Macro-Economic Effects Regarding Congestion Management in Europe

Study on behalf of the Bundesnetzagentur (Germany), the Commission de Régulation de l'Energie (France) and E-Control (Austria)

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Contents

EXECUTIVE SUMMARY

Non-discriminatory and efficient access to cross-border capacity is a key to competitive European gas markets. DG Competition of the European Commission stated in its sector inquiry[1] that European Interconnection Points (IPs) suffer extensively from contractual congestions. Contractual congestions occur if the full capacity is booked in advance, preventing market parties from getting access to the transport capabilities in the shorter term, but only part of the capacity is actually used for the physical gas transport.

The European regulators responded to this problem by issuing two draft guidelines: The Pilot Framework Guideline on Capacity Allocation (CAM) and the recommendations for Guidelines on Congestion Management Procedures (CMP). With the aim of preventing, or at least limiting, contractual congestions, ERGEG proposes the introduction of several new principles in these guidelines with respect to access to cross-border capacities.

The Bundesnetzagentur (Germany), the Commission de Régulation de l'Energie (France) and E-Control (Austria) asked E-Bridge to analyse the macro-economic effects resulting from the application of the two guidelines.

The macro-economic evaluation considers quantitative and qualitative evaluation criteria. The main quantitative evaluation criteria are the Total Social Welfare Gain (gross benefits) and the convergence of market prices. The main qualitative criteria are market liquidity and the impact on market structure, namely influences on the number and structure of competing market parties.

The resulting present study does not analyse all aspects of the two drafted guidelines, but instead focuses on the introduction of a) the firm day-ahead “use it or lose it” (UIOLI) principle (as part of the CMP) and b) bundled products as well as a virtual interconnection point (as part of the CAM).[2]

The firm day-ahead UIOLI principle provides that transport capacity, which is not booked, must be returned to the market parties. This mechanism requires that the rights to make changes to the nominations after day-ahead (re-nomination rights) must be constrained.

Bundling of products has the aim to harmonize entry and exit capacities. This shall ensure that transaction costs of trading via an IP will be reduced as market parties will not face the risk of un-harmonized allocation of exit- and entry capacities. Also the reduction to a single capacity is discussed which leads to the fact that only a single market party can book this capacity (with having only a single nomination). As this second feature still seems to be in discussion within ERGEG (and ERGEG is aware of potential problems) we focus on the first aspect of bundled products and will only make remarks on the second aspect (but a detailed analysis is beyond of the scope of the study). Currently, it is planned to apply the bundled products only to new contracts.

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[1] DG COMPETITION, Report on energy sector inquiry, Brussels 10 January 2007.

[2] In the first draft of the Pilot Framework Guideline combined products were considered as an intermediate step to bundled products. The revised Framework Guideline on CAM (after the public consultation) will no longer contain the term "combined product". It will focus on bundled products and the integration of several bundled products between two market areas to a "virtual interconnection point".

A virtual interconnection point integrates all the bundled capacities between two adjacent market areas and is a step of further bundling.

The analysis is performed for four IPs.

- Blaregnies/Taisnières (Belgium and France);
- Bunde/Oude & Bocholtz (Germany and the Netherlands);
- Moffat (UK and Ireland);
- Oberkappel (Germany and Austria).

The IPs, which have been selected by the project Steering Committee, differ in their characteristics. The IP Blaregnies/Taisnières (Belgium and France) is an IP with a mainly unidirectional utilization, Bunde/Oude & Bocholtz (Germany and the Netherlands) is a Hub-to-hub interconnection with a strong bilateral utilization, Moffat (UK and Ireland) is an IP with excess capacity and the IP Oberkappel (Germany and Austria) is physically congested. As the analysis is based on historical data – the gas year 2008/09 – the availability of data was another important selection criterion for the IPs.

For each IP, the additional available capacity that would have been made available by applying the CMP principles has been assessed. As the CMP guideline does not determine detailed provision on how the capacity, which is not nominated day-ahead and which is returned to the market, shall be re-allocated to the market parties, we assume that the capacity made available by applying the new ERGEG principles will be fully used to arbitrage between the markets.

Based on this assumption of a perfect re-allocation of the transmission capacity, the calculated Total Social Welfare Gain and the calculated price convergence represent the maximum economic benefit that can be expected short-run. The actually implemented methods for re-allocating the capacity will have an important role in achieving this maximum economic benefit and may reduce these benefits.

The core of the analysis is the simulation of the market behaviour at each side of the IP. For each market, the total demand and supply curves have been modelled. The model has been developed on the basis of empirical estimations and publicly available data. The parameters of the demand and supply curves have been adjusted to the historical volumes and prices observed in each market in the gas year 2008/09. This “bottom up” approach makes it possible to calculate the potential Social Welfare Gain and the price convergence in each market. In order to check the plausibility of the assumptions and the adequacy of the results, a cross-check has been performed with the overall price elasticity values of each market. This “top-down” cross-check delivered satisfactory results that confirmed the underlying assumptions.

It needs to be noted that a) the market model and b) the historical data selected do not permit exact simulation of the market's potential future behaviour. However, the results provide a solid estimate of the order of magnitude of the expected benefits. The conclusions do not depend on minor variations of the results.

The **main conclusions** are:

The direct Social Welfare Gain resulting from the introduction of the CMP is moderate but relevant.

The estimated Total Social Welfare Gain estimated for the IPs varies between € 2 and € 10 million p.a. per IP.[3] Compared to the market volume in each market, this welfare gain can be considered to be moderate but nevertheless relevant.[4]

It is important to note that this Social Welfare Gain results from a better utilization of the existing transport capacities and does not require additional pipeline capacity.

The introduction of CMP leads to significant price convergences and will increase both market liquidity and competition.

The introduction of the firm day-ahead UIOLI principle increases the price convergence between the markets significantly. At most IPs, the physical transmission capacity is sufficient to offset the price differences between the markets for the vast majority of days during the year.

Equal prices between markets have an important effect on liquidity and competition.

Firstly, the market behaves like a single market with significantly increased liquidity. This makes market prices more reliable and predictable and fosters gas trade.

Secondly, competition will be increased, as parties in one market can be expected to influence trade in the other markets. This increases the number of competing parties and reduces the market share of the incumbents.

These secondary effects of price convergence and higher liquidity are considered as highly important, though with the existing data a serious quantification seems not feasible.

Bundled products and a virtual interconnection point effectively reduce transaction costs.

Bundled products, i.e. products that harmonize the entry/exit capacities of the adjacent network operators of an IP, are an important prerequisite for cross-border trade. Bundled products reduce market parties' risks and significantly reduce their transaction costs.

Please note that a “bundled product” in this study refers to the harmonization of the entry/exit nomination, not necessarily to a single nomination (or other features) further discussed in the context of bundled products. While the introduction of a harmonized nomination of exit-/and entry capacity is a must, these add-ons are not.[5]

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[3] For Moffat no benefits are estimated as the same spot market price applies on both sides of the IP.

[4] The benefits for Oberkappel and Bunde/Bocholtz cannot be simply added if the Social Welfare gain is calculated separately for the IPs, with each IP connecting NCG to another market area since price arbitrage gains would be counted double in this case.

[5] A single nomination is often regarded as a mean to introduce new market parties in the market and increase competition. If the introduction of the CAM and CMP increases cross-border trade and leads to converging prices for most of the time, the requirement for single nominations may be omitted.

In addition, introduction of a virtual interconnection point, i.e. integration of capacity at two or more points that connect the same two adjacent entry-exit systems into a virtual interconnection point, is fundamental to efficient utilization of existing capacities.

Particularly during the early phases of a Pan-European gas market, when the cross-border trade that could actually increase competition among market parties has not yet been sufficiently established, transaction costs are relevant and may create a significant hurdle for increasing trades. Bundled products and virtual interconnection points are a key to reducing the transaction costs.

Restriction of re-nomination rights does not necessarily lead to restricted trading options.

The introduction of the firm day-ahead UIOLI principle requires a (partial) restriction of the re-nomination rights of the capacity holders. The simulation shows that the final physical flows – even in the case of complete price convergence – are significantly lower than the maximum technical capacity for most of the IPs for most of the time. This means that the actual need for physical flows can be satisfied in the majority of cases. This is important because the released capacities through the application of CMP can be used for flexibility purposes as well.

In other words, the requirements changing the nominations in short-run can usually be satisfied. The restrictions of re-nomination rights do not restrict trading options, provided that the capacities are re-allocated to the market efficiently. The introduction of an effective day-ahead allocation mechanism, therefore, is indispensable for any successful implementation of the UIOLI principle.

The concrete design of the day-ahead allocation mechanism is beyond the scope of this study. Therefore, we recommend that ERGEG consider introducing main requirements of an efficient day-ahead allocation mechanism in the future development of the network code by ENTSOG and ACER.

However, re-nomination rights have an important role for market parties in the case of physical congestions. For IPs with structural physical congestions, the treatment of re-nomination rights requires special considerations.

Investment obligations are not a useful means for resolving contractual congestions.

Most of the analysed IPs enjoy sufficient physical transmission capacity.[6] Additional investments in physical capacities would increase economic benefits only to a limited extent. Additional investments make sense only after the existing capacities are efficiently utilized and physical congestions occur, i.e. after the implementation of CMP and CAM.

[6] The IP in Oberkappel must be considered a special case. The maximum technical capacity was lower than the actual used capacity for a significant amount of time (due to the available data). It is our understanding that the physical capacities are scarce at Oberkappel.

For most of the analysed IPs, the value of additional physical transmission capacity is limited. In light of the regulatory complexity of investment obligations, we do not consider such obligations to be suitable for the task of resolving contractual congestions.

Network operators should calculate and publish short-term maximum transport capacities for each IP.

Any efficient allocation of transport capacities requires that information about the available capacity be made available to the market parties. Reliable information about the available capacity for the next day is required not only for the UIOLI process, but also for safe and reliable operation of the network. It is therefore necessary that network operators calculate the short-term available transport capacity in a transparent way and make it available to market parties.

The study contributes to the assessment of the macro-economic effects of CMP and CAM. It comes to the conclusion that the main economic benefits result not only from the directly measured Social Welfare Gain of efficient day-ahead allocation, but also – and primarily in the long run – from the relevant indirect consequences, such as the increase of market liquidity and competition resulting from the convergence of market prices.

In order to realize these benefits, bundled products (according to the definition used in this study, i.e. harmonization of exit- and entry-capacities), at least, need to be introduced. Such products would reduce the transaction costs of market parties and ensure more efficient utilization of existing capacities. Further, those bundled products (as used in the study) can even be managed over all IPs connecting the same adjacent market areas.

Due to the importance of an efficient day-ahead allocation mechanism, we recommend that together with firm day-ahead UIOLI clear requirements for such a mechanism shall be introduced in the near future.

1 SCOPE OF THE STUDY

1.1 BACKGROUND

DG Competition's energy sector inquiry report describes the problems in accessing gas transmission capacity and identifies contractual congestions as one of the major hurdles to the development of a competitive internal gas market.[7]

Contractual congestions reduce the access available to firm pipeline capacities. In the past, several proposals have been made regarding ways of overcoming the problem of contractual congestions and of facilitating cross-border gas trade. However, the mechanisms applied today have been unable to facilitate a functioning capacity market and to encourage efficient use of the available transmission capacities. Only recently, in two antitrust settlements, DG Competition found that long-term capacity booking was an abuse of a dominant market position.[8] Such abuse is seen as a sort of predatory booking, i.e. booking, by incumbents, that keeps competitors out of the market. What is more, such booking keeps lower prices in spot markets from being passed on to all consumers.

In January 2009, ERGEG drafted initial principles on capacity allocation mechanism (CAM) and congestion management procedures (CMP), in the interest of solving contractual problems. The principles were widely and repeatedly discussed with market parties. An evaluation of the relevant comments paper was published in September 2009.

At the 17th Madrid Forum, ERGEG presented a revised proposal on future principles on CAM & CMP and developed a Pilot Framework Guideline on CAM in December 2009. In the first quarter of 2010 the Pilot Framework Guideline on CAM was assessed in a public consultation. In addition – and in what is the reason for the present study – ERGEG published recommendations for guidelines on CMP to be adopted via comitology procedure.[9]

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[7] Contractual congestions are situations at an IP at a certain time where the allocations of capacities is such that further demand for firm transport rights cannot be fulfilled even in situations where physical capacity is available. Thus there are two characteristics of contractual congestions: (i) At an IP to a certain time (especially day-ahead) physical capacities can be made available by releasing potentially unused capacities but they are not available, due to the manner in which the system of booking and reserving capacities functions. (ii) In principle, there is demand for the capacities in question. Even in the absence of demand for such capacities, a contractual congestion exists but does not necessarily have to be resolved.

[8] DG Competition, The GDF Suez and E.ON Ruhrgas commitments, Presentation of Celine Gauer at the ERGEG Workshop on Pilot Framework Guidelines on Gas Capacity Allocation, Brussels, 02.02.2010

[9] Under the comitology procedure, the Commission adopts decisions for the implementation of its legislation. The proposals for these decisions must be approved by Member States via a qualified majority. The Commission first submits a proposal to the Comitology Committee. If the Committee does not reach a qualified majority in favor or against, then the proposal is submitted to the Council. If the Council does not reach a qualified majority within three months, then the Commission adopts the decision. If the Council rejects the Commission proposal by a qualified majority, then the Commission has to re-examine its proposal. It may re-submit the same proposal, submit an amendment proposal or submit a proposal for co-decision.

These guidelines are intended to serve as input for the Commission for the revision of the Annex of Regulation (EC) 715/2009.

The comitology procedure requires that the guidelines be accompanied by an impact assessment. This impact assessment includes an analysis of the quantitative impact of defined policy options and selected mechanisms.

E-Control, Bundesnetzagentur (BNetzA) and Commission de Régulation de l'Energie (CRE) commissioned E-Bridge to carry out a study on the macro-economic effects of the guidelines on CMP and the Pilot Framework Guideline on CAM.

The results of the study shall be used as a contribution to the required impact assessment.

1.2 THE ERGEG GUIDELINES

1.2.1 Guideline on CMP

The Guidelines on CMP[10] provide the following issues:

- Border specific arrangements (C1.2)
- Existing contracts (C1.3)
- Incentivisation (C 1.4)
- Capacity calculation and network security (C.2.1 to C 2.3)
- Capacity increase by oversubscription and buy-back arrangements (C 2.4)
- Capacity increase by procurement of system energy (C 2.5)
- Capacity charges (C 2.6)
- Re-marketing booked capacities (C 2.7)
- **Firm day-ahead Use-it-or-lose-it (UIOLI) (C 3.1)**
- Long term UIOLI (C 3.2).

As not all issues can be analysed in a quantitative study, it has been decided to focus the attention on firm day-ahead UIOLI.

Firm day-ahead UIOLI is useful as it frees unused day-ahead capacities and provides possibilities for trade. It is expected to be an effective tool against contractual congestions, especially if there are no functioning secondary markets.[11] Further, secondary markets are often not very effective today. The reason for this may be that capacity holders do not offer enough capacities to protect gas markets from competition or to have high flexibility day-ahead for their planned transport and cases of force majeure.

Firm day-ahead UIOLI is further seen as a method to increase short-term flexibility in the market. Short-term flexibility is the possibility to react to price differences between two

[10] ERGEG, Congestion management on European Gas Transmission Networks – recommendations for Guidelines Adopted via a Comitology Procedure, Ref: E09-GNM-10-07, 10 December 2009.

[11] Contractual congestions could be seen as the result of capacity hoarding. On the other side, capacity hoarding is a reasonable behavior safeguarding safety margins for the trade.

adjacent markets and to transport gas to the place of higher valuation (market place with higher spot prices).[12]

Under the firm day-ahead UIOLI approach, if demand for firm day-ahead capacity regularly exceeds pertinent offers, national regulatory authorities (NRA) may ensure that a transparent and non-discriminatory firm day-ahead UIOLI procedure is established, to bring unused firm capacity back to the market on a day-ahead basis.

The firm day-ahead UIOLI procedure consists of

- A nomination schedule,
- A reduction of existing re-nomination rights where these rights exist,
- Allocation of day-ahead capacities.

Nomination schedule

At the request of the NRA and subject to their approval, the transmission system operator sets the time of nomination so that any resulting day-ahead capacity can be allocated in due time prior to the start of the main trading activities day-ahead. The day-ahead capacity is the capacity which is made available in case of contractual congestion by restriction of re-nomination rights.

Reduction of re-nomination rights

In order to make capacities available, re-nomination rights have to be reduced or removed. Otherwise, released capacities cannot be used for allocation day-ahead (D-1). Several ways of restricting re-nomination rights are possible.

Allocation of day-ahead capacities

The capacities are offered as firm capacities to the market. Firm day-ahead entry capacity is allocated by implicit or explicit auction only. National regulatory authorities may prohibit the establishment of reserve prices in such auctions. Offer and allocation of firm day-ahead entry capacity are performed in such a way that buyers can take part in daily gas trading. The detailed auction design applied is subject to approval by the NRA.

1.2.2 Pilot Framework Guidelines on CAM

This Pilot Framework Guideline[13] is focussed on:

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[12] Short-term flexibility is a basic requirement for the development of competitive markets because it provides additional possibilities for arbitrage and, thus, can influence the structure of contracts in the longer run.

[13] ERGEG, Capacity Allocation on European Gas Transmission Networks, Pilot Framework Guideline, Ref. E 09-GNM-10-05, 10. December 2008

- Adaptation of existing capacity contracts (F 1.2)
- TSO cooperation (F 1.3)
- Contracts, codes and communication procedures (F 1.4)
- Capacity products (F 2.1)
- Interruptible capacity products (F 2.2)
- Breakdown and offer of capacity products (F 2.3)
- **Cross-border products (F 2.4)**
- Primary capacity allocation (F 3.1- F3.3)
- Re-marketing of booked capacities (F 3.4)
- Booking platforms (F 3.5)

The scope of this study is to carry out an analysis of the economic effects of **selected policy options** which are seen as **central elements** in the policy approach by ERGEG.

The Pilot Framework Guideline after the Consultation will differentiate between bundled products and a virtual interconnection point as the two possibilities for cross-border products.[14]

The definitions of the CAM are sometimes perceived as a bit ambiguous by the market parties. For the present study, such products are analysed on the basis of the understanding set forth below. Our understanding of these products is also illustrated in Figure 1 below (which compares them to the status quo).

Bundled products

Bundled products bundle the entry-capacity products and the corresponding exit capacity. All available exit capacity is allocated to adjacent transmission system operators only. This ensures that when entry or exit capacity is booked at one side of the border, there will always be sufficient exit or entry capacity available at the opposite side. Significantly, the exit and entry capacities are harmonized, which considerably reduces the transaction costs and risks of the market parties.

Virtual interconnection point

The virtual interconnection point goes a step further. The capacity at all IPs connecting adjacent markets is integrated into one virtual interconnection point. The exit and entry capacity at every IP is integrated such that the transport of gas from one market to an adjacent market is provided on the basis of a single allocation procedure.

[14] This classification is based on actual information of ERGEG within this study.

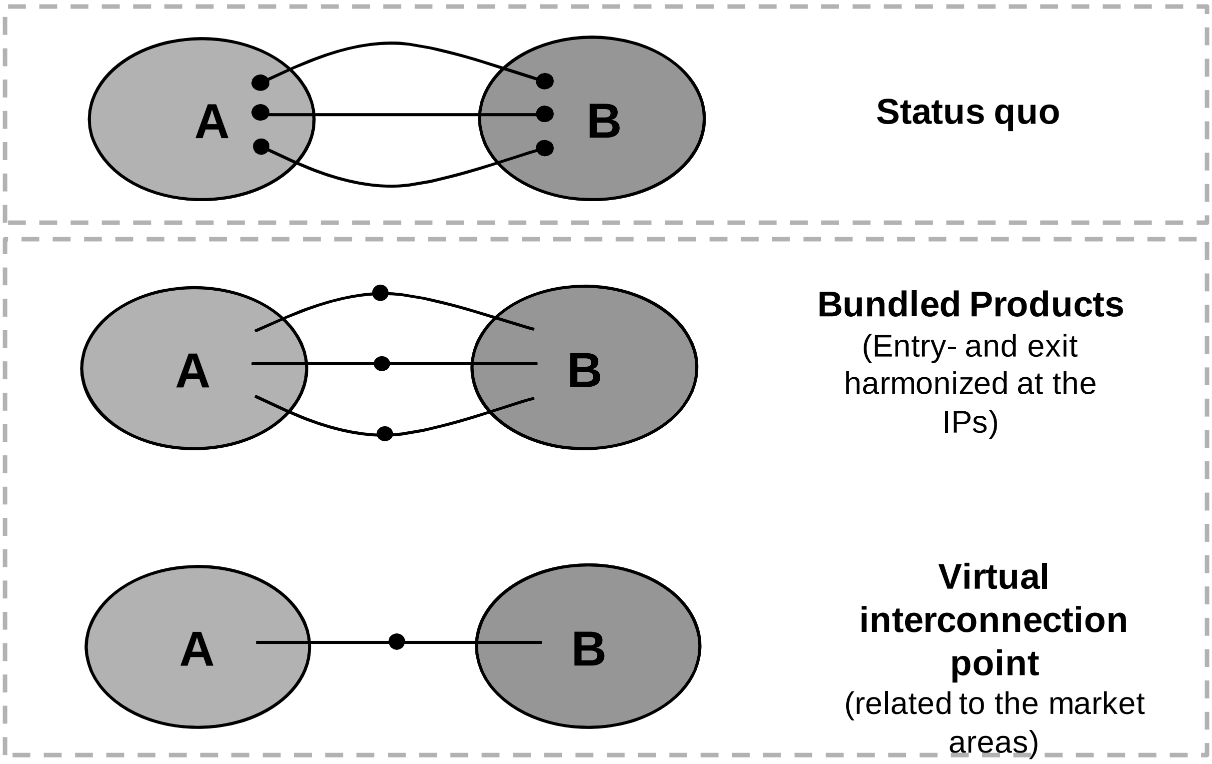

Figure 1: Bundled products vs. virtual interconnection point (as used in this study)

1.3 POLICY OPTIONS

There are three policy options for ERGEG to choose from with respect to the implementation of CMP and CAM recommendations.

They are illustrated in Figure 2:

Option 1 **"Business as usual"**	▪ No European-level harmonization: CMP and CAM are mainly designed at Member State level and coordinated between neighbouring countries ('business as usual'). ▪ Central and harmonized CMP and CAM as proposed by ERGEG do not exist.
Option 2 **"Application of ERGEG principles"**	▪ Firm day ahead UIOLI and cross-border products are applied (as major parts of the ERGEG principles) across all Member States. National Regulatory Authorities (NRA) may provide options to adapt specific modifications. However, the basic principles above are applied by all NRAs across the EU.
Option 3 **"Investment obligations"**	▪ The obligation to invest in additional physical capacity, after CMP, is applied to resolve contractual congestions and physical capacity turns out to be insufficient.

Figure 2: Basic policy options for the evaluation of ERGEG principles with respect to the two guidelines

These options are defined as the relevant scenarios and used for the assessment of the policy impacts of CMP.

1.3.1 Option 1: Business as usual

Option 1, which represents business as usual (or the status quo), can be seen as the baseline scenario. Therefore it is described in more details. In Europe, CMP and CAM differ widely from one country to another. There are even differences in one country between the TSOs. This is a source of sub-optimal use of infrastructure. In general, several developments in option 1 are possible in the future. First, it can be assumed that there is no change to the status quo. Capacity booking remains as the current nomination and re-nomination schedule. No bundled products or virtual interconnection points are introduced.

Option 1 includes other possibilities as well. Each Member State can introduce new CMPs or CAMs. For example Member State A may wish to introduce firm day-ahead UIOLI. This may put some pressure on the adjacent Member States because the introduction of new CMPs on one side of an IP is not very effective if there is no change on the other side. For example, if, by firm day-ahead UIOLI on the side of Member State, new capacity is made available day-ahead, such capacity cannot be used if the corresponding capacity on the other side of the IP (Member State B) is not released. Veto policies are possible as well. In principle, due to the importance of co-ordination in any effective solution, an approach of an "active" Member State can be blocked by a "passive" neighbour. If an adjacent Member State does not wish to introduce the same regulation, a different solution will prevail. Further, some "trading of rules" may occur. If a Member State has selected the introduction of a CMP and the adjacent Member State prefers the status quo or a different procedure, the two States may find a common solution comparable to the classification trading of two agents in an Edgeworth Box[15], which describes the possible trade between two agents (the average trader on each national side of an IP) endowed with different commodities (the existing rules and the different economic outcomes on each side which are the result of the application of the rule).

The future evolution of CMP and CAMs therefore might be interdependent to some extent even without additional coordination by ERGEG. The development of market rules in one country will have at least some influence on the solution found elsewhere in Europe, especially if the Member States involved are interconnected by gas pipelines. Nevertheless, the concrete development of such an uncoordinated diffusion of market rules is difficult to anticipate and does not lend itself to quantitative modelling.

Therefore, we will use the status quo as the reference for policy option 1.

1.3.2 Option 2: Common application of the ERGEG principles

ERGEG wants CMP and CAM to be harmonized at every IP in Europe. This entails the requirement that compatible capacity products have to be offered, using compatible timing and processes. In addition, the information processes on both sides of an IP have to be compatible.

For the purpose of this study, we analyse the introduction of basic CMP and CAM principles, namely firm day-ahead UIOLI and the introduction of bundled products or virtual interconnection points. The proposed UIOLI mechanism (including a suitable procedure for allocating the unused capacities) ensures that the unused capacity is made available to the market on the day ahead.[16]

The NRAs may well develop and apply different processes and modifications. However, this study shall provide an indication of whether the ERGEG guidelines should be applied to all IPs or only to some IPs.

1.3.3 Option 3: Introduction of additional investment obligations

Option 3 describes the resolution of contractual congestions through additional investments in physical capacities on the IPs as an obligation.

[15] The Edgeworth Box is a traditional visualization of the benefits potentially available from trade. The idea is to take some starting allocation of goods between two individuals (A and B) and determine the set of reallocations that could benefit both of them by trading. See Mas-Colell, A. W., Michael D. and Jerry R. Green (1995); Microeconomic Theory, New York: Oxford University.

[16] Oversubscription and buy-back-arrangements are other principle ways of increasing the availability of capacity that are not analysed in this study.

The ERGEG principles are focussed on the reduction of contractual congestions. Contractual congestions appear if the capacities are fully booked in advance but then not fully used. Discrepancies between booked and actually used capacities can arise in two ways:

- Market parties book capacity in order to have flexibility to react quickly to fluctuations in demand and production.
- Market parties book capacity with the aim of restrict competitors' access to the market.

Where contractual congestions are due solely to market parties' striving for flexibility, they can be resolved via additional physical capacity. At the same time, the resulting physical capacity may clearly exceed actual transport requirements.

Additional physical capacity will most likely increase the actual transport capacity during at least some hours of the year. Such increases, in turn, add to trade possibilities and social welfare.

Therefore, this policy option is introduced as an obligation to invest in and to enhance physical trade.

This option is further based on the assumption that CMP (e.g. firm day-ahead UIOLI regarded in this study) are used in a way that will not allow market parties to restrict market access to the new capacities as well, by simply booking the new capacities (possibly, for strategic reasons).

2 WORK APPROACH

2.1 GENERAL APPROACH

The main objective of the study is to carry out macro-economic analysis of two selected CMP and CAM principles, the firm day-ahead UIOLI and the bundled products and virtual interconnection points. The macro-economic effects include the Total Social Welfare gain (gross benefits) and convergence of market prices (price convergence), as well as effects on liquidity, competition, etc.

The analysis is based on historical data for the four selected IPs. The use of historical data ensures that the results reflect actual market behaviour at relevant IPs, rather than the behaviour of theoretical models only.

The IPs have been selected jointly with the involved Steering Committee of the Regulatory Authorities. The analysis is based on historical data of the gas year 2008/2009 (GY 2008/09), and thus is a static analysis of the effects expected on that data if the new policies were applied.

An important requirement for the study was that all conclusions be based on publicly available data.

Importantly, for the analysis of the firm day-ahead UIOLI principle, complete restriction of the re-nomination rights is assumed. The effect of a partial restriction of re-nomination rights is discussed qualitatively following the quantitative analysis.

2.2 EVALUATION CRITERIA

2.2.1 Quantitative criteria

2.2.1.1 Total Social Welfare (Gross benefits)

The Total Social Welfare is the sum of additional consumer, producer and congestion returns on option 2 (or alternatively 3) compared to status quo (option 1). Thus, the additional gross benefits (or additional Total Social Welfare) are calculated for the purpose of evaluation.

The Total Social Welfare is created in this study by the use of additional available capacities released either by firm day-ahead UIOLI or by new investments in physical transmission capacities. Additional capacities (including those achieved by re-allocating existing capacities and those offered by investments) offer additional possibilities for cross-border trading.

Additional trade between two adjacent market areas occurs when the price differences are relevant and price arbitrage is possible. Price arbitrage enables a shipper to transport gas from the low-price country (the exporting country) into the high-price country (the importing country).

The following Figure 3 depicts the cross-border trade and the welfare created thereby. The relevant description of arbitrage trades is general, and can be applied to any additional capacity available at a certain time at a certain IP.

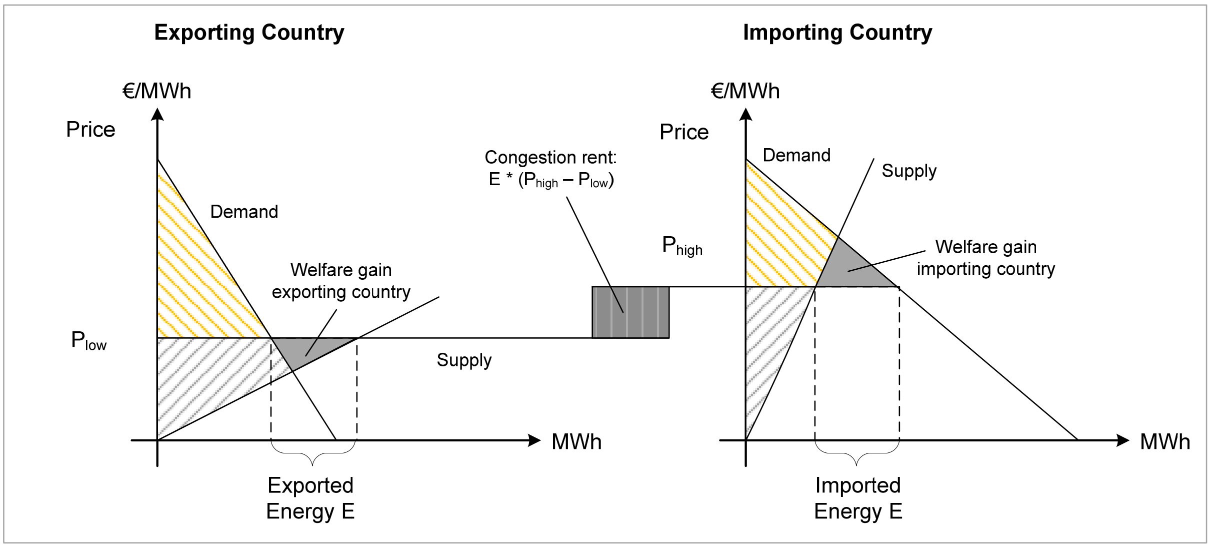

Figure 3: Price arbitrage and resulting rents achieved via coupling of two markets

In export of gas (energy E) from the low-price country to the high-price country, the following effects occur:

Energy is offered by a shipper in the importing market at the price of the low-price market, plus the transmission fee. The imported energy reduces the price in the high-price market.

By this price reduction the consumers in the high-price country gain additional welfare, which equals the additional consumer rent under the demand curve between the old and the new market price**.** In the importing country, part of this additional consumer rent has to be seen as redistributed rents. In the low-price country exporting the energy, the price will rise, thereby reducing consumer's rents. This "loss" is equal to the consumer rents under the demand curve between these two prices. The net gain of consumer rent is the sum of welfare gain of consumers (importing country) and welfare loss of consumers (exporting country). That net gain is marked in gray in Figure 3.

As the arbitrageurs between the two countries, the producers in the low-price country will realize additional producers' rent. That rent is equal to the additional profits of those players. On the other side of an IP, the producers in the high-price country will lose rents due to the decreased price. Again, this entails redistributed rents. The net gain of producers' rent is marked in gray again.

The consequence of price arbitrage is that prices on the adjacent markets will equalize if there is no physical congestion between the two markets, i.e. if the additional capacities are large enough to cover all arbitrage trades. This is the result of the law of one price. Otherwise, if there are relevant restrictions in physical capacities for this trade, the price will still differ between the two markets. The price difference between the two markets multiplied with the volume offered and traded from the low-price country to the high-price country is the congestion rent (the gray rectangle in Figure 3) which accrues. That rent can be attributed to the TSOs for capacity physical extension or used for reduction of network tariffs. The congestion rent, as the additional consumer and producer rent, is a part of the benefits of additional trade. Congestion rents have to be used for lowering tariffs or for investments in higher capacities.[17]

The economic value of the additional trade (net benefits) is equal to the sum of additional rents (consumer rents plus producer rents plus congestion rents) as the gross benefits per year minus the (annualized) costs which accrue by the creation of those new capacities compared to the status quo.

2.2.1.2 Price convergence

Another advantage of new CMP applied is the possible price convergence. Price convergence is the reduction of price differences between two (spot) markets; it is exemplified in the following Figure 4 which shows the price differences between TTF and EEX in the GY 2008/09 for a selective time period.

In the Figure 4, the spot market prices of EEX and TTF as well as the average of these prices – as a possible result of price convergence – are shown.

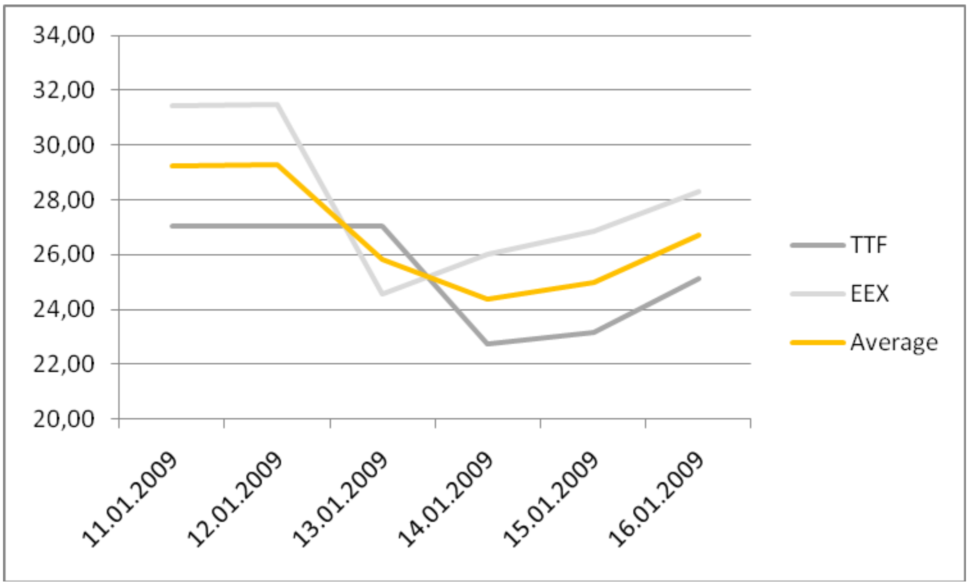

Figure 4: Example of price convergence between the Netherlands and Germany

It can be seen that price convergence reduces price differences between adjacent markets and also can reduce the volatility of prices. Additional effects will be discussed – such as better market signals and better reference prices as well as effects on the structure of (long-term) supply contracts – that can occur as spot-market trading becomes attractive via increasing liquidity. Liquidity can be seen as a main driver of the development of energy markets because it offers trade possibilities. Illiquid markets are not attractive for shippers

[17] As congestion rents are a result of limited capacities, there are some advantages in using these rents for investments in higher capacity, because such use reduces future congestions and increases capacities toward a more favourable status.

because they can be used only rarely or on random occasions (and that circumstance creates additional information costs).

2.2.2 Qualitative criteria

In addition, we evaluated the expected outcomes in a broader context, by applying a range of qualitative criteria.

In the qualitative analysis of CMP, we will focus especially on

- Liquidity of markets,
- Influences on long-term consumption patterns,
- Market structure, etc.

Further, we evaluated bundled products and virtual interconnection points in light of

- Reduction of transaction and information costs,
- Limitation of harmful strategic actions,
- Better market monitoring,
- Signals for physical investment.

Those aspects were chosen because the main economic questions concerning cross-border products are:

- Does the bundling of exit and entry capacities reduce the transaction costs of booking activities?
- Does the bundling of exit and entry capacities have relevant effects on strategic bookings?
- Does bundling of exit and entry capacities yield additional information on capacity mismatches?
- Does it set incentives for a better cross-border harmonization of capacities?
- Are there some effects which are relevant for market monitoring?
- Will congestions, which provide valuable information relative to physical investment, send clear signals?

These questions are relevant because of the following effects:

- Reduction of transaction and information costs increases the efficiency of the capacity use.
- Reduction of harmful strategic incentives enhances opportunities for better usage and decreases risks of predatory booking and market foreclosure.
- Market monitoring can be improved if additional market information is collected and made available for NRAs' control of anti-competitive acts.

- Signals for physical investments are analysed under the assumption that such signals – e.g. physical congestions – will not be obscured by noise. A "noise" in this context is an influence on investment requirements, in a regulatory regime, that can affect demand – for example (especially in the context of this study), congestion-management rules that promote sub-optimal use of available capacities and may even increase investment requirements beyond the optimal or “necessary” level.

2.3 MODELLING OF THE AVAILABLE CAPACITY

The simulation is based on assessment of the short-term available capacity that would be made available by applying a firm day-ahead UIOLI principle. The calculation is shown in Figure 5:

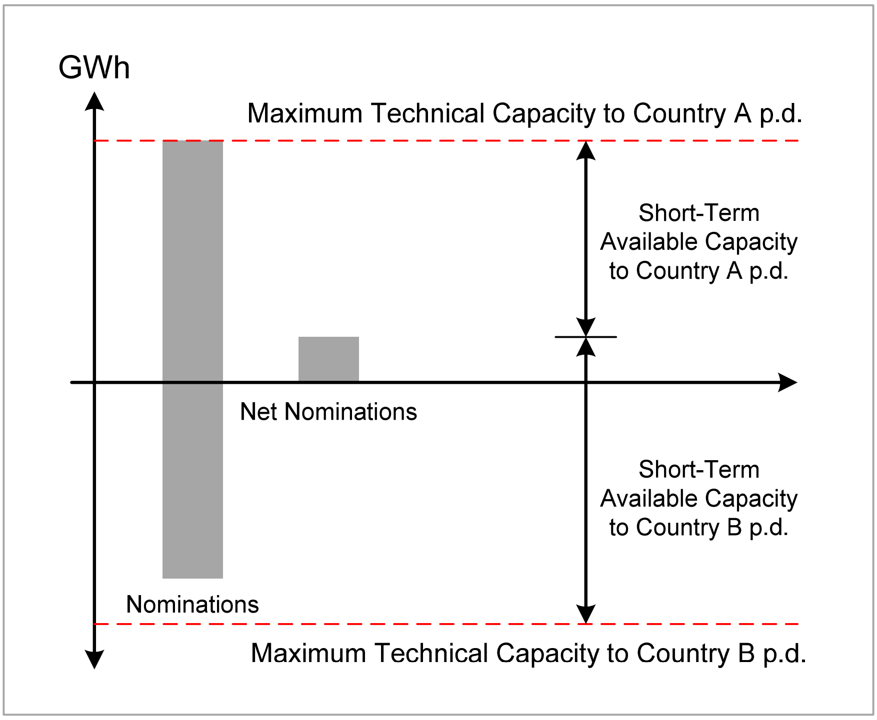

Figure 5: Calculation of the short-term available capacity

For each IP, the maximum short-term entry and exit capacities are provided. They represent the maximum capacity of the IP for the following day, considering all available information available to the network operator on the potential load flows the next day. As this information was not available for all IPs during the analysed gas year, we use the maximum technical entry/exit capacity, as provided by network operators at each side of an IP. Where different entry/exit capacities were provided, the smaller value was used. In the analysis later in this study, we indicate where different capacities have been provided**.** The day-ahead nominations have been provided for each IP. Based on the day-ahead nominations, the net nominations were calculated. The net nominations represent the day-ahead expected aggregated nominated physical flow through the IP. We acknowledge that use of firm day-ahead UIOLI could have a relevant influence on the nominations made (especially if the full

ERGEG target model is applied, capacities are auctioned and there is a possibility of lower prices for capacity allocated day-ahead (in contrast to the outcome for the primary-capacities market). Therefore we used the real net flows, which represent the real capacity requirements.

Thus, the calculations made reflect a market coupling at the border as a benchmark result for the application of the new CMP. At the project's start, the Steering Group saw this approach as useful, because it reflects all potential possibilities for further trade over and above the status quo of network usage. The short-term available capacity is calculated as the difference between the maximum short-term technical capacity and the net nominated flows. The flows represent the maximum additional capacity that would have been made available to the market if the firm day-ahead UIOLI principles had been applied. Re-nomination rights would have been restricted completely then or offered only on an interruptible basis.[18]

2.4 MODELLING THE MARKET BEHAVIOUR

In order to calculate the Social Welfare Gain and the impact of the analysed CMP and CAM principles on the prices in the market, a market model was developed, based on the aggregated demand and supply curves in each national market. As this information is not available, the demand and supply curves are reconstructed based on publicly available information.[19]

Making additional capacity available through the firm day-ahead UIOLI principle leads to additional trade between the countries and to a convergence of prices, and it increases the Social Welfare. The market model assumes that the additional capacity is used by the market parties to arbitrage between the markets.

Transaction costs or other hurdles to use of this capacity are not considered. The resulting economic benefits can therefore be regarded as the theoretical maximum benefit. However, they provide a useful indication of what the potential benefits would be if the markets were competitive and efficient (in a static sense).

It is important to note that this analysis evaluates the effect of the CMP and CAM principles. The actual benefits depend on how the principles are realized in practice, i.e. how the capacities are allocated day-ahead to the market parties. The Framework Guidelines allow implicit or explicit auctions to be applied, but leave further detailing to network operators' description in corresponding network codes on capacity allocation. This seems a sensible approach, as the network operators must develop the most effective approach under the specific circumstances of each market. However, the effectiveness of these solutions may reduce the calculated benefit.

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[18] If nominations differ widely from the real flows this may indicate a potential blocking by excessive nominations. This is another reason for a use of the flows.

[19] This is described below in chapter 3.

2.5 THE SELECTED IPS

2.5.1 Selection criteria

Criteria for the selection of the IPs were agreed by E-Control, BNetzA, CRE and ERGEG-members in the Steering group.

The main criteria for choosing the IPs are:

- Data availability
- Diversity of considered IPs and markets
    - Transit share of gas flows
    - National importance
    - Connecting liquid markets (in reasonable ways)
    - Physical vs. contractual congestions
    - Capability of cross-border bundling.

Besides the diversity of the considered IPs, the data availability for each IP was a key issue for the selection. The better the data availability, the less data had to be replaced with assumptions (indicative data).

With respect to the defined high-level criteria the following IPs were chosen:[20]

- Oberkappel (Germany and Austria)
- Bunde/Oude & Bocholtz (Germany and the Netherlands)
- Blaregnies/Taisnières (Belgium and France)
- Moffat (UK and Ireland)[21]

The main characteristics of the four IPs selected are characterized below in an overview for each IP. Bunde/Oude & Bocholtz were regarded as one IP (thus as a limited type of a virtual interconnection point).

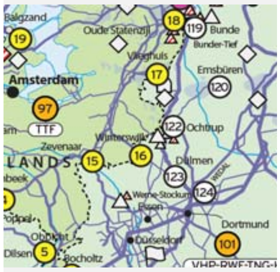
In addition to these main characteristics, we looked at the relevant markets' rules at the borders.

[20] Throughout the data research, however, it turned out that finding correct data actually was more difficult than anticipated. This shows that the transparency can be improved.

[21] All IPs except Moffat are used bi-directionally.

2.5.2 Overview of the selected IPs

2.5.2.1 Bunde/Oude & Bocholtz

Overview	❑ Both located at the border between Germany and the Netherlands. ❑ H-Gas, connecting the Dutch market and the NCG market area, which is the most liquid one in Germany ❑ The entry/exit points of Bunde/Oude and Bocholtz were regarded together for a better simulation of the effects between the Dutch and the German market. This can be seen as a kind of bundling as well. ❑ Bunde is IP No. 18, and Bocholtz IP No. 14, in the GTE capacity map. 
TSOs	❑ E.ON Gastransport (Germany) ❑ Gastransportservices (The Netherlands) ❑ Other TSOs connected to these IPs are not considered in this study (e.g. Gasunie Deutschland, Wingas)

Technical Capacity	❑ The Dutch regulators did not grant permission to publish technical capacity data for Oude Statenzijl.[22] However, from the GTE capacity map we calculated a total capacity of 615,480,000 kWh/d from the Netherlands to Germany.[23]
	❑ Germany to the Netherlands: 460,920,000 kWh/d.
	❑ However, since there are multiple pipelines at these IPs, we looked for the smallest common capacity for both exit and entry in each direction and calculated the following numbers, which were used in the model:
	    ❑ Germany to the Netherlands: 195,000,000 kWh/d
	    ❑ The Netherlands to Germany: 158,000,000 kWh/d

Average Usage of Capacities	❑ Germany to the Netherlands: 72.6% ❑ The Netherlands to Germany: 76.5%
Days with cross-flows exceeding technical capacity	❑ Germany to the Netherlands: 134 ❑ The Netherlands to Germany: 20

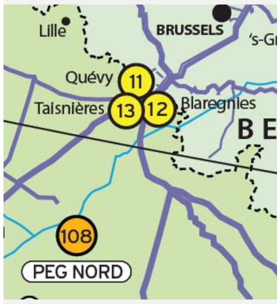
[22] Energiekamer, Decision Draft 102806.

[23] GTE Capacity map, July 2009.

Exit/Exports[24]	❑ Germany to the Netherlands: 2.4% ❑ The Netherlands to Germany: 26.9%
Entry/Imports	❑ Germany to the Netherlands: 25.3% ❑ The Netherlands to Germany: 5.3%

Table 1: Information on the IPs Bunde and Bocholtz

2.5.2.2 Blaregnies/Taisnières



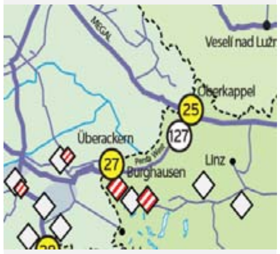
Overview	❑ Located at the border of France and Belgium ❑ Connecting PEG Nord, the most liquid market in France, and Belgium with high capacities for H-Gas (L-Gas is not regarded) ❑ From the Belgian side mostly transit flows in contrast to the flows from France ❑ Blaregnies/Taisnières is IP No. 12 and 13 in the GTE capacity map
TSOs	❑ GRTgaz (France) ❑ Fluxys (Belgium) ❑ Other TSOs connected to these IPs are not considered in this study
Technical Capacity	❑ GRTgaz: Entry 558,469,978 kWh/d, Exit 121,683,623 kWh/d ❑ Fluxys: SEGEO Entry 72,571,200 kWh/d, SEGEO Exit 267,955,200 kWh/d; TROLL Entry n/a, TROLL Exit 449,383,200
Average Usage of Capacities	❑ France to Belgium: 32.1% ❑ Belgium to France: 54.5%
Days with cross-flows exceeding technical capacity	❑ Not observed

[24] The relation between exit at the respective IP and exports, and the relation between entry and imports are able to describe the relative national importance of the flows at the IP.

Exit/Exports	❑ Both countries are importers of natural gas and only transmit to other countries
Entry/Imports	❑ North France gets 5.61% of its imported gas at this IP ❑ Belgium: 7.35%

Table 2: Information on the IP Blaregnies/Taisnières

2.5.2.3 Oberkappel

Overview	❑ Located between Austria and Germany ❑ H-Gas connecting MEGAL and WAG ❑ Important IP for the South-German region connecting the NCG market area to Austria ❑ Oberkappel is the IP No. 25 on the GTE capacity map	
TSOs	❑ E.ON Gastransport (Germany) ❑ BOG (Austria) ❑ Other TSOs connected to this IP are not considered in this study (GRTgaz)	
Technical Capacity	❑ Germany to Austria: 99,360,000 kWh/d ❑ Austria to Germany: 258,336,000 kWh/d	

Average Usage of Capacities	❑ Germany to Austria: 117%
	    ❑ Physical flows are higher than technical capacity (net flows)
	❑ Austria to Germany: 4%
	    ❑ Partly due to Ukrainian supply stop in 2009; no gas flows on 249 days	

Days with cross-flows exceeding technical capacity	❑ Germany to Austria: 365 days	
Exit/Exports	❑ Germany to Austria: 38.8% ❑ Austria to Germany: 1.23%	
Entry/Imports	❑ Germany to Austria: 8.76%	

	❑ Austria to Germany: 0.51%

Table 3: Information on IP Oberkappel

2.5.2.4 Moffat

Overview	❑ Located in Scotland ❑ Central connection of Ireland with UK gas market ❑ From Moffat, gas is shipped to three jurisdictions (Ireland, Northern Ireland and the Isle of Man) via interconnectors which are subject to the provisions of inter-governmental treaties between the British and Irish Governments. ❑ The Moffat Exit Point currently delivers 95-100% of Ireland's gas demand and thus the security of supply of all three jurisdictions downstream of this IP is highly reliant on gas that flows through this interconnector. ❑ Moffat is the IP No. 24 in the GTE capacity map	
TSOs	❑ Gaslink (Ireland) ❑ National Grid (UK)	
Technical Capacity	❑ Gaslink: Entry 339,643,000 kWh/d ❑ National Grid: 433,000,000 kWh/d.	
Average Usage of Capacities	❑ Gaslink: Entry 56.9%	
Days with cross-flows exceeding technical capacity	❑ No congestion observed	
Exit/Exports	❑ Ireland imports 95-% of its natural gas demand at present with the remaining 5% being provided by indigenous production. Ireland does not export.	
Entry/Imports	❑ Ireland: 95%, Northern Ireland: 100%, Isle of Man: 100% ❑ UK: 0%	

Table 4: Information on the IP Moffat

2.5.3 Market rules at the IPs

The most relevant **market rules** at the selected points for this study are

- The time schedule for nominations and re-nominations,
- The timing of the gas day,
- The day-ahead UIOLI-mechanism applied at the IPs.

These market rules have been observed for the four IPs in the study.[25]

Time schedule for nominations and re-nominations[26]

- Oberkappel:

  At Oberkappel on the Austrian side (BOG), the time for nominations is 12:00 h (D-1), while on the German side (EGT) it is 14:00 h (D-1). Re-nominations can take place at the Austrian and German side at every hour until 2 hours before delivery.

- Bunde/Bocholtz:

  At Bunde/Bocholtz on the German side, the same conditions for nominations and re-nominations apply as in Oberkappel. On the Dutch side, conditions for nominations are equal to those on the German side. Re-nominations can take place until 2 hours before delivery; for trades on the TTF, the cut-off time is only half an hour before delivery.

- Blaregnies/Taisnières:

  Nominations on both sides of the IP are possible until 14:00 h (D-1). The times for re-nominations are every full hour between 16:00 (D-1) and 3:00 (D-0) for GRTgaz. On the Belgian side (Fluxys), re-nominations can takes place at every hour until 2 hours before delivery.

- Moffat:

  The times for nominations are 10:00 h (D-1) in Ireland (Gaslink). In GB (National Grid) they differ between exit with 13:00 h for daily metered and 14.00h for non-daily metered flows (portfolios) and entry at 14:30 h. The times for re-nominations for Gaslink are every hour between 18:00 (D-1) and 1:45 (D-0). For National Grid they are every hour between 15:00 (D-1) and 4:00 (D-0).

[25] Information is taken from the Code of Operations of each TSO publicly available.

[26] The index "D" refers in the following to the gas day.

Timing of the gas day

At all IPs within the study the gas day starts at 06:00 (D-0) and ends at 5:59 h (D-0).

Short-term UIOLI applied

- Oberkappel:

In Germany, TSOs are entitled to offer non-nominated capacities day-ahead on an interruptible basis without releasing the original capacity owner from his payment obligations. The same applies in case of nominations distinctly below the allocated capacities. The shippers' rights of re-nomination remain unaffected (§ 13 section 1 GasNZV). The capacities created by day-ahead UIOLI are offered as interruptible capacities. In Austria, the framework for day-ahead services allows the use of the short-term UIOLI-principle. BOG has the right to offer unused contracted capacities on an interruptible basis to other shippers without any change of the bookers' rights.[27]

- Bunde/Bocholtz:

The same rules as in Oberkappel apply on the German side. On the Dutch side, GTS must offer unused capacity at least on an interruptible and day-ahead basis.[28]

- Taisnières/Blaregnies:

On the French side, a day-ahead UIOLI is applied by GRTgaz which allows a shipper to request additional capacity beyond its operational capacity. The requested additional capacity can be (wholly or partly) allocated to the said shipper if another shipper does not use all of its operational capacity on a given day. In Belgium, at each entry point, Fluxys makes entry capacity (D-1) available – on an interruptible basis, and depending on outstanding nominations – to shippers registered as day-ahead users. Such entry capacity may be reduced and/or interrupted in accordance with nominations at the observed entry point. In the Code of Conduct a day-ahead UIOLI for Fluxys is defined, but according to information of the NRA, it has never been applied.[29]

- Moffat:

On the Irish side no UIOLI is applied and no interruptible capacities are offered, since no contractual congestions occur. Hence, there is no need to offer such services to shippers. Under the current exit arrangements on the GB side there is no interruptible capacity booking per se. In effect users nominate an interruptible supply point and are allocated gas against this point. Under the enduring exit regime, effective from 1 October 2012, National Grid will

[27] See BOG Code of Operations „Day-Ahead Services".

[28] See Dutch Energy Regulation Chamber Energiekamer „UIOLI Consulting Document", June 2009.

[29] See ERGEG North-West Gas Regional Initiative UIOLI Questionnaire Answer Synthesis.

be obliged to release an ‘off peak’ product. The quantity to be offered will be determined as a UIOLI amount, which is the difference between the firm NTS exit (Flat) capacity holdings at the NTS exit point and the quantity of NTS exit (flat) capacity that is expected to be utilized by users for the purpose of facilitating gas flows (assessed from a rolling average over a thirty day period (from D-36 to D-7 inclusive). The daily interruptible (flat) exit capacity made available through this mechanism will be allocated via a day-ahead pay-as-bid auction.

3 ESTIMATION OF SUPPLY AND DEMAND CURVES

3.1 CORNERSTONES OF THE MODEL FOR SUPPLY AND DEMAND CURVES

Modelling of the supply and demand curve plays an essential in our analysis of social welfare gains and price convergence resulting from the CMP and CAM.

Supply and demand curves reflect the prices for additional demand or generation. Both curves can be constructed via willingness-to-pay or offer curves. However as information about the market curves are usually proprietary information of the energy exchanges and therefore are confidential, they were simulated in a specific model. The model is based on publicly available data and information.

For modelling purposes, the demand and supply curves are split into different elements, to shape the entire demand and supply curve realistically, on a sound basis.

The following Figure 6 provides an overview of the elements used to construct the demand and supply curves for each day considered throughout the time period. The functions are based on national characteristics and therefore reflect the peculiarities of each interconnection point in the modelling.

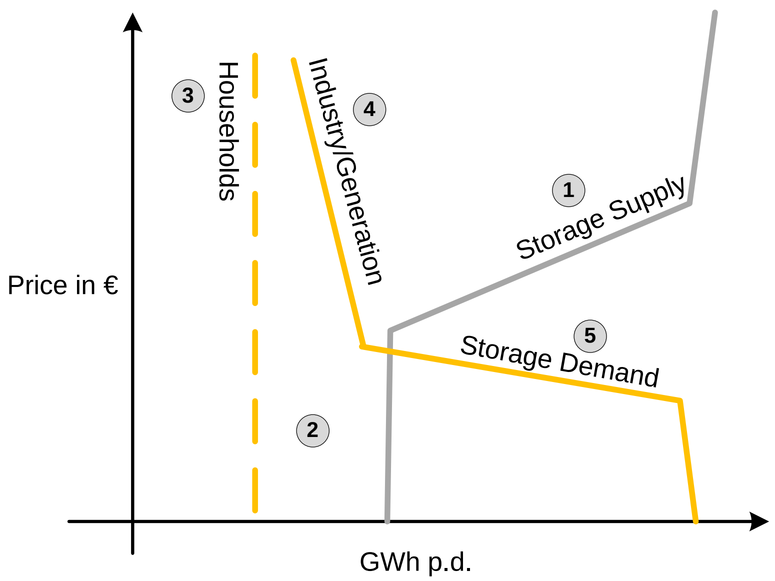


Figure 6: Supply and Demand Elements

For the supply curve we assumed a split into two elements: on one side, a sort of "base supply" and, on the other, a storage-facilities supply.

(1) Here, the storage facilities are used to release gas (supply). The mechanism and dependencies are similar to the ones used for the (storage) demand curve.

(2) Here, the volumes of net imports and production determine the "base flow" and can be characterized mainly as "take or pay" clauses which make them price-inelastic in a short-term view.

The demand curve is divided into three elements for modelling.

(3) The first element represents the consumption of the households. This demand is totally price-inelastic and only temperature-dependent. The assumption of price inelasticity is supported by the fact that households do not react to short-term price signals and hardly react to long-term price signals. Mainly, temperature determines their level of demand.

(4) The second element is the gas demand of industry/generation. Industry/generation demand includes gas demand, on the part of industrial clients and power generators, for processes and for heating. The total demand has different components, consisting of inelastic demand, temperature-elastic demand and price-elastic demand.

(5) The third element of the demand curve represents the demand of storage facilities. Storage demand depends on the market prices and the availability of storage capacities. Based on the available storage capacities in each market, a demand curve, reflecting the available storage capacity, has been developed. If lower prices prevail in the market, gas will be put into storages, assuming sufficient capacity is available.

A detailed derivation of supply and demand curve is found below in the next chapters.

3.2 MODEL OF SUPPLY CURVE

The supply curve consists of two elements:

- Net import/production curves and
- Storages.

3.2.1 Net-imports and production

The information used for net-imports/production is based on publicly available data, which is provided on a monthly basis by national statistic sources or any comparable institution.

The net-imports/production ($NIP_{p.m.}$) curves are assumed to be nearly totally inelastic, since they are assumed to consist mainly of "take or pay" contracts. In order to calculate daily supply curves, it has been assumed that the NIPs are equally allocated over the days of one month. They are nearly inelastic in the short term, and therefore no daily changes are to be expected.

NIPs are usually contracted with a "take or pay"-clause. The importing party pays a price for the imported gas, irrespective of the volume. Most "take or pay" contracts usually have some possibilities to react on changing demand. However, NIPs are mainly characterised by the "take or pay" clause and modelled by negligible marginal costs.

3.2.2 Storage

Storage supply is price-elastic. In modelling storage supply, it is essential to assume that the sum of net-imports/production plus storage supply ($STS_{p.d.}$) is equal to the total demand

($D^i{}_{p.d.}$). This volume ($STS_{p.d.}$) is determined for every day and is used to calibrate the price curve for storage capacity. The storage price curve depends on the total storage volume in a market area, the availability of storage capacity, injection and withdrawal costs, etc.

Based on analysis of national demand and storage pattern, the price curve of storage has been derived as shown in the following Figure 7.

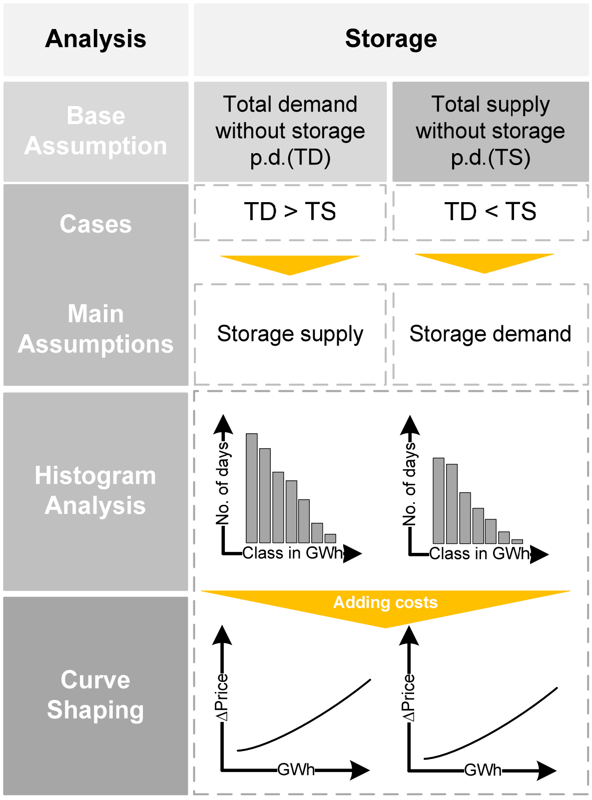


Figure 7: Overview modelling of storage demand and supply

We assumed storage supply for market situations where modelled total demand without storage (TD) is higher than the total supply (TS) without storage. If the demand is lower than the supply, then the volume delta is equal to the storage demand. Published storage costs and capacities were used to allocate these cost figures over the histogram classes of capacities. Therefore storage costs decrease with higher use of the storage facilities (higher frequency), thereby showing economies of scale. By using the information about the demand and supply functions without storage, the model calibrates the starting point for a storage supply curve.

Once the supply elements, base and storage supply, have been constructed, the resulting curves are added to the supply curve which is specific for each day and each market area analysed in the study.

3.3 MODEL OF DEMAND CURVE

The demand curve consists of three consumption groups, which are

- Households,
- Industry/generation and
- Storages.

3.3.1 Households

The households demand curve is temperature-elastic. For modelling purposes, the average daily temperature of each market area analysed, approximated by the data of a representative climate station, is used as the input parameter. The demand curve is totally price-inelastic.

Gas companies use Standard Load Profiles (SLP) to describe household consumption under a daily temperature prognosis. For our modelling we used the SLP DE-HEF03. This profile assumes that consumers on weekdays and weekends have the same consumption value if the temperature is equal on these days. The daily consumption is modelled by multiplying the yearly average amount ($ØDHH_{p.d.}$) by the daily temperature factor ($SLP_{p.d.}^{temp}$).

Temperature sensitivity is limited via variance analysis in which variance of the data to be explained by our estimates is minimized throughout the total monthly consumption of each Member State.

3.3.2 Industry/generation

The Industry/generation demand curve is split into process demand and heating demand, while the generation is modelled only with process demand.

Heating demand of industrial clients is obviously temperature-elastic, as is the demand of households. The amount of heating demand is below 5% of the total industrial and generation demand. This part is modelled in a manner similar to that used for households' demand.

Gas demand for processes is assumed to be price-elastic and not temperature-elastic. All used elasticity values are based on public studies for each country.[30] The process gas consumption has been divided into a base gas demand ($DIG_{p.d.}^{pro-b}$) plus a price-elastic demand ($DIG_{p.d.}^{pro-p}$).The base demand represents the minimum demand and is inelastic. It is constructed on the basis of published data and of indicative assumptions about the

[30] Nilsen, O.B, Asche, F. and Tveteras R., Natural gas demand in the European household sector; Working paper no. 44/05 of the Institute for Research in Economics and Business Administration, Bergen 2005, and Liu, G, Estimating Energy Demand Elasticities for OECD Countries – A dynamic Panel approach, Discussion Paper no. 373; March 2004, Statistics Norway, Research department.

percentage of base demand with respect to total demand.[31] Only the price-elastic demand depends on the national price elasticity.

3.3.3 Storage

The storage demand curve is developed in a manner similar to that used for the storage supply curve. The storage demand is assumed to be relevant for all the cases where the total demand without storage is smaller than the total supply without storage (see Figure 7). The storage demand curve reflects a price curve which is determined by storage operating and injection costs and increases through rising storage capacity requests.

3.4 TOTAL MODEL OF THE IP

The following Figure 8 summarizes the main assumptions and the modelling steps.

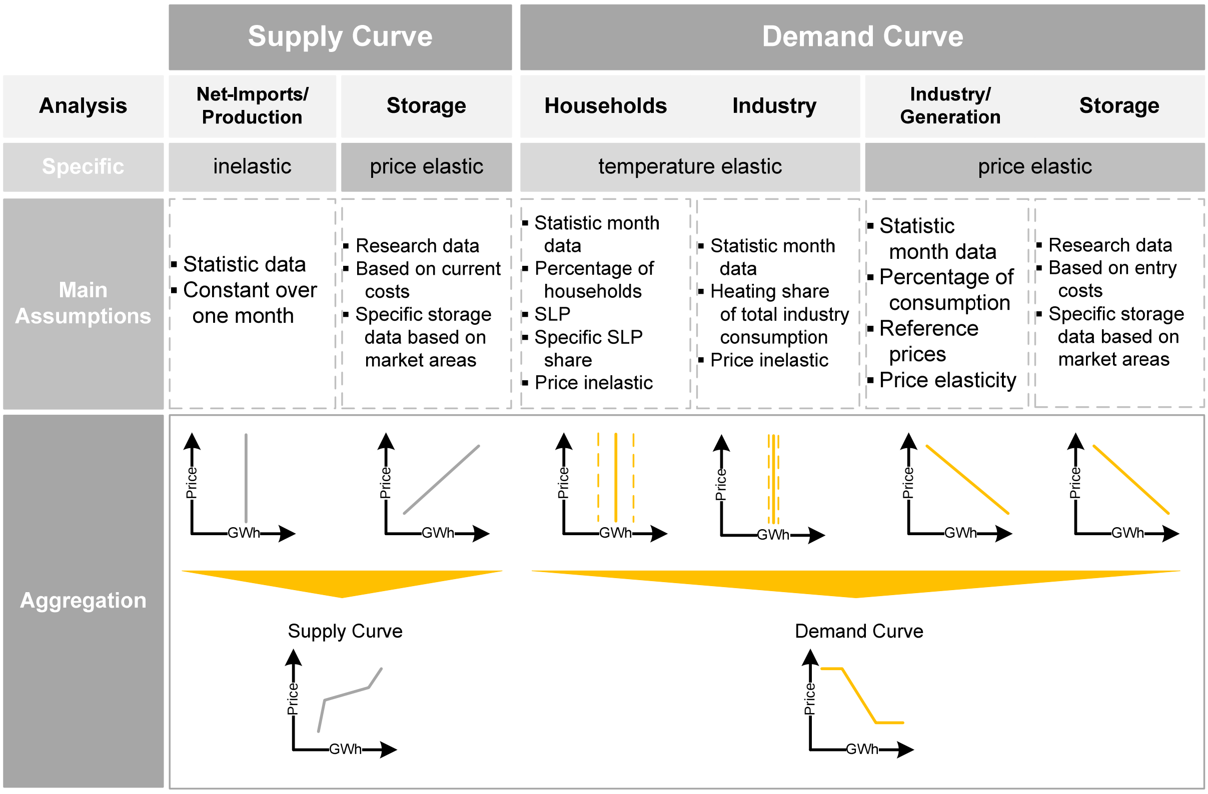


Figure 8: Overview of the market model

The market model leads to individual supply and demand curves for each market at either side of an IP. The model adjusts the daily supply and demand curves based to the specific historic price on each power exchange market.

[31] These assumptions reflect the fact that increasing prices tend to lower gas consumption but do not reduce it to very low levels, as both industry and generation have a steady demand.

These daily market curves form the basis for the assessment of the Total Social Welfare gain or the price convergence resulting when additional transmission capacity is made available by applying the ERGEG principles.

Plausibility check of demand and supply curves

The demand and supply curves have been developed ‘bottom-up’. The aim of the cross-check was to estimate demand and supply price elasticity values ‘top-down’[32] and to compare the results with the ‘bottom-up’ approach. In the process, differences between summer and winter had to be taken into account.

In summer it can be assumed that supply is nearly totally price-inelastic but storage demand is price-sensitive. Changes in prices were used to check the assumed elasticity of the storage demand functions.

In winter the situation is different. Demand is close to being totally price-inelastic and dependent on the temperature. Supply is regarded as price-elastic. Thus price differences can be used to check the assumptions relative to the demand curve.

- For Austria and Germany (NCG) we checked the supply functions on the calculated daily volumes fed out of storages, by a linear regression including a dummy variable for monthly effects. Also respective calculations for the summer time confirmed that the work approach in principle. The supply functions estimated showed an R^2 of 49% for Germany (winter) as the best result.

These results were interpreted as indicating that the assumptions made are plausible and can be used within the model.

Furthermore the results may be sensitive on the modelling of the parts of the demand and supply curve which are influenced by storage. Therefore we checked the results carefully on the robustness of the benefits depending on variations on storage demand and storage supply functions. In detail both injection and withdrawal costs were separately changed by comparison to the input value. According to this sensitivity analysis, welfare gain changed in average by +2% (+5%) in winter times when the injection costs are reduced by 10% (30%), while welfare gain decreases by 1% (4%) in case these costs are assumed to increase by additional 10% (30%). For the summer time the sensitivity is higher which can be traced back to fact that storage facilities are normally used for winter time preparing and therefore increasing demand of injection facilities.

[32] In order to cross-check the results the net-export curves have been generated. These curves have been composed on the basis of actual market observations with regard to the range of possible underlying demand and supply curves.

Average sensitivity results for the welfare gains		Injection costs		Withdrawal costs	
		Winter	**Summer**	**Winter**	**Summer**
Percentage costs change	**-30%**	+5%	+15%	+11%	+6%
	-10%	+2%	+6%	+3%	+2%
	+10%	-1%	-4%	-3%	-2%
	+30%	-4%	-9%	-7%	-5%

Table 5: Overview average sensitivity results

For decreasing withdrawal costs, it can be highlighted that a 10% (30%) cost decrease creates average additional welfare gains of 3% (11%) in winter times and 2% (8%) in summer times. The sensitivity effects are lower during summer as feed-out facility demand is less than in winter times.

Summarizing the results of the sensitivity analysis, it can be generally highlighted that increasing costs treats to decreasing welfare gains which have quite replicable effects on the results.

4 MACRO-ECONOMIC ANALYSIS

4.1 INPUT DATA

The minimum volume of data was defined and discussed with the NRAs, in order to clarify the final volume of the requested data.

The data list is categorized as shown in the table below:

Technical Data	Market Data	Other Data
Technical capacity	Transport fees	Supply
Booked/subscribed firm capacity	Active shippers at the IPs	Temperature
Booked/subscribed conditional capacity	Gas consumption	Standard load profiles
Booked/subscribed interruptible capacity	Allocation of consumption	Prices for household and industry
Available firm capacity	Maximum load	Gas storage information
Available conditional capacity	Long-term supply contracts	Storage capacity
Available interruptible capacity	Short-term supply contracts	Feed in/feed out volumes
UIOLO subscribed capacity	Day-ahead prices (PX)	Feed in/feed out prices
UIOLO available capacity	Other prices (OTC)	Active shippers storage
Nomination	Cross border prices	Demand/consumption
Re-nomination	Price elasticity of demand	Gas production (national)
Allocation	Correlation day-ahead price (PX) and OTC	Price
Physical gas flow	Secondary markets	Import/export

Table 6: Overview input data

The data were collected for the IPs Bunde/Statenzijl and Bocholtz (Germany-Netherlands), Oberkappel Germany-Austria), Blaregnies/Taisnières (France-Belgium) and Moffat (UK-Ireland). The survey period is from 1 October 2008 – 30 September 2009 (GY 2008/09).

To speed up the process of data collection, the NRAs have been asked to support this process. The available data or data sources supplied by the NRAs indicated that the information required can be found on the TSOs or ENTSOG transparency platform. In addition to relying on the support of the NRAs, we carried out extensive data research of our own, with a special focus on public data available on web sites of such institutions as transmission system operators, power exchanges and statistical institutes. Those additional resources were useful for filling in gaps in market data.

Checks of the available data identified discrepancies in technical exit and entry values. These resulted from discrepancies in conversion rates on both sides of the investigated IP (e.g. conversion of gas volume from cubic metres into equivalent amount of energy in kWh).

The different conversion rates were investigated and discussed with the NRAs. To render the values on both sides of the IP comparable and usable, one standardized conversion rate was applied. In addition, it has to be noted that some data are generally not available in the form of demand and supply curves. Such data have been reconstructed by the available data.[33]

Publicly available data for the time period of the GY 2008/09 were:

- **Gas data**

  Information about own production, import, export, consumption by demand groups (households & small business, industry, generation) as well as storage balance in kWh for each country provided on a monthly basis (which are used for the calculation of demand and supply curves).

- **Weather data**

  Average daily temperature for a representative city for each country / market area (which is the daily basis for the calculation of the standard gas consumption sheets and therefore the demand function).

- **Storage data**

  Information about storage operators of the respective countries / market areas, such as prices, volumes and capacities (storage prices have been weighted according to volume in order to consider storage size). The data about total volumes and feed-in as well as feed-out capacity are included in the basis for calculation of the storage curve (demand and supply).

- **Other information**

  Price elasticity of each demand group; this is country-specific data that was required for the demand function.

  Day ahead prices such as power exchange prices and OTC prices (data from brokers).

- **Missing data for Belgium**

  Information about the import, export and consumption was available only for 2008. We used the percentage change in Germany between 2008 and 2009 and multiplied this with the figures for Belgium (in the form of approximated data).

Supply and demand are constructed on the basis of different assumptions, which are explained in detail in Chapter 3. The data were used for calibration of the model with a base scenario.

[33] As mentioned above, in the process of gathering information, we noticed that data transparency is not always a high priority.

4.2 ANALYSIS OF THE CMP FIRM DAY-AHEAD UIOLI PRINCIPLE

4.2.1 Quantitative evaluation

4.2.1.1 Overview

The Social Benefit Analysis (SBA) is a well-known method for analyzing market framework changes in terms of monetary units. It calculates advantages and disadvantages, expressed in gross benefits and costs. The SBA used compares the options in a comparative-static sense, i.e. it analyses gross benefits and cost compared to the status quo by assuming that the status quo is immediately replaced by one of both options.

The SBA was used in this study for the calculation of the gross benefits as follows:

- For each IP the model was calibrated first by the status quo (option 1).
- In a second step the additional capacities made available by firm-day-ahead UOILI were calculated and the resulting benefits were estimated based on the calibrated model (option 2).
- All results are compared to the base scenario for the GY 2008/09.
- Depending on the availability the costs of the new CMP were discussed in addition. Thus the SBA in this study focuses on the additional gross benefits or additional Total Social Welfare of the new CMP.
- As illustrated in Figure 3 in chapter 2.2.1.1, the additional welfare calculated is estimated by the area which is between the old interception and the new price level circumscribed by the supply and demand curves plus the congestion rent. The congestion rent is the product of export values times the price difference between both markets. Thus the welfare (gain) is the sum of (additional) consumer/producer and congestion rent. As consequence, ceteris paribus, the Total Social Welfare is higher the more price differences can be reduced. The maximum welfare can be limited by the technical capacity.[34]

The following chapter describes for three IPs the available capacities, Total Social Welfare, price convergence and the effect of additional investments.

While Bunde/Bocholtz, Blaregnies/Taisnières, and Oberkappel are included in the analysis, Moffat was not quantitatively analysed because there were no price differences between both sides of the IP (thus no potential price arbitrage and no net export curves to be detected).[35]

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[34] Based on the available information and data the model used several information sources. On the one side the supply curve is described by the sum of all natural gas imports, the exploration in each country as well as the supply of gas storage operators. In the last case the gas storage volume was adjusted by the geographic position of the IP in connection to the gas storages itself. And on the other side is the demand curve which is generated by the consumption of end consumers, industrial users and the generation plus the feed-in demand of gas storage users.

[35] We checked the data carefully, but it was not possible to analyse every (possible) data error in data published (or missing data).

4.2.1.2 Bunde/Bocholtz

4.2.1.2.1 Available capacity

This interconnection point between Germany and the Netherlands is quite representative for the net flows between these countries.[36] During summer time net flows are directed to the Netherlands and in winter times net flows go from the Netherlands to Germany in order to covering the increased demand by German customers.

Figure 9 displays the net flows at Bunde/Bocholtz towards the Netherlands (positive values) and to Germany (negative values) as well as the maximum technical capacities in both directions for the GY 2008/09. Over this period the maximum capacity has been reached only during a few days in December 2008 and January 2009.

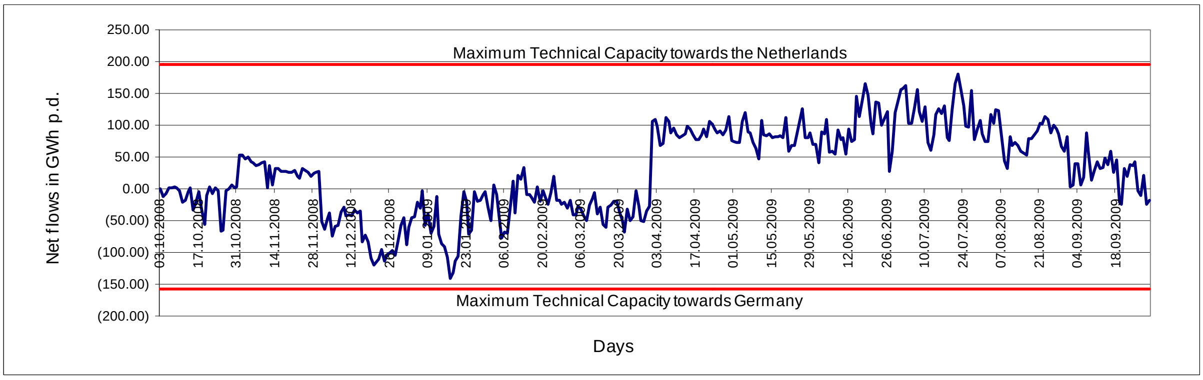

Figure 9: Net flows between Germany and Netherlands (Bunde/Bocholtz)

In April 2009 the net flow switched direction and then, for the rest of the period, moved towards the Netherlands. This can be explained by the higher prices in the Netherlands or the strategic behaviour of filling gas storages in preparation for winter.

Figure 10 shows the degree of physical utilisation relative to the respective technical capacity in each direction. Positive values stand for net flows in direction to the Netherlands, while negative utilisation values stand for net flows towards Germany. In both directions, net flows reached nearly the maximum capacity on some days.

[36] Please note that in this study, we refer to Bunde/Bocholtz as one (virtual) interconnection point.

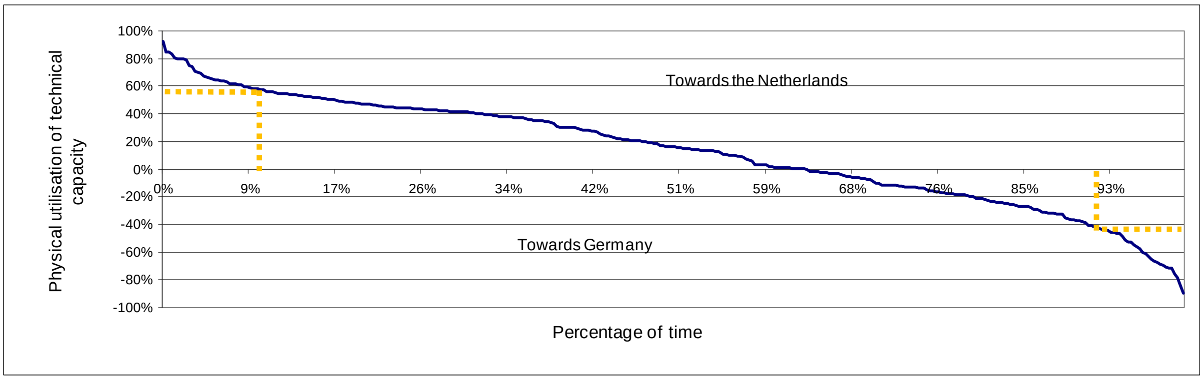

Figure 10: Physical utilisation of technical capacity (Bunde/Bocholtz)

The net flows towards the Netherlands exceed for nearly 10% of the time 60% of the maximum available capacity. For Germany the situation is somewhat different as nearly in 10% of the time the net flows are higher than 40% of the technical capacity towards Germany.

The IP is only used to 60% or less for about 85% of the time. Only 3% of the time has been more than 80% of the capacity used.

In Figure 11, an additional (yellow) line is included. This line shows the net flows of policy option 2, which have been calculated by the E-Bridge model.

Under policy option 2, i.e. the application of the firm day-ahead UIOLI principle, the model shows that there are additional flows (yellow line compared to the blue line) on the interconnection between both countries. Existing price convergences are reduced by flows from the low-price area to the high-price area.

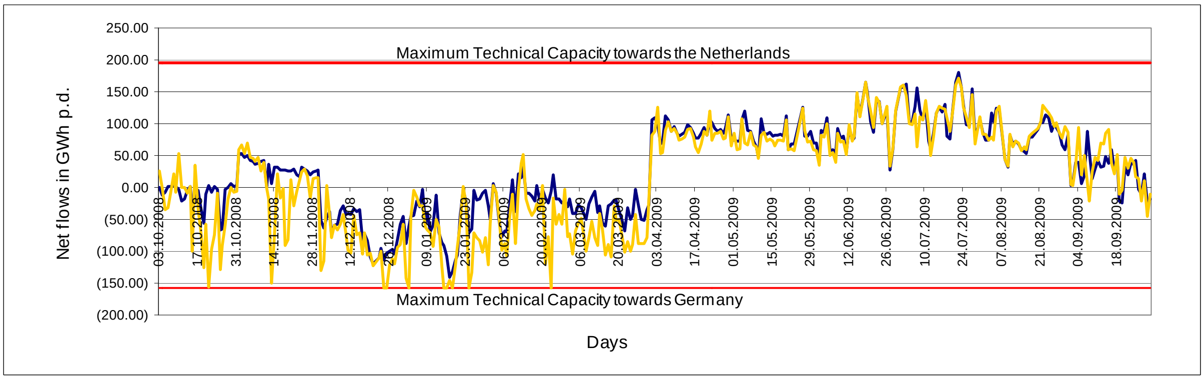

Figure 11: Net flows and available capacity at Bunde/Bocholtz after UIOLI

In some cases the flow in the model for policy option 2 is lower than in the base case ex ante (policy option 1). This fact comes from adverse flows, which are flows on a specific day from the high-price to the low-price area (adverse flow). Such adverse flows might be the result of long-term contracts to be fulfilled (or transits). In such cases, the flow is not price-sensitive with regard to spot market differences. Nevertheless, price arbitrage leads to a correction, which can be seen in Figure 11: as the model reduces the existing adverse flows in total, by transferring natural gas into the high-price market, a reduction in comparison to the initial flow results.

In Figure 12, the actual physical utilisation is compared to the calculated outcome of policy option 2 and highlights the additional flows to the high-price area (policy option 2: yellow line compared to policy option 1: blue line).

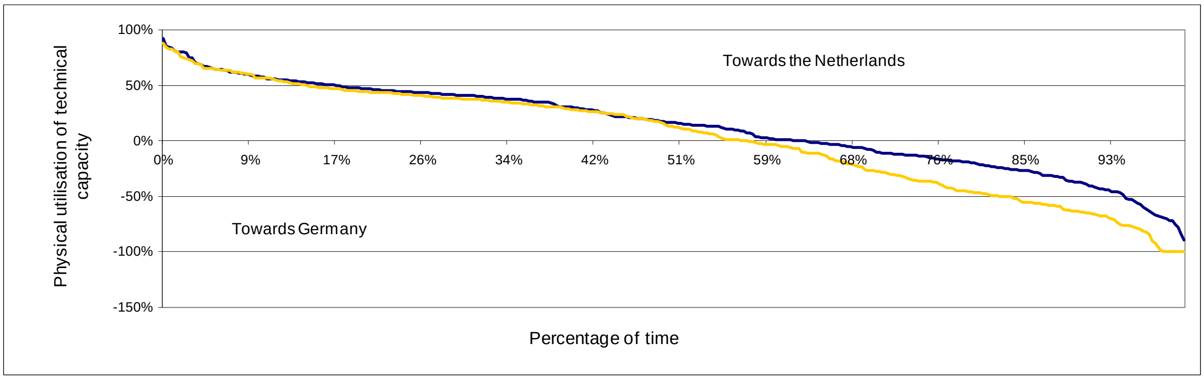

Figure 12: Physical utilisation of available capacity at Bunde/Bocholtz after UIOLI

After the implementation of policy option 2 the technical capacity used is below 60% for 78% of the time. For 6% of the time, the capacity used is above 80%.

4.2.1.2.2 Total Social Welfare (gross benefits)

The (additional) Total Social Welfare is based on the data we used for the modelling. The results shown indicate that the main welfare gains are created by flows towards Germany.

In the following Figure 13, this can be seen in the blue points on the right side of the vertical dotted line, which shows the welfare gains that can be achieved through price arbitrage.

The dots represent the additional capacity made available by firm-day-ahead UIOLI for one single day in the GY 2008/09 and the welfare generated by price arbitrage on that day.

Dots to the left of the Figure 13 show welfare gains by price arbitrage from flows towards the Netherlands.

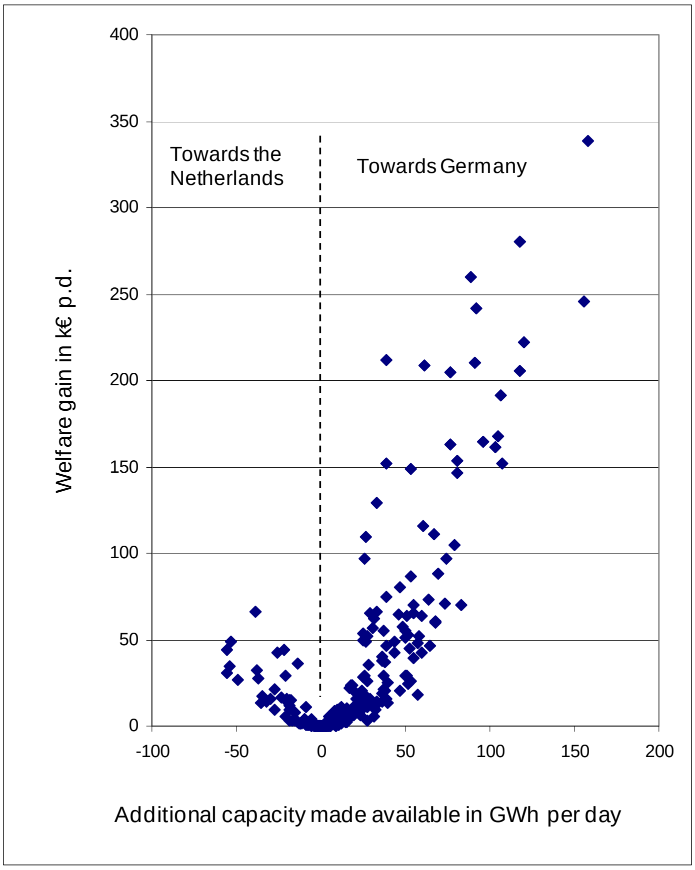

Figure 13: Total Social Welfare of policy option 2 at Bunde/Bocholtz

The total annual social welfare gain (gross benefit) is some 9.6m€ (per year) based on the data of the gas year 2008/09.

4.2.1.2.3 Price convergence

In the previous chapter, it was shown that policy option 2 leads to additional flows between both countries. On average (which means for the whole gas year), the price was 1.2€ higher in Germany than in the Netherlands.

Conversely, the Dutch average price was on average 0.6€ higher than German price in the cases where the price difference between the Netherlands and Germany was positive.

The following Figure 14 describes the price differences between both markets in detail: It displays the initial price difference, i.e. existing day-ahead price differences between TTF in the Netherlands and NCG H-Gas in Germany for the GY 2008/09 (policy option 1) as well as remaining price differences under policy option 2, as they have been calculated by the E-Bridge model (grey bars). Still remaining price differences in case of additional capacity investments are illustrated by orange bars.

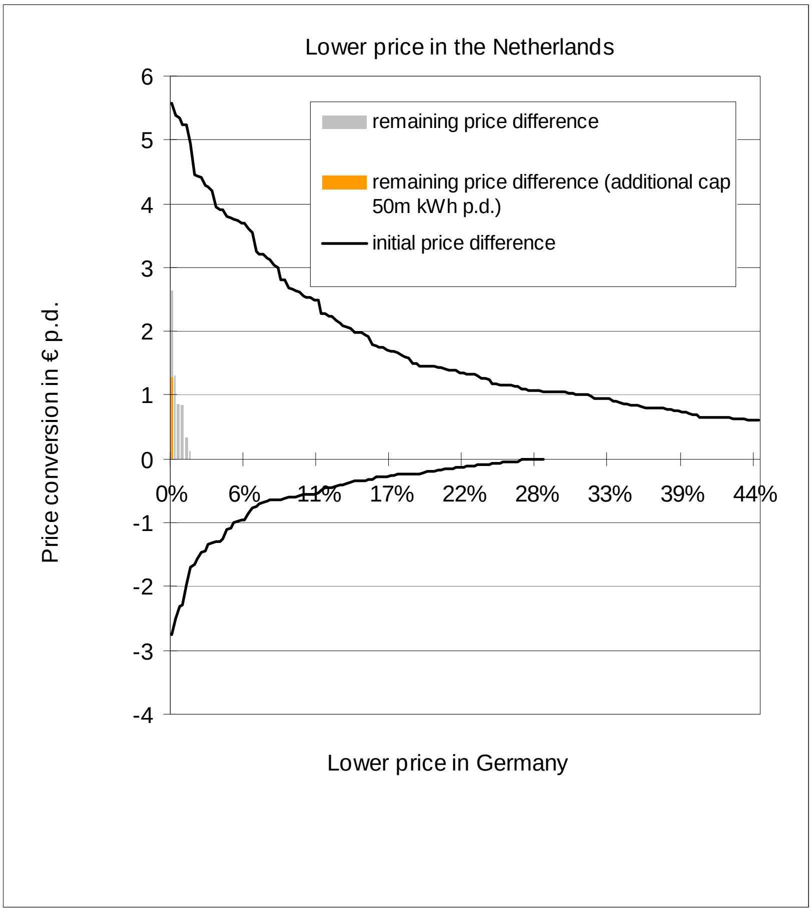

Figure 14: Price conversions – Bunde/Bocholtz

Figure 14 shows that the German price was more than 2.3€ higher than the price in the Netherlands on 10% of the days of the GY 2008/09.

By implementation of firm day-ahead UIOLI principles, nearly all price differences can be reduced. Only for seven days is no additional technical capacity available to reduce the remaining price difference after use of firm day-ahead UIOLI. This is shown in the Figure 14.

4.2.1.2.4 Effect of additional investments

As the application of policy option 2 cannot achieve full price convergence, we assumed that an additional capacity of 50GWh p.d. is available.

Due to this assumption the remaining price difference can be eliminated and an additional but limited welfare of 0.25m€ generated.

4.2.1.3 Blaregnies/Taisnières

4.2.1.3.1 Available capacity

Blaregnies/Taisnières is the most important interconnection point between France and Belgium, as most of the Belgian gas flows from Zeebrugge into France over this interconnection point.

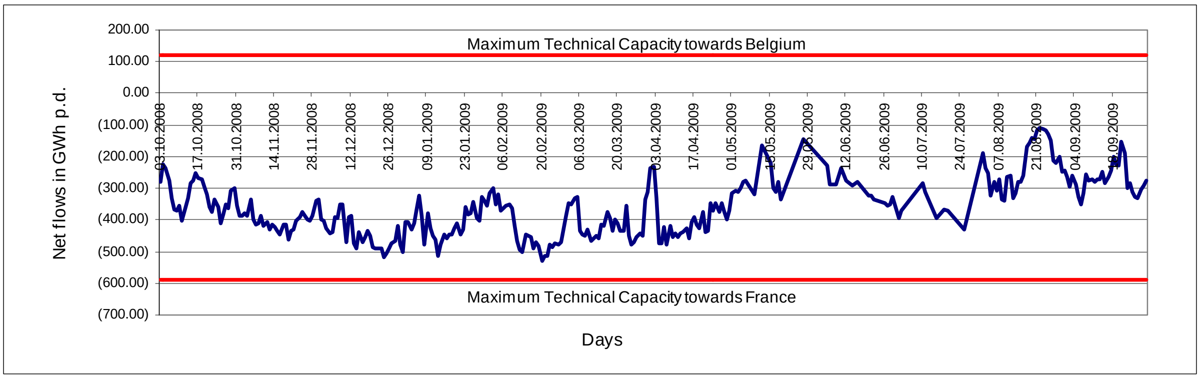

Figure 15: Net flows between Belgium and France (Blaregnies/Taisnières)

As can be seen in Figure 15, natural gas has flown through this IP only in the direction towards France in the gas year 2008/09. During this GY, the maximum technical capacity of Blaregnies/Taisnières was never attained.

Analysis of the physical utilization of Blaregnies/Taisnières (see Figure 16) shows that 10% of the time less than 40% of the maximum technical capacity has been used.

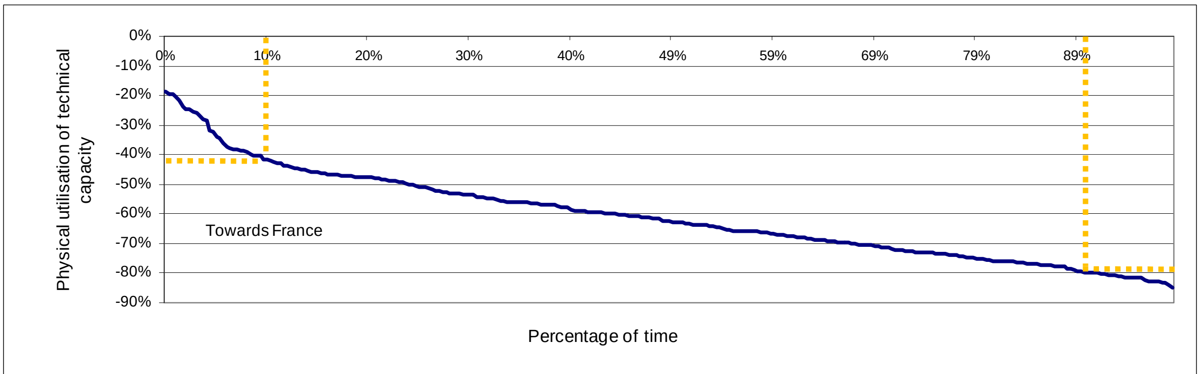

Figure 16: Physical utilisation of technical capacity (Blaregnies/Taisnières)

The use of the technical capacity is less than or equal to 60% for about 45% of the time. For 10% of the time the load factor is 80% or higher.

In a result similar to that obtained for Bunde/Bocholtz, implementation of policy option 2 in the modelling creates additional flows between both countries, as opportunities for price arbitrage are exploited. This is illustrated in Figure 17 (policy option 2: yellow line compared to policy option 1: blue line).

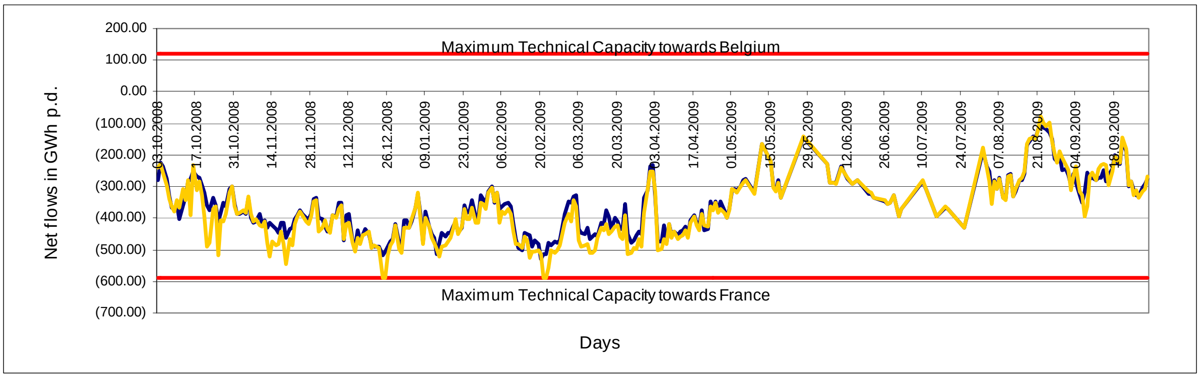

Figure 17: Net flows and available capacity at Blaregnies/Taisnières after UIOLI

The flows initialised by firm day-ahead UIOLI are mainly from Belgium to France for the time period of the gas year 2008/09.[37]

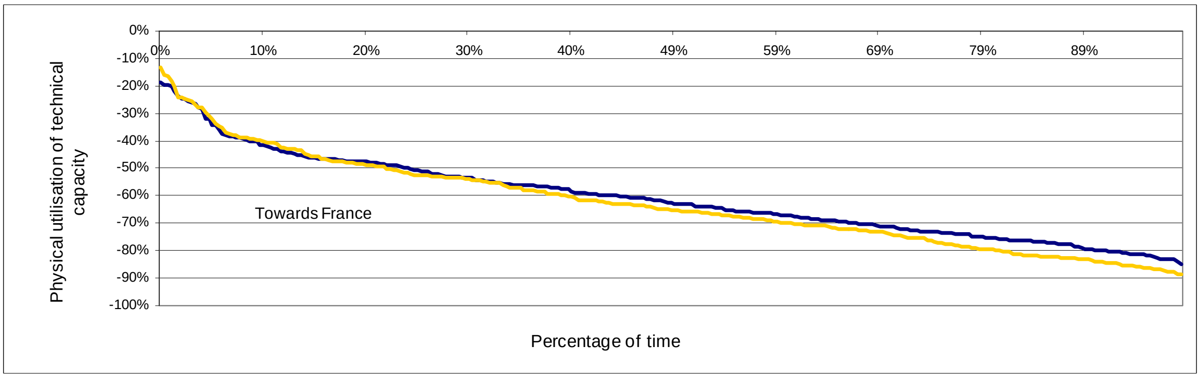

Figure 18: Physical utilisation of available capacity at Blaregnies/Taisnières after UIOLI

In Figure 18, actual net flows (policy option 1) are compared to calculated net flows after introduction of UIOLI (policy option 2). The firm day-ahead UIOLI principle leads to a steady increase of flows towards France and therefore reduces the unused capacity in this direction. Due to these flows the following results were obtained: For nearly 40% of the time the transmission pipe is used by 60% or less of the available capacity to France (including the additional flows to France). Approximately 80% or more of the available capacity is used 20% of the time.

4.2.1.3.2 Total Social Welfare (gross benefits)

Policy option 2 creates a welfare gain on the interconnection point Blaregnies/Taisnières of 6.9 m€.

[37] The additional flows reduce the existing price differences between France and Belgium nearly completely.

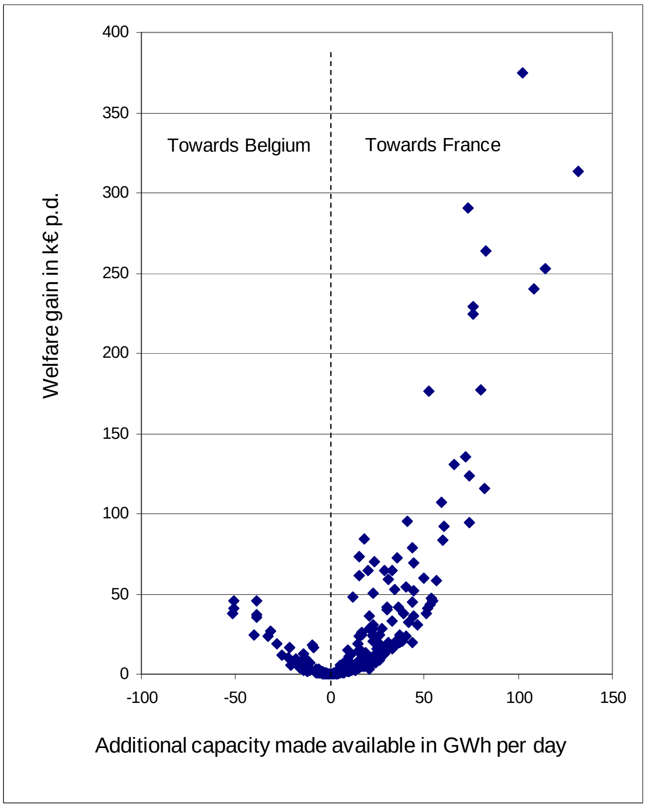

Figure 19: Total Social Welfare of policy option 2 at Blaregnies/Taisnières

Welfare gains result mainly from additional flows towards France; these can be seen on the right side of the Figure 19. On the interconnection point adverse flows are relevant (left side in Figure 19). The amount of welfare in times of adverse flows under policy option 1 is 0.6m€ (this is included in the welfare estimations).

4.2.1.3.3 Price convergence

The situation for Blaregnies/Taisnières is similar to the one at Bunde/Bocholtz, as at both interconnection points additional welfare can be created by using unused capacity to decrease price differences between two markets.

At times where Belgium is the low-price area, the average price difference is 1.7€. On the other hand, the average price difference is 0.7€ in cases in which France is the low-price area.

The following Figure 20 illustrates the price difference in detail. It shows that most of the time the price in Belgium was higher and that the maximum price difference was approximately 8€.

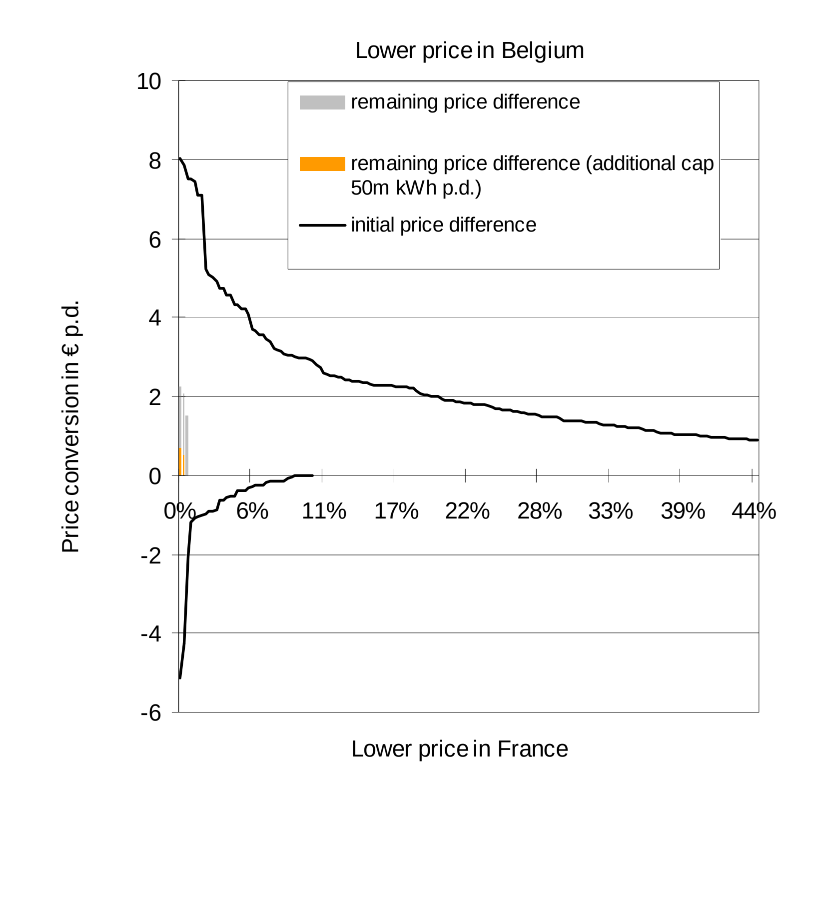

Figure 20: Price conversions – Blaregnies/Taisnières

Furthermore, the Figure 20 reflects the effect of the firm day-ahead UIOLI principle of reducing nearly all price differences.

Only on three trading days do we have a remaining price convergence between 1.5€ and 2.2€, as is indicated in the Figure 20.

4.2.1.3.4 Effect of additional investments

The amount of days with price differences can be reduced further to only one day by using policy option 3 in the modelling (if 50 GWh p.d. per day is added). The price difference is then between 0.5€ and 0.7€.

The welfare gain increases only by 0.12m€ under policy option 3.

4.2.1.4 Oberkappel

4.2.1.4.1 Available capacity

The third interconnection point within the quantitative analysis is Oberkappel, which transfers gas between Austria and Germany.

The analysis of available data about the technical capacity and physical flows between Austria and Germany reveals situations of physical congestions.

The technical capacity towards Austria is given as some 72GWh p.d. in the publicly available data. In contrast to this, actual flows in the gas year 2008/09 were up to 160GWh p.d. (see Figure 21).

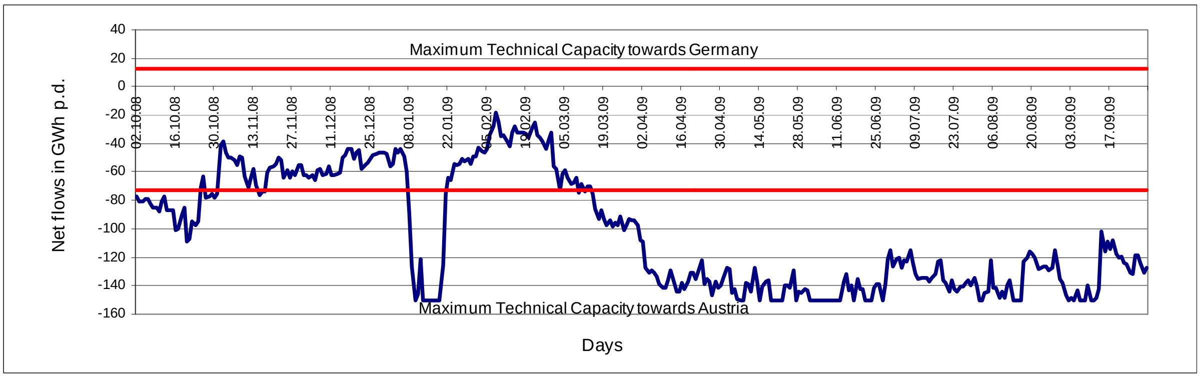

Figure 21: Net flows between Austria and Germany (Oberkappel)

This shows that capacity use is high and that the flows are far beyond the officially published technical capacity. Based on information published by the TSOs, we assumed for the modelling that the maximum technical capacity is 13GWh p.d. for flows towards Germany, while technical capacity towards Austria is roughly 5.5 times higher, i.e. 72GWh p.d.

Net gas flows were directed only towards Austria and the technical capacity was exhausted in nearly 70% of the analysed time.

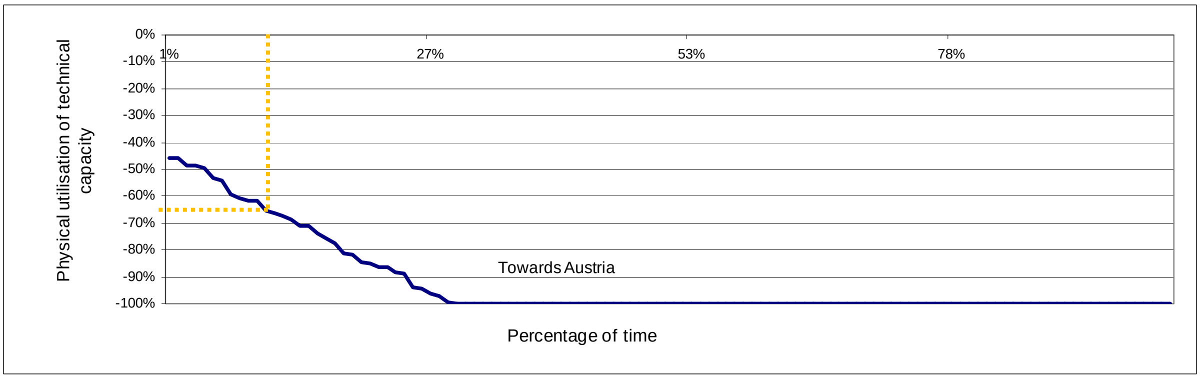

Figure 22: Physical utilisation of technical capacity (Oberkappel)

The capacity at the IP Oberkappel towards Austria was highly used. The load factor was only 8% of the time below 60%. Capacity utilisation was above 80% for 84% of the time.

We note in this context again that the results are based on public information on technical capacities and flows, as they have been published by the TSOs. This information was used for this calculation despite the fact that throughout the year higher flows were possible. No data from GRTgaz Deutschland were available publically for the GY 2008/09. They may change the figure of net flows in the sense that the net flows will be closer to, or even below, the technical capacities. These flows were not regarded because we assumed that the flows do not go to the market areas of NCG, as the network of GRTgaz Deutschland was not a part of the market area in the respective gas year.

In discussion, the German TSO (EGT) indicated that under their understanding of German law, and because the calculation covers three years, the calculation is conservative. A higher technical capacity could be calculated (D-3), but there are no real financial incentives for such a dynamic capacity calculation under the existing revenue cap. This contrasts with the situation in the UK, where the NRA has established financial incentives to maximise the firm capacities offered to the market.

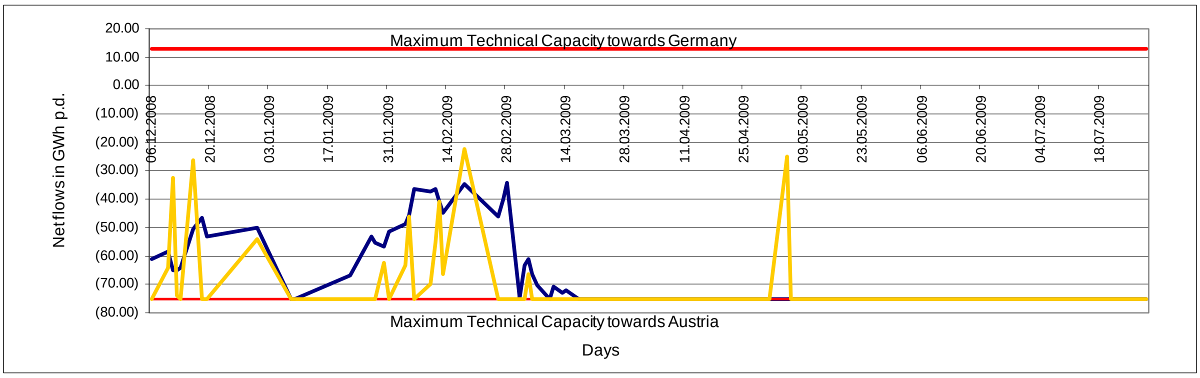

Figure 23: Net flows and available capacity at Oberkappel after UIOLI

In a few cases, policy option 2 offers the possibility of transferring additional natural gas amounts between two countries.

This increase can be seen in the Figure 23, as the yellow line (policy option 2) is clearly below the initial physical utilisation curve (blue line: policy option 1).

It has to be mentioned that in the E-Bridge model, the calculated model flows are restricted according to the publicly available data for the GY 2008/09. Therefore, welfare gain could be higher due to remaining arbitrage possibilities in a (potentially more representative) year with less atypical flows.

The Figure 24 below shows adverse flows to which the same explanations apply as were provided for the other IPs (see, e.g., Figure 12).

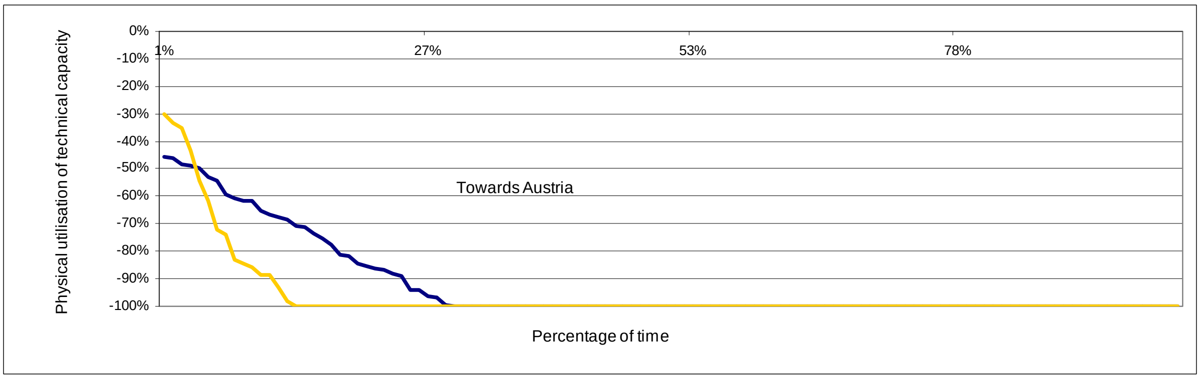

Figure 24: Physical utilisation of available capacity at Oberkappel after UIOLI

By introducing policy option 2 the unused capacity due to contractual congestion decreases as the additional flows are mainly directed towards Austria. There is a decrease of 2 percentage points for the times where the maximum load is 60% and less.

<u>Remarks on the gas year used for the modelling</u>

We acknowledge that the situation between both countries might be seen as specific for the gas year 2008/09, when political conflicts and trade system changes occurred in countries such as Ukraine. Further, there was a change of the grid code in Hungary, an atypical import pattern in Slovenia and a change in some portfolios of Austrian suppliers who bought more from Germany because of the Ukraine crisis.

Even if the gas year 2008/09 may not be very representative (and the situation may even change partially as a result of the inclusion of GRTgaz Deutschland in the NCG market area) it can be used for plausible welfare calculations reflecting comparable situations at heavily used IPs.

4.2.1.4.2 Total Social Welfare (gross benefits)

The welfare gain of policy option 2 is around 2m€ in total for the IP Oberkappel, based on the analysed days and results mainly from flows to Austria; see Figure 25.

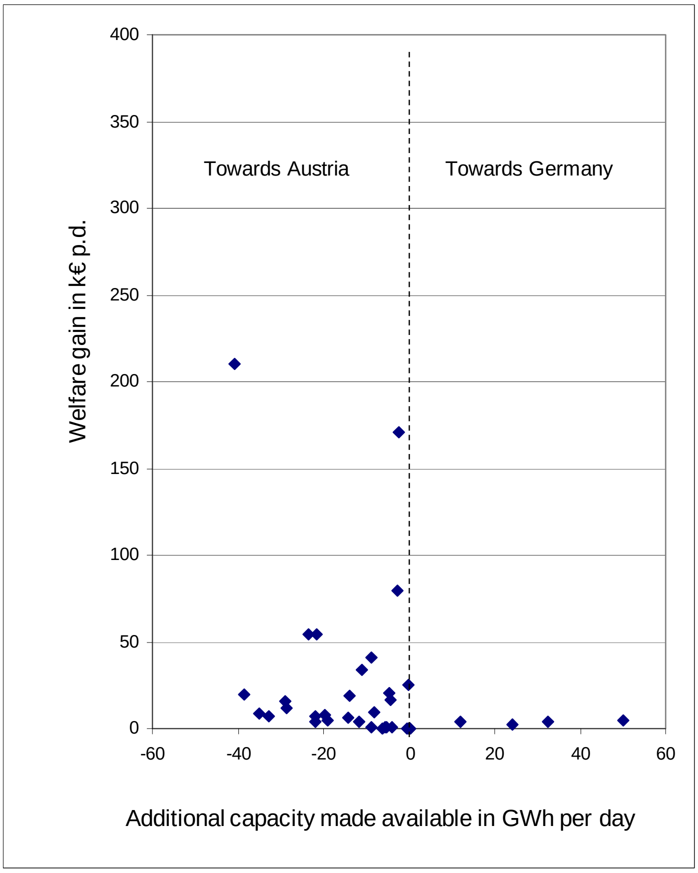

Figure 25: Total Social Welfare of policy option 2 at Oberkappel

The rather limited welfare gain reflects the results of limited physical capacity in the direction of the high-price area.

As the analysed GY might be atypical, it has to be concluded that in more typical year the welfare generated by firm-day-ahead UIOLI could have been higher, thus showing higher benefits of the new CMP. On the other hand, it has to be mentioned that high price differences between Austria and Germany during the analysed GY 2008/09 may also be a result of physical congestions. Further, a dynamic capacity calculation may facilitate more-effective use of the IP, by adding additional possibilities, for resolving contractual congestions that are not obvious from the published data.

4.2.1.4.3 Price convergence

In Oberkappel the welfare gain was limited for the data of the gas year 2008/09. Thus it is not surprising that the price differences are not much reduced. The former average price difference between Germany and Austria decreased only by 0.05€ to a level of 2.05€.

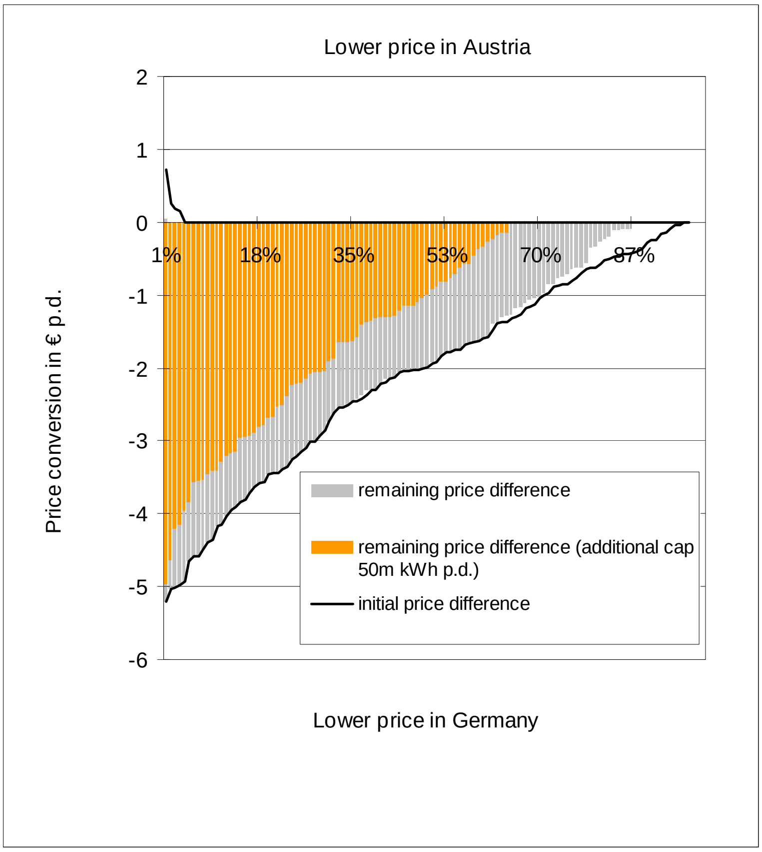

Figure 26: Price conversions – Oberkappel

This result can be seen in Figure 26. It illustrates the restricted price convergence and the relevant remaining price differentials.

As the year may be atypical, it has to be concluded that in more typical years the price convergence generated by firm day-ahead UIOLI might be higher. Again a dynamic capacity calculation would be favourable in this context.[38]

4.2.1.4.4 Effect of additional investments

In Oberkappel available capacity is rather limited according to the publicly available data; therefore the IP seems to be different from the other IPs with regard to policy option 3.

By adding additional capacity of 50GWh p.d. the welfare gain is relevant. It is approximately 9m€ and the additional capacities will reduce the average price difference to a level of 1.29€. Again, as the year is atypical, it has to be concluded that in more typical years the benefits generated by additional investments may be lower than in this year.[39]

The cost of respective investments to increase physical capacities 50 GWh/d are around 50 million € based on investments costs made public by EGT as well as by our own estimations.

[38] This is a general result beyond the special case of the IP in Oberkappel.

[39] This is a result of a higher effectiveness of the new CMP.

Source was the public information of EGT on the extension of Megal of 100 GWh and its costs.[40] We used approximately 55% of the costs outlined for the estimate of the relevant costs in this study.

E-Bridge made a rough estimation of investment costs and came to nearly the same result. Note that, generally spoken, the capacity of a pipeline system may be enlarged by increasing either the diameter of the pipes or the difference in pressure within the line. Simplicity half (and well knowing that this solution would not always be feasible) E-Bridge assumed for the estimation that capacity shall be enlarged only by an investment into additional compressor power (which will increase the possible difference in pressure). Using current conditions in Oberkappel as starting point (49 bar / 67.5 bar min. / max. pressure; technical capacity of 100m kWh / d which is equivalent to some 100 Nm^3 / s), and assuming an overall degree of effectiveness of natural gas compression of 32%, E-Bridge calculations come to the result that operating energy input of compressors should be some 13 MW to offer existing technical capacity. In order to increase the compression relationship (i.e. max. to min. pressure) from 1.38 to 1.73, which would increase technical capacity from 100m kWh / d to 150m kWh / d equivalent to some 150 Nm3 / s, an additional installation of 21 MW compression capacities (operating energy input) would be necessary. Investment costs were about €m 52 and marginal transportation costs about 1 percent of the additionally transported energy.

Thus, in a longer perspective, the increase in capacity makes sense and is useful, especially in light of effects we just saw in the spot markets.

4.2.2 Restriction of re-nominations

Re-nominations are relevant for calculation of available firm day-ahead capacities, as they tend to restrict such capacities. The higher the re-nominations, the lower the available firm capacity released is. On the other hand, re-nominations are relevant in the context of needed flexibility for original capacity holders as within firm day-ahead UIOLI existing re-nomination rights are restricted, thus reducing flexibility of these shippers.

There are several possibilities to change existing re-nomination rights. Re-nomination rights could be abolished completely and only be offered on an interruptible basis or by granting firm re-nomination rights that make up a certain amount defined by a rule, e.g. the sum of 2% of booked capacity and 2% of the technical capacity at the IP, which is discussed in the documents E-09-GNM-10-04.[41]

Other re-nomination formulas can be used as well, e.g. the current one in Germany, which was proposed by BNetzA and which sets restrictions such that (i) if nominations are between 0 and 20% of the bookings, they can be further reduced only by 50% of the nominations made and increased to 90% of the bookings; (ii) if nominations are in a range of 20% and 80% of the bookings, they can be modified to every volume between 10% and 90% of the

[40] Public information from EGT, MEGAL gibt weiter Gas - Unternehmen investiert geschätzt 95 Millionen Euro in Ausbau des überregionalen Netzes, 2009.

[41] ERGEG, Congestion management on European Gas Transmission Networks Recommendations for Guidelines Adopted via a Comitology Procedure - Impact Assessment - Ref: E09-GNM-10-04, 10 December 2009

bookings; and (iii) if nominations are in a range of 80% to 100% of the bookings, they can be reduced to 20% and by 50% of the difference between bookings and nominations above 80%.

If re-nomination can only be made on an interruptible basis a lexicographic ordering of capacity booking is applied. In this case there are no restrictions on the amount of capacities released by firm day-ahead UIOLI.

In the case of a rule keeping the existing re-nominations rights to a certain extent, the remaining re-nomination rights have to be subtracted from the capacities released by firm day-ahead UIOLI. For example, the 2+2 rule requires that for small booking shares it be (approximately) 2 % of the technical capacity. For large booking shares, it is 2% of the relevant own booking plus 2% of the technical capacity.

In our perspective, two simplified cases can be regarded for analysis:

(i) Weak restrictions on re-nominations

(ii) Strong restrictions on re-nominations

If a restriction is weak, the remaining flexibility is relatively high and should in general be enough to be adapted to the needs of flexibility. Examples of weak restrictions include the planned restrictions on re-nominations in Germany.[42] Such weak restrictions will limit the potential balancing costs which can occur if re-nominations are widely different from nominations and are sanctioned with the balancing energy price. If the restrictions of re-nominations are strong, e.g. only interruptible re-nomination rights are offered, relevant additional balancing costs will occur in the status quo. To some extent, even the 2+2-rule is regarded as strong by bigger shippers, as it favours smaller shippers.

The importance of potential balancing costs can differ widely between the IPs. In principle, it depends on the difference between nominations and re-nominations. Potential balancing costs cannot be estimated by existing data because we expect that nominations and especially re-nominations will be quite different in a new setting defined by the new CMP.

Further, in the context of the ERGEG target model, capacity prices are determined within auctions, such that changes in capacity rights will be reflected in the prices as capacity prices without / with limited re-nomination rights will be lower. Re-nominations will be priced separately in such cases. What is more, even if there are restrictions on re-nomination rights, the shippers can use the released quantities for re-nominations. If capacity is not scarce in the day-ahead auction, the price would be around zero (adding flexibility at no additional costs).[43]

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[42] BNetzA, Beschlusskammer 7, Festlegungsverfahren zum Kapazitätsmanagement, Bonn, 9.Februar 2010

[43] If the volume of re-nomination rights offered has to be determined at the time of calculation of available rights for daily-short-term auctions, as the volumes reserved for re-nominations are subtracted from total short-term available capacity at the time of its determination. Such a procedure is necessary if re-nominations rights are firm capacities.

- Thus it seems useful to adapt re-nomination rights to the entire context of capacity regulation in gas.
- This indicates that weaker restrictions on re-nomination rights are useful if the capacities are not auctioned and/or there is little contractual congestion.
- Higher restrictions on re-nomination rights are attractive after full application of the ERGEG target model and/or in case of persisting relevant contractual congestions.
- For IPs with structural physical congestions, the treatment of re-nomination rights requires special considerations.

4.2.3 Allocation of day-ahead capacity

We looked at the final physical flows within the simulations and noticed that even in case of a complete price convergence these flows are significantly lower than the maximum technical capacity for most of the IPs for most of the time. This means that the actual need for physical flows can be completely satisfied in the majority of cases after the application of an effective firm day-ahead UIOLI. This is important because released capacities which are effectively re-allocated can be used for re-nominations purposes as well. They can be attractive especially if the full auctioning of capacities is applied by the ERGEG target model and the allocated capacities are on average less expensive than the original ones.

Thus for the benefits pointed out in this study it is necessary that the capacity which has not been nominated to day-ahead, and which has been returned to the market, be re-allocated to the market parties in an efficient way.

The concrete design of the day-ahead allocation mechanism is beyond the scope of this study. However, we recommend that main requirements be considered in the network code to be developed by ENTSOG in dialogue with ACER.

4.2.4 Qualitative analysis of “indirect” welfare gains from CMP

4.2.4.1 Market liquidity

Liquidity of day-ahead natural gas markets will be increased by CMP. This is a result of the release of booked capacities which give access to the adjacent spot markets. The creation of liquidity can be described by a process of price equalization, as adjacent markets' liquidity is pooled when no congestions remain. If congestions remain at the border, additional liquidity can be assessed by (addition of) day-ahead entry and exit capacities, as those are the capacities available for trade cross-border.

We see an increase in liquidity as an important prerequisite for the development of a mature spot market for natural gas. At present, delivery contracts on the wholesale market, which are between wholesale traders and retailers and/or large industrial customers, are mostly consumption-dependent (so called full supply contracts). Sometimes, boundary conditions limiting the delivery, like a maximum delivery, exist. In these contracts, the quantity risk is borne by the seller, while the price is related to an index (e. g. oil price) and thus borne by the buyer. The buyer is not allowed to re-sell the gas quantities to other retailers or wholesale customers.

Mature spot markets will lead to short term contracts which will be based less on an index. This can influence the structure of contracts in the longer term. Moreover, import contracts are expected to be less of a take-or-pay-type. From an economic viewpoint, such a development is seen as favourable, since if the contracted price is related to an index (as it is the case in the current situation) it does not reflect the short run scarcity (or short-term costs) of natural gas. As a consequence, the normal price adaption mechanism is suspended or does not work properly, which may lead to a misallocation of gas consumption in the short term. Higher liquidity may have a positive impact on procurement in the spot market as well.

4.2.4.2 Market structure

Price differences between two adjacent markets can be explained in terms of transport costs, transaction costs, and market power, etc.

Thus, the price differences detected between the IPs analysed in this study can have different sources. The likely reasons are described below.

Transport costs

Gas to be transported from Market A to Market B is more expensive in Market B if the transport costs from A to B have to be added as relevant costs. Thus the law of one price applies in a modified sense, as prices in Market A plus transport costs from A to B equal the prices in B. Under this modified law, the trade possibilities might be lower.

Transaction costs

Transaction costs of booking and nominating can be relevant, especially in the context of the status quo of separate bookings needed for entry and exit capacities and limited public information. Especially if price differences are small, transaction costs become relevant and may hinder price arbitrage because these costs will be reflected in the decisions of the shippers. Bundled capacity products and virtual interconnection points are able to tackle this problem, as they are designed to reduce transaction costs.[44]

Cournot competition

Market power could be another reason for price differences between adjacent markets. Oligopolistic competition is the usual economic explanation. There are several models of oligopolistic competition, whereby the Cournot model is the explanation which is the most famous one and applied most often, especially in modelling.

The typical Cournot model describes the competition by N volume-setting firms which react to the volumes set (and the prices which result through them) by the competitors. Thus, a Cournot model is a generalization of the original 2-firm-Cournot game for describing industry

[44] Market coupling would be a further step for the reduction of transaction costs and information costs, as the capacity allocations and intended energy transports are covered at the same time.

structure. Each of N firms will choose a quantity of output. Price is a commonly known decreasing function of total output. All firms know N and take the output of the others as given. Each firm has a cost function depending on its outputs. Usually the cost functions and the demand curve of the market are treated as common knowledge. Often the cost functions are assumed to be the same for all firms. The prediction of the model is that the firms will choose Nash equilibrium output levels.[45]

Within a Cournot model the prices between two adjacent markets will differ depending on the number of players in the two markets, cost function differences, transport and transaction costs as well. They are expected to be lower the higher the number of players is and the lower the transport and information costs are.

Price differences can be explained by Cournot behaviour, but due to the restricted information about the relevant cost functions and demand it is not possible, with our data, to test if they are the right explanation. Thus explanations other as the one discussed above are relevant as well. Nevertheless, it has to be taken into account that the number of market players is relevant for market results and, in the Cournot model, has a well-known effect.[46] As the number of market participants along with market size should increase, prices can be expected to converge to the results of perfect competition. Therefore, CMP can have a relevant influence on the market organization in the longer run, as the liquidity of the adjacent markets is pooled and the day-ahead market will become a more attractive marketplace for new market players.

<u>Fringe Competition</u>

In addition, we investigated a fringe competition (or dominant form) model, where the dominant firm can set a (price or) quantity belonging to its own demand curve. Fringe firms, which are small firms competing with the dominant firm, adapt their quantities to the quantity set by the dominant firm. Such an investigation is interesting because at the IPs there are, or may be, dominating firms. We checked the model for the demand and supply curves received at Bunde/Bocholtz, via indicative assumptions with regard to the marginal costs of supply and the importance of short-run trade to total trade.

In our model we obtained a possible explanation for the underdeveloped secondary markets as ex ante of the application of firm day-ahead UIOLI. The dominant firm may decide to sell capacity to the secondary market, and that may influence the market price of the gas sold, in light of the applicable higher liquidity and the available alternative for keeping the capacity. Under our indicative calibration, the dominant firm prefers to keep those capacities thereby blocking entry ex ante of day-ahead. This is an explanation of possible (anti-competitive) capacity hoarding. As welfare increases by firm day-ahead UIOLI, this is a relevant structural argument for the application of the new CMP <u>in the context of the fringe competition</u>, as firm day-ahead UIOLI is stronger than the implementation of secondary markets in the context of releasing capacities and preventing capacity hoarding.

[45] Nash equilibriums are sets of strategies for players in a non-cooperative game such that no single one of them would be better off switching strategies unless others did.

[46] See for example Bester, H, Theorie der Industrieökonomik, Berlin, 2004, S.82.

Further, we expect that after the use of firm day-ahead UIOLI the amount of capacities used will be higher than they would without firm day-ahead UIOLI, thereby reducing the prices on the energy markets.

Additional remarks

It has to be added that spot markets are mainly used for portfolio optimization at the moment. Such a restricted use of the spot markets can be explained by the structure of service contracts where long-term contracts are dominating.

This contract structure may even lead to a situation where existing price arbitrage possibilities will not be used because there is not enough demand cross-border at the time of possible trade because the volumes are kept in longer-term contracts.

4.2.4.3 Consumption pattern

By the new CMP the procurement risks for the portfolio management will decrease. This sets incentives for a better use of the spot markets by the shippers. Long-term consumption patterns might be relevant in our qualitative analysis too. The idea is that day-ahead markets may become a more attractive market place for retailers and industrial customers. This can influence the consumption pattern.

If industrial consumers see advantages in short-term flexibility in markets, they can optimize their portfolio in an ongoing process. This will lead to a higher churn rate.

4.2.4.4 Long term capacity utilisation

Depending on the rules of re-nomination the new CMP may create additional incentives to sell underutilized capacities in secondary markets.

Selling of capacity rights is attractive, from an economic viewpoint, when such rights would otherwise be kept, with no compensation via firm day-ahead UIOLI. This is especially true if strong restrictions on re-nominations rights apply. Then, a capacity owner will expect unused capacities to be kept with the UIOLI-process. If capacity owners know ex-ante that the flexibility offered by the booking is more or less necessary, they will sell the capacities because such sales will grant them extra payments. More concretely, capacity owners will have an extra incentive to calculate the opportunity costs of higher flexibility, especially if they expect that new rights supplanting the re-nomination rights could be bought at the day-ahead capacities markets at low costs.[47]

[47] The opportunity costs are the expected revenues they will get on the secondary markets.

4.2.5 Potential risks

4.2.5.1 Peak demand

Finally, potential risks of the new CMP in difference to physical investments have to be pointed out.

It has to be noticed first that firm day-ahead UIOLI and the whole ERGEG approach on CMP and CAM reduce the danger of over-investments in physical capacities, as better rules on the usage of existing capacities highlight the real need for additional capacities.

On the other hand, additional investments generally facilitate better management of peak demands, simply by making more physical capacity available, thereby reducing the risk of potential physical congestion. Nevertheless, it has to be questioned whether every physical congestion cross-border should be eliminated, especially where such congestion occurs only on a few days.

The cost of eliminating such congestions should be covered by the expected benefits. As useful and effective CMP and CAM will have an influence on the relevance of congestions, they will also have an influence on the expected benefits of physical investments. In general, benefits will be lower as available capacities are better used.

4.2.5.2 Flexibility

Another point, which has been outlined before, concerns the loss of contract value for shippers with firm capacity reservations including full re-nomination rights, i.e. the uncompensated loss of flexibility.

A loss of flexibility through the application of the firm day-ahead UIOLI principle will be uncompensated if the capacities freed up are sold at the regulated tariff. Then the reduction of use is not reflected in the capacity price paid.

This fact can be seen as an argument for the auctioning of capacity rights and for more weak restrictions on re-nomination rights when firm day-ahead UIOLI is applied. On the other hand, NRAs and ERGEG have to remember that weak rules have to be compatible with the aim of creating effective day-ahead capacity markets, because these goals are potentially countervailing.

4.3 BUNDLED PRODUCTS AND VIRTUAL INTERCONNECTION POINTS

4.3.1 Overview

Combining and bundling capacities are discussed under cross-border products in the guideline on CAM. After the consultation, only bundled products and virtual interconnection points will be considered. These descriptions are partly ambiguous. We used a general definition of bundled products exemplified in Chapter 1.2.2 (see Figure 1 in Chapter 1.2.2 for an illustration of these CAMs).

Currently, it is necessary for a physical transport cross-border to book an exit and entry capacity. By the creation of bundled products this procedure will be simplified as by the booking of exit capacities the entry capacities in the adjacent markets are added (and vice versa). In a virtual interconnection point, all the capacities offered on different IPs between two (or more) market areas are managed together on a booking platform such that only the capacity available between two market areas counts and not the capacities at each IP. Such an approach relies on the simple interests of the shippers. Shippers have no interest in using a certain IP or a certain capacity. They only have interest in available capacities between the point of the injection of the gas and the point of delivery including (potential) countertrading possibilities facilitating trade in the case of (physical and/or contractual) congestions.

In the following, the different CAMs are discussed in detail on the basis of the qualitative evaluation criteria pointed out. The analysis is mainly focussed on the short-term, thus day-ahead-products. We wish to mention that the analysis for the long-term is rather similar as long-term bundling of capacities is rather comparable to short-term bundling. Long-term bundling applies to monthly, seasonal, yearly or multi-yearly capacities.

4.3.2 Transaction costs

4.3.2.1 Bundled products

With a bundled capacity product, the exit capacity from market A is matched with the correspondent entry capacity in market B. A bundled product allows shippers to transport gas in one step from one market to an adjacent market, which significantly reduces their transaction costs. It can be excluded that exit-capacities are booked with no corresponding entry-capacity at the other side of an IP.

As main advantage, with bundled products no separate booking of entry and exit capacity products has to be managed. Transactions costs of booking will be reduced by this. Transaction costs are the cost of information on the availability and the matching of entry and exit capacities at each side of the IP and the costs of booking and its coordination between several IPs. Relevant transaction costs reduce the attractiveness of price arbitrage and thus (short-term) trade, especially if the price differences are small.

The likely consequence of a lack of any bundled products would be a lower use of available capacities. Arbitrage trade possibilities would be reduced; especially in a day-ahead context. As a consequence, the law of one price would apply less, which means less arbitrage trades would be realized.

To our understanding, for day-head or within day products, bundled capacity products are the only way to book these products considering the short lead time for the realization of the flows. Thus, at least the harmonization aspect of bundled products is a <u>necessary part</u> of the market organization which uses firm day-ahead UIOLI.

The argument of the reduction of relevant transaction costs is less important in the context of longer-term bookings, but even for capacities throughout a range from months to several years combination of exit and entry capacities reduces informational and organizational costs of booking. Significantly, if bundling is used for day-ahead capacities, the incremental cost for longer-term products will be very low if such bundling is applied for short-term products.

4.3.2.2 Virtual interconnection points

By virtual interconnection points the transaction costs and information asymmetries will be reduced as well. The expected reduction is higher than in the case of bundled products; the booking procedure will become less complicated for the shippers, as the booking relies on the virtual capacity of all cross-border IPs.

This offers a better use of the available capacities and a more coordinated bidding of the shippers on the IPs/booking platforms between two adjacent market areas, as their bidding does not have to rely on the success in gaining capacity split over several IPs.

In addition it has to be noted that, if capacities are only bundled at each IP, organisation of the day-ahead auctions might be useful, e.g. sequential auctions might well be held. Then, shippers can update their information on (remaining) capacity requirements, as by sequential auctions the allocation takes place at different times.[48]

4.3.3 Strategic aspects

4.3.3.1 Bundled products

A bundled capacity product sets incentives for a better matching of capacities as the common calculation of the available capacity on both sides of an IP is expected to be incentivised. Without bundled capacity products a sub-optimal calculation of technical and available capacities is more attractive. A lower amount of available capacities day-ahead can be favourable if access maximization is not the goal of the owners of an IP.

Further potential strategic effects of mismatching of capacities are reduced; for this explanation we start with a definition of mismatch.

<u>Mismatch:</u>

Mismatch is defined as the difference between exit and entry capacities in one direction at an IP

Mismatches can be created by strategic booking. This can be illustrated with examples. If exit and entry capacities are equal, when x% of the capacity on one side of an IP is strategically booked, the same percentage cannot be used on the other side. More generally, the effect of strategic booking (within the actual regulation, “No bundled products”) is:

- If capacities on the on the two sides are X and Y, the reducing effect on available capacities at the IP by blocking can be approximated by x*X is x*X if X is the limiting side (X<Y) and Y- (1-x)*X if Y is the limiting side (X>Y).
- Thus, blocking of the limited side is more effective if market access is predated.

By bundling capacities strategic booking becomes less attractive as the costs increase. The costs of the strategic bookings (“blocking”) for the booking party are the capacity fees for x

[48] For example, there are two IPs (IP1 and IP 2) connecting market areas A and B. If first an auction is held for the IP 1, then, the shippers can bid in a second auction at IP2 on the results (the capacities they have got) in the first auction, offering a better co-ordination of the bids. Shippers will have a higher probability that they will get the capacities they need.

(exit or entry fees). A blocking can have the aim to deter entry if capacities correspondent to the booked capacities cannot be used. In the case of bundled products, the costs of booking are the capacity fees for both sides instead of the costs for one side) which have to be included in the new capacity fee. Thus, the expected costs of blocking capacities are higher.

Remarks on network economics

Mismatches are influenced by the network usage in each market area, influencing the available capacity day-ahead and within day. Entry capacity at an IP in the sense of the maximum rate at which gas can flow in a particular period can fluctuate substantially over time, not only as a consequence of equipment failures but also because of changes in the levels and patterns of flows through the transport system. For example, since flows are driven by pressure differences, changes in demand, by changing pressure differences, will alter the capacity of the system. More specifically, the capacity to flow gas at an IP can be much lower in summer, when demand for gas is relatively low, than in winter, when demand for gas is higher.[49]

Thus, mismatches of daily – available – capacity can be the result of changes in the levels and patterns of physical flows through the transport system even if the technical capacities at one IP are much more harmonized. Nevertheless, bundling capacities is favourable as discussed above.

4.3.3.2 Virtual interconnection points

As with bundled products it has to be acknowledged that virtual interconnection points reduces strategic booking incentives.

The arguments are mainly those discussed above in the chapter on bundled capacities.

4.3.4 Market monitoring

4.3.4.1 Bundled products

Bundled capacities can make strategic bookings more obvious if a monitoring of the usage of capacities is applied. Identification of strategic booking is relevant because it can be classified as anti-competitive behaviour which has to be sanctioned, e.g. by the price for balancing energy plus an extra fee.

Bundling capacities may further render structural differences between the methods of capacity calculation used by the TSOs more obvious, as within the bundling of capacities common approaches for the capacity calculation might or have to be found. If the calculation of technical as well as available capacities is done separately, it might be that less than the maximal amount of bundled products can be offered.

Therefore, beyond any harmonization of capacity products, common rules have to be defined for the capacity calculation.

[49] See Yarrow, G., Capacity auctions in the UK energy sector, Utilities Policies 11/2003, p. 9-20

4.3.4.2 Virtual interconnection points

Virtual interconnection points will bring additional transparency to the markets. This helps to enhance market monitoring. The arguments are mainly those discussed above in the subchapter on bundled capacities.

If information is aggregated by virtual interconnection points on a booking platform the transparency should even be better.

4.3.5 Investment signals

4.3.5.1 Bundled products

Bundled capacities reduce strategic actions, thereby facilitating market monitoring and helping to lower transaction costs. Therefore, it can be assumed that available capacities will be used more effectively than under the status quo.

Thus, it can be evaluated on a better information basis if physical congestions can be seen as a signal for investments.

4.3.5.2 Virtual interconnection points

Virtual interconnection points will have the effect of a better allocation of all physical flows through the gas transport systems as the capacity needs are co-ordinated all together.

In a complex one-step-calculation all exit and entry capacity demands are respected taking account of the technical capacities of the pipelines, the pressure differences and the availability of storage facilities (internal and external of an TSO pipeline network, LNG injections as well as the best use of (internal) system balancing energy. Such a comprehensive view on available capacities and (technical) flows is not possible in the case that just bundled products are used at the several IPs connecting adjacent markets. Thus, by virtual interconnection points the capacity available and the expected trade volumes will be optimised.

Therefore we expect that the investment signals of physical congestions should be much clearer for evaluation of needed investments in physical capacities. In addition (relating to the argument of better signals), it has to be noticed that the current system may inflate the real capacity demand because of several reasons. Without virtual interconnection points (or as a first step, envisaged after the consultation, toward the creation of bundled products), we expect that available capacities will not be used in a favourable way in which capacities influence the demand for physical extensions, via demand-revealing processes.

4.3.6 Main results

4.3.6.1 Bundled products

The results for bundled products are summarized in the following Figure 27.

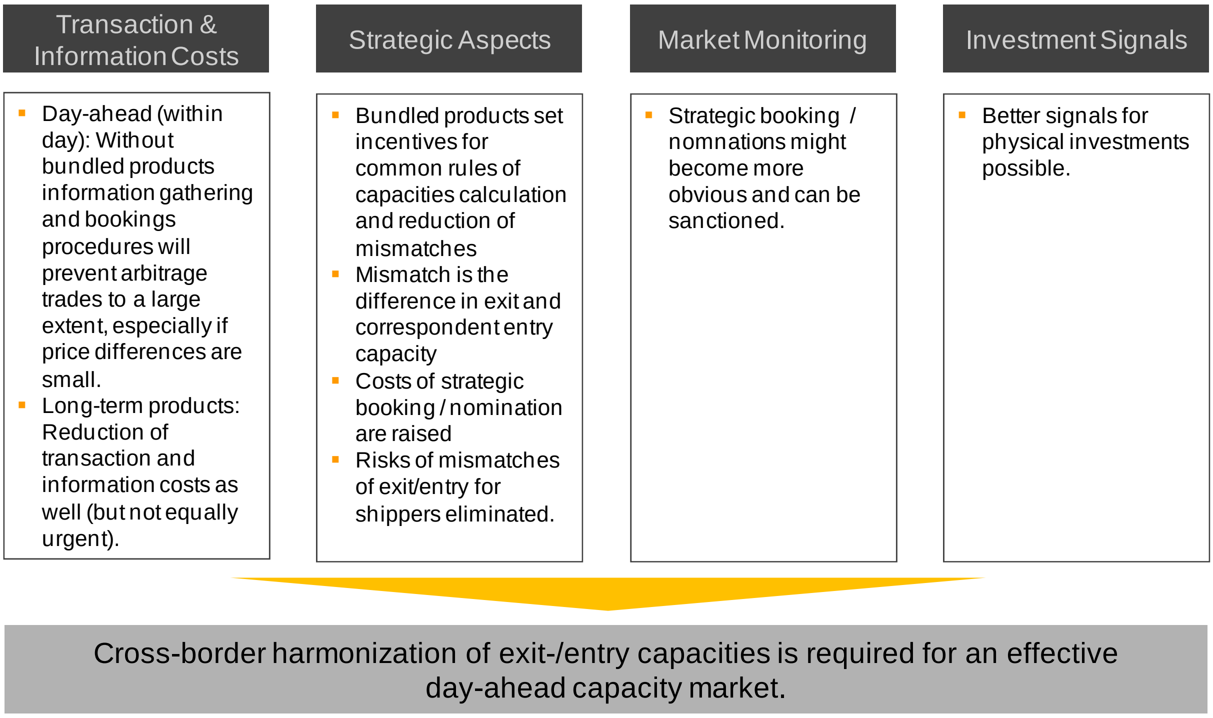

Figure 27: Results for bundled products

Summing up, bundling of capacities reduces transactions and information costs and creates incentives for a reduced mismatch of capacities and harmonized rules. Furthermore, it enables better market monitoring and a better signalling for investments. At the very least, bundled capacities are needed for the creation of an effective short-term capacity market day-ahead.

It has to be noted further that a bundled product refers to the harmonization of the entry/exit nomination, not necessarily to a single nomination or single capacity created. While the introduction of a harmonized nomination of entry-/and exit capacity is a must, which means by booking the exit capacity the entry capacity is added (and vice versa), the single nomination (or other features) is not.[50]

Relevant effects of new CAM on the market structure in the downstream market, which are discussed currently within ERGEG, might be regarded in detail in a Pilot project.

4.3.6.2 Virtual interconnection points

The results of the sections on virtual interconnection points are summarized below in a similar Figure 28.

[50] A single nomination is often regarded as a mean to introduce new market parties in the market and increase competition. If the introduction of the CAM and CMP increases cross-border trade and leads to converging prices for most of the time, the requirement for single nominations may be omitted.

Transaction & Information Costs	Strategic Aspects	Market Monitoring	Investment Signals
▪ All available capacity is regarded at one time for booking/nomination (and real-time allocation of flows) on the booking platform ▪ Reduction on informational asymmetries between TSOs and shippers ▪ Bidding needs no further co-ordination for the IPs	▪ Strategic booking / nomination might be dis-incentivised as well. ▪ Better co-ordination of the bids are possible for the shippers.	▪ Better market monitoring,	▪ By the optimized use of the IPs capacities the signals for physical investments are much clearer.

Further product bundling (virtual interconnection points) is not required ad hoc, but will give a further strong push for an effective day-ahead capacity market.

Figure 28: Results of the sections on virtual interconnection points

Virtual interconnection points reduce transactions and information costs further on and make the bidding for the bidders much easier, as they will just bid for the aggregated virtual capacity. The advantages concerning the strategic effects and the market monitoring are (at least) comparable to those of bundled products.

As information on available capacities and technical flows will be aggregated, market monitoring might be easier, as in the case of bundled products.

Further, it is expected that the signal for investment should become clearer.

4.3.7 Further qualitative impacts

4.3.7.1 Total social welfare (gross benefits)

As at least the harmonization of exit- and entry capacities is <u>necessary</u> we expect, as outlined above, relevant welfare effects of bundled products. These effects are incorporated in our welfare calculations made.

The reduction of social welfare without having bundled products can only be calculated in a very indicative way because it refers to unknown transactions and information costs. Therefore, we stick to qualitative arguments. A loss – measured in the – relative – reduction in the (expected) use of potentially available capacities – might be higher in the short term than in the long term.

Virtual interconnection points may add additional welfare to the application of bundled products; the net benefits will depend on the costs of implementing it.

4.3.7.2 Price convergence

Price convergence was a main result of the application of firm day-ahead UIOLI. Again bundled products contribute to this positive outcome because without bundling the use of day-ahead capacities would be lower.

Virtual interconnection points are expected to be even more effective with regard to the aims of reducing price discrepancies and of optimising the availability and the use of capacities. As a result, cross-border trade could increase, leading to increased price arbitrage that would reduce price differences between the European gas markets.

- ❑ Bundled products as well as virtual interconnection points will therefore contribute to a further integration of adjacent gas markets.

Virtual interconnection points, as a further step of the integration, can even pave the way to pan-European gas markets via step-by-step market coupling, as such a further bundling of capacities leads to a situation where the TSOs have to manage the optimized individual lines in a concerted manner.

4.3.7.3 Further effects

We noted the positive effects of firm day-ahead UIOLI on the market liquidity, market structure and (potentially) on the structure of contracts. These effects are based on the use of bundled products within the new CMP. As virtual interconnection points will lead to higher liquidity we expect positive effects of the virtual interconnection points concerning the other qualitative criteria as well. They should be as least as positive or even better as for bundled products because liquidity and availability of capacities is a main driver of competition and competition will have an influence on the structure of contracts in the longer run.

Virtual interconnection points are even able to resolve some potential risks of security of supply which are raised in the context of restricting re-nominations by firm short-term UIOLI. As capacities are bundled on a booking platform, the need of balancing energy can even be better anticipated in advance by the TSOs.

4.4 DISCUSSION OF A BUNDLED PRODUCT AT MOFFAT

In the following it is discussed if the bundling of capacities may even contribute to a better regulation at the Moffat IP.

A ‘Ticket-to-Ride’ / Capacity Register mechanism is currently applied at the Interconnector Moffat Point. The Capacity Register at Moffat provides security of supply protection for downstream Shippers at Moffat in that only parties who have contractual relations with Shippers active downstream from Moffat are entitled to book NTS Exit capacity at Moffat upon booking Moffat entry capacity from Gaslink. Shippers are entitled to book (or have booked on their behalf) corresponding quantities of Moffat exit capacity from National Grid, whereby the gas nomination matching is organized by a Moffat agent who reconciles NTS nominations with downstream nominations in Ireland. This scheme represents a variation of a bundled product, where shippers on both sides of the interconnector point have capacity and nominate in tandem to effect cross border flows. They do not have to be the same entity. This system will remain in place until 1 October 2012.

A new regime for Moffat will become effective with the year 2012 by the UK NTS Exit Reforms which were implemented on 1st April 2009.[51] The NTS exit reforms were driven by the separation of the gas network into separate transmission and distribution system owners, whereas previously, the network was owned and operated by a single entity. The NTS exit regime is based on the idea of a user commitment for capacity expansion (revealed preferences for future demand) whereby users can acquire capacity (both existing and new) but have to provide a financial commitment to secure these rights. The reforms will revoke the 'Ticket-to-Ride' mechanism. For new (incremental) capacity, the NTS exit reforms will introduce a four year commitment capacity booking regime (initial allocations can be reduced at 14 months notice).

Incremental capacity must now be booked three years in advance for a four year commitment period on the NTS side of Moffat. 'Prevailing rights' to capacity at Moffat were allocated in May 2009 to existing NTS Shippers only, based on the use during the gas year 2007/08. Irish shippers, who were also NTS shippers, were allocated capacity but this represented only a fraction of the Irish market requirement.

The NTS Exit Reforms have posed concern for all three markets downstream of Moffat in respect of security of supply and possible market foreclosure risks. These concerns surrounding the implementation of the NTS Exit Reforms have been well documented in the Uniform Network Code Modification Proposal (UNC243V[52]). However they are not shared by Ofgem and this modification proposal was rejected in April 2009.

A detailed evaluation of the issues is beyond of the scope of this study.[53] Nevertheless, we consider that offering of a bundled product as well as firm day-ahead UIOLI may be of help to find a resolution to the Moffat exit point discussion. The matter of the initial allocation and the rights associated with these will still need to be resolved.

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[51] They will become effective for capacities availability starting from 1 October 2012.

[52] Code Modification Proposal 0243 - http://www.gasgovernance.com/NR/rdonlyres/89F92554-1655-46CF-87B2-6F546529B0C7/32410/0243ModificationProposal.pdf

[53] For this study it is has to be recognized that, without going into the complex details, the NTS exit reform have the aim of anticipating the future needs of network capacity by 4-years booking of enduring rights in advance, where in addition annual and daily capacities are made available by auctions (pay-as-bid). Thus, the system collects the preferences for capacity uses based on the actual capacity needs.

5 CONCLUSIONS

5.1 TOTAL SOCIAL WELFARE IS MODERATE BUT RELEVANT

The Figure 29 below compares the results on the additional welfare (gross benefits) of option 2 compared to the status quo if firm day-ahead UIOLI (and bundled products) was applied.

It shows a relevant gain in Total Social Welfare (gross benefits) but this gain is moderate but relevant.

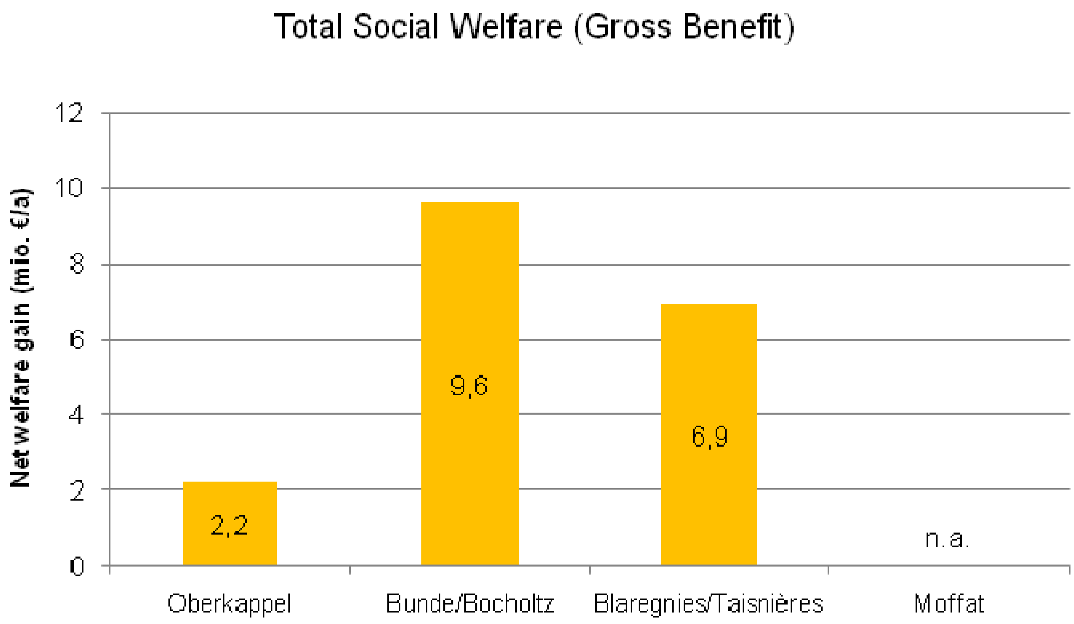

Figure 29: Welfare results

- A welfare gain of around **9.6m€ per year** can be reached for **Bunde/Bocholtz**.
- A somewhat lower welfare gain of **6.9m€ per year** would be reached in **Blaregnies/Taisnières**.
- A welfare gain of approximately **2.2m€ per year** has been calculated for **Oberkappel**.[54]

No estimation has been possible for Moffat due to equal prices on both sides of the IP. Thus no arbitrage trade is possible and no additional welfare can be calculated.[55]

Costs for this new CMP are expected to be rather low, thus net benefits should be close to our welfare calculations.

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[54] Welfare is calculated under the assumption of available bundled products and the public available data of the gas year 2008/09.

[55] The benefits for Oberkappel and Bunde/Bocholtz cannot be simply added if total welfare gain is calculated for the IPs in the study because both calculations are made ceteris paribus without considering further IPs connecting NCG.

Total Social Welfare as well as net benefits might be higher if prices differences between the market areas are larger than in the gas year 2008/09 (higher arbitrage possibilities).[56]

5.2 PRICE EQUALIZATION IS AN IMPORTANT ADVANTAGE

Firm day-ahead UIOLI and bundled products lead to price convergence. Thus, the spot markets of the adjacent countries will be in a better equilibrium and the law of one price can apply.

Again, as for welfare, the benefits of price equalization are higher (lower) if the relevant price differences are higher (smaller) than in the gas year 2008/09.

Price convergence is very important in the European context of gas markets because the volatility of gas price on the European gas market is high. It can be expected that by better congestion management procedure more credible spot market signals will evolve as they will be based more on real scarcities (and not contractual congestions).

Thus, the spot market will send a better signal to the shippers and become a more attractive platform for trade. This will lead to a better integration, e.g. a more realistic vision of a Pan-European spot market.

5.3 MARKET LIQUIDITY INCREASES

A higher liquidity can be expected because on the day-ahead basis both adjacent markets can be used for gas trades and transaction costs of such trades would be much lower.

Liquidity of day-ahead natural gas markets will be increased by CMP on average; this leads to more competition. Depending on the rules of re-nomination the new CMP may create additional incentives to sell underutilized capacities on secondary market. Further, changes in contract structures may occur, e.g. shorter term contract will become more attractive, as on more liquid gas markets, e.g. the Henry Hub in the United States, the contracts are mostly below one year.[57]

Thus in the longer run even the total welfare by ERGEGs policy approach should be higher than in the short-run. It has to be noted in addition that the simple access to the contractually congested capacities can be seen as **important structural advantage** as new shippers can enter the day-ahead market.

[56] A higher Welfare and additional price convergence can be expected especially for Oberkappel because the gas year 2008/9 seems to be rather atypical.

[57] Such an expectation is in line with actual changes. Gazprom has agreed changes to gas contracts with European energy groups to allow up to 15% cent of sales to be linked to gas prices on the spot market. Thus spot markets will become more and more important even for the relation to gas importers and this will influence contract structures in the longer run.

5.4 BUNDLED PRODUCTS AND VIRTUAL INTERCONNECTION POINTS ARE NECESSARY FOR AN EFFECTIVE REDUCTION OF TRANSACTION COSTS

At least the harmonization of exit- and entry capacities products is seen as necessary if firm day-ahead UIOLI is to be applied effectively. It is necessary because without such a bundled capacity the realization of arbitrage trade seems to be impossible within the time frame set. This advantage applies to bundled products, too.

To our expectation the loss of welfare of the CMP without bundled products would be a major part of the additional rents gained.

Bundled products are even favourable for long-term-capacity products as these reduce transaction and information costs in general and can, thereby, contribute, to a better usage of existing capacities. We expect rather low (incremental) costs, and thus the study is clearly in favour of those products (as used in the study).

We note that actually it is planned that bundling will only be applied to new contracts and there are different further features of bundled products in discussion. We pointed out that these features may not be a must, if sufficient price arbitrage will occur without their application.

Virtual interconnection points are not necessary for the implementation of firm day-ahead UIOLI per se, but they can have important welfare effects.

Virtual interconnection points would lead to additional reductions in transaction costs and better usage of the technical capacities of two adjacent market areas and, thus, would lead to further price convergence – and, thereby, to further market integration – which is important in the context of Pan-European spot markets.

5.5 EFFECTIVE DAY-AHEAD ALLOCATION MECHANISM SHOULD BE IMPLEMENTED

The introduction of a firm day-ahead UIOLI principle requires a restriction of the re-nomination rights of the capacity holders.

The simulations show that the final physical flows – even in case of a complete price convergence – are significantly lower than the maximum technical capacity for most of the IPs for most of the time. This means that the actual need for physical flows can be completely satisfied in the majority of cases. This is important because capacities released via firm day-ahead UIOLI can be used for flexibility purposes too.

The benefits pointed out are based on the assumption that the capacity which has not been nominated day-ahead, and which has been returned to the market, will be re-allocated to the market parties in an efficient way. The concrete design of the restrictions of day-ahead allocation mechanisms is beyond the scope of this study.

However, we recommend the introduction of main requirements of an efficient rule in the further development of the Network Code, if such requirements are not included in the Guidelines in due time.

Re-nomination rights were discussed qualitatively in the study. The right application of re-nomination rights depends on the manner in which capacity is allocated and on the relative importance of contractual congestions. For IPs with structural physical congestions, the treatment of re-nomination rights requires special considerations.

5.6 POLICY OPTION 2 IS FAVORABLE

Policy option 2, the common approach of the ERGEG principle firm day-ahead UIOLI – is favourable.

For the three IPs analysed quantitatively, relevant gross benefits were calculated, and it was found that significant price convergences could be achieved. Thus, option 2 will lead to higher short-term flexibility day-ahead.

We expect rather limited costs of the new CMP. The potential loss of flexibility is more important, but it will be reflected in the capacity prices – including the prices of the day-ahead capacities – after full implementation of the ERGEG target model. It has to be mentioned that the released capacities can be used for re-nomination purposes too, as outlined in the conclusion above.

More credible spot markets signals will evolve, as liquidity will be higher and changes in the contract structures and the market structures as well are possible.

5.7 OPTION 3 (OBLIGATIONS FOR PHYSICAL INVESTMENT) IS NOT A SENSIBLE OPTION

There is no need to have obligations for physical investments as long as there are no clear physical congestions even after the implementation of CMP.

In Oberkappel, based on the public available data, physical investments could yield a welfare gain of 9 million € per year. The cost of physical is investments of 50 GWh/d are around 50 million €; thus, in a longer perspective, the increase in capacity makes sense and is useful, especially in light of effects we just saw in the spot markets.

At the other three IPs, no physical investments needs can be identified within our study, as in Bunde /Bocholtz and Blaregnies/Taisnières there are only few days where prices differences will then remain after firm day-ahead UIOLI. In Moffat no physical investments are needed.

5.8 THE CALCULATION AND PUBLICATION OF SHORT-TERM MAXIMUM TRANSPORT CAPACITIES FOR EACH IP IS IMPORTANT

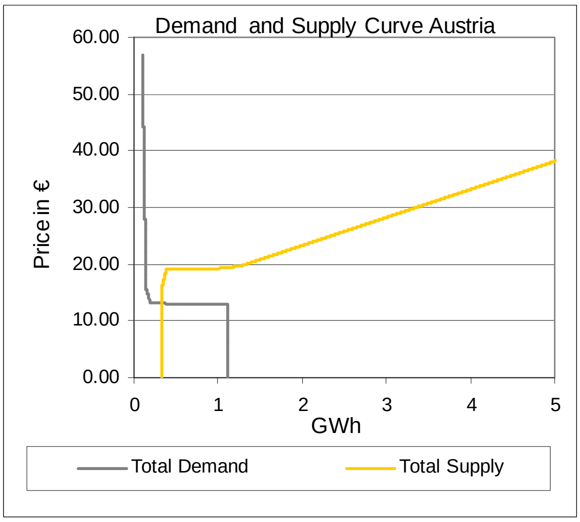
Our analysis shows in addition that a proper determination of the maximum short-term technical capacity is the main prerequisite for any congestion-management procedures. For an effective implementation of option 2 it is necessary that actual short-term maximum transport capacities, e.g. on a basis of (D-3) calculations of the technical capacities, be available and published at every IP. This is necessary because any efficient allocation of transport capacities requires that information about the available capacity be made available to the market parties. Furthermore, such allocation will lead to higher technical capacity availability, as not all general risks will be included in a short-term calculation and thus higher price arbitrages could be possible.

Beyond the implementation of option 2, this information is also required for a safe and reliable operation of the network. It is therefore necessary that network operators calculate the short-term available transport capacity in a transparent way and make it available to market parties. If necessary, dynamic capacity calculations could be incentivised by financial instruments.

APPENDIX A: ILLUSTRATION OF THE CONSTRUCTION OF DEMAND AND SUPPLY CURVE FOR "OBERKAPPEL"

In chapter 4 the construction of the supply and demand curves were derived. In the following we describe the practical compound of both curves for the example of Oberkappel for the 9th June 2009.

The interconnection point of Oberkappel is characterized by several capacity constraints over the year. In June 2009 the sum of German gas net-imports/production was of around 83GWh, while 10GWh for Austria, respectively. For the model calculations, both values were equally allocated over the days in June (assuming steady import and production during the month) and result in a daily supply of 2.7GWh in Germany and 0.33GWh in Austria.



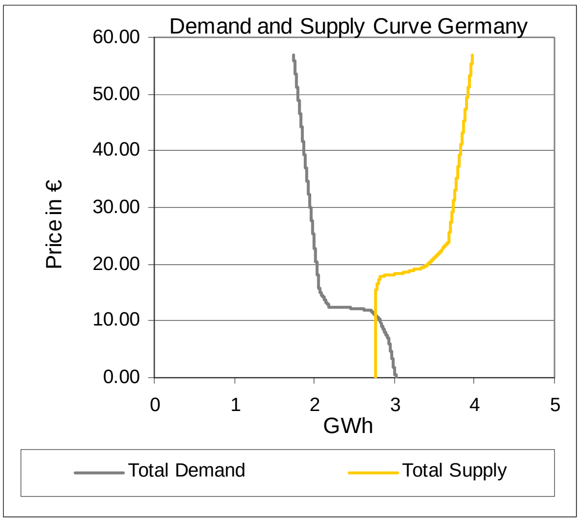


Figure 30: Exemplary supply and demand curve – Austria and Germany

The model storage supply curve covers the supply gap if demand (without storage) exceeds the supply of net-imports/production. The German storage feed-in and feed-out costs are estimated by average feed in tariffs of 7.124€/kWh/a as well as average tariffs of 5.425€/kWh/a for extracting. General operating storage costs are assumed to be 0.002€/kWh/a. In the case of Austria it is assumed that feed-in and out costs are 8.270€/kWh/a and for operating 0.002€/kWh/a, using the same approach. Due to this cost assumption and the derivation of the histogram analysis, the storage price curve can be constructed.

On the other side the demand curve is derived in separated elements. In an earlier chapter were mentioned the three elements of households, industry and generation as well as storage facilities.

Households have a temperature-elastic function, therefore the average daily temperature is used for modelling daily household demand. For both countries Austria and Germany, we used Standard Load Profiles developed by TU München, but adapted them on regional conditions.

The analysis of household demand structure shows that the temperature-elastic demand can be split into direct elastic and a base demand part. Altogether, the annual household demand accounts for 35% of total demand in Germany, and 26% in Austria.

The second demand element is industry and generation. It is assumed that the elasticity is '-0.07' in Germany and '-0.09' in Austria. Both assumptions lead to a decreasing industry demand in Germany between 128 and 172GWh and in Austria between 8 and 14GWh.

For the 9th of June 2009 the estimated consumption, as an outcome of the model, was 0.46GWh in Germany and 0.01GWh in Austria.

APPENDIX B: DATA SOURCES

Bunde/Bocholtz	
Import/Export	NED: Centraal Bureau voor de Statistiek, 2008/09 GER: Bundesamt für Wirtschaft und Technologie, 2008/09
Consumption	NED: Centraal Bureau voor de Statistiek, 2008/09 GER: Bundesamt für Wirtschaft und Technologie, 2008/09
Production	NED: Centraal Bureau voor de Statistiek, 2008/09 GER: Bundesamt für Wirtschaft und Technologie, 2008/09
Technical/Flow data	NED: Gastransportservices, 2009 (not publicly available anymore) GER: E.ON Gastransport, 2008/09
Weather data	NED: European Climate Assessment GER: Deutscher Wetterdienst
Storage price	NED: Gastransportservices, 2009 GER: E.ON Gastransport, 2009
Technical storage data	NED: Gastransportservices, 2009 GER: GSE Capacity map, 2009
Day ahead prices	NED: Information from E-Control GER: EEX, 2008/09
Price elasticity of demand	Derived from the working papers Nilsen, O.B, Asche, F. and Tveteras R.; Natural gas demand in the European household sector; Working paper no. 44/05 of the Institute for Research in Economics and Business Administration, Bergen 2005, and Liu, G, Estimating Energy Demand Elasticities for OECD Countries – A dynamic Panel approach, Discussion Paper no. 373; March 2004, Statistics Norway, Research department.

Blaregnies/Taisnières	
Import/Export	FR: Ministère de l'Écologie, de l'Energie, du Développement durable et de la Mer, 2007/08/09 BE: Direction générale Statistique et Information économique, 2008
Consumption	FR: Ministère de l'Écologie, de l'Energie, du Développement durable et de la Mer, 2007/08/09; GRTgaz, 2009 BE: Direction générale Statistique et Information économique, 2008
Production	FR: Ministère de l'Écologie, de l'Energie, du Développement durable et de la Mer, 2007/08/09; monthly data only available for 2007 through PEGASE database, were adjusted according to 2008/09

	production figure BE: Direction générale Statistique et Information économique, 2008; EIA, 2008
Technical/Flow data	FR: GRTgaz, 2009 BE: Fluxys, 2009
Weather data	FR: European Climate Assessment BE: Meteo Charleroi
Storage price	FR: GRTgaz, 2009 BE: Fluxys, 2009
Technical storage data	FR: GSE Capacity map BE: GSE Capacity map
Day ahead prices	FR: Powernext BE: Information von E-Control
Price elasticity of demand	Nilsen, O.B, Asche, F. and Tveteras R (2005) and Liu, G,(2004)

Oberkappel	
Import/Export	GER: Bundesamt für Wirtschaft und Technologie, 2008/09 AUT: E-Control, 2008/09
Consumption	GER: Bundesamt für Wirtschaft und Technologie, 2008/09; Bundesverband der Energie- und Wasserwirtschaft; 2007/09 AT: E-Control 2008/09
Production	GER: Bundesamt für Wirtschaft und Technologie, 2008/09 AUT: E-Control 2008/09
Technical/Flow data	GER: E.On Gastransport, 2009 AUT: E-Control, 2009
Weather data	GER: Deutscher Wetterdienst AUT: European Climate Assessment
Storage price	GER: E.On Gastransport, 2009 AUT: BOG, 2009
Technical storage data	GER: GSE Capacity map, 2009 AUT: E-Control, 2009
Day ahead prices	GER: EEX, 2008/09 AUT: Information from E-Control
Price elasticity of demand	Derived from the working papers of Nilsen, O.B, Asche, F. and Tveteras R (2005) and Liu, G,(2004)

Moffat

Import/Export	IRL: Gaslink, 2008/09 UK: Department of Energy and Climate Change 2008/09
Consumption	IRL: Gaslink, 2008/09 UK: Department of Energy and Climate Change 2008/09
Production	IRL: Gaslink, 2008/09 UK: Department of Energy and Climate Change 2008/09
Technical/Flow data	IRL: Gaslink, 2008/09 UK: NTS 2008/9
Weather data	IRL: European Climate Assessment UK: European Climate Assessment
Storage price	IRL: No storage UK: Nationalgrid
Technical storage data	IRL: No storage UK: Not analysed[58]
Day ahead prices	IRL: Not analysed UK: Not analysed
Price elasticity of demand	Nilsen, O.B, Asche, F. and Tveteras R (2005) and Liu, G,(2004)

[58] Price and storage data were not analysed in detail because by the modeling it turned out that Moffat offers no possibilities for price arbitrage as the same price applies on both sides of the IP.

APPENDIX C: RELEVANT LITERATURE

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