



# Improving incentives for investment in electricity transmission infrastructure

A REPORT PREPARED FOR THE EC

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# Executive Summary

Over the next decade there is likely to be a requirement for a very significant increase in the amount of transmission investment across the EU. Given this pressing need, Frontier Economics and Consentec were appointed by the EC to examine the current structure of incentives for transmission investment in the EC and to suggest proposals to improve these incentives.

The primary focus of the report is investment in regulated transmission investment which is likely to facilitate cross border flows (although we recognise that merchant transmission investment also may play an additional role). Transmission investment that is likely to increase capacities for cross-border and regional flows can clearly include investments within a jurisdiction.

The assignment did not involve the analysis and improvement of other basic elements of the regulatory framework for interconnected TSOs in the EU. Hence, the treatment of congestion revenues and inter TSO compensation (ITC) were not specifically considered although a European investment fund based on congestion revenues and integration with a newly designed and appropriate ITC scheme could also be relevant for overcoming investment problems.

## INTERNATIONAL REVIEW

An international review shows that the current concerns in relation to transmission investment incentives inside the EU are neither new nor unique. Problems in securing adequate investments in transmission systems can be observed in many jurisdictions worldwide. One of the main reasons also is similar worldwide: acceptance problems and long lasting delays in the approval process for new lines.

In spite of this general problem, a number of lessons can be learnt from international experience:

- In countries where there are overlapping regional and state jurisdictions (i.e. US and Australia), there has been a clear policy move towards the **introduction of a single entity with planning responsibility** at the regional or national level. Furthermore, the single planning entity is typically independent to some degree of the interests of the asset owners in relation to whose networks it is considering expansions.
- The **transmission planning process has become more open and transparent** – that is, it is based on modelling and analysis which is visible to all relevant stakeholders, and there are opportunities for all relevant stakeholders to input to the planning process.
- The issue of **mismatches between the incidence of transmission expansion costs and the accrual of benefits** has clearly been recognised in a number of systems.
- There is precedent for **incentivising TSOs further in relation to the delivery of national investment projects** and **specific target outputs.**

- The specific process and incentives relating to transmission investment need to be based on a **stable overall regulatory regime**, with a cost of capital provided to TSOs which is appropriate for the risks they are undertaking. While regulators need to remain vigilant against companies earning excess profits, they also need to ensure that new investment can be adequately financed by TSOs.

## CROSS-BORDER ASPECTS

The necessary steps of **identification, planning, financing, approving and building** of new transmission lines are often difficult and contentious. But particular practical problems arise when cross border investments are considered:

- **Identification of adequate investments** is more difficult as it requires a cross border view as to the benefits of an investment. Therefore, the co-ordinating TSOs need to understand and come to a common view on current and likely future **market developments across jurisdictions**. As well as an **assessment of the benefits**, the relevant TSOs also need to determine and agree the **level of costs** that are likely to be incurred.
- The requirements for **additional interaction** with regulators, potentially to secure financing for all sides of any cross border interconnection are also likely to complicate matters further.

Besides these increased practical problems a **fundamental problem** can arise in cross-border investments. This is the case when costs and benefits are not equally distributed among the concerned countries or parties. And this is often the case even with investments which show a very beneficial overall welfare effect, e.g. in cases where transit countries would have to invest in order to enable low-cost generation to be exported.

Such a **mismatch in the distribution of costs** (e.g. a transit country's investment) **and benefits** (importing country's savings) can effectively **impede an investment** which would increase **European welfare and market integration** and is the key problem to be addressed. (The existence of congestion revenues and the ITC mechanism make analysis of these problems more complex and potentially more subjective. But in the way these mechanisms have been designed up to now they do not solve the root problem of mismatched incentives for investments, and arguably it is not clear that they could be designed to achieve this objective.)

Solving these problems of identification of strategic projects and addressing the mismatch of costs and benefits in many cases requires **improved and strengthened cooperation and coordination on a European or regional level**, including improvements in the regulatory framework and in the structural and organisational setting.

The main elements of the potential solution we consider are:

- an EU wide organisation (or a series of regional organisations[1]) to undertake **supra-national network planning** complementing individual TSOs national network planning but not withdrawing planning responsibility from TSOs;
- an EU wide organisation (or a series of regional organisations) to **oversee this analysis and planning, and to sanction the spend** associated with the identified schemes; and
- an EU wide organisation (or a series of regional organisations) to ensure that the **costs of the schemes which are developed are allocated** in such a way as to ensure that there are no jurisdictions which suffer a material net cost.

The process of network planning and project identification is currently undertaken by most TSOs in relation to the development of their own national networks. Many of the EC's recent policy moves have been aimed at ensuring that national transmission planning is undertaken on both an independent and transparent basis. However, from the point of view of **securing appropriate European transmission investment**, it is equally important for it to be undertaken on a structured and transparent basis **supra-nationally**. The required process comprises of five steps:

- **inventory** of the European transmission system(s);
- **market assessment** of the status quo of (integrated) European electricity market(s);
- **forecast** of the transmission demand drivers;
- **Analysis of bottlenecks**; and
- analysis of **strategic projects** for transmission investment.

The process of **EU wide integrated and coordinated network planning** should yield **binding results** for the national actors and ideally comprise

- a statement of the areas of the supra-national grid on which there are material and non-transient cross-border **bottlenecks which should be addressed by new investment**;
- a statement of the **preferred investment schemes** required to remove these bottlenecks; and
- a **cost benefit analysis** of the preferred scheme, which sets the overall economic benefit of the transmission investment (in terms of reduced cost of meeting future load) against the investment cost.

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1 It may be that the development of regional arrangements, possibly with a defined hierarchy of planning commitments, is a pragmatic solution.

ENTSO (European Networks of TSOs as proposed in the third legislative package) already have the remit to undertake investment planning along the lines articulated above. Therefore, they could be well placed to undertake the network and investment planning role. However, there are some important limitations to the way in which ENTSO have been defined – the most important of which is their lack of independence of decision marking.

Under any scenario, it is obvious that national TSOs will continue to need play a pivotal role in relation to network planning – they are, of course, the most familiar with the technical characteristics of their networks. Equally, discussions amongst concerned TSOs are inevitable to find the most appropriate solutions to pending planning issues. However, the lack of a governance process independent of national interests in relation to cross border planning processes could be a drawback:

- it may reduce the extent to which network planning and identification of priority schemes is performed on a neutral basis;
- it may reduce the legitimacy and trustworthiness of the plans put forward; and
- it may reduce the likely ability to come to a clear and timely view on priority network developments.

Equally, a regulatory institution is required to oversee the activities of ENTSO, and to undertake the required cost reallocation. ACER may be able to play some of these roles – it would need to be able to:

- exercise oversight over ENTSO's planning process;
- commit to project development based on ENTSO's planning outputs and its own analysis of priorities; and
- facilitate reallocation of cost between Member States according to a set of defined principles, in order to ensure that no country is left with a negative net benefit as a result of committed developments.

## INCENTIVE MODELS

There exist a number of possible arrangements for TSO incentives that could be implemented at country level and which might serve to promote transmission investment. They are related to the way in which strategic projects are proposed and approved at the supra-national level and it is worth noting that there is no one "perfect solution", nor are all of these arrangements appropriate for all countries and TSOs. Rather they need to be considered in the context of specific problems that need addressing in each jurisdiction. Therefore, they would need to be implemented on a case-by-case basis depending on the nature of the problem and the national legal and regulatory framework in place. Care has to be taken to ensure that arrangements only aim at incentivising decisions within the effective scope of possible actions for TSOs.

- *Uplift to rate of return for TSOs* – to encourage delivery of strategic investments, the TSO would receive an uplift to its normal regulated rate of return on the capital associated with the investment. From a customer perspective this would be justified on the basis that these investments would generate more benefits than the additional cost customers incur through higher transmission charges to fund the uplift. One potential weakness of this approach is that it might over-skew the incentives for the TSO to identify and deliver investment. A potential, partially mitigating, solution to this would be to structure the uplift scheme so that the rate of return uplift is set on a sliding scale basis or linked to some measure of usefulness of the assets once they are commissioned.
- *Market based incentives for TSOs* – these could possibly encourage TSOs to undertake quasi-merchant transmission investment, though for commercial, technical and regulatory reasons merchant investment is not likely to be appropriate in all cases. The key features of this approach could be the definition (by the regulator) of a level of transmission capability that is funded under the standard price control and additional market based revenues for additional capacity provided by the TSO (perhaps subject to caps and collars to mitigate both the upside and downside faced by the network company). This is in much the same way as a merchant investor would receive rents for releasing additional transmission capacity and could therefore encourage the TSO to identify and then deliver incremental investment over and above baseline levels defined by the regulator. One of the key issues relates to estimating the "baseline" capacities. These clearly depend on the networks, but also on the dispersion of generation and load locally and in neighbouring countries. Their estimation is therefore highly complex. Since the TSO would potentially have a strong incentive to minimise the baseline capacity set with such a scheme, this capacity setting would need to be subject to detailed regulatory oversight.
- *Micro incentives on TSOs* – the regulator would identify those aspects of TSO behaviour that might need additional incentivisation, e.g. timely delivery of identified transmission infrastructure improvements (where delivery times can be influenced by TSOs). The regulator would put in place an incentive scheme for the TSO, allowing the company to capture an upside for above target performance and requiring it to face a downside for below target performance. The approach could be potentially enhanced by setting a generic benchmark for average performance against a certain metric. This would have the benefit of ensuring that individual cases did not particularly distort the overall scheme.
- *Performance based incentives* – are following the aim of giving as many degrees of entrepreneurial freedom as possible to TSOs and reducing regulatory intrusion to the unavoidable minimum. Therefore, objectives are defined in the most general manner, e.g. with indicators that should cover completely the relevant tasks of a TSO, using parameters that are quantifiable and available and relying only on exogenously verifiable parameters that can not be arbitrarily altered by the TSOs. The definition of the TSO's tasks could include the reduction of congestion and the creation of new and/or the

provision of existing interconnection and transmission capacities in order to maintain and/or increase security and diversity of supply in a country or control area. Suitable performance indicators could include parameters such as Available Cross Border Capacities, Cross Border Flows or Cross Border Exchange Programs. Significant regulatory oversight would be required in relation to the setting of incentive scheme capacity targets.

# 1 Introduction

Over the next decade there is likely to be a requirement for a very significant increase in the amount of transmission investment required across the EU. Although there is considerable uncertainty on the precise level, the cost of the overall additional requirement has been estimated at over €100bn of new infrastructure[2]. While the cost is uncertain, it is clear that there are three key drivers to this large investment programme:

- First, if the 2020 carbon emissions and renewable targets are to be met, a very large amount of new generation will need to be connected to the EU transmission network. Given that a significant proportion of the most favourable sites for renewables generation are relatively distant from centres of load, this implies that there will be a need for significant volumes of new transmission infrastructure. In addition it is likely that a new wave of conventional generation will be constructed to replace an ageing European generation fleet that might not be located where existing plant are currently sited.
- Second, additional infrastructure naturally opens up markets to competition, as additional imports can compete with incumbent domestic generation. Increased interconnection presents a way, therefore, of reducing market concentration in any individual market, thereby facilitating competition.
- Third, increased interconnection improves security of supply. This is all the more important given that a large proportion of renewables generation that is likely to connect to the network is intermittent in nature. Improved interconnection is likely to reduce the costs of holding back up reserve to cover this intermittency.

Given this pressing need, Frontier Economics and Consentec were appointed by the EC to examine the current structure of incentives for transmission investment in the EC and to suggest proposals to improve these incentives.

This report's conclusions have been developed through a series of workshops that have been held with representatives from a large number of stakeholders across the EU in H1 2008, including:

- European Commission;
- Council of European Energy Regulator;
- European Transmission system operators associations;
- individual TSOs; and
- individual regulatory authorities.

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2 In their 2006 World Energy Outlook, the IEA estimated European electricity transmission investment requirements to be $159bn. Following the adoption of tighter renewables and $CO_2$ targets by the EC, this is likely to have grown.

Comments of these stakeholders have been considered for this final version of the report.

From the outset it is worth stressing that the primary focus of the analysis presented in this report has been on measures that might potentially improve incentives and mechanisms for the delivery of investment in regulated transmission investment. Although it undoubtedly has a role to play, we have paid less attention to the issues associated with merchant transmission investment. Similarly, we have also focused on transmission investment that is likely to increase cross-border and regional flows, although, where relevant, we have also considered mechanisms that might facilitate investment within a jurisdiction.

Equally, it is important to note that we have not considered:

- factors which may influence the level of transmission demand for particular levels of future generation and load. An example of one such factor would be the definition of the structure of network charges (both electricity and gas), as these may have a material influence on the siting decisions of new plant and hence on the need for transmission;
- possible enhancements of other basic elements of the regulatory framework for interconnected TSOs in the EU. Hence, the treatment of congestion revenues and inter TSO compensation (ITC) were not specially considered, although a European investment fund based on congestion revenues and integration with a newly designed and appropriate ITC scheme might also be of relevance for overcoming investment problems;
- whether the models proposed here could be applied to the gas transmission networks of Europe;
- the effectiveness or otherwise of individual wholesale market design and the extent to which energy prices are considered to provide an efficient signal for grid reinforcement; and
- measures to ensure efficient use of existing interconnector capacity, such as improved international coordination.

It was noted by some members of the working group which considered the issues and potential solutions suggested in this report that improved economic incentives might only be part of the solution. For example, a more consistent approach to planning and consent approvals might aid transmission investment, which might not be subject to economic incentivisation. However, even then, the group agreed, that there might be some possible improvements that might be worth consideration.

The report has four further chapters:

- chapter 2 sets out the **current problems** that we have identified in relation to ensuring an appropriate volume of transmission investment;
- chapter 3 provides a summary of selected **experiences from other jurisdictions** that are, to some extent, relevant to the issues in the EU;
- chapter 4, explains our first set of proposals. These relate to **changes that would need to be implemented at an EU** or, at the very least, a regional level; and
- chapter 5 describes **proposals that might be implemented at the country wide level**.

# 2 Current problems

In this chapter we describe our views as to the current problems that impact upon the level of transmission investment, particularly when the investment is across national boundaries:

- first, we discuss **practical problems** that may create barriers for transmission investment; and
- second, we explain some **economic disincentives** that potentially impact upon the level of cross-border transmission investment.

We then consider broader issues with securing the appropriate level of transmission investment, and in particular the possible implications of the inappropriate allocation of risk within transmission investment projects.

Finally, we set out a framework for considering these problems which we then use to consider possible solutions.

We note that whilst most problems we identify are likely to discourage transmission investment (and, indeed, that is the focus of our discussion), there may, conceptually at least, be some problems that might result in too much investment or, potentially, the wrong type of investment. Our discussions touch on this also.

## 2.1 PRACTICAL PROBLEMS

The process and procedures necessary to bring about an increase in electricity transmission are, at a high level, generic to all member states of the EU. While they could be divided into a large number of steps, we have identified four key elements that appear most relevant for any individual jurisdiction:

- First, the need for additional transmission investment within the country must be **identified**. Typically this will involve the host TSO undertaking network analysis to identify current and future congestion, considering physical reinforcement options to address this congestion, and then undertaking cost benefit analysis of the proposed investments. For the costs, this estimate is (relatively) straightforward as it merely is an estimate of the costs of installation of the new line(s) or reinforcement of existing assets. However, even at a country wide level, an assessment of the benefits is more difficult. The benefits of a transmission investment manifest themselves in either reduced costs of congestion and/or reductions in the wholesale price of electricity[3]. As we will discuss in more detail later, this requires an assessment of likely developments in generation and demand over the life of the new assets – which is inherently uncertain and subject to error.

[3] One TSO comment highlights the impact of regulated transmission investments on the reliability of the electricity systems, the fact that in some cases investments in transmission assets need to be carried out due to their high importance in terms of security of supply and other benefits such as environmental costs; these aspects should also be taken into account.

- Once an investment opportunity has been identified as likely to bring net benefits, there are a number of steps that need to be undertaken before delivery of the investment can be secured. In particular, an investment needs to be **financed**. From the perspective of the regulated TSO, therefore, it is likely to seek some surety from the regulator that it will be able to recover the costs of the transmission investment (most probably through transmission charges on customers) – critically including an appropriate return on capital.
- At the same time, the TSO is likely to commence the detailed **planning** of the line (i.e. detailed development of the engineering solution to be adopted) and application for the **necessary consents** to ensure that the line can be built. The latter in particular is often complicated and tends to require the management of a large number of different public authorities and other stakeholders. For more contentious lines, this process can be particularly awkward and time consuming, potentially delaying the commissioning of the project for long periods of time.
- Finally, the assets must actually be **constructed**. This phase bring project delivery risks that will need to be managed by the TSO and will tend to be a function of the terrain that a line covers, its distance and technology.

These steps are often difficult and contentious, even within the confines of a single jurisdiction. However, when cross border investments are considered these steps become considerably more difficult for a number of reasons:

- Identification of possible investments is more difficult as it requires a cross border view as to the benefits of an investment. Therefore, the co-ordinating TSOs need to understand and come to a common view on current and likely future market developments across jurisdictions. As well as an assessment of the benefits, the relevant TSOs also need to determine and agree the level of costs that are likely to be incurred.
- The requirements for additional interaction with regulators, potentially to secure financing for both sides of any cross border interconnection are also likely to complicate matters further.
- The planning and consents process needs to be undertaken in a number of jurisdictions, meaning investment can potentially only proceed at the pace of the slowest.
- Similarly, the build of the infrastructure needs to be co-ordinated between the two TSOs and full commissioning will only occur when all elements of the project in all jurisdictions are completed – meaning the benefits of any project can only be delivered once the slowest element of the project is completed.

These predominantly practical co-ordination problems that are likely to arise when an increasing number of stakeholders are involved are not typically balanced by particular additional reward for cross border investment. ETSO's contributions also highlighted the particular difficulties in interregional – and intra-regional – transmission investment planning.

## Current problems

It is also worth noting that the identification of transmission investment opportunities is potentially more difficult in an environment which does not have integrated transmission and generation planning. To varying degrees generation at a particular site and additional transmission are substitutes: what is demanded is power at a certain location – and both represent methods of achieving this. Under an integrated model it is more straightforward to plan centrally the location of generation and the requirements for transmission investment as one process, particularly given the potential for differing lead times for transmission and generation.

Prior to the third package, there was little or nothing present in Europe at the institutional level which helped to support the cross-border planning process – it was left to bilateral or multilateral discussions between individual TSOs (supported through funding from the TEN programme if relevant).

It has been recognised (not least with the third package proposals) that this approach is not calculated to achieve optimal planning outcomes. In the third package, the EC have proposed that ENTSO engage in transmission planning on the European level, and this should go some way towards addressing identification issues. However, experience indicates that even when there is an umbrella organisations for the TSOs to undertake this planning role (as is the case in the Nordic system with Nordel) the results are not always fully supported – we return to this point below, and consider the possible learning points from the Nordel experience and their relevance to the ENTSO proposals.[4]

There are no clear proposals in the third package for new approaches to securing regulatory sanction from Member State regulatory authorities in relation to investment spend – and there are reasons to believe this may be an important issue. It is therefore this to which we now turn.

## 2.2 ECONOMIC DISINCENTIVES

Any regulated transmission investment that facilitates greater cross border flows is likely to impact on the interconnected electricity markets in two ways:

- First, the additional flow of electricity across the new infrastructure means that wholesale prices in each country that is connected is very likely to change.[5]

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4 Problems can arise if not all results developed by an umbrella organisation are approved by all affected TSOs. We address this topic in section 4.1.1.

5 In ETSO's view, how electricity markets react to infrastructure changes depends on the market design.. While this can be true, our view is that it is possible to draw general conclusions on the impact of infrastructure investments on a given market situation irrespective of the details of the market design (for example, increased interconnection between a generally low cost producer and a high cost producer is likely to lead to flows that reduce the price in the high price market). Also, it is, unlikely that efficient design of commodity markets (electricity) will deliver the right results in the infrastructure market (cross-border capacities) which is under consideration here. In order to reach the right incentives for TSOs, next to efficient electricity market design additional measures have to be implemented.

- Second, the cost of the transmission investment, which is generally a regulated investment, will, most likely to be borne by the grid users of the network in which the new asset are located.

We discuss now how the interaction of these two factors might currently act as a barrier to securing sanction for the financing of transmission investment itself, in the context of a stylised example, as set out in Figure 1 below.


Figure 1: Stylised example of interconnector flows

In this stylised example we assume that an investment in Country B alone allows a greater flow of electricity from the low priced country, Country A, to the high priced country, Country C[6]. In this case, the wholesale prices in each electricity market would be expected to change as follows:

- Prices in Country A would increase as the increased exports would, from the perspective of Country A's wholesale market, appear to increase demand in the market, thereby requiring additional (more costly) generation to operate.
- Prices in Country C would fall as a result of the increased flows of cheaper electricity from Country A, via Country B as more expensive local generation is displaced by cheaper imports.
- In Country B, prices would stay the same – assuming the net inflow from Country A is offset by an equivalent net outflow to Country C.

If we now consider the impact on transmission charges of the investment and ignoring, for the moment, the influence of the allocation of congestion rents and the Inter TSO Compensation (ITC) mechanism, then it is clear that Country B would incur the additional cost of the infrastructure in its transmission charges, whereas Countries A and C would incur no additional costs.

Overall therefore, in this stylised example, there appear to be the following beneficiaries and losers arising from an investment in Country B:

- in Country A, the generators gain and customers lose out as a result of the change in the wholesale price;
- in Country C, lower wholesale prices mean that customers benefit and domestic generators lose out; and

6 For the purposes of this simple example, we assume fully competitive markets in all three jurisdictions.

- in Country B, customers lose out as they must pay higher transmission charges[7].

If we assume that the investment is beneficial from an overall perspective in that the overall generation costs of meeting demand in the three countries are reduced by a greater amount than the costs of the new transmission infrastructure (over its lifetime), then it would appear sensible, given this net welfare increase, for the investment to be undertaken. However, from the perspective of Country B alone this investment is welfare reducing – its customers see higher transmission charges for no corresponding benefit. In these circumstances the regulator in Country B might not sanction the investment – indeed, in some jurisdictions it might be legally compelled to veto the investment given it is contrary to the interest of the customers in that jurisdiction.

This example demonstrates that the incentives of individual countries might not be aligned with overall welfare improvement when considered from a wider regional perspective. However, the example ignored the impact of congestion rents and the ITC mechanism. Even when this impact is considered, it is not clear that they will necessarily solve the incentives issue in all cases.[8]

An increase in cross border capacity as a result of investment in one of the interconnected TSO areas will result in:

- a change in the expected present value of future congestion rents across the border – they may increase or decrease. There may be "knock on" effects on the rents across other borders in the region; and
- a change in the expected present value of ITC payments and receipts by countries in the region – countries facing an increase in transit flows should face either a reduction in payments or an increase in receipts.

It might be expected that, for beneficial investments, the present value of congestion rents would increase by a sufficiently large sum to fund the investment.

First, it is important to note that, from a social welfare viewpoint, the optimal level of transmission investment is not necessarily the point at which congestion rents are maximised. Put another way, the capacity on a particular interconnector could be at the level which maximises congestion rent while social welfare improving investments could still be made.

In order for these investments to be made on a merchant basis, some of the benefits from either (or potentially both) generators and customers in the interconnected market would need to be combined with congestion rent in order to fund the expansion.

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7 To the extent that the TSO's cost of capital is lower than the regulated cost of capital used by the regulator in its calculations of allowed revenue, the host TSO might be regarded as a beneficiary.

8 One TSO states the opinion that the ITC mechanism is not an incentive mechanism, and that it therefore should be clear that it is not intended to solve the incentive issues of the stylised example in any case.

Even if a potential increase in congestion rents were sufficient to fund the link, there still may be problems in taking the investment forward.

In the example above, Countries A and C would need to agree with Country B that Country B could keep a large share (potentially 100%) of the increase in congestion rents at the borders which resulted from the investment within Country B. This may prove difficult even in the simple case where there are three countries, each with one border. Within a meshed system, the negotiations required to arrive at the correct rent sharing may be significantly more complicated – they may require agreement by multiple TSOs on rent sharing based on reasonably subjective analysis as to the likely magnitude of the future rents, and each TSO's appropriate share.

Therefore, while bilaterally negotiated congestion charging arrangements may sometimes facilitate new investment (for example if rents are agreed to be shared on a non-50:50 basis), this is not likely always to be the case.

Neither does the ITC mechanism necessarily address the problem. Going back to the example above, if B makes the investment, it is likely that A and C will face an increase in ITC payments (as they are now causing "transits" through B).

In some situations, these payments would help to address the mismatch in incentives. In other situations, however, they could distort behaviour. For example, if it were possible to develop interconnection between A and C directly, then while this might not be the lowest cost option, it may appear favourable to countries A and C, as it would result in them avoiding increased ITC payments.

In order to avoid such effects and to add value, as highlighted in ETSO's comments, the ITC mechanism would need to be redesigned and adequately integrated into a more comprehensive arrangement. The constituent elements could, for example, be a European investment fund based on congestion revenues and the cross-border instruments and incentive schemes described in detail in chapters 4 and 5. The detailed consideration of such an arrangement is outside the scope of this study.

In summary, however, while the existence of congestion rents and the ITC mechanism make analysis of the problem more complex and potentially more subjective, they do not necessarily address the root problem of mismatched incentives for investment. Neither is it necessarily clear that they ever could, though arrangements may be designed which mean that they could work in the right direction.

It is important to note that this is not simply a theoretical problem. We are aware that the misalignment of costs and benefits has distorted investment decisions in the past. For example:

- the Nordel investment programme. In this case, the investment programme initially identified a set of optimal transmission investments for the region. However, the investment programme had to be adjusted so as to ensure that the incidence of costs and benefits was more balanced across the region – despite the fact the revised investment programme delivered, overall, significantly lower overall benefits. The programme

was also accompanied by an agreement to share congestion rents on a non-equal basis;[9]

- participants in the workgroup noted that similar issues had arisen in the context of Slovenia and its neighbours, as described in the EC Country Study 2007; and
- in North America, it appears that a proposed expansion of a line between Quebec and the PJM market in the North East of the USA was vetoed as the Canadian politicians were concerned that it would raise prices in the domestic market.

## 2.3 ALLOCATION OF PROJECT RISKS

All capital projects face risk. These relate principally to two key areas:

- **cost overrun** in construction – the overall cost of delivering a project might be significantly more than expected[10]; and
- **low utilisation** – once operational, market conditions might be such that actually the asset was not required after all. In this case the asset becomes stranded[11].

The allocation of these risks between customers and the TSO will be a key determinant of the level and nature of transmission network investment which is undertaken. For example, for if the regulated rate of return on capital that a TSO is allowed to recover through tariffs is higher than the TSOs actual cost of capital then:

- if the TSO bears no utilisation risk, there would be an incentive to propose projects which would be marginal or even unjustified on an objective cost benefit basis; and
- if the TSO bears all construction cost risk, they may avoid undertaking projects which they consider as too risky or difficult – or at least demand that they are granted additional return or provided with additional contingency budget in order to undertake them.[12]

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9 These practical problems should not lead to a dismissive assessment of the Nordel planning model in general. The general approach, the participation of stakeholders and the documentation can clearly serve as useful learning points for potential enhancement.

10 This is also true of ongoing maintenance costs – although the overall level means this is likely to be significantly less material.

11 It is worth noting that, even in these circumstances, the assets would still provide security of supply benefits.

12 In Annex 1, we provide a survey of how project risk is allocated between TSOs, connecting parties and customers.

The overall principle of efficient risk allocation is that risks should be borne by those that are best placed to manage them – to do otherwise will simply increase the cost of capital of the entities bearing the risks, and in the end increase the overall cost to customers of securing the investments required.

To achieve the appropriate level and nature of transmission investment at an efficient cost to the customer, it is therefore important that:

- where there are clear risks that can be controlled by the TSO directly, they should be borne by the TSO – an example might be the effective project management of the construction phase of an investment;
- where there are clear risks that can be influenced by connecting parties, it is sensible to pass a proportion of this risk on to them. This situation might arise if the lead time for transmission investment is longer than the lead time of the connecting party's investment - the TSO would need to commence costly investment prior to the connecting party commencing its build. The risk exists therefore, that the TSO builds assets that are not actually required as the connecting party decides not, in the event, to proceed. The most extreme form of mitigation of this risk would be a "deep connection" policy in which all of the deep reinforcement costs are charged to the connecting party in advance. This has a recognised number of drawbacks including subjectivity of cost assessment and potentially deterring requests for connection. Other approaches would place less overall cost onto the user, whilst still requiring some form of commitment from the user. For example, a connecting party might agree to pay a number of years' worth of transmission charges;
- where the TSO has some influence over outcomes, but this influence is shared with others, there could be some sharing of risk between the customer and the TSO – in such situations, the risk placed on the TSO needs to be weighed up against the risk of increasing the cost of capital it requires. One example might be the utilisation of new investments – while these will depend on the broader energy market context, the TSO should prioritise those investments which are likely to be highly utilised[13]. Another example might be the actual time for consents to be achieved relative to an average, forecast or benchmark; and
- where the TSO has little or no influence over outcomes – for example, long term asset price inflation – these risks should be borne by customers.

Clearly, TSOs should not be rewarded (e.g. through a higher cost of capital) for undertaking projects which have little by way of incremental risk relative to their "average" new investment.

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13 A measure which is more within the control of the TSO might be "utilisation relative to forecast". While it may be appropriate (e.g. for security of supply, or for energy delivery at specific times of day or year) to build an asset which is not expected to be highly utilised, the TSO should still have a clear view of likely utilisation, as this would be a key input to any cost benefit analysis.

## 2.4 FRAMEWORK FOR CONSIDERING INVESTMENT BARRIERS

In the discussion above, we have highlighted a range of problems or barriers to achieving the appropriate level of transmission investment.

These barriers vary according to the nature of solution which they require:

- some barriers cannot be solved at the level of individual country institutional or regulatory regime, and require action at the European (or at least the regional) level; and
- some barriers can be addressed by changes to within country regimes.

In Figure 2 below, we summarise our view on the categorisation of the barriers identified.

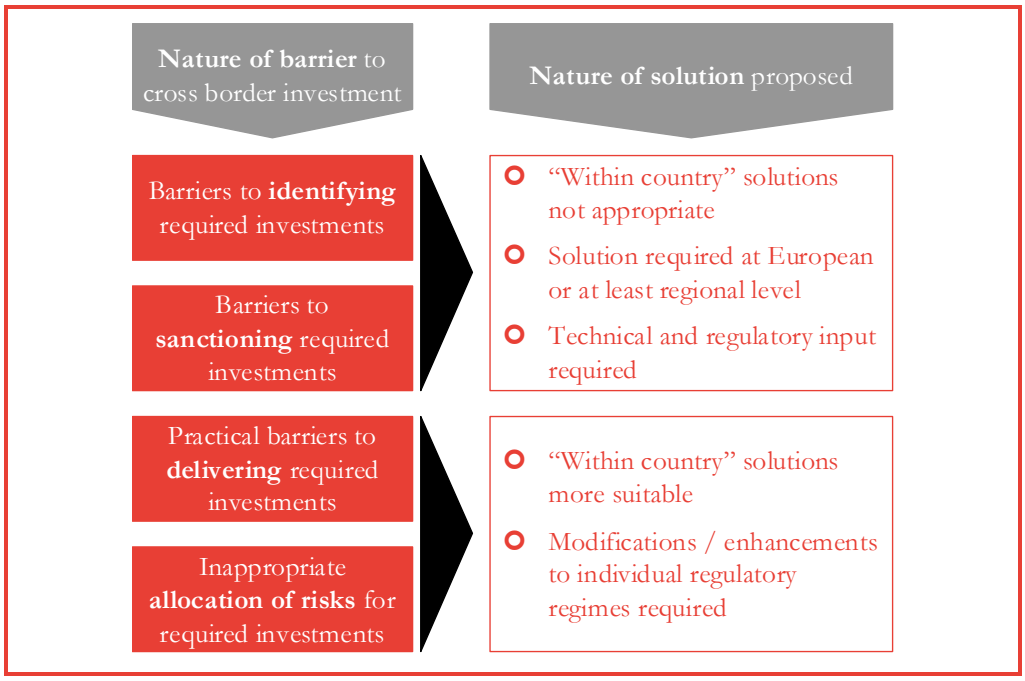


Figure 2: Nature of solutions proposed for investment barriers identified

Following a brief summary of the results and insights from our high level review of international experience in relation to transmission investment following this categorisation, we proceed to consider:

- in chapter 4, possible European or regional solutions; and
- in chapter 5, possible within country solutions.

# 3 Review of international experience

Having considered the key problems in relation to achieving an appropriate level of transmission investment, we undertook a high level review of the way in which different countries have attempted to ensure that their (national) levels of transmission investment were appropriate. We mainly considered the approach taken in relation to electricity transmission investment, but for some countries, we have also considered the gas system where we believed there were particular lessons to be learned.

The results of this review are attached at Annex 2. In this chapter, we present a summary of the output from this international review, along with an overview of the key resulting insights.

## 3.1 SUMMARY OF INTERNATIONAL REVIEW

While we have only considered experience of achieving the right levels of transmission investment within systems, we believe there are countries whose experience is of relevance to the barriers requiring a solution at the supra-national level and others where the experience is more relevant to promoting within system investment.

We summarise each set of experience separately.

| | US | Australia | Argentina |
|---|---|---|---|
| Relevance to Europe | • Often nodal pricing regimes – network investment impacts wholesale prices between states within a region<br>• Network revenue set at state (not regional) level | • Zonal pricing – network investment impacts wholesale prices between states<br>• Network revenue set at state, not national level | • Nodal pricing regime – inter-regional investments impact regional wholesale prices<br>• Voting process to sanction network spend |
| Key points | • RTOs (independent of network owners) have single, region-wide expansion plan<br>• RTOs may attempt to charge for network investment based on those who benefit<br>• Issues with state regulators sanctioning spend where benefits are elsewhere | • SO (independent of network owners) prepares single plan of priority "national" investments<br>• Issue identified in relation to lack of linkage between this plan and approvals for network spend<br>• Review group proposed stronger linkage to remove barrier | • Onus put on network users to identify potential investments<br>• Identification of beneficiaries of network expansions attempted – though contentious<br>• Costs targeted at beneficiaries<br>• TSOs bid to build new lines |

Table 1: Review of countries with experience relevant for investment to facilitate cross-border flows

*Source: Frontier Economics / Consentec*

| | GB (electricity) | GB (gas) | Italy (electricity and gas) | Germany (electricity and gas) |
|---|---|---|---|---|
| Relevance to Europe | • Issues identified as a result of high cost of congestion following liberalisation | • Issues identified as a result of uncertainty as to the location and nature of future sources of gas<br>• Issues identified as a result of congestion at entry points | • Regulator identified need for greater investment in network assets | • Evolving process for determining new network spend<br>• Significant need for renewables-linked investments |
| Key points | • TSO incentivised to reduce costs of congestion – including through network investment<br>• Significant reduction in congestion costs as a result of incentivisation<br>• No risk of TSO pushing congestion to the borders – limited transits, and clearly defined border capacities<br>• Frequent resetting of incentive scheme (e.g. every 1 or 2 years) means that, in reality, it is unlikely to support significant investments | • Users bid for access to gas system over long term<br>• TSO uses long term bids to identify network build requirements<br>• If TSO sells more than "baseline" capacity funded through price control, may keep some proportion of market revenue<br>• Separate incentives on time taken to commission investments | • Regulator provides higher cost of capital for assets defined as "strategic"<br>• Some evidence (from electricity at least) of higher investment taking place | • System analysis to identify investment requirements<br>• Consultation with regulatory and other stakeholders<br>• Transparent process envisaged<br>• Questions in relation to overall level of return on equity |

Table 2: Review of countries with experience relevant for investment to facilitate cross-border flows

*Source: Frontier Economics / Consentec*

## 3.2 INSIGHTS FROM INTERNATIONAL REVIEW

We believe there are a number of insights which it is possible to derive from the international review.

First, in both of the countries where there are overlapping regional and state jurisdictions (i.e. US and Australia), there has been a clear policy move towards the **introduction of a single entity with planning responsibility** at the regional or national level[14].

Furthermore, in both cases, the single planning entity is independent of the interests of the asset owners in relation to whose networks it is considering expansions.

In the US, this is at least in part because the planning entity is also the system operator, and frequently the network owners are not unbundled from generation or retail interests – therefore, the rationale for the independence may have more to do with independence of the system operator in relation to short term wholesale market considerations than with investment.

However, both in Australia and the US, there may also have been a rationale for ensuring that the investment planner was an independent entity, in that it ensures that the overall investment plan is developed in a fully neutral manner. While (unbundled) transmission owners are likely to be less keen on ensuring specific outcomes than generators or retailers, there will still be vested interests – they could include, for example:

- the desire to avoid significant network investment in order to keep tariffs in the area to a lower level; or
- the desire to see significant network investment in order to increase earnings as a result of the differential between the allowed and actual cost of capital.

Second, the **transmission planning process in many jurisdictions is open and transparent** – that is, it is based on modelling and analysis which is visible to relevant stakeholders, and there are opportunities for stakeholders to input to the planning process.

Clearly this was taken to an extreme in the Argentinean case, where beneficiaries were actually asked to vote on particular expansion schemes. However, in the US, in Australia, in Germany and in GB, the transmission planning process is relatively transparent and actively involves stakeholders. Spanish representatives in the Working Group also stated that there was significant stakeholder involvement in the Spanish transmission investment planning process.

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14 In Europe there are examples where the independent planning concepts have recently been revoked (for example, Italy, Poland and Hungary). However, these models were all implemented where the issues relating to conflicting network owner interests were of an order of magnitude lower than those of Australia and the US and, potentially, Europe as a whole.

Third, the issue of **mismatches between the incidence of transmission expansion costs and the accrual of benefits** has clearly been recognised in a number of systems. As would be expected, this is most prevalent in the systems where there is nodal, or at least locational pricing (as it is under such a regime that different groups of network users within a country or region benefit or suffer most sharply as a result of changes in transmission capacity).

Fourth, there is some **precedent for establishing charges for use of the network which recognise the incidence of benefits**. Both in the US and Argentina, arrangements to allow for such charges have been put in place – presumably in an effort to attempt to mitigate the impact of mismatches between costs and benefits. However, it would appear that where this has been tried, the identification of the beneficiaries (and the extent to which they benefit) has remained a contentious process.

It is worth noting that this may provide further rationale for the full independence of the network planning entity in the US (as they have responsibility for calculating such "targeted" network charges).

Fifth, there is **precedent for incentivising TSOs in relation to the delivery of national investment projects**. There is experience of a number of different techniques – from the relatively simple, such as the specification of an uplift to the rate of return for some asset classes and protection against the risk of low utilisation through to more involved schemes which attempt to allocate some risk of under-utilisation to the TSO.

Sixth, there is also **evidence of the implementation of incentive schemes which target specific outputs.** The GB gas transmission incentive scheme is a particularly good example here, with incentives placed on the time taken to deliver investments through the planning process.

Finally, and perhaps most obviously, the specific process and incentives relating to transmission investment need to be based on a **stable overall regulatory regime, with a cost of capital provided to TSOs which is appropriate for the risks they are undertaking**. The utility sector has moved into a period of high capital investment requirements across the value chain as a result of ageing assets, the need to decarbonise generation, and the aim of implementing an effective internal market. In combination with a high commodity price environment, there will be significant pressure on regulators to hold down price increases. While regulators need to remain vigilant against companies earning excess profits, they also need to ensure that new investment can be adequately financed.

Indeed, in this context, it is worth citing the example of Germany. Given the current (yet to be finalised) incentive regulatory arrangements proposed for the German network, there may be a risk that - for example through adjustment - lags, the regulator only allows TSOs to recover an effective return on capital that is below the actual cost of capital of the business[15].

If this is the case in any country, the implications are potentially significant. TSOs may have insufficient financial incentive to undertake further investment in the network (they may have public service or reputational incentives) – ultimately this could lead to reductions in standards of service of the network business.

15 While the headline cost of capital may be more in line with allowed returns, the other costs and risks borne by the TSO elsewhere in the regulatory arrangements may make the effective rate materially lower. This is a risk to which a number of companies and commentators have pointed.

# 4 Inter-regional proposals

As we noted in the introduction, we have divided our proposals to address the issues that we have identified. In this chapter, we discuss proposals that could be implemented at an EU wide or inter-regional level in order to address some of the issues that we have identified. In the following chapter we then set out solutions that would promote transmission investment that might be implemented at a regional or country level (single jurisdiction).

## 4.1 OVERVIEW OF OUR PROPOSED SOLUTION

As we discussed above, two of the most serious impediments to transmission investment are:

- a lack of consistent network planning on a supra-national basis in order to identify cross-border investments; and
- the potential disincentives for individual jurisdictions to proceed with a transmission investment if it caused the jurisdiction to incur a net cost even if, overall the investment was welfare enhancing across the region.

In order to address these problems, there needs to be:

- an EU wide organisation (or a series of regional organisations[16]) to undertake **supra-national network planning** to identify strategically important transmission investment requirements, to identify preferred transmission schemes to address the requirements, and to consult on the conclusions of its analysis. This would be a complement to, and not a substitute for, individual TSO network planning. TSOs would continue to manage the development of their own national networks within the context of a supra-national network plan to enhance cross border flows;
- an EU wide organisation (or a series of regional organisations) to **oversee this analysis and planning, and to sanction the spend** associated with the identified schemes; and
- an EU wide organisation (or a series of regional organisations) to ensure that the **costs of the schemes which are developed are allocated** in such a way as to ensure that there are no jurisdictions which suffer a material net cost.

We are aware of the valuable work that is already carried out by TSOs, regional TSO associations and ETSO. Nevertheless a persistent lack of coordinated decision making may continue to exist due to the absence of these three deciding EU wide organisations (or series of regional organisations)[17].

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16 It may be that the development of regional arrangements, possibly with a defined hierarchy of planning commitments, is a pragmatic solution.

17 One TSO even expresses concerns that ETSO experience indicates that if cost reallocation is designed without a broad consensus, it will result in winners and losers among Member States, and practical implementation will be controversial. This reinforces the need to ensure on an EU level that no country suffers net costs for the benefit of other countries.

It should be clear that the organisations undertaking supra-national network planning, financial sanction and cost allocation should not be established in an unnecessary bureaucratic manner. Indeed, it would be a detrimental outcome if the proposals set out here resulted only in another layer of bureaucracy rather than an enhancement of the current regime. Financial sanction and cost allocation could be combined and the tasks do not need to be allocated to new bodies, as a good proportion of the required skills sets exist and are well developed within the existing TSO and regulatory bodies.[18]

Therefore we consider below the requirements of each role, before considering the extent to which the institutions which the EC proposes to create in the third legislative package (ENTSO-E, ACER) could effectively undertake the tasks.

### 4.1.1 Supra-national network planning and scheme design

***Role***

The outputs from the network planning and scheme design process at the supra-national level should ideally be:

- a statement of the areas of the supra-national grid on which there are material and non-transient cross-border bottlenecks which should be addressed by new investment;
- a statement of the preferred investment schemes required to remove these bottlenecks[19]; and
- a cost benefit analysis of the preferred scheme, which sets the overall economic benefit of the transmission investment (in terms of reduced cost of meeting future load) against the investment cost.

This process is one which is currently undertaken by most TSOs in relation to the development of their own national networks. Many of the EC's recent policy moves have been aimed at ensuring that national transmission planning is undertaken on both an independent and transparent basis. However, from the point of view of securing appropriate European transmission investment, it is equally important for it to be undertaken on a structured and transparent basis supra-nationally[20].

The required process comprises of five steps:

- inventory of the European transmission system(s);
- assessment of the status quo of (integrated) European electricity market(s);

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18 Furthermore, it is worth noting that these proposals apply more to incremental investment that enhances flows between two AC systems. Our view is that, where DC investment is required, it is feasible and possible that merchant investment can serve as an additional mechanism for delivery.

19 In this context, "network planning" refers to the activity of route design rather than the activity of securing planning permission and the wayleaves and permits necessary to commence construction.

20 We note that this is a potentially complex and time consuming task.

- forecast of the transmission demand drivers;
- analysis of bottlenecks; and
- analysis of strategic investment projects.

It is important to note that each of these steps should only be undertaken "above" the national TSO level in relation to projects of supra-national relevance (e.g. in relation to significant and non-transient cross border bottlenecks). National transmission system planning should still be undertaken at the national level (such national planning will, however, need to integrate network developments required under any supra-national plan).

The *inventory* should lead to a technical documentation of the transmission system which allows a comparison of existing transmission capacities while taking into account the characteristics of a meshed interconnected system. This could be achieved through a common grid model (the level of detail would need to be discussed[21], but a starting point could be PTDF-matrix vs. nodal grid model as discussed in various European Electricity Initiatives for the purpose of congestion management.).

The *electricity market assessment* should comprise a review of market fundamentals of the different interconnected markets, in particular taking into account the technical characteristics of electricity generation technology and the primary energy basis for electricity generation. The degree of detail should be comparable to that of the transmission system inventory. Together, these two elements should form a Common Grid Model and Common Market Model.

The *forecast* of transmission demand drivers should integrate consumption as well as generation perspectives for an appropriate time horizon, taking into consideration factors such as:

- demand growth profiles (driven by economic growth and energy efficiency progress);
- fuel cost projections for different generation technologies; and
- renewable electricity generation and the development of conventional and nuclear power generation.

The *bottleneck analysis* should then bring together these elements and quantify the need for and the potential benefit of investment in new transmission capacities in the European transmission system.

This analysis should then be the input to an *analysis of strategic investment projects*, which should involve the assessment of different physical transmission schemes (i.e. new lines, new transformers, phase shifters, revoltaging) which could address the priority bottlenecks. The assessment should be on the basis of both cost and effectiveness at addressing the identified bottlenecks.

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21 For example, it may be important to take into account the impact of internal congestion on interconnector capacity.

These schemes could either be proposed by national TSOs themselves (who will be most familiar with their detailed network configuration), or could be suggested by the body undertaking the planning process. The output of this phase would be a statement of the preferred schemes to address the priority bottlenecks.

In reality, there is likely to be some need for iteration between the high level scheme design and some steps leading up to the bottleneck analysis. There is also likely to need to be strong interaction between the body undertaking the design of new schemes and the national TSOs within whose networks the new assets would sit. The TSOs will need to support the overall process by:

- providing data on costs;
- supporting analysis of how new transmission investments would impact on national transmission stability (as crucial part of security of supply and legal obligation of most national TSOs); and
- considering how the transmission investment projects could be integrated within their overall network development plans.

These five steps would then allow a cost benefit analysis of the priority transmission schemes to be undertaken – in other words, the present value[22] of the economic benefit (reduction in despatch costs, increase in security of supply, reduction in generation investment) over time could be set against the upfront investment costs. Importantly, this cost benefit analysis, along with supporting assumptions should then be published as a consultation, in order that concerned stakeholders[23] could

- understand the analysis – and as a result, come to their own view as to the likely pattern of European grid developments over time (and potential perform their own "what if" analysis); and
- voice their views as to the appropriateness of the analysis and conclusions.

Conceptually, the cost benefit analysis described above should be carried out for the lifetime of the proposed transmission investment project. However, in reality, even a time horizon of 20 years (which should, on average, include 10 years prior to the commissioning of the line and 10 years post commissioning[24]) will introduce significant uncertainty into the results.

Practically, therefore, a 20 year time horizon may be appropriate, provided the cost benefit results are considered in a consistent manner – for example, with a 20 year time horizon, a ratio between costs and benefits of, say, 50-75% may be considered sufficient to indicate a positive overall economic benefit.

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22 Standard assumptions on factors such as discount rates, asset lives etc. would be required.

23 ETSO suspects that the confidence of market participants and consumers might be altered by their involvement in the planning process (e.g. definition of relevant scenarios). We do not see any reason for this fear but, on the contrary, judge, for example Nordel's experience as a positive and promising example that the integration of stakeholders improves their confidence.

24 It is likely to take at least 10 years to design, build and commission new transmission capacity.

## Inter-regional proposals

Alternatively, the relation between yearly savings and an annuity of the investment costs could be considered.

***Required attributes of organisation undertaking the role***

The role described above will require a number of capabilities. Most important are:

- a familiarity with network modelling and planning techniques;
- a familiarity with fundamental market modelling; and
- an ability to either develop, or at the very least scrutinise, transmission investment proposals.

It will also be important for this body not to be dependent on unanimous decisions from national TSOs, particularly given the highly complex nature of many of the variables which will go into the analysis. International network planning will inevitably involve discussions among the TSOs. Multilateral negotiations are necessary and inevitable in order to find the most appropriate solutions to pending planning issues. Therefore a clear institutional and procedural framework on an EU wide level, independent of national veto rights, is necessary in order to bring these discussions efficiently to decisions and subsequent actions.

Otherwise problems can arise if not all results developed by the EU wide (or regional) organisation are approved by all affected TSOs. Conflicts between a TSO's responsibility for its own network and for ensuring security of supply in its own control area on the one hand and the need for cross-border capacity expansion could be the consequence. TSOs should therefore perhaps be entitled to object against projects in cases where security of supply is demonstrably put at risk, but not when these negative effects can be overcome.

By establishing such a clear hierarchy, responsibility for network planning should *not* be withdrawn from TSOs and they would *not* be reduced to pure network financing institutions. However, some degree of subordination of national TSOs under a European wide decision making body would adequately reflect the complexity of the TSO business in cross-border coordination and cooperation[25].

Furthermore, a high degree of transparency in the decision making processes of the organisation will be critical.

Examples of supra-national transmission plans that are currently in existence in Europe include Nordel and also the output of the UCTE regional forum. However, discussions with participants from the Nordic region have indicated that, although their TSOs have indeed collaborated to develop a forward looking plan, there are a number of issues with both the process and the outcome.

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25 There would inevitably still be many details to be worked out in relation to such a body – not least its governance and reporting, particularly as the risks of identified projects might be difficult to align with the decision making body's role.

In terms of the process of developing the plan:

- there has been relatively little transparency in relation to the analysis underlying the plan – many of the calculations and assumptions remain a "black box" to participants; and
- the TSOs all have different methods of evaluating the future evolution of the market, and the regulators also had differing viewpoints.

In terms of the outcome of the process:

- participants have indicated that the output was more the result of a political negotiation in relation to which projects should be progressed, rather than an objective cost benefit analysis; and
- participants also suggested that the final projects were chosen on the basis of a "balance" of projects being implemented across the Nordic countries (and hence cost borne in each) rather than as a result of the choice of optimal reinforcements from an economic viewpoint.

Despite these issues, we stress that Nordel's plan clearly represents a step in the right direction.

### 4.1.2 Oversight of planning process and sanction of capex

***Role***

Once the consultation process referred to above has come to its conclusion, there will be a need for:

- the detail of the analysis, conclusions and consultation responses to be reviewed and verified; and
- a decision to be taken on whether the priority projects identified should go ahead.

These are both typically regulatory, rather than technical roles.

The first of the tasks is simply one of oversight of the planning work undertaken previously. However, given the importance – and subjectivity – of the analysis involved, some level of regulatory oversight would be beneficial. An independent assessment should also be made of the relevance and significance of consultation responses.

The second task, however, is more fundamental. There needs to be a final decision taken as to whether investments should proceed – and given the potential for this decision to impact differentially on Member State interests, it is arguably preferable for this decision to be undertaken centrally.

Once the decision to proceed has been taken, it carries with it financial implications – it is not credible to impose an obligation on the TSOs to develop their networks in a particular way without ensuring that this activity can be (efficiently) financed. This part of the role could be undertaken centrally, though it may be possible to leave the definition of efficient costs to the national regulatory authorities.

In a number of RTO agreements in the US, transmission owners are required to expand their networks in line with the RTO's regional expansion plan *provided* they get regulatory sanction. This approach leaves the right of veto at the state level, and therefore does not resolve the incentive issues. Either this right of veto should be removed (by placing the decision making at the supra-national level), or the incentive issues should be addressed by other means (such as a reallocation of the investment costs between systems). We turn to this in the next section.

***Required attributes of organisation undertaking the role***

The organisation undertaking this role must have a familiarity with network planning and market modelling in order to be able to exercise sufficient oversight. However, the level of familiarity could clearly be lower than that of the planning entity itself.

The key capability required by the organisation is that related to interpretation of cost benefit analysis and project appraisals, as this organisation will effectively become the decision making body in relation to whether transmission projects with supra-national relevance proceed.

The organisation would clearly need to be independent of all TSO, energy market and Member State influence, in order to ensure that its decisions were made on the strength of the economic case itself, rather than on the basis of specific Member State interests or priorities.[26]

### 4.1.3 Cost reallocation

***Role***

As we noted in the previous chapter, a key problem in relation to investment relates to the potential for mismatch between where the costs and benefits accrue.

As a result, simply sanctioning the spend is not sufficient. In order to avoid creating relatively arbitrary winners and losers between Member States, it is important that an organisation is tasked with assessing the incidence of costs and reallocating them to ensure inter-state distributional effects are addressed. It is the costs which must be reallocated because the benefits will accrue on the basis of energy market transactions, which cannot easily be adjusted.

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[26] ETSO's comments point to the question of whether – in terms disposing of the necessary resources – such an organisation even exists (and that if this was the case then at least a significant part of the necessary technical and economical expertise would have to be subcontracted to consultancy firms), and whether this institution would be prepared to take over the responsibility for its decisions (e.g. impact of approved/rejected interconnectors on security of supply). ETSO concludes correctly that as a consequence, both National and European legislation would have to be adapted in order to accommodate such shared responsibilities. We discuss the responsibility for security of supply also on page 31 and address the suitability of existing organisations or those to be created on the basis of the third package in section 4.2.

Consider a stylised example similar to that set out in Figure 1 above, in which there are three countries (A, B and C). Further assume that the cost (i.e. the investment) is incurred in B, and that exports increase from A to C, such that A also incurs a cost (through higher wholesale prices) and significant benefits (from lower wholesale prices) accrue in C[27]. Table 3 below sets out, at a stylised level, our assumed incidence of costs and benefits

| Country | TSO direct costs | Customer market-driven benefits | Net benefit to customers |
|---|---|---|---|
| A | 0 | -3 | -3 |
| B | -10 | 0 | -10 |
| C | 0 | 19 | +19 |

Table 3: Stylised example of costs and benefits

*Source: Frontier Economics / Consentec*

As Table 3 indicates, Country A's customers are left worse off (by 3 units) on account of the increased generation in A leading to an increase in the wholesale price. Conversely Country C's customers are better off by 19 units as a result of reduction in wholesale market price that the imports induce. Country B's customers are left 10 units worse off on account the cost of the transmission infrastructure sited in their country. Overall the investment is net welfare enhancing by 6 units (i.e. 19 units minus 10 and minus 3).

The reallocation that is required must result in no jurisdiction wishing to veto the new investment as a result of them suffering a loss of welfare. That is to say, at worst each country must have a zero expected net benefit – and ideally a small positive expected benefit (given that the magnitude of benefits is inherently uncertain)[28].

It may be considered desirable to go further than this and to ensure that the countries share the net benefit of the investment (or at least that a material share of the benefit accrues in the country or countries which has to make the investment). However, this further step is inevitably a political question – a judgement will need to be taken between the need to incentivise countries to progress projects and the acceptability of reallocating potentially significant costs between countries.

Taking the minimum required reallocation, with reference to the stylised example above, customers in country C would need to pay:

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27 Note that in reality, the impact of other cashflows will need to be taken into account, such as revenues from congestion rent at borders, and payments or revenues from the ITC scheme.

28 Again, we note that the task of reallocating funds between jurisdictions in Europe is likely to be both complex and potentially subject to political influence.

- customers in country A  an expected value of 3; and
- customers in country B an expected value of 10.

This could be done through a series of increments to grid fees in country C which were then paid to the TSOs A and B[29].

As an option, and given that the third package indicates use of congestion fees as a source of funding for new investment, consideration could be given to the use of congestion rent income as an alternative (or, at least, a complement) to increased grid fees in country C.

It should be noted that, in reality, the costs and benefits will be nowhere near as certain as is indicated in this stylised example.  A range of costs and uncertain future wholesale market revenue implications (including those from congestion rents and ITC) will also need to be taken into account in relation to the calculation of an appropriate reallocation.

The legal route through which any such reallocation is achieved would also need to be considered – for example, it might be that an organisation is given a legal power to require payment from TSOs in one country into a central fund, which is then paid out to other countries.  Importantly however, while there may be a route of appeal, individual national regulatory authorities should be obliged to accommodate the implications of these cost transfers.[30]

A further issue discussed by the group was whether, were forecast benefits not to materialise as expected from a given investment, it would be appropriate to review the original cost and benefit reallocation.  Our view, is that such an ex post review would not be appropriate.  Given that the decision to undertake an investment would be taken on the basis of the best, and collectively agreed, information at the time that the investment was sanctioned, and actual costs are subsequently incurred, then it would not be appropriate to reallocate the benefits in a manner that differs from the original agreed plan.

### *Required attributes of organisation undertaking the role*

This role mainly involves the calculation of the transfers required (based on the cost benefit analysis referred to above) and implementation of the transfers. Independence and transparency will again be critical – however, arguably the legal powers to support the required actions of the organisation are more important in this instance than its attributes itself.

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29 Note that, if a large number of transfers between countries were to be required, it would be simpler for the amounts to be paid into a fund which then paid out to recipient countries.

30 ETSO's comments note that due to the divergence in various regulatory and governance prerequisites – as well as other fundamental prerequisites – for the different TSOs it is probably not possible to suggest one single solution that has the desired effect in all European countries. As "only" a reallocation of financial resources is affected, the degree of responsibility of the proposed institution here is relatively lower than the liability of the suggested planning organisation. However, decisions on cost reallocation are also critical as they will inevitably contradict interest of single players (namely the ones which have to bear financial burdens). The example of ITC illustrates that a broad consensus on such topics is difficult to achieve.

## 4.2 RELEVANCE OF "THIRD PACKAGE" INSTITUTIONS

In the third legislative package, the EC proposes to create new bodies of TSOs (ENTSO) and to create a new regulatory body (ACER). It is therefore relevant to consider whether these organisations have the right constitution and governance to undertake the activities described in the previous section.

ENTSO already have, under the third package proposals, the remit to undertake investment planning along the lines articulated above. Therefore, they could be well placed to undertake the network and investment planning role. However, there are some important limitations to the way in which ENTSO have been defined – the most important of which is their lack of independence of decision marking. The Terms of Reference attached to the ENTSO-E Declaration of Intent signed in Prague by the CEO's of most European TSO companies indeed describe ENTSO-E's objective to "foster and to demonstrate enhanced levels of coordination and cooperation between TSOs at a pan European and regional level ensuring optimal management, sound technical evolution and secure operation of the European electricity transmission system, and enhancing efficient functioning of the European electricity market". However, in order to really reach this objective decision making at ENTSO must become independent from national veto rights.[31]

Under any scenario, it is obvious that national TSOs will continue to need play a pivotal role in relation to network planning – they are, of course, the most familiar with the technical characteristics of their networks. Equally, discussions amongst concerned TSOs are inevitable to find the most appropriate solutions to pending planning issues – this is particularly true for any technical issue. However, as we note above, the lack of a governance process independent of national interests in relation to cross border planning processes could be a drawback:

- it may reduce the extent to which network planning and identification of priority schemes is performed on a neutral basis – it may become more of a political negotiation between TSOs, as participants have argued is currently the case with the Nordel grid plan[32];
- it may reduce the legitimacy of the plans put forward and reduce the extent to which market participants have confidence in them; and
- it may reduce their likely ability to come to a clear and timely view on priority network developments as a result of the need to secure sign-off to conclusions from multiple TSOs (as clearly has been the case in the recent evolution of the ITC mechanism).

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31 ETSO's contributions highlighted the fact that international network planning will inevitably involve some discussions on technical issues, that such discussions do not mean that planning is performed on a biased (not neutral) basis and that multilateral negotiations are necessary and inevitable in order to find the most appropriate solutions to pending planning issues. We fully agree to this and therefore emphasize the need for a clear institutional and procedural framework on an EU wide level, in order to bring these discussions efficiently to decisions and subsequent actions.

32 This drawback of national interest positions should not lead to a dismissive assessment of the Nordel planning model in general. The general approach, the participation of stakeholders and the documentation can clearly serve as useful learning points for potential enhancement.

A regulatory institution is required to oversee the activities of ENTSO, and to undertake the required cost reallocation. ACER may be able to play some of these roles – it would need to be able to:

- exercise oversight over ENTSO's planning process;
- commit to project development based on ENTSO's planning outputs and its own analysis of priorities (perhaps leaving the definition of efficient investment levels to national authorities); and
- facilitate reallocation of cost between Member States according to a set of defined principles, in order to ensure that no jurisdiction is left with a negative net benefit as a result of committed developments.

## Inter-regional proposals

# 5 Within country proposals

Having considered potential solutions to the economic incentive problems associated with cross-border investments which need to be addressed at the supra-national level, in this section we discuss possible arrangements for TSO incentives that could be implemented at the country level and which might serve to promote transmission investment.

We note that the two are related, in that schemes proposed and signed off at the supra-national level will need to be implemented by TSOs under regimes (e.g. in relation to planning and permitting) which predominantly operate within country.

From the outset, it is worth noting that the schemes presented in this chapter are not "perfect solutions". Rather they need to be considered in the context of specific problems that need addressing in each jurisdiction. Therefore, they would need to be implemented on a case-by-case basis depending on the nature of the problem.

We have divided the discussion into two sections:

- first, we describe a number of possible models (known as incentive models) that might have some beneficial impacts – these were considered by all of the workgroup; and
- second, we provide an assessment of the each incentive model, highlighting its strengths and weaknesses.

## 5.1 INCENTIVE MODELS

One perceived issue with the promotion of transmission investment is that TSOs, who are usually the main agent tasked with identifying and delivering additional transmission infrastructure, might not have sufficient incentives to consider fully the potential for transmission investment that enhances cross-border flows.

One example might be situations where DC and AC transmission investments are possible alternatives and common planning procedures could – if designed and implemented in a particular way in a given country – be biased towards the AC investment, despite the significant planning hurdles. In such cases it might be appropriate to consider making an investment in DC equipment as, despite the increase in the cost of the investment and the lack of frequency synchronisation, the more timely delivery of the investment could mean that it actually generated greater net benefits.

In addition, some have expressed a concern that TSOs, given their history of being monopoly businesses, might not have sufficiently entrepreneurial cultures. It is clear that across Europe, TSOs operate within a range of different cultures and organisations, from those in the private sector and with a clear profit motive, to those in the public sector, with, potentially, a broader set of objectives. If, in TSOs with characteristics which are less purely profit focused, a lack of entrepreneurial spirit is a concern, the creation of stronger financial incentives to steer decision making further may be beneficial.

Therefore the focus of our consideration of incentive arrangements that might be delivered within country has been on proposals that place, to varying degrees, financial incentives on TSOs to identify and deliver in a timely manner transmission investment that has the potential to enhance cross border flows. However, we stress that the appropriateness of a particular incentive scheme is dependent on the situation within a country. The options described in the following address a range of problems that might occur in different countries. This may not lead to the conclusion that they could all be applied on all countries or TSOs. Especially, before any solution is implemented, it is important to be clear that the action being incentivised is actually to some extent controllable by the national TSO, and cannot be impeded materially by the actions of others in a way which is not considered by the regime.

We have considered four options.

- Incentive Model 1: Uplift to rate of return for TSOs ("RoR+").
- Incentive Model 2: Market based incentives for TSOs ("Market").
- Incentive Model 3: Micro incentives on TSOs ("Micro").
- Incentive Model 4: Performance based incentives ("Macro").

We describe the main features of each in the following subsections.

### 5.1.1 Incentive Model 1: Rate of return uplift (RoR+)

The main thrust of this approach is to encourage the TSO to deliver (and possibly identify) additional transmission infrastructure by awarding additional funds for undertaking the investment. The main features of the model are:

- A set of "strategic" investments would be identified. These would be those investments that are considered to deliver significant economic benefits (such as, for example, those which reduce internal congestion). Where the responsibility for identification would lie would need to be considered further. Two possible options are:
    - for a consultative cost-benefit analysis programme involving relevant stakeholders such as TSOs, generators, regulator and customer groups to be responsible for identification;
    - alternatively, the regulator might alone be responsible for defining strategic objectives which the TSO would then respond with detailed plans to the regulator.
- Following the identification of the investments considered most beneficial (through which ever route is considered most appropriate), the host TSO would be tasked with delivering the investment. To encourage delivery in a timely manner, the TSO would receive an uplift to its normal regulated rate of return on the capital associated with the investment. From a customer perspective this would be justified on the basis that the timely delivery of these investments would generate more benefits than the additional cost customers incur through higher transmission charges to fund the uplift.

- The uplift on the rate of return would only accrue to the TSO from the point of commissioning of the new infrastructure. In this way, the TSO would be encouraged to deliver the investment in a faster time frame and, potentially, to consider more innovative solutions to any potential issues it might encounter. For example, planning problems that might arise might be resolved with different routing or technological approaches.

One potential weakness of this approach is that it might over-skew the incentives for the TSO to identify and deliver investment, with the result that investment is delivered that, in the event, is not actually needed. Alternatively, a TSO might get a premium payment for investment that it would have undertaken in any event. Either case is more likely to arise in situations where it is the TSO that is responsible for identification although it could still occur through other identification processes. This would be doubly bad from a customer perspective. First, it would be paying for assets that are not needed. Second, it is paying a higher rate as a result of the uplift.

However, it should be clear that a sound definition of strategic projects on European level (see section 4.1.1 for the details) already mitigates the risk of overinvestment considerably.[33]

A potential, partially mitigating, solution to this would be to structure the uplift scheme so that:

- the rate of return uplift is set on a sliding scale basis. The greater the volume of investment undertaken by the TSO, the extent to which it is rewarded through a higher uplift is reduced; or
- the rate of return uplift is linked to some measure of utilisation or usefulness [34] of the assets once they are commissioned.

Both of these might reduce the tendency of the incentive scheme to encourage over investment. However, in so doing it dilutes the original incentive scheme.

### 5.1.2 Incentive Model 2: Market based incentives (Market)

A second model for encouraging TSOs to undertake transmission investment is to introduce some elements of the incentives that encourage merchant transmission investment. As is well understood, merchant investment occurs when private sector individuals believe that the revenue from sales of capacity on new transmission infrastructure will exceed the costs of the investment. This risk reward trade off encourages the merchant investor to identify those opportunities where investment is most required (as this is where capacity is likely to be priced most highly) and then deliver investments in a timely manner relative to market demand (as this ensures the maximum present value of revenues).

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33 ETSO's comments furthermore refer to the fact that national or European authorities have an important role in the process and suggest that they could be involved in the selection of "strategic" projects in order to reduce the risk of approving an unjustified project.

34 Such a measure of utilisation should also take into account security of supply functions of assets.

Of course, for a variety of commercial, technical and regulatory reasons merchant investment is not likely to be appropriate in all cases. However, introducing some elements of the incentives that encourage merchant investment to TSOs might have the desired impact of delivering additional transmission infrastructure. The key features of this approach could be:

- the regulator first defines a level of transmission capability that is funded under the standard price control. Typically, this level of transmission capability would reflect the existing assets as well as any assets that the regulator might have agreed should be included in a forthcoming price control as part of the standard investment programme. In this way, the "baseline" level of transmission capacity will be defined that reflects the existing infrastructure and planned increase in it. Crucially, this baseline infrastructure is funded at the standard regulated cost of capital which ultimately feeds in to customer tariffs;
- for any additional capacity delivered above this baseline volume, the TSO receives a proportion of the market based revenues that arise from congestion management. This is in much the same way as a merchant investor would receive rents for releasing additional transmission capacity. This would therefore encourage the TSO to identify and then deliver in a timely manner incremental investment over and above baseline levels to the extent that it believed it would generate additional revenues. If highly utilised investments are delivered, the TSO would earn high profits for a period of time – but conversely, if the new capacity is underutilised (i.e. if too much capacity is built, or it is built in the wrong place), the TSO may not cover all of its asset costs;
- the scheme could operate for a fixed number of years before the assets associated with the incremental investment are absorbed into the asset base – and from which point earn the standard regulated rate of return. This would mitigate the long term risk exposure of the TSO, and also ensure a sharing of benefits with customers;
- the scheme can be set up to limit the degree of risk and reward to which the TSO is exposed. For example, the TSO could receive only a proportion of the revenues (say 50%) that arise from congestion management – with the remainder being returned to customers through a general reduction in the level of transmission charges. Conversely, the scheme might also be set up to limit the downside risk of the TSO. If, in the event, the additional revenues from congestion rents are insufficient to cover the costs of the incremental investment then – rather than being exposed to all of the cost – some might be funded through customer charges. Clearly the exact parameters would need to be considered in some detail – the key point is that upside and down risks can be limited and/or shared so that the TSO is only exposed to a proportion of the risk of any additional incremental investment.

## Within country proposals

One of the key issues in relation to the implementation of this sort of scheme relates to estimating the "baseline" border capacities. These clearly depend on the networks, but also on the dispersion of generation and load locally and in neighbouring countries. Their estimation is therefore highly complex. Since the TSO would potentially have a strong incentive to minimise the baseline capacity set with such a scheme, this capacity setting would need to be subject to detailed regulatory oversight.[35]

### 5.1.3 Incentive Model 3: Micro incentives (Micro)

A third approach considered by the working group was to set so-called micro incentives on particular aspects of TSO behaviour. This relatively simple approach has the following key elements:

- The regulator would identify those aspects of TSO behaviour that might need additional incentivisation. For example, it might consider that the time period between approval and delivery of identified transmission infrastructure improvements is too long.
- Once identified, the regulator would put in place an incentive scheme for the TSO. In this case, it would set a scheme in place to encourage more timely delivery by setting up a system of higher payments for the TSO if it were to deliver the investment within a predefined time period. Alternatively it might incur penalty payments were it to exceed a certain time limits set by the regulator.
- The approach could be potentially enhanced by setting a generic benchmark for average performance against a certain metric. This would have the benefit of ensuring that individual cases did not particularly distort the overall scheme.
- It might also be appropriate to allow the TSO to exempt itself from a certain number of cases that are used in the calculation of its performance against the target metric. This would mitigate the risk that the TSO is overly exposed to risks that are outside of its control.

For example, over the period of the scheme, the regulator might say that, on average, the TSO must deliver new investment within 4 years. Were, in the event, it to deliver investment in an average time period of 3 and a half years it would receive an additional payment stream. Conversely, were it to take four and a half years to deliver the project then it would incur a financial penalty. Additionally, the regulator might allow the TSO to exempt a certain number of projects from the calculation of its performance (on account of

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35 One TSO made a number of comments on this solution, which would need to be addressed by the overall regulatory framework within which it was implemented:
– Security constraints may imply that priority investments are not necessarily those that generate additional revenues; these necessarily should be included into the baseline investments.
– This proposal could set an incentive for TSOs to under invest, or to invest in transmission assets with capacities lower than the optimum, as lower transmission capacities may result in higher congestion rents. This can generally be the consequence of merchant transmission investment.

the fact that, over a given period, there might be a small number of atypical projects that would have the effect of biasing upwards the TSOs overall performance against the target metric). By such means it would also be possible to exclude the risk that external factors influencing infrastructure development were ignored and TSOs were unreasonably exposed or penalised by the reason of uncontrollable external processes such as planning and consents procedures.

### 5.1.4 Incentive Model 4: Performance based incentives (Macro)

The concept of performance based incentives is following the aim of giving as many degrees of entrepreneurial freedom as possible to TSOs in their decision making and reducing regulatory intrusion to the unavoidable minimum. In contrast with Incentive Model 3, objectives are defined in the most general way leaving all internal measures, optimisation potentials and trade-offs to the TSOs.

However, defining such objectives could raise practical implementation problems. The indicators against which TSOs would be measured are comparable to those that usually have to be applied for the definition of benchmarking parameters – they should ideally[36]:

- cover *completely* the relevant tasks of a TSO,
- use parameters that are *quantifiable* and *available;* and
- rely only on *exogenously verifiable* parameters that can not be arbitrarily altered by the TSOs.

The definition of the TSO's tasks could include the reduction of congestion and the creation of new and/or the provision of existing interconnection and transmission capacities in order to maintain and/or increase security and diversity of supply in a country or control area.

Suitable performance indicators could include parameters such as Available Cross Border Capacities[37], Cross Border Flows or Cross Border Exchange Programs, that have already been discussed in other contexts as e.g. in the discussion of Flow Based Allocation and Congestion Management . Even then, many of these parameters are not entirely within TSO control (e.g. border flows) or are not entirely objective and observable (e.g. border capacities).

As with Incentive Model 2 (Market), therefore, clearly significant regulatory oversight would be required in relation to the setting of incentive scheme capacity targets. Care would be needed to ensure that the targets were not too easy to achieve, and to ensure that incentivisation in relation to specific targets did not actually distort TSO behaviour.

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36 One TSO, quite correctly, emphasises that any performance based incentive scheme should be based on objective and observable parameters entirely within TSO control and that it should not incentivise actions that may be against the fulfilment of security standards.

37 A similar incentive scheme was placed on those parties developing the NorNed interconnector.

The applicability of Incentive Model 4 (Macro) may well vary depending on the situation of the country. For example, the congestion management incentive scheme in the GB market has been effective at least in influencing the operational activity of the TSO in relation to redispatch. It may also have contributed to the investment incentive, although its impact would be limited by its relatively short term nature.

However, the GB TSO is not able to manage internal congestion by "pushing it to the borders" – the border capacities to the island network are clearly defined. If a similar incentive regime was implemented in a system in the middle of a meshed ac network, more regulatory oversight would be required – as the regulator would need to be sure that incentive scheme profits were the result of effective management of the causes of congestion, rather than just the result of reducing the utilisation of border capacity.

## 5.2 INITIAL ASSESSMENT

We now set out an initial generic assessment of the incentive models described above. We assess the models against three simple criteria:

- **Effectiveness.** That is the extent to which the scheme is likely to encourage the delivery of additional transmission infrastructure.
- **Limiting risk of over investment.** Extent to which there is a risk that the scheme creates a set of incentives on TSOs that means that additional transmission investment is delivered that is not, in the event, actually required.
- **Complexity.** The extent to which schemes might introduce significant complexities in the way in which TSOs are regulated. This creates risks of unanticipated consequences. In addition, it creates costs for customers of additional regulatory oversight.

We consider the schemes against each criterion in turn before providing a summary of our assessment.

### 5.2.1 Effectiveness

In terms of ensuring delivery of additional investment, in our view the most effective scheme is the Incentive Model 1 (RoR+) approach under which the rate of return is uplifted for particular schemes identified as strategic. Although a fairly blunt instrument, it seems likely that by providing clear and stable levels of additional funding, it is likely to encourage this additional investment. Indeed, the example of Italian gas storage (for which the regulator put in place a similar scheme that has generated significant additional investment in the sector) serves to illustrate that it can be effective.

Depending on the details of the parameterisation of the scheme and the risk appetite of the TSO, our view is that Incentive Model 2 (Market) has the potential to deliver improved incentives for delivery of transmission investment by TSOs. It has the particular advantage over some of the other schemes in that it leaves most of the decision making with the TSO. Arguably, this is beneficial

as, of all the stakeholders involved in the process, it is best placed to make the appropriate decision on a particular investment. It therefore encourages the TSO to identify efficient transmission investments (as well as incentivising their subsequent delivery), because the TSO will not cover all costs if its investments turn out not to be required – and will earn additional revenue if the investment is significantly utilised.

That said, a possible impediment of this approach is that the regulator could potentially expose the TSOs to some downside risk through the way it establishes the scheme's parameters, which even if small and coupled with significantly higher upside risk might deter investment. The experience of UK gas transmission demonstrates that this is a potential risk.

Incentive Model 3 (Micro) has limited impact in terms of identification of potential investment opportunities as it focuses its attention on encouraging efficient and timely delivery of identified investments. In this regard, the model could be considered to be "micro-managing" particular aspects of the TSOs performance that the regulatory bodies considered need enhancing. Therefore, in respect of delivery it would be possible to create as strong or as weak as an incentive as possible depending on the key parameters of the regime.

If clear output measures can be defined within a particular regulatory regime, by incentivising outputs of the TSO, such as the volume of congestion, Incentive Model 4 (Macro) has the same benefit as Incentive Model 2 (Market), in that it leaves the decision making responsibility with the TSO. It therefore encourages it to identify and then deliver the investment in a timely manner.

However, the regulator would be required to establish a view on the "right" level of investment (through a target level of congestion or border capacity). This contrasts to incentive model 2 (Market), which relies on the market revenues from market splitting or capacity auctions to provide an incentive – as investment and capacity is delivered, the available congestion rents will fall.

Furthermore, there is not yet clear evidence of an output based incentive mechanism being set for a sufficiently long time period (without the targets being reset) to allow investment incentives (as opposed to those for effective system operation) to develop.

### 5.2.2 Limiting risk of over investment

Incentive Model 1 (RoR+) involves a significant risk that:

- **customers overpay**: customers may end up paying a significant rate of return uplift in relation to assets whose construction had little by way of incremental risks;
- **too much investment is delivered**: a high rate of return will increase the incentive on TSOs to suggest schemes for regulatory sanction without them necessarily being fully justified on a cost benefit basis; and
- **the wrong mix of investment may be delivered**: the decision as to which types of investment qualify for an uplift is essentially administrative in this mode – this would need to be kept under frequent review, and may create the risk of the wrong mix of investment being undertaken.

By placing some down-side risk on the TSO if the investment is not actually utilised, Incentive Model 2 (Market) has the distinct advantage of reducing the likelihood of over-investment. However, since it relies on the level of congestion rent to provide incentives, it may actually not provide a sufficiently strong incentive to make investments, or at least the right level of investments (as we noted above, the capacity related to the maximum level of congestion rents is not necessarily the same as the socially optimal capacity level).

Incentive Model 3 (Micro) creates no additional risk of over investment as it does not incentivise identification of the possible transmission opportunities.

Incentive Model 4 (Macro) may, if the targets for output measures are chosen carefully, avoid a significant risk of over-investment. This will depend on regulatory attitudes – if targets are frequently reset, the incentives may not be strong enough to bring forward investment. Conversely, if a long term target of zero congestion were set, the resulting incentives may be too strong.

### 5.2.3 Complexity

A significant disadvantage of Incentive Model 2 (Market) and Incentive Model 4 (Macro) is that they are both relatively complex to operate. In particular, the setting of transmission capacity "baselines" in Incentive Model 2 (Market) is likely to be especially difficult (and potentially contentious). Also, the monitoring of performance during the scheme can potentially be complex and costly. Again, this is especially likely to be the case with Incentive Model 4 (Macro), in which the effects of regulated assets need to be disentangled with the impact of assets under the incentive scheme to assess their overall contribution to available transmission capacity.

By contrast, Incentive Model 1 (RoR+) is particularly straightforward to administer – simply requiring a small adjustment in the calculation of the allowed revenue on delivery of the required investment. Similarly, Incentive Model 3 (Micro) is relatively straightforward to set and then monitor performance against.

### 5.2.4 Summary

Table 4 below summarises the results of our initial assessment of the incentive models, in the context of possible outcomes that may be observed in a given jurisdiction. That is not to say that such problems necessarily arise (or that they are necessarily the "fault" of the TSO), but rather that there is the possibility of a range of concerns that might be addressed through additional incentivisation.

| | Nature of problem identified | | | |
|---|---|---|---|---|
| Incentive Model: | TSO not progressing planning application with sufficient speed | TSO not identifying optimal schemes | TSO delivering too slowly | TSO not responding to market needs |
| 1: rate of return uplift | ✓✓ | | ✓✓ | |
| 2: market based incentives | ✓ | ✓ | | ✓ |
| 3: micro incentives | | | ✓✓ | |
| 4: performance based incentives | ✓ | ✓ | | ✓✓ |

Table 4: Summary of assessment of incentive models against criteria

It might also be appropriate to use the incentive models together. For example, incentive models 2 (Market) and 3 (Micro) might encourage the TSO to identify optimal schemes and then deliver them promptly.

## Within country proposals

# Annexe 1: Survey of allocation of investment risks between TSO, participants and customers in the EU

| Country | Is approval for electricity transmission capex sought ex ante? | Do TSO owners face any risk of ex post electricity transmission capex disallowance? | Other material issues in relation to allocation of investment risks between customers and TSO? |
|---|---|---|---|
| GB | No. An allowance is given ex ante at the time the price control is set – however, this does not constitute approval for specific projects, but is based on an expectation of the efficient cost of projects expected to be required over the next 5 years. | Yes. If capital programme management is deemed to have been inefficient, or if projects have been undertaken which were unnecessary (and could have been judged so at the time which the spend was committed) | Discussions are ongoing in relation to the length of time for which users must commit to pay use of system charges upon connection. |
| DE | Yes, for some elements. For "expansion" and congestion related capex , ex ante approval is sought for an investment budget. Projects which do not secure this approval will not be funded. For replacement capex, financing is provided through a benchmarking process – there is therefore no ex ante approval. | Yes, for replacement capex. Funding is provided by a benchmark – less efficient TSOs will not have their investment fully funded | |
| LT | Yes, only the costs of the approved investment projects are included in the electricity prices. | No. | - |

| Country | Is approval for electricity transmission capex sought ex ante? | Do TSO owners face any risk of ex post electricity transmission capex disallowance? | Other material issues in relation to allocation of investment risks between customers and TSO? |
|---|---|---|---|
| NL | At the moment ex ante (i.e. before investment is made) approval is not legally possible. However the Ministry of Economic Affairs is working on an amendment of the Electricity Act to make ex ante approval for big expansion projects possible. | Yes; this is one of the main reasons for the amendment underway. | No, not at the moment but depending on the exact text of the amendments this can change. |
| PT | Yes. Capex is based on an investment budget settled ex-ante. | No. The capex is adjusted two years later. | ERSE is finalising a Public Consultation process for the review of a new regulation for the next regulatory period 2009-2011. |
| AT | No, Regulator (Energie-Control Kommission) only approves the capex ex-post. However, the TSO has a duty according to the Article 22a Paragraph 1 of the Austrian Electricity Act to generate at least once a year a long-term grid planning for the voltage levels 110/220/380 kV; the TSO can, according to the Article 22a Paragraph 5 of the Austrian Electricity Act, submit this long-term grid planning to the Federal Minister of Economy and Labour for approval. So far, the Federal Ministry has always asked the Regulators view and opinion on those long-term plans, which were in all cases evaluated positively by the Regulator. | Yes, if the investment does not correspond to the best technology (“Stand der Technik”) and the best efficiency in economic and functional terms, as it is prescribed by the law. | Currently there is no incentive regulation for the TSOs, but considerations of possible model and deployment are ongoing. |

| Country | Is approval for electricity transmission capex sought ex ante? | Do TSO owners face any risk of ex post electricity transmission capex disallowance? | Other material issues in relation to allocation of investment risks between customers and TSO? |
|---|---|---|---|
| SK | Yes, the investment factor is one of the components of the allowed revenue for access to the transmission grid and for electricity transmission, which is approved ex ante for the following year. | Not applicable. There is an ex ante set formula for investment expenditures including an interval, within which the TSO is incentivised to keep investments expenditures. | |
| IE | Specific capital expenditure approval is required ex-ante for very large transmission projects such as the planned interconnector to GB.<br>For all other projects capex allowance is set ex ante at the time the price control is set. | In Ireland the Transmission system asset owner (ESB) is separate from the system operator (EirGrid).<br>No benefit will be retained by the owner or operator through the reduction of the cost, volume or quality of its investment. | |
| CZ | No. Only in case of substantial deviation of planed investments from investments in the past the regulator asks TSO for detailed explanation. | No. Asset base is annually adjusted according to the level of investments two years ago. | |
| FI | No. Network investments are approved in tariff methodology at their replacement value/net present value. Regulatory Authority defines in its regulatory decision how asset base is calculated and included in evaluating reasonableness of pricing | No. Asset base is annually recalculated based on investments in previous year and depreciation. Costs are also annually updated. | |

| Country | Is approval for electricity transmission capex sought ex ante? | Do TSO owners face any risk of ex post electricity transmission capex disallowance? | Other material issues in relation to allocation of investment risks between customers and TSO? |
|---|---|---|---|
| SE | No, decided by Government, no explicit about capex in our electricity law. | No. | Sometimes the customers has to pay extra when the investment is extra ordinary. |
| FR | Yes. Total expected capex are taken into account when setting tariffs.<br>Furthermore, CRE approves transmission investment plans on an annual basis. | No. Stranded costs are taken into account when setting tariffs. | Capex is a pass-through item: unexpected investments of a given regulatory period are fully taken into account when setting following tariffs. In the same way, forecasted investments that haven't been realised are taken into account when setting following tariffs. |
| GB | No. An allowance is given ex ante at the time the price control is set – however, this does not constitute approval for specific projects, but is based on an expectation of the efficient cost of projects expected to be required over the next 5 years. | Yes. If capital programme management is deemed to have been inefficient, or if projects have been undertaken which were unnecessary (and could have been judged so at the time which the spend was committed) | Discussions are ongoing in relation to the length of time for which users must commit to pay use of system charges upon connection. |
| DE | Yes, for some elements. For "expansion" and congestion related capex , ex ante approval is sought for an investment budget. Projects which do not secure this approval will not be funded. For replacement capex, financing is provided through a benchmarking process – there is therefore no ex ante approval. | Yes, for replacement capex. Funding is provided by a benchmark – less efficient TSOs will not have their investment fully funded | |

Table 5: Survey of approaches to allocation of investment risk in EU jurisdictions

## Annexe 1: Survey of allocation of investment risks between TSO, participants and customers in the EU

# Annexe 2: Experience from other jurisdictions

A large proportion of the issues that we have touched on in this report have been, at least in part, addressed in other jurisdictions both individually within some EU states and in other non-EU jurisdictions. As part of our work programme we have therefore examined some of these experiences. Whilst there are no directly comparable examples, we have found a few relevant case studies that have served to provide some suggestions for some of the problems that we address.

In this annexe, we briefly set out the relevant issues of each case study from the following jurisdictions and sectors:

- Argentinean electricity sector;
- GB electricity transmission incentive schemes;
- GB gas market;
- Australian electricity sector;
- Italian gas storage market;
- US RTO electricity market; and
- German electricity market

## ARGENTINIAN ELECTRICITY SECTOR

### *Background*

The Argentinean electricity sector was extensively liberalized in the 1990s. The wholesale market arrangements put in place involved a centrally dispatched, nodal pricing regime.

However, in the preceding years there had been a significant lack of transmission investment. There were markedly different prices between certain areas, not least as a result of the distance between major load centres and areas of significant hydroelectric production.

This resulted in a situation which has a number of parallels to the situation in Europe – mainly that there were different price areas with a need for greater connection between them, and that different groups of customers would benefit from such transmission expansions.

### *Approach to transmission investment*

The incumbent transmission companies were, following liberalization, forbidden to initiate expansions in network capacity. Rather, a process of "public contest" was used to trigger expansions.

The beneficiaries of transmission expansion were identified (be the generators, distribution companies or large users). Prior to any expansion being triggered, at least 30% of these beneficiaries must make a request for the expansion (with the regulator undertaking cost benefit analysis to validate this request).

Following a valid request, the independent dispatch organization would then calculate the charges that would apply to them based on the extent to which they were likely to benefit. All the beneficiaries then voted on whether they wanted the transmission expansion to go ahead – if more than 30% voted against it, then the expansion would not take place.

Once experience was gained of the operation of these arrangements, the rules were change because of the accrual of significant congestion rent. The rents were put in a fund (the SIMEX fund) to reduce the charges resulting from any new investment.

## AUSTRLAIAN ELECTRICITY SECTOR

### *Background*

There is a National Electricity Market (NEM) in Australia, within which each state has both a separate price area, and a separate (mostly unbundled) transmission owner.

Network regulation is predominantly at the state level. The single national system operator (NEMMCO) does not own network assets.

### *Approach to transmission investment*

Under the present NEM arrangements (put in place in 2004), NEMMCO's role in relation to transmission planning largely revolves around the publication of an "Annual National Transmission Statement (ANTS)". The ANTS provides an integrated overview of the current state and potential future development of national transmission flow paths (NTFPs). NTFPs are the main transmission corridors within and between the jurisdictional transmission systems.

In developing the ANTS, market simulations are used to forecast network congestion, and identify the potential need for NTFP augmentations from a market benefits perspective. Conceptual augmentations are then developed in consultation with Jurisdictional Planning Bodies (typically the network owners), taking information from their annual planning reviews into account.

This results in a prioritised list of NTFP augmentation opportunities, each of which consists of a package of conceptual augmentations. The prioritised list of NTFP augmentation opportunities supports the national transmission planning process by indicating where attention is best focused for further and more targeted investigations.

To enhance national co-ordination of transmission, since 2004, NEMMCO has role in transmission planning process – publishes annually an integrated view of current state of national transmission statement and identifies potential investment (on basis of market modelling)

Projects which are "recommended" through the current country-wide planning process still need to be formally proposed by the relevant TNSP and then go through regulatory approval process. In this sense, NEMMCO's current role is similar to that proposed for ENTSO.

A major set of NEM reform proposals were put forward by the Energy Reform Implementation Group (ERIG)[38] following a detailed review published in January 2007. In relation to the existing arrangements, ERIG found that "whilst the general level of investment is reasonably appropriate and no new major interconnectors appear economical at present, "*the mechanisms are not in place to ensure the efficient ongoing development of the national transmission system. There is evidence that inefficiencies have been caused by the lack of such mechanisms and efficient investment opportunities have been missed as a result*" [emphasis added].

The review recommended changes both to the incentives for efficient investment and, more significantly, to the institutional and structural arrangements for transmission planning in order to co-ordinate investment on a national basis.

The review suggested that:

- **NEMMCO take up a stronger role**: ERIG proposes that NEMMCO collates, analyses and disseminates information and delivers strong and well informed independent advice by developing a strategic national transmission plan. This plan should set out proposals for the longer term efficient development of the transmission network which is consistent with the efficient development of the overall power system; and
- **investment plan links to regulatory revenue**: ERIG proposes that the plan directly links to the setting of the revenue allowance provided for TNSPs for a regulatory period.

## US RTO ELECTRICITY SECTOR

### *Background*

A nodally priced wholesale market was introduced to the PJM area in the late 1990s. In common with the European market, there are a number of different price areas, but there are several transmission owners across the area.

There is a single system and market operator, PJM, who have responsibility for day to day operation, and also has some responsibilities in relation to transmission investment

38 ERIG is a group established by the Council of Australian Governments to recommend proposals for reform in a number of areas, including "achieving a fully national transmission grid".

### *Approach to transmission investment*

PJM is given responsibility to develop a Regional Transmission Expansion Plan (RTEP). The RTEP consolidates the transmission needs of the region into a single plan which is assessed on the basis of maintaining the reliability of the PGM region in "an economic and environmentally acceptable manner and in a manner that supports competition".

The studies to develop the plan are required to include:

- identification of projected limitations on the system's physical, economic and/or operational capability or performance;
- evaluation and analysis of potential enhancements and expansions; and
- engineering studies needed to determine the effectiveness and compliance of recommended enhancements with system reliability, operational performance and economic efficiency criteria.

Once it has been developed, the recommended RTEP developed by PJM is consulted upon. Subject to the requirements of their other legal and regulatory obligations (including siting, construction and operating permits) as well as the availability of required financing, transmission owners are required to deliver the expansions in the RTEP.

In the event that a transmission owner declines to construct an enhancement, PJM are required to inform FERC.

For some facilities, transmission owners are permitted to determine charges for transmission expansions which are focused on certain transmission users (based on the extent to which they benefit from the expansion).

## GB ELECTRICITY MARKET

### *Background*

The England & Wales electricity market was liberalised in 1990, with new wholesale market arrangements being introduced in 2001. The market has always had a single price zone, with congestion being addressed through countertrading.

### *Approach to transmission investment*

From 1990, National Grid Company was made responsible for investment planning – undertaking forecasts of demand and supply, carrying out system studies to identify potential areas of congestion, and identifying required transmission expansions. Offer, and its successor Ofgem, have always been responsible for signing off investment spend.

During the mid 1990s, the cost of resolving congestion rose significantly. As a result, new arrangements to incentivise National Grid to reduce costs were introduced.

National Grid is set a target cost for resolving congestion – if it manages this congestion at a cost below this target, it is allowed to keep some proportion of the difference. In contrast, if it spends more money, it has to pay part of the difference.

In some circumstances, therefore, this arrangement incentivises National Grid to consider undertaking network investments more quickly than it otherwise would, in order to reduce its exposure to congestion costs under the incentive regime. However, the impact of this effect is limited by the fact that the target for congestion costs is frequently (e.g. annually) reset.

Equally, it is important to note that it is difficult for National Grid to push national congestion to the borders – this would be an issue for this form of incentive scheme were it operated in an interconnected ac system.

## GB GAS MARKET

### *Background*

The gas transmission capacity regime was introduced at the end of the 1990s, in response to significant congestion at one of the main gas network entry points, and in response to uncertainty as to the future location at which producers would seek to bring gas onshore.

### *Approach to transmission investment*

The TSO is required to make available prescribed quantities of entry capacity at each entry point. Market participants then bid for capacity in auctions for up to 18 years in advance.

If the TSO has a sufficient volume of bids at a given point, the TSO is required to make new capacity available over and above the baseline quantity at that point. The price control for the TSO specifies the amount of additional allowed revenue which they are allowed to recoup in relation to such new capacity.

The TSO is obliged to deliver capacity within a set time period once new investment is triggered. This includes time to secure consents and time to build the relevant assets. The set time period is currently 42 months for entry capacity and 38 months for exit capacity.

In addition, the TSO has a small number of "permits" which it can choose to secure exemption from individual projects.

If the TSO delivers capacity ahead of time, it can either sell capacity early (and then keep the additional revenue) or convert it into permits for future use.

## ITALIAN ELECTRICITY AND GAS MARKETS

### *Background*

The Italian electricity and gas markets have been gradually liberalised. The regulatory authorities have continued to express concern about the level of electricity transmission investment, and the volume of gas storage investment being brought forward.

### *Approach to transmission investment*

As a result of this concern about the level of investment, the regulatory authorities have decided to award rates of return above the normal estimate of the TSO WACC in certain circumstances.

For 2008 – 11, electricity transmission increments above normal WACC are:

- for system security investment - 2 percentage points;
- for congestion relieving investments – 3 percentage points; and
- for other investments – 1 percentage point.

For gas storage, a tariff system was introduced which allows for a return on capital of 7,1% real, pre-tax, and for an increase in return for new investments of 4%. Equally, the revenues of storage sites are guaranteed regardless of actual site usage.

The overall impact of both schemes is to provide utilities with a significantly higher rate of return than is deemed necessary for certain investments.

In terms of their effectiveness, following the review of gas storage tariffs, new storage projects were launched (Stogit has announced the intention of developing around 4.2 bcm). That said, it is not clear if these investments are a direct result of the new tariff system (or indeed whether they will all be realised).

## GERMAN TRANSPORT SYSTEMS (ELECTRICITY AND GAS) MARKET

The regulatory regime for electricity and gas transmission investment in Germany is evolving with the introduction of incentive based regulation (due to be implemented in 2009).

Three different categories[39] of transmission investment have been defined:

- replacement investment;
- expansion investment; and
- "restructuring" investment (that associated with addressing congestion).

The proposed regulatory treatment of the investment types varies.

Revenue to fund replacement investment is to be assessed through a benchmarking exercise – with TSOs being allowed revenue related to that which the most efficient firm proposes.

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39 While the categories are defined separately, there is actually the potential for significant overlap between them – for example, asset replacement may not be conducted on a like for like basis, but may involve replacement of a line with higher voltage assets capable of addressing some network congestion. The treatment of such projects – which are likely to be a relatively frequent occurrence – has not yet been fully considered.

For the other two categories, TSOs will be required to submit "investment budgets" to the regulator. The law gives a number of examples of investments which would qualify for an investment budget, including the connection of power plants (in particular, renewables) and the expansion of cross border capacities in electricity and gas transport systems.

The detail of investment budgets are likely to be based on:

- definition of framework conditions for relevant network and market scenarios;
- development of relevant scenarios, and development of a grid planning model for Germany
- a 10-15 year bottleneck analysis and evaluation of necessary capacity expansion in order to define necessary investment measures;
- grid planning and individual scheme design.

A relatively open and transparent approach to investment planning is foreseen by the regulator, as shown in Figure 3.

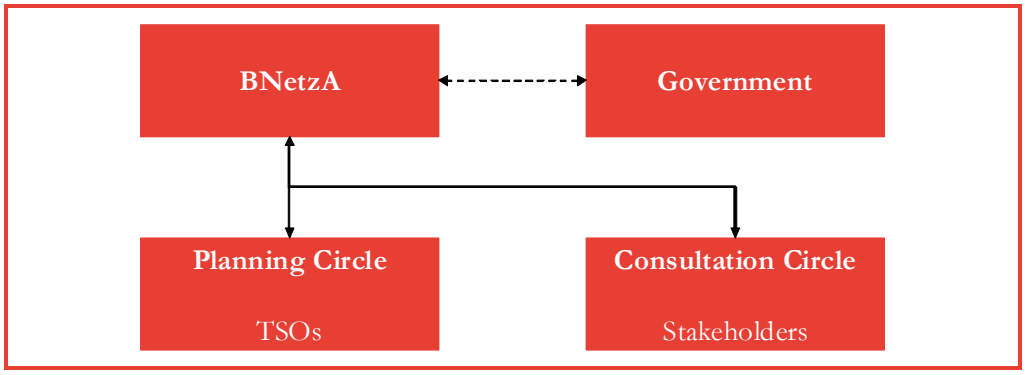


Figure 3: Stylised view of consultation process

It is proposed that:

- the detailed analysis is undertaken by the TSO in consultation with the Bundesnetzagentur;
- the BNetzA would be responsible coordination with the Federal Ministry of Economics) and for ensuring coordinated grid planning among the German TSOs; and
- the assumptions and results of the analysis are provided to a wider circle of parties in order that the views of all other relevant stakeholders (mainly power plant operators and energy traders) can be taken into account.

## Annexe 2: Experience from other jurisdictions

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