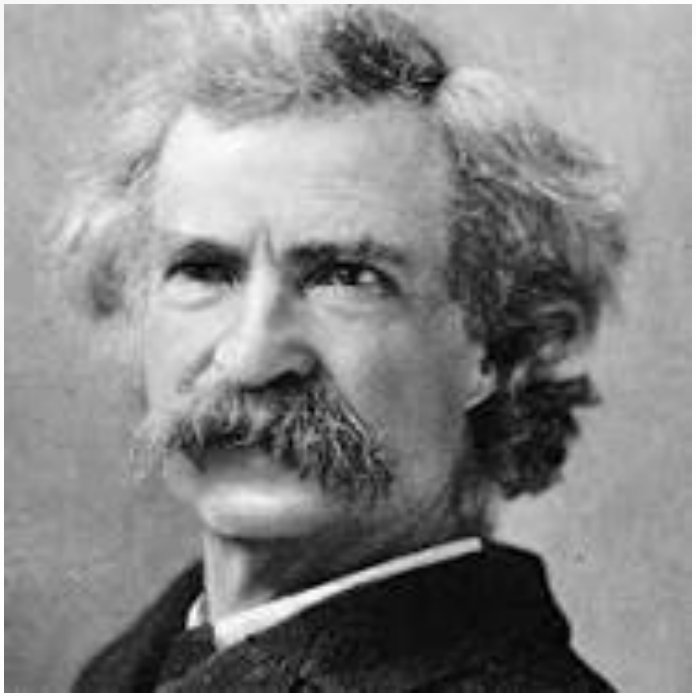
What would Mark Twain tell us in the 21st Century? Experiences with Modeling the Water-Energy-Food Nexus in an International Development Context



Fernando Miralles-Wilhelm
(and a bunch of other people!)
University of Maryland

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Famous Quotes

“It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.”

Mark Twain

The water-energy-food challenge is already present and very real

Water shortages hit US power supply

Updated 10:54 20 August 2012 by Sara Reardon

OP-ED CONTRIBUTOR

Will Drought Cause the Next Blackout?

By MICHAEL E. WEBBER

Published: July 23, 2012 | 150 Comments

Austin, Tex.

China power crunch to worsen as drought slashes hydro

Recommend 6 people recommend this. Be the first of your friends.

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Connecticut nuclear power plant shut down one unit due to hot water from Long Island Sound

Published: Monday, August 20, 2012

Maharashtra: Parli power plant shuts down after severe water crisis

By Reported by Rashmi Rajput, Edited by Amit Chaturvedi | Updated: February 17, 2013 17:33 IST

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Asia Risks Water Scarcity Amid Coal-Fired Power Embrace

(Reuters) - The worst drought to hit central China in half a century has brought water levels in some of the country's biggest hydropower producing regions

as bayou floods Tue, May 17 2011

Japan keeps Fukushima shutdown target

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'Water becoming a serious constraint for power generation'

The power plant has an installed capacity of 1130 MW.

Bloomberg News

China, India Lack Water for Coal Plant Plans, GE Director Says

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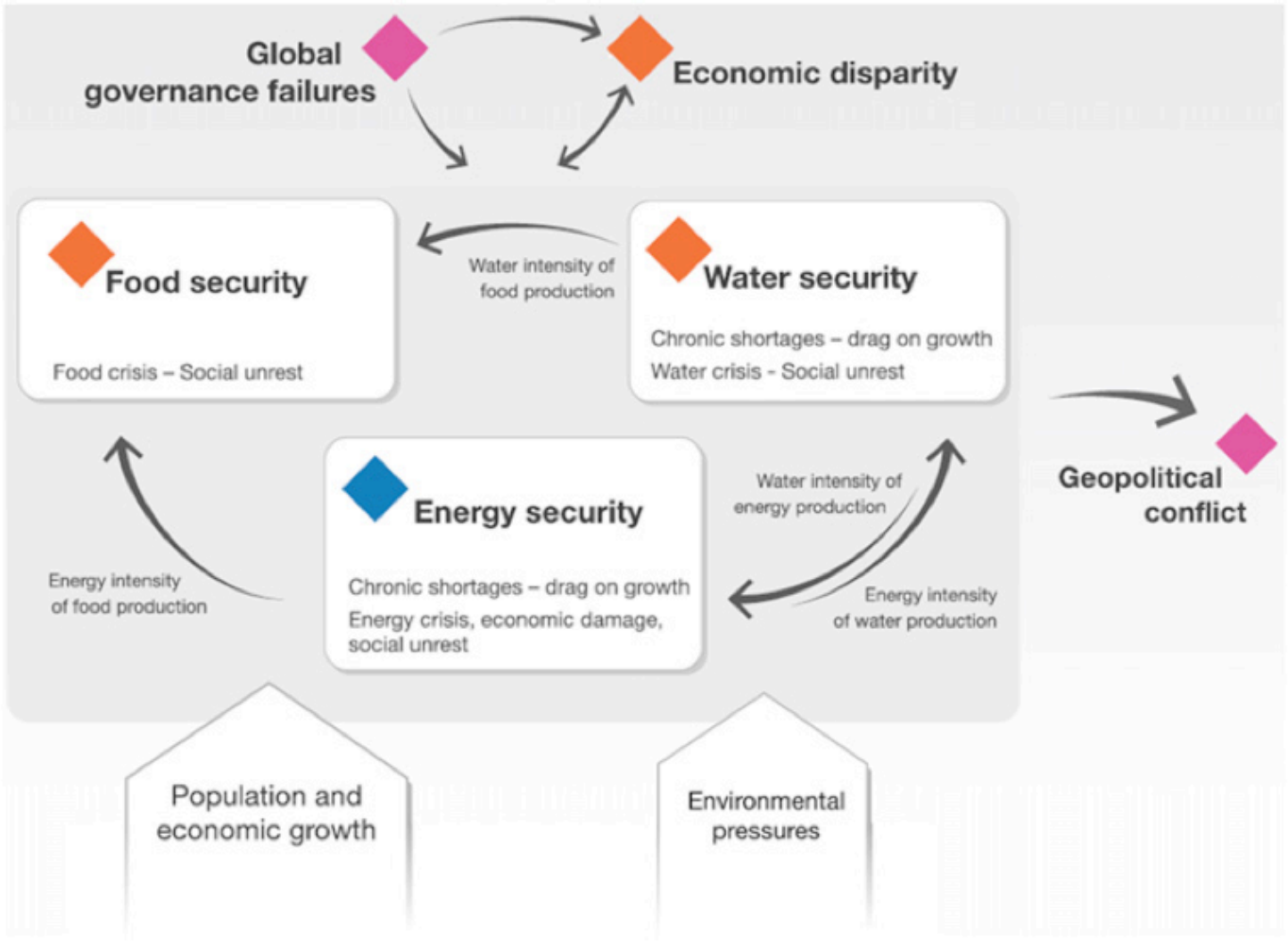
In an interconnected world, water is no longer a local problem only

- Increase in food production required to feed a world of 8 billion by 2030, 9 billion by 2050
- Increased dependence on food trade exposes countries to water stress impacts abroad

- Trade-offs between water and energy including integrated management of hydro and other energy sources
- Regional cooperation needed to optimize hydropower in conjunction with other water uses

- Increased water demand from growing cities
- Growing numbers of people and value of assets at risk from flooding

Water-Energy-Food Nexus



Nexus schematic with a WEF security focus (Bazilian et al. 2011).

Working with International Development Banks

- World Bank, IDB, EBRD, ADB, AfDB, others.
- Development bank owners are its clients.
- These clients are countries (but really governments)…
- …so, “country needs” are often mixed up with “political needs”.
- How can you effectively get science (and specifically IAM) into politically and demand-driven decision-making processes?
- How do you do this in regions with varying political tendencies, agendas and levels of development?

LAC: Required Investment in Power Generation (2015-2025)

Required Investment in Electricity Generation for the Period 2015-2025					
	Cumulative Capacity (MW)	Additional Capacity (MW)	Required Investment (2012 M US$)	2014 GDP (2012 Bn US$)	Investment as % of 2014 GDP
Brasil	219,003	46,047	$135,730	1399	9.7%
Mexico	83,048	38,552	$55,898	1266	4.4%
Colombia	21,175	5,295	$18,868	261	7.2%
Chile	23,849	5,086	$16,155	210	7.7%
Bolivia	2,810	1,441	$2,666	15.6	5.8%
Peru	22,476	10,525	$37,028	138	3.7%
Argentina	39,000	7,203	$6605	402	1.6%
Venezuela	37,000	7,058	$6472	228	2.8%
LAC	**500,000**	**123,000**	**$304,393**	4564	6.7%

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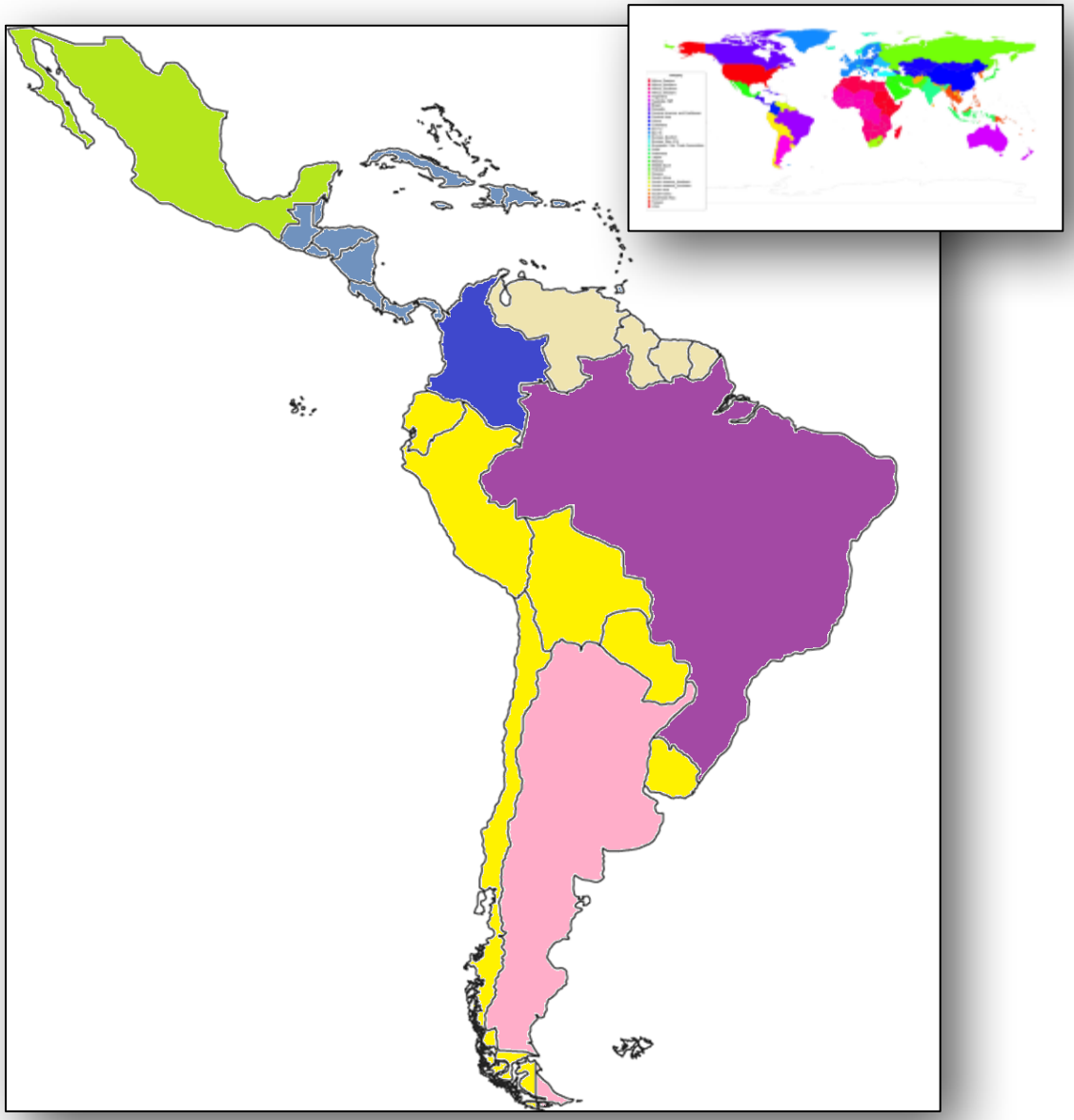
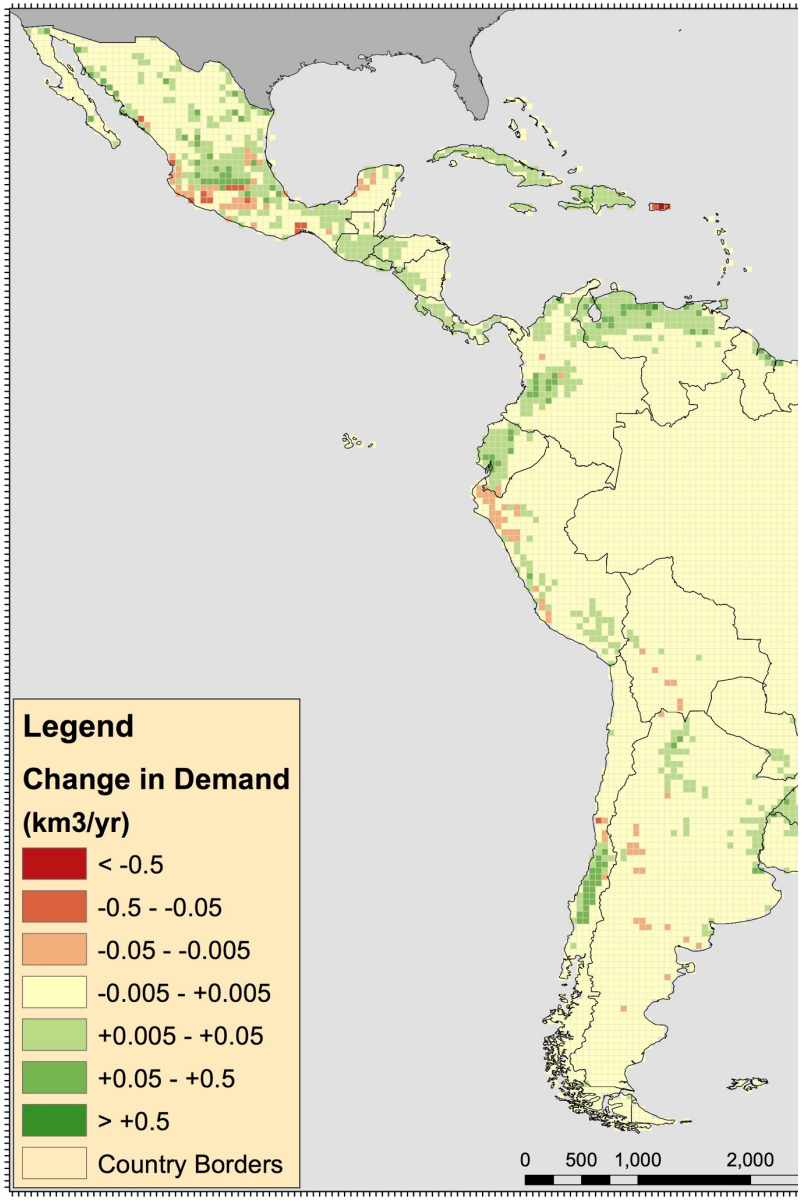
GCAM-LAC: Latin America and the Caribbean (aka, “GCAM en Español” ☺)

- Argentina
- Brasil
- Colombia
- México
- América Central y el Caribe
- América del Sur (Norte)
- América del Sur (Sur)



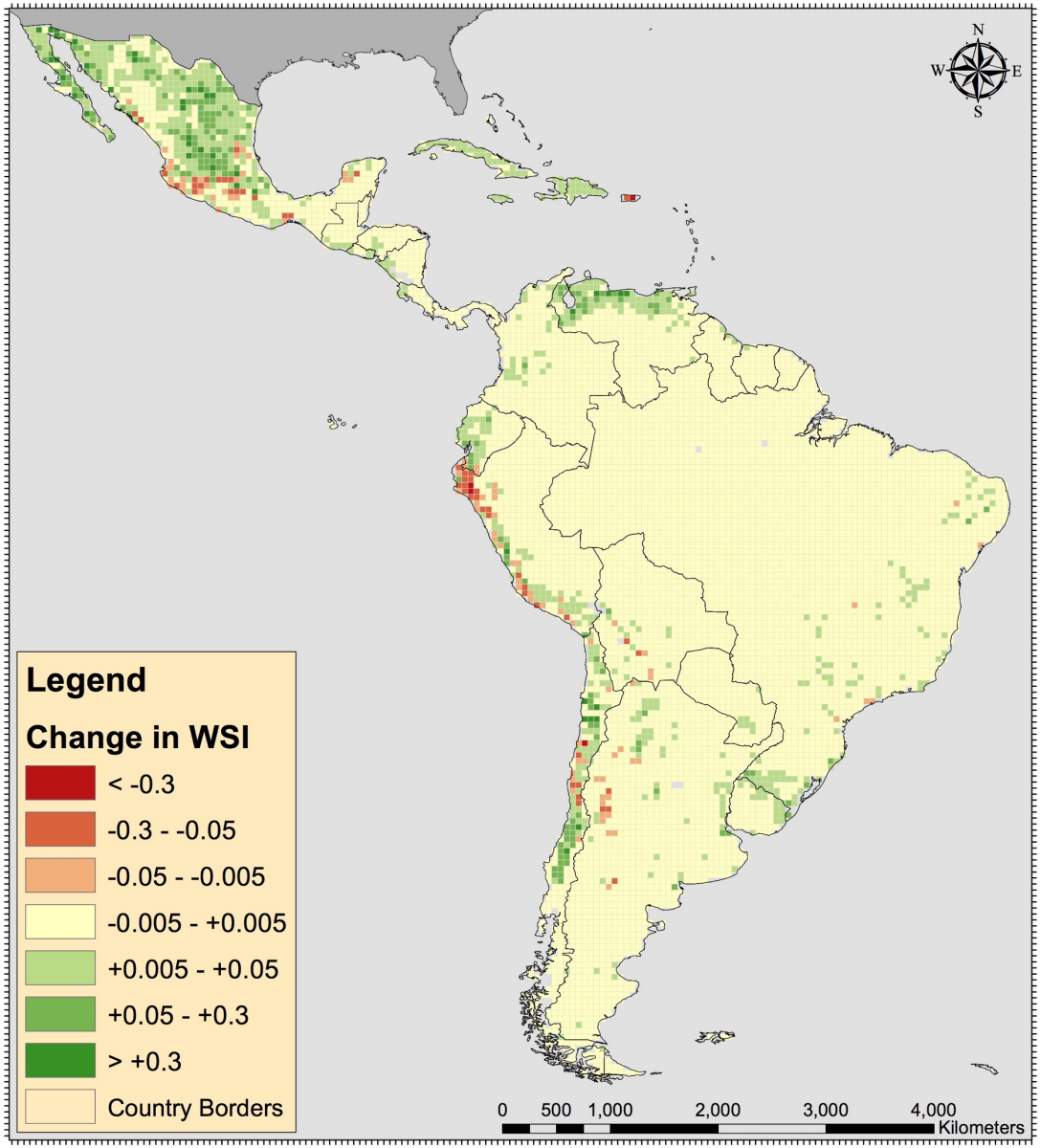
Change in Water Demand (km^3/y) for the Latin America and Caribbean (LA

Year: 2050
Scenarios: SSP3 vs. SSP1



Change in Water Scarcity Index (WSI) for the Latin America and Caribbean (LAC) Region

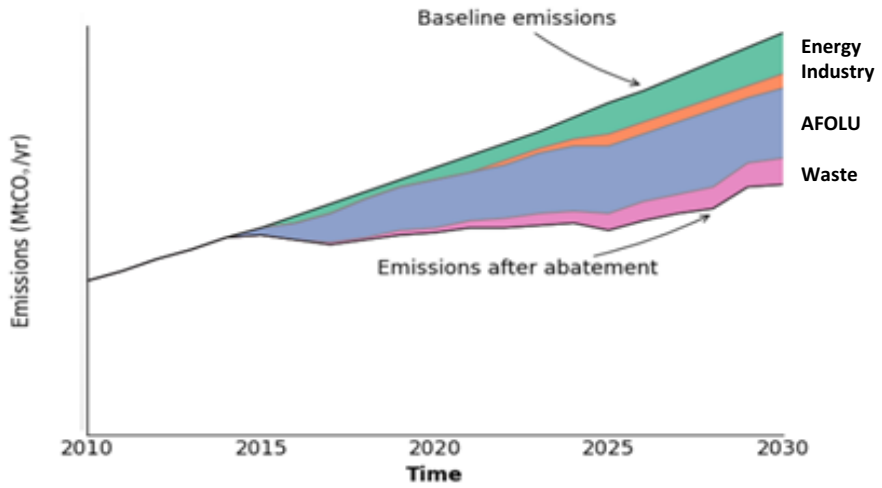
Year: 2050
Scenarios: SSP3 vs. SSP1



Colombia NDC Background

Universidad de los Andes

CONTRIBUCIONES SECTORIALES



Source: Cadena et al. 2015

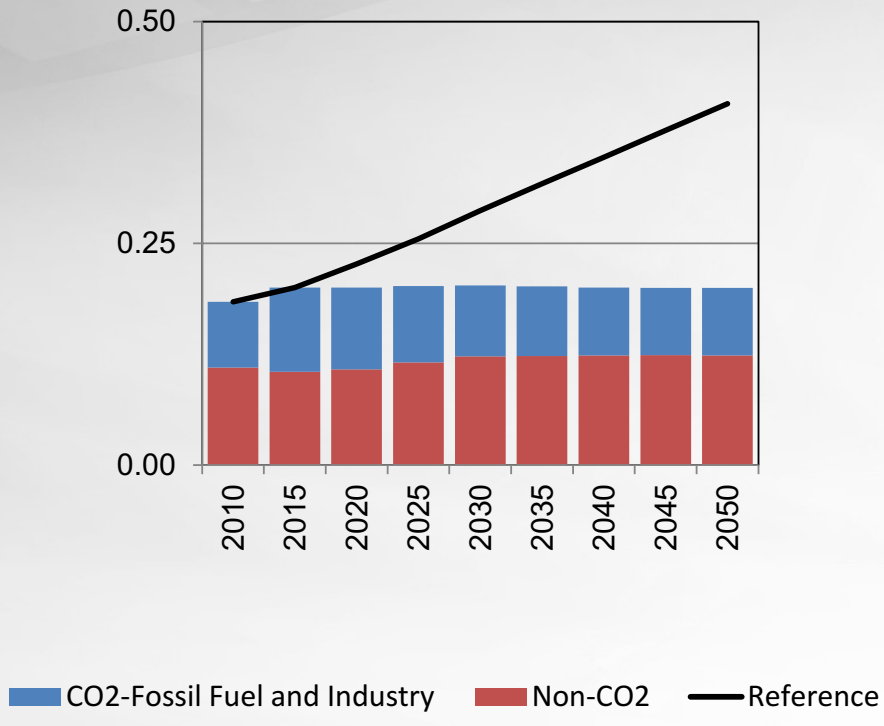
- **NDC target:** 20% below BAU for 2030
- **2030 BAU** = 335 MtCO2e
- **Conditional NDC target:** 30% below BAU for 2030
- **Long-term scenario:** assumed to meet conditional NDC by 2050

- Global emissions share in 2010 was 0.46%; highly vulnerable to climate change impacts given its geographical position and socioeconomic conditions
- In 2010, energy sector had 32% share and agriculture and forestry had 58% share of the total emissions.
- By 2030 BAU, energy sector becomes largest source of emissions with 44% share (vs. 43% AFOLU)

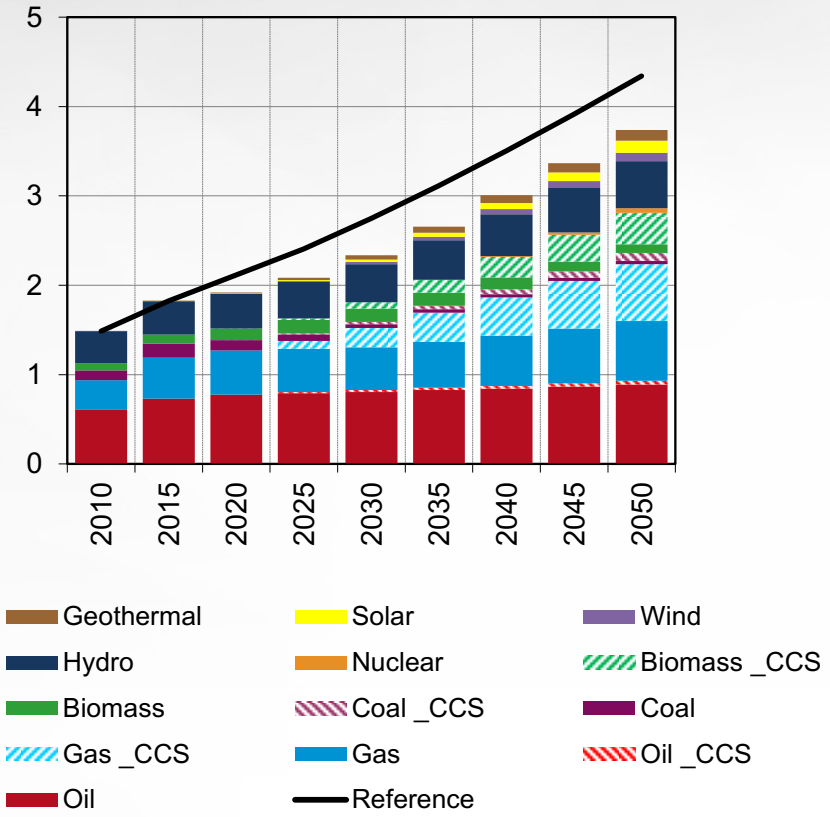
GHG Emissions & Energy

NDC Scenario: Colombia

a. Greenhouse gas emissions [GtCO2-eq]



b. Primary energy [EJ]



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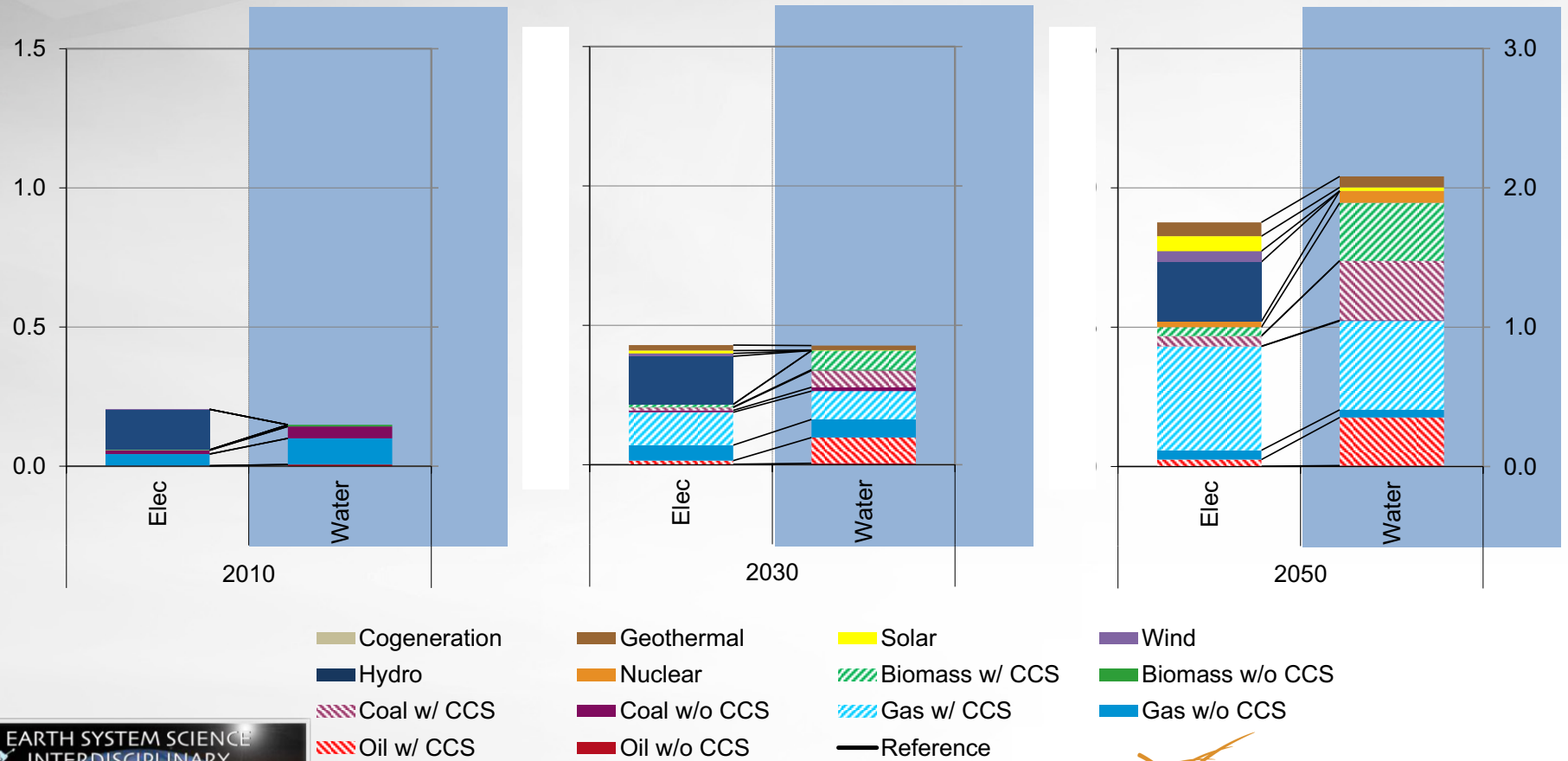
Electricity

NDC Scenario: Colombia

a. Electricity generation [EJ] b. Water withdrawals for electricity [billion m3]



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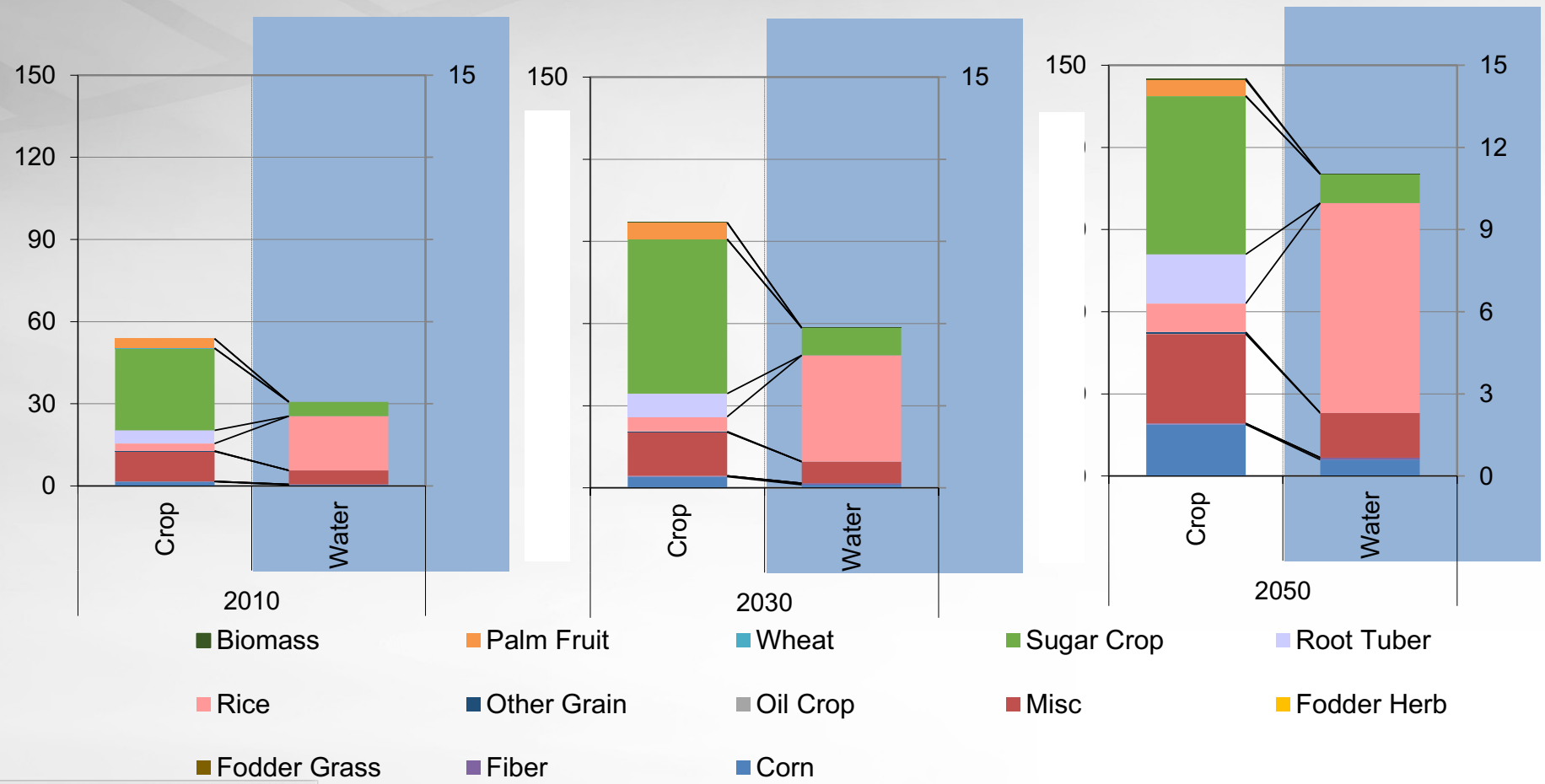
Crop Production

NDC Scenario: Colombia

a. Crop production [Mt]

b. Water withdrawals for irrigation [billion m3]



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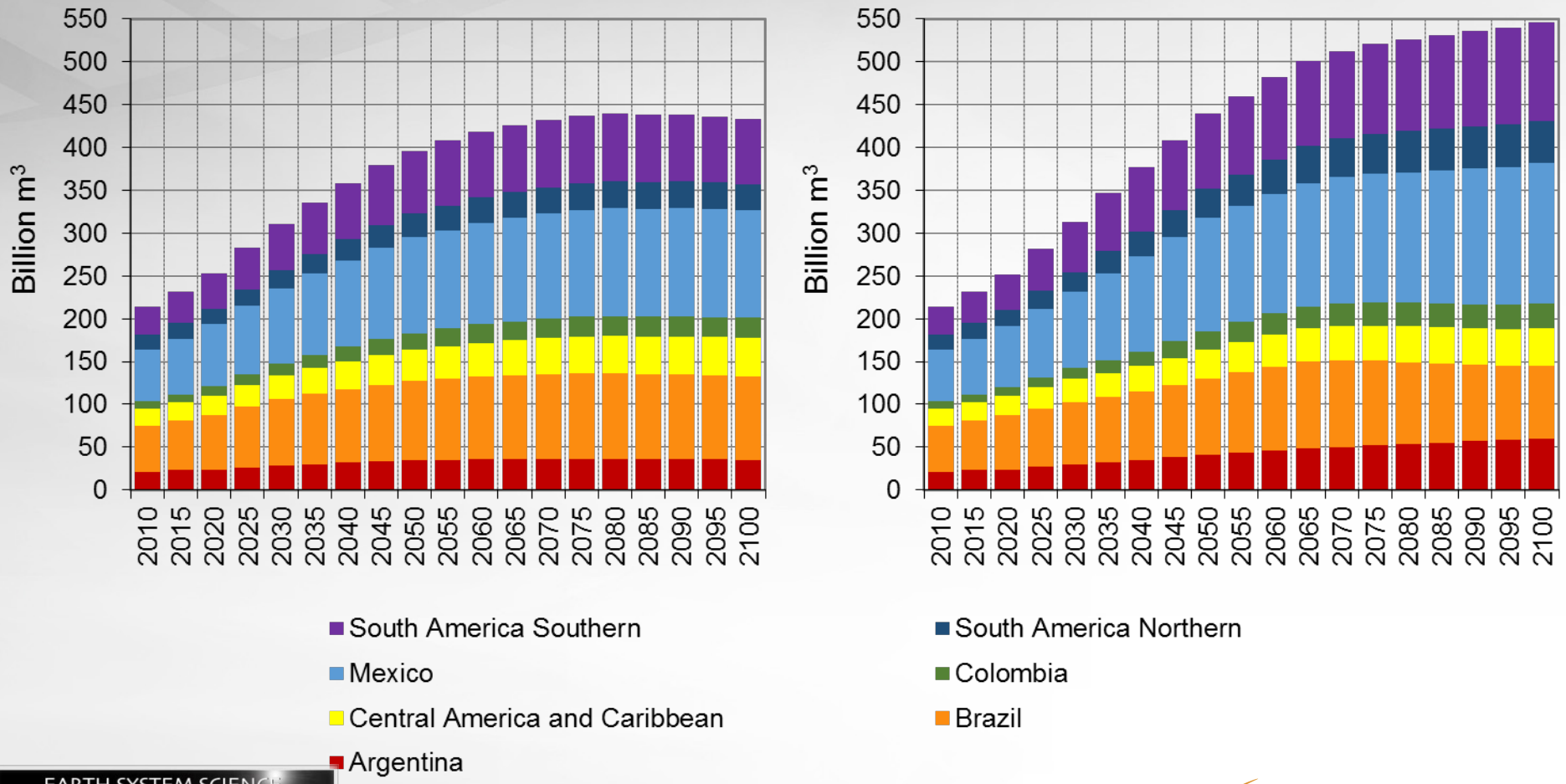
Total Water Demand

a. Reference (No Policy) Scenario

b. Policy (NDC) Scenario



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Total Water Demand

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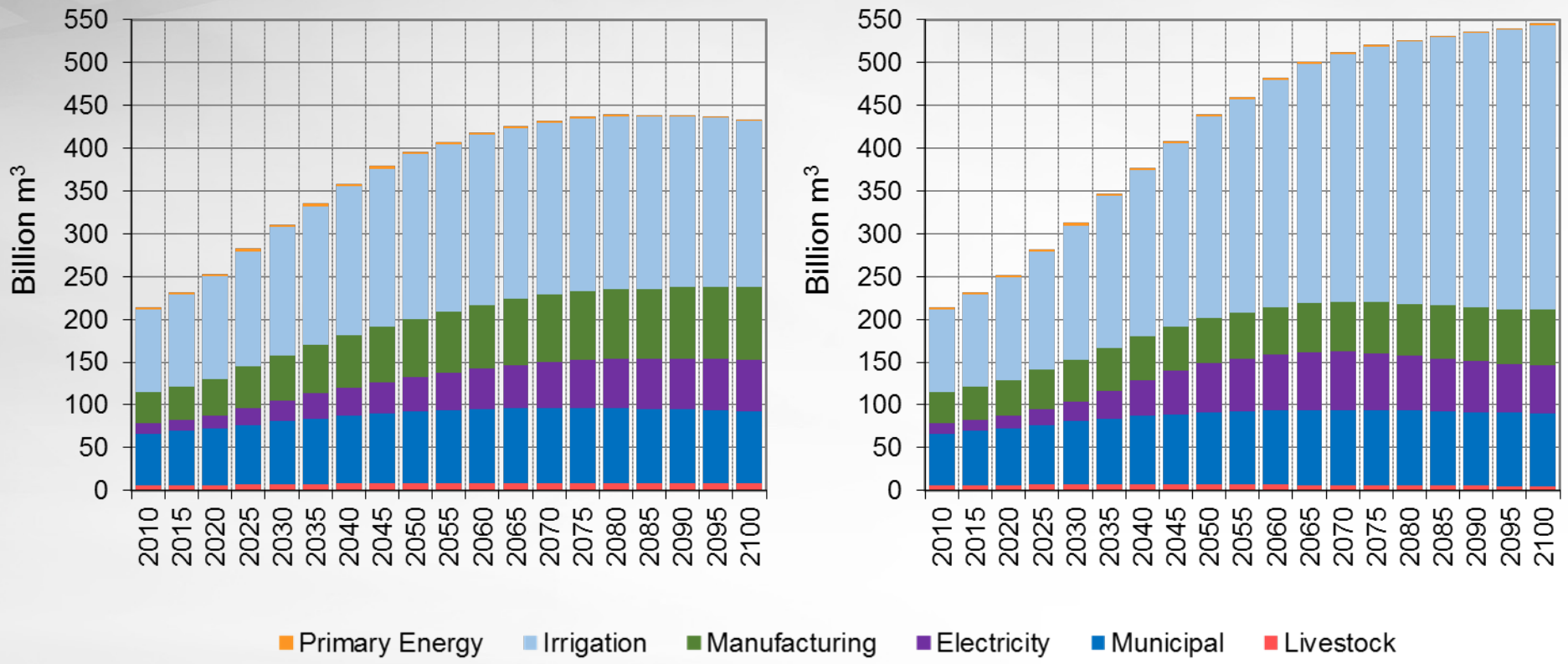
b. Policy (NDC) Scenario



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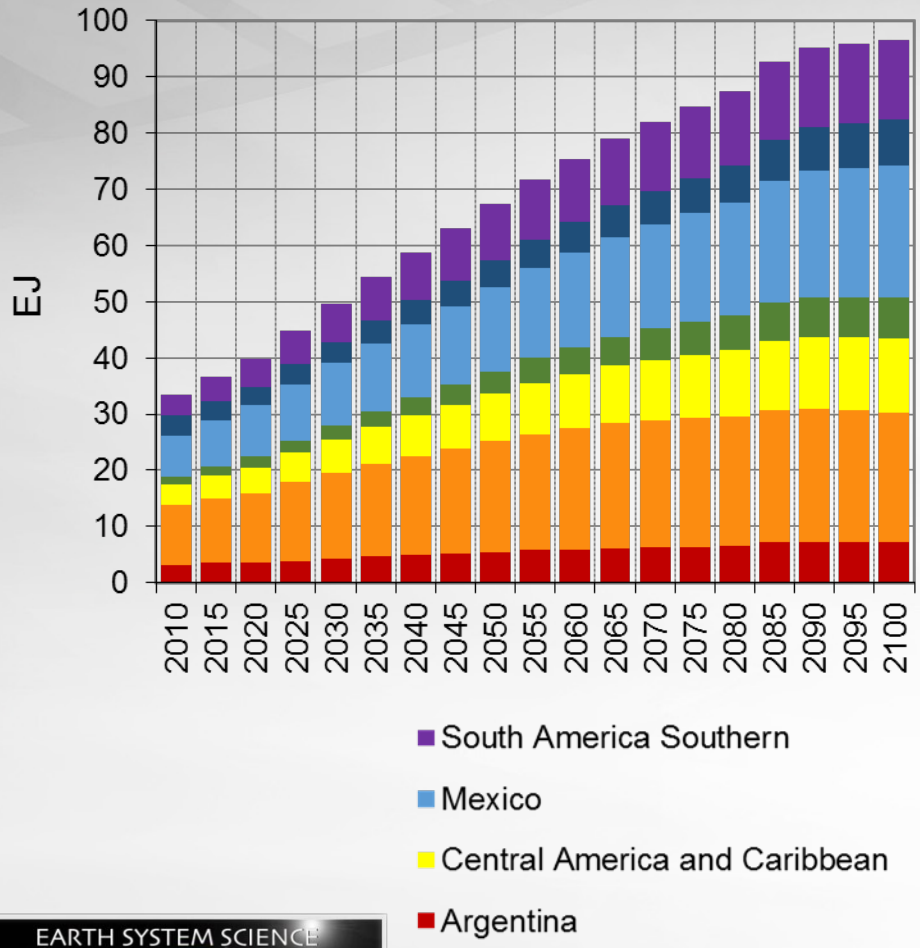
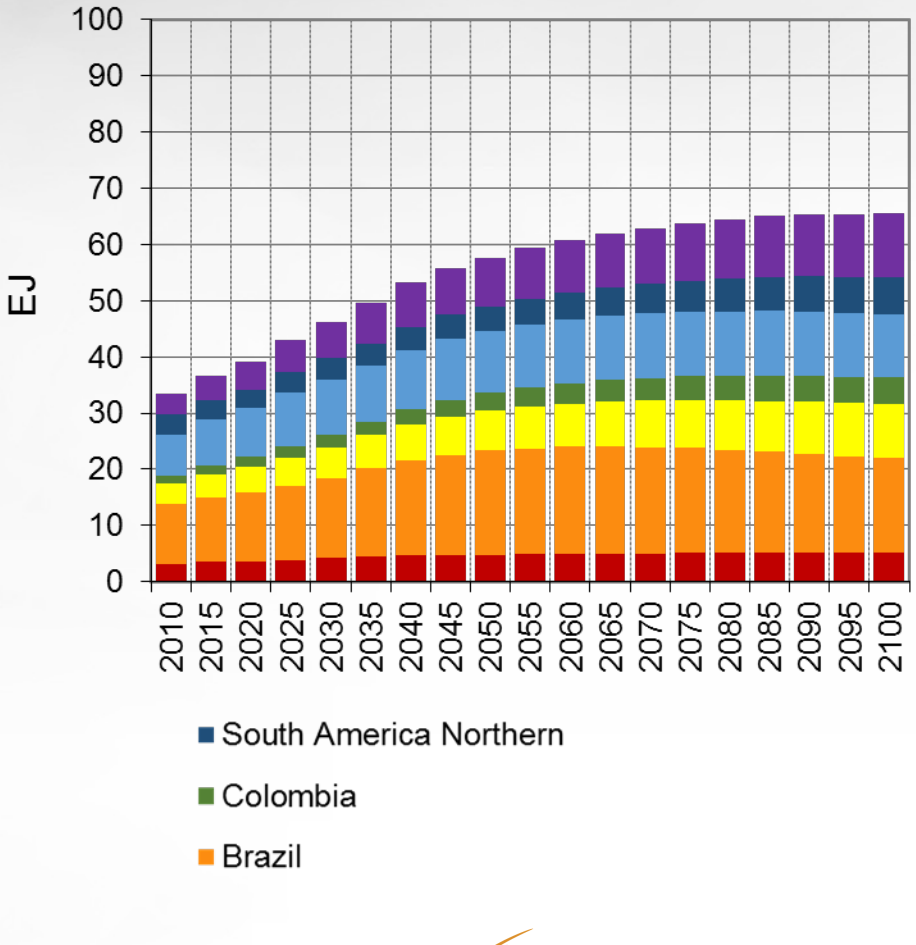
Primary Energy

a. Reference (No Policy) Scenario



b. Policy (NDC) Scenario



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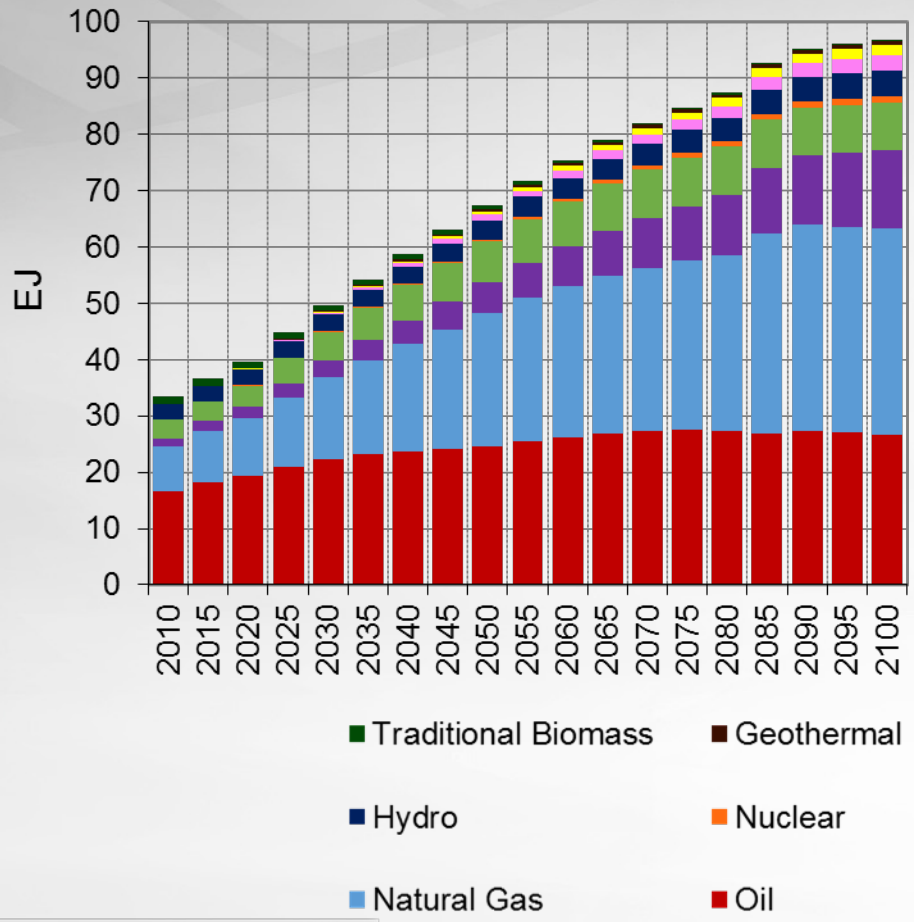
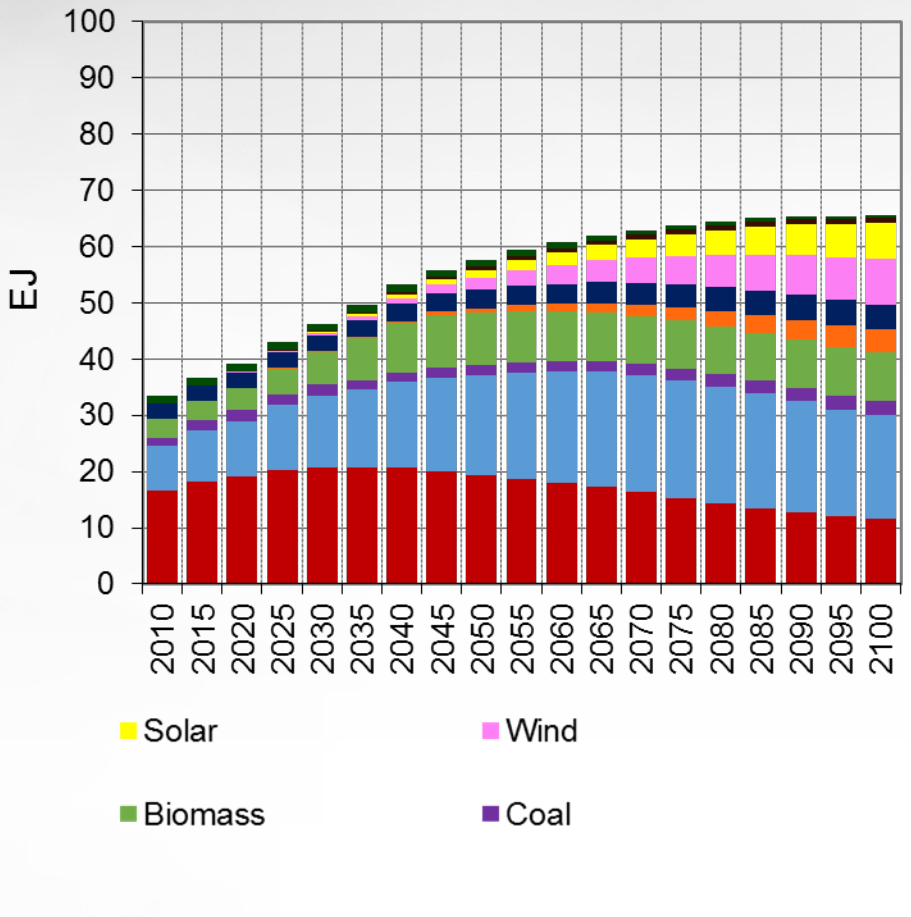


b. Policy (NDC) Scenario



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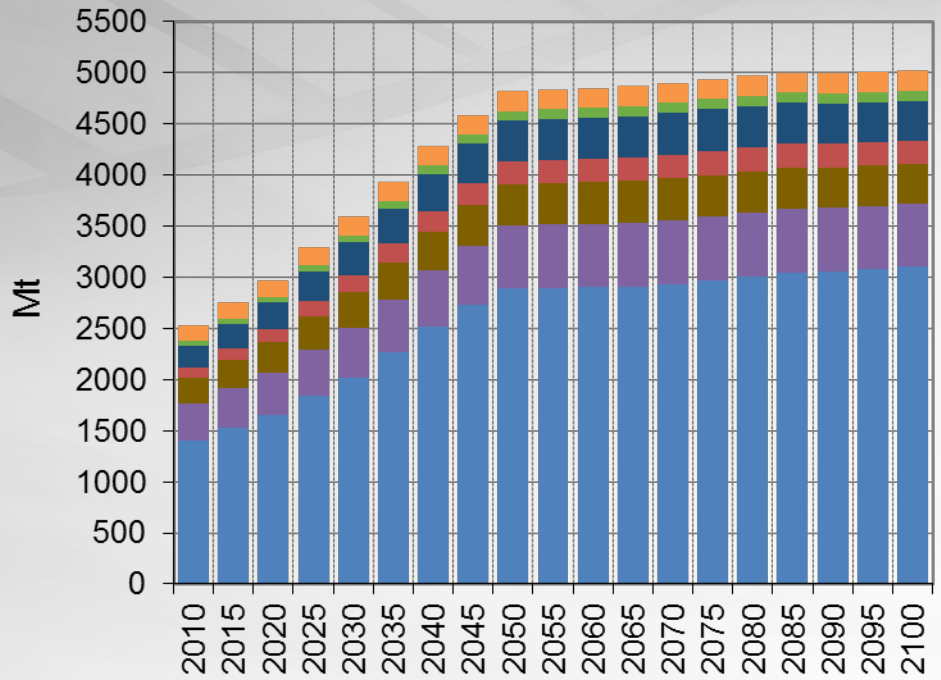
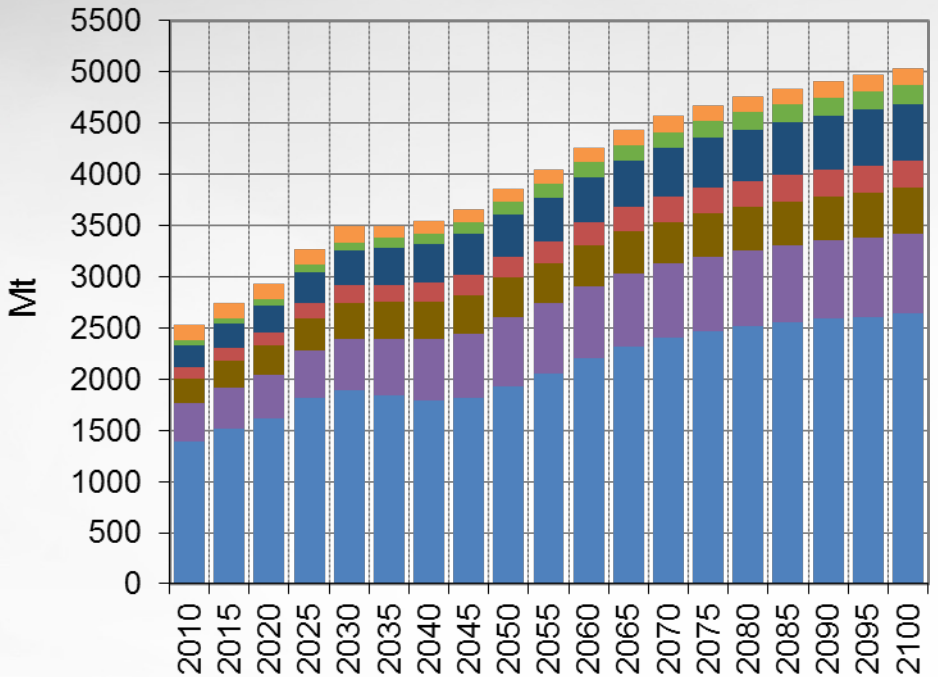
Food Production

a. Reference (No Policy) Scenario



b. Policy (NDC) Scenario



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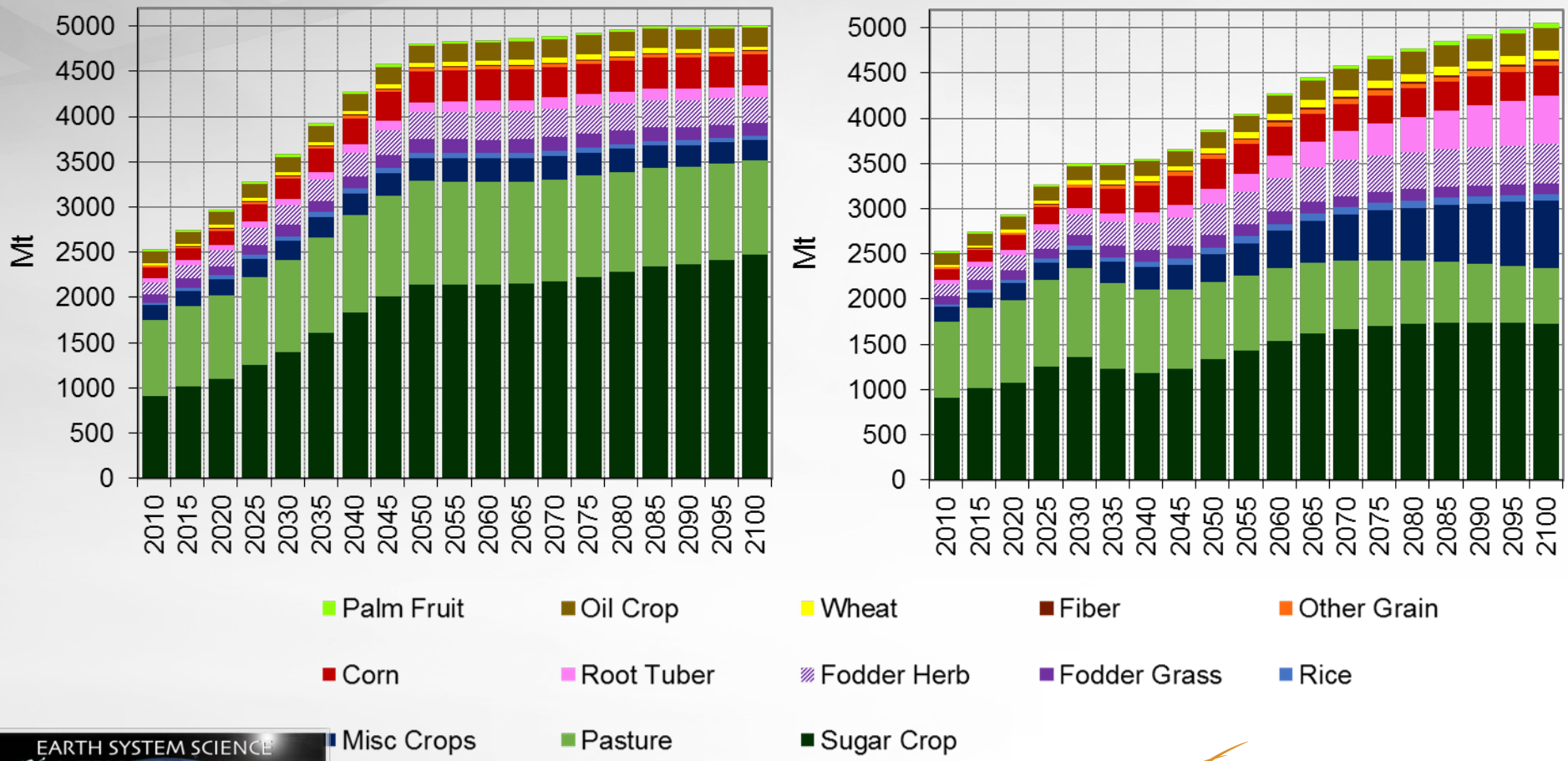
Agricultural Production

a. Reference (No Policy) Scenario

b. Policy Scenario



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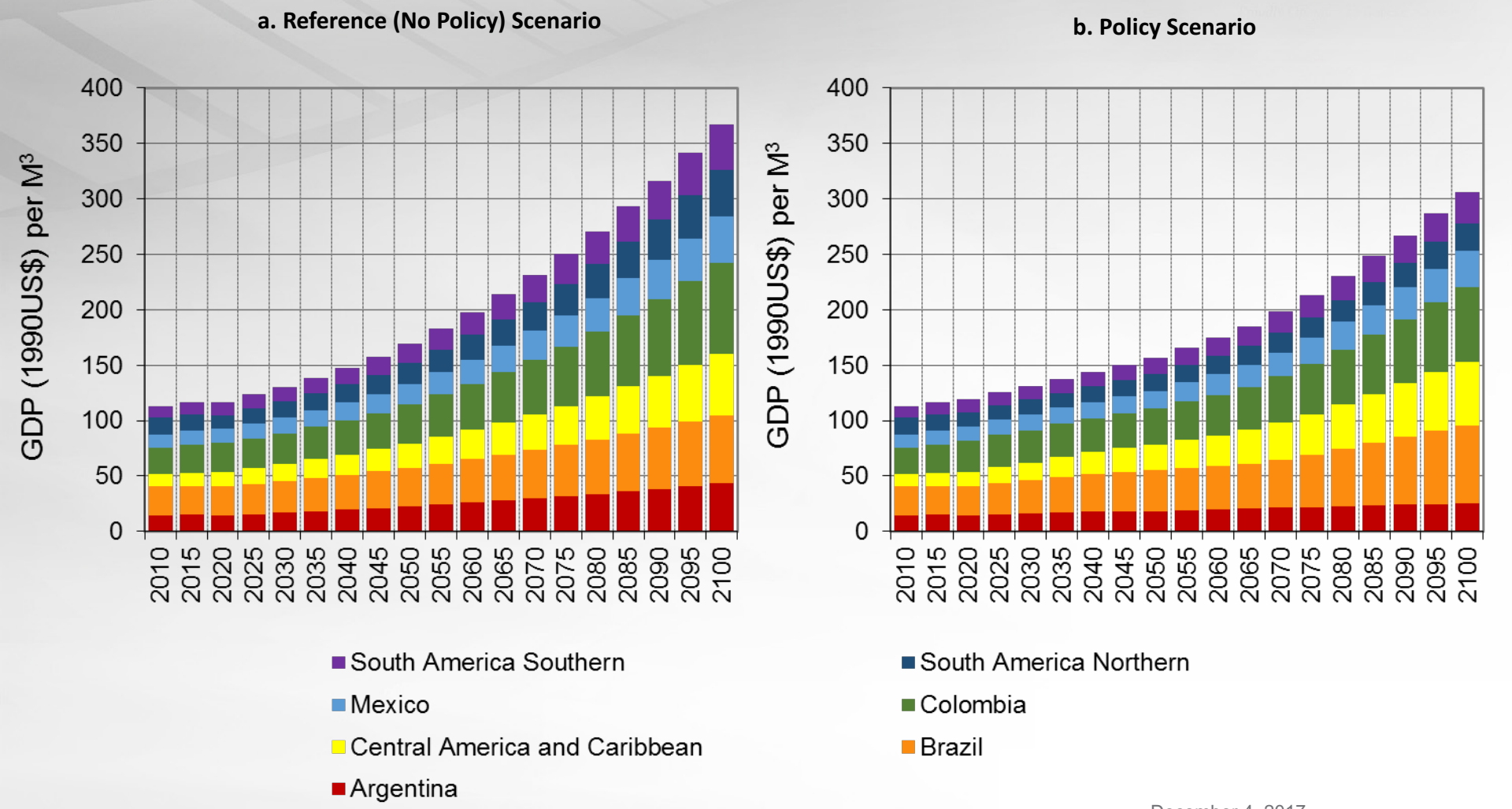
Water Intensity of the Economy



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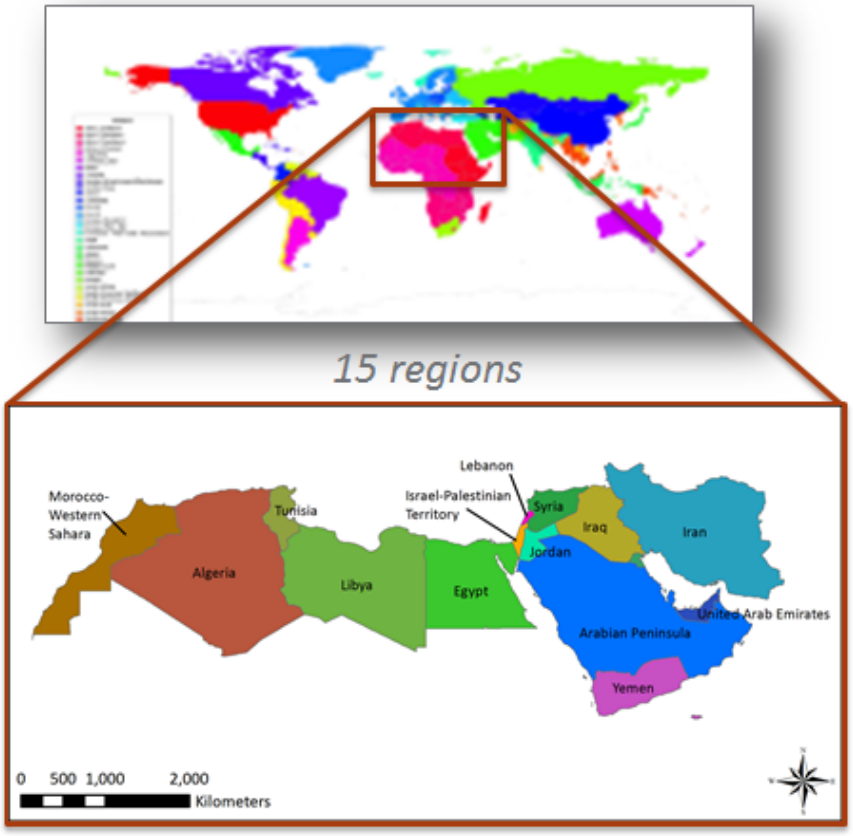
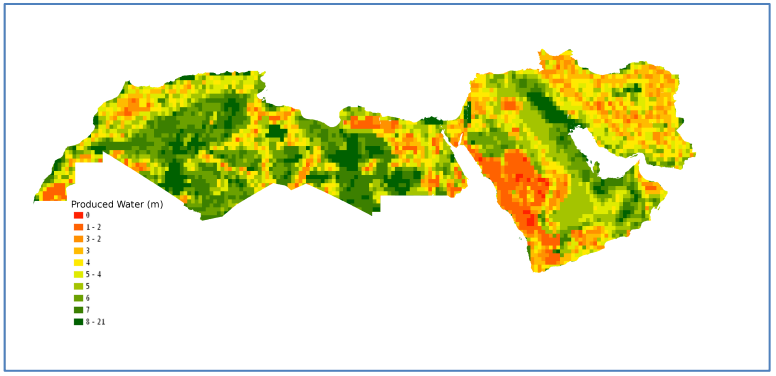
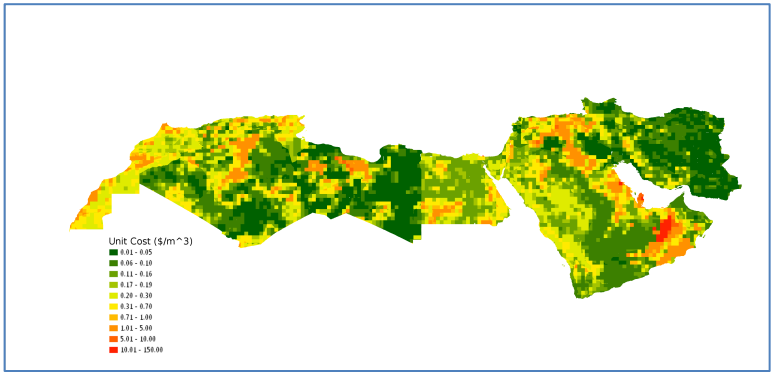
GCAM Application: The MENA Region



The GCAM-MENA model

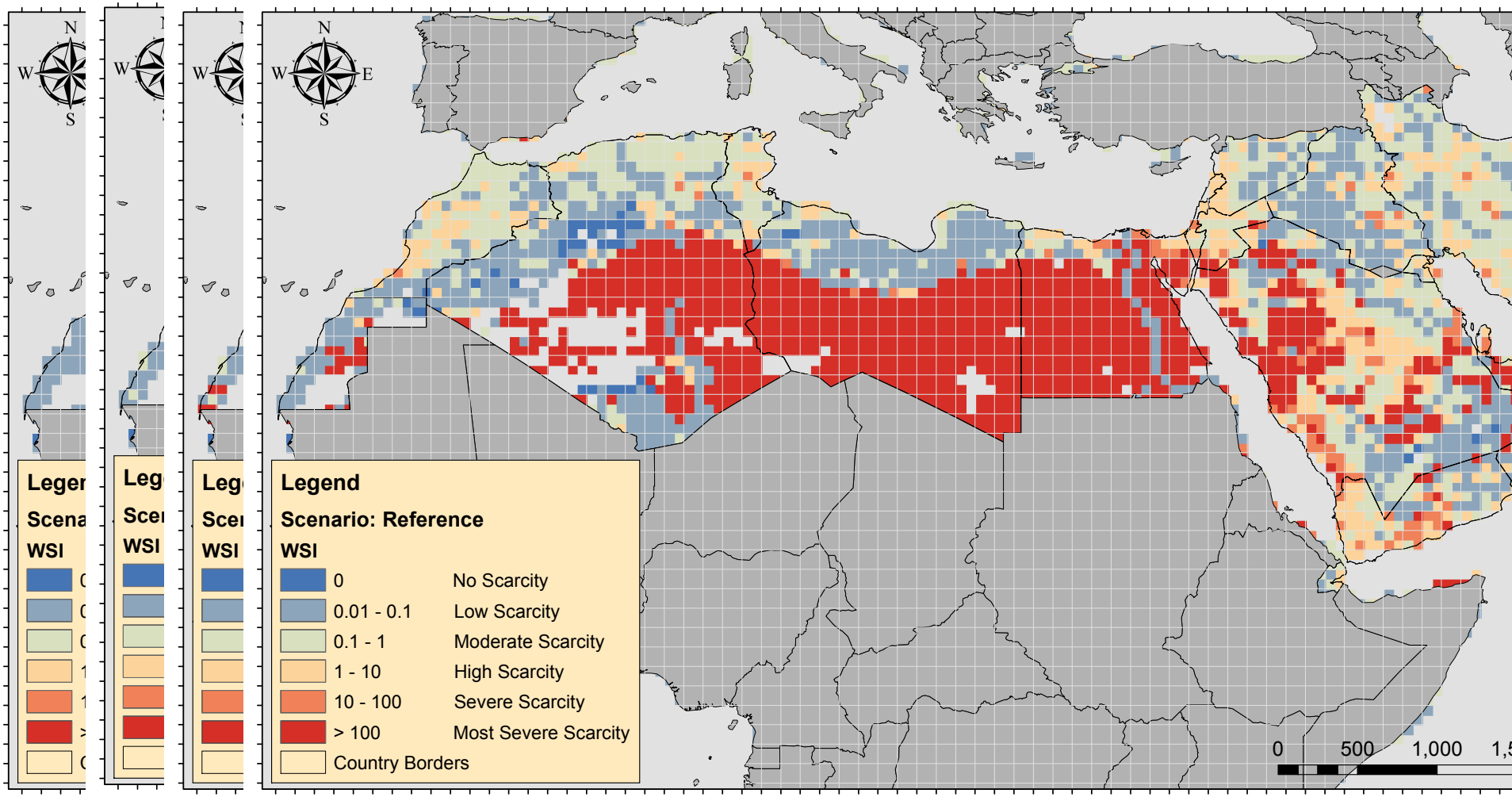




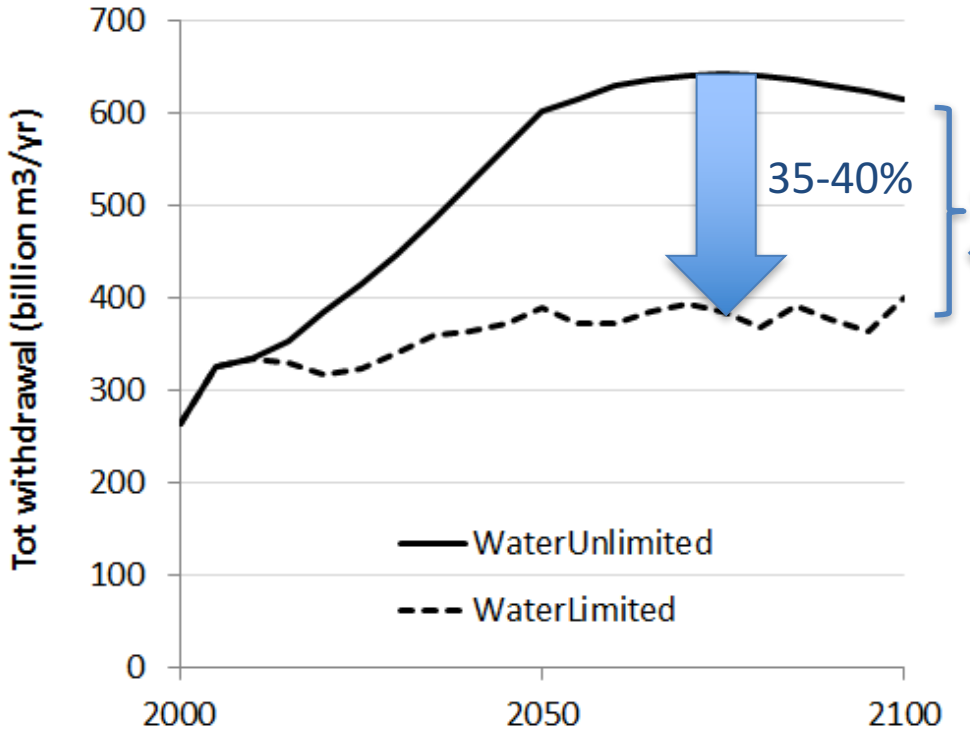
We constructed three groundwater resource curves for each of the 15 regions in MENA

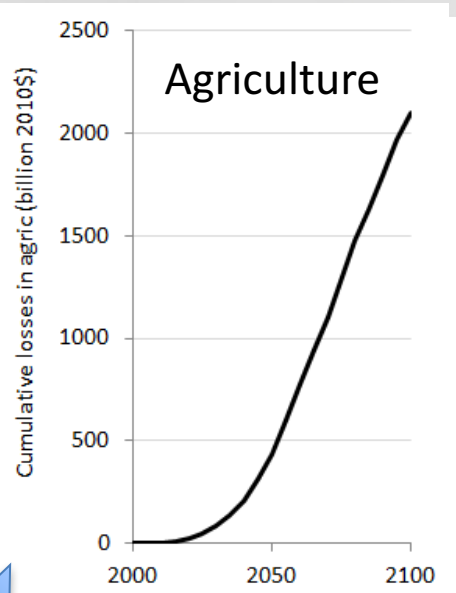
Water Scarcity Index (WSI) for the th th the Middle East and North Africa (MENA) R

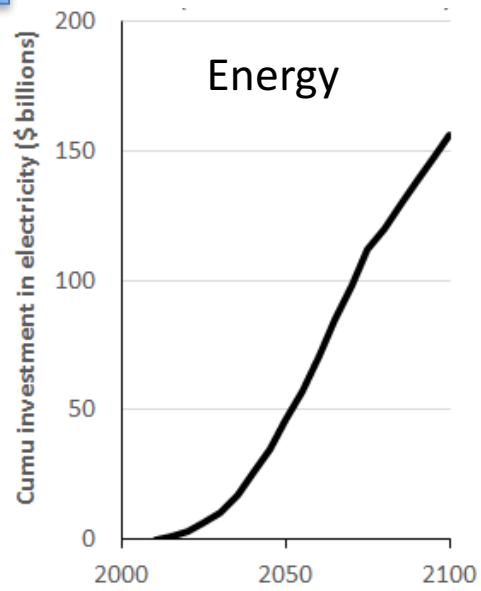
2100



Implications of water scarcity on needed investments







Cumulative investments (2015-2100) required to satisfy water demand through desalination ~ 70 x 10^9 USD

Some takeaways...

- IAM can facilitate ”Nexus Thinking” -> focus on **upstream integrated planning** toward investments. This is where larger gains can be achieved (?) It is a tough sell though, and the economics/financial case must be made.

- What are the “side effects”? Strong need to **build capacity** toward integrated planning, and identification of tradeoffs and synergies in water-energy-food systems.

- There is significant opportunity to influence decision-making at several levels if IAM as a tool/process is **packaged properly** and its value is clearly shown.