Insights from the nexus assessments of the Drin and Drina River Basins

26th July 2022

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Water-energy modelling in Drin and Drina countries – Scope

Drin Driving question (basin):

"What are the costs and benefits of <u>shifting to a "flood-smart", cooperative hydropower operation regime</u> along and between the two hydropower cascades in the Drin basin?"

Drina Driving question (countries, region):
"How to <u>increase the share of RE</u> in the Drina riparians in a way that <u>optimizes the resources available (including financial),</u> minimizes the negative impact on the environment (including transboundary), and maximises the multi-sectoral benefits of projects?" (responding to the countries' vision of achieving climate neutrality by 2050 - *Sofia Declaration*)

Water-energy models


Map of Large Hydropower Plants (HPPs) in the Drin River Basin

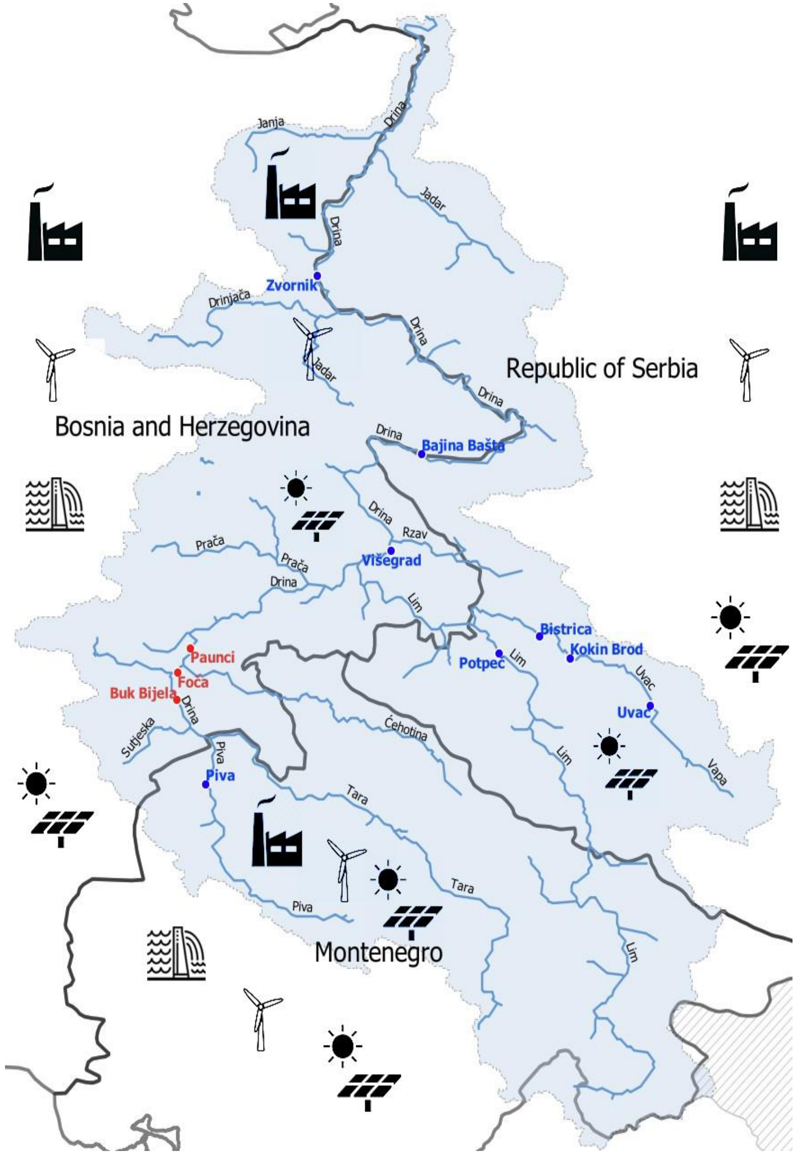
Approach:

techno/economic "least cost optimization" models of the power sector

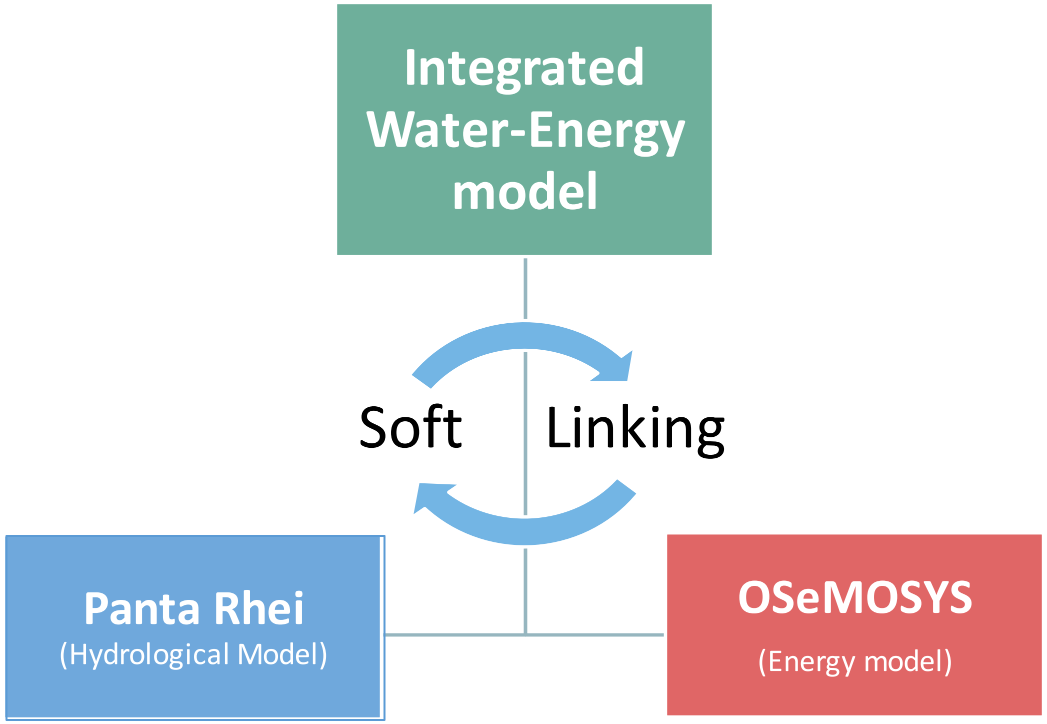
- Power sector in all riparian countries represented with good technological detail
- Emphasis on the operation of hydropower cascades in each basin.

Accessibility: model developed in an open-source framework (OSeMOSYS*) to facilitate replicability and transparency (of data and assumptions).

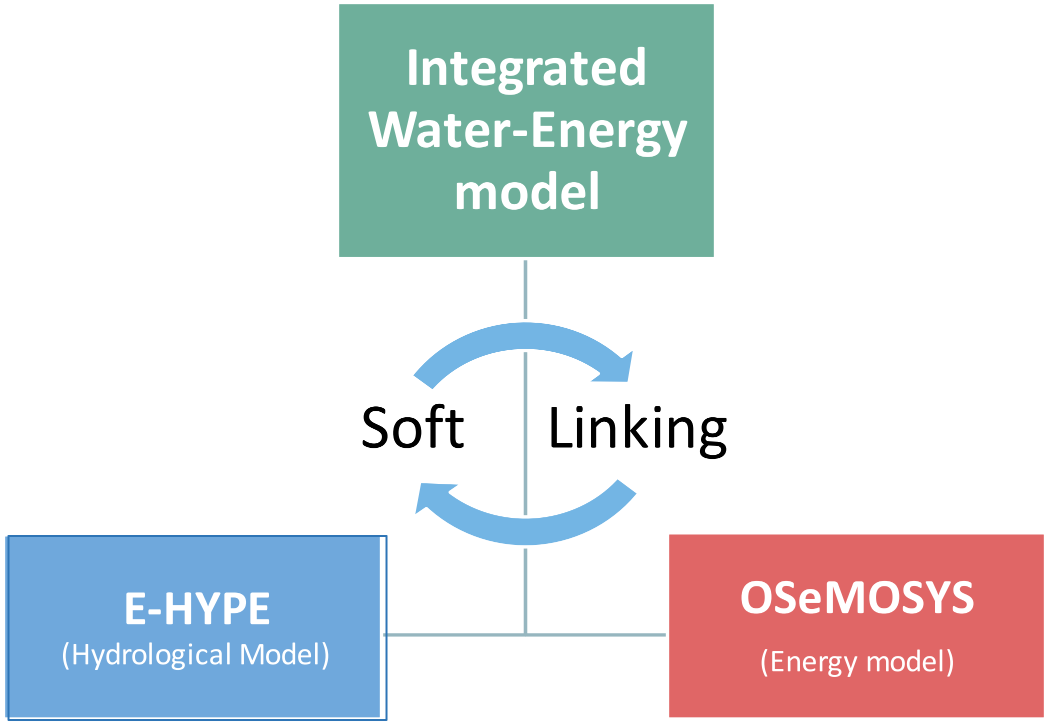
*OSeMOSYS: Open Source energy Modeling System.



Water-energy models:

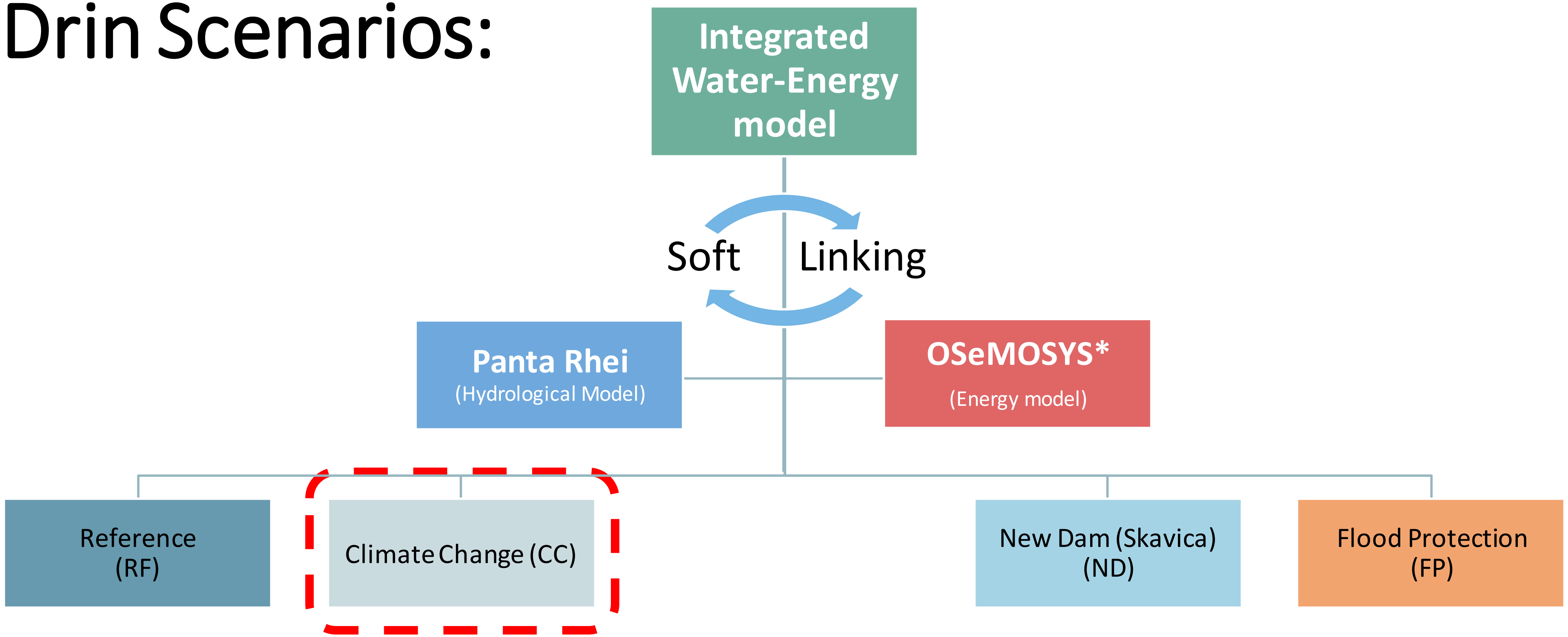


Drin



Drina

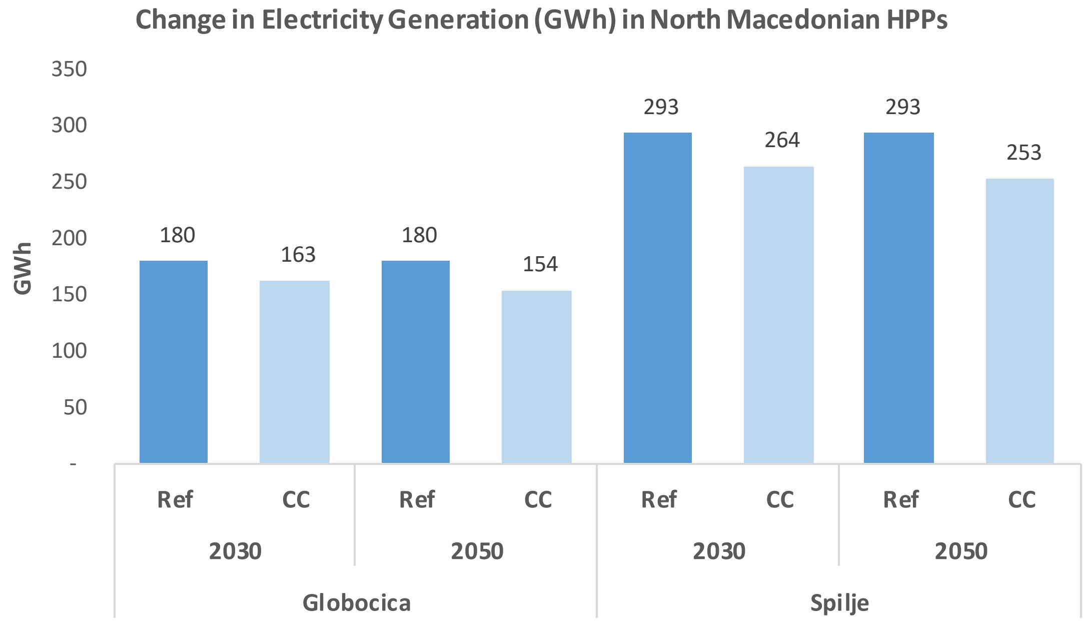
Drin Scenarios:

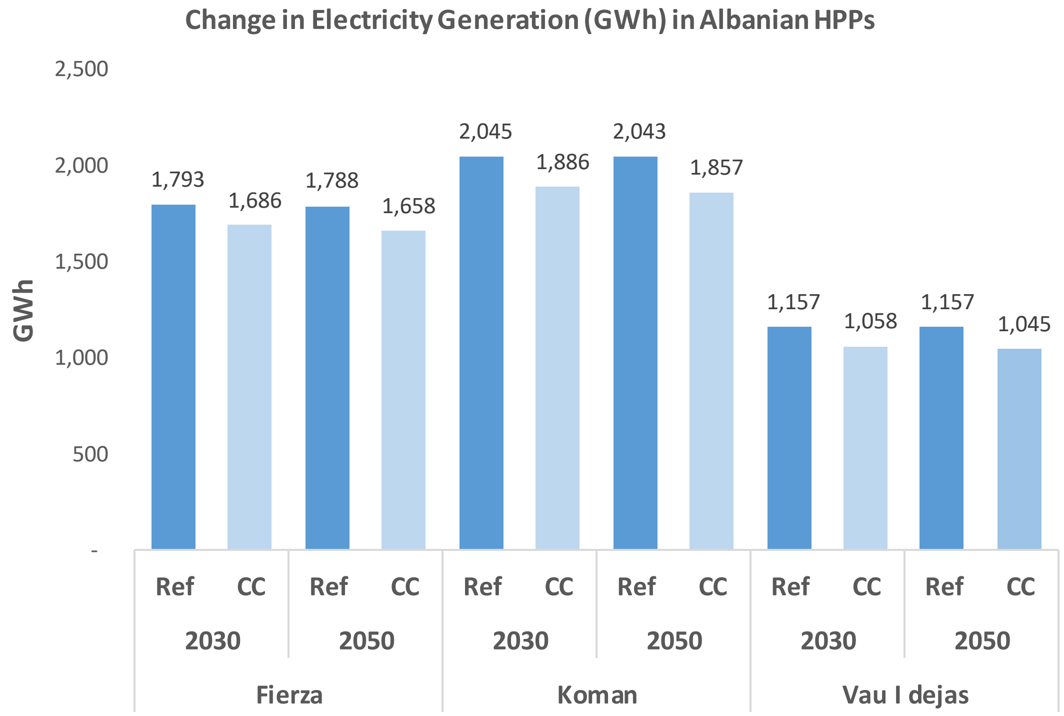


Climate Change scenario (CC):

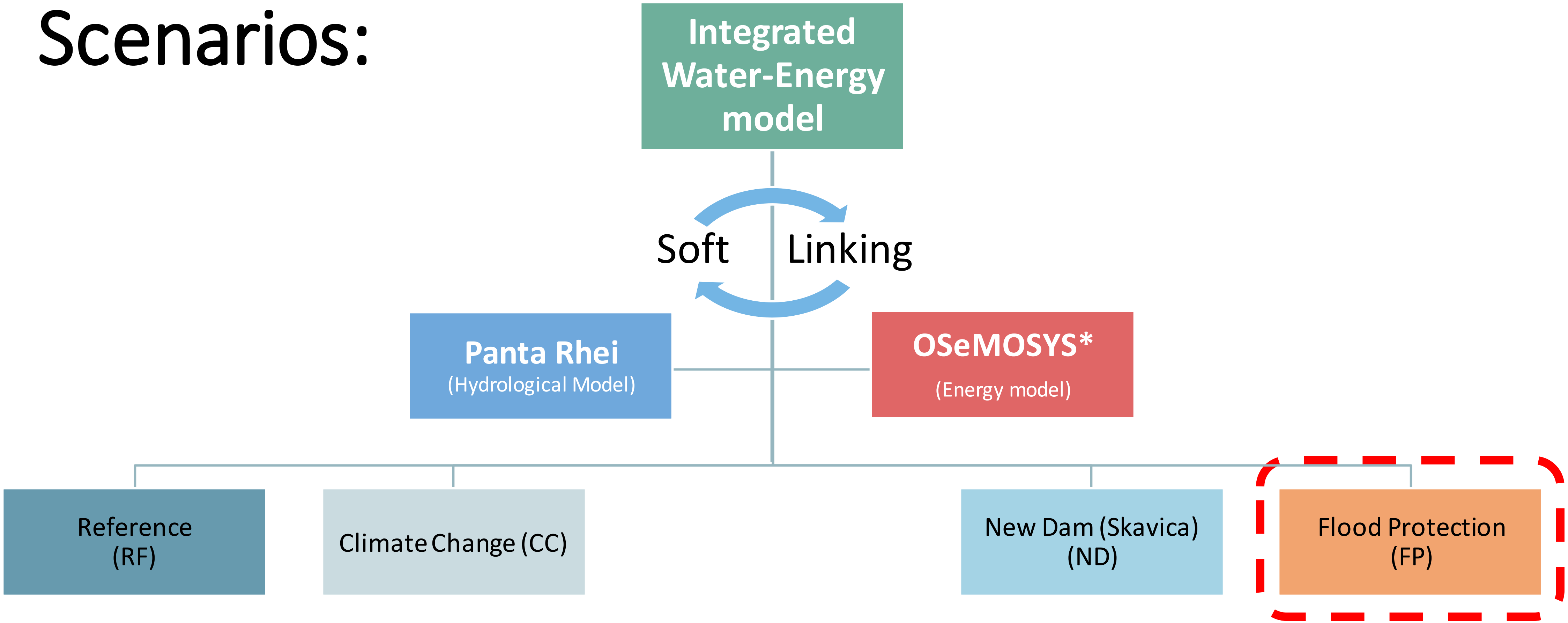
- The changes in electricity generation in N.Macedonia will drop by 10% in 2030 and 14% in 2050.
- In Albania the drop will be about 7% in 2030 and 9% in 2050.

Losses in (GWh)	2021-2035	2021-2050
Globocica	17	20
Shpilje	27	32
Total ELEM	**44**	**52**
Fierza	93	108
Koman	154	167
Vau dejas	95	102
Total KESH	**342**	**377**





Scenarios:


Integrated Water-Energy model
Soft
Linking
Panta Rhei
(Hydrological Model)
OSeMOSYS*
(Energy model)
Reference (RF)
Climate Change (CC)
New Dam (Skavica) (ND)
Flood Protection (FP)

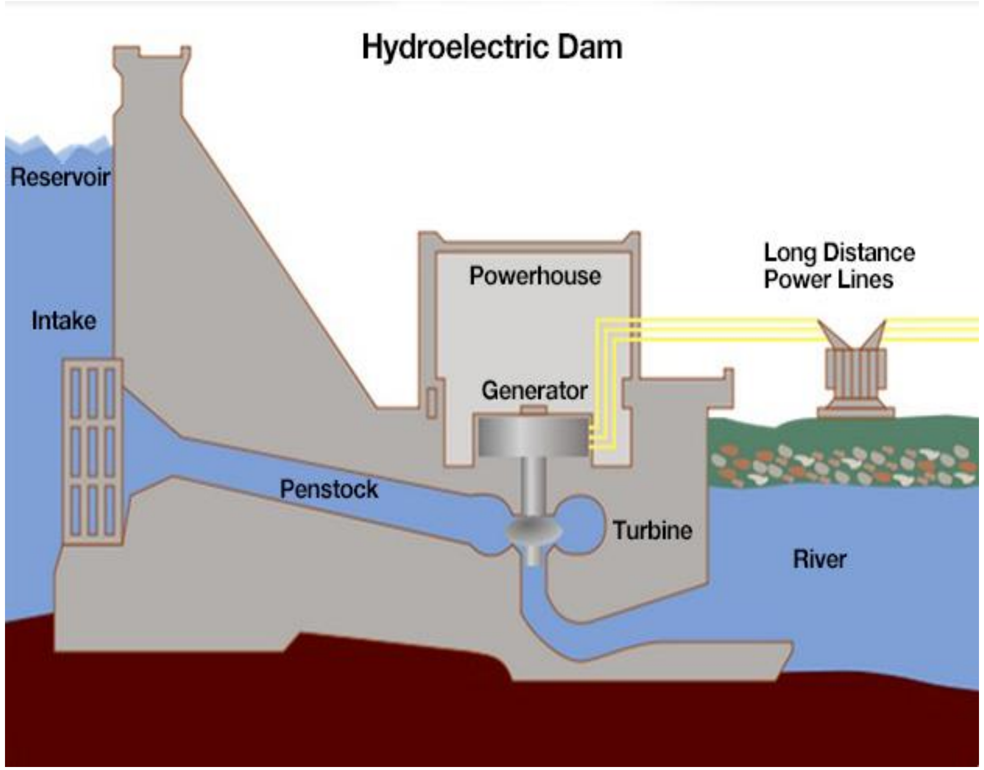
Flood Protection (FP) scenario:

- **Key question**: Can we achieve a better flood control if we increasing the buffer volume in the reservoirs? And what is the trade-off with electricity generation?

- Two reservoirs (one in each country) were chosen to explore this scenario due to their large storage capacity and impact on flood management:
    - Spilje dam (NK): 506 MCM
    - Fierza dam (AL): 2350 MCM

- Sensitivity analysis: increasing the buffer volume by
    - **5%,** 10%, 15% and **20%**

- Changes were applied in the wet season (Oct-May)



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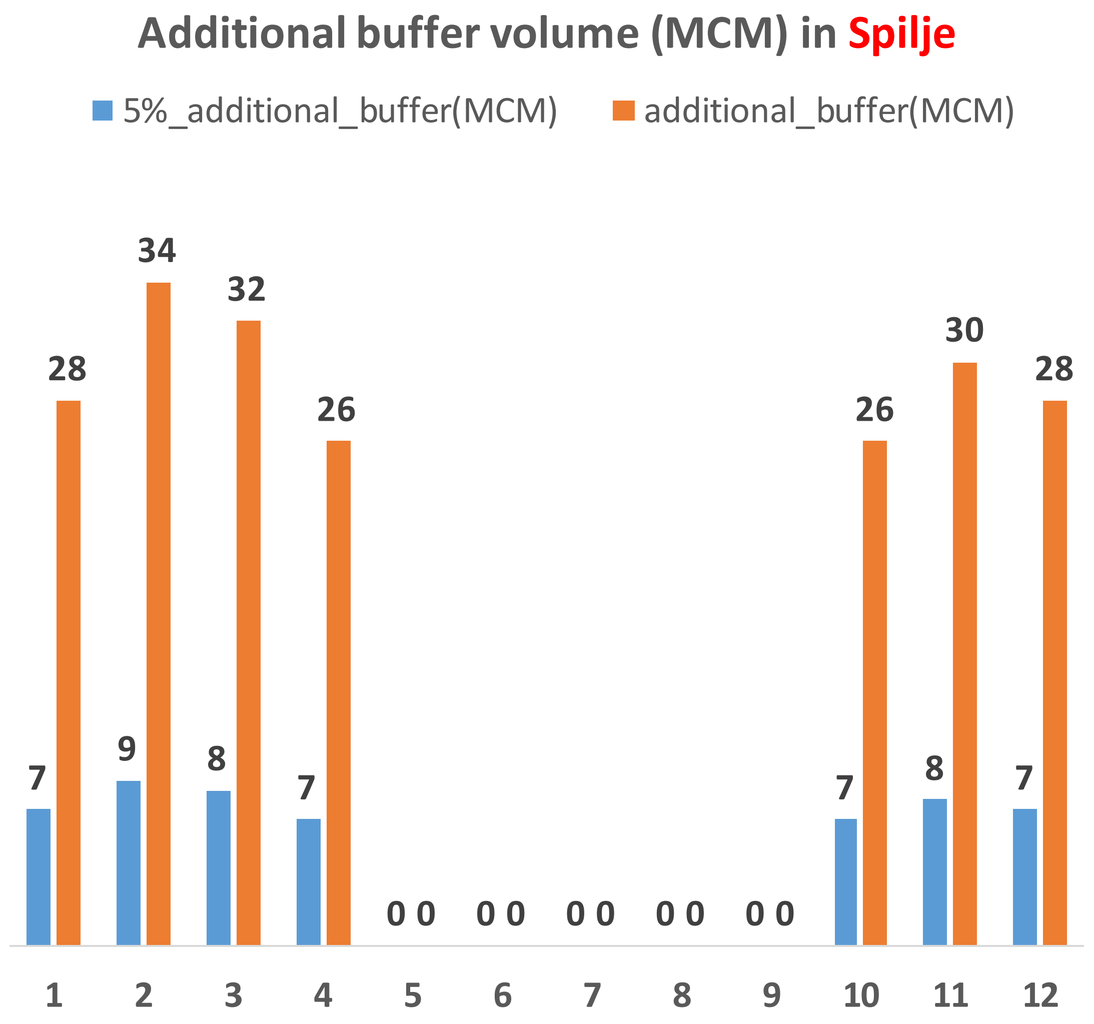
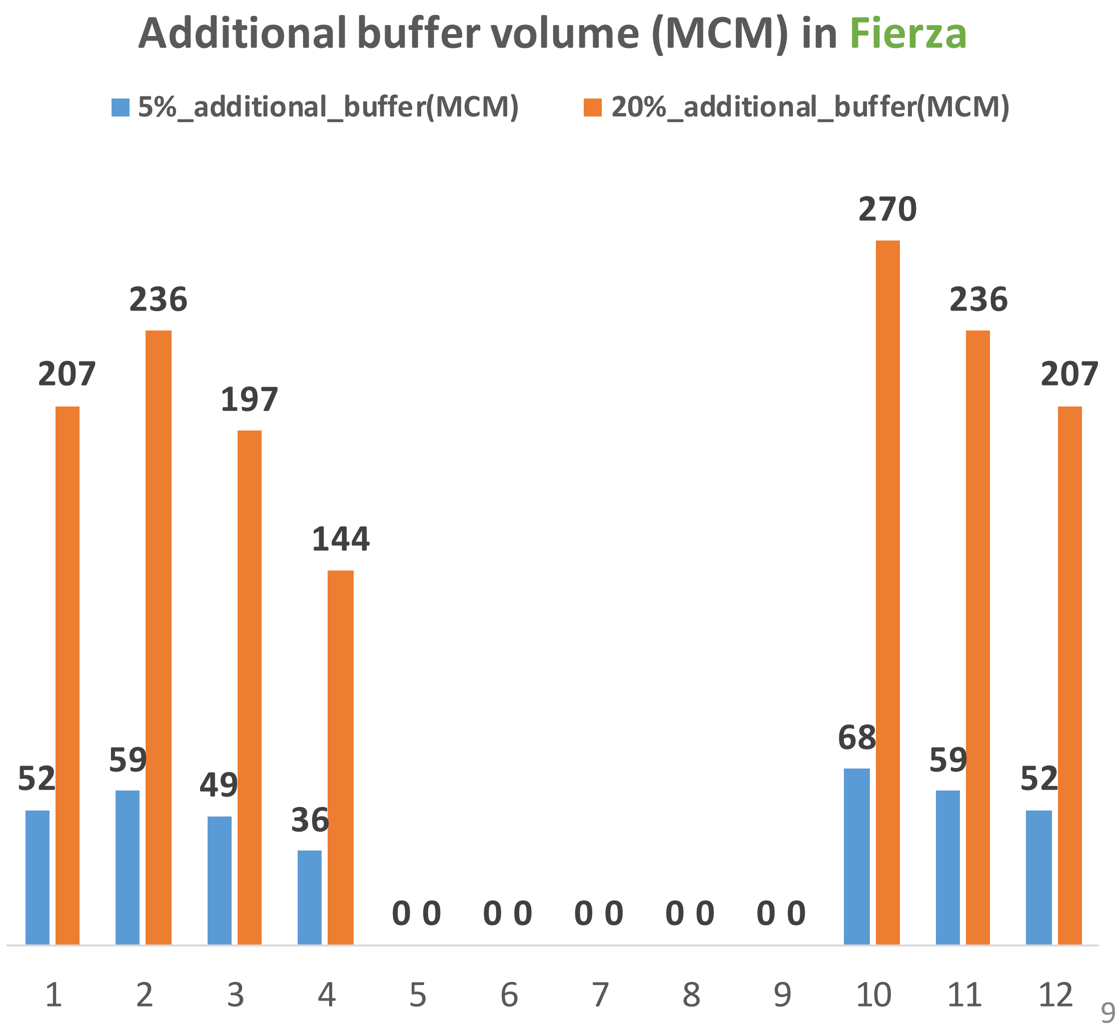
Flood Protection (FP) scenario:

Change in the **buffer volume** in Spilje and Fierza dams for two scenarios: 5% and 20% increase in flood buffer.

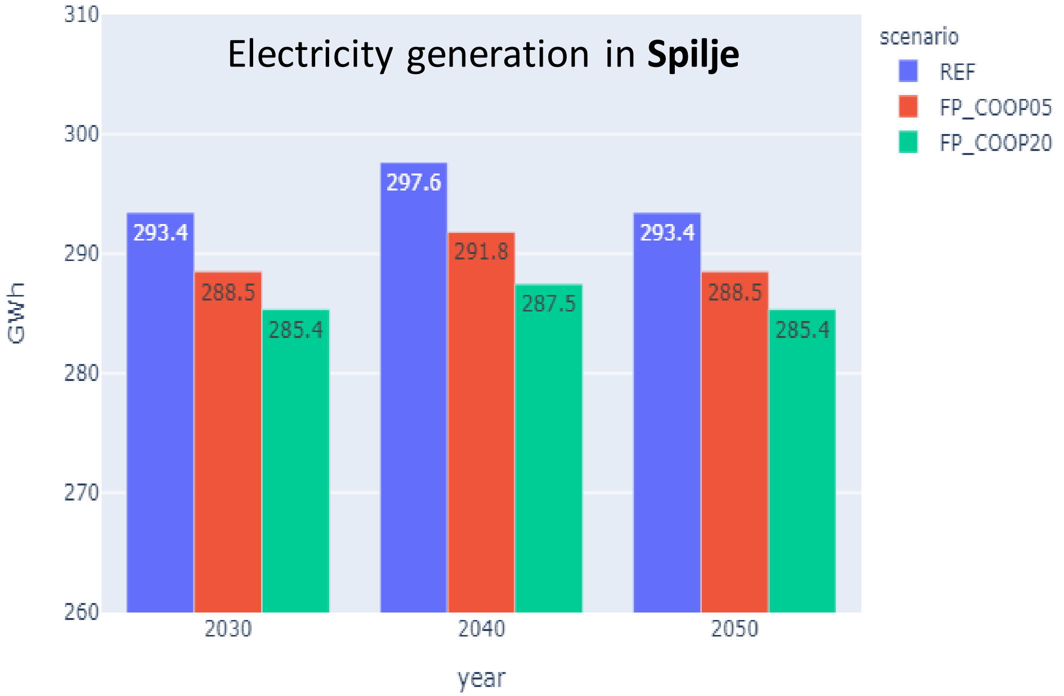


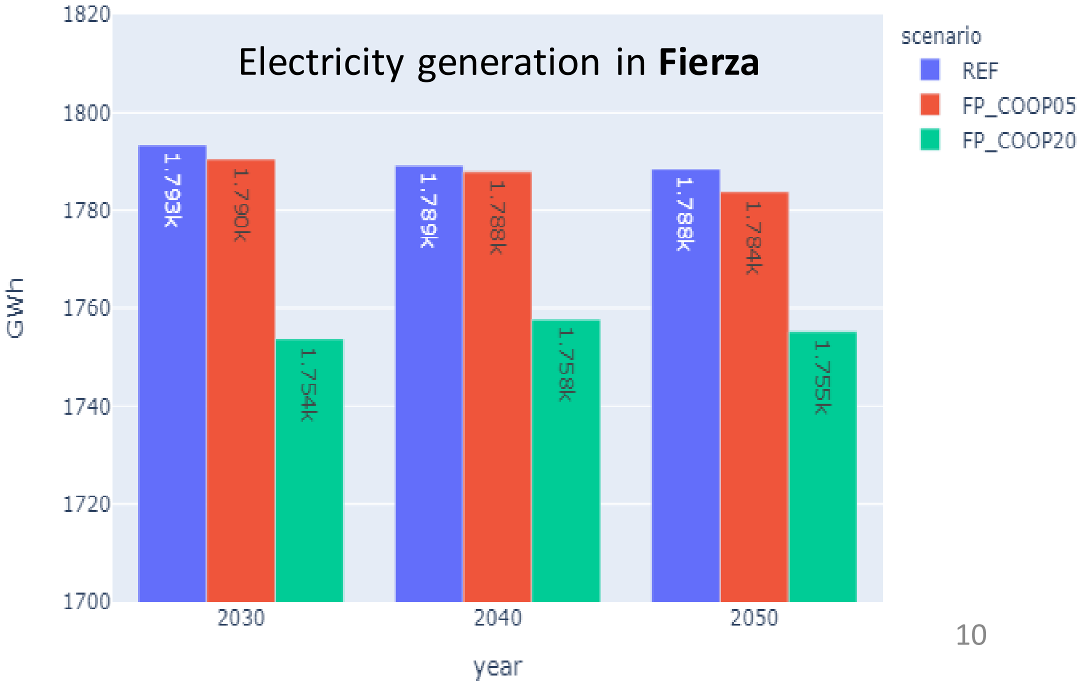


Flood Protection (FP) scenario:

- Changing the operational rules in Spilje and Fierza will have minor impact on electricity generation.

Dam	Spilje		Fierza	
Scenario	+5%	+20%	+5%	+20%
Mean annual change in generation (GWh)	- 5	- 8	- 5.4	- 34
% change in generation	- 1.7 %	- 2.7 %	- 0.3 %	- 1.9 %





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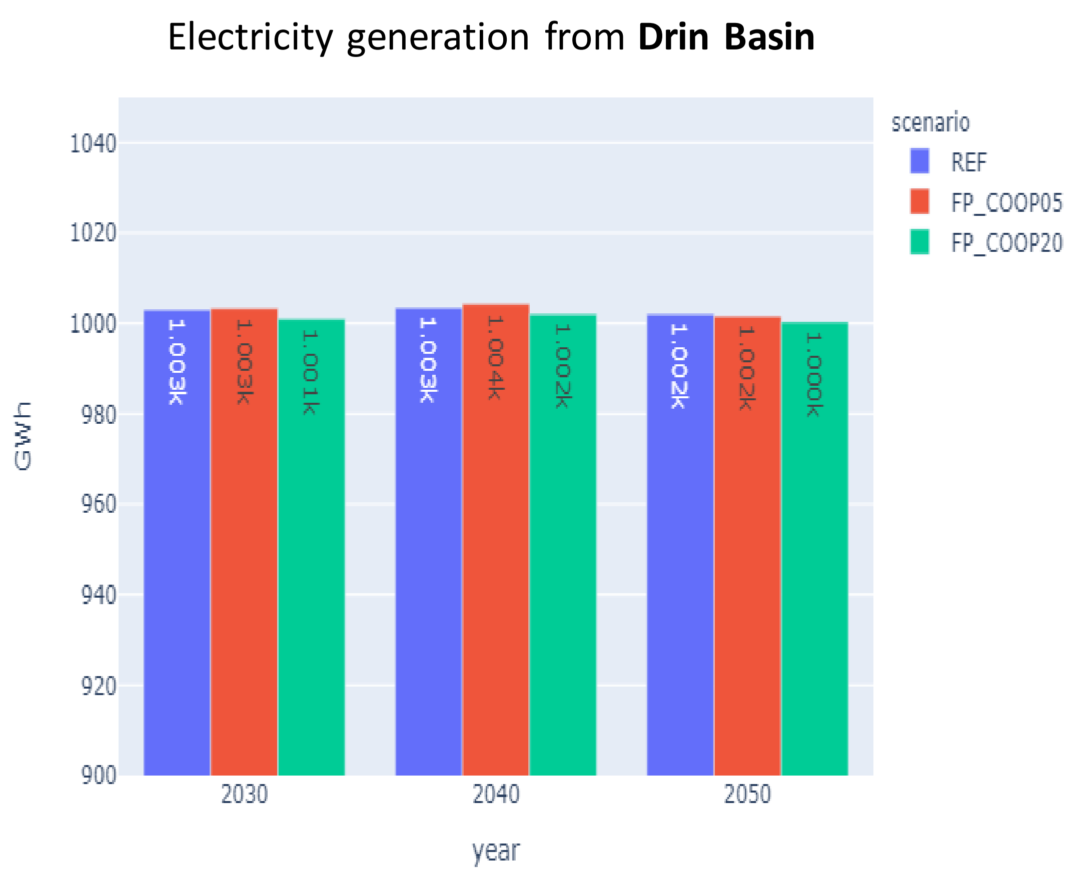

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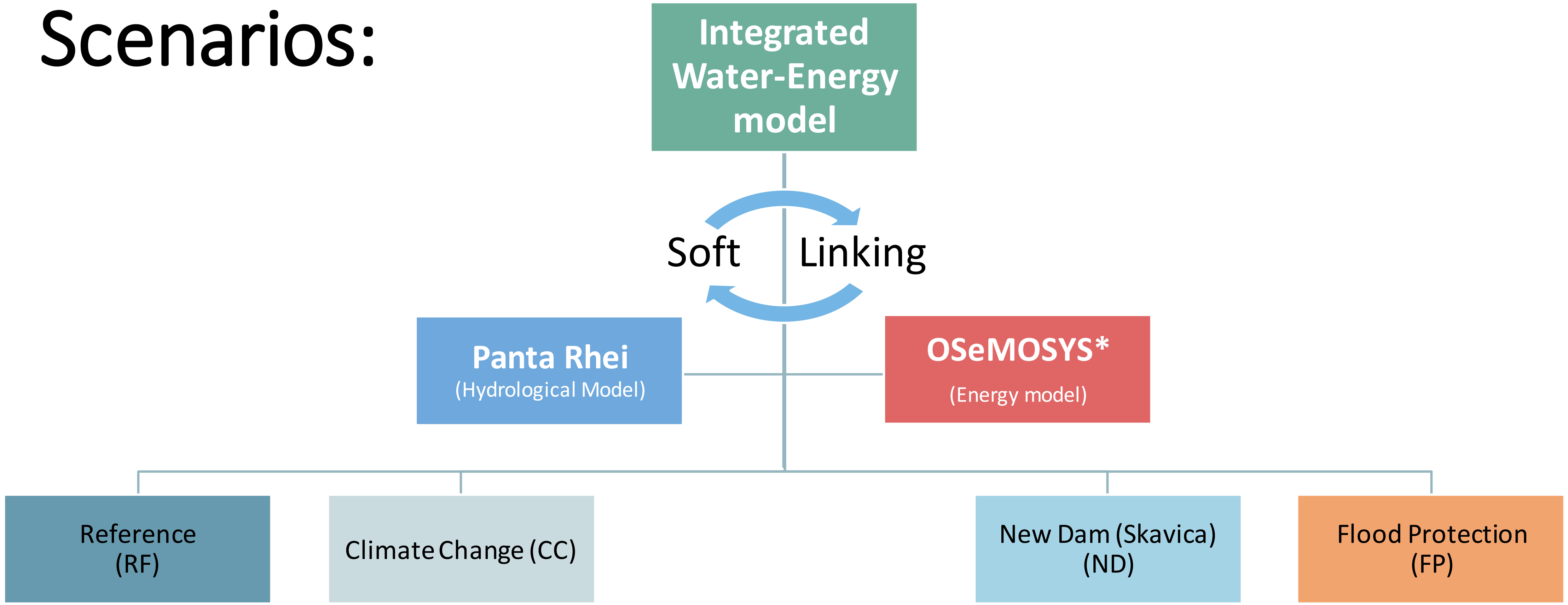


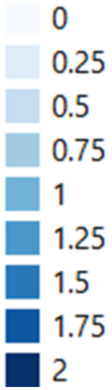
What would be the impact in terms of flood damage?

Collaboration with other projects

- Flood hydrograph (outflow in m3/sec)
- 2D hydrodynamic modeling (GIZ)
- Flood damage modeling.

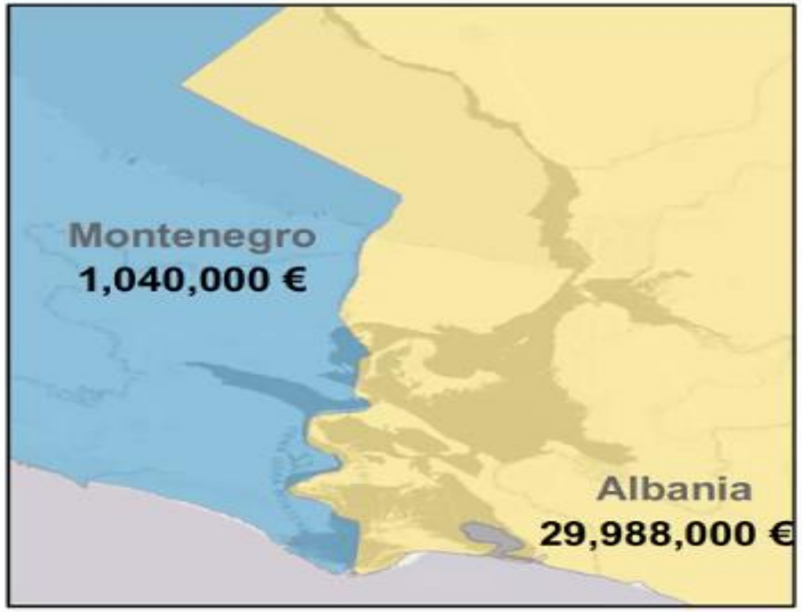
Flood Protection (FP) scenario:

Water Depth BAU Q10

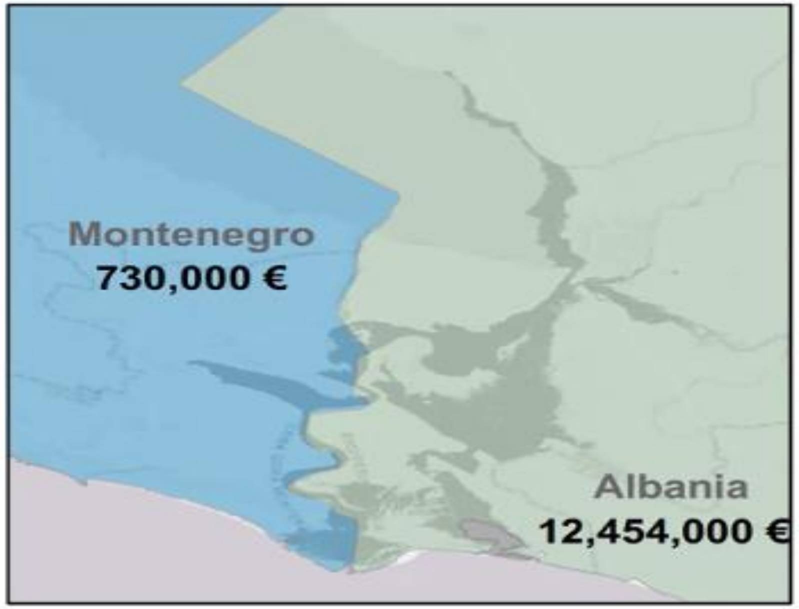


Water Depth Buffer 20% Q10

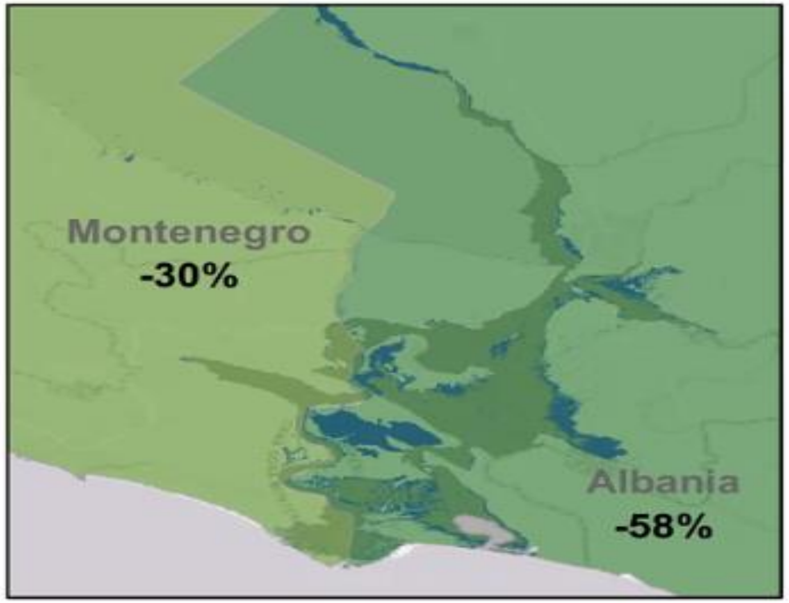
Flood Protection (FP) scenario:



Flood damages (Euros) – Ref scenario



Flood damages (Euros) – 20%buffer scenario



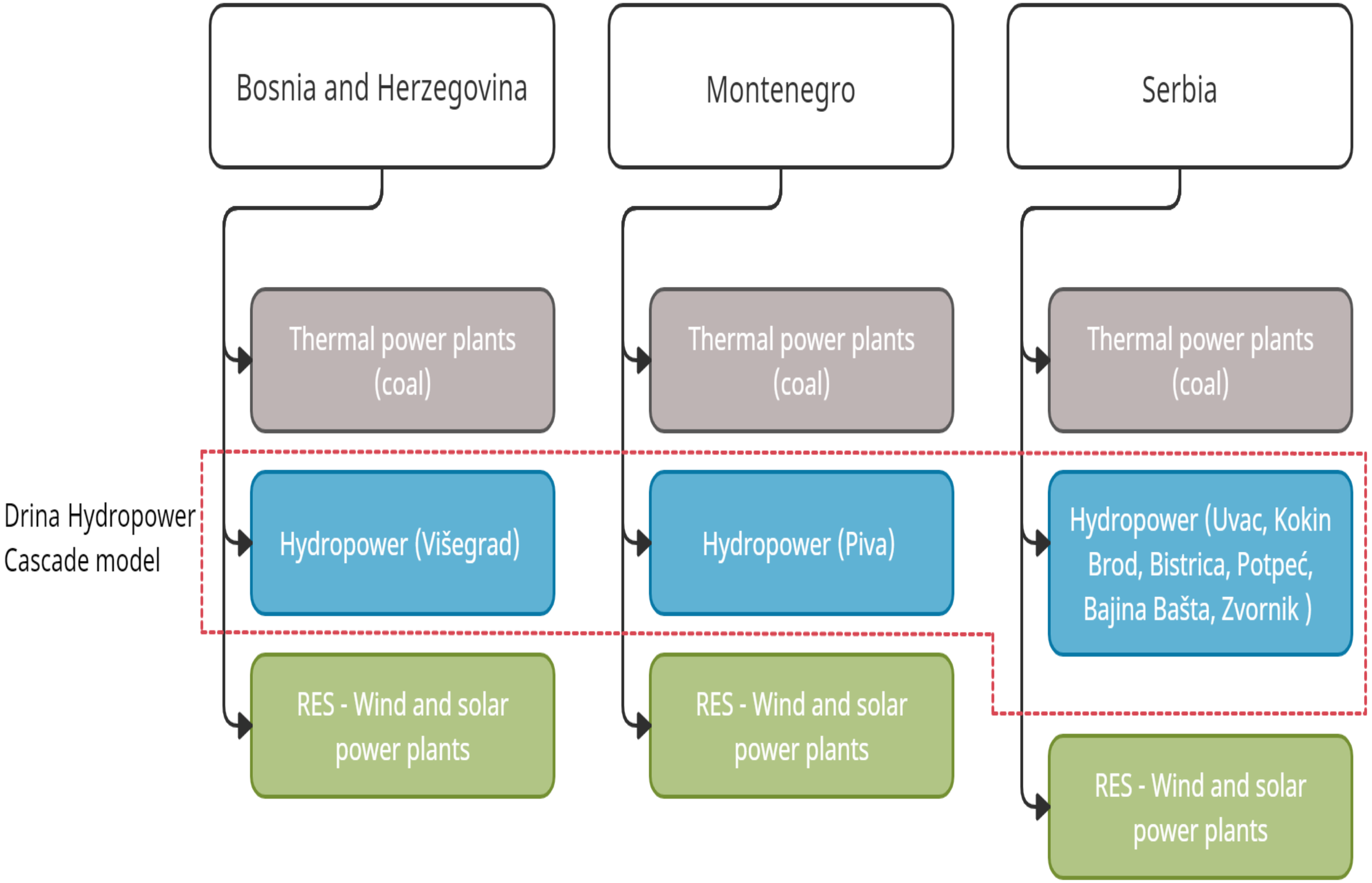
Difference (%) between two scenarios

Estimates of economic damages

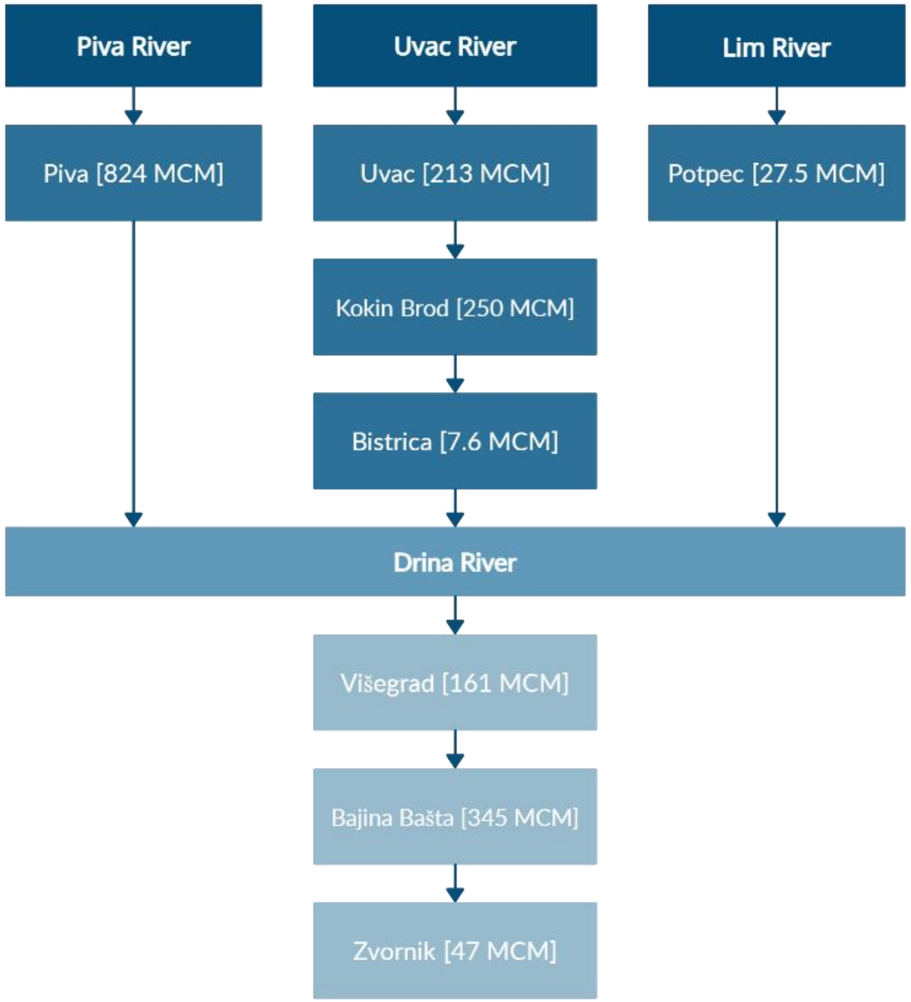
Final higlights from the Drin nexus assessment

- **Climate change** will impact hydro generation in the Drin basin causing 6-14% decline in the coming **two decades**.
- The benefits of ***Skavica hydropower*** plant will not be limited to flood mitigation but it will also ***improve the energy independency.***
- **Changing the operational rule** of the dams to accommodate floods would have a **minor impact** on the security of **electricity supply**.
- However, it has the potential to **spare additional 7-34 MCM** of volume to be used for **flood control**.
- The **savings in terms of flood damages** are **considerable** for small to medium floods.

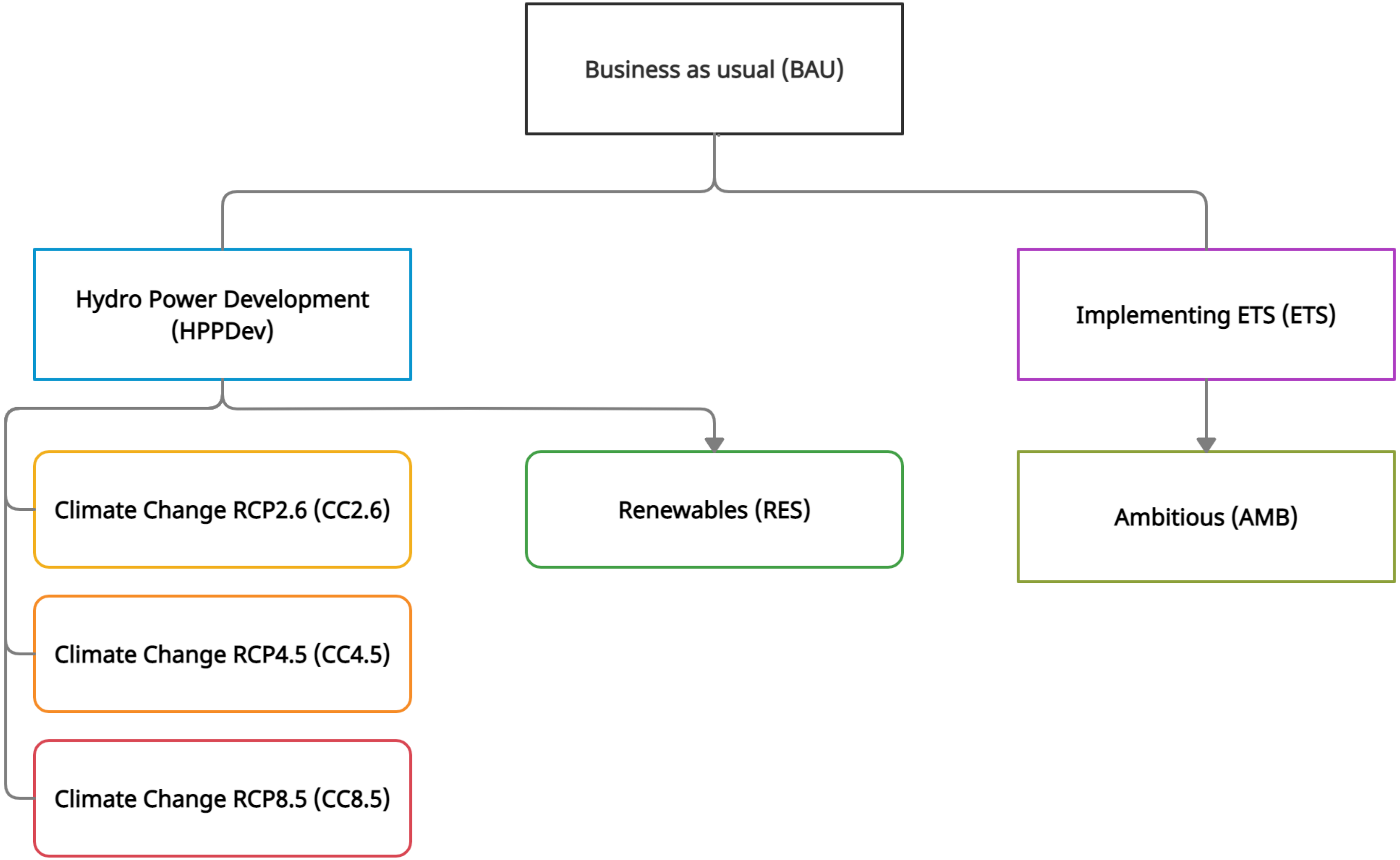
Drina River Basin



*A distinction made between technologies inside and outside the Drina River basin for each technology type



The scenarios explored in this project



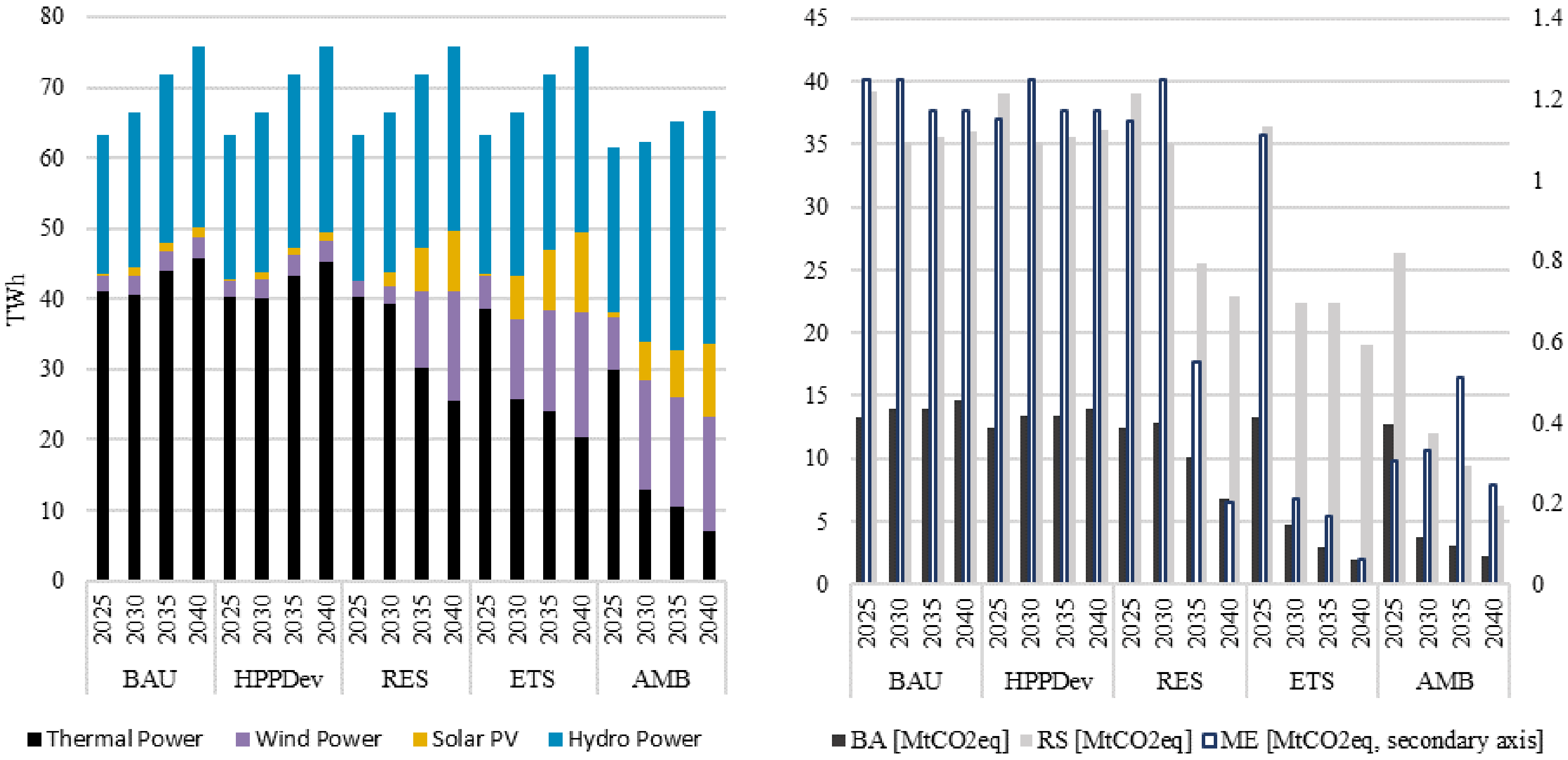
The role of re in achieving the NDCs

RES can determine a sharp decrease of emissions in a cost-competitive way.

Reductions are limited in BAU and HPPDev where RES are limited (old TPPs are replaced by new ones). They are far more significant in the RES, ETS, and AMB scenarios.

The emission reduction in the power sector meet NDC pledges in all countries in ETS and AMB.

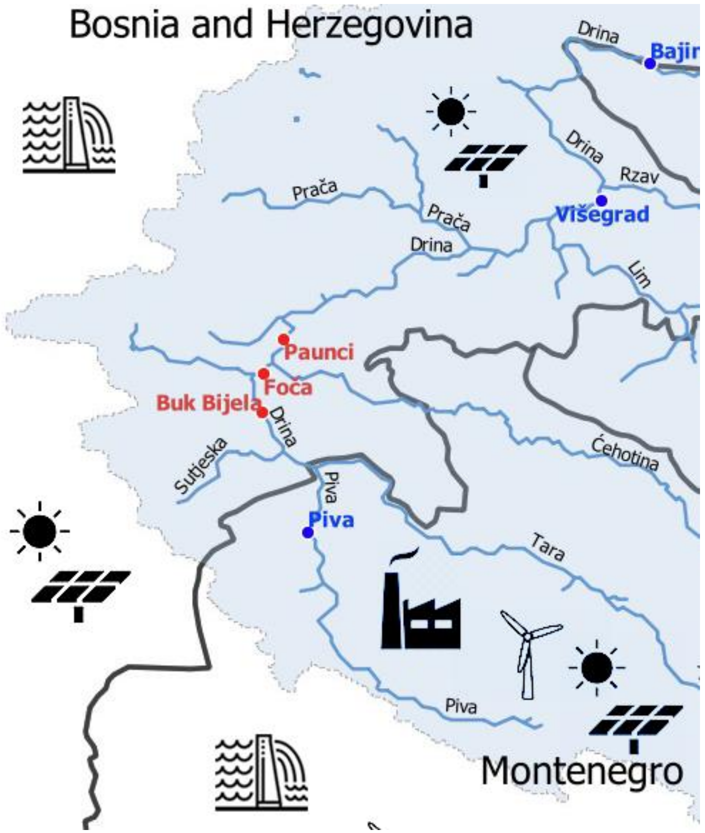
Note: From a purely economic perspective, **hydropower remains a competitive source** (under the assumptions of the study, non-hydro RES are competitive with coal but not with hydro).



Electricity supply (left) and CO_2eq emissions (right) for multiple scenarios

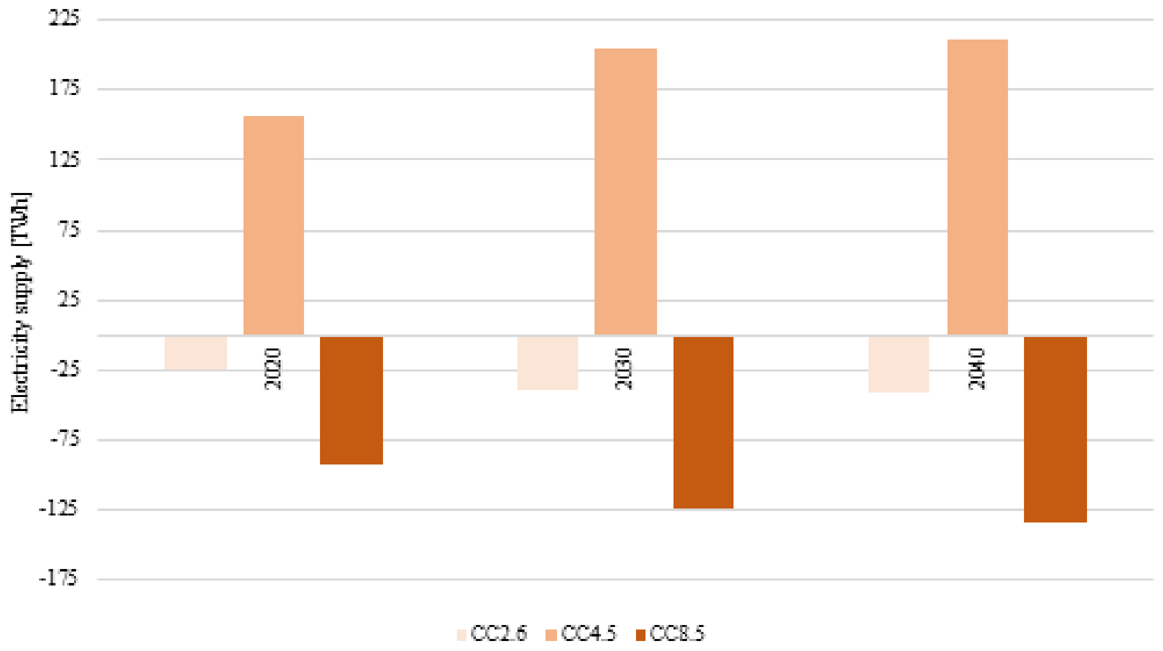
The impact of new HPP in the DRB (in a least-cost electricity system)

- Three projects were included in the HPPDev scenario: HPP Buk Bijela, HPP Foča, and HPP Paunci, which had the closest commissioning date according to info available (combined generation capacity of 180.9 MW)
- The system-wide impacts on power supply would be modest, however
- Expanded hydropower capacity could have important implications on water management (to be explored).



The effects of climate-induced variability on hydropower generation

- Climatic changes a complex: different possible patterns of precipitation and water availability in the short/medium term.
- The impact on the productivity of HPPs *cannot* be predicted with good confidence.
- -> HPP should be planned **taking into account the risks in different possible scenarios and their probability (**not on the basis of one or few individual climate projections)



Climate Change impact on power supply from cascade HPPs in the HPPDev scenario under different RCP's.

Selected recommendations

Most effective means to harness the untapped potential for non-hydro RES (thereby decarbonizing the power sector) are:

- facilitating investments in non-hydro RES (improving their competitiveness)
- establishment of a carbon market, carbon pricing (ETS)

Climate uncertainty requires «robust» HP planning (against different possible scenarios)

Drina II Nexus Assessment Technical Report - Structure

Background

- A summary of the Drina Nexus Participatory Process throughout the years
- Towards a «Nexus Roadmap» for the Drina RB

Energy-Water Scenarios

- *Technical/resource focused*
- Sustainable Energy Deployment (modelling of energy-water scenarios) in the Drina

Options for Flow Regulation

- *Legal/Governance focused*
- Flow regulation modalities in the Drina (formalization options)

Conclusions & Recommendations

- From the assessment so far (several topics)
- On Energy-Water Planning
- On Formalizing Flow Regulation

WHY FORMALIZING FLOW REGULATION?

- *"All economic activities as well as other interests related to the water, depend on a timely flow of adequate quantities of water, with fit-for-purpose quality.*
- *Currently, in the Drina Basin the regulation of flow is uncoordinated and sub-optimal, and this has an impact on both water availability and quality.*
- *The different users would therefore benefit from a holistic approach to basin management […] To capitalize on the benefits, coordinated policy and technical actions at different levels, across borders are necessary"*
- Statement from the High-Level Workshop, 2019

- *Participants agreed that cooperation between sectors at the national and basin level could be improved, there is lack of data in the basin, particularly related to monitoring (incl. on e-flows) as well as relevant information on ongoing projects in the basin.*
- *Participants stressed the necessity of the dialogue between representatives of all hydropower companies and authorities with the aim to harmonize the work of hydropower plants.*
- 2nd meeting of the Expert Group, 29 March 2021.

Where are the gaps in legislation?

How can they be fixed?

Key Recommendations on flow regulation

Based on areview of legislation in the basin's riparians and good practices from international experience, the analysis established common objectives:

- Long term: Effective cooperation on a range of issues across-sectors (co-optimizing the value for different uses (hydropower generation, etc.), meeting different water-related needs, minimizing negative impacts from flooding, and ensuring integrity of the ecosystems)
- Interim term: Developing a road map towards a basin-wide regime for flow regulation (thereby addressing fundamental issues related to basin-wide cooperation generally, building an enabling environment for action planning in areas relevant to flow regulation, and stablishing a set of milestones and objectives for investments).

Main recommendations:

- Ensuring an effective and inclusive platform for transboundary water cooperation in the Drina RB, based on existing or new platforms (several options).
- Acting at the national and basin level in all 3 countries on planning, around Disaster Risk Reduction, renewable energy with state-of-the-art SEA, implementation of transboundary SEA with respect to relevant plans, programmes and policies, coordination of national level permitting processes
- A High-level Meeting on Flow Regulation in the DRB

Possible next steps for the Drina RB

Immediate opportunities:

- - implementation of climate related recommendations from the project
- - inclusion of nexus analyses outcomes in NAPs

Possible opportunities:

- - climate project proposal to e.g. Adaptation Fund, GCF
- - further capacity building on e.g. climate adaptation, water-energy planning for climate resilience, financing transboundary cooperation