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towards2030

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How can renewables and energy efficiency improve gas security in selected Member States?

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About the project

The aim of **towards2030-*dialogue*** is to facilitate and guide the RES policy dialogue for the period towards 2030. This strategic initiative aims for an intense stakeholder dialogue that establishes a European vision of a joint future RES policy framework.

The dialogue process will be coupled with in-depth and continuous analysis of relevant topics that include RES in all energy sectors but with more detailed analyses for renewable electricity. The work will be based on results from the IEE project beyond 2020 (www.res-policy-beyond2020.eu), where policy pathways with different degrees of harmonisation have been analysed for the post 2020 period. **towards2030-*dialogue*** will directly build on these outcomes: complement, adapt and extend the assessment to the evolving policy process in Europe. The added value of **towards2030-*dialogue*** includes the analysis of alternative policy pathways for 2030, such as the (partial) opening of national support schemes, the clustering of regional support schemes as well as options to coordinate and align national schemes. Additionally, this project offers also an impact assessment of different target setting options for 2030, discussing advanced concepts for related effort sharing.

Who we are?

Vienna University of Technology, Energy Economics Group (EEG), Austria *(Project coordinator)*
Fraunhofer Institute for Systems- and Innovations Research (Fraunhofer ISI), Germany
Energy Research Centre of the Netherlands (ECN), Netherlands
Center for European Policy Studies (CEPS), Belgium
National Technical University of Athens (NTUA), Greece
Consejo Superior de Investigagiones Cientificas (CSIC), Spain
Ecofys Netherlands and affiliates (Ecofys), Netherlands
REKK Energiapiaci Tanacsado Ltd (REKK ET), Hungary
European University Institute, Florence School of Regulation (EUI), Italy

Executive Summary

This fact-finding paper seeks to identify recent trends in natural gas use and import dependencies in twelve rather vulnerable EU Member States and to analyse the potential to reduce insecurity of external gas supplies of these countries in the short and longer term up to 2030. In doing so, the potential contribution of renewables and energy efficiency to reduce gas import dependency will be assessed.

The main findings of this assessment can be summarised as follows:

- Energy efficiency measures can reduce the gas demand of the assessed Member States on the eastern border of the EU by 14 % while resulting in average net savings of € 3.5 billion per year. For doing so, only a moderate policy intervention is required, meaning that all policy measures currently implemented as well as their upcoming revisions are enforced and a selection of new policy measures is introduced.
- A strong deployment of renewables as anticipated in the alternative policy scenarios leads to increases in system costs and support expenditures at EU-28 level but for the assessed 12 Member States this may even lead to savings in support expenditures for renewables in range of € 2.0-2.1 billion per year in the period post 2020, which is mainly due to improved framework conditions (i.e. removal of non-economic barriers).
- The increase in renewables and energy efficiency comes along with benefits related to Europe's trade balance due to a (significantly) decreased demand for fossil fuels and related imports from abroad. Thus, natural gas demand can be reduced by more than 20% in the assessed countries, if a 30% target for renewables and energy efficiency by 2030 is aimed for.
- From the detailed gas market modelling we can conclude that it seems feasible to reduce Russian dependency on natural gas supply to a very low level without causing skyrocketing natural gas prices in any of the EU member countries. As most extreme case we analysed the scenario of increased renewables and energy efficiency combined with a "breaking up" policy of long-term gas contracts, assuming that Russian long-term contracts and the related take-or-pay obligations are cancelled, and Russian gas is purchased on a short term base competing with other sources. In this scenario it is possible to reduce Russian gas imports to 79 TWh/year, which is 6.5% of the present level. This can be achieved on a market basis, through better interconnectivity and energy efficiency and renewable energy driven gas demand reduction.
- Security of supply benefits of the EU renewable and energy efficiency policies can only be achieved, if the infrastructure development policy of the EU is realised in a consistent manner – this concerns in particular the gas infrastructure but also the power grid.
- From a gas market perspective this means that the selected infrastructural projects of common interest as well as the decisions on the reverse flow upgrades on the selected EU interconnectors must be enforced, their accomplishment is a key factor in achieving the benefits quantified in this paper.
- There are important impacts not only on the 12 Member States as results show, but also on the whole EU. This means that there are important drivers for a general EU involvement, opening up opportunities to achieve a win-win situation for all European countries in the case of a coordinated intervention.

Introduction

This fact-finding paper seeks to identify recent trends in natural gas use and import dependencies in 12 rather vulnerable EU Member States (MSs)[1] and to analyse the potential to reduce insecurity of external gas supplies of these countries in the short and longer term up to 2030. In doing so, the potential contribution of renewables and energy efficiency to reduce gas import dependency will be assessed.[2] Two reasons can be given for the focus on the gas sector in this first issue paper of the **towards2030-*dialogue*** project: first gas-based energy services currently play an essential societal role in most of the focus countries, whilst secondly the lion's share of their gas imports tends to be pipeline gas from Russia. At short notice, no easy alternatives are at hand rendering these countries vulnerable to serious gas supply risks.

Approach and assumptions

The approach taken for this assessment is twofold, combining retrospective statistical fact-finding with forward-looking analysis of relevant trends up to a 2030 time horizon.

As a starting point, a detailed statistical coverage on the gas supply security situation of the selected Member States, those most vulnerable to Russian gas supplies, is provided by ECN. This serves as basis for the comprehensive outlook towards 2030 on gas demand and supply, bringing together three distinct model-based assessments.

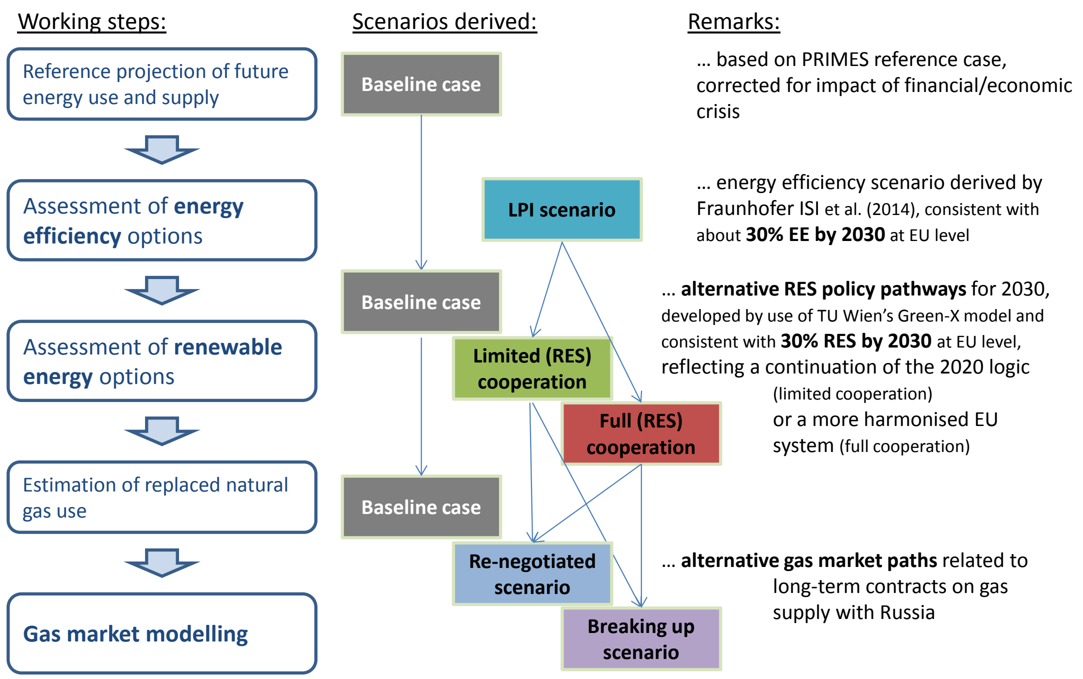

Figure 1. **Approach taken for assessing the future contribution of renewables and energy efficiency to gas supply security in selected MSs**

[1]Focus countries of this paper are the following 12 EU Member States: Bulgaria, Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, Slovakia, and Finland.

[2]Despite various options are available to replace imported natural gas in future years, this assessment focuses on energy efficiency and renewable energy options, as they are the core policies at EU level that also have significant impact on gas consumption.

Figure 1 provides an overview on the working steps taken and the corresponding scenarios derived within the prospective assessment. The individual working steps can be described as follows:

- The starting point for the assessment of natural gas replacement through increasing the use of renewable energy sources (RES) and energy efficiency is to have a clear **reference trend on future supply and use of energy**, and specifically related to natural gas. As baseline projection we make use of (an adapted version of) the European Commission's latest reference scenario on EU energy, transport and GHG emissions trends to 2050 as derived by the PRIMES model (EC, 2013).
- Next, **energy efficiency** comes into play: The analysis underlying the assessment of energy efficiency policy options until 2030 is based on detailed modelling of the final energy demand in the different demand sectors. The Low Policy Initiative (LPI) scenario as used in this assessment has been conducted in the frame of a study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy-efficiency/saving potential until 2020 and beyond, conducted on behalf of DG ENER by a consortium led by Fraunhofer ISI (Braungardt et al., 2014).
- As third pillar, an assessment of **renewable energy** options is undertaken: By use of a TU Vienna's specialised energy system model (Green-X) a quantitative analysis is conducted to assess feasible RES developments up to 2030 according to selected policy pathways, indicating RES deployment at MS and at EU-28 level as well as related impacts on costs, expenditures and benefits. Thus, three distinct scenarios are developed:
    - As reference, a baseline case is derived that builds on the baseline projection of energy demand and assumes that RES policies are applied as currently implemented (without any adaptation) until 2020, while for the post-2020 timeframe a gradual phase-out of RES support is presumed.
    - Complementary to above, two alternative RES policy pathways are assessed assuming a higher level of ambition concerning RES deployment. Aligned to the outcomes of the energy efficiency assessment (i.e. the LPI scenario is used as basis), at EU level a RES share of about 30% by 2030 (as share in gross final energy demand) is anticipated as target level in both assessed cases.

      The detailed policy approach to achieve the targeted RES deployment differs between both scenarios: In the case of *limited (RES) cooperation*, a continuation of the current policy framework with national RES targets (for 2030) and national RES support schemes (in order to meet the given targets) is assumed. RES cooperation between MSs comes into play in the case of insufficient or comparatively expensive domestic renewable sources.

      In the case *full (RES) cooperation* the assumption was taken that a harmonised support scheme for RES in the electricity sector comes into play where a least-cost approach is used for resource allocation across the EU. The final allocation of policy costs, i.e. the support expenditures that have to be borne by consumer, follows however again the logic of national RES targets, reflecting full (RES) cooperation between MSs.
- The next step aims to bring together the outcomes of the assessments of increasing energy efficiency and renewables, **estimating the replacement effect** of both **on natural gas**. For doing so, we make use of PRIMES forecasts related to the conventional supply portfolio, i.e. the share of the different conventional conversion technologies in each sector at country-level. Sector- as well as country-specific conversion efficiencies derived on a yearly basis are consequently used to calculate the amount of avoided primary energy based on the renewable generation figures obtained. Assuming that the relative composition of the fossil fuel mix is unaffected, avoidance can be expressed in units of coal or gas replaced.
- Finally, applying REKK's European Gas Market Model (EGMM), a modelling approach is used to **analyse the feasibility and impacts of assessed gas replacement options from a gas-market perspective**,

considering infrastructural specifics and prerequisites as well as complementary regulatory measures. Complementary to baseline, the two scenarios of reduced gas demand as derived above (i.e. limited and full (RES) cooperation, both combined with enhanced energy efficiency policies) are investigated under a *re-negotiation* and a *breaking-up* gas market scenario:

- The re-negotiation scenario assumes that long-term contract-based imports are reduced in proportion to overall gas demand decline (compared to baseline).
- The breaking-up gas scenario assumes that Russian long-term contracts are completely resolved and then Russian gas is solely purchased on a spot basis.

The impact is quantified through the application of EGMM, which generates projections of wholesale gas prices in Europe under these alternative scenarios. In addition the gas market model also calculates the projected impacts of alternative policy scenarios on the 'gas bills' countries have to pay to satisfy the gas demand of their consumers. This assessment should be seen as a first approximation to assess the gas security of the European countries; further assessment and wider use of additional indicators may be elaborated in the near future.

Results

Energy use and import dependencies: current trends

Energy supply security is a multi-facetted issue. Its connotation is inherently contextual and subjective (Jansen and Seebregts, 2010; Jewell et al, 2014). The present paper zooms in on gas security and considers how to reduce, in short-term and mid-term, in selected EU Member States the external dependency of gas supplies on a single, dominant, external supplier. The ongoing Russian-Ukrainian stand-off and its possible impact on energy supply security in the focus countries form the backdrop of this paper (see e.g. EurActiv, 2014, on Russia-EU gas flow reduction actions, recently undertaken on the part of Gazprom).

In principle, a wide range of proxies for economic vulnerabilities to energy imports can be used (see e.g. Percebois, 2006). The European Commission uses the so-called **energy dependency rate** as central indicator.[3] It shows the proportion of energy that an economy must import. It is defined as net energy imports divided by gross inland energy consumption plus fuel supplied to international maritime bunkers, expressed as a percentage. A negative dependency rate indicates a net exporter of energy while a dependency rate in excess of 100 % indicates that energy products have been stocked. For kicking off the analysis of energy supplies security, the energy (gas) dependency rate is a useful indicator to provide a first and preliminary litmus indication of the overall vulnerability of a country to sudden disruptions in external energy supplies. In fact, it is important to consider external energy security issues *by fuel* to gain a better understanding of the overall risk at stake (Le Coq and Palseva, 2009). Other aspects such as import sourcing and transport route concentration, ease of supplier and/or fuel substitution are relevant as well. The following indicators, expressing information on percentage points shares based on volume terms, are used in our assessment of the status quo of gas supply security in the focus countries:

a) The share of gas in gross inland energy consumption
b) Gas dependency rate: the share of net gas imports in gross inland gas consumption
c) The share of Russia in net gas imports
d) The share of gas originating from Russia in gross inland gas consumption.

[3] See e.g.
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=Energy_production_and_imports&printable=yes

While in the background report (Toth et al., 2014) all indicators are used, subsequently we focus on the share of gas (a) and the share of gas originating from Russia (d). In Figure 2, we combine this information: in most of the countries the Russian gas represents almost 100% of the total import, but there are significant differences in the importance of gas among these countries. In general, we might assume that in case Russian gas provides more than 20% of total energy consumption, a country is highly dependent on Russian import. Figure 2 reveals that four of the 12 focus countries face a material problem regarding Russian gas dependency, namely Lithuania, Latvia, Hungary and Slovakia.

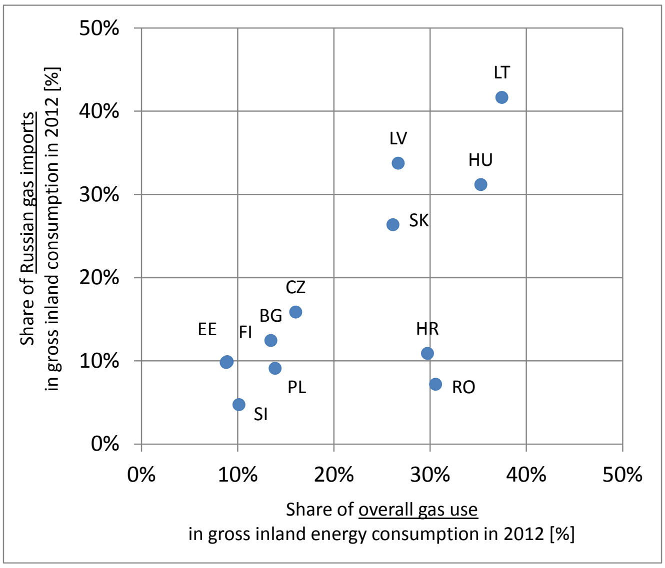

Figure 2. **Fraction of gas consumption versus share of Russian gas import, both with respect to Gross Inland Energy Consumption in 2012**

Source: Eurostat

The Baltic countries and Bulgaria, Slovakia and Finland are completely and continuously dependent on Russian gas. Only Slovenia managed to substantially limit the dependency by relying on gas from Algeria and, recently, western European countries. An interesting observation in the light of the subject of this paper is that the fraction of Russian gas has increased in recent years for the Czech Republic, Hungary and Romania.

A special case is Croatia that, in 2011 did not renew the previous long-term contract with Russia, instead in an open call invited international suppliers – among them Gazprom - to supply households for a 3 year period. ENI (Italy) was the selected shipper. There are however smaller amounts imported on a commercial basis from Hungary, which is most probably Russian source gas, but it is no longer a Russian contract.

Total imported gas by the EU from Russia was around 108 bcm/year in 2012.[4] Out of this quantity, the 12 focus countries account for 35 bcm/year.

Renewables and energy efficiency replacing natural gas: Scenarios on future developments up to 2030

This assessment focuses on energy efficiency and renewable energy options since they are the core policies at EU level that also have significant impact on gas consumption. Thus, this subsection is dedicated to present the outcomes derived from the quantitative assessment of replacing natural gas use in selected Member States by increased energy efficiency and renewable energy deployment.

[4] In 2013 EU imports from Russia reached a level of 126 bcm.

Figure 3 summarises the outcomes of the energy efficiency analysis, indicating demand developments up to 2030 at 12 MS level according to baseline conditions (i.e. default and corrected PRIMES reference case) and if moderate energy efficiency policies are implemented as assumed in the LPI scenario. By 2030 savings in energy demand of 219 TWh can be achieved with respect to the baseline for the 12 countries that are considered. Significant contributions to energy efficiency potentials are provided by industry, the tertiary sector, residential and non-residential buildings as well residential electricity use. For gas consumption this translates into savings of 95 TWh, corresponding to 14.3% of default gas consumption in 2030, see Figure 6 (right). The net benefit of the energy efficiency measures is estimated to € 3.5 billion on average per year between 2020 and 2030.

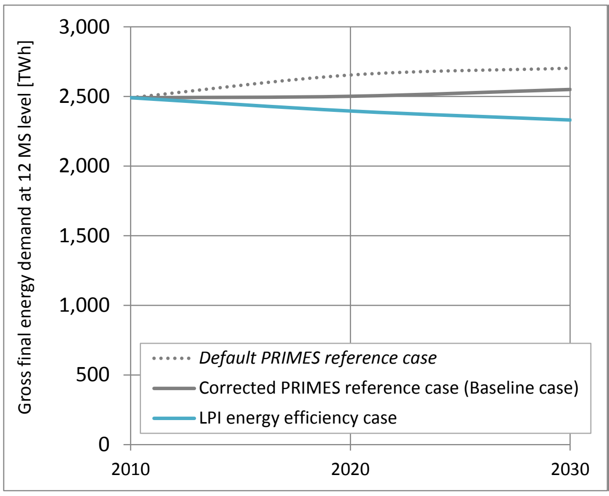

Figure 3: Development of gross final energy demand at 12 MS level according to assessed scenarios related to energy efficiency (i.e. default and corrected PRIMES reference and LPI)

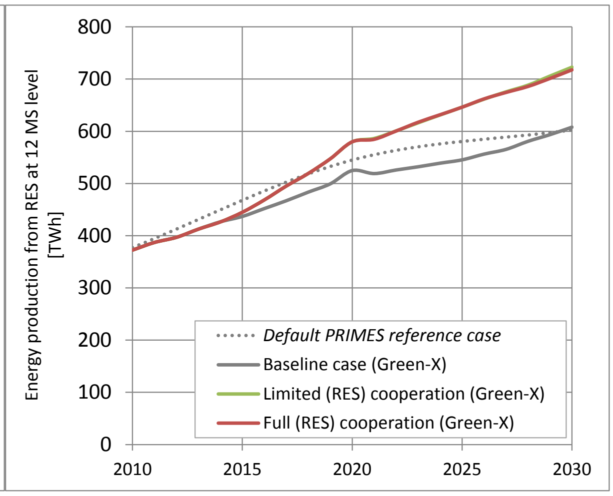

Figure 4: Development of energy production from RES at 12 MS level according to assessed Green-X scenarios(i.e. baseline and limited/full (RES) cooperation)

Results on the replacement effect of an increased deployment of renewables are discussed next. Figure 4 shows the development of RES generation up to 2030 according to the different Green-X scenarios assessed at the level of the aggregate of all assessed 12 Member States. Comparing baseline with alternative policy scenarios of limited and full (RES) cooperation, on average at 12 MS level an increase by 108.9-114.5 TWh is observable by 2030, corresponding to 18.1-18.9% of default (baseline) figures on 2030 RES deployment. The spread in country-specific changes is however significantly larger, ranging from about 7% (Hungary) to 47% (Bulgaria) in the case of full cooperation. By sector differences in RES deployment are highest for biofuels in transport, followed by RES in the electricity sector, but also RES in heating and cooling show a significant increase in the case of ambitious RES targets and dedicated moderate to strong RES support as preconditioned in the policy variants.

Since the underlying policy concepts on RES cooperation differ only in the period post 2020 both alternative paths show an identical RES deployment in 2020. Furthermore, at aggregated 12 MS level the difference between both alternative policy cases in total RES deployment is also comparatively small in 2030.

Figure 5 illustrates some direct economic impacts of increasing RES deployment. While benefits in terms of fossil fuel (and specifically gas) replacement are discussed later, below we focus on direct costs and expenditures that come along with an enhanced RES deployment both from a system perspective (i.e. additional generation costs for RES compared to the reference scenario based on conventional power sources) as well as when looking at distributional effects among different actors (i.e. support expenditures for RES that are transferred from energy consumer to RES producer). Thus, Figure 5 provides a summary of both and offers also an illustration of the necessary investments into RES. Scenario-specific results are shown at 12 MS level and for comparison also for the EU in total (EU-28). Not surprisingly, increasing RES deployment as assumed in the alternative policy cases requires additional investments: on average throughout the period 2021 to 2030 yearly capital expenditures increase by 14-18% compared to baseline according to the derived alternative policy scenarios. This comes along with an increase in system costs – i.e. additional generation costs rise by 12-30%, corresponding to additional costs in range of € 0.2-0.4 billion on average per year at 12 MS level. The increase in system costs is more pronounced if national RES policies remain the key driver for investments and, in turn, RES cooperation across the EU is limited as assumed in the case of limited (RES) cooperation. Contrarily, under a more harmonised policy framework (i.e. full (RES) cooperation), where resource allocation across countries follows a least-cost approach, the increase in generation costs can be classified as moderate.

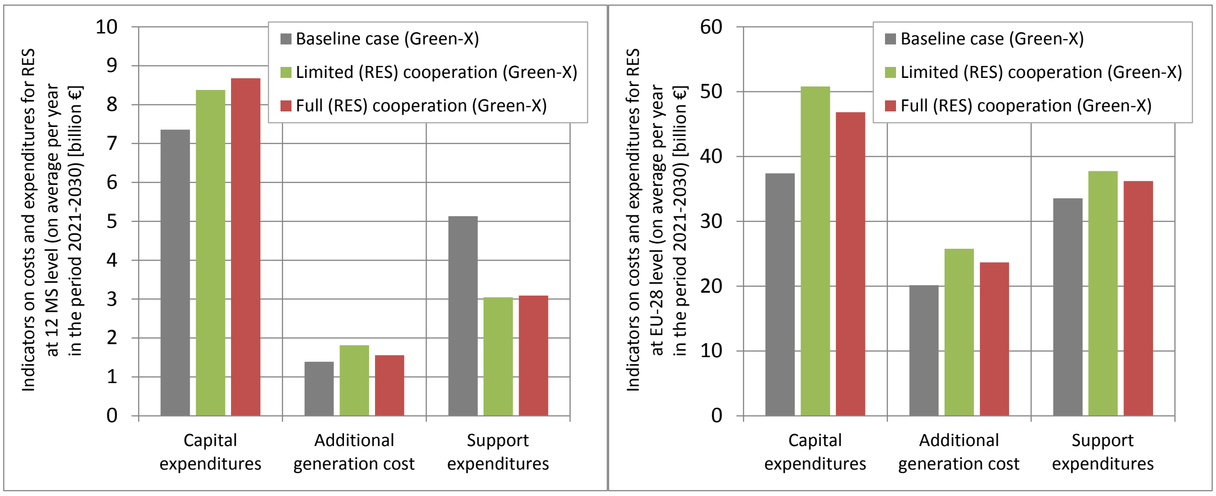

Figure 5: Indicators on costs and expenditures for RES at12 MS (left) and at EU-28 level (right) according to assessed Green-X scenarios

Support expenditures for RES, generally named as "policy cost", show a different pattern. Remarkably, at the aggregate of our 12 focus countries (12 MS) savings in terms of support expenditures can be identified compared to baseline, partly of significant magnitude: according to our assessment € 2-2.1 billion (or 40-41%) can be saved compared to baseline on average per year in the period 2021 to 2030 if alternative policy pathways are pursued.[5] This is a consequence of improved framework conditions (i.e. removal of non-economic barriers) and, in turn, an increased deployment of cheap to moderate RES potentials that would otherwise remain untapped.

Note, however, that the post-2020 EU-wide RES policy framework, in particular the effort sharing across Member States of a (possible) European 2030 RES target, has a significant impact on the magnitude of savings: if RES-related support expenditures have to be borne by the country where deployment takes place, cost savings are somewhat smaller for the 12 MSs, i.e. ranging from 23-27% (compared to baseline). In our assessment, in both alternative policy paths, the final allocation of policy costs across countries follows however again the logic of national RES targets that similar to 2020 consider the economic wealth of countries. This leads to a moderate monetary redistribution from "West to East" and from "North to South", causing the increase in savings.

Finally, Table 1 provides a summary of the impacts of alternative policy scenarios for renewables and energy efficiency at 12 MS level, expressing the demand reduction due to energy efficiency and the increase in RES deployment as well as accompanying direct economic impacts. Complementary to that, Figure 6 shows the resulting reduction in demand for fossil energy in general, and for gas in particular.

[5] At aggregated EU-28 level a different trend occurs: alternative policy scenarios that come along with increases in RES deployment by about 30% (compared to baseline) in 2030 lead to an increase of support expenditures by 8-13% (again, compared to baseline).

Table 1. **Summary of impacts of alternative policy scenarios for renewables and energy efficiency at 12 MS level**

Impact of alternative policy scenarios for renewables & energy efficiency at 12 MS level - indicating the change compared to baseline			
Energy efficiency:	Unit	Low Policy Initiatives (LPI) case	
Gross final energy demand 2030	TWh	-219.3	
Net cost of energy efficiency measures	billion € (on average per year (21-30))	-3.5	
		Alternative policy cases	
Renewables:	Unit	Limited (RES) cooperation	Full (RES) cooperation
RES generation 2030	TWh	114.9	109.8
Additional generation cost (for RES)	billion € (on average per year (21-30))	0.4	0.2
Support expenditures (for RES)	billion € (on average per year (21-30))	-2.1	-2.0

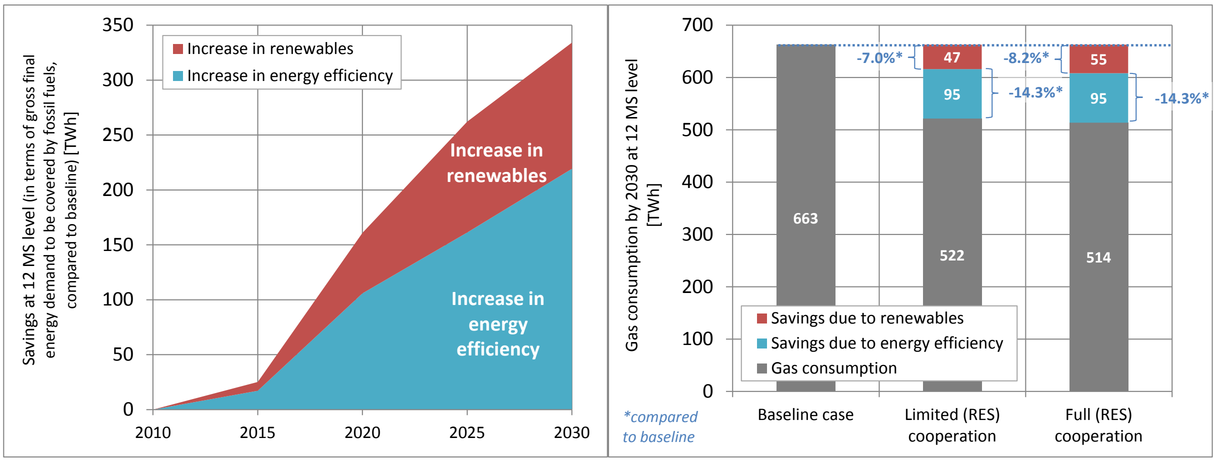

Figure 6. **Reduction of fossil energy (left) and gas consumption (right) under two alternative renewables and energy efficiency policy scenarios in the assessed 12 Member States**

Gas market modelling: Assessing the impacts of reduced gas demand on gas supply security

Key outcomes from the gas market modelling are discussed next, indicating the feasibility of reducing gas demand and the cost impacts related to that from a gas market perspective. To highlight the most important results for the EU 28 and the 12 MSs, they are presented in Figure 7 in a more clear-cut manner. The graphs shown therein highlight the quantity of natural gas purchased from Russia at the aggregated EU-28 level, and the gas cost saving resulting in the modelled scenarios at EU-28 as well as at 12 MS level – at present (2012) and in future years (2020 and 2030) according to assessed gas market intervention scenarios (i.e. baseline, re-negotiation and breaking-up scenario), reflecting therein distinct levels of overall gas demand (based on the different renewables and energy efficiency scenarios derived, i.e. baseline and alternative policy paths of limited or full (RES) cooperation).

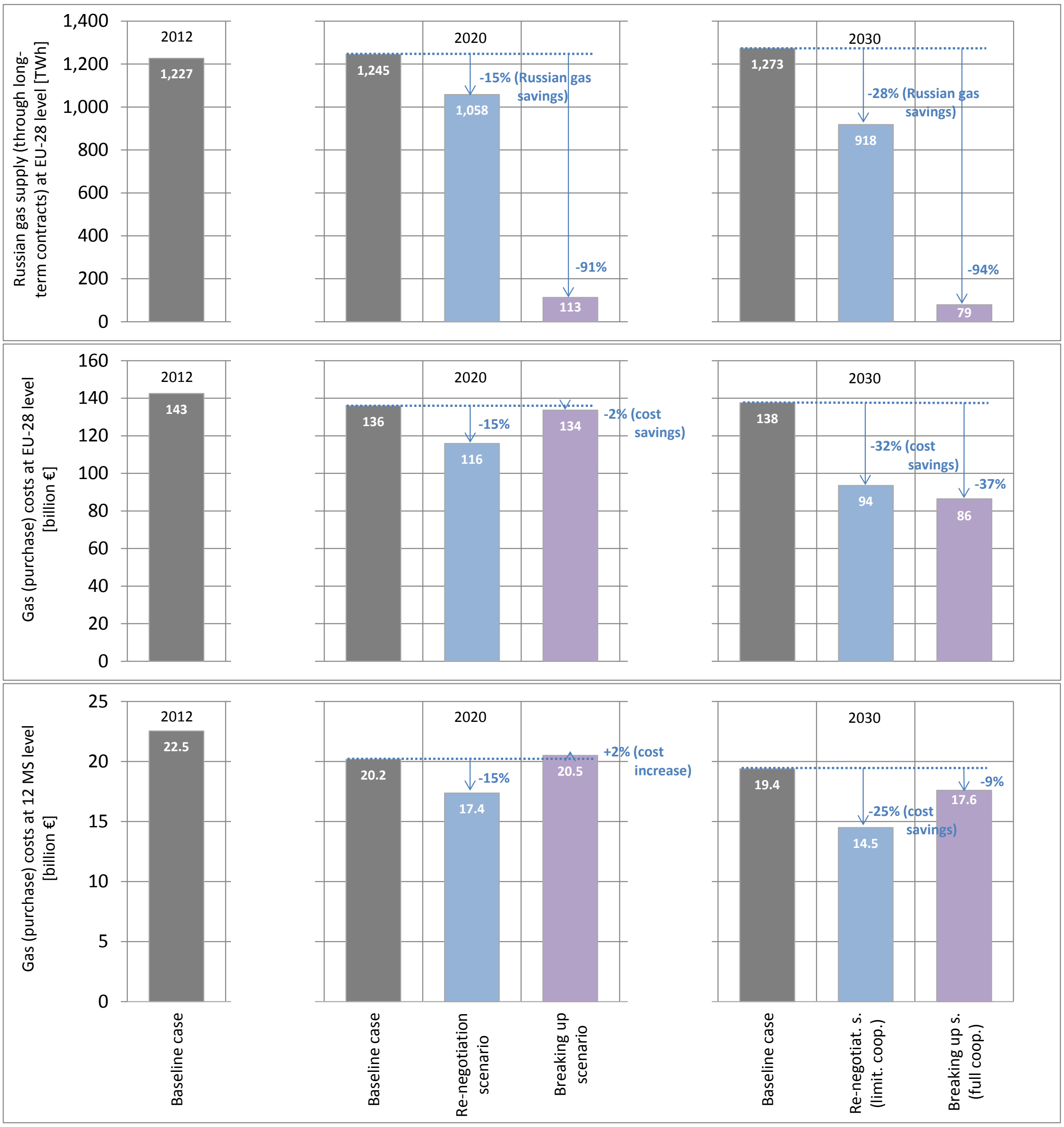

Figure 7. **Key results from the gas market assessment for 2012, 2020 and 2030 according to (selected) assessed scenarios: Russian gas supply at EU-28 level (top), Gas purchase cost at EU-28 level (middle) and at 12 MS level (bottom)**

The following outcomes should be highlighted:

- In the reference case we can observe a price convergence of the European gas markets due to improved interconnections, mostly in Central Eastern Europe. The volume of Russian gas imports and Russian gas dependency increases towards 2030.
- When the re-negotiation scenario is applied in combination with enhanced energy efficiency and renewable energy policies, this results in a massive 148-155 TWh gas demand reduction on the EU level by 2020 compared to the reference scenario. Dependence on Russian gas under long term contracts reduces by 355 TWh in the re-negotiation scenarios by 2030. In both the limited and the full cooperation cases there is a price decrease in Europe, also reflected in a reduction of gas purchase cost to an aggregated savings at 12 MS level of € 2.8 billion by 2020 and € 4.9 billion by 2030 in the re-negotiation scenarios.

- By 2020, the same renewable and energy efficiency scenario combined with a breaking up policy will lead to an increase in gas purchase related expenditures in 12 MSs by € 318 million, which is the cost of eliminating all Russian contracts in 2020 (excl. contract severance payments). By 2030 the breaking up policy would also bring benefits on the 12 MSs and on the EU-28 levels compared to our baseline case.

Thus, these results shed light on an additional important impact of the assumed scenarios. While our detailed assessment is focusing on the 12 MSs most affected by the present gas market situation due to the Ukrainian-Russian conflict, the results discussed above and illustrated in Figure 7 show that the impacts of the modelled policies – renewable, energy efficiency and gas market interventions – would bring significant benefits not only for the 12 MS but also for the whole European Union as well. What we can observe is that cost savings are in a range of 10-25% for the 12 MSs and 30-37% for the EU-28 by 2030 in the modelled scenarios.

Interesting to see is that the breaking up scenarios does still bring benefits in the long term (by 2030), although there are costs in the beginning of the period (in 2020). While the breaking-up scenario would significantly reduce Russian gas brought to the EU markets under long term contracts, substitution of long-term contracted Russian gas does not necessarily come along with significant extra costs neither for the 12 MS nor for the EU-28 gas consumers when compared to the results from the re-negotiation scenario.

Conclusions and policy recommendations

The main findings of this assessment can be summarised as follows:

- Energy efficiency measures can reduce the gas demand of the assessed Member States on the eastern border of the EU by 14 % while resulting in average net savings of € 3.5 billion per year. For doing so, according to the detailed study on energy efficiency policies in the EU led by Fraunhofer ISI (Braungardt et al., 2014) only a moderate policy intervention is required, meaning that all policy measures currently implemented as well as their upcoming revisions are enforced and a selection of new policy measures is introduced.
- A strong deployment of renewables as anticipated in the alternative policy scenarios (of limited / full RES cooperation) leads to increases in system costs and support expenditures at EU-28 level but for the assessed 12 Member States this may even lead to savings in support expenditures for renewables in range of € 2.0-2.1 billion per year in the period post 2020, which is mainly due to improved framework conditions (i.e. removal of non-economic barriers).
- The increase in renewables and energy efficiency comes along with benefits related to Europe's trade balance due to a (significantly) decreased demand for fossil fuels and related imports from abroad. Thus, natural gas demand can be reduced by more than 20% in the assessed countries, if a 30% target for renewables and energy efficiency by 2030 is aimed for.
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References

Braungardt, S., Eichhammer, W., Elsland, R., Fleiter, T., Klobasa, M., Krail, M., Pfluger, Ben, Reuter, M., Schlomann, B., Sensfuss, F., Tariq, S., Kranzl, L., Dovidio, S., Gentili, P., 2014. Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy-efficiency/saving potential until 2020 and beyond, http://ec.europa.eu/energy/efficiency/studies/doc/2014_report_2020-2030_eu_policy_framework.pdf, accessed on 27 October 2014.

EurActiv, 2014. Moscow limits German and Polish gas flows as 'warning', http://www.euractiv.com/sections/global-europe/moscow-limits-german-and-polish-gas-flows-warning-308383, accessed on 11 September 2014.

European Commission, 2013. EU energy, transport and GHG emissions trends to 2050: Reference Scenario 2013. DG Energy, DG Climate Action and DG Mobility and Transport, December 2013.

Jansen, J.C., Seebregts, A.J., 2010. Long-term energy services security: What is it and how can it be measured and valued? Energy Policy, 38(2010), 1654-1664.

Jewell, J., Cherp, A., Riahi, K.. 2014. Energy security under de-carbonization scenarios: An assessment framework and evaluation under different technology and policy choices. Energy Policy, 65(2014), 743-760.

Le Coq, C., Paltseva, E., 2009. Measuring the security of external energy supply in the European Union. Energy Policy 37(2009). 4474-4481.

Percebois, J., 2006. Dependance et vulnerabilité: deux façons connexes mais differantes d'aborder les risques énergétiques. Cahier no. 06.03.64. CREDEN Cahiers de recherche. Université de Montpellier

Toth, B., Selei, A., Szabo, L., Kaderjak, P., Resch, G., Liebmann, L., Jansen, J., Boonekamp, P., Jablonska, B., Ragwitz, M., Braungardt, S., 2014. Background report on "What can renewables and energy efficiency contribute to improving gas security in selected Member States?" A report compiled within the Intelligent Energy Europe project towards2030-dialogue, accessible at www.towards2030.eu. Budapest, Hungary, 2014.