The environmental impact of the off-grid backup electricity generating sector in Lebanon

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I. INTRODUCTION

In this paper we assess the effect of backup generation of electricity on total CO2 emissions from the power sector in Lebanon. Lebanon enjoys a large degree of electrification (close to 100% [1]), yet the electricity supply is the most unreliable one in the region [1] and characterized by frequent and lengthy power cuts. Electricite du Liban (EDL) is the sole official provider of electricity in Lebanon and is 100% owned by the government. EDL is currently however only able to provide around 60% [1] of total electricity consumed in Lebanon. Demand exceeds supply due to insufficient capacity. The subsequent rationing of demand that translates into lengthy daily power cuts has led to the gradual development of an off-grid parallel network. It has been estimated that roughly 33% to 38% of electricity demand/consumption in Lebanon comes from backup generation. [1]This share might further increase to around 60% by 2015 if no major changes are made to EDL supply [1]. In this paper we show that a business as usual (BAU) baseline scenario will lead to CO2 emissions from backup generation representing more than 50% of total CO2 emissions from the power sector in just a few years. The dominance of the unregulated backup sector both in terms of power supply and in terms of CO2 emissions leads to a variety of additional hurdles preventing the implementation of efficient Greenhouse Gas mitigation in Lebanon.

In this paper we mainly rely on scenario analysis to represent the different paths that the electricity sector could take. In each scenario we predict the growth of both the primary (EDL) and secondary (backup generators) supply and the share of GHG emissions due to electricity generation. First, we define a baseline scenario with a base year of 2006 being the business-as-usual (BAU) scenario, in which EDL does not expand its generating capacity. Second, we define scenario 1 in which EDL expands its capacity to meet 100% the rising demand via extensive use of alternative or renewable energy sources. All proposed scenarios are analyzed for the period 2006-2040.

II. GREENHOUSE GAS EMISSIONS IN LEBANON

Total CO2 emissions from fuel combustion for Lebanon represent 13.33 (Mt of CO2) whereas per capita CO2 emission represent 3.29 (tCO2/capita).(IEA, Energy Statistics – Energy Indicators for Lebanon). For the world's 30 largest emitters of CO2, per capita emissions range from around 1 (tCO2/capita) for India to around 20 (tCO2/capita) for the US (Source WRI). In absolute terms Lebanon's emissions represent only a very small part of the world's total CO2 emissions, future environmental agreements will however increasingly

be more inclusive and developing countries will have to share the cost of mitigation.

Figure 1 shows the breakdown of GHG emissions by sector based on the nationwide GHG inventory that was prepared in 1998 [2] following the ratification of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994. It should be noted here that the methodology followed in preparing the GHG emissions inventory is that of the Intergovernmental Panel on Climate Change (IPCC) [3]. The national GHG inventory was later updated for the year 1999 as part of the regular updates required from Lebanon being a signatory to the UNFCCC. The total GHG emissions during 1994 in million tons of CO_2 equivalent were 15.7 according to the United Nations Statistics Division. Consequently, the energy sector would have contributed 11.62 million tons of CO_2 equivalent during that year.

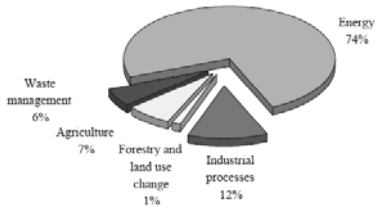

Figure 1. 1994 GHG emissions by sector

Source: Chedid and Ghajar (2004).

As depicted in the figure the overwhelming majority of emissions are produced by the energy sector, which are due mainly to fuel oil, gasoline, and gas/diesel oil consumption. Electricity's share of emissions in the energy sector was approximately 30% in 1994 [4]and increased to 33% in 1999 [5]. Electricity's 1994 breakdown in consumption was as follows: residential sector 48%, public sector 12%, industrial sector 23% and technical and non- technical losses 17% [5].

There exists a more than proportional relation between economic growth and energy/electricity demand growth in middle income countries. If supply is not expanding accordingly this can represent a constraint to economic growth [1]. The estimated electricity consumed in Lebanon in 2006 is 13,200 GWh [1]. With an estimated GDP growth of 5% between 2010 and 2015, total electricity demand is estimated to increase at 5.9% annually during this period [1].

III-ELECTRICITY SUPPLY/DEMAND

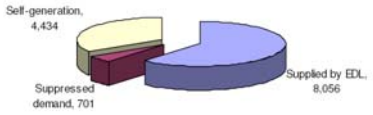

Figure 2: Estimated Total demand of Electricity in 2006 (in GWh)

Source: World Bank Analysis 2007 based on Chubu Consulting report data. Republic of Lebanon, Electricity Sector - Public Expenditure Review, 2008, Sustainable Development Department, Middle East and North Africa Region, Report No. 41421-LB, The World Bank Group

Of the estimated 13.200 GWh of electricity consumed in Lebanon in 2006 approximately 8.056 GWh were provided by EDL, 4.434 GWh were provided by self generation and 701 GWh are estimated to represent suppressed demand [1]. It has been estimated that roughly 33% to 38% of electricity demand/consumption in Lebanon comes from backup generation [1]. This share might further increase to roughly 60% by 2015 [1].

IV- CONCLUSIONS

It is obvious that no environmental policy aimed at reducing CO2 emissions in Lebanon can ignore the backup generation sector given its importance in overall electricity provision. This sector as mentioned above, being unofficial and hence unregulated, will pose significant hurdles to

environmental policy-makers when implementing measures aimed at reducing CO2 emissions.

One issue that arises is that increasing electricity tariffs in order to reduce demand and hence reduce emissions, might have the opposite effect. This will happen because consumers would in such case increasingly rely on their relatively cheaper/cost efficient secondary power sources. Such an outcome might actually lead to increased electricity consumption and thus CO2 emissions.

In order to be more efficient at reducing emissions, it is suggested to focus on energy-efficiency measures such as CFL lighting or home insulation, which would lead to a reduction in demand from both primary and secondary electricity sources. Similarly, any incentives for renewable energy sources in terms of financing or subsidies would help replace demand from backup generators.

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