

#### برنامــج قــطر الوطــني للأمــن الــفذائي OATAR NATIONAL FOOD SECURITY PROGRAMME

### Sustainable water planning for food security

**Dr. Patrick Linke** Gulf Water Conference, Doha, 22 April 2012



# **GLOBAL FOOD SECURITY PROBLEM**

Pressure on food supplies

- Expanding demand for food, feed and bio-fuels
- The rising price of energy
- Increasing land and water scarcity
- The effects of climate change

Consequence

Increasing scarcity of food supply places Qatar's food security at risk

[Source: World Bank report "World Bank Calls for Renewed Emphasis on Agriculture for Development", May 2008]



) مكتب ولي العهد Dffice of the Heir Apparent



# **DOMESTIC ISSUES**

- Water:
  - Aquifers are under threat of depletion: ~ 220 vs 60 million m3/yr
  - Our water reserves are only 2 days
  - Total farms down 30% mostly due to water issues
- Only one-tenth of the arable land in Qatar is cultivated
- 90% of our food is imported





## **Current Water Resource Allocation (conceptual)**





برنامــج قــطر الوطــني للأمــن الــغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



### **Groundwater Depletion**



15 % of Country Area Underlain with TDS < 1,000 mg/L (Schlumberger Water Services)



برنامج قــطر الوطــني للأمــن الــفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



2 % of Country Area Underlain with TDS < 1,000 mg/L (Schlumberger Water Services)







برناميج قيطر الوطيني للأمين المغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME

Office of the Heir Apparent







# **Aquifer Recharge**

- Stop depletion of aquifers
- Build up reserves
- Enhance Water security
- But: need to provide alternative water to agriculture

## National ASR project with Kahramaa



برنامج قـطر الوطـني للأمـن الـغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME







# Desalination

- Replacement of groundwater use
- Additional capacity to enable higher domestic agricultural production
- Energy supplied by renewable energy (mainly solar)
- Minimize impacts (e.g. industrial city synergies)
- Every drop counts Use most water efficient agricultural production methods and technologies



برنامج قـطر الوطــني للأمــن الــغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME







### WATER – ENERGY SYSTEMS DEVELOPMENT

#### **Guiding Principles**

- Low impact
- Technology neutral
- Flexible
- Performance oriented
- Synergetic
- Integrated



برناميج قيطر الوطيني للأمين المغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME مكتب ولي العهد Office of the Heir Apparent



### WATER – ENERGY INFRASTRUCTURE ELEMENTS



Note: Not drawn to scale



برنامج قـطر الوطـني للأمـن الـفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



مكتب ولي العهد Office of the Heir Apparent

## **Exploring Water and Energy Interactions**



برناميج قيطر الوطيني للأمين المفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



## **Model Objectives**

Understand the interaction between the QNFSP water and energy related components

L

Develop a model to simulate the interaction between the QNFSP water and energy related components

Explore different scenarios and what if scenarios

Support policy development in light of observations



برناميج قيطر الوطيني للأمين المغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



## Why do we need a model?



- Policy-making and regulation: Requires clear understanding of impacts on efficiency of the system
- Systems engineering: Systems design and technology selection
- Technology development / applied science: Focus on technologies crucial to efficiency of the system



Office of the Heir Apparer



برناميج قيطر الوطيني للأمين التغذائي IONAL FOOD SECURITY PROGRA

#### Illustration of Level 1 Water and Energy Model Interaction



#### Illustration of Level 2 Water and Energy Model Interaction



#### Snapshot of Level 3 Water & Energy Model Interaction

















برناميج قيطر الوطيني للأمين المغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME

#### Sample of Model Screenshots









## **Illustration of Model Results**



برناميج قيطر الوطيني للأمين المفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



## Stand Alone Solar Scenario

- Concentrated Solar Power for QNFSP desalination power demand
- No use of gas fired power plants

برناميج قيطر الوطيني للأمين التغذائي

ÖATAR NATIONAL FÖOD SECURITY PROGRAMME

No grid interaction



Office of the Heir Apparen

Cost Break Down \*



\* All costs are shown as percentage of stand alone solar scenario total system cost

مكتب ولى العهد

#### Scenario Cost Comparison \*



Cost reduction from synergy identification

More cost reduction is possible with further optimization

Conservative estimates for solar power generation

Conservative estimates for gas only scenario



\* All costs are shown as percentage of stand alone solar scenario total system cost



برنامج قـطر الوطـني للأمـن الـغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME

#### Scenario Cost Comparison\*

#### Variation in LNG export price

#### Variation in solar plant lifecycle



DLR solar cost assumptions (approximate)



\* All costs are shown as percentage of stand alone solar scenario total system cost

مكتب ولي العهد Office of the Heir Apparent

برنامــج قــطر الوطــنـي للأمــن الــغذائـي QATAR NATIONAL FOOD SECURITY PROGRAMME

## Cost Break Down Comparison \*



#### Balanced Green- Conventional Desalination Cost Break Down

#### Balanced Green-Smart Desalination Cost Break Down



**QNFSP Cost = 88 % Overall System Cost = 75 %** 

\* All costs are shown as percentage of stand alone solar scenario total system cost



Design a system that rewards non-optimal operation of subcomponents to improve the overall system efficiency

برناميج قيطر الوطيني للأمين اليغذائبي ÖATAR NATIONAL FÖOD SECURITY PROGRAMME

Office of the Heir Apparent





## Water & Energy Technology Industries

- Many emerging technologies
- Identify & exploit opportunities for Qatar
- Pull with infrastructure investments
- Develop and retain capacity to attain market leadership in areas with strategic opportunities
- Develop and monetize know how globally ... and help diversify Qatar's economy



برناميج قيطر الوطيني للأمين المغذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



#### **Dimensions of Technology Selection**





برنامـج قـطر الوطــنـي للأمــن الــغذائـي QATAR NATIONAL FOOD SECURITY PROGRAMME



## Myriad of choices





برناميج قيطر الوطيني للأمين المفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME



## **Complex relationships**



Exploring opportunities across the various value chains.



برناميج قيطر الوطيني للأمين المفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME





### WATER – ENERGY SYSTEMS DEVELOPMENT

#### **Guiding Principles**

- Low impact
- Technology neutral
- Flexible
- Performance oriented
- Synergetic
- Integrated



Enable infrastructure projects to pull target technologies / services.



بـرنامــج قــطر الـوطــني للأمــن الــفذائي QATAR NATIONAL FOOD SECURITY PROGRAMME مكتب ولي العهد Office of the Heir Apparent



# Thank you.

### www.qnfsp.gov.qa



