RAP Energy solutions for a changing world

Advisory Note: Balancing Framework Guidelines to Promote an Integrated, Low-Carbon, European Electricity Market[1]

(June 8, 2012)

I. Introduction

The increased integration of Member State energy balancing activities is an important step in meeting Europe's objectives for an integrated and low-carbon electricity market. Balancing on a broader regional or continental basis will reduce the overall need for reliability resources[2] through increased mutual support and enhanced operational efficiency brought about by utilising the most cost-effective balancing options. The benefits of integrated energy balancing will be even more apparent in moving to a low carbon European electricity system, as balancing over wider areas will release the considerable potential of both geographic and technology diversity. This diversity reduces aggregate output variability so that less balancing is required.

The development of European framework guidelines and network codes to harmonise energy balancing settlement, products and trading arrangements should serve to progress both market integration and decarbonisation aims together. However, it will be important to ensure that arrangements designed to facilitate the immediate priority of market integration also enable Europe's decarbonisation objectives and do not preclude options that have the potential to significantly reduce the overall cost of meeting them.

To this end, this Advisory Note sets out a number of key observations and issues to be addressed in developing the guidelines and codes on energy balancing. In particular, we highlight the need for the framework guidelines to enable and encourage:

- Balancing products and services with the necessary flexible, dynamic capabilities,
- Balancing actions across all timescales: market, operational and investment,
- An "equitable" approach to imbalance charging, noting the particular circumstances faced by intermittent renewables,
- Balancing over wider geographic areas, and
- Tapping the strategic benefits of allocating interconnector capacity for balancing.

[1] Lead authors: Phil Baker (University of Exeter) and Meg Gottstein (Regulatory Assistance Project)

[2] We use the term "reliability resources" in this Advisory Note to broadly refer to system resources (including demand-side and storage) that will be required to reliably operate a low-carbon power system across all timescales. This includes, but is not limited to, operating reserves (e.g., frequency containment, restoration and replacement reserves) specifically defined in the ACER draft Framework Guidelines.

In the sections that follow, we elaborate further on these key areas of consideration. Where applicable, we also provide specific recommendations with reference to ACER's recently issued draft Framework Guidelines on Electricity Balancing.[3]

II. Delivering Balancing Resources with Flexible, Dynamic Capabilities

Europe has set a course for power sector decarbonisation that will require an unprecedented level of "intermittent" renewables in the mix (e.g., solar, wind) and as such the power system assets for which they are the primary energy source are only partially controllable.[4] As more of these intermittent resources are deployed in order to meet Europe's aggressive carbon-reduction targets, conventional generation will increasingly need to follow a "net demand"[5] profile that is less predictable and has quite different characteristics from the total demand profiles seen today. In particular, consumer demand and the availability of intermittent renewables can change in opposite directions any day, every day, at any time during the day and even several times a day. It will be more volatile and costly to balance such a system if the reliability resources available for system balancing continue to be dominated by unresponsive generation—or simply generation that isn't flexible and dynamic enough.

Notwithstanding the contribution to be made by demand response and other technologies such as utility-scale or distributed storage, the future generation fleet will need to possess capabilities that can accommodate these new dynamics, including more rapid ramping ability, frequent start-stop capability, and the ability to turn down to low loads. Failure to deliver these enhanced dynamic capabilities will not only increase energy balancing costs, they will also increase pressure to curtail/restrict the output from intermittent renewables. That is, the lack of sufficient operational flexibility in the system has the potential to create increasing tension between system reliability and decarbonisation objectives.

This conflict can be largely avoided by taking a forward-looking approach to the capabilities required to effectively balance the system. Some markets have begun to recognise that rising shares of intermittent resources are creating the need for a new class of flexibility products. They are designed to ensure there is sufficient capability to ramp supply resources up and down (or, in the case of demand resources, down and up) fast enough, far enough and frequently

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[3] Available at: http://www.acer.europa.eu/portal/page/portal/ACER_HOME/Stakeholder_involvement/Public_consultatations/Open_Public_Consultations/DFGEB-2012-E-004

[4] We refer to these as resources as ***intermittent renewables*** throughout this paper consistent with the terminology used in the draft Framework Guidelines. Such resources can be curtailed if needed and to varying degrees available capacity can be held as reserve; however their dispatchability is significantly less controllable than conventional thermal generation.

[5] "Net demand" – demand minus the output of intermittent renewables, to be supplied by conventional generation or other reliability resources. See *Beyond Capacity Markets - Delivering Capability Resources to Europe's Decarbonised Power System* at http://www.raponline.org/document/download/id/4854

enough over multiple scheduling intervals to complement in a least-cost manner the characteristics of intermittent renewable production. In response, we see new ramping services and products being developed for ancillary services that operate in concert with the wholesale energy market.[6]

In many markets, a prescriptive approach is taken to deliver the capabilities that the transmission system operator (TSO) requires to balance the system, that is, everyone connecting to the system is required to provide them. Mandating capabilities via grid or network codes gives TSOs the assurance that those capabilities will be available in sufficient quantities at all times. This may be appropriate for certain fundamental capabilities, i.e. governor frequency response. However, for other capabilities, such as ramping, where not all generation is required to have a particular ability, a market approach can avoid the unnecessary costs associated with overprovision. A market-based approach to these capabilities would therefore be preferable, informed by cost-reflective pricing signals emerging from the imbalance settlement process. For example, these "capability services" could be put out to auction by the TSO, similar to how secondary and tertiary control services are delivered in Germany and elsewhere.

The definition of appropriate standardised balancing products, setting out required technical and dynamic characteristics, should also inform the investment process and ensure that balancing resources have appropriate capabilities going forward. The combination of a market-based approach and standardised products would encourage innovation and the development of alternative means of provision. In this context, the requirement set out in 3.2.1 of the draft Framework Guidelines to establish common balancing products is welcome. However, in addition to seeking to improve liquidity and cross-border trading, the move towards harmonised products should also seek to create new flexibility services that address net demand balancing requirements.

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[6] The California ISO is developing a Flexible Ramping Product, which is a 5-minute upward or downward ramping product procured day-ahead and dispatched in real-time. See the most recent proposals and notices at: http://www.caiso.com/Documents/Flexible%20ramping%20product%20-%20relevant%20market%20notices. The Midwest ISO is also developing a product to manage the variability of net load caused by increased wind penetration which will obtain up ramp and down ramp capabilities. The Ramp Capability Model issues payments to resources cleared for ramp capability regardless of real-time dispatch instructions. See *Ramp Capability for Load Following in the MISO Markets* athttps://www.midwestiso.org/Library/Repository/Communication%20Material/Key%20Presentations%20and%20Whitepapers/Ramp%20Capability%20for%20Load%20Following%20in%20MISO%20Markets%20White%20Paper.pdf.
Additionally, minimum ramp up and ramp down rates have been implemented in Ireland's EIR Grid Code; Australia has also implemented a minimum ramp rate requirement for generators in its energy market.

The general emphasis throughout the draft Framework Guidelines on the need to encourage demand-side participation in balancing activities is also welcome. However more could be done in this respect. For example, the need for network codes to encourage the emergence of demand aggregators could be highlighted, while a requirement to publish imbalance prices *ex ante* would be particularly valuable. While *ex ante* imbalance prices may not capture all incurred costs, they would provide a useful signal for providers and would encourage demand side participation in energy balancing.

Other initiatives to encourage demand side participation might include the specification of a "dynamic demand"[7] product as an alternative to frequency containment reserves delivered via generation governor response. A non-mandatory product specification would encourage cooperation between suppliers, TSOs and manufactures to develop the means of exploiting the considerable potential of this technology.

III. Energy Balancing Is Integral to the Market across all Timescales

While energy balancing is often considered as an activity that takes place following market (or "gate") closure with the TSO as the sole counterparty, it is in fact an integral part of the electricity market and impacts all timescales. Balancing activity takes place in market timescales as parties respond to changes in forecast output or demand and attempt to balance their contractual positions. The scale of this activity will increase with the continuing deployment of intermittent renewables, as forecasts of generation output will become more volatile and subject to significant change as real time is approached. The requirements set out in the draft Framework Guidelines for gate closure to be as close to real time as is practical and for imbalance charges to be cost-reflective are helpful in this respect as participants will be encouraged to take appropriate balancing action in market timescales, thereby reducing the residual balancing burden on TSOs. We generally support these requirements with one strong caveat: Actions to harmonise imbalance settlement prices should not lead to unintended adverse consequences for renewable investment or undermine Europe's ability to meet its 2050 decarbonisation targets. (See Section IV.)

TSOs will also need to take action prior to gate closure to ensure that sufficient energy balancing resources are available in real time. Dynamic constraints will require TSOs to commit or "warm" some generation ahead of gate closure, and TSOs may also be required to participate in the energy market to purchase energy options in order to supplement balancing bids and offers made by individual parties. More generally, TSOs will need to ensure that

[7] "Dynamic demand", making domestic and commercial demand such as refrigeration, water heating and air conditioning etc., frequency-sensitive. Suitably equipped appliances can monitor mains frequency in situ and switch on and off accordingly, increasing the frequency-sensitivity of overall demand and reducing the need for containment reserves.

sufficient useable reserves are held at the day-ahead and intra-day stages to account for demand and generation uncertainties, and that all secured contingencies can be covered in real time. With the increase of intermittent renewable resources in the mix, these reserves will increasingly need to provide the flexible capabilities described above, enabling the TSO to effectively balance the system around "net demand" in real-time.

Beyond the intra-day and day-ahead timescales action will, as now, be required in operational planning timescales, i.e. 1-2 years ahead, with TSOs needing to ensure that generation maintenance schedules are consistent with the availability of sufficient balancing options in real time. In investment timescales, i.e. 3 years ahead and beyond, action will be required to ensure that new reliability resources possess the flexible, dynamic capabilities that are compatible with a low carbon electricity system, and that demand response is encouraged to fulfil its considerable potential to minimise the associated reliability challenges.[8] In this respect, current thinking will need to move "beyond capacity markets" and look to the design of longer-term capability products that match future, expected net demand patterns. Balancing arrangements that explicitly value flexibility can serve to inform this design by signalling both the flexibility products required and the value of those products closer to real-time.

IV. Energy Balancing and Renewables

Difficulties in forecasting the output of intermittent renewable generation other than in short timescales will create additional balancing challenges as the deployment of these technologies continues to meet national and European renewable targets. These challenges can be minimised by improved forecasting performance and ensuring that short-term spot markets are sufficiently liquid to allow intermittent generation to trade out imbalances prior to gate closure where possible. However, the particular difficulties faced by intermittent renewable resources in achieving an energy balance suggests that further measures may be required in order to ensure a level playing field.

The requirement set out in the draft Framework Guidelines that parties should be allowed to balance as close to real time as is possible and the requirement in the draft network code for Capacity Allocation and Congestion Management (CACM)[9] that gate closure should be a maximum of 1 hour ahead of the next market time period, will be helpful for intermittent generation as forecasting accuracy increases rapidly as real time is approached. Similarly, the requirement set out in 5.3 of the draft Framework Guidelines for imbalance prices to be cost-reflective is also welcomed, as it would appear to rule out imbalance pricing arrangements that

[8] For example, steps to encourage the aggregation of small industrial, commercial or domestic demand side response by third parties to provide utility-scale services to TSOs.

[9] See Article 65 of the draft Network code for Capacity Allocation and Congestion Management at https://www.entsoe.eu/consultations/download.php?id=ffff-be6a-cda7-0d06-47b2

are penal in nature.[10] Penal imbalance pricing discriminates against intermittent generation which has difficulties contracting ahead due to inherent problems in accurately forecasting output, and often has no alternative but to rely on residual TSO balancing action post gate closure.

These measures are helpful and appropriate; however they may not be sufficient. While it seems reasonable that intermittent renewable generators be responsible, at least to some degree, for the financial consequences of any imbalance, their output is dependent on motive forces beyond the control of operators and they will therefore be forced to trade in the imbalance market more often than conventional technologies, as noted above. Moreover, wind and solar are always likely to be "on the wrong side of the balancing argument," in other words, having to achieve a contractual balance by selling energy when it is cheap and buying energy when it is expensive suggests that existing balancing arrangements may in fact discriminate against these technologies[11]. This and the fact that excessive rigor in exposing intermittent technologies to imbalance charges may well impose risks to renewable deployment that could compromise carbon reduction targets, suggests that a "broader view" of balancing arrangements is warranted.[12]

In this context, the requirement set out in section 5.2 of the draft Framework Guidelines that "*the Electricity Balancing Network Code(s) shall impose that generation units from intermittent renewable energy sources do not receive special treatment*……." would appear to rule out taking a "broader view" of the balancing arrangements to be applied to intermittent generation, and is therefore a concern. While it would be wrong to unduly discriminate in favour of intermittent renewable resources, measures that reflect the particular difficulties referred to above and allow intermittent generation to be treated in an *equitable* fashion, would not amount to undue discrimination and should be permissible.

One such measure would be to allow intermittent generation to aggregate imbalances within individual price zones. Imbalance aggregation would take advantage of geographic diversity to reduce the overall balancing charges seem by intermittent resources, while maintaining

[10] Asymmetrical imbalance prices are usually designed to discourage imbalance. For example, in Great Britain, parties whose imbalance reduces net system imbalance will pay or receive a price which is reflective of intra-day energy prices, rather than TSO avoided cost. Symmetrical imbalance prices may be considered cost reflective if the intention is to cover transaction costs rather than discourage imbalance.

[11] The fact that intermittent renewables are more susceptible to imbalance arrangements and prices has been recognised by FERC, who in Order No. 890-A excluded these resources from the penalties associated from the highest tier of energy imbalances. See http://www.balch.com/files/upload/FERC_1_21_2010_NOI_VER.pdf

[12] See *Beyond Capacity Markets - Delivering Capability Resources to Europe's Decarbonised Power System*, section V.E at http://www.raponline.org/document/download/id/4854.
Also see Advancing ***Both*** *European Market Integration and Power Sector Decarbonisation: Key Issues to Consider*, at http://www.raponline.org/document/download/id/879

incentives to balance. Aggregation would be consistent with the on-going development of sophisticated national or regional forecasting tools by TSOs, and would reflect that the fact that the role of TSOs is to balance aggregated supply and demand within price zones, not the output of individual generators. Imbalance aggregation for intermittent renewable generation is a measure supported by ENTSO-E.[13]

Other measures to assist intermittent generators that have difficulty in forecasting output might include the ability to trade out imbalances ex-post where there is dual imbalance pricing.[14] This would again be compatible the TSO's task to balance energy on an aggregated or net basis, however it might discriminate against smaller participants who would be required to establish a meaningful trading capability. Moreover, moving to a single imbalance price (or one with a very small differential to reflect transaction costs) would moot the need for/advantage of ex-post trading. By inference (e.g., "cost-reflective imbalance pricing"), the draft Framework Guidelines appear to be moving in this single-price direction, which we support.

V. Advantages of Balancing Over Wider Geographic Areas

Traditionally, energy balancing post market closure has been a concentrated activity, with individual TSOs balancing energy within their control areas on a more or less stand-alone basis. However, balancing over wider areas will allow increased operational efficiency through the use of the most cost-effective balancing resources and an overall reduction in the level of reliability resources required. The integration of Europe's electricity markets opens up the possibility of realising these efficiencies, and the common merit order approach to balancing foreseen by the draft Framework Guidelines, albeit with the initial acceptance of TSO reserve margins, appears to provide the most appropriate way forward.[15]

As decarbonisation of Europe's power systems progresses with the increasing deployment of intermittent renewable technologies such as wind and solar, the advantages of energy balancing over wider areas will become even more apparent. The effects of geographic and technology diversity will reduce the regulating burden and will reduce the severity of the

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[13] See *Developing Balancing Systems to facilitate the Achievement of Renewable Energy Goals*. Position paper by ENTSO-E, November 2011 at https://www.entsoe.eu/fileadmin/user_upload/_library/position_papers/111104_RESBalancing_final.pdf

[14] For example, with Great Britain's dual pricing described in an earlier footnote, those finding themselves "short" in a "short" market and facing high spot market prices for energy would benefit from finding someone who was "long" and not in a position (under GB's pricing approach) to access the true value of their "helpful" imbalances, and vice-versa.

[15] Currently, balancing services are generally exchanged across interconnectors on a TSO to TSO basis, i.e. TSOs offer surplus balancing energy to adjacent systems. The draft Framework Guidelines signal a move to expanding "market coupling" to balancing timescales, that is, by establishing a common merit order of balancing options to ensure the most cost-effective use of available resources. During the transition, the draft Framework Guidelines still permits the TSOs to hold back some reserves, but the draft establishes the principal of a common merit order approach.

extreme or "tail" events that need to be secured. This diversity reduces aggregate output variability so that less balancing is required. The value of location-constrained technologies such as pumped-storage, which are particularly effective in providing reserve and energy balancing services, will also be increased. Balancing over wider areas can also facilitate better coordination and harmonisation of capability incentive arrangements (referred to above) beyond national borders. Overall, balancing over wide areas will reduce the operational costs of balancing and holding reserves, while at the same time reducing balancing resource requirements. The need to curtail the output of intermittent renewable resource due to energy constraints will also be reduced.

The draft Framework Guidelines are particularly ambitious in relation to balancing over wide areas, setting out a staged transition to a situation where *all* balancing resources will be available to *all* electricity grids, subject to the availability of transmission. This vision has significant implications for the traditional role of TSO's in ensuring the security of national electricity grids, raising the prospect of a supra-national TSO who would ultimately become responsible for the resolution of imbalances on a European scale, including re-dispatch to resolve transmission congestion. While likely to take many years to achieve, the vision set out by the draft Framework Guidelines has the potential to maximise the benefits available from geographic and technological diversity, and therefore offers the prospect of achieving Europe's decarbonisation goals in the most cost-effective fashion.

VI. Interconnector Capacity and External Balancing

Balancing over wider areas ultimately depends on the availability of adequate levels of transmission, and specifically interconnector, capacity. Market integration, and particularly decarbonisation, will result in higher levels of interconnection between price zones and therefore increase the potential for energy balancing over wider areas. Bringing together this need for balancing over wide areas and the fact that energy balancing-related actions extend across all market timescales, raises the issue of whether or not it is necessary to reserve interconnection capacity in order to ensure that previously arranged "external" capacity or reserve options are available for balancing in real time.

To date, guidance in the form of the "Revised ERGEG Guidelines of Good Practice for Electricity Balancing Markets Integration"[16] has prohibited the reservation of interconnection capacity for balancing purposes, other than in the particular case of dc circuits. This has effectively restricted the exchange of balancing services to a level determined by the availability of unused

[16] Available at http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/ELECTRICITY/New%20GGP%20Balancing%20Markets%20Integration/CD/E09-ENM-14-04_RevGGP-EBMI_2009-09-09.pdf

interconnector capacity. Furthermore, the CACM Framework Guidelines[17] effectively prevent the reservation of interconnector capacity within day-ahead timescales through the application of "use-it-or-sell-it" (UIOSI) rules at the day-ahead stage. This aversion to capacity reservation reflects concern over the possibility of capacity hording and that capacity available for transparent energy trading would be reduced, thereby reducing potential gains in social welfare.

However, it is possible to envisage circumstances where the loss in social welfare caused by limiting energy trading between Member States would be out-weighed by welfare gains arising from access to external balancing resources. As first argued by ETSO in 2006,[18] the incremental value of interconnector capacity will reduce as the capacity allocated to energy trading increases, eventually reducing to zero when the interconnector becomes uncongested. At the same time, the incremental value of capacity allocated to balancing services will increase as the allocated capacity decreases. The value of balancing services will also often increase as real time is approached, as various balancing options fall away due to dynamic constraints.

This suggests that the optimum mix of interconnector capacity would involve some allocation to balancing energy services, and argues in favour of the firm reservation of interconnector capacity. It is clear however, that the optimum allocation of capacity will vary according to circumstance. For example when intermittent renewable resource availability is high, energy price differentials across the interconnector will widen and the value of interconnector capacity for energy trade will increase accordingly. At the same time, internal conventional generation will be displaced from the energy market and be available to provide reserve and balancing energy.[19] The value of imported balancing energy would therefore be reduced and it would be appropriate to allocate all, or almost all, interconnector capacity to energy trading. Conversely, there will be situations where the output of intermittent generation is reduced, internal generation is required to meet energy demand and the value of imported balancing energy is increased, suggesting that some reservation of interconnector capacity to support external energy reserve would be justified.

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[17] Available at http://www.acer.europa.eu/portal/page/portal/ACER_HOME/Public_Docs/Acts%20of%20the%20Agency/Framework%20Guideline/Framework_Guidelines_on_Capacity_Allocation_and_Congestion_M/FG-2011-E-002%20(Final).pdf

[18] See *Key issues in Facilitating Cross-Border trading of Tertiary Reserves and Energy Balancing*; ETSO 2006 at http://www.marketcoupling.com/document/1000/ETSO%20-%20Report%20on%20Balance%20Management%20Harmonisation%20and%20Integration.pdf

[19] As discussed above, it will be important that this conventional generation has the requisite flexible capabilities to balance the system around the energy available from intermittent renewables—irrespective of whether it provides internal or external balancing services.

The draft Framework Guidelines recognise the potential for increased social welfare through the reservation of interconnector capacity for balancing purposes and permit such an allocation where a benefit can be demonstrated. The Guidelines therefore require TSOs to develop a methodology that will allow the appropriate allocation of capacity to trading and balancing purposes to be established. In developing this methodology, it will be necessary to ensure that all value issues are captured, not just those associated with welfare based on differential energy prices. As discussed previously, balancing over wider areas allows the benefits of diversity to be more fully exploited, reducing the overall level of reserves that need to be carried and ultimately reducing the total amount of reliability resources required. In order for these "strategic" benefits to be realised however, it will be necessary to ensure that their value is fully recognised in any process that aims to optimise the allocation of interconnector capacity between energy trading and energy balancing. Furthermore, there will be a need to ensure that the "strategic" or "capex" value of balancing over wide areas[20] is fully taken into account when investing in interconnection, and that sufficient capacity is provided to accommodate all economically justified energy trading and balancing requirements.

With a generation mix that contains a high level of intermittent renewable generation, the optimum allocation of interconnector capacity will be highly dependent on weather conditions and therefore difficult to identify accurately much in advance of real time. A stochastic approach may allow general rules to be established to guide the allocation of interconnector capacity, however capacity allocated via such means may well prove to be sub-optimal in the event and consequently subject to change. It is worth exploring, therefore, whether there are other considerations that need to be taken into account in order to simplify the capacity allocation problem.

One such consideration might be the existence of synergies between the need for balancing energy trades and the availability of interconnector capacity. For prearranged reserve or balancing energy trades to be credible, they must be backed by reliable interconnection or transmission capacity. This requirement underpins the current position set out in the Balancing Good Practice Guidelines that reserve trading requires either the absence of congestion or the availability of firm interconnector capacity. However, the synergies between balancing need and interconnector availability that seem likely to develop with the continued deployment of intermittent renewable generation could result in this requirement becoming unnecessarily restrictive. As indicated above, under circumstances when renewable output is high, interconnector capacity is likely to be fully utilised in transferring renewable energy and displaced internal conventional generation will be available to provide reserve, reducing the

[20] For example, capital savings from the reduced level of reliability resources required due to mutual support.

need for imported balancing energy. Conversely, when renewable output is low, interconnector capacity could potentially be underused and available to import balancing energy to supplement internal generation capacity, which will be required for energy purposes.

There will not always be a perfect fit between the need for imported balancing energy and availability of interconnector capacity, and more work needs to be done to understand the correlation between the two. Intuitively, however, such a correlation should exist and seems likely to become more pronounced as decarbonisation progresses. If proved to be reliable, the existence of such synergies or correlation may remove or reduce the need to reserve interconnection capacity in order to ensure that reserves and balancing energy trades can be fully utilised when required.

VII. Key Messages and Conclusions

Integrating Europe's electricity balancing arrangements is crucial to the development of an integrated low carbon electricity market, having the potential to deliver cost savings through mutual support and the utilisation of the most efficient balancing resources. The draft Framework Guidelines represent an important step in promoting integration. However arguably more could be done to recognise that: (1) new flexible capabilities will be required of balancing services and products, (2) energy balancing is an activity that pervades all market timescales, (3) intermittent renewable generation should be dealt with in an equitable fashion with respect to imbalance charging, and (4) realising the benefits of mutual support may require the reservation of interconnector capacity.

Ensuring balancing resources have appropriate flexible, dynamic capabilities

Decarbonisation will require sufficient reliability resources, including storage and demand response, to balance the system around "net demand" profiles, that is, around the availability of energy from intermittent renewables. Network codes designed to harmonise balancing products should therefore explicitly value a range of flexible capabilities as an increasing proportion of renewables enter the mix. These include more rapid ramping ability, reduced minimum on and off times and the ability to turn down to low loads. The specification of standardised products is very helpful in this respect. However, additional guidance that recognises the need for new flexible capabilities for these products and market-based delivery is still required.

Energy balancing impacts the market across all timescales

As currently crafted, the Framework Guidelines focus mainly on actions that occur just post-market closure. However, balancing is an activity that requires action in all timescales - market, operational and investment. The Balancing Framework Guidelines would be greatly strengthened by recognising that there is a continuum of actions required to ensure that adequate levels of balancing resource, with the appropriate dynamic characteristics, are available in real time. A forward-looking approach would look to the design of longer lead-time capability products and services that match future, expected net demand patterns, and can be delivered from a range of options including storage, demand response and cross-border trading.

Balancing and intermittent renewables

The Framework Guidelines need to recognise the particular difficulties faced by intermittent renewable generation in balancing output to commitments. While intermittent technologies should be encouraged to forecast output accurately via some exposure to imbalance charges, excessive exposure could impact negatively on the deployment of renewables to meet Europe's decarbonisation targets. Measures should be considered that allow intermittent generation to be treated in an equitable fashion. One such measure could be the aggregation of intermittent renewable imbalances within individual price zones, which would be consistent with the role of TSOs to balance on an aggregate basis while maintaining forecasting incentives.

Balancing over wide areas and the need for interconnector capacity reservation

Balancing over wide geographic areas will become increasingly important as decarbonisation progresses, potentially reducing operational costs through the use of the most cost-effective balancing resources and reducing the level of reliability resource requirements via mutual support. The ambitious vision of a fully integrated balancing function foreseen by the draft Framework Guidelines, where *all* balancing resources are available to *all* grid systems, would provide a platform to allow these operational costs to be minimised.

Delivering these cost efficiencies will depend on the availability and allocation of sufficient interconnector capacity. The draft Framework Guidelines usefully permit the reservation of interconnector capacity for reserve and balancing purposes in circumstances where social welfare is enhanced. However, if the value of mutual support is to be fully realised, it will be necessary that the methodology used to optimise the allocation of interconnector capacity takes into account all value issues, including the potential reduction in reserve generation capacity brought about by reserve sharing on a wider and ultimately continental scale.

As decarbonisation progresses, synergies between the need for interconnection capacity reservation and the availability of that capacity, are likely to develop. These could reduce the need to reserve interconnector capacity and work should progress to identify how reliable these synergies might be.

About the Regulatory Assistance Project (RAP)

RAP is a global non-profit team of experts that focus on the long-term economic and environmental sustainability of the power and natural gas sectors (www.raponline.org).

RAP's European Programme has developed several briefing papers on the European Framework Guidelines and Network Codes to identify and communicate key issues that are integral to Europe's dual objectives of market integration and decarbonisation. These papers and more information on related RAP activities can be viewed here: http://www.raponline.org/featured-work/eu-electricity-market-reform-encouraging-investment-in-low-carbon-resources

Global
US
China
EU

The Regulatory Assistance Project

48 Rue de Stassart
Building C, BE-1050
Brussels, Belgium

phone: +32 2-894-9300
fax: +32 2-894-9301

www.raponline.org