Getting the incentives for the grid investment and usage right.

Insights from Germany

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Engineering vs. economist's view on electricity systems I

- Engineering perspective - What is the optimal (cost efficient / reliable / emissions minimizing / …) electricity system:
  - How much new grid is needed and where?
  - Optimal implementation of non-wire alternatives
  - Optimal precautions to ensure reliability

- Economic perspective - What electricity system will emerge given the existing markets, regulations and other incentives? How costly/efficient will the system be? How to change the incentives to achieve the optimal system?

- With "benevolent social planner": engineering solution = economic solution. But what happens when there are multiple actors making independent decisions?

Engineering vs. economist’s view on electricity systems II

Consider the decisions made by a network operator about grid expansion.

- Engineering perspective
  - How much new grid is needed and where?
- Economic perspective
  - network operators are monopolists and hence heavily regulated
  - typically, the rate-of-return of investment is regulated
  - Public participation + other regulatory obligations (Anschlusspflicht - § 18 EnWG)

Engineering vs. economist's view on electricity systems III

Consider the decisions made by a system operator when facing thermal overload during peak demand.

- Engineering perspective
  - Optimal decision of investment in a new feeder vs implementation of non-wire alternatives (e.g. demand response program)

- Economic perspective
  - Return on investment is guaranteed but costs usually only passed – incentive not to do NWA
  - The NOVA principle enshrined in German law - to prioritise grid optimisation and reinforcement over grid expansion.
  - But: how to implement that? Information advantage of network operators.
  - Alternative: cost-sharing contracts, cost benchmarking etc.

What are “incentives”?

Markets

- Prices
- Do the relevant markets exist? What are the trading rules? (e.g., CO2 allowances)
- What are the properties of the products traded in the market? (e.g., instantenous reserve procurement – minimum availability)

Regulations, requirements, bans

- Maximum emissions factors
- Subsidy schemes
- ban on the sale of new petrol and diesel cars

Non-monetary incentives

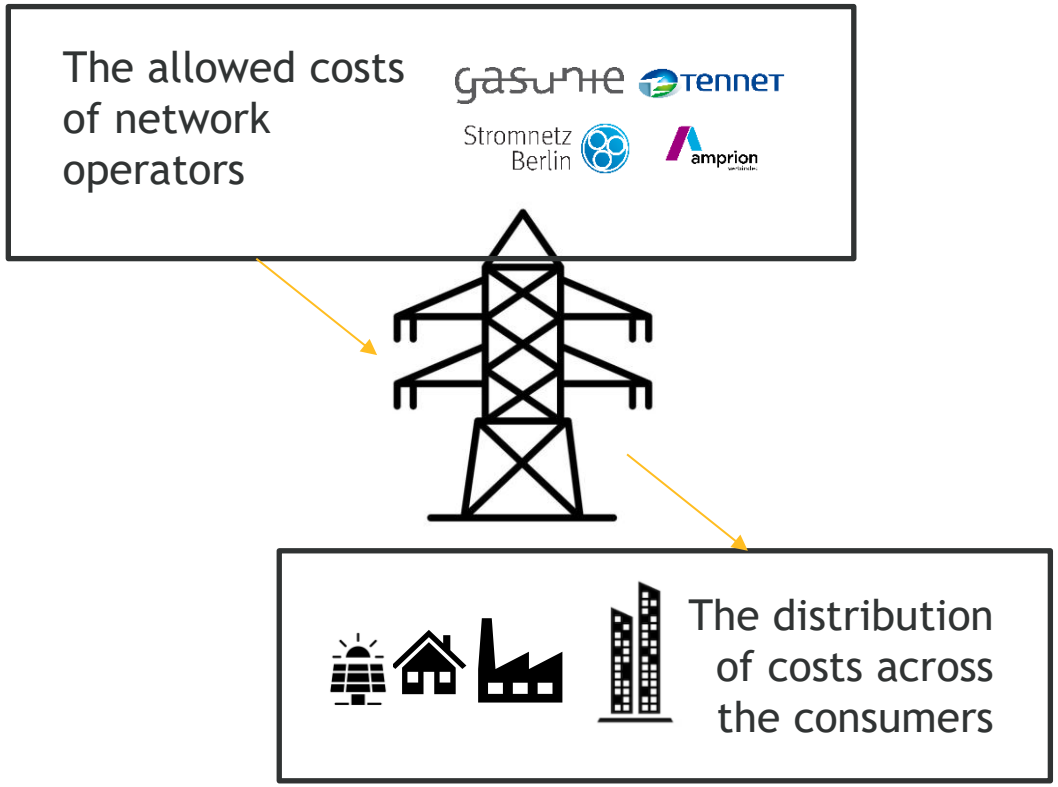
- Warm glow
- Prestige

New times, new challenges

- The quick transformation of the electricity system leads to new challenges and intensifies the existing ones:
  - Renewables
  - Electrolyzers
  - Network buildout on a massive scale
  - Optimal precautions to ensure reliability

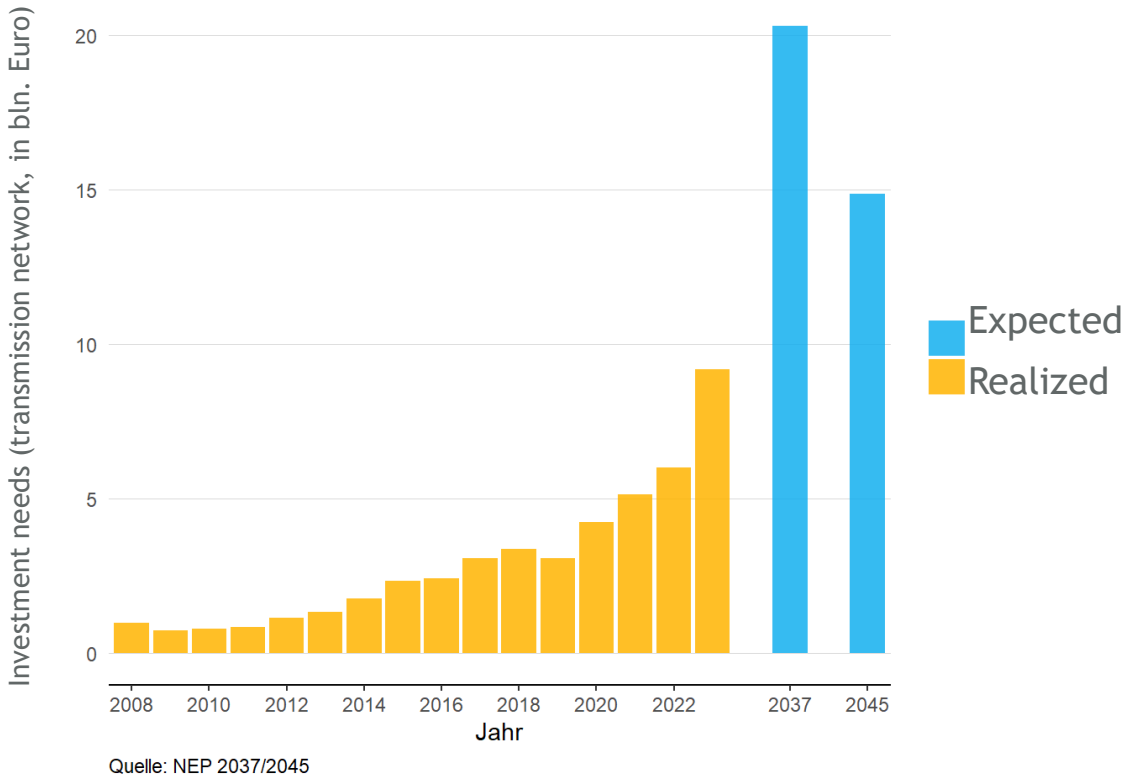
- What do we do about that?
- Particular role for legislators and Federal Network Agency (German: Bundesnetzagentur or BNetzA)
- September 2021 -> European Court of Justice (ECJ) ruling that parts of the German energy legislation restricted the agency's decision-making autonomy.

Revamp of network regulations due to the ECJ ruling



Getting the grid investments right - capital cost allowance

Exploding need for new grids->soaring costs of misaligned incentives



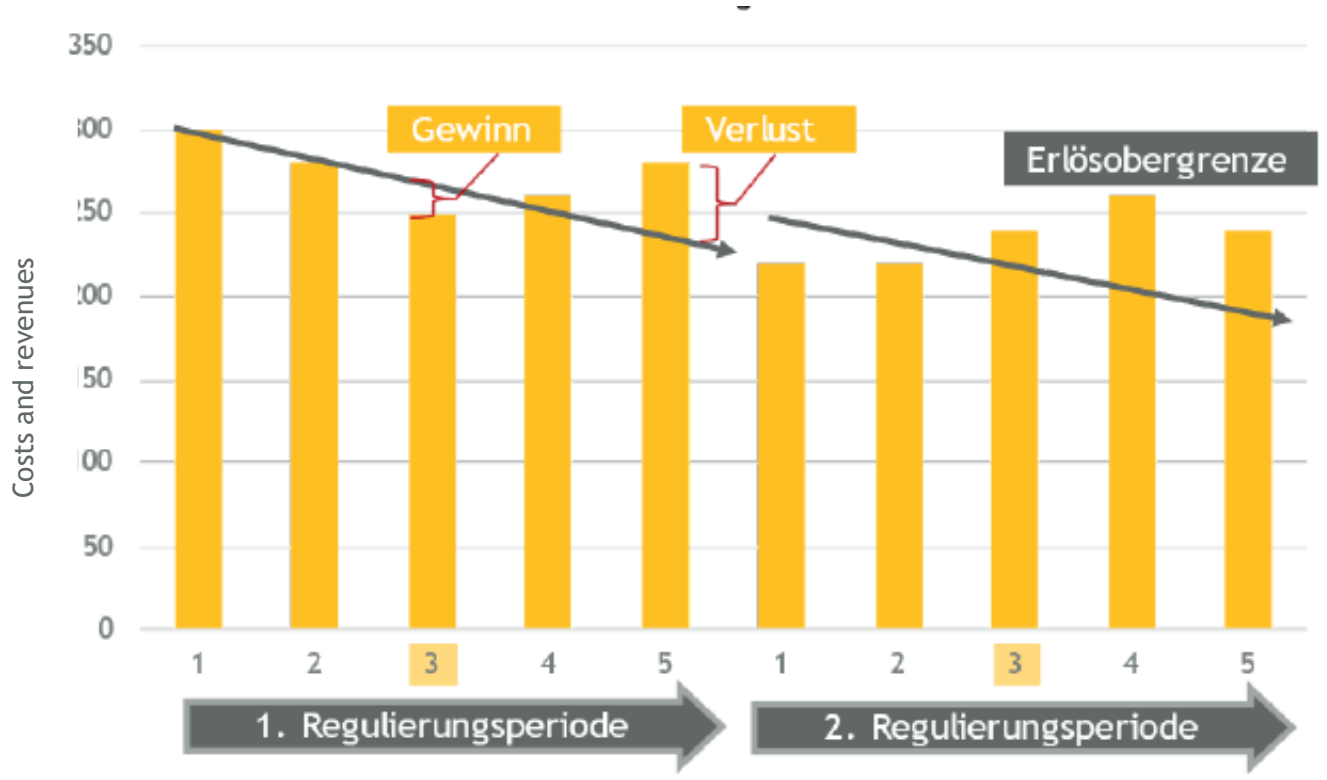
Quelle: NEP 2037/2045

How much ROI should the network operators have

- The network operators need return on the capital invested to attract financing, both internal and external (Kapitalkostenaufschlag)
- But: Averch-Johnson effect: $\pi(K) = r'K - C(K)$
- Complex „science“ of establishing the applicable rates
- For new assets, for year 2025: return on own capital: 6,95%, debt financing: 3,91%.
- High financing costs -> would public ownership of grids or PPAs? (public bonds yield around 2,9% now)

Getting the grid investments right – incentivizing cost-savings

Efficiency approach to the maximum recoverable costs until now

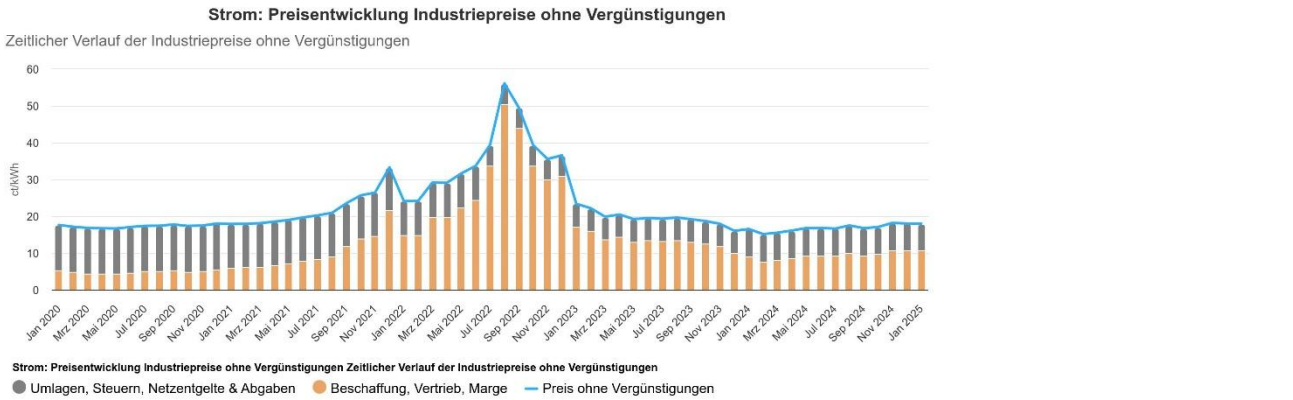


New concepts

- So far – incentive regulation through efficiency approach to the total recoverable costs, with adjustment factors dependent on the how efficient the network operator already is. Additionally – quality incentives (SAIDI).
- But: how do you find out the proper benchmarks? What should be allowed costs? What qualities should be accounted for? (e.g. voltage quality)
- „RAMEN“ proceedings – improvements in methodology for incentive regulation
- For the future – do we need performance-based regulation?

Incentivizing the right consumption patterns

(„Baseload“) industrial consumers enjoying exemptions from grid charges

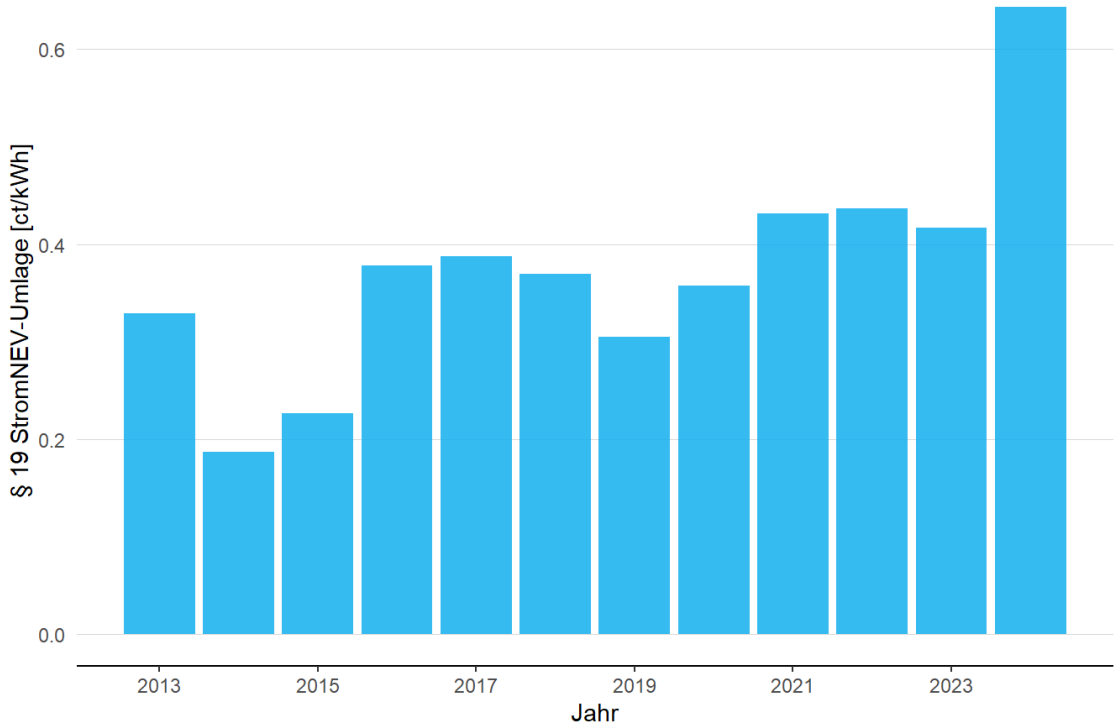


Quelle: SMARD

- Until now, § 19 StromNEV allows substantial exemptions for industrial consumers from grid charges (international competitiveness)
- One of the criteria for awarding the exemptions: „baseload type of consumption“
- The costs of upgrades in distribution networks needed to accommodate renewables covered in the area where the renewables are located

Incentivizing the right consumption patterns II

Additional charges to finance the exemptions for the industry



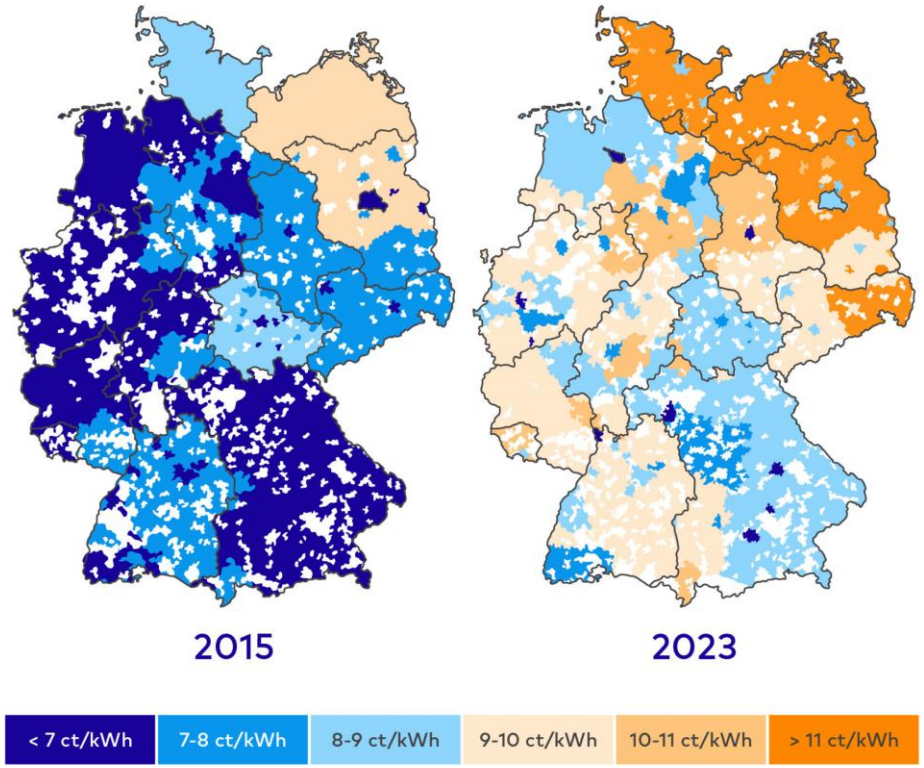
Quelle: BNetzA

„AgNeS“ proceeding

- remove the „baseload character“ of exemptions
- offer exemptions for flexible assets (see also problem of batteries „double paying“ grid charges)
- offer additional exemptions for allowing the network operator to directly decrease load in the emergency situations
- But: the cross-subsidy character of exemptions not addressed

Incentivizing the right consumption patterns III

Grid charges increasing unevenly for households



Changes in how the costs are allocated geograhically

- Since 2025, additional, localized levy to redistribute costs of interconnecting the renewables in a fair manner

„Use instead of curtailing“ §13k ENWG

Problem of renewable curtailment

- Congestion means that the electricity from renewables does not always reach demand and gets curtailed. Problem accelerated by a single bidding zone design.
- Example (before §13k): curtail & compensate - When the North–South corridor congests, wind parks in Mecklenburg-Vorpommern often get curtailed. The TSO pays redispatch/curtailment compensation to the wind park; these costs are socialized into network charges.
- With §13k: “use instead of curtail”:

  Trigger: congestion imminent in the zone.
  Mechanism: the TSO/DSO can allocate the otherwise-curtailed MWh to pre-qualified flexible assets (electrolyser, heat pump, storage charging) instead of curtailing the wind park.
- But: Perverse incentives (moral hazard) & gaming of the system.

Market-based procurement of instantenous reserve

In September 2023, the Federal Network Agency initiated a determination procedure the specifications and technical requirements for the transparent, non-discriminatory and market-based procurement of the non-frequency-based system service ‘Inertia of local grid stability’ (”instantaneous reserve").

Starting in 2026, transmission network operators need to be procuring instantenous reserve through markets. How should such a product be defined? Do the offering resources need to be available the whole time? How long an optimal contract should be? Should prices be fixed or vary over time / over the assets?

Examples of regulatory innovations from other countries

In 2022, E-REDES, the largest Portuguese DSO, launched a local flexibility market auction in eight areas to assess the willingness of grid users to adjust their electricity production or consumption in exchange for a compensation. Direct consumers and entities aggregating smaller consumers could participate. The first auction received 623 bids, from 21 different entities, primarily from industrial customers. Flexibility requested with 1-week of advance notice attracted the most interest and was more popular than those options requiring shorter activation times.

The 2024-2031 Italian regulatory framework links grid operators' revenue to efficiency rewards instead of grid investments. Grid operators can keep a part of the savings from the proposed grid investments when they are compared with other alternative solutions or historical costs. There is also an incentive for grid operators to reduce electricity interruptions and losses. The TSO is further rewarded for lowering the cost of balancing electricity supply and demand and increasing the amount of electricity that can be transported between geographical areas, especially when achieved with low capital expenditure.

The 2024-2031 Italian regulatory framework also reduces the financial risk for grid operators by balancing actual and allowed revenues through compensatory mechanisms. If actual revenues fall short, this is compensated through specific tariff components. The regulatory authority monitors the return on regulatory equity and debt levels to ensure financial health, helping to secure favourable loans. The framework also foresees a compensation for incremental operational costs and unforeseen cost changes, such as regulatory or service obligation modifications, and allows for ex-post inflation adjustments.

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