Energy transition: Future challenges for current benchmarking methods

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Efficiency benchmarking needs to be embedded in the wider regulatory environment which is largely driven by the energy transition

Regulatory challenges for energy networks …

Electricity TSO

- **Significant expansion of the grid with asso… …ents**
- De… …ments under public law
- Hi… …asing … …for anci…
- Proportion of so-called "p… uninfluenceable costs" of a… total costs

Major investments

Length of the regulatory period

Gas TSO

- Short… …zation of the network to in… …rections and integration c…
- **In… …he n… …ially dispen… …d ...**
- … **simultaneously con… …k to the transportation of …**

Decommiss-ioning of assets

Repurposing to H2

Electricity DSO

- Expansi… …grading of the grids for the co… …of electricity from r… …neration plants and for th… …gy supply of numerous addi… …s (e.g. heat pumps and electric cars) with...
- … **very different impacts … distribution grid oper… …us voltage levels**
- Strong need for digitaliza… …ation
- **Large number of grid operators**

Increasing heterogeneity

Large number of operators

Gas DSO

- Climate neutrality by 2045 at the latest will lead to the… **…he grids for the majority of…**
- Se… …operation during the trans… …emain guaranteed
- Retention of parts of th… …idual cust-omers, **uncertaint… …o H2**
- Orderly transition t… …y industry for operato…
- **Large number of grid operators in municipal-ities with or without completed heat planning**

Changing supply tasks

Gas phase out with different speed

…with implications for benchmarking

- Are the current methods able to deal with the challenges?
- What is the role of efficiency benchmarking in the future regulatory regime for energy networks?
- Should the implications of the energy transition be incorporated in the benchmarking and/or in the network regulation as such?
- To what extent will benchmarking models have to differ between electricity and gas on the one hand and TSOs and DSOs on the other hand in order to cope with the different challenges of their supply tasks?

*) Source: BNetzA Eckpunktepapier (2024) Netze. Effizient. Sicher. Transformiert (DeepL translation)

The four components of the benchmarking analysis are differently affected by the current challenges

Today's focus

A benchmarking framework is composed of two steps:

Define and undertake the benchmarking analysis

1. **Costs (Input)**
Definition of costs, e.g. total cost, opex, capex, repex or by activity?

2. **Cost drivers (Output)**
e.g. aggregated or detailed, specific energy transition parameters?

3. **Sample**
e.g. international or domestic data; cross-section or panel data, sample size

4. **Techniques**
e.g. DEA, SFA

Apply the benchmarking analysis

Efficiency target
Set at or below 100%

Efficiency score
e.g. based on average score across models, regulatory judgment, etc.

Incentives
e.g. do DSOs and TSOs have incentives to provide accurate data (e.g. forecasts)?

Glide path
e.g. should a glide path be allowed when imposing an efficiency target?

1

Challenges on the input side driven by the energy transition having a different impact on electricity and gas networks

Main challenges

- **Major investments in upcoming years**: How to deal with high anticipatory investments in electricity networks (and potentially H2) having a time-lag for respective outputs (e.g. asset utilisation) which can differ over time or across operators?
- **Rapidly changing cost structures**: Is it still appropriate to determine efficiency scores from a static base year, although costs (and outputs) can change considerably during the regulatory period?
- **Heterogeneous capital costs for gas networks**:
  - Impact from companies' flexibility in setting depreciations (KANU 2.0) on comparability of capital costs across operators?
  - Are there transparent rules for cost allocation of gas assets which get repurposed from methane to H2?

Inputs – Possible "solutions/implications"

- **Stronger cost standardisation** to account for a higher degree of heterogeneity, but reflecting the application of benchmarking results in regulation
- Including future costs e.g. based on an **"agreed" investment plan** btw. operator and regulator or **forecasted costs** (as partially done in the UK) (?)
- **Benchmarking of separate cost items** that are still comparable between operators, indicative example:
  - Capex (and repex) with a unit cost approach and opex with DEA
  - Process benchmarking of costs per activities if overall opex become more difficult to compare in the future
- *Inputs must not be seen in isolation:*
  - *Better alignment of inputs and outputs → outputs*
  - *Analysis of cluster of operators → sample*

2

Challenges on the output side mainly arising from increasing heterogeneity and the need of more forward-looking information

Main challenges

- **Heterogeneity about the future dynamics of infrastructure utilization**: do the actual cost drivers map future supply tasks or are major adjustments or new parameters necessary to better account for the transformation process?
- **Repurposing of gas assets**: How to deal with methane network assets that are linked to output parameters that are repurposed within a regulatory period?
- **Forward looking information becoming more important**: Is it still accurate to primarily use historical outputs that display the past supply tasks, e.g. how to deal with future outputs for electricity DSOs related to anticipatory investments?

Output – Possible "solutions/implications"

- **Modification of the cost driver analysis** focusing more on the future developments/dynamics
- **Adjustments and improvements in parameter definition**
  - Inclusion of environmental factors "controlling" for energy transition effects (that might evolve over time) (UK)
  - Exclusion of assets that are intended to be repurposed within the next regulatory period (→ *also for inputs*)
  - Evaluation of aggregated structural parameters accounting for new developments from the energy transition (AT)
- Stronger usage of **more forward-looking outputs** such as
  - "potential" instead of actual parameters (e.g. potential instead of actual peak load)
  - forecasted parameters as e.g. in the UK DSO benchmarking

3

Challenges from the sample from a cross-sectional and time-varying perspective

Main challenges

- **Changing sample size**: does the number of operators to be benchmarked change (simplified procedure and its thresholds)?
- **Sample split**: is a sample split necessary as a comparison between all operators not any more appropriate? (as for example potentially for the regional gas TSOs in the DSO benchmarking or for gas operators that fully switch to H2?)
- **Accounting for strong sample variations over time**: how to control for externally driven time-varying effects stemming from the energy transition (such as the rapid growth of renewable feed-in or the uncertain electricity demand from EV and heat pumps)?

Sample – Possible "solutions/implications"

- **Modifications of the simplified procedure** e.g. lowering the thresholds to have a larger sample size which allows a more accurate analysis
- **Cluster building** with a pre-selection of subgroups of "comparable" operators to compare apples with apples
  - *Smaller sub samples may not allow the usage of "data hungry techniques" such as SFA → techniques*
- Usage of **panel data** to better account for within group variations and deviations in inputs and outputs over time (e.g. through a time trend variable)

Challenges for the benchmarking techniques

According to the EUGH decision, BNetzA is not any more bound to existing provisions such as ARegV, which for example requires the usage of the same techniques for elec. and gas DSO

Main challenges

- **Appropriateness of existing methods**: are the existing methods (or slight adaptations) still fit for purpose and allow to account for higher heterogeneity and/or account for new developments? Examples for DSOs:
  - *SFA*: Do additional parameters to control for higher heterogeneity pose problems for a translog specification?
  - *DEA*: Does additional heterogeneity increase the risk of non-identified outliers leading to biased efficiency scores?
  - *SFA/DEA*: Do both techniques allow the usage of forward-looking input and output data?
- **Individual approaches**: Do strongly diverging network sectors require specific techniques for elec. and gas?
- **New developments**: are there new and superior benchmarking techniques available from the scientific world that can better deal with the challenges?

Techniques – Possible "solutions/implications"

- A **toolkit approach** might be an interesting step forward using specific approaches for the specific challenges for elec./gas DSOs and TSOs and to detect the efficiency score (→ next slides)
- There might be merits in **combing techniques**
  - *within cost category*: this can increase reliability of results (as currently done for German DSO/TSO)
  - *across cost category*: as different techniques are potentially more appropriate for different cost categories (this can also help to identify specific sources of inefficiencies more accurately)
- Usage of **ex-post correction** of efficiency scores for effects resulting from the energy transition as a second-best approach (examples are AUS, NOR controlling for environmental factors)

International examples show that there are different ways to deal with the challenges

1 Inputs

- **UK** (elec/gas DSO)
  - using forecasted costs
  - cost adjustments as for labour market conditions, urbanity and sparsity etc.
- **FIN** (elec DSO)
  - differentiation of opex and capex in RP4/5
  - accounting for opex-capex shift
- **AUS** (elec DSO)
  - differentiation of opex/ capex

2 Outputs

- **UK** (elec/gas DSO)
  - usage of partially fore-casted outputs and a composite scale variable
  - elec: one model includes uptake of low carbon technologies (EV, HP)
- **AT** (elec DSO)
  - Agg. outputs accounting for “new” developments
- **FIN** (elec DSO)
  - annual update of reason. costs with “up-dated” valu-es and fixed parameters

3 Sample

- **UK** (elec/gas DSO)
  - usage of panel data
  - accounting for structural breaks through separate time trends for historical and forecasted data
- **FIN** (elec DSO)
  - large panel data set (89 DSO for 8 yrs in RP4/5)
- **AUS** (elec. DSO)
  - International panel with Ontario for 2006-21

4 Technique

- **FIN** (elec DSO)
  - Historical move from SFA/DEA to StoNED
  - StoNED for opex
  - Replacement values with unit costs for capex
- **UK** (elec/gas DSO)
  - COLS, pooled OLS (elec)
  - Technical assessment, unit cost/ expert reviews
- **AUS** (elec DSO)
  - OLS/SFA CD/TL for opex
  - engineering models capex

Although the structures of the sectors and regulatory regimes differ across countries there are some interesting international experiences on how to deal with the challenges from the energy transition that might be of help in the ongoing debate in Germany

The are several benchmarking approaches available that can be tailored to the specific needs of electricity and gas network in Germany requiring a careful evaluation

Benchmarking techniques*

Descriptive techniques	**Performance indicators**	▪ Partial Performance Indicators (PPIs) (which include unit costs)
Mainly based on **economic theory**	**Parametric**	▪ OLS, Corrected OLS (COLS), Modified OLS (MOLS) ▪ Quantile regression ▪ Stochastic Frontier Analysis (SFA) ▪ Variations of SFA (e.g. four random components SFA)
	Non-parametric	▪ Data Envelopment Analysis (DEA, bootstrapped DEA) ▪ Free Disposal Hull (FDH) ▪ Multilateral Total Factor Productivity (MTFP) ▪ Multilateral Partial Factor Productivity (MPFP)
	Semi-parametric	▪ Stochastic non-smooth envelopment data (SToNED) ▪ Stochastic FDH/DEA ▪ Variations of SToNED (Maindiratta; Fan, Li & Weersink; Parmeter and Racine)
Mainly based on **engineering rationale**	**Engineering based**	▪ Process benchmarking ▪ Reference Network Analysis (RNA) ▪ Engineering models

Indicative examples for the discussion

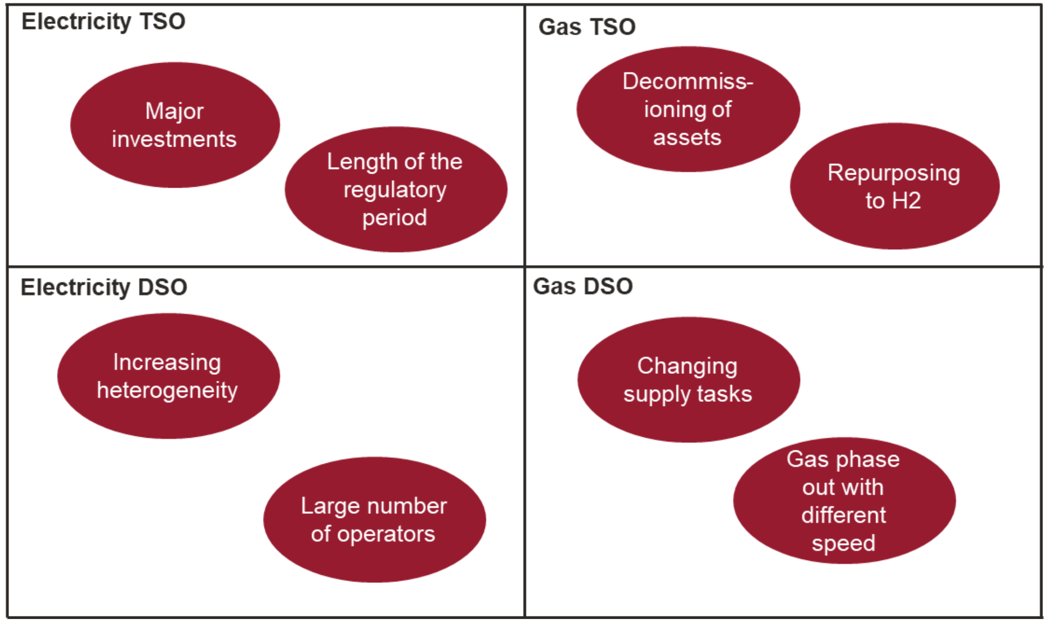
A **toolkit approach** tailored to the specific needs of each network sector is worth considering:

- *Elec DSO*: pot. continuation of total costs approach; testing/comparing the results of additional semi-parametric techniques with SFA/DEA
- *Elec TSO*: e.g. unit cost approach as investment volumes are fixed through the NDP but prices might deviate substantially over time and btw operators (differentiation btw opex and capex possible)
- *Gas DSO*: e.g. non-/semi-parametric methods (as weights are freely selectable); in the very long-run there might be the perspective of an (additional) process benchmarking of opex combined with a unit cost approach for investments
- *Gas TSO*: potentially same as for gas DSOs
- *H2 operators*: e.g. unit cost approach as investment volumes are fixed through the NDP (but benchmarking to start at a later stage)

*) Source: Frontier (2023) together with Mark Andor and Chris Parameter for ACM

Several ways to deal with the arising challenges: a toolkit approach with tailor-made benchmarking models for the different energy networks as one promising option

Regulatory challenges



Next steps

- EUGH decision opens the floor **for new ways of the benchmarking analysis** implying that BNEtzA is not any more bound by legal provision such as ARegV
- **BNetzA may use its degrees of freedom** to further develop the benchmarking dealing with the arising challenges stemming from the energy transition
  - Sectors are moving away from the “steady sate” such that more substantial changes to the existing benchmarking model might become necessary at least in the mid to long-term
- A **toolkit approach** tailored to the specific needs of each network sector might be an appropriate solution to deal with the future challenges