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MORE SECURITY, LOWER COST

A SMARTER APPROACH TO GAS INFRASTRUCTURE IN EUROPE

JONATHAN GAVENTA, MANON DUFOUR, LUCA BERGAMASCHI

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About E3G

About E3G

E3G is an independent climate and energy think tank, working to accelerate the global low carbon transition. E3G specializes in climate diplomacy, climate risk, energy policy and climate finance.

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SUMMARY

A smarter approach to energy security can deliver security for lower cost.

Energy security is too important for Europe's future to be managed within narrow silos. This report addresses how a more integrated approach to energy security can help Europe stay secure for lower cost, by:

> Treating energy efficiency as a deployable infrastructure

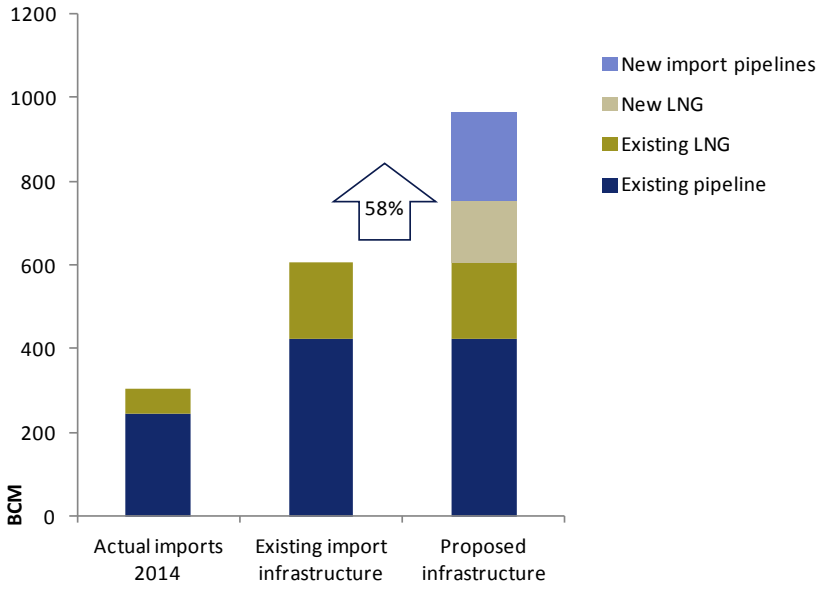
> Maximising the synergies between different infrastructure types

> Ensuring consistency with EU climate and energy goals, rather than pursuing contradictory policies.

Current approaches lack alignment.

If current plans were to materialise, the EU would see a significant increase in gas infrastructure, with pipelines and LNG terminals under development collectively representing a 58% increase in EU gas import capacity.

Figure 1: Projects representing a 58% increase in EU gas import capacity are under development (Source: E3G, Bruegel, ENTSOG, European Commission)



This new infrastructure is planned based on the expectation of rising gas demand. There are uncertainties about whether this will materialize. EU infrastructure planners and institutions have a track record of persistently overestimating gas demand. Despite previous expectations of a significant increase in gas consumption, EU gas demand has fallen by a fifth since 2010.

Looking forward, projections diverge. Demand falls significantly in scenarios in which EU energy and climate targets are met, but rises in scenarios where this constraint is not present. Projections of gas imports follow a similar trend. The primary EU gas network development plan is not, however, based on meeting EU energy and climate targets. As a result, the gas demand assumed for network planning is 30-55% higher in 2030 than a scenario in which the proposed 30% energy efficiency target for 2030 is met – creating the risk of policy misalignment.

Gas infrastructure also continues to be planned largely separately from electricity and demand-side infrastructure, despite the interactions between different sectors. This means opportunities to make use of electricity infrastructure and demand-side investment for increasing security of gas supply may be missed.

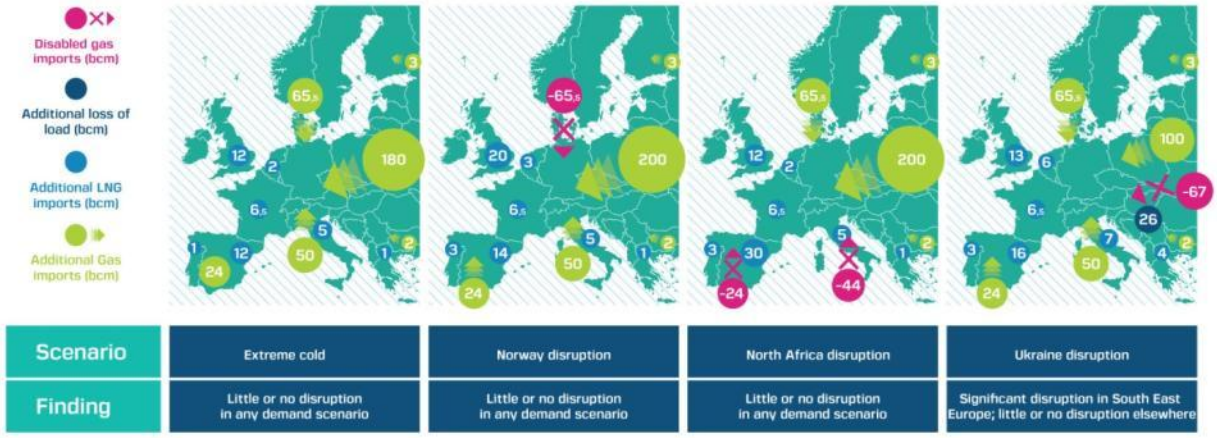
Infrastructure needs are limited and can be lowered further.

To assess the potential of a more integrated approach to energy security, energy consultants Artelys and Climact were commissioned by E3G and partner organisations in the Energy Union Choices consortium to model different infrastructure strategies against a range of demand scenarios and potential shocks and disruptions. The results are striking:

> **Europe's current gas infrastructure is highly resilient to supply shocks; limited investment may be needed in South East Europe**

A range of demand scenarios and extreme disruption cases were tested – including an extreme cold year and year-long disruptions to Norwegian, North African and Ukrainian imports. Existing EU gas infrastructure was sufficient to ensure physical security of supply in nearly all of these cases. The exception to this is South East Europe, where steps need to be taken to ensure physical security of supply in the event of a disruption from Ukraine.

Figure 2: Europe's existing gas infrastructure provides resilience against a range of shocks and demand scenarios; investment may be needed in South East Europe (Source: Artelys / Climact)



> Integrating gas and electricity systems delivers supply security at lower cost

A smarter integration of European gas and electricity systems and demand-side management can significantly decrease investments in gas infrastructure. In both the 'high demand' and the 'current trends' scenarios, investment needs are cut in half by utilising the flexibilities of cross-border electricity network to help manage the impacts from a disruption to gas supplies.

Figure 3: An integrated perspective looking at gas, electricity and buildings efficiency together has the potential to reduce gas infrastructure investments by 80% (Costs of gas infrastructure to ensure security of supply, in billion €; Source: Artelys/Climact)

> Demand reduction and buildings efficiency significantly reduces investment needs

Buildings are an integral part of the EU's energy system. Implementing demand side measures in line with a 2030 efficiency target can reduce infrastructure investment requirements by up to 74%. An integrated perspective looking at gas, electricity and buildings efficiency together has the potential to reduce gas infrastructure investments by 80%.

> Delivering the EU's 2030 targets can significantly reduce gas imports into Europe

A low carbon pathway in line with its 2030 climate and energy targets can reduce imports by 95bcm (-29%) compared to a scenario that fails to meet these targets.

> New gas infrastructure assets will be superfluous by 2050

Once built, new gas infrastructure has a lifetime of 40 years or more. By 2050, the dual impact of economy-wide efficiency improvements and electrification trends will sharply reduce gas demand in Europe – making new gas infrastructure superfluous before the end of its economic life.

New approaches are required.

A smarter approach to gas security is needed. It should:

1) **Treat energy efficiency as infrastructure**

   The first best option for managing energy security risk is effective management of energy demand. Meeting the 30% energy efficiency target for 2030 at European level makes the security challenge manageable. Demand-side investments should be given parity with other forms of infrastructure for energy security and be treated as a deployable option rather than as a fixed externality. Proposed new gas investments should also be tested against alternatives – including demand reduction, demand response, and electrification.

2) **Plan for the future we're aiming for**

   Network developers should base gas and electricity infrastructure planning and prioritisation on scenarios that meet EU climate and energy targets, rather than undermining them.

3) **Integrate infrastructure planning**

   Independent, integrated and transparent assessment of security of supply is needed to ensure proposed gas infrastructure is fully in the interests of consumers.

4) **Prioritise software over hardware**

   Security depends more on system rules more than on new pipelines. The EU should continue to implement market reforms and crisis response provisions.

5) **Test projects for long-term viability**

   Lock-in and stranded asset risks change the economics of new gas infrastructure. Projects should be tested for viability in a low carbon future.

6) **Phase out public funding**

   There are better uses of public money than large-scale investment in new gas infrastructure that may not be needed. EU funding for new gas infrastructure should be phased out by the time of the next European budget.

INTRODUCTION

Energy security matters.

Energy underpins our economy and society. European citizens need warm homes, functioning infrastructure, and thriving businesses and industry. Unexpected disruptions can have both an economic and social cost. Europe's vulnerability on energy also feeds wider geopolitical risk and can aggravate conflict. As a result, energy security has rightly become a key theme of the EU's Energy Union. Ensuring the resilience of the energy system is central to the success of Europe's energy transition.

The nature of the energy security challenge is changing.

Europe faces new threats and challenges, with rising geopolitical risks to Europe's east and south. At the same time, the EU energy system is rapidly changing. Europe is witnessing structural changes in its energy demand, increasing interconnection between markets, deploying new renewable sources of energy and integrating energy and digital technologies.

In this changing context, energy security cannot be managed within narrow silos. Individual fuels cannot be addressed in isolation from each other; energy supply cannot be segregated from demand; and immediate energy infrastructure choices cannot be separated from Europe's low carbon energy transition.

New thinking on energy security is needed.

The first test of the success of the Energy Union is the infrastructure choices that are made. Poor energy infrastructure decisions can have significant implications, from diverting scarce public money away from high value projects in other sectors or regions, to creating 'lock in' to levels of gas consumptions that are in conflict with EU climate change goals. Ultimately, European consumers bear most of the risks related to building energy infrastructure – building too much or too little, in the wrong place or of the wrong type.

This report looks at how Europe can be more secure for a lower cost, by taking a best-value approach to energy security which:

> Treats energy efficiency as a deployable infrastructure

> Maximises the synergies between different infrastructure types

> Ensures consistency with EU climate and energy goals, rather than pursuing contradictory policies.

CHAPTER 1

THE CURRENT EU APPROACH TO GAS INFRASTRUCTURE AND SECURITY

A significant quantity of gas infrastructure is being planned in Europe, with security of supply often quoted as a key driver for new infrastructure. A range of sources of public funding is being used to support development of this new infrastructure, in the form of both loans and grants. This infrastructure expansion comes despite recent reductions in EU gas consumption. Meeting EU energy and climate targets will require a reduction in fossil fuel use over time, raising questions about how new gas infrastructure is planned and prioritised in the energy transition.

Significant new gas infrastructure is planned

Despite the recent fall in gas demand, a significant quantity of gas infrastructure is being planned in Europe. This includes both new import capacity and strengthening internal gas transmission networks within the EU.

Import pipelines

Much of the current political focus on energy security concentrates on new gas import infrastructure. This includes a number of large 'mega-projects' aimed at increasing import capacity:

> **Nord Stream II** is a controversial project to connect Russia to Germany, in parallel to the existing Nord Stream I pipelines. It is sponsored by Gazprom, EON, BASF Wintershall, Shell, OMV and Engie. It would add 55 bcm/a to EU gas import capacity.

> **Southern Gas Corridor** is a flagship project supported by the European Commission. It is a successor project to the now-defunct 'Nabucco' project. The Southern Gas Corridor includes the Trans-Adriatic Pipeline (TAP), the Trans-Anatolian Pipeline (TANAP) and the Trans-Caspian Pipeline (TCP). The Southern Gas Corridor is initially planned to have an import capacity of 10 bcm/a from 2019, but the European Commission suggests that import capacity could eventually reach 100 bcm/a.[1]

[1] European Commission (2016) **Gas and oil supply routes**

> **Turkish Stream** is a successor to the now-defunct South Stream project. The project is currently suspended due to geopolitical conflicts between Russia and Turkey. It was originally proposed to bring 47 bcm/a from Russia to Europe via Turkey.

> The **Galsi** pipeline will link Algeria with Italy and has a proposed capacity of 7.6 bcm/a. It is due for completion in 2018.

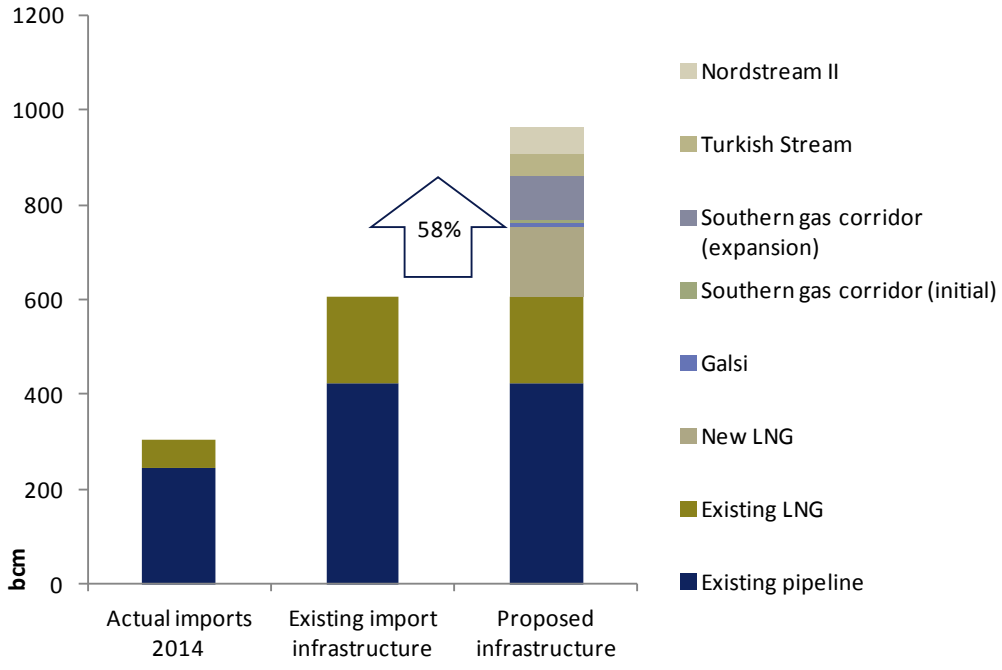
Further gas import projects such as a 'Bulgaria Stream' pipeline have been discussed in the media but not yet confirmed.

Liquefied natural gas

In addition to new import pipelines, a number of new LNG import facilities have been proposed. The European Network of Transmission System Operators (ENTSOG) Ten Year Network Development Plan identifies a total of 39 LNG projects, of which 13 selected as Projects of Common Interest.

Together these LNG have an import capacity of 147 bcm/a. This would represent an 80% increase on existing LNG capacity, if the proposed infrastructure is built.

Figure 4: Current and planned EU gas import infrastructure (Source: E3G based on EC, Bruegel, media reports)



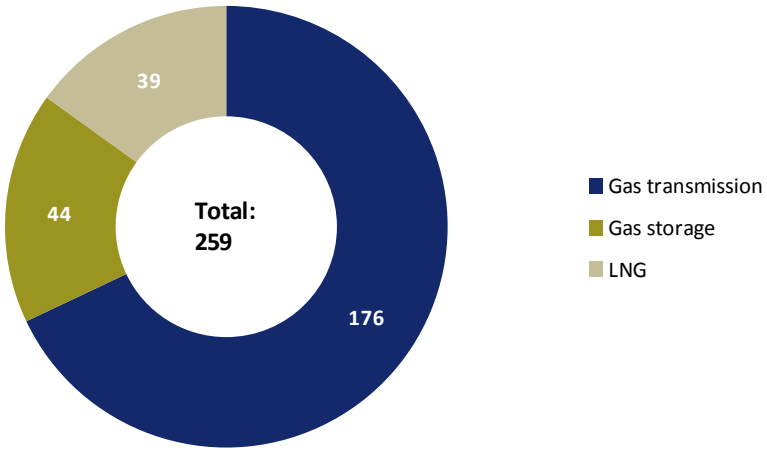
The LNG projects and new pipelines proposed collectively represent new import capacities of around **357 bcm/a** – higher than the EU's total gas imports in 2014, and equivalent to a 58% increase in gas import capacity. In reality, however, some projects compete with others and not all will go ahead.

Internal gas transmission and storage

New gas import infrastructure only represents one element of the new infrastructure planned. It sits alongside a programme for development of gas transmission and storage within the EU. ENTSOG – the group of EU gas infrastructure operators tasked with system planning – publishes a Ten Year Network Development Plan every two years.[2]

The TYNDP includes all 'projects of European significance' under development by the gas Transmission System Operators (TSOs). In the most recent TYNDP, 259 projects were put forward, including 176 gas transmission projects, 39 LNG projects and 44 storage projects.

Figure 5 Gas projects of European significance planned in the Ten Year Network Development Plan (Source: ENTSOG TYNDP 2015)



A subset of the overall project list assembled by ENTSOG has been selected as EU 'Projects of Common Interest' (PCIs).[3] The PCIs are selected for their contribution to the three pillars of the EU energy policy objectives:

> Completion of the internal market and competition

> Security of supply and supply diversification

> Sustainability and integration of renewables.

The list of projects is updated every two years, with the latest update was released in late 2015. EU countries are required to give projects selected as Projects of Common Interest the highest priority designation in their national infrastructure planning. In addition, projects have access to accelerated permitting procedures, improved regulatory conditions and financial support (including the Connecting Europe Facility).

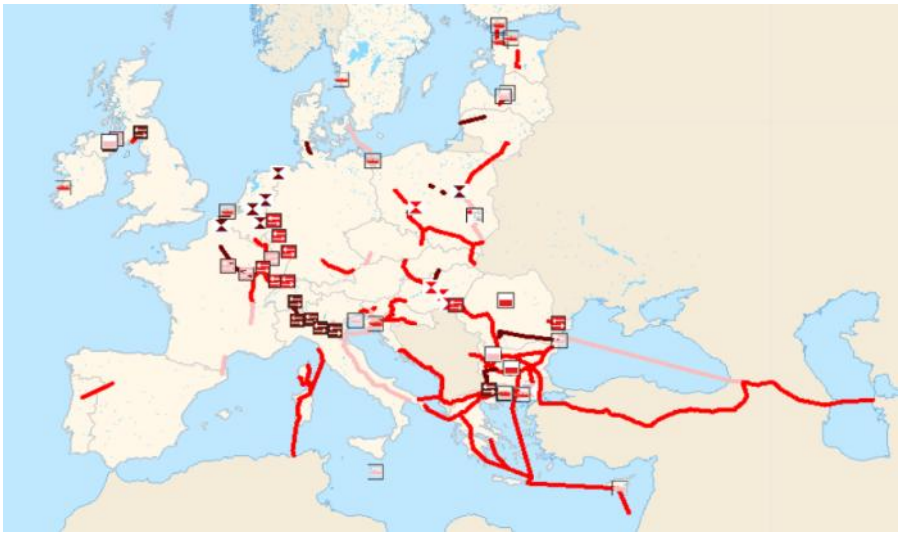
[2] ENTSOG (2015) **Ten Year Network Development Plan**

[3] European Commission (2016) **Projects of Common Interest**

77 of the 195 Projects of Common Interest are gas infrastructures, and include import pipelines, cross-border transmission, LNG terminals and gas storage projects.

In some cases clusters of competing or potentially competing projects are included on the same border, and not all will ultimately get built. Once these have been accounted for, the final number of Projects of Common Interest that should be seen as intended to be built is between 65 and 74[4].

Figure 6: Gas Projects of Common Interest 2015 (source: European Commission)



The PCI list has also been supplemented by various other more ad-hoc European designations signalling political prioritisation:

> A list of 'key security of supply infrastructure projects' included in the European Energy Security Strategy in 2014.[5] There was very little transparency about how these projects were selected – but the majority concern gas rather than electricity.

> The European Commission's LNG strategy, published in February 2016, included a further list of 12 priority projects including LNG terminals, internal pipelines and storage.[6] The total investment cost for these projects is approximately €5 billion. The Commission's LNG strategy proposed: *"the EU and Member States should commit themselves to moving towards rapid final investment decisions on these priority projects"*.

[4] **European Commission Delegated Regulation (EU) 2016/89**

[5] European Commission (2014) **European Energy Security Strategy {SWD(2014) 330 final**

[6] European Commission (2016) **An EU strategy for liquefied natural gas and storage**

Gas infrastructure receives considerable public funding

New gas infrastructure can receive a range of political and financial support from the European Union and associated institutions.

Much of the gas infrastructure under development in Europe is supported through regulated investment. Gas transmission system operators identify investment needs, and if they receive approval from regulators, they may recover costs and a profit margin on their investment through consumer tariffs. Some projects are developed on a merchant basis, where the developer takes the risk and the initial investment cost is recouped via margins on sales.

These models for financing gas infrastructure are supplemented by a broad range of funds and financing instruments from EU budgets and institutions. These have included:

> **Connecting Europe Facility**
€5.85 billion was allocated in the 2014-2020 EU budget period for the Connecting Europe Facility for Energy (CEF). The CEF focuses on cross-border energy networks in both gas and electricity. 25 grants for gas projects worth **€406m** were allocated in 2015, and a further **€207m** was allocated in early 2016[7]. All of these projects are also on the TYNDP and PCI list. By contrast, electricity projects received €293m in 2015 and only €10m in the 2016 round. This means that over two thirds of Connecting Europe Facility funding so far has gone to gas – despite the CEF regulation specifying that the 'major part' of the facility should go to electricity.[8]

> **European Energy Programme for Recovery**
The European Energy Programme for Recovery was established in 2009 as a response to the financial crisis. **€1,363m** was spent on gas projects, compared to €905m on electricity infrastructure.[9]

> **TEN-E fund**
The Trans-European Networks for Energy fund spent **€64m** for gas in the previous EU budget period, compared to €81m for electricity. It has been replaced by the Connecting Europe Facility.

> **European Structural and Investment Funds**
European Structural and Investment Funds are the EU's main investment policy tool, and include the European Regional Development Fund, the European Social Fund and the Cohesion Fund. **€977m** was spent on gas infrastructure in the 2007-2013 EU budget period, with a further **€769m** earmarked to be spent on gas infrastructure in current budget period[10]

[7] European Commission (2016) **Connecting Europe Facility Supported actions - January 2016;** European Commission (2016) **List of actions selected for receiving financial assistance under the second CEF Energy 2015 call for proposals**

[8] European Parliament and Council (2013) **Connecting Europe Facility regulation**.

[9] European Court of Auditors (2015**) Improving the security of energy supply by developing the internal energy market: more efforts needed**

[10] European Environment Agency (2008) **EN34 Energy Subsidies**; Bankwatch et al (2016) **Enfants Terribles**

> European Investment Bank

The European Investment Bank seeks to promote EU objectives by providing long-term financing on favourable terms. Over the last decade, the European Investment Bank has signed agreements to support approximately **€17 billion** of loans to gas projects (which include pipelines, distribution networks, LNG infrastructure, gas power generation and associated infrastructures).[11] This includes €9.6 billion of gas investment in the last 5 years, representing around 19% of the €51.7 billion the EIB invested in the energy sector overall. In addition, media reports suggest that the EIB will invest €1 billion in the TANAP pipeline and a further €2 billion in the TAP pipeline (both part of the Southern Gas Corridor)[12].

Table 1: EU public funding for gas infrastructure, 2007-present

Source	Fund	Amount
European Commission infrastructure funding	Connecting Europe Facility	**€612m** spent on gas infrastructure projects since 2015
	European Energy Programme for Recovery	**€1,363m** spent on gas projects in the EEPR between 2009 and 2013, compared to €905 billion for electricity
	TEN-E (2007-2013)	**€64m** for gas in the last budget period, compared to €81m for electricity
European Structural and Investment Funds	European Fund for Regional Development, European Social Fund, Cohesion Fund	**€977m** spent on gas infrastructure in 2007-2013 budget period. A further **€930m** earmarked for gas infrastructure in current 2014-2020 budget period
European Investment Bank	EIB energy lending and European Fund for Strategic Investment	**€17 billion** in loans to gas projects from 2007-present A further **€2 billion** under consideration to support the TAP pipeline and **€1 billion** to support the TANAP pipeline.

[11] EIB (2013) **EIB Energy Lending Policy**; EIB (2016) **Energy Finance Contracts Signed**

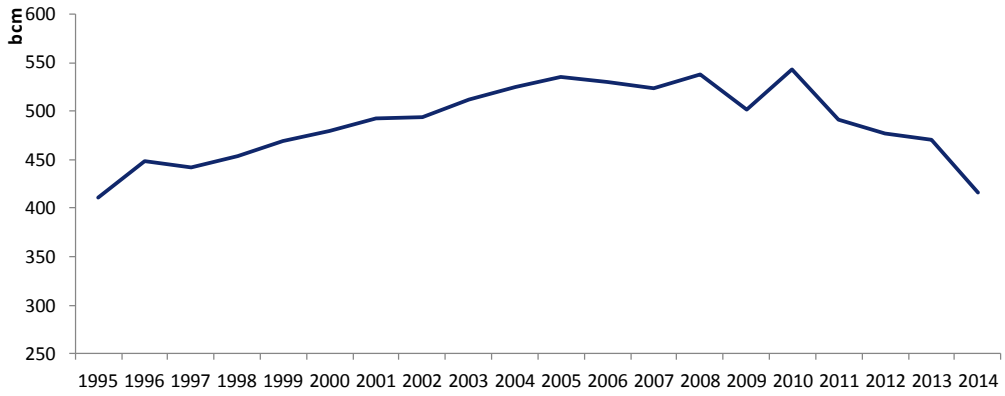
[12] Politico (2016) **EIB to decide on TANAP loan before August**

Gas demand has fallen; future demand will be lower if targets are met

Europe's current pipeline of gas infrastructure projects is based on the expectation of rising gas demand. By contrast, gas consumption in Europe has been falling and by 2014 was 23% lower than its peak in 2010.[13]

This fall in demand has led to spare import capacity on the European system. Utilisation of gas import pipelines stood at 58% in 2014 and usage of LNG terminals at only 32% - meaning only half of total EU gas import capacity was utilised.[14]

Figure 7: Gas demand in the EU from 1995 to 2014 (Source: Eurostat)



Future projections of gas demand diverge. Demand falls in scenarios in which EU energy and climate targets are met, but flatlines or rises in scenarios where this constraint is not present. Projections of gas imports follow a similar trend. However new gas infrastructure is planned solely on the basis of a presumption of rising demand; projects are not tested against scenarios in which targets are met.

ENTSOG's Ten Year Network Development Plan 2015 uses two scenarios on gas demand to 2035 to help inform their infrastructure planning. Both show continuous increases in gas demand: the low demand scenario implies an increase in gas demand of 12.5% over 2014 levels, while the high demand scenario represents an increase of 35%. Neither scenario is fully consistent with EU targets.

These scenarios contrast sharply with other scenarios that are more closely aligned with EU climate and energy targets of at least 40% greenhouse gas reductions (compared to 1990), at least 27% renewables and at least 27% improvement in energy efficiency by 2030, and an 80-95% reduction in greenhouse gases by 2050.

[13] Eurostat (2015) **Natural gas consumption statistics**. Early indications suggest a slight recovery in gas demand in 2015, but final statistics are not yet available. See Eurogas (2015) **Eurogas Statistical Report 2015**

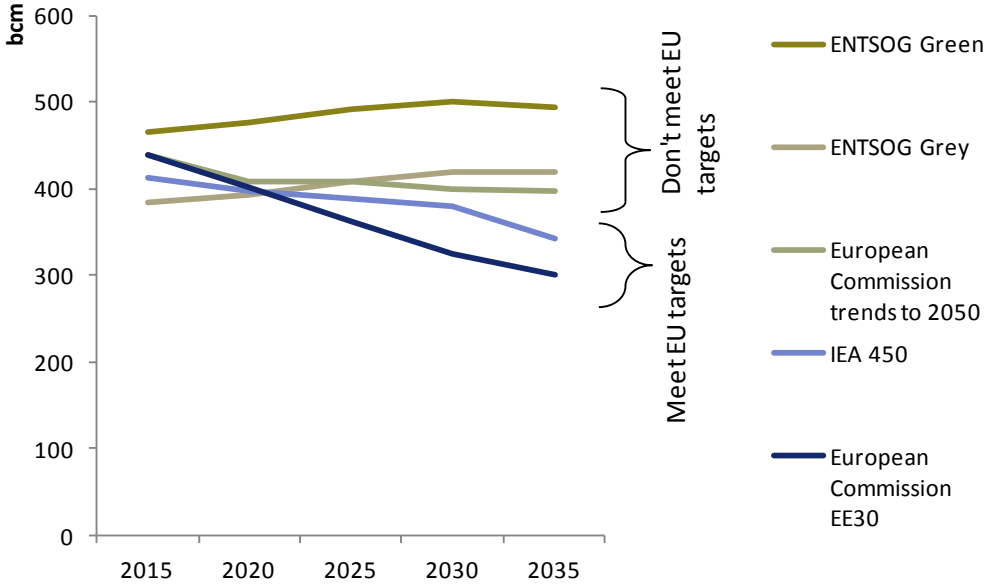
[14] Source: Bruegel (2016) **Rethinking the Security of the European Union's Gas Supply**

> The *European Commission 'trends to 2050'* scenario is based on the PRIMES model. It meets the lower end of the 80-95% GHG 2050 target but not intermediate renewables or efficiency targets. In this scenario gas demand is **5-20% lower** than in the ENTSOG scenarios for 2030.

> The *European Commission EE30* scenario applies a 30% energy efficiency target (referenced as an objective in the October 2014 council conclusions), as well as a 27% renewable energy target and a 40% greenhouse gas target. In this scenario gas demand is **23-35% lower** than in the ENTSOG scenarios for 2030.

> The *IEA 450* scenario is based on a global energy transition consistent with keeping global warming to a maximum of 2 degrees. Within this scenario gas demand in Europe is **10-24% lower** than the ENTSOG scenarios.

Figure 8: Gas demand projections to 2035. (Source: European Commission; ENTSOG; IEA)



Projections of gas import needs to 2035 follow similar patterns. There is considerable uncertainty over future rates of indigenous EU gas production, including on rates of production in the North Sea and in the Netherlands, and on future development of shale gas, biogas and other resources. Central scenarios from the IEA and ENTSOG project a decline in EU gas production of 39-47% (around 65 bcm) by 2035.[15]

When combined with demand projections, this means ENTSOG's scenarios foresee an increase of import needs of 22-29% and the *European Commission 'trends to 2050'* an increase of 7%. In contrast, import scenarios of the IEA 450 and *European Commission EE30* expect gas imports to decline by 3% and 26% respectively over this time period.

[15] E3G based on IEA (**WEO 2015**) and ENTSOG (**TYNDP 2015**).

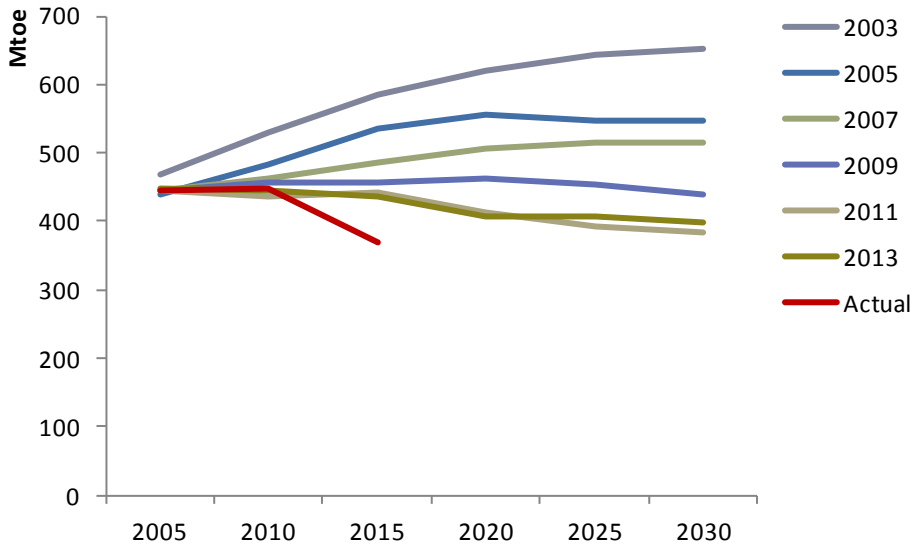
Europe has a track record of overestimating gas demand – and may be overbuilding its gas infrastructure as a result.

EU gas demand has been consistently overestimated in recent years – by the European Commission, ENTSOG, the IEA and the gas industry itself. The European Commission has lowered its projections of gas demand in every bi-annual assessment it has produced for the past decade.[16] This mismatch has been critiqued by the European Court of Auditors, who highlighted the uncertainty it creates for investors.[17]

> The Commission has persistently overestimated gas demand … and needs to restore the credibility of the forecasts it uses.
> – European Court of Auditors, December 2015

Similarly, ENTSOG projections used to plan new infrastructure have also been higher than what has materialized in reality. In the ENTSOG 2009 'Ten Year Network Development Plan', it foresaw an 8% increase in gas demand from 2010 to 2013. In practice, demand fell by 14% - a difference of 22%.[18] This means that the infrastructure plans based on these projections may have overestimated the amount of new investment required.

Figure 9: European Commission projections of gas demand and actual consumption (Source: E3G; European Commission)



[16] E3G (2015) **Europe's declining gas demand**

[17] European Court of Auditors (2015**) Improving the security of energy supply by developing the internal energy market: more efforts needed**

[18] E3G (2015) **Europe's declining gas demand**

Gas, electricity and efficiency infrastructures remain disconnected

Gas infrastructure continues to be planned largely separately from electricity and demand. This means opportunities to make use of electricity infrastructure and demand-side investment for increasing security of gas supply may be missed.

ENTSO-E and ENTSOG were set up to work towards the much-needed completion of the EU internal market for gas and electricity and enhance cooperation between European electricity TSOs and gas TSOs respectively. Their objectives were geared towards building more cross border connections, and ensuring that such connections were run effectively.

They were very effective in doing so and much progress has been achieved in building the European internal energy market over the past 10 years. However, as European energy policy and political objectives shifted towards resource efficiency, and demand for electricity and gas has started to flatten or decrease, the focus and mandate of the ENTSOs has not been updated.

Even though the TEN-E regulation mentions that "energy efficiency gains may contribute to reducing the need for construction of new infrastructures", the ENTSOs focus remain essentially on building more interconnections and identifying investment gaps – rather than flagging up potential over-investment, or identifying economically and environmentally beneficial alternatives to new infrastructure investments.

To date, cooperation between ENTSO-E and ENTSO-G has been relatively limited. Whilst the optimal management of their own systems is an explicit objective, cooperation with one another, or consideration of demand-side options (energy savings and demand response) to optimise the overall European energy system is not part of their official mandate. As a point of illustration, their respective founding texts do not even refer to their "sister entity", and energy efficiency is only mentioned once in the context of network codes. The only joint area of work highlighted by the TEN-E regulation is to develop a consistent and interlinked model by end of 2016 to support the cost and benefits analysis of specific projects. The two networks have also taken steps to rely on consistent datasets for their analysis.

Cost-benefit analyses are not sufficient if they are only done in silos. Effective energy system optimisation requires the ENTSOs, and their regulating entity ACER, to go further: actively consider cross sector optimisation between gas and electricity networks, and apply an 'efficiency first' test when assessing the value of new investments.

CHAPTER 2

WHAT INFRASTRUCTURE DOES EUROPE ACTUALLY NEED?

An integrated perspective on gas, heat and electricity systems has the potential to improve European energy security and lower energy system costs. A consortium of organizations including E3G, the European Climate Foundation, Agora Energiewende, the Regulatory Assistance Project and WWF commissioned leading energy consultants Artelys and Climact to assess the impacts of taking such an integrated perspective on energy infrastructure requirements to ensure security of supply.

The assessment – **Energy Union Choices: A perspective on infrastructure and energy security in the transition** - investigates the resilience of the EU gas system and the adequacy of existing capacity under a set of different possible futures and scenarios. The scenarios represent a wide range of energy demand projections and looks at a set of extreme disruption cases. It seeks to answer the questions:

> Which infrastructure investments are lowest risk and regret to ensure resilience throughout the transition?

> Can an integrated view of infrastructure investments (across electricity, gas, heat, demand-side and storage) help meet security of supply challenges at a lower cost?

The key findings of the analysis are reproduced below. The full assessment and methodology can be downloaded from www.energyunionchoices.eu.

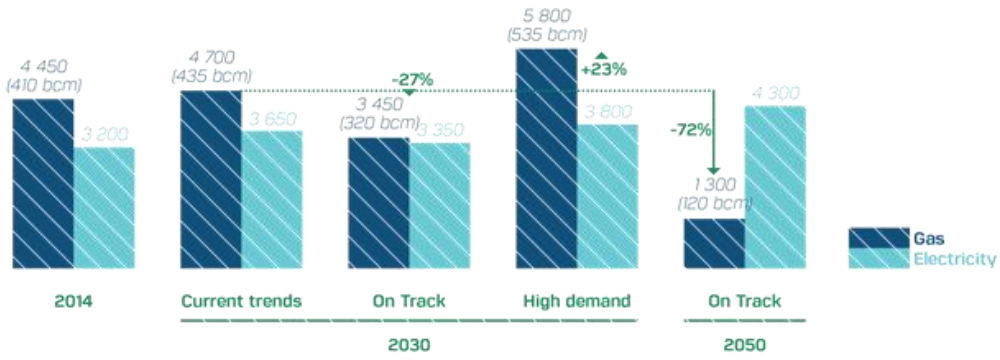
Finding 1

Europe's current gas infrastructure is highly resilient to supply shocks; limited investment may be needed in South East Europe

Under normal market conditions, Europe does not need any new import capacities into Europe or cross-border gas infrastructure between Member States to secure supplies. Extrapolating current trends and policies in the European energy market to 2030, gas demand remains at similar levels as today prompting no supply shortages or new infrastructure needs. The situation improves substantially in the case of full implementation of 2030 targets, as demand reduces to 320 bcm (from 410 bcm today).

Even in a scenario where gas demand increases towards 2030 (to 535 bcm), the analysis shows that the diversity of existing gas routes and infrastructure is sufficient to avoid loss of load in the European Union. While this scenario represents a real failure to meet the 2030 targets, it indicates that the continent's existing gas infrastructure has a good margin to secure supplies. Also, it should give policy makers the confidence that the existing gas system can handle an accelerated coal phase-out in the power sector without significant new infrastructure investments.

Figure 10: Gas and power demand in Europe (in TWh and bcm), for the scenarios considered (Source: Artelys/Climact)



Existing infrastructures can also ensure gas security of supply for most of Europe under extreme cold weather conditions, with an 8% increase in average consumption. Only in a few countries, like Serbia and Finland, the margins are rather tight and cold weather conditions in combination with high demand can lead to some security of supply concerns.[19]

It is common practice at national and EU level to assess system resilience against a range of disruption scenarios that are considered likely and impactful. Infrastructure investments are then prioritized accordingly. This report finds that current gas infrastructure in Europe provides sufficient optionality to face major and unprecedented stress and supply disruptions cases.

For example, if imports from North Africa were interrupted for an entire year, EU countries could rely on more Russian gas (+ 48 bcm, adding up to a total of 201 bcm) as well as more Iberian LNG imports (+ 19.5 bcm, adding up to a total of 32.5 bcm), transported across the continent via existing pipelines. In case Norwegian supplies become unavailable[20], more Russian gas is transported from the east (+ 48 bcm, adding up to a total of 201bcm) and more LNG comes in from the south (+ 4 bcm, adding up to a total of 17 bcm).

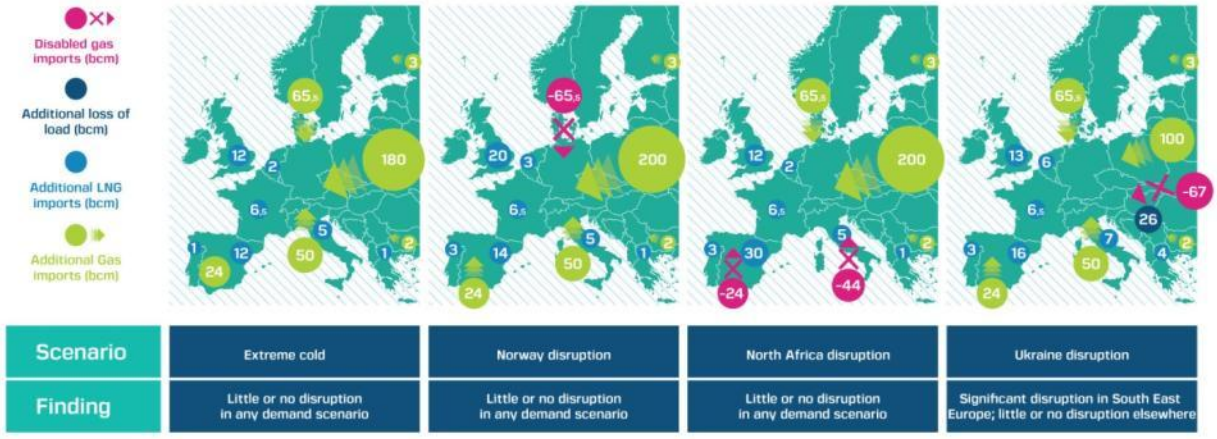
[19] The Finnish National Energy Security Agency (NESA) developed a specific Gas Emergency Response Plan, which includes gas demand reduction measures, control of gas deliveries, alternatives fuel stock for fuel switching and cut back of contractual supplies (see "Provisions for and actions in a potential disturbance in the Natural Gas supply, NESA, Oil pool committee, 2013")

[20] The Campbell's Atlas of Oil and Gas Depletion (2013) projects that Norwegian gas production could peak in 2018, and that their total fossil fuel production (oil and gas) would decrease by two thirds by 2030.

The extreme case of a year-long Ukrainian transit shutdown does not result in any loss of load in most of the European continent, with the exception of some countries in South Eastern Europe, which are strongly affected (loss of load up to 26 bcm). This is due to constraints in the pipelines between Western and South Eastern Europe, unable to sustain a sufficient flow of gas from the (largely underutilised) LNG terminals in Western and Northern Europe.

The report identifies South Eastern Europe as the region in Europe where a real gas security of supply issue occurs. The question is to what extent that means new investments in gas infrastructure assets – gas solution to gas problems – or whether an integrated perspective on gas, electricity and building infrastructure together can help meet supply security standards at lower costs.

Figure 11: Gas imports and loss of load under extreme conditions (Current Trends, 2030) (Source: Artelys/Climact)



Finding 2

Integrating gas and electricity systems delivers supply security at lower cost

In case of gas supply concerns, the tendency is to solely look at gas supply solutions. This report finds that, under current gas demand trends, investments of up to €6.9 billion in a mix of new LNG terminals, pipelines and gas storage facilities are required to provide the necessary options to deal with a Ukraine transit disruption case. Under a high gas demand scenario, this number increases to €14.1 billion.

A smarter integration of European gas and electricity systems and demand-side management, however, changes the picture and can significantly decrease investments in gas infrastructure. In both demand cases, investment needs are cut in half (to €3.7 billion in the Current Trends scenario and to €7.7 billion in the High Demand scenario). This cost reduction comes from an optimal leveraging of the

synergies between gas and power systems, by displacing the use (and, to a lesser extent, the location) of gas-based generation in areas with less congestion risks and re-importing the electricity using existing electricity transmissions. Because gas-for-power demand has the tendency to be peaky, leveraging the power system from other regions has the additional benefits of reducing peak demand in the regions having issues. On the demand side, the use of already existing oil back-up capacities in gas-heavy industries would also contribute significantly to this reduction. Both these aspects help decrease the overall gas demand during crisis situations, which avoids oversizing those new gas infrastructure assets that are still needed.

Finding 3

Demand reduction and buildings efficiency significantly reduces investment needs

Buildings are an integral part of the EU's energy system. The report finds that implementing demand side measures, in line with a 2030 efficiency target[21], can significantly reduce gas demand and infrastructure investments requirements. This report shows that an integrated perspective on energy security, looking at gas, electricity and buildings efficiency together, has the potential to reduce gas infrastructure investments by 80%, equivalent to €2.8 billion (from €14.1 billion).

Figure 12: Overview of costs to 2030 (investment and maintenance) in billion € to ensure security of supply across scenarios and strategies (Source: Artelys/Climact)

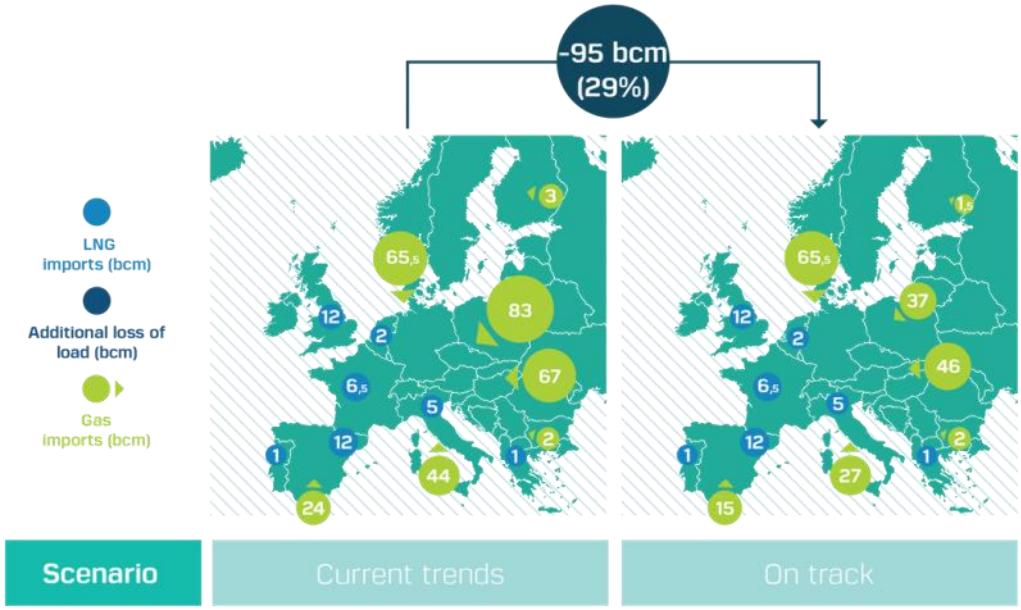
[21] The On Track scenario assumes 30% primary energy savings (compared to the 2007 reference), which is consistent with the upper end of the 2030 target for efficiency adopted at the October 2014 European Council.

Finding 4

Delivering the EU's 2030 targets can significantly reduce gas imports into Europe

The European Union is currently highly dependent on energy imports. This report finds that, if the EU continues on a low carbon pathway in line with its 2030 climate and energy targets, it can reduce imports by 95 bcm (-29%), compared to a scenario that fails to meet these targets.

Figure 13: Gas and LNG imports to Europe in the standard case - Overview for the different scenarios (Source: Artelys/Climact)



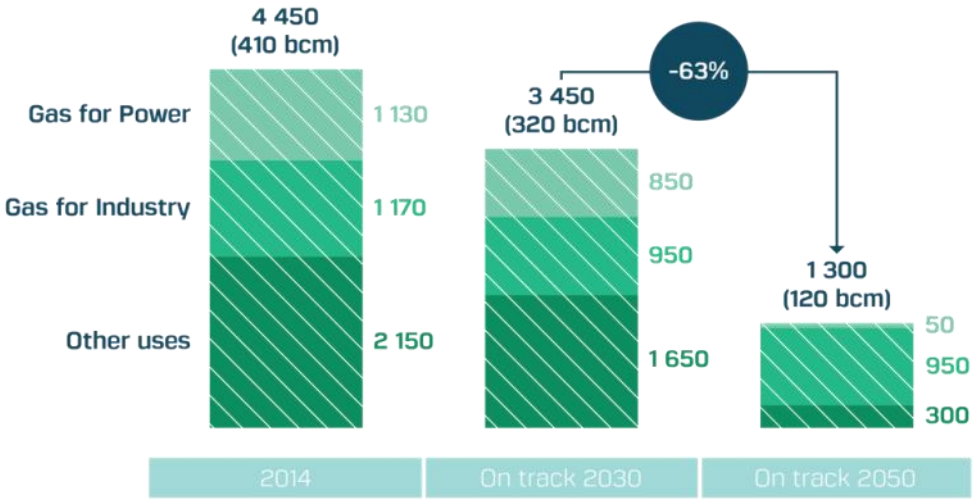
Finding 5

New gas infrastructure assets will be superfluous by 2050

Large infrastructure assets have a lifetime much beyond the next 15 years. It is important, therefore, to keep a long-term perspective when assessing investment decisions. By 2050, the dual impact of economy-wide efficiency improvements and electrification trends sharply reduce gas demand in Europe. As shown above, gas demand may reduce to 120 bcm, down 63% from 410 bcm today, while demand for electricity increases by 28% in the same period. These figures are indicative of the changing nature of the energy security challenge.

That means that any new investment in gas infrastructure in the coming years is at serious risk of becoming stranded before the end of its lifetime. The graph below shows the reduction in imports needed to supply the EU's gas demand in 2050.

Figure 14: Gas consumption per sector in Europe (TWh and bcm) (Source: Artelys/Climact)



The analysis in context: comparing infrastructure assessments

Only a small proportion of the current gas infrastructure planned is identified as needed for security of supply, even in the extreme disruption scenarios.

The Artelys/Climact analysis focused on physical security of supply of gas. This is only one of the drivers of new gas infrastructure: other drivers include creating more competition and integrating markets. Similarly, while four extreme stress tests were applied, the model did not test all potential sources of disruption. It is nevertheless useful to make a comparison between the core projects and routes identified as needed to be able to cope with a gas supply interruption via the Ukraine in the modelling, and the scale of new investments planned:

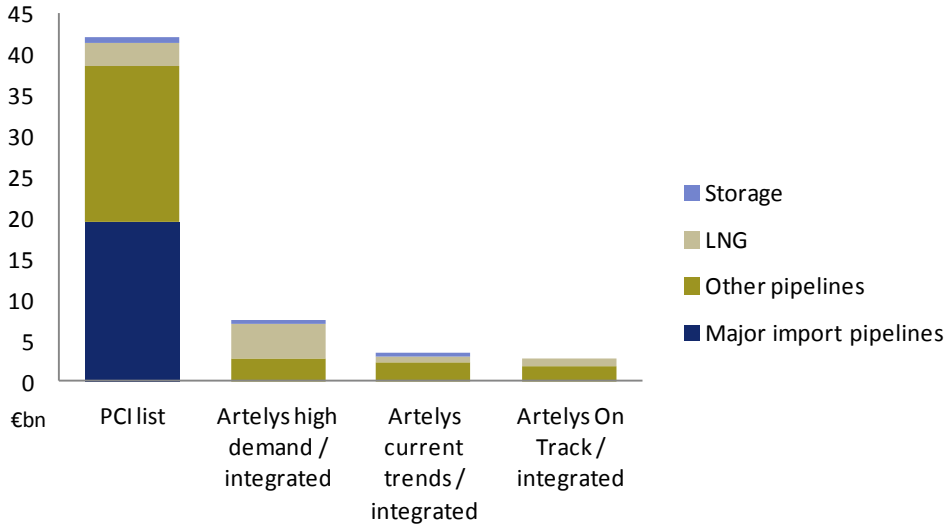
> None of the import **megaprojects** (e.g. Nord Stream II, Southern Gas Corridor) were identified as needed for security of supply under any of the scenarios or supply shocks – despite the considerable political focus these projects attract.

> The modelling suggested that 5 bcm of new **LNG** capacity is sufficient to manage supply security in the scenarios modelled. This compares to 147 bcm planned in the ENTSOG Ten Year Network Development Plan.

> The investments identified as potentially needed for security of supply represent a small proportion of the current planned infrastructure investment in the **ENSTOG TYNDP** and the **PCI** list, with €2.7 billion of investment needed in the 'On Track' scenario, compared to approximately €42 billion required to complete the projects in the PCI list.

The scale of the difference between the scenarios suggests that there could be major benefits in seeking to lower investment needs through a smarter approach to infrastructure development.

Figure 15: Gas infrastructure investment in PCI list and modelling scenarios (€bn) (source: E3G, Climact, Artelys)



CHAPTER 3

A SMARTER APPROACH TO GAS SECURITY

Europe can build less and stay secure. A new approach to gas infrastructure is needed to avoid building unneeded capacity and ensure taxpayer and consumer money is well spent.

A smarter approach to gas security has six components:

1. Treat energy efficiency as infrastructure
2. Plan for the future we're aiming for
3. Integrate infrastructure planning
4. Prioritise software over hardware
5. Test projects for long-term viability
6. Phase out public funding

Treat energy efficiency as infrastructure

Demand-side investments should be given parity with other forms of infrastructure for energy security.

Energy efficiency is often treated in the realm of environmental policy. Yet efficiency has many of the characteristics of infrastructure, as defined by the IMF and OECD: it is long-lived, fixed capital; it requires upfront investment; it provides inputs to a wide range of goods and services; and frees up capacity elsewhere in the economy.[22]

This assessment suggests that energy efficiency should also be treated as an energy security infrastructure – as it forms a direct alternative to supply-side investments.

Giving full parity to efficiency as an infrastructure priority will require reforms to economic appraisal of energy efficiency projects, accounting rules on efficiency investments and reforms to how efficiency is treated within EU state aid rules.

The first best option for managing energy security risk is effective management of energy demand. Meeting the 30% energy efficiency target for 2030 at European level makes the security challenge manageable.

In October 2014, European leaders agreed to an EU-level target of at least 27% for improving energy efficiency in 2030 compared to projections of future energy

[22] Frontier Economics (2015) **Energy Efficiency as an Infrastructure Priority**; E3G (2016) **Energy Efficiency as Infrastructure**

consumption, with a commitment to review this target by 2020 ,"having in mind an EU level of 30%".[23] The 30% target level has been publicly backed by European Commission President Jean-Claude Juncker and Commissioner for Energy and Climate Miguel Arias Cañete.

This analysis suggests there is a strong energy security case for adopting and delivering a 2030 energy efficiency target for at least a 30% improvement in energy efficiency. Compared to the 'current trends' scenarios, gas imports in a scenario that meet the 30% target fall by 96 bcm (29%). Overall gas use falls by 27% compared to the 'current trends' scenario and by 22% compared to 2014 levels. Investment requirements for maintaining supply security drop by up to 74% compared to a high demand scenario.

Demand is not a fixed externality; it is a deployable option.

Targeted investment in demand management and demand reduction in the areas most vulnerable to energy security disruptions can further improve European resilience at lower cost. Rather than treating gas demand as a fixed input to security assessments and infrastructure planning, demand reduction should be seen as a policy option and infrastructure investment that can be actively deployed to address energy security problems.

At present, those economies with the highest dependence on gas from a single supplier are also those with the highest levels of energy intensity.[24] Yet EU investments in energy efficiency are currently poorly correlated with those countries with the highest opportunities for improving the energy productivity of their economies.[25] Focusing EU technical assistance, structural and cohesion funds, and financial instruments on the areas of highest vulnerability can both enhance European energy security and avoid the need for significant new gas infrastructure investment.

Investments should be tested against alternatives – including demand reduction, demand response, and electrification.

To ensure best value investment across infrastructure types, new gas infrastructure should be tested against alternative options, including demand reduction, demand response and electrification.

As noted in a recent analysis from the Regulatory Assistance Project, the current Internal Gas Market Directive would allow for member states to introduce a 'public service obligation' on infrastructure developers. This could take the form of a least cost investment requirement to mandate assessment of both supply- and demand-side resources when considering infrastructure expansion. Similar requirements in the

[23] **European Council conclusions, October 2014**

[24] E3G (2014) **Energy Efficiency as Europe's First Response to Energy Security**

[25] Notre Europe (forthcoming) Investment in Europe: Making the best of the Juncker Plan

US have enabled system operators to defer billions of dollars of new investment through investing in demand-side alternatives.[26]

Introducing a least-cost investment requirement could, in fact, improve the economics, reliability and efficiency of the overall system by coming up with the most cost-effective portfolio of resources through a cost-benefit analysis.
- Regulatory Assistance Project, 2016

The Trans-European Networks for Energy (TEN-E) regulation, which sets the rules for selection of EU Projects of Common interest, will be reviewed in 2017. This is an important opportunity to introduce a similar least-cost investment requirement into EU infrastructure project prioritization.

Plan for the future that Europe is aiming for

Network developers should base gas and electricity infrastructure planning and prioritisation on scenarios that meet EU climate and energy targets, rather than undermining them.

European infrastructure network operators do not currently fully incorporate EU climate and energy targets into their modelling used for the assessment of new gas infrastructure. Instead, higher demand scenarios that represent policy failure are typically used. As a result, infrastructure plans will be misaligned with other areas of EU policy making. This 'policy cannibalism' creates risks either of making it harder for EU objectives to be achieved or of costly overdevelopment of infrastructure.

To avoid this risk, future iterations of infrastructure network development plans and project prioritization processes should incorporate both 2030 and 2050 EU energy and climate objectives into their central scenarios.

Integrate infrastructure planning

Independent, integrated and transparent assessment of security of supply is needed to ensure proposed gas infrastructure is fully in the interests of consumers.

Energy infrastructure planning and development in Europe has progressed significantly over the last decade, with an increasingly regional and European approach and steps forward being taken on transparency.

[26] Regulatory Assistance Project (2016) **Unlocking the Promise of the Energy Union: "Efficiency First" is Key**

An indispensable input … would be a sophisticated market development model capable of describing predictions for infrastructure needs under various policy and market scenarios, including a robust range of demand scenarios. At present, the Commission does not have a modelling tool in-house, nor does it have access to such a tool in ACER. To date, the Commission has used energy market modelling from an external contractor, while ACER relies on ENTSO-E and ENTSO-G modelling.
- European Court of Auditors, December 2015[27]

Further reforms are still required to ensure best value for consumers and to take advantage of the considerable benefits of optimizing infrastructures across gas, electricity and demand. Gas TSOs are highly expert in gas market dynamics and infrastructure, but are not necessarily best placed to assess overall system dynamics, or impacts of policy or demand measures. Concerns have been also raised about potential conflicts of interest, a persistent overestimation of gas demand and a failure to align gas network planning with wider EU objectives and targets on climate change, renewable energy and energy efficiency.

A solution to these challenges was recently put forward by the European Court of Auditors in their review of EU energy security. They proposed that an independent market development model should be used to test and evaluate investment plans put forward by infrastructure developers. Such an approach would be able to identify opportunities for lowering costs as a result of synergies between gas, electricity and demand-side infrastructure, as well as providing stronger and more transparent oversight of EU infrastructure development.

Prioritise software over hardware

Security depends more on system rules more than on new pipelines.

While limited new physical infrastructure is needed for security of supply, markets and emergency response procedures need to be working well for existing infrastructure to be used efficiently and for security to be guaranteed. This requires a continuation of efforts to implement EU market rules, including the Third Energy Package and completion of the gas Network Codes.

A new regulation on gas security of supply was put forward by the European Commission in February 2016. This rightly focuses on crisis response and cross-border solidarity. Measures proposed include emergency response provisions to ensure the needs of vulnerable customers are met first, and a shift to regional emergency planning.

[27] European Court of Auditors (2015**) Improving the security of energy supply by developing the internal energy market: more efforts needed**

Further proposals on rebooting the 'software' of EU gas security have been put forward by Bruegel, an EU thinktank. Noting market failures in rewarding supply security, the authors propose the creation of an administered EU market for a gas security margin. This would oblige gas importers and producers to maintain a security margin for use in emergency situations – and could take the form of supply options, interruptible demand, fuel switching or storage.[28]

Test projects for long-term viability

Lock-in and stranded asset risks change the economics of new gas infrastructure.

Gas infrastructure has a long lifespan: once built, new pipelines and LNG terminals can last 30 to 40 years or more. Yet the dynamics of the energy transition are moving far more rapidly, which raises questions over whether new infrastructure whether will be needed over its full economic lifetime. A new pipeline that is planned now and comes on stream in 2020 will still be there in 2060 – by which time the EU has committed to have largely decarbonised its energy sector.

The Artelys/Climact analysis identified that current gas infrastructure is more than sufficient to ensure security of supply in a 2050 scenario which meets the EU's 80-95% GHG reduction target. Overall gas consumption falls by 71% compared to 2014, and gas import needs become negligible. This means that new infrastructure projects will become surplus to requirements if EU objectives are met.

This changes the economics of new investment. It can no longer be assumed that the future will look similar to the past, or that sufficient demand will materialize to make projects viable. New gas infrastructure projects should be evaluated to test their economic viability through their full lifespan. Where projects are not needed in a 2050 time horizon, they will need to be able to recoup their full investment costs over a shorter timeframe. As a result, cost-benefit assessment should assess the economic case for new gas infrastructure against a 15- or 20-year timespan rather than over 40 years, in recognition of the asset stranding risk.

Phase out public funding

There are better uses of public money than large-scale investment in new gas infrastructure that may not be needed. EU funding for new gas infrastructure should be phased out by the time of the next European budget.

Gas infrastructure has been a major recipient of public funding over the last decade, receiving several billion € in grants and financial instruments from the EU budget, and tens of billions € more in loans from the European Investment Bank.

[28] Bruegel (2016) **Rethinking the Security of the European Union's Gas Supply**

Further public investment in gas infrastructure would not appear to represent good public value, considering the limited needs investment needs for security of supply, the limited potential lifespan of new investments, the failure to test investments against alternatives and against European targets, and the opportunity cost from not investing in other more productive areas.

Continuing to fund gas infrastructure from public budgets also runs contrary to the commitments the EU undertook in the 2008 G8 summit in Pittsburg to phase out fossil fuel subsidies.

In 2016 the EU will carry out a mid-term review of its budget. This should aim to reorient remaining energy spending from high carbon sectors such as gas to more productive low carbon investments. This includes rebalancing Connecting Europe Facility spending away from gas and towards electricity, in line with the stipulation in the CEF regulation that the major part of CEF funding should support electricity infrastructure.

By the time the next EU budget period begins in 2021, nearly all of the gas infrastructure projects in the current Ten Year Network Development Plan are due to have entered construction phase or been completed. By this point, the EU should aim to phase out fossil fuel subsidies from its budget entirely, and EU budget lines currently used to support new gas infrastructure should be refocused on more productive investment elsewhere.

CONCLUSIONS
STAYING SECURE IN A CHANGING MARKET

The nature of the energy security challenge is changing. Infrastructure development looks very different in an expanding market – where pipelines can be developed in expectation that the demand will eventually materialise. This no longer reflects the realities of the European energy system, where the dynamics of demand have shifted and the risk of asset standing is significant.

A new approach is needed for ensuring energy security in an energy system in transition. This approach should avoid silos between different infrastructure types, treat demand-side solutions as deployable infrastructure, and re-align infrastructure development with EU energy and climate goals. By doing so, Europe's energy system can become even more resilient against unexpected shocks and crises – while providing better value for European citizens and consumers.