Grenzüberschreitender Ausbau von Erneuerbaren Energien in der CESEC-Region

(Central and South Eastern Europe energy connectivity)

EnInnov 2022

Lukas Liebmann, Gustav Resch

The study

"Study on the Central and South Eastern Europe energy connectivity (CESEC) cooperation on electricity grid development and renewables"

Objective: To provide significant and practical contributions towards facilitation of the integration of renewable energy sources (RES) in the CESEC region

through

Approach: Analysis of studies, data & projects
Cross-verification with relevant (national) data
Modelling
Stakeholder consultation
Interviews

1. **Highest-potential renewable energy zones** with cross-border dimension
2. **Infrastructure** and **interconnection needs** to ensure RES integration in the CESEC region
3. **Challenges and barriers to RES deployment and cross-border cooperation** in the CESEC region
4. **Conclusions & recommendations**

The team

CESEC team

Content manager
Gustav Resch
(TU Wien)

Process manager
Marie-Jose Zondag
(Ecorys)

Quality Control
Monique Voogt
(SQ Consult)

1. Renewable energy potential
Gustav Resch
Lukas Liebmann

2. Infrastructure needs & potential projects
Laszlo Szabo & Karsten Lüdorf
András Mezősi, Enikő Kácsor,
Alfa Diallo

3. Barriers for implementation
Jenny Winkler
Ammar Maghnam
Hazem Abdel-Khalek

4. Conclusions & recommendations
Marie-Jose Zondag
Iulia Falcan
Laura Heidecke

5. Stakeholder involvement
Marie-Jose Zondag
Laura Heidecke
Yoeri Dijkhof

1. Highest-potential renewable energy zones

Objectives

- **Identify areas with the highest and most cost-effective potential for RES** ("renewable energy zones")

(based on energy resources, related cost, commercial interest)

- **Identify possible cost-effective "cross-border renewable energy projects"** with a cross-border dimension

(to be further assessed and taken up in the CESEC framework)

ECORYS Answering tomorrow's challenges today

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

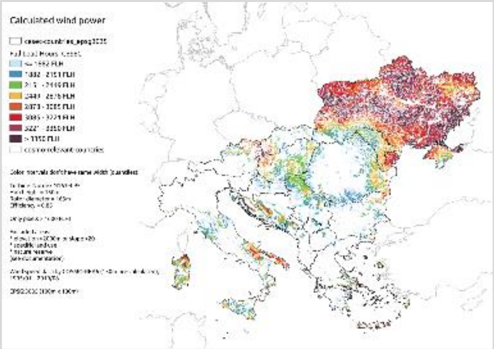
Approach highest-potential renewable energy zones

used as basis for subsequent modelling:

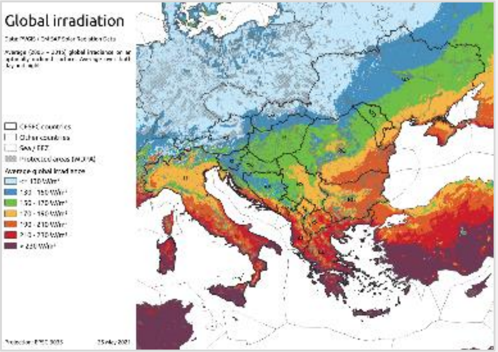
Assessment of RES potentials in the CESEC region

A comprehensive **literature survey as basis** for subsequent analysis …

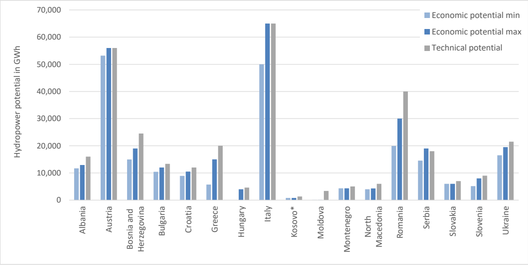
… **complemented by an own GIS-based analysis for solar and wind energy** using meteorological and land use data, considering e.g. distance rules and environmental constraints for wind energy



Example: GIS-based analysis for wind (above) and solar (below)



Example: Literature survey on hydropower potentials in CESEC



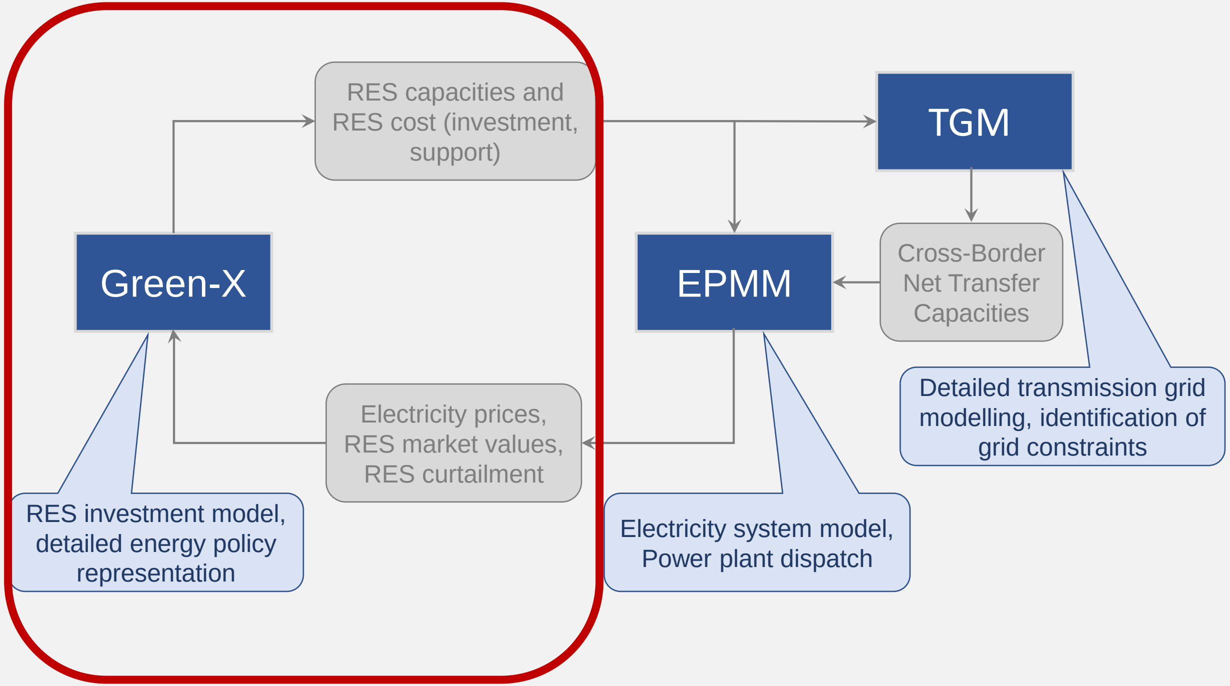
Indicator in MW	Existing installations in 2015	Existing installations 2020	Additional economic potential			Additional technical potential			Additional potential: planned outside protected areas (March 2021)
Source	IRENA (2020)	JRC (2020)	ECN (2004)	IRENA et al. (2017)	Neubarth (2018)	GX (2019)	IRENA et al. (2017)	Neubarth (2018)	RiverWatch (2021)
Albania	1,798	2,039	1,437	3,967	3,900	3,101	4,813	4,800	63
Austria	13,351	13,558	11,300	n.a.	n.a.	13,223	n.a.	n.a.	n.a.
Bosnia and Herzegovina	2,055	2,000	1,219	4,565	4,200	6,014	6,110	6,100	n.a.
Bulgaria	2,206	2,921	1,401	3,867	4,000	4,327	9,022	9,000	105
Croatia	1,915	2,125	2,042	2,904	n.a.	3,143	3,035	n.a.	75
Greece	2,693	3,395	2,523	3,500	6,200	3,425	8,000	8,000	53
Hungary	57	48	48	n.a.	n.a.	360	n.a.	n.a.	n.a.
Italy	14,628	19,393	14,927	n.a.	n.a.	19,302	n.a.	n.a.	n.a.
Kosovo*	43	65	n.a.	180	n.a.	n.a.	495	n.a.	n.a.
Moldova	16	n.a.	n.a.	16	n.a.	n.a.	840	n.a.	n.a.
Montenegro	651	675	n.a.	1,947	2,000	n.a.	2,040	2,700	5
North Macedonia	658	575	880	1,303	1,300	2,129	1,636	2,300	110
Romania	6,359	6,174	5,765	7,893	n.a.	8,470	15,385	n.a.	n.a.
Serbia	2,408	2,800	3,813	3,560	3,600	5,959	4,736	4,700	187
Slovakia	1,606	2,455	2,400	n.a.	n.a.	1,984	n.a.	n.a.	n.a.
Slovenia	1,115	1,239	847	1,568	n.a.	1,382	3,804	n.a.	115
Ukraine	4,697	n.a.	n.a.	10,276	n.a.	n.a.	13,647	n.a.	n.a.
CESEC	**56,256**	**59,460**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**

Approach highest-potential renewable energy zones

used in model-based RES analysis:

Modelling system

Figure: ***Model coupling*** *between Green-X, EPMM and TGM* ***for an assessment of RES developments in the electricity sector*** *under distinct grid topologies*



Approach highest-potential renewable energy zones

used in model-based RES analysis:

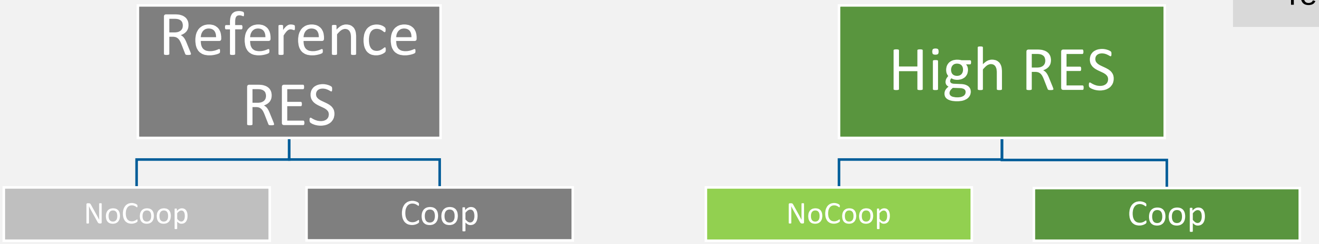
Scenario definition

Two pairs of scenarios for the RES uptake towards 2050:

- Reference RES scenarios (**RefRES**): in accordance with **national planning** (**National Energy and Climate Plans** or alternative sources where not applicable)
- High RES scenarios (**HighRES**): assessing the **feasibility of reaching a higher level of RES deployment** in accordance with **decarbonization needs / European Green Deal perspective**

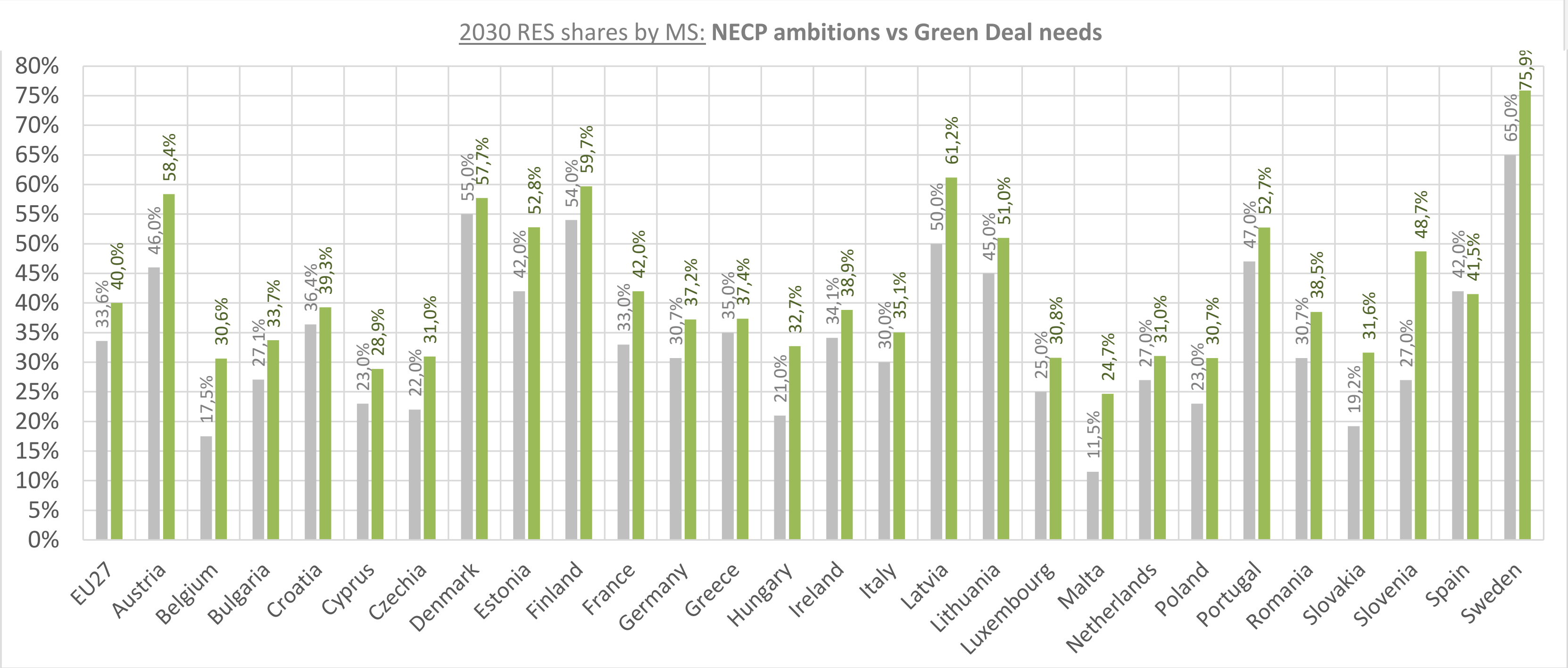
Both scenarios are replicated to analyze the impact of Cross-Border RES cooperation:

- Domestic RES target fulfilment (-**NoCoop**): focus on using domestic resources
- With (full) RES cooperation across the CESEC region (-**Coop**): a **region-wide, least-cost approach** within the CESEC region.



Brief recap of 2030 RES targets (at EU level)

2030 RES shares by EU MS according to ***NECP ambitions*** *vs* ***Green Deal needs***

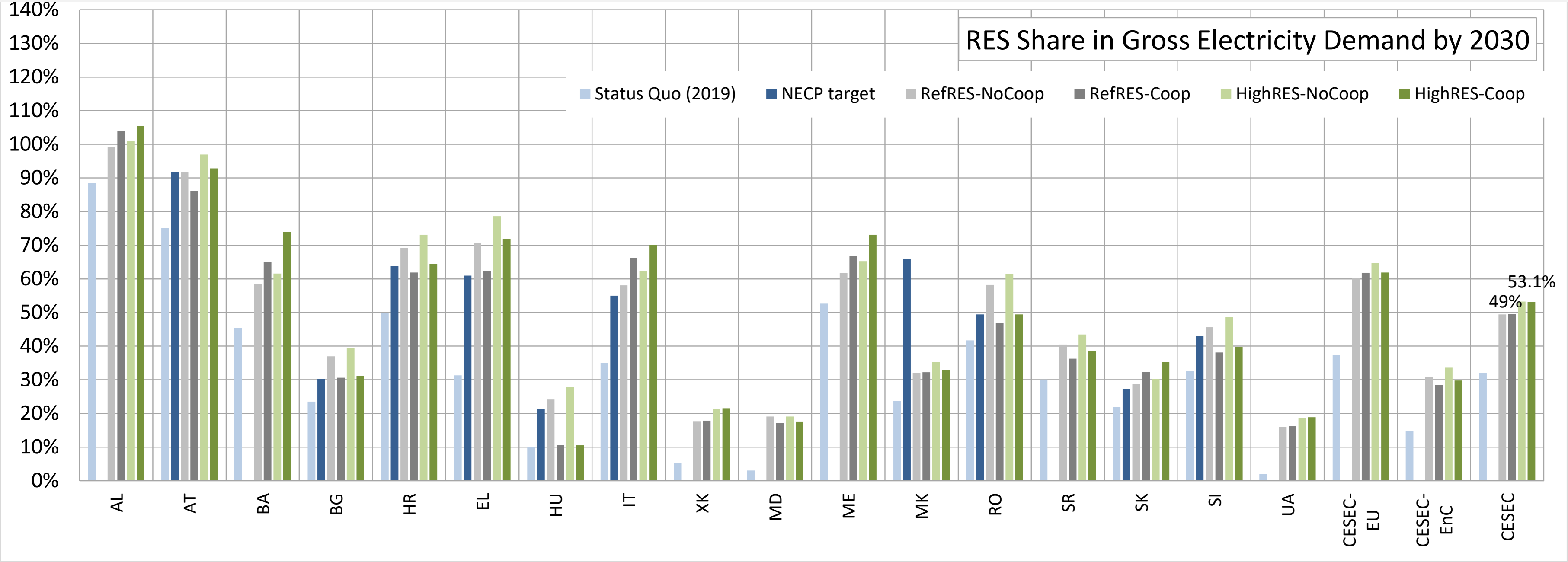


(Source: NECP & own analysis)

RES uptake in the electricity sector (CESEC)

At CESEC level:
- **53.1%** (**HighRES** scenarios)
- **49%** (**RefRES** scenarios)

2030 share of electricity generation from renewables in gross electricity demand



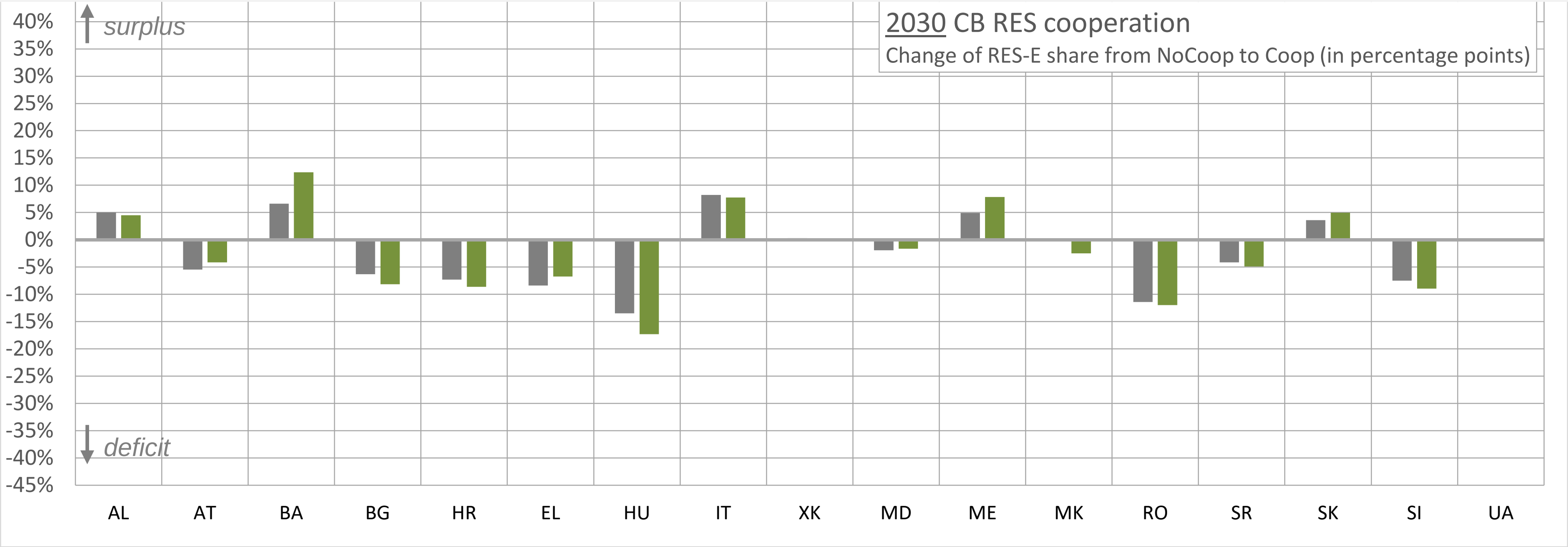
(Source: Eurostat, NECP & Green-X modelling)

ECORYS Answering tomorrow's challenges today

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

Cross-border RES cooperation in the 2030 context (CESEC)

2030: Change of RES-E share in gross electricity demand (in percentage points) driven by RES cooperation



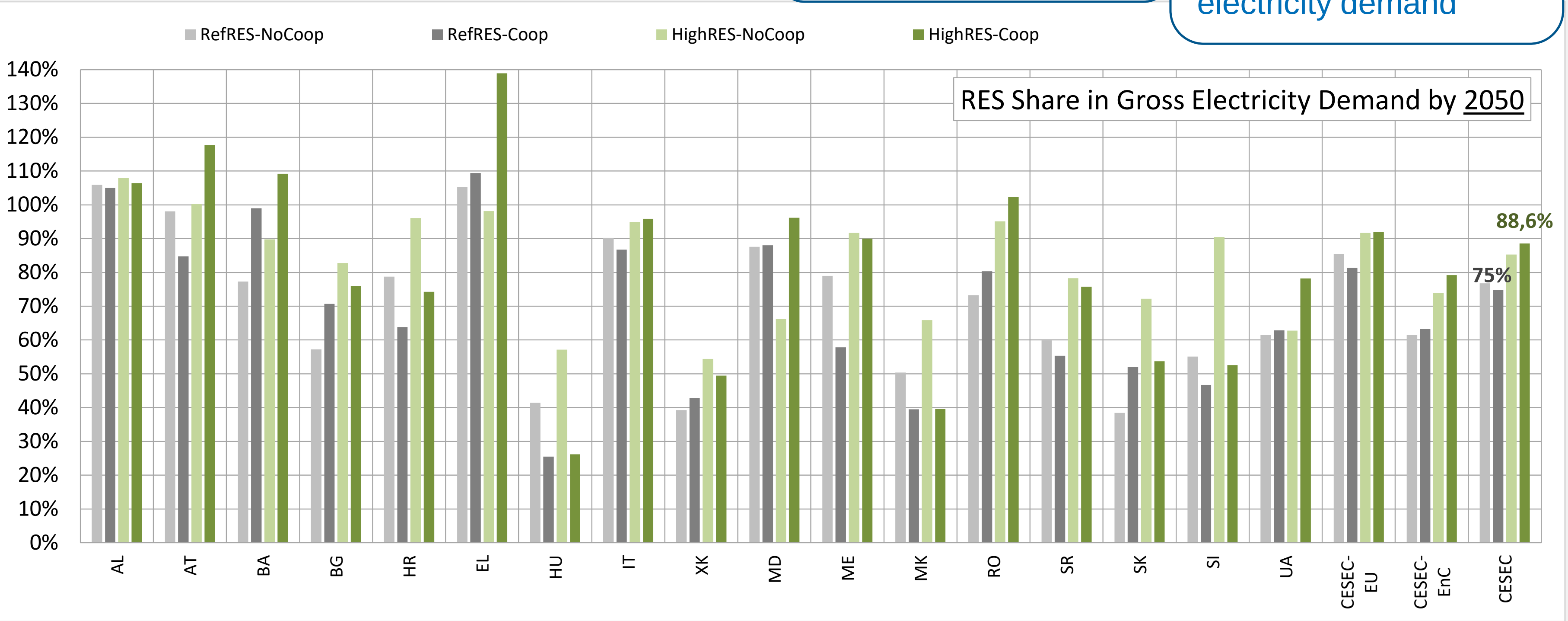
(Source: Green-X modelling)

RES uptake in the electricity sector

At CESEC level:

- **88.6%** (**HighRES** scenarios)
- **75%** (**RefRES** scenarios)

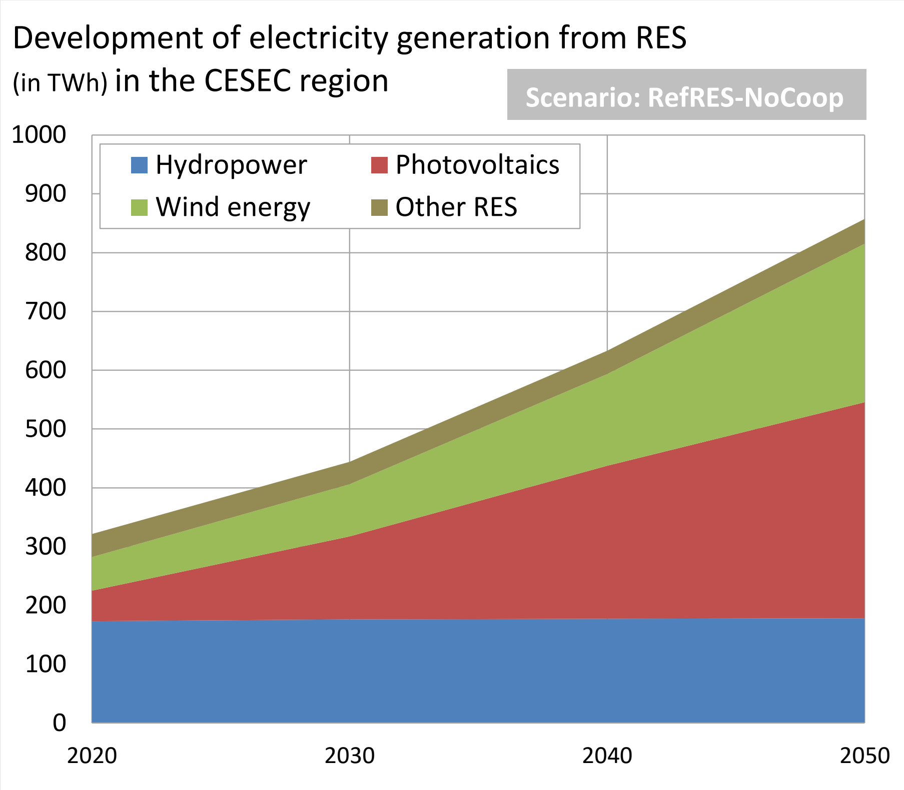
2050 share of electricity generation from renewables in gross electricity demand

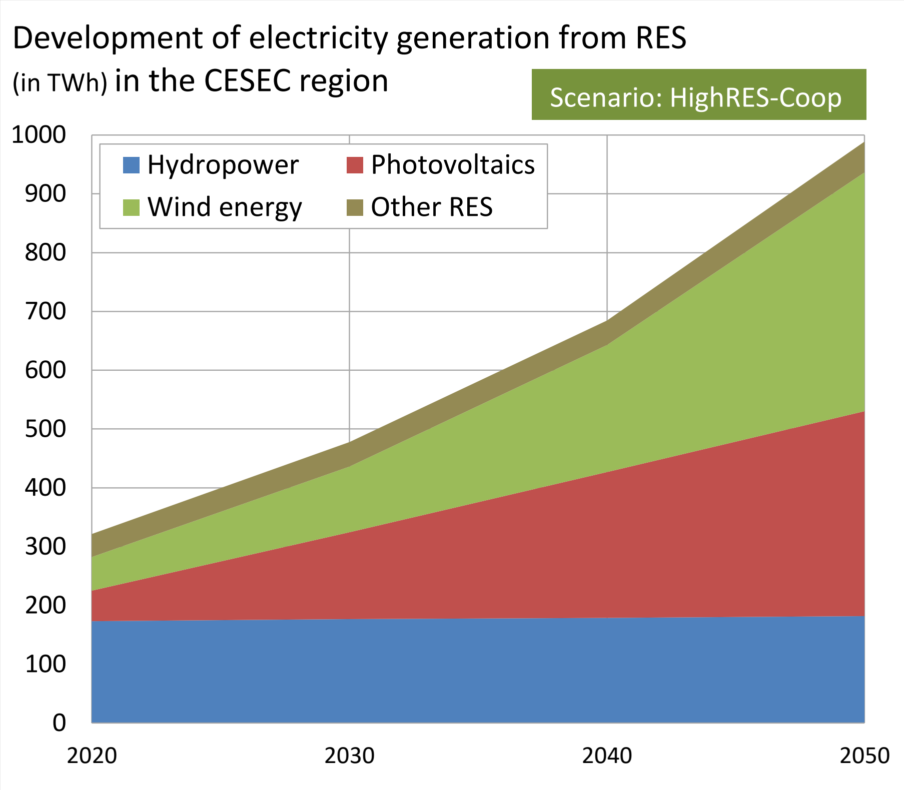


(Source: Eurostat, NECP & Green-X modelling)

Development of electricity generation from RES:

(Source: Green-X modelling)

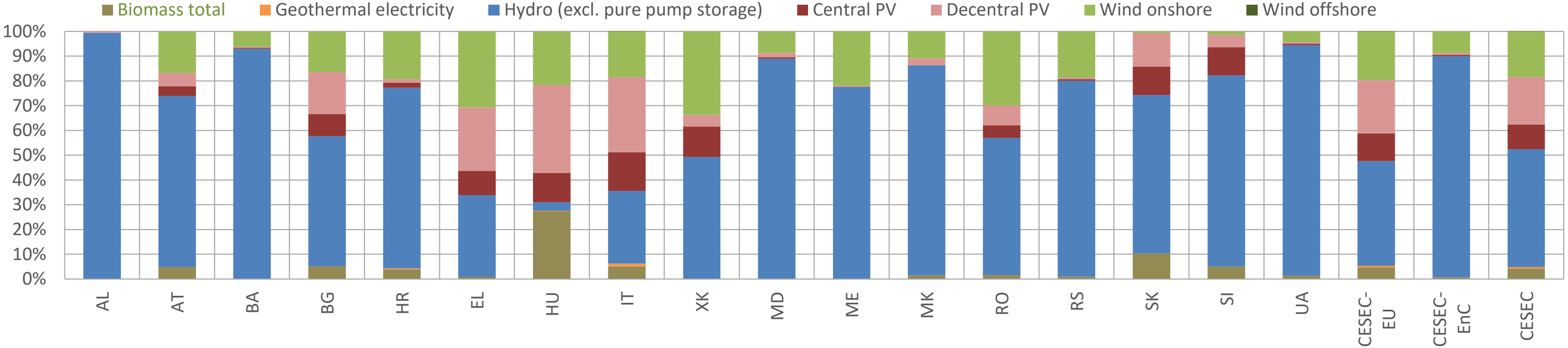




Changing the RES technology mix

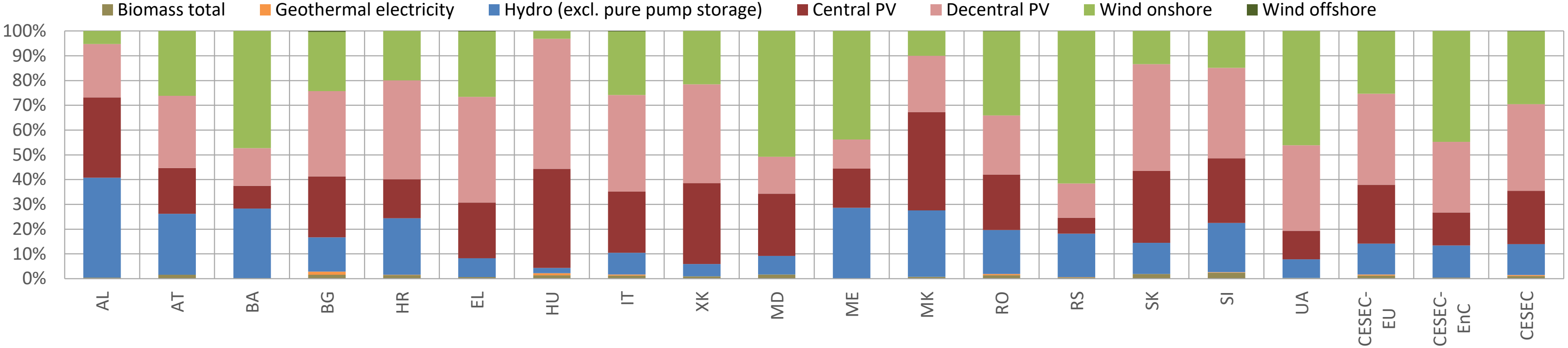
Country-specific technology mix of installed RES capacities at present (2020 - top) and in future (2050 - bottom)

Technology mix of installed RES capacities (in % of total RES) by 2020



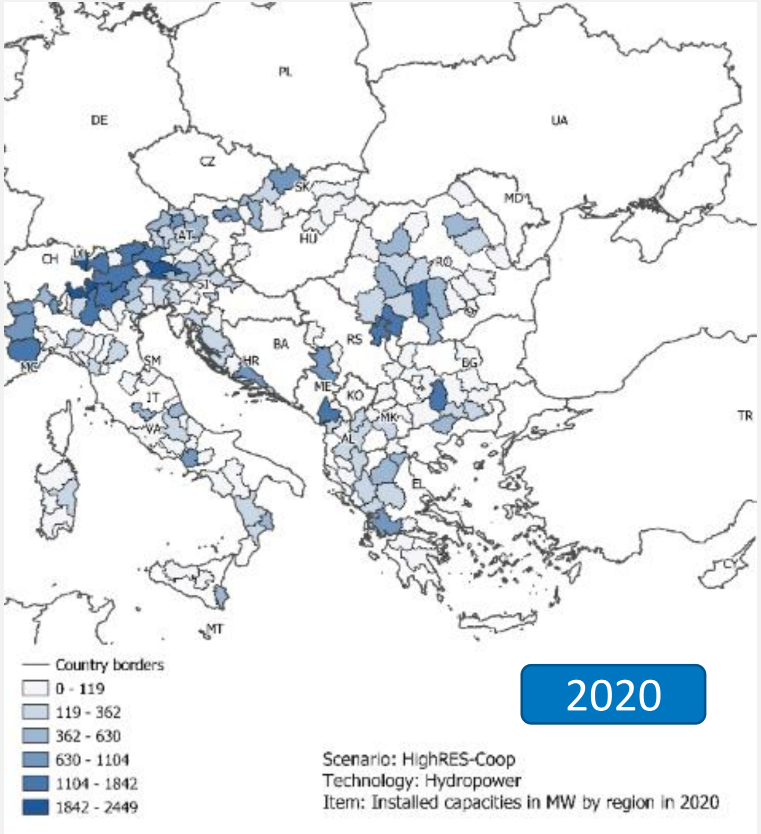
Technology mix of installed RES capacities (in % of total RES) by 2050

Scenario: HighRES-Coop

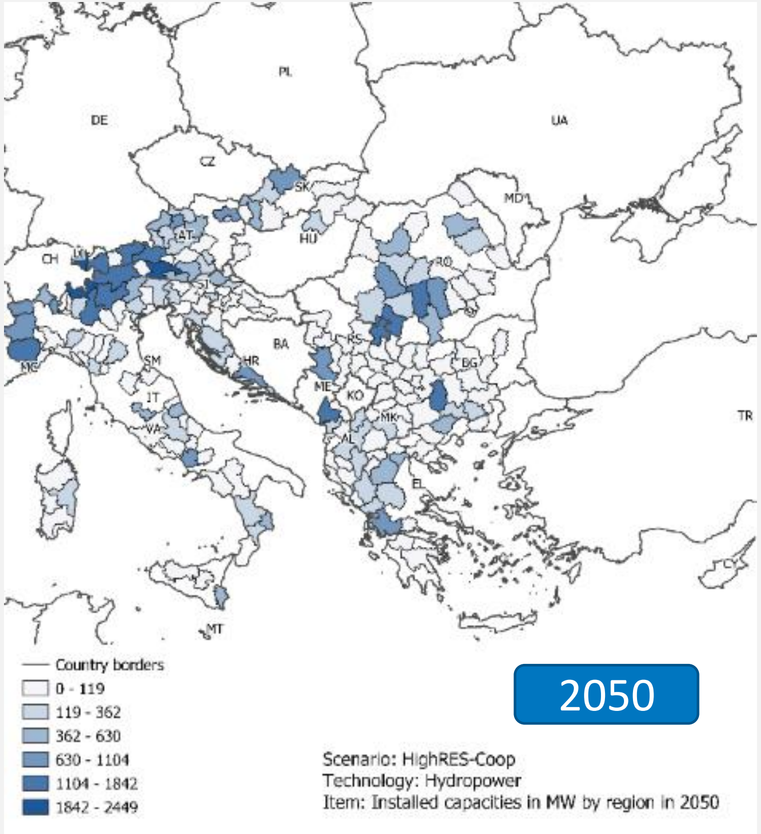


(Source: Green-X modelling)

Identification of promising CB RES projects in the CESEC region

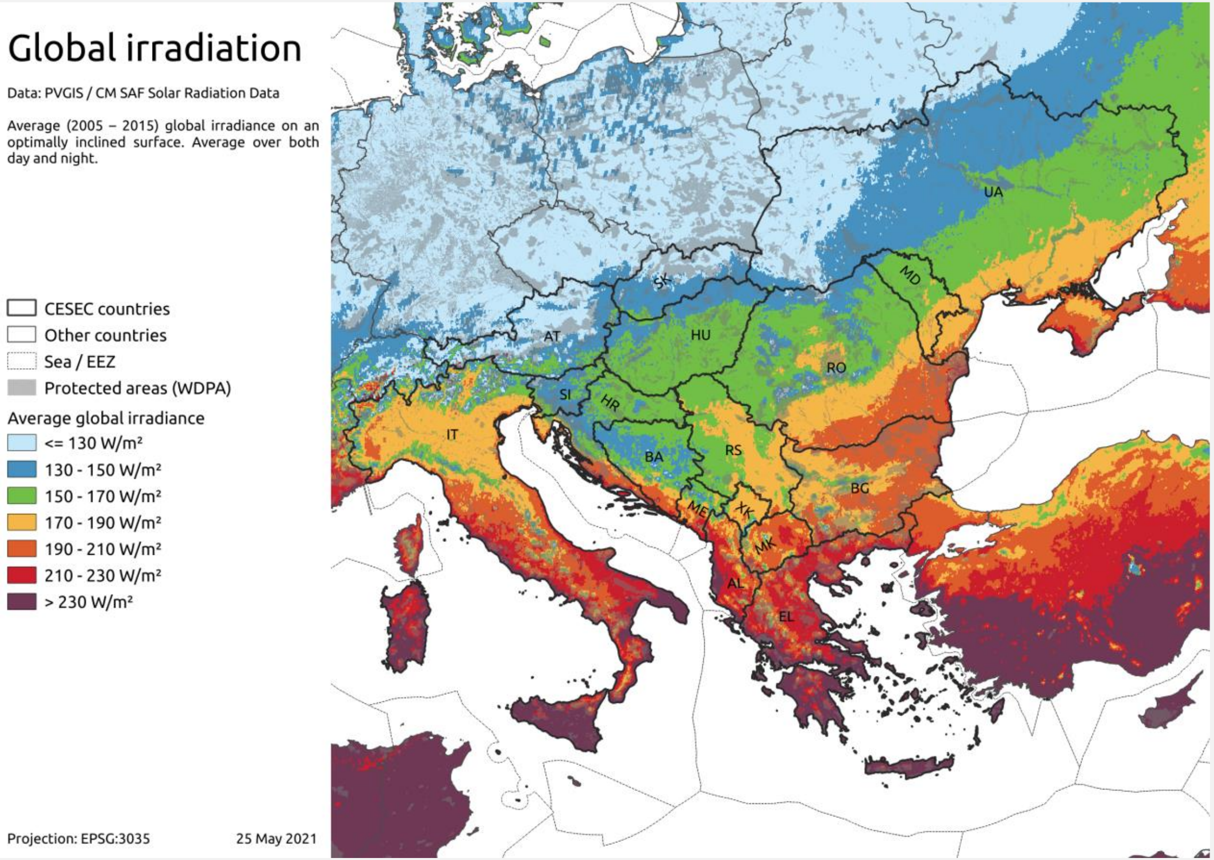


Insights from the mapping exercise: Trends in **hydropower exploitation**



(Source: Green-X modelling & own analysis)

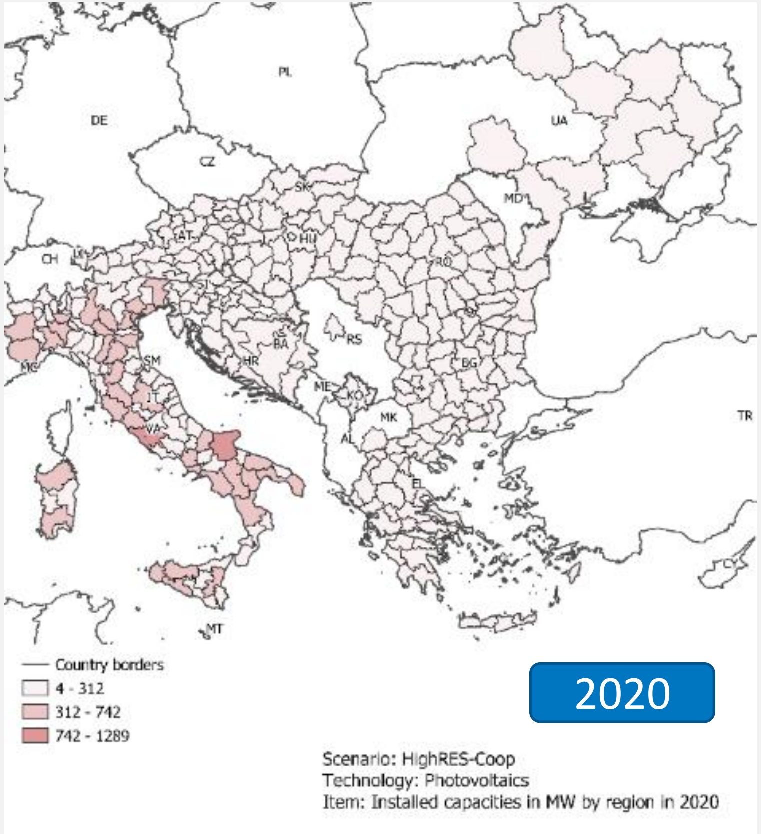
Identification of promising CB RES projects in the CESEC region



GIS-based analysis of solar potentials

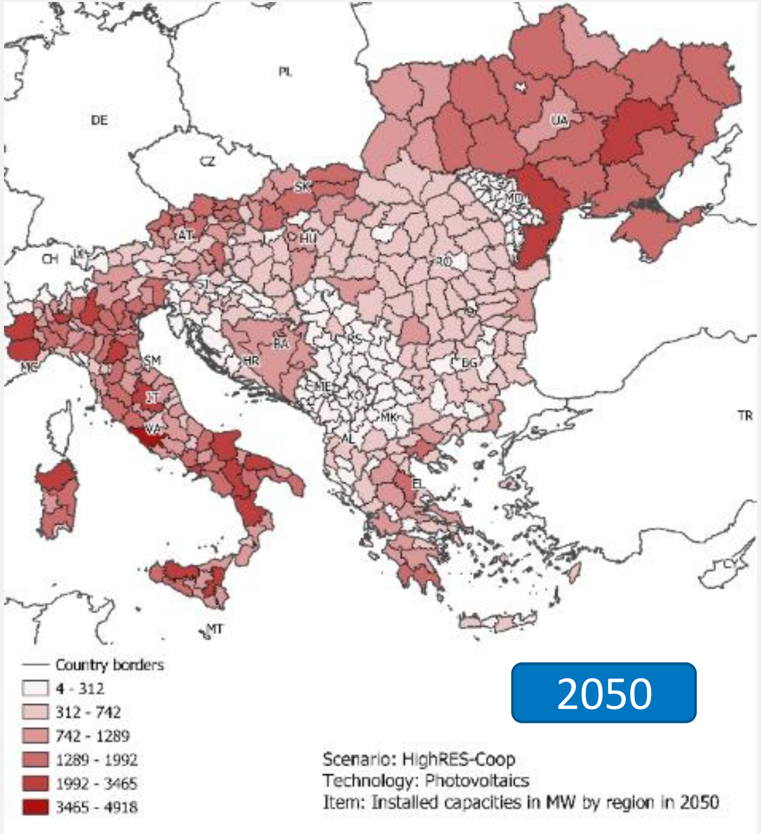
(Source: Own analysis)

Identification of promising CB RES projects in the CESEC region

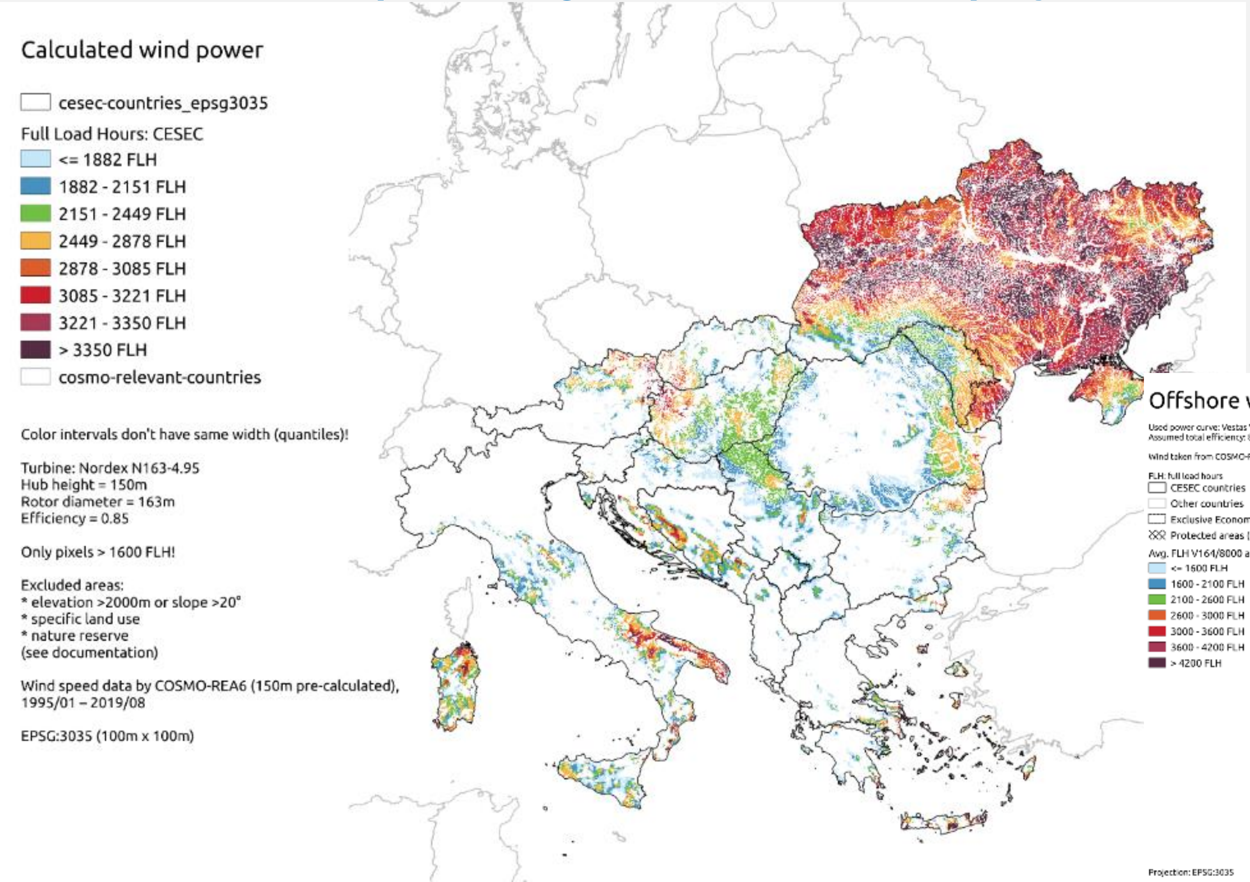


Insights from the mapping exercise: Trends in **photovoltaics exploitation**

(Source: Green-X modelling & own analysis)



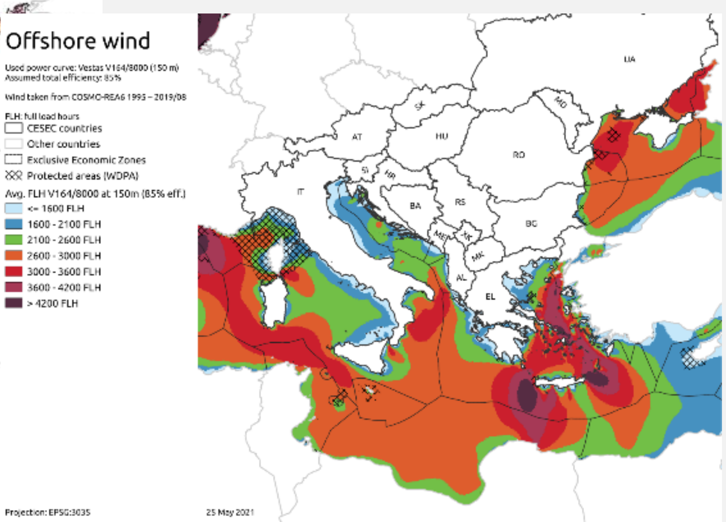
Identification of promising cross-border RES projects in the CESEC region



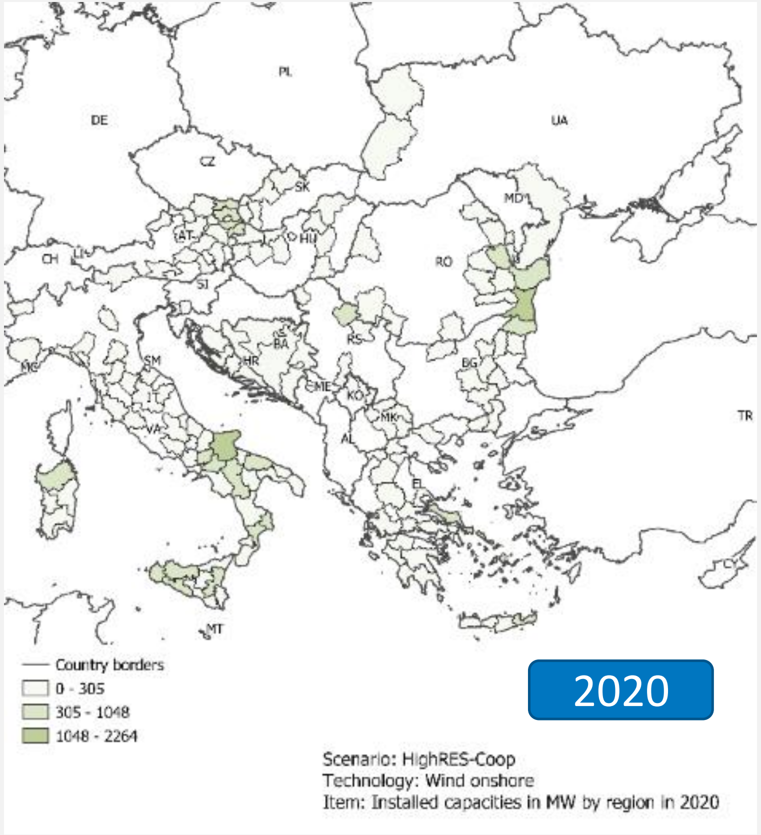
GIS-based analysis of wind potentials

(onshore & offshore)

(Source: Own analysis)

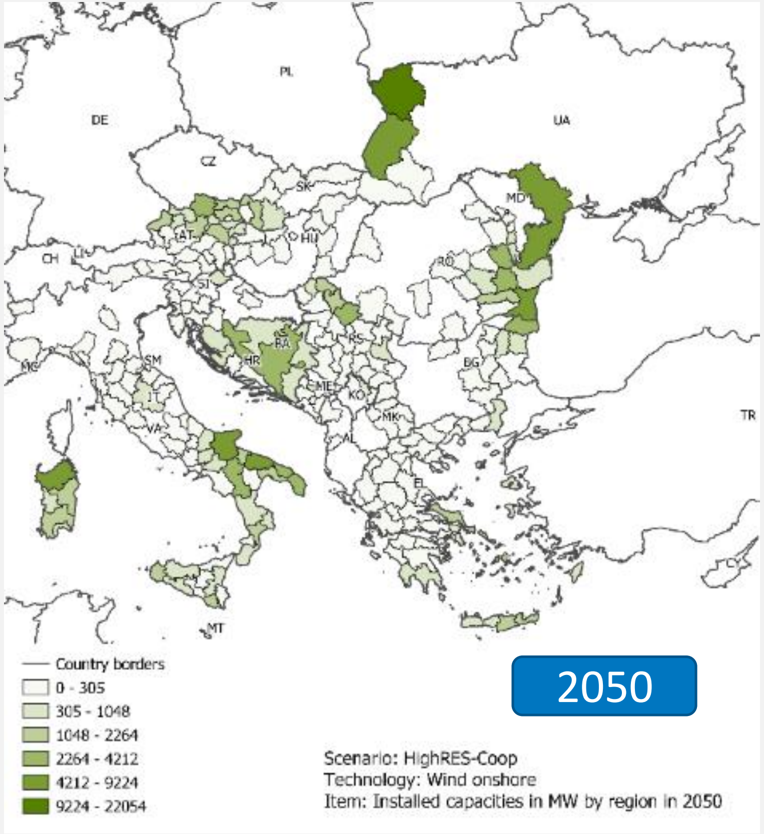


Identification of promising CB RES projects in the CESEC region



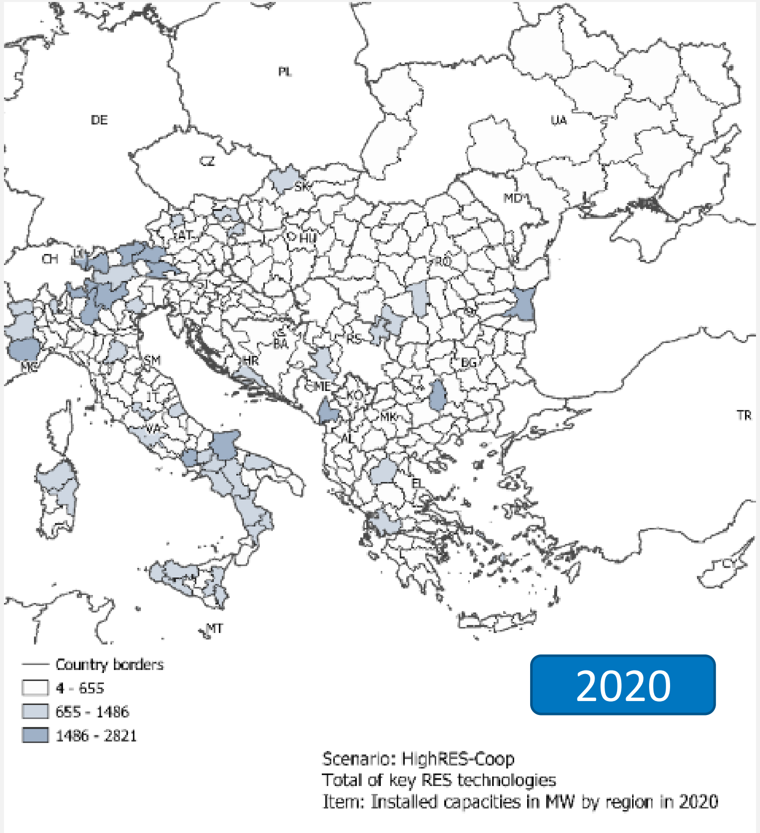
Insights from the mapping exercise: Trends in **wind (onshore) exploitation**

(Source: Green-X modelling & own analysis)



ECORYS | Answering tomorrow's challenges today
TECHNISCHE UNIVERSITÄT WIEN

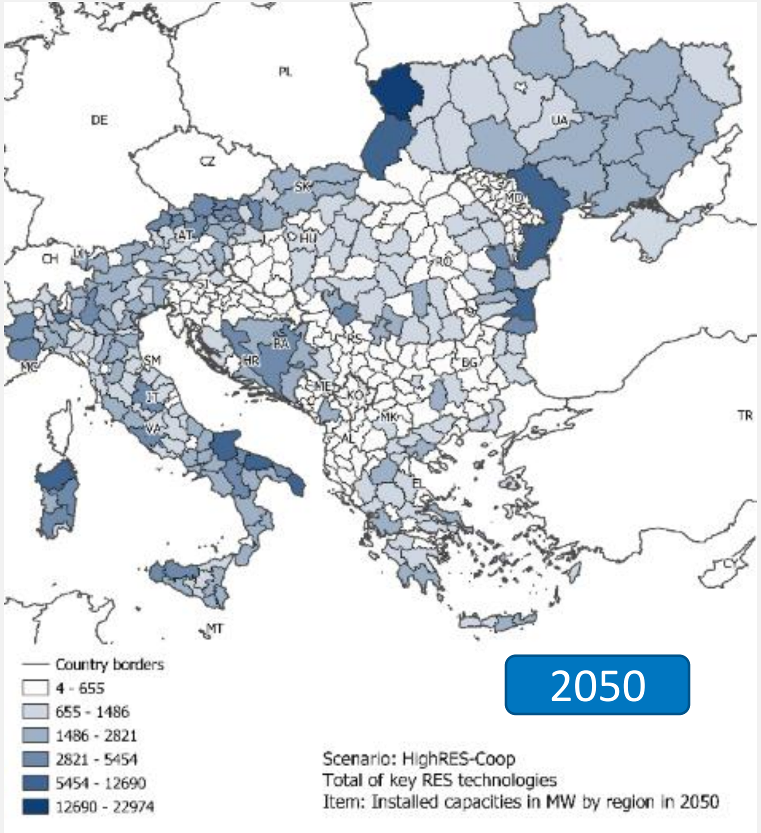
Identification of promising CB RES projects in the CESEC region

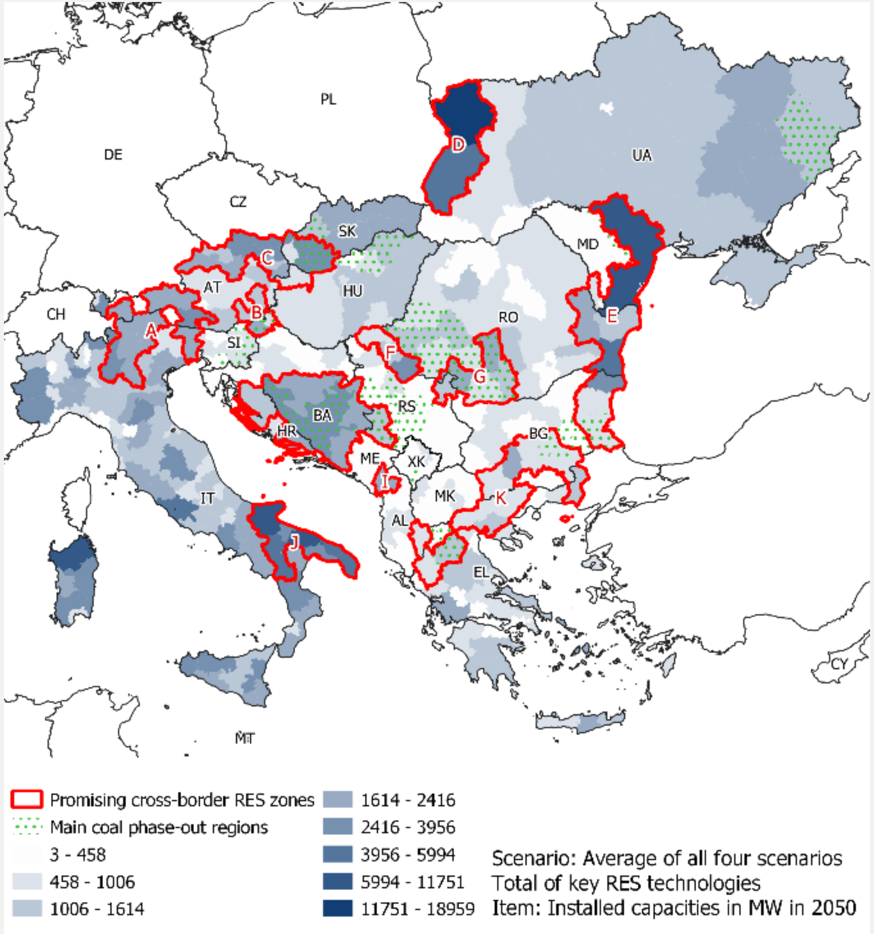


Insights from the mapping exercise: The **aggregated** trend

(hydro + wind + PV)

(Source: Green-X modelling & own analysis)





Identification of promising (Cross-Border) RES projects in the CESEC region

A. (AT-IT): Strong dominance of storage hydropower in mountainous parts, complemented by photovoltaics.

B. (AT-SI): Offering a balanced mix of wind, photovoltaics and hydropower.

C. (AT-HU-SK): Wind available at several hotspots at favourable conditions (despite not used equally in all three countries involved), combined with run-of-river hydropower and photovoltaics.

D. (UA): Favourable wind conditions, waiting to be exploited at large scale and complemented by some photovoltaics in mainly rural areas.

E. (BG-MD-RO-MD): Wind is generally available at favourable conditions, waiting to be exploited at large scale, complemented by photovoltaics and minor small-scale hydropower developments.

F. (RS): Promising wind potentials, complemented by photovoltaics.

G. (RO-RS): Offering a balanced mix of hydropower and photovoltaics, complemented by some wind developments at best available sites.

H. (BA-HR-RS): Balanced mix of wind, photovoltaics and (mainly existing) hydropower.

I. (AL): Providing a balanced mix of wind and photovoltaics, complemented by (mainly existing) hydropower.

J. (IT): Favourable wind sites still waiting to be exploited and room for a strong uptake of photovoltaics.

K. (AL-BG-EL): Offering favourable potentials for photovoltaics and (mainly existing) hydropower, complemented by wind at certain hotspots.

Conclusions and recommendation

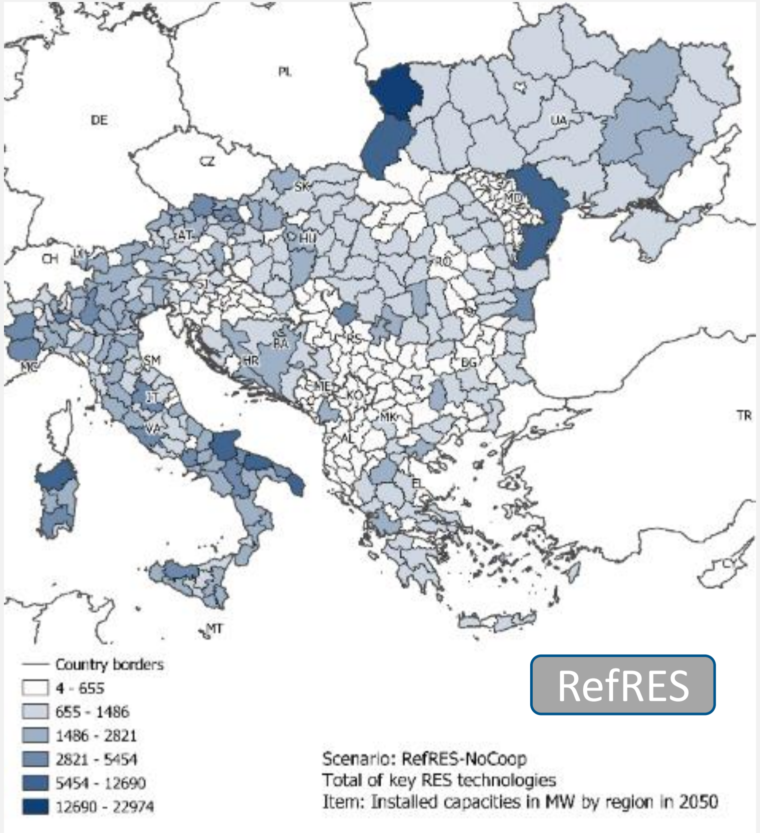
- Mapping exercise for the CESEC region **reveals the massive energy transition envisaged: Renewables expected to dominate power supply in future**
- **Photovoltaics is** a key technology already today and in future, **representing a promising generation asset at a local level**
  → **broadened geographical distribution of RES installations**
- If **certain areas offer economically viable potentials also for other key RES technologies (onshore wind)** → **power density increases** significantly
- **Combination of solar PV and wind energy** at regional level
  → **areas with most promising site conditions**, serving as basis for further elaboration of CB RES and infrastructure cooperation
- **2040 is marked by a series of challenges**: the uptake of RES is expected to accelerate and the power grid stability faces serious concerns of curtailment and bottlenecks. However, already planned infrastructure projects seem suitable to address these challenges. **We recommend ensuring that they will be realized on schedule**

Thank you

Details and contact of project coordination:
https://www.ecorys.com/netherlands/our-work/study-central-and-south-eastern-europe-energy-connectivity-cooperation#

Lukas Liebmann, liebmann@eeg.tuwien.ac.at
Gustav Resch, resch@eeg.tuwien.at

Identification of promising CB RES projects in the CESEC region



Insights from the mapping exercise:

Comparing the **aggregated** trend by 2050

(hydro + wind + PV)

(Source: Green-X modelling & own analysis)