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EDITORIAL

India's impending energy crisis?

Sustainable infrastructure development is a global challenge. As emerging nations strive to improve the quality of life for their citizens coupled with an emergence of greater personal wealth in both urban and rural communities, the desire for increased thermal comfort is a growing and yet understated challenge for electricity infrastructure that is already undergoing considerable expansion. A case in point that of India. An IEA World Energy Outlook Special Report stated that 'India's power system needs to almost quadruple in size by 2040 to catch up and keep pace with electricity demand that – boosted by rising incomes and new connections to the grid – increases at almost 5% per year'. The role of air-conditioning is and will be significant in both rural and urban areas with the potential to lack sufficient electricity supply capacity to meet expected demands. This is in spite of policies such as '24 $\times$ 7 Power for All', the 'Make in India' campaign and proposed stronger building codes to reduce demands.

In India, more people are in a position to afford air conditioners, which with current technologies can consume five times as much electricity as an evaporative air cooler. The market for air conditioners is already growing rapidly: sales of around 1 million units in 2003–2004 rose to more than 3 million units in 2010–2011 and very strong further growth is expected, with one estimate putting annual sales as high as 50 million units by 2050. Therefore air conditioning is a major problem and it is coupled with an increasing need for electricity for appliances, domestic hot water usages and increases in space heating where appropriate.

Alternate approaches to providing space cooling, heating and hot water include solar water heating and/or biomass heating coupled with absorption or adsorption chillers. However, there is not the possibility of supporting electric appliance usage growth without the incorporation of some form of heat driven electricity generator or significant photovoltaic capacity. Thus, a complex system of heat sources and additional generators are required and such systems suffer from inappropriate costs. The complexity of such a system can be greatly simplified by the deployment of advanced solar collectors, hot and cold thermal storage and a Rankine Cycle capable of either electricity generation and/or heating/cooling capacity or domestic hot water as required. Thermal storage allows for time management and supports flexibility of system use. Furthermore, if such systems once developed can be adapted to regional solar energy resources, manufacturing, installation and maintenance capabilities, it will also serve regional economic growth in development, installation and maintenance.

In addition to the importance to India, within the UK, the ability to provide demand side management with electrical heating and cooling systems via heat pumps and thermal energy storage has been noted. Some scenarios imply a peak demand of 7 GW from air-source heat pumps which in turn suggests approximately 3.5 million heat pumps at current performance rates. If such units become organic Rankine Cycles and generate power as well, a portion of the proposed UK market in batteries could also be utilised up to 2.3 GW.

Finally, the IEA Technology Roadmap – Energy Storage noted that in order to support electricity sector decarbonisation, an estimated 310 GW of additional grid-connected electricity storage capacity would be needed in the United States, Europe, China and India. The report states that heat pumps, in particular in high concentration urban areas, will allow them to provide thermal energy storage demand response services, for example, peak reduction and flexibility. Thus, solutions (with modifications) can make a global impact with mass energy storage supporting demand side management through heat pumps and heat driven cycles.

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