The environment for gas network investment in Europe

A REPORT PREPARED FOR GTE INVESTMENT CLIMATE WG

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Executive summary

Substantial ongoing investment is required in European gas networks over the next few decades to:

- **ensure security of supply** (e.g. allowing for greater diversification of gas sources as indigenous production declines; ensuring there is sufficient capacity to meet peak demand reliably);
- **increase competition and reduce prices** (e.g. by completing the EU internal market, achieving market integration and allowing greater trade of gas); and
- **help reduce carbon emissions** (e.g. by ensuring gas generation continues to displace higher carbon-intensity coal and complements intermittent RES generation; increasing biogas injection into the gas grid).

The International Energy Agency estimate that EU investment in gas transportation (including gas transmission, gas distribution and LNG facilities) will need to be maintained at over €12bn/year between now and 2035. There are substantial social benefits likely to flow from these investments.

However, these investments, which are often driven by expected peak demand levels, must be made in the context of substantial uncertainty round the future *annual* volumes of gas demand in the long-term. There is a paradox that, while major investments are likely to be needed over the next two decades to meet peak demands and other requirements, the annual demand base on which investment costs can be recovered could erode substantially in the very long-term, in some scenarios.

Given the long life of gas assets (over 40 years in many cases), to finance them efficiently, investors therefore need assurance that their efficiently-incurred costs will be recoverable under the regulatory framework, even in scenarios where demand falls substantially.

There are three key elements to this.

- **The regulatory regime needs to be perceived as stable over the long-term**. Investors require long-term visibility over revenues. This means the terms of the regime need to be visible enough and predictable many decades ahead. Related to this the allocation of long-term demand risks between investors, customers and taxpayers needs to be clear.
- **The terms of the regime need to allow for investors to recover their efficient investment and financing costs.** The revenues allowed under the regime need to be sufficient to incentivise investment. In particular, the

allowed returns under the regulatory regime need to be sufficient to cover investors' cost of capital and fairly compensate them for the risks they incur.

- **A credible route for cost recovery**. The credibility of the regulatory regime in ensuring recovery of investment costs also fundamentally depends on there being a credible route to cost recovery from customers over the long-term (both in terms of the size of the customer base and how they pay for gas transmission services). If not investors will perceive the terms will be changed in the future.

Delivering these three key elements may become increasingly challenging in the future. Particularly as many gas markets in Europe move from having high and stable patterns of gas demand to lower and more unpredictable patterns. There are a number of reform options to help secure the investment needed in gas transmission in this context (see Figure 1). These include the following.

- **Improving the stability of the regulatory regime**. Given the long life of gas assets, investors need long-term visibility of the regulatory regime and how the regulator will behave in future. Key to this is having a fully independent regulator and a clear, well-defined appeals process. In addition, the regulatory rules can be set to give greater assurance that the regulated asset base (RAB) will not be devalued in unexpected ways in the future (or retrospectively) by the regulator.

  More generally there needs to be consistency between the regulatory regimes for gas and wider energy policy. In particular, investors in gas need greater certainty around the role of gas in the long-term and how regulatory rules will be adapted to this.

- **Increasing the speed of money and using WACC premia for new investments**. In regions where gas demand is expected to fall in the long-term, there is a case for speeding up the recovery of investment costs to help secure the investment needed. This could be achieved through accelerating depreciation for new investments. Using a stylised model we find that reducing the depreciation period from 40 to 20 years would only increase retail gas prices by around 0.1% between 2015 and 2035, and would reduce tariffs in the very long term.

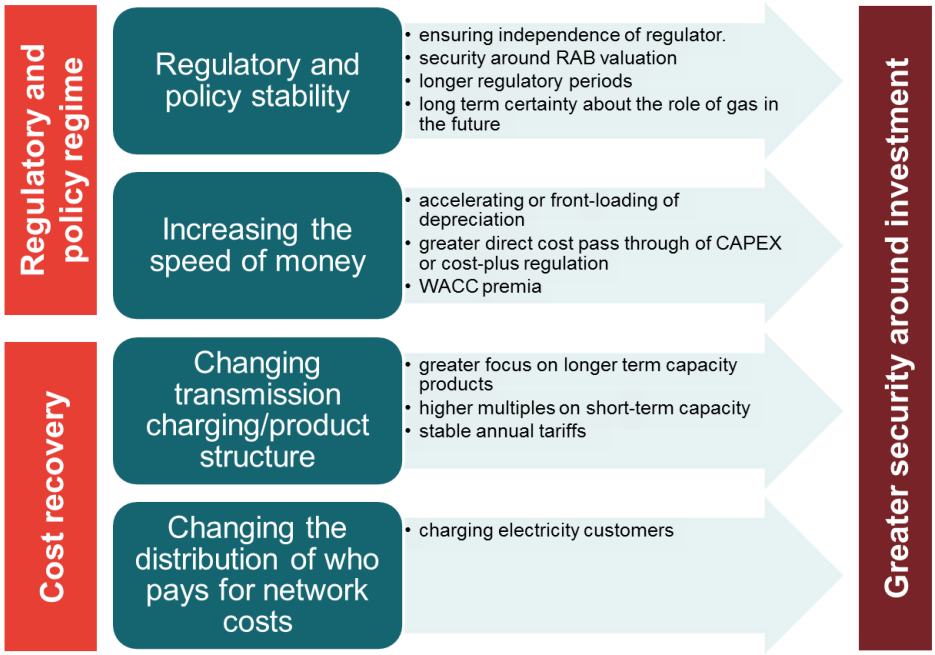
  An alternative to increasing the speed of money would be to provide WACC premia to help support new investments. The impact on retail prices from introducing premia for new investments would be limited. Using our stylised model we find that applying a WACC premium of 1% to all new investments from 2015 to 2035 would increase average retail prices by less than 0.1% during this period.

- **Changes to the structure of transmission charging and product structures**. In many gas transmission markets there has been a trend toward capacity bookings being made on a short term (e.g. daily basis). In these situations capacity has been booked at peak times but left unbooked in many other periods. This in turn has created concerns around revenue stability. In addition, the prices and revenues during peak times have been limited because of low multipliers allowed on prices at peak times.

  To enhance the potential for raising revenues there are a number of options including: (i) encouraging purchase of longer term capacity to match peak usage; (ii) moving from low short term multipliers that make sure capacity is used to high multipliers that help make sure costs are recovered; and (iii) moving to new categories of tariffs, relying less on bookings, and which are hence more stable. This includes charging options which socialise some costs across all transmission consumers.

- **Changes the distribution of who pays for network costs**. To enhance the potential for cost recovery, options to charge other types of consumers, or change the distribution of who pays should also be considered. This could include charging some gas transmission costs to electricity customers (to ensure the security of supply benefit coming from power stations using the gas transmission network is fully paid for).

Figure 1. Toolkit of options to help secure gas network investment



Source: Frontier Economics

This 'toolkit' represents a range of options open to national regulators and energy ministries to help secure the required socially beneficial investment in gas. The appropriate options to choose will depend, to an extent, on the national context. For example, in countries where gas demand is expected to fall more rapidly in the long-term measures to give greater assurance over costs recovery are likely to be more important.

Many of these options require major changes in regulatory thinking and the therefore the process to determine reform options should begin now. Moreover, most options will work better if they are implemented early, before the issues around cost recovery become too severe.

Without any reform of the investment environment for gas transmission, there is a risk of either underinvestment, or investment only being possible at a high cost of capital. Neither is in the interests of consumers.

1 Introduction

There is significant ongoing investment required in European gas networks to increase security of supply, to better interconnect gas infrastructure between relevant countries, to bring new sources of gas (including the future increased LNG) to European customers, and to facilitate new uses of gas (e.g. as a fuel for vehicles).

Achieving this investment will require investors to be persuaded as to the attractiveness of the gas infrastructure sector. Investor sentiment will in part depend on whether regulation is allowing existing infrastructure investors to make an adequate return. It will also depend on the proposed terms for future investments, and the credibility with which promised future revenues can be collected from customers.

Frontier Economics have been commissioned by Gas Infrastructure Europe (GIE) to consider these issues. This report is structured in three sections:

- in Section 2 we provide an overview of the future level and pattern of gas demand in Europe. We then review the future investment required in gas transmission in Europe;
- in Section 3, we consider the environment for investment in gas transmission, including the regulatory regime and impact of changing patterns of demand; and
- finally, in Section 4, we consider the actions that may be necessary to ensure the required investment in gas transmission is realised.

2 Outlook for gas demand and investment needs in Europe

In this section we explore the future evolution of gas demand in Europe along with the investment requirements for gas transmission assets and the benefits of this to consumers.

Gas demand in Europe could fall substantially in the longer term…

Future network investment is taking place against an overall context in which gas demand (and therefore the customer base from which infrastructure costs can be recovered) could fall in substantially by 2050. This is as a result of climate change mitigation measures such as:

- increased renewables generation displacing gas power generation;
- electrification of space heating;
- increased use of biomass in district heating; and
- improvements in energy efficiency in homes and buildings.

The last couple of decades have seen substantial growth in the use of gas for power generation, putting upward pressure on overall gas demand. However, in recent years gas demand has fallen rapidly, peaking in 2010 falling by 28% by 2014[1] as a result of weak economic growth, energy efficiency, competition from coal and expansion of renewables generation.

Looking to the future, there is a large amount of uncertainty around future gas demand in Europe, with substantial falls in annual consumption possible in the long term in some scenarios. In particular, Europe has set further renewables growth and carbon targets beyond 2020. Significant further growth in renewables production, electrification of heat and energy efficiency could put further downward pressure on annual gas demand.

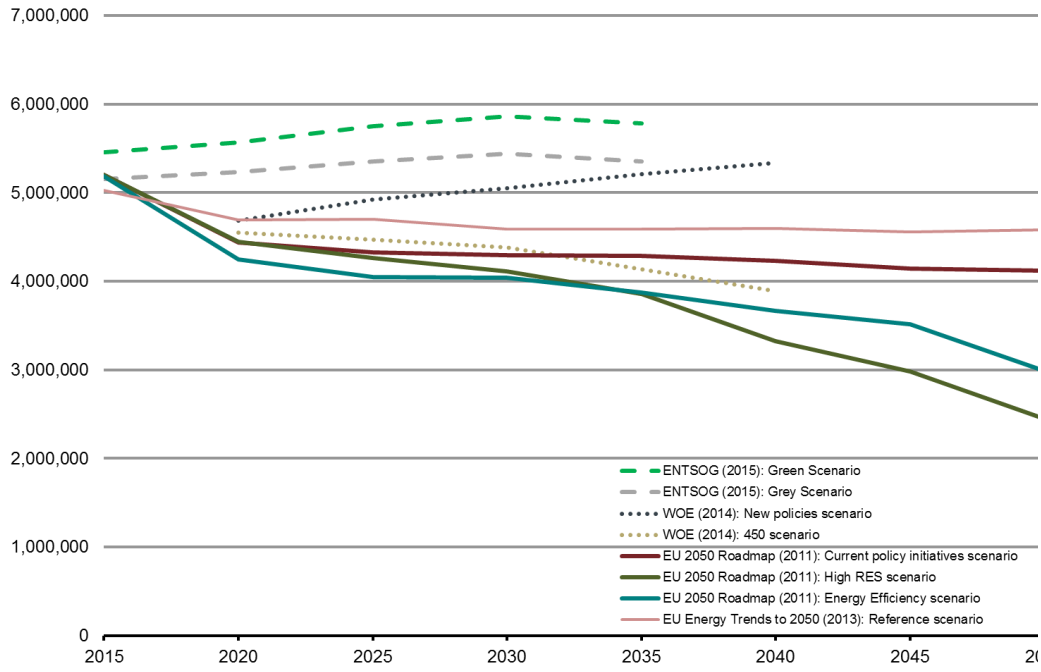
The EC 2050 roadmap (published in 2011) set out a number of scenarios for meeting carbon targets. These showed overall gas demand as being relatively stable in the 2020s, but beyond 2030 showed the potential for substantial reductions in gas use in a few scenarios, particularly in a scenario of high RES penetration.

Similarly, recent projections of EU gas demand from the ENTSOG Ten Year Network Development Plan show gas demand rising slightly until 2030 until it begins to fall beyond then. Finally, the International Energy Agency recently

1 Eurostat statistics

published a range of gas demand projections in their 2015 World Energy Outlook. In their 'New Policies' scenario gas demand rises over the next two decades. However, in their '450' scenario, which is consistent with reducing carbon emissions to limit global temperatures rises to 2 degrees Celsius, gas demand falls substantially. These scenarios are all shown below in Figure 2.

Figure 2. Future gas demand scenarios for the EU27 (GWh/year)



Source: EC Roadmap 2050 (2011); IEA World Energy Outlook (2014); ENTSOG TYNDP (2015)

The potential for falls in gas demand is high and use of gas for power generation is already well-established. In these regions, growth in renewables generation, energy efficiency and electric heating have a large potential to displace gas. In addition, in Finland and the Baltics there is large potential for biomass to replace gas in district heating as a result of subsidy schemes.

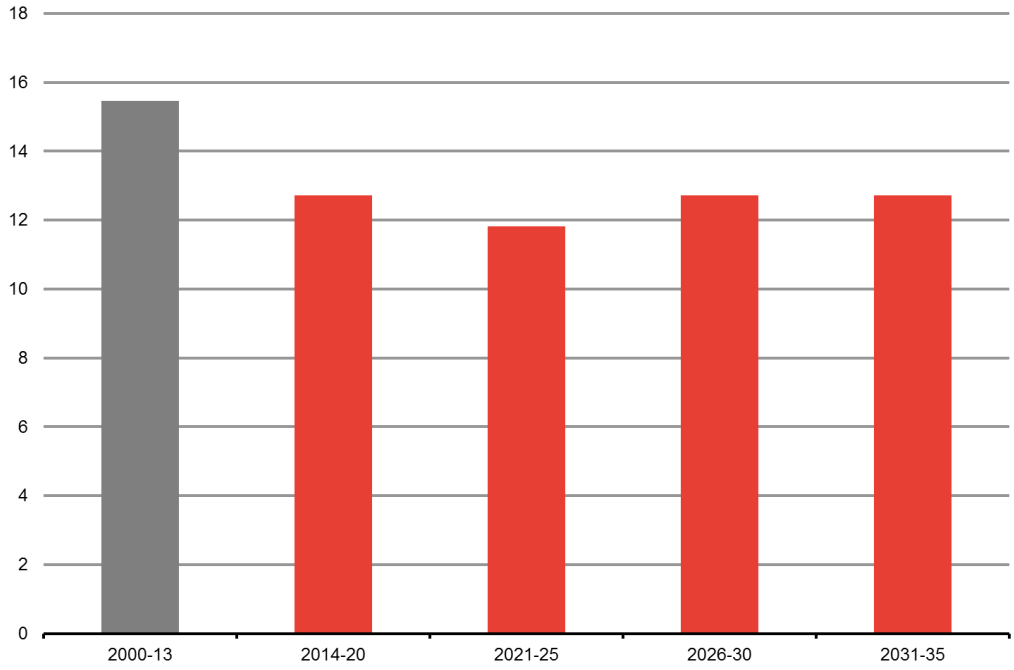
…and in this context substantial investment is still required

Despite the potential for falls in the *annual volume* of gas consumed, substantial investment in gas transmission is expected to be required over the next few decades.

The International Energy Agency estimate that EU investment in gas transportation (including gas transmission, gas distribution and LNG facilities) will need to maintained at similar rates to that seen over the last 15 years (see Figure 4 below). They estimate average investment of over €12bn/year will be required between now and 2035.

Outlook for gas demand and investment needs in Europe

Figure 3. Average annual gas transportation investments in the EU under the IEA World Energy Outlook "New Policies Scenario" (€bn/year)



Source: IEA (2014) *World Energy Investment Outlook*

Note: figures rounded to the nearest billion US dollars and converted to Euro using an exchange rate of 1.1.

There are a number of drivers of new investment requirements over the next few decades.

- **Investment to ensure peak demands and security of supply standards are met**. Peak gas demands are a key driver of the requirement for transmission capacity. Many scenarios forecast that peak demand across the EU will rise over the next decade (for example in the 2015 TYNDP maximum peak demand is reached in 2025 in ENTSOG's Green scenario). Moreover, while the overall *annual volume* of gas demand may fall in many countries beyond 2030, the pattern of demand is likely become more volatile as a result of growing intermittent renewables generation displacing gas generation. This means overall gas demand volumes are likely to fall faster than the peak demands beyond 2030. Therefore the overall capacity required may not fall substantially even when annual demand is falling[2].

[2] As an example of this, in the UK Ofgem has developed a "green transition" scenario which has gas annual demand falling by 70% by 2050. But in this scenario peak demand only falls by 30%.

Outlook for gas demand and investment needs in Europe

In addition, further investment in infrastructure is still required to ensure peak demands can still be met with a high probability in the event of supply disruptions. For example, a number of EU countries still do not meet the 'N-1' standard, which requires that peak demands can still be met even if the main infrastructure fails[3]. Investment will also be required to maintain and reinforce existing capacity in all countries.

- **Diversification of sources of gas for Europe and completing the internal market**. ENTSOG estimate that EU production of conventional gas could decrease by 60% by 2015[4]. As a result, new investment in LNG facilities, pipelines and reverse flow capabilities will be required to give the EU access to new sources (e.g. imports via LNG and from the Caspian as well as potentially shale gas) and to adapt the European gas system to future gas flow patterns. In addition, new investment is needed to complete the internal EU market, allowing gas to be traded freely across the EU so the benefits of trade can be realised and gas flows to where it is most valued with prices converging.

- **Expanding the gas network to new customers** will require new pipelines. This includes the expansion of the gas network to new areas (e.g. in the west of Northern Ireland) and to allow greater use of gas as an alternative fuel for transport[5]. Projections in the 2015 TYNDP show rapid expansion gas as a transport fuel over the next two decades, from less than 25,000 GWh/year in 2015 to over 100,000 GWh/year in 2035[6].

- **New investment in gas power and CHP generation in some countries** where gas generation is still expanding will change the geographic pattern of gas demand and require new pipeline connections.

- **New facilities will be needed to allow injection of biomethane into the network and exploit the potential for energy storage** in the network (e.g. power to gas technologies where there is surplus renewables generation).

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3 As of 2014, the number of Member States who comply with the 'N-1' rule was 20. EC (2014) *Preparedness for a possible disruption of supplies from the East during the fall and winter of 2014/2015*

4 ENTSOG (2015) *Ten Year Network Development Plan 2015*

5 Under the Directive 2014/94/EU Member States are required to develop national policy frameworks to support alternative fuels, including the underlying infrastructure required

6 ENTSOG (2015) *Ten Year Network Development Plan 2015*

There are major societal benefits to this investment…

These investments, if realised, will bring substantial benefits to society, helping to resolve the energy "trilemma": improving security of supply, reducing prices and reducing carbon emissions. For example:

- **security of supply will be improved** through investments in pipelines, LNG facilities and reverse flow capacity which allow for greater diversification of gas sources for the EU. This will help reduce countries' exposure to supply shocks and to price volatility. For example, in the Baltic region new investments will reduce dependence on Russian gas while in South-West Europe new pipeline connections can help reduce exposure to global LNG prices. The value of this increased security of supply is very high for gas consumers, with estimated value of lost load (VOLL) of around €1,000/MWh for many types of consumers[7].

  In addition, investments to allow greater use of gas as a transport fuel will reduce EU oil dependence, again increasing security of supply;

- investment in new pipelines, interconnections, LNG facilities and reverse flow capacity will also help deliver new gas sources to EU customers, **increasing competition** and helping to **reduce prices**. In addition, expanding access to the gas network to new customers through infill and network extension projects will help lower heating costs for these customers by allowing them to switch away from more costly options such as oil heating; and

- new investments will help **reduce carbon emissions** by facilitating the use of gas as a power generation source, and the use of high efficiency CHP plant, replacing high carbon fuels such as coal, lignite and oil (the emissions intensity of a gas CCCT power station is roughly half that of a coal power station and a two-thirds of an oil station). Moreover, gas power stations are flexible and therefore complement the growth of intermittent low-carbon generation such as wind.

  In addition, new investment will facilitate the injection of low-carbon biogas into the network and help expand the use of gas as a lower-carbon transport fuel.

Figure 4 summarises how new gas investments help resolve the energy "trilemma".

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7 See for example London Economics (2011) *Estimating Value of Lost Load (VoLL): Final Report to Ofgem*

Outlook for gas demand and investment needs in Europe

Figure 4. How new investment in gas transmission helps resolve the energy trilemma

	The energy "trilemma"		
Investment drivers	**Improving security of supply**	**Increasing competition & reducing prices**	**Reducing carbon emissions**
Investment to ensure peak demands and security of supply standards are met	✓✓✓	✓✓✓	✓
Diversification of sources (e.g. LNG, new pipelines, reverse flow)	✓✓✓	✓✓✓	✓
Facilitating the use of gas for power and CHP generation	✓	✓✓	✓✓✓
Expanding access to the gas network to new customers	✓✓	✓✓	✓✓
Increased use of natural gas as a fuel source for the transport sector	✓	✓✓	✓✓
Facilitating storage of energy (e.g. power to gas)	✓✓	✓	✓✓✓
Facilitating injection of biogas	✓✓	✓	✓✓✓

Despite the importance of these investments to consumers, they must be made in an increasingly challenging investment climate. As shown earlier, there is a large amount of uncertainty around future gas demand, with drops in annual demand of up to 40% possible by 2040. At the same time revenues will need to be maintained (or possibly even expanded) over this period so that the cost of existing and future investments in gas networks can be recovered.

A 40% reduction in demand implies average network tariffs would need to increase by 67% to maintain revenues. Given network tariffs typically represent over 10-20% of the bill (depending on the type of consumer) retail prices would need to increase by 7% to 14% to achieve this. In addition, increased volatility in gas demand could increase the number of periods where capacity is not fully utilised. As a result, recovering costs could become increasingly challenging and regulators may come under increasing pressure to reduce revenue allowances in future price controls.

Therefore it is increasingly important that network owners have security that they will be able to recover the costs of new and existing investments over the long term. We discuss how this can be achieved in the rest of this report.

3 Financing the investment

Gas transmission investments are long-lived assets whose costs need to be recovered over a long period of time from a broad group of customers. To finance them efficiently, this means investors require a regulatory regime which provides high certainty that investment costs can be recovered over their lifetime. The section discusses the two key elements of this: (i) the terms of the regulatory regime; and (ii) the means through which revenues are raised to recover investment costs.

Financing the investment: securing the right terms

For investments to be financed at a reasonable cost, a fundamental requirement is that the terms of the regulatory regime are set such that they allow efficiently incurred investment costs to be recovered with a high degree of certainty over time. There are two key elements to this.

- **The regulatory regime needs to be perceived as stable and transparent over the long-term**. Investors require long-term visibility over revenues. This means the terms of the regime need to be visible and predictable many decades ahead. There are a number of factors which impact on this, including:
  - *the independence and transparency of the regulatory process*. Having a fully independent regulator means the regime is less susceptible to short-term, politically-motivated changes in the regulatory rules, which undermine investor confidence. Similarly the regulatory process needs to transparent with decisions well-justified and consistent so that investors can assess likely changes more predictably (e.g. price controls should be consulted on thoroughly with the reasons for decisions well-evidenced and published).

    In addition, many countries have an appeals process where price control decisions by the regulator can be appealed to courts and/or competition authorities. This can provide further security that decision-making will be consistent and well-justified;
  - *the length of price control period*. The terms of the price control are most likely to change at the beginning of each new price control period. Therefore, longer price control periods can give investors more certainty (at least within the price control period). In Great Britain, after a major review of price control regulation in 2010, the regulator for energy networks decided to increase the length of price controls from 5

to 8 years. They argued this would be *"sending a strong signal that we have moved away from short-termism"*[8]; and

- *the scope for Regulated Asset Base (RAB) revaluation*. Investors need to know that the regulated value of their assets, on which they earn a regulated return, will not be changed in unpredictable ways in the future or retrospectively. Therefore, clear rules on how the RAB is valued are needed. From an investors' perspective, ideally the RAB value should be "locked-in" at the point efficient investments are made.

  In many countries (e.g. UK, France) there is very limited scope or precedent for RAB revaluations. However, in other countries there remains some risk of RAB revaluations, in particular due the use of benchmarking to revalue the RAB at each price control. If there are revaluations of the RAB, it is critical that this is done in a transparent and predictable way, and that any risk of RAB revaluation is reflected in the allowed returns for investors.

- **The terms of the regime need to allow for investors to recover efficient investment and financing costs**. The revenues allowed under the regime need to be sufficient to incentivise investment, In particular the allowed return (WACC) on capital for the transmission networks needs to be sufficient to cover their cost of capital and adequately compensate for the risk of investments (e.g. if there are greater risks around new investments then this should be reflected in the WACC allowed for these).

  Given the uncertainty around future gas demand volumes, and how revenue allowances may be affected if demand falls substantially, investors may be facing increasing risk. This in turn increases the cost of capital for these firms. Therefore in future, the allowed WACC for gas networks may need to increase.

  Equally, the method of assessing the efficiently incurred capital costs that are allowed to be entered into the RAB needs to be fair and transparent.

Making the terms of investment bankable in these ways is in consumers' interests. It ensures that the socially beneficial investments outlined in the previous chapter are made and that these can be made at a low cost. Failure to make investments bankable (e.g. by reducing allowances below that needed to recover investment costs) may reduce tariffs in the short term. But this is ultimately against the interests of customers: it will result in either under-investment. Or investments will only be made at a higher cost to consumers, since investors will require higher returns to compensate them for the additional regulatory risk.

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8 Ofgem (2010) *RIIO: A new way to regulate energy networks*

Financing the investment: ensuring credible cost recovery

Having determined an amount of revenue to recover, the credibility of the regulatory regime also fundamentally depends on there being a credible route to cost recovery from customers. If investors fear that costs cannot be recovered in an acceptable way, they are likely to assume that the terms are likely to be changed in the future, as politicians and regulators react. As a result investment will either dry up, or be available only at a high price.

However, there is a tension between ensuring prices are such that costs can be recovered and setting prices at a level which ensures transmission capacity is used efficiently. If there is significant spare capacity, the cost reflective price for access should be very low. Charging in this way ensures that the existing infrastructure is put to efficient use. But it may not allow its sunk costs to be recovered.

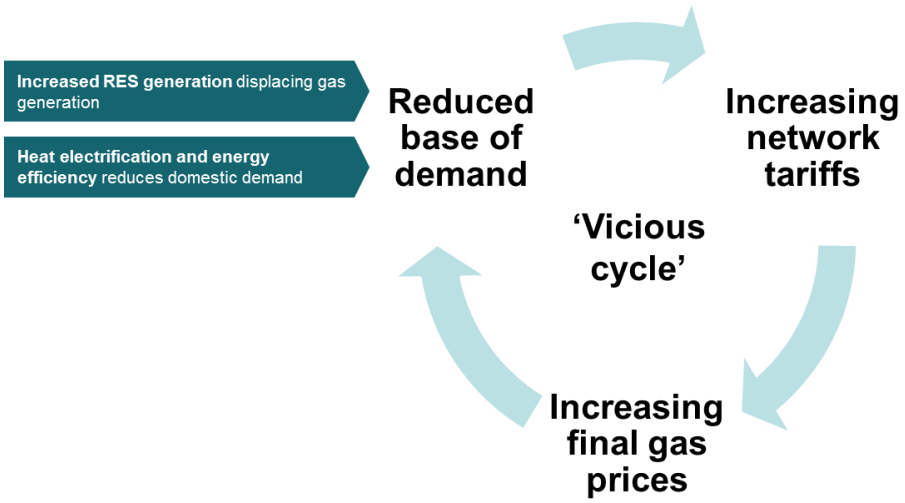
Transmission network charges in Europe generally attempt to strike a balance between ensuring cost recovery and incentivising efficient use of capacity. While tariffs are set to ensure overall revenues are sufficient to recover investment costs, there has been a trend to allow users to pay for the use of the gas network more cheaply on a day by day basis. While this encourages marginal use of the existing assets, it creates more challenges for sunk cost recovery as flows fall.

In addition, in countries where the volume of gas demand falls substantially there is a risk of a vicious cycle developing where falling demand means higher tariffs are required to maintain revenues, which in turn will reduce demand again as retail prices rise (see Figure 5).

To provide an illustration of this, as shown in Section 2, in some scenarios gas demand could fall by up to 40% by 2040. To keep total revenues for network operators broadly constant in this context (which may for example be required given new investments and the need to compensate existing investments) average network tariffs would need to increase by 67%. Network tariffs typically represent over 10-20% of the bill for customers, and therefore this network tariff increase would increase final retail gas prices by around 7-14%. For energy intensive industries which compete in international markets this price increase is material and could lead to significant further reductions in demand over the long term as industries relocate or reduce output. This would exacerbate the issue of declining demand volumes[9].

[9] Long-term gas price elasticities of over 0.1 to 0.2 have been measured, suggesting an increase in retail prices of 7-14% would reduce demand by up to 3%.

Figure 5. 'Vicious circle' of falling demand in the gas sector



Source: Frontier Economics

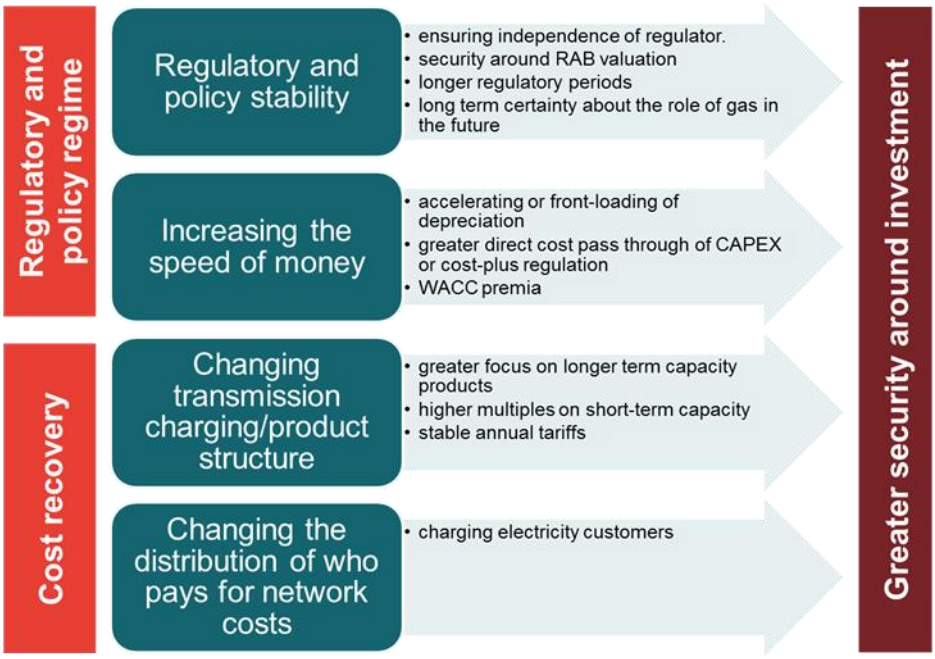
It is therefore critical that new solutions for cost recovery are found which are credible over the long term and which are adapted where the pattern of gas demand becomes lower or more volatile. These solutions range from changing the way in which transmission capacity is paid for, to expanding the customer base from which gas transmission costs are recovered. We discuss these potential solutions in detail in the next section.

4 Actions to secure the required investment in gas networks

In this section we set out the range of measures that could play a role in helping to secure the required investment in gas transmission in the future, along with some of the advantages and disadvantages of these.

We outline four areas where measures could help support investment in gas transmission which are summarised in Figure 6.

Figure 6. 'Toolkit' of options to help secure gas network investment



Source: Frontier Economics

Enhancing the long-term stability and transparency of the regulatory/policy regime

Given the long life of gas assets, investors need long-term visibility of the regulatory regime and how the regulator will behave in future. Key to this is having a fully independent regulator, which has a long-term mandate and is removed from political processes (including ideally through its financing). Without independent regulation the short-term political temptation to reduce allowed revenues below that needed to recover investments cost can be very high: since most costs are sunk, only very low revenues are required to ensure the assets are maintained and continue to operate.

Actions to secure the required investment in gas networks

Much progress has been made in moving to independent regulation and this is now a requirement under the Third Energy Package. Most countries in Europe have now moved to a system of independent regulation but there remain some decisions that are made by energy ministries (e.g. in Spain allowed revenues are still set by the energy ministry) and many cases of political intervention. Moreover, in some countries the process for decision-making and for appeals to independent courts is not as transparent or well-developed as it could be.

Even with an independent regulator and clear appeals processes, the terms of the regulatory regime can be designed to give investors more certainty that their investment costs will be recovered. In particular, the regulatory rules can be set to give greater assurance that the regulated asset base (RAB) will not be devalued in the future by the regulator (e.g. this could be set in legislation as has been attempted in Belgium). In addition, longer price control periods may help give investors greater certainty (since the risk of RAB revaluation is greatest at the beginning of each price control).

Reducing regulatory risk in these ways helps to support investment (and allows it to take place at a lower cost), therefore benefitting consumers.

Outside of the regulatory regimes for the networks, investors would also benefit from greater long-term visibility about the role of gas in the future and the policies which influence this. In particular, greater long-term certainty about the future of the EU ETS, RES subsidies and energy efficiency policies would help TSOs better plan gas investments since future demand would be more certain.

Increased speed of money and investment incentives

In regions where the gas demand is expected to fall there is a case for speeding up the recovery of investment costs. This would require a small increase in tariffs to a large group of customers in the short/medium term rather than attempting to recover costs from a reduced customer base in the long-term, which would require higher tariffs increases.

There are at least two ways the speed of cost recovery can be increased:

- most obviously, gas assets could be depreciated more quickly (as Ofgem has done in relation to gas distribution by front-loading deprecation profiles). This means that capex would be recovered more quickly.
- secondly, and more radically, some capex could be directly passed-through by TSOs (this currently the case for some expansion investments in Germany, and some replacement capex in the UK). This means capex costs for new investments would be recovered from customers immediately.

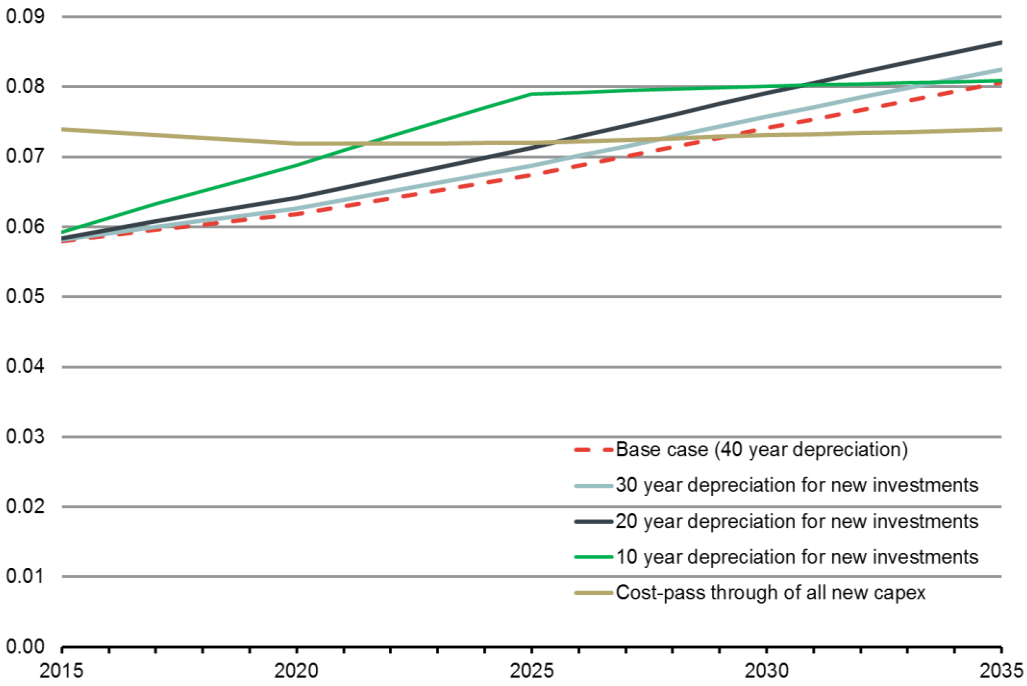
Figure 7 shows our stylised modelling of the impact of different options to increase the speed of money for new assets compared to a base case which

assumes new investments are depreciated over a 40 year lifetime (Annex 1 sets out all the assumptions used in this stylised model). The modelling shows that increasing the speed of money increases tariffs in the short-term, but in the long term tariffs stabilise.

The effect on tariffs is only very modest for the option to reduce depreciation to 20 years. It increases average transmission tariffs by 5% between 2015 and 2035. Given that transmission costs represent around 2-3% of retail prices, the effect on overall retail prices during this period would be minimal, an increase of around 0.1%.

This increased speed of money would help reduce long-term risks around cost recovery for investors, and therefore help support investment.

Figure 7. Average transmission tariffs under different regulatory reform options (c/kWh)



Source: Frontier Economics, based on a simple stylised model of a transmission network (see Annex 1)

In securing the investment needed, an alternative to increasing the speed of money would be to provide a WACC premium to encourage new investments. WACC premia are currently paid for new investments in Italy and France, although in general this is not common in Europe at present.

The impact on retail prices of introducing premia for new investments would be limited. Using our stylised model we find that applying a WACC premium of 1%

Actions to secure the required investment in gas networks

to all new investments from 2015 to 2035 would increase average tariffs by 2.6% and increase average retail prices by less than 0.1% during this period.

Changing the transmission charging/product structure to enhance cost recovery

There are number of changes to how transmission capacity is paid for that could improve the security around revenues. In many gas transmission markets there has been a trend toward capacity bookings being made on a short term (e.g. daily basis). In effect this has meant that some customers are not bearing the risks around future gas demand. In these situations capacity has been booked at peak times over the short term but left unbooked in many other periods and over the long term.

This in turn has created concerns around revenue stability. In addition, the prices and revenues during peak times have been limited because of low multipliers allowed on prices at peak times. These two factors undermine the potential to recover sufficient revenues.

To enhance the potential for raising revenues there are a number of options including the following.

- **Moving from low short term multipliers that make sure capacity is used to high multipliers that help make sure costs are recovered**. In the EU Network Code on harmonised transmission tariff structures for gas, the caps on short term multipliers of 1.5 (of the annual reserve price) for quarterly products and 3 for daily products could be relaxed. This would help ensure the full value of capacity can be recovered at peak times and further incentivise long-term bookings;

- **Reducing the availability of short-term capacity bookings and encouraging purchase of longer term capacity to match peak usage**. Another option to improve revenue certainty for investors would be to encourage a move towards more longer-term booking of capacity. This would transfer risks around future demands to the parties who can best manage these risks: the network users. This would in turn mean there are fewer periods where capacity is left un-booked and give greater long-term visibility of revenues. A greater level of long-term booking could be encouraged by relaxing rules restricting the length and volume of long-term contracts that can be offered for gas capacity. For example, the current EU network code on Capacity Allocation Mechanisms requires that at least 10% of interconnector capacity must be offered no earlier than the annual quarterly capacity auction. Alternatively, certain classes of customer could be required to book a minimum percentage of their required capacity long term;

- If such a move were made a careful balance needs to be struck to ensure that short-term incentives to use the network efficiently are preserved; and

- **Moving to new categories of tariffs which are more stable**. A further option to help provide a more stable revenue stream would be to require networks users to pay 'fixed' annual tariffs (as opposed to paying only when capacity is booked). The size of these payments could be determined according to various different measures (e.g. peak day consumption for an individual user or a deemed 1 in 50 year peak consumption value). Similar to this, mandatory bookings from network users could be required.

When considering these options a careful balance must be struck between enhancing the potential for cost recovery and ensuring that capacity is used efficiently (i.e. use of capacity is maximised and by customers who value it most).

Expanding the customer base and changing the distribution who pays for gas network cost

To enhance the potential for cost recovery, options to charge other types of consumers, or change the distribution of who pays should also be considered.

Economic theory suggests that network charges recovering sunk costs should be focused on those who are least price sensitive (Ramsey pricing). There are two advantages to this:

- revenue recovery is maximised since the demand base is less likely to be eroded by rising prices; and

- it encourages the most efficient use of the gas network because price sensitive customers will face prices closer to forward looking marginal costs and use the gas network efficiently, while demand from price insensitive costumers will be relatively unaffected.

However, there are major political and equity issues with Ramsey pricing as it involves discriminating against (and for) certain customer groups.

Other alternatives to expand the base on which investment costs are recovered include the following.

- **Ensuring electricity customers pay network charges to reflect the security of supply benefits provided by gas.** There is an argument that, at present, electricity customers do not fully pay for the security of supply benefit coming from power stations using the gas transmission network, especially if generators are only paying for daily capacity. In addition, much of the risk around gas consumption relates to uncertainty around demand for gas generators.

Actions to secure the required investment in gas networks

In situations where gas power generation volumes fall materially but they continue to be required to provide a reliable back up to intermittent renewable electricity production, it could be argued that the gas network is providing both a service to its direct customers (gas transport) and a service to electricity customers (security of supply). Electricity customers would have significant willingness to pay to fund the cost of the gas network as a back-up source of fuel for generation, given the high value of lost load (VOLL) in electricity.

The amount levied on electricity customer could be set in proportion to the amount the contribution of gas power generation to peak gas demand. We estimate that for a country with a high proportion of gas power generation, such as Great Britain, around 20% of peak gas demand is from power generation. If 20% of gas transmission charges were directly paid for by electricity customers, we estimate this would increase retail electricity prices by less than 0.05c/kWh (less than 0.2%)[10].

We note that this a second-best alternative to ensuring power generators pay for the security of supply benefits of the gas network directly through gas network charges.

- **Recovering some costs from general tax revenues**. Another option is to recover some of the gas investment costs from government tax revenues, to offset the prices faced by gas network users.

  There is an efficiency advantage to this, as reducing transmission prices brings them closer to marginal costs which encourages more efficient use of the gas assets. However, this must be offset against the inefficiencies caused by higher taxes, which can alter people's incentive to work, save or earn profits.

  Moreover, this option may not gain widespread public acceptance in the long-term. If many taxpayers are not using the gas network in the future, they may not accept having to pay for it. Related to this, revenue payments from the tax regime may be considered significantly less 'bankable' than payments from regulated tariffs. This is because fiscal policy (i.e. tax and spend) is very changeable over time, politically determined and outside the control of independent regulators.

  A more 'bankable' alternative would be to part-fund certain new gas investments through up-front *grant payments* recovered from taxation. To some extent this is already happening through EU grant funding given to

[10] However, we note that levies on electricity are already high relative to gas, in particular because renewable generation subsidy costs are typically recovered from electricity customers. This would clearly need to be taken into account in those countries where electricity levies are already high.

Projects of Common Interest. This is a reasonable approach for projects which have major cross-border benefits or where there are major external benefits not captured by transmission investors (e.g. security of supply, carbon savings).

Actions to secure the required investment in gas networks

5 Conclusions

Securing investment in gas transmission may become increasingly challenging given uncertainty around future levels and pattern of gas demand in Europe. The discussion in the previous section has shown that a number of regulatory reform options exist to help secure future investments in gas assets.

Many of the options require major changes in regulatory thinking and therefore the process to determine reform options should begin now. Moreover, most options will work better if they are implemented early, before the issues around cost recovery become too severe. Early action will also reassure investors in energy infrastructure that there is a plan to secure credible cost recovery.

Solutions will vary from country to country. For example, in countries where gas demand is expected to fall more rapidly in the long-term measures to give greater assurance over cost recovery (e.g. accelerated depreciation, expanding the customer base) are likely to be more important. Meanwhile, any moves to charge electricity customers for a greater proportion of gas transmission costs would only be justified in countries where gas generation represents a large portion of power capacity.

In general it is clear that without any reform of the investment environment for gas transmission, there is a risk of either underinvestment, or investment only being possible at a high cost of capital. Neither is in the interests of consumers.

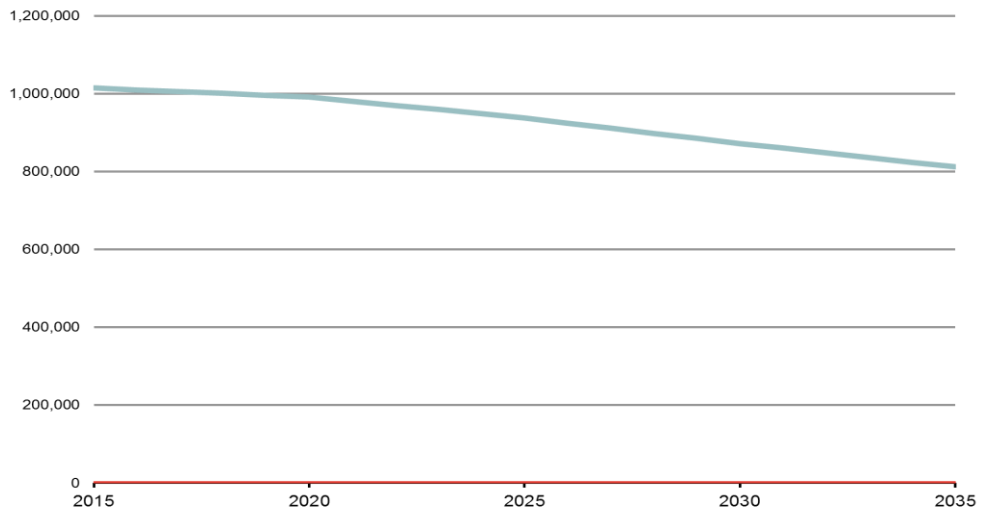
Annexe 1: Assumptions used in the stylised transmission financial model

To provide a high-level illustration of the impacts of different policy reform options on average transmission tariffs, we have developed a simple financial model of a transmission network. The ensure to key parameters are in proportion to what might be observed in reality, we have based the assumptions very roughly on the levels for gas transmission in Great Britain.

Table 1. Assumptions used in the stylised transmission financial model

Parameter	Assumption
Baseline WACC	5%
Opening RAV (2015)	€6,000m
Annual OPEX	€125m
Annual CAPEX	€175m

Figure 8. Gas demand assumptions for stylised model (GWh/year)



Source: Based in ENTSOG 'Green' Scenario for the UK

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