Cost assessment in a regulatory context

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Introduction

• in many EU countries, benchmarking is considered a key tool for measuring companies’ performance and providing information to stakeholders
• in a regulatory context, it is often used to inform regulatory decisions and for business planning purposes
• different legal and economic regulatory frameworks, structures, ownership, and maturity of the industry may require different approaches to benchmarking
• approaches to benchmarking often vary by regulator
• against this backdrop, we will focus on benchmarking to promote cost efficiency by:
  • illustrating the key principles and objectives of efficiency assessment
  • outlining a menu of tools
  • examining case studies from the water and other regulated sectors
  • setting out some important considerations when deciding on an approach
Overview

• principles and objectives
• a menu of tools
• case studies
• key considerations
What is inefficiency in a regulatory context?

- **input minimisation**
  - what is the minimum level of input that the unit could operate at, given the level of output?

- **output maximisation**
  - what is the maximum level of output that the unit can produce, given the level of input?

Exogenous factors (e.g. population density)

Key
- Y output
- K capital
- L labour
- M materials (or all other inputs)
Schematic representation of efficiency assessment

A production/cost function describes the transformation relationship—a ‘black box’—which converts inputs into outputs.

Inputs

\[ X = \begin{cases} 
L = \text{labor} \\
K = \text{capital} \\
M = \text{materials and supplies} \\
C, \text{cost} = w \cdot x \\
w = \text{input prices}
\end{cases} \]

Transformation

Outputs

\[ Y = \text{total energy delivered, passengers transported, water delivered, track replaced, etc.} \]

Factors outside management control

\[ Z: \text{country- or region-specific factors} \]
\[ (\text{e.g. customer density, topography, regional wages}) \]

Production frontier

output-oriented (OO) technical inefficiency: output loss due to technical inefficiency

input-oriented (IO) technical inefficiency: the amount by which inputs can be reduced without reducing output
Overview

• principles and objectives
• a menu of tools
• case studies
• key considerations
Efficiency benchmarking
Bottom-up versus top-down approaches

Top-down approaches model a ‘decision-making unit’—a self-contained unit that has some degree of management autonomy for which inputs and outputs can be readily identified and ascribed, such as a company or a management region within a company.

Bottom-up approaches examine a company in greater detail (at a disaggregated level), considering the workings of the processes. Benchmarking occurs at the level of individual activities, such as HR or IT.
Regulatory approach to determining potential cost reductions

Top-down assessments
- inter-company comparisons
- intra-company comparisons (zones, works)
- international comparisons
- company-specific (or special) factors, ‘noise’
- indirect comparisons (e.g. total factor productivity, TFP)

Historical information
- comparing outturn performance to that planned versus that allowed, and explanations thereof
- rates of change
- past initiatives
- performance elsewhere
- lessons from precedents

Future considerations
- detailed review of business plans
- technological change
- input price and (other) cost pressures
- changes in exogenous drivers (e.g. volume)
- controllability
- company forecasts (and comparisons thereof)
- achievability

Bottom-up assessments
- detailed review of business plans, companies’ cases, pay, initiatives
- engineering/bottom-up unit cost comparisons
- process/activity(funcional (e.g. HR) benchmarks with other companies and other sectors
- hypothetical efficient company

Often a range of approaches is used to establish efficient costs
Overview

• principles and objectives
• a menu of tools
• case studies
• key considerations
Introduction to the case studies

To identify which drivers may help to determine the most appropriate tool to use in a regulatory context, we have selected the following case studies for discussion.

<table>
<thead>
<tr>
<th>#</th>
<th>Case Study</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WICS (Scotland)</td>
<td>External comparators; relatively simple approach and service KPIs</td>
</tr>
<tr>
<td>2</td>
<td>Ofwat (England and Wales)</td>
<td>Assessment using data over time for several regional private regulated companies</td>
</tr>
<tr>
<td>3</td>
<td>Ofgem (Great Britain)</td>
<td>Menu of bottom-up and top-down tools</td>
</tr>
<tr>
<td>4</td>
<td>DTe (Netherlands)</td>
<td>Single industry-wide efficiency target</td>
</tr>
</tbody>
</table>
Case study 1

- WICS: external comparators and service KPIs
Case study: WICS’ approach
Overview

The benchmarking approach adopted by the Water Industry Commission for Scotland (WICS) is an interesting case for a number of reasons:

1. how to benchmark a company’s performance when there are no comparators available to the regulators within its jurisdiction?

2. what compatibility issues arise when using external comparators?

3. how can quality of service (using KPIs) be integrated within the cost assessment framework?

The cost efficiency and KPI analysis informed the engagement between Scottish Water (SW) and the Customer Forum
## Case study: WICS’ approach

### Availability of comparators

In the past (e.g. SRC 2010–15), WICS overcame the lack of comparators by benchmarking SW’s performance against English and Welsh companies.

<table>
<thead>
<tr>
<th>Ensuring consistency of data</th>
<th>Important to ensure that the technical and accounting information about SW is consistent (e.g. allocation of expenditure items)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPEX efficiency:</strong> based on comparison to E&amp;W companies</td>
<td>Econometric analysis using nine OPEX models across different activities (e.g. water distribution, sewer network). SW added to original sample. Adjustment to residuals to account for noise</td>
</tr>
<tr>
<td><strong>CAPEX efficiency:</strong> relevance of asset groups</td>
<td>Cost base analysis following Ofwat’s approach at PR09. Standard cost templates independently reviewed to ensure quality of cost base submissions. Median benchmark to minimise the influence of outliers</td>
</tr>
<tr>
<td><strong>Special factors:</strong> accounting for other factors</td>
<td>A special factor process can be put in place to consider issues that are specific to the company and not accounted for by the model (e.g. bad debt collection practices in Scotland)</td>
</tr>
</tbody>
</table>

Once the largest savings were achieved, WICS decided to hold its level of OPEX broadly flat after inflation. A similar challenge/requirement was proposed in the latest price review.

WICS’ approach is to examine SW’s performance using KPIs against Ofwat’s sample. Overall Performance Assessment (OPA) is a weighted average of 17 KPIs on service levels, customer service, and environmental performance. WICS assessed the overall performance of SW by examining trends in both relative spend and relative service performance.

Integrating quality of service with cost assessment is a topical issue for several regulators (e.g. Ofwat).

### Case study: WICS’ approach

#### Level of service KPIs

Examples of the measures of service performance used by WICS in the latest review

<table>
<thead>
<tr>
<th>Area</th>
<th>Typical measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply</td>
<td>• drinking water quality compliance</td>
</tr>
<tr>
<td></td>
<td>• number of taste and odour complaints</td>
</tr>
<tr>
<td></td>
<td>• customer hours without water</td>
</tr>
<tr>
<td></td>
<td>• customers affected by use restrictions</td>
</tr>
<tr>
<td>Wastewater</td>
<td>• flooding incidents from storms whose intensity is less than X</td>
</tr>
<tr>
<td></td>
<td>• number of pollution incidents</td>
</tr>
<tr>
<td></td>
<td>• population equivalent served by works meeting discharge consent standards</td>
</tr>
<tr>
<td>Customer service</td>
<td>• number of contacts resolved first time</td>
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<td>• speed of response</td>
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<td>• customer satisfaction with response</td>
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<td>• customer perception of value for money</td>
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<tr>
<td>Asset maintenance and</td>
<td>• number of mains bursts</td>
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<tr>
<td>sustainability</td>
<td>• proportion of sewers in poor condition</td>
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<td></td>
<td>• number of days when a treatment works or reservoir suffers an unplanned outage</td>
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<td></td>
<td>• CO\textsubscript{2} tonnes emitted</td>
</tr>
</tbody>
</table>

Case study 2

- Ofwat: several regional private regulated companies
Case study: Ofwat’s approach

Overview

At PR14, Ofwat used data on 18 water and 10 wastewater companies over time. A large dataset was therefore available to Ofwat following consistent cost and cost driver definitions, which enabled an assessment of the companies’ cost performance:

• use of panel data (data across companies and over time), which increases the number of cost drivers that can be used
• a TOTEX (OPEX + average CAPEX) approach, to overcome bias towards CAPEX over OPEX
• different levels of aggregation
  • water: TOTEX, or BOTEX + unit cost
  • wastewater: BOTEX by value chain + unit cost
Case study: Ofwat’s approach

TOTEX cost assessment

1. Data

- forecast cost drivers from engineering consultancy
- historical data
- forecast drivers

2. Model specification

- 3 TOTEX and 2 BOTEX econometric models
- enhancement ‘unit cost’ models and unmodelled costs
- apply coefficients to forecast cost drivers

3. Application

- equal weighted model results: TOTEX prediction
- upper quartile (UQ) efficiency adjustment
- 5% cap on the cost threshold
- ‘special factors’ and ‘deep dive’ assessments

Model inputs
Models
Predicting future costs
Triangulation
Efficiency challenge
Cost exclusions
Baseline

- add model adjustments, including business rates, Open Water and pension adjustment
- 75:25 interpolation of Ofwat’s view and companies’ submission to derive the IQI baseline

Case study: Ofwat’s approach
TOTEX cost assessment

1. Data

- 3 TOTEX and 2 BOTEX econometric models
- enhancement ‘unit cost’ models and unmodelled costs
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2. Model specification

- equal weighted model results: TOTEX prediction
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- ‘special factors’ and ‘deep dive’ assessments
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In previous reviews, Ofwat had used a cross-sectional dataset (e.g. 18 companies). At PR14, it used a panel dataset (data across companies and over time).

### Case study: Ofwat’s approach

#### Panel dataset

<table>
<thead>
<tr>
<th>Time</th>
<th>Company</th>
<th>A</th>
<th>B</th>
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<th>D</th>
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- **Time series**
  
- **Cross-sectional**

**Historical data**
- Used to estimate the relationships between costs and cost drivers.

**Forecast data**
- Historical relationships are then applied to forecasts of the cost drivers.
Case study: Ofwat’s approach
Level of aggregation

Water: TOTEX econometric modelling

Some models include enhancement (i.e. TOTEX is modelled). Modelling enhancement is relatively difficult (TOTEX models could not be developed for sewerage).

Water: disaggregated econometric modelling

BOTEX (OPEX and maintenance expenditure) models + 3 ‘unit’ enhancement cost models (supply and demand balance, connections and lead) + unmodelled costs are also used.

Sewerage: BOTEX econometric modelling

2 of 5 sewerage models consider BOTEX; 2 models consider treatment and sludge; and 1 considers network. 12 unit cost models + unmodelled costs to derive TOTEX basic cost threshold.
## Case study: Ofwat’s approach
### Different cost drivers (water)

<table>
<thead>
<tr>
<th>Cost area</th>
<th>Sub-cost category</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTEX/BOTEX</td>
<td>Core</td>
<td>Length of mains, property density, usage</td>
</tr>
<tr>
<td>(variables marked * excluded from the refined model)</td>
<td>Input prices</td>
<td>Average regional wage</td>
</tr>
<tr>
<td></td>
<td>Network</td>
<td>Population density, proportion of metered properties*, proportion of usage by metered household properties*, proportion of usage by metered non-household properties*</td>
</tr>
<tr>
<td></td>
<td>Treatment and sources</td>
<td>Sources*, pumping head*, proportion of water input from river abstractions, proportion of water input from reservoirs</td>
</tr>
<tr>
<td></td>
<td>Activity</td>
<td>Proportion of new meters*, proportion of new mains*, proportion of mains restored/renovated</td>
</tr>
<tr>
<td></td>
<td>Quality</td>
<td>Properties below reference pressure level*, leakage*, properties affected by unplanned interruptions &gt; 3 hrs*, properties affected by planned interruptions &gt; 3 hrs*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost area</th>
<th>Sub-cost category</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit cost enhancement models</td>
<td>Supply–demand expenditure</td>
<td>Total enhancements to supply–demand balance (combined peak and average)</td>
</tr>
<tr>
<td></td>
<td>New development expenditure</td>
<td>Total number of new connections</td>
</tr>
<tr>
<td></td>
<td>Lead expenditure</td>
<td>Number of lead communication pipes replaced for quality</td>
</tr>
</tbody>
</table>
## Case study: Ofwat’s approach
### Different cost drivers (wastewater)

<table>
<thead>
<tr>
<th>Cost area</th>
<th>Sub-cost category</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOTEX</td>
<td>Core</td>
<td>Length of sewers, density</td>
</tr>
<tr>
<td></td>
<td>Input prices</td>
<td>Regional wage</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>Load, proportion treated in bands 1–3</td>
</tr>
<tr>
<td>Unit cost enhancement models</td>
<td>First time sewerage</td>
<td>Connectable properties potentially served by s101A schemes</td>
</tr>
<tr>
<td></td>
<td>Sludge enhancements</td>
<td>Calculated additional sludge (thousand tonnes dry solids)</td>
</tr>
<tr>
<td></td>
<td>Event duration monitoring</td>
<td>No. of intermittent discharge sites with event duration monitoring</td>
</tr>
<tr>
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<td>Storage at intermittent discharge sites</td>
<td>Volume of storage provided at CSOs, storm tanks, etc. to meet spill frequency requirements (m3)</td>
</tr>
<tr>
<td></td>
<td>Groundwater schemes</td>
<td>Current population equivalent served by groundwater protection schemes</td>
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<tr>
<td></td>
<td>P removal at filter works</td>
<td>Current population equivalent served by filter works with tightened/new P consents</td>
</tr>
<tr>
<td></td>
<td>Reduction in sanitary determinands</td>
<td>Current population equivalent served by STWs with tightened/new sanitary parameter consents</td>
</tr>
<tr>
<td></td>
<td>UV disinfection</td>
<td>Current population equivalent served by STWs with tightened/new UV consents</td>
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<tr>
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<td>Odour</td>
<td>Number of odour-related complaints</td>
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<td>Sewage treatment growth</td>
<td>Change in population</td>
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<td>Sewer flooding</td>
<td>Number of connected properties</td>
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<td>Private sewers—pipes</td>
<td>CSV of blockages and collapses</td>
</tr>
</tbody>
</table>
Case study 3

• Ofgem: a menu of bottom-up and top-down tools
Case study: Ofgem’s approach

Overview

Ofgem used the RIIO (Revenue=Incentives+Innovation+Outputs) model for setting the network companies’ price controls

- a proportionate approach was used to assess the network company plans, depending on the quality of the business plan submitted and the network company’s performance in delivering outputs and value for money in previous periods
- different models were used to derive a catch-up efficiency challenge (bottom-up and top-down approaches)
- a further efficiency challenge was applied to all operators (frontier shift net of real price effects)
Case study: Ofgem’s approach
TOTEX cost assessment (RIIO-ED1 and GD1)

Model inputs
RIIO-ED1 and GD1
- historical and forecast data from the companies
- pre-adjusted for company-specific issues (one- and two-sided adjustments)

Models
RIIO-ED1
- 2 top-down TOTEX models (different cost drivers)
  - 1 disaggregated result from a number of unit cost and econometric models
RIIO-GD1
- 1 top-down TOTEX model (historical and forecast data)
  - 3 middle-up models (OPEX, CAPEX, REPEX) (but not ultimately used)
  - 7 activity-level disaggregated models (forecast and historical data)

Predicting future costs
RIIO-ED1
- modelled business plan data directly alongside historical data
RIIO-GD1
- apply coefficients from modelling historical data and first two years of business plan data to forecast cost drivers

Triangulation
RIIO-ED1
- fast-track: 12.5% weighting on each of the top-down models, and 75% weighting on the disaggregated model
  - efficiency adjustment
RIIO-GD1
- slow-track: 25% weighting on each of the top-down models, and 50% weighting on the disaggregated model

Efficiency challenge
RIIO-ED1
- upper quartile (UQ) efficiency adjustment
  - cost threshold based on 75:25 weighting on Ofgem’s view and companies’ forecast, respectively
  - immediate catch-up set and no time-profiled efficiency targets
RIIO-ED1 and GD1
- pass-through of ‘special factors’ allowance

Reverse cost adjustments
RIIO-ED1
- modelled business plan data directly alongside historical data
RIIO-GD1
- apply coefficients from modelling historical data and first two years of business plan data to forecast cost drivers

Baseline
RIIO-ED1 and GD1
- pass-through of ‘special factors’ allowance

Predicted future efficient cost level
Frontier shift and RPEs overlay

Case study: Ofgem’s approach
TOTEX cost assessment (RIIO-ED1 and GD1)
Case study: Ofgem’s approach
RIIO approach: assessment toolkit

Ofgem’s proportionate approach to cost assessment (RIIO toolkit)

Case study: Ofgem’s approach
RIIO approach: levels of aggregation

Ofgem: different econometric models considered

RIIO-GD1
1 TOTEX model, 3 middle-up models, and 1 bottom-up model (modelled over historical and forecast periods). The bottom-up approach consisted of seven functional models:

1. work management
2. the emergency service
3. repairs
4. maintenance
5. mains reinforcement
6. connections
7. REPEX

RIIO-ED1
2 TOTEX models (using different cost drivers) and a bottom-up approach comprising various unit cost and regression models. Examples of bottom-up models:

- tree-cutting expenditure, trouble calls, closely associated indirects, business support costs, non-operational CAPEX
- more than 20 other disaggregated models: connections, reinforcement, asset replacement, I&M, etc.

In both reviews, for non-regressed cost activities Ofgem carried out qualitative and technical assessments to determine efficient costs
### Case study: Ofgem’s approach
#### Different cost drivers (GD1 example)

<table>
<thead>
<tr>
<th>Cost area</th>
<th>Sub-cost category</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top-down TOTEX (single model)</td>
<td></td>
<td>CSV of MEAV, emergency, repair, maintenance, connections and mains reinforcement costs</td>
</tr>
<tr>
<td>Middle-up model (aggregated CAPEX, REPEX, OPEX)</td>
<td>CAPEX</td>
<td>CSV of MEAV, connections and mains reinforcement costs</td>
</tr>
<tr>
<td></td>
<td>OPEX</td>
<td>CSV of MEAV, emergency, repair and maintenance costs</td>
</tr>
<tr>
<td></td>
<td>REPEX</td>
<td>Length of less than 7bar metallic network, REPEX CSV</td>
</tr>
<tr>
<td>Bottom-up regressions</td>
<td>Top-down OPEX</td>
<td>CSV of MEAV and PREs</td>
</tr>
<tr>
<td></td>
<td>Work management</td>
<td>MEAV</td>
</tr>
<tr>
<td></td>
<td>Emergency</td>
<td>CSV of external condition reports (20%) and number of customers (80%)</td>
</tr>
<tr>
<td></td>
<td>Repair</td>
<td>Total mains and service condition external reports</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>Maintenance MEAV</td>
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<tr>
<td></td>
<td>Connections</td>
<td>Number of connections</td>
</tr>
<tr>
<td></td>
<td>Mains reinforcement</td>
<td>Main reinforcement workload</td>
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<tr>
<td></td>
<td>REPEX</td>
<td>REPEX tier 1 workload</td>
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Case study 4

• DTe: a single industry-wide efficiency target
Case study: DTe’s approach

Overview

• DTe (now ACM) regulates the tariffs for regional gas and electricity DSOs in the Netherlands

• in NG3R and NE4R, DTe set an allowed income level at the end of the regulatory period equal to the sector-average cost level

• an expected productivity growth was applied to the sector-average efficient cost level to determine the sector-average efficient cost (and income) at the end of the regulatory period

• all companies are permitted to charge tariffs consistent with the sector-average cost level at the start of the period

• DTe set firm-specific X-factors that make each DSO’s tariffs reach the sector-average efficient cost level by the end of the period. Companies with:
  • actual costs lower than the sector average had an incentive to keep their costs low, since they would outperform the regulatory target
  • costs higher than the sector-average economic costs had an incentive to reduce their costs in order to increase their profitability
If some convergence occurs but there is still significant variation between companies, the more efficient companies (including the frontier company) would see their profits from outperformance gradually diminish over the price review period. However, the approach remains robust.

If significant convergence occurs and the scope for frontier shift is limited, efficient companies may find that their economic costs are greater than the allowed average expenditure.

If there has been significant convergence in the past, the approach may need to be adjusted for catch-up effects. But using data envelopment analysis (DEA), it was found that no adjustment was necessary.

Source: Oxera (2008), ‘Should DTe adjust expected productivity growth for catch-up effects when setting the X factor?’, prepared for the DTe, April.
Overview

• principles and objectives
• a menu of tools
• case studies
• key considerations
Guiding principles in the choice of an approach to cost efficiency (I)

The legal framework and regulatory duties and objectives will provide an overarching requirement for the benchmarking work that is necessary. Different approaches may produce different types of outcome that need to be integrated into the broader regulatory framework. For instance:

- some approaches do not provide separate estimates of catch-up/’static’ and frontier shift/’dynamic efficiency’
- some approaches are more robust at estimating (large) inefficiency gaps and thus providing challenging targets

Industry structure. A regional structure provides the opportunity to undertake detailed benchmarking analysis. A single or more limited number of companies tends to require more ‘innovative’ approaches (such as bottom-up analysis, international companies, comparisons across operational units within businesses)
Guiding principles in the choice of an approach to cost efficiency (II)

Data availability. The adopted approach needs to be able to be implemented using mature benchmarking data that is either already available or can feasibly be gathered and relied upon by the regulator.

Implementation time. Different approaches require different timeframes for implementation. A key factor here is the availability, comparability and maturity of benchmarking data.
High-level messages

‘One size fits all’ does not appear possible or even desirable

- different regulators may face different sets of regulatory objectives
- the regulatory framework may differ (e.g. incentive regulation vs cost-plus approaches or promoting contestability with ex post controls)
- even assuming a similar mandate for regulators and comparable choices in terms of regulatory framework, the regulatory context needs to be considered when it comes to promoting efficiency (including the industry structure and the level of ‘industry maturity’)

Against this backdrop, different tools may be appropriate for different contexts. In addition, the tools may need to evolve over time, as the industry evolves. This is not to say that common ground cannot be found, as can be seen in the use of pan-European benchmarking exercises of transmission and rail operators.
THANK YOU FOR YOUR ATTENTION!

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