Mapping out vulnerable sectors in the Eastern Partnership countries – structural change, Visegrad experience and relevance for EU policy

Energy Industry Report

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Acronyms

CHP - Combined Heat and Power
CIS - Commonwealth of Independent States
DCFTA - Deep and Comprehensive Free Trade Agreement
EE - Energy Efficiency
EAP3 - Belarus, Moldova, Ukraine
ESCO - Energy Service Companies
EU ETS - EU Emmission Trading System
IEA - International Energy Agency
IMF - International Monetary Fund
Mtoe - Million tonnes of oil equivalent
RES - Renewable Energy Sources
TPES - Total Primary Energy Supply
V4 - Visegrad Four: Czech Republic, Hungary, Poland, Slovakia

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Executive Summary

- The EAP3 energy sectors have achieved a significant drop in energy intensity since the late 1990s. Total energy consumption fell by more than 10% between 1998 and 2013, despite high GDP growth rates. This was predominantly due to the rise in oil and gas prices and the incumbent efficiency potential. Despite major efforts, dedicated energy policies only had a moderate impact on efficiency gains.
- All the decrease in energy demand came from the oil and gas sectors. The demand for these products fell by more than 25% between 1998 and 2013. Substitution by nuclear, renewables, and especially coal was significant. This stands in marked contrast to aggregate V4 figures, where all fuels but coal have experienced an increase in their respective shares in TPES, or the EU28, where the growth of renewables relegated all other fuels to the background.
- High energy prices and intensity levels played a critical role in worsening macroeconomic balances in Moldova and Ukraine. Foreign account and fiscal deficits increased substantially prior to the 2008 crisis and contributed significantly to the accumulation of public debt and to the slow post-crisis recovery. Macro-stability still constitutes a definite constraint on energy imports, providing an additional incentive for energy efficiency and supply security. Belarus experienced more diverse pass-throughs of high energy prices, in many ways increasing the country's dependency on cheap inputs.
- At the same time, import dependence ratios between the V4 and the EAP3 had leveled off by the early 2010s. This was almost equally due to the increase in energy imports in the V4, in absolute terms, and the rising domestic production in the EAP3, primarily in relative terms (even in absolute terms, internal supply in the EAP3 has grown moderately). By 2013, self-sufficiency was around 62-67% in both cases, and since then self-sufficiency in the EAP3 has surpassed V4 levels.
- High GDP growth rates between 1998 and 2013 were essential in maintaining the robust trend in efficiency improvements. Average annual growth rates in the EAP3 countries were almost thrice the EU28 growth rate (4.4% vs. 1.5%) and also exceeded the V4 pace of growth (3.2%). On the regional level, growth was driven by the third sector. Maintaining robust economic growth is crucial for future intensity trends, too, and its role will increase as the incumbent saving potential inherited from the Soviet age declines. Without a moderate convergence in economic performance, the current efficiency improvement trend would likely become stuck at relatively low levels.
- Modernization patterns are strongly present in some segments. In many sectors EAP3 consumptions patterns followed the Western/V4 trajectory with a little time lag. Oil product demand in transportation and electricity demand in residential sectors grew similarly to the patterns observed in the V4. This incremental growth in demand improved efficiency indicators and is predominantly market-driven. This trend may lessen in the years to come, as it is related to motorization and the spread of consumer society patterns.
- Industrial and corporate efficiency gains had the biggest input on improving intensity trends between 1998 and 2013. Especially after 2007, industrial energy demand fell considerably, in particular in sectors with high gas/oil inputs. Unlike Ukraine and Moldova, Belarus was able to maintain its high industrial growth rates with stagnating energy demand almost exclusively thanks to sharply improving terms of trade. Nonetheless, this is an one-time benefit for the region, mainly stemming from the de-industrialization of high energy added-value sectors (in Ukraine) and favorable terms of trade (in Belarus). Further industrial efficiency improvements increasingly require additional structural drivers and largely depend on major institutional factors, like inflow of FDI into industry, macro-stability, and access to capital.

- Residential demand intensity indicators per capita in heating and cooking were roughly 10% and 30% higher than in the V4 and the EU28, respectively. No significant improvements can be observed in this subsector. Potential savings in the housing sector will be realized slowly or at high social/financial costs. The implications of consumer price distortions, primarily in Ukraine, are apparent in the statistics. Unlike the V4, and despite growing import prices, aggregate residential gas consumption has grown in the EAP3, primarily due to low Ukrainian internal price levels.
- The heat and electricity generation sectors remain the single biggest efficiency reserve. Adaptation is under way, heat generation fell drastically primarily due to the decrease in industrial demand. The use of gas and oil product is decreasing. Some positive trends are at hand, but major modernization will be unavoidable in the years to come, and it will offer an opportunity to redesign the sector. Furthermore, the gradual replacement of heat-only generation by combined generation would be desirable in district heating. V4 experiences provide a valuable set of applicable policies, even if the situation of the two regions still differs in many segments.
- Energy policies are at different stages of development in the EAP3 region. Energy policy mindsets are dominated by industrial logic, supply security and social affordability considerations, and supply management ambitions. Efficiency, climate policy, and demand management considerations, by contrast, are heavily underrepresented, even if their role has been growing. Visegrad experience transfer shall be differentiated nationally, should be provided very selectively and only if its implementation is guaranteed. The EAP3 region will continue to be capital-scarce and have weaker regulatory capabilities, while its price regimes will remain less transparent and less reliable than is typical for the V4 countries. Social affordability considerations will play a greater role in the EAP3 nations' energy policy than in the latter set of countries. The regional policy context will remain uncertain and constitute a bottleneck even for V4 experiences.
- The general attitude towards V4 energy policy experiences differs in the three EAP3 countries. Belarus has a Janus-faced energy landscape, in which diversification and efficiency policies are present, but at the same time cheap energy inputs constitute a major driver of growth. Government efficiency efforts are isolated rather than being part of a broader strategic approach, and they are not underpinned by structural drivers or regulatory activities. Nonetheless, the relatively centralized decision-making, the low number of stakeholders and clear ownership patterns offer a few unique opportunities for certain activities. In many regards, Belarus may provide a more favorable domestic context – especially for residential efficiency projects – than some other post-Soviet states.
- Moldova has created a relatively transparent price and regulatory regime, and a moderately favorable investment climate. It has considerable achievements both in the field of import diversification and interconnectivity. Moldovan energy markets are liberalized, even if they remain under-institutionalized and grapple with low levels of liquidity. Thus Moldovan energy policies can adopt a selected set of EU regulations and are capable of sending optimal signals to market stakeholders. Current regulatory experiences from the V4 are partly adaptable in the fields of EE and RES.
- Ukraine's energy track record is controversial due to a long history of price distortions and high levels of subsidies, accompanied by lack of investments and lack of clarity about energy policy priorities. The country is in a stage where energy demand has been declining steeply, primarily due to de-industrialization and macroeconomic imbalances. Consequently, the most important challenges are the creation and reinforcement of local regulatory and market institutions, the elimination of excessive subsidies and price distortions, and increasing the reliability of the investment climate. Furthermore, in Ukraine the maintenance of the current self-sufficiency policies will require increasing efforts in the years to come. Thus, the V4

experiences should focus more on shaping the country's energy policy profile, promoting local priorities and providing a basic outline for further activities.

- Shifting energy policy attention towards demand management is a key challenge for the years to come. Unlike the V4, where efficiency requirements conform to EU standards and the relevant obligations are distributed among market actors, the EAP3 countries address these issues through a dedicated central apparatus, based on an industrial logic. Organizations established for the purposes of achieving efficiency improvements are relatively weak and their activity is impeded by inter-ministerial conflicts. Nevertheless, this tradition is adequate in the local contexts, as long as it accompanied by some government-provided support schemes and success in adopting secondary legislation. Thus the key question is whether these entities will be left alone with the full responsibility for managing demand or receive sufficient governmental backing in discharging this responsibility. Efficiency should remain a government objective rather than a goal pursued by a single agency, and all related ministries and corporations should play a role in the process of achieving it.
- The refurbishment and replacement of old thermal plants in the generation sector of the three countries analyzed is a major task for the coming years. This may require a coordinated policy effort and cooperation between different sets of owners and actors. Volatility in demand, lack of long-term financing, and the presence of natural monopoly and oligopoly situations require a more accentuated regulatory framework in order to allow cost-benefit relations to work. The district heating sector poses the biggest challenge in this regard. As some Moldovan examples show, in certain cases a deliberate disconnection policy with a support regime may be an optimal choice, primarily in rural areas, if the housing stock makes it possible. A set of refurbishment actions (like metering, wall insulations) should precede plant and network reconstructions.
- Due to social affordability considerations, social/industrial subsidies will likely remain sizeable in these economies. Nevertheless, these countries face a key challenge in defining target groups more accurately and ensuring that subsidies are cost-reflective. Excessive subsidies may constitute potential hotbeds of rent-seeking practices, could endanger macro-stability and distort fuel choice at the micro level.
- RES policies will remain low-profile in the region. In light of the low level of business transparency, large-scale subsidy regimes are neither affordable nor advisable. Nonetheless, just as in the V4, biomass potential may be utilized in a financially meaningful way. Total biomass and waste consumption in the EAP3 countries was four times less than in the V4. Visegrad CHP alone used more biomass than the EAP3 states altogether. Thus, biomass – except for biofuel production – is a credible option in the residential segments. A mix of market creation, technological support, and simplified regulatory procedures may bring visible results even in the short-term.
- Self-sufficiency and import substitution are capital-intensive options. Despite major improvements in import reduction over the last decade, given the current scale of investments the prevailing level of self-sufficiency is not sustainable in the long run. Thus a reasonable import diversification in oil, gas and electricity segments should be considered as a viable alternative to self-sufficiency, especially in Ukraine. An exclusive insistence on domestic supply options would derail sectoral investments and may lead to suboptimal capital allocation.
- The V4 countries and EU donors have implemented a significant number of efficiency projects at the municipal level. These projects usually include renovations of district heating systems, which involve, among other things, installations of boilers based on biomass fuels, reconstruction of municipal public lighting, also using modern LED technologies, or improving the energy efficiency of buildings and their insulation. These are funded by EU structural funds and through ENI. In order to facilitate more projects and to improve the capacity of

Ukraine and Moldova to implement EU co-funded projects, the V4 can share with them their experience in adapting national legislation to the EU's energy and climate policy, including when the regulatory framework for providing energy services, energy auditing, strategies for the renovation of buildings, financial mechanisms for implementing projects, and raising public awareness in the field of energy savings.

- Following the accession of Ukraine and Moldova to the Energy Community Treaty, their energy strategy documents identified integration into the energy market of the EU as a long-term priority. The only way for Ukraine and Moldova to implement this priority is by first gaining access to the emerging regional energy market in Central Europe, with respect both to natural gas and electricity. Promoting imports from the West may not only ease concerns about the supply of Russian energy, but may also help address the problem of underinvestment in local energy sectors. Thus V4 governments should consider the option of including Ukraine and Moldova in the work of the V4 High Level Group on Energy Security (V4 HLGES) as part of a V4 Plus formula. The V4 HLGES has emerged as a very efficient platform for achieving regional agreement on the development of priority interconnectors, which have significantly strengthened the security of gas supply in the region. As a result, they provide one of the physical foundations of the future regional energy market. Accordingly, Ukraine and Moldova should consider the possibility of applying for an observer status in the CZ–SK–HU–RO electricity market-coupling, as has Poland, for example. Although the gradual inclusion of Ukraine and Moldova in the creation of the regional Central European energy market is a long-term goal indeed, it should be viewed as a strategic framework for V4-EAP3 cooperation in the field of energy.

Introduction

Eastern European energy matters have expanded far beyond their previous policy boundaries in the last 15 years. They are now interconnected with a significant number of political, strategic, security, social, and macroeconomic issues, creating a complex environment for decision-making. Energy affected political decision-making processes through domestic residential prices, the distribution of wealth between various domestic groups and countries. Macroeconomic stability was challenged by high import prices, which led to huge deficits in the current account and fiscal balances. Sovereignty was perceived to be threatened primarily on account of the producers' leverage as a result of their supply dominance. The changing energy relations created a lot of new problems, and they did so rapidly and often unexpectedly. Energy policies had to manage these challenges in an environment fraught with massive uncertainty.

The situation in the former Soviet Union was of particular significance in this regard. These countries were severely affected by all the abovementioned aspects: their economies experienced a major external input price shock and often the deterioration in their of terms of trade. They had to face the rise of Putin's Russia, its shifting foreign policy ambitions, and its increased leverage in energy matters. The changing energy rents triggered fierce domestic conflicts among various groups of the local elites concerning the distribution of these incomes and access to cheap inputs. In the last 15 years, the rules of the game have changed drastically in the former Soviet Union, primarily in the three Eastern Partnership countries analyzed in this Report, namely Moldova, Ukraine, and Belarus (EAP3).

The 2009 gas crises showed that the existing stakeholders at the time were no longer able to contain their conflicts, and the problems between them may spill over in other regions. By 2015 it became obvious that post-Soviet energy issues require broader international attention and new international actors will have to enter the region. As of now, it goes without saying that the EU, IMF, World Bank, and ultimately Western nations have to actively track and influence regional developments. Energy was not the only but one of the major variables in this conceptual and political shift.

Nevertheless, due to the complex understanding of the issue of energy it became more difficult to determine the optimal goals and the instruments available. Many international actors were active in the energy sectors of these countries and provided expertise and assistance. Expectations regarding Western support vary according to their potential, motivations, and character. For NATO, until recently the EAP3 energy situation was considered more like a potential unconventional, soft security threat[1] that could potentially affect/weaken the responsive capabilities of the alliance in certain situations. For the IMF, the issue was a distinct aspect of a broader energy subsidy problem, and it was perceived as a source of macroeconomic vulnerability and of expensive and inefficient policies.[2] In the IMF's calculations, which relied on a broad definition of subsidies, Ukraine was ranked first globally in terms of total subsidies for energy products, while Moldova provided the lowest level of

[1] Andrew Monaghan: NATO and energy security after the Strasbourg-Kehl summit. NATO Defense College, 2009. Available at: http://fpc.org.uk/fsblob/1073.pdf (01.22.16)

[2] Benedict Clements et al.: Energy Subsidy Reform: Lessons and Implications: Lessons and Implications. IMF 2013.

support in the CIS in 2013.[3] The International Energy Agency provided the most comprehensive overview of energy policies in the countries concerned,[4] assessing the entire spectrum of the sector. In its reports it underlines not only the significance of efficiency, as the biggest potential for improving energy balances in the post-Soviet region, but also evaluates the policy-making process and the sector-specific investment climate. The World Bank, the EBRD, and some national donors (like SIDA, NEFCO, E5P, GIZ, etc.) also provide assistance and have valuable field experience – with mixed results – in these countries. The most favorable "would-be" target for efficiency projects is the district heating sector,[5] due to its high loss ratio, social relevance, and high visibility. Unfortunately, some of these projects were canceled or failed to yield the expected results, primarily due to the complex stakeholder problems in this particular field. These cases clearly show that despite the existence of positive precedents, applicability and local context are important variables in Western experience transfer.

Nonetheless, there is no doubt that among western partners, the European Union and its member states have the most at stake when it comes to EAP3 energy matters. The EU plays an important role as a norm-setter, as a regulator (primarily through the Energy Community and the DCFTAs in Moldova and Ukraine), as a partner in supply security management (gas reserve flows, gas transit), as a donor and assistance provider (ENPI, ENI), and sometimes as a mediator (winter deals between Ukraine and Russia in 2014 and 2015). However, unlike the institutions listed above, on account of its internal diversity the EU does not have a clear mission as to what it seeks to achieve through its EAP3 energy actions. Some authors argue that its activity is mainly reactive and cannot be fully understood without considering the interdependence between the EU and Russia.[6] Others even encourage this geopolitical discourse and would use the Union's regulatory leverage to counterbalance Russia in the EAP3 region.[7] Nonetheless, a significant portion of the relevant literature only regards the Russia-factor as the runner-up in terms of the process of policy approximation. They interpret the EU's activities in the EAP3 countries as an extension of its internal energy policies to new areas rather than an attempt at counterbalancing Russia's influence.[8] The EU's Eastern energy measures have not been clearly delineated and the quest for an optimal framework is continuously ongoing.

There is a common view that new EU members, especially Visegrad states (V4) can provide some guidance to the EAP3 in managing the energy problems of the latter, in other words that they can contribute to the EU's Eastern Policy with their past experience. Visegrad countries understandably

[3] IMF, Fiscal Affairs Department: How Large are Global Energy Subsidies? June 29, 2015. Available at: http://www.imf.org/external/pubs/ft/survey/so/2015/NEW070215A.htm "country-level estimates" link (01.24.16)

[4] IEA: Eastern Europe, Caucasus and Central Asia. 2015. Available at: http://www.iea.org/bookshop/705-Eastern_Europe,_Caucasus_and_Central_Asia (01.24.16)

[5] Yadviga Semikolenova; Lauren Pierce; Denzel Hankinson: Modernization of the District Heating Systems in Ukraine: Heat Metering and Consumption-Based Billing. World Bank, Washington D.C, 2012, p.15. Fan Zhang; Denzel Hankinson: Belarus Heat Tariff Reform and Social Impact Mitigation. World Bank, Washington D.C, 2015.

[6] Nataliya Esakova: European Energy Security: Analysing the EU-Russia Energy Security Regime in Terms of Interdependence Theory. Springer, 2012.

[7] Keith C. Smith: Russia and European Energy Security – Divide and Dominate. CSIS, October 2008. Available at: http://csis.org/files/media/csis/pubs/081024_smith_russiaeuroenergy_web.pdf (01/22/16)

[8] Francis McGowan: Can the European Union's Market Liberalism Ensure Energy Security in a Time of 'Economic Nationalism'? In: Journal of Contemporary European Research, Vol. 4, No. 2, pp. 90-106; Heiko Prange-Gstöhl: Enlarging the EU's internal energy market: Why would third countries accept EU rule export? In: Energy Policy Volume 37, Issue 12, December 2009, pp. 5296–5303.

feel more committed to these efforts on account of their physical proximity, its impact on their own security needs and foreign policies. They are also often perceived as actors that have real capabilities at their disposal to intervene more efficiently than others because of the Soviet legacy and the transition experience that they have in common with the EAP3 countries. These expectations seem to be justified in many subsectors, even if their actual role is often exaggerated and lacks solid statistical evidence.[9] Thus these countries are expected to provide some sort of added value in designing EAP3 energy assistance programs and to increasingly contribute to the process of convergence.

This Report aims to analyze and specify these assumptions. In *Chapter 2*, we provide a detailed comparative statistical overview of key long-term energy trends in the V4 and the EAP3. These trends rest on a large number of different, often external, drivers, such as market dynamics, prices, technological development, and social standards. Energy policies are often overrated in this regard. Market signals, if not distorted, can often provide the strongest incentive for efficiency improvements. The EAP3 as a region has performed surprisingly well in terms of energy efficiency, even if this is measured against a very low baseline. As the statistical analysis will show, both the V4 and the EAP3 intensity indicators per unit of GDP halved between 1990 and 2013. Nevertheless, the EAP3 region saved this amount primarily in the hydrocarbon sectors, in contrast to the V4, where intensity improvements came predominantly from the less efficient coal sectors. Nonetheless, in many respects the EAP3 had to go through a more rocky accommodation path than the V4 or the EU28, sometimes outperforming these subjects in terms of the improvement of its intensity indicators. The Chapter identifies the transformation and residential sectors as areas where potentially significant savings may still be realized. In the first area, i.e. transformation, policy-makers face a stakeholder problem and a problematic technological legacy, while the situation in the latter is mainly the result of past, and sometimes prevailing, price distortions.

In *Chapter 3* we briefly differentiate the EAP3 countries, their energy sectors and examine the role of different corporate, ownership, management, and political factors in the national energy consumption trends. Ukraine, Moldova, and especially Belarus followed different paths over the last 15 years, and the outcomes of their respective trajectories differed as well. While many focus on experience transfer from West to East, one should not forget the compatibilities within the EAP3 energy systems and the need for differentiating between these countries.

Energy policies with a special focus on energy efficiency will be analyzed in *Chapter 4.* Energy efficiency as a policy message from the V4 is somewhat bizarre, since none of these countries treat efficiency as a priority in their respective strategies. Nonetheless, new EU members had to set a high number of national targets and had to implement many administrative measures as part of their accession processes, and as a result they have a clear legal commitment to implement these. The issue of efficiency is much "softer" in the EAP3, and these countries have only loose commitments resulting from their DCFTAs and the Energy Community and/or a free hand to determine their efforts.

[9] Maybe it is enough to point out that despite solid improvements, the EAP3 region's energy intensity per unit GDP (0.99 Mtoe/bln USD2005) in 2013 was twice as high as the corresponding figure in the V4 in 1990 (0.49). IEA statistics.

Finally, in *Chapter 5* we examine the residential and the district heating sectors in more detail. These are policy-intensive fields, with high social sensitivity and political significance. Due to the technologically outworn thermal generation plants, there is a clear necessity for energy policy decision makers to intervene and gradually modernize these capacities. These actions will lock-in the future of the sector for decades to come, highlighting the need for smart, coordinated measures.

Statistical overview

The aim of this chapter is to provide a statistical background for the entire Report and underpin the policy recommendations with a more factual analysis. It compares and explains the Visegrad and EaP3 energy trends in the last two decades. We prioritized the impact of high energy (primarily oil and gas) prices on these economies from the various variables we explored. By 2011, the global oil price (in real terms) had exceeded its historic peak in the late 1970s. Natural gas and imported coal prices in Europe and in Asia Pacific increased fivefold between 1999 and the early 2010s. Nevertheless, though this was not the only issue affecting energy efficiency and energy policy in general, it was likely the most important non-incumbent issue. Accordingly, the time span of our analysis stretches from 1998 to 2013. As we lacked the capacity to analyze the entire period in question, we included statistical data only for the following six years: 1998, 2001, 2004, 2007, 2010, and 2013.

Even if the Report focuses on the V4 and EAP3 countries, at certain points in the study we included comparative data for the EU28 and Russia. It would be difficult to describe long-term tendencies without having a broader overview and setting some benchmarks. The EU28 data are used to demonstrate the energy intensity trends of the developed world in the given timeframe (in the EU28 both GDP and TPES (total primary energy supply) heavily rely on the EU15). Given its non-binding efficiency target, the wide variety of policies it pursues, and a competitive market pattern, the EU28 constitutes the "high-end" of Europe's energy efficiency trajectory. At the other end, Russia is used to present what may be referred to as a "low adaptation" path. Given its soft internal pricing and relatively weak efficiency efforts, Russia is often perceived to be maintaining its high-intensity trajectory. As the following chapter will show, many of these hypotheses seems to be justified, even if some distinctions should be made.

Visegrad and EAP3 paths are usually perceived to be "somewhere between" these two benchmarks. The "Eastern end" of the EU still features some legacies of Socialist energy patterns but is in the process of catching up to the core EU countries in terms of policies, trends, and technology. The EAP3 region in particular is often perceived to have a post-Soviet consumption and industrial pattern with all the features of an importer country. In this chapter we also aim to show that even if most of these perceptions are correct, the picture is a bit more complex and more nuance is needed. The table below provides a brief insight into different models of adaptation to the changing external environment.

Table 1 *Selected energy-related indicators for some European countries, 1998-2013*

	EU28	V4	EAP3	Russia
GDP(2005)/capita in 1998 (000 USD)	25035.3	7279.8	1216.7	3275.5
TPES/GDP(2005) in 1998 (toe/000 USD)	0.14	0.38	2.11	1.21
Average annual GDP growth rate between 1998-2013, %	1.5	3.2	4.4	4.9
Average annual TPES growth rate between 1998-2013, %	-0.28	-0.03	-0.75	1.46

Source: IEA

Western European countries have mature consumer societies, low GDP growth, economies with low energy intensity, and some past experience of managing oil price hikes (e.g. after 1973). These countries also relied on relatively clear-cut patterns of energy demand prior to 1998, transparent pricing, efficient competition rules and a high variety of energy and industrial policy capabilities that they could utilize. Consequently, microeconomic adaptation was driven both by markets and policy actions. The former resulted in technological improvements and their swift introduction into the production chains, in the car industry or in electricity generation, for example. Policy actions have set some new priorities with a focus on creating more competitive patterns in some segments (like natural gas), and considerations involving efficiency and decarbonization became full-fledged vectors of policy action. No doubt, these policies represented the high water mark for efficiency management policies in Europe.

Table 2 *Some systematic characteristics of the four European regions, 1998-2013*

European Union-28	Visegrad-4
Developed economies, relatively low growth potential; Post-industrial era, low energy intensity of GDP growth; Mature consumer societies, expensive energy is affordable; Capital-abundance in energy sectors, Western corporate culture; Emerging sectoral policies with high variety of targets;	Catching-up to the EU, relatively high growth potential; Huge inflow of Western FDI, production chains rapidly modernized; Emerging consumer societies, social affordability is an issue; Capital-sufficiency in conventional sectors, mixed corporate culture; Following EU sectoral policies with a delay, capability constraints;
Eastern Partnership countries-3	**Russia**
Strong growth with macroeconomic vulnerabilities; High share of industry in GDP with constant value chains, no significant FDI; Polarized societies, consumer patterns remain segmented; Capital-scarcity in energy sectors, few changes in their corporate strategies; Sectoral policies in development, huge inadequacies;	Robust growth partly due to raw material exports; Industry dominates, some improvements in value chains, low level FDI inflow; Highly polarized society, with robust consumption potential at the top; Capital-sufficiency varies between sectors, extractive corporate strategies; Strong verticality in sectoral policies with new priorities;

Further to the East, for the post-Socialist and post-Soviet countries this period marked their first encounter with high energy prices. These countries weathered the 1970s under the Soviet Bucharest formula and pricing regimes, which helped them in alleviating and substantially moderating the domestic impact of the international energy crisis. For the new EU-members, in particular the Visegrad countries, the rise in energy input prices constituted a headwind in their efforts to catch up to the West. Their GDP growth rates between 1998 and 2013 substantially exceeded those of the EU15. The patterns of Western consumer societies spread quickly across the region, resulting in a new wave of motorization and booming residential energy demand. Nevertheless, these countries still had efficiency reserves to be mobilized. Even if the low hanging fruits of efficiency gains, inherited from the heavy industrial segments of the Socialist era, had been mostly "harvested" by 1998, the potential in energy generation, industry, and transportation was still significant. Industrial performance largely relied on multinational and foreign companies, stakeholders who can manage their energy bills effectively.

The complex economic landscape was further complicated at the policy level. Unlike in Western Europe, high energy prices also took their toll in macroeconomic and social regards. Between 2007 and 2011 the average trade balance of energy products in the EU10 was -4.5% of GDP in contrast to -2.8% in the EU15.[10] The share of utility bills in the disposable income of households was also roughly twice the customary Western figures. Russian supply security also became a major policy issue after the 2009 gas crisis. This led to a high variety of factors and a complex environment that affect Visegrad energy policies. While market trajectories pointed towards decreasing energy intensity in the overall economy, on the policy agenda the issue of energy efficiency was overshadowed by a high number of issues involving security and affordability. These achievements were mainly the result of microeconomic and market trends, while policy changes had only a limited impact on them.

In the case of EAP3 countries the 2008 crisis was a more important watershed than for the others. Thus, the aggregated numbers between 1998 and 2013 do not reveal the full truth, and due to the good performance prior to 2008 they show a more favorable picture about the current trends. This is mainly due to the late, but much more stormy encounter with global energy prices after 2008. Increased energy import prices, and the Russian leverage that they engendered, were a major shock in several aspects. As we saw in the 1970s in the Third World, high input prices became a considerable threat to long term macroeconomic stability for low GDP/capita economies. Energy import bills emerged not only as microeconomic constraints for many industries, but also as a challenge in terms of financial sustainability at the national levels. Accordingly, high energy prices contributed considerably to the deceleration of growth and to increasing budget and foreign account deficits. Not independently from these trends, Russia's prominent role in energy supplies drove these countries into a corner: they had to choose between promoting social consolidation and preserving their perceived or real sovereignty. This established an increasingly political environment for energy policy. As a result, these countries attained visible achievements in terms of energy intensity, even if at a very high macroeconomic and social cost.

Russia remained a benchmark in terms of its combination of post-Soviet energy patterns and limited (and highly mixed) impact of global oil price increases on internal energy demand. Domestic price increases were relatively modest, high export prices established a favorable macroeconomic environment for much of the period. Policy actions in the field of efficiency were selective without a broader context and were often not supported by industrial and residential pricing. Nevertheless, Russia also provided a good example of incumbent efficiency potential. Energy intensity remained on an improving trajectory, primarily as a result of changing production assets, improvements in technology, and smarter corporate policies by foreign and domestic actors alike. Thus, the high levels of economic growth in Russia were accompanied by a slowly decreasing trend in energy intensity (Table 1).

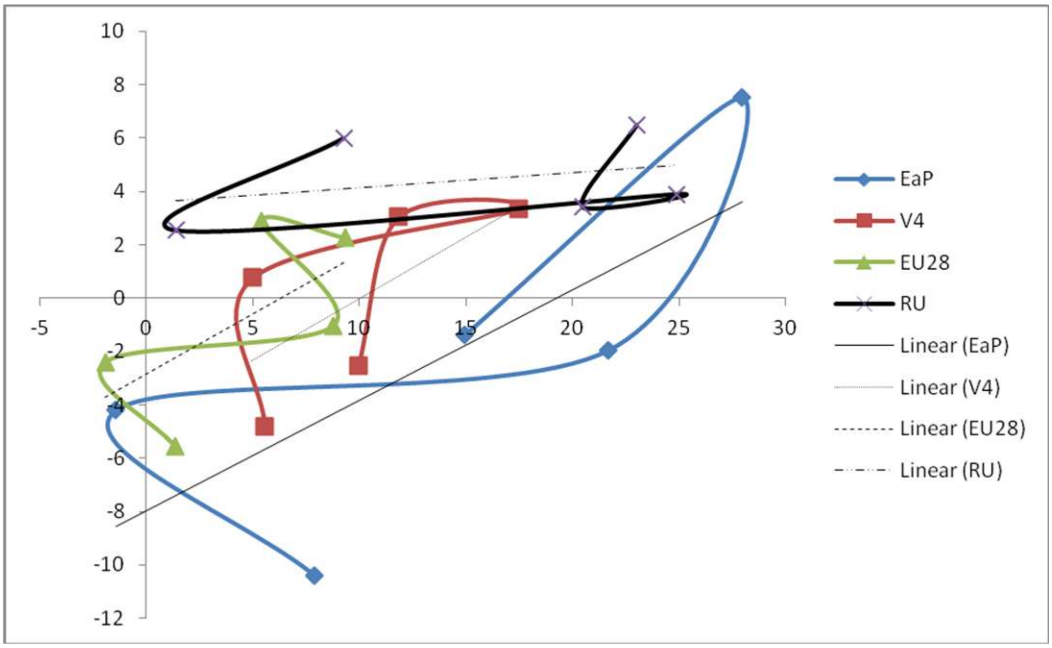
[10] European Economy – Member States' Energy Dependence: An Indicator-Based Assessment. Occasional Papers 145. April 2013. Available at: http://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp145_en.pdf (10/20/2015)

We primarily relied on the statistical datasets of the International Energy Agency (IEA), and we will follow its classification and benchmarking. Where necessary, we also added price, GDP, and different stock data from other sources, and these were indicated accordingly. As we used only a limited number of years, in some particular cases we cross-checked calculations and trends against a bigger dataset, which was not always indicated in the text.

Energy trajectories in Europe: the four cases and the three drivers

Energy demand in the EU28 reached the level of 1985 in 2014, while the former Soviet countries' total consumption at that time was equal to the Soviet demand of 1976.[11] Maybe it would be accurate to say, that the century-long trend of ever increasing energy demand in wider Europe recently came to an end. Demography, GDP growth potential, industrial structure, efficiency and climate policy measures all point towards further drops in energy demand. Even if some particular factors were to change and trigger higher energy consumption in the future, it is unlikely that those would not be offset by other contravening factors. Europe seems to be doomed to a stagnation or even for gradual decrease in its TPES.

Figure 1: *Relations between GDP (X) and energy demand (Y) growth in Europe, 1998-2013*



Source: IEA. Horizontal axis – change of GDP from the previous period, %; Vertical axis – change of TPES from the previous period, %. (Periods: 1998-2001-2004-2007-2010-2013). GDP is measured in constant 2005 USD prices.

The decreasing trend in energy demand was accompanied by positive GDP growth rates. Figure 1 below shows the basic outline of these decreasing intensities in the four European country sets. As is apparent on the horizontal axis, economic growth was steady until 2007: in the post-Soviet region, tri-annual growth rates were between 15-27% in the first half of the 2000s. Nonetheless, growth rates dropped sharply everywhere in Europe between 2010 and 2013: the EU28 and the EAP3 experienced negative growth in the 2007-10 period. The vertical axis values suggest a more

[11] BP Statistical Review of World Energy, 2015

consistent downward trend in energy use. With the exception of Russia, between 2010 and 2013 energy consumption decreased substantially everywhere. In the EU28 and the EAP3 it had been declining since 2007 and 2004, respectively.

Figure 1 also suggest a robust magnitude of efficiency improvements in Eastern European countries (except Russia). In the EAP3 countries, the respective trends in economic and energy demand were practically decoupled at certain times. As can be seen above, EAP3 countries were able to achieve relatively high growth rates even with minimal additional energy input in the early 2000s. Between 2010 and 2013, during the years of the major gas and oil price surge, they reduced their energy demand by more than 10% while they held on to positive growth rates. Given this magnitude, it is reasonable to assume that the EAP3 economies were more affected by the changing environment and/or had a greater domestic incumbent energy efficiency potential to draw on in these years.

The case of Russia renders the EAP3 trend even more emphatic: as Russia's industrial structure are similar to those found in the EAP3 countries, its economic growth was not accompanied by large scale decrease in its TPES. However, the following should not come as a surprise: given its energy exports and the steady rise of oil prices, Russia's domestic energy consumption is not necessarily strongly correlated with its economic growth. We observed positive efficiency trends in the EU28 and the V4, but this was far less pronounced. This phenomenon only underlines the conventional wisdom about economic convergence: higher national GDP/capita also assumes higher TPES/capita. One of the key questions of this Report is whether the EAP3 countries can boost these efficiency gains further and maintain a positive trajectory in this regard regardless of their economic performance.

The drivers of these improving efficiency trends differ in various parts of the continent. In the next few pages we will try to provide a basic list of the main drivers and develop some basic assumptions about their relevance in each of the European regions. In order to add more depth to the analysis and improve the transparency of the Report, we will focus on three basic interrelated drivers in our overview:

(1) incumbent efficiency potential, structural change, and technological development;
(2) external price signals, primarily increases in oil and gas import prices;
(3) domestic policy measures, especially at the state and municipal levels.

These three drivers do not cover all the major efficiency triggers in these economies. Energy demand trajectories were also heavily influenced by corporate policies, social patterns of energy use, and, most importantly, non-energy related factors of economic growth. Among the latter, the global financial crisis of 2008 and its impact will be highlighted in the discussion below. At the same time these three drivers constitute by far the most important factors of real and potential change. Looking at Table 2, we can identify some highlights regarding these drivers. The changing energy-mix in these four cases is even slightly more telling when it comes to the role of each driver.

Table 3 *Energy supply in selected European regions/countries, TPES, 1998 and 2013, ktoe, %*

	EU28				V4			
	1998		*2013*		*1998*		*2013*	
Coal	333044	**19.7%**	**286390**	**17.6%**	**93601**	**52.0%**	**75162**	**41.9%**
Crude oil and oil products	645121	**38.1%**	**513092**	**31.6%**	**37149**	**20.6%**	**39340**	**21.9%**
Natural gas	373242	**22.0%**	**386740**	**23.8%**	**32637**	**18.1%**	**33077**	**18.4%**
Nuclear	243190	**14.4%**	**228612**	**14.1%**	**10055**	**5.6%**	**16203**	**9.0%**
Other	99237	**5.9%**	**209943**	**12.9%**	**6675**	**3.7%**	**15467**	**8.6%**
Total	1694305	**100.0%**	**1625632**	**100.0%**	**180117**	**100.0%**	**179306**	**100.0%**

	EAP3				Russia			
	1998		*2013*		*1998*		*2013*	
Coal	39728	24.2%	42580	29.1%	110836	18.9%	108328	14.8%
Crude oil and oil products	26046	15.9%	17932	12.2%	120543	20.5%	160110	21.9%
Natural gas	75337	45.9%	58268	39.8%	310874	52.9%	395048	54.1%
Nuclear	19608	11.9%	21848	14.9%	27784	4.7%	45318	6.2%
Other	3383	2.1%	5862	4.0%	17914	3.0%	22086	3.0%
Total	164101	100.0%	146489	100.0%	587951	100.0%	730890	100.0%

Source: IEA

The fact that demand for renewables in the EU28 passed the 10% threshold (indicated in the "other" line in the Table) around 2010 is a perfect demonstration of the magnitude of the common climate policy driver. Biofuels and waste were by far the biggest components of this growth, while combined solar, wind, and geothermal energy came in second. These achievements have been reached despite the decrease in total demand and they owe primarily to the EU's administrative measures and subsidies concerning sustainability, the 20% renewables target, and the introduction of the ETS. These trends were less dominant in the Visegrad region – probably because of its lower renewables targets – and were almost completely absent in the EAP3 countries and Russia (in Russia the biggest increase in renewables came from hydro energy).

In the Visegrad region the drop in coal demand was the most visible factor. The replacement of coal with other fuels dominated in the last two decades. This is a long-term incumbent process, a general trend in the developed countries. The composition of coal savings is very similar in the EU28 and the V4: electricity generation, industrial, and residential use were equally affected. This suggests that an overarching trend prevails, namely the massive inflow of Western technology, which lessens the significance of local factors, like reserve depletion and the decommissioning of old power generation units in the Czech Republic or Poland. These effects were particularly strong in the Visegrad region, due to its high starting levels in the early 1990s, the rapid modernization of production chains, and changing residential preferences. The effects of climate policies and ETS are difficult to measure, but a review of the time series data, which goes back quite a while, shows that their influence was rather limited. Unlike in the Visegrad region, in the EAP3 countries coal demand grew, likely as a result of the surge in oil prices and on account of the changing price and supply security conditions.

Residential coal demand was on a similar track as the declining Western European and Visegrad trajectories, and the increase almost fully came from the power generation sector.[12] The same is true for Russia: coal almost fully disappeared from residential consumption, but maintained its role in industry.

The EAP3 energy-mix seems to reflect the effects of the hike in oil and gas prices, which was the major driver after 1998. Total hydrocarbon demand fell by roughly 25 Mtoe in 15 years, which suggests a drastic adaptation to the new price and security patterns. However, incumbent factors should not be underestimated either: between 1992 and 1998, in a depressed price environment, the total drop in gas and oil demand reached almost 66 Mtoe, falling from 166.7 to 101.4 Mtoe. Nevertheless, there is some evidence that helps to reveal the role of the oil price boom. The most conclusive argument concerns the decreasing share of hydrocarbons in the total energy-mix. In the 1990s, in the midst of economic collapse, their share was almost unchanged (63.2% in 1992 and 61.6% in 1998). By 2013, after 15 years of relative prosperity, their share had dropped to 47.8%, while the supply of other fuels even grew in absolute terms. Furthermore, as we will see below, domestic demand closely followed the trajectories of import prices. The "dark age" of hydrocarbons in the EAP3 region began after 2007 and especially after 2010, when local import prices sky-rocketed. The comparative overview also supports this statement in the Visegrad region, despite higher prices, hydrocarbon demand has not dropped at all, likely due to economic growth and coal reserves depletion.

It would be difficult to identify any of these drivers in the case of Russia. This owes in part to the absence of these drivers or their relatively weak impact. Due to its resource abundance, Russia could follow a high-intensity path without any particular demand for policy designs or competitive push to constrain the role of fuel inputs in its value chains. In some regards, it represents a "current policies and environment" scenario from the late 1990s, signaling an alternative development path in which internal prices remain low and scarcity does not arise. Nevertheless, this statement needs to be taken with a grain of salt, and one must consider many additional channels, primarily the direct and indirect role of increased domestic production and exports as one of the key drivers.

As these four examples show, the "top stories" in these regions and countries were rather different over the last 15 years. One needs to be careful with respect to make assertions concerning similarities and differences, since the underlying demand trajectories simultaneously conceal many unique factors and exhibit the imprints of some overarching tendencies. Furthermore, the impact of the same external effects can be rather different, depending on the recipients' economic and social relations. This comparison repeatedly underlines the fact that one cannot easily juxtapose the Visegrad region with the EaP3 countries; one must have a deep understanding of the context and keep in mind of the applicability of any solutions. Thus, the chapter will try to analyze the general context of the energy trends in the Visegrad and EaP3 regions to explore their common features.

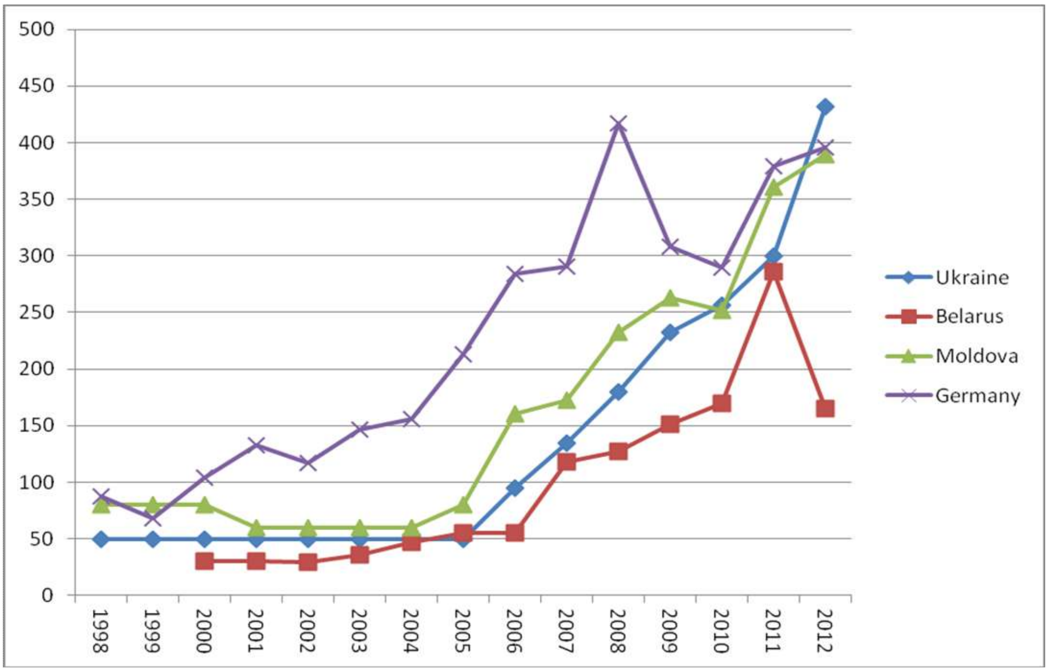
[12] In this Report we use the IEA statistical definition for the transformation sector. Nonetheless, in the statistical part we often focus only on the heat and electricity generation segments and the related power plants, while we exclude other subsectors (like refineries and other conversions). These definitions will be duly indicated in the text below.

Fuel demand trends – on the stormy waters of global gas and oil prices

Oil and in particular natural gas issues were undoubtedly in the focus of energy policy debates during the last 15 years. As Figure 2 shows below, the rise of global oil and gas prices set in relatively late in the EAP3 region, and it affected these countries differently. As for natural gas prices, until the mid-2000s they did not follow the global trend and usually remained "soft", since payments to Gazprom were highly conditional. However, the transition to European price formulas and levels was completed by 2009 (except in Belarus), putting these countries under permanent Russian financial pressure. In the case of oil and oil products, data are somewhat unclear, primarily because of the Belarusian tolling schemes. The average export prices of Russian crude oil sold to CIS countries remained remarkably below the levels Russia charged to countries in the Far Abroad (in 2013, these figures were 53.5 USD/brl vs. 106.8 USD/brl, respectively[13]). But as the volumetric data suggest, the difference is mainly due to the Belarusian factor. Crude exports to Ukraine and other CIS countries gradually lost their significance and were replaced with oil product exports.

At the same time, this price shock triggered a fast volumetric accommodation in Ukraine and Moldova. In Figure 3 we applied the SITC3 estimate (mineral fuels) to gas and oil imports. Even if hydrocarbon imports as a share of GDP were significantly higher than in the V4 and EU28, Ukraine and Moldova were able to keep these shares relatively stable. Despite the more gradual price increase in the V4 and the EU28, the share of their energy import bills as a percentage of GDP increased by 83.8% and 147.3% between 2002 and 2012, respectively. In Ukraine and Moldova, by contrast, the same aggregate indicators slightly decreased in the reference period.

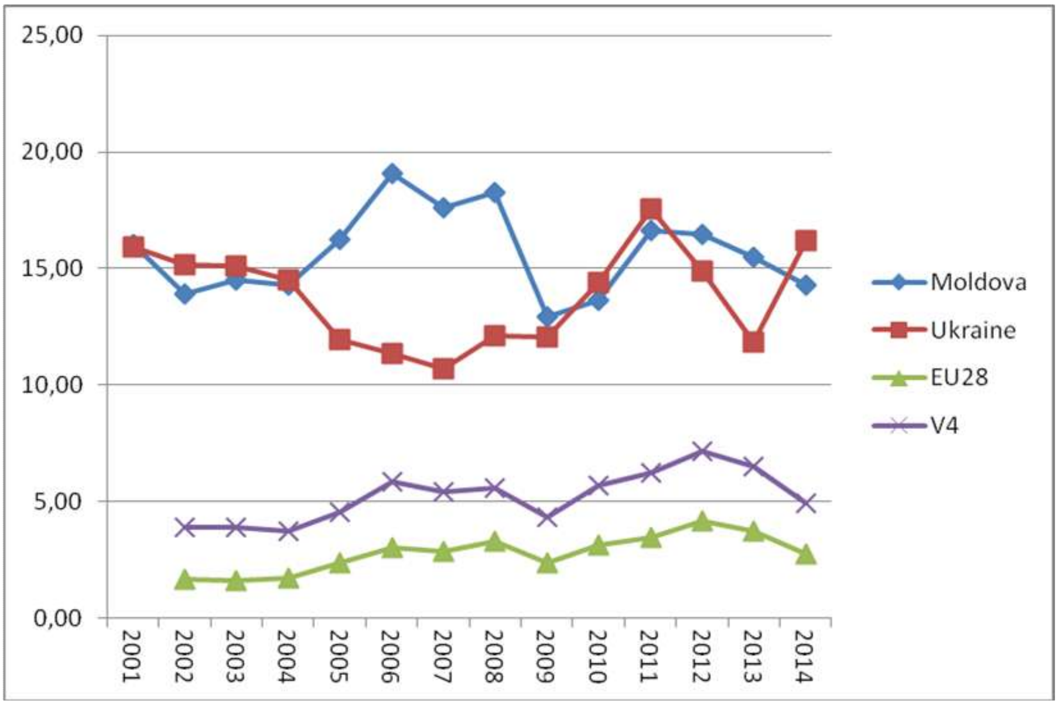
Figure 2 *Gas import border prices, 1998-2012, USD/000m3*



Source: Margarita M. Balmaceda (2013), p.40; Oxfordenergy; BAFA

[13] Russian Central Bank, Table: Экспорт Российской Федерации сырой нефти за 2000-2015 годы. Available at: http://cbr.ru/statistics/?PrtId=svs (12.19.2015)

Figure 3: *The share of mineral fuel imports (SITC3) in GDP, 2001-14,%*



Source: Eurostat, national statistics, for GDP data IMF WEO(2015) Database

The reduction in hydrocarbon demand came from different segments. As Figure 4 shows, the EAP3's demand for oil products in the transportation sector increased only by 12.3% in 15 years. At first look, this appears to be in sharp contrast with the V4 countries and to some extent with Russia, as both of these exhibited a massive increase in demand. However, fundamental data support the view that the trends in the transportation sector were parallel in the V4 and the EAP3. As for personal cars, the rate of increasing in their overall numbers in the two regions was comparable. For example, between 2000 and 2012 the number of personal cars increased approximately at the same speed in Hungary and Ukraine (a total of 26.2% increase in Hungary and up from 17 to 22 per 100 households in Ukraine[14]). The same is true for road freight transport – both the V4 and the EAP3 countries showed a robust increase in this field.[15] It is reasonable to say that V4 and EAP3 followed the same trajectory in these segments, with a considerable time lag around 2000. Prosperity and fast motorization began around the late 1990s in the V4, while demand in the EAP3 fell sharply after the 1998 crisis and rebounded only in the mid-2000s.

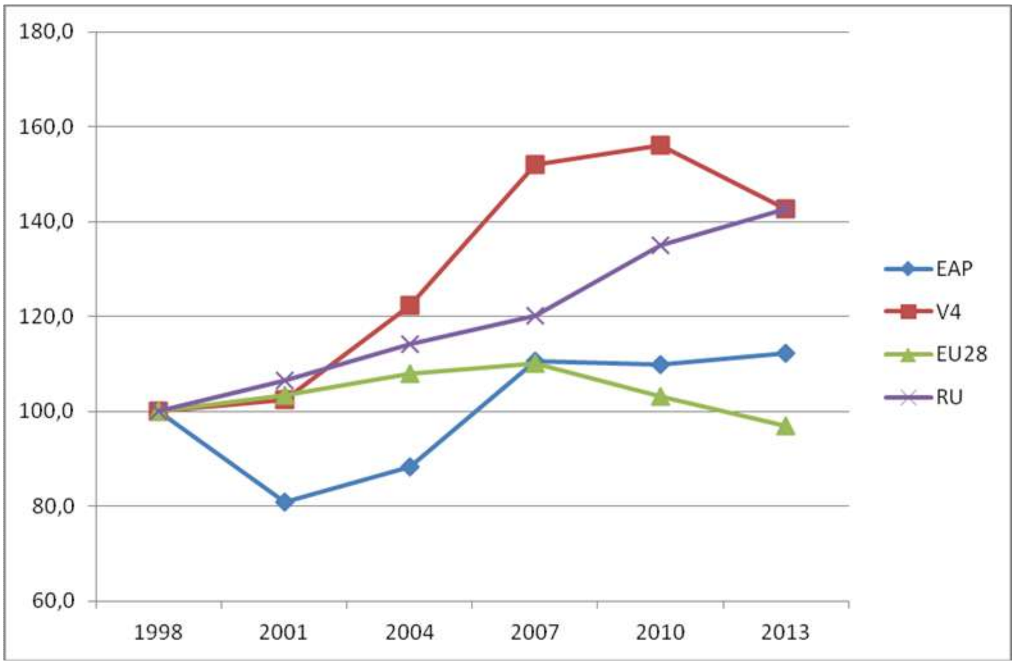
The composition of Russian growth is different. Road freight transport did not play an important role, it grew only by 44% between 2003 and 2012. At the same time the stock of personal passenger cars

[14] Hungarian Statistical Office, Table 4.5. Transport. Available at: http://www.ksh.hu/docs/hun/xstadat/xstadat_hosszu/h_odme001.html (29.12.2015.) and Statistical Service of Ukraine. Available at: http://ukrstat.org/uk/operativ/operativ2007/gdvdg_rik/dvdg_u/Ndtt2006_u.htm (12.19.2015)

[15] Between 2003 and 2012, road freight transport in million tons/km increased from 6,793 to 42,905 in Ukraine and Moldova, and from 167,612 to 347,837 in the V4 states. Available at: http://knoema.com/ITF_GOODS_TRANSPORT/goods-transport (12.19.2015)

doubled from 17.6 million in 1997 to 36.9 million in 2013.[16] Thus the more stable Russian oil demand in the transport segment likely stems from higher personal incomes and cheaper gasoline prices.[17] The spread of consumer society patterns were more sudden and more robust in Russia than in other regions of Eastern Europe.

Figure 4 *Oil product demand in transport, 1998-2013, 1998=100%*



Source: IEA

Nonetheless, most of the oil savings came from non-transportation demand (see Table 4). In 1998 transportation counted for less than half of total EAP3 oil demand, while in 2013 its share approached three-fourths. This trend is in line both with earlier developments in the post-Soviet region and global trends. Oil products practically disappeared from the EAP3 generation sector due to a roughly 90% drop (in 1998, approximately one-fourth of total oil product demand came from power and heat generation), and its consumption halved in other, industrial and residential sectors and in non-energy use. While with some exceptions we witness similar trends in the V4 countries, in Russia the trajectory was significantly different. Even if oil lost ground to other fuels in the Russian power and heat generation sector, oil products spread thorough the other segments: residential non-transportation demand doubled, non-energy use tripled. Most likely the increased fuel oil supply played a crucial role in this regard: its production has been growing as a result of more Russian refining, while its external markets have been shrinking because of stricter environmental regulation. Thus, the increasing use of oil products in Russia cannot be fully seen as a legacy of the past, there is a certain current inertia in this process.

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[16] "Park of passenger cars in Russia has doubled for 15 years". Available at: http://www.rusautoconnect.com/en/novosti/53-news/135-parc-of-passenger-cars-in-russia-has-doubled-for-15-years.html (12.19.2015)

[17] In 2012, 1 liter of gasoline cost 0.99 USD in Russia, 1.35 USD in Ukraine, and 1.87 USD in the V4. Source: World Bank, Table: Pump price for gasoline (US$ per liter). Available at: http://data.worldbank.org/indicator/EP.PMP.SGAS.CD?page=2 (12.19.2015)

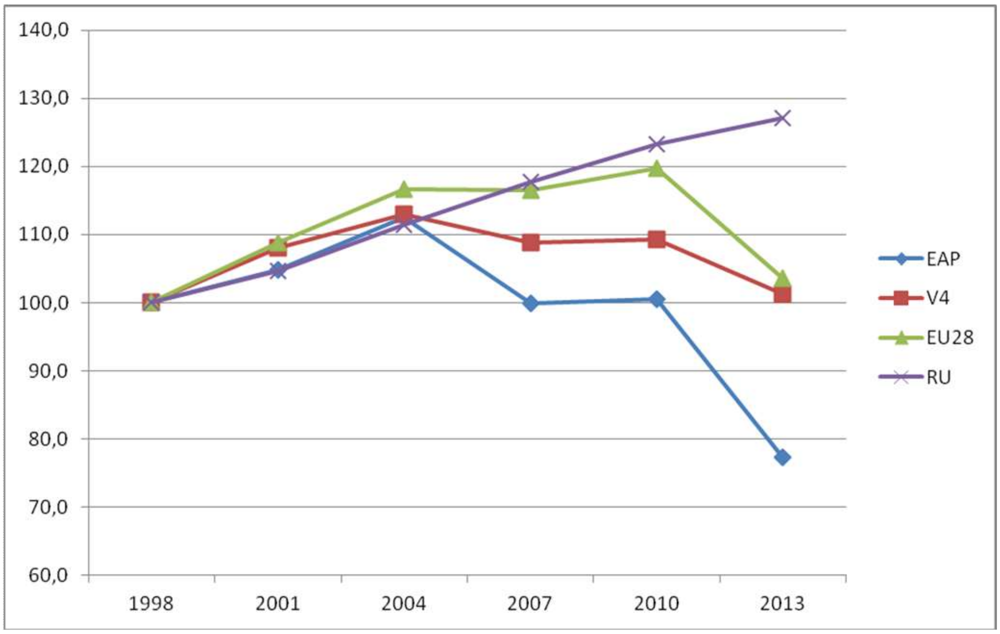
Table 4 *The share of transportation in total oil demand in 1998 and 2013, %*

	France	V4	EAP3	Russia
1998	49.45%	46.35%	44.28%	34.58%
2013	55.49%	62.46%	72.25%	37.15%

Source: IEA

Natural gas was undoubtedly the top energy story of the last 15 years in Eastern Europe. It lies at the crossroads of all three main drivers. Given its surging price levels, which were in 2013 multiple times higher than the price at the beginning of our analysis, the huge efficiency potential, and the sensitivity to regulation and supply security concerns, gas demand trends best describe the quality of adaptation to the new environment. It is probably no surprise that gas markets performed very differently in these Eastern European regions. As can be seen in Figure 5, until 2004 European energy markets followed the same path: solid growth, growing gas demand, and moderate prices created a favorable environment for a balanced development. However, after the mid-2000s gas markets – except the Russian – became depressed due to a combination of weak growth, technological change, and high prices. The trend was strong enough to offset the impacts of the impending buyers' market after 2008. The capability to substitute gas consumption became a strong indicator of adaptation.

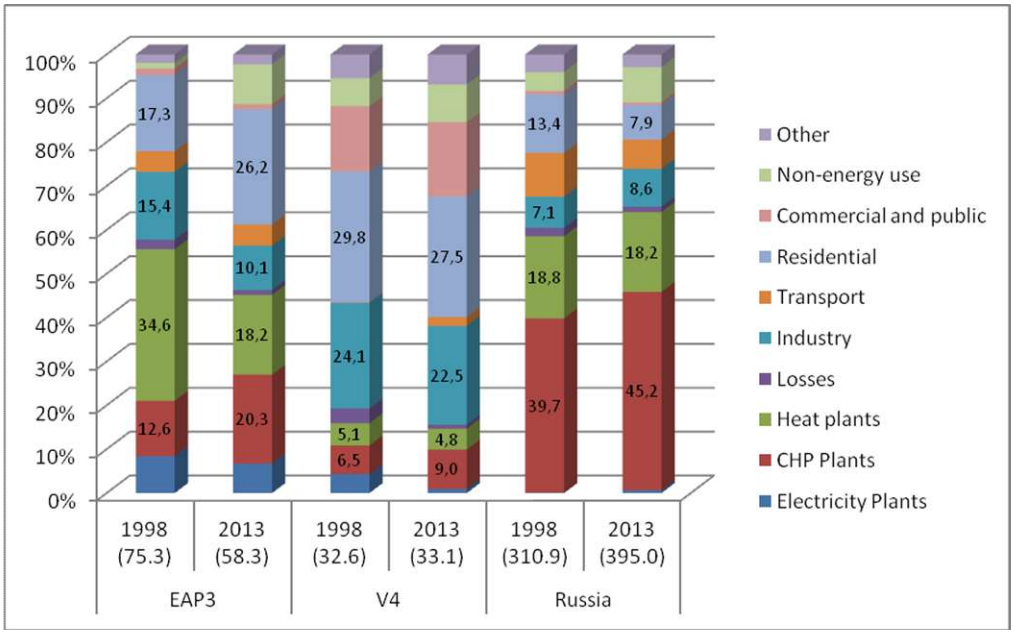
Figure 5 *Gas demand in Europe, 1998-2013, %, 1998=100%*



Source: IEA

As Figure 6 demonstrates below, the three post-Socialist markets can be characterized differently. In Russia, natural gas has continued its pre-2008 trajectory and total consumption grew by 27% in 15 years. It gained even more ground in the power generation segment and remained important for industry both as a fuel and a raw material. The basic reason is the relatively oversupplied Russian market, where price levels remained low in both the industrial and regulated segments. Thus for many companies natural gas has been a fuel of choice, a competitive and comfortable option. Visegrad gas markets practically stagnated and the composition of their demand remained stable. At the same time, the aggregate numbers obscure divergent national patterns. In resource-scarce, highly gasified economies, like Hungary, consumption collapsed in all demand segments. However, this decrease was offset by the depletion of coal reserves and growth in gas demand in other countries, like Poland.

Figure 6 *Composition of gas consumption in Eastern Europe in 1998 and 2013 (total Mtoe), %*

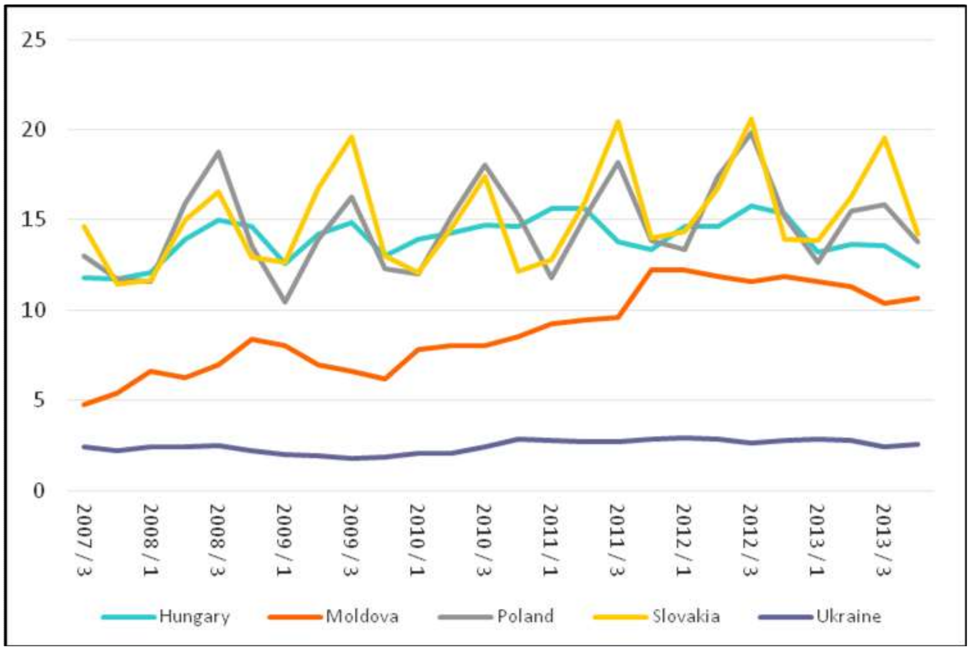


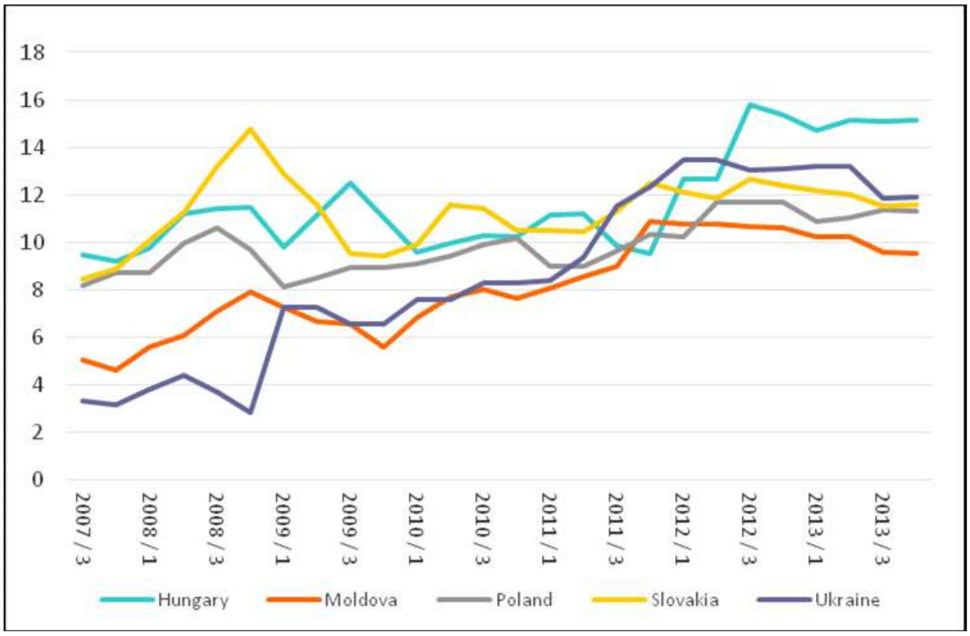
Source: IEA

EAP3 countries' gas markets were in turmoil. They suffered a 31.2% drop between 2004 and 2013, almost exclusively on account of Ukraine and Moldova. This also means that in less than a decade, Gazprom lost an export market equal to 80% of the Visegrad demand. The generation sector contributed the greatest slice to this drop, showing some signs of fundamental change. Heat plants alone contributed 15.4 Mtoe to this drop. Industry added another 5.7 Mtoe, culminating in the closure of many chemical and energy-intensive enterprises in Ukraine. Both fuel swaps and efficiency gains played an important role. Coal and residential gas demand rose moderately (by approximately 5 Mtoe) but heat demand decreased remarkably (also by 5 Mtoe). The expansion of CHP plants, sometimes at the expense of heat and electricity plants, was also an important incumbent efficiency factor everywhere in the region, primarily in Russia.

Domestic pricing trends partly explain this drop. As is apparent in Figure 7, Ukraine and Moldova went through a painful price adjustment process especially in the industrial and to a lesser extent in the non-residential sectors between 2007 and 2013. Industrial prices moved in tandem with average import costs, bankrupting many energy-intensive factories. With the exception of Ukraine, residential natural gas prices also followed this trend, though in a more hectic manner. Thus the main question here is not whether the demand for gas has declined, but at what macroeconomic price. Whether the producers were able to swap to other fuels, invested into more efficient technologies, or simply stopped production.

Figure 7 *Natural gas prices for natural gas in residential (above) and non-residential (below) sectors in selected Eastern European countries, EUR/GJ 2007-2013*

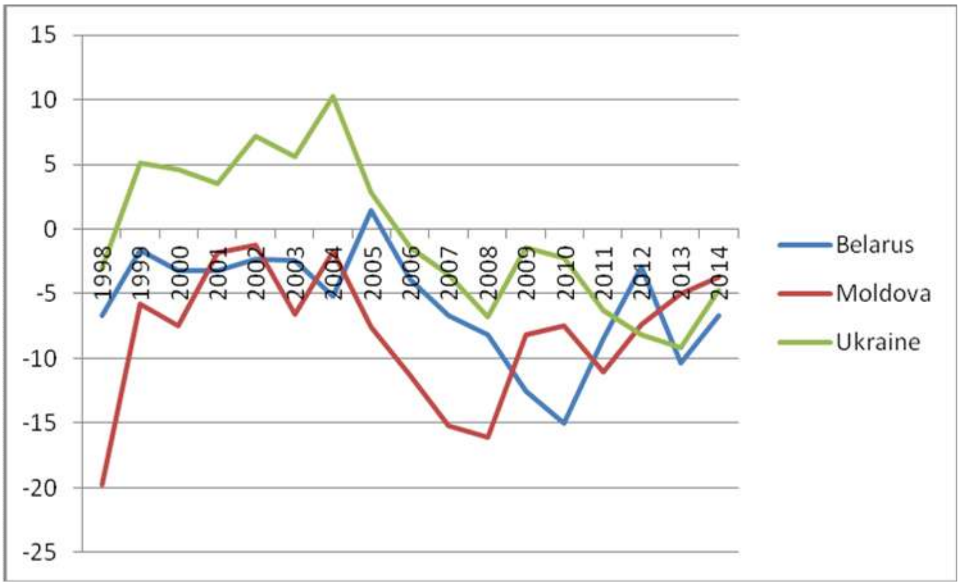


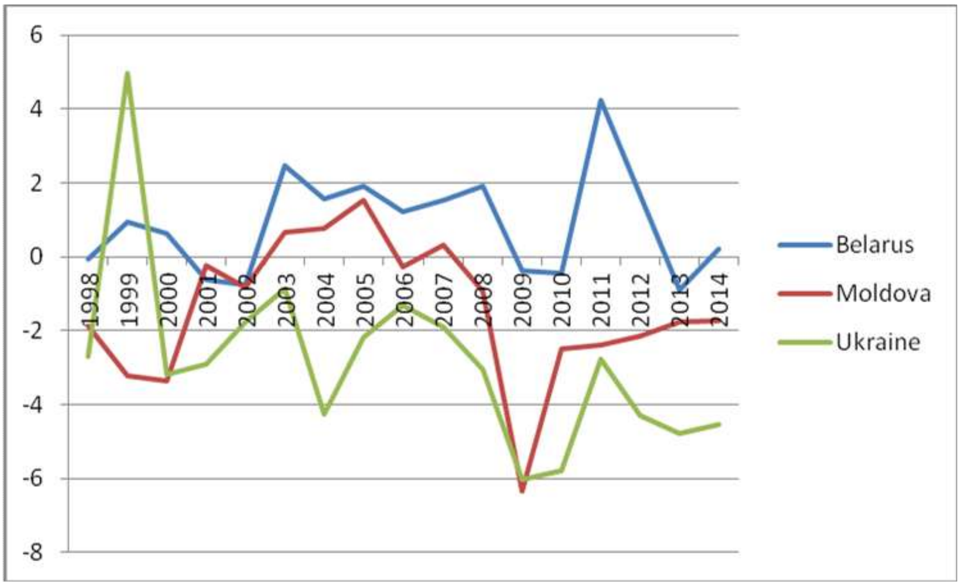


Source: ERRA

Besides the deteriorating microeconomic climate, high import prices also took a macroeconomic toll. The fiscal and current account implications of the adaptation can be seen below, in Figure 8. In addition to other factors, changes in terms of trade and booming energy prices are also likely to have contributed a considerable amount of growing current account deficits in all three countries. Consequently, high energy import prices evolved into a major source of macroeconomic vulnerability. In combination with other factors, they contributed to a series of currency crises in Belarus after 2008, and to a significant increase in the level of state debt in Ukraine. The situation was further exacerbated in Ukraine, where the government failed to raise gas and heat prices in the residential sector. In the late Yanukovich-period, the deficit of Naftogaz was greater than the deficit of the entire central budget. In these cases, domestic pricing remained a major transmission instrument between high input pricing and macroeconomic vulnerability, and indirectly also emerged as a trigger for a more accentuated role in energy security.

Figure 8 *Current account balances (above) and fiscal deficits (below) in the EAP3 countries, 1998-2014, % of GDP*

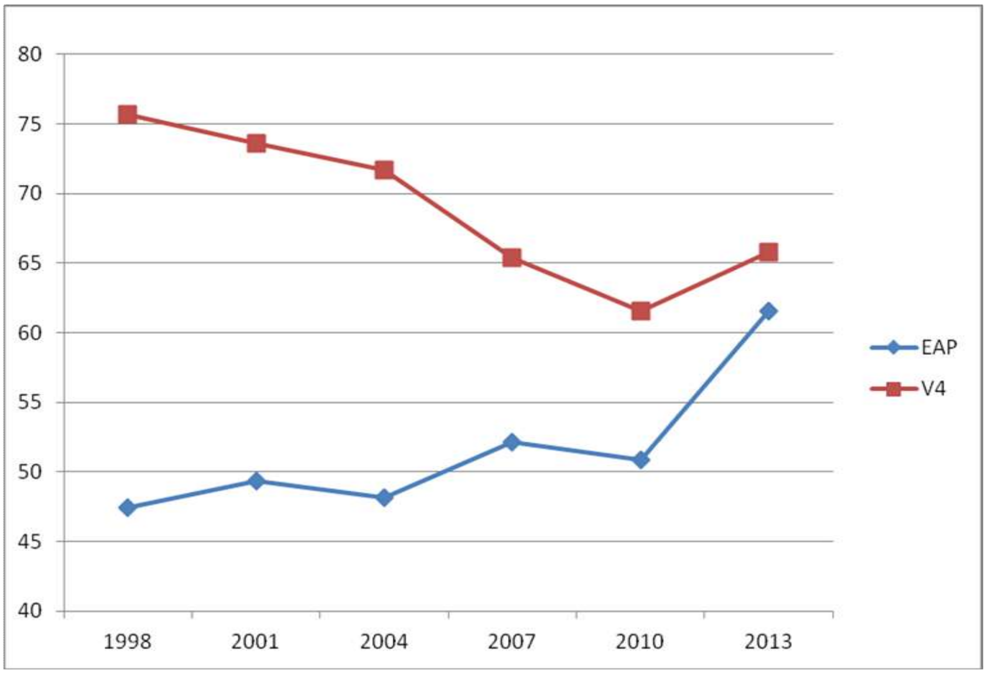




Source: IMF

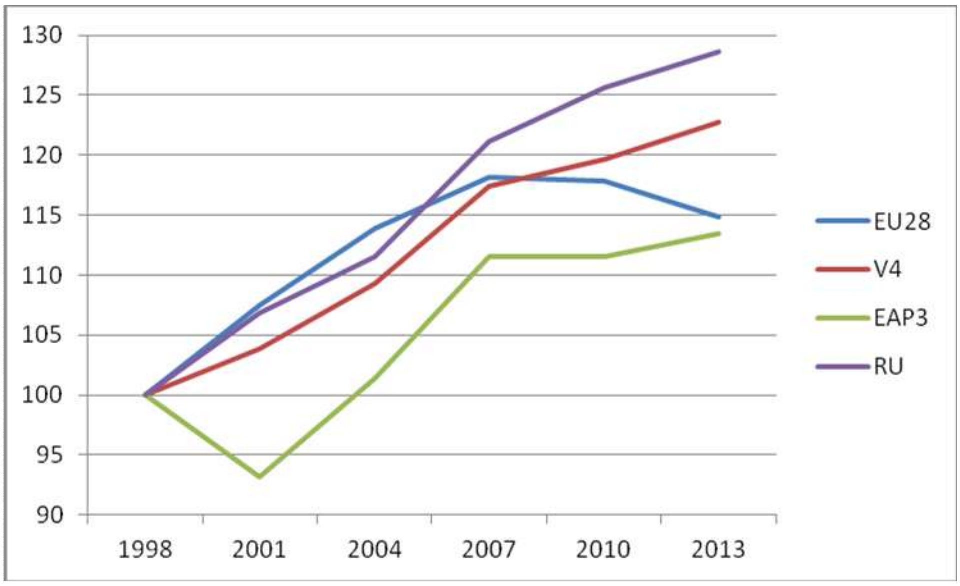
Self-sufficiency trends, dominated by decreasing hydrocarbon demands, improve the general picture of macroeconomic implications. Due to the sizable drop in total demand, the EAP3's self-sufficiency ratio had grown by 14.14% to 61.59% by 2013 (Figure 9). In a countervailing development, due to decreasing domestic coal supply (and demand), the V4 became increasingly reliant on imports. Thus the self-sufficiency ratios practically leveled off in the V4 and the EAP3 by the end of the period under review. Nevertheless, the national trajectories illustrate the substantial volatility of these trends. Unlike Moldova and Ukraine, Belarus increased its gross imports by 56.2% in the last 15 years, mainly due to its tolling schemes and energy added-value production chains. In the V4 region, the Czech Republic, Slovakia, and to a lesser extent Hungary, were able to maintain their levels of self-sufficiency, the overall decline in the region's figures stemmed almost exclusively from Poland.

Figure 9 *Self-sufficiency in V4, EAP, 1998-2013, TPES%*



Source: IEA

Figure 10 *Electricity consumption in Europe, 1998-2013, 1998=100%*



Source: IEA

Electricity demand trajectories show considerable similarities to the growing demand for oil products in all the four cases (Figure 10). This is an incumbent global trend that stems from technological development and is primarily driven by the expansion of services and household demand. As can be observed in Table 5, the relative share of industrial electricity demand has been shrinking everywhere, while in absolute terms it grew considerably in the V4 and in Russia, while decreased only modestly in the EAP3 and in the EU28. Thus, the drive comes primarily from residential and office demand. The new wave of consumption trends seemed to begin decelerating in the EU28 only recently, leaving considerable room for catching up in Eastern Europe. Computerization and the spread of electric appliances still have a solid potential in the V4 and EAP3 regions, even if the pace may be much lower in the years to come.[18]

Table 5 *The share of industrial electricity consumption in total electricity demand, 1998, 2013, %*

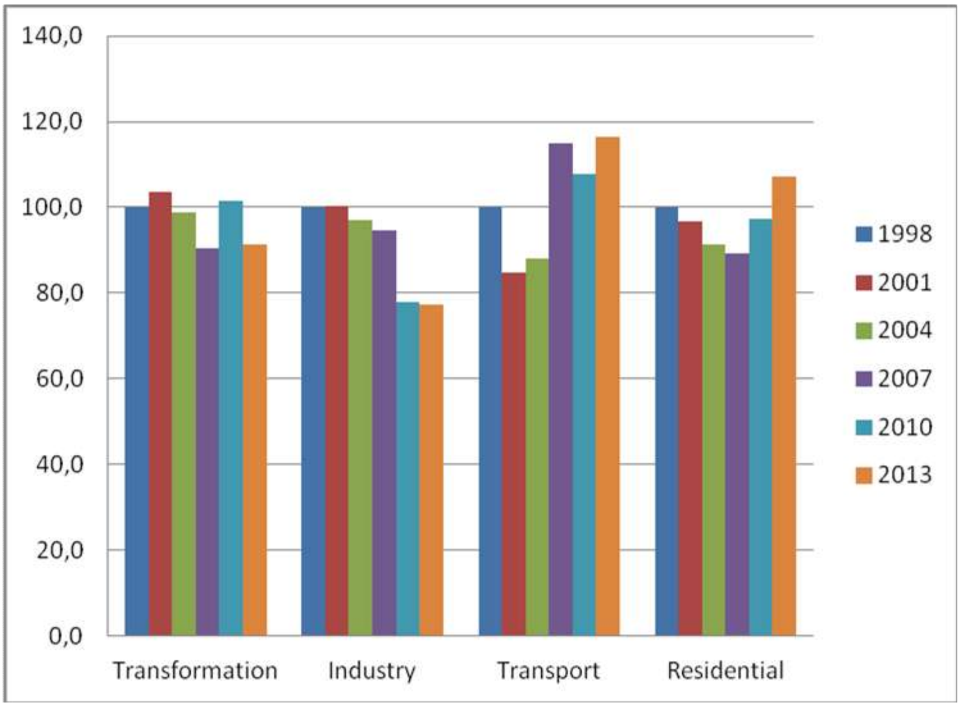
	EU28	V4	EAP3	Russia
1998	41.99%	40.97%	49.77%	48.94%
2013	36.05%	40.49%	42.33%	45.25%

Source: IEA

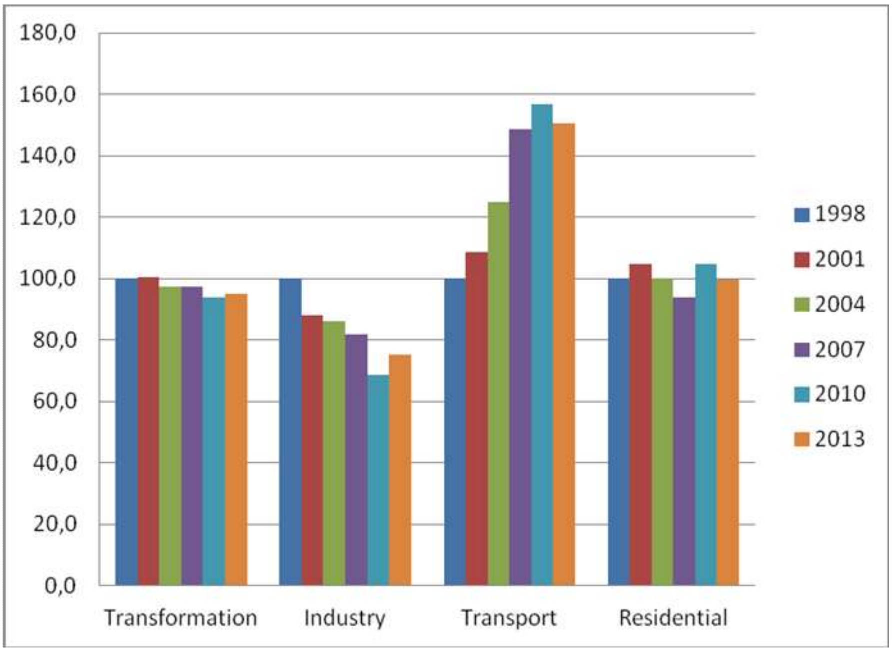
Sectoral efficiency relations

In order to have a better insight into efficiency relations in the two regions, it is crucial to review not only the energy mix, but also the sectoral level. Fuel swaps affect efficiency levels differently and cannot reveal some important interconnections. Thus, in the following subchapter we explore some aggregated consumption trends in the most sizeable demand segments.

Figure 11 *Sectoral/average energy intensity [TPESsect/TPES per unit GDP(2005)] in EAP3 (above) and V4 (below) countries, 1998-2013, 1998=100%*



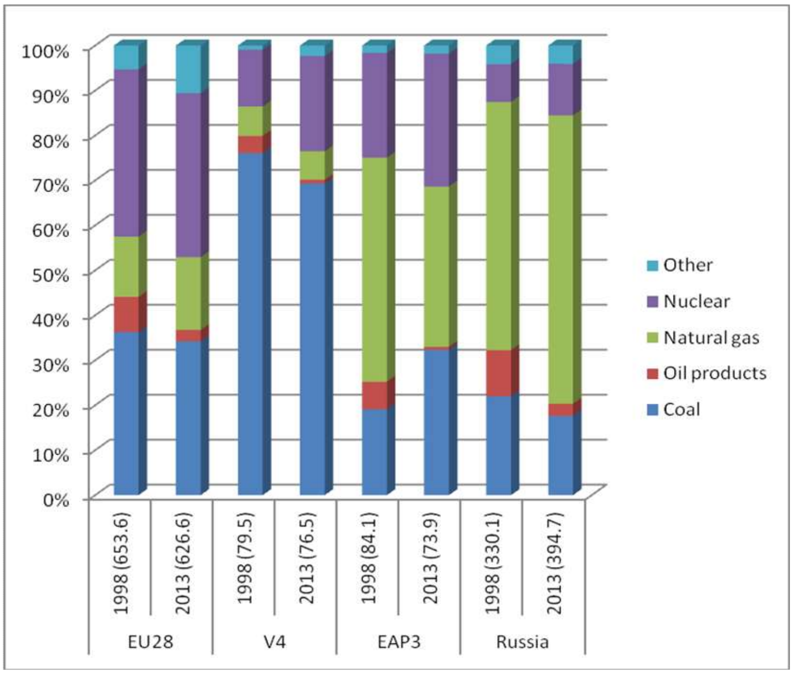
[18] Using internet access as an indicator of computerization, there were 83.75 internet subscriptions per 100 people in 2014 in France, 75.61 in the V4, and only 49.67 in the EAP3. World Bank Millennium Indicators. Available at: http://data.worldbank.org/indicator/IT.NET.USER.P2 (01.16.2016)



Source: IEA

As can be seen in Figure 11, the composition of energy intensity per unit GDP followed similar patterns in the EAP3 and the V4. Keeping the different GDP trajectories in mind, the transformation and residential sectors exhibit the most parallel features, while industrial demand and particularly transportation were obviously on different tracks. The policy implications are substantial, since usually the former two sectors are identified as potential fields for Visegrad experience transfer. The macro-statistical background suggests more similarities and fewer differences, but we have to take a look at the details to determine the underlying trends.

Figure 12 *The fuel mix of electricity and heat generation in Europe, 1998, 2013, (total generation inputs in Mtoe), %*



Source: IEA

15 years in the generation sector is a medium-long period, it constitutes only between one half, one-third of the assets' life cycle. Thus, the changes in production and efficiency chains are relatively small, they only indicate certain shifts rather than paradigmatic turns in development. Figure 12 below demonstrates that the fundamental shifts in these four generation sectors were rather different and very much interconnected with the underlying drivers discussed at the beginning of the chapter. This means that the dominant trend in the V4 transformation sector was the retrenchment of coal and the swap to nuclear. In the EAP3 sectors, by contrast, decline in the hydrocarbon – primarily natural gas – consumption was the most visible factor, while the share of coal has increased.

Looking at the generation plant composition in Table 6, the differences are relatively big. The gross efficiencies of plants are roughly in line with European levels, improvements may have come from fuel swaps and higher utilization rates (Russian data should be taken with some reservations). Nonetheless, these rough averages include the sizeable Ukrainian nuclear fleet and obscure most of the inefficiencies in other segments of the generation sector. Still, the heating sector remains the hotbed of inefficiencies in the region. Both macro-statistics and micro surveys[19] show that people opt for individual heating systems whenever they can, because of lower costs and the low level of public trust in maintenance and related companies (DH companies and Zheks). This further deteriorates the density of the network and increases the reportedly high losses in the system.[20] Furthermore, due to preferential tariffs, it has been a source of corrupt practices in certain periods and countries.

Table 6 *Plant-type composition of the electricity and heat generation sectors, 1998, 2013, %*

		Share in total generation		
		Electricity plants	CHP	Heat plants
EU28	1998	69.9%	25.1%	5.1%
	2013	65.6%	29.7%	4.9%
V4	1998	20.1%	64.1%	15.8%
	2013	20.9%	68.6%	10.5%
EAP3	1998	31.7%	18.5%	49.8%
	2013	42.5%	28.5%	29.0%
Russia	1998	10.3%	54.6%	35.0%
	2013	14.1%	59.1%	26.7%

Source: IEA

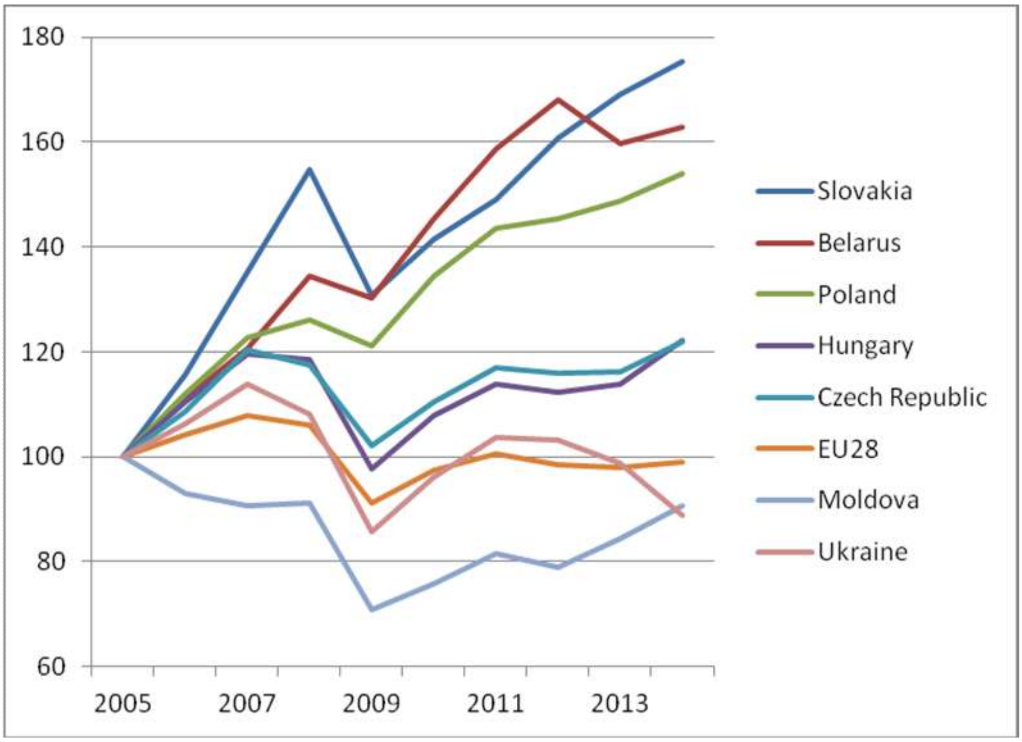
Despite the falling EAP3 heat production (-23.9% between 1998 and 2013), proportionally the losses in the network decreased even more, by 76.5%. Thus heat had a major ameliorating impact on the official loss ratio in the electricity and heat cycle, falling from 18.87% in 1998 to 10.34% in 2013 (in the V4 it grew from 6.85% to 7.34%). Nevertheless, in absolute terms reported electricity and heat network losses in the EAP3 systems were abnormally high in 1998, almost three times the total TPES

[19] Yadviga Semikolenova; Lauren Pierce; Denzel Hankinson: Modernization of the District Heating Systems in Ukraine: Heat Metering and Consumption-Based Billing. World Bank, Washington D.C, 2012. p.15. Fan Zhang; Denzel Hankinson: Belarus Heat Tariff Reform and Social Impact Mitigation. World Bank, Washington D.C, 2015.
[20] According to IEA, in district heating systems more than half of the input fuel is wasted as it moves through the value chain. IEA: Ukraine 2012 – County Study., p. 51.

level of Moldova. Thus, it is more likely that changing regulations, improved transparency standards, and less corrupt practices around the mid-2000s "contributed" to these statistical efficiency gains (a comparable amount of "transformation loss" emerged in the statistical category of "non-energy use"). Despite all these achievements, potential efficiency improvements still appear to be sizeable in the heat and gas sectors. Until now, industry had the bigger impact on the declining heat consumption, the residential system remains highly fragmented and technologically outdated.

A closer look at industrial intensity trends also reveals some factors on which the trajectories of the V4 and the EAP3 diverge. Intensity indicators have been gradually improving in the V4 region, reaching a 31.4% relative gain as compared to average intensity in 2010. Apart from the gradual decline in the share of total GDP produced by industry, this improvement comes primarily from the multinational value chains that dominate industrial output in the V4. On the contrary, industrial energy intensity improvements in the EAP3 remained relatively low until 2007. Among the explanatory factors, the favorable terms of trade (high export and low energy import prices) until the 2008 financial crisis played a dominant role. These boosted even the relatively high intensity production chains prior to the crisis. The situation had changed radically by 2010, and forced those sectors with high input costs to cease their production. This wave of de-industrialization resulted in some improvements in sectoral intensity. This process is directly corroborated by national output data for some energy intensive industries, and is indirectly supported by a 36.6% drop in non-energy (raw material) demand for fuels between 2007 and 2013 in the EAP3 region. Figure 13 also highlights the divergent industrial production performance trends in Belarus on the one hand, and Ukraine and Moldova on the other. In addition to other explanatory factors (like easier access to the Russian market in the case of Belarus), differences in energy input prices must play a considerable role in this divergent development.

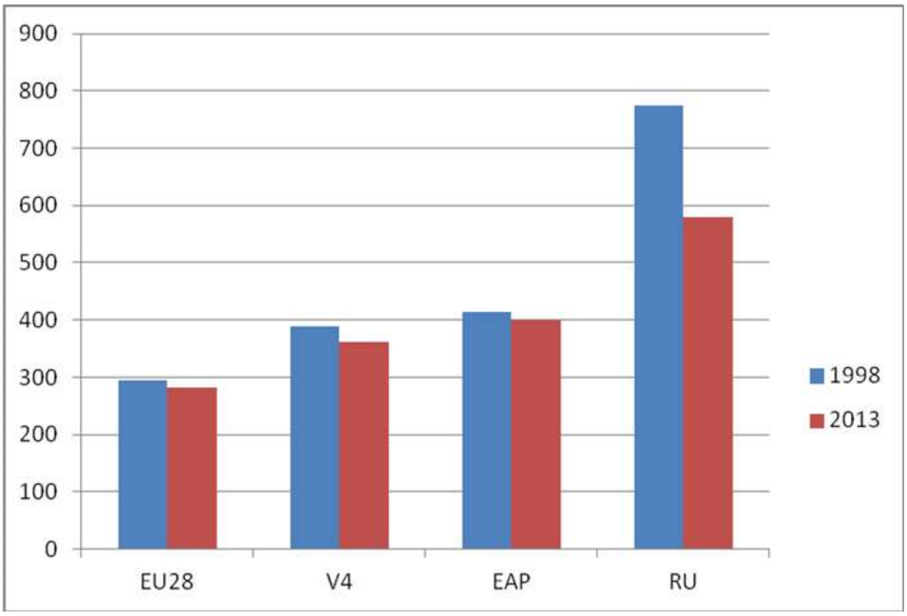
Figure 13 *Industrial output in some European countries, 2005-2014, 2005=100%*



Source: Eurostat, national statistics

Residential consumption has been long in the spotlight of external and internal attention. This is primarily due to its social and political significance, as well as its difficult technological structure It is usually perceived as a top priority issue on national agendas, even if there are no proper domestic capabilities to change the situation or to improve efficiency. Figure 14 below shows that improvements in the residential demand per person are tiny both in the V4 and the EAP3 regions. The Table does not include electricity and oil product consumption (this distorts especially the Russian data considerably), and consequently it focuses primarily on demand for consumption related to heating spaces and water, and for purposes of cooking. The gap between the EU28 and Eastern Europe is still substantial and hardly anything has been done to narrow it.

Figure 14 *Residential coal, gas, heat consumption in 1998 and 2013, ktoe/m people*



Source: IEA

Still, total residential demand constitutes only about 20% of TPES, even less if we exclude electricity. Consequently, one should be cautious about expecting large-scale energy savings or macroeconomic changes by attaining V4 efficiency levels in the EAP3 countries. Closing the roughly 10% gross (without taking into account specific factors like heating degree days) end-user efficiency gap between the V4 and the EAP3, or the 30% gap between the EU28 and the EAP3, the total TPES would decline only by approximately 2.5 and 7.5 Mtoe, respectively. These savings are becoming more and more significant as the total EAP3 TPES sinks. Nevertheless, due to the excessive total energy consumption in 2013 they constituted only 1.7% and 5.1% of the total TPES. Taking into account the complexity of these measures, their time-, capital- and policy-intensive nature, it is not surprising that authorities and energy policies focused on other fields to reduce demand.

Table 7 *The share of residential gas and heat demand in total gas and heat use in Europe, 1998, 2013, %*

	EU28	V4	EAP3	Russia
1998	34.62%	54.62%	30.90%	30.90%
2013	34.28%	46.49%	37.79%	12.80%

Source: IEA

The situation looks a bit different if one looks at the demand for gas and heat separately from coal demand. As Table 7 above shows, V4 households were able to decrease their gas and heat demand substantially (by 13.6% in absolute terms) between 1998 and 2013. This is a major achievement, since this trend goes against the general Visegrad trajectory of the declining share of coal consumption. Not surprisingly, this tendency started after 2004, parallel to the rising oil and gas price levels. Many households opted for coal and, to a lesser extent, biomass as a response. In the EAP3 countries we see an opposite trend: by 2013 residential gas and heat demand had grown by 3.9% in absolute terms. It is even more telling that the trend of slowly decreasing residential gas and heat consumption turned around after 2007. In the midst of gas price debates and booming import prices, the population decreased its coal demand and turned back to heating based on natural gas. This very much appears to be a result of misleading internal pricing. While industry turned to coal and other substitute fuels in the EAP3, raising the price levels of these alternatives, an increasing number of households opted for natural gas instead. This only aggravated the already severe subsidy and macroeconomic sustainability problems in the region, primarily in Ukraine.

Coping with post-Soviet inertia – comparing the EAP3 countries

The three EAP countries are often perceived as having opted for different energy development paths. Apart from their common Soviet legacy, they differ from one another in several respects: the composition of their energy mix, their levels of self-sufficiency, their GDP structure and the role of heavy industry therein, their foreign policy and energy relations with Russia, and the dominant ownership forms in the national economy (Table 8). Naturally, these broad differences also imply substantial variations in their national consumption patterns. In terms of economic growth, Belarus performed fairly well thanks to its sizeable heavy industry, its pronounced orientation towards Russia, and improvement in its terms of trade. In the meanwhile, Moldova was able to reduce its export dependency on Russia, and despite its worsening terms of trade it weathered the 2008 financial crisis and the subsequent period of booming oil prices relatively successfully. Ukraine had an intense debate about its volatile foreign economic orientation and experienced fierce domestic tensions during this period. Nonetheless, its high self-sufficiency ratio provided an important buffer in terms of external price shocks and their management.

Table 8 *Some basic indicators of the EAP3 countries*

	Belarus	Moldova	Ukraine
Share of industry in GDP in 2013, %	42.0	17.1	26.2
Share of merchandise trade in GDP in 2013, %	109.8	99.2	77.0
Share of Russia in total trade in 2012, %	47.4	20.0	29.3
Net barter terms of trade in 2013, 2000=100%	116.9	73.5	94.7
TPES/GDP in 2013, Mtoe/th. USD (2005)	0.59	0.76	1.19
Self-sufficiency in TPES in 2013, %	14.6	9.9	74.0

Source: World Bank, IEA, national statistics

Surprisingly, these differences have not left much of an obvious impact on the improvements of their intensity indicators. Table 9 below shows this ambivalent situation between 1998 and 2013. Despite their rather different energy intensity levels (the Moldovan economy was half as energy intensive than Ukraine in 2013) the three countries have achieved approximately the same level of improvement. These countries were able to improve their intensity levels at an even pace until the crisis of 2009, which hit Ukraine and Moldova hard. However, between 2010 and 2013 the intensity indicators leveled off, and today these countries need only half as much energy for a unit of GDP as in 1998.

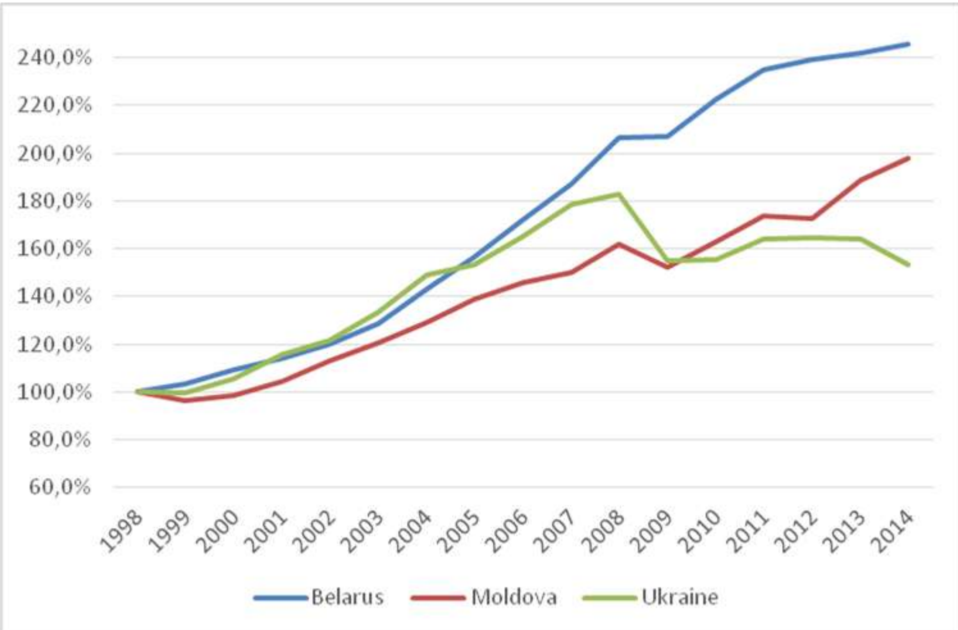
Table 9 *Efficiency trends in EAP3 countries, 1998-2013, TPES/GDP (2005), Mtoe/ths USD, 1998=100%*

	1998	2001	2004	2007	2010	2013
Belarus	100.0%	86.8%	75.2%	59.7%	49.6%	45.7%
Moldova	100.0%	81.9%	72.9%	62.7%	60.2%	45.8%
Ukraine	100.0%	85.5%	71.4%	58.1%	60.6%	49.4%

Source: IEA

It is only logical that the underlying stories are very different in the three cases. In Belarus, much of the improvement stemmed from the robust economic growth during the period. The 2008-2009 financial crisis had a relatively mild impact and economic performance boomed in the aftermath of the crisis. This process was led by industrial production, which outperformed other sectors. This growth was accompanied by a minimal increase in energy inputs (Table 10 and 11). In this regard, Belarus represents an industrial growth model in that is typical of a favorable global and national price environment. In contrast to the situation in Belarus, in Moldova and Ukraine both GDP and industrial production collapsed in 2009 (Figure 15). Moldova recovered quickly, but industrial production did not play an outstanding role in the recovery: its pace of expansion was similar to the growth of other segments of Moldova's economy. Energy efficiency improvements were achieved with only relative loss of growth potential. In Ukraine the crisis led to a severe drop in GDP, which was not followed by a recovery, and industrial output remained sluggish. Industrial energy consumption in Ukraine fell by 37.5% between 2004 and 2014, due to the closure of large segments of energy-intensive industries and stagnation in total industrial output. Thus, Ukraine after 2007 can be characterized as a stagnating economy with a painful structural industrial adaptation process.

Figure 15 *GDP trends in the EAP3 countries, 1998=100%*



Source: IMF

Table 10 *TPES in EAP3 countries, 1998-2013, 1998=100%*

	1998	2001	2004	2007	2010	2013
Belarus	100.0%	99.4%	107.9%	112.3%	110.8%	109.8%
Moldova	100.0%	85.4%	94.5%	94.0%	98.2%	85.9%
Ukraine	100.0%	98.8%	106.0%	102.7%	97.6%	85.6%

Source: IEA

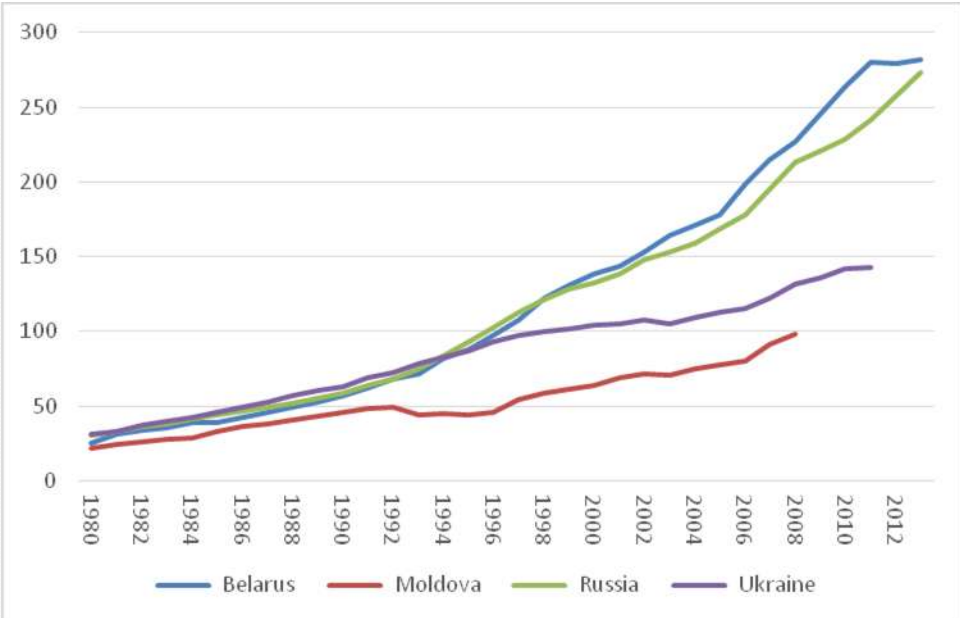
Table 11 *Industrial production in the EAP3 countries, 2004-2013, 2004=100%*

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belarus	100.0	110.0	122.3	132.8	147.9	143.3	160.0	174.6	184.7	175.7
Moldova	100.0	106.3	99.0	96.3	97.0	75.4	80.7	86.7	84.0	89.7
Ukraine	100.0	103.1	109.5	117.3	111.4	88.5	99.1	107.0	106.5	101.9

Source: National statistics

It is difficult to ascertain the role of energy input prices on these divergent industrial output trajectories. In the case of oil refinement, the situation is rather obvious: this activity practically halted in Ukraine and Moldova, while it prospered in Belarus. Between 1998 and 2007 oil refinement in Belarus surged from 11.6 to 21.5 million tons, becoming the single largest item in the Belarusian energy balance. Due to the Belarusian refinery tolling scheme and lower import prices for domestic use, the country practically became a chain in the Russian rent distribution system. According to IMF estimates, oil price increases alone had a modest but positive direct contribution to growth, boosting it by up to 0.5% of the GDP.[21] The indirect effects of high energy prices, especially through the access to the Russian market, had an even bigger positive impact.

Figure 16 *The number of private passenger cars in the EAP3 countries and in Russia, per 1000 persons*



Source: CISSTAT

Table 12 presents some other sectors in Belarus and Ukraine that have a medium to high energy/raw material input need. The gap between the two outputs was much wider than that between the respective national averages. Ukrainian chemical and metal industries collapsed in 2008-09, and their recovery was much more sluggish after 2010. The Belarusian chemical and metal sectors weathered the crisis relatively well and boosted their performance when the input price gap increased again after 2010. Sectors with higher energy inputs generally outperformed other branches. This is another piece of compelling evidence that besides other factors, like export destinations and domestic economic relations, fuel input prices play a significant role in industrial output.

[21] IMF Country Report No. 15/136, Republic of Belarus, May 2015, p 8.

Table 12 *Industrial output in certain selected branches in Belarus and Ukraine, 2007-13, 2007=100%*

		2007	2008	2009	2010	2011	2012	2013
manufacture of chemicals and chemical products	UA	100.0	91.7	69.1	84.0	103.9	100.0	80.7
	BY	100.0	114.5	135.7	177.1	182.7	219.1	180.1
manufacture of rubber and plastics products	UA	100.0	97.3	66.1	74.6	84.6	79.5	77.4
	BY	100.0	120.6	113.4	139.8	146.8	159.8	162.4
manufacture of basic metals and fabricated metal products	UA	100.0	88.6	63.1	72.7	80.7	77.8	73.6
	BY	100.0	114.4	103.5	126.5	133.5	140.1	132.0

Source: National statistics

Both export volumes and energy input data suggest that growth in the energy-intensive segments of the Belarusian industry stemmed from the improving terms of trade rather than from efficiency improvements. Unlike agriculture and machine industry, the Belarusian exports of major energy-intensive products stagnated in volumetric terms after the mid-2000s. The level of potash and fertilizers exports was volatile, but did not grow in volumetric terms between 2005 and 2013. Oil product exports were around 13.5 million tons both in 2005 and 2013, and except for 2012 they never exceeded 15.7 million annually. At the same time, industrial energy consumption decreased only slightly, by 6.9% between 2007 and 2013. All these data justify the assumption that improving terms of trade had by far the biggest role in boosting industrial growth after the mid-2000s. Structural factors, including improvements in efficiency through modernization and better organization, might also have played an important role, but their impact was not comparable to the changing global price environment or the impact of relatively cheap energy inputs from Russia.

In this regard, the Belarusian energy trajectory is Janus-faced. On the one hand Belarus officially strives for decreasing intensity factors and has been setting a high number of ambitious efficiency targets since the mid-2000s. According to the State Committee for Standardization, the funds spent on attaining energy savings increased by a factor of more than ten between 2001 and 2010, and their value reached 1.17 billion USD in 2010.[22] On the other hand, direct and indirect dependence on high oil prices had been growing substantially as a result of the terms of trade and, more importantly, on account of Russian input price concessions. These create a growing number of negative economic, trade, and political risks. Since 2014 many of the negative pass-throughs generated by the external environment have hit the Belarusian economy, worsening the already severely affected macroeconomic landscape. Energy today constitutes one of the main points of vulnerability for Belarus.

Ukraine and to lesser extent Moldova followed the Belarusian path well until the mid-2000s. Nevertheless, the complex political relationship with Russia hindered any large-scale economic arrangements in these cases. Ukraine and Moldova have been paying European energy prices since the late 2000s, their energy trade status is regarded as least preferred by Russia, and they may even be subjects to boycotts. As Table 8 shows, their terms of trade have deteriorated substantially, especially in the case of Moldova. There were some attempts to insulate some industries from the negative impact of these trade policies, such as the production of fertilizers by Dmytro Firtash in Ukraine, but most of these attempts have failed. Thus, in these two countries the negative impact of the global price environment was full-fledged and it triggered an intense process of adaptation.

[22] Energy Charter Secretariat, 2013: In-Depth Review of the Energy Efficiency Policy of the Republic of Belarus, p73.

In many ways Moldova was better prepared for these adjustments. The share of industry in the national GDP was much lower than in Ukraine, and per capita residential energy consumption was only 37.2% of the Ukrainian level in 1998, owing in part to the lower heating degree day levels. The series of price increases began well before the mid-2000s, allowing for a more gradual adaptation process. Unlike Ukraine, Moldova did not try to implement a massive subsidy regime in the residential gas and electricity sectors or in the tiny heavy-industrial segment. As can be seen in Table 13, the liberalization of utility prices resulted in a sharp increase of the share of housing costs in total household expenditure already in the late 1990s, which led to intense microeconomic reactions. As demonstrated in the Machine Industry Report, in Moldova Western FDI played a considerably greater role in triggering industrial growth and setting management benchmarks than in Belarus or Ukraine, resulting in a more sustainable energy demand trajectory for these segments.

Table 13 *The share of costs for housing and municipal services in total household expenditure*

	1996	1999	2002	2005	2008	2011	2012	2013
Belarus	4.9%	1.8%	6.3%	7.7%	5.4%	4.2%	3.1%	3.3%
Moldova	5.7%	14.7%	16.0%	17.6%	n.a.	n.a.	n.a.	n.a.
Russia	4.8%	4.2%	5.6%	7.0%	6.1%	7.4%	7.0%	6.7%
Ukraine	n.a.	7.7%	8.7%	6.6%	6.8%	8.1%	8.4%	n.a.

Source: CISSTAT

In many regards all these changes made Moldova a bit more resilient to price shocks than many other post-Soviet countries. Early and relatively extensive price liberalization in the residential sectors enhanced individual responses to market fluctuations. Between 2010 and 2013, industrial production in Moldova was able to grow faster than in Belarus, and in this time there was also a significant drop in sectoral energy consumption. Not surprisingly, the share of sectoral investments in GDP remained relatively high in international comparison, especially if the relatively small size of the Moldovan industry is taken into account. Moldova modernized some of its generation units primarily for security reasons, and has achieved a remarkable drop in its rate of network losses (Table 14).

Table 14 *Investments into electricity, gas, steam and air conditioning supply, in % of GDP*

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Czech Republic	1.99	1.52	1.20	1.19	0.78	0.87	0.92	1.27	1.33	1.63	2.30	2.05	1.70	1.65	1.59
Hungary	1.36	1.02	0.99	1.16	0.99	0.84	0.83	0.71	0.73	0.87	0.90	0.96	0.58	0.52	0.44
Slovakia	2.66	2.35	1.62	1.45	1.16	1.33	2.68	4.82	1.79	2.09	2.18	2.71	2.41	1.41	2.35
Moldova	1.38	2.14	1.27	1.15	1.69	1.64	2.08	2.18	1.87	1.99	1.75	1.68	1.63	1.02	n.a.
Ukraine*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.86	1.04	1.81	2.00	1.44

*Excluding the temporarily occupied territories, the Autonomous Republic of Crimea and the city of Sevastopol, for 2014 also excluding the part of the anti-terrorist operation

Source: Eurostat, national statistics

On the whole, energy policy in Moldova remained relatively depoliticized due to the lack of large-scale rent-seeking stakeholders with heavy-industry assets (like in Ukraine) and the lack of a dedicated political cooperation with Russia on energy prices (like in Belarus). In this situation, the conventional considerations of an importer country became dominant in the decision-making process. Thus issues like improving energy security, both in the gas and electricity sectors, and increasing energy efficiency all throughout the value chain, have emerged as priority factors in sectoral decision making, opening up cooperation opportunities with EU and other Western donors.

The patterns of Ukrainian adaptation to the energy price shock were more chaotic. Potentially, Ukraine could have chosen between a relatively energy-intensive development path through cooperation with Russia and securing favorable terms of trade on the one hand, or increasing self-sufficiency and relying on its abundant domestic resources, modernizing its sectoral assets, and triggering some efficiency improvements through moderate price increases on the other. In many respects, the choice between the two policy outputs was determined by considerations outside the sector, like foreign policy and domestic political processes. In this regard it is accurate to say that between 1998 and 2013 the Ukrainian energy discourse became highly politicized and less consistent.

Table 15 *Self-sufficiency in the EAP3 countries, 1998-2013, %*

	1998	2001	2004	2007	2010	2013
Belarus	12.9%	14.2%	13.2%	13.8%	14.4%	14.6%
Moldova	2.5%	3.3%	3.6%	3.3%	6.2%	9.9%
Ukraine	55.0%	56.9%	55.8%	61.0%	59.6%	74.0%

Source: IEA

As is apparent in Table 15 above, among the EAP3 countries Ukraine alone was able to increase significantly its self-sufficiency ratio – which had been fairly high to begin with –between 1998 and 2013. Roughly two-thirds of this improvement came from a decrease in total TPES, while one-third stemmed from domestic production increases, primarily of coal, but also of nuclear and natural gas. The increase in the levels of self-sufficiency was reasonable in economic terms, since most of the import reduction came from the oil and natural gas sectors. As developments after 2013 showed, these trends could have been sustained further, but only at the price of extraordinary social sacrifices. In contrast to Moldova and Belarus, enhanced self-sufficiency, both through efficiency improvements and a reliance on domestic resources, is a credible response in Ukraine. Nonetheless, self-sufficiency is a capital-intensive policy option. The most important questions are whether Ukraine can modernize its production assets, accumulate sufficient funds, and provide a complex institutional backup to sustain these achievements.

The bulk of the Ukrainian energy infrastructure was built in Soviet times: nuclear plants were built mainly in the 1980s, thermal plants predominantly between the 1950-70s, and the gas transmission network in the 1970s. Unlike Moldova, which has lost much of its generation capacity due to the Transnistrian conflict, and Belarus, which has invested relatively extensively into new generation capacities and pipelines after 1991, outlays for infrastructure are significant in Ukraine. Consequently, investment liabilities in the generation sectors are huge: the average age of the thermal plant fleet is around 50 years,[23] and the bulk of the nuclear plants will be decommissioned by the 2030s. The problems are further aggravated by the lack of clarity regarding the future of the transit of Russian gas or the falling heat demand in the country. It is still unclear what the policy responses are to these investment challenges, from what sources, in which ownership forms, and in what regulatory framework these issues will be addressed.

[23] Their average age was 47 years in 2012. In: Ukraine – 2012: International Energy Agency, p169.

This is particularly true for the nuclear sector. Ukraine is heavily reliant on the generation of nuclear power, which supplies about half of its total electricity demand. At the same time, 12 out of its 15 reactors are up for life extension and security improvement projects until 2020, and will have to be decommissioned by the first half of the 2030s. Thus generation capacity is the Achilles-heel of future self-sufficiency ambitions. It is likely that Ukraine will not be able to cope efficiently with the dearth of capital in its energy sector. Consequently, it will also have to reconsider its self-sufficiency ambitions and try to attain a diversified import portfolio in the long-term.

Energy policy overview

Since the mid-2000s, the evolution of energy policy has accelerated in both the V4 and EAP3 countries alike. New strategies, new actors, and new institutions emerged, each with their own distinct set of priorities. In parallel, considerations involving security of supply took the center stage in all these countries. Despite many years of rhetorical and political pronouncements since 1989-91, this was a new conceptual framework for sectoral policies, challenging the prevailing mindsets. Prior to the mid-2000s, energy policy was dominated by industrial policy considerations and supply management attitudes. At the beginning, this was a hostile environment for the idea to establish new, sometimes policy-intensive subsectors (like renewables) or for trying to address efficiency goals and manage energy demand. Supply security was increasingly understood in terms of the diversification of supply between existing subsectors, while the modernization of production patterns or limiting demand were less likely to be considered as options to attain supply security. These attitudes began to change recently, which has led to a significant diversification in the energy policy instruments.

In the chapter below we review the evolution of energy policies, with a special focus on energy efficiency (EE) and renewables (RES). In the V4, these policy frameworks are predominantly set by EU rules. The Visegrad countries assumed numerous obligations – even if often inflated ones – with respect to implementing a wide variety of policy measures in these fields. Policy measures adopted since 2004 show that, despite legal commitments, the shift from conventional sectoral policies to demand management and promoting the generation of renewable energy is relatively slow and sluggish. The EAP3 countries had a free hand in determining what efficiency efforts they took and in setting their renewable targets. As the analysis below shows, these countries have handled these issues differently in their national policies and have sometimes reached inconclusive results.

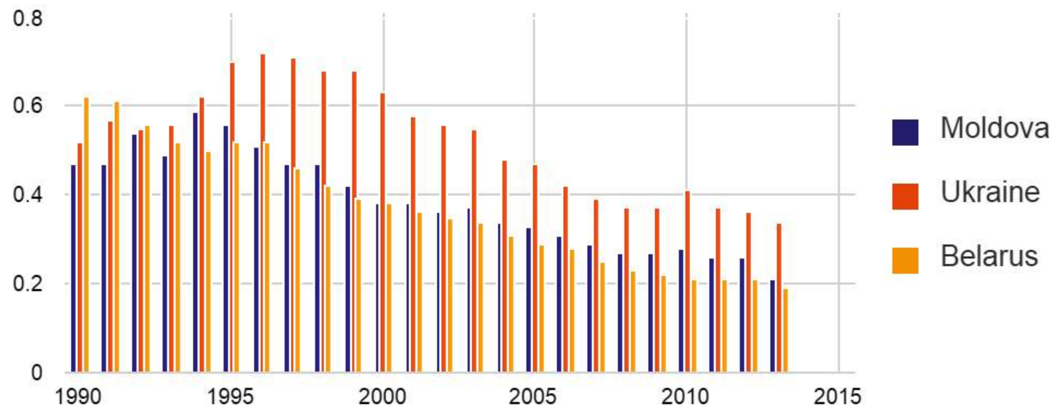
Since the mid-2000s, political pressure and rising energy prices have forced the energy-poor post-Soviet countries to adjust their energy policies to new priorities, such as energy efficiency (EE) and the growing role of renewable energy (RES), in order to reduce their dependence on imported sources of energy. Energy policies in Belarus, Ukraine, and Moldova have pursued the same goals: to enhance energy security and to increase energy efficiency. The methods for achieving these goals were quite similar in the cases of Ukraine and Moldova, while they were slightly different in Belarus. The respective energy policy trajectories of these countries were mainly determined by the political vectors chosen by them, and these divergent trajectories were confirmed – more or less officially – once again in 2010, when Moldova and Ukraine[24] joined the Energy Community Treaty, while Belarus opted for the Eurasian Customs Union. As a result, the trajectory of Ukrainian and Moldovan energy policy developments was almost the same, especially after signing the Association Agreement with European Union in 2014, which established a political and economic association of these countries with the EU. Through these agreements, both countries committed to bringing their economic policies, legislation, and regulations in a broad range of areas, including energy, in line with the corresponding policies, legislation and regulations of the European Union. Even the legislative

[24] The Protocol on Accession of Ukraine to the Energy Community Treaty was signed in September 2010, and in 2011 Ukraine became a full member of the Energy Community

framework, which was initially the same in all countries as a result of a common model inherited from the Soviet period, was gradually reshaped to the specific needs and priorities of each country.

The main indicator measuring the energy performance of a national economy is the energy intensity of GDP. However, even this indicator is not sufficient to capture the actual level of energy efficiency, as the energy intensity of GDP can be easily influenced by structural changes in the economy and the different economic profiles of individual countries. A lack of detailed and reliable energy data by sector makes it difficult to measure changes in energy efficiency. Nevertheless, it may provide a general idea about the energy performance of the country in question.

Figure 17 *Energy intensity (TPES/GDP(PPP)) (toe/1000 2005 USD)*



Source: IEA Energy Atlas

All three countries faced the need to gradually increase gas prices as Russian gas became more expensive. The most affected were Belarus and Moldova, where the share of gas from Russia dominates the TPES. Even Ukraine, which has its own production of natural gas –unlike Moldova and Belarus – imports more than half of its domestic demand. This renders the country vulnerable and threatens its energy security (see Table 16). Nevertheless, this was not enough to stimulate energy efficiency improvements in Ukraine and Moldova until a few years ago.

Table 16 *Macro energy indicators in Moldova, Belarus and Ukraine*

Indicators, 2013	**Moldova**	**Belarus**	**Ukraine**
Self-sufficiency, %	10	15	74
Total Primary Energy Supply (Mtoe)	3.07	27.28	116.14
Energy Intensity (TPES/GDP(PPP)) (toe/thousand 2005 USD)	0.21	0.19	0.34
TPES/population (toe per capita)	0.96	2.88	2.55
Share of gas in TPES (%)	68.4	55.5	35.1
Self-sufficiency of natural gas, %	0	1	38.8
Share of Industry in Total Final Consumption (%)	22	34	38

Source: IEA Statistics

An analysis of the evolution of energy intensity in the countries surveyed over a period of more than 20 years shows a continuous decline despite increasing industrial production volume in all three countries. This is explained by the – occasionally modest – efforts in these countries to reduce their energy consumption. Another explanation for the continuously decreasing energy intensity against the backdrop of a growing GDP is the structural change ongoing in these economies, where the service sector has gained a significant share of the economy and the most energy inefficient industrial enterprises have gone bankrupt.

The energy consumption in buildings, especially residential and public buildings, represents a significant share in the TPES of these countries. In light of increasing energy prices, energy policy has recently considered this sector as one of the most promising in terms of reducing energy consumption. In this context, Moldova has already adopted the law on energy performance of buildings which transposes the EU directive 2010/31/EC while Ukraine has drafted the law.

In terms of investments, Belarus started to invest massively in energy efficiency prior to Moldova and Ukraine. The authoritarian regime and the small share of privately owned enterprises limit the capabilities and sustainability of this sector. Nevertheless, public investments in energy efficiency are higher in Belarus than in Ukraine and Moldova.

Tariffs play an important role in stimulating energy efficiency, especially in countries with a market economy. Although the tariffs for electricity and gas were near cost recovery levels in the past years, the respective tariffs applicable to different customer categories remain misbalanced in Belarus and Ukraine. Another important issue are the debts of the energy companies, which affect the financial viability and the energy security of the countries concerned. Regulatory institutions, responsible tariff setting have different forms of subordination in the three countries. The regulatory role in Belarus is exercised by the Ministry of Economy, which lacks the autonomy to properly perform the regulatory functions with regard to state-owned energy companies.[25] In Ukraine and Moldova, there are dedicated autonomous agencies.

Energy efficiency plays an important role in the energy policy of all three countries, which is also reflected in the main national development documents, such as strategies and programs. The implementation of the policies on energy efficiency began earlier in Belarus than in other post-Soviet states, when the government created a Committee for Energy Efficiency and Control in 1993. In Ukraine, the first law on energy conservation was adopted in 1994, while in Moldova the first law on energy conservation was adopted only in 2000. In parallel with the policies on energy efficiency, renewable energy sources started to penetrate the energy markets in these countries. In their dedicated national policies, these countries set ambitious goals for renewable energy and primary source diversification. Belarus established a goal of attaining a 25% share of alternative and renewable sources in its primary energy mix by 2020, without any efficiency targets.[26] Moldova and Ukraine set both energy efficiency and renewable targets for the period until 2020.

Over time, the institutional and policy framework in energy efficiency has improved significantly, but its implementation remains challenging. In most cases, this problem owes to a lack of well-designed secondary legislation that sets out in detail the rules and procedures for sector governance while it also considers how to provide rule of law guarantees in the sector. In addition, legal acts appear to be amended regularly without subsequent changes being made to other related acts, leaving them

[25] Belarus: Addressing challenges facing the energy sector, World Bank, June 2006. Available at: http://siteresources.worldbank.org/BELARUSEXTN/Resources/BelarusEnergyReview_July2006-full.pdf (29.05.2016)
[26] Incentivising Renewables: The Baltics and Belarus, 2011, Clifford Chance. Available at: http://www.cliffordchance.com/briefings/2011/02/incentivising_renewablesthebalticsandbelarus.html (29.05.2016)

vulnerable to multiple interpretations and shadow practices.[27] The attempts to create authorities responsible for EE and RES policies in horizontal, inter-ministerial coordination often fail to deliver the necessary results. Simultaneously, the responsibility issue remains acute, as these countries have a relatively low number of directives that mandate certain responsibilities for corporate stakeholders. Consequently, the implementation of administrative measures remain highly selective and there is no consistent separation of responsibilities between the actors in the sector.

The relatively low energy prices compared to EU average in the countries surveyed represent a drag on legal initiatives that promote energy efficiency. The most important explanation for this is the low number of bankable energy efficiency projects before 2010-2011, when the energy prices reached a peak in Ukraine and Moldova, though they were lower in Belarus. This is partly due to the absence of markets related to energy service companies (ESCO) in these countries. This may also owe to the fact that energy efficiency technologies come from countries where energy prices are higher, and energy efficiency is used as a tool for both increasing competitiveness and a way to reduce energy bills.

Despite the adoption of key primary legislation, the absence of secondary legislation, missing regulations, and sectoral norms often hinder the implementation of energy efficiency investments. The slow pace of the development of secondary legislation in Ukraine and Moldova was also criticized by the Energy Community Secretariat. By using the old Soviet Construction Codes and Regulations, which do not consider energy efficiency as an important criterion, the quality of the energy efficiency measures and huge investments become compromised. The financial assistance provided by the EU for investment projects comes with specific requirements regarding the standards to be applied. This makes the implementation process difficult, but at the same time it also pushes governments to be more active in the development of secondary legislation.

Table 17 *A comparative table on energy targets*

Targets	Moldova	Belarus	Ukraine
Energy intensity of GDP	Reduction by 10% until 2020 compared to level of 2009	Reduction by 13% until 2020 compared to 2010 (from 426 to 370)	Reduction by 20% until 2020 compared to 2014
The efficiency of total primary energy use	Reduction by 20% until 2020 based on the reference year 2009	-	Reduction by 9% until 2020 based on the average of 2005-2009
The share of renewable energy sources in the total energy mix	17% by 2020	6% by 2020 and 8% by 2030	11% by 2020

Source: author's compilation

All three countries take a slightly different approach to the implementation of their energy efficiency policies because of differences in their respective macroeconomic profiles. Ukraine has the biggest energy efficiency potential in the industrial sector, especially in heavy industry, while Moldova and Belarus consider that energy efficiency in the building sector has the biggest potential for reducing

[27] OECD/IEA report, 2015

energy consumption. From an energy security perspective, the replacement of imported energy sources with green energy production, especially biomass, could be a medium or long-term solution. The major share of natural gas in the country's energy balance is also an issue when the increase of the gas price affects the entire national economy. According to the Table 17, we observe a similar approach in terms of establishing targets in the case of Ukraine and Moldova, countries that are committed to the EU energy path and have adopted the same targets as the EU based on a top-down approach, while in case of Belarus the targets seem to be more realistic.

Moldova

The energy sector in Moldova has a similar development pathway as that observed in other post-Soviet countries. Energy efficiency and energy security have emerged as strategic priorities since the Republic of Moldova became independent. The first energy strategy was adopted in 1997 and it was replaced by other strategies in 2000, 2007, and 2013. Even though energy efficiency was reflected in some shape or form in other energy policy documents, the first actual law on energy conservation was adopted in 2000. Despite the administrative framework and numerous instruments to promote energy efficiency, no significant progress has been achieved over a period of 10 years. The year 2010 saw the adoption of the law on energy efficiency, which transposed Directive 2006/32/EC. Based on this law, the Energy Efficiency Agency and Energy Efficiency Fund were established and the National Energy Efficiency Program 2011-2020 was adopted. In order to implement the program, the National Energy Efficiency Action Plan was adopted for the period 2013-2015. With a much stronger commitment by Moldova, and generous support from international energy donor and funding institutions, significant and promising progress was achieved.

The key currently effective policy documents for promoting energy efficiency are:

- Law on renewable energy sources, 2007;
- Law on energy efficiency, 2010;
- Law on electricity, 2009;
- Law on natural gas, 2009;
- Law on energy performance of the buildings (in line with 2010/31/EU directive), 2014;
- Law on energy labeling, 2014;
- Energy strategy 2030, 2013.

The National Energy Efficiency Program 2011-2020 specifies the objectives of increasing the share of renewable energy sources in the total energy mix of Moldova from 6% in 2010 to 17% by 2020, and to increase the efficiency of total primary energy consumption by 20% until 2020, based on 2009 as the year of reference.

Analyzing the progress achieved by Moldova in terms of energy intensity, a relatively constant decrease was registered. Since 1996, energy intensity decreased from 0.51 toe/1000 2005 USD (PPP) to 0.21 toe/1000 2005 USD (PPP) in 2013. Compared to OECD energy intensity of 0.13 toe/1000 2005 USD (PPP) in 2013, the factor of difference between the two figures is 1.6.

Real financial support for energy efficiency began only in 2013, after the establishment of the Energy Efficiency Fund. Hundred million MDL were available for investments in 2012, and about 465.2 million MDL were planned for 2015.

Renewable energy sources are considered a viable method for enhancing the energy security of Moldova. Nevertheless, this sector did not achieve significant progress. Overall, capacities totaling 2.02 MW of solar energy, 1.1 MW of wind energy, and 112.57 MW of biomass heating had been built by 2015. According to research performed on the subject, biomass has a huge potential in the production of heat energy. It could replace about 50% of natural gas imports from Russia.[28]However, the actual realization of this potential is slow due to various factors, such as: 1) political and institutional resistance; 2) relatively new market and technologies; 3) access to wood procured from illegal logging, etc.

Between 1997–2012 the price of electricity increased from 679 MDL/MWh to 2,245 MDL/MWh (average). The price of electricity increased steeply – by around 200% – after 2006. Natural gas prices have been rising steadily, resulting in a tariff increase from 454 MDL per 1,000m³ in 1997 to 6,830 MDL per 1,000m³ in 2015. Since 2006, natural gas prices has shown a steep increase of around 340%. The main reason for the significant increase in gas tariffs was the new agreement with Gazprom in 2006, which stipulated that by 2011 gas prices would be adjusted to the price level of EU consumers. With respect to the reflection of costs in the prices of gas and electricity paid by final consumers, both private and residential sectors are paying market price levels. The only difference is the residential sector's VAT exemption.

Belarus

Belarus began to focus on energy efficiency policy somewhat earlier than Moldova and Ukraine. The government created a Committee for Energy Efficiency and Control in 1993 (which was subsequently transformed into the Committee for Energy Efficiency and then, in 2006, became the Department of Energy Efficiency of the State Committee for Standardization of the Republic of Belarus). In 1998 the first Law on Energy Savings was adopted.

The key documents – in force at the end of 2015 – which support the development of energy efficiency policies are the following:

- Resolution № 1084 of the Council of Ministers of December 23, 2015 "On the concept of energy security of the Republic of Belarus";
- Law №239_3 of the Republic of Belarus of January 8, 2015 “On energy saving";
- Law № 204-3 of the Republic of Belarus of December 27, 2010 “On renewable energy sources";
- Directive № 3 of the President of the Republic of Belarus of June 14, 2007 “Economy and thrift - the main factors of the state's economic security";

[28] *Estimating the energy potential of biomass from agricultural crops at regional and rayon levels for 2009-2010.* Study prepared by IDIS "Viitorul" as part of the Moldova Energy and Biomass Project funded by the European Union, co-funded and implemented by UNDP Moldova.

- Presidential Decree № 550 of December 1, 2014 "On the most important parameters of socio-economic development of the Republic of Belarus for 2015";
- Resolution № 1238 of the Council of Ministers of December 24, 2014 "On indicators of socio-economic development of Belarus for 2015"; etc.

A number of programs were developed for the purpose of implementing the energy efficiency policies of the Republic of Belarus. These include the following:

- National Energy Saving Program for 2011-2015;
- National Program for the development of local and renewable energy for 2011-2015;
- State program for the construction of energy sources on local fuels in 2010-2015;
- State program in Belarus for the construction of hydroelectric power stations in 2011-2015;
- State program for the development of the Belarusian energy system until 2016.

Analyzing the most relevant documents it can be observed that energy efficiency is a priority also from an energy security point of view. The Republican Energy Saving Program developed over the period 1996-2015 plays a central role in this regard. As it is presented in the table below, the government has significantly increased the amount of funds for all energy efficiency promotion programs. It is also important to point out the ambitious targets set out in the last program, according to which energy intensity should drop by 50% by 2015 compared to the 2005 level. To meet this goal, the government anticipates investments of 8.6 billion USD. However, this goal was not attained in 2015 (energy intensity fell only by 11.3% between 2010 and 2015). In the most recent edition of the Belarusian energy security concept for the period between 2015 and 2020, energy intensity is projected to drop only by 2.1%.

Table 18 *Investments into energy efficiency in Belarus, mln. USD*

National Program for Energy Savings	1996-2000	2001-2005	2005-2010	2011-2015
Investments, million USD	370.5	795.0	2,600	8,662[30]

Source: Compilation from the Energy Efficiency Programs of Belarus Republic

The gas price increase imposed by Russia was a strong argument in favor of focusing on energy efficiency as one of the measures to enhance energy security and to mitigate the eventual impact of the price increase on the economy and the population. This was one of the reasons for increasing investments in the third energy saving program, from 795 million USD to 2,600 million USD, and to do the same in the fourth program, which saw its funding grow from 2,600 million USD to 8,660 million USD.

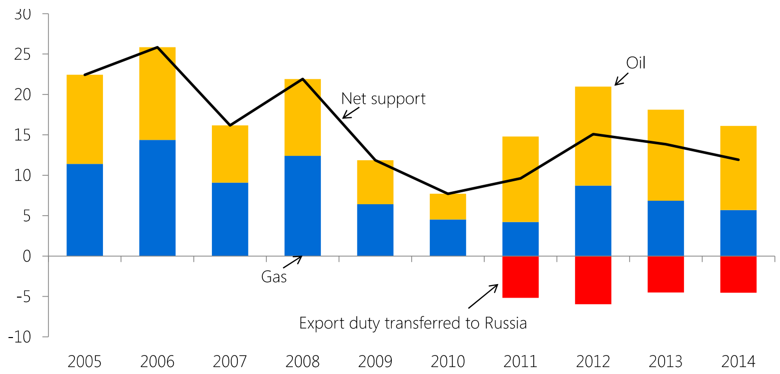
An analysis of the changes in GDP and energy intensity during the time when these programs were being implemented reveals that the economy's energy intensity was decreasing continuously, improving by a factor of about 2.7. Compared to Ukraine and Moldova, the Belarusian economy has made the most progress. Between 2001–2008, the average annual GDP growth was 8.3%. Growth slowed substantially due to the global economic crisis of 2008–2009: it dropped to 0.2% in 2009. Tight monetary and fiscal policies in late 2011 and throughout 2012 helped to restore macroeconomic stability in the country by 2013. The influence of the government over the economy,

[30] ПОСТАНОВЛЕНИЕ СОВЕТА МИНИСТРОВ РЕСПУБЛИКИ БЕЛАРУСЬ 24 декабря 2010 г. № 1882 Об утверждении Республиканской программы энергосбережения на 2011–2015 годы

as well as administrative interventions in credit allocation and the widespread use of subsidies, played an important role in this process.[31] The country's close relationship with Russia, which was also officially reinforced by the creation of the Customs Union in 1995, needs to be highlighted here.

Despite the gradual gas price increases imposed by Russia in 2006, the overall change in price was much more modest in Belarus than in Moldova or Ukraine. In 2014, the average import price for gas was about 175 USD/1000m3 in Belarus, compared to 385 USD/1000m3 in Ukraine and 377 USD/1000m3 in Moldova. The preferential gas price for Belarus created an important competitive advantage for its economy as compared to Ukraine and Moldova. The annual level of Russian price support as a percentage of Belarusian GDP remained constant during the last two decades. Only in 2014 did the price support for Belarus, which results from discounted prices on gas and duty-free oil for Belarus' domestic needs, climb to over $6.2 billion or 8.1% of GDP.[32]

Figure 18 *Russian price support of energy trade to Belarus, % of GDP*



Source: http://eng.kef.research.by/webroot/delivery/files/english/KEFe2015_Bakker.pdf

The focus on public investments in energy efficiency, co-opting the private sector, is one of the weak points of Belarusian energy policy. Due to the absence of market conditions public investments are often not used in the most efficient way and are limited. On the other hand, raising energy prices to a justified, cost-reflective level is a precondition for making the private sector interested in investing in energy efficiency. Due to price acceptability, the level of dependence on energy imports has not changed over the last decades. At the same time, Belarus has demonstrated a capability to diversify its energy imports by importing oil from Venezuela and Azerbaijan between 2010-2012.[33]

Another way to enhance energy security is development of local RES. To this end, Belarus adopted the National Program for the Development of Local and Renewable Energy between 2011-2015. The most relevant achievement registered by the end of 2013 are the following:[35]

- 23 biogas plants with a total capacity of 24.33 MW;
- 24 solar power installations with a total capacity of 51.75 MW;
- 28 operating wind turbines with a total capacity of 6.57 MW;

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[31] Belarus ENERGY Sector: The Potential for Renewable Energy Sources and Energy Efficiency, 2014. Available at: https://ener2i.eu/page/34/attach/0_Belarus_Country_Report.pdf (29.05.2016)
[32] Aleś Alachnovič: How Russia's Subsidies Save The Belarusian Economy, 08/26/2015. Available at: http://belarusdigest.com/story/how-russias-subsidies-save-belarusian-economy-23118 (29.05.2016)
[33] Alexander Čajčyc Belarus To Diversify Away From Russian Oil Supplies,03/16/í2010. Available at: http://belarusdigest.com/story/belarus-diversify-away-russian-oil-supplies-1891 (29.05.2016)
[35] Belarus ENERGY Sector: The Potential for Renewable Energy Sources and Energy Efficiency, 2014.

- 100 geothermal installations with a total capacity of 5.5 MW).

Ukraine

The first law on energy conservation was adopted in Ukraine in 1994, the year that also saw the creation of a State Committee on Energy Conservation. Without adequate financing and political support, only modest progress was made over a period of about 10 years. In 2005 the State Committee on Energy Conservation was disbanded by a Decree of the President of Ukraine. In the same year by Presidential Decree ordered the creation of the National Agency *of* Ukraine *for* Efficient Usage *of* Energy Resources. The new government agency has broader responsibilities than the committee that preceded it. The National Agency was replaced by the State Agency on Energy Efficiency and Energy Savings (SAEE) in 2011.[36]

The key energy policy documents on the subject of energy efficiency and energy security are:

- Law of Ukraine on Energy Conservation, 1994;
- Law of Ukraine on Electricity Industry, 1997;
- Law on Electricity Market, 2014;
- Law on the Natural Gas Market, 2015;
- Law of Ukraine on Alternative Types of Fuel, 2000;
- Law of Ukraine on Alternative Types of Energy Sources, 2003;
- Law of Ukraine on Combined Production of Heat and Electricity (Cogeneration) and Use of Waste Energy Potential, 2005;
- Law of Ukraine on Heat Supply, 2005;
- Energy Strategy of Ukraine 2030, 2013; etc.

The main national energy policy document is the 2030 Energy Strategy, the final draft of which was approved in February 2014. The main targets established by the strategy are: to reduce the energy intensity of GDP by 20% by 2016, as compared to the 2008 value; to reduce the energy intensity of GDP by 50% by 2030; to reduce electricity losses through power grids from 14.7% in 2005 to 8.2% by 2030.[37] In the revised strategy, energy efficiency and energy security have become a higher priority against the backdrop of the disputes with Russia concerning gas supply and gas price increases, which exceeded 400 USD/1000m3 in 2013.

The following programs and plans were drawn up to implement state policies on energy efficiency and energy security :

- State Target Economic Program on Energy Efficiency for the period 2010-1015;
- National Renewable Energy Action Plan up to 2020;
- National Energy Efficiency Action Plan up to 2020.

[36] Climate change legislation in Ukraine, The 2015 Global Climate Legislation Study, 2015. Available at: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/05/Global_climate_legislation_study_20151.pdf (05/29/2016)
[37] Ibid.

The implementation of the National Energy Efficiency Action Plan up to 2020 will be funded with a total amount of 1011.3 billion UAH, allocated from different sources.

Analyzing the evolution of Ukraine's energy intensity since 1996, we see a continuous decrease, except the period 2009-2010, the time of the global crisis. So starting in 1996 energy intensity decreased from 0.72 toe/1000 2005 USD (PPP) to 0.34 toe/1000 2005 USD (PPP) in 2013. Compared to the OECD's average energy intensity of 0.13 toe/1000 2005 USD (PPP) in 2013, the Ukrainian value is more than 2.5 times higher, and the implication is that Ukraine can be characterized as one of the most energy intensive countries globally. At the same time, this difference also reveals that there are vast reserves in terms of reducing the energy intensity of the Ukrainian economy. A reduction of the energy intensity by about 26% of the 2013 level hypothetically would be enough to put an end to Ukraine's dependence on imported energy sources. An alternative, but more expensive scenario would be to replace imported natural gas with biomass. REMAP 2030 revealed a biomass potential of 813 PJ [39] in 2013, the utilization of which could reduce imports by about 20%. Analysis of changes in the volume of industrial products sold between 2001-2013 (current prices) shows that this indicator grew more than six-fold during thus period, while at the same time energy intensity decreased 1.7 times which demonstrates a good performance.

RES are expected to contribute significantly to greater energy security in Ukraine. During the last four years, this sector has started to demonstrate significant progress. At the end of 2014, there were power plants in operation with the capacity to generate 497 MW wind, 818.9 MW solar and 49.1 MW of biomass (including biogas) energy.[40] The installed capacity of power plants generating heat from renewable energy sources amounts to 520 MW (as of October 2013).[41]

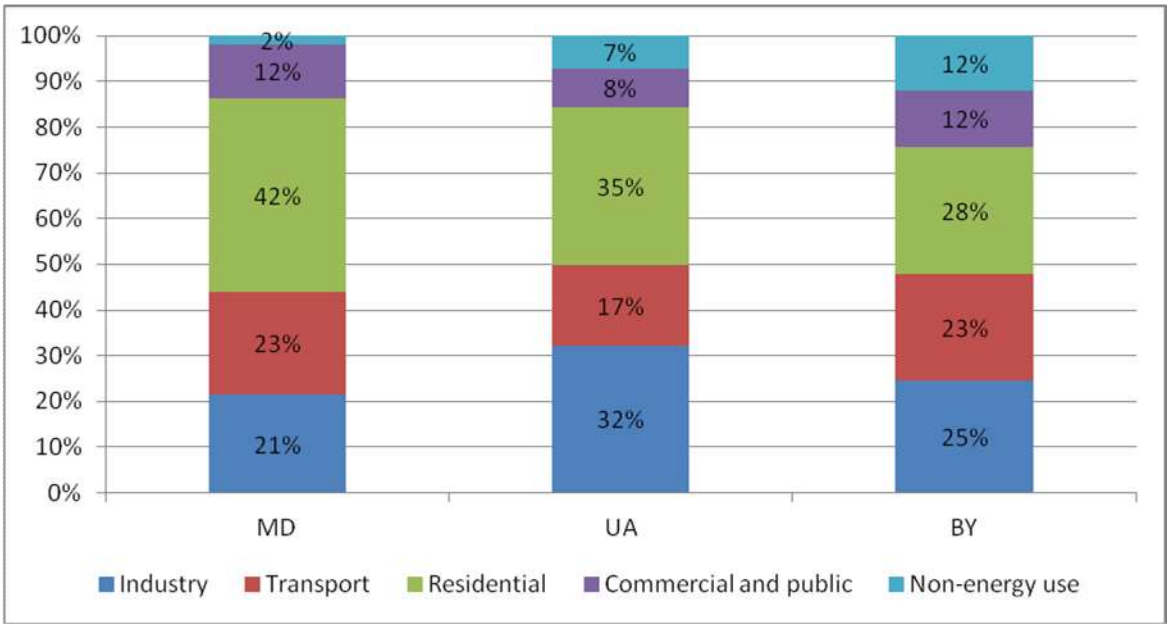
A major barrier in stimulating households to conserve energy is the financial burden borne by the energy industry, which subsidizes the electricity consumption of the public and residential sectors. After numerous official declarations that at public and residential prices would be adjusted to reflect actual energy market prices, a new deadline, April 2017, was set in line with International Monetary Fund and World Bank obligations.[42] Residential prices for electricity and gas were increased substantially in 2015. This is a multi-step process and prices will reach cost-recovery levels of 2014 by 2017.

[39] REMAP 2030 Renewable Energy National Energy Efficiency Action Plan Through 2020, Prospects for Ukraine, April 2015. Available at: https://www.irena.org/remap/IRENA_REmap_Ukraine_paper_2015.pdf (29.05.2016)
[40] Ibid.
[41] National Renewable Energy Action Plan (NREAP) 2020. Available at: https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3430146/067A653E3AF24F62E053C92FA8C06D31.PDF (29.05.2016)
[42] Energy Community Country Brief, Spotlight on Ukraine, Issue 2, 11/13/ 2015

Residential energy efficiency and district heating

Residential sector has the biggest share in energy consumption in the EAP3 countries. In Moldova residential consumption constitutes 42%, in Ukraine 35% and in Belarus 28% of total demand, respectively. Industry ranks second in Belarus and Ukraine while in Moldova only third after transport. The diagram presented in Figure 19 reflects the composition of demand and the economic profile of the countries. In this regard residential sector is a major segment with significant efficiency potential.

Figure 19 *Share of energy consumption per sectors in EAP3 countries in 2013, %*

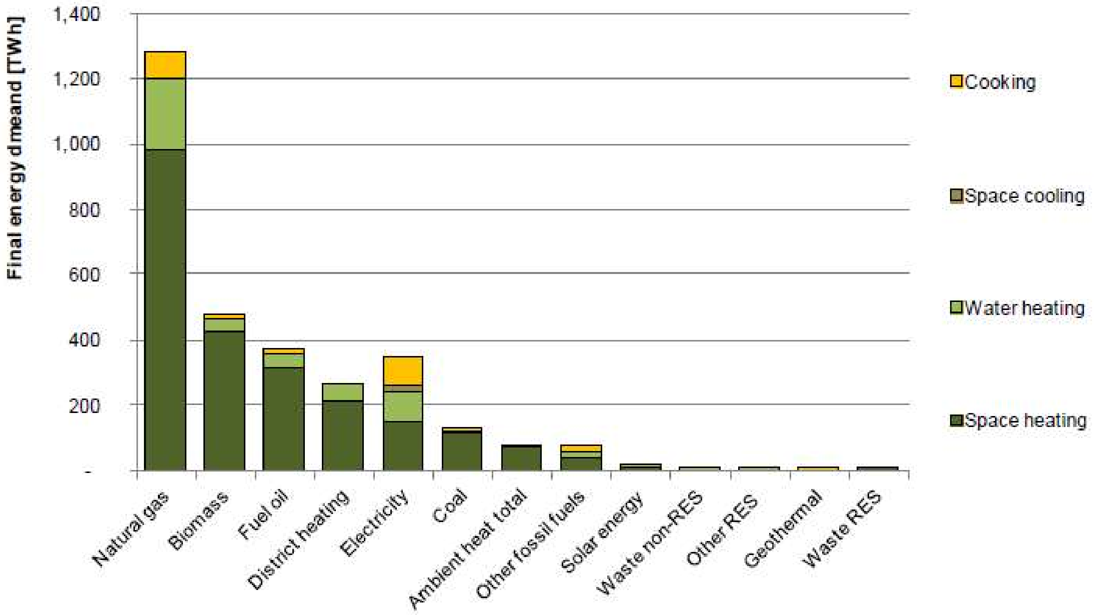


Source: IEA

Natural gas is the main energy source used in the residential sector, it had a 26% share in EAP3 and 27% share in V4 countries according to IEA data for 2013. In the EU28 space heating is dominant accounting for 68 % of the total final energy household demand in Europe (Figure 20).[43] Only 11 % of the final energy demand comes from non-heating and cooling purposes. Space cooling is a relevant end-use category for certain countries in Europe, however, the overall share of the final energy demand in the European residential sector is negligible. Poland, Hungary and Slovakia have the highest shares of heating in total final consumption within OECD.

[43] Mapping and analyses of the current and future (2020-2030) heating/cooling fuel deployment (fossil/renewables), Work package 1: Final energy consumption for the year 2012. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/Report%20WP1.pdf (16.05.2016)

Figure 20 *Final energy demand by residential end-uses and energy carriers in EU 28*



The membership of Ukraine and Moldova in the Energy Community facilitates the interest of international investment institutions in energy efficiency projects including residential sector. A good example is the Residential Energy Efficiency Financing Facility provided by EBRD, offering funds up to €75 million to Ukraine and €35 million to Moldova. The financing instrument provided by EBRD has a high importance even if the results are not the desired ones. There are various barriers related to the high interest rates of the local banks, lack of experience in cooperation with home owners associations, low family incomes, inadequate public awareness of the benefits of EE projects, etc.

A common issue for all the three EAP3 and V4 countries are the Soviet-designed flat houses and/or the accompanied generation and district heating systems. District heating is a complex value chain, that can provide an efficient space heating solution if managed in a conscious, well-regulated way. Most of the EU15 countries have higher utilization of central heating than in Eastern Europe.[44] Some Nordic countries with 90-100% share of central heating within space heating are typical examples of good governance in these specific sectors. Nonetheless, this requires efficiency measures at every stage of the system: at house insulation and at end-user measures; at the level of the heat distribution network; and in particular in the generation sector. It is very telling that Nordic countries usually consume less heat per square meter/heating degree day due to better house insulation than some Southern or Visegrad members: i.e. an average Finnish flat requires 20% less heat than a Polish one. Distribution losses depend not only on the technical characteristics of the network, but also on its density. In Scandinavia disconnection is often administratively banned, thus the network can be planned with high certainty and less demand volatility. At last, high representation of combined heating in total generation provides high efficiency levels. It also enhances waste or RES utilization, which may provide some diversification benefits and less price volatility.

[44] David Andrews; Anna Krook Riekkola; Evangelos Tzimas et al.: Background Report on EU-27 District Heating and Cooling Potentials, Barriers, Best Practice and Measures of Promotion, EC JRC, 2012. p29. Available at: https://setis.ec.europa.eu/sites/default/files/reports/Background-Report-on-EU-27-District-Heating-Cooling-Potentials-Barriers-Best-Practice-Measures-Promotion.pdf (29.05.2016)

Unlike the Nordic countries, EAP3 and V4 states could not develop their CHP-DH regimes in a smooth, gradually extended way. Their systems were designed closely connected to Socialist industrial considerations. Plant closures and recession in the 1990s, privatization of the housing stock and the absence of modernization brought many further inefficiencies into the value chains. While in Sweden and Finland total heat consumption doubled between 1990 and 2014, in Poland and Ukraine its total (industrial and residential) consumption fell by two-thirds, in Hungary and Czech Republic demand halved in the same period. Thus, besides managing the original problems of low technical quality and low efficiency, these systems also need a considerable redesigning, optimization of their capacities. Consequently, it is reasonable to address the residential district heating systems in a holistic, dedicated way in the years to come.

The usual size of district heating operators or the number of supplied households (i.e. in Hungary 16%, in Ukraine 43% in 2011) varies heavily both within V4 and EAP3. The public image of district heating is relatively bad in most countries either because of high prices and/or unreliable services. Nonetheless, there is a high number of characteristic differences between V4 and EAP district heating systems. As Table 6 already indicated, in V4 heat production mainly comes from cogeneration. Heat-only plants still have significant shares in both regions, but aggregates for V4 are much lower than EAP3 proportions. EAP3 shares of heat-only plants remained three times bigger than in V4 both in 1998 and 2013. This is one of the major sources of higher intensity indicators and consequently higher costs in the sector. Combined systems are undisputedly more efficient than heat-only plants. The respective EU regulations (since 2004 when the EU Directive on Combined Heat and Power, 2004/8EC was accepted) and the accompanied reporting system and planning regime are important policy tools for the V4 countries.[45]

Second, the housing stock in many regards differs in the two regions: in V4 the Soviet-type block houses have a relatively smaller share in the total housing stock. According to Eurostat, the V4 shares of flat houses with 10 or more flats were between 26.8% in Hungary and 45% in Slovakia in 2011.In comparison: in all Baltic states these proportions were above 50%.[46] This opened the way for a faster modernization of the housing stock, metering and enhancement of individual regulation of heating in the Visegrad countries. Refurbishment of old housing stock is sometimes limited by technical factors, but the price liberalization and the relatively high cost of heat supply provides a major motivation even for larger household communities to limit demand. In the countryside, the relatively small unit size of housing blocks enhanced easier disconnection from the network, in some cases resulting in the final closure of inefficient systems and their substitution with house or individual heating. This partly explains the relatively high penetration rates for small-size CHP gas turbines as an alternative to medium-size, outdated plants in V4. In general, for the V4 countries the challenge of district heating modernization was less acute in terms of the whole energy policy landscape, even if the nature of problems were rather similar.

The management of district heating is a very policy-intensive field, in which a high level of differentiation is required. Practically every single plant differs, many stakeholders and ownership relations are involved, creating a complex environment for decision making. The low quality of the

[45] The respective national reports can be found at: https://ec.europa.eu/energy/en/topics/energy-efficiency/cogeneration-heat-and-power

[46] Table „Distribution of population by degree of urbanisation, dwelling type and income group"

service and the lack of proper investment in the system caused massive disconnection of the consumers and switch to individual gas boilers, especially in multifamily houses. These lead to the bankruptcy of many centralised heating companies and the extension of related subsidy regimes. This trend was particularly strong both in V4 and EAP3, parallel to the construction of new housing in the 2000s and the rise in natural gas prices since 2003. Practically all countries introduced similar measures, lowering the tariffs or the related taxes and/or administratively regulating disconnections, in some cases practically banning it in order to demotivate consumers to switch from centralized system to individual heating systems. Different measures were implemented: the authorities imposed up to 20% payment of the bill for centralized heating system for apartments which have neighbor apartments connected to this system in Moldova. In Hungary the VAT rate for district heating was lowered to 5% (the general VAT rate is 27%) and in multi-storey buildings 100% approval rate is necessary for disconnection, making it nearly impossible.

In the V4 countries the management of district heating was accompanied by other policy measures, primarily related to the fulfilment of the respective EU commitments. Both EU Directive on Combined Heat and Power (2004/8EC) and Directive on Renewable Energy played a certain role in this regard. Increasing cogeneration level remained a policy target, resulting in some support schemes, enhancing the instalment of small-scale generation gas engines and some medium-sized CHP units. In parallel, renewables and waste approached 8% in total CHP and heat-only generation by 2013. It is very telling, that V4 countries used more RES in CHP than the EAP3 countries altogether. If we add tariff policy to these measures, it is reasonable to say that V4 energy policies created a more diversified and reliable framework for district heating than in the EAP3. EU regulations constituted the main driver of change, even if implementation varies substantially from country to country.

Nonetheless, in the sphere of district heating, the potential impact of non-dedicated, nation-wide policies bring suboptimal results if not accompanied by differentiation on the regional or municipal levels. Price regulations are not the only factor in this regard. For example, in Ukraine the low residential gas prices prompted many households to disconnect, aggravating the implications of an already costly policy measure. At the same time early price liberalization in Moldova (Table 13) led to a drastic drop in the share of central-heated dwelling spaces from 89% in 1990 to 28.4% in 2007 (even if it increased again to 39.3% by 2013). In Belarus and Ukraine the similar shares in 2013 were 73.9% and 64.9% respectively. Many heating plants were mothballed or even closed down in Moldova, while individual responses to price increases became possible. Consequently, biomass and waste utilization grew rapidly in the final consumption after 2004 reaching 9% of the total and 26.7% of residential demand in 2013 (8.8% in Belarus, 4.2% in Ukraine). Nevertheless, the Moldovan case remains highly controversial: while it also enhanced more individual responses to domestic price fluctuations, it also resulted in lower district heating densities, aggravating the already existing problems in the subsector.

Looking at the significant liabilities and worn-out technical equipment through the EAP3 countries, in particular in Ukraine, the region has a chance to considerably redesign its generation landscape in the decade to come. It is important to make specific, case-by-case decisions: given the extremely old thermal generation and distribution assets, disconnection and fragmentation of the system can be a reasonable response in certain cases. In the case of Moldova or Poland, some countryside operators successfully stopped their production and changed to individual/block heating, creating a more reliable service. In some cases full modernization of the housing stock and successively the refurbishment of the network may provide lower tariffs in the medium term. Understandably the current deadlock, when operators insist on their activities but are not capable to renovate their production assets, is far from optimal. In this regard the two major challenges are the high number and diversity of actors and interests involved (households, DH operators and owners, municipality, state institutions, donor/investor) and the fragmentation of funds between too many systems. Usually investment funds if provided, are sufficient only for partial refurbishment of the system, preserving, sometimes even increasing inconsistencies in the network.

One of the major dilemmas these countries face is whether to refurbish the system or the housing stock first. Optimally the housing stock refurbishment with metering, insulation and replacement of windows and doors shall be the first step, since these measures can decrease the aggregate demand by 40%. Nevertheless, administrative capacities, funds, stakeholder situations and relatively low financing periods do not favor collective housing renovations. It is easier to modernize the DH system, even if once these investments have been made, the operator will be disincentivized in any further refurbishment and full savings will not be achieved. Furthermore, some V4 pilot projects show that complex renovations, despite their technically favorable characteristics, may end up in massive economic waste due to mismanagement and lack of coordination. The practical compromise is often the partial renovation of the housing stock, introduction of (floor) metering, in some cases thermal insulation prior to DH modernizations.

The typical buildings with a high priority for energy rehabilitation are the buildings constructed during the Soviet period when no energy efficiency concerns were taken into account. The EAP3 housing stock constitutes a relatively unified picture with some dominant types of buildings. The following key types of multi-storey buildings are distinguished in Moldova, Ukraine and Belarus:

1. Panel buildings (1950s – 90s). This group represents old panel buildings, typical panel buildings made of reinforced concrete and ceramist concrete. All these buildings are constructed of relatively cheap materials, have from 3 to 22 floors with low ceilings (2.5-2.75 m).

2. Old brick buildings (middle of 1950s – 80s). The majority of these buildings were constructed in the Khrushchev-era. Officially, the period of their construction began in 1955 after the Decree of Soviet government "About Fight against Architectural Redundancies". Typical features of these buildings are thin walls, low ceilings (2.5 m), short durability period and extremely small internal area of apartments.

3. Modern brick buildings (after 1991). This type unites all brick buildings constructed after the fall of the Soviet Union. The height of ceiling increased to 3 m, number of floors is usually up to 30, and the internal area of apartments became bigger.

4. Buildings constructed mainly under Stalin (1920s – middle of 1950s). The majority of these buildings were constructed after the end of World War II. Key features of such constructions are high ceilings – 3-4m, thick brick walls, the number of floors varies from 2 to 13, there are usually 2-4 apartments per floor.

The majority of these buildings require refurbishment due to their age. Nonetheless,,they are usually occupied by low income families, with no financial sources to improve the state of utility services systems and the building in general. In this situation special financing instruments have to be developed with participation of the local governments, financing institutions and dwellers/associations of owners. As the awareness and benefits of the energy refurbishment of the buildings are not well disseminated, pilot projects with high and visible impact will be necessary to achieve changes.

A common problem of all the above mentioned categories of buildings is the need of capital repairs. This is often not related to energy efficiency but to the general state of the building. This is one of the main reasons why the energy refurbishment projects are quite expensive. The typical energy refurbishment measures that can be applied to multi-storey buildings are indicated below.

Thermal insulation of exterior walls

For the thermal insulation of exterior walls using a thermal composite insulation system, the insulation material (polystyrene or mineral fiber boards, thickness > 10 cm) is attached to the walls and coated with a final layer. This method is widely employed in retrofit projects in Central Europe. The installation must be carried out according to national norms, installation guidelines and European standards.

Thermal insulation of top floor and basement

Thermal insulation of the top floor or technical level will be carried out using insulation boards. The insulation design should allow access to both the technical level and the basement. If the technical level is intended for housing technical equipment, the floor construction and insulation must be designed accordingly.

Replacement of old windows/doors

Old windows will be replaced by energy efficient windows, including windowsills. The installation must be carried out according to national norms, installation guidelines and European standards.

Refurbishment of the internal heating system

The existing 1-string heating system will be replaced with a 2-string heating system, including radiators, thermostatic valves, balancing valves, heat insulation of all pipes, etc. The thermostatic valve enables users to regulate the indoor temperature according to their actual needs.

Installation of a heat substation

Installation of a heat substation, usually in the basement of the building, will ensure the heat and domestic hot water at the required parameters. A maximum efficiency is obtained when the heating distribution system is redesigned from vertical to horizontal which will allow installation of individual meters per apartment or floors.

Refurbishment of the lighting system

Refurbishment of the lighting system requires replacing light bulbs and old fluorescent lamps with conventional ballasts with energy saving lighting systems and maintaining/adapting the existing lighting system (e.g. cleaning of bulbs, installation of reflectors, motion sensors, etc.).

Pilot projects and current experiences show other shortcomings, related to the applicability of Western practices. The applied technical solutions do not consider the sustainability of the projects (cheap materials, low quality work, no complex approach of applied measures). Local construction industries are often not capable of providing the required quality. Massive reconstruction would require a significant scale-up of knowledge and equipment on the corporation side. Since Western construction firms are underrepresented on local markets, this experience transfer might be difficult.

This problem is further aggravated, since the transposition of the secondary legislation according to EU directives (committed to be transposed by Ukraine and Moldova) is in delay. Therefore the old Soviet norms are still applied. This constitutes a problem both at the new dwellings and the refurbishment of the old ones. Nonetheless, the local development of EU standards shall take into account the standards of the existing housing stock.

Public procurement procedures do not consider energy efficiency criteria and are price-oriented, which is a concern regarding the quality of the project. This is often related to the low level and the fragmentation of funds.

Outlook

The conventional question in every experience transfer is whether donors can identify agents of change, players who are reform-minded and can cooperate in modernizing the system from within. The EU's Eastern policies often face these difficult challenges. With respect to the energy achievements of the V4, three major factors played decisive roles: the structural trends in the economy led by multinational corporations, the high involvement of foreign companies in local energy sectors and EU accession, its efficiency and energy-related acquis and the structural funds that accompany the latter. None of these factors are heavily present in the EAP3. To a considerable extent, the efficiency drivers in the EAP3 countries resulted from external factors and the adaptation was largely painful.

Consequently, the V4 does not offer a readily accessible set of experiences for the EAP3 countries. Despite all these differences, the Report demonstrated some fields of existing and potential cooperation. I would like to use the present Outlook to highlight some further potential fields that may become more important in the years to come, and in which the V4 may provide some examples to follow for EU assistance. First, interconnectivity and single market policies form a major common interest. Until now, progress has been limited to natural gas sectors and was driven by supply security considerations. Nonetheless, as the EAP3 investment gaps in the transformation sectors are gradually being felt, the approximation in the electricity markets will be more and more important. This is not only a supply security measure for the EAP3. The alternative for electricity trade between the EU and the EAP3 is the extended utilization of outdated nuclear, coal, and fossil generation plants. The problem is already present in Belarus and Moldova, but the situation may turn out to be more acute in Ukraine after the 2020s. The V4 has all the forums, institutions, and interests to launch this process in time.

Second, as was shown in the Report, the heat, and in particular the district heat, sector will become a major topic in the years to come. Western support and local funds are not sufficient to perform a comprehensive renovation of building stocks, distribution, and generation plants. Consequently, some compromises will have to be found, stakeholder and coordination problems will have to be solved. V4 regulators, technical staff, and civil organizations have a broad set of experiences to manage these challenges and achieve good cost-benefit results amid relative capital-scarcity.

Third, as local governments introduce cost-reflective pricing and cut back their extensive price subsidy regimes, energy poverty and related social consequences will emerge. These countries will become increasingly less able to manage the consequences, causing a relatively large pauperization in urban areas and loss of access to electricity and heating for many rural families. The V4 countries face similar problems, especially after the oil and gas price hikes of the 2000s and the 2008 financial crisis. The local experiences of municipal governments and social organizations might be useful in these regards.

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