



# Interdisciplinary Centre for Security, Reliability and Trust

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## Assessing the need for power system flexibility on a global level: A multi-criteria assessment index

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# Need for Power System Flexibility: A Global Index



## Motivation

- Industrial sector could play a vital role in balancing the power system by making production process flexible and adapting to the fluctuating electricity supply (VRE), i.e., industrial demand side management.
- The aim of our research is to find countries with the highest need for power system flexibility, especially in their industrial sector.

## Research Question

- Which countries in the world have the highest need for power system flexibility?
- Focusing on the industrial sector, one of the main end-user of electricity
  - Indicators: economy, electricity capacity & generation, impact of industry on the country's GDP

## Research Method

- Researching key economic & energy related indicators for all countries and collecting data for these indicators.
- Ranking countries using the `analytical hierarchy process (AHP)` of the `multi- criteria decision analysis (MCDA)` method. Indicators were given equal weights due to their equal importance.
- Researching and reviewing relevant criteria for the selected countries (e.g., Electricity market structure).

## Data / Evidence

- We used IRENA, IEA, World bank etc. databases as sources for our data
- We have created a Database of 196 countries
- 61 countries have 100% RE electricity targets (until mid 2021)

# Method / Research Approach

Step 1: Researching and selecting indicators for country analysis

Step 2: Secondary Data Collection Sources: IRENA, World Bank, IEA, Govt NDC report

Step 3: Index making\*\*: Normalization of collected data for direct country-to-country comparison

Step 4: multiplication of the normalized value of the selected criteria to get the top 25 countries

Step 5: In-depth power market analysis of top countries

\*\*Theoretical Background:

1. Sustainable energy transition readiness: A multicriteria assessment index.
2. A comparison of environmental and energetic performance of European countries: A sustainability index.
3. What is in an index? Construction method, data metric, and weighting scheme determine the outcome of composite social vulnerability indices in New York City

# Method / Research Approach: a visual representation

Country Name	GDP per capita
Luxembourg	1,00
Macao SAR, China	0,73
Switzerland	0,71
Ireland	0,69
Norway	0,66
Iceland	0,58
Singapore	0,57
USA	0,57
Qatar	0,56

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Country Name	VRE Capacity
Denmark	1,00
Germany	0,96
Tuvalu	0,88
Uruguay	0,76
Ireland	0,71
United Kingdom	0,68
Belgium	0,67
Kiribati	0,64
Spain	0,62

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Country Name	VRE Generation
Denmark	1,00
United Kingdom	0,79
Uruguay	0,72
Lithuania	0,72
Ireland	0,57
Germany	0,50
Tuvalu	0,48
Spain	0,47
Portugal	0,47

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Country Name	Industrial Electricity Consump.
Iceland	1,00
Mozambique	0,97
Congo, Dem. Rep.	0,74
Kazakhstan	0,74
Mongolia	0,73
China	0,73
Trinidad and Tobago	0,71
Chile	0,71
Vietnam	0,69

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Country Name	Impact of Industry on GDP
Brunei Darussalam	1,00
Qatar	0,95
Kuwait	0,94
Equatorial Guinea	0,91
Oman	0,87
Iraq	0,84
Azerbaijan	0,83
Congo, Rep.	0,80
Saudi Arabia	0,78

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# Method / Research Approach: a visual representation



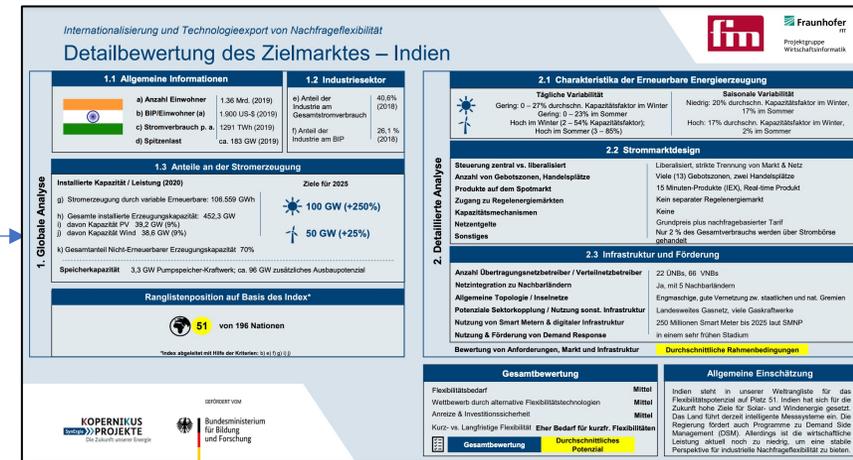
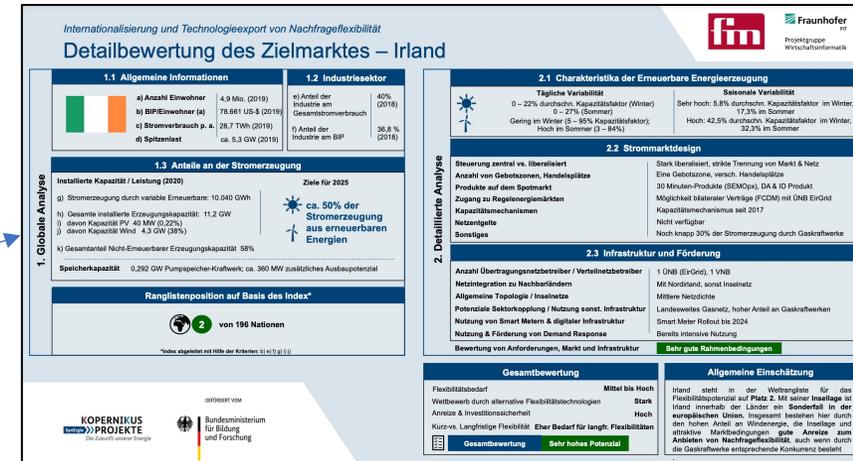
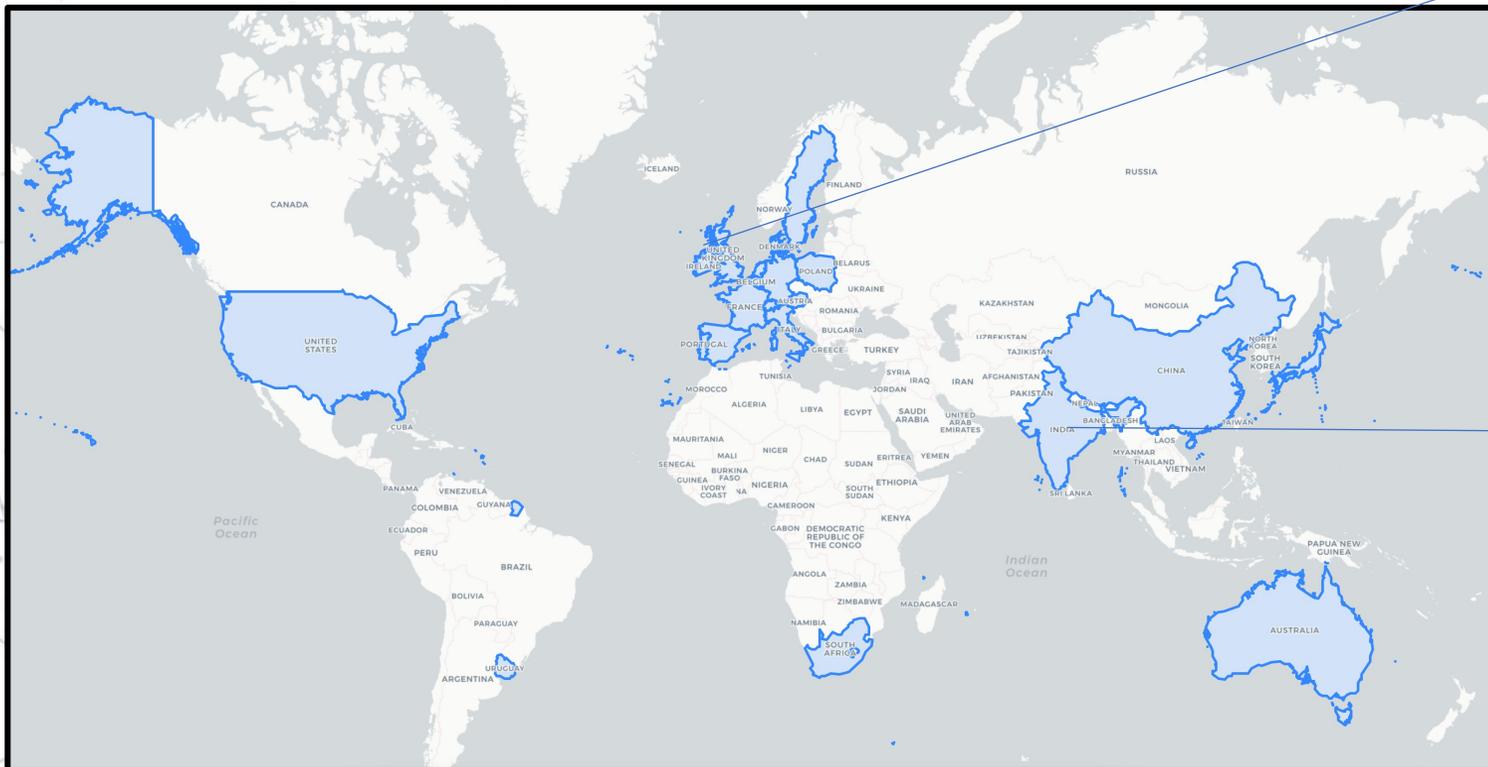
Top 25 Countries of the Index	
1	Denmark
2	Ireland
3	Germany
4	Belgium
5	Luxembourg
6	Uruguay
7	United Kingdom
8	Spain
9	Austria
10	Lithuania
11	Italy
12	Netherlands
13	Portugal
14	Australia
15	Sweden
16	Finland
17	Japan
18	Romania
19	Chile
20	Greece
21	China
22	USA
23	France
24	Poland
25	Switzerland

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# Index for industrial flexibility need: A market analysis of countries with the highest need for flexibility helps us to better assess the boundary conditions in different countries

We assessed the industrial demand side flexibility need of all countries based on key economic & energy related indicators.

You can check the map on: <https://synergie2.fim-rc.de/int/display.html>



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