ESL-IC-12-10-52

Enhanced Operation Strategies for Air-Conditioning and Lighting Systems Toward Peak Power Reduction for an Office Building in Kuwait

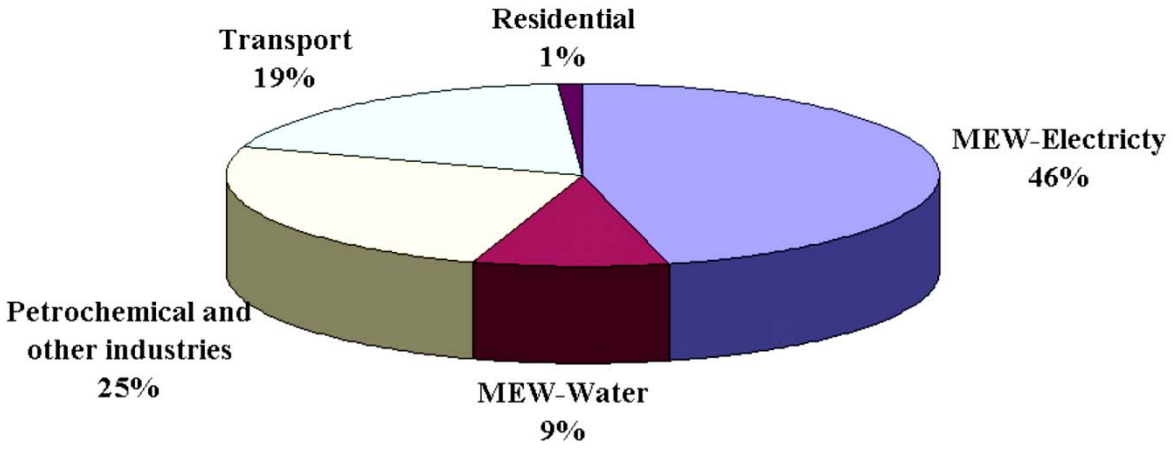
F. Alghimlas
A. Al-Mulla
G.P. Maheshwari
D. Al-Nakib

Building and Energy Technologies Department
Environment and Urban Development Division

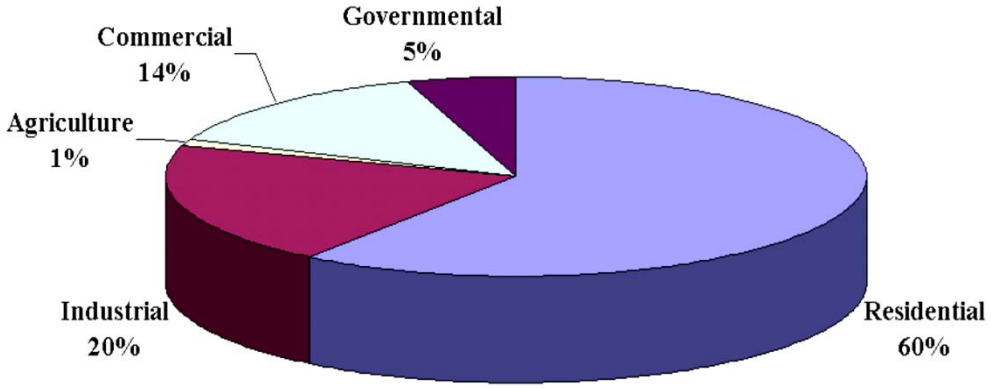
ICEBO 2012
Manchester, United Kingdom
October 23-26, 2012

معهد الكويت للأبحاث العلمية
KUWAIT INSTITUTE FOR SCIENTIFIC RESEARCH

Electricity Use by Sector in Kuwait

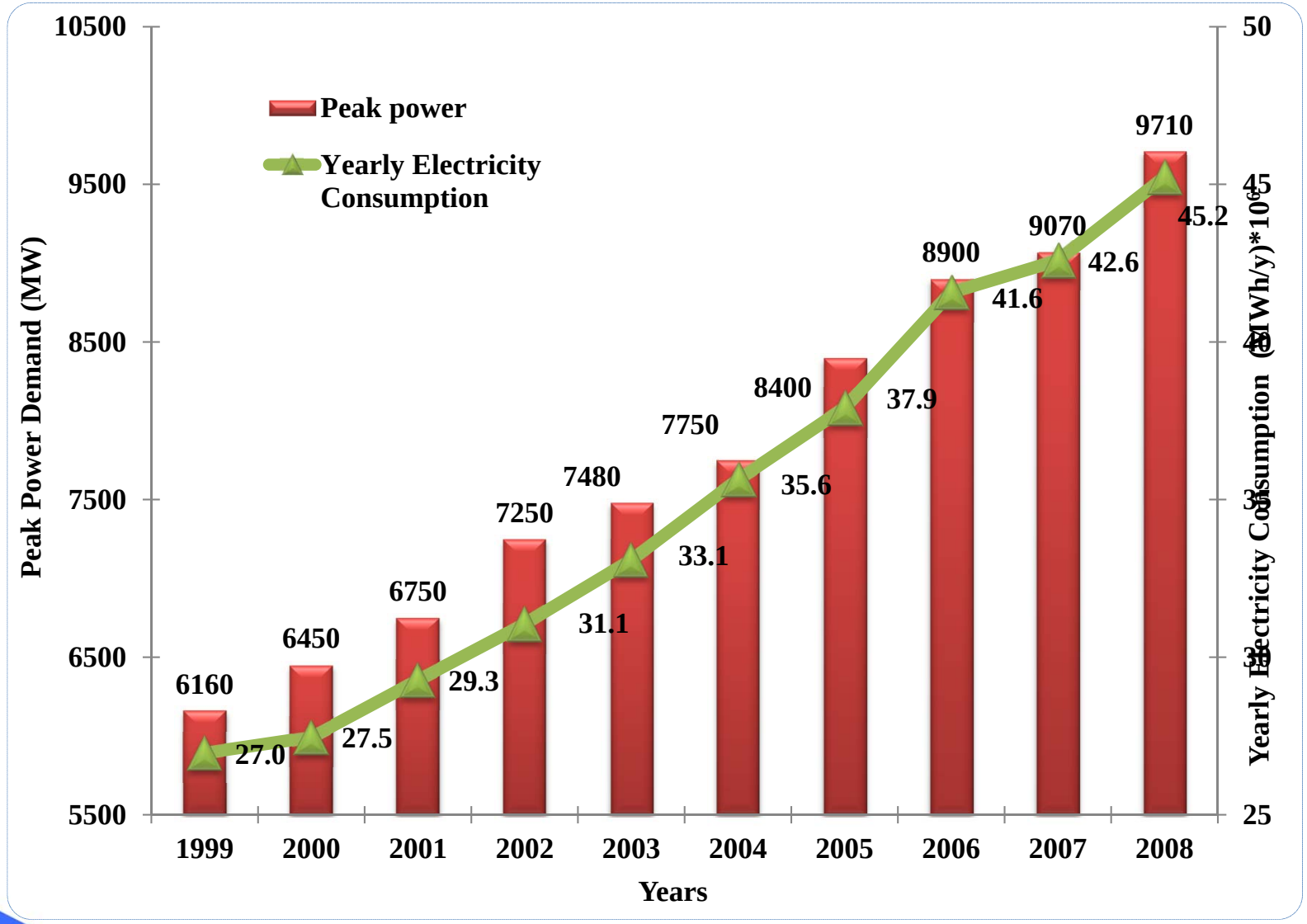


Percentages of Primary Energy Utilization

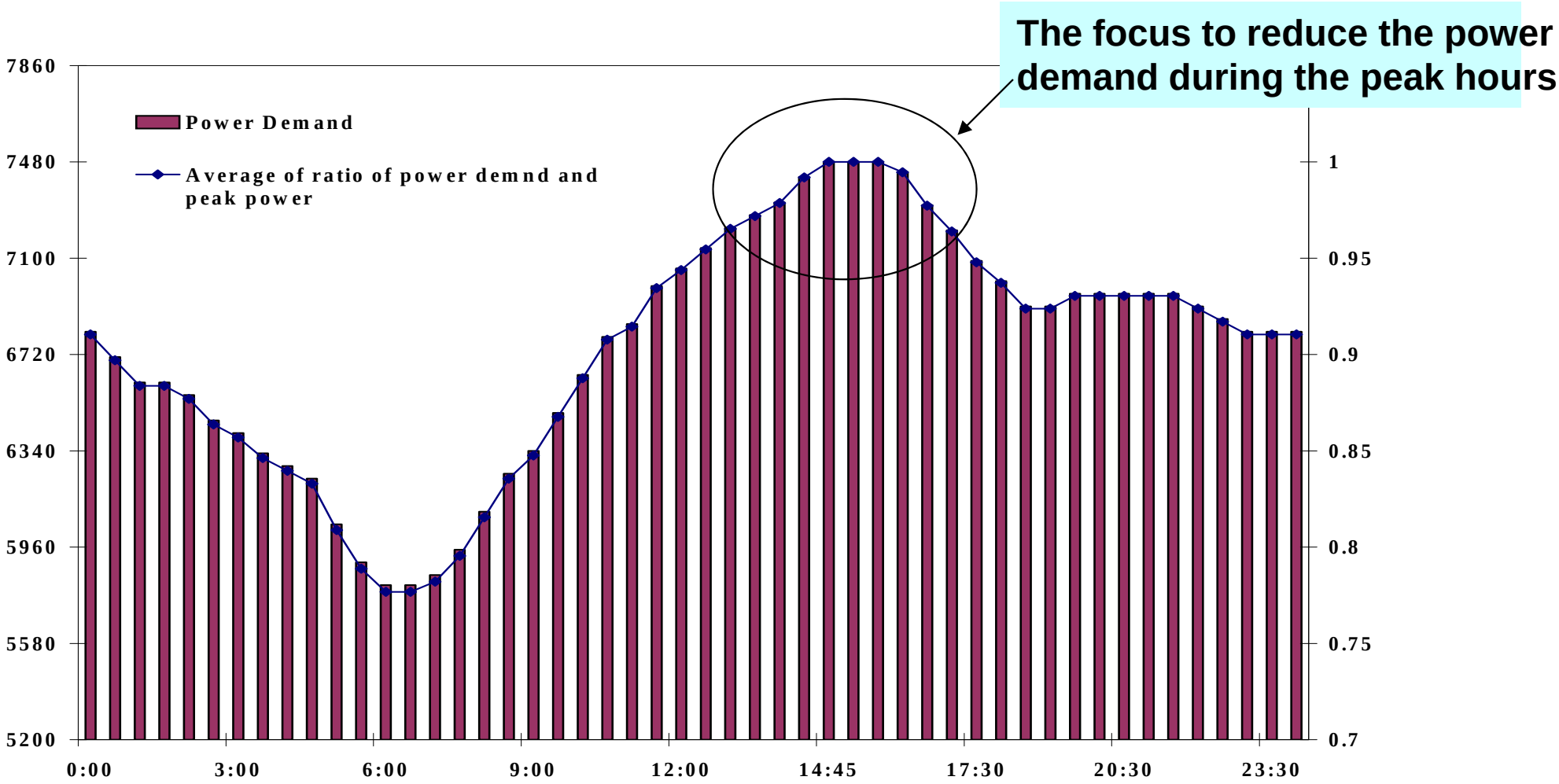


Percentages of Electricity Utilization

Yearly Increase in Power and Energy



Typical Power Demand Profile for Summer Day



Options to Reduce Fossil Fuel Consumption

1. Implement energy efficiency and conservation measures in buildings to reduce their demand for electricity.

2. Generate and distribute electricity more efficiently.

3. Use Renewable Energy Resources to generate electricity.

KISR Achievement in Energy Auditing Program

Building	Year	Energy Saving (%)	Peak Power Reduction (%)
Kuwait Port Authority	1996	30	20
KISR Main Building	2000	21	20
MEW and MPW buildings in South Surra	2004	20	38
Public Authority for Civil Identifications	2004	12	5
Al-Fanar Shopping Mall	2004	8	15

Objectives

- To achieve a minimum 5% reduction in peak power demand of buildings between 13:00 and 14:00 h.
- To achieve a minimum 20% reduction in peak power demand of buildings after 14:00 h.
- To develop guidelines for country wise implementation of peak power reduction strategies in all governmental buildings.

Methodology

- Study the operation features of the building.
- Establish the baseline power demand profile.
- Develop the innovative approach strategies for A/C and lighting systems.
- Apply the developed strategies and modify them if required.

(1)Ministry of Health (2) Chamber of Commerce (3) Justice Palace
(4) Public Institution for Social Securities (5) Liberation Tower
(6) Ministries Complex
(7) Public Authority of Youth and Sports (8) State Audit Bureau

Building Description

- PIFSS building was inaugurated in 2005.
- It consists of a 24-storey office tower and an adjoining 3-storey podium block for the public with a total air-conditioned space of around 58,000 m^2.
- Majority of the building occupants vacate the premise at 14:00 h.
- Building has a peak load of 3,000 kW.

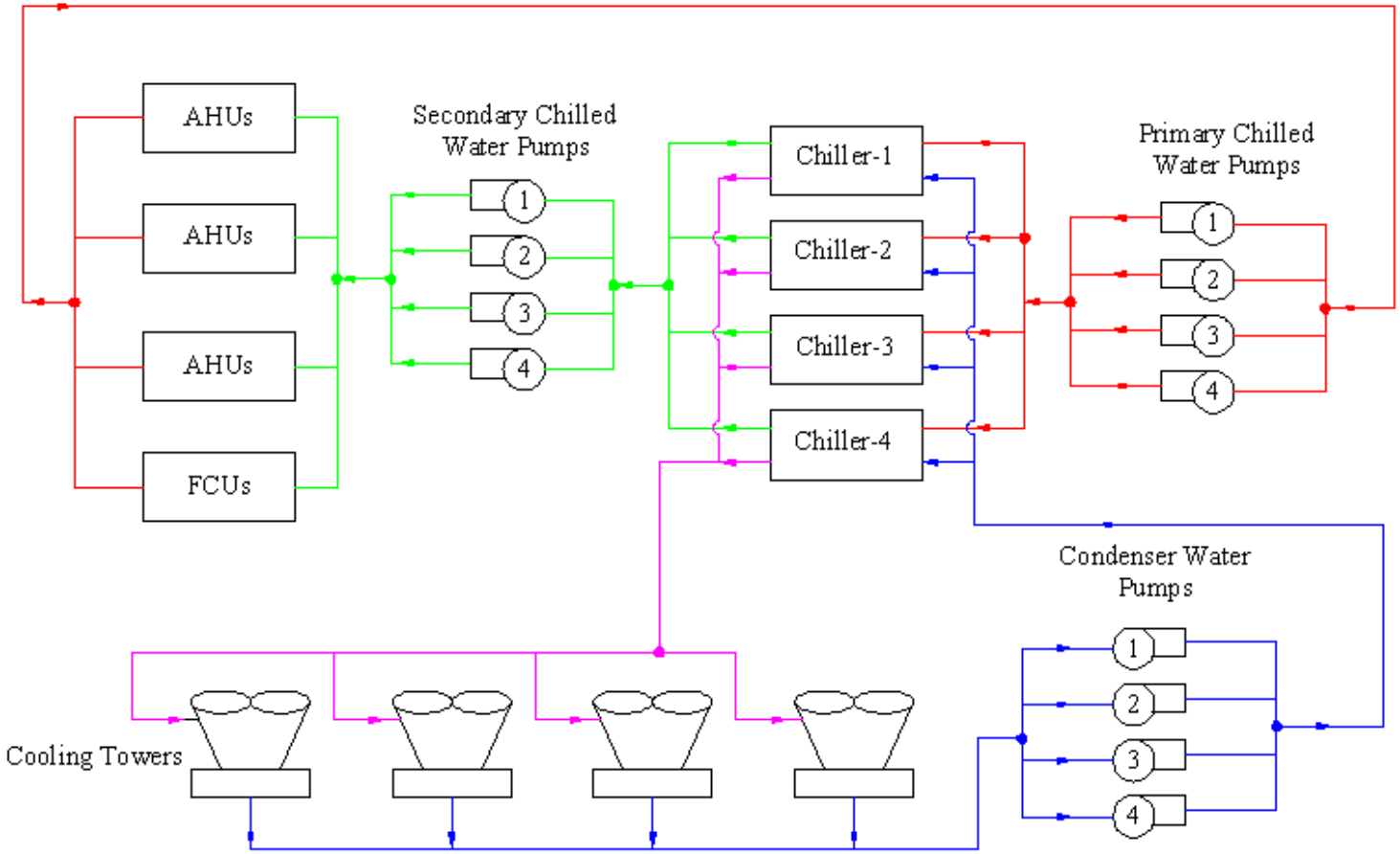
Building Description cont'd

- Building automation system (BAS) monitors and controls important parameters such as:
  - supply air temperature
  - duct static pressure in the AHUs
  - static pressure in the secondary chilled water pumps
  - supply water temperature from the chillers.

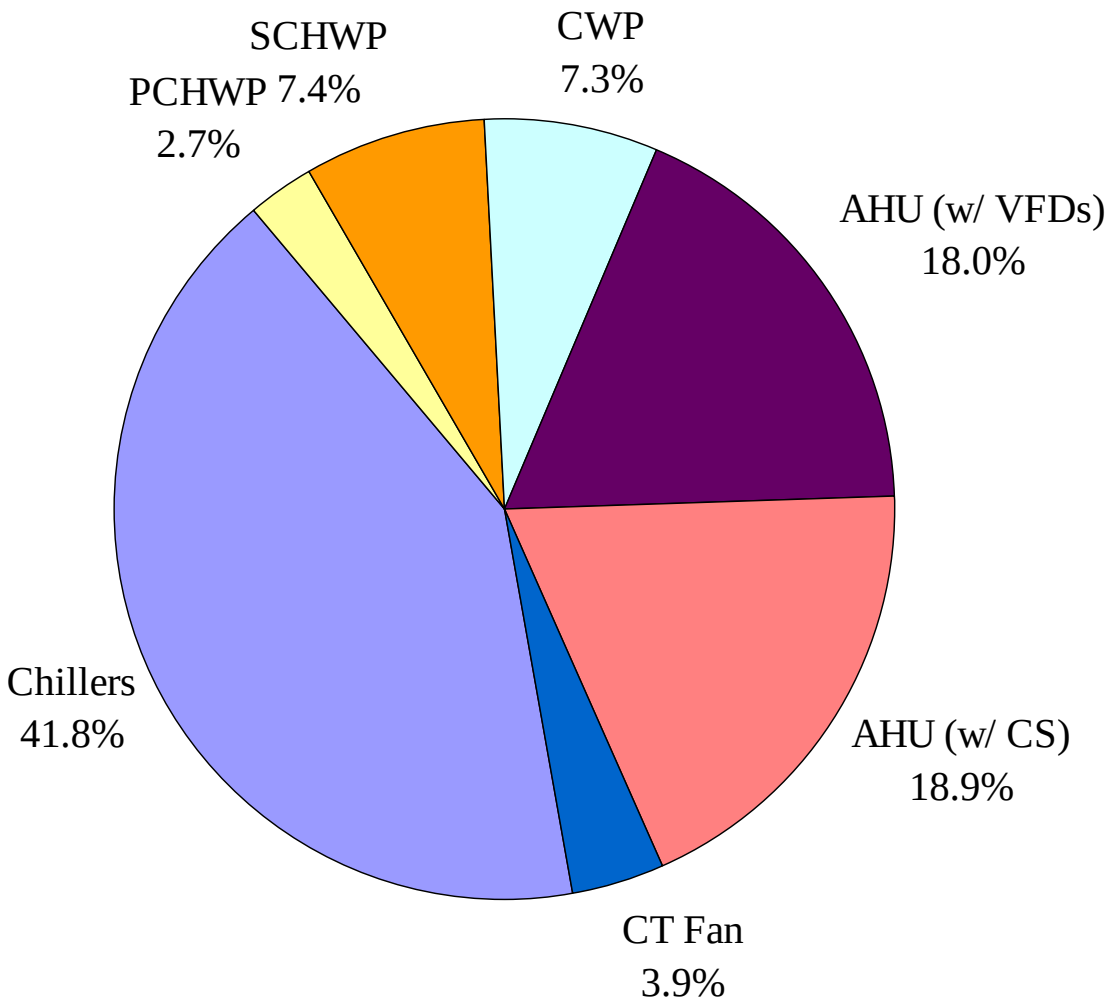
HVAC System Description

- Water-cooled chillers with 1,368 RT capacity are at 957 kW.
- Primary and secondary (w/ VFDs) chilled water pumps are at 168.75 kW.
- Condenser water pumps are at 167.85 kW.
- Cooling tower fans at 90 kW
- Air handling units (including FCUs) are at 562.5 kW, of which 274.5 kW fans equipped with VFDs.
- Total VAC system power demand is 1,946 kW.

VAC System Description cont'd



Share of Power Demand in Peak Summer Season



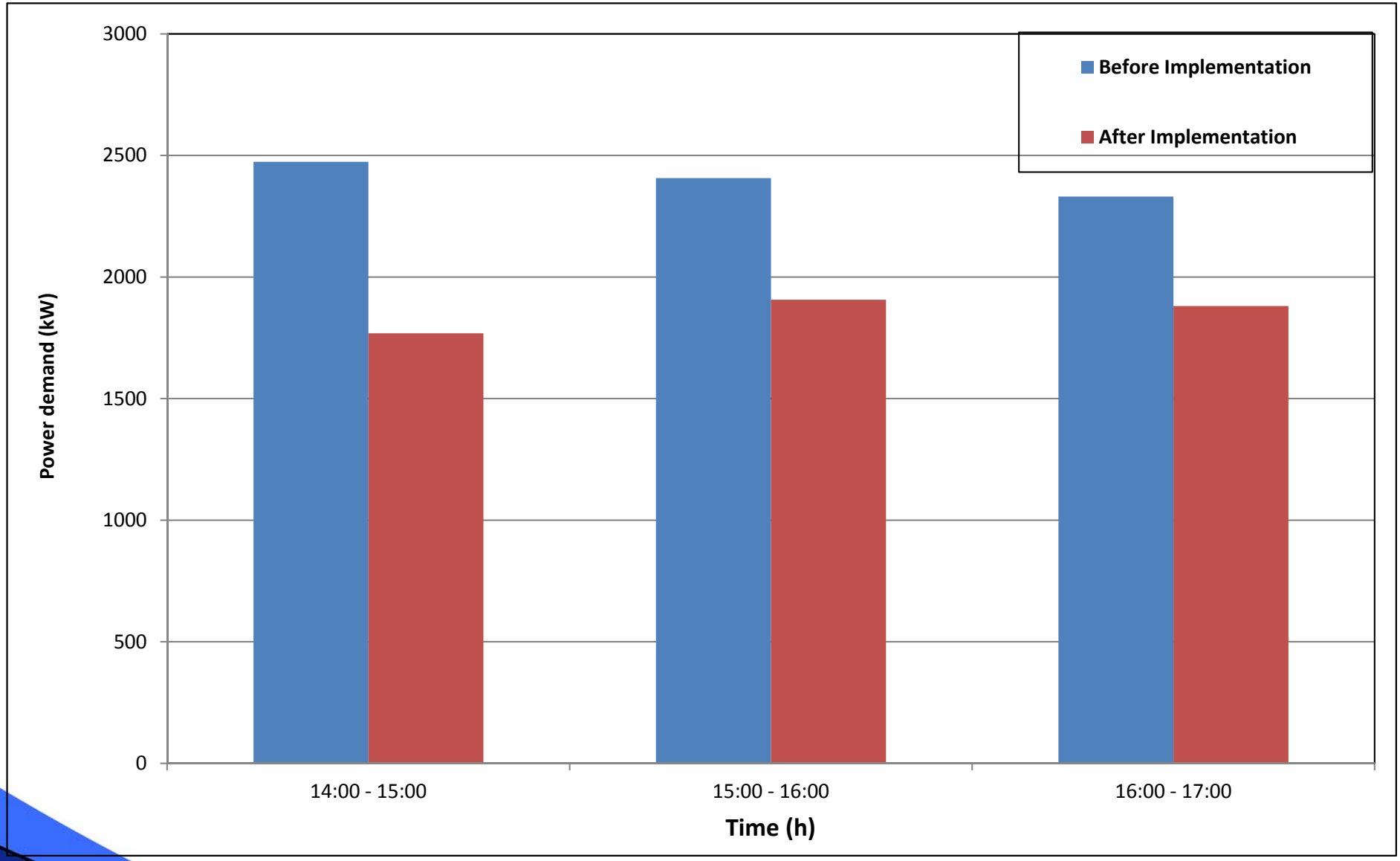
Lighting System

- One of the most energy efficient lighting system in the country.
- First to use LED lamps for outside lighting.
- It uses energy efficient fluorescent tubes with electronic control gears (ECGs) and compact fluorescent lamps (CFLs).
- High bay high intensity discharge lamps (HIDs) in Podium.
- Fully controlled by BAS.
- Most of the lighting systems is switched off after working hours except for some areas.

Approach & Methodology

- De lamping
- Re wiring and switching off the lighting system during the day in the staircases and lift lobbies and after working hours in Podium's high bay luminaires, floor lights, planters and underneath counters.
- Use of time-of-day control for AHUs between 14:00 and 19:00 h.
- Upgrading the BAS to implement TDC for room temperature.

Power Demand Profile before and After Implementation of Optimized Operation Strategies



Project Achievements

- All time savings of 2.7 kW in the lighting system.
- Additional direct savings of 31 kW in the lighting system between -14:00 and 19:00 h.
- Direct savings of 92 kW through TDC of some of the AHUs.
- Additional indirect savings of over 265 kW.
- Overall reduction in peak power demand of over 17% between 14:00 and 19:00 h.

Special Achievement

- Implementation of TDC for room temperature after upgrading the BAS in October 2007 achieved a direct savings of over 183 kW and indirect savings of 73 kW in fans and pumps power between 14:00 and 17:00 h. These savings are expected to be higher during peak summer season. Accordingly, overall reduction in power demand is going to exceed 25%.

Acknowledgment

- Ministry of Electricity and Water – Water (Project Code # EU046C)
- Management of Participated Ministries and Government Institutions
- Kuwait Foundation for the Advancement of Sciences for funding