important achievements in terms of electrification rates, these rates vary considerably – between 100 per cent in some countries such as Kuwait, to 7.7 per cent in Comoros, Djibouti, Mauritania, and Somalia. In terms of cooking and heating, almost one-fifth of the Arab population rely on non-commercial fuels like wood, dung, and agricultural residues particularly in Comoros, Djibouti, Sudan, Yemen, and Somalia but also in Algeria, Egypt, Morocco, and Syria.[10]

This study looks at the case of prevailing energy poverty in Yemen. Yemen is a relevant case to study for a number of reasons. Firstly, Yemen faces acute poverty and energy poverty at multiple levels. It is one of the poorest countries in the Arab world: in 2007, 35 per cent of the population, some seven million Yemenis, were poor according to the measurement of national poverty, with more than 2.5 million people living below the food poverty line.[11] Another 35 per cent of the population may be deemed to be on the border of absolute poverty – 40 per cent live on less than $2 per day.[12] Secondly, the Yemeni case is particularly interesting because of the country's status as a net energy exporter.[13] Nevertheless, it still suffers from widespread energy poverty; large segments of the Yemeni population both in rural and urban areas rely heavily on traditional fuels such as fuelwood and dung, while the electrification rate is relatively low – only 54 per cent of Yemeni households have access to

[7] IEF (2010).
[8] See, for instance, Barnes et al. (2010), Ezzati and Kammen (2001), Bruce (2005), Heltberg (2005).
[9] Two reports available about the region are United Nations Economic and Social Commission for Western Asia (ESCWA)/League of Arab States (2005) and Energy Research Group (2005).
[10] United Nations Economic and Social Commission for Western Asia (ESCWA)/League of Arab States (2005).
[11] Government of Yemen, Central Statistical Agency (2009).
[12] As we will further discuss below, poverty levels seem to have increased dramatically in the most recent years, making the situation more severe for an even greater proportion of Yemenis.
[13] Yemen exports both crude oil and, since 2009, natural gas. In June 2010, Yemeni Central Statistics Office stated that Yemen had become a net importer of crude oil in 2009, something President Saleh also acknowledged shortly afterwards. Economist Intelligence Unit (2010), 12.

electricity. Thirdly, the inflow of international aid, and the engagement of international organizations such as the World Bank and the IMF imply the availability of household level data and detailed reports about the features of energy poverty inside Yemen. This provides us with a valuable basis for our understanding and analysis of energy poverty and its interaction with poverty.

Throughout much of this report, we focus on energy poverty as being mainly associated with households. However, we also acknowledge the pivotal role which energy access has for economic growth, not least because of its role in technological and industrial development – influencing the quality of the labour force through human development – and in improving access to the outside world. As predicted in the literature on energy poverty, we find that energy poverty and overall poverty in Yemen interact and are mutually reinforcing. While low levels of income limit the energy choices for poor households, the lack of access to modern forms of energy in turn intensifies overall poverty, through its negative impact on productivity, efficiency of production processes, health, education, and integration with the rest of the world. Thus an improvement in the population's access to higher quality forms of energy, such as LPG and electricity, as well as improved ways of using traditional forms of energy, can make an important improvement in the area of poverty and enhance economic efficiency and environmental sustainability. This does not imply that access to modern forms of energy by itself is a sufficient condition for poverty alleviation. However, it is difficult to envisage a situation in which poverty could be substantially reduced in Yemen without improving poor households' access to modern fuels and electricity.

The available data also reveals that Yemen's household energy ladder consists of a number of different fuel types, but movement along the ladder is not automatic, and it is not clear that fuel types such as fuelwood – typically deemed inferior by the energy ladder hypothesis – are necessarily inferior fuels in practice. We find that energy access is affected by a range of factors which include, in addition to household income and fuel price, the cost of switching fuels, the cost of new equipment, cultural preferences, and critically, access to infrastructure, where there is a strong regional division of access due to lack of infrastructure, especially in the case of electricity. Household poverty, meanwhile, remains the single most important factor affecting energy access in the first place.

The report also finds that, in light of the size of energy subsidies in Yemen, the continued widespread observation of energy poverty suggests that energy subsidies have not improved energy availability in Yemen over the years, especially in terms of improving access to electricity. In fact, one could argue that subsidies may have had the effect of limiting investment in infrastructure and of diverting funds away from key sectors, such as health and education, which are essential for poverty eradication. Care must be taken, however, with demands for a quick and total elimination of these subsidies. Fuel subsidies in particular have become the most important social safety net for the poor, and hence any removal of subsidies must be accompanied by respective expansions of other forms of social welfare, in order to prevent increasing the incidence of poverty.

This report is divided into two parts. In Part 1, Chapter 1 sets out the theoretical background to this study, the relation between energy and development. Part 2 focuses on energy poverty in Yemen by looking at five related aspects: Chapter 2 examines the single most important cause of energy poverty in Yemen, income poverty levels. Chapter 3 discusses the impact of poverty, along with other causes of energy poverty, on energy access. Chapter 4 examines in more detail the relationships between poverty and energy poverty levels, thereby showing how the two concepts are in reality mutually reinforcing. Chapter 5 focuses on the impact of Yemen's fuel energy subsidies on energy poverty. Chapter 6 contains policy options deduced from this discussion.

PART 1: Theoretical Background

1. Energy and Development

The definition of energy poverty varies across studies and may include more than one dimension such as the 'lack of an efficient supply and distribution infrastructure for modern fuels; no access to reliable and affordable supply of electricity; low consumption of modern energy per capita; and high reliance on traditional biomass for cooking'.[14] The IEA's[15] definition of energy poverty focuses on the access of households to modern forms of energy, specifically access to electricity and access to clean cooking facilities.[16] The IEA emphasizes that the traditional use of biomass[17] does not refer to the fuel itself, but rather to the basic technology used in cooking – such as a three-stone fire or inefficient cooking stoves. A distinction is also often made between 'energy poverty' and 'fuel poverty' where the latter refers to the inability of households with low income to afford the purchase of sufficient energy, despite the availability of modern fuels.

In this paper, we focus on the simple definition of energy poverty: *a household is said to be energy poor if it does not have access to electricity or to 'modern forms of fuel' for cooking and heating.* Modern fuels are often contrasted with 'traditional fuels' which include fuelwood and charcoal, agricultural residues, and animal dung used in inefficient devices. These sources of energy are grouped under a variety of labels, including 'traditional biomass energy', 'traditional biofuels', 'non-commercial energy', 'rural energy'; and 'combustible renewables and waste'. These labels, however, are not accurate and should be treated with caution. For instance, fuelwood and charcoal are increasingly being traded in commercial markets, especially in urban areas. The term 'traditional' is also inaccurate, as charcoal and fuelwood can be used in traditional cooking stoves, or in modern equipment to generate heat or electricity. The phrase 'rural energy' is also inaccurate, as 'traditional fuels' are an important energy source for poor urban households. Keeping in mind the limitations of the various labels, in this paper we use the concept of 'traditional fuels/biomass' to refer mainly to fuelwood and charcoal used for heat and cooking, and candles and kerosene for lighting.

[14] See OPEC Fund for International Development (2010), 19.
[15] The IEA's proposed 'Energy Development Index' covers four factors similar to those of OFID.
[16] IEA/UNDP/UNIDO (2010). The report also notes that other aspects include 'providing access to electricity and mechanical power for income-generating activities, the reliability of the supply to households and to the wider economy and affordability of energy expenditure at the household level.' (page 8).
[17] Intergovernmental Panel on Climate Change (IPCC) defines biomass in terms of the following categories: Solid Biomass (Wood/Wood Waste, Sulphite Lyes, Other Primary Solid Biomass, Charcoal); Liquid Biomass (Biogasoline, Biodiesels, Other Liquid Biofuels); Gas Biomass (Landfill Gas, Sludge Gas Other Biogas); Other non-fossil fuels (Municipal Wastes).

These are contrasted with 'modern fuels' which include kerosene, natural gas, LPG, and electricity for heating and cooking, and electricity for lighting.

1.1. The Links between Energy and Development

While alleviating energy poverty does not constitute one of the Millennium Development Goals (MDGs), it is widely recognized that improved access to energy services is one of the underlying conditions for achieving the MDGs. The Johannesburg Plan of Implementation notes that meeting the MDGs requires that countries:

> Take joint actions and improve efforts to work together at all levels to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the Millennium development goals, including the goal of halving the proportion of people in poverty by 2015, and as a means to generate other important services that mitigate poverty, bearing in mind that access to energy facilitates the eradication of poverty.[18]

It is possible to identify many reasons why development specialists and international organizations have focused on energy issues in their analysis of poverty.[19] First, there is a wide consensus that the lack of access to modern forms of energy and household poverty tend to reinforce each other. On the one hand, the lack of access to clean and efficient sources of energy limits the possible ways in which poor households can improve their incomes and achieve productivity gains. On the other hand, many characteristics of the poor – such as low and irregular income, lack of basic education, and restricted access to public services – imply that the options available to the poor in terms of access to modern energy services are limited. Therefore, there is a wide recognition that while the provision of modern forms of energy by itself does not guarantee the achievement of the goals of economic development and poverty reduction, it is difficult to 'envisage successful development without this occurring'.[20] Second, improving access to modern forms of energy and poverty reduction programmes are complementary. For instance, it has been shown that the provision of both electricity and education together are likely to have a proportionately larger impact on development than the provision of just one of these services.[21] Third, the transition of households to modern forms of energy involves substantial costs and investment outlays. Energy access is not, therefore,

[18] UN Department of Economic and Social Affairs (2004).
[19] See Raman and Toman, (2006); Barnes and Floor (1996).
[20] Raman and Toman, (2006).
[21] Raman and Toman, (2006).

automatic. Energy access is also highly uneven, which poses issues of equity. In many developing countries, large segments of the population, especially households in rural areas, have failed to climb the energy ladder and currently have no access to modern forms of energy. Fourth, the lack of access to modern forms of energy can be caused by a large array of factors. These include institutional factors as well as regulatory and pricing issues, and hence governments, through initiating and revising existing policies and undertaking necessary investments, can play an important role in alleviating energy poverty. Finally, energy poverty has become strongly intertwined with environmental and sustainability issues which need to be integrated into any plans or programmes aimed at alleviating energy poverty.

Various theoretical and empirical studies suggest the existence of a fuel continuum that varies with the level of economic development.[22] Bruce identifies an energy ladder in cooking and lighting, which are the dominant energy-using activities for poor households.[23] For cooking, the energy ladder ranges from traditional biomass or solid fuels (fuelwood, dung cake, crop waste, charcoal, coal) to liquid fuels (kerosene) to gaseous fuels (LPG, gas) to electricity. For lighting, the energy ladder ranges from lanterns, candles, and torches, to kerosene lamps, to electricity. As households climb the energy ladder, the fuel becomes more efficient but also more costly. In terms of lighting, lanterns, candles, and torches have weak illuminating power, or light intensity. Candles and inefficient lanterns can also emit smoke. Kerosene lamps produce better light, but are associated with some health and fire risks.[24] The transition to electricity eliminates many of these risks and increases lighting efficiency. It is important to stress that the focus should not only be on the type of fuel per se, but also on the capital equipment and technology used in burning the fuel. For instance, more efficient woodstoves can improve the energy efficiency of burning wood.[25]

[22] This is often referred to as the energy ladder. It is widely recognized that the transition from one type of energy to another is not automatic. Others are more critical, suggesting that the energy ladder is a conceptual construct with no association to reality, especially in contexts where poor households are constrained in their fuel choices. Nevertheless, the energy ladder remains a useful analytical concept to analyse energy poverty-related issues.

[23] Bruce (2005).

[24] IEA/UNDP/UNIDO (2010).

[25] While the efficiency of woodstoves ranges from 10% to 15%, stoves that use charcoal can achieve 25%. The efficiency of LPG and electric stoves is even higher, ranging between 55% and 75%. Taking into account these large differences in efficiencies, it is not clear that the cost of traditional fuels – adjusted for efficiency – is always cheaper than modern fuels.

Moving up the energy ladder is often linked to improvements in income or stages of economic development. At the lowest levels of economic and social development, energy sources for cooking tend to come from harvested sources. In the intermediate stages, charcoal, animal power, and some commercial fossil energy such as kerosene become more important. It is only in the most advanced stages of development that fossil fuels, such as natural gas, and ultimately electricity become predominant.[26] The pace of transition from traditional biomass to electricity varies. Access to electricity often increases faster than access to modern fuel largely as a result of government policy, which often gives higher priority to electrification.[27] Equally importantly, the relationship between income and reliance on traditional biomass is not linear. Historical evidence from the USA suggests that as income per capita rises, energy intensity tends to decline, but the rate of biomass intensity (biomass per unit of GDP) tends to decline at a much faster rate.[28]

While income is an important enabling factor in climbing the energy ladder, the causality also runs in the opposite direction, i.e. improved access to energy can contribute to improvements in incomes. The literature identifies a large number of channels by which climbing the energy ladder could promote productivity and development. The inability to use modern forms of energy results in low productivity and poor quality output, which in turn leads to lower income.[29] Schurr finds that changes in the *quality* of energy services enhance economic productivity, even after accounting for the physical availability of energy.[30] Specifically, the increased use of more flexible energy forms, such as liquid fuels and electricity, boosts productivity by enhancing 'the discovery, development, and use of new processes, new equipment, new systems of production, and new industrial locations'.[31] Energy access can induce structural socio-economic transformations, as economies move towards large scale industrial projects, and workers make use of efficient capital stock and new technologies to boost output and productivity. Many studies find that electricity use and wealth creation are interrelated[32] though the evidence on causality is mixed.[33] Power outage due to unreliable

[26] Toman and Jemelkova, (2003); Barnes and Toman (2006).
[27] IEA/UNDP/UNIDO (2010).
[28] Victor and Victor (2002).
[29] Gupta and Sudarshan (2009).
[30] Schurr (1982 and 1984).
[31] Schurr (1984), 415.
[32] Ferguson et al. (2000).
[33] For instance, Altinay and Karagol (2005) find unidirectional causality going from electricity consumption to GDP growth in the context of Turkey, while Yoo (2005) finds evidence of bi-directional causality in the

infrastructure causes economic losses, mainly in industrial and commercial sectors, and is a deterrent to employment growth.[34] Energy access also increases market size and access by lowering transportation and communication costs. Electricity plays an essential part in the provision of modern telecommunications infrastructure, such as telephone lines and television access, as well as access to mobile phone and internet facilities. Telecommunications allows access beyond one's most immediate neighbourhood, and enables individuals to communicate with the outside world, to study or to find paid work. A television may not only provide entertainment, and thus better life quality, but may provide essential information about weather forecasts (important for agricultural production), events of national importance, and citizens' rights. In addition, government promotion campaigns – relating to anything from environmental awareness to the availability of subsidized LPG – rely, particularly in remote areas, on word of mouth or television.

While traditional forms of fuel such as fuelwood can be obtained at no financial cost, especially in rural areas, collecting fuelwood is a time consuming activity. This often results in little time being available for households to engage in productive activities, invest in human capital, and improve their quality of life.[35] Since women have the primary responsibility for collecting fuelwood, the energy–poverty nexus has an important gender dimension.[36] Evidence suggests that the use of biomass is higher for households where more women and children, i.e. labour resources, are available.[37] Male household members get involved in the collection process only when there is a need to transport the wood over long distances and in large quantities. Gorgan and Sadanand study the impact of introducing labour-saving technologies such as electrification on women's decisions relating to resource allocation.[38] Using a cooperative Nash bargaining model, the authors show that electrification has the effect of reducing women's fertility and increasing the time women spend in the labour market. This re-allocation of resources in turn may have large impact on poverty reduction.[39] This outcome, however, depends on the availability of work opportunities. If,

context of Korea. On the other hand, Stern (1993) finds no relationship between energy or electricity consumption and economic growth for the USA.

[34] Hallward-Driemeier and Aterido (2007).

[35] Barnes and Floor (1996).

[36] Clancy et al. (2003).

[37] Barnes et al. (1994).

[38] Grogan and Sadanand (2009).

[39] The authors provide empirical evidence from Guatemala in support for their hypothesis. They find that electrification causes women to spend substantially less time cooking and more time working outside the home.

due to lack of work opportunities, the cost of collecting fuelwood is practically zero, then fuelwood will remain popular even when there is access to modern fuels and electricity.

Another way in which access to modern forms of energy can contribute to higher productivity gains is through augmenting labour inputs by building human capital. For instance, the use of modern fuels can improve the productivity of education inputs. The decision to read, and to spend time on reading, is linked in part to the availability of a reliable source of energy for lighting. It has been found that the decision to read and the time spent on reading and studying is higher in homes with electricity. This contributes to better educational achievements and higher human capital accumulation.[40] Kammen suggests that improved stoves and modern cooking fuels reduce the time spent on collecting fuelwood, increasing the amount of time that children spend in school, which leads to improvements in human capital.[41]

Many studies have also shown that modern fuels are cleaner and safer. Table 1 below shows that the health damaging pollutants per unit of energy delivered per fuel are much higher for traditional fuels in comparison to LPG. Furthermore, poor households do not allow sufficient airflow into the stove, resulting in indoor air pollution and serious health risks such as bronchitis, emphysema, and other respiratory diseases.[42] Given that women are most closely associated with the combustion of biomass, they have the highest exposure to health risks of all members of the household.[43] The World Health Organization estimates that indoor air pollution due to inefficient biomass consumption kills 1.45 million people every year. The International Energy Agency (IEA) projects that unless the problem is dealt with, by 2030 over 1.5 million people per annum would die due to indoor air pollution. Cross country studies have shown that good health has a positive, sizable, and statistically significant effect on aggregate output, and hence at the macro level deterioration in health due to the use of traditional forms of energy has a negative impact on economic growth.[44]

[40] Ramon and Toman (2006).
[41] Kammen (1995).
[42] WHO (2005); Ezzati and Kammen (2001).
[43] Gupta and Sudarshan (2009).
[44] Bloom et al. (2004).

Table 1: Health Damaging Pollutants per Unit Energy Delivered by Fuel: Ratio of Emissions to those of LPG

	LPG	Kerosene	Wood	Roots	Crop Residue	Dung
Carbon Monoxide	1.00	3.1	19	22	60	64
Hydrocarbons	1.00	4.2	17	18	32	115
Particulate Matter	1.00	1.3	26	30	124	63

Source: Bacon (2010), Oxford Energy Forum, May 2010

The energy–poverty nexus has also equity and rural–urban dimensions. In general, poor households in rural areas use less energy than their wealthier counterparts and are often forced to rely on biomass for cooking, as it is more readily available than LPG or kerosene. Wealthier households in rural areas have more choice, but the propensity to use fuelwood and wood chips for fuel remains quite high, and access to electricity may not be possible due to lack of infrastructure. Hence, traditional sources of energy remain an important component of the household's energy mix. In urban areas, poor households tend also to rely on traditional sources of energy, but in a different way from the poor in rural areas; the urban poor have to purchase their fuelwood, making them more vulnerable to any increase in the price of fuelwood relative to other fuels.[45] More generally, poor people in urban areas spend a larger fraction of their income on fuels when compared to wealthier urban people. Ramon and Toman report that poor households often spend between 10 per cent and 20 per cent of their income on energy, compared to around 5 per cent for households in the top quintile.[46] In rural areas, poor households limit their spending to fuels used for lighting, such as candles and kerosene. Nevertheless, evidence from countries such as India suggests that the poor still spend a much higher proportion of their income on energy, compared to households in the highest income brackets.

Reliance on traditional biomass can, moreover, pose some environmental challenges. Unsustainable levels of collection and harvesting of biomass, such as fuelwood, can contribute substantially to deforestation, soil degradation, silting of water resources, and flooding.[47] Recent evidence also suggests the black carbon, or soot, emitted from the burning of biomass in inefficient stoves plays an important role in global warming.[48] Increasing

[45] See for instance Gupta and Sudarshan (2009) in the case of India.
[46] Ramon and Toman (2006).
[47] ADB (2007); WHO (2005).
[48] IEA/UNDP/UNIDO (2010).

access to modern fuels and electricity does not necessarily lead to higher levels of environmental pollution, for many higher-quality fuels are actually more fuel-efficient than biomass. A recent OECD/IEA outlook estimated that universal access to modern forms of energy would not have a substantial impact on global energy demand, production, or CO_2 emissions.[49]

1.2. Climbing the Energy Ladder

The determinants of switching from traditional fuels to modern fuels have been widely analysed in the literature. Existing studies suggest that fuel choices depend on a complex set of factors, such as the level of income, fuel availability, capital costs, fuel prices, household size, gender roles, wage rates, and cultural preferences.[50] In the energy-ladder model, assuming that energy is available, income is expected to play a major role in determining fuel choices. It is often argued that as incomes rise, households tend not only to consume more of the same fuel but also to move up the energy ladder towards higher quality fuels.[51] However, recent evidence suggests that this may not necessarily be the case. As incomes rise, households tend to increase the number of fuels used (this is known as fuel stacking) and do not completely switch from the consumption of traditional fuels to modern ones. In other words, fuel types such as fuelwood are not inferior, as implied by the energy-ladder hypothesis.[52]

The reluctance to make the transition to more modern sources of energy can be due to a number of factors including preferences, reliability of the supply of fuel, volatility of fuel prices, and the cost of switching. In many developing countries, even wealthy households may not have access to modern fuels, because the infrastructure is not in place (the availability issue). For instance, natural gas, which is a more energy efficient cooking fuel than traditional biomass, suffers from low penetration ratios, especially in rural areas. Another important determinant is the cost of switching or connecting to modern fuels. The literature emphasizes the role of up-front costs in prohibiting households from switching to more efficient sources. For instance, purchasing modern stoves to burn LPG may be beyond the reach of many households in developing countries, even when the fuel is available and affordable. Similarly, connecting to the natural gas network or electricity grid may be beyond

[49] IEA/UNDP/UNIDO (2010), 17.
[50] Gupta and Sudarshan (2009).
[51] ESMAP (2000); Barnes and Toman (2006)
[52] Heltberg (2005); Masera et al. (2000); Mekonnen and Köhlin (2008).

the means of most poor people, especially given their low levels of consumption.[53] The cost of fuel is also another important determinant in switching. If the cost of fuel is high, or highly volatile, poor households would be discouraged from making the switch away from traditional biomass. This is especially the case from the perspective of a poor household, where biomass allows them to harness a source of energy without incurring a financial cost.

Finally, one has to take into account the cost of substitutes. Given the complementarities of fuelwood and kerosene in cooking, there is an implication that as the price of kerosene goes up, households (especially in rural areas) react swiftly by substituting away from kerosene towards fuelwood, which is widely available. In the context of Pakistan, Ghouri finds a relatively high short run and long run price elasticity for kerosene, which is many times higher than that for gasoline and diesel.[54] Furthermore, Kojima finds that as the price of kerosene increased between 1994 and 2001, households responded by replacing kerosene with biomass in cooking, both in rural and urban areas, with the largest percentage increase in the uptake of free biomass occurring among the lowest 40 per cent in urban areas.[55] Similarly, in Nigeria, Maconachie et al. find that rising prices of kerosene and other petroleum-based domestic fuels have made fuelwood a much more attractive alternative as a domestic fuel choice. This has increased pressure on woodland resources.[56]

1.3. Subsidies and Energy Poverty

Protecting households with low income from rising fuel costs is considered as a key rationale for energy subsidies.[57] Since the share of energy in total spending of low-income households is high, increases in energy price would have a direct income effect, exacerbating their poverty. High energy prices also induce indirect effects, as they increase the cost of other goods and services used by the poor.[58] Subsidizing the cost of energy is one way to alleviate the impact of high energy prices on the poor. Rather than targeting the poor directly, many governments tend to keep the price of all petroleum products below international prices. Alternatively, some governments target those fuels that are widely used by the poor. Other governments try to target the poor in an indirect way. For instance, diesel is subsidized on the grounds that it is widely used in the public transport sector – considered as the main mode of

[53] Barnes and Toman (2006).
[54] Ghouri (1996).
[55] Kojima (2006).
[56] Maconachie et al. (2009).
[57] Adelerman (2002).
[58] Baig et al. (2007).

transport for low income households – or on the grounds that diesel is widely used by farmers in rural areas. Other countries provide subsidies to producers on the grounds that subsidies would reduce production costs, and that these producers would pass the lower costs on to end-users by offering cheaper consumer goods.

However, various studies have suggested that subsidies are not necessarily the most effective policy which can be used to protect the income of the poor. The case against fuel subsidy is mainly based on four main arguments. Fuels subsidies often results in large losses for national oil companies or local distributors. These in turn undermine the incentive for suppliers or distributors to extend electricity and gas infrastructure to new areas and/or to provide a high quality service such as high voltage and uninterrupted electricity supply. Countries that have witnessed dramatic improvement in access have achieved it through public investment in infrastructure, rather than through granting fuel subsidies. Second, subsidies induce inefficiency by distorting relative prices, leading to some unintended consequences. In some contexts, for instance, subsidizing kerosene has contributed to large volumes of kerosene being diverted to the automotive diesel sector, as kerosene is a near perfect substitute for diesel.[59] Third, energy subsidies have adverse consequences on the environment by encouraging overconsumption and undermining sustainable development. Finally, subsidies result in substantial leakage to unintended groups, and hence are not the most efficient method of protecting the income of poor households. Thus, there have been increasing calls for countries to adopt more targeted programmes.

The empirical evidence on the impact of targeted programmes on poverty, however, is not conclusive.[60] Untargeted transfers may have some 'hidden benefits'. First, they minimize the error of exclusion. In a survey of nine developing countries, Cornia and Stewart found that universal food subsidies are associated with significantly lower errors of exclusion than targeted programmes.[61] Second, developing targeted transfer programmes requires administrative capabilities which are often not readily available, are very costly to develop, and may be more open to corruption. Third, untargeted transfer programmes have higher chances of success and survival, since these programmes receive wider political support than

[59] Barnes and Toman (2006).
[60] Besley and Kanbur (1993); van de Walle (1998); Ravallion (2003).
[61] Cornia and Stewart (1993).

targeted transfer programmes.[62] Finally, making transfers conditional on certain criteria, such as the level of income of the household, can induce behavioural responses that reinforce poverty. For instance, households may be reluctant to increase their income, or may decide to reduce the supply of their labour, to keep entitlement to subsidies. Universal subsidies, on the other hand, generate only an income effect but no substitution effect and thus are expected to have a less important impact on work incentives. Thus, Van de Walle notes that 'narrow targeting often has hidden costs, and once these costs are considered, the most finely targeted policy may not have any more effect on poverty than a broadly targeted one'. Martin Ravallion concludes that 'it is not clear that targeted transfers dominate other options. These may include direct efforts to make factor markets work better for the poor, ... supply side interventions in schooling and healthcare, or even untargeted transfers'.[63]

Regardless of the issue of targeting, the fact remains that abolishing fuel subsidies without any compensating measures will increase the incidence of poverty, and hence is socially and politically undesirable. Thus any reform of subsidies must be accompanied by measures to protect poor households from any decline in real income. Given the impact on the poor of abolishing subsidies, countries often take measures to protect the income of the poorest households by establishing or increasing the efficiency of existing safety nets. Social safety nets are defined as transfer programmes whose main objective is to reduce poverty and/or protect those who are highly vulnerable to adverse shocks. Given that the sources of poverty and the nature of shocks differ, so does the nature of safety nets. Dreze and Sen have distinguished between two roles of safety nets.[64] The first role is promotional, where the objective of the safety net is to tackle poverty through various measures such as increasing the asset base of households, promoting independence, and allowing households to invest and engage in high risk/high return activities to improve their livelihoods. The second role of safety nets is protective, mainly aimed at channelling transfers to those vulnerable to adverse shocks, so that they do not fall further into a poverty trap. It is important to recognize that the creation of effective safety nets is very costly, and can prove to be a formidable challenge for many developing countries. In contrast, safety nets are widespread in developed countries, although there is wide variation between them in terms of the composition of social spending,

[62] Cornia and Stewart (1993); Skocpol (1991); Gelbach and Pritchett (2002).
[63] Ravallion (2003), 27.
[64] Dreze and Sen (1991).

the fraction of GDP devoted to social spending, and the role of social safety nets.[65] Further, the expansion of social safety nets in developed countries has taken many decades, and has been shaped by the particular political, economic, social, and institutional transformations in each of these countries.[66] In developing countries, social safety nets are less widespread, and when compared to OECD countries, spending on social protection programmes is smaller both in absolute and relative values.[67]

One of the main obstacles in accessing modern forms of energy such as LPG, natural gas, and electricity is the high initial costs of connecting to these sources. Thus, rather than opting for *fuel* subsidies, there might be a case for energy *connection* subsidies. The success of such a policy would depend on a number of factors. Firstly, it depends on the willingness and ability of distributors to extend network access to poor households. In the case of some countries, such as India and Pakistan, the cost of grid provision does not favour any extension of access to rural populations, where there is difficult terrain, dispersed settlement, and low consumption. There has therefore been an increasing emphasis on decentralized sources of power and off-grid alternatives such as small diesel generators, solar photovoltaic, wind generators, and other renewable energy sources. The advantage of renewable energy is that it has low running costs, though the upfront costs can be high.

The effectiveness of connection subsidies also depends on whether poor households are willing or able to pay for a connection. This can explain why projects aimed at extending modern forms of energy have been most successful in places where incomes have already been rising, as this creates an enabling environment for connection.[68] In areas where income is low, the government can offer connection subsidies. As in the case of consumption subsidies, connection subsidies should also be well targeted. In this respect, given that already connected households are likely to belong to the highest income groups, the benefit incidence of connection to gas or electricity networks is likely to be only amongst the non-poor.[69] This is especially true in countries with high connection rates, where non-poor households are likely to constitute the bulk of the connected population. Ajwad and Wodon (2001) provide support for this hypothesis, where they find that the marginal benefit

[65] Tesiluc (2006).
[66] Alesina and Glaeser (2004).
[67] Tesiluc (2006)
[68] Barnes and Floor (1996).
[69] Komives et al. (2007).

incidence for a wide range of services is progressive. Furthermore, the connection subsidy is likely to succeed in raising a particular fuel's consumption if the fuel itself is affordable to households once the initial equipment is supplied. Evidence from the Deepam scheme in India suggests that a large local price difference between LPG cylinders and biomass meant that many rural households returned to biomass-fired stoves after having received an LPG stove.[70] Hence, incentives must be given to households to keep using the more expensive higher-quality fuel in the long run.

[70] Rajakutty and Kojima (2002).

PART 2: Energy Poverty in Yemen

2. Poverty and the Yemeni Economy

Income plays a crucial role in determining the range of goods and services an individual or business chooses to consume; both in general and in the Yemeni context, energy poverty must hence be seen as first and foremost a symptom of overall poverty levels. Yemen's case is an important case in point: surrounded by some of the world's wealthiest countries, situated on the Arabian Peninsula, and endowed with its own modest wealth in exportable hydrocarbons, Yemen is today one of the poorest countries in the entire Arab world (see Table 2).[71] According to the Yemeni Poverty Report of 2007, some seven million Yemenis, 35 per cent of the population, were found to be poor by their national poverty line, with more than 2.5 million people living below the food poverty line. Another 35 per cent of the population may be deemed to be on the border of absolute poverty – 40 per cent live on less than $2 per day.[72]

Table 2: GNI per Capita, Atlas Method (Current US$) in Selected Arab Countries, 2008

Income Group Classification 2008	Country	Per Capita GNI in 2008
High Income	Bahrain	25,420
	Oman	17,890
	Saudi Arabia	17,710
	Libya	12,380
Upper Middle Income	Lebanon	6,980
	Algeria	4,260
	Iran	4,120
	Jordan	3,660
Lower Middle Income	Tunisia	3,540
	Morocco	2,520
	Syria	2,150
	Iraq	2,060
	Egypt	1,800
	Djibouti	1,210
	Yemen	960

Source: World Bank (2011).

[71] Table A1 in the Appendix provides some selected summary statistics for Yemen and the Arab world. Yemen performs relatively poorly on almost every socio-economic indicator, especially in terms of mortality rates, life expectancy, and the quality of infrastructure.

[72] Government of Yemen, Central Statistical Agency (2009); See Appendix Table A2 for a summary of Yemen's social and economic indicators.

2.1. Extent and Quality of Poverty

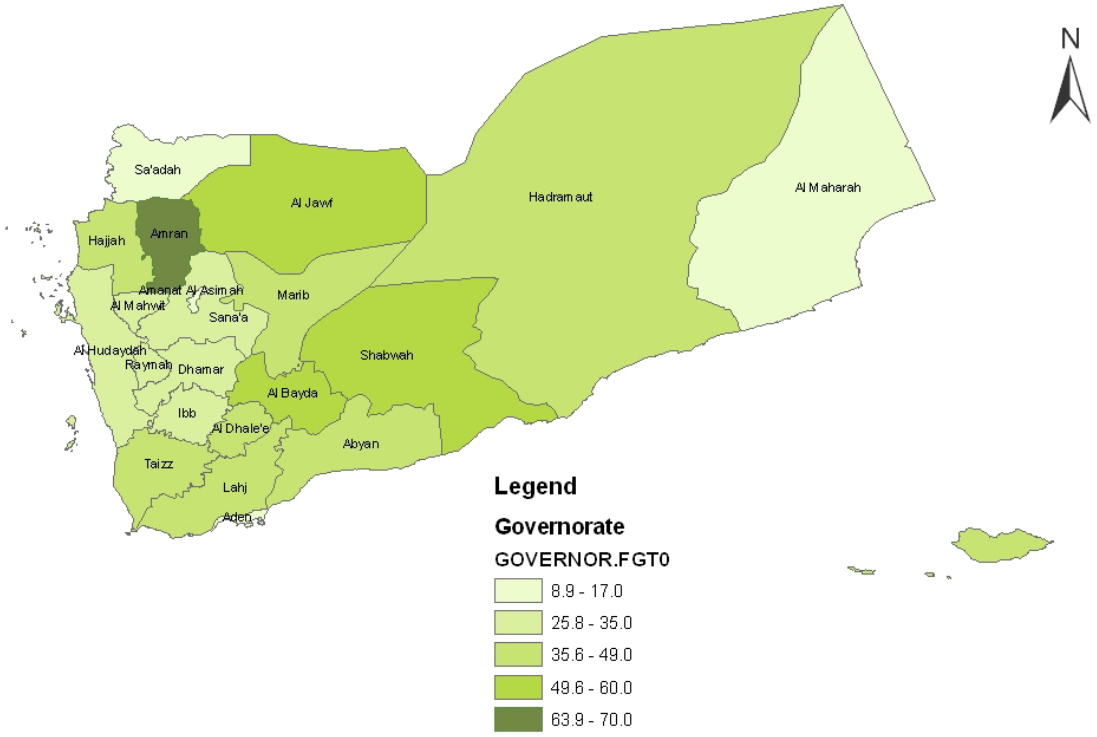
Poverty in Yemen is both widespread and severe. Yemen's poor lack access to a range of essentials, such as a sufficient diet, basic health services, and education. Women and children are particularly affected by poverty. Malnourishment among both children and adults is widespread, with 45 per cent of children below the age of five being underweight. Both child and maternal mortality is high, by both international and Middle Eastern standards, owing much to low access rates to health services. Half the population is illiterate, and school access rates at primary level, remaining at 65 per cent, are relatively low. Results of most recent poverty-related surveys suggest that for the poorest, access rates to education have deteriorated.[73] Yemen's poor also lack access to energy, particularly to modern forms of energy such as liquid fuels and electricity: for instance, nearly 80 per cent of Yemen's poorest income decile have no access to electricity, the basis for many essential tasks from food refrigeration to essential lighting.[74]

Poverty in Yemen has a strong geographical dimension, with the urban–rural divide being one of the most important distinctions. Yemen's urban areas comprise some 27 per cent of the population but only 16 per cent of the country's poor.[75] Twenty per cent of the urban population live below the national poverty line, compared with 40 per cent of the rural population, while access rates to both health services and education are respectively higher in urban areas. The slight decline in Yemen's poverty rates since the mid-1990s mainly reflects developments in urban areas, whereas rural poverty rates have not changed substantially over the same period of time.[76] Poverty is, moreover, strongly regionally concentrated, implying vast regional differences in terms of development, the quantitative concentration of poor families, and the incidence of poverty. Data by the UNDP and World Bank collected since the 1990s suggest that in spite of an overall slight decline in poverty, in three out of seven regions, poverty has worsened, and per capita consumption has declined dramatically.[77] The wealthiest parts of Yemen are found in former North Yemen, around the capital of Sana'a, surrounding coastal governorates, and the port of Aden. Poverty is highly concentrated in Yemen's most northern and central governorates, and the former South Yemen.[78] The three

[73] Government of Yemen, Central Statistical Agency (2009).
[74] World Bank (2005a), 2.
[75] Government of Yemen, World Bank, and UNDP (2007), 25.
[76] Government of Yemen, Central Statistical Agency (2009).
[77] Government of Yemen, World Bank, and UNDP (2007), 20.
[78] Government of Yemen, World Bank, and UNDP (2007), 9

governorates of Hajjah, Taizz, and Al-Hudayah hold more than one third of Yemen's poor alone. The incidence of poverty, i.e. the proportion of poor to other households, ranges between 5.4 and 71 per cent. Amran, followed by Shabwah and Al Bayda, faces the highest levels of poverty incidence in Yemen (see Figure 1).[79]

Figure 1: The Percentage of Poor by Governorate in Yemen, 2005/2006



Source: Government of Yemen, WB, UNDP (2007), 27.

Poverty has a stronger impact on women than on men. Maternal mortality rates are among the highest in the Middle East, owing to only a third of all births being attended by skilled health care personnel. Little more than half of all school-aged girls attend primary school, and high dropout rates reduce the number of women with secondary education to less than 8 per cent. Female illiteracy is high, with fewer than 35 per cent of women in 2004 being literate, compared with 73 per cent of Yemeni men.[80] Outside the agricultural sector, women comprise 6.3 per cent of the labour force, one of the lowest rates in the world.[81] As a result, family income depends heavily on a single source of income.

[79] UNDP based on HBS 2005/2006. Government of Yemen, World Bank, and UNDP (2007), 25.
[80] UNESCO UIS database 2007.
[81] Government of Yemen, Central Statistical Agency (2009).

2.2. Reasons for Poverty Levels in Yemen

Yemen's historical development, both politically and economically, provides some important leads for understanding the country's widespread poverty in its current form. Politically, the country was divided into a republican North and a communist South between 1962 and 1990, the year of Yemen's reunification. The rapidly widening income gap between Yemen, in the south of the Arabian Peninsula, and its northern Gulf neighbours, in addition to the GCC (Gulf Cooperation Council) building boom following the 1973 oil price shock[82] triggered a wave of Yemeni migrant workers from both sides of Yemen into the Gulf states, most of them to Saudi Arabia. By 1975, some 630,000 North Yemenis worked as migrants, out of a total population of 5.3 million. By the end of the decade, the number of North Yemenis abroad had grown to 800,000.[83] During the 1970s, labour remittances, a large part of which moved across the borders without formal government control or the ability to tax incomes, became the single most important source of revenue for the Yemeni economy.[84]

The discovery of commercial quantities of oil in Yemen in 1984 dramatically changed the composition of North Yemen's main sources of income, as well as the role of the state in distributing oil revenues. Export revenues for oil soon began to flow directly into state coffers, providing a substantial new source of income, and one on which the Yemeni state still overwhelmingly relies: 75 per cent of the public budget, and the bulk of its export revenues result directly from the export of crude oil.[85] The state, previously unable to raise sufficient revenues from the taxation of Yemen's largely informal economy, now had a potentially powerful financial resource at its disposal, despite Yemen's far more limited reserves than those of its rich Gulf neighbours.[86] Oil revenues soon overtook remittances in terms of income generated, although remittances remained an important second source of income to the economy.[87]

[82] Saudi Arabia's national per capita income, for instance, had grown by 1992 to more than 20 times national per capita income in Yemen. Smaller Gulf states such as the UAE and Kuwait by then had 40 times the national income of Yemen. World Bank (2011), p.c. GNI at current US$ (WB's Atlas Method)

[83] Dresch (2000), 131; Colton provides different numbers: she, like Dresch, refers to the 1975 population census but quotes North Yemen's total population as 6,492,530, of which 1,234,000 people were assumed to be migrant workers abroad. Colton (2010), 412.

[84] Dresch (2000), 131, 157; Colton (2010), 410; Alley (2010), 387–8.

[85] World Bank (2008a), 7; IMF (2009), 12. In September 2009, Yemen began exporting LNG which is likely to contribute an increasing share towards export earnings – the EIU estimates that for 2010, the share of LNG could be as high as 28% of all export earnings, with oil exports accounting for most of the rest. Economist Intelligence Unit (2010), 9.

[86] Alley (2010), 389.

[87] Dresch (2000), 161; Alley (2010), 388–9.

Since 1990 Yemen has, furthermore, been hit by a number of macroeconomic shocks. In 1990, the reunification of North and South Yemen acted as the first major shock, with record government expenditure in that year and subsequent years aimed at absorbing large numbers of Yemenis into the new government's public sector employment.[88] Security expenditure rose sharply, justified by the need to secure the new state via large police and military forces. By the early 1990s, the economy of the newly unified Yemen nearly collapsed under the weight of some 880,000 Yemeni workers, most of them unskilled, returning from working in the Gulf. This augmented the labour force by one third in the space of a few months. Yemen's unemployment rate rose rapidly, with official and unofficial accounts from the mid-1990s ranging between 10 and 40 per cent unemployment.[89] The country was deprived of its second most important source of income after oil at the time, workers' remittances from the Gulf states, practically overnight.[90]The government's policy of public spending financed by debt in the years up to 1995 further rendered the economy increasingly unstable. With a rapidly depreciating currency, highly volatile levels of inflation above 30 per cent,[91] and rapidly rising government debt, the government faced effective bankruptcy at the end of 1994, and turned to the IMF and World Bank for loans and a restructuring programme for Yemen's shattered economy.[92]

Two other factors substantially contributed to this situation: demography, and the impact of Yemen's fragile decision-making centre. Yemen's population growth has been among the highest in the world, currently at 3 per cent growth per annum, down from 4 per cent in the 1970s and 80s. Between 1970 and 2010, Yemen's population quadrupled, with more than half of Yemenis today being below the age of 24.[93] The central government, health, and education services, and essential infrastructure have been unable to catch up with the country's high population growth, while the labour market has been unable to absorb the growing number of job seekers. Many of Yemen's young people remain inadequately trained or educated, rendering their job search even more difficult. Urbanization rates are high, with Sana'a's population growing at 7 per cent each year, which places a drain on urban provision of basic services.[94] Still, two-thirds of the population of 23 million are rural, living scattered

[88] Al-Asaly (undated), 9–10.
[89] Colton (2010), 46; Dresch (2000), 185.
[90] Dresch (2000), 185.
[91] Republic of Yemen, Central Statistics Office (2004).
[92] Colton (2010), 417; Al-Asaly (undated), 10.
[93] World Bank (2011).
[94] Boucek (2009), 6.

across Yemen's geographically challenging mountainous and dry territory. Some 135,000 villages exist across the country, with many settlements still remaining cut off from central government control, and modern comforts such as sanitation and electricity.[95]

Yemen's political power centre remains fragile. The country's long-term president, Ali Abdallah Saleh, has been in power since 1976, and he, his family, and his close allies are understood to control a wide range of businesses in the economy, including businesses in key sectors such as the oil and gas industries.[96] Corruption is widely considered omnipresent throughout the economy, with one estimate suggesting that some 30 per cent of total government revenues never appear on the government's budget.[97] It is hence clear that it is not just the lack of large oil and gas reserves, in comparison to Yemen's Gulf neighbours, that causes Yemen to face such high levels of poverty (the position which tends to be emphasized by the government) it is, rather, the lack of effective channelling and distribution of the accruing hydrocarbon revenues through the central government which has been widely criticized as another cause for the lack of wealth creation from hydrocarbon reserves for Yemen's economy.[98]

Tribal structures remain strong in many regions, resulting in the creation of micro-states within the state – often resulting in a vicious cycle, in which the absence of government reach further incentivizes self-help based on traditional ties such as family, clan, or religious sect. The influence of central government policies on many regions is hence limited.[99] The Yemeni state is also known to base much of its political standing on informal ties of clientalist networks that reward loyal clients, while ignoring or punishing non-allies or politically insignificant regions.[100] A continued north–south divide, coupled with allegations of the government's intentional neglect of certain regions, have led to recurring regional tensions, protests, and periodic violence.[101] Terrorist attacks in multiple forms are a new, additional source of domestic instability.[102] Facing these combined issues, the domestic security

[95] Boucek (2009), 10
[96] Colton (2010), 423; Alley (2010), 387–8.
[97] Boucek (2009), 9; Dresch (2000), 177, 192, 203–4; Phillips (2007), 14–15; Colton (2010), 423; Alley (2010), 387; See also USAID (2006), Yemen Corruption Assessment. September 2006.
[98] Colton (2010), 423; Alley (2010), 387–8; Dresch (2000), 157, 177, 192; Boucek (2009), 9; Phillips (2007), 14–15.
[99] For a detailed discussion of Yemen's tribal politics, see Phillips (2010), 18–19.
[100] See for instance Boucek (2009), 6; Phillips (2007), 3, 14.
[101] Boucek (2009), 15; Dresch (2000), 191.
[102] Boucek (2009), 12.

situation has effectively undermined Yemen's attempts to promote itself as a location for either private domestic and foreign direct investment outside the oil and gas sector, or as a tourist destination – both important sources of new revenues and foreign currency.

Financially dependent on international aid since the 1970s, Yemen has become a long-term challenge for international development agencies.[103] The fears of Gulf neighbours, and the even more pronounced fears of Europe and the USA, that Yemen might eventually disintegrate and become a second Afghanistan, have already prompted ample promises, and provisions, of aid for Yemen in the past decades.[104] The combined pledge made at the most recent donor conference for Yemen in 2006, for instance, was to provide some $5.7 billion as aid to the country in the coming years – money aimed at targeting the many facets of poverty.[105] A number of internationally coordinated structural adjustment programmes have been launched since the mid-1990s, aiming at restoring monetary stability and restructuring government spending in areas ranging from public employment to reductions in subsidies.[106] Several specific programmes target issues such as food security, poverty reduction, and access to health, education, and electricity. Many of these programmes are supported by different funds, most importantly Yemen's Social Fund for Development (SFD),[107] the Public Works Fund (PWF),[108] and the Social Welfare Fund (SWF).[109]

2.3. Yemen in 2011

The political developments unfolding in Yemen since the beginning of 2011 as part of the revolutionary contagion spreading through the Arab world, which have produced dramatic changes in Egypt, Tunisia, and Libya, will certainly have an impact on the socio-economic development and the political landscape of the country. [110] As of the date of writing this, many observers believe that the regime of the post September 1961 coup d'état (reinforced after the unification of 1990) is about to give way to a new, more representative, democratic

[103] See also Boucek (2009), 20.
[104] Boucek (2009), 3.
[105] World Bank (2010a), 2.
[106] Colton (2010), 417; See also World Bank (2006).
[107] See the fund's website at: www.sfd-yemen.org/SFD/index.htm.
[108] For activities, see the World Bank's website: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/0,,contentMDK:22719166~pagePK:146736~piPK:226340~theSitePK:256299,00.html?cid=3001_6.
[109] Information about the fund is available at: http://web.worldbank.org/external/projects/main?Projectid=P117608&theSitePK=40941&pagePK=64283627&menuPK=228424&piPK=73230. For an overview over all programs, see World Bank (2010), Yemen Quarterly Economic Review. Summer 2010, 8. The programmes are further discussed below in section 3.4.
[110] For instance, see 'Anti Saleh Protesters Continue Protesting in Yemen', *Yemen Post*, 8 April 2011

regime. And as is the case with such historical changes, the transition period to such a regime will take time, and the outcome of the Yemeni Revolution will certainly change the course of its development. Early Institute of International Finance (IIF) estimates that include the first economic consequences of these protests and Yemen's continued instability suggest Yemen's real GDP growth will slow substantially in the next two years, from 7 per cent in 2010 to 3 per cent in 2012.[111] With high levels of uncertainty, it seems unlikely that such forecasts will quickly change.

One very severe risk for Yemen's economy at the moment is the rapid depletion of Yemen's oil reserves which expected in the coming one to two decades.[112] The consequent decline in export revenue implies that Yemen's current main source of income, as well as the state's most important source of foreign currency, is due to disappear in the next decade. In the absence of non-hydrocarbon sectoral development in the coming years, it is hence difficult to see how Yemen will manage its macro economy without foreign aid. Efforts have been made by the central government to develop the country's natural gas deposits, and earn additional revenues by the export of LNG.[113] The latter initiative, however, comes with its own problems, including the difficult task of weighing up export plans against the need for gas as fuel and feedstock by the domestic electricity sector and by industry.[114]

Meanwhile, many of Yemen's poverty indicators have worsened in the most recent years. Despite record oil prices between 2005 and 2008, more recent reports, such as a 2010 World Food Programme (WFP) report, come to the conclusion that Yemen's poverty levels have risen substantially since 2005.[115] According to the most recent data, nearly 43 per cent of Yemen's total population now fall below the national poverty line – this figure rising to almost half (47.7 per cent) for Yemen's rural population.[116] An explanation for this change can partly be found in Yemen's reliance on food imports for over 70 per cent of its food needs. Yemen's import bill has been rising dramatically in recent years, owing to high world

[111] IIF (2011).
[112] BP's Statistical Review states Yemen R/P rate as 24.5 years, while World Bank estimates suggest a more gloomy scenario that forecasts the depletion of Yemen's oil reserves as early as in the next 10 to 12 years. BP (2010), 6; World Bank (2006), 2; 'WB in Renewed Warning of Oil Depletion in Yemen', *Yemen Post*, 10 April 2010.
[113] World Bank (2010a), 5.
[114] Gerner and Tordo (2011).
[115] WFP (2010), 25.
[116] WFP (2010), 25.

food prices, particularly for wheat and cereals, the basis of the everyday diet of Yemenis.[117] High domestic inflation levels of up to 18 per cent in recent years have been partly blamed on this rise in international food prices.[118] The rapid depletion of Yemen's ground water reserves, fuelled by uncontrolled consumption mainly by the agricultural sector, and the absence of central water management by the government, has exacerbated this situation. The UN Food and Agriculture Organization lists Yemen as among the world's most water scarce nations, with some of the lowest rates of per capita access to fresh water.[119] With both food and water being increasingly scarce, the WFP report of 2010 hence concludes that the country's aim to decrease poverty levels to 10 per cent by 2025 is becoming increasingly difficult to achieve[120] – a conclusion which this report tends to follow.

[117] ROY Central Statistics Office trade statistics; Republic of Yemen (2002), 21.
[118] World Bank (2010a), 14–15; Colton (2010), 420
[119] Boucek (2009), 6; Republic of Yemen (2002), 24; See also World Bank (2010b), 8
[120] WFP (2010), 25.

3. Yemen's Energy Ladder

Energy access in Yemen strongly reflects the country's high level of poverty, as well as strong divergences between Yemen's different regions, particularly in relation to the urban–rural divide. In this paper, we largely follow the most recent Yemeni household survey of 2005/2006 carried out by World Bank (HES).[121] Yemen's energy ladder consists of a number of different fuel types – access to, and use of which, we find is dependent on four main factors: household income; availability of necessary infrastructure and other incentive structures encouraging use of more costly forms of energy; the price of fuel and of the equipment necessary to use the fuel; and individual household preference.

Table 3: Percentage of households that report use of each fuel

	Urban	Rural	Total	Lowest decile	Highest decile
Electricity	92	42	53	22	82
PEC grid	80	23	36	11	62
Non-grid, incl. self-generation	12	19	18	9	19
No access to electricity	8	58	47	78	18
LPG	93	74	78	49	93
Diesel	13	4	11	3	34
Kerosene	46	83	75	92	57
Fuelwood	36	85	74	80	66
of which purchased	24	24	24	13	36
Charcoal	12	6	8	2	18
Dung	3	23	18	12	21
Crop residue	3	26	23	24	20
of which purchased	<0.5	1	1	<0.3	2

Source: HES I (2005/2006), p.2

Yemen's energy situation is characterized by three main tendencies: firstly, energy access for a vast part of the population, particularly for the rural poor, is low, both in terms of quantity consumed and in terms of quality of fuel. The poor overwhelmingly rely on biomass and some forms of liquid fuel. Secondly, traditional fuels/biomass continues to be used by all income groups, indicating (i) that movement along the energy ladder is not , automatic (ii) that fuels traditionally deemed inferior, such as biomass, tend not necessarily to be inferior in practice; and (iii) the lack of adequate energy infrastructure. Thirdly, and perhaps most

[121] World Bank (2005a, b). The data found by this survey was largely collected in 2003 but the extent of households interviewed for the survey and the quality of the data mean the survey is the single most detailed, comprehensive, and reliable assessment of household energy use available for Yemen. A total of 3,540 households participated in the survey.

distinctively, indicating the extent of energy poverty in Yemen, electrification rates are appallingly low, with nearly half of the population lacking access to electricity. In the following, access to three separate categories of energy is discussed: access to traditional fuels/biofuels; access to modern fuels, i.e. liquid fuels; and access to electricity.

3.1. Traditional Fuels/Biomass

Traditional fuels/biomass include fuelwood, charcoal, crop residues, and dung. Despite wider perceptions of traditional fuels as being inferior to higher quality fuels, all of these fuels remain widely used by all income groups, including the richest income deciles in Yemen's society. Dung and charcoal usage actually increases alongside income group (see Table 3). Yemen's widespread use of traditional fuels across all households is the result of the combined impact of prices for individual fuels as well as their available substitutes (which vary in most cases both regionally and seasonably), local availability of different fuel types, as well as individual household preference. Income levels do make an important contribution, but their impact differs depending on fuel type.[122] In all cases, the poor continue to outspend wealthier income deciles by the proportion of income they spend on energy, with the lowest three income deciles spending an estimated 12 to 14 per cent on energy, including biomass, liquid fuels, and electricity, compared with an average of 9 per cent between all income groups and 7 per cent in the highest income decile.[123]

Fuelwood continues to be one of the most widespread fuels used in Yemen throughout all income groups: in the last Household Energy Survey of 2005, 74 per cent of all Yemeni households reported the use of fuelwood, with a relatively modest decline from 80 per cent in the lowest income groups to 66 per cent in the highest. In rural households, the same pattern is also observed. In terms of quantities consumed: the lowest and highest income deciles consume 146kg and 117kg per household per month, while mid-income households consume about half that rate.[124] The dominant use of wood is for cooking, but a significant number of Yemenis also use wood for heating, even in big cities (where the average use is 31 per cent, even higher than the national average of 24 per cent) and in fully electrified households.

[122] For the purpose of this study, we assume income levels are fixed, and can be divided into different income deciles, as practiced also in World Bank (2005a and b). In practice, however, we have to assume that incomes, particularly among lower income groups where work opportunities may arise ad hoc or on a seasonal basis, vary each month. This expected variation in household income may in and of itself constitute an additional reason why households do not completely switch from one fuel to another.
[123] World Bank (2005a), 66.
[124] World Bank (2005b), 117.

Greater availability of wood outside urban areas, and the relatively larger share of poor households in rural areas, also means that a far greater percentage (85 per cent of rural households) consume fuelwood, compared to 36 per cent of urban households. [125]

The decline in wood consumption in some income groups, particularly in urban areas, may be seen as the result of proportionately greater reliance on LPG for both cooking and heating the higher the income group, and also of the relatively higher price of wood in urban areas, where substantially more wood has to be purchased rather than collected owing to the lack of wood sources in and around towns and cities. In the top income groups, households have the luxury of choice between different forms of cooking, and cultural preference may well turn quality wood-fired cooking into a luxury good, which is consumed alongside existing LPG facilities. This pattern is confirmed by survey observations concerning the preferred use of fuelwood by high-income households for the preparation of meat and for barbecues.[126] Moreover, even lower income groups tend to prefer wood over its next best substitute, kerosene, due to differences in the taste of prepared food. [127]

While the effect of income on fuelwood consumption is not as direct as would have been expected, income does crucially have an impact on the method of obtaining wood. Only 13 per cent of the lowest income households purchase wood, usually to mix it with lower quality self-collected material, compared with 36 per cent of the highest income households. Wood collection is confined to areas with small forests or scrubland. The substantially greater distances from forests or scrubland for urban collectors of fuelwood partly also explain the overall higher purchasing rates in urban areas compared with rural areas.[128] Collecting distances are in any case significant: the average is 2 km, but more than 30 per cent of households reported distances of more than 3 km. Collection may occur once per week, once per month, or on a daily basis, depending on local conditions.[129]

Charcoal is reportedly used in 18 per cent of Yemeni households. It is typically mixed with other forms of biomass for cooking and heating, where it can contribute 1–15 per cent of the energy mix. Consumption of charcoal increases with income from 2 per cent of the lowest

[125] Refer to Table 3; See also World Bank (2005a), 117.
[126] World Bank (2005a), 37.
[127] World Bank (2005a, 39) comes to the same conclusion.
[128] The other logical explanation is the higher concentration of high-income groups in urban areas compared to the countryside.
[129] World Bank (2005b), 109.

income decile to 18 per cent in the highest income decile. Urban use is double that of rural use, despite higher prices in urban areas.[130]

Crop-residues and dung are overwhelmingly collected, and are used primarily in rural households with little variation across income groups. Principal use is reported by about 23 per cent of all households. Both crop residues and dung are typically mixed with wood, and possibly charcoal, for heating and cooking, and are used increasingly at times of high seasonal wood prices (for instance during the rainy season) and high collection distances for wood.[131]

3.2. Modern Fuels

Modern, liquid fuels used by households in Yemen include kerosene, LPG, and diesel. Their patterns of usage are directly impacted by government policies, given the government's dominating role in the up-, mid-, and downstream sectors of the country's own production of oil and natural gas, as well as its role as a regulator of domestic petroleum product prices. Yemen's domestic product consumption has hence, for many years, been essentially a response to the distortions created by production and pricing decisions made by the central government – in particular to the price of different types of fuels relative to each another, and to traditional biomass and electricity.[132]

Kerosene is the most basic petroleum product used in Yemen, and is consumed almost exclusively by households rather than by the transport and industrial sectors. About one-third of its use is for cooking and two-thirds for lighting. As in the case of fuelwood, kerosene continues to be used by a large share of households across all income groups, ranging from 92 per cent of the poorest households to 57 per cent of the richest.[133] The percentage of households using kerosene is higher in rural than in urban areas, but the quantities consumed are relatively similar. Kerosene prices vary, and many of the poor spend time travelling to purchase kerosene where it is cheaper, or resort to traditional fuel substitutes, particularly wood. Retail prices also vary between urban and rural areas as well as locally, owing to the

[130] World Bank (2005b), 119.
[131] World Bank (2005b), 120.
[132] We discuss the specific impact of subsidies later, in Section 5.
[133] World Bank (2005b), 21.

lack of central price enforcement mechanisms in view of the theoretical kerosene subsidies in place in Yemen.[134]

Kerosene consumption and expenditure are highly dependent on household access to higher quality substitutes such as LPG, grid electricity, or self-generated electricity as power for lighting.[135] Poor households consequently outspend the rich on kerosene consumption, both in terms of quantities consumed and in terms of household expenditure.[136] The only available low-cost substitutes for kerosene lamps are candles or dry cells, both of which are less efficient than kerosene. Nevertheless, kerosene is considered by wide parts of the population as an inferior product, particularly in lighting, where LPG lamps and electricity are substantially brighter, cleaner, and more efficient than kerosene. The HES reports that:

> both men and women also dislike the poor quality of kerosene light, which they say is insufficient for doing any type of work at night. Parents complained that children are unable to study or do their homework with a kerosene lamp.[137]

In the absence of access to higher forms of energy, kerosene remains an important fuel, but its use among higher income households also continues: even households with electricity access continue to use some kerosene for lighting and as a starter fuel for stoves and ovens. The reason is probably the relatively lower cost in comparison to other liquid fuels, which lead even many higher income households to use kerosene for all purposes where electricity or LPG are not necessary, e.g. additional lighting and cooking on an open fire.

Diesel, by contrast, seems to be a fuel sharply concentrated in wealthy households. Some 21.6 per cent of diesel consumption in 2003 was for private households (the rest being used by road transport, commerce, and industry), 51 per cent of which were in the top income deciles, and 34 per cent in the top income decile alone, compared with 1–9 per cent in the bottom 50 per cent income households. Of the lowest income decile, only 3 per cent of households use diesel.[138] Among household use, agriculture is the single largest consumer of diesel: 21.5 million litres of the total 45 million litres consumed per month in 2003 were used

[134] World Bank (2005b), 22–4.
[135] World Bank (2005b), 25.
[136] World Bank (2005b), 25.
[137] World Bank (2005a), 43.
[138] World Bank (2005b), 33.

for this purpose.[139] The use of diesel for agriculture is highly concentrated in the highest two income groups: 29.8 per cent of the top 2 decile households report diesel use for agriculture, but only 1.7 per cent of the lowest two deciles of rural households.[140] Given the predominance of irrigation pumping in the use of diesel, there are sharp differences between urban and rural households. 45 per cent of rural households in the top decile use diesel, as opposed to only 10 per cent in urban areas.[141] The second largest use of diesel is for self-generation of electricity, with 14 million litres per month.[142]

Perhaps the most critical development in Yemen's consumption patterns in the past 10 years has been the increasingly widespread use of *LPG*, following large scale government promotion programmes that include the heavy subsidization of LPG on the domestic market.[143] In consequence, LPG consumption tripled between 1995 and 2003.[144] The government of Yemen adopted these policies due to 'concerns over deforestation, the heavy time burden on rural women and children for fuelwood collection, the health impacts of using fuelwood for cooking, and the strong preference expressed by all income groups for LPG as the most desired fuel for cooking.'[145] LPG is primarily used for cooking, but also to a lesser extent for lighting, space heating, powering fridges, and agricultural pumps. Some 10 per cent of LPG consumption is in non-household use, for road transport given the price incentive to switch from gasoline to LPG.[146]

The highly subsidized prices for LPG currently make it the cheapest liquid fuel in Yemen, with the lowest cost for calorific value. A total of 78 per cent of all households reports the use of LPG, which translates into 49 per cent of the poorest households and 93 per cent in the highest income group. In the lower and medium income households, access to LPG is higher in urban than in rural areas. In urban areas, LPG is used by 97 per cent of households even in the poorest income groups.[147] Higher income groups spend relatively more on LPG than poorer households. Consumption levels per household are relatively constant in most income

[139] World Bank (2005b), 34.
[140] World Bank (2005b), 34.
[141] World Bank (2005b), 34.
[142] World Bank (2005b), 34.
[143] According to the HES 2005, LPG is the most highly subsidized of all petroleum products: in 2003, the domestic price was only 23% of the import parity price. World Bank (2005b), 77.
[144] World Bank (2005a), 25.
[145] World Bank (2005b), 59.
[146] World Bank (2005b), 60.
[147] World Bank (2005b), 62.

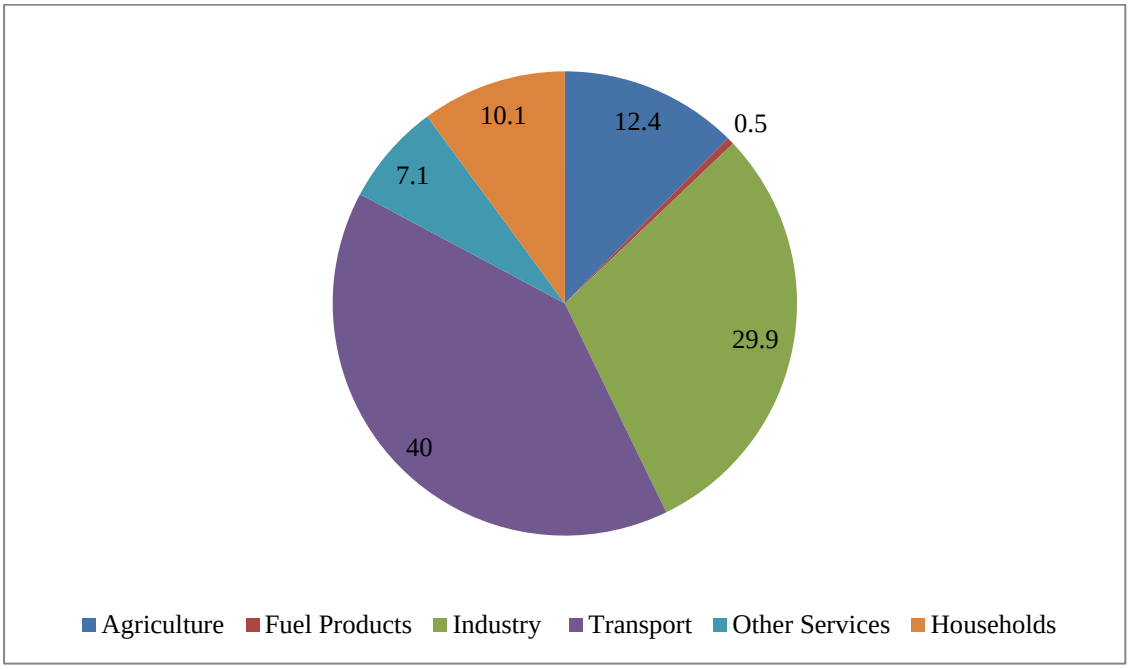
groups but fall sharply in the two lowest income groups, for whom the initial investment of LPG equipment (including the price for a large 11 kilo cylinder, the standard size sold in Yemen) appears to remain a critical hurdle to access.[148]

The retail price of LPG in the main urban areas is regulated by the government, but prices actually paid in many rural shops differ, with prices reaching almost double the official price.[149] Lack of ability to enforce regulated prices and transport costs add to the official retail price.

In 2009, total petroleum product consumption per capita in Yemen amounted to around 2.6 oil barrels per year.[150] This figure compares well to other countries in the Arab world, even those with higher per capita GDP such as Morocco, Tunisia, and Egypt.[151] However, as Figure 2 below shows, a large share of petroleum products is consumed as an intermediate input in the various sectors. The most important sectors in terms of fuel consumption are transport, followed by industry, which is dominated by the oil and gas industry. Although the volume of oil production is relatively small compared to neighbouring countries, in 2007 the oil sector accounted for 22.3 per cent of GDP, while non-oil industry accounted for a mere 14.8 per cent.[152] According to IEA data, around 20 per cent of final oil consumption is used by the oil sector.[153] The consumption of the household sector is relatively low, accounting for only 10 per cent of overall consumption. This figure, however, underestimates household consumption as it includes only direct usage of the fuel. Households are also important indirect users of modern fuels, for instance through the consumption of electricity (mainly based on oil-fired power plans), food (whose transport depends on gasoline), and water (which is extracted by pumps using diesel).

[148] World Bank (2005b), 64.
[149] World Bank (2005b), 73.
[150] Although Yemen is an LNG exporter, natural gas plays no role in the Yemeni energy mix. Hence, we only focus on the consumption of petroleum products.
[151] See Figure A1 in the Appendix.
[152] Breisinger et al. (2010).
[153] IEA (2010).

Figure 2: Sectoral Share in Liquid Fuel Consumption



Source: Breisinger et al. (2011)

3.3. Electricity

Lack of access to electricity is perhaps one of the most striking forms of energy poverty in Yemen. Only 54 per cent of Yemeni households have access to some electricity,[154] 36 per cent of which are served through the country's main Public Electricity Company (PEC) grid, the rest being connected to village-based mini-grids or use self-generators run on mostly on diesel or gasoline.[155] Where electricity is available to households, it is used for lighting, television, and some refrigeration by both well-off and poor households. In the lowlands and coastal areas, electricity is also important for cooling (ventilation or, more rarely, air conditioning) during the hot seasons. The very poor use electricity primarily for lighting.[156]

Lack of access to electricity in Yemen is primarily a problem of infrastructure, and only secondarily of income, pricing, or preference. The necessary infrastructure that is scarce in

[154] Reported figures on electricity access in Yemen vary considerably across studies. World Bank (2005b) finds that 53.4% of households have access to electricity, a considerable proportion of which is not served by the Yemeni Public Electricity Company (PEC) national grid. IEA's electricity access database on the other hand reports an electrification rate of only 38.2% in 2008. The Ministry of Energy and Electricity of the Republic of Yemen reports that in 2009, 49% of the Yemeni population were served by the Yemeni Public Electricity Company (PEC), compared to 40% in 2005. This section relies on World Bank's households survey results. However, when making comparisons with the rest of the Arab world, we use the IEA figures, as the IEA offers the most comprehensive database. Table A3 in the Appendix shows that Yemen has one of the lowest electrification rates in the Arab world.

[155] World Bank (2005b), 89.

[156] World Bank (2005a), 50.

Yemen includes both generation capacity in existing power plants, and the country's transmission and distribution (T&D) network. Yemen's total installed generating capacity in 2009 stood at 1,551 MW,[157] for a population of 24 million people. Per capita consumption of electricity in Yemen is, at some 203 KWh per capita in 2009, only one-tenth of the Arab world's average of some 2,000 KWh p.c.[158] The country's main PEC grid connects mainly urban areas and the cities, and until now has entirely excluded the former South Yemen. Overall, 92 per cent of urban households, but only 42 per cent of rural ones have access to electricity. 96 per cent of those households not served with electricity are in rural areas, making the lack of access to electricity an essentially rural problem.[159]

Where there is grid access, both residential and industrial users experience occasional shortages and load shedding. Supply disruptions occur many times during the year as a result of old, inefficient generation, and transmission and distribution (T&D) infrastructure, technical failures, and the recurring shortage of fuel, particularly diesel, in power generation plants.[160] This situation is also particularly damaging for businesses and industries, which make substantial losses from load shedding and recurring power outages. An IFC Enterprise Survey found that in 2010, more than 50 power outages were experienced countrywide, most of which lasted several hours, causing substantial commercial losses for businesses. [161] Many smaller businesses hence make the extra investment in backup diesel-fired generators, which creates additional cost.

The main reason for this situation is long term lack of investment in Yemen's utility sector, including in new capacity, the maintenance and repair of old T&D infrastructure, and the expansion of Yemen's electricity grid towards southern and particularly rural communities. Yemen's public utility PEC is severely underfunded, not least due to Yemen's government-regulated pricing system, which was originally intended to help poor people access electricity. With electricity prices having been held down artificially for years under an

[157] Republic of Yemen, Ministry of Energy and Electricity (2009b), 18.
[158] Republic of Yemen, Ministry of Energy and Electricity (2009b), 19. Comparison numbers from IEA (2010); Figure A2 in the Appendix shows that electricity consumption per capita in Yemen is one of the lowest in the Arab world.
[159] World Bank (2005b), 89.
[160] This widespread problem was for the first time thoroughly acknowledged at an unusually outspoken press conference in January 2010 by Yemen's energy and electricity minister, Awadh Al-Suqatari. Assamiee, M., 'Yemen's electricity problem in details', *Yemen Times*, 18 January 2010.
[161] IFC (2011). See also Assamiee, M. 'Yemen's Electricity Problem in Details', *Yemen Times*, 18 January 2010.

extensive electricity subsidy system, PEC has for many years been unable to recover its costs.[162] In consequence, PEC currently has neither the financial nor the physical capacity to make expensive large-scale investments in the extension of its main grid to remote provinces.

One widely-spread alternative has been the use of PEC-managed local mini-grids, and also of independent neighbourhood mini-grids that supply electricity for a few hours per day. Several foreign donor projects have also focused on mini-grid provision. Many family-owned systems, including home-generator mini systems, moreover function as informal mini-grids shared between neighbours, who pay the generating household a connection fee. Self-generation typically implies a few hours per day of service, compared with up to 24 hours a day electricity access for users of PEC main grid electricity – access to electricity is thus not only rare, particularly for the rural poor, but where access exists it is also often of poor quality at restricted hours of the day.[163] Self-generation based on non-renewable fuel is furthermore subject to the availability of the input fuel in the first place. Renewable power projects avoid this problem, but remain at the moment case-based and small scale.[164]

Illegal connections to electricity, particularly by the urban poor, are often the result of poverty and of lacking income to pay for a legal connection. An estimated one-third of PEC's electricity is thought to be wasted or stolen, an appallingly high figure in a country with a lack of sufficient power generation capacity in the first place.[165] Electricity theft and the additional problem of non-payment subsequently result in large financial losses to the Public Electricity Company (PEC), which further exacerbates the inability of PEC to extend services or reduce charges to those with an official connection.[166] Once more, the poorest are impacted most by these consequences. PEC has begun recently to introduce underground cables which are likely to reduce losses from illegal connections while also increasing the

[162] See also World Bank (2005b), 94.
[163] World Bank (2005b), 91.
[164] Some new additions include the first phase (260MW) of the Marib gas-fired plant, launched in 2009, with a further 400MW being planned in the second phase. This second phase will be jointly financed by the government of Yemen, the Saudi Fund for Development, the Arab Fund for Economic and Social Development (AFESD), and the Omani government. Another joint AFESD and World Bank project is a planned 60MW wind farm in Makha.
[165] Shaher, M., 'Billions of rials lost from electricity sector', *Yemen Times*, 12 February 2011
[166] Assamiee, M., 'Yemen's electricity problem in details', *Yemen Times*, 18 January 2010; Shaher, M., 'Billions of rials lost from electricity sector', *Yemen Times*, 12 February 2011

safety standards of its network – electrocutions of both electricity workers and people trying to illegally connect to the grid are still common in Yemen.[167]

[167] Shaher, M., 'First underground electricity cables planned for Yemen', *Yemen Times,* 27 December 2010

4. Interaction between Poverty and Energy Poverty

While it is clear that a number of factors that are linked to poverty rates – such as lack of income and of necessary infrastructure – directly impact the extent of energy poverty, energy poverty itself also has a fundamental impact on economic development in Yemen. Energy poverty must hence be seen as both a symptom of poverty in Yemen, and as a hurdle for the amelioration of poverty at the same time. Making energy, particularly more modern forms of energy, available to a large portion of Yemen's population might thus have an important supporting effect on poverty alleviation rates. The following discussion hence focuses specifically on the two-tier relationship between energy access and poverty: it follows in variable order some of the UN Millennium Development Goals which Yemen supports, i.e. enhanced food security, better access to education and health, gender issues, environmental degradation, and access to means of communication. All of these issues are discussed with reference to energy poverty, asking how the two sets of indicators mutually impact one another.

4.1. Energy and Food Security

The first and most basic Millennium Development Goal to which Yemen subscribed is the reduction of extreme poverty and hunger. Yet in recent years, Yemen has found it more difficult than before to ensure that all parts of the population have access to sufficient nutrition, and energy plays an indirect, yet very important, role in the problem. Food poverty is widespread in Yemen: in 2005 12.5 per cent of Yemenis were found to live below the national food poverty line, and thus suffered from inadequate calorie intake. The number is closely related to levels of poverty, for more than a sixth of Yemen's population, some 17.4 per cent, lived at the time on less than $1 per day, a number more than five times as large as in 1993. These figures are believed to have further worsened in the most recent years owing to soaring domestic food prices as a result of high international food prices, increasing fuel prices that increase the cost of food production, and the impact of the financial crisis on workers' remittances from abroad, and thus on household incomes.[168] Yemen's malnutrition rates among adults and children are of great concern: 45 per cent of children under the age of five are estimated to be underweight – a third severely so. In addition, 27 per cent of pregnant and 35 per cent of lactating women in Yemen are malnourished.[169]

[168] UN HLTF (2009); World Food Programme (2010), 14.
[169] UN HLTF (2009), 3.

Energy relates to food poverty by being a necessary input for the preparation of most types of food, including most basic food items that make a large contribution to the nutrition of the poor in Yemen such as bread, porridge, and sweet tea.[170] Most food items in a more varied diet, including vegetables, eggs, meat, and fish, involve substantially longer cooking than the former, with the exception of bread. Consumption is also a function of income, as the poor tend to cut back most on everything other than cereals, oil, and sugar – the main components of their most basic meals.[171] This factor may well be due to the cost associated with these food items, but the longer cooking time for these types of food additionally increases the cost per meal for the poor.[172] Yemen's most recent Household Energy Survey accordingly found that:

> Poor and very poor households limit their cooking to once a day (usually lunch) and prepare foods that require less energy in their preparation such as tea, coffee and porridge. Foods that require more energy and slow cooking, such as meat, tend to be cooked using wood. Those that require less energy, such as fish stews may be cooked over LPG. Poor and very poor households consume little meat and when they do, it is *daka* (minced meat) which lends the dish a meat flavor and requires less fuel to cook.[173]

The inability of poor households to further compromise on their expenditure on basic food items is what causes them to rely to a great extent on collected fuels for the preparation of their meals, mainly wood (which can be of very poor quality in wood-scarce areas), mixed with dung and crop residue, and other collected materials.[174] The collection of these fuels is often time-inefficient, as it directs large amounts of working time by multiple family members away from possibly paid work or education, and is hence highly poverty-reinforcing.[175] The use of inefficient stoves further exacerbates the real cost of biomass by increasing the quantities of biomass needed to cook a meal. The most commonly used forms of stove in both poor and mid-income households are the traditional three-stone open fire stove, called *massad*, and the half-enclosed, home-made *mawqad*. Both allow only the cooking of one item at a time and burn fuel wastefully. The more efficient *tanoor* allows for simultaneously baking bread and cooking meat, but is more expensive, not least because it

[170] WFP (2010), 31.
[171] WFP (2010), 31.
[172] That is in addition to the availability of refrigeration, which lengthens the time during which perishable food such as meat, vegetables, and dairy products can be safely stored.
[173] World Bank (2005a), 36.
[174] World Bank (2005a), 35.
[175] We discuss these issues separately in Section 4.2. below.

requires high quality wood. Consequently, only higher income households tend to use a tanoor.[176]

The government's policy of actively encouraging households to switch to LPG stoves has seen some positive results, with the marked rise in LPG consumption among a number of mid- and lower income groups. Subsidized LPG prices have, however, not been able to reach the poorest of Yemen's society. For these income groups, both the initial cost of LPG equipment, primarily an LPG stove, but even more the relatively high cost of a standard size LPG cylinder remain powerful deterrents. For instance, in 2005 the most basic, two-burner LPG stove, cost between YR1,200 and 1,600, and an 11 kilo cylinder of LPG cost YR2,500 to 3,000, implying an initial expenditure of no less than YR3,700, almost one half of the poorest decile's average income in Yemen of YR9,000 (around US$42) per month.[177] The poor would hence need to compromise on their already scarce food consumption in order to improve their access to LPG, whose costs they see in contrast to that of biomass, which many rural households can collect at what they perceive as zero-cost – this explains why the very poor, in the case of cooking fuels, find it so difficult to climb up the energy ladder.

Energy poverty also affects the food security of Yemen's population via its direct impact on agricultural productivity. A recent WFP report of a recent large-scale survey found that:

> crop yields remain below potential compared with levels of other countries having similar environmental conditions, which in turn keeps the agricultural income of households significantly below potential. Access to efficient and sustainable irrigation mechanisms is extremely limited and unequally distributed across governorates and socio-economic groups. Reliance on rainfall for the cultivation of crops was significantly associated with increased food insecurity at the rural household level: while 38.8 per cent of households relying on rainwater were found to be food-insecure, only 15.7 per cent using irrigation mechanisms such as cisterns and reservoirs were food-insecure.[178]

The same report finds that modern irrigation techniques using diesel-powered water pumps substantially increase crop production, [179] but pumps are expensive initially, and require diesel or gasoline, sometimes mixed with LPG, to run. [180] Lack of access to fuel, due to lack

[176] World Bank (2005a), 36.
[177] World Bank (2005a), 45.
[178] WFP (2010), 76; FAO/WFP (2009), 18–19.
[179] FAO/WFP (2009), 18.
[180] World Bank (2005a), 27.

of income or fuel price levels, has widely hindered the widespread use of better irrigation techniques, thereby impairing poor agricultural producers' ability to increase their yield. The HES of 2005 appallingly reveals that while more than two-thirds of Yemenis live in rural areas and are therefore likely to be engaged in some form of agriculture, only 4 per cent of rural households and 3 per cent of the poorest households use diesel for pumping or in generators for other uses.[181] More efficient irrigation methods could, in addition, help the country's desperate fight against the depletion of its ground water; Yemen's water levels are thought to decrease by several metres per year, consumption is far above natural recharge levels of aquifers, with more than 90 per cent of water consumption stemming from agriculture.[182] The World Bank has long complained about the wasteful water consumption of standard diesel-fuelled pumps.[183] The use of more sophisticated fuel-powered irrigation systems is likely to help the cause of efficiency.[184]

Higher crop yields would not only benefit farmers directly, they might also help Yemen alleviate its excessive reliance on imported food. An estimated 70 to 80 per cent of Yemen's cereal requirements alone are imported,[185] exposing the country to fluctuations in world market prices for grain and other food items. A look back into history reveals that this situation has not always been so, for 25 years ago Yemen was nearly self-sufficient in food production. While the country's declining ability to feed itself has multiple causes, including high population growth rates in the past 30 years, and the replacement of grain by other crops, including qat,[186] irrigation techniques remain a critical factor in addressing the issue.

4.2. Energy and Education

A strong link exists also between access to higher quality sources of energy, and access to education in Yemen. The lighting of classrooms, and of houses at times when schoolwork is being done, is essential for successful educational attainment – lighting stretches the hours of the day beyond daylight and extends the hours of work that can be done. Lighting is particularly a problem of the poor and of rural areas. The latest HES of 2005 finds that

[181] World Bank (2005a), 2, 48.
[182] UN HLTF (2009).
[183] World Bank (2005b), 44.
[184] UN HLTF (2009).
[185] UN HLTF (2009), 2.
[186] Qat is a plant used as a mildly narcotizing drug consumed throughout Yemen by men, women, and children. Estimates suggest more than half of Yemen's agricultural production is today in qat.

Yemeni schools in rural areas widely lack access to any form of energy.[187] The consequences for schools are described as:

> None of the rural schools had lighting. The bigger school districts have a morning and afternoon shift but classes must end by 4:45 p.m. due to lack of light. Schools and mosques use car batteries to power their microphones.[188]

Where electricity exists, through a mini-grid or the use of car batteries, the costs are often collected from pupils, thereby creating an unsustainable burden for very poor families.[189] In poor households, the only form of lighting by night is often only a candle or a kerosene light, seen widely as completely unsuitable for any type of work, particularly for children's schoolwork.[190] The lack of more than one light per household also forces families to gather into a single room by night, which tends to make concentrated schoolwork impossible.[191] The more efficient and brighter LPG lights which provide an alternative for electricity – often not accessible in rural homes – remain financially out of reach for many poor families. Access to electricity remains out of reach for both reasons of cost, and of access to a grid in many rural areas. Beyond lighting, fans for improved ventilation in summer, and space heating in winter, are basic needs for a suitable learning environment which are likewise a rare commodity in many rural Yemeni schools owing to the absence of electricity and of access to higher quality fuels, or to the inability of schools/parents to pay for them.[192]

The reliance of households on traditional, collected fuels has, furthermore, an indirect impact on education rates, particularly in the case of girls and women. As the traditional primary collectors of fuelwood in particular, women and girls can spend a great amount of time collecting wood (regardless of income), time which could otherwise be spent in school. Many Yemenis point out that fuelwood collection contributes to low school enrolment rates for girls.[193] The average time spent per household and month on the collection of fuelwood, according to the HES, is some 100 hours, thus on average 25 hours per week – the equivalent of a half-school day each day. Yemen still displays a vast gender gap in education. Only 55 per cent of primary school-aged girls were enrolled in primary education, compared to nearly

[187] World Bank (2005a), 35.
[188] World Bank (2005a), 53.
[189] World Bank (2005a), 53.
[190] World Bank (2005a), 43.
[191] World Bank (2005a), 43.
[192] World Bank (2005a), 53.
[193] World Bank (2005a), 49, 52.

75 per cent of boys in 2005. This does, however, already constitute a dramatic improvement to the situation of the mid-1990s, when a mere 39 per cent of girls attended primary school compared with 70 per cent of boys. Drop-out rates for girls are nevertheless high: only 65 per cent of girls who attend primary school complete the first four years of school. This low primary enrolment rate feeds through into the secondary and tertiary education of girls: the ratio of girls to boys decreased from 68 per hundred boys in primary school, to 49 in secondary school, and 37.5 at university level in 2006. Women's active contribution to registered labour outside the agricultural sector likewise remains small, at a little less than 6 per cent of the total labour force, effectively rendering the majority of Yemeni households dependent on a single earner. Collection of fuelwood also has an impact on men and boys, who may assist girls and women or accompany them over longer distances deemed too dangerous for females on their own. As a result boys may miss school as much as girls in certain regions.[194]

4.3. Energy and Health

The interrelation between energy poverty and lack of access to health care is particularly striking in Yemen. Energy, particularly electricity, is of vital importance in the functioning of health care provision, by enabling necessary lighting, space heating, refrigeration of medicines, and the use of life-saving medical equipment. Telephone lines in health centres and clinics can be essential in allowing enquiries and requests for equipment or specially skilled staff, particularly in isolated rural health centres. Energy is also essential for the running of most modern health-facilitating factors, such as access to clean drinking water and sewage systems through the use of fuel-power pumps. Lack of access to electricity in both rural and urban areas means that many health clinics are either non-operational or severely compromised. A survey by the Ministry of Health and USAID in five provinces (Amran, Al Jawf, Marib, Sa'adah, and Shabwah, representing both rural and urban areas) found that many public health facilities, including hospitals and health centres, lacked access to clean water, electricity, telephone lines, and sewage systems.[195]

This situation is severely distressful in light of Yemen's pledge to improve the population's access to health care in the coming years and decades. Child and maternal mortality rates in Yemen remain excessively high, with 92 child deaths per 1,000 births, and 210 maternal

[194] World Bank (2005b), 112.
[195] Ministry of Health & USAID (2005, 2006).

deaths in 100,000 women, far above the average of the wider region.[196] Almost all of these deaths would be avoidable if skilled health personnel attended births in adequate surroundings – such as adequately lit rooms with access to clean water and to medical machinery in case of complications and caesarean sections.[197] Child immunization, such immunization against measles, remains incomplete, with effectively only two-thirds of children of one year or less being immunized. Total lack of refrigeration in health centres, due to lack of access to electricity, effectively means that no vaccinations or other medicines that require cooling can be stored and hence given out.[198] Lowering maternal and child mortality are also key targets of the Millennium Development Goals which Yemen has striven to fulfil.

Unreliability of electricity services through power cuts have been a related problem encountered by Yemen's health system. Recurrent power cuts in hospitals hit even main cities such as Sana'a and Aden, and can last for many hours. Aden's power shortages in the past few summers led to large numbers of patients travelling to Sana'a for medical treatment, leading to the total overcrowding of hospitals in the capital. Several patients died from overheating due to the lack of air conditioning and ventilation (at temperatures above 50° Celsius), and from lack of access to life-supporting machines for several consecutive hours or days.[199]

Lack of access to piped water and electricity within the home has a similarly detrimental impact, particularly on the rural population's health. Access to drinking water and sewage systems are both essential to an individual's health, but such access is conditional on access to energy that will power both systems' water pumps. While around 90 per cent of the urban population have access to improved water facilities and sanitation, these numbers decrease to 35 per cent (for piped water) and 26 per cent (sewage) of the rural population. The health of poor households is additionally affected by the overwhelmingly higher use of low-quality, dirty fuels than is the case in wealthier households. The kind of fuel in this context is just as

[196] A 2009 UN report speaks of 365 deaths per 100,000 births, therefore estimating maternal mortality even higher. UN HLTF (2009); WHO, UNICEF, UNFPA, World Bank (2010).
[197] WHO, UNICEF, UNFPA, World Bank (2010). See also Nasser, A., 'Time to combat Yemen's maternal mortality', *Yemen Observer*, 7 March 2011
[198] Experienced, for instance, by World Bank project workers at recent project in the village of Ka'awa. Deghaili (2009).
[199] Assamiee, M., 'Increased blackouts after fires at Mukalla and Aden power stations', *Yemen Times*, 12 July 2010

important as the type of equipment and the ventilation of the house. Cooking in poor households typically takes place in the main room of the home, which is sometimes also the only room of the house. Lack of ventilation (particularly in winter when these stoves also provide the only available form of space heating) means that much of the toxic exhausts from burning wood, dung, crop, sometimes mixed with other collected materials such as paper, cardboard, or even plastic and other litter, constitute a substantial health risk to all members of household, but particularly to women and children, who spend longer periods of time in the house than men.[200]

Where wood is used with sufficient ventilation the health hazard is less. It is mainly only high-income families which can afford the luxury of a higher-quality tanoor in addition to an LPG stove, and they often have the option of cooking in a separate room. The problem of ventilation is thus mainly one affecting poor households, implying that the poor also suffer more from associated health problems such as respiratory diseases that are observed in Yemen.[201]

In part, the health problems associated with inferior fuels such as wood, but also with kerosene, have been causal to the government's decision to promote the much wider use of LPG for cooking, heating, and lighting, through extensive subsidies and public campaigns to increase the use of LPG. The uptake of LPG in recent years has been substantial, a success which may be ascribed to the above-mentioned government policies.[202] LPG consumption rose dramatically from some 7,433 tons in 1990 to 624,813 tons in 2003, the bulk of which (some 90 per cent) is used for household consumption.[203] Today, 78 per cent of all households report the use of LPG, including 49 per cent of the poorest decile, statistically a tremendous success. Still, the use of LPG stoves and lighting remains too expensive for the poorest, and is expensive enough, vis-à-vis other liquid fuels and biomass, to lead to the parallel use of several other fuels along with LPG, even in high-income households.

4.4. Energy and the Environment

A number of international organizations, including the World Bank, have for many years promoted greater environmental protection in Yemen as part of international initiatives to

[200] World Bank (2005a), 2.
[201] Rajakutty and Kojima (2002).
[202] World Bank (2005b), 59.
[203] World Bank (2005b), 59.

protect the global environment, and in response to particular sources of local concern. Environmental degradation has multiple causes including, in the case of Yemen, high population growth rates in the past three decades, and rapid urbanization rates fed by ever greater numbers of rural poor seeking work in the cities. A widespread misconception is that greater access to energy, particularly liquid fuels and electricity, to ever increasing numbers of people, must necessarily impact the environment negatively. In reality, energy poverty may be seen as part of the problem of environmental degradation, while improved access to higher quality forms of energy may actually benefit the cause of environmental protection.

Water pollution and habitat degradation are widespread problems across Yemen, and are particularly visible in the cities. The creation of urban slums, where people live with scarce access to electricity and clean water, is often coupled with the littering of urban habitats. An environmental report by the World Bank describes the living conditions of Yemen's urban poor and their impact on the environment in the following way:

> A key issue confronting Yemen is poverty, and the linkage with environmental degradation, and resource depletion – occurring in both rural and urban areas … Foremost among the environmental concerns of the urban poor arc health problems resulting from substandard living conditions that do not shield them from human excreta and other wastes and natural hazards. In most cities, it is not only the impact of urban environmental deterioration on the poor that is a concern. Poverty is itself a major factor in urban environmental degradation as the rural poor migrate to the cities in search of income-producing opportunities. The poor lack the financial resources to compete for serviced land and adequate housing in safe locations. In Sana'a the poor have no access to safe water. As a result, the poor are often forced to occupy illegal settlements on hazard prone or environmentally sensitive land.[204]

While energy poverty is part of the overall picture of the kind of poverty that is described above as leading to habitat degradation, energy also affects some key measures required to deal with the above living conditions. First and foremost, electricity, either from grid power or from fuel-powered generators, is a prerequisite for functioning fresh water and sewage systems, which form essential necessities in any urban community. Industrial contamination of groundwater in Yemen often combines with the leakage of human waste which cannot be effectively removed in cities where no functioning sanitary facilities exist; low pressure in pipes as a result of scarce pumping power leads to leakages and contamination of clean water

[204] World Bank (2000), 2.

by insufficiently transported sewage.[205] Numbers from 2000 suggest that only half of Yemen's urban population at the time had access to piped water and sanitation, which in addition to environmental concerns raises serious concerns about public health.[206]

Rural land degradation is a second problem in Yemen, and is likewise closely associated with poverty. A World Bank report of 2000 highlights the interrelation between poverty and environmental concerns in the case of Yemen in the following way:

> In rural areas, high levels of poverty often have led to environmental degradation. Households are living at levels well below subsistence levels and use soils, forest, and other resources at rates that exceed sustainable limits for recovery or renewal. The poor have no other option than to adopt short-term survival strategies which do not incorporate longer term resource management considerations. If the poor have no alternatives, they will continue to use land and water resources in ways that will threaten their future productivity.[207]

Rural land degradation consists of water depletion, sand encroachment, and increasing infertility of soil, as well as worrying rates of deforestation. Only 1 per cent of Yemen's land is covered by forest areas,[208] which is a paradox given that large parts of the population continue to rely on fuelwood, the rural poor in particular. Many rural dwellers already find it more difficult than before to access suitable woodlands, a development which also follows the re-allocation of land tenure after the 1990 reunification, and increasing pressure on existing forest and rangelands. In consequence, many households collect at increasingly large distances from their homes, which at times results in unsustainable social pressure.[209] In view of Yemen's ongoing deforestation, the need to encourage alternative sources of energy to wood seems particularly pressing.

Land degradation is a related problem. Only 3 per cent of the land is suitable for agriculture, while an estimated 60 per cent of the land is unusable desert territory.[210] The increasing use of fossil-fuelled water pumps in Yemen has, in this context, been criticized as contributing to the depletion of groundwater levels in Yemen, and therefore of having had a worsening

[205] World Bank (2000), 4.
[206] World Bank (2000), 4.
[207] World Bank (2000), 2.
[208] Government of Yemen, Central Statistical Agency (2009).
[209] The 2005 HES points out that unauthorized wood collection, as a result of changed land tenure patterns, have moreover led to various community-wide tensions. World Bank (2005a), 22.
[210] World Bank (2000), 5; Government of Yemen, Central Statistical Agency (2009).

impact on environmental protection.[211] However, the main problem regarding pump systems and water depletion appears to lie not in the use of more modern irrigation techniques *per se*, but in the wasteful use of water over and above those quantities that would realistically be needed to produce agriculturally in Yemen. Wasteful water consumption is a result of the lack of technical sophistication of irrigation mechanisms (rather than the actual use of pumps), lack of information by farmers (leading, in most cases, to a lack of alternatives to current usage patterns as long as no restrictions on the use of water are enforced), as well as the lack of a price mechanism reflecting the environmental cost of pumping water, owing to widespread and popular diesel subsidies that render the use of larger quantities of water for higher income farmers cheap because of low fuel costs for pumps. The 2005 HES subsequently points out that the partial or complete removal of subsidies on diesel (as well as on gasoline, which can also be used in pumps) might have a positive impact on water waste levels in agriculture.[212] In addition, an important structural problem underlying Yemen's water use patterns is the absence in vast parts of the country of any form of resource governance, including the regulation and management of water use.[213] With no improvement to this regulatory side of water management, even the complete absence of water pumps is unlikely to cause a substantial reversal of current water consumption patterns in Yemen.

4.5. Energy and Access to the Outside World

All modern forms of telecommunications require electricity, which currently only about half of Yemen's population has access to. The poor use electricity primarily for lighting, and only with an increase of income can people afford a television, or at lower cost, a radio, and the required electricity to run it. Yemen's telecommunications indicators reflect this lack of electricity access: out of 100 Yemenis, only 4.9 have a fixed telephone line; 14.1 have a mobile phone subscription (reflecting the easier access of wealthier Yemenis to mobile networks than to fixed line access at home), and only 1.6 have an internet subscription. These numbers are among the lowest in the world, and stand in striking contrast to data for Yemen's wealthy and well-connected next-door GCC neighbours Saudi Arabia and Oman.[214] Even simple items such as cassette tapes and microphones/amplifiers, used in schools, mosques, and other public bodies, are often unusable due to lack of electricity in many rural areas.[215] In

[211] For instance, see World Bank (2005b), 43; World Bank (2000), 2.
[212] World Bank (2005b), 42–3; World Bank (2005a), 77.
[213] World Bank (2000), 4.
[214] Numbers for 2008. World Bank (2011).
[215] World Bank (2005a), 53.

addition to compromising all the services received by rural populations, an important indirect impact of the lack of such essential infrastructure is the consequent lack of appeal many rural areas have for qualified staff in areas such as health and education. Few graduates of colleges and universities in the cities feel inclined to move to areas cut off from their surroundings, knowing the consequences to both their workplace and their homes of lack of access to electricity. Increased rural access to essential forms of telecommunications could hence also improve the chances of rural areas attracting larger numbers of skilled services.[216]

The total lack of access to basic telecommunications experienced by relatively vast parts of the population, moreover, effectively hinders communities' access to the wider world, and isolates them within their own country. Access to public administrative services, be it for legal advice, a company registration, or an application for an electricity line, is particularly difficult in far remote areas and villages in the absence of any form of telecommunications – a problem also further exacerbating existing levels of corruption at all levels of the country.[217] Yemen's difficult geography, with its widely dispersed communities, thus implies that entire regions are rendered de facto voice- and speechless in the absence of access to telecommunications.

[216] See for instance World Bank (2005a), 53.

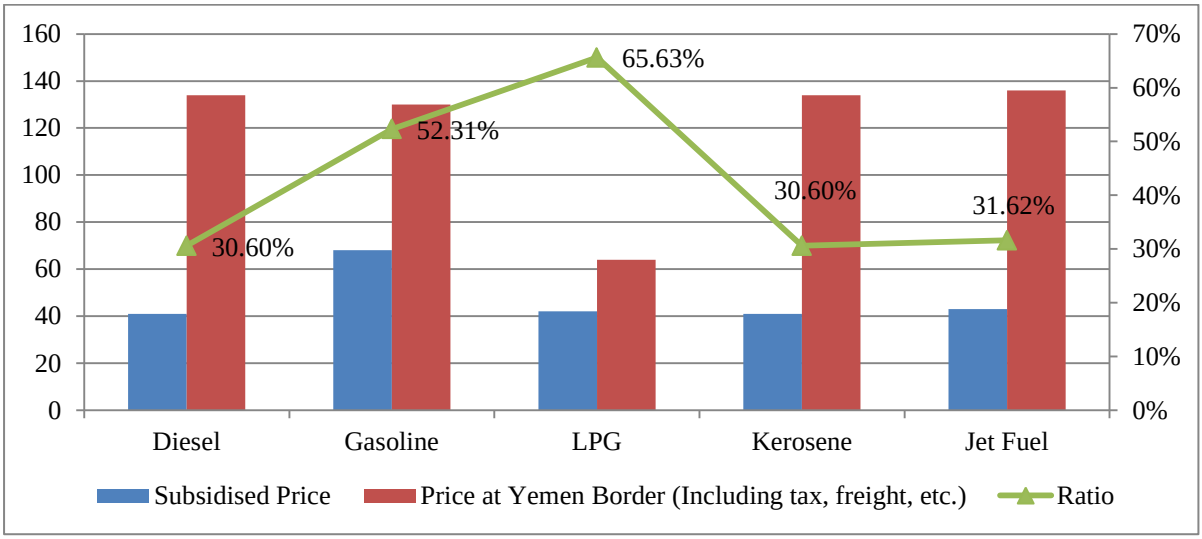
[217] See, for instance, USAID (2006). Even Yemen's energy and electricity minister now complains publically about the existing levels of corruption. Assamiee, M., 'Yemen's electricity problem in details', *Yemen Times*, 18 January 2010

5. Energy Subsidies in Yemen

Energy subsidies constitute the most important social safety net for poor households in Yemen. The government subsidizes all petroleum products regardless of whether the type of fuel is extensively used by households or industry, or is the fuel choice of the poor or the rich. The government does not operate a rule-based mechanism for pricing petroleum products, it adjusts prices in an ad hoc manner. In the early part of the 2000s, the price of petroleum products remained fairly stable with the price of gasoline fixed at 35 riyals between 2000 and 2004, the price of diesel rising slightly from 10 riyals in 2000 to 17 riyals in 2004, and the price of kerosene was fixed at 16 riyals. In 2005, the government announced that it would remove subsidies on petroleum products, but then reversed its decision under pressure from violent demonstration and riots. Following the events of 2005, the government decided to take a more cautious approach, increasing fuel prices gradually. By 2011, the price of gasoline had increased to 75 riyals, the price of diesel to 50 riyals and that of kerosene to 50 riyals. Nevertheless, as shown in Figure 3 below, the prices of petroleum products remain at a fraction of the cost of imported fuel, with diesel, kerosene, and jet fuel being the most subsidized fuels.[218] The largest share of petroleum subsidies accrues to diesel followed by gasoline and LPG. In contrast, the share of kerosene, mainly used by poor households, is quite small and has been in decline in the last few years. While the direct use of diesel is limited within poor households, it is important to note that it is widely used in the agriculture sector, for food transport, and for water extraction and transport, where currently, large segments of the Yemeni population depend on purchased water. Thus, any rise in the price of diesel would have indirect effects on households' income.

[218] Due to limited refining capacity, Yemen is forced to import petroleum products at international prices and sell them in the local market at subsidized prices.

Figure 3: Domestic Price and Price at Yemen Border by Type of Fuel (in YR/litre), 2010 Q2

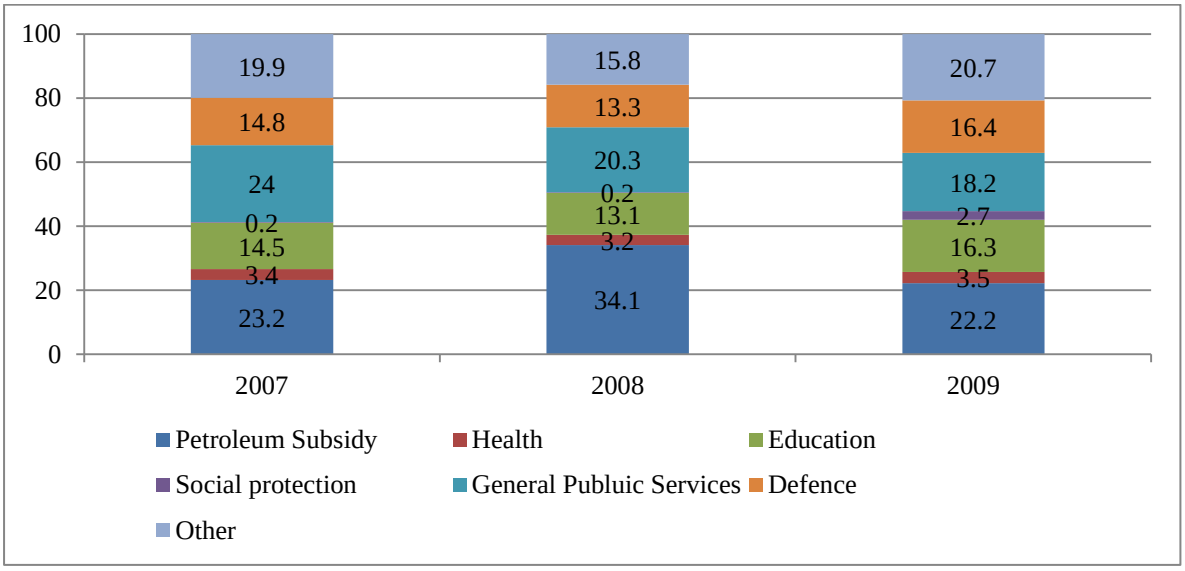


Source: Breisinger et al. (2011), Table 1.

Based on Ministry of Finance statistics, the Government of Yemen spent 23 per cent, 34 per cent, and 22 per cent of its budget on petroleum subsidies in 2007, 2008, and 2009 respectively. To put these figures in perspective, in 2009 subsidies on petroleum products exceeded the expenditure on education and that on defence, and amounted to almost seven times the expenditure on health (see Figure 4). The share of government expenditure on social protection is quite low, but rose considerably in 2009. According to the Central Bank of Yemen Annual Report 2009, expenditure on subsides in 2009 stood at 6.5 per cent of GDP, having reached 12 per cent in 2008 as a result of the hike in international fuel prices in the first half of 2008.[219]

[219] These figures should be treated with caution as they depend on the method used in calculating energy subsidies. A recent joint report by IEA/OPEC/OECD/World Bank (2010) for the G20 Summit notes that 'finding a commonly agreed definition of subsidies has proven a major challenge in the G20 context and countries have decided to adopt their own definition of energy subsidies' (page 8). International organizations such as the IEA use the price-gap methodology, which involves measuring the differential between prices of fuels in international markets and the price at which they are sold in domestic markets. On the other hand, 'OPEC is of the opinion that the benchmark price to be used in the case of energy resource well-endowed countries should be the cost of production' (page 4). The joint report recognizes the difficulties in measuring subsidies and notes that 'the price-gap method has limitations which apply particularly in the case of countries with large endowments of energy resources' (page 13). For more details, see IEA/OPEC/OECD/World Bank (2010).

Figure 4: Percentage of Total Government Expenditure by Various Categories



Source: Breisinger et al. (2011), Table 1.

It is important to stress that in practice, petroleum subsidies constitute the most important social safety net in Yemen. It is estimated that petroleum subsidies keep around 1.5 million people from slipping into poverty.[220] However, these subsidies are not targeted, which raises such issues as how much poor households benefit from existing subsidies, and whether governments can improve on this outcome.

Table 4 below shows the share for the total amount of subsidy captured, by income group, for three types of fuel: LPG, kerosene, and diesel. With the exception of kerosene, the bulk of these subsidies are captured by the top three income groups. In the case of LPG, the top three income groups capture 40 per cent of the subsidy compared to 21 per cent for the lowest three income groups. In the case of diesel, the concentration is higher, where the top three income groups capture 70 per cent of the subsidy compared to 6 per cent for the three lowest deciles. This is to be expected as poor households' consumption of these fuels is relatively low. For instance, in the case of LPG, the consumption for the top income group is three times higher than the lowest income group. In case of diesel, the top income decile consumes around 40 times the amount consumed by the lowest income decile. In contrast, the bulk of the kerosene subsidy is captured by the lowest income deciles, where the three lowest income groups capture almost 40 per cent of the subsidy compared to 22 per cent for the three top income

[220] Government of Yemen, World Bank, UNDP (2007).

groups. This therefore indicates strong evidence of substantial leakages for the high income groups, especially for diesel.

Table 4: Subsidies Accruing to Income Decile by Fuel

	Subsidy Captured by Each Decile			***Subsidy as a % of total expenditure***		
Income Decile	**LPG**	**Kerosene**	**Diesel**	**LPG**	**Kerosene**	**Diesel**
1	5	13	1	12.7	2.5	13.1
2	7	13	1	7.5	1.4	5.4
3	9	13	4	6.6	1.2	12.2
4	7	9	4	5.7	1	9.1
5	10	9	6	5.7	0.8	10.9
6	10	11	3	4.7	0.7	7.1
7	12	8	12	4.7	0.7	10.1
8	11	8	13	4.3	0.6	11.9
9	13	7	17	3.3	0.4	7.3
10	16	7	40	2.1	0.2	4.7

Source: World Bank (2005a)

Table 4 also shows the share of subsidy as a proportion of total household budget across fuels. This share tends to decline as we move up the income distribution ladder for both LPG and kerosene, with a steeper decline in the case of LPG where the share falls from 12.7 per cent for the poorest income decile to 2.1 per cent for the richest income decile. This suggests that any removal of fuel subsidies would be regressive in nature, in the sense that removal of subsidies would result in declines in income for households in all income groups, but with a greater decline for households in low income groups in relation to high income groups. In contrast, for the case of diesel, there is no uniform behaviour. For poor households, the share of subsidy for diesel out of household budget is quite high; it fluctuates in the middle of the distribution; and then falls for the top two income groups.

Regardless of the extent of leakage of benefits to unintended groups under the currently untargeted fuel subsidy programme, the fact remains that in Yemen, any removal of subsidy which is not coupled with a transfer programme would increase the incidence of poverty. Petroleum subsidies constitute the most important safety net for the poor in Yemen. The World Bank estimates that without these subsidies, the poverty rate would increase by 8.2 percentage points, with the impact being higher in rural areas.[221]

[221] Government of Yemen, World Bank, UNDP (2007)

One way to tackle the problem of leakage is to make transfers to the poor through the available safety nets. When a social safety net already exists, the budgetary savings from eliminating subsidies can be used to expand the size of the programme. In Yemen, there are a variety of social safety nets, the most important of which are the Social Welfare Fund (SWF), the Social Fund for Development (SFD), and the Public Works Fund (PWF). The main objective of the SWF is to provide support for poor households through direct transfers, for permanent social assistance or for temporary relief. The dispersal of funds is targeted on the basis of geographical criteria, and on other criteria that measure the degree of deprivation. In terms of targeting, the SWF performs relatively well, with roughly half of the SWF payment going to the poor. Although benefits do leak to the non-poor, the World Bank finds that the relative share of SWF transfer to income is progressive across the income groups. Nevertheless, the fact remains that given the limited size of the fund, it excludes the majority of the poor, and even if the safety net is extended to all the poor, the amount of transfer payment per capita is too small to make a large difference to poverty. The Yemeni government has recently expanded the size of the SWF and changed the targeting mechanism, which is expected to bring more benefits to the poor.

Another important programme is the SFD which has three main components: Community Development, Institutional Support and Capacity Building, and Small Scale Enterprise Development. According to World Bank estimates, the SFD benefits more than one million people, half of whom are women. In terms of targeting, the bulk of transfer payments accrue to the poorest income group. The PWP does not involve transfer payments, but instead attempts to create jobs through development of infrastructure projects.

It is important to note the weaknesses of the various safety nets: they adopt an ad hoc selection mechanism for beneficiaries; many locations are not covered by the programmes; and programmes deliver transfers infrequently and in an unpredictable manner. Distributing energy subsidies through existing safety nets is thus not very cost-effective and likely to miss many of the poor households.[222]

[222] Government of Yemen, World Bank, UNDP (2007).

In the case of electricity, the government's support to the electricity sector in 2008 amounted to USD 1.1 billion.[223] Part of the financial loss incurred by the PEC results from the government's low electricity prices which do not cover production costs. Given that access to electricity increases with income, the largest share of electricity subsidies is currently being captured by the top income groups and by those with a connection to the national grid. As seen from Table 5 below, only 18.6 per cent of households in the lowest income group in rural areas have access to electricity compared to 75.8 per cent in urban areas. Very poor households, both in the cities and in rural areas, find the initial connection fee for electricity access particularly expensive, given the proportionally high fee in comparison to their expected relatively small usage.[224] Only 11 per cent of the poorest are connected to the PEC grid, the rest rely on some form of (neighbourly) self-generation.[225] Access to electricity improves as we climb the income ladder both for rural and urban households. However, while in urban areas 95.6 per cent of households in the top income group have access, in rural areas only 76 per cent of households in the top income group have access to electricity. This implies that income plays a role in determining access to electricity, albeit subordinately to the physical availability of grid access in the first place.

Table 5: Access to Electricity by Income Decile

Income Decile	Urban %	Rural %
1	75.8	18.6
2	84.2	22.0
3	90.9	35.8
4	93.3	38.5
5	88.5	43.5
6	90.4	49.5
7	92.0	55.3
8	95.3	53.3
9	94.7	68.1
10	95.6	76.0

Source: World Bank (2005a).

Recently, the Yemeni government has reduced the tariff rates for small consumers while increasing those for big consumers and for the government. However, these adjustments in

[223] Assamiee, M., 'Yemen's electricity problem in details', *Yemen Times*, 18 January 2010.
[224] Very poor households typically consume electricity for about one or two light bulbs, hence a marginally small amount of electricity.
[225] World Bank (2005b), 90.

tariff rates make no difference for those not connected to the national grid i.e. mainly the poor. Low pricing policy also hurts the poor by limiting the capability of the PEC to extend its grid to poor households, especially those in rural areas. On the other hand, one of PEC's main arguments against extending Yemen's main grid in the first place is the limited usage of electricity by the poor, which tends to not cover the costs of connecting remote places in the absence of connection fees.

6. Policy Options

Tackling energy poverty in Yemen must necessarily involve a multi-tiered process that deals with the interrelated factors that cause energy poverty in the first place. The previously discussed four main factors affecting energy poverty are (i) income, (ii) infrastructure, (iii) prices of fuel and equipment, and (iv) preferences. Any comprehensive approach towards Yemen's energy poverty will require addressing all four of these factors.

1. Address income poverty. This option is most self-evident and crucial for the reduction in energy poverty. Key to improving incomes is economic growth driven not only by the hydrocarbon industry, but by a variety of sectors. Government channelling and allocation of hydrocarbon revenues, as long as these are still available, will be crucial in this context. A prerequisite for a more effective distribution of revenues will be, however, substantial improvements in the transparency and accountability of the government of Yemen and its administration. Governmental change, possibly in reaction to ongoing protests throughout the country, might positively contribute in this regard. Growth-enhancing investments into crucial sectors aimed at providing a more diversified economic base must subsequently be key to government policy.

Tax revenues from such a productive base will also be critical to support a second mechanism of addressing income poverty, through enhancing and expanding social security networks. Such an expansion must once more be accompanied by a more transparent process of distributing funds within the country so as to reduce leakages through administrative inefficiencies. A lower perception of risk, in the presence of a sounder social safety net, increases personal and small business investment, and improves the chances that children will be educated. This, in turn, enhances human capital and improves productivity. International aid can be targeted directly towards strengthening social safety nets and/or increasing the funding within existing transfer programmes.

International funding has the advantage of increasing available funds for safety nets, but it also has some disadvantages. These include instability of funding, stop and go programmes, and the problem of coordination amongst donors themselves and/or between donors and local governments. More regional development assistance funds should lead international efforts to channel international development assistance into the country – the need for which might be

more acute in the event of the collapse of the current government of Yemen. Any transition towards a more representative form of government, and the high expectations that would follow a change in government, would need the active involvement of all of Yemen's neighbours to provide timely and effective development assistance to the country.

2. Invest in Necessary Infrastructure. Well-targeted infrastructure projects that increase the availability of modern form of energy, particularly of electricity, are urgently needed in Yemen. The precarious isolation experienced by wide parts of the country for decades, not least due to lack of physical access via roads, and the virtual non-existence of electricity in half of the country, are deeply inhibiting factors to Yemen's economic development path. Other infrastructure requiring investment includes public schools, health centres and clinics, in addition to electricity lines across regions, and paved roads that make remote areas more accessible. Investment in this regard should come from both Yemen itself, and the international donor community. International and regional development assistance agencies and funds can contribute to this by targeting the infrastructure projects with the highest impact on reducing energy poverty, and financing infrastructure projects that reduce the urban/rural discrepancies.

3. Revisit Pricing Policies. It appears clear that merely subsidizing electricity has not resulted in improving access to electricity, especially for those households living in rural areas. This argument is particularly strong given the severe distortions created by low electricity prices in Yemen's investment climate for its utilities sector. An argument may be made in favour of public subsidization of T&D network expansions, and possibly of lifeline rates, if applied sensibly. In the case of fuel subsidies, the argument is far more complex. In view of the high fiscal burden of these subsidies on the government budget, and the substantial leakages identifiable within the system, a reform of the subsidy system that involves all fuels is unavoidable. Pricing remains a key guiding force in all households' decisions about fuel consumption. Thus, any pricing reform should include reforming relative prices of fuels by narrowing or widening differentials in order to promote the use of some fuels, reduce leakage, or reduce wasteful consumption. However, the burden of the reduction or removal of fuel subsidies is likely to hit poor social groups the hardest, and it is hence imperative to accompany any subsidy reductions with other forms of social safety nets to compensate for the rise in fuel prices. As long as this is not possible, fuel subsidies will remain the country's most important social safety net.

4. Target household preferences. Individual preferences clearly play an important role in household fuel choice, which may or may not be tied to economic considerations. The most evident problem lies in uninformed choices: collected fuels are preferred over purchased ones because they come at a perceived zero cost. Preference is hence given to what is perceived to be the cheapest solution to a household's fuel needs. The real cost of these inferior fuels is, however, not zero in practice because the impact of dirty fuels on health, particularly that of women and children, can be high, and the time spent on collecting fuels may be inefficiently spent if those collecting the fuel could have gone to school instead, or worked in paid employment. Tackling these preferences needs to involve targeting the socio-economic environment of families making fuel choices, most importantly through employment-creating economic activities that employ both men and women. With more employment options for both genders, the perceived cost of not educating girls and boys, and of adults collecting fuelwood rather than working, will increase. Households would then have a cost incentive to invest in more costly and more efficient fuels and equipment.

Given Yemen's current economic situation, it is also clear, however, that poor Yemeni households in rural and urban areas will continue to rely primarily on less efficient and dirtier fuels, such as biomass and also kerosene. Thus, an energy poverty strategy should also encourage more sustainable, more efficient, and safer uses of traditional fuels. This may include afforestation programmes aimed at ensuring sustainable supplies of fuelwood, and woodland areas not used for fuelwood collection; and the promotion of cleaner ways of using traditional sources of energy, such as improved stoves and ventilation in the home. Many of these measures would not involve a substantial extra cost, but would mainly imply giving better information to the population about health risks and ways to avoid them, for instance by cooking outside the house rather than inside whenever weather conditions allow. Measures could also involve clear explanations of the substantial benefit a household may gain from making minor investments in better equipment.

Appendix

Table A1: Selected Socio-Economic Indicators for Yemen and the Arab World, 2008

	Arab World	Yemen
Macroeconomic Indicators		
GDP growth (annual %)	6.36	3.65
GDP per capita (constant 2000 US$)	2937.44	559.97
Food imports (% of merchandise imports)	12.24	24.76
Foreign direct investment, net inflows (% of GDP)	5.23	5.78
Fuel exports (% of merchandise exports)	74.40	92.41
Fuel imports (% of merchandise imports)	8.05	28.89
Military expenditure (% of GDP)	4.90	4.45
Population and Labour		
Age dependency ratio (% of working-age population)	62.86	87.21
Labour force, female (% of total labour force)	24.70	20.81
Labour participation rate, female (% of female population ages 15+)	26.16	19.50
Labour participation rate, male (% of male population ages 15+)	76.33	73.40
Labour participation rate, total (% of total population ages 15+)	51.79	46.60
Population ages 0–14 (% of total)	34.18	44.21
Population ages 15–64 (% of total)	61.89	53.42
Population ages 65 and above (% of total)	3.93	2.37
Population growth (annual %)	2.07	2.87
Fertility rate, total (births per woman)	3.26	5.22
Rural population (% of total population)	44.68	69.36
Life expectancy at birth, female (years)	70.57	64.60
Life expectancy at birth, male (years)	66.85	61.31
Life expectancy at birth, total (years)	68.66	62.92
Mortality rate, adult, female (per 1,000 female adults)	129.44	202.44
Mortality rate, adult, male (per 1,000 male adults)	177.83	251.27
Mortality rate, infant (per 1,000 live births)	37.84	52.80
Mortality rate, under 5 (per 1,000)	51.66	69.50
Education		
Public Spending on Education (% of GDP)	4	5.7
School enrolment, primary, female (% net)	81*	65.68
School enrolment, primary, male (% net)	87.7*	79.42
School enrolment, primary, (%net)	84.4*	72.68
Illiteracy rate (15 years and above)	41.10	29.00
Infrastructure		
Telephone lines (per 100 people)	10.30	4.87
Improved sanitation facilities (% of population with access)	75.52	52.00
Improved sanitation facilities, rural (% of rural population with access)	63.06	33.00
Improved sanitation facilities, urban (% of urban population with access)	88.52	94.00

Improved water source (% of population with access)	81.61	62.00
Improved water source, rural (% of rural population with access)	72.71	57.00
Improved water source, urban (% of urban population with access)	90.50	72.00
Internet users (per 100 people)	16.23	1.61

Source: World Bank (2011) and Joint Arab Economic Report (2010)

* Numbers for 2007

Table A2: Selected Socio-Economic Indicators for Yemen, 1990–2009

Indicator Name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Poverty																				
Poverty headcount ratio at $2 a day (PPP) (% of population)			15.4						36.4							46.6				
Poverty headcount ratio at national poverty line (% of population)									40.1							34.8				
Poverty headcount ratio at rural poverty line (% of rural population)									42.5							40.1				
Poverty headcount ratio at urban poverty line (% of urban population)									32.3							20.7				
Population below food poverty line (rural), percentage																15.53				
Population below food poverty line (urban), percentage																4.33				
Population below food poverty line (total), percentage									17.6	17.7						12.46				
Malnutrition prevalence, weight for age (% of children under 5)			29.6				34.2	47.6						43.1						
Education																				
School enrolment, primary (% net)										55.9	58.2	65.8		71.3	73.7	75.0			72.7	
School enrolment, primary, female (% net)										41.2	46.1			58.9	61.8	64.8			65.7	
School enrolment, primary, male (% net)										70.0	69.7			83.2	85.0	84.9			79.4	
Literacy rate, adult female (% of females ages 15 and above)					17.1										35.3					44.7
Literacy rate, adult male (% of males ages 15 and above)					56.7										74.1					79.9
Literacy rate, adult total (% of people ages 15 and above)					37.1										54.8					62.4
Ratio of girls to boys in primary and secondary education (%)										49.9	55.6	55.5		60.7	62.7	65.7				
Ratio of young literate females to males (% ages 15–24)					42.7										65.0					75.5
Health																				
Maternal mortality ratio (national estimate, per 100,000 live births)														365.0						
Mortality rate, infant (per 1,000 live births)	88.0					84.4					72.5					59.3	57.0	54.9	52.8	50.8
Mortality rate, under-5 (per 1,000)	124.8					119.2					100.4					79.8	76.2	72.8	69.5	66.4
Births attended by skilled health staff (% of total)			15.9					21.6						26.8			35.7			
Fertility rate, total (births per woman)	8.1	8.0	7.8	7.6	7.4	7.2	7.0	6.8	6.6	6.5	6.3	6.1	6.0	5.8	5.7	5.6	5.5	5.3	5.2	5.1
Low-birthweight babies (% of births)					47.0			31.9												
Environment & Infrastructure																				

Forest area (% of land area)	1.0										1.0					1.0				
Improved sanitation facilities (% of population with access)	18.0					28.0					37.0					46.0			52.0	
Improved sanitation facilities, rural (% of rural population with access)	6.0					14.0					21.0					29.0			33.0	
Improved sanitation facilities, urban (% of urban population with access)	64.0					73.0					81.0					89.0			94.0	
Improved water source (% of population with access)						67.0					65.0					63.0			62.0	
Improved water source, rural (% of rural population with access)						60.0					59.0					58.0			57.0	
Improved water source, urban (% of urban population with access)						88.0					82.0					75.0			72.0	
Telephone lines (per 100 people)	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.5	1.6	1.9	2.3	2.8	3.5	3.9	4.3	4.5	4.7	4.9	5.1
Mobile cellular subscriptions (per 100 people)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.8	2.5	3.4	7.3	10.8	13.8	15.4	16.1	16.3
Energy																				
Energy use (kg of oil equivalent per capita)	204.1	237.1	246.5	203.2	202.7	220.1	216.7	222.9	231.0	253.2	260.7	281.1	264.3	284.9	302.2	312.8	316.9	323.8	326.3	
Energy use (kg of oil equivalent) per $1,000 GDP (constant 2005 PPP)	114.9	137.1	138.3	115.0	117.5	119.1	114.7	112.9	113.3	124.5	126.4	134.2	125.0	134.6	141.3	142.6	144.1	146.6	146.7	
Electric power consumption (kWh per capita)	119.5	127.1	128.3	130.9	117.6	123.0	118.6	131.6	128.4	126.8	135.6	139.6	147.1	157.1	165.9	175.7	185.4	201.8	219.9	

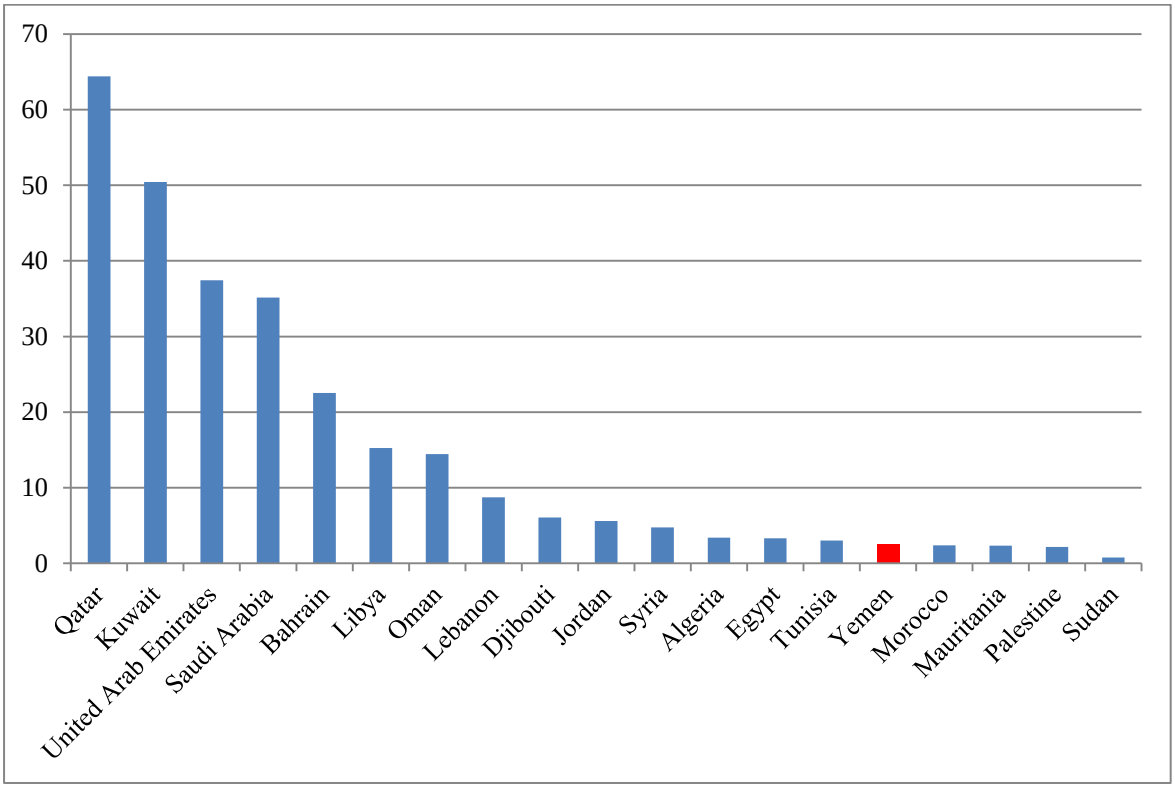
Source: World Bank (2011); Government of Yemen, Central Statistical Agency (2009).

Table A3: Electricity access in 2008 in Selected Arab Countries

	Electrification rate Total (%)	Urban (%)	Rural (%)	Population without electricity millions
Algeria	99.3	100.0	98.0	0.2
Bahrain	99.4	100.0	95.0	0.0
Egypt	99.4	100.0	99.1	0.5
Iraq	85.0	99.0	57.0	4.2
Jordan	99.9	99.5	100.0	0.0
Kuwait	100.0	100.0	100.0	0.0
Lebanon	99.9	100.0	99.3	0.0
Libya	99.8	100.0	99.0	0.0
Morocco	97.0	98.0	96.0	0.9
Oman	98.0	99.9	93.0	0.1
Qatar	98.7	100.0	70.0	0.0
Saudi Arabia	99.0	100.0	95.0	0.2
Sudan	31.4	47.5	19.0	27.0
Syria	92.7	100.0	84.0	1.5
Tunisia	99.5	100.0	98.5	0.1
United Arab Emirates	100.0	100.0	100.0	0.0
Yemen	38.2	75.0	22.0	14.2

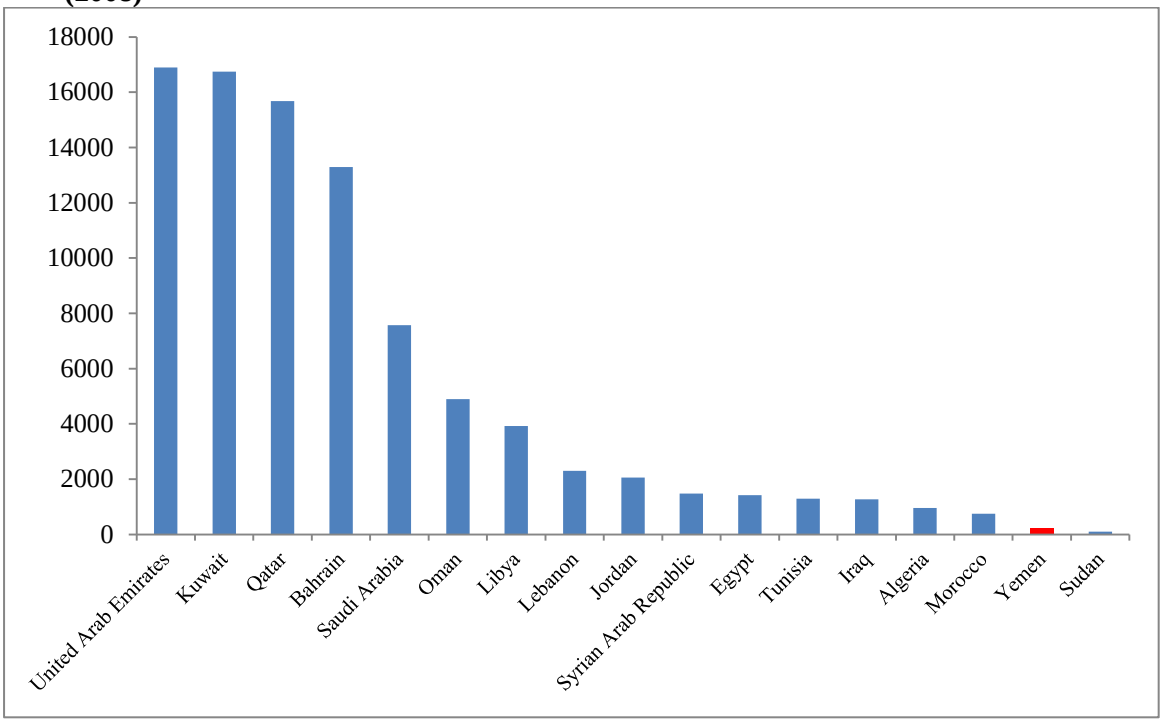
Source: IEA (2009)

Figure A1: Total Petroleum Product Consumption per capita per year (barrels of oil) in 2009



Source: Energy Information Administration (EIA), International Energy Statistics Database (EIA website) ; Includes motor gasoline, jet fuel, kerosene, distillate fuel oil, residual fuel oil, LPG, other products

Figure A2: Electricity consumption/population (kWh per capita) in Selected Arab Countries (2008)



Source: IEA Online Database.

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