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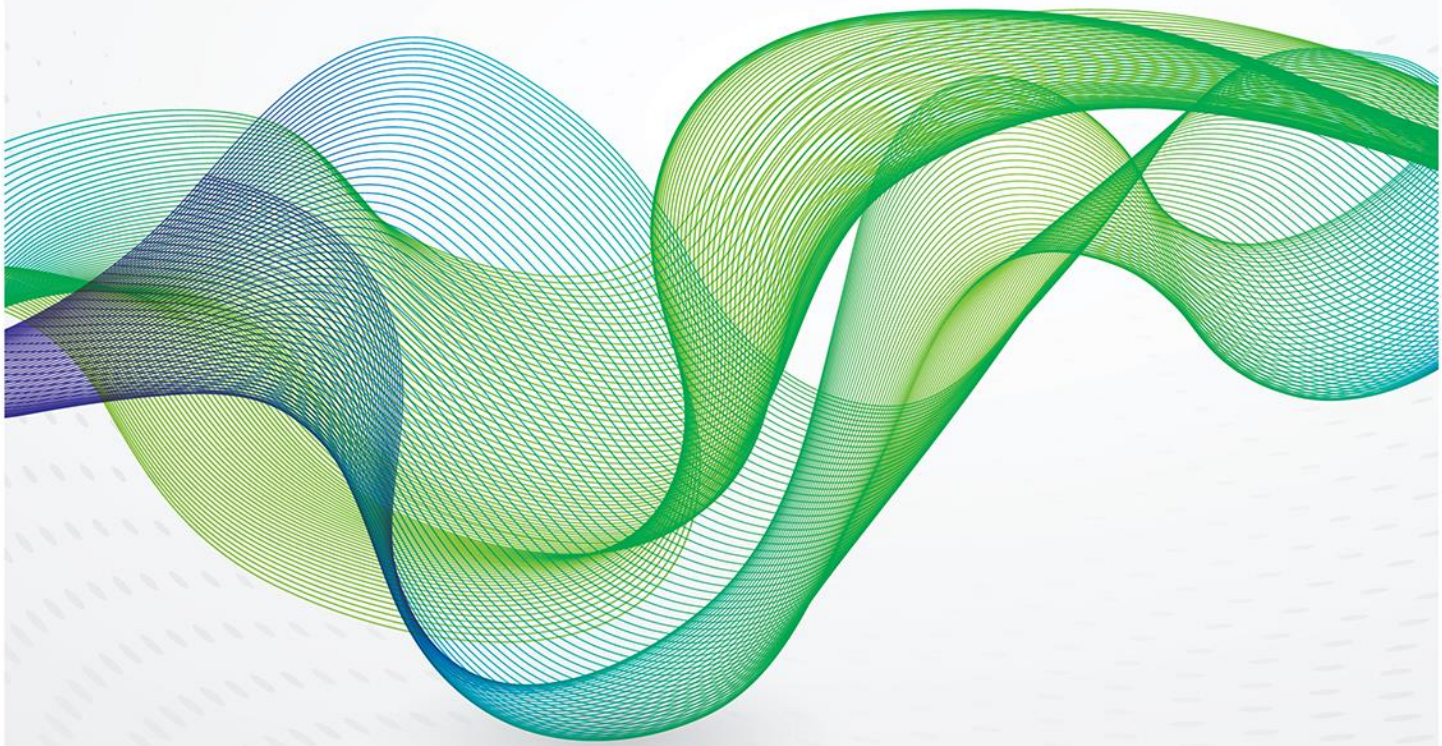
The Ukrainian residential gas sector: a market untapped



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Preface

This paper by Piotr Rozwałka and Hannes Tordengren makes a significant contribution to the research of the natural gas market in Ukraine, which is important both as an example of a former Soviet country in transition, and as a market moving towards integration with Europe.

The paper focuses on Ukraine's residential and district heating sectors, which have epitomised a well-known set of problems faced in former Soviet countries: outworn infrastructure, heavily subsidised pricing structures and inefficient consumption. It seeks to ascertain the potential of reforms that have now begun, focused on bringing prices to import price parity. It provides estimates of the potential gas savings both from price reform and from other efficiency measures (infrastructure investment, etc).

For readers in Europe, the paper is of interest for the insights it provides into a market that, while having contracted sharply in recent years, is still among the continent's largest, and as a result of the start-up of "reverse flow" trading – bringing gas into Ukraine across its western border – is accessible to European market players.

For readers in the former Soviet countries, the paper may also be of interest for what it says about the effect of reforms on consumption, on state and gas sector finances and their potential for energy policy.

Piotr Rozwałka and Hannes Tordengren, who have written this paper as visiting researchers on the OIES Natural Gas Research Programme, brought a great deal of analytical skill, attention to detail and breadth of vision to a complex subject. The result is a substantial addition to the programme's output.

Simon Pirani

About the Authors

Piotr Rozwałka and Hannes Tordengren are Visiting Research Fellows at the Oxford Institute for Energy Studies. Both are Wallenberg Fellows at Georgetown University, Washington DC. Rozwałka has a Master's degree in Economics from Stockholm School of Economics and specialises in the energy sector. Tordengren has a Master's degree in International Economics from Stockholm School of Economics, with a focus on energy economics and European security policy.

Contents

Figures

Tables

1 Introduction

After more than a decade of failure to reform its household gas sector, Ukraine is now progressing rapidly towards market-prices for gas, full integration into the European Union's internal gas market and an opening of its gas transmission systems through the unbundling of the transmission and production assets of Naftogaz, the former national gas and oil monopoly. Reforms deemed impossible just a couple of years ago have become a reality through the dual pressures of heightened insecurity of supply of gas from Russia in the aftermath of the conflict in parts of Donetsk and Luhansk and the increasingly unmanageable burden on the Ukrainian state finances caused by the previous system of heavy subsidies on natural gas. In 2014 Ukraine paid some 0.4% of GDP in explicit subsidies for utility services, 0.5% in implicit heat subsidies, and another astounding 5.6% in implicit subsidies for natural gas for household use. The very substantial size of the subsidy is the result of a very low regulated price of natural gas used both directly by households as well as transformed by District Heating Companies into heat for the population. A host of problems have emanated from this policy choice. First, Ukraine has the lowest energy efficiency level in all of the European region in terms of energy use by households[1]. Second, as Ukraine needs to import a sizeable share of its gas consumption from abroad, partly financed by the state budget, the level of budgetary deficit fluctuates together with the import price, becoming a source of significant volatility for the state budget. This is further amplified by the depreciation of the Ukrainian currency which negatively affects Ukraine's ability to pay for dollar- and euro-denominated gas imports from Russia and Europe. Last, the subsidized prices of natural gas have been used as a clandestine means to extract rents for the political elite, utilizing preferential access to subsidized gas and then reselling it at higher prices.

Reforming this system has proven very hard. For the last decade almost every Ukrainian government has agreed with the International Monetary Fund (IMF), as a part of a package of reforms, to rapidly decrease the subsidies for natural gas, with no apparent progress. In the aftermath of the financial crisis, in November 2008 the Tymoshenko government agreed to phase out the subsidies over 3 years, then in September 2010 the Azarov government promised to do so over 2.5 years, and finally in March 2015 the Yatseniuk government agreed to phase out the subsidies over 2 years[2]. The system has been so hard to reform in part because of regulatory capture by interest groups earning rents from the previous system, and in part due to public opposition to gas price increases. Nevertheless, between 2014 and 2016, Ukraine has significantly raised the price of gas, entirely removing implicit subsidies on natural gas in May 2016.

This successful tariff increase together with the above mentioned changes in the right to access to distribution networks, will create opportunities for gas producing companies to cater to the needs of a 45 million population consuming around 17.2 bcm/year[3], previously closed off from competition. This paper gives an overview of the reforms affecting the market and creates an estimate of the expected size of the household demand for natural gas after the reforms. The lessons learned from Ukraine will also serve as an example of a subsidy reform, relevant for other countries with large energy subsidies. Specifically, this paper addresses three key research questions:

1) Which reforms of the Ukrainian gas market are being implemented and how should they be evaluated to create a functioning market for gas in Ukraine?

2) What will the size of the household market for natural gas be under different scenarios until 2020?

3) What will the price reform effects be, especially on the Ukrainian state finances and the increased revenues available for domestic gas production?

[1] Repko *et al.* (2015).
[2] Naftogaz (2015c).
[3] Mcm stands for thousand cubic meters, mmcm for million cubic meters, and bcm for billion cubic meters.

2 The Ukrainian natural gas sector

2.1 Development of gas consumption in Ukraine

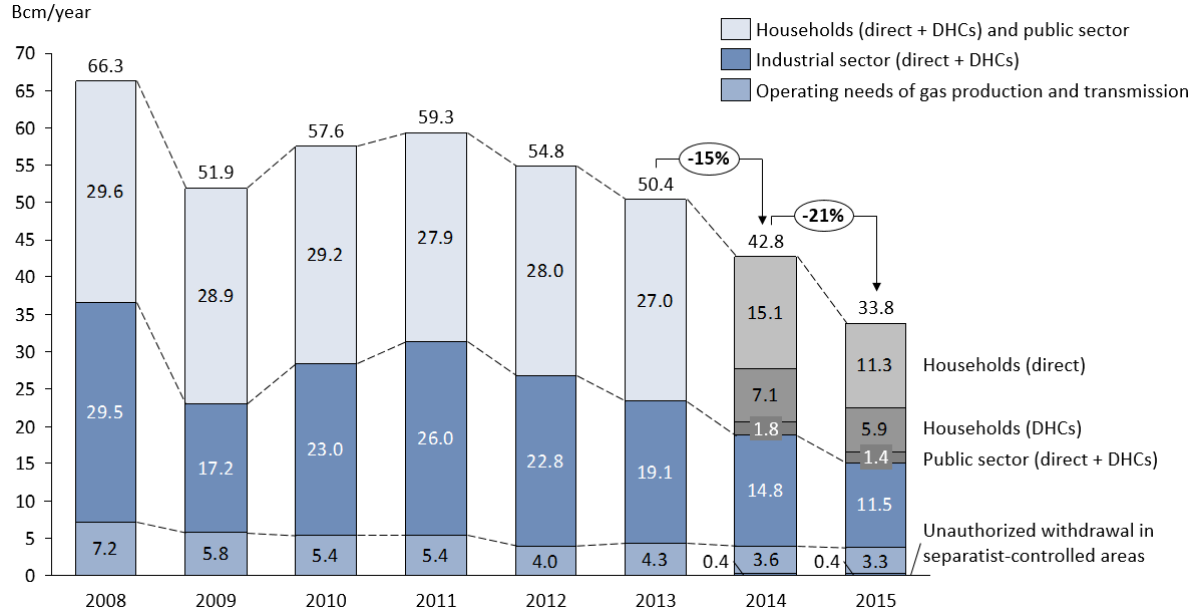
In this paper, we are primarily concerned with how the removal of implicit natural gas and heat subsidies affects household consumption in Ukraine. The first step in order to understand this relationship is to look at what is driving gas demand. When discussing the pricing of natural gas in Ukraine, a distinction has to be made between the consumption by, on the one hand, households and district heating companies, and on the other hand industrial consumers. The focus of this paper is on the former, where the tariffs have been state-regulated and subsidized, while the tariffs for Ukrainian industrial customers were adjusted to import-parity prices almost a decade ago[4].

Ukraine emerged as an independent state in 1991 with gas heavily subsidized and used in an extremely wasteful way. The domestic annual natural gas consumption of 118 bcm placed Ukraine as number 3 in the world at that time, after the U.S. and Russia[5]. Since then Ukrainian natural gas consumption has been decreasing, especially since 2007 and again from 2012. We note that the heavily gas reliant Ukrainian industry suffered tremendously from the 2008 financial crisis, with consumption almost halving between 2008 and 2009 but then quickly rebounding in the following years as economic growth recovered again. Household consumption, on the other hand, shows a much more stable pattern, explained by the price of gas for households in real terms being almost constant from 2008 until 2014.

Between 2013 and 2015, total consumption decreased by 33%, to 33.8 bcm[6] (see Figure 1 below). One of the key drivers of this decrease is the loss of control over Crimea and areas in Donetsk and Luhansk, all heavy gas consuming regions. 30% of Donetsk and Luhansk (which is now under separatist control) in the time prior to the conflict was directly responsible for around 20% of total Ukrainian gas consumption. We estimate that the loss of areas in Donetsk and Luhansk and the loss of Crimea is responsible for around ⅓ of the total decline in the period[7]. Most of the remaining decline was caused by industrial and household demand falling rapidly. Between 2013 and 2015, industry output was in free fall, driving down industrial gas consumption by almost 40%. At the same time, households experienced a 119% weighted average USD increase in the tariffs for natural gas (see Figure 2) while simultaneously experiencing a decline of average per capita income of almost 50%[8]. Last but not least, the winters of 2014 and 2015 were relatively milder than previously which further stimulated lower consumption. As a result, the hitherto relatively constant Ukrainian household consumption of natural gas has declined by some 31% from the 2013 level (Figure 1)[9]. For our study, the most relevant period of analysis is the years from 2014–2016, since that is the time when gas and heat prices have increased and we can expect households to start adjusting their consumption in response (see Figure 2).

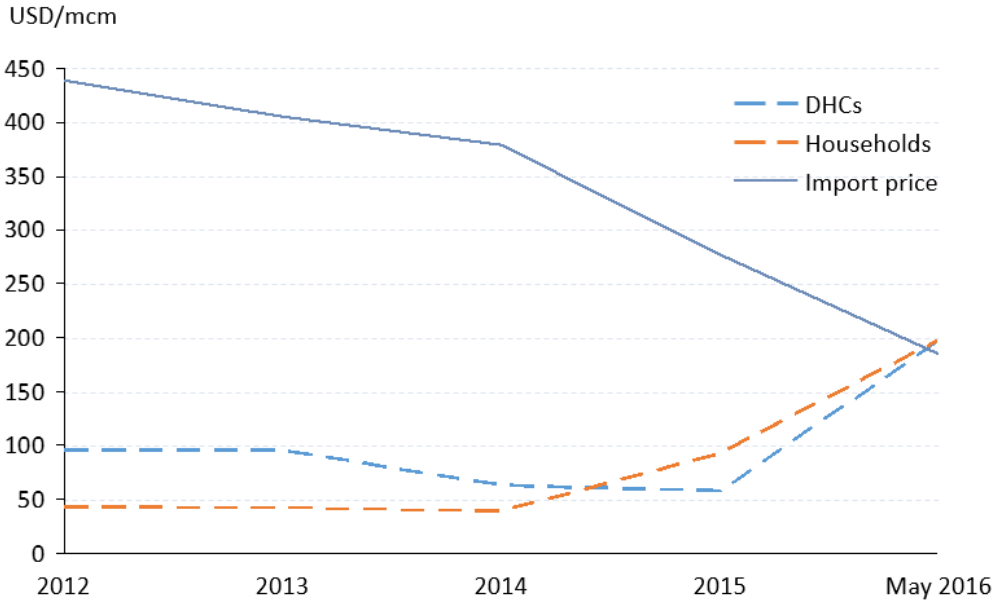
[4] Henderson & Pirani (2014).
[5] Sarna, A. (2013). Kyiv's gas strategy: closer cooperation with Gazprom or a genuine diversification. OSW Commentary No. 110. http://www.osw.waw.pl/sites/default/files/commentary_110.pdf.
[6] Naftogaz (2016, April 15). Natural gas consumption in Ukraine (bcm). http://naftogaz-europe.com/article/en/GasConsumptioninUkraineeng.
[7] 2013 shares of total consumption: Donetsk (14%), Luhansk (7%), Crimea (4%). 30% of Donetsk and Luhansk and Crimea represented around 11% of Ukrainian gas consumption in 2013, which is equivalent to 1/3 of the decrease between 2013 and 2015 (MinReg, 2016).
[8] World Bank (2016).
[9] The weather-led decline in winter consumption may, of course, not continue if “normal” weather conditions return in future years.

Figure 1: Natural gas consumption in Ukraine, 2008-2015



Source: Own calculations based on Naftogaz, 2016b & 2016d.
Note: The figures for 2014 and 2015 exclude Crimean gas consumption.

Figure 2: Prices of gas for households, District Heating Companies, and import prices, 2012–2016



Source: own estimates based on MERT (2016), Naftogaz (2015a), and press releases.

Looking at the regional distribution of the decline of consumption, in 2015 aggregate natural gas consumption in Ukraine decreased in all regions except in Odessa, where a small increase was observed[10]. The most dramatic decline is found in the Luhansk and Donetsk regions, portions of

[10] The 4% (0.09 bcm) consumption increase in the Odessa region is explained by the intensification of the Odessa Port Plant activities (+0.26 bcm). At the same time, households in the region reduced gas consumption from 0.66 bcm to 0.54 bcm (–19%), a decline comparable to that of residential customers in other regions of Ukraine (Naftogaz, 2015c).

which remain controlled by separatists, which experienced gas consumption declines of –67% and –46%, respectively. It is worth noting that both these regions were heavy gas consumers prior to the military conflict, with large industrial gas consumption. When adding up the decrease from only these two regions, together, they account for a third of the decrease in total gas consumption between 2014 and 2015 (3.1 bcm)[11]. It is important to note that some of this decline in consumption stems from the fact that Ukraine has partly stopped supplying the separatist-controlled areas with gas[12], although the majority of the decline is still attributable to real decreases in the demand for gas.

Household direct natural gas consumption is divided into different categories depending on their usage. The first category of households use gas only for cooking with a gas stove and a gas oven. These households typically rely on district heating companies (DHCs) for hot water and heating, which they purchase separately from their gas bill (although as mentioned above heating is mostly derived ultimately from gas as an input). The second category uses gas for cooking and also for water heating, but receives heating from DHCs. The third category uses gas for cooking, water heating and heating, and in total accounts for 83% of total household consumption of gas in Ukraine[13].

A second major consumer of gas in the household market is DHCs, providing the population with heat in the form of hot water. 40% of households rely on DHCs for their heating needs[14]. In 2015, those DHCs constituted 17.5% of all the Ukrainian gas consumption (5.9 Bcm; see Figure 1 above). It is worth noting that the percentage decrease in gas consumption for district heating from 2014–2015 is smaller than for other household gas usage. This is explained by the dual effect of lower real price increases for heating compared to other gas usage (see Chapter 4) and very low rates of metering and regulation devices for heating, which makes it very hard for households to respond to price changes (see more in Chapter 5 on energy efficiency).

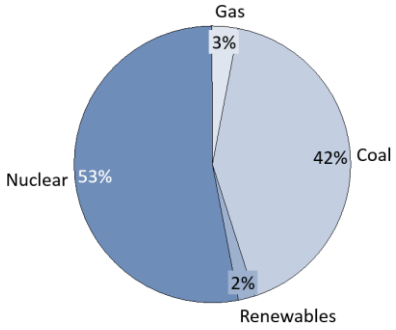
Last, households which do not have a central gas connection often use refillable liquefied petroleum gas (LPG) cylinders to fuel their cooking stoves[15]. According to our estimates based on the household survey[16], in 2014 nearly 13% of Ukrainian households owned gas cylinders. LPG is also increasingly popular as a car fuel. In 2015, LPG accounted for almost a quarter of all Ukrainian car fuel consumption and the total LPG consumption reached 1.1 million tonnes[17].

2.1 Overview of Ukraine gas sector

In total, as much as 31% of Ukraine's primary energy is supplied by gas (Figure 3), despite the fact that only 3% of electricity is produced from gas (Figure 4). This is the result of gas having a very prominent position in heat generation. Gas accounts for almost three-quarters of fuel consumed by both district heating companies (DHCs) and households with private heating systems[18]. In addition, 1.5 bcm of gas is used for heating water, representing around 25% of the total gas consumption of DHCs and is also often used for cooking by households.

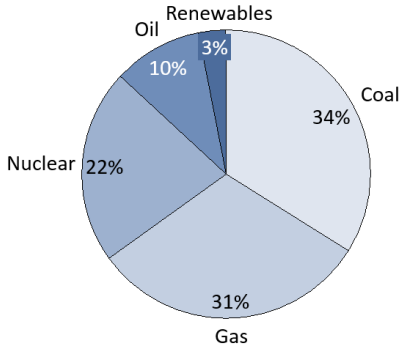
[11] Naftogaz (2016, February 1). All but one region in Ukraine reduced gas consumption in 2015. http://naftogaz-europe.com/article/en/allbutoneregioninukrainereducedgasconsumptionin2015eng.
[12] In May 2016, Gazprom claimed that it delivered to the separatist-controlled areas gas worth $600 million ("Gazprom": dolg Kieva za gaz dlja Donbassa - $600 mln, *Vesti Ekonomika*, May 31, 2016). This would imply a total volume of 2-3 bcm delivered to these areas since the beginning of the conflict.
[13] Naftogaz (2015c).
[14] MinReg (2016).
[15] LPG (propane and butane) is calorifically richer than methane and is imported and distributed by rail and road rather than pipeline. It is also priced differently and exhibits a very different demand, which is why LPG is outside of the scope for this paper.
[16] Please refer to subsection 6.1 for details about the household survey.
[17] Kuyun, A. (2016, January 27). Rynok sžižennogo gaza v Ukraine vyhodit na novyj ètap razvitija. *Business Information Network*. http://bin.ua/news/economics/oilandgas/183538-rynok-szhizhennogo-gaza-v-ukraine-vyxodit-na.html.
[18] MinReg (2016).

Figure 3: Ukrainian electricity generation by energy source, 2014



Source: MinReg (2016)

Figure 4: Primary energy consumption in Ukraine, 2014



Source: MinReg (2016)

Understanding the importance of the role of subsidies in Ukrainian gas consumption also requires looking at how Ukraine's gas is sourced: either from Ukrainian domestic production or from imports from Russia or the EU. In 2015, Ukrainian state and private producers supplied 19.9 bcm of natural gas. This marks a 3% decline from 2014, caused by the loss of production assets in Crimea and a lack of investment in new extraction capacity[19]. Given the 2015 total gas consumption of 33.8 bcm, local production provided for more than a half of the total demand[20]. Additionally, 16.4 bcm of gas was imported from Europe and Russia, with as much as 63% of that gas coming from the European direction—up from just 26% in 2014[21]. This remarkable shift of supply was made possible by the increasing integration between Ukrainian and European gas markets, exemplified by the introduction and expansion of the reverse flows through Budince, Slovakia, which accounted for 94% of European imports in 2015[22]. Ukraine's rapid expansion of European imports is to a large extent a consequence of a Ukrainian political decision to diversify their gas supply in the wake of escalating political tensions with Russia. This is part of a larger strategy to increase Ukraine's energy security, by increasing diversity of supply, increasing domestic production and decreasing domestic consumption. The subsidy reform will help accomplish the latter, driving a decrease in consumption, which will decrease the need for Ukraine to import gas.

Ukraine has an important position as a strategic partner due to its large transit gas transportation system. Ukraine has an entry capacity of 288 bcm/year and an exit capacity of 151 bcm/year in the direction of the EU. The annual utilized capacity, however, has been falling for the last 10 years and in 2015 stood at only 67.1 bcm (see Figure 5). From a Russian perspective, it would be advantageous to limit the need for Ukrainian transit, exporting directly to the European markets through an expansion of the Nord Stream pipeline. For such reasons, transit through Ukraine has been in a long-term decline, while still remaining an important source of security of supply for large parts of Europe.

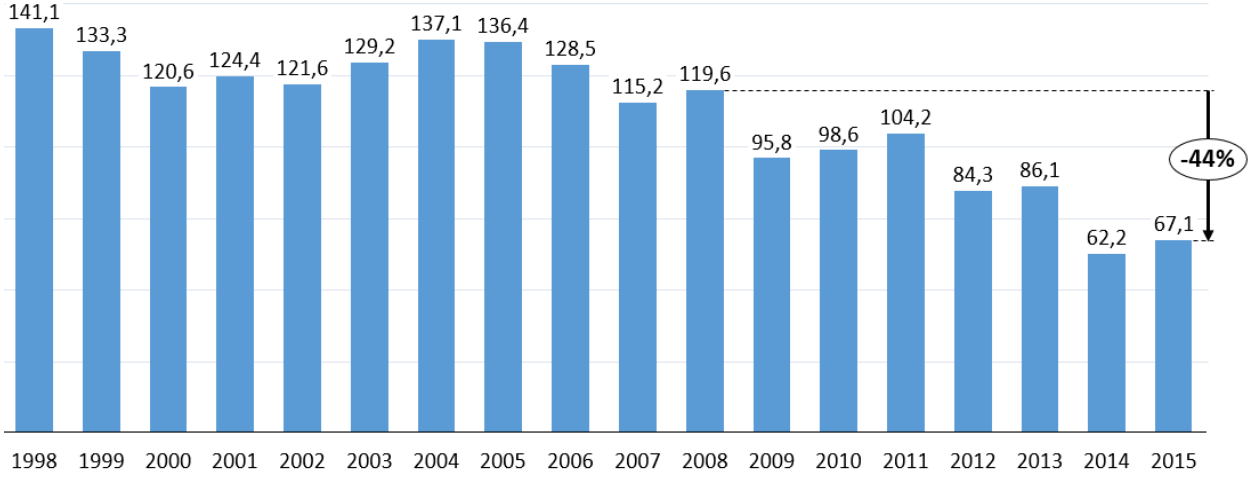
[19] Naftogaz (2016, February 2). Gas production in Ukraine decreased by 3% in 2015. http://www.naftogaz.com/www/3/nakweben.nsf/0/970478E2A71A6B0FC2257F4C00580C55?OpenDocument.

[20] Not all gas produced in Ukraine is consumed in the country: some is added into storage and some is exported. Between 2013 and 2015, Ukraine noted around 2 bcm of increased storage of gas (Naftogaz, (2016b)).

[21] Naftogaz (2016, February 2). Ukraine purchased 63% of its imported gas in Europe in 2015. http://www.naftogaz.com/www/3/nakweben.nsf/0/8FD7A9A348A0844DC2257F4C005802FD?OpenDocument.

[22] Ukraine doubled gas import from Europe (2016, January 8). Natural Gas Europe. http://www.naturalgaseurope.com/ukraine-doubled-gas-import-europe-halved-import-russia-2015.

Figure 5: Natural gas transit through Ukraine, bcm



Source: Own graph based on Naftogaz (2015e) and Interfax Ukraine (2016).

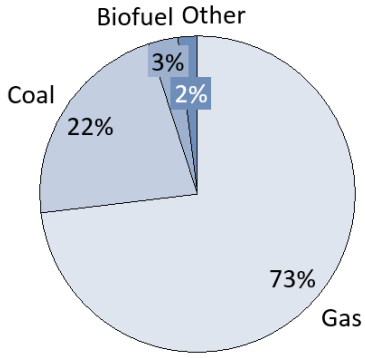
Additionally, Ukraine possesses the largest system of underground gas storage facilities in Europe. It consists of 12 separate facilities with a total capacity of around 31 bcm. This constitutes over a quarter of the total EU-28 capacity[23]. The majority of the storage capacity is conveniently located in western Ukraine, close to the European markets. However, there are growing doubts whether Ukraine will be able to compete with existing storage in central and eastern Europe. The European decline in demand for gas, coupled with more competition and investments in storage has decreased the competitiveness of the Ukrainian storage offerings[24]. From a Ukrainian perspective, trying to market this excess storage capacity forms an important part of the negotiations between Ukraine and the EU.

2.2 District heating companies

Around 40% of Ukrainian households rely on district heating companies (DHCs) for the provision of hot water and heating[25]. To produce this thermal energy, the state-owned, municipally administered DHCs rely on around 30,000 boiler houses as well as 250 combined-heat and power plants fueled with gas[26]. The boiler houses differ significantly in output, with as few as 161 of them representing more than 50% of production, then followed by a majority of boiler houses with very small capacity. Primarily, these boiler houses are fueled with gas, making up 73% of total fuel usage for centralized heating (Figure 6). This share might decrease somewhat over time as gas prices increase, as exemplified by the 800 boiler houses that switched to using wood fuel during 2015. DHCs are major consumers of gas, in 2015 consuming 5.9 bcm, 17.5% of the total Ukrainian gas consumption. When producing heating, purchasing fuel in the form of gas accounts for around ¾ of DHC costs[27]. This makes understanding the functioning of DHCs important in estimating the future of gas consumption in Ukraine.

[23] Naftogaz (2015c).
[24] The World Bank (2016). Analysis of the Restructuring Options of NJSC Naftogaz. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2016/04/04/090224b08425d6e7/1_0/Rendered/PDF/Analysis0of0th0ons0of0NJSC0Naftogaz.pdf
[25] MinReg (2016).
[26] Ibid.
[27] Ibid.

Figure 6: 2014 fuel consumption for district heating generation (total 12.2 mtoe)



Source: MinReg (2016)

District heating systems are widely used in central and eastern European countries as well as in the Nordic countries. District heating can be an efficient way of providing especially urban areas with heat generation, if the energy losses in production and transmission are minimized. In Ukraine, the district heating system has remained mostly unreformed since the collapse of the Soviet Union. The municipality-run DHCs suffer from severe under-financing because consumer tariffs are set at 77% of the cost of delivering the service (2015), up from 64% in 2014[28], but still below a sustainable level allowing long-term investments in new infrastructure[29]. The main problems with the current provision of DHC services are that billing is seen as unfair and non-transparent by the users, and that the quality of the service is considered to be very low[30]. The first problem stems from the fact that consumption is often not metered and thus does not represent actual usage of natural gas, ignoring the effect from factors such as the number of radiators in each apartment, construction materials of the building and so on. The second problem stems from perceived quality issues, such as late starts of the heating season or the need to pay additional money for heat engineers and plumbers, although these services are technically covered by residential rental payments.

The continued reforms of the heating tariffs, coupled with the introduction of consumption-based billing through investments in meters, would help with many of the issues outlined above. This, in turn, should allow for greater energy-efficiency in the delivery of heating services, decreasing the consumption of natural gas. It would also give consumers the incentives to change their consumption, decreasing wasteful heat usage. For a more detailed overview of the potential for these types of measures, see Chapter 5 on energy efficiency.

3 Prospects for a market for natural gas in Ukraine

One of the research questions of this paper is to evaluate how the Ukrainian market for natural gas will function in 2020. In a publication by the Council of European Energy Regulators, some characteristics of a well-functioning market are outlined[31]. On the supply side, there should be a low concentration of market power in any given player in the system, allowing consumers to benefit from competition and innovation. Furthermore, barriers to market entry should be as low as feasible, allowing new suppliers to enter the market. Last, there should be a close relationship between the wholesale markets and retail prices. This includes transparent pricing of gas as a commodity, giving

[28] This is only part of the subsidy in the delivery of heat, though, since the DHCs buy heavily subsidized gas from Naftogaz, at UAH 1,271/mcm, 79% lower than the import-parity price of UAH 6,086/mcm in 2015.
[29] MinReg (2016).
[30] Semikolenova, Pierce & Hankinson (2012).
[31] Noorlander, M. (2016, February 4). What should a well-functioning retail energy market look like? *Council of European Energy Regulators*. *CEER.*

market actors the input to set retail prices for energy. On the demand side, it is important that consumers have access to appropriate information about the offers from different suppliers, as well as how the switching process works.

This chapter will evaluate the progress on all of these factors separately in order to draw conclusions on the prospects for a competitive market for household natural gas in Ukraine. It will start, however, by looking at the reform of Naftogaz.

3.1 Reforming Naftogaz

The starting point of the current Ukrainian gas sector reforms was a 2011 membership in the Energy Community and ensuing obligation to implement the Third Energy Package by January 1, 2015. The new law passed in April 2015 "On the natural gas market" lays the foundation for an integration of the requirements of the Third Energy Package into Ukrainian legislation as well as starting the process of implementing reforms connected with integrating the Ukrainian and European gas markets[32]. For Ukraine, the most important implication of this agreement has been the planned unbundling of the gas transmission network from the production of natural gas, through the separation of Naftogaz and Ukrtransgaz into separate entities. The decision by the Ukrainian Cabinet of Ministers outlining the method chosen for unbundling will take place in the latter part of 2016[33].

This would alter the current role of Naftogaz, the state-owned gas and oil monopoly, which has a central position in the gas market of Ukraine, controlling both the majority of upstream operations (production of gas and oil), domestic transmission and distribution pipeline networks (through Ukrtransgaz), transit of Russian gas to Europe, Ukrainian gas imports, as well as gas storage. The planned reforms would open up access to the transmission networks, allowing private actors to sell gas to households through *oblgaz*es [regional gas distribution companies] (see more in section 3.3). The Third Energy Package aims to eliminate any conflict of interests between production and transmission of gas. The reasoning behind the package's legislation is that gas pipelines are natural monopolies and allow network operators to favor their own energy production and supply companies. A key requirement from the legislation of the package is the "third party access principle", which requires that all "gas suppliers be given non-discriminatory access to the transmission network" as well as that the transmission companies need to "apply regulated tariffs so as to avoid any abuse of dominance"[34].

There are three different ways of fulfilling the requirements of the EU. The German Advisory Group to Ukraine argues for the most comprehensive form for Ukraine, full ownership unbundling. Generally, this option is advisable when there are serious concerns about the ability of the regulator to uphold non-discriminatory third party access[35]. Ukraine's limited institutional capacity makes a strong case for choosing this option, limiting the Ukrainian state's ability to interfere. Ideally, Ukraine should invite a foreign investor to own and operate the network, not only importing technical know-how but also improving the governance of the transmission system operator and accomplishing a complete unbundling from production[36]. This solution may be difficult to implement in Ukraine, due to the strategic importance of gas transmission through Ukraine from Russia to Europe, which makes it hard to give over the ownership of the gas system to a non-state actor. It would also be difficult to find a potential buyer, since an investor generally would require some track-record of good regulatory

[32] Naftogaz (2015). Law on the natural gas market. http://www.naftogaz.com/files/Information/Ukraine%60s%20Natural%20Gas%20Market%20Law_engl.pdf
[33] [Reform of "Naftogaz": Europe wants to separate the services of the Ministry of Energy and Coal Mining and Naftogaz] (May 2016) Ekonomika. http://economy.apostrophe.com.ua/article/jenergetika/2016-05-12/reforma-naftogaza-v-evrope-hotyat-obyedinit-predlojeniya-minenergouglya-i-nak/4904
[34] European Commission (March 2011). Questions and Answers on the third legislative package for an internal EU gas and electricity market. http://europa.eu/rapid/press-release_MEMO-11-125_en.htm?locale=en.
[35] Zachmann, G. (2015). How to unbundle Naftogaz. *German Advisory Group*. http://zachmann.be/wp-content/uploads/2014/06/unbundle-naftogaz.pdf.
[36] Ibid.

practice in order to invest money in such a newly created entity[37]. To overcome this problem, a solution favoured by the German Advisory Group is to initially sell a share of the gas transmission system to an international financial institution (such as the EBRD)[38].

During the Ukrainian Energy Forum in March 2016, Naftogaz outlined its vision of how Ukrtransgaz should be unbundled from Naftogaz. In its preferred alternative, the State Property Fund of Ukraine will hold a majority stake in a newly formed transmission company, inviting a foreign EU or US partner to buy a minority position[39]. The main responsibility of such a company, similar to Ukrtransgaz's role today, would be to operate the trunk natural gas pipelines both for transit and domestic transmission of gas as well as operating the gas storage depots. This alternative leaves the new company under government control, but still invites a foreign investor to get a minority stake of up to 49% in the company. Such a solution would still suffer from the risk posed by state ownership of both the supplying companies and the transmission companies, undermining the non-discriminatory operations of the company. However, if a buyer were to be found, it would also bring advantages in terms of increased international credibility as well as better corporate governance. If successfully implemented, this would lay the foundation for third parties to sell gas to *oblgaz*es and DHCs in a non-discriminatory way, breaking the dominant position of Naftogaz as the sole supplier of gas to households in Ukraine.

Another crucial area of reform is the governance structures of Naftogaz itself. Currently, Naftogaz's operations are controlled by a host of government functions, including the Cabinet of Ministers, the Energy Ministry and the Finance Ministry. The supervisory board of Naftogaz is controlled by the Energy Ministry and members of the board are appointed without a clear and transparent system for nomination and election. Decisions on appointments, dismissals and remuneration of management at Naftogaz and its subsidiaries are executed by the government agencies and not by independent boards[40]. Altogether, this creates a system that lacks transparency and stimulates a large scope of political control of both Naftogaz's supervisory board and its management. It has also led to a short-sightedness in the political directions and decision-making in regards to Naftogaz, changing with each election cycle[41].

The gas industry reform plan, approved by the Cabinet of Ministers in March 2015, requires that the corporate governance structure of Naftogaz be reformed and aligned with OECD standards. Many actors, including the European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB), as well as Naftogaz itself, are also pushing for these reforms to be implemented. As of April 2016, the prospects for implementation seem rather optimistic, first because of a successful deal in October 2015 for a loan from the EBRD, conditional on corporate governance reform[42] and more recently the establishment of a more independent supervisory board, with its first meeting in May 2016[43]. A transparent, reformed Naftogaz with better corporate governance practices, subject to independent and professional oversight might be able to overcome the historical deficiencies of the company and root out malpractices as well as allow the company to become profitable in the long term. This will create more stability in the Ukrainian gas market, decreasing the current large uncertainty.

[37] Ibid.
[38] Ibid.
[39] Naftogaz (2016). Full Ownership Unbundling. http://www.naftogaz.com/files/Information/2016-03-01_Naftogaz_Unbundling_ASC.pdf.
[40] Naftogaz (2015c).
[41] Boytsun, A. (2016). Personal communication between Piotr Rozwałka, Hannes Tordengren and Andriy Boytsun, Center for Economic Strategey, 19 Feb 2016.
[42] Pyrkalo, S. (2015). EBRD, Ukraine agree Naftogaz reform, sign US$ 300 million loan for winter gas purchases. EBRD. http://www.ebrd.com/news/2015/ebrd-ukraine-agree-naftogaz-reform-sign-us-300-million-loan-for-winter-gas-purchases.html.
[43] Interfax Ukraine. (2016a). Ex-energy minister Demchyshyn joins Naftogaz Ukrainy supervisory board. http://en.interfax.com.ua/news/economic/339219.html.

3.2 The role of the regulator

The other main actor in the Ukrainian gas market is the regulator of the Ukrainian energy markets, the National Commission for State Energy and Public Utilities Regulation (NCEPUR). Currently, the Cabinet of Ministers wields a large power over the Ukrainian gas market, formulating the overarching policy for the functioning of the market as well as setting the gas prices. According to the Third Energy Package, this will have to change. NCEPUR needs to be fully independent from the government and act as a neutral arbiter of the gas market, including the setting of prices. As of April 2016, the necessary changes in legislation to accomplish this are not yet passed. Currently, the legal foundation of NCEPUR is unclear, with the President still having the legal power to establish and liquidate the body at will, a right which has twice previously been used to dismiss NCEPUR's management[44]. Furthermore, the decisions of NCEPUR are not final, but subject to review by the State Committee for Regulatory Policy of Ukraine. Last, financing of NCEPUR is also not independent from political interference. NCEPUR is financed from the state budget and directly controlled both in how it allocates its annual budget and in decisions on human resources[45]. Currently, new legislation is being prepared, which hopefully will address some of these issues[46]. In May 2016, the prices for natural gas were set at the import-parity level, increasing faster than the pace required by the IMF. From 2016 onwards, domestic prices of gas should be based on the import-parity price of gas. In the future, if the tariffs were to be insufficiently adjusted after price increases, due to political pressure, the problems with previous subsidized gas prices will reoccur. This is a rather likely scenario, since the political leadership has been unwilling to give up control of the regulator, at least in the short term. The risk of a setback will increase if gas import prices were to rapidly increase from their current low levels, increasing the pressure on politicians to shield the population from the resulting price increases and thus increasing the temptation to revert to the previous pricing mechanism. Therefore, it is paramount that the tariffs set by the regulator reflect import prices in the future, which would be best accomplished by making the regulator independent from political meddling. In the long run, an internal market for gas allowing the market players themselves to set prices for gas should be introduced, a prospect which at the moment seems rather far away into the future.

3.3 Regional gas distribution companies

Crucial to the functioning of this new market will be the way *oblgaz*es [regional gas distribution companies] operate. Previously owned by Naftogaz, the *oblgaz*es were "privatized" in 2012, when private actors were allowed to buy their shares. The market which emerged is very concentrated around the company Gaztek, controlled by the business group of the oligarch Dmytro Firtash. Firtash made his fortune from the role he played in the gas dealings between Russia and Ukraine, with the company RosUkrEnergo in the 2000s acting as an intermediary for selling gas[47]. During the privatization of *oblgaz*es in 2012, Gaztek won 14 out of 17 bids, allegedly acquiring the regional gas companies for prices far below market rates, often without real competition[48]. Now Firtash's business group, through its intermediaries, controls some 70% of the Ukrainian gas distribution market[49]. In essence, a state-monopoly has been exchanged for an almost private monopoly[50]. This market concentration in the hands of one actor will hamper the efforts to create a competitive market for

[44] Energy Community. (2016). Ukraine Regulatory Authority. https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Ukraine/Regulatory_Authority.
[45] Ibid.
[46] The current proposal for new legislation is the 2966-d "Draft Law on the National Commission for state regulation in the energy and utilities".
[47] Chow, E., & Elkind, J. (2009). Where east meets west: European gas and Ukrainian reality. The Washington Quarterly, 32(1), 77-92.
[48] IPress (2012). Firtaš hoče privatizuvati desjat' oblgaziv. http://ipress.ua/news/firtash_hoche_pryvatyzuvaty_desyat_oblgaziv_6531.html.
[49] MinReg (2016).
[50] OSW (2012). Dmytro Firtash's companies are monopolising the retail gas market in Ukraine. *Ośrodek Studiów Wschodnich*. http://www.osw.waw.pl/en/publikacje/analyses/2012-10-24/dmytro-firtashs-companies-are-monopolising-retail-gas-market-ukraine.

household gas. Even if a successful unbundling of Ukrtransgas and Naftogaz were to happen, a large part of the access to private gas consumers will still be in the hands of one single business group. However, Firtash has not been able to go to Ukraine since 2014, after the minister of interior of Ukraine Avakov promised to have him arrested were he to come back to the country. In early 2014, the FBI had Firtash arrested for a short while in Austria, charged with bribing Indian officials over a titanium deal. He was later released[51]. Still, he seems to continue to wield influence over Ukrainian politics as well as controlling a large business empire in Ukraine. At the time of writing, the outlook for a transparent and competitive Ukrainian gas distribution market is thus uncertain.

District Heating Companies operate under very different circumstances from the Oblgaz companies. DHCs are state-owned and operated by the municipalities. Traditionally, DHCs have only bought gas from Naftogaz. As the prices for gas paid by the DHCs reaches import-parity level, selling gas to DHCs could become attractive to other market actors. One remaining obstacle is the currently low customer payment rate (61.3% in 2014)[52] and the very strained financial situation of DHCs, making payments from DHCs unreliable. A second obstacle is the legal constraints on the way DHCs choose which actor to buy gas from, potentially hampering the ability of a private actor to supply DHCs with gas.

3.4 Arbitrage and rent-seeking under the dual price structure

Heavily subsidizing gas for households, while at the same time applying a much higher, market-based price to industry consumers, allows for arbitrage and rent-seeking. Getting hold of the cheap gas and selling it expensively is very lucrative if the price differentials are as large as they have been in Ukraine (up to 10 times). Having a system with very low levels of metering of gas consumption, until recently the case in Ukraine, makes it easier to get away with these practices. The purpose of most of these schemes is to get control of public resources for your own business interests[53].

For most of Ukraine's political history, profits emanating from access to cheap subsidized gas resold at market prices have been financing well-connected individuals within the political elite of the country. This has hampered the willingness to reform the system of subsidized natural gas. To understand the prospects for implementing the reforms requires an understanding of the way the pricing of gas has been inextricably linked to the interests of political and business leaders of Ukraine for many years.

One source of rents has come from gaining the right to sell Russian, Ukrainian or Central Asian gas to Europe. An example is the extremely favourable contract given to RosUkrEnergo in 2006, acting as an intermediary between Gazprom and Naftogaz[54]. RosUkrEnergo was allowed to buy gas from the Central Asian producing countries, ship it through Russia and Ukraine and sell it to European markets, free of Russian export duties. The large profits from this trade were used with very limited transparency, allegedly to corrupt the political elite[55]. Many of these practices seem to have stopped or declined in their extent in recent years. The intermediary role of RosUkrEnergo was abolished y in 2009 when a new contract for gas supply with Gazprom took effect.

Large business conglomerates, with a vertically integrated business group controlling both gas supply companies with access to subsidized gas and also simultaneously having a stake in industries reliant on gas as an input, are best placed to profit from the price differential between imported and exported gas. One example is Dmytro Firtash's business group which simultaneously controls *oblgaz*es and chemical plants. Another example is that Privat Group controlled the board of UkrNafta through a 42%

[51] Walker, S. (2016) Caught between Russia and the US? *The Guardian*. http://www.theguardian.com/world/2016/jan/23/dmytro-firtash-ukraine-oligarch-exile-caught-between-russia-us

[52] NCEPUR (2015)

[53] Solonenko, Iryna (2015). State and oligarchs: Towards a new social contract? Newsletter by the German Advisory Group Issue No. 83. http://www.beratergruppe-ukraine.de/wordpress/wp-content/uploads/2014/06/Newsletter_83_2015_German-Advisory-Group.pdf

[54] Chow, E., & Elkind, J. (2009). Where east meets west: European gas and Ukrainian reality. The Washington Quarterly, 32(1), 77-92.

[55] Ibid.

minority share, and directed the output of the company to the business interests of the Privat Group, even though Naftogaz owned 50% plus one share of UkrNafta. A political struggle over the control of UkrNafta erupted in 2015 between Naftogaz and Privat Group, seemingly resolved in favour of Naftogaz through a change of the legislation on how many votes are required to win votes in the board of the company[56].

Estimating the amount of gas involved in illicit reselling of household gas to industries is difficult, but gas industry specialists put the total at around 1.5 bcm/year before the April 2015 price increase and possibly at 0.5 bcm/year or lower after the price increase. The value of selling 1.5 bcm in 2014, earning the arbitrage between the consumer prices and the import parity prices, is around $450 million[57], while the value of selling 0.5 bcm in 2015 is around $50 million[58], giving an indication of the rapid decrease of rents available in the system.

The gas price reforms are diminishing the scope and incentives for all types of gas-related rent-seeking, which, together with an increased level of metering and transparency throughout the whole system, should already in 2016 bring to an end *oblgazes*' ability to resell gas to industry consumers at higher prices as well as other arbitrage opportunities. As the availability of corrupt rents from gas price arbitrage diminishes, the ability to affect the political process through this channel also diminishes. This large decrease in the scope for corruption in the gas sector as a result of the subsidy reform should be considered a major success of the Ukrainian government and will make it easier to sustain the continued reform process.

4 Subsidy reforms

Upon gaining independence, Ukraine was endowed with a Soviet system for managing natural gas, where gas prices for households and industry were set centrally and no market for gas existed. The implicit subsidies in the form of underpriced gas for households had served as a social policy which became increasingly expensive in recent years. In the Ukrainian public debate, household prices well below the import price have often been justified by populists who have been arguing that cheap domestic gas production, which since the 90s stood at around 20 bcm/y[59], should be used for the population's needs. In accordance with Ukrainian legislation, any domestic gas extraction company which is at least 50% directly or indirectly state-owned must sell all of its marketable gas to Naftogaz at subsidized state-determined tariffs so that cheap gas is available to the public[60]. Needless to say, this has been one of the core reasons for the continued stagnation of Ukraine's main gas producer, Naftogaz's subsidiary Ukrgazvydobuvannya (UGV), despite its low extraction costs compared to the import prices[61].

Since the state-controlled local production does not provide enough gas to cover the household gas demand—in 2014 it accounted for 63% of the consumption,[62] Naftogaz has historically incurred large losses from reselling imported gas at a subsidized price. Together with the rising gas import price and massive hryvnia depreciations of 2008–2009 and 2014–2016, this resulted in large transfers from the Ukrainian state budget to cover Naftogaz deficits. In 2014, they reached the magnitude of 27% of the

[56] Chazan, G. (2015, March 25). An oligarch brought to heel. *Financial Times*. http://www.ft.com/intl/cms/s/0/b0b04474-d232-11e4-a225-00144feab7de.html.
[57] The import-parity price was $339/mcm while the weighted average retail price to consumers was $39/mcm (see Figure 7).
[58] The import-parity price was $185/mcm while the weighted average retail price to consumers was $92 (see Figure 7)
[59] Pirani, S. (2007)., p. 46 & Naftogaz (2015, April 6). Gas Production by Naftogaz of Ukraine. http://www.naftogaz-europe.com/article/en/GasProductionbyNaftogazofUkraine.
[60] Naftogaz (2015c).
[61] In 2014, the average cost of production of conventional gas in existing wells was $25-30/mcm while gas from new wells cost $50-80/mcm (Naftogaz, 2015c). In 2015, UGV was selling its gas to Naftogaz for $20/mcm net of 70% royalties and other taxes (*ibid.*).
[62] In 2014, 13.9 out of 22.1 bcm, or 63%, of gas consumed by households and DHCs producing heat for households was domestically produced (Naftogaz, 2015c).

Ukrainian national budget, or 6% of GDP[63]. The drain from the state budget, together with IMF pressure to reform the pricing of natural gas in order to get an extension on a $17bn loan, made the Ukrainian government drastically decrease implicit household gas subsidies, beginning in 2014 and finishing on May 1, 2016 when implicit gas subsidies were fully removed.

In accordance with economic theory, implicit subsidy should be understood as a governmental transfer to households in which the Ukrainian government has an opportunity cost of providing the subsidized prices, which has to be compensated through fewer public services or higher taxes[64]. This is in line with the methodology of the IEA[65] and pre-tax subsidy definition of the IMF[66]. Thus, we define implicit subsidies as not only including a direct loss from a below-the-cost sale of the imported gas but also an implicit loss in the form of a foregone revenue from a cheap sale of the domestic gas below the market rate. Since there is no competitive gas market in Ukraine which would provide us with a market rate, in order to establish an implicit subsidy level, we need to compare the gas price which Naftogaz charges with a reference/benchmark price that approximates the market price. Since Ukraine is a net importer of gas, we look at the import parity price.

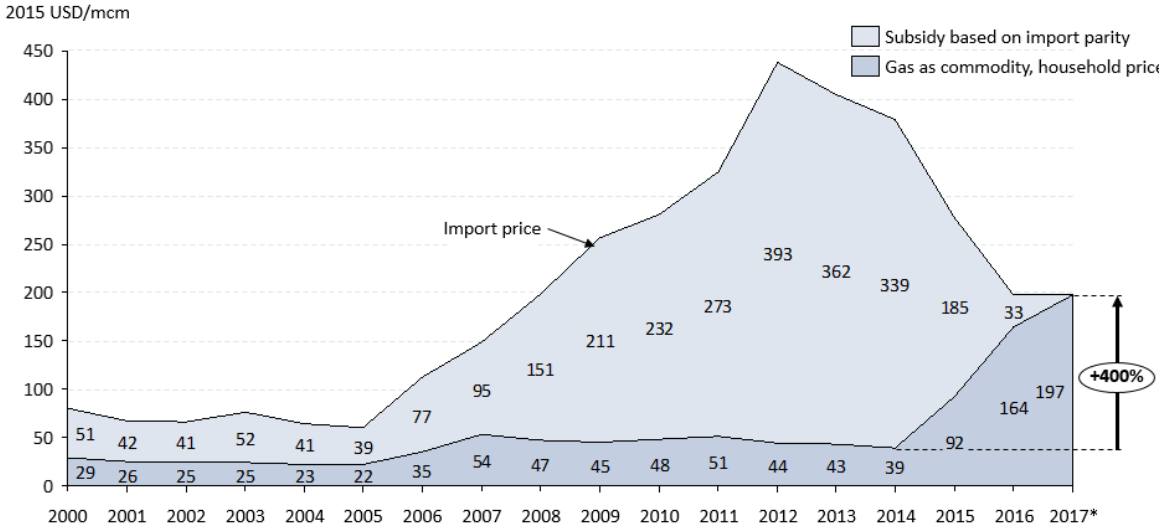
4.1 Gas prices

The household gas tariff in Ukraine comprises various components. The largest component is the price of gas as a commodity, that is, the price paid to Naftogaz for the gas it provides, excluding charges for additional services such as: tariffs for transportation through the transmission and distribution pipelines, a supply tariff, and taxes.

Between 2000 and 2005, the final consumer price of gas for households was kept at a constant level in the local currency, UAH 185/mcm[67], or $44–47 in 2015 dollars. However, only around half of that price was constituted by the price of gas as a commodity. Given that the import price of Russian gas oscillated between $60–80/mcm and the price of gas as a commodity in dollars fluctuated between $20–30/mcm[68], the implicit subsidy during the period was around 2/3 of the import price (Figure 7)[69].

[63] Naftogaz (2015a).
[64] Cf. Mitra, P. & Atoyan, R. (2012).
[65] IEA (2014)., p. 315.
[66] Clements, M. B. J., Coady, D., Fabrizio, M. S., Gupta, M. S., Alleyne, M. T. S. C., & Sdralevich, M. C. A. (2013). Energy subsidy reform: lessons and implications. International Monetary Fund, p.7 For a more comprehensive discussion of different subsidy methodologies used by international organizations please refer to Box 1 in: Bárány, A., & Grigonytė, D. (2015). Measuring fossil fuel subsidies. ECFIN Economic Brief, (40).
[67] Mikhaylovskaya, S. (2009). Osobennosti formirovanija i ustanovlenija cen na prirodnyj gaz dlja razlichnyh kategorij otrebitelej. http://erranet.org/index.php?name=OE-eLibrary&file=download&id=6315.
[68] Naftogaz (2015 a).
[69] Dollar prices in constant 2015 dollars.

Figure 7: Gas as a commodity—weighted-average household prices and the implicit subsidies



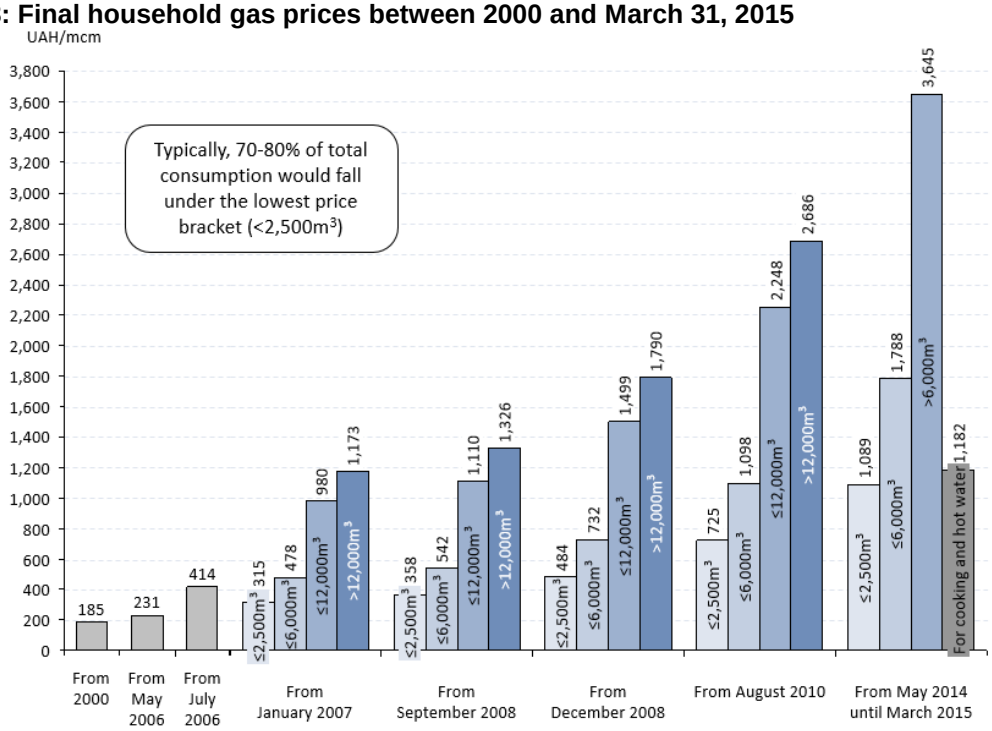
Source: Authors' estimates based on data from Naftogaz (2015a), (2015b), (2016a) and news reports.

As a result of the 2004–2005 Orange Revolution, the relationship between Ukraine and Russia deteriorated and Moscow decided that it would no longer provide Ukraine with cheap gas, especially given that European market prices were rising and, thus, so was the opportunity cost[70]. The political dimension of this decision becomes clear when we look at the Russian gas prices for Belarus in the same period, which remained at low levels despite similar economic pressures[71]. As a consequence, the Ukrainian import prices started increasing markedly but household prices failed to rise correspondingly (see Figure 7). After strong hryvnia depreciation in the second half of 2008 and the first quarter of 2009, the gap between the price for household gas as a commodity and the import price grew even larger, despite a 50% increase in household prices during the course of 2008. In total, between 2000 and 2012 the price of gas as a commodity increased by 52% from $29/mcm to $44/mcm. In the meantime, however, the import price rose from $80/mcm to $438/mcm, a drastic increase of 448%.[72] Consequently, the weighted-average import price of 2012 grew to a staggering 10 times the price households paid, translating itself to a subsidy of $393 for every mcm consumed by a Ukrainian household.

In the period from 2000–2016, the nominal final household gas prices were increased on 9 occasions (Figure 7 and Figure 8). After two increases the gas price reached UAH 414/mcm in July 2006[73]. Then, on January 1, 2007, a significant change was made when prices were made volume-dependent. Four volume brackets were established: for yearly consumption equal to or below 2,500 m^3, equal to or below 6,000 m^3, equal to or below 12,000 m^3, and above 12,000 m^3. Additionally, each volume category had two slightly different prices, one for metered consumption and another, 10% higher, for non-metered use. The prices were increased further in September and December 2008, August 2010, May 2014, April 2015, and May 2016. As of May 1, 2014, the last volume bracket was abandoned, making "above 6,000 m^3" the new highest threshold. At the same time, a new category of prices was introduced for gas consumed exclusively for cooking and heating purposes, which essentially applied to blocks of flats with a district heating connection, and again had two price points depending on whether the consumption was metered or not.

[70] Pirani, S. (2007)..
[71] Yafimava, K. & Stern, J. (2007).
[72] Prices in constant 2015 dollars.
[73] Mikhaylovskaya, S. (2009).

Figure 8: Final household gas prices between 2000 and March 31, 2015

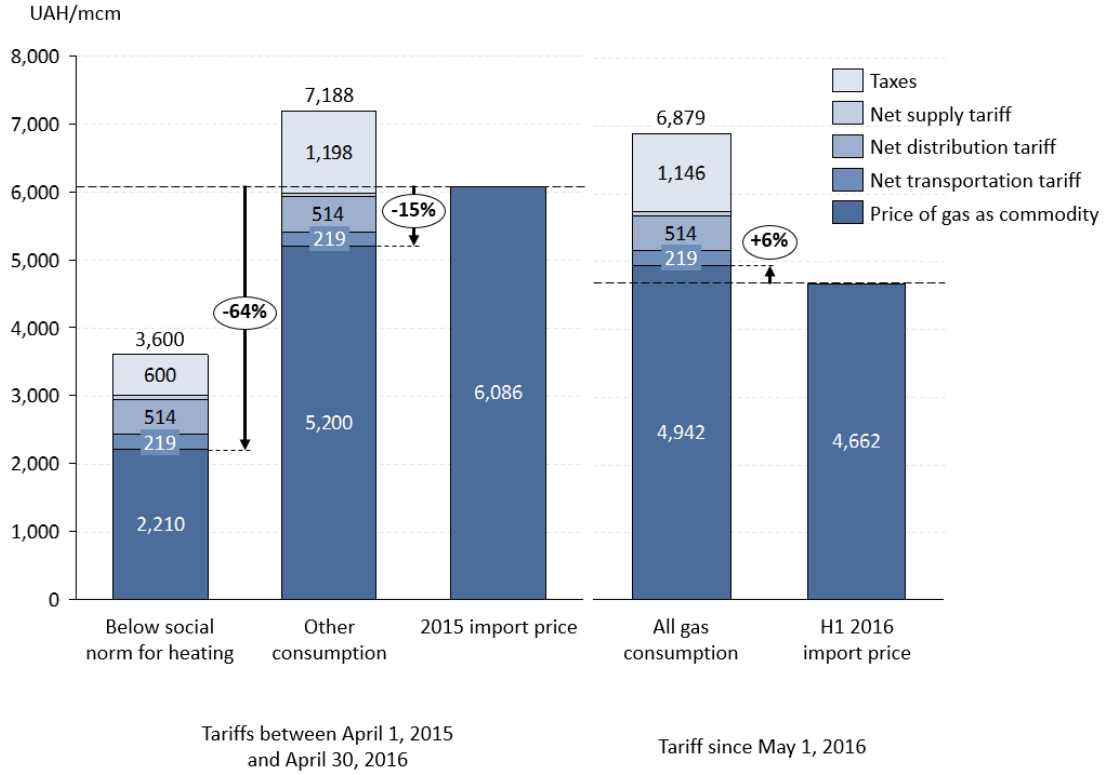


Sources: Mikhaylovskaya, 2009; Decree № 812 from July 13, 2010 and Decree № 420 from April 3, 2014 by the National Commission for Energy Regulation (НКРЭ Украины). The prices shown for 2007 and onwards are metered-consumption prices—the prices for non-metered consumption can, however, be easily obtained by adding 10% to the metered prices.

Notably, the price system was constructed in such a way that once a household consumed more than a given threshold volume, it would pay a higher price not just for the volume above the threshold but rather for the entire consumption. This could have strong consequences for a household, for example a family which in a given year consumed 2,501 m^3 of gas would have to pay a significantly higher bill than a family which consumed 2,500 m^3. This system, however, was abolished on April 1, 2015, when a substantial price increase was enacted together with a simplification of the pricing system. From then onward, only two household gas prices existed (Figure 9). A lower price of UAH 3,600/mcm was assigned to households which, for instance, used gas for producing heat. Moreover, this discounted price was applied only to consumption below the so-called social norm—that is the first 1,200 m^3 consumed, and only during the heating season—from October to April. A higher price, UAH 7,188/mcm, applied to consumption exceeding 1,200 m^3 and for all the consumption in the other months. This price was also applicable all year round to households not buying gas to produce heat, independently of the volume consumed [74]. Given the weighted-average 2015 import price of $277/mcm, the prices for gas as a commodity after the April 2015 price increase stood at 36% of the import parity for consumption within the social norm and at 85% for all other consumption (Figure 9).

[74] See Decree № 420 by National Commission for Energy Regulation [НКРЭ Украины] from April 3, 2014.

Figure 9: Final household gas tariffs after April 1, 2015



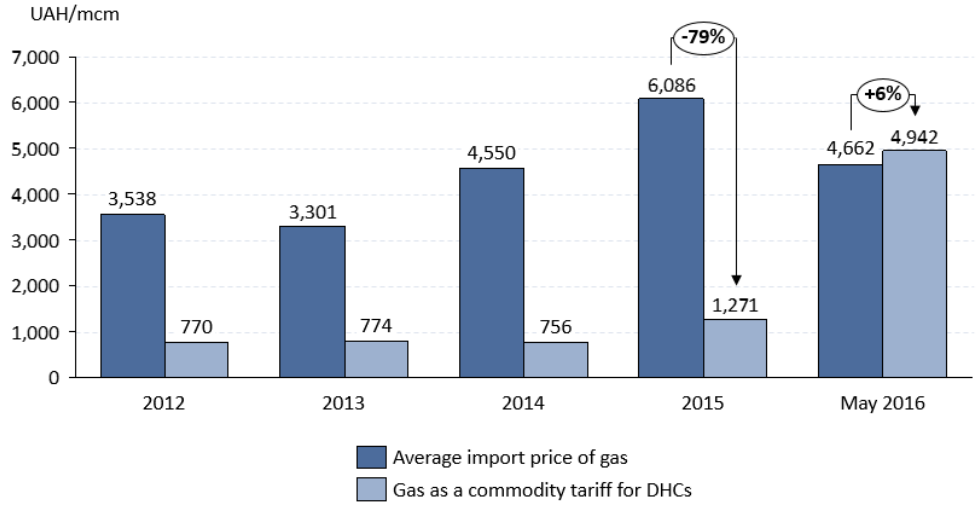
Source: own estimates based on data from MERT (2016), Naftogaz, (2015a) & (2016c), and $185 estimate of the import price in H1 2016.

With a much lower import price in the first half of 2016, it was possible for the government to achieve import-parity a year ahead of schedule. On May 1, 2016, gas tariffs were unified and set at UAH 6,879/mcm—for the first time in history at the import parity (Figure 9).

4.2 District heating tariffs

District heating prices exhibited a similar trend to household gas tariffs. Despite increasing gas import prices between 2006 and 2012 (Figure 6), heat tariffs were not adjusted and the gap between them kept on growing. Since the DHCs produce heat for the population's needs, the government kept the prices artificially low to reflect the local production cost rather than the real value of heat. Additionally, the heat tariff was mispriced in yet another way. Not only did DHCs receive artificially cheap gas but they also sold the heat at below the already subsidized production cost (Figure 10 and Figure 11).

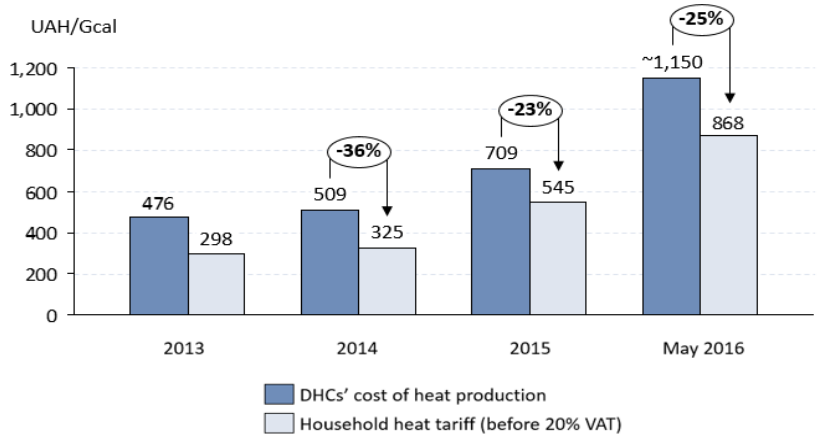
Figure 10: Gas tariffs for DHCs



Source: authors' estimates based on MERT (2016), Naftogaz (2015a), and press releases. The import price based on weighted-average import prices and an average UAH/USD exchange rate for a given year. For May 2016, $185/mcm import price assumed.

In 2014, the annual average price of gas as a commodity that Naftogaz charged the DHCs was UAH 756/mcm[75]. Given that the weighted average 2014 import price was $379/mcm, or around UAH 4,550, the gas for DHCs was sold at 17% of the import price. The average weighted heat tariff before VAT was, in turn, UAH 325/Gcal, although the average heat production cost equaled UAH 509/Gcal[76] (Figure 11). Thus, in addition to a subsidy for gas sold to DHCs, the heat consumed by households was further subsidized by more than a third. This second cost had to be covered by transfers either from the local or state budgets[77].

Figure 11: Heat production costs and tariffs



Source: authors' estimates based on MERT (2016) and MinReg (2016).

On May 1, 2016, the price of gas as a commodity for DHCs producing heat for households was set at the import-parity level of UAH 4,942/mcm—the same price as the price of gas as a commodity for

[75] Naftogaz (2015 a).
[76] MinReg (2016).
[77] Ibid.

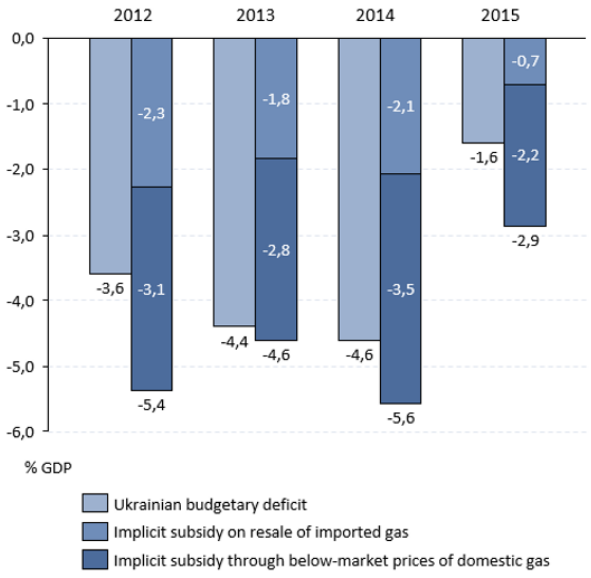
households[78]. Effectively, both households and DHCs prices for gas were thus unified and set at the import price, bringing an end to the implicit gas subsidies.[79] At the same time, however, the heat tariff did not increase enough to fully reflect the cost of heat production. From a previous weighted-average tariff of UAH 654/Gcal, or UAH 545/Gcal before VAT, it increased to UAH 1,041/Gcal, or UAH 868 before VAT[80]—while the cost of heat production with the new gas price is around UAH 1,150/Gcal. Thus, although the gas sold to DHCs is no longer subsidized, there is still an implicit subsidy on heat at around 25% (see Figure 11).

After the removal of the gas subsidy and bringing the tariffs to the import parity, the last main step remaining to complete the gas pricing reform will be to deregulate price setting, a move expected to happen either in 2016 or 2017, and allow private players to compete with Naftogaz. Before that happens, however, we cannot be certain that the implicit gas subsidies have been permanently removed. In case of a significant rise of import prices, the Ukrainian executive authorities may find themselves under strong popular pressure and prove unwilling to raise gas prices, effectively reintroducing implicit subsidies.

4.3 Implicit natural gas subsidies

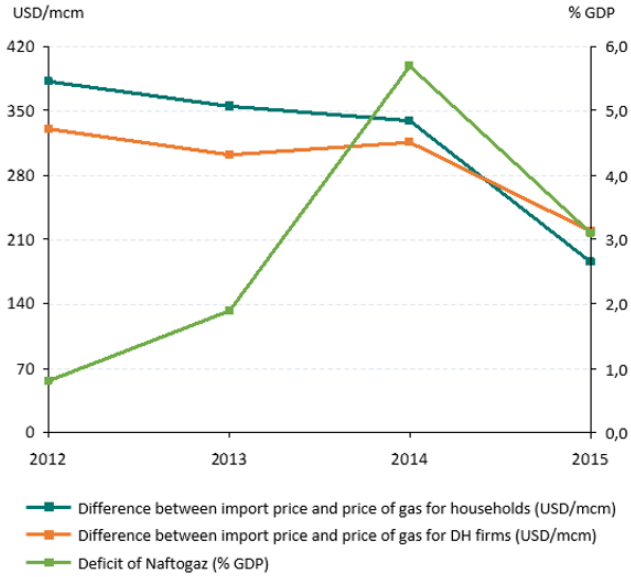
As mentioned above, due to the fact that it has been possible to use domestic state-controlled production to satisfy a large portion of household consumption, it is necessary to differentiate between two different forms of implicit subsidies: a subsidy through an actual financial loss created by reselling imported gas to households at a discount and a subsidy in the form of Naftogaz's foregone revenues from selling the domestic gas at below the import price.

Figure 12: Implicit gas subsidies compared to the Ukrainian budgetary deficit, 2012–2015



[78] MERT (2016)
[79] Since the final gas price for DHCs does not include the supply tariff, it was set slightly lower than the one for households and, as of May 1, 2016, amounted to UAH 6,810/mcm (MERT, 2016).
[80] MERT (2016), & MinReg (2016).

Figure 13: Differences between import gas price and gas prices for the population, 2012–2015



Source (Figures 12 & 13): Data on the Ukrainian budget deficit from CASE Ukraine (2016), Ukraine's GDP data from World Bank (2016), Naftogaz's deficit from Repko et al. (2015), import and utility prices based on Naftogaz (2015a, 2015c, 2016a), news reports, and authors' estimates.

Table 1: The size of the Ukrainian implicit gas subsidies

	Household & DH consumption, bcm	Import price, USD/mcm	Weighted-average price of gas as a commodity, $/mcm	Naftogaz's loss, $bn	Naftogaz's loss, GDP
2012	26	425	61	9.5	5.4%
2013	25	397	59	8.5	4.6%
2014	22	379	47	7.3	5.6%
2015	17	277	81	3.4	2.9%

Source: see Figure 12 and Figure 13. Naftogaz's loss is calculated by multiplying household & DH consumption with the difference between the import price and the weighted-average price of gas as a commodity.

To use an example, in 2014 households (including DHC) consumed 22.1 bcm of natural gas out of which 13.9 bcm came from Ukrainian domestic production by UGV, which had to sell it at subsidized prices to Naftogaz, and 8.2 bcm came from imports[81]. Given that the weighted-average price of gas as a commodity for DHCs producing heat for households and the price of gas as a commodity for direct household use equaled $47/mcm[82], and that the weighted-average import price throughout the year equaled $379/mcm, the 2014 implicit subsidy through Naftogaz's foregone revenues on domestically produced gas can be estimated at $4.6bn, or 3.5% of GDP[83] (Figure 12). In addition, reselling the 8.2 bcm of imported gas at $47/mcm generated a direct financial loss of $2.7bn, or 2.1% of GDP[84]. In 2014, Q1 the weighted-average import price was substantially lower than in the remaining quarters ($269/mcm versus 472 in Q2, 353 in Q3, and 360 in Q4) and it appears that in its accounting Naftogaz assumed that all gas imported in Q1 was resold to households. This leads to a

[81] Naftogaz (2015).
[82] The household price of gas as a commodity equaled at the time UAH 473/mcm, or $39/mcm, while the price of gas as a commodity for DHCs producing heat for households equaled UAH 756/mcm, or $63/mcm (Naftogaz, 2015a).
[83] IMF's Article IV consultation document from November 2013 mentions 7.5% of Ukrainian GDP going to energy subsidies in 2012. Their number is 2% higher than ours as it also includes explicit subsidies and subsidies on other energy.
[84] Please note that our calculations yield somewhat higher cost of sales of imported gas and thus a higher subsidy level than Naftogaz's own calculations (Naftogaz, 2015).

lower cost of sales to households as compared to the industry, which "bought" the more expensive gas imported in the other quarters. We, on the other hand, assume a constant and proportional fraction of sales between households and industry throughout the year) bringing total subsidies to 5.6% of GDP (Table 1). Finally, DHCs selling heat at below the production cost constituted an additional cost of UAH 7.6bn in 2014, or 0.5% of GDP.

Together these three implicit subsidies had been constantly larger than the total Ukrainian budget deficit, vividly illustrating the scale of the problem. It is also important to recognize that since the implicit subsidies applied indiscriminately to each household, the more gas and heat a household consumed—the larger the subsidy became. Consequently, affluent Ukrainian households tended to benefit more than poor ones[85]. At the same time, it is important to note that these three implicit subsidies are not the only subsidies present in the household gas and heat markets. Households also receive direct non-cash subsidies in the form of social assistance and benefits which further lower their gas and heat bills. The state transfers these direct household subsidies directly to the companies distributing gas and heat to compensate them for corresponding revenue losses. The way in which such explicit subsidies affect our estimates is discussed in section 6.3.

In Figure 13, the Naftogaz deficit is plotted against the difference between import prices and the price of gas for households. At first glance, we would expect that Naftogaz deficits as a share of GDP should largely exhibit covariance with this difference (as the differential of prices goes up, we would expect that the Ukrainian state needs to use more money to refinance Naftogaz). This is not the whole picture, however. The size of the transfers as a share of GDP which Naftogaz needs each year to finance its operations will crucially depend on three factors other than the price differential: first, the size of Naftogaz's debt and thus its interest repayments, second, the value of the Ukrainian currency in relationship to the currency in which Naftogaz repays its debt and, third, the total size of the Ukrainian economy. First, Naftogaz was amassing dollar-denominated debt in the years up to 2014, which incurred larger yearly interest rate payments. Second, when the Ukrainian hryvnia started depreciating in 2014, losing 50% of its value against the dollar in just a year, this led to a massive currency-related loss, estimated by Naftogaz at UAH 45bn in 2014[86] (around $3.75bn assuming UAH 12/$1, or equivalent to 2.9% of Ukrainian GDP). Third, the Ukrainian economy contracted by around 7% in 2014, while gas consumption and the import to household price differential was relatively constant, also driving up Naftogaz's deficit as a share of Ukrainian GDP. In 2014, as Naftogaz's deficit was approaching 6% of Ukrainian GDP, the situation became critical. The system of heavily subsidized domestic gas consumption, necessitating the Ukrainian state to transfer several percentages of GDP on a yearly basis in order to cover Naftogaz's deficit, had become untenable. Aggravated by the severe currency depreciation as well as the GDP contraction, gas subsidies had developed into a matter of vital importance to the entire Ukrainian public finances, threatening to cause a Ukrainian default on its debts, with wide and far-reaching implications for the real economy.

4.4 Non-payment

Another relevant aspect related to the subsidies is the problem of non-payments. The Ukrainian household natural gas market has experienced different degrees of non-payment at virtually all stages of the value chain. DHCs and *oblgaz*es have long had trouble paying Naftogaz for the gas they buy. This is amplified by the fact that the heat and gas they provide is also not fully paid for by Ukrainian households. On average, payment for utility services by Ukrainian households takes 2.1 months[87].

By the end of 2014, *oblgaz*es owed Naftogaz UAH 8.1bn, around $0.7bn[88]. On top of that, as of February 2016, DHCs (including thermoelectric plants) had a debt to Naftogaz of UAH 24.8bn, or around $1bn[89]. In 2015, this debt increased by UAH 5bn out of which 73%, or UAH 2.9bn, was a

[85] Cf. Mitra, P. & Atoyan, R. (2012).
[86] Naftogaz (2015a).
[87] MinReg (2016), p. 7.
[88] Naftogaz (2015), p. 30.
[89] Ibid., p. 42.

result of the state failing to pay DHCs for both the implicit and explicit subsidies which it required them to provide[90]. In that sense, the largest portion of the debt in the household gas market is state-promised subsidies which have not yet been covered. The importance of the DHCs' financial problems can be illustrated by the overall level of payment by the DHCs. In 2012, 68.9% of outstanding bills were paid, then dropping to the abysmal 29.9% in 2013, followed by 61.3% in 2014[91]. So far, there has been no legal way for Naftogaz to cut off supply to non-paying DHCs and *oblgaz*es. The legislation required to allow Naftogaz to cut off supply to non-paying customers has yet to pass in Parliament, and if it does, it needs to survive legal challenges and there needs to be political willingness to implement it, before it would actually affect the non-payment rates.

Although Naftogaz is reticent in providing information on the actual levels of non-payments, generally we should expect that as gas and heat prices are raised according to the new import-parity tariffs, this will result in higher non-payment rates among consumers. As a consequence, Naftogaz, *oblgaz*es, and DHCs will get higher levels of accounts receivable. A part of that debt can be expected never to be repaid and as such might have to be restructured or impaired at a future date. This could be considered an additional subsidy: some consumers will be receiving gas and heat free. Still, it differs from a regular subsidy in key ways, as there is no explicit intent of the state to provide this payment as a price reduction and it is not recurring or mandated. It is also likely to occur only infrequently, as part of major financial stress on gas consumers and providers. For this reason, we will not include non-payments in our estimation of the overall level of subsidies in the Ukrainian natural gas market. We should, however, be wary of the impact of increased non-payments on the natural gas market through potential financial problems they may cause for the market participants.

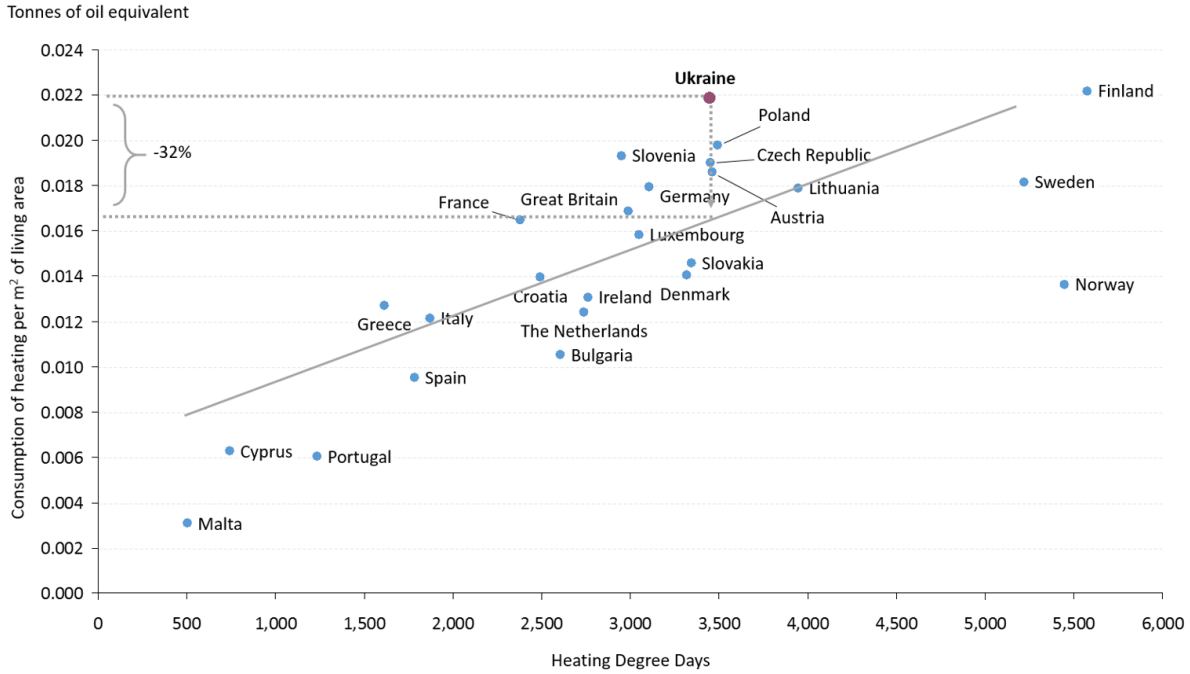
5 Energy efficiency

Energy efficiency is a function of the price of energy, state policies, legislation, and societal norms and knowledge about energy preservation. This paper tries to determine the effect of the subsidy removal on gas consumption. It is a difficult task: as the price of gas increases, so do the incentives for households to invest in energy saving equipment and the incentives for companies to provide energy saving products. Simultaneously, in Ukraine, the reform of gas prices is coupled with an effort by the state and international financial institutions to increase the financial support for households and district heating companies to make energy-saving investments. Most of these changes, which are mainly caused by the natural gas price increase, will be taking place over a ten-year period, only partially visible in our price elasticity estimate. This chapter provides an overview of where Ukraine is today in terms of energy efficiency and what type of changes, with the resulting savings, can be expected in the short and long run.

Ukraine is one of the least energy efficient countries in the world. Measured as energy usage per unit of GDP, in 2013 Ukraine consumed 3.8 times the European average[92]. A large share of this inefficiency is driven by a lack of incentives for energy-saving investments due to highly subsidized cheap gas. A comparison of the energy efficiency of the Ukrainian housing stock with European countries also shows that Ukraine is lagging behind, albeit less than in terms of GDP: Ukrainian households consume around 32% more heat per square metre than the European average, after adjusting for the number of heating days degree days (HDDs; see Figure 14). When compared with other Central and Eastern European (CEE) countries with similar levels of HDDs, Ukraine has an energy consumption 10% higher than Poland, 15% higher than the Czech Republic and 50% higher than Slovakia. It is important to note that this underestimates Ukraine's energy efficiency problems as Ukraine is also lagging behind other countries in other aspects such as the efficiency of generating heat from gas or heat transmission losses.

[90] Ibid, p. 38.
[91] NCEPUR (2015).
[92] Radeke, J. & Kosse I. (2013). Towards higher energy efficiency in Ukraine's district heating sector. German Advisory Group. http://www.beratergruppe-ukraine.de/download/PolicyBriefings/2013/PB_01_2013_eng.pdf.

Figure 14: Heating usage per square metre of living area in Ukraine, comparison with European countries, 2013



Source: Adapted from Repko, 2015.

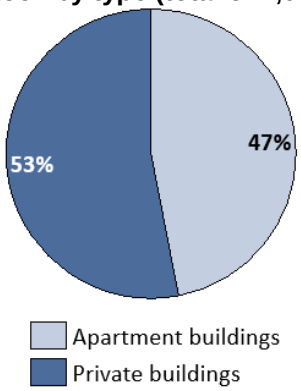
Most of the 18.6 bcm gas consumed by households and the public sector is used for heating purposes, and that is also where the most energy is wasted, as compared to most European countries. If Ukraine were to reach the current EU average level of efficiency in heating generation, then 11.4 bcm of gas could be saved, a huge 61% of the total gas consumption for that purpose[93]. The real potential for savings is much harder to estimate and depends on the success of legislation reforms, availability of financing for energy efficiency investments, behavioural changes reducing waste, and the pricing of natural gas. For our purposes, we estimated the most likely scenario for energy efficiency gains, which we will employ in the demand estimation section of the paper. The following provides an overview of the type of measures and the associated energy savings possible for, on the one hand, private houses and blocks of flats and, on the other hand, district heating companies (DHCs).

5.1 Energy efficiency in private buildings and blocks of flats

Blocks of flats make up 47% of Ukraine's total housing stock, measured in square metres, but only 3.7% of the total number of buildings (Figure 15). Around 50% of Ukraine's total housing stock was built between 1946 and 1970, which is a relatively high number compared to for example Czech Republic and Lithuania (see Table 2). Very few of these buildings have been renovated since construction and they have very low standards of energy efficiency.

[93] MinReg (2016).

Figure 15: Breakdown of housing stock by type (total of 1,066 million m^2)



Source: MinReg, (2016)

Table 2: Breakdown of buildings by the year of construction, comparison with European countries

Period of construction	**Ukraine**	**Germany**	**Czechia**	**Lithuania**
Until 1919	5%	14%	11%	6%
1919–1945	13%	14%	14%	23%
1946–1970	51%	46%	25%	33%
1971–1980	16%	13%	22%	18%
After 1981	15%	13%	28%	20%

Source: MinReg, (2016)

Most of the blocks of flats are connected to district heating networks which supply them with both heat and hot water. The private buildings, on the other hand, often have separate gas boilers which provide them with hot water and heating.

There are three main types of measures which can be implemented to improve the energy efficiency of blocks of flats and private houses. First, meters for consumption of heat, water, and gas can be installed. This is a measure which gives households incentives to modify their consumption when prices rise and thus induces behavioural changes to save energy. The second type of measure includes the use of more efficient gas boilers used for producing heating or hot water. The third measure involves investment in thermo-modernization, including insulating roofs, walls and basements, and replacing windows and doors. These measures can be introduced both for private houses and blocks of flats.

Private houses and blocks of flats connected to DHCs often lack meters for heating and hot water consumption (see Table 3). This has serious implications for people's incentives to use heating efficiently, making individual savings pointless (since household bills are not based on the individual level of consumption). As of January 2016, only 51% of blocks of flats were equipped with building-level heat meters, up from 40% in 2014[94]. Such meters were being rapidly introduced during 2015 and this will continue in 2016, with a goal of 80% of buildings being equipped with meters at the end of the year[95]. The fraction of metered buildings differs widely between regions, with rather high fractions of metering in *oblast*s [provinces] like Lviv (73%), Kyiv (70%) and Mykolaiv (68%) but very low in *oblast*s like Ternopil (7%) and Poltava (24%)[96]. Buildings without meters cannot control the temperature locally since they lack a building level substation (heating decisions are taken centrally by DHCs). In

[94] MinReg (2016).
[95] Ibid.
[96] Ibid.

practice, households in such buildings regulate the temperature by opening the windows (if it is too hot) or using supplementary sources of heating, such as electric heaters, if it is too cold. For hot water, the average fraction of metering is higher, at 64% of all buildings, with the highest in Zhytomyr and Kirovohrad (100%) and the lowest in Odessa (19%) and Luhansk (23%). Such meters can reveal if households were being overcharged or undercharged, by allowing transparency in billing. This can potentially have large effects: a research report estimates heat supply norms to be set around 8% too high (at 0.14 Gcal/m3 compared to actual 0.129[97]). Thus, the introduction of meters will not only induce behavioural changes to save energy but also lead to "savings" due to previously unreasonably high norms.

Table 3: Metering of different types of consumption, 2015

	Services provided by DHCs		**Services provided by *Oblgazes***		
Type of consumption	Heating (building level meter)	Hot water (household meter)	Gas for heating	Gas for cooking/ hot water	Gas for cooking
Share of metered households, 2015	51%	64%	~100%	72%	27%

Source: Minreg, (2016); Naftogaz, (2015c) and MigNews, (2015).

Metering for direct gas consumption by households used for heating and hot water is much higher, almost at 100%[98]. Households using gas only for cooking have a much lower fraction of meters, at 27% in 2015[99]. Altogether, 93% of the volume of gas sold was metered in 2015[100]. If current legislation which requires all household gas consumption in Ukraine to be metered before January 1, 2018 is implemented, we should expect this fraction to increase even further[101].

After metering and replacement of boilers, thermo-modernization offers the highest potential for energy savings. Thermo-modernization includes measures like insulating roofs, walls and basements, and replacing windows and doors. These measures are more expensive than the previous options considered but have larger potential to save energy. In a comparative study looking at different types of initiatives from CEE and CES countries, the Alliance to Save Energy finds that utility bill savings of 40-60% can be achieved through comprehensive thermo-modernization[102].

5.2 Energy efficiency of district heating companies

The energy efficiency of the Ukraine district heating system lags far behind comparable countries. The largest inefficiencies result from large energy losses during the production and distribution of hot water by the district heating companies (DHCs), with an estimated 59% of the total energy lost[103]. A comparable number for German DHCs is 32%, which indicates that huge savings could be made.

In Ukraine, district heating is either produced by smaller gas boiler houses, or by larger cogeneration plants, producing both electricity and heat at the same time. The latter are predominantly used in urban areas. The largest potential for energy efficiency gains for district heating comes from rehabilitating boiler houses which are old and inefficient and increasing the efficiency of gas transmission gas by replacing old network pipes. The regulated very low prices for heating in Ukraine have resulted in DHCs acquiring large losses, covered by the Ukrainian authorities, but also in an

[97] Ibid.
[98] Ibid.
[99] Na Novyj god doma bez sčetčikov otključat ot gaza (2015, December 2). *MigNews*. http://mignews.com.ua/ukraine/8561671.html.
[100] Ibid.
[101] Naftogaz (2015).
[102] Alliance to Save Energy (2007). Addressing Affordability of Utility Services in Urban Housing: Energy Efficiency Solutions. https://www.ase.org/sites/ase.org/files/residential_ee_study_final.pdf.
[103] Radeke, J. & Kosse I. (2013). Towards higher energy efficiency in Ukraine's district heating sector. German Advisory Group. http://www.beratergruppe-ukraine.de/download/PolicyBriefings/2013/PB_01_2013_eng.pdf.

inability to finance energy-efficiency saving investments. Thus, both the production and transmission of heat is inefficient, which often also leads to low service quality, especially in the stability of heat delivery and the temperature of the delivered heat to the end consumer[104]. The Ministry for Regional Development estimates that 23% of the total length of heating networks is worn out and unsafe, and in some areas this number is as high as 51% (Odessa), resulting in large losses of heat as well as unreliable service[105]. So far, unfortunately, only a limited number of transmission network renovations have been carried out. There has been some replacement of boilers, on the other hand, with 480 out of 30,000 boiler houses modernized in 2015, with a resulting decrease in gas consumption of around 28 mmcm/year[106]. A separate mechanism resulting from the gas price increases is that boilers are being redirected to alternative fuels. As of 2015, 801 boiler houses were redirected to other fuels, 70% to wood, representing 50 mmcm/year in decreased gas consumption, so far a small amount[107].

Building on the content of this chapter, Chapter 6 provides an overview of different scenarios for energy savings, with estimates of the particular effects of different energy efficiency measures on gas consumption in Ukraine.

6 Estimating household demand for gas in Ukraine

In order to assess the effect of the removal of the implicit gas and heat subsidies on Ukrainian natural gas demand, we will estimate the household gas and household heat price elasticities of demand. Having done that, we will be able to establish a precise relationship between the gas tariffs, consumption and the elimination of the subsidies.

As outlined in the introduction, the major factors in the decline in Ukrainian gas demand that we observed in both 2014 and 2015 are the occupation of Crimea and parts of Luhansk and Donetsk *oblast*s, the ensuing economic downturn, relatively mild winters, and the partial removal of gas subsidies. Looking forward at the household part of the gas market, we expect a continuing drop in consumption in the next 2 to 5 years. The main driving forces for household demand until 2020 will be the process of households adjusting to the complete removal of the implicit gas subsidies in May 2016, the ongoing expansion of explicit gas subsidies, energy efficiency improvements, changes in income level as well as the fluctuations in the gas import price. To assess the changes, we will first construct an econometric model predicting how household demand will react to the recent price increase as well as to potential changes in income. Next, using different scenarios for the development of these factors, we will estimate the household gas demand in 2020, with a further estimate of additional energy efficiency changes by 2025.

6.1 Price and income elasticities of gas and heat demand

In May 2016, the Ukrainian government removed implicit gas subsidies and thus for the first time in Ukraine's modern history household prices were set at the import parity. To assess how this steep price increase will affect the household demand, we created an econometric model for the price-elasticity of both gas and heat demand. The model employs a cross-section analysis of 2014 microdata from the Household Living Condition Survey conducted by the State Statistics Service of Ukraine and provided to us by the Kiev School of Economics. The survey is compiled on a quarterly basis and is targeted at a sample of between 8,500 and 11,000 Ukrainian households, providing information about social and demographic characteristics, living conditions, structure of actual

[104] Semikolenova, Pierce & Hankinson (2012).
[105] MinReg (2016).
[106] Ibid.
[107] Ibid.

expenditure, income, state benefits and other indicators relevant for estimating household living standards[108].

We estimate the price elasticity of gas through a log-linear function of demand for a given household i:

$$\ln Q_i = \alpha + \beta_1 \ln P_i + \beta_2 \ln Y_i + \beta_3 \ln \text{area}_i + \beta_4 \ln \text{HDD}_r + \sum_{d=1}^{4} \delta_d X_d + \varepsilon_i$$

where Q_i is the volume of gas consumed by a household without a DH connection throughout 2014. Since the household survey data does not provide information about the actual consumption of gas, we calculate the volume based on the household's reported gas expenditure and the explicit gas subsidies it received. P_i is the effective price which a household paid and also reflects the subsidies and benefits it obtained. Y_i stands for the household's total income, $area_i$ for the total square metre size of the household's accommodation, HDD_r represents the number of heating degree days for the oblast r in which the household was located[109], while X_d is a vector of household's characteristics captured by four dummy variables representing the type of accommodation (house vs. apartment), the presence of a gas water heater and an individual heating system, and whether the house is new (a new building constructed after 1990 or an old one renovated after 2000).

The reason we estimate the gas demand only for households without a district heating connection reflects the fact that we expect consumption in households with DH to be mostly inelastic to price variation. Households which obtain heat through a DH network consume gas mostly for cooking purposes, and sometimes for heating water in the bathroom. In 2014, such gas consumption remained largely unmetered and most households paid a flat rate independent of the amount of gas used. Thus, whichever price such a consumer faces, we expect them not to adjust their behaviour, at least until metering becomes more commonplace. To verify our expectations, we ran a separate regression for such households and indeed found that their consumption in 2014 was entirely inelastic to price variation.

The price elasticity of heat is estimated through a similar log-linear function, where Q_i is the volume of district heat consumed, also derived from the reported heat consumption and the size of explicit subsidies which a given household received. Instead of a dummy vector, however, we use only one dummy variable representing the construction date of a given building (pre– vs. post–1980). This reflects the fact that the residential buildings from before 1980 tended, on average, to be more energy-efficient[110].

Table 4: Regression results

	Gas demand	Heat demand
Price elasticity	–0.20	–0.15
Income elasticity	0.22	0.10

Source: Own estimates.

In accordance with our expectations, we find that heat demand is more inelastic than gas demand. For every 10% increase in the price of heat its consumption falls by 1.5%, while for gas a 10% price increase leads to 2.0% less demand for gas[111]. The results reflect the strong difference between the proportions of metered volume between the two types of gas consumption, with over 90% metered gas consumption but only 40% metered heat consumption. It also reflects the differences in the substitutability and household demand functions between the types of goods.

[108] Details and methodology of the survey can be accessed at http://www.ukrstat.gov.ua/metaopus/2015_eng/e_1_1050001_2015.htm & https://ukrstat.org/uk/metod_polog/metod_doc/koment/koment_dom_gosp.htm.

[109] The HDDs are mostly obtained from the meteorological data of the main airport in a given oblast.

[110] Mitra, P. & Atoyan, R. (2012)..

[111] Importantly, we assume that the price elasticity of the consumers who do not pay their bills quickly is the same as the price elasticity of the paying consumers—despite a time difference in payment. Thus, the rising levels of non-payment should not affect our demand estimations.

Apart from establishing price elasticities, the model measures the extent to which other relevant variables influence both the heat and gas demand. Most importantly, gas demand is more sensitive to income changes, for the same reasons as it is more sensitive to variation in price. For every 10% increase in income, gas demand rises by 1.6% while heat demand rises only by 1.1%. More detailed results are presented in Appendix A, while a more detailed description of the model used is available through the portal of the Stockholm School of Economics.[112]

6.2 Estimation of the effect from a full subsidy removal

In this section, first, a measure of the required price increases to reach full subsidy removal is calculated. Then the baseline upon which the consumption change should be based is derived. Finally, applying the elasticity measures, estimates of decrease in the size of the market due to the subsidy cancellation is presented.

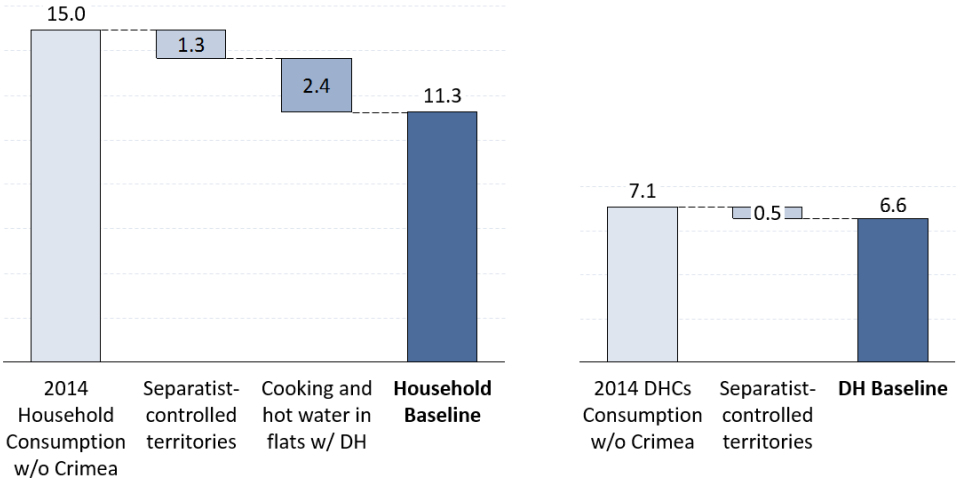
In 2014, the household tariff for gas on average equaled UAH 1,030/mcm or $86/mcm, out of which the price of gas as a commodity was UAH 473/mcm, or $39[113]. Assuming that the 2017–2020 domestic household price of gas as a commodity was to equal $200/mcm, which is roughly the May 2016 forward price for December 2017 at the German NGC hub together with transportation costs to Ukraine, the 2014 *price of gas as a commodity* would have to increase by 407% to reach import parity, holding explicit subsidies, inflation, and currency exchange rate constant. Given no change in transportation, distribution and supply tariffs, and adjusting for VAT and the 4% surcharge, this would translate into the *final price* of gas having to increase by 237% from the 2014 level to reach the import-parity level. Applying our elasticity results of 2.0% decrease of demand for each 10% increase in price, we estimate direct gas consumption to fall by 48% as a result of a full implicit subsidy removal. This estimate changes to 39% and 56% if we assume the price will change to $170 and $230/mcm respectively.

The 2014 weighted-average consumer heat tariffs including VAT, in turn, equaled UAH 390/Gcal, while the DHCs' total heat production costs equaled on average UAH 509/Gcal. To reach the price of gas as a commodity of $200/mcm, the gas component of the UAH 390/Gcal heat tariff would have to increase by 315%. Assuming no change in transportation tariffs, other costs, and adjusting for VAT, the final price of heat would have to increase by 148% from the 2014 level to reach the cost-recovery level, translating into a 22% fall in consumption from a full subsidy removal. With $170 and $230/mcm prices the fall would be 19% and 25% respectively.

It is worth noting that the 2020 price of gas as a commodity could equal more than $230/mcm. If the prices for consumers were to increase to around $300/mcm, especially taking into account the low average Ukrainian income, it is hard to say how the consumers would react. Our elasticities would lose their accuracy as they were measured in a situation of low prices where consumers did not face unaffordable tariffs. Consumers still need to heat their houses and cook even when they cannot pay their bills. Thus, many households might continue consuming heat and gas even without intending to pay for it—merely because of a lack of substitutes. In other words, with very high prices we should expect additional tariff increases to have a diminishing effect on reducing consumption, making it difficult to use our model to predict consumption changes. If, on the other hand, the price dropped to as little as $140/mcm, we would expect to see only 30% and 16% less gas and heat consumption, respectively.

[112] Rozwałka P. & Tordengren H. (2016).
[113] Naftogaz (2015a), p.9.

Figure 16: Consumption baselines for estimating the subsidy removal's effect, bcm



Source: Own estimates based on Naftogaz, (2015c & 2016a)

The percentages of the predicted fall in the consumption should be applied to correct consumption baselines (see Figure 16). The official figures reported by agencies include Crimean consumption for the first two months of 2014 so we excluded the Crimean data. Furthermore, households in territories controlled by separatists are not affected by the Ukrainian reforms and thus their consumption will not react to the subsidy removal and hence we exclude an estimate of their consumption from our baseline. How the consumption in the separatist-controlled territories is reacting to the ongoing conflict is a topic for separate research, especially as those territories are now partly supplied with gas from Russia. In addition, our household consumption baseline, as suggested by our regression results, excludes households connected to district heating, since they exhibit no price elasticity in their gas demand. For the baseline of gas consumption by the DHCs producing heat for the population, we only need to exclude the 2014 consumption in Crimea and the separatist-controlled territories. This results in a baseline of 11.3 bcm for direct household gas consumption and 6.6 bcm for heat consumption.

Table 5: Consumption decline due to the removal of subsidies, three scenarios

	$170 import price	**$200 import price**	**$230 import price**
Gas baseline, bcm	11.3	11.3	11.3
Tariff increase for import-parity	194%	237%	281%
Gas price elasticity	(0.20)	(0.20)	(0.20)
Change in consumption, bcm	(4.4)	(5.4)	(6.4)
Gas-for-heat baseline, bcm	6.6	6.6	6.6
Tariff increase for import-parity	129%	148%	167%
Heat price elasticity	(0.15)	(0.15)	(0.15)
Change in consumption, bcm	(1.3)	(1.5)	(1.6)
2014 market w/o Crimea	22.0	22.0	22.0
Total consumption change, bcm	(5.7)	(6.8)	(8.0)
Total consumption change	(26%)	(31%)	(36%)

Source: Own estimates.

Applying our elasticity regression results (Table 5), a 48% decline in household consumption due to the removal of the subsidy translates into a 5.4 bcm decrease in gas consumption, while the other price scenarios result in 4.4 and 6.4 bcm decreases. The DHCs' gas consumption would fall by 1.5 bcm under the medium price scenario and 1.3 and 1.6 bcm with a low and high prices. Altogether, we expect the market to decline by 5.7–8.0 bcm (26–36%), with the most likely medium scenario indicating a 6.8 bcm (31%) decline.

6.3 Estimation of the effect of changes in explicit natural gas and heat subsidies

In order to correctly estimate the actual effect on demand from removing the gas subsidies in Ukraine, the actual price increase for the average consumer needs to be calculated. The Ukrainian government is planning to expand current explicit subsidies for the population, thus partly offsetting the price increases. This section tries to derive an estimate of the actual price increases for the consumers, assuming different scenarios of changes in explicit subsidies.

Explicit subsidies for housing and utility services (HUS) in Ukraine are targeted governmental payments designed to ease the burden of payment on both the poorest citizens and those with special status. Contrary to implicit subsidies, explicit subsidies are not applied indiscriminately and thus better fulfill the social purpose of protecting the vulnerable. Normally, the explicit subsidies are disbursed to the utility companies which then deliver the subsidized services to the households, which simply receive a lower bill. In 2015, only 2% of the explicit subsidies were directly paid to the households[114]. Unfortunately, it is commonplace that the utilities do not actually receive the necessary funding. In 2015, a third of explicit subsidies ended up as budgetary debt[115]. At the same time, however, the absence of comprehensive gas and heat metering allows utility firms to overstate household consumption in order to illicitly capture part of the state subsidies[116].

It is important to note that the estimation in Section 6.1 assumes no change, from 2014 onward, in the percentage of household gas and heat expenditures covered by explicit governmental subsidies and thus the absolute value of the subsidies is assumed to grow proportionally with the price increase. This is in line with Ukraine's governmental plan of rolling out a more extensive system of targeted explicit subsidies. The plan, which is developed with IMF assistance, strives to ease the burden of the implicit subsidy removal on vulnerable citizens. According to the IMF, as much as 27% of all Ukrainian households need to be shielded from the tariff increases[117]. This change in explicit gas subsidies needs to be taken into account when estimating gas demand in 2020.

In 2014, the Ukrainian budget provided around UAH 6bn for various HUS subsidies[118]. Since gas subsidies accounted for around 46% and heat subsidies for roughly 30% of the total value of the HUS subsidies[119], we estimate their 2014 value at UAH 2.8bn and UAH 1.8bn, respectively. Assuming a constant portion of gas and heat bills covered by the explicit subsidies, the scenarios from Chapter 7 imply that the gas and heat subsidies would grow to UAH 9.3bn and UAH 4.5bn (in 2014 hryvnia), respectively, with gas as a commodity price of $200/mcm.

Provided that we assume a full realization of the IMF's proposal to protect the 27% poorest households from an implicit subsidy removal by keeping their gas and heat prices at an average 2014 effective price, and increased prices to import-parity only for the remaining 73%, we coincidentally find that this would increase the cost of the explicit subsidies almost precisely to the levels assumed in

[114] Pavlyuk S., (2016, February 2). *Pochemu energeticheskie subsidii nas ubivayut: Ekspert.* http://giga.ua/субсидии-украина-эксперт.
[115] MinReg (2016).
[116] Pavlyuk S., (2016, February 2). *Pochemu energeticheskie subsidii nas ubivayut: Ekspert.* http://giga.ua/субсидии-украина-эксперт.
[117] IMF (2014a). p. 21.
[118] MinReg (2016).
[119] Estimates based on data from the 2014 household living condition survey.

Section 6.1[120]. In particular, if we raise the gas and heat prices to import-parity only for the 73% richest households, we find that the total decrease in overall gas consumption with a $200/mcm import price is expected to equal 6.7 bcm, marginally different from the 6.8 bcm stated in the previous section. It is uncertain, however, if the governmental explicit subsidy program will be that extensive. With less than 27% of households shielded from the price increase, more families will face higher prices and thus the consumption will fall further. Table 6 shows this full scenario as well as two other scenarios: assuming only 18.5% and 10% of households being protected from the tariff increase. Those scenarios result in 7.4 and 8.0 bcm decrease in consumption, respectively, if the price is $200/mcm.

Table 6: Consumption decline, scenarios based on the extent of the explicit subsidies

Share of households protected from the price increase	**10% of households**			**18.5% of households**			**27% of households**		
Import price per mcm	$150	$180	$220	$150	$180	$220	$150	$180	$220
2014 market w/o Crimea	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Total consumption change, bcm	6.7	8.0	9.3	6.2	7.4	8.6	5.7	6.7	7.8
Total consumption change	31%	37%	42%	28%	34%	39%	26%	31%	36%

Source: Own estimates.

Last but not least, the predictions of the changes in gas and heat demand derived from our model do not fully take into account the effects of depreciation of the hryvnia. Estimating how depreciation will affect consumption is difficult, since it also depends on the influence of inflation and income changes. Generally, hryvnia depreciation leads to a rising price of imports. If, however, depreciation was to be perfectly matched by CPI inflation (including gas and heat prices), the real price of gas and heat would not change—only real income would decrease. If, however, the depreciation is not fully matched by inflation, as has been the case in 2014–2015, the market price of gas and heat will be rising in real terms, shadowing the difference between inflation and depreciation. Predicting the way these factors will interact up until 2020 is complex. For this reason, in our estimation of demand for gas and heat we will only include the effect from the expected changes in income over time and will not attempt to predict the future Ukrainian discrepancy between depreciation and inflation.

6.4 Estimation of the effect of changes in energy efficiency

In this section, an estimate of the reduction in the demand for gas resulting from energy efficiency investments will be derived. Five areas of savings were outlined in the energy efficiency chapter: behavioural savings from metering of heat, hot water and gas, savings from more efficient boilers, savings from thermo-insulation investments and savings from more efficient heat generation and transmission among DHCs. Several estimates of the potential gas savings in Ukraine from these types of measures have previously been made[121]. We base our analysis on these estimates, using 2014 as the baseline (very little has happened to energy efficiency since 2015, so either year could be used). The analysis will make a distinction between the short and the long term, defined as the period until 2020 for the short term and 2020–2025 for the long term.

The scenarios start from a baseline of the total potential gas savings from energy efficiency related measures, estimated at 11.8 bcm, or a 63% reduction from the 2015 levels of consumption. In Table 7, the total gas savings and required investments for our three different scenarios are outlined, as well as the total potential.

[120] Importantly, we assume that the poorest 27% households consume around 23% of the total gas consumption (estimates based on: Naftogaz [2015, June 5]). Monthly Natural Gas Payments per Household in Ukraine. http://www.naftogaz-europe.com/article/en/engconsumption).

[121] Semikolenova, Pierce & Hankinson (2012), Naftogaz (2015d) & MinReg (2016).

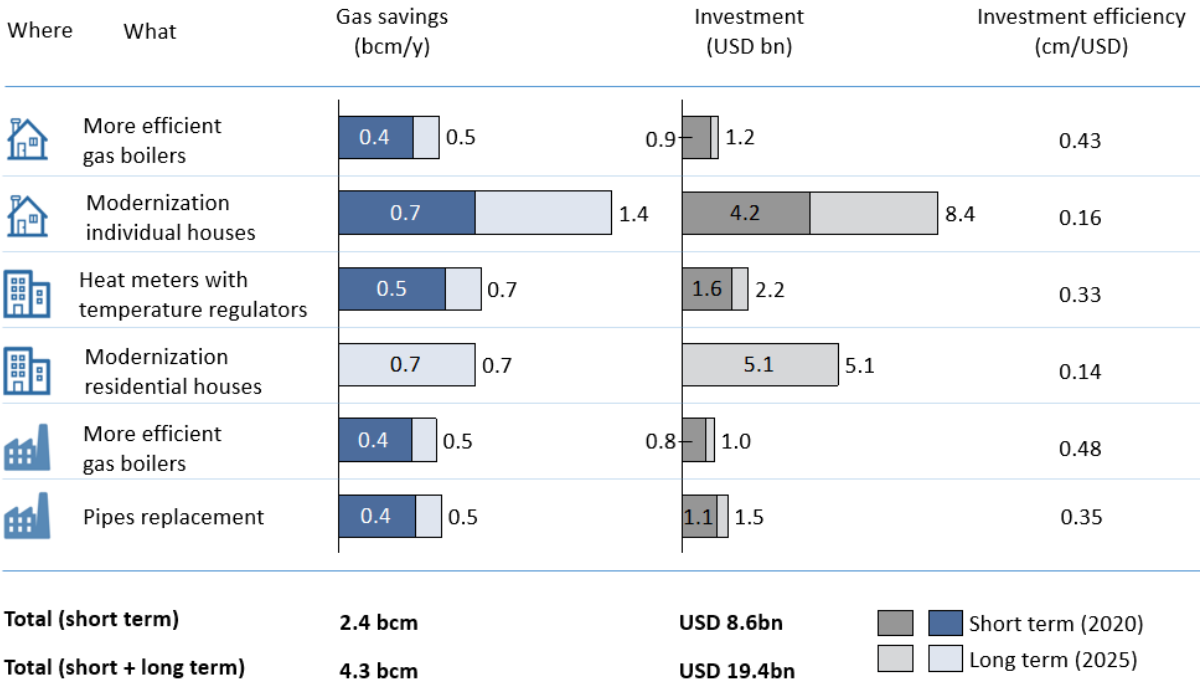
Table 7: Energy savings possible under different scenarios, short and long term (2020)

	Low scenario		Medium scenario		High scenario		Total potential	
	Short	Long	Short	Long	Short	Long	Short	Long
Total gas savings, bcm/y	1.6	2.5	2.4	4.3	3.3	6.3	6.0	11.8
Total investment, $bn	5.3	10.2	8.6	19.4	12.7	29.3	23.3	57.4

Source: Own scenario estimates based on Minreg, (2016) and Naftogaz, (2015d).

In Table 8, our medium scenario for the development of Ukrainian energy efficiency measures is outlined in more detail (medium scenario). In a similar fashion, the low scenario and the high scenario are outlined in more detail in the appendix in Table 16 and Table 17.

Table 8: Estimate of gas savings in a medium scenario, long and short term



Source: Own scenario estimates based on Minreg, (2016) and Naftogaz, (2015d).

The medium scenario in Table 8 has been created by separately evaluating the probable extent of implementation of each possible energy efficiency measure, weighing the probabilities according to:

- If it already started in 2015, such as metering and replacement of boilers in DHC, the measure gets a high estimate of implementation (around 80% in scenario 2);
- If it has a comparatively high investment efficiency measured in saved cm/$, it will get a higher estimate of implementation (between 40–50% in the medium scenario for gas boilers for individual houses and district heating companies);
- If the measures require legal changes or large investments, they are deferred to the long term and given a quite low estimate of implementation, for example thermo-modernization of blocks of flats estimated at 30%, and only in the long term.

To conclude, in the medium scenario it is assumed that the easily available and relatively economically efficient measures are undertaken to a large extent, namely investments in more

efficient gas boilers for households, heat meters for blocks of flats[122] and investments in more efficiency in generation and transmission of DHCs. Thermo-modernization of the housing stock is assumed to be done only to 30% of its potential, even in the long term, due to the legal and financial hurdles to be overcome, as well as its relatively low rate of return compared to the other measures. The total savings from energy efficiency measures are estimated at 2.4 bcm in the short run and at 4.3 bcm in the long run, the latter representing 19.5% of the total consumption in the sector in 2014.

6.5 Estimation of the effect of income changes

Another important factor that will affect the development of gas and heat demand in the future is household income. In accordance with theory, all other things equal, we expect that the richer the Ukrainian households get, the more gas and heat they will consume, and vice versa. As found by our model, for each 10% increase/decrease in income, the gas and heat demand is expected to grow/fall by 2.2% and 1.1%, respectively.

Due to the ongoing economic crisis, Ukrainian real GDP fell in 2015 by 9.9% but, according to the IMF prediction is expected to rebound by 1.5% in 2016 and by a further 2.5% in 2017[123]. If the 2.5%/year growth were to continue until 2020, real GDP would be almost 1% higher than in 2014. Even if the growth path will not be realized to such an extent or, on the contrary, will surprise us by its pace, the 2020 real GDP in high likelihood will lie within ±7% of the 2014 level and, for simplicity, we expect the same for real income. As seen in Table 9, such changes in income will have a very small expected effect on both gas and heat demand.

Table 9: Consumption decline, scenarios based on different income changes

	Low growth	Medium growth	High growth
2017–2020 annual change in real GDP	1.0%	2.5%	4.0%
2020/2014 total change in real GDP	(4.8%)	0.9%	7.0%
Change in gas consumption, %	(1.0%)	0.2%	1.5%
Change in heat consumption, %	(0.5%)	0.1%	0.8%
Total change, bcm	**(0.15)**	**0.03**	**0.22**

Source: Own estimates.

7 Scenarios for demand

There are numerous factors which will determine the household natural gas demand in Ukraine in 2020. In the next few years, the most important factor will be households adjusting themselves to the removal of the implicit subsidies—a mechanism which has already created a strong downward pressure on gas consumption. At the same time, we expect to see simultaneous investments in energy efficiency measures, stemming from increased prices and governmental efforts, which will further drive the decrease. Third, the Ukrainian government promised to shield the poorest from the effects of the subsidy removal and thus the extent of this help will also change the predicted size of the market. Fourth, we expect changes in household income to play only a minor role, as we anticipate similar income in 2020 as in 2014. Last but not least, we do not factor in the possible effects of an increased non-payment rate as we assume that both paying and non-paying households will adjust their consumption in a similar fashion. A summary of the factors can be seen in Table 10 below.

[122] Heat meters are not strictly speaking an energy efficiency measure, since the efficiency gains are achieved entirely through behaviour changes, leading to lower energy consumption. They are included here since they require investments (in meters) and will lead to less gas being consumed in Ukraine.
[123] IMF (2016).

Table 10: Summary of changes in the overall household gas demand

2020 import price	**$170**			**$200**			**$230**		
Effect of the implicit subsidy removal, bcm[124]	(5.7)			(6.8)			(8.0)		
Households protected from the price increase	10.0%	18.5%	27.0%	10.0%	18.5%	27.0%	10.0%	18.5%	27.0%
Additional change from explicit subsidy, bcm	(1.1)	(0.5)	0.0	(1.2)	(0.5)	0.0	(1.3)	(0.6)	0.2
Total change from subsidy removal, bcm	(6.7)	(6.2)	(5.7)	(8.0)	(7.4)	(6.7)	(9.3)	(8.6)	(7.8)
Energy efficiency by 2020	low			medium			high		
Total change, bcm	(1.6)			(2.4)			(3.3)		
Annual GDP growth (2017–2020)		1.0%			2.5%			4.0%	
Total change from income, bcm	(0.2)			0.0			0.2		

Source: Own estimates. Numbers may not add up due to rounding.

Based on our estimates, we have constructed three scenarios which exemplify different possibilities of how demand could develop (see Table 10). Scenario 2 is constructed with the values of variables chosen in order to represent our estimates of what we think is most likely to happen. Scenario 1 and Scenario 3 provide scenarios with likely developments which give a low and high estimate respectively.

Scenario 1: low import price of $170, extensive protection of vulnerable households through explicit subsidies covering 27% of all households, low energy efficiency investments, and 2.5% annual GDP growth from 2017 onwards. Under this scenario, the import price will be low—resulting in lower domestic gas prices. As a consequence, the increases from the 2014 price of gas and heat necessary for establishing import-parity will be relatively low. This, in turn, will not stimulate energy efficiency as strongly as with high prices and thus we assume low energy efficiency investments in this scenario. At the same time, because prices are low it will prove cheap for the government to provide vulnerable households with explicit subsidies easing the burden of higher prices and thus we assume a full coverage of 27%. All in all, under such circumstances we predict a fall in the household market size of only 33%, or 7.2 bcm, to a level of 14.8 bcm of household gas consumption in 2020.

Scenario 2: medium import price of $200, extensive protection of vulnerable households through explicit subsidies covering 27% of all households, medium energy efficiency investments, and 2.5% annual GDP growth from 2017 onwards. In this scenario, import prices will be at the same level as in the first half of 2016 and thus will put more pressure on energy efficiency investments than in Scenario 1. Although funding explicit subsidies will be more expensive, it should still be possible to provide them to the full proposed scope, especially given the promise of the IMF to provide loans towards that end[125]. In such a case, we see the demand fall by around 41%, or 9.1 bcm, to 12.9 bcm of gas consumption.

Scenario 3: high import price of $230, medium protection of the vulnerable households through explicit subsidies covering 18.5% of all households, high energy efficiency investments, and 2.5% annual GDP growth from 2017 onwards. The high import price of $230 will make gas very expensive

[124] Assuming a stable relative share of explicit subsidies. For more details, see Chapter 4.3 on implicit natural gas subsidies.
[125] MinReg (2016).

to households given the import-parity pricing. This will drive their consumption down and exert a large pressure to implement energy efficiency measures. Correspondingly, the size of explicit subsidies needed to shield the poorest will grow considerably and we assume only 18.5% of households to be protected from the price increases. In this scenario, we expect demand to fall the most, possibly by as much as 54%, or 11.9 bcm, to a very low level of 10.2 bcm demand in 2020.

Table 11: Scenarios for overall household gas demand changes

	Scenario 1	Scenario 2	Scenario 3
2014 market w/o Crimea	22.0	22.0	22.0
Total change in consumption, bcm	(7.2)	(9.1)	(11.9)
Total change in consumption, %	(33%)	(41%)	(54%)
2020 household market size, bcm	**14.8**	**12.9**	**10.2**

Source: Own estimates.

Overall, the import price has the largest effect on the final predicted consumption, with up to 2.3 bcm difference between a $170 and a $230/mcm import price. This is explained by the fact that with the higher import price, the consumer prices of gas and heat will have to increase by 88 and 44 percentage points more from the 2014 price levels than with the low import price. When applying our elasticity results, differences in import prices result in large effects on consumption. Additionally, the different scenarios for energy efficiency investments lead to quite large differences in the results: 1.7 bcm more savings in Scenario 3 than in Scenario 1. Last, after adding the effects from different levels of explicit subsidies, the total range of our three scenarios adds up to a difference of up to 4.6 bcm in final household and DHCs gas consumption. Our main prediction of the market in 2020 is Scenario 2, where we expect the market to be 12.9 bcm, down 41% from the baseline (Table 11).

In addition to the effects outlined in Table 11, there will be an additional 1.9 bcm/year of gas savings from long term energy efficiency investments until 2025, according to Scenario 2 (Table 8). The majority of these additional savings come from thermo-modernization of private houses and residential buildings, which will happen only over the long term. Thus, the total demand for gas in 2025 is estimated at 11 bcm in Scenario 2.

7.1 Effects on the Ukrainian state budget from a decrease of subsidies

For Ukraine, the previously highly subsidized gas consumption for households was increasingly costly for the state budget. As we calculated in Chapter 4, the average implicit subsidy for gas consumption paid by the Ukrainian state has been 1.7% of GDP in the period from 2012–2015. When the pricing reforms have been fully implemented, this type of subsidy will disappear entirely. Simultaneously, the implicit subsidy will be partly exchanged by explicit subsidies, in 2014 at $0.4bn (0.3% of 2014 GDP) and following our Scenario 2, rising to $1.15bn USD (0.87% of 2014 GDP). The net effect of the reform will thus, according to our medium estimate, amount to yearly savings of around $1.5bn (1.14% of 2014 GDP; see Table 12).

Table 12: Yearly budgetary savings from changes in subsidies

	2014	2020
Implicit subsidy ($bn)	2.27	0
Explicit subsidy ($bn)	0.38	1.15
Total yearly savings from 2016 onwards ($bn)	**1.5**	

Source: Own calculations. All numbers refer to the 2014 exchange rate of 12 UAH/USD.

This should be seen as the lowest estimate of the effect on the Ukrainian budget. In reality, the Ukrainian state has had to cover Naftogaz's deficits of several percentage points of GDP per year, in 2014 as much as 6% of GDP, in addition to the implicit subsidies covering deficits related to currency losses, repayment of outstanding debt and non-payment by DHCs. As was outlined in the Chapter 4 on subsidies, households might react to rapidly increasing tariffs by even further decreasing their level

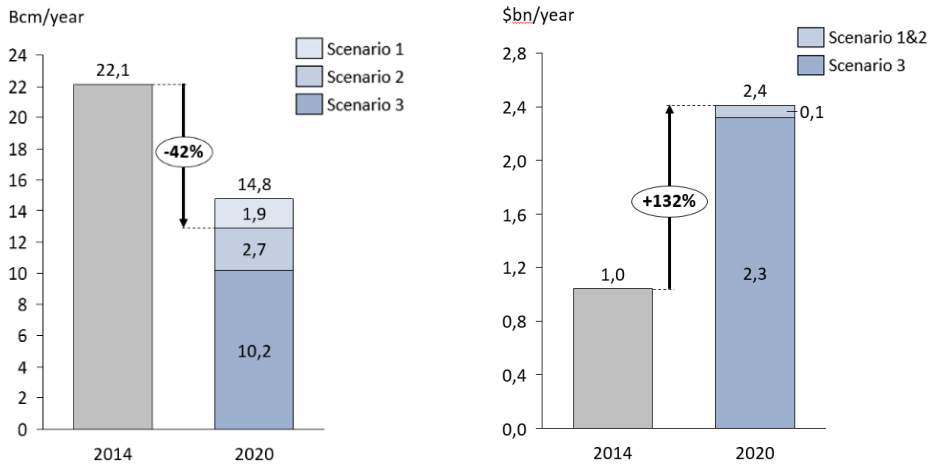
of payments for gas, making the financial situation for DHCs and *Oblgaz*es critical. This in turn could force the Ukrainian government to provide funding to restructure this debt, at an additional cost to government finances not included above. The size of such financing should occur only once and be rather limited as compared to the yearly savings from the removal of the subsidies.

The new pricing system should provide more stability to the Ukrainian state budget, minimizing the large payment fluctuations seen in previous years. Additionally, the new pricing system will create increasing revenues from taxes and royalties on domestic production of gas, now sold at import-parity prices rather than at low, subsidized prices. Last, using the same (or less) money, targeted subsidies provide the same or better support for the most vulnerable parts of the Ukrainian population, as compared to across-the-board implicit price subsidy.

7.2 Effects on the household natural gas market from a decrease of subsidies

Increasing revenues from the higher household gas prices affect the Ukrainian national budget through the lower level of subsidies, but they will also give Naftogaz, mainly through its gas production company Ukrgazvydobuvannya, significantly increased revenues from supplying the Ukrainian market. But the change in the size of the market is relevant to all companies who supply the domestic Ukrainian market. In Figure 17, the estimated size of the 2020 market for natural gas is presented.

Figure 17: Increased size of the natural gas market for households and DHCs, 2020



Source: own estimates. Note that the scenarios assume different import-parity prices for gas (Scenario 1: $150, Scenario 2: $180, and Scenario 3: $220/mcm.)

In Figure 17, we note that in Scenario 2, the most likely scenario, the decrease in the volume of gas sold from the 2014 level is 42%, while the dollar value of the market increases by 132%, to $2.4bn. However, the real attractiveness of the market will depend on profitability and access to the market. Profitability will, besides investment and operational costs and the sales price, mainly depend on the royalty and corporate tax levels imposed by the Ukrainian government. The royalty levels for UGV, defined as a percentage of the selling price, have been fluctuating markedly over the last years, increasing from 20% in 2014, to 70% in 2015 and then down to 50% from April 1, 2016[126]. The royalties for private producers of gas have also been changing, from 55% to 29% for wells less than 5

[126] Simultaneously with the increase in 2015, the price for gas increased. Naftogaz (2015) still estimates that the high royalty had severe consequences for UGV's profitability.

km deep and from 28% to 14% for wells deeper than 5km[127]. The fluctuating royalty rates have made the business environment uncertain for production companies, but the recent changes in tariff structures seem to indicate that the Ukrainian government wants to make the business environment somewhat more attractive.

Importantly, together with both household and DHC gas tariffs, the tariff which UGV receives for the gas it produces has also been strongly increased. From a previously very low level of UAH 1,590/mcm, which led to underinvestment, it was raised threefold to UAH 4,849/mcm, out of which half will go to the state budget in the form of royalties[128]. The government hopes that this will stimulate state-controlled gas production to grow from the current 14.5 to 20 bcm/y by 2020[129], possibly allowing overall Ukrainian production to rise up to 27–30 bcm/y[130].

8 Conclusion

In the last three years, Ukraine underwent a profound reform of its natural gas market. A country which for a decade had been a prime example of how a dysfunctional energy subsidy can cause wasteful energy usage, high financial costs for the state budget and declining domestic production, has become a potential success story of an energy subsidy reform. In 2014, Ukrainian households and DHCs paid a gas tariff in which the gas as a commodity component stood at only 10% and 17% of the average import price, respectively. Furthermore, the cost of heat for the population, produced by DHCs mostly from the subsidized gas, was subject to a second stage of subsidization—as households paid less than ⅔ of the DHCs' already low production cost. By May 1, 2016, the implicit gas subsidies for both households and DHCs had been fully removed, leaving behind only the implicit heat subsidies, now providing households with around a 25% discount on the heat tariff. This profound reform meant significant price increases, although lower than anticipated due to the decrease in European prices for natural gas during the period of the reform. The subsidy reform is, however, highly vulnerable as the legislation required to ensure the independence of the national regulator (NCEPUR) is not yet passed. Prices are still set under significant political influence, which has far-going implications for the sustainability of the reform. For example, as import prices increase in the future, NCEPUR may fail to adjust the domestic prices accordingly, due to political pressure. Similarly, with possibly increasing rates of non-payment among consumers due to the recent subsidy removal, the public pressure to decrease prices could also rise. Thus, implicit gas subsidies may rapidly be reintroduced into the system, bringing with them the associated negative externalities. In our analysis, however, it is assumed that the reform is not scaled back.

In order to assess how overall gas consumption is going to respond to the subsidy removal, we estimated price elasticities of household demand for both gas and heat in 2014. We found that for every 10% increase in the gas and heat tariffs, households consume 2.0% and 1.5% less gas and heat respectively. Assuming a constant 2014 USD/UAH exchange rate, by reaching an import-parity price of gas of $200/mcm, we expect households to consume 48% less gas and 22% less heat. The price increase, in turn, together with an increased political ambition, began to stimulate energy efficiency investments. According to our estimates, by 2020, we should see between 1.6 and 3.3 bcm less demand for natural gas due to such improvements, driven mostly by modernization of individual houses and installation of heat meters in blocks of flats. Altogether, depending on the assumptions,

[127] Afendikov, M. & McGrath, P. (2016, January 4). Ukraine Natural Gas Royalty Rate Reduced to 29%. *Market Wired*. http://www.marketwired.com/press-release/cub-energy-inc-announces-ukraine-natural-gas-royalty-rate-reduced-to-29-tsx-venture-kub-2085185.htm.
[128] MERT (2016),
[129] Ibid. & Naftogaz (2016, February 2). Gas production in Ukraine decreased by 3% in 2015. http://www.naftogaz.com/www/3/nakweben.nsf/0/970478E2A71A6B0FC2257F4C00580C55?OpenDocument.
[130] Ukrgazdobycha: Ukraina k 2020 godu smozhet dobyvat do 30 mlrd kubov gaza (2016, May 11). RIA Novosti. http://ria.ru/world/20160511/1431209002.html.

we expect to see between a 5.7 and 9.3 bcm decline in natural gas consumption, constituting a 26–42% decline from the 2014 baseline. By 2025, we anticipate another 0.9–3.0 bcm decrease due to additional long-run energy efficiency improvements. Importantly, our estimates are in the lower range given the additional effect from possible hryvnia depreciation, which makes attaining import parity prices more expensive for the households.

One of the problems with the large subsidies was the high costs to the Ukrainian state budget, at around 2% of GDP per year. The subsidy reform entirely removes the implicit gas subsidies, while increasing the explicit subsidies paid to vulnerable households. The net effect from these two measures is yearly savings of around 1.1% of the 2014 GDP, or $1.5bn per year. This is only the direct effect. The reform also decreases the state's exposure to Naftogaz's highly fluctuating deficit, in 2014 amounting to as much as 6% of Ukrainian GDP. The reformed system allows the Ukrainian state to increase its spending on direct gas subsidies to the most vulnerable parts of society, while still providing large savings for the state budget, helping to alleviate Ukraine's very grave financial situation. On the other hand, however, the removal of the implicit subsidies may lead to increased rates of non-payment among the population, which were not possible to measure prior to this publication. This, in turn, may require the government to step in and bail out affected households, effectively creating one-off costs to the budget. Finally, an additional problem for the Ukrainian state has been the way subsidies created ample opportunity for corruption, created by the price differential between residential gas and gas used by industry. The removal of the subsidies has the added benefit of completely eliminating such corruption, helping to decrease the amount of gas-related corruption in Ukraine.

Key to how the household market for gas will function are the institutional changes currently being undertaken in Ukraine. The main concern is to what extent third parties will be allowed non-discriminatory access to the transmission network. The current proposed method for unbundling Naftogaz has the state owning both entities, which raises some doubts as to the real independence of the newly created transmission system operator. The suggested inclusion of a foreign minority shareholder in this new entity would alleviate some of the concerns about the Ukrainian state's ability to own and operate the newly created actor with good corporate governance and limited political meddling. However, it will be very hard to find an interested buyer considering the currently very uncertain market opportunities for a transmission operator in Ukraine. Additionally, the corporate governance reforms of Naftogaz and its subsidiaries will play an important role in creating a stable and non-corrupt Ukrainian business environment for natural gas. Naftogaz seems serious about the corporate governance reform of the company and the pressure from international organizations such as the EBRD has been very strong, so there is a decent chance that Naftogaz will start acting more like a modern corporation in the coming years.

Another key factor of the market is the ongoing reform of the regulator's role (NCEPUR) in setting gas prices. The main concern is to what extent the regulator will be free from political influence as well as its commitment to set the domestic prices at the import parity price level. The future attractiveness of the market will depend on gas prices being set at import parity levels, which in turn requires an independent regulator with a clear mandate. Additionally, the current high market concentration of *oblgaz*es, with 70% of the market being controlled by one actor, is likely to hamper the development of a competitive market for natural gas. Last, supplying gas to DHCs could become attractive as the commodity prices for DHCs are set at import parity levels. The main concerns about DHCs are their high non-payment rates caused by their very difficult financial situation.

In 2015, Ukraine for the first time since its independence imported less gas than it produced domestically, 16.4 bcm versus 19.9 bcm[131]. Ukrainian gas production has been relatively stagnant so this change in import dependency can be mostly attributed to the fall in consumption. If other consumption and local production remains stable, the household subsidy reform together with the

[131] Naftogaz (2016, February 2). Naftogaz released a summary of Ukraine's 2015 gas consumption, production and imports data. http://www.naftogaz.com/www/3/nakweben.nsf/0/FBBBC945CFD75869C2257F4C0057B9A6?OpenDocument.

ensuing energy efficiency improvements can make the need to import gas 35–63% smaller in 2020 than in 2014, positively contributing to Ukrainian energy security. Simultaneously, despite the falling consumption of gas, the dollar value of the market will be increasing as a result of higher tariffs. By 2020, the household gas market should be worth around $2.3bn, compared to around $1.1bn in 2014. The new financial conditions for natural gas production could allow UGV and other Ukrainian producers to scale up their production, further decreasing the Ukrainian dependency on imports. From 2014 to 2016, the tariffs for UGV have been increased by three times, in line with the government's ambitious plans to increase domestic production. Although the government claims it would like to produce 27–30 bcm/y by 2020 and become a net exporter of gas, the future remains very uncertain as the industry remains skeptical about the effectiveness and consistency of the reforms and many international players cancelled a number of important projects.

The successful removal of natural gas and heat subsidies in Ukraine can serve as an example for other countries that may consider implementing similar reforms. Many former post-Soviet states have similar issues as Ukraine with subsidized energy prices, leading to low energy efficiency, high costs for the state budget and less profitable domestic gas extraction. Reformers should take advantage of the currently very low international prices for natural gas by decreasing or removing price subsidies, while also introducing efforts to increase energy efficiency. The framework presented in this paper for calculating the effects on the size of the gas market could be used by policy makers seeking to evaluate the effects of a whole or partial subsidy removal of natural gas.

Bibliography

CASE Ukraine (2016). *The price of the state: budget deficit in Ukraine*. Retrieved from http://cost.ua/en/budget/deficit.

Henderson, J., & Pirani, S. (2014). The Russian gas matrix: how markets are driving change. Oxford University Press: Oxford, UK.

IEA (2014). World Energy Outlook 2014. OECD/IEA Retrieved from http://www.worldenergyoutlook.org/weo2014/.

IMF (2014a). Ukraine, Request for a Stand-by Arrangement. IMF Country Report No. 14/106 Retrieved from https://www.imf.org/external/pubs/ft/scr/2014/cr14106.pdf.

IMF (2016). Central, Eastern, and Southeastern Europe: How to Get Back on the Fast Track. Regional Economic Issues: May 2016. Retrieved from http://www.imf.org/external/pubs/ft/reo/2016/eur/eng/pdf/rei0516.pdf.

Interfax Ukraine (2016, April 4). *Ukraina v I kv.-2016g uveličila tranzit gaza v 1.5 raza*. Retrieved from http://interfax.com.ua/news/economic/335278.html.

MERT (2016). Čomu i jak zminjujut'sja cini na gaz i teplo z 1 travnja 2016 r. Retrieved from https://issuu.com/mineconomdev/docs/ministrypresentation11-2.

MigNews (2015, December 2). *Na Novyj god doma bez sčetčikov otključat ot gaza*. Retrieved from http://mignews.com.ua/ukraine/8561671.html.

Mikhaylovskaya, S. (2009). *Osobennosti formirovanija i ustanovlenija cen na prirodnyj gaz dlja različnyh kategorij potrebitelej* [PowerPoint slides]. Retrieved from http://erranet.org/index.php?name=OE-eLibrary&file=download&id=6315.

MinReg (2016): The Ministry of Regional Development, Construction, and Communal Living of Ukraine. *Heating in housing and utilities sector: status and prospects, document for discussion* [PDF Document]. http://www.slideshare.net/ZubkoGennadiy/heating-in-housing-and-utilities-sector.

Mitra, P. & Atoyan, R. (2012). Ukraine Gas Pricing Policy: Distributional Consequences of Tariff Increases. *IMF Working Paper.* Retrieved from https://www.imf.org/external/pubs/cat/longres.aspx?sk=40047.0.

Naftogaz (2015a). *Reforming Naftogaz of Ukraine, strategic objectives* [PDF Document]. Retrieved from http://www.naftogaz.com/files/Information/Naftogaz_Reforming-eng.pdf.

Naftogaz (2015b, August 17). *Naftogaz publishes statistics of imported gas prices for the second quarter 2015.* Retrieved from http://naftogaz-europe.com/article/en/StatisticsGasPrices.

Naftogaz (2015c). *Naftogaz of Ukraine: annual report 2014* [PDF Document]. http://www.naftogaz.com/files/Zvity/Naftogaz_Annual_Report_2014_engl.pdf.

Naftogaz (2015d). *Ukraine's gas market reform: green light to investments in natural gas transmission, production and energy efficiency* [PowerPoint slides]. Retrieved from http://www.naftogaz.com/files/Information/2015-07-13%20UA-US%20Naftogaz%20Forum%20Presentation.pdf.

Naftogaz (2015e, April 7). *Natural gas transit via Ukraine 1998-2014*. Retrieved from http://naftogaz-europe.com/article/en/NaturalGasTransitviaUkraine.

Naftogaz (2016a, February 8). *Naftogaz released gas imports statistics for Q4 2015*. Retrieved from http://naftogaz-europe.com/article/en/NaturalGasTransitviaUkraine.

Naftogaz (2016b, January 14). *Ob"emy prirodnogo gaza v podzemnyh hranilišah gaza Ukrainy*. Retrieved from http://naftogaz-europe.com/article/ru/gasstorageinjectionrus.

Naftogaz (2016c, April 28). *Gazovyj paritet: v cene na gaz postavlena točka*. Retrieved from http://www.naftogaz-europe.com/article/ru/gazovyjparitetvcenenagaz.

Naftogaz (2016d, January 29). *Gas consumption in Ukraine declined by 21% in 2015*. Retrieved from http://naftogaz-europe.com/article/en/vikoristannjagazueng.

NCEPUR (2015). *Zvit pro rezul'tati dijal'nosti Nacional'noï komisii, ŝo zdijsnjue deržavne reguljuvannja u sferah energetiki ta komunal'nih poslug*. Retrieved from http://www.nerc.gov.ua/data/filearch/Catalog3/Richnyi_zvit_2014.pdf.

Pirani, S. (2007). Ukraine's gas sector. *Oxford Institute for Energy Studies.* https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG21-UkrainesGasSector-SimonPirani-2007.pdf

Rozwałka P. & Tordengren H. (2016). Household demand for natural gas in Ukraine—the effects of the subsidy reform. *Stockholm School of Economics.*

Repko, M., Antonenko, H., Kukhta, P., Piontkivska, I., and Zakharov, A. (2015). Či povinna cina na gaz buti rinkovoju. Analitična zapiska [PDF Document]. *Center for Economic Strategy.* Retrieved from http://ces.org.ua/wp-content/uploads/2015/07/ces_paper_gas_prices_ukr.pdf.

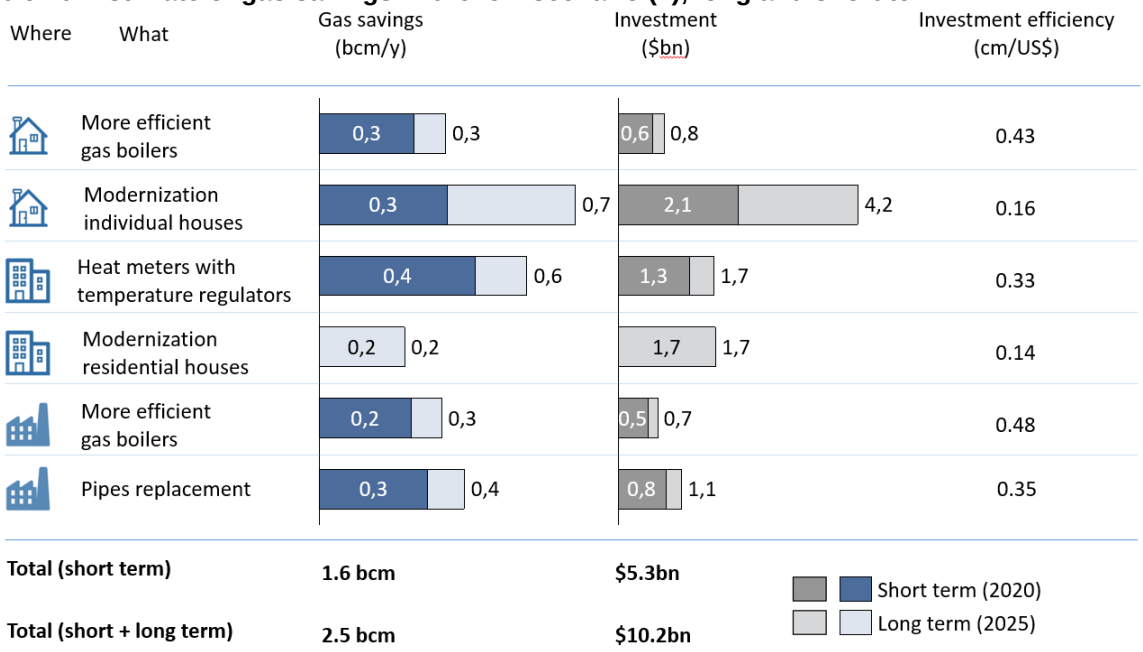
Semikolenova, Y., Pierce, L., & Hankinson, D. (2012). Modernization of the district heating systems in Ukraine: heat metering and consumption-based billing. World Bank Report No. 64989-UA.

World Bank (2016). *Ukraine data*. Retrieved from http://data.worldbank.org/country/ukraine.

Yafimava, K. & Stern, J. (2007). The 2007 Russia-Belarus Gas Agreement. *Oxford Institute for Energy Studies*. Retrieved from https://www.oxfordenergy.org/publications/the-2007-russia-belarus-gas-agreement/.

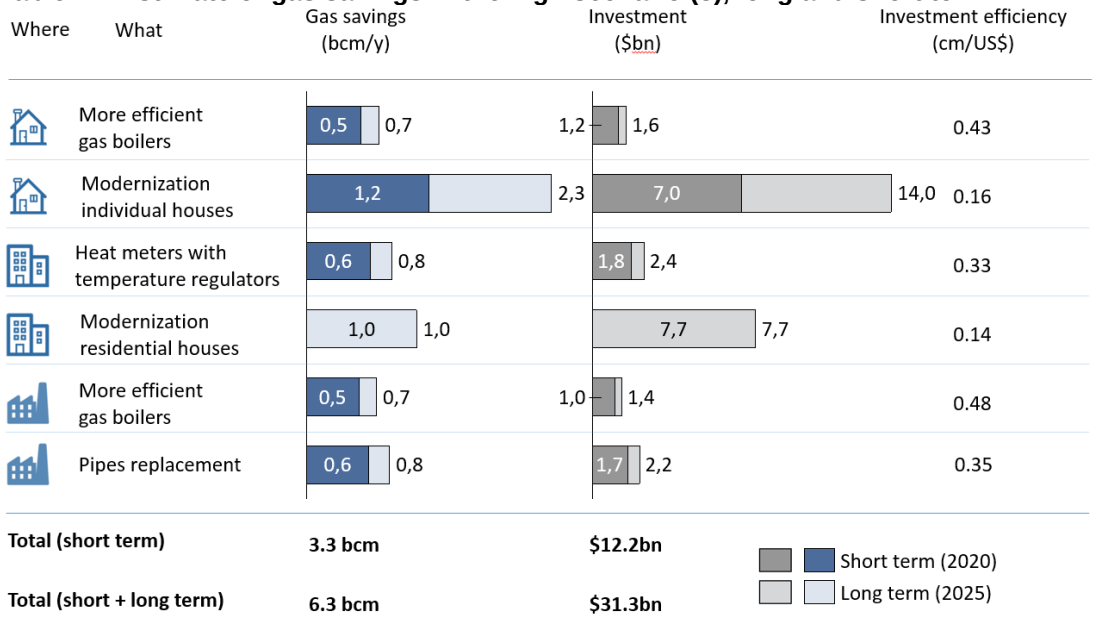
Appendix

Table 16: Estimate of gas savings in the low scenario (1), long and short term



Source: Own scenario estimates based on Minreg, 2016 and Naftogaz, 2015d.

Table 17: Estimate of gas savings in the high scenario (3), long and short term



Source: Own scenario estimates based on Minreg, 2016 and Naftogaz, 2015d.