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Electric Load Assessment

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Abstract — **Climate change has serious implications for the electricity sector, mainly for the future of electricity demand and supply. The focus of this paper is limited to a literature review of the impact of climate change on electricity systems and markets. This paper also focuses on the hydro electric power and its advantages. It also presents an overview of energy efficiency principles. Moreover, the electric power sector is the single largest source of sulphur dioxide (SO2), oxides of nitrogen (NOx), mercury and other particulate emissions. There are measures to reduce greenhouse gas (GHG) emissions from buildings fall into one of three categories: switching to low-carbon fuels including a higher share of renewable energy, or controlling the emissions other than CO2 GHG gases, reducing energy consumption and embodied energy in buildings.**

I. INTRODUCTION

Climate change has serious implications for the electricity sector, mainly for the future of electricity requirement and supply. Understanding the climate change physical process and its impact on electric power systems is of increasing importance to policy makers across the world. The present increase in global atmospheric carbon dioxide (CO2) is mainly due to emissions from the combustion of fossil fuels for transportation and electricity generation the electric power sector is the single largest source of sulphur dioxide (SO2), oxides of nitrogen (NOx), mercury and other particulate emissions. Considering the large fraction of emissions associated with electricity generation and use, it is rational to assume that any response to climate change must have a central focus on the electricity sector. Not all aspects of climate change have equal impact on electrical load. Among all the climate factors, temperature is considered to be a major factor contributing to the variation of electrical loads because cooling and heating loads may take up to 90% of the total building energy consumption corresponding impacts on the power grid are anticipated to be as follows:

- Long-term sustained temperature changes may affect consumer behavior and lead to fundamental changes of the system load. For example, an enhanced number of blistering summer days will increase the penetration of air conditioning (a/c) loads and, therefore, change both the magnitude and the composition of the load.
- Temperature spikes are important to estimate the peak loading condition of power systems. On a hot summer day, at the distribution level, concurrent topping out of the cooling load may overload the distribution feeders and the transformers. At the transmission level, this may result in transmission system congestion. Furthermore over, the power system reserve and constancy margin will be significantly reduced when electricity demand and the percentage of motor loads such as a/c units, airing fans, and refrigeration equipment, increases importantly. Hence, the power grid will be prone to faults and move to an unstable state when temperature spikes.
- An extreme event, such as a heat wave or a cold front, puts the power grid on heavy loading conditions for longer durations than a temperature spike. Such events are more likely to cause 4power system overload, allowing a vast area load to peak at the same time and causing a system-wide power shortage or widespread blackout.

Section II provides a brief literature review on electric load assessment. Section III presents discussion on hydro-electric power .Section IV provides advantages of hydro-electric power. Section V presents Overview of energy efficiency principles. Finally, summarize and conclude the electric load assessment

II. LITERATURE REVIEW

Even the objective of the present study is challenging, some of the earlier studies have been carried out separately to study the climate separately at various scales. The electric usage and energy load at different city level also studied by some researchers. Some of the preliminaries works have been surveyed and presented in this report. In the future several other related works will be studied and the discussion about their methodology and findings with the comments will be presented. Generally, India’s contribution to climate change presents a daunting challenge for improvement. India is the fourth largest emitter of global greenhouse gas (GHG) emissions after China, the United States and Russia, adding about 5 percent of total emissions in 2007. But it is likewise home to a third of the world's poor. India's per capita CO2 emissions of 1.3 tons are well beneath the world average of 4.4 tons. Even by 2020, with nearly a fifth of the world's population, its share is expected to rise to only 7 percent, according to the International Energy bureau Reference Scenario. The Indian government has been uncompromising in its aversion to allowing climate considerations to slow its economic growth. Yet, within the country, growth has largely benefited the middle and upper classes, with hundreds of millions remaining in poverty. In light of the urgency for a global turnaround in emissions before 2020, and the failure of some developed countries to reduce their own emissions despite the Kyoto Protocol, it is imperative that growing countries expand their economies at diminishing rates of carbon intensity, preferably with assistance from the said countries. Indeed, preventing atmospheric GHG concentrations from reaching dangerous levels will require drastic reductions in the emissions of same gas.

The power sector faces many challenges – large power shortages, inadequate approach coverage, and financially crippled electricity companies. As a result, regenerate efforts in recent decades have accorded higher priority to these challenges than to improving efficiency. Climate change has serious implications for the electricity sector, particularly for the future of electricity demand and supply. Understanding the climate change process and its impact on electric power systems is of increasing importance to policy makers across the world. The present increase in global atmospheric carbon dioxide (CO2) is mainly due to emissions from the combustion of fossil fuels for transportation and electricity generation [1]. In the US, energy related CO2 emissions account for more than 80 percent greenhouse gas emissions [2].In the US alone, generation of electricity accounts for nearly 40 percent of all US carbon dioxide emissions [2]. In addition, the electric power sector is the single largest source of sulfur dioxide (SO2), oxides of nitrogen (NOx), mercury and other particulate emissions [3]. Even with strong global efforts to mitigate greenhouse gas effects, the effect of climate change are still likely to be pronounced due to historic and extant anthropogenic emissions [1]. Considering the large fraction of emissions associated with electricity generation and use, it is rational to assume that any response to climate change must have a central focus on the electricity sector. Some of the key environmental effects of climate change are: a rise in global surface temperature, changes to hydrological periods, rise in normal sea levels and higher frequency of extreme weather events. The disruption to the generation and supply of electricity is likely to be considerable due to these environment shifts. Capital stock in the form of generation, transmission and distribution assets must adapt to meet the challenges of climate change in the future. Unfortunately, the electricity sector is burdened with assets that have a long economic life spanning a few decades.

To ensure that the electricity sector is best suited to meet the challenges of climate change in the coming decades, there is an imperative need to accurately predict the multi-decadal trends in electricity markets and systems. Climate change is likely to have significant implications for both the supply- and demand-side components of electricity systems and markets. To get an idea on the vast scope of the problem, consider the implications of a surface temperature raises. In general, higher surface temperature are expected to increase the demand for cooling, diminish the demand for heating and reduce the efficiency of thermal power generating equipment [5-8]. Research studies have predicted a systematic decline in the efficiency of thermal power generating equipment due to rising cooling water temperatures and accompanying decrease in source-sink temperature differential in a generating unit [9-11].

The other concomitant changes associated with climate change are expected to transform the electricity sector by encouraging more non-carbon sources in the generation portfolio (including nuclear) and inducing widespread adaptations to transmission and distribution infrastructure [9, 12]. An economic model to study the climate change effects must at the very least attempt to incorporate these predicted implications. Whereas Ventosa et al. [13] have dealt with the various generation and dispatch models under a competitive market regime; this paper reviews the literature on models that have explicitly incorporated the effects of climate change. Almost of the models reviewed in this paper are long term models spanning a few decades into the future. A list of models covered in this paper is by no means complete.

III. Environmental impact of electricity generation

The environmental impact of electricity generation is significant because modern society uses more amounts of electrical power. This power is commonly generated at power plants that convert some other kind of energy into electrical power. Individuals can produce electrical power by utilizing available natural resources, few of following can be used which will reduce electricity consumption from supplier.

A. Hydroelectric power

Development of large-scale hydroelectric power has environmental impacts associated with the change in water flow and the impediment of water in a reservoir. The natural flow of silt down the river will be interrupted, affecting downstream ecosystems. Where large reservoirs are not cleared of trees before flooding, the methane gas released by decaying wood can be comparable in greenhouse effect to the CO2 emissions of a fossil-fuel plant of similar output. The filling of large reservoirs can induce earth tremors, which may be large enough to be objectionable or destructive. For example, the 1967 Koynanagar earthquake of 6.9 magnitudes was created after the filling of the Koyna Dam in India, with 180 fatalities. A magnitude 7.9 earthquake near the Zipingpu Dam, China, in 2004, with 70,000 fatalities may also have been triggered by the weight of the reservoir. Hydroelectric power facilities also create conditions where methylation occurs in the reservoir areas. The mechanism of methylation that results in elevated levels of methylmercury concentrations is not fully understood at this time. Current theories revolve around anaerobic bacteria in oxygen-deprived layers of water converting elemental mercury to methylmercury, which is more readily absorbed into the food chain and other organisms

B. Wind power

Wind power harnesses mechanical energy from the constant flow of air over the surface of the earth. Wind power stations generally consist of wind farms, fields of wind turbines in locations with relatively high winds. Primary publicity issues regarding wind turbines are their older predecessors, such as the Altamont Pass Wind Farm in California. These older, smaller, wind turbines are rather noisy and densely located, making them very unattractive to the local population. The downwind side of the turbine does disrupt local low-level winds. Modern large wind turbines have mitigated these concerns, and have become a commercially important energy source. Many homeowners in areas with high winds and expensive electricity set up small windmills to reduce their electric bills.

C. Biomass

Electrical power can be generated by burning anything which will combust. Some electrical power is generated by burning crops which are grown specifically for the purpose. Usually this is done by fermenting plant matter to produce ethanol, which is then burned. This may also be done by allowing organic matter to decay, producing bio gas, which is then burned. Also, when burned, wood is a form of biomass fuel.

Burning biomass produces many of the same emissions as burning fossil fuels. However, raising biomass captures carbon dioxide out of the air, so that the net contribution to global atmospheric carbon dioxide levels is small. The process of growing biomass is subject to the same environmental concerns as any kind of agriculture. It uses a large amount of land, and fertilizers and pesticides may be necessary for cost-effective development. Biomass that is grew as a by-product of agriculture shows some promise, but most such biomass is currently being used, for plowing back into the soil as fertilizer if nothing else.

D. Solar power

Currently solar photo voltaic power is used primarily in Germany and Spain where the governments offer financial incentives. In the U.S., Washington State also provides financial incentives. Photo voltaic power is also more common, as one might expect, in areas where sunlight is abundant. It works by converting the sun's radiation into direct current (DC) power by use of photo voltaic cells. This power can then be converted into the more common AC power and fed to the power grid. Solar photo voltaic power offers a viable alternative to fossils fuels for its cleanliness and supply, although at a high production cost. Future technology improvements are expected to bring this cost down to a more competitive range. Its negative impact on the environment lies in the creation of the solar cells which are made primarily of silica (from sand) and the extraction of silicon from silica may require the use of fossil fuels, although newer manufacturing processes have eliminated CO_2 production. Solar pow`1` ` ``` er carries an upfront cost to the environment via production, but offers clean energy throughout the lifetime of the solar cell. High scale electricity generation using photo voltaic power requires a large amount of land, due to the low power density of photo voltaic power. Land use can be reduced by installing on buildings and other built up areas, though this reduces efficiency.

IV. Overview of energy efficiency principles

Design strategies for energy-efficient buildings include reducing loads, selecting systems that make the most efficient use of closed energy sources and heat sinks and using efficient equipment and effective control strategies. An unified design approach is required to assure that the architectural elements and the engineering systems work efficiently together.

A. ***Reduce heating, cooling and lighting loads***

A simple strategy for bringing down heating and cooling loads is to set apart the building from the environment by using high levels of insulant, optimizing the glazing area and minimizing the infiltration of outside air. This approach is nearly appropriate for cold, overcast climates. A more efficient strategy in most other climates is to use the building envelope as a filter, discriminating accepting or rejecting solar radiation and outside air, calculating on the need for heating, cooling, airing and lighting at that time and using the heat capability of the building structure to change in thermal loads on a time scale of hours to days

B. ***Use active solar energy and other environmental heat sources and sinks***

Active solar energy systems can provide electricity generation, and space conditioning. The ground, water, aquifers and open bodies of water, and to lesser extent so air, can be used selectively as heat sources or drops, either directly or by using heat pumps. Space cooling methods that disperse heat directly to natural heat sinks without the use of refrigeration cycles (evaporative cooling, radioactive cooling to the dark sky, earth-pipe cooling) can be used.

C. ***Solar thermal energy for warming and hot water***

Majority solar thermal collectors used in buildings are either

Flat-plate or evacuated-tube collectors. Integrated PV/thermal

collectors (in which the PV panel serves as the outer part of a thermal solar collector) are also commercially available (Brazilian *et al.*, 2001). 'Combi-systems' are solar systems that provide both space and water heating. Looking on the size of panels and storage tanks, and the constructing thermal envelope performance, 10 to 60% of the combined hot water and heating requirement can be met by solar thermal systems at central and northern European locations. Prices of solar heat have been 0.09–0.13 €/kWh for large domestic hot water systems

D. ***Lighting systems***

Lighting energy use can be decreased by 75 to 90% compared

to conventional practice through (i) use of day lighting with moving in and daylight sensors to dim and switch off electric

lighting; (ii) use of the most effective lighting devices available; and (iii) use of such measures as ambient/task lighting.

E. ***High efficiency electric lighting***

Presently 1.9 GtCO2 are emitted by electric lighting worldwide, equivalent to 70% of the emissions from light passenger vehicles (IEA, 2006b). Continuous advances in the efficacy of electric lighting devices have occurred during the past decades and can be expected to continue. Progress in lamps have been accompanied by betterments in occupancy sensors and reductions in cost (Garg and Bansal, McCowan *et al.*, 2002). A reduction in residential lighting energy use of a factor of four to five can be attained compared to incandescent/halogen lighting. For lighting systems providing ambient (general space) lighting in commercial buildings, the energy expected can be reduced by 50% or more compared to old fluorescent systems through use of efficient lamps (ballasts and occupancy sensors, item by item or zone switches on lights and lighter color finishes and furnishings). A further 40 to 80% of the remaining energy use can be saved in perimeter zones through day lighting (Rubinstein and Johnson, Bodart and Herde, 2002). A simple strategy to further bring down energy use is to provide a relatively low background lighting level, with local levels of larger illumination at individual workstations. This strategy is referred to as 'task/ambient lighting' and is popular in Europe. Not only can this alone reduce lighting energy use in half, but it allows for a greater degree of individual control over personal lighting levels and can reduce uncomfortable levels of glare and high contrast. About one third of the world's population depends on fuel-based lighting (such as kerosene, diesel), contributing to the major health burden from indoor air pollution in growing countries. While these devices provide only 1% of global lighting, they are responsible for 20% of the lighting-related CO2 emissions and consume 3% of the world's oil supply. A CFL or LED is about 1000 times more efficient than a kerosene lamp. Efforts are underway to encourage replacement of kerosene lamps with LEDs in India. Recent progresses in light-emitting diode (LED) technology have importantly improved the cost-effectiveness.

F. ***Day lighting***

Day lighting systems involve the use of natural lighting for the perimeter areas of a building. Such systems have light sensors and mechanisms to control artificial lighting. Opportunities for day lighting are strongly influenced by architectural decisions early in the design process, such as constructing form; the provision of inner atria, skylights and clerestories (glazed vertical steps in the roof); and the size, shape and position of windows. IEA (2000) provides a comprehensive sourcebook of conventional and less conventional techniques and technologies for day lighting. A number of recent studies indicate savings in lighting energy use of 40 to 80% in the day lighted perimeter zones of office buildings

V. CONCLUSION

The impact of climate change on the electricity sector is the first step in understanding and building scenario-based or optimization models of electricity markets. This survey highlights the research areas where the knowledge frontier has advanced significantly (i.e. on temperature sensitive demand estimation) and areas where it is limited or lacking (e.g. supply side impacts, modeling extreme events, combined modeling etc.). It is desired that the outcome of this research review could inform the design of future electricity market/system models. In most developed countries, the energy consumption in buildings is still increasing (IEA, 2004f). Although some of this growth is offset by increased efficiency of major energy-consuming appliances, overall consumption proceeds to increase due to the growing demand for amenities, such as modern electric appliances and increased ease. The limited overall impact of policies so far is due to several factors: (i) slow implementation processes (e.g., as of 2006, not all European countries are on time with the implementation of the EU Buildings Directive); (ii) the lack of regular updating of building codes (requirements of many policies are often close to common practices, despite the fact that CO2-neutral construction without major financial sacrifices is already possible) and appliance standards and labelling; and (iii) insufficient enforcement. In addition, demonstrated that barriers in the building sector are numerous; diverse by region, sector and end-user group, and are particularly strong. There is no single policy instrument that can capture the entire potential for GHG mitigation. Due to the especially strong and various barriers in the residential and commercial sectors, getting over these is only possible through a diverse portfolio of policy instruments for effective and far-reaching GHG abatement and for taking advantage of synergistic effects .Since climate change literacy, awareness of technological, cultural and behavioral choices and their impacts on emissions are important preconditions to fully operating policies, these policy approaches require to go hand in hand with programmers that increase consumer access to information, awareness and knowledge *(high agreement, medium evidence)*. In summary, significant CO2 and other GHG savings can be achieved in buildings, often at net benefit to society (in addition to avoided climate change) and also meeting many other sustainable development and economic objectives, but this needs a stronger political commitment and more ambitious policy-making than today, including deliberate design of policies as well as enforcement and regular monitoring.

VI. Future work

Solar energy is not available at night, making energy storage an important effect in order to provide the continuous availability of energy. Both solar power and wind power are intermittent energy sources, intending that all available output must be taken when it is available and either stored for *when* it can be used, or carried, over transmission lines, to *where* it can then be used. Off-grid PV systems have traditionally used rechargeable batteries to store excess electricity. Solar energy can be stored at high temperatures using molten salts. Salts are an efficient storage medium because they are low-cost, have a high particular heat capacity and can deliver heat at temperatures compatible with conventional power systems. Conventional hydroelectricity works very well in conjunction with intermittent electricity sources such as solar and wind, the water can be restrained and allowed to flow as required with virtually no energy loss. Wind power and solar power tend to be somewhat complemented, as there tends to be more wind in the winter and more sun in the summer.

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