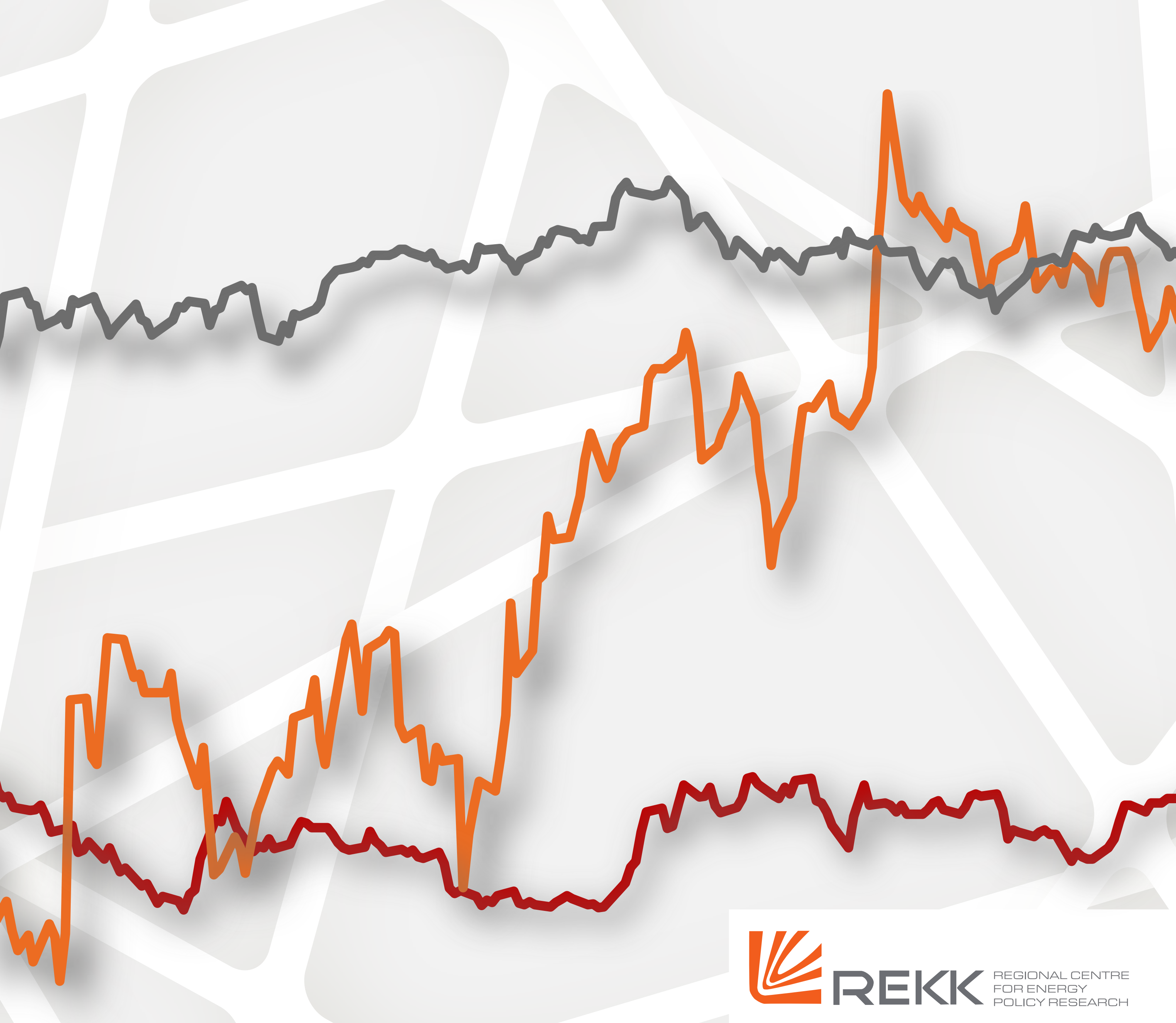

REKK REGIONAL CENTRE FOR ENERGY POLICY RESEARCH

HUNGARIAN ENERGY MARKET REPORT

Q2 2015

REKK REGIONÁLIS ENERGIAGAZDASÁGI KUTATÓKÖZPONT

The aim of the Regional Centre for Energy Policy Research (REKK) is to provide professional analysis and advice on networked energy markets that are both commercially and environmentally sustainable. We have performed comprehensive research, consulting and teaching activities on the fields of electricity, gas and carbon-dioxide markets since 2004. Our analyses range from the impact assessments of regulatory measures to the preparation of individual companies' investment decisions.

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- ERRA summer schools
- Regulatory trainings
- Price regulation
- Electricity market trainings
- Market monitoring
- Gas market trainings
- Tailored trainings upon request

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Geographically, our key research area is the Central Eastern European and South East European region:

- Regional electricity and natural gas modelling
- CO_2-allowance allocation and trade
- Renewable energy support schemes and markets
- Security of supply
- Market entry and trade barriers
- Supplier switching

Consultancy

- Pride forecasts and country studies to support investment decisions
- Consultancy service for large customers on shaping their energy strategy on the liberalised market
- Consultancy service for regulatory authorities and energy supply companies on price regulation
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Nowadays, due to market opening, energy markets cannot be analysed without taking into account regional environment. We monitor the market situation and developments of the countries of the Central Eastern and South East European region. We have built a regional electricity market model including all countries of the EU to forecast regional electricity prices. In 2012, we have developed a regional gas market model for the Danube Region countries, which was expanded to a model covering Europe.

The experts of REKK with their energy regulatory experience and academic background can supply scientific solutions taking also into account the specialities of the given markets.

Dear Reader!

For the last few years a number of EU communications have been released, all of which influence the future of electricity markets. In particular, guidance issued on the reform of national renewable support schemes and capacity markets can substantially alter the policies shaping electricity markets in Europe.

First we assess the auction mechanism. This is the core element of the future support scheme for European renewable electricity generation that provides for the selection of projects eligible for support and determines the level of support. Starting in 2017, the Member States of the EU, including Hungary, will have to fully switch to a renewable auction support scheme, a system profoundly different from the current feed-in tariff arrangement.

The goal of our short analysis is to review the most important questions facing auction based renewable capacity development, also framing international experience with a sample of 13 countries. In the article we examine the question of technology neutrality, the types of auction mechanisms applied, the possible criteria of evaluation, the conditions of participation and the monitoring of project implementation. We aim to introduce the different choices available for the development of the bidding process and identify traits of the most successful countries that have undergone this transition to help guide the transition of national auction systems in Europe.

In our second article we consider implications of the addition of Romania's OPCOM to the Czech-Slovakian-Hungarian 3M electricity market, an event that has fundamentally influenced the last half year of HUPX pricing. The 3M joint power market had been coupled since September 2012, and on 20 November 2014 it was joined by Romania's next-day market, resulting in the 4M market coupling. In the first part of the article we briefly depict the theoretical model and the main operating principles of market coupling, then we evaluate the impact of Romania's connection based on price convergence, used as the indicator for the performance of market coupling. With the help of the characteristic baseload demand and supply curves of the countries participating in market coupling, we analyse the impact of market coupling on cross-border trade and the equilibrium price of each country.

Finally, we describe the British capacity auction from last December, widely viewed as a milestone in the history of European electricity markets. The gradual closure of uncompetitive gas fired power plant capacities and the significant decline in power plant investments has raised serious concerns over the security of supply in a number of European countries. Some, including the UK, have reacted to these risks by anticipating or introducing capacity mechanisms that reward the availability of power plant generating capacities, posing serious challenges to the single European market. In the article we review how the British capacity market is regulated and briefly evaluate the results of the first auction, offering important lessons to both Member States that flirt with the idea of capacity mechanisms and the European Commission that is busy with the development of a uniform European electricity market.

Péter Kaderják, Director

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Energy market developments

The first quarter of 2015 saw stabilizisation of oil prices: Brent prices steadily exceeded the January bottom in February and March. The world market price of coal and the Henry Hub and Japanese natural gas spot prices continued to decrease, while the German border price of Russian natural gas remained level. Domestic power generation rose slightly, and the share of import in electricity consumption hit a two year low. Hungarian gas exports to Ukraine was relaunched in the first quarter of 2015 and more than one third of total natural gas exports, amounting to nearly one bcm, left Hungary through Beregdaróc.

International price trends

In the first quarter of this year there was finally a reversal in the steady decline of oil prices since the middle of 2014; February saw a significant rise in monthly average Brent prices (20%) followed by a moderate decline in March. As a result, the average price of the quarter (53.9 USD) lagged behind the average of October-December 2014 by more than 20 USD (Figure 1). At the same time, the crude oil market seemed to stabilise: Brent closed March above 53 USD and prices in February and March were already above the January floor (46 USD). However, the trend in coal prices did not show any change as ARA prices settled below 60 USD/barrel by the end of the quarter.

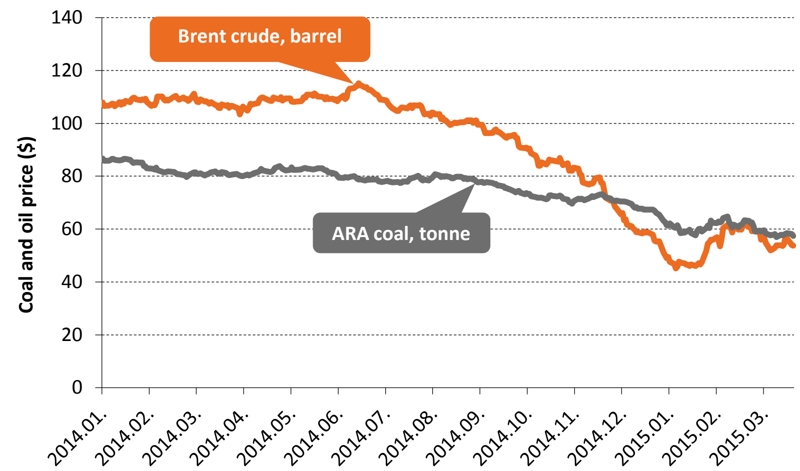
Figure 2 depicts the price developments in international gas markets which mostly declined in the first quarter. The March average of Henry Hub was 2.84 USD/MMBtu, the lowest point since August 2012. While Henry Hub prices practically halved in the past year however, the decline of prices in EUR is less dramatic due to the strengthening USD. At the same time, TTF spot prices hardly lagged behind those from the previous year, declining only 4% in the last three months. However, there was a significant drop in Japanese spot LNG prices amounting to more than 30% in the last three months and close to 60% on an annual level. The drop is not as drastic when including contracted Japanese LNG imports: prices (in USD) were down by 14% on a quarterly basis and purely 19% year to year. In the first quarter of 2015, there was hardly any changes in average German border prices of Russian origin: the average price in March (29.25 EUR/MWh) exceeded the price of last December by only 1%.

Year-ahead German baseload power prices fell slightly from the relatively stabile 34.5 EUR/MWh of the previous three quarters to 32.3 EUR/MWh (Figure 3). Changes in peak prices were also moderate, and fluctuating near 41 EUR/MWh between January and March compared to the prices of previous quarters ranging from 43 to 44 EUR/MWh. In the first quarter, the average price of EUA futures slightly exceeded 7 EUR/ton, which indicates a 40 eurocent increase from the average of October-December 2014.

The profitability of gas- and coal-fired power plants can be measured by two kinds of price differences: with the clean spark spread for gas-fired plants, and with the clean dark spread for coal-fired generation. Both indicators show the difference between electricity prices on exchanges and the cost of electricity generation, represented by the cost of gas (spark spread) or coal (dark spread) needed for generating 1 MWh of electricity and the additional cost of CO_2 emission allowances. Figure 4 shows the monthly averages of these two indicators, which are calculated using spot baseload power prices on the German EEX exchange and Dutch TTF and ARA coal prices.

The clean spark spread has mostly been in the negative in previous years and – following a temporary rise – worsened further in the first quarter: in March gas-fired power plants produced nearly 11 EUR loss by generating 1 MWh electricity. Thus, the competitiveness of coal remained unchallenged: the profit produced by 1 MWh electricity exceeded 17 EUR in February and declined to 11.4 EUR in March, resulting in more than a 22 EUR difference between clean dark spread and clean spark spread.

Figure 1 **Prices of year-ahead EEX ARA coal and Brent crude oil futures from January 2014 to the end of March 2015**



Source: EEX, IEA

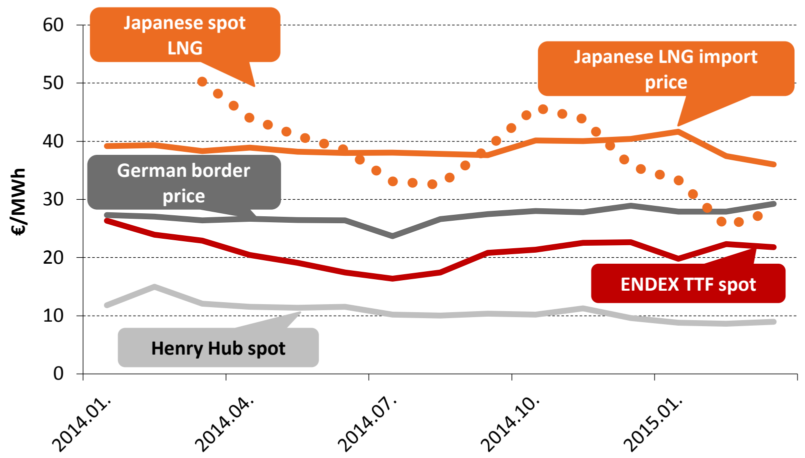
Overview of domestic power market

Similar to previous quarters, the Austrian import capacity was again the most expensive interconnection in the first quarter: import capacity prices exceeded 9 EUR/MWh both in January and February, which was still a moderate decline from of interconnection capacity auction prices of the fourth quarter of 2014 (10-12 EUR) (Figure 5). However, the drop in Slovakian-Hungarian capacity prices was more robust: the import of 1 MWh electricity cost 9.5 EUR in December, while only 3.8 EUR in March. Romanian import capacity prices also plummeted: after nearly halving (4 EUR/MWh) between November and December, price varied between 2.3 and 2.6 EUR/MWh in the first quarter. Electricity imports from Serbia, Croatia and Ukraine cost as much as a few eurocents.

In the first quarter of 2015, net domestic power generation exceeded that of the fourth quarter of 2014 by 4%, and covered 71% of consumption (Figure 6). This is 2% higher than in the previous quarter, leading to a smaller share of imports: first quarter import share accounted for 29%, a two-year low. In the second quarter of 2014, close to 43% of domestic consumption was met through import.

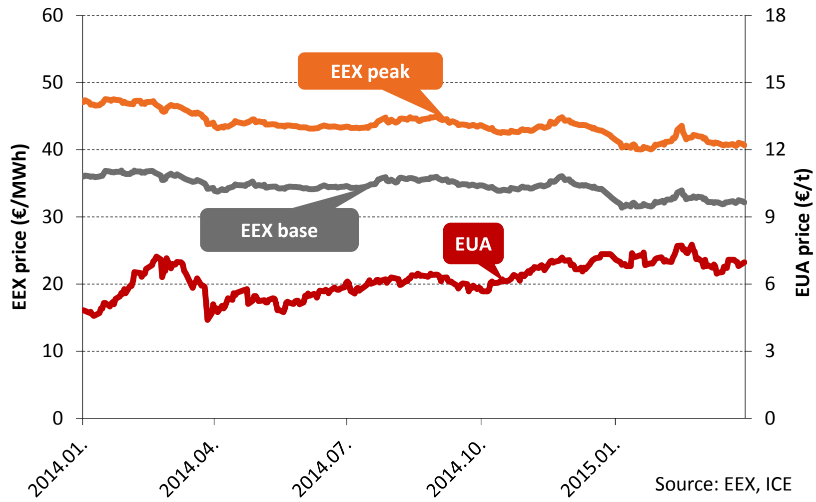
On Central European power exchanges, year-ahead baseload futures continued to fall. On HUPX, at 41.8 EUR/MWh on a quarterly average, which is a 1.2 EUR decline compared to last year's fourth quarter (Figure 7). However, HUPX remained the most expensive power exchange in the region: prices for year-ahead baseload futures were 9.9 EUR lower in Czech Republic, 9.5 EUR lower in Germany, and 7.3 EUR less in Slovakia. On day-ahead markets, Hungarian prices were on average 7.6-7.7 EUR higher than Czech and German, while 3.4 EUR higher than Romanian prices in the first quarter (Figure 8). While HUPX saw November price gaps exceeding 56 EUR in November compared to more tightly aligned Czech and German prices, in the first quarter the highest price premium did not reach 40 EUR.

Figure 2 **Prices on select international gas markets from January 2014 to March 2015**



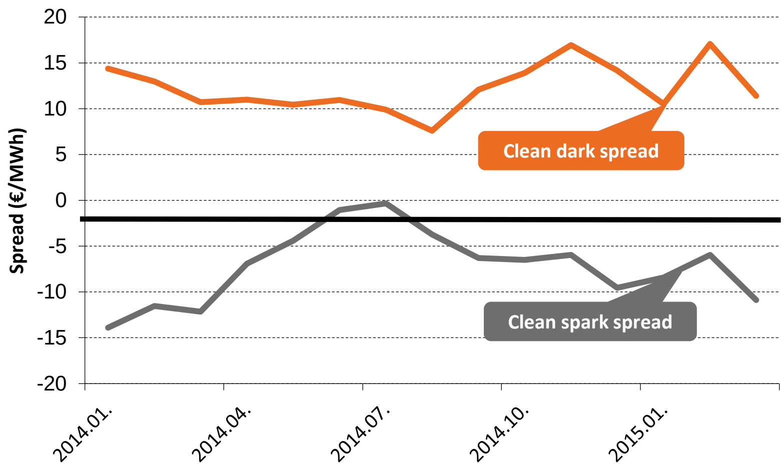
Source: Statistical Office of Japan, EIA, Gaspool, IMF

Figure 3 **Prices of EEX year-ahead futures and CO_2 allowances (EUA) with December delivery from January 2014 to the end of March 2015**



Source: EEX, ICE

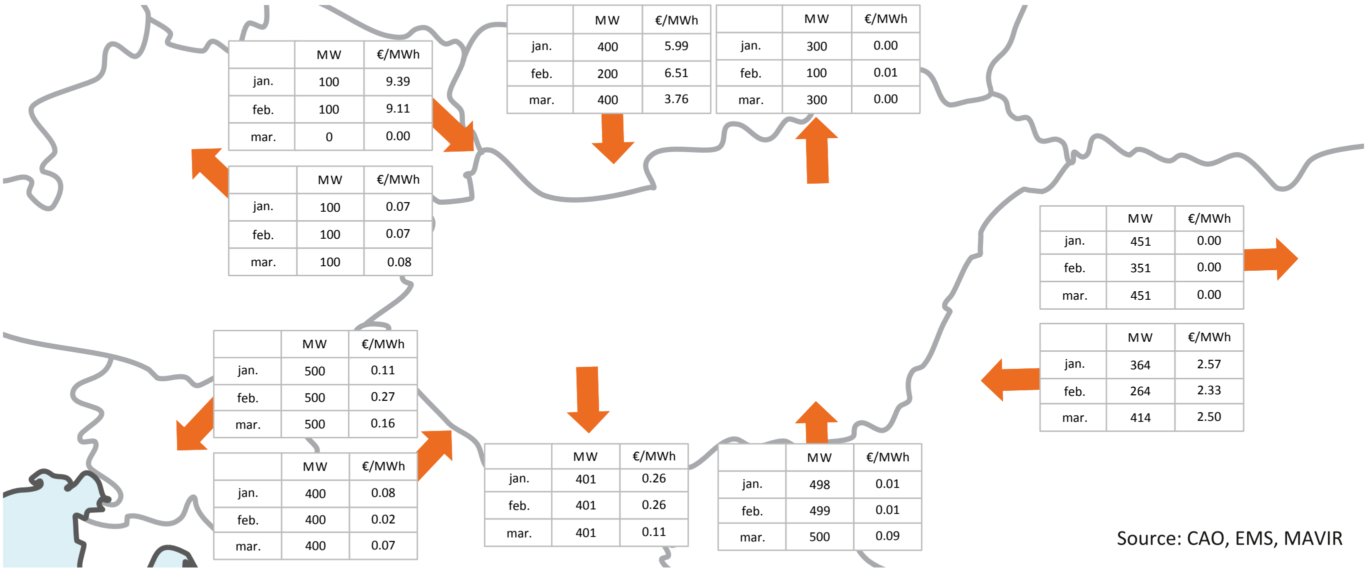
Figure 4 **Clean spark spread (gas fired power plants) and clean dark spread (coal fired power plants) on German market from January 2014 to March 2015**



Source: REKK calculation based on EEX, ICE and Gaspool data

Note: in our calculations we assumed an efficiency of 50% for gas-fired and 38% for coal-fired power plants.

Figure 5 **Result of monthly cross-border capacity auctions in Hungary, Q1 2015**



	MW	€/MWh
jan.	100	9.39
feb.	100	9.11
mar.	0	0.00

	MW	€/MWh
jan.	100	0.07
feb.	100	0.07
mar.	100	0.08

	MW	€/MWh
jan.	400	5.99
feb.	200	6.51
mar.	400	3.76

	MW	€/MWh
jan.	300	0.00
feb.	100	0.01
mar.	300	0.00

	MW	€/MWh
jan.	451	0.00
feb.	351	0.00
mar.	451	0.00

	MW	€/MWh
jan.	364	2.57
feb.	264	2.33
mar.	414	2.50

	MW	€/MWh
jan.	500	0.11
feb.	500	0.27
mar.	500	0.16

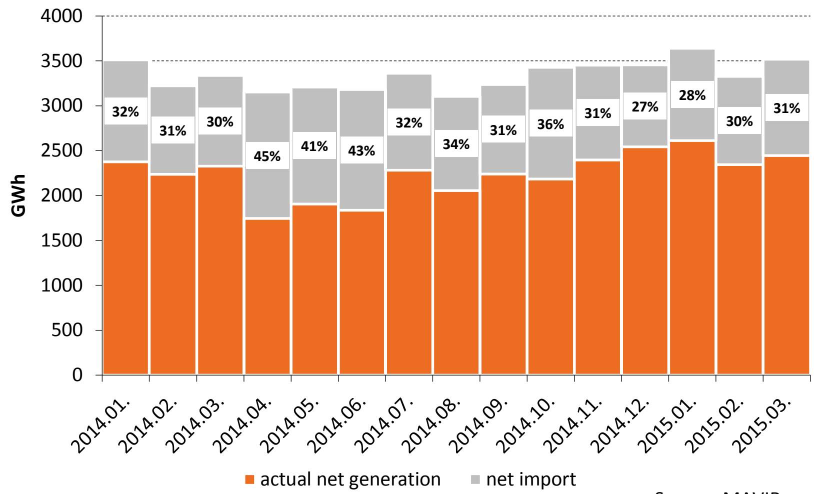
	MW	€/MWh
jan.	400	0.08
feb.	400	0.02
mar.	400	0.07

	MW	€/MWh
jan.	401	0.26
feb.	401	0.26
mar.	401	0.11

	MW	€/MWh
jan.	498	0.01
feb.	499	0.01
mar.	500	0.09

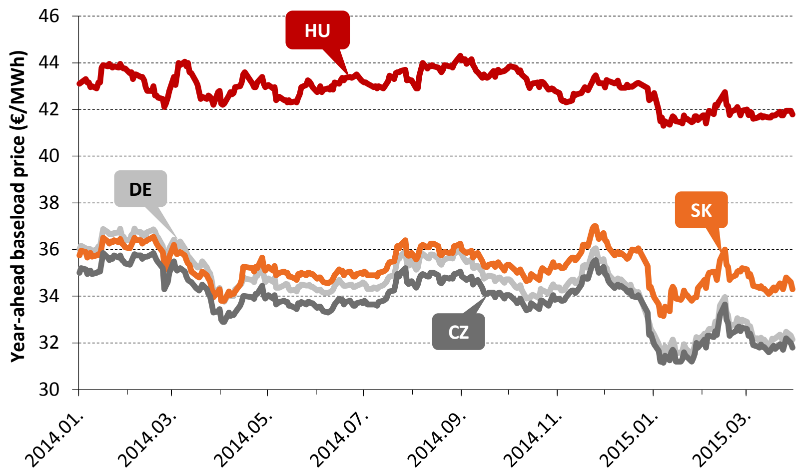
Source: CAO, EMS, MAVIR

Figure 6 **Net electricity production of domestic power plants and monthly net electricity import between January 2014 and March 2015**



Source: MAVIR

Figure 7 Year-ahead baseload futures prices in given countries of the region, between January 2014 and end of March 2015



Source: EEX, HUPX, OTE

Figure 9 depicts the operation of market coupling, which shows that the difference between Hungarian and Slovakian power prices exceeded 10 EUR in 41% of hours in January. In February and March, prices were mostly aligned: the difference did not exceed 1 EUR in more than 50% of the hours. While Romanian prices adjusted to Hungarian prices, Hungarian and Czech markets' price movements were similar during the quarter: the difference between HUPX and OPCOM prices were lower than 1 EUR in 70-80% of hours.

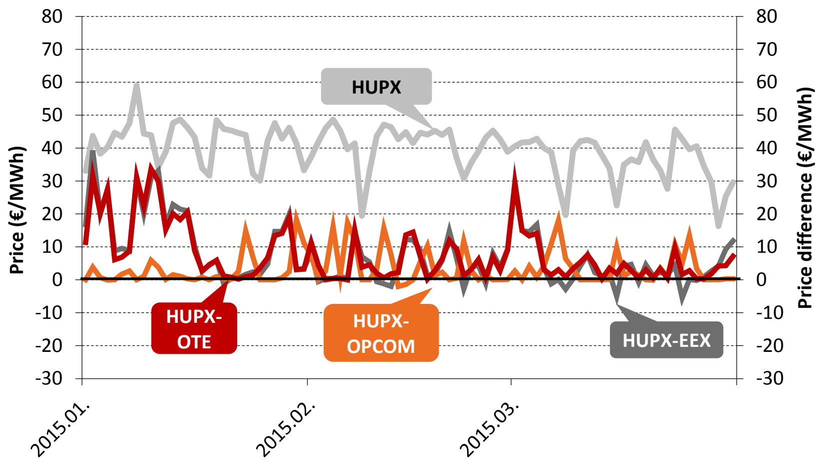
The wholesale price is affected by the costs incurred from the deviation of energy prices from normal schedule and balancing. The system operator determines the accounted unit price of upward and downward regulation based on the energy tariffs of the capacities used for balancing. The order for using these capacities is established based on the energy tariffs offered on the day-ahead regulated market. The system for charging balancing energy has been developed by MAVIR so that it provides incentives for market participants to try to manage foreseeable deficits and surpluses through exchange based transactions – in other words, covering the expected deficit and surplus by balancing the energy market should not otherwise be attractive for them. For this purpose, the price of upward balancing energy cannot be lower than the HUPX price for the same period, while the system operator does not pay more for downward balancing energy than the price at the exchange. In the first quarter of 2015, the average price of positive balancing energy accounted for 19.3 HUF, however, it peaked at 34 HUF by the end of the quarter (on 31 March) (Figure 10). This peak could be explained by power plant breakdowns, which led to nearly 900 MW capacity falling out of the system: 500 MW in Paks, 232 MW in Gyöngyösvisonta, 120 MW in Litér and 25 MW in Százhalombatta.

Overview of domestic gas market

Gas consumption of the first quarter of 2015 was nearly 400 mcm higher than that of the previous year, which was can be mostly attributed to colder weather (Figure 11). Although even the first quarter of this year was warmer than the average, the price gap was lower than last year. Temperature adjusted data shows that the first quarter's consumption exceeded the consumption of the previous year's first quarter by 29 mcm.

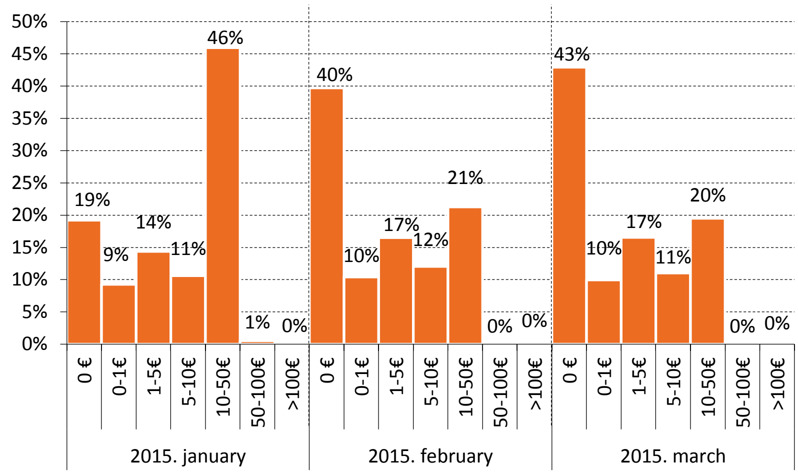
Increasing consumption was accompanied by a moderate change in source structure (Figure 12) including a striking upsurge in net withdrawal. While storage declined by 1 bcm in the first quarter of 2014, this figure was close to 2.3 bcm in the first quarter of 2015. Despite this fact, domestic storages were filled 19.5% in March 2014 and 23% in March 2015 because storages were more prepared leading into the 2014/15 heating season than before. At the beginning of the 2013/14 heating season, storage levels did not reach 47%, while they exceeded 70% at the beginning of the 2014/15 heating season. The increasing importance of storage gas could be primarily explained by the Russian-Ukrainian conflict, which is also supported by import data: while import from Ukraine exceeded 1.3 bcm a year ago, it did not surpass 950 mcm in this quarter. Austrian imports only slightly shifted (by 2%), while domestic production grew by 4%. In conjunction there was a growth in exports, growing from 590 mcm to 990 mcm in the first quarter year to year. During the quarter, Hungary transported 334 mcm of gas to Ukraine compared to zero last year in Q1. More than 10% of Ukrainian import in March came from

Figure 8 **Comparison of day-ahead baselaod prices on the EEX, OPCOM, OTE and HUPX exchanges between January and March 2015**



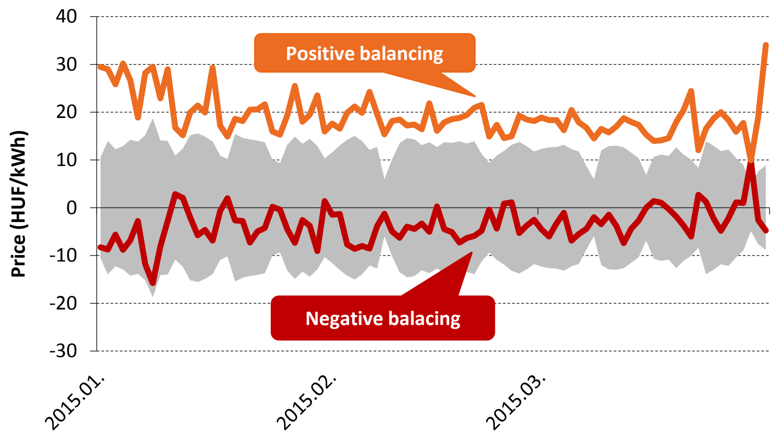
Source: EEX, OPCOM, OTE, HUPX

Figure 9 **Frequency of various levels of price difference between the Hungarian and the Slovakian exchanges between January and March 2015**



Source: REKK calculation based on OTE data

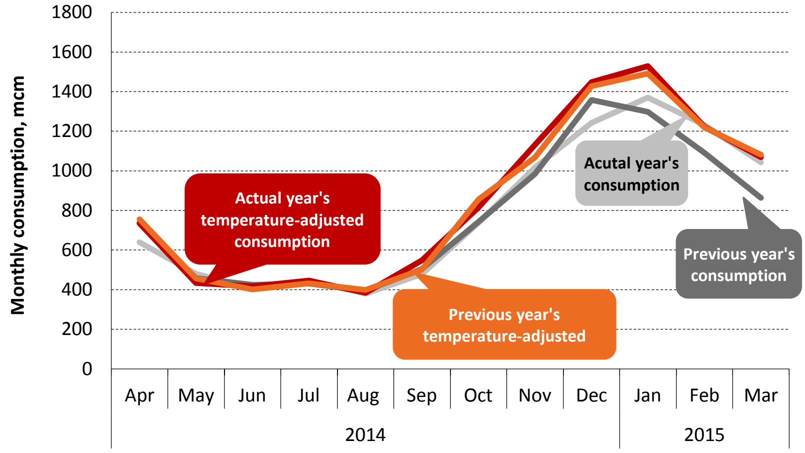
Figure 10 **Daily average of balancing prices and spot HUPX prices, Q1 2015**



Source: MAVIR, HUPX

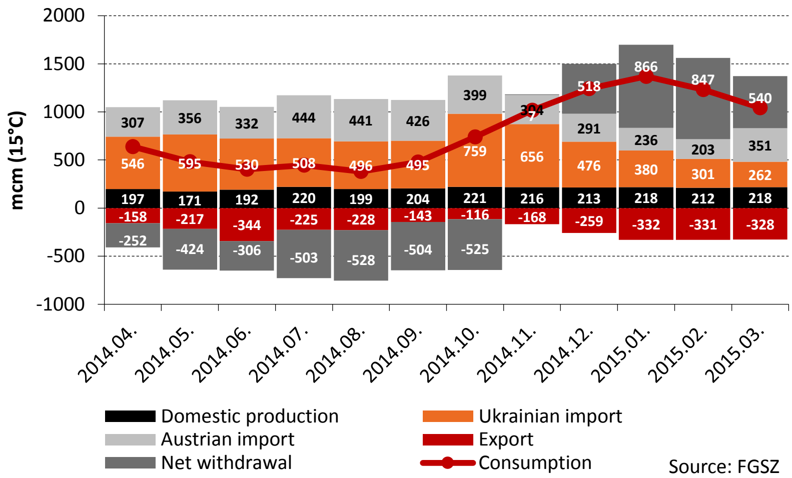
Note: the upper treshold of the gray area denotes the HUPX day ahead price, while the lower treshold indicates the HUPX price multiplied by -1. According to the Commercial Code of MAVIR, this is the upper and lower minimum of balancing energy price.

Figure 11 **Unadjusted and temperature-adjusted monthly gas consumption between April 2014 and March 2015 compared with the respective data in the previous year**



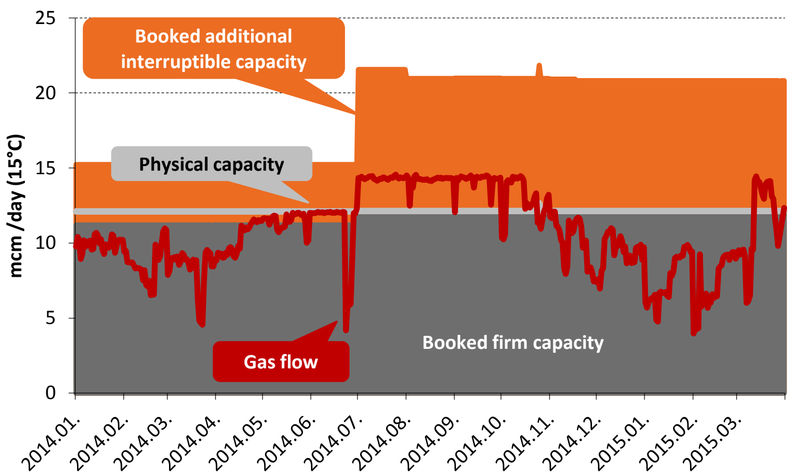
Source: FGSZ, European Climate Assessment & Dataset, REKK estimation

Figure 12 **Source structure of Hungarian gas market by month between April 2014 and March 2015**



Source: FGSZ

Figure 13 **Transmission at the Mosonmagyaróvár (Austrian border) entry point between January 2014 and March 2015, together with booked interruptible and non-interruptible capacities**



Source: FGSZ

Note: physical capacities are values published by FGSZ

Hungary. The reason behind the high export to Ukraine could be that Gazprom offered more favourable prices to Ukraine than European traders, and in the meantime European traders tried to unload some of their contracted quantities.

Austrian import declined not only on a yearly but also on a quarterly basis. Compared to the 995 mcm of gas coming through the Mosonmagyaróvár entry point in last October –December, just 789 mcm were transported to Hungary in the first quarter of 2015. However, daily figures show that shipment significantly grew from the middle of February. While interconnection capacity utilization was 58% in the first half of the quarter, it amounted to 86% in the following one and a half months (accounting for a quarterly 72% compared to 89% in the fourth quarter of 2014). Traders used 42% of all (interruptible and non-interruptible) capacities, which was 10% lower than in the previous quarter (Figure 13).

It follows that with falling Ukrainian import the transport at the Beregdaróc entry point also declined. Gas was shipped on 37% of physical capacities in the previous quarter, which declined to 19%, meanwhile only 56% of contracted capacities were used in the first quarter of 2015 (Figure 14).

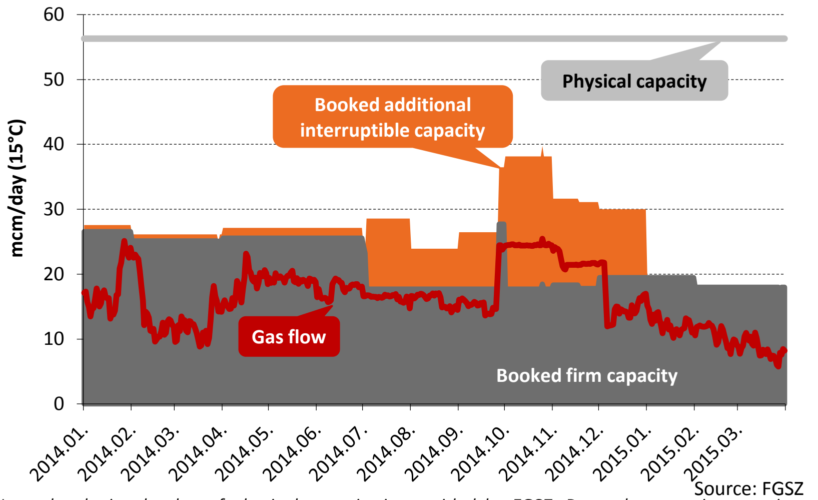
The reason for the low utilization of import capacities is the wait-and-see attitude of gas markets. Since the drop in oil prices at the end of 2014 will have an effect on oil-linked gas price functions only from the third quarter of 2015 on, traders are seeking to shift their scheduled shippings to this favourably priced period.

Regarding export, the most notable element of Figure 15 is the restart of export to Ukraine following suspended shippings at the end of September 2014. Despite the fact that the previous quarter's Serbian export rose from 475 mcm to 624 mcm in the first quarter of 2015, the share of Serbia in the Hungarian gas export decreased (from 87% to 63%). This is certainly due to restarted Ukrainian transports, when in the first quarter of

2015 Ukraine's share was 34% of the Hungarian exports following 2014 Q4 when not a single gas molecule left Hungary for Ukraine through Beregdaróc. However, there was also a significant drop in export to Romania from 53 to 20 mcm, thus the share of Romania in the Hungarian export declined from 10% to 2%. Total Hungarian exports grew from 544 to 990 mcm, compared to Q4 2014.

Oil-linked import prices did not yet include the fall on oil markets, thus prices remained beyond 100 HUF/cubic meter in the last quarter. Oil-linked prices might have only a limited effect on combined import and recognised gas prices since the regulator has calculated the gas prices used for universal service providers as the weighted average of 75% spot and 25% oil-linked prices since April. Consequently, the effect of the fall in oil prices is a quarter less, and appears more significantly in gas prices only once the effect of oil-linked prices is also evident in TTF prices. In the first quarter of 2015, recognised prices remained below TTF, which resulted from the difference in real exchange rates and those regulated in decrees: at the real exchange rate, quarterly household gas prices would amount to 83 HUF/cubic meter instead of 73 HUF/cubic meter. These low recognised purchase costs cause significant losses to universal service providers, thus, not surprisingly, they are exiting universal service activity which will be transferred to the Első Magyar Nemzeti Közszolgáltató (ENKSZ, national public utility services): after purchasing FŐGÁZ (the oldest gas supplier in Hungary), ENKSZ is likely to take over universal service cutomers from E.ON and GDF Suez.

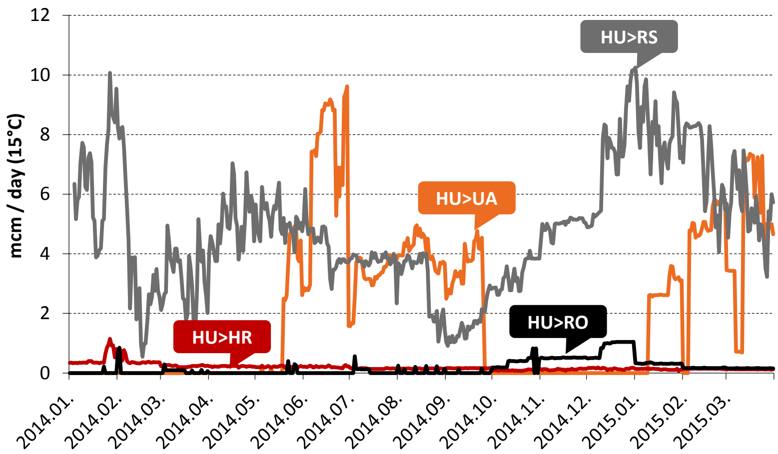
Figure 14 **Transmission at the Beregdaróc (Ukrainian border) entry point between January 2014 and March 2015, together with booked interruptible and non-interruptible capacities**



Source: FGSZ

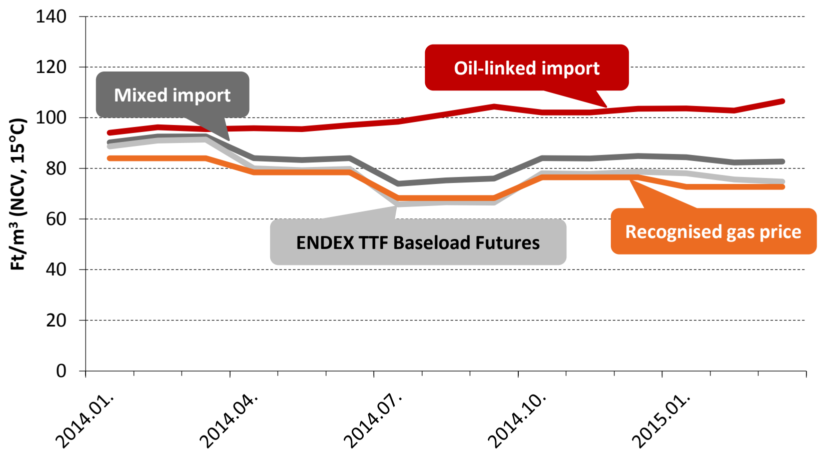
Note: the depicted value of physical capacity is provided by FGSZ. Data also contains transit gas flows entering Hungary via Ukraine and leaving in the direction of Serbia and Bosnia-Herzegovina.

Figure 15 **Hungary's natural gas exports to Ukraine, Romania and Serbia from January 2014 to March 2015**



Source: FGSZ

Figure 16 **Recognized natural gas selling price of universal service providers, and factors of the gas price formula between January 2014 and March 2015**



Source: REKK calculations based on EIA and ICE data

Note: The "recognized natural gas price" is an estimate by REKK for the regulated price calculated by the Hungarian energy regulator (MEKH) every quarter – the estimation is based on the regulated gas price formula and the EUR and USD exchange rates used by the regulator, using publicly available information. The estimate does not take into accoun the effects of natural gas from storage facilities on the recognized price, which is also part of the gas price formula. We calculate the price of "mixed import" similarly, but in this case we use market exchange rates instead of those set by the price regulation decree.

Renewable auctions: questions and experience

Within the next year and a half EU member states need to adjust their support schemes for the generation of renewable based electricity to the prescriptions of the EU guideline on state aid published in 2014.[1] As the main rule, the guideline requires the allocation of support through a bidding process and the direct market sale of the produced electricity. Accordingly, the support schemes based on feed-in tariffs and the obligatory purchase of the produced electricity, currently still applied in a number of member states, need to be amended: either a green certificate system has to be introduced, or renewable based electricity generation can be supported through a bidding process based premium. The deadline for the introduction of the measure of directly selling in the market is 1 January 2016, while the deadline for competitive bidding processes is 1 January 2017.

Why are competitive bidding processes (auctions) good? The fundamental goal of the system is to reduce the support needed to establish renewable capacities by introducing competition among technologies as well as projects within technologies, as a result of which the least-cost bids will be entitled for support. Past experience indicates that the regulator is not always capable of determining the exact level of necessary support evidenced by frequent revisions in response to technological development.[2] Another advantage of a competitive bidding system as opposed to a regulation based on administratively set prices is that the decision makers can control the level of new capacities in accordance with national/EU targets or the available budget, while they also retain the option of ensuring that priorities across technologies are attained (see later). Another non-trivial argument is that the bidding process allocates capacities/budgets in a transparent and normative manner, potentially contributing to greater public support of renewable energy generation.

There are many fields in which competitive bidding for scarce resources is customary. Typical areas of applications include the allocation of telecommunication frequencies, the sale of government bonds or CO_2 allowances, the distribution of oil / gas and geothermal concessions, and the acquisition of system level reserve capacities. This practice is also used more and more frequently to boost renewable capacities: while in 2009 only 9 countries opened competitive bids for new renewable capacities, the number of such countries increased to 55 by 2014.[3]

These bids are organised in a number of fundamentally different ways: they differ based on the commodity that is to be purchased (generating capacity or produced electricity), the subject of the bid (the level of required support, the capacity to be installed or the volume of targeted production), the competition among technologies (technology-neutral or technology-specific), the time horizon of the auctions, the conditions of participation and the criteria of evaluation. The variation of bidding processes, nevertheless, conceals a number of similarities and substantial accumulated experience. Our goal with this short analysis is to review the most important issues related to auction based renewable capacity development and to describe the international practice based on a sample of 13 countries.

Technology neutrality

The bid announcement may apply to a specific renewable technology or a range of technologies (possibly all of them). Under a technologically neutral bidding process all technologies compete with each other and those that require the least support will be implemented. As a result it can be the case that some technologies are left without any support or a single technology obtains most of the offered support.[4] In technology specific bidding processes, on the other hand, projects compete with each other only within the specified technology. In this case - by establishing the auctioned volume for each technology prior to the bidding process - the government can influence the share of given technologies within the future capacity mix. On a limited scale similar preferences can also be integrated into technology neutral auctions (minimum/maximum capacity by technology), but these constraints reduce the efficiency of the competition. In order to safeguard the security of the electricity system the system operator should also be able to set capacity constraints into the auction announcement for weather dependent power plants.

1 European Commission C(2014) 2322 guidelines on state aid, covered in detail in the 2/2014 issue of our Report („The nightfall of the obligatory purchase regime”)
2 We have already covered the experience related to the renewable support schemes for photovoltaic energy in issue 1/2014 of the Report (“Problems related to the support schemes of renewable based electricity generation and the reform concepts of the EU”).
3 REN21, Renewables Global Status Report, 2014
4 In the Netherlands, for example, as a result of the 2012 inclusion of renewable heat projects to the support scheme that had previously been available only for electricity, suddenly heat projects fetched the majority of the common support budget, while the unit cost of support notably decreased (since heat generation had a lower unit cost).

During a technologically neutral bidding process identical competitive conditions need to be created for technologies with different system level ancillary costs. Today in Hungary, for example, weather dependent renewable producers either do not have to offer a schedule (photovoltaic producers) or the allowed deviation from schedule is wider (wind based producers).[5] Positive discrimination played a crucial role in the penetration of renewable production all over Europe. The EU guideline targeting the market integration of renewable production, however, clearly prescribes the termination of this practice: renewable producers also have to bear the costs of balancing that originates from the deviation from the schedule, as long as there is a liquid intraday market in operation.

Mainly technology specific bids are organised within the inspected countries. So far photovoltaic in France and Germany and only wind capacity in Hungary have been auctioned. Separate auctions may also be set up even within a given technology: In France power plants below and above 250 kW compete separately, in Morocco and China bids are site specific. In the rest of the examined countries a wider range of renewable technologies are grouped for the auctions. Electricity purchase bids in Brazil may be technology neutral as well as technology specific. Of the bids for electricity delivery to be started in three and five years (A-3 and A-5 auctions), A-3 auctions are announced primarily for wind, solar and small hydro plants, while A-5 auctions are available for large hydro and conventional power plants. Of the inspected countries (or states), only California organises purely technology neutral bids, and these have been awarded mainly to photovoltaic capacities.

A transition between the purely technology neutral and the technology specific systems is represented by those solutions in which two groups of technologies - the so called mature technologies and the still expensive technologies (which are, however, becoming cheaper and cheaper) - are addressed separately by the support regime. Under the current English support scheme (CfD) separate budgets are earmarked for three technology groups during the auctions and the renewable projects competing for support are assigned into the mature (e.g. on-short wind power plants, biomass fired plants and solar power plants), the less mature (e.g. wave power plants, tidal power plans, off-shore wind turbines) or the biomass conversion group. Moreover, the government has the option of setting minimum expected and/or maximum allowed capacities for given renewable technologies for specific periods. For the first period (2015/16-2018/19) minimum capacity was set for tidal power and wave power stations (10 MW). While the minimum capacity does not guarantee that projects delivering the expected capacity indeed enter the grid, these projects compete only with each other (as long as there is more demand for support than the established minimum capacity) and only the unsuccessful bids are added to the general auction.

The Dutch support scheme is seemingly technology specific, but the different technologies indirectly compete with each other. During the auctions - executed six times a year - investors make bids for the volume of renewable based energy generation at the announced level of support. In the Netherlands there is a single budget for all technologies together, but the level of support is differentiated by the technology (the difference between the market price and the pre-set base value that represents the generating cost of the given technology), therefore the projects within a technology compete with each other, and indirectly with all projects. More expensive technologies are allowed to enter administratively, as a technology independent category ("free category") is always available, allowing the entry of those projects with a more expensive technology that are - due to an investment grant or for some other reason - willing to produce electricity at a lower price than the typical level of the technology, at the highest base value of the period in question.[6] The SDE+ system, thus, includes mainly the mature technologies, and a separate auction is announced by the Ministry of Economy for the development of more costly off-shore wind power plants.

Setting the volume to be auctioned

A question related to technology neutrality is how the volume of energy to be purchased is set by the bidding process, and there are typically three: either setting the budget limit for support (billion HUF/year), fixing the electricity generating capacity to be installed (MW) or by establishing the annual amount of electricity to be produced (GWh).

An advantage of setting a budget limit is that renewable projects receive exactly as much support as intended, either annually or for a period of several years. The targeted capacity (MW) of each technology, however, is a more transparent indicator for decision makers, and it is also easier to match to the notion of investment grants to the end goal of capacity development. The capacity based target is also

5 7/2014 MEKH Resolution
6 Typically osmosis based projects, off-shore wind projects, manure mono-fermentation and biogas gasification belong here.

advantageous from another perspective: in case of weather dependent technologies the size of capacities that can be integrated into the system is easier to control. However, renewable targets are measured and assessed according to the desired volume of annually generated electricity (GWh), meaning that the actual GWh of renewable production intended to be supported should be set as part of the auction announcement.

Technology specific auctions are almost always denominated in capacity.[7] In the case of technology neutral bids the level of production is set in Brazil while capacity is set in California. In the latter case, however, the process practically led to the procurement of a single technology (photovoltaic). In the Netherlands and the UK, where technologies also compete, the accepted projects are limited by the pre-set budget. In the UK the government sets separate budgets for the three technology categories (mature, "less mature" technologies, and biomass) for years in advance. At the auctions in the Netherlands producers can offer generated quantities at increasing base values (the estimated production cost that drives the premium) until the annual budget is exhausted.

The types of auctions

The ideal auction mechanism provides incentives for participants to make offers commensurate with their costs, preventing collusion and the displacement of cost efficient projects. The mechanism of the auction may be sealed bid or descending clock, while with respect to setting the final price it may be a uniform price or a pay-as-bid price auction.

In case of sealed bid auctions each participant makes a bid, including price (i.e., the unit support demanded by the given player) and volume, without knowing the bids of all others. After putting the bids in order, the winning bids can be selected as a function of the volume to be acquired. The advantage of this system is its simplicity, making it attractive to both the issuer of the bid and potential participants. Since these types of auctions typically take place in a single round, collusion is more difficult. In addition, if the costs of entry are not prohibitively high, smaller participants will be encouraged to join the process, lessening the potential displacement effect. Single round, static auctions, however, are more likely to lead to an inefficient outcome since decisions are made with less information and the valuation of competitors and bidders cannot react to each other's decisions. Thus the high uncertainty over the accepted price is incorporated into the single bid, increasing the risk that the auction price may exceed the efficient price. Nonetheless, in most of the countries covered, single round, sealed bid auctions are carried out.

In case of uniform price auctions each winning bidder receives the same price: the highest accepted or the lowest rejected price. If the competition is intense enough, this method provides an incentive to participants to submit price offers that equal their costs. Since everyone receives the same price, this type of auction "over-supports" low cost winners. Of the inspected countries, uniform price auctions take place in China and the UK. In these auctions bidders tend to submit prices below the realistic level, hoping that the final price will be determined by the offer of another bidder with a higher price, while the low price ensures a winning bid. During the first auction of the British CfD system, for example, two PV projects were selected with a rather low price of 50 GBP/MWh, making their execution unlikely.

For the above reasons, in cases when the competition in the market is not efficient enough or the bids are vastly different and difficult to compare (due, for instance, to differing cost structures as a result of varying technologies), the pay-as-bid auction tends to prevail: in most of the examined countries (e.g. France, Germany, Italy, Turkey, South Africa) pay-as-bid auctions are applied. When this method is used, each winning bidder receives the price it offered. A disadvantage is that bidders often determine the prices they submit not based on their costs but according to an estimation of what might be the highest accepted bid, and set their own bid to that level (or a little below it), which may result in an inefficient outcome.

In case of descending clock auctions bidding starts at a high price and declines from round to round. At each price bidders submit the volume that they offer. The auction continues until the offered volume meets the volume to be purchased. The advantage of descending clock auctions is that based on the results of the previous rounds, bidders may get a sense of the reservation price of others - the price that can be expected -, therefore they can adjust their offer to be in line with other offers. As a result, a multi-round fierce price competition may emerge, contributing to efficiency. The disadvantages of uniform price auctions also continue to hold in this instance. In addition, if the competition is not strong enough, the multiple round execution (and the declining number of participants through the rounds) fosters collusion among bidders, as a result of which the auction may terminate before it ideally would

7 Of the analysed countries, there is an exception, Peru, where the intended purchase is measured in MWh.

and the price may be higher than expected. For descending clock auctions, the starting price and the termination of the auction (specified as the level of over-supply) are important factors.

These two options are combined into a hybrid form in Brazil. In the first step, the purchaser continues to decrease the price during a descending clock auction until the oversupply falls below a given level (amount to be purchased + X%). Afterwards all the remaining participants submit their final bid through a sealed bid auction, the price of which cannot exceed the closing price of the descending clock auction. This method combines the advantages of both auctions: the first phase enables participants to get information about the price, allowing efficient competition to emerge, while the second phase prevents collusion among the low number of participants.

The criteria of evaluation

A bidding process is able to minimize demand for support (this is a necessary, but not a sufficient condition) if the sole criterion of evaluation is the level of the requested support (the premium). The auction, however, may also create room for the consideration of other valuation criteria as well. These may include job creation, sustainability, the impact of the investment on local industry, or even cogeneration. In this case, however, not even within a given technology is it guaranteed that the investment with the lowest cost takes place. Furthermore, the bidding process will be less straightforward and transparent. The inspected countries therefore typically decide on the support for projects solely based on price. An exception is France, where overall CO_2 impact for projects with a capacity of 100-250 kW are evaluated with a weight of 33% while projects above 250 kW ancillary considerations (CO_2 and environmental impact, feasibility and R&D impacts) receive a 60% weight. In South Africa 30% of the evaluation depends on job creation and the share of domestically manufactured equipment. Factors on top of price are also considered in Morocco and China. In addition to the reduced efficiency of cost based competition, the complicated system of evaluation and the validation of the related data requires substantial efforts on the part of authorities and - as in the case of many French bids - it results in more invalid bids.

The preconditions of participation and monitoring

The preconditions to participation in the auction and the sanctions applied for late or missing execution should be analysed together. Both facilities aim to screen bidders that are less serious and/or not well prepared to implement the project. In short, if one of the criteria is strictly set, it will also impact the other. If the pre-qualification phase imposes strict constraints, the projects eligible for support based on the bidding process will fail at a lower rate and, similarly, problematic projects can also be eliminated during the implementation phase. In the latter case, however, the failed projects leave the support regime at a late stage, and therefore they will be replaced by new bidders later in the process. One solution for the replacement of eliminated capacities is for non-winning projects to maintain their offers for an extended period and later qualify as supplemental projects in accordance with the original tender, or if the volume available for auction is larger than the originally targeted level (from the beginning assuming a percentage of failure). High barriers to entry (strict pre-qualification) limit the number of participants within the bidding process, placing smaller, less capitalised bidders in a disadvantageous position and thus limiting competition. High deposit requirements and the prospects of substantial sanctions may also increase the risk premium and thus the demand for support.

Acquiring the permits requested for pre-qualification is time consuming and costly, making it more difficult for smaller participants to enter and compete. A number of documents need to be submitted during the pre-qualification process in most of the examined countries, including the site use permit (e.g. South Africa, California, Netherlands), environmental permit (e.g. Brazil, Netherlands, Poland), network access approval (e.g. Brazil, California, UK). In case of biomass projects, proof of the security of fuel supply may also be required (e.g. South Africa, Brazil, UK above 300 MW). Of the criteria pertaining to the applicants the two most frequently required are experience with investments/project implementation within the sector (e.g. Morocco, California) and appropriate financial background (e.g. Morocco, UK). Documents verifying the economic and financial viability of the project need to be submitted in South-Africa, Italy and Morocco, among others.

Financial guarantees may also be linked to the phases of evaluation and implementation: between pre-qualification and contracting - in order to elicit serious offers - the so called bid bond and after contracting the performance bond. After the auction is over, the bid bond is returned to unsuccessful bidders, while winning participants may lose this sum if they decide not to sign the contract. The performance bond is to be paid at the time of signing the contract in order to safeguard the implementation of the project.

In Brazil the bid bond is set at 1% of the planned project cost, while the performance bond makes up 5% of the project cost. In Italy a bid bond equal to 5% of the investment cost has to be deposited, rising to 10% if support is awarded. In Peru a 20,000 USD/MW bid bond and a 100,000 USD/MW performance bond is to be provided, while in Germany the required deposit is 4 EUR/kW in case of the bid bond and 50 EUR/kW for the performance bond.[8] Within the South African bidding process the deposit is 12,500 USD/MW for the pre-qualification phase and the performance bond is twice as much. The winners of the French PV auction are bound by a performance bond of 50,000 EUR/MW. The 2009 wind auction of Hungary prescribed a so called source certification (60,000 EUR/MW). In the UK, on the other hand, no deposit is required, the implementation of the projects is meant to be ensured through a system of penalties.[9]

The high value deposit alone may guarantee that most of the contracted capacities are indeed installed. In Peru, without a pre-qualification step, solely through a requirement of large deposits it was possible to ensure that delays are minimal and most projects are successfully implemented. Due to the large deposit requirement, nevertheless, the number of bidders and the strength of the competition has not met expectations.

Project implementation is promoted and delays are sanctioned in a number of ways:

- the performance bond is released gradually in steps;
- progress reports are requested;
- loss of the performance bond, financial penalty and reduced support;
- termination of the contract and exclusion from future auctions.

The gradual release of the performance bond can be assigned to the completion of predetermined phases of the projects. In the UK and France this is linked to contracting a certain percentage of the planned investment sum. A peculiarity of the French process is that a bank guarantee of 30,000 EUR/MW needs to be provided in the 17th year of operation, to be released gradually.

The requirement for progress reporting is in itself motivating, allowing for delays to be detected earlier and possibly even corrected. In Peru, for instance, project developers need to submit a "progress report" every three months.

If the operation is being launched with a delay, sanctions may include items in addition to losing the performance bond: in Peru, for instance, the deposit needs to be increased by 20% if there is a delay, rising to 50% if the delay extends beyond 1 year. In Italy each month of delay results in a 0.5% reduction of the support, while in the UK the support period is shortened by the length of the delay. According to the rules of the French PV auction, the period of support is reduced by twice the length of the delay. Investors may also be motivated to implement the project by setting a separate penalty: e.g. the winners of the French PV auction are excluded from the support scheme if they fail to meet their obligations, on top of which they also have to pay a penalty of 5,000-100,000 EUR/MW depending on the size.

If the delay exceeds a specific length, the contract is usually terminated and the support is withdrawn (in case of a 1 year long delay in Brazil and Peru, and 2 years in Russia). An additional sanction may prohibit bidding with the same project again for a given period of time (e.g. in the Netherlands if a project is not completed within 4 years, new support cannot be requested for 5 years).

Transformation of the Hungarian regulation

The development of the new support mechanism that complies with the EU guidance is taking place at present in Hungary with the participation of the MEKH and the NFM. According to the ambitious schedule by May 2015 Hungary agreed to the main concepts of the planned support scheme with the European Commission and, considering the evaluation of the Commission, the government will develop the regulatory details of the new system before the end of the year.

Since - with the exception of the withdrawn wind auction - Hungary does not have experience in auctioning the support for renewable capacities, it makes sense to announce a number of smaller auctions, in order to be able to utilise the initial experience for subsequent events.

Understanding the bidding process and acquiring experience is also important for the producers. It would be crucial to announce an auction calendar covering at least a medium time horizon fixing the expected schedule as well as the volume to be auctioned. Setting the total amount of renewable electricity for the medium run is a prerequisite for successful tendering. The auction calendar would make the new system more predictable for in-

8 Platts No. 697, 2 February 2015
9 http://www.nortonrosefulbright.com/knowledge/publications/119411/electricity-market-reform-a-practical-guide-to-contract-allocation-for-low-carbon-generation

vestors, it would help the timely preparation of projects and thus it would presumably increase the share of implemented projects. Lastly, harmonising the auctions with the allocation of investment grants is also vital: if the two types of support are offered in parallel by the Hungarian state, then their schedule (most critically, the frequency) needs to be coordinated with the participation of the responsible government bodies.

Energy market economics / specialist training at Corvinus University of Budapest

The goal of the energy market economist training is to provide future energy experts with a theoretically sound, practical and complex knowledge base and analytical skills. The training can be attended by anyone with college degree. The two-semester programme allows the participants to gain comprehensive and methodologically established perspectives on the European and Hungarian regulatory framework, market structure and characteristics of competitive liberalised electricity and gas markets. Primer courses of the training include microeconomics, industrial organisations, theory and practice of regulation, Hungarian and European Union competition and energy law. Methodology courses cover essential data analysis, statistics, accounting, controlling and corporate finance skills. Specialist courses give valuable insight to the workings of electricity, natural gas and renewable markets by presenting Hungarian and international practices, including models of liberalisation, energy trading systems and exchanges, greenhouse gas markets and renewable support schemes. Security of supply is a central part of the course. Regulatory practices handling social issues in the energy sector are also covered.

Instructors of the course are experienced professionals of the University, who are acclaimed internationally within the field. Industry experts are often invited to give lectures.

The training offers practical and theoretical knowledge for experts of energy companies. With a better understanding of regulated energy industries, lets the companies benefit from a sound strategy and improvement in day-to-day work.

The course is available in Hungarian language.

For further information on the 2015/2016 training, visit our website at

www.rekk.eu

Results of The Czech-Slovakian-Hungarian-Romanian electricity market coupling

Romanian OPCOM joined the coupled Czech-Slovakian-Hungarian electricity markets on 20. November 2014, thus forming the 4M market coupling. Our article gives an evaluation of the performance of the first five months (The time period 19. November 2014. – 20. April 2015.) of market coupling. The first part of the analysis introduces the theoretical model and the main principles of the market coupling, then we assess the performance of the coupling considering price convergence as an indicator.

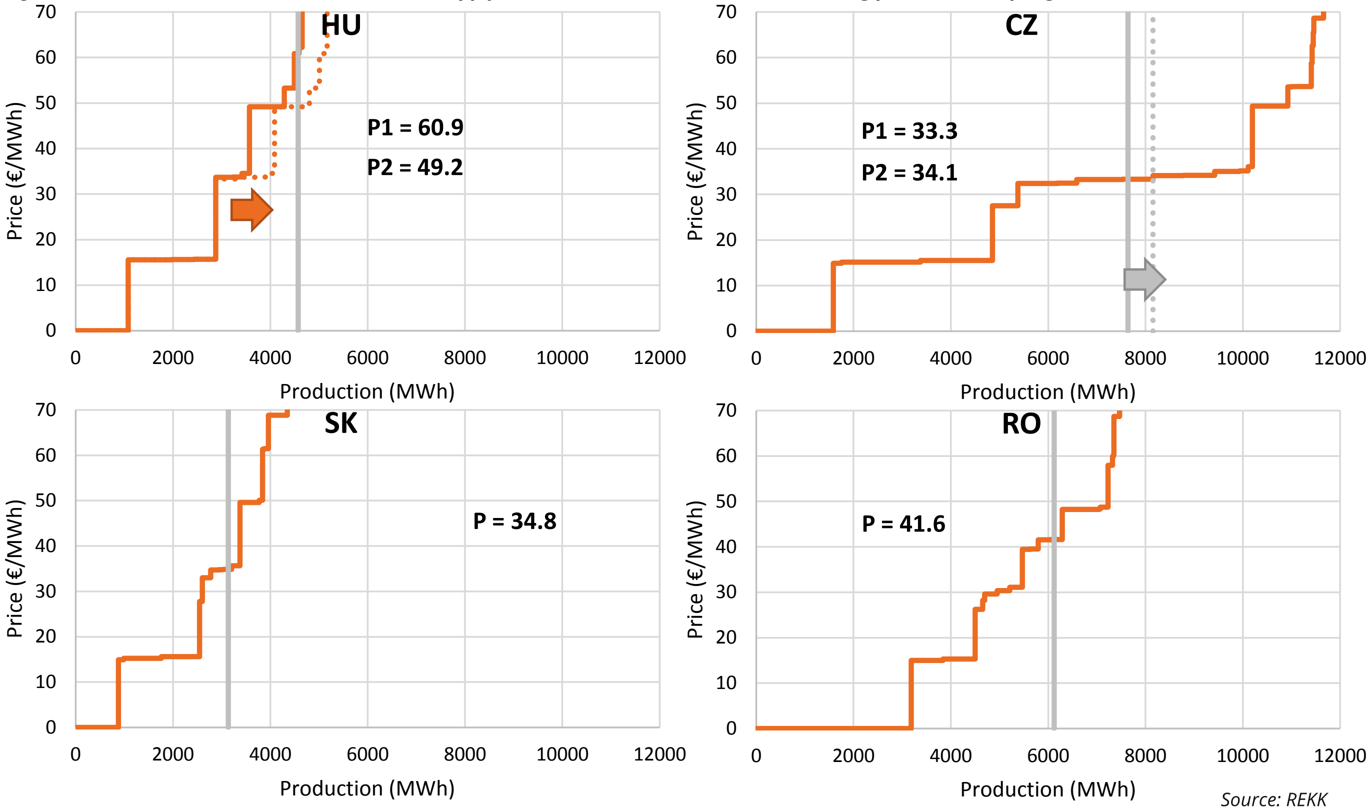
Functioning of the market coupling

The bottom line of market coupling is that producers and traders of the coupled countries or regions should be able to sell and purchase electricity without the need to book cross-border capacities in neighboring countries. The prerequisite of effective market coupling is the availability of sufficient cross-border capacities. TSOs active in the 4M market coupling announce day-ahead cross-border capacities for each hour; actual available capacity for market coupling flows will be equal to the minimum of the cross-border capacities announced by the two neighboring TSOs.

For traders, the main advantage of the market coupling is that market players only need to register at one exchange participating in the coupling, and their sale and purchase offer will be valid in the whole coupled region. Market players may submit their sell or buy bid for any day-ahead hour – by matching the bids, an equilibrium price is calculated for each country. Countries with higher prices will be net importers of electricity, while countries with lower prices will be net exporters. Marker coupling will result in price convergence only if available cross-border capacities are not congested. If no congestion is observed, electricity flows from the lower price region to the higher price regions, causing a drop in price in more expensive regions and a hike in price for cheaper regions. The price effect of electricity flows is determined by the characteristics of the markets, such as elasticity of supply and demand and the equilibrium price without cross-border trade.

We present the workings of the market coupling with an example. Based on installed capacity and load observed, we have plotted the characteristic baseload supply and demand curves for the four markets. Supply curves were calculated using 2015 installed capacities and fuel prices, while demand is set by assuming baseload electricity consumption in 2014. Supposing perfectly inelastic electricity de-

Figure 17 **Characteristic baseload demand and supply (merit order) curves of countries taking part in 4M coupling**



Source: REKK

mand and excluding the possibility for trade, we observe that Hungary is the most expensive market, followed by Romania, then the Slovakian and Czech markets. Czech and Slovakian modelled prices are in line with the 2014 average electricity price, while in the case of Hungary and Romania modelled prices exceed the historical average. For Hungary the reason for this difference is that the demand curves plotted did not yet include imports – in the Hungarian market, nearly 30% of electricity consumed is made up of imports, which tends to be cheaper than domestic electricity generation, thus shifting the high modelled electricity prices. For Romania, the main cause for the difference of modelled and historical prices is that we applied lower capacities for hydro generation in reflection of its intermittency.

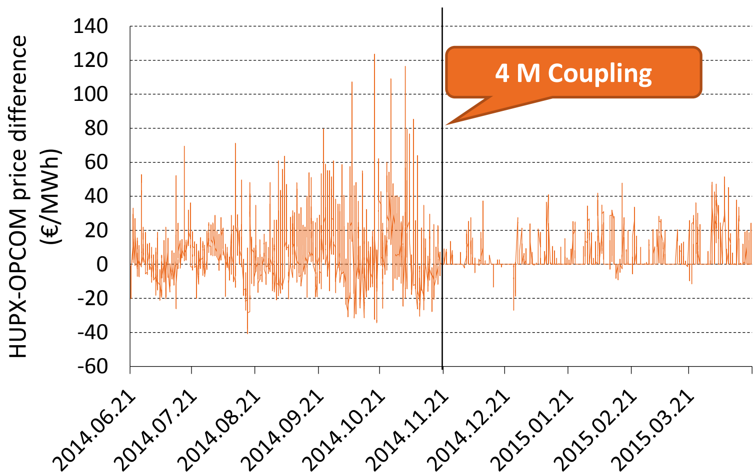
The modelled demand and supply curves present us with a relatively expensive Hungarian market. This induces an import demand, which can be satisfied with Slovakian, Romanian or Czech supply, up to the limits of available cross-border capacities (See Figure 17.). The Hungarian demand will use the cheapest available supply bid throughout the market (in the example, based on the supply curves plotted this is 33.3 EUR/MWh, amounting to 513 MWh – see Figure 17.). If there is sufficient cross-border capacity at the Czech-Slovakian and the Slovakian-Hungarian border, then the Hungarian supply curve is amended with the price-quantity combination, and the Czech demand expanded with 513 MWh of export. Consequently, the Czech equilibrium price will rise slightly to 34.1 EUR/MWh, while the Hungarian equilibrium price falls considerably, from 60.9 EUR/MWh to 49.2 EUR/MWh. Imports and exports are traded up until the point when all markets equalize, in this case we find no congestion on the cross-border trade, or until the point when cross-border capacities may not be used due to congestion. Therefore, if full price convergence is observed in coupled electricity markets no congestion occurs, while any price difference is representative of insufficient available cross-border capacities.

We must not ignore that price convergence and subsequent welfare effects are not only achieved by the coupling of exchanges, but also through explicit allocation of cross-border capacities and bilateral trade. The main difference of the two mechanisms is that in case of coupled markets, allocation of cross-border capacities is more efficient, thus resulting in greater price convergence. Furthermore, market coupling day-ahead cross-border trade is conducted on exchanges instead of OTC markets, thus the price convergence effect of bilateral trade appears on the exchanges as well.

Evaluating the market coupling

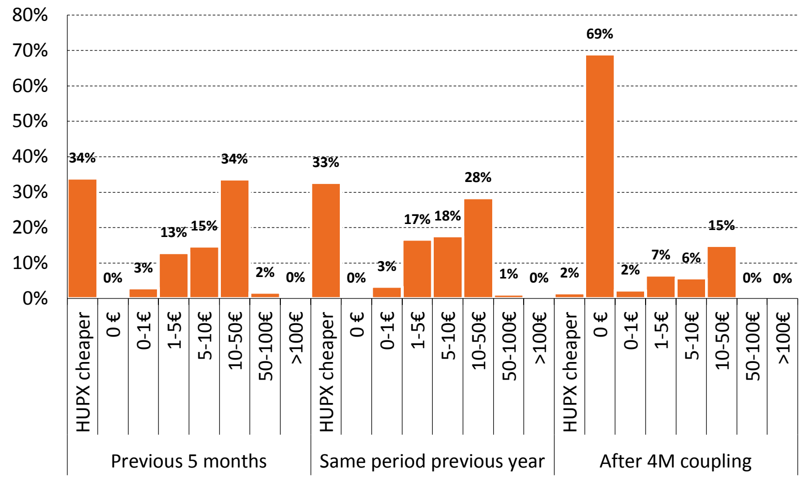
In the past five months since the commencement of the 4M market coupling (19. November 2014.), Hungarian and Romanian exchange prices have narrowed considerably. In Hungary, this meant the easing of wholesale electricity prices: the 5 month HUPX average wholesale price prior to the market coupling amounted to 42.7 EUR/MWh, which dropped to 39.6 EUR/MWh in the 5 months following the coupling. In the same time, Czech wholesale electricity price fell by only 60 Eurocents, while Slovakian prices stagnated. Romanian wholesale power price displayed a small price increase, from 35.7 EUR/MWh to 35.9 EUR/MWh. Considering the same period in the previous year (20.11.2013.-20.04.2014.) the same magnitude of price difference may be observed – HUPX price decreased from 41.1 EUR/MWh to 39.6 EUR/MWh while OPCOM prices rose by 20 Eurocents. The performance of market coupling may be measured by the fact that since the coupling, price difference and price deviation between Hungarian and Romanian markets shrunk. This is illustrated by Figure 18, which displays the hourly price differences between the Hungarian and Romanian markets before and after coupling. It is apparent that both the absolute value and the deviation of prices decreased. At the same time, Czech and Slovakian equilibrium prices have been breaking away from the Hungarian price, splitting the 4M market coupling into two price zones: a Czech-Slovakian and a usually more expensive Hungarian-Romanian price zone. Czech and Slovakian exchange prices generally correlate, but in the rare case of breaking away, the Czech market adjusts to German prices while the Slovakian market follows Hungarian prices.

Figure 18 **Hungarian and Romanian hourly price difference before and after the 4M market coupling**



Source: OTE, REKK

Figure 19 **Distribution of Hungarian and Romanian price differences before and after 4M coupling**



Source: OTE, REKK

Performance of 4M coupling is most readily measured by price convergence. To assess price convergence, we classified hours passed since the 4M coupling into 5 categories: the first category includes hours when 4M coupling occurred, and the same prices are observed for all four markets (4M same price). The second category (CZ-SK and HU-RO) incorporates those cases when the 4M coupling is split into two price regions, a Czech and a Slovakian equilibrium price and a more expensive Hungarian and Romanian market clearing price. We have differentiated a case when the Romanian market breaks away from the 4M coupling, but the other three markets have the same market clearing price (RO separate, CZ-SK-HU same price). The fourth category lists the hours when the Czech and Slovakian markets equalize, but the Hungarian and Romanian markets have a different clearing price each (RO separate, HU separate). The last category shows the hours when the Czech market breaks away from the 4M market and adjusts to the German electricity exchange (CZ cheaper). Table 1 displays the classification of the hours passed since market coupling to these categories.

The correlation of Hungarian and Romanian exchanges is corroborated by the fact that in more that 2/3 of the period, prices have equalized. In the remaining 1/3 of the time, the Romanian market proved to be cheaper, with quite high price differentials (10-50 EUR/MWh). Prior the market coupling, Hungarian prices proved to be cheaper than Romania approximately one third of the time – this phenomenon ceased after the coupling, due to the fact that cross-border capacities connecting Hungary and Romania tuned out to be sufficient, allowing for price equalization. The ratio of hours during which the Hungarian price is more expensive then the Romanian one has decreased since the market coupling, demonstrated by the shrinking average price in Hungary. Convergence of Hungarian and Romanian prices turned out to be stronger than convergence of the Hungarian to Slovakian or Hungarian to Czech prices.

We must note that the available Romanian-Hungarian cross-border capacities and the Hungarian-Romanian available capacities differ significantly: much more cross-border capacity exists in the Hungarian-Romanian direction than in the opposite. Average Hungarian-Romanian cross-border capacities available for coupling were 1200 MW, while in the opposite direction this was merely 36 MW. The disruption in convergence of Hungarian and Romanian prices is unequivocally caused by the scarcity of allocated cross-border capacities on the Romanian-Hungarian border: according to TSO data, total technical capacity of this border is 670 MW. Despite this fact, average available cross-border capacity for day-ahead trading purposes was only 36 MW; the available capacity has surpassed 400 MW for only a few hours in the period. It is notable that this meager cross-border capacity still allows for strong price convergence between Hungarian HUPX and Romanian OPCOM.

Ideally, we would expect most of the hours to be listed in category 1; that is all markets should have the same market clearing price during the whole period. In reality, in the 2014 November-2015 April period only one fifth of the hours fit this category. The most prevalent outcome of the 4M market coupling in this period was the splitting of the 4M to two regions, a Czech-Slovakian and a more expensive Hungarian-Romanian equilibrium price. 3M coupling, when Czech-Slovakian-Hungarian prices equalize but Romanian prices break away, was observed in 16% of the period.

Knowing these facts, the performance of the 4M coupling is a bit more complex – although it was beneficial for the Hungarian markets, the coupling has not yet reached its full potential.

1. The most common outcome (in 42% of the period) was a split into two price zones. This splitting was more often observed in peak hours. The divergence is certainly caused by scarce cross-border capacities, which can be exacerbated by technical deficiencies and market protection as well.
2. Prices have equalized in a scant 21% of the observed period. This occurred more often in off-peak (69%) than in peak hours (31%), meaning that in low-demand off-peak

Table 1 **Evaluating the performance of 4M coupling**

		CZ	SK	HU	RO	Distribution	Off-peak hours	Peak hours	HUPX €/MWh
1	4M same price	P	P	P	P	**21%**	*69%*	*31%*	29.2
2	CZ-SK and HU-RO	P1<P2	P1<P2	P2>P1	P2>P1	**42%**	*34%*	*66%*	41.3
3	RO separate, CZ-SK-HU same price	P1>P2	P1>P2	P1>P2	P2<P1	**16%**	*55%*	*45%*	37.4
4	RO separete, HU separate	P1	P1	P2	P3	**13%**	*26%*	*74%*	45.4
5	CZ cheaper	P1	?	?	?	**7%**	*5%*	*95%*	54.2

Source: REKK

hours equilibrium price was reached at the leftmost part of the merit order curve, and no huge cross-border flows appeared

3. The Romanian market broke away from the 3M markets in 16% of the period. This occurred with the same probability in peak and off-peak hours. A lower Romanian price may be caused by surging cheap hydro production and low availability of Romanian-Hungarian cross-border capacities.
4. Three different prices (Czech-Slovakian, a more expensive Hungarian and cheaper Romanian) occurred in 13% of the time, typically in peak hours.
5. Those periods when the Czech market price broke away from the other three exchanges were predominantly peak hours, altogether 7% of the time. The reason for this phenomenon may be the cheap German PV and intermittent renewable generation, which pulls down the Czech prices.

So it can be concluded that price convergence is achieved mostly in off-peak hours while divergence is more typical in peak hours. From a welfare point of view, this is suboptimal: peak hour convergence would result in much greater gains in welfare for the region.

Summary

We have shown that the 4M coupling brought about a 2-3 EUR/MWh price drop in the Hungarian market. Price convergence occurs mostly in off-peak hours, while peak hours display a 2M-2M market divide, meaning a split between common Czech-Slovakian and a Romanian-Hungarian price zone with the latter remaining more expensive. The main barrier of stronger price convergence is the lack of sufficient cross-border capacity on the Romanian-Hungarian or the Slovakian-Hungarian border. Since the day-ahead cross-border capacities submitted for market coupling is not publicly disclosed (only the minimum of those two values) it is not clear if the convergence is hindered by TSOs actions or unknown technical issues. Hungarian consumers would reap huge welfare benefits if the price convergence occurred not only in off-peak but peak hours as well. It must be pointed out that a lower Hungarian wholesale price equates to lower revenues for Hungarian power producers, since cheaper power imports would crowd them out even in peak hours. To sum up, the 4M coupling is successful and effective, but a further expansion of day-ahead available cross-border capacities would further enhance price convergence and performance of the coupling.

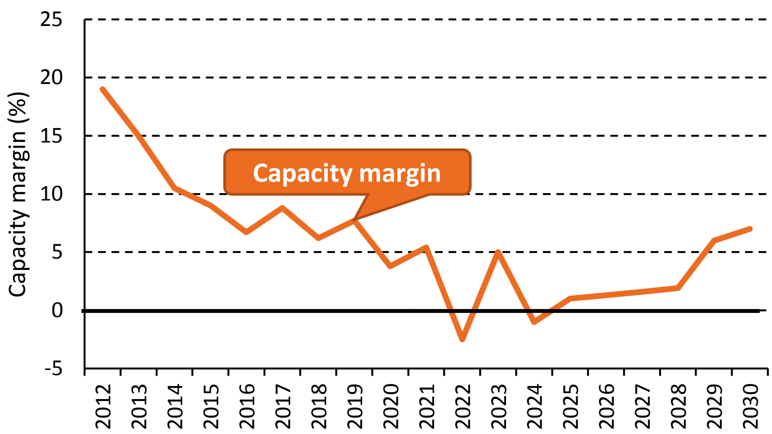
Power Plant Capacity Auction in the UK

Recently, European electricity market models have been facing serious challenges: growing renewable electricity generation and unfavourable price conditions/negative spread resulted in the collapse of profitability of natural gas fired power plants, forcing operators to mothball significant parts of existing capacities and postpone or cancel new investments. This trend has raised security of supply concerns in several European countries, a number of which are responding with the introduction of capacity mechanisms that reward the availability of power plant capacities.

There are various types of capacity mechanisms that are planned or have been introduced across the EU. Several countries use capacity payments, others provide strategic reserves contracted by the TSO, while some establish capacity markets.[1] Capacity mechanisms established and introduced at a national level distort competition among power plants, adversely impact the single European electricity market and may lead to the dissolution of the energy only model used so far.

Because of this threat to the unified EU market, the European Commission is becoming more active in addressing associated challenges with capacity mechanisms. It issued a notice in late 2013 that included specific recommendations related to capacity mechanisms and were included in the environmental and energy state aids 2014 guidelines. Furthermore, in April 2015, the Commission launched a sectoral inspection in order to highlight best practices for countries moving forward with capacity mechanisms. Based on the available analyses and inspections, it will revise the European power market (target) model. There is a good chance that this review will lead to new rules and regulations aiming for the harmonisation of capacity mechanisation by 2016.

Figure 20 **Long-term estimates of capacity margins**



Source: OFGEM, DECC

There are intensive scholarly debates among energy experts about the role of capacity markets that have led to a number of publications on the topic from various think-tanks. Thus when a pillar of the British electricity market reform (EMR) was to include the preparation of capacity auctions, developments were closely watched. The capacity market elaborated in the United Kingdom was approved by the Competition Directorate of the European Commission launched in December 2014 and could be a milestone in the development of European electricity markets. The British capacity market is a pioneer in Europe that could lead to an extension of capacity mechanisms or the further liberalization of existing electricity markets. Both possible outcomes will be effectual in the future make-up and operation of electricity markets. Therefore, it is important both for European countries that are considering capacity mechanisms and the European Commission – seeking to establish and maintain a single European energy market – to understand the particularities of the British capacity market along with an assessment of outcomes from the first auction held in December 2014.

Rules of British capacity auctions

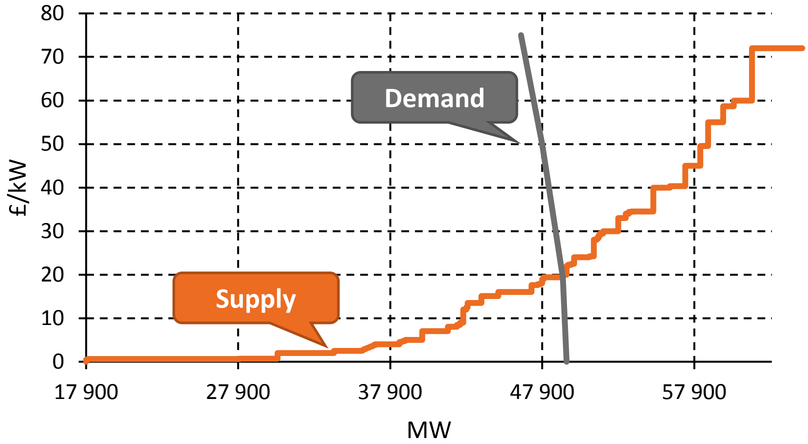
The British government justified the need for a capacity market with mounting supply security concerns, stemming from i) the negative spread on several European markets, spurred by investments in renewables and lack of additional investment incentives, and ii) future capacity losses resulting from the approaching closure of nuclear and coal-fired power plants reaching the end of their lifespan. Forecasts made by Ofgem and DECC (Department of Energy and Climate Change) projected a significant increase in the probability of loss of load by 2015/16 and from 2018/19 on, and a continuous decline in de-rated capacity margins.

The British government wants to ensure the future availability of power plant capacities by establishing capacity markets. The TSO (and the so-called Settle-

1 See more details on capacity mechanisms in our article „Unilateral measures or EU coordination? The question of European capacity mechanisms" in 2013 Q2 of our Quarterly ment Body, respectively) procures what it estimates to be necessary future capacities on central auctions, and payment is set on the market by the capacity supply and demand at auction.

Demand for available capacities, i.e. target capacity level, is set by the government based on the TSO's proposal taking into consideration the expected capacity margin and the acceptable level of security of supply. It is the responsibility of the TSO to forecast the expected capacity margin and the expected (peak) demands on an annual basis and the standard for loss of load as 3 hours.[2]

Figure 21 **Demand and supply curve of British capacity auction**



Source: NationalGrid (2014): Provisional Auction Results. T-4 Capacity Market Auction 2014.

The supply side is diverse, with the following entities allowed to participate in the capacity auction: new and existing generation capacities, DSR (Demand Side Response), small storages connected to distribution networks and stakeholders undertaking permanent reductions in electricity demand. However, the following forms of capacity are ineligible to participate in the capacity market: capacities receiving support through the renewable support schemes (ROC, CfD, FiT) and temporarily (until the necessary technical and regulatory conditions are determined) interconnection capacities and non-GB capacities.[3]

Though participation in capacity auctions is voluntary, a pre-qualification stage is mandatory for all generators. The most important element in pre-qualification is based on historical figures for operation and availability which will determine the amount of capacity (percentage of nominal capacity) each participant can bid into the auction.

The auction is run in a descending clock and a „pay as clear" format, which means that providers confirm they will offer capacity at a specified price and in further rounds are held to a lower price until the auction discovers the minimum price at which there is sufficient capacity. All participants are paid the same price offered by the most expensive successful bidder. However, bidding is constrained by the fact the existing power plants can participate as pure price takers. In order to avoid gaming, they can bid a maximum 50% of the expected costs of new entries (set by DECC as 49 GBP/kW), which amounts to 25 GBP/kW,[4] while new capacities' bidding price cap is much higher (75 GBP/kW).

Successful bidders receive capacity payment set by the capacity market and in return they are obliged to deliver electricity in periods of system stress in order to maintain security of supply. Providers are obliged to deliver energy when the TSO issues a Capacity Market Warning for an expected stress event, when voltage control or controlled load shedding has to be applied for at least 15 minutes in order to preserve system integrity. The warning is issued at least 4 hours in advance of a half-hour settlement period of any anticipated stress event.

Successful bidders conclude capacity agreements of various durations with the TSO and the Settlement Body, respectively. Existing capacities and DSRs are eligible to access one-year capacity agreements. Existing power plants that require major refurbishment (at least 125 GBP/kW investment cost) may have access to 3-year agreements, while new entrants (at least 250 GBP/kW investment cost) are eligible for 15-year capacity agreements. The capacity agreements refer to gas years, which run from 1 October to 30 September of the following year.

Two auctions are held prior to a delivery year. The first one is held 4 years ahead of delivery, while the second is a year-ahead auction. The TSO may procure refurbished or new generation capacities in the first auction, while the second auction allows for the replacement of missing capacity with operating capacities or DSRs given more precise demand estimations.

Auctions are financed by suppliers in proportion to their market share and the peak demand of their customers. Charges are calculated by the TSO on the basis of the demand of winter working days between

2 The expected loss of load is measured by the index LOLE (Loss of Load Expectation). LOLE, however, shows the probability of emergency measures the TSO is supposed to take in order to prevent disturbances (loss of load)

3 However, future renewable and interconnection capacities that are not auctioned are taken into account as demand reducing factors when capacities procured on the auction are determined

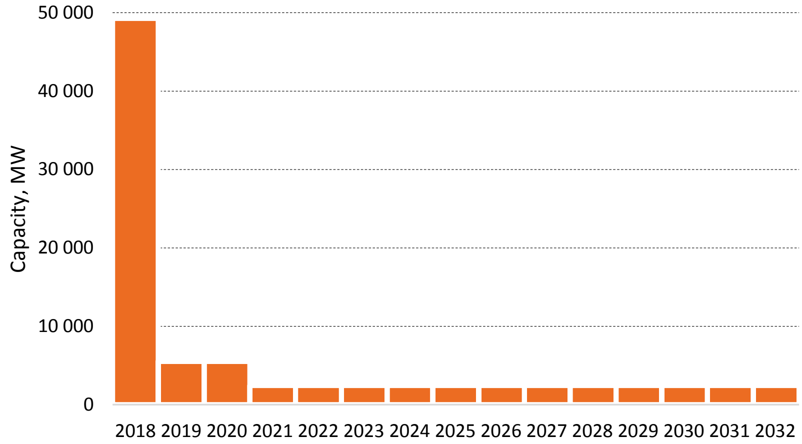
4 Expected bid of a new entrant is determined from the production costs of a new build OCGT plant minus expected electricity market revenues.

16.00 and 19.00, thus motivating traders to reduce customers' demand in peak hours.

Results of the first capacity auction

The first auction took place in December 2014, where capacities with a delivery for 2018/19 were purchased. The TSO was going to conclude 47 to 50 GW capacity depending on bids at the expected costs of new entries, which amounted to 49 GBP/kW. The wide range indicates that the TSO would have concluded more capacities at lower prices and less at higher prices.

Figure 23 **Volume of capacities contracted in the first capacity auction (MW)**



Source: NationalGrid (2014): Provisional Auction Results. T-4 Capacity Market Auction 2014

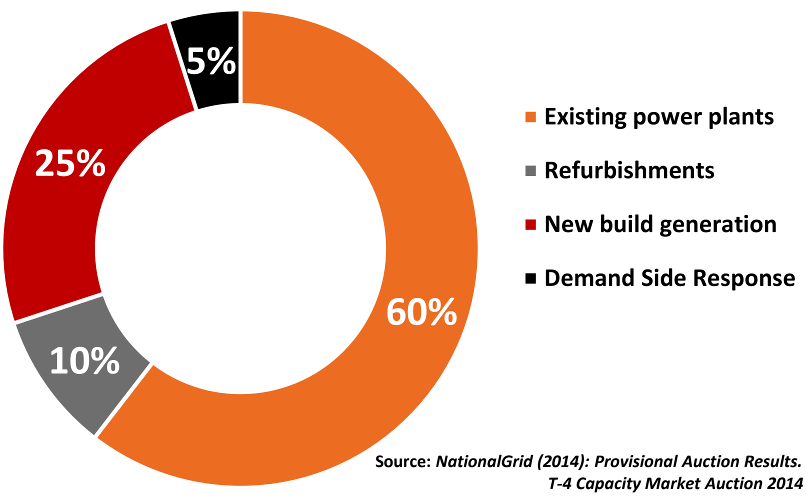
Those opposed to capacity auctions argue that high payments will either go toward preserving old and polluting coal-fired power plants or providing base-load generation capacities which would have been invested in and undertaken regardless, rather than facilitating new capacity investments. However, the results of the first British capacity auction failed to justify the above concerns.

40 GW capacity was contracted at 19.4 GBP/kW/year, well below the anticipated price. Similarly to US capacity auctions, a majority of the bids (more than 60%) were practically zero (1-2 GBP/kW/year) offered by existing and operating power plants. The low clearing price likely emerged because the electricity market revenues expected by new entries were higher than anticipated by the TSO. In other words, new entries based their calculation for return on investment at lower capacity prices.

Successful bidders include old fossil-based, refurbished and new build capacities, as well as DSRs. As it was expected, the majority (60%) of capacities (officially Capacity Market Units, CMUs) procured in the auction were existing power plants, with close to10% power plants to be refurbished, 25% new build and less than 5% DSR. The majority of new power plant capacity amounting to 2.6 GW will be provided by the 1800 MW, 61% efficiency Trafford CCGT, while the remaining GWs will be provided by a large number of relatively small (on the average 14 MW) OCGTs. This indicates that under current circumstances, sponsors seek flexible and less capital intensive projects. Although small OCGTs have lower efficiency, the risk of deficit is lower due to the decreasing capacity utilisation.

The concern that capacity payments facilitate further operation of outdated and polluting power plants was not substantiated in this case. 33% of currently operating coal-fired power plants (and 15% of gas-fired plants) were not successful on the auction. In total, near 10 GW of existing generation capacities failed to secure a capacity agreement.

Figure 22 **Share of successful participants broken down by fuel types**



Source: *NationalGrid (2014): Provisional Auction Results. T-4 Capacity Market Auction 2014*

About 75% of capacity agreements consist of a one year duration, which ensure the majority of necessary capacities for 2018/19. 20% of agreements have been concluded by new build capacities for 15 years: CCGT and OCGT capacities accounting for 2.4 GW will go toward meeting the supply security targets set by the British government until as late as 2032. Other agreements have been concluded for 3 years, spanning 3 GW of refurbished generation capacities.

Results of the first British capacity auction by themselves cannot be deemed extraordinary. The procured capacity might have been contracted at less than half of the expected price. While a majority of capacity demand will be satisfied by existing power plants, the capacity payment scheme has triggered significant new capacity investments while also stimulating more DSR measures.

Britain's successful capacity auction will likely encourage other countries to follow suit. In 2014 the European Commission stated that the capacity auction is in accordance with the rules on state aid, and with the UK's positive experience this will be even more difficult to overturn out of principle.

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