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IMPLEMENTATION MONITORING AND EVALUATION OF THE IMPACT OF THE GAS NETWORK CODES AND GUIDELINES ON THE INTERNAL MARKET

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FINAL REPORT

Cambridge Economic Policy Associates Ltd

CEPA

CONTENTS

1. INTRODUCTION

Cambridge Economic Policy Associates (CEPA) is pleased to submit this Final Report to the Agency for the Cooperation of Energy Regulators (ACER) in relation to Contract No. ACER/OP/DIR/08/2013/LOT 2/SC06 for a study on monitoring and evaluating the impacts of gas network codes and guidelines on the internal market.

This report is structured as follows. Section 2 summarises the legal background and context for this study. Section 3 lays down our study methodology and analytical framework. Section 4 contains a review of the relevant literature, as well as a summary of the best practices obtained from interviews conducted with a small number of organisations that are familiar with monitoring activities of similar complexity and objectives. Section 5 discusses, in detail, the desired effects of each network code and guideline, including potential ways of measuring those desired effects. Potential ways to measure the achievement of each high-level policy goal are discussed in Section 6. Recommended indicators are presented in Section 7, together with the discussion of the results of our performance evaluation of each proposed indicator. Section 8 provides the estimated implementation cost estimates and an implementation workplan for the recommended monitoring methodology.

The following annexes accompany the report: Annex A provides the detailed specification of each proposed indicator. Annex B contains the bibliography.

2. BACKGROUND AND CONTEXT

Legal background

The EU-wide internal market in natural gas, which has been progressively implemented throughout EU Member States since 1999, aims to:

> "*deliver real choice for all consumers of the European Union, be they citizens or businesses, new business opportunities and more cross-border trade, so as to achieve efficiency gains, competitive prices, and higher standards of service, and to contribute to security of supply and sustainability.*"[1]

To advance the completion of the internal market in energy and the creation of a level playing field for all market participants, the EU introduced the Third Package of Gas and Electricity Directives, which was transposed into national law by European Member States from March 2011. Regulation (EC) No 715/2009 (the "Gas Regulation") and Directive 73/2009 (the "Gas Directive") outline the creation of Network Codes (NCs) and Guidelines (GLs) (in particular the Commission's Commission Guidelines on Congestion Management Procedures[2]).

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[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0036:0054:en:PDF

[2] Commission Decision of 24 August 2012 on amending Annex I to Regulation (EC) No 715/2009 of the European Parliament and of the Council on conditions for access to the natural gas transmission networks (2012/490/EU), OJ L 213/16, 28.8.2012,

The Gas Regulation also established ACER's high-level market monitoring responsibilities, which include monitoring and analysing the implementation of the network codes and their impact on the four high-level policy goals of:

- (1) market integration[3];
- (2) non-discrimination;
- (3) effective competition; and
- (4) efficient market functioning.

With a mandate to promote cross-border trade and EU market integration, ACER has a role to support the implementation of the NCs/GLs and to facilitate the completion of the single EU market for electricity and natural gas. ACER plays a central role in the development of EU-wide network and market rules, and it also coordinates regional and cross-regional initiatives to support market integration. In addition, ACER is responsible for monitoring the work of European Networks of Transmission System Operators (ENTSOs), one for natural gas and another for electricity transmission.

Following the implementation of the Third Energy Package, NCs and GLs have been developed in a number of areas covering:

- the application of congestion management procedures—CMP Guideline—applicable since October 2013;
- capacity allocation mechanisms—NC CAM—applicable from November 2015;
- gas balancing network code—NC BAL—applicable from October 2015;
- transmission tariff structure harmonisation network code—NC TAR—currently being developed;
- interoperability and data exchange network code—adopted in April 2015;
- In addition, a proposal for an amendment of the NC CAM and NC TAR to include rules on incremental and new capacity (INC) is currently being developed. All of the above NCs and GLs, except the network code on interoperability and data exchange, are covered in this study.

ACER's responsibilities include undertaking two annual monitoring activities:

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http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:231:0016:0020:en:PDF

[3] The recent Gas Target Model (GTM2) update defined "market integration" and "market connection" as two separate concepts. The result of market integration is that the wholesale price of gas within the newly created larger market becomes uniform (for the same traded product and the same trading time and venue). Market connection refers to measures taken to improve arbitrage between two (or more) neighbouring gas hubs aimed at reducing but not necessarily eliminating price differentials. Since the objective of this report is to assess market impacts, and not develop measures to facilitate market integration, we applied a broader meaning of market integration that includes both of the above two GTM2 concepts.

- the Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets (“Market Monitoring Report”), which analyses the progress towards creating integrated well-functioning internal energy market as envisaged by the Third Energy Package; and
- the Implementation Monitoring Reports, which verify compliance with NCs and GLs and assesses the impact of the NCs and GLs on the gas market, as required by Article 9 (1) of the Gas Regulation[4].

Given the interactions between the implementation of the harmonised rules contained in NCs and GLs and the functioning of the internal gas market, ACER wishes to merge the two sets of analyses into one integrated economic analysis covering both the impact of NCs/GLs and market evolution into the Market Monitoring Report. The objective of this study is to derive suitable indicators that enable quantitative economic analysis of the impact of NCs and GLs that will also ensure effective monitoring of the high-level policy goals.

3. STUDY METHODOLOGY

In this section, we present our methodology for selecting and evaluating the relevant indicators. We start by proposing an analytical framework to identify a relevant set of indicators. We then describe the steps undertaken in our analysis and the process of evaluating the potential indicators.

3.1. Analytical framework

The objective of the study is to develop a set of indicators to assess the impact of the network codes and guidelines in achieving the higher-level energy market objectives put forward in the Third Energy Package.

We rely on a relatively simple analytical framework for identifying suitable indicators and for mapping these indicators to high-level policy goals where possible. The framework consists of four main phases:

- identify the desired effects of each network code and guideline;
- identify indicators that measure that impact of network codes in terms of their desired effects;
- identify indicators that measure market performance in terms of the high-level policy goals set out in the Gas Regulation;
- analyse how the implementation of each network codes and guidelines affects the broader gas market in terms of the high-level policy goals.

The proposed framework is illustrated in Figure 3.1 below.

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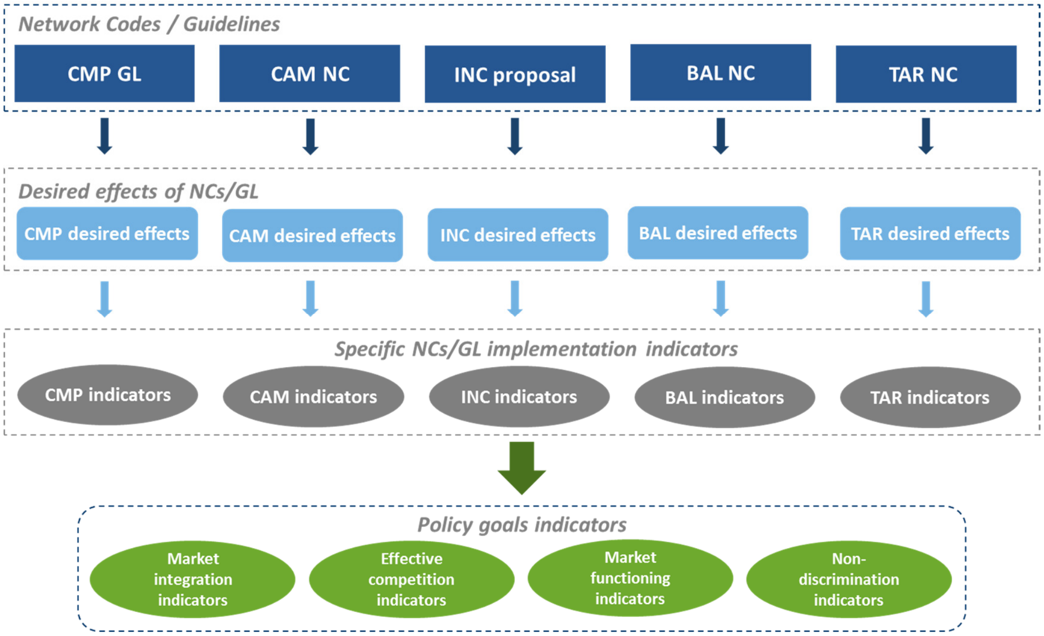
[4] Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009

Figure 3.1: Analytical framework for identifying indicators and evaluating outcomes



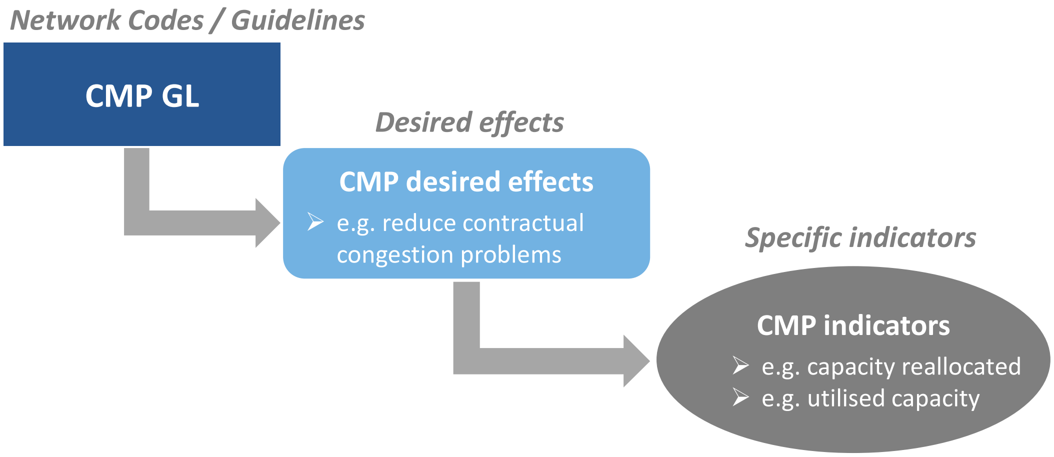
In the first stage of the project, we sought to build a wide-ranging list of possible indicators covering both network code effects and the high-level policy goals. In the second stage, we refined, analysed and evaluated the proposed list of indicators in order to select a set of indicators that is most suitable for ACER's network code impact and market monitoring activities.

Network codes desired effects and impacts

The first step of our methodology was to analyse and understand the desired effects of each network code/guideline. Each network code/guideline is designed to have a specific impact or address a specific problem affecting cross-border gas flows, and thus, implicitly the functioning of the internal European gas market. It is therefore important, as a starting point, to identify these desired effects in order to be able to specify which indicators are most suitable for measuring the effectiveness of the NCs/GLs. The desired effects of each NC/GL are then translated into desired outcomes, which serve as the basis for designing specific indicators.

Figure 3.2. illustrates, with an example, the reasoning steps we used to derive suitable indicators for measuring the desired effects of network code/guideline implementation. We started by reviewing the gas market issues that each network code/guideline aims to address and the objectives that it was designed to achieve. For example, we identified that the main desired effect of CMP GL was to reduce contractual congestion at interconnection points, which hinders efficient cross border gas flows. We then identified potential ways and proposed indicators for measuring whether contractual congestion is actually reduced by applying the CMPs.

Figure 3.2: Illustration of reasoning steps for identifying suitable network code/guideline indicators



It is worth noting that many network code provisions work as a package, and multiple network codes can target common areas or address similar problems. Whereas we were looking to analyse as wide a range of potential indicators as possible, we found it was not appropriate to develop a unique indicator for each desired effect. In general, it was also not possible to isolate the effect of one particular provision, or even one particular network code, on a certain high-level policy goal. The framework illustrated in Figure 3.1 should therefore not be understood as a one-to-one mapping of network codes, desired effects and specific indicators.

High-level policy goals indicators

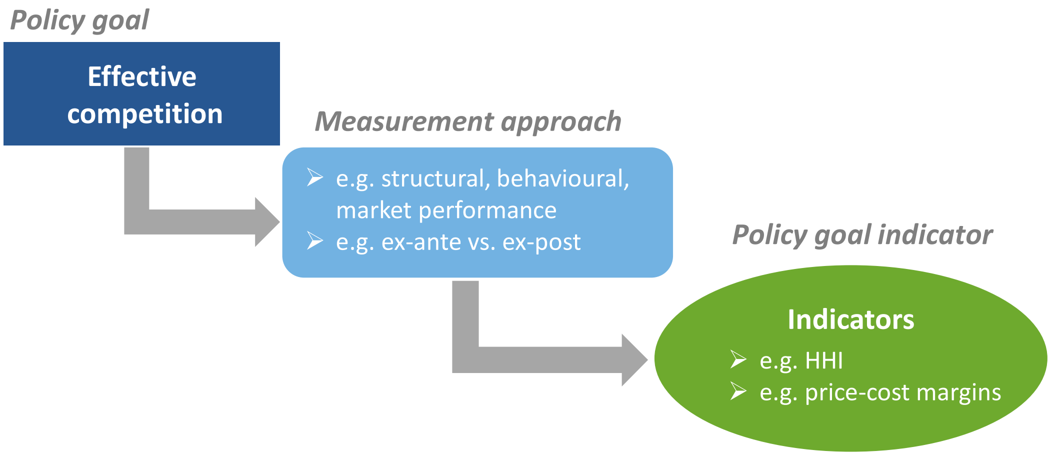
The high-level policy goal indicators were developed to measure how the market is changing and evolving, and whether there is progress towards achieving the goals set out in the Gas Regulation. The four high-level policy goals are listed below:

- market integration;
- effective competition;
- non-discrimination; and
- efficient functioning of the market.

To derive suitable indicators to measure market performance against each of these goals, it is important to have a clear interpretation of the meaning of each objective in terms of market behaviour and performance. Our research indicates, however, that there is no consensus among policy makers, academics and economists as to what constitutes, for example, effective competition or effective market functioning. Therefore, in this study we provide an interpretation for each of the high-level policy goal.

Figure 3.3 illustrates the steps used to derive potential indicators for monitoring gas market performance against high-level policy goals. For example, for the high-level policy goal of ensuring effective competition, the first step was to offer a conceptual framework for understanding what effective competition in the context of the European gas market means. Assessing whether competition is effective involves looking at the structure of the market, the behaviour of market participants and outcomes produced by the market. Based on this we then identified indicators that can be used to monitor each of these aspects of the market.

Figure 3.3: Illustration of steps for identifying suitable high-level policy goal indicators



While the high-level policy goal indicators show how the market is changing, the indicators related to the effects of the network codes/guidelines offer some insight into why the market is changing. Ideally, one would empirically establish correlations that that describe the linkages between the implementation effects of network codes/guidelines and higher-level market developments. The difficulty in doing this is that gas market outcomes are likely to be affected by a multitude of factors, not just the impact of network codes/guidelines. As such, pointing to direct cause-and-effect outcomes is generally not possible. Therefore, instead of establishing empirical correlations based on actual data, we identified potential correlations between the proposed network code/guideline and high-level policy goal indicators.

As mentioned earlier, the network codes/guidelines should be regarded as a package of measures. Equally, no single indicator on its own can give a definitive answer as to the changes going on in the market. Instead, conclusions about the evolution of the market have to be based on interpreting a whole set of indicators and the interaction between them. We highlight in our analysis the interactions between various indicators and the instances where indicators should be interpreted jointly.

Counterfactual

Ideally one would compare market outcomes and network code/guideline impacts against a counterfactual or a baseline. Constructing a proper counterfactual is, however, difficult because it is not possible to determine what would have happened in the absence of these new rules. Some of the most effective methods used in policy evaluations include randomized control trials where the impact of a policy intervention can be isolated by comparing changes in a group affected by the intervention versus developments in a control group unaffected by the policy. This is generally not feasible in the case of NCs/GLs as it would effectively require that the provisions be applied only to a sub-group of interconnection points.[5]

In this case, it is still possible to conduct an evaluation, for example, by considering the state of the gas market before and after the implementation of the NCs/GLs. However, any conclusions about causal relationships between NC/GL implementation and market outcomes need to be inferred carefully, because the impact of other factors driving market outcomes cannot be easily isolated. Furthermore, a simple before-and-after comparison might overlook the fact that some market changes may occur before the network codes/guidelines are actually implemented. This could happen if NC/GL provisions are implemented in domestic rules before the required implementation date, or if market participants or market operators change their behaviour in anticipation of the new rule implementation. An alternative could be to conduct a before-and-after comparison across countries (i.e., compare pre-implementation countries to post-implementation countries, assuming that their implementation dates differ). This approach has the drawback that the countries in the two groups may have markedly market fundamentals, which may largely explain the observed differences in market outcomes. Nevertheless, the concurrent implementation of network codes/guidelines across the EU implies that in the future sufficient impact data should become available to make overall trends discernible.

3.2. Steps undertaken

To inform our analysis into the design and evaluation of indicators, we have undertaken the following main steps:

- reviewing ACER's current market monitoring framework and activities;
- conducting a literature review of relevant publications; and
- undertaking interviews with a small number of organisations with experience in market monitoring and/or internal European gas market development and impact of EU network codes/guidelines.

Literature review

We have prepared a preliminary list of relevant publications on market monitoring approaches in gas markets and/or other network industries in the EU and other OECD countries. The findings from these papers serve as an input into establishing an analytical framework to identify and design the relevant indicators. As far as possible, we have focused on publications that:

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[5] Initial implementation impacts could be assessed by comparing a control group of IPs that include "late implementers" to a group of "early implementers"; however after some time, once the network codes/guidelines are implemented in all Member States, such control group would cease to exist. Also, several impacts are likely to occur only when network codes/guidelines are implemented on both sides of an IP.

- discuss impacts that are quantifiable and can be developed into market indicators;
- study cross-border impacts, given the primary purpose of NCs/GLs; and /or
- address the desired effects that NCs/GLs were intended to achieve.

Although there is a significant body of literature available on gas market integration and competition within and across markets, the amount of research that covers all points listed above is fairly limited. The selected literature was useful, however, in providing illustrations of market monitoring frameworks used in other regulated sectors and suggesting indicators for measuring market performance. The bibliography of the publications we relied on is included in Annex B. Main lessons from the literature reviews are discussed in the next section.

Interviews

Our approach to this study also included interviews with a small number of organisations that are familiar with monitoring activities of similar complexity and objectives, and/or with the operation of the European gas market and the effects of the NCs/GLs. Six such organisations were identified and interviewed, including:

- **Ofgem** – the energy regulator for Great Britain;
- **Monitoring Analytics** – the independent market monitor for the PJM wholesale electricity market in the United States.
- **Federal Energy Regulatory Commission (FERC)** – The federal energy regulator in the United States;
- **European Federation of Energy Traders (EFET)** – an association of EU gas market participants;
- **Intercontinental Exchange (ICE)** – an EU gas exchange operator; and
- **ICIS Heren** – an EU energy market information provider.

The interviewees were provided with a standard questionnaire to be completed prior to a telephone interview. Although the interviewees are active in different markets and their roles vary significantly, learning about their experiences in overseeing and monitoring markets proved useful in developing the proposed methodology. Market monitoring best practices based on the experiences of our interviewees are summarised in the next section.

4. LITERATURE REVIEW AND BEST PRACTICES

Summary of literature review

Our literature review has identified several studies and papers that focus on the high-level policy goals. These include the Booz& Co (2013) study, which assesses the benefits of the internal energy market, and integration of energy networks in both gas and electricity markets. To support this assessment, the authors conducted a comprehensive literature survey to help identify and measure the benefits (i.e. desired impacts) of market integration, such as the impacts on wholesale prices, security of supply, market entry, and competition.

Our proposed measures of market competitiveness were informed by several of the papers listed in the bibliography. Carstensen (2006), Chessler (1996) and Intereconomics (2011) focus on the concept of effective competition, assessing its meaning and conditions under which it can arise, as well as approaches that can be used to ascertain whether competition in the market is sufficient to prevent the exercise of market power. These papers provide relevant examples not just for energy markets but also for other network industries. Ledgerwood and Harris (2012) propose an economic framework to describe manipulation in a manner that could provide a more uniform approach to the detection, analysis and punishment of manipulative behaviour than what is currently in place in different countries. Lastly, Twomey, Green, Neuhoff and Newbery (2009) review the literature and publicly available information on market power monitoring in electricity wholesale markets, in the context of the policy goal of effective competition. This paper establishes a useful framework by categorising the various methods of detecting market power that have been employed by academics and market monitors/ regulators. These techniques include structural and behavioural indices and analysis as well as various simulation approaches. The paper also summarises indicators used by various market monitors.

Lasource (2013) focuses on assessing the level of transparency in European energy markets, recognising the importance of access to relevant market information in ensuring that wholesale market prices are competitive. The report reviews the main initiatives taken to promote and enhance the transparency of European wholesale energy markets on an annual basis, in terms of both public governance and private operators' actions. It also summarises challenges with access to data that is required for efficient market monitoring and detection of market abuse.

Other papers and studies included in the bibliography are either focused on a specific desired effect of a network code/guideline or contain specific indicators that measure market impacts. Heather (2012) provides a comprehensive review of hub-based gas price formation mechanisms, including the development of liquidity and correlation between hub prices, as well as conditions for hubs to become credible price discovery and reference points. Monitoring Analytics (2014) and Potomac Economics (2014) are the annual reports of two US wholesale electricity market monitors. These reports contain a comprehensive assessment of the performance of their respective markets. They also provide a summary of their analytical framework, including a detailed discussion of their methods and indicators to assess the performance of the market.

Ofgem (2014) focuses on the implementation aspects of the CAM network code in the gas market of Great Britain, including practical issues, such as whether capacity should be bundled into two or three Transmission System Operator (TSO) bundles, and whether the

CAM network code should only be implemented at Interconnection Points (IPs). The report also discusses the potential benefits and impacts of implementing the CAM network code.

Petrovich (2014) analyses price correlation between European trading hubs and provides useful information about ways of interpreting and measuring price correlation and price volatility in the context of an integrated market. Stern and Rogers (2014) aim to illuminate dynamics of developing competition in the European wholesale gas market, including a look at European price evolution and the key determinants of hub pricing, examining the changing roles and risks facing the three key groups of gas market players: producers and exporters, midstream energy trading companies, and local distribution companies.

Summary of best practices

Below we summarise key takeaways from our interviews:

- Monitoring methodology must evolve as the market evolves. Therefore, indicators used to measure network code/guideline impacts and the achievement of the high-level policy goals will have to be evaluated from time to time, as market fundamentals change and new types of market behaviour are detected.
- Access to granular and quality data is essential for effective monitoring. The market monitor should have access to all market data, including commercially sensitive information.
- No single indicator is likely to serve as a definitive measure of whether certain impacts or the high-level policy goals have been achieved. Therefore, judgment is required on the part of the market monitor to assess market outcomes based upon multiple indicators.
- Indicators must be interpreted in conjunction with market fundamentals. Most indicators should be perceived as flags to be investigated by the market monitor. Thus conclusions do generally require the judgment of the monitor.

5. MEASURING THE IMPACT OF NETWORK CODES AND GUIDELINES

5.1. Desired effects of network codes and guidelines

The EU network codes and guidelines are a means to achieve the high-level policy goals for the internal market, established in the Gas Regulation[6]: (1) market integration; (2) non-discrimination; (3) effective competition; and (4) efficient market functioning. To measure the impact of the network codes/guidelines, it is important to identify and understand their desired effects, both in terms of advancing the above high-level policy goals, as well as tackling the specific problems that the codes were intended to address.

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[6] Regulation (EC) No 715/2009 (the “Gas Regulation”)

There are several problems in identifying the desired effects of each network code/guideline, as well as how those network codes/guidelines contribute to the achievement of the high-level policy goals. First, our review indicates that some of the high-level policy goals may not be well defined, at least in economic terms. For example, there is no consensus among economists on the best means of achieving effective competition, and even on what constitutes "effective competition".[7] This may create a problem, since assessing whether the high-level policy goals are met, or whether the implementation of the network codes/guidelines significantly contributes to the achievement of those goals, is difficult in the absence of a clear benchmark or target. Second, our analysis indicates that often even with regard to individual network codes/guidelines the problems they were intended to address, their objectives or their desired effects are not always clear. Therefore, one of the objectives of this study was to identify and interpret the desired effects of each network code/guideline.

As a first step in identifying the desired effects, we reviewed the main objectives of each network code with respect to the specific problems they were intended to address. These problems have been perceived to be obstacles to market integration and the development of a well-functioning internal energy market, and thus tackling them was seen as a way to achieve the high-level policy goals. A brief description of these objectives for each network code is included in Table 5.1 below.

Table 5.1: Objectives of network codes and guidelines

Network code/guideline on	**Main objective(s)**
CMP Guideline	• Eliminate unfulfilled capacity demand (contractual congestion)[8] at interconnection points (IPs) to enable efficient capacity utilisation, unless technical capacity is fully utilised. • Maximise the availability of firm capacity by reoffering already booked, but unused, capacity to the market.
Capacity Allocation Mechanisms (NC CAM)	• Establish transparent, economically efficient, standardised and non-discriminatory processes, schedules and methods for the allocation of standardised capacity products at IPs. • Enable network users to flexibly use the existing transmission system to arbitrage price differentials between virtual trading points (VTPs). • Simplify access to and use of cross-border capacity. • Concentrate liquidity at hubs (rather than at IPs). • Attract new users and suppliers to increase market liquidity, and thus to enhance the efficiency of the price discovery mechanisms. • Maximise the technical and available capacity at IPs.

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[7] That said, competition policy, by and large, does not have much problem identifying lack of effective competition in practice.

[8] Unfilled capacity demands could be measured for example by the presence of an auction premium (over the regulated price), where auctions are held, or unsuccessful requests.

Network code/guideline on	Main objective(s)
Incremental and new capacity (NC CAM amendment for INC)	• Establish transparent, efficient, standardised and non-discriminatory processes, timelines and methods for capacity demand assessment and capacity allocation for incremental or new gas transmission capacity.
Balancing of Transmission Networks (NC BAL)	• Introduce and enable transition to a market-based balancing regime in a timely manner. • Provide network users with information to enable them to manage their balancing risks and opportunities in an economically efficient, non-discriminatory manner. • Provide maximum flexibility to network users to access system flexibility via renomination rights. • Incentivise network users to balance their portfolios self-responsibly and ensure that imbalance charges are cost-reflective (market-based balancing). • Enable network users and TSOs to use the same trading platforms to facilitate trade and balancing. • Facilitate trading between balancing zones to enhance short-term market liquidity and to provide gas flexibility via market mechanisms.
Harmonised Transmission Tariff Structures (NC TAR)	• Tariff methodology to be transparent and non-discriminatory and to be justified from the perspective of cost reflectivity thus minimising cross-border gas trade distortions. • Tariff calculations to be fully replicable by network users including all calculation tools and input assumptions/parameters. • Sufficient information to enable network users to forecast transmission tariffs to a reasonable extent. • Promote stability of transmission tariffs for network users and financial stability of transmission system operators. • Establish harmonised transmission tariff structures for gas to facilitate the merging of entry-exit systems.

The next step is to identify the desired effects of each network code/guideline by decomposing their objectives into preferred outcomes. The objectives listed in the above table can be interpreted as narrowly defined goals. In addition, and perhaps more importantly, each network code/guideline is intended to contribute to the achievement of one or more high-level policy goals. Thus, keeping both the narrow and broad objectives in mind, and establishing linkages between the two, is important when evaluating the impacts of the network codes/guidelines. While a network code/guideline may achieve its stated, narrowly defined objectives, it may not have much impact on the market in terms of the high-level policy goals. For example, the implementation of the CMP guideline and the CAM network code may result in a transparent, non-discriminatory and efficient capacity allocation across the EU, other factors, such as an exercise of market power, non-competitive behaviour by market participants, or barriers to entry, may prevent the full achievement of the high-level policy goals of effective competitive and efficiently functioning of markets.

Therefore, for each network code/guideline we identify: (1) problems and issues the network code/guideline was intended to address; (2) desired outcomes; and (3) how each network code/guideline may advance the high-level policy goals. These elements are somewhat intertwined. For example, preferred outcomes are often associated with the elimination of the observed problems. Similarly, the perceived problem may be the fact that the high-level policy goals have not yet been achieved (e.g., balancing markets are not competitive).

Analysis of the CMP Guideline

First, the desired effects of implementing the CMP guideline are summarised in Table 5.2, listed in the order of how quickly each impact is expected to occur. In the short term, the successful implementation of the CMP guideline can be measured by the amount of capacity that is made available (and that would not have been available without the CMP), and by verifying that neighbouring TSOs coherently apply the CMP, and thus no capacity remains unused because of incompatible protocols/methods or lack of coordination.

In the longer term, the CMP can contribute to the achievement of high-level policy goals in several ways: (1) the market will function more efficiently if all participants that wish to use the network gain access, subject to availability of physical capacity; (2) more transmission capacity between markets may increase competition and liquidity in both the capacity auctions and the commodity markets; (3) the CMP mechanisms ensure that capacity cannot be foreclosed either on a long- or a short-term basis, thus providing more certainty to potential new entrants; and (4) assuming more capacity is made available that spurs competition, the market should become more integrated, as observable by increasing price convergence.

Table 5.2: Analysis of the CMP Guideline

Problems/issues	Desired effects / outcomes	How it may advance high-level policy goals?
• **Contractual congestion in the presence of unused technical capacity**: total *ex-ante* demand for transmission capacity exceeds technical firm capacity (i.e., contractual congestion occurs); however some shippers that hold capacity do not intend to utilise it (e.g., in an attempt to foreclose the market), and some technical capacity remains unused *ex post*.	• Additional capacity offered by TSOs through reoffering of already booked, but unused capacity (and purchased when there is demand for it). • Coherent application of CMP procedures either side of IPs. • Unused firm technical capacity due to contractual congestion is minimised. • Persistent price differentials, in excess of transportation and transaction costs, do not exist between entry-exit zones in the absence of	**Efficient market functioning** • Enhance overall market efficiency by better network utilisation. **Effective competition** • Increase liquidity in both capacity and commodity markets. • Support market entry by preventing long- and short-term capacity foreclosure. **Market integration** • Increase price convergence.

Problems/issues	Desired effects / outcomes	How it may advance high-level policy goals?
	physical congestion between them.	• Connect markets and enable efficient flow of gas across entry-exit zone borders.

The CMP Guideline is intended to address the issue of *contractual congestion* in the context of unused pipeline capacity. Contractual congestion is defined in the Gas Regulation as follows:

> "'contractual congestion' means a situation where the level of firm capacity demand exceeds the technical capacity;"

The CMP Guidelines further specify the circumstances when interconnection points are considered contractually congested and congestion management measures should be applied by the respective TSOs.[9] It is important to emphasise that contractual congestion, as defined above, is not inherently a problem, and therefore the desired effect should not be to eliminate all contractual congestion. Rather, contractual congestion becomes a problem when some shippers that have contracted firm capacity, which they do not intend to utilise, directly or indirectly prevent other market participants from obtaining that capacity, resulting in some technical capacity that remains unused (despite unfulfilled demand for the capacity).[10]

Analysis of NC CAM

Table 5.3 below contains a summary of the problems, desired effects, and contributions to advancing the high-level policy goals for the CAM network code. Problems that the CAM network code is intended to address are manifold, stemming primarily from the fact that the prevailing cross-border capacity allocation mechanisms were not market-based, transparent or non-discriminatory; the capacity products offered and the timing of allocations were not coordinated between TSOs. Another potential problem is that, perhaps partly due to operational requirements, TSOs tend to be conservative when determining available technical capacities and there may be little transparency regarding the process for determining such capacities. As shown, the CAM code is likely to contribute to all four high-level policy goals, although the magnitude of those impacts is not entirely clear.

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[9] In its annual congestion reports, ACER identifies contractual congestion by assessing whether any of the conditions set out in paragraph 2.2.3.1 of the CMP GL are fulfilled (for example by examining whether in auction regimes the auction cleared with an auction premium (i.e., the clearing price was higher than the reserve price, i.e. the regulated tariff).

[10] Similarly, physical congestion is not by itself a problem (depending on the frequency of occurrence), but the reality of complex, meshed networks. Demand for pipeline capacity is driven by a number of factors, including price differential between neighbouring markets, transmission tariffs, etc. It is not realistic to expect that an integrated network should operate without any congestion, nor would it be economically efficient to eliminate all physical congestion. In fact, as market integration advances, some parts of the network are likely to experience more congestion than currently, partly due to the fact that the current network was not designed for an EU-wide internal market, and partly due to changes in consumption and production patterns over time.

Table 5.3: Analysis of NC CAM

Problems/issues	Desired effects / outcomes	How it may advance high-level policy goals?
• **Prevailing capacity allocation mechanisms often favour incumbents over new entrants**: this asymmetric position is the result of a lack of transparency and/or the fact that applied mechanisms are not market-based (e.g., "first-come-first-served"); • **Lack of alignment between national/TSO rules for capacity allocation** (e.g. different capacity product definitions, timings) unnecessarily complicated access and use of IP capacity and thereby limiting cross-border flows, and thus act as an impediment to the creation of a well-functioning internal market for gas; • **Lack of transparency in capacity allocation mechanisms**: creates unwarranted cost and complexity for shippers; weakens signals for new investment; • **Lack of network access hampers competition**: potential new entrants may be discouraged due to the combination of factors above.	• Easier acquisition and use of IP capacity (single purchase for bundle and single nomination, common platforms, etc.). • Maximise technical capacity offered through joint TSO capacity (re-) calculations; • Elimination of unrealized cross-border trades due to mismatches in technical capacities at an IP and due to different capacity allocation processes (e.g., timing, products, etc.). • Increase liquidity at virtual hubs by eliminating trading at flange; • Progression towards maximum capacity to be sold as a bundled product; • Enhanced secondary trading of capacity (through platforms); • Increasing number of (new) shippers purchasing short-term capacity.	**Efficient market functioning** • More efficient network use by offering maximum technical capacity; • More efficient network use by allocating scarce capacity efficiently, using auctions (i.e., based on shippers' willingness-to-pay); • Reduce complexity and transaction costs involved in cross-border transport and trade; **Effective competition** • Increase and concentrate liquidity and competition at hubs); **Market integration** • Increase price convergence (if CAM results, at least on a short-term basis, in more capacity, and/or increased competition); • Connect hubs and enable efficient flow of gas across entry-exit zone borders. **Non-discrimination** • Create a level playing field for all shippers by making capacity allocation mechanisms more transparent, standardised and non-discriminatory by design.

It should be noted that there is a considerable overlap between the CMP guideline and the CAM network code. Both are designed to increase transmission capacity available for cross-border trade.[11] Furthermore, the CAM network code applies only to existing capacity at IPs, not capacity that is made incrementally available at existing IPs or new capacity between two

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[11] NC CAM can be thought of as a means of defining and allocating transmission capacity, whereas CMP could be interpreted as a way to maximise the use of the already allocated capacity.

market areas. ENTSOG has recently submitted its "Incremental Proposal"[12] that consists of: (1) amending NC CAM with respect to principles linked to the offer and allocation of incremental capacity; and (2) including in TAR NC a chapter on issues related to the economic viability of incremental capacity projects and related tariff setting principles.

The objectives of the proposed rules on incremental and new capacity[13] are similar to those of the CAM network code: establish harmonised and market-based mechanisms to allocate and price incremental and new capacity. Problems, desired effects, and impacts on the high-level policy goals are summarised in Table 5.4 below.

Table 5.4: Analysis of proposed rules on incremental and new capacity

Problems/issues	Desired effects/ outcomes	How it may advance the high-level policy goals?
• **Lack of a transparent, economic, efficient and non-discriminatory, process of capacity demand assessment**; • **Lack of a transparent, efficient and non-discriminatory, market-based system (and process) of capacity allocation** for incremental or new gas transmission capacity; • **Lack of consistent and transparent approach for assessing investment efficiency**.	• Capacity demands for incremental and new capacity are satisfied in a market-based manner (i.e., based on binding user commitments, primarily using CAM auctions, and in limited cases in alternative CAMs); • Incremental/ new capacity projects are efficient and financially viable; • Economic test applied to proposed projects is an accurate reflection of the share of expected benefits between users triggering the investment and other network users generally.	**Efficient market functioning** • Expand the EU-wide gas transmission network in an efficient (cost-effective) manner while meeting the network users' needs; **Effective competition** • Increase liquidity and competition at hubs; **Market integration** • Increase price convergence; • Increase physical interconnection and security supply (e.g. through firm backhaul) **Non-discrimination** • Create a level playing field for all shippers by making capacity allocation mechanisms more transparent and non-discriminatory by design.

Analysis of NC BAL

The balancing network code is at the heart of the integrated European energy market. Currently, in many countries much of the balancing of the gas system is conducted by the TSOs based on long-term contracts, often with a single supplier. As a result, there is no competitive market for short-term flexibility. NC BAL aims to shift responsibility for short-

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[12] ENTSOG, Final Incremental Proposal for submission to ACER, INC0223-14, 26 December 2014.

[13] The proposed rules would be implemented as amendments to NC CAM and NC TAR.

term balancing to network users and assign only a residual balancing role to the TSO, and to create a market for short-term flexibility that delivers benefits to the consumers.

Problems and desired effects associated with the balancing network code, as well as its potential contributions to achieving the high-level policy goals, are summarised in Table 5.5 below.

Table 5.5: Analysis of NC BAL

Problems/issues	Desired effects/ outcomes	How it may advance the high-level policy goals?
• **Market fragmentation and lack of competitiveness:** market integration is hampered by differences in balancing regimes; • **Non-market based balancing:** most balancing is performed by TSOs; • **Lack of transparency**: balancing regimes and charges are often not transparent; • **Significant barriers to entry**: market participants often have insufficient information about their balancing positions; new entrants, in the absence of liquid balancing markets, tend to have more difficulty balancing their portfolios than incumbents. Imbalance charges may be excessively high and not cost-reflective, creating a barrier to market entry.	• Transparent, well-functioning, short-term flexibility market • TSO plays an enabling role by: (1) establishing/ supporting a trading platform; (2) supporting maximum opportunities for renomination; (3) providing sufficient information (e.g. demand, cash-out evolution, system status); • Minimal long-term contracting for flexibility; • Small volumes / low frequency of TSO balancing actions (only residual balancing); • Transparent balancing mechanisms: follow merit order; transparent decisions whether to buy/sell gas; determination of required volumes; • Shippers to perform primary balancing role (supported by the TSO as an enabler); • Increased liquidity and competitiveness; • Barriers to entry and cross-border trade are eliminated.	**Efficient market functioning** • Transparent markets/ mechanisms can reduce balancing needs and the overall cost of balancing; **Effective competition** • Reduced barriers to entry • Improved cross-border trade and competition. **Market integration** • Harmonised balancing rules and nomination timing and procedures promote cross-border trade; **Non-discrimination** • Transparency in balancing mechanisms and markets supports equal treatment.

Analysis of NC TAR

Methodologies for determining transmission tariffs vary widely across Europe. Concerns have been raised that the applied methodologies may not be cost-reflective.[14] These concerns have supported the case for an EU-wide network code aiming to increase transparency and harmonisation of tariff methodologies.

Table 5.6 below lists potential problems associated with differences in tariff methodologies between entry-exit zones, including desired effects of harmonised tariff structures, and how harmonisation may contribute to high-level policy goals. We note that problems listed in the table are potential problems.

Table 5.6: Analysis of NC TAR

Problems/issues	Desired effects/ outcomes	How it may advance the high-level policy goals?
• **Unjustified differences in tariff methodologies may result in tariff levels which distort cross-border trade and competition;** • **Lack of transparency** in tariff methodologies and their application; • **Transmission tariffs are not cost-reflective;** • **Transmission tariffs are unstable and unpredictable;** • **Long- and short-term capacity prices** are inappropriately determined in relation to each other; • **Inconsistent interruptible capacity pricing**: e.g., wide variation in the discounts applied;	• Transparent tariff methodologies are implemented, with minimal cross-subsidy between users, and are reasonably cost-reflective; • Shippers can reasonably predict and replicate transmission charges using publicly available data; • TSOs are able to recover allowed revenues without significant and/or persistent under- and over-recovery and without large and frequent tariff adjustments; • Tariffs should give appropriate investment signals; • Harmonised, transparent, cost-reflective and non-discriminatory entry/exit tariffs promote cross-border trade.	**Efficient market functioning** • Increased transparency and predictability decreases market participants' risk and associated costs; • Cost-reflective tariffs promote more efficient network utilisation and expansion; **Effective competition** • Harmonised tariff methodologies should reduce discriminatory or non-cost reflective tariffs which may promote cross-border competition; **Market integration** • Harmonised tariff methodologies should reduce discriminatory or non-cost reflective tariffs which may promote cross-border trade; **Non-discrimination** • Transparency and minimal cross-subsidies eliminate/reduce discrimination between users

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[14] The European Commission have received a number of complaints about transmission tariffs.

5.2. Potential indicators to measure the desired effects of network codes and guidelines

In Table 5.7, we outline *potential* indicators to measure the desired effects and outcomes of each network code/guideline, not all of which are included in the recommended methodology. This wide range of potential indicators was first qualitatively assessed, before creating a shortlist of these potential indicators for detailed design to be included in the recommended methodology. The potential indicators in Table 5.7 include several types: (1) binary (e.g., yes/no, pass/fail); (2) formulaic (calculated using a formula, assuming availability of relevant data); (3) scores/ratings (e.g., survey responses). We briefly comment on each potential indicator in the rightmost column of the table.

Table 5.7: Potential indicators to measure the desired effects of network codes and guidelines

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
CMP Guideline		
Unused capacity reoffered by TSOs at IPs	• CMP capacity made available (kWh/d) during a specified period by: ○ OS&BB[15] ○ FDA-UIOLI ○ Surrender ○ LT-UIOLI	• Data should be available from ENTSOG Transparency Platform
	• Increase in available average-day & peak-period firm capacity from prior year at each IP (% change year-on-year)	• A significant increase, either one-time or a gradual increase over time, may indirectly indicate improved network utilisation • The impact of incremental and new capacity must be controlled for in order for the indicator to be meaningful
Coherent application of CMP procedures on both sides of IPs	• Number of IP sides with the same type of CMP applied on both sides as a percentage of total IPs	• To get a sense of potential cross-border flows impacted by mixed CMP regimes, indicator could be weighted by either actual flows and/or technical capacity.
	• Frequency of the separate application of CMP at each IP	• Should be separated by the type of CMP used
	• Number of standard capacity products (Yearly, Quarterly, Monthly, Daily, Within-day) for which CMP is applied	• Should be separated by the type of CMP used
	• Contractual capacity utilisation per shipper (max.%, cf. LT UIOLI "triggers" as defined in CMP GL)	• Provides an indication whether contracted capacity may be "hoarded", but it should be carefully interpreted; it may not be straightforward to distinguish between: (1) actions to

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[15] Oversubscription and buy-back.

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
Unused technical capacity due to contractual congestion is minimised	• Overall contracted capacity utilisation (daily flows/booked capacity)	withhold capacity intentionally to manipulate the market; from (2) network users holding capacity for its option value • Necessary data should be available from the NRAs/TSOs wherever LT-UIOLI is applied
	• Unsuccessful requests for capacity at IPs (auction clearing price > reserve price): number of occurrences, product types (duration) and amount of capacity	• Since CMP is intended to address problems associated with contractual congestion, its impacts should be evaluated in that context • Data should be available from ENTSOG Transparency Platform
	• Capacity amount, product types (duration) and number of occurrences of secondary capacity requested/offered/traded at (congested) IPs	• Provides an indication of whether the use of CMP drives capacity holders to trade their unwanted capacity on secondary markets. Particularly important to assess this in relation to contractually and physically congested IPs
NC CAM		
Harmonised timing of capacity allocation	• Harmonised timing of CAM auctions (number of TSOs following ENTSOG's auction calendar)	• A lack of harmonised timescales hampers market integration
Increase in offered technical capacity, *all else equal*	• Technical capacity is dynamically recalculated by TSO (yes/no) • Frequency of dynamic recalculation (quarterly, monthly, daily, etc.)	• Dynamic recalculation at a relatively high frequency is likely to make more capacity available at places where the market values it • Note that frequent recalculation may only be necessary where capacity utilisation is high and/or where technical capacity is low
	• Increase in available average-day & peak-period technical capacity from prior year at each IP (% change year-on-year)	• Data should become available from ENTSOG Transparency Platform
Easier, efficient acquisition and use of IP capacity (single purchase for bundle and	• Number of platforms for (bundled) capacity bookings at IPs / alternatively: number of TSOs/IPs that have not joined a Booking platform	• One CAM requirement is the setting up of joint booking platforms for selling bundled capacity

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
nomination, common platforms, etc.)	• Average number of IPs per booking platform • Volumes of bundled capacity offered and sold on capacity booking platforms (per product type, per IP/direction)	• To facilitate capacity bookings at different IPs, it would be desirable to have common platforms, e.g. PRISMA
Elimination of trading at flange (all trading forced to virtual hubs)	• Traded volumes at hubs / VTP • (Residual) Traded volumes at flanges/ borders	• Data might be difficult to acquire for flange trades (supply contracts)
Progression towards maximum capacity sold as a bundled product	• Unbundled and bundled capacity ratio • Short-term bundled and unbundled capacity bookings (DA and within-day) • Longer-term bundled and unbundled capacity bookings (beyond DA) • Technical capacity mismatches between both sides of an IP	• Should move towards nearly all capacity booked as bundled at IPs • Unbundled capacity may still be offered where there is a mismatch between technical capacities either side of an IP
Enhanced secondary trading of capacity	• Volume of capacity offered/requested/traded on secondary exchanges (by product types, IP level)	• Data should become available from PRISMA and other secondary platforms (TSOs)
Elimination of unrealized cross-border trades due to mismatches in technical capacities (at an IP) and due to different capacity allocation processes (e.g., timing, products, etc.)	• Contractual capacity utilisation at IPs (booked/technical capacity), as an indication of underutilisation due to capacity mismatches • Physical capacity utilisation at IPs (flows/technical capacity), as an indication of underutilisation due to capacity mismatches	• NC CAM should facilitate capacity bookings at IPs; physical utilisation is likely to be affected by several factors
Rules on incremental and new capacity (INC)		

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
Capacity demands for incremental and new capacity are satisfied in a market-based manner	• Incremental and new capacity offered through open seasons (auctions or alternative CAMs)	• To give an indication of the role of auction mechanisms in allocating incremental/new capacity
Incremental/ new capacity projects are efficient and financially viable	• Proportion of incremental/new capacity proposed project that pass/fail the economic test (based on assessment by NRAs)	• Details on projects that fail the economic test might not be publicly available
Economic test applied to proposed projects is an accurate reflection of their economic feasibility	• Range of f-factor values used in the calculation of the economic test	• The range of these values gives an indication of the minimum ratio of binding commitment to the cost of the incremental/ new capacity applied in different jurisdictions • To some extent the f factor is an indication of the extent to which the NRA believes the project is necessary
NC BAL		
Transparency of the balancing mechanism	• Publication frequency of the data on the balancing status of each shipper (e.g., two times per day)	• Shippers can manage their imbalances efficiently only if they have up-to-date information regarding their balancing status
	• Total balancing procured by TSO via market-based mechanisms as a % of total balancing requirement	• Under the assumption that market-based mechanisms are transparent, this indicator provides an indication of the share of overall balancing that is procured in a transparent manner. • Evaluating whether the mechanism requires a review of several elements, including: (1) that the mechanism follows the merit order; (2) required volumes are transparently determined; and (3) decisions regarding any other parameters are transparent
	• Market participant surveys on their perceptions with respect to: ○ Transparency in the development of balancing charges	• To ensure validity of results, standard questionnaires, sampling and evaluation methods, etc. must be used

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
	○ Transparency and non-discrimination in the balancing mechanism ○ Incentives for TSOs to balance through market	
TSO performs residual balancing	• Total balancing procured by the TSO (MWh/d) as % of total daily balancing requirement (TSO balancing actions + shipper-procured balancing on Trading Platform and OTC + exercise of physical flexibility)	• May require a definition of threshold for “residual” balancing
	• Neutrality charge for balancing for each TSO (daily, short- and long-term) broken down into constituent parts	• Neutrality charge refers to the difference between the amounts received/ receivable and the amounts paid/payable by the TSO for balancing services • According to the principle of neutrality imbedded into BAL NC, the TSO should neither gain nor lose by facilitating/performing balancing. Even though there will always be some costs associated with TSO balancing, the net gain to the TSO should converge to zero.
Shippers perform primary balancing	• Total balancing procured by non-TSO participants as a % of total balancing requirement	• May require a definition of threshold for “primary” balancing
	• Total balancing procured by non-TSO participants to manage *within day obligations* (system-wide, balancing portfolio, entry-exit point)	• Balancing purchases may not be identifiable by purpose (i.e., daily balancing vs. within-day balancing obligations)
No long-term contracting for flexibility	• Total balancing services procured by the TSO under long-term contracts (MWh) as % of total balancing volume procured by the TSO	• Indicator should converge to zero
Increased liquidity and competitiveness	For each balancing zone: • Total volume of trades involving: (1) TSO and (2) all other non-TSO participants • Number of registered participants	• Much of the same liquidity and competitiveness indicators can be applied to the balancing market as to the broader market, as discussed in Section 6

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
	- Number of independent participants (i.e., multiple affiliates of a holding company should be counted as one). - Number of active participants (i.e. those who have conducted at least one trade in the last 12 months); - Churn rate: volumes traded relative to the final consumption.[16] - Quantity traded (in absolute terms, relative to local demand, and relative to local demand + transit flows) - Order book volume (total MWh of bids and offers at a given point in time)	
	- Increase in within-day cross-border flows (year-on-year % increase)	- The impact of the BAL NC cannot be isolated, but potential trends in the data may provide an indication of the potential impacts
NC TAR		
Transparent tariff methodologies are implemented, with minimal cross-subsidy between users, and are reasonably cost-reflective	- Robustness of decision making and overall process associated with establishment of tariff methodology (rating; qualitative scoring)	- Evaluation of key elements of NC TAR via a qualitative assessment. These elements should be evaluated by qualified analysts (i.e., not through surveys of market participants) against objective criteria using standard scale for scoring
	- Availability of all models and data to enable replication of actual tariffs (rating; qualitative scoring)	
	- Availability of information to enable network users to predict future tariff levels (rating; qualitative scoring)	

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[16] Note that while ACER no longer uses the churn rate for assessment with respect to the updated Gas Target Model (GTM2), we did consider it for assessing the market impacts of network/codes guidelines. Whilst we agree that the churn rate should not be used as a standalone indicator of market performance, we believe that, as part of a package of indicators, it is a useful measure of market performance. The detailed description of our recommended churn rate indicators is included in Annex A.

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
	• Performance against chosen cost allocation test: Fail if $\frac{\|(R{:}CD)_{DM} - (R{:}CD)_{CB}\|}{\frac{1}{2}\{(R{:}CD)_{DM} - (R{:}CD)_{CB}\}} > 10\%$ where (R : CD)DM and (R : CD)DB are the revenue-cost ratios of domestic and cross-border customers, respectively	• Revenues and costs allocated to each group of customers must be carefully examined
Shippers can reasonably predict and replicate transmission charges using publicly available data	• Market participant surveys on understanding of transmission charging and perceived difficulty in replicating tariffs	• To ensure validity of results, standard questionnaires, sampling and evaluation methods, etc. must be used. • It may be difficult to separate two effects: (1) increased understanding of the tariffs due more data and transparency provided per NC TAR; (2) learning by shippers new to the market
Tariff stability	• Evolution of tariffs at IPs, as a consequence of the network code (i.e. over and above variations) excluding other effects (new assets, efficiency regulation, etc.) • Magnitude of changes in tariff levels over a certain threshold within a given period (e.g., tariff level change > 10% within a 3-year period or between relevant tariff periods)	• To get a sense of whether the costs allocation methodology results in stable tariff levels over the years
	• Frequency of revenue reconciliation • Proportion of TSO revenue subject to reconciliation	• Details of revenue reconciliation mechanisms, including frequency of reconciliation, are to be determined by the NRAs
TSOs are able to recover allowed revenues without significant and/or persistent under- and over-recovery;	• Annual under/over recovery for each TSO	• To give an indication whether the tariff methodology results in charges, which are likely to ensure cost recovery for the TSO

Desired effects/ outcomes	Specific indicator/ technical parameter	Comments
Required new investments are sufficiently incentivised	• Periodic assessment of potential investors' willingness to participate in required projects	• Determining whether incentives are sufficient, ex ante, requires judgement • Ex post, a lack of investor interest is a clear indication that incentives are insufficient and/or the project is not economically viable
Harmonised, transparent, cost-reflective and non-discriminatory entry/exit tariffs promote cross-border trade.	• Difference in reserve prices and payable prices at each side of IPs (per auction and product)	• Differences may be due to differences in regulated asset base and volumes • One would expect greater differences where allowed revenues unpredictably change and where anticipated bookings do not materialise
	• Differences between multipliers applied at each side of IPs to: ○ Quarterly standard capacity products ○ Daily standard capacity products	• Multipliers are used to calculate a reserve price for a non-yearly standard capacity products as a proportion of the reference price of the standard firm, annual capacity product • Relatively large differences indicate lower degree of harmonisation • At the moment, it is unclear how the multipliers are expected to be set
	• Number of cost allocation methodologies used in the EU	• Relatively large differences indicate lower degree of harmonisation, although the total number may remain constant even when tariffs diverge • Indicator value should drop as the methodologies allowed under NC TAR are implemented

6. MEASURING MARKET OUTCOMES

In the previous section we reviewed the desired effects of each network code/guideline, including how they may advance the high-level policy goals. For each of the identified desired effects, we developed a wide-ranging list of potential indicators for an initial qualitative assessment. A shortlist of these potential indicators proceeded to the next stage of the project and was considered for detailed design.

A similar approach was applied to develop high-level policy goal indicators to measure market impacts. As discussed in the previous section, each network code/guideline has several immediate desired effects or outcomes[17], as well as potential contributions to achieving one or more of the high-level policy goals. Given a fair degree of overlap between the high-level policy goals[18], and the fact that most network codes/guidelines aim to contribute to the achievement of multiple high-level policy goals, it was generally not possible to establish a one-to-one mapping between the narrowly defined desired effects of network codes/guidelines (or their technical parameters) and the high-level policy goals. As a result, we found it was not be possible to measure the isolated impact of each individual network code/guideline on the achievement of the high-level policy goals.

In the remainder of this section, we discuss the potential ways of measuring the achievement of the high-level policy goals. Following performance evaluation, a subset of these potential indicators was chosen to be included in the recommended methodology, presented in Section 7 of the report.

6.1. Potential indicators to measure the achievement of the high-level policy goal of effective competition

As discussed in Section 3, the high-level policy goal of effective competition can be achieved in a variety of market settings. The network codes/guidelines that are subject of this study tend to focus on only a subset of those market settings. For example, rules on congestion management and capacity allocation mechanisms (CMP GL, NC CAM, and proposed CAM amendments on incremental and new capacity) are intended to promote competition by reducing structural barriers to entry, and thereby trying to increase market liquidity. This can be achieved by either increasing transmission capacity between national markets or by more efficiently allocating existing, scarce transmission capacity between those markets. Interconnecting regional markets increases the set of potential buyers and sellers, thus effectively enlarging the relevant market. If these markets become sufficiently large and liquid, market participants can easily buy or sell the relevant product without significantly

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[17] Since network codes/guidelines are a means to achieve the high-level policy goals, the immediate desired effects or outcomes of network codes/guidelines (e.g., making more IP capacity available) can be viewed as "inputs", while the high-level policy goals can be viewed as the "outputs".

[18] For example, truly competitive markets tend to be efficient, integrated, and non-discriminatory.

affecting its market price. Thus, liquidity is desirable because it reduces the ability of any individual market participant to engage in market manipulation. Although competitive markets are frequently characterised by liquidity, it is neither a necessary nor a sufficient condition to conclude that a given market is competitive.[19]

A key aspect of effectively competitive markets is the issue of market power.[20] It is a necessary condition for such markets that no exercise of market power or other forms of non-competitive behaviour distort market prices.[21] A comprehensive framework to monitor for market power has already been developed in competitive wholesale electricity markets.[22] Here we present a modified version of that framework, with potential indicators that are adapted to monitoring competition in natural gas markets, including a discussion of their main strengths and weaknesses.

The techniques for detecting market power can be classified along two dimensions: (1) whether they are applied ex-ante or ex-post; and (2) whether they are in the long-term, or the short-term, as shown with illustrative examples in Table 6.1 below. Ex-ante indicators can be used to detect *potential* market power, while ex-post indicators can be used to detect an *actual* exercise of market power. Long-term measures are either applied over a longer period or are focused on relatively stable aspects such as market structure. Short-term indicators are used to detect actual or potential exercise of market power in short period (e.g., in a single auction), and may be combined with measures to automatically mitigate market power (e.g., setting bids exceeding a reference prices equal to that price).

Table 6.1: Classification of market power detection measures[23]

	Ex-ante	Ex-post
Long-term measures	• For example: structural indices (e.g., combined market shares, HHI, residual supply index); measures of barriers to entry/exit	• For example: competitive benchmark analysis based on historical costs
Short-term measures	• For example: bid screens comparing bids to references bids before auction clears	• For example: residual demand analysis

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[19] Market manipulation is possible even in liquid markets (see Ledgerwood and Harris (2012), p. 24), and concentrated and illiquid markets may behave in a competitive manner (e.g., because of the threat of new entry; see Bender et al., p.5). Experience with other commodity markets also demonstrates that liquidity in every regional market is not a pre-requisite to competition. For example many global markets, such as the market for crude oil, have only two to three true trading points, which serve as reference points for other locations. Similarly, Henry Hub serves as the reference pricing point for the entire North American gas market.

[20] Other network codes (NC BAL, NC TAR) are intended to reduce barriers to entry and distortions to cross-border flows, and thus enhancing liquidity and competition as described above).

[21] We note that the effect of a lack of effective competition may exhibit itself in not just prices, but also quality, innovation, etc.

[22] Twomey et al. (2008).

[23] Twomey, Green, Neuhoff & Newbery (2008), Table 1.

Given the design of the European internal gas market, the most suitable indicators are likely to be ex-post, perhaps with the exception of structural indices and market simulation techniques, which can be applied both ex ante and ex post.

Market power can further be categorised by indices that measure: (1) market structure (e.g., number of active participants); (2) market conduct (i.e., market participant behaviour); and (3) market performance (e.g., liquidity). The potential indices for each of these categories are summarised in Tables 6.2 through 6.4 below.

- It is important to assess these three types of indicators jointly. A market may not be structurally competitive, but market participants may behave in a competitive manner, and thus the overall market performance may be competitive. The reverse may also be true: a market may be structurally competitive in its construct (through legislation, OTC and exchange contracts, etc.), but the actual behaviour may turn out to be not competitive.

Furthermore, several pre-conditions must be met in order for a successful application of these methods to detect and assess structural market power:

- A relevant product (e.g., forward, balancing, capacity) must be defined.
- Relevant geographic markets for each product need to be defined.[24]

It is important to define both of these elements correctly because infrastructure constraints are likely to cause varying degree of market segmentation between regional gas hubs. These delineations will not be stable, but change over time, and thus the definitions will have to change appropriately. Inappropriately defined geographic markets may lead to incorrect conclusions regarding market competitiveness.

The indicators presented in this section cannot generally identify the impact of a single factor, such as the implementation of a network code/guideline, on market competitiveness, but rather reflect the combined effect of all relevant fact. Although the precise impact of individual network codes/guidelines on facilitating effective competition may not be directly measurable, the potential indices in this section, when tracked over time, may provide some indication of their effectiveness:

- For example, if the CMP guideline and CAM network codes significantly increase the availability of transmission capacity between entry-exist zones, structural indices should reflect a more competitive market as geographic markets (defined as described above) are effectively enlarged.

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[24] Relevant geographic market may not follow Member State boundaries. It may be defined by transmission constraints. Since physical congestion and system conditions vary over time, the definition of the relevant geographic market must be dynamic in nature to reflect those changes.

Table 6.2: Potential market monitoring indicators to measure structural market power

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
Market structure indices			
1. Combined market shares	• Sum of market shares of the n largest sellers/buyers in each relevant market (balancing, forward, CAM auctions) • Combined market shares of downstream suppliers (diversity of supply indicators)	**Strengths**: • Can be applied ex-ante or ex-post • Straightforward to calculate • For newly-established mechanisms/markets (e.g., CAM auctions, balancing), the competitive structure can be immediately assessed **Weaknesses**: • Has been criticised for not appropriately accounting for relative markets shares[25] • Defining the relevant market may be difficult because it requires an analysis of transmission constraints and potential gas that can be delivered • The relevant market may have to be redefined frequently, as it changes with transmission constraints	• Requires data on offers and cleared bids from CAM auctions; traded volumes in bilateral trading/exchanges, and balancing markets • To define relevant market, data on transmission constraints and congestion is needed
2. Herfindahl–Hirschman Index (HHI)	• Same types of indicators as above, except using the HHI formula (i.e., sum of squared market shares)	**Strengths**: • All of the above; plus: • Commonly applied and competitive thresholds in other markets/jurisdictions have already been established[26] • Accounts for differences in relative market shares • An improvement over current method[27] which calculates HHI at the MS level based on market shares of different upstream companies **Weaknesses**:	• Same as above

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[25] For example, markets shares of 25% and 25% of the top two suppliers would yield the same index value as if the markets shares were 49% and 1%, even though the distribution of market power would be radically different.

[26] For example, the US Federal Energy Regulatory Commission (FERC) has adopted the US Department of Justice/Federal Trade Commission Merger Guidelines which characterise markets based on HHI values as follows: if HHI<1000, market is *unconcentrated*; if 1000<HHI<1800, market is *moderately concentrated*; if HHI>1800, market is considered *highly concentrated*.

[27] See Figure 73 in ACER's latest Market Monitoring Report.

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
		• High HHI (as do all market structure indices) only indicates potential market power, not necessarily an actual exercise of market power • Defining the relevant market may be difficult because it requires an analysis of transmission constraints and potential gas that can be delivered • The relevant market may have to be redefined frequently, as it changes with transmission constraints	
Pivotal Supplier Index (PSI)	• As for the above indices, a separate PSI can be calculated for each relevant market • Can be *single PSI* (to measure unilateral market power), or *joint PSI* (to measure the joint market power of several of the largest suppliers)	**Strengths**: • Unlike market shares and HHI, accounts for not just supplier concentration but also market demand, thus reflecting actual market conditions • Focuses on periods when the exercise of market power is the most likely **Weaknesses**: • More involved to calculate than HHI and market shares • PSI is a binary index; the index may be triggered if the supplier is pivotal in a single period • Although the concept of PSI is generally accepted, details of implementation (e.g. threshold values) are critical and can easily lead to over- and under-mitigation/detection	• Same as above • Also requires market demand data
Residual Supply Index (RSI)	• Separate RSI for each relevant market.	**Strengths**: • Same as for PSI • Advantage over PSI: RSI is a continuous index, it may thus better measure changes in structural market power (e.g., in response to the implementation of network codes/guidelines) **Weaknesses**: • Same as for PSI	• Same as for PSI
Demand Responsiveness Index **Residual Demand Analysis**	• Price elasticity of market demand in each relevant market (short- and long-term)	**Strengths**: • Takes into account demand conditions and can track dynamically changing markets. **Weaknesses**: • Like the supply-side structural indicators, high demand responsiveness does not preclude the exercise of market power.	• Demand and willingness-to-pay data is needed

Table 6.3: Potential market monitoring indicators to measure market participant behaviour

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
Market participant behaviour indices			
Lerner Index (LI)	• (P – MC)/P, calculated for each producer/supplier, where P is the price received; and MC is the marginal cost of production/supply • Wholesale-retail mark-ups (gas suppliers' over wholesale costs factored into post-tax retail prices)[28]	**Strengths**: • Strong theoretical foundation: if LI significantly exceeds zero for an extended period, it may be a strong indication of a potential exercise of market power **Weaknesses**:[29] • Determining the marginal costs of each producer/supplier at any given point in time may be difficult. (This could be mitigated by replacing MC in the formula with a competitive benchmark price or bid/offer, e.g. bids/offers of the same producer/supplier in periods when the market was deemed to be competitive) • Because of data issues (lack of availability and insufficient data quality), not yet widely used for gas market monitoring	• Requires bid/price and marginal cost data • Even in a perfectly competitive market, the market price can exceed the marginal cost of the marginal producer (although for relatively short periods) if supply is constrained • If marginal producer/supplier setting the market price can be identified, calculation of LI can be focused on those market participants only • Ideally, LI would be calculated at each step of the supply chain
Price Cost Margin (PCM)	• (P – MC)/MC	**Strengths**: • Same as above **Weaknesses**: • Same as above	• Same as above
Bid Correlation Analysis	Metrics to detect whether market participants deviate from	**Strengths**: • Indicators are relatively easy to derive and update. **Weaknesses**:	• Depending on the specific indicator, may require detailed

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[28] ACER's current methodology of calculating wholesale-retail price mark-up, described in Annex 1 of the 2013 Market Monitoring Report could be easily adapted.

[29] Some argue that LI and PCM are not suitable indicators because of the difficulty in determining the competitive price levels/marginal costs. While it is true that determining the competitive price levels can be challenging, we believe that the potential benefit/strengths of these behavioural indices outweigh their weaknesses. From our interviews with regulators and market monitors, we learned these measures are considered to be the most important indicators in markets with the most developed market monitoring practices.

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
	bidding the marginal costs in response to system conditions: • Correlation between bids/offers and the level of demand • Correlation bids/offers and the existence/magnitude of congestion between markets • Correlation between bids/offers and the market price • Comparing bid/offer patterns between participants	• Requires moderate-to-high effort to identify, analyse, and confirm that observed correlations are likely to be the result of non-competitive behaviour • Economic theory may not provide much guidance to interpreting indicator values (e.g., threshold values) or to identifying non-competitive behaviour (e.g., suspicious bid/offer patterns among participants)	bid/offer data, demand & congestion data

Table 6.4: Potential market monitoring indicators to measure market performance

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
Market performance indices			
Liquidity measures	For each relevant market/product (spot, prompt, forward): • Total demand • Numbers of trades • Products actively traded (Within Day, Day Ahead, Balance of Month, Month ahead, Quarter ahead, Season +1, Season + 2, Year + 1, Year + 2, Year + 3) on each platform (OTC, exchange) • Number of registered participants • Number of independent participants (i.e., multiple affiliates of a holding company should be counted as one) • Number of active participants (i.e. those who have conducted at least one trade in the last day/week) • Number of traders who do not have physical positions[30] • Churn rate: ratio between the amount of gas traded at a given hub or market place and the amount of physical gas throughput in the area or region covered by the hub or the market place	**Strengths**: • Straightforward to calculate and easy to interpret • Liquidity measures may be used to measure the achievement of other high-level policy goals (e.g., highly liquid markets reduce transaction costs, thus making market more efficient) **Weaknesses**: • There are no theoretically-justified threshold values sufficient to conclude that competition is effective • Liquidity is neither a sufficient nor a necessary condition for effective competition (although liquid markets tend to be competitive, while illiquid ones tend to be less competitive)	• Requires data on market demand, trading, tradable products, and market participants; some of which may be difficult to obtain

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[30] "Non-physical" traders will generally only trade in competitive/active markets and increasingly favour financial markets (exchanges or financial OTC products, often based on exchange indices. Thus this indicator is a measure of the confidence held in the market.

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
	• Quantity traded (in absolute terms, relative to local demand, and relative to local demand + transit flows) • Order book volume (total MWh of bids and offers at a given point in time; measure of market "depth")		
Spot market exposure	• Percentage of total gas procured in balancing, spot, prompt, and forward markets • Percentage of total gas consumed that is procured outside competitive market mechanisms (e.g., under long-term contracts)	**Strengths**: • Provides a measure of total demand met in the short term when markets may be more susceptible to an exercise of market power • IEA has developed similar indicators (although its methodology is not always clear and the time delays to publication can be quite long) **Weaknesses**: • Data may not be publicly available and market participants may not be willing to disclose how they procure their physical requirements • For gas delivered at hubs under long-term contracts, it may be difficult to separate volumes for intended for local consumption vs gas intended for transit • These indicators on their own may not provide sufficient evidence of market power concerns	• Volumes procured in the market and through other mechanisms
Competitive Benchmark Analysis	• Estimate of the marginal cost of a (hypothetical but realistic) marginal producer/supplier (used in combination with other market participant behavioural indices)	**Strengths**: • A well-founded analysis can provide a credible and useful benchmark of what a competitive market should look like • This approach has been applied in a number of wholesale electricity markets • Maybe be backward-looking (based on historical data) or forward-looking (simulation-based; see below) **Weaknesses**: • Considerable effort in model development • Results may be sensitive to assumptions	• Data on marginal costs, market prices • Marginal producer/supplier needs to be identified for each period • When different historical periods are analysed and compared, a period when market was deemed competitive

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
			may have to be identified
Net Revenue Analysis	• Revenues net of costs for representative producers/suppliers • This analysis is used to compare revenues with estimates of costs on a medium-term basis, typically a year. Comparisons can be made between net revenues and: ○ Annual fixed costs of operation ○ Entry costs (the full annualised costs of a new asset) ○ Exit costs (the costs that could be avoided if the producer withdrew from the market)	**Strengths**: • Measures attractiveness of the market to new entrants. If net revenues of incumbents are high but new entry does not take place, it may indicate that there are some barriers to entry **Weaknesses**: • Requires considerable effort • May be difficult to collect required data	• Capital and operating costs, technological data
Simulation Models	• Virtually all of the above indicators can constructed from the output data of sufficiently granular structural simulation modes	**Strengths**: • Potentially the most powerful tool to analyse market, since such models are capable of explicitly incorporating many structural, behavioural and market design factors relevant to market power • Maybe used to establish a competitive benchmark (based on marginal cost bidding) or to model other forms of market conduct (e.g., oligopolistic behaviour) • Similar models (of even higher complexity) are commonly used in the electricity sector **Weaknesses**: • Complex models may be difficult and costly to construct and maintain • Some input data may be difficult to obtain. Results may be driven by assumptions • Complex forms of market behaviour may be difficult to incorporate	• Detailed data on production costs, spatial distribution of demand, demand elasticities, representation of the physical network, transmission constraints, etc.

6.2. Potential indicators to measure the achievement of the high-level policy goal of efficient market functioning

Well-functioning markets are efficient. As discussed above, perfect competition, and thus perfectly efficient markets in the gas sector are not achievable in reality because several of the key pre-conditions of such markets (e.g., no transaction costs, absence of externalities, perfect information) cannot be met. Therefore, the high-level policy goal of efficiently functioning markets needs to be evaluated in the context of effectively (or workably) competitive markets. The key aspects of such markets in the context of efficiency are the following:

- **Few barriers to entry and exit**—recognising the fact that entering markets in certain parts of the value chain may require significant investment.
- **Market prices are generally cost-reflective**—In the short-term, prices generally reflect marginal costs, including opportunity costs and costs associated with negative externalities. In limited periods, in the presence of capacity constraints, prices may rise above marginal costs, reflecting the value of scarcity.
- **Overall costs of serving customer demand are minimised**—Competitive markets with efficient price formation tend to minimise overall costs along the entire value chain.
- **Transaction costs are minimised**—this can be facilitated by liquid spot and forward markets featuring low bid-ask spreads and/or centralized exchanges.
- **Network infrastructure is efficiently utilised**—this falls within the overall objective of minimising overall costs; inefficient network use is likely to yield higher than optimal costs.
- **Market signals are sufficient to support new investment**—Efficient, workably competitive markets can sustain themselves by providing adequate incentives for new investment at the right times and at the right locations.[31]
- **Liquid forward markets enable market participants to efficiently manage risk**—this can be achieved by providing opportunities for hedging risk and assigning responsibility for risk management to those who are best capable of dealing with it.
- **Transparency**—Markets can only function efficiently if all participants have access to timely market information and have confidence in price formation. Since transparency is intricately linked to the high-level policy goal of non-discrimination, we will address it in more detail in the next section.

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[31] We should note here that even very liquid global markets, such as the market for crude oil, are characterised by boom-bust investment cycles, in the oil sector occurring roughly every seven years.

In light of these characteristics, we propose the following specific indicators to measure market efficiency, summarised in Table 6.5 below.

Table 6.5: Potential market monitoring indicators to measure efficient market functioning

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
Network capacity, utilisation, and expansion	- Capacity utilisation at each IP (average-day and peak flow/technical capacity)	**Strengths**: - Relatively easy to calculate **Weaknesses**: - By itself is not a direct measure of market efficiency - IP capacity utilisation is the composite effect of many factors that may be difficult to isolate	- Already used by ACER (see 2013 MMR, Figure 79). - Note that there is some overlap with the use of capacity utilisation as a measure of network code desired effects. The indicator considered here is a broader measure of efficient network use
	- Value of congestion at each IP (euros/IP/year)	**Strengths**: - Relatively easy to calculate: value of congestion = observed price spread x capacity - Can be used as a proxy to illustrate potential gains from increased transmission capacity **Weaknesses**: - Indicator may potentially over-/underestimate congestion if there are network effects (i.e., increasing capacity at an IP changes flows in other parts of the network)	- Cannot be used as a sole indicator of short-term efficiency of network use, but is a useful indicator to analyse longer-term market performance
	- Potential net welfare gains from arbitraging price differentials at IPs with unused physical capacity (euros/year/IP)	**Strengths**: - Helps identify IPs where potentially efficient flows are not realised - Allows one to rank IPs in the order of increasing potential gains **Weaknesses**: - Identifying reasons/factors that prevent those flows requires ad hoc analyses for each IP - The coexistence of hubs and long-term contracts pricing mechanisms meant educated guesses had to be performed on the final gas price for each market area (particularly for those	- Already used by ACER (see 2013 MMR, Figure 77)

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
		MSs without liquid hubs). As such pricing differentials can be challenged	
	• Welfare loss from apparently inefficient flows at each IP (euros/year/IP). ○ Flows in opposite direction implied by price spreads (incl. transmission charges) between zones, valued at the observed price differential	**Strengths**: • Helps identify IPs where market may be most distorted • Identifies IPs with the largest potential gains **Weaknesses**: • Identifying reasons/factors (e.g., long-term contracts) that prevent those flows requires ad hoc analysis	• Unlike the above metric, this indicator measures not what could be potentially gained, but what has been lost in efficiency due to lack of market integration
	• Unused technical capacity due to contractual congestion at each IP ○ A composite indicator measuring the frequency of a simultaneous: (1) lack of physical congestion between two zones; and (2) price differential between their respective hubs	**Strengths**: • Identifies those instances when contractual congestion results in market inefficiency • May be used in combination with the above indicators to monetise welfare losses **Weaknesses**: • Requires detailed data and calculation may be more involved	• May build on ACER's annual analysis of contractual congestion
Market-based procurement and efficient price formation	• Share of IP technical capacity allocated in market-based mechanisms (% of technical capacity)	**Strengths**: • Relatively easy to calculate **Weaknesses**: • Can only be interpreted as a measure of market efficiency, if the market-based allocation mechanisms are themselves efficient	• The indicator should converge to 1 over time
	• Total balancing need (MWh) as % of total physical volumes	**Strengths**: • Relatively easy to calculate **Weaknesses**: • None identified	• If incentives embedded in NC BAL are effective, all else equal, indicator value should fall over time
	• Total balancing costs (in euro) as % of total physical volumes	**Strengths**: • Relatively easy to calculate	• If incentives embedded in NC BAL are effective, all else

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
		Weaknesses: • None identified	equal, indicator value should fall over time
	• Share of total balancing need procured by the TSO (% of total balancing requirement) ○ Of which, share procured through competitive mechanism	**Strengths**: • Relatively easy to calculate. **Weaknesses**: • Can only be interpreted as a measure of market efficiency, if the market-based allocation mechanisms are themselves efficient • Requires balancing volumes from all shippers	• TSO's share of balancing should decline over time, and the share procured through competitive mechanisms should converge to 1
	• Mark-up indices (Lerner index, price-cost margin)	**Strengths**: • Prices significantly and persistently above marginal costs may imply inefficient price formation **Weaknesses**: • See previous discussion of market behaviour indices	
Transaction cost and risk metrics	• Number and types of hedging products available at each market	**Strengths**: • Relatively easy to identify and measure **Weaknesses**: • Although easily measurable, may not accurately reflect the breadth and depth of hedging instruments/markets	
	• Standard survey to measure shippers' market experience regarding: ○ Market complexity ○ Size of transaction costs ○ Breadth and depth of hedging markets ○ Market transparency and predictability	**Strengths**: • Standard scores could be track shippers' perception/experience and satisfaction over time • Open-ended questions could be used to solicit information about difficult to identify market design flaws **Weaknesses**: • Responses may be subjective • May be time-consuming and resource-intensive • Potentially low response rate	• To ensure validity of results, standard questionnaires, sampling and evaluation methods, etc. must be used • Furthermore, participants should be required to respond in a timely fashion. In order to minimise bias in responses, questions should focus on what shippers' do

Potential measure	Specific indicators	Strengths & Weaknesses	Comments
			(e.g., products traded, timing of trades, costs incurred, etc.) not what they wish for
Barriers to entry	- Market participant surveys on perceived barriers to entry (e.g., credit requirements, lack of liquid spot and forward markets in the balancing zone, etc.)	Same as above	- See above
	- Number of new entrants in each relevant market (exchanges, balancing capacity auctions, by MS)	**Strengths**: - Easy to construct **Weaknesses**: - Not sufficient to draw conclusions about barriers to entry (an increasing number of participants does not necessarily imply no barriers to entry, although a lack of entry into markets where potential gains could be realised is a cause for concern)	- Could be segmented into groups of registered, active, etc. participants

6.3. Potential indicators to measure the achievement of the high-level policy goal of market integration

The generally accepted economic definition of an integrated or unified market is that, in the absence of physical, infrastructure, regulatory or institutional constraints, prices in different locations that lie within a single market will easily and quickly converge to a single price. This is known as the Law of One Price. This economic concept states that in a single market differences in prices in different locations will only reflect transaction and transportation costs. Prices can diverge as a result of local shocks but these price differentials should dissipate rapidly through arbitrage within the integrated market. Essentially, an integrated market allows local price shocks resulting from demand or supply changes to be absorbed into a much larger market thus smoothing the effect on any one region.

Price convergence in an integrated market assumes that prices are the result of supply and demand forces. The interaction of market forces gives scope for arbitrage. If prices are set through other mechanisms such as oil-indexed long-term contracts, for example, then the scope for arbitrage is greatly reduced and price differentials between sub-areas of the market are likely to persist. Many commodity prices are set in a global market with regional prices moving closely together and price differentials primarily reflecting transportation costs. This is the case of oil, for example, where price movements of different crude oil benchmarks (Brent, WTI) follow each other relatively closely.[32] In contrast a similarly integrated global natural gas market has not yet developed and the price movements of major hubs shows less correlation.[33] The reasons cited for this are different pricing systems (i.e. gas hub prices, oil-linked prices, monopoly set prices), long-term contracts (usually oil-indexed) that restrict the scope for arbitrage, infrastructure limitations (e.g. availability of pipeline capacity or LNG terminals) and national policies (e.g. import or export restrictions) that limit trading.

The degree of integration in the gas market and the ability to converge to a single price depends on the availability of the physical infrastructure allowing gas to flow freely between market zones. Any physical barriers to trade resulting from congested or otherwise unavailable infrastructure should result in price de-linkages. Market integration however also depends on the removal of other barriers to trade such as contractual, regulatory or political barriers that inhibit the free trading of gas.

The benefits of market integration include increasing competition in the market and strengthening security of supply. In the context of the US gas market, Makholm (2007) observes that effective liberalisation and continental-wide market integration in the US

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[32] Note that there are some fundamental differences between gas and other commodities. For example, oil is a primary source of energy, which is, in the majority of cases, refined into products that are then consumed. Apart from (the very important) role of gas as a feedstock in mainly chemical processes, gas is an energy product that is consumed 'as is'.

[33] See Global Natural Gas Markets Overview: A Report Prepared by Leidos, Inc., Under Contract to EIA (August 2014). We should also note that there are signs that the gas market is globalising.

ensures security of supply for any region or city, by allowing the price mechanism to efficiently manage local demand or supply shocks.

Table 6.6: Potential market monitoring indicators to measure market integration

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
Market integration			
Hub gas price convergence	- Price differentials between gas hubs - Number of days when price spreads are at the respective transmission charges	**Strengths**: - Simple to calculate **Weaknesses**: - Hub prices only available for a few major hubs; price formation in many MSs is limited	- Monthly averages of month-ahead prices (Bloomberg) - Already used by ACER (see 2013 MMR, Figure 72 and 85)
Hub gas price correlation	- Correlation between price levels at different hubs - Correlation between price levels when markets are physically disconnected - Correlation between prices excl. periods of physical disconnection - Regression analysis	**Strengths**: - Correlation indices: easy to calculate and obtain data - Regression analyses reveal not only correlations between prices, but also serve as a tool to determine whether a liquid hub (e.g., TTF) can be used for financially hedge physical positions in another hub **Weaknesses**: - Correlation indices: simplistic measures of market integration: do not necessarily imply proper market functioning or competition - Hub prices are only available for a few major hubs - Price correlation on its own does not necessarily imply integration, nor is it an indicator of a hub being active or inactive, in absolute terms or in relation to the other hubs	- Day-ahead/month ahead prices
Price volatility correlation	Correlation between different measures of volatility: - **Price dispersion (absolute price levels)**: standard deviation, coefficient of variation - **Price velocity (absolute price changes)**: mean absolute deviation	**Strengths**: - Volatility is important for market participants; it is the most representative metric of market risks and the difficulties involved in hedging - Price volatility in an integrated market should be similar across hubs and the level of integration should be reflected in a lower overall price volatility. Volatility between hubs indicates whether	- Daily, hourly prices

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
	- **Return volatility (relative price changes)**: standard deviation	participants can hedge their physical positions in one hub with financial hedges in another hub[34] **Weaknesses**: - Volatility correlation on its own does not necessarily imply integration if correlation is driven by a common outside factor	
Border prices vs. hub prices	- Difference between border prices and hub prices	**Strengths**: - Border prices closer to hub prices indicate wholesale markets are driven by supply/demand **Weaknesses**: - Potential data problems	- Average border price = total value of imports /total volume imported (Eurostat)
Oil indexed contracts vs. hub indexed	- Share of contracts indexed to oil prices /gas hub prices	**Strengths**: - Can provide a measure of the extent to which wholesale prices are the result of market forces **Weaknesses**: - None identified	- Already used by ACER in 2013 MMR
Welfare losses due to lack of market integration	- Potential net welfare gains from arbitraging price differentials at IPs with unused physical capacity (euros/year/IP)	**Strengths**: - Helps identify IPs where potentially efficient flows are not realised - Allows one to rank IPs in the order of increasing potential gains **Weaknesses**: - Identifying reasons/factors that prevent those flows requires ad hoc analyses for each IP	- Already used by ACER in 2013 MMR (Figure 77)
Security of supply	- Residual Supply Index (RSI)	**Strengths**: - See Table 6.2	- Same as for RSI indicator described in the competition

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[34] For example, although TTF can be used to financially hedge physical PEG Nord positions, it cannot be considered as a reliable financial hedge for physical PEG Sud or PEG TIGF positions. This is because it would leave traders exposed financially to the consequences of physical constraints between the Nord and Sud zones.

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
		Weaknesses: - See Table 6.2	section, except aggregated by producer/supplier country of origin - GTM2 proposed indicator that will be assessed in next MMR editions
	- Number of supply sources (by country)	**Strengths**: - Already used by ACER. **Weaknesses**: - May understate security of supply if other sources of supply are potentially available.	- Already used by ACER in 2013 MMR. - GTM2 proposed indicator that will be assessed in next MMR editions

6.4. Potential indicators to measure the achievement of the high-level policy goal of non-discrimination

Non-discrimination can be interpreted as a situation where all network users and market participants receive comparable treatment, unless a differential treatment is justified by significant variations in the costs of serving those groups. Non-discrimination therefore does not necessarily imply identical treatment, but rather treatment that places the various participants on an equal footing. For example, charging different tariff rates to different groups is non-discriminatory as long as those differences reflect the underlying costs of providing service to those groups. In practice, some form of discrimination may occur between the following groups of users:

- New entrant vs incumbent.
- Domestic vs cross-border.
- Supply side vs demand side (e.g., in balancing).

The high-level policy goal of non-discrimination is closely linked to the other three high-level policy goals. Efficient markets generally require an absence of undue discrimination between participants. Similarly, complete market integration can only be achieved if there is no discrimination between domestic and cross-border participants. Lastly, applying the principle of non-discrimination may be seen as a way of facilitating competition.

Transparency is one way of fostering non-discriminatory arrangement. Transparency requirements embedded in the network codes/guidelines are intended to provide market participants all relevant information on transmission tariffs, production, consumption, and system conditions in a non-discriminatory manner. In addition, several network codes/guidelines mandate the creation of open market-based mechanisms as a way of fostering transparency.

Practical implementation of the principle of non-discrimination can be translated into the following elements:[35]

- **Non-discriminatory network access**—Ensuring non-discriminatory access to the physical network infrastructure for all market participants, as established in the third party access rules, is crucial for competition and market efficiency. If the owners of physical infrastructure were able to discriminate between users, effective competition would not be able to evolve.
- **Non-discriminatory balancing mechanisms**—Balancing rules must be non-discriminatory and transparent to ensure that all shippers can efficiently balance their positions.

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[35] Note that non-discrimination is a key principle applied in retail market competition. However, retail issues are beyond the scope of this report, and are therefore not covered here.

- **Non-discriminatory and transparent capacity allocation mechanisms (CAM)**—All shippers can gain access to the cross-border capacity under comparable terms.
- **Non-discriminatory and transparent congestion-management procedures (CMP)**—All shippers can gain access to the cross-border capacity allocated via the CMP comparable terms.
- **Non-discriminatory secondary trading of capacity rights**—TSOs, storage and LNG operators must facilitate free trading in capacity rights in a transparent and non-discriminatory manner.
- **Provision of TSO services on a non-discriminatory basis**—TSOs must offer their services on a non-discriminatory basis to all network users.
- **Non-discriminatory tariffs**—Harmonisation of transmission tariff structures is meant to result in tariffs that are non-discriminatory and cost-reflective. Harmonisation does not mean that the tariffs are equal between Member States, but rather that the methodologies employed meet minimum requirements and are well understood by market participants.
- **No undue barriers to entry and exit**—The threat of entry may be a key factor restraining incumbents, and thus ensuring competition. Some barriers to entry may be discriminatory and weaken competition. One such example may be high collateral requirements for some market participants that do not reflect their credit risk.

In the previous sections, we discussed ways of measuring the other three high-level policy goals, effective competition, market integration, and efficient market functioning. Assessing non-discrimination is less straightforward because many of the factors considered to be non-discriminatory treatment are difficult to measure. Potential ways of assessing non-discrimination:

- **Detailed analysis of established mechanisms**—Several of the network codes/guidelines (CAM, CMP, and BAL) establish market-based mechanisms to ensure non-discrimination. A detailed review of the design of each element of these mechanisms is one way of assessing whether they are non-discriminatory. Auction mechanisms are, in principle, non-discriminatory mechanisms; however "the devil is in the detail". Even seemingly small details in design may result in a discriminatory treatment. The analysis should examine whether auction clearing mechanisms, eligibility rules, penalties, and other elements are consistent with the principle of non-discrimination.
- **Detailed analysis of transmission tariff design**—The analysis should review tariffs and verify that transmission charges are reflective of any differing costs of serving the specific customer groups.

- **Detailed analysis of the provision of TSO services**—Analysis of the mechanisms TSOs use to provide or procure services on behalf of the shippers (e.g., balancing, connections). The review should examine whether any elements of these mechanisms are discriminatory.

Table 6.7 summarises potential indicators that can be measured other aspects of non-discrimination and transparency.

Table 6.7: Potential market monitoring indicators to measure non-discrimination and transparency

Potential measure	Specific indicators	Strengths & Weaknesses	Data required
Compliance with transparency requirements	• One availability indicator per required data item	**Strengths**: • Transparency requirements are defined and embedded in network codes/guidelines **Weaknesses:** • Formal compliance does not necessarily imply a sufficient level of transparency	• Published data should be complete, of the required quality, and provided in a user-friendly format (see below)
Quality of published data	• Timeliness/ frequency of updates • Completeness of data • Granularity • User-friendly format	**Strengths**: • ACER has already developed a methodology[36] **Weaknesses:** • Updates may be data-intensive • Some aspects of quality may be difficult to quantify	• Varies by indicator type
Barriers to entry due to discrimination	• Number of new entrants in each relevant market • Number of competition referrals or complaints received/upheld by market participants	**Strengths**: • Easy to construct **Weaknesses**: • Low value does not necessarily indication discrimination against new entrants, but fundamental market conditions (e.g., market may be oversupplied at the moment)	• Same indicator as the one for measuring efficient market functioning • Vigorous new entry indicates that the market is non-discriminatory against new entrants

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[36] Monitoring of Gas Transparency requirements TSOs' compliance with Chapter 3, Annex I of Regulation (EC) No 715/2009, Update of ACER analysis for 23rd Madrid Forum, 9 April 2013; http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Report_Gas_Transparency_Monitoring%209%20April%202013.pdf

7. PERFORMANCE EVALUATION OF RECOMMENDED INDICATORS

In this section, we first present our recommended set of indicators, separated into two groups: (1) network code/guideline indicators; and (2) market monitoring indicators.[37] Next, we discuss the results of our evaluation of the proposed indicators, including their strengths and weaknesses, limitations and robustness. Further, we discuss foreseen interactions and correlations between the proposed indicators.

7.1. Recommended indicators

We recommend that ACER adopt a total of 44 indicators, including 22 network code/guideline indicators and 22 market monitoring indicators.

Network code/guideline indicators are summarised in Table 7.1 and consist of: (1) three indicators (CMP.1 through CMP.3) to measure the impacts of the CMP Guideline; (2) six indicators (CAM.1 through CAM.6) for measuring the impacts of NC CAM; (3) three indicators (INC.1 through INC.3) for the proposed INC amendment; (4) four indicators (BAL.1 to BAL.4) for NC BAL; and lastly (5) six indicators (TAR.1 through TAR.6) for NC TAR. The market monitoring indicators include: (1) ten indicators (CO.1 through CO.10) to measure competition impacts; (2) four indicators (MF.1 through MF.4) of efficient market functioning; (3) six indicators (MI.1 through MI.4) to measure market integration impacts; and (4) two indicators (ND.1 and ND.2) for non-discrimination.

Most of the proposed indicators are not standalone measures of network code/guideline impacts or market performance, and thus they should not be used in isolation to draw conclusions regarding the impacts of network codes/guidelines. There are important correlations and interactions between the proposed indicators, which may impact both the validity, but also the interpretation, of the proposed indicators. Some of the high-level linkages between network code/guideline indicators and high-level policy goals have already been explored in Section 6. In this section, we identify and discuss more specific correlations and interactions between the proposed indicators.

We provide detailed specification of each proposed indicators in Annex A, including: (1) calculation principles; (2) strengths and weaknesses; (3) data requirements and data sources interpretation and thresholds; (4) potential correlations with other indicators; (5) practical considerations and previous usage; (6) implementation costs; and (7) evaluation summary. We note that the proposed indicators can be further disaggregated (e.g., by focusing on a specific market area or product). We do not define all possible sub-indicators, but do describe where such possibilities exist.

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[37] The market monitoring indicators reflect the four high-level policy goals: effective competition (CO); efficient market functioning (MF); non-discrimination (ND); and market integration (MI). In the remainder of the report, these abbreviations are used to identify and reference indicators relevant to each goal.

Table 7.1: Recommended indicators to measure the desired effects of network codes and guidelines

Ref. ID	Indicator	Unit	Primary data source(s)
CMP Guideline			
CMP.1	Additional capacity volumes made available through each CMP	kWh/d or kWh/h	ENTSOG TP[38]
CMP.2	Utilisation of contracted capacity at IPs per shipper	% flows/booked capacity	REMIT
CMP.3	Aggregate utilisation of contracted capacity at IPs (flows/booked capacity)	% flows/booked capacity	ENTSOG TP
NC CAM			
CAM.1	Year-on-year increase in average-day and peak-period technical capacity at IPs	kWh/d or kWh/h	ENTSOG TP
CAM.2	Bundled capacity release	MWh	REMIT
CAM.3	Share of total capacity sold as bundled on capacity booking platforms	% of all IP capacity sold	REMIT
CAM.4	Secondary market-traded bundled capacity and unbundled capacity	% of bundled capacity sold	REMIT
CAM.5	Contractual capacity utilisation at IPs (booked/technical capacity)	% of technical capacity	ENTSOG TP
CAM.6	Physical capacity utilisation at IPs (flows/technical capacity)	% of technical capacity	ENTSOG TP
INC			
INC.1	Incremental and new capacity offered through open season / auctions	MWh	NRAs/TSOs
INC.2	Proportion of proposed incremental/new capacity projects that pass/fail the economic test	% of all proposed projects	NRAs/TSOs
INC.3	Range of f-factor values used in the calculation of the economic test	number(s) chosen by NRA(s)	NRAs/TSOs
NC BAL			

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[38] ENTSOG Transparency Platform.

Ref. ID	Indicator	Unit	Primary data source(s)
BAL.1	TSO balancing through short-term standardised products vs. balancing services contracts	% of total TSO balancing volume	REMIT/TSOs
BAL.2	TSO share of total balancing	% of total balancing requirement	REMIT/TSOs
BAL.3	Physical linepack day-on-day changes	mcm	NRAs/TSOs
BAL.4	Balancing net neutrality analysis	€/MWh	REMIT/TSOs/NRAs
NC TAR			
TAR.1	Stakeholder assessment of robustness of decision making and overall process associated with establishment of tariff methodology	multipoint scale	Survey of EU trade associations
TAR.2	Assessment of availability of all models and data to enable replication of actual tariffs	multipoint scale	Survey of NRAs/ EU trade associations
TAR.3	Stakeholder assessment of information availability to enable tariff predictions	multipoint scale	Survey of NRAs/stakeholders
TAR.4	Pass/fail compliance with cost allocation test	binary (pass/fail)	NRAs
TAR.5	Revenue Reconciliation parameters and outcomes	€, time, and frequency (years)	TSOs
TAR.6	Multipliers applied by each TSO	number(s) chosen by NRA(s)	PRISMA/TSOs/NRAs

Table 7.2: Recommended indicators to measure the achievement of the high-level policy goal of effective competition

Ref. ID	Indicator	Unit	Primary data source(s)
High-level policy goal of effective competition			
CO.1	Herfindahl–Hirschman Index (HHI)	number between 0 and 10,000	REMIT
CO.2	Residual Supply Index (RSI)	share of total demand	REMIT
CO.3	Price-Cost Margin (PCM)	share of marginal cost	REMIT; for other sources see Chyong and Hobbs (2014)
CO.4	Gas demand	TWh	Eurostat/TSOs/IEA
CO.5	Participants	number	REMIT, exchanges
CO.6	Products traded	types	REMIT, exchanges
CO.7	Traded volumes	TWh	REMIT, exchanges
CO.8	Depth of market	index	ICIS Heren
CO.9	Churn rate	ratio	same as for CO.8 and CO.5
CO.10	Simulation model	various (see Annex A)	various (see Annex A)
High-level policy goal of efficient market functioning			
MF.1	Transaction costs	€	Survey
MF.2	Value of congestion at each IP	€/IP/year	ENTSOG TP; MI.1
MF.3	Potential net welfare gains from unused physical capacity	€	ENTSOG TP, MI.1
MF.4	Potential welfare loss from apparently inefficient flows at each IP	€	ENTSOG TP, MI.1
High-level policy goal of market integration			
MI.1	Price convergence	€/MWh	REMIT
MI.2	Price correlation	correlation coefficient	REMIT
MI.3	Price volatility correlation	correlation coefficient	REMIT

Ref. ID	Indicator	Unit	Primary data source(s)
MI.4	Contract vs. spot gas prices	€/MWh	REMIT
MI.5	Oil-indexed vs. gas hub pricing	relative volumes	REMIT
MI.6	Number of supply sources	number of source countries	Eurostat Comext
High-level policy goal of non-discrimination			
ND.1	Quality of published data	multipoint scale	survey
ND.2	Barriers to entry	multipoint scale	survey

7.2. Performance evaluation of the proposed indicators

At the outset of our evaluation process, we established a set of criteria for shortlisting indicators from the potential set of indicators identified in the first phase of this project. Using these criteria, we then evaluated the likely performance of each potential indicator. Next, we discuss the selection criteria and their rationale in some detail, followed by the main findings of our evaluation process. This includes a high-level discussion of the merits of the selected indicators, as well as the reasoning for not including some potential indicators in our recommended methodology. Additional information on the results of our performance evaluation is included in the individual evaluation forms for each recommended indicator in Annex A of this report.

Evaluation criteria

As described in our methodology, potential indicators discussed in Section 6 were considered for further evaluation and detailed design if they performed reasonably well against pre-set evaluation criteria. The following criteria were used:

- **Balance between each proposed indicator's strengths and weaknesses**—through a qualitative assessment, we selected those indicators where the strengths of each indicator significantly outweigh its weaknesses.
- **Relevance to high-level policy goals and network codes/guidelines**—As outlined in Section 6, the implementation of network codes/guidelines may result in some immediate desired effects (i.e., intermediate goals), and they may also contribute to the achievement of the high-level policy goals. Therefore, we aimed at selecting indicators for which there is a reasonably direct linkage between the desired effect it measures and the high-level policy goals, and avoided selecting indicators that measure technical compliance with specific provisions of the network codes/guidelines.
- **The proposed indicators are both necessary and sufficient for impact monitoring**—Since no single indicator is deemed sufficient to measure the implementation of network codes/guidelines or the achievement of high-level policy goals, a set of indicators is necessary to monitor the impact of network code/guideline implementation. To maximise the efficiency of implementation monitoring, our goal was to identify indicators that are both *necessary* (e.g., because they measure the impact of an important aspect of the network code/guideline) and *sufficient* (i.e., the recommended indicators form a minimal set of indicators required for effective monitoring). In other words, the proposed set of indicators, as a package, should measure reasonably well the market impacts of the network codes/guidelines.

- **Data availability and accessibility**—Availability of input data for the proposed indicators was an important consideration in the selection process; however we did not exclude potential indicators solely on the basis of the required data being *currently* unavailable. In fact, many of our recommended indicators rely on data that is currently not available but is expected to become available in the near future, as the relevant legal framework is already in place to ensure this. Ultimately the robustness of any assessments will depend on the coherence and completeness of data available to ACER.
- **Feasibility and practical usability**—When selecting indicators, we were also mindful to propose a set of indicators that can be efficiently implemented and maintained by ACER. Thus, we were seeking data sources and approaches where synergies between developing the indicators are maximised. We were also conscious that ACER will need to update the indicators on an annual basis, and therefore we were seeking indicators that are suitable for this purpose.

Each potential indicator identified Sections 5 and 6 was evaluated on its own merit against the above criteria. Below we discuss the results of this evaluation, including the rationale for including or excluding certain indicators in the proposed methodology.

CMP indicators

The proposed CMP indicators include:

CMP.1 **Additional capacity volumes made available through each CMP**
CMP.2 **Utilisation of contracted capacity at IPs per shipper (flows/booked capacity)**
CMP.3 **Aggregate utilisation of contracted capacity at IPs (flows/booked capacity)**

These three indicators perform well against the above criteria. Indicator CMP.1 is a direct measure of a CMP desired effect (i.e. increase/maximise available IP capacity) under each of the allowed mechanisms (i.e. FDA UIOLI, Surrender, LT UIOLI, and OSBB). In addition, there are statutory requirements in place to make these data available, thus we expect that the relevant data of the required quality will be available and easily downloadable from ENTSOG's Transparency Platform. Subsequent processing would not require significant resources from ACER. As discussed in Section 5, the indicator measures additional capacity made available over a specified period at IPs by the application of CMP, thus potential correlations between CMP-related IP capacity increases and the high-level policy goals are fairly clear. The most significant impacts are expected at contractually congested IPs (either from a recall of previously contracted capacity via FDA UIOLI, Surrender, LT UIOLI, or through a potential release of additional capacity via OSBB). Therefore, the indicator should be interpreted in the context of ACER's other work[39] which identifies contractually congested IPs, as well as in conjunction with the identification of the potential benefits arising from arbitrage (i.e., estimated using capacity made available, hub price differentials and transportation costs between IPs).

Indicators CMP.2 and CMP.3 measure the extent to which booked capacity at IPs is utilised at the individual shipper level and in the aggregate level, respectively. Since problems with contractual congestion arise from booked but unused capacity when an IP is physically congested, these two indicators are relevant measures of the desired effects of the CMP GL. In particular, we believe that in order to have a comprehensive monitoring framework, it is important to monitor individual network user activity. Indicator values will have to be interpreted with care. High levels of booked capacity utilisation might be considered desirable, but low utilisation does not necessarily imply capacity "hoarding". We expect that the required data to develop these indicators will be readily available from the ENTSOG Transparency Platform and from the REMIT database.

Next, we briefly discuss the rationale for not recommending to implement (or not including in this particular set of indicators), at least at this time, some of the other potential CMP indicators identified in Table 5.7. These include indicators that are covered in other areas, such as the "*Increase in available average-day and peak-period firm capacity from prior year at each IP (% change year-on-year)*". This indicator relates to some common aspects of CMP GL and NC CAM thus, in order to avoid a duplication of indicators, we decided to include it in the methodology as a NC CAM indicator (CAM.1), discussed below. Similarly, other potential CMP indicators related to contractual capacity, physical utilisation, and secondary trading have been incorporated into the recommended CAM indicators. Other indicators considered in Table 5.7, for example, "*Harmonised timing of CAM auctions*" refer more to compliance monitoring of the implementation of CAM rules rather than an economic effect arising from CAM implementation.

NC CAM indicators

The proposed CAM indicators are:

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[39] ACER's annual report on contractual congestion at interconnection points; for the latest report see http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Gas%20Contractual%20Congestion%20Report%202014.pdf.

CAM.1 Year-on-year increase in average-day and peak-period technical capacity at IPs
CAM.2 Bundled capacity release
CAM.3 Share of total capacity sold as bundled on capacity booking platforms
CAM.4 Secondary market-traded bundled capacity and unbundled capacity (% of bundled capacity sold)
CAM.5 Contractual capacity utilisation at IPs (Booked/technical capacity)
CAM.6 Physical capacity utilisation at IPs (flows/technical capacity)

The first four indicators, CAM.1 through CAM.4, are clearly related to the desired effects of NC CAM. In addition, they are relatively simple to derive, and they can be used to measure some desired effects—namely increased technical capacity determination, offering and use of bundled capacity, and secondary capacity trading, immediately following code implementation. Further analysis of these indicators will afford ACER the opportunity to assess whether provisions of NC CAM (e.g., technical capacity recalculation) deliver cross-border capacity to those who wish to use it. Data required to construct the indicators should be readily available from the ENTSOG Transparency Platform and from REMIT. As is the case with most indicators, their validity will critically depend on the accuracy and completeness of the source data.

Indicators CAM.5 and CAM.6 do not necessarily map into one of the identified desired effects of the NC CAM; however, we believe they are essential to establish a context in which the other indicators are evaluated. Specifically, they provide an indication of the extent to which full cross-border network capacity is booked and the extent to which the cross-border network capacity is utilised.

Identified, but not recommended potential CAM indicators include two potential indicators related to the harmonised timing of capacity allocation listed in Table 5.7: (1) Application of the common gas day throughout Europe; and (2) Harmonised timing of CAM auctions. We do not recommend them to be included in the current monitoring methodology because they focus on specific rules in NC CAM, rather than the impacts of the code, and thus should be the subject of technical compliance monitoring.[40]

Two other potential indicators we do not recommend are: (1) *Number of platforms for (bundled) capacity bookings at IPs*; and (2) *Average number of IPs / booking platform*. We expect that the number of platforms for (bundled) capacity bookings at IPs will not be large, given the existence of the PRISMA platform to which many TSOs have already signed up. Therefore, we believe that there would be little merit in retaining these indicators since the

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[40] Note, for example, that ENTSOG's annual auction timetable should confirm that the timings of all auctions are harmonised.

overall CAM network code objective of a small number of platforms is effectively already delivered.

Table 5.7 also identified "*Elimination of trading at flange (all trading forced to virtual hub)*" as a desired effect.[41] Trading at virtual hubs is measured by indicators proposed under the high-level policy goal of effective competition, and therefore not addressed here. Table 5.7 also included indicators aimed to assess: "*Progression towards maximum possible release of capacity via bundled capacity*". The proposed indicators CAM.2, CAM.3 and CAM.4 are sufficient measures of this effect. Lastly, Table 5.7 also identified the "*Elimination of unrealised cross-border trades due mismatches in capacity allocation processes*" as a desired effect of NC CAM. The CAM network code already does this via many of its provisions (e.g., the rules to maximise the release of bundled capacity and the standardisation of auction calendar). Other indicators elsewhere in the framework assess the extent of loss of welfare associated with the lack of alignment of hub prices.

INC indicators

At this time, the amendment of NC CAM for new and incremental capacity has not yet been finalised, and may therefore be subject to substantial change. Our proposed INC indicators are based on the latest proposal:

INC.1	**Incremental and new capacity offered through open season / auctions**
INC.2	**Proportion of proposed incremental/new capacity projects that pass/fail the economic test**
INC.3	**Range of f-factor values used in the calculation of the economic test**

Indicator INC.1 monitors for the evolution of incremental and new capacity projects that progress to binding commitment phase in CAM auctions and open season procedures. INC.2 is a straightforward measure of whether Incremental Capacity projects are able to progress in terms of passing/failing the economic test used to assess the economic viability of incremental capacity projects. Lastly, INC.3 measures the range of f-factors, defined in the draft NC TAR42 as the percentage of the increase in allowed revenue (due to the incremental allocation) to be committed to via the auction or "open season" process, used across the EU. All three indicators rely on relevant data that should be requested from the NRAs or TSOs. We expect that the overall burden to process and analyse the data should be minimal. Importantly, in addition to constructing these indicators, the monitoring framework should

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[41] It is, however, not clear whether all trades at the IPs are prohibited. It is possible that, for example, unbundled firm capacity could be used in conjunction with interruptible (or legacy) firm on the other side of the IP to effect a trade between shippers at the IP. As we progress towards maximisation of bundled capacity release, flange trading is likely to decrease, but not likely to disappear.

[42] Article 43 of NC TAR.

also highlight any differences between NRAs, including f factor, WACC, depreciation and revaluation rules, with respect to the treatment of incremental and new capacity projects.

NC BAL indicators

The proposed BAL indicators are:

BAL.1	**TSO balancing through short-term standardised products vs. balancing services contracts**
BAL.2	**TSO share of total balancing**
BAL.3	**Physical linepack day-on-day changes**
BAL.4	**Balancing net neutrality analysis**

The proposed indicators focus on the objective of NC BAL that TSOs should undertake balancing actions using either: (1) short-term standardised products traded on a platform; or (2) contract for balancing services through a public tender (although option (1) should have priority). Indicator BAL.1 measures the share of balancing under options (1) and (2), respectively, as a share of total balancing performed by the TSO. Indicator BAL.2 is a simple and relatively clear measure of one of the BAL NC's principal objectives: to get TSOs to do most of the balancing through short term products on trading platforms where possible. Indicator BAL.3 is a measure, when interpreted in conjunction with other indicators and data, of the physical performance of the regime in respect of daily matching of inputs and offtakes on the system. Another key objective of the NC BAL is to create balancing regimes which are cost-reflective, fair and which minimise the distortions of the balancing actions on shipper behaviour. BAL.4 is a key indicator of the performance of the balancing regime in this respect and measures the extent to which the cash-flows associated with TSO balancing actions (both sales/purchases of gas and imbalance cashout prices) are revenue neutral to the TSO.

The required data for BAL.1 and BAL.2 should be available from REMIT or can requested by ACER from TSOs based on REMIT provisions. Data for BAL.3 is currently not available in a standard format, and will therefore have be requested from the TSOs and collected by ACER. Data for BAL.4 will come partly from REMIT (using figures obtained by calculating BAL.1 and BAL.2) and partly will need to be collected by ACER from TSOs.

An important objective of the NC BAL is creating competitive and well-functioning short-term balancing markets. Implementation impacts with respect to this objective can be assessed by applying our indicators of effective competition (discussed below) to the short-term balancing market. Thus, in order to avoid duplication of indicators, we do not propose such indicators specifically for NC BAL. Applying competitiveness indicators requires a definition of the relevant market as the balancing market. As no established definition of such market exists, an assumption has to be made. We would propose to treat all trades in respect of Gas Day D being made after 13:00 D-1 as balancing trades.

NC TAR indicators

The proposed TAR indicators are:

TAR.1	**Stakeholder assessment of robustness of decision making and overall process associated with establishment of tariff methodology**
TAR.2	**Assessment of availability of all models and data to enable replication of actual tariffs**
TAR.3	**Stakeholder assessment of information availability to enable tariff predictions**
TAR.4	**Pass/fail compliance with cost allocation test**
TAR.5	**Revenue Reconciliation parameters and outcomes**
TAR.6	**Multipliers applied by each TSO**

The first three indicators (TAR.1 through TAR.3) are survey-based assessments of several of the desired effects of NC TAR. They rely on qualitative assessment by the survey respondents which include major European trade associations, NRAs and other stakeholders. These three indicators are closely related and it makes practical sense to combine these into a single multi-section annual survey. We have however proposed three separate indicators as we believe it is useful to be able to distinguish between the different aspects of the tariff process that these indicators measure:

- TAR.1 measures the overall robustness of the tariff methodology and decision making process;
- TAR.2 measures the availability of information to enable market participants to replicate current tariffs; and
- TAR.3. measures whether there is sufficient and usable information to enable market participants to reasonably predict future tariff levels.

We recommend to conduct these surveys once a year. Although responses to surveys may be subjective, we believe that their value can be maximised by encouraging the participation of recommended groups of respondents (e.g. major European associations) that can submit responses each year covering a majority of EU Member States.

The other three proposed indicators (TAR.4 through TAR.6) are based on technical aspects of NC TAR. Indicator TAR.4 measures pass/fail against a test that is designed to confirm that tariffs do not distort pricing and that revenue is raised in a fair proportion from domestic and cross-border network users. Indicator TAR.5 is composed of four elements: (1) underlying allowed revenue requirement; (2) frequency of revenue reconciliation; (3) time lag of reconciliation and (4) reconciliation amount (absolute level and proportion of TSO revenue). These elements may provide some evidence (or lack thereof) of tariff distortions and cross-subsidies. For example, shorter lags in revenue reconciliation may imply smaller distortions and cross-subsidies. Similarly, the indicator may be used to assess the proportion of the revenue that is to be recovered in a different time period than that in which associated costs arise. Such temporal dislocation of revenue recovery may imply potential cross-subsidies within the tariffs. Reconciliation sums (as % of underlying revenue requirement) may increase as more commercial approaches to capacity booking are adopted leading to changes in shippers' capacity booking behaviour (e.g. shift from long-term to short-term capacity products).

Indicator TAR.6 includes seasonal product multipliers used by the TSOs. Ideally, NRAs would consult NRAs in adjacent markets when setting the multipliers. We propose ACER to request NRAs to report any instances where the NRA believes that the adjacent zones multiplier is likely to distort capacity bookings and/or flows. This is necessarily a very subjective test but would provide a start point for exploring the effectiveness of the multiplier regime (if it is implemented). Cross-border flow of gas is most likely to be distorted if multipliers either side of the IP are very different. Various formulations could be made to measure the divergence and a good test statistic could be derived by summing and squaring the differences in proportions for each standard product (as specified in the technical appendix).

Some potential indicators identified in Table 5.7 were not included in the final methodology because the above indicators adequately reflect the desired effects they would measure. Another indicator identified there—magnitude of changes in tariff levels over a certain threshold within a given period (e.g., tariff level change > 10% within a 3-year period or between relevant tariff periods)—has been rejected because we do not consider it a viable indicator to apply to all methodologies across Europe. Some methodologies (e.g. distance to virtual point A and matrix methodologies) may lead to substantial volatility in tariffs. Whereas postage stamp changes are likely to yield more stable prices being based upon underlying allowed revenue and revenue reconciliation sums which in sum divided by forecast bookings are likely to be more stable than some of the prices that will emerge from other approaches. Tariff predictability is an issue that must be adequately explored as part of a consultation about tariff methodologies envisaged in NC TAR. The questionnaire envisaged in indicator TAR.1 could be used to provide an opportunity for stakeholders to raise any concerns arising out of the implementation of the methodology; particularly for those that might be experiencing unstable prices.

Table 5.7 includes another desired effect of NC TAR: required new investments are sufficiently incentivised. The specific indicator/technical parameter contemplated there was "*periodic assessment of potential investors' willingness to participate in required projects*". This goes to the heart of the regulatory contract between investor (TSO) and NRA. This has been rejected at this time since the monitoring framework is unlikely to be able to address this issue. The INC proposal is designed to address this issue and the associated indicators in this area should be revisited once that proposal is finalised.

Table 5.7 captures a series of potential indicators in respect to the desired effect that "*harmonised, transparent, cost-reflective and non-discriminatory entry/exit tariffs promote* *cross-border*“. A potential indicator suggested there, but not recommended to be included in the monitoring methodology was: “difference in reserve prices and payable prices at each side of IPs”. Differences in reserve prices may be the result of a wide range of different reasons, including: the underlying allowed revenue for the TSO, the choice of detailed methodology, the level of bookings and flows and their patterns relative to other bookings/flows across each adjacent network. There is no reason why either the reserve price or the payable price at each side of an IP should be the same. Therefore this potential indicator would not be a reliable measure of the desired effects, and therefore is not recommended.

Indicators of Effective Competition

The proposed indicators for measuring the achievement of effective competition are:

CO.1	**Herfindahl–Hirschman Index (HHI)**
CO.2	**Residual Supply Index (RSI)**
CO.3	**Price-Cost Margin (PCM)**
CO.4	**Gas demand**
CO.5	**Participants**
CO.6	**Products traded**
CO.7	**Traded volumes**
CO.8	**Depth of market**
CO.9	**Churn rate**
CO.10	**Simulation model**

The above indicators each focus on one of three aspects of competition: (1) market structure, measured by CO.1 and CO.2; (2) market participant behaviour, measured by CO.3; and (3) market performance, measured by indicators CO.4 through CO.10. We discuss further these indicators according to these groupings.

Effective competition – market structure

A market monitoring activity looking at the state of competition in the market must focus both on detecting the potential for market power as well as the actual exercise of market power.

Market structures indicators, particularly the size and market shares of the largest firms, usually get great attention in competition investigations because market structure has a strong impact on the behaviour of firms in the market. To measure market structure we recommended using two indicators, HHI and the Residual Supply Index (RSI).

HHI is a widely used measure of market concentration. It captures the level of concentration across the whole market and reflects the individual market shares of all firms as well as the number of firms in a market. The rationale for looking at the level of market concentration is that the higher the concentration in a market the higher the potential for market participants to exercise market power. Economic theory suggests that higher market concentration would result in higher prices. Empirical studies show that HHI divided by the elasticity of demand, under certain conditions such as constant marginal costs and no capacity constraints, is equal to the Cournot equilibrium Lerner index, which is another indicator of market power discussed below.[43]

RSI indicates if a certain source of supply is pivotal (i.e. if total demand in a market cannot be met without gas from that source of supply). RSI is calculated using supply capacity values of different suppliers / supply sources.

The HHI and RSI measures can be calculated for different markets based on the relevant product and geographical definition applied in each case. As part of the GTM2 set of indicators ACER will calculate HHI based on the market shares of upstream firms bringing gas into the relevant market and an RSI based on the supply capacity of different supply sources. We recommend calculating HHI and RSI for other relevant markets as well. An HHI can be calculated by looking at the shares of transmission capacity holdings of different firms covering both domestic and interconnection points. Similarly an RSI can be calculated at a disaggregated firm level by using capacity holdings as a measure of the supply capacity held by each firm. HHIs can also be constructed to measure market concentration in short-term balancing markets.

As shown in Table 6.2, we have also considered other potential market structure indicators. The first and most simple indicator is (combined) market shares. Market shares for all firms in the market will have to be calculated for the HHI indicator. Given that HHI is a more sophisticated indicator than individual or combined market shares we considered there is little merit in including market shares as a separate indicator.

The Pivotal Supply Index (PSI) is a binary (yes/no) index which also measures if a particular supplier is essential to meet demand over a given period. Given its similarity to RSI we considered that only one of these two indicators should be recommended. Unlike PSI, RSI provides a continuous measure of pivotality so it gives a better indication of the degree of flexibility in the market.

The Demand Responsiveness Index and Residual Demand Analysis were also considered as potential indicators. They require detailed demand data including willingness to pay of consumers. These indicators have been used particularly in electricity markets studies. Getting the necessary data for gas markets and performing the calculations for these indices is likely to be more difficult.

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[43] Twomey, Green, Neuhoff & Newbery (2008)

Effective competition – market participant behaviour

In competitive markets, price-taking sellers should offer their product at or near their marginal cost of production or upstream supply, and the Price-Cost Margin (PCM)[44] is one potential measure of market participant behaviour. Although even in competitive markets high mark-ups over costs may occasionally occur, when that happens, one would expect new entrants to enter, putting a downward pressure on the price the sellers can charge, and thus eliminating or reducing the mark-up over time.

If market participants possess market power in several segments of the natural gas supply chain, then a phenomenon called double marginalisation (i.e., mark-up over marginal costs may be applied separately in each segment of the supply chain) may occur. Thus, upstream gas producers may apply a significant mark-up on the gas they produce, and wholesale market traders or retail suppliers may apply additional mark-ups. The resulting price paid by the final consumer could thus reflect non-competitive behaviour by several upstream market participants. To assess the behaviour of all market participants, it is therefore appropriate to introduce a mark-up indicator in each segment.

ACER already uses gas suppliers' mark-up, the difference between the energy component of the retail price and the wholesale market price, as an indicator of retail market competitiveness. We recommend to extend this analysis to other upstream segments of gas supply chain.

The most challenging part of calculating the PCM indicator is to estimate the marginal costs of market participants. With access to full transactional data under REMIT, ACER could potentially determine the costs of each participants downstream from the producer segment, by examining the purchase price of each relevant transaction. Estimating the marginal costs of producers requires assumptions about a production cost function and data on relevant parameters. Our discussions with gas market modelling experts have revealed that, although this may be a fairly difficult task, sufficient information is already available, and sufficient work has already been done to make this a viable approach for ACER. For example, Chyong and Hobbs (2014) use a functional specification for a production cost function that realistically reflects the behaviour of gas producers: i.e., natural gas is extracted from several fields simultaneously with distinct cost structures, and the cheapest gas fields are developed and produced first. However, in order to keep the analysis tractable, some simplifying assumptions (e.g., ignoring some inter-temporal production constraints and costs arising from depletion effects may have to be ignored). Some production function parameters will have to be gathered for each gas field, this however does not have to be actual data from each field; proxy data from fields in similar geological formations may be used. In particular,

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[44] Note: the Price Cost Margin and the Lerner Index (LI) are two similar indicators that use the same input data and have the same relative advantages. LI is calculated as the price mark-up over marginal costs divided by the price whereas PCM is calculated as the price mark-up over marginal costs divided by the marginal cost of production.

a lot of such data is available from gas fields in the USA; Chyong and Hobbs (2014) provide relevant sources.

Although the effort required to prepare and maintain the proposed mark-up indicator would be significant, we believe the benefits would significantly outweigh the costs. Mark-up indices over costs are the ultimate reflection of market participant behaviour, and they are used by other market monitors as a key indicator. Costs would involve gathering and maintaining an up-to-date database on all producers' and suppliers' costs, and it may require some specialised expertise. There are, however, significant synergies with other approaches to assess market competition, in particular market simulation models. Those models use the data required to construct the proposed indicator as input in modelling.

An important consideration would be the threshold value applied to PCM below which the markets would be deemed competitive. Theoretically, the threshold value is zero; however in practice some reasonable threshold (e.g., 10% adder over marginal costs) should be applied.[45] We recommend to apply an initial threshold value, and re-evaluate it in the future in light of the observed values.

Effective competition – market performance

The last seven indicators proposed under the goal of effective competition (CO.4 through CO.10) can be used to assess overall performance of the gas market. They include: (1) gas market demand; (2) participants; (3) products traded, and (4) volumes traded which are relatively easy to collect and interpret. They often serve as input for constructing other indicators. They can also be used to establish the context for the market in which other indicators should be evaluated.

Indicators CO.8 (Depth of market) and CO.9 (Churn rate) are indicators of market liquidity. The depth of the market reflects the amount of tradable volume on each bid/offer quote. Ideally, it should reflect both the 'tightness' of the bid/offer spreads for all traded products along the curve, as well as the 'depth' or amount of volume on the bid and the offer curve. A 'proxy' for this metric could be the "Tradability Index" as calculated and published by ICIS Heren, although this primarily shows the tightness of the bid/offer spreads along the curve.

The churn rate reflects the ratio of all traded volumes to the demand for the underlying physical product. It is one of the most important metrics used to analyse a hub's evolution towards a fully liberalised and commercial market. A high churn rate is the result of a market that has many participants (and many participant types), trading many different products in large volumes. It is an objective statistic, but one must ascertain that the same methodology

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[45] This is, for example, the threshold allowed by the wholesale market rules in the PJM wholesale electricity market. The market monitor for PJM has observed that the vast majority (90%+) of marginal units do not apply the allowed adder; in fact many bid below what is the official definition of marginal costs plus the 10% adder. This has raised questions about the validity of the marginal cost formula laid down in the PJM tariff.

is applied across all Member States/Market Areas when the churn rate is calculated. It is also very important to establish whether 'consumption' figures or 'demand' values are used as the denominator.[46] Our understanding is that the current EU definition of churn rate is to use the consumption figures in each Market Area. However, using the demand figure is more commonly used in other commodities. As the NCs are implemented across all Member States and all gas is delivered to virtual hubs (as opposed to border points), it can be deemed that all that gas could be traded in each hub; therefore, at that stage, it would be more relevant to use the demand figures as the denominator. We recommend to calculate both a 'gross' churn rate using demand values and a 'net' churn rate using consumption values.

Simulation models are a market monitoring tool, rather than a single indicator. Potentially, they represent the most powerful method to assess market performance, but they are also the most time- and resource-intensive applications. A simulation model requires a detailed (physical) representation of the market and market participant behaviour (e.g., perfect competition, Cournot oligopoly, etc.). They can be calibrated to market observed market outcomes, and they can also be used to establish a competitive benchmark. Because simulation models are a structural representation of the market, they can often be used to analyse isolated impacts of policy and market changes. On the other hand, simulation models also have some drawbacks, since they necessarily represent an abstraction of actual markets. Further information on data and other requirements for developing a simulation model are discussed in the evaluation form of indicator C.10 and also in Chyong and Hobbs (2014).

Although developing a fully functioning market simulation model for ACER would more costly than developing the other indicators, we believe that its added benefits, and the fact that fully functioning models already exist, significantly outweigh the costs.

Indicators of efficient market functioning

MF.1	**Transaction costs**
MF.2	**Value of congestion at each IP**
MF.3	**Potential net welfare gains from unused physical capacity**
MF.4	**Welfare loss from apparently inefficient flows at each IP**

Transactions costs (MF.1) represent the "cost of doing business" at a given hub or market. It is useful to express transaction costs in terms of €/MWh, although there may be economies of scale and smaller players may face higher unit costs then market participants trading larger volumes. Since transaction costs may involve a multitude of different charges and fees incurred at different stages of the trading process, therefore we believe that it is most appropriate to gather such data using a survey. The disadvantage is that the responses may

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[46] In this context, demand refer to gas volumes including transit and exported gas. Consumption refers to gas consumed internally within a market.

be somewhat subjective. They may also be influenced by different interpretations of the survey respondents of what constitutes transaction costs. Some of these drawbacks can be mitigated by effective survey results. High transaction costs may act as a barrier to entry. Therefore, if the survey yields a significant number of consistent responses that transaction costs are unduly high in a given market area, ACER should investigate and attempt to objectively determine if that is the case, and whether high transaction costs constitute a barrier to entry.

The value of congestion at IPs (MF.2) represents the approximate monetary value of expanding transmission capacity at each IP, measured by the product of: (1) price differential between hubs; and (2) physical capacity of the IP. Although it is not an absolute indicator of market inefficiency, consistent monitoring of this indicator may uncover potential issues related to market efficiency in the future. Specifically, one would expect that new incremental capacity would be added at the most congested IPs. Therefore, we recommend regular monitoring of this indicator.

Indicators MF.3 and MF.4 measure the potential welfare gains and losses associated with unused technical capacity at IPs, or the use of such capacity in non-economic ways (e.g., when gas is flown from high-priced areas to low-priced areas). In simple terms, these indicators can be interpreted as losses (or forgone gains) from the lack of complete market integration and the lack of efficient market functioning. The main advantages of these indicators include that they would enable ACER to identify IPs where potentially efficient flows are not realised and IPs where inefficient flows occur. They also allow the ranking of IPs in the order of increasing potential welfare gains and decreasing potential welfare losses. Identifying the reasons behind the observed situation would require ad hoc analyses that may have to be performed separately for each IP. Also, correctly interpreting the indicators would require substantial analysis and expertise (i.e., understanding the physical and commercial aspects of gas). Since ACER already performs analyses for indicator MF.3, the costs involved in calculating in implementing them would be minimal. A more significant cost would be the time and effort spent on the ad hoc analyses.

These two indicators may be sensitive to the input data used, especially prices and price differentials. For some hubs several price indices may currently be available from different index developers. In some cases the price indices significantly vary, reflecting the differences in the index developers' methodologies, and using these different indices may lead to different conclusions. Potential refinements to this indicator thus could include to use a more refined (and perhaps more accurate) price index based on transactional data available under REMIT. Under REMIT, ACER will have data on all gas market transactions concluded, thus there is an opportunity to develop a (potentially) more accurate price index.

Indicators of market integration

The recommended market integration indicators are:

MI.1 **Price convergence**
MI.2 **Price correlation**
MI.3 **Price volatility correlation**
MI.4 **Contract vs. spot gas prices**
MI.5 **Oil-indexed vs. gas hub pricing**
MI.6 **Number of supply sources**

As discussed in Section 6.3, the economic concept of market integration states that in a single market differences in prices at different locations should only reflect transaction or transportation costs. This also presumes that prices respond to changes in supply and demand, or to put it differently, that they are determined as a result of market forces. Our recommended indicators for measuring progress towards market integration focus on comparing prices in different markets/hubs and determining how these prices are formed.

For comparing prices across different gas hubs, we recommend examining the level of price convergence, price correlations between markets and also the correlation between volatility of prices in different markets. These are three very important metrics in assessing the traded gas markets of Europe. Price convergence is a good indicator of market integration although it has its limitations. Price convergence can really only happen if the infrastructure between two or more hubs is capable of physically transporting a sufficient volume of gas to equalise prices.

Price correlation is a better indicator of whether two (or more) adjoining markets are reacting to the same supply/demand fundamentals. In an integrated market supply/demand shocks would be expected to be transmitted from one area to another relatively quickly thus driving correlation between prices in different markets. Price volatility would also be expected to be similar in adjoining hubs if markets are properly integrated. Price volatility convergence is important as it is the most representative metric of market risks and the difficulties involved in hedging. Differences in price volatility between hubs indicates that it would not be prudent to use one hub to financially hedge a physical position in the other.

Some care needs to be taken in interpreting price correlations between markets. Correlations of prices or of volatility do not by themselves prove market integration. Correlations could potentially be driven by a common external factors affecting both (all) markets such as, for example, oil price movements. In this case changes in oil prices and the prevalence of oil-indexed gas contracts in these markets would also need to be considered before reaching any definite conclusions.

The proposed set of indicators measuring price formation looks at the extent to which a hub has progressed towards gas supply/demand fundamentals in its pricing. This is about assessing the balance in a given market between contracted gas and ‘spot’ (i.e., hub-sourced) gas. It is also about the price formation of the contracted gas: whether oil (or other form of) indexation or gas-on-gas pricing is prevalent. Where contract prices are close to hub prices, this would imply that a large percentage of contracted gas is being market-priced.

A significant problem with looking at different price indices across various markets is that prices are only available in some hubs while others are still lacking transparency if traded at all. We believe that transaction reporting under REMIT should help solve most of these problems by providing detailed price and contract data for all markets.

Indicators of non-discrimination

The recommended indicators for non-discrimination are:

ND.1	**Quality of published data**
ND.2	**Barriers to entry**

Indicator ND.1 is a survey-based assessment of the quality of data published by TSOs and NRAs. Since there may not be an objective definition of data quality, it is expected that stakeholders will interpret it differently, which will likely be reflected in their responses to the survey questions. Nevertheless, data quality is a very important component of market transparency, and therefore we believe it is important to have an indicator in place to measure it.

Our proposed indicator ND.2 consists of identifying and measuring the ‘real’ cost of a (typical/hypothetical) new entrant in the market, including both physical shippers and financial players. This cost assessment should include network access fees, storage requirements (where applicable) and costs, transportation costs, legal costs (documentation, permits, licences, etc.), regulatory costs (compliance, reporting, etc.) and trading costs (personnel, IT, credit, etc.), as well as operating costs (structuring/flexibility requirements, hedging and portfolio management cost, etc.).

We propose that the analysis be conducted by ACER, with input from the NRAs. ACER’s own analysis could be supplemented by a survey of stakeholders regarding the existence of barriers to entry. Such a survey would be similar to the one described above for ND.1.

Potential correlations between the proposed indicators

As discussed earlier, many of the desired effects, and thus the proposed indicators, are intricately linked. Whether any particular aspect of a network code/guideline has a material impact on the achievement of any of the high-level policy goals is largely an empirical question. Since none of the network codes have been implemented to date (except the CMP guideline), we were not able to conduct such an empirical analysis. We did, however, explore potential (i.e., theoretical) correlations. Below we describe those correlations between the network code/guideline indicators for which a fairly strong theoretical case can be made. The matrix below identifies the indicators that we believe could be significantly correlated. Each type of such correlation is discussed in more detail below.

Table 7.1: Direct links between proposed NC and high-level policy goal indicators

Type	CO	MF	MI
CMP Guideline indicators			
CMP. 1	CO.1 to C.10	MF.3	MI.1 to MI.3
CMP. 3	CO.1 to C.10	MF.3	MI.1 to MI.3
NC CAM indicators			
CAM. 1	CO.1 to C.10		MI.1 to MI.3
CAM. 2	CO.1 to C.10 (weak)		CO.1 to C.10 (weak)
CAM. 3	CO.1 to C.10 (weak)		CO.1 to C.10 (weak)
CAM. 4	CO.1 to C.10 (weak)		CO.1 to C.10 (weak)
CAM. 5		MF.3	
CAM. 6	CO.1 to C.10	MF.3	MI.1 to MI.3
NC BAL indicators			
BAL.1	CO.1 to C.10 (for BAL market)		
BAL.2	CO.1 to C.10 (for BAL market)		

We expect a fairly strong correlation between indicator CMP.1 (Additional capacity volumes made available through each CMP) on one hand, and market competitiveness indicators (CO.1 – CO.10) and market integration indicators MI.1 through MI.3 (price convergence; price correlation; price volatility correlation) on the other. Increased capacity between gas markets due to the application of the CMP and increased utilisation of contracted capacity should, all else equal, dilute local market power and create a less concentrated market (reflected in indicators CO.1 and CO.2), higher competitive pressures should reduce mark-ups (reflected in indicators CO.3 and CO.4), and overall create a more liquid market (as measured jointly by indicators CO.5 through CO.10). A similar correlation can be expected between CAM.5 (Contractual capacity utilisation at IPs; booked/technical capacity) and CAM. 6 (Physical capacity utilisation at IPs; flows/technical capacity), and the competitiveness indicators ((CO.1 – CO.10) and market integration indicators MI.1 to MI.3. CMP impacts in terms of competition and market integration rest on the crucial assumption that the capacity released under the CMP is purchased and used by market participants. Similarly, we assume that the CAM indicators above would reflect a situation where increased contractual and physical capacity utilisation is, at least partly, the result of competitive pressures.

We would expect a somewhat weaker correlation between CAM.3 (Share of total capacity sold as bundled on capacity booking platforms) and indicators MI.1 through MI.3. This is because it is unclear to what extent the lack of bundled capacity availability currently impedes cross-border trade. If it is a significant barrier, then a strong correlation between the two indicators should be expected.

There should be a significant correlation between indicator CMP.3 (Aggregate utilisation of contracted capacity at IPs) and indicator MF.3 (Potential net welfare gains from unused physical capacity), since increased utilisation of contracted capacity is likely to result in lower unused capacity (assuming there is unfulfilled demand for capacity). An indirect impact may be that increased utilisation of contracted capacity could reduce price differentials between hubs, and thus the forgone value of unused capacity would be lower.

Lastly, we expect significant correlation of indicators BAL.1 (TSO balancing through short-term standardised products) and BAL.2 (TSO balancing through contracted services) with the competitiveness indicators (CO.1 through CO.10). The TSO procuring balancing through standardised products (presumably through organised markets), while refraining from contracting for balancing services, should, all else equal, lead to more competitive markets, as reflected in market structure, behaviour and performance indicators.

The correlations we have outlined above are largely single correlations (i.e., statistical relationship between two variables). In addition to these single correlations, partial and multiple correlations are also possible. For example, a partial correlation may occur when the statistical relationship between two indicators depend on certain conditions. For example, the application of CMP could improve IP utilisation only if the price differential between hubs is sufficiently large for profitable arbitrage. Multiple correlations may exist when two independent variables explain a third dependent variable. For example, hub price differentials and contracted capacity utilisation may explain changes in market shares.

Correlations between other indicators may exist and should be explored post implementation.

8. COST ESTIMATES AND IMPLEMENTATION TIMELINES

In this section we outline indicative cost and timeline estimates associated with implementing the recommended methodology and the proposed indicators. These are costs that will be incurred by ACER as a direct result of implementing the proposed monitoring methodology. It does not include costs or effort related to activities that are expected to be conducted irrespective of the implementation of the proposed methodology, such as REMIT data collection. It also does not include costs related to stakeholder engagement by ACER or costs incurred by stakeholders.

8.1. Estimated costs per indicator

Potential costs associated with implementing the recommended methodology fall into three broad categories:

- **Monetary costs**—incurred for purchasing specific publications, access to databases or specialised services required for calculating the recommended indicators;
- **Time/effort**—defined as full-time equivalent (FTE) days needed to derive the recommended indicators;
- **Expertise**—whether specialised expertise is required to calculate and interpret the recommended indicators, or to maintain the methodology.

Monetary and time-related costs are classified into three ranges as defined in the table below. Time-related costs refer to time and effort spent in the course of collecting, processing, and querying the data, performing necessary calculations and presenting results. Where specialised expertise is required we highlight this for the respective indicator and specify the type and level of expertise needed.

Table 8.1: Monetary and time-related cost ranges

Type of cost	Minimal	Moderate	High
Monetary	< €1,000	€1,000 - €5,000	> €5,000
Time	< 6 FTE days	6 – 15 FTE days	> 15 FTE days

In Tables 8.2 and 8.3 below, we summarise the estimated costs associated with calculating each indicator based on the ranges defined above. These costs have been set out in more detail in the Implementation costs section of the indicator assessment. They reflect the estimated costs of calculating each indicator on a standalone basis. There are however significant synergies in calculating sets of indicators together due to the fact that in many cases the data collection and processing, research and analysis needed for calculating one indicator can be used in many cases to derive other indicators with little additional effort. This categorisation also does not take into account the work already undertaken by ACER for the MMR. We consider this in Section 8.2 below when calculating the estimated total cost of implementing the proposed methodology.

Table 8.2: Estimated costs associated with calculating recommended NC indicators

Type	Monetary costs	Time	Expertise	Synergies
CMP Guideline indicators				
CMP. 1	Minimal	Minimal	No	
CMP. 2	Minimal	Minimal	No	
CMP. 3	Minimal	Minimal	No	🟦
NC CAM indicators				
CAM. 1	Minimal	Minimal	No	🟦
CAM. 2	Minimal	Minimal	No	🟩
CAM. 3	Minimal	Minimal	No	🟩

Type	Monetary costs	Time	Expertise	Synergies
CAM. 4	Minimal	Minimal	No	
CAM. 5	Minimal	Minimal	No	🟦
CAM. 6	Minimal	Minimal	No	🟦
INC indicators				
INC.1	Minimal	Minimal	No	🟥
INC.2	Minimal	Minimal	No	🟥
INC.3	Minimal	Minimal	No	🟥
NC BAL indicators				
BAL.1	Minimal	Minimal	No	▨
BAL.2	Minimal	Minimal	No	▨
BAL.3	Minimal	Moderate	No	
BAL.4	Minimal	Moderate	No	
NC TAR indicators				
TAR.1	Minimal	Minimal	No	⬛
TAR.2	Minimal	Minimal	No	
TAR.3	Minimal	Minimal	No	⬛
TAR.4	Minimal	Minimal	No	
TAR.5	Minimal	Moderate	No	
TAR.6	Minimal	Moderate	No	

Note: Colours in the right hand column denote groups of indicators where significant cost synergies can be achieved by calculating the indicators together

Table 8.3: Estimated costs associated with calculating recommended high-level policy goals indicators

Type	Monetary costs	Time	Expertise	Synergies
High-level policy goal of effective competition				
CO.1	Minimal	Moderate	No	🟩
CO.2	Minimal	Moderate	No	🟩
CO.3	Moderate	High	Yes	🟧
CO.4	Minimal	Minimal	No	
CO.5	Minimal	Minimal	No	🟦
CO.6	Minimal	Minimal	No	🟦
CO.7	Minimal	Minimal	No	🟦
CO.8	Minimal	Minimal	No	
CO.9	Minimal	Moderate	No	🟦

Type	Monetary costs	Time	Expertise	Synergies
CO.10	High	High	Yes	🟨
High-level policy goal of efficient market functioning				
MF.1	Minimal	Minimal	No	
MF.2	Minimal	Minimal	No	🟩
MF.3	Minimal	Minimal	No	🟩
MF.4	Minimal	Minimal	No	
High-level policy goal of market integration				
MI.1	Minimal	Minimal	No	🟩
MI.2	Minimal	Minimal	No	🟩
MI.3	Minimal	Minimal	No	🟩
MI.4	Minimal	Minimal	No	
MI.5	Minimal	Minimal	No	
MI.6	Minimal	Minimal	No	
High-level policy goal of non-discrimination				
ND.1	Minimal	Minimal	No	🟪
ND.2	Minimal	Minimal	No	🟪

Note: Colours in the right hand column denote groups of indicators where significant cost synergies can be achieved by calculating the indicators together.

Most of the costs fall into the minimal category for both monetary and time related costs. This reflects the fact that the most of the proposed data sources will already be available to ACER free of charge either through REMIT, the Transparency Platform or from other public sources. The FTE days required to calculate most of the indicators are also relatively low due to the fact that the data for most of the proposed indicators should be readily available and the calculations relatively simple. The main task for most of the indicators will be the processing and querying of the data, and setting up (spreadsheet) templates for performing the required calculations. Whilst the time and effort involved in such tasks should not be underestimated, we estimate that this should take in general more than 2-3 days per indicator.

8.2. Implementation workplan

In this sub-section, we outline an implementation workplan for the proposed methodology. Since the implementation dates of individual networks codes/ guidelines vary, and some of the data sources proposed for this monitoring will not be immediately available, a multi-phased implementation of the proposed methodology is appropriate. Therefore, the workplan assumes that implementation would start in the fourth quarter (Q4) of 2015, with the main implementation phases determined according to the following criteria:

- the (expected) effective dates of each NC/GL;
- the dates when the proposed data sources are expected to become available;
- whether a baseline value for the indicator needs to be established;
- whether the indicator (or a similar indicator) is already calculated by ACER; and
- whether there are synergies from a simultaneous implementation of multiple indicators.

In addition, we have prioritised indicators in terms of relative importance by NC/GL within each implementation phase. This prioritisation is based on our assessment of how closely an indicator measures a specific impact of a NC/GL and refers to the order in which the implementation of the indicators should be undertaken. We note that this should not be interpreted as a ranking of the quality of the indicators nor that indicators ranked lower are less useful part of the proposed market monitoring methodology. As noted previously in the report, the proposed indicators should be considered together and the methodology should be implemented as a package.

The only NC/GL currently in effect, for which implementation impacts could be observable, is the CMP GL. The BAL NC and CAM NC will need to be implemented by October 2015 and by November 2015, respectively. As the TAR NC and INC have not yet been finalised, and thus their effective dates are not yet know, it is likely that their provisions will not come into effect before 2017.

Many of our proposed indicators rely on REMIT data. The data reporting under REMIT standard-contract transactions in organised marketplaces will begin in October 2015, while the reporting of non-standard contracts will begin in April 2016. Therefore, the implementation of any indicators that require both standard and non-standard transactional data will start after that date.

Based on these milestones we have identified four main phases for the implementation of the proposed methodology:

- **Phase I (Q4 2015 – Q1 2016)**: this phase includes the implementation or setup[47] of those indicators for which a baseline needs to be established, data is already available and where there are synergies among the indicators or with the work already undertaken for the annual MMR. This phase also includes some indicators which rely on REMIT reporting of standard contracts concluded on organised marketplaces;

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[47] By implementation setup we mean setting-up the data queries, templates and data gathering or data download processes necessary for the development of the indicators as well as testing the availability and reliability of the proposed data sources.

- **Phase II (Q2 - Q4 2016)**: this phase consists of the initial implementation setup of those indicators which rely on REMIT reporting of both standard and non-standard contracts;
- **Phase III (Q1 – Q3 2017):** this phase includes the first annual application of the proposed indicators for the MMR to be published in October 2017, using a full dataset for calendar year 2016[48];
- **Phase IV (Q4 2017 and beyond)**: the phase involves implementing the TAR NC and INC proposed indicators.

The objective of this workplan is to be able to produce the full set of proposed indicators (except the indicators covering NCs not yet implemented) in the 2017 MMR (i.e. covering the gas year 2016). The proposed workplan is illustrated in the figure below.

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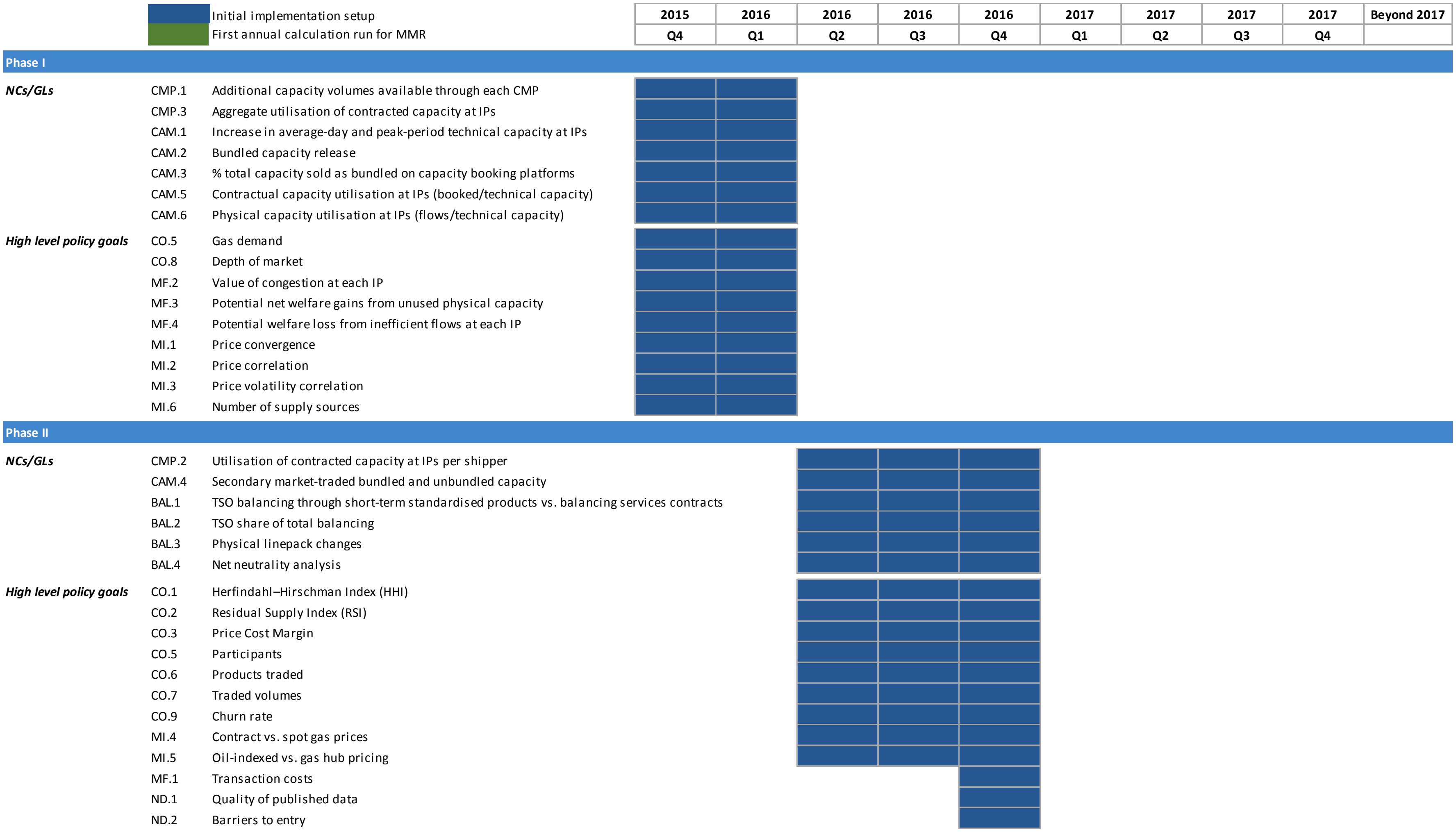
[48] For the indicators relying on REMIT non-standard transactional reporting only 9 months' worth of data will be available for 2016 (from April 2016).

Figure 8.1: Proposed implementation workplan



🟦 Initial implementation setup
🟩 First annual calculation run for MMR

			2015	2016	2016	2016	2016	2017	2017	2017	2017	Beyond 2017
			Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Phase I												
NCs/GLs	CMP.1	Additional capacity volumes available through each CMP	🟦	🟦								
	CMP.3	Aggregate utilisation of contracted capacity at IPs	🟦	🟦								
	CAM.1	Increase in average-day and peak-period technical capacity at IPs	🟦	🟦								
	CAM.2	Bundled capacity release	🟦	🟦								
	CAM.3	% total capacity sold as bundled on capacity booking platforms	🟦	🟦								
	CAM.5	Contractual capacity utilisation at IPs (booked/technical capacity)	🟦	🟦								
	CAM.6	Physical capacity utilisation at IPs (flows/technical capacity)	🟦	🟦								
High level policy goals	CO.5	Gas demand	🟦	🟦								
	CO.8	Depth of market	🟦	🟦								
	MF.2	Value of congestion at each IP	🟦	🟦								
	MF.3	Potential net welfare gains from unused physical capacity	🟦	🟦								
	MF.4	Potential welfare loss from inefficient flows at each IP	🟦	🟦								
	MI.1	Price convergence	🟦	🟦								
	MI.2	Price correlation	🟦	🟦								
	MI.3	Price volatility correlation	🟦	🟦								
	MI.6	Number of supply sources	🟦	🟦								
Phase II												
NCs/GLs	CMP.2	Utilisation of contracted capacity at IPs per shipper			🟦	🟦	🟦					
	CAM.4	Secondary market-traded bundled and unbundled capacity			🟦	🟦	🟦					
	BAL.1	TSO balancing through short-term standardised products vs. balancing services contracts			🟦	🟦	🟦					
	BAL.2	TSO share of total balancing			🟦	🟦	🟦					
	BAL.3	Physical linepack changes			🟦	🟦	🟦					
	BAL.4	Net neutrality analysis			🟦	🟦	🟦					
High level policy goals	CO.1	Herfindahl–Hirschman Index (HHI)			🟦	🟦	🟦					
	CO.2	Residual Supply Index (RSI)			🟦	🟦	🟦					
	CO.3	Price Cost Margin			🟦	🟦	🟦					
	CO.5	Participants			🟦	🟦	🟦					
	CO.6	Products traded			🟦	🟦	🟦					
	CO.7	Traded volumes			🟦	🟦	🟦					
	CO.9	Churn rate			🟦	🟦	🟦					
	MI.4	Contract vs. spot gas prices			🟦	🟦	🟦					
	MI.5	Oil-indexed vs. gas hub pricing			🟦	🟦	🟦					
	MF.1	Transaction costs					🟦					
	ND.1	Quality of published data					🟦					
	ND.2	Barriers to entry					🟦					

🟦 Initial implementation setup
🟩 First annual calculation run for MMR

			2015	2016	2016	2016	2016	2017	2017	2017	2017	Beyond 2017
			Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Phase III												
	Calculation of all indicators listed in Phases I and II for the Annual MMR 2017							🟩	🟩	🟩		
Phase IV												
NCs/GLs	TAR.1	Stakeholder assessment of robustness and overall process associated with establishment of tariff methodology										→
	TAR.2	Assessment of availability of all models and data to enable replication of actual tariffs										→
	TAR.3	Stakeholder assessment of information availability to enable tariff predictions										→
	TAR.4	Pass/fail compliance with cost allocation test										→
	TAR.5	Revenue Reconciliation parameters and outcomes										→
	TAR.6	Multipliers applied by each TSO										→
	INC.1	Incremental and new capacity offered through open season / auctions										→
	INC.2	Proportion of proposed incremental/new capacity projects that pass/fail the economic test										→
	INC.3	Range of f-factor values used in the calculation of the economic test										→
High level policy goals	CO.10	Simulation model										→

Cost of implementation

Based on the per-indicator costs presented in Section 8.1, we provide a total estimated cost of implementing the proposed methodology takes into account synergies between indicators. For time related costs, we consider an estimated number of days for each indicator at the high end of each defined range given. For our estimate we assume that:

- An indicator in the minimal category will require an average of 6 FTE days;
- An indicator in the moderate category will require 15 FTE days on average; and
- An indicator classified as high cost will require 30 FTE days on average.

In addition, for those indicators already calculated by ACER in previous MMR reports (e.g. physical and contracted capacity utilisation, number of gas supply sources, total gas demand, etc.) we assume the average implementation costs will be 3 FTE days. Furthermore we expect that where synergies can be achieved by calculating indicators together, the average cost for each indicator involved will be reduced by a half.

We estimate that the costs for the first year of implementation of the proposed methodology will be around **220 FTE days**. By implementing the methodology in phases this cost will be spread over multiple years. The implementation cost associated with each phase is shown in the table below.

Table 8.4: Implementation costs by phase

Phase	Period	Cost (FTE days)
I	Q4 2015 – Q1 2016	20
II	Q2 2016 – Q4 2016	54
III	Q1 2017 – Q3 2017	74
IV	Q4 2017 and beyond	72
Total		220
Total MMR 2017		148

While the greatest amount of work will still be done in phase III (the first three quarters of 2017) when all the data required for the MMR will be available, the phased implementation means that half of the time required to calculate the indicators for that year's MMR will be expended before 2017.

Phase I

This phase involves setting-up and calculating indicators for which the input relevant data should become available in the near future, a baseline value may need to be established or the indicators are already used in the MMR report.

The indicators suitable for implementation in this phase are listed in the table below. The order in which the indicators for each NC/GL and each high-level policy goal have been listed reflects the priority we have assigned to each indicator for this implementation phase.

Table 8.5: Indicators to be implemented starting in Phase I

Ref. ID	Indicator	Primary data source(s)
CMP GL		
CMP.1	Additional capacity volumes made available through each CMP	ENTSOG TP
CMP.3	Aggregate utilisation of contracted capacity at IPs (flows/booked capacity)	ENTSOG TP
NC CAM		
CAM.2	Bundled capacity release	REMIT (standard contracts)
CAM.3	Share of total capacity sold as bundled on capacity booking platforms	REMIT (standard contracts)
CAM.5	Contractual capacity utilisation at IPs (booked/technical capacity)	ENTSOG TP
CAM.6	Physical capacity utilisation at IPs (flows/technical capacity)	ENTSOG TP
CAM.1	Year-on-year increase in average-day and peak-period technical capacity at IPs	ENTSOG TP
High-level policy goal of effective competition		
CO.8	Depth of market	GTM 2 indicator
CO.4	Gas demand	Eurostat/TSOs/IEA
High-level policy goal of efficient market functioning		
MF.3	Potential net welfare gains from unused physical capacity	ENTSOG TP, price data
MF.4	Potential welfare loss from apparently inefficient flows at each IP	ENTSOG TP, price data
MF.2	Value of congestion at each IP	ENTSOG TP, price data
High-level policy goal of market integration		
MI.1	Price convergence	Current price data*
MI.2	Price correlation	Current price data*
MI.6	Number of supply sources	Eurostat Comext
MI.3	Price volatility correlation	Current price data*

** Temporary data sources to be used until primary data source listed in Table 7.2 becomes available*

Implementation of the CMP.1 and CMP.3 indicators could start immediately as the CMP GL is already in effect and the data *should* be available on the ENTSOG TP. We recognise, however, that the ENTSOG TP may not currently contain all the required data. An early implementation of these indicators should help identify instances where data is not available or not reliable, and thus, should allow ACER enough time to resolve these issues with ENTSOG.

Four of the seven NCs/GLs indicators recommended for implementation in this phase (CMP.3, CAM.1, CAM.5 and CAM.6) are already effectively included in the ACER MMR report.[49] The calculation of these three CAM NC indicators can also offer baseline values prior to full CAM NC implementation. For CAM.2 and CAM.3 indicators, baseline values are not needed as bundled capacity will only become relevant after the provisions of the CAM NC come into effect.

Most of the high-level policy goal indicators to be implemented at this stage require wholesale price data as well as capacity/flow data. Our recommended price data source, presented in Table 7.2, is REMIT (covering both standard and non-standard contracts). As full REMIT data will not be available until Q2 2016, the price methodology currently applied in the MMR could be used in the interim. Price convergence and price correlation are already analysed in the MMR report although some additional calculations will be required for implementing the proposed correlation methodology.

The two indicators (CAM.2 and CAM.3) rely on REMIT data therefore it will only be feasible to start implementing them once the REMIT data on standard contracts becomes available.

Phase II

In this phase, the implementation of indicators that rely on non-standard REMIT data can begin. The indicators suitable for implementation in this phase are listed in the table below. The order in which the indicators for each NC/GL and each high level policy goal have been listed reflects the priority we have assigned to each indicator for this implementation phase.

Table 8.6: Indicators to be implemented starting in Phase II

Ref. ID	Indicator	Primary data source(s)
CMP GL		
CMP.2	Utilisation of contracted capacity at IPs per shipper	REMIT
NC CAM		
CAM.4	Secondary market-traded bundled capacity and unbundled capacity	REMIT
NC BAL		
BAL.1	TSO balancing through short-term standardised products vs. balancing services contracts	REMIT/TSOs
BAL.4	Net neutrality analysis	REMIT/TSOs
BAL.2	TSO share of total balancing	REMIT/TSOs

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[49] e.g. Figure 79 of the Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2013

Ref. ID	Indicator	Primary data source(s)
BAL.3	Physical linepack changes	TSOs
High-level policy goal of effective competition		
CO.1	Herfindahl–Hirschman Index (HHI)	REMIT
CO.2	Residual Supply Index (RSI)	REMIT
CO.9	Churn rate	REMIT, exchanges, CO.4
CO.3	Price-Cost Margin (PCM)	REMIT and other sources
CO.7	Traded volumes	REMIT, exchanges
CO.5	Participants	REMIT, exchanges
CO.6	Products traded	REMIT, exchanges
High-level policy goal of efficient market functioning		
MF.1	Transaction costs	Survey
High-level policy goal of market integration		
MI.4	Contract vs. spot gas prices	REMIT
MI.5	Oil-indexed vs. gas hub pricing	REMIT
High-level policy goal of non-discrimination		
ND.2	Barriers to entry	Survey
ND.1	Quality of published data	Survey

Some of the indicators listed in this phase, such as MF.1, ND.1 and ND.2, are developed through stakeholder surveys. Those surveys will need to be conducted after the end of the calendar year covered by the MMR (in this case 2016). Since survey design will need to be developed earlier, we envisage the implementation setup for these indicators to take place in Q4 2016.

Phase III

Phase III involves performing the first annual calculation for the MMR of all the indicators presented in phases I and II above. The work will be executed using the data queries and templates set up during the first two implementation phases and a full dataset for 2016. The stakeholder surveys designed in the previous phase will also need to be conducted to gather data for the relevant indicators.

This phase will end with the publication of the MMR report covering the year 2016 and will represent the end of the implementation phase for all indicators except, market simulations, and indicators measuring the impact of NC TAR and INC.

Phase IV

The implementation of the remaining indicators will depend mainly on when the provisions of the TAR NC and INC will come into effect therefore a precise schedule cannot be provided although it is likely that the implementation will occur beyond 2017. In addition we also envisage that the simulation modelling we have recommended as an indicator of effective market competition will be a longer-term project with implementation potentially taking place after the first run of the proposed methodology has been performed in 2017. The table below lists the remaining indicators to be implemented beyond 2017. Again we have listed the indicators in the order of the priority assigned for this implementation phase for each NC/GL and each high level policy goal.

Table 8.7: Indicators to be implemented starting in Phase IV

Ref. ID	Indicator	Primary data source(s)
NC TAR		
TAR.4	Pass/fail compliance with cost allocation test	NRAs
TAR.5	Revenue Reconciliation parameters and outcomes	TSOs
TAR.1	Stakeholder assessment of 1) robustness of decision making and 2) overall process associated with establishment of tariff methodology	Survey
TAR.2	Assessment of availability of all models and data to enable replication of actual tariffs	Survey
TAR.3	Stakeholder assessment of information availability to enable tariff predictions	Survey
TAR.6	Multipliers applied by each TSO	PRISMA/TSOs/NRAs
INC		
INC.2	Proportion of proposed incremental/new capacity projects that pass/fail the economic test	NRAs/TSOs
INC.1	Incremental and new capacity offered through open season / auctions	NRAs/TSOs
INC.3	Range of f-factor values used in the calculation of the economic test	NRAs/TSOs
High-level policy goal of effective competition		
CO.10	Simulation model	Various

Monetary costs

For a small number of indicators there are also likely to be monetary costs associated with implementing the methodology. These refer for example to purchasing access to information on cost data for the calculation of the Price-Cost Margin indicator. The total monetary costs would be moderate (i.e. up to €5,000). The largest monetary cost is likely to be incurred if the market simulation modelling is outsourced. In assessing monetary costs we assume that other process requirements such as providing sufficient data storage capabilities and updating hardware/software to process large amounts of data are either already available to ACER or will be provided outside the scope of the gas monitoring process (for example, this will likely be required to handle the large datasets created through REMIT reporting).

Set-up versus ongoing costs

The cost estimates set out in this section refer to the initial implementation setup of the proposed indicators (setting up queries, creating spreadsheet templates, designing surveys, etc.) as well as running the first annual calculation of most of the indicators for the 2017 MMR. Once these set-up processes are implemented and the first calculation is performed the ongoing costs of running the process for subsequent years are likely to be significantly lower. The first annual calculation run in 2017 (Phase III) is estimated to take 74 FTE days. This cost is likely to fall, possibly starting with the second annual calculation, as a learning process develops. To this estimate, the cost of calculating the rest of the indicators set out in Phase IV must be added. Assuming half of the implementation cost for these indicators (total estimated cost of 72 FTE days) refers to the first actual calculation of the indicators gives an extra 36 FTE days. This means that the time cost of calculating all the proposed indicators on an ongoing basis in subsequent years should be a maximum of 110 FTE days although the actual cost is likely to be significantly lower depending on the learning process.

ANNEX A – DETAILED SPECIFICATION OF RECOMMENDED INDICATORS

In this annex, we provide evaluation forms for the recommended indicators. Each form contains the following fields: (1) description; (2) calculation principles; (3) strengths and weaknesses; (4) data requirements and sources; (5) interpretation of indicator values, including threshold values (if applicable); (6) potential correlations and interactions with other indicators; (7) practical considerations and previous usage of the proposed indicator; (8) implementation cost estimates; and (9) an evaluation of the proposed indicator in terms of practical usability, strengths and weaknesses and robustness.

A.1. Proposed indicators to measure the desired effects of network codes and guidelines

A.2.1. CMP Indicators

Desired effect: Additional capacity offered by TSOs at IPs

Indicator	Description
CMP.1 Additional capacity volumes made available through each CMP (kWh/d or kWh/h)	Capacity made available over a specified period by the application of CMP at contractually congested IPs (either from a recall of previously contracted capacity via FDA UIOLI, Surrender, LT UIOLI, or through a release of additional capacity via OSBB).

Calculation principles

- No manipulation of the input data is required to derive indicator values for a given period. Pursuant to Regulation (EC) 715/2009 Annex 1, 3.3(1)(k), indicator values should be published on the ENTSOG Transparency Platform as fields 42 - 45.
- On an annual basis, we envisage summarising the data by IP and by CMP application (FDA UIOLI, Surrender, LT UIOLI, OSBB) in the following format:

Product	FT UIOLI	Surrender	FDA UIOLI	OSBB
Volume of capacity released at IP				

- It would also be interesting to observe the additional capacity made available by type of product (annual, quarterly, monthly and daily) as different products will serve different purposes on the market. Data at this level of granularity may not be available however ACER may consider requires TSOs to publish this information.

Strengths	Weaknesses
• Indicator values should be readily available as a result of existing legislation. • API (Application Program Interface) enables efficient data downloads.	• Comprehensive data not yet available on ENTSOG TP. • Lack of standardisation of data (no data dictionary for ENTSOG transparency) may make it difficult to interpret outcomes. Therefore it is recommended that ACER request ENTSOG to construct a data dictionary to define the methodology for the submission of each field on the Transparency Platform.

Data requirements	Data sources

• Capacity made available during the specified period by each type of CMP. • Data granularity at a daily level.	• ENTSOG Transparency Platform, fields 42 – 45 inclusive.

Interpretation and thresholds

- Low or zero values imply a limited impact of CMP on cross-border trade for a given period, although the reasons behind it (e.g. FD UIOLI is not implemented, absence of contractual congestion, etc.) would need to be identified separately.
- Each indicator (FDA UIOLI, Surrender, LT UIOLI, and OSBB) needs to be interpreted separately. For example, whether the application of OSBB makes longer-term (quarterly and annual) or short-term (daily) capacities available, since each has a potentially different impact on the market. Short-term capacity may facilitate short-term arbitrage, but it may be insufficient to facilitate cross-border trades consistent with the timescales of a retail portfolio. Similarly, FDA UIOLI may provide some confidence that some day-ahead capacity may become available, however it may be insufficient to incentivise new entry.
- An important consideration is whether the capacity that is made available is bundled/unbundled and firm/interruptible. Having a lot of capacity available on one side of an IP may not be helpful unless either (firm) bundled capacity or (interruptible) unbundled capacity is also available on the other side of the IP to effect the cross-border flows.
- The release of “CMP capacity” should also be considered in the context of previously available “technical capacity” (annual capacities on the ENTSOG capacity map might be a good measure). However the CMP capacity might not be easily separable from other effects (e.g., TSO dynamic “within-year” recalculation of capacity). All that matters from a market perspective is whether adequate capacity is made available. Whether that capacity arises from, for example, dynamic recalculation of capacity or CMP measures is only of secondary importance.
- Indicator measures only capacity that was made available, thus it should not be interpreted as capacity actually booked.

Potential correlations with other indicators

- CMP indicators may only be relevant at IPs with contractual congestion. Where capacity is available with low risk of price escalation in auctions, the CMP provisions will be irrelevant.
- Regulation (EC) 715/2009 requires reporting “unsuccessful requests” for firm capacity with a duration of one month or more, where auctions of monthly (or longer) capacity have cleared above the reserve price and where no firm capacity with a duration of one month or longer has been offered in the regular allocation process.
- Making additional capacity volumes available could improve physical and contractual capacity utilisation at IPs and encourage market entry thus improving market liquidity and competition. This depends, however, on the assumption that the additional capacity is purchased and used by shippers.
- This relationship is also neither unidirectional nor linear. It is important to consider the fact that even the threat of a CMP action can have an impact. For example, if the threat of CMP results in increased secondary trading of capacity or encourages shippers previously ’hoarding’ capacity to make use of that capacity, then the capacity utilisation of the pipeline will improve, although this may also be reflected in lower volumes made available via CMP (because there would be less unused capacity to ‘lose’).

Practical considerations and previous usage

- This indicator is most relevant at IPs where contractual congestion is prevalent. There may be merit in canvassing network users each year to indicate any IPs where they consider it is either impossible or unviable to secure capacity. ACER should then encourage the relevant NRAs to investigate. ACER should further encourage NRAs in their annual reporting to ACER to report their own assessment of contractual congestion and the effectiveness of CMP implementation.

Implementation costs

- Implementation costs should be minimal given easy access, standard format, and limited need for data manipulations – no monetary costs involved and little time necessary to extract the data.

- Developing indicators that distinguish between different capacity products may me more costly, because capacity platforms may not necessarily provide data in the required format, and changes to existing systems or for additional TSO data capture may be required.

Evaluation

- Indicator is a direct measure of CMP application, and statutory requirements mean it should be available and easy to download and subsequently process.
- The ACER CMP Implementation Monitoring and Congestion reports contain other useful information related to the application of CMP and compliance of MSs with the requirements of the CMP GL. This indicator should be used in conjunction with these other indicators.

Desired effect: Minimised unused capacity due to contractual congestion

Indicators	Description
CMP.2 **Utilisation of contracted capacity at IPs per shipper (% flows/booked capacity)** CMP.3 **Aggregate utilisation of contracted capacity at IPs (% flows/booked capacity)**	These measures provide an indication of the extent to which the booked network capacity is utilised both at the individual shipper and at the aggregate levels. It is particularly useful to consider these indicators at congested IPs where CMPs are applied.

Calculation principles

- As actual flow data at the individual network user level is not available, we propose using nominations as a proxy for the utilisation of booked capacity.
- Daily information at each IP side should be available for both booked capacity and nominations from REMIT reporting.
- The calculation of booked capacity at a daily level would involve adding together the capacity held under annual products as well as the relevant quarterly, monthly and daily products.
- The level of booked capacity for each shipper should be determined by taking account of both primary capacity allocations and secondary trading of capacity.
- For the aggregate level, data can be used from the ENTSOG Transparency Platform. (Field 2 Firm booked capacity & field 9 Allocations).
- Data should be analysed annually, taking account of the sums of technical capacities, booked capacities, actual flows or nominations. Analysing data during peak days (or perhaps longer, high-demand periods, e.g. peak month) might also be relevant.

Strengths	Weaknesses
• All data should be available through REMIT and ENTSOG TP. • Developing the indicator secures a base set of data applicable for each IP that will provide context to the analysis framework relevant to other indicators.	• None identified.

Data requirements	Data sources
• Individual shipper-booked capacity at each IP. • Individual shipper nominations for each IP. • Total booked capacity at each IP. • Total flows at each IP.	• REMIT fundamental data provides information on shipper bookings and nominations. • Fields 2 and 9 from ENTSOG Transparency Platform.

Interpretation and thresholds

- High levels of booked capacity utilisation might be considered desirable, but low utilisation does not necessarily imply capacity “hoarding”.
- Actual bookings will depend on several factors, including the expectation of future constraints (e.g., inability to buy capacity later and closer to gas flows) and the relative pricing of the sub-annual products (i.e., tariff multipliers). Actual cross-border flows will also depend on actual demands for gas, price spreads between hubs on the relevant day, and the manner in which gas to meet demand is sourced.

Potential correlations with other indicators

- These indicators should be considered together with other related network utilisation indicators described in the NC CAM section—booked/technical capacity and physical utilisation (CAM.5 and CAM.6).
- The application of CMPs at congested IPs should result in higher utilisation of booked capacity and also higher physical utilisation of the network. On the other hand, if capacity bookings at a particular IP drop then this may result in higher utilisation of booked capacity but not necessarily physical capacity.

Practical considerations and previous usage

See above.

Implementation costs

- Data will be readily available through REMIT and the ENTSOG Transparency Platform once they are fully functioning.
- Sourcing aggregated levels based from the TP data would require very little time and effort. More significant resources will be expended for calculating individual shipper bookings at a daily level. The overall time costs, however, are expected to fall in the minimal category.

Evaluation

- Indicator relates to a key problem which is addressed by the CMP GL and might be regarded as essential context in the assessment of other indicators in this paper.

A.2.2. NC CAM Indicators

Desired effect: Increase in offered technical capacity.

Indicator	Description
CAM.1 **Year-on-year increase in average-day and peak-period technical capacity at IPs** (kWh/d or kWh/h)	The intent of NC CAM is that TSOs will jointly appraise capacity availability (i.e. technical capacity) with a view to maximise capacity release, especially bundled capacity. Processes will likely vary between TSOs, ranging from full hydraulic simulations against a wide range of scenarios to rather more pragmatic approaches based on operational assessment of the “headroom” for additional gas close to times of gas flow. Proposed indicator tracks year-on-year changes of technical capacity at individual IPs, reflecting the impact of these different approaches.

Calculation principles

- Pursuant to Regulation (EC) 715/2009 Annex 1 3.3(1)(k), Technical Capacity values should be published on the ENTSOG Transparency Platform in Field No. 1.[50]
- The base data must be derived at a daily level of granularity. Where Technical Capacity does not change day-on-day, the start and end-date for that level of Technical Capacity is available enabling a full population of daily data.
- The increase in Technical Capacity needs to be calculated with respect to a base level. Two approaches should be used: (1) Technical capacity levels compared with a reference period prior to the CAM network code implementation (Gas Year 2014/2015 or Calendar Year 2014) could be used; (2) In subsequent years, year-on-year changes should be used as a second indicator. The before-and-after CAM interpretation needs to take into account the fact that some TSOs might already conduct dynamic recalculations or joint assessments of technical capacity.
- Increase in average-day capacity is calculated as the difference between average daily technical capacity in the reporting period and average daily technical capacity in the reference period.
- Increase in peak-period capacity is calculated by reference to the highest [e.g., top 10] flow days over the relevant periods. The physical flow data is available on the ENTSOG TP Field No. 10 on a daily basis to facilitate the derivation of peak-period usage.

Strengths	Weaknesses
• The data is readily available to calculate the indicator.	• No data dictionary exists for the ENTSOG TP, therefore it is not clear whether the Technical Capacities reported there are always updated to reflect the full effects of dynamic capacity recalculation.

Data requirements	Data sources
• Technical capacity data required for each IP side over the reporting period.	• All relevant information should be available on the ENTSOG TP (Technical Capacity in Field No. 1).

Interpretation and thresholds

- A primary objective of the CAM network code is that technical capacity is dynamically recalculated so that capacity release is optimised. TSOs are expected to make better assessments, especially in timeframes when there is greater certainty about pipeline and plant availability and expected flow patterns. Thus the determination of maximum flow capability will generally become more accurate, the closer to actual gas flow the calculation is performed. At a congested IP, the market would be well served with a daily reassessment from both TSOs that would feed into a daily update of available capacity. An additional indicator that might provide some insight is the number of times Technical Capacity changes during the reporting period per IP.
- The Technical Capacity data relates to capacity on each side of the IP. TSOs are required to publish their assessments of Technical Capacity, i.e. their assessment of maximum capability to flow gas at the IP, having regard for network and plant availability and supply and demand levels and patterns in their respective networks.
- Technical capacity levels should not be expected to be the same either side of an IP. However, the number of times the Technical Capacity changes will provide an indication of how often Technical Capacity is dynamically recalculated by the TSO. On the other hand, network users may not see any change, unless the change in Technical Capacity is reflected in capacity availability for shippers (i.e. both TSOs have an ability to offer some capacity). This is not likely to be a problem at IPs with plentiful unsold capacity.
- Two elements, however, might be worthy of additional investigation in the future:
    - Comparison of technical capacity at either side of an IP – as a vehicle for assessing mismatches.
    - The effect of dynamic recalculation on the availability of bundled capacity.

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[50] ENTSOG Transparency Platform – Data Publication Format; https://transparency.entsog.eu/pdf/TRA158_TP%20Data%20Publication%20Format_%20FINAL.pdf

    - Raw and part-processed data should be analysed with the TSOs/NRAs to develop an understanding of the practicalities and effects of dynamic capacity recalculation.

Potential correlations with other indicators

- Increases in average-day and peak-period capacity availability have most value at IPs that have high utilisation and where significant price differentials exist between hubs (i.e., generally at IPs that are constrained). Therefore, the average-day and peak-period increases defined here should be considered in conjunction with the proposed CMP congestion indicators. Related high-level policy goal indicators are prices and price convergence indicators related to the high-level policy goal of market integration.
- The increased availability of technical capacity should be assessed in the context of whether OSBB affords an opportunity for the TSO to make extra revenue from increased capacity offers. However, this incentive is most likely based on OSBB quantities sold rather than technical capacity determined so expert interpretation may be necessary to support these assessments.

Practical considerations and previous usage

- Persistent mismatch of technical capacity on either side of an IP should not automatically be assumed to be a problem. It would, however, be a problem if the capacity constraint could be alleviated by one or both of the TSOs better managing technical capacity across their entire systems. Assessing this would be challenging, and therefore we do not recommend to perform it on a regular basis. The proposed indicator should, however, be used to identify where more dynamic recalculation (and hence higher capacity availability) might yield additional welfare gains, particularly via increased convergence of hub prices.
- The dynamic recalculation of capacity is designed to increase technical capacity. To assess this going forward, a reference level should be established. This could be the annual period leading up to the implementation of CAM (i.e., year ending September or October 2015) although the CAM implementation date should not be interpreted as aa clear changeover moment given that some TSOs might already apply procedures to maximise technical capacity.
- Each calendar[51] year, the technical capacity should be analysed using daily values. An indicator of increased technical capacity is the difference between the average level[52] of technical capacity over the year and the reference level. The value could also be expressed as a percentage.

Implementation costs

- Data should be easily extracted via API from the ENTSOG Transparency Platform.
- Processing to get base data should be easy and quick, generating few costs and requiring limited expertise. Therefore costs are likely to be minimal.
- Whilst substantial insights can be obtained from the data, it may be necessary however to explore individual technical capacity redetermination processes (at least, its frequency) with relevant TSOs and to understand how the business processes that determine technical capacity translate into potential release of bundled and unbundled capacity each side of the IP.
- The value from the data will come from analysis in conjunction with a range of other indicators. Some automated processing tools to filter data so that analyst attention is focussed on, for example, congested points is desirable to ensure efficient processing and interpretation.

Evaluation

The indicator is simple to derive and will provide an insight into a desired effect of the network code, namely increased technical capacity determination following network code implementation. Further analysis will afford ACER the opportunity to assess whether the Technical Capacity recalculation is delivering cross-border capacity to those who wish to use it.

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[51] This will depend upon whether reporting is to be aligned with CMP statutory obligations or not.

[52] Other measures, perhaps peak (maximum) over the monitoring period, could also be relevant. Some extra capacity on days of high flows might create significant welfare gains, whereas extra capacities at other times will probably not have much impact.

Desired effect: Progression towards maximum possible release of capacity via bundled capacity.

Indicator	Description
CAM.2 Bundled capacity release	Historical data on capacity release and sales enable the split of both available and sold capacity to be determined. Thus, it is possible to derive the extent of bundled capacity that was potentially made available to network users at each IP.

Calculation principles
• Bundled capacity quantities at IPs are derived for the CAM.3 indicator. • REMIT data permits the calculation of the unsold quantities remaining with respect to each day at each IP. • Records relating to all auctions of bundled capacity would enable the last auction to be determined that released any IP bundled capacity: Field 12 – Offered capacity indicates the quantity offered in the final auction. Other records linked to this auction (using Field 3 – Process identification) can be used to calculate the capacity sold in that auction. The difference between the Offered capacity and capacity sold in that auction identifies the level of unsold capacity. Thus the sum of capacity sold and that left unsold in the final auction is the total amount of capacity offered. • For reporting purposes summary statistics at the IP level would be reported. The primary statistic should be average bundled capacity level released over the year.

Strengths	Weaknesses
• Source data is readily available from REMIT • Programming data extracts and manipulation should provide no major challenges – if calculation burden proves significant then routines (e.g., automated queries) could be developed to efficiently download/process the information for parts of the year and progressively build the databases necessary.	• Accuracy of outcomes will depend crucially on the accuracy and completeness of records in REMIT database.

Data requirements	Data sources
• Data download, processing and intermediate data storage will be necessary.	• REMIT database

Interpretation and thresholds
Bundled capacity release is expected to increase depending on: • Progressive reduction of legacy unbundled capacity holdings (including natural expiry, sunset clause, CAM restrictions of further unbundled release) • Increased cooperation between TSOs and co-ordinated capacity calculation. • The analysis should therefore look at trends in the data year-on-year to see if the objectives are delivered. • Bundled capacity bookings will exhibit substantial profiling once the tariff network code (NC TAR) is implemented and a more network users face variation in underlying unit costs of annual, quarterly, monthly and daily capacity.

Potential correlations with other indicators
• This measure is complementary to those based on Technical Capacity. This “capacity made available” might be expected to be close to Technical Capacity but mismatches may render some Technical Capacity

stranded. Furthermore, Bundled Capacity made available may be reduced because of prior unbundled sales.

Practical considerations and previous usage

n/a

Implementation costs

- Performing the required data processing and calculation for each IP is likely to be a non-trivial task. The overall time required is likely to be at the higher end of the minimal category.
- All the necessary data should be available to ACER.

Evaluation

Given the emphasis placed on bundled products, having high-level indicators to measure the use and availability of bundled capacity is important. Data collection and processing however will likely require some software development within ACER.

Desired effect: Easier acquisition and use of IP Capacity (single purchase for bundled capacity and nomination, common platforms, etc.)

Indicator	Description
CAM.3 **Share of total capacity sold as bundled on capacity booking platforms**	Volumes of bundled capacity sold on capacity booking platforms as a % of all IP capacity sold. The CAM network code envisages that bundled capacity should be the main firm capacity product offered at IPs.

Calculation principles

- REMIT database will provide the necessary data to derive bundled capacity volumes at each IP together with the unbundled capacity that may be sold at either or both sides of the IP.
- Calculation routines, however, would be necessary to process the data for each IP for each day including the following fields in the wholesale energy products for transportation of gas file:
  - Fields 10 and 11 – start and end of runtime of capacity transaction
  - Field 15 – quantity
  - Field 23 – bundling.

Products at IP	Quantity (kWh/d or kWh/h)
Firm bundled	
Unbundled firm side 1	
Unbundled firm side 2	

- Firm capacity sold per day at each IP would be assessed as:

Firm bundled + max (Unbundled firm side 1, Unbundled firm side 2)

- The firm bundled proportion would be defined as Firm bundled/Firm capacity sold.
- A reporting period proportion would be derived based on summation of the Firm bundled over the period divided by the summation of Firm Capacity sold over the period.
- Higher level aggregations taking account of Bundled firm capacity and Total sold capacity at all IPs could be used to provide a Europe wide indicator of progress towards the objective that most capacity is purchased on a bundled basis.

Strengths	Weaknesses

<table>
<tr><td>• Source data captured under REMIT
• Processing of data is straightforward</td><td>• Statistics are dependent on many transactions and hence depend critically on both accuracy and completeness of source data in REMIT database.</td></tr>
<tr><th>Data requirements</th><th>Data sources</th></tr>
<tr><td>• All required data is available from REMIT
• Source data will need to be processed so an extraction and processing tool will be necessary to be run at least once a year.</td><td>• REMIT database – wholesale energy products in relation to the transportation of gas</td></tr>
<tr><th colspan="2">Interpretation and thresholds</th></tr>
<tr><td colspan="2">• Bundled capacity necessarily has to co-exist with unbundled capacity. Whilst the aspiration of the CAM was that unbundled capacity sales should be small there may be opportunities for network users to purchase unbundled capacity particularly during capacity release processes occurring before November 2015 when there are no limitations on the amount of unbundled capacity that can be sold.[53]
• Subject to the limitations in CAM network code, unbundled capacity can still be sold after CAM is implemented.
• Nevertheless high proportions of bundled capacity as defined in the indicator above could be regarded as a success of the network code, mainly because of its effects to focus trading at the hubs rather than at the IP flange.
• Processed data from each year’s download should be retained to permit the development of time series data both at individual IP and aggregated IP levels to illustrate the change in both absolute levels of bundled capacity and the development of its proportion.</td></tr>
<tr><th colspan="2">Potential correlations with other indicators</th></tr>
<tr><td colspan="2">• Capacity bookings will be heavily influenced by multipliers. Thus, the implementation of the tariff network code should be expected to reduce overall bookings since it will provide much stronger incentives to book capacity much closer to gas flow.</td></tr>
<tr><th colspan="2">Practical considerations and previous usage</th></tr>
<tr><td colspan="2">n/a</td></tr>
<tr><th colspan="2">Implementation costs</th></tr>
<tr><td colspan="2">• Costs likely to fall in the minimal category. The Data will be available from REMIT. Data processing routines will be necessary to extract the information for each IP.</td></tr>
<tr><th colspan="2">Evaluation</th></tr>
<tr><td colspan="2">This should provide a straightforward indicator that will indicate at each IP how successful the network code has been in ensuring high levels of bundled capacity sales.</td></tr>
</table>

Desired effect: Enhanced secondary trading of capacity

Indicator	Description
CAM.4 Secondary market-traded bundled capacity and	The secondary traded market is an alternative to primary capacity purchase from the TSO.

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[53] After CAM implementation, technical capacities mismatches between the two sides of an IP will result in TSOs offering unbundled capacity. Market appetite for this type of capacity will depend on the market player’s assessment of whether interruptible capacity on an economically efficient basis will be available on the other side of the flange.

unbundled capacity (% of bundled capacity sold)	

Calculation principles

- REMIT data provides a series of fields that can be used to categorise records in the wholesale energy products – transportation of gas database e.g. the inclusion of valid Transferor and Transferee (Fields 36 and 37)[54]
- The data should be processed to yield daily information about secondary trade activity at each IP. Using Field 23 – Bundling, the data can be assessed as either bundled or unbundled secondary transactions.
- Secondary traded quantities can therefore be derived for each IP and for each day or over the reporting period.
- The measure should be defined as a % of the bundled capacity sold at that IP.

Strengths	Weaknesses
• Data readily available from REMIT • Data extracts are straightforward and can be efficiently managed with intermediate processed data stored in ACER databases	• Analysis and interpretation depends critically on completeness and accuracy of source data

Data requirements	Data sources
• All required data is available from REMIT	• REMIT – wholesale energy products for transportation of gas

Interpretation and thresholds

- Generally capacity trading volumes should be expected to be low (certainly when compared with gas trading activities); high capacity churn factors should not be expected. Even where most capacity is sold long term, experience suggests it is unlikely that capacity trading will exceed 10% of primary sales particularly when so much emphasis is placed upon the TSO making short term primary capacity available (including via CMP measures).
- Most learning is likely to come from a more detailed assessment of what is happening at individual IPs.
- The analysis should also look at whether bundled or unbundled capacity is being traded and the economic viability of that including relativities of firm/interruptible pricing and the TSO approaches to release and pricing of interruptible.

Potential correlations with other indicators

- Secondary trading is only likely to occur where significant quantities of capacity are sold well in advance of gas flow. Without abundant primary capacity in the market, there cannot be a liquid secondary market, and the capacity market price will be capped by the short term primary capacity price until a “constraint” occurs and auctions clear above the reserve price. Thus there are several conditions that need to be satisfied before secondary trading is likely to be viable including the perception of constraint, the relative prices of long- and short-term capacity making longer term capacity bundles economically viable and a sufficient price gas commodity price to justify and incremental cross-border flows.

Practical considerations and previous usage

See above.

Implementation costs

- Costs likely to fall in the minimal category. The Data will be available from REMIT. Data extraction should be relatively simple and easy to process to IP level of granularity.

Evaluation

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[54] See Table 4 TRUM

This should be an indicator in the final overall monitoring framework, secondary capacity is an alternative to primary capacity therefore potentially providing an opportunity for capacity market functioning. However the extent of secondary trading has to be interpreted in the context of both shape and extent of primary bookings.

Desired effect: Elimination of unrealized cross-border trades and unused capacity due mismatches in capacity allocation processes (e.g., timing, products, etc.).

Indicator	Description
CAM.5 Contractual capacity utilisation at IPs (Booked/technical capacity) **CAM.6 Physical capacity utilisation at IPs (flows/technical capacity)**	These measures would provide an indication about the extent to which full cross-border network capacity is booked and the extent to which the cross-border network capacity is utilised.

Calculation principles
• Daily data for each IP side should be available for Technical capacity (Field 1), Booked firm capacity (Field 2) and flows (Field 9) from the ENTSOG Transparency Platform. • Given that mismatches in Technical Capacity are considered elsewhere, the daily technical capacity for this analysis should be the min technical capacity at each IP. The IP should not be expected to be able to flow above the Technical Capacity if it is being dynamically recalculated or the subject of reasonable TSO incentives to release capacity to support the market. • Data should be available It may be relevant to analyse data over the year taking account of sums of technical capacities, booked capacities, actual commercial flows ((re)-nominations) or actual flows. However information related to peak flows (or perhaps some other high demand situation based over a slightly longer period e.g. highest three day flows) might be relevant.

Strengths	Weaknesses
• Data should all be available on ENTSOG TP. • Developing the indicator secures a base set of data applicable for each IP that will provide context to the analysis framework relevant to other indicators.	• None identified

Data requirements	Data sources
• Data already available via API interface. • Data should be downloaded for both sides of each IP because booked capacities may differ either side of IP • May be limited processing requirements post download of information to deliver daily information.	• Fields 1, 2, 9 from ENTSOG Transparency Platform.

Interpretation and thresholds
• High levels of booking and usage against technical capacity do not necessarily represent efficient outcomes. Both the technical capacity and the booked capacities have option values respectively to the community of users and individual users, respectively. What is actually booked will depend on factors including the perception of a constraint (interpreted as not being able to buy capacity later and closer to gas flows) and the relative pricing of the sub-annual products. Actual cross-border flows will depend on actual demands for gas and the manner in which gas to satisfy the demand is sourced. • There are therefore few clear rules that can be specified as to how the two principal measures should be assessed. Superficially high levels of capacity booked v technical capacity and that flows should be a high

<table>
<tr><td>level of capacity booked might be considered good but we should be wary of such simplistic interpretations.
• These indicators and the underlying data are designed to provide context in the interpretation of other indicators in the framework. They should therefore be considered as support materials rather than measures that directly define the performance of the gas regime.</td></tr>
<tr><td>Potential correlations with other indicators</td></tr>
<tr><td>• Data provided as context for consideration when other indicators are being assessed and other regime matters are being researched.</td></tr>
<tr><td>Practical considerations and previous usage</td></tr>
<tr><td>See above.</td></tr>
<tr><td>Implementation costs</td></tr>
<tr><td>• Data will be readily available once ENTSOG Transparency Platform is fully functioning.
• Downloading and processing the data should require minimal effort and time.
• The data set obtained will provide useful input to other indicator calculations.</td></tr>
<tr><td>Evaluation</td></tr>
<tr><td>Measures in this section should be regarded as essential input to the overall assessment of many other indicators in this paper.</td></tr>
</table>

A.2.3. INC Indicators

Desired effect: Capacity demands for incremental and new capacity are satisfied in a market-based manner.

<table>
<tr><th>Indicators</th><th>Description</th></tr>
<tr><td>INC.1 Incremental and new capacity offered through open season / auctions</td><td>The Amendment Proposal to Commission Regulation (EU) No 984/2013 which amends the CAM network code for Incremental capacity states that incremental capacity may be offered through auctions and in specific circumstances through “open season” procedures. Proposed indicator tracks new capacity added (during the MMR review period) using both procedures.</td></tr>
<tr><td colspan="2">Calculation principles</td></tr>
<tr><td colspan="2">Each Regulator should report its cross-border (CAM) incremental capacity projects unless an agreement is reached that a lead NRA is appointed for reporting purposes:
• NRAs or TSOs should be requested to capture capacity quantities that are offered in CAM Incremental projects. This should cover the lowest and highest level of incremental capacity offered in the process for each project. Data should be reported on a project-by-project basis; data associated with the date on which the binding offer phase commenced.
• A basic indicator is the number of projects offered (phase starts) to the market per reporting period.</td></tr>
<tr><td>Strengths</td><td>Weaknesses</td></tr>
<tr><td>• The frequency of incremental capacity offerings will be visible and easy to count.</td><td>• We may not have enough incremental offerings to be able to make determinations (at least in the short term)</td></tr>
</table>

- Data for both low and high levels of incremental capacity will be useful when considering future policy.[55]
- Providing data by capacity auction or open season facilitates transparency and in combination with other incremental indicators may highlight the merits of each approach.

Data requirements

- Individual records for each Incremental project that progresses to Binding Phase.
- Some projects may cover multiple IPs and the data must identify the linkage.
- The maximum and minimum offered should be captured.

Data sources

- Data for incremental capacity offered in auctions will be reported upon/published soon after auction completes. However, this will only be mandatory (under the CAM network code amendment) if the economic test is passed. NRA's/TSO's will need to collate and provide the fuller dataset as used in the pre-auction discussions and notices.
- Data on "open season" procedures should also be provided by NRA's/TSO's. The "Demand Assessment Report" as foreseen by the CAM network code Amendment could be a useful source.

Interpretation and thresholds

- The underlying data used in this area should also be compared with the level of activity in the Projects of Common Interest/Connecting Europe Facility activities and in conjunction with potential infrastructure build requirements established in ENTSOG's TYNDP.
- A real risk is that the short-term focus of the current regime prevents longer term investment commitments being made.

Potential correlations with other indicators

- These datasets should be considered in conjunction with those IPs that have exhibited contractual congestion or very high levels of utilisation.

Practical considerations and previous usage

- Data volumes should not be large but ACER will be dependent of TSO/NRAs being diligent about reporting. ACER should construct a simple record system to facilitate the processing.

Implementation costs

- Likely to be minimal. Relatively straightforward data collection and processing.

Evaluation

The indicator monitors for the evolution of Incremental Capacity projects, and assesses whether the individual and combined NRA policy making fairly balances the needs of all 3 groups; TSOs, committing users and the generality of users remains a subjective assessment. These high-level issues (about efficiency of regulatory settlements) have not been considered even if the tariff network code recognises that it is probably not possible to effectively assess where:

- Incremental/ new capacity projects are efficient and financially viable
- Economic test applied to proposed projects is an accurate reflection of their economic feasibility.

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[55] For instance, when the test is failed or only passed at low levels of capacity this may indicate a future requirement at the same IP or at an alternative.

The monitoring framework should however highlight differences in treatment by NRAs as a vehicle for ensuring transparency and accountability for the decisions they make in respect of the incremental investment parameters (including f and the underlying parameters including WACC, depreciation and revaluation rules).

This indicator is only monitoring projects for which incremental capacity is actually offered. There may be merit in collecting at least some basic information on projects that do not reach this stage – such as a count of enquiries made for incremental capacity.

Desired effect: Incremental/ new capacity projects are efficient and financially viable

Indicators	Description
INC.2 **Proportion of proposed incremental/new capacity projects that pass/fail the economic test**	The Amendment Proposal to Commission Regulation (EU) No 984/2013 which amends the CAM network code for Incremental Capacity defines the economic test as a means of assessing the economic viability of incremental capacity projects.

Calculation principles

Each Regulator should report on the test for its cross-border (CAM) incremental capacity projects unless an agreement is reached that a lead NRA is appointed for reporting purposes:

- NRAs or TSOs should report success/failure in respect of the market test for each project together with the level of incremental capacity to be added to technical capacity at the IP where test is satisfied.

Strengths	Weaknesses
• A simple and straightforward measure • Data for incremental capacity offered in auctions will be reported upon/published soon after the auction completes.	• Failure of the test does not necessarily mean project is not efficient nor does passing the test may ensure efficiency.

Data requirements	Data sources
• Individual records for each Incremental project that progresses to Binding Phase	• Data for incremental capacity offered in auctions will be reported upon/published soon after auction completes. • However, this will only be mandatory (under the CAM network code amendment) if the economic test is passed. The number that fail the test can be determined by subtraction from the number of IPs where incremental is offered. • The results for "open season" procedures should also be provided by NRA's/TSO's.

Interpretation and thresholds

- The number of projects in total and the pass/fail ratio should also be compared with the level of activity in the Projects of Common Interest/Connecting Europe Facility activities and in conjunction with potential infrastructure build requirements established in ENTSOG's TYNDP.
- A real risk is that the short term focus of the current regime prevents longer term investment commitments being made.
- A high level of test failures may not necessarily mean an uneconomic project it could, for instance, indicate the need for more information to be provided to shippers (for instance where there is not a mandatory premium shippers may bid at too low a price level) and/or TSO's may need to consider the possibility of a

mandatory premium. (Although, this may have been part of the pre-bid discussions to rule out ineffective incremental auctions.)

- This is perhaps another subject for best practice discussion within ACER's Tariff WG.
- Consideration should be given as to whether it might be worthwhile to also monitor the existence (or not) of a mandatory premium as well as any auction premium to look for correlations with pass/failure of the test.

Potential correlations with other indicators

- These datasets should be considered in conjunction with those IPs that have exhibited contractual congestion or very high levels of utilisation.

Practical considerations and previous usage

- Data volumes should not be large but ACER will be dependent of TSO/NRAs being diligent about reporting. ACER should construct a simple record system to facilitate the processing.

Implementation costs

- Likely to be minimal. Relatively straightforward data collection and processing.

Evaluation

This indicator is a very straightforward measure of whether Incremental Capacity projects are able to progress. Assessing whether the individual and combined NRA policy making fairly balances the needs of all 3 groups; TSOs, committing users and the generality of users remains a subjective assessment. These high-level issues (about efficiency of regulatory settlements) have not been considered even if the tariff network code recognises that it is probably not possible to effectively assess where:

- Incremental/ new capacity projects are efficient and financially viable
- Economic test applied to proposed projects is an accurate reflection of their economic feasibility.

The monitoring framework should however highlight differences in treatment by NRAs as a vehicle for ensuring transparency and accountability for the decisions they make in respect of the incremental investment parameters (including f and the underlying parameters including WACC, depreciation and revaluation rules).

Desired effect: Economic test applied to proposed projects is an accurate reflection of their economic feasibility

Indicators	Description
INC.3 **Range of f-factor values used in the calculation of the economic test**	Article 43 of the TAR network code defines the f-factor as the percentage of the increase in allowed revenue (due to the incremental allocation) to be committed to via the auction or "open season" process.

Calculation principles

Each Regulator should report its cross-border (CAM) incremental capacity projects unless an agreement is reached that a lead NRA is appointed for reporting purposes:

- NRAs should report the f-factors applicable at each side of the IP and the combined f-factor as well as the basis under which they have been combined to generate a combined f, including an account of any inter-TSO commitments relevant to the attribution of the commitment.

Strengths	Weaknesses
• Simple and straightforward values • Easy to calculate the range	• Underlying reasons for differences will be needed for any meaningful evaluation

<table>
<tr><td></td><td>• The necessary data will be harder to collect and will be more subjective</td></tr>
<tr><th>Data requirements</th><th>Data sources</th></tr>
<tr><td>• Individual records for each Incremental project that progresses to Binding Phase</td><td>• The data for the f values individually and combined will be published under Article 20c(5) of Commission Regulation (EU) No 984/2013
• In the case of a redistribution of revenue between TSOs NRA co-ordinated approval is required and so the necessary information is known to the NRA’s even if it is not formally published.</td></tr>
<tr><th colspan="2">Interpretation and thresholds</th></tr>
<tr><td colspan="2">• Legitimately f-factors either side of an IP might be very different representing very different risk distributions between TSOs/committing network users/generality of network users. Simple tabulation of different f-factors will indicate whether there is consistency of application both within a TSO/NRA (for different IPs) and across different NRAs. Consistency should not be expected but it is important that the reasons for differences are well understood.</td></tr>
<tr><th colspan="2">Potential correlations with other indicators</th></tr>
<tr><td colspan="2">• These datasets should be considered in conjunction with those IPs that have exhibited contractual congestion or very high levels of utilisation.</td></tr>
<tr><th colspan="2">Practical considerations and previous usage</th></tr>
<tr><td colspan="2">• Data volumes should not be large but ACER will be dependent of TSO/NRAs being diligent about reporting. ACER should construct a simple record system to facilitate the processing.</td></tr>
<tr><th colspan="2">Implementation costs</th></tr>
<tr><td colspan="2">• Likely to be minimal. Relatively straightforward data collection and processing.</td></tr>
<tr><th colspan="2">Evaluation</th></tr>
<tr><td colspan="2">This monitor for Incremental Capacity projects gives an indication of the possible risks for the three groups (TSOs, committing users and the generality of users) and the relative risks associated with different IPs and across different NRA’s.
Assessing whether the individual and combined NRA policy making fairly balances the needs of all 3 groups; TSOs, committing users and the generality of users remains a subjective assessment. These high-level issues (about efficiency of regulatory settlements) have not been considered even if the tariff network code recognises that it is probably not possible to effectively assess where:
• Incremental/ new capacity projects are efficient and financially viable
• Economic test applied to proposed projects is an accurate reflection of their economic feasibility.
The monitoring framework should however highlight differences in treatment by NRAs as a vehicle for ensuring transparency and accountability for the decisions they make in respect of the incremental investment parameters (including f and the underlying parameters including WACC, depreciation and revaluation rules).</td></tr>
</table>

A.2.4. NC BAL Indicators

Desired effect: TSO conducts market-based balancing (i.e. through standardised traded products).

Indicator	Description

BAL.1 Share of TSO balancing through short-term standardised products vs. balancing services contracts	According to BAL NC, TSOs should undertake balancing actions using either: a) Short term standardised products traded on a platform b) Balancing services contracted through a public tender (option a) should have priority) Indicator measure share of balancing under options (a) and (b), respectively, as a share of total balancing performed by the TSO.

Calculation principles

- Total TSO balancing is the sum of (a) short term standardised products traded by TSO on a trading platform; and (b) balancing actions undertaken through contracted balancing services. Primary data source for TSO balancing trades is REMIT (see Data sources below), which should contain all balancing trades of the TSO on organised marketplaces.
- Identifying balancing trades in REMIT requires the following main steps. First, the product needs to be defined. We propose to define balancing trades as trades for gas delivered on gas day D concluded after 1pm on gas day D-1. Specifically, transactions with the following parameters[56] must be selected from the REMIT data:
  - Delivery must take place on a given gas day D (field no. 49/50 in the REMIT reporting format);
  - Transaction must be concluded after 1pm on day D-1 (field no. 30);
  - Settlement method must be physical (field no.26);
  - TSO is the designated market participant, counterparty or beneficiary (field nos. 1 & 8).
- Data on balancing actions undertaken through balancing services contracts may not be publicly available but ACER can request this information based on REMIT provisions.

Strengths	Weaknesses
• Direct measure of progress towards one of the main goals of BAL NC - to encourage balancing actions through trading platforms	• Some data on contracted balancing services may have to be collected directly from TSOs. Based on BAL NC requirements, TSO may only publish aggregate annual data on its balancing actions. An annual monitoring of the indicators would be possible in the absence of such data; however more granular data would be required to observe any daily or seasonal patterns.

Data requirements	Data sources
• Market based (i.e. trading platforms) transactions undertaken by TSO for balancing purposes • Balancing actions using contracted balancing services	• Transactions from organised markets should become available through REMIT in the first half of 2017. • Data on contracted balancing services can also be requested (via a reasoned request) by ACER based on REMIT provisions. A request could potentially be made for the data to be provided annually for market monitoring purpose. • A potential (albeit less practical) alternative is to source the data directly from TSOs / trading platforms. • BAL NC requires TSO to publish information on balancing actions annually. Some TSOs may

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[56] We refer to data fields and specifications of REMIT data established in the REMIT Transaction Reporting User Manual (TRUM).

	publish information on a more disaggregated basis. Some TSO already publish such information.[57] In this case the data would need to be collected from different sources.

Interpretation and thresholds

The BAL NC states that TSOs should prioritise the use of trading platforms (and particularly title products) for balancing purposes. The proposed indicator may reveal that a relatively small portion of balancing is conducted through trading platforms. Such indicator values may need to be interpreted with caution. They may, for example, reflect the TSO's inability, rather than unwillingness to balance through the market. Some of the possible explanations are:

- the trading platform is insufficiently liquid to meet the TSOs balancing requirements; or
- short-term standardised products available are inappropriate for balancing.

Potential correlations with other indicators

- Significant correlation is likely between % of TSO balancing through traded products and short-term balancing market liquidity indicators. TSOs should use traded products unless these are not suitable or liquid enough. Therefore in liquid markets, the TSO should be able to conduct most of the balancing actions on the trading platform.
- Note that this correlation does not imply a one-directional causality rather the relationship is likely to be circular. Increased TSO trading through markets should help increase liquidity but also increased liquidity should permit the TSO to conduct its trades in the marketplace.

Practical considerations and previous usage

n/a

Implementation costs

- Minimal-to-moderate, assuming relevant data is readily available. We estimate that annual processing the REMIT data and development of indicators would require up to 5 full-time equivalent (FTE) days.
- No out-of-pocket costs incurred.
- No specialised expertise required.

Evaluation

This is a simple and relatively clear measure of one of the BAL NC's principal objectives: to get TSOs to do most of the balancing through short term products on trading platforms where possible.

Desired effect: shippers perform primary balance and TSO has 'residual' balancing role.

Indicator	Description
BAL.2 TSO balancing as % of total balancing requirement	Measure of the 'residual' balancing volume undertaken by the TSO. One of desired effects of the BAL NC is to reduce the amount of balancing actions undertaken by the TSO by encouraging shippers to balance their own portfolios.

Calculation principles

% balancing undertaken by TSO = total quantity of gas traded by TSO for balancing purposes / total volume of balancing trades

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[57] For example, Gasunie (Dutch TSO) publishes data on balancing actions undertaken on the market: http://www.gasunietransportservices.nl/en/transportinformation/balancing/balancing-actions-emergency-calls

- As for the previous indicator, balancing trades could be defined as follows:
    - Delivery must take place on a given gas day D (field no. 49/50 in the REMIT reporting format);
    - Transaction must be concluded after 1pm on day D-1 (field no. 30);
    - Settlement method must be physical (field no.26).
- Total TSO balancing trades should include both balancing gas procured/sold through organised marketplaces and gas provided under contracted balancing services. These figures should be available from the calculation of the previous indicator on TSO balancing actions.
- If adding the TSO balancing figures from the previous calculation with the filtered data for all balancing trades care needs to be exercised not to double count TSO balancing trades.
- Total volume of balancing trades is calculated as the sum of all balancing transactions by TSO and non-TSO participants. When both counterparties are non-TSO, matching buy-sell transactions must be identified and their respective volumes counted only once.
- Calculations can be done on a daily or annual basis.

Strengths	Weaknesses
• Direct measure of the proportion of total balancing trades associated with the TSO and thus an indication of its 'residual' balancing role.	• A clear definition for identifying balancing trades does not exist. Therefore an assumption has to be made about what constitutes a balancing trade. • Identifying total volume of balancing trades is more difficult when transactions of non-TSO entities must also be considered.

Data requirements	Data sources
• Total volume of gas procured by TSO for balancing purposes. • Total volume of balancing trades executed by all market participants	• The proposed primary data source for this indicator is REMIT, which should provide sufficient detail on balancing transactions of both TSOs and market participants. • Data on TSO contracted balancing services may have to be requested by ACER from TSOs separately.

Interpretation and thresholds

- Balancing network code is designed to generate a "small" residual balancing role for TSOs. Ideally the frequency of TSO interventions would be minimal, and generally sizes (quantity of gas) of balancing actions should be low, although some balancing role for the TSO is likely to remain.
- It is difficult to be precise about how "small" and "low" should be defined as a success criteria. Therefore it might be appropriate to set a benchmark derived from balancing markets that are assessed as functioning reasonably well (e.g. GB) and then seek to make comparisons with other countries. Further analysis and enquiry might then be necessary to explain the differences.
- It is important to consider that balancing requirements can be affected by a range of factors. Some of these can be external (such as extreme weather patterns affecting demand), quality of TSO off-take forecasts or other parameters in the balancing regime (e.g. imbalance charges). These factors may vary across markets, therefore a single threshold may not be appropriate.

Potential correlations with other indicators

- This indicator is only part of the greater picture and needs to be considered together with the other balancing indicators. In particular this can be considered together with liquidity indicators of the short-term balancing market. More liquid markets would likely imply that market participants trade more frequently but also part of the liquidity of the balancing market may be driven by the TSO's involvement.

Practical considerations and previous usage

n/a

Implementation costs
• Minimal-to-moderate (depending on the data availability and processing required). We estimate that processing the REMIT data would require up to 5 FTE days. Since some of the calculations/work are also needed for other indicators, costs may be lower (per indicator) when multiple indicators are prepared jointly. • No out-of-pocket costs incurred. No specialised expertise required. • Higher costs will be incurred if the data is not available on a centralised database and needs to be collected from different sources (trading platforms, TSO websites) and processed into a standardised format.
Evaluation
This is a relatively simple indicator that provides an indication of how significant the TSO's presence is in the balancing market, and directly measures of the desired effects of NC BAL.

Desired effect: TSO should achieve an end of day linepack position consistent with economic and efficient operation of the transmission network.

Indicator	Description
BAL.3 Physical linepack day-on-day changes	Difference between daily physical inputs onto and daily physical offtakes out of the transmission system.

Calculation principles
• Measured directly by TSO-provided estimates of the difference in linepack at the start of the day and the end of the day. Daily data can be aggregated. Average change over a period (daily, seasonal or an annual average) gives an indication of the extent to which the system has been in balance. • Data may show or allow calculation of other sub-indicators based on actual changes, absolute changes and percentage changes.[58] • A useful indicator would be the % change in linepack, benchmarked across European TSOs.

Strengths	Weaknesses
• Data provides the most obvious indication about whether overall inputs and offtakes are close and therefore the system is "in balance".	• Data is currently not available in a standard format; thus it will need to be derived by TSOs and collected by ACER.
Data requirements	**Data sources**
• Linepack levels (i.e. quantity of gas in the system) at the start/end of each day.	• Data would have to be collected from TSOs websites or requested directly from TSOs[59] • NRAs

Interpretation and thresholds
• Generally day-on-day physical linepack changes should be small, consistent with the objectives of BC BAL, reflecting the aggregate effects of network users (assuming the TSO generally makes no intervention). Occasionally, however, operational issues may require the TSOs to deviate from this (e.g. it may be better

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[58] The absolute change refers to the magnitude of the day-on-day change (that is its size ignoring its direction so linepack changes of -2 and +3 would contribute respectively 2 and 3 to any calculations).

[59] TSOs will need to develop methodologies (where they do not already exist) and outputs will need to be derived from operational systems

to keep more gas in the system in winter to provide greater resilience). Thus while there may larger periodical shifts in linepack levels, generally linepack changes should, particularly when averaged over a period, be relatively small.

- TSO interventions in the market might be considered for two purposes: (1) addressing overall shipper imbalances; or (2) to effect other operational requirements. ACER could monitor and analyse daily data in individual countries to further its understanding of balancing regime functioning. Unless the specific circumstances in a country warrant consideration in the monitoring report the simple indicator of performance over relevant periods (probably the year) would be reported.

Potential correlations with other indicators

- Balancing interactions are complex. Considerable analysis and interpretation is necessary to understand whether the regime is functioning well in each country. No single indicator can provide a reliable indicator of balancing regime health and proper functioning. To some extent all the indicators in this section can be considered together.
- For example, linepack changes should be considered alongside the volume of TSO balancing actions to determine whether minimising TSO balancing intervention is achieved by allowing greater linepack variation. In addition, some TSOs may offer a linepack flexibility service.
- The differences between aggregate system imbalances and linepack changes represents the difference between what has actually happened physically on the system in a day compared with the commercial representation on the day. TSOs may, for example, use Operational Balancing Agreements (OBA), which would result in a mismatch between physical gas flows and commercial allocations.

Practical considerations and previous usage

Once collected, the data sets will lend themselves to some easy summary statistics and comparative analysis but great care will be needed to draw inferences in the context of any assessment of overall regime functioning.

Implementation costs

- Most analysis and monitoring activity in this area will be conducted at a national level and will be an essential part of ensuring locally functioning markets. For some TSOs this may require developing new methodologies and monitoring techniques to derive the quantity of gas in the system at any one time. ACER can collect data from TSOs/NRAs.
- Costs will arise for the collation and high-level analysis of the data at the European level. Given that the data will be collected from different sources and processed centrally this might involve moderate costs.

Evaluation

This indicator helps to build a complete picture of the operation of the balancing regime. It is the only proposed NC BAL indicator that focuses on the physical condition of the system. It also helps to understand how aggregate imbalances of network users are addressed by the TSO.

Indicator	Description
BAL.4 Balancing net neutrality analysis (expressed in €/ MWh)	Indicator measures the performance of the balancing regime. The Balancing regime will create a series of cash-flows associated with the purchase and sale of gas. These cash-flows include those associated with TSO purchase and sale of gas for balancing purposes and the cash-flows associated with imbalance cashout. The proposition is that if the regime is delivering appropriate incentives than the net cash-flow associated with these transactions should be close to zero. Neutrality credits/debits will be redistributed to network users in accordance with the Balancing Neutrality Methodology defined in accordance with the balancing network code.

Calculation principles

This is a basic measure of net cash-flow associated with four blocks effectively:

Net cash flow = *Income from TSO balancing gas sales - Cost of TSO balancing gas purchases + Income from shipper payment for gas via imbalance cashout short positions - Payments to shippers for gas via imbalance cashout long positions*

- The data required for TSO balancing activity should include both short term standardised products and any balancing services contracts. The data and calculation of cash flows associated with TSO balancing actions (both gas sales and purchases) should be available from the calculation of indicators BAL.1 and BAL.2.
- The indicator could be reported as a single number over a monthly period (as shippers are also charged imbalance charges on a monthly basis). It would be useful however to have daily data for each of the 4 cash flow blocks as this would provide many insights into the functioning of the balancing regime.
- The data for imbalance charges needs to be provided separately for cashout long positions (TSO payments) and cashout short positions (TSO income). However the data is only needed for aggregate shipper imbalances on a given day split by long/short positions (i.e. individual shipper imbalances are not required).
- For each day the data table below should be available for each balancing zone. Whilst the energy quantity is not required to construct the primary indicator it will have major value to assist interpretation of the functioning of the regime.

Neutrality component	Cashflow	Energy quantity
TSO Balancing gas purchases		
TSO Balancing gas sales		
Imbalance cashout (shipper short positions)		
Imbalance cashout (shipper long positions)		

- To deliver a comparator between balancing regimes the net neutrality cashflow should be divided by the balancing regime throughput to derive a €/MWh measure. The reporting should report an overall annual value although lower level reporting might provide further insights into the functioning of the regime.

Strengths	Weaknesses
A very good indicator of the overall performance and functioning of the balancing regime	If net cash flows are not close to zero the indicator will not indicate from where deficiencies in the regime arise

Data requirements	Data sources
As defined above. This will include the neutrality account perspective: • volume and revenues of TSO balancing gas sales; • volume and expenditures for TSO balancing gas purchases; • revenues from imbalance short positions; • expenditures to shippers for imbalance long positions. TSO gas sales and purchases should include both transactions through short-term standardised products and balancing services contracts. This should be available from the calculation undertaken for indicators BAL.1 and BAL.2.	Data on TSO balancing transactions executed on organised marketplaces will be available through REMIT. Data on cost and quantity of balancing actions undertaken through contracted balancing services can be requested by ACER from TSOs (via a reasoned request) based on REMIT provisions. Data on imbalance and payments charges may be sourced from TSO websites / NRA (where available). However the data may not be publicly available at the daily level. Additional data submission (to cover aggregated daily imbalance positions) from TSOs/NRAs is likely to be necessary to support both the generation of the indicator and further analysis of the functioning of the regime.

Data should be provided on a daily basis over the reporting period.	

Interpretation and thresholds

- The net neutrality value may provide an indication of how well the regime is functioning. If all is functioning well then this basic financial measure should be close to zero. This is consistent with the idea that network users should face "cost reflective” imbalance cash out prices.
- The magnitude of the number represents the net redistribution between shippers and provides an indication of whether the regime functions in an equitable and non-distortive manner.
- Dividing the net figure over throughput generates a comparator across zones.
- The full daily data set would permit valuable insights into regime functioning and the overall behaviour of the regime. For example even if net neutrality is close to zero over a period is the same true on a daily basis? Is the aggregated imbalance performance consistent over all days in the year and if not what are the commercial and physical realities that might have influenced this?
- The interpretation of the indicator will need to take into account both operational circumstances (conditions on the day) and the wider market characteristics (e.g. market liquidity).

Potential correlations with other indicators

- If either net neutrality over the period is not close to zero, or substantial net costs/revenues are generated on certain days then wider measures of regime performance will need to be assessed. For example, the TSO balancing actions would need to be considered to determine whether they are performing in an efficient manner (i.e. playing a residual balancing role and transacting close to market prices). Therefore there are linkages between this indicator and the other BAL indicators.

Practical considerations and previous usage

- Data required for this indicator is not publicly availability at the moment in many balancing zones. At the national level this kind of analysis has been performed. In GB neutrality was heavily scrutinised during the evolution of the balancing regime and informed the both the development of the imbalance cashout pricing, TSO incentives and the TSO’s operational balancing decision making process. Provision of relevant basic neutrality data will ensure that that the regime both develops and operates in an equitable manner with no material distortions.

Implementation costs

- Implementation costs are likely to fall into the moderate category. Costs will be somewhat mitigated by the fact that two out of the four cash-flow datasets needed should be constructed for calculating other indicators.
- Aggregated imbalance data is currently not widely available publicly. This represents a major, and unsatisfactory, gap in currently available information. The imbalance cashout data should be readily available in TSO systems. The main challenge will be make this data available to ACER. Implementation costs can be kept low if a standard reporting framework is developed to make it easy for ACER to process received information.

Evaluation

Probably the best single indicator of whether a functioning short term gas balancing market exists in a balancing zone.

A.2.5. NC TAR Indicators

Indicators TAR.1 to TAR.3 in this section rely on stakeholder scoring of different aspects of the tariff-setting process through annual surveys. The indicators are closely related and it makes practical sense to combine these into a single multi-section annual survey. We have however proposed three separate indicators as we believe it is useful to be able to distinguish between the different aspects of the tariff process that these indicators measure:

- TAR.1 measures the overall robustness of the tariff methodology and decision making process;
- TAR.2 measures the availability of information to enable market participants to replicate current tariffs; and
- TAR.3. measures whether there is sufficient and usable information to enable market participants to project future tariffs.

Desired effect: Transparent and reasonably cost-reflective tariff methodologies are implemented, with minimal cross-subsidy between users.

Indicator	Description
TAR.1 Stakeholder assessment of robustness of decision making and overall process associated with establishment of tariff methodology	Qualitative scoring of robustness of decision making and overall process associated with establishment of tariff methodology.

Calculation principles

- Each year, the major European associations and other stakeholders[60] should be invited to rate the robustness of the tariff setting process in each country on a subjective multi-point scale ranging through: Completely satisfied—Partially Satisfied—Partially dissatisfied—Completely dissatisfied.
- For any country/TSO that does not get a “Completely satisfied” rating the respondent should provide at least a comment justifying his rating. The survey should be completed annually although recognising that methodology reviews are less frequent.
- The survey should be relatively short but aim to gauge stakeholder views on different aspects of the tariff methodology. An example structure is presented below.

Subject	Assessment (CS/PS/PD/CD)	Explanation/ Rationale
How satisfied are you with the robustness of the decision making for setting tariffs?		
How satisfied are you that the stated objectives for gas transmission tariffs are met through the current tariff methodology in your country?		

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[60] This might be one of the rare cases where an external assessment is required because the monitor is so subjective. Whilst the survey should try to gauge the views of as many stakeholders as possible it is especially important to encourage the major European associations to submit responses to the survey each year.

How satisfied are you with the process to establish the tariff methodology? (particularly relevant when changes in the tariff methodology are implemented)		

- Indicators TAR.1 to TAR.3 could be combined into a single three-part annual survey.

Strengths	Weaknesses
• Relatively cheap and easy to implement especially if assessment is integrated into a larger stakeholder survey • Stakeholder survey can also bring out useful information for identifying potential shortcomings of the tariff methodologies in different countries.	• Subjective data requiring user inputs • Response rate for some MS may be low. Responses from major European associations should be encouraged as their membership is likely to cover a majority of EU Member States.

Data requirements	Data sources
• Stakeholder scoring of NRA decision making and assessment of overall process of choosing the tariff methodology	• Survey: inputs should be canvassed from market participants particularly the major European associations • The survey should be open so that any stakeholder should be able to respond and provide inputs

Interpretation and thresholds

- Whilst only a subjective assessment, the indicators should provide an indication of progress achieved by the implementation of the NC TAR from a stakeholder perspective. To support this analysis a “baseline” position should ideally be requested shortly after the TAR NC is finalised but before the process of consultation about methodologies is made. The questionnaire should then be repeated after the consultations to select the methodologies have been conducted. It should be recognised however that some countries may have already incorporated some of the TAR NC proposals into their tariff methodology.

Potential correlations with other indicators

- This indicator should be considered together with the assessments undertaken for TAR.2 and TAR.3 in this section.

Practical considerations and previous usage

- It will be important to assess progress over the first few years of tariff implementation. The survey will be run annually so that it reflects the stakeholder perception of the last methodology consultation in each country.

Implementation costs

- The individual costs for this indicator are likely to be minimal due to the simple nature of the survey which requires little time spent on design and processing responses. The main costs are likely to arise due to the need to actively solicit responses from stakeholders. The costs per indicator will be further reduced if this is incorporated into a larger stakeholder survey.

Evaluation

Provides a stakeholder assessment of the effectiveness of the tariff methodology and robustness of NRA’s decisions post-code implementation compared with pre-code status.

Indicator	Description

TAR.2 **Assessment of availability of all models and data to enable replication of actual tariffs**	Survey-based assessment of models and data availability. It seeks to measure whether market participants have sufficient information to understand and replicate the calculation of current tariffs.

Calculation principles

- Similar to TAR.1, this should be surveyed with inputs from major European Associations and other stakeholders. The indicator should be assessed for two areas (spreadsheet model and full input data availability). These should be assessed as Completely Available (CA), Partially Available (PA) or Unavailable (U). Comments must be provided to prove justifications for any other response than CA.

Subject	Assessment (CA/PA/U)	Explanation/ Rationale
Availability of all spreadsheet models used for setting tariffs		
Availability of all input data to enable replication of tariffs		

- Can be combined together with indicators TAR.1 and TAR.3 into a single three-part annual survey.

Strengths

- Relatively cheap and easy to implement especially if assessment is integrated into a larger stakeholder survey
- Provides easy identification of stakeholder views about transparency

Weaknesses

- Subjective data requiring user inputs
- Response rate for some MS may be low. Responses from major European associations should be encouraged as their membership is likely to cover a majority of EU Member States.

Data requirements

- Stakeholder assessments and commentary on data availability

Data sources

- Survey
- European associations should be encouraged to provide inputs each year
- Any stakeholder should have opportunity to submit its assessment together with rationale/explanation of any deficiencies

Interpretation and thresholds

- The NC TAR should provide full transparency and replicability of the charges derived in accordance with the detailed cost allocation methodologies i.e. that part of the TSOs allowed revenue referred to as Transmission Services (in the latest publicly available tariff code proposal – 26 December 2014 ENTSOG submission).
- The survey, however, should cover all charges faced by network users associated with access to the European transmission network. It therefore will provide valuable insights into the transparency and replicability of all transmission tariffs.
- Compared to TAR.1 and TAR.3 which require subjective rating by stakeholders, this indicator should provide a more factual assessment regarding the availability of information

Potential correlations with other indicators

- Indicator should be considered in conjunction with TAR.1 (above) and TAR.3 (below).

Practical considerations and previous usage

- Establishing baseline position before entry into force of NC TAR would be useful to assess effectiveness of network code implementation by comparison with future reporting from NRAs/wider actors.

Implementation costs

- The individual costs for this indicator are likely to be minimal due to the simple nature of the survey which requires little time spent on design and processing responses. The main costs are likely to arise due to the need to actively solicit responses from stakeholders. The costs per indicator will be further reduced if this is incorporated into a larger stakeholder survey.

Evaluation

Recommended indicator which will provide evidence of the transparency and replicability of tariff arrangements. Easy data to collect and of sufficient importance that European institutions will invest necessary time to research and submit inputs. ACER will need to interpret differences in stakeholder opinion but this will inform whether increased transparency obligations are necessary.

Indicator	Description
TAR.3 Stakeholder assessment of information availability to enable tariff predictions	Qualitative assessment of availability of information to enable network users to predict future tariff levels (rating; qualitative scoring).

Calculation principles

- Necessitates the use of a survey/questionnaire. The questionnaire will afford an opportunity for stakeholders to indicate any deficiencies in the TSO provision of information to support future projections.
- The responses should indicate whether the respondent is Completely Satisfied - Partially Satisfied - Partially dissatisfied—Completely dissatisfied with the TSO’s provision of projected information. Where respondent is not completely satisfied an explanation respondents must be provided. An example of the structure of the survey is presented below.

Subject	Assessment (CS/PS/PD/CD)	Explanation/ Rationale
How satisfied are you with the range of information provided by the TSO to enable future tariff projections?		
How satisfied are you with the quality of the information provided by the TSO to enable future tariff projections?		
Overall how satisfied are you that based on all information available a reasonable future tariff level prediction can be made?		

- Indicators TAR.1 to TAR.3 could be combined into a single three-part annual survey.

Strengths	Weaknesses
• Relatively cheap and easy to implement especially if assessment is integrated into a larger stakeholder survey • Provides easy identification of stakeholder views about predictability of transmission tariffs.	• Requires subjective assessment by stakeholders • Response rate for some MS may be low. Responses from major European associations should be encouraged as their membership is likely to cover a majority of EU Member States.

Data requirements	Data sources
• Stakeholder responses including justification as illustrated above	• Survey: responses from stakeholders • European associations should be encouraged to provide inputs each year

	• Any stakeholder should have opportunity to submit its assessment together with rationale/explanation of any deficiencies

Interpretation and thresholds

- To support this analysis, a “baseline” position should be requested from stakeholders before the NC TAR comes into force. The baseline may not provide a completely accurate view of the impact of the NC TAR implementation as some countries may have already incorporated some of the TAR NC proposals into their tariff methodology. The baseline should be able to identify MS which lag behind in terms of availability of information and compare how this changes after the implementation of the NC TAR.
- Predicting future charges will depend upon some projections (e.g. total TSO allowed revenues). NRAs/TSOs should have a role in providing some key input projections (and associated sensitivities). However not all required inputs (e.g. gas prices and network user capacity bookings) might be reasonably forecastable by the TSOs/NRAs (at least more than a year ahead) and therefore network users must be expected to make their own forecasts and input them to the models as appropriate to derive their own projections of tariffs.
- Many inputs to the tariff methodologies may become increasingly uncertain going forward, particularly such inputs as capacity bookings (which might become more variable given the commercial incentives that are being introduced that will inevitably promote short-term optimisation over longer term bookings for many users). Even allowed revenue streams may increase in uncertainty including, for example, some increased revenue reconciliation adjustments because of increased volatility of collected revenues. Therefore even if tariff predictability is a desired effect of the TAR NC it may be difficult for network users to reasonably predict tariff levels. The assessment should try to identify where lack of predictability results from unavailability or poor information provided by the TSO or from unforeseen changes in the input data used for calculating tariff levels.

Potential correlations with other indicators

- Indicator should be considered in conjunction with TAR.1 and TAR.2.

Practical considerations and previous usage

- ACER’s interpretation of the survey results will need to consider what reasonably can be provided to assist network user tariff forecasting. Stakeholders will have high expectations about the accuracy of forecasts of key inputs but the complex interactions within the regime will make Tariff predictions in the future much more difficult. TSOs/NRAs have a role to ensure network users are properly supported where TSOs/NRAs are best placed to provide data to support predictions. However network users must accept that TSOs/NRAs will not be able to provide all necessary data to high accuracy levels.

Implementation costs

- Costs are likely to be minimal – due to the simple nature of the survey which requires little time spent on design and processing responses. The main costs are likely to arise due to the need to actively solicit responses from stakeholders. The costs per indicator will be further reduced if this is incorporated into a larger stakeholder survey

Evaluation

The indicator will provide data on stakeholder perspectives about the ability to forecast tariffs. Stakeholder feedback will help to provide explanation of potential deficiencies. Stakeholder comments to provide rich feedback to support monitoring report development and to inform whether regime needs to evolve to change obligations on TSOs/other actors that could provide relevant data to support better predictability of tariffs.

Easy to process data into summary data for each tariff regime (e.g. % of respondents completely satisfied).

Indicator	Description

TAR.4 **Pass/fail compliance with cost allocation test**	Performance against chosen cost allocation test. It aims to demonstrate the degree of cost-reflectivity of the cost allocation methodology.

Calculation principles

- Cost allocation test to be calculated according to the formula provided in the TAR NC. The test as defined in the Draft TAR NC submitted by ENTSOG for ACER's opinion is:

$$\text{Fail if } \frac{|(R{:}CD)_{DM} - (R{:}CD)_{CB}|}{\frac{1}{2}\{(R{:}CD)_{DM} + (R{:}CD)_{CB}\}} > 10\%$$

Where $(R: CD)_{DM}$ and $(R: CD)_{CB}$ are the revenue-cost ratios of domestic and cross-border network users, respectively.

- Assessment should look both at the outcome of the test and the derivation of the values used in the test.

Strengths	Weaknesses
• Test is fully specified in the draft NC TAR • Test results can be provided by NRAs	• Test results depends on the cost drivers chosen and may be prone to manipulation

Data requirements	Data sources
• Outcome of the test (pass/fail) • The values for the four measures used to derive the test (revenues and cost driver value for both domestic and cross-border users)	• NRAs to provide outcome and values used in the test • A justification where test fails but resulting tariffs are implemented should also be provided.

Interpretation and thresholds

- The test is designed to confirm that tariffs do not distort pricing and that a fair proportion of revenue split is achieved over domestic and cross-border flows. However the underlying cost drivers within transmission networks are not obvious. The data requirements therefore include the 4 data items that enable the two ratios in the text to be calculated.
- ACER's assessment must determine whether the revenue and cost drivers used by the NRAs in the calculation of the test are reasonable.

Potential correlations with other indicators

- The revenues and cost drivers for domestic and cross-border network users could be compared with the respective actual or projected flows and bookings at cross-border or domestic entry/exit points.

Practical considerations and previous usage

- Whilst the revenue apportionment between cross-border and domestic is prescribed explicitly in the network code the basis for calculating the cost driver measure is not. The cost drivers need to be combined to describe a single measure and then relevant values for domestic / cross-border users must be derived. ACER may wish to encourage transparency about how the methodology for the cost driver measure is applied. This is perhaps another subject for best practice discussion within ACER's Tariff WG.

Implementation costs

- Minimal – the NRAs should be able to provide the test results for each individual MS.

Evaluation

Recommended because it is the only easily available indicator of the cost-allocation performance of the tariff regime. Summary data (the 4 inputs to the test) will be available from NRAs when the tariff methodology is approved after the NC TAR is implemented and at each subsequent tariff methodology review.

The test only applies to Transmission Services Revenue and can only be assessed in this context.

Desired effect: TSOs are able to recover allowed revenues without significant and/or persistent under- and over-recovery

Indicator	Description
TAR.5 **Revenue Reconciliation parameters and outcomes**	Over or under recovery of transmission services revenue is to be redistributed/recovered via adjustments to transmission services charges. Four underlying parameters are suggested: 1. Underlying allowed revenue requirement 2. Frequency of revenue reconciliation 3. Lag of reconciliation 4. Reconciliation amount - Absolute level and proportion of TSO revenue

Calculation principles

The NC TAR provides the basis for all information required in this section:

Subject	Outcome	Explanation/ Rationale
Frequency of revenue reconciliation (no. of times/year)		
Lag of revenue reconciliation (years)		
Reconciliation amount (€)		
Underlying allowed revenue requirement (€)		

- The reconciliation amount is the financial value of the Transmission Services Revenue under or over-recovery in the last available accounting period for which the outcome is known. The underlying allowed revenue requirement is the Transmission Services Revenue requirement as used in the most recent tariff setting process.
- An explanation/rationale field should be provided to enable any other supporting information e.g. confirmation of the period to which the reconciliation amount relates and that associated with the underlying allowed revenue requirement.

Strengths	Weaknesses
• Data is readily available to TSOs/NRAs • Data is required by NC TAR	• No standardised reporting or data source available to ACER • Readily available data (i.e. required by the NC TAR) only relates to Transmission Services Revenue

Data requirements	Data sources
• Data is required for all four parameters specified above	• NRA/TSO

	The data should be publicly available but may not be easily accessible. Processing can be facilitated if TSOs/NRAs agree to provide the data in a standardised format.

Interpretation and thresholds

- Parameter 1 indicates the underlying revenue requirement. This should cover the revenue that the TSO should receive for its regulated activities in the particular year. This should cover all capital costs (return and depreciation taking account of asset revaluation principles), operating costs and any additional incentive adjustments.
- Measures 2 and 3 provide factual data about the implementation of specific NC TAR provisions.
- The lag refers to the time between the tariff under- or over-recovery and its correction later. Shorter lags may imply smaller distortions and cross-subsidies as portfolios change. However some NRAs/TSOs may choose to spread reconciliation over longer periods to smooth pricing impacts (e.g. smoothing last year's over- or under-recovery over a 2 year period).
- The reconciliation amount and the underlying allowed revenue can be used to derive a proportion of the revenue that is to be recovered in a different time period than that in which associated costs arise. Thus the absolute reconciliation quantity and proportion provide evidence of temporal dislocation of revenue recovery and therefore potential cross-subsidies within the tariffs. Large and persistent under- or over-recovery amounts may suggest that tariff are not set at a level that accurately reflects the TSOs annual costs.
- The reconciliation amount would also provide an indication of the part of allowed revenue stream that arises from previous over/under recovery of revenue. Reconciliation sums may be expected to increase as more commercial approaches to capacity booking are adopted in the market place to ensure they remain competitive in the wholesale market.

Potential correlations with other indicators

- Tariff prices are likely to influence booking levels and may subsequently affect flows on the system.
- Changes in booking behaviours, particularly with regard towards shorter term bookings, are likely to exaggerate over and under-recovery issues. There may also be merit in assessing reconciliation quantities in the context of the frequency and extent of tariff revisions. Whilst stakeholders want tariff stability, fixing tariffs, say in advance of the last annual bundled IP auction for any Gas Year, may actually contribute to material over or under-recoveries. Thus there is a trade-off between these two objectives that might warrant ACER investigation when assessing the above indicators.
- This is likely to impact over and under-recovery although comprehensive approaches to analyse these effects is considered to be beyond the scope of the monitoring given the uncertainties associated with the Tariff code to be implemented, the lack of information readily available expected from NC TAR and the complexity of analysing the data.

Practical considerations and previous usage

- Data submission needs to define, for example, the relevant periods that reconciliation sums relate to and the period to which the underlying allowed revenue relate. The tariff reconciliation provisions only correspond to Transmission Services Revenue. ACER may wish to explore revenue recovery issues associated with Dedicated Services where these might represent a significant proportion of the TSOs allowed revenue stream.

Implementation costs

- Gathering and interpreting the relatively detailed data for this indicator is likely to incur moderate costs.
- Costs could be reduced if reporting of data is encouraged via NRA annual reporting.

Evaluation

Provides clear indication of how concrete provisions of NC TAR have been implemented and how the regime is performing in respect of revenue reconciliation.

Indicator	Description
TAR.6 Multipliers applied by each TSO	Multipliers applied by each TSO to[61]: 1. Quarterly standard capacity products 2. Monthly standardised capacity products 3. Daily standard capacity products

Calculation principles

- Data for each TSO should be gathered in the following format:

Multipliers	Values for each time period in gas year	Explanation/ Rationale
Quarterly	Each of Q1/Q2/Q3/Q4	
Monthly	Each of M1/…../M12	
Daily	Each day	

- NC TAR is not prescriptive and so different factors could apply for Entry and Exit (or even could be determined on a specific IP basis).
- Various formulations could be made to measure the divergence and a good test statistic could be derived by summing and squaring the differences in proportions for each standard product.
- For example, suppose the Multipliers for Quarterly Capacity are defined as $M_{i,j}$ where i = 1,..4 for quarters and j = 1, 2 for each side of the IP. The proportions of each M on each side can be calculated as:
    - $P_{i,j} = Mi,j/(M_{1,j} + M_{2,j} + M_{3,j} + M_{4,j})$ for each quarter I and each IP side j.
    - A measure of the extent of the mismatch could then be defined as $(P_{1,1}-P_{1,2})^2+(P_{2,1}-P_{2,2})^2+(P_{3,1}-P_{3,2})^2+(P_{4,1}-P_{4,2})^2$.
    - This statistic could then be ranked for all IPs to identify the IPs most likely to have bookings that might not be closely aligned with those that underpinned the separate tariff derivation of component prices either side of the IP.

Strengths	Weaknesses
• Data should be easy to source	• Not clear what the remedy is if multipliers are different

Data requirements	Data sources
• For each reporting year and each TSO the 4, 12, 365 multipliers respectively for Quarterly, Monthly, Daily factors would need to be captured.	• Data should be available from PRISMA for most IPs and could be requested from other platform operators. No standardised data extract is thought to be available. • Alternatively data could be sourced from TSOs or NRAs directly.

Interpretation and thresholds

- Multipliers should be set by NRAs subject to consultation with adjacent NRAs. To assist ACER in its regime monitoring NRAs should be asked to report any instance where the NRA believes that the adjacent zones multiplier is likely to distort capacity bookings and/or flows. This is necessarily a very

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[61] These may not necessarily be the same for entry and exit flows.

subjective test but would provide a starting point for exploring the effectiveness of the multiplier regime (if it is implemented).

- Cross-border flow of gas is most likely to be distorted if multipliers either side of the IP are very different. Note that separate multipliers may exist for entry and exit flows.

Potential correlations with other indicators

- The role of multipliers is crucial and will have a fundamental impact on capacity booking behaviours.
- Unless network users envisage a situation where they won't be able to get capacity (i.e. the site is contractual congested and the CMPs do not effectively provide the confidence that capacity will be available) then all network users should be expected to behave in a way that optimises the financial cost of their capacity bookings (e.g. heavily discounted short-term capacity products can be expected to shift shipper behaviour away from long-term capacity bookings at uncongested points).

Practical considerations and previous usage

- Multiplier data would need to be collected and likely processed within the monitoring system.

Implementation costs

- Overall costs are likely to be moderate. The multiplier data itself is relatively simple to produce. The main challenges relate to the high number of multipliers that apply to different products, different types of the year, etc.

Evaluation

Multiplier information will be one of the major determinants for capacity booking and will therefore have major impacts on TSO revenue recovery as well as broader regime monitoring. It is the combined effects of multipliers either side of the IP rather than their differences that are likely to determine booking behaviour. IPs with the largest differences are likely to require investigation.

A.2. Proposed indicators to measure the achievement of the high-level policy goal of effective competition

A.2.1. Market structure

Indicator	Description
CO.1 Herfindahl-Hirschmann Index (HHI)	A widely used measure of market concentration. HHI captures the level of concentration across the whole market and reflects the individual market shares of all firms as well as the number of firms in a market. HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases. The higher the concentration in a market the higher the potential for market participants to exercise market power.

Calculation principles

- The HHI is calculated by taking the sum of the squares of the respective market participant's market shares:

$$HHI = S_1{}^2 + S_2{}^2 + \ldots + S_n{}^2$$

where S_i is the market share of each company *i.*

- The HHI measure can be calculated for different markets based on the relevant product and geographical definition applicable in each case:
    - Upstream markets (production and imports);
    - Spot / balancing markets;
    - Forward markets;
    - Transmission capacity markets – in this case the HHI refers to the concentration of buyers (capacity holders) rather than sellers.
- The calculation of the HHI for upstream supply of gas is part of the GTM2 set of indicators that will be produced by ACER. This calculates HHI based on the market shares of upstream firms producing or importing gas into each Member State.
- An alternative (complementary) HHI could be calculated based on transmission capacity holdings by different market participants at domestic entry and interconnection points. The data for this would come from the primary and secondary capacity allocation reporting under REMIT.
- Another useful HHI could be calculated for the balancing market to track progress towards the goal of creating more liquid and competitive balancing markets. The balancing market could be defined as all transactions with delivery on gas day D undertaken after 1pm on gas day D-1.
- The HHI calculation needs to take into account cross-ownership between different market players.

Strengths	**Weaknesses**
• Compared with a simple market shares indicator, HHI also accounts for relative market shares. • Can be readily applied to newly created markets (transmission capacity or balancing markets).	• Defining the relevant market is important and can be difficult

Data requirements	**Data sources**
• Individual transaction data (sales/purchases) for all sellers/buyers in a market. • Capacity allocations by shipper	• REMIT data should contain both details on gas transactions and capacity allocations.

Interpretation and thresholds

- The higher the market concentration the higher the HHI (with only one firm in an industry, its market share would be 100% and HHI would equal 10,000).
- HHI indicators are widely used by various regulatory authorities in competition investigations and mergers and acquisition cases. Examples of thresholds used currently or in the past are:
    - ACER's revised GTM2 metric envisages a threshold of HHI below 2,000 for a competitive market.
    - The European Commission in its merger guidelines has considered the following ranges for its competition assessments:
        - HHI below 1,000 should not raise competition concerns,
        - HHI between 1,000 and 2,000 can raise competition concerns if the change in HHI as a result of a merger is more than 250;
        - HHI above 2,000 with an increase in HHI of more than 150 post-merger should raise competition concerns.
- The US Department of Justice (DoJ) also issued guidelines to be used in competition cases. The thresholds were relaxed in 2010 compared to the previous values (see table below).[62]

US Department of Justice HHI thresholds

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[62] US Department of Justice, Herfindahl-Hirschman Index http://www.justice.gov/atr/public/guidelines/hhi.html

Category	Previous threshold	2010 threshold
Unconcentrated market	< 1,000	< 1,500
Moderately concentrated	1,000 – 1,800	1,500 - 2,500
Highly concentrated	> 1,800	> 2,500

- The old DoJ thresholds are also used by FERC when assessing market concentration. FERC decided not to adopt the new DoJ thresholds.[63]
- While the examples of the thresholds used by different competition authorities are useful in giving an indication of how to interpret HHI values, they also point to the fact that there is no universal accepted definition of what constitutes an acceptable level of market concentration.

Potential correlations with other indicators

- Economic theory suggests that higher market concentration would result in higher prices. ACER's current monitoring report illustrates this. However prices in different markets will be affected by several factors apart from market concentration.

Practical considerations and previous usage

- Widely used to measure market concentration in competition cases. Calculating HHIs for the gas wholesale market tends to be more difficult than for other markets.

Implementation costs

- Slightly more time consuming than calculating market shares for a limited number of companies as this requires calculation of market shares for all companies in the market. The overall time cost is likely to be moderate. However ACER already uses HHI in the MMR and will calculate this as part of the GTM2 set of indicators.
- Extra time will be required to calculate the proposed alternative HHIs.

Evaluation

HHI is a useful indicator for assessing the market concentration and competition. It is widely used and understood although excessive reliance should not be placed on the results of this indicator. HHI is a measure of market structure. Even markets that that have an uncompetitive structure may produce competitive outcomes if the threat of competition is sufficiently strong. .

Indicator	Description
CO.2 **Residual Supply Index (RSI)**	Measures the % of total demand that can be met by the remaining supply capacity in the market after eliminating the largest source of supply. It indicates if a certain source of supply is pivotal (i.e. if total demand in a market cannot be met without gas from that source of supply).

Calculation principles

- RSI is calculated using supply capacity values of different suppliers / supply sources:

RSI = (Total supply capacity – Supply source capacity) / Total demand

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[63] McDermott Will & Emery, "FERC Reaffirms Merger Policy; Does not Adopt DOJ/FTC 2010 Horizontal Merger Guidelines" http://www.mwe.com/FERC-Reaffirms-Merger-Policy-Does-Not-Adopt-DOJFTC-2010-Horizontal-Merger-Guidelines-02-27-2012/

- The supply capacity can be determined by the physical production capacity or pipeline/ LNG terminal capacity in the case of gas imports.
- The RSI is part of the GTM2 set of indicators that will be produced by ACER. The RSI proposed for the GTM2 framework measures the supply capacity of different supply sources.
- A similar measure can be calculated at firm level using capacity holdings for each shipper. In this case the measure would take into account the booked capacity at all entry points to a system held by individual shippers (and taking account of the ultimate ownership of each firm). The rational for this measure is to determine whether a single firm could constrain supply to the market due to holding a pivotal share of total transmission capacity. The RSI would be calculated as follows:

  RSI = (Total transmission capacity – Largest capacity holder bookings) / Total demand

- The RSI can be calculated at the daily level in which case it is interesting to observe on how many days in a period a supplier is pivotal as well as the level of dependence on that supplier. The RSI can also be calculated on an aggregated basis for an entire year.

Strengths	Weaknesses
• Provides an indication of the potential to exercise market power due to the fact that a supplier is necessary to meet demand (i.e. is pivotal). • Unlike PSI, RSI provides a continuous measure of pivotality so it gives a better indication of the degree of flexibility in the market • There is flexibility in using thresholds	• RSI relies on supply capacity measures that may be based on unrealistic assumptions. For example, there may be large interconnection capacity between two markets but not enough gas to fill that capacity at reasonable prices.

Data requirements	Data sources
• Pipeline capacity data, LNG terminal capacity • Shipper level capacity bookings • Demand data	• Technical capacity data from ENTSOG TP • Shipper level capacity data from REMIT. This should take account of both primary capacity allocations and secondary trading of capacity. • Demand data from Eurostat/IEA.

Interpretation and thresholds

- If RSI is less than 100 percent of demand, the respective supply source is needed to meet demand, and is therefore a pivotal player in the market
- In the GTM2 set of indicators, a RSI threshold value of 110% is used.
- The RSI metric can be applied to different time frames - daily RSI with a potential threshold that RSI should be more than 110% for 90-95% of the days in a year.
- RSI gives flexibility in using thresholds (unlike PSI) which can be used to account for collusion or operating reserve requirements.

Potential correlations with other indicators

- RSI has been used successfully to predict market power measured by price-cost mark-up.[64]
- RSI can be used in conjunction with HHI. In particular a more robust assessment of competition in a market can be conducted if both market concentration and reliance on a single supply source are considered. Where a supply source is deemed pivotal it is also important to consider if that supply source is competitive. For example, the Irish market is heavily dependent on one supply source (interconnector with GB) however GB market concentration (as measured by HHI) would be relatively low compared to other European gas markets.

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[64] Twomey, Green, Neuhoff & Newbery (2008)

Practical considerations and previous usage
Studies in electricity market have shown that an RSI around 102% will result in market price outcome close to competitive benchmark.[65]
Implementation costs
• We have classified implementation costs for this indicator as moderate. The calculation of the RSI based on supply sources is relatively straight-forward and requires high-level data so the time and effort required should be low. This work would also form part of the GTM2 indicator calculation. • Calculating the proposed secondary RSI would require more time. Data should be readily available although some filtering and processing will be required. Some of the more challenging work such as determining ownership linkages between companies will have to be done for other indicators.
Evaluation
RSI is another wisely used and important indicator for determining if a supplier is essential in meeting demand. It works well as a complement to the HHI indicator because whereas HHI measures market shares based on actual flows or actual capacity holdings, RSI measures the possibility for exercising market power based on potential supply capacity.

A.2.2. Market participant behaviour

Indicator	Description
CO.3 Price-cost margin (PCM)	Measure of mark-up over marginal cost of each supplier/producer.

Calculation principles

- Price cost-margin: (P – MC)/MC, where P is the price received by the producer; and MC is the marginal cost of production/supply.
- Indicator value can measure: (1) mark-up by producers (i.e., initial sale of gas in the wholesale market); and (2) mark-up by traders/wholesale suppliers. Situation when mark-up occurs at both levels, it is referred to as “double marginalisation”.
- ACER already calculates a wholesale-retail mark-up (gas suppliers’ mark-up over wholesale costs factored into post-tax retail prices)[66] by estimating mark-ups using wholesale price indices. That methodology could potentially be refined by examining REMIT transactional data, and determining actual mark-up applied by each market participant.
- For producers, the calculations are more complex and may require certain assumptions (e.g., producers extract gas from several fields simultaneously with distinct cost structures; the cheapest gas fields are developed and produced first; ignore inter-temporal production constraints and costs). Under these assumptions, an increasing marginal cost function in the following form may be specified:

$$TPC'(q) = \kappa + \rho q + \mu \, ln\left(1 - \frac{q}{CAP^{PR}}\right)$$

$$\kappa, \rho > 0, \mu < 0, q < CAP^{PR}$$

where κ is the minimum per unit cost, ρ is the linearly increasing per unit cost, and μ is the maximum per unit production cost.

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[65] Ibid.

[66] ACER’s current methodology of calculating wholesale-retail price mark-up, described in Annex 1 of the 2013 Market Monitoring Report could be easily adapted.

- The above parameters may be approximated by data on fields from similar geological formations; it is not necessary to acquire data on every production field.[67]

Strengths	Weaknesses
• Key indicator of competitiveness with a strong theoretical foundation. • Used by other market monitors when data permits. • Can be used assess the evolution of competition over time, thus it is a useful metric to measure the impact of NC implementation. • Approach has already been applied by academics in gas market modelling.	• Full assessment of competition requires calculating mark-ups over the entire supply chain which is time- and data-intensive (especially, developing marginal cost estimates for each producers). • Indicator values *may* indicate an exercise of market; however in order to reach definitive conclusions, an examination of fundamentals data and system conditions may be required.

Data requirements	Data sources
• Prices received and marginal cost of production for different producers (see discussion above).	• See discussion and source referenced above. • REMIT, if further refinements to ACER's wholesale-retail mark-up are considered.

Interpretation and thresholds

- The theoretical benchmark value is zero (i.e., perfect competition). Practical experience monitoring of other energy markets (e.g., PJM) suggests that in truly competitive markets, mark-ups may be close to this level (although questions have been raised whether marginal costs were accurately calculated).
- Even in a perfectly competitive market, the market price can exceed the marginal cost of the marginal producer (although for relatively short periods) if supply is constrained. Thus indicator values should be over a longer period of time (e.g., a year).
- To assess competition, marginal costs of the marginal producer/supplier are the most relevant; however determining the marginal producer/supplier generally requires assessment of all (most) producers/suppliers.
- Estimating marginal costs of production/supply may be difficult and as such the estimates produced are likely to be an approximation of actual mark-ups. The measure should however provide an indication of market participant behaviour over time and across different markets. It should flag for example instances where similar type of producers charge significantly different mark-ups in different markets.

Potential correlations with other indicators

- Gas market simulation models require the same input data.

A correlation should theoretically exist between market concentration levels and price mark-ups. However this may not always be true. Even where market structure indicators such as HHI point to a concentrated market, other factors (such as the threat of entry) may cause market players to behave in a competitive manner.

Practical considerations and previous usage

- ACER already calculates a wholesale-retail mark-up index (see discussion above).
- A similar measure to the PCM is the Lerner Index = (P – MC)/P.
- The two indicators require the same data and similar calculations. Due to the similarities we have only recommended using the PCM which is more commonly used to calculate mark-ups.

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[67] Chyong and Hobbs (2014), provide sources and parameter values for the production cost function in Appendix B, Table B.6; Energy Economics 44 (2014) 198-211.

• The literature points to some theoretical linkages between the Lerner Index and other competition indicators. For example there is a theoretical equivalence between the inverse of the residual demand elasticity and the Lerner Index. Also, under certain conditions, most critically constant marginal costs and no capacity constraints, the HHI divided by the elasticity of demand is equal to the Cournot equilibrium Lerner index.
Implementation costs
• Moderate-to-high: depending on how well ACER can leverage research that already exists in the field. • Requires specialised expertise, thus it may be most efficient to outsource some tasks. • Some monetary costs might be incurred for purchasing access to publications that contain relevant information. These costs are likely to be minimal to moderate.
Evaluation
ACER's current methodology lacks a comprehensive assessment of market participant behaviour. The proposed indicator fills this gap and also serves as a useful metric to assess the impact of network codes/guidelines on competition.

A.2.3. Market performance

Liquidity measures

<table>
<tr><th>Indicator</th><th colspan="2">Description</th></tr>
<tr><td>CO.4 Gas demand</td><td colspan="2">Total gas demand in a Market Area</td></tr>
<tr><th colspan="3">Calculation principles</th></tr>
<tr><td colspan="3">• This is a useful indicator for providing background information and context to the assessment and interpretation of other indicators. Generally, no significant data manipulations are required although there are some methodological issues to be considered.
• The indicator is an objective statistic, but data must be collected using the same methodology across all Member States/Market Areas.
• It is very important to establish whether 'demand' means 'consumption' in the Market Area or means 'total demand' including 'transit' gas or exports.
• Both are useful metrics and should be recorded.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">• Relatively easy metric to obtain
• Shows relative importance/size of one market against the others.
• Is essential for the calculation of the churn rate.
• Is useful in helping analyse results of other performance indices.</td><td>• Publication of this data is not standardised across all Member States/Market Areas.[68]
• Can be in volume and/or energy -> needs care collecting data and converting to one methodology.
• Absolute demand is not necessarily an indicator of market performance in its own right (should be used in conjunction with other metrics).</td></tr>
<tr><th colspan="2">Data requirements</th><th>Data sources</th></tr>
<tr><td colspan="2">• Data in energy (TWh) for each Member State</td><td>• This data is currently available, albeit with varying time lags depending on the country/source used.</td></tr>
</table>

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[68] IEA physical data reflects 'normalised' TSO data into the same methodology. We assume that data from Eurostat is also derived using a common methodology: http://ec.europa.eu/eurostat/statistics-explained/index.php/Natural_gas_consumption_statistics

• Can be observed on a monthly basis and then aggregated to quarterly or annual totals.	• Potential data sources are IEA and Eurostat • Most TSOs now publish timely data, but note caveat above regarding methodology etc. • The IEA publishes 'standardised' data with about 10 weeks delay (this has the advantage of providing 'normalised' data under the same methodology).

Interpretation and thresholds

- First it is essential to determine whether collecting/using/analysing consumption or total demand
- Either way, it must be the same metric for all Member States/Market Areas
- As mentioned above, absolute volume is no indication in itself of market performance but, in combination with other metrics, becomes a very useful figure
- Over time, it shows trends in consumption and in some countries of exports, which can then be compared to traded activity

Potential correlations with other indicators

This is used in assessing the relative importance of the other liquidity measures.

Practical considerations and previous usage

- This is a basic indicator used in all commodity markets when comparing trading to total physical demand (churn rate).
- This is a low resource cost metric, especially if using trusted external sources (such as IEA).

Implementation costs

- The time involved is also minimal.
- The time needed comes more from making sure of the standardisation of the data rather than the time spent collecting it.
- Once a data source is established the time taken for each 'Time Period' (say each month or quarter, etc.) should be less than one day for all the Market Areas

Evaluation

ACER already uses this information in its annual MMR, and we recommend to maintain it for use in conjunction with other indicators.

Indicator	Description
CO.5 Participants	Total number of market participants

Calculation principles

There are several metrics to record under this heading:

- The number of 'registered' participants
- The number of 'active' participants
- The type of participants:
    - physical: producer, wholesaler, retailer, consumer
    - financial: hedging, speculating
    - administrative: balancing agent, storage requirements, etc…
- The assessment of the number of market participants should take into account common ownership of firms (i.e. number of independent participants has to be considered).

Strengths	Weaknesses
• This is an important metric to establish both the number and type of participants • A market with a high proportion of financial players will generally indicate a liquid mature market and is a measure of confidence in that market	• Not all Market Areas have ‘registered’ traders (e.g. NBP) and currently data is not standardised across Europe in either its definition or its publication but REMIT should help solve this • Often subjective to determine the number of active participants • Also often subjective to determine the split between physical trading and financial trading

Data requirements	Data sources
• List of registered participants and their trading activity • Information on the type of participant (if available) • Need to determine the total number of participants, those that are ‘active’ and, if possible, the distribution between physical and financial. • Data can be observed on an annual basis.	• The best data source in the future will be REMIT. Data on registered market participants can be obtained from the REMIT register of market participants. • REMIT transaction data can be used to determine ‘active ‘ participants • The data is also available currently but is not standardised across all markets. • Some TSOs publish the number of ‘registered’ traders. • Some exchanges also publish the number of ‘registered’ traders. • OTC brokers will give an accurate indication of the number of ‘active’ traders on their own books. • Establishing the type of participant may be more difficult or time-consuming particularly in markets with higher number of participants.

Interpretation and thresholds

- It is necessary to clearly define what data is being collected.
- This metric requires an amount of subjective interpretation (particularly in defining an ‘active’ participant and determining common ownership).
- Defining an ‘active’ participant is quite difficult as it is to a certain extent subjective. However, as a general rule, the greater the number of participants, the more liquid a market will tend to be and the less likely it is that it could be manipulated. The actual number in each market area will to a certain extent depend on the physical flow volumes but, in European gas markets, a minimum of ten active companies is probably necessary.
- OTC brokers will give an accurate indication of the number of ‘active’ traders but their own individual coverage of a given market may be limited.
- The more ‘active’ traders in a given market, the ‘better’: improves liquidity, improves competition to trade and usually results in ‘tighter’ bid/offer spreads, and reduces the chances of market manipulation.

Potential correlations with other indicators

- This metric is one of the ‘key elements’ used to analyse a hub’s evolution towards a fully liberalised and commercial market.
- It needs to be used in conjunction with traded volumes, traded products, market depth and churn rate.

Practical considerations and previous usage

- This metric is also used in other commodity and financial markets to determine both the extent of trading and the independence of the resultant traded prices.

Implementation costs

- The time needed will come from interrogating the various sources, both electronic and oral. Some aspects of this metric will take longer to determine due to its more subjective nature however, it has the advantage that it only needs to be updated annually and a lot of the information is likely to be consistent over the years.
- Overall the cost should be relatively low.

Evaluation

The number of participants is an important metric of markets; it serves as input for other indicators. Although it may not alone provide enough information whether market performance and competition is effective. As for most other indicators in this group, it should be used in conjunction with other indicators.

Indicator	Description
CO.6 Products traded	Types of products available to trade

Calculation principles

- The traded market can comprise bilateral trading, OTC trading and exchange trading
- All three categories should be monitored to accurately reflect the traded gas market in each Market Area
- It is also important to record both what products are available to trade and those that do actually trade
- Finally, the analysis should also look at which products are available and trade along the traded ’curve’ (balancing, spot, prompt, near curve, mid-curve and far curve)

Strengths	Weaknesses
• Relatively easy metric to obtain • The greater the variety of products available to trade (and especially those actually traded), will show the maturity and liquidity in any given market • Likewise, if a large number of financial products are traded this will also show the acceptance of a particular market to a greater variety of participants	• Not all Market Areas are active yet

Data requirements	Data sources
• Need to determine all the products available to trade, those that are ‘actively traded’ and, the distribution between physical and financial, spot/prompt/near-mid-far curve • Can be observed on an annual basis	• The best data source in the future will be REMIT. Reporting under REMIT should provide transaction data for all trading (bilateral, OTC and exchanges) • Some of the data is currently available from brokers for the OTC markets and from the exchanges for their markets

Interpretation and thresholds

- The more products are available and traded in the market the greater the choice for market participants. However not all available products may be traded.

- The more mature and developed markets will have OTC and exchange products traded from spot to far curve. However even in more liquid and mature markets, liquidity may be quite low for products far along the curve.

Potential correlations with other indicators

- This metric is one of the 5 ‘key elements’ used to analyse a hub’s evolution towards a fully liberalised and commercial market
- It needs to be used in conjunction with traded volumes, participants, market depth and churn rate

Practical considerations and previous usage

- This metric is also used in other commodity and financial markets to determine both the extent of trading and the mix of participants (different participants often trade different products)

Implementation costs

- The time needed will come from interrogating the REMIT database and processing the information. Costs should be kept low by the fact that information is only required on an aggregated annual basis.
- The overall implementation cost should be minimal

Evaluation

The number and types of products traded is an important metric of markets. As for most other indicators in this group it has to be considered together with the other indicators in this section as it does not alone provide enough information whether market performance and competition is effective.

Indicator	Description
CO.7 Traded volumes	Total volume of gas traded

Calculation principles

- Objective statistic but should use the same measure as for gas demand (i.e. energy / TWh)
- Must take all sources of trading for each Market Area: OTC and exchanges, including spreads between hubs
- Should distinguish in the final results the split between different contracts (e.g. OTC and Exchange)
- Can also distinguish the split between, spot and prompt trading (often regarded as ‘physical balancing’ trades) and curve trading (often regarded as ‘risk management’/hedging or pure financial/speculative trades)

Strengths	Weaknesses
• Relatively easy to obtain • The more volume traded, especially if across the whole timeline will show the maturity and development of any given market	• Not all market areas are active yet • Important to not take ‘traded volume’ figures from TSOs who only see the (net) nominations

Data requirements	Data sources
• Should be observed on a monthly basis (and aggregated to quarterly and annual if desired) to help reveal any ‘patterns’ of trading and any trends • Must take all sources of trading for each Market Area: bilateral, OTC and exchanges.	• Best data source in the future will be REMIT. • Can be currently obtained from brokers for the OTC markets or from the exchanges for their markets

Interpretation and thresholds

- The more volume traded in a given market, the ‘better’
- There is no absolute volume of trades that will indicate a market’s maturity, but the comparison of traded volumes to the gas demand (churn rate – see indicator CO.9)
- However, analysis must also be made of which products are being traded (indicator CO.6)
- This will help determine whether a Market Area is a ‘balancing’ area or a ‘risk management’ (hedging) one

Potential correlations with other indicators

- This metric is one of the 5 ‘key elements’ used to analyse a hub’s evolution towards a fully liberalised and commercial market
- It needs to be used in conjunction with participants, products traded, market depth and churn rate

Practical considerations and previous usage

- This metric is also used in all commodity and financial markets to determine both the extent of trading and the mix of trading across different products
- This metric can take a while to collect due to the need to interrogate several sources
- It should be collected at least monthly, although it can be aggregated to form quarterly or annual statistics

Implementation costs

- The cost should be minimal. The time needed will come from interrogating and processing the REMIT database. There are also cost synergies with other indicators particularly CO.6 and CO.9.

Evaluation

Traded volumes are an important metric of markets, although they may not alone provide enough information whether market performance and competition is effective. As for most other indicators in this group, it should be used in conjunction with other indicators.

Indicator	Description
CO.8 Depth of market	The amount of tradable volume on each bid/offer quote

Calculation principles

- If possible, need to calculate both the ‘tightness’ of the bid/offer spreads for all traded products along the curve; and the ‘depth’ or amount of volume on the bid and the offer
- If possible, also helps to know whether there is additional volume at the next price after the best bid/offer
- A ‘proxy’ for this metric could be the “Tradability Index” as calculated and published by ICIS Heren, although this primarily only shows the tightness of the bid/offer spreads along the curve
- ACER will however calculate a set of GTM2 indicators that includes:
    - Order book volume;
    - Bid-ask spread;
    - Order price book sensitivity.
- These indicators can be used to assess the depth of the market.
- Given that ACER has already adopted the GTM2 indicator, we recommend it to be also included in this methodology.

Strengths	Weaknesses
• A very good indicator of mature, liquid markets • The Tradability Index is readily available	• Quite difficult to accurately obtain, especially in less developed/transparent markets • Not all market areas are active yet

	• In some markets it is difficult to get reliable figures • OTC subjective / exchange can be objective depending on trading platform • The Tradability Index has limitations as it does not show the real depth of the market[69]
Data requirements	**Data sources**
• This is a difficult metric to obtain, yet alone obtain accurately across all markets. • It should be monitored on a real-time basis but at very least at several pre-determined points in the trading day.	• This data is not available for all markets and may not be fully or accurately available even in some of the currently traded gas Market Areas. • It requires access to trading screens, both OTC and exchange. • If screen trading is not available in certain markets, would require oral questioning of OTC brokers.

Interpretation and thresholds

- The closer the bid/offer spreads the more liquid a traded market.
- The further along the curve that there are close bid/offer spreads, the more mature and developed the market.
- The more volume available to trade on both the bid and the offer at any given time, the more liquid the market.
- Difficult/subjective to interpret results as they will differ greatly across the European gas hubs.
- However, a similar methodology to the ICIS Tradability Index could be used whereby there are two (or more) thresholds recorded in order to create an ‘index’ of market depth.

Potential correlations with other indicators

- This metric is one of the ‘key elements’ used to analyse a hub’s evolution towards a fully liberalised and commercial market.
- It needs to be used in conjunction with participants, products traded, traded volumes and churn rate.

Practical considerations and previous usage

- Both the narrowness of bid/offer spreads and the tradable volumes behind those quotes are assessed in other traded markets.
- This is a time consuming metric to collect accurately and in detail.
- It will require oral questioning in some markets.
- It may require the need for trading screen Licences and associated fees.
- If using the ICIS Tradability Index, it will greatly reduce data collection times but may not give the required results.

Implementation costs

- The time needed will come from interrogating the various sources.
- The expertise needed is that of someone who understands both the gas market and traded markets generally.

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[69] The ICIS Tradability Index looks at 10 contracts along the curve from WD to 3yrs forward contracts and attribute a single ‘point’ if the bid/offer spread is within €0.5/MWh for each of the ten contracts; then repeats the same process but this time a single point is awarded if the bid/offer spread is within €0.3/MWh for each of the contracts. Therefore the highest score possible is 20.

- The cost is likely to be moderate, both in terms of manpower and data fees if the indicator is calculated anew. However as ACER will calculate a set of indicators for GTM2, those indicators can be used at no additional cost.
- Also if using the ICIS Tradability Index as a proxy for this metric, the time and cost elements will be much less.

Evaluation

The depth of the market is a key factor for traders, therefore it should be monitored. This is a measure that is hard to defined and measure precisely, therefore initially we recommend using indicators that are already available. In the future, as more market data and experience becomes available, ACER should evaluate other alternative indicators of market depth.

Indicator	Description
CO.9 Churn rate	The ratio of all traded volumes to the demand for the underlying physical product.

Calculation principles

- Maybe the most important metric of the 'key elements' used to analyse a hub's evolution towards a fully liberalised and commercial market. A high churn rate is the result of a market that has many participants (and many participant types), trading many different products in large volumes.
- Objective statistic but must retain same methodology across all Member States/Market Areas.
- The globally recognised definition of churn in commodity markets is :

Churn rate = total trade volumes / total underlying physical volumes (throughput)

- It is very important to establish whether to use 'consumption' figures or 'demand' figures for the denominator. Consumption refers to the total amount of gas consumed in a market and excludes transit/exported gas.
- The current EU definition of churn rate is to use the consumption figures in each Market Area. However, using the demand figure is more commonly used in other commodities.
- As the NCs/GLs are implemented across all Member States and all gas is delivered to virtual hubs (as opposed to border points), it can be deemed that all that gas could be traded in each hub; therefore, at that stage, it would be more relevant to use the demand figures as the denominator.
- A possible solution is to calculate two measures: a 'gross' churn rate (including exported/transit gas) and a "net" churn rate (using domestic gas consumption).
- We recommend calculating the denominator as total traded volume in a market over a given period (month, quarter, year) across all products available (ranging from spot to forward contracts).
- The churn rate should be calculated for each month and then aggregated to quarterly and annual levels.

Strengths	Weaknesses
• Probably the best indicator of a mature, liquid market as it encompasses all the other metrics in one.	• Only truly relevant in those markets that are actually liquid. • Those markets that are still emerging will have a very low churn rates and cannot then be directly compared with this metric.

Data requirements	Data sources
• Traded gas volumes and gas demand (including domestic consumption and transit/exported gas) for each market.	• Traded volumes can be assessed using REMIT data • The IEA publishes 'standardised' gas demand data

• Should be observed on a monthly basis (and aggregated to quarterly and annual if desired) to help reveal any ‘patterns’ of trading and any trends.	

Interpretation and thresholds

- Generally, commodity markets are deemed to have reached maturity when their churn rate reaches or exceeds a multiple of 10 times total trading volume over physical demand
- The assessment should bear in mind however that while increased market liquidity across Europe should result in higher churn rates, it is probably not realistic to expect all markets to reach the churn rates associated with mature liquid markets.
- This is a well-established practice across the world and should also be used for European gas markets

Potential correlations with other indicators

- Maybe the most important metric of the 5 ‘key elements’ used to analyse a hub’s evolution towards a fully liberalised and commercial market as it comprises each of the other elements as well as gas demand
- It is the one metric that is generally used by all traders to quickly ascertain the maturity and liquidity of a market

Practical considerations and previous usage

- This metric is used in all commodity and financial markets to assess the maturity and liquidity of a given market
- This is a relatively easy metric to calculate once all the input data has been collected
- It should be collected at least monthly, although it can be aggregated to form quarterly or annual statistics

Implementation costs

- The time needed will come from collating the physical gas demand and traded volumes indices; once they are done, the churn rate is quick and straight forward to calculate
- The data should be readily available. Traded volumes are also calculated for indicator CO.7 and demand data for indicator CO.4 The additional cost of calculating this indicator should therefore be minimal.

Evaluation

Although the churn rate may not, by itself, provide sufficient evidence for definite conclusions about market performance, it is a key measure of market performance and therefore was recommended to be included in the proposed methodology.

Indicator	Description
CO.10 Simulation models	Structural models of the natural gas market, representing both the physical properties of the network, as well as market participant behaviour. A simulation model is not an indicator per se, but it can be used to derive most of the indicators included in this methodology.

Calculation principles

- Simulation models require detailed data on the physical transmission network, including physical limitations in order to accurately model and predict gas flows.
- Market participant behaviour must be represented in order for realistic results. Consumers should be assumed responsive to price fluctuations. Producers and suppliers should be treated as profit-maximising firms.
- Costs of extraction and transportation must be reasonably well represented.
- For additional detail on gas market modelling, see Chyong and Hobbs (2014).
- Simulation models are time-intensive and require specialised expertise therefore it may be more efficient to outsource the setup of the model

Strengths	Weaknesses
• Model outputs can be used to derive a large number of indicators. • Can be used to derive a competitive benchmark. • Can be used to analyse isolated impacts and sensitivities. • Can be calibrated to observed market outcomes (i.e., prices).	• Model may be complex. • Requires specialised expertise. • Calibrating the model may be difficult. • Certain market participant behaviour (e.g., market manipulation) may be difficult to model. • Some assumptions need to be made, which can influence the results.

Data requirements	Data sources
• Requires large number of variables. • Granular data is necessary.	• The data is mostly available but may be difficult to obtain • Need to compile all relevant data from both published sources (annual reports, official reports and surveys, etc.) and directly from market participants

Interpretation and thresholds

- Depends on the particular objective of the modelling exercise - .a large variety of scenarios can be modelled.

Potential correlations with other indicators

- Data collected for indicator CO.3 would serve as input into a gas market model.

Practical considerations and previous usage

- Use of simulation models is fairly common in electricity markets, less so in gas markets.
- Academics have developed an EU-wide simulation model of the natural gas market. See Chyong and Hobbs (2014).

Implementation costs

- Implementation costs both in terms of time and resources is likely to be high.
- It may be most efficient to outsource the setup of the model, given that modelling platforms already exist.

Evaluation
While a market model could potentially offer many advantages, the associated costs are likely to be high. On balance, it is still likely that the benefits would outweigh the costs, and therefore we would recommend ACER to start investing an in-house model development.

A.2.4. Proposed indicators to measure the achievement of the high-level policy goal of efficient market functioning

<table>
<tr><th>Indicator</th><th colspan="2">Description</th></tr>
<tr><td>**MF.1 Transaction costs**</td><td colspan="2">Measure to evaluate the cost of “doing business” at a Market Area hub</td></tr>
<tr><th colspan="3">Calculation principles</th></tr>
<tr><td colspan="3">• Using survey techniques to interrogate the shipper community on what, why and how they trade and their costs.
• Standard questionnaires, sampling and evaluation methods must be used.
• Shippers should be made to respond in a timely manner for the results to be of use.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">• Relatively easy to identify and measure.
• Questions can be ‘fine-tuned’ year on year depending on market development generally and what ‘issues’ may have emerged.
• It could be implemented immediately.</td><td>• May not be fully inclusive of all aspects of the market.
• Relies on subjective interpretation of both the questions and the answers.
• Consistent quality of information may be difficult to achieve.
• Potentially low response rate (unless obligation).</td></tr>
<tr><th colspan="2">Data requirements</th><th>Data sources</th></tr>
<tr><td colspan="2">• Questions would need to cover:
  • Shippers’ activity in the traded market, their costs and whether they trade direct, through brokers or on exchanges?
  • What products do they trade?
  • What part/parts of the curve they trade?
  • Do they trade for purely physical reasons (sales/ procurement/ balancing), for risk management, or for speculative reasons?</td><td>• The shipper community should provide the needed data.
• Also, non-shipper traders should be included, if practicable</td></tr>
<tr><th colspan="3">Interpretation and thresholds</th></tr>
<tr><td colspan="3">• The responses may be subjective, therefore caution must be exercises when interpreting the survey results.
• The analysis on the responses may be objective or subjective, depending on the question
• However, the same methodology must be kept across all countries.</td></tr>
<tr><th colspan="3">Potential correlations with other indicators</th></tr>
<tr><td colspan="3">• Will help to confirm other market performance and market functioning indicators.</td></tr>
<tr><th colspan="3">Practical considerations and previous usage</th></tr>
<tr><td colspan="3">• ACER has already conducted a shipper survey in early 2014 (although the response rate was very poor).
• Preparation and filling out of such a survey could be time consuming.</td></tr>
</table>

- The analysis is likely to be resource intensive.

Implementation costs

- This would be an annual or even biennial process and the whole process will take quite some time.
- The expertise needed is divided between the preparation of the questionnaire and the analysis of the responses.
- For the questionnaire, the expertise is in understanding the structure of traded market s and what makes them efficient and successful.
- For the analysis, the expertise will be in good statistical analytic skills.
- The costs involved are likely to be moderate but, if done properly, could be outweighed by the results it would bring.

Evaluation

High transaction costs may constitute a barrier to entry and thus obstruct the efficient functioning of the internal gas market. Although survey-based methods generally rely on voluntary participation, even a few response identifying a genuine barrier to entry could be very useful; therefore we recommend adopting this indicator.

Indicator	Description
MF.2 **Value of congestion at each IP**	Measures the approximate monetary value of expanding transmission capacity at each IP.

Calculation principles

- Value of congestion is the product of: (1) price differential between hubs (after taking account of transportation costs); and (2) physical capacity of the IP.
- Calculations also need to take into account that technical capacities may also vary in the course of a year.
- Congestion value should be calculated on a daily basis, and summarised on an annual basis.
- It may be useful to rank the most congested IPs in terms of descending congestion costs.

Strengths	Weaknesses
• Helps to see where the physical constraints in the internal market are.	• Quite difficult to accurately obtain data, especially in less developed/transparent markets • Need to ensure the same methodology is used across Europe

Data requirements	Data sources
• Daily data on gas hub price differentials. • Daily data on technical capacity at each IP.	• Required technical capacity data should be available from the ENTSOG Transparency Platform. • Price data is available from the sources discussed in the evaluation form for indicator MI.1.

Interpretation and thresholds

- In the short-term, the existence of congestion should not necessarily be interpreted as market inefficiency.
- In the long-term, however, one would expect that technical capacity at the most congested IPs would be increased if the reduction in the monetary value of congestion exceeds the cost of the incremental new capacity.
- If that does not occur, the causes should be identified on an ad hoc basis.

Potential correlations with other indicators

- There are correlations between this indicator and indicator MI.1 measuring price convergence. More generally there are potential correlation with any other indicator that measures congestion (e.g. CMP indicators) or market prices.
- Similarly, the proposed indicator is correlated (and shares synergies) with indicator CAM.1, monitoring year-on-year changes in technical capacity.

Practical considerations and previous usage

n/a

Implementation costs

- Implementation costs will be minimal, assuming required data are readily available. Both technical capacity data and market price data will need to be sourced for other indicators so they should be readily available for calculating this indicator.

Evaluation

Although not an absolute indicator of market inefficiency, consistent and regular monitoring of this indicator may uncover potential issues in the future.

Indicator	Description
MF.3 **Potential net welfare gains from unused physical capacity** **MF.4** **Potential welfare loss from apparently inefficient flows at each IP**	Measure of the foregone/potential welfare gains or welfare losses that result from unused physical capacity when profitable arbitrage trades could be made between IPs, or the potential welfare losses when gas flows against price differentials. In simple terms, one could interpret these indicators as losses from the lack of complete market integration and the lack of efficient market functioning.

Calculation principles

- Estimates of welfare loss may be very sensitive to the particular price index used. They may also lead to incorrect conclusions if some transportation costs (e.g., commodity charges in transmission charges) are disregarded. Therefore these components must be evaluated carefully at each IP.
- Indicator M.3 is essentially the same analysis already performed by ACER; derived as the product of: (1) unused physical IP capacity by the price differential between the two adjoining markets (after taking account of transportation costs).
- Potential refinements to this indicator could include to use a more refined (and perhaps more accurate) price index based on transactional data available under REMIT. Current price index developers sampling methods to develop their indices, without have access to all data on relevant transactions. Under REMIT, ACER will should have data on all gas market transactions available, thus there is a potential to develop a (possibly) more accurate price index.
- Indicator M4 is calculated only for IPs and only for periods when gas flows occur from the high-priced zone to the low-priced zone. The indicator for these IPs and days is derived as the product of: (1) flows between the affected IPs; by the (2) price differential between the two adjoining markets (after taking account of transportation costs).

Strengths	Weaknesses
• Helps identify IPs where potentially efficient flows are not realised and IPs where inefficient flows occur. • Allows the ranking of IPs in the order of increasing potential welfare gains and decreasing potential welfare losses.	• Identifying reasons and factors that prevent those flows requires ad hoc analyses for each IP. • Requires a thorough understanding of all costs traders face in cross-border trade.

Data requirements	Data sources
• Should be monitored on a daily granularity • Physical capacity available and used at IPs • Daily gas prices for markets either side on an IP • Gas transport tariffs at each IP	• Flows, technical capacity and tariffs at each IP will be available from ENTSOG TP. • Gas prices can be currently sourced from index providers such as ISIS Heren. • After full REMIT data is available, this can be used to calculate gas prices in each market.

Interpretation and thresholds

- Unused physical capacity at IPs when there is a price arbitrage to be had in the adjoining hubs could indicate a lack of market integration, some barriers to entry, or other forms of market inefficiency.
- Similarly, gas flows against price differentials may occur for a number of reasons, including must-take provisions contained in long-term contracts.

- The reasons for each IP may have to be identified individually, and in some cases it may be difficult to identify the real reasons for the particular situation. Potentially, REMIT transactional data could be used this purpose; it would likely be the most efficient way to find an explanation.

Potential correlations with other indicators

- Welfare losses will decline as price differentials decrease or as physical capacity utilisation increases.
- Can be used in conjunction with the following indicators to help determine why arbitrage might not happen between markets when a price differential exists:
    - Utilisation of contracted capacity at IP
    - Prevalence of contract gas prices vs. spot gas prices
    - Prevalence of oil-indexed vs. gas priced contracts.

Practical considerations and previous usage

- ACER has previously used indicator MF.4.
- The calculations are quite simple to do.
- The analysis needs careful interpretation not to arrive at the wrong conclusion.

Implementation costs

- The costs involved in calculating this indicator are minimal particularly as the necessary data is also required for many other indicators.
- The expertise needed is that of someone who understands the physical and commercial aspects of gas.

Evaluation

This indicator is actually a composite indicator bringing together physical utilisation and flows at an IP and price differentials and helps to determine where the lack of market arbitrage and other forms of inefficiency are the biggest problem.

A.2.5. Proposed indicators to measure the achievement of the high-level policy goal of market integration

Indicator	Description
Gas prices MI.1 **Price convergence** MI.2 **Price correlation** MI.3 **Price volatility correlation**	Price convergence, price correlation and price volatility between gas prices in different countries.

Calculation principles

- Price convergence measures could be an indicator of market integration but has its limitations
- Price convergence is measured by looking at the price differential between different markets. In an integrated market these differentials would be close to 0 after taking into account gas transportation costs.
- Price correlation is a better indicator that two (or more) adjoining markets are reacting to the same supply/demand factors. Correlations can be affected however by common trends and seasonality factors across all markets. To adjust for these biases price correlations should be calculated as follows:
    - Correlations should be calculated over periods shorter than a year (for example, half year periods or quarters) - this helps to reduce the correlation bias associated with common seasonal (i.e. summer/winter) price fluctuations

  - Weekends should be excluded from the data series so correlations are calculated only on the basis on weekday prices – this eliminates the correlation bias driven by within week price fluctuations (i.e. gas prices are higher during the week and lower at weekends).
  - Identify potential outliers that may distort the correlation measure. In particular when sudden and large price swings occur in a given market the correlation coefficient over a longer period of time may be affected. The analysis should try to identify the reason for these price movements and also a calculation
- Price correlation can be used to test for de-linkages between markets. When markets are integrated, low price correlations should only occur if the physical infrastructure is unavailable or not sufficient (congested). This theory can be tested by excluding those days when IPs were unavailable (flows close to 0) or physically congested (flows close to 100% of capacity).
- Price volatility (i.e. price changes) needs to be measured but so too the price volatility correlation which, in an integrated market world would be similar in adjoining hubs. Measuring price volatility correlation is also useful as it addresses the serial correlation bias (caused by similar price trends) associated with price level correlation.

Strengths

- All fairly simple to calculate
- In an integrated market prices should respond in a similar way to changes in supply/demand therefore price correlations should be high
- Price and volatility correlations are important indicators for traders

Weaknesses

- Prices only available in some hubs and in others are still lacking transparency if traded at all. However once the full REMIT dataset is available, prices could be calculated for each market.
- Correlation (of prices or of volatility) does not in itself prove market integration
- Interpretation of results needs to be done carefully to avoid drawing wrong conclusions. In this respect correlation and convergence should be analysed together.

Data requirements

- Complete price data sets for each traded hub
- The two main price series required are for the Day Ahead and the Month Ahead contracts
- It is probably not necessary for gas to look at shorter time frames

Data sources

- Daily price data for all markets should be available from REMIT and ACER could use the transaction data to build price indices for each market.
- The data for those hubs that are now trading is currently available from various providers.

Interpretation and thresholds

- Price convergence can really only happen if the infrastructure between two or more hubs is capable of physically transporting sufficient gas to equalise the markets (whether that actually happens or not, it’s the ability to do so that’s important)
- Price convergence does not always reflect the true cost of transportation
- Price convergence is by no means an indicator of a hub being active or inactive, in absolute terms or in relation to other hubs
- Price convergence and correlation need to be considered together. Two hubs may display correlated price movements but there may still be a persistent price differential above transportation costs between the two markets. Similarly price shifts leading to higher price convergence may result in lower price correlation over a given period of time.
- Lack of price correlation may imply infrastructure bottlenecks and other barriers to trade, market power, lack of market information.
- Price volatility in a hub is not in itself ‘bad’; in fact it will no doubt attract speculative traders and help increase liquidity

- Price volatility convergence is important as it is the most representative metric of market risks and the difficulties involved in hedging. Different price volatility between hubs indicates that it would not be prudent to use one hub to financially hedge a physical position in the other

Potential correlations with other indicators

- Can be used in conjunction with gas demand data, churn rates, networks data
- Other indicators, such as physical utilisation, can be used to test for price correlations when IPs are unavailable or congested. In general in such situations we would expect to see lower correlation and less price convergence.
- Can also be used in conjunction with price formation indicators below. If prices are not set by market forces but through oil-indexation for example, physical disconnection should not cause price de-linkages. Similarly if a high proportion of gas is delivered under long-term contracts, we may observe gas flows that do not follow price differentials.

Practical considerations and previous usage

- ACER already uses price convergence analysis, but measuring price correlations and price volatility correlation should enhance the understanding of the degree of market integration.
- The calculations are quite simple to do
- The analysis needs to be carried out with care

Implementation costs

- These indicators should be monitored regularly although aggregated results may only be published yearly as part of the MMR.
- Good statistical analytical skills are needed.
- The costs involved are likely to be minimal to moderate depending on the depth of the analysis performed. There are significant synergies in calculating all three indicators.

Evaluation

These are three very important metrics in assessing the traded gas markets of Europe.

Indicator	Description
Price formation **MI.4 Contract prices vs. gas spot prices** **MI.5 Oil-indexed vs. gas-on-gas pricing**	Contract prices vs. spot prices; oil indexed prices vs. hub prices

Calculation principles

- Contract prices versus gas spot prices is about the balance in a given market between contracted gas and ‘spot’ (hub sourced) gas. The calculation of the indicator will show both the relative volumes of gas traded under long-term contracts and at hubs and their relative prices.
- The second indicator is about the price formation of the contracted gas: whether oil (or other form of) indexation is common or gas-on-gas pricing is applied. The indicator will show the prevalence of different types of gas price indexation as proportion of contracted gas in a given market.
- These indicators can be calculated on an annual basis.

Strengths	Weaknesses
• Can show the extent to which a hub has progressed towards gas supply/demand fundamentals in its pricing	• The change from traditional oil indexed gas contracts to new style market priced contracts is slow to happen in eastern Europe

- When the data is available, the calculations are relatively simple to do	- Official border pricing data is not standardised across all countries

Data requirements	Data sources
- Day Ahead and Month Ahead price series for each of the analysed hubs - Gas contracts price data - Data on contract indexation	- Once REMIT data is available, this will provide detailed information on prices, contract types and indexation methods.

Interpretation and thresholds

- Where contract prices are close to hub prices, this would imply that a large percentage of contracted gas is being market-priced.

Potential correlations with other indicators

- Where the proportion of contracted gas is large and contract prices differ from hub prices, this could reflect in lower price convergence and price correlation with other markets (if prices in these other markets are linked more to hub prices and gas-on-gas pricing).
- Price correlations may occur if similar indexation is applied to gas prices in other markets. In this case price correlation would be driven by a common external factor, such as the price of oil for example, rather than by integration between markets.

Practical considerations and previous usage

- So far border prices and in particular the German average border price (BAFA) has been extensively used in analytical reports, in gas contract price arbitrations and by energy regulators to ascertain the level of development in the German and west European gas market
- However, the analysis needs care as the border price statistics from one country will probably have a different methodology to those from another country; they may also ignore other commercial agreements between sellers and buyers during the transition phase of gas contract price formation

Implementation costs

- The costs involved are likely to be minimal, particularly if some of the data querying on prices in different markets will already be undertaken for the proposed price indicators. Most of the work will involve filtering the data to obtain the relatively information.
- The expertise needed is that of a good understanding of gas contracts, hub markets and statistical analysis

Evaluation

These indicators are important to determine to what extent gas prices in a given market are formed based on trading at hubs.

Indicator	Description
MI.6 Number of supply sources	Indicator offers a measure of security of supply (i.e. securing gas supplies from varying supply sources)

Calculation principles

- Security of supply can be accessed by using both the Residual Supply Index and noting the number of supply sources by country
- The RSI has already been proposed as an indicator of competition in the market.
- The number of supply sources will already be calculated by ACER as part of the GTM2 indicators.

Strengths	Weaknesses

• Looks at both supplier concentration and also market demand, thus reflecting actual market conditions	• Can be mis-interpreted in the results, for example,

Data requirements	Data sources
• Separate RSI for each relevant market • Aggregated by producer/supplier country of origin • List of supplying countries of gas to each EU MS.	• Data is currently available • IEA for gas demand and countries of origin • GIIGNL for LNG data

Interpretation and thresholds

- Simply, the greater the sources of supply, the greater the security of supply;
- The more even the share of suppliers to a country, the greater the security of supply to that country

Potential correlations with other indicators

- Can be used alongside HHI and RSI indicators

Practical considerations and previous usage

- ACER has previously used this indicator
- The calculations are reasonably easy to do
- The analysis needs careful interpretation to not arrive at the wrong conclusion

Implementation costs

- These indicators can be reviewed annually
- The expertise needed is that of someone who understands the physical and commercial aspects of gas
- The costs involved are minimal.

Evaluation

Simple indicator giving an indication of the security of supply of a Member State based on the number of sources it can rely on to source gas.

A.2.6. Proposed indicators to measure the achievement of the high-level policy goal of non-discrimination

Indicator	Description
ND.1 Quality of published data	Survey-based assessment of the quality of data published by TSOs and NRAs. While the transparency provisions require data to be published, it may not improve market transparency much unless the published data is easily accessible, accurate and timely.

Calculation principles

- As in case of the TAR indicators (TAR.1 through TAR.3), the survey should be conducted annually, using a multi-scale assessment of the quality of published data by market participants.
- A subjective multi-point scale ranging through: Completely satisfied—Partially Satisfied—Partially dissatisfied—Completely unacceptable—could be applied. For any country/TSO that does not get a "Completely satisfied" rating the respondent should provide at least a comment justifying his rating. Wider actors (e.g. individual network users should also be able to respond). The survey should be completed annually although recognising that methodology reviews are less frequent.

Type of data	Assessment	Explanation/

	(CS/PS/PD/CU)	Rationale
[Name of data]		

Strengths	Weaknesses
• Relatively easy to implement.	• Subjective data requiring user inputs. • Response rate may be low.

Data requirements	Data sources
• Survey to assess the quality of data published by TSOs and NRAs.	• Inputs should be canvassed from all stakeholders.

Interpretation and thresholds

- Whilst only a subjective assessment, the indicator should provide an indication of stakeholders' satisfaction with data quality.
- There are no really objective measures of data quality, thus differences in views on what constitutes quality data should be expected.

Potential correlations with other indicators

- Indicators TAR.1 through TAR.3 also rely on a survey-based method. Potentially these surveys could be combined.

Practical considerations and previous usage

- None identified.

Implementation costs

- Minimal – data is relatively straightforward to obtain and process.

Evaluation

Provides a stakeholder assessment of the quality of data available publicly. Since market transparency is a key aspect of non-discrimination, the indicator is an effective reflection of that achievement of that high-level policy goal.

Indicator	Description
ND.2 Barriers to entry	Measures the ability (or lack thereof) and cost for shippers/traders to enter the market.

Calculation principles

- Consists of identifying and measuring the 'real' cost of a (typical/hypothetical) new entrant in the market.
- Assessment should consider both physical shippers and financial traders.
- Cost assessment should include network access fees, storage requirements (where applicable) and costs, transportation costs, legal costs (documentation, permits, licences, etc.), regulatory costs (compliance, reporting, etc.) and trading costs (personnel, IT, credit, etc.).
- ACER's own analysis could be supplemented by a survey of stakeholders regarding the existence of barriers to entry. Such a survey would be similar to the one described above for ND.1.

Strengths	Weaknesses
• Many new entrants may suggest few barriers to entry but, see 'weaknesses'.	• Many new entrants may NOT suggest few barriers to entry – simply that there are other financial/commercial reasons to enter a particular market.

<table>
<tr><td>• Similarly, few new entrants may or may not indicate the presence of barriers.</td><td>• This may not be a reliable metric when taken on its own.</td></tr>
<tr><th>Data requirements</th><th>Data sources</th></tr>
<tr><td>• The number of market participants in each Market Area
• The size of the MA, both physical and trading.
• Cost items described above.</td><td>• ENTSOG Transparency Platform and NRAs.</td></tr>
<tr><th colspan="2">Interpretation and thresholds</th></tr>
<tr><td colspan="2">• It is important to evaluate not only the absolute number of new entrants but to look at their category (physical players or traders) and whether they are ‘active’ or not
• Many trading houses have in the past registered to trade a given market ‘just in case’ but then never actually participate</td></tr>
<tr><th colspan="2">Potential correlations with other indicators</th></tr>
<tr><td colspan="2">• Should echo the results of other shipper questionnaires.
• Will help to confirm other market performance and market functioning indicators</td></tr>
<tr><th colspan="2">Practical considerations and previous usage</th></tr>
<tr><td colspan="2">• Performing the analyses for all Member States could be quite time consuming
• The analysis will be quite subjective and should be treated with some caution</td></tr>
<tr><th colspan="2">Implementation costs</th></tr>
<tr><td colspan="2">• Conducting the analysis would require expertise in understanding the different types of participants and being able to make a judgement on their activity and effect on the market
• Initial setup costs may be moderate; ongoing costs should be minimal.</td></tr>
<tr><th colspan="2">Evaluation</th></tr>
<tr><td colspan="2">Barriers to entry is difficult to identify through objective measures. The suggested indicator combines analysis of entry costs with a survey-based assessment of perceived barriers to entry, supported by market data and data on actual market entry.</td></tr>
</table>

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