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Water-Energy-Food Nexus Webinar series

Topic: **Tools and Methods to find Nexus Solutions: Examples from Morocco and Jordan**

Presenters: Francesco Fuso-Nerini, Brian Joyce, Camilo Ramirez Gomez, and Annette Huber-Lee

15 February 2021

Set limits-Defining the safe boundary conditions for water sustainability

WATER Productivity Efficiency, and Sustainability in the NENA countries

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Webinar series objectives

- Give a **deeper understanding of the water-food-energy (WEF) nexus**, including how it is defined and its importance
- Navigate approaches for identifying both **nexus challenges and solutions to those challenges**, and what types of **tools** may be developed to find robust solutions
- Use **case studies** of current efforts and best practices to manage the **water-energy-food (WEF) nexus in NENA countries and beyond** for sustainability and resilience of people and ecosystems

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Webinar series

No.	Date	Title
1	2 Feb 2021	Understanding the nexus and nexus challenges: Examples from around the world
2	15 Feb 2021	Tools and Methods to find Nexus Solutions: Examples from Jordan and Morocco
3	2 Mar 2021	A Water-Energy-Food Nexus approach for evaluating the sustainability of the Mediterranean Diet: The Case of Lebanon
4	16 Mar 2021	The WEF Nexus on the ground: practical applications from the Maghreb and West Africa
5	30 Mar 2021	Selected experiences with WEF Nexus decision-making: applications in Jordan and Morocco
6	tbd	tbd

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Objectives for today

- Deepen understanding of the nexus and focus on how to find solutions to nexus challenges
- Focus on the tools to investigate the nexus
- See applications of identifying nexus solutions in Jordan and Morocco
- Group work on Nexus solutions

Finding nexus solutions: methods and applications

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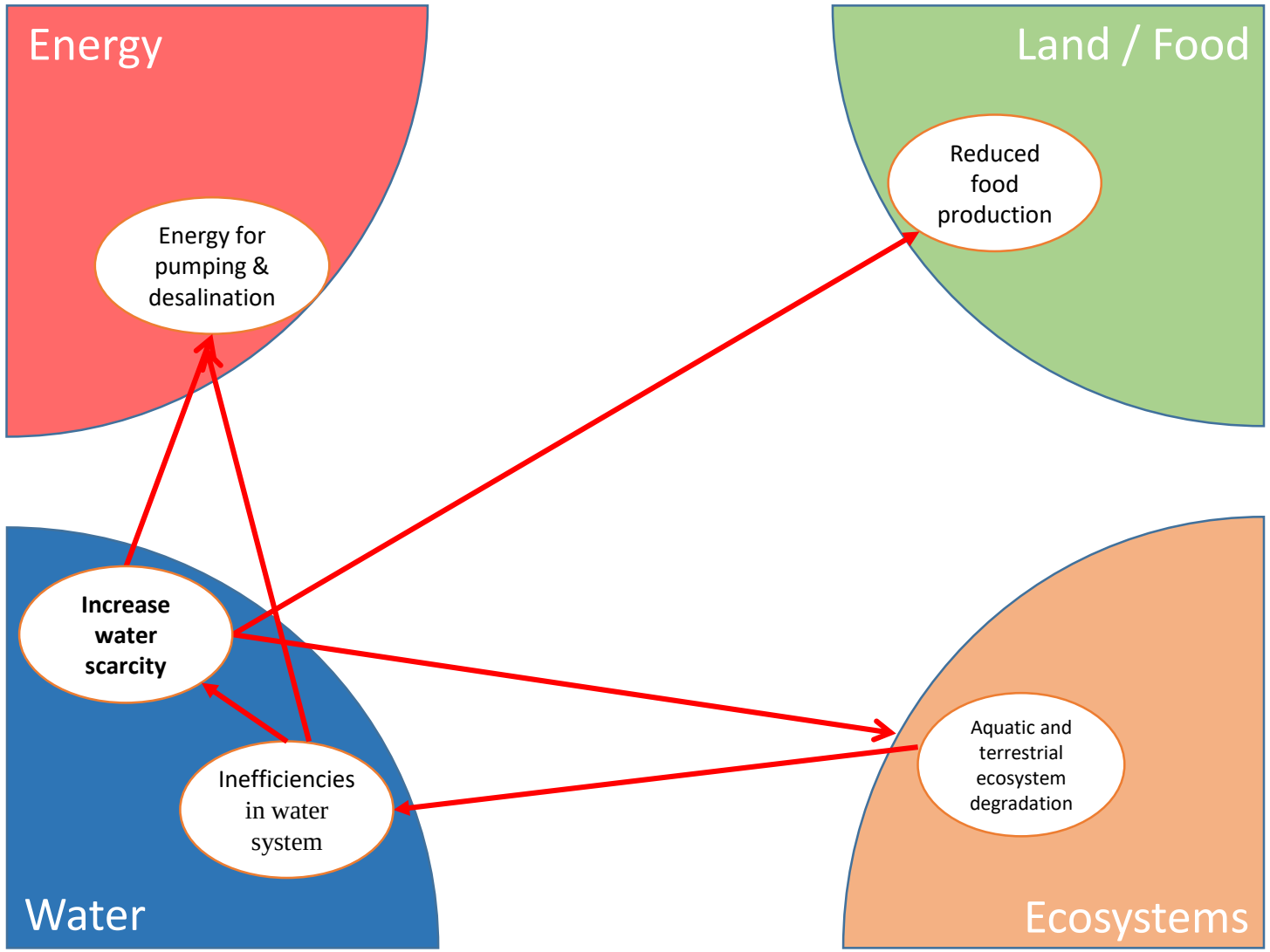
Water scarcity and inefficiencies in the system



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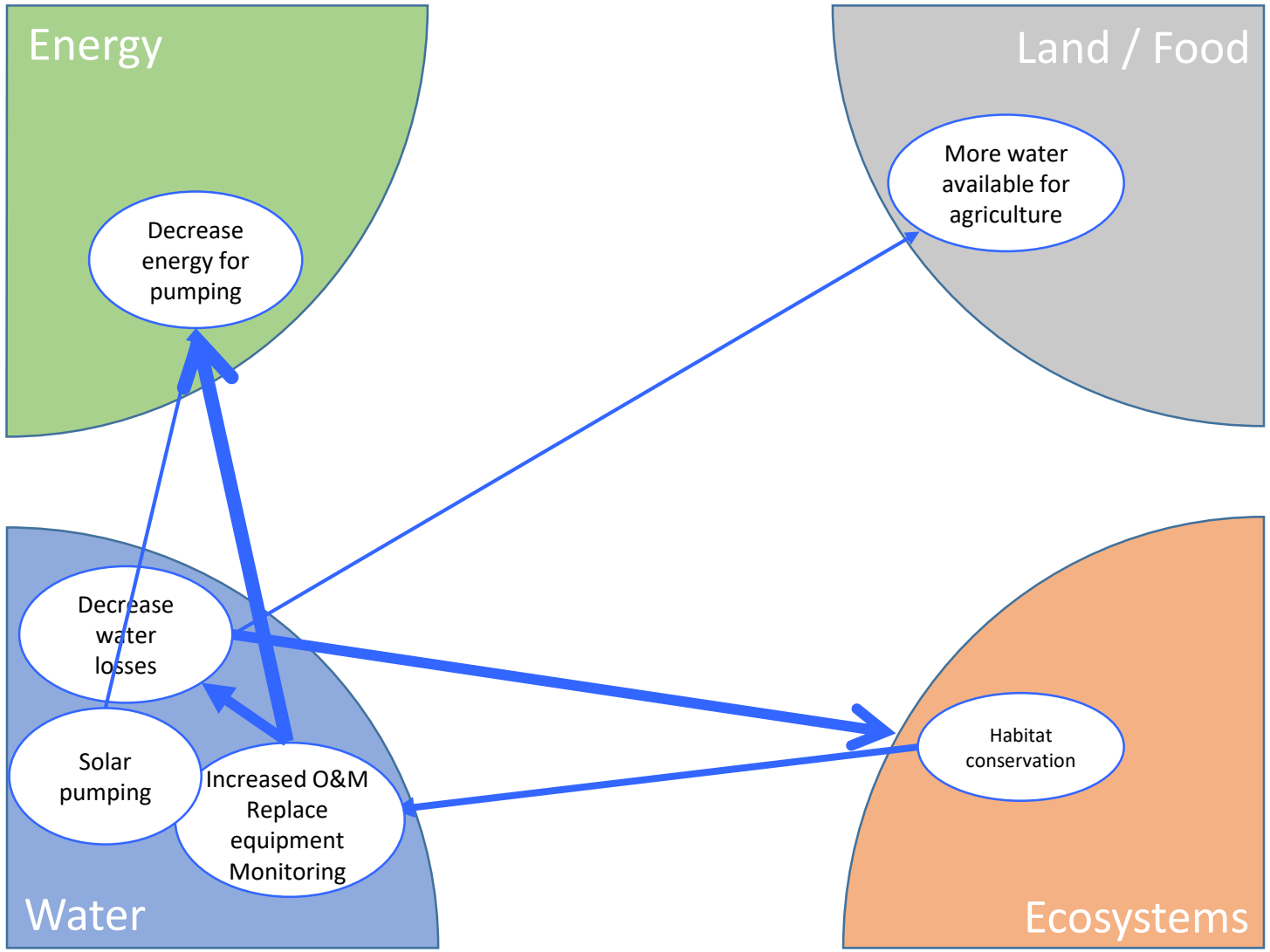
Water scarcity and inefficiencies in the system



The 5 Is (UNECE 2015)

Categorizing solutions to Nexus Challenges

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The 5 Is

Institutions

Information

International Cooperation

Instruments

Infrastructure

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Institutions

Spanning from institutional reforms to improved institutional cooperation and governance culture.

Examples:

- Clarify **roles and responsibilities** of organizations.
- Set up or improve existing mechanisms for **coordinating across sectors**
- Ensure **coherence between sectoral strategies**.

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Information

Improving collection, accessibility and communication of data, information and knowledge related to local resources and their dynamics.

Examples:

- Improve **monitoring** of resource availability, quality, uses etc., as well as forecasting and prediction.
- Identify **policy implementation barriers**.
- Improve **knowledge** of nexus challenges

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Instruments

Defining and implementing various instruments to address trade-offs and promote synergies in the management of natural resources and environmental protection

Examples:

- **Policy instruments**, plans for key sectors
- **Economic instruments** to provide incentives for rational and sustainable resource use, including **tariffs** by consumption and fees
- **Legal instruments** such as agreements and protocols

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Infrastructure (and investments)

Planning (i.e. designing, siting, financing) and modernizing or modifying existing infrastructure.

Examples:

- Direct investments towards **multi-purpose infrastructure projects**
- Improve **resource efficiency** in transmission and conveyance networks on the user side as well, taking into account indirect and cross-sectoral impacts.
- Account for different needs (including environmental needs) in optimizing the use of existing structures.

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International coordination and cooperation

broadening the scope of international cooperation to identifying common priorities

- Define areas of **common interest for regional development** and potential complementarities of resources and between policy goals.
- Facilitate **trade to improve water, energy or food security**; optimize the use of resources and infrastructure at the regional level.

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Water scarcity and inefficiencies in the system

Institutions

- **Cooperation** between water and energy institutions to define a plan of energy efficiency and renewables in water system

Information

- **Automation** of water system operations
- **Training** of O&M personnel

Instruments

- **Enforcement** of existing laws against illegal wells
- Improve collection efficiency through performance based contracting

Infrastructure

- Rehabilitation and **enhancement of equipment**
- Decentralized Wastewater Management
- **Solar PV water pumping**
- **Desalination**

Finding Nexus Solutions – Jordan case

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Mapping of solutions

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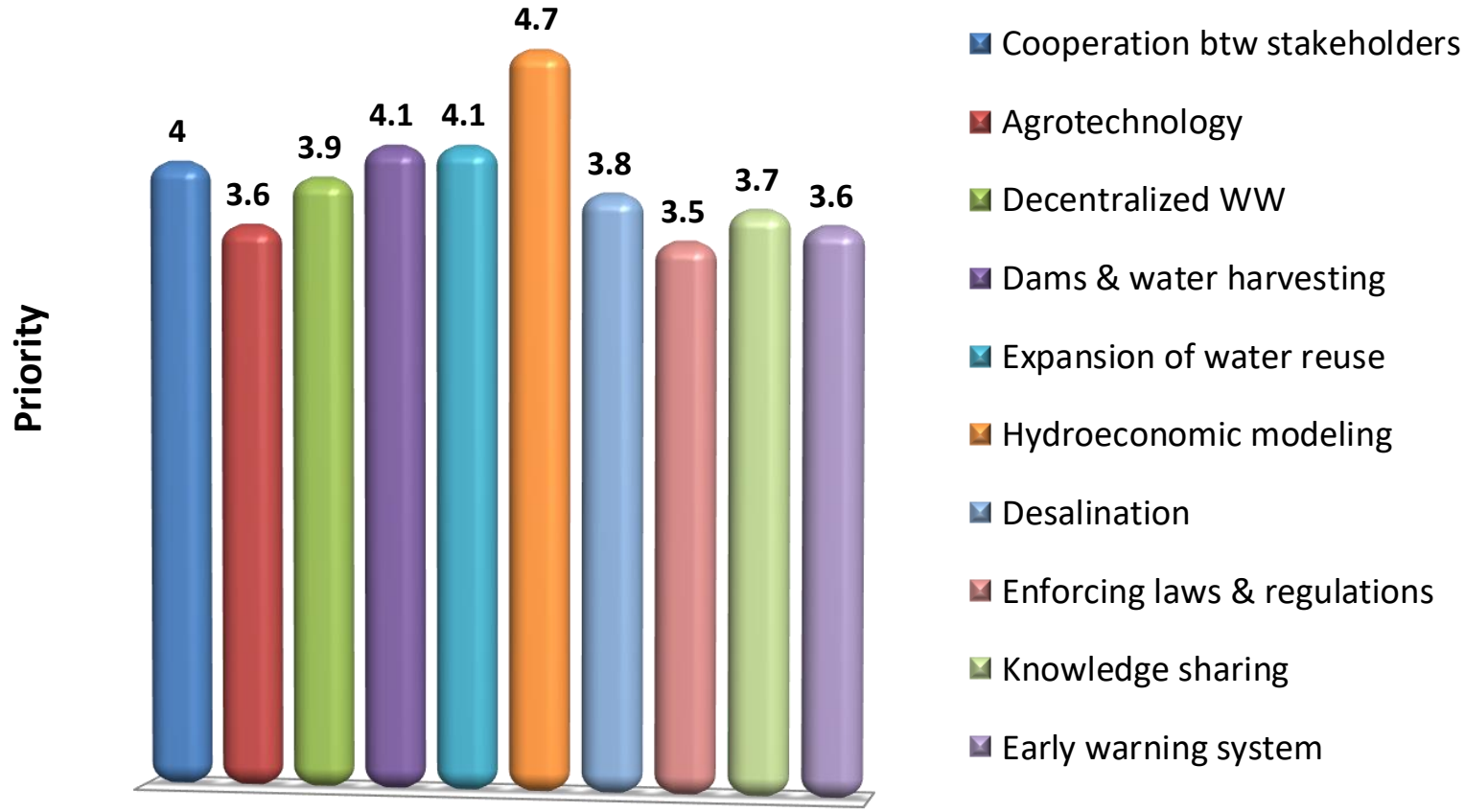
Mapping of solutions

INFORMATION			INSTITUTIONS & COOPERATION		
Change diet	Campaign for population growth control	Hydroeconomic modeling	Coordinated and management plans	Encourage the applied agricultural research	Cooperation between stakeholders
Knowledge sharing between different parties	Farmer's school	Drought early warning & drought prepared plans	Work together	Using comparative advantages of each country in the region in regional cooperation	Enforcing laws & regulations
INFRASTRUCTURE			**INSTRUMENTS**		
Supplementary irrigation methods	Maintenance of water network	Dams & Water harvesting	Shift focus from land productivity to water productivity	Developing a decision support system for decision makers	Insurance for CC/extremes
Desalination	Expansion of Water Reuse	Decentralized waste water management	Use agrotechnology methods to reduce the effect of climate change	Modify cropping patterns	

Results summary for nexus solutions



Finding Nexus Solutions – Morocco case

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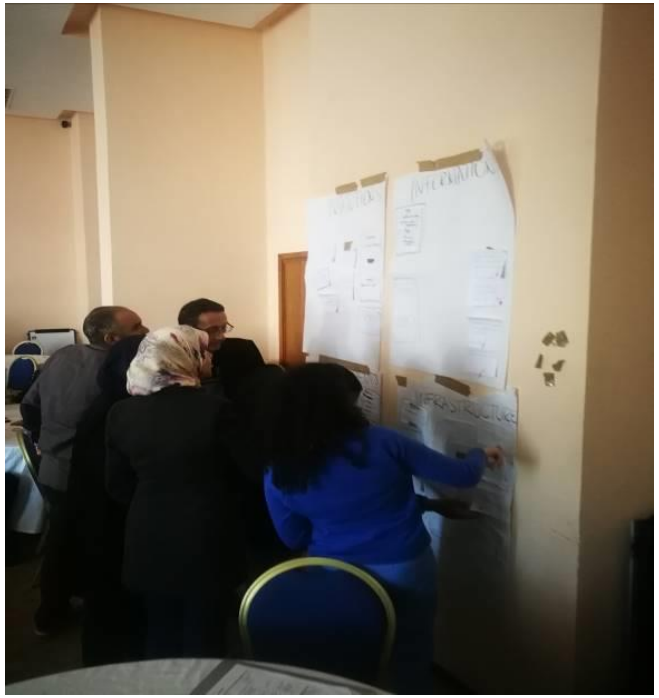
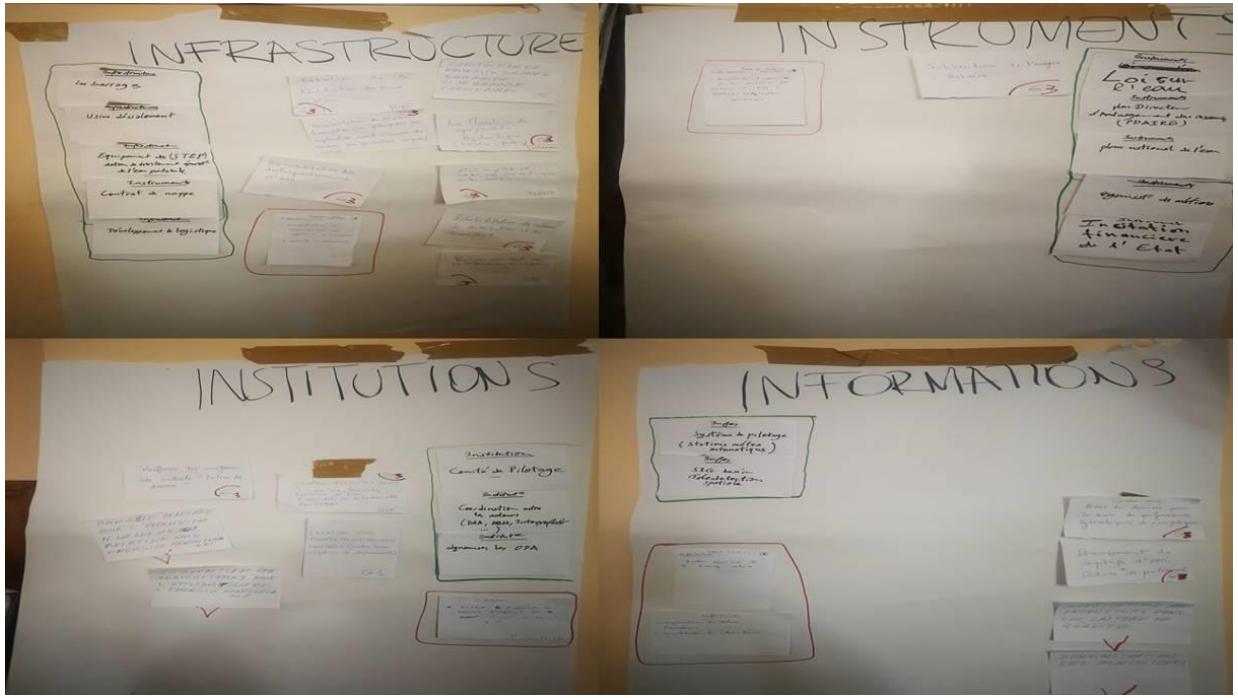
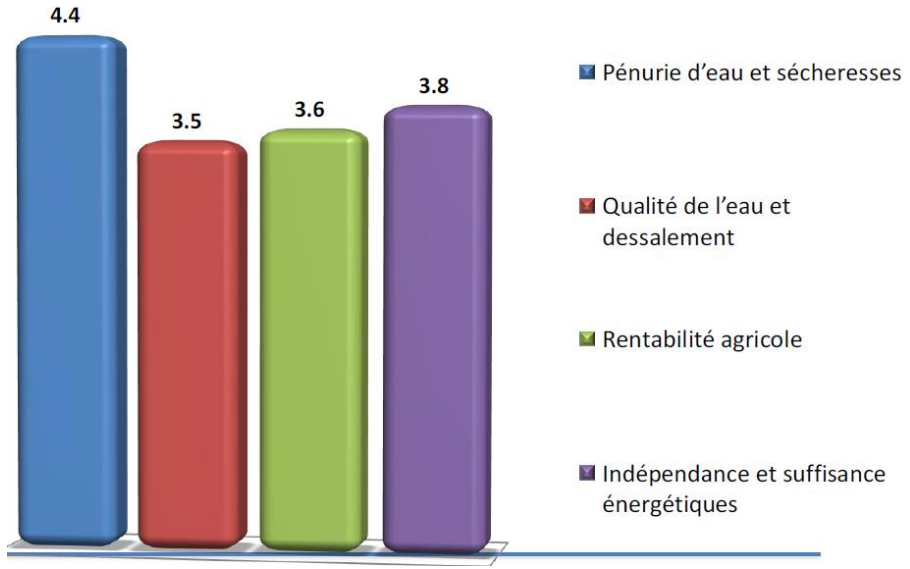
Mapping of solutions





Results summary for nexus solutions

key Challenges



key Solutions

- Improving the efficiency of the irrigation system,
- Rationalization of water use,
- Desalination projects
- Save the water table level and control wells drilling,
- Improve the coordination between different stakeholders in the Souss-Massa basin.

From challenges and solutions to scenario analysis: Tools to investigate the nexus

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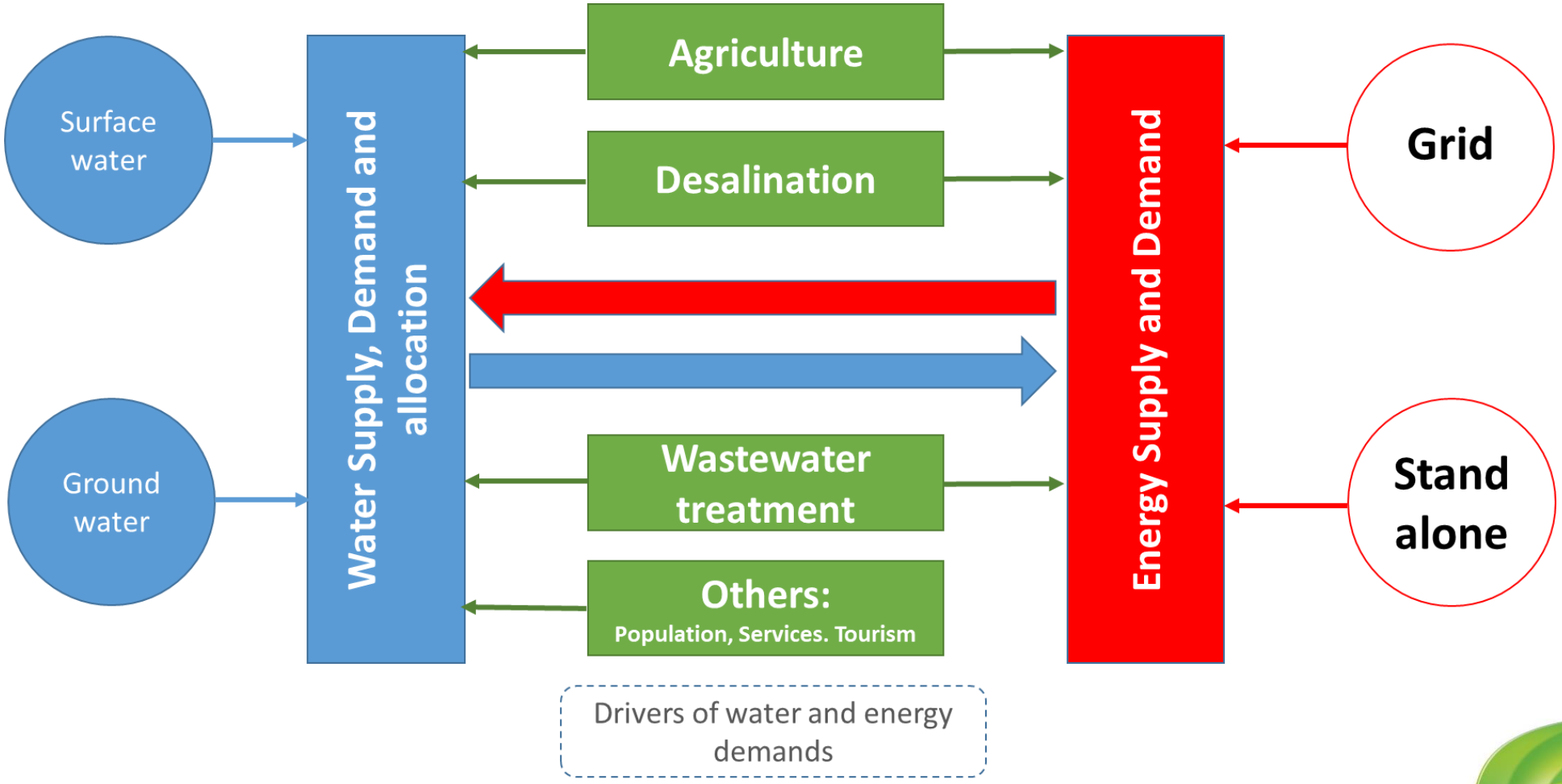
The Nexus model for Morocco and Jordan



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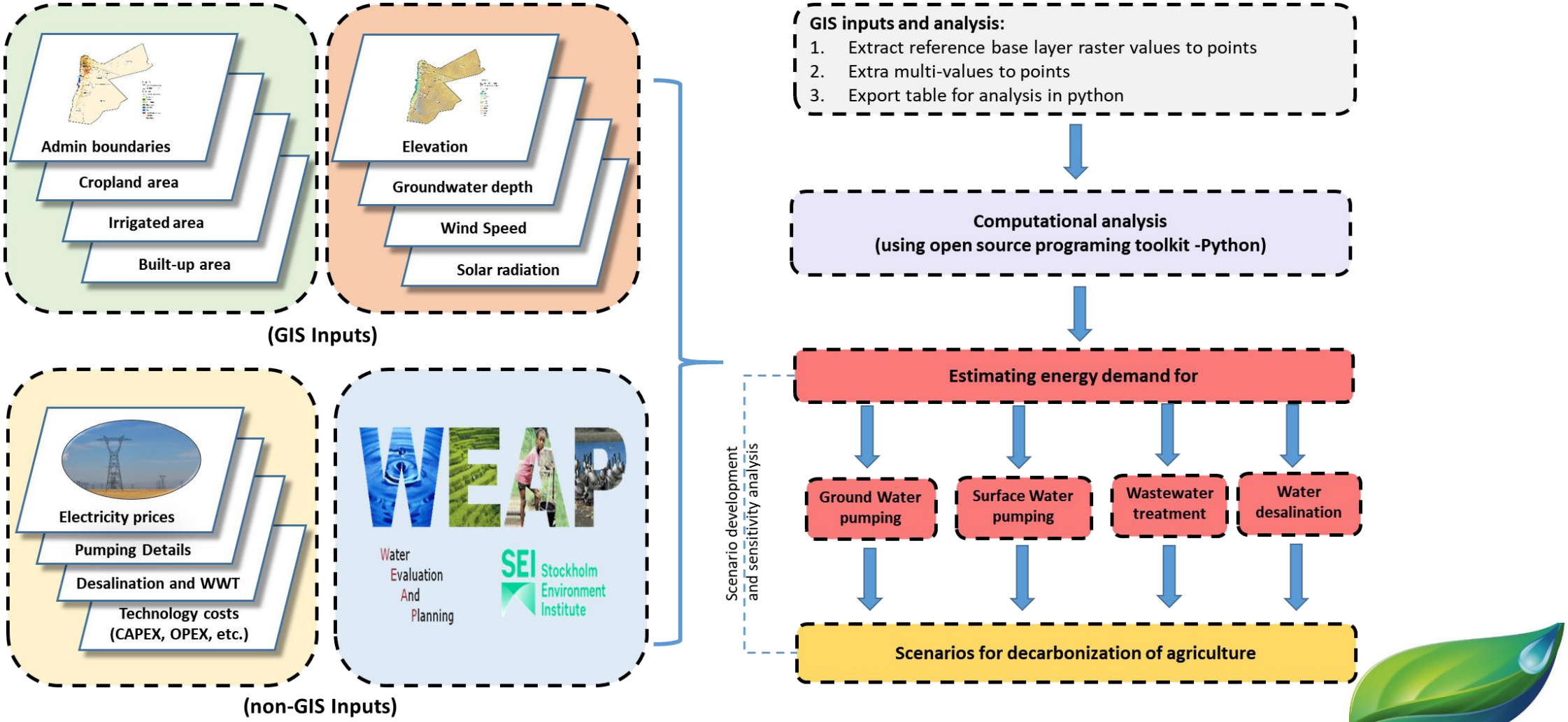
The Integrated water, energy, agriculture model for Morocco and Jordan



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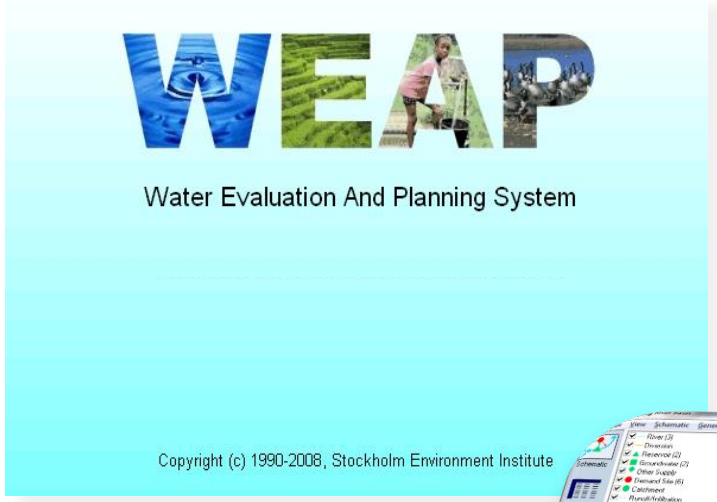
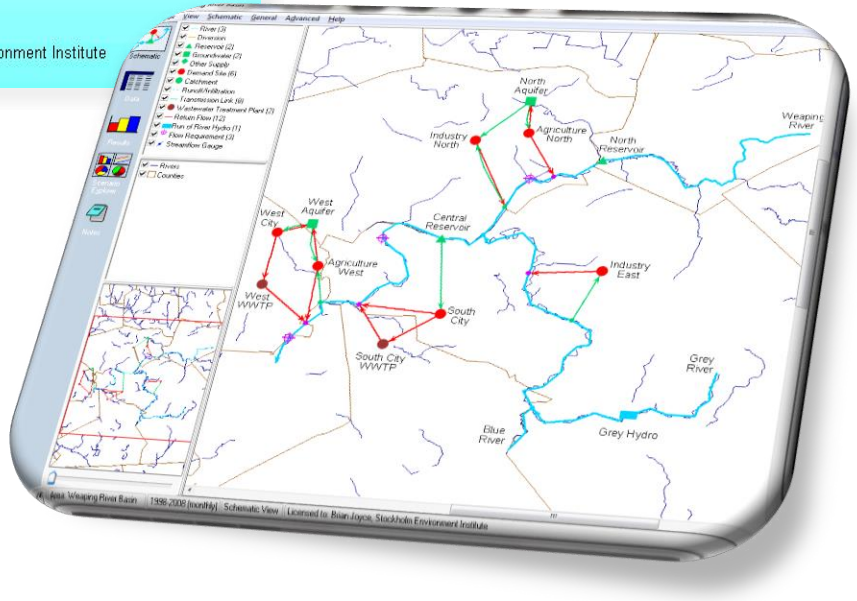
Water Evaluation and Planning (WEAP) Tool



- Generic water resources management modeling tool
- Evaluates scenarios aimed at balancing water supply and demand



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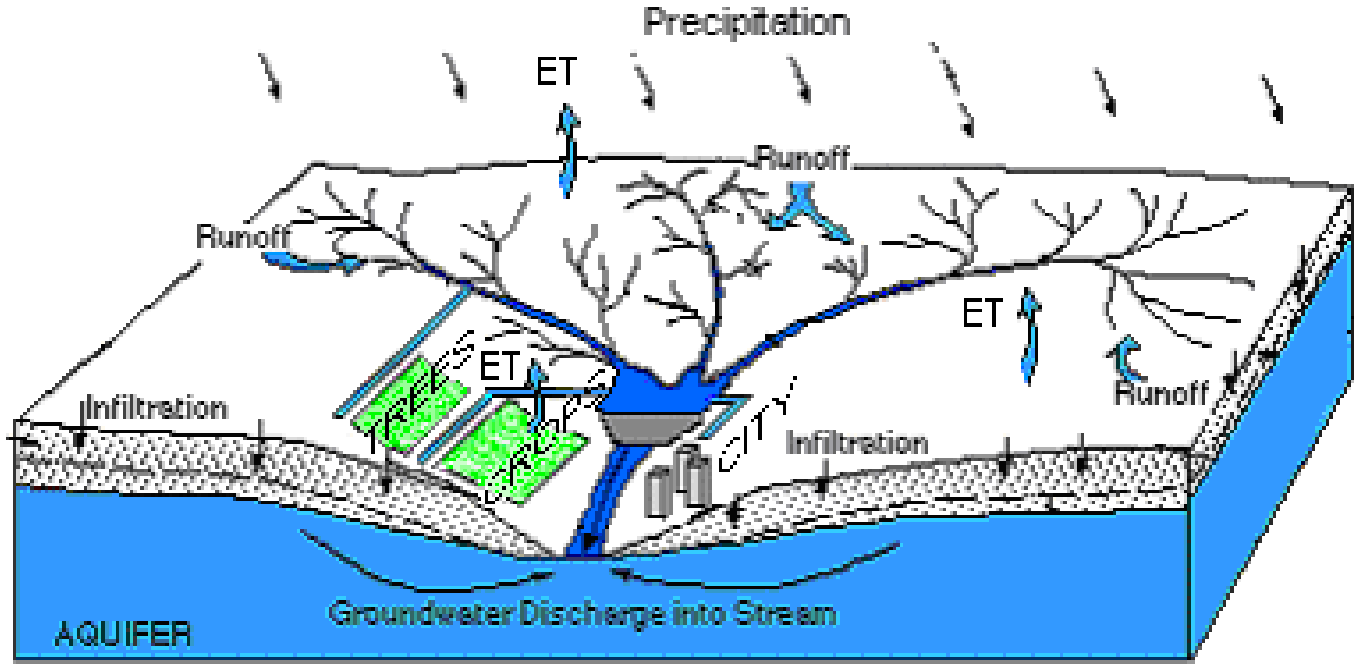
WEAP integrates natural and human systems

- Includes a full accounting of water flows throughout basin
- Water infrastructure and demands are nested within the underlying hydrological processes



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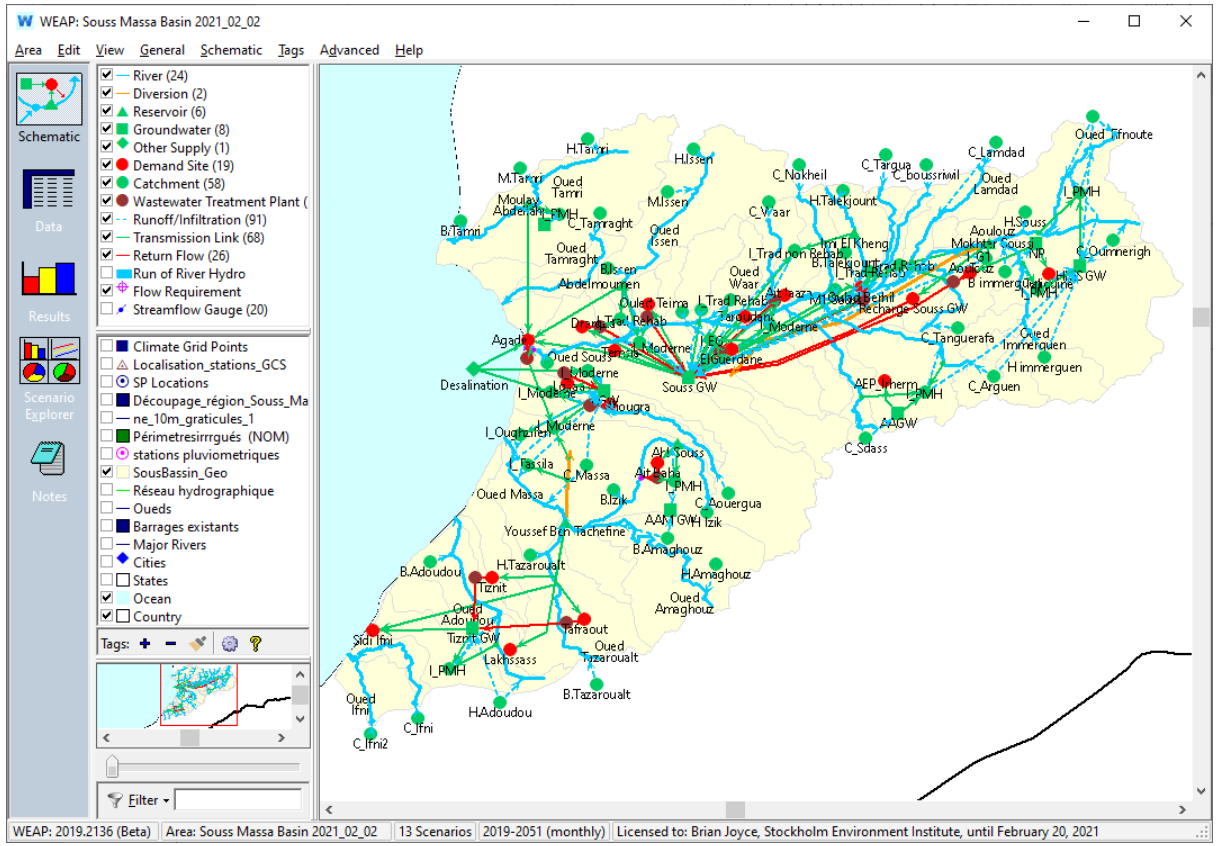
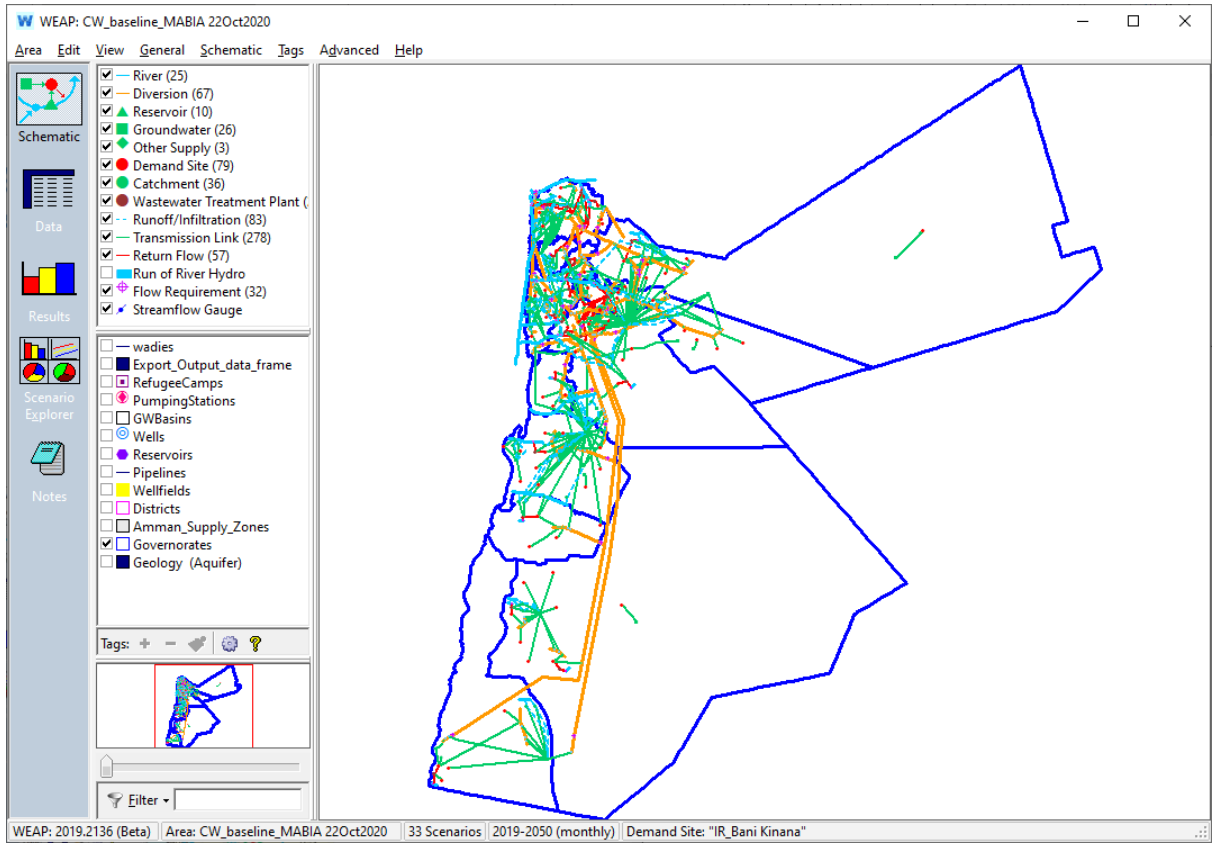
WEAP models for Morocco and Jordan

Morocco (Souss-Massa River Basin)



Jordan (National)



Scenario analysis for Jordan

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Scenarios developed to explore nexus solutions

- New water supply (Red Sea – Dead Sea Project)
- Increase water productivity
- Reduce leakage and non-revenue water
- Increase energy efficiency for water pumping

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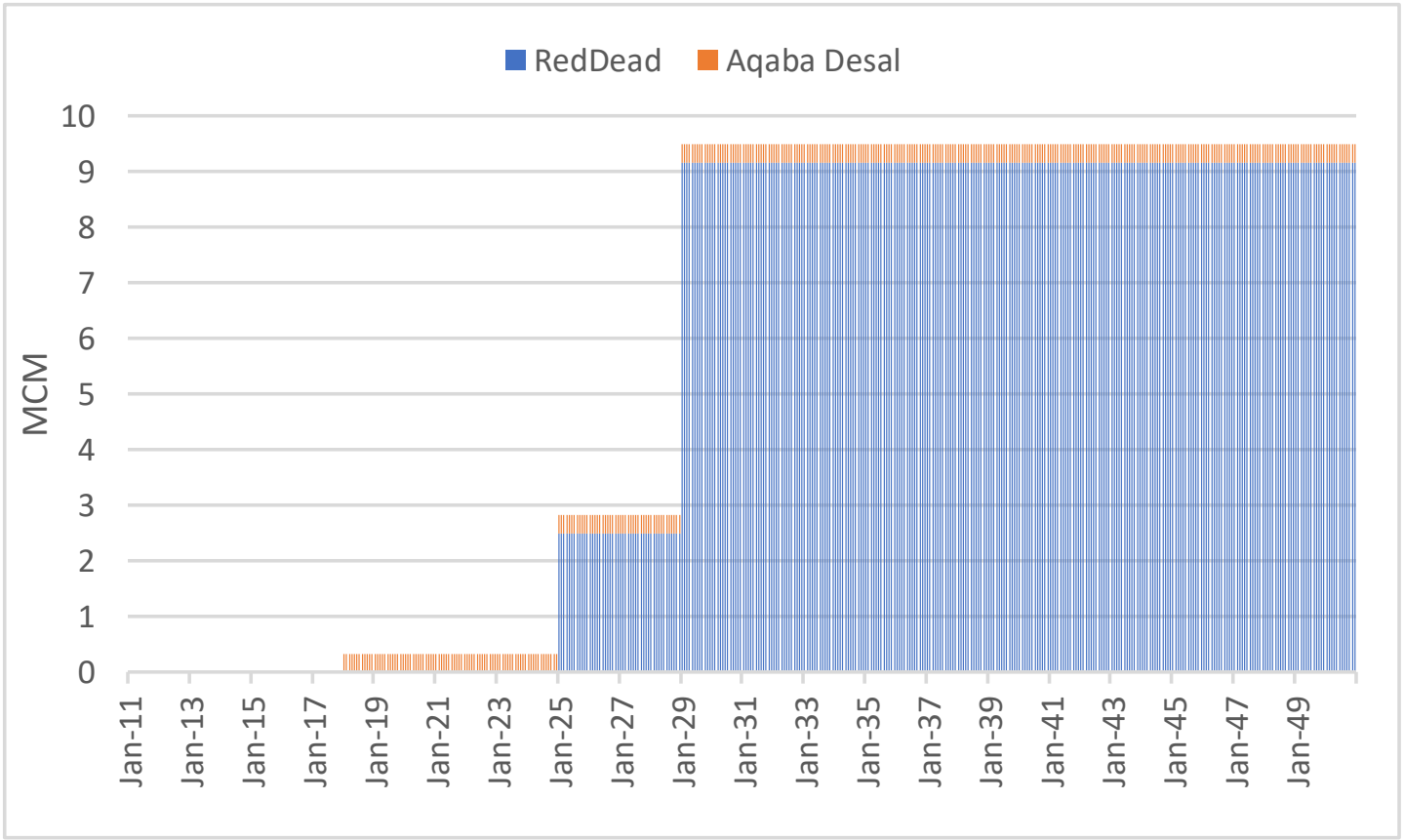
Scenario analysis for Jordan: Adding new water supply

- Red-Dead Desalination Project (110 MCM/year)



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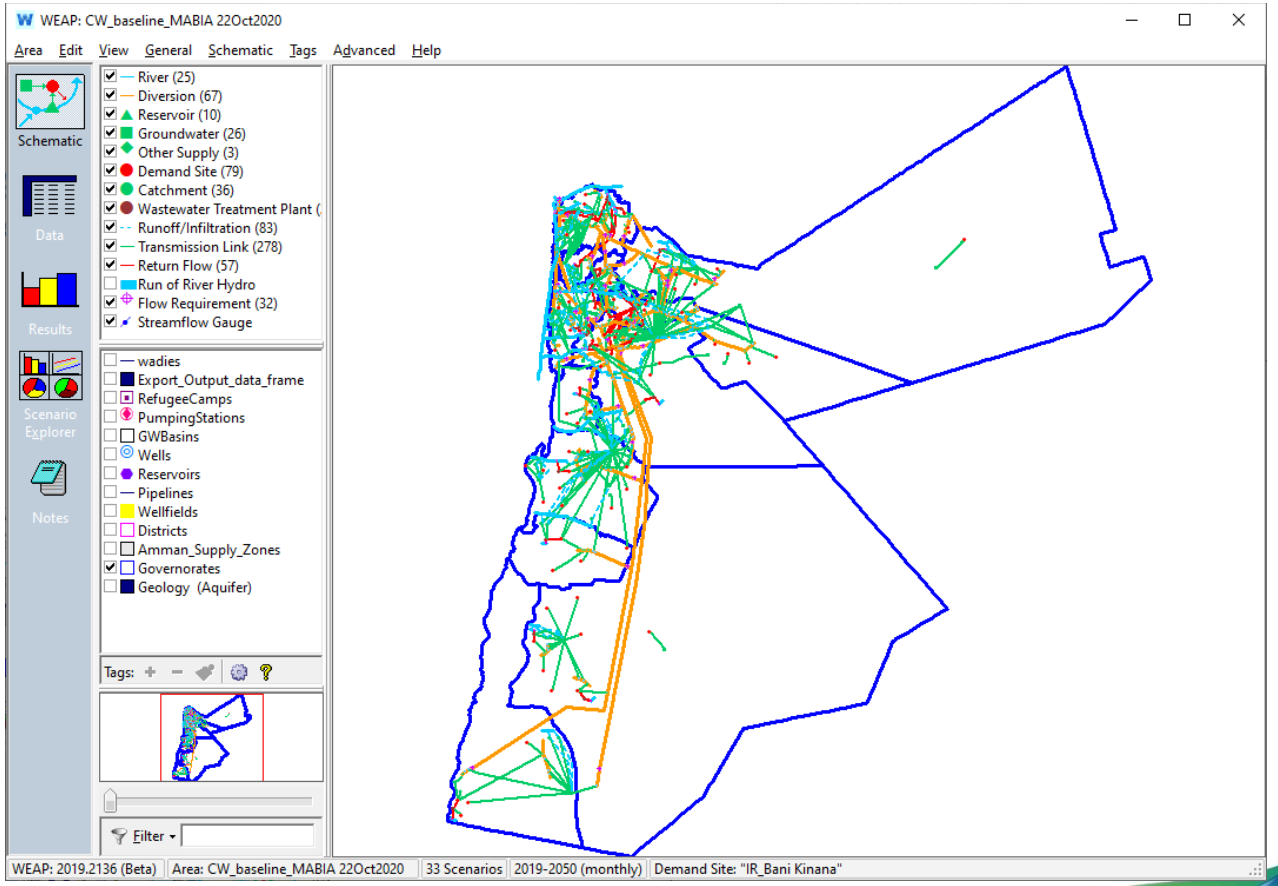
The water and agricultural model for Jordan

Model includes:

- Water **demand** sites aggregated by governorate
  - Water sectors: Residential, Commercial, Tourism, Industry, Agriculture, Refugees
- Irrigated **agriculture**
  - Climate-driven water demands for 17 major crop types
- 12 major **groundwater** basins
  - 67 well fields
- **Surface water** supplies
  - Local wadis,
  - Imports from Syria (Yarmouk River) and Israel (Lake Tiberia)
  - Desalination
- Water **distribution network**
  - 67 pipelines and canals



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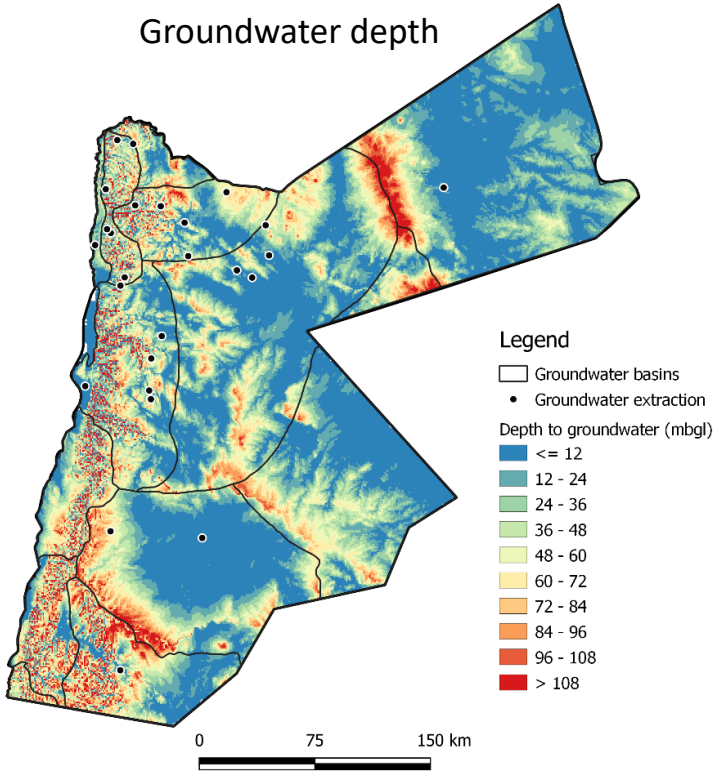
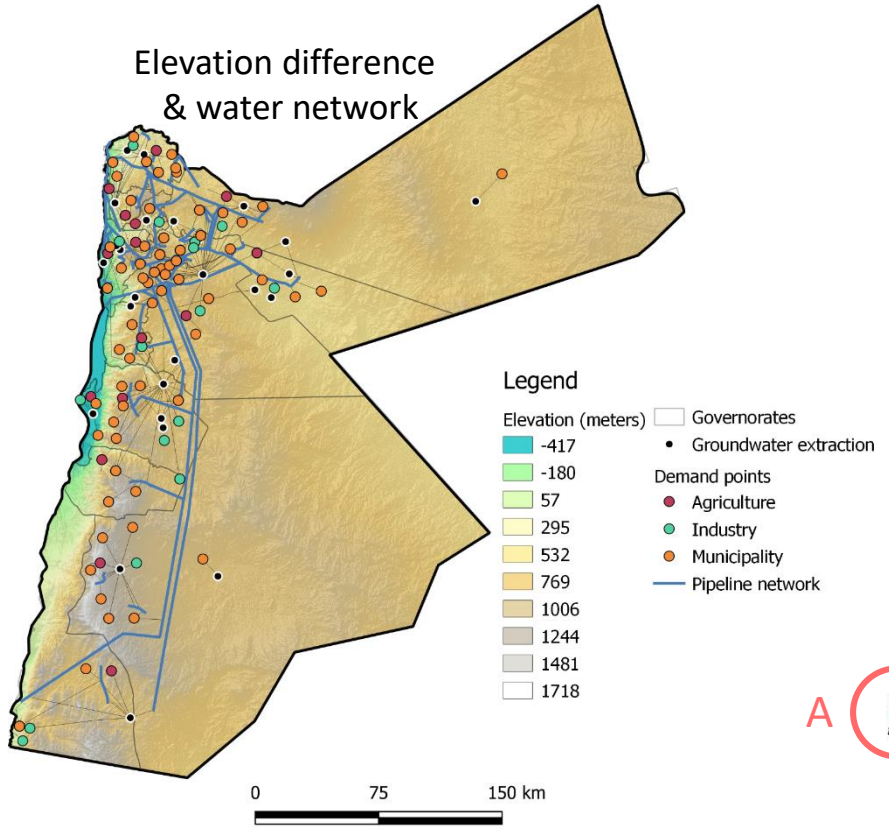
The Energy model for Jordan

WEAP + Technical specifications + **GIS input and analysis**

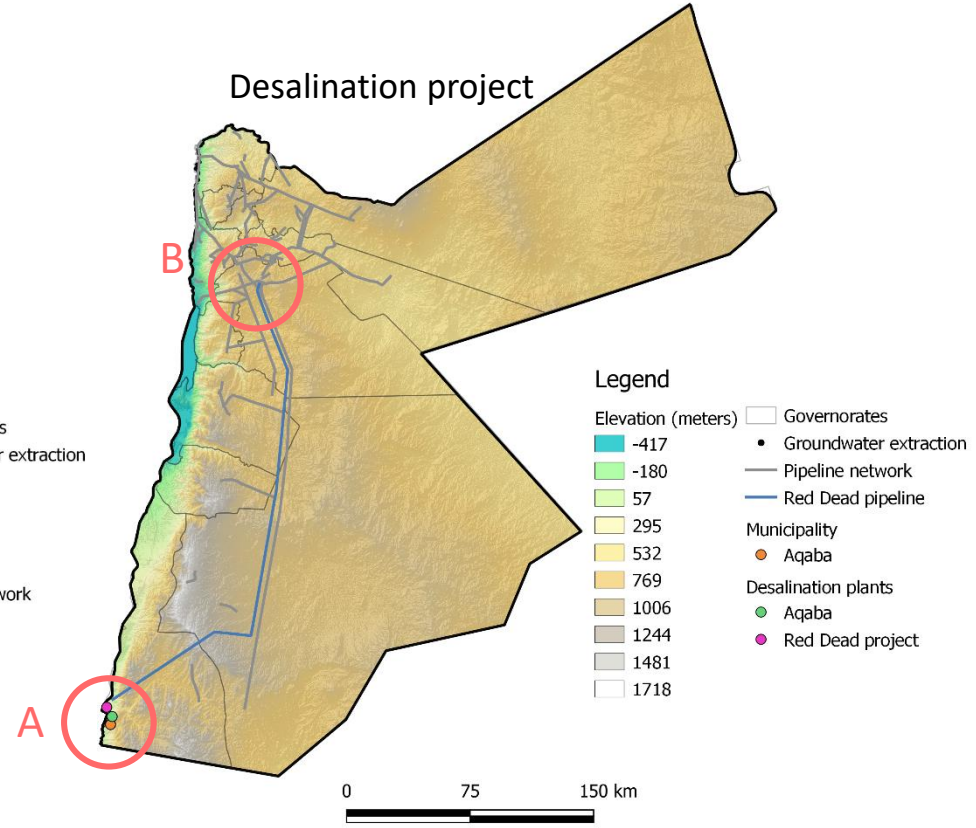
Groundwater depth



Elevation difference & water network



Desalination project



- Groundwater pumping energy
- Surface water pumping energy
- Desalinated water energy
- Wastewater treatment energy

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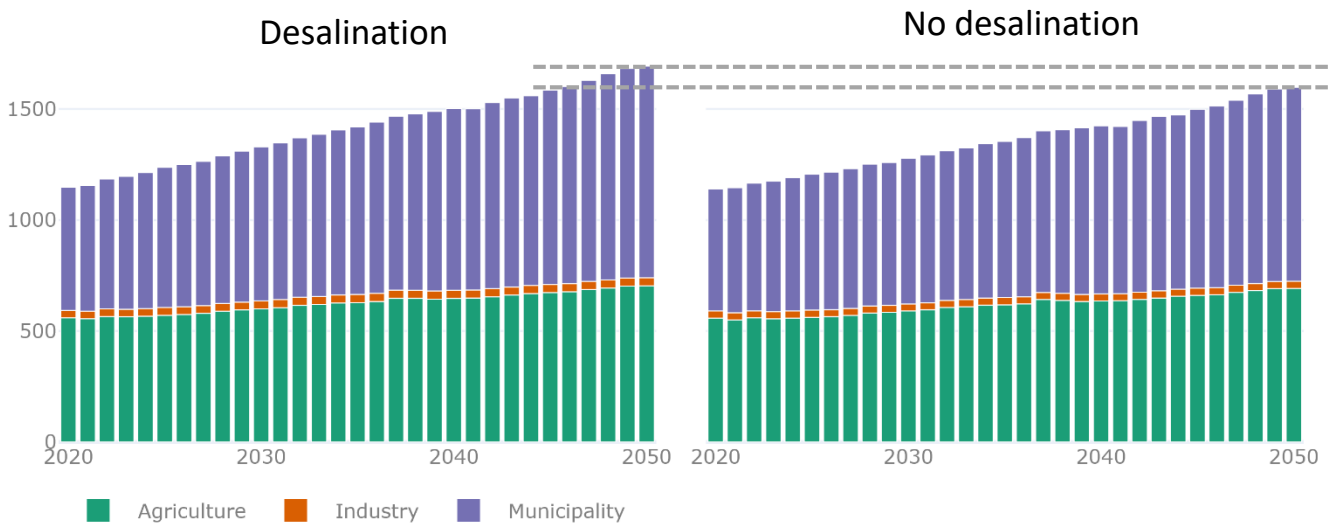
Selected results for Jordan

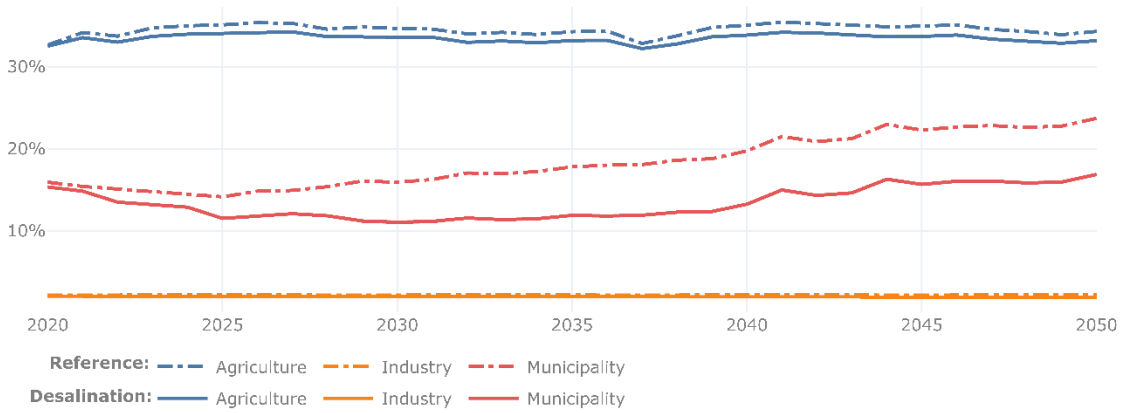
How could the Red-Dead desalination project aid in reducing **water scarcity**?

- The overall **water deliveries** could increase on **average by 4.3% annually**
- The **unmet demand** could decrease on **average by 6.5% annually**

Water delivered (Mm3)



Unmet water demand (%)



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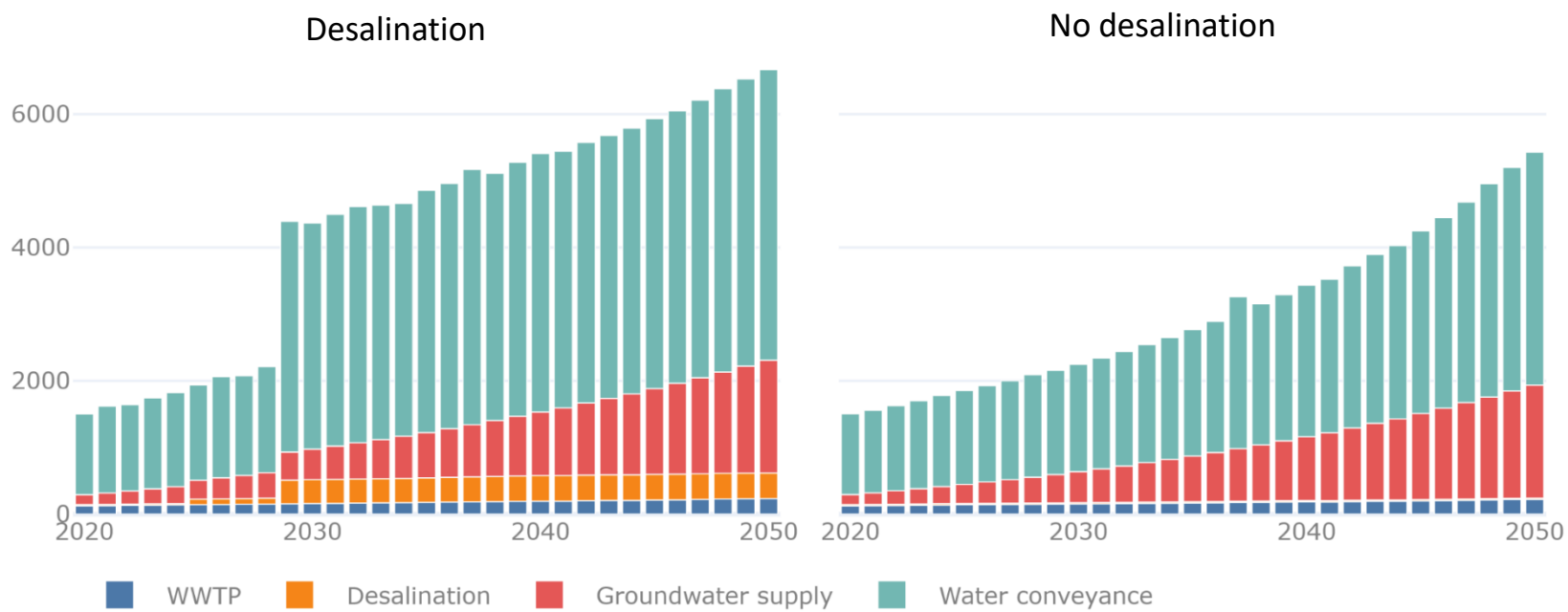
Selected results for Jordan

Which should be the additional **energy requirements**?

- For **desalination: around 355 GWh annually**
- For **conveyance: around 1 896 GWh annually**

Energy demand (GWh)



Scenario analysis for Souss-Massa in Morocco

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Scenarios developed to explore nexus solutions

- New water supply (desalination plant)
- Wastewater reuse in agriculture
- Increase water productivity
- Solar PV adoption in agriculture
- Butane phase-out

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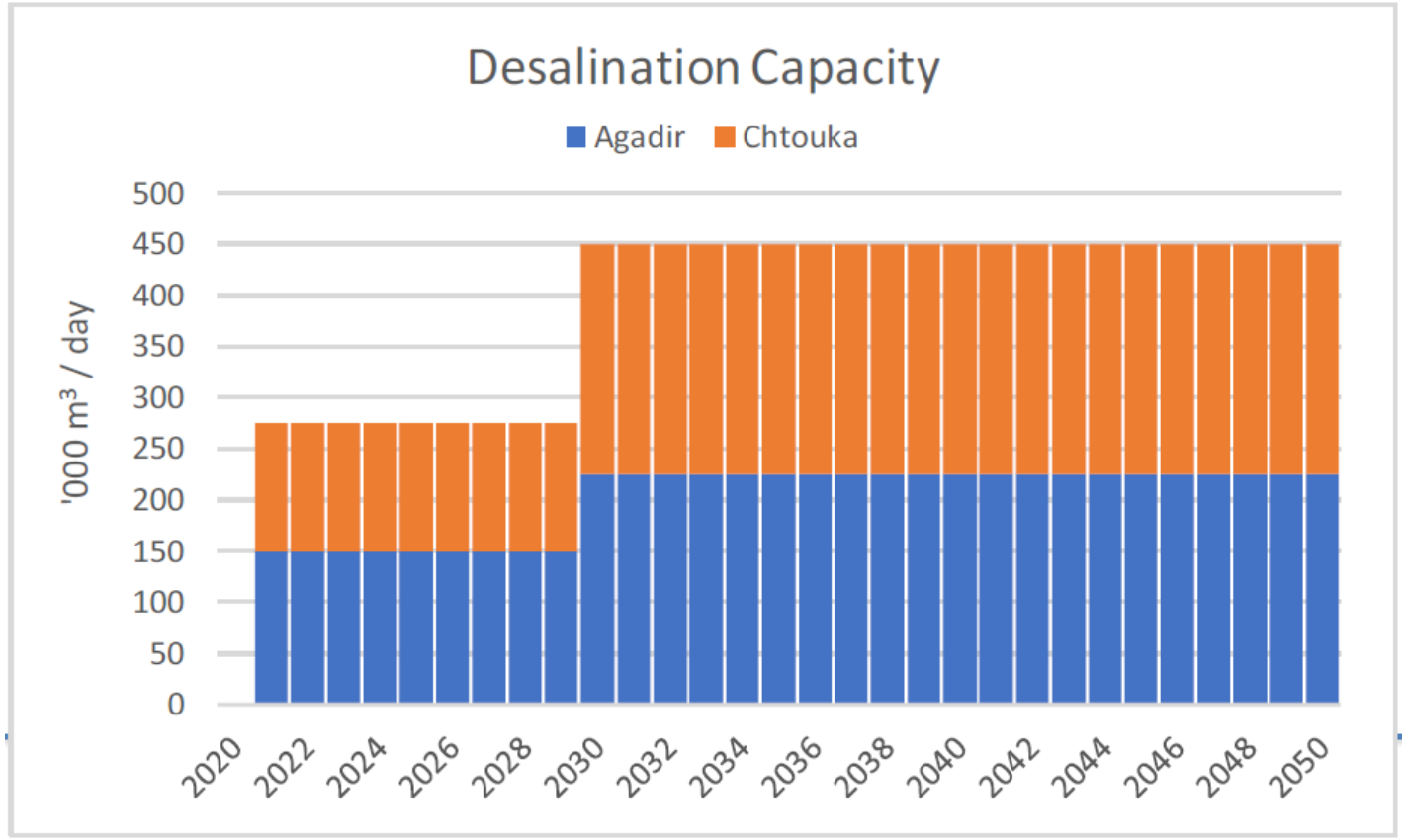
Scenario analysis for Morocco: Desalination at Agadir

New desalination plant at Agadir augments supplies for coastal urban (Agadir) and irrigated agricultural (Chtouka) water demands



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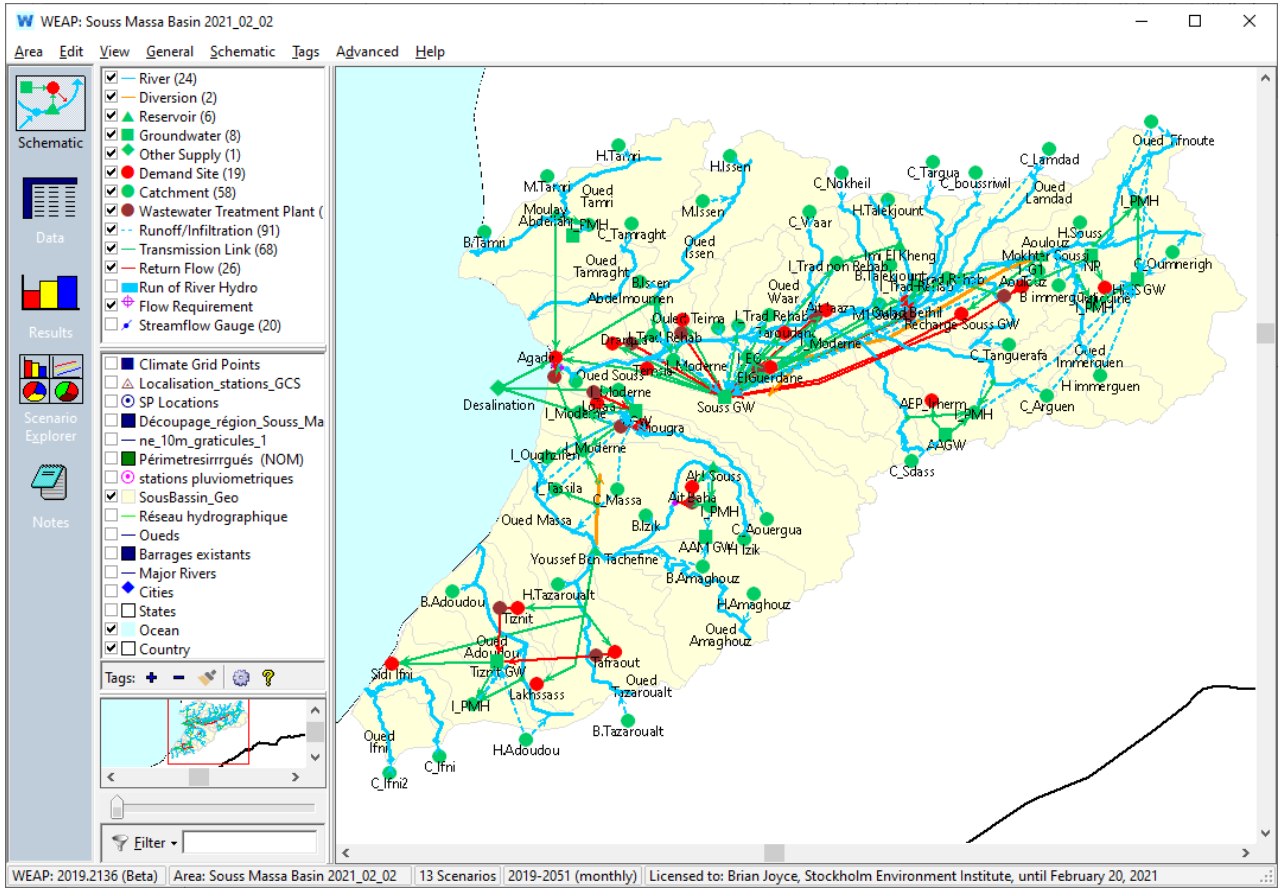
The water and agricultural model for Morocco

Model includes:

- 19 water **demand** sites
  - Water sectors: Residential, Commercial, Industry
- 22 **irrigated** districts
  - Climate-driven water demands for 6 major crop types
- 8 major **groundwater** basins
  - Simulate depth to water table
- **Surface water** supplies
  - Local wadis
  - Desalination
- Water **distribution network**
  - 4 major pipelines and canals



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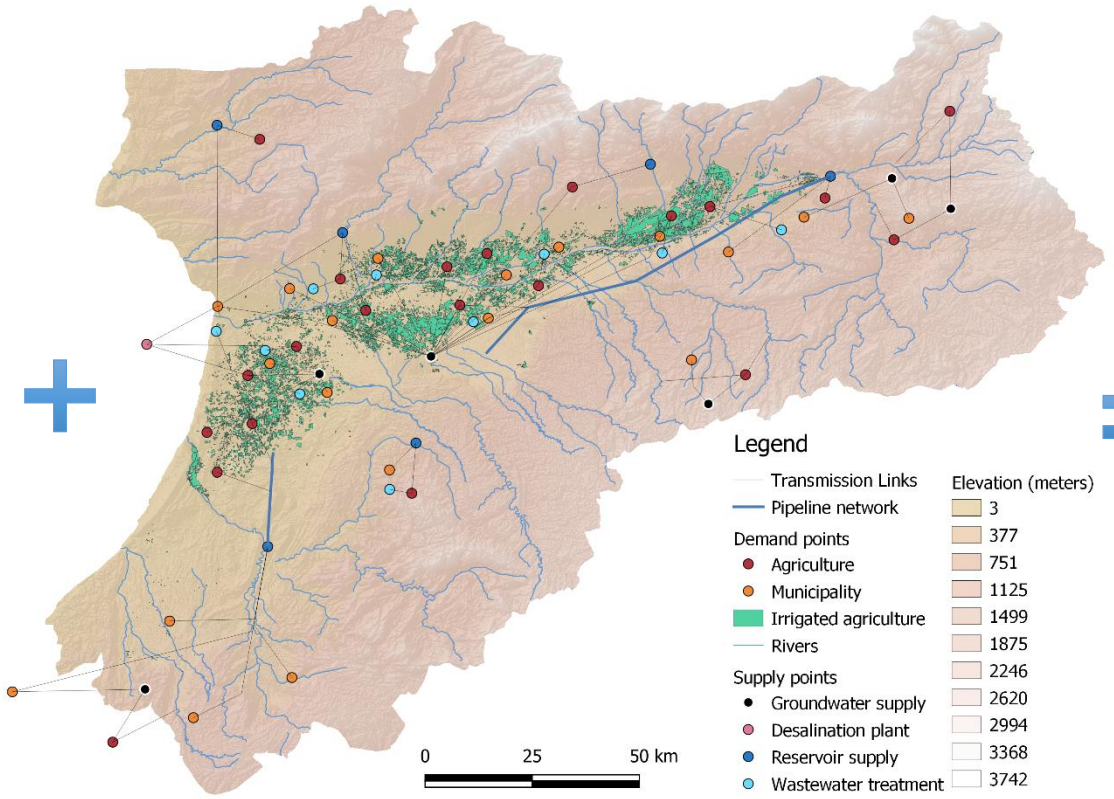
The Energy model for Morocco

WEAP + Technical specifications +



GIS input and analysis

=

- Groundwater pumping energy
- Surface water pumping energy
- Desalinated water energy
- Wastewater treatment energy
- Solar PV pumping for agricultural

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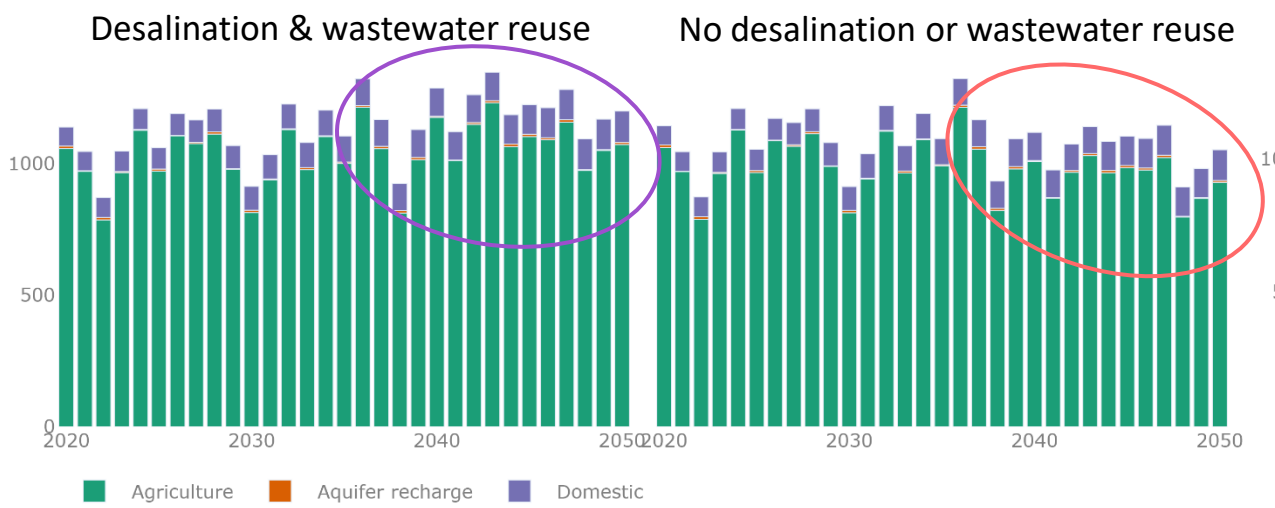
Selected results for Morocco

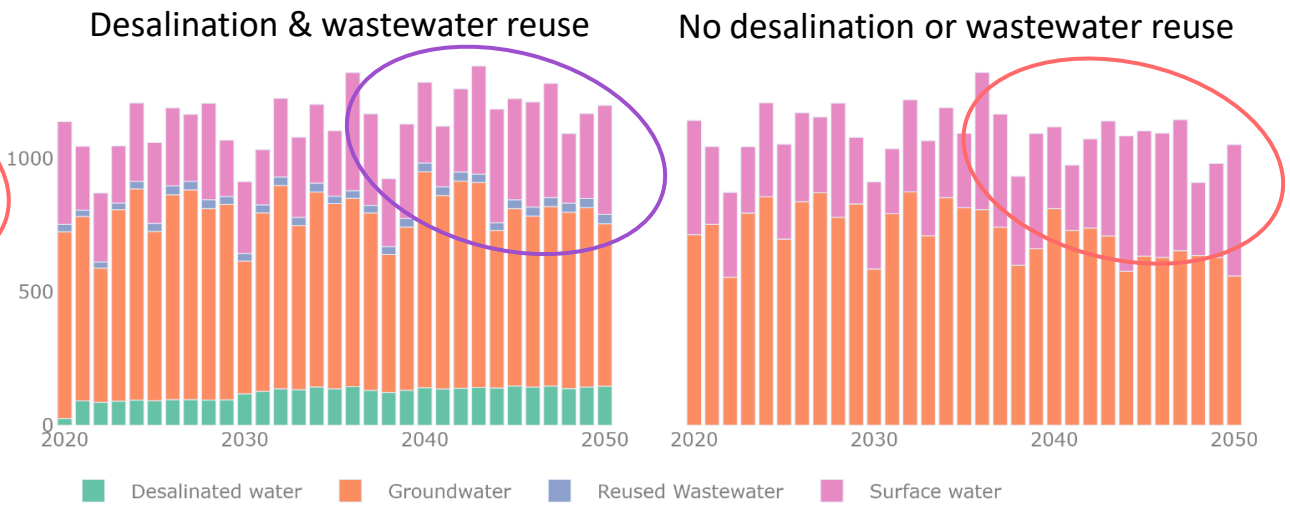
How could the combination of **desalination** and **wastewater reuse** reduce **water scarcity**?

- Around **30.65 million cubic meters** of **treated wastewater** could be **reused in agriculture annually**.
- Around **44 million cubic meters** of **groundwater** could be **saved annually**.
- The overall **water deliveries** could **increase** in average **by 5.3% annually**

Water delivered (Mm3)



Water supply Mm3



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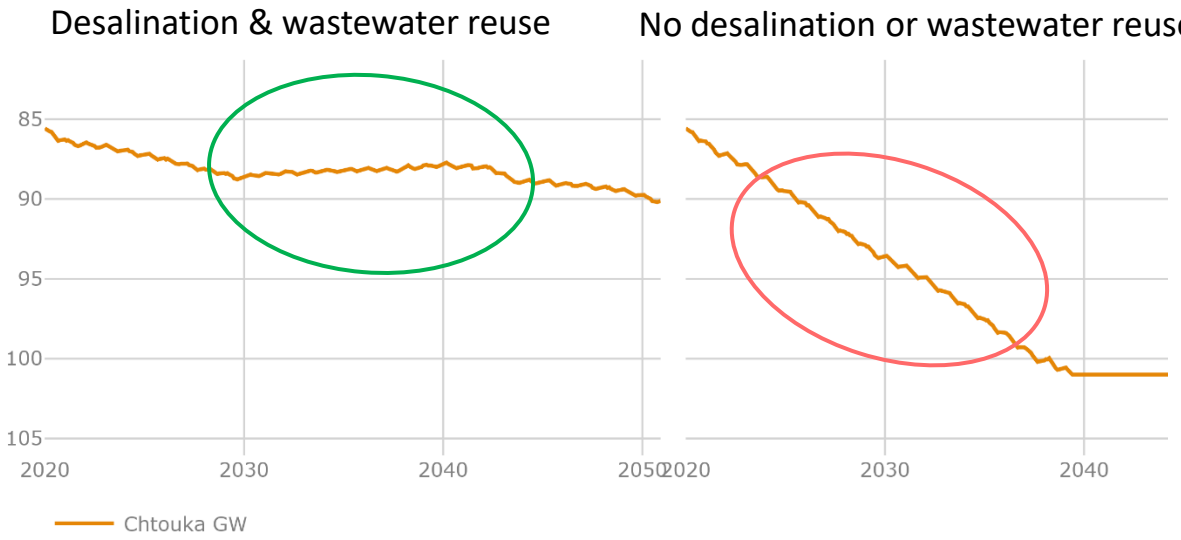
Selected results for Morocco

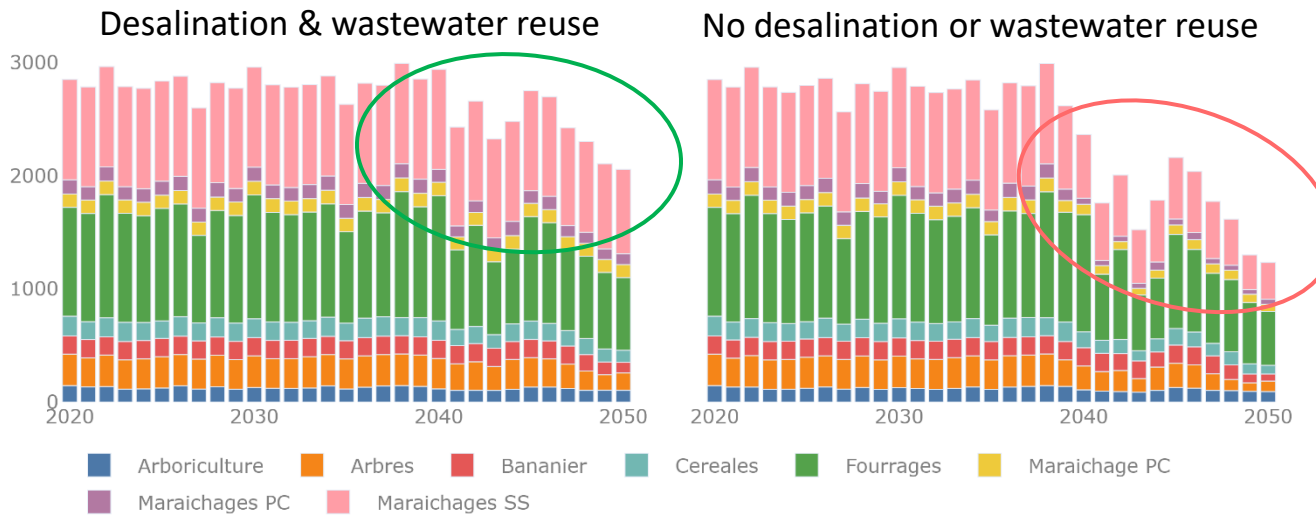
How could desalination and wastewater support the restoration of **groundwater aquifers** and **agricultural production**?

- The Chtouka aquifer could see a substantial recovery on groundwater levels, **avoiding around 10 meters** of drawdown by 2050
- Crop production could benefit from an increase in the availability of water.

Chtouka groundwater depth (mbgl)



Crop production (ton)



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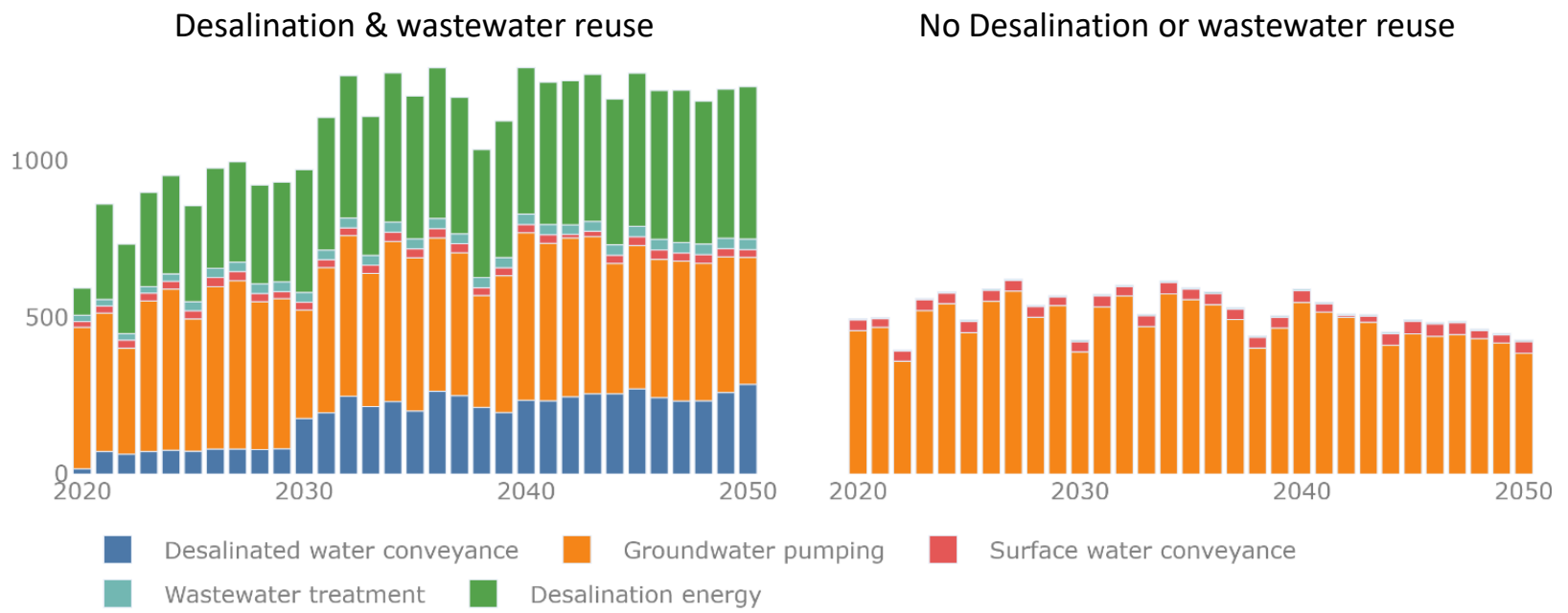
Selected results for Morocco

What could be the **additional energy requirements**?

- For **desalination:** around **402 GWh** annually
- For **conveyance:** around **182.8 GWh** annually
- For **wastewater treatment:** around **26 GWh** annually

Energy demand (GWh)



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Scenario analysis for Morocco for energy

Butane use phase-out from agricultural pumping and adoption of PV solar pumping:

- Highly subsidised
- Inefficient pumping and high emissions

Several scenarios analysed:

- Butane phaseout by:
  - No phase-out
  - Year 2040
  - Year 2030
- PV pumping adoption by 2040:
  - 10% share
  - 20% share
  - 50% share

Source: www.lorentz.de

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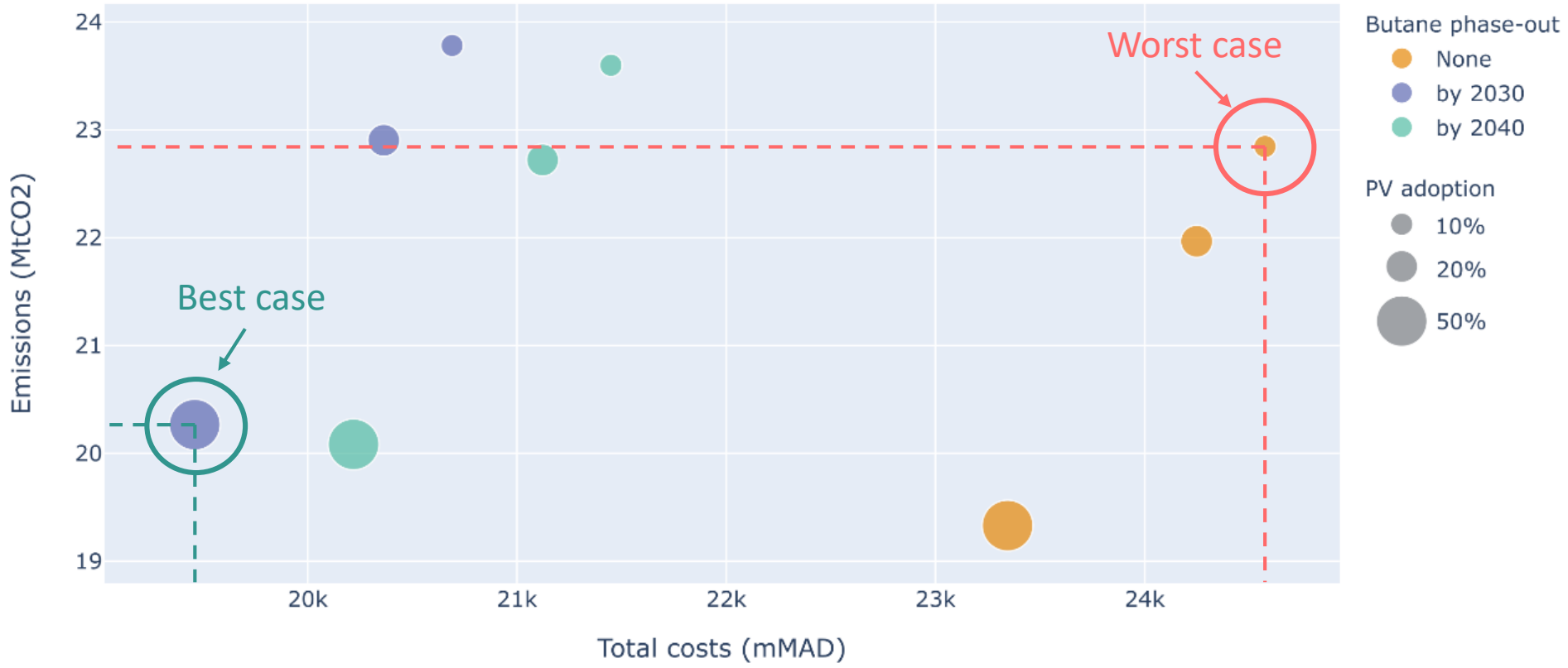
Selected results for Morocco

Butane phase-out and PV adoption(%)



Visualization platforms for Souss-Massa and Jordan

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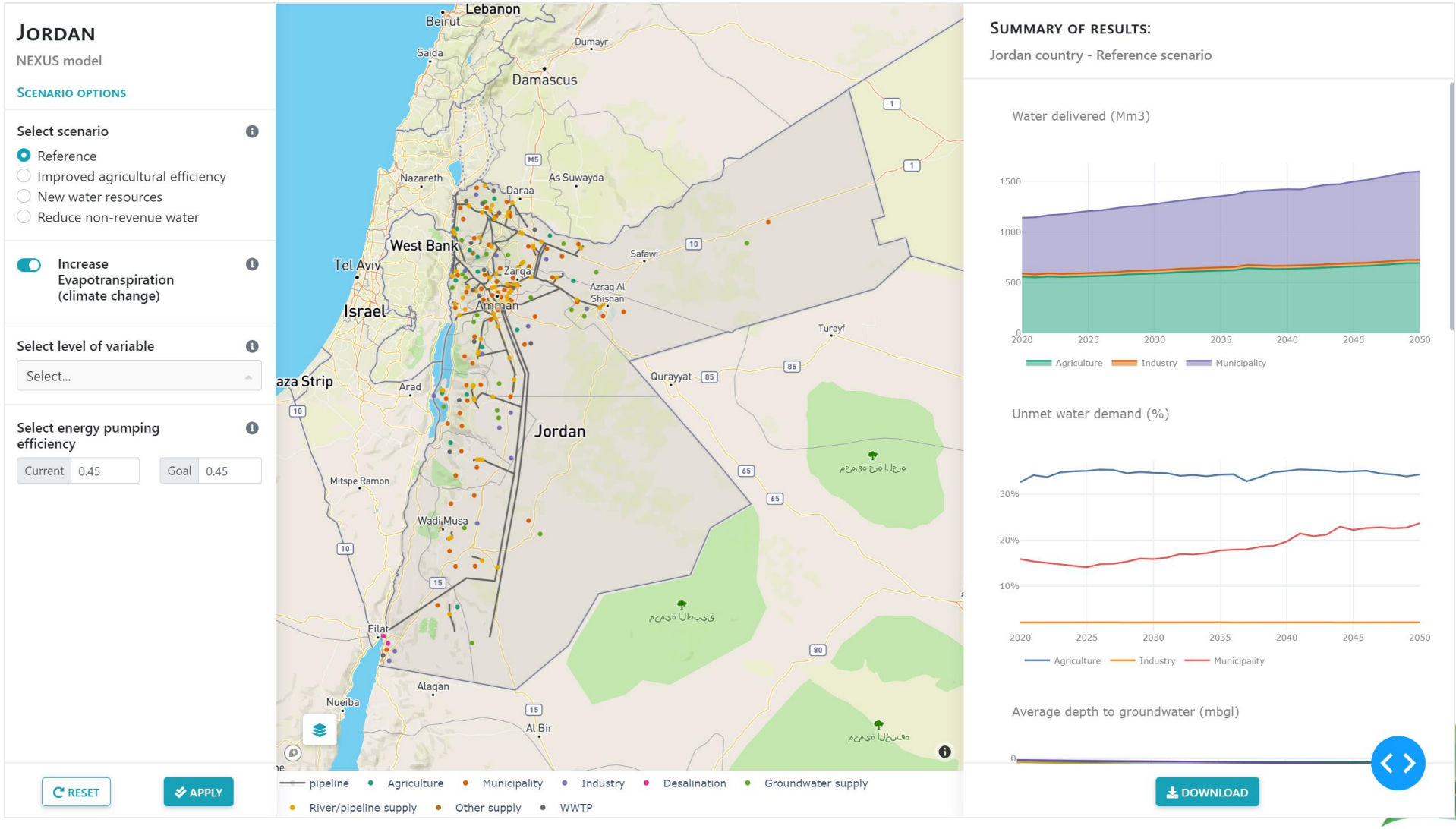
The visualization platforms (under construction)



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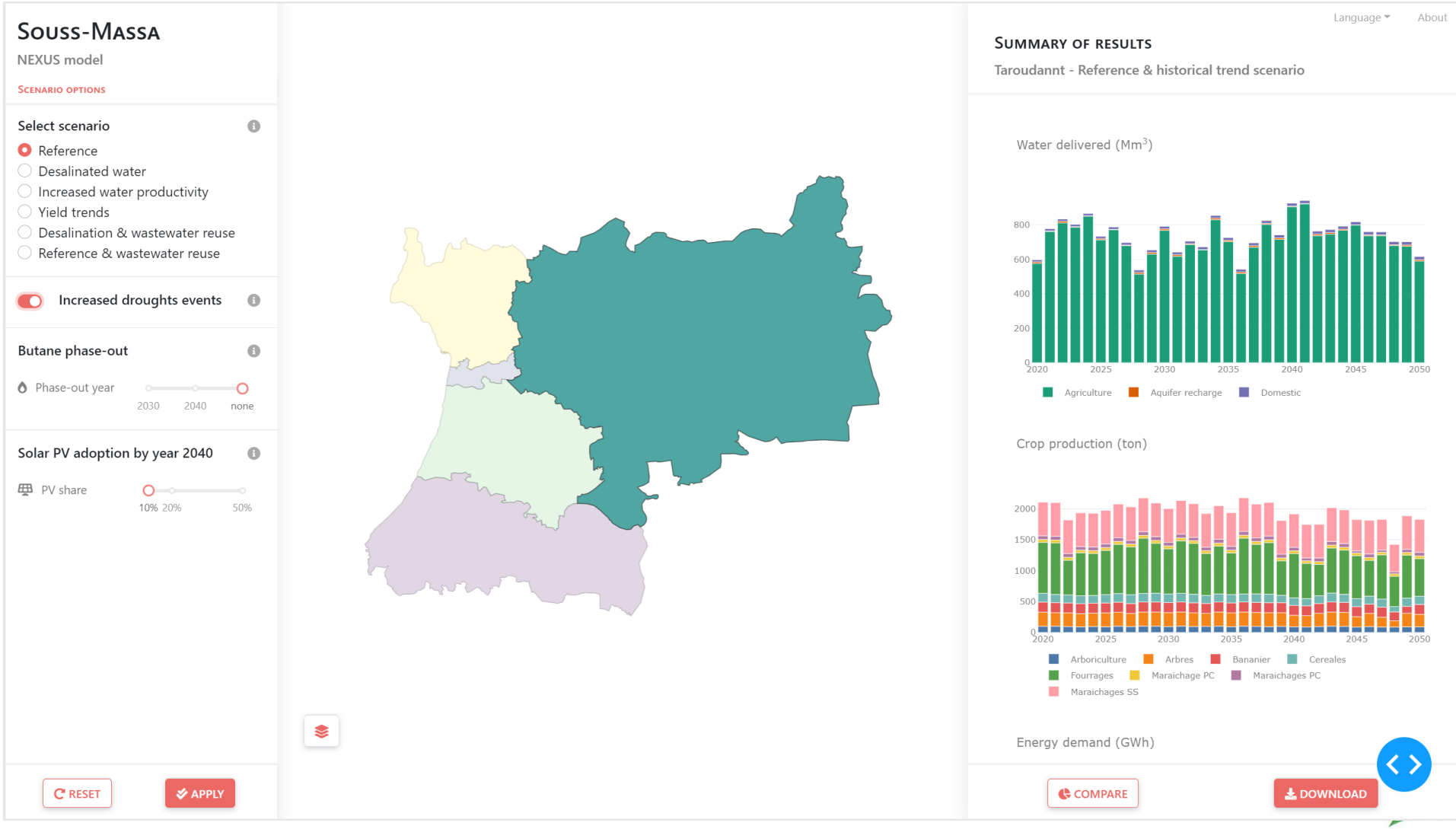
The visualization platforms (under construction)



Q&A

Finding Nexus solutions

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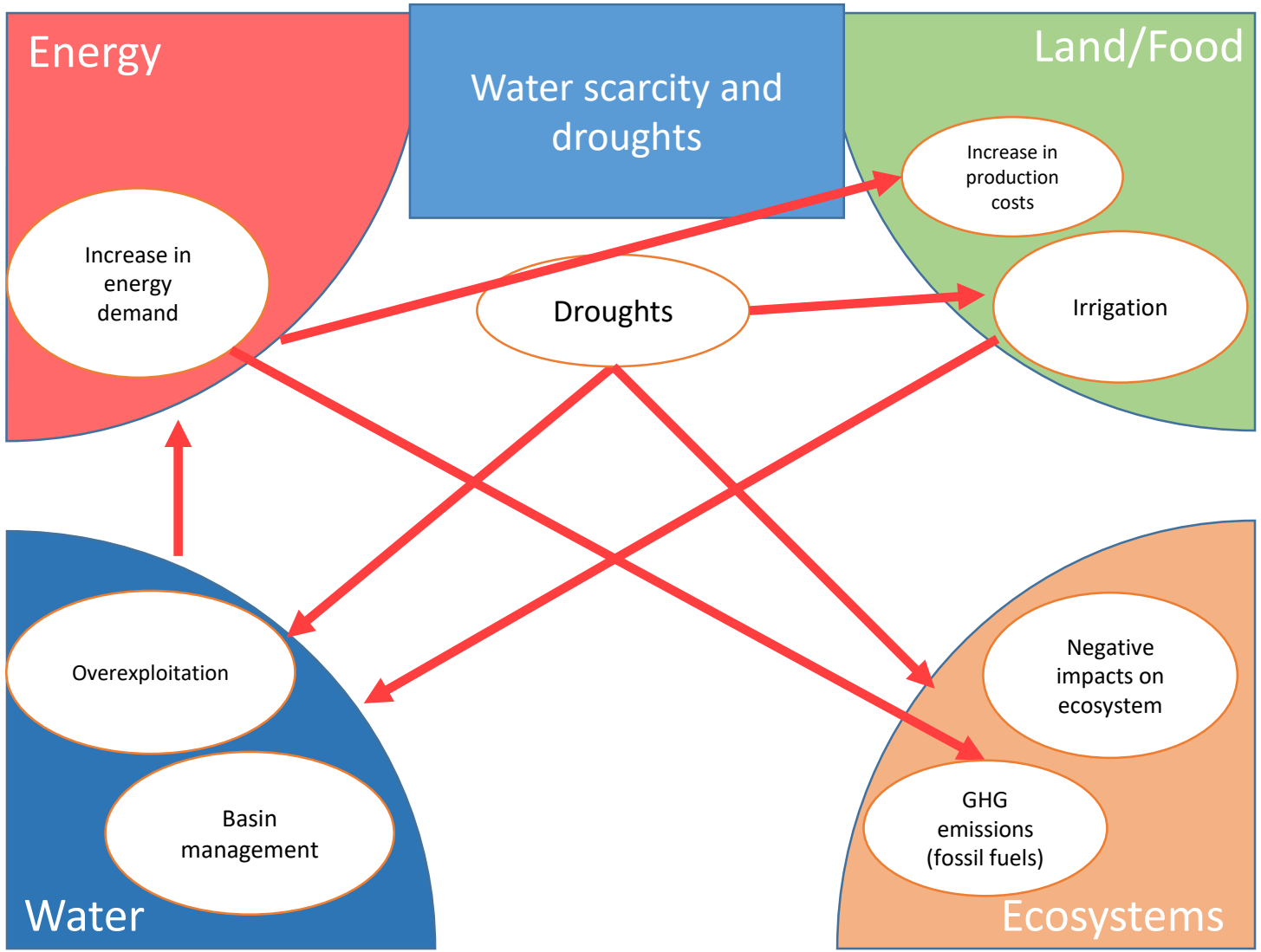

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Discussion points (15 min)

1. Each participant reflects which type of nexus solutions could address water scarcity and drought issues? (2-3 min)
2. Each participant presents proposed solutions to the rest of the group
3. Report back and Mentimeter

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Participants inputs via mentimeter

Please briefly describe one Nexus solution that you think would be very promising to address drought and water scarcity issues

- wastewater treatment and recycling
- Drip irrigation
- Desalination
- Solar irrigation
- circular sanitation value chain design for food, water, energy, and ecosystems
- wastewater treatment
- hydroponics combined with solar energy
- water storage and recylcing at multiple levels - household to regional
- agricultural water reallocation and enhance on-farm irrigation systmes

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Participants inputs via mentimeter

Please briefly describe one Nexus solution that you think would be very promising to address drought and water scarcity issues

integrated policies

water demand for agricultural and urbanization domain

Use of drip coupled with the use of solar energy, in particular for underground pumping, this is a case applicable in southern Algeria.

Built small reservoirs. have very efficient water networks, focused on reduce losses and increase water reuse

Institutional dialog and proper arbitration

Lease contract should be regulated

The proper water auditing and return flow from each water demand site, with treatment plant.

policy incentives to reduce water demandcross-sectoral coordination to adapt economic activities to drought conditionsbuilding resilience to drought through appropriate agricultural model

drought charges

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Participants inputs via mentimeter

Please briefly describe one Nexus solution that you think would be very promising to address drought and water scarcity issues

The way to increase water could be better in the way to increase production. Indeed this could help in the dry conditions to still producting.

A management plan has to be done for resources according to the results the project is collecting. This must improve the water utilization and the enhance WP

in order to solve water scarcity we need to know what it the main causes, so there is a need for data sharing: water use for crop export, water footprint for each crop production (monthly, yearly reported data) ground water withdrawal, water intake

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This activity is implemented under the project “Implementing the 2030 Agenda for water efficiency/productivity and water sustainability in the NENA countries”, which is funded by the Swedish International Development Cooperation Agency. This project is implemented under FAO’s Water Scarcity Initiative.

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Thank you!

http://neareast.fao.org

WATER
Productivity
Efficiency, and
Sustainability
in the NENA countries

Sweden
Sverige