# The Prospects for Electricity Trade Between the GCC Countries


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*MEED 2nd Middle East Power and Water*

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# ADWEC and GCC / ENG Grids

# Law Number 2 of 1998

ADWEC is the single buyer and seller of electricity and water.

ADWEC is responsible in the Emirate of Abu Dhabi for :

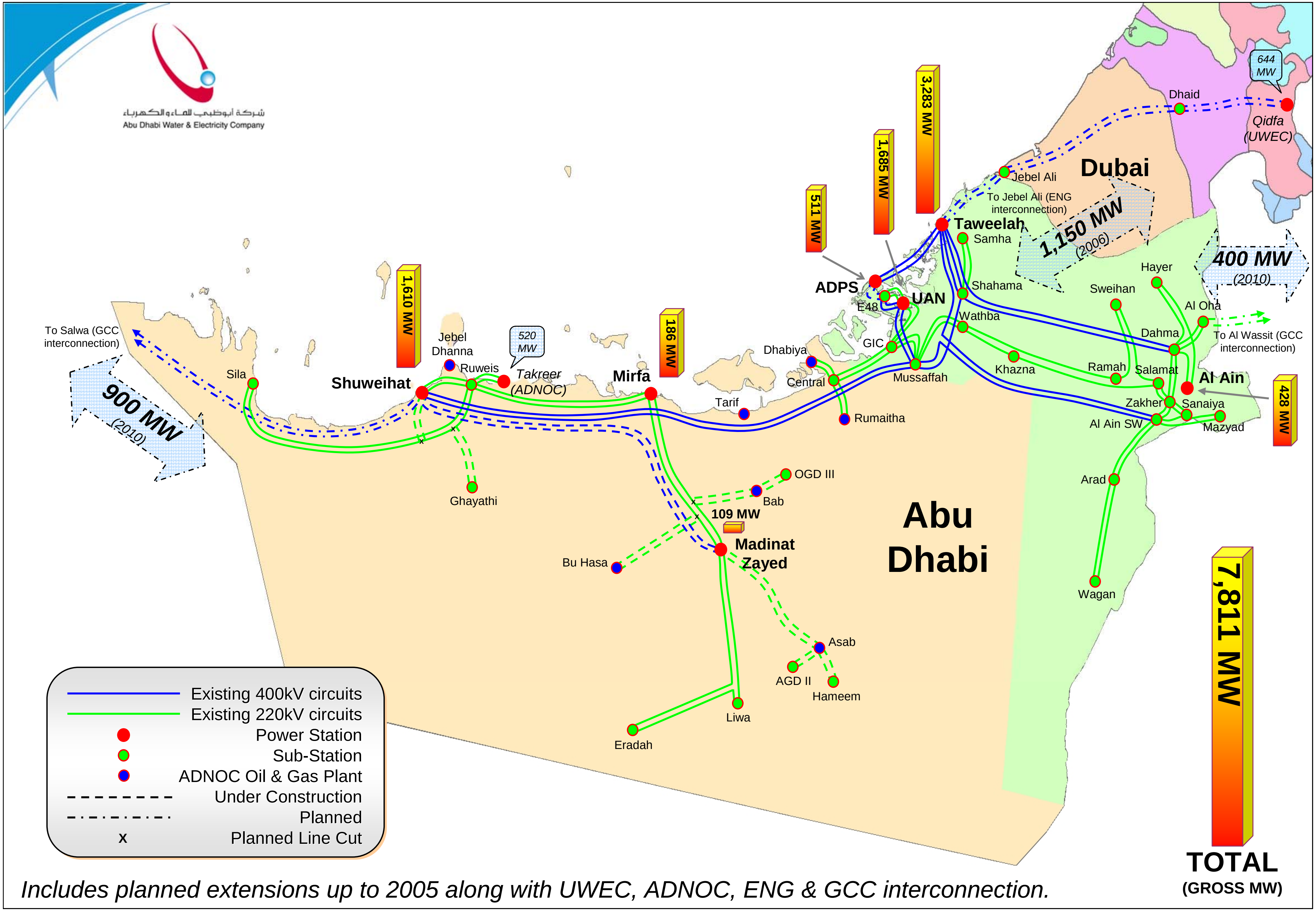
- Electricity & Water Demand Forecasting.
- Electricity & Water Capacity Planning.

ADWEC's legal duties are fulfilled via :

- Annual Electricity & Water System Demand Forecast Report (2005 – 2015).
- Annual Statement of Future Capacity Requirements (2005 – 2015).

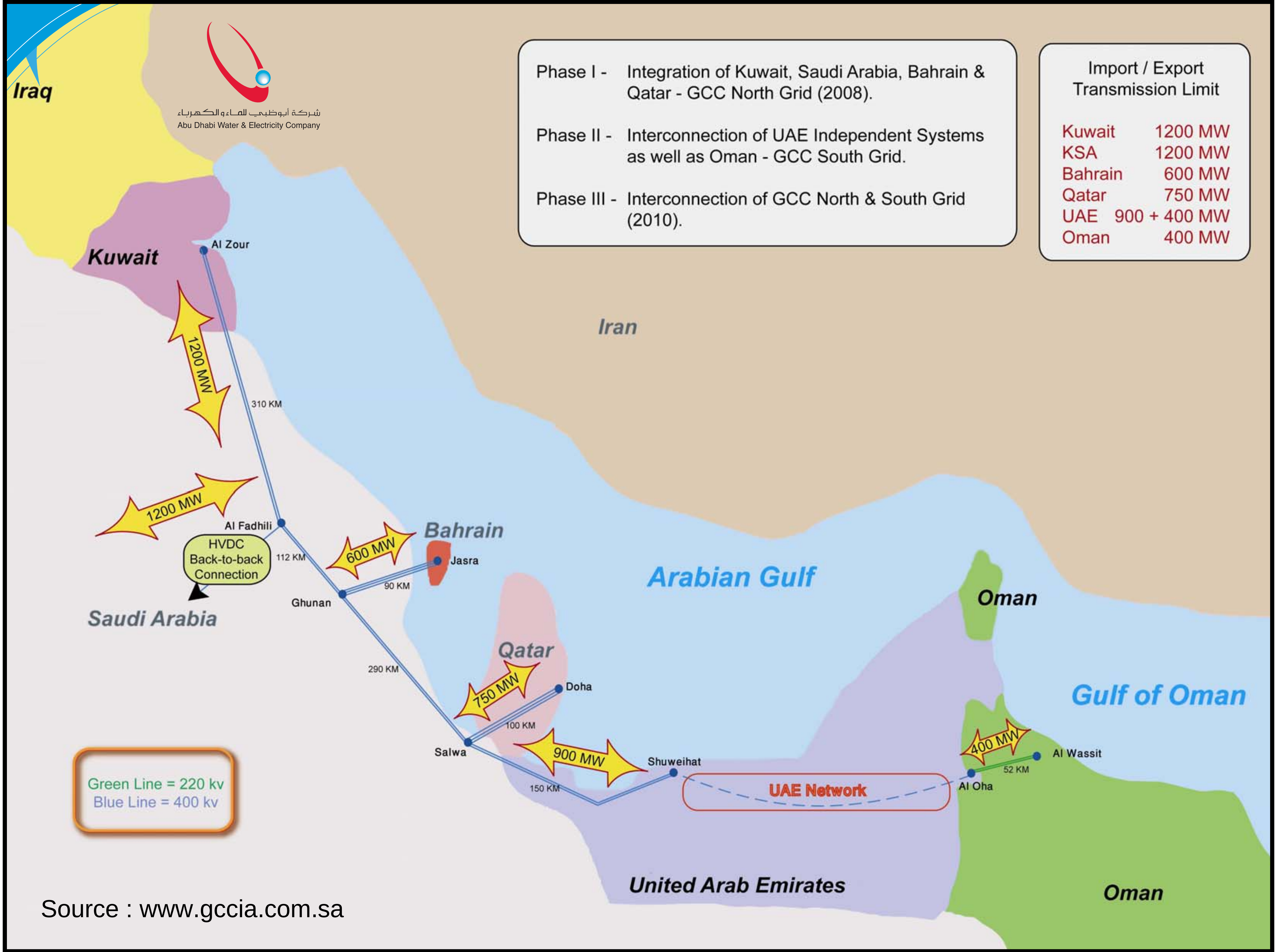
GCC / ENG Grids create issues that do not exist in independent systems.

# Emirate of Abu Dhabi's GCC / ENG Interconnections




*Includes planned extensions up to 2005 along with UWEC, ADNOC, ENG & GCC interconnection.*

February 27, 2005




Source : www.gccia.com.sa

# Emirate of Abu Dhabi
# GCC / ENG Grid Interconnections

| | MW |
|---|---|
| **Western GCC Grid** (Kuwait, Bahrain, Qatar and Saudi Arabia) | 900 |
| **Eastern GCC Grid** (Oman) | 400 |
| **Emirates National Grid** (Other UAE Emirates) | 1150 |
| **Total Abu Dhabi Interconnections** | **2450** |

# GCC / ENG Grid Interconnections

| | Total GCC / ENG Grid Interconnections (MW) | Percent of 2003 Peak |
|---|---|---|
| **Bahrain** | 600 | **39.1%** |
| **Kuwait** | 1200 | **16.0%** |
| **Oman** | 400 | **15.3%** |
| **Qatar** | 750 | **32.4%** |
| **Saudi Arabia** | 1200 | **4.6%** |
| **Abu Dhabi** | **2450** | **59.3%** |

Abu Dhabi 2003 peak was 4134 MW.

Saudi Arabia 2003 Peak 26,272 MW
Eastern Region 2003 Peak 8,280 MW *(region that will directly connect to GCC grid).*
Central Region 2003 Peak 8,415 MW *(only Saudi region connected to Eastern Region).*

# ADWEC's Response to ENG / GCC Interconnections

ADWEC has started to monitor the GCC countries & UAE Emirates :

- Total Generation Capacities (MW)
  - New Capacity
  - Retired Capacity
  - Substitute Capacity
- Peak Demand
- Demand Profile
- Timing and Delays in New Capacity & Maintenance Outages

Monitoring exercise will analyze the impact of the GCC / ENG grids on Abu Dhabi.

The monitoring exercise is in early stages and will be regularly updated.

Continuously updated – static studies quickly become outdated.

# ADWEC GCC / ENG Monitoring

- Collect information on new capacity primarily from public sources.
- Three electricity peak demand growth assumptions examined.

**GCC Grid Analysis - Annual Electricity Demand Growth Scenarios**

| Low | Base | High |
|---|---|---|
| 4% | 6% | 8% |

- Peak Demand / Capacity analysis done for each GCC country.
- 20% Reserve Margin assumed in order to calculate Required Capacity.

**Required Capacity = 1.2 x Peak Electricity Demand Forecast**

- Unplanned capacity is assumed to be in multiples of 500 MW, creating surpluses.

# Potential Regulatory Issues

GCC / ENG grids will provide emergency supplies, but what about economic trade?

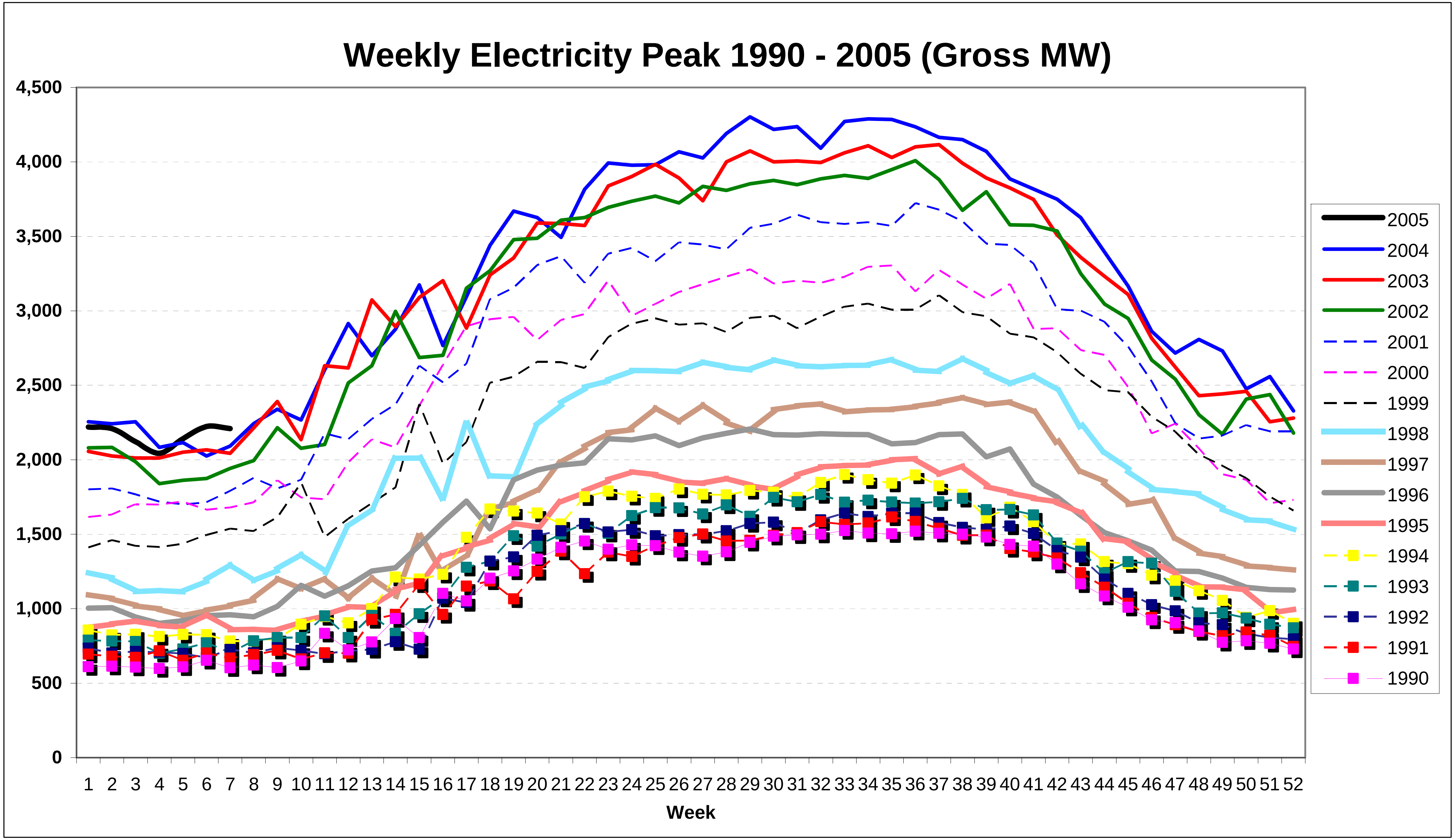
- Privatisation creates pricing and settlement issues.
- Domestic consumers should not subsidise electricity exports.
- No cross-subsidization - clear allocation of fuel costs.
- Exports should not receive subsidies – unless policy decision explicitly taken.
- Electricity exports will increase variable O&M revenues to IPPs / IWPPs.
- Regulators will need to carefully consider capacity installed mainly for exports.

# Pricing Issues

- Relative electricity Export / Import prices will determine the prospects for trade.
- Import price (variable O&M + fuel + transmission) <= domestic price.
- Export price => Economic Production Costs.
- Exports will improve generation fuel efficiency, thereby lowering unit fuel costs.
- Should importing country also benefit from exporter's lower unit fuel costs?
- Differences in fuel input prices create opportunities for electricity trade.
- Should export price include Availability Costs?
- Wheeling charges need to be defined.

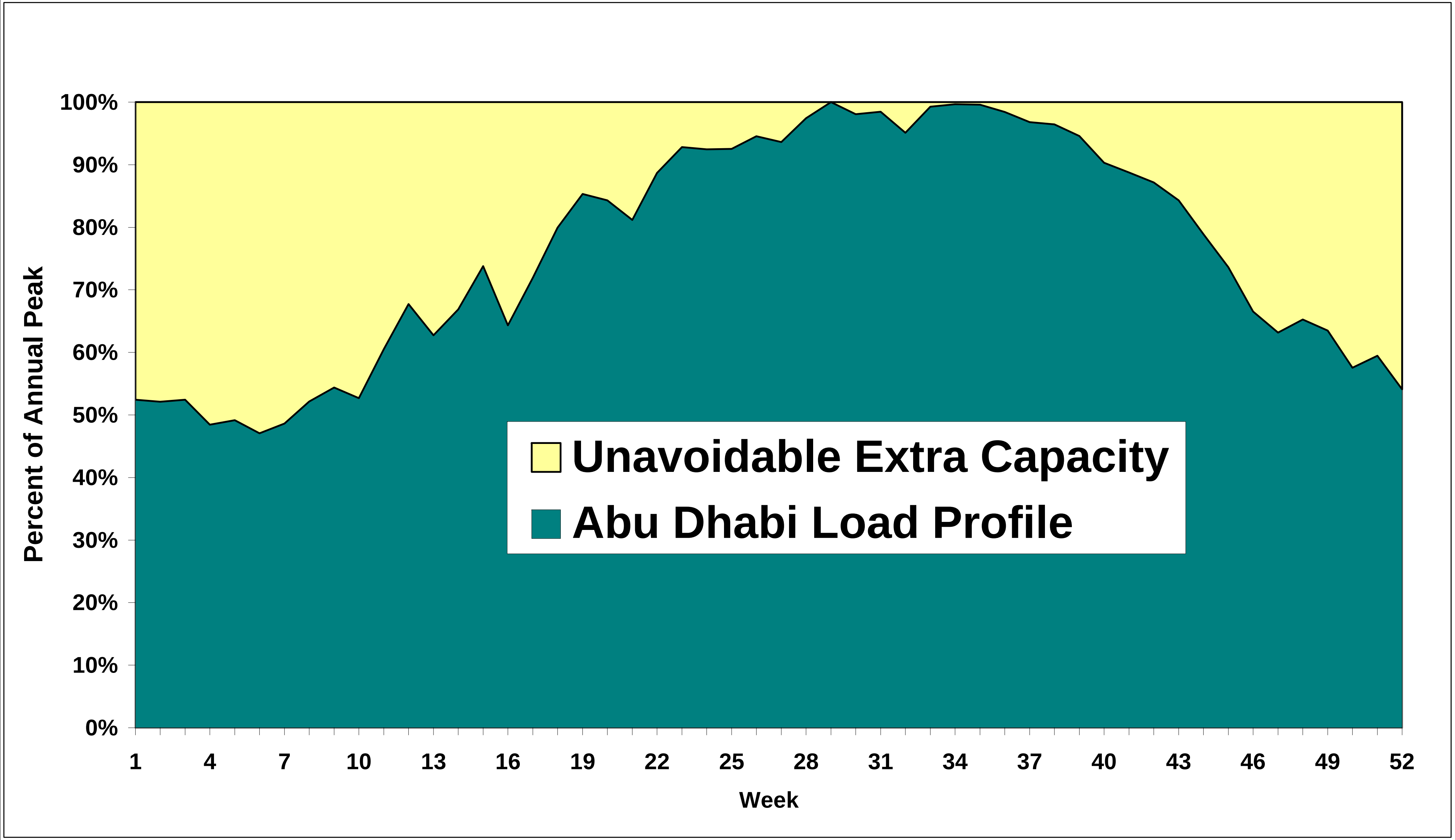
# Emirate of Abu Dhabi
# &
# GCC / ENG Grids
# Lessons

# Abu Dhabi Demand Profile



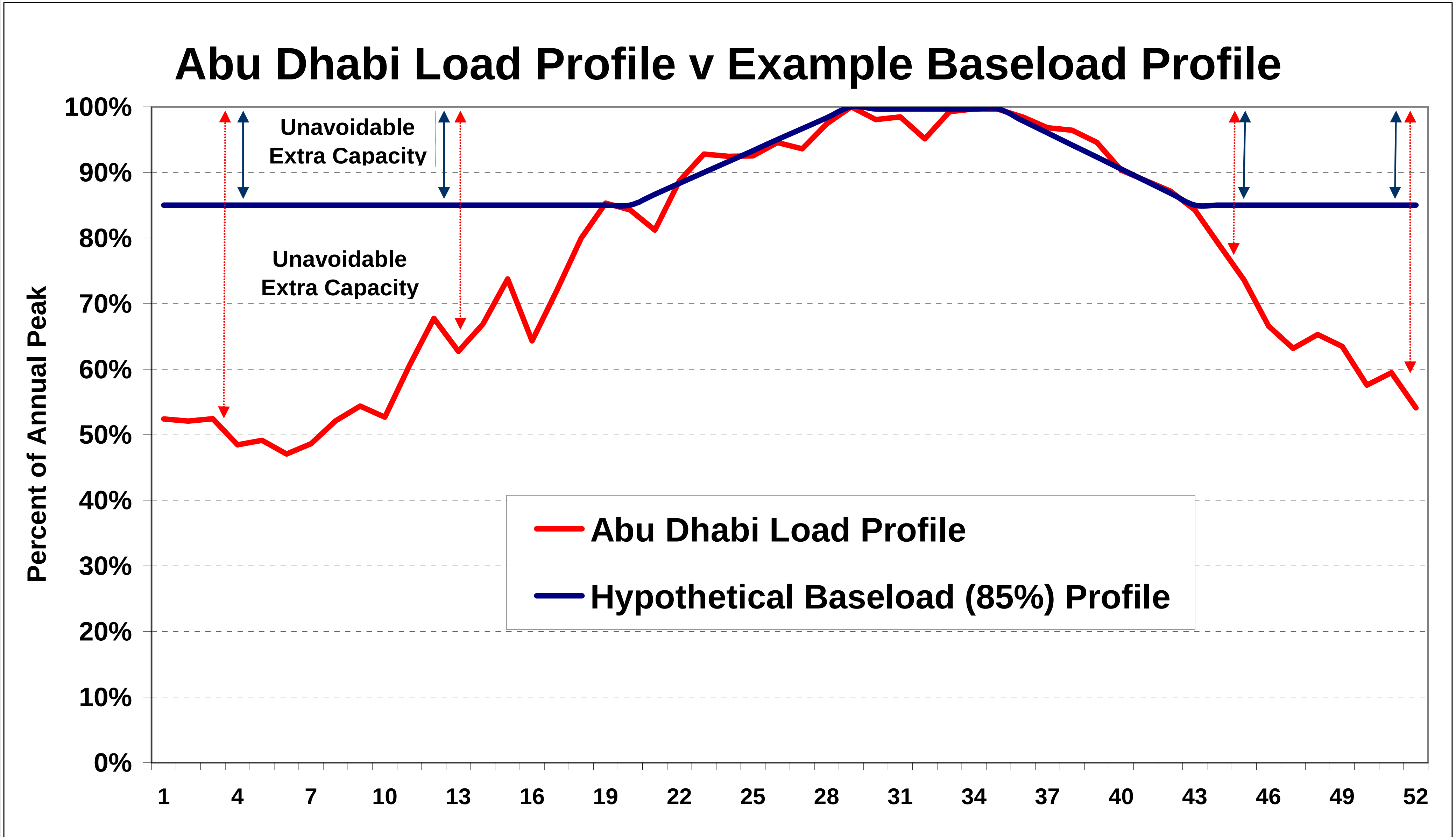

**Kuwait, Qatar and Dubai have similar Demand Profiles**

# Abu Dhabi Weekly Load Relative to Annual Peak




**Like other systems Abu Dhabi has unavoidable extra capacity**

# Unavoidable Extra Capacity v Load Profile




**Baseload demand profiles typically have less spare capacity - Creates Potential for Trade**

# Factors Determining Electricity Trade

- Demand Profile – determines spare capacity

  Winter – high spare capacity / low electricity demand

  Summer – low spare capacity / high electricity demand

  Suggests greatest potential for economic trade in Spring / Autumn.

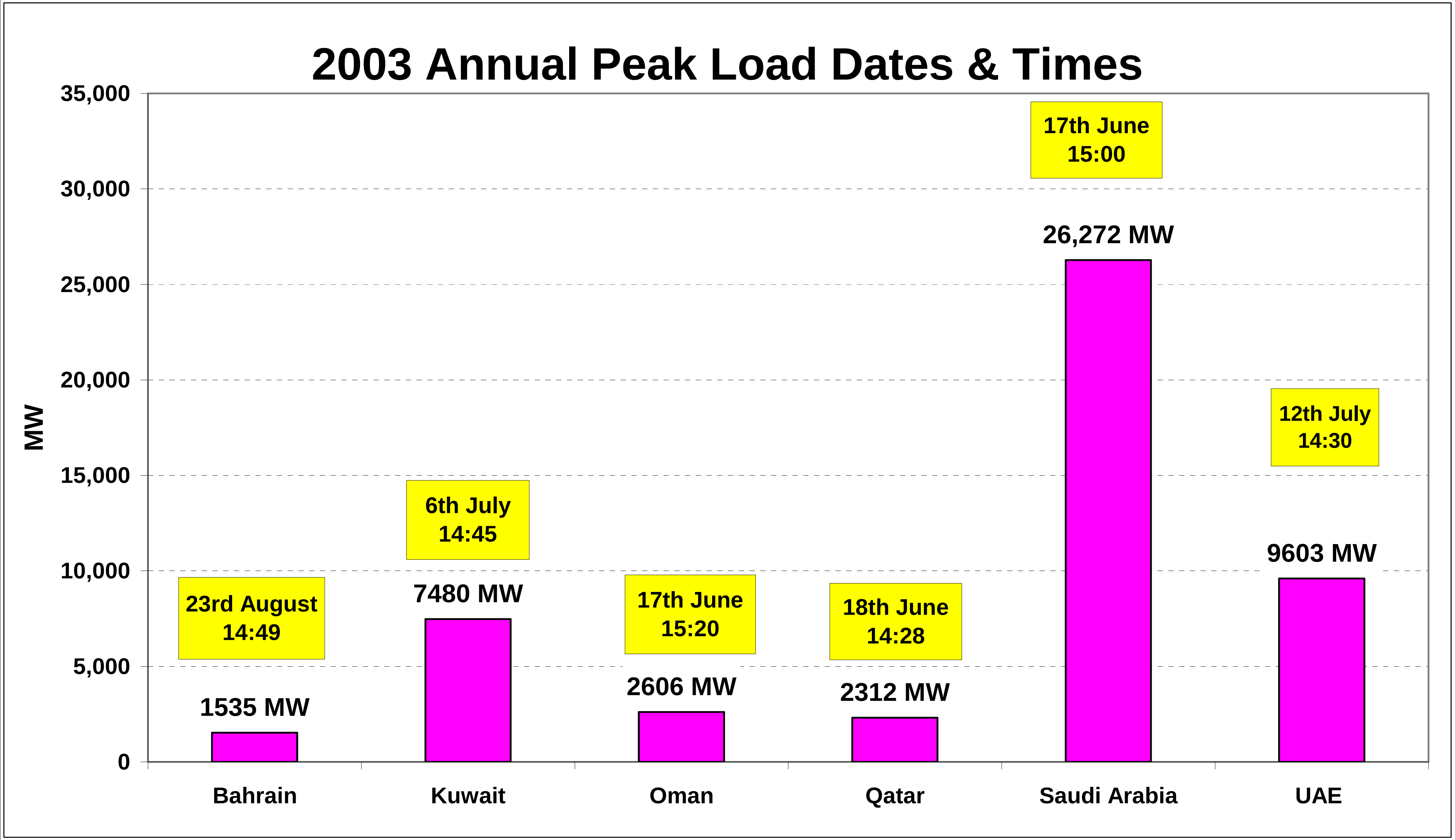
  Air conditioning dominated profiles v Baseload Profiles.

- Requirement to maximise water production.
- Countries relative cogeneration (electricity & water) v single cycle capacities.

- May need to generate some electricity to support local transmission system.
- Scheduled / unscheduled maintenance outages.

- Timing of Annual Peak demands.
- High electricity Summer demand during non-peak hours – high trade potential.

# 2003 GCC Annual Peak Demands




Source: www.gcc-cigre.org

**Oman, Qatar & Saudi Arabia peaks happened within 24 hours in 2003**

# Temperature & Water Issues

- Capacity in AD is installed on the basis of Reference Site Conditions (e.g. 46°C).

- During Winter gas turbines may produce more electricity :

  ADWEA IWPP (4.9 GW = GT + ST) Capacity +10% extra electricity in Winter.

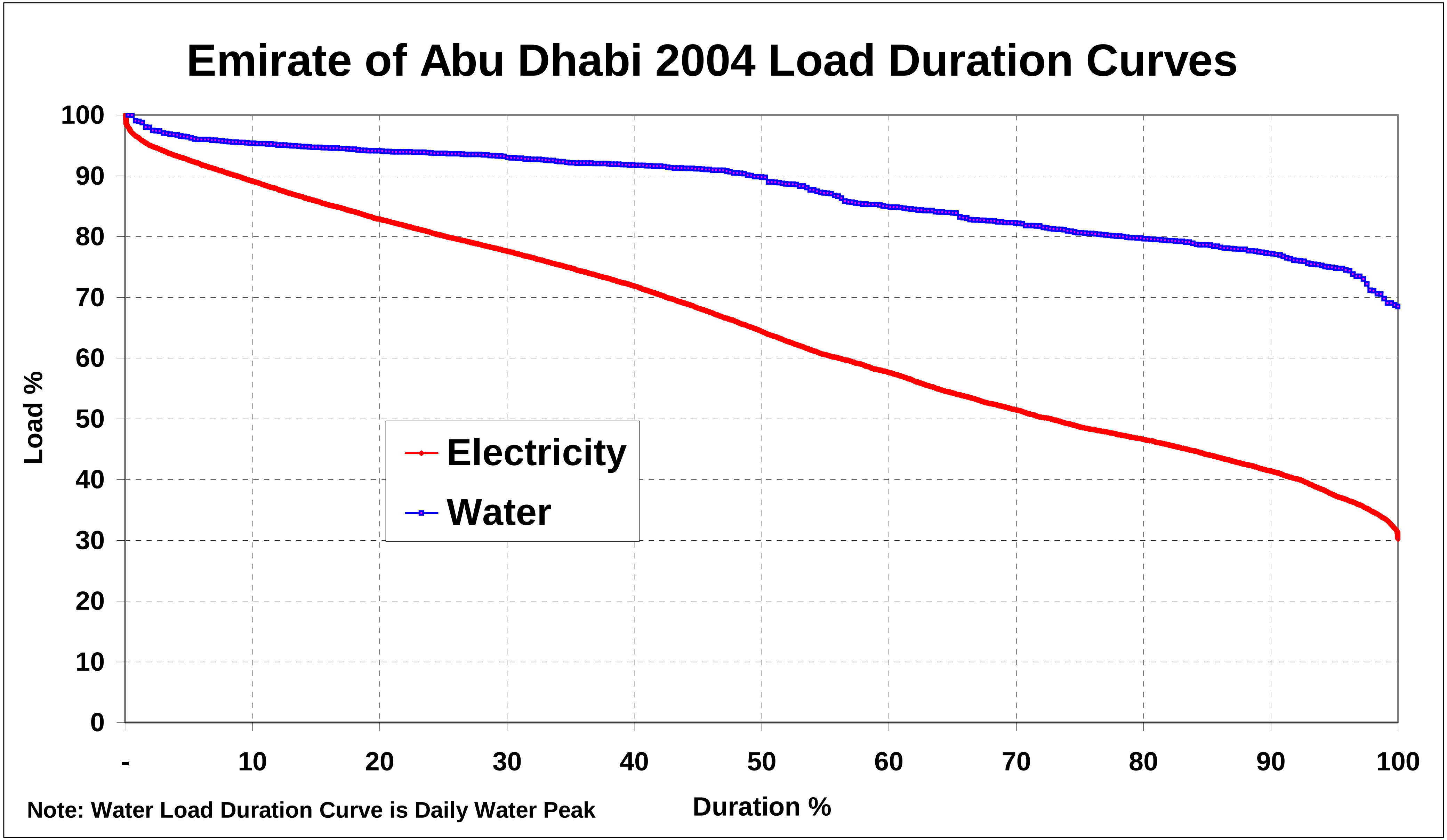
  Approximately +500 MW extra electricity available in Winter.

- Extra temperature related output partly offsets maintenance outages in Winter.

- Abu Dhabi's IWPP cogeneration stations often need to produce 30% - 35% of electricity capacity in order to maximise water production.

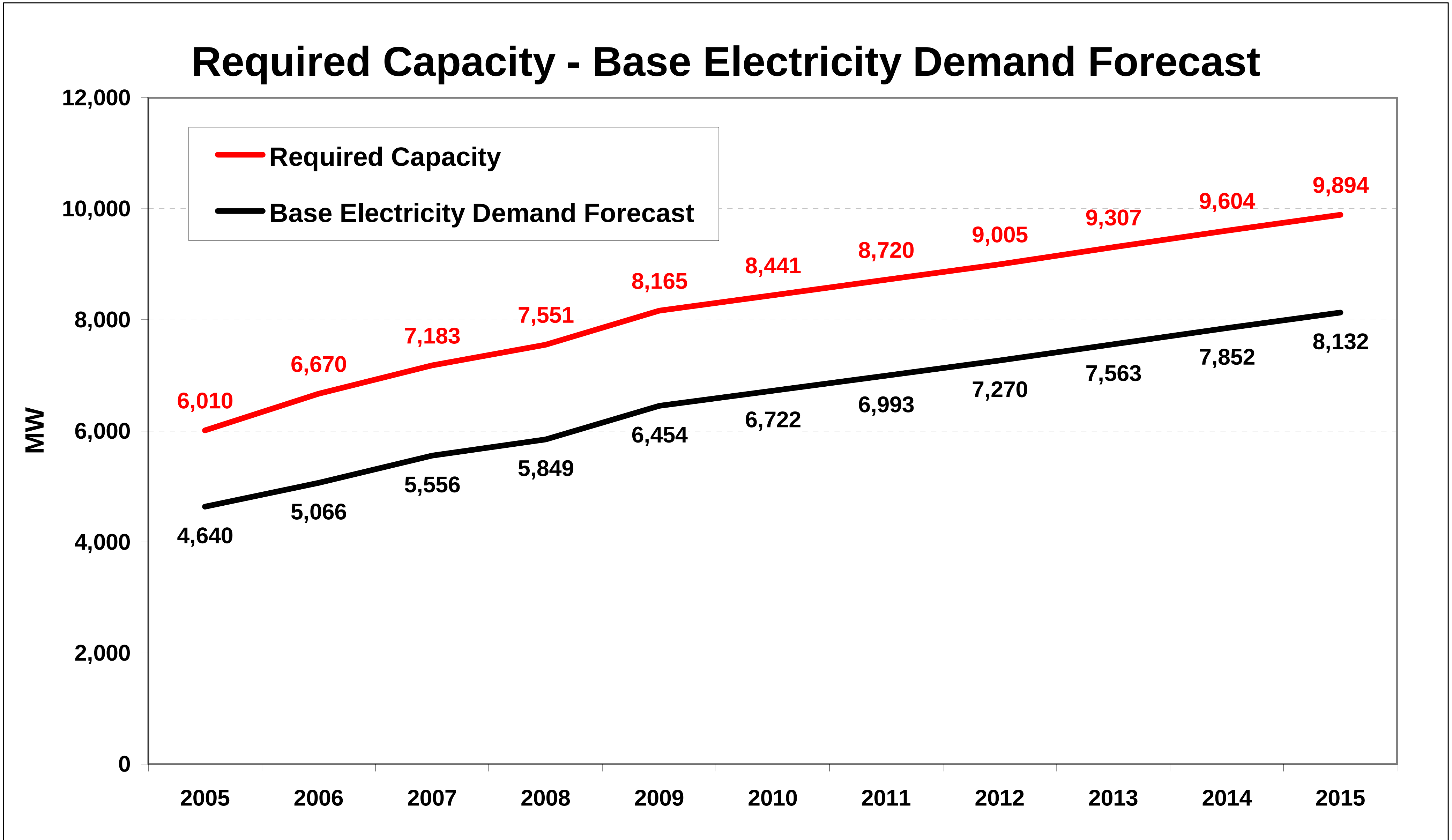
- Alternative plant types may avoid the need to generate electricity for water production purposes (e.g. RO and waste incinerators for distiller steam).

# Abu Dhabi Load Duration Curves




**Conclusion: Water production varies less than electricity**

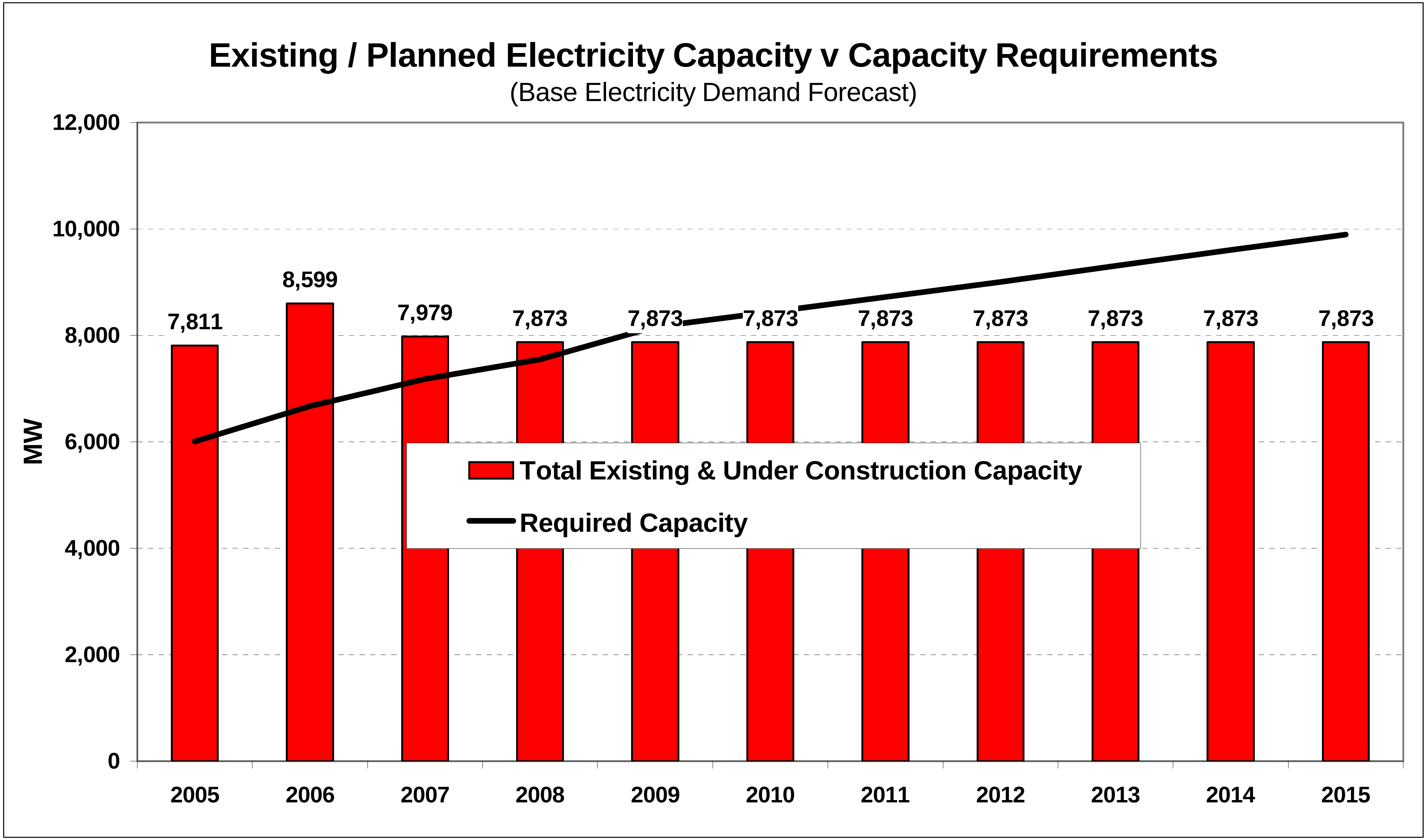
# Abu Dhabi Required Capacity




## Reserve capacity might be used for interruptible exports

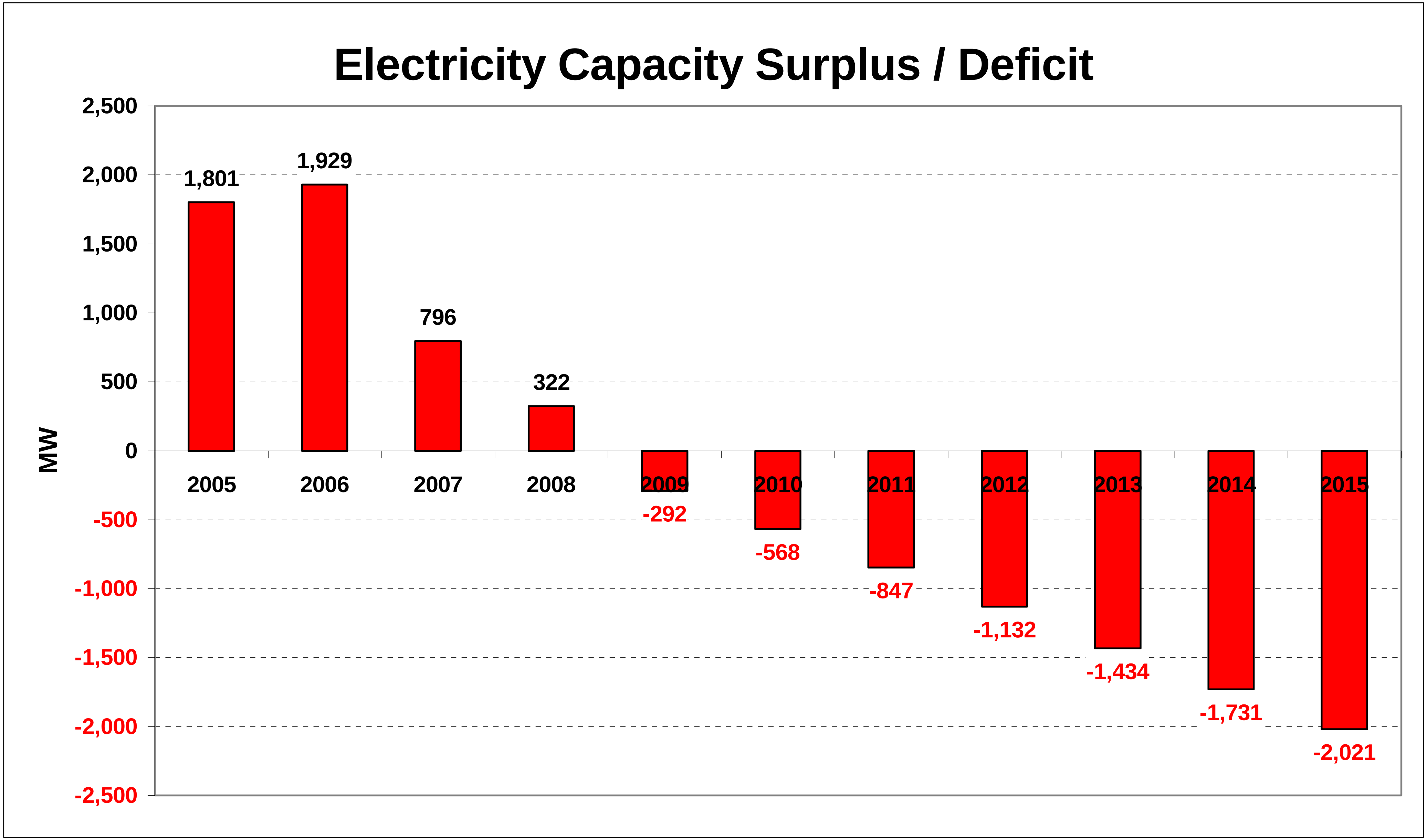
Note: Required Capacity based on LOLE of 0.1

# Abu Dhabi Required Capacity v Planned Capacity




Note: Required Capacity based on LOLE of 0.1

# Abu Dhabi Potential Exports



# GCC Countries
# &
# GCC / ENG Grids
# Data

# Bahrain Highlights

- 2004 Peak = 1,647 MW
- Capacity = 1,879 MW
- Last 5 years average annual demand growth of 6.5% p.a.
- GCC Grid interconnection = 600 MW = 36.4% of 2004 peak.

**New Capacity**

| | | |
|---|---|---|
| 2004 | Al-Hidd Phase II | 700 MW |
| 2006 April | Al-Ezzal Phase I | 470 MW |
| 2007 May | Al-Ezzal Complete | 1000 MW (including Phase I). |
| 2011 – 2020 | MEW Proposed station | 3000 MW (phased). |

Rifa station (700 MW) currently being rehabilitated to extend its life.
Manama (< 100 MW) gradually being retired (finish end – 2005).

**Ministry of Electricity and Water**
New capacity not required after Al-Ezzal until 2011 if 6.5% demand growth persists.

MEW peak electricity demand forecast:

2010 = 2,468 MW
2020 = 4,312 MW

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Kuwait Highlights

- 2003 Peak = 7,480 MW
- Capacity = 9,300 MW
- Recent years electricity demand has grown at 5% - 6% p.a.
- GCC Grid Interconnection = 1200 MW = 16% of 2003 peak.

**New Capacity**

Two new stations are under construction, Al-Zour South and Al-Zour North.

Al-Zour South will consist of eight open cycle gas turbines.

Al-Zour North 5 x 500 MW turbines.

| | | |
|---|---|---|
| 2004 August | Al-Zour South Phase I | 480 MW |
| 2005 May | Al-Zour South Complete | 1000 MW (including Phase I) |
| 2006 late | Al-Zour North | Scheduled to begin operations |
| 2009 | Al-Zour North Complete | 2500 MW |

Forecasts suggest electricity demand will grow at 7% - 9% p.a.

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Oman Highlights

- 2003 Peak = 2,606 MW
- Capacity = 2,900 MW
- Electricity consumption is growing at 4% – 5% per annum
- GCC Grid Interconnection = 400 MW (via Abu Dhabi) = 15.3% of 2003 peak.

**New Capacity**

By 2006, 3,260 MW of capacity will be required

Government raising capacity from 2,268 MW (end 2002) to 3,260 MW (end 2006).

Oman's Government forecasts electricity demand will be 75% higher in 2015.

| | | |
|---|---|---|
| 2008 | Sohar | 1,400 MW Aluminium smelter plant |
| 2006 | Sohar IWPP | 585 MW (33 MGD) |
| 2004 | Qarn Alam | 140 MW (captive power station) |
| 2003 | Al Kamil IPP | 285 MW (replace diesels in Sharqiyah region). |
| 2003 | Barka IWPP | 427 MW (20 MGD) |
| 2003 | Salalah IPP | 200 MW (replace the diesel units in Salalah and Raysut) |

Next IWPP expected to add 450 MW (20 MGD) to the existing Barka plant.

Expected to include the acquisition of the Government 687.5 MW Rusayl plant.

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Qatar Highlights

- 2004 Peak = 2,520 MW
- Capacity = 3,069 MW
- Electricity consumption is growing at 8% – 9% per annum.
- GCC Grid Interconnection = 750 MW = 29.8% of 2004 peak.

**New Capacity**

| | | |
|---|---|---|
| 2004 | Ras Laffan IWPP | 750 MW |
| 2006 | Ras Laffan II (B) IWPP Phase I | 600 MW (15 MGD) |
| 2008 | Ras Laffan II (B) IWPP Complete | 1025 MW (60 MGD) including Phase I. |
| | | |
| 2002 | Ras Abu Fontas B Expansion | 380 MW (total station 1030 MW) |

Electricity demand is forecast to reach 5000 MW by 2012.

Proposed 1000 MW captive power station for a world scale aluminum complex.

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Saudi Arabia Highlights (i)

- 2003 Peak = 26,272 MW
- Eastern Region 2003 Peak = 8,280 MW
  *(region that will directly connect to GCC grid).*
- Central Region 2003 Peak = 8,415 MW
- GCC Grid Interconnection = 1,200 MW = 4.6% of 2003 peak (26,272 MW).

- Peak Electricity Demand growth forecast 4% - 4.5% p.a.

Eastern region currently only interconnected to Central Region (380 kV / 60 Hz link).

By 2006, SEC expects to have two major transmission islands:
Eastern - Central region – Approximately Two-Thirds of consumption.
Western - Southern region – Approximately 30 percent of consumption.
Northern region accounts for remainder.

The SEC says eventually all the regions will be connected.

- Western Region 2003 Peak = 7,411 MW
- Southern Region 2003 Peak = 1,791 MW

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Saudi Arabia Highlights (ii)

## New Capacity

| Station | Capacity MW | Completion Dates | Other |
|---|---|---|---|
| **Riyadh's PP9 Expansion** | **480** | Scheduled completion September 2004. (started February 1st 2004!) | **SEC**'s ultra-fast program |
| **Riydah PP9 Expansion** | **1200** | February 2005 contract award imminent. | **SEC** |
| **Najran Expansion** | **50** | Bids submitted on 10/1/2005 | **SEC** |
| **Qurrayat Expansion** | **25 - 30** | Bids due by 29/3/2005. | **SEC** |
| **Marafiq (Jubail) IWPP** Phase I | **2400** | Completion 2007 / 2008 | Phase I (RFP issued in July 2004) - Pre-qualify bids by 28/2/2005 |
| **Phase II** | **1500 - 2000** | | +300,000 cubic meters of water a day |
| **Al Shoaiba Phase III (Shuaiba / Shouaiba IWPP)** - Western Province | **650 - 900** | PCOD September 2008 (49 months after RFP issued) | + 194 MGD |
| **Al Shuqaiq II IWPP** - Western Province | **700** | Expressions of interest invited in 2005 | + 24 MGD |
| **Ras Al-Zour (Ras Az Zour / Ras AlZor) IWPP** - Eastern Province | **2500** | No timeframe set (timetable for first 4 IWPPs 2006 - 2010 | + 176 MGD |
| **Al Jubail III IWPP** - Eastern Province | **1100** | No timeframe set (timetable for first 4 IWPPs 2006 - 2010 | + 75 MGD |
| **SADAF IPP** | **260** | Completion 2005 Q2 | Currently under development. |
| **Saudi Aramco IPP**<br>*Ras Tanura (150MW and 645,000lb/h steam)*<br>*Ju'aymah (308MW and 1,250,000lb/h steam)*<br>*Shedgum (308MW and 1,250,000lb/h steam)*<br>*Uthmaniyah (308MW and 1,250,000lb/h steam)* | **1074** | Phased basis March - December 2006 | Project with Saudi Oger & International Power. |

# Large number of short term non-IWPP projects

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Saudi Arabia Highlights (iii)

## New Capacity

| Station | Capacity MW | Completion Dates | Other |
|---|---|---|---|
| **Shuaiba (Shoaiba) Power Plant Expansion** | **1100** | First turbine by mid-2006 | Contract should include an option to build a further 3 units on the same site which could be exercised within 12 months. |
| **Jeddah PP3 Expansion Scheme** | **640** | 2005 | 8 x 80 MW turbines. |
| **Al Khafji Captive Power Plant** | **90** | May 2004 | 3 GTs x 30 MW = 90 MW |
| **Hail Power Station Expansion** | **100** | Under Construction | 2 x 50 MW |
| **Tabuk Project Expansion** | **120** | Awarded May 2003. | Client is SEC. |
| **Asir & Bisha Station Expansions**<br>- Southern Region | **330** | Contract awarded February 2004 | Client SEC South |
| **Riyadh SEC Turnkey Plant** | **240** | Fall 2005 | Client SEC |
| **Jizan Plant Expansion** - Southern Region | **200**<br>3 Gas Turbines | 1st GT August 2005<br>2nd GT November 2005<br>3rd GT August 2006 | |
| **Qassim Upgrade** | **300** | Project under construction. | |
| **Berri Gas Plant (Saudi Aramco)** | **300** | April 2005 | Saudi Aramco is actively planning power generation facilities to save electricity costs at the plants it operates. |
| **Arar** | **100 - 120** | - | Client SEC |
| **Rafah** | **50 - 60** | - | Client SEC |
| **Rabigh IWSPP (Saudi Aramco** Captive Power Pla | **400** | Bid closing date 30/4/2005 | Client Saudi Aramco |
| **Maaden** Captive Power Plant | **1500** | | Captive Power Plant. |

**Large number of short term non-IWPP projects**

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# Saudi Arabia Highlights (iv)

## New Capacity

### SEC 2010 – 2017 Proposed Power Generation Projects

| Station | MW | MGD | Completion Dates | Region |
|---|---|---|---|---|
| Muzahimiyah / Al-Mazahimiyah | 1,725 | | 2010-2012 | Central |
| Rabigh-II / Rabigh 2 | 2,400 | 150 | 2011-2013 | Western |
| Qurayyah-II / Al-Qurayyat 2 | 3,600 | 150 | 2012-2014 | Eastern |
| Sulbokh / Salboukh | 1,725 | | 2012-2014 | Central |
| Power Plant #10 / Riyadh PP10 | 1,725 | | 2014-2016 | Central |
| Yanbu-II / Yanbu 2 | 2,400 | 150 | 2014-2016 | Western |
| Shuqaiq-II / Shuqaiq 2 | 600 | 23 | 2015-2017 | Southern |
| **Total** | **14,175** | | | |

## Conclusion

The impact of Saudi Arabia on the GCC Grid is difficult to predict because of

- Limited transmission facilities within and between regions (e.g. national grid).
- Large number of short-term expansion projects.
- Installation of substitute capacity for SEC electricity (Saudi Aramco / Marafiq).

In practice Saudi Arabia's modest GCC Grid interconnection of 1200 MW limits the impact of Saudi Arabia on the GCC Grid.

Note : All of the above data is taken from publicly quoted sources and are not ADWEC estimates.

# United Arab Emirates Highlights (i)

**2003 Capacities**

| | ADWEA | DEWA | SEWA | FEWA | UWEC | Total |
|---|---|---|---|---|---|---|
| **Peak** | 4,116.0 | 2,784.0 | 1,217.1 | 1,042.5 | | **9,159.6** |
| **Installed Capacity** | 5,530.0 | 3,833.0 | 1,751.0 | 1,191.0 | 660.0 | **12,965.0** |

Source: UAE Ministry of Energy

**Abu Dhabi**

End-2005 Capacity : 7,811 MW *(see previous Abu Dhabi slides for details)*

2010 Required Capacity : 8,441 MW *(LOLE 0.1)*

2004 Peak : 4,320 MW

2004 Peak Growth : 4.5%

Demand Forecast : 5.9% p.a.

1990 – 2004 Demand : 7.7% p.a.

2015 Demand : 8,132 MW

**Dubai**

Ambitious economic development plans imply rapid electricity demand growth.

Early 2004 Capacity : 4710 MW

2010 Capacity : 9,800 MW

2004 Power Consumption : 14% p.a.

2005 – 2012 Power Consumption : 15% - 18% p.a.

Note : All of the above non-Abu Dhabi data is taken from publicly quoted sources and are not ADWEC estimates.

# United Arab Emirates Highlights (ii)

**New Capacity**

**(i) Abu Dhabi**
Existing planned & under construction capacity will reach 7,873 MW by 2008.

From 2009 new, as yet unplanned, capacity will be required.

Plans to retire approximately 500 MW at Abu Dhabi Power Station in 2006.

Other older capacity is scheduled for retirement in 2007 / 2008 (1.3 GW).

**(ii) Dubai**
Phase II of the Aweer Power station (H Station) : 400 MW (2006)

L Station Phase I : 860 MW *(work in progress)*
L Station Phase II : 1200 MW *(2007 – 2008)*

M Station Proposed at Jebel Ali.

Note : All of the above non-Abu Dhabi data is taken from publicly quoted sources and are not ADWEC estimates.

# Conclusions

- Electricity trade during peak summer hours will be limited.
- Electricity trade will be possible during summer non-peak hours & winter months.
- Spring / Autumn months will also provide some opportunities for electricity trade.
- Unavoidable capacity surpluses will be significant during the winter months.
- Current type of plant mix means that maximising water production forces stations to continue to generate electricity during winter, alternative plant mix boiler / MSF.
- Electricity exports lower unit generation costs due to increased fuel efficiency.
- Variations in load profiles will provide opportunities for some electricity trade.
- Lumpiness of new capacity additions will create surplus capacity in certain years.

# THANK YOU