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ELECTRICAL LOAD COMPONENTS OF IRAN ELECTRICAL NETWORK

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Abstract- This paper presents the influence of electrical component in load peak and evaluates how we can reduce the peak load. Energy intensity in Iran is 3 times over than average of the world and this figure shows that the energy efficiency in Iran is low level in comparison of developed country. In addition, peak load in Iran is very high in constraint base load. On the other hand, we must increase investment in electrical network includes generating, transmission and distribution. It is important that peak load is recurred in short period in summer that which has called annual peak. Daily peak load is happen the early of night, the reason of the phenomena, is lighting load. In this paper, component load effectiveness is shown. It is reasonable, if we find the solution, we will analyze every parameter. Prominent component will be defined and the methodology for decline of load peak will be also illustrated.

Keywords: Load Component, Electrical Network, Peak Load, Cooling System, Climate.

I. INTRODUCTION

In the Figure 1, trend of generation and consumption is given in 2020. Between 2000 and 2008 the energy consumption has risen and generation is level out. Balancing between generation and consumption is changed and this signal shows that many problems will be faced in the near future. Peak load reaches 37700 MW in June 2010 and this is the highest peak can be seen in the recent years. Obviously, the peak load happened in summer, the main reason is cooling load. The difference between minimum and maximum load is 10000MW approximately. Figure 2 illustrates the load curve in France which is not smooth and very unbalanced. Many power plants must generate the power for a short period of time (1 month). If we concentrate in load management, we can reduce the peak load and do not need much investment for generating new power plant.

Figure 3 shows that peak load in previous years in France. The comparison between diversity years will be extracted peak load increase every year dramatically (8 percent). Obviously, in future, many problems for demand side management will be faced, so that identification of component load peak is considerable for policy making. In addition, the most important issue is that power plant in Iran consume many fossil fuel and environmental will be polluted by thermal power plant.

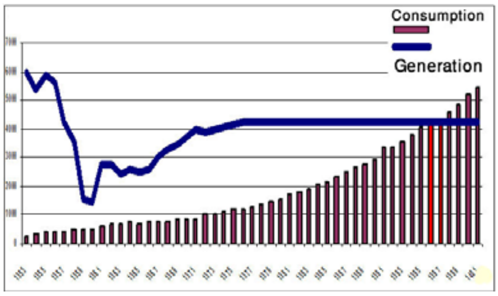


Figure 1.a. Trend of generation and consumption in electrical network

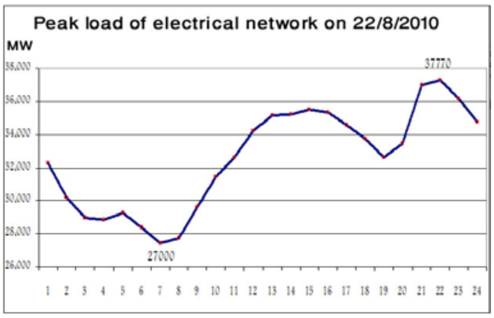


Figure 1.b. Load curve in 2010 for Iranian electrical grid

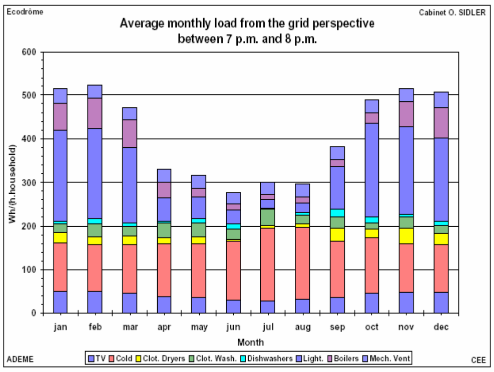


Figure 2. Average monthly load (France)

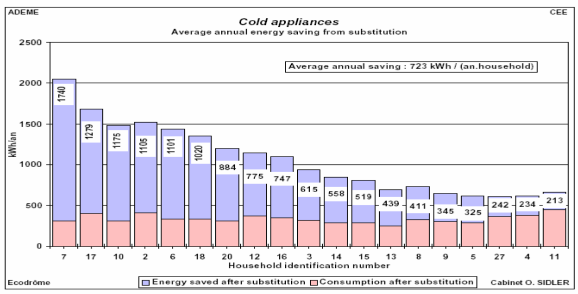


Figure 3. Cooling appliances average annual energy saving (France)

II. EXPERIMENTAL RESEARCH

Load identification is vital for load management. The coming figures show that successful achievement in France. The most important loads are TV, refrigerator, washing machines, cooling system, and defined share of equipment by measuring the loads from 8 a.m. to 7 p.m. The result shows that by managing important can be reduced peak. Energy consumption is reduced in cold appliances by substituting new devices. Incandescent lamps are replaced by compact fluorescent lamp (CFL) and this project has succeeded, 224 kWh is energy saving for a household per year. Adjustment of boiler is very important due this activity in France can be saved energy (Figure 5).

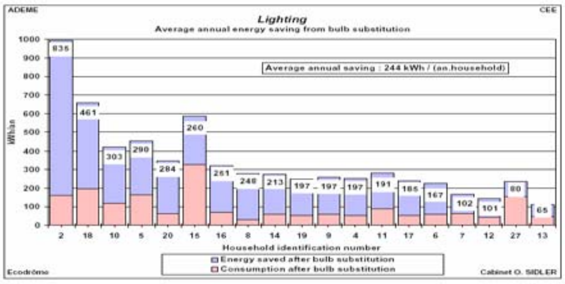


Figure 4. Lighting average annual energy saving (France)

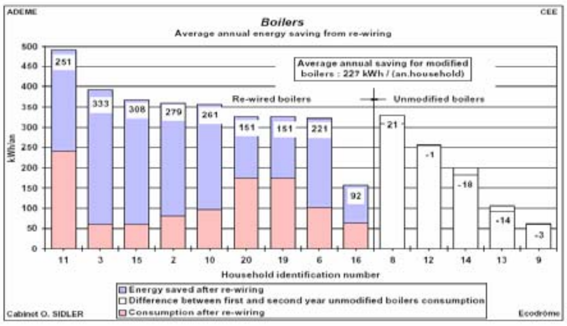


Figure 5. Boiler average annual energy saving (France)

Energy saving is obtained for three appliances including: cooling system, boiler and lighting. The energy saving due to program is 1026 kWh per year and is shown in Figure 6. Applying high efficiency washing machines and dryer is caused 70 kWh energy saving per year for a household (Figure 7). The result shows that it is possible 1192 kWh energy saving by saving program.

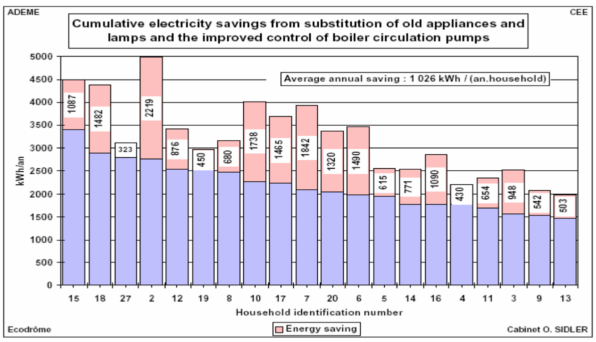


Figure 6. Cumulative electricity saving

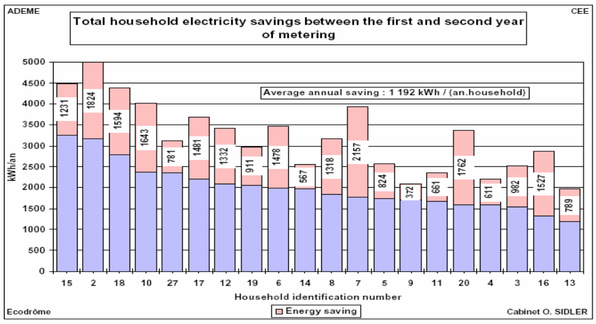


Figure 7. Total household electricity saving

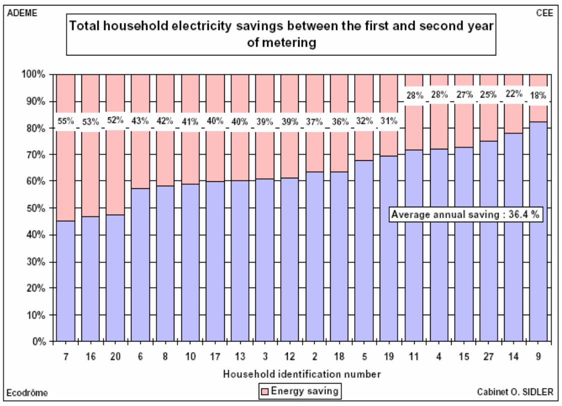


Figure 8. Percent of energy saving

Furthermore, this issue is illustrated energy saving is 36.4 percent annually (Figure 8). In OECD country, share of each devices in electrical load are given (Figure 9).

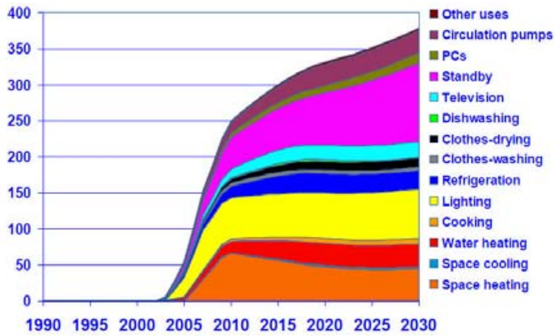


Figure 9. Priority of appliances for energy saving in OECD country

Energy efficiency is the best method for sustainable energy and protection of environment. Based on 550 and 450 policy scenarios, we should apply energy efficiency policy for environment protection (Figure 10). There are no alternative instead of energy efficiency.

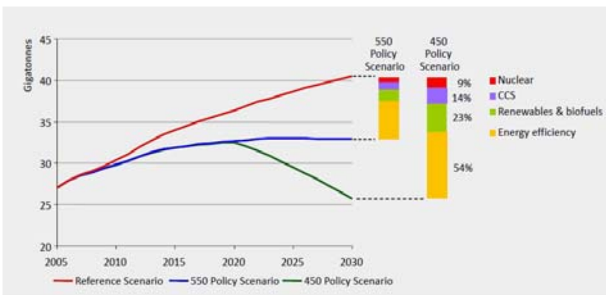


Figure 10. 550 and 450 policy scenarios for warming climate change

Consequently, energy saving is the best method for preventing of environmental. In OECD Country survey, it is possible 35 percent energy saving (Figure 11).

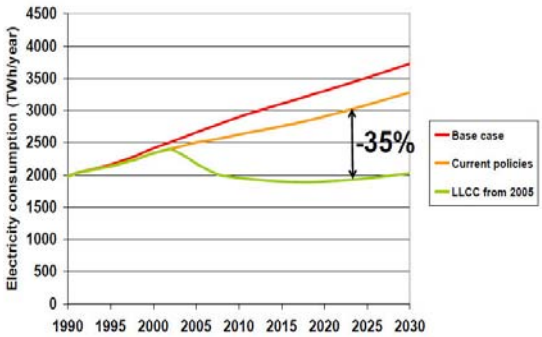


Figure 11. Energy saving in OECD country (2030)

III. LOAD CHARACTERISTIC IN IRAN

Iran is divided to the climates (zone) for studying energy consumption and end user energy by government including wet, cold, very hot and wet, and hot and dry. Pattern of consumption is very different for each climate. Cooling load in Iran is the most significant role in annual peak load because the mains source for supplying of cooling system is electricity. In contrast, heating system also consume gas energy. Consequently, peak load in summer is raised every year. Identification component load can be obtained by real measuring in acceptable samples from every climate and each sector. Table 1 shows the experimental samples in each climate. Power analyzer was installed in 200 feeders for summer and winter and results extracted.

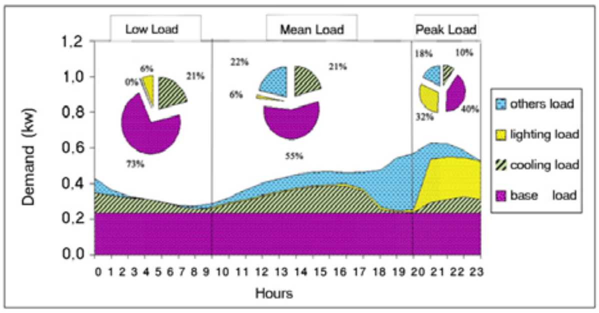
Table 1. Number of measuring for any feeder in hot and ordinary season

Climates	Wet	Cold	Very hot & wet	Hot & dry	Total
Home sector	10	80	15	55	160
Commercial sector	12	28	6	24	70
Public sector	4	23	4	22	53
Agriculture sector	4	14	2	11	31
Industry sector	2	31	2	16	51
Total	32	176	29	128	365

Based on research it is concluded that share of home sector is 47 percent in electrical peak load and 33 percent in electrical energy consumption, consequently, home sector is the highest consumer in demand and consumption.

A. Cold Climate

In the cold climate some extent by two factors, temperature and relative humidity are determined and supply conditions is done by cooling systems. Cooling systems by working together in different types and its application is used to large size-dependent local climatic conditions. Cooler in the subject of this research is the direction of compression cooling systems cycle and the rest of the steam is removed due to moisture and lower temperature under ventilation, creates. Figure 12 illustrates detachment of load curve in home sector.



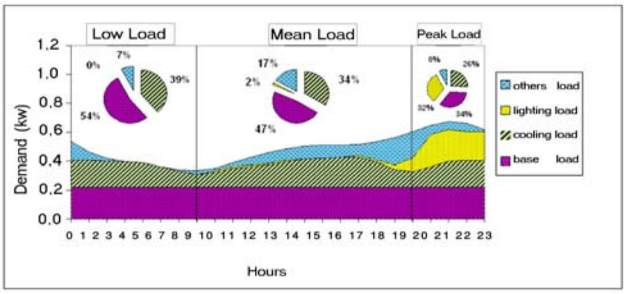
Load curve for household sector to every component cold climate

Figure 12. Detachment of load curve for home sector in cold climate

Obviously, base load is 30 percent of total load. A participant in this climate is 7 percent from all of home sector. Share of low load and medium load and peak load from total energy consumption is 22.49 and 29 percent, respectively. Cooling load is 18 percent, base load 55 percent, lighting 10 percent and others 17 percent from total of energy consumption.

B. Hot and Dry Climate

Index of detachment load in hot and dry climate is given in Figure 13. In comparison, the cooling load in cold climate is continues, and constant in final hours and inconsiderable in hot and dry climate in daily load (24 hours). Share of low load, medium load, and peak load is 25, 47, and 28 percent, respectively. Also cooling load 32 percent, base load 46 percent, lighting load 9 percent, and other 13 percent have dedicated from total energy consumption.



Load curve for household sector to every component hot and dry climate

Figure 13. Detachment of load curve for home sector in hot and dry climate

C. Wet and Very Hot Climate

Index of detachment load in wet and very hot is given in Figure 14. As matter of fact, the cooling load is dominated all of load, while the minimum is 50 percent of peak load. Except base load that continues load, light in load only take part in peak load. Participants are 3 percent of total home sector, in spite of, the cooling load is the most serious in peal load in country.

Quota of low load, medium load and peak load is 29, 49 and 22 percent, respectively. The cooling load 74 percent, base load 14 percent, and light in 4 percent and others 8 percent have dedicated themselves from of total energy consumption.

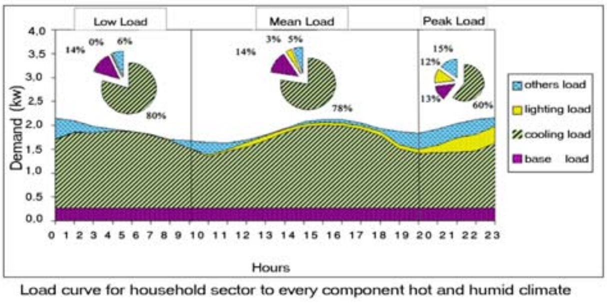


Figure 14. Detachment of load curve for home sector in wet and very hot climate

D. Moderate and Wet Climate

Index of detachment load in moderate and wet is given in Figure 15. Participants are 11 percent of total home sector. Finally, participants in cold and hot and dry climates are 80 percent. In the moderate and wet climate, it is estimated the share of low load, medium load, and peak are 33, 47, and 30 percent, respectively. Meanwhile, cooling load 69 percent, base load 21 percent, lighting 6 percent, and other 4 percent have dedicated themselves from of total energy consumption.

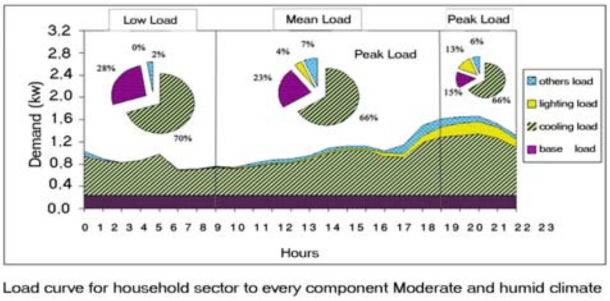


Figure 15. Detachment of load curve for home sector in moderate and wet climate

IV. RESULTS

The results show that cooling loads are the most significant influence in peak load and in the recent years produce many problems for electrical network. Cooling load plays vital role in hot and wet climate and hot and dry climate. Also, lighting load is effectiveness in electrical network, particularly in daily load at night. Finally, Figure 16 and Table 2 show that each climate has diversity role in peak load detachment load based on installed power analyzer.

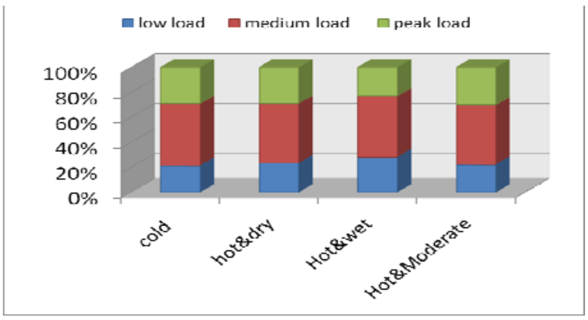


Figure 16. Share of load form electrical energy consumption in home sector

Table 2. Share of each climate in electrical load

Climates	Share of participants from total (%)	Share of low load (%)	Share of medium load (%)	Share of peak load (%)
Cold	7	22	49	29
Hot & dry	80	25	47	28
Hot & wet	3	29	49	22
Hot & moderate	7	23	47	30
Average		25	47	28

V. CONCLUSIONS

In conclusion, if we identify component load such as cooling, lighting and base load, then energy saving program will be achieved. By the way, not only identification component load but also energy efficiency for equipment is necessary for peak shaving. Estimates show that, it is possible peak shaving by improving the efficiency of equipment, particularly cooling system.

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BIOGRAPHY

Reza Effatnejad was born in Abadan, Iran, 1969. He received the B.Sc. degree from K.N. Tossi University of Technology and the M.Sc. degree from University of Amirkabir and the Ph.D. degree from Iran University of Science and Technology all in Power Electrical Engineering (Tehran, Iran), in 1992, 1996 and 2002, respectively. Currently, he is an Assistant Professor of Power Electrical Engineering at Islamic Azad University, Karaj Branch (Karaj, Iran). He is also an academic member of Power Electrical Engineering at Islamic Azad University and teaches Power System Analysis, Power System Operation, and Electrical Machines. He has published more than 40 papers in journals and international conferences. Power and energy is the main field of his study.