Water consumption and availability

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CEDREN – Centre for Environmental Design of Renewable Energy

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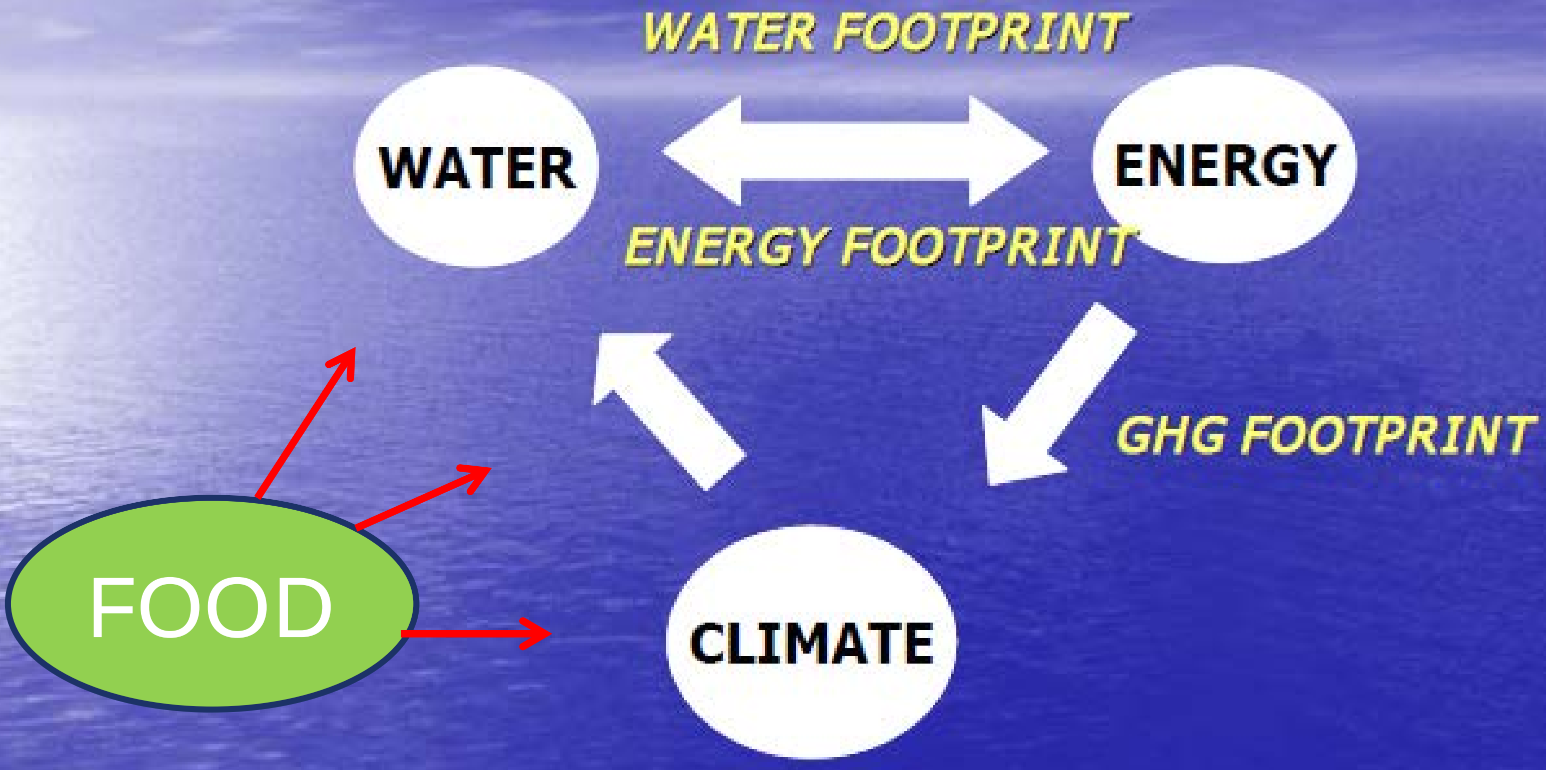
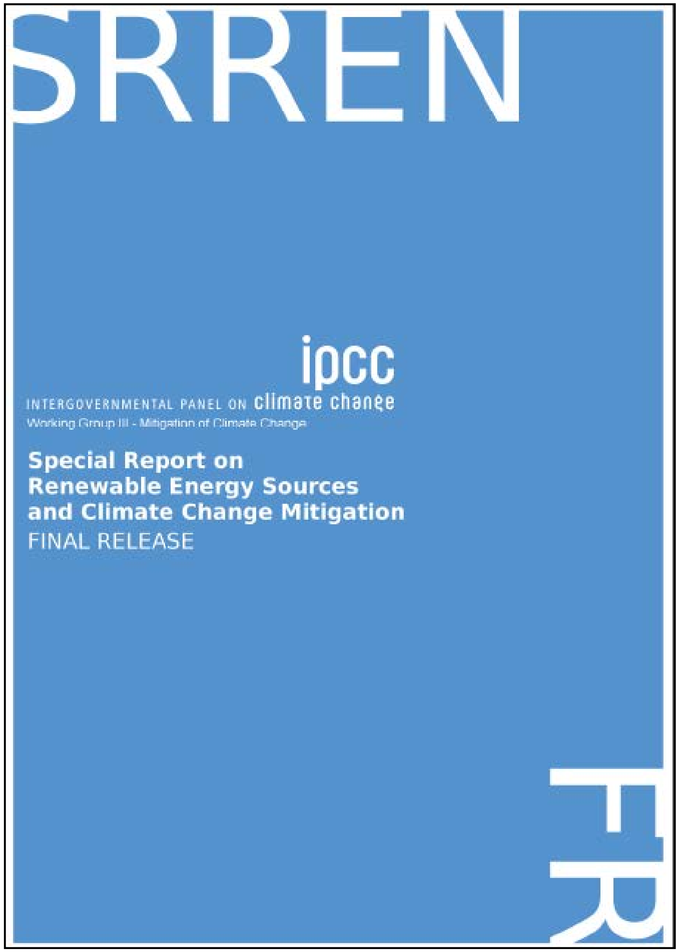
Water, energy, climate, food nexus



- an inter-related system!

IPCC (2011) raised water consumption in the energy sector

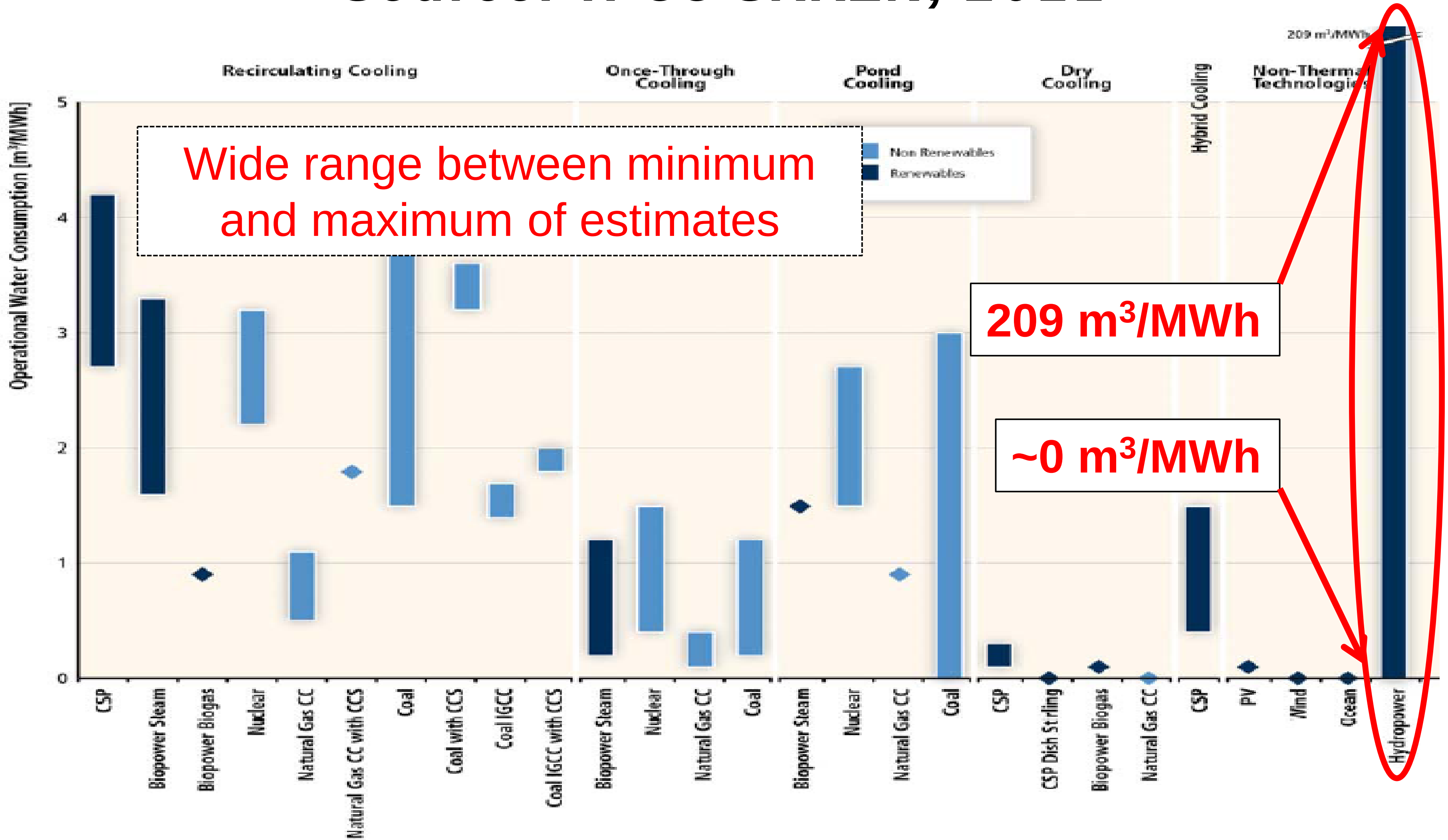


IPCC Special Report on Renewable Energy (2011):

- What is the potential for renewable sources to replace fossil-based fuels?

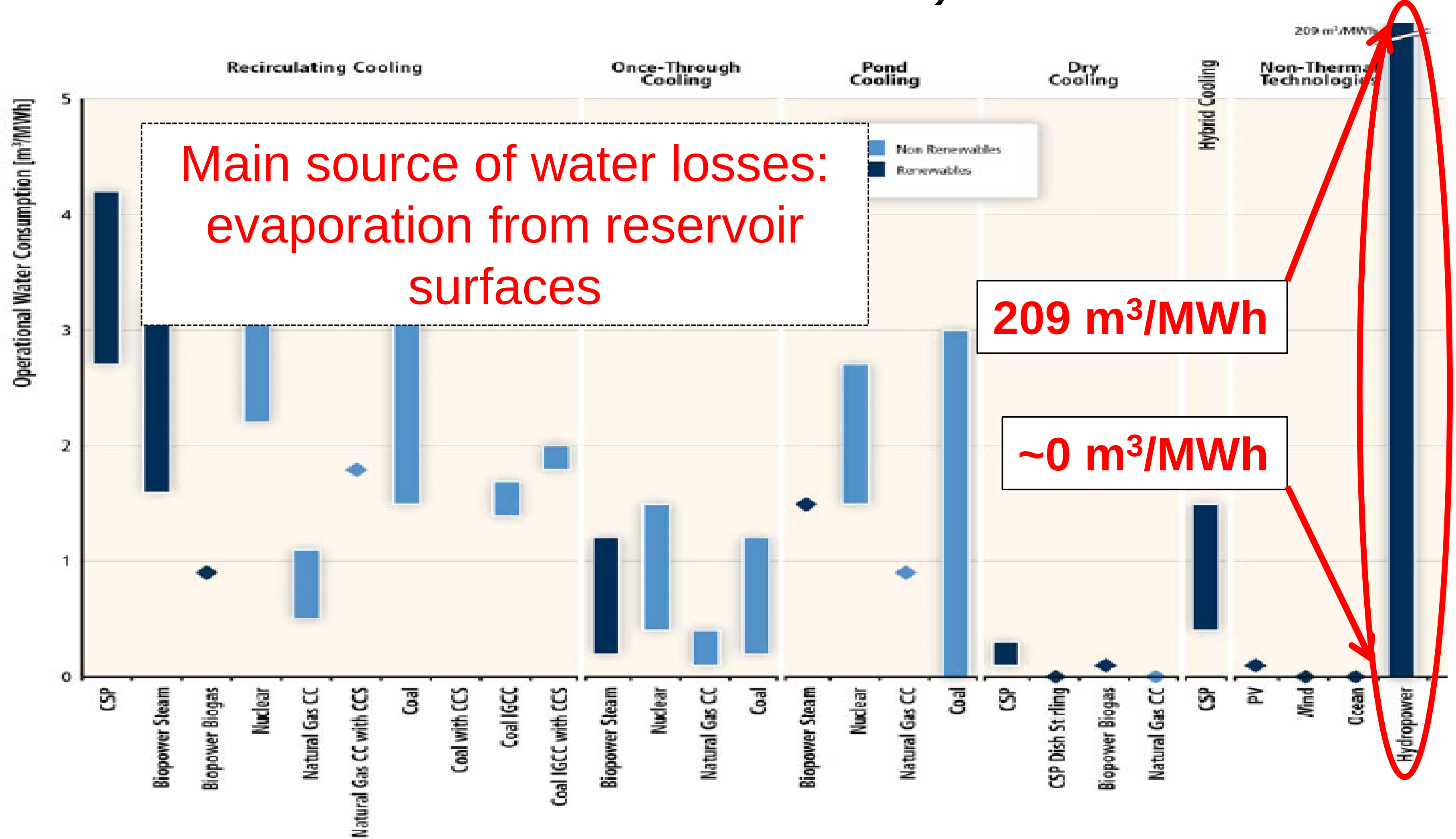
- The different technologies benchmarked with respect to various criteria, including ‘water needed to produced 1 MWh electricity (*water consumption*)’

Water consumption from electricity generation: *Source: IPCC SRREN, 2011*



N:	18	4	1	5	4	1	16	2	7	3	1	3	3	9	1	1	1	7	11	2	1	2	4	2	2	1	4
Sources:	11	3	1	5	4	1	8	1	2	1	1	3	3	4	1	1	1	2	4	2	1	2	2	2	2	1	2

Water consumption from electricity generation: *Source: IPCC SRREN, 2011*



	CSP	Biopower Steam	Biopower Biogas	Nuclear	Natural Gas CC	Natural Gas CC with CCS	Coal	Coal with CCS	Coal IGCC	Coal IGCC with CCS	Biopower Steam	Nuclear	Natural Gas CC	Coal	Biopower Steam	Nuclear	Natural Gas CC	Coal	CSP	CSP Dish Stirling	Biopower Biogas	Natural Gas CC	CSP	PV	Wind	Ocean	Hydropower
N:	18	4	1	5	4	1	16	2	7	3	1	3	3	9	1	1	1	7	11	2	1	2	4	2	2	1	4
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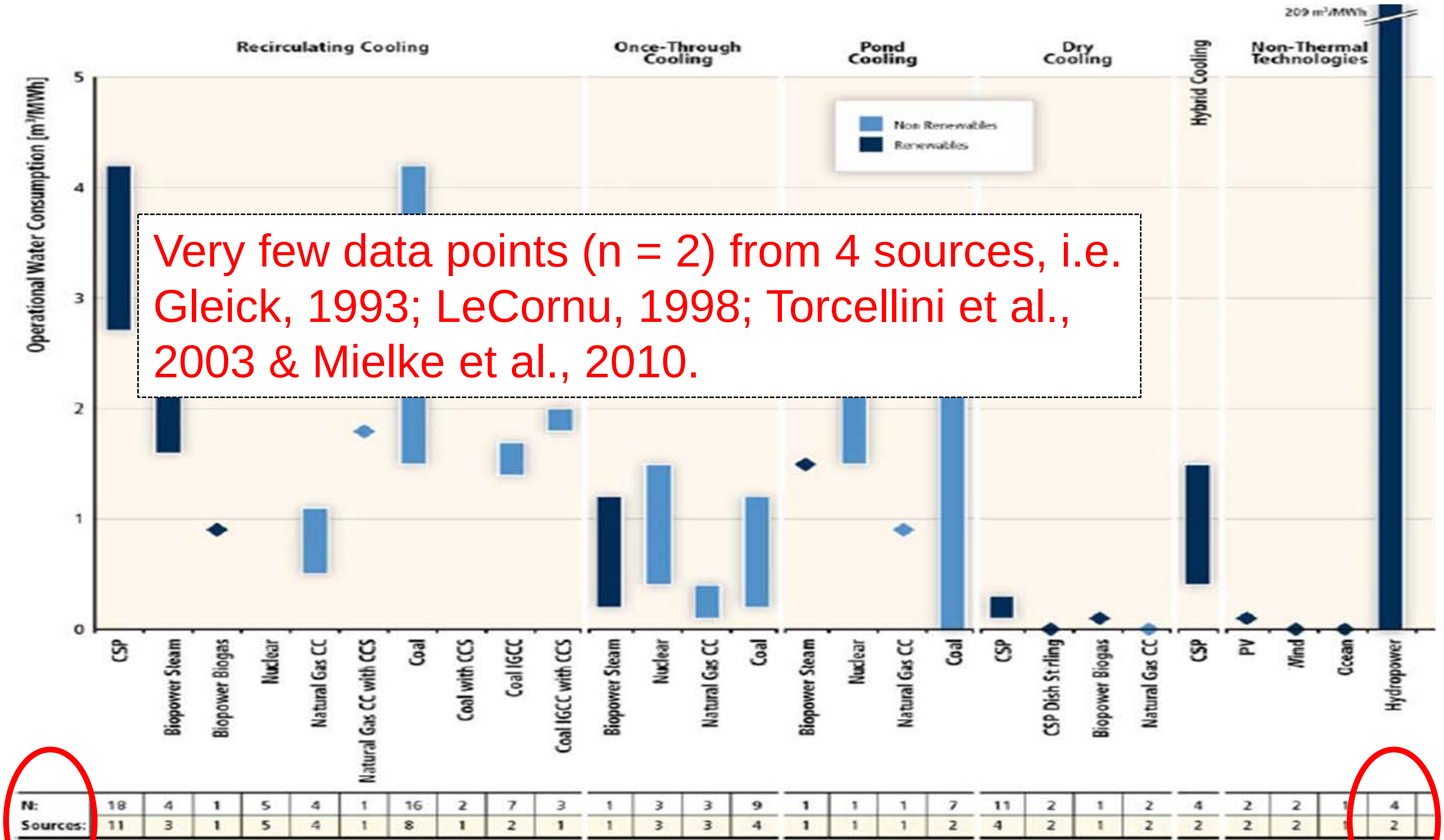


IPCC SRREN (2011) states

- *Upper values for hydropower result from few studies measuring <u>gross evaporation</u> values, and <u>may not be representative.</u>*
- *<u>Allocation schemes</u> for determining water consumption from various reservoir uses in the case of multipurpose reservoirs can significantly influence reported water consumption values.*

The concern in the hydropower sector

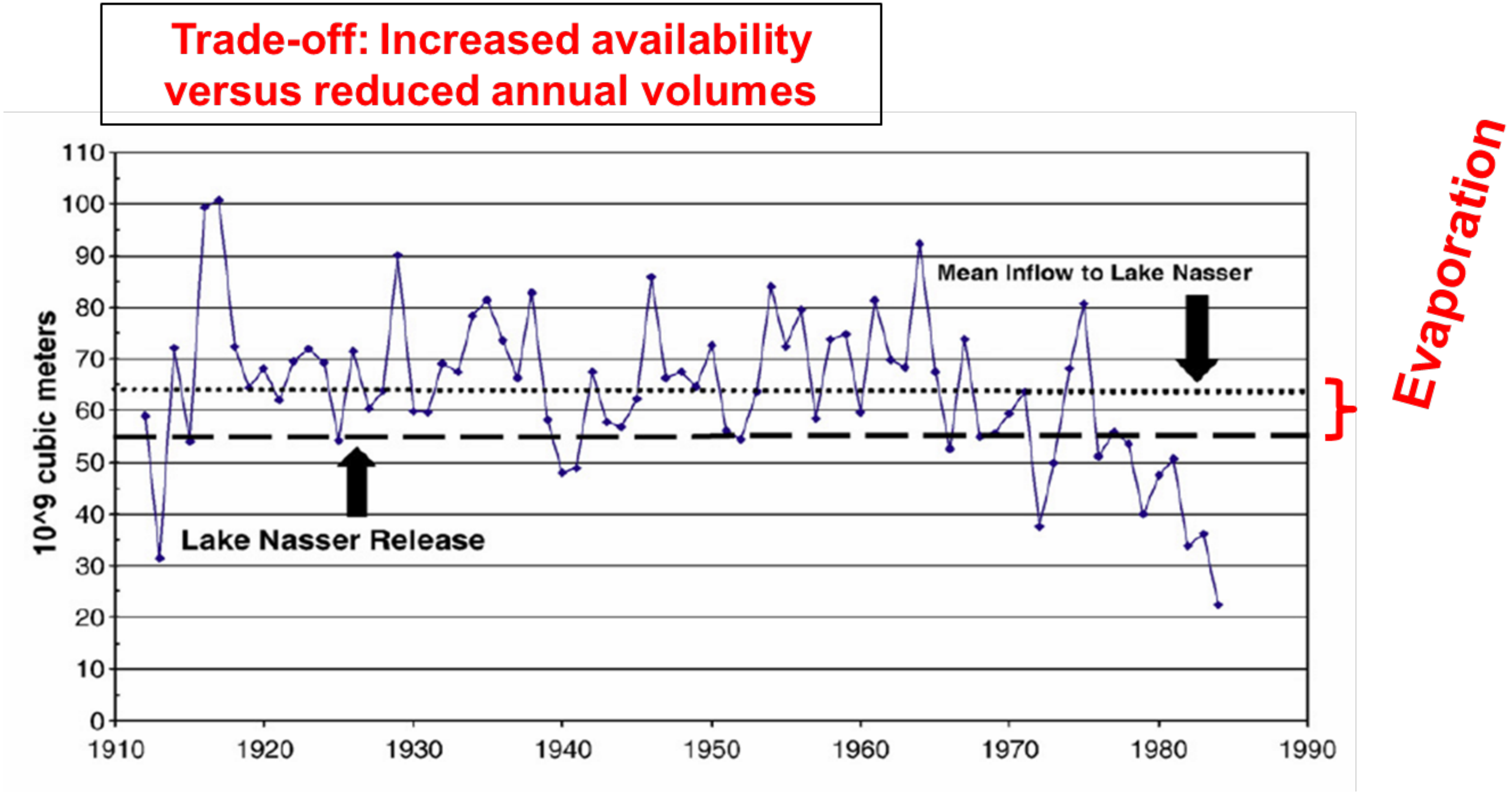
- A fear that the high numbers can be taken as ‘typical water footprint of hydropower’
- Potentially a large reputational and business risk
- Might disqualify hydropower based on an unfair methodological basis
- The water footprint methodology seems to gain an increasing foothold
- Does not take into account the increased water availability introduced by reservoirs

ISO Water Footprint 14046

On-going scientific debate

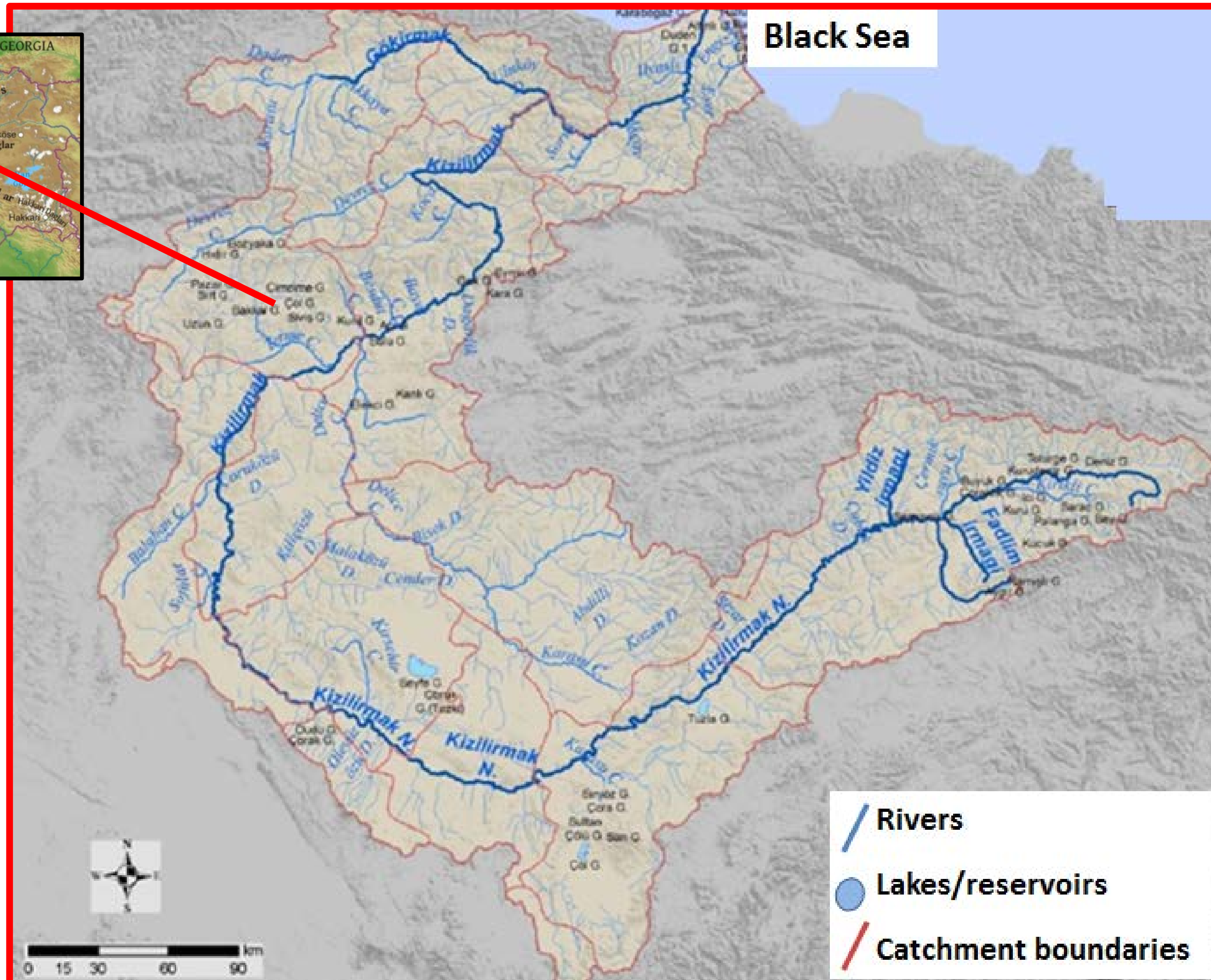
- “The methodology is immature”
- “Hydropower is a large water consumer”
- “High water consumption in water stressed regions, but reservoirs needed”
- “Reservoirs needed to mitigate climate change”
- “Water security”

The trade-offs – Case Egypt



The role of reservoirs:

Case study Kizilirmak River Basin, Turkey



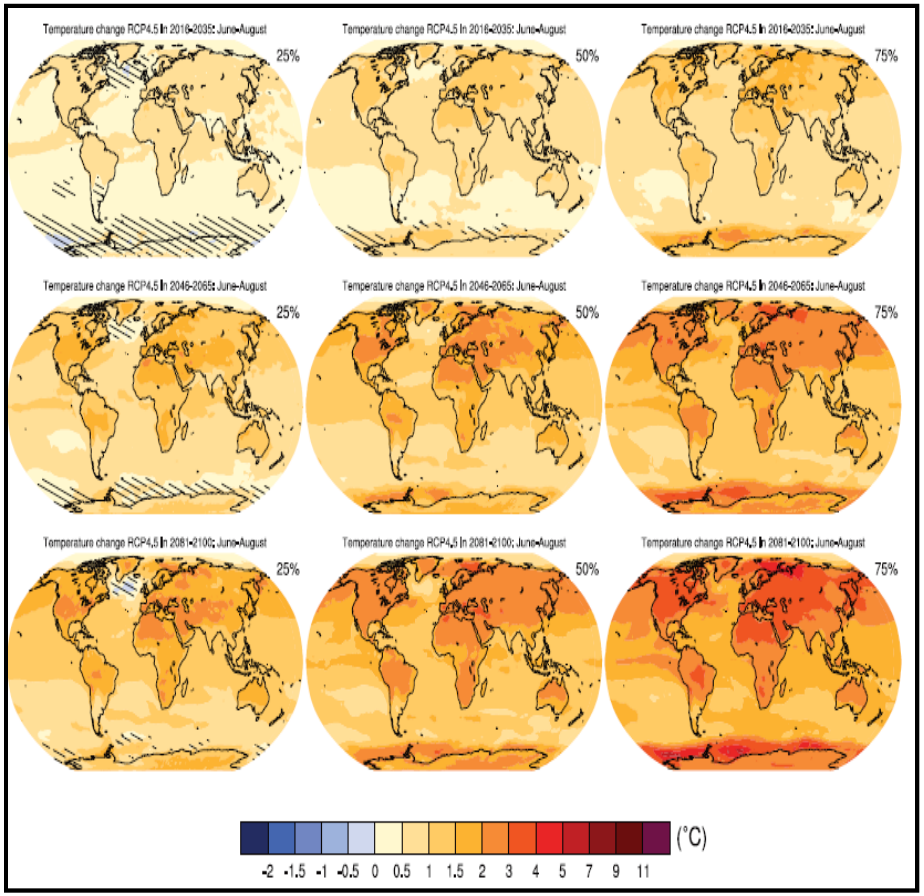
Concerns

How much water will be available for use (HP production) in the future?

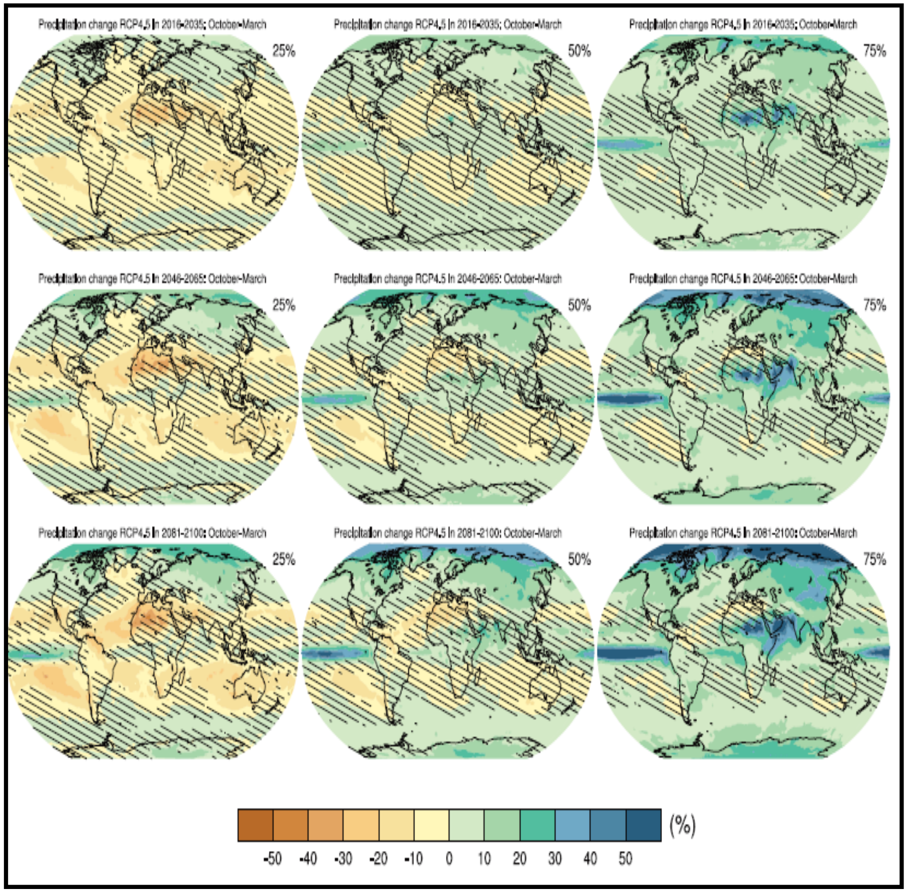
1. Climate change
2. Land use changes/irrigation practice
3. Effects of reservoirs on downstream use

Climate change

Temperature

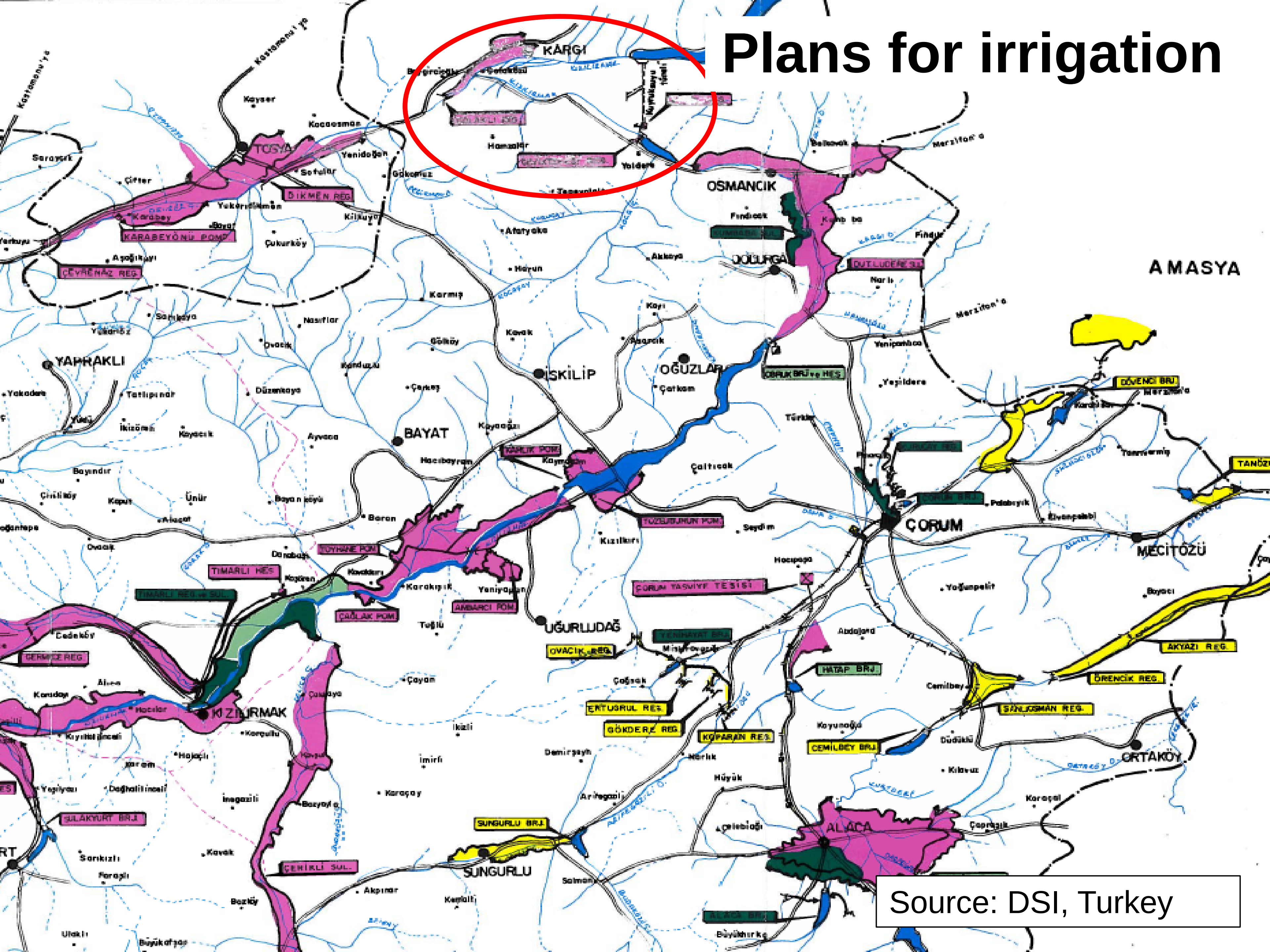


Precipitation



Source: IPCC, 2013: Annex I

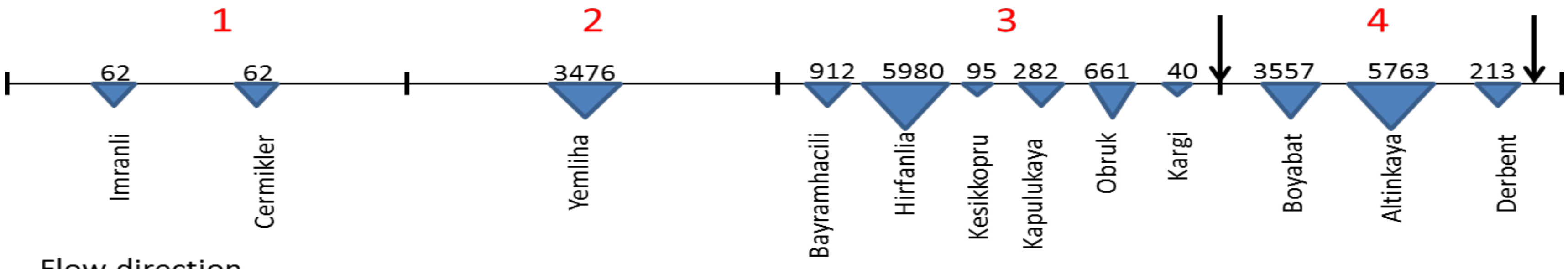
Plans for irrigation



Source: DSI, Turkey

WEAP Model setup:

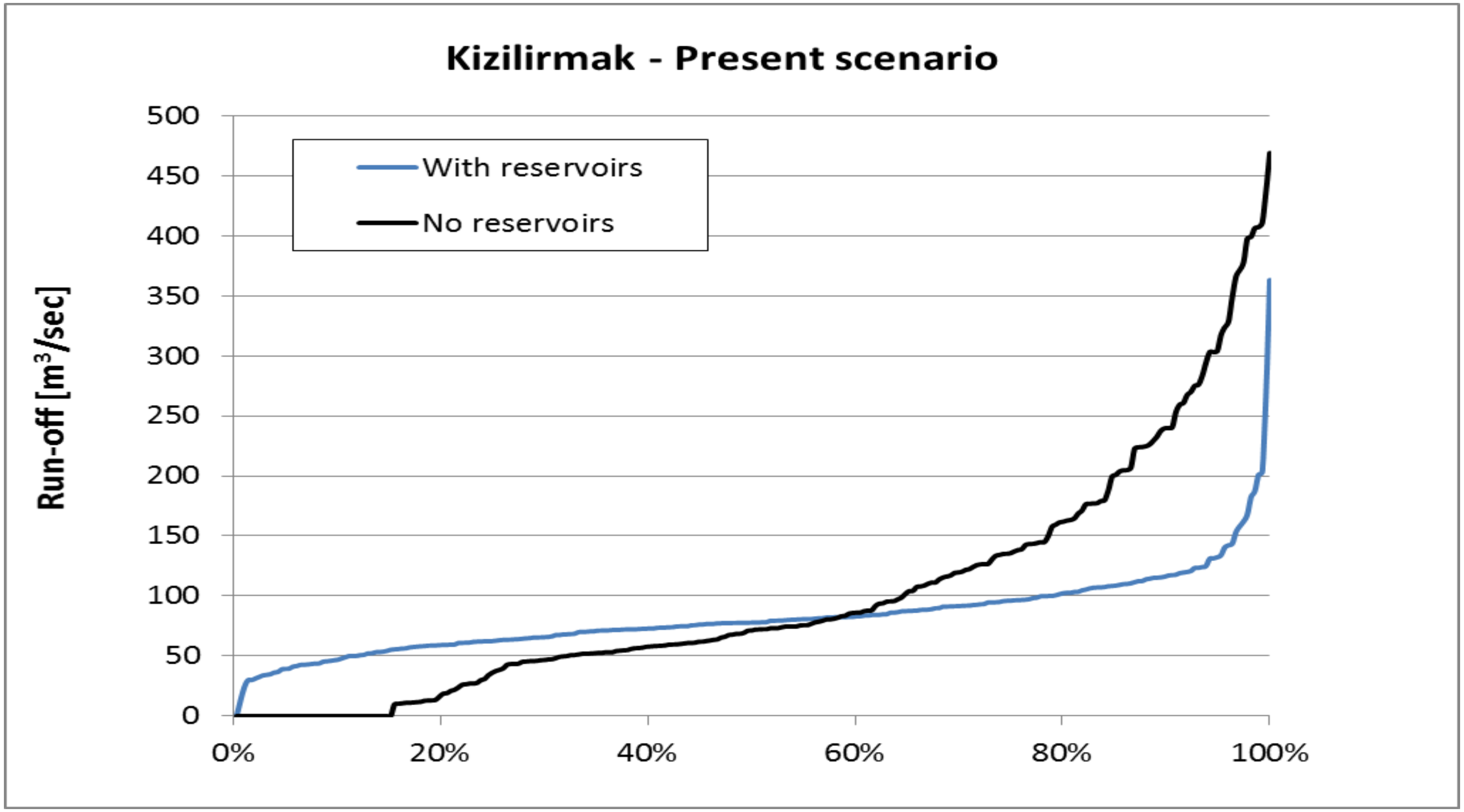
The river basin schematically presented



- Red numbers on top: sub-basin numbering
- Black numbers: volume of reservoirs in mill. m3

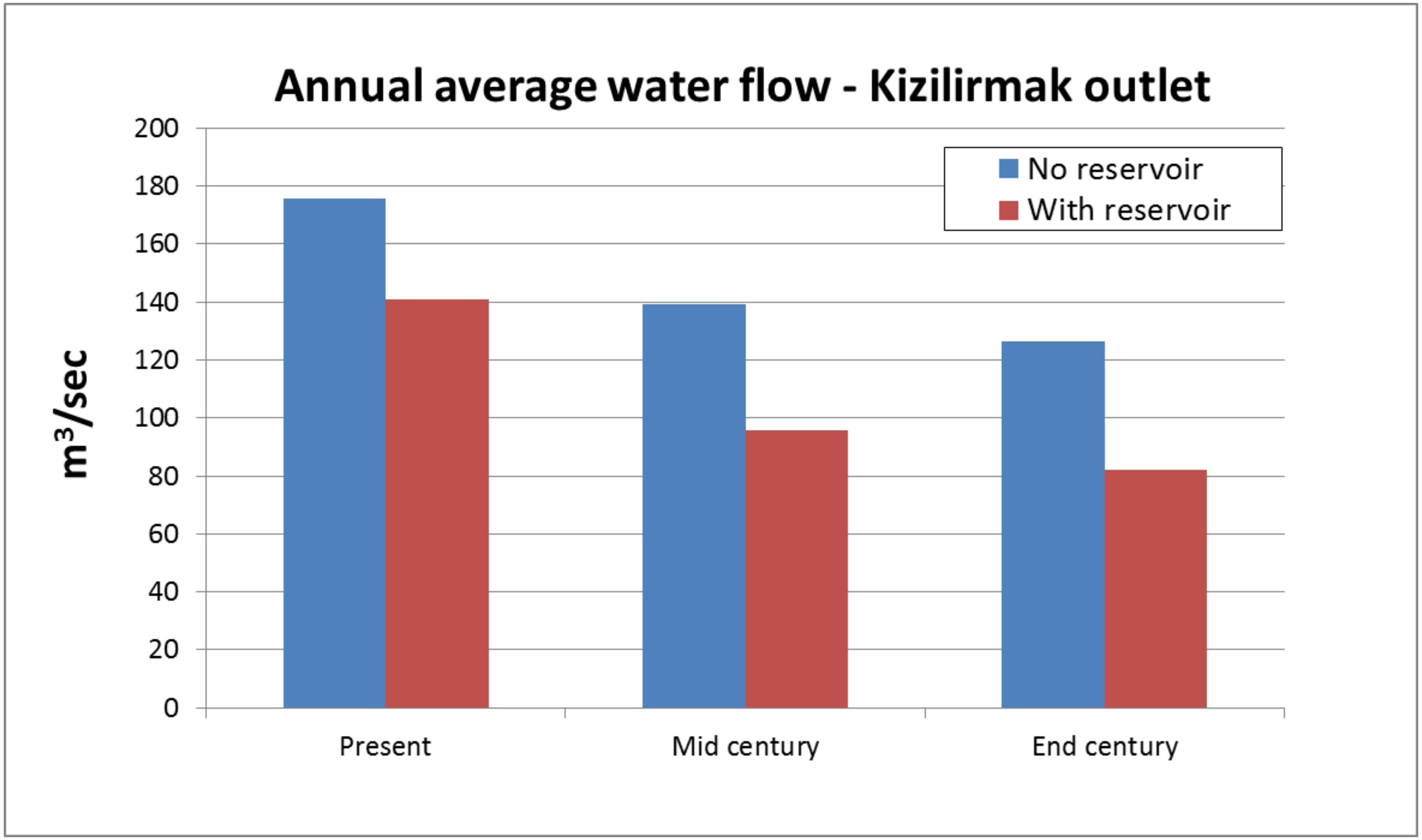
Typical effect of reservoirs:

- Increased low flow
- Reduced floods

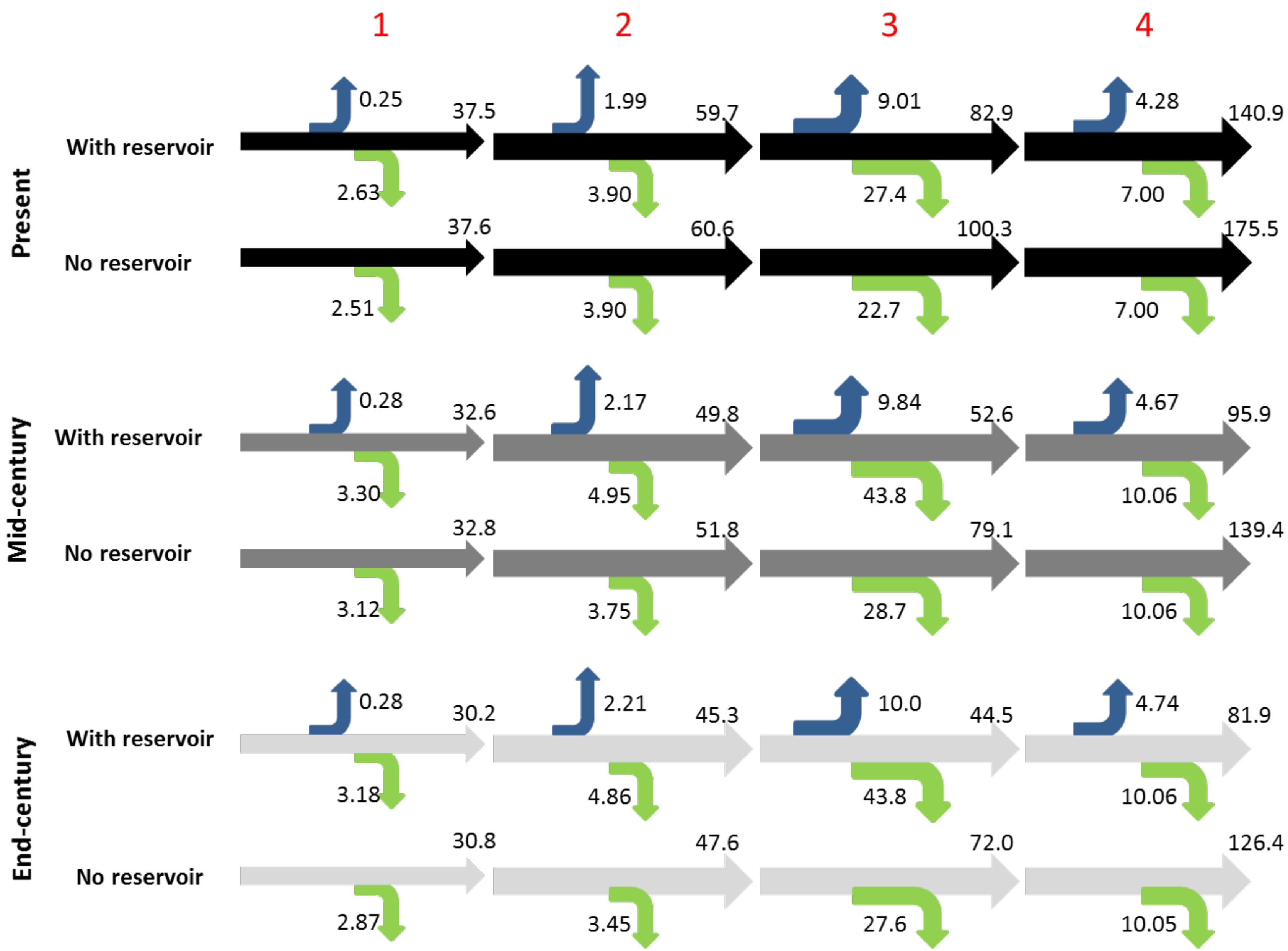


Present conditions (climate and irrigation)

Effect of climate change, irrigation and reservoirs



The water consumption, Kizilirmak



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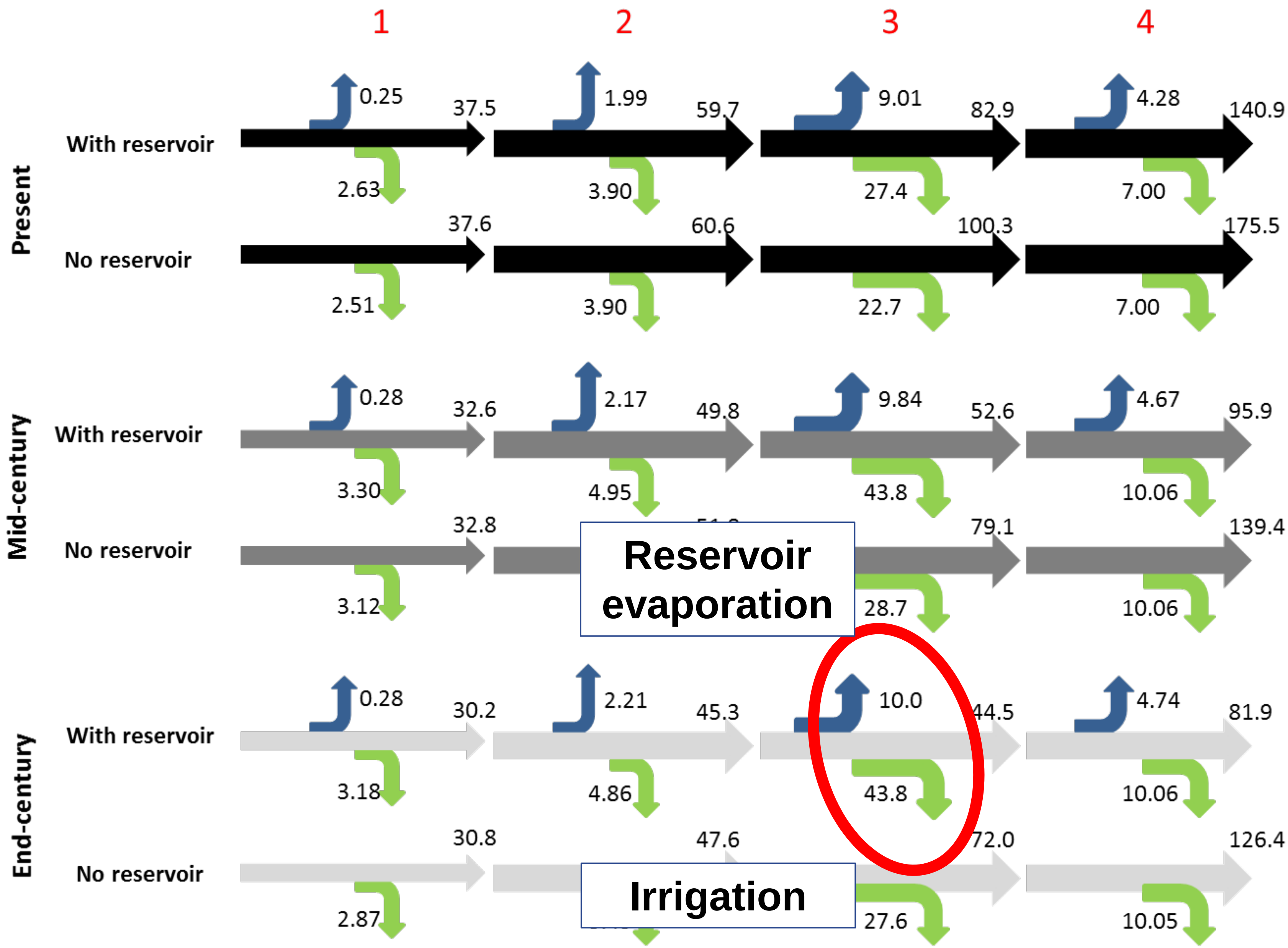

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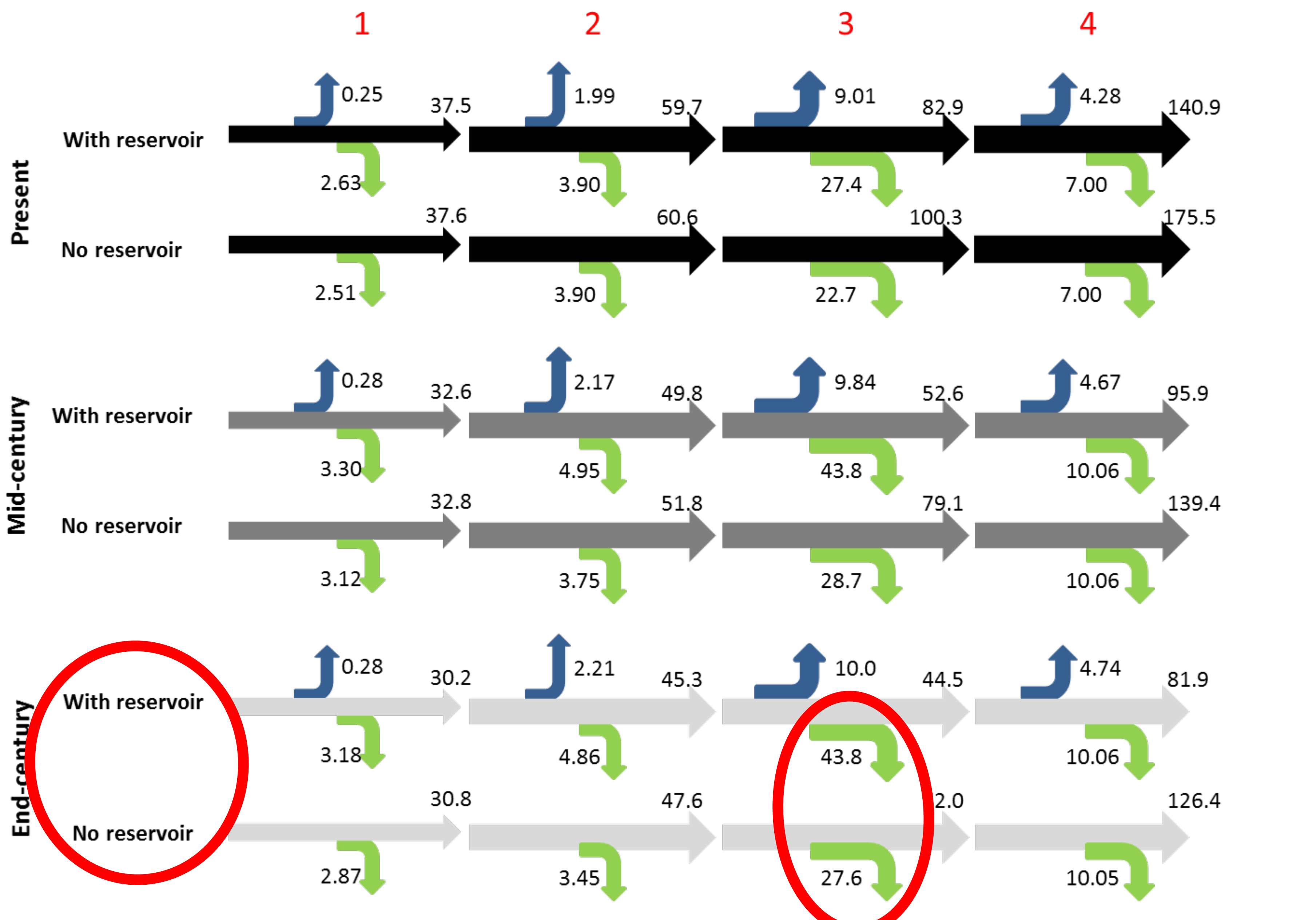

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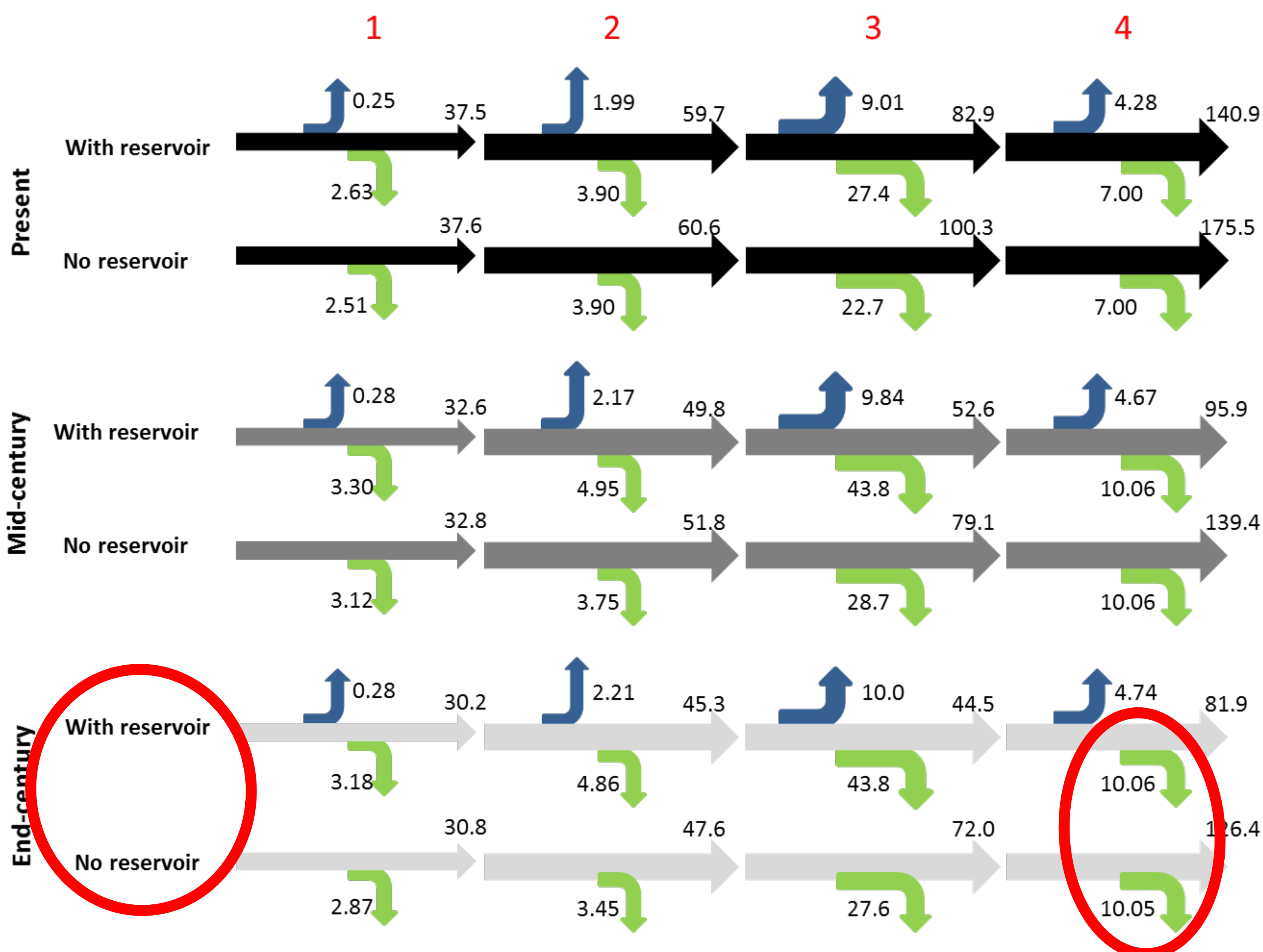


Risks of future hydropower developments

Large uncertainties

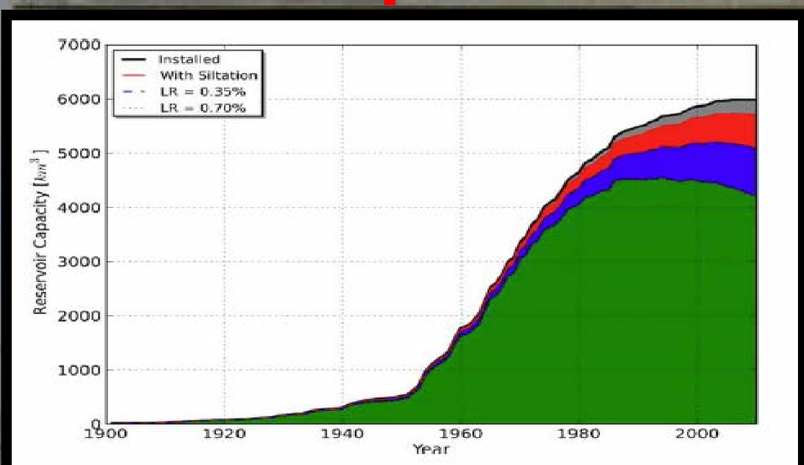
Climate change:

- Lower precipitation?
- Higher evaporation?
- More intense short-term events?

Changes in use of water:

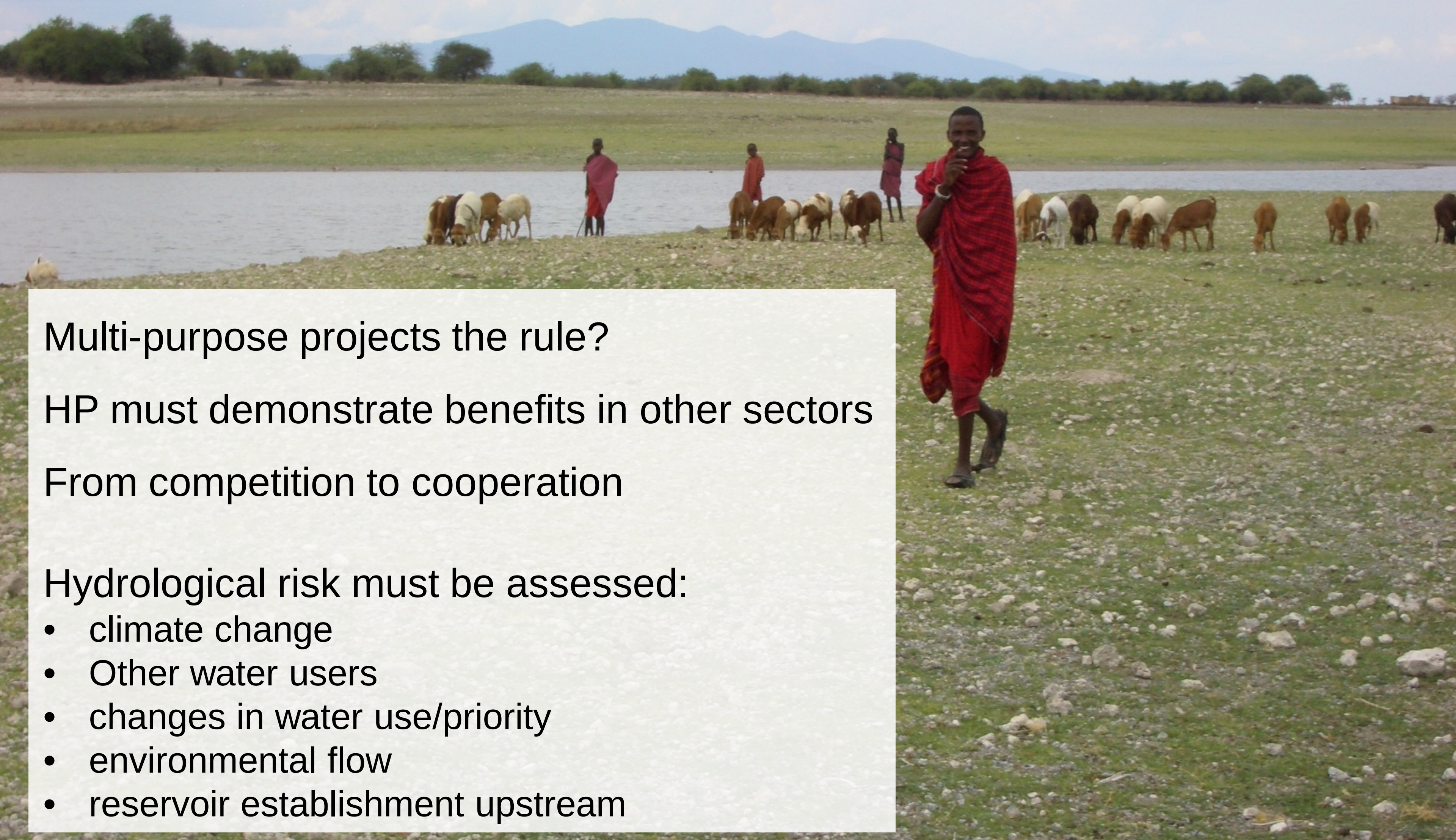
- Growing population
- More food needed/irrigation
- Environmental requirements
- Multi-purpose reservoirs

Change in storage capacity



Source: Wisser et al., 2013

Reflections on future hydropower development & planning



Multi-purpose projects the rule?

HP must demonstrate benefits in other sectors

From competition to cooperation

Hydrological risk must be assessed:

- climate change
- Other water users
- changes in water use/priority
- environmental flow
- reservoir establishment upstream

Planning the water resources:

A challenge with many and big uncertainties

Robust Methodologies & Tools needed

Owens Lake, California