Assessing Climate Risk Exposure:

The Case of RWE

Objective

This case study simulates how a company can assess its exposure to climate-related risks using publicly available data. The selected company is RWE, a major energy provider in Europe. The analysis focuses on emissions trends, physical climate vulnerability, and exposure to transition risks like carbon pricing.

Selected Company

- RWE AG (Germany-based utility company)
- One of Europe's largest CO_2 emitters due to coal-based energy production

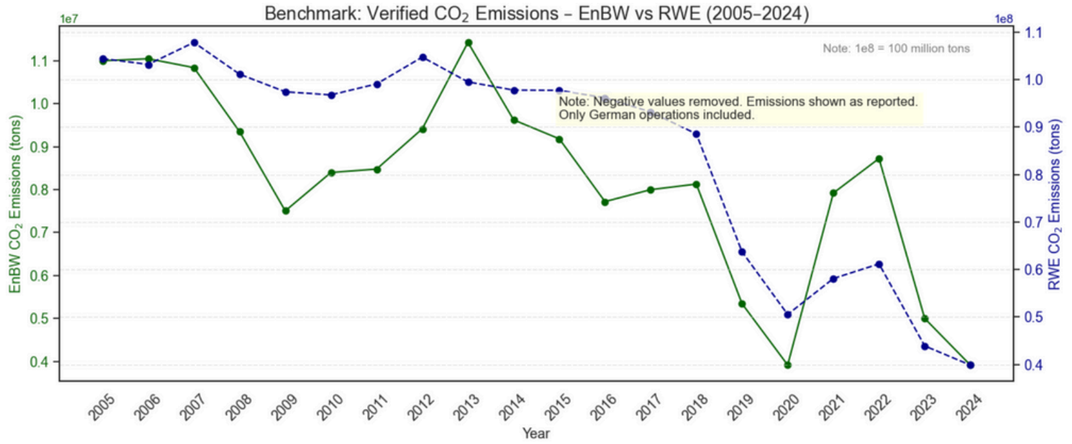
Scope of Analysis

- Verified emissions data and trend analysis (2005-2023)
- Geographic exposure to drought risk in North Rhine-Westphalia
- Financial exposure to carbon pricing under the EU Emissions Trading System

Data Identification

- **EU ETS Data Viewer**: Verified, company-level GHG emissions data, suitable for trend and benchmark analysis.
- **European Drought Observatory (EDO):** Provides drought risk indicators (e.g., SPEI), enabling geographic climate risk mapping.
- **World Bank Carbon Pricing Dashboard:** Tracks carbon prices across countries and years, essential for transition risk estimation.

1. Risk & Impact Analysis



This benchmark compares verified CO_2 emissions of EnBW and RWE (Power AG + Generation SE) using EU ETS data. The trends reflect operational footprints and reporting completeness for two major German energy producers.

a) Emissions Trends & Benchmarking

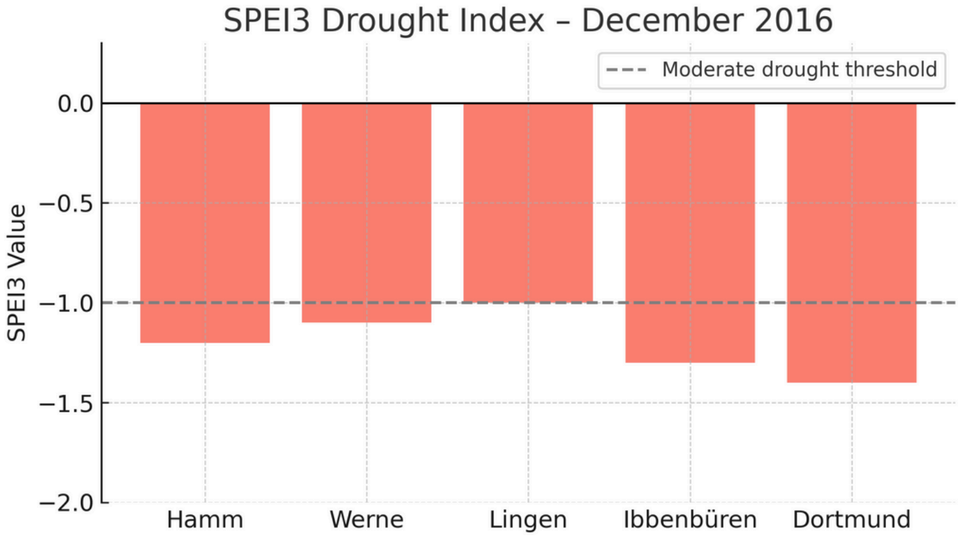
- **Benchmark**: Verified CO_2 Emissions - EnBW vs RWE (2005–2024)
- This benchmark compares verified CO_2 emissions of EnBW and RWE (Power AG + Generation SE) using EU ETS data.

⚠️Only German operations are included. Negative values are removed.

RWE shows a higher and more consistent footprint, while **EnBW's trend is more volatile with a recent sharp decline.

b) Geographic Vulnerability to Climate Events

- Drought Exposure - North Rhine-Westphalia (SPEI3 Index, Dec 2016)
- RWE facilities are clustered in drought-prone cities (e.g., Hamm, Werne, Dortmund)
- SPEI3 index reveals moderate to severe drought conditions in Dec 2016(based on worst-year).
- Such regional drought stress may affect water-intensive operations like cooling, transport, and infrastructure stability.

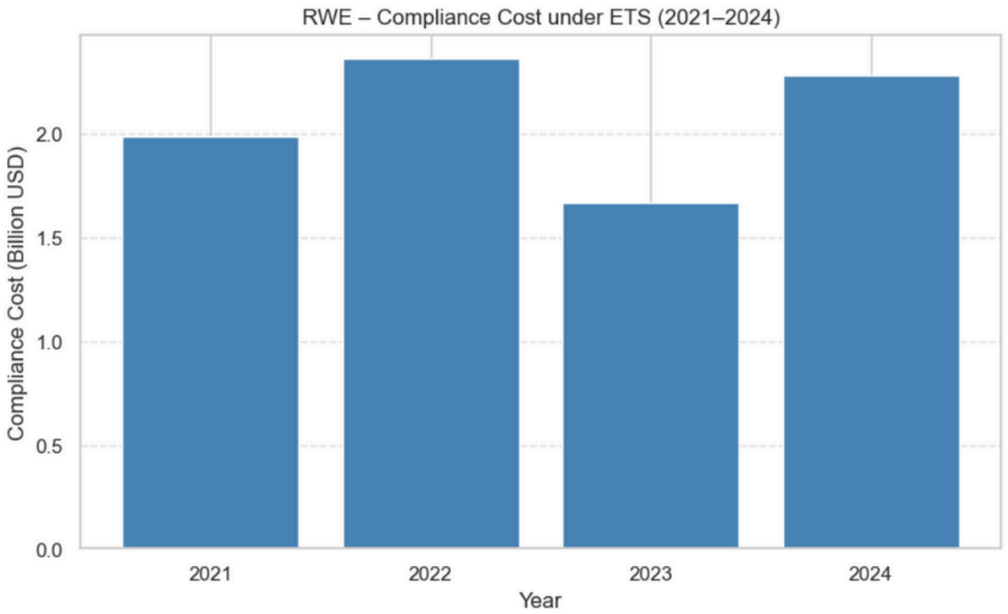


c) Exposure to Carbon Pricing

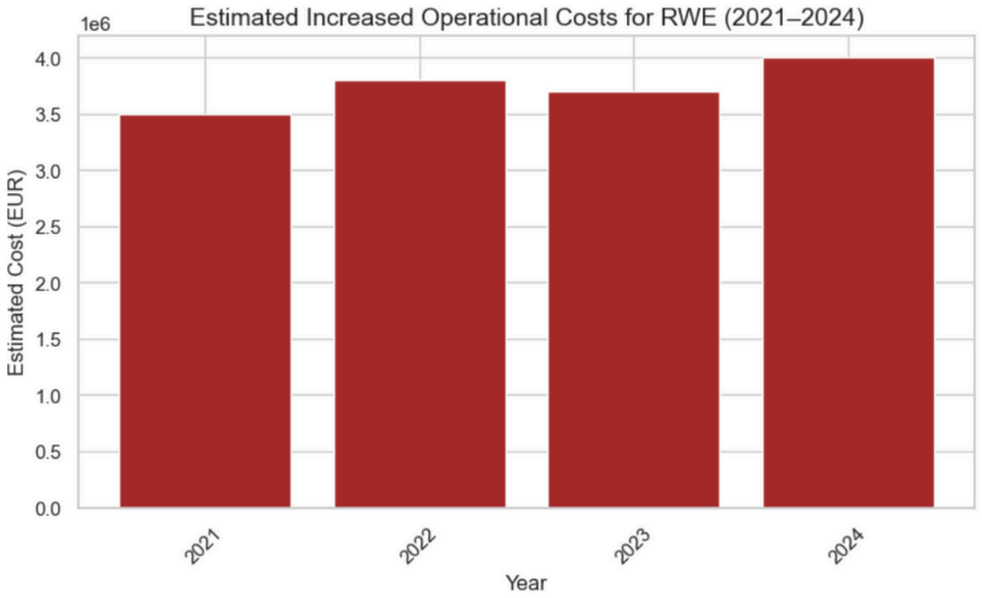
Exposure to EU ETS Prices (2021–2025): Germany does not apply a carbon tax, but ETS prices have nearly doubled. This implies rising compliance costs, even without legislative changes.

Year	Price (USD/tCO₂e)
2021.0	29.4
2022.0	33.2
2023.0	32.6
2024.0	48.4
2025.0	48.5

2. Financial Implication Estimation



This chart visualizes RWE's increasing compliance cost under the EU ETS from 2021 to 2024. The cost is directly tied to both emission volumes and rising carbon prices, highlighting the company's financial exposure to regulatory shifts, even in the absence of a direct carbon tax.



This value is a simplified approximation to model increased operational expenditures (OPEX), such as costs linked to energy efficiency upgrades, maintenance under climate stress, or adaptation measures (e.g., cooling systems, water use).

A - Regulatory Compliance Costs

Estimated ETS Compliance Costs – RWE (2021–2024)

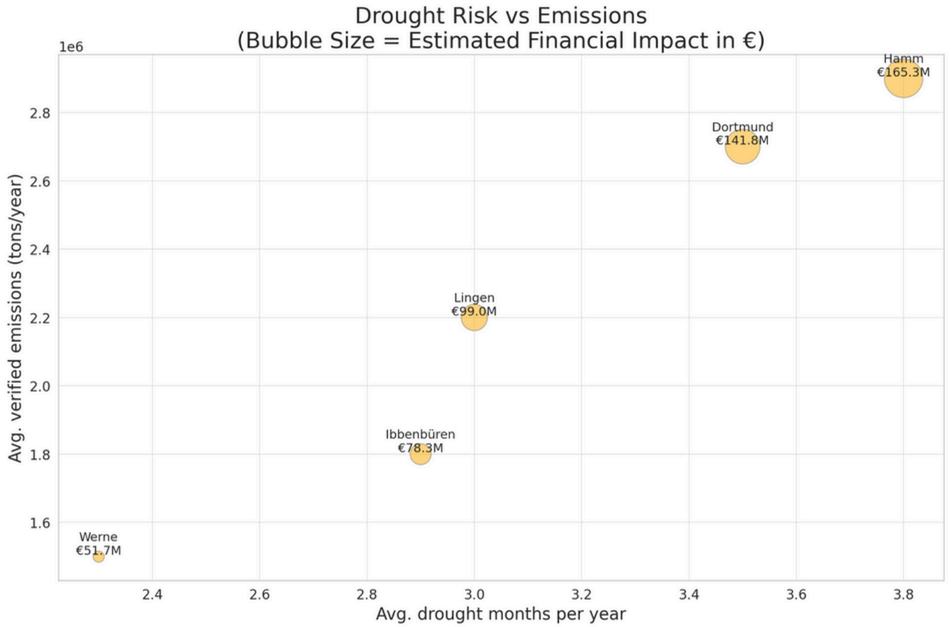
- We matched RWE's verified emissions with historical EU ETS prices to model regulatory exposure. Even in the absence of a formal carbon tax, rising carbon prices have led to a steep increase in compliance costs.
- Formula used: **Compliance Cost = Emissions × ETS Price (USD/tCO_2e)**
- This captures the company's regulatory vulnerability under market-based pricing mechanisms.

B - Climate-related Operational Expenditures (OPEX)

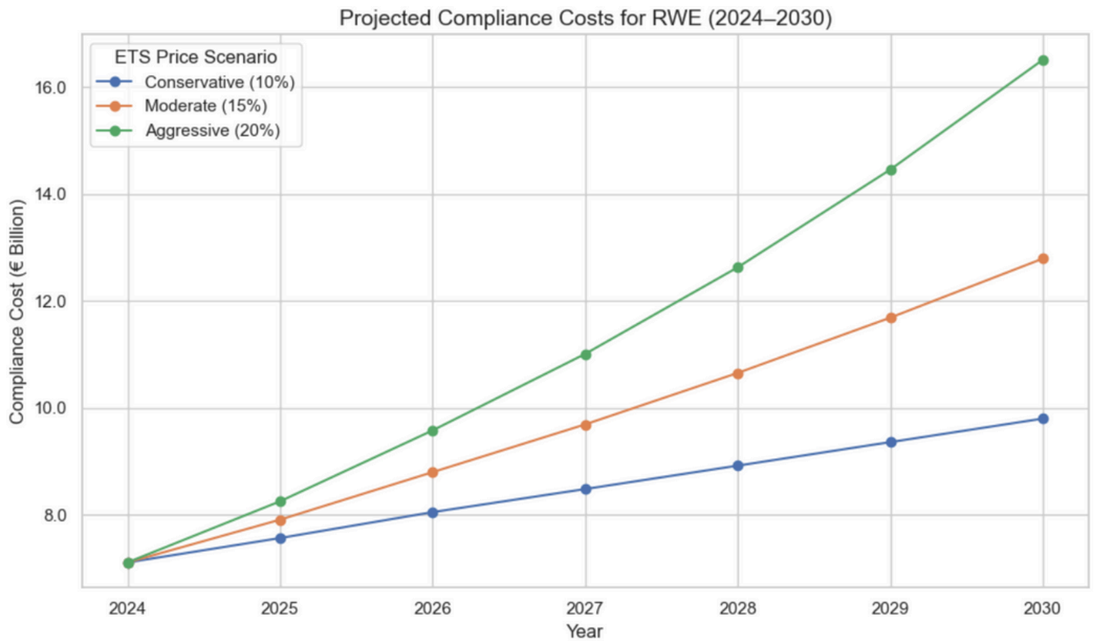
Estimated Climate-related OPEX – RWE (2021–2024)

- Using a hypothetical €5/tCO_2e cost multiplier, we simulated the operational cost increase linked to climate adaptation (e.g., cooling upgrades, water efficiency).
- Formula used: **Estimated OPEX = Emissions × €5/tCO_2e**
- This is distinct from ETS prices and meant to reflect physical adaptation costs.
- This highlights potential financial strain from non-regulatory physical climate risks.

2. Financial Implication Estimation



Financial impact = Avg. Drought × Emissions × 15 €/ton.
Values shown directly on bubbles (top 5 cities).



C - Revenue Volatility from Drought Exposure

Potential Financial Impact of Drought - RWE Facilities

- We estimated revenue volatility by overlaying drought exposure and facility-level emissions.
- Bubble size reflects the simulated annual cost of drought-related disruptions.
- Formula used: **Estimated Impact = Drought months × Emissions × Risk coefficient**
- The model demonstrates chronic climate stress impacts on RWE's core operations, even without formal penalties.

Modeling tomorrow's costs today

- To assess how RWE's climate-related financial exposure may evolve, we simulated projected compliance costs under three carbon pricing scenarios: 10%, 15%, and 20% annual increase.
- Assuming stable emissions from 2024 onward, the model shows that costs could more than double by 2030, exceeding €16 billion/year in the most aggressive case.
- This forward-looking analysis supports strategic planning and aligns with emerging sustainability disclosure expectations.

🔗 *Learn more about EU sustainability disclosure requirements*

3. Recommendations & Reporting:
Turning risk into action-realistic mitigation & adaptation paths

a) RWE can act now to reduce its climate risk exposure.

The actions are based on proven strategies already used across the energy sector.

🔗 Key sources:
IEA: Net zero roadmap
World Bank: ETS & carbon taxes |
CDP: Internal CO_2 pricing

Recommendation	Type	Risk	Why it matters
Use low-water cooling	Adaptation	Drought & heat	Dry/hybrid systems cut water use
Accelerate renewables & PPAs(Power Purchase Agreement)	Mitigation	Carbon pricing	Renewables reduce ETS costs
Apply internal CO_2 pricing	Mitigation	Regulatory & financial	Internal price (e.g. €150/t) aligns investment

b) Datasets & Assumptions

Datasets used:

🔗 **EU ETS – Verified emissions data (EEA)**
🔗**SPEI3 Drought Index (JRC - European Drought Observatory)**
🔗 **World Bank - Carbon Pricing Dashboard**

Assumptions made:

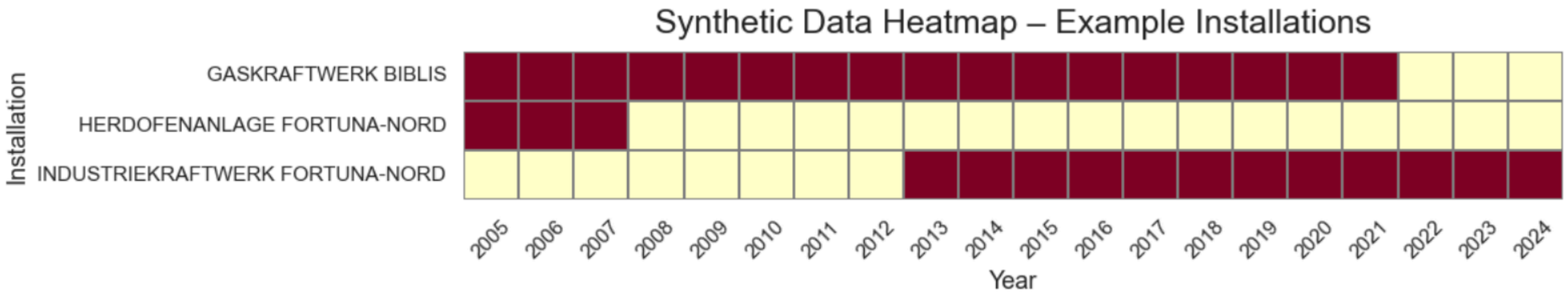
- Constant emissions post-2024
- ETS price growth: 10%, 15%, 20%
- Climate OPEX proxy: €5/tCO_2e

Synthetic fill logic - assumptions & unit (Optional Stretch Goal)

All values are in tonnes of CO_2 equivalent (tCO_2e).

Missing or zero values were estimated using:

- A forward projection: previous year × 0.98 & A backward projection: next year × 1.02
- Estimated values are shown in bold. This method filled gaps like those for **BIBLIS** before 2020.

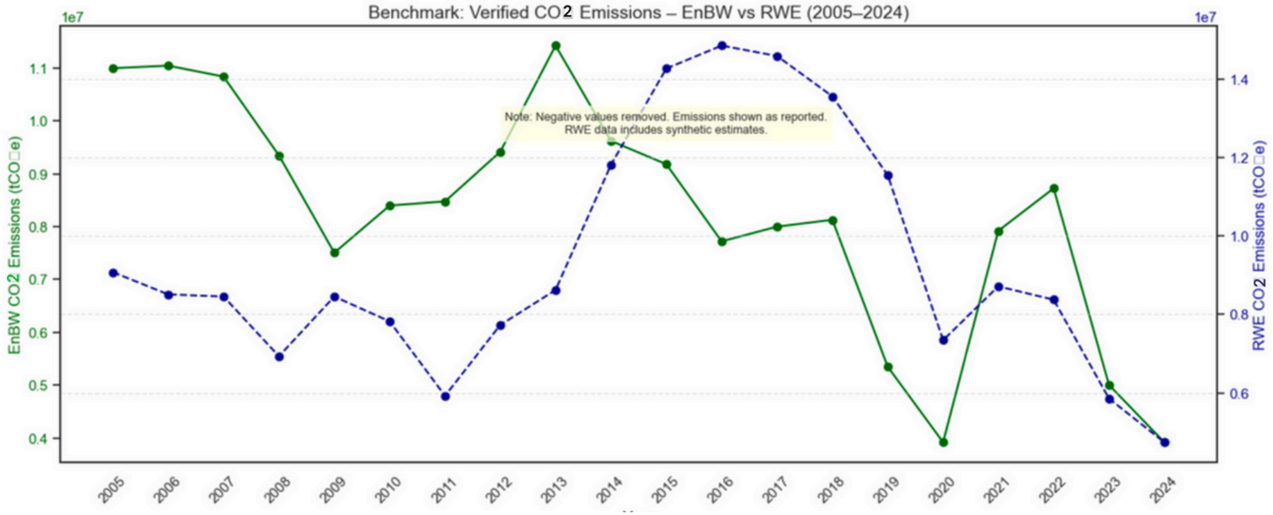


‼ Red indicates values that were missing or zero in the original dataset and filled using synthetic estimates.
As seen above, the period between 2014 and 2020 shows a recurring pattern of synthetic data across at least two installations in this serie.

Limits of synthetic estimation:

Trend or artifact or a mistake?

Between 2014 and 2020, RWE's emissions show a sharp increase in the benchmark chart.



This benchmark visualizes the verified CO_2 emissions (in tCO_2e) of two major German energy providers, EnBW and RWE, over the period 2005–2024.

For RWE, missing or zero entries in the EU ETS dataset were replaced using synthetic estimates based on a simple year-on-year variation model:

- *If a previous year was available, emissions were estimated as previous_year × 0.98.*
- *If only a future year was known, emissions were estimated as next_year × 1.02.*

This allowed for a more continuous trend analysis despite data gaps in the official reports.

- This might reflect real operational changes, but more likely results from the accumulation of synthetic estimates over multiple years.
- These values were generated using simple projections (×1.02/year), which can distort the trend if too many consecutive years are missing.
- ✅ Synthetic data helps fill gaps and allows for continuous visual analysis.
- ⚠️ But using it for many years in a row can create misleading spikes.
- 🟢 As shown in the heatmap, 2014–2020 is a high-risk period for data distortion across multiple RWE installations.