Il ruolo del gas come fonte di transizione verso un'economia "decarbonizzata" è ampiamente riconosciuto nelle politiche energetiche a livello globale. Che si tratti di non convenzionale statunitense o di liquefatto asiatico, al gas è stato affidato il compito di trainare i sistemi energetici verso una maggiore sostenibilità in attesa che le energie rinnovabili possano dare pieno contributo alla rivoluzione green.

Safe e Accenture seguono da diversi e complementari osservatori l'evoluzione di questo tema con l'obiettivo di fornire un contributo al dibattito. L'articolo che segue, a firma di Danilo Troncarelli, Managing Director Energy & Utility di Accenture Strategy, ripercorrendo l'evoluzione del ruolo del gas naturale in Europa, individua i fattori abilitanti e l' apporto "decarbonizzante" nei prossimi decenni, con particolare riferimento a protagonisti, assetti di mercato e tecnologie.

Raffaele Chiulli, Presidente - SAFE

accenturestrategy

Natural Gas role in the energy transition

By Danilo Troncarelli, Managing Director Energy & Utility di Accenture Strategy

1. Introduction

The first worldwide agreement on greenhouse gas emissions was signed in April 2016. The 196 countries responsible for 55% of total CO_2 emissions agreed, at the Conference of the Parties in November 2015, to commit to cap global warming at a maximum 1.5°C, a more challenging target than the 2°C cap originally proposed.

Given this commitment, signatory countries need to review their energy strategies in order to reduce emissions by actively promoting low carbon economy policies. Prior to COP21, the European Commission[1] (EC) had set a roadmap to cut greenhouse gas (GHG) emissions by 80% below 1990 levels by 2050. Although this roadmap goes in the same direction as the COP21 principles, it needs to be strengthened in order to address the new and more challenging target.

The Pre-COP 21 roadmap set ambitious checkpoints only for renewable energy sources (RES) and energy efficiency. The role that natural gas can play in this context was largely overlooked. Revisiting the guidelines in the light of the COP21 target might be an opportunity to close the gaps in the old roadmap and recognize natural gas as an energy transition enabler.

[1] European Commission, A Roadmap for moving to a competitive low carbon economy in 2050

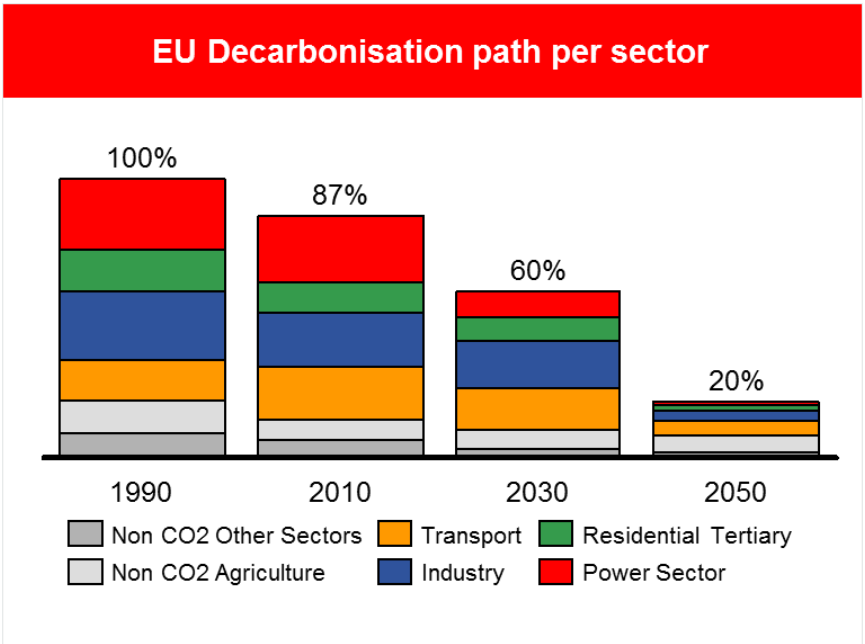

Figure 1 - Decarbonisation roadmap[2]

Indeed, natural gas is the only fossil fuel that can help the European Union reach its ambitious sustainability targets and at the same time safeguard energy security and competiveness requirements while avoiding:

- re-carbonization risk (gas to coal);
- disruption in infrastructures;
- miss-planned investments;
- incentive schemes that distort market dynamics

2. The role of gas in Europe today

Europe is the world's largest importer of natural gas. Consumption across the continent is high and local gas reserves are low.

The European Commission has introduced new guidelines to foster the creation of trans-European energy networks, namely the TEN-E projects plan. Interoperability and development of trans-European networks for transporting electricity and gas are essential factors for the effective operation of an internal energy market able to ensure energy security.

The guidelines[3] identify the main PIC (Projects of Common Interest) for the gas infrastructure to be developed in the coming years. Interconnections with countries outside the EU are also included in order to ensure the security and diversification of supply.

[2] Accenture Research on EU Commission
[3] European Commission, Trans European Energy network

The most important project is the "Southern Corridor" pipeline that will connect Europe to the oil and gas fields of Azerbaijan. Several other projects to build or upgrade LNG receiving terminals across Europe, are either at approval stage or under construction. These projects to enable supply diversification will generate

greater competition in gas markets.

Figure 2- Large Project of Common Interest[4] in the gas sector

3. The role of gas in Europe tomorrow

Natural gas can serve as a bridge for energy transition. However, it requires capital-intensive investments and clear national and EU commitments to long-term frameworks that attract investors and guarantee minimum gas infrastructures. To this end, EU decision-makers are urged to adapt current policies to encourage cost-efficient, low-carbon investments – including in gas – that take into account the infrastructure differences that exist between EU Member States. There are numerous frameworks in the EU today, that aim to cut GHG emissions, albeit with different timelines and scope sectors – and gaps in between. As a result, to reach the ambitious goals which the EU has set for 2050, changes are needed in current policies, including ETS.

[4] European Commission, Project of Common Interest for Natural Gas

Initiative	Geo Coverage	Sector Coverage	Targets
1. Roadmap to low-carbon economy	EU	All sectors (domestic reductions alone)	40% cut in emissions (from 1990 levels) by 2030, 60% - by 2040, 80% - by 2050
2. 2030 framework	EU	All sectors	40% cut in GHG emissions (from 1990 levels) 27% RES share in consumption 27% energy savings from BAU scenario
3. "20-20-20"	EU		20% cut in GHG emissions (from 1990 levels) 20% RES share in consumption 20% energy savings from BAU scenario
3.1. ETS[5]	EU	45% of EU GHG emissions: energy-intensive industries, power and heat generation, commercial aviation	21% cut in emissions (from 2005) by 2020 forecasted 43% by 2030
3.2. ESD	EU	55% of GHG emissions: housing, agriculture, waste, transport (excl. aviation). LULUCF and international shipping are not included	Binding annual targets (compared to 2005) through mechanism of Annual Emissions Allocation. In 2020, -10% compared to 2005 for non-ETS Emissions
4. UNFCCC (Kyoto protocol)	World (excl. major emitters)	12% of global emissions All sectors (includes LULUCF, but not international aviation)	1st period (2008-12) – average 5% cut in emissions below 1990 levels 2nd period (2013-20) – at least 18% below 1990 levels
5. UNFCCC (Paris agreement)	World (195 countries)	All sectors	Keeping the increase in global average temperature to well below 2°C above pre-industrial levels (long-term goal) To limit the increase to 1.5°C

Table 1 - Decarbonisation frameworks for the EU[6]

The European energy panorama is still quite fragmented. Specific sectors therefore have different underlying fundamentals and regulatory frameworks across countries and regions. As the greenest fossil fuel, natural gas should play an important role in the decarbonisation project, by supporting the RES and the deployment of clean technologies across all end-user sectors.

This transition is unprecedented and it is difficult to predict its pace. It will doubtlessly bring about innovation and exciting opportunities, as well as challenges. Accenture Strategy has published this report to propose a number of overarching recommendations and principles to underpin possible pathways to a decarbonized framework for the following sectors:

- power generation;
- residential and Tertiary;
- industrial;
- transport;
- agriculture.

[5] New ETS system should be approved into 1st Quarter 2017
[6] Accenture Research on EU Commission

3.1. Role in Power Generation

The transition to near-zero emission power generation systems will require that conventional generation systems make room for the gradual penetration of RES while providing flexibility and supply security services in the cleanest way. On the other side of the coin is the need to safeguard stable and secure cash flows. This will require a deep redrafting of market rules, the integration of NG and RES generation through fair regulation and the introduction of new concepts such as Virtual Power Plant (VPP).

Currently, subsidized generation and other public interventions distort the market and influence price formation. Operators in this scenario lack the signals they need in order to define long term investment strategies that ensure system adequacy and promote decarbonisation. This, in turn, influences market participants for all kinds of assets such as thermal or renewable generation, storage or demand response.

Accenture Strategy has identified three main actions that would enable gas to play a primary role in the energy transition within the power generation sector.

3.1.1. Long term Capacity Remuneration

When analyzing the expected growth in power capacity in the EU, it can be seen that renewables are set to gain weight at the expenses of fossil sources. It follows that there will be higher risks of shortages, especially in winter and summer. Although there is no imminent of any major black-out at aggregate EU level, not all EU Member States are equally immune from possible energy shocks.

Germany and Italy are particularly vulnerable. Denuclearization in Germany, which is scheduled for completion in 2022, will contribute to a reduction in system adequacy and a negative power balance in the winter. In Italy, available conventional capacity has declined in recent years because many oil-fired and combined cycle plants have been decommissioned. This trend is expected to continue for the next decade and no replacement production sites are scheduled to open.

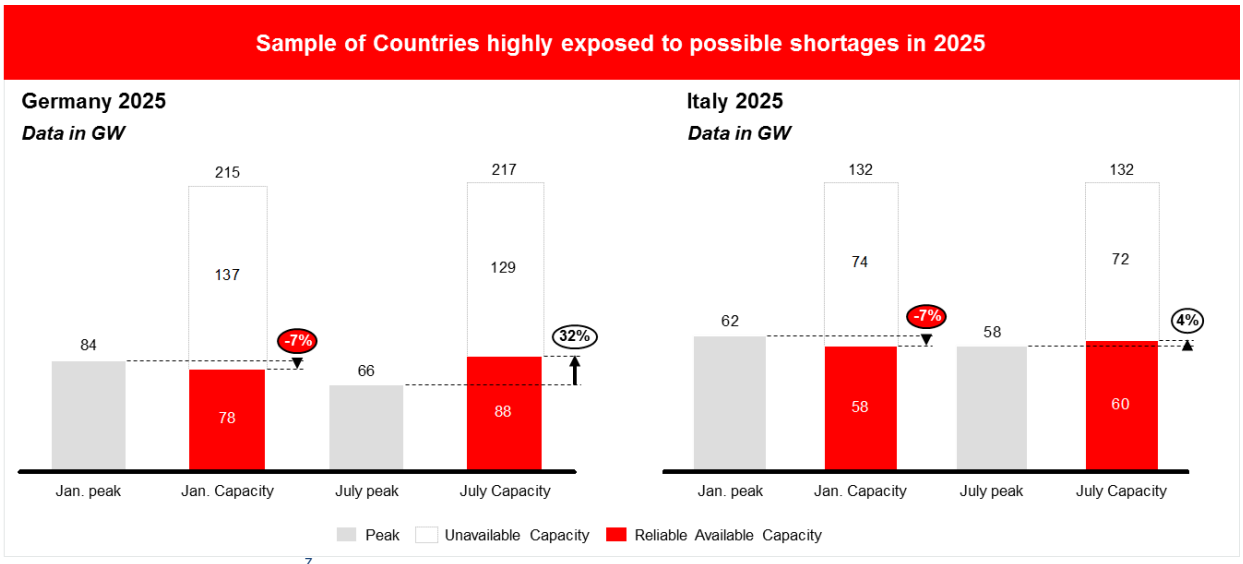

Figure 3 - Exposure to shortage[7]

Capacity markets should be designed in a way that ensures long-term security of supply in the most cost-efficient and sustainable manner. In this light, a Capacity Remuneration Mechanism (CRM) should be an

[7] Accenture elaboration of data: ENTSO-E, Scenario Outlook & Adequacy forecast 2015 (Estimates based on Scenario B 'Best Estimate')

indispensable part of future market frameworks. Governments should avoid non market-based measures, such as preventing plant closures or subsidizing specific types of assets. Conversely, market-based CRM should provide signals for existing competitive capacity to remain online or for new capacity to be developed in order to reach system adequacy targets with capacity provided by conventional and renewable generation, demand response and storage assets. In such a competitive market-based scenario, gas-fired power plants would have advantages because of their high flexibility. Indeed, these advantages could be enhanced thanks to regulatory frameworks, demand aggregation, advancements in production technology, Virtual Power Plants and the development of Coordinated Capacity Markets at European regional levels.

3.1.2. Less penalizing merit order

From a market standpoint, natural gas power generation faces stiff competition from other sources such as coal and renewable energies. A weak price signal in the carbon market, combined with growing imports of competitively priced coal, high subsidies and feed-in-tariffs for selected preferred low-carbon technologies, is gradually driving gas out of the merit order leading to higher decarbonisation costs and, in the worst scenario, to the risk of re-carbonisation.

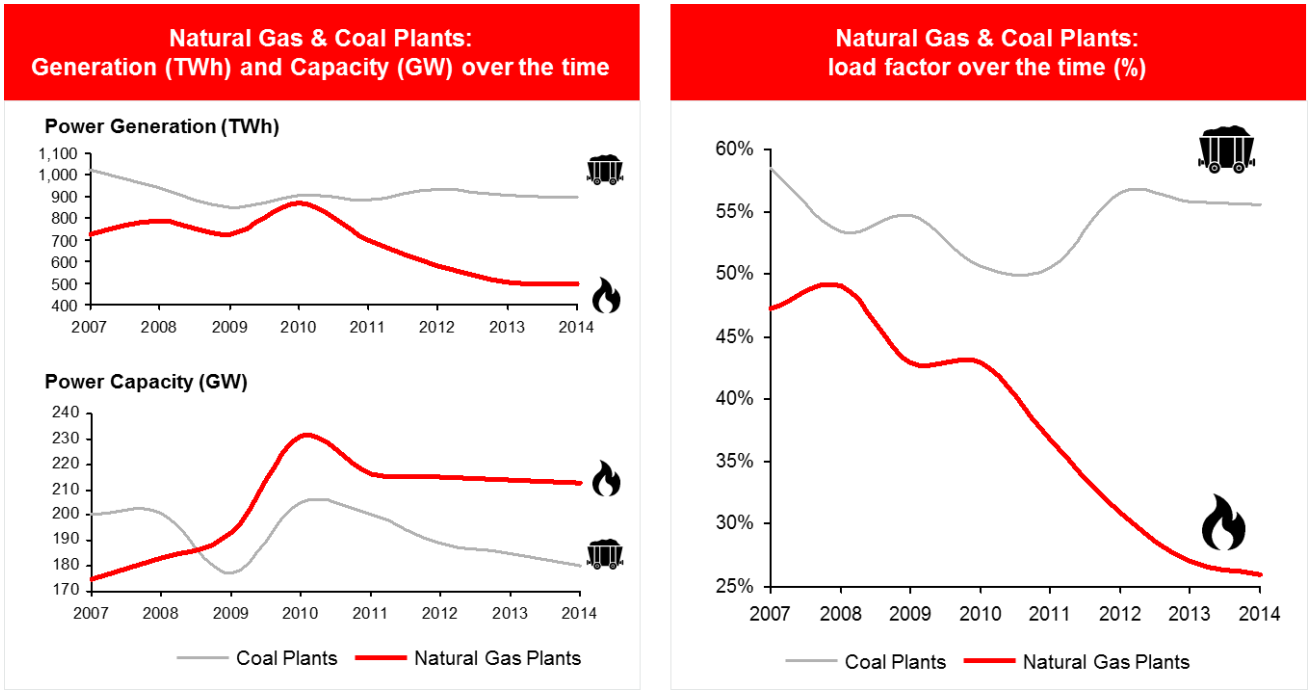

Figure 4 - Natural gas plants and Coal plants load factor in the EU[8]

Policy intervention to ensure a less penalizing merit order is therefore particularly urgent and should be centered on two actions:

1. **ETS reinforcement**
   The EU Emissions Trading System (ETS) was launched in 2005 in order to reduce GHG emissions in Europe. In its current form, the system is not truly competitive because the carbon price would need to be considerably higher in order to encourage natural gas usage.
   Several proposals are being evaluated to identify the best way to raise the price of CO_2s to 40 €/t and consequently promote the switch from coal to natural gas.

[8] Accenture Research on Eurostat and IEA, World Energy Outlooks (2009, 2010, 2011, 2012, 2013, 2014, 2015), OECD Publishing, Paris
Load factor calculated as (Total Generation pa)/ (Capacity 8760 hrs)

Furthermore, the ETS should broaden its scope to take account of the fact that 60% of GHG emissions come from sectors which are outside the remit of the ETS.
A new ETS scheme is expected to be approved in Q1 2017, during the Slovenian presidency.

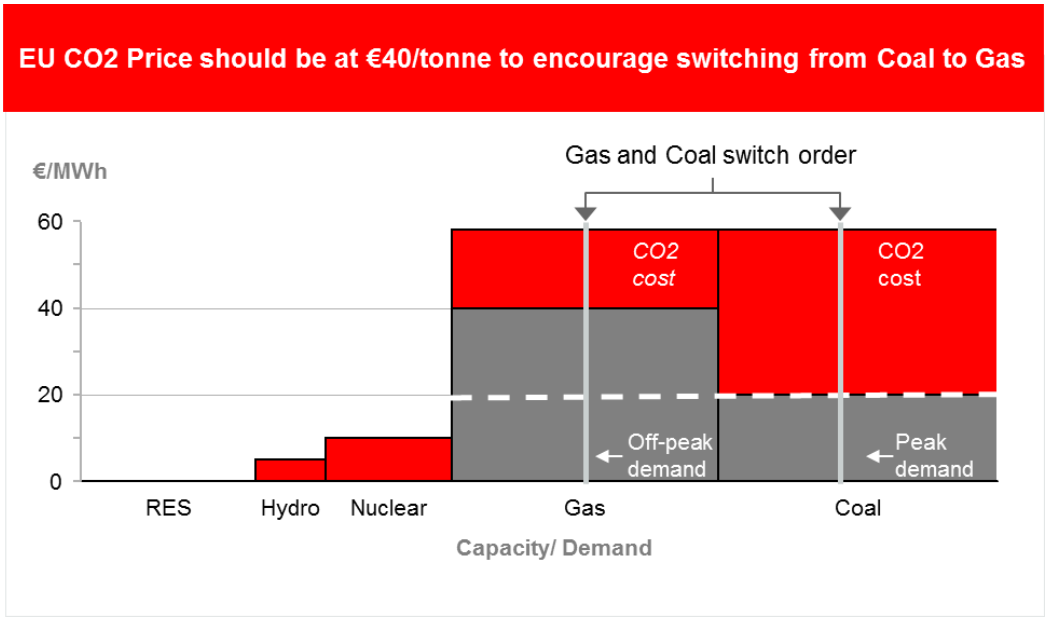

Figure 5 - Necessary increase in the carbon price[9]

2. **Integration of RES into the market**
   To date, the development of RES has been fostered through incentives and other favourable operational breaks such as grid connection and dispatch priority.
   A new market framework in which both RES and gas can contribute to the development of a carbon-free generation sector, will require the complete integration of RES into the energy market though operational and market equalization. This may entail the end of "produce and forget" approaches, the introduction of penalties for unbalancing and the end of priority dispatching for renewables. Additionally, RES policies should direct subsidies to non-mature technologies only, while stronger ETS mechanisms should support the grid parity of other market-ready solutions.

3.1.3. New technologies and regulatory frameworks

Access to renewables and the introduction of energy efficiency measures have changed end-users' perception of energy usage. The savings achievable from self-consumption have made investments in distributed energy resources (DER) very attractive. This is especially true for industry where joint electricity and heat consumption make gas-fired combined heat and power (CHP) the optimal solution for smaller scale players to save on costs and reduce GHG emissions.

Similarly, micro gas cogeneration engines and fuel-cells will prove to be an ideal alternative for people in the residential sector who both produce and consume energy, especially in district-heating areas. In such contexts, the coupling of smart electricity and heat grids may lead to the creation of flexible, cost-effective solutions that sustain the energy transition and avoid major issues on the larger power generation side. This paradigm will largely depend on how the regulatory framework encourages the adoption of new technologies such as Virtual Power Plants and Demand Response. Other influencing factors are the capacity of aggregation, the growth in self-consumption and the ability to optimize the production based on energy

[9] Accenture Research on Lazard, Stranded Assets in the Utilities Sector, 2015; EEA, Trends and projections in the EU ETS in 2015; EEA, Trends and Projections in Europe, 2015; https://euobserver.com/environment/132045

market prices. Heating and cooling and the electricity system can support each other in the path toward decarbonisation. It is essential to recognize the links and commonalities among them and exploit the synergies.

Among the other technologies, digital will enable the energy transition at different levels. In particular, IoT, Analytics, Cloud and Robotics could evolve the energy system to the next level of development. The most promising digital technology with the most interesting applications in the utility and energy sectors is, without doubt, the blockchain. Already applied to enable new business models, it aggregates both supply and demand in a way that produces high returns on DER production: additional revenue streams derive from the flexibility to stabilize the grid or even sell energy to other micro grids.

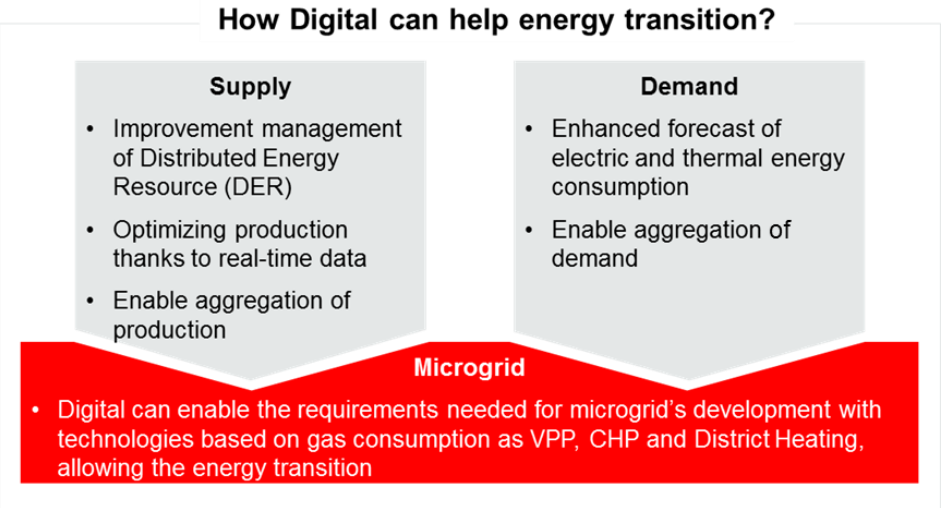

Figure 6 - Role of digital into the energy transition

3.2. Role in the Residential and Tertiary sectors

Energy efficiency measure and the greater availability of electrical technologies had led to a stark decline in the consumption of natural gas across the EU. However, policy makers should take into account that, while the wider use of electrical technologies may exacerbate power generation challenges on both the generation and distribution sides, efficient gas technologies are cost-effective solutions that can provide the power system with "smart" support. Natural gas technologies (efficient boilers, CCHP, district heating & cooling) can be integrated within Smart Grid environment to maximize RES usage while providing cost-effective, clean heating and cooling.

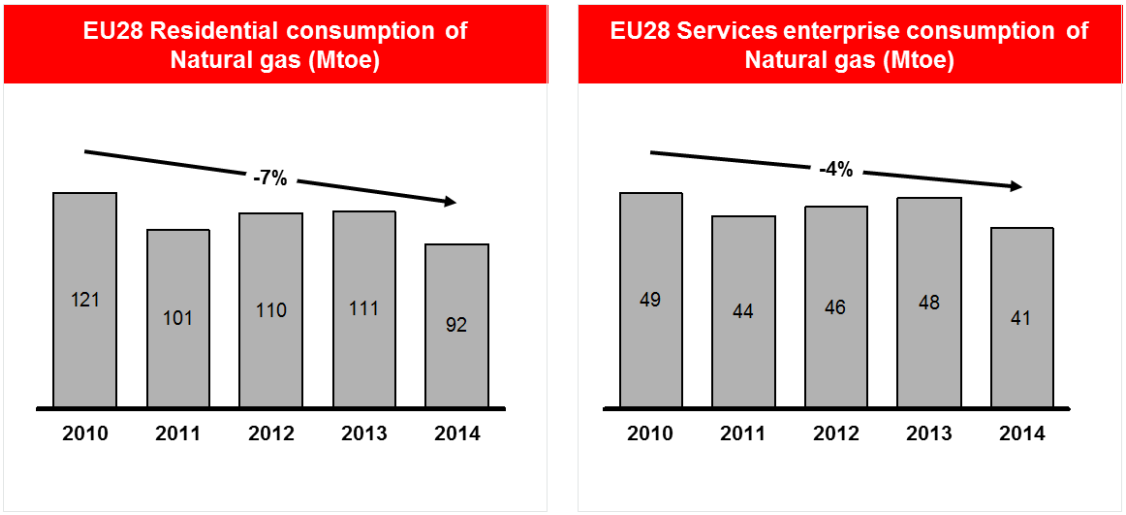

Figure 7 - Decrease in the gas consumption in the last five years[10]

Energy consumption in the EU is highly based on fossil fuels. In 2014, the residential sector accounted for 221 million tonnes of oil equivalent (Mtoe) of final energy heating and cooling consumption. The same year, services accounted for a mere 90 Mtoe. The relative weight of each sector varies form one EU country to another depending on economic structures, climate, and other factors. Natural gas is the principal fuel used for heating and cooling, but overall averages hide major variations in regional and national fuel mixes.

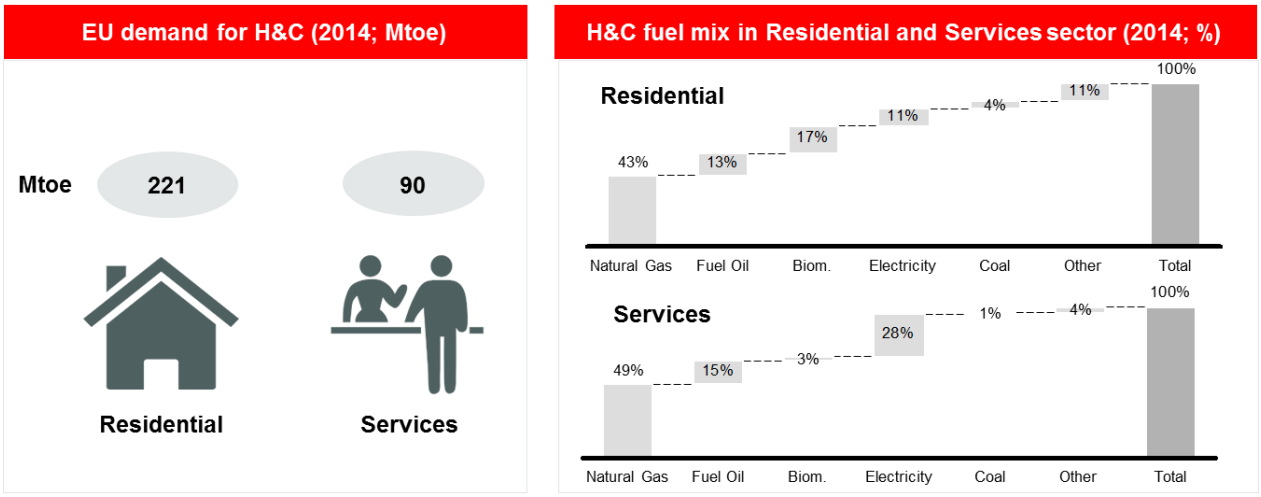

Figure 8 - Energy consumption in the Residential and Services sectors[11]

The Energy Union Strategy has recently proposed new rules for heating and cooling systems in buildings and industry to improve energy security across the EU, address the post-COP 21 climate agenda and make the sector smarter and more sustainable. The strategy sets out a series of actions to:

- make it easier to renovate buildings;
- increase the share of renewables;
- reuse energy waste from industry;
- engage consumers and industries through advanced metering, billing and real-time control.

[10] Eurostat 2014, 2013, 2012, 2011, 2010
[11] Accenture elaboration of Eurostat data

Benefits expected to flow from the strategy include cost cuts for households, the creation of new jobs and a reduction in CO_2 emissions.

Accenture Strategy has identified three key actions that would enable gas to play a primary role in the energy transition within the heating & cooling sector, bearing in mind the EU framework:

- sustain the economic appeal of efficient technologies though other carbon pricing mechanisms;
- realize heating & cooling district networks by leveraging the spread of mini and micro CHP technologies with natural gas playing an active role in DER and Power Generation down streaming;
- enhance regulatory frameworks to promote VPP, DER and self-consumption in order to let natural gas technologies support the power generation and distribution challenges with high efficiency and cost-effective technology.

3.3. Role in the Industrial sector

Within the Industry sector, gas remains a potential substitute for more polluting fuels that help the competitiveness of EU industry. However, Industry is not the largest contributor to EU emissions and forecasts show this will likely still be the case by 2020. Energy consumption declined at almost twice the rate of value added since 2007; that evidences about decoupling between production and energy use, while role of fossil fuels, including gas, has been reducing at the background of increasing role of electricity and biomass.

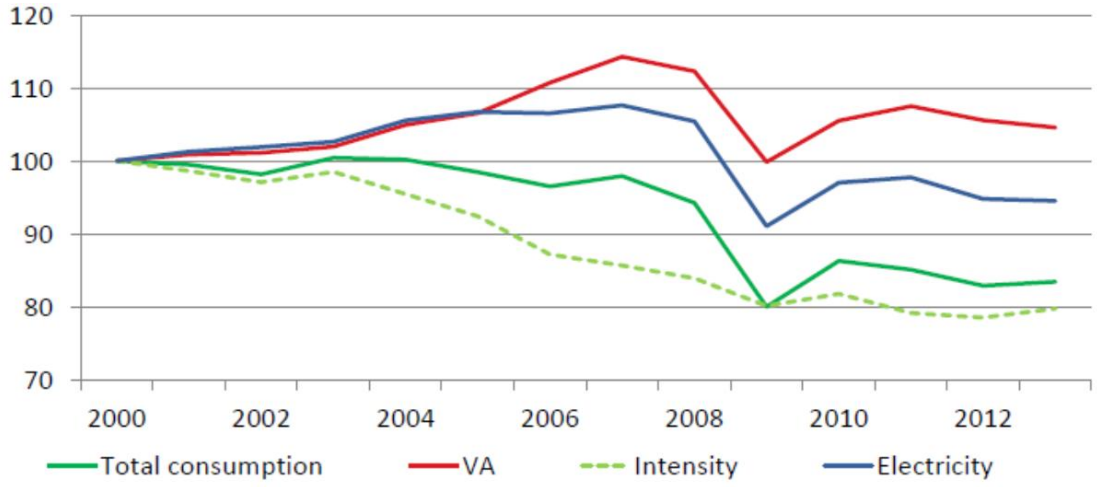

Figure 9 - Energy consumption and activity in industrial sector[12]

As for the residential and tertiary sectors, the diffusion of electrical technologies may heightens the power generation and distribution challenges, while efficient gas technologies are cost-effective solutions that can provide "smart" support to the power system.

[12] Accenture elaboration on ODYSSEE-MURE data

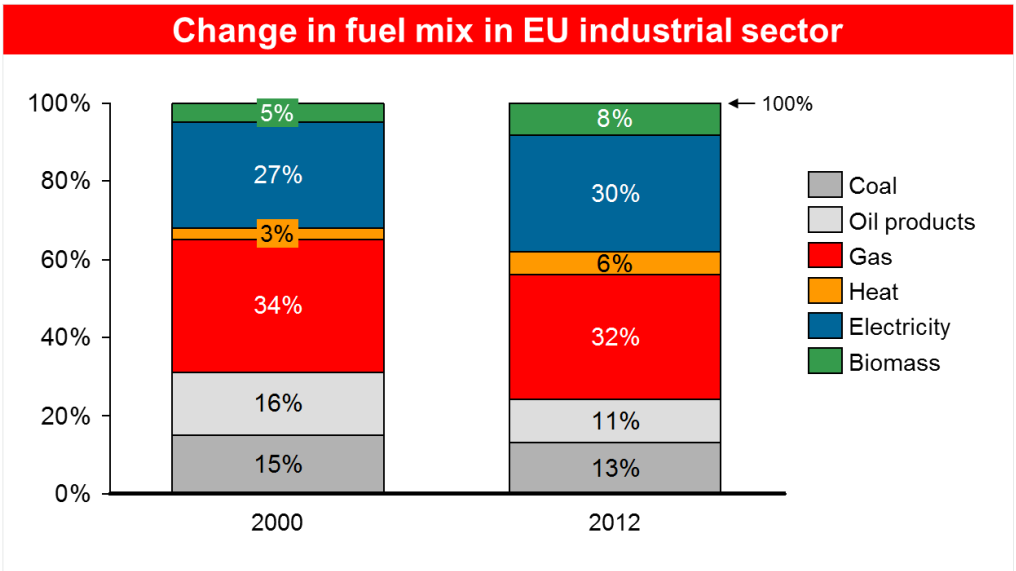

Figure 10 - Change in fuel mix in EU industrial sector[13]

Accenture Strategy has identified four actions that would enable gas to play a central role in the energy transition within the industrial sector:

- adopt strong ETS to avoid gas-to-coal re-carbonisation as a result of lower priced raw material and weak CO_2 prices. Industrial processes must be overhauled and the low cost of coal dissuade investors from pursuing efficient gas technologies;
- support the economic appeal of efficient technologies that promote research into new, cleaner technologies that "green" industrial processes and enable heat recovery and storage;
- incentivise the integration of industry end-user within heating & cooling district networks where CHP production can be shared for different purposes;
- mandate regulatory frameworks to promote VPP, Demand Response and self-consumption as solutions that position natural gas technologies to support power generation and distribution using efficient, cost-effective technology.

3.4. Role in Transport

Within the transport sector, natural gas can play a determining role in achieving the maximum results from electrification and in reducing emissions from non-electrifiable means of transport.

In the marine segment, the International Maritime Organization has recently imposed new restrictions on sulphur emissions in Sulphur Emission Control Areas. LNG is currently the most economically sustainable fuel that can be used to comply with the new limits and perhaps with even more stringent future limits. LNG could be used instead vessels' current fuel. Admittedly, the switchover would not be immediate: it would entail sizeable investments to modify refueling infrastructure and require ship-owners to convert on-board fuel systems. A strong commitment from public institutions would be needed to begin this process and provide ship-owners with a stable framework within which to plan their investments. In this regard, it is worth bearing in mind that the Alternative Fuels Infrastructure Directive 2014/94/EU (AFI Directive) requires EU Member States to develop national policies by November 2016 that facilitate the deployment of LNG fueling stations at all maritime and inland ports by 2025 and 2030 respectively.

[13] Accenture elaboration on ODYSSEE-MURE data

As for terrestrial transport, there were 1.18 million natural gas vehicles (NGV) in circulation in the EU at the end of 2015, representing less than 0.5% of total market. The top four countries account for 95% of the market, with Italy alone accounting for over 900,000 NGVs, or 77%. This shows that, despite an EU target of 5% by 2020, the current share of NGVs is very small even in top countries. Steps are being taken, however, to introduce programs that promote natural gas as alternative clean fuel for vehicles. The Agency for the Cooperation of Energy Regulators (ACER) believes that gas may play a significant role in the next decade provided that appropriate market conditions exist by 2025 from the standpoint of:

- economic growth;
- availability of financing and incentives;
- advantages in fuel prices;
- commitment to low taxation;

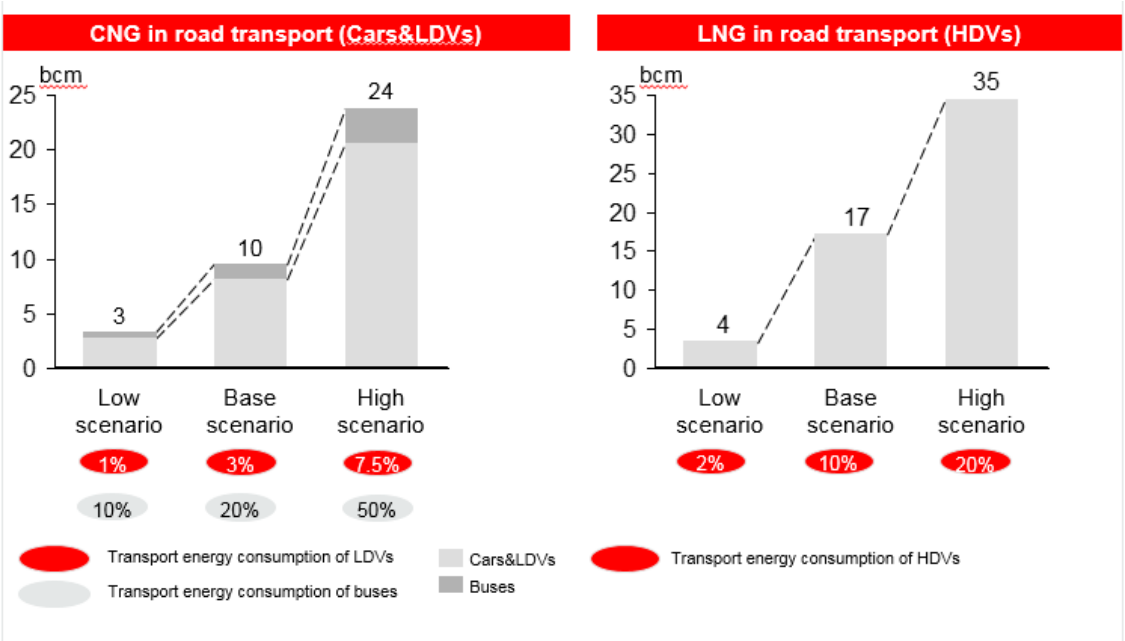

Figure 11 - - NG for transport market scenarios[14]

At present, the AFI Directive requires EU Member States to develop national policies by November 2016 that facilitate the use of alternative fuels and ancillary infrastructure for road transport.

The Directive requires the deployment of fueling points for heavy duty vehicles at standard intervals and at least every 400 km on the Trans European Network Transport (TEN-T) by 2025. LNG Blue Corridors is one of various massive projects that promote the use of LNG as a fuel for long-distance trucks across the EU. The project aims to roll out and demonstrate four LNG Blue Corridors following:

- the building of 14 new LNG or L-CNG stations along 4 Trans-European routes;
- the creation of a fleet of approximately 100 LNG heavy duty vehicles

In the case of motor vehicles, the Directive envisages the development of an appropriate number of refueling points at standard intervals within urban and TEN-T core networks by 2020 and 2025 respectively. However, given the determination of the EU to significantly reduce GHG emissions, it is likely that electricity will outperform natural gas as an alternative fuel unless new power-to-gas technologies make it easier to obtain gas from decarbonised sources.

[14] ACER; EU Commission

3.5. Role in Agriculture

The major source of GHG emissions in agriculture is the agricultural activity itself. The use of natural gas in agriculture can incentive to maximize the production of biogas from manure and scrap, which are the main sources of GHGs.

Greenhouse heating and cooling is a typical use of natural gas in agriculture; anyway, its penetration can be deepened through other usages as the deployment of natural gas engine tractors. In turn, a higher penetration of natural gas use in agriculture could stimulate the production of biogas for self-consumption.

Nearly 70% of biogas in the EU is produced in agricultural sector, leading by Germany where great examples of closed-cycle biogas production in agriculture are arising.

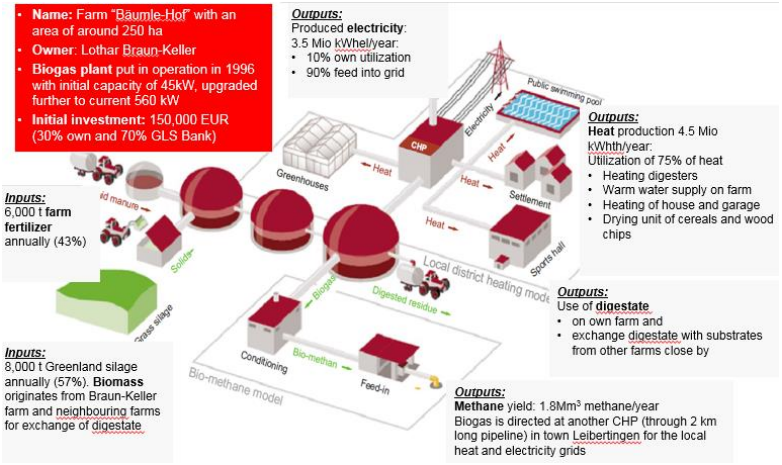

Figure 12 - Example of closed-cycle biogas production in agriculture: German farm in Leibertinger, Baden-Württemberg[15]

4. Conclusion

This short paper provides a few arguments that support the view that natural gas will play the pivotal role as "enabler" in drive to decarbonise between now and 2050, and afterwards. Market operators should actively assist policy makers to define the future energy roadmap and illustrate how natural gas can help to ensure energy continuity, security and cost-effectiveness as well as cut GHG emissions from the outset.

Solutions and answers to future energy challenges are complex. They can only be addressed with multi-faceted technologies and well-planned preparatory transition phases. A mix of different solutions will be required to define the long term energy paradigm.

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http://www.safeonline.it/centro-studi-e-ricerche/pubblicazioni/le-fonti-fossili-non-convenzionali/

[15] SustainGas Best Examples