Mobilizing Electricity Companies to Implement Energy Efficiency

USAID Jordan Energy Sector Capacity Building Activity
Grayson Heffner, Resident Advisor

Training Workshop on “Electricity Efficiency in Generation, Transmission and Distribution”
4-5 September 2016
Contents

- Jordan’s Energy Crisis and Energy Policy Response
- What is DSM?
- Why involve electricity companies in energy efficiency?
- What kind of framework is needed to promote DSM?
- Jordan’s DSM program design
- Economics of a DSM program
- DSM targets for Jordan
Jordan’s energy sector faces multiple challenges

Rapidly growing energy demand
- 7% annual growth in primary energy demand
- 6% annual growth in electricity demand

Near total dependency on imported fuels
- 97% of energy needs met through imports
- 10% of GDP annual spending on energy imports (2015)

Large subsidy flows for household electricity consumption
- $400 million spent in 2015 on electricity subsidies

Mobilizing the investment to expand energy resources
- New supplies (conventional and renewable)
- Transmission additions

All figures from GOJ documents and data
What is Demand-Side Management (DSM)?

*Energy-saving activities delivered by energy utilities to their customers*

**DSM measures include:**
- Advice and assistance
- Promoting energy-saving behavior
- Incentives to invest in energy-saving measures
- On-bill financing
- Procurement and distribution of energy-saving technologies

**Who benefits from DSM?**
- Energy consumers, through lower energy bills
- Utilities and governments, through reduced energy investment needs and lower subsidy flows
- Local communities and businesses, through economic development
- Society, through lower GHG emissions
DSM has proven effective in the U.S. and globally

- DSM accounts for about 15% of annual energy-savings in the US\(^1\)
- DSM spending is funded through utility bills
- Utilities must be able to recover their costs and lost revenues
- Incentive payments encourage utilities to meet their energy-saving targets
- A regulatory and legal framework is required
- DSM programs can deliver up to 3-5% annual savings on a long-term basis

\(^1\)IEA 2014 US In-Depth Policy Review
Minimum requirements for utility participation in DSM

## Global DSM/EE spending by energy utilities

<table>
<thead>
<tr>
<th>Region</th>
<th>Energy Revenues (USD Billions)</th>
<th>2011 EE Spending (USD Millions)</th>
<th>Spending metric (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America¹</td>
<td>400</td>
<td>7,800</td>
<td>1.9</td>
</tr>
<tr>
<td>EU 28²</td>
<td>650</td>
<td>2,500</td>
<td>0.4</td>
</tr>
<tr>
<td>Australia</td>
<td>25</td>
<td>90</td>
<td>0.35</td>
</tr>
<tr>
<td>Brazil</td>
<td>50</td>
<td>25</td>
<td>0.5</td>
</tr>
<tr>
<td>China</td>
<td>410</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

¹ Electricity only  
² Gas and electricity  

Sources: Lees 2012; Crossley & Swanson 2011; Faruqui 2011; Heffner 2012
Jordan’s electricity distribution companies are well positioned to promote energy saving

- Strong technical and administrative capacity
- Billing data needed to segment markets and qualify customers
- Access to financing
- Familiarity and branding
- Complete geographic coverage
- Well-placed to overcome the low-awareness and risk-aversion of end-users
### Distributor DSM Models

1. Distributor is an **Energy Services Provider**, delivering energy savings. Regulator may set targets, fees, incentives, penalties, and require evaluation requirements.

2. Distributor **adds DSM/EE investments to its rate base**, with its return on equity recovered through tariffs.

3. Distributor **facilitates development of EE projects**, recovering program costs and a success fee through tariffs or an external fund.


5. Distributor **procures EE equipment and provides to customers on a credit-repayment basis**, earning a profit. Regulator may or may not provide oversight.

6. Distributors **are obliged to meet energy savings targets** set by the regulator. The regulator imposes a penalty for non-compliance.
## DSM incentive mechanisms around the world

<table>
<thead>
<tr>
<th>Country</th>
<th>Energy utilities covered</th>
<th>DSM/EE mechanism</th>
<th>Customers covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Energy retailers including oil companies</td>
<td>Savings obligation</td>
<td>All except large industry</td>
</tr>
<tr>
<td>Italy</td>
<td>Energy distributors</td>
<td>Savings obligation + White Certificates</td>
<td>All</td>
</tr>
<tr>
<td>UK</td>
<td>Energy retailers</td>
<td>CO2 reduction target</td>
<td>Residential with low-income set-aside</td>
</tr>
<tr>
<td>Denmark</td>
<td>Energy distributors</td>
<td>Savings obligation</td>
<td>All except transport</td>
</tr>
<tr>
<td>Australia</td>
<td>Energy retailers</td>
<td>Savings obligation</td>
<td>Varies by state</td>
</tr>
<tr>
<td>US</td>
<td>Energy distributors and retailers</td>
<td>EE resource standards + shareholder incentives</td>
<td>All</td>
</tr>
<tr>
<td>Canada</td>
<td>Energy distributors</td>
<td>EE resource standards</td>
<td>All</td>
</tr>
<tr>
<td>Brazil</td>
<td>Electricity distributors</td>
<td>EE spending obligation</td>
<td>All, with set-aside for low-income households</td>
</tr>
<tr>
<td>China</td>
<td>Municipal power companies</td>
<td>DSM resource standard</td>
<td>All</td>
</tr>
</tbody>
</table>
## Mobilizing DSM mechanisms to meet economic objectives

<table>
<thead>
<tr>
<th>Economic objectives</th>
<th>DSM mechanism</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize energy subsidies to consumers</td>
<td>DSM programs focused on subsidized consumers</td>
<td>India, Indonesia, Jordan</td>
</tr>
<tr>
<td>Control growth in energy demand growth</td>
<td>Energy and capacity savings targets for energy providers</td>
<td>Saudi Arabia, Indonesia</td>
</tr>
<tr>
<td>Improve reliability and avoid supply shortages</td>
<td>Energy and capacity reductions in response to system needs</td>
<td>South Asia, Africa, Asia, US</td>
</tr>
<tr>
<td>Managing commercial and network losses</td>
<td>Loss reduction savings targets</td>
<td>South Asia, Africa</td>
</tr>
</tbody>
</table>
Jordan’s DSM program targets households receiving electricity subsidies

Jordan’s challenges in serving the household sector

- 40% of total electricity used
- Fastest-growing sector
  - 75,000 new households annually
  - 7% annual growth
- Main recipient of energy subsidies
  - 400 million JD (2015)

2014 data
Jordan’s tariff structure creates distinct market segments
Developing a DSM Incentive Mechanism in Jordan

Establishing a regulatory and legal framework
- DSM Recommendations adopted
- DSM Guidance issued by EMRC

Tools to design and evaluate DSM programs
- DSM financial analysis model
- National household load survey

DSM capacity building
- DSM units at each electric utility
- Regulatory oversight procedures

DSM funding
- Through 2017: JREEEF revolving fund
- Post-2017: Tariff revenues
Household end-use energy use in Jordan (1)

Source: Electric Demand Side Efficiency Potential in Jordan, Nexant, February 2011
Household Load Survey Results – Lighting

84% of Jordanian homes have at least one compact fluorescent lamp.

40% of Jordanian homes still have energy inefficient incandescent lamps.

1.6% of Jordanian homes use energy efficient LED lighting.

17 million Total CFLs, FTLs, and incandescent lamps in Jordanian homes, or 12 lamps per household.

There is a major opportunity to replace Jordan’s 17 million CFLs, FTLs, and incandescent lamps with energy efficient LEDs.
Household Load Survey Results - Appliances

75 PERCENT of Jordanians surveyed own one-door refrigerators ranging from 5-19 ft³

36 PERCENT of refrigerators are more than 10 years old, which are less than half as efficient as today’s models

98 PERCENT of Jordanian homes own TVs, washing machines and refrigerators

1.4 MILLION refrigerators in Jordanian households

There is a major opportunity to replace old washing machines and refrigerators with new energy efficient models
Household Load Survey Results - Water Heating

Household distribution for electric and/or solar water heaters

Most of the solar water heater market potential is for medium- and lower-usage households.
DSM Financial Analysis Model

Main Menu

Go To Input Pages
- Inputs - General
- Inputs - Discos
- Inputs - Customers
- Inputs - NEPCO
- Inputs - Measure Data
- Inputs - Measure Budgeting
- Inputs - Tariffs
- Inputs - Measure Selection

Go To Graphics
- Program Administrator
  Prog Cash Flow Chart
- Individual Participant
  Charts
- Participation Charts

Go To Reports
- Program Summary Results
- Prog Summary Cost Effectiveness
- Program Benfits Results
- Annual Program Energy Savings
- Annual Program Financial Savings
- Program Rate Impacts
- Program RIM Test
- Individual Participant Results

Portfolio Summary Results
- Portfolio Summary Cost Effectiveness
- Portfolio Participation Results
- Portfolio Energy Savings
- Portfolio Financial Savings
- Portfolio Rate Impacts
- Portfolio RIM Test
## Costs and Benefits associated with DSM

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
<td>• Energy savings</td>
</tr>
<tr>
<td></td>
<td>• Lower energy bills</td>
</tr>
<tr>
<td></td>
<td>• More disposable income</td>
</tr>
<tr>
<td></td>
<td>• Customer share of equipment purchase</td>
</tr>
<tr>
<td><strong>Utility</strong></td>
<td>• Peak demand reduction</td>
</tr>
<tr>
<td></td>
<td>• Reduced cost of electricity supply</td>
</tr>
<tr>
<td></td>
<td>• Reduced losses</td>
</tr>
<tr>
<td></td>
<td>• Reduced network congestion</td>
</tr>
<tr>
<td></td>
<td>• Customer good will</td>
</tr>
<tr>
<td></td>
<td>• Utility costs to procure &amp; deliver</td>
</tr>
<tr>
<td></td>
<td>• Distribution and marketing costs</td>
</tr>
<tr>
<td></td>
<td>• Measurement &amp; verification</td>
</tr>
<tr>
<td><strong>GoJ</strong></td>
<td>• Reduced subsidy outlays</td>
</tr>
<tr>
<td></td>
<td>• Lower energy bills for gov’t buildings</td>
</tr>
<tr>
<td></td>
<td>• Reduced spending on new supply</td>
</tr>
<tr>
<td></td>
<td>• Incentive payments to customers</td>
</tr>
<tr>
<td></td>
<td>• Incentive payments to the utility</td>
</tr>
<tr>
<td></td>
<td>• DSM regulatory oversight costs</td>
</tr>
<tr>
<td></td>
<td>• Measurement &amp; verification</td>
</tr>
</tbody>
</table>
Example: Financial analysis of energy-saving lamps

<table>
<thead>
<tr>
<th>Bulb Type</th>
<th>Incandescent</th>
<th>CFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Use</td>
<td>75W</td>
<td>22W</td>
<td>11W</td>
</tr>
<tr>
<td>Purchase Price</td>
<td>0.5JD</td>
<td>2 JD</td>
<td>4 JD</td>
</tr>
<tr>
<td>Life of the Bulb</td>
<td>1000 hours</td>
<td>10,000 hours</td>
<td>25,000 hours</td>
</tr>
<tr>
<td>Hours per Day</td>
<td>6 hours</td>
<td>6 hours</td>
<td>6 hours</td>
</tr>
<tr>
<td>Bulb lifetime</td>
<td>0.5 year</td>
<td>5 years</td>
<td>15 years</td>
</tr>
<tr>
<td>Annual bulb replacement Cost</td>
<td>1 JD</td>
<td>0.4JD</td>
<td>0.27JD</td>
</tr>
<tr>
<td>Annual Cost to participants (.033JD/kWh)</td>
<td>4JD</td>
<td>1 JD</td>
<td></td>
</tr>
<tr>
<td>Annual cost to NEPCO (.1 JD/kWh)</td>
<td>5 JD</td>
<td>3 JD</td>
<td></td>
</tr>
<tr>
<td>Total Cost over 1 year</td>
<td>5 JD</td>
<td>3 JD</td>
<td></td>
</tr>
<tr>
<td>Simple Payback - Participant (years)</td>
<td>N/A</td>
<td>0.39</td>
<td>3.77</td>
</tr>
<tr>
<td>Simple Payback - NEPCO (years)</td>
<td>N/A</td>
<td>0.11</td>
<td>1.06</td>
</tr>
</tbody>
</table>
Step-by-step DSM program design

• Identify energy savings opportunities
  – By end-use
  – By customer class

• Estimate the potential benefits
  – For customers
  – For utilities
  – For NEPCO, government and regulators

• Develop the implementation approach
  – Specifications and testing needs
  – Procurement
  – Marketing and distribution
  – Measurement and evaluation

• Program cost estimation
DSM targets in Jordan

• 2016 DSM pilot projects:
  – 50,000 LED lamps for households
  – 1000 household SWHs

• 2017-2018 DSM pipeline:
  – Household refrigerator replacement
  – High-efficiency appliance rebates
  – Household PV

• 10-year DSM outlook:
  – Scale-up successful DSM projects with funding through tariffs
  – Goal: 1% annual household electricity savings and 10% reduction in subsidies
Thank you!

Grayson Heffner, Resident Advisor
gheffner@deloitte.com