United Arab Emirates

مجلس الإمارات للتنافسية
ecc
Emirates Competitiveness Council

UAE: Smart country

Innovations in energy, transportation & water (ETW)

Dublin, Ireland

29/05/2012

CONTENT

Background about the UAE (1/2)

** Image circulated on the web on Facebook.*

Background about the UAE (2/2)

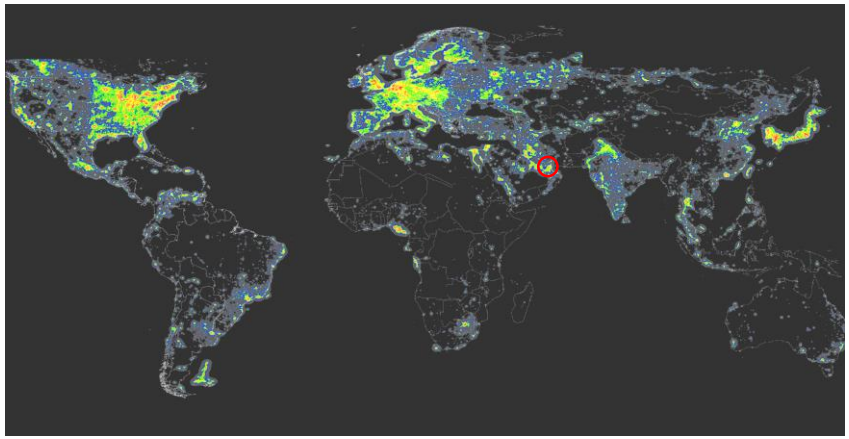
- Government type: Federation of 7 emirates
- Capital city: Abu Dhabi
- Largest city: Dubai
- Land area (km^2): 83,600
- Water area (km^2): 0
- Exchange rate (AED per USD): 3.6725
- Population: 8.5 million
- National population: 1.6 million
- Non-national population: 6.9 million
- GDP (US$ BN): 358.1
- PPP GDP (US$ BN): 260.8
- Per capita GDP (US$): 42,129
- Per capita PPP GDP (US$): 30,682
- CPI inflation: 0.9%
- Labour force: 5.3 million
- Current account balance (% of GDP): 10.7
- Foreign currency reserves (US$ BN): 55.3
- Central bank interest rate (% APR): 1.00
- Per capita carbon footprint (mt CO_2): 34.6*

- President: Sheikh Khalifa bin Zayed Al Nahyan
- Vice president & prime minister: Sheikh Mohammed bin Rashid Al Maktoum
- WEF Global Competitiveness Index: 27 / 142
- IMD World Competitiveness Yearbook: 28 / 59
- National Competitiveness Research: 25 / 65
- INSEAD Global Innovations Index: 34 / 125
- Environmental Performance Index: 77 / 132
- Contribution of oil & gas to GDP (%): 27.8
- Share of global oil production (%): 3.2
- Share of global oil reserves (%): 5.5
- Number of nuclear power plants: 0
- Electricity production (kWh billion): 80.9
- Electricity consumption (kWh billion): 70.6
- Roadways (paved km): 4,080
- Major aeroports: Dubai, Abu Dhabi, Al Ain
- Total number of airports: 41
- Dubai airport (total passengers): 51 million
- Dubai airport (mt of cargo): 2.3 million

CONTENT

Green policy goals and initiatives of the UAE

1. Renewable energies. Clean fuels. Energy efficiency.
2. Green investment. Green technologies. Green jobs.
3. Green buildings. Sustainable transport. Clean air.
4. Carbon emissions reduction.
5. Efficient use of water, electricity, and natural resources. Waste management. Environmental education and awareness.
6. Innovative clean technologies. Carbon capture and storage. Convert waste to energy.



Actions on climate change in the UAE

Energy efficiency & conservation (e.g. green building codes, CFL bulbs)

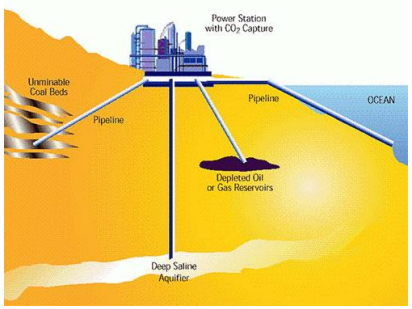
Renewable energy (e.g. solar, wind)

Civilian nuclear energy (plant built by international coalition led by Korea)

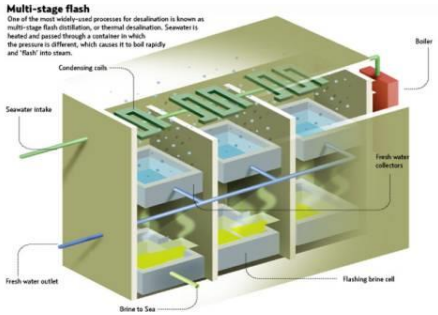
Reduce carbon emissions; improve quality of life; enhance economy

Transportation (e.g. mass transit, vehicle fuel efficiency)

Carbon capture & storage (e.g. Masdar/BP JV)



Waste energy capture (Dubal and Emal desalination plants)



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Energy, water & transportation players in the UAE

** This is not an exhaustive list of all the ETW players in the UAE. It is provided only to give a reference to the major players that are currently active in the ETW spaces*

Energy, water & transportation projects (1/2)

Player	Project / mission	Description	Field
ICBA	Marginal quality water usage	▪ Develop and promote the use of sustainable agricultural systems that use saline ground water to grow crops ▪ Recycle and re-use waste water ▪ Disseminate knowledge / share research	Water
EAD	Solar desalination	▪ There are currently 30 experimental solar-powered water desalination plants in operation in the emirate of Abu Dhabi ▪ Solar desalination is a zero-carbon technology that extracts brackish water from groundwater and purifies it into potable water* ▪ Working with Masdar to develop safe disposal technology of the brine from desalination	Water
DSCE	Mohammed Bin Rashid Solar Park	▪ Aim of producing 1000 MW of electricity ▪ Uses otherwise desert wastelands and natural abundance of sunshine as resources for sustainable, green energy production ▪ Dubai's Integrated Energy Strategy (IES) 2030 aims to produce 5% of energy requirement from solar technology by 2030	Energy
Masdar	▪ Solar power plant ▪ Carbon-neutral city (Masdar City)	▪ The largest photovoltaic (PV) plant in MENA;10 MW PV plant is registered for carbon credits** and has reduced CO_2 by mt 24,000 ▪ Masdar City is a carbon-neutral city in Abu Dhabi which aims to promote the technologies being developed by Masdar	Energy

** Currently the UAE spends $800 million annually on building, operating and maintaining desalination plants and this cost is expected to rise to over $3 billion by 2018 (notwithstanding the introduction of the solar desalination plants). The plants are also used to create watering holes for the Arabian Oryx*

*** Under the UN's Clean Development Mechanism (CDM) programme*

Energy, water & transportation projects (2/2)

Player	Project / mission	Description	Field
ENEC	Nuclear energy	▪ $20 billion Braka plant to built by coalition led by South Korean will be first nuclear plant in the UAE ▪ Target to deliver electricity to the UAE grid in 2017 ▪ By 2020, ENEC hopes to produce over a quarter of the nation's electricity needs (ahead of the 12% goal set for 2030 by the Dubai IES 2030)	Energy
TAQA	Seven power plants	▪ Plants produce nearly 10,783 MW of power and 3.58 million cubic metres of water a day of desalination capacity ▪ Provide 98% of Abu Dhabi's water and electricity needs (works in partnership with ADWEA)	Energy / water
RTA	▪ Dubai metro ▪ Marina tram ▪ Water taxis	▪ The Dubai metro is the first urban train network in the Arabian Peninsula (robotically operated) ▪ Tram currently under construction in Marina area ▪ The water taxi service covers 18 locations on the Dubai Creek and to various tourist spots throughout Dubai	Transportation
Abu Dhabi Executive Council	Abu Dhabi metro and rail	▪ The Abu Dhabi rail would be linked to the Dubai metro and other cities in the UAE as well as to other GCC countries (has yet to begin) ▪ Lines would connect Abu Dhabi's central business district with Sowwah Island, Reem Island, Saadiyat Island, Yas Island, Abu Dhabi International Airport, Masdar City, Capital City district, Emerald Gateway, Zayed Sports City and Adnec	Transportation

Why ETW are strategically important for the UAE

- Although an energy-rich nation, the oil and gas is limited to Abu Dhabi
- As part of its commitment to reducing CO_2 emissions, and its desire to be a leading player in the renewable energy sector, the UAE is targeting solar and other forms of alternative energy
- There are monetary benefits to developing green energy

- The UAE is a global transit hub which relies on its transportation infrastructure to support its logistics and tourism sectors
- Mass transit is needed to help ease the pressures of fossil fuels used in automobile travel
- Solutions are needed to deal with CO_2 emissions from aeroplanes given Dubai's status as transit hub

- Water is a scarce resource in the UAE. For its own water security and the need to need to support key industries its management is vital
- With no large bodies of fresh water, and the expense and energy consumption involved in desalination, it is imperative for the UAE to find solutions to minimise usage and maximise efficiency

- The intersection of energy, transportation and water are at the heart of the UAE's green economy goals as set forth by the prime minister HH Sheikh Mohammed bin Rashid Al Maktoum

"Our goal from this national initiative is clear, that is to build an economy that protects the environment as well as an environment that supports the growth of the economy. We in the UAE, within the vision 2021, are striving to build a diversified economy based on knowledge and innovation, through which we can provide excellent employment opportunities to our citizens. Through this, we can protect our natural and environmental resources, and strengthen our competitive position in global markets, especially in the areas of renewable energy products and technologies on the green economy".
HH Sheikh Mohammed bin Rashid Al Maktoum*

- With the abundance of sunshine and vast empty swathes in the desert the UAE has a natural advantage as a solar power generator – nonetheless, air-borne sand poses a challenge on current solar panel technologies
- Dubai's metro system has not only reduced the number of cars on the road (thus reducing CO_2 emissions), it has also propped up the property market at a time when prices were in free fall in the aftermath of the property bubble
- Dubal is a joint desalination and aluminium smelting entity that uses waste energy from smelting for desalination

** Announced at the 2012 World Energy Forum in Abu Dhabi*

Sheikh Mohammed's Green Energy Plan

1 Programmes & policies

- Promote the production and use of renewable energy and related technologies
- Promote the use of clean fuel for energy production
- Enhance the efficiency of energy consumption in both public & private sectors

2 Government policies

- Encourage investments in green economy
- Facilitate the production, import, export and re-export of green products and technologies
- Create job opportunities for citizens in green economy

3 Green city

- Policies to preserve the environment and raise the energy efficiency of houses and commercial buildings
- Promote environment friendly transportation
- Programmes to purify the air in cities in the UAE

4 Climate change

- Policies and programmes to reduce carbon emissions from industrial and commercial sites, as well as from households
- Promote organic agriculture through a series of incentives at the federal and local levels
- Programmes to maintain biodiversity and to protect ecological balance (wildlife and marine environment)

5 Green life

- Policies and programmes to ration the use of water resources, electricity, and natural resources
- Projects to recycle waste* generated by commercial or individual use
- Awareness-raising initiatives and environmental education

6 Green technology

- Development and promotion of green technology
- First phase: Carbon capture and conversion of waste into energy (methane)

** The UAE is still lagging in this sector, with no major formal recycling programme (for households or businesses) in the country*

The UAE’s plans for energy, water & transportation

Dubai Integrated Energy Strategy 2030

- The Dubai Integrated Energy Strategy 2030 seeks to reduce the emirate of Dubai's dependence on imported gas by achieving five per cent of power supplies from solar energy, 12 per cent from clean coal, 12 per cent from nuclear, and the remaining 71 per cent from gas
- Sets target to reduce Dubai’s energy consumption by 30% by 2030
- HH Sheikh Mohammed Bin Rashid Al Maktoum announced a $3.27 billion solar project as part of this strategy

ETW events in the country

1. 17th World Aluminium Conference
2. World Energy Forum 2012
3. World Future Energy Summit

- Through its innovative strategies and goals for the green economy the UAE has been lauded by Ban Ki-moon as “justifiably becoming renowned as a hub for progress” that is helping push the country onto “the brink of an exciting sustainable future [with] clean energy for all”*

* *Remark by Bank Ki-moon, Secretary General of the United Nations, at the 2012 World Future Energy Summit*

Energy, water & transportation events

17th World Aluminum Conference

- The UAE is home to two aluminium processing companies – Emirates Aluminium (Emal) based in Abu Dhabi, and Dubai Aluminium (Dubal) based in Dubai
- Aluminium processing is a very energy intensive process (Dubal accounst for a quarter of Dubai's energy consumption)
- Advances in the aluminium smelting process have far-reaching effects on energy goals given the intensity of the process
- Dubal is a leader in aluminium processing technologies which it exports globally
- The17th World Aluminum conference took place in Abu Dhabi April 30-May 1

World Energy Forum 2012

- The UN has designated 2012 as the "International Year of Sustainable Energy for All"
- The 2012 World Energy Forum will be held in Dubai in October 2012 – the first time it will be held outside of the UN's facilities
- Leaders from member states of the UN, inter-national organizations, and corporations will seek tangible progress towards cleaner, safer, and more sustainable energy as well as achieving universal access to modern energy services
- Chart a roadmap for a sustainable energy mix that can fuel global economic and social development

World Future Energy Summit

- Hosted by Masdar (a Mubadala company) the World Future Energy Summit is an annual gathering held in January in Abu Dhabi that gathers global leaders to discuss long-term sustainable goals/plans for energy and energy security
- Aim is to support future energy, energy efficiency and clean technologies by engaging political, business, finance, academic and industry leaders to drive innovation, business and investment opportunities in response to the growing need for sustainable energy
- An all encompassing theme for the WFES is "clean energy for all"

CONTENT

Case study (water): International Centre for Bio-saline Agriculture (ICBA)

- Water is a scare commodity in the UAE where there is a severe freshwater shortage
- ICBA's mission is to demonstrate the value of marginal and saline water resources for the production of economically and environmentally useful plants. ICBA works to improve productivity and sustainability of water use with a special emphasis on the effective use of marginal-quality water*

Waste water management

- Brackish/saline groundwater is the main irrigation water source in the UAE
- ICBA's experiments focus on the analysis of the chemical contents of the drainage effluents and their interaction with salts for different plant species to determine ways to biologically cleanse drainage wastewater
- Exploring the use of municipal wastewater as a source for water irrigation
- Farmers are installing small-scale reverse osmosis plants to extract salt from saline water
- Developing low-cost technologies for low-quality water use by small scale farmers
- Capturing, recycling and re-using water
- Research on plant varieties that can filter waste water

Bio-saline agriculture

- Through their experiments, ICBA screens for identification of salt tolerant germplasm (conventional crops and halophytes) to sustain ecosystem productivity
- ICBA has identified several varieties of vegetation that can be supported with saline water and that have commercial value such as *beta vulgaris*, *ipomea pescaprae*, *heianthus debilis*, *pennisetum glaucum*
- Growth of *salicornia* (succulent) with sea water for use as biofuel and for CO_2 capture/equilibrium. Project is supported by Boeing, and Etihad Airways, amongst others
- Testing of salt tolerance and yield in forage crops such as barley, triticale, pearl millet and sorghum
- Date palm trees irrigated with saline water

- Through these measures the UAE has been able to vegetate much of the desert with plant species that use marginal quality water. The plant species have thus also provided as cover and habitat for animals and humans alike
- Bio-saline agriculture is allowing the UAE to meet the challenge of food security by supporting domestic farmers

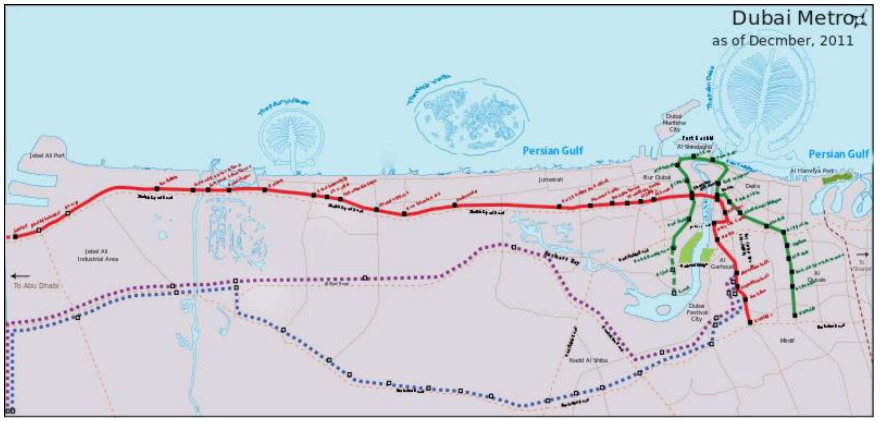
** ICBA has an international mandate and is funded by the Islamic Development Bank, the UAE government, as well as others . It is based in Dubai*

Case study (transportation): Dubai metro

- As part of the UAE's goal of reducing its carbon emissions and for improving its transportation infrastructure Dubai launched its metro system in 2009
- The red line, which runs across the length of Dubai, opened in 2009, while the green line, which loops around the Dubai Creek, opened in 2011
- Plans for developing three additional lines have been put on hold because of the financial crisis of 2009
- The Roads and Transport Authority (RTA) allows for sponsorship (i.e. naming rights) of metro stations
- The RTA is also currently constructing a tram line in the Marina district of Dubai that is scheduled to open in 2014 (14.5 km of tracks and 19 stations when completed)

Features of Dubai metro

- Operated by Serco (a UK company) on behalf of the RTA
- Driverless and fully automated
- First urban train network in the Arabian Peninsula
- First metro system in the Arab World
- 75 km of lines (52.1 red line; 22.5 green line)
- 47 stations (29 red line; 20 green line; 2 interchange)
- Red line carries 180,000 passengers per day
- Green line carries 120,000 passengers per day
- Runs at 5-minute intervals and at shorter periods at peak
- Operates with a smart card; fee based on distance



Outcome

Reduce carbon emissions by replacing cars on the road and enhance livability of the city (which has also boosted real estate prices) – next step bike lanes!

Case study (energy/water): Dubai Aluminium (Dubal)

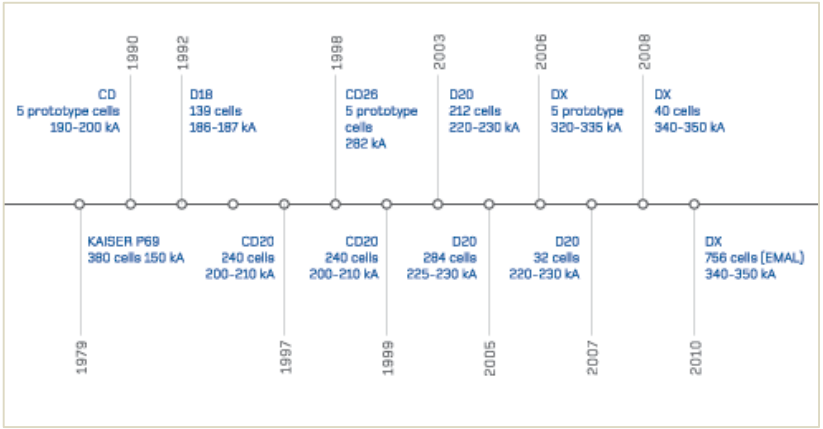
- Aluminium smeltering is an energy-intensive process that generates a lot of waste energy
- Water desalination is an energy-intensive process that consumes a lot of energy
- With virtually no fresh water resources in the UAE desalination is the only viable option to meet the water needs of the country
- Founded in 1979 Dubai Aluminium (Dubal) is one of the world's leading aluminium smelting centre and surpassed 1 million metric tonnes of aluminium production in 2010
- Dubal is also a water desalination plant that cleverly captures the waste energy from aluminium smelting to desalinate sea water. Thus Dubal helps meet the water needs of Dubai by absorbing otherwise waste energy
- Dubal is a fully owned by the emirate of Dubai and has helped the UAE in its process of economic diversification

Features of Dubal

- 480 hectare site on the outskirt of Dubai city
- Consumes ¼ of all energy in Dubai
- 3,800 employees operating 27 furnaces
- R&D leader in smelting (technology is sold abroad)
- Products: foundry alloy, extrusion billet, high purity, busbar, anode bar
- Electric power generation capacity: 2,350 MW (at 30 C)
- Desalination (fresh water production capacity): 110,000 m^3 per day
- Annual aluminia consumption: 1,930,000 mt

Outcome

Capture what is otherwise waste energy from aluminium smelting to power desalination of water (synergy)



** A very similar story exists for Emirates Aluminium (Emal); in fact, Dubal is an investor in Emal*

Case study (energy): Dubai Carbon Centre of Excellence (DCCE)

- *"The UAE is striving to develop and boost its rich resources and expertise in the international energy markets and enhance its leading role as a world centre for renewable energy research and development."*
  HH Sheikh Khalifa bin Zayed Al Nahyan
- *"We recognize that preserving our energy resources will be one of the greatest challenges in our drive towards sustainable development. This, however, will not materialize unless the different facets of our society adopt energy conservation principles in their core values. The future generations will be the chief beneficiary of our achievements and the best judge of what we accomplish in this field."*
  HH Sheikh Mohammed bin Rashid Al Maktoum
- The DCCE was established in January 2011 under the Dubai Supreme Council of Energy with a target of eliminating 5 million tonnes of CO_2 emissions and to promote green economic development

Facilitate transition to green economy

- As part of the UAE's overall green economy plan the DCCE will look at market opportunities to engender voluntary CO_2 emissions

Identify eco-investments & green finance

- Help identify projects that will reduce carbon emissions
- Leverage expertise of centre to fund projects that will reduce CO_2

Generate extra carbon-based revenues

- As a developing country the UAE is allowed a certain quota under the Kyoto Treaty that it is allowed to trade in the market place

- By treating carbon emissions reduction as an economic opportunity, the DCCE aims to act as a catalyst for carbon reduction amongst organisations in Dubai and support government entities in improving their environmental efficiency

- Dubal GTX (steam optimisation across entire plant)
- Dubal D18+ (production process architecture to reduce CO_2)
- Desalination (energy efficiency of desalination pumps)
- Regenerative burners (waste gases in lieu of cold air burners)
- Green building PoA (energy efficiency in buildings)
- CFL (free distribution of CFL light bulbs)
- Solar farm (installation of 19MW solar plant)
- Waste heat recovery (waste heat from kiln production to generate 15MW of renewable power)
- Inlet coolers (use of pre-cooling stackable units in power)
- Absorption chillers (heat as mean to generate cooling power)
- Alternative fuels (refuse-derived fuel in industrial furnaces)
- Dubai Municipality STP (capture CH_4; convert for fleet)

CONTENT

Table of ETW projects (1/4)

Entity	Sector	Location	Projects	More Information
International Centre for Biosaline Agriculture (ICBA)	Water	Dubai	Marginal quality water resources: Develop and promote the use of sustainable agricultural systems that use saline ground water to grow crops; manage waste water (i.e. recycle and re-use such water as well as minimising its production)	
Environment Agency-Abu Dhabi (EAD)	Water & energy	Abu Dhabi	▪ Solar desalination project: There are currently 30 experimental solar-powered water desalination plants in operation in the emirate of Abu Dhabi ▪ Desalinated water used to support local wildlife (esp. the Arabian oryx)	
Dubai Supreme Council of Energy (DSCE)	Water, power & transportation	Dubai	Launched Mohammed Bin Rashid Solar Park to: ▪ Reduce carbon footprint ▪ Convert desert wastelands into a natural resource environment ▪ Promote sustainability and preserve natural resources ▪ Increase social levels of awareness about climate change and sustainable energy	DSCE is the governing body tasked with policy development, planning and coordinating with concerned authorities & energy bodies to deliver new energy sources while employing a balanced approach to protecting the environment.
Masdar	Energy	Abu Dhabi	▪ Solar power plant: A 10 MW grid connected solar plant to power the construction activities of Masdar City ▪ Masdar is also running a carbon capture and storage system in conjunction with BP in the Emirates Steel plant. CO_2 will be compressed, dehydrated and then pumped through 50km of pipeline and injected in on onshore field. This will reduce CO_2 emissions by 40%	A Mubadala company
Emirates Nuclear Energy Corporation (ENEC)	Energy	Abu Dhabi	Nuclear energy projects targets to deliver electricity to the UAE grid in 2017. By 2020, it is projected that nuclear energy will produce nearly a quarter of the nation's electricity needs	

Table of ETW projects (2/4)

Entity	Sector	Location	Projects	More Information
TAQA	Energy	Abu Dhabi	Seven plants that poduce nearly 10,783 MW of power and 3.58 million cubic metres of water a day (MIGD) of desalination capacity.	51% owned by Abu Dhabi Water and Electricity Authority (ADWEA)
Road and Transport Authority (RTA)	Transportation	Dubai	▪ The Dubai metro is the first urban train network in the Arabian Peninsula ▪ Tram in Marina district is currently under construction. It will connect the Marina district with the red metro line ▪ The water taxi service covers 18 locations on the Dubai Creek and tourist spots of the Emirate that are linked with the hotels, marine clubs and tourist locations	
Abu Dhabi Executive Council (ADEC)	Transportation	Abu Dhabi	▪ The Abu Dhabi metro would be linked to the Dubai metro and other cities in the UAE and to other GCC countries ▪ Within Abu Dhabi the metro line would connect the central business district with Sowwah Island, Reem Island, Saadiyat Island, Yas Island, Abu Dhabi International Airport, Masdar, the Capital City district, Emerald Gateway, Zayed Sports City and Adnec.	
Abu Dhabi National Oil Company (ADNOC)	Energy & transportation	Abu Dhabi	ADNOC provides the following services/products (partial):: ▪ Aviation services ▪ Marine services ▪ Lubricant oil and greases ▪ Liquefied natural gas	
Dubai Carbon Centre of Excellence (DCCE)	Energy	Dubai	Dubai Carbon Centre of Excellence focuses on global carbon-project opportunities ▪ Acts as a catalyst for the generation of a carbon efficient economy in Dubai ▪ Develops carbon incentives for Dubai's key stakeholders	

** See "This time is different: Eight centuries of financial folly" (Reinhart & Rogoff (2009))*
*** Technical recession is defined as two consecutive quarters of real GDP contraction – this definition is not followed by the US (it has a recession dating committee)*

Table of ETW projects (3/4)

Entity	Sector	Location	Projects	More Information
Abu Dhabi Water and Electricity Authority (ADWEA)	Water and Energy	Abu Dhabi	Strategic Projects: ADWEA provides supervisory consultation services Water Projects: Supply and installation of 33/11 KV main switching stations and modification of existing stations in the Western Region at 740,1 million dirhams Distribution Projects: Supply & installation of ductile iron water pipelines through different areas at east & west Lewa costing 100,5 million dirhams	
International Renewable Energy Agency (IRENA)	Energy	Abu Dhabi	Innovation and Technology Centre: ▪ Assist governments on request in energy planning for more efficient and effective renewable energy technology and innovation strategies ▪ Facilitate a better understanding of cost and cost reductions through technology development and market deployment to accelerate renewables uptake	
Borouge	Water	Abu Dhabi	Innovation Center: The Innovation Centre initially focuses on development of pipe, film and moulding applications. Wire and cable applications will be introduced in conjunction with the Borouge 3 project, which increases the production capacity to 4.5 million tonnes per year.	
STRATA	Transportation	Al Ain	Aerospace Hub: The Aerospace hub will consist of various industrial projects, a business park, office facilities, educational research and development activities complimented with world-class community services and amenities. Strata – the Aerostructures manufacturing plant was the key anchor tenant build in 2010	A Mubadala Company

** See "This time is different: Eight centuries of financial folly" (Reinhart & Rogoff (2009))*
*** Technical recession is defined as two consecutive quarters of real GDP contraction – this definition is not followed by the US (it has a recession dating committee)*

Table of ETW projects (4/4)

Entity	Sector	Location	Projects	More Information
Ministry of Energy (MOE)	Energy	Abu Dhabi	Two desalination projects using reverse osmosis technology. One plant is in Ras Al Khaimah and the other in Ajman. Total combined daily production capacity of 57 million litres per facility. Total cost of the two facilities of AED 750 million.	
Arab Water Academy (AWA)	Water	Abu Dhabi	Educational projects cover climate change and sustainable land-water management, water governance, non-conventional water resources, and designing and implementing successful utility reform	Created with the aim of becoming a regional “centre of excellence” for executive education in water. It is hosted by EAD and partners with ICBA