Cooling in Dubai: A Market Share and Efficiency Study

The RSB and Cooling in Dubai

The Dubai Integrated Energy Strategy 2030 (DIES2030) was deployed in 2011 under the guidance of HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai. The DIES2030 aims to secure a sustainable supply of energy and to enhance the efficiency of water, power and fuel use in the Emirate. In 2013 as an integral part of the strategy, the Dubai Supreme Council of Energy (DSCE), the governing body responsible for planning and co-ordinating the strategy with concerned authorities, developed a Demand Side Management (DSM) strategy, which identified eight programmes collectively designed to deliver Dubai's energy efficiency targets. In 2015 Dubai's rooftop solar programme, Shams Dubai, became the DSM Strategy's ninth programme.

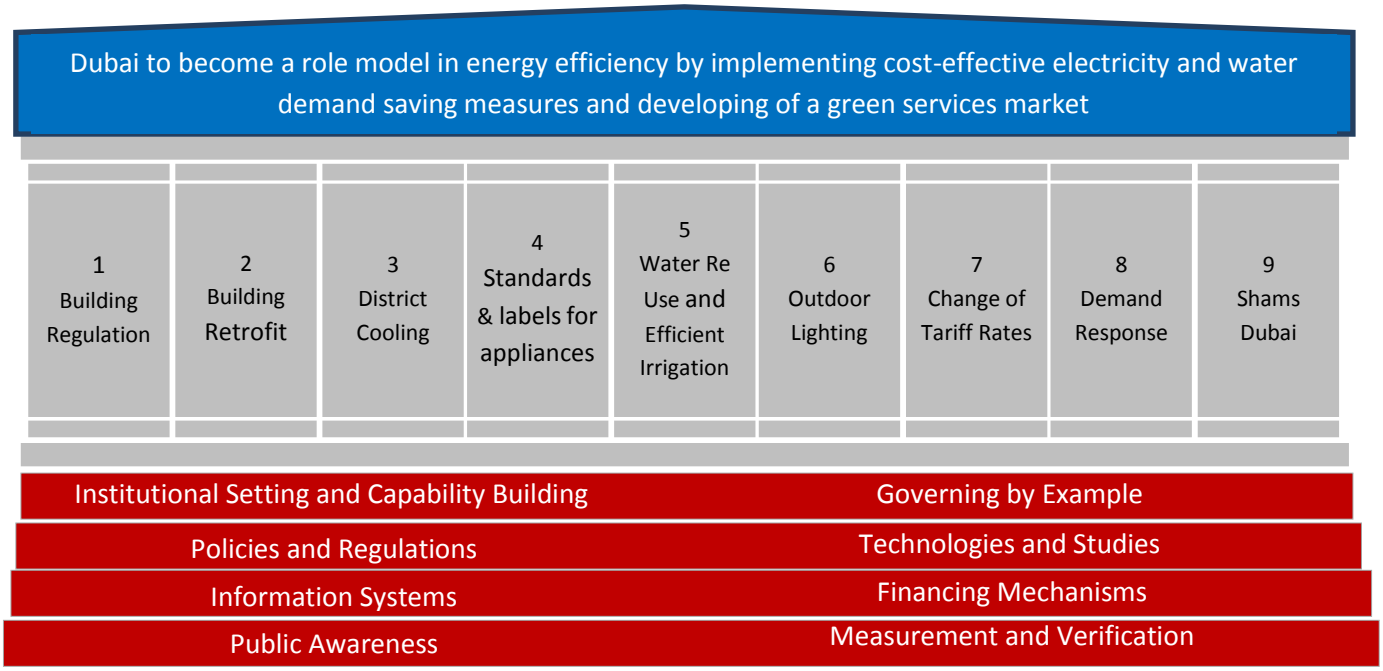

Figure 1: Dubai's Demand Side Management Programme

Cooling is Dubai's major energy use and so any strategy intended to raise energy efficiency will have to tackle cooling – both efficiency in its supply and in its use. Several of the DSM strategy's programmes are expected to increase cooling efficiency. The building regulations involve higher insulation standards and minimum cooling equipment ratings; the retrofit programme will tackle cooling in existing buildings; the appliances and equipment programme will raise standards for equipment and use labelling better to inform consumers; and the district cooling programme aims to exploit the benefits of providing cooling from central plant delivered through chilled water networks to multiple buildings in dense urban environments.

All of these programmes can benefit from an improved understanding of Dubai's cooling market: How large is it? What are the common technologies used to deliver cooling? How efficiently do those technologies operate?

With this in mind, the RSB commissioned a study ("Cooling Market Share and Efficiency Comparisons") from local engineering consultants to help answer these questions, in particular to:

1) Assess the current market share of the different cooling technologies in operation in Dubai;
2) Assess the "on-site" efficiency of the different technologies in use and indicate how that efficiency might vary with time; and
3) Determine the overall cooling load in Dubai.

The project phases included data collection and analysis; supplier surveys; statistical assessments and on site testing of the five main cooling technologies in use in Dubai:

- Central Cooling - Water Cooled
- Central Cooling - Air Cooled
- Variable Refrigerant Flow
- Ducted Split /Packaged Units
- Split Units/Window AC

Market Share by Cooling Technology

The market share of each technology was calculated through a survey of industry experts coupled with an estimate of the total floor area in Dubai of different building types. This analysis was combined with data on the output of the district cooling sector to give a view of overall cooling market share by technology as shown below:

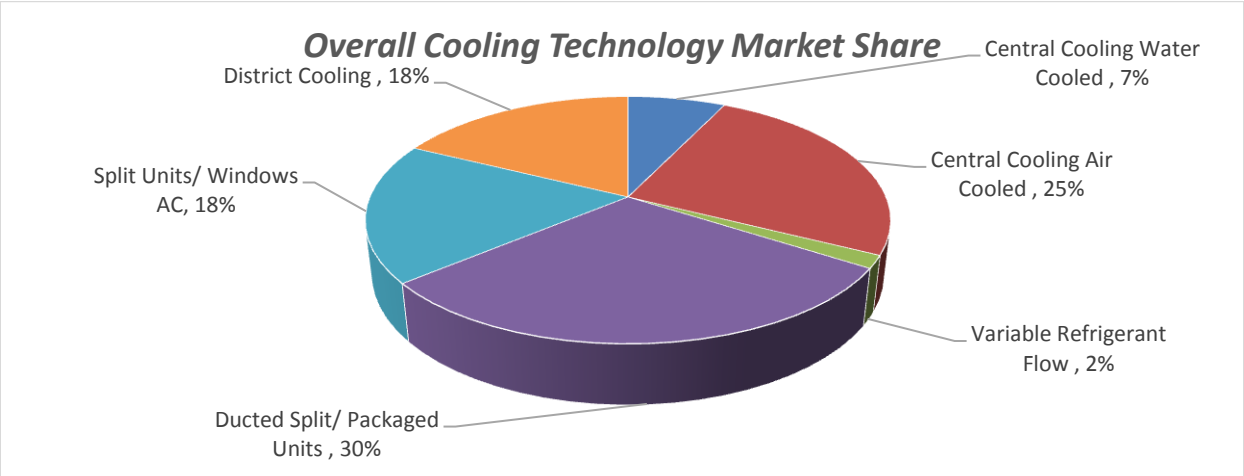

Figure 2: Market Share of Cooling Technologies in Dubai

Relative Efficiency of AC systems

Some 145 cooling systems were studied in buildings to calculate the efficiency of the different cooling technologies. On site testing was chosen so that real world performance could be assessed, allowing the impact of age and maintenance practices to be reflected in the assessment. Measurements were taken over several months and weather conditions were taken into account to develop annual average efficiencies for each of the technologies. These results were then compared with the efficiency of district cooling systems (inclusive of network losses) as shown below.

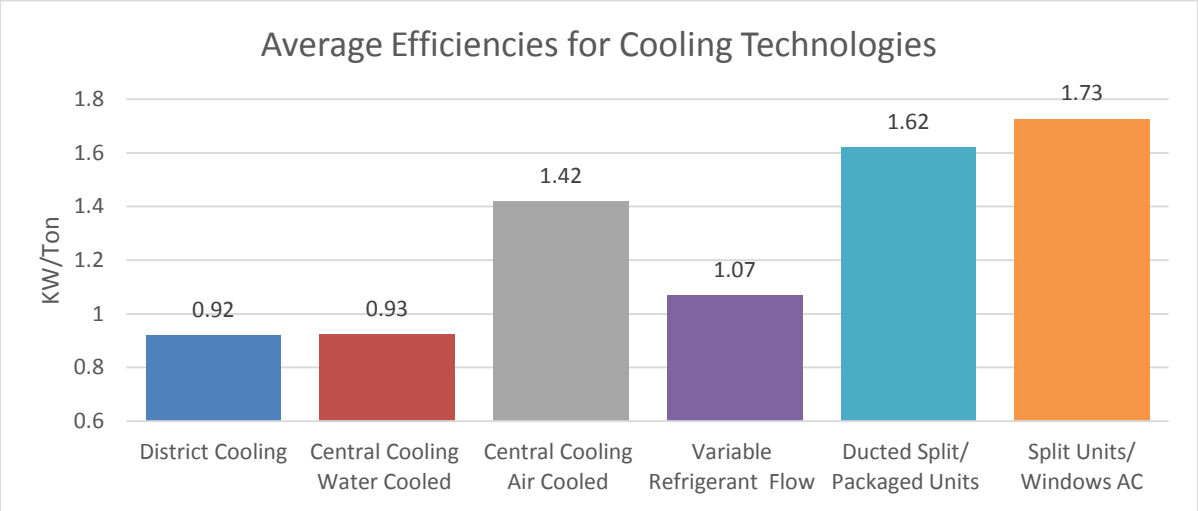

Figure 3: Average Efficiencies for Cooling Technologies Operating in Dubai

The study shows that water cooled solutions, whether at a district or building scale offer superior energy efficiency to their air-cooled alternatives.

The weighted average efficiency of cooling systems (other than district cooling) was assessed to be 1.51KW/TR, whilst district cooling efficiency calculated from data provided to the RSB by district cooling firms is 0.92KW/TR.

There are some applications where water cooled technology may not be an appropriate solution, for example where there is low cooling load density or intermittent demand. So it is worth noting the relative efficiency of air-cooled solutions. In this case the study suggests that variable refrigerant flow (VRF) technology offers significantly better efficiency than ducted, split or window AC, although VRF is not yet widely deployed and the assessment of its efficiency was not therefore derived from on site measurements.

Measurements taken from different cooling technologies during the on-site testing phase of the study showed that performance of all technologies deteriorated with age, although the study did not determine if this was due to improved technology in systems or maintenance practice. There was also a significant spread in performance of the systems tested in each technology, suggesting that operational practice is a significant factor in cooling energy use.

Peak Cooling Load and Annual Cooling Electrical Consumption

The market share assessment combined with the relative efficiency of each cooling technology enables an assessment of the annual electrical demand from each technology. Whilst split/window and split/ducted packaged units occupy some 48% of cooling market share, they drive 58% of the total cooling electrical load on the DEWA grid. At the more efficient end of the range district and central water cooled technologies occupy 25% of market share at only 16% of the electrical load.

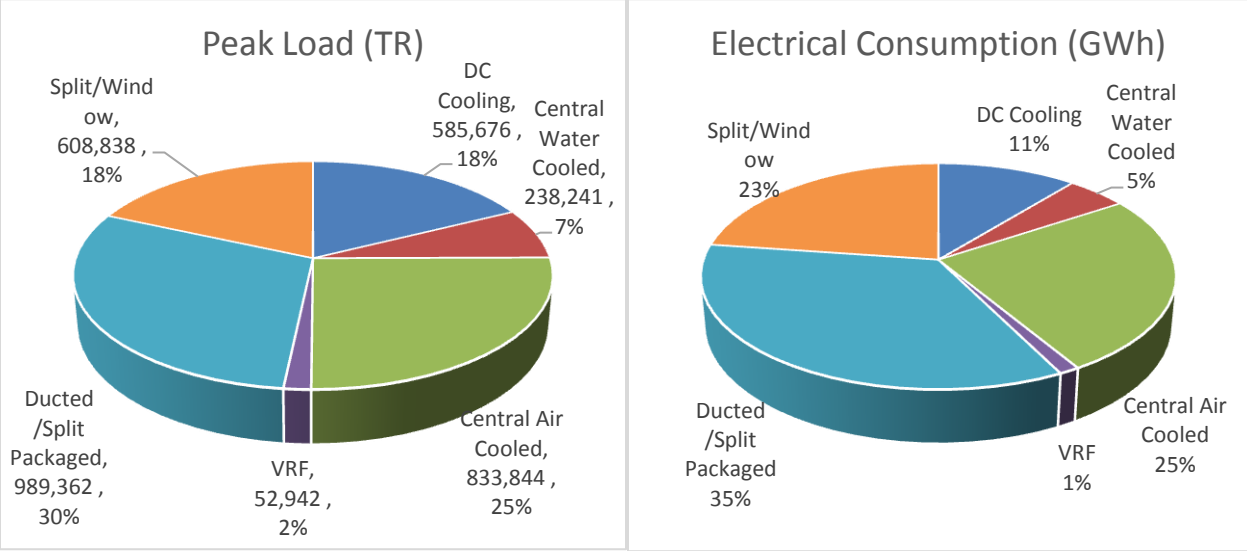

Figure 4: Peak cooling loads and corresponding annual electrical demands

Summary and next steps

This study identifies, for the first time, the market share of key cooling technologies in Dubai and assesses the efficiency of each of those technologies. It confirms that there is potential for significant energy savings through the widespread adoption of energy efficient cooling solutions.

One of the study's aims was to corroborate the assumptions used to track progress against the DSM strategy's district cooling programme

The study was designed and executed in such a way that it can be readily updated. These updates will also help inform assessment of delivery of the DSM strategy as overall cooling load can be estimated and compared to the underlying growth in Dubai's building stock.