

ANALYSIS OF EARTH HOUR - 2009 IMPACTS

FINAL REPORT

Mel George, Victor Jose

Dept. of Energy Science and Engg., IIT Bombay

Major cities across the world switched off their lights from 8:30 PM to 9:30 PM (local time) on Saturday 28th March, 2009 to create awareness about Global Warming. This event, known as the “Earth Hour” was aimed at helping governments frame new policies to replace the Kyoto Protocol.

We wish to analyse here how much impact the Earth Hour had on our power system (Maharashtra, Mumbai and IIT Bombay in particular) in terms of demand reduction and load despatch. We believe that this analysis will give an idea regarding the impacts of such voluntary reduction in electricity demand and shall be useful to utility companies and Load Despatch Centres.

A. Mumbai City

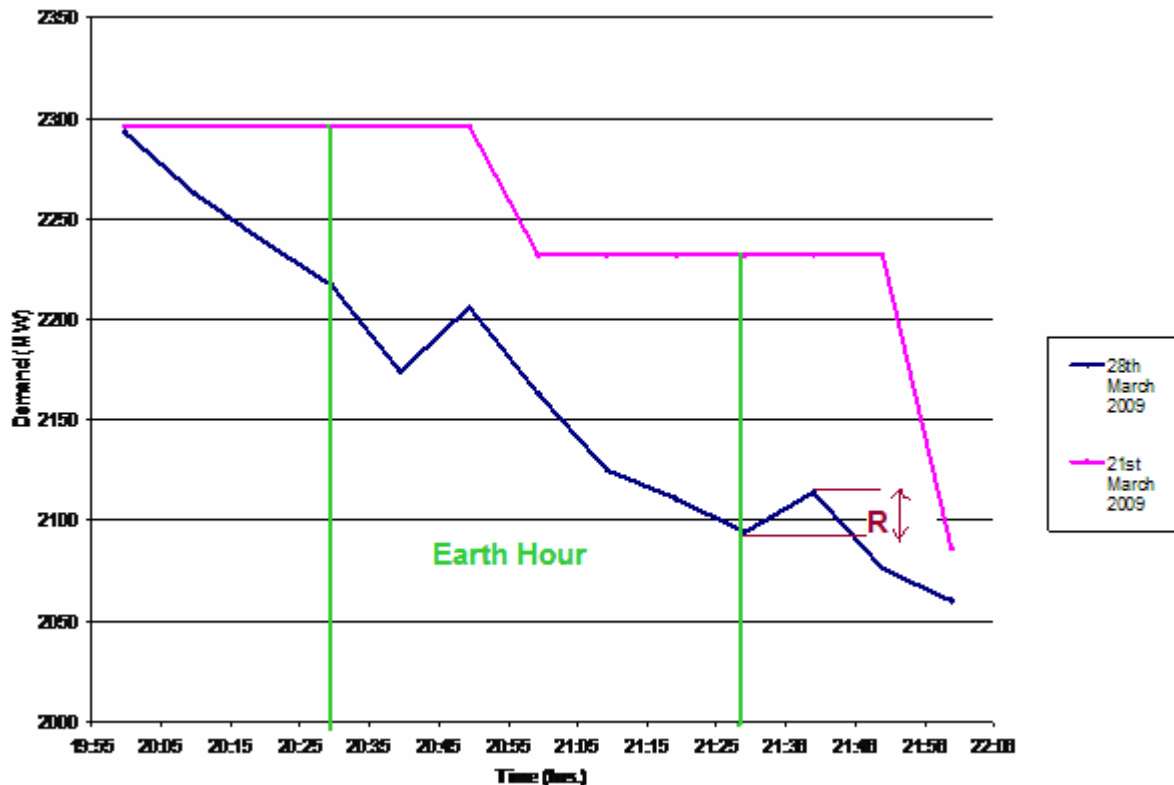


Fig. 1: Mumbai city load demand during 2000 hrs to 2200 hrs on 28-03-2009 and 21-03-2009

Using the load pattern in Fig. 1, we plot the average demand during the 2 hours.

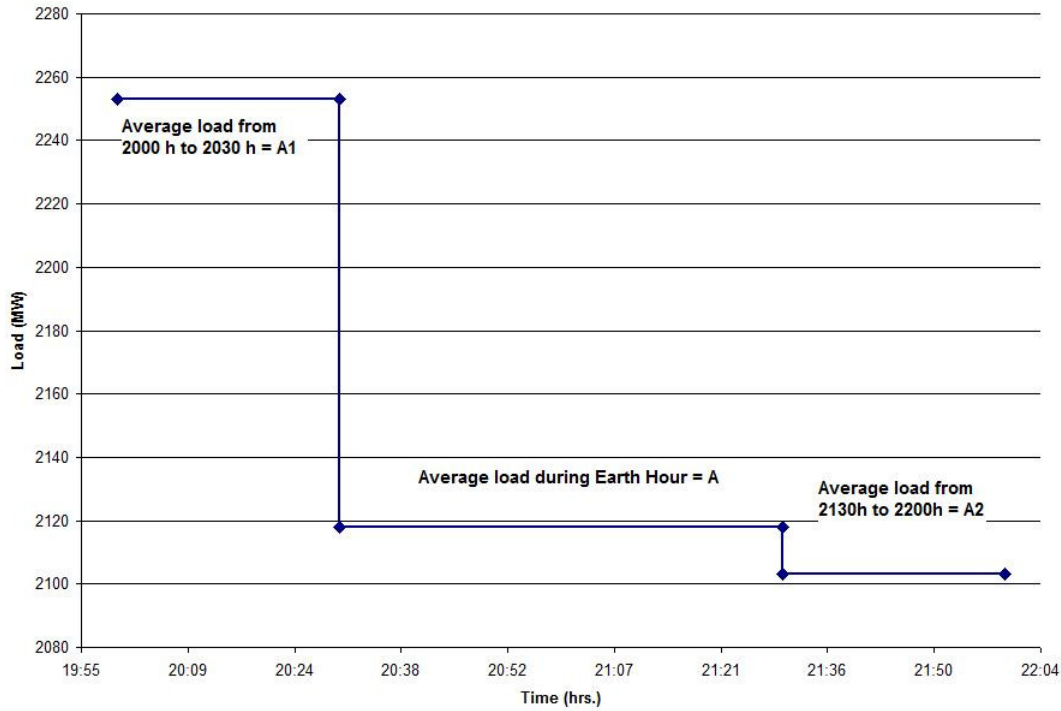


Fig. 2: Average load before, during and after Earth Hour in Mumbai on 28th March, 2009

The average loads during the Earth Hour are compared with the average of the loads before and after the event. Average demand during Earth Hour = A

Average demand either side of Earth Hour = $(A1 + A2)/2 = B$

We assume the expected load during 8:30 PM – 9:30 PM in the absence of Earth Hour to be B. Comparing A and B, the load reduction in Mumbai city due to Earth Hour was about 3.4%.

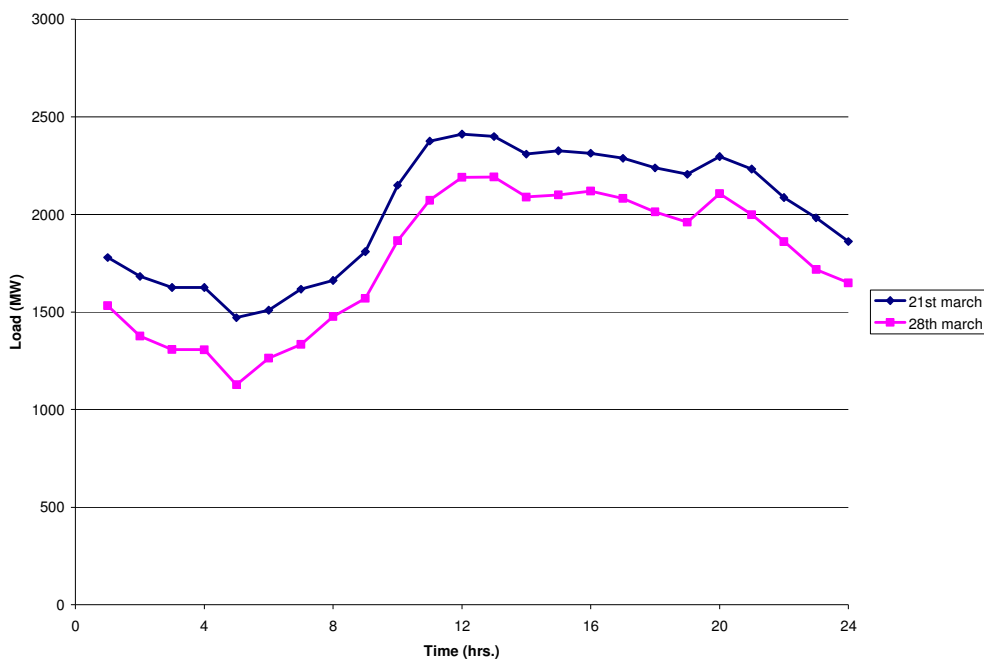


Fig. 3: Hourly load curve for Mumbai on 21st and 28th March, 2009

The hourly load patterns for Mumbai on 21st and 28th March 2009 have been shown in Fig. 3. It is observed that the loads on 28th March are always lower by about 200 MW. This may be attributed to the day being a fourth Saturday of the month and some major industries may have been shut down. The load pattern normalised with respect to the peak load on both days has been shown in Fig. 4. Only a marginal reduction in load can be observed on 28th March.

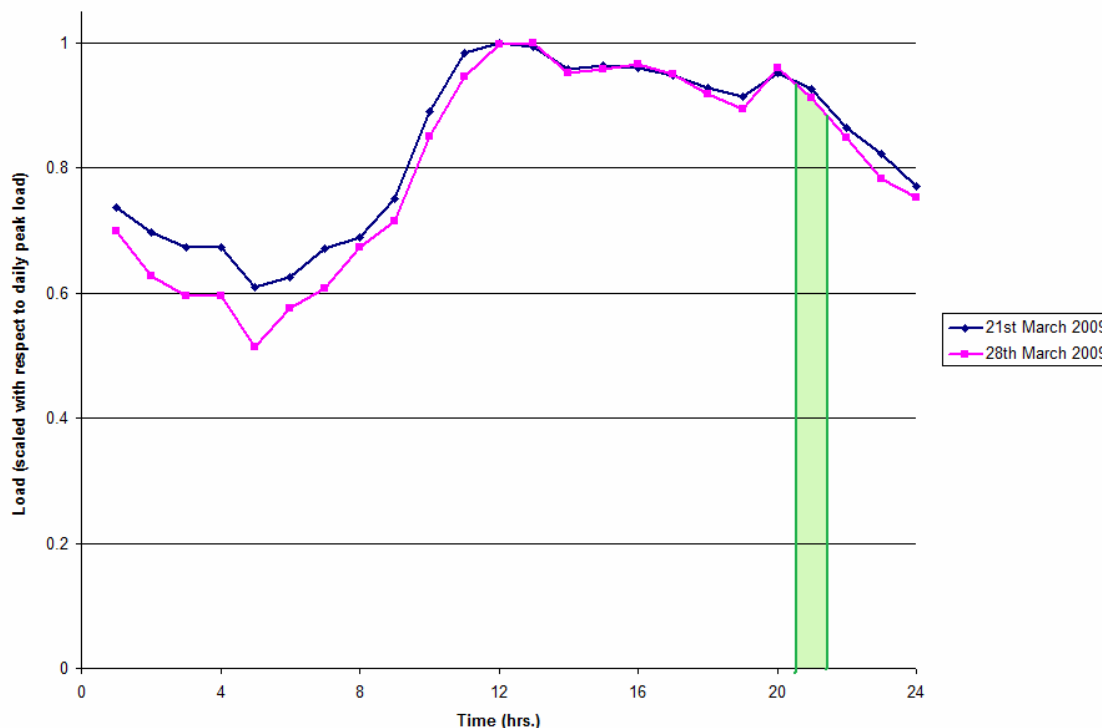


Fig. 4: Normalised load curve for Mumbai city on 21st and 28th March, 2009

On comparing the two load patterns for the Earth Hour period, a reduction of about 3.9% can be seen. However, it is not advisable to attribute this reduction merely to Earth Hour and there may be other factors like holidays, temperature effect.

Time	Average load on 21 st March 2009 (MW)	Average load on 28 th March 2009 (MW)	Percentage change
8 PM to 9 PM	2296	2253	-1.9%
9 PM to 10 PM	2232	2146	-3.9%

Another possible way to estimate the load reduction due to Earth Hour can be the amount marked as “R” in Fig. 1, i.e. the increase in demand just after the Earth Hour ended. It is about 25 MW or 1.1%

B. Maharashtra State

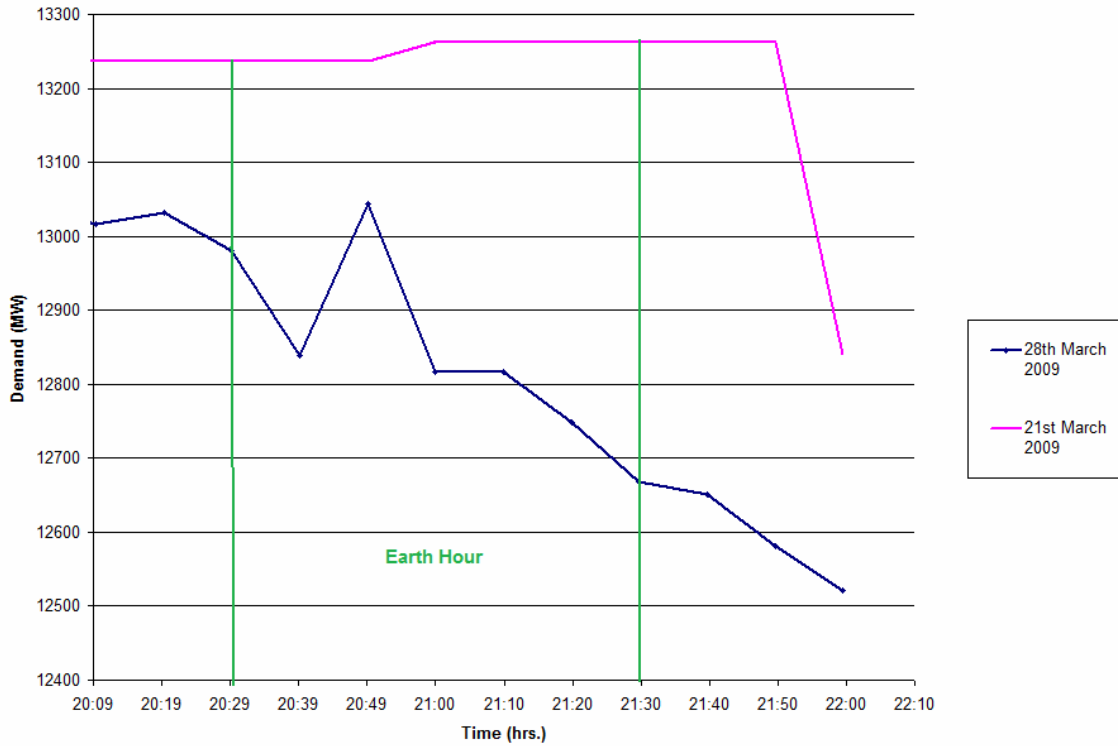


Fig. 5: Maharashtra state load demand during 2000 hrs to 2200 hrs on 28-03-2009 and 21-03-2009

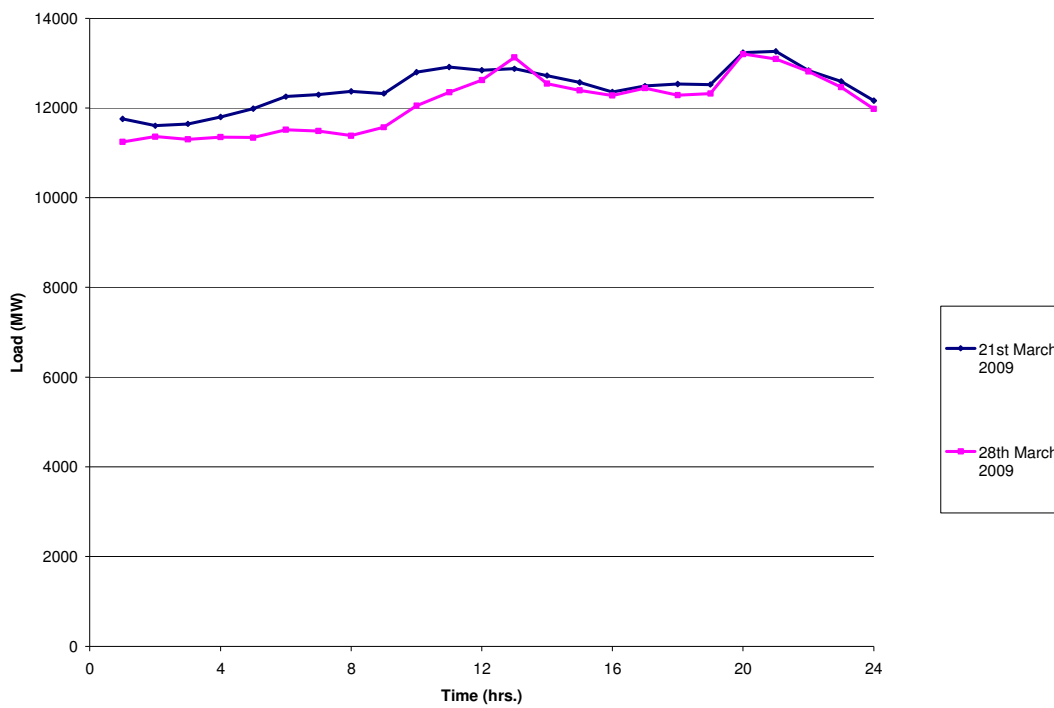


Fig. 6: Load curves for Maharashtra state on 21st and 28th March, 2009

Time	Average load on 21 st March 2009 (MW)	Average load on 28 th March 2009 (MW)	Percentage change
8 PM to 9 PM	13237	12919	-2.4
9 PM to 10 PM	12840	12584	-2.0

It can be seen that there is a **reduction of about 2% in the total demand of the state**, as compared to the corresponding period last Saturday. However, the demand on 28th March seems to be generally lower than 21st March (Fig. 6). So, it can be said that there was not much impact due to Earth Hour when considering the entire state.

On comparing the average demand variation before, during and after the Earth Hour, we find no significant variation in the Maharashtra load. The small effect was only due to the voluntary reduction in Mumbai demand and there was negligible effect in the rest of the state.

C. IIT Bombay

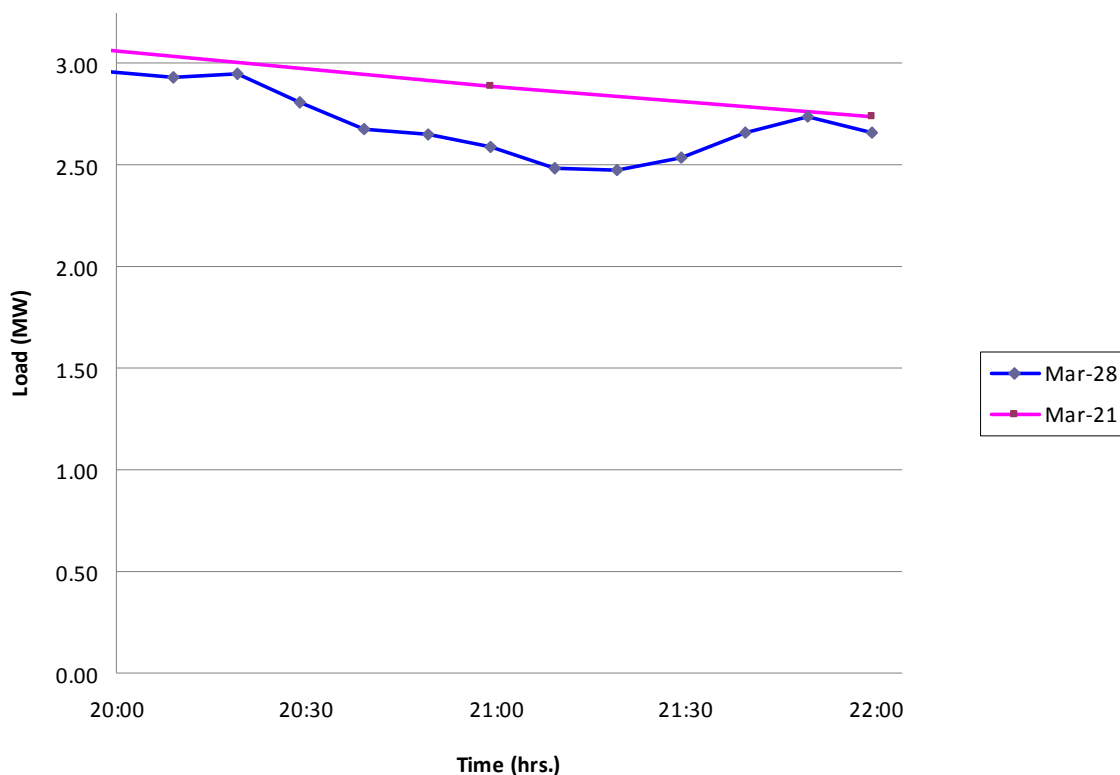


Fig. 7: IIT Bombay demand during 2000 hrs to 2200 hrs on 21st and 28th March 2009

It can be seen that there was a reduction in demand at IIT Bombay to the extent of 11% during Earth Hour. The comparison with average demand during the previous Saturday is presented in the following table.

Time	Average load on 21 st March 2009 (MW)	Average load on 28 th March 2009 (MW)	Percentage change
8 PM to 9 PM	2.98	2.80	-6.1
9 PM to 10 PM	2.82	2.60	-7.8

D. Impact on Grid Frequency

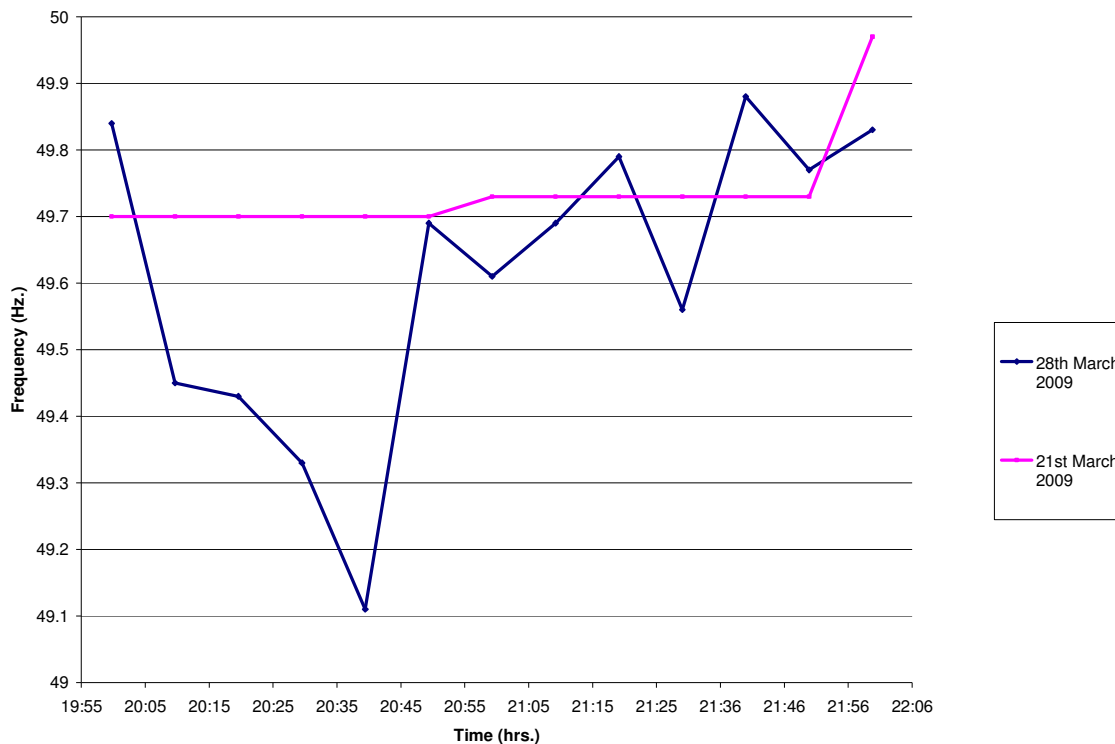


Fig. 8: Grid frequency on 21st and 28th March 2009

Not much can be deciphered from the above graph. There is a significant dip in frequency at the start of Earth Hour, though causes are unclear.

E. Impact on Generation Scheduling

One can observe a sudden rise in hydro power generation from 80 MW to 920 MW around 2030 hrs. This must have been done in anticipation of load fluctuations during Earth Hour. An analysis of the inter-state power exchange shows a corresponding reduction in power drawn by Maharashtra from the Central Share (4948 MW at 2020 hrs. to 4002 MW at 2030 hrs.). Thus, there was no change in the state power generation during the period.

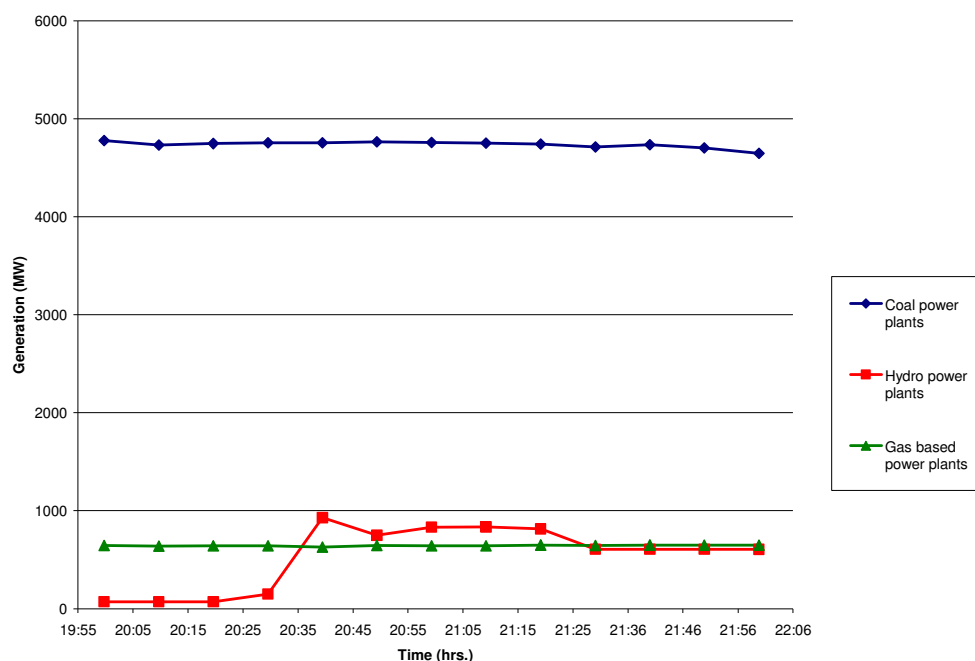


Fig. 9: Maharashtra state generation scheduling during 2000 hrs to 2200 hrs on 28-03-2009

F. Emission Savings

The average demand reduction due to Earth Hour in Mumbai was about 60 MW. Using the emission factor for the grid i.e. 0.82 t CO₂/MWh (Central Electricity Authority), the net emission reduction during Earth Hour was about 50 tonnes of CO₂.

Conclusions

Our analysis shows that the maximum possible impact was a reduction of about 3.5-4% in demand in Mumbai. Actual savings may be lower. Emission reduction would also be of the same order.

References:

1. Generation, Exchange and Demand Overview, Maharashtra State Load Despatch Centre, Kalwa, <http://mahasldc.in/scada-data/>
2. Baseline Carbon Dioxide Emission Database, Central Electricity Authority, <http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20webs%20ite.htm>

Acknowledgement:

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