Wind and solar benchmarks for a 1.5°C world

Developing national-level benchmarks to achieve renewables deployment in line with the Paris Agreement

NEW CLIMATE INSTITUTE

CLIMATE ANALYTICS

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Authors

NewClimate Institute

Gustavo De Vivero

Swithin Lui

Emily Daly

Markus Hagemann

Ana Missirliu

Climate Analytics

Lara Welder

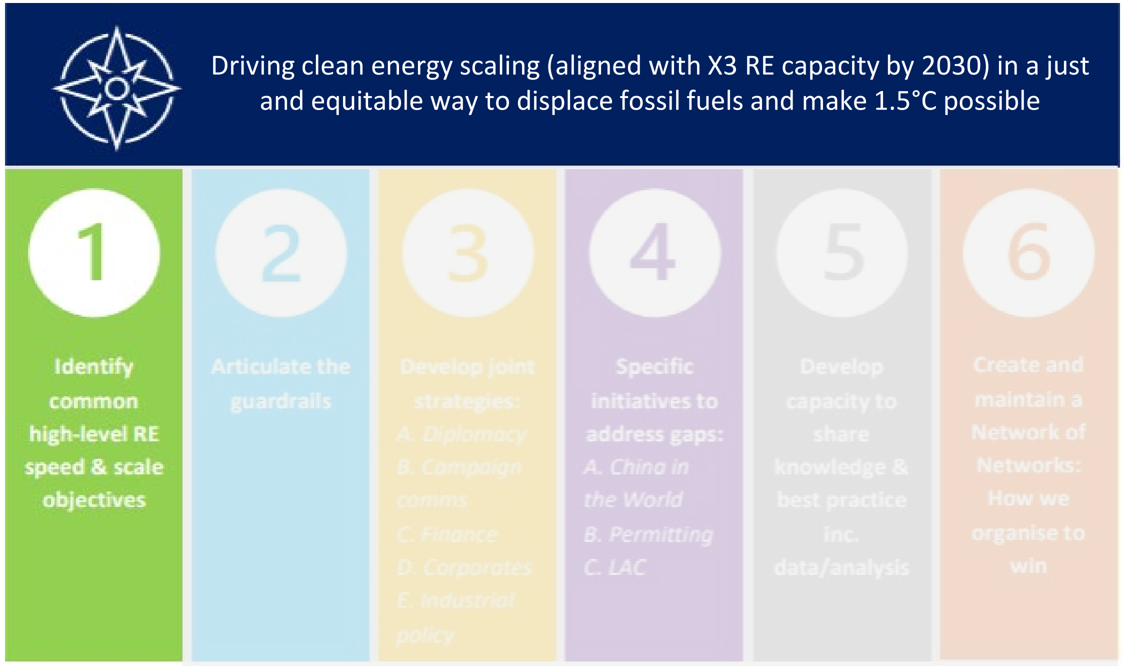
Neil Grant

Tina Aboumahboub

Claire Fyson

Context

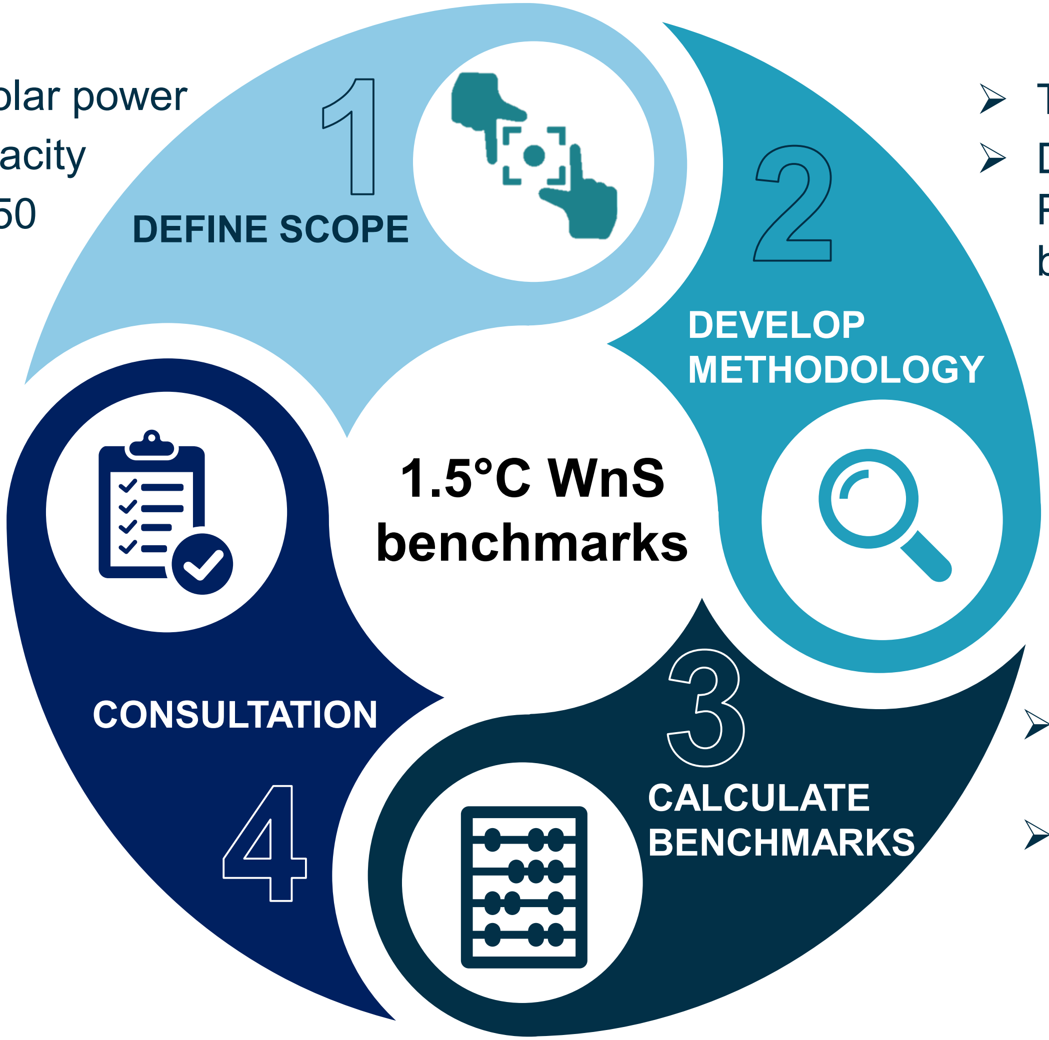
- A rapid transformation of the power sector is urgently needed to help safeguard 1.5°C. To this end, countries must commit to tripling renewable energy capacity by 2030 globally.
- Wind and solar (Wns) deployment is accelerating due to technological advancements, favourable economics, and policy developments.
- However, WnS capacity deployment under current policies falls short, concentrated only in a few regions.
- Comprehensive research is needed on the required levels of WnS installations globally to meet the 1.5°C limit of the Paris Agreement and what this means in terms of scale & speed of ambition at the national level.
  - **How much** WnS specifically needs to be built
  - **Where** does it need to be built, and
  - **When** does it need to be built by?



Overview

- ➢ <u>Technologies:</u> Wind and solar power
- ➢ <u>Units</u>: Generation and capacity
- ➢ <u>Years</u>: 2030, 2040 and 2050

- ➢ Test different approaches and methods
- ➢ Develop a methodology to determine Paris-compatible wind and solar benchmarks



- ➢ Test methodology for an initial subset of countries (6)
- ➢ Compare benchmarks with national policy targets for wind and solar

- ➢ Consult network for validation and collaborate on engagement needs

Methodology

Key elements of the proposed framework

1st test countries

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Income level

G20 / Annex diversity

Consortium expertise

Political relevancy

Group priorities & impact considerations

Literature availability

Geographical diversity

Wind and solar potential

Fossil fuel mix

Wind and solar mix

Method framework

Key elements to construct the methodology

I Guiding principles

II Narrative considerations

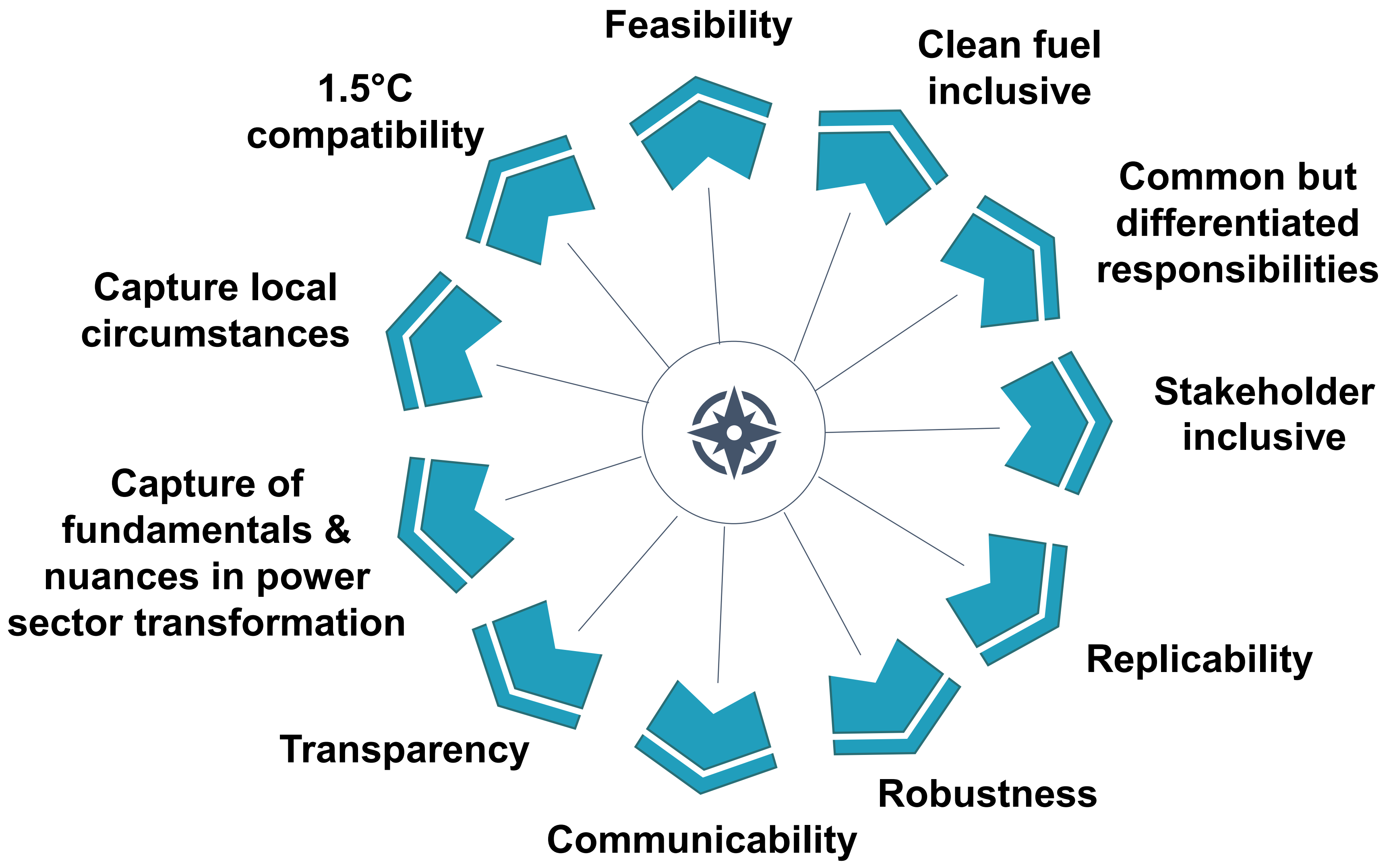
III Lines of evidence

Method framework

I Guiding principles

II Narrative considerations

III Lines of evidence



Method framework

I Guiding principles

II Narrative considerations

III Lines of evidence

For example:

- Electrification of end-use sectors
- Energy Efficiency
- Composition of the clean energy mix

How Much Electricity is Needed to 'Electrify All'?

Energy focus — **Climate focus** — **Diffusion focus**

Method framework

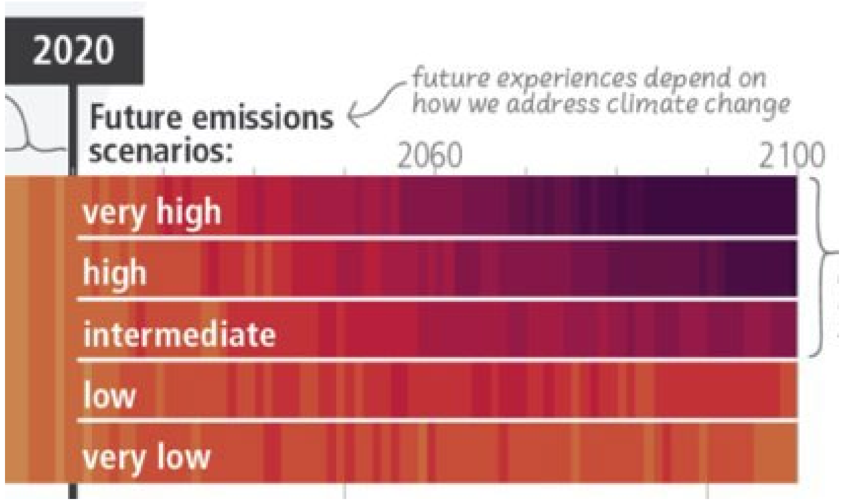
I Guiding principles

II Narrative considerations

III Lines of evidence

For example:

- Paris compatibility
- Role of power sector in climate mitigation
- Urgency and pace
- Common but differentiated responsibilities



Energy focus — **Climate focus** — **Diffusion focus**

Method framework

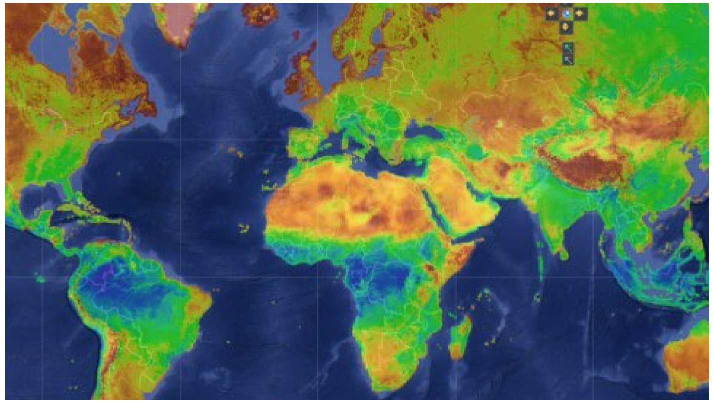
Guiding principles

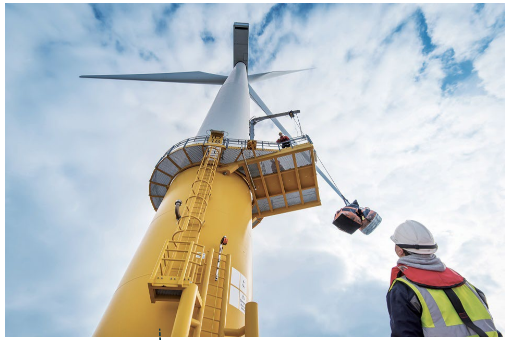
II Narrative considerations

III Lines of evidence

For example:

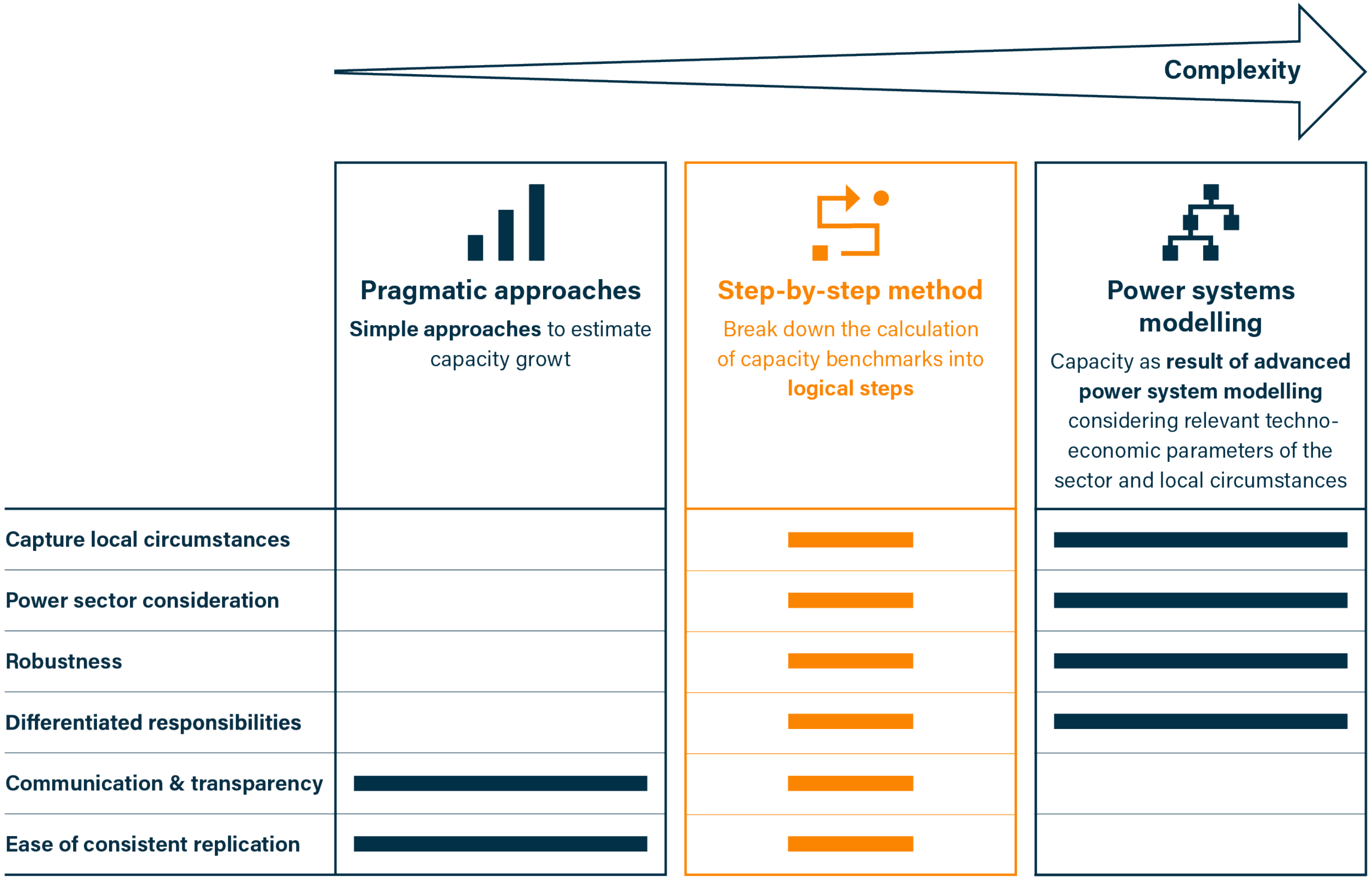
- Supply chains
- resources availability





Energy focus **Climate focus** **Diffusion focus**

Method framework



Bar length in each column represents how much the guiding principle can be accounted by each approach

Overview of lines of evidence

Integrating multiple lines of evidence

- **Downscaled global pathways**
- **High-ambition national studies**
- **RE potential & power system analysis**
- **Evidence-based safeguards**

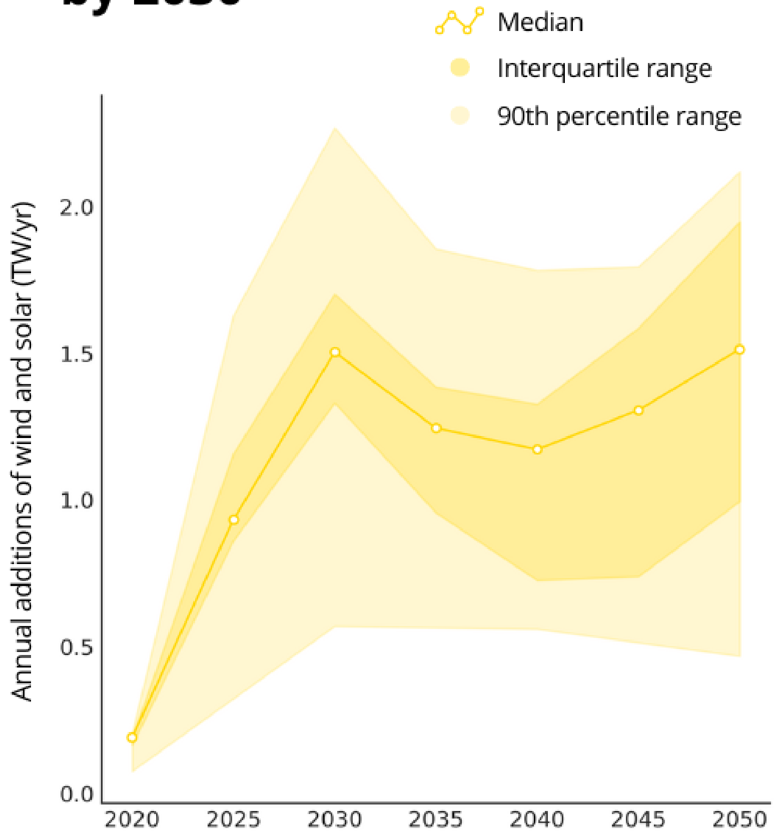
Global pathways

National benchmarks need to be consistent with the 1.5°C and the guiding star

Global pathways assessed by the IPCC are downscaled to the national level

Link to 1.5 TW/y of wind and solar and tripling renewable capacity by 2030

Wind and solar capacity additions reach 1.5 TW/yr by 2030



Source: https://tinyurl.com/2030-targets

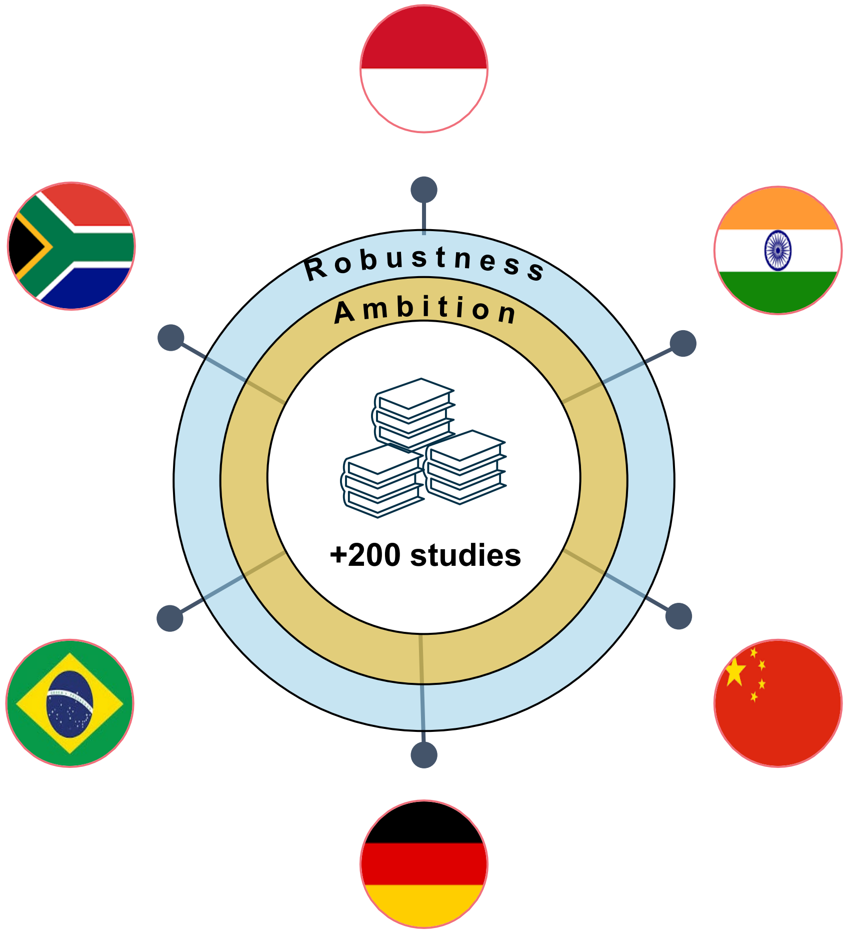
High-ambition national studies

National benchmarks need to be relevant in local contexts

+200 studies reviewed – focus on energy modelling exercises

Studies filtered based on level of ambition, robustness and energy transition challenges

Use ambitious national studies as inputs to inform key parameters of the methodology



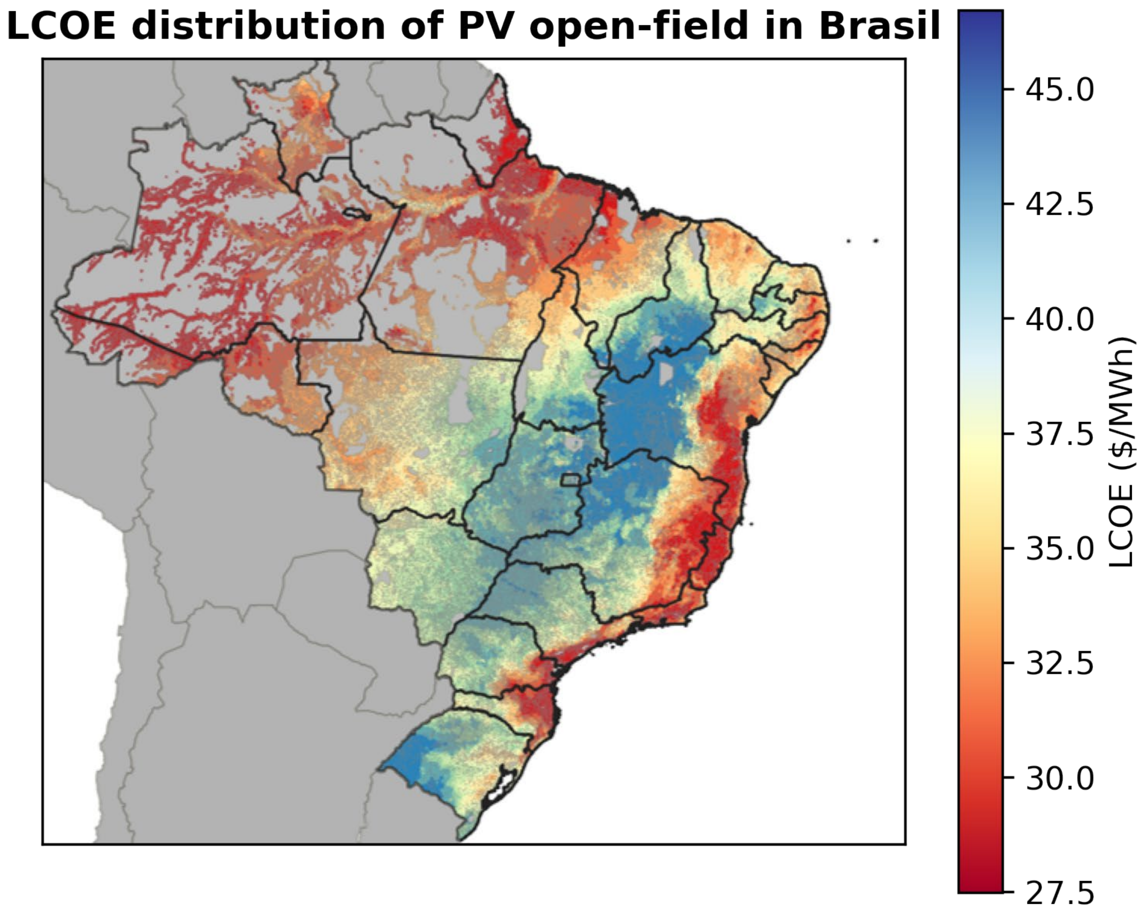
Renewable potential analysis

National benchmarks should reflect national circumstances and resource potentials

High-resolution renewable potential analysis considering:

- Land availability
- Weather data
- Latest cost projections

Provides cost/potential data for modelling work

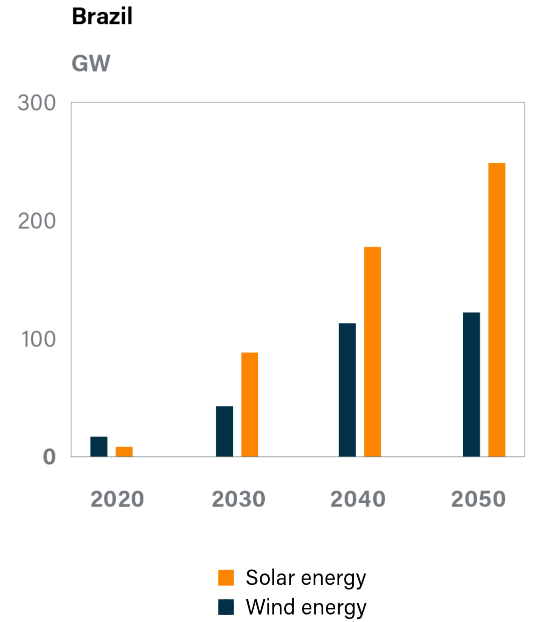


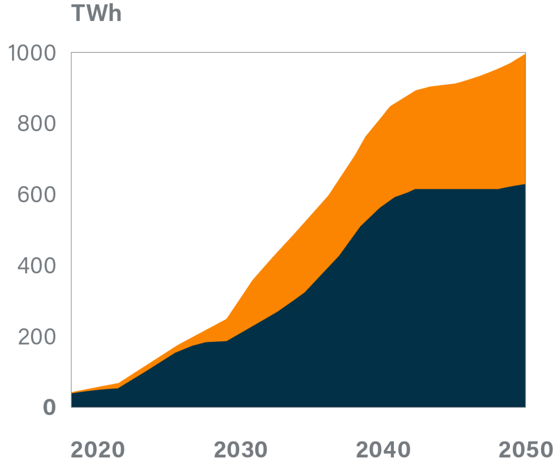
Simplified power system analysis

Infer possible cost-optimal split into wind and solar

Renewable potential with high resolution modelling

Outputs: cost-optimal wind and solar capacity and generation out to 2050





Evidence-based safeguards

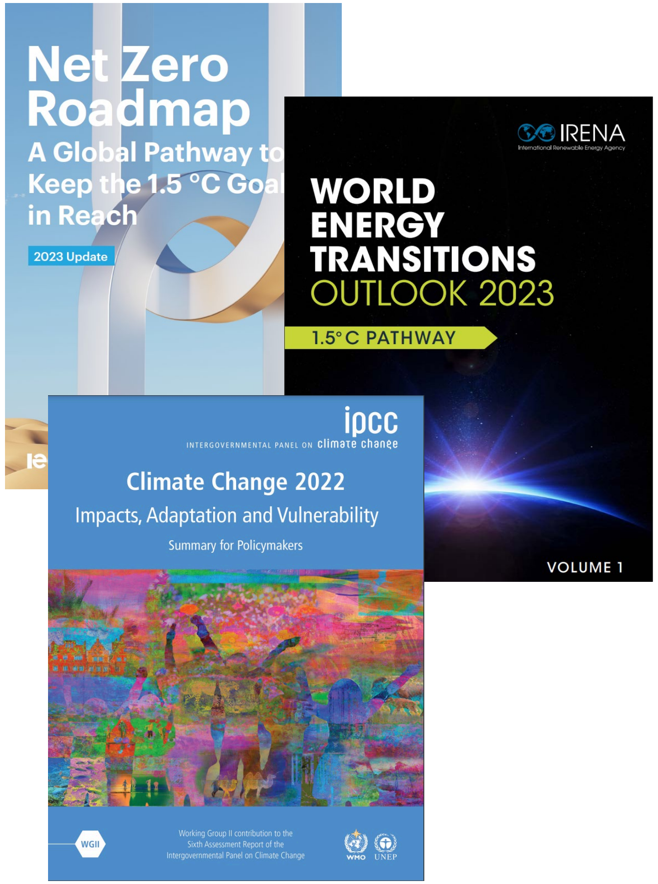
Inform methodology with messages accepted by scientific community. Benchmarks and methodology need be coherent with global messages

Simple approaches can simplify methodology, improving communicability without compromising robustness

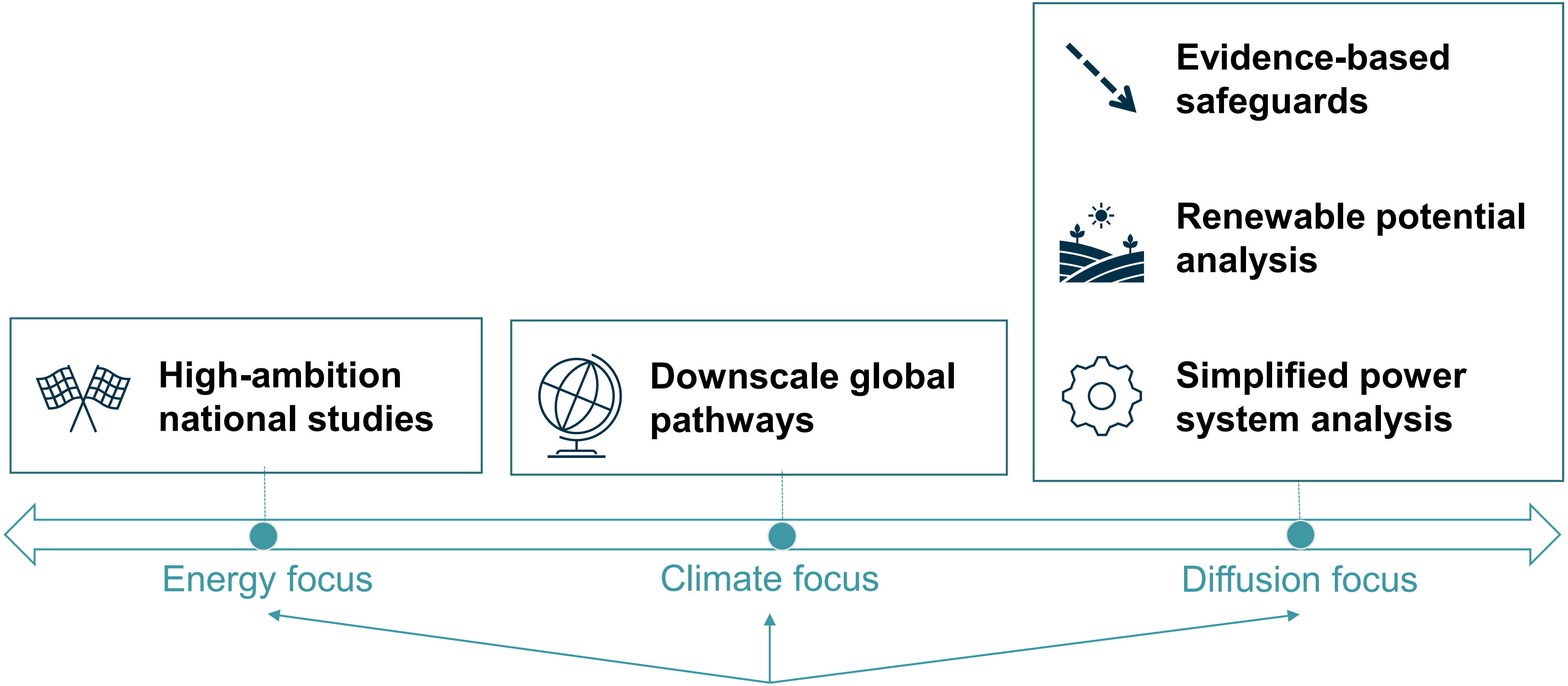
Use (informed) safeguards to ensure consistency with key narrative objectives of the benchmarks.

We use three types of the safeguards in the methodology:

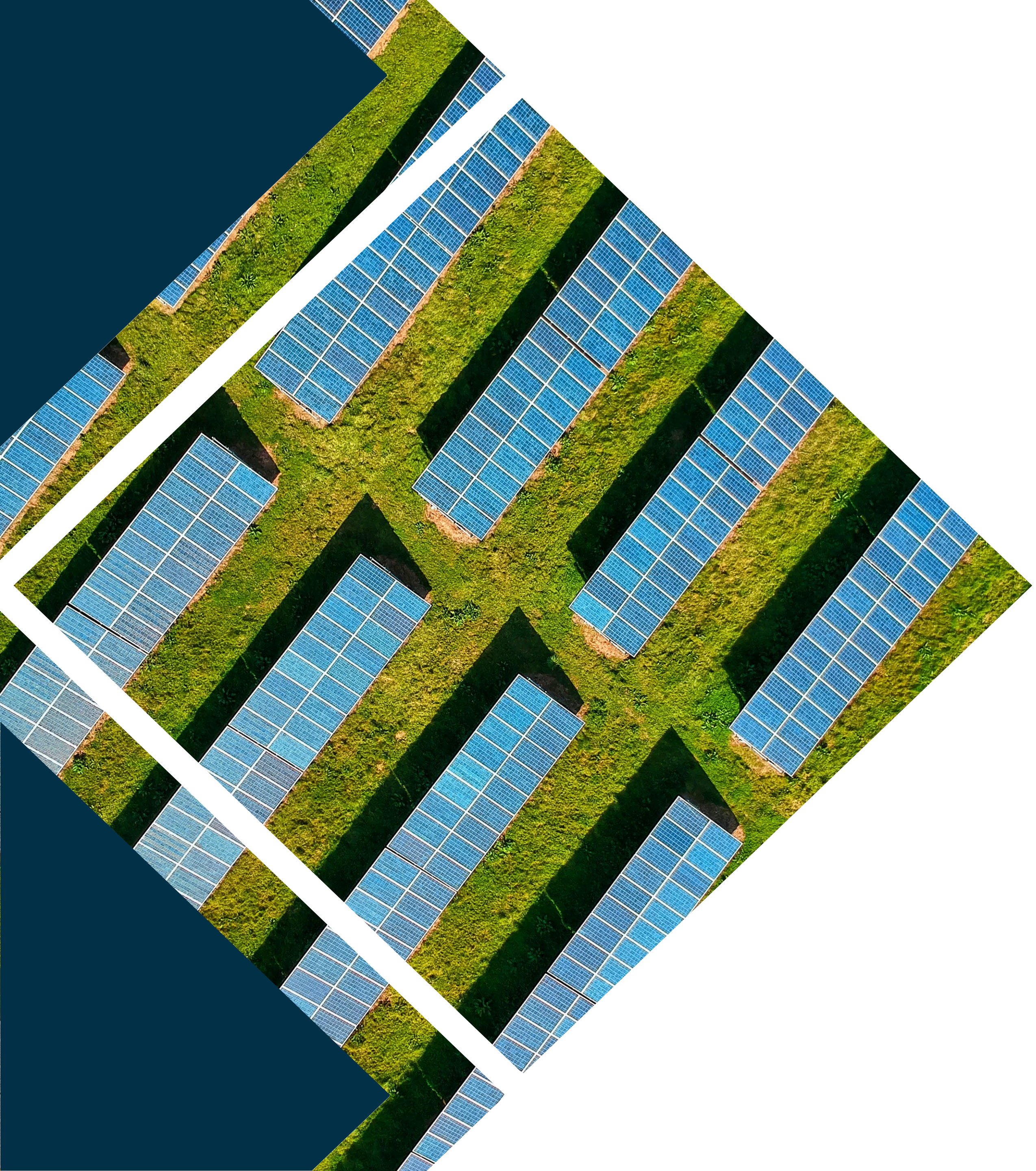
- High electrification to capture energy transition nuances
- Common but differentiated responsibilities through different timelines in phasing out fossil fuels in the power sector
- National renewable energy targets and policies



Diverse lines of evidence permeate the methodology



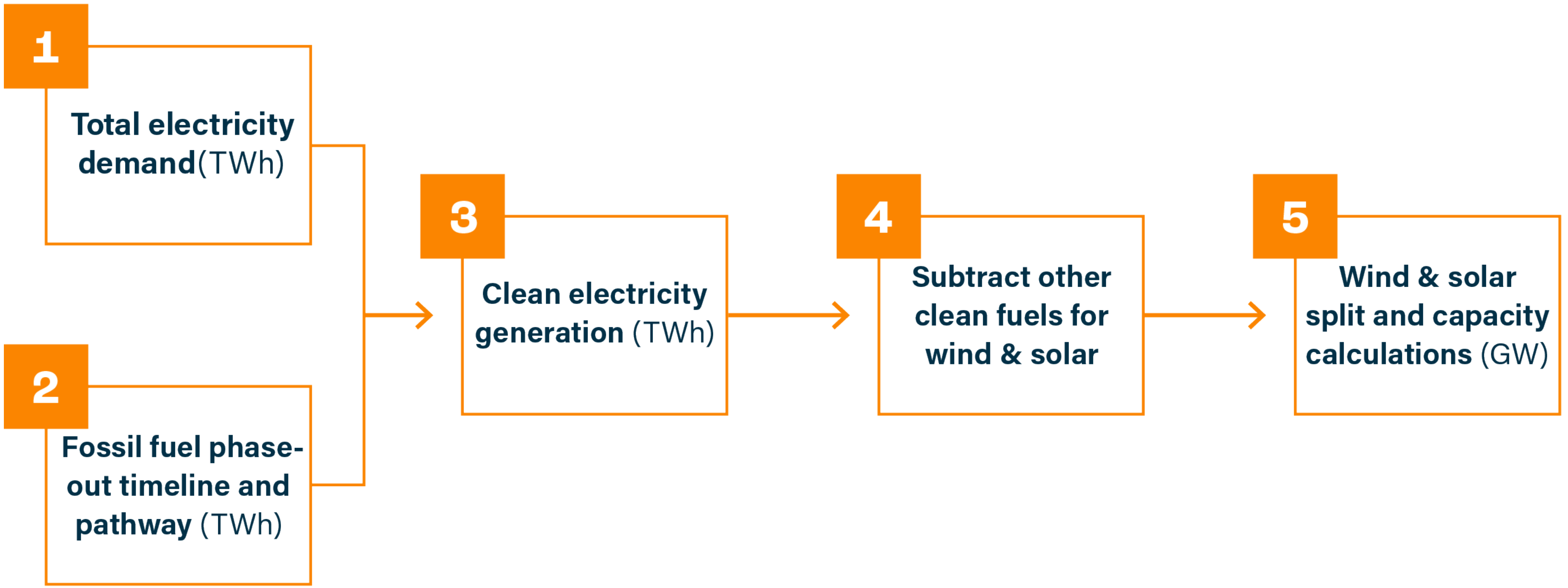
Integrate multiple lines of evidence to capture different narrative-relevant elements in the methodology



Methodology

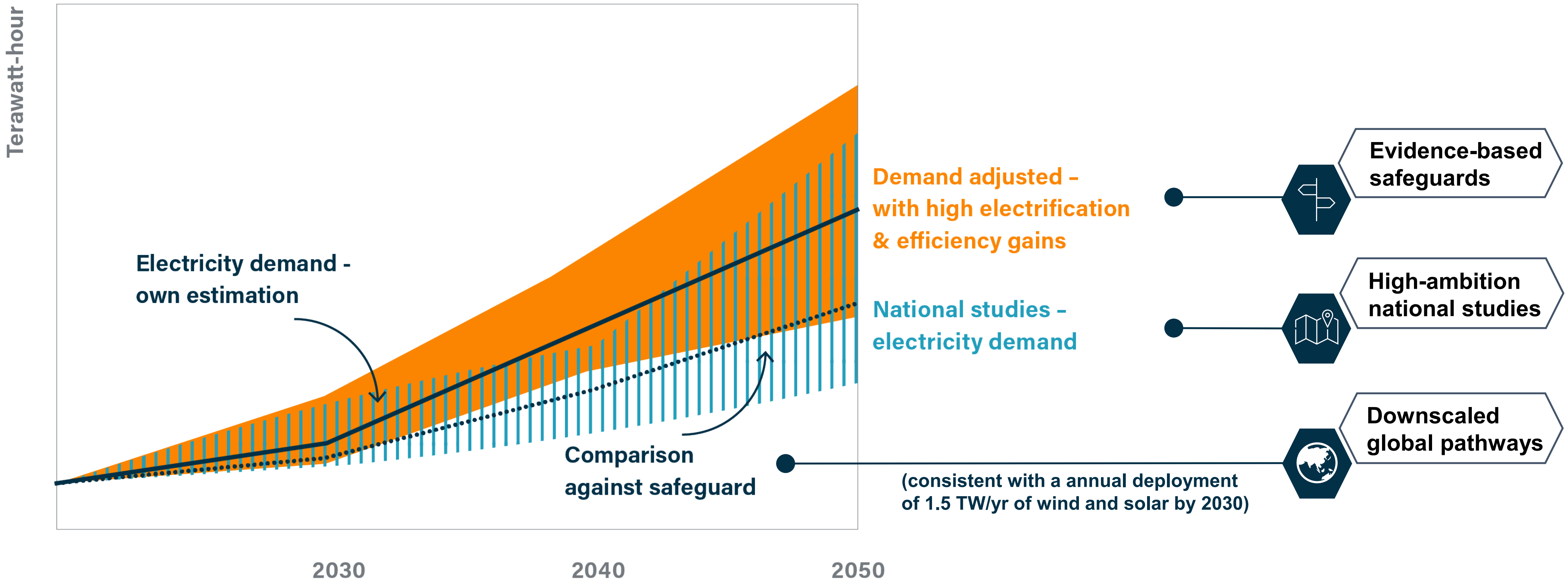
Step-by-step method

Step-by-step method



1 Total electricity generation

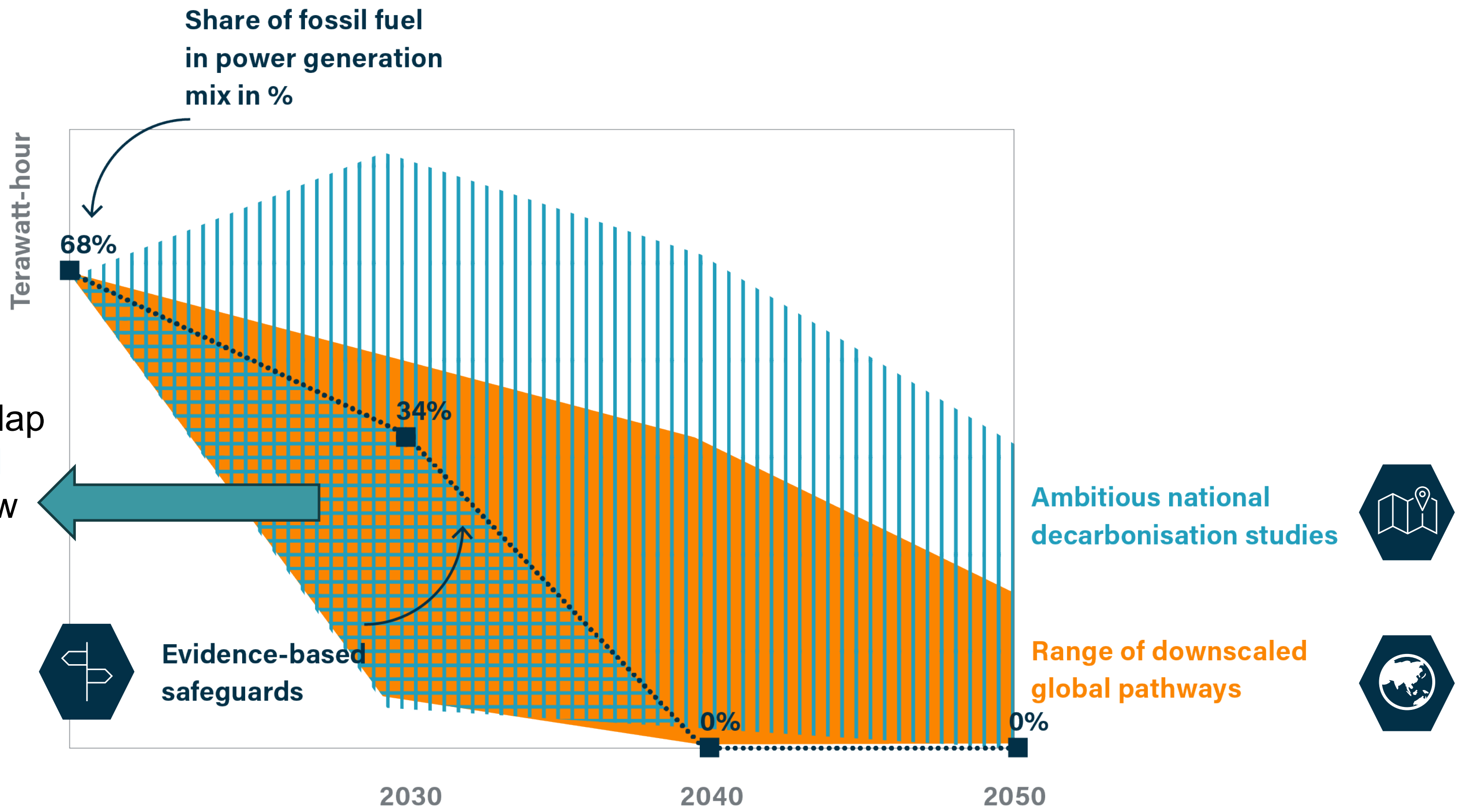
1. Extract electricity demand projections for 2030, 2040, and 2050 from **ambitious national studies**
2. Adjust demand to account for high electrification & efficiency gains, and meet global benchmarks informed from **evidence-based safeguards**
3. Ensure that demand growth is consistent with the **global ambition** call to deploy of 1.5 TW/yr of WNS by 2030



2 Fossil fuel (FF) phase-out pathways

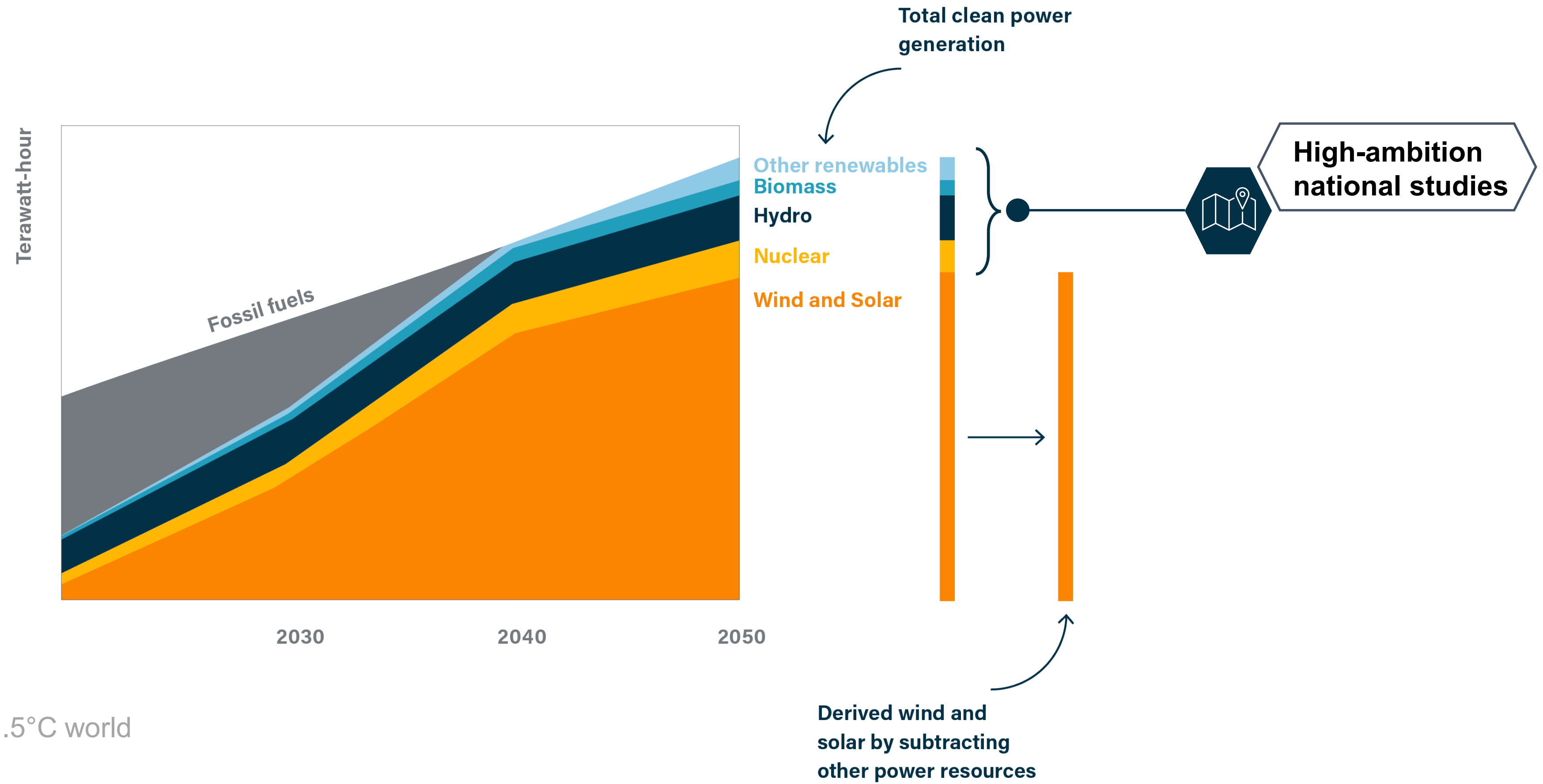
1. Produce a range of electricity generation pathways from FF based on **ambitious national studies**
2. Produce a similar range from **downscaled 1.5°C compatible global scenarios**
3. Identify the intersection of these two ranges, representing the speed and scale of decarbonisation pathways that aligns with the goals of the Paris Agreement while capturing local circumstances countries.
4. Integrate differentiated timelines for phasing out electricity generation from FF, applied as **safeguards** (2035 for advanced economies, 2040 for China, and 2045 for emerging economies)

We take the wedge comprised in the overlap between national studies and downscaled global trajectories, limited to the part below the evidence-based safeguard



3 4 Clean electricity generation & subtract non-WNS

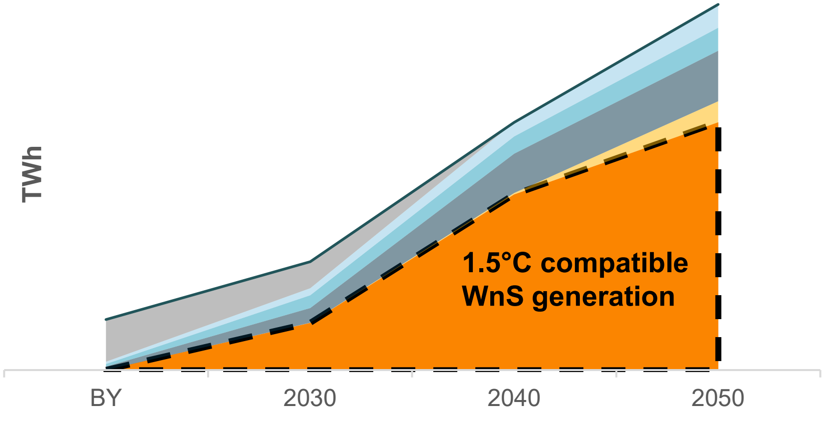
1. Obtain electricity generation from carbon-free resources: from total electricity generation (step 1), subtract fossil-fired generation (step 2)
2. Subtract estimates of electricity generation attributed to hydroelectricity, biomass, other renewable resources, and nuclear power – informed from **national studies'** estimates – from the total clean electricity generation
3. The result of the subtraction is equivalent to electricity generation from wind and solar

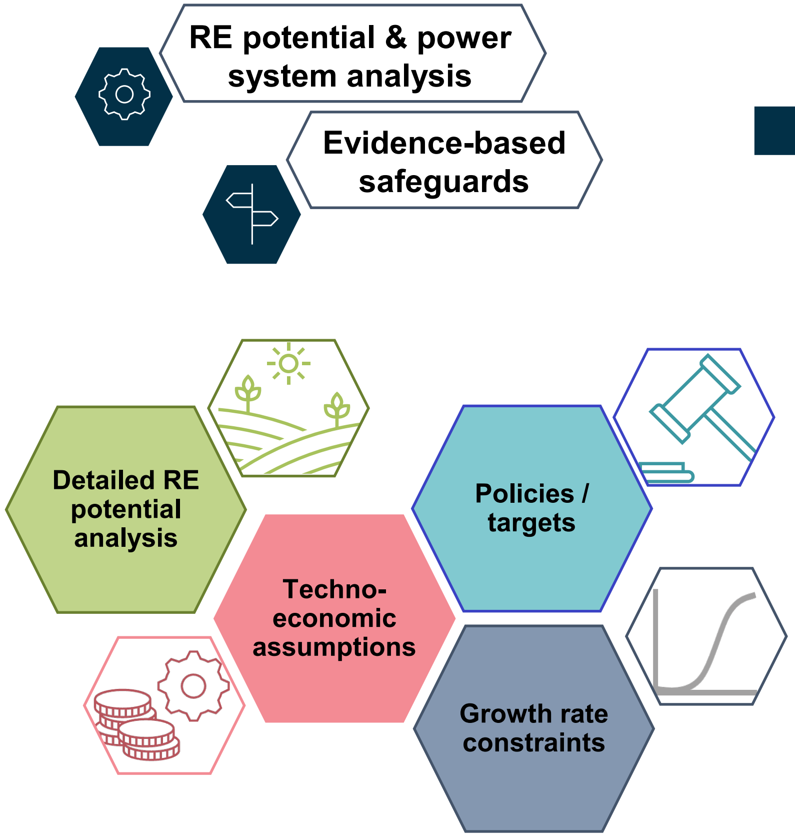


5 WNS breakdown and capacity calculation

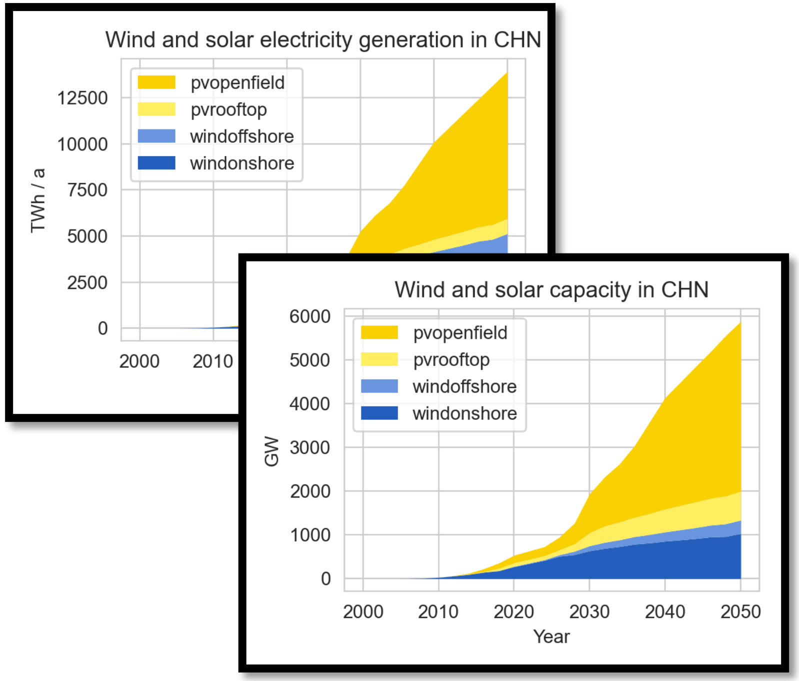
1. We use a **renewable potential analysis** to calculate the technical potential of each technology in the country
2. We force the model (**power system analysis**) to deploy at least the level of solar and wind seen in countries' **current targets and pledges**.
3. Calculate capacity requirements [GW] based on national resource potentials and limited by growth constraints

1.5°C compatible WnS generation (steps 1-4)





Generation and capacity of wind and solar

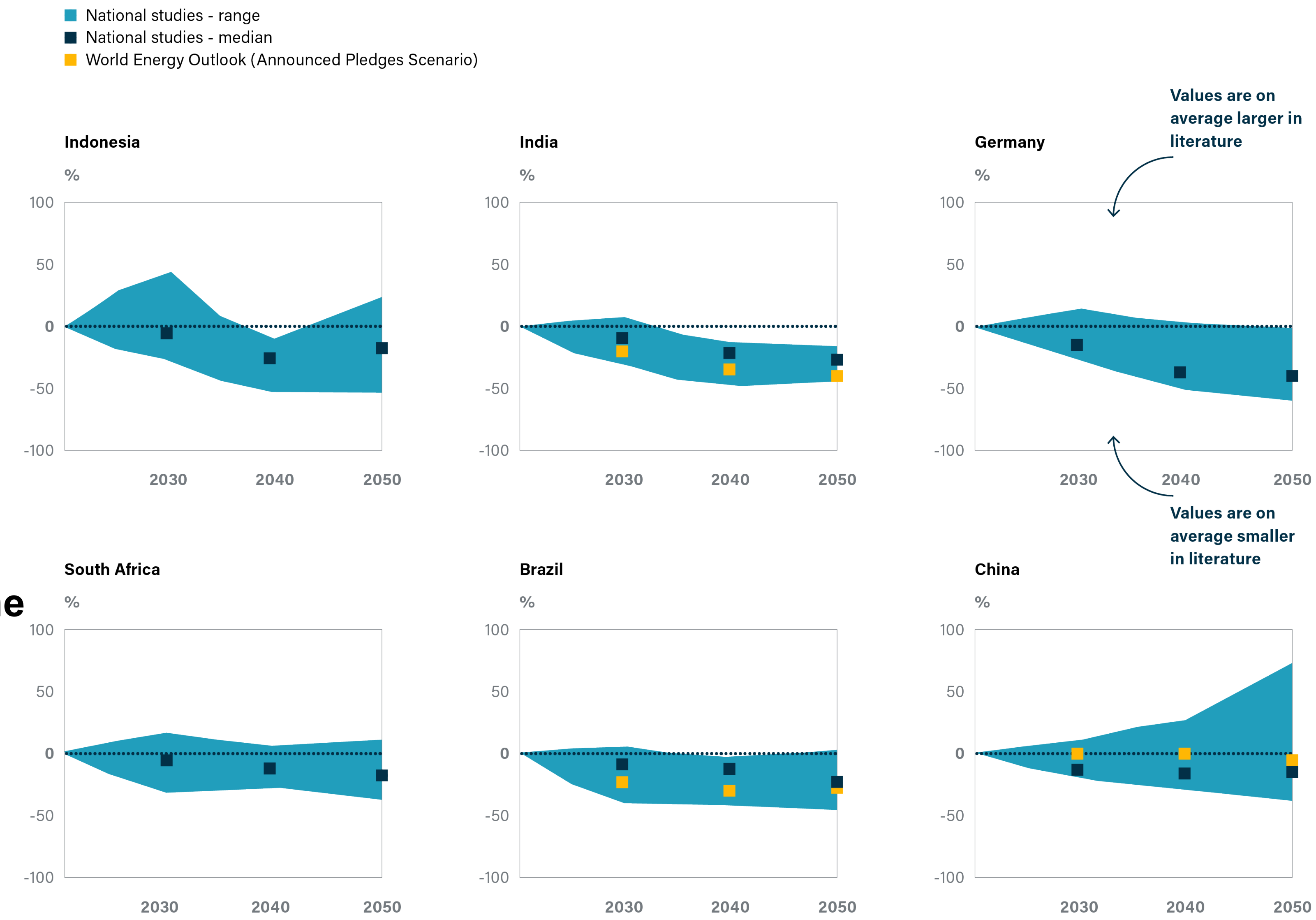


Results

Application of the methodology

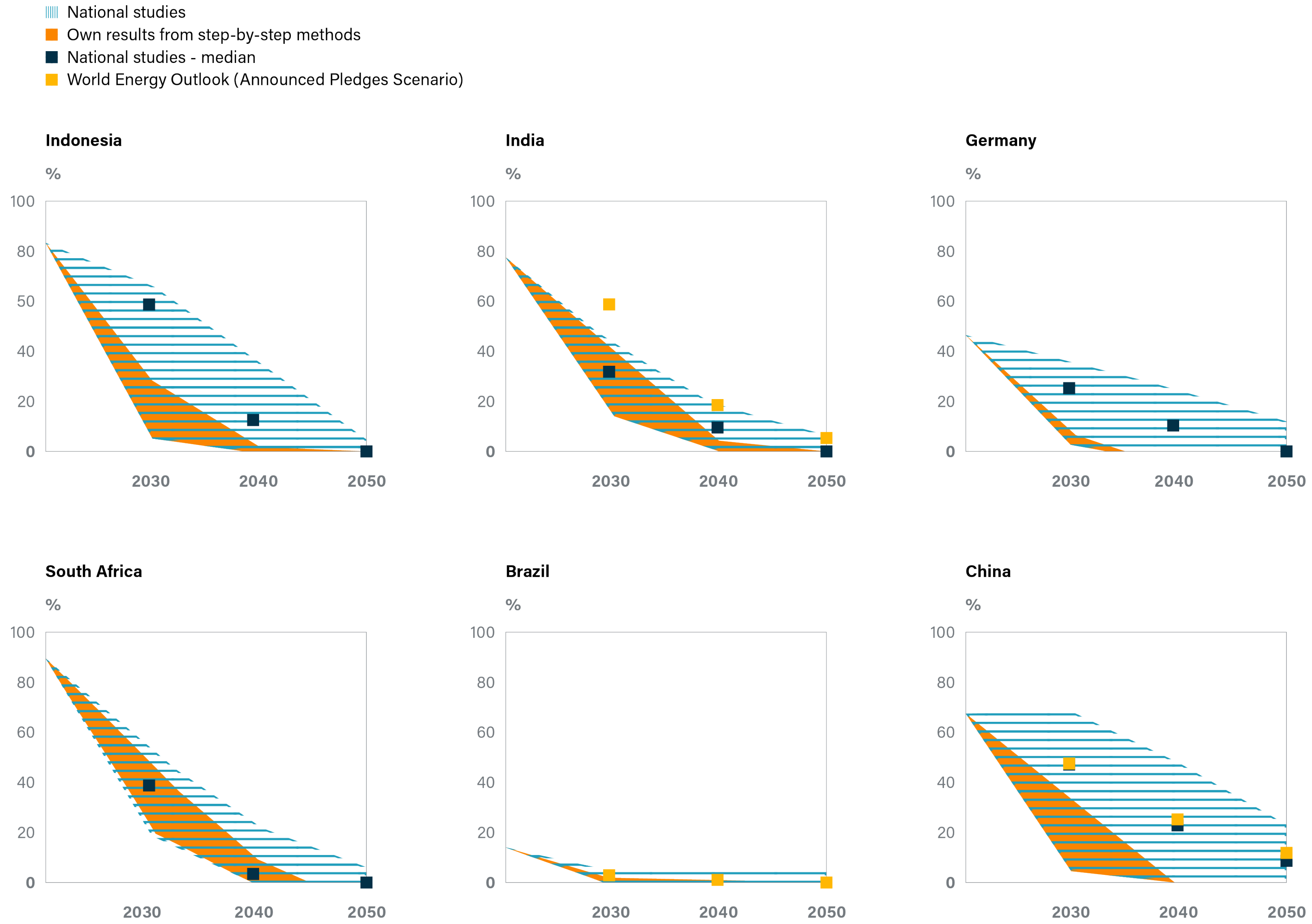
Electricity demand

- **Electricity demand up to 2050 show an increasing trend in all countries**
- **Mainly due to greater electrification, capturing the economy-wide role of clean electricity**
- **Our method yields higher electricity demand, on average, compared to the literature (although consistent in general)**



Fossil fuel phase-out pathways

- **All countries follow a downward trajectory towards a phase-out of fossil fuel electricity generation by 2035-2040**
- **The most significant reductions in fossil fuel generation occur within the next decade in the pursuit of limiting warming to below 1.5°C**
- **Our results fall within the range of national studies, slightly outpacing the median of national studies**



Wind and Solar generation

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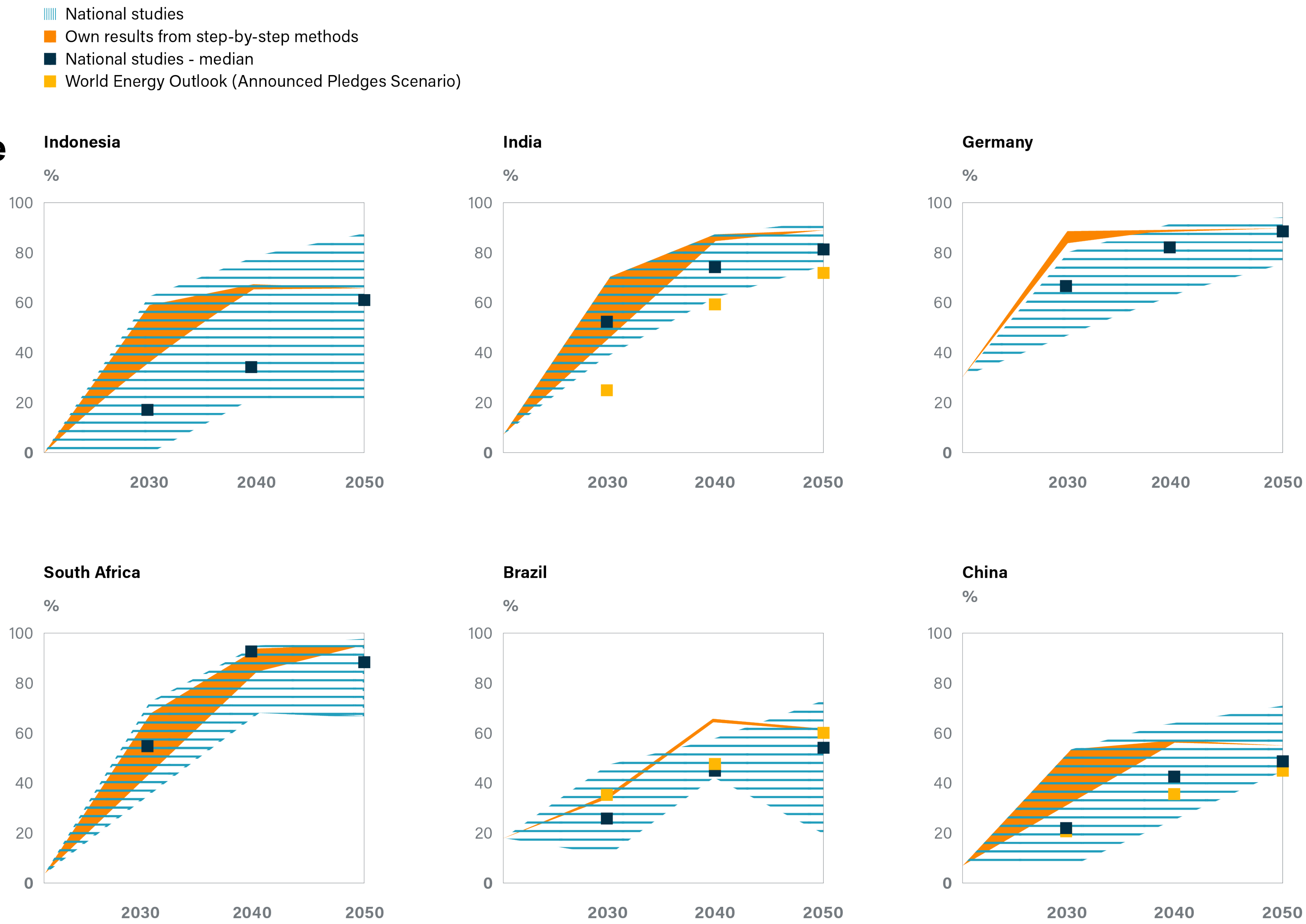
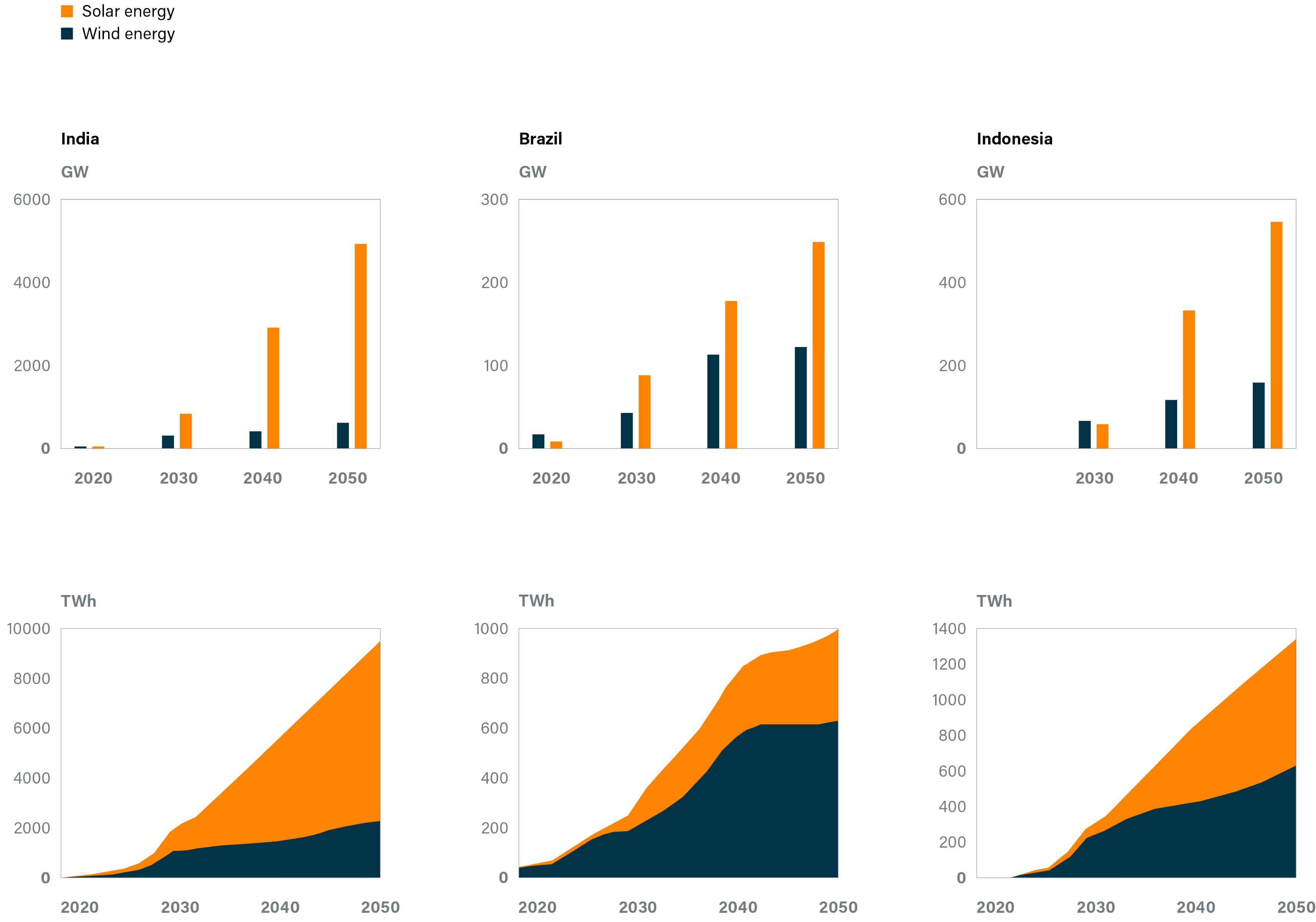
- **We observe a substantial upsurge in WnS generation, especially in the coming decade**
- **Our methodology’s results align with national studies, tending towards the most ambitious end of the range**
- **The results show a considerable variation in the penetration WnS in the generation mix from country to country due to the influence of other carbon-free technologies within each country.**



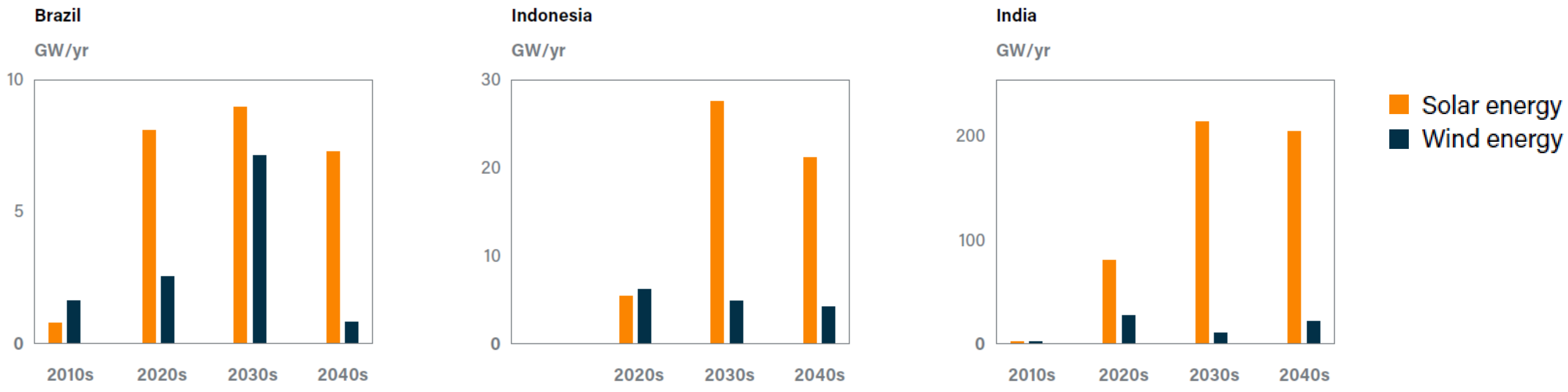
1.5ºC compatible WnS benchmarks

- **Higher electricity generation from WnS leads to higher capacity installations**
- **WNS capacity needs to grow rapidly to align with a global 1.5ºC pathway.**
- **Key drivers of the split are:**
  1. **Cost assumptions**
  2. **Resource availability**
  3. **Driving policies**
  4. **Assumptions on efficiencies**



Annual capacity deployment

- **All countries need to increase the pace of wind and solar deployment considerably**
- **Fastest roll-out (% terms) in the 2020s. Growth relaxes in 2030s/40s, but is still substantial**
- **The fast roll-out is needed to drive fossil phaseout and meet the rapid electrification**
- **There are differences in the deployment dynamics between countries, driven by differences in the rate of WnS deployment required to align with 1.5ºC and comply with national targets**



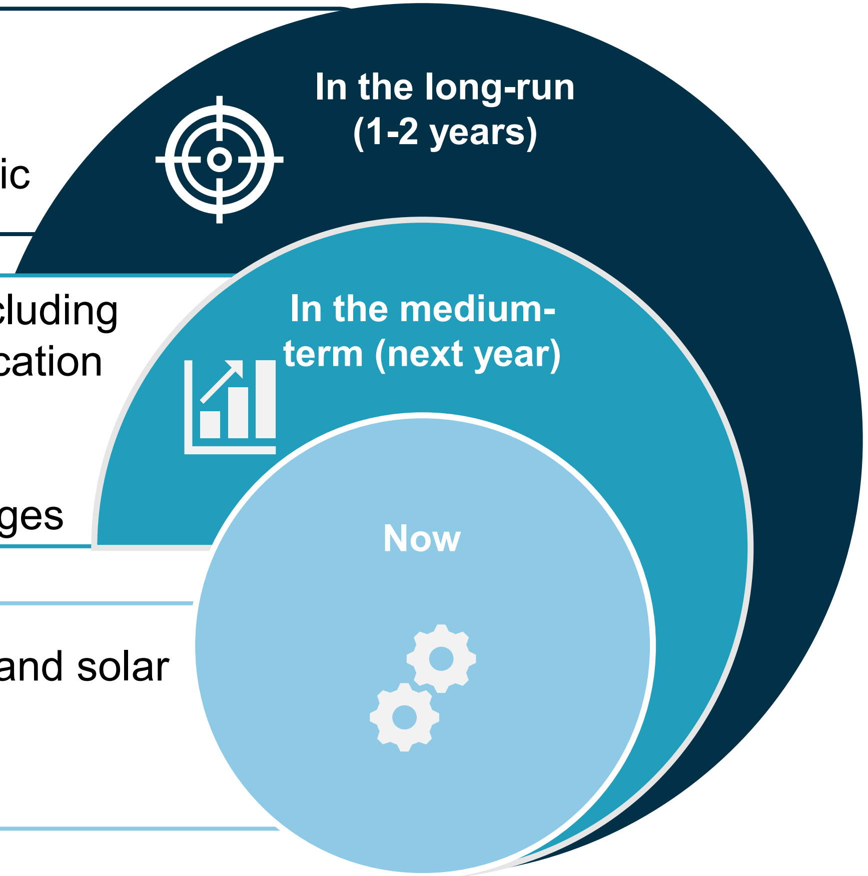
Note: The bars represent decadal averages. Therefore, annual capacity additions within each decade may vary, having a smooth increasing/decreasing trend over the decade.

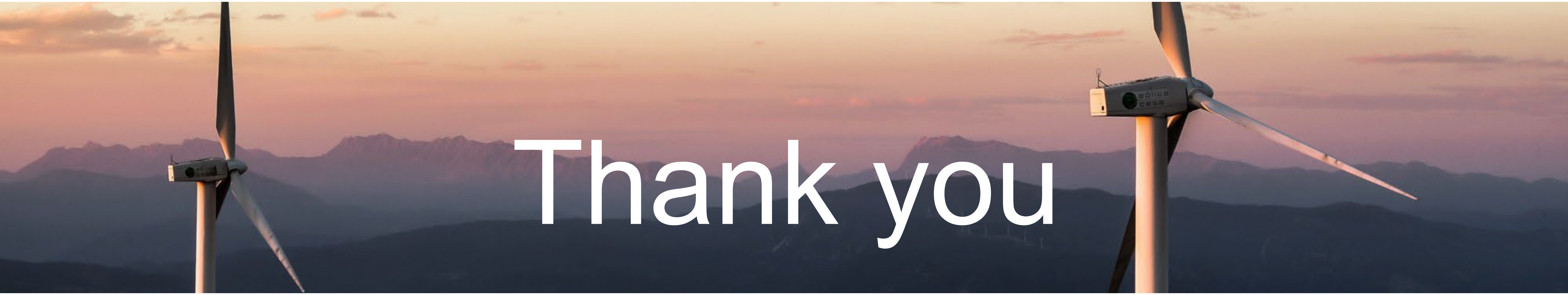
Stay tuned!

- Scale up country coverage (+20 countries)
- Work closer with campaigns and amplify messages
- Host benchmarks in a data portal accessible to public

- Roll-out the methodology to a >10 countries (including the 6 in the preliminary phase) – including publication
- Share and validate results with actor groups in countries
- Work closer with campaigns and amplify messages

- Developed a methodology to calculate wind and solar benchmarks for a 1.5°C world
- Run preliminary results for 6 countries





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