Drina River Basin nexus assessment - Phase II

National Consultation meeting

KTH – Royal Institute of Technology:
Emir Fejzić
Youssef Almulla
Dr. Vignesh Sridharan
Dr. Francesco Gardumi

Agenda

- Project aim
- Approach
- Key questions
- The river basin
- HPP cascade methodology
- Preliminary results

The aim of the Drina Nexus Phase II

The project aims to:

- Provide a substantive background for the Drina Nexus Roadmap
- Provide an analysis of energy-water scenarios and options to formalize flow regulations.
- Identify possible nexus projects and related investments

Approach

- Electricity sector expansion model developed with OSeMOSYS (cost-optimizing, open-source framework) for Phase I will be used. The model structure includes a multi-country power system.
- The model calculates least-cost investments and energy balances in each of the countries (BA, ME and RS) for the 2020-2040 period.
- Emphasis on the operation of hydropower in cascade as well as the effects of non-hydro RES on hydropower and flood control/environmental flows
- Key questions and nexus implications of potential developments in the electricity system of the riparian countries (i.e., beyond the basin).

Key questions to be addressed in Phase II

Key questions include investigating:

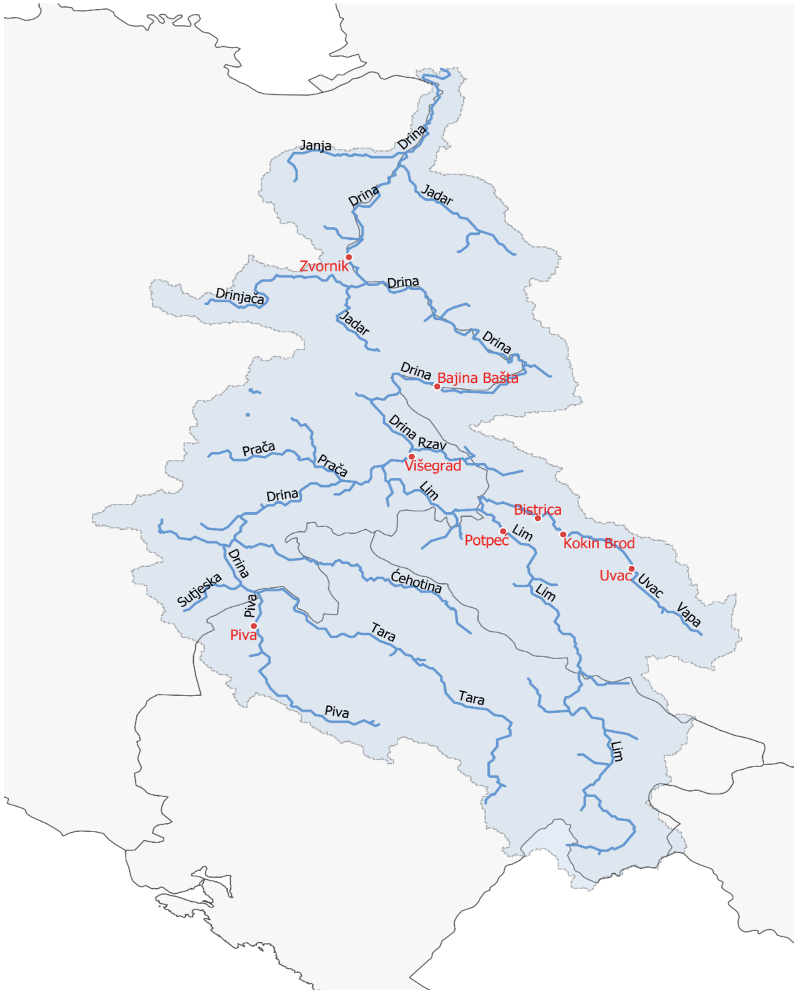
- Benefits an increased share of non-hydro RES bring in terms of GHG emissions reduction and reduced stress on hydro power considering the need for **flood containment measures and changing RES prices**
  - To what extent may hydro power plants provide environmental services (e.g., environmental flows and flood control), what impact does that have on their potential generation?
- The role renewables (hydro and non-hydro) in the Drina basin can play in achieving the UNFCCC **Nationally Determined Contributions**.

Key questions to be addressed in Phase II

Key questions include investigating:

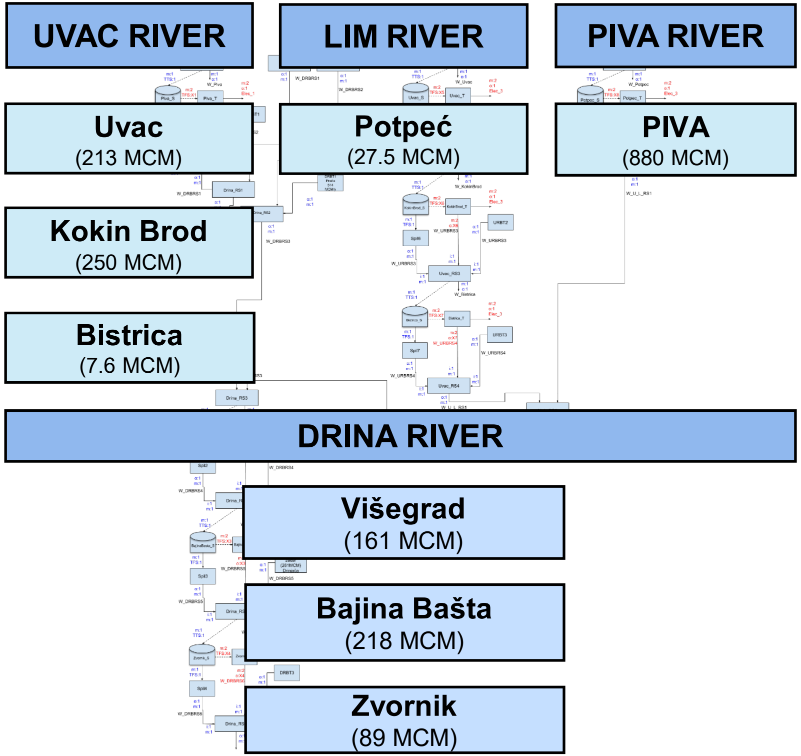
- Effects of **climate induced variability** on hydropower generation
- The role non-hydro RES could play if proposed plans for **HPP development** in the DRB were executed
- Effects the **Emission Trading Scheme**, as part of the EU integration pathway, can have on hydro and non-hydro RES development in the riparian countries
- In which way hydro and non-hydro RES can be impacted by the implementation of **energy efficiency** measures (demand- and supply-side)

Map of the Drina River Basin

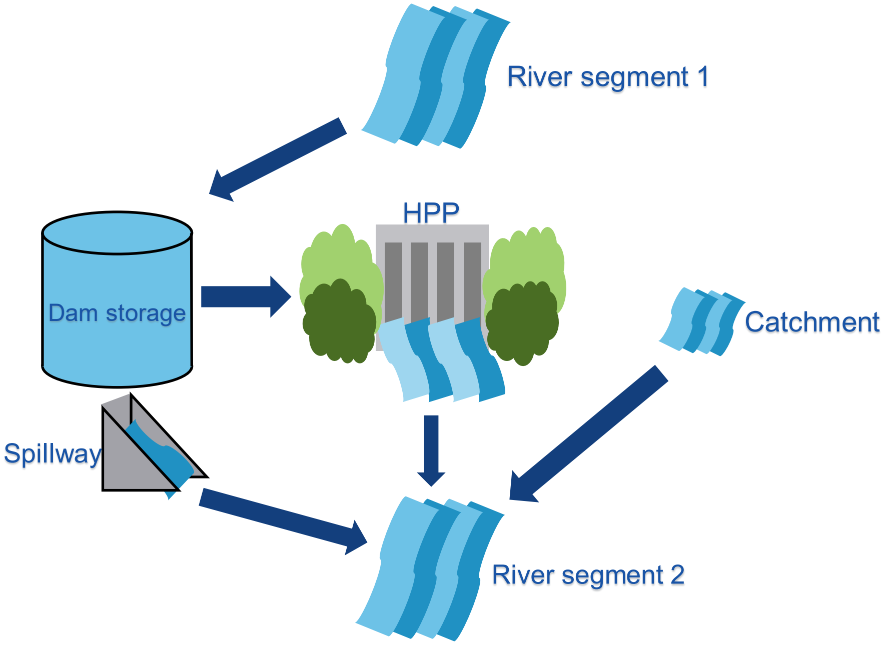


Methodology – cascade representation

- Development of a Drina Hydro-cascade representation in the model
- Power production from hydropower plants within the Drina River Basin based on:
  - Water availability
  - Rules of operation
  - Environmental flows
  - Useful storage volumes and discharge rates



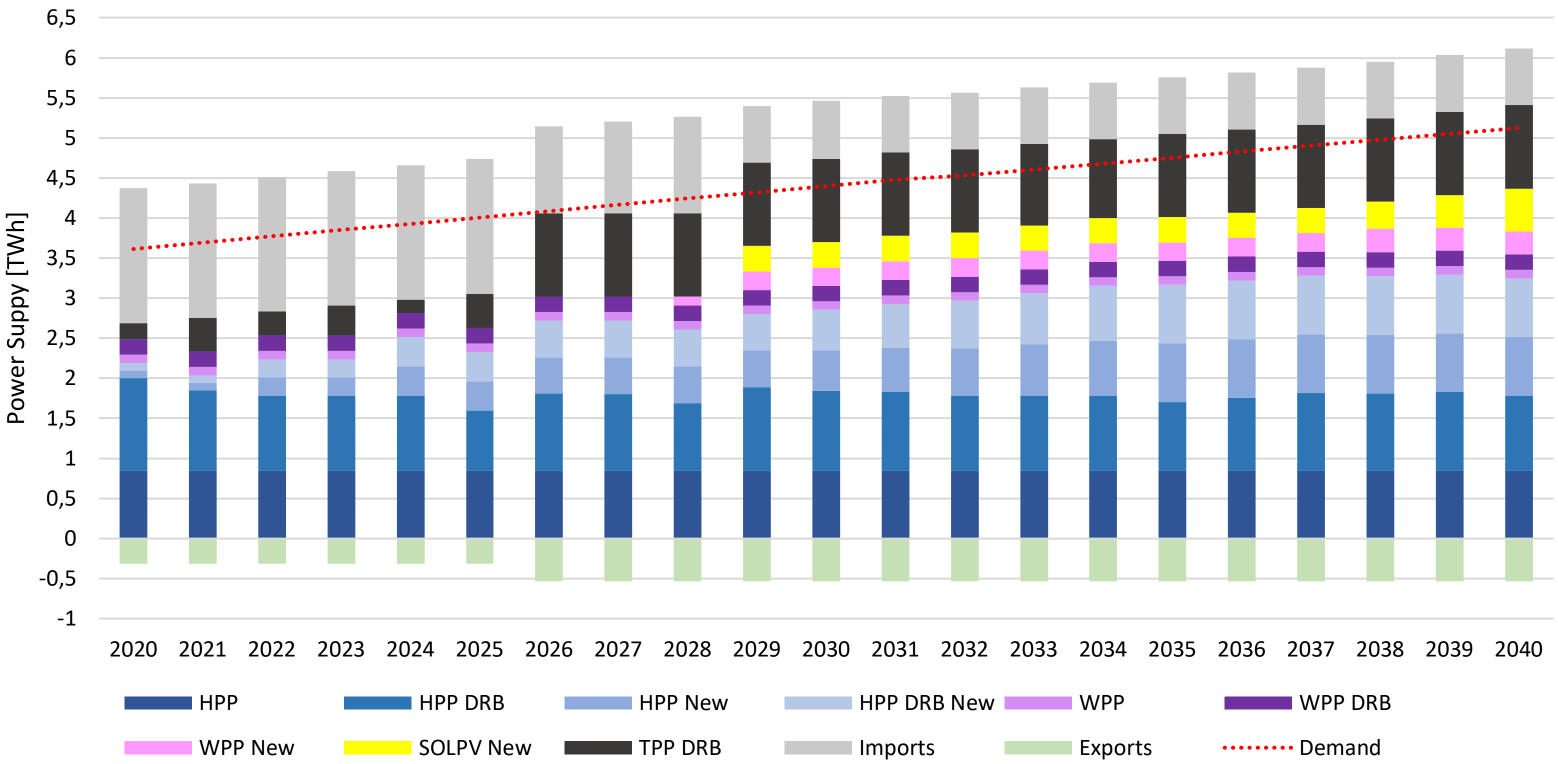
Methodology – cascade representation



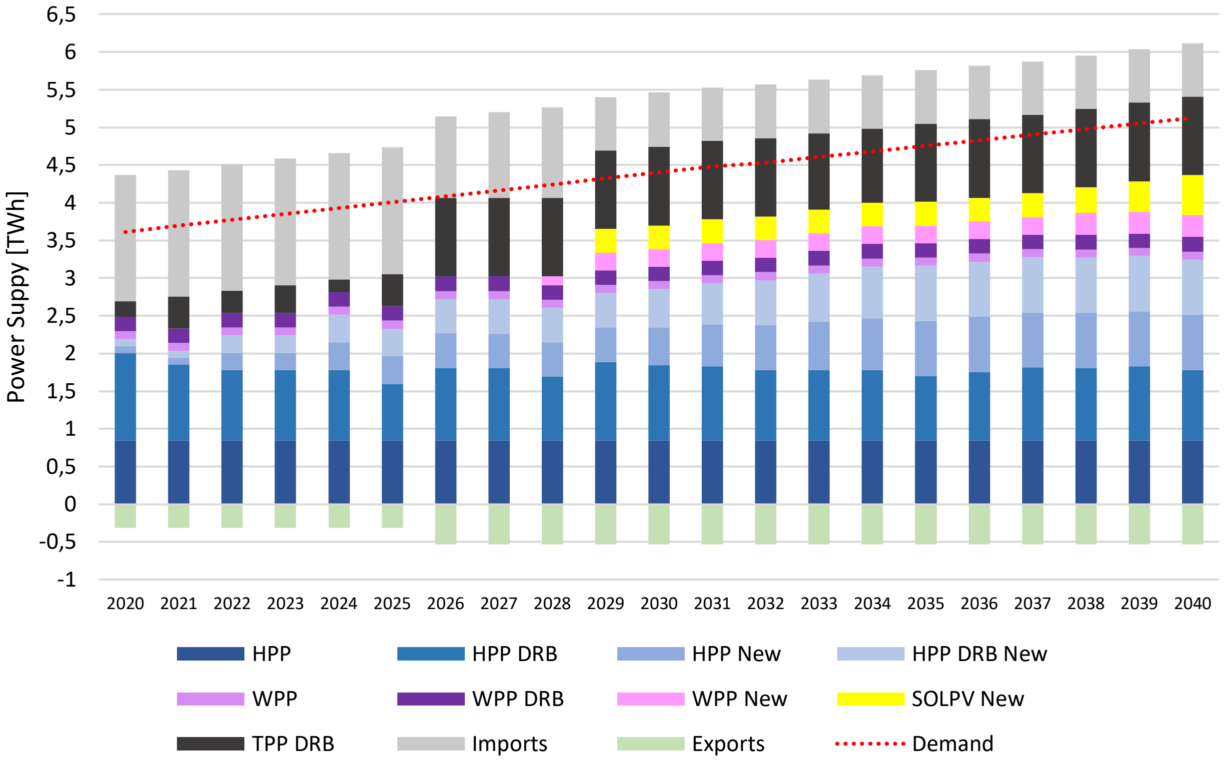
- Floods and droughts controlled by upstream river segments and catchments
- Considers water availability, operational rules, environmental flows
- Discharges [m^3/s] for *normal years* based on monthly multi-year average flows
- **Inputs**: dam storage [MCM], monthly discharges [m^3/s], spillway capacities [m^3/s], water needed for power production [m^3/kWh]

Preliminary results

Power production, imports and exports - Montenegro 2020-2040



Power production, imports and exports - Montenegro 2020-2040

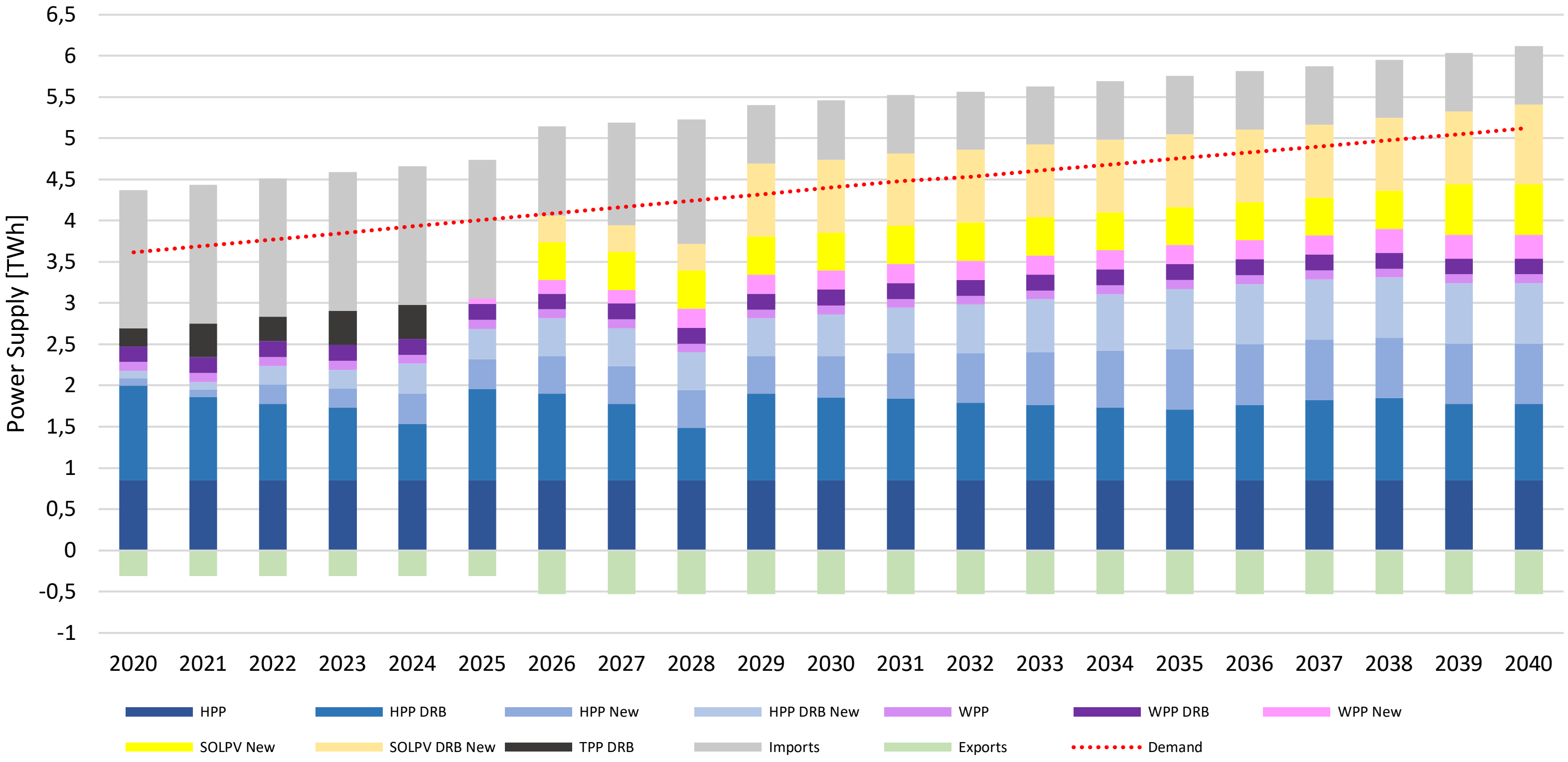


New RES additions:

- Wind: 125 MW
- Hydro: 320 MW
- Solar: 513.5 MW

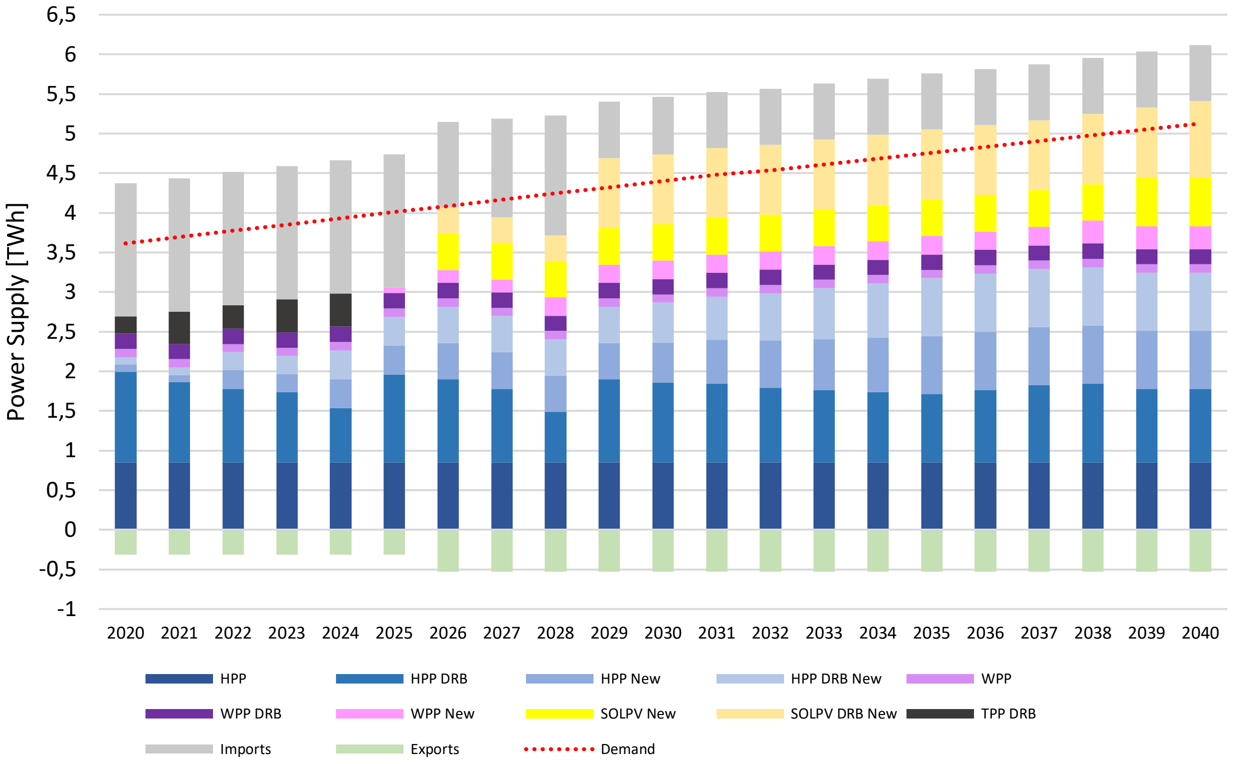
Power production, imports and exports - Montenegro 2020-2040

TE Pljevlja – Decommissioned in 2025



Power production, imports and exports - Montenegro 2020-2040

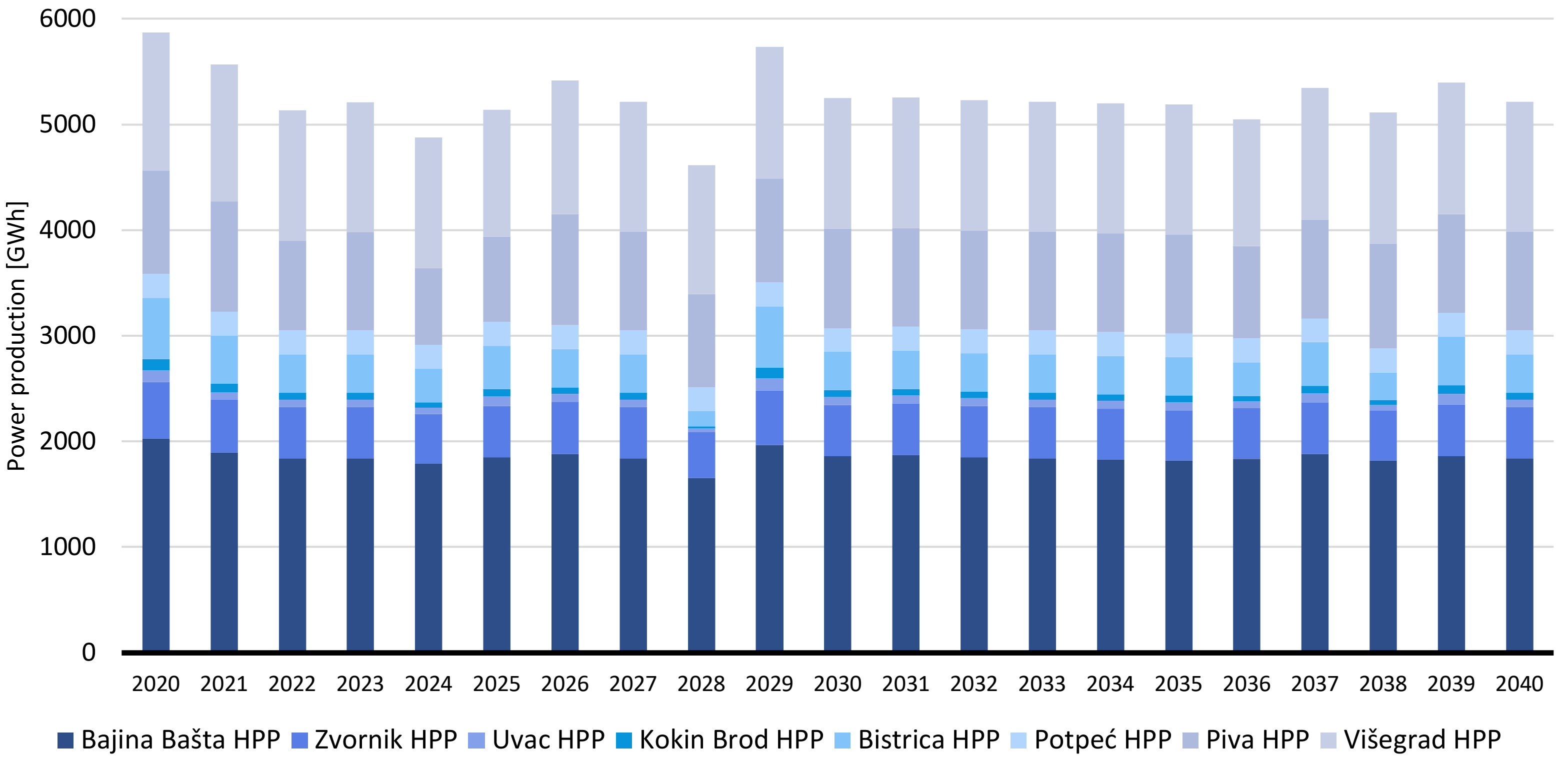
TE Pljevlja – Decommissioned in 2025



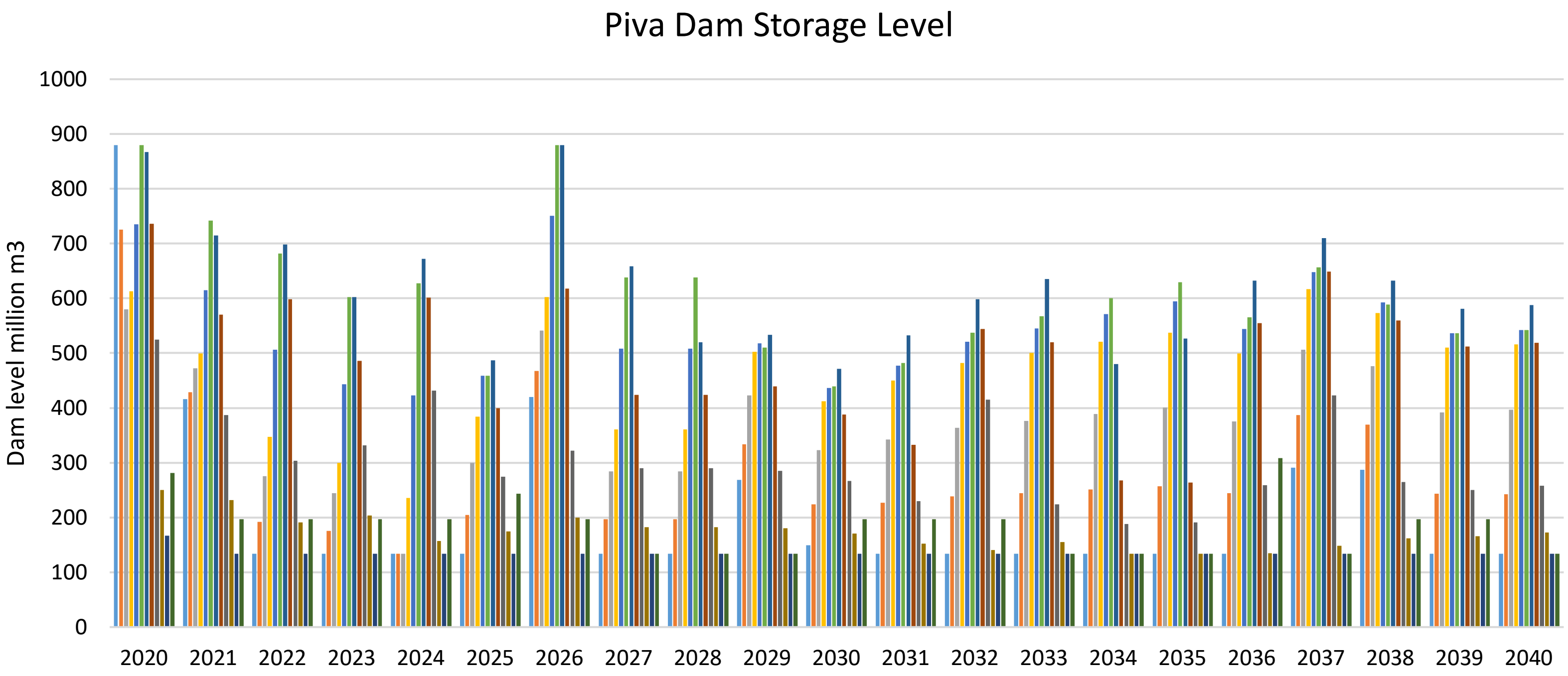
New RES additions:

- Wind: 125 MW
- Hydro: 320 MW
- Solar: 1082 MW

Production by HPPs in the Drina River Basin 2020-2040



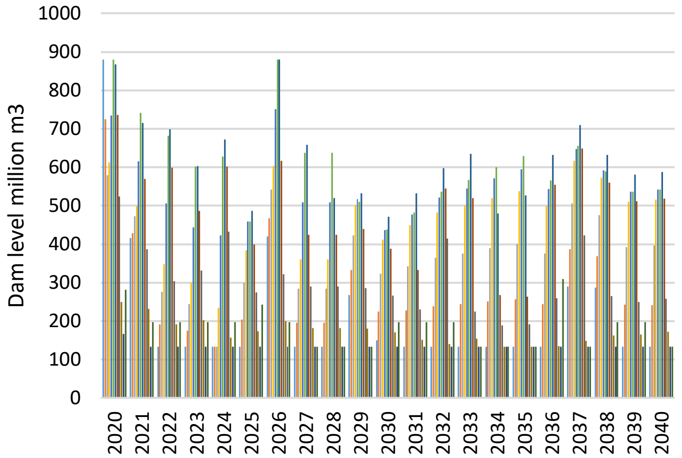
Dam storage levels example - 2020-2040



Dam storage levels example - 2020-2040

Obtained calibrations for the period 2020-2040 for HPPs within the Drina River Basin Cascade include:

- Yearly discharge of water through the turbines, i.e., water used for power production [million m^3/year]
- Discharge of water through the spillways [million m^3/year]
- Inflow to the dam storage [million m^3/year]
- Cost of power production [million USD/year]
- Power production [GWh]



Drina River Basin nexus assessment - Phase II

National Consultation meeting

KTH – Royal Institute of Technology:
Emir Fejzić
Youssef Almulla
Dr. Vignesh Sridharan
Dr. Francesco Gardumi