

Energy Efficiency Program for the State of Kuwait

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Presentation Outline

- Energy Scenario in Kuwait
- Energy Code of Practice
- Energy Auditing Program and Peak Power Reduction Strategies.
- Centralized Demand Side Management (DSM)
- Energy Efficiency Technologies (EET) Program
- Conclusions

Kuwait's Energy Scenario

- Weather is extremely hot and summer season is very long.
 - Air-conditioning is must for all types of buildings.
 - Higher yearly consumption of electricity (kWh/year).
- A/C and lighting account for 85% of annual peak load & 65% of yearly electricity consumption.
- Consumer pays around 5% of actual cost of energy.
- Energy conservation code of practice is applied for all new and retrofitted building since 1983.

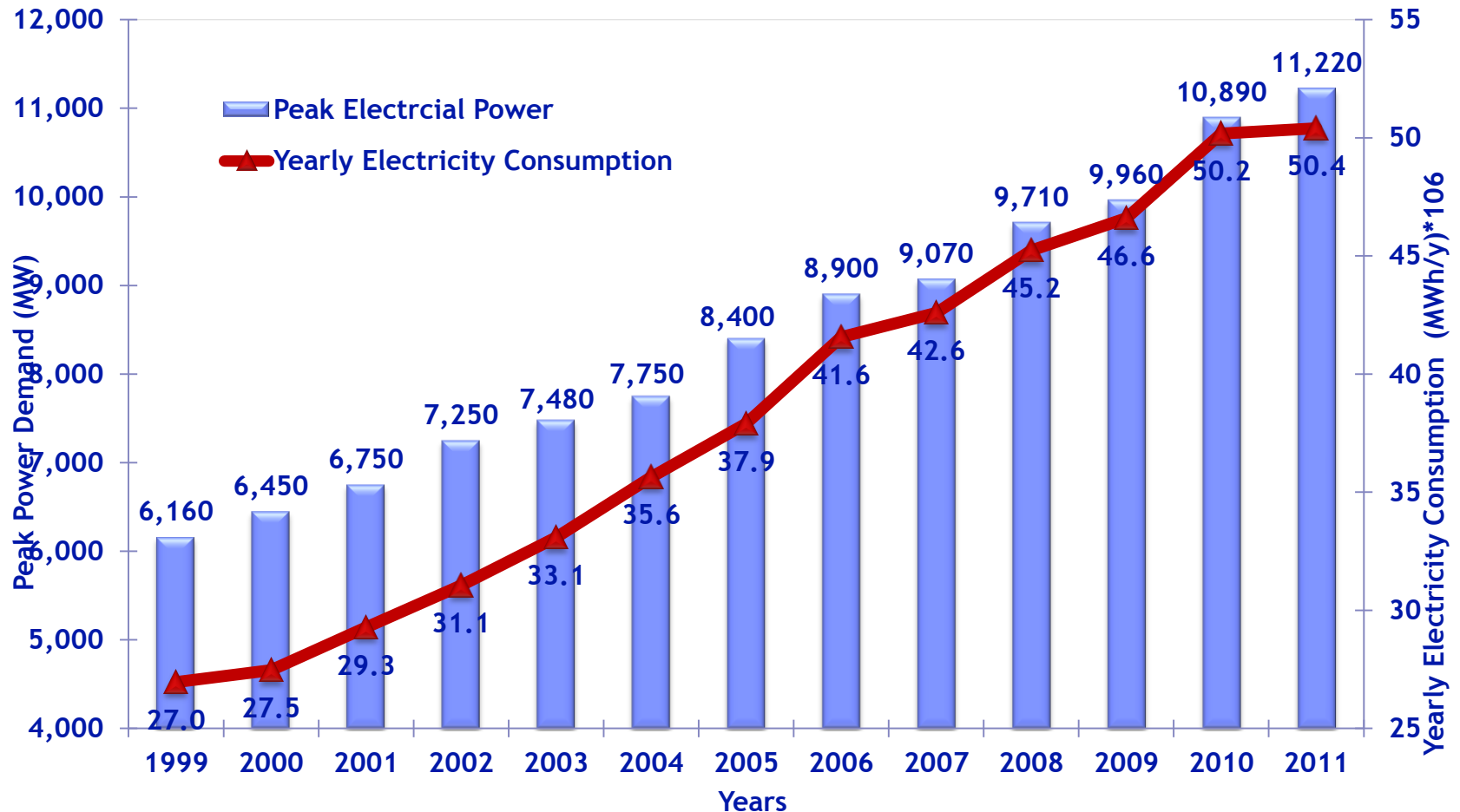
Kuwait's Energy Scenario

- 2011/2012 fuel bill to generate electricity was KD2.5 billion.
- Since 1999, energy and power are growing 5.4% & 5.1% annually.

Relevance of Energy Conservation to Kuwait

- Kuwait's only resources of primary energy are oil and natural gas.
- These resources are major sources of revenue, including foreign exchange.
- They are non-renewable and are associated with generation of greenhouse
- Presently, local energy consumption, excluding feedstock for refineries, is around 15% and it is increasing continuously.
- Buildings are biggest consumer of primary energy and electricity.

Power and Energy Demand in Kuwait



Energy Conservation Program Code of Practice (MEW/R-6)

MEW/R6/1983	MEW/R6/2010
❖ Thermal insulation of walls and roofs excluded columns and beams.	❖ Thermal insulation of exposed columns and beams is to be made mandatory.
❖ A common glazing-to-wall area ratio was specified regardless of building class.	❖ Maximum glazing-to-wall area ratios are specified for each class of glazing.
❖ Three-dimensional thermal bridging due to window frames was not considered.	❖ Thermal breaks for window frames are mandatory to prevent thermal bridging.
❖ Limits for U-value, SHGC and visible transmittance for windows were not specified.	❖ Acceptable ranges of U-values, SHGC and visible transmittance for whole window assemblies are specified for different types of glazing.
❖ One set of design weather conditions was specified for the entire state of Kuwait.	❖ Separate design weather conditions are defined for Kuwait's coastal and interior zones.
❖ Application of water-cooled A/C systems was mandatory for capacities higher than 1,000 RT.	❖ The capacity for mandatory use of water-cooled A/C systems is reduced to 500 RT for interior areas while 1,000 RT for coastal areas to be continued.
❖ ASHRAE's 1979 standard ventilation rate of 5 CFM/person was used.	❖ The higher of ASHRAE's latest ventilation rate of 20 CFM/person or 0.5 ACH + exhaust air is used.

Major Differences Cont'd ...

MEW/R6/1983	MEW/R6/2010
❖ Application of thermal storage systems was not considered.	❖ Cool storage systems are mandatory for buildings with partial occupancy.
❖ Thermal insulation of exposed floors was not considered.	❖ Thermal insulation for exposed floors with R-value of 10 is mandatory.
❖ No rigorous analysis on the application of cooling recovery units (CRUs) was made.	❖ Use of CRUs for recoverable exhaust air of more than 940 L/s, taking into account weather zone and building type, is mandatory.
❖ Application of programmable thermostats for A/C control was not considered.	❖ Clear recommendations for the application of programmable thermostats, including recommended pre-cooling levels.
❖ No rigorous analysis on the application of variable speed drives (VSDs) was made	❖ Use of VFDs in cooling tower are mandatory for all sizes and locations.
❖ Application of seawater for condenser cooling was not considered	❖ Use of seawater for condenser cooling for W/C plants of 5,000 RT or more is mandatory for coastal zone.

More than KD 4.5 billions has been saved from the Code

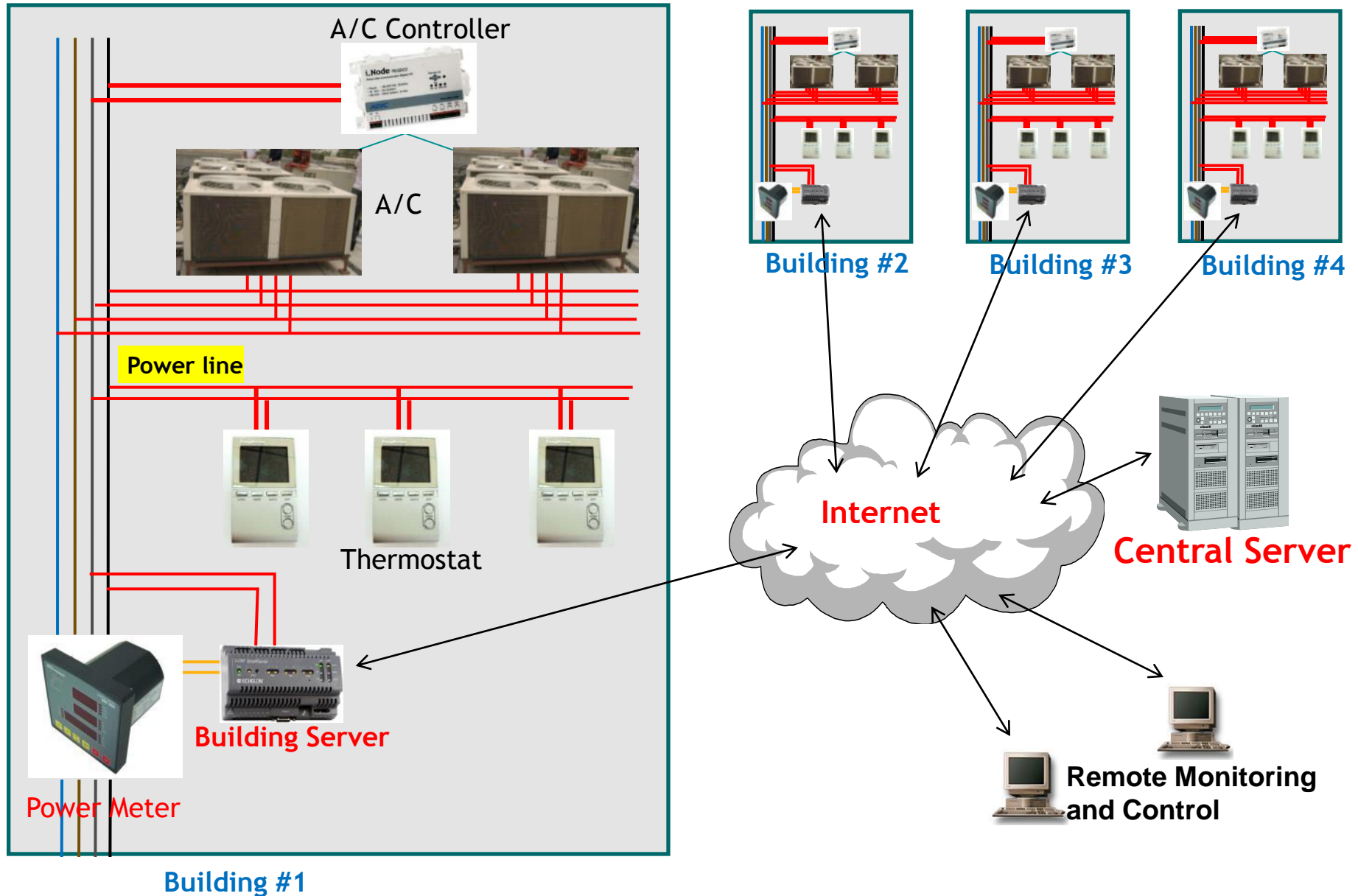
KISR Achievements in Energy Auditing in Buildings

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

Peak Power Reduction through Implementation of Smart Operation Strategies

Building	Peak Power Demand (kW)	Reduction in Power Demand (kW)	Percentage Savings (%)
Ministries Complex	12,000	610 ~ 6,800	5 ~ 79
Justice Palace	3,600	510 ~ 825	7 ~ 24
Liberation Tower	3,400	200 ~ 890	5 ~ 26
Public Institution for Social Securities	2,600	300 ~ 570	11 ~ 25
Ministry of Health	2,200	530 ~ 680	24 ~ 39
Chamber of Commerce	2,000	160 ~ 460	12 ~ 31
State Audit Bureau	1,450	240 ~ 570	11 ~ 40
Public Authority for Youth and Sports	930	150 ~ 300	16 ~ 42
Total	28,180	3,700 ~ 9750	13 ~ 42

Centralized DSM Pilot Project



Estimated National Savings from Centralized DSM System

Type of building	Peak load	Daily Energy	No. Units	Expected savings		National Savings	
				Peak Power	Daily Energy	Peak Power	Daily Energy
	kW	kWh/d/unit		%	%	MW	MWh/d
Villas	50	840	108,000	10	5	540	4,536
Villas - Holiday	40	720	27,000	15	25	162	4,860
Schools	320	4,608	1,000	75	20	240	922
Mosques	90	1,728	1,000	0	15	0	259
Government buildings	200	2,880	900	60	20	108	518
Total						1,050	11,095

Integrated Demand Side Management and Photovoltaic System for schools in Kuwait

- After successful commissioning and testing of the Kuwait DSM pilot project, a road map was proposed to implement the DSM strategies from a centralized remote control for all schools in Kuwait, through a five-year proposal as a first step towards a comprehensive national plan.
- the Ministry of Education assigned KISR to implement the DSM system in 90 schools in Mubarak Al-Kabir Educational Area.

Objectives of the Current Project

- To design, develop and install a DSM system for energy management and water-monitoring through centralized remote control feature.
- To develop optimal control operation strategies for individual school.
- To study the use of rooftop PV system for one school.
- To evaluate power and energy savings of different Energy Conservation Measures (ECMs).
- To develop a certification program for engineers and technicians for the proposed DSM system.
- To prepare a draft national policy for implementing DSM system in other buildings.

EET Program - Background

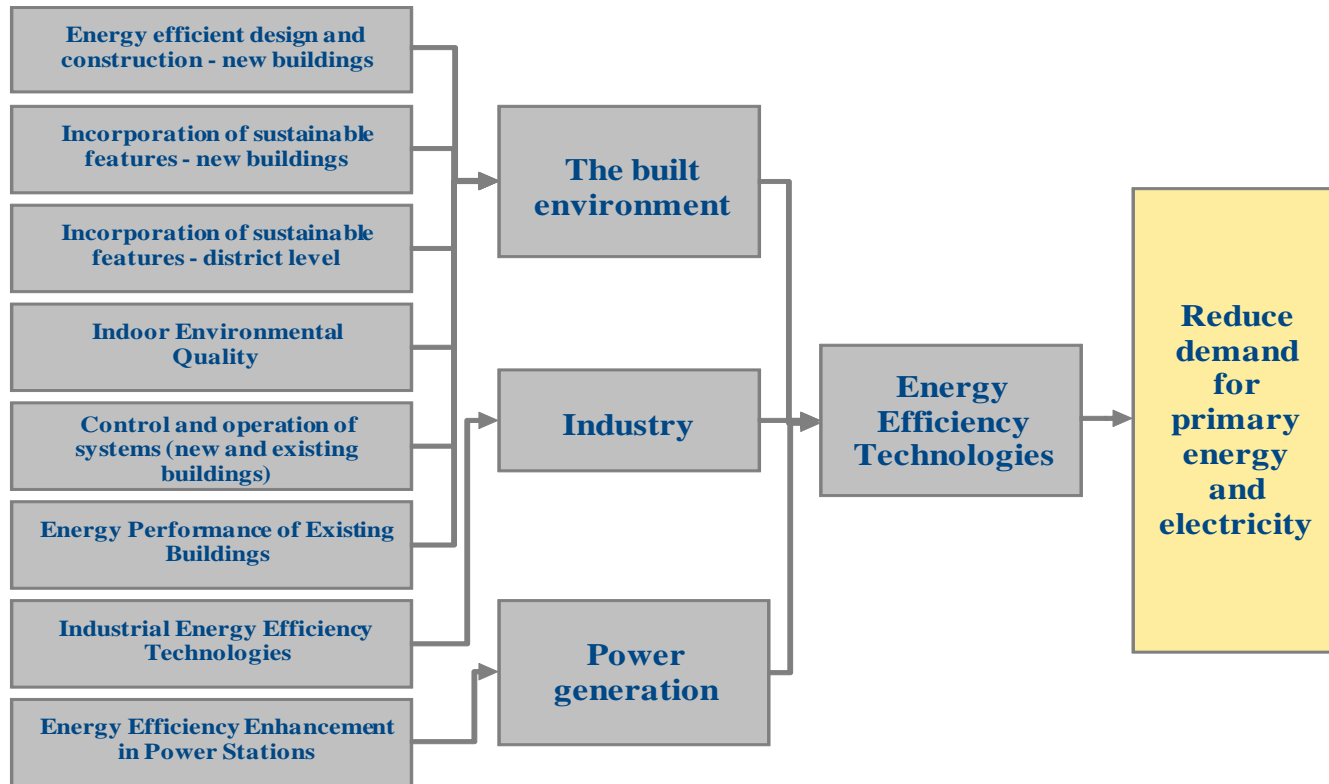
- National challenge
 - “To reduce per capita energy consumption without impacting the quality of life”
- Program Rationale
 - Kuwait’s only sources of primary energy, oil and natural gas, are non-renewable resources that generate greenhouse gases
 - power stations and industry consume 55% and 25% respectively of Kuwait’s primary energy.
 - Buildings account for 85% of peak power and 80% of Kuwait’s electricity use, and 37% of the primary energy consumption in the country.
 - EET program is directed to improve the efficiency of power stations and to reduce demand for power through energy efficient technologies in buildings and industrial sector.

Background Cont'd

- Program Vision
 - Pursue innovative solutions for reducing the per capita energy consumption through implementing energy efficiency technologies program in buildings, power stations and industries
- Program Aims to
 - Improve the energy efficiency of Kuwait's power stations by 5%.
 - Reduce energy consumption by 10% in existing buildings and industries.
 - Reduce energy consumption by 30% in new buildings from the current level.

Background Cont'd

Program's Logic tree



Projects under the EET Program

S. No.	Title
1	Develop and Update Building energy code and design guidelines
2	Performance Verification of Fenestration Products
3	Cool Roofs and Urban Heat Islands Mitigation
4	Development of National Code for Lighting Systems in Buildings
5	Updating of MEW Electrical Codes
6	Optimum thermal resistance for walls, roof and floor of buildings
7	Minimum energy efficiency for different air-conditioning systems
8	Effect of Alternative Refrigerants on the Performance of Air-Conditioning Units in High Ambient
9	Minimum energy efficiency for domestic and office appliances
10	Guidelines and recommendations for installation and maintenance of air-conditioning systems.
11	Guidelines for Verification of Building Energy Code Compliance and Energy Labelling
12	Design of a Sustainable Traditional Kuwaiti Villa

Legend

Ongoing
Projects

MEW Projects

Projects under the EET Program

S. No.	Title
13	Construction and Performance Evaluation of a Sustainable Traditional Kuwaiti Villa
14	Establishment and Performance Assessment of A Sustainable Model Building in Kuwait
15	Performance Assessment of Encapsulated Latent Ice Storage System
16	Assessment of Geo-thermal Heat Pump Application
17	Assessment of the Electromagnetic Field around the electrical Secondary transformers in schools And residential area
18	Development of Design Guidelines of District Cooling System for Al-Khairan New Residential City
19	Indoor Environmental Quality (IEQ) Assessment and Development of codes
20	Integrated Demand Side Management and Photovoltaic Systems for Schools in Kuwait
21	Green Building Certification for the oil Sector Complex Building
22	Implementation of Energy Efficient Retrofits for Five Existing Private Office Building and Shopping Malls
23	The Potential of Energy Conservation and Peak Power Reduction in the Residential Sector

Legend

Ongoing
Projects

MEW Projects

Research Laboratories to be established

S. No.	Research Laboratories
1	Building Energy Simulation
2	Fenestration Laboratory
3	Cool Roof Laboratory
4	Lighting Laboratory
5	Electrical Systems Laboratory
6	Environmental Chambers and Hot Box
7	HVAC and A/C Performance Rating Laboratory
8	Energy Labelling Laboratory
9	Thermal Energy Storage Laboratory
10	Indoor Environmental Quality and Air Filtration Laboratory
11	Energy Systems Laboratory

Conclusions

- It is very important to ensure proper implementation of the Energy Code of Practice, which saved the country more than KD 4.4 billions up to date.
- Energy auditing program and peak power reduction strategies saved tremendous amount of power and energy in existing buildings.
- Centralized DSM system offers a very good tool for power and energy management for the State of Kuwait.
- EET program will further help to reduce the demand for primary energy and electricity in Kuwait.

Thank You