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Towards a Consistent, Transparent and Future-Proof Methodology for the Electricity Primary Energy Factor

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ABOUT MARCOGAZ

Founded in 1968, MARCOGAZ is the technical association of the European gas industry. It represents 28 member organisations from 20 countries. Its mission encompasses monitoring and policy advisory activities related to the European technical regulation, standardisation and certification with respect to safety and integrity of gas systems and equipment, rational use of energy as well as environment, health and safety issues. It is registered in Brussels under number BE0877 785 464.

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Executive summary

Although MARCOGAZ represents the European gas sector, **the electricity Primary Energy Factor (PEF) is of direct relevance to gas stakeholders**. Natural gas remains an important contributor to electricity generation in many European power systems and therefore influences electricity PEF calculations. In addition, electricity PEFs are widely used in the Energy Performance of Buildings Directive (EPBD), Ecodesign and Energy Labelling regulations, where they directly affect the comparative assessment of gas- and electricity-based technologies. **Changes in electricity PEF values may therefore influence product classifications, technology rankings and building-performance assessments** even where the physical performance of products and buildings remains unchanged. **MARCOGAZ therefore supports a transparent, technology-neutral and methodologically robust approach to electricity PEF calculation**.

The electricity PEF should remain a transparent and robust indicator of energy-system efficiency, complementary to greenhouse-gas and renewable-energy indicators. Renewable electricity should retain a total PEF equal to 1 under the **direct-equivalent convention**. This preserves the visibility of efficiency improvements while maintaining a clear distinction between energy efficiency and environmental performance.

For regulatory applications, **MARCOGAZ recommends a methodology anchored in recent observed data and supplemented, where required, by a limited and transparent forward-looking adjustment aligned with regulatory review cycles**. The same assumptions and forecasting horizon should apply consistently across all energy carriers.

Temporal granularity should remain proportionate to the intended application. Annual factors should continue to provide the reference for benchmarking and regulatory accounting. Seasonal factors may improve representativeness in building applications, while dynamic indicators can provide useful additional information for flexibility, storage and demand-response applications. However, considerations relating to data availability, quality, transparency, reproducibility and cross-country comparability argue for a cautious and progressive development of dynamic indicators, without making hourly PEFs the general regulatory reference at this stage.

Dynamic PEFs can improve the representation of electricity consumption in specific flexibility use cases, but they are not yet sufficiently mature or harmonised to replace annual PEFs as the European regulatory benchmark.

1. Regulatory, Methodological and Policy Foundations

1.1. Regulatory framework

Historically, **the Primary Energy Factor has been used to express the amount of primary energy required to deliver one unit of final energy**. As such, it provides a measure of energy-system efficiency and enables consistent comparisons between technologies and energy carriers. The current legislative framework combines the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD), each serving different policy objectives while relying on the same underlying concept of primary energy.

Directive (EU) 2023/1791 on Energy Efficiency (EED, 2023) establishes the **framework applicable to electricity conversion coefficients used for the calculation of energy savings in primary-energy terms**. It provides for periodic revision of the default coefficients on the basis of observed data and requires the effects of such revisions on related Union legislation to be considered.

Directive (EU) 2024/1275 on the Energy Performance of Buildings (EPBD, 2024) **uses Primary Energy Factors for the assessment of building energy performance**. It allows Member States to define forward-looking factors adapted to building-performance calculations and explicitly allows several levels of temporal resolution, from annual to hourly. **Methodological consistency should therefore be achieved through common definitions, transparent conventions, harmonised reporting and robust documentation** rather than through the systematic use of a single numerical value.

> *The calculation of primary energy shall be based on **regularly updated and forward-looking primary energy factors** (distinguishing non-renewable, renewable and total) or weighting factors per energy carrier, which have to be recognised by the national authorities and taking into account the expected energy mix on the basis of its national energy and climate plan. Those primary energy factors or weighting factors may be based on national, regional or local information. Primary energy factors or weighting factors **may be set on an annual, seasonal, monthly, daily or hourly basis or on more specific information made available for individual district systems**.*
>
> ***Primary energy factors or weighting factors shall be defined by Member States**. The choices made and data sources shall be reported **according to EN 17423 or any superseding document**. Member States may opt for an average Union primary energy factor for electricity established pursuant to Directive (EU) 2023/1791 instead of a primary energy factor reflecting the electricity mix in the country.*

In addition, the Commission published a common general framework for the calculation of the energy performance of buildings (EPBD_Annex_12, 2025), providing **additional elements regarding the expected calculation of the PEF**:

> *When defining PEFs, Member States must take into account the following aspects:*
>
> - ***Forward-looking**: when evaluating the performance of a building (new, existing, under construction, etc.), the calculation methodology will reflect the performance of the building at a given moment. However, the building may be operating for a significant amount of time in the future. For example, the performance of electricity grids or district heating systems is continuously improving, particularly as the share of renewable energy sources increases.*
> - ***The expected energy mix on the basis of its national energy and climate plans (NECPs)**. NECPs contain information on the current performance of different energy*

carriers according to their sources. They also include information about their expected progress in the future in line with the objective of achieving decarbonisation by 2050.

The two Directives therefore do not necessarily require one identical numerical factor for every application. The EED provides an EU-level reference for energy-savings calculations, whereas the EPBD allows Member States to define factors adapted to building-performance calculations. Methodological consistency should consequently be pursued through common definitions, transparent conventions, comparable reporting and explicit justification of application-specific choices.

European standards already provide an appropriate framework. EN 17423 supports the determination and reporting of primary-energy factors, while EN 15316-4-5 and EN ISO 52000-1 provide complementary methodologies relevant to energy-performance calculations. **MARCOGAZ supports the systematic application of these standards to improve transparency and comparability across Europe**.

Key messages

- Future-oriented PEFs are compatible with regulatory stability provided methodologies remain transparent and harmonised.
- The EED and the EPBD pursue different objectives but should rely on coherent methodological foundations.
- EN 17423 should serve as the common reporting framework to ensure transparency and comparability.

1.2. Methodology

1.2.1. General principles

The PEF is not a directly measured physical property. It is a calculated indicator whose value depends on methodological choices, including geographical scope, system boundaries, allocation rules, treatment of losses, electricity exchanges, storage and self-consumption. **Meaningful comparison therefore requires transparency regarding the assumptions used in the calculation**.

A credible methodology should systematically disclose renewable, non-renewable and total components, data sources, reference periods, allocation approaches and geographical boundaries. Comparability ultimately depends more on transparency than on the use of an identical value across all applications.

Key messages

- PEF values reflect methodological choices and must always be interpreted together with their assumptions.
- Comparability requires full transparency regarding system boundaries, allocation rules and calculation conventions.
- Transparency is more important than achieving a single harmonised numerical value.

1.2.2. Non-combustible renewable energy should retain a PEF of One

The treatment of renewable electricity remains one of the most debated topics in the ongoing review of electricity PEFs. Some stakeholders have proposed assigning a total PEF of zero to non-combustible renewable electricity. **MARCOGAZ does not support this approach.**

Renewable electricity should retain a total PEF equal to 1 under the direct-equivalent convention. The objective is not to attribute an environmental burden to renewable electricity but to preserve the distinction between environmental performance and energy efficiency. A renewable PEF equal to 1 ensures that efficiency improvements remain visible and measurable, even in highly renewable energy systems. **This is already recognised in** (EED, 2023)**, recital 146**.

> *(…) For non-combustible renewable energy, the method is the direct equivalent based on the 'total primary energy' approach. (…)*

Under a zero-equivalent convention, additional renewable consumption would no longer influence total primary-energy demand, making efficiency improvements effectively invisible within the indicator. Such an outcome would weaken the Energy Efficiency First principle and reduce the ability of the PEF to capture the benefits of more efficient energy use.

The direct-equivalent convention avoids this problem while maintaining a zero non-renewable component for renewable electricity. Carbon emissions, life-cycle impacts and resource consumption should continue to be assessed through dedicated environmental indicators rather than by modifying the role of the PEF itself.

Key messages

- Renewable electricity should retain a total PEF equal to 1 under the direct-equivalent convention.
- A renewable PEF equal to 1 preserves the Energy Efficiency First principle.
- Energy efficiency and environmental performance should be measured using distinct indicators.

1.2.3. Ensuring methodological consistency

Changes in electricity PEF values can significantly affect the outcomes of energy policies. In building-performance calculations, revised electricity PEFs may alter calculated primary-energy demand and energy-performance classifications, even without concrete action in favour of efficiency (insulation, switch to a more efficient energy system for heating). In Ecodesign and Energy Labelling regulations, modifications of electricity conversion factors may change compliance thresholds and influence the relative positioning of competing technologies (Marcogaz_Ecodesign, 2021).

These effects do not argue against updating PEF values. However, they demonstrate the importance of impact assessments, transition measures and potential recalibrations whenever substantial

revisions are introduced. Regulatory outcomes should reflect genuine performance improvements rather than methodological adjustments alone.

Key messages

- PEF revisions should not create artificial regulatory winners and losers.
- Significant revisions should be accompanied by impact assessments and recalibration measures.
- Regulatory outcomes should reflect genuine performance improvements rather than methodological updates.

2. Recommendations for future electricity PEF updates

2.1. Keep PEF focused on what it measures best: energy efficiency

One of the central questions emerging from the ongoing review concerns the role that the PEF is expected to fulfil. Some stakeholders view it primarily as a signal for future investment decisions and decarbonisation pathways, while others regard it mainly as a measure of actual energy-system efficiency.

MARCOGAZ considers that these perspectives are not contradictory but should be addressed through complementary indicators. **The PEF was originally developed to measure how efficiently primary energy resources are converted and delivered to final users**. While decarbonisation, renewable deployment, affordability and energy security are essential policy objectives, they should not all be incorporated into a single indicator.

As the energy transition accelerates, **policymakers increasingly need several complementary indicators**. The PEF should continue to provide a transparent measure of energy-system efficiency, while greenhouse-gas indicators and renewable-energy indicators monitor other dimensions of performance.

Key messages

- The primary role of the PEF is to measure energy-system efficiency.
- Decarbonisation, renewable deployment and energy security require complementary indicators.
- Combining multiple policy objectives within a single metric reduces transparency.

2.2. Preserve technology neutrality in efficiency metrics

Electrification will play an important role in the energy transition. However, policy objectives promoting a particular energy carrier or technology should not alter the PEF or compromise its original

purpose. Support for electrification should rely on dedicated policy instruments, while **the PEF should remain an objective and technology-neutral measure of energy-system efficiency,** without directly or indirectly favouring one energy carrier over another.

Maintaining the neutrality of the PEF is particularly important when comparing technologies using different energy carriers. A **transparent and technology-neutral efficiency metric**, combined with greenhouse-gas and renewable-energy indicators, provides a more robust framework for technology assessment and policy evaluation.

Key messages

- Electrification can be supported through dedicated policy instruments.
- Efficiency metrics should remain technology neutral.
- PEF values should not be adjusted to favour a specific energy carrier.

2.3. Evidence-based PEF calculation

Forward-looking information can be useful where PEFs influence decisions involving long-lived assets such as buildings and heating systems. However, regulatory PEFs should remain anchored in observed and verifiable system performance.

MARCOGAZ supports a methodology based primarily on recent quality-controlled observed data, complemented where necessary by a limited forward-looking adjustment. The observed component would ensure traceability and allow ex post comparison with actual performance. The prospective component should reflect only developments supported by adopted policies, National Energy and Climate Plans and sufficiently mature infrastructure or generation projects.

This consistency should also apply to gaseous energy carriers. Where forward-looking factors reflect the expected evolution of the electricity mix, the methodology should equally allow the progressive integration of renewable and low-carbon gases, including biomethane injected into the gas grid, to be reflected where relevant and supported by robust data. Future assumptions should be applied consistently across all energy carriers. Where forward-looking factors reflect the expected evolution of the electricity mix, the same time horizon and evidentiary standards should apply to gaseous energy carriers, including the progressive integration of biomethane and other renewable or low-carbon gases where supported by robust data and adopted policies. Applying projected improvements to electricity while maintaining purely historical assumptions for other vectors would create a methodological bias unrelated to actual performance. Any recognition of renewable or low-carbon gases should distinguish the physical grid mix from contractual allocation, use transparent certification and accounting rules, and prevent double counting of renewable attributes. Alignment with regulatory review cycles would be consistent with the Commission's recommendations:

- the cycle of revision of the Energy Efficiency Directive (EED, 2023, Article 31)

*(…) 7. By 25 December 2026 and **every four years thereafter**, the Commission shall revise the default coefficients on the basis of observed data. Those revisions shall be carried out taking into account its effects on Union law such as Directive 2009/125/EC and Regulation (EU) 2017/1369.*

- the position of the Commission regarding buildings in (EPBD_Annex_12, 2025)

*Since two of the main uses of the calculation methodology are to produce EPCs and apply minimum energy performance requirements, **the Commission recommends the use of a forward-looking PEF that includes only a short- to medium-term forecast (e.g. five years)**. A longer forecast would be difficult to communicate to building users, who would not see the benefits of the improvements in the grid for a long period of time. It is important to underline that **PEFs must remain neutral and reflect all technologies equally**. If, for example, the PEF for a given carrier takes into account progress over the next five years (in line with the NECPs), the PEFs for other carriers must follow the same criteria. Otherwise this could result in inequalities and unfair treatment between technologies.*

Key messages

- Observed data should remain the foundation of electricity PEF calculations.
- Forecasts should be limited, transparent and aligned with regulatory review cycles.
- Identical forecasting assumptions should apply to all energy carriers.

2.4. Seasonal PEFs can already improve accuracy

Annual average values may not adequately reflect seasonal variations in electricity generation, renewable availability and demand patterns. **Seasonal differentiation may therefore provide a practical improvement in representativeness without introducing excessive complexity**.

Seasonal PEFs are particularly relevant for buildings, where heating and cooling loads vary substantially throughout the year. They can improve the representation of actual operating conditions while remaining understandable, transparent and relatively easy to implement. This is explicitly stated in (EPBD, 2024).

*The calculation of primary energy shall be based on regularly updated and forward-looking primary energy factors (distinguishing non-renewable, renewable and total) or weighting factors per energy carrier, which have to be recognised by the national authorities and taking into account the expected energy mix on the basis of its national energy and climate plan. Those primary energy factors or weighting factors may be based on national, regional or local information. Primary energy factors or weighting factors **may be set on an annual, seasonal, monthly, daily or hourly basis or on more specific information made available for individual district systems**.*

Implementation would nevertheless require harmonised definitions of seasons, geographical boundaries and calculation conventions. The added value is likely to be highest in building-energy and flexibility applications and lower in annual reporting or benchmarking exercises.

Key messages

- Seasonal PEFs provide a practical improvement over annual averages.
- Seasonal differentiation better reflects variations in generation mixes and demand profiles.
- Seasonal approaches remain simpler and more transparent than full hourly methodologies.

2.5. Choose the right PEF calculation approach, based on objectives

Average and marginal PEFs answer different questions and should not be considered interchangeable (Marcogaz, 2016). Average PEFs remain appropriate for energy balances, benchmarking, regulatory reporting and most building-performance calculations.

Marginal factors estimate the effect of incremental changes in electricity demand or generation and may therefore provide complementary information for flexibility, storage, load shifting and investment decisions.

MARCOGAZ considers that average PEFs should remain the reference for regulatory accounting and comparability. Where marginal factors are used, methodologies should clearly define the time horizon, system boundary and counterfactual assumptions.

Key messages

- Average PEFs measure overall system performance.
- Marginal PEFs evaluate the impact of incremental changes in demand or generation.
- Both metrics are useful but serve different analytical and policy purposes.

3. Conclusions

The future development of electricity Primary Energy Factors should remain guided by a simple objective: preserving a transparent, robust and credible indicator of energy-system efficiency while progressively improving its ability to reflect evolving energy systems.

This objective can best be achieved through **methodologies based on observed and verifiable data, supported by transparent reporting conventions and applied consistently across technologies and energy carriers**. Renewable electricity should retain a total PEF equal to 1 under the direct-equivalent convention, preserving both the visibility of efficiency improvements and the integrity of the Energy Efficiency First principle.

The energy transition will increasingly rely on renewable integration, electrification, flexibility and sector coupling. In this context, **the PEF should continue to evolve while preserving its primary role as an energy-efficiency indicator**. A methodology combining transparent conventions, observed data, limited forward-looking adjustments and appropriate temporal resolution would provide a robust

framework for supporting both the Energy Efficiency First principle and the long-term evolution of European energy systems.

Key messages

- The primary role of the PEF is to measure energy-system efficiency.
- Renewable electricity should retain a total PEF equal to 1 under the direct-equivalent convention.
- Future updates should be based on observed data complemented by a limited and transparent forward-looking adjustment.
- Dynamic indicators may support flexibility, storage, smart charging and demand-response applications, but annual and seasonal PEFs should remain the primary reference for regulatory purposes until harmonised data-quality and methodological requirements are fulfilled.
- Transparency, neutrality and methodological consistency must remain the guiding principles of future PEF revisions.

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