



# Keynote

## Water-Energy-Food Nexus

**Hani Sewilam**

Professor & Director,

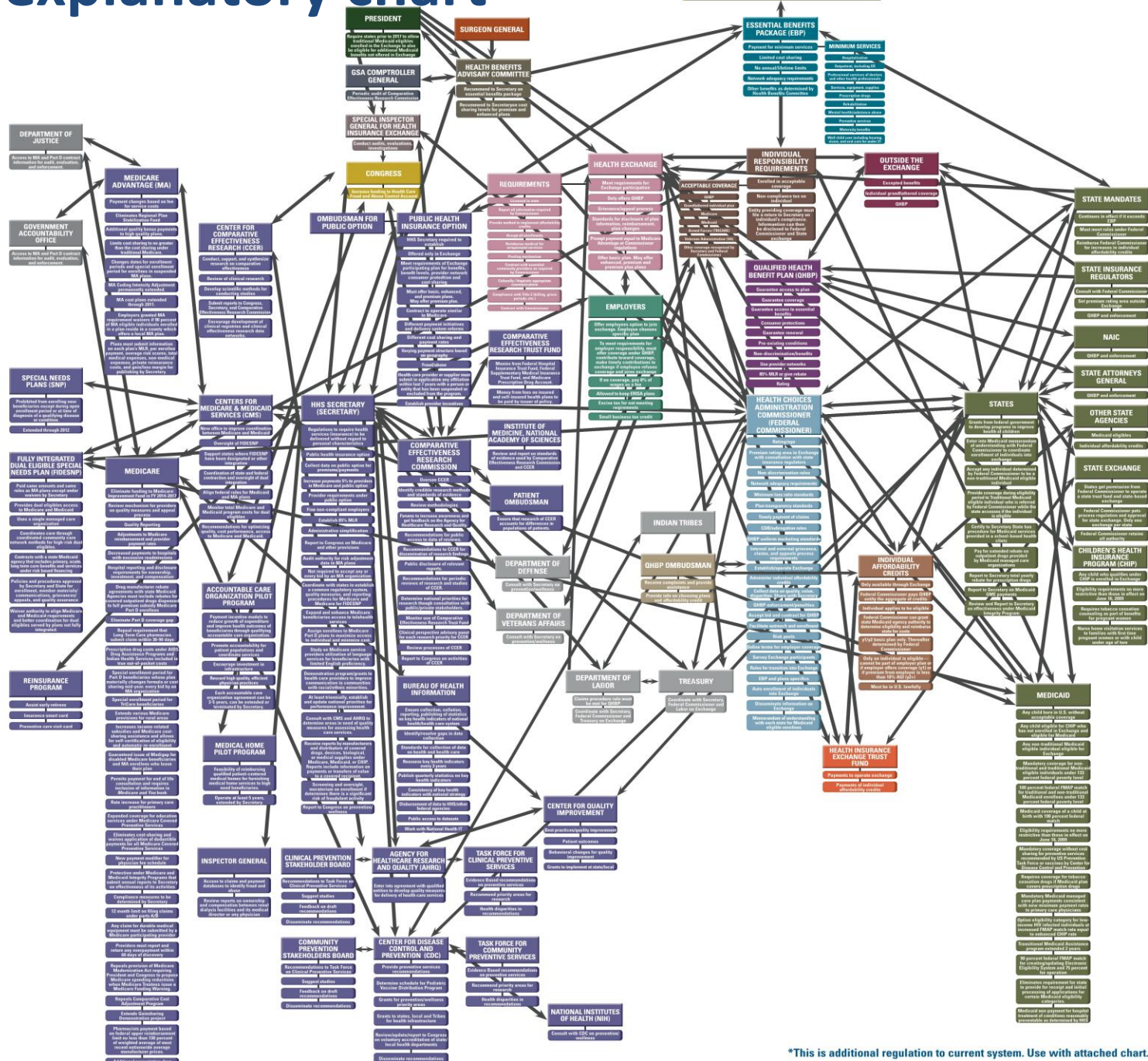
The Center for Sustainable Development

The American University in Cairo

**Egypt**

# Self-explanatory chart

## HEALTH INSURANCE PLANS

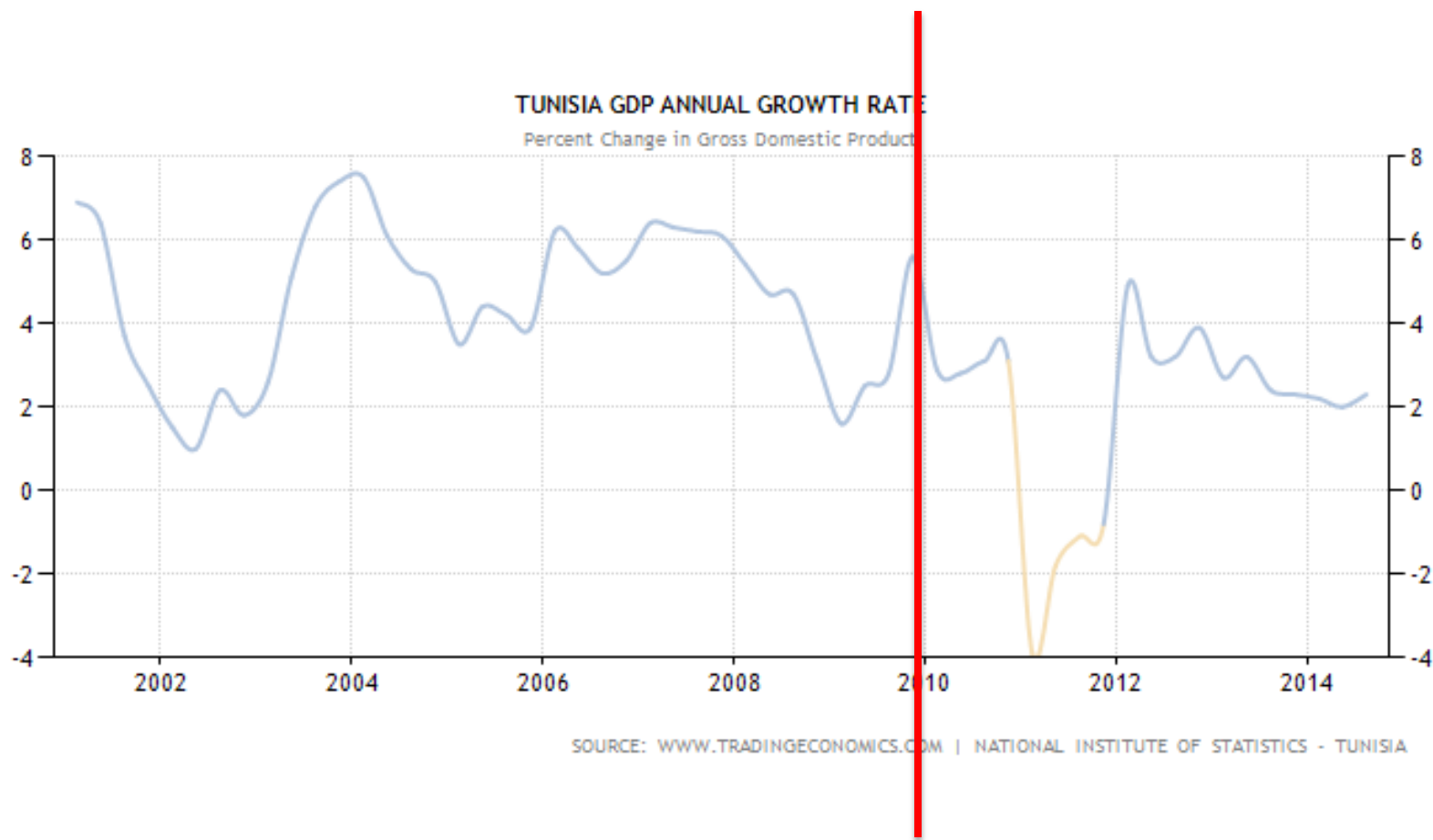


\*This is additional regulation to current system. Use with attached chart.



# What is Development?

## GDP – Growth Rate in Tunisia





# What is Development?

## GDP – Growth Rate in Egypt





## GDP in Egypt

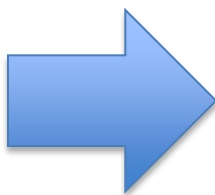
2001	2002	2003	2004	2005	2006	2007	2008
3.5%	3.2%	3.2%	4.1%	4.5%	6.8%	7.1%	7.2%
2009	2010	2011	2012				
4.7%	5.1%	1.8%	1.5%				

*GDP is calculated as the value of the total final output of all goods and services produced in a single year within a country's boundaries.*





# Economic Growth



- Food Security
- Health Services
- Education Services
- Employment Opportunities
- Environmental Protection





**Sustainable Development**

**Unsustainable Development**

**Environment**

**Society**

**Economy**









**Food**



# *Food security*

*“Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life”*

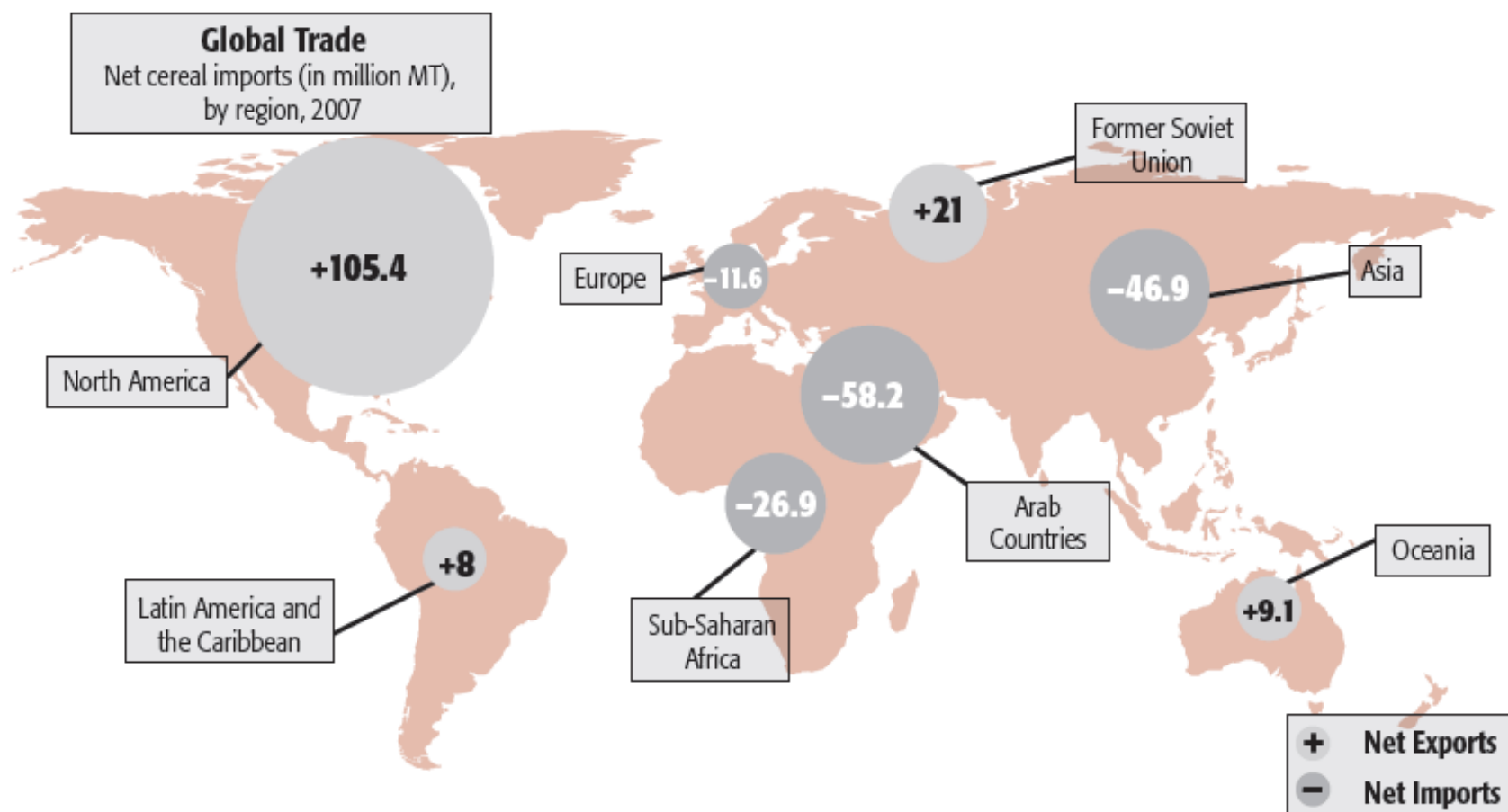
*(World Food Summit, Rome, 1996).*



- ***Food availability:** sufficient quantities*
- ***Food access:** access able by individuals*
- ***Utilization:** adequate diet, clean water, sanitation and health*
- ***Stability:** accessibility over time*

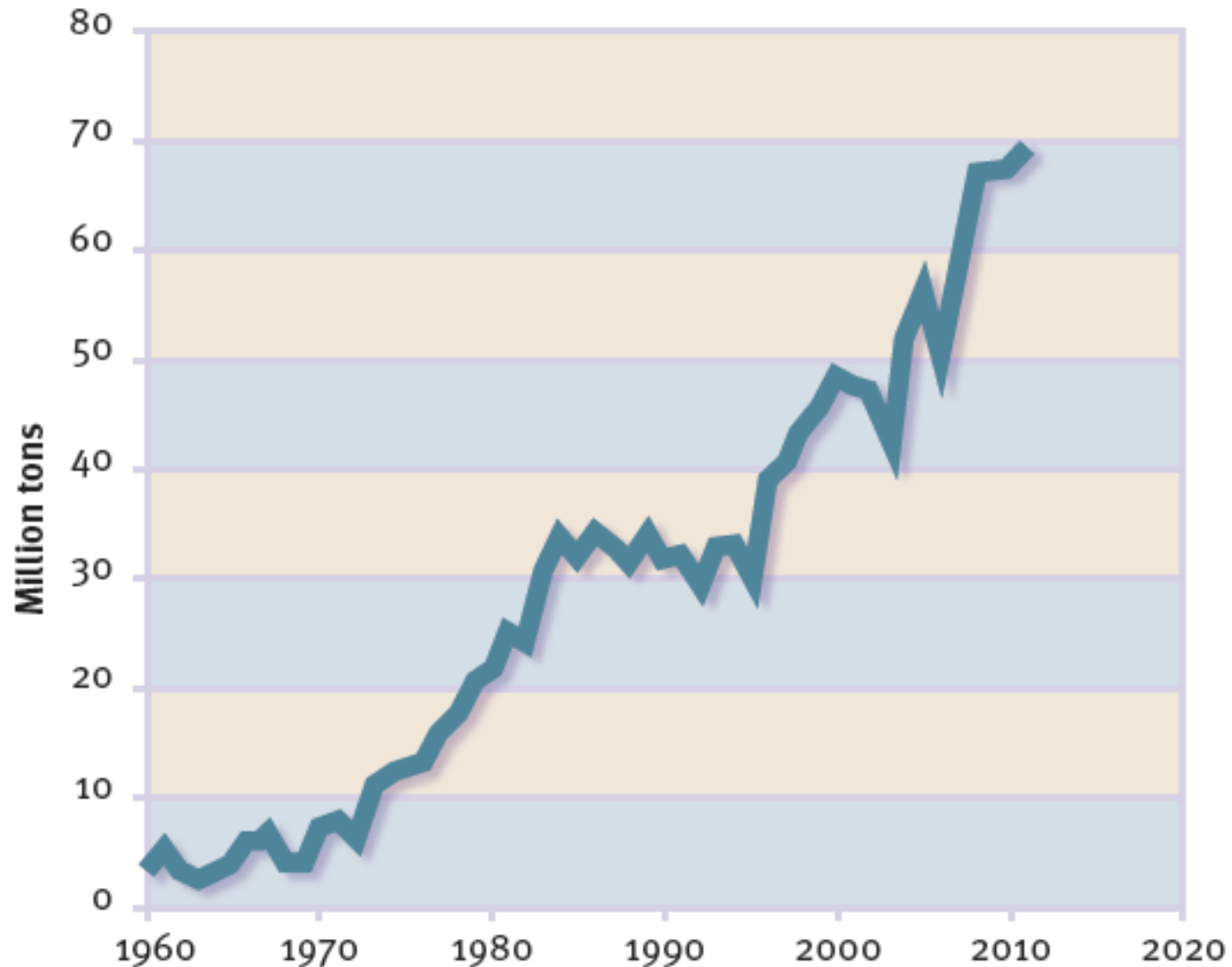


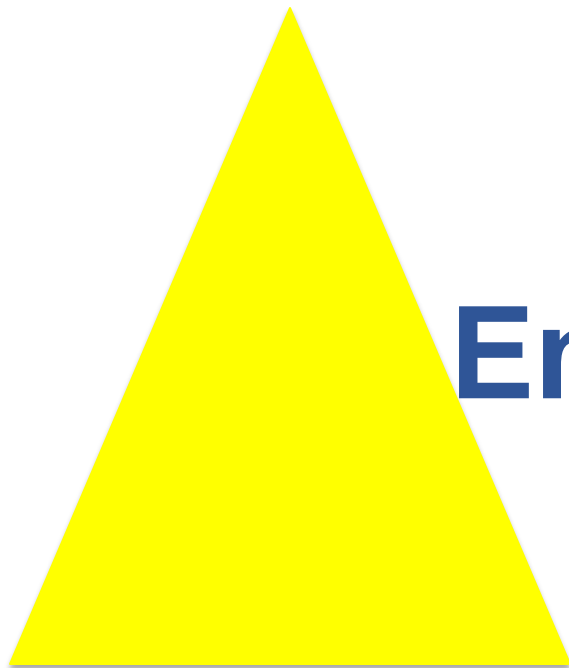
# Arab Countries Are the Largest Net Importers of Cereal in the World





# Net grain imports to the Arab Middle East and North Africa, 1960–2011

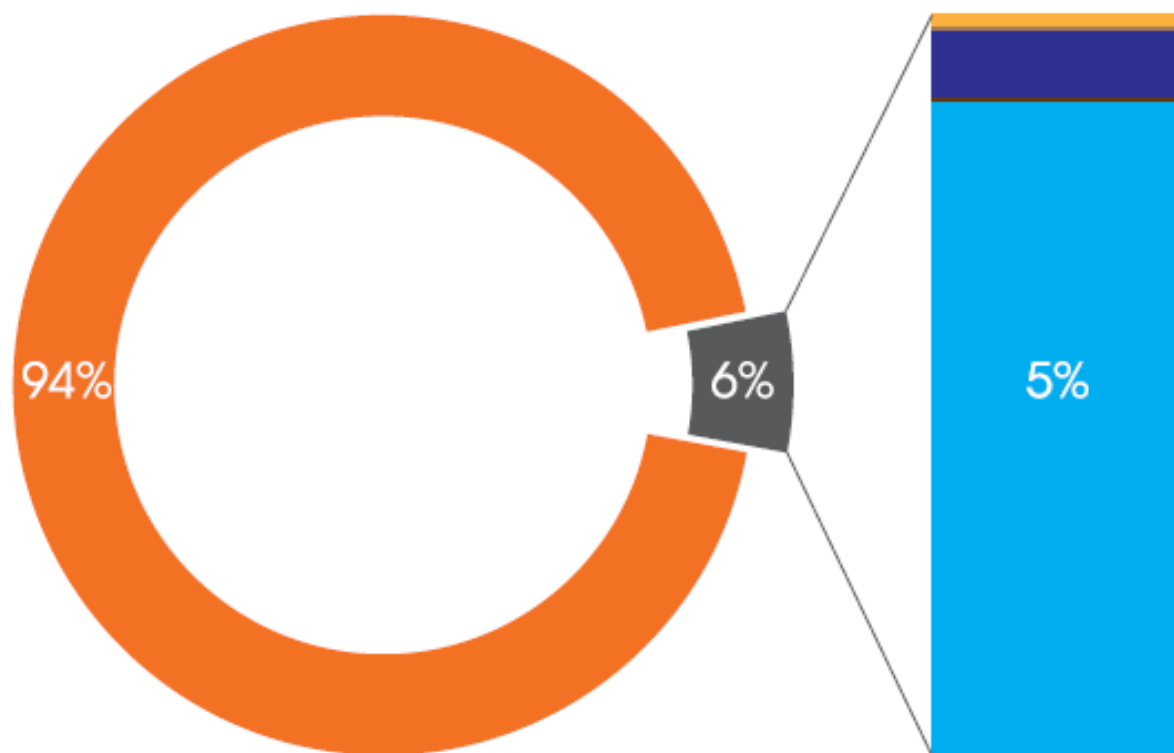




**Energy**

# Energy in the Arab Region

Share of installed power generation capacity by technology in 2012



Fossil Fuel

Wind

CSP

Waste to Energy

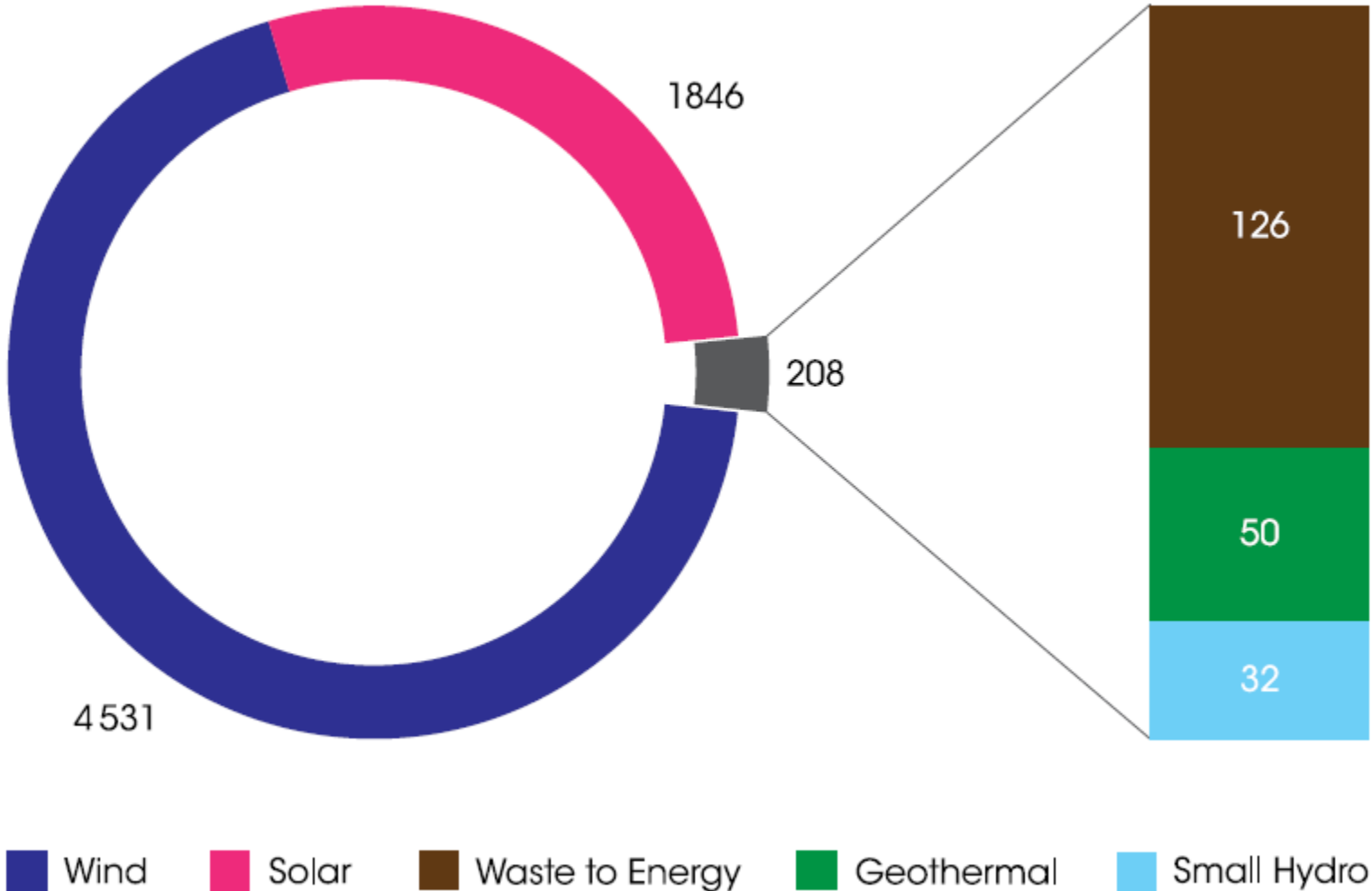
PV

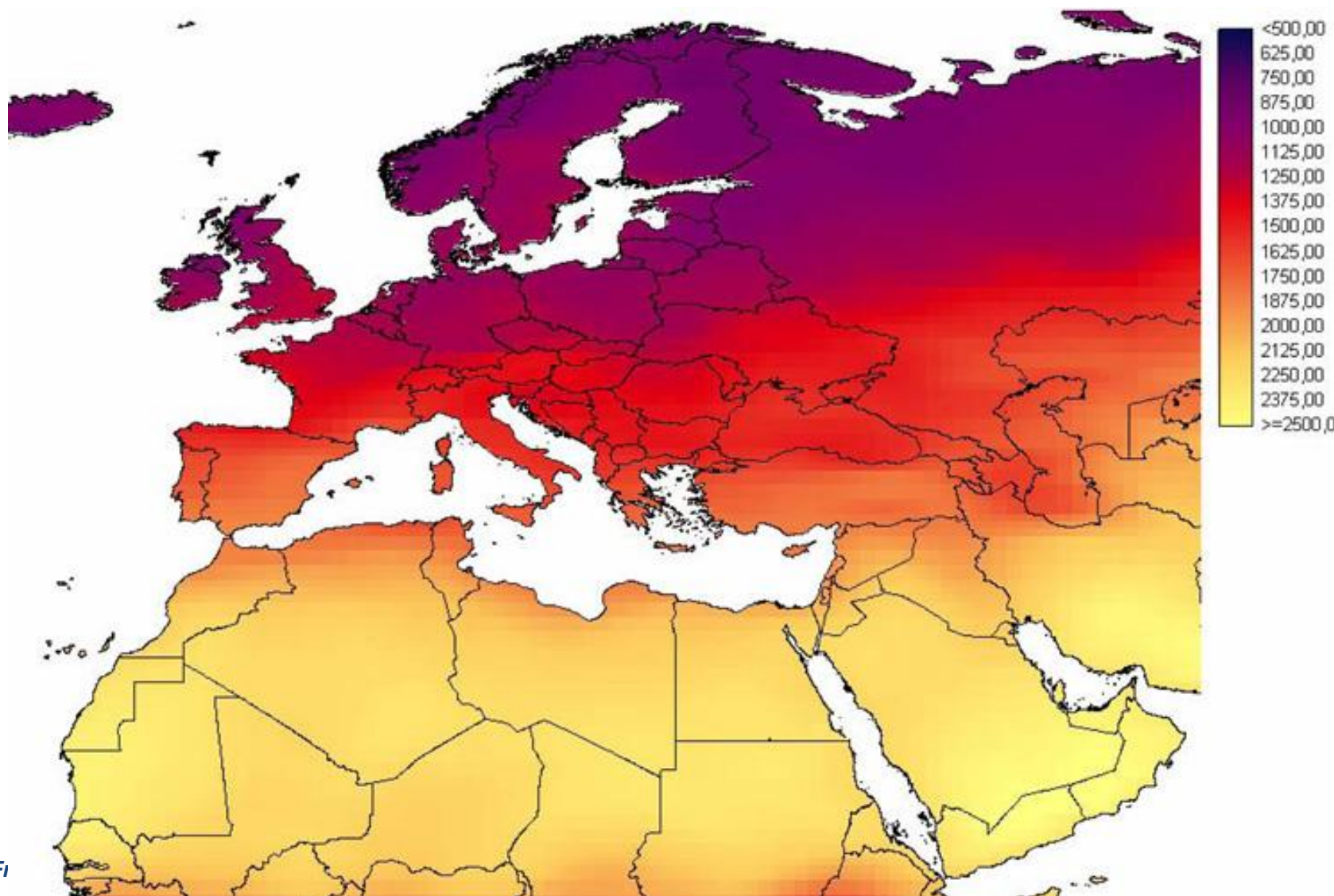
Hydro





Renewable Energy Project Pipeline (MW) Announced in 2013





## DESERTEC-EUMENA



Concentrating  
Solar Power



Hydro



Photovoltaics



Biomass



Wind



Geothermal

 **DESERTEC**  
FOUNDATION

### CSP collector areas for electricity



World 2005



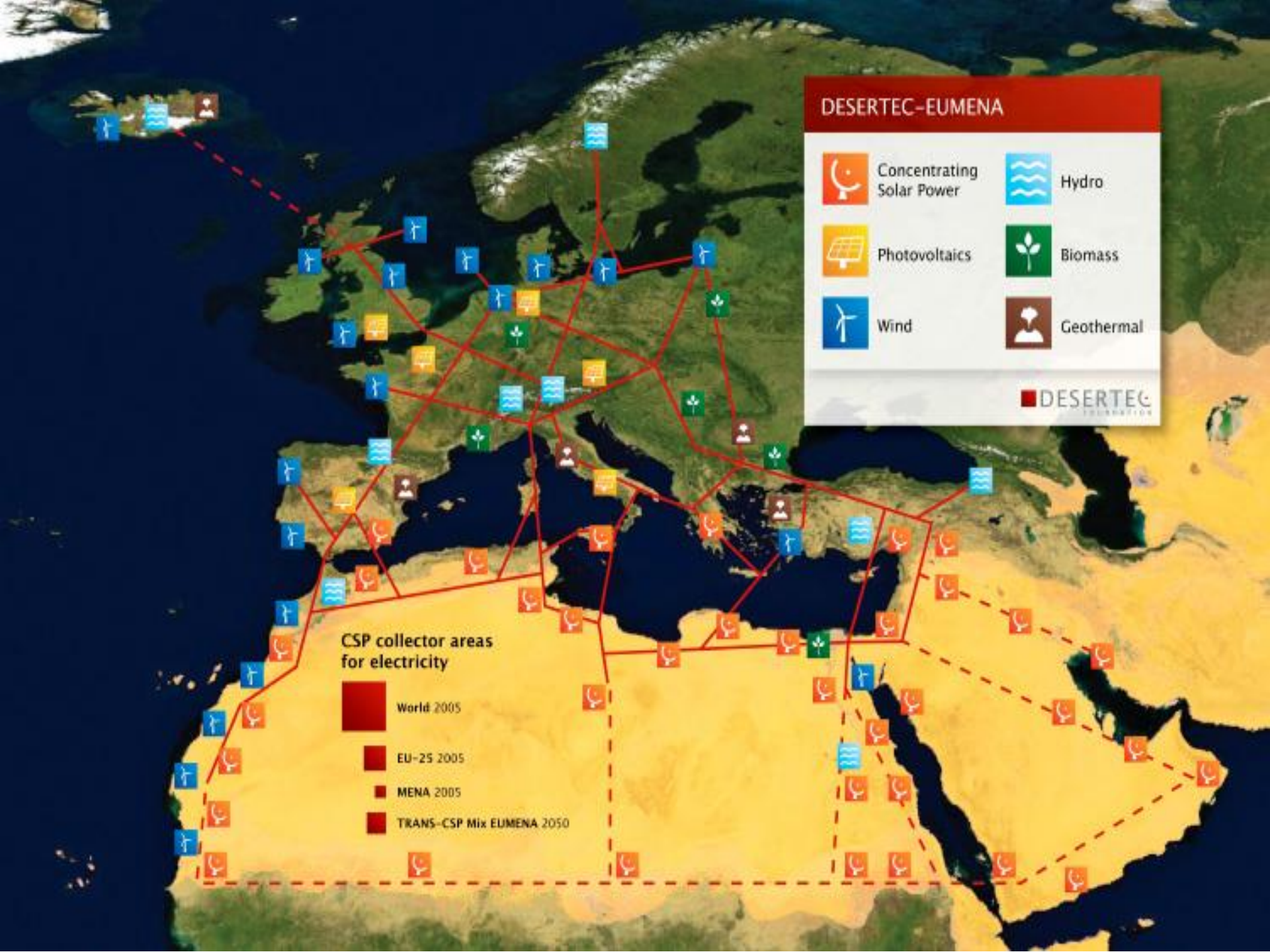
EU-25 2005



MENA 2005



TRANS-CSP Mix EUMENA 2050



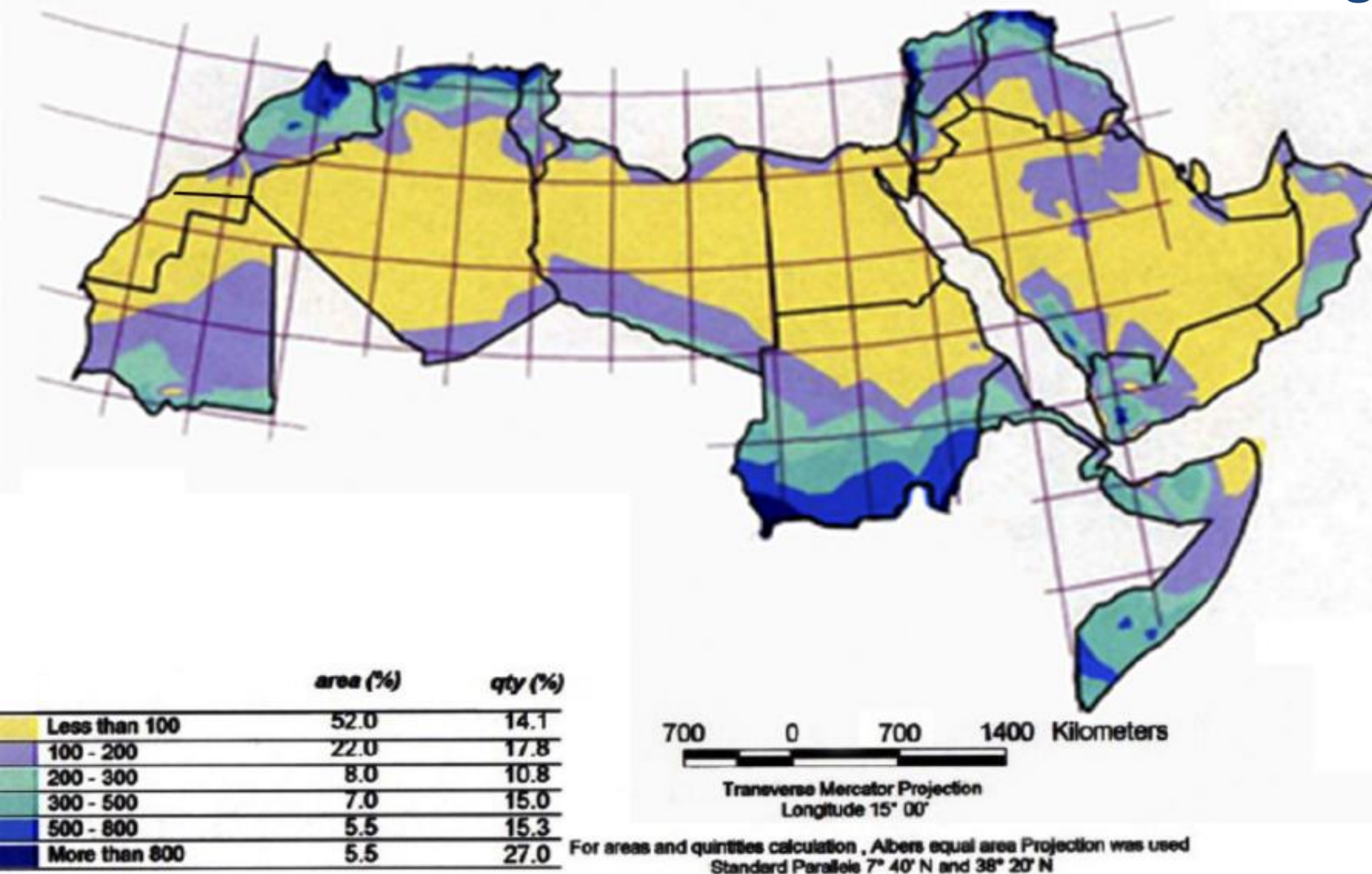




**Water**

# Water in the Arab Region

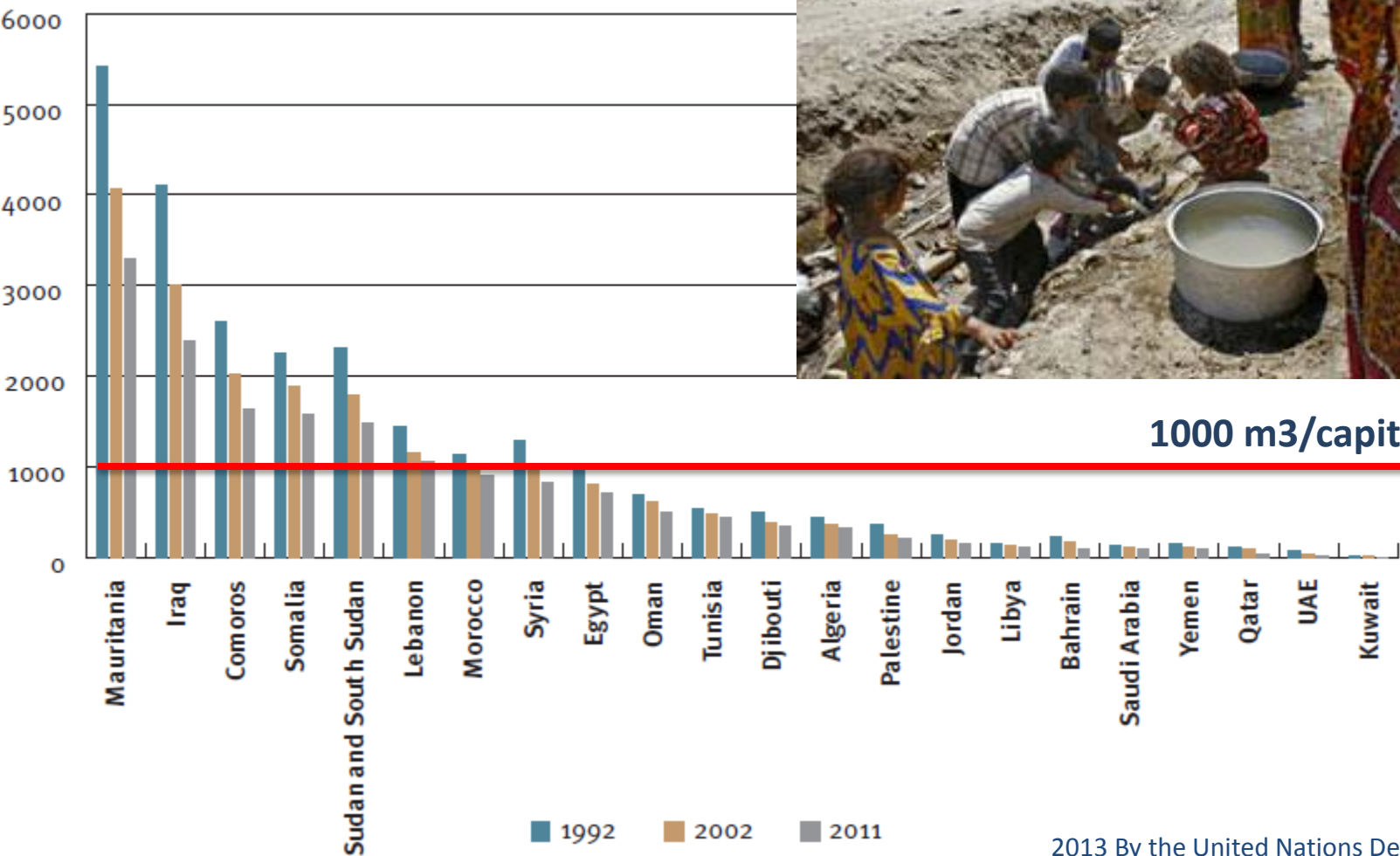
## Rainfall in the Arab Region





# Total renewable water resources per capita, 1992, 2002 and 2011

Cubic metres per inhabitant per year



1000 m3/capita/year

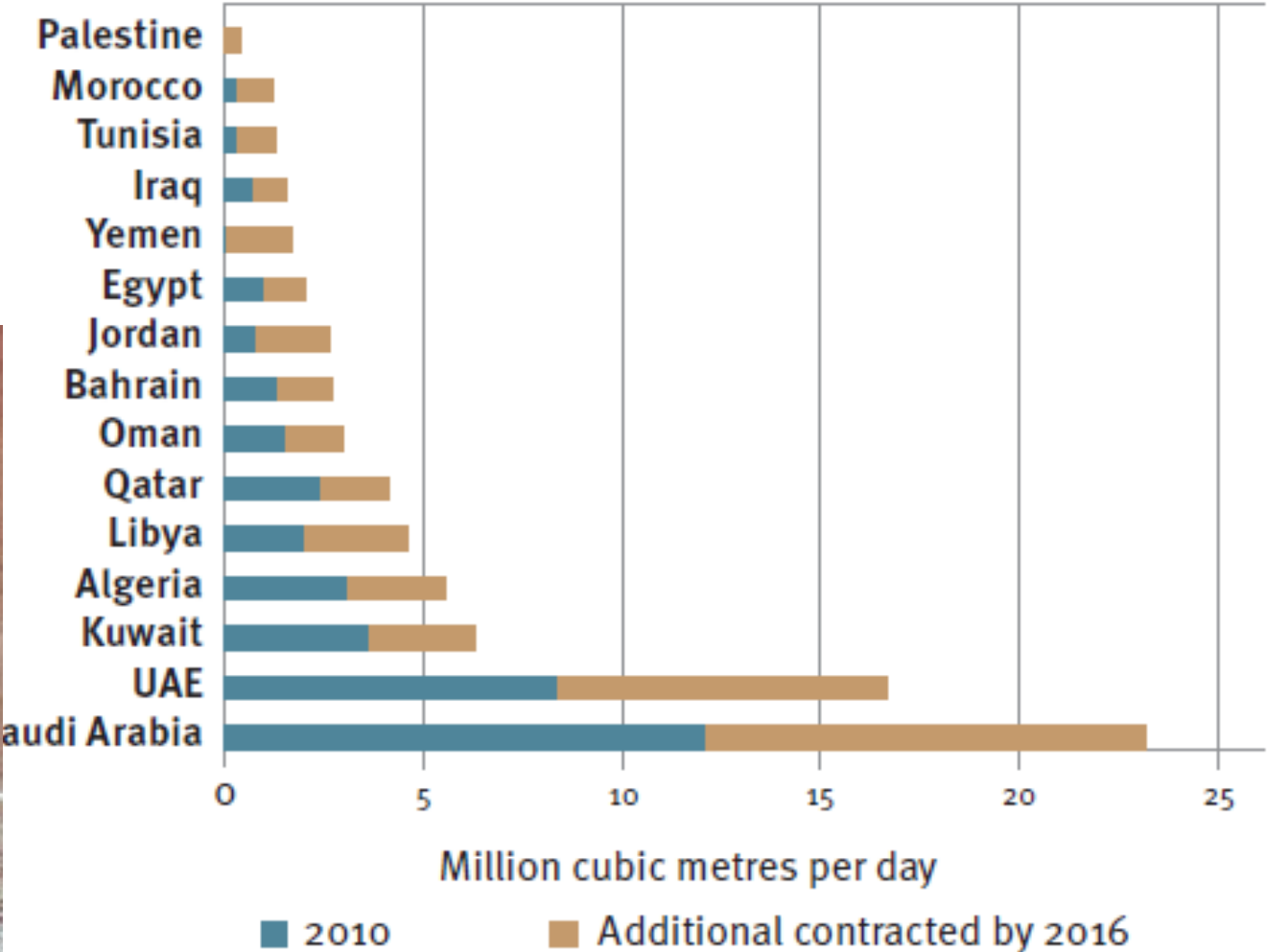




# Accumulated desalinated water in selected Arab countries,

2010 and 2016.

Total contracted capacity of all desalination plants in Arab countries



2013 By the United Nations  
Development Programme

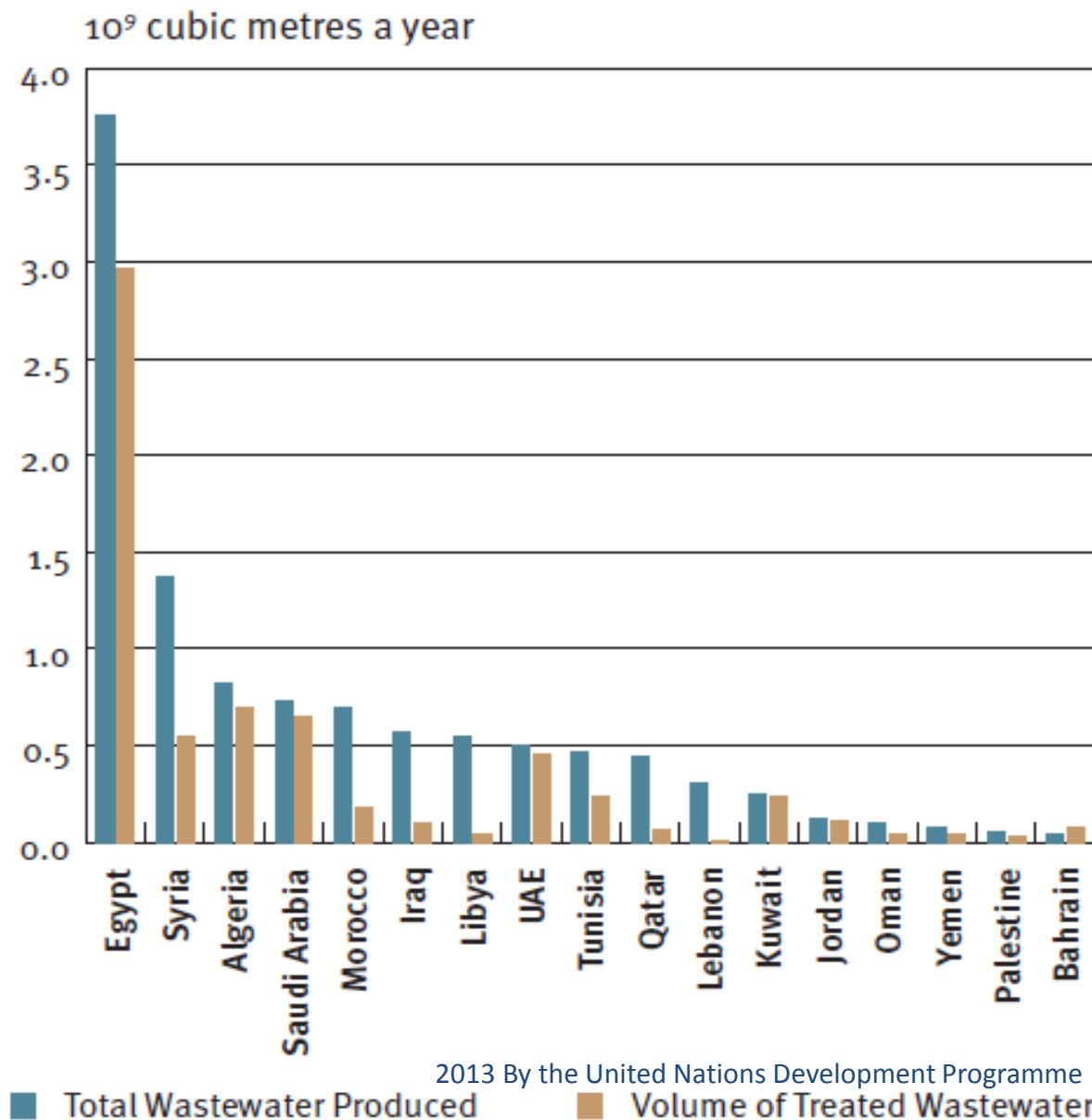


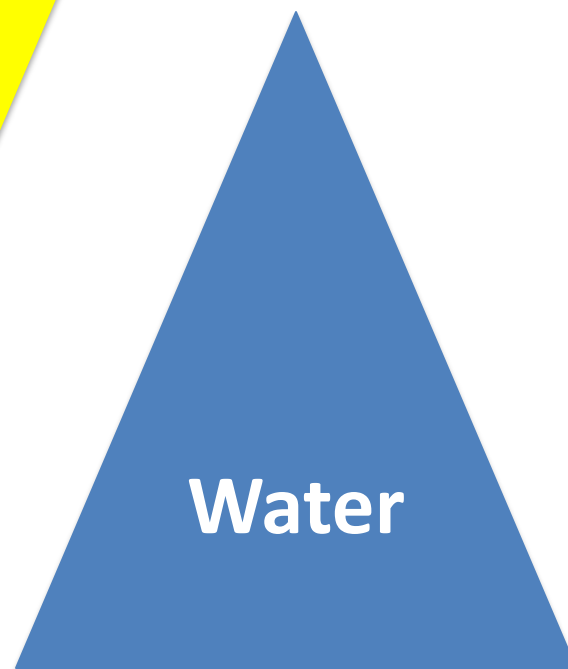
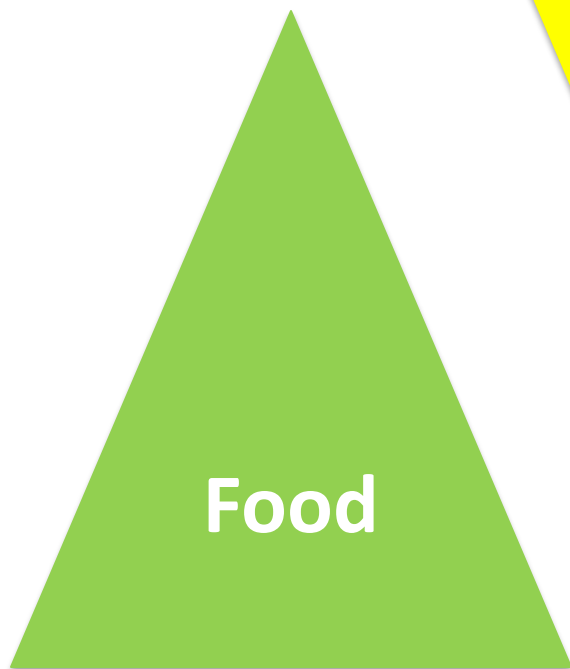


## Wastewater produced and treated in some Arab countries,

2009–2010

- Treated wastewater is 4.7 billion m<sup>3</sup>/year
- few countries have institutional guidelines for regulating treated wastewater
- about 40 per cent of wastewater is untreated.







# *Slice of Pizza*

**333 gallons (1,260 liters) of water**



*dough, tomato sauce and cheese*

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

VIRTUAL  
**WATER**



**4500**



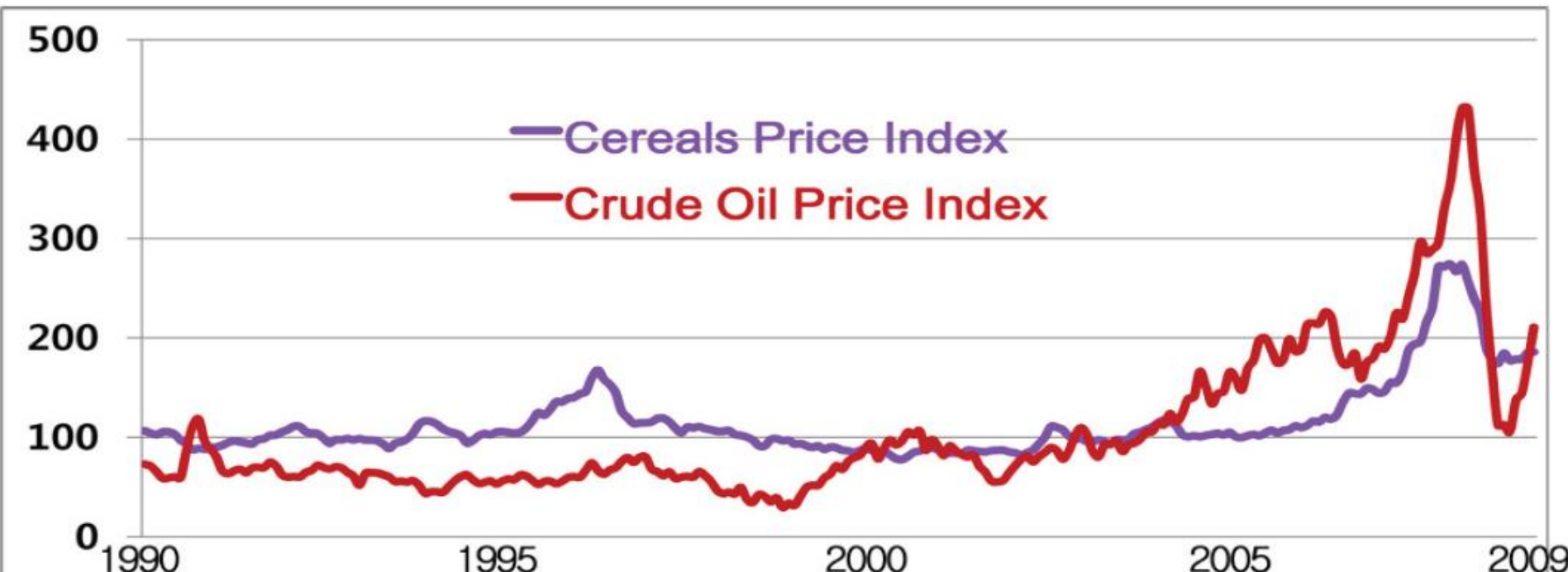
litres of water for  
one steak (300g) of  
**Beef**





# Energy & Food

The food sector currently accounts for around 30 percent of the world's total energy consumption.





# Energy & Food



Energy for Food	Food for Energy
Producing fertilizers	Biofuels
Agriculture processes	
Food Processing	



# Energy & Water



Energy for Water	Water for Energy
Pumping	Cooling
Sewage treatment	Hydropower
Transport	Biofuel
Desalination	Heating



# Food & Water



## Water for Food

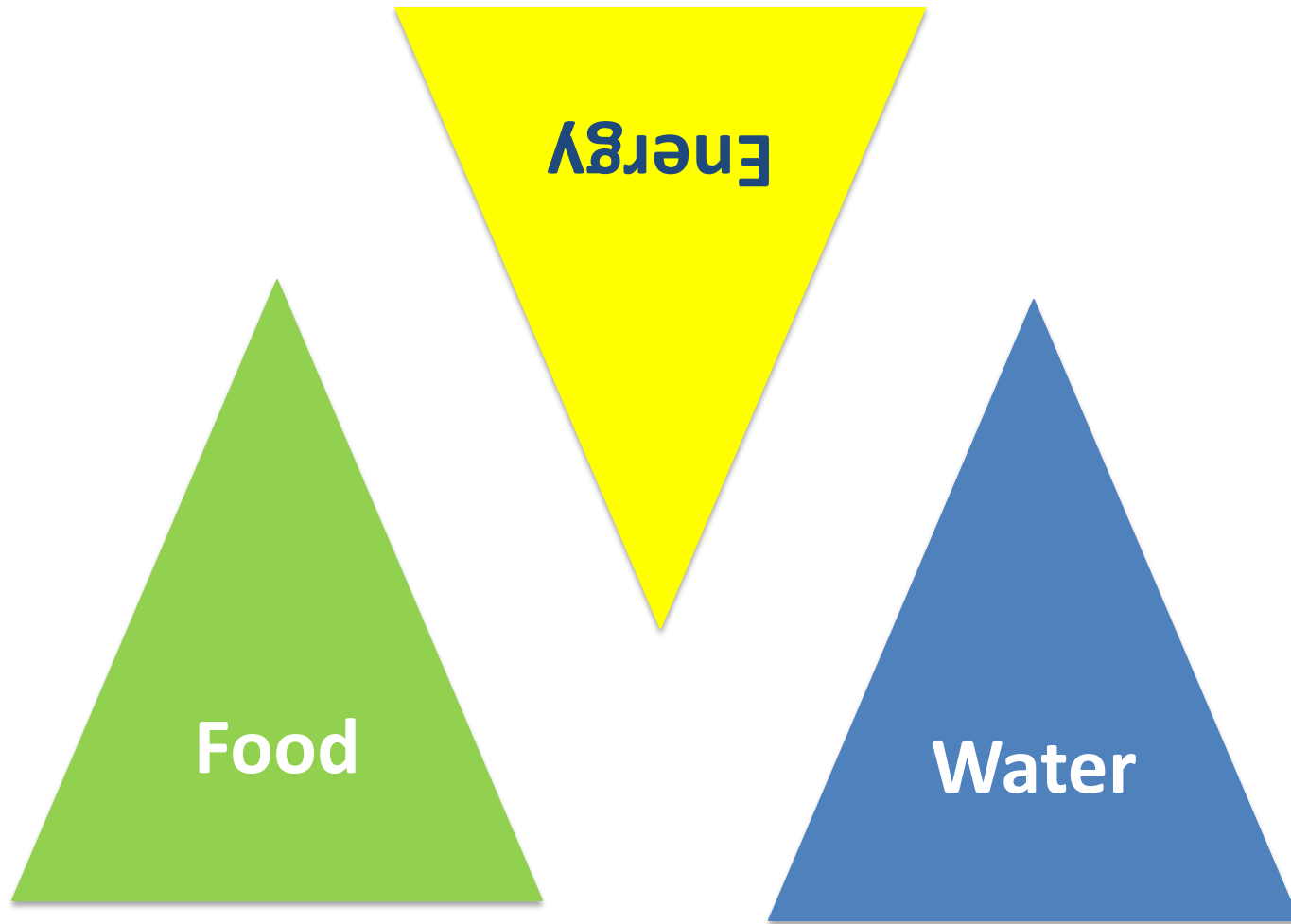
Irrigation

Processing





# Water-Energy-Food Nexus





# Water-Energy-Food Nexus





# The Case of Egypt



# WEF Policy Framework



# Knowledge Triangle Platform for Water-Energy-Food Nexus

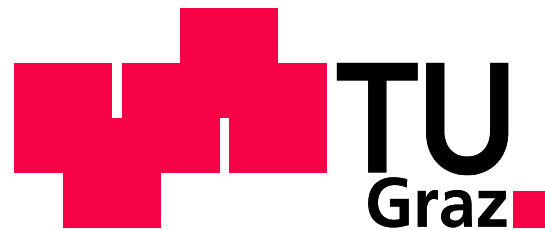
- Develop a national Water-Energy-Food strategy and collaboration platform
- Training junior researchers on interdisciplinary water-energy-food research and offering PhD Summer Schools
- Developing a web-based knowledge-sharing system





# TriNex Partners

POLITECNICO DI MILANO

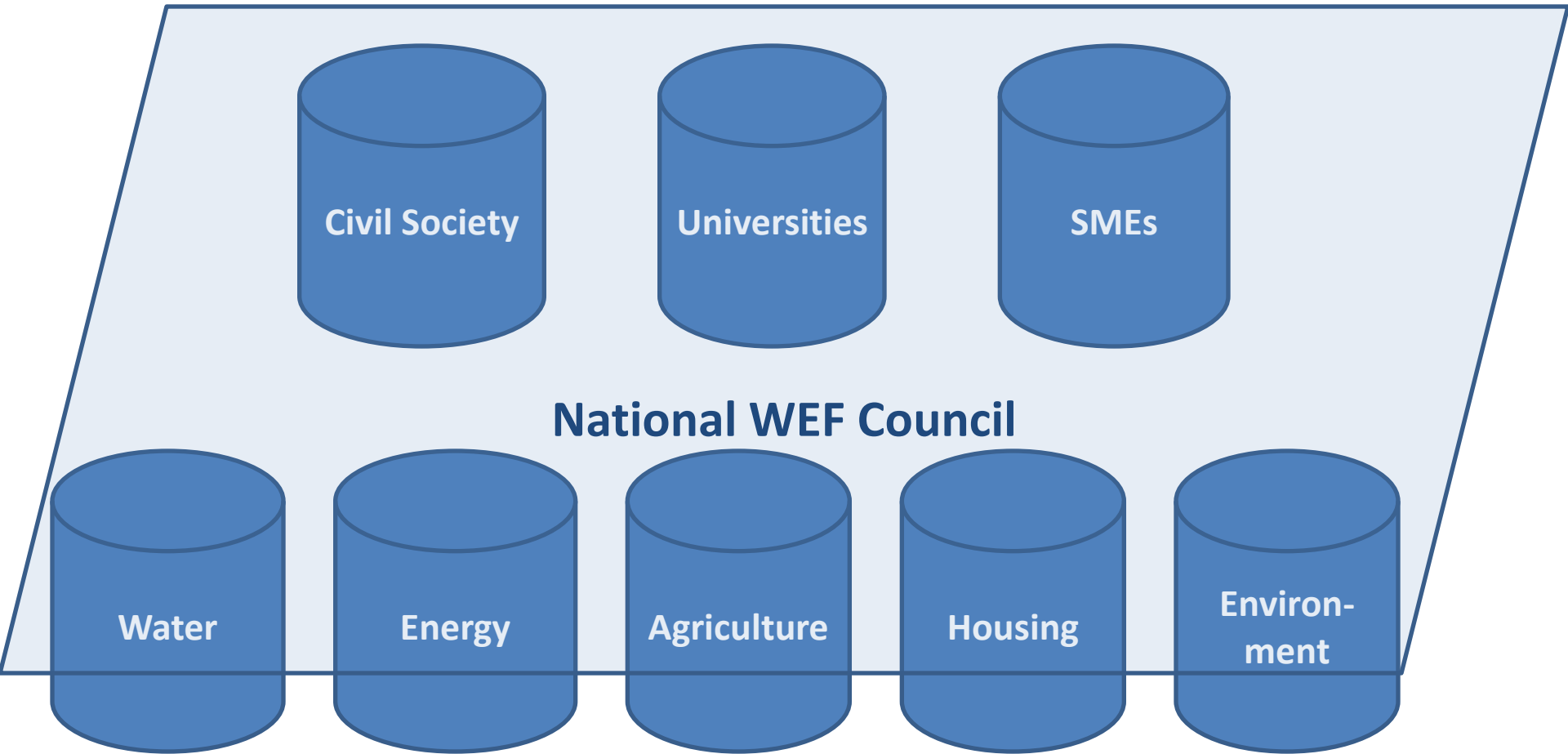


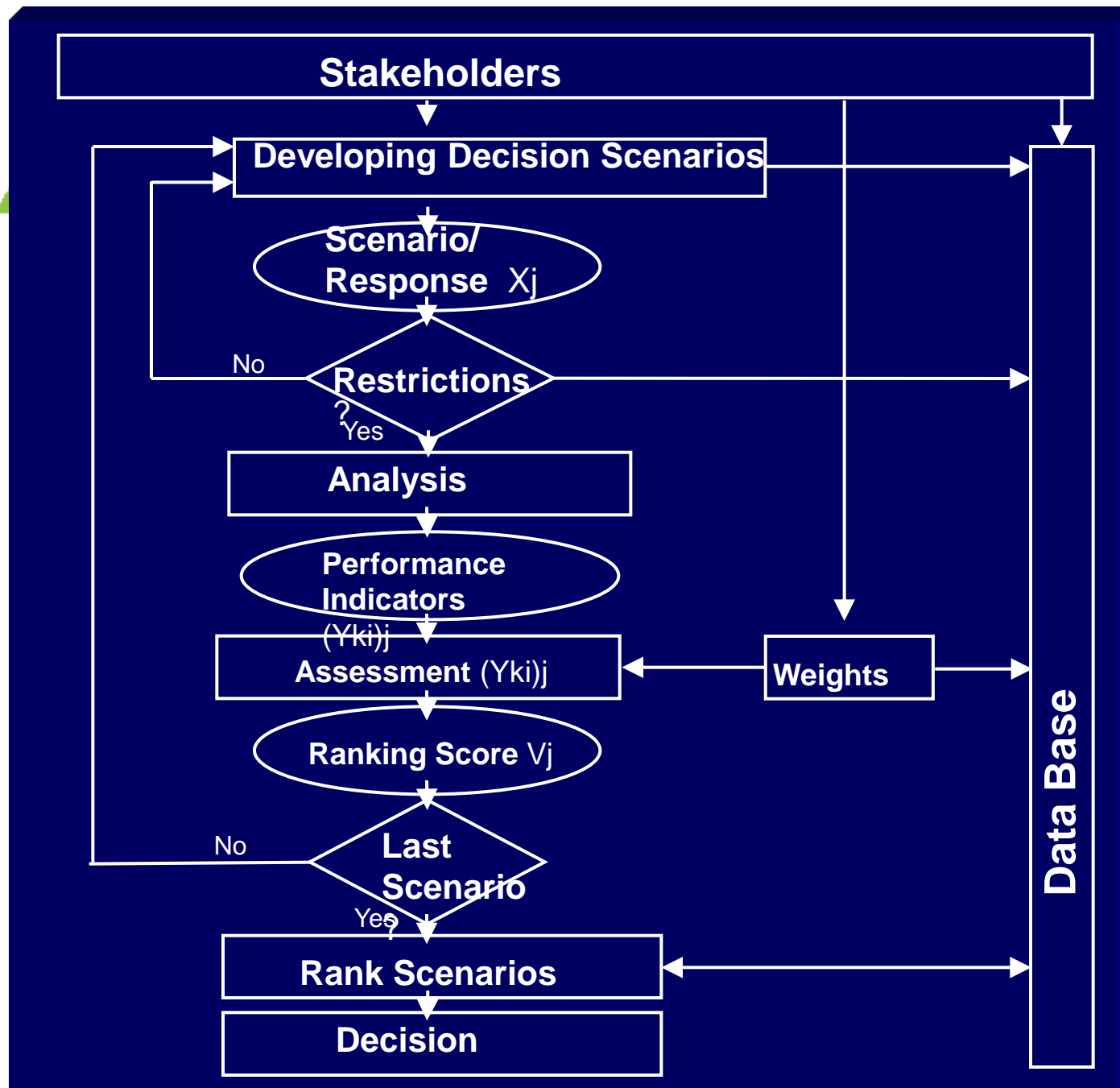
Cairo University





# National WEF Council (Stakeholders)





# WEF Nexus Decision Making Process



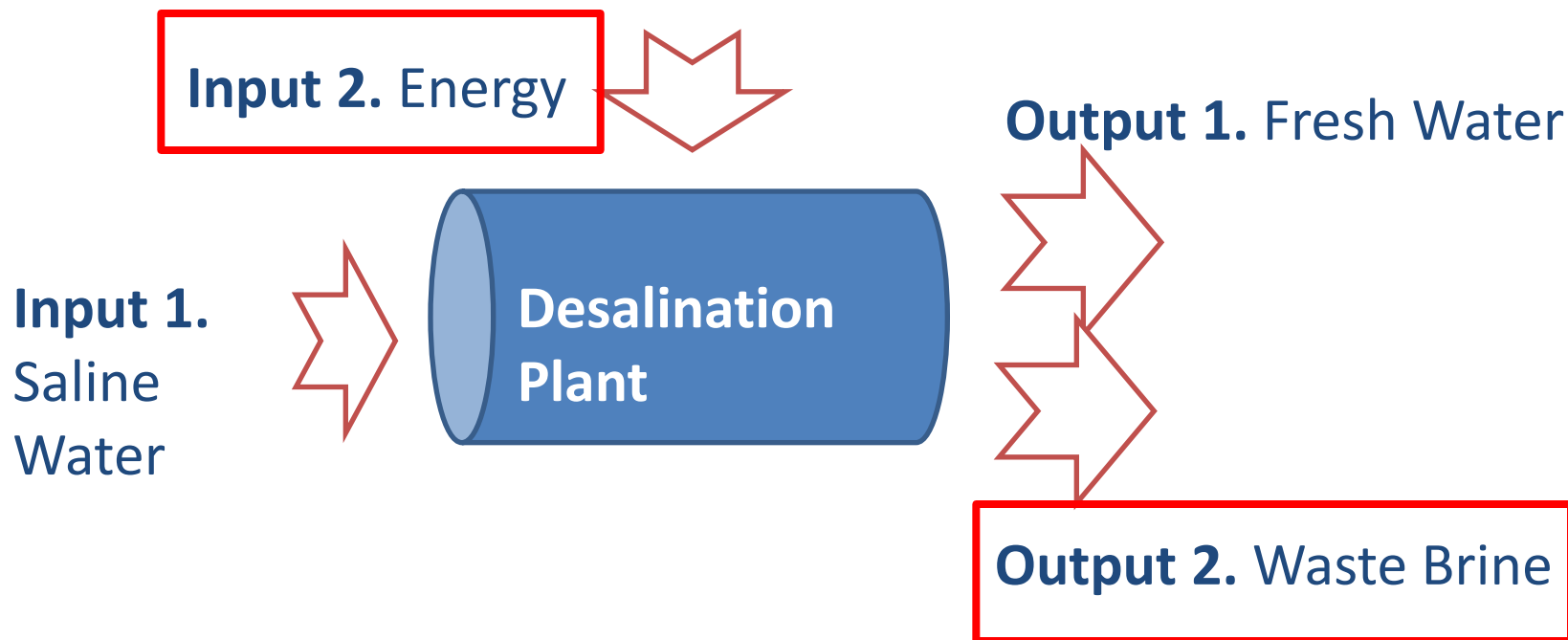


# WEF Research





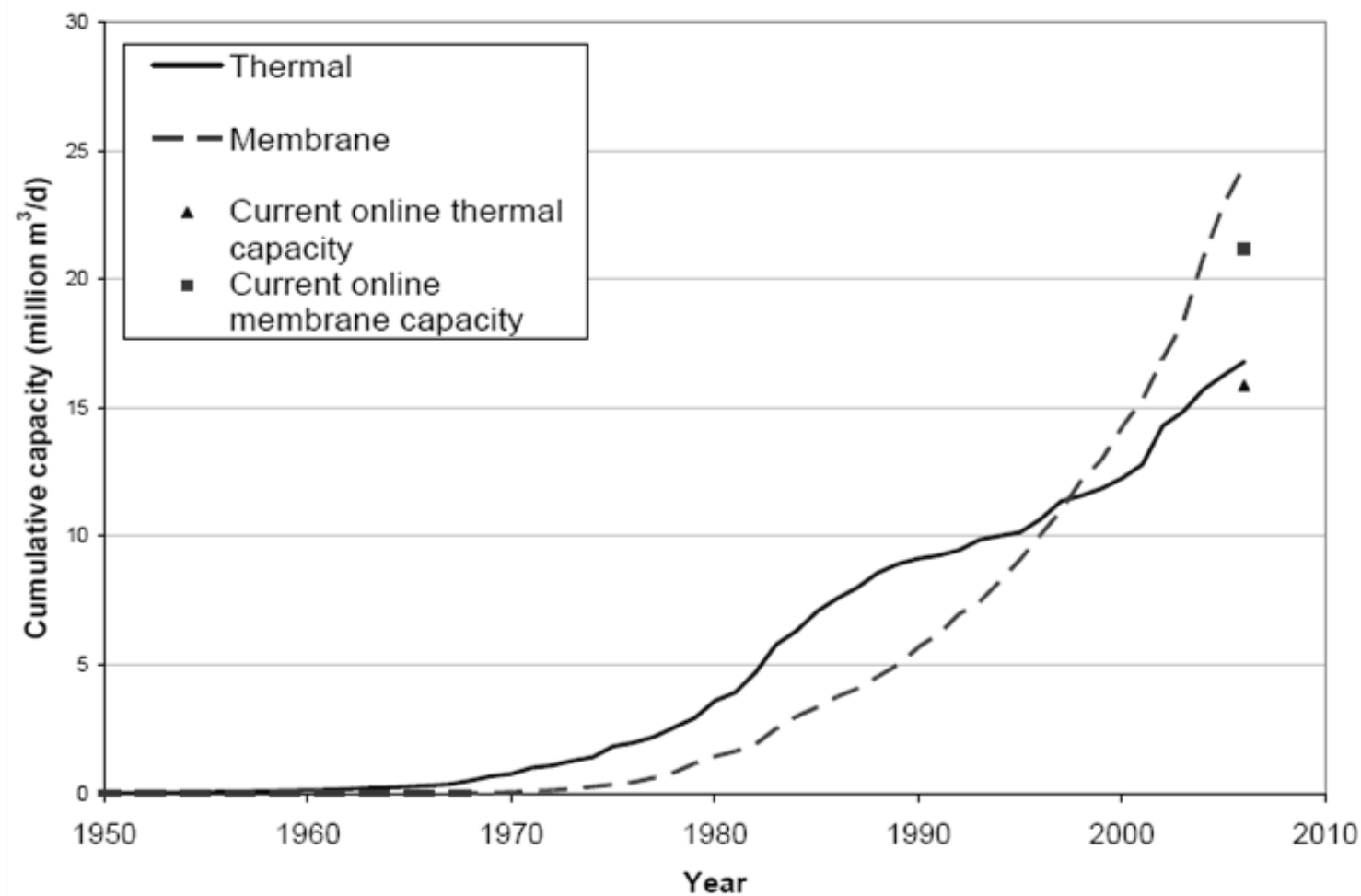
# Greening the Desalination





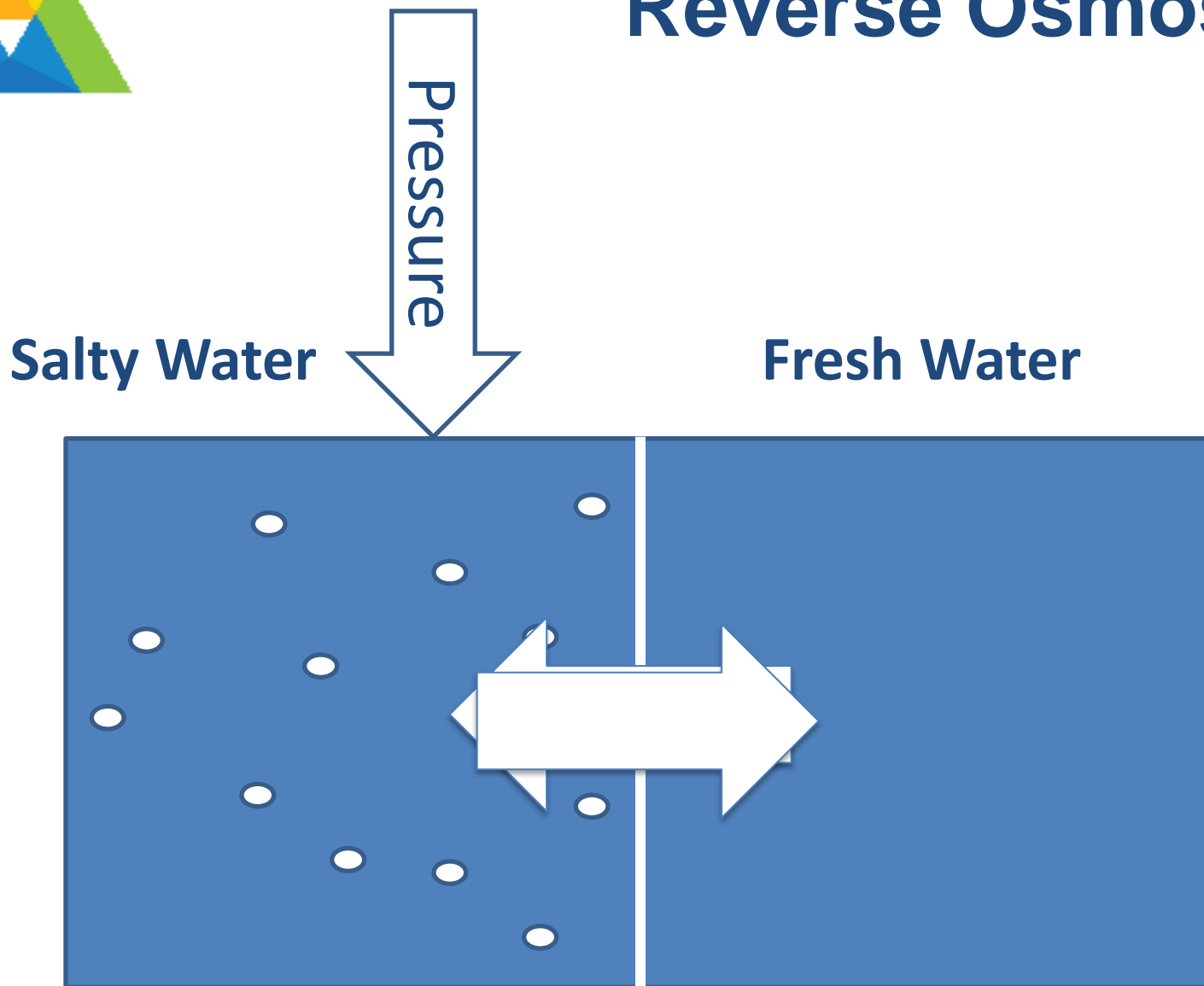


# Thermal vs. Membrane





# Reverse Osmosis

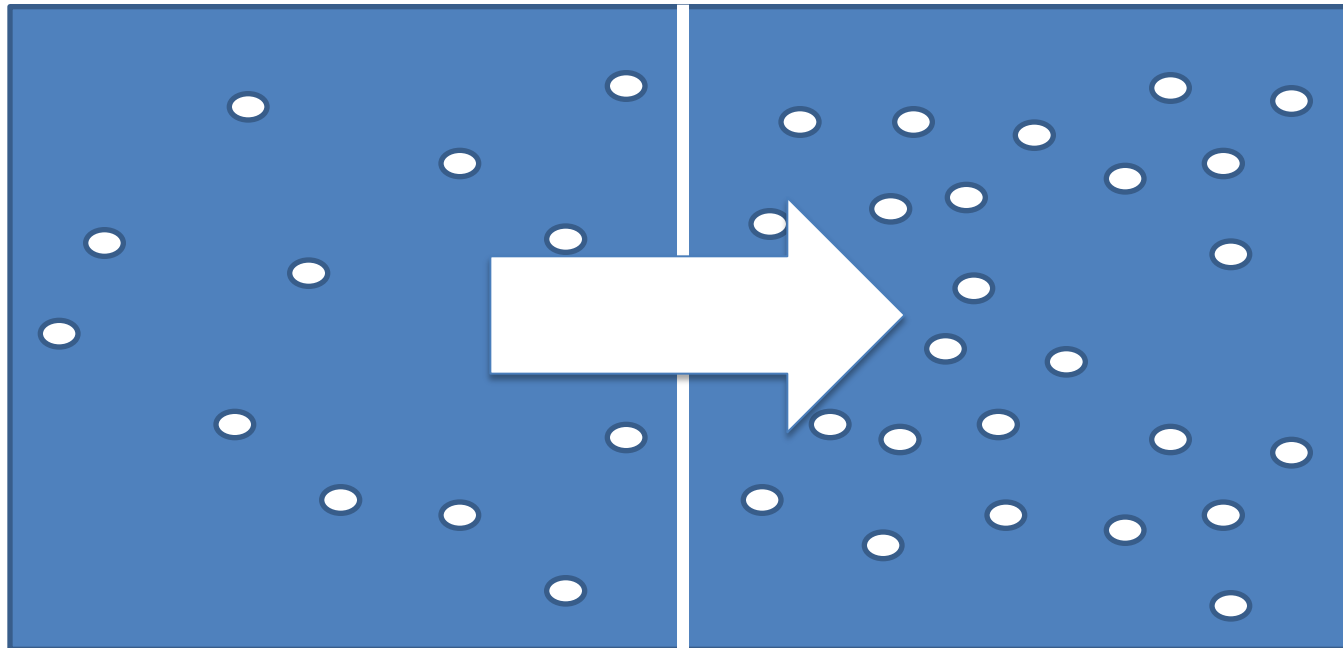




# Forward Osmosis

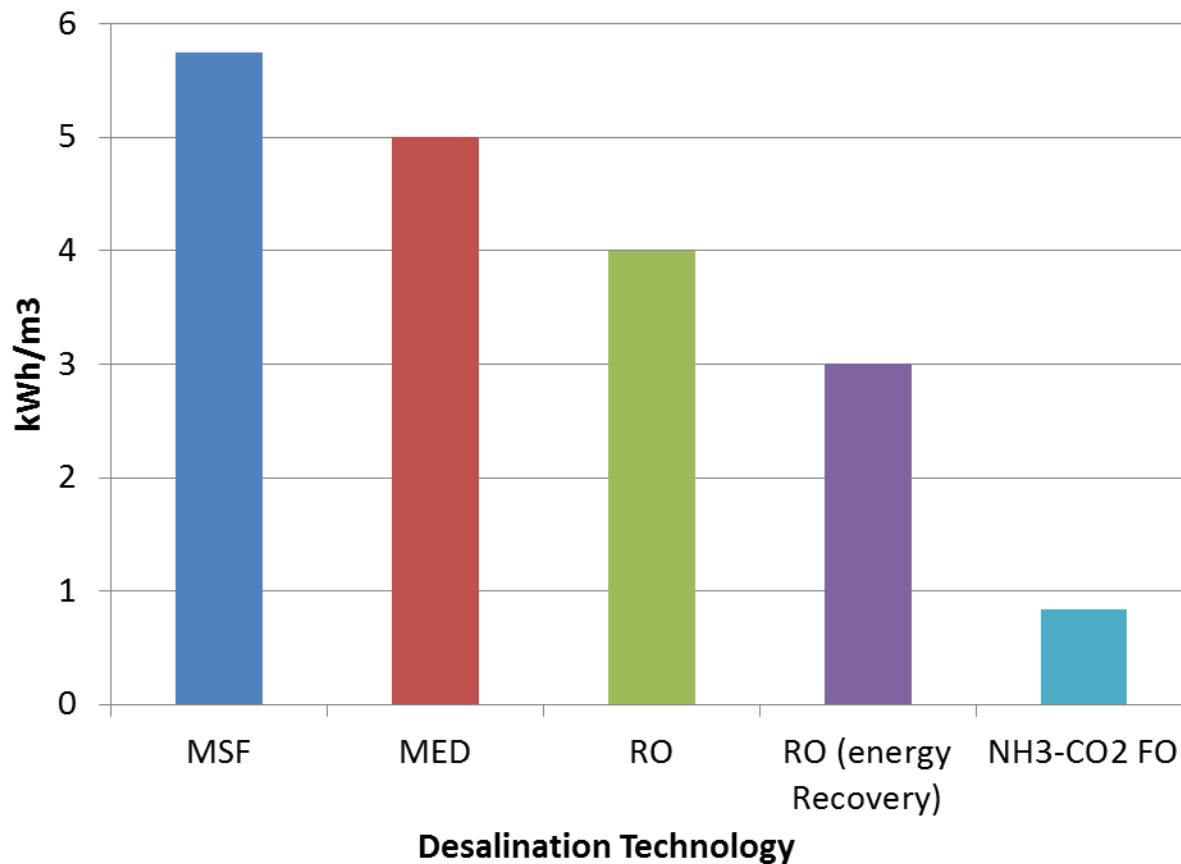
**Salty Water**

**Draw Solution** (e.g. Mg Sulphate)



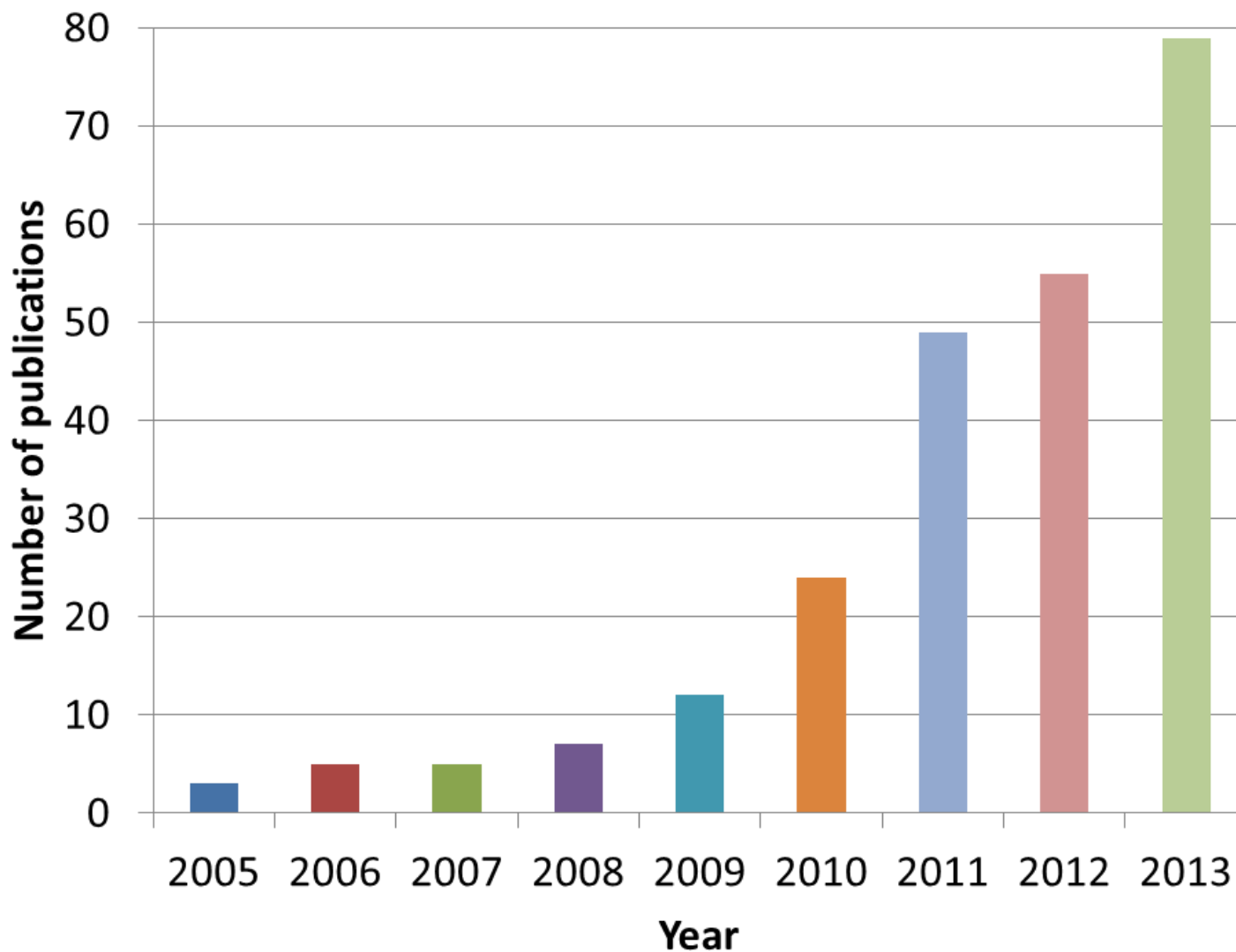


# Energy for Desalination



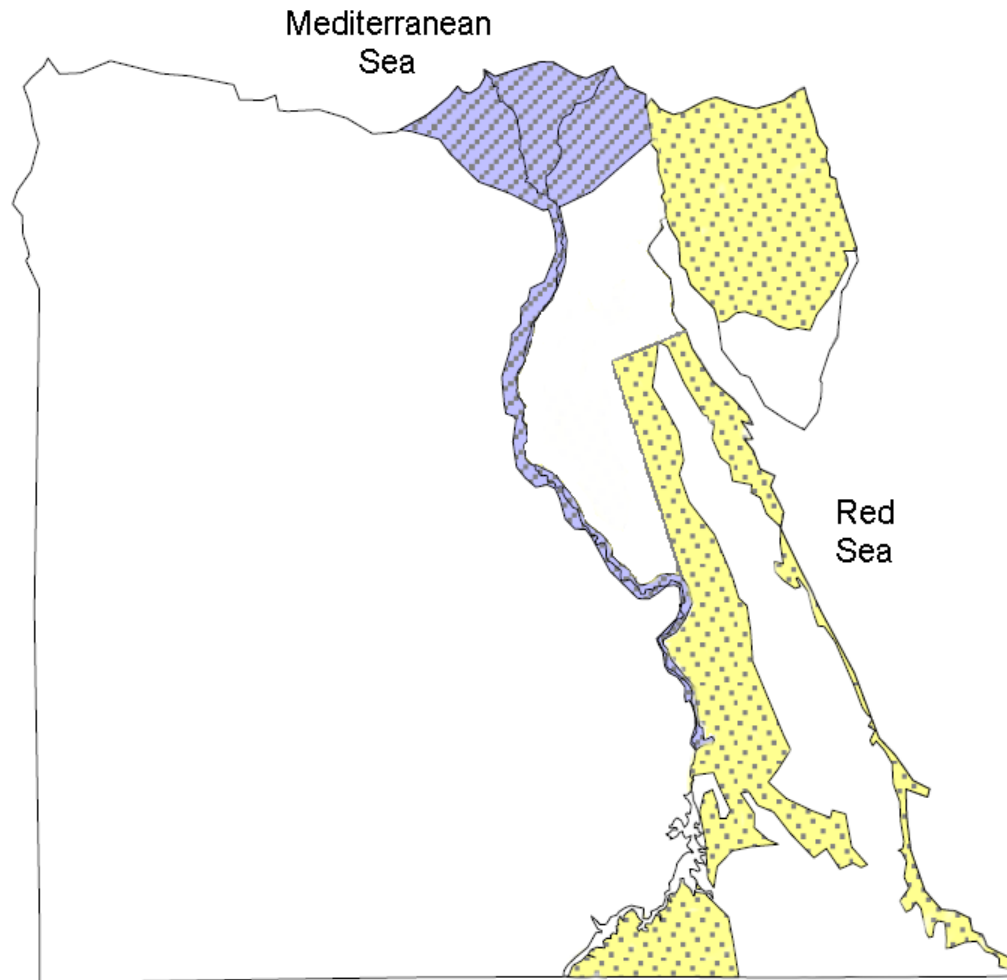


# Growing Nr of Publications





## Selected Areas for potential FDFO application in Egypt





# ZLD



Solar Energy

Photovoltaic



Subsurface  
Irrigation



Desalination Unit

Red Sea



Byproduct



Fish Farming



Irrigation with  
salty water





# The Nexus Model

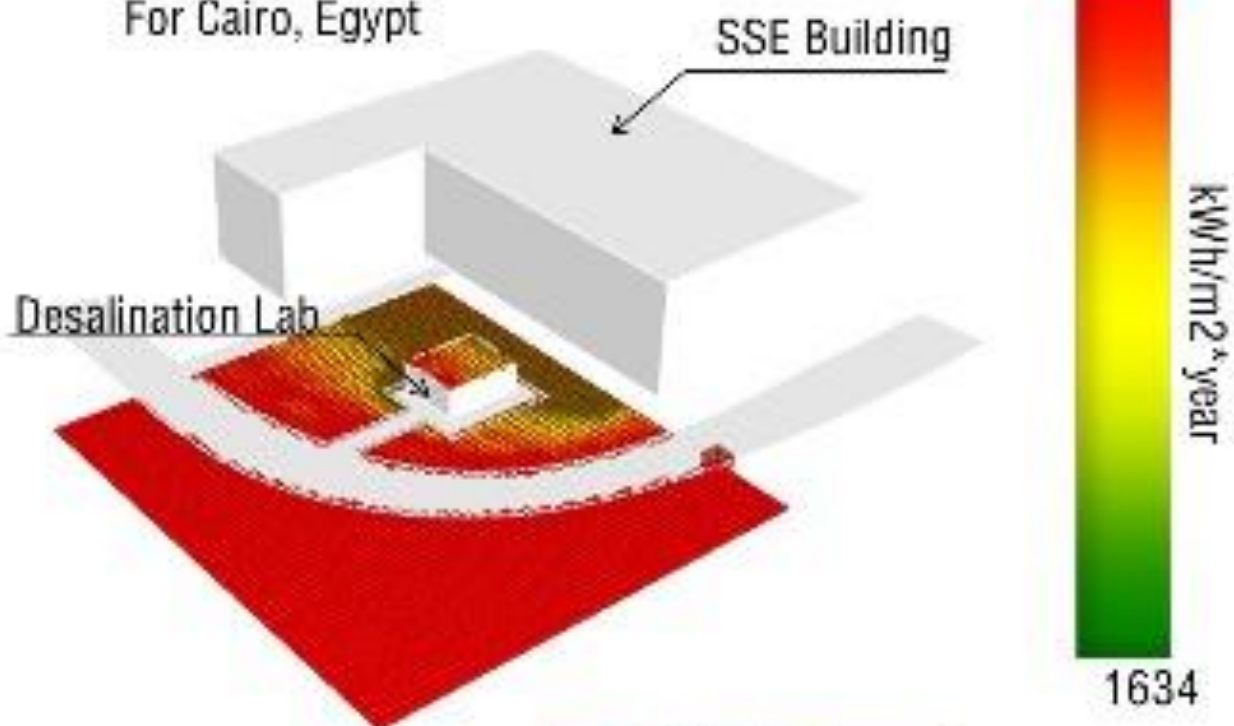






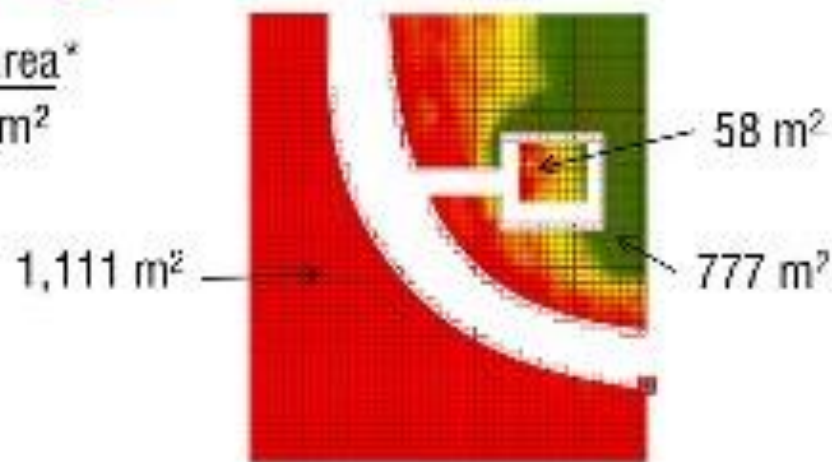
# Annual Solar Radiation

For Cairo, Egypt



Possible PV area\*

Total 1,946 m<sup>2</sup>



\*Roughly Estimated

# The Nexus Model





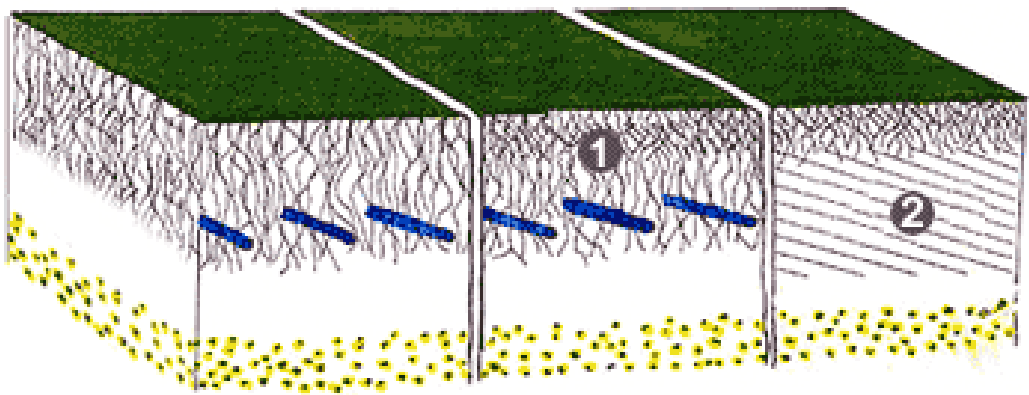
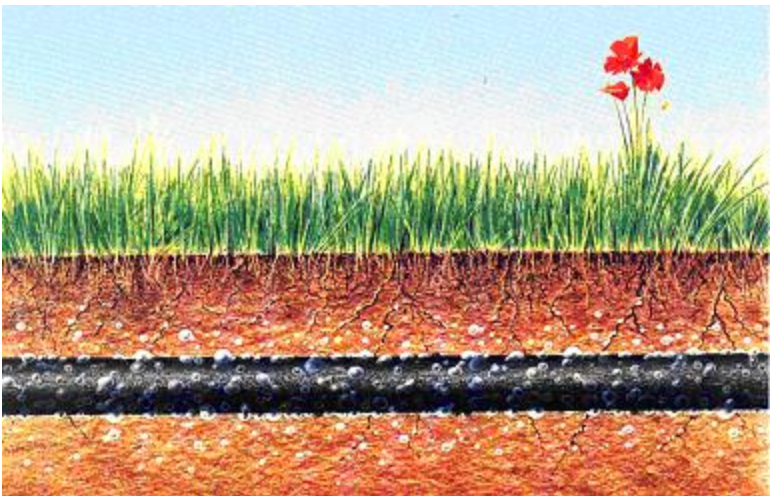
# The Nexus Model







# Sub-surface Irrigation







## End Products

- Zero CO2 Energy
- Low cost desalinated water
- Energy-smart food



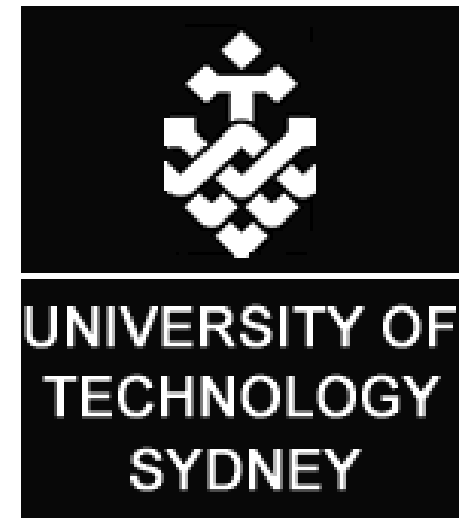
**RWTH**AACHEN  
UNIVERSITY

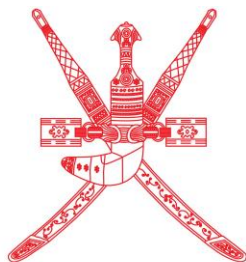


University of  
Connecticut



**GUTech**  
RWTHAACHEN  
الجامعة الألمانية للتكنولوجيا في عمان  
German University of Technology in Oman





*Sultanate of Oman  
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# MSc in Sustainable Development

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