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Water-Energy-Food Nexus

Analytical Framework and Applications

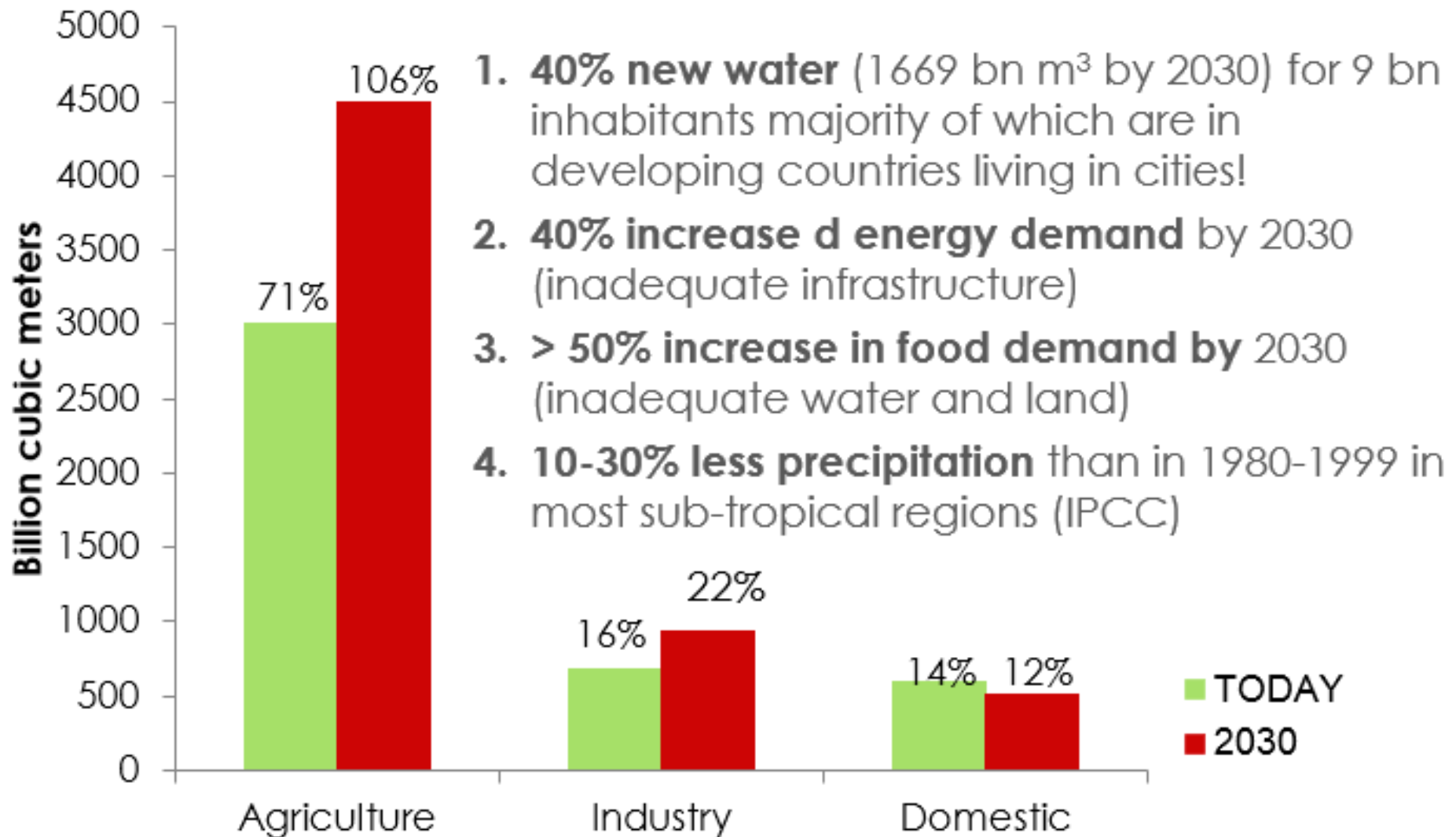
Bassel T. Daher
Rabi H. Mohtar

Nexus Dialogue on Water Infrastructure Solutions
Beijing, China, 13-15 November, 2014

Outline

- **Water-Energy-Food Nexus Framework**
- **Applications**
 - Qatar
 - MENA
 - Texas
 - US-China
- **Wrap Up**

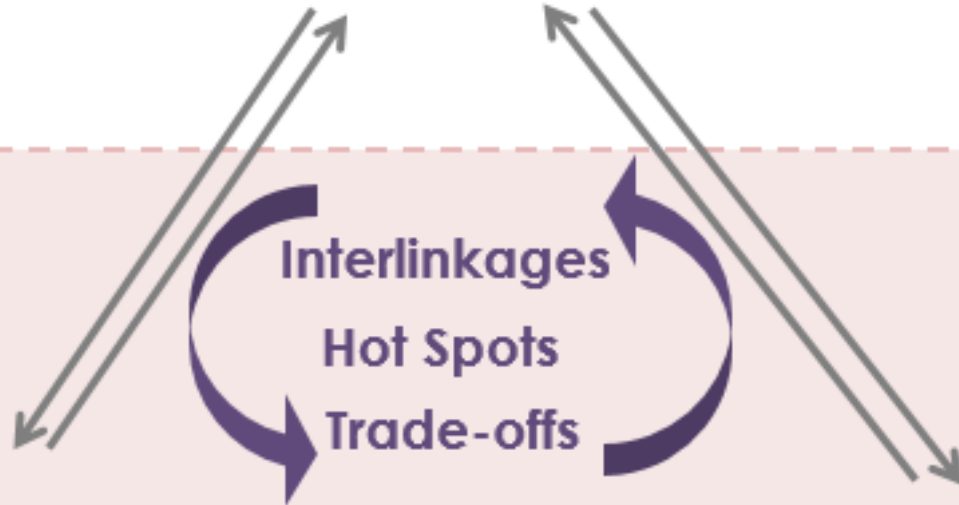
Grand Challenges



Source: Water Security: The Water-Energy-Food-Climate Nexus. WEF, 2010

There is a need for a
holistic
and
system level
platform
for solution assessment

Food



Energy

Water



The Resource Management Strategy Guiding Tool

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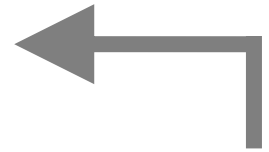
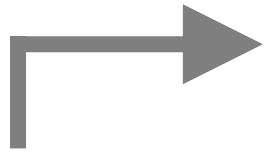
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The Resource Management Strategy Guiding Tool



ADMIN interface

Local Characteristic Data

Local Yields

Water Requirements

Energy Requirements

Land Availability

Import Data

Other

Science

USER interface

Scenario Components

Food Self-Sufficiencies

Water Sources and Amounts

Energy Sources and Amounts

Sources of Import Countries

Tool Output

Water Requirement (m3)

Financial Requirements (\$)

Local Energy Requirement (kJ)

Energy-Import (kJ)

Local Carbon Emissions (ton CO2)

Carbon-Import (ton CO2)

Land Requirement (ha)

(Daher, Mohtar)

Policy

Sustainability Index of Scenario

Qatar

- Ranks 3rd in NG reserves; Ranks 12th in Oil reserves
- Arid Climate
- **Water:** 99% Desalination
- **Agriculture:** limited by low water quantity and quality, unsuitable soil, climatic conditions → low crop yields
- Food imports exceed **90%**
- Qatar National Vision 2030
- Qatar National Food Security Program (QNFSP)

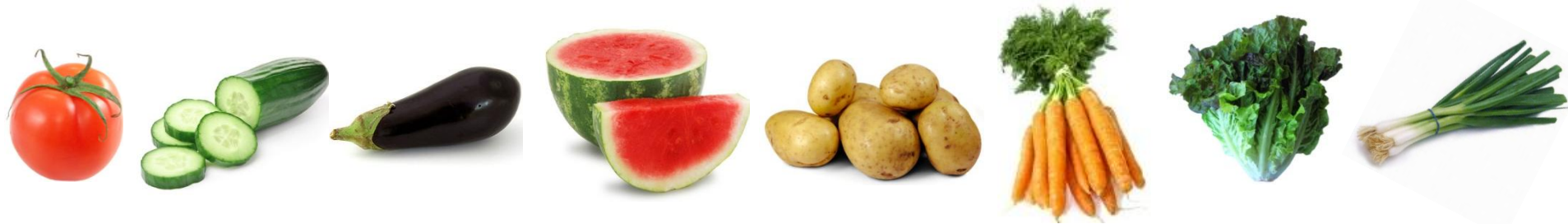
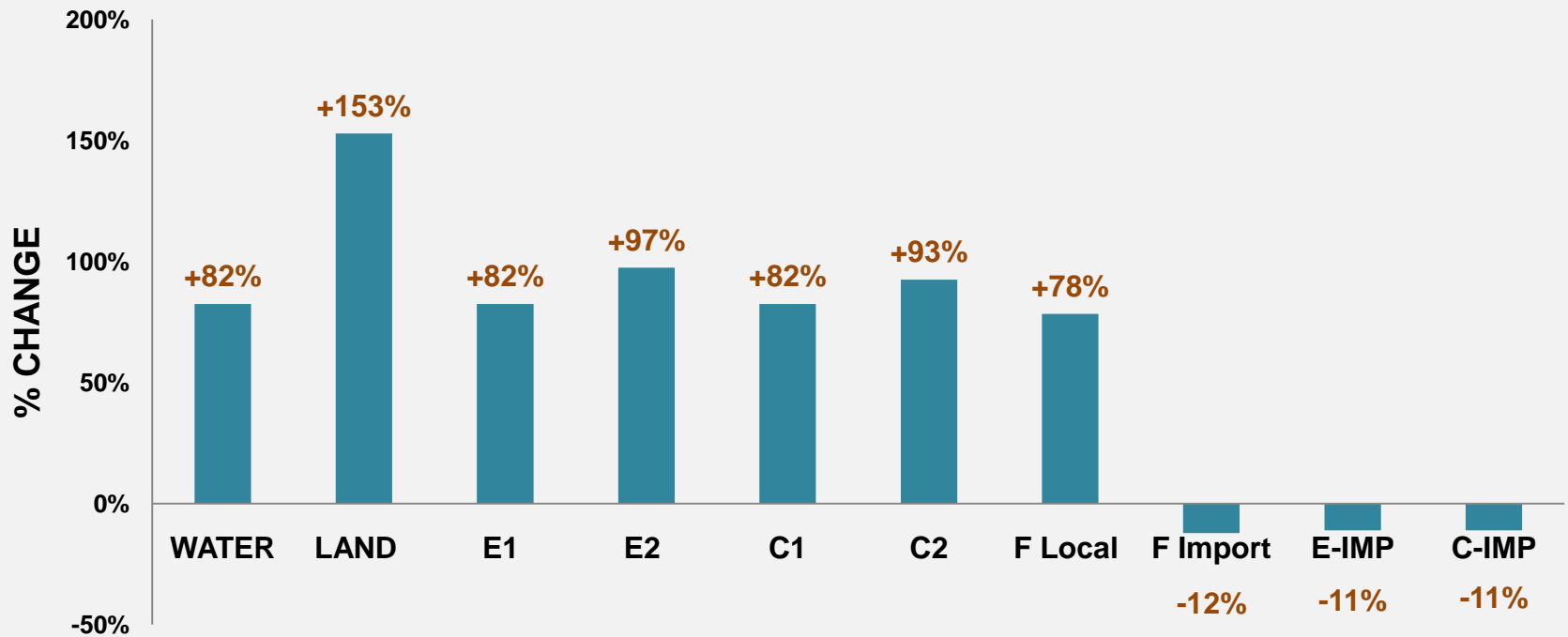


(Source: Athaia, 2011)

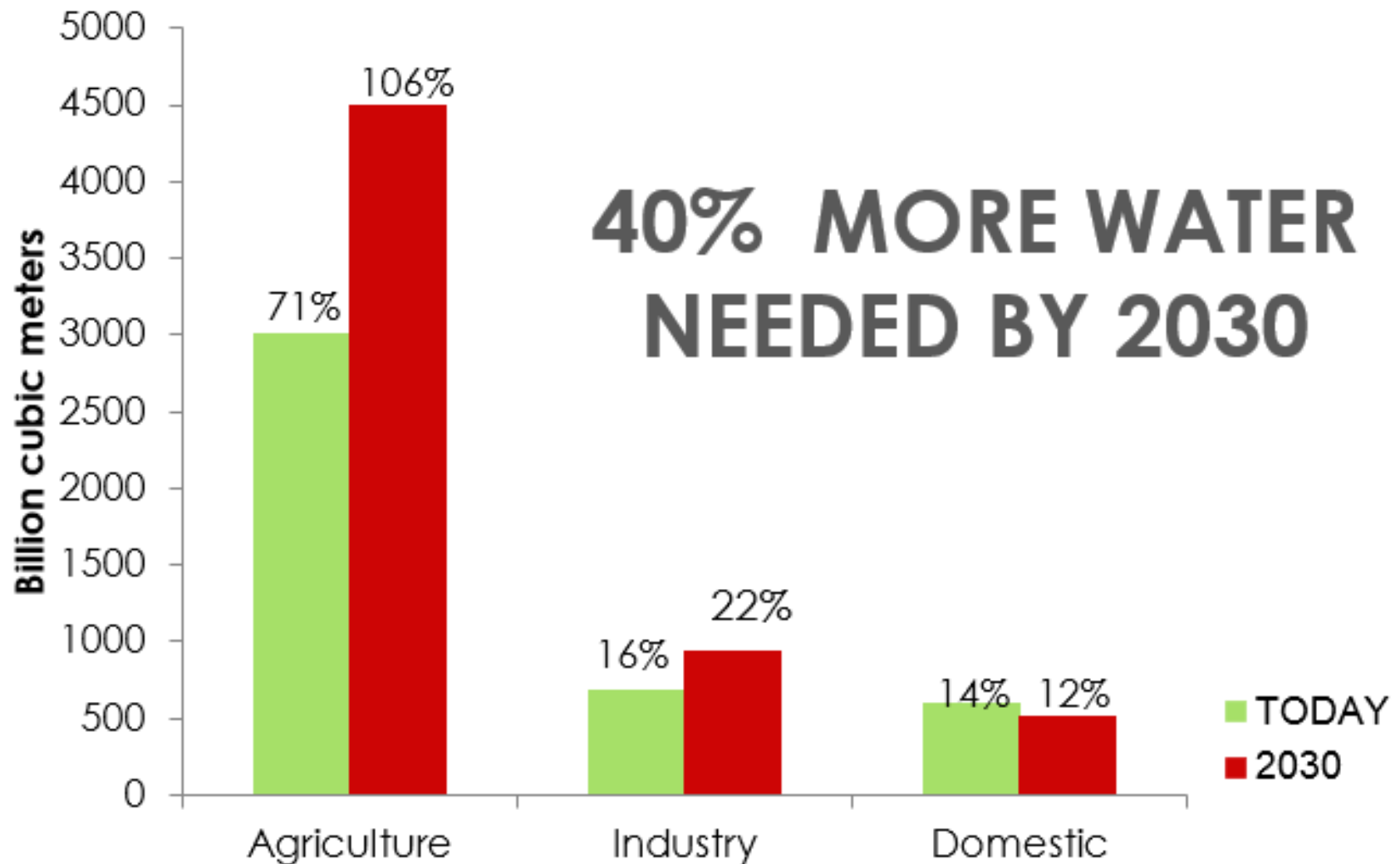
Discussions

Hypothetical Scenario

Percentage change for resources as a result of **10%** increase in self-sufficiency per product



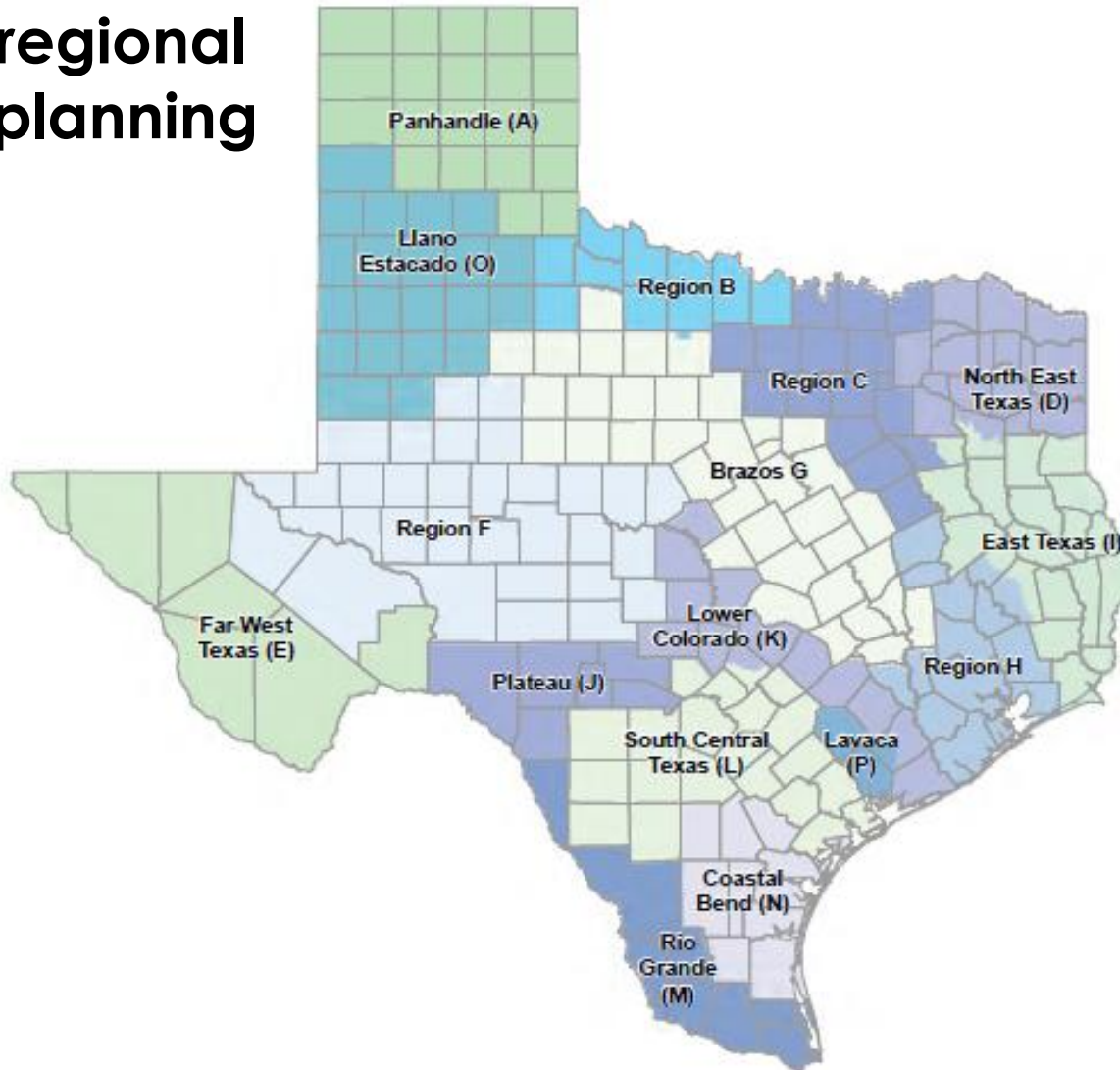
Grand Challenges



Source: Water Security: The Water-Energy-Food-Climate Nexus. WEF, 2010

WEF Nexus in Texas

The 16 regional water planning groups



(Texas State Water Plan 2012)

US-China Agricultural Trade

- Over the past 15 years, **China** has become the **largest dairy importer worldwide**. China's dairy imports have increased by approximately 10 per cent annually since 2000 and are expected to grow further in the coming years (USDA, 2014).
- **Bunge** has **invested 300m USD** to build the first export food commodity terminal in over 25 years in Longview, Washington to serve Asian markets more efficiently and in less time (Bunge, 2014).

Research Questions

- **To what extent is the US dairy systems sufficiently resilient** to sustain future trade growth with China? How would increased agricultural production for export affect interconnected water and energy systems?
- **How could we IDENTIFY AND QUANTIFY possible trade-offs** among interconnected systems and **what is the threshold** beyond which growing more agricultural products for export becomes unsustainable (from a resource and environmental perspective)?

Wrap Up

- Need for developing and improving **assessment tools for trade-offs analysis** to support dialogue
- **Holistic** yet **localized** assessments and solutions
- **Better identification and accounting** - which would lead to better management- of untapped resources (green water)

WEF Nexus Research Team



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