

# Cost-optimal role of wind and solar power in Europe under climate change

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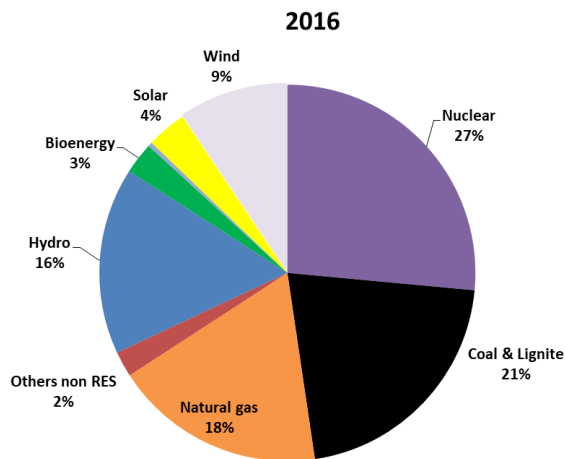
**EMP-E 2020: Modelling Climate Neutrality for the European Green Deal**

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# The European power system

## THE EU27+ power sector



Share of total generation per source

- 1012 GW of installed capacity (260 GW of wind and solar)
- ~40% of the production coming from fossil fuels
- ~1000 Mt CO<sub>2</sub> coming from public electricity and heat production

What do we study? : EU power sector decarbonization

Our decarbonization objective : Identify planification pathways corresponding to limits on cumulative CO emissions from 2020 to 2050



# TIMES Model : eTIMES-EU



**Regions considered**

- CWE region
- CEE region
- Nordic & Western Nordic
- British Island
- Iberian peninsula
- NEE region
- Alpine peninsula
- SEE region

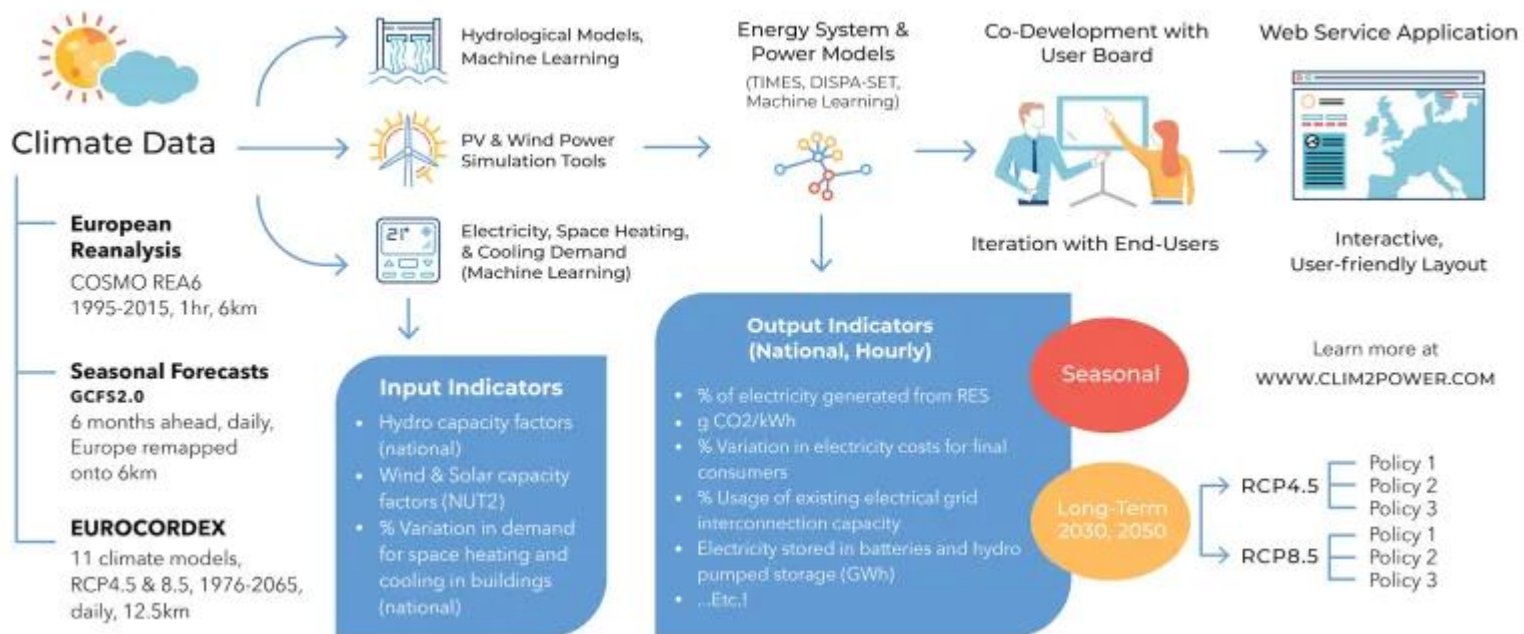


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Country groups	Group code	Included countries name (and short code)
Alpine Peninsula	ALP	Italy (IT)
British Islands	BIS	Ireland (IE), United Kingdom (UK)
Iberian	IBE	Spain (ES), Portugal (PT)
Central West Europe	CWE	Austria (AT), Belgium (BE), Switzerland (CH), Germany (DE), France (FR), Luxembourg (LU), Netherlands (NL)
Central East Europe	CEE	Czech Republic (CZ), Poland (PL)
Nordic & Western Nordic	NWN	Denmark (DK), Finland (FI), Norway (NO), Sweden (SE), Iceland (IS)
Nordic & Eastern Nordic	NEE	Estonia (EE), Lithuania (LT), Latvia (LV)
South Eastern Europe	SEE	Bulgaria (BG), Greece (GR), Croatia (HR), Hungary (HU), Romania (RO), Slovenia (SI), Slovakia (SK)

- **Electric system model**
- **Spatial resolution** : 29 regions considered aggregated in 8 interconnected groups
- **Temporal resolution** : Milestone years represented by 64 time slices (3h step for 2 typical days and 4 seasons)
- **Linear optimization model** : minimization of the total discounted cost of the system
- **Decison years**: 2016, 2017, 2020, 2025, 2030, 2035, 2040, 2045, 2050

# Integration of climate variability



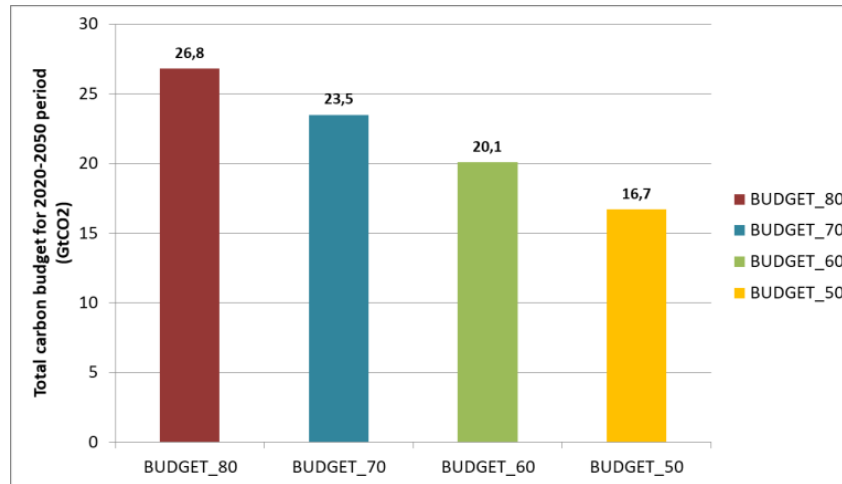
A thorough pipeline from *climate data projections* to *national energy system input indicators* from 2030 to 2050:

- Hydro capacity factors
- Wind and solar capacity factors
- Variation in electricity demand (volumes and intra-annual structure)
- Variation in heat demand (intra-annual structure)

# Scenario description



## 4 carbon-budget scenarios



### Default hypotheses:

- Initial demand\* from EU Reference Scenario
- Country specific development rhythms calibrated with historical values
- Announced coal phase outs arrive at planned date
- No targets on France nuclear activity
- Renewable potentials calibrated with JRC-ENSPRESO database and interconnections until 2030 with TYNDP2016
- Fuel and technology costs calibrated with IRENA and WEO2016

# Results

## CO2 emissions reduction compared to 2016

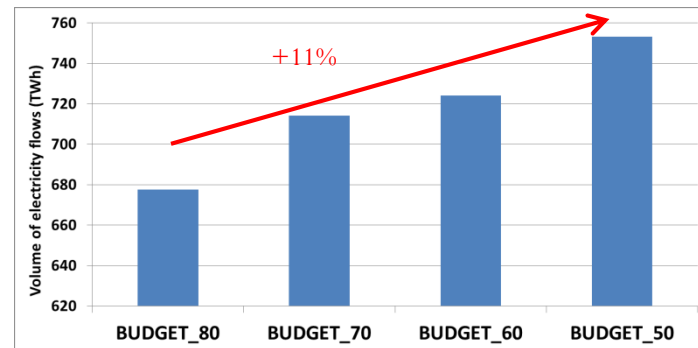
Year/Scenario	BUDGET_50	BUDGET_60	BUDGET_70	BUDGET_80
2030	-37,26%	-30,81%	-22,81%	-16,48%
2050	-83,23%	-66,49%	-51,05%	-33,71%

- At least **37% of emissions reduction** needed by 2030 compared to 2016 levels to be on track with a budget of 16,7 Gt

## Share of electricity generated by solar and wind in 2050

Scenario	Solar	Wind
BUDGET_50	28%	31%
BUDGET_60	28%	30%
BUDGET_70	25%	28%
BUDGET_80	22%	25%

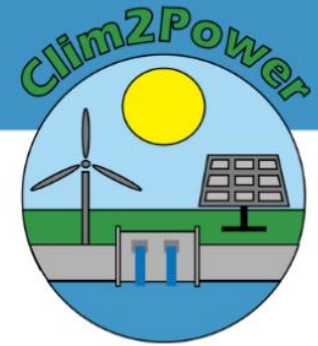
## Volume of electricity flows in TWh in 2050



- Solar and wind contribute to at least 57% of electricity generation even in the BUDGET\_80 scenario
- Physical electricity flows raise by 11% between the two extreme scenarios



# You're Invited to our results showcase!



## Join Clim2Power on 9 November:

We are pleased to invite you to Clim2power's Results Showcase Session to be held online on 9 November 2020. Members of the Clim2power consortium will present project results and explore opportunities for future collaborations. Please save the date. More details will be provided in the following weeks.

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Thanks!



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