



شركة أبوظبي للماء والكهرباء
Abu Dhabi Water & Electricity Company

The Challenges of Supplying Electricity and Water

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(ADWEC)**

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ADWEC and Law Number 2 of 1998



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ADWEC is the **Single Buyer and Seller** of electricity and water.

ADWEC is responsible inter alia for :

- Electricity & Water **Demand Forecasting**.
- Electricity & Water **Capacity Planning**.
- Contracting of new IWPP capacity and BST preparation.
- Contracting for gas / fuel supply.
- Financial Settlement

ADWEC's legal **Demand Forecasting** and **Capacity Planning** duties are fulfilled via annual :

- ***Electricity & Water Demand Forecasts.***
- ***Statement of Future Capacity Requirements.***

Article 30 of Law Number 2 of 1998



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Requires ADWEC to

‘ensure that, at all times, all reasonable demands for water and electricity in the Emirate are satisfied’.

To satisfy Law Number 2’s requirements ADWEC prepares annual forecasts of electricity and water demand.

ADWEC’s **Demand Forecasts** are used to prepare :

- ***ADWEC Statement of Future Capacity Requirements***
- ***TRANSCO 5 Year Planning Statement***
- ***Bulk Supply Tariff, ADWEA Budget and Other Planning.***

Key Recent Demand Developments



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1. Changes in **land ownership laws** during 2005
Resulted in the creation of **Mega Projects** :
Al Reem Island, Al Raha Beach, Saadiyat Island, Yas Island etc...
2. Releasing of **surplus oil revenues** for major infrastructure developments and **Mega Projects**.
3. Release of **Plan Abu Dhabi 2030**
4. **1.2 trillion AED** to be spent on Development Projects (ADCCI).

Result = Development Boom

Development Boom will require **significant** quantities of extra electricity and water capacity over and above the “normal” developments assumed in pre-2005 demand forecasts.

Overview



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- **\$172+ billion** of **Mega Projects** announced since 2005 (real estate /commercial / mixed use) e.g. Al Raha Beach, Al Reem Island, Saadiyat Island, Yas Island.
- ADWEC must purchase additional IWPP capacity for the demand increase.
- Higher demand creates need for more **new IWPP Capacity**
- **2006 peak per capita consumptions** (approximate) were

Electricity 3 kW per capita

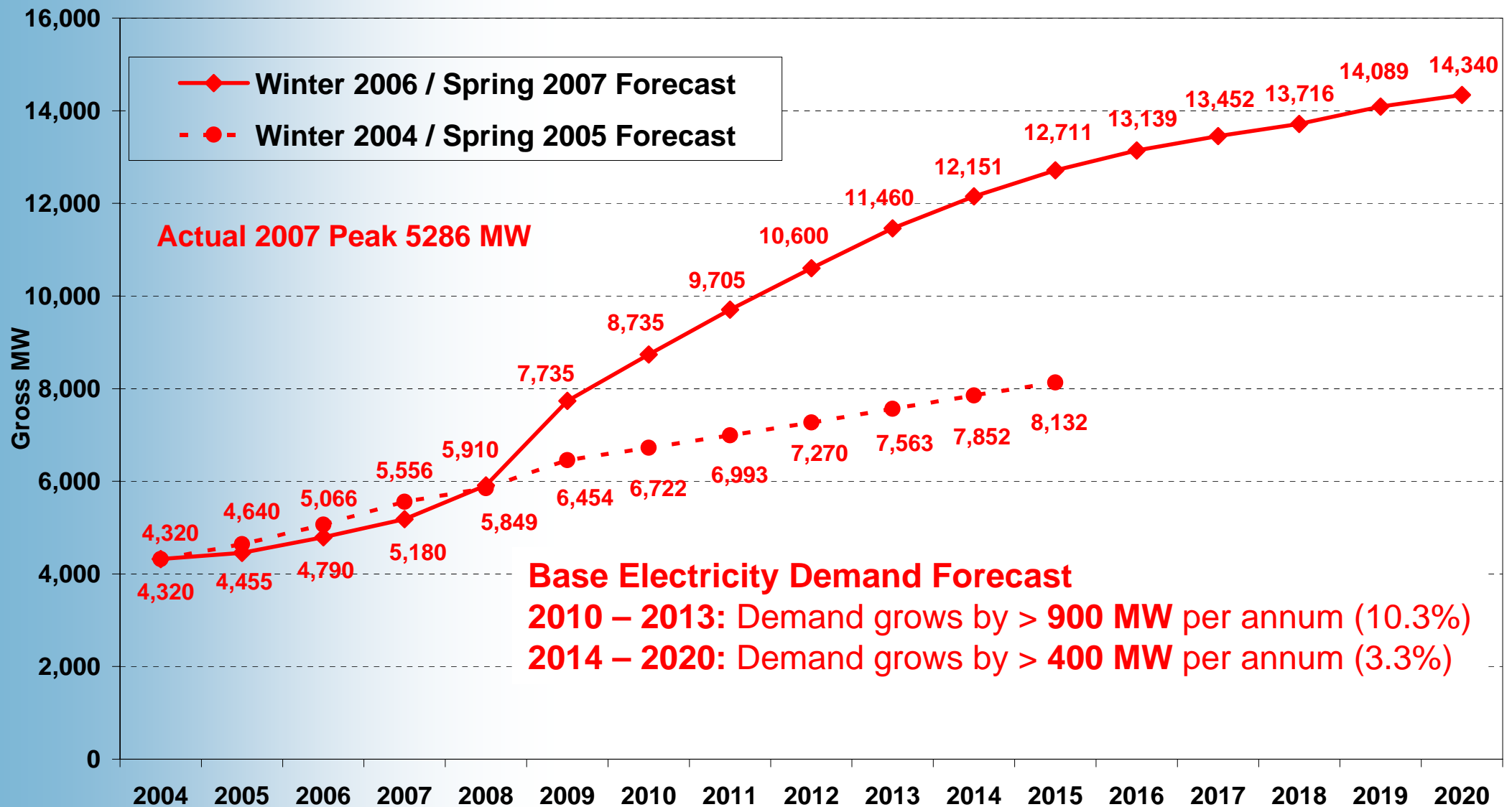
Water 82 gallons per capita

Base Electricity Demand Forecast



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System Peak Demand Forecast

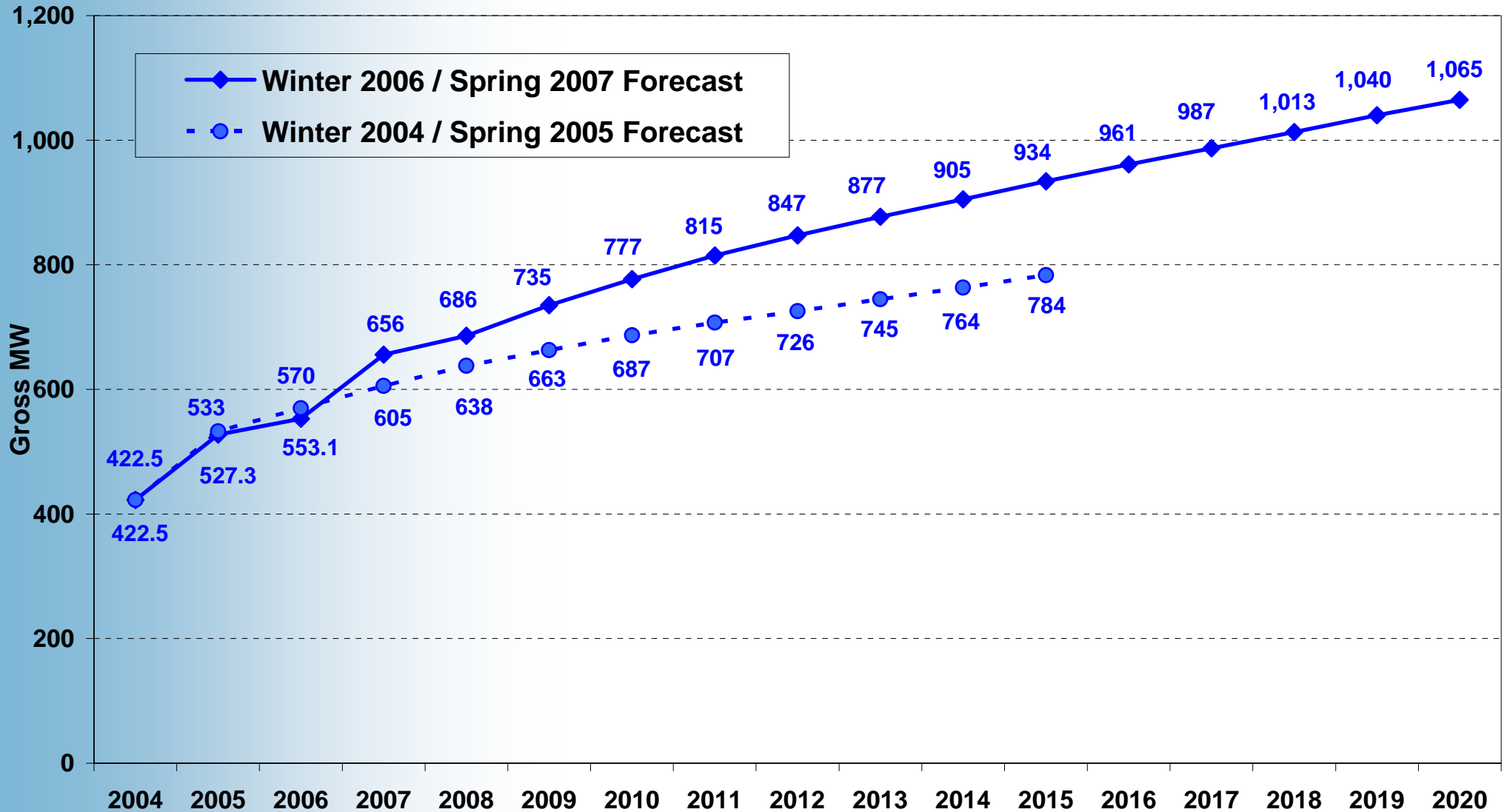


Base Water Demand Forecast



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System Peak Demand Forecast



Two Main Challenges



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- **Implementation / Timing of Mega Projects**

Changes to the original Masterplans

Construction delays

Occupancy delays

- **Population Forecasting**

Where will the Mega Projects' population be sourced from?

Existing population?

New immigrants?

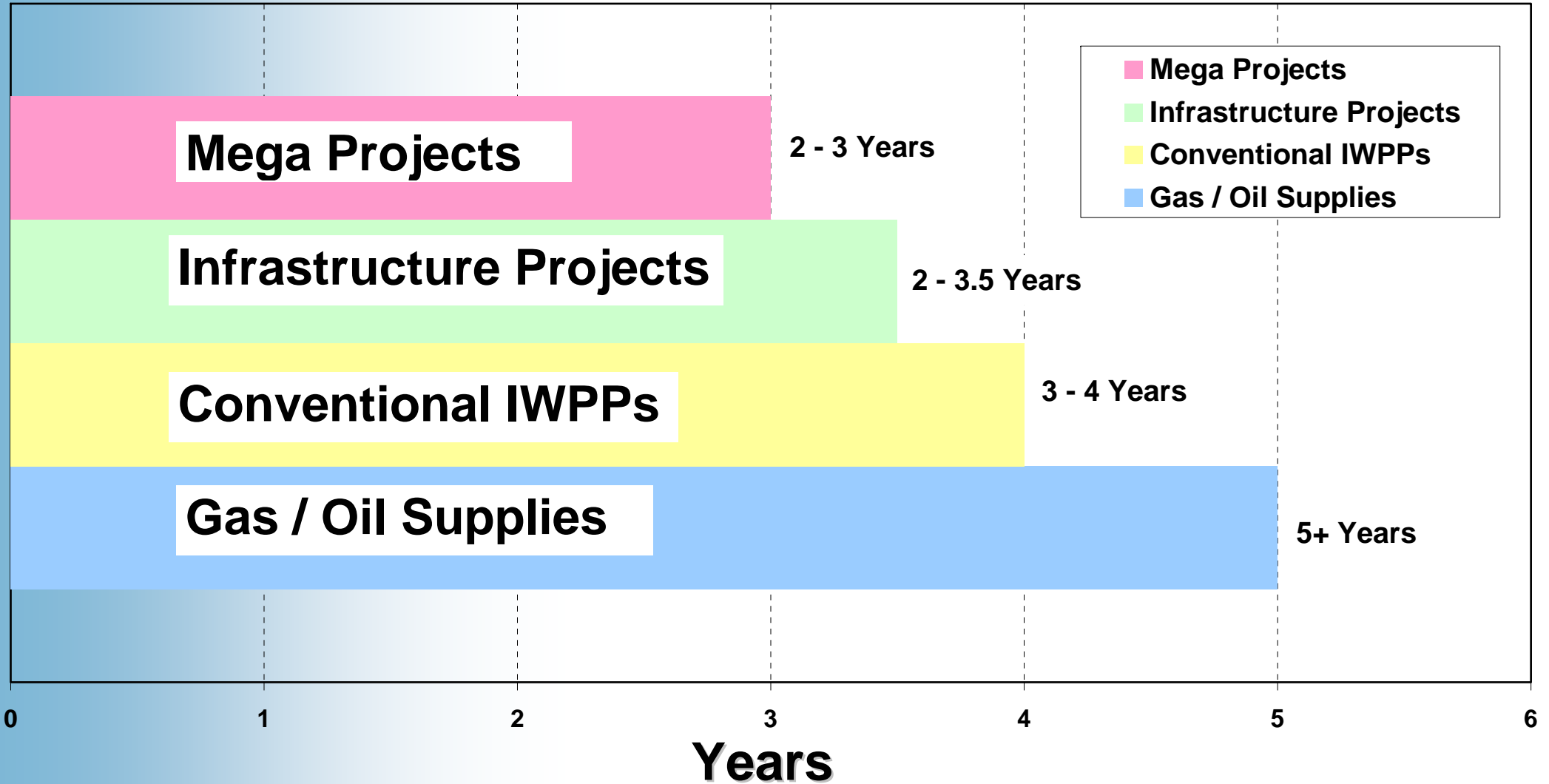


Implementation / Timing Challenges

Implementation Schedules



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Implementation / Timing Challenges



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- 1) The timing and implementation of Mega Projects needs to be **synchronized** with the development of utility capacity and vice versa.
- 2) **Shortage** of contractors and / or labour could result in delays.
- 3) Developers provide **Connected Load forecasts** to ADWEC.
- 4) **Developers' Project date estimates** are invariably optimistic, actual timing is likely to be delayed by at least **1 – 2 years**.
- 5) **Peak Demand will likely lag** Connected Load because of lag associated with *moving in* etc.
- 6) Relationship between Peak Demand and Connected Load depends on **Demand & Diversity Factors**.
- 7) ADWEC has used District Cooling adjusted **Demand / Diversity Factors** of **33.25% (High)**, **28.125% (Base)** and **23.125% (Low)**.



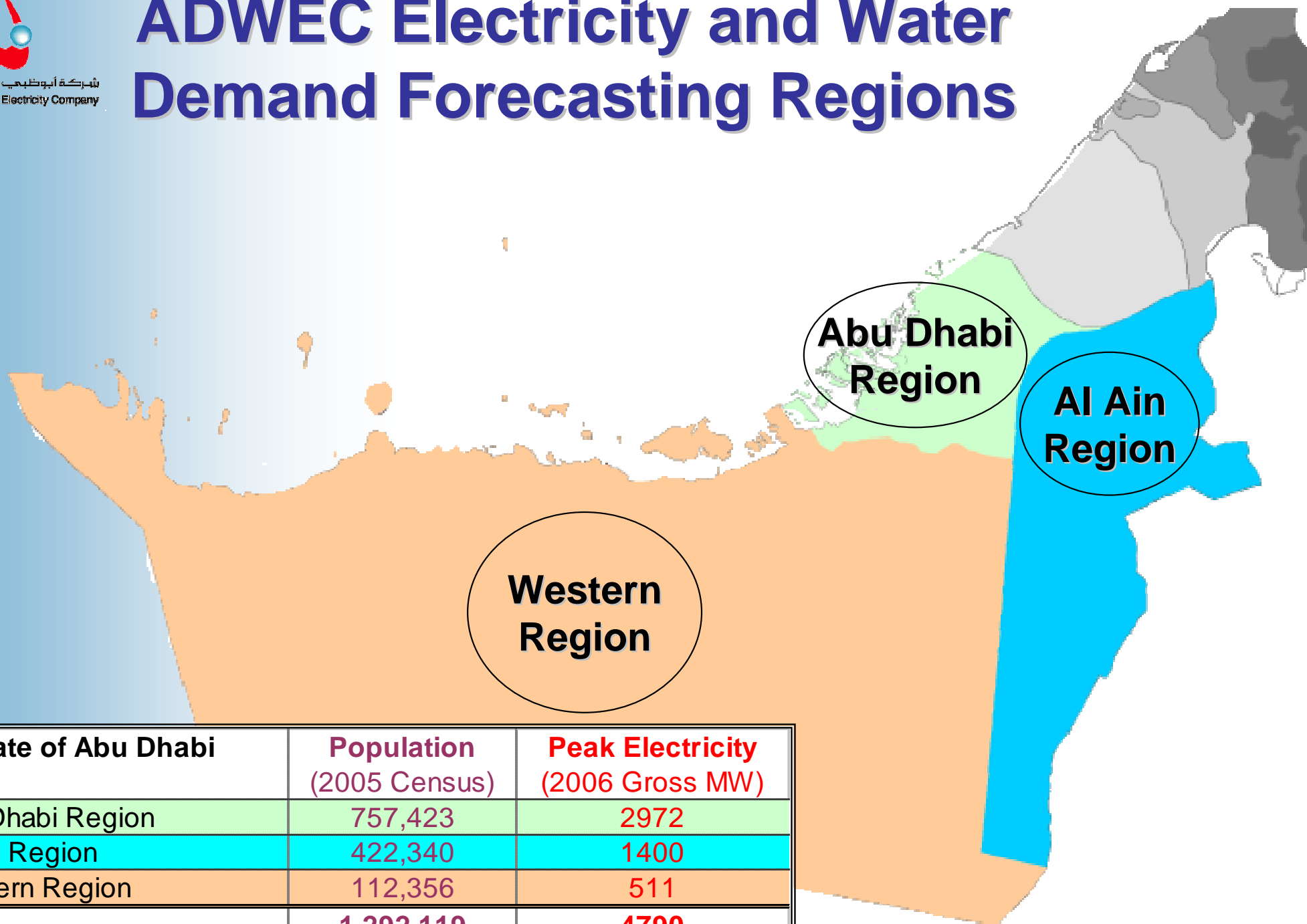
Population Forecasting

Challenges



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ADWEC Electricity and Water Demand Forecasting Regions



Emirate of Abu Dhabi	Population (2005 Census)	Peak Electricity (2006 Gross MW)
Abu Dhabi Region	757,423	2972
Al Ain Region	422,340	1400
Western Region	112,356	511
Total	1,292,119	4790

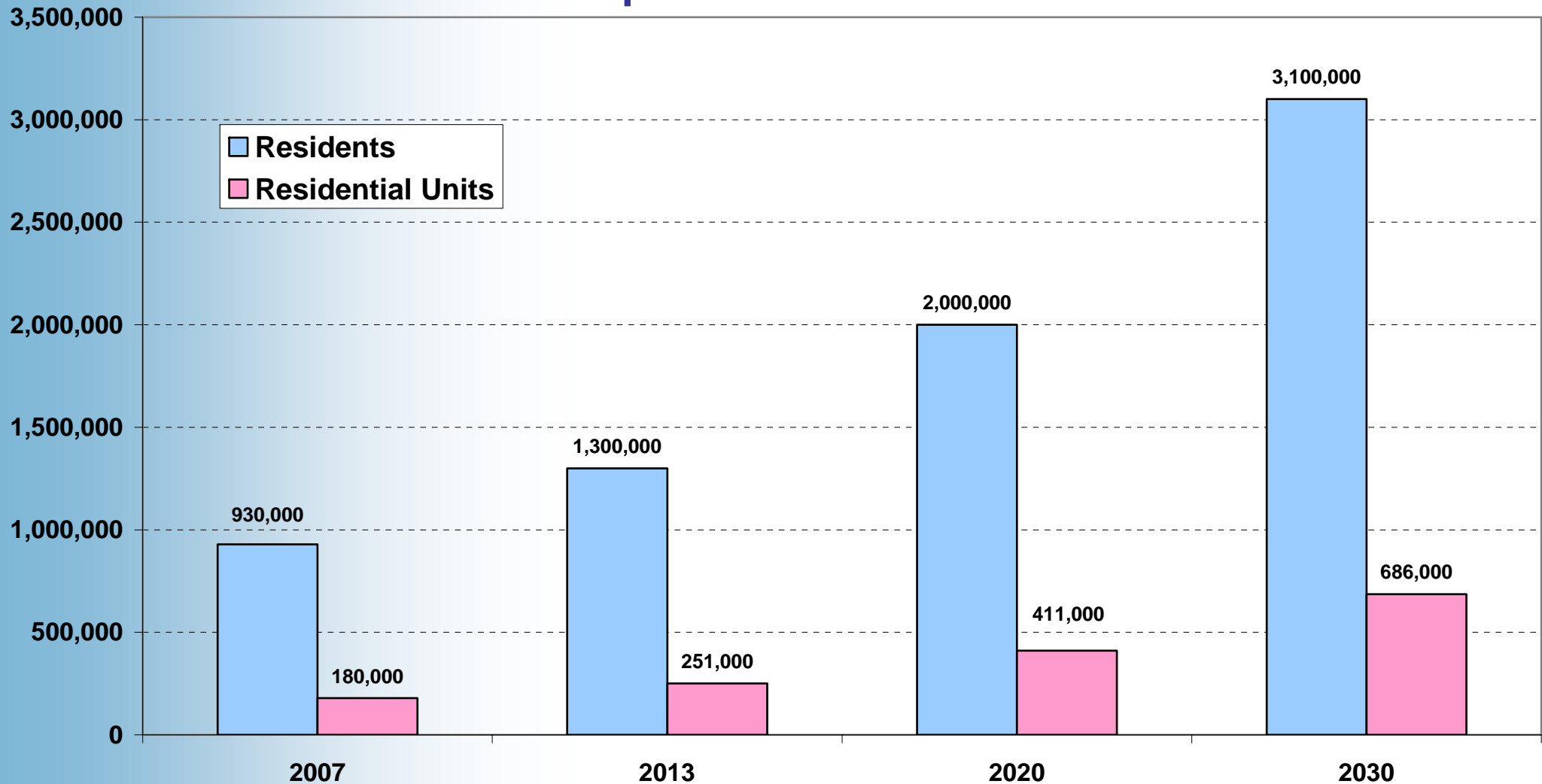
The sum of regional peaks is not equal to the system peak because of timing differences.

Abu Dhabi Metropolitan Area



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Population Forecasts



Where will the Mega Projects' Population come from?

Abu Dhabi Metropolitan Area - 2030



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Abu Dhabi Island	Population	Mainland	Population
Abu Dhabi Island	425,000	Capital District	240,000
Al Reem Island	200,000	Al Shamkhah	130,000
Central Business District / Financial Center	190,000	Al Raha	120,000
Saadiyat Island	120,000	Desert Villages	110,000
Grand Mosque District	120,000	Yas Island	100,000
South Hdayriat Island	100,000	Mussafah	100,000
Al Mina	100,000	Al Falah	100,000
Al Suwwah	30,000	Mohammed Bin Zayed Center	80,000
Lulu Island	20,000	Khalifa City A	70,000
Inner Island	20,000	Capital District North	70,000
Marina Village	5,000	Bani Yas	70,000
Total	1,330,000	Capital District South	55,000
North Coast	Population	Mohammed Bin Zayed City	50,000
New Port City	150,000	Airport District	50,000
Al Rahba	110,000	Between the Bridges	25,000
Al Shahama	110,000	Total	1,370,000
Ghantoot District	100,000		
Total	470,000	Total Population	3,170,000

Population Project Phasing



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Projects to start before 2015	
Project Name	Population
Capital District	240,000
Al Reem Island	200,000
Grand Mosque District	120,000
Saadiyat Island	120,000
Al Raha	120,000
Yas Island	100,000
South Hudayriat Island	100,000
Al Falah	100,000
Capital District North	70,000
Airport District	50,000
Al Suwwah	30,000
Between the Bridges	25,000
Lulu Island	20,000
Total Population	1,295,000

Projects to start after 2015	
Project Name	Population
Khalifa Port & Industrial City	150,000
Desert Villages	110,000
Al Shahama	110,000
Al Rahba	110,000
Mussafah	100,000
Ghantoot District	100,000
Al Mina	100,000
Mohammed Bin Zayed Center	80,000
Baniyas	70,000
Capital District South	55,000
Inner Island	20,000
Marina Village	5,000
Total Population	1,010,000

Continuing Developments	
Project Name	Population
Abu Dhabi Island	425,000
Central Business District / Financial Center	190,000
Al Shamkha	130,000
Khalifa City A	70,000
Mohammed Bin Zayed City	50,000
Total Population	865,000

Total 2030 Abu Dhabi Metropolitan Area Population: 3,170,000



SUMMARY

Key Uncertainties



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- **Implementation / Timing / Size** of Mega Projects
- **Population / Number of new expatriates** living in Mega Projects
- **Unannounced** new Mega Projects
- **Zonescorp**: Special Economic Zones, clusters and worker cities
- **District Cooling**: used in place of Conventional Air Conditioning
- **Waste Water** use in Irrigation / District Cooling etc
- **Fuel Supply** to the Electricity and Water sector
- **Masterplans** for the other parts of the Emirate.

All of the above uncertainties can be overcome via a continuous dialog between relevant institutions and timely policy decisions.



THANK YOU

Electricity Peak Demand Forecast



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Table: Winter 2004 / Spring 2005 Forecasts by Region

High Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	2715	2896	3050	3246	3410	3558	3716	3870	4027	4191	4356	4507
Al Ain	1316	1449	1584	1707	1808	1906	1993	2088	2188	2291	2398	2510
Western Region	386	441	633	860	941	1366	1458	1559	1672	1804	1949	2136
SYSTEM	4320	4894	5385	5943	6297	6982	7329	7687	8064	8473	8899	9358
Base Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	2715	2852	2979	3152	3297	3424	3557	3684	3814	3952	4089	4210
Al Ain	1316	1436	1556	1666	1755	1842	1918	2002	2090	2182	2277	2376
Western Region	386	439	624	841	905	1308	1372	1436	1501	1570	1631	1696
SYSTEM	4320	4640	5066	5556	5849	6454	6722	6993	7270	7563	7852	8132
Low Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	2715	2802	2899	3046	3165	3267	3367	3458	3550	3646	3739	3811
Al Ain	1316	1421	1527	1618	1684	1742	1790	1840	1886	1931	1974	2016
Western Region	386	437	617	828	887	1284	1343	1402	1462	1526	1583	1642
SYSTEM	4320	4418	4782	5208	5439	5968	6163	6353	6540	6735	6918	7082

Source: ADWEC Demand Forecast Report 2005 – 2015.

Electricity Peak Demand Forecast



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Table: Winter 2006 / Spring 2007 Forecasts by Region

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
High Forecast															
Abu Dhabi	2,972	3,533	4,357	5,999	7,011	7,725	8,705	9,311	9,785	10,412	10,641	10,798	11,118	11,270	11,412
Al Ain	1,400	1,422	1,499	1,612	1,741	1,807	1,923	1,993	2,068	2,136	2,199	2,264	2,324	2,391	2,460
Western Region	511	725	739	1,267	1,255	1,439	1,513	1,584	1,622	1,661	1,703	1,757	1,793	1,825	1,858
System	4,790	5,576	6,474	8,714	9,822	10,769	11,917	12,651	13,227	13,947	14,275	14,545	14,954	15,200	15,441
Base Forecast															
Abu Dhabi	2,972	3,100	3,766	5,006	5,956	6,787	7,545	8,310	8,922	9,390	9,739	9,966	10,116	10,387	10,542
Al Ain	1,400	1,440	1,517	1,612	1,702	1,721	1,819	1,858	1,920	1,990	2,040	2,103	2,168	2,226	2,295
Western Region	511	730	738	1,261	1,242	1,379	1,436	1,507	1,537	1,570	1,607	1,636	1,689	1,741	1,772
System	4,790	5,180	5,910	7,735	8,735	9,705	10,600	11,460	12,151	12,711	13,139	13,452	13,716	14,089	14,340
Low Forecast															
Abu Dhabi	2,972	3,100	3,623	4,538	5,154	5,919	6,729	7,316	8,011	8,579	8,789	9,099	9,296	9,453	9,703
Al Ain	1,400	1,440	1,533	1,659	1,746	1,737	1,786	1,813	1,839	1,886	1,935	1,981	2,042	2,109	2,165
Western Region	511	730	740	1,267	1,246	1,362	1,395	1,445	1,500	1,537	1,577	1,610	1,647	1,687	1,729
System	4,790	5,180	5,788	7,327	7,996	8,851	9,728	10,380	11,141	11,781	12,075	12,455	12,745	13,005	13,346

Base Electricity Demand Forecast

2010 – 2013: Demand grows by > **900 MW** per annum (10.3%)

2014 – 2020: Demand grows by > **400 MW** per annum (3.3%)

Water Peak Demand Forecast



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Table: Winter 2004 / Spring 2005 Forecasts by Region

High Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	281.1	345	369	401	432	449	469	489	507	528	548	569
Al Ain	110.6	159	185	203	218	236	251	260	269	279	287	297
Western Region	30.7	60	68	76	81	86	91	98	100	103	107	110
SYSTEM	422.5	564	622	680	732	771	811	847	877	910	942	977
Average Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	281.1	327	340	358	375	384	394	404	415	426	437	448
Al Ain	110.6	148	167	179	190	203	214	220	226	232	238	245
Western Region	30.7	58	63	69	73	76	79	83	85	86	89	90
SYSTEM	422.5	533	570	605	638	663	687	707	726	745	764	784
Low Forecast	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Abu Dhabi	281.1	308	311	315	317	319	319	319	322	324	326	328
Al Ain	110.6	138	148	155	162	170	177	180	183	186	189	192
Western Region	30.7	55	58	62	64	66	67	69	69	69	71	71
SYSTEM	422.5	501	517	531	543	555	563	568	574	580	585	590

Source: ADWEC Demand Forecast Report 2005 – 2015.

Water Peak Demand Forecast



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Table: Winter 2006 / Spring 2007 Forecasts by Region

	Supply 2004	Supply 2005	Supply 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
High Forecast																	
Abu Dhabi	283.0	310.6	333.8	371	388	417	442	468	488	508	529	543	561	579	593	608	626
Al Ain	110.6	151.7	166.4	269	284	305	326	341	352	376	388	425	414	415	435	455	463
Western Region	28.8	65.0	52.9	76	83	90	94	99	102	105	108	111	113	116	119	123	127
Abu Dhabi Emirate	422.5	527.3	553.1	716	754	812	863	908	942	989	1,025	1,079	1,087	1,110	1,147	1,186	1,216
Northern Emirates			7	15	31	36	43	49	50	53	53	57	58	61	67	68	68
Total			560	731	785	848	906	957	992	1,042	1,078	1,137	1,145	1,171	1,214	1,254	1,283
Most Likely Forecast																	
Abu Dhabi	283.0	310.6	333.8	350	367	396	422	444	465	483	501	518	536	552	567	581	595
Al Ain	110.6	151.7	166.4	233	240	254	265	278	287	296	304	313	321	329	338	347	356
Western Region	28.8	65.0	52.9	73	79	85	89	93	96	98	100	102	104	106	109	111	114
Abu Dhabi Emirate	422.5	527.3	553.1	656	685	735	777	815	848	877	905	934	960	987	1,013	1,039	1,065
Northern Emirates			7.03	11	21	25	29	31	32	33	34	35	36	36	39	40	41
Total			560.2	667	706	760	806	846	880	910	939	968	997	1,023	1,053	1,079	1,105
Low Forecast																	
Abu Dhabi	283.0	310.6	333.8	328	345	376	402	422	442	457	475	494	508	525	541	553	565
Al Ain	110.6	151.7	166.4	200	198	200	212	210	216	220	234	235	246	247	232	242	260
Western Region	28.8	65.0	52.9	69	75	81	83	86	88	90	92	94	95	96	98	100	102
Abu Dhabi Emirate	422.5	527.3	553.1	597	618	656	696	719	745	767	801	823	848	867	871	895	927
Northern Emirates			7	8	11	16	17	17	18	18	18	18	19	20	20	20	21
Total			560	605	629	673	713	736	763	785	819	841	868	886	891	916	949

The demand forecast years shown in grey are when water transmission constraints are expected to constrain water supply to be less than water demand.

Network constraints mean that **Abu Dhabi Emirate's** water demand may exceed water supply.

So for the purposes of forecasting water capacity requirements and auxiliary electricity consumption the following Abu Dhabi Emirate water supply quantities have been assumed.

From 2011 onwards the water demand forecast have been used to forecast water capacity requirements and electricity consumption.

System	Constrained Supply (MGD)			
	2007	2008	2009	2010
	580	592	620	742

2006 - 2020 Average Annual Growth Rates

	High	Base	Low
Abu Dhabi	4.6%	4.2%	3.8%
Al Ain	7.6%	5.6%	3.2%
Western Region	6.4%	5.6%	4.8%
Abu Dhabi Emirate	5.8%	4.8%	3.8%

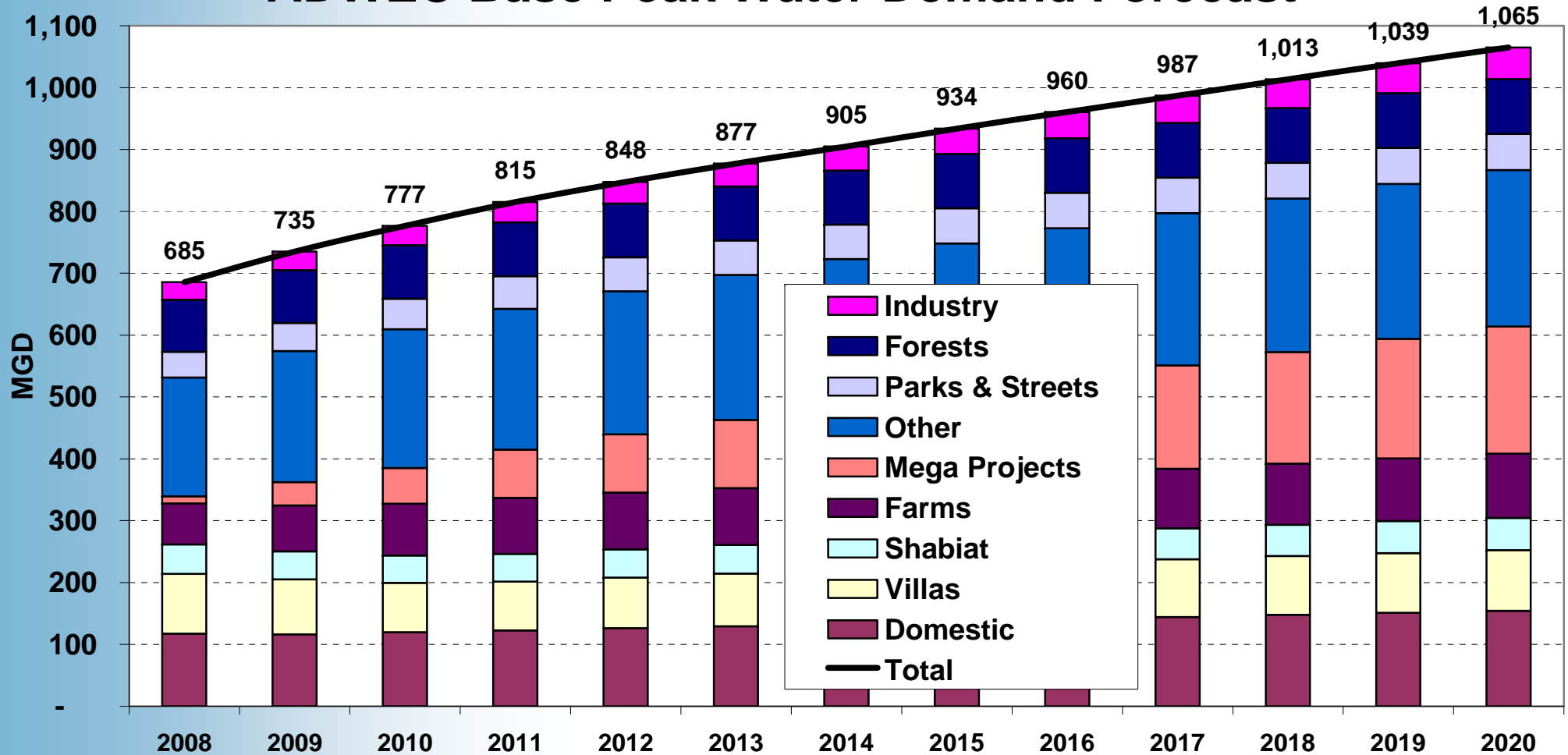
Source: ADWEC Winter 2006 / 2007 Demand Forecast.

Base Water Peak Demand Forecast



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ADWEC Base Peak Water Demand Forecast



Base Water Peak Demand Forecast



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Year	Domestic	Villas	Shabiat	Farms	Mega Projects	Other	Parks & Streets	Forests	Industry	Total Abu Dhabi Emirate
2008	117	97	48	66	12	192	41	84	28	685
2009	116	89	45	74	38	212	45	85	30	735
2010	120	80	44	84	58	224	49	86	31	777
2011	122	79	45	90	78	228	53	87	33	815
2012	126	82	46	92	94	231	55	87	35	848
2013	130	85	47	92	110	235	55	87	37	877
2014	133	87	47	92	124	238	56	88	39	905
2015	137	90	48	93	139	242	57	88	41	934
2016	141	92	49	94	153	244	57	88	43	960
2017	144	94	50	96	167	246	58	88	44	987
2018	148	95	51	99	180	248	58	88	46	1013
2019	151	97	52	102	193	251	58	89	49	1039
2020	154	98	52	104	206	253	58	89	51	1065

Abu Dhabi's Mega Projects



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Rank	Residential / Commercial Mega Projects	AED Billion	US \$ Billion
01	Yas Island	146.8	39.9
02	Al Reem Island	110.1	30.0
03	Saadiyat Island	100.0	27.2
04	Al Raha Beach	66.2	18.0
05	Mina (Zayed) Port	55.0	15.0
06	Ain Al Emarat (<i>Al Ain</i>)	40.0	10.9
07	Danet (<i>Pearl of Abu Dhabi</i>)	33.9	9.2
08	UAE Nationals (<i>18,250 units</i>)	22.0	6.0
09	Capital Centre (ADNEC)	8.0	2.2
10	Rawadat	5.5	1.5
11	Central Market	4.5	1.2
12	Al Gurm Resort	4.4	1.2
13	Saraya	3.5	1.0
14	Al Reef Villas	3.0	0.8
15	Building Material City (<i>@ MBZ city</i>)	3.0	0.8
96%	Sub-Total	605.9	164.9
4%	Other Projects	26.3	7.1
	Total	632.2	172.0

Table shows only real estate / mixed use projects.

Excludes Zonescorp industry, KPIZ, tourism, aluminium smelters, worker camps and oil / gas sector etc.

ADWEC has identified more than **630 AED Billion (\$172 Billion)** of Mega Projects (real estate / mixed use) that will require electricity and water from ADWEC.
Abu Dhabi's 2006 GDP = 367 Billion AED (\$100 Billion)

Industrial Development



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Development	Area
Mussafah	6,100,000 m ²
Mussafah South	4,500,000 m ²
Airport District	2,900,000 m ²
Maffraq	1,500,000 m ²
KPIZ	-
Total	15,000,000 m²

ADWEC Electricity Demand Forecasts



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(Mega Projects Assumptions)

District Cooling is more energy efficient than Conventional Air Conditioning.
District Cooling is assumed to be installed in **50%** of all Mega Projects.

1. High Demand Forecast

33.25% Demand / Diversity Factor *(35% before District Cooling 20% saving)*

Developers' Time Schedules

Potential Population Substitution from Existing Population = **6%**

Mega Projects' Existing Population Substitution Cap = **10%**

2. Base Demand Forecast

28.125% Demand / Diversity Factor *(30% before District Cooling 25% savings)*

Developers' Time Schedule + 1 Year Delay

Potential Population Substitution from Existing Population = **15%**

Mega Projects' Existing Population Substitution Cap = **20%**

3. Low Demand Forecast

23.125% Demand / Diversity Factor *(25% before District Cooling 30% savings)*

Developers' Time Schedule + 2 Year Delay

Potential Population Substitution from Existing Population = **20%**

Mega Projects' Existing Population Substitution Cap = **30%**