

# Multi-criteria based selection of RES technologies design of „optimal“ RES mix

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**2nd Regional Exchange of Modelling Experts involved  
in the Development of Integrated National Energy  
and Climate Plans (NECPs) in SEE Countries**

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## ***1. Problem definition***

- Projection of electricity demand with EE measures and electrification of H/C and transport
- Targets for RES share - % and GWh increase of RES-E
- Identification of potential RES-E projects: SHPP, RoR HPP, PSHPP, sHPP, WPP, UPV, DPV, mPV, bioTPP, CHP
- ***Scenarios development*** (Least Costs Planning with balancing and load frequency control (LFC) constraints, Multi-objective scenario development)
- ***Multi-criteria Analysis of scenarios, Multi-criteria Decision Making***

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## **2. Multi Criteria Decision Making (MCDM) Methods**

- E. Triantaphyllou, „*Multi-Criteria Decision Making Methods: A Comparative Study*“, Springer 2000 (WSP, WSP, AHP, ELECTRE, TOPSIS)
- J. Lu, G. Zhang, D. Ruan, F. Wu, “*Multi-Objective Group Decision Making Methods, Software and Applications With Fuzzy Set Techniques*“, ICP 2007
- **MCDM** is a sub-discipline of operations research that **explicitly evaluates multiple conflicting criteria** in decision making. Conflicting criteria are typical in evaluating options: **costs** or price is usually one of the main criteria, and some measure of „quality“ are typically **another criteria, usually in conflict with the cost.**

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### ***3. MCDM support for planning „optimal“ RES mix***

- M.L. Kamari etc., „*Applications of multi-Criteria Decision-Making (MCDM) Methods in Renewable Energy Development: A Review*“, RERA 2019
- Criteria for RES technology selection: ***Economic, Technical, Environmental, Socio-political, Risk*** (AHP/ANP, TOPSIS)
- RES mix/portfolio development scenarios - quantitative assessment
- Simplified scenario assessment using criteria: LCOE for RES technology, system LCOE, balancing and LFC constraints.

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***4. The case of BH NECP first draft***

- TFEC (- self consumption of TPP and industrial CHP) (i.e. in 2030 = 14.000 GWh)
- RES-E 2030 NECP target: increase from 6.500 GWh to 9.500 GWh (with average hydrology)
- Short term and long term variability (WWS nexus)
- LCOE (with projection of trends)
- Balancing and LFC constraints (i.e. 840 MW WPP and 825 MW PV, or max. 5% PV and 10% WPP in TFEC)
- Preference for DPV and mPV-prosumers (50% of PV energy)

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## ***5. Discussion and further activities***

- Exchange of information: investment costs, load factor, equity and loan costs, WACC, LCOE for RES technologies (IRENA studies)
- Multi-objective scenarios development methodology (i.e. job creation, regional development, location, ownership)
- Decision making support. Optimization software (i.e. Times/Markal), Simulation software (i.e. EnergyPlan)
- Balancing and frequency regulation constraints – national v.s. regional approach (software ?)
- Review of the regional studies (SEERMAP, IRENA REmap, EnC, EC, WB/IFC, Agora Energiewende)



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**THANK YOU !!!**