

# Potentials of Variable Renewable Energy Sources and “Low-Hanging Fruits” Electrification in Europe

**FFE** Forschungsgesellschaft  
für Energiewirtschaft mbH

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## Motivation

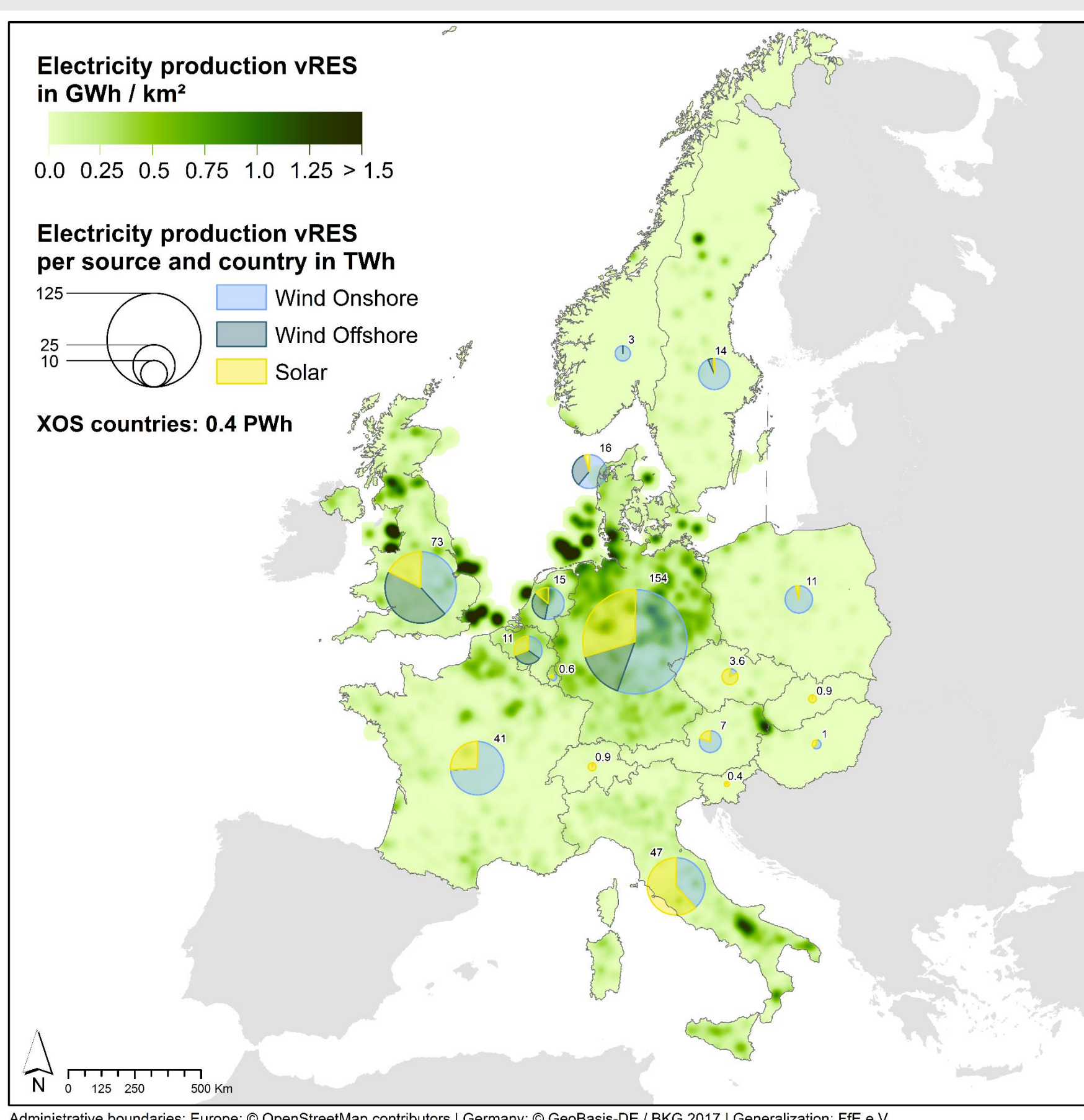
- The topic of **decarbonization through electrification** should be viewed in a **European context**. A scenario in which only Germany is electrified can lead to false conclusions
- A common **argument against** wide-spread **electrification** is that the **potential** for renewable energy sources is **insufficient** to cover the additional electricity demand
- Variable renewable energy (vRE)** potentials are therefore **compared to** the electrical energy consumption in case of a “**low-hanging fruits**” **electrification scenario**
- Analyzed vRE sources are **onshore** and **offshore wind** and **onsite** and **onsite solar power**. Electrification is assumed for passenger road transport, heating and hot water and process heat

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## Key messages

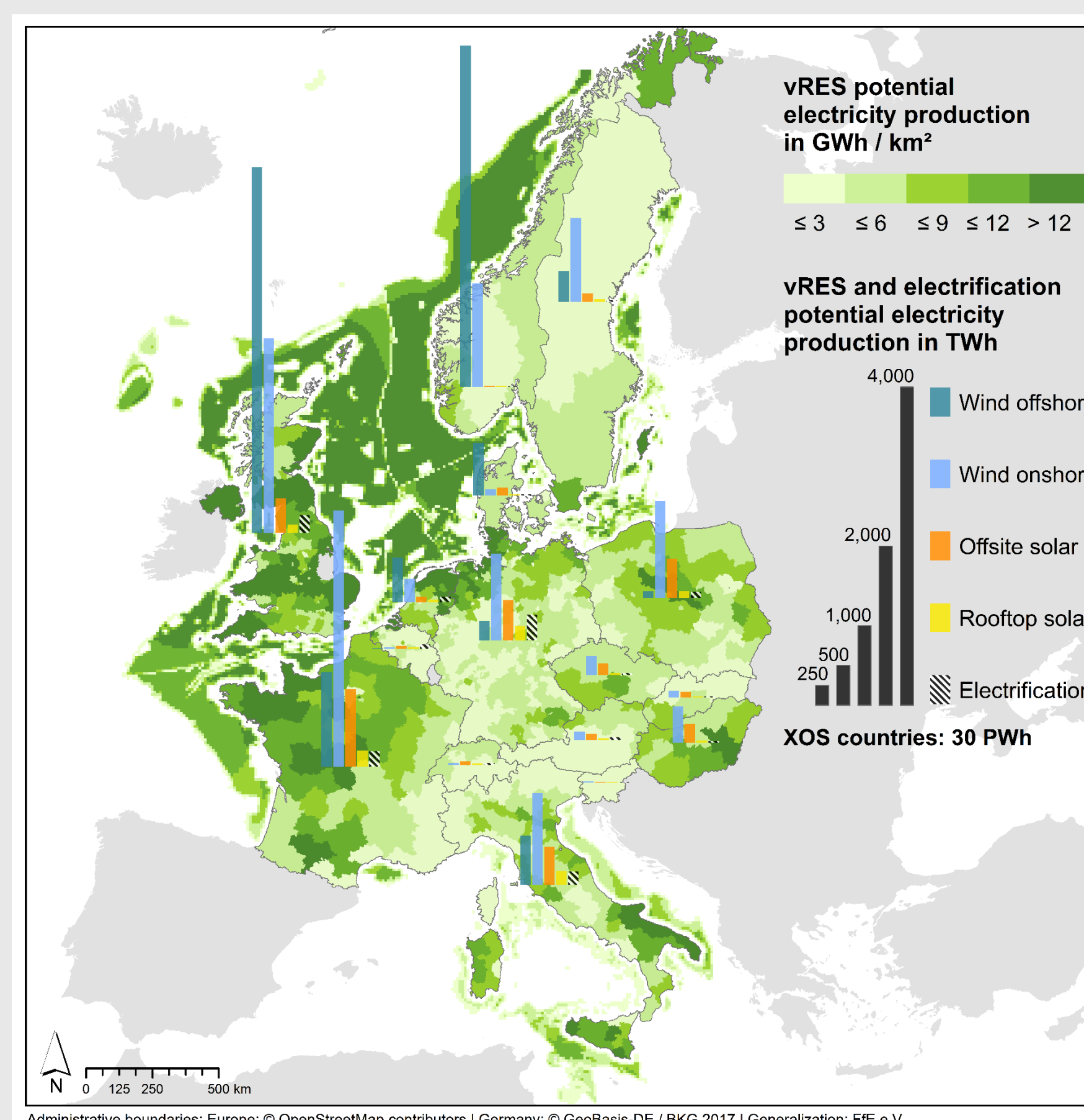
- The **theoretical potentials** for variable renewable energy sources in Europe are **significantly higher** than the total electrical energy demand in case of a “**low-hanging fruits**” **electrification scenario**
- Comparing today's** production from variable renewable energy sources to the total electricity demand after electrification highlights the challenge with respect to the **transformation speed**
- Load centers** and **areas** with **high potentials** for variable renewable electricity production **rarely correlate**, indicating further challenges for the transmission system
- All countries** face a **two-fold challenge** as decarbonization requires a significant transformation of the supply and demand-side

Status quo (2018): Regionalized electricity production from variable renewable energy sources



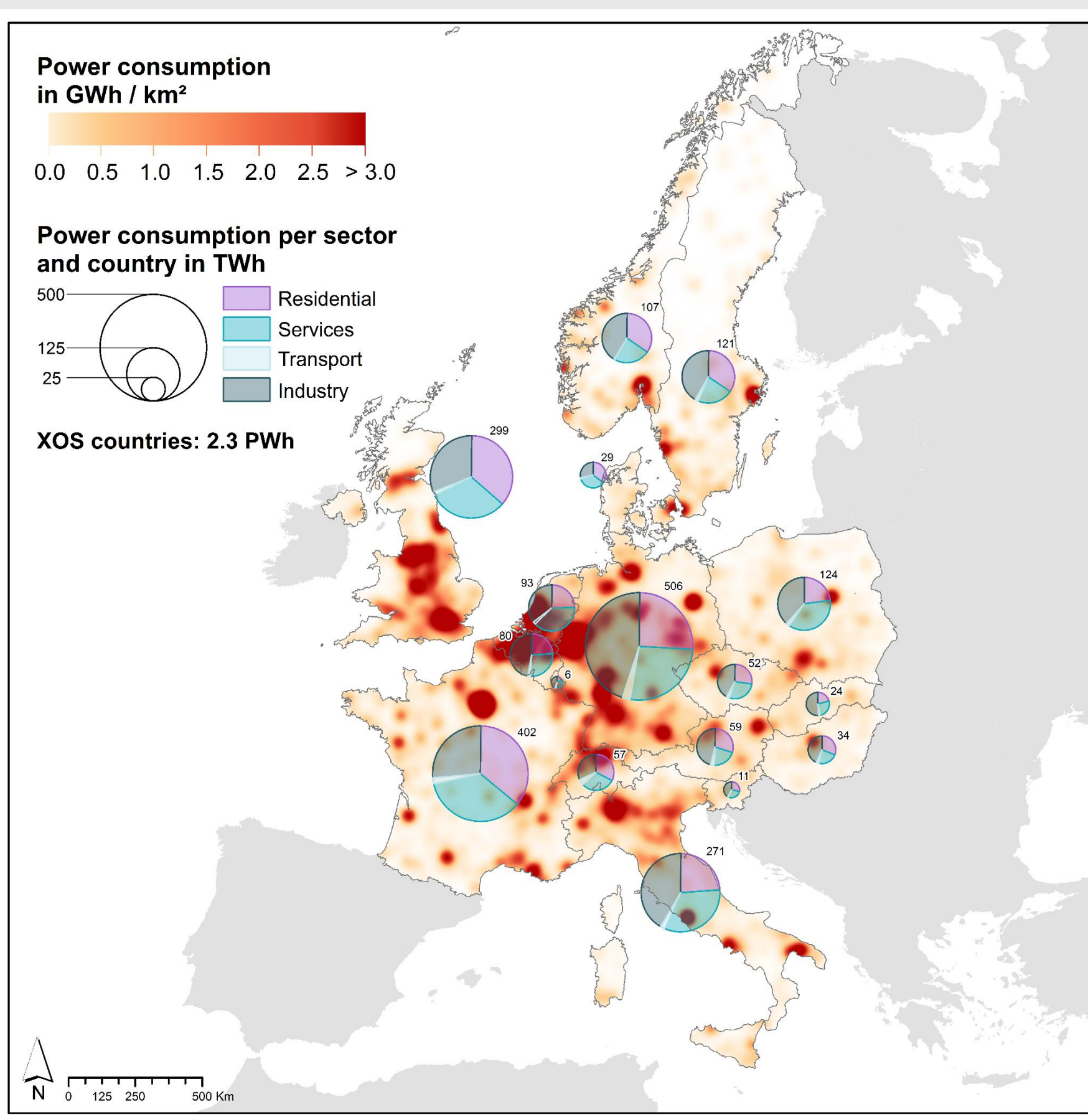
- The diagram shows the regionalized electricity production from variable renewable energy sources (vRES) for Germany and its electrical neighbors
- Total production** from vRES in the analyzed countries amounts to **400 TWh**
- Countries with the **highest electricity production** from variable renewable energy sources are: **Germany, United Kingdom, Italy and France**
- Supply centers** are mainly located in the north sea

Potential for variable renewable energy sources and “low-hanging fruits” electrification scenario



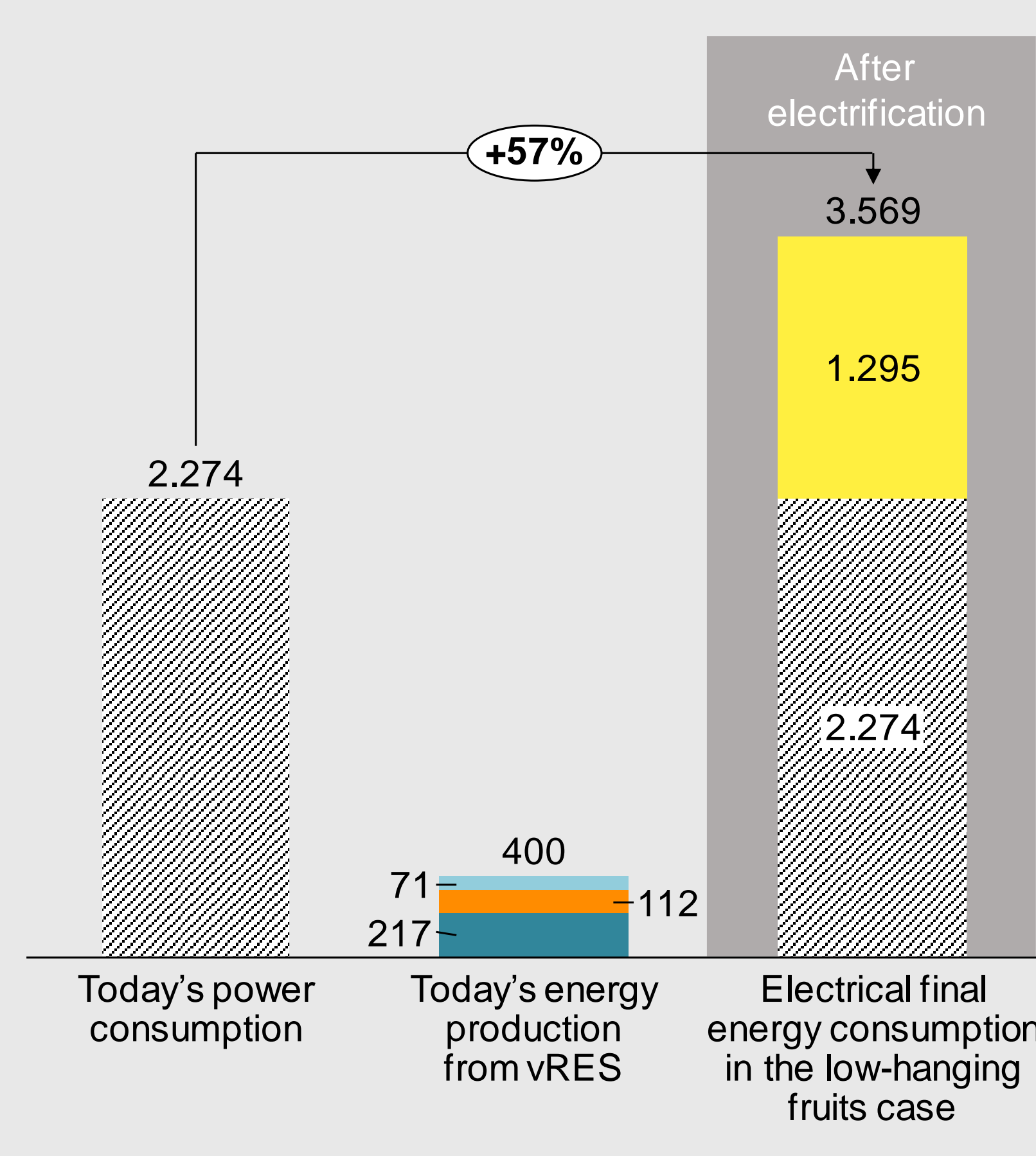
- The diagram shows the regionalized potential for electricity production from variable renewable energy sources (vRES) and the additional electrical final energy consumption in a “low-hanging fruits” electrification scenario for Germany and its electrical neighbors
- Total (theoretical) potential for electricity production** from vRES amounts to **30 PWh**
- Total post-electrification electricity consumption** across all end-use sectors is **3569 TWh**

Status quo (2014): Regionalized electrical final energy consumption



- The diagram shows the regionalized electrical final energy consumption for Germany and its electrical neighbors
- Total electricity consumption** across all end-use sectors in the analyzed countries is **2300 TWh**
- Countries with the **highest electricity consumption** are: **Germany, France, United Kingdom, and Italy**
- Load centers** are focused on areas with a high population density and/or industrial production

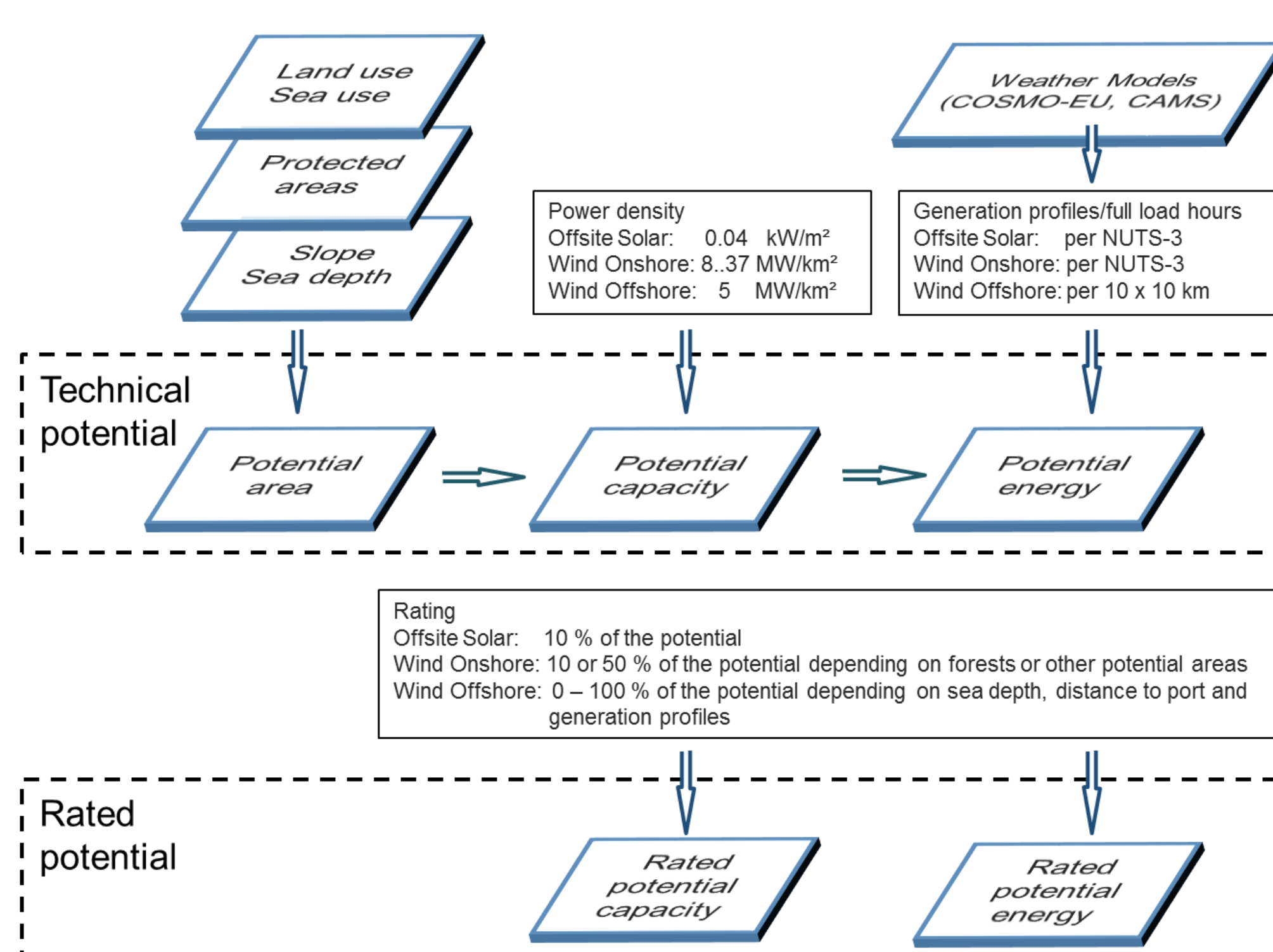
The resulting challenge: Comparison of today's electricity production from variable renewable energy sources to electricity demand



- The diagram compares today's production from variable renewable energy sources to the current and post-electrification electricity consumption for Germany and its electrical neighbors
- Covering the additional electricity demand requires a **three-fold** increase of vRES production compared to today
- Considering the costs and elapsed time involved in reaching today's production level of vRES, highlights the **magnitude** of the future challenge

Additional power consumption  
Electrical final energy consumption 2014  
Photovoltaics  
Wind onshore  
Wind offshore

## Methodology – variable RES



## Methodology – electrification

Step 1: European application balances

	H&C	Rest
Electricity	X	1-X

Step 1a: electricity share in heating and cooling (H&C) (2012)

Heating and Cooling	Space Heating	Hot water	Process heat <100 °C	...	Process cooling
Electricity	$X \cdot a_1$	$X \cdot a_2$	$X \cdot a_3$	...	$X \cdot a_9$
Oil	$b_1$	$b_2$	$b_3$	...	$b_9$
Gas	$c_1$	$c_2$	$c_3$	...	$c_9$
...	...	...	...	...	...

Step 1c: share of electricity consumption by rest application taken from German application split (2014)

Rest	ICT	Mech. Energy	Lighting
Electricity	$(1-X) \cdot 5\%$	$(1-X) \cdot 89\%$	$(1-X) \cdot 6\%$

Step 1b: shares of FEC by H&C application and energy carrier (2015)

Core assumption: rest applications are powered by electricity

Step 2: Determining additional electrical final energy consumption

