Knowledge Triangle Platform for Water-Energy-Food Nexus
TriNex

EU funded project between European and Egyptian Universities

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for the Water-Energy-Food Nexus

Helmy Abouleish

- **Managing Director of the SEKEM initiative** that works for sustainable development in Egypt since 1977
- Under his stewardship, the SEKEM Initiative received the **"Right Livelihood Award 2003"**
- Member of the **Schwab Foundation for Outstanding Social Entrepreneurs** since 2004
- **Founder and co-founder of various organizations including**: The Egyptian National Competitiveness Council (ENCC), the International Association for Partnership (IAP), the Egyptian Biodynamic Association (EBDA), the Centre for Organic Agriculture in Egypt (COAE), SEKEM Development Foundation (SDF).
- Helmy Abouleish is a passionate advocate of **sustainable agriculture and sustainable development**.

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Rasha El-Kholy

- Prof. Dr. Rasha El-Kholy has 19 years experience working in the field of **water resrouces management and environmental protection.** She has **managed many foreign funded research projects** as well as national programs in the field of water Engineering.
- Rasha Elkholy is currently **the Dean of faculty of Engineering at Heliopolis University for Sustainable Development**. She has more than 10 years experience developing specialized post graduate training programs and under graduate academic curricula as well as supervising M.Sc. Students.
- She also serves as a **short term consultant for the United Nations - Food and Agriculture Organization (FAO)** and highly involved with international organizations.
- **Prof. El-Kholy has published several scientific research papers in international scientific journals in addition to some chapters in international books**. She is an active member in many international associations annealing scientific research to serve humanity's well-being and protect the environment.

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Gabriele Cassetti

- Member of **UNESCO Chair in “Energy for Sustainable Development” at Politecnico di Milano**
- Contract professor in the course ‘Energy for Sustainable Development’ at Como Campus.
- PhD in “Energetic and Nuclear Science and Technology” on advanced exergy analysis and environmental impact of energy systems.
- Collaborator of the Rector’s Delegate to Cooperation and Development.

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TEMPUS – GIEP project

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Hani Sewilam

- Professor of Sustainable Development and Water Resources Management
- Director of the UNESCO Chair for Climate Change and Water Resources Management
- Academic Director of the Engineering Hydrology at the RWTH Aachen University in Germany
- Coordinator for the Capacity Building Initiative of the United Nations Water
- Director Center for Sustainable Development at the American University in Cairo
- Researcher at the National Water Research Center in Egypt
- Advisor and Member of the Board of several Universities and International Organizations

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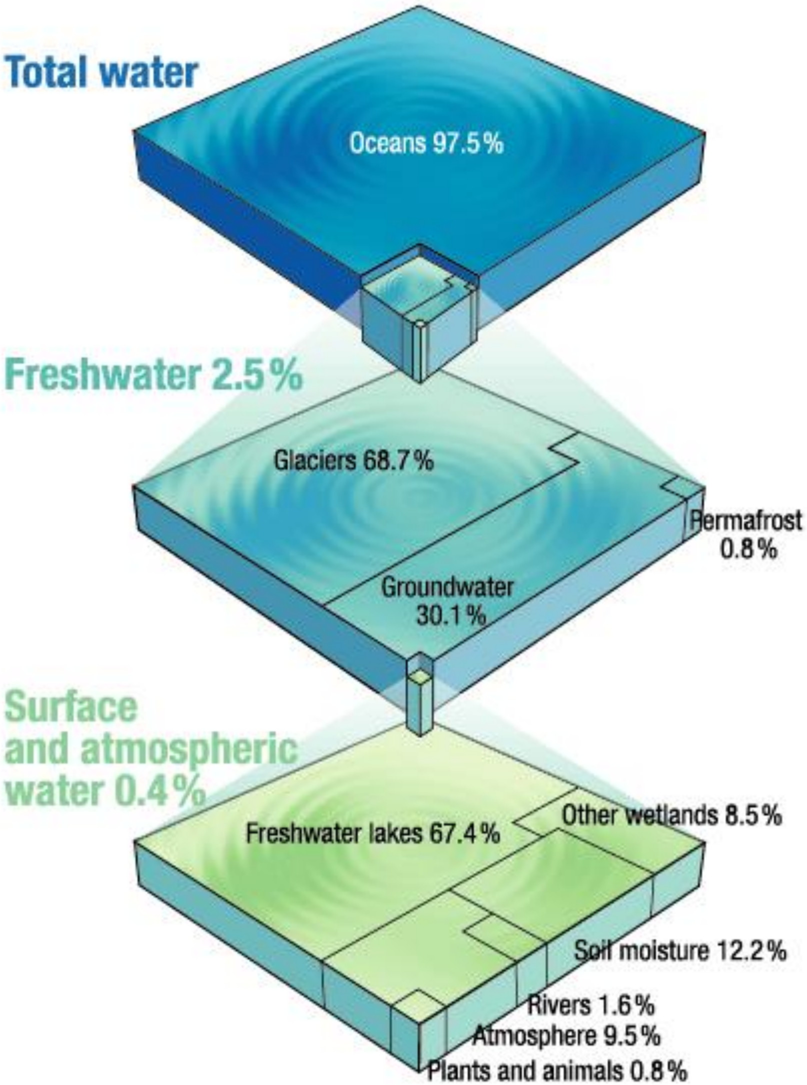
Global Water Situation



Source : Ramsar

Total amount of water:

1.4 billion cubic kilometer (km^3)

Freshwater sources:

35 Mio km^3 => 3%

24 Mio km3 is inaccessible as frozen in ice caps and glaciers

0.77% => 11 Mio km3 as groundwater, surface water and in plants and atmosphere

The eight Millennium Development Goals (MDGs) – which range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015.

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Global Water Challenges

More than ***1 billion people lack access*** to clean drinking water

Half the hospital beds in the world are occupied by patients with easily prevented water-borne disease

Half the people in the world do not have ***sanitation systems*** as good as those in Ancient Rome

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One-Third of MDGs depends on Water

The United Nations Secretary-General's Advisory Board on Water & Sanitation

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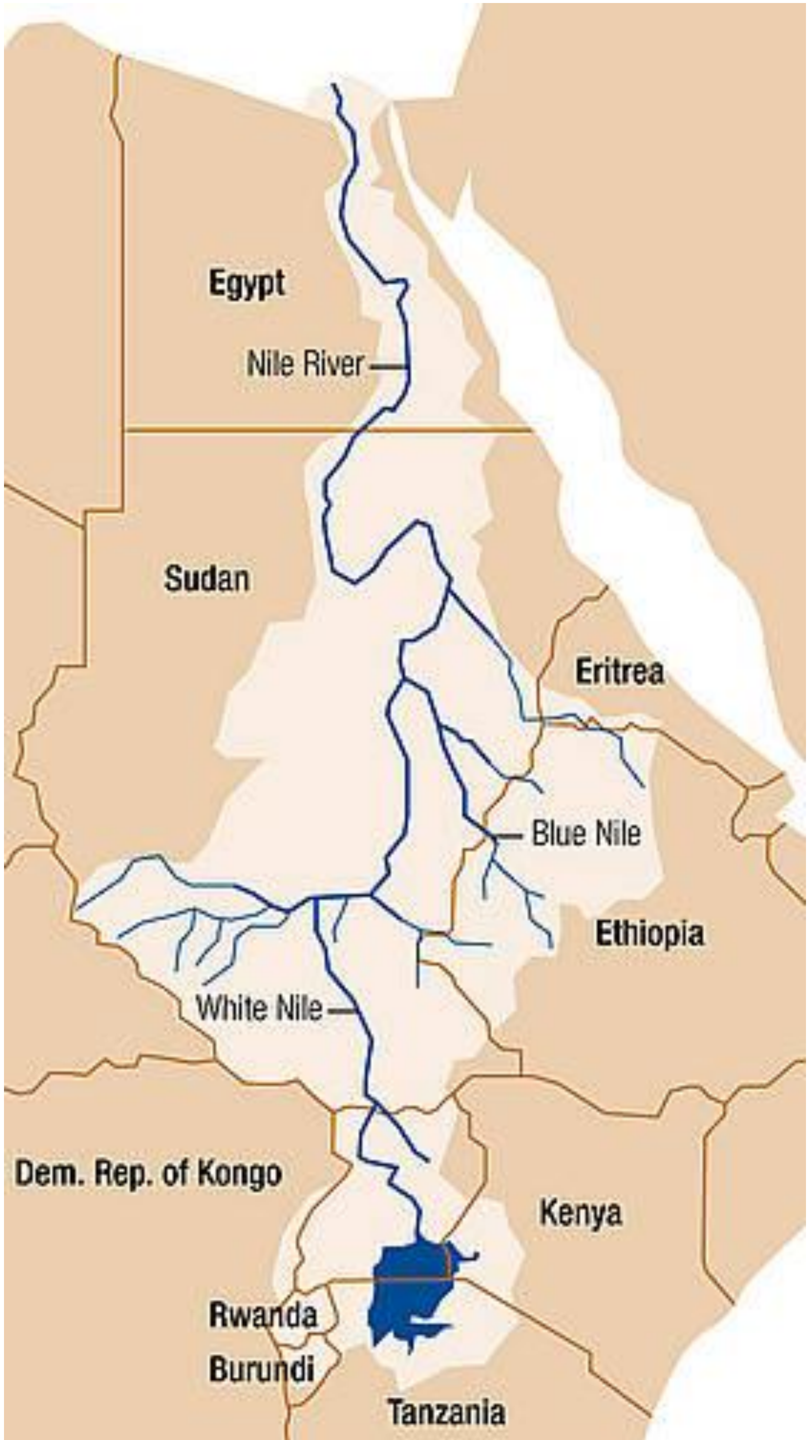
River Nile

1. Burundi,
2. Congo,
3. Egypt,
4. Eritrea,
5. Ethiopia,
6. Kenya,
7. Rwanda,
8. South Sudan,
9. Sudan,
10. Tanzania, and
11. Uganda.



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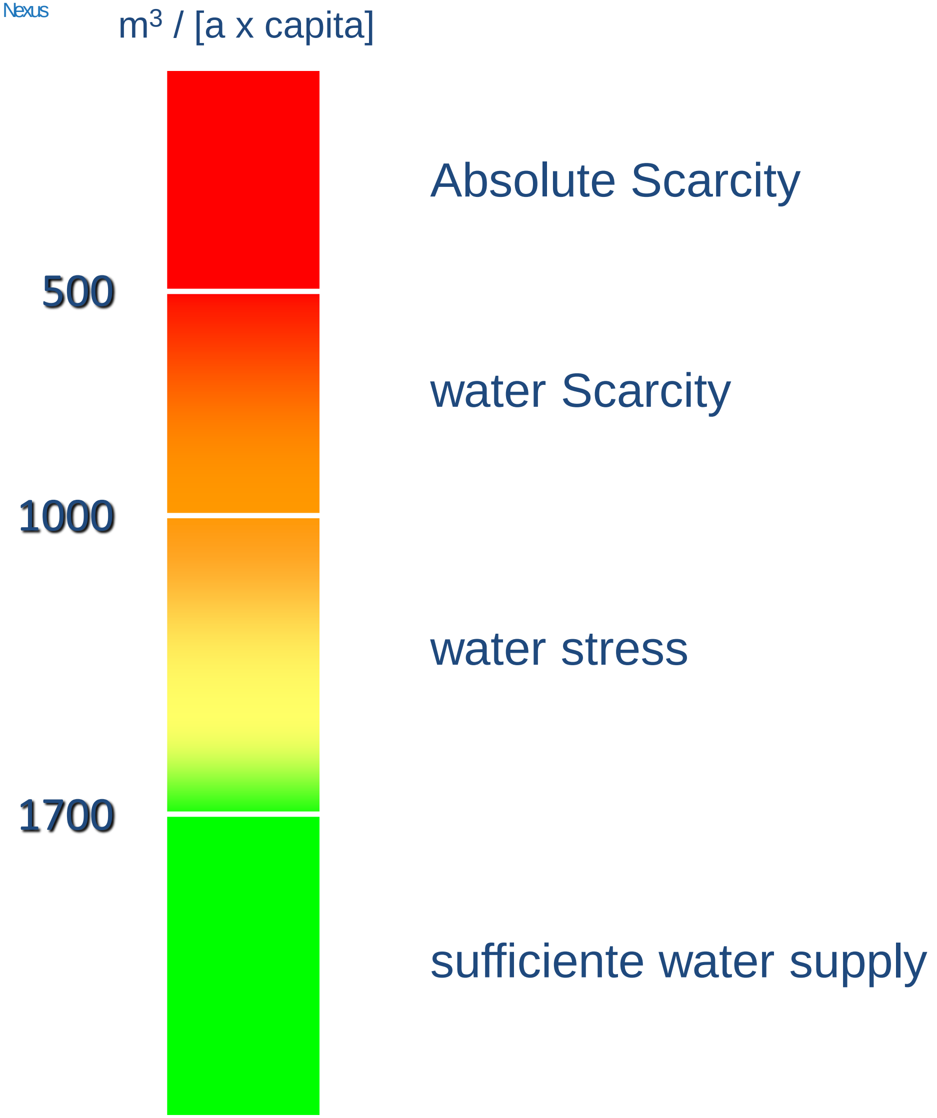
The Falkenmark Indicator



(Falkenmark 1989).

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1 glass of milk

200 litres

1 cup of tea

35 litres

1 cup of coffee

140 litres

1 orange

50 litres

1 apple

70 litres

1 glass of wine

120 litres

1 potato

25 litres

1 hamburger

2400 litres

Virtual Water

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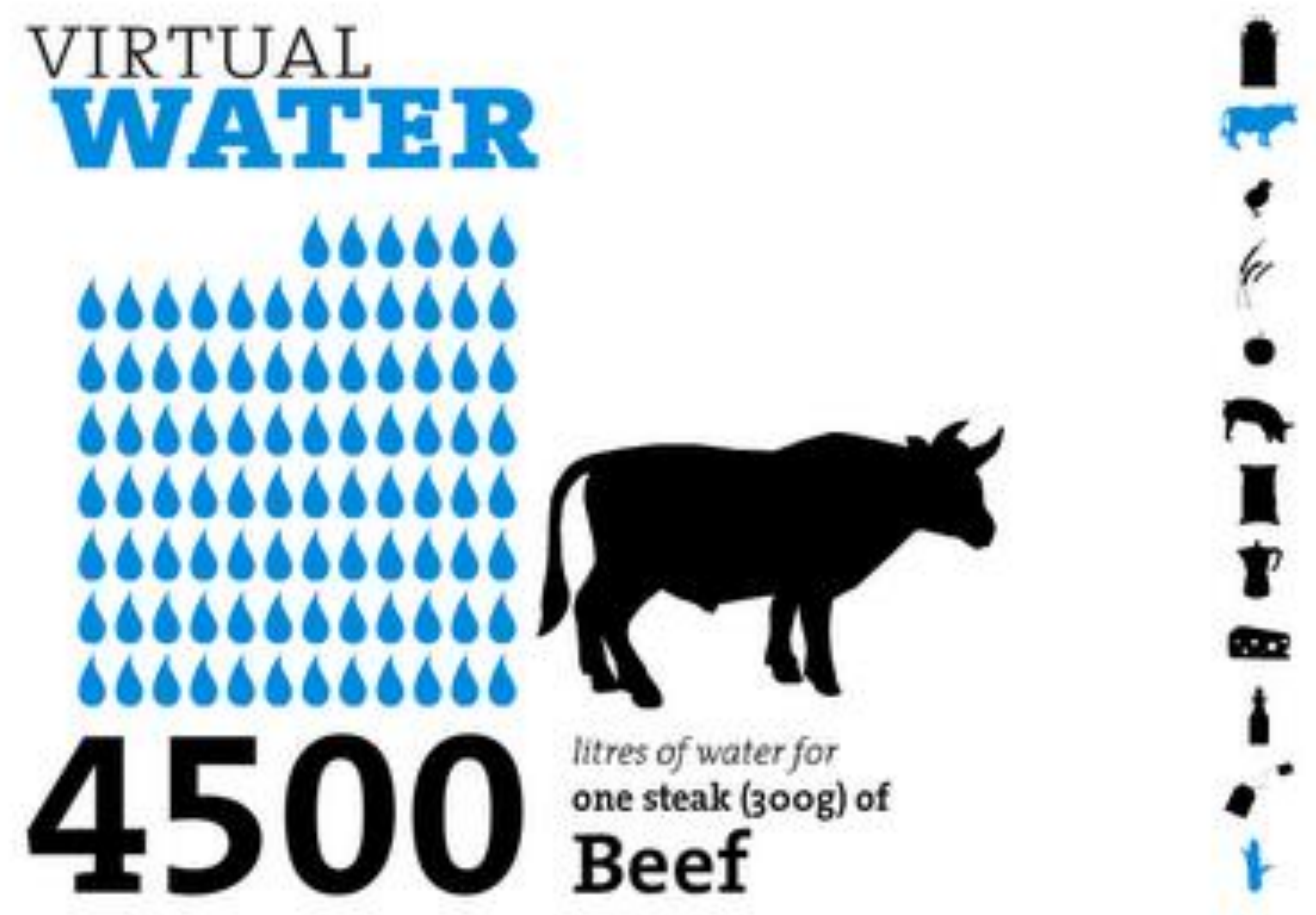

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Agriculture

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*Between **1976 and 1994**, Egypt lost an average of **8000 ha** of agricultural land **yearly**.*

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Water Footprint

- The blue water footprint refers to consumption of ***blue water resources (surface and groundwater)*** along the supply chain of a product.

- The green water footprint refers to consumption of ***green water resources (rainwater insofar as it does not become run-off).***

- The grey water footprint refers to pollution and is defined as the ***volume of freshwater that is required to assimilate the load of pollutants*** given natural background concentrations and existing ambient water quality standards.

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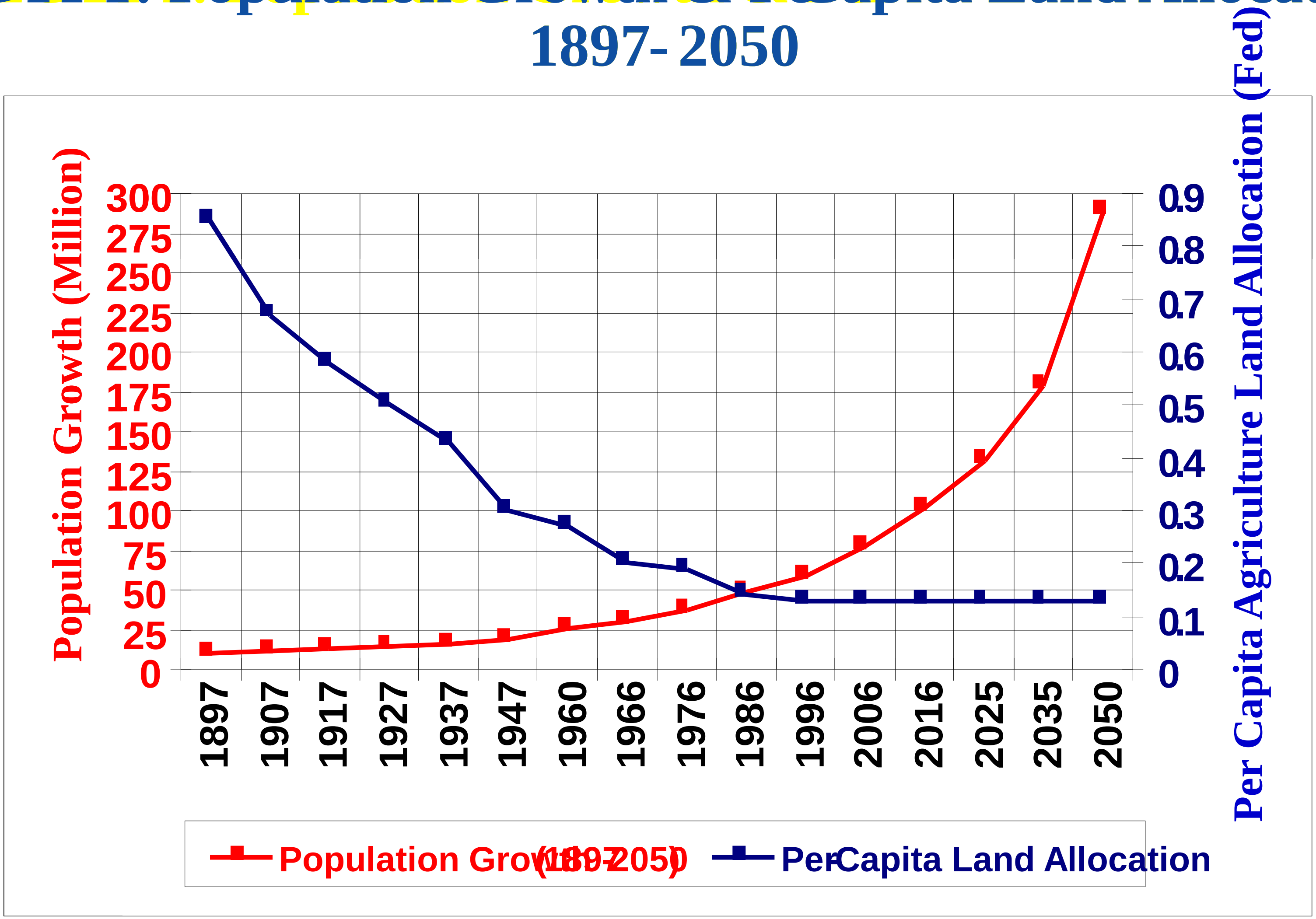
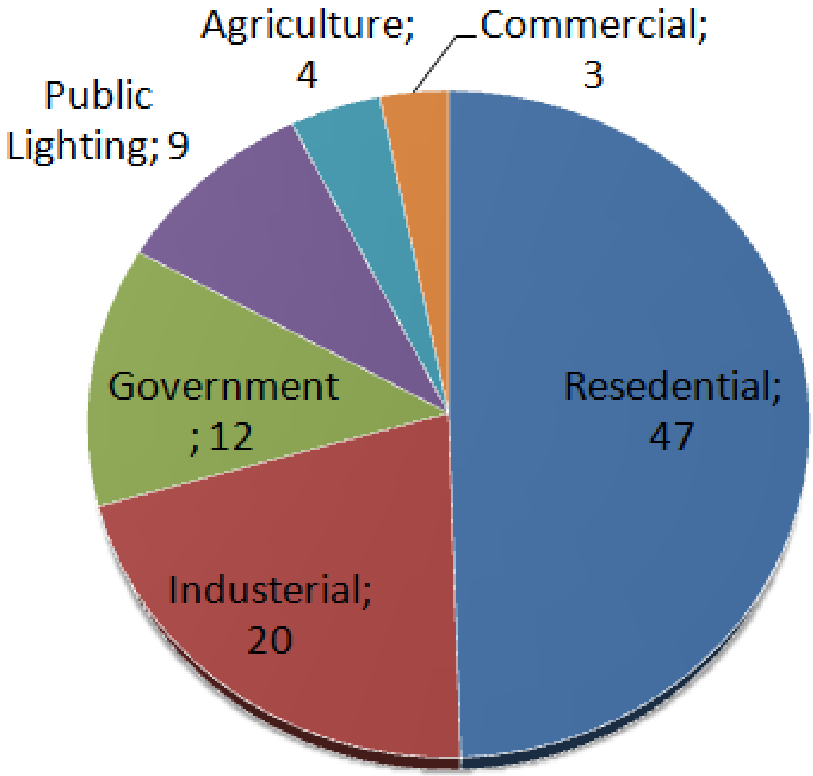
EGYPT: Population Growth & Per-Capita Land Allocation 1897- 2050

EGYPT: Population Growth & P-C



Energy

Egypt is facing a crucial energy problem. ***Natural gas consumption nearly doubled over the last decades*** *and reached 1.6 trillion cubic feet in 2010. Total* ***petroleum consumption has risen by about one-third*** *over the same time period.*



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Research: Desertec

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Sketch of a possible infrastructure for sustainable power supply to Europe and the Mediterranean.

Renewable Energy + Desalination

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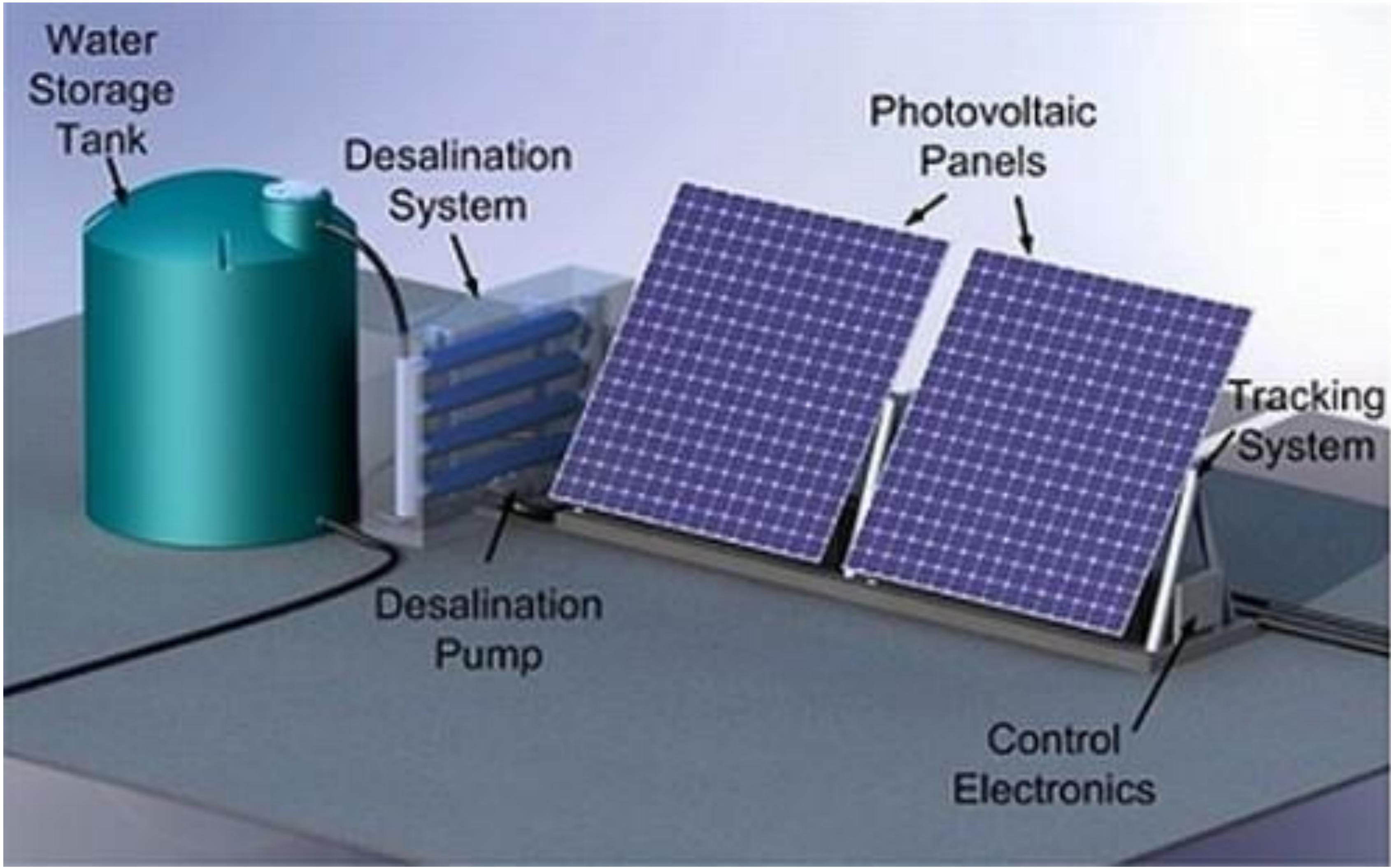

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Food security and sustainable agriculture

Biovision Alexandria Conference 2014
Tuesday, 8th April, 2014

Helmy Abouleish
Managing Director – SEKEM Group

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Global Challenges

- Population Growth
- Climate Change
- Environmental degradation
- Resource scarcity
- Food security

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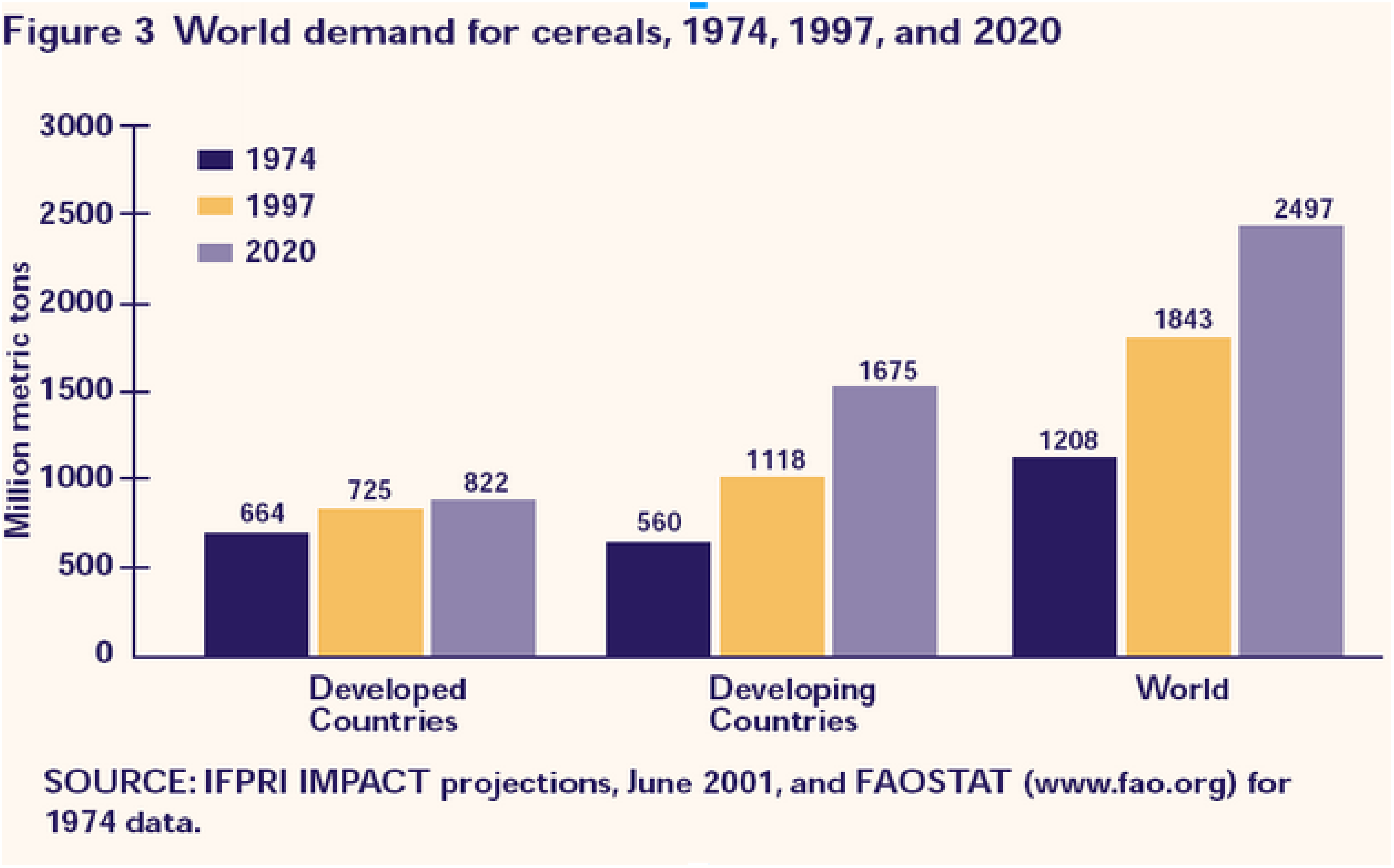
Food consumption increases



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Global Challenges

- 800 mio new consumers in the global middle class expected till 2020
- Growing and shifting demand for „high value“ food (meat, fish, dairy, fruits and vegetables)
- Resource intensive production of „high value“ food
  - Adds to raising food prices
  - Food will be larger share of total consumer expenditure
  - Incentives shift from imported to cheaper, seasonal local consumption

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Source: Deloite – Consumer 2020: Reading the signs

Figure 3: The ecological footprint of food

Assumes an average egg weighs 60g, and the density of milk is 1kg per litre.
Based on production in England and Wales
Based on production in England and Wales, assumes all production is on land of an equal grade

Sources: Water http://www.waterfootprint.org/?page=files/productgallery; emissions and land use UK DEFRA (2006), http://goo.gl/T12ho; grain National Geographic, *http://goo.gl/4CgFB; calories USDA National Nutrient Database, http://goo.gl/7egTT*

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Sustainable Agriculture is the only solution!

- Long term yield increase
- True cost of organic products are increasingly cheaper in the future
- Closed nutrient cycles + local production & consumption
  - Decouples energy prices and commodity prices
- Improved climate change adaptation
- Promotes climate change mitigation
- Only way to stop the loss of arable land

The new paradigm of sustainable agriculture!

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Egypt Water Dilemma & Interventions

Biovision Alexandria Conference 2014
Tuesday, 8th April, 2014

Rasha Elkholy
Dean, Faculty of Engineering – Heliopolis University

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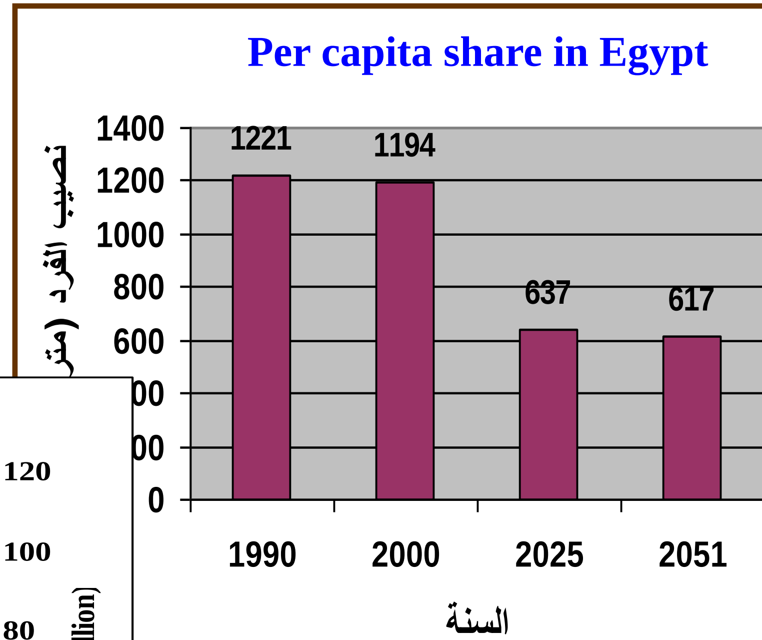
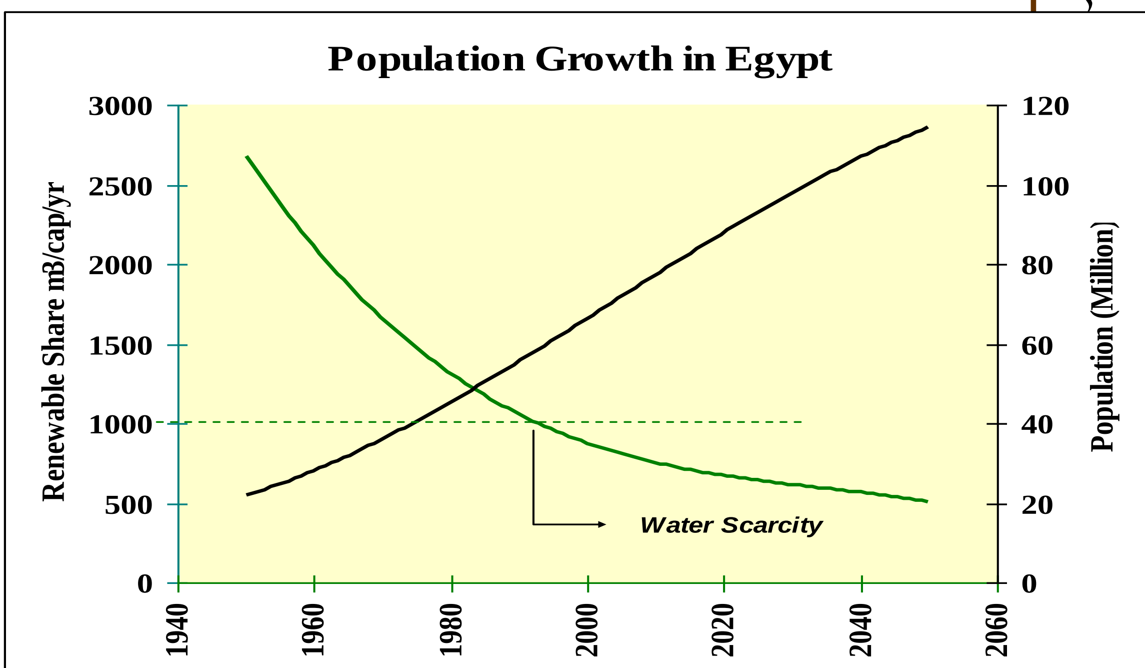
Water Scarcity

The annual per capita share of water resources is dramatically reduced from more than 2500 m^3 at the year 1950 to less than 850 m3 at the year 2010, and is further projected to fall to about 500 m3 /cap/yr by year 2050





Water Scarcity

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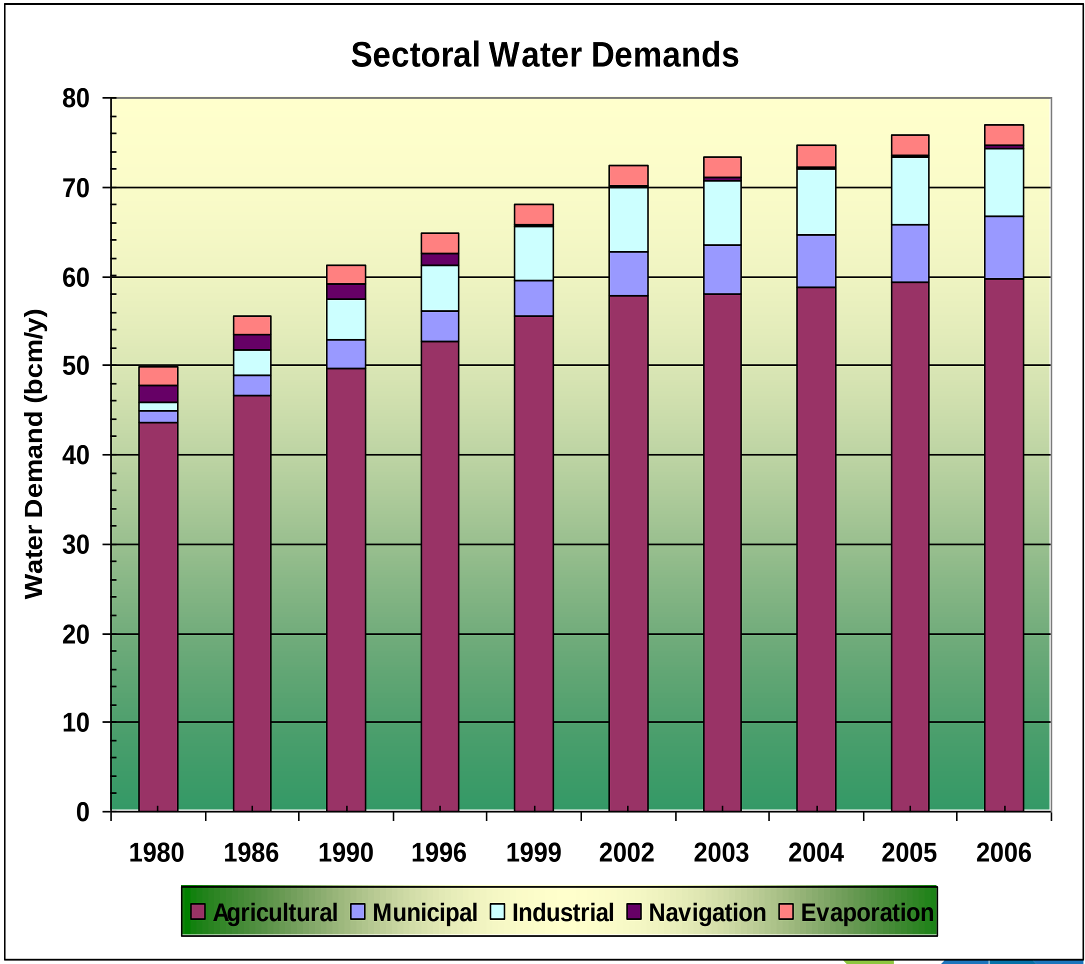
Demand on Water Resources

- Drinking water actual requirements = 9 BCM
- Groundwater provides 17% of the latter
- 97% of urban population, and 70% of rural population of Egypt relies on piped water supply.
- 52% of urban populations, and 11% of rural population have full sanitation services



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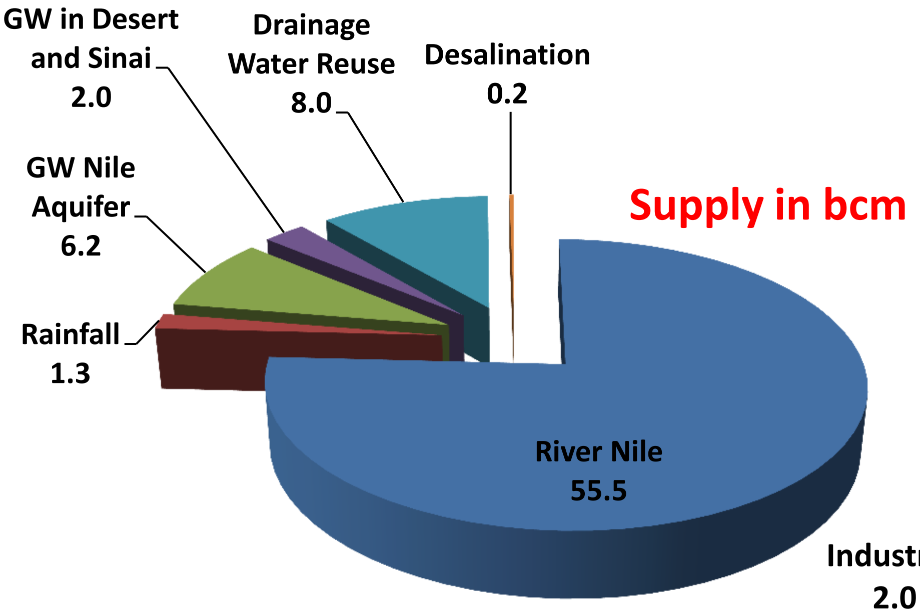
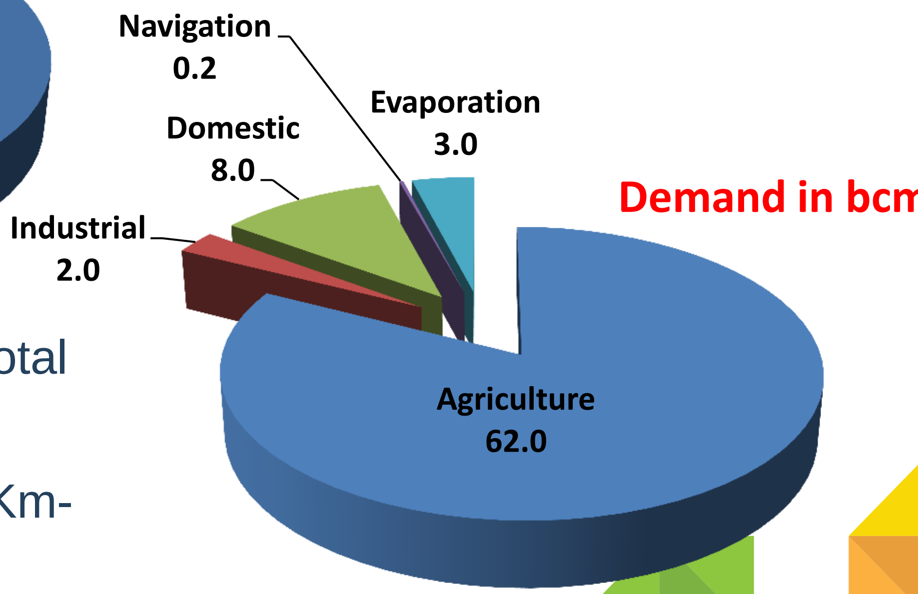
Supply Vs Demand





- Agriculture accounts for 82% of the total demand for freshwater
- Evaporation losses from the 31,000 Km-long water conveyance network is estimated at about 3.0 BCM/yr

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Water Quality & Pollution

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- Waste water : full potable water network while partial sanitation network
- Agriculture drainage with fertilizers & pesticides polluting surface and GW
- Nile River : mostly good except from industry points as well as in Rosetta and Damietta branches in addition to sewage, and agriculture pollutants
- Main canals : WQ is moderate except: Fayoum with organic pollutants Elsalam , Bahr Moeas, el bahr el Abbassy, and El- Mahmodeia
- Agriculture drains: high pollution from sewage in village without services - Winter is better than summer
- GW: Most wells in Nile delta and Valley are suitable for drinking and irrigation. Some pollution in the new reclaimed lands within Nile Delta, with Heavy metals violating limits in deep GW and need treatments

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Crop Requirements

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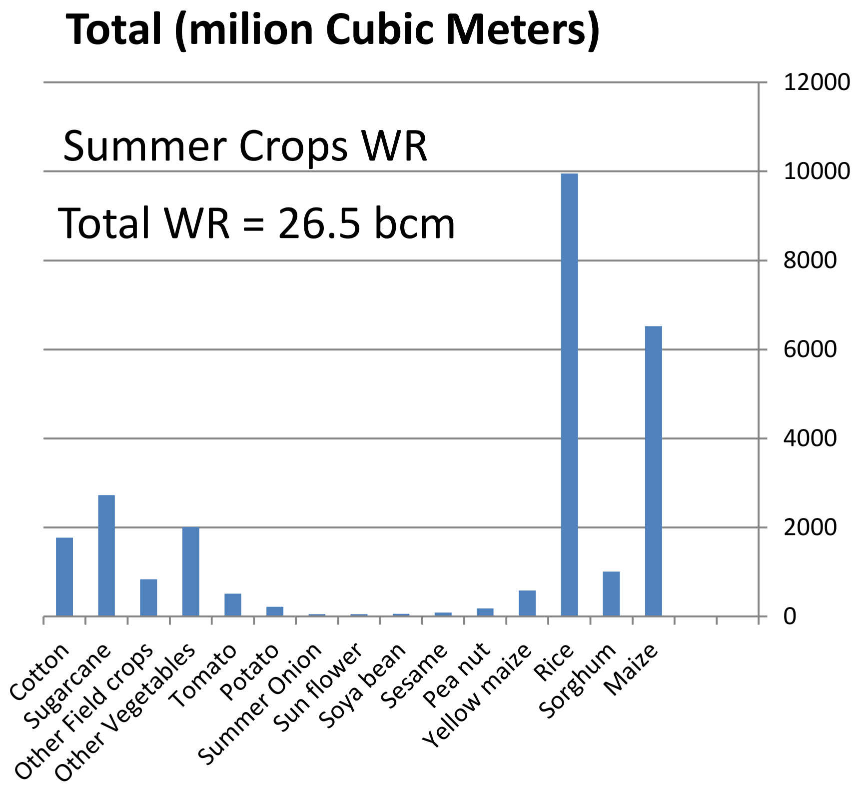

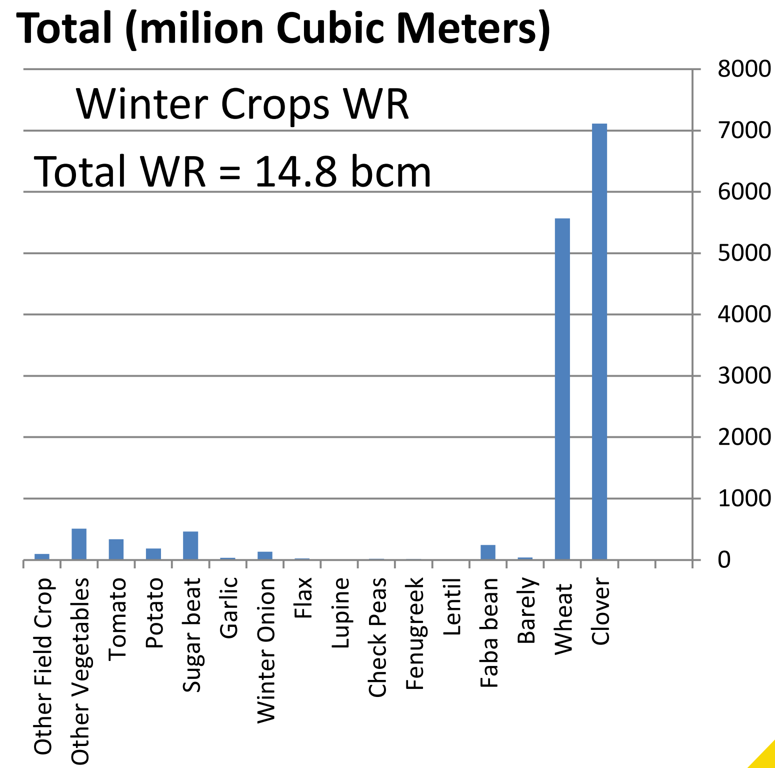

- **Wheat**: Production : 7.2 million tons & Import : 7.9 million tons
- **Maize**: Production : 7.4 million tons & Import : 5.3 million tons
- **Rice**: Production : 5.5 million tons with 105.5% self sufficiency

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Interventions

(Water Strategy Pillars)

1. Water resources Development

(Invest in desalination of sea water & brackish GW, cooperation with NB countries, Increase GW rational use, rain & Flash Flood harvesting, better management of the shallow GW in the Nile Valley)

2. Improve the rational use of the current WR

(Increase Water Use Efficiency, Ag. land protection & improve fertility and productivity, Improve infra-structures & water distribution structures based on actual needs, Improve water availability for all purposes)

3. Protection of Public Health and Environment

(Prevention and combating the WR pollution, treating polluted water from different activities, pollution control & considering the water suitability for its specific usage purposes)

4. Provide suitable environment for planning

(Improve WR planning & provide required finance & improve cooperation and coordination in the water sector, decrease population growth rate)

Research & Development

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(Opportunities)

Technical → Social → Institutional → Laws & Regulations → Finance

- Renewable energy technology for water resources development
- Solar Pumping technology & remote connectivity
- Desalination technology with cheap energy resources
- RS Management Technology for different WR
- Canals water distribution remote management & technology (SCADA systems)
- O&M research & new technologies for all WR
- Rain & Flash flood harvesting research & technology
- Treatment technology

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Energy Challenge in DCs

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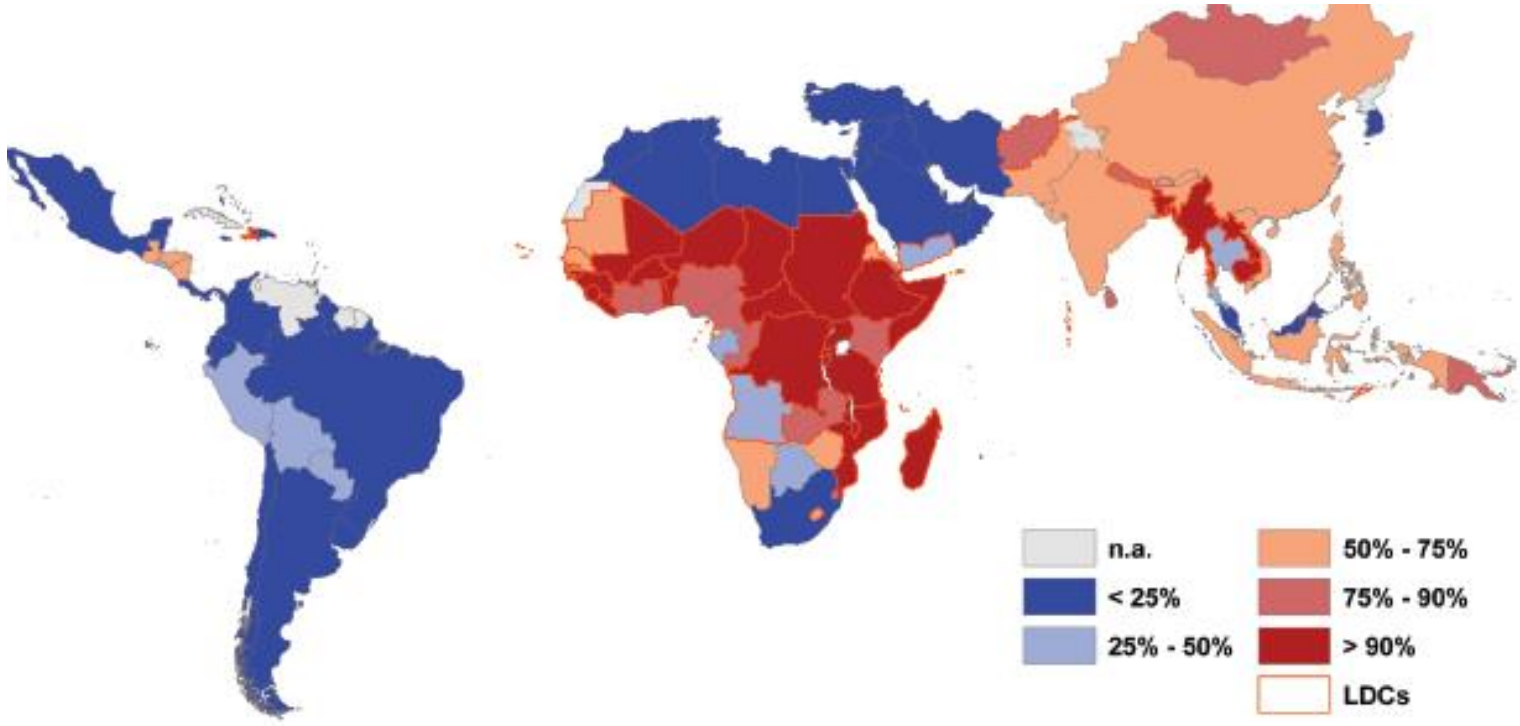
1.3 billions no access to electricity

Source: WEO 2012, IEA



2.6 billions rely on biomass for domestic usage

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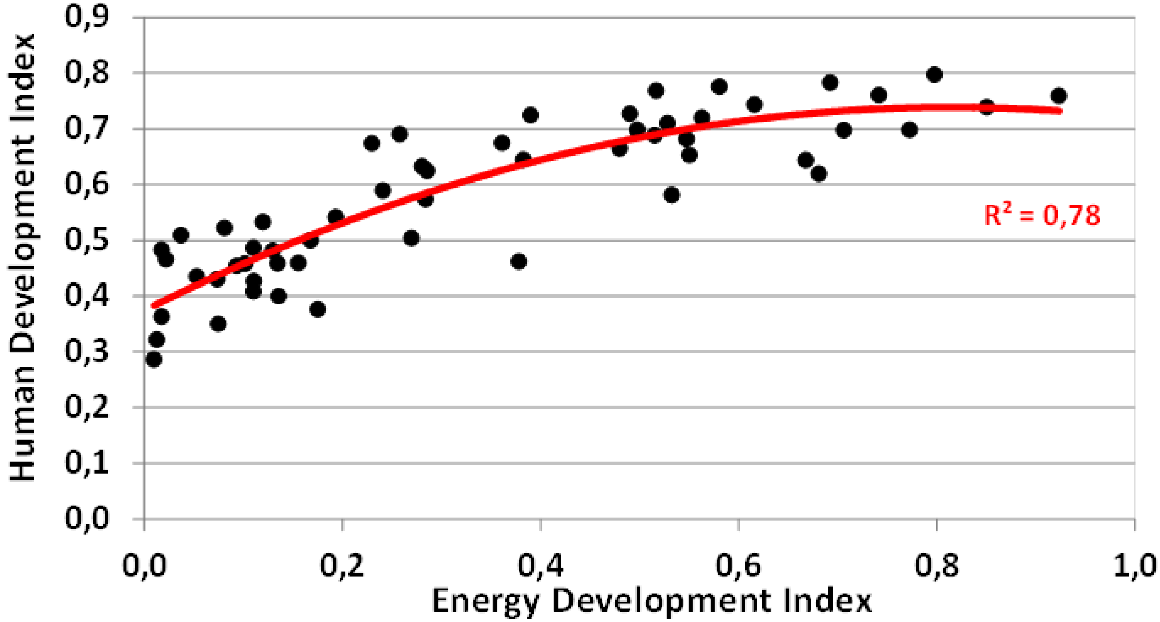
Energy and Development



Which strategies?

Possible options according to the **IEA forecast**: 50-250 kWh per year per capita

Improve access to the national electric grid

Foster distributed generation

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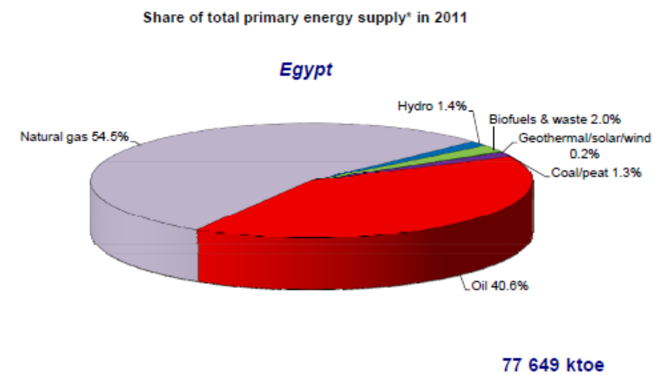
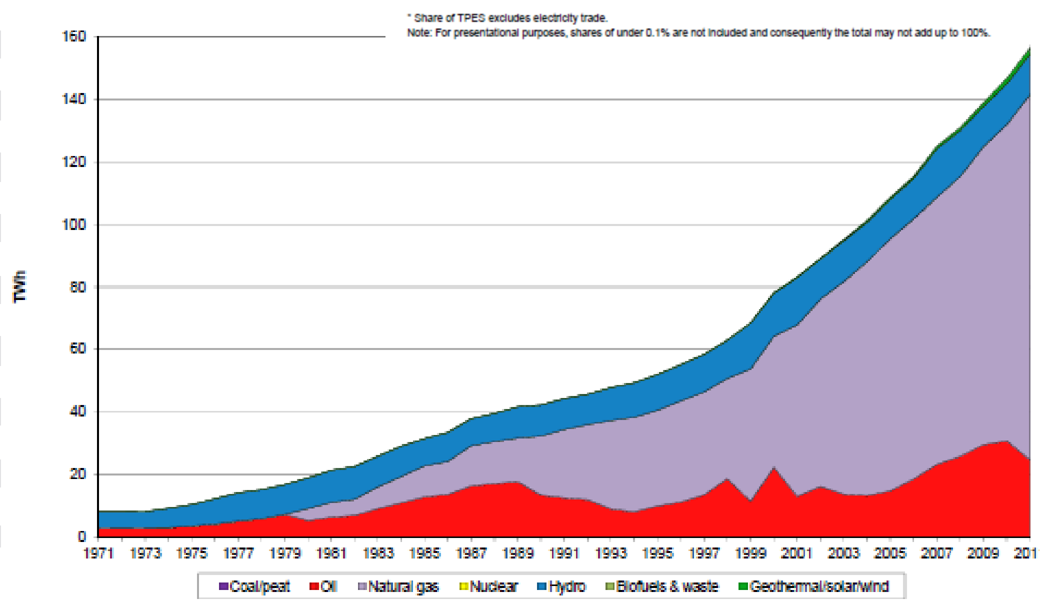
and Egypt?

Access to electricity in Egypt

		Electrification Rate (%)		Rural Electrification Rate (%)
		2005	2010	2010
NOEC	Algeria	98.1	99.3	97.9
	Bahrain	99.0	99.4	94.7
	Egypt	98.0	99.6	
	Iran	97.3	98.4	
	Iraq	15.0	98.0	
	Kuwait	100.0	100.0	
	Libya	97.0	99.8	
	Oman	95.5	98.0	
	Qatar	70.5	98.7	
	Saudi Arabia	96.7	99.0	
	Syria	90.0	92.7	
	UAE	91.9	100.0	
	Yemen	36.2	39.6	
NOIC	Djibouti	n/a	50.0	
	Israel	96.6	99.7	
	Jordan	99.9	99.4	
	Lebanon	99.9	99.9	
	Malta	n/a	n/a	
	Morocco	85.1	98.9	
	Palestinian Territories	n/a	n/a	
	Tunisia	98.9	99.5	

Source: MENA RSR 2013, REN21





Source: IEA2013

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Clean Energy Technologies

Which alternatives are possible?

1. Renewable energies

Rec
Inv
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and

2. Biofuels

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3. Energy Efficiency

Recent progress:
Evidence of renewed focus from governments, with many major energy countries announcing new measures.

Key conditions:
Policy action to remove barriers obstructing the implementation of energy efficiency measures that are economically viable

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Source: WEO 2013, IEA

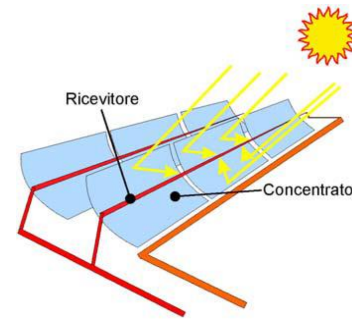
Desalination plant (Trapani, Italy)

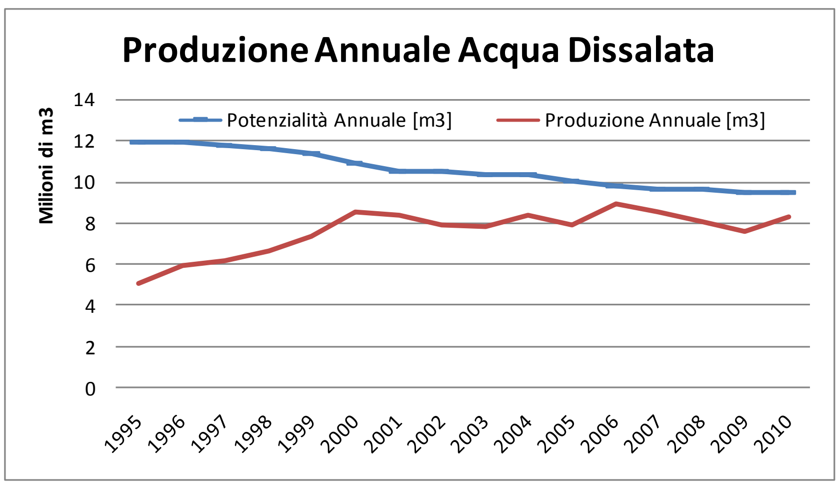
Carachteristics:

- 4 units MED-TVC 4 x 9.000 m^3/giorno
- 2 Heaterd (40 MW_t) - 54 t/h of saturated vapor 45 bar and 260°C
- 4 sea pumps 4 x 2.100 m^3/h

Mineralization Unit

- 2 storages 2 x 13.000 m^3
- Thermal Power required: **73,9 MW_t**
- Electric Power required: **4,1 MW_e**





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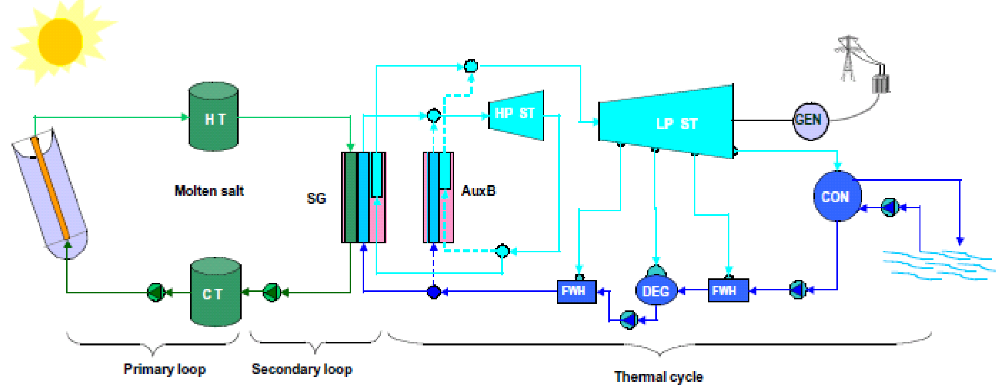

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Objective 1 – TriNex aims to develop a national Water-Energy-Food strategy and collaboration platform for researchers and decision makers

Objective 2 – Develop a Water-Energy-Food training program for officials from different ministers and raising the awareness of policy makers.

Objective 3 – Training junior researchers on interdisciplinary water-energy-food research and offering PhD Summer Schools

Objective 4 – Developing a web-based knowledge-sharing system to enable all the stakeholders (universities, research centers, ministers, NGOs) to share knowledge and exchange experience.

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TriNex Partners

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RWTH AACHEN UNIVERSITY

POLITECNICO DI MILANO

TU Graz

process engineering

SEKEM

THE AMERICAN UNIVERSITY IN CAIRO

Cairo University

ALEXANDRIA UNIVERSITY

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