Report No. 49923-SY

Syrian Arab Republic
Electricity Sector Strategy Note

August 15, 2009

Sustainable Development Department (MNSSD)
Middle East and North Africa Region (MNA)

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Energy Sector Management Assistance Programme

Document of the World Bank

CURRENCY EQUIVALENTS
(Exchange Rate Effective March 31, 2009)
Currency Unit = Syrian Pound (SP)
US$ 1 = SP 48.43

ABBREVIATIONS AND ACRONYMS

AGP	Arab Gas Pipeline
CCGT	Combined-Cycle Gas Turbine
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CF	Carbon Finance
CFB	Circulating Fluidized Bed
CFL	Compact Fluorescent Light
CTF	Clean Technology Fund
DNA	Designated National Authority
EB	Executive Board
EE	Energy Efficiency
EPC	Engineering, Procurement and Construction
EU	European Union
GHG	Greenhouse gases
GoS	Government of Syria
HFO	Heavy Fuel Oil
ICA	Investment Climate Assessment
IGCC	Integral Gasification Combined Cycle
IPP	Independent Power Producer
KP	Kyoto Protocol
LM	Load Management
LNG	Liquefied Natural Gas
MSP	Mediterranean Solar Plan
MTOE	Million Tons of Oil Equivalent
NERC	National Energy Research Center
p.a	per annum
PEDEEE	Public Establishment for Distribution and Exploitation
PEEGT	Public Establishment for Electricity Generation and Transmission
PPA	Power Purchase Agreement
PPP	Public-Private Participation
SGC	Syrian Gas Company
RE	Renewable Energy
RE	Renewable Energy
VER	Verified Emission Reduction

Vice President:	Shamshad Akhtar
Country Director:	Hedi Larbi
Sector Director:	Laszlo Lovei
Sector Manager:	Jonathan D. Walters
Task Team Leader:	Husam M. Beides

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This document was written by Husam Beides, Ananda Covindassamy, Waleed Alsuraih, Henk Busz and Khalid Boukantar with contributions from Mohab Hallouda, Paul Noumba Um, Maria Vagliasindi and Antony Lim. The team is grateful for guidance provided by Jonathan Walters, comments provided by peer reviewers Ashok Sarkar, Hossein Razavi, and Masaki Takahashi and for Anna Bjerde for leading this work at its initiation. The authors are also grateful to the staff of the Ministry of Electricity in Syria who provided valuable support and cooperation in the preparation of this report.

The document was prepared in part by assistance from the Energy Sector Management Assistance Program (*ESMAP*). *ESMAP* is a global technical assistance program which helps build consensus and provides policy advice on sustainable energy development to government of developing countries and economies in transition. *ESMAP* also contributes to the transfer of technology and knowledge in energy sector management and the delivery of modern energy services to the poor. For more information on the program see the website www.esmpap.org

EXECUTIVE SUMMARY

This Electricity Sector Strategy Note was prepared by the World Bank, at the request of the Government of Syria. It identifies options for the Government to improve the financial and technical performance of the electricity sector. The note focuses in particular on the following ***major sector objectives***:

- Increasing the efficiency of the electric power sector, including by reducing large technical and commercial losses now standing at 27% of demand;
- Reducing the growing gap between demand and supply of electricity through capacity expansion, thus enhancing security of electricity supply and reducing power outages;
- Increasing security of supply further in an environmentally sustainable manner by developing vigorous energy efficiency and renewable energy programs;
- Encouraging regional energy integration through a series of targeted investments in electric power and natural gas;
- Attracting private sector investment into generation capacity expansion, including in renewable energy, through Independent Power Producers;
- Making the electricity sector financially viable and coordinating natural gas production plans with electricity generation requirements;
- Introducing electricity sector reforms and associated institutional changes to facilitate and enable the above.

Electricity Sector Challenges

The Ministry of Electricity regulates and manages the electric power sector. *The Public Establishment for Electricity Generation and Transmission (PEEGT)* is responsible for planning, development, operation and maintenance of the generating plants and transmission networks. The *Public Establishment for Distribution and Exploitation of Electric Energy (PEDEEE)*, has similar responsibilities for the distribution network.

After years of relative stability the Syrian power sector is now facing a number of major challenges, including rapidly growing electricity demand; a widening demand-supply gap, leading to frequent load shedding; large technical and non-technical losses in the network; fuel security issues due to an inadequate supply of domestic gas; a deteriorating financial performance, requiring large Government subsidies; and the need to attract private financing to help close the demand-supply gap. Exhibit 1 shows some major sector organization and performance indicators for Syria compared with other countries. It shows that Syria lags behind these countries on each of these major indicators.

Exhibit 1: Syria Sector Performance Benchmark

	Syria	Jordan	Egypt	Morocco	Turkey	Romania	Bulgaria
Sector Structure Indicators							
Unbundled	P	Y	Y	N	Y	Y	Y
Corporatized	N	Y	Y	Y	Y	Y	Y
Regulator	N	Y	Y	Y	Y	Y	Y
Private Investments	N	G, D	G	G, D	G, D	G, D, T	G, D,T
Performance Indicators							
System Losses (%)	27	17	16	16	17	11	13
Outage Frequency (Day/yr)	43	0.3	18	5.8	3.1	3.0	2.8
Average Tariff (USc/Kwh)	4.42	7.0	2.0	11.0	13.1	15.9	10.6

P: Partial. Y: Yes. N: No. G: Generation. T: Transmission. D: Distribution

These electricity sector challenges can be addressed by a significant change in Government policy towards the energy sector. They include notably measures such as:

- Commercialization of generation, transmission and distribution, including unbundling into separate units and subsequent corporatization as state-owned companies;
- Substantial adjustments in electricity tariff structure and levels, including coordination with input fuel prices (gas and heavy fuel oil);
- Major technical and non-technical electricity loss reduction programs;
- Major investments in the order of about US$10.5 billion in generation, transmission and distribution through 2020
- Strong support for, and implementation of, substantial energy efficiency and renewable energy programs; and

This Executive Summary summarizes the issues and recommends proposed actions.

Electricity Demand and Supply

Demand: During 2002-2007, the demand for electricity in Syria increased on an average by a very high rate of 7.5% per year, caused by: (i) strong economic growth; (ii) electricity tariffs that are below cost recovery level and that do not encourage energy efficiency; (iii) high technical and non-technical network losses; and (iv)an inflow of refugees from Iraq. During the same period, the power system experienced increasing difficulties in meeting demand. Load shedding increased sharply starting in 2006 (Exhibit 2).

Exhibit 2: Unserved Load Due to Load Shedding (in GWh)

	2002	2003	2004	2005	2006	2007
Unserved load	86.3	83.4	103.8	55.0	345.1	427

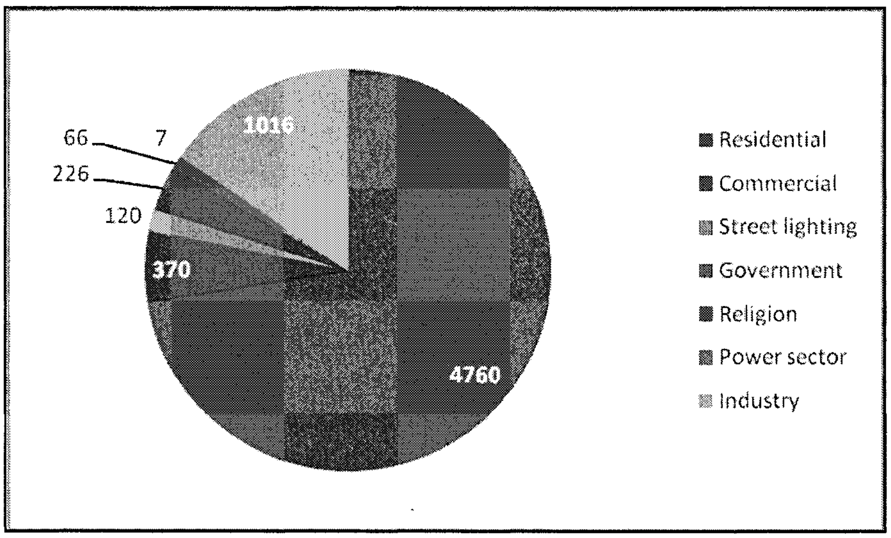
In 2007 PEDEEE had about 4.6 million customers and 99% of the population had access to electricity. About 75 % of delivered energy was billed; the remaining 25%[1] consisted of technical (15%) and non-technical (10%) losses. About 5% of billed energy was not collected,

[1] 25% is the distribution loses. Total system losses including transmission losses is about 27%

mainly due to low payment levels by government entities. Assuming more commercially acceptable loss levels, the equivalent financial loss to PEDEEE on account of these three factors was about US$ 278 million in 2007 alone.

Residential and industrial consumers are the largest categories, constituting 47% and 37%, respectively, of 2007 total electricity consumption. In contrast, the commercial sector constituted only 9% of the electricity consumption. Compared to other intermediate income countries, the demand from industry is high and the demand from commercial activities is relatively low. In terms of capacity demand and during system peak, residential users had by far the largest peak demand with 4,760 MW, followed by industry with 1,016 MW. Residential consumers typically use a great deal of capacity but only during relatively short periods, while industry uses a given capacity on a more continuous basis throughout the day (Exhibit 3). Hence it is very important to manage the demand of the residential sector by reducing its demand for peak capacity.

Exhibit 3: 2007 Demand Structure During System Peak (in MW)



Supply: The total *installed* power generating capacity in Syria was about 7,500 MW in 2007, of which 6,250 MW was actually *available*; this capacity was inadequate to meet peak demand of 6566 MW in 2007. No new capacity was added to the system between 2001 and 2006. In 2007, 300 MW was added through conversion of an existing plant and a major new 750 MW gas-fired plant is expected to become fully operational during 2009. Expansion of two existing power plants by a total of 750 MW is expected to be completed by the beginning of 2010. Without further capacity additions, however, the demand-supply gap will increase rapidly during the coming years.

Base case demand forecast projects a 67% increase in electricity demand during 2009-2020[2]. This would require the addition of about 7000 MW of new generation capacity during the same

[2] Corresponding demand increases over the same period are 106% in the high case scenario and 45% in the low case scenario.

period[3]. The investments in new generating capacity and in expansion of the transmission and distribution networks would cost an estimated US$ 10.5 billion, of which US$ 7.0 billion for generation and US$ 3.5 billion for rehabilitation and expansion of the transmission and distribution networks.

Energy Efficiency Potential: Energy efficiency in Syria is still in the early stages. The Government has recently established the National Energy Research Center (NERC) to deal with energy efficiency and renewable energy issues. It has also started implementing enacted legislations to promote energy efficiency and several small pilot energy efficiency programs have been initiated.

NERC has presented a draft preliminary plan for implementation of efficiency programs. The plan forecasts reducing electricity demand by 19% by 2030 compared to a business-as-usual scenario. This is a very ambitious goal considering the limited track record of the existing institutions to develop energy efficiency programs and scale up their implementation, and given the absence of energy efficiency "infrastructure" in Syria. Nevertheless, based on that plan and World Bank experience in the Region, it is estimated that industrial sector electricity demand could be reduced by up to 15% over the next ten years and residential demand by about 10%. The equivalent energy efficiency "negawatts" (i.e., capacity that does not need to be built or is freed up for other uses) are estimated at about 931 MW by 2020. Reaching that target will require that aggressive energy efficiency programs are developed and implemented.

Regional Integration: Syria's power system is connected to the power systems of Iraq, Jordan, Lebanon, and Turkey. Cross-border electricity imports and exports have developed through bilateral agreements. However, the present situation where most countries in the sub-region have a shortage of electricity, keeps utilization of interconnection capacities to minimal levels. Exchanges are essentially limited to emergency operations to serve the grids during critical conditions only.

Egypt, Jordan, Lebanon, and Syria have also embarked with EU support on the establishment of a *regional gas market* which will ultimately be integrated with the EU internal gas market. This market will interlink the respective countries through the 1,300 km long *Arab Gas Pipeline (AGP[4])*. Segments of AGP connecting Egypt, Jordan, Syria and Lebanon have been completed. Since Egypt may not be in a position to supply additional gas, Syria could in the long term be able to obtain gas imports from other countries, such as Iraq and Iran. This would be feasible once the planned AGP connection to Turkey is completed and especially if an extension of the AGP to Iraq is developed.

Syria would benefit from a Mashreq regional energy market, integrated in the long term with Turkey and European energy markets. Development of such a regional market requires

[3] Assuming about 2,500 MW of older capacity would need to be retired during 2009-2020 and the requirement to establish 10% of reserve margin by 2020.

[4] The AGP is being constructed with the objective of exporting gas from Egypt to Jordan, Syria and Lebanon and in the long term from Egypt and possibly Iraq via Turkey to Europe through its future connection to the Turkish network and pipelines (including the planned NABUCCO pipeline). The first three phases of the AGP have been completed connecting Egypt, Jordan, Syria, and Lebanon. Tendering for stage 1 of the last phase of extending the pipeline to Turkey has been initiated. The pipeline has a 36" diameter, with an ultimate capacity of 10 bcm/yr.

sustained commitment and coordination between countries in the region. However, it would yield substantial mutual benefits including energy supply security, better utilization of the region's enormous gas reserves and development of renewable energy under the Mediterranean Solar Plan.

To enhance integration of Syria within the Mashreq region and eventually with the EU market the following regional projects could be considered:

- *Electric Power*: (i) construction of a 400 kV interconnection with Iraq and a gas-fired generation plant supplied by gas from the Iraq's Akass field, which is close to the border with Syria. This plant could supply electricity to Syria and Iraq and possibly to Jordan; and (ii) rehabilitation and reinforcement of the existing 400 kV interconnection between Syria and Turkey.
- *Natural Gas*: (i) complete the final two stages of the AGP within Syria (Aleppo-Kilis and Aleppo-Furglus); (ii) complete the AGP link to the Turkish gas network; and (iii) build a gas pipeline from central Iraq through Syria to the AGP, for domestic consumption and export, the latter either via an LNG terminal or via the Turkish transmission system to Europe.

Recommendations:

- The Government should start implementing major energy efficiency programs to slow the growth of electricity demand. At the same time it should start a vigorous program to reduce technical and non-technical losses.
- Non-technical losses need to be reduced by upgrading the consumer metering and billing systems, including: (i) replacing outdated meters by modern electronic meters; and (ii) upgrading customer information systems, including improving the client data base. Technical losses should be reduced by major investments in the distribution networks.
- Loss reduction programs should focus first on the Damascus, Rural Damascus, and Aleppo regions since the largest losses occur there.
- Syria should develop its generating capacity while curbing uneconomic demand. At the same time it should seek to expand opportunities of regional integration.

Generation Expansion Strategy

Syria needs about 7,000 MW of additional generating capacity by 2020 to meet growing demand and establish a reserve margin about 10%. The choice of the best combination of technologies and fuels for meeting demand in Syria should be based on their comparative costs and risks. A generation costing model is used to determine the preferred new generation mix. The resulting generation expansion plan calls for the development of up to 1,640 MW of new peaking capacity, about 5,300 MW of new base load capacity and 120 MW of new wind power plants by 2020 as follows:

- *Peaking plants*: The preferred option is gas or HFO-fired medium-speed diesel engines or gas turbines.
- *Base load plants*: Since gas supply may be a problem, new base load capacity developed in the medium term should have a combination of CCGT operating on gas, as well as

thermal steam plants with dual fuel capability. Given the present shortage of supply, Syria may also consider developing some amount of low-speed diesel engines as a base load taking advantage of their fast track development. Depending on the availability prospect of regional supply of piped gas, Syria may in the long term also wish to consider coal-fired steam power plants, which can switch at limited cost from coal to gas or to HFO. This would help diversify fuel sources and enhance Syria's security of supply. While coal has environmental disadvantages compared to gas, these can be effectively minimized by using modern technologies and high-grade coal.

- *Renewable Energy (RE)*: Syria should carefully investigate and develop its renewable energy potential. The Mediterranean Solar Plan, in which Syria is participating, also encourages development of RE sources other than solar. RE would: (i) diversify Syria's fuel sources and enhance its security of energy supply; (ii) reduce its greenhouse gas emissions and enable it to profit from Clean Development Mechanism credits and potential project financing from the Clean Technology Fund[5]; (iii) generate local employment; and (iv) extend the life of its fossil fuel reserves. RE cannot displace large conventional power plants, but it can substantially reduce the need for more fossil fuel-fired generating capacity. To encourage the development of Syria's renewable energy resources the Government should take a number of actions as elaborated in Chapters 3 and 6.

Recommendations:

- For new generating capacity Syria needs to consider fuel mix, plant technology, and associated risk profiles;
- In the medium term new generation capacity should be gas fired. Part of that capacity should have fuel switching capability;
- In the longer term and depending on availability of domestic and imported gas, Syria may consider development of coal-fired power plants; and
- Syria should encourage development of its renewable energy resources as a matter of priority. Comprehensive renewable energy resource studies, assessing the potential of renewable resources must be prepared.

Financial Aspects

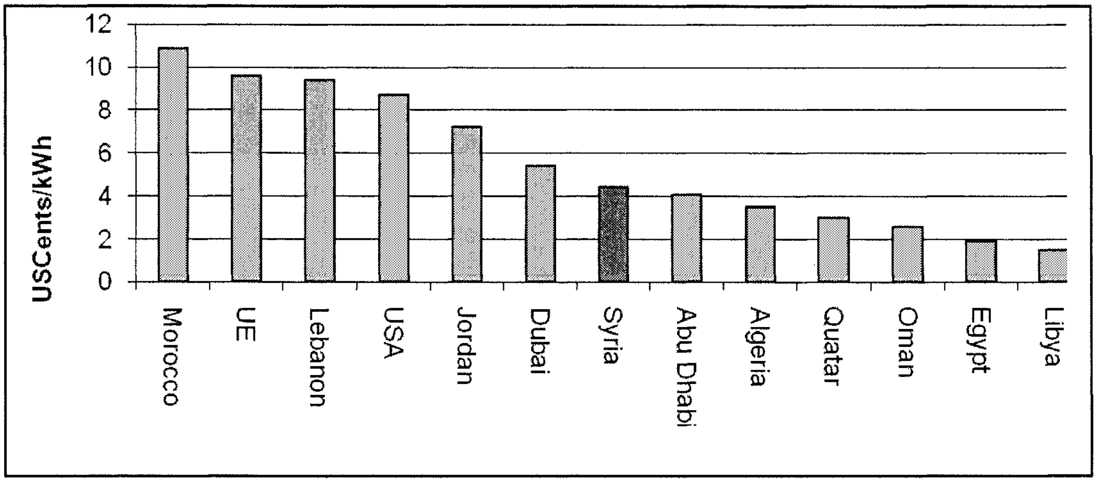
The power sector's ability to finance almost US$10.5 billion in investments from its own resources and through private sector financing depends on the magnitude and stability of its cash flow. This requires: (i) adjustment of electricity tariffs, including coordination with input fuel prices; and (ii) reduced network losses, improved metering and billing, and improved payment discipline.

Electricity tariffs: The average tariff level in Syria is low at US Cents 4.42/kWh. This is comparable to the tariffs in oil and gas exporting countries such as Algeria, Abu Dhabi (UAE), and Qatar, but significantly lower than the tariffs in regional non-oil rich countries such as

[5] The Clean Technology Fund (CTF) is a collaborative effort by International Financial Institutions and bilateral donors to promote scaled-up demonstration, deployment, and transfer of low-carbon renewable energy technologies. Over US$ 6 billion has been pledged to the CTF, which is managed by the World Bank.

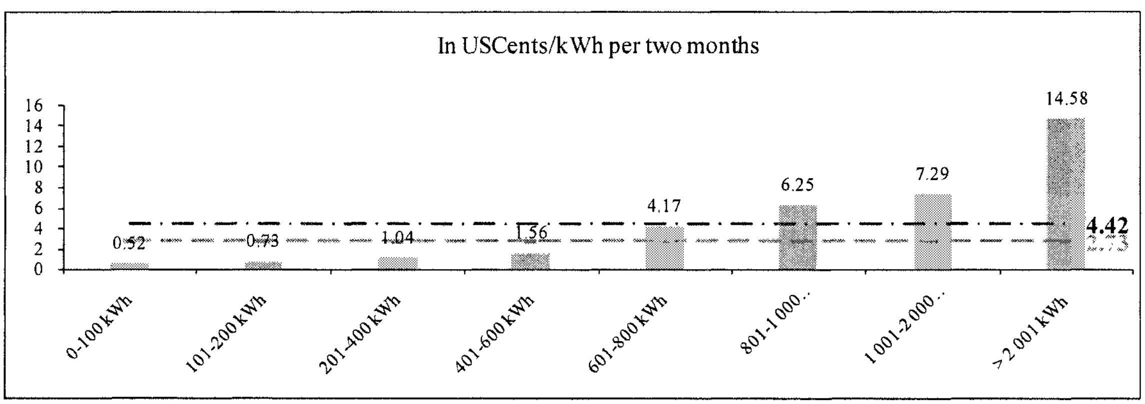
Jordan, Lebanon, Morocco as well as Dubai (UAE), the EU and the US (Exhibit 4). The Syrian tariff is not enough to cover the power system's operating costs, let alone its investment needs. It is particularly low for residential consumers at an average of US Cents 2.73/kWh.

Exhibit 4: Electricity Tariffs in Syria Compared to Regional Tariffs



The tariff structure for residential consumers consists of eight electricity consumption blocks, ranging up to 2,000 kWh and above (Exhibit 5).

Exhibit 5: Block Structure of Electricity Tariff for Residential Consumers (per two months)



The tariff for consumption up to 300 kWh per month (or 600 kWh per two month) is much below the level of the average tariff and could be considered to fall under the lifeline tariff for subsidizing consumption of basic electricity needs, although it is in line with the threshold for basic electricity needs which is usually about 300 kWh per month. However, the rates for consumptions within this block are extremely low, as shown in Exhibit 5, indicating high amount of subsidy which may not be needed. In addition, such a "lifeline" block of 300 kWh per month also benefits the medium and large residential consumers, who use far more than the basic electricity needs and who, at the same time, could pay higher tariffs.

The affordability of electricity of low-income households and the burden that necessary future tariff increases and collection enforcement will impose on them is an important issue to consider by the Government. In principle this is best addressed through targeted support programs through cast transfer programs (social safety net) to eligible needy households. Shifting the burden to the utility by means of lower tariffs undermines the financial viability of the utility and discourages energy conservation. However, in many countries, including Syria, the administrative capacity to identify eligible recipients of a subsidy on a means-tested basis and administer a subsidy program is limited. The next best method is to continue with the electricity lifeline tariff until the capacity to administer a cash transfer program is in place. The tariff structure should nevertheless be revised to achieve a better targeting of the lifeline tariff for low income residential customers including considering the exclusion from the social tariff of the first 600 KWh of consumers with bi-monthly consumption in excess of 600 KWh and a reduction of number blocks including the gap in the tariff between the average tariff and the lifeline block.

The electricity tariffs for medium and high voltage consumers are structured on a time-of-day basis. This provides in principle the right incentive to shift their demand from peak to off-peak periods, which is an essential requirement for load management and energy efficiency. However, the time-of-day tariff does not apply to low voltage consumers (residential and commercial), even though they represent 56% of the demand and are responsible for most of the peak demand. Therefore, it is recommended that future tariff revisions extend time-of -day differentiation to low voltage consumers as their metering systems permit.

***Fuel Prices**:* Until 2008 all fuels used in the power sector were domestically produced and their prices were set by the Government well below international prices. As a result, the natural gas and oil sectors incurred significant revenue shortfalls on the sale of their products to the power sector. If fuels were priced at or near international parity level, electricity consumers would have to pay a higher tariff. Higher fuel prices would benefit the gas and oil producing companies and would enable them to invest in exploration and production. This should eventually make more gas available to the power generation sector.

***Sector Financial Performance**:* During 2004-2008, the financial performance of the sector deteriorated as input fuel prices started escalating faster, but were still below international levels, than electricity tariffs. As a result, *as of 2008, the sector's revenues from operations were insufficient to cover cash operating expenses* and the sector could not contribute to capital investment. Action is urgently needed to restore the sector's financial viability and capacity to support the investments needed to meet future demand. Three scenarios were developed to examine the sector future financial performance assuming that fuel prices are adjusted to international parity levels. The second and third scenarios would require strong schemes to protect low-income consumers:

- *First scenario: no real tariff increases.* As a result, the sector's operating cash flow would become *minus* US$ 1.5 billion by 2010 and minus US$ 2.7 billion by 2020. Under this scenario, the financial subsidy needed from the Government would be a staggering US$ 33.6 billion during 2008-2020 to support the cash flow requirement of the sector and finance its investments.

- *Second scenario: accelerated tariff increases (90% in 2010 and 20% in 2011)*, assuming fuel prices to the power sector are adjusted to international parity price. Afterwards the tariff would need to be maintained at the 2011 level in real terms. Under this scenario, the financial subsidy through 2012 needed from the Government would be limited to US$ 1.3 billion.
- *Third scenario: 20% per annum increases through 2013 and 10% in 2014.* The sector's cash flow equilibrium level would be reached by 2015. The Government would have to subsidize some of the investment costs of the sector through 2015 in the amount of US$ 4.4 billion.

Recommendations:

- The sector's ability to finance almost US$10.5 billion in investments from its own resources and through private sector financing requires both loss reduction as well as coordinated adjustment of electricity tariffs and input fuel prices;
- Tariff increases of at least 20% per annum through 2013 and 10% in 2015 will be necessary to reach the cash flow equilibrium level for the sector by 2016 at the latest;
- The subsidy to higher income residential consumers should be reduced by applying the social tariff to monthly consumption below, e.g., 300 kWh;
- Input fuel prices should be set either based on the domestic marginal production cost (all fuels are mainly produced domestically) or at the export parity price for fuel oil and diesel and at the import parity price for gas. Fuel prices at full cost recovery (or economic) levels would benefit the gas and oil producing companies and would therefore enable them to invest in exploration and production. This should eventually make more gas available to the power generation sector.

Role of the Private Sector

The enormous investment needs of the electricity sector would be an intolerable drain on the government budget if they were to be met by public financing. Therefore, in addition to making the sector able to self-finance a portion of these investments, the Government needs to attract private sector investment in the power sector. Attracting private equity or commercial loans will require firm commitments from the Government to improve the financial performance of the power sector.

Private sector participation in Syria would most likely be focused on the generation sector through Independent Power Producers (IPPs). In the longer term private investment in the distribution sector could also be considered. Because of its pivotal role, the transmission sector would remain in state hands, as is the case in most countries.

Recommendations:

To attract private sector participation in building new generating capacity the Government will need to do the following:

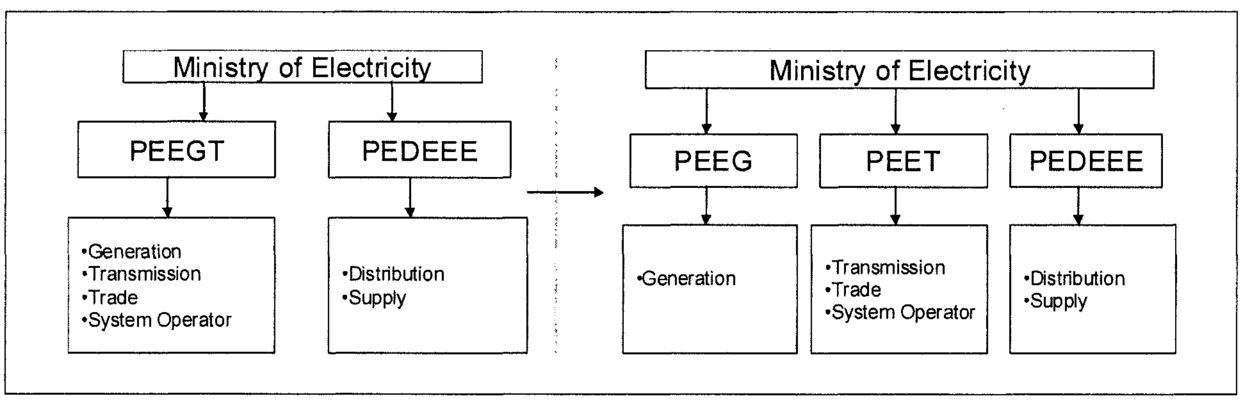
- Develop and implement a strategy that lays out the policy and regulatory frameworks and recommends measures necessary to ensure an environment conducive to private sector involvement, competitiveness, and transparency.
- Establish a government PPP Unit[6] in charge of management of private sector participation in developing infrastructure (economic and social) and in implementation of necessary regulations.
- Designate a working team in the Ministry of Electricity to coordinate with the PPP Unit the development of new IPPs. The working team will also:
    - Prepare feasibility studies for a pipeline of generating projects that could be offered to private investors;
    - Assess with the PPP Unit and the Ministry of Finance the need for, and level of, guarantee packages or other credit enhancement instruments that may need to be provided by the Government to attract private investment; and
    - Prepare IPP bidding packages for the selected generating plants and carry out a transparent bidding process.

Electricity Sector Restructuring

The high level of technical and commercial losses, poor quality of service, poor financial performance (partly due to the absence of adequate tariff increases), and the absence of accrual accounting and financial management systems are posing formidable challenges to the electricity sector. To improve the efficiency and productivity of the power sector and the quality of service, its structure and the operational relationships between units should be revised.

A *road map for sector restructuring* is proposed for consideration by the Government. The principal sector restructuring measure in the short term would consist of "functional unbundling" (Exhibit 6) of generation and transmission, i.e., creating separate units under the Ministry of Electricity (the distribution units are already unbundled). This includes allocating management, staff, assets and liabilities to each unit and introducing commercial accounting and management systems.

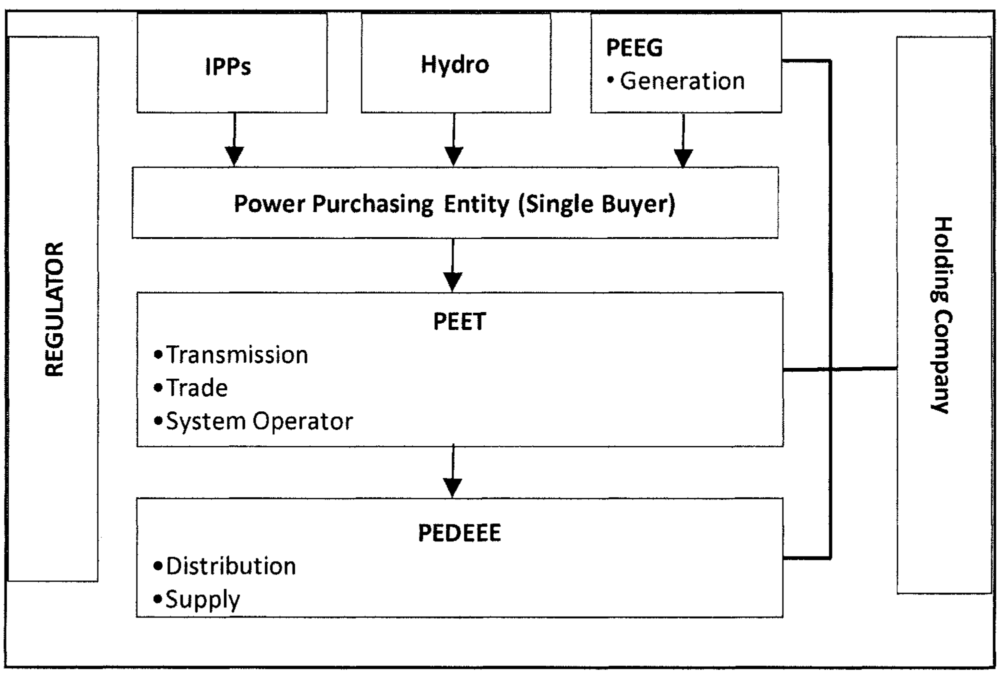
Exhibit 6: Functional Unbundling of the Electricity Sector (2010-11)



[6] PPP Unit: Is a government dedicated Public-Private Participation Unit that could operate as part of the Prime Minister Office with responsibility for Economic Development.

Once this has been achieved, the generation, transmission, and distribution units would be *incorporated as state-owned companies operating on a commercial basis*, possibly under a holding company structure (Exhibit 7). Such a commercial reorientation would: (i) ensure that management of the incorporated entities would have the incentive to improve efficiency and productivity; (ii) facilitate better supervision and monitoring of sector performance; and (iii) facilitate attracting private investment into the sector. Performance contracts between the Government and the sector companies would help to hold the companies accountable for their performance. Under this restructuring model a state-owned Power Purchasing Entity would be established to act as a single buyer to contract electricity wholesale from the generation companies and then resell it to the distribution companies. The single buyer could be part of the Transmission Company (PEET) or be established as a separate company. The advantage of the latter arrangement, shown in Exhibit 7, is that if wholesale tariffs are set below cost recovery and Government subsidies are not forthcoming, PEET would not be affected and would continue to be able to fulfill its vital functions of system operation and transmission expansion

Exhibit 7: Corporatization Under One Holding Company



Sector restructuring requires also the separation of the sector ownership/policy and the regulatory functions. This can be achieved through the creation of an electricity sector regulator, set up either as an autonomous entity within the Ministry of Electricity or as an independent regulatory agency. The regulator's functions would consist mainly of: (i) monitoring sector operations to ensure efficient and non-discriminatory functioning of the market; (ii) developing price setting methodologies and tariff systems; (iii) issuing licenses to market operators and monitoring compliance; and (iv) benchmarking the performance of the licensees to ensure economic operation of the systems. The Ministry of Electricity would remain responsible notably for setting sector policy, ensuring strategic planning and providing overall sector oversight.

Energy Efficiency and Renewable Energy Strategy: Making progress in energy efficiency (EE) and renewable energy (RE) is critical and requires a comprehensive approach. In that context the Government should ensure not only that specific EE/RE policies and legislation are formulated, but also see to it that these are actually implemented and enforced. The principal recommended steps are: (i) formulating an EE/RE policy; (ii) adopting comprehensive and consistent supporting legislation; (iii) establishing a specialized agency (NERC could be transformed into such an agency); (iv) preparing strategies and action plans; and (v) establishing a dedicated fund for EE and RE development and put in place special financial incentives. Most importantly, electricity tariffs should be restructured and adjusted to provide consumers with the appropriate signals and incentives.

Gas-to-Power Coordination: Low gas prices and inadequate coordination between natural gas production plans and electricity generation requirements have led to constraints in the present gas supply to the electricity sector. This situation needs to be urgently addressed. Therefore a gas-to-power strategy must be developed and a coordination mechanism (the joint coordination committee) between the Ministry of Electricity and Ministry of Petroleum and Mineral Resources should be established. That committee should coordinate: (i) development of the investment programs for both sectors; (ii) funding and implementation of the investments; and (iii) the pricing and supply contracts between the gas and power sectors, because the gas price directly impacts the gas sector's investment capacity and electricity production cost.

Recommendations:

- The objective of sector restructuring is to ensure that sector management has both the autonomy and the incentives to address existing sector shortcomings and to potentially enable it to attract private participation;
- The first restructuring measure should consist of "functional unbundling" of generation and transmission, i.e., creating separate units under the Ministry of Electricity. The distribution units are already unbundled;
- As a next step, the generation, transmission, and distribution units should be incorporated as state-owned companies operating on a commercial basis, possibly under a holding company structure. Separation of the ownership/policy and the regulatory functions is necessary and can be achieved through the creation of an electricity sector regulator;
- To promote EE and RE, the Government should ensure that specific EE/RE policies and legislation are formulated and that these are actually implemented and enforced. Most importantly, electricity tariffs should be restructured and adjusted to provide consumers with the proper signals and incentives; and
- A gas-to-power strategy must be developed and a coordination mechanism should be established between the Ministry of Electricity and Ministry of Petroleum and Mineral Resources.

ملخص تنفيذي

قام البنك الدولي بإعداد مذكرة استراتيجية قطاع الكهرباء بناءً على طلب الحكومة السورية. وهي تحدد البدائل والخيارات للحكومة لتحسين الأداء المالي والتقني لقطاع الكهرباء. تركّز المذكرة بشكل خاص على ***أهداف القطاع الرئيسية*** التالية:

- زيادة كفاءة قطاع الكهرباء من خلال تقليص الفواقد الفنية والتجارية التي تبلغ حالياً نسبة 27% من الطلب؛
- تقليص الفرق المتزايد بين الطلب والعرض على الكهرباء عن طريق زيادة القدرة الإنتاجية، وبالتالي تعزيز ضمان تزويد الكهرباء والحد من انقطاع الطاقة الكهربائية؛
- تأمين التغذية بطرق اكثر استدامة وافضل بيئيا عن طريق تطوير برامج رفع كفاءة الطاقة والطاقة المتجددة؛
- تشجيع التعاون والربط الاقليمى فى مجال الطاقة عن طريق سلسلة من الاستثمارات المستهدفة في الطاقة الكهربائية والغاز الطبيعي؛
- استقطاب الاستثمار من القطاع الخاص لزيادة قدرة التوليد، بما في ذلك مجال الطاقة المتجددة، عن طريق منتجي الطاقة المستقلين؛
- جعل قطاع الكهرباء قابلاً للاستمرار مالياً وتنسيق خطط إنتاج الغاز الطبيعي بما يتوافق مع متطلبات توليد الكهرباء؛
- تنفيذ إصلاحات فى قطاع الكهرباء و تغييرات مؤسسية من اجل تحقيق الاهداف المذكورة أعلاه.

التحديات التي تواجه قطاع الكهرباء

يناط بوزارة الكهرباء تنظيم وإدارة قطاع الكهرباء. وتهتم *المؤسسة العامة لتوليد ونقل الطاقة الكهربائية (PEEGT)* بتخطيط وتطوير وتشغيل وصيانة محطات التوليد وشبكات النقل. أما *المؤسسة العامة للتوزيع واستثمار الطاقة الكهربائية (PEDEEE)*، فلديها مسؤوليات مماثلة في ما يتعلق بشبكة التوزيع.

بعد سنوات من الاستقرار النسبي، يواجه قطاع الكهرباء السوري اليوم عدداً من التحديات الرئيسية، بما فيها النمو السريع للطلب على الكهرباء؛ والفرق المتزايد بين الطلب والعرض، المؤدي إلى فصل الاحمال؛ وفواقد فنية وغير فنية عالية في الشبكة؛ وأمور متعلقة بضمان الوقود بسبب التزويد غير الملائم للغاز المنتج محلياً؛ وأداء مالي متدهور، والذي يؤدي إلى الكثير من الإعانات الحكومية؛ والحاجة إلى استقطاب التمويل الخاص للمساعدة في تقليص الفرق القائم بين الطلب والعرض. يتضمن جدول (1) بعض مؤشرات التنظيم والأداء الرئيسية لسوريا بالمقارنة مع البلدان الأخرى. ويظهر الجدول أنّ سوريا متأخرة في كل مؤشر من هذه المؤشرات الرئيسية.

جدول (1): معيار أداء القطاع في سوريا

	سوريا	الأردن	مصر	المغرب	تركيا	رومانيا	بلغاريا
مؤشرات بنية القطاع							
منفصل	جزئياً	نعم	نعم	كلا	نعم	نعم	نعم
شركة مملوكة من الدولة	كلا	نعم	نعم	نعم	نعم	نعم	نعم
منظم	كلا	نعم	نعم	نعم	نعم	نعم	نعم
مجالات الاستثمارات الخاصة	كلا	توليد، توزيع	توليد	توليد، توزيع	توليد، توزيع	توليد، توزيع، نقل	توليد، توزيع، نقل
مؤشرات الأداء							
فواقد الشبكة (%)	27	17	16	16	17	11	13
معدل تكرار انقطاع التيار (يوم/ السنة)	43	0.3	18	5.8	3.1	3.0	2.8
متوسط التعريفة (سنت أميركي/ كيلو واط ساعة)	4.42	7.0	2.0	11.0	13.1	15.9	10.6

يمكن مواجهة تحديات قطاع الكهرباء بإحداث تغيير ملحوظ في سياسة الحكومة تجاه قطاع الطاقة. يتضمّن ذلك إجراءات محددة كالتالية:

- تحويل مؤسسات التوليد والنقل والتوزيع الى منهجية العمل التجاري، بما فيه التقسيم إلى وحدات منفصلة ولاحقاً تحويلها إلى شركات تملكها الدولة؛
- اجراء تعديلات جذرية في هيكلة ومستويات التعريفة الكهربائية، و التنسيق مع أسعار وقود المحطات (الغاز والوقود الثقيل)؛
- تنفيذ برامج الحد من الفواقد الكهربائية الفنية والتجارية ؛
- توفير استثمارات رئيسية بقيمة 10.5 مليار دولار أميركي في التوليد والنقل والتوزيع حتى عام 2020؛
- توفير دعم لتنفيذ برامج موسعة خاصة بكفاءة الطاقة والطاقة المتجددة؛

وهذا الملخص التنفيذى يلخص النقاط والمحاور الأساسية للإستراتيجية ويوصي بالإجراءات التنفيذية اللازمة.

الطلب والعرض على الكهرباء

الطلب: خلال الفترة الممتدة بين 2002 و2007، ازداد الطلب على الكهرباء في سوريا بمعدل مرتفع جداً نسبته 7.5% سنوياً، وذلك بسبب: (1) النمو الاقتصادي الكبير؛ و(2) التعريفة اقل من مستوى استرداد الكلفة مما لا يشجع على ترشيد استخدام الطاقة؛ و(3) الخسائر الفنية وغير الفنية مرتفعة في

الشبكات؛ و(4) تدفق اللاجئين من العراق. وخلال الفترة ذاتها، واجه نظام الكهرباء صعوبات متزايدة في تلبية الطلب. وازداد معدل فصل التيار بحدة بدءًا من العام 2006 (الجدول 2).

جدول 2: القدرة الكهربائية غير المزودة بسبب فصل التيار (جيغا واط ساعة)

	2002	2003	2004	2005	2006	2007
القدرة الكهربائية غير المزودة	86.3	83.4	103.8	55.0	345.1	427

في عام 2007، كان للمؤسسة العامة لتوزيع واستثمار الطاقة الكهربائية حوالى 4.6 مليون مشترك و99% نسبة تغطية الخدمة الكهربائية من السكان. وتم استخراج فواتير الى حوالى 75% من الطاقة المرسلة اما بالنسبة للـ25%[7] المتبقية فقد تضمنت فواقد فنية بنسبة (15%) وفواقد غير فنية بنسبة (10%). ولم يتم تحصيل حوالى 5% من قيمة الفواتير وذلك نتيجة لانخفاض مستويات الدفع من قبل الجهات الحكومية. إذا افترضنا أن الفواقد كانت على مستويات مقبولة تجارياً، لبلغت الخسارة المالية المكافئة التي تتكبدها المؤسسة العامة لتوزيع واستثمار الطاقة الكهربائية بسبب هذه العوامل الثلاثة حوالى 278 مليون دولار أميركي في الغام 2007 وحده.

يشكل الاستهلاك المنزلى والتجارى الشريحة الاكبر من الاستهلاك ، بنسبة 47% و37% على التوالي، من استهلاك الكهرباء الإجمالي لعام 2007. بالمقابل، لم يمثل القطاع التجاري سوى 9% من استهلاك الكهرباء. بالمقارنة مع بلدان أخرى متوسطة الدخل، الطلب من قطاع الصناعة مرتفع والطلب من الأنشطة التجارية منخفض نسبياً. اما بالنسبة للطلب على القدرة وخلال ذروة الشبكة، فان الاستهلاك المنزلى قد سجل أعلى ذروة طلب وهى 4,760 ميغا واط، يليه قطاع الصناعة بقدرة 1,016 ميغا واط. الاستهلاك المنزلى يحتاج قدرات عالية ولكن خلال فترات وجيزة نسبياً، بينما القطاع الصناعى يستخدم قدرات معينة ولكنها تمتد لفترات اطولً خلال اليوم (الجدول البياني 3). وبالتالي فمن المهم جداً إدارة الطلب على الطاقة للقطاع المنزلى و تخفيض طلبه على القدرة فى اوقات الذروة لخفض الزيادة فى الحمل الاقصى للشبكة.

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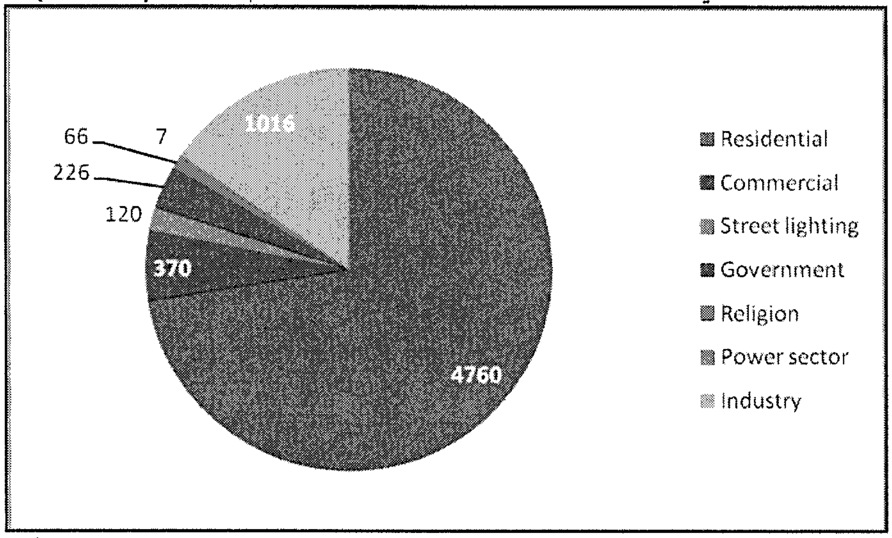
[7] تشير نسبة 25% إلى فواقد التوزيع. أما مجموع فواقد الشبكة بما فيها فواقد النقل فيبلغ نسبة 27%.

الجدول البياني 3: بنية الطلب خلال ذروة الشبكة للعام 2007 (ميغا واط)



-- السكني، -- التجاري، --إنارة الطرق، --الحكومة، --الديني، -- قطاع الكهرباء، --الصناعة

تزويد الكهرباء: *بلغت* القدرة *المركبة* الإجمالية للتوليد في سوريا حوالى 7,500 ميغا واط في عام 2007، منها 6,250 ميغا واط كان *متوفراً* فعلياً؛ لم تكن هذه القدرة ملائمة لتلبية الطلب الذروي البالغ 6,566 ميغا واط في العام 2007. لم تتم إضافة أي قدرة جديدة إلى النظام بين العامين 2001 و2006. في عام 2007، تمت إضافة 300 ميغا واط من خلال تحويل محطة قائمة إلى دورة مركبة. كما يتوقع أن تنضم محطة رئيسية جديدة سيتم تشغيلها بالغاز بقدرة 750 ميغا واط بالكامل خلال 2009. ويتوقع توسيع محطتين قائمتين لتوليد الطاقة بقدرة إجمالية تبلغ 750 ميغا واط في أوائل 2010. بيد أن الفرق بين العرض والطلب سرعان ما سيتسع في السنوات القادمة في حال عدم زيادة القدرة.

تقدّر الزيادة المتوقعة في الطلب على الكهرباء بنسبة 67% في السيناريو الأساسي خلال الفترة الممتدة بين 2009-2020[8]. مما سيتطلب إضافة قدرة توليد جديدة تبلغ تقريباً 7000 ميغا واط خلال الفترة عينها.[9] وسوف تتكلف الاستثمارات في قدرة التوليد الجديدة وفي توسيع شبكات النقل والتوزيع مبلغاً يقدر بـ10.5 مليار دولار أميركي، منه 7.0 مليار دولار أميركي للتوليد و3.5 مليار دولار أميركي لإعادة تأهيل وتوسيع شبكات النقل والتوزيع.

امكانيات كفاءة الطاقة: لا تزال كفاءة الطاقة في مراحلها الأولى في سوريا. أسست الحكومة مؤخراً المركز الوطني لبحوث الطاقة (NERC) لمعالجة المسائل المتعلقة بكفاءة الطاقة والطاقة المتجددة. وبدأت أيضاً بتطبيق تشريعات تم سنّها لتعزيز كفاءة الطاقة وتم إطلاق عدة برامج تجريبية صغيرة متعلقة بكفاءة الطاقة.

وقدم المركز الوطني لبحوث الطاقة خطة أولية لتطبيق برامج كفاءة وترشيد الطاقة. تتوقع الخطة تخفيض الطلب على الكهرباء بنسبة 19% بحلول 2030 بالمقارنة مع السيناريو الاعتيادي. إن هذا

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[8] تبلغ زيادة الطلب المقابلة خلال الفترة نفسها نسبة 106% في سيناريو الحالة القصوى ونسبة 45% في سيناريو الحالة الدنيا.

[9] افتراضاً أنه يجب سحب حوالى 2،500 ميغا واط من القدرة القديمة خلال الفترة الممتدة بين 2009 و2020 وأنه يجب إنشاء هامش احتياطي بنسبة 10% بحلول 2020.

الهدف طموح جداً نظراً إلى النتائج المحدودة التي سجلت حتى الان في تطوير برامج متعلقة بكفاءة الطاقة وزيادة تطبيقها، وكذلك إلى غياب "البنية التحتية" لكفاءة الطاقة في سوريا. من ناحية أخرى، وعلى أساس هذه الخطة وخبرة البنك الدولي في هذا المجال، يتوقع احتمال تقليل طلب القطاع الصناعي على الكهرباء بنسبة 15% في السنوات العشر القادمة وطلب القطاع المنزلي (السكنى) على الكهرباء بنسبة 10% تقريباً. ويقدّر معادل كفاءة الطاقة الـ"نيغاواط" (أي القدرة التي لا تحتاج إلى التراكم أو المحررة لاستخدامات أخرى) بحوالى 931 ميغا واط بحلول 2020. سيتطلب تحقيق هذا الهدف تطوير وتنفيذ برامج جدّية متعلقة بكفاءة الطاقة.

التكامل الإقليمي: نظام الكهرباء في سوريا متصل بأنظمة الكهرباء في العراق والأردن ولبنان وتركيا. وقد تم استيراد وتصدير الكهرباء عبر الحدود من خلال اتفاقيات ثنائية. بيد أن فى الوضع الراهن تعاني معظم البلدان في المنطقة المتصلة من نقص في الكهرباء ولذا فأن تبادل الطاقة من خلال الربط الاقليمى ما زال دون المستوى المرجو. والتبادلات محدودة بشكل أساسي بالعمليات الطارئة لخدمة الشبكات في الظروف الحرجة فقط.

كما بدأت كل من مصر والأردن ولبنان وسوريا، بدعم من الاتحاد الأوروبي، بإنشاء *سوق غاز إقليمية* سيتم تكاملها في نهاية المطاف بسوق الغاز الداخلية الخاصة بالاتحاد الأوروبي. ستربط هذه السوق البلدان المذكورة ببعضها البعض عن طريق *خط أنابيب الغاز العربي* البالغ طوله 1,300 كلم *(AGP[10])*. تم إنجاز أجزاء من خط أنابيب الغاز العربي الواصل بين مصر والأردن وسوريا ولبنان. وبما أن مصر قد تعجز عن توريد وتصدير المزيد من الغاز فى المستقبل، فقد تستطيع سوريا على المدى الطويل أن تحصل على واردات غاز من بلدان أخرى كالعراق وإيران. سيكون الأمر ممكناً عند الإنتهاء من وصل خط أنابيب الغاز العربي المخطط له بتركيا ولا سيما في حال تم تمديد خط أنابيب الغاز العربي إلى العراق.

ستستفيد سوريا من سوق الطاقة الإقليمية في المشرق، المتكاملة على المدى الطويل بأسواق الطاقة التركية والأوروبية. يتطلب تطوير سوق إقليمية كهذه التزاماً مستداماً وتنسيقاً بين البلدان في المنطقة. من ناحية أخرى، سيقدم منافع متبادلة ملحوظة بما فيها ضمان توريد الطاقة، واستخدام أفضل لاحتياطي الغاز المتوفر في المنطقة، وتطوير الطاقة المتجددة بموجب خطة البحر المتوسط للطاقة الشمسية.

بغية تحسين تكامل سوريا في منطقة المشرق وفي نهاية المطاف في سوق الاتحاد الأوروبي، من الممكن النظر في المشاريع الإقليمية التالية:

- *الطاقة الكهربائية:* (1) إنشاء خطوط ربط على جهد 400 كيلوفولت (ك.ف.) مع العراق ومحطة توليد مغذاة بالغاز ومزودة بغاز من حقل عكاز العراقي القريب من الحدود السورية. يمكن أن تورد هذه المحطة الكهرباء إلى سوريا والعراق وربما إلى الأردن؛ و(2) إعادة تأهيل وتعزيز خط الربط الكهربى على جهد 400 كيلوفولت القائم بين سوريا وتركيا.

[10] يتم إنشاء خط أنابيب الغاز العربي بهدف تصدير الغاز من مصر إلى الأردن وسوريا ولبنان وعلى المدى الطويل من مصر وربما من العراق عبر تركيا إلى أوروبا عبر وصله المستقبلي بالشبكة وخطوط الأنابيب التركية (بما فيها خط الأنابيب NABUCCO المخطط له). انتهى تنفيذ المراحل الثلاث الأولى من خط أنابيب الغاز العربي، الواصلة بين مصر والأردن وسوريا ولبنان. وتم إطلاق المناقصة للجزء (1) من المرحلة الأخيرة لتمديد خط الأنابيب إلى تركيا. يبلغ قطر خط الأنابيب هذا 36 إنش وقدرته القصوى 10 مليارات متر مكعب/ السنة.

- *الغاز الطبيعي:* (1) إتمام المرحلتين النهائيتين من خط أنابيب الغاز العربي داخل سوريا (حلب- كيليس وحلب- الفرقلس)؛ و(2) ربط خط أنابيب الغاز العربي بشبكة الغاز التركية؛ و(3) بناء خط أنابيب غاز من وسط العراق عبر سوريا إلى خط أنابيب الغاز العربي، للاستهلاك المحلي، وللتصدير إما عبر محطة للغاز الطبيعي المسال أو عبر شبكة النقل التركية إلى أوروبا.

التوصيات:

- يتطلب أن تبدأ الحكومة بتطبيق برامج رئيسية متعلقة بكفاءة الطاقة بغية تخفيض زيادة الطلب على الكهرباء. في الوقت ذاته، يتطلب أن تطلق برنامجاً فعالاً لتقليص الفواقد الفنية وغير الفنية.
- يجب تقليص الخسائر غير الفنية عن طريق تحديث أنظمة المعايرة واصدار الفواتير الخاصة بالمستهلكين، بما في ذلك: (1) استبدال العدادات القديمة بعدادات إلكترونية حديثة؛ و(2) تحديث أنظمة المعلومات حول المشتركين وتحسين قاعدة بيانات العملاء. ويجب تقليل الفواقد الفنية عن طريق استثمارات رئيسية في شبكات التوزيع.
- يتطلب أن تركّز برامج تقليص الفواقد أولاً على مناطق دمشق وريف دمشق وحلب التي تشهد أكبر نسبة من الفواقد.
- يتطلب أن تطور سوريا قدرة التوليد لديها فيما تخفف الطلب غير الاقتصادى. في الوقت عينه يتطلب أن تسعى إلى توسيع فرص التكامل والربط الإقليمي.

استراتيجية توسيع التوليد

تحتاج سوريا إلى قدرة توليد إضافية تبلغ حوالى 7,000 ميغا واط بحلول 2020 بغية تلبية الطلب المتزايد وإنشاء هامش احتياطي بنسبة 10%. ويجب أن يعتمد اختيار أفضل مزيج تكنولوجيا للتوليد والوقود لتلبية الطلب في سوريا على تكاليفها ومخاطرها. وتم استخدام نموذج لحساب تكاليف التوليد وتحديد أفضل مزيج توليد جديد. وتتطلب خطة توسيع التوليد المبلورة تطوير قدرة جديدة للحمل الذروي تبلغ 1,640 ميغا واط وقدرة جديدة للحمل الأساسي تبلغ 5,300 ميغا واط تقريباً ووحدات جديدة لتوليد الطاقة بالرياح بقدرة 120 ميغا واط بحلول 2020، على النحو التالي:

- *وحدات ذروية:* أفضل خيار يكمن في محركات تعمل على الديزل أو تربينات غازية متوسطة السرعة ومغذاة بالغاز أو بزيت الوقود الثقيل.
- *وحدات الحمل الأساسي:* بما أن توريد الغاز قد يكون عائقاً، يجب ان تملك قدرة الحمل الأساسي الجديدة التي يتم تطويرها على المدى المتوسط مزيجاً من تربينات غازية ذات دورة مركبة تعمل على الغاز ووحدات بخارية ذات قدرة وقود مزدوجة. نظراً إلى النقص الحالي في التزويد، يمكن أن تنظر سوريا أيضاً في تطوير كمية من المحركات التي تعمل على الديزل بسرعة خفيفة كحمل أساسي وذلك للاستفادة من تطورها السريع. وحسب توفر تزويد إقليمي من الغاز المنقول عبر الأنابيب، يمكن أن تنظر سوريا على المدى الطويل في إنشاء وحدات توليد الطاقة على البخار المغذاة بالفحم التي يمكن أن تتحول بكلفة محدودة من فحم إلى غاز أو إلى زيت الوقود الثقيل. سيساعد ذلك على تنويع مصادر الوقود وتحسين ضمان التوريد في سوريا. فبينما للفحم مساوئ بيئية بالمقارنة مع الغاز، إلا أنه يمكن الحد من هذه المساوئ بفعالية باستخدام تقنيات حديثة وفحم عالي النوعية.

- *الطاقة المتجددة*: يتطلب أن تدرس سوريا وتطور بدقة إمكانيات الطاقة المتجددة لديها. تشجّع خطة البحر المتوسط للطاقة الشمسية التي تشارك فيها سوريا على تطوير موارد الطاقة المتجددة غير الشمسية. ستقوم الطاقة المتجددة بما يلي: (1) تنويع موارد وقود سوريا وتحسين ضمان توريد الطاقة، (2) التقليل من انبعاث غازات الاحتباس الحرارى وتمكين سوريا من الاستفادة من المنافع في آلية التطوير النظيف ومن تمويل محتمل لمشاريعها من صندوق التكنولوجيا النظيفة[11]؛ (3) إحداث فرص عمل محلية؛ و(4) تمديد العمر الاحتياطي للوقود الأحفوري في سوريا. لا يمكن للطاقة المتجددة أن تحل محل وحدات الطاقة التقليدية الكبيرة، ولكنها قادرة على تقليل الحاجة إلى مزيد من قدرة التوليد المغذاة بالوقود الأحفوري بشكل ملحوظ. بغية التشجيع على تطوير موارد الطاقة المتجددة في سوريا، على الحكومة أن تتخذ الإجراءات المشروحة في الفصلين الثالث والسادس.

التوصيات:

- فيما يتعلق بقدرة التوليد الجديدة، سوف تحتاج سوريا إلى النظر في مزيج الوقود وفي تكنولوجيا الوحدات وفي المخاطر ذات الصلة؛
- يتطلب أن تكون القدرة مغذاة بالغاز في عمليات التوليد الجديدة المتوسطة الأمد. ويجب أن يكون جزء من هذه القدرة قابلاً لتحويل الوقود؛
- أما على المدى الطويل وبالاعتماد على توفر الغاز المحلي والمستورد، يمكن أن تنظر سوريا في تطوير محطات الطاقة المغذاة بالفحم؛
- يتطلب أن تقوم سوريا على تطوير موارد الطاقة المتجددة لديها ووضع هذا التطوير ضمن أولوياتها. ويتطلب إعداد دراسات شاملة حول موارد الطاقة المتجددة لتقييم إمكانياتها وفرص الاستفادة منها.

النواحي المالية

إنّ قدرة قطاع الكهرباء على تمويل ما يقارب 10.5 مليار دولار أميركي باستثمارات من موارده الخاصة وعن طريق التمويل من القطاع الخاص تعتمد على حجم التدفق النقدي واستقراره. يتطلب الأمر: (1) تعديل تعريفات الكهرباء، والتنسيق مع أسعار الوقود ؛ و(2) التخفيف من فواقد الشبكة، وتحسين القياس ونظام الفواتير وتحسين الانضباط بالدفع.

تعريفة استهلاك الكهرباء: يبلغ معدل التعريفة في سوريا مستوى منخفضا يساوي 4.42 سنتاً أميركياً/ كيلو واط ساعة. هذا المستوى شبيه بالتعريفة في البلدان المصدّرة للنفط والغاز كالجزائر وأبو ظبي (الإمارات) وقطر ولكنه أقل بكثير من التعريفة في البلدان الأقليمية غير الغنية بالنفط كالأردن ولبنان والمغرب فضلاً عن دبي (الإمارات) والاتحاد الأوروبي والولايات المتحدة الأميركية (الجدول البياني 4). لا تكفي التعريفة السورية لتغطية تكاليف تشغيل نظام الطاقة، ولا حتى الاحتياجات الاستثمارية في سوريا. وهذا المستوى متدنٍ خاصة بالنسبة للاستهلاك المنزلى إذ يبلغ متوسط معدل التعرفة حوالى 2.73 سنتاً أميركياً / كيلو واط ساعة.

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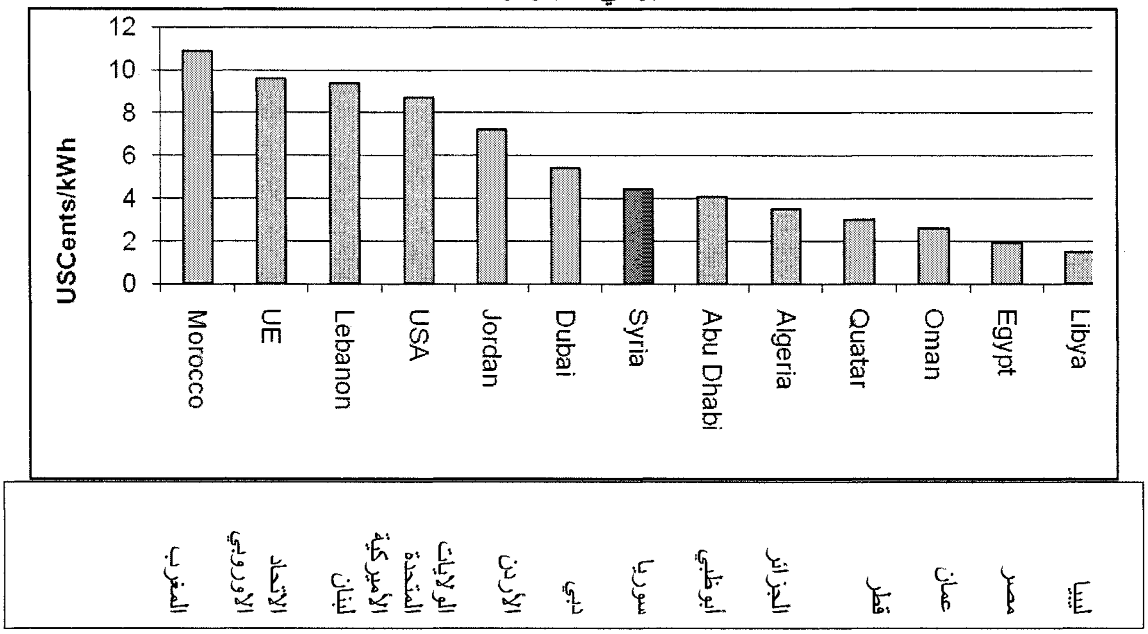
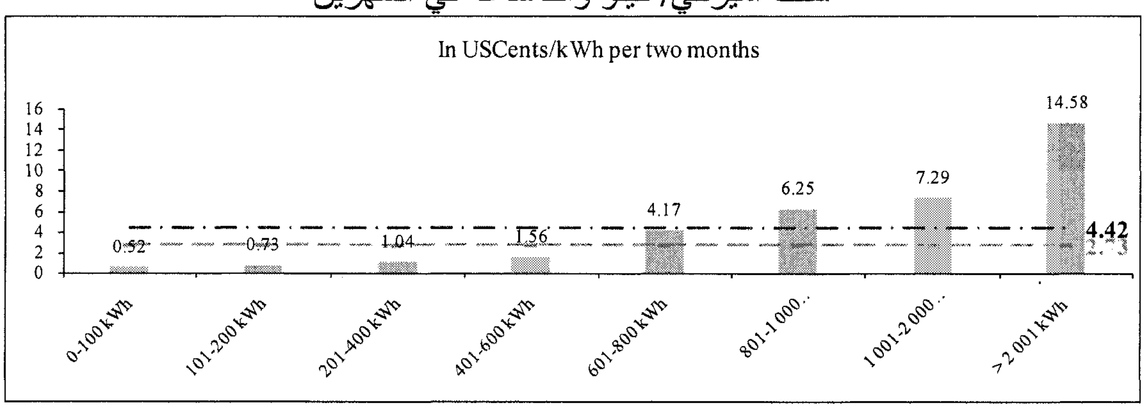
[11] صندوق التكنولوجيا النظيفة عبارة عن جهد تعاوني بين مؤسسات التمويل الدولية والمانحين الثنائيين لتعزيز زيادة تشغيل وتوزيع ونقل تقنيات الطاقة المتجددة المنخفضة الكربون. تم تخصيص ما يفوق 6 مليار دولار أميركي لصندوق التكنولوجيا النظيفة الذي يديره البنك الدولي.

الجدول البياني 4: تعريفات استهلاك الكهرباء في سوريا بالمقارنة مع التعريفات الإقليمية
سنت أميركي/ كيلو واط ساعة



تتألف التعريفة المنزلية من ثماني شرائح لاستهلاك الكهرباء، تصل إلى 2,000 كيلو واط ساعة وما فوقها (الجدول البياني 5).

الجدول البياني 5: شرائح تعريفة استهلاك الكهرباء المنزلي (في الشهرين)
سنت أميركي/ كيلو واط ساعة في الشهرين



إنّ تعريفة الاستهلاك حتى 300 كيلو واط ساعة في الشهر الواحد (أو 600 كيلو واط ساعة في الشهرين) تقل بكثير من معدل التعريفة ويمكن اعتبارها ضمن التعريفة الضرورية لدعم استهلاك احتياجات الكهرباء الأساسية، على الرغم من أنّها ضمن حدود مستوى احتياجات الكهرباء الأساسية التي تبلغ عادة 300 كيلو واط ساعة في الشهر الواحد. من ناحية أخرى، تبلغ معدلات الاستهلاك ضمن

هذه المجموعة مستوى منخفضاً للغاية، كما تظهر في الجدول البياني 5، مما يشير إلى نسبة عالية من الإعانات التي قد لا تدعو الحاجة إليها. بالإضافة إلى ذلك، يستفيد المستهلكون المتوسطون والكبار من هذه المجموعة "الضرورية" البالغة 300 كيلو واط ساعة في الشهر الواحد فيما يستخدمون أكثر بكثير من احتياجات الكهرباء الأساسية وفي الوقت نفسه يقدرون على دفع تعريفات أعلى.

يشكّل كل من القدرة على تحمل الكلفة من قبل الأسر المتدنية الدخل والعبء الذي ستفرضه عليها الزيادات المستقبلية الضرورية للتعريفة وتنفيذ إجراءات التحصيل مسألة مهمة تتطلب اهتمام الحكومة. في المبدأ، يمكن معالجة هذه المسألة على أفضل عبر برامج الدعم المستهدفة عبر برامج تحويل الأموال (شبكة الضمان الاجتماعي) للأسر المحتاجة والمؤهلة للحصول على هذا الدعم. فتحويل العبء إلى المؤسسة عن طريق تخفيض التعريفة يقلل من قدرة المؤسسة المالية ولا يشجع على ترشيد استخدام الطاقة. من ناحية أخرى، وفي عدة بلدان بما فيها سوريا، فإن القدرة الإدارية على تحديد المؤهلين للحصول على إعانات على أساس استطلاع الموارد وتطبيق برنامج إعانات ما زالت محدودة. أما ثاني أفضل أسلوب فيكمن في الاستمرار بفرض تعريفة الكهرباء الضرورية حتى التمكن من تطبيق برنامج لتحويل الأموال. غير أنّه يجب مراجعة هيكلة التعريفة لكي تستهدف التعريفة الضرورية المستهلكين السكنيين ذوي الدخل المتدني بشكل أفضل، كالنظر في إقصاء المستهلكين ذوي استهلاك شهرين يزيد عن 600 كيلو واط ساعة من التعريفة الاجتماعية لأول 600 كيلو واط ساعة وتقليص المجموعات بما فيها الفرق في التعريفة بين معدل التعريفة والشريحة الضرورية.

وتُنَظم تعريفات استهلاك الكهرباء لمستهلكي التوترات المتوسطة والعالية على أساس وقت الاستخدام اليومي (نهار-ليل) مما يوفر في المبدأ الحافز الملائم لتحويل طلبهم من فترات الذروة إلى الفترات الأخرى، وهذا متطلب ضروري لإدارة الحمل وكفاءة استخدام الطاقة. من ناحية أخرى، لا تنطبق التعريفة المستندة إلى وقت النهار على مستهلكي التوترات المنخفضة (المنزلي والتجاري)، على الرغم من أنهم يمثلون 56% من الطلب وهم مسؤولون عن معظم الطلب في فترات الذروة. بالتالي، يوصى بأن يطبق نظام تعريفة وقت الاستخدام في المستقبل على مستهلكي التوتر المنخفض بقدر ما تسمح به أنظمة القياس.

أسعار الوقود: حتى العام 2008 كان الوقود المستخدم في قطاع الكهرباء منتجاً محلياً وكانت الحكومة تحدد أسعاره ما دون الأسعار الدولية بكثير. نتيجة لذلك، تكبد قطاعا الغاز الطبيعي والنفط عجزاً ملحوظاً في الإيرادات من بيع منتجاتهما لقطاع الكهرباء. إذا تم تسعير الوقود بمعدل التكافؤ الدولي أو ما يقاربه، سيضطر مستهلكو الكهرباء لأن يدفعوا تعريفة أعلى. وستفيد أسعار الوقود الأعلى شركات إنتاج الغاز والنفط وستمكنها من الاستثمار في التنقيب والإنتاج. مما سيوفر المزيد من الغاز لقطاع توليد الطاقة في نهاية المطاف.

أداء القطاع المالي: خلال الفترة الممتدة بين العامين 2004 و2008، أخذ الأداء المالي للقطاع يتدهور فيما بدأت أسعار الوقود ترتفع أسرع ولكنها بقيت ما دون المستويات الدولية. نتيجة لذلك، *منذ عام 2008 لم تعد إيرادات القطاع من العمليات كافية لتغطية مصاريف التشغيل النقدية* ولم يتمكن القطاع من المساهمة في الاستثمار الرأسمالي. من الضروري اتخاذ الإجراءات اللازمة لإعادة إحياء القطاع مالياً وإحياء قدرته على دعم الاستثمارات اللازمة لتلبية الطلب المستقبلي. تم تطوير ثلاثة سيناريوهات للنظر

في الأداء المالي المستقبلي للقطاع إن افترضنا أنه تم تعديل أسعار الوقود وفق مستويات التكافؤ الدولية. سوف يتطلب السيناريوهان الثاني والثالث خططاً فعّالة لحماية المستهلكين ذوي الدخل المنخفض:

- *السيناريو الأول: بدون زيادة فعلية في التعريفة.* نتيجة لذلك، سيبلغ تدفق التشغيل النقدي للقطاع *سلباً* 1.5 مليار دولار أميركي بحلول 2010 وسلباً 2.7 مليار دولار أميركي بحلول 2020. وفق هذا السيناريو، ستبلغ الإعانة المالية المطلوبة من الحكومة 33.6 مليار دولار أميركي خلال الفترة الممتدة بين العامين 2008 و2020 بغية دعم متطلبات التدفق النقدي للقطاع وتمويل استثماراته.
- *السيناريو الثاني: زيادة التعريفة بشكل متسارع (90% في 2010 و20% في 2011)*، افتراضاً أنّه تم تعديل أسعار الوقود لقطاع الكهرباء وفق سعر التكافؤ الدولي. بعد ذلك، يجب المحافظة على المستوى الذي تصل إليه التعريفة في 2011 فعلياً. وفق هذا السيناريو، سوف تكون الإعانة المالية حتى نهاية 2012 المطلوبة من الحكومة محدودة بـ1.3 مليار دولار أميركي.
- *السيناريو الثالث: زيادات بنسبة 20% سنوياً حتى نهاية 2013 و10% في 2014.* سيتم بلوغ توازن في التدفق النقدي للقطاع بحلول 2015. وعلى الحكومة أن تدعم بعض تكاليف الاستثمار الخاصة بالقطاع حتى نهاية 2015 بمبلغ 4.4 مليار دولار أميركي.

التوصيات:

- لكي يستطيع القطاع تمويل استثمارات بحوالى 10.5 مليار دولار أميركي من موارده الخاصة وعبر التمويل من القطاع الخاص يجب تخفيف الفواقد فضلاً عن التعديل المنسق لتعريفات استهلاك الكهرباء وأسعار الوقود ؛
- زيادة التعريفة بأقل تقدير بنسبة 20% سنوياً حتى نهاية 2013 وبنسبة 10% في 2015 بغية تحقيق مستوى توازن التدفق النقدي للقطاع بحلول 2016 كحد أقصى؛
- تخفيض الإعانة المقدمة إلى المستهلك المنزلي ذو الدخل المتوسط و المرتفع عن طريق تطبيق تعريفة اجتماعية على الاستهلاك الشهري ما دون الـ300 كيلو واط ساعة فقط؛
- تحديد أسعار مدخلات وقود إما وفق كلفة الإنتاج الهامشية المحلية (كل الوقود تقريباً منتج محلياً) أو وفق سعر التكافؤ لتصدير زيت الوقود والديزل وسعر التكافؤ لاستيراد الغاز. ستفيد أسعار الوقود ذات مستويات استرداد الكلفة الكاملة (أو المستويات الاقتصادية) شركات إنتاج الغاز والنفط وبالتالي ستمكنها من الاستثمار في التنقيب والإنتاج. مما سيوفر المزيد من الغاز لقطاع توليد الطاقة في نهاية المطاف.

دور القطاع الخاص

ستشكل احتياجات قطاع الكهرباء الاستثمارية الهائلة عبئاً مرهقاً على ميزانية الحكومة في حال تلبيتها عن طريق التمويل العام. بالتالي، بالإضافة إلى تمكين القطاع من تمويل جزء من هذه الاستثمارات تمويلاً ذاتياً، على الحكومة أن تستقطب استثمار القطاع الخاص في قطاع الكهرباء. سيتطلب استقطاب التمويل الخاص أو القروض التجارية التزامات ثابتة من الحكومة بغية تحسين الأداء المالي لقطاع الكهرباء.

أن مشاركة القطاع الخاص في سوريا ستركز على الأرجح على قطاع توليد الكهرباء عن طريق منتجي الطاقة المستقلين. ويمكن النظر أيضاً في الاستثمار الخاص في قطاع التوزيع على المدى الأطول. نظراً إلى دوره الأساسي سيبقى قطاع النقل ملكاً للحكومة كما هو الحال في معظم البلدان.

التوصيات:

بغية جذب مشاركة القطاع الخاص في بناء قدرة توليد جديدة، على الحكومة أن تقوم بما يلي:

- تطوير وتطبيق استراتيجية تحدد السياسات والأطر التنظيمية وتوصي باتخاذ الإجراءات اللازمة لتأمين بيئة ملائمة لمشاركة القطاع الخاص والتنافسية والشفافية.
- إنشاء وحدة حكومية للشراكة بين القطاعين العام والخاص[12] مسؤولة عن إدارة مشاركة القطاع الخاص في تطوير البنية التحتية (الاقتصادية والاجتماعية) وفي تطبيق الأنظمة اللازمة.
- تعيين فريق عمل لدى وزارة الكهرباء للتنسيق مع وحدة الشراكة بين القطاعين العام والخاص بشأن تطوير السوق لاستيعاب منتجي الطاقة المستقلين. كما سيقوم فريق العمل بما يلي:

- إعداد دراسات جدوى لسلسلة مشاريع توليد يمكن عرضها على مستثمرين من القطاع الخاص؛

- إجراء تقييم مع وحدة الشراكة بين القطاعين العام والخاص ووزارة المالية الحاجة إلى ومستوى الضمان أو أدوات تحسين الاعتمادات الأخرى التي قد تقدمها الحكومة لاستقطاب القطاع الخاص؛

- إعداد عروض العطاء الخاصة بمنتجي الطاقة المستقلين لوحدات التوليد المختارة وتنفيذ عملية طرح العطاءات بشفافية.

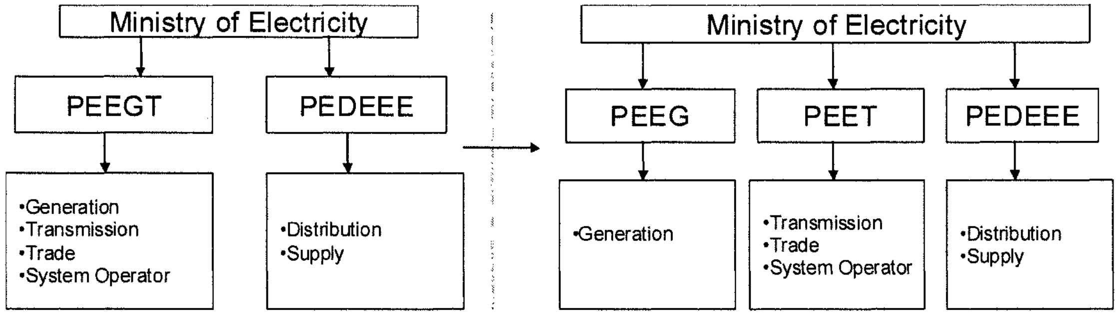
إعادة هيكلة قطاع الكهرباء

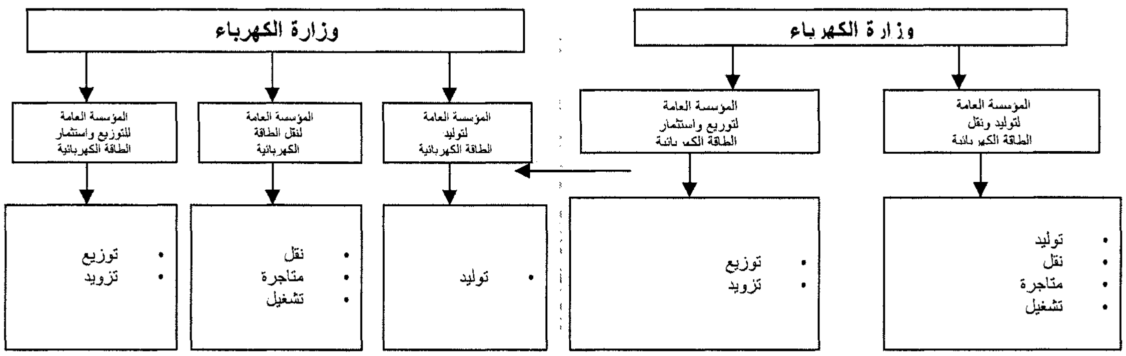
يواجه قطاع الكهرباء تحديات كبرى بسبب مستوى الفواقد الفنية والتجارية المرتفعة، ونوعية الخدمة المتدنية، والأداء المالي الضعيف (ويرجع ذلك نسبياً إلى غياب الزيادات الملائمة للتعريفة)، وغياب أنظمة محاسبة الاستحقاق المتأخرة والإدارة المالية. بغية تحسين كفاءة قطاع الكهرباء وإنتاجيته ونوعية الخدمة، يجب مراجعة هيكله والعلاقات التشغيلية بين الوحدات.

تم اقتراح *خريطة طريق لإعادة هيكلة القطاع* لتنظر فيها الحكومة. سيتألف الإجراء الرئيسي لإعادة هيكلة القطاع على المدى القصير من "الفصل للأنشطة" (الجدول البياني 6) للتوليد والنقل، أي إنشاء أنشطة منفصلة ضمن وزارة الكهرباء (وحدات التوزيع مفصولة حالياً). يتضمّن ذلك تعيين إدارة وموظفين وأصول ومطلوبات لكل وحدة وإدخال أنظمة محاسبة وإدارة تجارية.

[12] وحدة الشراكة بين القطاعين العام والخاص: عبارة عن وحدة حكومية تُعنى بالشراكات بين القطاعين العام والخاص ويمكنها العمل كجزء من مكتب رئيس الوزراء وتأخذ على عاتقها التنمية الاقتصادية.

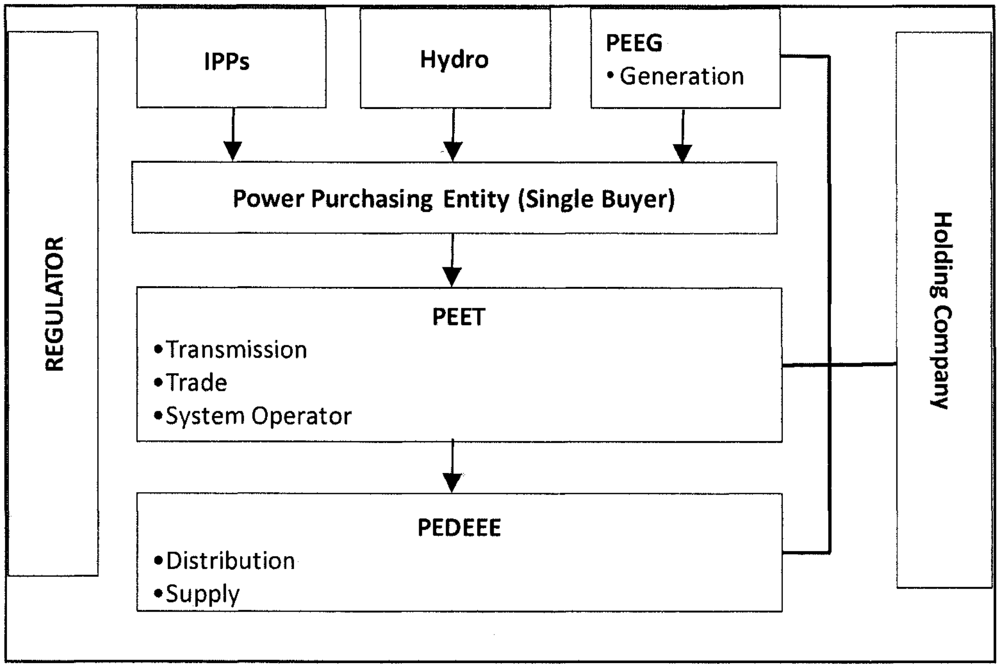
الجدول البياني 6: فصل الأنشطة لقطاع الكهرباء (2010-2011)

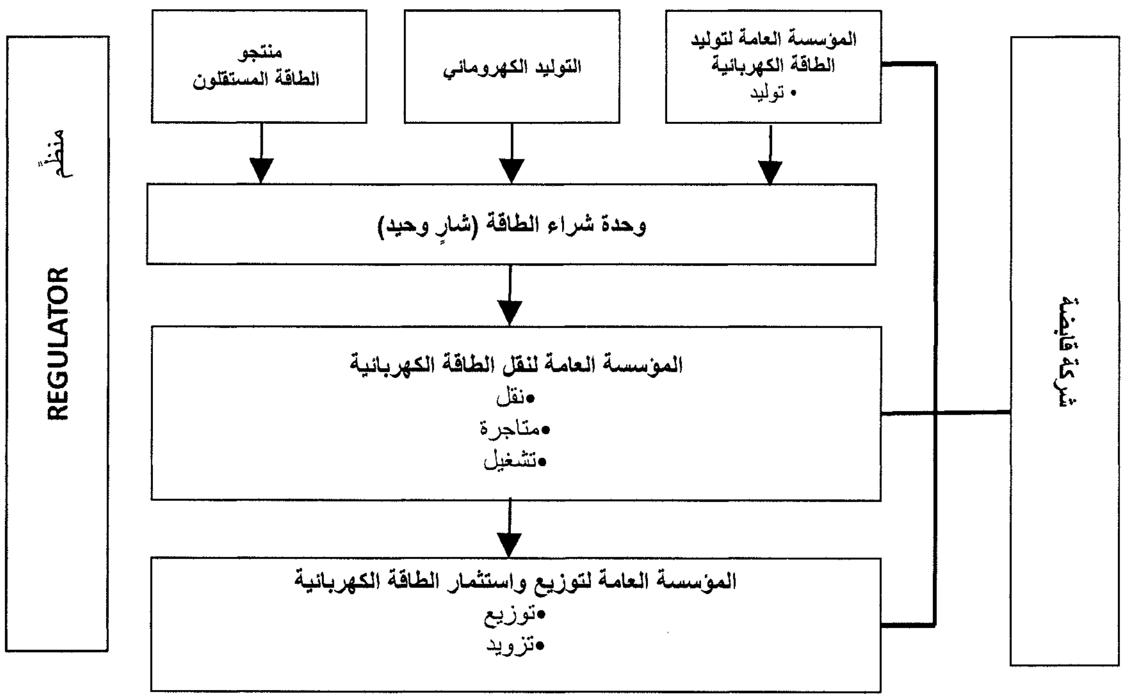




عندما يتم تحقيق ذلك، سيتم تحويل أنشطة التوليد والنقل والتوزيع إلى *شركات مملوكة من الدولة تعمل على أساس تجاري*، ربما تحت بنية شركة قابضة (الجدول البياني 7). ستؤدي إعادة التوجيه التجارية هذه إلى ما يلي: (1) الحرص على أن تملك إدارة الأنشطة التي تم تأسيسها الحافز لتحسين الكفاءة والإنتاجية؛ (2) تفعيل عملية تحسين الإشراف على أداء القطاع ومراقبته؛ (3) تسهيل عملية استقطاب القطاع الخاص نحو هذا القطاع. سوف تساعد عقود الأداء المبرمة بين الحكومة وشركات القطاع على محاسبة الشركات على أدائها. وفق نموذج إعادة الهيكلة هذا، سيتم إنشاء وحدة لشراء الطاقة مملوكة من الدولة للعمل كشارٍ وحيد بهدف شراء كهرباء بالجملة من شركات التوليد ومن ثم إعادة بيعها إلى شركات التوزيع. يمكن أن يكون الشاري الوحيد جزءًا من شركة النقل (المؤسسة العامة لنقل الطاقة الكهربائية) أو يمكن إنشاؤه كشركة منفصلة. أما فائدة الترتيب الأخير، والذي يظهر في الجدول البياني 7، فهي أنّه في حال تم تحديد تعريفات البيع بالجملة ما دون مستوى استرداد الكلفة ولم تتوفر الإعانات الحكومية، لن يؤثر ذلك على المؤسسة العامة لنقل الطاقة الكهربائية التي ستظل قادرة على القيام بوظائفها الأساسية من توسيع التشغيل والنقل.

الجدول البياني 7: التحويل إلى شركات مملوكة من الدولة تحت شركة قابضة واحدة





تتطلب إعادة هيكلة القطاع أيضاً فصل ملكية/ سياسة القطاع والأنشطة التنظيمية. يمكن تحقيق ذلك عن طريق إنشاء جهة لتنظيم قطاع الكهرباء، إما على شكل هيئة مستقلة ضمن وزارة الكهرباء أو كجهة تنظيمية مستقلة. سوف تتضمّن الوظائف الرئيسية للمنظم ما يلي: (1) الإشراف على عمليات القطاع للحرص على عمل السوق بكفاءة بعيداً عن التمييز؛ (2) تطوير منهجيات تسعير وأنظمة التعريفة؛ (3)

إصدار تراخيص للعاملين في السوق والإشراف على تقيدهم بها؛ (4) قياس أداء المرخص لهم للحرص على تشغيل الأنظمة الاقتصادي. سوف تبقى وزارة الكهرباء مسؤولة بشكل خاص عن وضع سياسة القطاع وتأمين التخطيط الاستراتيجي والإشراف الكامل على القطاع.

استراتيجية كفاءة الطاقة والطاقة المتجددة: من المهم إحراز تقدّم في مجال كفاءة الطاقة والطاقة المتجددة ويتطلب الأمر اعتماد إجراءات شاملة. في هذا السياق، على الحكومة أن تحرص ليس فقط على صياغة سياسات وتشريعات محددة خاصة بكفاءة الطاقة والطاقة المتجددة بل أيضاً على تطبيق هذه السياسات والتشريعات فعلياً. أما الخطوات الرئيسية الموصى بها فتتضمن: (1) وضع سياسة خاصة بكفاءة الطاقة/ الطاقة المتجددة؛ (2) اعتماد قانون داعم بحيث يكون شمولياً ومتجانساً؛ (3) إنشاء وكالة متخصصة (يمكن تحويل المركز الوطني لبحوث الطاقة إلى هذه الوكالة)؛ (4) إعداد استراتيجيات وخطط عمل؛ (5) إنشاء صندوق مخصص لتطوير كفاءة الطاقة والطاقة المتجددة وتطبيق حوافز مالية خاصة. وأهم من ذلك، يجب إعادة هيكلة تعريفة الكهرباء وتعديلها لتزويد العملاء بالإشارات والحوافز الملائمة.

تنسيق تزويد الغاز إلى قطاع الكهرباء: وضع كل من أسعار الغاز المتدنية والتنسيق غير الملائم بين خطط إنتاج الغاز الطبيعي ومتطلبات توليد الكهرباء قيوداً على توريد الغاز الحالي لقطاع الكهرباء. يتطلب معالجة هذا الوضع على الفور. بالتالي، يتطلب تطوير استراتيجية لتزويد الغاز إلى قطاع الكهرباء وإنشاء آلية تنسيق (لجنة التنسيق المشتركة) بين وزارة الكهرباء ووزارة النفط والموارد المعدنية. فتقوم هذه اللجنة بتنسيق ما يلي: (1) تطوير برامج الاستثمار لكلا القطاعين؛ (2) تمويل الاستثمارات وتنفيذها؛ (3) تسعير وتوفير العقود بين قطاعي الغاز والكهرباء، لأن سعر الغاز يؤثر مباشرة على قدرة قطاع الغاز على الاستثمار وعلى تكلفة إنتاج الكهرباء.

التوصيات:

- تهدف إعادة هيكلة القطاع إلى الحرص على أن تتمتع إدارته بالاستقلالية وأن تملك الحوافز لمعالجة نقاط الضعف القائمة في القطاع ولتمكينه من استقطاب مشاركة القطاع الخاص؛
- يجب أن تكمن أولى خطوات إعادة الهيكلة في "فصل الأنشطة" للتوليد والنقل، أي إنشاء وحدات منفصلة ضمن وزارة الكهرباء. وحدات التوزيع مفصولة النشاط.
- أما الخطوة التالية، فيتطلب أن تكمن في تحويل وحدات التوليد والنقل والتوزيع إلى شركات مملوكة من الدولة تعمل على أساس تجاري، ربما تحت بنية شركة قابضة. من الضروري فصل ملكية/ سياسة القطاع والوظائف التنظيمية عن طريق انشاء جهاز او جهة لتنظيم قطاع الكهرباء؛
- لتعزيز كفاءة الطاقة والطاقة المتجددة، على الحكومة أن تحرص ليس فقط على وضع سياسات وتشريعات محددة خاصة بكفاءة الطاقة والطاقة المتجددة بل أيضاً على تطبيق هذه السياسات والتشريعات فعليا. وأهم من ذلك، يجب إعادة هيكلة تعريفة استهلاك الكهرباء وتعديلها لتزويد العملاء بالإشارات والحوافز الملائمة.
- يتطلب تطوير استراتيجية تزويد الغاز إلى قطاع الكهرباء وإنشاء آلية تنسيق بين وزارة الكهرباء ووزارة النفط والموارد المعدنية.

Chapter 1. **ELECTRICITY DEMAND**

This chapter first reviews existing patterns of electricity demand in Syria and then provides a forecast of the development of demand through 2020 under various scenarios. These scenarios include an assessment of the reduction of peak demand if strong energy efficiency programs were to be implemented, including load management measures.

I. Evolution of Demand Through 2007

Since 2002, electricity demand in Syria has grown rapidly due to several factors:

- An acceleration of the country's industrialization combined with strong growth in the commercial and service sectors and increased penetration of appliances and air conditioning in households as the economy modernized and living standards increased;
- Electricity tariffs that are below cost recovery level (at present fuel prices) despite periodic adjustments, and therefore do not encourage efficient consumption of electricity;
- Lack of implementation of energy efficiency programs, since energy conservation policy in Syria is still in an early stage of development; and
- A significant inflow of refugees from Iraq.

Over the past six years, the consumption of electricity in Syria increased on an average by a very high rate of 7.4% per year: from 21.7 TWh in 2002 to 31.1 TWh in 2007 (Exhibit 1.1). The increase in the peak demand was also high at an average rate of 6.5% per year: from 4791 MW in 2002 to 6566 MW in 2007.

Exhibit 1.1: Electricity Demand 2002-2007

Year	Electricity[13] Consumption (GWh)	Peak demand (MW)	Available Capacity (MW)
2002	21,737	4,791	5,490
2003	23,414	5,081	6,565
2004	25,173	5,770	6,480
2005	26,917	6,008	6,008
2006	29,055	6279	5,950
2007	31,151	6566	6 250

Source: MOE Reports

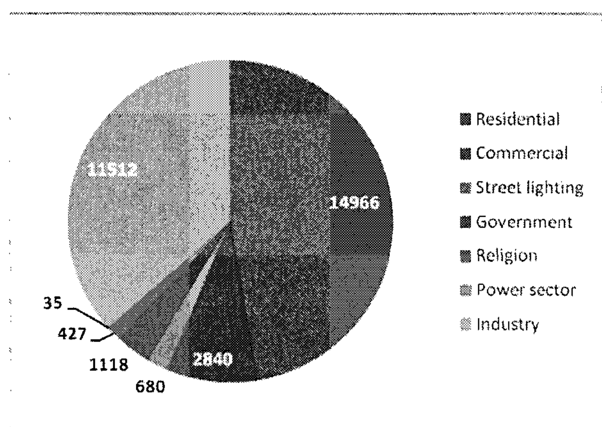
Demand Structure

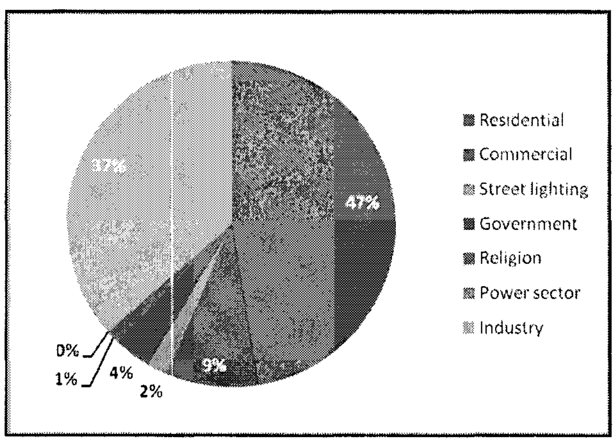
The 2007 electricity demand structure (Exhibit 1.2) shows that residential and industrial consumers are the largest categories, constituting 47% and 37%, respectively, of total electricity

[13] Electricity consumption does not include technical losses, internal power consumptions of generating plants and demand shedding but includes billed consumption of all consumers and non-billed consumption (commercial losses of 10%)

consumption. In contrast, the commercial sector constituted only 9% of total demand. Compared to other intermediate income countries, the demand from industry is high and the demand from commercial activities is relatively low.

Exhibit 1.2: 2007 Electricity Consumption Structure (in GWh and %)





Source: MOE Reports and World Bank Calculations

Network Technical and Non-technical Losses: In 2007 total technical losses (including transmission and distribution losses) represented about 17% of total demand in Syria, which is very high by international standards for comparable power systems and should not exceed 10% for total technical losses in the transmission and distribution power networks. The 2007 demand also includes 10% of non-billed demand representing non-technical losses[14]. This is also higher than the non-technical losses accepted by commercially operated power utilities and which are in the order of 2% or less.

[14] These losses are typically caused by energy theft, poor quality energy meters, defective energy meters, or errors in meter reading and billing.

Load shedding: The increasing difficulties experienced by the power system to meet the demand of the growing economy are shown by the level of un-served load in GWh reported by PEDEEE. Load shedding sharply increased from 2006 onward (see Exhibit 1.3 below).

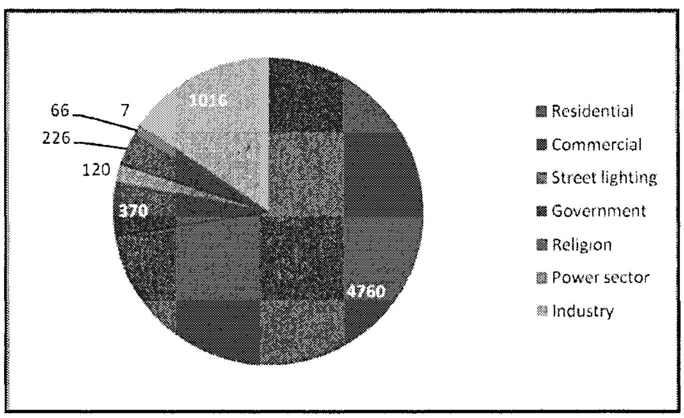
Exhibit 1.3: Unserved Load Due to Load Shedding (in GWh)

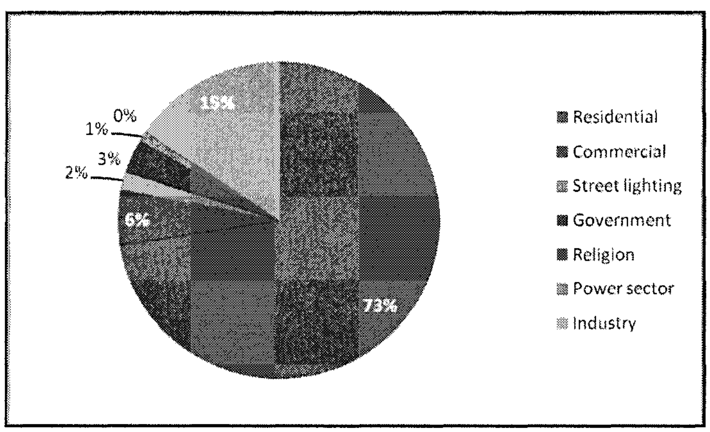
	2002	**2003**	**2004**	**2005**	**2006**	**2007**
Unserved load	86.3	83.4	103.8	55.0	345.1	427

Source: MOE Reports

Peak demand: In terms of capacity demand, Exhibit 1.4 shows that during system peak residential users had by far the largest demand with 4,760 MW, followed by industry with 1,016 MW. Residential consumers typically use a great deal of capacity but only during relatively short peak periods, while industry uses a given capacity on a more continuous basis throughout the day.

Exhibit 1.4: 2007 Demand Structure During System Peak (in MW and %)



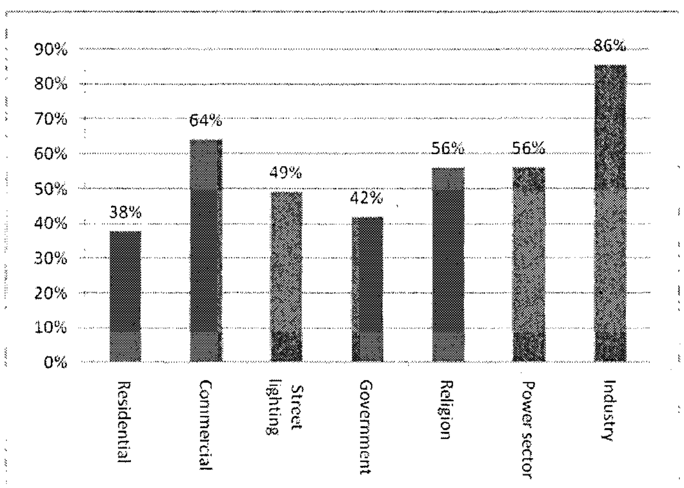


Source: MOE Reports and World Bank Calculations

A comparison between energy demand and peak demand shows that the load factor[15] varies significantly by consumer category (Exhibit 1.5). Residential consumers have a load factor of 38%, which is low by international standards, suggesting short but pronounced peak demand periods and a high utilization rate of inefficient appliances. In contrast, the industrial sector has a high load factor of 86% suggesting strong and continuous electricity demand of Syrian heavy industry. Because of the weight of industry in total demand, the overall system load factor is still relatively high at 67.2%.

As the Syrian economy modernizes, the role of heavy industry may decrease in relative terms, as has been the case in many other countries. This implies that the system load factor may decrease as the demand from residential consumers with a low load factor increases. In that case significant investment in additional capacity will be needed to meet a fast growing peak demand. Therefore, the Government may consider targeting the largest consumption categories through load management and energy efficiency programs to improve and/or retain their load factor (see the Energy Efficiency section in this chapter).

Exhibit 1.5: 2007 Consumer Load Factors



Source: MOE Reports and World Bank Calculations

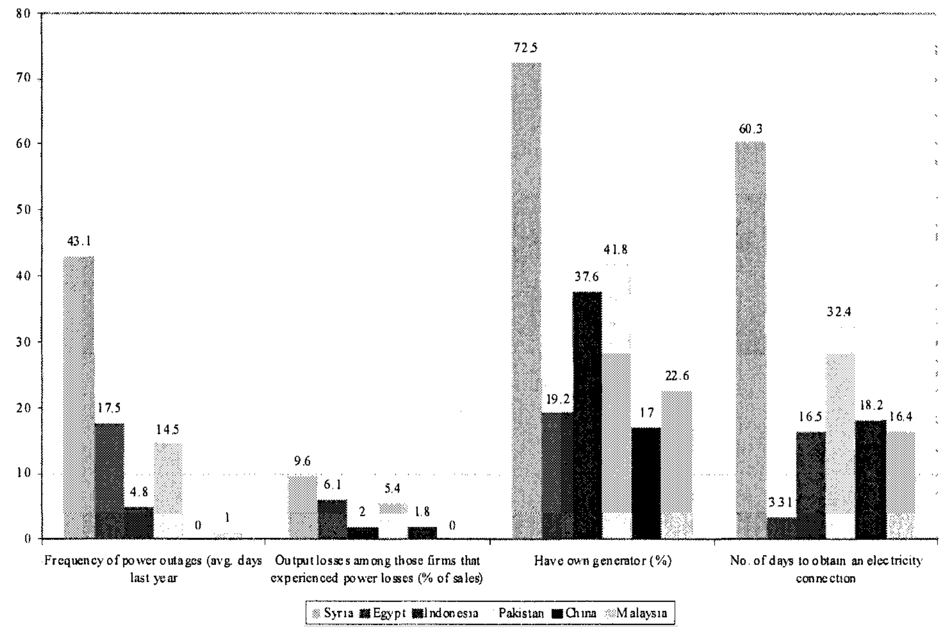
Quality of Service

The Investment Climate Assessment (ICA) conducted by the World Bank in 2005 shows (Exhibit 1.6) that the quality of electricity supply to industry in Syria is poor compared to similar

[15] Load factor is defined as total energy produced plus net import/exports in MWh divided by peak demand (MW) times 8760 (hours). The load factor is an indication of how intensively and efficiently capacity is being used. A low load factor requires that a significant generation capacity is used only for short periods of time to meet high peak demand while sitting idle most of the time. It requires the construction of expensive generation capacity used only intermittently. This represents a major financial burden for a power utility when the tariff for residential consumers do not include full cost covering peak and off-peak tariffs.

countries in terms of economic development. The level of un-served load has further increased in 2006 and 2007 indicating that the quality of services has not improved after 2005.

Exhibit 1.6: Electricity Power Supply Indicators: Syria and Comparators



Source: World Bank ICA, 2005

According to the ICA, the frequency of power outages encountered by Syrian firms was 43 days during 2005 while their comparators in Egypt suffered 18 days of outages and in Malaysia only one day. Similarly, output losses resulting from frequent power shortages are estimated at 9.6% of firms' turnover in Syria, as opposed to 6.1% in Egypt and 1.8% in Malaysia. A lack of reliability in the supply of electricity is undermining the competitiveness of Syrian firms, because of output losses and the additional cost of running private generators. As the Syrian economy grows and new industrial complexes are being established around several cities, addressing the issue of power shortages to industries should be a top priority for the Government of Syria to attract private investments and increase the competitiveness of the Syrian economy.

II. Demand Forecast

The key variables for future demand projections are GDP growth by sector, sectoral GDP elasticity of demand, tariff increases by category of consumers, and price elasticity by sector. Energy demand projections were prepared for the base case, high case and low case GDP scenarios. Annex 1.1 includes assumptions made in developing the base case, low case and high case demand projections. The base case projection is summarized below (Exhibit 1.7).

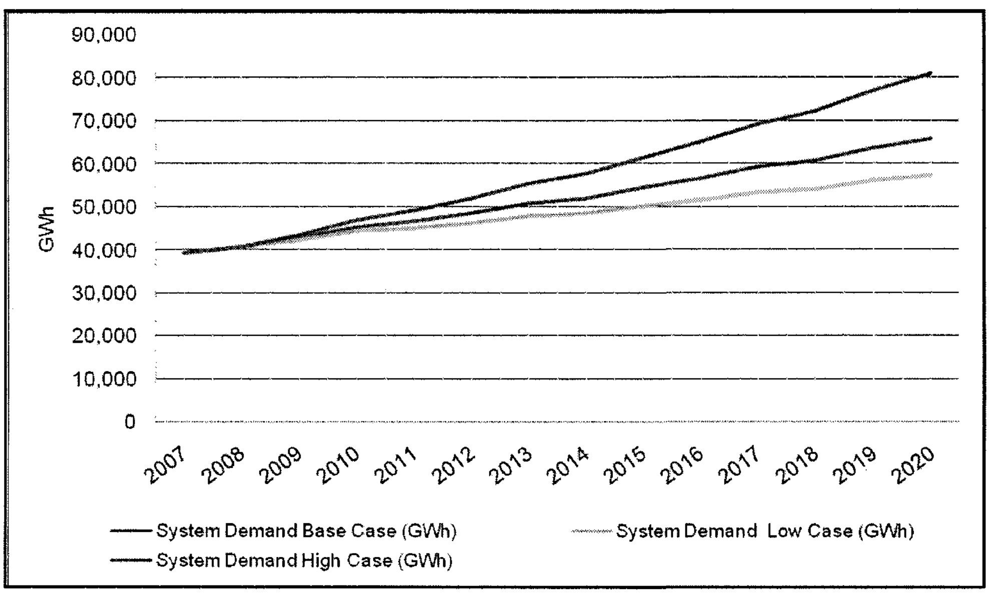
Exhibit 1.7: Electricity Demand through 2020 – The Base Case (in GWh)

	2007 (actual)	2010	2015	2020
Non-industrial	19,619	22,928	28,903	36,474
Industry	11,531	12,794	14,508	16,296
Total Consumption	31,151	35,722	43,412	52,770
Total Unconstrained System Demand[16]	39,379	45,346	54,498	65,752
Annual Growth Rate	5.0%	6.0%	4.7%	3.3%

Source: MOE Statistics, World Bank projections

The forecasts show that in the base case the average unconstrained electricity system demand growth rate during 2007-2020 is 4.0% per annum in the base case (67% over the entire period). Corresponding numbers are 5.8% in the high case (106% over the entire period) and 3% in the low case (45% over the entire period). These various forecasts are graphically plotted in Exhibit 1.8 and tabulated in Annex 1.2

Exhibit 1.8: Three Electricity Total System Demand Scenarios (in GWh)



Source: PEDEEE and PEEGT Statistics to 2007; World Bank projections 2007-2020

The forecasts suggest a slow-down in the growth of total demand after 2010. This is due to the moderate projected GDP growth, the expected modernization of the structure of the Syrian economy, a shift toward less energy intensive activities over time and the projected reduction in

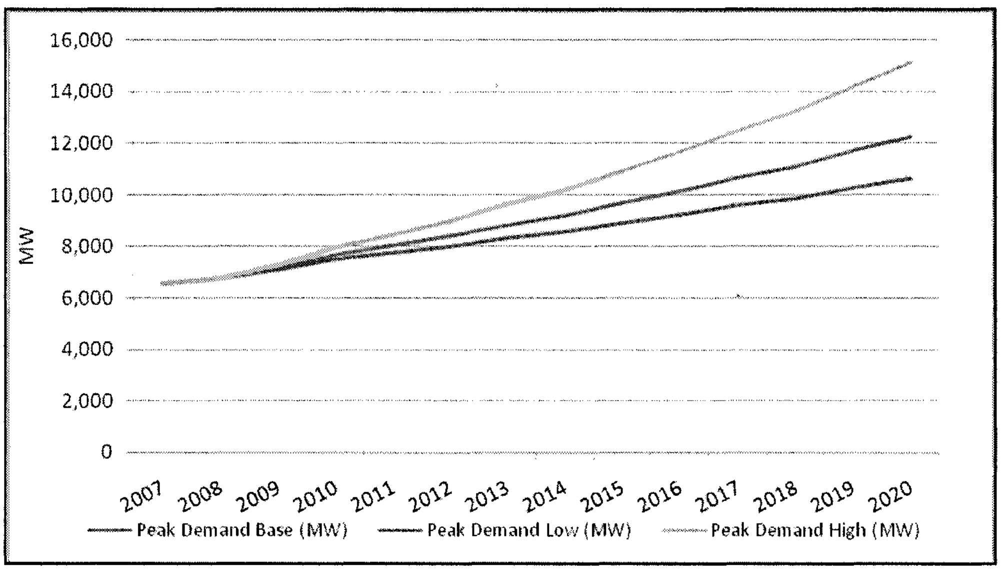
[16] Includes demand from all consumers, technical and commercial losses, the power sector's own consumption, net import and amount of load shedding.

technical losses. Nevertheless, needed generation will still grow strongly to meet system demand the projected total demand. During 2007 -2020, electricity generation is projected to increase by 26.4 TWh in the base case, 41.6 TWh in the high case, and 17.8 TWh in the low case, respectively. Therefore, significant investments in new generating capacity and in expansion of the transmission and distribution networks would be needed (Chapters 3 and 4). This underlines the importance of promoting and implementing energy efficiency programs to slow the growth of electricity demand. It also highlights the need for a vigorous program to reduce technical and commercial losses.

Peak Demand

The generating capacity needed to meet peak demand (excluding reserve margin) depends on demand growth and the evolution of the system load factor. Even assuming that the load factor of each consumer category remains constant, the shift in the structure of the economy will involve a faster growth of consumer categories with a lower load factor (residential and commercial) compared to consumer categories with a high load factor, such as a industry. This could result in a decrease in the overall system load factor from 67.2 in 2007 to 64.5% in 2015 and 61.4% by 2020.

Exhibit 1.9: Three Capacity Demand Scenarios (in MW)



Source: PEEGT and PEDEEE statistics through 2007, World Bank projections after 2007

Demand forecasts show that in the base case peak demand is projected to increase from 6,566 MW in 2007 to 12,245MW by 2020 (Exhibit 1.10 and Annex 1.2). The system will therefore need a minimum[17] of additional generating capacity of 5,680 MW by 2020 compared to 8,576 MW in the high case and 4,059 MW by 2020 in the low case. The average growth rate of the system capacity during 2007-2020 is therefore 4.9% p.a. in the base case, 6.6% p.a. in the high

[17] Without consideration for requirement of reserve margin or expected retirement of existing generation plants.

case and 3.8% p.a. in the low case. The challenges of meeting future demand through development of new generating capacity are addressed in Chapter 5.

Exhibit 1.10: Peak Demand through 2020 – The Base Case

	2007	2010	2015	2020
Peak Demand (MW)	6566	7,678	9,675	12,245
Growth rate (% in the year)	4.6%	6.8%	5.3%	4.7%

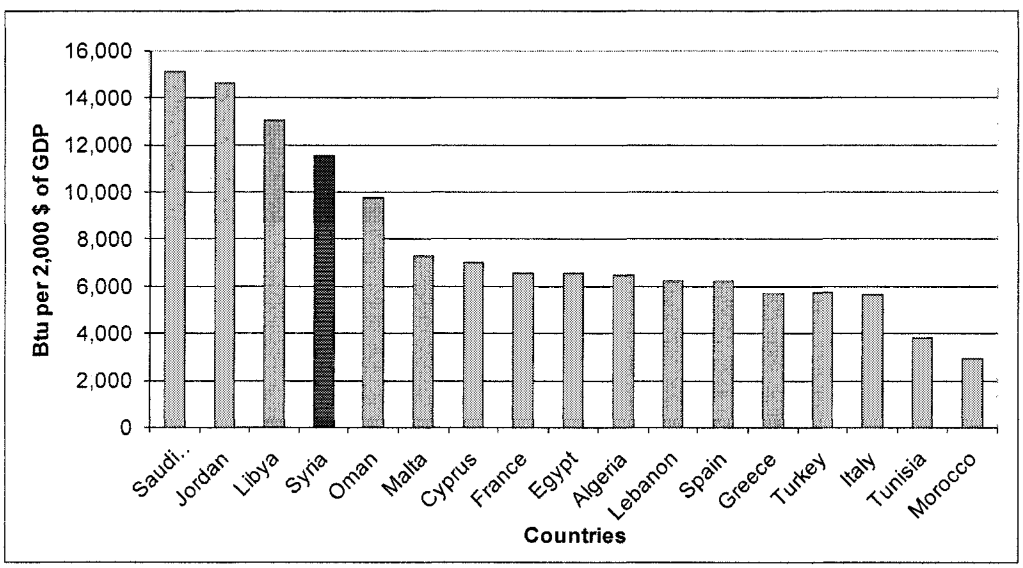
Source: MOE Reports and World Bank Calculations

III. Curbing Demand: Syria's Energy Efficiency Potential

Energy Efficiency

Energy intensity in Syria is among the highest in the Middle East and North Africa (MENA) region and is also higher than several EU countries as shown in Exhibit 1.11. Although these numbers need to be interpreted with caution, as the industrial structure of each country is specific, it suggests that there may be a considerable potential for energy efficiency improvement in Syria. In addition to the potential for improving energy efficiency in the industry sector, it is also clear that there is a vast potential for energy efficiency improvement in the residential sector.

Exhibit 1.11: Energy Intensity in Syria and Selected MENA and EU countries



Source: EIA statistics, 2006.

The Government of Syria has recently established the **National Energy Research Center (NERC)** which is to be responsible for formulating, proposing, and coordinating policies, plans and programs in the areas of renewable energy and energy efficiency. The Government has also commenced developing specific legislation to promote energy efficiency in Syria including:

- The Energy Conservation Law (enacted);
- The Labels and Standards Law (enacted); and
- The Insulation Code for Buildings (enacted).

Several pilot energy efficiency programs have been initiated in Syria, including:

- Programs for using high-efficiency compact fluorescent light (CFL) bulbs[18];
- Introduction of solar water heating technology for residential and industrial sectors; and
- Energy audits and efficiency improvement in selected public sector buildings.

In addition, a long term preliminary plan for implementation of efficiency programs has been presented by NERC to the Ministry of Electricity. The plan forecasts reducing electricity demand by 19% by 2030 compared to a business-as-usual scenario. This is a very ambitious goal considering the limited track record of the existing embryonic institutions to develop energy efficiency programs and scale up their implementation, and given the absence of an energy efficiency "infrastructure" in Syria. Chapter 6 reviews necessary institutional development and implementation mechanisms that need to be developed in Syria to promote and implement energy efficiency programs.

Nevertheless, based on estimates of the potential for energy efficiency in Syria prepared by NERC and on World Bank experience in the Region[19], it is estimated that industrial sector electricity demand could be reduced by up to 15% over the next ten years and residential demand by about 10%. Both are in comparison with a business-as-usual scenario, i.e., one without action to improve energy efficiency. The overall impact is a reduction of demand by about 3000 GWh by 2015 (6% of total demand), increasing to 5,600 GWh by 2020 (8.5% of total system demand). The equivalent energy efficiency "negawatts" (i.e., capacity that does not need to be built or is freed up for other uses) are estimated at 519 MW by 2015 and 931 MW by 2020.

[18] A tender has been prepared (but not yet issued) for one million Compact Fluorescent Lights (CFLs) with a cost of around US$ 1 million to be distributed mainly in the residential and public building sectors. The plan is to scale up this program to 6-10 million CFLs to make a significant impact on energy consumption. An important aspect for the success of the CFL program is the design of the distribution mechanism, which, based on international experience, could be best managed by the utility which has a consumer database and ongoing contacts with each consumer. Another important aspect is how the operation is planned and staged. Experience suggests that the first batch of CFLs could be subsidized, while the next batches could be distributed on a full cost recovery basis, preferably through a surcharge in the electricity bill. Experience suggests that quality tests should be performed and found satisfactory before CFLs are distributed or marketed, as the distribution of sub-standard products would damage future prospects for CFL development and negatively affect public perceptions about energy efficiency products in general.

[19] Source: Evaluation of the potential for energy conservation carried out in Morocco, Sidi Bernoussi Project (2006) and Tunisia (2008) under ESMAP financing.

Load Management

Load management is a special subset of an array of energy efficiency measures. It is typically implemented by the utility at the request of consumers, in exchange for favorable tariff treatment. It consists either of the utility switching off the supply of electricity for selected consumers and/or for specified appliances or equipment during periods of peak demand, or by consumers using electricity for major appliances (e.g., laundry machines, air conditioning) during off-peak hours. This usually has a significant impact on the system capacity needed and therefore reduces the peak capacity that needs to be built.

Residential consumers could be targeted by load management and energy efficiency programs to shift the load during peak hours and to promote efficient consumption of electricity. Load management of household consumption could also be encouraged by the application of time-of-day[20] pricing of electricity to consumers whose metering systems are upgraded to modern electronic or smart meters. The largest consumer and industrial categories could be targeted through load management and energy efficiency programs to improve and/or retain their load factor. Such programs include for example mandatory or voluntary energy audits and special tax incentives (e.g. accelerated depreciation, exoneration of import tax on energy efficient equipment) to encourage investments in energy efficiency programs.

Although the impact of load management is difficult to evaluate, considering that the load factor of residential consumers could increase by 0.25% per annum from 38% to 40.5% by 2020, the impact on system peak demand would be to free up 160 MW by 2010, 448 MW by 2015 and 866 MW by 2020.

Taken together, if Syria could fully realize the estimated potential for energy efficiency gains and load management, it would require about 1,797 MW less of capacity (14%) by 2020 than without implementation of energy efficiency and load management programs as shown Exhibit 1.12.

Exhibit 1.12: Impact of Energy Efficiency (EE) and Load Management (LM) on Peak Demand
(in MW)

	2007	**2010**	**2015**	**2020**
Peak demand without EE/LM	6,566	7,678	9,675	12,245
Impact of EE	0	0	-519	-931
Impact of LM	0	-160	-448	-866
Peak demand with EE/LM	6,566	7,518	8,708	10,448
Reduction due to EE and LM	**0**	**-160**	**-967**	**-1,797**

Source: World Bank estimates

[20] Time-of-day tariffs provide incentives to consumers to shift part of their electricity consumption during on-peak hours to off-peak hours.

Tariff Measures

Inadequate energy prices and structures, and distortions in prices between fuels, are a major barrier to energy efficiency investments. Consumers, manufacturers and service providers have little incentive to invest in energy efficiency unless energy prices are right. Even more important than absolute price levels from an energy efficiency point of view is that consumers' expenditures on energy must be significant enough as a percentage of their disposable income to make them take autonomous action.

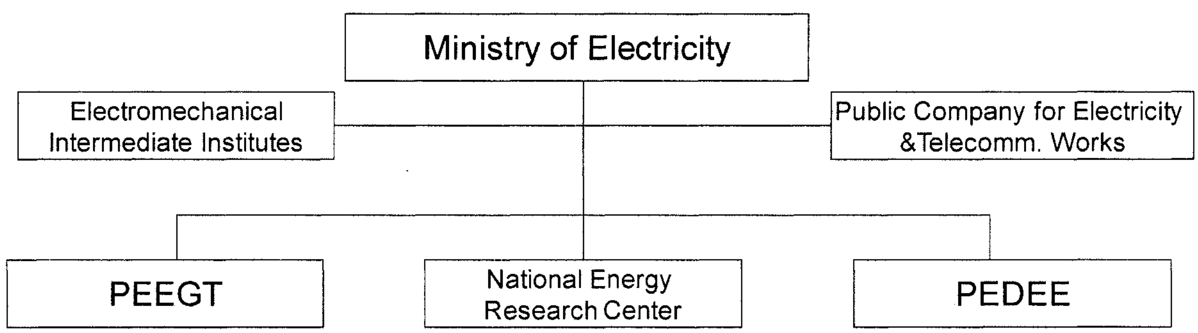
In this context, and for other reasons such as the financial viability of the utility, the Government should seriously consider revising the electricity tariff structure and level where appropriate, to ensure that each consumer category receives the proper signal and has an incentive to undertake energy efficiency investments. Tariffs issues are more extensively analyzed in Chapter 4.

Chapter 2. **ELECTRICITY SUPPLY**

I. Sector Organization

The electricity sector in Syria is organized under the Ministry of Electricity which regulates and manages the sector. The Public Establishment for Electricity Generation and Transmission (PEEGT) operating as part of the Ministry is responsible for planning, development, operation and maintenance of the generating plants and transmission networks. The Public Establishment for Distribution and Exploitation of Electric Energy (PEDEEE) and its fourteen regional branches have similar responsibilities for the distribution network. Exhibit 2.1 shows a basic organization chart for the electricity sector in Syria. Sector organization and restructuring are discussed in detail in Chapter 6.

Exhibit 2.1: Organization Chart of the Electricity Sector in Syria



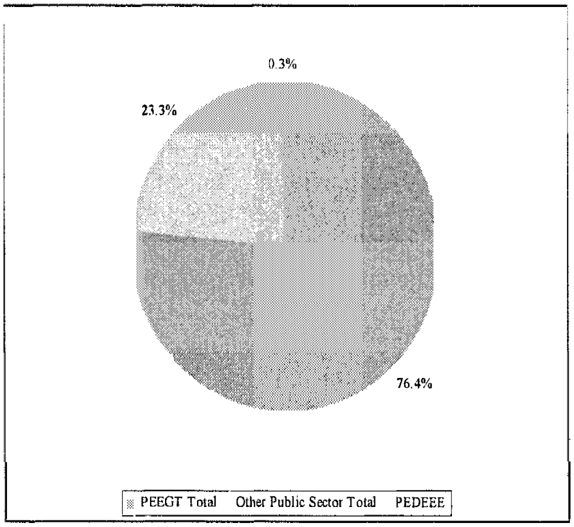
This chapter provides a review of the operational performance of the electricity sector and identifies key challenges which will be addressed in subsequent chapters of this note.

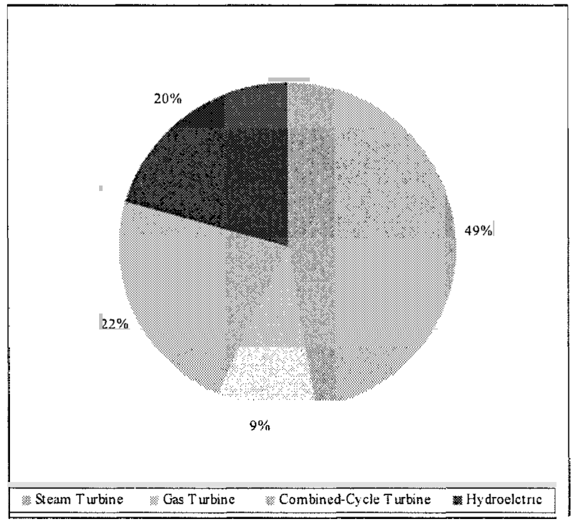
II. Electric Power Generation

Installed Capacity

In 2007 the total installed power generating capacity in Syria was 7,459MW of which 76.4% was supplied by PEEGT, 20.2% by the General Establishment of Euphrates Dam (Thawra, Baath, and Tishreen plants reporting to the Ministry of Irrigation), 1.6% by Syrian Petroleum Company, 0.9% by Homs refinery, 0.6% by Banias Refinery and 0.3% by PEDEEE. The generation mix consists of plants with different technologies including steam (47.6%), hydro (20.5%), gas open cycle turbines (9.5%) and combined-cycle turbines (22.5%), as illustrated in Exhibit 2.2 and Annex 2.1.

Exhibit 2.2: Power Generation Mix: Ownership and Technology





Source: MOE Reports and World Bank Calculations

Load Factor

Performance indices for the Syrian generating plants are summarized in Exhibit 2.3. The load factor according to plant type indicates that Syria relied primarily on steam power plants and to a lesser extent on CCGTs for meeting the system's base load demand, and on gas turbine and hydro power plants for peaking.

Exhibit 2.3: Generation Performance Indices, 2007

	Installed	Available	Production	Load	Availability
Steam	3,435	2,995	22,551	76%	87%
Gas	587	404	7,302	44%	69%
CCGT	1677	1600	5,263	65%	95%
Total -PEEGT	5699	4999	35,116	61%	88%
Hydro	1,528	1,151	3,526	42%	75%
System Total	7,227	6,150	38,642	52%	82%
Other Public Sector[21]	232	100			
TOTAL	7,459	6,250			

Source: MOE Reports and World Bank Calculations

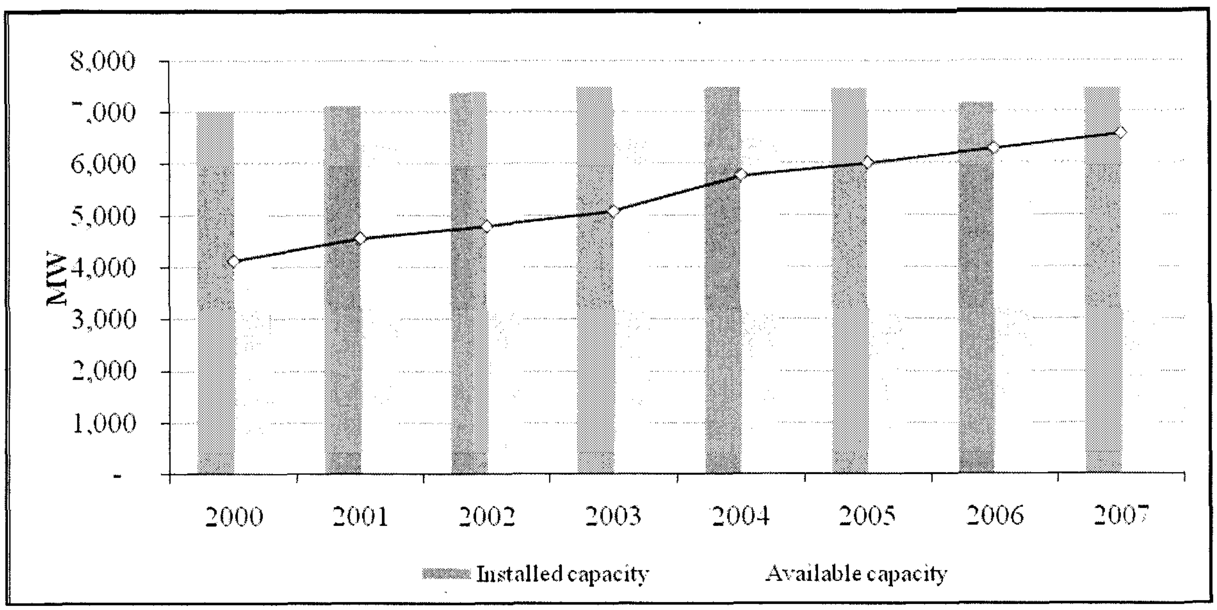
[21] Syrian Petroleum Company, Homs refinery, Banias Refinery and PEDEEE

Availability

Exhibit 2.3 shows that the total available generation capacity in 2007 was 6,250 MW out of 7,459 MW installed capacity due mainly to lack of investments in overhaul maintenance and rehabilitation of existing power plants. The average availability factors of different types of available generating plants in Syria were in 2007 at acceptable levels of above 85% and reaching 95% for the CCGT plant; gas plants were the exception at 69%. However, despite an average 88% availability factor, the total available capacity of 6,250 MW was inadequate to meet peak demand of 7,007 MW in 2007.

Exhibit 2.4 shows, available generating capacity has declined on average 3.2% per annum during 2003-2006, compared to about 7.4% per annum growth in peak demand in the same period. Although available capacity increased by 5% in 2007[22], the shortfall in available capacity remained high at 316 MW compared to 329 MW in 2006 due to growing demand. Even with new addition of generation capacity planned for 2009, the shortfall of generating capacity, unless major investments in new generation capacity are carried out, is expected to continue to rise during 2009-2020 due to retirement of an estimated 2476 MW of older generating units (Annex 2.2).

Exhibit 2.4: Peak Demand and Installed and Available Generating Capacity (1997-2007)



Source: MOE Reports and World Bank Calculations

The above exhibit shows that starting in 2005 demand outstripped available capacity. This means that the power system is operating without any reserve margin, which leads to frequent

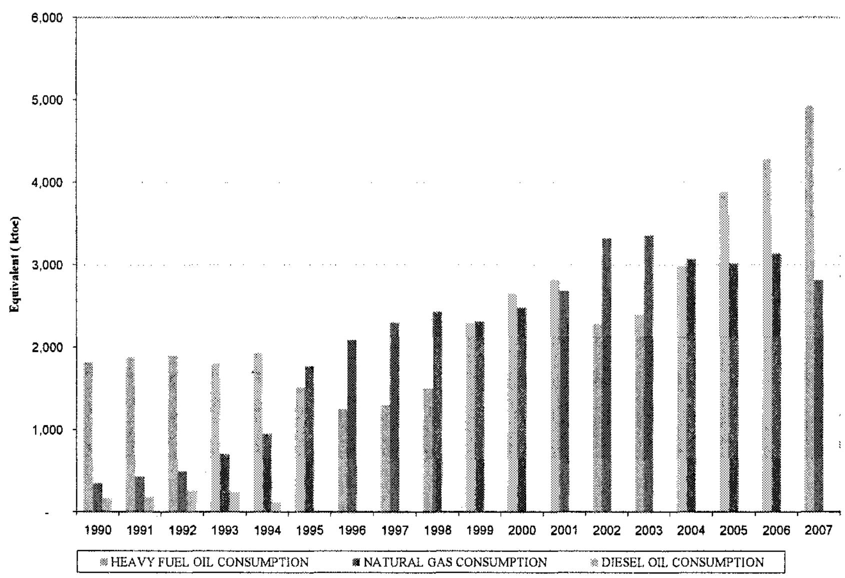
[22] 300 MW of new generation capacity was added in 2007 due to converting Nassrieh and Zayzoon open-cycle power plants to combined-cycle power plants.

load shedding. Generally, a capacity reserve margin of about a minimum 10% is considered necessary for reliable operation of the power system and security of the electricity supply.

Fuel Consumption

PEEGT's power plants burn heavy fuel oil (HFO), natural gas, and a small amount of diesel (Exhibit 2.5). Since 1996, HFO consumption has increased on average by 12% per annum, compared to 4% for natural gas. HFO consumption was virtually equal to gas consumption in 2004 and exceeded it by increasingly wide margins starting in 2005. This is partly due to the shortage of gas, which imposed an increasing reliance on HFO for base load steam power plants to meet growing demand. Even though the Nassrieh and Zayzoon power plants have been converted to combined-cycle in 2007, natural gas consumption has considerably declined by 11% compared to 2006. The potential of operating dual fuel power plants on natural gas has not been fully exploited since 2002 because of the unreliability of the natural gas supply. This is a critical issue to consider for future generating plant expansion (see Chapter 3).

Exhibit 2.5: Equivalent of Fuel Consumption by PEEGT's Power Plants



Source: MOE Reports and World Bank Calculations

Short-term Additional Capacity

No new generating capacity has been added to the system between 2001 and 2006. The conversion of the open cycle gas units at the Nasrieh and Zayzoon plants to combined-cycle with an additional capacity of 150 MW steam unit in each power plant was completed by the end of 2007. One of the major new plants that PEEGT counts on is the new 750 MW combined-cycle power plant at Deir Ali which would use natural gas as its main fuel. The Deir Ali power plant is expected to become fully operational during 2009. Expansion of the Tashreen power plant by

450 MW and the Banias power plant by 300 MW is also expected to be completed by end 2009 as summarized in Exhibit 2.6.

Exhibit 2.6: Power Generation Projects under Construction

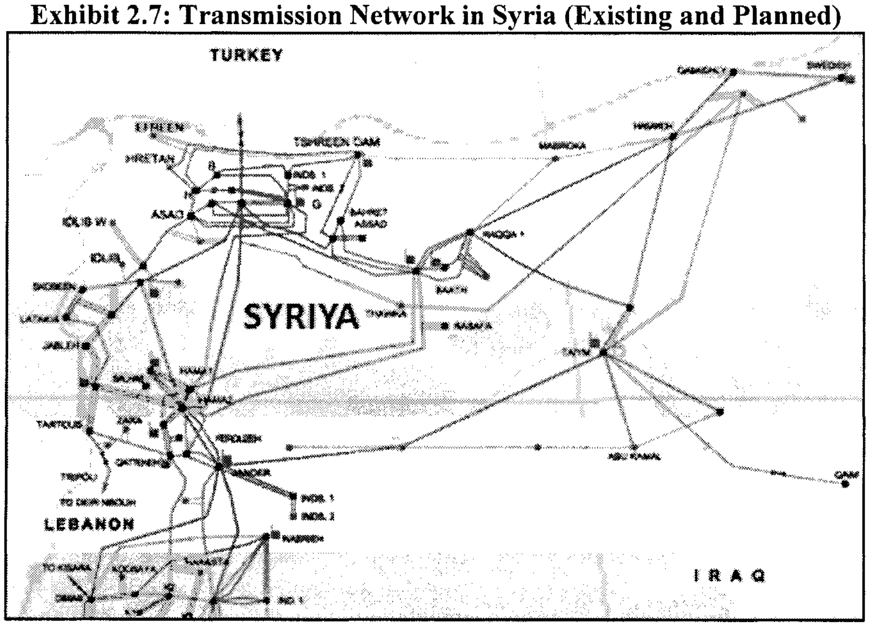
Power Plant	Type	Capacity (MW)	Status	Full Operation Year (estimated)
Deir Ali	Combined Cycle	750	Partially Operation in 2008	2009
Tishreen extension	Combined Cycle	450	Under Construction	2010
Banias Extension	Gas Turbine	300	Under Construction	2009

III. Transmission and Distribution

Transmission

The transmission system in Syria is planned, operated, and maintained by PEEGT. The main transmission network consists of 5,420 km of 230kV lines and 1,188 km of 400kV lines, plus associated substations and transformers. As illustrated in Exhibit 2.8, the 400 kV south-north transmission interface connects major generating plants with the transmission grid, while the load centers in the country's five regions are supplied by the major 230kV network. Internal constraints within the 230 kV transmission network exist, primarily due to limited transformer capacity in substations that are feeding major load centers. In addition, reliability problems exist in some parts of the network due to limited redundancy in equipment and lines. Therefore, PEEGT is planning to expand the 400 kV transmission network to reinforce the transmission capacity of its national transmission network (Exhibit 2.7).

Exhibit 2.7: Transmission Network in Syria (Existing and Planned)



Source: AUPTDE

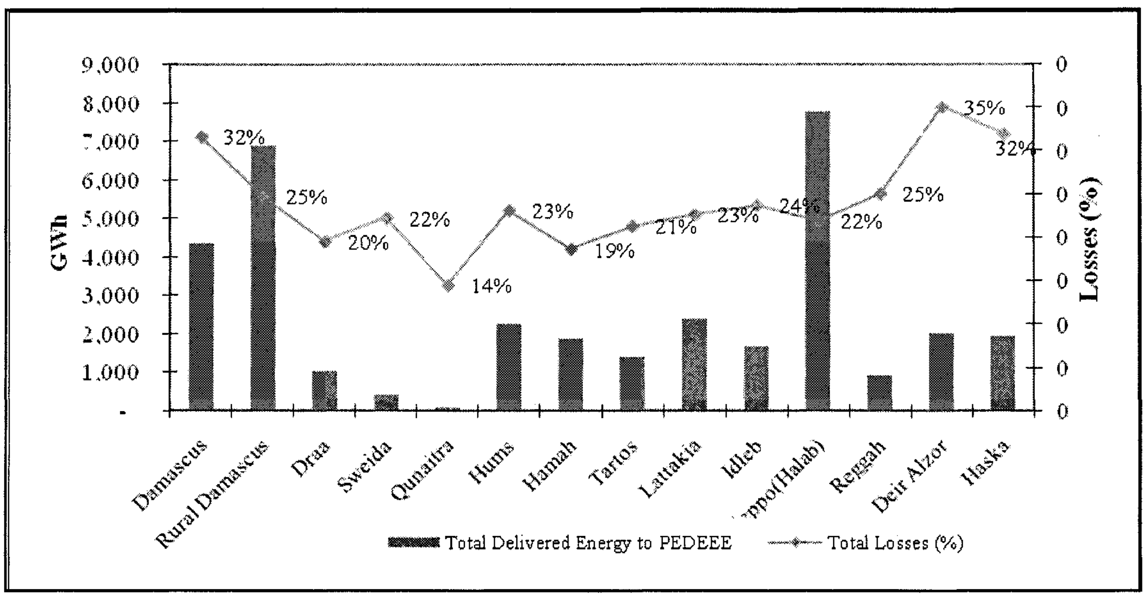
Distribution

The Syrian distribution system is planned, operated, and maintained by PEDEEE and its fourteen regional companies. By end 2007 PEDEEE had about 4.6 million customers. Over the last 30 years Syria has undertaken rural electrification programs to connect communities to the national network, thus increasing access to electricity to an impressive estimated 99% of the population.

In 2007, the electricity supply delivered to the distribution networks[23] reached 34.9 TWh. Electricity sales to 57 large consumers (2.2 TWh) at 66kV represented 8.6% of the total energy billed, while sales to all other consumers below 66kV were 23.9 TWh. Billed electricity accounted for 75 % of the total delivered energy. The remaining 25% represents technical (15%) and non-technical losses (10%) which have been decreasing from 27.2% in 2002, but remain high. In 2007, the collection rate as reported by PEDEEE was about 95%, mainly due to low payment levels by government entities.

Exhibit 2.8 shows network losses in the governorate distributional companies. Given that the largest losses exist in the regions of Damascus, Rural Damascus, and Aleppo which have the largest consumption; PEDEE should focus its loss reduction programs on those three regions in order to gain maximum benefit.

Exhibit 2.8: Distribution Network Losses by Governorate



Source: MOE Reports and World Bank Calculations

These very large losses (25%)[24] and non-payment of bills equaling (up to 5%) together amount to about 30% of energy delivered to PEDEEE. This weighs heavily on PEDEEE's financial

[23] Electricity Supply to 66kV networks and below.

[24] 25% is the distribution losses. Total system losses including transmission is losses is about 27%

performance. At an average tariff of US Cents 4.42/kWh and assuming 10% as an acceptable level of technical losses and 2% for non-payment of bills, the equivalent financial loss to PEDEEE was about US$ 278 million in 2007 alone[25]. This is a clear indication that the metering and billing systems of PEDEEE are in need of a major overhaul to reduce non-technical losses including: (i) replacement of outdated consumer meters by modern electronic meters[26] and; (ii) upgrading of customer information systems including the client data base to improve billing and customer services. In addition, major investments for rehabilitation and expansion of the distribution networks will be needed to reduce technical losses.

IV. Regional Integration

Syria's power system is the second largest in the Arab Mashreq region, after Iraq. Due to its pivotal geographic location, Syria is positioned to play an important role in the development of regional Mashreq energy (electricity and gas) markets. In the longer term these markets could be integrated with the Turkish and EU energy markets.

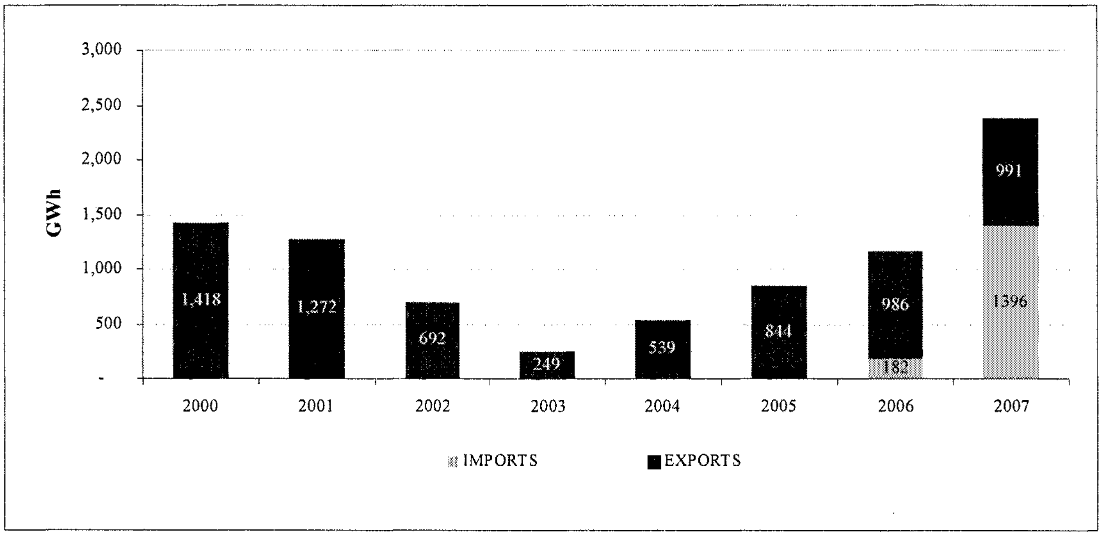
Electricity

Syria is a member of the Seven-Consortium Interconnection (EIJLLST) that links the power grid of Egypt, Iraq, Jordan, Lebanon, Libya, Syria, and Turkey at the 400kV and 500kV level. The Syrian transmission system is connected to the power systems of Iraq, Jordan, Lebanon and Turkey with 9 interconnections, at voltages ranging from 66 kV to 400 KV (Annex 2.3).

Syria's cross-border energy imports and exports have developed through bilateral agreements. Exhibit 2.9 shows annual electricity imports and exports between Syria and neighboring countries. The present situation, where countries in the sub-region have a shortage of electricity and the technical limitation in the network have kept utilization of interconnection capacities to minimal levels (Annex 2.3). Therefore, exchanges are essentially limited to emergency operations to serve the grids during critical conditions only.

[25] Calculated as 30-12=18% of combined losses times 34,926 GWh times US Cents 4.42/kWh.
[26] Such modern electronic meters can also facilitate energy efficiency measures such as load management.

Exhibit 2.9: Syria Electricity Imports and Exports (1997-2007)

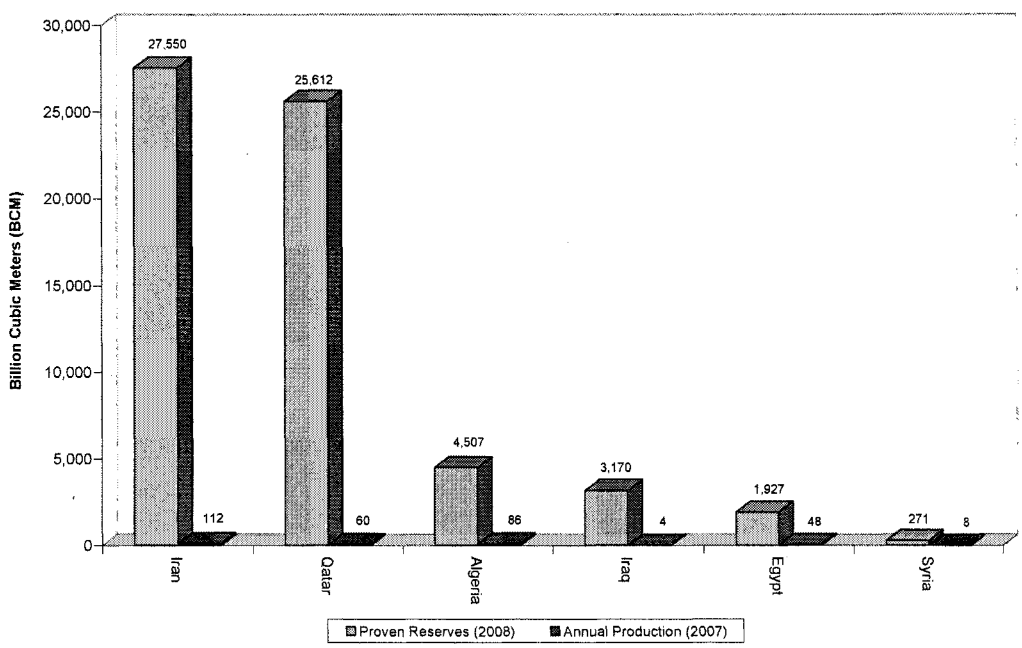


Source: MOE Reports

Natural Gas

The capacity expansion plan for the power generation sector in Syria relies on natural gas as the main source of fuel. Syria's proven reserves estimated at 270 bcm are the lowest compared with other countries in the region as shown in Exhibit 2.10, but theoretically would be sufficient to supply all new generating capacity to be built during the next 10 years. However, inadequate investment in bringing new gas reserves into production have made domestic gas supply insufficient to meet the gas demand of the power sector. The latter needs to increasingly rely, at least in the short to medium term, on other types of fuel (such as HFO or diesel) or greater imports of natural gas from the regional market.

Exhibit 2.10: Regional Proven Gas Reserves (2008)



Source: IEA (2008)

With technical assistance from the EU, Egypt, Jordan, Lebanon, and Syria have embarked on the establishment of a regional gas market which will ultimately be integrated with the EU internal gas market. The objective of the project is to interlink the respective countries through the 1,300 km long Arab Gas Pipeline (AGP[27]) to tap the proven gas reserves in the region. Therefore, in the longer term, once the sections of the AGP from Homs to Kilis are completed, Syria may be in a position to supplement its domestic gas supply with imports from countries other than only Egypt[28].

The potential for regional energy integration is significant for Syria due to its strategic location in the middle of the Mashreq region. Syria could benefit from future development of a Mashreq regional energy market, integrated in the long term with the Turkish and EU markets. Benefits to Syria include securing necessary gas imports for its power sector, enhancing opportunities for bilateral power exchanges with neighboring countries, and receiving wheeling charges for energy exchanges between countries in the region. Benefits for the whole region also include energy

[27] The AGP is being constructed with the objective of exporting gas from Egypt to Jordan, Syria and Lebanon and in the long term from Egypt and possibly Iraq via Turkey to Europe through its future connection to the Turkish network and pipelines (including the planned NABUCCO pipeline). The first three phases of the AGP have been completed connecting Egypt, Jordan, Syria and Lebanon. Tendering for stage 1 of the last phase of extending the pipeline to Turkey has been initiated. The pipeline has a 36" diameter, with an ultimate capacity of 10 bcm/yr..

[28] Syria has signed an agreement with Egypt to purchase gas for its new 750 MW Deir Ali CCGT plant. However, given the emerging constraints in the supply of Egyptian gas due to the increase of its own domestic gas demand and growing LNG export commitments, Egypt may not be in a position to supply additional gas to Syria.

supply security through the enhanced ability of each country to access additional natural gas resources and electricity available in the region, better utilization of the region's enormous gas reserves and development of renewable resources.

Potential for Development of Regional Interconnection with Syria

To enhance future integration of Syria within the Mashreq region and eventually with EU energy markets, several electricity and gas regional projects could be considered for development including:

- Complete the final two stages of the AGP, from Aleppo to Kilis and from Furglus to Aleppo. The first stage is already being tendered.
- Complete the AGP link from Kilis to the Turkish gas transmission network. Syria needs the connection to be able to import gas through Turkey;
- Development of a gas pipeline from central Iraq through Syria to the AGP for domestic consumption and for export, the latter either via an LNG terminal or to Europe through Turkey. The opportunity of this gas pipeline is to allow Iraq develop and export gas from the Akass gas field. The field is close to the border with Syria and about 50 km from the Syrian gas network. Syria has also spare processing capacity at the nearby Deir Ezzor and Omar plants which also could be used to process Akass gas.
- Reinforcement of existing 400 kV transmission interconnection between Syria and Turkey including assessment of requirements of eventual synchronization of the their two power grids;
- Development of 400 kV transmission interconnection capacity with Iraq and explore the potential of development of regional generation plant(s) supplied by gas from Akass gas field to supply electricity to Iraq, Syria and Jordan as well.

The development of these projects would however require close cooperation between countries in the region.

Chapter 3. GENERATION EXPANSION STRATEGY

The energy balance projections in Chapter 2 show that Syria needs 3800 MW of additional generating capacity by 2015 or about 7000 MW of additional capacity by 2020. This is needed to meet the increase in peak demand, replace older units gradually being retired, and restore a reserve capacity of about 10% of peak demand. At present no reserve capacity is available, which leads to frequent power outages.

Exhibit 3.1: Capacity Needed to Meet Demand Through 2020 (in MW)

	2007 (actual)	2010	2015	2020
Peak demand[29]	6,566	7518	8709	10448
Existing installed capacity with retirement	6250[30]	7376	5771	4650
Additional capacity with 10% reserve		894	3808	6843

Source: World Bank projections

To build this capacity, the Government of Syria has a number of alternatives to consider, including fuel mix, plant technology and risk profiles. It also needs to examine the economics of each option. This chapter provides an assessment of these alternatives and recommends a strategy to develop this new capacity. The investments needed and their financial implications are discussed in Chapters 4 and 5.

I. Fuel Sourcing Options

Syria has several fuel sourcing options for its power sector. Each fuel has a different risk profile, which needs to be carefully weighed in choosing the technologies to be used for development of generating capacity. The fuels considered for new power generation in Syria are: (i) natural gas (domestic and imported); (ii) heavy fuel oil (HFO); (iii) diesel; and (iv) imported coal. The following subsections discuss the availability and price risks associated with each type fuel.

A. Availability Risk

Natural Gas

At present, the annual gas consumption of the power sector is about 4 bcm[31]. Gas consumption is expected to increase to 13.2 bcm by 2020, *assuming that all new generating capacity will be gas fired*, as shown in Exhibit 3.2.

Exhibit 3.2: Gas Consumption by Power Generation Through 2020

	2007	2010	2015	2020
Gas consumption (bcm)	4.2	5.8	9.1	13.2

Source: World Bank projections

[29] Assuming implementation of energy efficiency and load management programs
[30] In 2007 out of 7459 MW of installed capacity on 5250 MW of capacity was actually available
[31] Billion cubic meter

Domestic Gas: The Syrian Gas Company (SGC) reportedly plans to provide the power sector about 7 bcm of gas by 2012 and beyond[32]. However, since the power sector's gas demand for the same year is projected to be 7.5 bcm, gas imports of at least 0.5 bcm would be required to supply the power sector by 2012 and increasing thereafter. Further complicating the picture, gas storage capacity is limited so far. This adds to the gas availability risk, since gas production has to be adjusted to power sector demand on a real time basis. Therefore, in the medium term the availability risk of domestic gas to the power sector is rated moderate, subject to successful development and operation of new gas production facilities under development by SGC. Despite adequate proven gas reserves, however, in the longer term the availability risk of domestic gas to fully supply the gas needs of the power sector could become high in case of: (i) shortcomings in translating supply-demand plans into investment programs and in funding them as needed; and (ii) insufficient focus on development of new gas fields.

Imported Gas: The availability risk of imported gas is moderate in the medium term as supply will be based on long term contracts with exporting countries and agreements have been signed with Egypt to supply about 1 bcm starting 2009. In addition, with the completion of the Arab Gas Pipeline and its interconnection with Turkey and possibly in the long term with Iraq, several sources of imported gas (e.g. Iran and Iraq) could become available to Syria. However, the expected increase in demand for gas in the entire region, combined with possible delays in development of a regional gas network and market, could make the availability risk of imported gas for Syria high in the long term. Therefore, depending on the prospect of regional supply of piped gas, Syria may in the long term consider mitigating availability risk of gas through development of a re-gasification facility for imported Liquefied Natural Gas (LNG), provided the logistics cost is found acceptable and a reliable supply is secured under a long term supply contract.

HFO and Diesel

Exhibit 3.3 shows the forecasts for HFO and diesel consumption by the power generation sector through 2020. These projections also assume that all new generating capacity will be gas fired.

Exhibit 3.3: HFO and diesel Consumption by Power Generation through 2020 ('000 tons)

	2007	2010	2015	2020
Heavy fuel oil	4,532	4,073	4,073	3,138
Diesel	3.0	2.9	2.8	2.2

Source: World Bank estimates

The availability risk for HFO and diesel is low, as Syria has its own refining capacity, using domestic oil. In addition, these products are available on the spot market or under long term supply agreements. The infrastructure risk is also low, as only limited investment in infrastructure is needed, except for rather inexpensive storage and unloading facilities.

[32] This would be feasible after the completion of four new gas production facilities currently under development and are expected to come in operation during 2009-2011. Production level after 2012 and beyond 7 bcm/year depends on further investment in new gas fields and production facilities.

Imported Coal

The availability risk is low, as coal is readily available on the international market under spot or long term contracts. However, the physical infrastructure risk is rated as low to moderate since irreversible investment in unloading facilities and transport capacity would be needed if it is decided to use coal as a source of fuel for part of the new generating capacity.

B. Economic Price and Risk

In addition to availability risks, the price risks associated with specific fuel options are key factors in determining the preferred mix of the new generating capacity. Fuel price risks reflect the dependence of the price of fuel delivered at the plant on international prices and the volatility of the price of each fuel.

The economic value of the various fuels may differ from the price paid by the power sector, as fuel prices in Syria are set with significant Government involvement. The economic value of each fuel should be considered when comparing the cost to the Syrian economy of alternative power generation policies. That value depends on whether the fuel is traded on the regional energy market or not as follows:

- HFO and diesel are produced in Syria. They can be either exported or used in the domestic power sector. The economic value of HFO and diesel is therefore the export price, which represents the value the Syrian economy would forego by using these fuels in power plants rather than exporting them.
- Gas is produced domestically, but it is also imported. Since additional demand will have to be met by imported gas, the economic cost of consuming an additional unit of gas in a power plant is the value of the import of that unit of gas. The economic cost to the power sector is therefore the gas import price plus the domestic transport cost.
- Coal is for Syria only available on the international market. The economic cost is therefore the import price plus handling and transport cost to the plant.

The actual price of each fuel to the power sector may, however, differ from the economic value because of Government fuel taxation, subsidization, and/or price control policies. In the future, fuel prices paid by the power sector should converge towards economic costs to ensure that investment and trading decisions in the sector are economically sound and not distorted.

Natural Gas

The economic price of the gas used by the Syrian power sector should be determined by the import price plus the transport cost to the plant, which is estimated at US$ 2.0/mmbtu, for a total cost of US$ 6.7/mmbtu (in 2009) to US$ 8.5/mmbtu (in 2015). Since gas import contracts are typically largely linked to international oil prices, the price risk on gas is similar to the price risk on oil, though slightly lower. Therefore, the price risk for imported gas is moderate to high depending on availability of regional gas, while the price risk for domestic gas will remain moderate as gas will probably continue to be supplied and regulated by state-owned SGC.

HFO and Diesel

The economic value of HFO and diesel is the sum of the export price and transport cost to the plant. The export price is taken as equal to the spot market price of diesel and HFO for the Mediterranean area. The transport cost from the refinery to the plant is estimated as US$ 20 per ton/100 km. The economic value of HFO for 2008 is therefore US$ 388/ton (average international price for 2008 plus US$ 20) [33]. For diesel, the 2008 international reference price is US$1,377/ton including transport cost[34]. Prices of these two products are highly correlated to price of oil as well as to variations in the seasonal demand. Price volatility and therefore price risk is high for both products, although more for diesel than HFO.

Imported Coal

International coal prices are generally quoted FOB[35]. A freight cost of US$ 10/ton should be added. The cost of logistics and delivery to the plant is estimated as US$ 15 per ton, including the infrastructure cost. In 2008, the economic cost of coal at the plant was US$ 79 plus US$ 10 for freight plus US$ 15 for local logistics, for a total of US$ 104/ton. Coal price volatility has increased in recent years, although it remains less volatile than that of petroleum products. Therefore, the price risk for coal is moderate.

C. Summary - Fuel Risk Matrix

Altogether, the fuel risk for the power sector is significant in the short term, but could improve in the longer term with the development of domestic gas sources, the construction of a regional gas pipeline system, and the development of multiple-fuel power plants. The risk matrix of each of the fuel options is summarized in Exhibit 3.4.

Exhibit 3.4: Fuel Risk Matrix

Fuel	Availability risk	Infrastructure Risk	Price Risk	Overall risk
Domestic gas	Moderate/High	Moderate/High	Moderate	Moderate/High
Imported gas	Moderate	Moderate	Moderate	Moderate
Coal	Low	Low	Moderate	Low
HFO/diesel	Low	Low	High	Moderate

Moderate/High means a moderate risk in the medium term and a high risk in the long term.
Source: World Bank estimate

II. Generation Technology Options

The generation technology options available to Syria for meeting its future power demand differ regarding their suitability for meeting peak or base load demand, their flexibility in terms of fuel-switching capacity, their environmental performance, and their cost.

[33] Average price for the first six months of 2008. Based on Bloomberg price quotes.
[34] Average price for the first six months of 2008. Based on Bloomberg fuel price quotes
[35] Source: Bloomberg fuel price quotes

Peak Load Generation

Peak generation technology includes hydro, diesel engines (low or medium speed), and open cycle gas turbines. New hydro is not considered to be a feasible option in Syria, because of the limited number of potential new sites.

Medium-speed diesel engines could be considered as an option for peaking generation because of their relatively low investment cost and fuel flexibility, since they can run on gas, diesel oil or fuel oil for extended periods of time without significant technical penalty. In addition, their construction cost is short. The typical investment cost for diesel engines is US$ 700-900/kW installed at a typical size of 30-40 MW.

Gas turbines provide the flexibility needed to meet peak demand and intermediate demand following the daily and weekly load curves. They also have a low upfront investment cost of US$500-800/kW, depending upon the size of the unit. On the other hand, gas turbines can run only on gas or on diesel as a costly alternative fuel and have a low efficiency of about 33% to 35%.

Base Load Generation

To meet base load demand, Syria has the choice between combined-cycle gas turbines (CCGTs), low-speed diesel engines, and steam turbines. CCGTs have a higher fuel efficiency of about 48% to 50% and a lower capital investment cost of about US$ 1000/kW installed, but they have a narrower fuel flexibility range. CCGTs can burn gas or diesel at a much higher fuel cost. They can also burn HFO but only for short periods of time under exceptional circumstances and leading to a penalty on efficiency, maintenance cost and plant availability. CCGT typically operate in a load range of 85-60%.

Steam plants, on the other hand, are the most versatile in terms of fuel use, although with an efficiency slightly lower than CCGTs. They can burn gas at a fuel cost of US Cents 5.9/kWh, HFO at a fuel cost of US 6Cents 5.2/kWh, coal at a fuel cost of US Cents 2.0/kWh, and diesel at a fuel cost of US Cents 15.0/kWh. The capital cost for steam plants ranges from US$ 1,250/kW installed for HFO-fired plants to US$ 1700/kW installed for coal-fired plants[36].

Low-speed diesel engines are flexible and can operate in a load range of 85% to 40%; they are fuel flexible and can burn gas, diesel oil or HFO. Their construction cost is US$ 600-800/KW installed for units up to 80-100 MW of capacity, with a short construction time.

III. Generation Mix Options

Ultimately, the choice of the best combination of technologies and fuels for meeting peaking and base load demand in Syria should be based on their comparative costs and risks. A generation costing model has been used to determine the preferred new generation mix to meet the growing demand in Syria. The model includes detailed assumptions for fuel price projections, generation capital costs, and financing charges.

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[36] Capital costs for typical units in the 300-500 MW range.

Fuel prices

The price scenario used in this note to determine a preferred generation mix assumes future international prices that are based on current trends in oil prices and the impact of the world economic slow-down. Under this scenario, shown in Exhibit 3.5, oil prices retreat from their 2007 peak level in the second half of 2008 and are assumed to stabilize at US$ 80/barrel (in current US $) by 2020.

Exhibit 3.5: Fuel Price Scenarios Through 2020 (current US$)

Year	**Oil**	**HFO**	**Diesel**	**Gas (imports)**	**Coal**
	US$/bbl	US$/tonne	US$/tonne	US$/tcm[37]	US$/tonne
2010	53	220	900	240	55
2015	80	360	1400	340	75
2020	82	410	1600	390	80

Source: World Bank, DEC

Generation Investment Costs

Investment or capital expenditures (capex) for various types of generating technology used in the financial model are shown in Exhibit 3.6. The construction costs increased significantly for all technologies in the past three years, but prices seemed to be stabilizing as of late 2008. The investment costs used in the calculations below include installation cost and ancillary facilities.[38]

Exhibit 3.6: Generation Capital Cost

	Gross Output (MW)	**CAPEX US$/KW**
Medium Gas Turbine 150 MW	150	700
Medium Combine Cycle 300 MW	300	1000
Large Combined Cycle 450 MW	450	920
Fuel Oil Steam Cycle 300 MW	300	1 250
Gas Steam Cycle 300 MW	300	1 250
Coal Steam Cycle 300 MW	300	1 700
Gas Fired Low Speed Diesel Engine 80 MW	80	875
Gas Fired Medium Speed Diesel Engine 40 MW	40	850

Source: World Bank/ESMAP

[37] The conversion factor of thousand cubic meters (tcm) of gas to million British thermal units (mmbtu) is 38.33 mmbtu per tcm. A price of $260/tcm is therefore equivalent to $ 6.78/mmbtu

[38] Source: World Bank - ESMAP *"Study of Equipment Prices in the Power Sector"*, Technical Paper, 2008. Construction costs are projected to decrease in 2010 compared to the 2008 peak level, as the international demand for new plants weakens due to the international economic crisis. As the world economy recovers, it is likely that the demand for new plants will accelerate again and price will increase back to 2007 level.

Financing Costs

The full plant cost, based on international construction costs and fuel prices as discussed above, also depends on the cost of capital. The evaluation of generating plant options below compares only public sector financed plants, i.e., using softer financing provided by the Government. The financing terms assumed for the public sector option are given in Exhibit 3.7.

Exhibit 3.7: Public Sector Financing Terms for Generating Capacity

	Public Sector Financing
Debt to Equity ratio	100% debt
Return on equity	N/A
Interest on debt	LIBOR +50 bps
Guarantee fee	N/A
Profit tax	0%

Options for Meeting Peak Demand

The comparative cost of the various options available to the Government suggests that for units running at a load factor of 35% or less (i.e., peaking plant), the preferred option is gas or HFO fired diesel engines or, at similar levelized cost, gas turbines as shown in Exhibit 3.8.

Exhibit 3.8: Levelized Generation Cost – Peak Load Plant (US Cents/kWh)

Peaking Generation	**Fuel**	**Typical Size (MW)**	**Public Financing Load Factor 25%**	**Public Financing Load Factor 35%**
Gas Turbine	Gas	150	11.2	9.9
Gas Turbine	HFO	150	28.7	27.2
Gas Turbine	Diesel	150	25.9	24.5
Medium Diesel Engine	Gas	40	12.3	10.9
Medium Diesel Engine	HFO	40	11.7	10.3
Medium Diesel Engine	Diesel	40	28.5	27.1

Source: World Bank calculations

If gas is not adequately available then HFO-fired diesel engines is the best option for peaking plant. Considering the large cost difference between gas-fired and diesel/HFO-fired turbine units, the conclusion is that gas should be allocated on a priority basis to new peaking units, as alternative fuel solutions exist for base load plant as discussed below.

Options for Meeting Base Load

Levelized generation costs for different types of base load plant are summarized in Exhibit 3-9.

Exhibit 3.9: Levelized Generation Cost - Base Load Plant (US Cents/kWh)

Base Generation	Fuel	Size (MW)	Public Financing Load Factor		
			65%	75%	85%
Large CCGT	Gas	450	7.5	7.2	7.0
Large CCGT	HFO	450	14.7		
Large CCGT	diesel	450	19.2	18.9	18.7
Large Steam Turbine	Gas	450	8.9	8.6	8.3
Large Steam Turbine	HFO	450	8.6	8.2	7.9
Large Steam Turbine	Coal	450	6.3	5.8	5.4
Low Speed Diesel	Gas	80	9.1	8.9	8.7
Low Speed Diesel	HFO	80	8.5	8.3	8.1
Low Speed Diesel	Diesel	80	24.8	24.5	24.3

Source: World Bank calculations

The exhibit shows that the two least cost options for meeting base load are gas-fired CCGTs and coal fired steam units followed by gas or HFO steam or low speed diesel units. Gas-fired CCGTs have a significant environmental advantage compared to coal-fired units, but coal-fired steam units would help diversify the fuel consumption of Syria and enhance its security of supply. Low-speed diesel engines are an interesting alternative to gas fired CCGTs, although slightly more expensive, because of its fuel flexibility with little cost penalty. Therefore, if gas is available CCGTs look like a good option, but if there is uncertainty regarding the availability of gas, then CCGTs would have to run on diesel, at a high cost and then steam plants or low speed diesel engines become attractive.

Therefore, it is recommended that new generating capacity developed in the medium term should have a combination of CCGT operating on gas and thermal steam plants with dual fuel capability to run on gas, if available, or HFO and low speed diesel engines operating on gas or HFO. For longer term new generating capacity and depending on the availability of domestic and imported gas, Syria may consider the option of developing coal-fired steam power plants. These plants have more fuel flexibility and can switch with limited conversion cost from coal to gas or HFO. While coal has certain environmental disadvantages compared to gas, these can be effectively minimized by using modern technologies and high-grade coal. Modern coal-fired plants using supercritical technologies have an efficiency of about 45%, thus reducing both fuel costs as well as emission of the greenhouse gas CO_2 per MWh produced. Annex 3.1 describes possible configurations and uses for such a coal-fired power plant that could increase its total efficiency to an even higher level.

IV. Generation Expansion Plan

A preliminary concept generation expansion plan[39] has been developed to outline options for meeting the demand while maintaining adequate reserve margin. The plan calls for the development of up to about 1640 MW of new peaking generation capacity, about 5300 MW of

[39] This generation expansion plan is preliminary and developed to provide indicative information on the magnitude and types of generation capacity that can be considered for development in Syria. However, resource planning and least cost methodologies must be employed by PEEGT to develop a Master Expansion Plan for the electricity sector.

base load generation capacity and 120 MW of wind power plants to maintain up to 10% of reserve margin by 2020 as summarized in Exhibit 3.10.

Exhibit 3.10: Concept Generation Expansion Plan (in MW)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Wind			20			100						
Gas turbine	300								100	300	300	
Medium Speed Diesel		240			200						200	
Low Speed Diesel			300			300						
CCGT	750	450		450			600		500		400	
Steam Turbine					400			300				850
Total New Generation	1050	640	320	450	600	400	600	300	600	300	900	850

Source: World Bank estimates

The additional peaking capacity is recommended to comprise a combination of medium speed diesel and gas turbines while the new base load capacity will comprise mainly combination of CCGTs operating on gas and thermal steam plants with at least dual fuel capability. Given the present shortage of supply in Syria, some low speed diesel engines could also considered for development as a base load taking advantage of their fast track development. The total cost for the development of the new generation capacity is estimated at US$ 7.0 billion. In addition, a total of US$ 3.5 billion is assumed to be needed to rehabilitate and expand the transmission and distribution networks[40].

V. Renewable Energy (RE)

Syria has so far paid only limited attention to the development of its renewable energy resources. This was largely due to the perceived abundance of fossil fuels for power generation. However, energy demand (electricity and other final energy demand) has been rapidly catching up with the domestic supply of energy and the "external energy dependency ratio"[41] has decreased from 181 in 1995 to 34 in 2005. On current assumptions, domestic demand and supply are expected to reach equilibrium around 2011 and the dependency ratio is forecast to be -48 by 2020. This means that almost 50% of the energy necessary to meet demand would need to be imported by that time (Exhibit 3.11).

Exhibit 3.11: Syria - Energy Dependency, 1995-2020

	1995	2000	2005	2010	2015	2020
Domestic Supply (MTOE)	34.7	33.6	28.3	26.7	24.9	23.7
Domestic Demand (MTOE)	12.3	15.8	21.1	26.5	34.6	45.2
Energy Dependency Ratio (%)	+181	+113	+34	+8	-28	-48

Source: *Energy Efficiency and Renewable Energy Presentation, NERC*

[40] Investments in transmission as distributions are assumed to about 30-35% of the total electricity sector investment.

[41] Expressed as the number of times supply exceeds demand. A positive number indicates that energy supply exceeds demand, a negative number indicates that part of the energy needs to be imported.

While Syria has in principle enough natural gas reserves to last at least another 20-30 years, natural gas production and availability constraints have limited the full potential of using domestic gas in the power sector. Therefore, the increasing dependence on external sources of energy represents a security of supply issue for Syria.

Benefits of RE

There are several reasons why Syria ought to carefully investigate and develop its renewable energy potential:

- by using domestic renewable energy sources Syria would diversify its fuel sources for power generation and enhance its security of energy supply;
- increased use of renewable energy would reduce Syria's greenhouse gas emissions and enable it to profit from Clean Development Mechanism credits[42];
- renewable energy generates local employment opportunities, both in manufacturing (e.g., solar heaters and solar cells) as well as in agriculture (biomass collection); and
- the use of renewable energy would extend the life of Syria's fossil fuel reserves.

Status and Potentials

Current usage of renewable energy resources in Syria is limited to hydropower and biomass, and both represent only a small share of total energy demand (i.e., electricity and other final energy demand). Most other RE applications such as solar water heating and wind power are still in their pilot phases. In 2006, hydropower generation accounted for 0.88 MTOE[43] or 4.1% of energy demand, while biomass accounted for 0.6 MTOE (2.8% of demand) for a combined total of 6.9%. Regrettably, few studies have been made about Syria's RE potential and having such studies done should be one of the Government's main priorities in this area. Only with solid data being available can a realistic national renewable energy strategy be formulated. The sources of renewable energy with the greatest potential are likely to be:

- **Solar**: The solar radiation level in Syria is about 2,820-3,270 hours/year and the intensity is 5-6 kWh/m2. This level is good for solar heating, photovoltaic applications and probably for power generation based on the evolving concentrated solar power technologies. In comparison, Egypt (one of the regional leaders in solar energy), has an average of 3,600 hours/year and 5-7 kWh/m2.
- **Wind**: A good wind atlas needs to be developed for Syria. At this stage, the regions of Homs and Darra are believed to be promising sites, but there may be many others;
- **Hydropower**: While the large hydropower potential of Syria is exhausted, there may be small or mini hydropower potential in the country that has not yet been assessed; and
- **Biomass**: Often considered a somewhat backward rural fuel, biomass is being used increasingly (in North Western Europe in particular) either as the main fuel to fire power and/or heating plants, or as a supplemental fuel in a gas or coal-fired generating plant (co-

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[42] Syria ratified the Kyoto Protocol in 2005.
[43] Million Tons of Oil Equivalent

firing). Syria's agricultural sector should be able to generate a reliable supply of biomass for many decades, especially from large crops such as cotton, wheat and barley;

RE projects under consideration for implementation in Syria are shown in Annex 3.2. Most of these projects have yet to be developed into implementable projects either through public or private sectors financing. Scale up targets shown in Annex 3.3 for some RE (wind power) appear unrealistic to achieve. Solar water heating appears to be the low hanging fruit and vigorous promotion of this technology should be a top priority for the Government. However, as is the case for energy efficiency, efforts in this regard will not go far unless the Government is willing to undertake fundamental electricity tariff reform. Syria is also participating in the Mediterranean Solar Plan (MSP) and could benefit from technical assistance that may become available under the MSP for development of renewable projects.

Proposed RE Strategy

Renewable energy lends itself well to private sector participation. To encourage the development of its renewable energy resources the Government should:

- Take a policy decision that renewable energy should be developed as a matter of national priority;
- Fund through NERC the studies and collect the data necessary to prepare a comprehensive renewable energy resource study assessing potential of renewable resources including identifying concept projects for feasible renewable resources projects;
- Adopt a renewable energy Action Plan;
- Establish a stable and predictable regulatory framework for RE. Most important for private investors will be the *tariff* that specifies that renewable energy will be purchased by the grid (if grid-connected) against fixed prices for pre-determined periods of time. That way the investor can be sure to earn a reasonable return on his investment (if equipment is operated well and weather conditions are favorable) and commercial banks would be willing to provide financing;
- Tax credits and/or investment credits are also tools frequently used by governments to encourage RE investment by the private sector;
- If availability of funding is an issue creation of a special funding mechanism should be considered; and
- Identify Carbon Financing opportunities under the Clean Development Mechanism (CDM) for developed RE projects. Annex 3.3 includes a summary note on the CDM Opportunities in the Syrian Power Sector.

Renewable energy cannot displace the need for large conventional fossil fuel-fired power plants. However, the aggressive introduction of RE technologies can substantially reduce the need for more fossil fuel-fired generating capacity. While some of these technologies are still relatively expensive compared to conventional power generation, it should be borne in mind that costs are expected to come down with increased applications and that conventional power plants benefit from many direct and indirect subsidies that hide their true costs to society. These factors must be taken into consideration and calculated when comparing the different options.

Chapter 4. **FINANCIAL PERFORMANCE**

Chapter 3 concludes that Syria needs to invest about US$ 10.5 billion during 2008-2020 to rehabilitate and expand its power generation capacity and transmission and distribution networks as summarized in Exhibit 4.1:

Exhibit 4.1: Power Sector Investment Expenditures Through 2020 (US$ billions)

	2008-10	**2011-15**	**2016-20**	**Total**
Generation	1.0	2.8	3.2	7.0
Transmission and Distribution	0.5	1.4	1.6	3.5
Total	1.5	4.2	4.8	10.5

Source: World Bank calculations

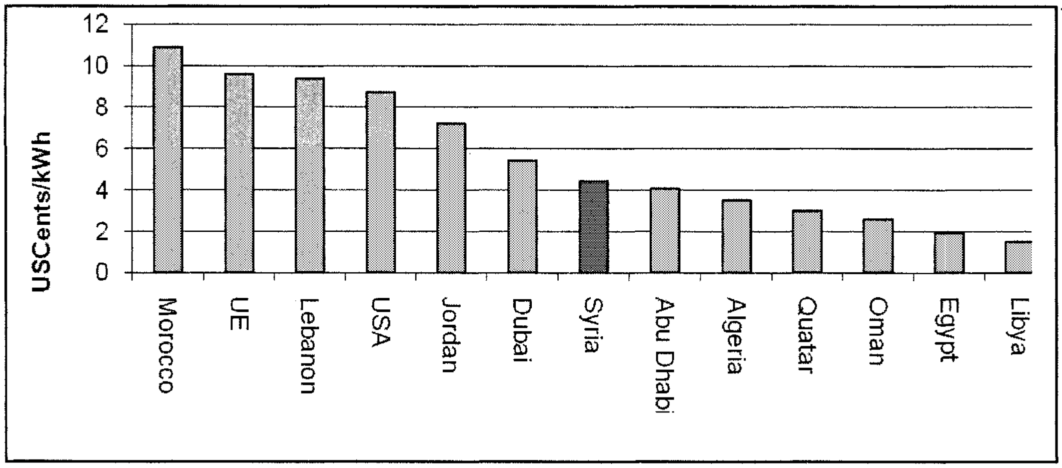
The Syrian power sector's ability to finance from its own resources the sector investment needs and to attract private sector financing through Independent Power Producers (IPPs) depends on the magnitude and stability of its future cash flow. This requires: (i) the *coordinated gradual but relatively rapid adjustment of electricity tariffs and power sector input fuel prices*; and (ii) the capacity of the sector to improve billing, strengthen payment discipline and reduce network losses.

I. Electricity tariffs

Tariff level

The average tariff level in Syria is low by regional standards, with an average level of approximately US Cents 4.4/kWh. This is comparable to the tariffs in oil and gas exporting countries such as Algeria, Abu Dhabi (UAE), and Qatar, but significantly lower than the tariffs in regional non-oil rich countries such as Jordan, Lebanon, Morocco as well as Dubai (UAE), the EU and the US (Exhibit 4.2).

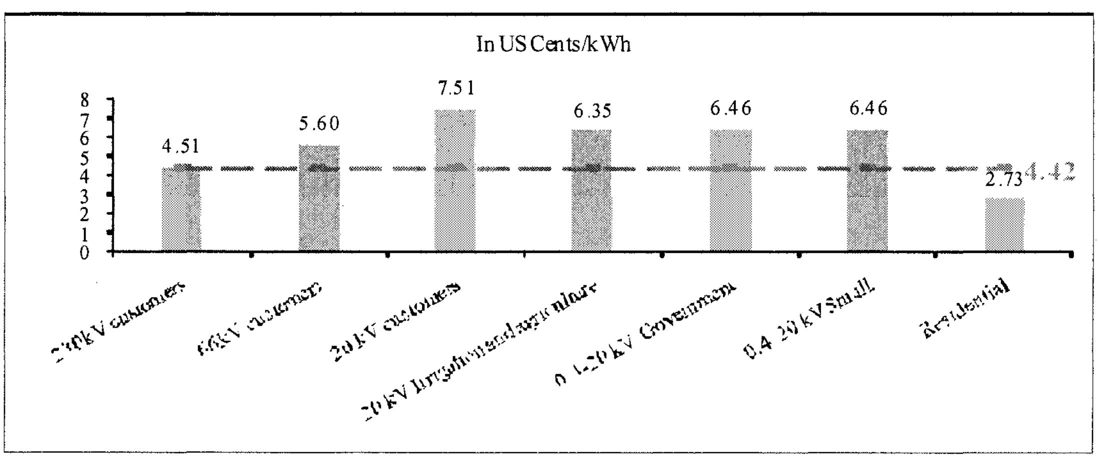
Exhibit 4.2: Electricity Tariffs in Syria Compared to Regional Tariffs



Even after allowing for the low cost of oil and gas in Syria until 2009 and assuming efficient operation of the system, this average tariff level is not enough to cover the operating costs and investment needs of power generation, transmission and distribution. It is also below what is needed to generate a cash flow sufficient to meet financial commitments under IPP's Power Purchase Agreements.

The electricity tariff in Syria differentiates between the various consumer categories as shown in Exhibit 4.3.

Exhibit 4.3: 2007 Electricity Tariffs by Consumer Category



Source: PEDEEE, Annual Report 2007

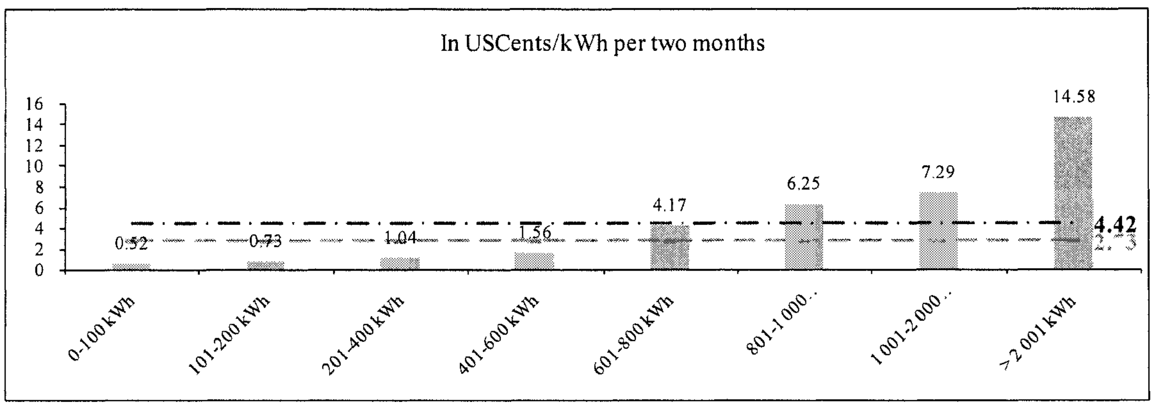
Exhibit 4.3 shows that the tariff is lower for high voltage industrial consumers (US Cents 4.51/kWh) than for lower voltage industrial consumers (US Cents 5.60-7.51/kWh), reflecting the lower cost of supplying electricity to the former. However, the tariff is very low for residential low voltage consumers at an average of US Cents 2.73/kWh[44], even though they are more expensive to supply than large consumers.

Tariff structure

The Syrian electricity tariffs for medium and high voltage consumers (20 kV, 66 kV and 230 kV) are appropriately structured on a time-of-day basis. This provides in principle the right incentive for those consumers to shift demand from peak to off-peak periods, which is an essential requirement for load management and energy efficiency. The time-of-day tariff does not apply to low voltage consumers (residential and commercial at 0.4 kV), although they represent 65% of the demand and are responsible for most of the peak demand. Therefore, it is recommended that future tariff revisions extend time-of -day differentiation to low voltage consumers as permitted by their metering systems.

The tariff structure for residential consumers comprising several blocks with a tariff ranging from US Cents 0.52/kWh for the first 100 kWh per two-month period to US Cents 8.33/kWh for consumption above 2000 kWh per two-month period (Exhibit 4.4).

Exhibit 4.4: Block Structure of Electricity Tariff for Residential Consumers (Per two months)



The tariff for consumption up to 300 kWh per month (or 600 kWh per two month) is much below the level of the average tariff and could be considered to fall under the lifeline tariff for subsidizing consumption of basic electricity needs, although it is in line with the threshold for basic electricity needs is usually about 300 kWh per month. However, the rates for consumptions within this block are extremely low, as shown in Exhibit 4.4, indicating high amount of subsidy which may not be needed. In addition, such a "lifeline" block of 300 kWh per month also benefits the medium and large residential consumers, who use far more than the basic electricity needs and who, at the same time, could pay higher tariffs.

The affordability of electricity of low-income households and the burden that necessary future tariff increases and collection enforcement will impose on them is an important issue to consider by the Government. In principle this is best addressed through targeted support programs

[44] Calculated on the basis of a bi- monthly consumption of 1000 kWh.

through cast transfer programs (social safety net) to eligible needy households. Shifting the burden to the utility by means of lower tariffs undermines the financial viability of the utility and discourages energy conservation. However, in many countries, including Syria, the administrative capacity to identify eligible recipients of a subsidy on a means-tested basis and administer a subsidy program is limited. The next best method is to continue with the electricity lifeline tariff until the capacity to administer a cash transfer program is in place. The tariff structure should nevertheless be revised to achieve a better targeting of the lifeline tariff for low income residential customers including considering the exclusion from the social tariff of the first 600 KWh of consumers with bi-monthly consumption in excess of 600 KWh and a reduction of number blocks including the gap in the tariff between the average tariff and the lifeline block.

An example of a tariff block structure that could be considered is a three block tariff which would allow a better targeting of tariff subsidy to lower income consumers. Such a structure would allow the tariff subsidy to be provided at lower rates for the first block assumed necessary to meet basic needs (e.g. 300 kWh/month). The second block could be between 300kWh/month and say 600 kWh/month and would be set closer to the level of cost recovery of the electricity supply to the residential consumers. The third block of 600 kWh/month and above could be set at a higher level to encourage efficient consumption of electricity by consumers. A final appropriate tariff structure should be determined by a more comprehensive assessment evaluating revenue requirements for full recovery of the cost of electricity supply, demand patterns by consumer category, and options for tariff design that will eliminate cross subsidies between and within different consumer categories while at the same time take into account affordability considerations. Annex 4.1 provides examples of international experience with block tariffs.

In revising the tariff structure, Syria may also consider incorporating a pass through mechanism to allow for regular adjustments of the tariff to account for changes in the prices of fuel used by the power generation plants.

II. Fuel Prices

Until 2008, all fuels used in the power generation sector were domestically produced. Fuel prices to the power sector are also set by the Government. Prices offered by the domestic refineries and the gas company did not refer directly to international prices. As the domestic refineries export HFO and diesel, therefore, supplies to the domestic power industries could be priced on the basis of the opportunity cost of export of the same product. Gas is not exported and its price was set without reference to import or export price. Actual (2006-09) fuel prices for the power sector are shown in Exhibit 4.5.

Exhibit 4.5: Prices of Fuel to the Electricity Sector

	2006	**2007**	**2008**	**2009**
HFO (US$/ton)	133.3	133.3	133.3	187.5
Gas (US$/tcm)	20.8	20.8	104.2	387.5
Diesel (US$/ton)	625	625	625	625

Source: PEEGT

Domestic heavy fuel oil (HFO) prices to the power industry are significantly below international price parity, even after the envisaged 2009 adjustment. The international price of HFO was about US$ 400/ton in 2008, expected to decrease to US$ 222/ton in 2009 but recover to around US$ 360/ton in current US$ by 2015 and US$ 410/ton by 2020.

Diesel is priced to the power sector at US$ 625/ton. The current level is significantly below the 2008 export parity price of about US$ 1,300/ton, projected to decrease to about $790/ton in 2009 and to recover to about US$1,400/ton in current US$ by 2015 and US$ 1600/ton by 2020.

The *domestic gas price* was about US$21/tcm but in 2007 this was adjusted to US$ 104/tcm in 2008 and to US$ 387/tcm for 2009. The 2008 gas price was below the European gas price, but the 2009 price is well above the European gas price and the regional gas import price of about US$ 260/tcm (including local pipeline transport cost). The 2009 gas price to the power sector is too high and above international parity prices. It is recommended that prices paid by the power sector for gas should converge toward import parity price, and not higher, to ensure that investment and trading decisions in the sector are economically sound and not distorted.

The Government should clarify its fuel pricing policy for the power sector and, in particular, decide whether fuel prices would be based on the domestic marginal production cost (all fuels are mainly produced domestically) or at the export parity price for fuel oil and diesel, and import party price for gas. Considering the inability of the gas sector to meet the needs of the power sector, despite sufficient reserves, the gas sector should retain a larger share of the rent to finance accelerated development of its production capacity without calling on budgetary support. The gas price to the power sector, however, should not exceed the gas import parity price to avoid distorting generation costs, thereby sending incorrect signals regarding future plant technology choices and power dispatch.

III. Financial Performance [45]

Current Situation

Based on the information received, the sector's financial performance was sustainable between 2000 and 2004, with a cash flow on operations ranging from US$ 100 million to US$ 240 million per year under fairly stable fuel prices and tariffs (Exhibit 4.6). The positive cash flow on operations was used for the sector's own contribution to capital investment, financing consumers' unpaid bills, and increases in short term receivables.

Exhibit 4.6: Past financial performance, 2000-2008 (US$ million)

	2000	2002	2004	2006	2008
Consolidated Revenue	511	721	767	1039	1344
Consolidated Expenses on Operations	409	500	527	1010	1497
Operating Cash Flow	102	221	240	29	-152

Source: World Bank calculations

[45] The power sector's consolidated financial performance (PEEGT and PEDEEE) has been evaluated on a cash flow basis. The financial model for the sector is an approximation used for general assessment of the sector financial performance.

During 2004-2006, the financial situation of the sector deteriorated as fuel prices started escalating faster than tariffs. Cash flow on Operations decreased during the same period from US$ 240 million to a mere US$ 29 million. It deteriorated further in 2007 as fuel prices were increased without equivalent increase in electricity tariffs to reach an estimated deficit of US$ 152 million by 2008. As of 2007, the sector's revenues were barely sufficient to cover cash operating expenses and are projected to be insufficient in 2008. From 2007 onward, the sector could not contribute to capital investment and its borrowing capacity has become non-existent. Action is therefore urgently needed to restore the sector's financial viability and capacity to support the capital investment needed to meet future demand.

Future Financial Performance without Real Tariff Increases

First scenario: no real increases: This *base case scenario* assumes that the announced 2009 domestic fuel prices for the power sector are used for 2009 cash flow calculation but projected international fuel prices (Exhibit 3.5) will be used thereafter. At the same time, power tariffs would be revised based on projected inflation only. Exhibit 4.7 shows the sector's financial performance without any real tariff increases.

Exhibit 4.7: Projected cash flow without real tariff increase, 2008-2020 (US$ million)

	2008	2010	2012	2014	2016	2018	2020
Total Revenues	1,344	1,738	2.097	2,512	3,048	3,710	4,562
Operating Expenses	1,497	2,742	3,598	4,766	5,517	6,242	7,187
Operating Cash Flow	-152	-1,004	-1,501	-2,254	-2,469	-2,531	-2,624

Source: World Bank calculations

Under the base case scenario (no tariff increase in real terms and fuel prices based on the 2009 level adjusted for future oil prices), the sector's operating cash flow will sharply deteriorate in 2010 and become minus US$ 1.01 billion. This is due to the envisaged increase in the gas price and the increase in gas demand. The impact of the fuel price increase would be to increase the fuel bill to the power sector from about US$ 1.1 billion in 2008 to US$ 3.1 billion in 2010. In the longer term, the sector cash flow from operations will deteriorate to minus US$ 2.5 billion by 2016 and to US$ 2.6 billion by 2020 because fuel prices remain relatively high while tariff adjustments are limited.

The financial support needed from the Government would be a staggering US$ 33.6 billion for the 2008-2020 period to support the cash flow requirement of the sector and finance its expected needs for capital investments. Consequently, it is clear that in the absence of changes in the power tariff and assuming international fuel prices, the sector will not be credit worthy in the future. As a result it would not be in a position to meet sector investment requirements, or to be a commercially acceptable counterpart for private sector financing in the absence of Government guarantee.

Suggested scenarios to restore sector credit worthiness

Scenarios for restoring power sector credit worthiness needs to be developed considering in parallel the cash flow requirements of the gas sector, which depends largely on the prices it can charge to the power sector. The present analysis did not have access to an evaluation of the cash flow needs of the gas sector. It was assumed that import parity price for gas would generate a sufficient cash flow in the gas sector to sustain its investment needs to meet the rapidly increasing gas demand. In the second and third scenarios it is also assumed that the sector will self-finance 30% of investment and borrow 70% at terms comparable to those charged by the International Financial Institution (IFIs)

Second scenario: accelerated tariff increases (90% in 2010 and 20% in 2011). If fuel prices to the power sector are adjusted to international parity price, the electricity tariff would need to be increased by about 90% on average in 2010 and another 20% in 2011 for the sector to meet after 2012 all its operating costs, capital investment needs and debt service obligations. Afterward, the tariff would need to be maintained at the 2011 level in real terms. Under this scenario, the total financial support needed from the Government would be limited to US$ 1.3 billion over the period after which the sector's cash flow equilibrium level would be reached (by 2012).

An immediate 90% increase in the electricity tariff may, however, not be feasible or acceptable to the government due to its social and political impact, especially if adequate social protection schemes are not in place to protect low income electricity consumers. Therefore an alternative gradual increase of the tariff may be considered.

Third scenario: 20% per annum increases through 2014. In the event the socially acceptable annual real tariff increase is capped at 20% per year from 2010 to 2013 and 10% in 2014, the financial equilibrium level is reached in 2015 instead of 2012 as in the previous scenario. The Government would have to bear some of the investment cost of the sector in the amount of US$ 4.4 billion over the period after which the sector's cash flow equilibrium level would be reached (by 2015).

Chapter 5. **ROLE OF THE PRIVATE SECTOR**

Chapter 3 concluded that Syria needs to invest almost US$10.5 billion to rehabilitate and expand its power generation capacity and transmission and distribution networks. Chapter 4 demonstrated that an average tariff increase of about 110% would make the electricity sector financially sustainable and allow it to self-finance 30% of capital investments during 2008-2020. Even with such tariff increases government subsidies for operations and investments would be needed in the amount of US$ 1.3 billion in case tariff is increased by 90% and 20% in 2010 and 2011 as the cash injection would still be needed prior to 2012. While a gradual tariff increases (20%per year from 2010 to 2013 and 10% in 2014) will require higher government subsidy in the amount of 4.4 billion until cash flow equilibrium level is reached in 2015.

These financing needs of the electricity sector and the amount of needed subsidy to finance sector investments are enormous and would be an intolerable drain on the government budget if they were to be met by public financing. Therefore, in addition to making the sector able to self-finance a portion of its investments, the Government is keen to attract private sector investment in Syria's power sector. This chapter discusses some major aspects associated with such private sector involvement.

I. Private sector Participation in the Power Sector to Date

Private sector participation in the power sector is at an early conceptual stage in Syria. It has been envisaged as part of an overall strategy to attract private sector participation in the Syrian economy and as a stand-alone objective, regulated by the general legislation on foreign investment. The Government, however, has yet to develop a vision and necessary regulatory framework for private sector participation in the electricity sector which could, for instance, specify requirements regarding the private sector's role and investment targets.

At the moment, Government expectations with regard to private investment in the power sector are still very generic and limited to generation only. They are:

- Mobilize funding required for capacity expansion without increasing pressure on the Government budget;
- Ensure more efficient operation of generating units by attracting highly qualified staff;
- Accelerate project implementation, with a lower risk of delays and cost overruns.

II. Major Considerations for Private Sector Participation

Private sector participation in the power sector has several major advantages. Chief among these are: (i) private financing is under normal circumstances readily available and eases the immediate pressure on the Government budget; (ii) private sector sponsored projects are in general implemented faster than public sector projects and thus less prone to construction delays and cost overruns; (iii) private investors generally operate plant and equipment more efficiently and commercially than state-owned enterprises; and (iv) they introduce modern management techniques into the sector that eventually may spread to the state-owned part of the sector as well.

On the other hand, the mobilization of private equity or commercial loans will require very firm commitments from the Government to improve the operational and financial performance of the electricity sector. This is necessary in order to generate the cash flow required to repay the commercial debts and the return on equity expected by private investors. However, in the absence of creditworthiness electricity sector, private lenders, and investors will require some form of Government guarantee for the payments expected from the state-owned power purchaser. Those guarantees will appear as contingent liabilities on the balance sheet of the Government[46].

Privately sponsored generation projects will also require more preparation time than what is generally needed for public sector projects because of: (i) the need to design and implement a transparent and competitive bidding process for the selection of the private sponsor; and (ii) negotiation of such projects entails the review and finalization of complex legal agreements and EPC (turnkey) contracts[47] required to provide comfort to the investors. There is a learning curve here, in that as Governments gains experience with such projects and private investors gain confidence in the regulatory system and political environment in a country, these lead times tend to become shorter. Nevertheless, the time required for the preparation of a privately sponsored power project is on average at least 24 months prior to the start of construction though the risk of subsequent delays and cost overruns is lower than for a state-owned entity.

III. Potential Areas for Private Sector Involvement

Private participation in the power sector may take several forms, which have been tested in various countries, and meet different goals of the Government. Options for private sector participation in Syria could be in the generation sector and in the longer term in the distribution sector. Because of its critical role, the transmission sector remains in most countries in state hands.

IPPs for the Construction of New Generation Capacity

Independent Power Producers (IPPs) investing in the generation sector can have several structures (see Annex 5.1). If tendering is transparent the IPP approach has the advantage that it stimulates competition between investors for entry in the market. The cornerstone of an IPP is a long term Power Purchase Agreement (PPA). PPAs are generally characterized by "take or pay" clauses, i.e., an obligation to pay for a certain amount of electricity regardless of consumption. The agreement is generally between the IPP developer and the national power company (typically the transmission company, which would be PEEGT under the present Syrian power sector structure). Since the credit standing of PEEGT is weak, a Government guarantee backing its payment obligations will be required.

Because the fuel supply is critical to an IPP, two alternatives are usually considered:

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[46] The financial markets will factor these contingent liabilities into their pricing of sovereign debt and also consider that they reduce the Government's ability to borrow correspondingly.

[47] Under Engineering, Procurement and Construction (EPC) contract the contractor agrees to deliver the keys of the plant once commissioned to the owner for an agreed amount. This way of contracting has gained worldwide acceptance among private strategic investors in the power sector

- the IPP is responsible for procuring all the fuel it needs. This structure is suitable when fuel can be procured on the international market, or when the domestic fuel market is liberalized; or
- the fuel is supplied by the electricity off-taker or by the Government. This is known as the "*tolling plant*" model under which the IPP receives a "toll", i.e., a fixed markup per kWh, for transforming fuel into electricity under an Energy Conversion Agreement.

In the case of Syria, if an IPP is gas-fired the tolling approach should be considered since the gas supply is under Government control. However, the Government would still need to pay the contractual capacity fee to the investor if the fuel supply were to be interrupted and the plant cannot produce power. If an IPP were to use imported coal, it would be appropriate to let the IPP carry the fuel risk. Regardless of the fuel supply arrangement, however, the investors should be held responsible for the plant heat rate, i.e., the efficiency of fuel usage.

Exhibit 5.1: Advantages and Disadvantages of the IPP Model

Advantages	Disadvantages
Mobilization of financing	Long term Power Purchase Agreements introduce an element of rigidity in the market. This can be mitigated by ensuring that IPPs do not represent more than 30% of the power generated in a country.
Requires minimal sector restructuring	IPPs may complicate future sector restructuring, as IPP agreements generally have clauses limiting the rights of Governments to make any structural change in the sector which may affect the credit worthiness of the power purchaser or its guarantor without the assent of the IPP owner or suitable compensation.
IPPs can be regulated entirely through contractual agreements between the parties with an option for international arbitration in case of disputes.	Power generated under IPP arrangements can be expensive because commercial financing under limited recourse can be expensive, and the expected return on equity may be in excess of 20% for countries perceived by the market as high risk.

Given the intention to create a more competitive wholesale power market, care should be taken in designing the Syrian IPP program in a manner that does not interfere with further power market reform. The problem, essentially, is that IPPs with long-term PPAs can distort power markets, and make effective competition more difficult to achieve[48]. This issue is discussed in more detail in Chapter 6.

[48] A good discussion of this problem and the solutions attempted in other countries can be found in the World Bank Policy Research Working Paper No. 2703, *Integrating Independent Power Producers into Emerging Wholesale Power Markets*, available at http://rru.worldbank.org/PapersLinks/Open.aspx?id=575. Much of this paper deals with the integration of existing IPPs with long-term PPAs into newly established competitive markets. However, the

To attract private sector participation in building new generating capacity the Government of Syria will need to do the following:

- Develop and implement a strategy that lays out the policy and regulatory frameworks and recommends measures necessary to ensure an environment conducive to private sector involvement, competitiveness and transparency.
- Establish a government PPP[49] Unit in charge of management of private sector participation developing in infrastructure (economic and social) and in implementation of necessary regulations.
- Designate a working team in the Ministry of Electricity to coordinate with the PPP Unit the development of new IPPs. The working team will also:
    - Prepare feasibility studies for a pipeline of generating projects that could be offered to private investors;
    - Assess with the Ministry of Finance the need for, and level of, guarantee packages or other credit enhancement instruments that may need to be provided by the Government to attract private investment; and
    - Prepare IPP bidding packages for the selected generating plants and carry out a transparent bidding process.

Given the sophistication and experience of private investors it is strongly recommended that the Government engage highly qualified transaction and legal advisors with broad international experience to develop an IPP strategy and conduct a pilot IPP.

Privatization of Existing Entities in the Sector

This approach has been followed in a number of East European countries, including Lithuania and the Czech Republic. Under this form of private sector involvement, the Government can bring in private investors either as minority or majority shareholders in the companies. The number of shares sold to private investors should be set either below the level of a blocking minority (partial privatization, Exhibit 5.2) or above (full privatization).

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paper also touches on designing new PPAs that contemplate the development of such markets. Such PPAs could contain provisions designed to encourage IPPs to participate in the market for the purpose of supplying ancillary services and relieving congestion; provisions designed to mandate the gradual entry of the IPP into the market; and provisions designed to achieve greater balance or "symmetry" in the buyout and termination clauses.

[49] PPP: Public Private Participation

Exhibit 5.2: Partial privatization of existing entities

Advantages	Disadvantages
The partial privatization allows the Government to raise fiscal proceeds	The management of the partially privatized entity has to be commercial and the Government loses some of its controlling power.
The partial privatization will require limited preliminary sector restructuring is needed (only the corporatization of the power company as a joint stock company is required	The presence of a minority shâreholder limits the capacity of the Government to further restructure the company, as the rights of the minority shareholders have to be preserved
The presence of a minority or majority private investor increases transparency, reporting and management discipline because management becomes accountable to private shareholders.	

In Syria, full or partial privatization of existing sector entities (generation and distribution) is currently not a priority. This option of private sector participation may be considered in the longer term for the distribution entities after commercialization and restructuring of the sector are completed (see Chapter 6). Privatization of existing generation plants is also not a priority as both the Government and private investors are more interested in the development of new generation capacity.

IV. Key Risks for Private Investors

The Government and the power sector management should be aware that, as seen through the eyes of a (foreign) private investor, entry into the power market of any given country is a risky proposition. The risks for private investors in the Syrian power sector have to be identified and strategies to manage them have to be developed. The key risks are:

Political risk

This risk is significant with the present political situation in the sub-region, generating considerable uncertainty for potential private investors in capital intensive infrastructure. Potential investors and lenders will take this risk into account in the pricing of their financing and expected return on equity rather than considering it as an insurmountable obstacle, provided all other risks are satisfactorily dealt with. Private investors often indicate that political risk management instruments, which can be provided by bilateral or multilateral finance institutions[50], would be necessary.

Credit risk

This is a major risk in the medium term. The financial situation of the power sector is not fully transparent, because of it structure and lack of commercial accounting system and consolidated accounts. Its creditworthiness depends currently entirely on Government decisions regarding

[50] For example, the World Bank Group offers partial risk guarantees (PRGs) to lenders through the World Bank; guarantees to lenders and investors through the Multilateral Investment Guarantee Agency (MIGA); and guarantees directly to investors by the International Finance Corporation (IFC).

fuel subsidies and future tariff adjustments. Private investors would not be willing to provide financing, as debt or equity, to a sector which may become unable to meet its payment obligations unless that risk is properly mitigated. Acknowledging that fact, the Government could: (i) make a commitment regarding how the power tariffs will be set and revised in the future and set targets for the sector's financial performance; and (ii) guarantee directly the power sector's financial obligations to investors and lenders -mainly in foreign currency- until there is a good track record over several years with tariff adjustments and improved financial performance of the sector.

Foreign exchange risk

This is a major risk in the medium term. Potential lenders will be reluctant to lend in Syrian Pounds because of the depreciation risk but, provided other risks are addressed, they will provide long term financing in foreign currency (usually US$ or €). For the power sector, the scarcity of financing in local currency is a challenge, as sector revenues are denominated in local currency. The resulting mismatch between the revenue currency and the currency used to finance investments by the private sector is a major issue for raising private financing for the power sector. Possible mitigating measures can be based on the "stripping" or unbundling of the foreign-exchange risk by distinguishing between risks which are controlled by the sovereign (e.g., exchange rate, convertibility, transferability), and those which are beyond the control of the sovereign (e.g., international fuel prices). Exchange rate risk can be mitigated to some extent through currency swap operations and hedging. In addition, special lending instruments with a reverse indexation on selected fuel prices could be used.

Fuel supply risk

The Syrian gas market is entirely controlled by the Government, both for its own gas production and imported Egyptian gas. Because of that, a private investor in new generating capacity will probably insist on a tolling agreement. Tolling (or energy conversion) agreements are used where fuel supply is under a monopoly and/or the risk of fuel supply is considered to be substantial. Under such an arrangement the investor is only responsible for converting the fuel provided to him into electricity. Any interruption of the fuel supply is not his responsibility and may cause him to claim liquidated damages from the monopoly supplier or Government. Worldwide, the large majority of IPPs are responsible for procuring their own fuel, but in the case of Syria a tolling agreement may be more appropriate.

Domestic Investors

While foreign investors bring international experience and offshore financing, there are significant benefits that domestic investors could bring. For example:

- Exposing electricity consumers to foreign exchange rate fluctuation risks should, if possible, be avoided or mitigated. This argues strongly for financing in local currency, which is possible only in larger economies with well-developed banking sectors or capital markets;
- In developing a project, investors need access to long-term funding at a reasonable interest rate. To avoid exposing consumers to interest rate fluctuations, investors are also

typically required to fix interest rates. Here, domestic investors may have an advantage over foreign investors through their ability to accept local treasury management instruments such as short-term hedging, ability to absorb the country risk, and their relationships with local financiers; and

- Domestic investors can invest in local currency and may accept local currency tariffs. This allows for a larger component of the IPP tariff to be denominated in local currency (especially the non-fuel costs). The mismatch of foreign-currency denominated project costs and local currency sources of funds can be more easily managed by domestic investors.

Chapter 6. **SECTOR REFORM**

The sector issues identified in the previous chapters call for a number of sector reforms and associated institutional changes. The main issues to be addressed are:

- introducing commercial management of the power sector to reduce large technical and non-technical losses. This would improve the sector's cash flow and reduce the need for new capacity as well as the need for State budget support;
- improving efficiency in energy utilization on the demand side to further reduce the need for future capacity investment;
- enhancing security of energy supply through diversification of the sources of energy, including renewable energy, thereby also extending the life of Syria's hydrocarbon reserves; and
- coordinating and optimizing the development and operation of the electricity and hydrocarbon sectors to ensure consistency between gas production and the fuel sourcing strategy of the power sector.

These issues are discussed in the sections below.

I. Electricity Sector Restructuring

The high level of technical and commercial losses, poor quality of service, poor financial performance (partly due to the absence of adequate tariff increases), and the absence of accrual accounting and financial management systems are posing formidable challenges. To improve the efficiency and productivity of the power sector and the quality of service, its structure and the operational relationships between units should be revised. The objective of this restructuring would be to ensure that sector management has both the autonomy and the incentives to address a range of existing shortcomings and to facilitate private participation in the sector.

Road Map: Given the above, a road map for sector reform should be developed to achieve optimal restructuring of the electricity sector and its transition to market opening if and when conditions for real competition have been met. A road map proposed for consideration by the Government of Syria could consist of three phases of reform, as outlined below.

Phase I: Short Term Sector Restructuring (2010-11)

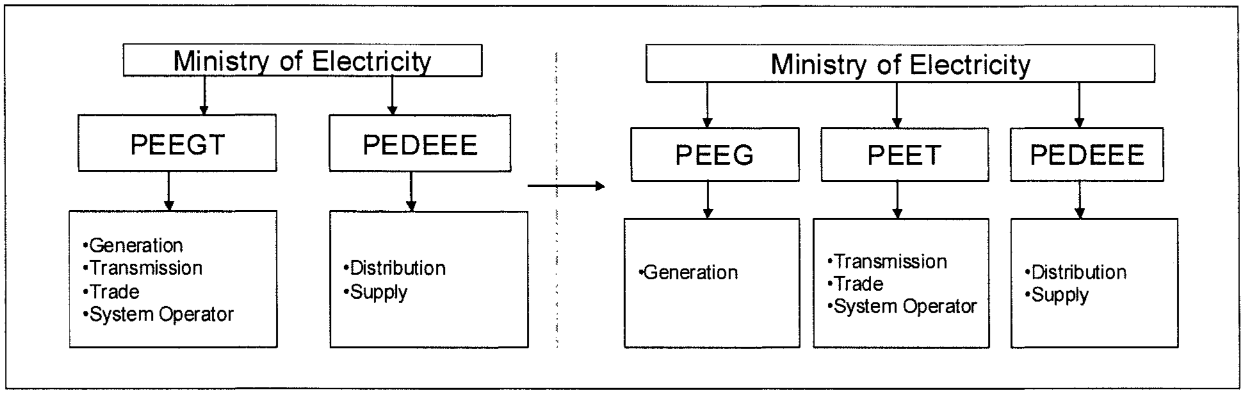
Sector restructuring during this first phase would lay the foundation for the reforms in Phases II and III. Major measures during this phase, which is expected to take about two years, would include:

- Functional unbundling of the generation and transmission functions into separate operational units under the Ministry of Electricity (the distribution units are already unbundled). This includes allocating management, staff, assets and liabilities to each unit and introducing commercial accounting and management systems for them;

- Development of an action plan for the restructuring of the electricity sector over the medium and long term (Phases II and III).

Exhibit 6.1 shows the current sector organization and compares it with the organization of the electricity sector after completing the functional unbundling of the generation, transmission and distribution businesses.

Exhibit 6.1: Functional Unbundling of the Electricity Sector (2010-11)



Phase II: Medium Term Sector Restructuring (2012-15)

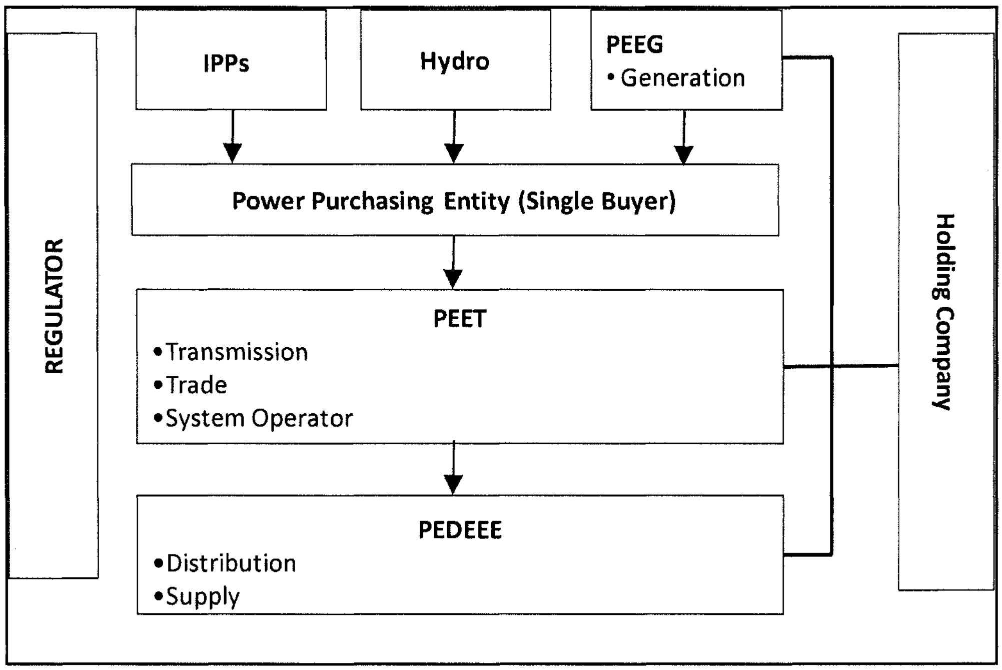
Incorporation: During this phase, which is expected to take about three years, the three electricity entities (generation, transmission, and distribution) should be incorporated as state-owned companies operating on a commercial basis. Such a commercial reorientation would:

- ensure that management of the incorporated entities would have the incentive to improve efficiency and productivity. As part of this, management would be given authority and responsibility to improve operations and service quality. At the same time, management would have an incentive to increase cash flow for reinvestment in the system, control costs and set-up financial management systems based on commercial practices;
- ensure that the management of the sector entities is accountable for their performance to their respective Boards of Directors;
- facilitate better supervision and monitoring of the sector performance, firstly by the Ministry of Electricity as the policy maker and, secondly, by a regulatory body to be established for the sector; and
- facilitate attracting private investment into the sector. Private sector involvement would be probably only focused on building new generation capacity.

To correctly implement corporatization a series of actions are required. One of the most important of these is the introduction of performance contracts between the Government and the sector companies, supported by a carefully designed incentive system linked to the achievement of performance targets. Such contracts will help to hold the companies accountable for their performance.

Market Structure: They are several alternative options for the restructuring of the electricity sector during this phase. The simplest and easiest option to implement is to incorporate the generation[51], transmission and distribution entities as subsidiaries of a state-owned holding company as shown in Exhibit 6.2. This model will also be sufficient to facilitate private sector participation in new generation capacity

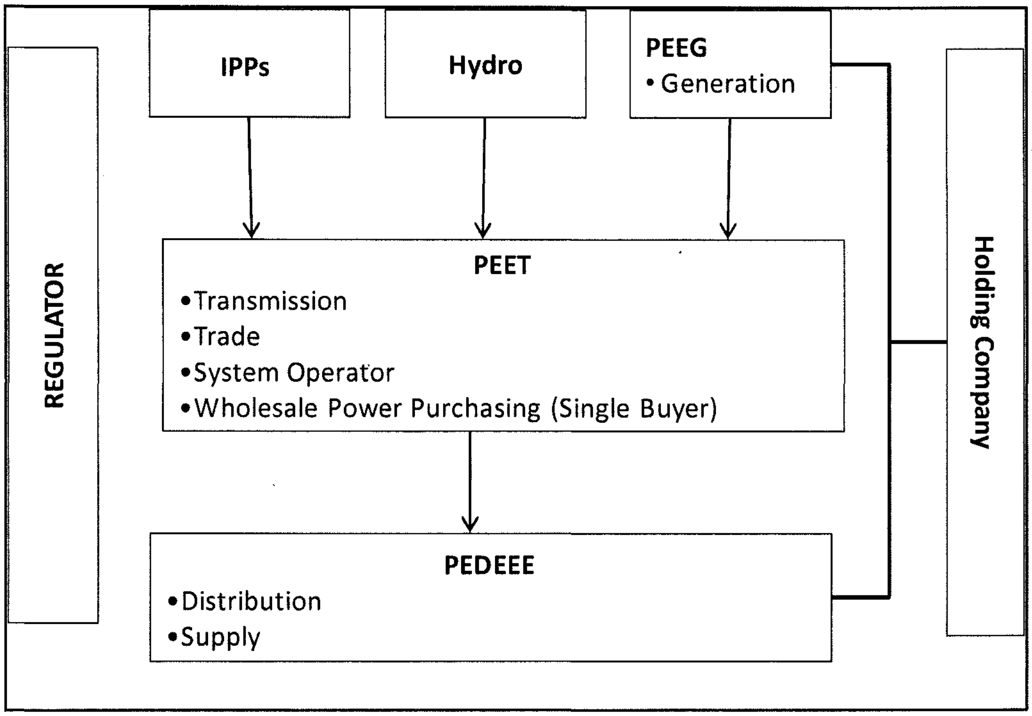
Exhibit 6.2: Sector Corporatization Under One Holding Company



In this phase, a state-owned Power Purchasing Entity will be established to act as a single buyer to contract wholesale electricity to the distribution companies from the generation companies. In the classical model during this phase, the single buyer is usually included as part of the transmission company as shown in Exhibit 6.3 and could be also considered. Advantages, however, of having the PPE separate from the transmission company are discussed in a subsection to follow.

[51] Further unbundling and grouping of generation plants (for example of similar operational efficiencies and type of fuel supply) into business units under the generation companies is encouraged to allow efficient implementation of operational and management improvement programs and to also allow comparative competition between them.

Exhibit 6.3: One Holding Company Including Single Buyer within Transmission Company



Other advanced options for sector corporatization which may be considered include the following:

- Option 2: generation and distribution are incorporated as subsidiaries of a state owned holding company, while transmission is incorporated as a separate state-owned company; and
- Option 3: generation, transmission and distribution are separately incorporated as state owned companies.

Market structure under these two options and the advantages and disadvantages of each of the options considered for Phase II are summarized in Annex 6.1.

***Electricity Sector Regulator*:** Sector restructuring under Phase II requires the separation of the ownership, sector policy and regulatory functions through the creation of an electricity sector regulator. This could be set up as an autonomous entity within the Ministry of Electricity or as an independent regulatory agency. The regulator's functions would consist notably of:

- monitoring sector operations to ensure efficient and non-discriminatory functioning of the market;
- developing price setting methodologies and tariff systems for different types of electricity services;

- issuing licenses to market operators and monitoring the compliance of the licensees with the provisions of the licenses, notably those related to quality of service; and
- benchmarking the performance of the licensees against each other and possibly against similar companies in the region, to keep costs under control. This would prevent unnecessary tariff increases by imposing economic operation of the systems

Sector Policy**:** The Ministry of Electricity would exercise the following functions:

- setting policy for the sector, including formulation of laws and strategy;
- ensuring strategic planning for future investment in generation and transmission capacity;
- deciding on the mode of service provision, such as development of new generation capacity through IPPs;
- proposing the extent and modes of sector subsidies to the Ministry of Finance. One of the key underlying principles when tariffs do not fully reflect costs; and
- Providing overall oversight of the sector, including monitoring of key performance indicators under a performance contract.

Independent Power Producers (IPPs): IPPs can be supported under all the three Phase II sector restructuring options described above. IPPs are often the first private investors in a power market dominated by state-owned power utilities, and they can enter the wholesale power market under any of the sector restructuring alternatives discussed above. In the case of Syria, IPPs can represent a timely solution to supply shortages, by adding supply capacity. Where IPPs signed long-term Power Purchase Agreements (PPAs), they were generally allocated construction and operating risks. IPPs are generally insulated under the terms of their PPAs against demand risk through take-or-pay provisions, dispatch risk, price risk, fuel risk, and exchange rate risk. However, special attention should be paid to IPP contracts in general and power purchase agreements (PPAs) in particular as they are not easy to reconcile with the introduction of competitive wholesale markets.

Power Purchasing Entity: To ensure that the transmission company does not experience recurring financial problems if wholesale tariffs are set below cost recovery and subsidies are not allocated immediately when needed, it is recommended that the single buyer function be assigned to a separate state-owned Power Purchase Entity (PPE), instead of the transmission company as in the classical single buyer model. Therefore it is recommended that a state-owned Power Purchasing Entity (PPE) is created and function until the transition of any of these Phase II options to a more competitive market structure (the long term target under Phase III). Its objective would be to contract energy for the distribution companies and large consumers from all generation companies. To that end it would design bilateral contracts and/or Power Purchase Agreements, administer procurement of electricity, and negotiate contracts. The PPE would also determine when the system needs additional capacity, and issue a request for proposals for any new capacity needed.

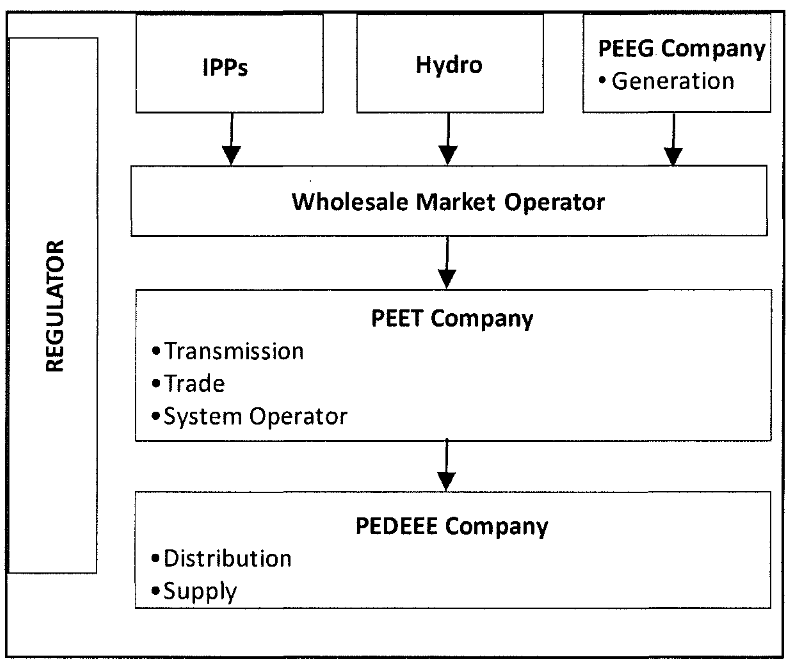
To mitigate problems associated with the PPE model (whether separate from the transmission company or part of it), it is highly desirable not to grant monopoly rights to the PPE, as they may be difficult to eliminate in the future. Avoiding monopoly rights can be achieved by:

- Establishing from the start the right of the distribution company and large consumers above a certain energy demand level to contract their electricity directly as they become financially creditworthy ("eligible consumers"). Such consumers will want to contract for electricity directly if they can obtain lower electricity prices than through the PPE;
- Giving the distribution company and large consumers the prerogative to buy a growing portion of their energy needs on the market as the power sector evolves; and
- Progressively lowering the energy demand threshold level at which consumers can become eligible consumers.

Phase III: Long Term Restructuring (≈2020)

Competitive wholesale electricity market: Introduction of such a market in Syria can only be considered once all electricity market opening conditions have been met, the regulations have been developed, and the market participants (especially the distribution company) have become creditworthy. Such a market would be based on: (i) bilateral contracts between distribution companies and large consumers, respectively, with generation companies; and (ii) a balancing market. Exhibit 6.4 shows a conceptual diagram of such a competitive wholesale electricity market.

Exhibit 6.4: Long Term Move towards a Competitive Wholesale Electricity Market



A move towards a competitive wholesale market entails the introduction of an organized market of generation entities, distribution entities and large users in which power is traded competitively, supported by a transmission entity, a power system operator and a power market administrator. This market structure allows distributors and large users of electricity to purchase electricity directly from generators they choose -either through a power exchange or bilaterally- and to transmit this electricity under open access arrangements over the power networks to the points of electricity consumption. Independent power suppliers (firms that specialize in energy trading, but do not own or operate distribution networks) are allowed to compete with distributors for the business of large users.

II. Energy Efficiency and Renewable Energy

The importance of energy efficiency (EE) and renewable energy (RE) has been highlighted in previous chapters. However, making progress in these two fields can be complex and requires a comprehensive approach. In that context the Government should ensure not only that policies and legislation on EE and RE are formulated, but also see to it that these are actually implemented and enforced. The principal recommended steps are:

- ***Adopting comprehensive and consistent EE and RE legislation***: The legislation should start with an EE and RE Framework Law. This Law would provide the overarching legal structure for all existing and future secondary legislation (laws and decrees) on EE and RE. The Law will also need to be complemented by regulations on load management, building codes, equipment and fuel efficiency standards, energy audits for large energy consumers, legislation on import and labeling of appliances, regulation for renewable energy development including feed-in tariffs, etc.;
- ***Establishing an EE and RE Agency:*** The agency would be supervised by the Ministry of Electricity but with operational independence. It would help formulate policy and legislation in these areas and ensure implementation. The establishment of NERC was intended for this purpose and NERC could be empowered with financial resources and operation capacity to be transformed into such an agency;
- ***Preparing EE and RE Strategies and Action Plans:*** The EE and RE Agency should take the lead in developing these strategies and action plans;
- ***Development of Financing Mechanism for EE and RE:*** Most countries who promote EE and RE have put in place special financial incentives. A menu of actions has been tested in various countries. Measures which have proven to be effective are:
    - Favorable tax regimes for the import of qualifying EE and RE equipment;
    - Direct subsidies for selected EE and RE programs, provided stable financing of these subsidies can be secured through surcharges on electricity or gasoline;
    - Creation of a compensation mechanism to finance the cost difference between renewable energy (usually wind and solar) and least-cost conventional energy, under a tariff system or a competitive tendering system;
    - Investment credits and/or tax credits to induce consumers to buy energy efficient equipment and to encourage development of various forms of renewable energy;
    - Dedicated credit lines with selected commercial banks that are interested in investing in these areas (possibly accompanied by technical assistance for project and risk appraisal); and

- Guarantee schemes to cover specific EE and RE risks, provided the banks' risk perception is indeed a significant obstacle to EE and RE lending.

A checklist for Government of measures to promote energy efficiency is attached in Annex 6.2.

III. Gas-Power Coordination

Low gas prices and inadequate coordination between natural gas production plans and electricity generation requirements have led to constraints in the present gas supply to the electricity sector. This situation needs to be urgently addressed. Projections of future electricity sector capacity demand indicate that gas needs to be used increasingly by the electricity sector for generation. Therefore a gas to power strategy must be developed and a coordination mechanism (hereafter called the joint coordination committee) between the Ministry of Electricity and Ministry of Petroleum and Mineral Resources must be established. Issues that should be considered by the joint coordination committee are:

- The power sector will be by far the most important consumer of gas in the foreseeable future. Therefore, the development of the investment programs for both sectors need to be fully coordinated in order to achieve an integrated approach to the fuel sourcing strategy on the supply and demand side.
- Implementation of the investment plans of the Syrian Gas Company and the power sector to ensure full coordination of funding and implementation of investment programs.
- Pricing and supply contracts between the gas and power sectors should also be coordinated because the gas price directly impacts gas sector investment capacity and electricity production cost. Therefore, it cannot be set independently of electricity prices and the investment programs of both sectors.

ANNEXES

GDP growth scenarios retained for demand projections

GDP Growth Scenarios	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
High Case	5.9%	6.7%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Base case	**4.4%**	**5.2%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**
Low Case	3.4%	4.2%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%

GDP elasticity of electricity demand by Sector

Demand Elasticity Assumptions	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Price Elasticity	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Income (GDP) Elasticities												
Residential	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Commercial	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Street Lighting	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Government	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Religion	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Power sector	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Industry	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15

The GDP elasticity of electricity demand assumptions are based on estimates given by SwedPower in the 2004 Power Sector Action Program for Syria and the Bank team experience in Ukraine, Czech republic, Egypt and Cameroon.

Summary EnergyUnconstrained Demand Scenarios														
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total Consumer Demand Base Case (GWh)	31151	33500	35264	37487	38754	40591	42514	43948	46029	48207	50488	52186	54653	56488
Total Consumer Demand Low Case (GWh)	31151	33500	34856	36630	37429	38749	40115	40990	42435	43930	45478	46470	48107	49157
Total Consumer Demand High Case (GWh)	31151	33500	35875	38792	40805	43486	46345	48747	51951	55367	59007	62061	66142	69562
Growth rate Base Case	7.2%	7.5%	5.3%	6.3%	3.4%	4.7%	4.7%	3.4%	4.7%	4.7%	4.7%	3.4%	4.7%	3.4%
Growth rate High Case	7.2%	7.5%	4.0%	5.1%	2.2%	3.5%	3.5%	2.2%	3.5%	3.5%	3.5%	2.2%	3.5%	2.2%
Growth rate Low Case	7.2%	7.5%	7.1%	8.1%	5.2%	6.6%	6.6%	5.2%	6.6%	6.6%	6.6%	5.2%	6.6%	5.2%
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Unconstrained System Demand Base Case (GWh)	39,379	40,768	42,763	45,346	46,737	48,547	50,804	52,035	54,498	56,595	59,273	60,745	63,616	65,752
Unconstrained System Demand Low Case (GWh)	39,379	40,768	42,272	44,312	45,139	46,343	47,937	48,532	50,243	51,574	53,391	54,091	55,997	57,219
Unconstrained System Demand High Case (GWh)	39,379	40,768	43,501	46,922	49,211	52,010	55,382	57,716	61,510	65,000	69,275	72,239	76,989	80,970
Growth rate Base Case	4.75%	3.53%	4.89%	6.04%	3.07%	3.87%	4.65%	2.42%	4.73%	3.85%	4.73%	2.48%	4.73%	3.36%
Growth rate Low Case	5%	4%	4%	5%	2%	3%	3%	1%	4%	3%	4%	1%	4%	2%
Growth rate High Case	5%	4%	7%	8%	5%	6%	6%	4%	7%	6%	7%	4%	7%	5%
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Peak Demand Base (MW)	6566	6758	7190	7678	8027	8401	8836	9192	9675	10129	10662	11104	11691	12245
Peak Demand Low (MW)	6566	6758	7106	7500	7749	8014	8330	8564	8907	9215	9586	9866	10264	10624
Peak Demand High (MW)	6566	6758	7316	7948	8458	9009	9644	10212	10941	11659	12494	13247	14199	15141
Growth rate Base Case	4.6%	2.9%	6.4%	6.8%	4.6%	4.7%	5.2%	4.0%	5.3%	4.7%	5.3%	4.2%	5.3%	4.7%
Growth rate Low Case	4.6%	2.9%	5.1%	5.5%	3.3%	3.4%	3.9%	2.8%	4.0%	3.5%	4.0%	2.9%	4.0%	3.5%
Growth rate High Case	4.6%	2.9%	8.3%	8.6%	6.4%	6.5%	7.1%	5.9%	7.1%	6.6%	7.2%	6.0%	7.2%	6.6%
		2.9%	6.4%	6.8%	4.6%	4.7%	5.2%	4.0%	5.3%	4.7%	5.3%	4.2%	5.3%	4.7%
		2.9%	5.1%	5.5%	3.3%	3.4%	3.9%	2.8%	4.0%	3.5%	4.0%	2.9%	4.0%	3.5%
		2.9%	8.3%	8.6%	6.4%	6.5%	7.1%	5.9%	7.1%	6.6%	7.2%	6.0%	7.2%	6.6%

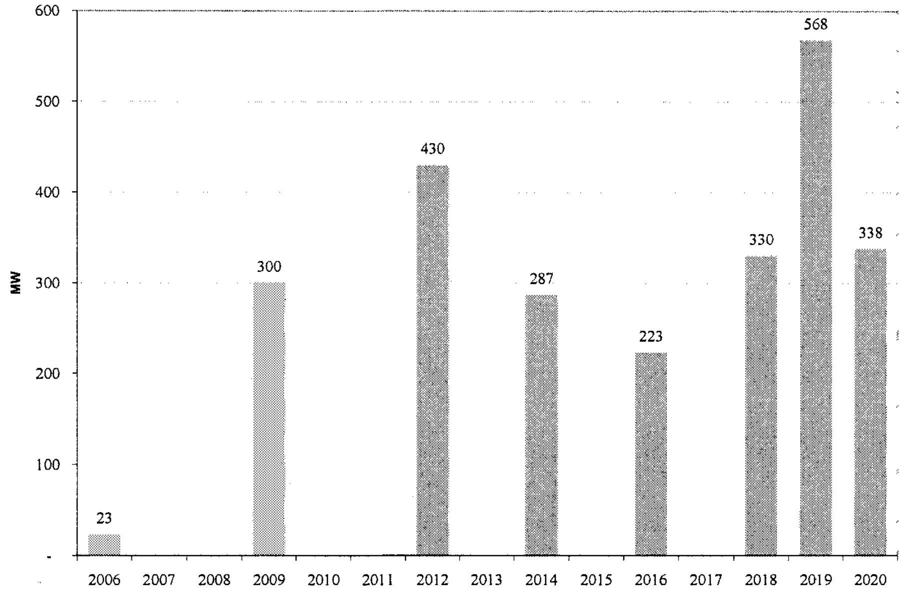
Annex 2.1

Summary of Power Generation Plants in Syria

Plant	Organization	Type	# of Units	Capacity (MW)		
				Unit	Installed	Available
Banias TPP	PEEGT	Gas Turbine	1	30	30	0
		Steam Turbine	4	170	680	340
Mehardeh TPP		Gas Turbine	1	30	30	0
		Steam Turbine	2	165	330	290
			2	150	300	240
Tishreen TPP		Gas Turbine	2	112.5	225	200
		Steam Turbine	2	200	400	400
Nassrieh CCPP		Gas Turbine	3	112.5	337.5	330
		Steam Turbine	1	150	150	150
Jandar CCPP		Gas Turbine	4	118.5	474	440
		Steam Turbine	2	114	228	200
Zayzoon CCPP		Gas Turbine	3	112.5	337.5	330
		Steam Turbine	1	150	150	150
Aleppo TPP (Halab)		Gas Turbine	1	30	30	0
		Steam Turbine	5	213	1065	1,065
Tayyem GTPP		Gas Turbine	3	34	102	68
Swedieh GTPP		Gas Turbine	5	34	170	136
Alzara TPP		Steam Turbine	3	220	660	660
Syrian Petroleum Company	Other public sector	Gas Turbine	6	20	120	60
Homs Refinery		Steam Turbine	2	32	64	40
Banias Refinery		Steam Turbine	4	12	48	0
Thawra Dam		Hydro	8	100	800	650
Baath Dam		Hydro	3	25	75	51
Tishreen Dam		Hydro	6	105	630	450
PEDEEE	PEDEEE	Hydro	2	8	16	0
			1	7	7	0
System Total					7,459	6,250
PEEGT Total					5,699	4,999
Other Public Sector Total					1,737	1,251
PEDEEE					23	0
Steam Turbine Total					3,547	3,035
Gas Turbine Total					707	464
Combined-Cycle Turbine Total					1677	1600
Hydro Turbine Total					1,528	1,151

Annex 2.2

Estimated Generating Capacity Retirement



Annex 2.3

Syria Regional Power Interconnections

Interconnection	Operational Year	Estimated Thermal Capacity (MW)	2006 Utilization
Syria-Lebanon, double-circuit, 66kV, 110MVA	1973	94	1.5%
Syria-Lebanon, single-circuit, 230kV, 267MVA	1977	227	3.6%
Syria-Lebanon, single-circuit, 400kV, 1135MVA	2000	965	15.1%
Syria-Lebanon, single-circuit, 400kV, 1135MVA	-	965	15.1%
Syria-Iraq, single-circuit, 230kV, 267MVA	2000	227	3.6%
Syria-Jordan, single-circuit, 230kV, 55MVA	1977	47	0.7%
Syria- Jordan, single-circuit, 230kV, 267MVA	1977	227	3.6%
Syria-Jordan, single-circuit, 400kV, 1135MVA	2000	965	15.1%
Syria-Turkey, single-circuit, 400kV, 1135MVA	-	965	15.1%

* Assuming load factor of 0.85

Coal-fired steam plant

While coal has certain environmental disadvantages compared to gas, these can be effectively minimized by using modern technologies and high-grade coal. Modern coal-fired plants using supercritical technologies have an efficiency of about 45%, thus reducing both fuel cost as well as emission of the greenhouse gas CO_2 per MWh produced. Furthermore, in Syria it might be possible to capture the CO_2 and inject it into working oil wells. This would enhance oil production and save precious domestic natural gas that is currently used for that purpose.

Carbon Capture and Storage (CCS) may also be possible in Syria, since the country may have many geologically suitable underground sites for that purpose such as abandoned oil wells, etc. Finally, *co-firing of coal and biomass* (e.g., straw) in a proportion of about 80/20 on an energy basis is a technique that is increasingly used in the EU and other developed economies, thus reducing coal consumption and greenhouse gas emissions while increasing the use of locally available renewable energy sources. Collecting and transporting biomass also has significant local revenue and employment creation impacts.

In terms of technology options, supercritical Circulating Fluidized Bed (CFB) technology that is at least CCS-ready is relatively easy to implement. Integral Gasification Combined Cycle (IGCC) technology is based on a CFB coal gasifier and the CCS option there is straightforward. Steam coal is suitable for any of these options.

Biomass co-firing will be easy with CFB but almost impossible with IGCC. So if the objective is coal/biomass co-firing, supercritical CFB is likely to be the only option. If built as CCS ready, supercritical CFB will go below zero in terms of greenhouse gas emissions, since it will store some CO_2 from biomass as well. This is probably the most cost efficient option and the least demanding in terms of skills and maintenance. If so desired, such a plant could be linked to a water desalination process by making use of the waste heat of the plant.

The following arrangement might be feasible in Syria: (i) a CFB based power plant with a solar-thermal assisted steam cycle plus utilization of about 20% of biomass; (ii) CCS ready (to be implemented when storage space becomes available); (iii) utilization of the plant's waste heat for drying of biomass and water desalination (these two processes could be solar assisted as well). Water desalination (for drinking water or irrigation) would play provide further flexibility to the plant, since waste heat can be used for evaporation during peak hours, while electricity can be used for reverse osmosis during off-peak hours. This configuration might also qualify the plant for Clean Development Mechanism credits[52].

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[52] To make even better use of the plant it could be used for district cooling of entire city areas, especially commercial districts, using cold sea water as a medium and heat exchangers. Compared to individual window air conditioners this reduces electricity consumption by a factor of 8-10.

Syria - Renewable Energy Plans

Renewable Energy Activities/Projects under Consideration or Implementation

Installing a 6 MW wind farm as a pilot project, financed by the Spanish government.
Installing a 12.5 MW wind farm as an experimental project, financed by investors.
Preparing terms of reference for a 100 MW wind farm.
Establish a National Fund of US$500 million for domestic solar water heating systems. Half the cost of these systems will be subsidized from this Government-financed Fund
Negotiations with investors are in progress to implement a 500 MW wind farm by 2010
Preparation of a feasibility study to establish a solar trough and electrocell manufacturing facility with a capacity of 11 MW/year. Ukrainian-Syrian joint venture. Start in 2009
Agreement with a German company to install a 10 MW PV power plant.
Cooperation with GTZ on the SOLARTERM project (launched end-2006). Aims to transfer technical expertise in the use of solar energy and to develop strategies and policies to generalize its application
Implementation of 19 small rural biomass projects and preparation of a large farm waste biodigester to generate electricity

Sources: *Renewable Energy and Energy Efficiency, Presentation, NERC*

Renewable Energy Plans in Syria, 2010-2030

Description	Units	2010	2015	2020	2025	2030
Solar Hot Water Systems	'000	480	1,500	3,000	3,500	4,000
Solar Thermal Industrial Process Heat	'000	75	325	550	800	1,000
Photo Voltaics (installed capacity)	MWh	.6	70	140	220	300
Wind Power (installed capacity)	MW	500	1,000	1,500	2,000	2,500

Source: *Renewable Energy and Energy Efficiency Presentation, NERC*

Mediterranean Solar Plan – Potential of Projects for Syria 2009-2010

Install 20 MW of wind power
Install 20 MW of PV power
Install 300 MW of concentrated solar power

Source: *Solar Plan for the Mediterranean*, Presentation, Philippe Lorec

Annex 3.3

Clean Development Mechanism Opportunities in the Syrian Power Sector

Introduction

The Syrian Arab Republic confirmed its adhesion to the Kyoto Protocol on the 05 September 2005 by the Presidential Decree N° 73 which was entered into force for the country on the 27th of April 2006. Syria is classified as a non-Anne1 country, that is, a country without binding limits to emitting greenhouse gases (GHG). Under the Clean Development Mechanism (CDM) of the Kyoto Protocol, Syria can reap carbon finance (CF) credits for new investment projects with potentials to reduce the emissions of GHG. The emission reduction (ER) credits generated from CDM projects can be sold to Annex 1 countries to meet their compliance obligations under the Kyoto Protocol.

Institutional Framework

The obligation to coordinate and implement the Kyoto Protocol resides with the Designated National Authority (DNA), which was established in Syria under the General Commission for Environmental Affairs of the Ministry of Local Administration and Environment. The Technical Committee of the DNA includes representative from of the Ministry of Electricity. The DNA is responsible for developing and promulgating standard procedures to ensure that the required Kyoto Protocol documentation processes are consistent with international practices as agreed with the Executive Board (EB) of the Kyoto Protocol. Project developers are required to adhere to the KP documentation processes in order for their CDM projects to qualify for registration and the ER credits to be sold in the compliance market. Therefore, it will be necessary to speed up the operationalization of the DNA to have its share in the CDM process

Roles and Functions: Importance of Coordination of the DNA[53]

The DNA is responsible for ensuring that the proposed CF projects of the country. As envisioned, the KP facilitates resource transfers, including technology transfers, from developed countries (primarily Annex 1 countries) to developing countries (non-Annex 1 countries). The DNA assumes the important responsibility to be the main interlocutor and the coordinating agency of the Government vis-à-vis the project developers and the buyers of the CERs. In addition, the DNA will help ensure that CF projects comply with the laws and regulations of the country. For instance, before a CF project can be registered as a CDM project with the KP Secretariat, a letter of authorization (LOA) is required for that particular project to be issued by the DNA of Syria. . Given such core CDM role for the DNA, therefore, it will be necessary to speed up its operationalization to have its share in the CDM process.

Syria also has the National Energy Research Center (NERC) that provides technical support in the assessment of CDM projects submitted to the DNA Secretariat. The Government has designated the NERC as the main institution that will determine the acceptability of any CF projects and provide the required technical input, if necessary, to the project.

[53] "Draft Proposal for the Operation of the CDM-Designated National Authority of the Syrian Arab Republic" (June 2008).

Carbon Trading – Growing Market

As of 2007, the global carbon market has grown to about $64 billion from US$ 31 billion in 2006.[54] There are two primary carbon trading markets: the compliance market and the voluntary market. The rapid growth of the compliance market is driven by the active trading in the certified emission reduction (CER) credits. This compliance market primarily dominated by CDM project-based transactions grew from US$5.8 billion in 2006 to US$7.4 billion in 2007. The ER credits, registered under the KP, are traded globally and sold at relatively higher prices as CER credits. Private investment firms buy CERs as investment assets to be sold to other buyers who are unable to meet their KP commitments. This secondary market of CDM project-based transactions also grew from US$0.4 billion in 2006 to US$5.4 billion in 2007.

In the voluntary market, the buyers are mostly private entities who are interested to promote corporate social responsibility (CSR) of their enterprise. Other buyers include enterprises in the countries who have not ratified the KP and, therefore, ineligible to carry out carbon finance transactions in the compliance market. The growth of the voluntary market is not expected to be as high as that of the compliance market as the Verified Emission Reduction (VER) credits are priced lower than CER and of smaller volume. Nonetheless, the voluntary market is growing, from US$146 million in 2006 to US$265 million in 2007.

Opportunities in the Power Sector for Carbon Finance Transactions

Based on the proposed direction and draft investment plans in the energy sector, several opportunities for carbon finance transactions can be identified. Although additional analyses will be required to pinpoint specific investment projects with potentials for carbon finance overlay, opportunities in the energy sector can be identified *a priori* on the supply-side management and on the demand-side management. Based on international experience under the Kyoto Protocol CDM projects, carbon finance projects can be developed in the power generation sub-sector and in the transmission and distribution sub-sector. Investments that improve efficiency in power generation and transmission and distributions that lead to lower consumption of fossil fuels have potentials for carbon finance transactions or ER credits.

Syria has identified supply deficiencies in her power-generating capacity and potential investment requirements. One major planned rehabilitation investment identified is to move from open-cycle to close-cycle thermal power plants, for instance, the planned transformation of the open cycle units at Nasrieh and Zayzoon. This technological change can certainly improve power generation efficiencies, which will likely result in lower GHG emissions from the power plants.

Investments are also being considered for fuel switch of the power plants of the Public Establishment for Electricity Generation and Transmission (PEEGT). The investments to rehabilitate and switch the power plants from heavy fuel oil (HFO) to natural gas have potentials for carbon finance transactions.

Renewable Energy Sources (RES)

To meet the country's energy requirement, Syria plans to augment its energy supply from renewable sources of energy, namely, hydropower, solar and wind. The geographic location of

[54] World Bank. State and Trends of the Carbon Market 2008. May 2008.

the country makes these RES as attractive options. Although hydropower potential may be restricted, solar and wind power generation opportunities may be large. The ability to generate carbon finance transactions by the investment projects in solar and wind power generation capacities will greatly depend on the ability to substitute power generated from fossil fuel sources or GHG emitting energy sources. If investment projects in RES can substitute for investment in the less efficient thermal power plants using HFO, then, there is potential for carbon finance transactions for these investments in RES. More important, the carbon revenue credits from these RES investments may make them financially viable in the long run since these ER credits will become CERs and will command higher prices in the compliance market. The CER revenues will be additional income streams to these RES projects.

Transmissions and Distribution Systems

Power distribution network of Syria is relatively inefficient. The network technical loss is about 15% of the total electricity supply while about 10% comes from non-technical loss. Future rehabilitation and investments in the distribution networks will likely have CF transaction potentials if these can lead to efficiency improvement that will reduce power supply generated from fossil fuels. The use of more efficient transformers and efficiency enhancing measures in the distribution networks have potentials for carbon finance transactions.

Demand-side Management: Energy Efficiency by the Power Users

Energy intensive industries, such as metallurgy and cement production, tend to be major emitters of GHG, thus they have big potentials for carbon finance transactions. Upgrading their technology, either through materials or processes that can lead to lower energy intensities, will likely lead to carbon finance transactions. Steel and chemical firms in China and Ukraine, for example, have benefited from carbon finance when their investments contributed to more efficient processes that reduce their energy utilization rates. Additionally, carbon finance transactions resulted in more revenues. It should be considered that most of the investments in energy efficiency can be financially justified even without carbon finance. However, there are also instances when carbon finance revenues made these energy efficiency investments financially viable especially when normally non-commercially viable technologies are used.

A more important challenge for the Government is the impact on the supply-side management at the household level. Based on the present estimates, residential consumers have a load factor of 34%, which is relatively low by international standards, while industries have a relatively high load factor of 82%, indicating high electricity demand by the industrial sector. The load factor among households is likely due to the predominant use of inefficient household appliances. Parallel to the energy efficient investment in the industrial sector is the promulgation of policies and programs for a more energy efficient use at the household level, which can have potential for carbon finance transactions. Programs to replace incandescent light bulbs with compact fluorescent lamp (CFL), in China, Uganda, and Argentina, for example, have provided these countries with carbon credit revenues. Similarly, projects and programs that replace less energy efficient household appliances, such as more efficient chillers in the Philippines and in China, have generated carbon revenues to the project developers. Energy efficiency programs targeted at the household level, which are implemented and bundled by the Ministry of Electricity, can likewise generate additional carbon finance revenues for Syria.

The Executive Board (EB) under the Kyoto Protocol has approved programmatic CDM to qualify for registration. Programmatic CDM is comprised of a Program of Activities (PoA) of related CDM projects that use the same methodology to estimate ER generated from the program. Non-Annex 1 countries have started to look into the potential carbon finance transaction opportunities under the newly approved programmatic CDM, especially those that will cover the whole country or a sector. Weather proofing and enhanced design standards of houses and buildings can lead to programmatic CDM transactions. Improving the housing design and construction standards in Syria with the goal of becoming more energy efficient to reduce power use at the household level can have potentials for carbon finance transactions.

Additional Considerations in the Power Sector

Project Feasibility Studies. Given the number of opportunities for potential carbon finance transactions in the power sector, resources will be required to develop project feasibility studies for each of these projects. The resulting project feasibility studies are necessary to provide the input for the Kyoto Protocol documentation. The Project Idea Note (PIN,) which is the first document in a carbon finance project, will depend on the information generated from these project feasibility studies. The final Kyoto Protocol document and the Project Design Document (PDD) cannot be completed without the feasibility studies of the identified investment project of the Ministry of Energy. The PIN and the PDD will determine whether the carbon finance project can be registered under the Kyoto Protocol. The information generated from these project feasibility studies will help address the CDM requirements of (i) additionality and (ii) monitoring verification reporting plan.

Grid Emission Factor (GEF). To estimate the ER credits in CF power projects, a grid emission factor will be needed. The GEF is used to estimate the baseline of the grid and how the energy sources are generated. The GEF will determine the amount of ER credits generated from a CF power project.

Summary and Conclusions

Syria's power sector has potentials for carbon finance transactions that can be offered in the compliance market. Planned investments in power generation and transmission and distribution networks to improve efficiencies will be attractive carbon finance projects. As a non-Annex 1 country, CF projects can offer CERs up to 2012 crediting period, or beyond 2012 if there is a follow-up international agreement to the Kyoto Protocol. The sooner the projects start generating ER, the more carbon revenues can be accumulated for these projects. Therefore, to accelerate the processing for these potential carbon finance transactions, the project feasibility studies and the GEF study need to be completed quickly. One should consider that CF project registration is a lengthy process.[55]

CF projects that do not generate sufficient volume of ERs and may not attract buyers in the compliance market can still benefit from the Kyoto Protocol by offering these in the voluntary market. In certain circumstances, there are buyers in the voluntary market who are willing to pay CERs and VERs with relatively higher prices than those in the compliance market.[56]

[55] CF project registration can take as long as two years or more especially if a new methodology is required. The availability of project-related data is one major cause of delays in completing the Kyoto Protocol documentation process.
[56] CF projects selling their ERs in the voluntary market are not subjected to the more stringent KP CDM requirements.

An institutional mechanism needs to be developed to effectively coordinate between the Ministry of Electricity and the Ministry of Local Administration and Environment the preparation of a power sector project pipeline which could be considered for carbon financing. The sector emission factor estimation is an important activity and should be completed.

Most important, project developers in Syria will need to closely coordinate their project development with the DNA to facilitate the issuance of the Letter of Authorization (LOA), which is required for registration with the CDM Secretariat.

Annex 4.1

International Experience with Block Tariffs[57]

Block tariffs generally include either two or three tariff blocks that have varying costs per energy unit. Block tariff systems are widely used for various reasons. They are well suited to providing incentives for the implementation of energy efficiency in households due to the increasing cost of energy units within a block as consumption increases. They have, however, also been utilized in order to provide protection from energy poverty for socially vulnerable groups when targeted social protection schemes have not yet be developed..

In order to provide protection against energy poverty in a block tariff it is necessary that the lowest block is affordable for all consumers and of a size that covers the energy requirements of vulnerable households. This makes it very difficult to target the intended group, especially if electric heating is used by vulnerable groups, as block tariffs will generally favor those that have the economic ability to change their heating source. However, a different form of block tariff can also be utilized, whereby the price per kWh is determined by which block the last kWh is consumed in. If, for example, the final kWh consumed falls in the block with the highest tariff, then all kWh are paid at this tariff. This system has the effect of increasing the incentive to reduce energy consumption amongst users as well as reducing the risk of free riders benefiting from the low tariff designed for socially vulnerable groups.

Block tariffs intended as social protection tools generally result in a number of groups benefiting from the program that do not require the assistance. This does, however, play a role in making this tariff form more politically attractive. Experience from other countries indicate that it can be difficult to determine an effective block tariff design, since it can lead to negative consequences for the power sector, energy efficiency and unintended benefits to higher income groups.

Experience with block tariffs in Bulgaria

In 2002 Bulgaria introduced energy reforms initiated by its Energy Strategy. This included amongst other things the commercialization and restructuring of utilities, the introduction of a modern legal and regulatory framework and the introduction of cost-reflective tariffs. Bulgaria realized that energy reforms and the introduction of a cost-reflective tariff should be implemented in tandem with a social safety program in order to protect socially vulnerable groups from the necessary tariff increases. Bulgaria utilized block tariffs as a temporary measure to protect vulnerable customers from sudden tariff increases. This resulted in a two block system being introduced from 2002 to 2006. The first block consisted of 75 kWh per month at a stable price for the whole period while the second block had indicative price increases with predetermined dates and levels of increase throughout the period. It was estimated that the 75kWh per month covers needs for lighting, a radio or television and some cooking. From October 2006 onwards the block tariff was replaced by a series of tariffs that consumers can choose between according to their consumption patterns. A two-block tariff system for district heating was also implemented in Bulgaria. The first block covers a monthly consumption of up to 250kWh while the second block covered consumption above 250kWh. This was combined with a monthly capacity payment with a fixed charge per square meter heating space. From October 2006 on the block tariff was replaced by a flat rate tariff.

[57] Adapted from *"Social Protection Against Energy Poverty", Ministry of Economy, Macedonia. March 2007.*

Eventually the block tariff system was phased out in Bulgaria and targeted social assistance payments and energy efficiency targets have been introduced, as these methods are generally more effective in the long-term than a block tariff system.

Experience with block tariffs in Serbia

Serbia introduced a block tariff system in 2001 in order to move towards cost recovery in the power sector as the power sector was one of the main sources of fiscal deficit for the Serbian economy due to its low operational efficiency, high levels of financial losses and debt service defaults caused in part by energy prices being lower than the cost of supply.

The Serbian tariff system is divided into the following three monthly tariff blocks; 0 –600kWh, 601kWh – 1600kWh and consumption above 1601kWh. The average household consumption in Serbia at the time of introducing the block tariff system was approximately 400kWh per month. The price of electricity has been raised substantially and on a regular basis in conjunction with the introduction of the three block tariff in Serbia. This has led to the aggregate price of electricity for households increasing from 0.9 US cents/kWh in October 2000 to 5 US cents/kWh at the end of 2005.

Initially the highest tariff block was substantially more expensive than the cheapest tariff block, but tariff increases have been directed at leveling the difference between tariff blocks as once tariffs achieve cost recovery the block tariff will be reformed.

There are also time-of-day tariffs within the Serbian block tariff. The block tariff in Serbia is seen as a temporary measure that can ease the transition for the customer from subsidized electricity prices to full cost recovery, whilst also encouraging energy consumption to become more efficient. The three block tariff in Serbia was introduced along with targeted subsidies for socially vulnerable groups.

Common Ownership Models for Private Power

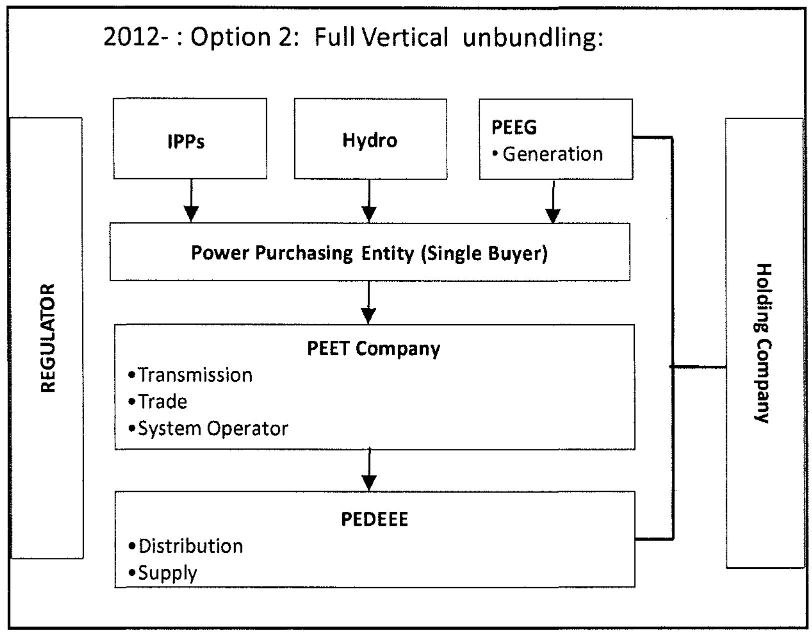
Build-Own-Operate (BOO). This common model calls for an investor to take responsibility for construction, ownership, and operation of the plant on an indefinite basis. It is normally initiated by a contract for the output of the power plant. Also known as the *perpetual franchise model*, the Build-Own-Operate model entails a private entity building, financing and operating the project under a perpetual franchise from the host government. The project developer retains title to the assets. Within this model, all financial support for project-related borrowings is provided by the private entity. The government regulates safety, quality of service and, possibly, user charges or profits. The BOO model can accommodate financing in the public securities market. However, in view of the innovative nature of many projects and the attendant economic risks, the public securities markets, both for debt and equity, will usually be available only after a project has operated successfully for a few years and has established an acceptable record of profitability.

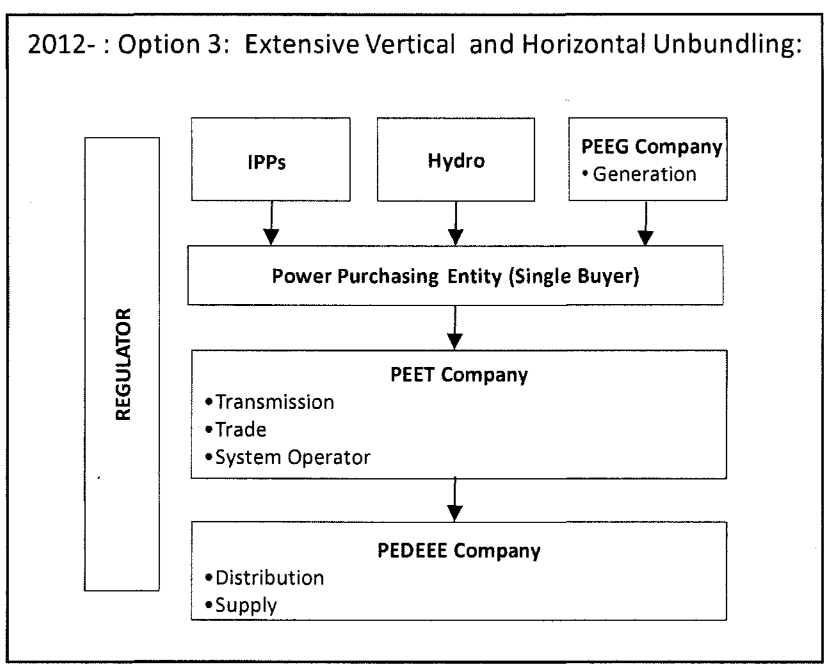
Build-Own-Operate-Transfer (BOT or BOOT). This scheme is similar to BOO but has a future transfer of ownership to a designee. The future transfer can be very important where a project has unique characteristics that preclude permanent private ownership, such as hydroelectric power stations. The private entity receives a franchise to finance, build and operate the project for a fixed period of time, *after which ownership reverts* to the host government (or some local or regional public authority administered by the host government). Ownership reversion is planned to occur only after the private sector entity receives the repayment of, and a satisfactory return on, the capital it has invested in the project. In return for the ownership reversion, the host government might be asked to furnish some limited credit support for project borrowings. The BOT structure is attractive to the host government because of the ownership reversion feature.

Build-Transfer-Operate (BTO). This scheme is used in jurisdictions where private ownership is not permissible, but private operation is desirable. A private entity designs, finances, and builds the project. The entity then transfers the legal title to the host government (or some local or regional public authority) immediately after the project facility passes its completion tests. The private entity then leases the project facility back from the public authority for a fixed term. A *long-term lease agreement* gives the private entity the right to operate the project facility and to collect revenues for its own account during the term of the lease. At the end of the lease term, the public authority operates the project facility itself or hires someone else (possibly the private entity originally involved) to operate it. Under this model, the host government or public authority has, at most, only a very limited responsibility for the project's financial obligations; the project company carries the principal responsibility.

Annex 6.1

Alternative Options for Sector Corporatization





Annex 6.1

Market Structure Option Comparison

	Option 1	Option 2	Option 3
Administrative requirements	**Low** • Easy model to be implemented.	**Medium** • Implementation requirements are slightly more demanding	**High** • Implementation requirements are very demanding both on the regulatory side as well as from the development of creditworthy companies
Ability to attract private investment	**Low** • Private participation limited to IPPs in generation. This may however be sufficient for Syria during the medium term as no other forms of private sector participation are envisaged	**Medium**: • Medium, as it allows introducing competitive pressures in the supply chain through a probably larger number of IPPs. This is due to perceived fair third party access due to separation of the transmission company	**High** • Very high, as it also allows to attract non-traditional service providers to enter the market
Transparency of prices and costs	**Low** • Low in terms of control of different elements of the value chain	**Medium** • Increased transparency in costs, transfer prices and corporate structures • Better control of the different elements of the value chain via benchmarking by the Ministry and the regulator	**High** • Each company is governed by a separate management and Board of Directors, reducing conflict of interests between the different segments of the market

Annex 6.2

Energy Efficiency (EE) Checklist

A. Legislation & Strategy
Energy Law
Energy Efficiency Law
Energy Efficiency Strategy and Action Plan
Other enabling legislation

B. Institutional
Energy Efficiency Agency

C. Energy Prices
Relative energy prices right
Absolute energy price levels cost-reflective

D. Financing Mechanisms
Energy Efficiency Fund
Utility DSM
Energy Services Companies (ESCOs)
Commercial bank lending

E. Public Sector Champion Role
Public buildings EE program
Energy Poverty Reduction EE program
EE Information campaigns
National Spatial Plan w. EE focus
Urban Development Plans w. EE focus

F. Codes and Standards
Buildings
- Building codes
- Effective enfoncement (e.g. usage License)
- Appliance standards
- Lighting standards

Industry
- Voluntary agreements
- Mandatory review of cogeneration potential

Transport
- Vehicle fuel efficiency standards
- Periodic vehicle inspections
- Fuel taxes

Labels
- Cars
- Appliances
- Homes

G. Economic Incentives
Tax reductions
Vehicle Fuel Taxes
Interest rate subsidies
Investment grants