



South East Europe workshop on grid integration of variable renewable energy sources

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RES integration

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Energy and power sector planning framework

Strategies and Plans by Government of Republic of Macedonia and Ministry of Economy

- **Strategy for Energy Development in the Republic of Macedonia by 2035**, MANU, 2016
- **Strategy for utilization of renewable energy sources in the Republic of Macedonia by 2020**, Ministry of Economy, 2010
- **Decision for total installed capacity of preferential RES generators**, Government of Republic of Macedonia, 2013 година
- **Renewable energy action plan for the Republic of Macedonia until 2025 with vision until 2030**, Government of Republic of Macedonia, 2015 година

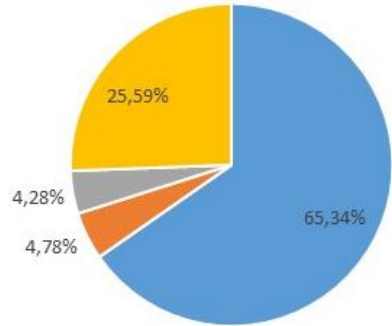
Study prepared by MEPSO

- **Study on the Integration of Wind Power Plants into the Macedonian Transmission System** – KEMA, 2011
- **Study on the forecast balance of electricity and power for long term and analysis of the adequacy of the transmission network in the Republic of Macedonia** - EIHP, 2016
- **Study for concepts of development the transmission network in certain regions for long-term period** - EIHP, 2017
- **Study for assessment of total costs for integration of RES in Macedonia** - EIHP, 2017

identification of different types of RES

condition 2015 and optimistic scenario

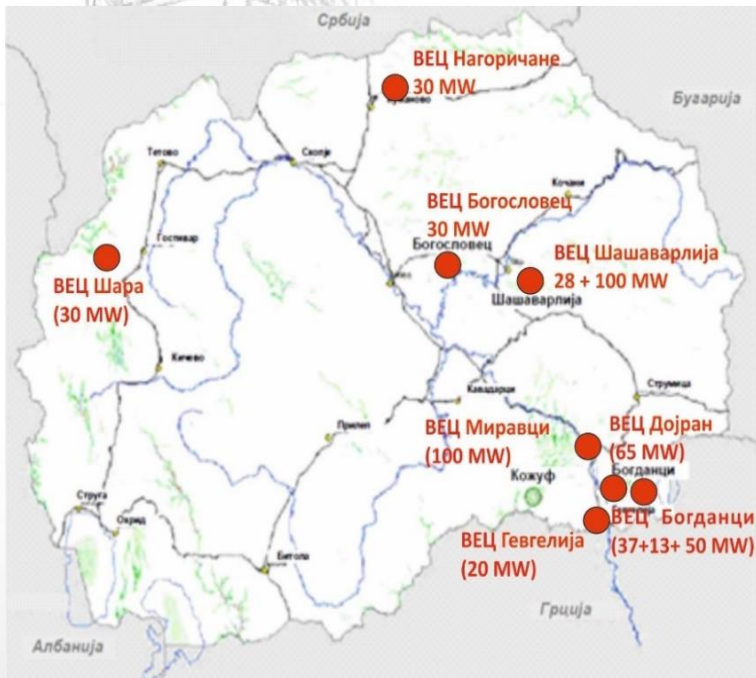
RES in Republic of Macedonia – year 2015



Participation in individual RES in the total production from RES in 2015

- Small HPP
- PVPP
- Biogass
- WPP

Type of RES	Installed capacity (MW)	Production (GWh)
WPP	36,8	120,8
PVPP	3,65 (less than 50 kW) 13 (from 50 kW to 1000 kW)	22,6
Biogas TPP	3,999	20,2
Biomass TPP	-	-
Small HPP	109	308,4



Analyzed locations of the new WPP

RES in Republic of Macedonia – future state

year	WPP	PVPP (start with 16,7 MW)
2020	50 MW	+25 MW
2025	108 MW	+50 MW
2030	228 MW	+150 MW
2040	503 MW	+250 MW

development of Macedonian power system

Forecast of consumption of electricity by 2040



- SCENARIO A : high demand increase (3,1%/year to 2,7%/year);
- SCENARIO B : low demand increase (2,5%/year to 0,9%/year);
- SCENARIO C : high demand increase (3,1%/year to 2,7%/year) and new industry;

Scenarios for development of power plants by 2040

year	2016		2020		2025		2030		2040	
Scenario	Installed capacity (MW)	Production per year (GWh)	Installed capacity (MW)	Production per year (GWh)	Installed capacity (MW)	Production per year (GWh)	Installed capacity (MW)	Production per year (GWh)	Installed capacity (MW)	Production per year (GWh)
„business as usual“	1.983	5.271	1.931	5.577	1.946	6.676	2.574	9.305	3.353	10.608
„coal-lignite“	1.983	5.271	2.051	6.401	2.246	8.676	2.874	11.305	3.653	13.108
„gas“	1.983	5.271	1.931	5.577	2.176	8.276	3.104	12.405	3.653	12.108
„green“	1.983	5.271	1.938	5.612	1.958	6.734	2.628	7.738	2.953	7.872

development of Macedonian electricity market

Feed-in Tariff

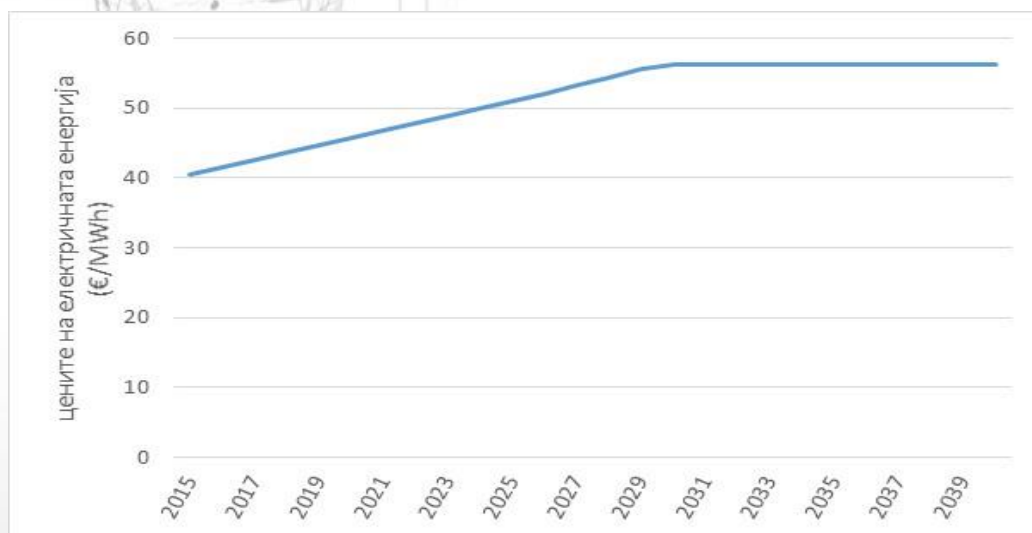
Renewable Technology	Install capacity	Applicable to Production to: (kWh/month)	Feed-in tariff (€/kWh)	Fixed Tariff Period
Small Hydropower	10 MW	85,000 - 170,000 - 350,000 - 700,000 - above 700,000	12.00 - 8.00 - 6.00 - 5.00 - 4.50	20 Years
Wind-power	50 MW	All	8.9	20 Years
Solar	1 MW	Less than 0.05 MW	16	15 Years
		More than 0.05 MW	12	
Biomass	3 MW	All	15	15 Years
Biogas	/	All	18	15 Years

Assumption on evolution of feed-in tariffs:

WPP: 71 €/MWh after year 2025

PVPP: 85 €/MWh after year 2025

Forecast on electricity wholesale price in MK

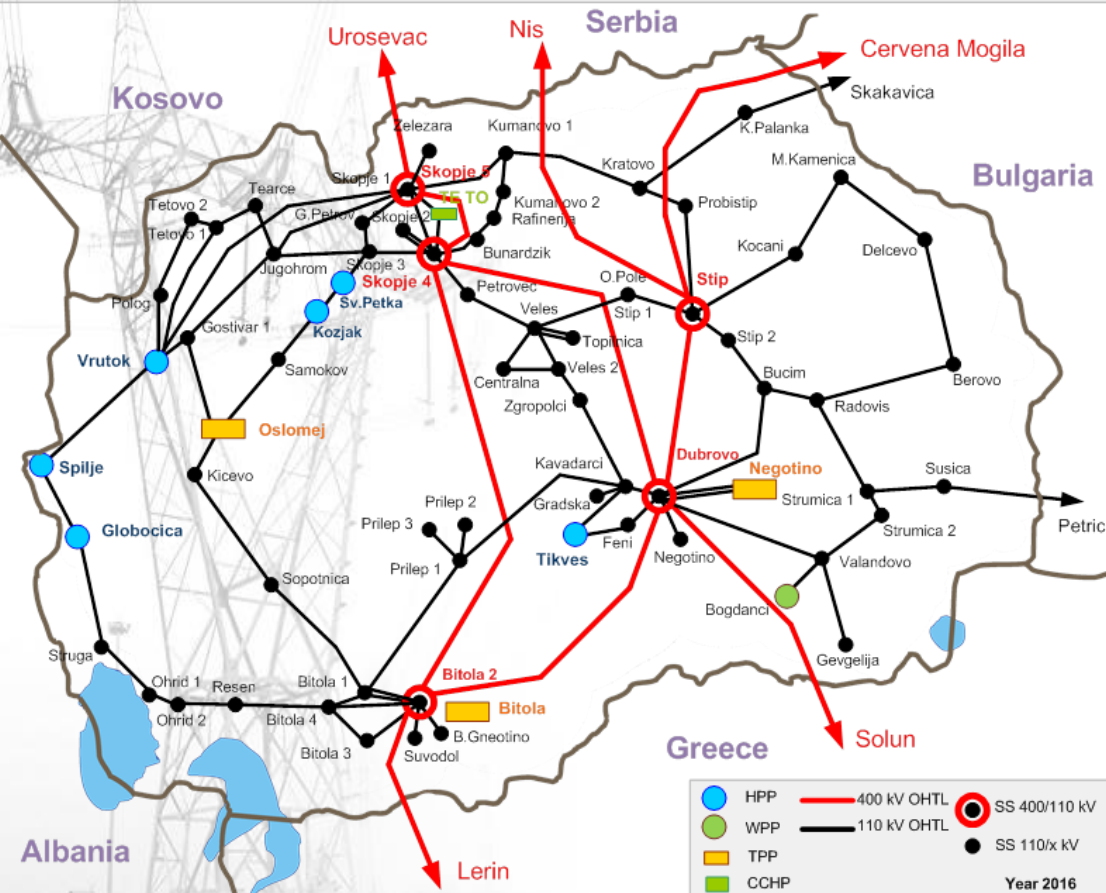


- € **40,6 €/MWh for existing state**
 - ▲ Average reference price at HUPX DAM
- € **45,7 €/MWh for year 2020**
 - ▲ Energy process and costs report, European Commission, 2014
- € **51,0 €/MWh for year 2025**
 - ▲ Interpolation of 2020 and 2030
- € **56,2 €/MWh for year 2030 and beyond**
 - ▲ SECI TSP Study on SEE Electricity Market Perspectives until 2030

methodology for estimate the impact of the RES integration on power system

Integration of WPP and PVPP in power system:

1. Impact on transmission network
2. Impact on system reserves
3. Impact of the costs of preferential RES on electricity price



Impact on transmission network (2020-2040)

- Upgraded the existing as a double circuit 110 kV transmission line SS Valandovo – SS Dubrovo with new conductor type AAAC-Z
- Upgraded the existing as a double circuit 110 kV transmission line SS Valandovo – SS Strumica 2 – SS Strumica 2 with new conductor type AAAC-Z

methodology for estimate the impact of the RES integration on power system

Impact on increase of transmission tariff due to integration of RES (2020 – 2040)

Year	Transmission tariff increase (€/MWh)		
	Scenario A	Scenario B	Scenario C
2020	0,61	0,64	0,61
2025	1,72	1,83	1,60
2030	1,91	2,11	1,71
2040	3,06	3,96	2,81

Existing transmission tariff:
4.24 €/MWh

Estimations of system reserves for RES (2020 – 2040)

Secondary reserve (aFRR)

- ▲ Will be kept at existing level, up to ± 41 MW

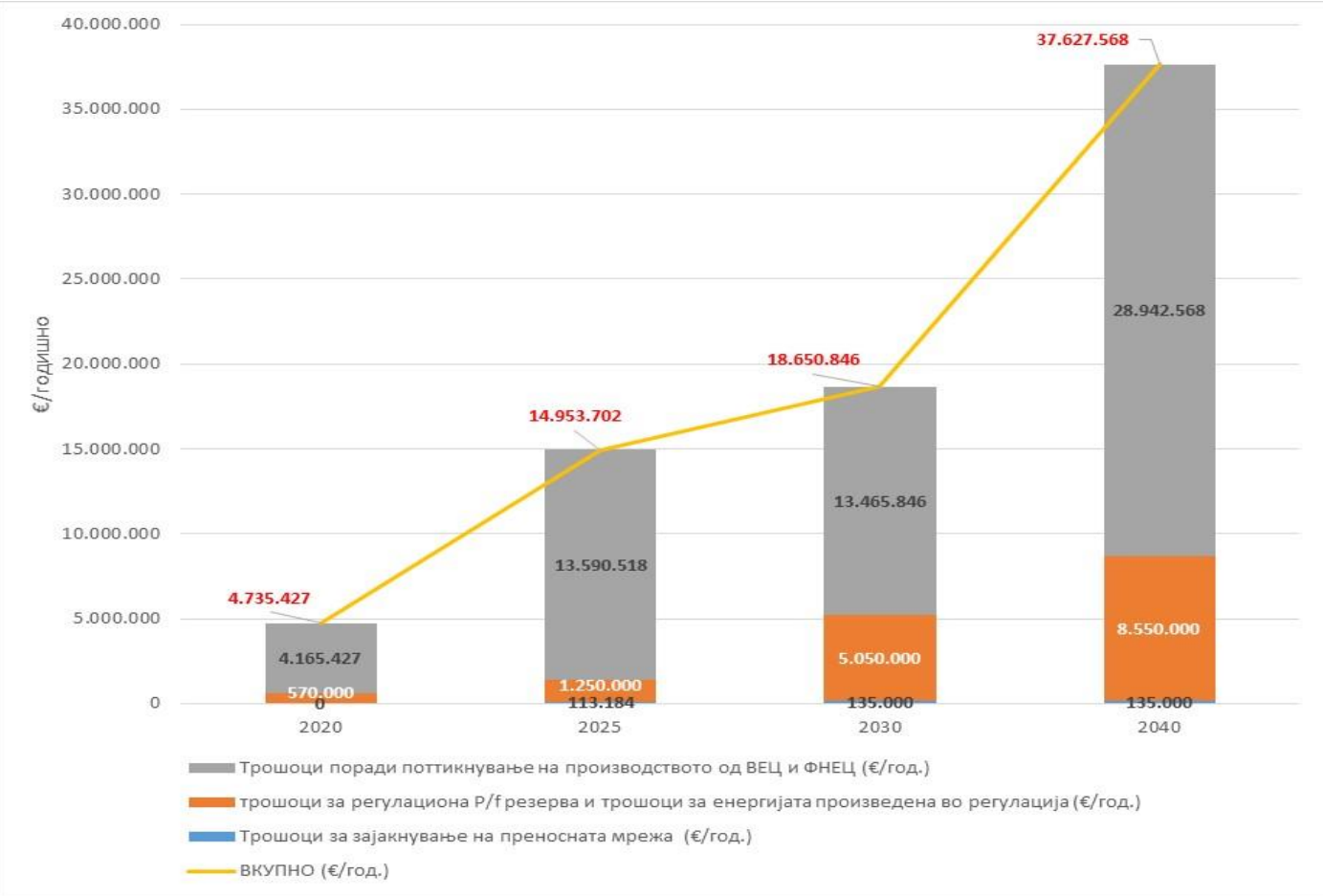
Fast tertiary reserve (mFRR)

- ▲ 2020: ± 111 MW
- ▲ 2025: ± 113 MW
- ▲ 2030: ± 116 MW
- ▲ 2040: ± 146 MW

Impact of WPP & PVPP

- ▲ 2020: ± 4 MW
- ▲ 2025: ± 6 MW
- ▲ 2030: ± 9 MW
- ▲ 2040: ± 39 MW

total costs due to RES integration (2020 – 2040)



- Total (€ /year)
- Costs for transmission network (€ /year)
- Costs for system reserve (€ /year)
- Costs for encouraging production from WPP and PVPP (€ /year)

conclusions

Ⓢ **All power system users have not financial responsibility for their unbalances, i.e. balancing mechanism is not defined in appropriate way**

Ⓢ **Short term (year 2020)**
WPP 50 MW / PVPP 41.7 MW

- ▲ MEPSO and ELEM should agree the system services for secondary and fast tertiary regulation
- ▲ ERC to approve the agreement and the cost to be valorized in transmission tariff
- ▲ To decrease the unbalances of TPP and HPP

Ⓢ **Mid term (year 2025)**
WPP 108 MW / PVPP 66.7 MW

- ▲ Continually to improve the production forecast of WPP and PVPP
- ▲ In case of lack of secondary and fast tertiary reserves, to find the possibilities to partially supply the reserves in the SMM control block

conclusions

Long term (years 2030 and 2040)

WPP 228 MW / PVPP 166.7 MW and WPP 503 MW / PVPP 266.7 MW

- ▲ With timely realization of projects for new accumulation HPPs and new TPPs, and with sharing and exchange of control reserves with neighboring control areas, MEPSO should not expect problems with lack of system services for balancing the production of WPPs and PVPPs
- ▲ If planned projects are not realized than the new assessment of RES integration possibilities shall be carried out
- ▲ If planned projects are not realized than MK should estimate technical possibilities and financial consequences of engagement of gas TPPs (new coal TPPs as well) in provision of system services for secondary and fast tertiary regulation

Thank you