

SLED Electricity Sector Scenario Assessment

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Outline of the presentation

1. Model applied
2. Scenarios
3. Main assumptions
 - 3.1. Demand
 - 3.2. RES assumptions
 - 3.3. CO2 pricing and its impacts
4. Results
 - Prices
 - Generation mix
 - Carbon emissions
 - RES support costs
 - Investment costs

Methodology

Assessed countries: Albania, Macedonia, Montenegro, Serbia

The SLED analysis is based on assessing three scenarios:

- Reference scenario (REF);
- Currently Planned Policies (CPP);
- Ambitious Climate Scenario (AMB).

Scenario assumptions were related to six dimensions:

- carbon value;
- energy/excise tax;
- environmental standards;
- deployment of renewable energy technologies;
- deployment of conventional generation technologies; and
- electricity demand (integrating assumptions on end-use energy efficiency improvement).
- Main tools: European Electricity Market Model of REKK and Network model of EKC
- WEB: <http://sled.rec.org/electricity.html>

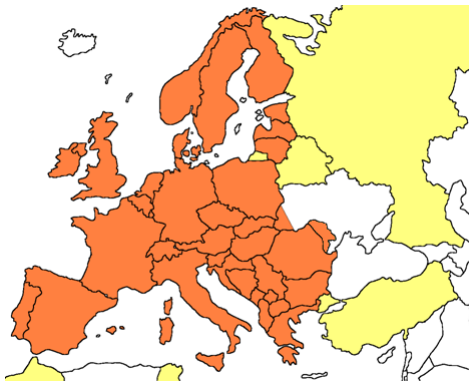
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Introduction

- Highlights:
 - Electricity trade is modelled within the whole EU and EnC countries
 - Hydro generation is modelled under average rainfall conditions, but in the sensitivity assessment the impacts of dry years are also simulated
 - Benchmark costs on investment are used
 - RES supports are calculated – based on global investment cost trends
 - Country assessments and regional assessments were carried out:
 - Regional assessment – on harmonised policies
 - It also includes Bosnia and Herzegovina

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Model functionality

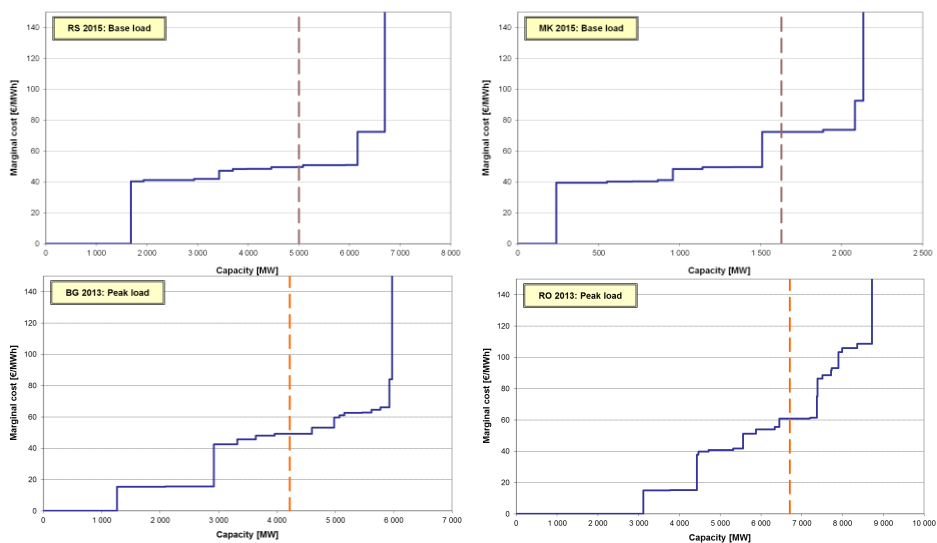


Comments:

- ▶ The map shows the main results of the model:
 - ▶ Competitive market equilibrium prices by countries
 - ▶ Electricity flows and congestions on cross-border capacities
- ▶ 36 countries are handled in the model.
- ▶ Morocco, Tunisia, Turkey, Moldova, Russia and Belarus are considered as exogenous markets
- ▶ In these markets the net export position are equal with the fact in 2013 (assumed a baseload flow)
- ▶ The model is calculating the marginal cost of around 5000 power plant blocks and sets up the merit order country by country.
- ▶ Taking into consideration the merit order and exports/import, the model calculates equilibrium prices.
- ▶ Power flow is ensured by 85 interconnectors between countries.

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Merit order curves - examples



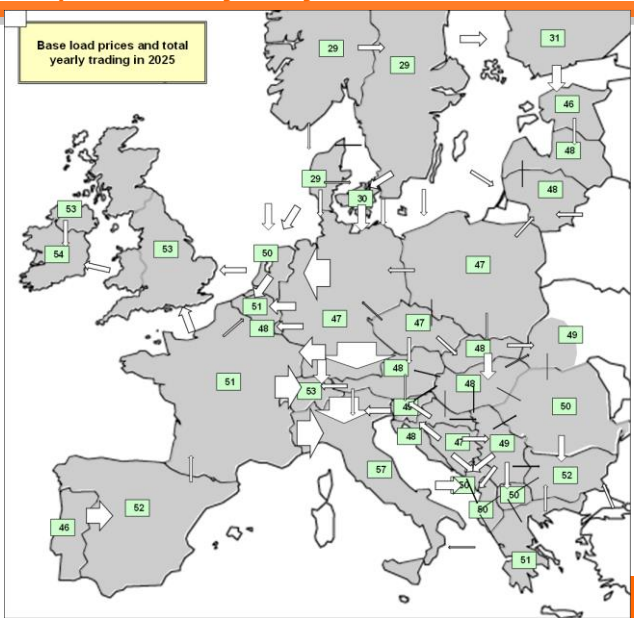
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Modelled baseload prices in 2015
(€/MWh), and the yearly trade flows



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Modelled baseload prices in 2025
(€/MWh), and the yearly trade flows



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2. Scenarios

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SLED Scenario definition - Reference Example of Montenegro

	Scenario assumptions	Reference GHG scenario (REF)
Taxation	Introduction of EU ETS	ETS to be introduced in 2025
	Introduction year of minimum excise duty	Year of introduction: 2020
Electricity supply	Enforcement of environmental standards (LCP Directive)	Due to requirement of LCPD directive Pljevlja I closes in 2023.
	RES-E deployment	NREAPs : 826 MW Hydro, 151 MW wind, 10 MW PV and 29 MW Biomass by 2020. By 2030: 826MW Hydro, 190 MW wind, 32 PV and 39 MW Biomass
	Conventional capacity developments	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023. Maoce TPP will not be built. FOR LCPD: Pljeva I will operate till 2023 (20000 hours between 2018 and 2023)
Electricity demand	Electricity demand KAP	According to 2014 May Strategy (KAP operates with two lines at 100% capacity from 2019) Means 100% total presently installed capacity (A and B line).

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SLED Scenario definition- CPP, AMB – Example of Montenegro



	Scenario assumptions	Currently planned policies GHG scenario (CPP)	Ambitious GHG policy scenario (AMB)
Taxation	Introduction of EU ETS	CO ₂ cost in 2020 is 40 % of the ETS price, from 2025 ETS is introduced	ETS to be introduced in 2020
	Introduction year of minimum excise duty	Year of introduction: 2020	Year of introduction: 2018
Electricity supply	Enforcement of environmental standards (LCP Directive)	Due to requirement of LCPD directive Pljevlja I closes in 2023.	Due to requirement of LCPD directive Pljevlja I closes in 2023.
	RES-E deployment	NREAPs : 826 MW Hydro, 151 MW wind, 10 MW PV and 29 MW Biomass by 2020. By 2030: 826MW Hydro, 190 MW wind, 32 PV and 39 MW Biomass	NREAPs : 826 MW Hydro, 151 MW wind, 19 MW PV and 29 MW Biomass by 2020. By 2030: 1267 MW Hydro, 229 MW wind, 32 PV and 64 MW Biomass
	Conventional capacity developments	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023.. For LCPD: Pljeva I will operate till 2023 (20000 hours between 2018 and 2023)	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023. For LCPD: Pljeva I will operate till 2023. 10 % biomass utilisation rate is assumed for Pljeva II.
Electricity demand	Electricity demand	KAP: 50% of the total installed capacity, according to the agreement on July 2015 stakeholder meeting. Only one line operating at 100%.	KAP: 50% of the total installed capacity, according to the agreement on July 2015 stakeholder meeting. Only one line operating at 100%.

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3.1. Demand

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Electricity consumption - Montenegro

GWh	2015	2016	2017	2018	2019	2020	2025	2030
REF	3 518	3 629	3 743	3 861	5 173	5 298	5 838	6 449
CPP	3 518	3 629	3 743	3 861	3 925	4 050	4 590	5 201
AMB	3 518	3 629	3 743	3 861	3 925	4 050	4 590	5 201

- Reference: consumption forecast of Energy Strategy (2014) is used
- In CPP and AMB scenarios KAP operates only at 50% of its total capacity (one production line) from 2018, which drives down electricity demand (assumption agreed on the July 2015 meeting)

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Electricity consumption

- Albania:

	GROSS CONSUMPTION GWh								
	2010	2011	2012	2013	2014	2015	2020	2025	2030
REF	6 970	7 342	7 617	7 700	8 179	8 229	9 550	11 138	12 990
CPP	6 970	7 342	7 617	7 700	8 153	8 153	9 165	9 165	10 918
AMB	6 970	7 342	7 617	7 700	8 153	7 909	9 121	9 095	10 857

- Macedonia

GWh	2015	2016	2017	2018	2019	2020	2025	2030
REF	8 224	8 214	8 204	8 194	8 184	10 251	12 040	14 262
CPP	8 224	8 223	8 221	8 220	8 218	8 210	8 946	9 580
AMB	8 115	8 115	8 115	8 115	8 115	7 646	8 224	8 750

- Serbia

GWh	2015	2016	2017	2018	2019	2020	2025	2030
REF	40 230	40 050	39 871	39 691	39 511	39 332	41 416	43 824
CPP	38 895	38 576	38 258	37 940	37 622	37 303	39 182	41 410
AMB	37 559	37 103	36 646	36 189	35 732	35 275	36 948	38 995

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3.2. Renewables developments

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Renewable electricity assumptions - Montenegro

Till 2020 we stick to the draft NREAP (2014) values in
the various RES-E technologies

Between 2020-2030:

- REF scenario: Hydro kept constant, rest of the technologies according to the Green book on Energy Strategy
- CPP scenario: Hydro kept constant, rest of the technologies according to the Green book on Energy Strategy
- AMB scenario: Hydro is allowed to further grow (Green Book assumptions), together with biomass

In this way capacity development is determined, while
production is forecasted by the model up till 2030
assuming country specific utilisation hour (solar and
wind) and average rainfall for hydro

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REFERENCE and Currently Planned Policy
scenario (CPP) capacity values (MW)

REF Scenario	2015	2016	2017	2018	2019	2020	2025	2030
Hydro*	661	744	753	821	826	826	826	826
Pumped storage	0	0	0	0	0	0	0	0
Geotherma l	0	0	0	0	0	0	0	0
Solar	3	6	7	8	9	10	22	32
Wind	0	118	126	126	151	151	172	190
Biomass	7	9	14	18	19	29	33	39

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AMBITIOUS scenario capacity values (MW)

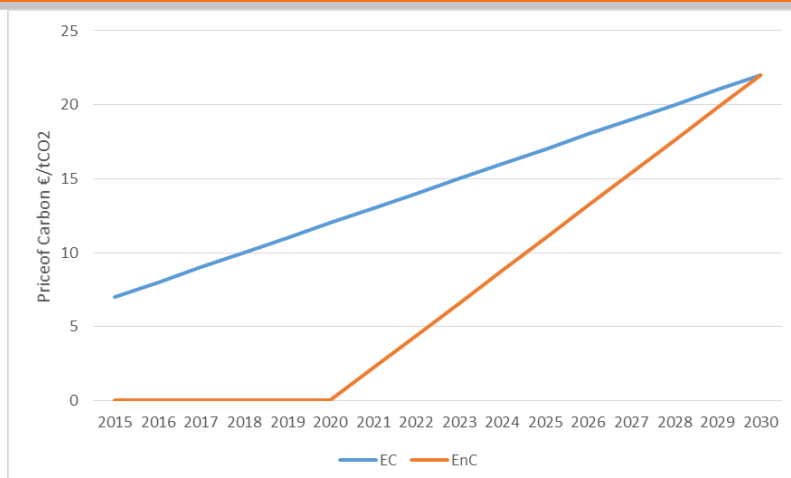
AMB Scenario	2015	2016	2017	2018	2019	2020	2025	2030
Hydro*	661	744	753	821	826	826	1 047	1 267
Pumped storage	0	0	0	0	0	0	0	0
Geotherm al	0	0	0	0	0	0	0	0
Solar	3	6	7	8	9	10	22	32
Wind	0	118	126	126	151	151	172	190
Biomass	7	9	14	18	19	29	57	64

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3.3. Carbon Pricing

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Carbon pricing assumption

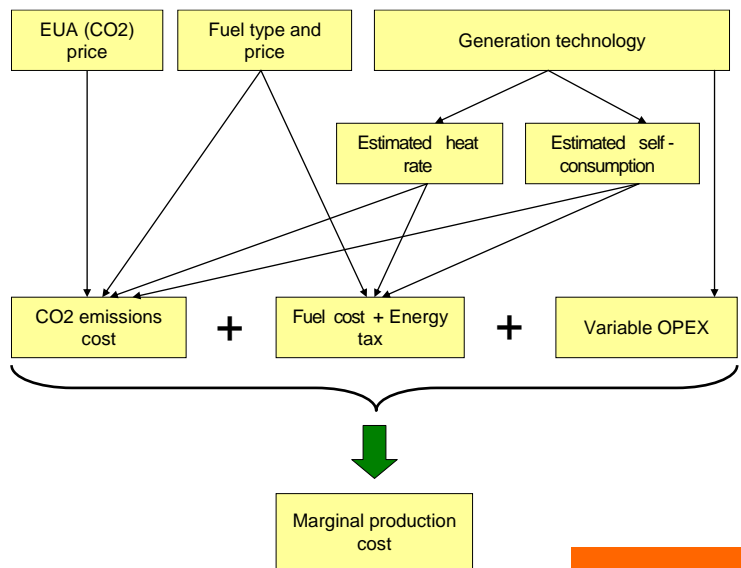


- EC Impact assessment gives a range of a carbon price of: 22-53 €/tCO₂ for 2030

Source SWD 2014(15)final

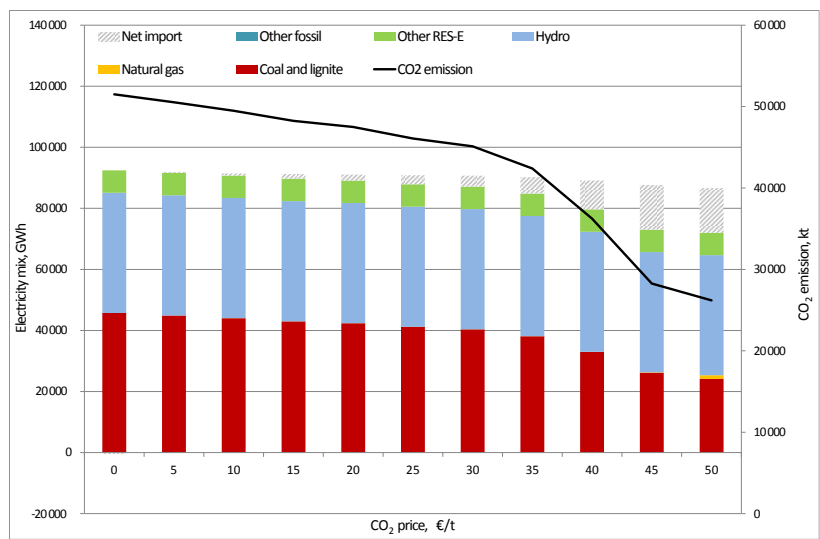
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Components of marginal cost



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Regional generation mix with different CO₂ prices in the AMB scenario (2030)

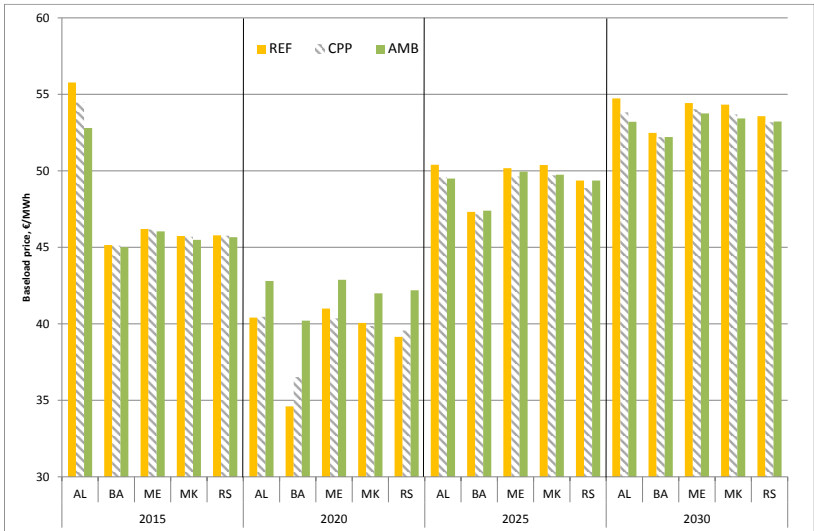


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- From 30-35 €/tCO₂ carbon price emissions start to decrease significantly
- Decreasing emissions from coal and lignite plants are replaced mainly by increasing import shares
- Gas starts to kick-in only at 50 €/tCO₂. This is due to the various impacts:
 - No competitive infrastructure
 - Less available gas capacities
 - Non competitive gas pricing in the region

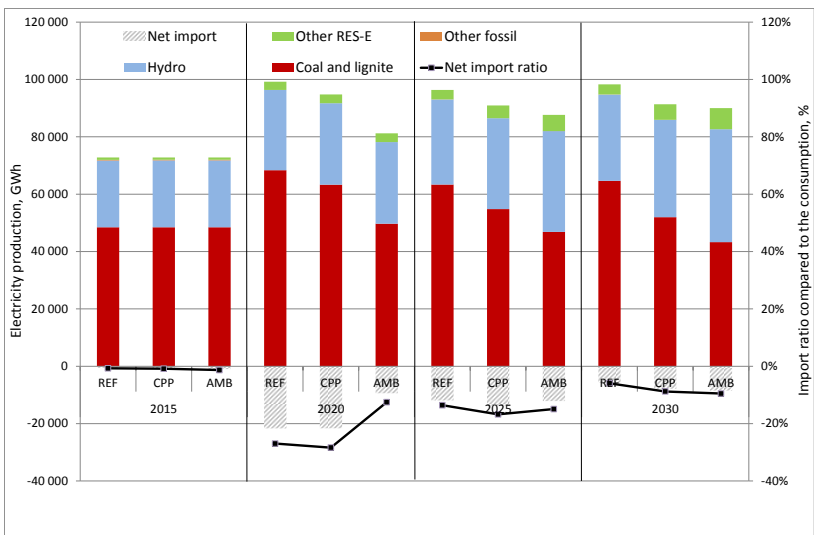
4. Main results

Wholesale baseload prices (€/MWh)



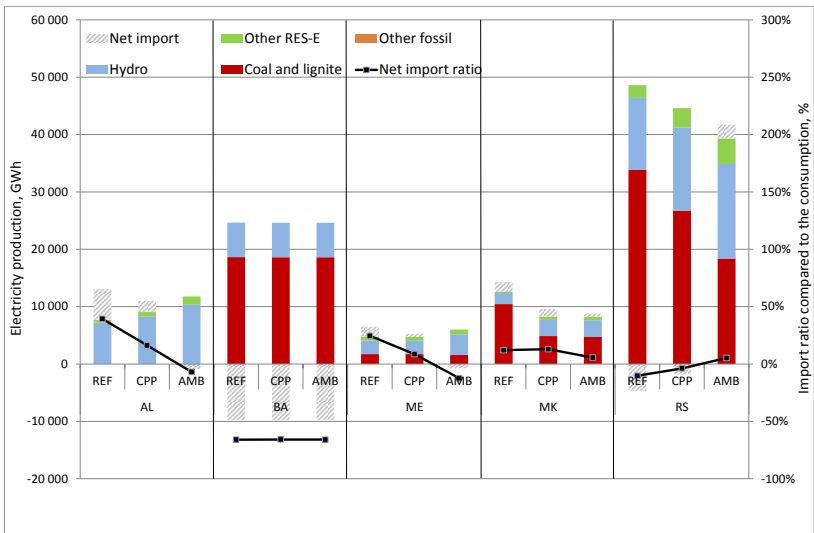
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Regional generation mix (BA, AL, ME, MK, RS) and net import



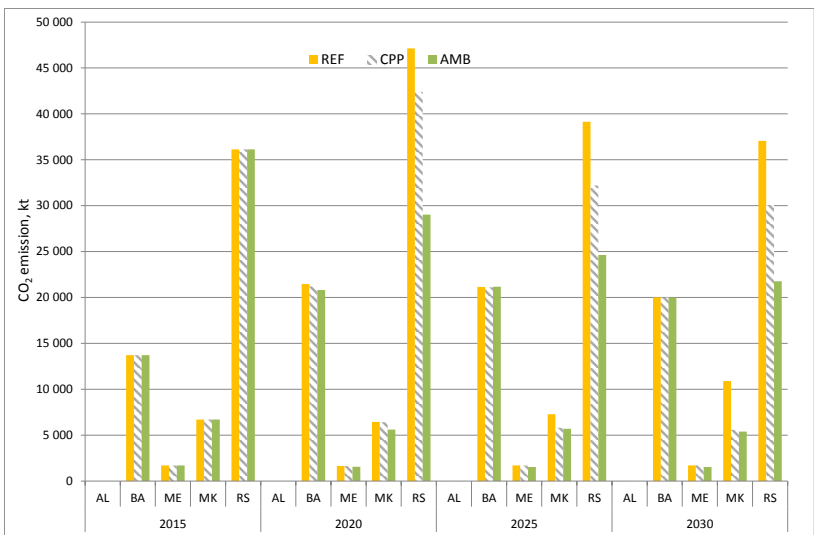
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Electricity mix in five countries (2030)



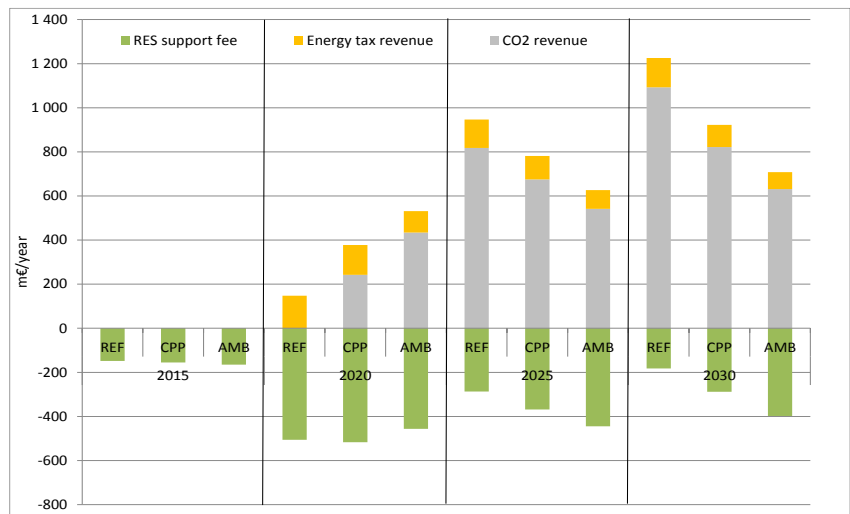
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CO₂ emissions in the five countries (2015, 2020, 2025 and 2030)



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RES expenditure vs Carbon revenues in the region



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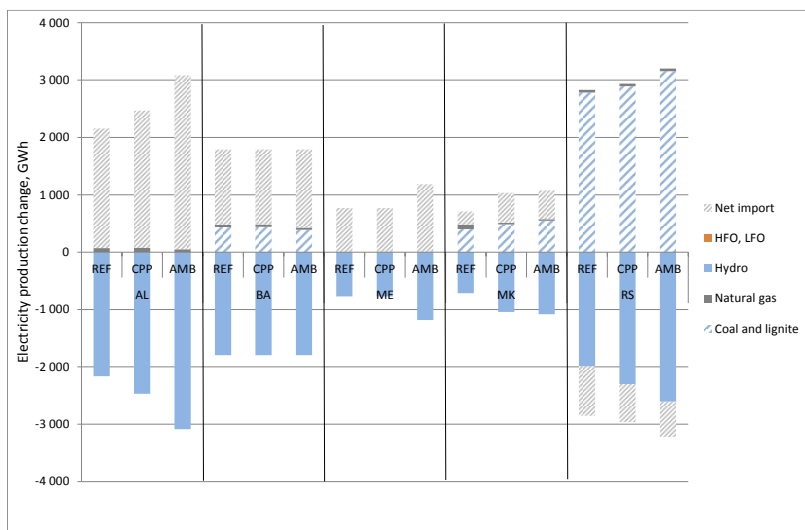
Investment cost needs

	Investment cost, €/kW	New capacity, MW			Investment cost, m€		
		REF	CPP	AMB	REF	CPP	AMB
Natural gas	1 000	1 920	1 480	1 480	1 920	1 480	1 480
Coal	2 000	5 049	3 254	1 999	10 098	6 508	3 997
Hydro	2 500	2 755	3 976	5 757	6 887	9 940	14 394
Geothermal	4 000	1	12	12	4	46	48
Solar	1 100	119	221	335	131	243	369
Wind	1 000	596	1 077	1 528	596	1 077	1 528
Biomass	3 000	209	319	461	626	957	1 383
Total	-	10 649	10 339	11 572	20 262	20 252	23 199

- The region faces significant investment needs in the future generation expansion: between 20-23 billion Euros
- Coal and lignite investments dominate in the REF scenario
- Hydro has the highest investments needs in the AMB scenario

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Generation mix change in the case of low hydro availability (2030)

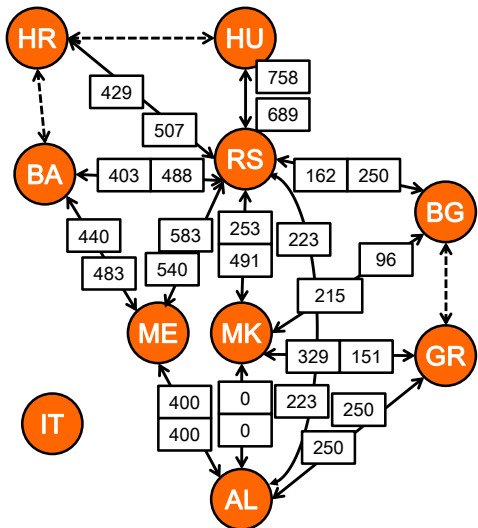


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Backup slides

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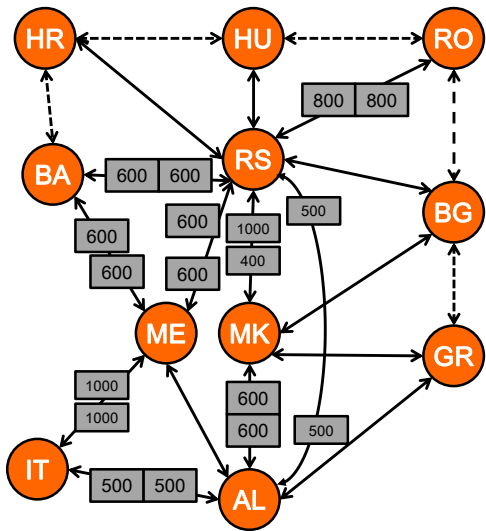
Present cross-border capacity



Origin and destination country		NTC value	
From	To	O → D	D → O
AL	MK	0	0
BA	RS	488	403
BA	ME	483	440
GR	MK	329	151
GR	AL	250	250
HR	RS	507	429
HU	RS	689	758
ME	AL	400	400
MK	BG	96	215
RO	RS	570	347
RS	ME	540	583
RS	MK	491	253
RS	AL	223	223
RS	BG	162	250

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Planned cross-border capacities



Country 1	Country 2	Year of commissioning	Investment status	O → D	D → O
RS	RO	2017	Approved	800	800
BA	ME	2023	Planned	600	600
IT	AL	2020	Planned	500	500
RS	MK	2015	Under construction	400	1000
MK	AL	2019	Planned	600	600
AL	RS	2016	Under construction	500	500
IT	ME	2018	Under construction	1000	1000
RS	BA	2022	Planned	600	600
RS	ME	2022	Planned	600	600

Under construction and approved categories are used in the model runs till 2030. IT-AL is not realised in the modelling period.

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Generation developments in the wider region

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Assumed capacities

Present installed capacity in the Region

	Coal and lignite	Natural gas	HFO/LFO	Hydro	Wind	Biomass	PV	Total
AL	0	0	0	1 801	0	5	2	1 807
ME	210	0	0	661	0	7	3	881
MK	824	290	210	644	37	0	15	2 020
RS	4 672	0	0	2 357	0*	1	7	7 037

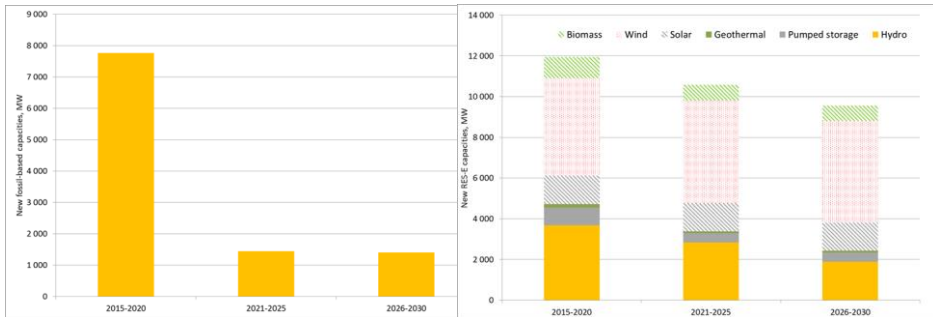
- Serbia is the biggest producer in the region followed by Macedonia
- Hydro generation presents very high shares compared to EU average shares (E.g. Albania, Montenegro)
- Natural gas has limited role in the regional generation mix

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New PPs in the wider region*

New coal-based power generation, MW

New RES-E generation capacity, MW



Region includes the following countries: AL; BA; BG; GR; HR; HU; ME; MK; RS; RO;

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Wholesale price evolution

- The main factors influencing the wholesale price developments in the region are the followings:
 - Generation expansion in the fossil based generation in the region is high. Over 7000 MW capacity (mainly lignite and coal) is built in the countries: AL; BA; BG; GR; HR; HU; ME; MK; RS; RO according to the national plans
 - New RES capacities above 12000 MW are also contributing to the price drop till 2020.
 - Higher interconnectedness in the region also allows trade of electricity (higher NTC)
- This development has impact on both baseload and peakload electricity wholesale prices: they have a significant drop between 2015-2020, followed by a continuous increase in the later periods.

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