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Energy Savings by Modification of Indian Standard Time

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***Abstract* — India currently faces a large energy deficit. This is primarily associated with the evening peak load demands which are not met. The major challenge for us is to meet those demands in a viable and economical manner. The insufficiencies should be fulfilled in the shortest period possible. Along with searching for new resources, we should also manage the existing ones. Many developed countries are employing strategies for this based on modifications of their standard time. This paper identifies the economically reasonable solution of advancing Indian Standard Time (IST) by half an hour to combat the challenge of energy deficit that India faces. Advancing the Indian Standard Time (IST) by half an hour will provide us with more daylight. In this paper, we propose to advance the IST by half an hour and bring it six hours ahead of Universal Coordinated Time. This will lead to a reduction in the energy consumption during peak hour time by approximately 11%.**

***Keywords*- Energy consumption, Peak load, Standard time**

I. INTRODUCTION

India is one of the largest countries in the world and is faced by many challenges like the rising consumption and demand for energy. India needs to find a solution to find a way to ensure energy sustainability without compromising its economic and social development. In order to optimize the power demand there is a need for reducing the peak demand which can have maximum impact. In future, peak demand in India will also rise due to the affluence of households and use of more appliances and air-conditioning.

A country's demand profile varies over time, on a daily and seasonal basis. In the first place, there is a constant base level of demand throughout the day and the year. Second, there is variable demand, referred to as peak demand. Daily demands peaks are caused when people turn on their water heaters at more or less the same time in the morning or their lights in the late evening. Similarly, afternoon peaks occur in urban as more and more commercial buildings are air-conditioned. Seasonal variations are caused, for example, by increased cooling needs in summer.

Section II reviews the available options that can be practised. Section III presents the details of the proposal. Section IV discusses the current scenario of India's energy consumption. Section V explains the energy savings that stems from using the method. Section VI lists the other benefits that accrue from the approach.

II. REVIEW OF AVAILABLE OPTIONS

In this section we review the rationales for introducing multiple time zones and daylight saving time (DST) and for rejecting both . In the northern hemisphere, DST involves setting clocks ahead by an hour in spring and setting them back by an hour in the fall. In the southern hemisphere, the two adjustments are reversed. We review an alternative, in effect a year-long DST, which avoids the risks associated with introducing multiple time zones or with bi-annual changes in DST.

A. DST AND PROBLEMS ASSOCIATED WITH IT

The DST involves advancing the time during summer and recessing the time during winter. For a country that has agriculture for its spine, incorporating Daylight Saving Time would create havoc in India. India is an agrarian country. When we speak of advantages concerning the daylight saving time, we assume that people use their watches or clocks for checking time. A farmer would never return home by checking his watch. Farmers usually work from sunrise to sunset. Returning home before sunset would be seen by a farmer as an hour lost rather gained. Unlike the farmer, his family would most probably adjust their routines according to TV schedules or the local clock (which will be an hour ahead considering DST is incorporated). Thus when the farmer returns home he will lose some precious time. This time he will try to account for by sleeping late. All in all this might eventually lead to seasonal affective disorders (SAD's), insomnia and myocardial infarctions. Even if the people adjust themselves to this new regime, the real problem with Daylight saving time is that it will come to us again and again. In winter the time of daylight reduces and so DST loses much of its importance [1]. After days or months of accustoming oneself to the new schedule there will come a day in winter when we set the clocks back to standard time. This plunges the day time to 25 hours and all the above problems rise again. The summer-winter paradigm will continue as it always has and people will have to do with changing patterns more often than not. Thus there are no real and immediate benefits apart from some cost related ones. A developing country would take years to get used to it.

B.Two Time Zones And Problems Associated With It

India has a large area. The sun comes up early in the north eastern parts of the country. Thus when the office timings as per the IST arrives late valuable hours of daylight are already lost and offices are forced to work into evening. People light up their offices artificially. This has been happening for quite a while now and has been brought into notice by the Assam state authorities. The western and eastern extremities of India are separated by just 4 minutes short of 2 hours [7]. The sun rises as early as 5 in the morning while the Indian standard office timings do not arrive as late as 10 in the morning. This affects the economy too as the northeast has cash rich petroleum and tea industry. Adding in another time zone will require large scale implementations. All our banks and other financial organizations use the standard time. Adding in another time may lead to mismatch in the data conveyed. As the money transactions are very time sensitive even a small mistake leads to massive losses. India boasts a large railway network. We have trains running into Assam. With two time zones the railway timings will need rescheduling. This is very important as the profits incurred from years of savings can be wiped out by a single deadly mishap on the tracks in seconds. Energy considerations fail to provide positive results as the north eastern and eastern grids together constitutes a mere 12-13% of the national peak over the year and a time shift will have negligible impact (Figure 2.1). Even in other fields large scale implementations would be required. This will take time and will not reap immediate benefits. The next section leads to the proposal.

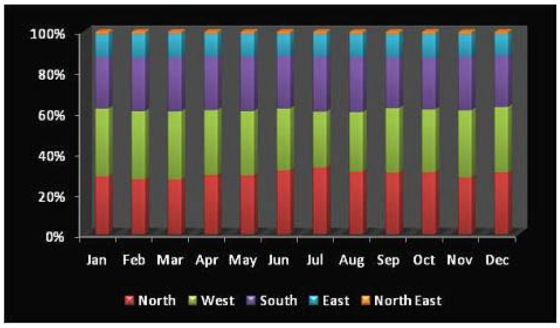

Figure 2.1 Zone wise breakup of national peak

III. THE PROPOSITION

After independence in 1947, Indian government established IST, the time observed throughout India, with a time offset of UTC+5:30 as the official time for the whole country [5]. We propose to advance the IST from being calculated on the basis of 82.5° E longitude, in Shankargarh Fort (25.15°N 82.58°E) to 90°E (Bengal- Assam border) i.e. from being 5h 30 minutes ahead of UTC to 6h ahead of UTC. As a result, an extra half an hour of day light would be available in the evenings, which will be useful in terms of energy savings and peak load reduction. Although, the Indian grid is one of the largest in the world with 232 GW of installed capacity, we still suffer a severe power deficit. The deficit in power in April-November 2013 was equal to 4.5% with the southern grid most affected [2]. The subsequent section explains the present situation of the energy sector in India.

IV. THE CURRENT SCENARIO

Data on electricity sector is majorly divided on six sectors- domestic, industrial, agricultural, commercial, railways and others. Figure 4.1 describes the relative sectorial loads for year 2011-12.

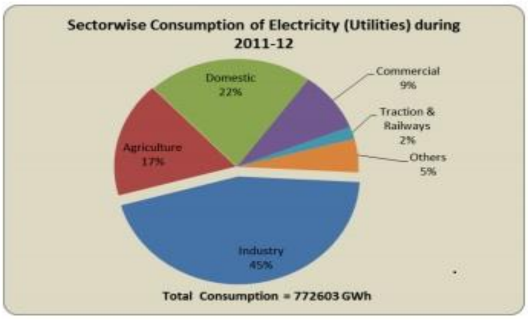

Figure 4.1 Sector wise breakup of electricity (utilities) during 2011-12 [4].

It shows that domestic sector demands approximately one fourth of the net consumption. An extra half an hour of daylight will produce larger savings in electrical energy in regions where evening lighting domestic loads are larger.

Our estimates of savings are based on actual seasonal load curves. A typical load curve has a double-hump shape. The morning peaks, caused mainly by water-heating (in winters, also some amount of space heating) are generally lower than the evening peaks, caused mainly by domestic, commercial and street lighting loads. To smoothen out local perturbations and estimate actual effect of daylight on electricity saving, we have plotted a load curve using data available for Maharashtra state [3]. Figure 4.2 shows load curve for Maharashtra state for 20 June 2011 and figure 4.3 represents the load curve for Maharashtra state for 21 December 2011. The next section quantifies the energy savings resulting from the method.

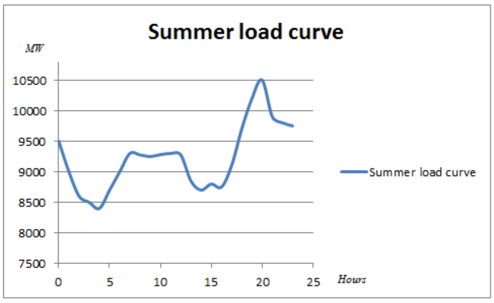

Figure 4.2 Summer Load Curve

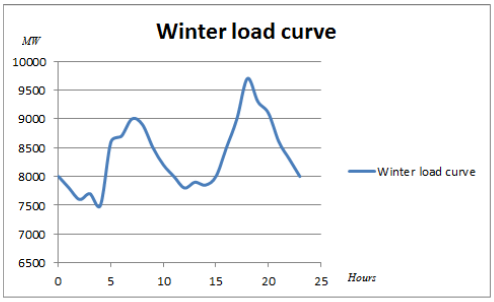

Figure 4.3 Winter Load Curve

V. ENERGY SAVINGS

Loads during night hours are primarily due to factories working in all three shifts, agricultural loads being supplied during nights and some commercial loads being connected in the business processing sector. Morning peaks during winter are larger, primarily due to water and space heating and also due to a certain amount of lighting because of late sunrise during winter. The steep rise in load after sunset appears primarily due to domestic lights, streetlights and some commercial lights. Figures 4.2 and 4.3 show that increase in load that follows sunset (which occurs 2 hours earlier in winter) is nearly same during both the cases summer (10.3 GW) and winter (~9.7 GW). This may be attributed to lighting loads as fans and cooling systems are seldom used in winter.

These assumptions make it fairly straightforward to calculate electrical energy savings following the advancement of IST. We assume that all loads except the domestic lighting remain unaffected by advancement of IST and are independent of sunset and sunrise. The savings of energy will take place due to prolonged daylight (the sunset will occur 30 minutes later than the present). This can be quantified by advancing the part of load curve around the sunset time by half an hour. Figure 5.1 shows the shaded area which gives the savings in energy; we can easily calculate the difference in energy consumption using graphical approach.

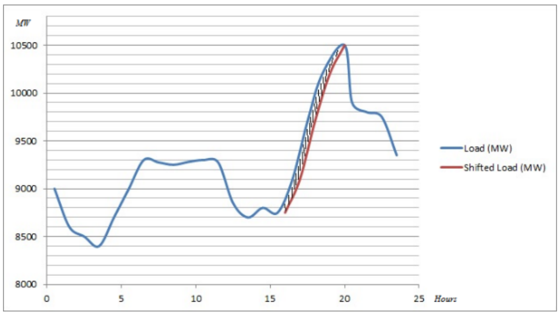

Figure 5.1 Analysis of resulting energy savings

The total energy savings estimated for a day is 0.135 GWh which is about 0.2% of the current consumption of the state, which might not seem large, but the percentage savings in the evening peak energy is 11% which is substantial. According to a study by National Institute for Advanced Studies, savings about 0.3% of the total consumption and a peak load energy savings of about 16% can be achieved on national level [5]. It is recognized that evening energy demand is most difficult to meet. This energy is often purchased at higher costs than the usual. Several electrical utilities are hard pressed to meet evening loads and have to resort to costly and polluting energy production using diesel or natural gas, adding to the emission of the greenhouse gases. If we consider an average price per unit of evening energy to be Rs.7, the money value of the savings would be around Rs 100 crores per annum which would partially alleviate the current deficit of evening demand. If we extrapolate this to national level, the savings would improve further. Advancing IST will continue to save expensive energy, increasing year after year with increasing domestic consumption. The only investments that will be required are for planning for the first year of implementation and for subsequent monitoring and evaluation.

We acknowledge that some lights may have to be switched on in the mornings, especially for school purpose, during winter, if we advance IST by half an hour. This increase can be compensated by having separate times for schools and colleges during winter, as many of the northern states do. Streetlights that will now be switched off half an hour later in the mornings will also be switched on later by the same duration in the evening. Since the usage is related to luminosity, there will not be any savings of electricity from streetlights. But since the evening energy units are costlier to obtain, there will be the net reduction in cost. The following section lists the other benefits of the technique.

VI. OTHER BENEFITS OF SHIFTING IST BY HALF AN HOUR

In 2009, the average monthly income in India was Rs 3000 [6]. If we assume 160 hours worked per month that comes up to Rs 18.75 per hour. In the early hours of the day when the daylight is ample, human mind is keener whereas in the evening it is worn out. By shifting IST by half hour, we are actually attributing some daylight of the morning to the evening time. Assuming it takes everyone 10 minutes to change all of his or her watches and clocks, the opportunity provides an individual an average potential of Rs 7.8125 by shifting the IST by half hour. By doing this we are just improving the quality of the late office hours. By no way are we increasing them. Half an hour of extra sunshine would also embolden people to venture out. Thus the market also gets a boost and the trade bolsters.

Numerous types of crime including assault and theft, peak during evening darkness, while the corresponding rates are very low during early morning. This allows society to take advantage of the fact that criminals are late to bed and late to rise. Extending the sunshine hours would save a large number of lives annually in reduced traffic fatalities during the evening.

Accident rates in India are ten times those in the developed countries on the basis of number of vehicles. A study conducted in Pondicherry has revealed that maximum number of traffic accidents occur in January and the peak time was found to be from 4-5 pm in the evening and a second peak was from 6-7 pm [5]. Even if the accident rates were brought down by one third of 1, it would result in saving of hundreds of lives every year [5]. The final section concludes the paper.

VII. CONCLUSION

India currently faces a huge energy deficit. It is only going to augment in coming years unless preventive measures are taken. Being a developing country, we cannot afford to reduce our energy consumptions, as it will greatly affect our economic growth. We also cannot depend largely on non-renewable energy sources as their stocks are depleting while becoming more and more expensive at the same time. Renewable sources of energy require huge capital investments and do not produce immediate and significant results. We need to manage the available resources with efficacy. In this paper, we have discussed a viable way of managing the increasing demands of energy and meeting the current deficit. Albeit DST (Daylight Saving Time) is practised in many developed countries, it has its own drawbacks in India. Splitting the country into two time zones would save some amount of energy but it comes along with the possibility of creating chaos and other political consequences. Implementing the proposed method of advancing IST by half an hour can prove to be a reasonable solution to the current deficit and burgeoning evening peak energy demands. According to our findings, the evening peak load demand, which we are finding very hard to meet, can be brought down by 11-12%. This would aid us in alleviating the energy deficit at minimal cost and would help us reducing the amount of load shedding. Along with solving the ongoing energy crisis, this would also curb social evils on account of increased day light.

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