Note de l'Ifri

Powering Kuwait into the 21st Century
Adopting a Sustainable Strategy

Maïté de Boncourt

September 2012

ifri
Gouvernance européenne
et géopolitique de l'énergie

The Institut français des relations internationales (Ifri) is a research center and a forum for debate on major international political and economic issues.

Headed by Thierry de Montbrial since its founding in 1979, Ifri is a non-governmental and a non-profit organization.

As an independent think tank, Ifri sets its own research agenda, publishing its findings regularly for a global audience.

Using an interdisciplinary approach, Ifri brings together political and economic decision-makers, researchers and internationally renowned experts to animate its debate and research activities.

With offices in Paris and Brussels, Ifri stands out as one of the rare French think tanks to have positioned itself at the very heart of European debate.

The opinions expressed in this text
are the responsibility of the author alone.

ISBN: 978-2-36567-060-9
© All rights reserved, Ifri, 2012

Ifri
27, rue de la Procession
75740 Paris Cedex 15 – FRANCE
Tel: +33 (0)1 40 61 60 00
Fax: +33 (0)1 40 61 60 60
Email: accueil@ifri.org

Ifri-Bruxelles
Rue Marie-Thérèse, 21
1000 – Brussels – BELGIUM
Tel: +32 (0)2 238 51 10
Fax: +32 (0)2 238 51 15
Email: info.bruxelles@ifri.org

Website: *Ifri.org*

Executive Summary

Over the last ten years, Kuwait's power consumption has doubled. This rising need for electricity has been mainly driven by the fast population growth rate, the increasing need for desalinated water, accounting for 93% of water consumption, and the economic development of the country. This electricity has been mostly generated from oil, which composes up to 73% of Kuwait power fuel mix. The amount of oil consumed in Kuwait's power sector, is therefore substantial, amounting to 8,67% of the country 2.5 million barrel per day oil production.

To evaluate the share of oil production consumed in the power sector, two different scenarios are constructed up to 2020 and extended to 2035. Oil consumption by the power sector will evolve according to the power consumption, taken on a business as usual trend of 5.6% here, the fuel input to produce 1KWh, based on the most efficient plant consumption rate today, and the share of oil in the power fuel mix. The no change scenario considers that the current fuel mix will remain relatively unchanged (70% oil and 30% gas by 2020); the new fuel mix scenario considers on the contrary a higher share of gas (60% by 2020). In both scenario the share of oil production burned into the power sector increases by 2035. Under the new fuel mix scenario, the share of oil production consumed by the power sector remains relatively constant until 2020. This scenario would have a lesser impact on Kuwait economy, however it is considered less probable than the no change scenario. Moreover these forecasts are based on very conservative assumptions; electricity consumption is indeed likely to grow much faster. This report bases power consumption growth on the observation of the last ten years, but the rate has increased faster since 2005. Moreover, the government economic development plan includes a large share of construction projects, which will likely lead to important energy consumption both for the construction phase and for the air conditioning of the new buildings. New refining activities will also be energy intensive. This in turn could increase the number of migrant workers and consequently the population would grow faster than on a business as usual trend. Consumption forecasts are well below neighbour countries estimates, and this report is also conservative compared to official forecasts data. Last but not least, other sectors such as transport or petrochemicals will need an increasing amount of oil. The domestic oil consumption will in any case in increase in the years to come.

© Ifri

This report concludes that Kuwait's power sector fuel mix and consumption path is not sustainable. In the short term, rising power consumption could lead to shortages in power capacity. Due to this unexpected power demand, capacity utilisation has been almost complete. Successive black outs in the last years led to the installation of expensive to run emergency gas fired turbines. In the no change scenario, growing power consumption would lead to decrease in oil export revenues, representing 91.6% of the state 2010/2011 budget. This would have a very negative impact on the overall economy, which is not substantially diversified yet. Costs would on the other hand increase as more power capacity would need to be installed, a larger amount of increasingly expensive fuel will have to be purchased and the state power subsidies bill, already amounting to $9 billion, will explode. While rising oil prices could compensate to a certain extent, and wait and see strategy risks locking Kuwait into a non viable path.

Recommendations:

- From a pure economic perspective, Kuwait would gain in taking advantage of the high value of oil either by choosing to export it at international market prices, who recently hit $120/barrel, or by keeping it in the ground for future generations while using cheaper gas in the future. Benefits of oil export could also still be given back to the population in the form of subsidies.

- Kuwait needs a new fuel mix strategy. The possibility to replace oil with gas in Kuwait's power plants will surely depend on the country's capacity to develop a gas strategy, either by increasing its domestic gas production or by securing gas imports at competitive prices

- The fulfillment of the Kuwait Project and the increase of oil production levels will be also decisive.

- Rapid domestic oil consumption increases could challenge the Gulf's ability to increase oil exports to support ever-growing global demand. High oil prices will in turn have the effect of encouraging the faster development of alternatives or of unconventional reserves, leaving OPEC with less control on oil prices. Domestic reform is the safest path to take in this equilibrium game.

© Ifri

Contents

© Ifri

Introduction

As skyscrapers spring up across the Gulf Countries, power consumption is booming, each day burning an increasing amount of that most highly-valued primary fuel: oil (gas-rich Qatar being an exception). The OPEC countries still represent one fourth of the global oil input used in the electricity generation sector. For economies based on oil rents, this is surprising

Kuwait has the highest dependence on oil revenues in the region. Oil earnings make up 95% of the state budget, a large share of which is redistributed in a social contract to the population in the form of various subsidies or directly through public sector jobs, providing employment to half of the working population. Globally, the importance of oil as input into electricity generation has dramatically declined in the past thirty years, mostly in response to high oil prices. Oil is indeed a highly valued commodity, hard to substitute as transport fuel or in petrochemical industries, and world demand is surging, with the gigantic needs of developing countries driving up prices.

At present, high oil prices are boosting the state oil exports revenues; scrapping past concerns about the increase of domestic oil consumption competing with share of oil available for exports. In fact, the Kuwaiti budget is running a surplus for the 12th consecutive year. Furthermore frequent new discoveries have softened fears of reserve depletion. Kuwait is doubtlessly oil rich.

But how long is its oil fuelled power system sustainable? Will domestic oil consumption compete with oil exports volumes? Many Gulf countries are already trying to restructure their power sector so as to face this new challenge. Similarly, Kuwait appears to have looked at new plans. Whether the measures being developed pave the way towards sustainability is, however, debatable.

This memorandum discusses the challenges to Kuwait's power sector's sustainability through to 2035, in terms of the security of oil supply and financial viability. The share of oil burned domestically by the power sector will depend on numerous indicators analysed in the first two chapters: Kuwait's power consumption growth, the share of oil in its power fuel mix, the efficiency of its power plants (i.e. its power sector heat rate), and the oil production level. Kuwait future power demand is projected at constant rate in chapter three. The subsequent amount of oil and gas needed depends on the power fuel mix; two scenarios are elaborated and

© Ifri

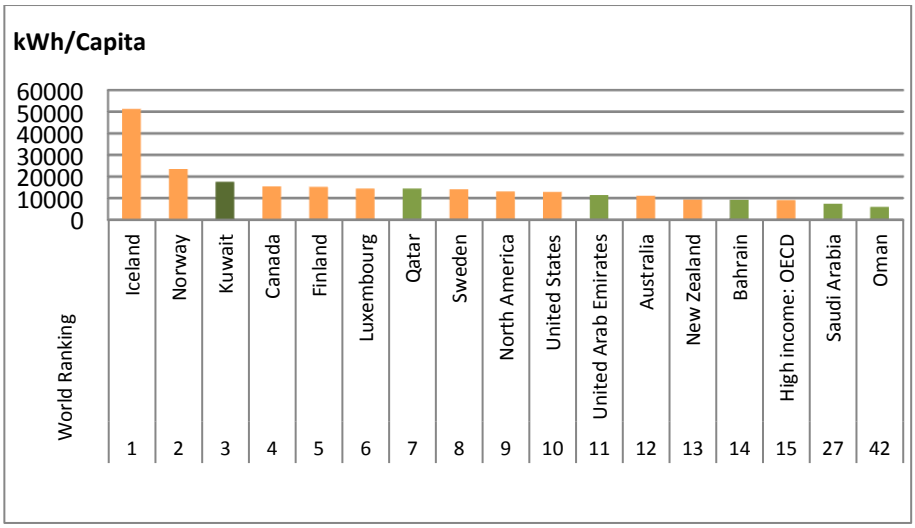
discussed in chapter four. This paper argues in the last part that with the current consumption growth rate, using oil as a fuel to produce power is not a viable strategy.

© Ifri

Kuwait's Ever-Growing Domestic Demand for Power

Over the last ten years, Kuwait's power consumption has doubled from 26,962 GWh to 46,601 GWh.[1] Its power consumption per capita now ranks among the highest in the world. Even on a regional basis, Kuwait consumes more electricity per capita than its neighbours.[2]

Graph 1: Power Consumption per Capita: World ranking of Selected Countries



Source: World Bank 2011.

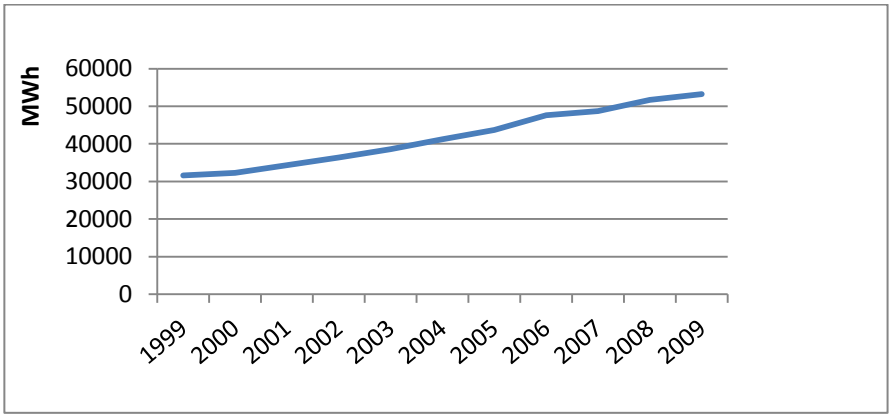
Over the ten years from 1999 to 2009, power consumption grew at an impressive annual rate of 5.3%.[3] This period was chosen as it provides a rather conservative view of the growth in Kuwait's domestic power consumption, while being sufficiently long to allow some projections to be made. In fact, the annual growth rate in power demand for 1999-2009 was smaller than in the previous twenty years. Moreover, going back earlier would actually distort the average compound growth rate as it would integrate the impact of the Gulf War, and reflect the slowing growth of demand to a lesser extent. The

1 Estimations of compound annual growth rate for 1999-2009, based on MEW statistical data 2010. MEW 6%?
2 Kuwait consumes 13,372 kWh/capita according to official data (MEW statistics)).
3 5.3% is the smoothed annualized gain of Kuwait's power consumption growth, the so called annual average compound rate.

© Ifri

period selected therefore implies rather conservative consumption growth. To meet its domestic growth needs, the Ministry of Electricity (now called Ministry of Electricity and Water, or MEW), has had to generate increasing amounts of power as shown in the graph below.[4].

Graph 2 Electricity Generation in Kuwait 1999-2009[5]



Source: MEW 2010

The demographic and economic impacts on Kuwait's rising demand for power

Power consumption has been directly linked to constant population growth, the increasing need for desalinated water and the economic development of the country.[6]

Kuwait's population is growing rapidly, although the growth rate has slowed in recent years.[7] One third of Kuwait's 3.4 million inhabitants are Kuwaiti nationals, while around 2.34 million persons are migrants, accounting for about 84% of total employment, and 95% of the private sector employment. The evolution of the population growth rate in recent years reflects the economic

4 Power generation is always higher than final power consumption, due to energy losses in the power grid, especially during summer months (around 15% in Kuwait). The graph represents the electricity transported by the grid. It therefore accounts for these efficiency losses. From 1999 to 2009, power generation grew at a rate of 5.6% against 5.35% for power consumption.

5 The graph is based on MEW 2009 Statistics. The total electricity generated includes the electricity exported to the network and the electricity consumed by power plants, probably to produce water. The 8% difference corresponds to the power consumption of desalination plants. Data do not indicate whether the 15% loss in power transmission is included: it is assumed here that they are.

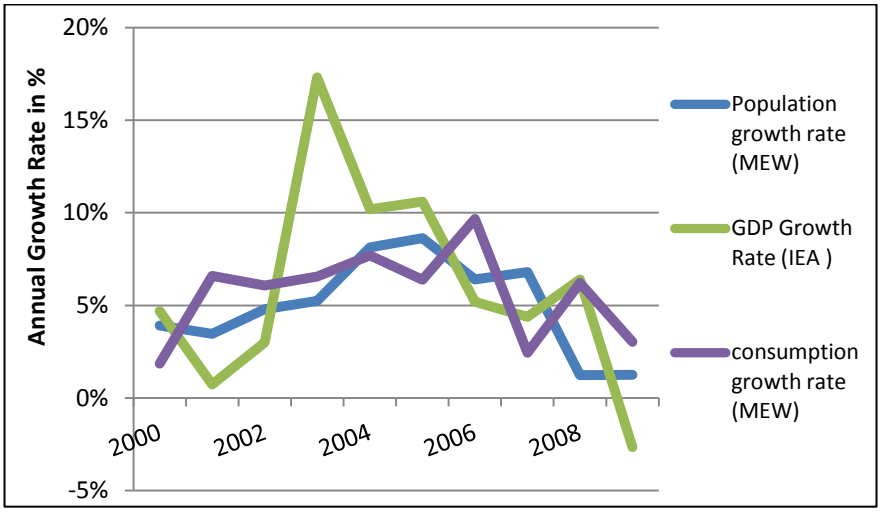
6 Kuwait's high power demand growth is in fact strongly correlated to both its population and GDP growth. For the years 1999- to 2009, the correlation factor measuring the linear relationship (resulting from the dependence) between electricity consumption and population as well as GDP is 0.99 (author's estimate on the basis of 2011 IEA data),): i.e. it is almost a perfect linear relationship.

7 For more details on the Kuwaiti population see NBK, Economic Brief, Vol.9, n°10, March 2009 available at :
http://kuwait.nbk.com/InvestmentAndBrokerage/ResearchandReports/$Document/OtherPublications/en-gb/MainCopy/$UserFiles/EBPopulationLF2009325.pdf

© Ifri

development of the country; the 2008 financial crisis led to a decrease of labour immigration. For 2005-2009, the annual average population growth rate was 3.9%[8].

Graph 3: Kuwait's GDP, Population and Power Consumption Growth, 1999-2009



Source: Author's analysis, MEW 2010 Statistics, IEA 2011 data

From 2005 to 2009, real GDP grew at a rate of 3% per year, less than in the last ten years. Fluctuations in Kuwait's GDP growth over the past ten years have reflected volatile international oil market prices and the volumes of oil produced and exported[9] rather than the country's economic development. It is thus not the most adequate indicator to analyse power consumption past and future growth.

The economic development of the country has certainly affected the consumption of power. The rise of demand in the 1970s resulted from the early development of Kuwait's petrochemical industry. The abrupt fall in the 1990s was due to the Gulf War, while the subsequent upward trend reflects post-war reconstruction.

This very high rate of consumption has also been encouraged by high electricity price subsidies, poor bill enforcement policies, and more recently by the rapid development of cities, housing and shopping malls. At the same time, little energy conservation has

8 . For 2010, the expatriate population grew at a rate of 0.5% against 3.9% for Kuwaiti nationals (source: Kuwait Economic Outlook 2011)

9 In 1997, oil prices went up following the Asian financial crisis. They went up again after 9/11, and following the decision of OPEC to decrease its export quota in 2002, prices kept rising after the Iraq war in 2003 to finally reach a peak in 2008. Kuwait oil export volumes have been limited by OPEC's production quotas, and remained relatively stable. A production peak was reached in 2008 at 2.8 mb/d, up from 2.2 mb/d in 2000, before OPEC quotas limited production in 2009 as demand weakened following the financial crisis. Production surged again this year reaching 2.8 mb/d in October 20119. OPEC adjusted its quotas after its 2011 December summit, to the real production levels of its members.

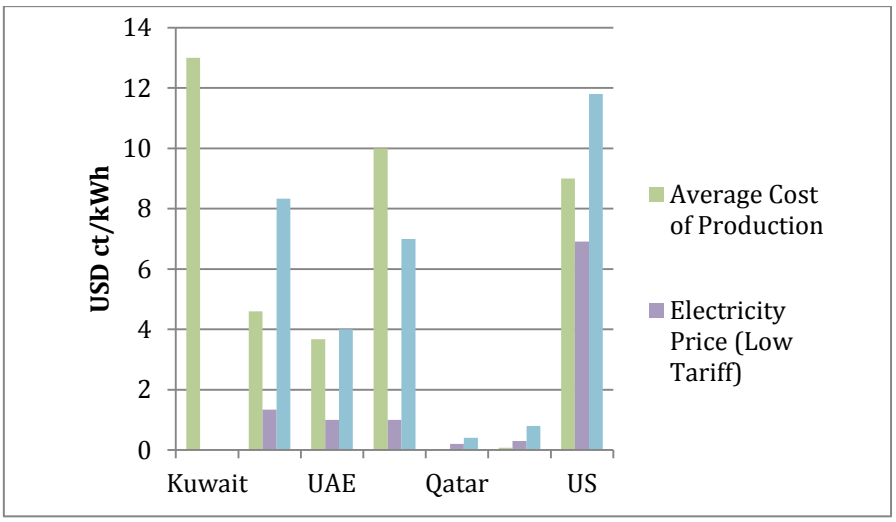
© Ifri

occurred. The residential sector now accounts for 46.9% of power demand, while 21.3% is driven by industrial growth and 12.9% goes to the trade and distribution sector.[10]

Power consumption is also indirectly linked to water consumption. In Kuwait, 93% of water demand is produced by desalination plants, consuming 8% of total power generation.[11] Along with population and GDP growth, water consumption has more than doubled in the last ten years. At 470.29l per capita per day, water consumption per capita also ranks among the highest in the world.[12]

Last but not least, power consumption in Kuwait has been encouraged by highly subsidized prices. Kuwaitis enjoy the cheapest electricity prices in the region: around $0.066 per KWh (refer to Graph 4 below). This impressive subsidy was fixed in the 1980s to encourage growth, and has remained untouched since then. Electricity sales cover a little less than one tenth of the power price, especially as payments are poorly enforced, and so do not even cover fuel costs. The price of electricity in Kuwait is fixed at 2 fils per KWh, while the cost of production is around 20 to 25 fils. The cost of fuel alone is around 26 fils/KWh (MEW 2009 statistics – author's calculations).

Graph 4: Power Generation Costs versus Electricity Prices in Selected Countries



Source: EIA, MEW, Rhadi 2010

10 Source: Kuwait Institute for Scientific Research (KISR), Conference on Technology and Poverty and Unemployment Control (ESCWA). Beirut, Lebanon, 2009 available at http://www.kisr.edu.kw/Data/Site1/images/kisr_publications/99906-41-72-2.pdf

11 Interview with Kuwaiti water sector experts

12 MEW 2009 data, UNEP data available at http://maps.grida.no/go/graphic/water_consumption_top_countries

© Ifri

Due to this unexpected power demand, capacity utilization has been almost complete. In 2006, 2007 and again in 2009, high summer temperatures led the power system to break down[13], emphasizing the urgent need for new power plants. This could mean that the temperature correction factor has been underestimated in the projections of power demand. In order to secure supply in the short term, emergency power plants were thus built in 2007-2008.Peak demand has risen even faster than the average consumption growth rate, leading to the under capacity problems. In the last ten years, capacity grew slower than power demand. On In recent years, the consumption rate has levelled off. the one hand, little industrial growth has actually occurred, due to public project delays and the slow development of the private sector. On the other hand, per capita consumption has probably reached its saturation level.

13 the principal reason for its blackouts were a congestion in the distribution system and a very small reservoir margin for the peak demands where the consumption is around 10700 MW and the maximum possible generation is 11500 MW, this is only brings a reservoir margin of 7 % when the normal reservoir margin is normally between 10 to 15%, in the year 2006 to its problem was added the failure of 300 MW from Doha West Plant leaving the system with least than 5% of share margin (source: Michael Wood, MEW consultant, quoted in http://www.thenational.ae/news/world/middle-east/blackouts-loom-in-kuwait-as-summer-sets-in#page1).

© Ifri

Burning Oil to Produce Power

To produce electricity, Kuwaiti power plants mostly burn oil. Oil has been the first-best fuel for power generation for a long time. While in other countries high oil prices, the risk of import disruption or environmental concerns have been decisive in adopting strategies to diversify energy sources, Kuwait – a small country with significant oil reserves – has not really been concerned.[14]

Kuwait is the fourth biggest OPEC producer. It currently pumps around 2.5 million barrels per day. Oil which is abundant and cheap to extract, has therefore appeared as the best fuel to produce power. Kuwait is thus still among the few countries worldwide using a large share of liquid feedstock for its power plants. The Kuwaiti power sector consumes 55% of internal oil for its primary consumption, and 8% of its total oil production[15], which is one of the highest proportions in the world.

Producer countries used to have less economic incentives than importing countries in switching out of oil in their power production, while high oil prices made no case for additional oil export. This strategy is now being called into question. Recently, the Gulf countries have become conscious of the excessive power consumption of their growth, burning oil useful to other economic sectors at rates which are hardly sustainable. Consequently, they have started to reform their power sector fuel mix. Saudi Arabia, which was using no gas at all in the 1970s, has for instance made significant efforts since then to increase the share of gas in its power

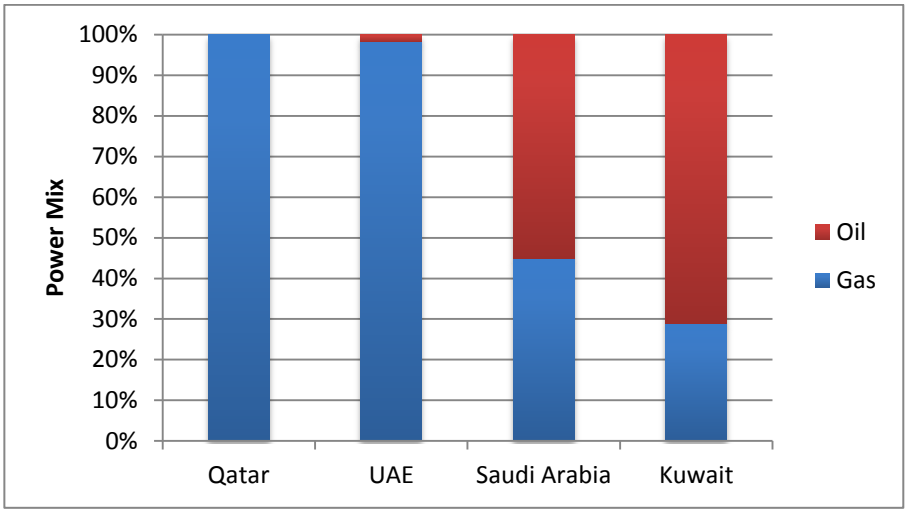
[14] According to the Energy Information Agency (EIA), Kuwait has reserves of 104 billion barrels, the 5th largest proven reserves worldwide (this includes half of the zone partitioned with Saudi Arabia) http://205.254.135.7/countries/country-data.cfm?fips=KU

[15] Consumption of oil by the power sector in Saudi Arabia has risen by 75% since 2000, to reach 9,1% of total oil production (an equivalent of 1.069mb/d out of 9.75969 mb/d produced (EIA, Joint Data Initiative, Saudi Arabia Ministry of Water and Electricity). According to the IEA, Saudi Arabia burns in comparison up to 1.2mb/d in the hottest day (http://english.alarabiya.net/articles/2011/07/14/157548.html). In the United Arab Emirates, gas constitutes the power sector main fuel (98%), with 2% only of fuel oil. In hot summer months more than 50% of the country production of gas (around 1.811 bcf) is burned in the power sector according to the oil minister (source: EIA, http://globalsmes.org/news/index.php?func=detail&detailid=619&catalog=34&lan=en&search_keywords=).

© Ifri

mix.[16] In contrast, Kuwait's power fuel mix remains largely oil based. Graph 5 gives a comparative overview of power mixes across selected Gulf countries.

Graph 5: Comparative Power Mixes in Selected Gulf Countries



Source: IEA 2010

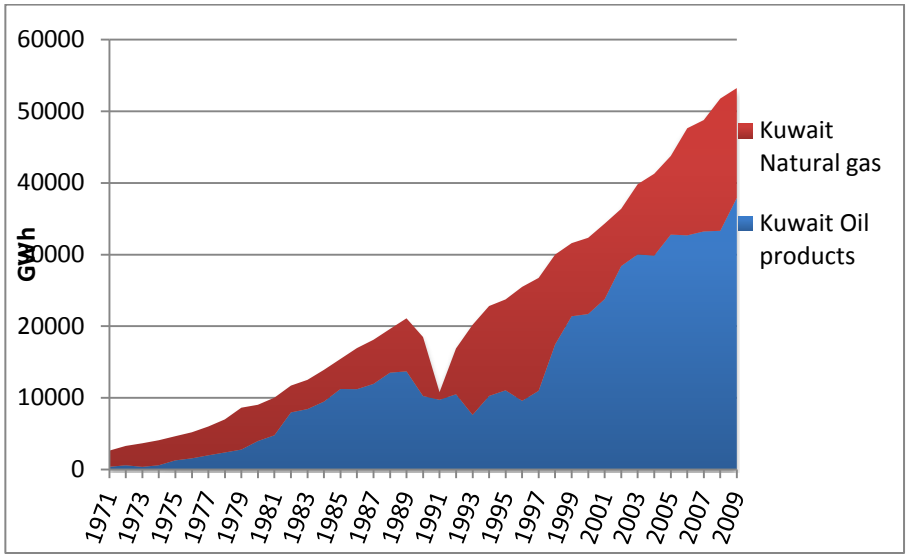
Kuwait's installed power capacity is made up of six thermal power stations burning fossil fuels. Apart from the Shuwaikh gas power plant, and the old Shuaiba power plant fuelled with gas and gasoil, all the other power plants can switch fuels, using crude oil, heavy oil or gasoil, as well as gas. Associated gas – gas produced as a side product of oil– has always been used in the power sector. While oil remains the most used fuel in power generation, Kuwait is trying to increase the share of gas. Gas nevertheless still represents a relatively small share of the total installed capacity powering steam turbines.[17]

Gas turbines and emergency power plants have been added since the 2006 black out, to meet rising demand and in particular rising peak demand. On the one hand, gas power plants have been faster to build; on the other hand, and there have been delays in projects to deliver crude and heavy oil for the power sector. The exploration of the heavy oil fields was postponed sine die, the fourth refinery tendered was not closed yet, and new technologies were needed to increase crude oil production from the older fields.

16 This effort is not adequately reflected below as values are not absolute values.
17 Gas turbines represent 28.7% of the total installed power capacity (12 579 MW).

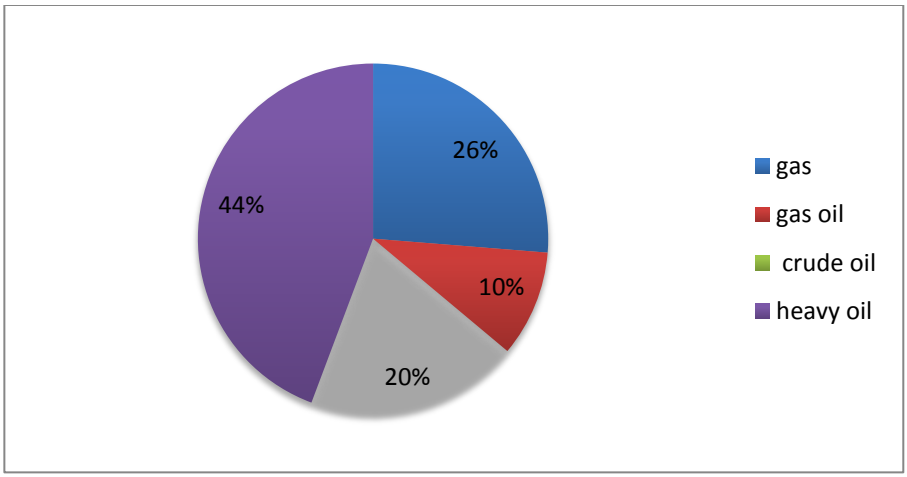
© Ifri

Graph 6: The Evolution of Kuwait's Power Mix, 1971-2009



Source: IEA 2011

Graph 7: Kuwait's Power Fuel Mix in 2009



Source: MEW 2010.

The amount of oil and gas burned to generate 1 KWh depends on the efficiency of the power plant. Old power plants and traditional steam or gas turbine power plants are less energy efficient than new technology power plants, especially if fuels are switched. The efficiency of Kuwait's power sector is measured by the *heat rate* i.e. the amount of input fuel – heat content – (Btu) per unit of output power. New power plant technologies have lower heat rates than old ones: they require less fuel to produce the same amount of power.

This indicator reveals that the Kuwaiti power sector is not very efficient. It has a high heat rate of 10,536 Btus/KWh, which means that power generation overall has a low energy efficiency of 32%, compared to 35% for the world's generating capacity. Graph 9 shows

© Ifri

the evolution of Kuwait's power sector heat rate. [18] In recent years, the efficiency of the power sector has increased slightly, thanks to the refurbishment of old power plants and the building of new efficient gas turbines. The higher rates for 2006 and 2008 are due respectively to high temperatures and the operation of emergency and little-efficient turbines used to cover surging demand peak.[19]

Kuwait power fuel mix leads to disequilibriums in the economy. Kuwait is not selling all the oil it could, as it burns 8% into its power sector. From a pure economic perspective, in order to take advantage of the high value of oil, Kuwait would either choose to export oil at international oil market prices, or keep it in the ground for future use while burning cheaper gas meanwhile. It is understandable that the massive reserves of the country benefit the population first, and therefore that oil is sold for a lower price than in other non-producing countries. Yet oil exports benefits could still be given back to the population in the form of subsidies. Such a strategy would probably limit the wasting of resources but would mainly depend on the political will and on the state ability to build a transparent and efficient system.

[18] IEA 2007 data. Oil fired power generation is more efficient: 48% for the OECD, and 37% for the world oil fired power generation. These numbers are more appropriate to compare Kuwait power sector efficiency, as it is mainly oil fired.

19 In Kuwait, the average heat rate of oil -fired power is lower than gas -fired power, because of the higher cycling of gas power stations used mostly in demand peak period. This study does not differentiate the heat rate of crude oil, gas oilgasoil or heavy oil power plants.

© Ifri

Kuwait's Future Domestic Power Demand

This chapter aims to evaluate the future fuel need of the power sector, in particular its oil consumption. To this end, future power consumption growth is assumed to grow at constant rate. This chapter assesses this possibility and indicates the amount of fuel that will be needed to produce electricity in 2020 and 2035.

The growth of power generation will remain constant, at an annual rate of 5.6%, assuming that present trends remain unchanged. This projection appears rational as regard the probable evolution of the different parameters (population, economic development, prices) and even conservative given current development policies. This projection assumes that electricity prices will remain unchanged, and subvention will still be as high as of today. MEW's electricity generation projections for 2014 are higher than the forecast presented in Graph 8.[20]

Kuwait's population will most probably grow steadily, at its current rate of 3.9% which reflects the annual growth rate of Kuwaiti nationals (unless immigration and naturalization policies change abruptly). New migration policies currently limit non-Kuwaiti population growth. In answer to a UN survey on migration in 2005, Kuwait declared its intention to lower the rate of migrants in its total population. The largest share of the Kuwaiti population belongs to the 20-39 age group. The Kuwaiti government is trying to promote the young Kuwaiti population's access to the labour market, by laws imposing higher rates of nationals and limiting the access of non-Kuwaitis to the public sector. The economic development plan, and in particular the new building projects, and certainly the need for the fast development of projects and new technologies, could on the contrary lead to a higher migration rate At constant average growth rate, the population increases at an annual growth rate of 3.9%, rising from 3.5 million inhabitants, up to 5.3 million by 2020 and more than triple that by 2035, to reach 9.4 million.

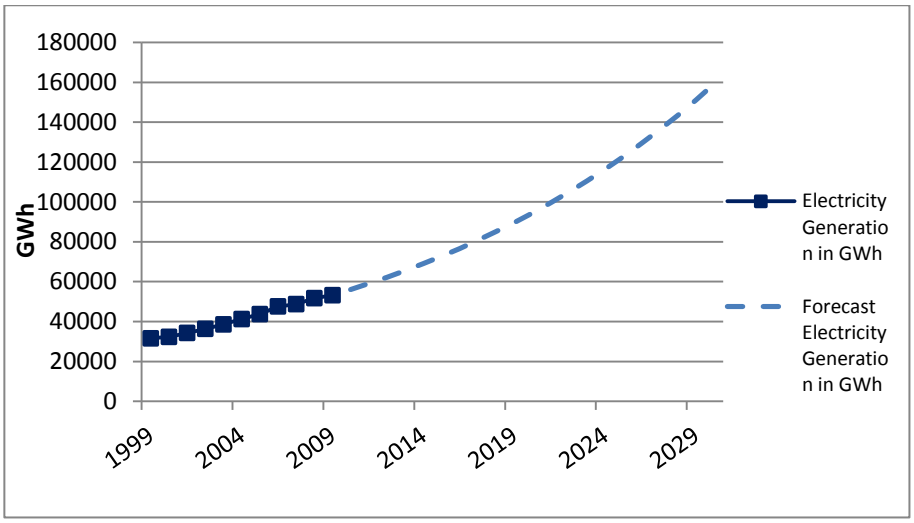
As explained in Chapter 1, the GDP is linked to oil export volumes and prices. It is likely to remain volatile and grow irregularly. The energy intensity[21] of the economy though relatively stagnant in

[20] MEW 2009 statistics.
[21] The energy intensity is the amount of energy consumed per unit of GDP

© Ifri

recent years – should increase as a result of government planning. As the government seeks to transform the country into a financial and services hub, intrinsically low energy intensive activities, a high budget share in the current Five Year Development Plan is allocated to the extension and building of new cities.[22] Given the fact that air conditioning is a decisive driver of consumption, power consumption and peak demand will probably reach very high levels, even if energy efficiency measures are being developed, in particular in the second energy code for buildings[23]. The contribution of the former building code is difficult to assess. Additionally, the government plans to develop its oil and gas sectors upstream and downstream; an energy intensive activity. This will require new amounts of both water and power.

Graph 8: Electricity Generation in Kuwait



Source: Estimation made by the author

The amount of fuel (Mbtus) needed to produce electricity will be determined by the evolution of the power sector's efficiency. The efficiency of the power sector is measured by the heat rate (the higher the heat rate, the lower the efficiency). There are two possibilities: either the efficiency of the power sector increases, i.e. the heat rate decreases, on a business as usual trend of 0.20% per year from 10,536 Btu/KWh to 10,309 MBtus/KWh by 2020 and to 10,007 Btus/Kwh by 2035 as represented on the upper curve of Graph 9. Or, the power sector's efficiency increases. Kuwait's most

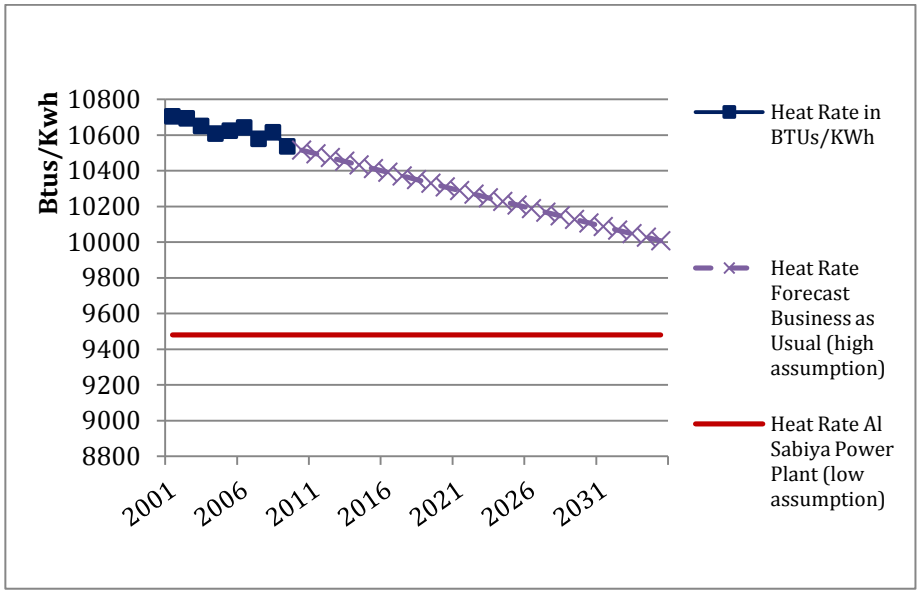
[22] More than 70% of the Five Year Plan is allocated to construction projects (($77 billion out of a $125 billion budget).

[23] Kuwait energy code for buildings has been developed as part of Kuwait energy conservation programme which started in the 70s. The first building code was applied to all new and retrofitted Air-conditioned buildings by the Ministry of Water and Electricity, and has been revised since in March 2010. It promoted among other measures the use of smaller air conditioning units to reduce the impressive energy consumption of buildings, due in particular to their air conditioning systems.

© Ifri

efficient power plant today, the Sabiya power station which has a heat rate of 9,480 Btus/Kwh, is taken as benchmark, and is represented by the red line. These two possible evolutions are shown in Graph 9.

Graph 9: The Evolution of Energy Efficiency in the Power Sector



Source : Estimation made by the author

In the next five years, old power plants will be dismantled at a faster rate than in the past, and gas fire turbines (which are amongst the least efficient plants), have a low life expectancy[24]. The efficiency of the power sector will therefore most probably be higher than on a business as usual rate.[25]

The efficiency of Kuwait's power plants could even improve more than shown in Graph 9. The MEW (Kuwait Ministry of Electricity and Water) expects power demand to double by 2020, and has launched a large reform program accordingly. Many older power plants have reached maturity and will be replaced, while additional capacity will be built, hopefully with more efficient power plants. More than half of the capacity planned for 2014 will consist of Combined Cycle Gas Turbines (CCGT) plants. These plants are much more efficient than the present steam and gas fired turbines. The most efficient CCGT turbine available today has in fact a heat rate of around 5,934 MW (GE turbine – with more than 60% efficiency), which is much less than the heat rate of Kuwait's most efficient plant currently. However, it is doubtful that Kuwait's power production system will reach such a level of efficiency. First of all, not all planned and to-be-planned power plants will use combined cycle gas technology. Secondly, power plants, including combined cycled

[24] Usually around five years.
[25] Possible improvements in the grid efficiency are not taken into account. They could further improve the sector efficiency.

© Ifri

plants, are being redesigned to allow for fuel switching, through dual fuel standard diffusion systems, and this will likely decrease their efficiency levels.

© Ifri

Kuwait's Future Oil Consumption: Jeopardizing the Security of Supply

Kuwait currently burns around 300,000 barrels of crude oil and refined products per day (8.67% of its oil production), to produce electricity.[26] Any significant increase of domestic oil consumption could put the Kuwaiti economy and social peace at risk. In fact, Kuwait remains highly dependent on oil revenues from exports, which represent 95% of its total foreign earnings. If too much oil is burned for domestic use, and less oil is available for exports, then this could decrease the state's revenues.

The future consumption of oil by the power sector will depend on the demand for electricity, the efficiency of the power sector and the fuel mix.

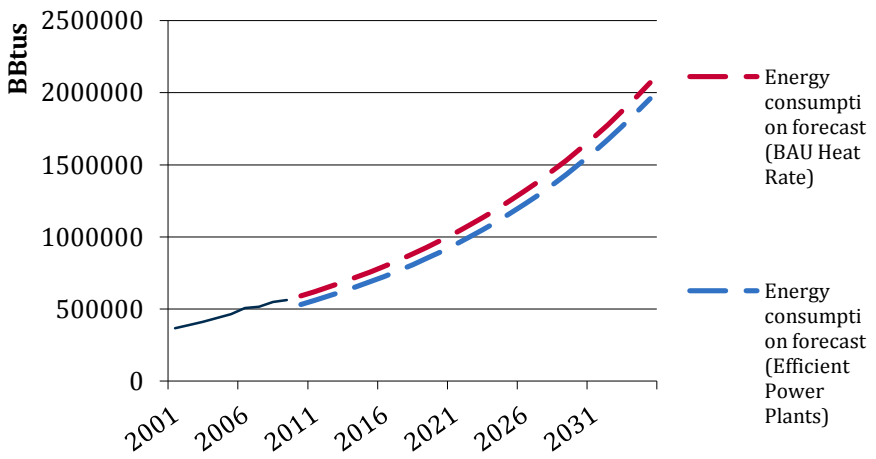
Graph 10 shows projections of the energy used by the power sector based on the evolution its efficiency. In real values, the efficiency of the power sector will be decisive for the amount of fuel consumed. However the power consumption is forecasted to grow at such a high rate, that the efficiency of the power sector will not influence the fuel input significantly (around 1%). This paper therefore assumes that the efficiency of the power sector reach the level of its most efficient plant today.

If power demand grows on a business as usual basis, Kuwait will produce 94.5 TWh of power by 2020 and 206.7 TWh by 2035 and for that purpose burn at least twice the current primary energy volumes of fuel. In turn, the share of oil production consumed will depend on the power fuel mix and the volume of oil produced.

[26] Author's estimates.

© Ifri

Graph 10: Energy Used by the power sector on the basis of different efficiency levels



Source: Estimation made by the author.

In order to evaluate the share of oil production consumed in the power sector, different scenarios are constructed through to 2035. Assumptions and hypotheses under these scenarios are then discussed. These scenarios do not take into account energy efficiency measures or the introduction of alternative technologies such as renewables or nuclear power. In contrast, it is assumed that all power projects are completed on time and that the production of oil increases as planned until 2020, and remains at 4mb/d from 2020 to 2035.

On the power sector side, the MEW has planned the retirement and modification of existing plants, and the building additional capacity through to 2014. Further capacity should come on stream by 2018, so as to achieve a plant network producing 20,000 MW by 2020. The Kuwaiti government has launched IWPP (Independent Water and Power Projects), to introduce private capital into its network, and tenders have already been launched. The future network of power plants should be much more efficient and be composed of dual plants (water desalination and power), dual fuel plants and combined cycle gas turbines. By 2014, Kuwait will obtain 7,200 MW of power from steam turbines, 1,004 MW from gas fired turbines, and 8,600 MW from combined cycle gas turbines. The following scenarios are based on the completion of these projects.

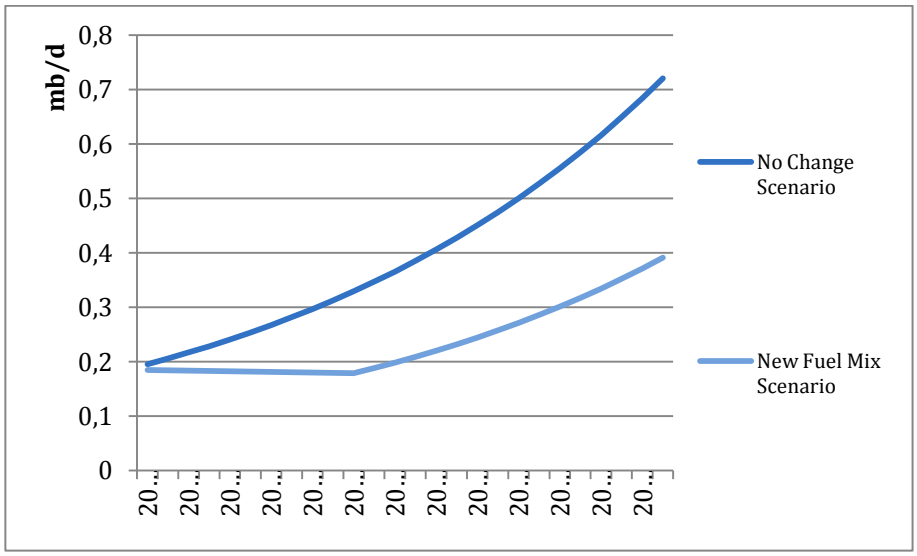
© Ifri

Table 1: Kuwait's Planned Power Capacity

	Total Installed Capacity	Total Steam Turbine Capacity		Total Gas Turbine Capacity		Total CCGT capacity		Share Gas + CCGT
2009	12579	8970	71,31%	3609	28,69%			28,69%
2010	13273	8970	67,58%	1112	8,38%	3191	24%	32,42%
2011	14593	8970	61,47%	1112	7,62%	4511	31%	38,53%
2012	16382	8970	54,76%	1112	6,79%	6300	38%	45,24%
2013	17562	8250	46,98%	1112	6,33%	8200	47%	53,02%
2014	16804	7200	42,85%	1004	5,97%	8600	51%	57,15%
2020	20000	10 000		1500		8600		

Regarding oil production, the IEA estimated Kuwait production in June at 2.5mb/d, a decrease from the 2.8 mb/d in 2008 due to OPEC tightening its quotas. Kuwait might actually have recently increased its production from the Burgan oil field.[27] In the future, the government is willing to increase its oil output to 3.5mb/d by 2015 and to 4mb/d by 2020, under the so-called Kuwait Project. The scenarios below are based on the assumption that this objective will be reached.

Graph 11: 2010-2035 Oil Consumption Forecast of the Power Sector in Mb/d, at an Efficient Heat Rate



Source: Author's own calculation

[27] Source: Gulf News, http://www.ft.com/intl/cms/s/0/a0ca9278-b821-11e0-8d23-00144feabdc0.html#axzz1jo9G9sJa

© Ifri

On the basis of these assumptions, two scenarios assess the oil to be consumed by the power sector under different power mixes

The ***new fuel mix scenario*** considers that the power fuel mix will evolve according to the planned power capacity until 2020. CCGT and gas turbines will solely operate on gas, while little fuel switching will occur. This scenario will depend on Kuwait's installed power capacity by 2035, whose gas share shall remain unchanged (60% gas power plants and 40% oil power plants). This scenario will surely depend on Kuwait's capacity to develop a gas strategy, either by increasing its domestic gas production or by securing gas imports at competitive prices.

There were recently signs of advancement for domestic gas production, with the signing of a technical service agreement with Shell in 2010, although no precise production target statements have yet been made. Gas exploration and production is likely to be less politically sensitive than oil. There is also a degree of optimism regarding the ability of Kuwait to import gas from Iraq. KEC recently participated with TPAO (Turkey) in the third bidding round of the 4.5 Tcf Siba and Mansuriya fields, in south-west Iraq. Significant delays in the building of the fourth refinery initially designed to fuel Kuwaiti power plants lends support to this scenario, as do the stalemate surrounding heavy oil field exploration in the north, and the ageing of existing fields that require IOC know-how and technology, which is still a politically sensitive issue. Additionally, Kuwait has already made significant efforts compared to its neighbours, to reduce gas flaring to 9.9%. Yet, 2.1 bcm of gas are still being flared each year, mainly in the partitioned zone. The Kuwait Petroleum Corporation (KPC) has decided to reach a target of zero flaring by 2020.[28] This, however, will hardly be sufficient.

The ***no-change scenario*** considers that the current fuel mix will remain relatively unchanged, evolving from its present composition (71.3% oil, 28.7% gas) to a power mix based on 70% oil and 30% gas. Although more than half of Kuwaiti power capacity will use Combined Cycle Gas Turbines by 2014, gas will continue to be used mostly for peak demand and power plants able to switch fuel will use oil first and foremost. After 2020, new power plant projects will be tailored for oil and heavy oil use. Although the mix remains unchanged, gas and oil use will increase in real value.

In this scenario, additional domestic oil supplies and the difficulty of importing natural gas or increasing domestic gas production by sufficient amounts will convince Kuwait to opt for more oil-fired generation. Domestic gas exploration and production is not developed in time to meet demand, while concerns over the security of supply limit the use of gas in power production. By 2015, this scenario will be challenged by the building of significant gas power

28 Source: Kuwait Makes up Gas shortfall, Middle East Economist Digest July 2011.

© Ifri

capacity. Yet in the longer term, the government is likely to complete the power station network with steam turbines, as the fourth refinery should be finished and ready to fuel new power plants. Additionally, the exploration and production of heavy fuel fields should increase Kuwaiti capacity.

If the power plants were to maximize their use of gas, this would require more than three times this amount in 2020 and seven times the amount by 2035 (see Table 2). Only part of this amount could be covered by associated gas production, which will increase along the ramping up of oil production. Therefore, non-associated gas production would have to be increased or more gas be imported.

This lack of domestic gas, and strong concerns over the security of supply explain why Kuwait has been reluctant so far to switch its power sector to gas. Kuwait recently became a net importer of natural gas. The power sector currently consumes more than half of the country's 414 Bcf domestic production {EIA data 2010}, mainly associated gas and around 130-140 mcf of non-associated gas[29]. The choice of transforming the power plants' conventional turbines into CCGT was therefore initially controversial, with KPC willing to fuel power stations with heavy oil and the Ministry of Power and Water opposing this for technical reasons[30]. Gas was finally opted for, following the discovery of a 35 Tcf non-associated gas reserve in the north of the country, and the constant delays in the building of the fourth refinery designed to produce clean fuel for power. As part of its Kuwait Project, the government objective today is to raise its northern gas production to 1 Bcf/d by 2015, and 5 Bcf/year by 2020, an ambitious target.

However, prospects for the production of non-associated gas remain uncertain. The country lacks the technical capacity for the exploration of its Jurassic gas field, whose discovery dates back to 2005. Kuwait needs technological input as gas resources in the north exist at excessively high pressures, are highly toxic and at high temperatures. The Dorrah offshore gas field (141Tcf) is also claimed by Iran and Saudi Arabia.

On the other hand, imports of natural gas have so far been restrained. To feed its internal demand, Kuwait started to import LNG. Kuwait has signed deals with Shell (in 2009) and with Vitol (in 2010), as well as for on-spot cargoes, and now imports 31 Bcf per year. Other prospects are rather limited. Projects of gas piped from Qatar have been stalled as Saudi Arabia objects to incursions in its territorial waters by foreign gas pipelines, although fair prices were negotiated. While a preliminary memorandum of understanding for the importation of natural gas from South Pars in Iran was signed in

[29] Source: Arabianbusiness.com, interview of Kuwait Oil Company Chairman Al-Rushaid, August 2011

[30] Heavy oil is more damaging for power stations, and requires frequent off-grid maintenance

© Ifri

2005, a dispute over maritime boundaries has blocked the process. In the current middle-eastern geopolitical context, the resumption of relations with Iran over energy imports remains quite unlikely. All energy trade with Iraq has been stopped since the Gulf war. Reconciliation is still pending on the UN mechanism for reparations of the 1990 invasion, on an agreement regarding the exploration of shared oil fields, and on the resolution of competitive port projects: Kuwait's planned Bubiyan terminal which is a few kilometres from Iraq's planned Grand al-Faw terminal. Moreover, Iraq seems willing to use its gas as a priority for power generation and the country's reconstruction.

Table 2 presents the share of the oil production that will be consumed by the power sector.

Table 2: Share of Oil Production Consumed by the Power Sector in %

	2010	2015	2020	2025	2030	2035
No change Scenario	7,82	6,89	8,23	10,69	13,87	18,01
With constant oil production	7,82	10,15	13,17	17,10	22,20	28,82
New Fuel Mix Scenario	7,16	4,93	4,46	5,79	7,52	9,77
With constant oil production	7,39	7,26	7,14	9,28	12,04	15,63

Source: Author's analysis, Kuwait Project production target.[31]

In these two projections, the MEW will face a real challenge to secure its feedstock. The **new fuel mix** scenario forecasts a slight impact only until 2020, rising more significantly after 2030. Under the most probable **no-change** scenario, the power sector's oil consumption will double by 2020. It will consume 17% of the total planned 4 mb/d oil production by 2035, rising from 8% in 2010. The fulfilment of the Kuwait Project, and the increase of oil production levels will be also decisive.

The ability of Kuwait to develop a gas strategy will be decisive under the New Fuel Mix scenario. Associated gas will increase along oil production, but this will hardly be sufficient to reach a 60% gas share in power production (new fuel mix scenario), and probably not even to keep a 30% share (no change scenario). Kuwait could decide

31 This graph is based on IEA data. According to the IEA, Kuwaiti oil production today is 2.5 mb/d, although production quotas have been reduced to 2.22mb/d in 2008. Oil Minister Mohammad Al-Busairi said Kuwait boosted its production way above production quota to 3 mb/d in October 2011 (http://www.arabtimesonline.com/NewsDetails/tabid/96/smid/414/ArticleID/177259/reftab/69/Default.aspx). In December 2011, OPEC agreed to raise its quota to its real production level. The Kuwait Project plans to increase oil production to 3.5mb/d by 2015 and 4 mb/d by 2020.

© Ifri

to opt for a secure gas strategy by gas resources on its soil, or find diplomatic solutions for the exploration of fields at its border with Iraq or Iran; it could also find economic ways to import gas. This new fuel mix strategy would make sense, given the revaluation of gas resources world-wide, following the production of unconventional resources. In the long term, oil is more limited than gas as a resource. Although oil and gas prices are still linked on given markets (Asia, and to a lesser extent Europe), new gas discoveries make sure the resource will be less valued than oil in the longer term.

In terms of oil volumes, forecasts made for Kuwait are less dramatic than existing forecasts for Saudi Arabia. In Saudi Arabia, 192 TWh are already consumed each year and constant trends suggest that all of the Kingdom's oil production could be burned in the power sector if nothing changes[32]. In Kuwait, the power sector does in fact not threaten to deplete oil production by itself, as the population is much smaller and growing at a slower pace. Under the relatively conservative forecasts considered, Kuwait's power sector faces little threat from a security of supply perspective.

However, while the power sector is the biggest consumer of oil, it is not the only one. In the future, oil consumption is going to increase in other economic sectors too. Industry and in particular petrochemical plants consume 27% of the total domestic oil consumption, transport 16.7%, and households the remaining 1%.[33] The fleet of 1.5 million vehicles grew at an annual rate of 13% per between 2000 and 2005.[34] Yet the density of the vehicle fleet is still lower than in western countries, and so oil consumption in transport is likely to keep increasing.[35] Additionally, a fourth refinery is planned under Kuwait Project and housing should increase under the Five Year Plan. Oil consumption by households and the petrochemical sector will increase as well. Studies forecast that aggregate domestic consumption of oil will reach the current oil output levels as early as 2025[36], and the Kuwait Institute for Science and Research (KISR) forecasts that the power sector will struggle to secure its fuel by that date[37]. Would these forecasts occur, this would disrupt dramatically

---

[32] For more information please find the newly published Chatham House report on Saudi Arabia domestic energy use at http://www.chathamhouse.org/publications/papers/view/180825

33 KISR, 2009

34 Sorour Alotaibi, Energy Policy, 2011

35 Car density is of 357/1000 residents compared to 828/1000 residents in the US source : Kuwait Government at: http://travel.state.gov/travel/cis_pa_tw/cis/cis_944.html

36 Sorour Alotaibi, Energy Policy, 2011

37 Source: Source: Kuwait Institute for Scientific Research (KISR), Conference on Technology and Poverty and Unemployment Control (ESCWA). Beirut, Lebanon, 2009

© Ifri

Kuwait's oil based economy as no more oil exports revenues would be available, forcing a gas strategy and economic diversification.

The amount of oil burned to produce power on the other hand is more critical as regards two other criteria, namely: sustainability and affordability.

© Ifri

Questioning the Sustainability of Kuwait's Oil-Dependent Economy

Risks of an Oil Production Plateau and the Feasibility of the Kuwait Project

The assumptions underpinning these three scenarios can be challenged. The first assumption is that Kuwait meets its oil production targets. This does not look very promising right now.

The future ability of Kuwait to meet its oil production targets will depend on the institutional deadlock and the improvement of the current, poor investment climate, as the country needs technological inputs. Kuwait's sovereignty over its resources and production, bans on foreign investment in the country's natural resources all leave no alternative to Technical Services Contracts (TSAs) with International Oil Companies, for whom the political risks might be too high. In fact, Kuwait's parliament, which has the right to approve budgets, and approves the decision of the central tender committee, has so far extensively used this prerogative to block individual oil exploration and production projects on grounds of corruption, and Kuwait currently ranks very low in the world ranking for FDI. Kuwait Project plans, among other things, the exploration of heavy oil fields in northern Kuwait, near the Iraqi border. These fields in particular are more difficult to explore, and require appropriate technologies. Contracts were therefore offered to IOCs, but then stalled in the face of political opposition. To meet the target, the focus has switched to the enhancement of the country's light crude production. The production of the Great Burgan field in eastern Kuwait has been constant since 1938. Enhanced oil recovery systems, through technical service contracts, are needed to stop the decline in production and enter the third recovery phase. Several companies have offered their services through heavy and long tendering procedures, though these have ended in deadlocks.

Projects in the downstream sector have encountered similar difficulties. One third of Kuwait Project's $90 billion budget has been allocated to the fourth refinery to provide fuel for power and for upgrading two other refineries dedicated to exports. However, following opposition in Parliament, the awarding of the refinery project to a Japanese and South Korean firm was scrapped at first. This has significantly delayed the project, which was initially supposed to be

© Ifri

operational by 2012 and is now postponed to 2016. The cost of the project has also risen dramatically.

Political problems therefore challenge Kuwait's ability to achieve the old Kuwait Project, proposed since 1990, to meet its oil production and refining targets, and pursue further production increases, although the budget has been dramatically increased since 2005.[38] The International Energy Agency does not forecast production above 3.5 mb/d by 2035.[39]

Kuwait's oil production will also be limited by OPEC quotas. The IEA forecasts an oil production quota of 3.5mb/d for Kuwait compared to the 4 mb/d planed under Project Kuwait.[40] Interviews with Kuwaiti oil sector representatives confirm concerns over the lifting of OPEC quotas.[41]

In sum the political risks, the need for technologies and know-how, and uncertainty over the evolution of OPEC quotas, challenge Kuwait's ability to reach its oil production target. As most of the gas produced is associated, this would in turn limit the availability of domestic gas and could lead to a larger share of oil being burned in power production.

Long Term Impacts on the State Budget

Growing power consumption associated or not with decreases in oil export revenues will, in the long term, negatively affect Kuwait's state budget.

Oil exports are the rock on which the Kuwaiti state is based. 61.4% of GDP is based on oil, and oil export revenues represented 81.6% of the state budget in 2009. They are expected to have reached 91.6% of the total budget in 2010/2011.[42] The state in turn provides around half the jobs in the country, while the private sector still represents a small share of employment. Maintaining revenues from oil exports is therefore crucial, given the lack of diversification of Kuwait's economy.

Surging power consumption, in particular if electricity is generated with oil, will increase the costs of the entire power generation sector. Kuwait's power sector fuel bill is already quite substantial: KD1.4 billion were spent in 2008 and KD2 billion for 2011

38 The Kuwait Project budget rose from $55 billion to $90 billion (source: Platts, 30th November 2010).
39 IEA, World Energy Outlook 2011.
40 The IEA World Energy Outlook 2011, and OPEC World Oil Outlook 2011, both forecast OPEC production quotas to double by 2035.
41 The current production of Saudi Arabia and Kuwait is already above their allowed quotas, particularly since the failed meeting in June 2011.
42 FMI, p17

© Ifri

($13.1 billion at current prices).[43] This bill will increase tremendously along with volumes of oil consumed and oil production costs. Currently, Kuwait enjoys very cheap oil production costs at around $50/60 per barrel (while it is around $75/80 in Saudi Arabia).[44] As more difficult oil has to be accessed and refined, operational costs are likely to rise in the years to come.

The state budget line for power costs will also grow, as more power capacity will have to be installed. The electricity cost line of the state budget is already increasing (from KD1,653 million for 2009/2010 to KD2,161 million by 2010/2011). Kuwait's current policy upgrade costs stand at around $27 billion, and the need to raise overall capacity from 14,000 MW to 25,000 MW by 2020 will add to costs.[45] Additionally, the fourth refinery has been defined as a strategic project. The refined products will not be exported to high quality fuel standard countries (it will only reach the Euro 4 standard, while Europe is already at Euro 6), and the fourth refinery is dedicated for the production of power fuel. Financial actors may be questioning the rate of return of the project, as it apparently faces financing difficulties.

The biggest problem will come from the future cost of power subsidies. Solutions have already been proposed so as to fix payment according to the amount of electricity consumed. But electricity, like oil, is considered a common good. In 2010, total subsidies amounted to $9 billion, less than Saudi Arabia's $41 billion, but much more per capita ($2,800/capita).[46]

In the worst case scenario, in which oil production reaches a plateau, while the share of oil in the power fuel mix remains around 70% Kuwait will likely face a substantial decrease in oil export revenues. Generally, the share of domestic oil consumption will increase in all cases, if the fuel mix and the efficiency of the Kuwaiti power sector evolve. These scenarios are also based on conservative forecasts of power demand. On the other hand, Kuwait's power expenses will rise in all cases.

The loss in export volumes could nevertheless be compensated by rising oil prices. Higher than expected oil prices have led to impressive budget surpluses in the last years. For the first eight months of 2011-2012, accounting revenues from oil reached KD17.8 billion ($64.8 billion), already exceeding planned revenues by KD5.4 billion.[47] Kuwait's budget was based on a $60/barrel price,

---

[43] Please refer to the following press article: "The heat is on for Kuwait" available at http://www.arabianbusiness.com/the-heat-is-on-for-kuwait-306572.html

[44] IEA, World Energy Outlook 2011, p140

[45] KD7.5 billion, available at: http://www.zawya.com/story.cfm/sidZW20110328000091

[46] IEA, World Energy Outlook 2011, p515

[47] Pétrole et Gas Arabe, January 2011

© Ifri

while the OPEC basket for 2011 was around $111/barrel.[48] This naturally leads to a feeling of impunity and wealth, which is, however, double-edged. The state budget remains highly uncertain, and volatile, subject to short term fluctuations in the oil markets. A wait-and-see strategy risks locking Kuwait into a non-sustainable path. When the time comes, the transformation of the power sector and the switch to gas may be blocked by the political deadlocks and the time spans needed to build new power plants and develop further oil and gas production.

Power Capacity Shortages

In the short term, rising power consumption could also lead to shortages in power capacity. Power consumption growth has already been underestimated in the past, leading to consumption cuts in 2006, as temperatures reached record levels. In June 2011, power consumption again reached 99% of the installed capacity, while most countries keep a spare capacity of 15%.[49] Major transmission issues and the slow rate of capacity construction are responsible for this struggle to meet demand peaks. Emergency solutions were taken, such as cuts in working days for public sector employees and the building of small emergency plants. Projects are already suffering delays. The 2009-2014 Five Year Plan was only passed in August 2011. While capacity has been planned for the next 5 years, several projects have already been delayed (Al-Zour IWPP, Sabyia were retendered and reconfigured several times between 2006 and 2009). In the absence of sufficient capacity in the future, building emergency plants could in fact decrease the power sector's efficiency and thereby increase its fuel consumption. The comparative assessment of power plants' efficiency, clearly demonstrates that emergency power plants are the least efficient. The government however is sticking to the ambitious schedule of allocating all IWPP by 2012, and recent efforts have been made in terms of project execution.

[48] Opec.org
[49] Source: Arabianbusiness.com

© Ifri

Conclusion

Kuwait relies on oil export revenues to sustain its economic model. The sustainability of the system will be challenged by the growing domestic consumption of oil, which could limit the ability of the country to export if OPEC quotas and the country oil production are not increased rapidly. The synergies of the power sector, which is consuming an increasing share of oil, could be used to solve this issue. This memorandum explains the need for change in the fuel mix and the efficiency of the power sector, as well as in consumption patterns.

Electricity Kuwait has been reluctant to depart from oil as the fuel of choice for its power sector. This memorandum shows that the sustainability of such a strategy, if such it is, is questionable in the long term. Escalating electricity demand and low priced gas will naturally challenge this position in the long term. The country has to develop a gas strategy. The availability of domestic gas is far more compelling, but even imported gas makes more economic sense.

The power sector fuel mix has been chosen given considerations of supply security, and so promotes the use of domestic fuel resources over imports, and the burning of highly-valued domestic oil, instead of lower price imported gas. The political deadlock is also responsible for the limited progress made on gas exploration and production, as Kuwait does have domestic gas reserves. Independence however is not synonymous with security, nor does self-sufficiency equal security of supply. In the case of Kuwait, this puts the economy and the social contract at stake. Without reforms of its power sector and in particular its fuel mix, Kuwait risks being locked into a non-sustainable path, which will be difficult to reverse when needed, given the time spans involved in building power plants and increasing the domestic production of crude oil. Fuel switching from gas to oil and vice-versa does seem to be a partial answer, but is not energy efficient. Nor are short term solutions of building emergency plants. The current strategy therefore carries considerable risks. If nothing changes, Kuwait could face problems in less than two decades. The Kuwait Institute for Scientific Research has forecast fuel problems for power demand as early as 2025. This may seem to be far off, but is actually a short term horizon given energy timelines. Besides sustainability, this situation ignores the opportunity of oil compared to other primary fuels. Oil would be better used in developing other sectors, or exporting production at world market prices.

© Ifri

Power subsidies are often pointed out as the primary problem. Greater efficiency and appropriate pricing could on the other hand reduce the load requirements measurably. Many solutions have already been put on the table in this regard. The government also plans to introduce renewables or increase energy efficiency. Solutions will be assessed in a forthcoming study. The gradual introduction of renewable as technologies become commercial could be part of the solution.

However, what is needed first is a dispassionate integrated plan and a clear vision of future domestic consumption as electricity infrastructure is very inflexible. Energy actors in Kuwait all have their separate scenarios for the evolution of power demand and supply, based on similar power consumption forecasts. But these scenarios are all set out on the basis of the self-interest. There is little concern for the overall sustainability of the system. Transparency could help in turn to raise awareness, and provide grounds for the introduction of more difficult measures such as cuts in subsidies.

Rapid domestic oil consumption increases could challenge the Gulf's ability to increase oil exports to support ever-growing global demand. High oil prices will in turn have the effect of encouraging the faster development of alternatives or of unconventional reserves, leaving OPEC with less control on oil prices. Domestic reform is the safest path to take in this equilibrium game.

© Ifri

Annex 1: Kuwait's Power Plants Overview

Power Plant	Capacity installed (MW)	Power produced (GWh)	Consumption (BTUs)	Consumption (GWh)	Efficiency (%)
Shuwaikh Station	252	325	1,0068E+13	2950,651133	11%
Shuaiba Stn.	1380	4290	4,8413E+13	14188,50549	30%
Doha East Stn.	1158	4769	5,5336E+13	16217,44449	29%
Doha West Stn.	2512,8	12086	1,24319E+14	36434,44559	33%
Az-Zour South Stn.	4376	19055	2,0225E+14	59273,85694	32%
Sabiya Stn.	2900,2	12691	1,20313E+14	35260,39827	36%
Total	9426,8	53216	5,60699E+14	164325,3019	32%

© Ifri

Annex 2: Kuwait planned power capacity by technology 2010-2014

Capacity Installed	Total MW	Oil Steam Turbines (MW)	Share of Oil Steam Turbines	Gas fired turbines (MW)	Share of Gas fired turbines	Combined Cycled Gas Turbines	Share of CCGT
2009	12579	8970	71,31%	3609	28,69%		
2010	13273	8970	67,58%	1112	8,38%	3191	24%
2011	14593	8970	61,47%	1112	7,62%	4511	31%
2012	16382	8970	54,76%	1112	6,79%	6300	38%
2013	17562	8250	46,98%	1112	6,33%	8200	47%
2014	16804	7200	42,85%	1004	5,97%	8600	51%

Source: MEW

© Ifri

Sources

Beside the press articles and interviews made in Kuwait with key actors of the power and oil sector, this note refers to the following sources:

Alotaibi Sorour, Energy Consumption in Kuwait, Prospects and Future Approaches, Energy Policy, vol 39, 637-643, 2011

Central Statistical Office (State of Kuwait), http://www.cso.gov.kw/

Energy Information Agency, http://www.eia.gov/kids/energy.cfm?page=about_energy_conversion_calculator-basics

International Energy Agency, *World Energy Outlook 2011*, Paris, 2011

International Energy Agency, *Statistics: Kuwait*, 2011

International Monetary Fund, Kuwait: Statistical Appendix, IMF Country Report No. 11/219, Washington DC, July 2011

KAMCO Research, Kuwait Economic Oulook: Changing Times... Adapting to New Economic Reality, February 2011

Kuwait Institute for Scientific Research (KISR), Conference on Technology and Poverty and Unemployment Control (ESCWA). Beirut, Lebanon, 2009 available at http://www.kisr.edu.kw/Data/Site1/images/kisr_publications/99906-41-72-2.pdf

Kuwait's Ministry of Water and Electricity, Statistical Data 2006-2010

Lahn G. & Stevens P, "Burning Oil to Keep Cool: The Hidden Energy Crisis in Saudi Arabia", December 2011, available at: http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/1211pr_lahn_stevens.pdf

NBK, Economic Brief, Vol.9, n°10, March 2009 available at http://kuwait.nbk.com/InvestmentAndBrokerage/Researchand

© Ifri

Reports/$Document/OtherPublications/en-gb/MainCopy/$UserFiles/EBPopulationLF2009325.pdf

OPEC Organization of the Petroleum Exporting Countries, *World Oil Outlook*, Vienna, 2011

OPEC Statistics 2011, available at http://www.opec.org/opec_web/en/

Rhadi H., On the Value of Decentralised PV systems for the GCC residential sector, Energy Policy, 2011 available at: http://ipac.kacst.edu.sa/eDoc/2011/191408_1.pdf

Research and Markets, Kuwait Oil and Gas Report, 2010-2011, available at: http://www.businesswire.com/news/home/20110217005762/en/Research-Markets-Kuwait-Oil-Gas-Report--

The Emirates Centre for Strategic Studies and Research, Future Arabian Gulf Energy Sources, *Hydrocarbon, Nuclear or Renewable?*, Abu Dhabi, 2008

© Ifri