

The 10 GW Solution To Saudi Arabia's Energy Problems

Ahmad Faruqui
August 2011

The Kingdom of Saudi Arabia (KSA) faces significant challenges in meeting its future electricity needs

Problems

- ◆ Rapid peak demand growth (6% per year)
- ◆ Capital-intensive grid expansion (SR 20 to 40 billion per year)
- ◆ Low resource utilization
- ◆ Mandatory load curtailment / blackouts in the summer
- ◆ Lost revenue when oil is sold to electric utilities at a substantial loss

Drivers of load growth

- ◆ Very hot climate
- ◆ Artificially low electricity rates
- ◆ Low consumer awareness of energy efficiency
- ◆ Ineffective enforcement of efficiency standards

Almost all of these problems can be addressed through the systematic application of Demand-Side Management (DSM)

DSM will provide several benefits to the KSA

- **Free-up capital investment that would otherwise be tied up in peaking generation plants for other productive uses in the Kingdom**
- **Free-up oil that is currently sold to the electric utilities at a significant discount to be exported, yielding higher revenues that can be used to promote economic development in the Kingdom**
- **Reduce greenhouse gas emissions and improve the health of Saudi citizens, today and in the future**
- **Allow for complementary development of renewable energy sources and integration of customer-side activities with the anticipated roll-out of the smart grid**

A phased approach to DSM is called for

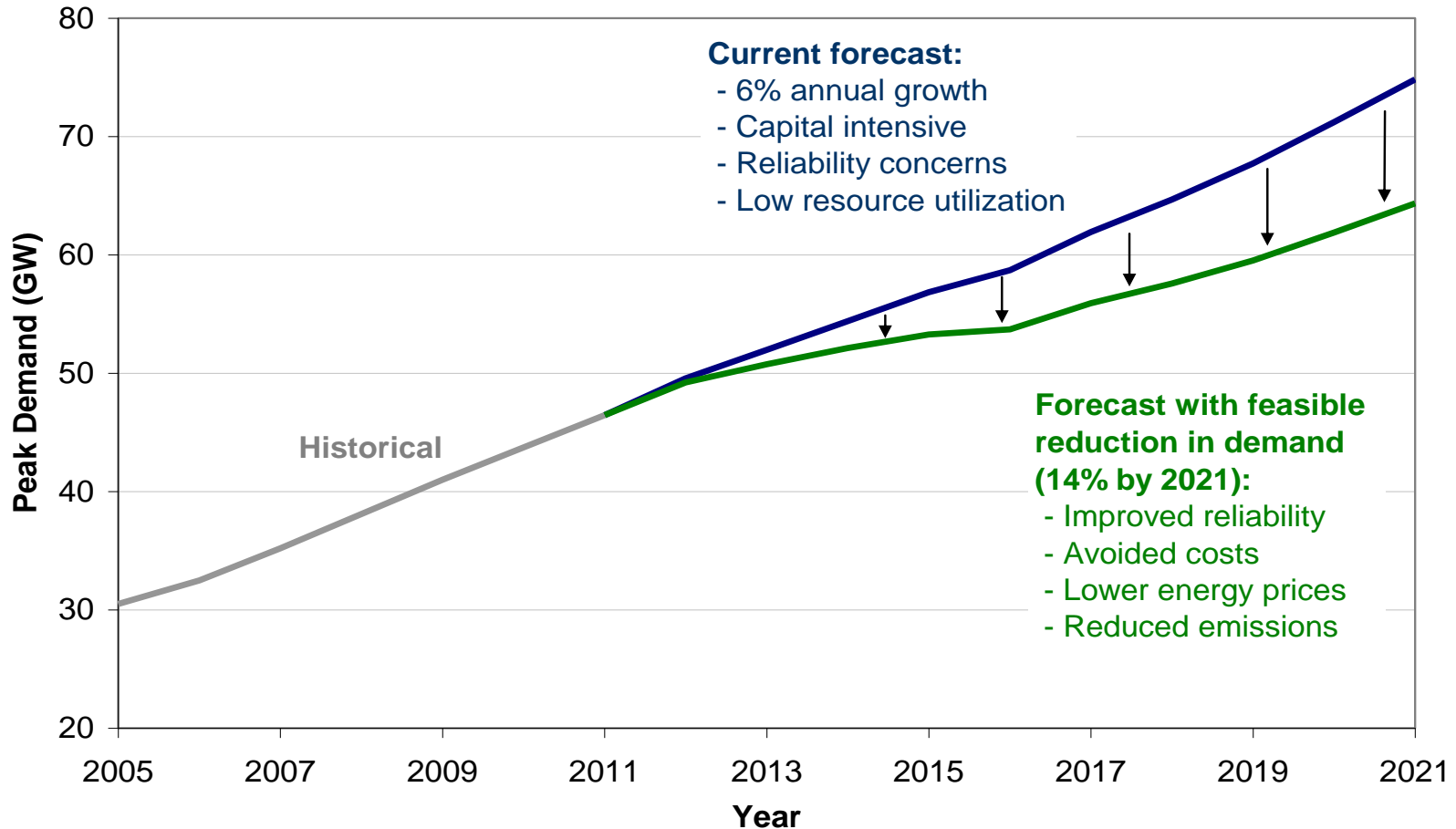
- **As a first step, we recommend the KSA launch five DSM programs starting next year**
 - ◆ These programs should focus on the largest end use of energy (i.e., space cooling)
 - ◆ They should be designed to reduce energy use, peak demand and improve system load factor
- **As a second step, pilot and test other programs in the years to come**
 - ◆ New pricing mechanisms (i.e., TOU, dynamic pricing)
 - ◆ New innovative technologies (i.e., PCTs, auto DR, water pumping, A/C retro-commissioning)
 - ◆ New information delivery mechanisms (i.e., in-home displays, web portals)

The five programs to launch in the next year

The DSM Plan	Description
EE Programs (Voluntary)	
1 Efficient Cooling	Encourage and assist customers in existing facilities to improve air-conditioning EE through incentives for replacement of a/c units
2 New Buildings Efficiency	Designed to accelerate the incorporation of EE in the design, construction, and operation of new, renovated or reconstructed homes and buildings in the KSA (mainly from insulation and a/c efficiency)
LM/DR Programs (Voluntary)	
3 Direct Load Control	A/C compressors are remotely cycled or shut down during times of high demand in return for incentive payments to participants (commercial, government and large residential sectors)
4 Interruptible Tariffs	Offer lower year-round rate in exchange for agreeing to reduce load to pre-specified level during a limited number of hours per year; Financial penalties for non-compliance (commercial and industrial sectors)
5 Curtailable Load Management	Customers receive a payment for each kilowatt of measured and verified demand reduction that they provide during load curtailment events (industrial sector only)

The five program DSM Plan will allow the KSA to manage unsustainable trends in peak demand growth

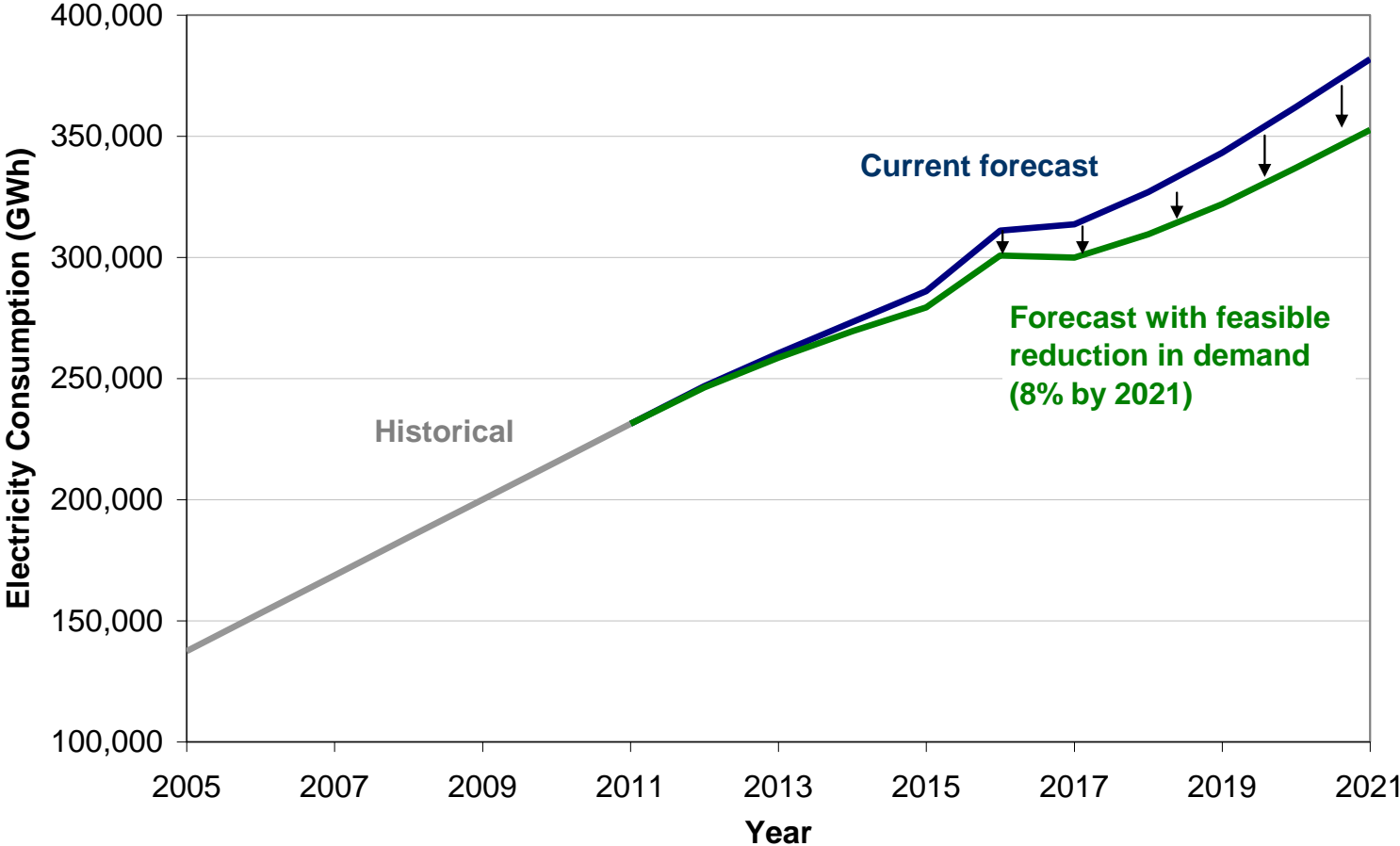
KSA System Peak Demand



Note: "Current forecast" projection provided by ECRA

It will also help to reduce unsustainable growth in electricity consumption

KSA Electricity Consumption



Note: "Current forecast" projection provided by ECRA. "Historical" extrapolated based on implied growth rate

The DSM Plan can reshape the KSA's electricity future

Reduce Growth in Peak Demand

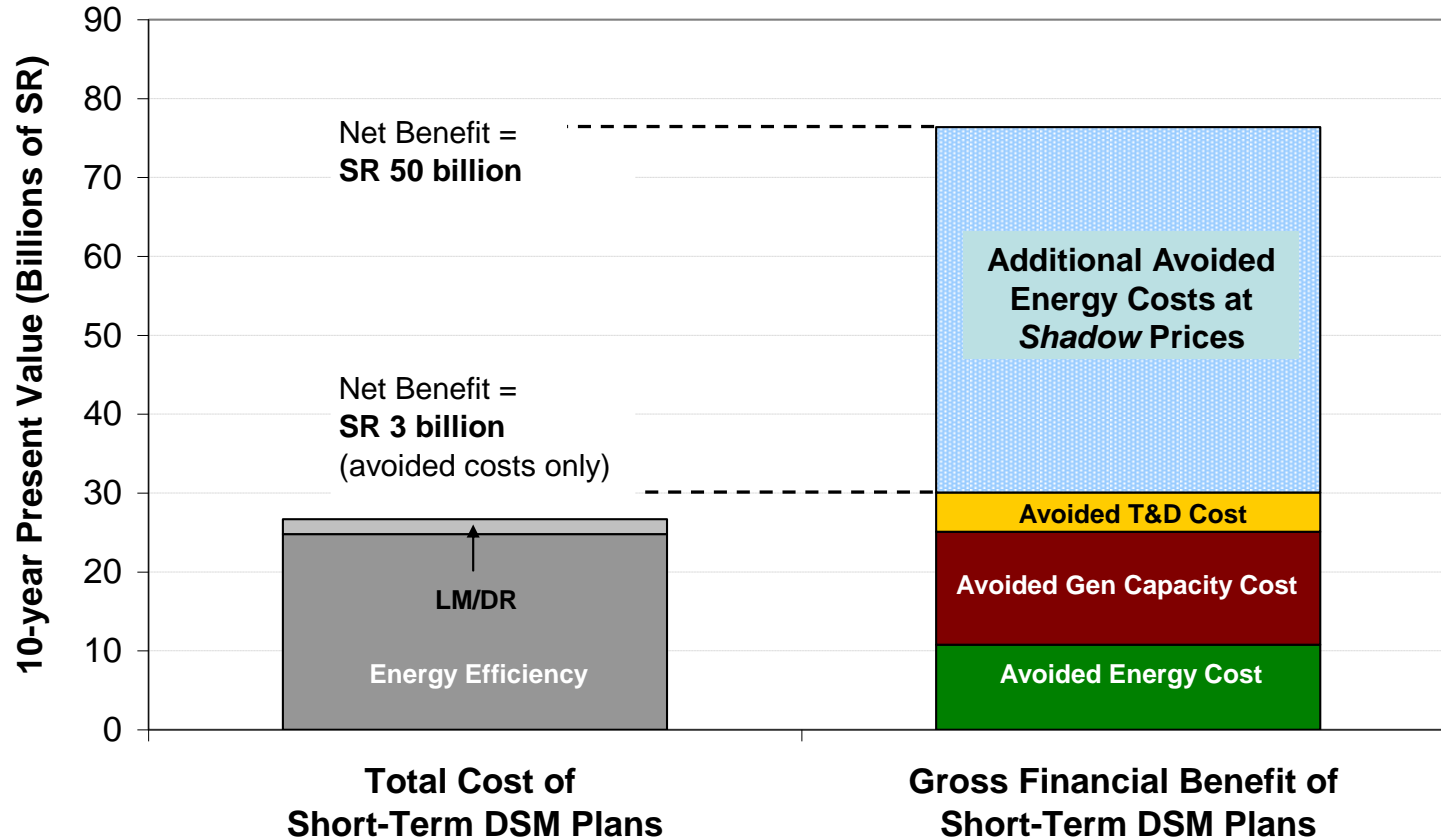
- ◆ 10.5 GW reduction in projected 2021 system peak, representing 14% of system peak
- ◆ Reduction of growth in peak demand between now and 2021 by 37%

Reduce Growth in Energy Consumption

- ◆ 29,000 GWh reduction in projected 2021 consumption, representing 8% of annual consumption in that year
- ◆ 129,000 GWh cumulative reduction by 2021
- ◆ Reduction of growth in consumption between now and 2021 by 19%

DSM can yield significant net benefits to Saudi society over the next decade

Costs and Benefits of Recommended DSM Programs



Note: Shadow prices are a conservative approximation of energy prices based on near-market price of oil used for electric generation, provided by Ministry of Petroleum and Minerals

We recommend a multi-track approach to DSM

- **Firstly, targeted energy awareness messages will be developed, leading to changes in customer behavior, e.g.:**
 - ◆ Lower your energy bills
 - ◆ Cleaner air is good for your health
 - ◆ Being “green” is good and virtuous
 - ◆ Make the best use of the Kingdom’s precious natural resources
 - ◆ Invest in the future of your children and grand children
 - ◆ Do better in per capita energy consumption than your neighbors and with countries at similar levels of economic development
- **Secondly, financial incentives will be used to bring about technological change by encouraging customers to buy efficient appliances and buildings**
- **Thirdly, in the long-term, raising electricity prices to reflect actual costs would turn DSM into a sustainable activity**

The DSM Plan has significant benefits, but will require a large commitment of resources

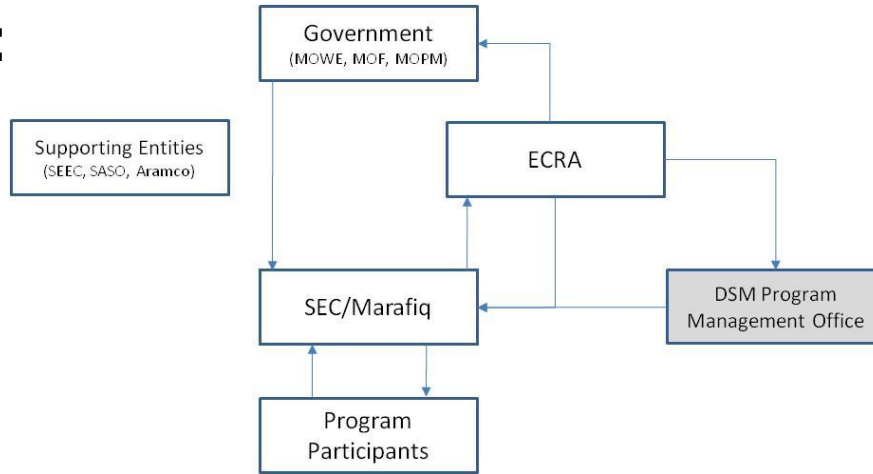
KSA's DSM Plan Summary Statistics

Total of Five DSM Programs	2012	2016	2021	Total (2012-2021)
Cumulative Participants or Installations*				
EE	363,000	6,285,000	17,337,000	17,337,000
LM/DR	21,000	262,000	348,000	348,000
Annual Benefits				
Energy (GWh)	500	10,200 (3.5%)	29,200 (7.6%)	129,000
Peak (MW)	330	5,100 (8.5%)	10,500 (14.0%)	10,500
CO2 (000 tonnes)	165	3,000	8,600	38,400
Annual Budget (million SR)				
Total (incentive + admin)	770	5,750	4,150	37,400

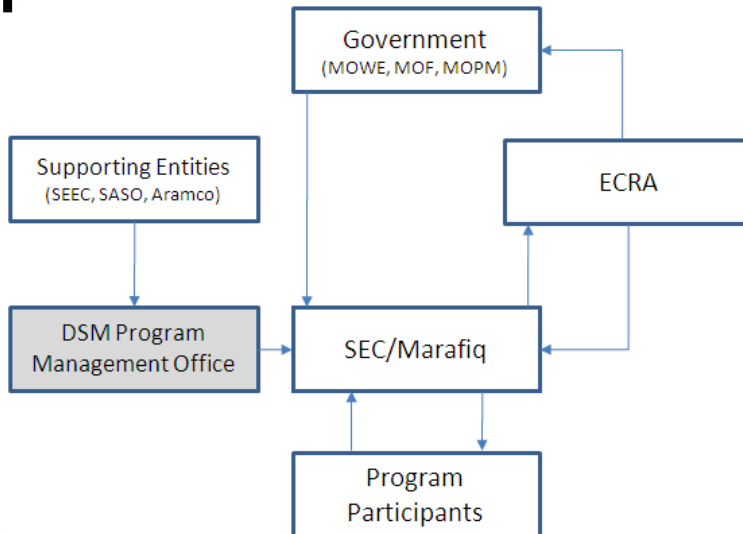
* The number of EE installations is greater than the number of EE participants; for example, one participant in the New Construction Efficiency program could have a high efficiency air-conditioner, wall and ceiling insulation, and high efficiency windows – these would represent four distinct installations in this table

Organizing for DSM

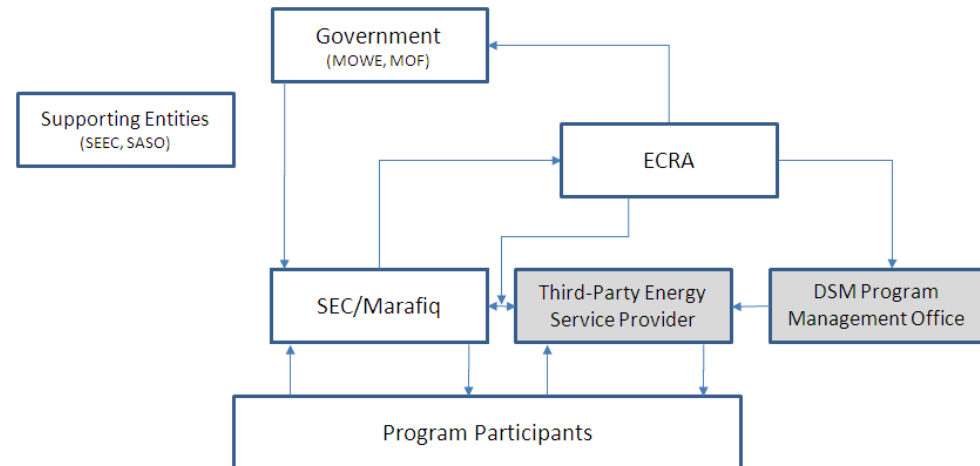
Option 1:



Option 2:



Option 3:



Why has DSM not happened already?

- **The responsibility for DSM is scattered across a number of entities (MOWE, SEC, SEEC, SASO, ECRA, Municipalities)**
- **There is no over-arching law or decree on energy efficiency**
- **There is a lack of DSM project management, supervision and execution skills**
- **There is no overall program with targets and measures**
- **There is an over-emphasis on continued studies / research, and little action**

Key decisions are now needed to move forward...

- DSM Leader?
- Organization Structure?
- Funding?
- Targets?
- Detailed Program Plans?

✓ Approve the DSM Plan

Implementation Plan Overview – 2011 to 2021

YEAR QUARTER	2011		2012				2013	2014	2015	2016	2017	2018	2019	2020	2021
	3	4	1	2	3	4									
Short-Term Activities:															
1: Secure program approvals, organizational structures and funding sources	■														
2: Develop detailed program plans			■												
3: Develop minimum equipment efficiency standards			■												
4: Issue tenders and select third-party implementation contractors				■											
5: Frame program delivery strategies				■											
6: Launch LM/DR & EE programs					■										
Long-Term Activities:															
1: Develop annual program performance reports							◆	◆	◆	◆	◆	◆	◆	◆	◆
2: Conduct process and impact evaluation studies				■				■		■		■		■	