# WATER-ENERGY MODEL – DRINA II

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# WATER-ENERGY MODEL – DRINA II

Key question: *"How to increase the share of RE in the Drina countries in a way that optimizes the resources available (including financial), minimizes the negative impact on the environment (including transboundary), and maximizes the multi-sectoral benefits of projects?"*

Better understanding of hydropower dynamics in the basin (costs&benefits, hydro/non-hydro competitiveness)

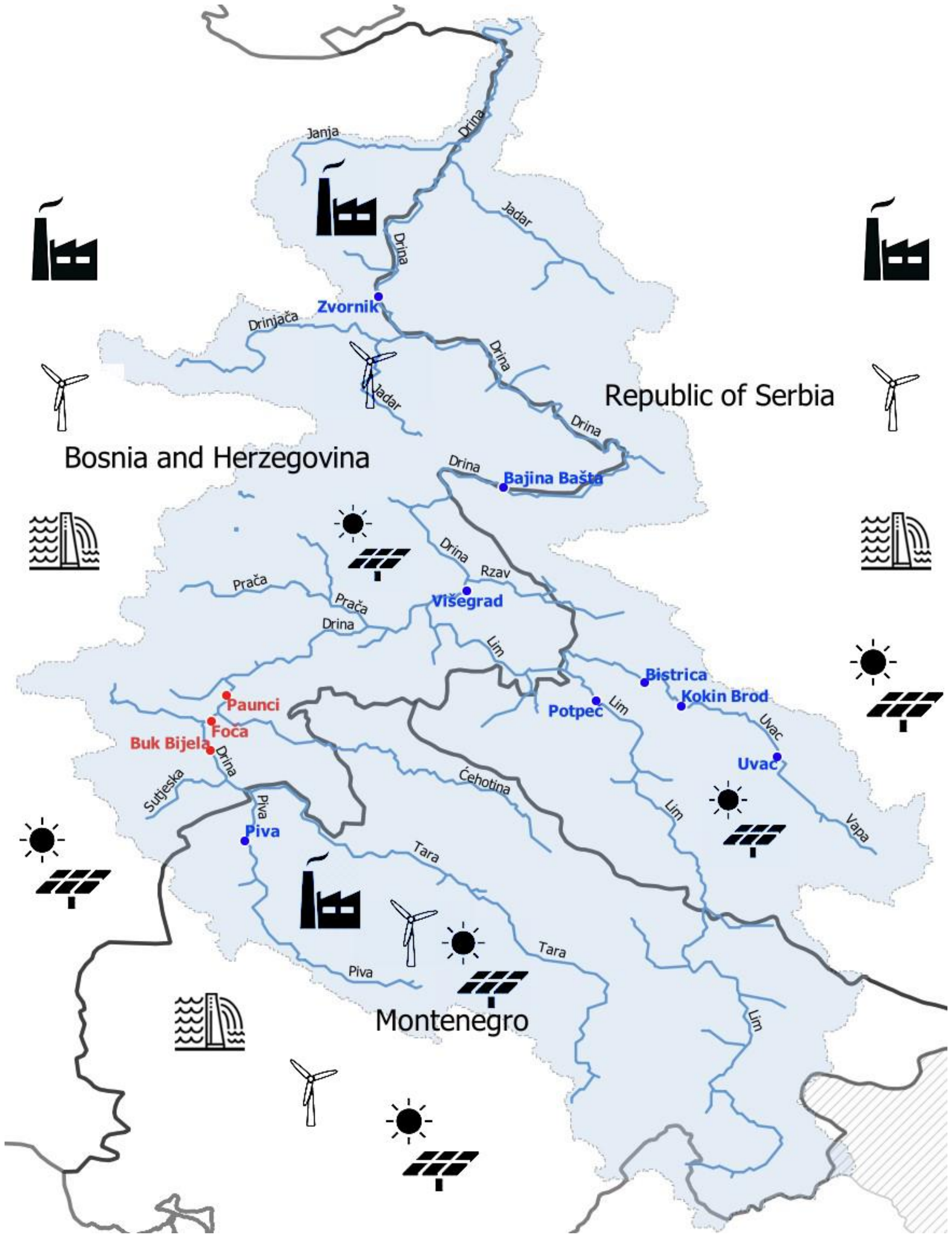
- ✓ **Drina Nexus I**: co-optimization of hydropower in the Drina River Basin, interconnections and trade, energy efficiency policy
- ➢ **Drina Nexus II**: linking hydropower development in the basin to the RE energy and climate commitments of riparians

# WATER-ENERGY MODEL

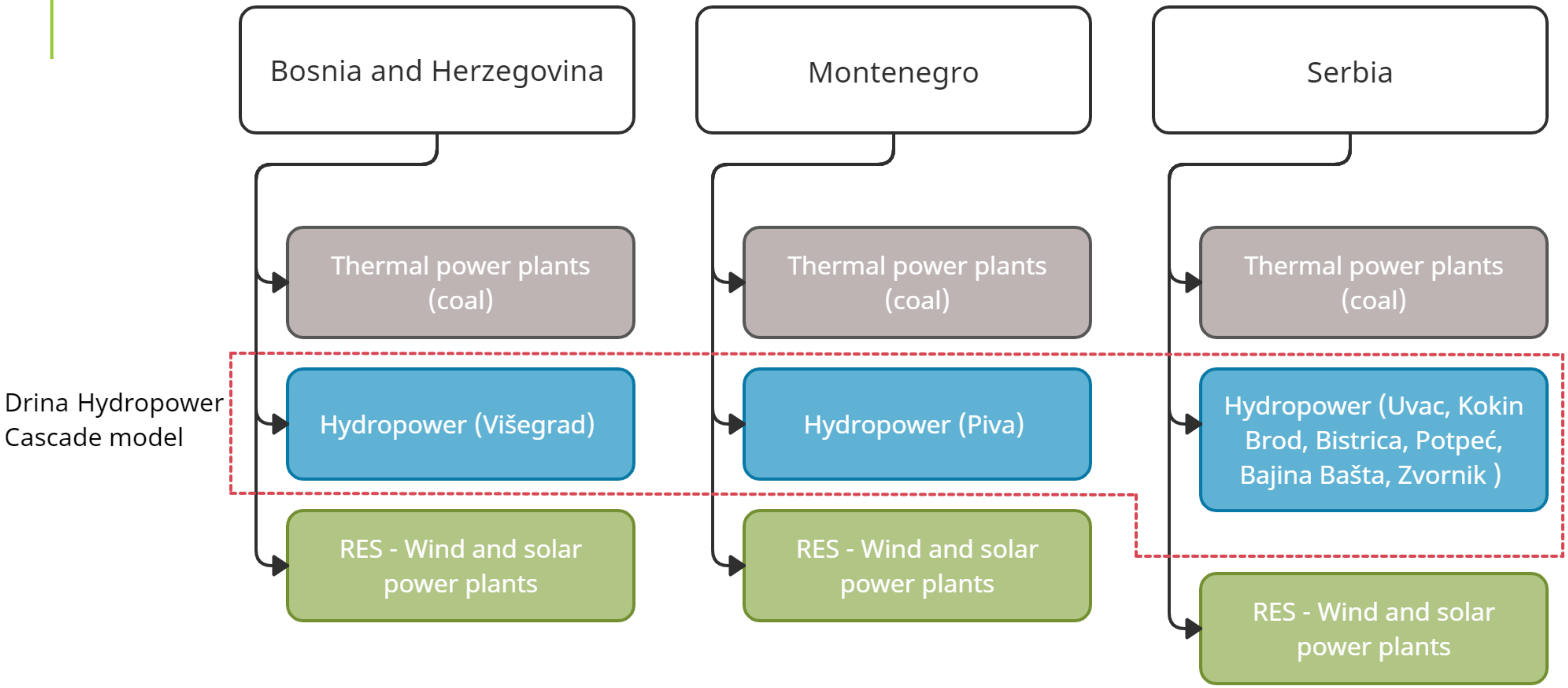
Model: a techno/economic least cost optimization model of the power sector

- Power sector in all three Drina River Basin countries (BA, ME and RS) represented with good technological detail
- Emphasis on the operation of hydropower in cascade

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



# METHODOLOGY



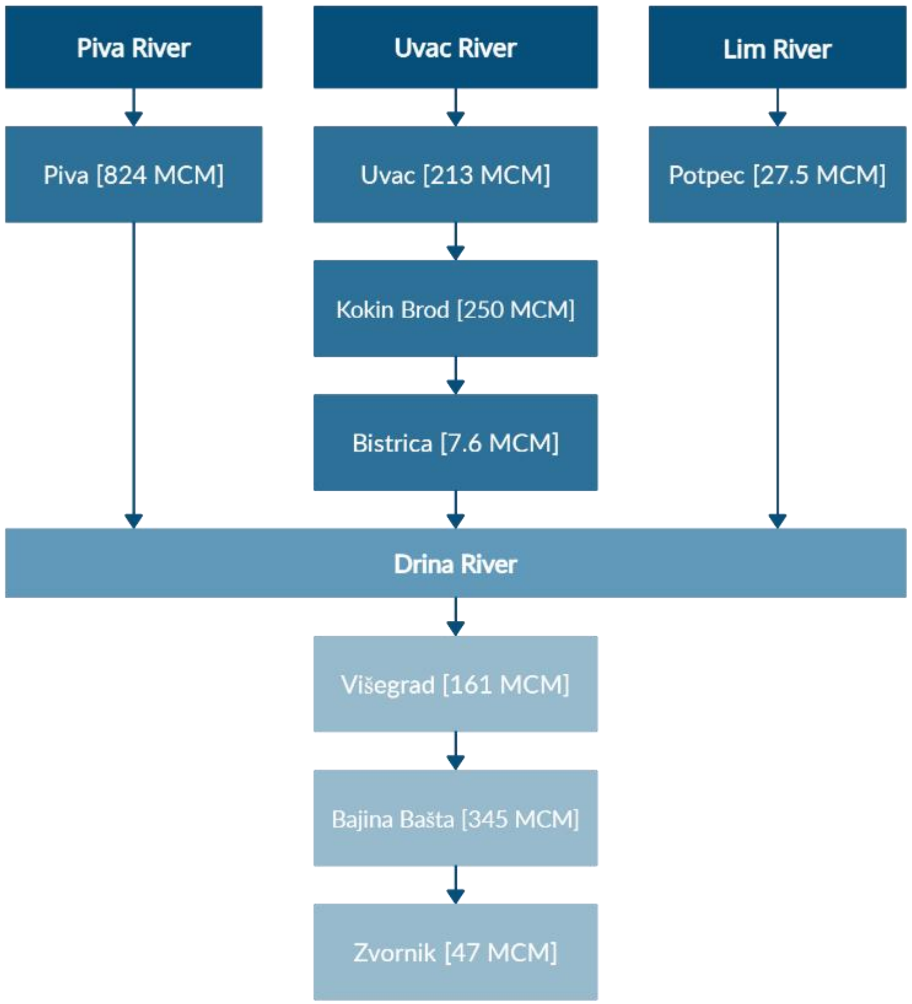

*A distinction made between technologies inside and outside the Drina River basin for each technology type

# METHODOLOGY - CASCADE REPRESENTATION

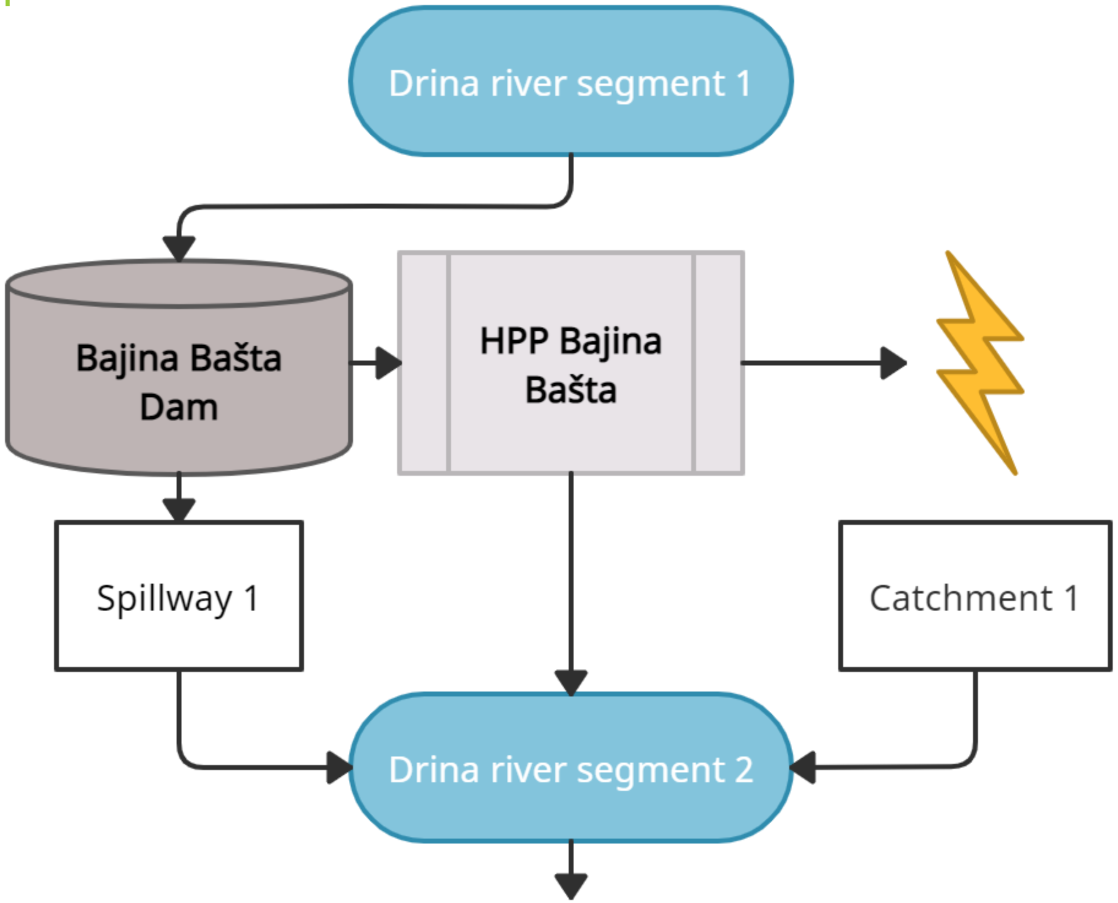
Development of a Drina Hydro-cascade representation in the model

Power supply from hydropower plants within the Drina River Basin based on:

- Water availability
- Rules of operation
- Environmental flows
- Useful storage volumes and discharge rates

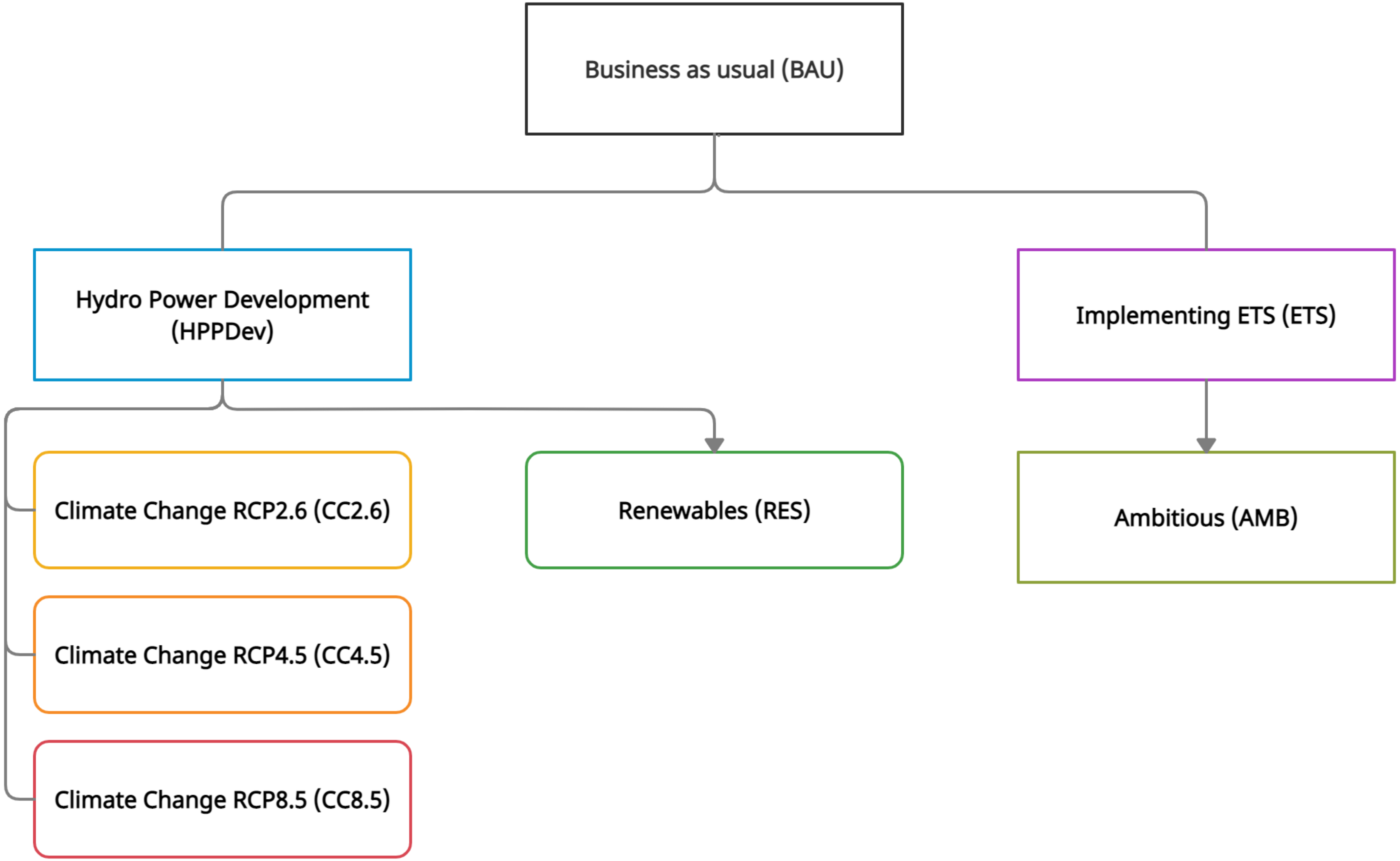


# METHODOLOGY - CASCADE REPRESENTATION




- Water availability controlled by upstream river segments and catchments
- Discharges [$m^3/s$] for *normal years* based on monthly multi-year average flows
- **Inputs**: dam storage [MCM], spillway capacities [$m^3/s$], water needed for power supply [$m^3/kWh$]

# THE SCENARIOS EXPLORED IN THIS PROJECT



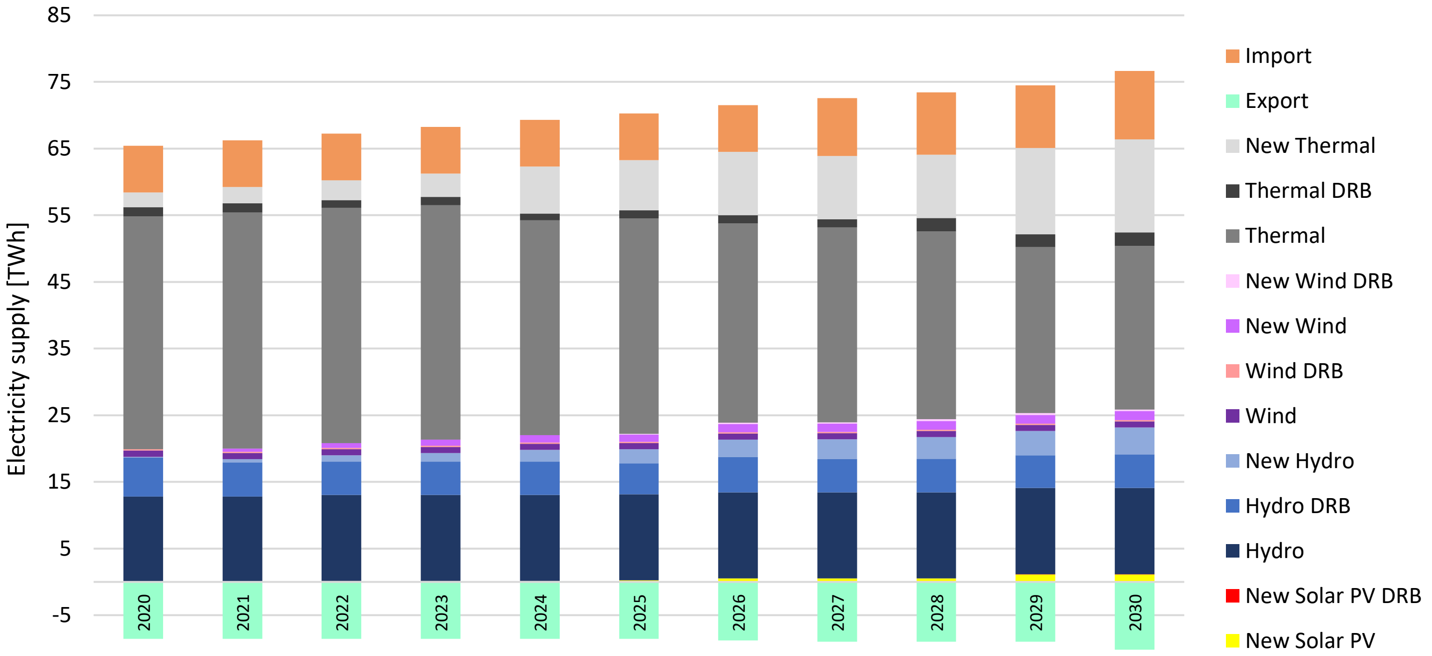
# 1. WHAT ROLE CAN RENEWABLES (HYDRO AND NON-HYDRO) IN THE DRINA BASIN PLAY IN ACHIEVING THE UNFCCC NDCS OF THE RIPARIAN COUNTRIES?

In BAU, RES technologies are a minor contributor to emissions reduction.

Emissions are primarily reduced by decommissioning existing coal-fired power plants in favor of new, more efficient thermal units.

-> share of renewable energy technologies (including hydro, solar and wind power) from 34% in 2020 to 39%

-> (share of new thermal from 4% to 21%)




Electricity supply [TWh] for the Drina riparians, including import and export; BAU scenario.

# 1. WHAT ROLE CAN RENEWABLES (HYDRO AND NON-HYDRO) IN THE DRINA BASIN PLAY IN ACHIEVING THE UNFCCC NDCS OF THE DRINA COUNTRIES?

RES declining prices allow non-hydro renewables to become cost-competitive by 2035.

ETS further increases their cost-competitiveness.

Even further increases in RES in the AMB scenario (energy efficiency measures and further technological advancements in non-hydro renewable energy)

| Technology type | 2030 | 2040 |
|---|---|---|
| Wind power | -1.4% | +446% |
| Solar PV | +71% | +487% |

Difference in power generation [%] from non-hydro renewables in the RES scenario compared to HPPDev.

# 2. WHAT BENEFITS DOES AN INCREASED SHARE OF NON-HYDRO RENEWABLE ENERGY BRING IN TERMS OF GREENHOUSE GAS EMISSIONS REDUCTION, AND IN TERMS OF REDUCED RELIANCE ON HYDROPOWER PRODUCTION?

Emission reductions are limited where renewable investments are scarce and old TPPs are replaced with new ones.

They are far more significant in the RES, ETS, and AMB scenarios.

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

Under the assumptions of the study, non-hydro RES are competitive with coal but not with hydro.

-> from a purely economic perspective, **hydropower remains a competitive source of electricity in this context.**

| Scenario | Reduction in 2030 [%] | Reduction in 2040 [%] |
|---|---|---|
| BAU | 3.2 | 0.6 |
| HPPDev | 5.1 | 2.4 |
| RES | 6 | 43 |
| ETS | 48 | 59 |
| AMB | 69 | 83 |

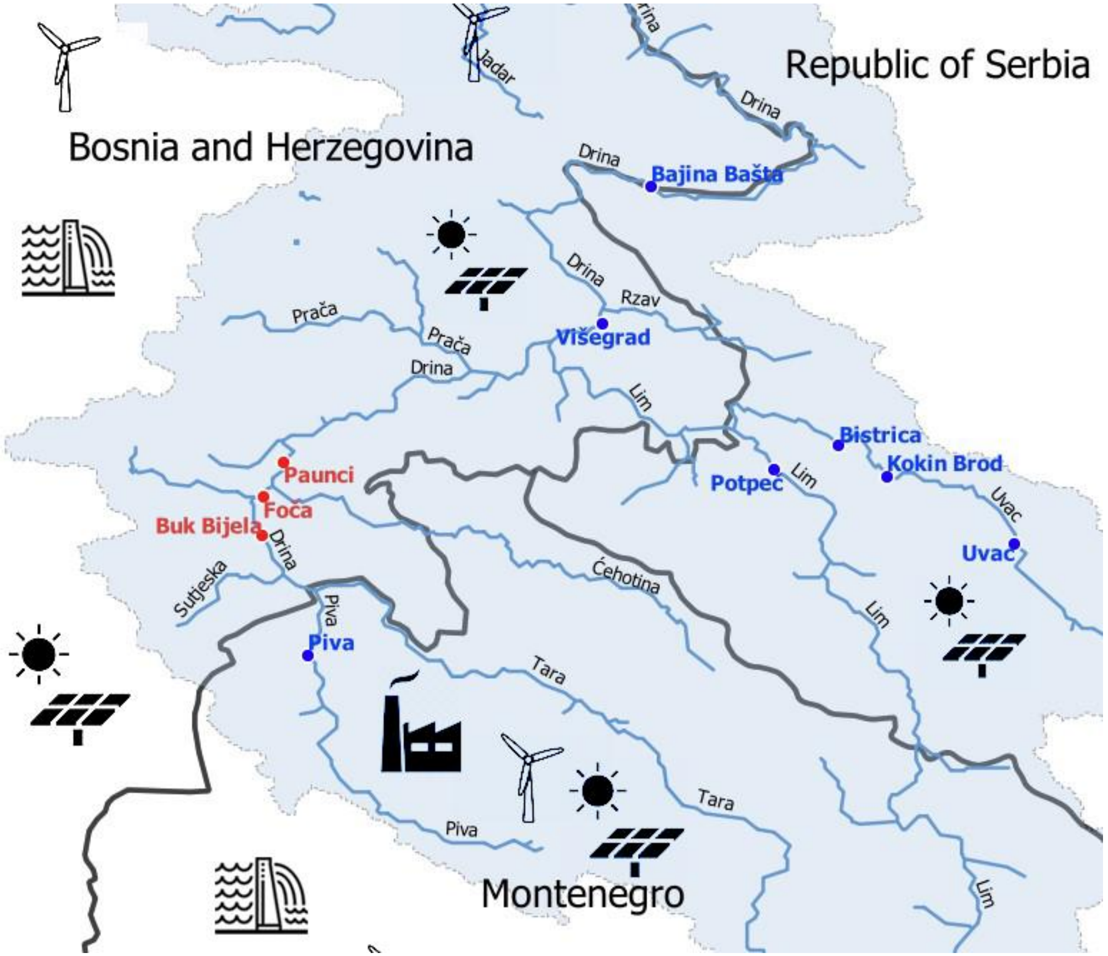
$CO_2$ emissions reduction compared to 2020.

# 3. IF THE PROPOSED PLANS FOR HPP DEVELOPMENT IN THE DRB ARE EXECUTED, WHAT COULD BE THE SHARE OF POWER SUPPLY AND INSTALLED CAPACITY OF NON-HYDRO RES, IN A LEAST-COST ELECTRICITY SYSTEM?

Only three projects were included in the HPPDev scenario: HPP Buk Bijela, HPP Foča, and HPP Paunci - 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.



# 4. WHAT ARE THE EFFECTS OF CLIMATE-INDUCED VARIABILITY ON HYDROPOWER GENERATION? HOW DOES THIS AFFECT PLANNING OF NEW HYDROPOWER?

Climatic changes a complex, in the short-term they may result in different patterns of precipitation and water availability.

**The impact on the productivity of HPPs cannot be predicted with good confidence.**

it can be recommended that the operation of HPPs and new HPP investments are planned **taking into account the risks of different intensities of change and their probability** (not on the basis of one or few individual climate projections)

| Power generation [TWh] | HPPDev | RCP2.6 | RCP4.5 | RCP8.5 |
|---|---|---|---|---|
| Hydro power inside the DRB | 113 | 113 | 117 | 111 |
| Thermal power inside and outside the DRB | 868 | 869 | 865 | 871 |
| Share of RES [%] | 38.3% | 38.2% | 38.5% | 38.1% |
| Share of non-Hydro RES [%] | 4.9% | 4.9% | 4.9% | 4.9% |
| Total emissions for the modelling period [Mt $CO_{2eq}$] | 1071 | 1071 | 1066 | 1073 |

Key outputs of the hydro development and climate change scenarios, as compared to the BAU.

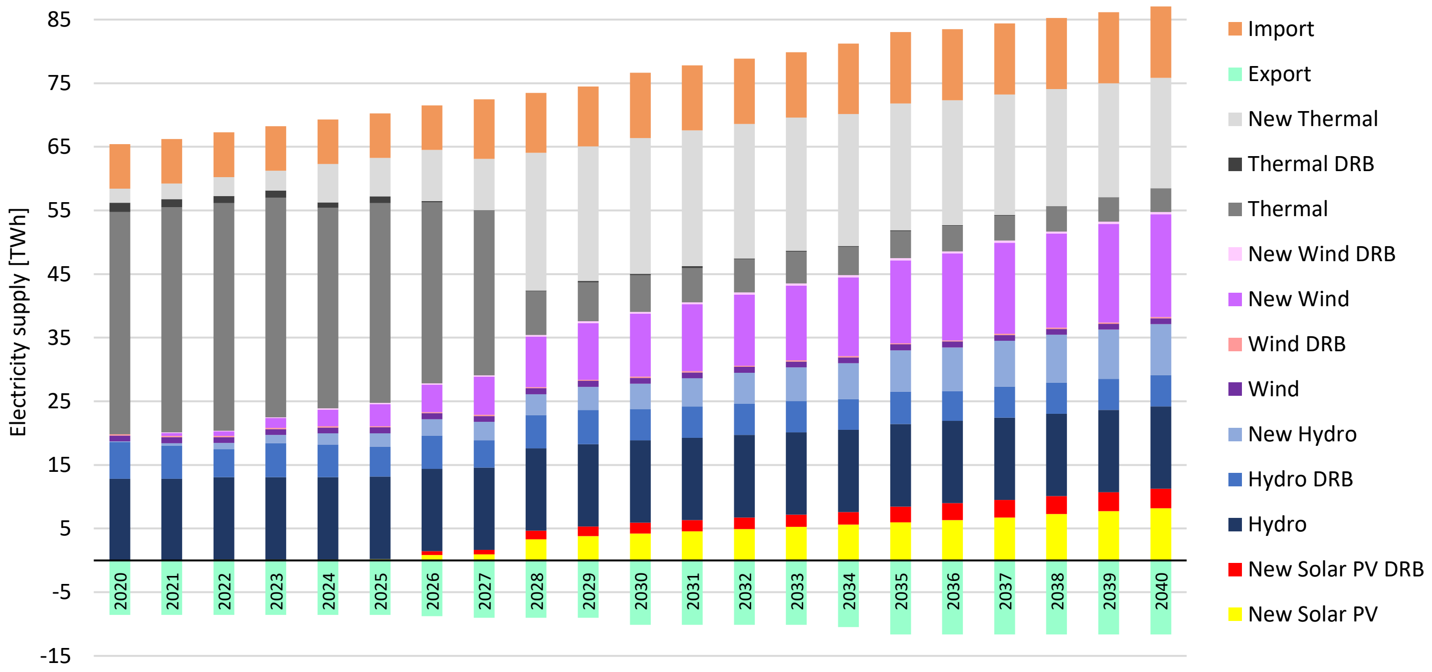
# 5. WHAT EFFECTS CAN THE EMISSION TRADING SCHEME, AS PART OF THE EU INTEGRATION PATHWAY, HAVE ON HYDRO AND NON-HYDRO RES DEVELOPMENT IN THE RIPARIAN COUNTRIES?

Existing TPPs reduce their power output by 80% by 2028.

Investments in RES are four times greater by 2030 compared with the BAU scenario

Non-hydro renewables account for over 80% of the new renewable capacity additions (great untapped potential)

In the Drina RB, hydropower could play a critical role in grid stabilization.




Electricity supply [TWh] for the Drina countries, including import and export; ETS scenario.

# 6. HOW ARE DIFFERENT TECHNOLOGIES IMPACTED BY THE IMPLEMENTATION OF ENERGY EFFICIENCY MEASURES (DEMAND SIDE) AND BY FURTHER AMBITIONS IN THE DEPLOYMENT OF RENEWABLES?

EE measures on the demand side affect TP as well as RES generation.

Lower electricity demand would alleviate pressure on HPP and could allow for a more rapid phase of the decommissioning of old TPPS, accelerating the decarbonization of the power sector.