





# Economic recession and natural gas demand in Europe: what happened in 2008-2010?

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## Summary and conclusions

This paper is a companion piece to the book "*Natural Gas Supply, Demand and Prices: Cycles, seasons, and the impact of LNG price arbitrage*" published in January 2011 by the OIES.[1] The aim of this paper was to give a short statistical update on gas demand since the book was finished. The main text provides some concise analysis on gas demand trends and the main sectors of consumption. The appendices offer additional statistical details by country.

**Natural gas demand in 2008-2010**

The initial conclusion is that it is very difficult to analyse what happened to gas consumption in Europe during 2008-2010. Available data in the public domain is contradictory, unsatisfactory and sometimes unavailable. Nonetheless, some general patterns seem to emerge from the statistical chaos.

Our calculation of seasonally adjusted gas demand data show that consumption in winter 2008-09 fell back to winter 2003-04 levels. Observed demand dropped by 5.6 percent in OECD Europe in 2009 compared with 2008 according to the International Energy Agency (IEA) *Natural Gas Information 2010*. The picture was not identical across the region, with the major fall registered in Greece, Hungary and Spain. The fall in industrial output and electricity generation lead us to believe that the industrial sector and to a lesser extent, the power sector were particularly hard hit. Statistical data for the end of 2009 and the first quarter of 2010 showed some signs of recovery, although this was largely due to colder temperatures than average and the previous winter. This kept demand in the residential and commercial sector high. We estimate that demand in the winter 2009/10 was about 9.5 billion cubic metres (bcm) higher than it would have been in an average winter.

If we take a look at natural gas demand in the winter months (December-March) and apply a temperature-correction to observed levels of gas demand [Table 1], we find that at normal/average temperatures, consumption in winter 2008-09 would have been 26.9 bcm lower than the previous winter instead of just 16.2 bcm lower given by the data on observed demand. This can be explain by a much warmer winter in 2007-08 than average (and therefore demand could have been higher than shown by the levels of observed demand), but also due to the impacts of economic recession. For the winter 2009-10, data on observed demand gives an increase of 22 bcm from the previous winter while temperature corrected data show a growth of just 14 bcm. As a result, we can say that colder than average temperatures had a large impact on the levels of gas demand in winter 2009-10, but that there were already some signs of economic recovery translated into levels of gas demand. Some switching to gas in the power sector also helped the rebound of gas consumption.

[1] Honore (2010), *Natural Gas Supply, Demand and Prices: Cycles, seasons, and the impact of LNG price arbitrage*, OIES/OUP: Oxford, http://www.oxfordenergy.org/gasprog.shtml

Table 1: Change in total gas demand during winter times in OECD Europe (2008-2010), observed and temperature corrected consumption (bcm)

| | Observed | Temperature-corrected |
|---|---|---|
| Winter 2008/09 compared to winter 2007/08 | -16.2 | -26.8 |
| Winter 2009/10 compared to winter 2008/09 | +22.5 | +14 |

Sources:
Observed demand: IEA (monthly), Natural Gas Survey, various issues, table 1
Temperature corrected demand: Author's analysis

**Signs of recovery in 2010**

Since the second half of 2009, industrial output has been slowly rising again. On the other hand, more electricity generated from nuclear, hydro and other renewables in 2010 has been dampening the recovery of gas demand in the power sector initiated in the second half of 2009. In the second and third quarters of 2010, industrial output and gas used for power generation slowed down. Temporary growth drivers provided by political and fiscal stimulus have ended and self-sustaining growth dynamics seem to have not replaced them yet. All these factors question the assumption of "faster and stronger recovery than previously foreseen" for 2010. Demand will recover progressively, but not necessarily faster than expected, except if the cold temperatures that happened in November and December 2010 improved natural gas consumption, which they probably did. Cold temperatures at the beginning and the end of the year will have boosted gas demand, and although the impact of cold temperatures should not be confused with underlying recovery, signs of economic improvement and, as a consequence, signs of a slow recovery of gas demand in 2010, enhanced by temperature effects, is the overall picture.

**New outlook up to 2020**

Despite the general gloom, my longer analysis[2] showed that there was some potential for growth in the European market. Looking forward, economic recovery will play an important role, but the key sector will be the power generation sector. Gas demand will be driven by the construction of new gas-fired power plants, but consumption will not be as much as anticipated by scenarios in the early to mid 2000s due to lower and very uncertain load factors. The major uncertainties in addition to the ones we had before 2008 (use of gas plants as back up generation for wind, efficiency measures and maturity in the industrial sector) are: When will the recovery happen? What shape it will take? Will industrial demand for power recover to pre-crisis levels? Will demand destruction need to be taken into account in new scenarios?

At the European level,[3] we anticipate an average increase of 0.6 percent per year (an average of 1.5 percent for the power sector and 0.2 percent for the non-power sectors) up to 2020. Gas

[2] Ibid
[3] In my book, Europe includes 35 countries (14 more than the OECD region considered in this paper) in order to take into account markets interconnected by pipelines: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of

consumption is expected to return to 2008 levels around 2012-13, but with major differences between the national markets, sectors of consumption and period of recovery. If this proves to be correct, gas demand was expected to be close to TOP levels of contracted pipeline gas in 2010, but should be slightly above in 2011. Indigenous production and annual contracted quantity (ACQ) levels of contracted pipeline gas can cover demand up until at least 2012, but all contracted gas (including LNG) is expected to be below demand post 2014 (or later if demand does not pick up as anticipated), which means that, despite a catastrophic 2009-year for gas demand, Europe will need to secure additional gas supply probably as soon as 2015 to cover its –still growing- consumption.

Macedonia, Romania, Serbia and Montenegro, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom (UK).

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# Definitions

## Regional definitions and country groupings

**OECD region**: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

**OECD Europe**: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey and United Kingdom. In this paper, we do not look at Iceland, which is not connected to the European gas network and does not consume any gas. There is therefore only 22 "OECD Europe" countries in our tables.

**Europe 27:** Belgium, Bulgaria, the Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden and the United Kingdom.

**Euro area (16 countries)**: Belgium, Germany, Ireland, Greece, Spain, France, Italy, Cyprus, Luxembourg, Malta, the Netherlands, Austria, Portugal, Slovakia, Slovenia and Finland.

## Natural gas demand

**Demand / consumption of natural gas:** in this paper, natural gas demand (or consumption) represents deliveries of marketable gas to the inland market. In the IEA tables (main statistical source), total demand includes:

1/ transformation sector (main activity electricity, autoproducers electricity, main activity CHP plants, autoproducers of CHP, main activity heat plants, autoproducers heat plants, gas works, gas to liquids, other transformation)

2/ energy sector (coal mines, oil and gas extraction, gas inputs to oil refineries, coke ovens, gas works, other energy)

3/ distribution losses

4/ final consumption:

i/ industry: iron and steel, chemical, non-ferrous metals, non-metallic minerals, transport equipment, machinery, mining and quarrying, food and tobacco, pulp, paper and printing, wood and wood products, construction, textiles and leather, non-specified;

ii/ transport: road, pipelines, non-specified

iii/ other sectors: commerce and public, residential, agriculture including fishing, non-specified

iiii/ non-energy use (industry): petrochemical feedstocks, other

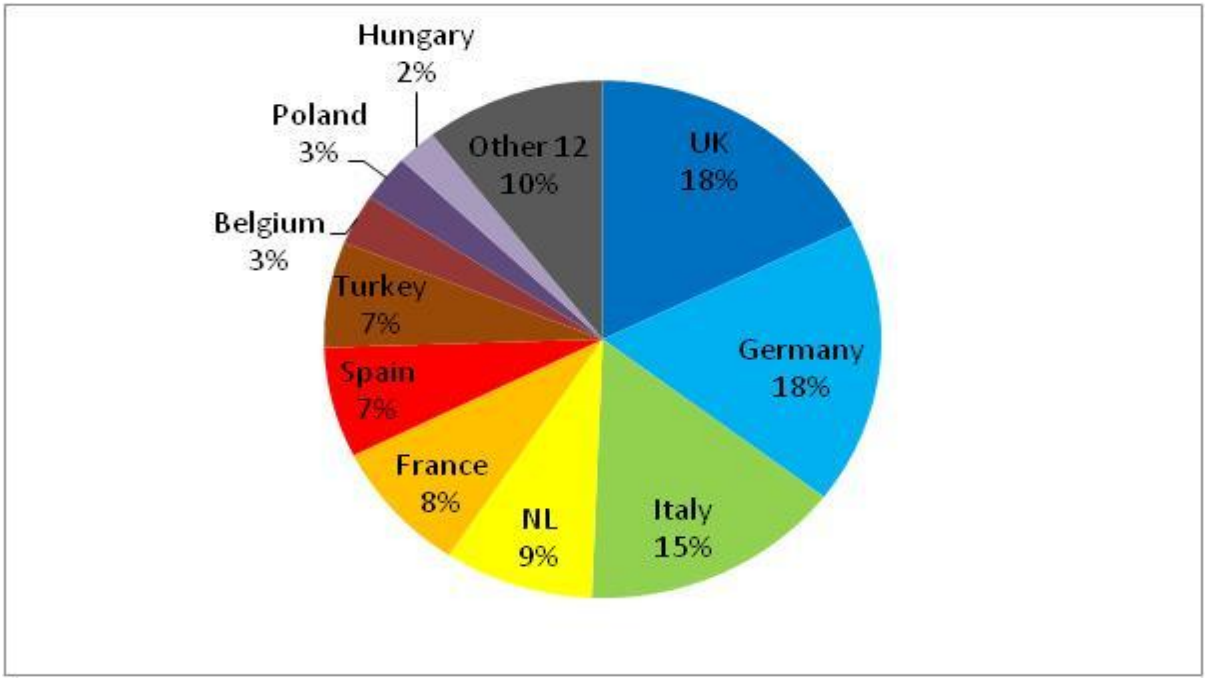
A detailed definition of natural gas (supply and) consumption items used in the IEA statistics can be found in IEA (annual), *Natural Gas Information*, pages xi–xiii. Additional information on IEA data on natural gas can be found in 'Energy Statistics, Manual', pages 55–68 (gas consumption on pages 64–65).

In this paper, the term "power sector" is largely used to describe the "transformation sector". The "non-power sectors" refer to total gas demand minus gas consumed in the power sector.

**The seven major natural gas markets in Europe**

**Seven "major gas markets" in OECD Europe in 2008[4]:** UK (18 percent of total demand), Germany (18 percent), Italy (15 percent), Netherlands (9 percent), France (8 percent), Spain (7 percent) and Turkey (7 percent).

Figure 1: National gas markets in OECD Europe in 2008




Source: IEA, *Natural Gas Information 2010*, part II, page 8, table 3

[4] Due to uncertainties regarding data for 2009, we decided to present the numbers for 2008. The ranks between the major seven markets may have changed in 2009, especially between the UK and Germany and Spain and Turkey, but these markets are still the by far the biggest consumers of gas in Europe.

## Abbreviations

| | |
|---|---|
| AGRY | Average growth rate per year |
| Bcm | Billion cubic metres |
| CHP | Combined heat and power |
| ENTSOE | European Network of Transmission System Operators for Electricity |
| EU | European Union |
| GDP | Gross domestic product |
| GWh | Gigawatt hour |
| HDD | Heating degree days |
| IEA | International Energy Agency |
| LNG | Liquefied natural gas |
| MBtu | Million British Thermal Units |
| Mcm | Million cubic metres |
| n/a | Not available |
| OECD | Organisation for European Economic Cooperation |
| OIES | Oxford Institute for Energy Studies |
| Q1, Q2, etc. | First quarter of the year (Jan-Mar), second quarter of the year (Apr-Jun), etc. |
| R&C | Residential and commercial |
| TJ | Tera joules |
| TOP | Take or pay |
| TWh | Terawatt hour |
| $ | US dollars |
| Vs | Versus |

## Introduction

This paper is a companion piece to the book "*Natural Gas Supply, Demand and Prices: Cycles, seasons, and the impact of LNG price arbitrage*" published on January 2011 by the OIES.[5] The first aim was to provide a short statistical update on gas demand since the book was finished. The text presents some concise analysis on gas demand and the main sectors of consumption based on statistical data and information available in the public domain at the time of writing (December 2010). The statistical appendices provide additional statistics by country and can be consulted by those wishing to explore the subject in detail.

The energy world and therefore the gas industry are not isolated from what happens in the rest of the economy. The global financial crisis and following economic recession[6] have caused major confusion in energy and gas markets fundamentals around the world. While gas demand declined in the wake of the economic downturn, new supply surged thanks to an increase in the world supply of liquefied natural gas (LNG) and an increase in shale gas production in the US. This unprecedented shift in supply/demand balances created new dynamics in the European gas industry. Since 2008, the European natural gas industry has seen its world turned upside down. The future of pricing mechanisms and long term contracts, the core of the regional gas industry for the past 50 years, are seriously questioned by almost all market players.

While all the aspects of these major developments are tremendously interesting for the future of the European gas market (demand, supply, pricing and contracting), this short paper is focusing on the demand side of the story: do we know what really happened in 2008 – 2010? And how is the recovery shaping up?[7]

The European natural gas industry was not immune to the effects of the international economic meltdown and demand declined by an unprecedented 5.3 percent in 2009.[8] The fall was expected to have been concentrated in two sectors, industry and power.[9] In the first three quarters of 2010, gas demand seemed to have picked up quickly (+7.3 percent), leading to expectations of a faster and stronger recovery than previously foreseen.[10] In order to try and understand the situation, we have decided to first look at the major sectors that have been hard hit by the economic recession, starting with some information on gross domestic product (GDP) growth rates before turning to industrial production and electricity generation. This information brings valuable information to interpret

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[5] Honore (2010), *Natural Gas Supply, Demand and Prices: Cycles, seasons, and the impact of LNG price arbitrage*, OIES/OUP: Oxford, http://www.oxfordenergy.org/gasprog.shtml

[6] Economic recession is defined as a decline in gross domestic product (GDP) for two or more consecutive quarters.

[7] For additional information, see Stern (forthcoming 2011), "Continental European Gas Prices in Transition", OIES

[8] IEA, Monthly Gas Survey, data calculated as an average of growth/decline in 2009 in the 22 OECD European countries. See Appendix 1 for more information on statistics.

[9] IEA (2010), *Medium-Term Oil and Gas Markets 2010*, page 141

[10] Eurogas (2010), "Eurogas: Gas Demand in 2010 Could Return to Pre-crisis Levels", Press Release, 16 September 2010

natural gas demand changes at the European and national level presented in the second section. Another major factor that influenced demand in 2008-2010 was colder than usual temperatures, whose impacts are examined in section three. The final section draws together some conclusions. The appendices provide additional statistical data, as available by December 2010, for the 22 countries considered in this paper that the reader can consult for more detailed information. Analysing natural gas consumption involves substantial statistical and methodological problems. Explanations of problems we have encountered with statistics can be found in Appendix 1 and should be consulted by those wishing to explore the subject in detail.

## I/ Economic activity in Europe in 2008-2010

This section provides an introduction to the major changes that took place in 2008-2010 in Europe, which in turn, had an impact on the energy -and gas- markets. It examines the downturn of the economic activity and GDP growth rate scenarios, before turning to production in industry and electricity generation, two sectors where gas demand is expected to have been particularly hard hit.

### 1/ Evolution of GDP and projection

The financial crisis began in mid-2007. It triggered the global economic crisis that transformed into a severe recession in the second half of 2008.[11] The globalisation of the contraction and the pace of the downturn were unprecedented post-World War II.[12] Initially, the depth of the recession was largely underestimated, and GDP forecasts for 2009 and beyond were revised downwards all though 2009.[13] The severity of the recession was confirmed with a decline of 1 percent of the world GDP in 2009 and 4.1 in the Euro area according to the OECD Economic Outlook published in November 2010.[14] Europe entered recession by the third quarter of 2008 and emerged by the third quarter of 2009.[15] By November 2010, the OECD expected 1.7 percent of economic growth in 2010 and 2011 in the Euro area and 2 percent in 2012, less than in the total OECD region, the USA and Japan, expect for 2012 [Figure 2].

[11] For more information on the economic crisis of the late 2000s, see IMF (2009), 'World Economic Outlook, crisis and recovery'

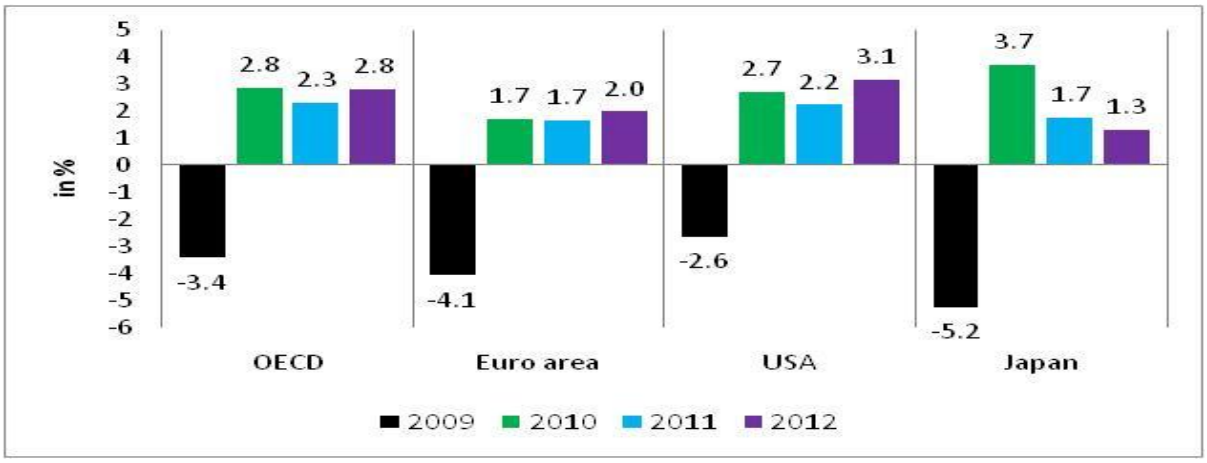
[12] IMF (2009), 'World Economic Outlook, update, Global Economic Slump Challenges Policies', and OECD (November 2010), 'OECD Economic Outlook n.88'

[13] See Honore (2010), *Natural Gas Supply, Demand and Prices, Cycles, seasons, and the impact of LNG price arbitrage*, page 247

[14] OECD (2010), "OECD Economic Outlook, volume 2010/2", page 12, table 1.1

[15] Eurostat, Monthly News-release, Euro-Indicators (several issues), tables on Growth rates of GDP in volume (based on seasonally adjusted data)

Figure 2: GDP - change from previous year, 2009-2012 OECD Projection




Source: OECD Economic Outlook n88" (November 2010), Statistical annex, excel sheet n.1

In 2009, major decline in GDP was seen in Finland and Ireland. Of the seven major European gas markets, Italy, the UK, Turkey and Germany were particularly hit.

The impact of the economic crisis was not uniform around the region [Table 2]. Some countries were out of it by early 2009 such as France, Germany, Portugal, Slovakia or Sweden), while others left recession later than the regional average, such as Hungary, Turkey and the UK which were not out until the end of 2009. Spain and Ireland had to wait until the first quarter of 2010, and Greece was still waiting in the third quarter of 2010 [Table 2]. Only Poland's economy did not enter into recession.

By November 2010, the OECD expected all economies to have positive growth rates in 2010 except Greece, Ireland and Spain. Uncertainty exists for Greece, Portugal, Spain and Ireland up until 2011-2012. All the other markets are expected to register growth from 2010, although at different rates. Turkey's GDP is expected to increase strongly in 2010, 2011 and 2012. Sweden and Slovakia's economies are also expected to bounce back quickly.

Table 2: GDP annual changes and end of recession in OECD countries and Euro area[16]

| | End of recession | GDP at market prices (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Euro area | 3Q09 | 1.8 | 3.1 | 2.8 | 0.3 | -4.1 | 1.7 | 1.7 | 2 |
| Austria | 3Q09 | 2.8 | 3.5 | 3.7 | 1.9 | -3.8 | 2 | 2 | 2 |
| Belgium | 3Q09 | 2 | 2.7 | 2.8 | 0.8 | -2.7 | 2.1 | 1.8 | 1.8 |
| Czech Republic | 3Q09 | 6.4 | 7 | 6.1 | 2.3 | -4 | 2.4 | 2.8 | 3.2 |
| Denmark | 3Q09 | 2.4 | 3.4 | 1.7 | -0.9 | -4.7 | 2.2 | 1.6 | 2.1 |
| Finland | 3Q09 | 3 | 4.4 | 5.3 | 1 | -8.1 | 2.7 | 3 | 3 |
| France | 2Q09 | 2 | 2.4 | 2.3 | 0.1 | -2.5 | 1.6 | 1.6 | 2 |
| Germany | 2Q09 | 0.9 | 3.6 | 2.8 | 0.7 | -4.7 | 3.5 | 2.5 | 2.2 |
| Greece | Still in by 3Q10 | 2.3 | 4.5 | 4.3 | 1.3 | -2.3 | -3.9 | -2.7 | 0.5 |
| Hungary | 4Q09 | 3.2 | 3.6 | 0.8 | 0.8 | -6.7 | 1.1 | 2.5 | 3.1 |
| Ireland* | 1Q10 | 6 | 5.3 | 5.6 | -3.6 | -7.6 | -0.3 | 1.5 | 2.5 |
| Italy | 3Q09 | 0.8 | 2.1 | 1.4 | -1.3 | -5.1 | 1 | 1.3 | 1.6 |
| Luxembourg* | 3Q09 | 5.4 | 5 | 6.6 | 1.4 | -3.7 | 3.3 | 3.3 | 3.2 |
| Netherlands* | 3Q09 | 2 | 3.4 | 3.9 | 1.9 | -3.9 | 1.7 | 1.7 | 1.8 |
| Norway | 3Q09 | 2.7 | 2.3 | 2.7 | 0.8 | -1.4 | 0.5 | 1.8 | 2.3 |
| Poland | Never in | 3.6 | 6.2 | 6.8 | 5 | 1.7 | 3.5 | 4 | 4.3 |
| Portugal | 2Q09 | 0.8 | 1.4 | 2.4 | 0 | -2.5 | 1.5 | -0.2 | 1.8 |
| Slovakia | 2Q09 | 6.7 | 8.5 | 10.6 | 6.2 | -4.7 | 4.1 | 3.5 | 4.4 |
| Spain | 1Q10 | 3.6 | 4 | 3.6 | 0.9 | -3.7 | -0.2 | 0.9 | 1.8 |
| Sweden | 2Q09 | 3.1 | 4.6 | 3.4 | -0.6 | -5.1 | 4.4 | 3.3 | 3.4 |
| Switzerland | 3Q09 | 2.6 | 3.6 | 3.6 | 1.9 | -1.9 | 2.7 | 2.2 | 2.5 |
| Turkey** | 4Q09 | 8.7 | 6.8 | 4.9 | 0.5 | -4.8 | 8.2 | 5.3 | 5.4 |
| UK | 4Q09 | 2.2 | 2.8 | 2.7 | -0.1 | -5 | 1.8 | 1.7 | 2 |

* GDP change in 2Q10 was negative compared with the previous quarter.

**Data for 3Q10 was not available at the time of writing.

Sources :

- End of recession for EU Member States and Norway from Eurostat euroindicators (several issues), Turkey from TMB (2010), "Enflasyon Raporu 2010-III", page 43
- GDP changes at market prices from OECD "OECD Economic Outlook n88" (November 2010), page 268

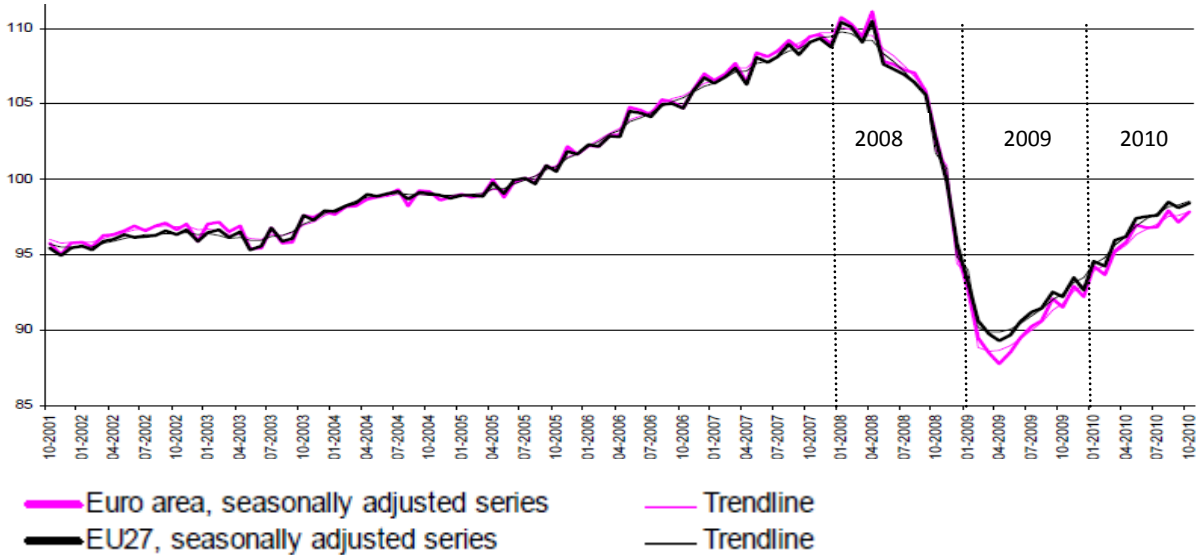
## 2/ Industry sector

Industrial production declined sharply in Europe in 2008-2009 [Figure 3]. It started to grow again from the second quarter of 2009, but was only back to 2003 levels by September 2010 [Figure 3]. More worrying for the near future were the signs of apparent slower growth rate since mid-2010 following the end of political and fiscal stimulus. Although we do not know the direct impact on natural gas demand since some fuels will have been hit more than others, these changes cannot be a

[16] Growth rates of GDP volumes based on seasonally adjusted data: The seasonal adjustment includes a working-day correction for the following Member States: Belgium, the Czech Republic, Germany, Estonia, Spain, France, Italy, Cyprus, Latvia, Lithuania, Hungary, Malta, the Netherlands, Austria, Poland, Slovenia, Slovakia, Finland, Sweden and the United Kingdom.

good omen for future quick recovery of natural gas demand. Gas demand was already slowing down in the industrial sector before 2008 due to maturity of the sector in the major markets, relocations – industry moving out of the area- and efficiency measures. It seems that scenarios will need to take into account some demand destruction following closure of plants that may not reopen.

Figure 3: Industrial production[17] in the Euro area and EU27, base 100 in 2005, for Jan.2001- Oct.2010




Source: Eurostat, News Release, Euro Indicators, 192/2010, 14 December 2010, page 1

As for GDP growth rates, industrial production changes were not uniform around Europe. Eurostat data (from the European Union statistical office) does not give any information for Norway, Switzerland, and more importantly in gas terms, for Turkey, the seventh largest gas market in OECD Europe.

At the European level, industrial output was down by 13.7 percent in 2009 [Table 3]. All countries saw their industrial production decline abruptly, but some countries were more severely hit by the crisis, such as Finland, Luxembourg, Hungary, Italy, Sweden, Germany, Czech Republic and Spain. The other major gas markets (France, the UK and the Netherlands) also faced severe reductions in industrial output.

For the first eight months of 2010, data show that industrial production was growing again in all countries except for Greece and Denmark. It was bouncing back particularly rapidly in Slovakia, Luxembourg, and more importantly, Germany, and Poland. Among other major gas markets, Netherlands was doing best, followed by France and Italy; the UK and Spain were much slower.

It is worth noting that despite encouraging growth in the first eight months of 2010, and as suggested by the regional situation, no countries with the exception of Slovakia and Poland had returned to 2008 levels. In the major gas markets most were still very far from 2008 levels (Spain, Italy, Germany, France, the UK and the Netherlands). Although we do not know the direct impact on

[17] Total industry excluding construction

gas demand for the industrial sector, we can presume that consumption has not rebounded, and will not do so any time soon unless the economic situation improves rapidly.

Table 3: Industrial production changes in Europe, 2008-2010

| | AGRY[18] (%) | January-August 2008-2009-2010 (%) | | |
|---|---|---|---|---|
| | 2008-2009 | 2009 vs 2008 | 2010 vs 2008 | 2010 vs 2009 |
| Euro area | -13.7 | -16 | -11 | 5.9 |
| Austria | -12.3 | -13.7 | -7.9 | 6.7 |
| Belgium | -14 | -15.4 | -10.5 | 5.8 |
| Czech Republic | -15.9 | -18.8 | -11.7 | 8.7 |
| Denmark | -14.7 | -13.8 | -14.9 | -1.3 |
| Finland | -19.1 | -20.9 | -15.4 | 7 |
| France | -12.1 | -14.6 | -10.2 | 5.2 |
| Germany | -16.9 | -19.9 | -11 | 11.1 |
| Greece | -8.6 | -9.1 | -15.3 | -6.8 |
| Hungary | -17.6 | -21.2 | -13.7 | 9.5 |
| Ireland | -8.5 | -8.5 | -3.3 | 5.7 |
| Italy | -17.6 | -20.4 | -17.3 | 3.9 |
| Luxembourg | -18 | -23.5 | -12 | 15 |
| NL | -7.6 | -9.7 | -2.8 | 7.7 |
| Norway | n/a | n/a | n/a | n/a |
| Poland | -3.8 | -7.1 | 2.9 | 10.8 |
| Portugal | -8.4 | -9.8 | -7.9 | 2.1 |
| Slovakia | -3.5 | -8.1 | 12.2 | 22.1 |
| Spain | -15.7 | -18.6 | -17.7 | 1.1 |
| Sweden | -17.4 | -19.7 | -13.4 | 7.8 |
| Switzerland | n/a | n/a | n/a | n/a |
| Turkey | n/a | n/a | n/a | n/a |
| UK | -10 | -11.2 | -9.7 | 1.7 |

Source: Eurostat (monthly), News Release, Euro Indicators, various issues

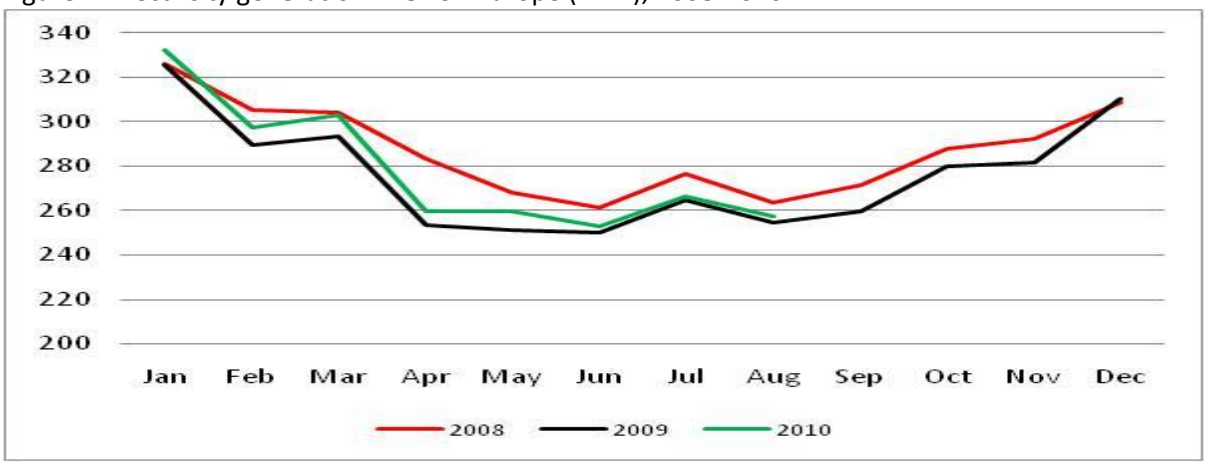
The economic downturn translated into reductions in gas demand from the industrial sector mostly during the first half of 2009, but also into a decline in power consumption by the industry sector.

## 3/ Electricity generation

In Europe, indigenous electricity generation was down by -4.9 percent in 2009. The sector was less impacted than industrial output, which may be explained by lower elasticities in the electricity sector and cold temperatures in both winters (2008-09 and 2009-10). The major decline concentrated in the first half of the year, especially in April [Figure 4]. Because there was no major drop in industrial output in that month, it is possible that this can be explained by changes in the residential and commercial sector, with people switching off their heating sooner than the previous year. Improved industrial production increased the need for power generation in the second half of 2009.

[18] AGRY: Average growth rate per year

Figure 4: Electricity generation in OECD Europe (TWh), 2008-2010




Source: IEA (monthly), Electricity Statistics, regional and country tables

Between January and August, consumption was 2.7 percent higher in 2010 than in 2009, but still 2.9 percent below the 2008 level over the same period [Table 4]. Contrary to expectations, five countries increased their indigenous generation of electricity in 2009 (Austria, Belgium, Luxembourg, Netherlands and Portugal). This is interesting because industrial output slumped in all these countries, sometimes sharply (Luxembourg, Belgium, Austria), so this trend is rather surprising. On the other hand, electricity generation crashed in Slovakia, Sweden, Hungary and Greece, in line with a collapse in industrial production. In the major gas markets, Germany, Italy, France, UK registered a sharp decline while it was less severe in Turkey and Spain. These trends corresponded roughly to expectations given industrial changes, except perhaps in Spain, where the decline in electricity generation might have been even more pronounced.

In the first three quarters of 2010, generation was up by only 1.8 percent, boosted mostly by the cold spell at the beginning of the year. Greece, Norway, Switzerland, UK, Netherlands, Ireland and Italy, had not grown back to 2009 levels over the same period, which was rather unexpected for Italy and the Netherlands considering the rebound in the economy in 2010. But Luxembourg, Finland, Turkey and Sweden had returned to strong growth.

However, the overall situation was not very encouraging, considering that only ten countries out of 22 had reached or exceeded 2008 levels. In the major gas markets, only the Netherlands and Turkey were consuming more, while the other markets were struggling to get back to pre-crisis levels (France, Spain, UK, Germany and Italy).

Electricity generation data gives us the general trend in the sector, not what happened specifically to natural gas used in power plants. ENTSOE publishes some monthly data on electricity generation by fuel. Although it is published at the regional level, and therefore can be used to compare one market to the other, some data were either missing or were insufficient for several countries.[19] The

[19] Denmark, Finland, Germany, Hungary, Ireland, Netherlands, Norway, Sweden, Switzerland, Turkey and the UK

following paragraph therefore shows results for 11 countries out of the 22 we consider in OECD Europe.

Table 4: Indigenous electricity generation changes in Europe, 2008-2010

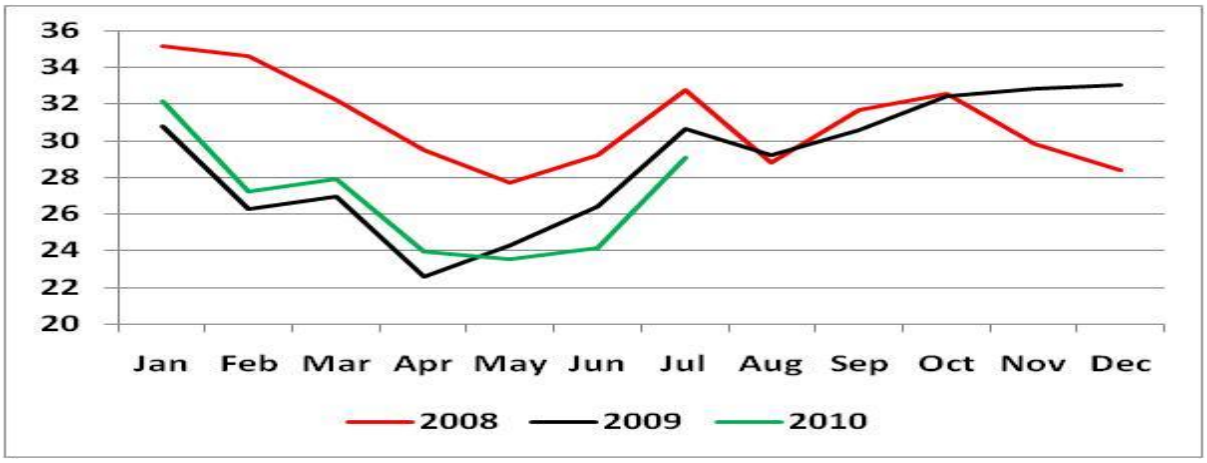
| | Elec prod in 2008 (GWh) | Share of European prod in 2008 (%) | AGRY (%) | Jan-Sep 2008-2009-2010 (%) | | |
|---|---|---|---|---|---|---|
| | | | 2008-2009 | 2009 vs 08 | 2010 vs 08 | 2010 vs 09 |
| OECD Europe | 3461.369 | 100 | -4.9 | -4.6 | -2.9 | 1.8 |
| Austria | 61.7 | 1.79 | 4.4 | 1.3 | 3.4 | 2.1 |
| Belgium | 80.9 | 2.35 | 7.8 | 12.6 | 18 | 4.7 |
| Czech Republic | 77.1 | 2.24 | -1.4 | -4.3 | 1.3 | 5.8 |
| Denmark | 34.6 | 1.01 | -0.1 | 3.9 | 10.1 | 6 |
| Finland | 74.5 | 2.16 | -7.9 | -8.7 | 1.6 | 11.4 |
| France | 549 | 15.94 | -5.7 | -4.9 | 1.1 | 4 |
| Germany | 613.2 | 17.8 | -8.6 | -5.8 | -5 | 0.9 |
| Greece | 57.4 | 1.67 | -9.2 | -3.7 | -12.1 | -8.7 |
| Hungary | 37 | 1.07 | -9.4 | -12.4 | -6.8 | 6.8 |
| Ireland | 29.2 | 0.85 | -8.1 | -6.4 | -6.8 | -0.4 |
| Italy | 304.4 | 8.83 | -8.4 | -10.3 | -10.6 | -0.3 |
| Luxembourg | 3.5 | 0.1 | 8.8 | 14.9 | 31.6 | 14.5 |
| NL | 102.7 | 2.98 | 4.9 | 5.4 | 4.4 | -0.9 |
| Norway | 143 | 4.15 | -7.7 | -13.1 | -18 | -5.6 |
| Poland | 141.2 | 4.1 | -2 | -2.6 | 1.6 | 4.3 |
| Portugal | 45.2 | 1.31 | 7.2 | 7.7 | 7.8 | 0.1 |
| Slovakia | 27.2 | 0.79 | -11.3 | -12.4 | -7.9 | 5.1 |
| Spain | 287.4 | 8.34 | -1.4 | -8.8 | -3.2 | 6.1 |
| Sweden | 146 | 4.24 | -10.5 | -10.8 | -5.4 | 6 |
| Switzerland | 66.9 | 1.94 | -0.6 | 1 | -3.5 | -4.5 |
| Turkey | 190.1 | 5.52 | -2.2 | -4.9 | 4 | 9.3 |
| UK | 372.9 | 10.82 | -4.8 | 2.4 | -3.5 | -5.7 |

Source: IEA (monthly), Electricity Statistics, regional and country tables

Electricity generation data by fuel at the European level shows that gas had not overtaken coal in the first quarter of 2009.[20] It then took a major share of electricity generation in the rest of the year [Figure 5]. Additional gas in autumn made up for lower generation from nuclear power (compared with 2008). Electricity generation in the eleven markets under consideration was slowly picking up in the second half of 2009, but still registered a sharp decline at -7.1 percent over the year.

[20] Coal prices fell from above $200 per tonne mid-2008 to about $60 per tonne by mid-2009. IEA (2010), *Medium-Term Oil and Gas Markets*, page 153

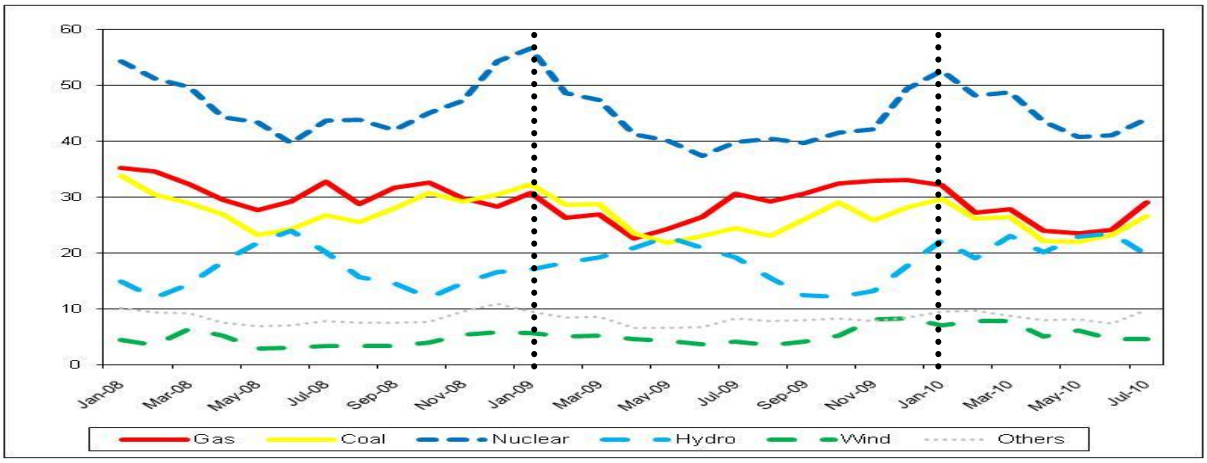
Figure 5: Electricity generation from natural gas in Europe (11 countries) (TWh), 2008-2010




Source: ENTSOE (monthly), generation data

In the first seven months of 2010, monthly electricity generation figures were close to 2009 levels, but still largely below pre-recession levels by about -15 percent over the same period. In the first half of 2010, gas and coal generated roughly the same share of electricity [Figure 5], while wind generation rose sharply in the first quarter [Figure 6]. In the second quarter, electricity produced for both gas and coal was lower while hydro generation sustained high levels. Overall, switching towards gas (against coal) was apparent in the first half of the year in some large markets of North West Europe such as the Netherlands, the UK, France and even Germany while the picture was relatively different in Southern Europe where electricity produced from gas was at 2009 levels in Italy and even lower in Spain due to increased hydro and wind generation.

Figure 6: Electricity generation by fuel in Europe (11 countries) (TWh), 2008-2010




Source: ENTSOE (monthly) generation data

This result hides a very diversified picture [Table 5], with countries which increased their electricity generated from natural gas in 2009, such as France, Luxembourg, Belgium, Austria and even Poland on the one hand and countries were electricity generated from gas dropped sharply such as Greece, Italy, Spain, Slovakia, Czech Republic and Portugal on the other hand. Unfortunately, lack of data on

other markets (such as Germany –the biggest electricity market in Europe) does not yet allow a clear view of the overall European situation.[21]

Table 5: Electricity produced from gas, 2008-2010

| | Elec prod from gas in TWH | | AGRY (%) | January-July 2008-2009-2010 (%) | | |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008-2009 | 2009 vs 2008 | 2010 vs 2008 | 2010 vs 2009 |
| 11 countries | 372.5 | 346 | -7.1 | -15.1 | -15.1 | 0 |
| Austria | 10.9 | 12 | 10.4 | 8 | 41.2 | 30.7 |
| Belgium | 23 | 26.8 | 16.6 | 6.2 | 36.7 | 28.7 |
| Czech Republic | 4.3 | 4.1 | -3.6 | -7.5 | 7.5 | 16.2 |
| France | 14.6 | 24 | 63.9 | 47.4 | 72.4 | 16.9 |
| Greece | 13.3 | 9.4 | -29.7 | -44 | -35.6 | 15 |
| Italy | 174.5 | 143.1 | -18 | -26.5 | -27.7 | -1.6 |
| Luxembourg | 2.4 | 2.8 | 18.1 | 48.8 | 52.8 | 2.7 |
| Poland | 3.9 | 3.9 | 1.6 | 1.5 | 5.8 | 4.3 |
| Portugal | 14.4 | 13.9 | -3.2 | -14.5 | -14.3 | 0.2 |
| Slovakia | 1.7 | 1.6 | -4.5 | -5.1 | -3.4 | 1.8 |
| Spain | 109.6 | 104.5 | -4.7 | -9.8 | -22.3 | -13.9 |

Source: ENTSOE (monthly), generation data

The analysis of industrial production and electricity generation offered us some initial indications on the general trends in these sectors that were badly hit by the economic recession in 2009.

## II/ Natural gas demand in the regional markets in 2008-2010

This second section focuses on natural gas demand. It first looks at total gas demand before turning to gas consumed in individual markets and sectors.

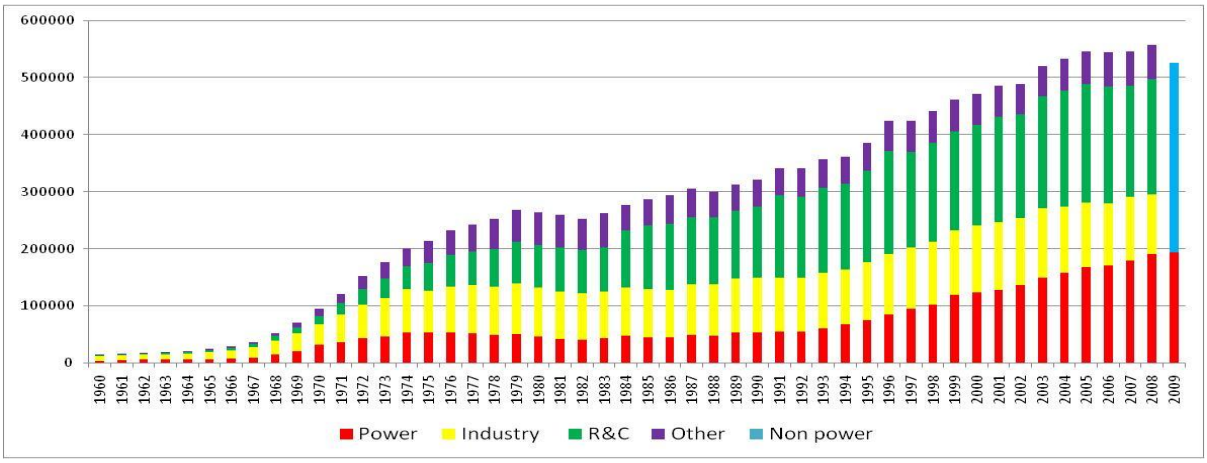
### 1/ European gas demand in 2008-2010

Natural gas consumption increased steadily in Europe over the last 20 years (1990-2008). It grew at an annual average rate of 4.2 percent in the 1990s, but slowed to 2 percent from 2000 to 2008. For the first time in twenty years, data on gas consumption for 2009 showed plunging natural gas demand in the face of economic contraction (but also because of the Russia-Ukraine dispute in January 2009), demand in OECD Europe fell by -5.6 percent[22] in OECD Europe, losing about 26 billion cubic metres (bcm) and falling back to 2003 levels [Figure 7].

[21] See Appendix 4 to Appendix 25 for additional details of electricity generation by fuels per country in 2008-2010.

[22] IEA, *Natural Gas Information 2010*, part II, page 8, table 3. See Appendix 1: note on statistics

Figure 7: Natural gas demand in OECD Europe, 1960-2010 (mcm)



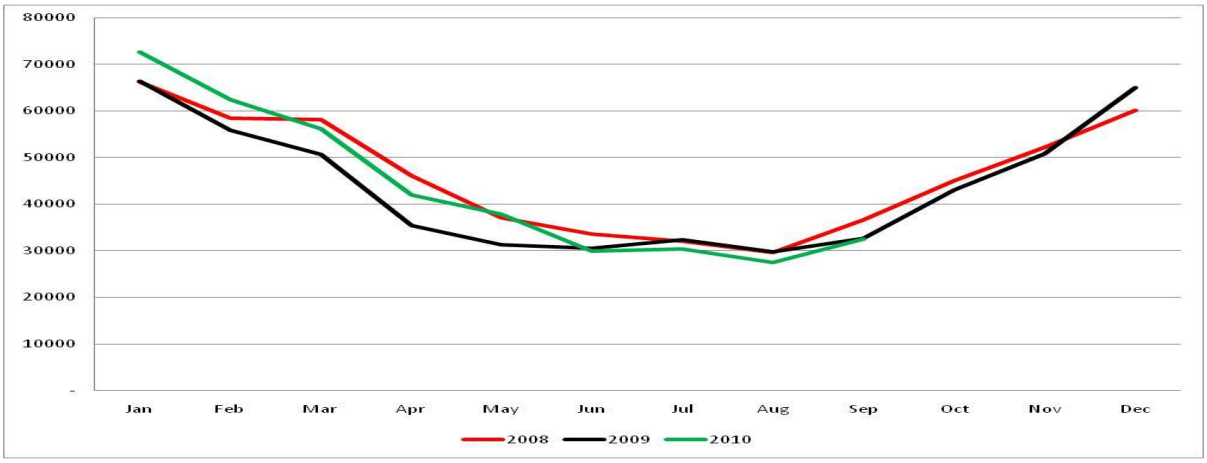

Sources: IEA (annual), *Natural Gas Information*, part IV, table 3A (several issues) ; IEA (monthly), Natural Gas Survey, table 1 (various issues), and author's analysis

The first half of 2009 was especially bad for gas demand in Europe, while the second half of the year was showing signs of catching up with 2008 levels, especially at the beginning of winter. This could be explained by improved demand in the two major sectors affected by the economic crisis, with industrial output on the rise again and electricity generated from gas close to 2008 levels and even higher in November –December.

In the first quarter of 2010, monthly data shows gas consumption much higher than the previous two years at the same period. This cannot be explained by gain in industry or power production, and must result from space heating in the residential and commercial sector.[23] Over the first half of 2010, some recovery seemed to be under way, with an increase of 7.3 percent of gas consumed compared to the same period the previous year with demand closer to 2008 levels [Figure 8]. However, industrial output and electricity generated from gas were showing signs of slowing down in the second quarter of 2010 compared to 2009 levels. Temporary growth drivers provided by fiscal stimulus had faded and self-sustaining growth dynamics were not yet ready to replace them.[24] These trends put a question mark on the assumption of "faster and stronger recovery than previously foreseen" for 2010.

[23] This is examined in the third section of this paper.
[24] OECD (2010), "OECD Economic Outlook, volume 2010/2", page 12

Figure 8: Natural gas demand in OECD Europe, 2008-2010 (mcm)




Source: IEA (monthly), Natural Gas Survey, various issues, table 1

**2/ Very diversified –and unclear- picture across Europe**

Gas demand dropped sharply in 2009 as a result of the economic crisis. Everybody seems to agree with this statement, however, different sources give very different results, in bcm, in percentage and even in directional change (more or less gas). Some explanations of problems we have encountered with statistics on gas demand can be found in Appendix 1 and should be consulted by those wishing to explore the subject in detail. In the following paragraphs, we used IEA data published in *Natural Gas Information 2010* for 2008-2009 and monthly Gas Survey for 2010 statistics, which at the time of writing, were available up to the third quarter of 2010.

Changes in natural gas demand showed strong variations between the European markets.[25] In 2009, gas demand declined in 15 countries out of 22 considered in this paper. It plummeted in Greece and Hungary and Spain. The decline was more focused on the industrial sector in Spain, but although electricity generation did not plummet, gas used for power generation registered a sharper fall. However bad their situation, it was not worse than in some other markets (Ireland and even the UK to a certain extent). Demand fell also sharply in Finland, in line with its poor economic situation. Six out of seven of the major gas markets registered a loss in consumption: Spain, but also UK, Italy, Germany, Turkey, and France, while demand in the Netherlands was mostly flat thanks to low gas spot prices which boosted gas for power generation [Table 6].[26] The amazing increase in Sweden can be explained by two factors: the opening of a gas-fired power plant and the size of the market (about 1 bcm), which means that only one gas-fired station can have such a major impact on total

[25] See Appendix 1: Note on statistics

[26] Statistics for Norway are unclear, and are not presented in Table 6, but preliminary data seem to indicate a loss of gas consumption in 2009 compared to the year before. Therefore it was counted in the 16 markets in this sentence. In addition, percentage changes for Germany and the Netherlands are widely spread depending on the source considered. See Appendix 1 for more information.

gas demand. While most of the markets registered a decline, gas consumption seems to[27] have increased in Norway, Portugal, Austria, Luxembourg and Poland in addition to Sweden.

Table 6: Natural gas gross consumption in the European major markets

| | Demand in 2008 (mcm)* | Share of European demand in 2008 (%)* | Average growth rate per year (%) | | | | January-September 2008-2009-2010 (%) ** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1960-2008* | 1990-2008* | 2000-2008* | 2008-2009* | 2009 vs 2008 | 2010 vs 2008 | 2010 vs 2009 |
| OECD Europe | 555800 | 93.5 | 7.9 | 2.4 | 2 | -5.6 | -8.2 | -1.6 | 7.3 |
| Austria | 8650 | 1.47 | 3.59 | 1.97 | 1.48 | 1.3 | 2.8 | 14.6 | 11.5 |
| Belgium | 17330 | 2.95 | 12.41 | 3.31 | 1.26 | -2.0 | 9 | 9.4 | 0.4 |
| Czech Republic | 8719 | 1.49 | 4.8 | 1.58 | -0.72 | -5.8 | -8.6 | 7.3 | 17.4 |
| Denmark | 4590 | 0.78 | Na | 4.56 | -0.8 | -4.2 | -4.7 | 6.2 | 11.4 |
| Finland | 4735 | 0.81 | Na | 3.21 | 1.51 | -9.6 | -14.2 | -6.3 | 9.2 |
| France | 45901 | 7.82 | 5.79 | 2.74 | 1.81 | -3.4 | -3.4 | 8.2 | 12 |
| Germany | 95793 | 16.32 | 9.91 | 1.78 | 1.11 | -5.5 | 2.9 | 4 | 1.1 |
| Greece | 4206 | 0.72 | Na | 21.68 | 9.39 | -16.2 | -27.1 | -15.6 | 15.7 |
| Hungary | 13167 | 2.24 | Na | 0.92 | 1.13 | -13.8 | -20.3 | -14.5 | 7.3 |
| Ireland | 5217 | 0.89 | Na | 4.61 | 3.33 | -3.1 | -5.3 | 5 | 10.8 |
| Italy | 84883 | 14.46 | 5.52 | 3.29 | 2.3 | -8.0 | -12.6 | -6.1 | 7.4 |
| Luxembourg | 1255 | 0.21 | Na | 5.33 | 6.56 | 1.1 | 1.4 | 10 | 8.5 |
| Netherlands | 48346 | 8.23 | 10.53 | 0.59 | -0.13 | 0.6 | -7.4 | 1.7 | 9.8 |
| Norway | 6707 | 1.14 | Na | 6.22 | 6.07 | 3.1 | Na | Na | Na |
| Poland | 16549 | 2.82 | 6.47 | 1.76 | 2.73 | 0.2 | -3.6 | 0.3 | 4 |
| Portugal | 4754 | 0.81 | Na | Na | 9.62 | 2.7 | -4.6 | -0.9 | 3.9 |
| Slovakia | 6308 | 1.07 | Na | -0.05 | -1.53 | -2.6 | 3.5 | 10.8 | 7.1 |
| Spain | 38183 | 6.5 | Na | 11.43 | 10.92 | -11.4 | -11.3 | -13.7 | -2.8 |
| Sweden | 913 | 0.16 | Na | 2.21 | 1.59 | 34.6 | 21.5 | 69.7 | 39.6 |
| Switzerland | 3429 | 0.58 | Na | 3.06 | 1.8 | -4.0 | 0.4 | 9.4 | 9 |
| Turkey | 37178 | 6.33 | Na | 14.09 | 12.17 | -4.3 | -13.3 | -2.3 | 12.7 |
| UK | 98990 | 16.86 | 16.12 | 2.98 | -0.35 | -8.3 | -14.4 | -5.4 | 10.4 |

Sources:

* Calculated from IEA (annual), *Natural Gas Information*, Part II.8, table 3

** Calculated from IEA (monthly), Natural Gas Survey, various issues, table 1

Data for the first three quarters of 2010 show demand slowly picking up, with consumption above 2009 levels for the same period., The exception was Spain, which still lagged behind by -2.8 percent due to a very slow economic recovery and additional availability of hydro and wind power to produce electricity. At the regional level, the 22 countries consumed 7.3 percent more gas than in the first three quarters of 2009. Apart from Sweden, faster recovery was seen in Czech Republic, Greece, Turkey, France, Austria, Denmark, Ireland and UK with double digit increase. Netherlands, Finland, Switzerland, Luxembourg, Italy, Hungary and Slovakia were also above the regional average of 7 percent. However, regional demand still remained below pre-recession levels (-1.6 percent),

[27] We say "seem to" because these statistics are subject to uncertainties, as explained in Appendix 1. Data from a different source show a decline for Belgium and Slovakia for instance (-2 percent and -2.6 percent respectively).

with several countries lagging behind 2008 levels: Greece, Hungary, Spain, Finland, Italy, UK, Turkey and Portugal. Since these countries included four of markets with the fastest growth in the period 2000 – 2008, this was not a good omen for gas demand in 2010. On the other hand, three out of the seven major gas markets (France, Germany and Netherlands) are showing signs of recovery compared to 2008 levels, but these three markets were not seen as major drivers for additional gas demand in the 2010s due to saturation of their national gas market and limited increase expected in the power sector.

**3/ Focus on gas used for power generation and other sectors**

Data on gas used in the power sector (public power plants) are available at the European level, and therefore can be used to compare one market to the other.[28] However, some data were missing or insufficient for several countries,[29] five of which were also missing data on electricity produced from gas. The paragraph below therefore shows results for 12 countries out of the 22 we take into account in OECD Europe.

At the regional level, these countries consumed 10.8 percent less gas for power generation in 2009 than in 2008 [Table 7]. The drop was most important in Hungary, Denmark, Portugal, Spain and the UK) according to Eurostat data. Sweden, Austria, Poland and the Netherlands increased the volume of gas for power.

Over the first seven months of 2010, all had climbed back to at least 2009 levels over the same period, except for Spain and Portugal. However, consumption in these 12 countries was still below pre-crisis levels by about 30 percent, with Spain, Portugal and Hungary lagging far behind. Spain, the fifth biggest consumer of gas for power generation in Europe and country with very rapidly growing demands for gas in the power sector consumed 19 percent less gas in the sector than in 2008. As important, the UK -with the largest demand for gas in the power sector- was also still 11.5 percent below 2008 levels.

Eurogas reported that economic recovery in 2010 stimulated gas demand in the industry sector, which was “especially visible in energy-intensive sectors, such as chemicals and steel” but lack of detailed data prevents us from being able to verify that statement.[30] From Eurogas data of gas demand by sector [Table 8], it appears that the economic recession had major impacts on the industrial and power sectors, but that the residential and commercial sectors managed to grow by 0.7 percent. After temperature correction however, this sector seems to have suffered too, albeit at a much lower level.

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[28] Some additional statistics on gas consumption split by sector are available at the national level, such as for Italy, Spain or the UK for instance. However, it is not possible to use these data to compare one country to another one due to different methodologies used.

[29] Countries for which data were missing included: Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Norway, Switzerland and Turkey; countries for which data on electricity generated from gas were missing included: Finland, Ireland, Norway, Switzerland and Turkey.

[30] Eurogas (2010), “Eurogas: Gas Demand in 2010 could Return to Pre-crisis Levels”, Press Release, 16 September 2010

Table 7: Natural gas demand for power generation, 2008-2010

| | Gas used in power station, in TJ | | AGRY (%) | January-July 2008-2009-2010 (%) | | |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008-2009 | 2009 vs 08 | 2010 vs 08 | 2010 vs 09 |
| 12 countries | 3479477 | 3102345 | -10.8 | -36.3 | -30.8 | 8.7 |
| Austria | 77111 | 81997 | 6.3 | 3.6 | 28.6 | 24.2 |
| Czech Republic | 24870 | 24308 | -2.3 | -5.3 | 11.6 | 17.9 |
| Denmark | 34511 | 24601 | -28.7 | -33.3 | 9.7 | 64.5 |
| Germany | 680454 | 604929 | -11.1 | -17.6 | -5.3 | 14.9 |
| Hungary | 178104 | 121417 | -31.8 | -34.6 | -17.1 | 26.6 |
| NL | 301493 | 320537 | 6.3 | -3.9 | 14.7 | 19.4 |
| Poland | 39797 | 40640 | 2.1 | 2.2 | 3.3 | 1.1 |
| Portugal | 97442 | 80407 | -17.5 | -22.9 | -28.8 | -7.6 |
| Slovakia | 17014 | 16580 | -2.6 | -3.8 | 6.2 | 10.4 |
| Spain | 684742 | 583008 | -14.9 | -19.4 | -38.3 | -23.4 |
| Sweden | 3612 | 11191 | 209.8 | 134.8 | 440.0 | 130.0 |
| UK | 1340327 | 1192730 | -11.0 | -20.4 | -11.5 | 11.2 |

Source: Eurostat, Energy Statistics Quantities, Supply gas monthly: nrg_103m, supply electricity monthly, gross consumption and net generation: nrg_105m

Table 8: Natural gas demand, percentage change by sector for 2009

| | R&C | Industry | Power | Total |
|---|---|---|---|---|
| OECD Europe | 0.7 | -8.7 | -10.5 | -5.6 |
| Austria | -1.8 | -5.8 | -7.2 | -1.8 |
| Belgium | 28.2 | -37.6 | 17.9 | 2.5 |
| Czech Republic | 1.0 | -12.3 | n/a | -5.2 |
| Denmark | -4.4 | -10.7 | -1.9 | -3.8 |
| Finland | 0.0 | -17.5 | -3.9 | -9.5 |
| France | 6.7 | -16.3 | -38.6 | -3.9 |
| Germany | 4.3 | -9.2 | -7.8 | -2.7 |
| Greece | 18.7 | 8.7 | -28.0 | -17.2 |
| Hungary | -1.5 | -18.2 | -27.0 | -13.3 |
| Ireland | -5.3 | -15.0 | -3.7 | -6.3 |
| Italy | 6.9 | -14.1 | -17.7 | -8.0 |
| Luxembourg | 55.8 | -36.8 | 10.5 | 2.4 |
| Netherlands | -1.5 | -3.0 | 5.8 | -0.7 |
| Norway | n/a | n/a | n/a | n/a |
| Poland | -7.0 | -4.6 | 7.4 | -3.8 |
| Portugal | 94.4 | -38.3 | -2.3 | 3.0 |
| Slovakia | -16.2 | -7.4 | n/a | -9.0 |
| Spain | -6.0 | -8.5 | -14.2 | -10.5 |
| Sweden | -9.1 | -4.9 | 68.8 | 18.7 |
| Switzerland | -1.5 | -9.0 | -4.3 | -4.2 |
| Turkey | 1.9 | -21.0 | -15.4 | -6.9 |
| United Kingdom | -10.9 | 32.1 | -4.5 | -7.7 |

Source: Eurogas: "Statistical report 2010" and "Statistics 2008", Inland deliveries of natural gas

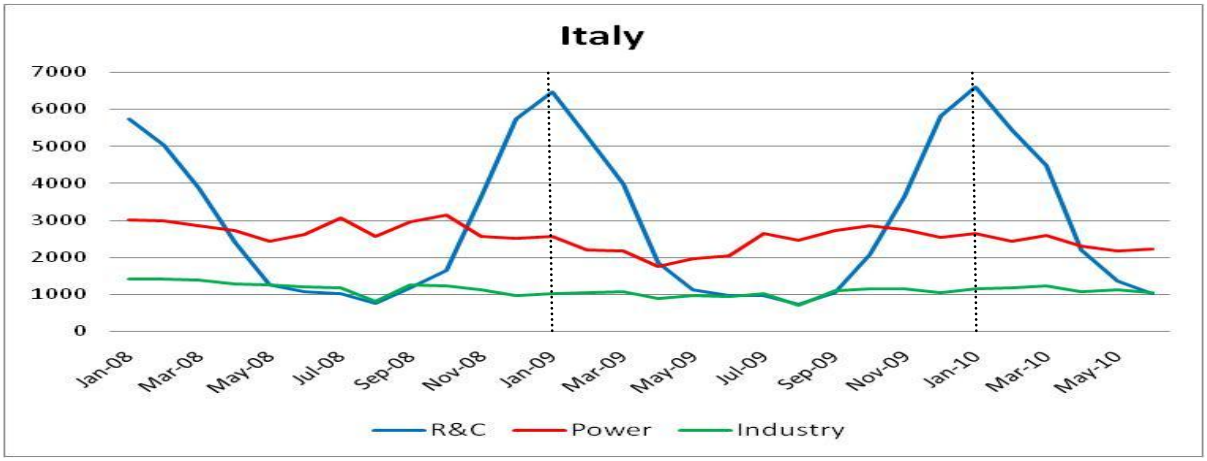
## III/ Cold winters and temperature-corrected data

Another factor that influenced gas demand in 2008-2010, but was not linked to the economic downturn, still needs to be considered if we are to understand gas consumption fluctuations: colder than usual temperatures during the winter of 2008-09 and 2009-10.

### 1/ Gas demand seasonality

As shown in Figure 9 with the example of the Italian gas market, industrial and power generation gas demand would normally be relatively flat throughout the year, at least compared to the residential and commercial sector. In the latter, demand for heating purposes increases as outside temperatures fall especially in winter times. Gas demand for cooling in the summer in Europe is not yet significant, except in Spain and Turkey.

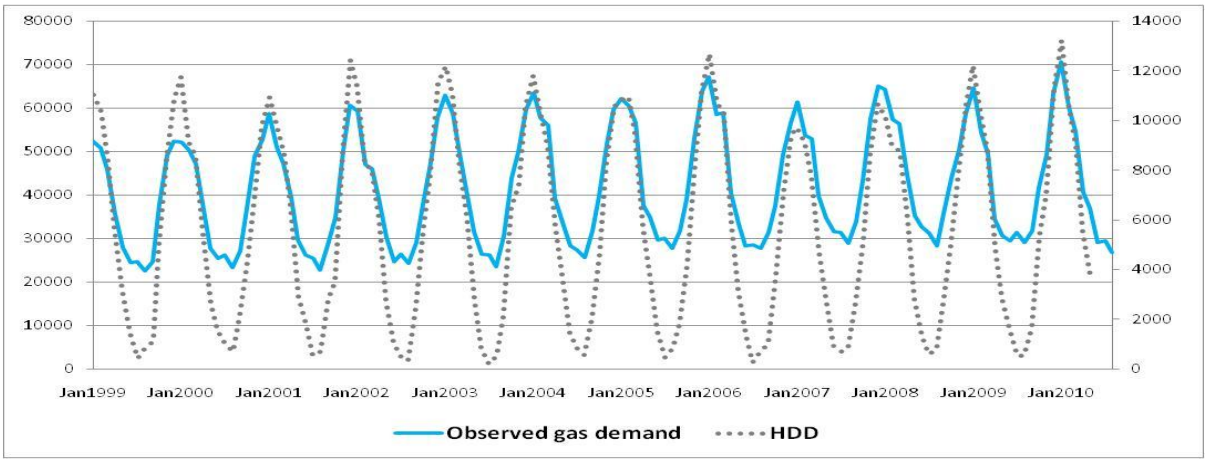
Figure 9: Monthly natural gas demand by sector in Italy, 2008-2010




Source: ENI, Snam Rete Gas, *Bilancio gas transportado*, several issues

The majority of the seasonal variations in Europe still occurs during the winter and is correlated with heating degree days (HDD) [Figure 10]. However, even if gas demand tends to follow variations of temperature, the relationship is not straightforward. There is no simple rule of thumb to calculate the impact of cold or mild temperatures on gas demand (i.e. a certain percentage of colder temperatures will not automatically lead to a certain percentage of gas demand growth).

Figure 10: Natural gas demand and HDD in OECD Europe, 1999-2010



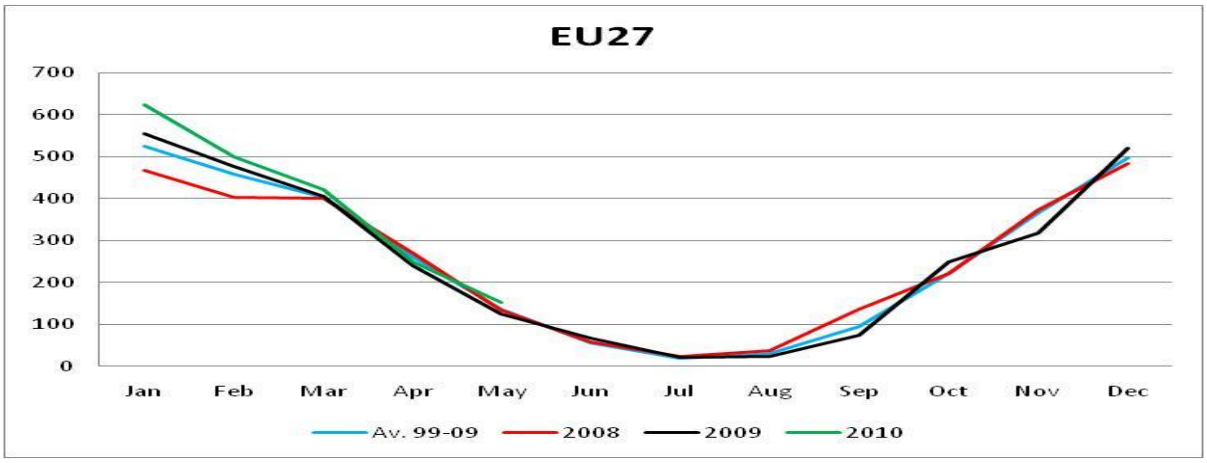

Notes: Left axis: mcm of gas demand, right axis: HDD

Sources: IEA (monthly), Natural Gas Survey, various issues and Eurostat, Energy Statistics, nrg_esdgr

## 2/ Heating degree days in winters 2008-09 and 2009-10

Winters 2008-09 and 2009-10 (December-March) were colder than winter 2007-08 and colder than average [Figure 11].[31] Winter 2009-10 was even one of the coldest in the last thirty years [Figure 25, page 47]. As a result, European gas demand jumped as shown in Figure 8 (page 25) because of increased heating demand especially in the residential and commercial sector.

Figure 11: Heating degree-days, 2008-2010




Source: Eurostat, Energy Statistics, nrg_esdgr

## 3/ Observed gas demand and temperature-corrected data

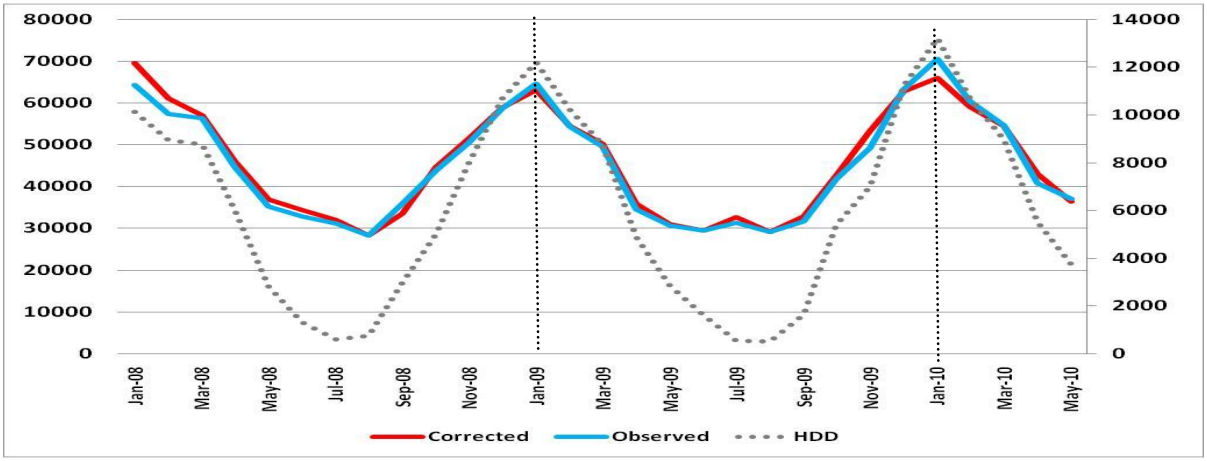
The massive demand growth is therefore largely due to cold winter, and cannot be accounted for as a sign of recovery. Exactly how much can be attributed to cold weather is difficult to calculate

[31] Average over the past ten years (1999-2009)

considering the numerous factors that influence gas consumption and the fact that gas can be –to a certain extent and within technological constraints, substituted by other fuels especially in the power generation sector.[32] We estimate that consumption in winter 2009-10 (between December 2009 and March 2010) was about 9.5 bcm higher in OECD Europe than it would have been in a normal winter [Figure 12].

The residential and commercial sectors seem to have been affected by the economic crisis too, despite very cold winters in 2008-09 and 2009-10. This could be explained by households starting their boilers later in the year and switching them off earlier due to high gas price levels.[33] This would explain the pattern of overall gas demand in April 2009, which cannot be explained by changes in the industry or the power sectors.

Figure 12: Temperature-corrected and observed gas demand (all sectors) (mcm) and HDD in OECD Europe, 2008-2010




Notes:
Demand in mcm on the left axis
HDD on the right axis
Sources:
Observed: IEA (monthly), Natural Gas Survey, various issues
Corrected: Author's estimates
HDD: Eurostat, Energy Statistics, nrg_esdgr

If we take a look at natural gas demand in the winter months and apply a temperature-correction to observed levels of gas demand [Table 9], we find that, at normal temperatures, consumption in winter 2008-09 would have been 26.9 bcm lower than the previous winter instead of just 16.2 bcm lower given by the data on observed demand. This can be explain by a much warmer winter in 2007-08 than average (and therefore demand could have been higher than shown by the levels of observed demand), but also due to the impacts of economic recession. For the winter 2009-10, data

[32] See Appendix 1 for additional explanations on seasonal adjustment methodologies.
[33] Oil-linked prices increased up to the end of 2008 and remained above $7 / MBtu in 2009. IEA (2010), *Medium-Term Oil and Gas Markets*, page 153.
For additional information on prices, see Stern (forthcoming 2011), "Continental European Gas Prices in Transition", OIES

on observed demand gives an increase of 22 bcm from the previous winter while temperature corrected data show a growth of just 14 bcm. As a result, we can say that colder than average temperatures had a large impact on the levels of gas demand in winter 2009-10, but that there were already some signs of economic recovery translated into levels of gas demand. Some switching to gas in the power sector also helped the rebound of gas consumption.

Table 9: Change in total gas demand during winter times in OECD Europe (2008-2010), observed and temperature corrected consumption (bcm)

| | Observed | Temperature-corrected |
|---|---|---|
| Winter 2008/09 compared to winter 2007/08 | -16.2 | -26.8 |
| Winter 2009/10 compared to winter 2008/09 | +22.5 | +14 |

Sources:
Observed demand: IEA (monthly), Natural Gas Survey, various issues, table 1
Temperature corrected demand: Author's analysis

Once again, the national data show a diversified picture. In Greece and Turkey, winters 2008/9 and 2009/10 were actually warmer than the previous year [Table 10]. Similarly, winter 2010 in Switzerland seem to have been milder than 2009. In the other markets, 2009 and 2010 were colder or much colder than 2008. This had an impact on gas demand during winter times. Gas demand is estimated to have been about 1 bcm higher than normal due to cold temperatures in winter 2008-09 and 9.5 bcm in winter 2009-10 (1.6 bcm in December, 6 bcm in January, 1.7 in February and 0.2 in March).

Most interesting values come from the major markets, where gas demand could have been 2.7 bcm lower in winter 2010 in the UK if temperatures hadn't been so cold. In Germany, it would have been 2.5 bcm lower, Netherlands 1.7 bcm and France 1.5 bcm. All these numbers are interesting when it comes to comparing by how much the players have been able to meet or approach their take-or-pay (TOP) commitments, meaning by how much the cold winter has helped relieve the tension caused by low demand and sales of cheaper spot LNG/gas at hubs.

Looking at temperature corrected data, only Austria, Greece, Slovakia and Turkey were showing strong signs of recovery of gas demand in 2010. Czech Republic, Germany, Ireland, Luxembourg, the Netherlands, Portugal and the UK were sending mixed signals, but these were much better than in Belgium, Denmark, Finland, France, Hungary, Italy, Poland, Spain and Switzerland where no signs of recovery were showing at all.[34]

[34] See Appendix 3 to Appendix 25 for more information on individual countries.

Table 10: Heating degree days, observed and temperature corrected demand in the European markets (mcm), December-March 2008-2009-2010

| | Changes in HDD in Dec-March 2008-2009-2010 (%) | | | Demand observed (mcm) | | | Difference observed / temperature corrected demand (mcm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2009 vs 2008 | 2010 vs 2008 | 2010 vs 2009 | Dec 07-Mar 08 | Dec 08-Mar 09 | Dec 09-Mar 10 | Dec 07-Mar 08 | Dec 08-Mar 09 | Dec 09-Mar 10 |
| OECD Europe* | 9.5 | 17.7 | 7.5 | 248032 | 231806 | 254337 | 9613.9 | -996.8 | -9539.3 |
| Austria | 9 | 9 | 0 | 3741 | 4144 | 4312 | 171.2 | 5 | -5.2 |
| Belgium | 16.6 | 19.1 | 2.2 | 6356 | 6706 | 8052 | 230.4 | -219.5 | -385.8 |
| Czech Republic | 10.6 | 16.4 | 5.3 | 4557 | 4574 | 4718 | 348.2 | -7.5 | -186 |
| Denmark | 12.2 | 31.4 | 17.1 | 2123 | 2038 | 2377 | 184.1 | -28.7 | -186.2 |
| Finland | 9.2 | 28.4 | 17.6 | 1908 | 1748 | 2085 | 106.8 | 37.5 | -84.4 |
| France | 14.4 | 14.8 | 0.3 | 24466 | 24055 | 25426 | 1047.5 | -376.7 | -1504.1 |
| Germany | 16 | 21.7 | 4.9 | 42292 | 42697 | 47230 | 2570.9 | 601.5 | -2535.7 |
| Greece | -1.4 | -13.9 | -12.6 | 1638 | 1072 | 1381 | 13.3 | 7.2 | 19.9 |
| Hungary | 3.4 | 6 | 2.5 | 6917 | 6155 | 6313 | 376.7 | 363.9 | 122.9 |
| Ireland | 7 | 23.5 | 15.4 | 2012 | 1951 | 2148 | 24.7 | -6.2 | -109.5 |
| Italy | 3.9 | 4.4 | 0.5 | 39847 | 36281 | 38616 | 1106.6 | 10.4 | 96 |
| Luxembourg | 15 | 15.1 | 0.1 | 569 | 478 | 559 | 18.4 | 1.4 | -16.3 |
| Netherlands | 16.2 | 23.2 | 6.1 | 24519 | 21990 | 23760 | 1393.9 | -805.9 | -1749.3 |
| Norway | 6.1 | 19.7 | 12.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| Poland | 11.9 | 23.9 | 10.8 | 7213 | 6972 | 7589 | 435.5 | -33.8 | -328.3 |
| Portugal | 4.6 | 10.8 | 5.9 | 1679 | 1419 | 1417 | 20.2 | 3.0 | 16.5 |
| Slovakia | 4.4 | 7.6 | 3.1 | 3171 | 2701 | 3535 | 144.3 | -37.2 | -242.4 |
| Spain | 9.3 | 10.7 | 1.3 | 14452 | 12154 | 12461 | 328.3 | -42.7 | -96.7 |
| Sweden | 12.4 | 26 | 12.2 | 447 | 518 | 772 | 36.2 | 4.4 | -55.0 |
| Switzerland | 11.4 | 7.2 | -3.8 | 1675 | 1831 | 1861 | 71.1 | -31.1 | -148.8 |
| Turkey | -8.8 | -21.4 | -13.9 | 14662 | 12249 | 14580 | -76.5 | 8.1 | 546.8 |
| UK | 6.9 | 16.8 | 9.3 | 43788 | 40073 | 45145 | 1062.1 | -449.9 | -2707.7 |

* In this table, OECD gas demand was calculated by adding the data for the 22 countries[35]

Sources:

Observed: IEA (monthly), Natural Gas Survey, various issues

Corrected: Author's estimates

HDD: Eurostat, Energy Statistics, nrg_esdgr

[35] See Appendix 1: OECD Europe vs sum of OECD European countries

## Conclusions and outlook for the early 2010s and beyond

The initial conclusion is that it is very difficult to analyse what happened to gas consumption in Europe during 2008-2010. Available data in the public domain is contradictory, unsatisfactory and sometimes unavailable. A range of -5.5 percent to +2.9 percent for the change of gas consumed in Germany in 2009 for instance seriously complicates analytical work. Nonetheless, some general patterns seem to emerge from the statistical chaos. First, gas demand collapsed in OECD Europe in 2009, but the picture was not identical across the region. Second, the fall in industrial output and electricity generation lead us to believe that the industrial sector and to a lesser extent, the power sector were particularly hard hit. However, gas used in power plants was also determined by the availability and competitiveness of other fuels (coal, hydro and other renewable). Third, temperatures in winter 2008-09 and 2009-10 were much colder than average, which boosted demand for heating in the residential and commercial sectors at the beginning of the year, and will most probably account for an important share of gas demand rebound in 2010. In the second and third quarters, industrial output and gas for power slowed down. Temporary growth drivers provided by political and fiscal stimulus have ended and self-sustaining growth dynamics have not replaced them. All these factors question the assumption of "faster and stronger recovery than previously foreseen" for 2010. However, we calculated that during the winter 2009/10 (December-March), 9.5 bcm of the 22.5 bcm increase from 2008-09 winter come from colder temperatures than average. The rest can be explained by economic recovery and some switching to gas in the power sector. Demand will recover progressively, but not necessarily faster than expected, unless the cold temperatures that happened in November and December 2010 improved natural gas consumption, which they probably will. Cold temperatures at the beginning and the end of the year will have boosted gas demand, and although the impact of cold temperatures should not be confused with underlying recovery, signs of economic improvement and, as a consequence, signs of a slow recovery of gas demand in 2010, enhanced by temperature effects, is the overall picture.

Despite the general gloom, my longer analysis[36] showed that there was some potential for growth in the European market, driven by the construction of new gas-fired power plants, even if not as much as had been anticipated by scenarios in the early to mid 2000s. At the European level,[37] we anticipate an average increase of 0.6 percent per year (an average of 1.5 percent for the power sector and 0.2 percent for the non-power sectors) up to 2020. European gas consumption is expected to return to 2008 levels around 2012-13, but with major differences between the national markets, sectors of consumption and period of recovery. If this proves to be correct, gas demand was expected to be close to TOP levels of contracted pipeline gas in 2010, but should be slightly above in 2011. Indigenous production and annual contracted quantity (ACQ) levels of contracted pipeline gas can cover demand up until at least 2012, but total contracted gas (including LNG) is expected to be less than demand post 2014 (or later if demand does not pick up as anticipated),

[36] Honore (2010), *Natural Gas Demand, Supply and Pricing: Cycles, seasons, and the impact of LNG price arbitrage*

[37] In my book, there are 35 countries considered in Europe. See footnote 3, page 10 for a list.

which means that, despite a catastrophic 2009-year for gas demand, Europe will need to secure additional gas supply probably as soon as 2015 to cover its –still growing- consumption.

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# Appendix 1: Note on statistics

## Sources

Analysing natural gas consumption patterns involves substantial statistical and methodological problems. There is a wide range of statistics on natural gas in the public domain.[38] To name but a few, they can be found from:

- Statistics published by national entities on their market. They can usually be found on the TSO's website, but can also be found from different sources. For instance, national statistics for the major gas markets[39] are available from the Department of Energy and Climate Change (DECC)[40] for the UK, the Federal Ministry of Economics and Technology[41] for Germany, Snam Rete Gas[42] for Italy, Gas Transport Services[43] for the Netherlands, GRT Gaz[44] for France, Enagas[45] for Spain and Botas[46] for Turkey.
- International companies, such as BP[47]
- Organisations, such as Eurogas[48]
- International organisations such as Eurostat,[49] the International Energy Agency (IEA),[50] or the EIA (Energy Information Administration).[51]

Despite this apparent profusion of information in the public domain, adequate statistics on natural gas demand are at best unsatisfactory and at worst, unavailable, especially for detailed statistics by sectors for instance. Data is hard to reconcile and it is complicated (and sometimes unfeasible) to obtain accurately defined, consistent or temperature-corrected historical series across countries for the European markets due to differences in:

- end-user classifications
- calorific value/temperature/pressure
- units and conversion factors

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[38] There is also a lot of information available for sale, but have decided to focus our work on information available on the public domain.
[39] See Definitions
[40] http://www.decc.gov.uk/en/content/cms/statistics/source/gas/gas.aspx
[41] http://www.bmwi.de/BMWi/Navigation/Service/publikationen,did=53736.html
[42] http://www.snamretegas.it/it/clienti_e_istituzioni/cln_istituzioni_bilancio_gas__andamento_2006.shtml
[43] http://www.gastransportservices.nl/en/transportinformation/physical-gas-balance
[44] http://wwww.grtgaz.com/module-chiffres/index.php
[45] http://www.enagas.com/cs/Satellite?c=Page&cid=1142417697838&language=es&pagename=ENAGAS%2FPage%2FENAG_demandaTiempoReal
[46] http://www.botas.gov.tr/index.asp
[47] http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622
[48] http://www.eurogas.org/figures_statistics.aspx
[49] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/introduction
[50] http://www.iea.org/stats/index.asp. The monthly statistics for OECD countries are available on the IEA website. Annual statistics compiled in the *Natural Gas Information* are only available for sale at bookshop prices.
[51] http://tonto.eia.doe.gov/country/index.cfm?ref=bookshelf

- the definition of regional areas, e.g. 'Europe': EU15, EU25, OECD Europe, EGTA (European Gas Trading Area), 7 major markets, etc.

As a consequence, it is important to use the same source of data as much as possible throughout the analysis in order to keep some consistency. In this study, the statistics published by the IEA were preferred. The main reasons are fourfold:

- In order to compare statistics in different markets, there was a need to find statistics calculated with the same methodology and presented in the same unit, which eliminated the statistics published by the national bodies,
- The IEA statistics are collected directly from official bodies of member countries and a transparent methodology is explained at the beginning of the IEA *Natural Gas Information* annual reports[52]
- It was critical to have data at country level, not just aggregated regional data. The addition of Turkey, the seventh biggest gas market (in 2008) was important.
- Monthly consumption for the member countries was available, but the data was provided for the IEA member countries only. These statistics are on-the-spot numbers[53] (revisions are not included in the archived files) and have no sectoral breakdown.

Additional remarks regarding IEA statistics should be made:[54]

- IEA data in million cubic metres are measured at 15 degrees C and at 760 mm Hg, i.e. Standard Conditions,[55]
- IEA statistics on natural gas supply and demands are actual data (observed ;[56] they are not temperature-corrected.

The IEA statistics on gas consumption in the annual reports 'Natural Gas Information' lag in data availability. For annual consumption, the time lag is one year, but it increases to two years for detailed statistics by sector.[57] When the IEA statistics were not available, we have quoted other sources of statistics such as Eurostat and Eurogas for instance. This is not without risk due to the many differences between sources.

Table 11 shows changes in natural gas consumption between 2008 and 2009. The unit is percentage, so there is no problem of conversion factor here. Still, the picture we get is rather puzzling. For instance, in Germany, gas demand may have slumped by 5.5 percent (IEA) or grown by 2.9 percent (Cedigaz). To try and get a clearer idea, we looked at national statistics provided by BMWI (the

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[52] Annual IEA statistics are published in the *Natural Gas Information* reports

[53] The IEA monthly statistics may be revised later on to correct possible mistakes or include up-dates later calculated by the IEA statisticians. There is therefore a margin of possible error in those numbers at the time of publication.

[54] A detailed definition of natural gas (supply and) consumption items used in the IEA statistics can be found in IEA (annual), *Natural Gas Information*, pages xi-xiii. Additional information on IEA data on natural gas can be found in 'Energy Statistics, Manual', pp. 55-68 (gas consumption on pages 64-65).

[55] IEA, *Natural Gas Information 2008*, Part 3, Definitions, page xi

[56] Although in the case of demand, the IEA provide both "observed" demand and "calculated" demand, but neither is temperature-corrected.

[57] The time lag for monthly statistics is three months.

German Federal Ministry of Economics and Technology) and the percentage change was -0.4, which does not compare to either of the extreme estimates. The story in other countries, such as Slovakia for instance, is as confusing. We have added three different sources of data for the IEA, because this is our main source, but other sources also provided different growth rates for gas demand (see footnotes 58 and 59). Getting such a wide range of percentage change depending on the sources, it is rather difficult to provide a picture of what happened in gas demand in these countries in 2009, let alone try and analyse the reasons.

The numbers we used in the main text are in bold (IEA-3, *Natural Gas Information 2010*), but this table highlights the difficulties and risks of misinterpretations in using several sources for an analysis.

Table 11: Comparison of natural gas demand changes in 2009 from the IEA, Eurostat, BP and Cedigaz

| | IEA -1 | IEA -2 | **IEA -3** | Eurostat | BP | Cedigaz | Eurogas |
|---|---|---|---|---|---|---|---|
| OECD Europe | -4.8 | -5.6 | **-5.6** | -5.3* | -5.9 | -4.9 | -7.2*** |
| Austria | -1.9 | 2.1 | **1.3** | -1.9 | -2.1 | 0.2 | -1.7 |
| Belgium | 15.5 | 13.6 | **-2.0** | 19.2 | 2.1** | 3.4 | -1.9 |
| Czech Republic | -5.7 | -5.8 | **-5.8** | -6.3 | -5.6 | 8.5 | -13.8 |
| Denmark | -2.5 | -2.5 | **-4.2** | -3.1 | -3.6 | -4.3 | -5.1 |
| Finland | -11.7 | -9.8 | **-9.6** | -12.3 | -10.5 | -8.9 | -10.1 |
| France | -2.2 | -3.8 | **-3.4** | -3.8 | -2.4 | -0.1 | -4.4 |
| Germany | 0.5 | 2.9 | **-5.5** | -0.7 | -3.7 | 2.9 | -4.0 |
| Greece | -16.1 | -16.1 | **-16.2** | -14.0 | -19.7 | -20.4 | -12.5 |
| Hungary | -14.1 | -15.4 | **-13.8** | -15.8 | -14.3 | -20.7 | -12.9 |
| Ireland | -4.6 | -4.3 | **-3.1** | -4.3 | -3.9 | 0.7 | -16.0 |
| Italy | -8.6 | -8.6 | **-8.0** | -7.8 | -7.7 | -10.0 | -8.8 |
| Luxembourg | 5.2 | 4.2 | **1.1** | 5.3 | n/a | 8.3 | -11.3 |
| Netherlands | -3.3 | -5.2 | **0.6** | -3.6 | 1.1 | -5.0 | 0.3 |
| Norway | -36.1 | -38.4 | **3.1** | -40.3 | -4.8 | 31.6 | n/a |
| Poland | -1.3 | -1.3 | **0.2** | -2.0 | -1.2 | -7.8 | -3.6 |
| Portugal | 2.1 | -3.5 | **2.7** | 1.9 | -7.8 | -3.3 | -6.9 |
| Slovakia | 14.0 | 13.9 | **-2.6** | 14.4 | -1.9 | -5.2 | -16.7 |
| Spain | -11.2 | -11.2 | **-11.4** | -10.2 | -10.3 | -9.9 | -10.6 |
| Sweden | 34.6 | 31.3 | **34.6** | 34.6 | 22.9 | 31.0 | 32.5 |
| Switzerland | -2.8 | -1.8 | **-4.0** | n/a | -2.5 | -2.8 | -3.9 |
| Turkey | -4.3 | -8.6 | **-4.3** | -8.7 | -10.6 | -12.1 | 12.9 |
| United Kingdom | -8.1 | -10.8 | **-8.3** | -11.3 | -7.5 | -7.2 | -17.8 |
| Bulgaria**** | n/a | n/a | -25.7 | -25.3 | -25.1 | -17.4 | -36.4 |
| Estonia**** | n/a | n/a | -37.1 | -31.3 | n/a | 12.7 | -34.2 |
| Latvia**** | n/a | n/a | -9.9 | -8.0 | n/a | 58.7 | -10.4 |
| Lithuania**** | n/a | n/a | -23.0 | -15.9 | -15.7 | -10.4 | -15.4 |
| Romania**** | n/a | n/a | -14.1 | -13.4 | -14.9 | -14.5 | -14.1 |
| Slovenia**** | n/a | n/a | -5.3 | -3.6 | n/a | -11.0 | 7.5 |

* OECD region minus Switzerland

** Belgium + Luxembourg
*** OECD region minus Norway
**** These countries are not studied in the main text. The numbers here are just for additional information
Sources:

1. IEA 1: Monthly Natural Gas Survey, September 2010, table 1, column 1 "2008" and column 2 "2009"
2. IEA 2: Monthly Natural Gas Survey, various issues, table 1, column 6 "month"
3. IEA 3: *Natural Gas Information 2010*, Part II, page 12, table 5
4. Eurostat: Energy Statistics Quantities, Monthly Supply Gas, nrg_103m
5. BP: Statistical Review 2010, Natural gas consumption, p27
6. Cedigaz: Natural Gas Consumption in the World – 2010 Edition, table 80[58]
7. Eurogas: Statistical report 2010 and Statistics 2008, Primary energy consumption[59]

**Additional remark on Table 10, on page 33: OECD Europe vs sum of OECD European countries**

In Table 10, on page 33, the line "OECD Europe" was calculated adding data for 22 countries provided by the IEA. However, some statistical difference exists between "OECD Europe" and the data found by adding all the countries in the OECD Europe region. In Table 10, we have decided not to use data on Norway, because it was unsatisfactory. This accounts for part of the discrepancy between the data on "OECD Europe" and the data provided by the sum of all the countries. The rest of the discrepancy is due to statistical differences, which are not clearly explained. Table 12 shows data for the OECD Europe calculated by adding the data for each market.

Table 12: Observed and temperature corrected demand in the European markets (mcm), December-March 2008-2009-2010

| | Demand observed (mcm) | | | Difference observed / temperature corrected demand (mcm) | | |
|---|---|---|---|---|---|---|
| | Dec 2007-Mar 2008 | Dec 2008-Mar 2009 | Dec 2009-Mar 2011 | Dec 2007-Mar 2008 | Dec 2008-Mar 2009 | Dec 2009-Mar 2011 |
| 22 countries | 248032 | 231806 | 254337 | 9613.9 | -996.8 | -9539.3 |
| OECD Europe | 243186 | 227274 | 248941 | 10319.3 | -432.24 | -6599.2 |

Source: IEA and author's analysis

[58] Table 78 (page 154) actually provides different annual percentage change for gas demand in 2009 for certain countries than table 80 (page 155): UK (-8 percent in table 78 and -7.2 percent in table 80), Germany (-0.7 and 2.9 percent), Italy (-8 and -10 percent), France (-2.7 and -0.1 percent) and Netherlands (0.8 and -4.9 percent). These statistical differences are not explained.
[59] Tables on "Primary energy consumption" and" Inland deliveries" of natural gas (with details on sectoral use) show very wide differences for percentage change for gas demand from 2008 to 2009.

**Temperature-correction of natural gas demand: a simple methodology**

Natural gas demand varies significantly from one month to another in most of the European countries. The seasonality can be explained by a number of factors such as the weather (temperatures, wind), length of the day and calendar effects (number of working days, holidays). Outdoor temperatures have the biggest influence on energy consumption for space heating purposes, particularly in the residential sector. Natural gas demand is higher in colder than average winters in Europe, and air conditioning units can boost electricity demand during hot summers, especially in southern European countries.[60] Analysing natural gas consumption trend requires comparing the actual/observed demand with temperature-corrected, in order to eliminate the impact of colder or warmer than average winters. While temperatures are a major factor for gas demand fluctuations, temperature-corrected data are not easily obtained, as they are not published at the European level,[61] at least in the public domain.

Several institutions have published guidelines or reports on seasonal adjustment methodologies[62] and seasonal adjustment software[63] are downloadable for free on the internet (such as the widely used auto-regressive integrated moving average –ARIMA- based method for instance). In this paper, we have used a much simpler methodology, which provide the reader with an easy rule of thumb to calculate temperature correction for gas demand.

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[60] Monthly data of natural gas demand show some peaks during the summer mostly in Spain, Turkey. The other markets are not experiencing a notable increase in consumption during the (hot) summer months yet.

[61] Some data are available at the national level, as in the UK for instance.

[62] These guidelines do not specifically focus on natural gas or energy, but they still provide interesting information on various methodologies used. To name but a few (in no particular order):
Energy Information Administration (EIA) (2007), "Impacts of Higher Natural Gas Prices on Local distribution Companies and Consumers", July 2007, Appendix C on page 42 (http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2007/ngpristudy/ngpristudy.pdf)
Eurostat (2007), "Panorama of Energy", 2007 edition, European Commission, Statistical books, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-76-06-604/EN/KS-76-06-604-EN.PDF
Eurostat (2009), "ESS Guidelines on Seasonal Adjustment", 2009 edition, European Commission, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-006/EN/KS-RA-09-006-EN.PDF
OECD (2007), "Development of Guidelines on Seasonal Adjustment Practices", this paper was based on Eurostat guidelines (not the ESS guidelines) http://www.oecd.org/dataoecd/49/46/38514023.pdf
United Nations (2009), "Report on Seasonal Adjustment Survey to the EECCA and Western Balkan countries", Economic Commission for Europe, Economic Statistics section, March 2009, http://www.unece.org/stats/publications/Report_seasonal_adjustment_survey.pdf
United Nations (2010), "Seasonal Adjustment Methods and Country Practices", Economic and Social Commission for Asia and the Pacific, Statistics development and Analysis Section, PowerPoint slides
Hungarian Central Statistical Office (2007), "Seasonal Adjustment Methods and Practices", July 2007, http://epp.eurostat.ec.europa.eu/portal/page/portal/ver-1/quality/documents/SEASONAL_ADJUSTMENT_METHODS_PRACTICES.pdf

[63] Free software:
Demetra: http://circa.europa.eu/Public/irc/dsis/eurosam/library?l=/software/demetra_software/
X12-Arima: http://www.census.gov/srd/www/x12a/
TRAMO-SEATS: http://www.bde.es/servicio/software/econome.htm

In 1996, the European Commission requested an assessment of climatic correction methods applied in some Member States. Eurostat presented its findings in 1998 and proposed a common method for heating correction in the final consumption sectors.[64] In order to calculate this corrected data, the final gas consumption, the share of gas used for space heating and the number of heating degree-days (HDD) needs to be known. Eurostat provides data on HDD (actual and relative) and the share of gas used in space heating in 2006 for the residential & commercial sector and the industry sector.[65] There are no data provided for the share of the gas that is temperature sensitive in the power sector. The possible explanation is that it is too difficult to isolate the role of the due to the switchability from one fuel to another one to produce electricity. As a consequence, temperature-corrected data cannot be calculated for the *total* demand using Eurostat methodology.[66] However, using the IEA monthly data, it was possible to determine the share of the total demand which is 'temperature sensitive' in the OECD markets, and by applying the Eurostat equations to this share of the market, we could calculate some temperature-corrected data for these countries for 2008-2010 winters.[67]

[64] For more information, see Eurostat (2007), *Panorama of Energy, Energy statistics to support EU policies and solutions*, pages 153–66.
[65] Ibid.
[66] Eurostat equation to calculate temperature-corrected data: Ent = Et / (b . dt + 1 - b) where Ent: temperature-corrected energy consumption; Et: actual energy consumption; b: heating share and dt: relative degree-days
[67] This methodology is close to the one proposed by the Energy Information Administration (EIA) in "Impacts of Higher Natural Gas Prices on Local distribution Companies and Consumers", July 2007, Appendix C on page 42.

## Appendix 2: List of figures and sources in Appendix 3 to Appendix 25

Appendices 2 to 24 present various figures, which give additional background information to try and understand what happened to natural gas demand country by country in 2009 and, more importantly, what path of recovery can be expected for 2010 and beyond. A short paragraph summarises the findings for each country.

We have tried to replicate the figures for each OECD country, however, due to unsatisfactory or unavailable data, some figures are missing for certain countries. In addition, we present data from various sources, which, as explained in Appendix 1, may lead to contradictory data.

The bullet points below provide the source for each figure, which will not be written at the bottom of the figures in Appendix 3 to Appendix 25 in order to save some space and gain clarity.

- Figure: Natural gas demand by sector in 2008 (% of total demand)
  Source: IEA, *Natural Gas Information 2010*, part IV, table 3A

- Figure: GDP percentage change from previous year, 2006-2010
  Source: OECD, OECD Economic Outlook n. 88 report, November 2010, statistical annex

- Figure: Production indices for total industry, excluding construction, seasonally adjusted (base year 2005), 2008-2010
  Source: Eurostat (monthly), News Release, Euro Indicators, various issues

- Figure: Indigenous electricity generation, 2008-2009-2010 (TWh/GWh)
  Source: IEA (monthly), Electricity Statistics, regional and country tables

- Figure: Electricity generation by fuels, 2008-2010 (TWh/GWh)
  Source: ENTSOE (monthly), generation data

- Figure: Year-to-date (Jan-Sept) comparison of electricity generation by fuel type, 2008-2009-2010 (TWh/GWh)
  Source: IEA (monthly), Electricity Statistics, regional and country tables

- Figure: Natural gas demand percentage change, 2008 to 2009, from various sources
  Sources:
  1. IEA 1: Monthly Natural Gas Survey, September 2010, table 1, column 1 “2008” and column 2 “2009”
  2. IEA 2: Monthly Natural Gas Survey, various issues, table 1, column 6 “month”
  3. IEA 3: *Natural Gas Information 2010*, Part II, page 12, table 5
  4. Eurostat: Energy Statistics Quantities, Monthly Supply Gas, nrg_103m
  5. BP: Statistical Review 2010, Natural gas consumption, p27
  6. Cedigaz: Natural Gas Consumption in the World – 2010 Edition, table 80
  7. Eurogas: Statistical report 2010 and Statistics 2008, Primary energy consumption

- Figure: Natural gas demand by month, 2008-2009-2010 (mcm)
  Source: IEA (monthly), Natural Gas Survey, various issues

- Figure: Natural gas use for power on left axis (TJ) and electricity demand and generation on right axis (GWh), 2008-2010
  Source: Eurostat, Energy Statistics Quantities, Supply gas monthly: nrg_103m, supply electricity monthly, gross consumption and net generation: nrg_105m,

- Figure: Natural gas use for power (mcm), 2008-2009-2010
  Source: Eurostat, Energy Statistics Quantities, Supply gas monthly: nrg_103m. Data in TJ converted in mcm[68]

- Figure: Change in industry production, power generation, HDD and gas demand by sector, 2008 to 2009 (%)
  Sources:
  1. Eurostat (monthly), News Release, Euro Indicators, various issues
  2. IEA (monthly), Electricity Statistics, regional and country tables
  3. Eurostat, Energy Statistics, nrg_esdgr
  4. Eurogas: Statistical report 2010 and Statistics 2008, Inland deliveries of natural gas

- Figure: Heating Degree Days, 2008-2009-2010
  Source: Eurostat, Energy Statistics, nrg_esdgr

- Figure: Heating degree-days in EU27, 1980-2010
  Source: Eurostat, Energy Statistics, nrg_esdgr

- Figure: Temperature corrected and observed natural gas demand on left axis (bcm) and HDD on right axis, 2008-2010
  Sources:
  1. Temperature corrected demand: Author's analysis
  2. Observed demand: IEA (monthly), Natural Gas Survey, various issues, table 1, column 6 "month"
  3. HDD: Eurostat, Energy Statistics, nrg_esdgr

- Figure: Temperature corrected natural gas demand in mcm, 2008-2009-2010
  Sources: Author's analysis

[68] Conversion factors: Average values (for 2003-2008) gross calorific value of natural gas for consumption:

| | Austria | Czech Rep. | Denmark | Germany | Hungary | NL | Poland | Portugal | Slovakia | Spain | Sweden | UK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| kj/cm | 39810 | 37839 | 41779 | 36867 | 37547 | 33339 | 35283 | 40605 | 38004 | 42488 | 42045 | 39726 |

Source: IEA (2010), *Natural Gas Information 2010*, "Country specific conversion factors", page xxix

## Appendix 3: Europe

Natural gas consumption in OECD Europe fell by 5.6 percent in 2009 according to the IEA *Natural Gas Information 2010.*. Since the second half of 2009, industrial output is slowly rising again. On the other hand, more electricity generated from nuclear, hydro and other renewable sources in 2010 is dampening the recovery of gas demand in the power sector initiated in the second half of 2009.Uncertainties regarding the pace of recovery, now that fiscal stimulus has faded, remain high. Cold temperatures at the beginning and the end of the year will have boosted gas demand, and although the impact of cold temperatures should not be confused with underlying recovery, signs of economic improvement and, as a consequence, signs of a slow recovery of gas demand in 2010, enhanced by temperature effects, is the overall picture.

Figure 13: Natural gas demand by sector in 2008, in percent

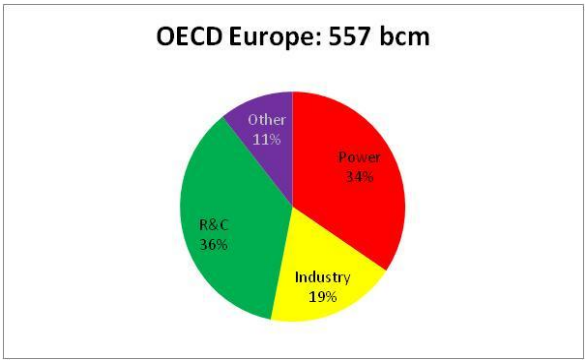



Figure 14: GDP percentage change from previous year, 2006-2012

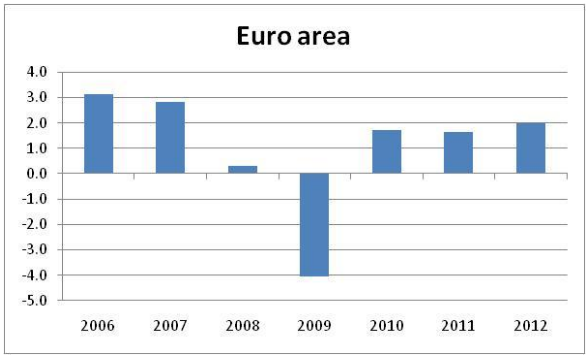



Figure 15: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

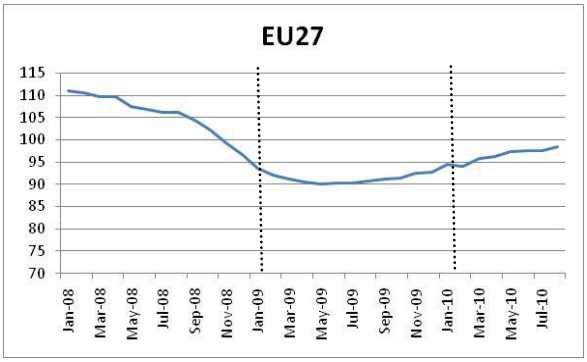



Figure 16: Indigenous electricity generation, in GWh, 2008-2009-2010

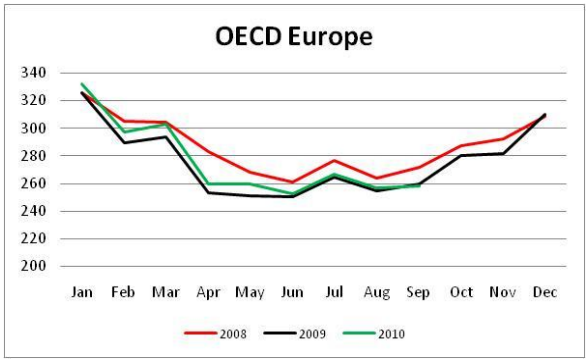


Figure 17: Electricity generation by fuels, 2008-2010, in TWh[69]

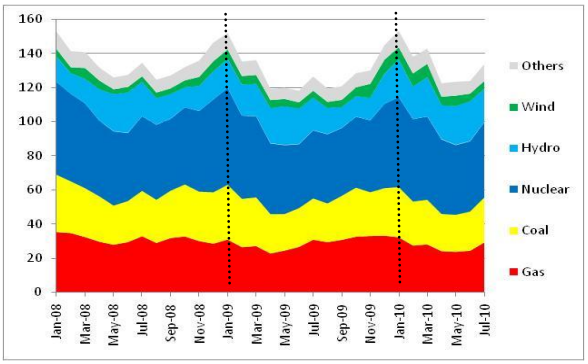



Figure 18: Electricity generation by fuels, 2008-2010, in TWh[70]

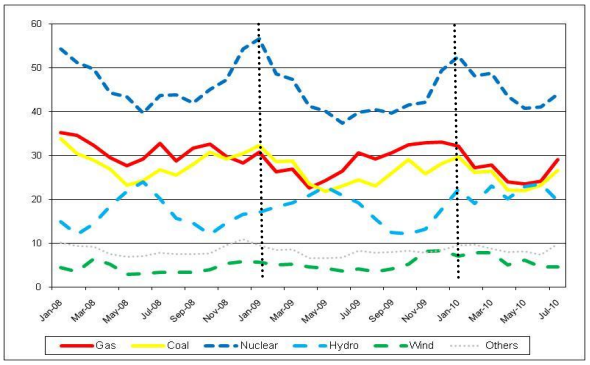



Figure 19: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2009-2010

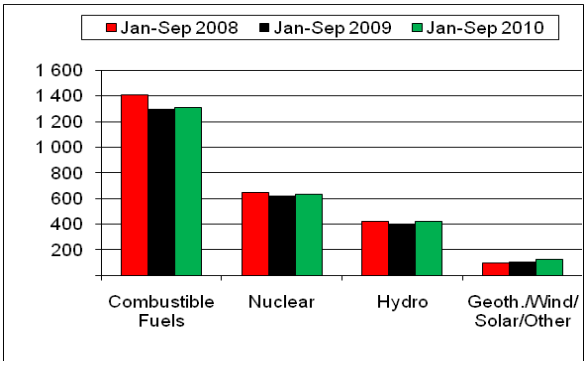



Figure 20: Natural gas demand percentage change, 2008 to 2009, from various sources

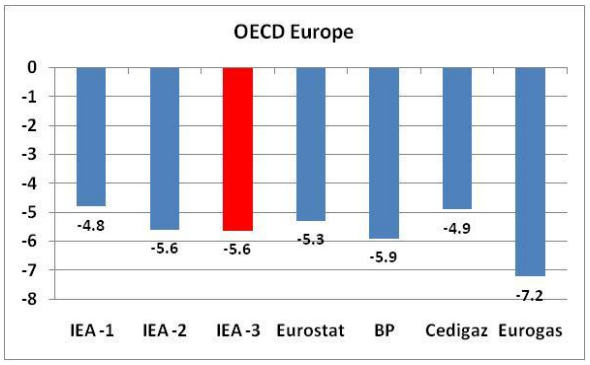



Figure 21: Natural gas demand by month, 2008-2009-2010, in mcm

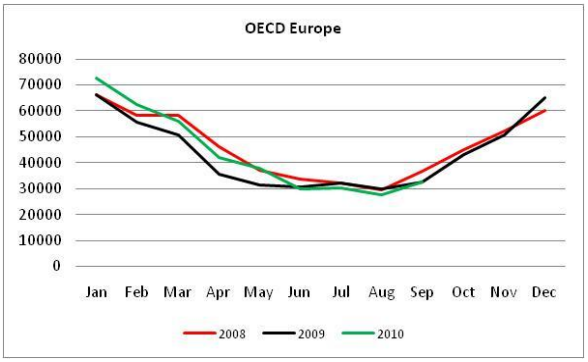
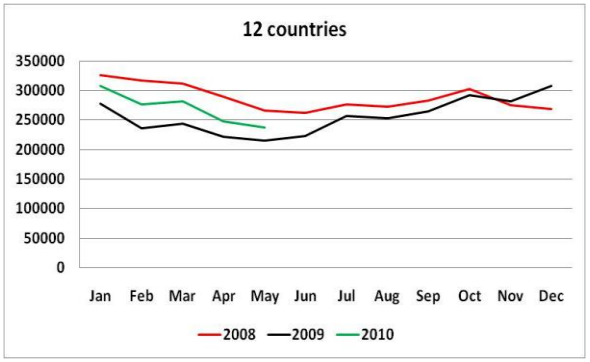



Figure 22: Natural gas use for power (mcm), 2008-2009-2010




[69] Due to lack of data, these charts represent the trends of electricity generation in 11 countries only

[70] Ibid

Figure 23: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

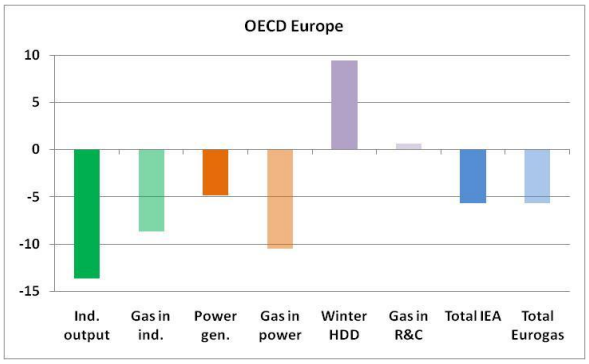



Figure 24: Heating degree-days, 2008-2009-2010

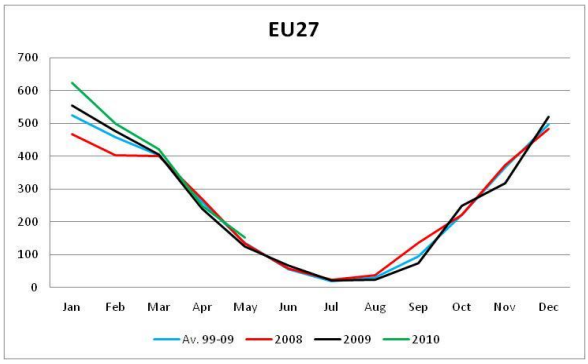



Figure 25. Heating degree-days in EU27, 1980-2010

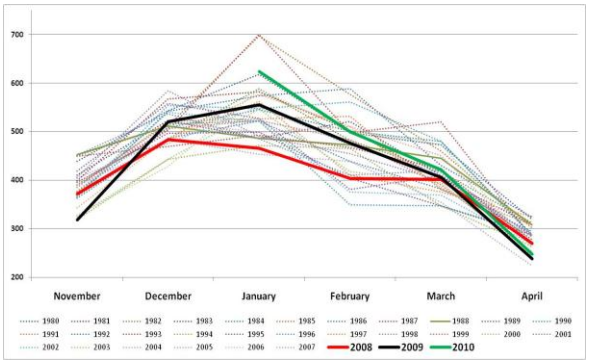



Figure 26: Temperature corrected and observed natural gas demand in mcm and HDD, 2008-2010

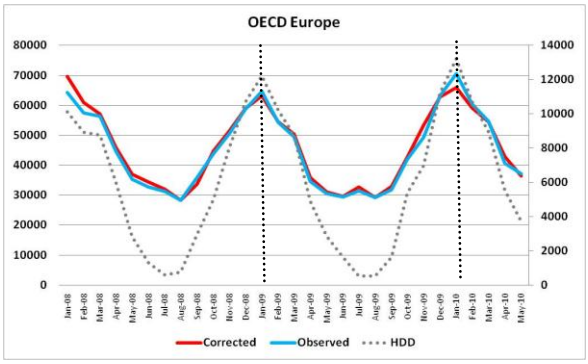
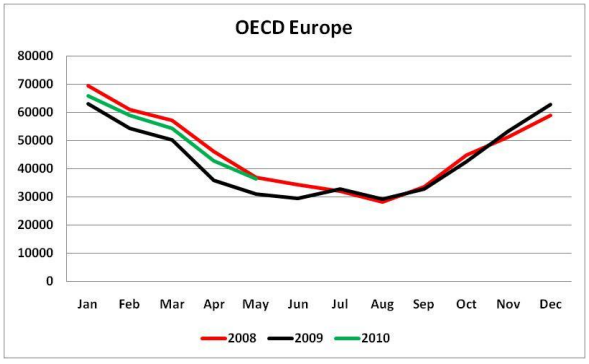



Figure 27: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 4: Austria

Natural gas consumption in Austria grew by 1.3 percent in 2009 according to the IEA *Natural Gas Information 2010*, although other data registered a decline (Eurostat, BP, Eurogas). Since the second half of 2009, industrial output and gas used in the power sector have been increasing fairly strongly.. Temperatures in winter 2009-10 were quite similar to the previous year; therefore higher gas demand in the first three quarters of 2010 is most probably the sign that recovery is under way in Austria.

Figure 28: Natural gas demand by sector in 2008, in percent

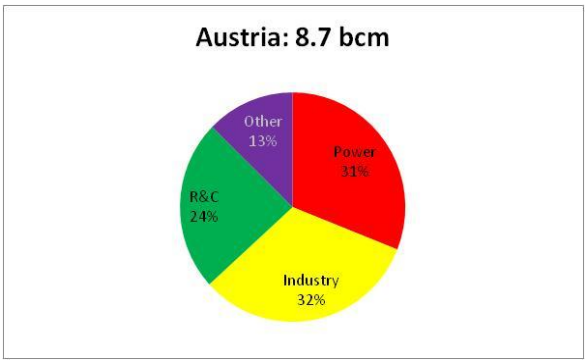



Figure 29: GDP percentage change from previous year, 2006-2012

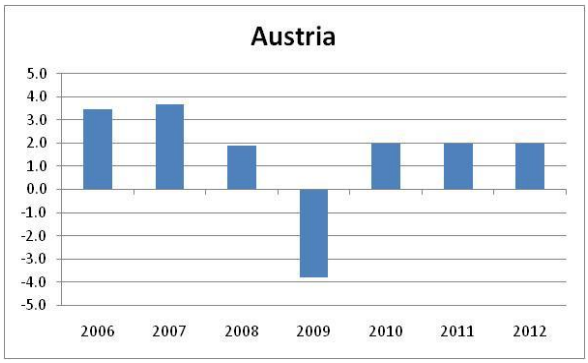



Figure 30: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

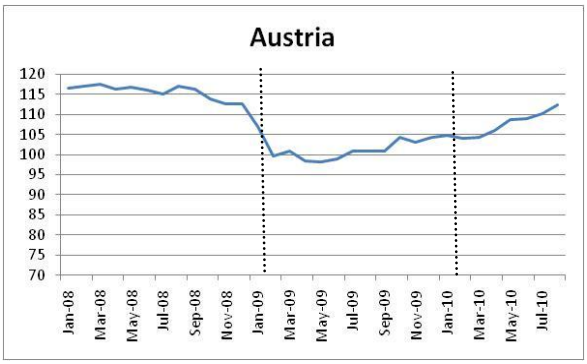



Figure 31: Indigenous electricity generation, in GWh, 2008-2010

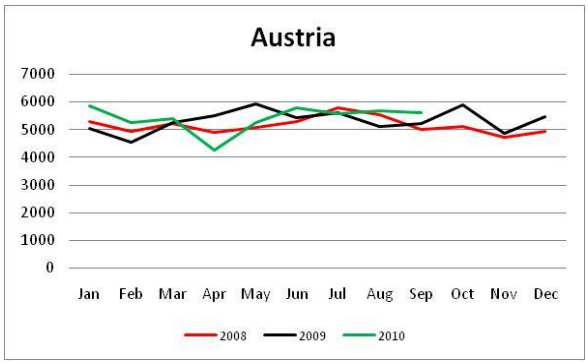


Figure 32: Electricity generation by fuels, 2008-2010, in TWh

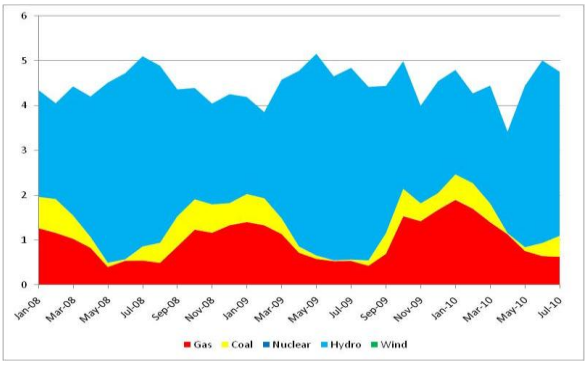



Figure 33: Electricity generation by fuels, 2008-2010, in TWh

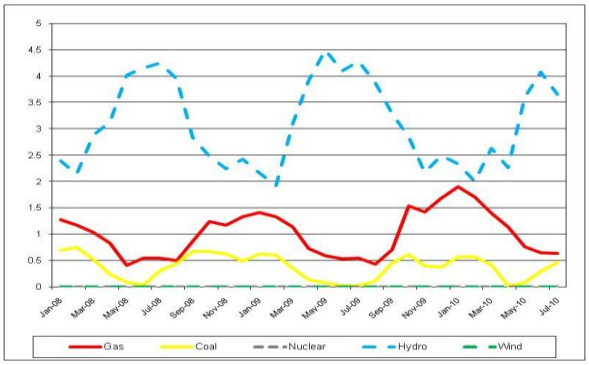



Figure 34: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

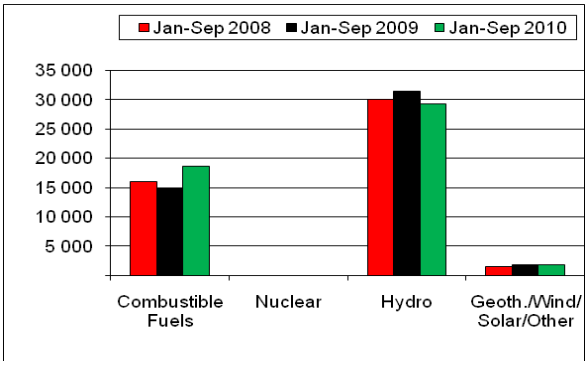



Figure 35: Natural gas demand percentage change, 2008 to 2009, from various sources

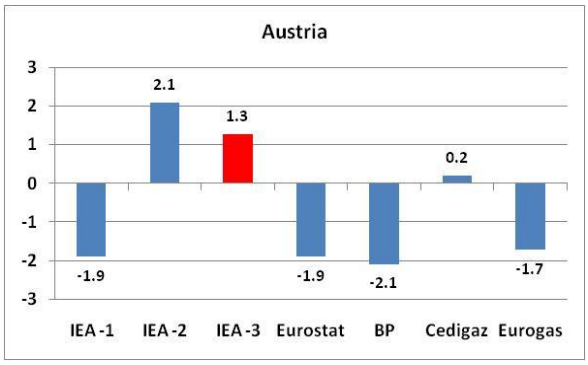



Figure 36: Natural gas demand by month, 2008-2010, in mcm

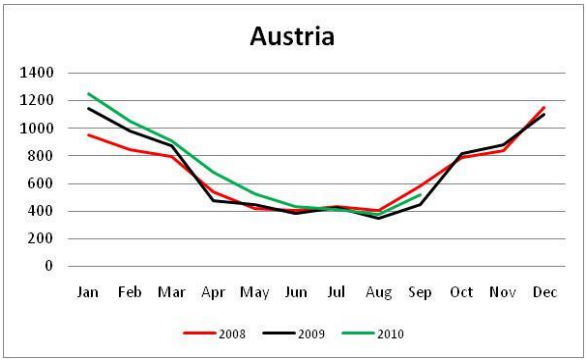



Figure 37: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

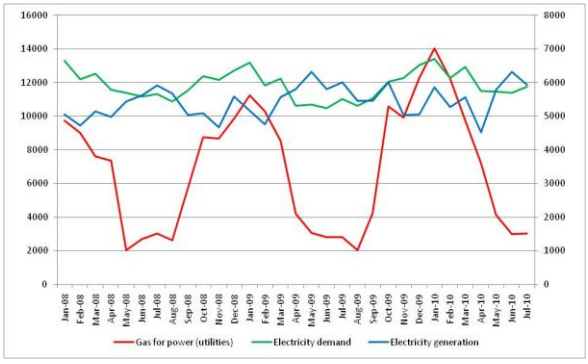


Figure 38: Natural gas use for power (mcm), 2008-2010

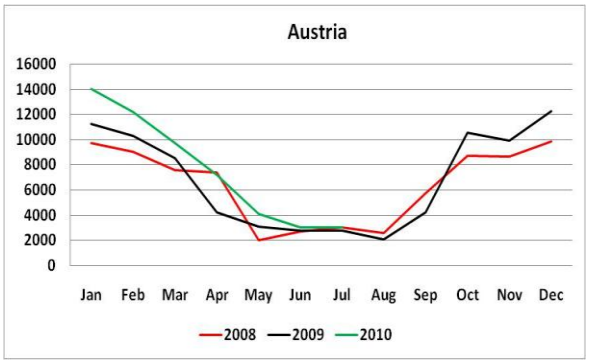



Figure 39: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

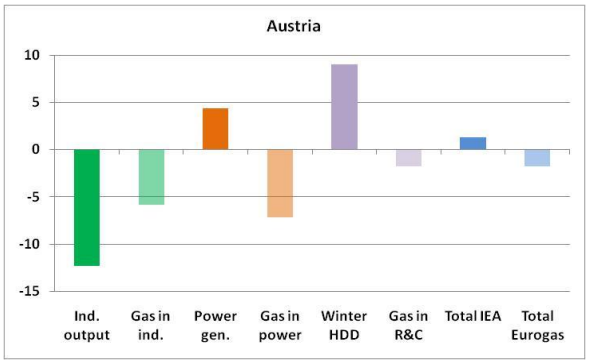



Figure 40: Heating degree-days, 2008-2010

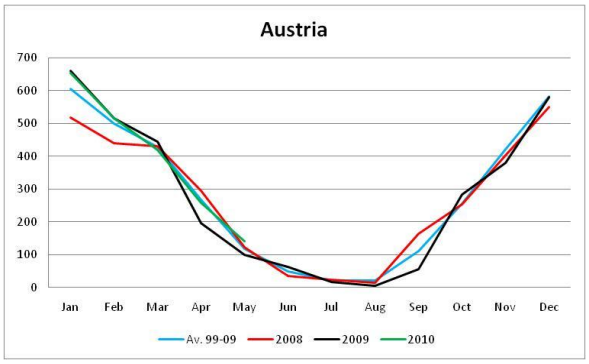



Figure 41: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

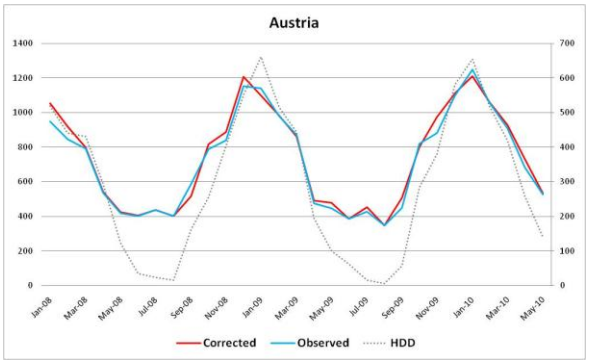
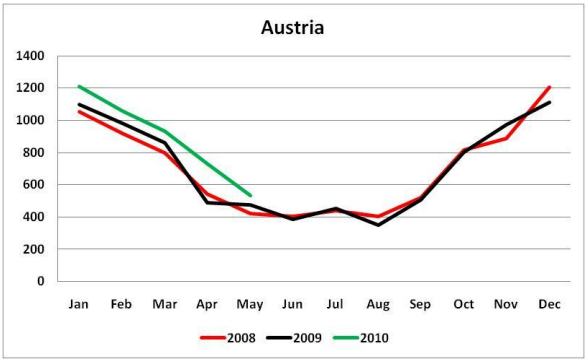



Figure 42: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 5: Belgium

Natural gas consumption in Belgium fell by 2 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output increased in early 2010 but has since flattened after the second quarter. After a strong rise in 2009, electricity generated from gas is decreasing. Temperatures in winter 2009-10 were quite similar to the previous year. As a result, higher gas demand in the first quarter of 2010 was probably due to recovery, but the process has since slow down, or even stopped.

Figure 43: Natural gas demand by sector in 2008, in percent

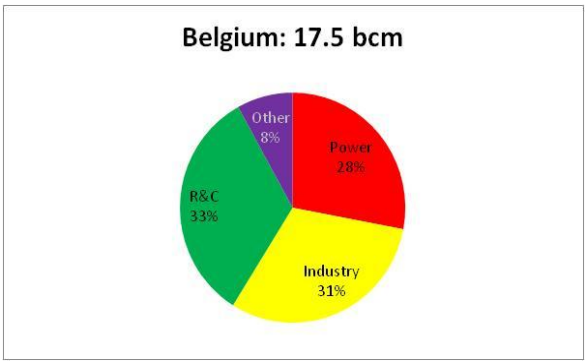



Figure 44: GDP percentage change from previous year, 2006-2012

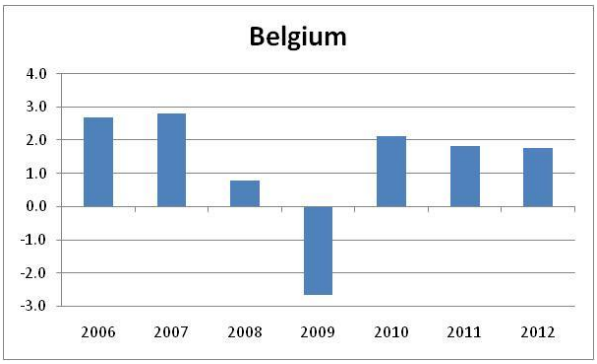



Figure 45: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

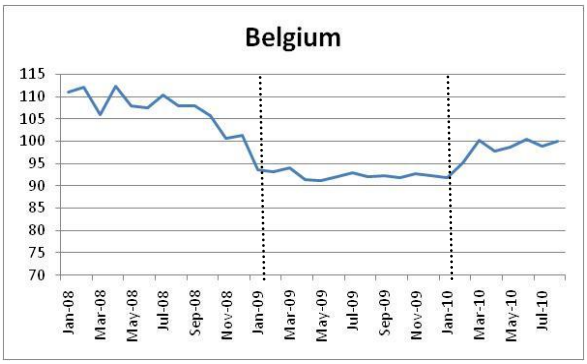



Figure 46: Indigenous electricity generation, in GWh, 2008-2010

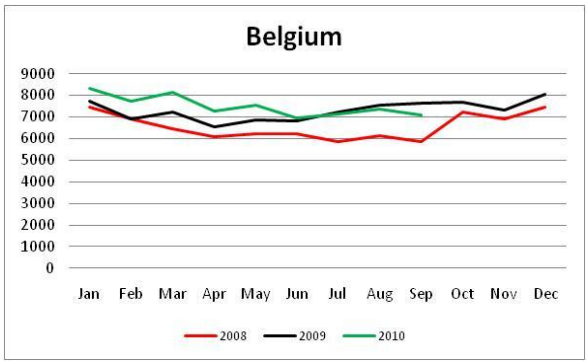


Figure 47: Electricity generation by fuels, 2008-2010, in TWh

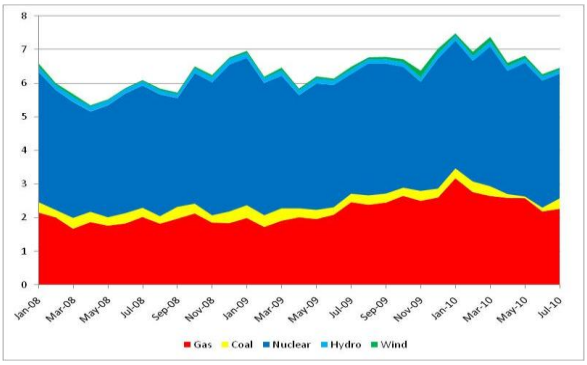



Figure 48: Electricity generation by fuels, 2008-2010, in TWh

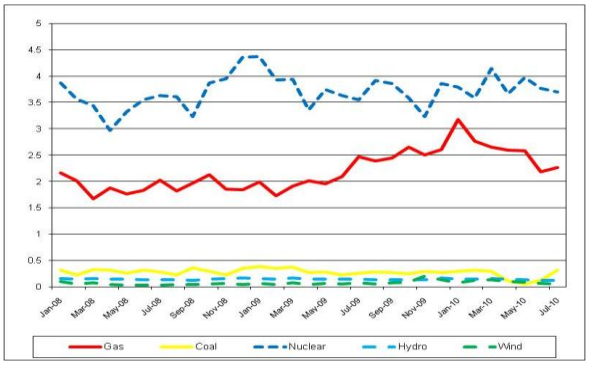



Figure 49: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

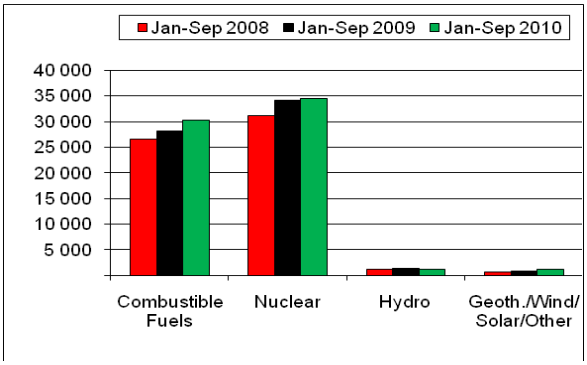



Figure 50: Natural gas demand percentage change, 2008 to 2009, from various sources

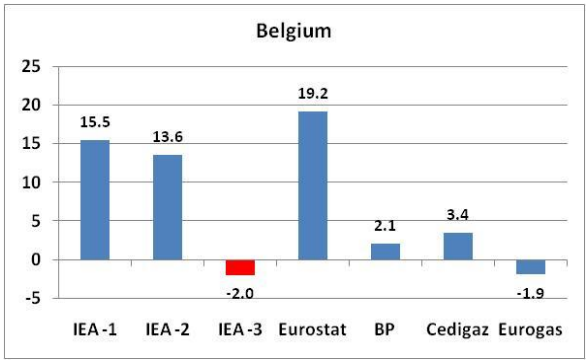



Figure 51: Natural gas demand by month, 2008-2010, in mcm

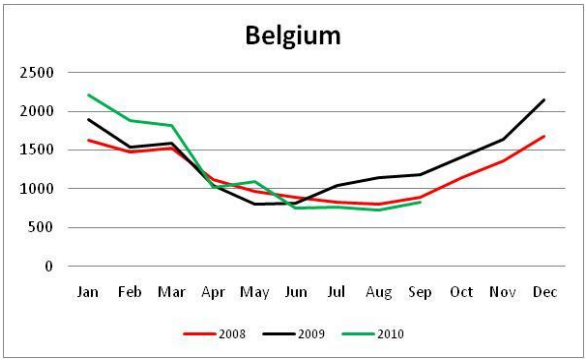



Figure 52: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

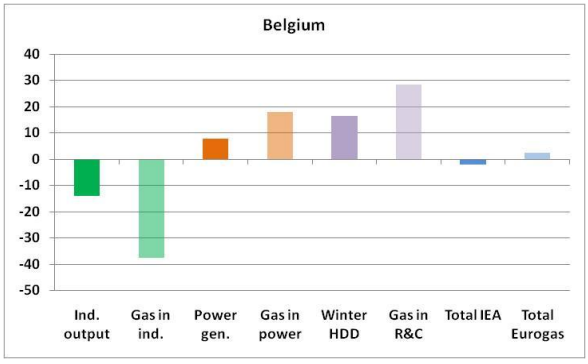


Figure 53: Heating degree-days, 2008-2010

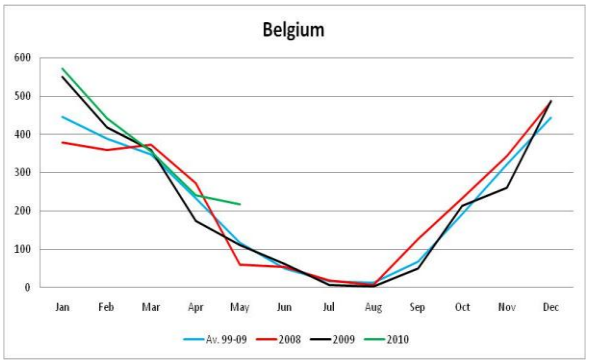



Figure 54: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

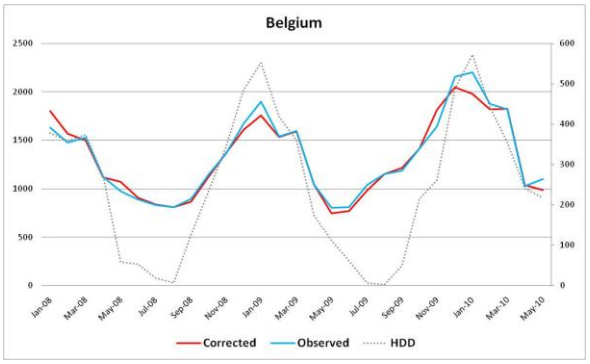
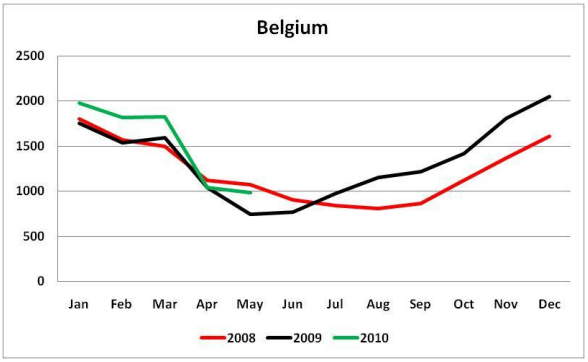



Figure 55: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 6: Czech Republic

Natural gas consumption in Czech Republic fell by 5.8 percent in 2009 according to the IEA *Natural Gas Information 2010*. Since the second quarter of 2009, industrial output has been rising slowly. Gas used in the power sector is limited. Temperatures in winter 2009-10 were quite similar to the previous year. We do not see signs of gas demand recovery in the first three quarters of 2010.

Figure 56: Natural gas demand by sector in 2008, in percent




Figure 57: GDP percentage change from previous year, 2006-2012

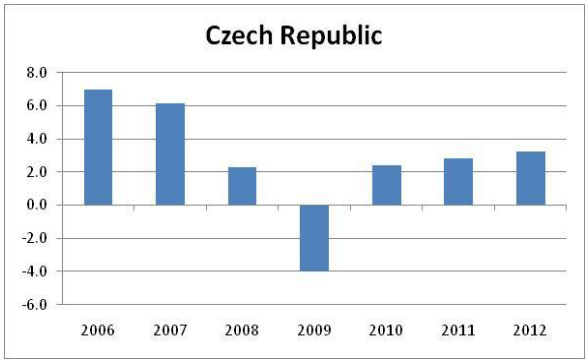



Figure 58: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010




Figure 59: Indigenous electricity generation, in GWh, 2008-2010

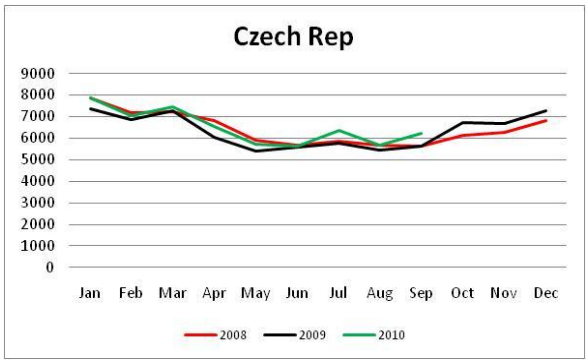


Figure 60: Electricity generation by fuels, 2008-2010, in TWh

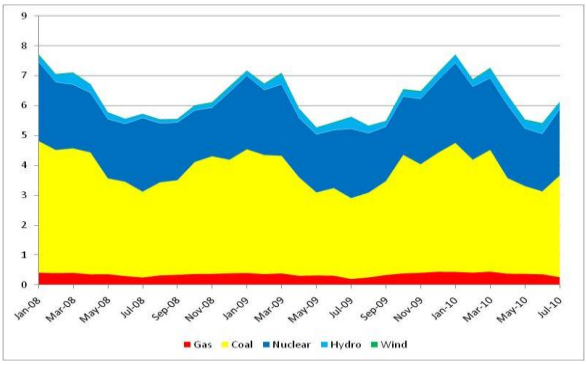



Figure 61: Electricity generation by fuels, 2008-2010, in TWh

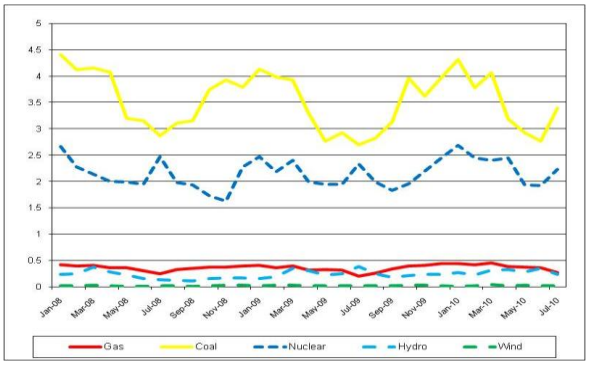



Figure 62: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

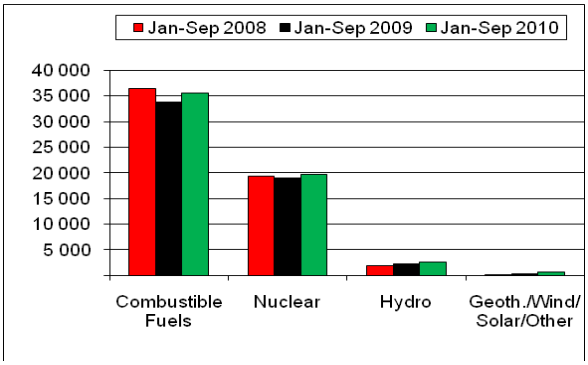



Figure 63: Natural gas demand percentage change, 2008 to 2009, from various sources

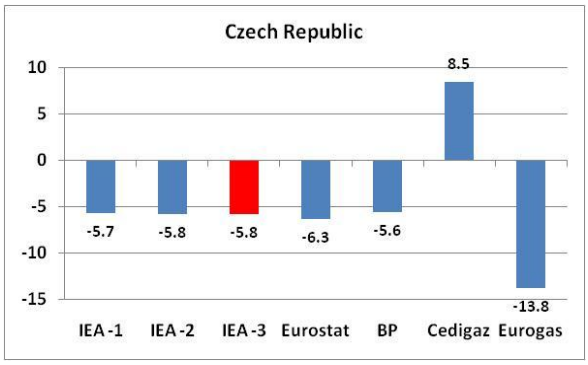



Figure 64: Natural gas demand by month, 2008-2010, in mcm

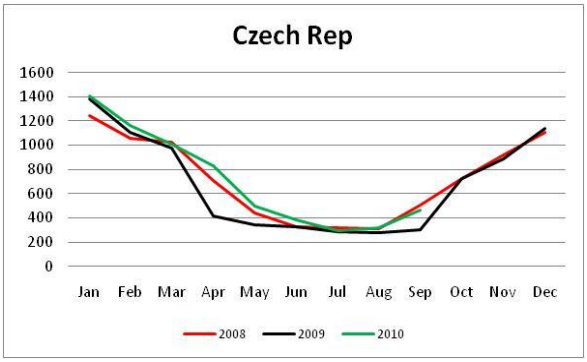



Figure 65: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

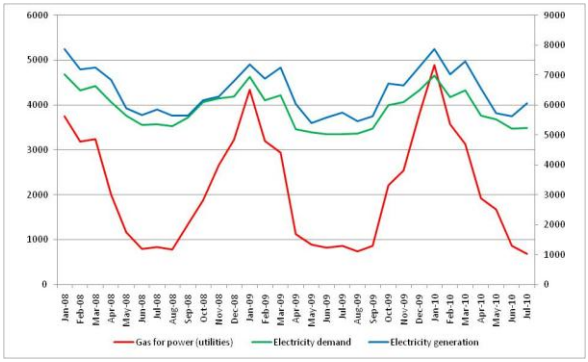


Figure 66: Natural gas use for power (in mcm), 2008-2010

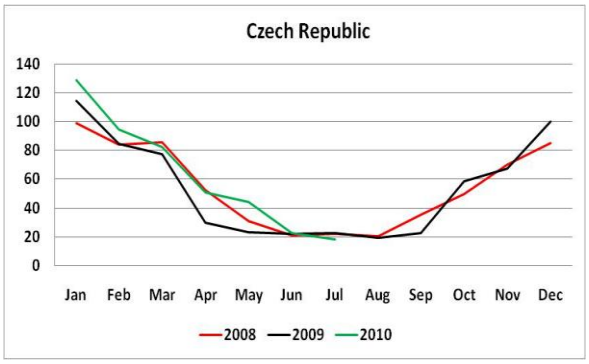



Figure 67: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

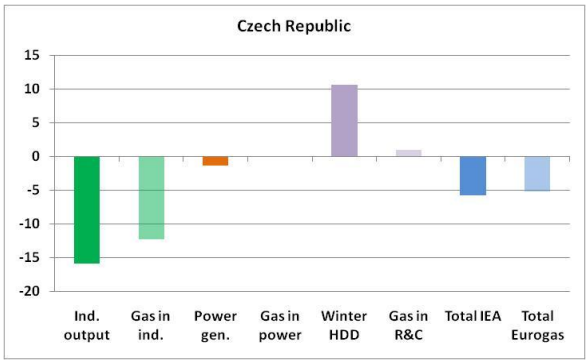



Figure 68: Heating degree-days, 2008-2010

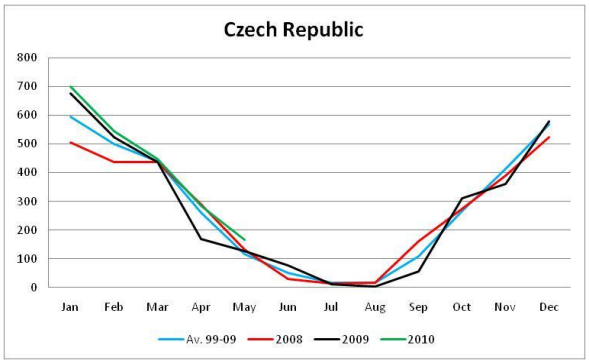



Figure 69: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

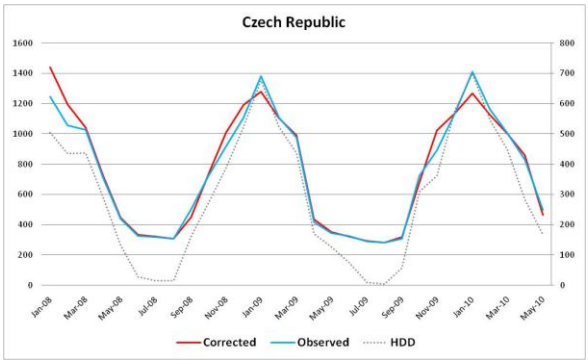
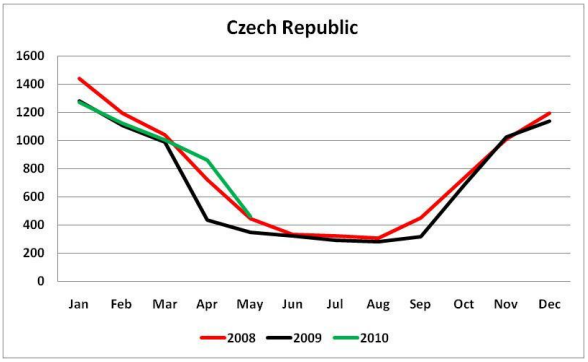



Figure 70: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 7: Denmark

Natural gas consumption in Denmark decrease by 4.2 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output grew in the first half of 2010, but showed signs of decline again in the fourth quarter. Lots of electricity was produced from gas in winter 2009-10, which was much colder than the previous year. Despite these mixed signals, we expect a slow recovery for gas consumption in Denmark in 2010.

Figure 71: Natural gas demand by sector in 2008, in percent

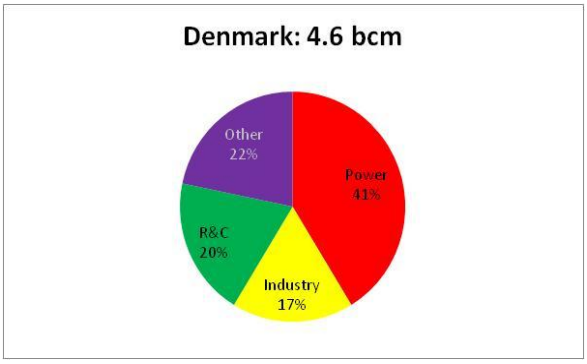



Figure 72: GDP percentage change from previous year, 2006-2012

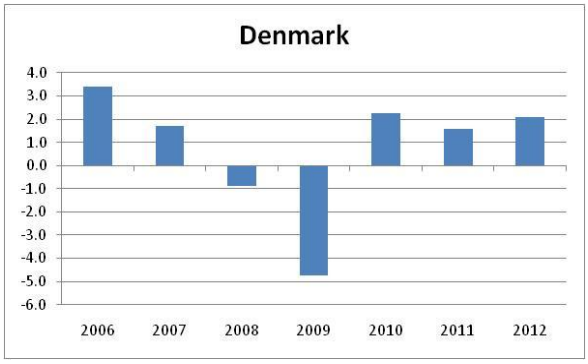



Figure 73: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010




Figure 74: Indigenous electricity generation, in GWh, 2008-2010

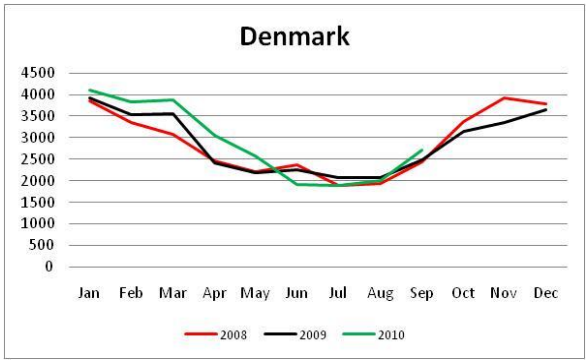


Figure 75: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

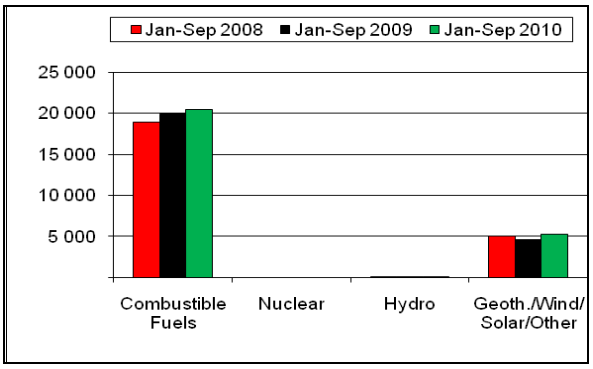



Figure 76: Natural gas demand percentage change, 2008 to 2009, from various sources

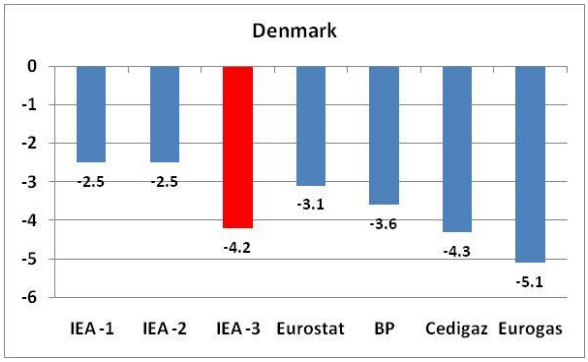



Figure 77: Natural gas demand by month, 2008-2010, in mcm

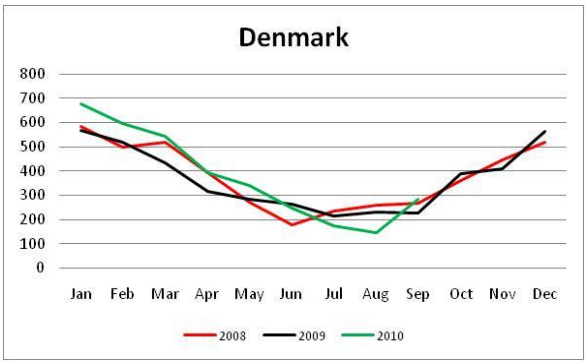



Figure 78: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

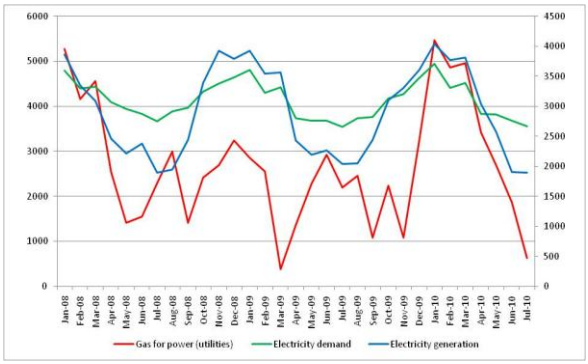



Figure 79: Natural gas use for power (in mcm), 2008-2010

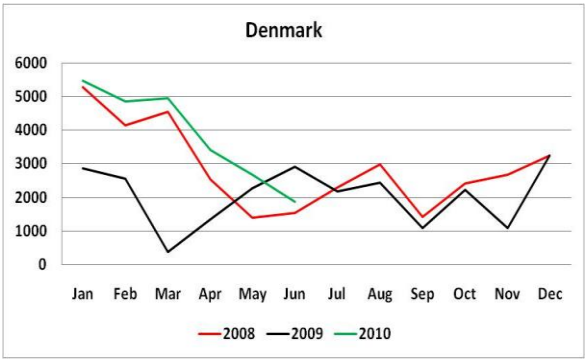



Figure 80: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

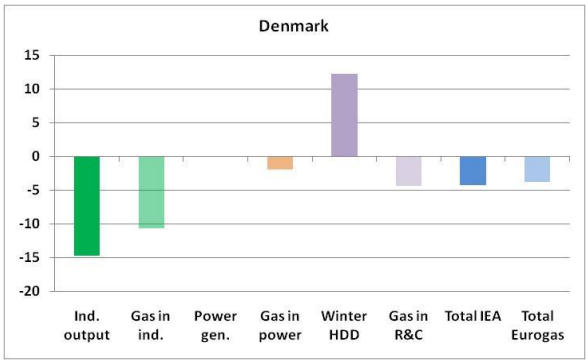


Figure 81: Heating degree-days, 2008-2010

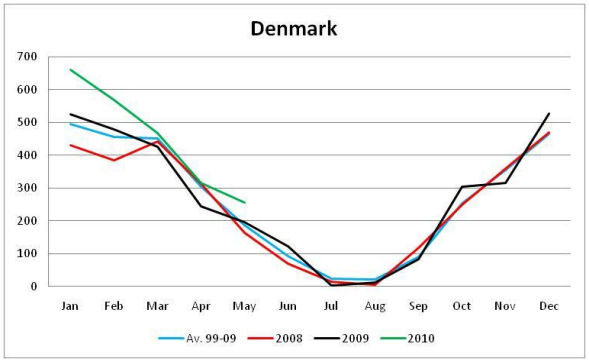



Figure 82: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

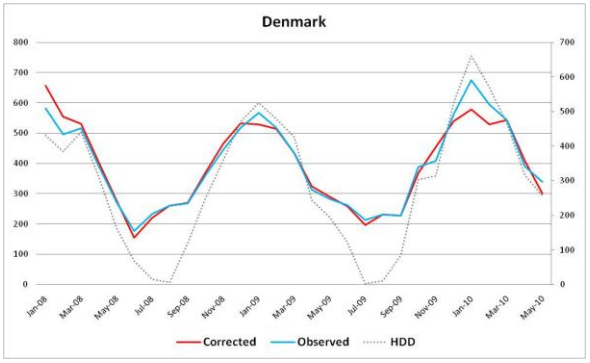
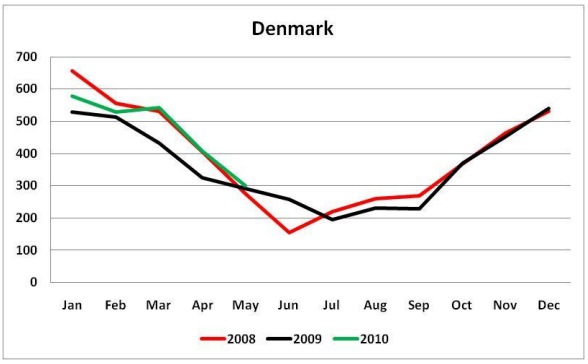



Figure 83: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 8: Finland

Natural gas consumption in Finland fell by a whopping 9.6 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output increased in 2010. Electricity generated from gas may also be on the rise, although lack of data makes this difficult to prove. Temperatures in winter 2009-10 were much colder than the previous year and explain higher gas demand in the first quarter of 2010. As a result, we don't think gas demand is on the path of recovery in the first three quarters of 2010.

Figure 84: Natural gas demand by sector in 2008, in percent

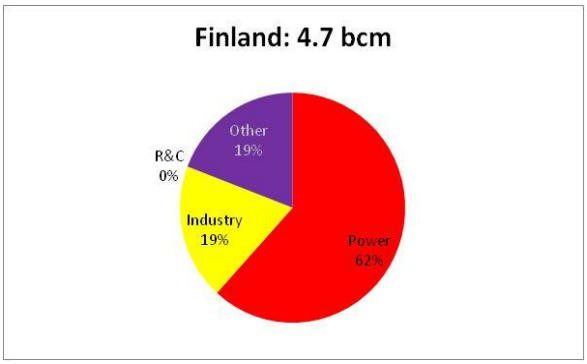



Figure 85: GDP percentage change from previous year, 2006-2012

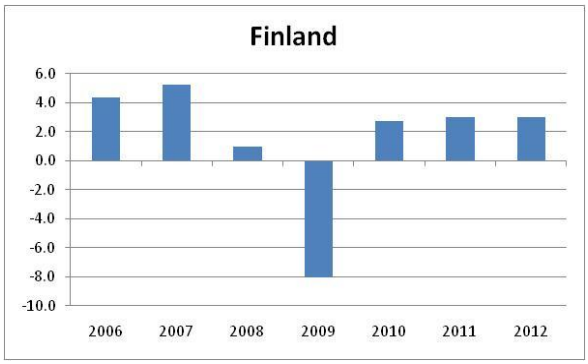



Figure 86: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

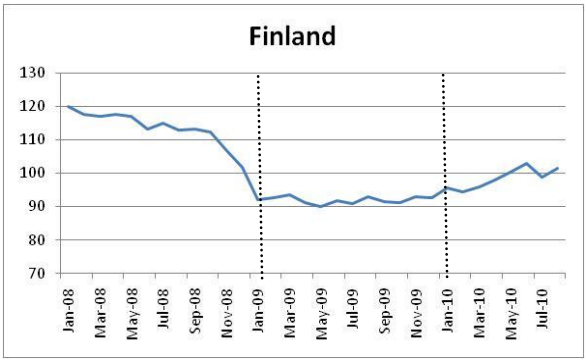



Figure 87: Indigenous electricity generation, in GWh, 2008-2010

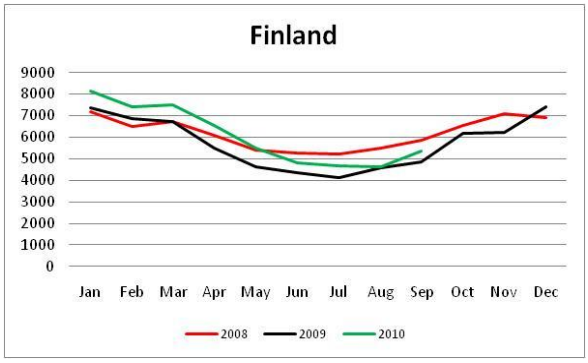


Figure 88: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

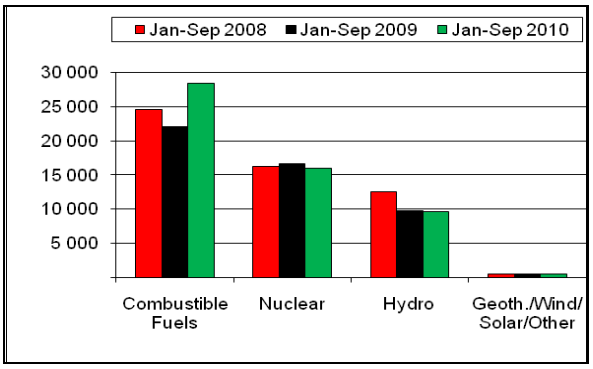



Figure 89: Natural gas demand percentage change, 2008 to 2009, from various sources

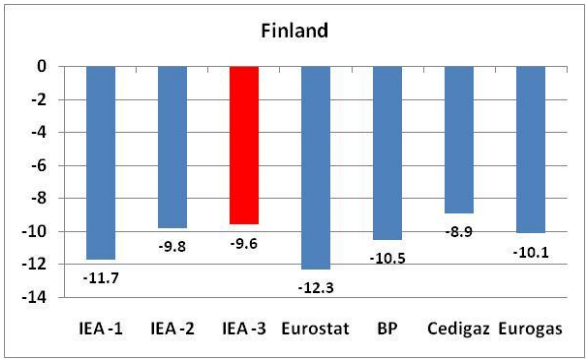



Figure 90: Natural gas demand by month, 2008-2010, in mcm




Figure 91: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

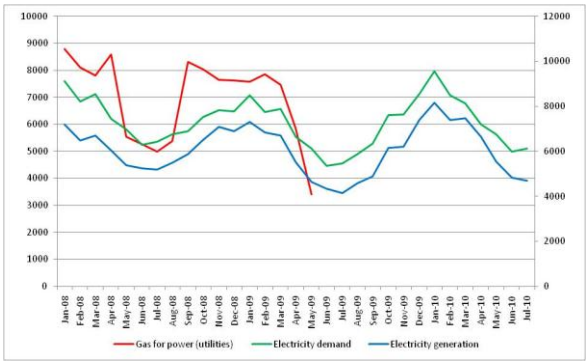



Figure 92: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

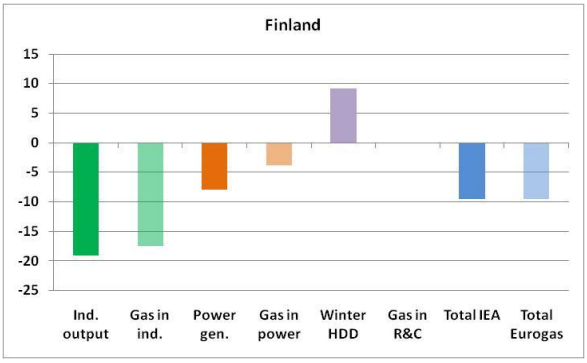



Figure 93: Heating degree-days, 2008-2010

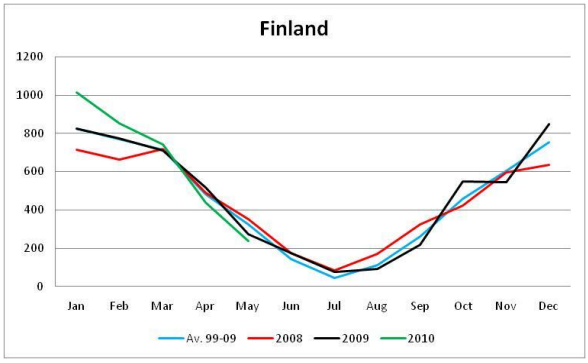


Figure 94: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

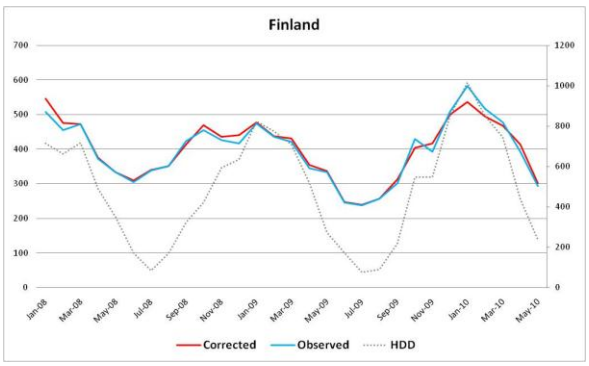
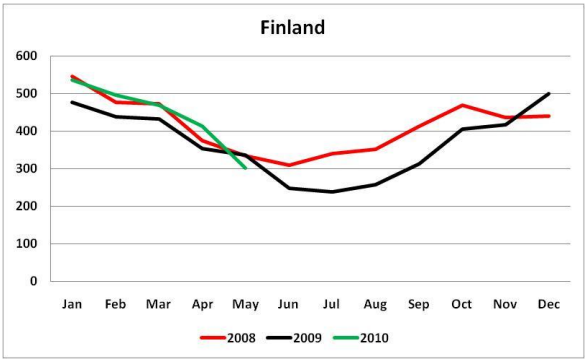



Figure 95: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 9: France

Natural gas consumption in France fell by 3.4 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output has been increasing very slowly since the second quarter of 2009. Lower electricity generated from nuclear in 2009 accounted for more electricity from gas. However, nuclear power is back on track in 2010 and gas for power has therefore been limited, despite 1.3 GW of additional gas power plants that enter operation in 2010. Higher gas consumption winter 2009-10 was mostly due to very cold temperatures. As a result, we do not expect major recovery in 2010.

Figure 96: Natural gas demand by sector in 2008, in percent

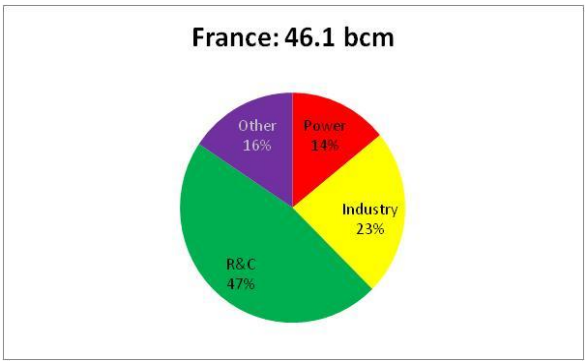



Figure 97: GDP percentage change from previous year, 2006-2012

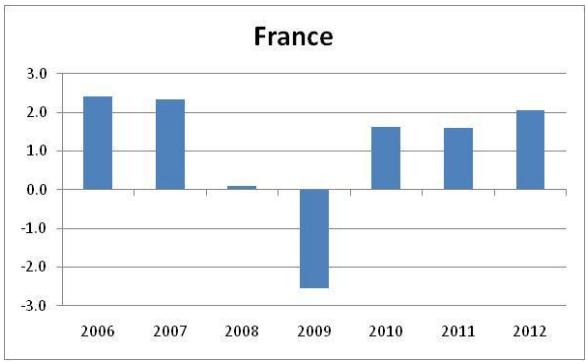



Figure 98: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

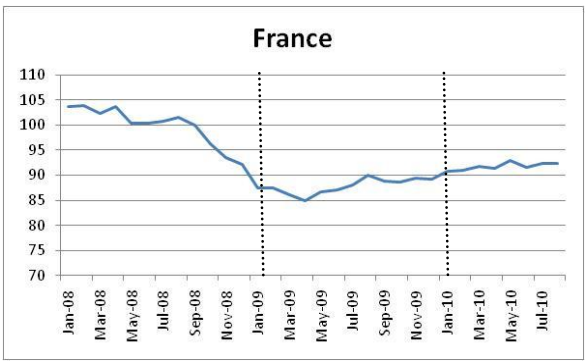



Figure 99: Indigenous electricity generation, in GWh, 2008-2010

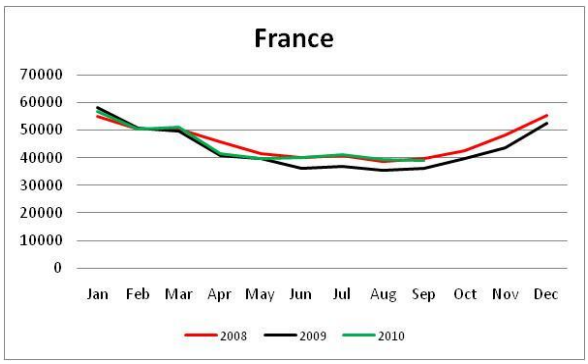


Figure 100: Electricity generation by fuels, 2008-2010, in TWh

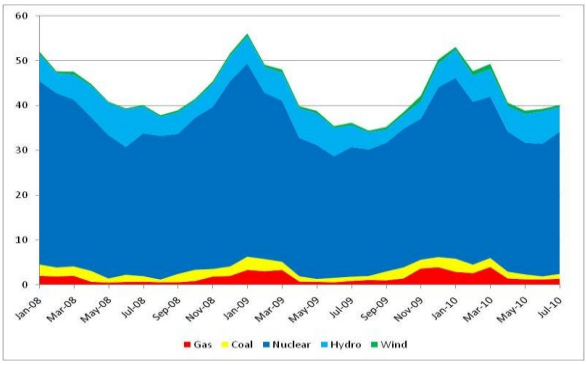



Figure 101: Electricity generation by fuels, 2008-2010, in TWh

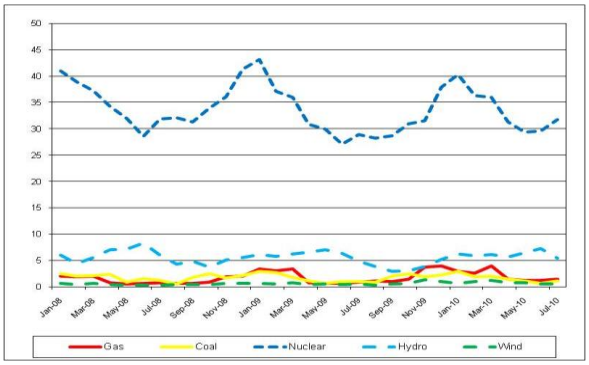



Figure 102: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

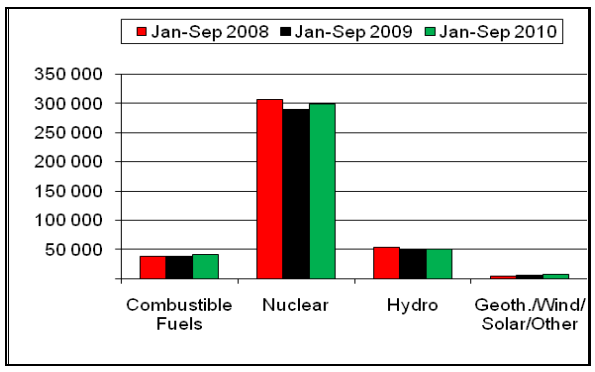



Figure 103: Natural gas demand percentage change, 2008 to 2009, from various sources

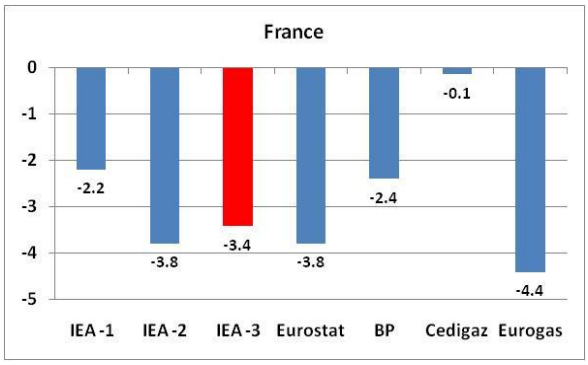



Figure 104: Natural gas demand by month, 2008-2010, in mcm

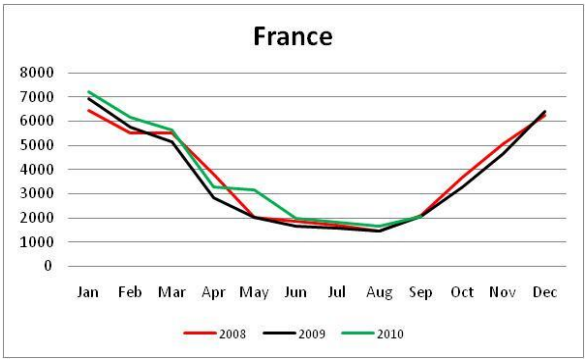



Figure 105: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

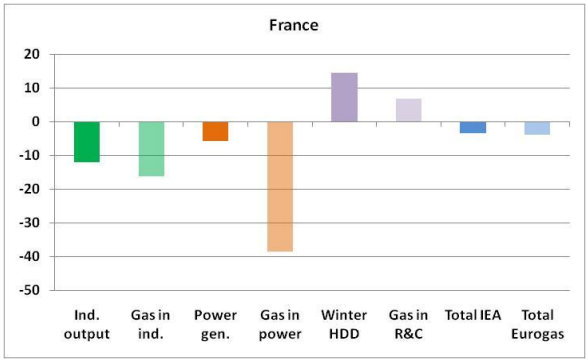


Figure 106: Heating degree-days, 2008-2010

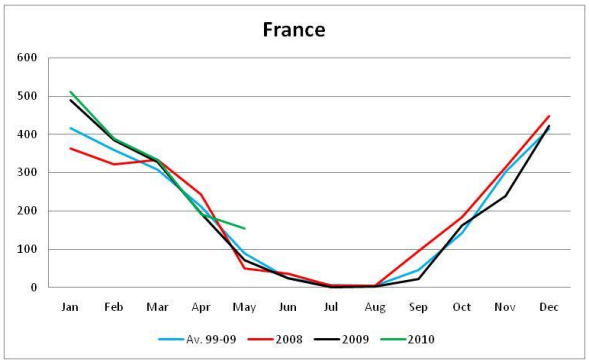



Figure 107: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

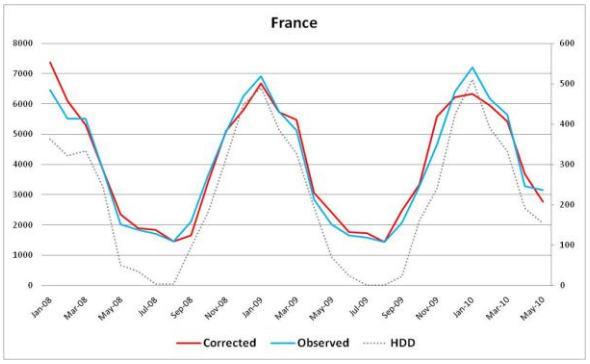
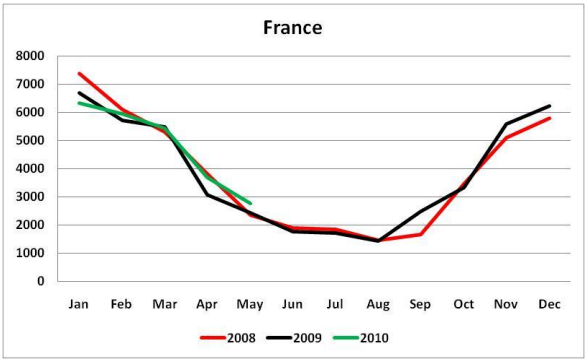



Figure 108: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 10: Germany

Natural gas consumption in Germany fell by 5.5 percent in 2009 according to the IEA *Natural Gas Information 2010,* although there are a lot of uncertainties and a wide range (-5.5 percent to +2.9 percent). Industrial output increased since the second quarter of 2009. Electricity generated from gas also seems to be on the rise in 2010, thanks to 1.8 GW of additional gas power plants that entered operation in 2010. Temperatures in winter 2009-10 were much colder than the previous year and explain higher gas demand in the first quarter of 2010. Gas demand recovery in 2010 seems to be under way, although signs in the third quarter were mixed.

Figure 109: Natural gas demand by sector in 2008, in percent

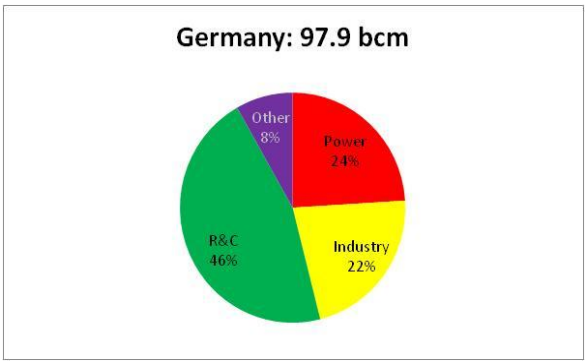



Figure 110: GDP percentage change from previous year, 2006-2012

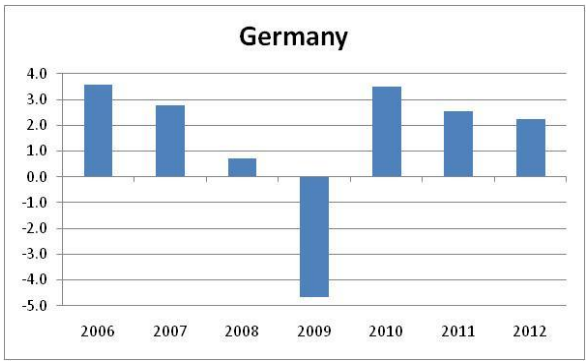



Figure 111: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

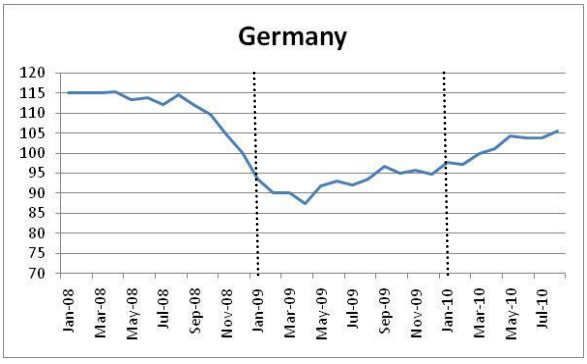



Figure 112: Indigenous electricity generation, in GWh, 2008-2010

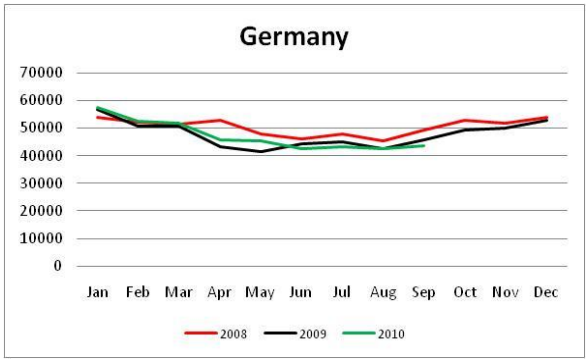


Figure 113: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

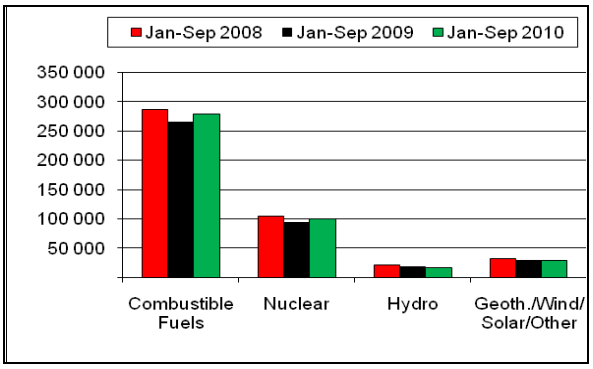



Figure 114: Natural gas demand percentage change, 2008 to 2009, from various sources

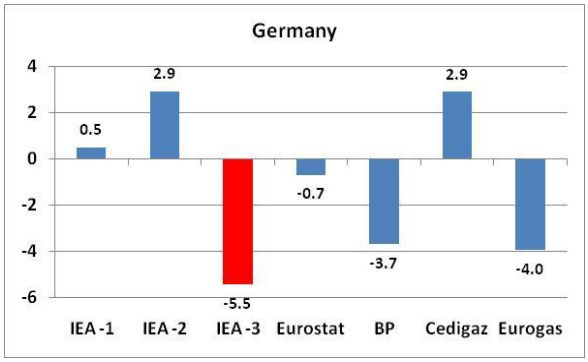



Figure 115: Natural gas demand by month, 2008-2010, in mcm

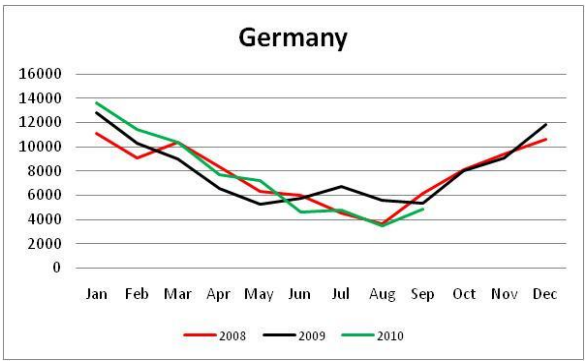



Figure 116: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

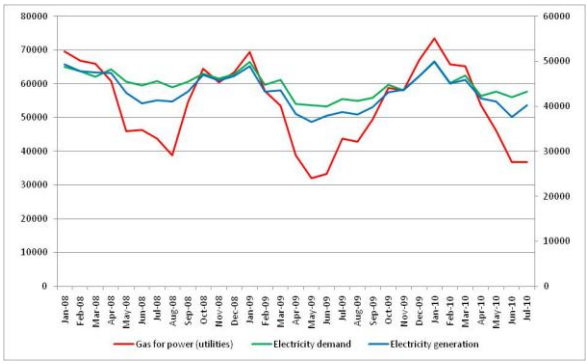



Figure 117: Natural gas use for power (in mcm), 2008-2010

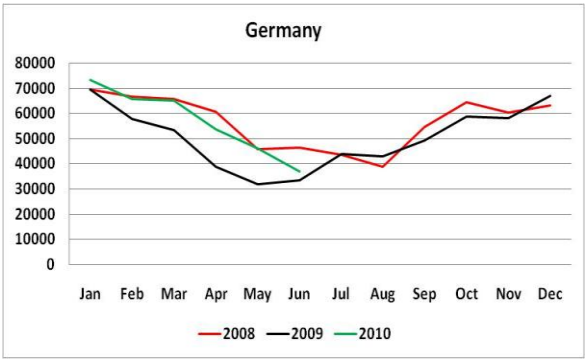



Figure 118: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

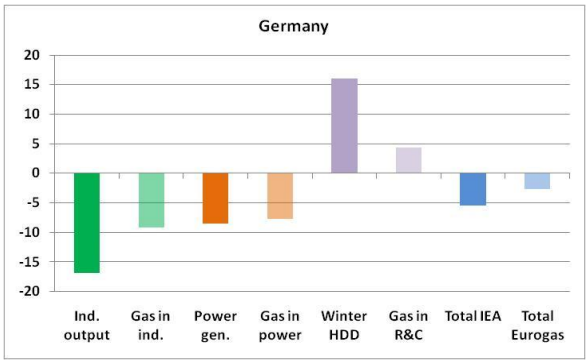


Figure 119: Heating degree-days, 2008-2010

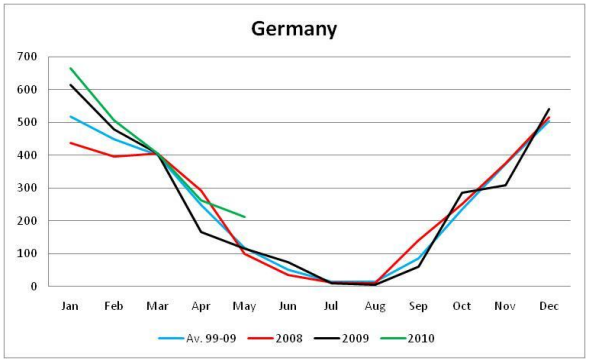



Figure 120: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

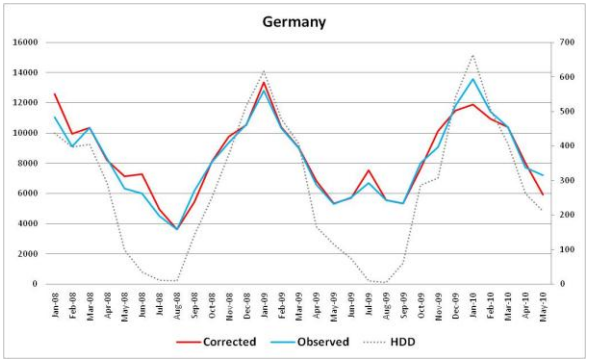
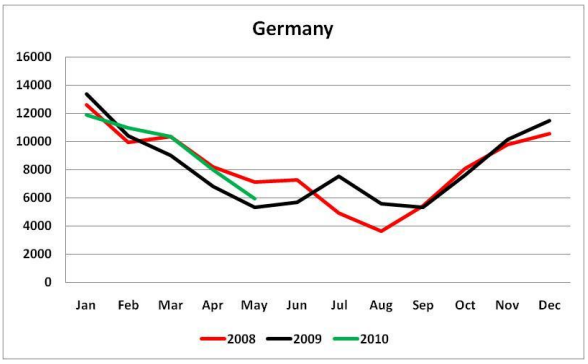



Figure 121: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 11: Greece

Natural gas consumption in Greece fell by a whopping 16.2 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output was down again in 2010, while electricity generated from gas was slightly on the rise. Temperatures in winter 2009-10 were much warmer than the previous winter, therefore higher gas demand in the first half of 2010 must have come from an increased use of gas in the power sector, which may be considered as a sign of gas demand recovery.

Figure 122: Natural gas demand by sector in 2008, in percent

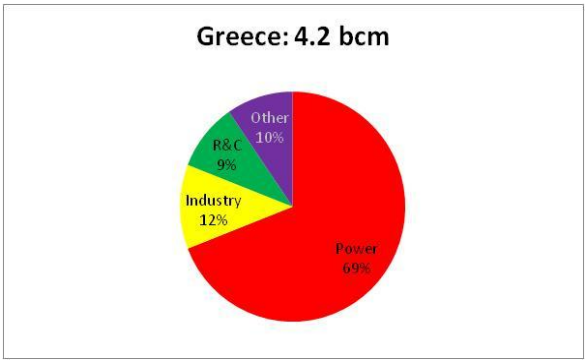



Figure 123: GDP percentage change from previous year, 2006-2012

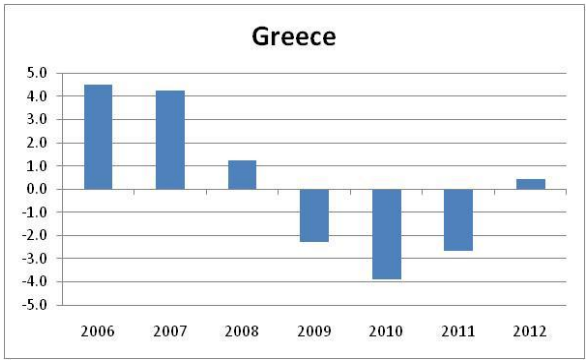



Figure 124: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

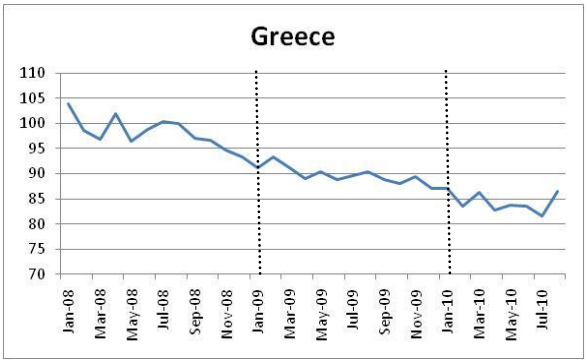



Figure 125: Indigenous electricity generation, in GWh, 2008-2010

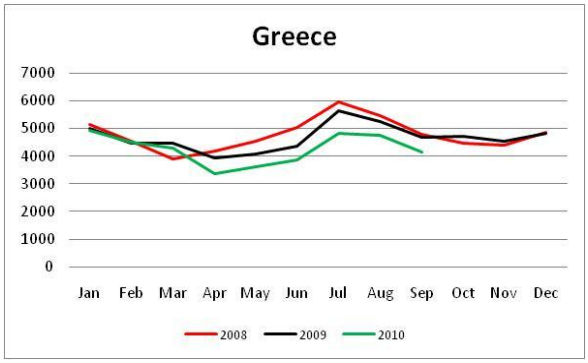


Figure 126: Electricity generation by fuels, 2008-2010, in TWh

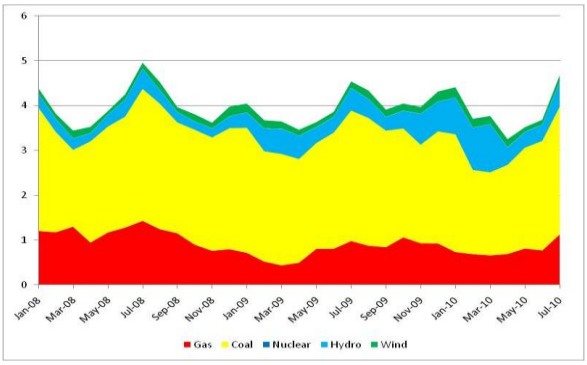



Figure 127: Electricity generation by fuels, 2008-2010, in TWh

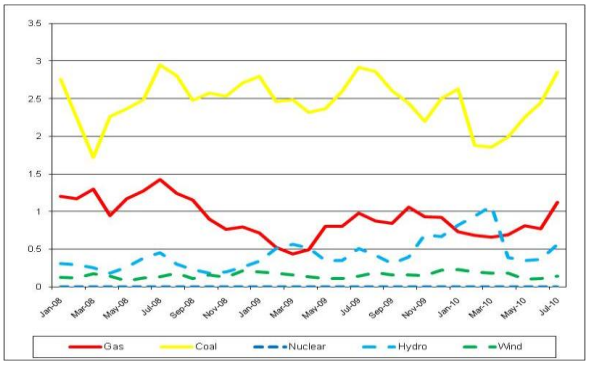



Figure 128: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

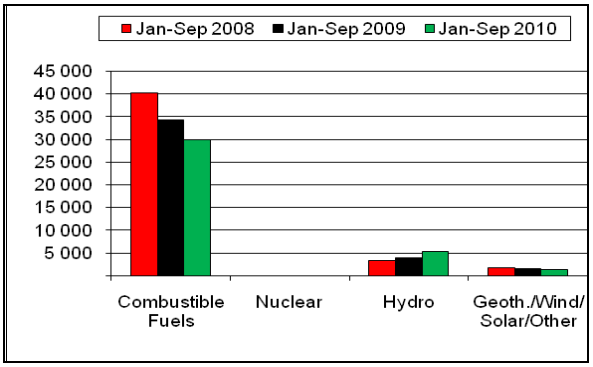



Figure 129: Natural gas demand percentage change, 2008 to 2009, from various sources

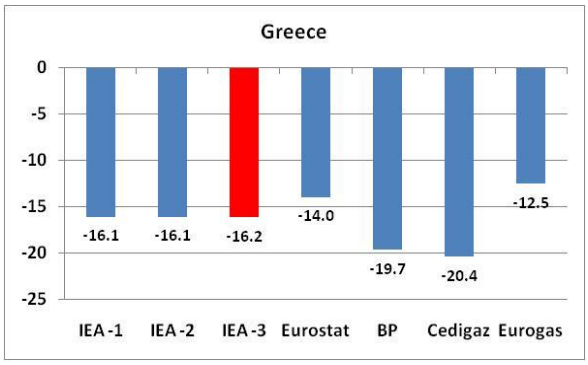



Figure 130: Natural gas demand by month, 2008-2010, in mcm

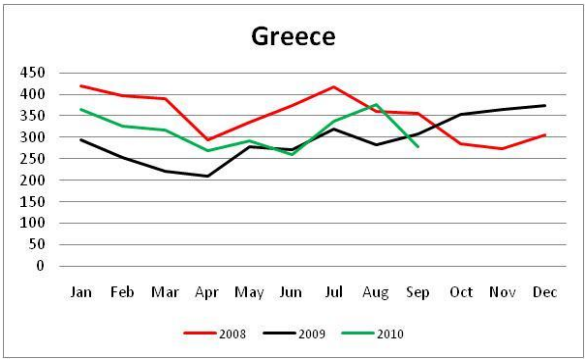



Figure 131: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

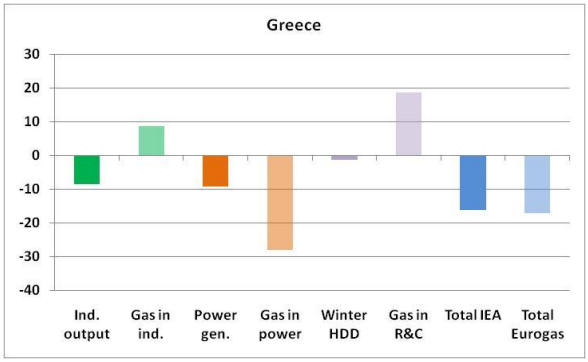


Figure 132: Heating degree-days, 2008-2010

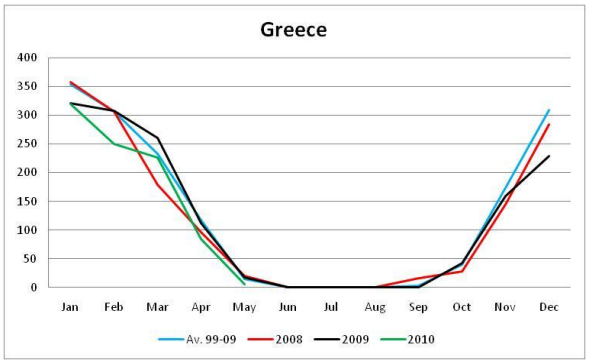



Figure 133: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

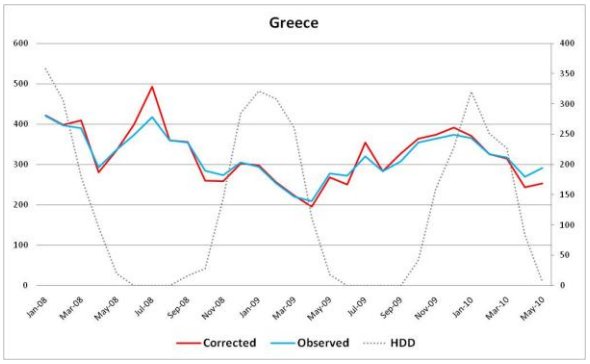
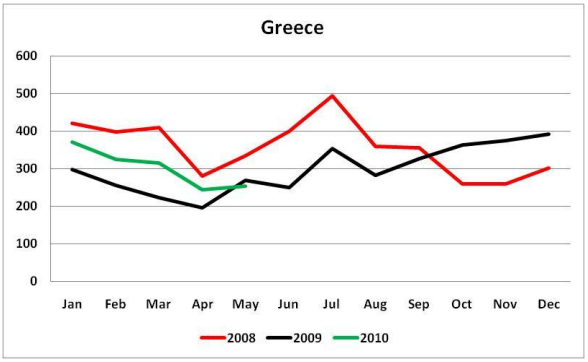



Figure 134: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 12: Hungary

Natural gas consumption in Hungary fell by a massive 13.8 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output increased again in 2010, while electricity generated from gas was similar to the previous year. Temperatures in winter 2009-10 were very close to the previous winter. Gas demand in 2010 is very close to 2009 levels, and we do not expect much recovery in 2010.

Figure 135: Natural gas demand by sector in 2008, in percent

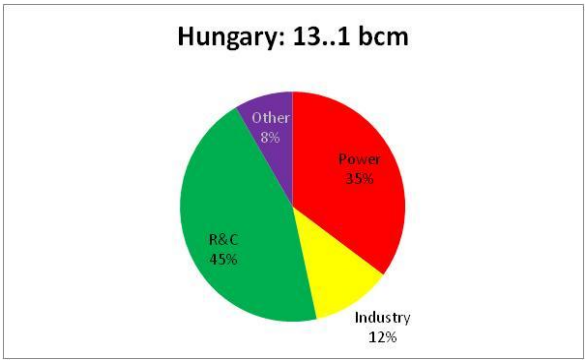



Figure 136: GDP percentage change from previous year, 2006-2012

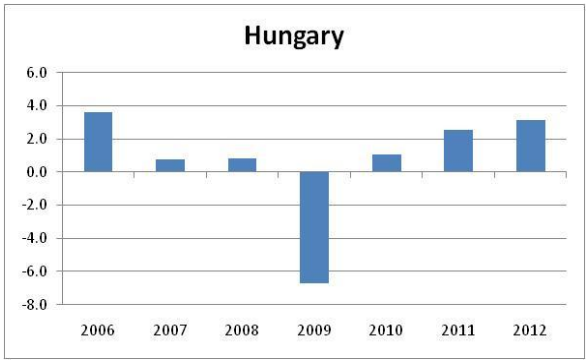



Figure 137: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

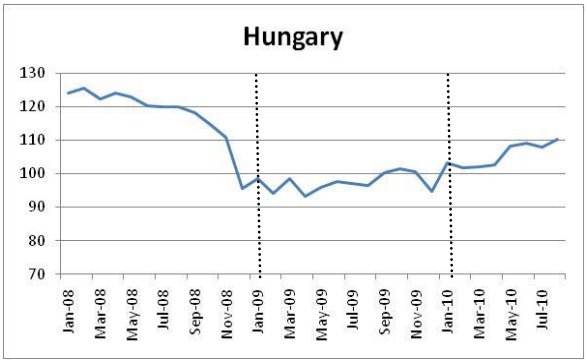



Figure 138: Indigenous electricity generation, in GWh, 2008-2010

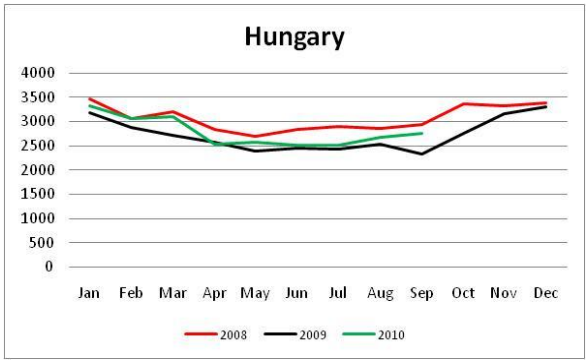


Figure 139: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

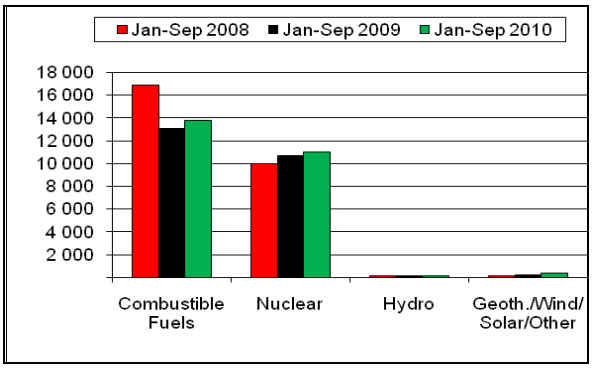



Figure 140: Natural gas demand percentage change, 2008 to 2009, from various sources

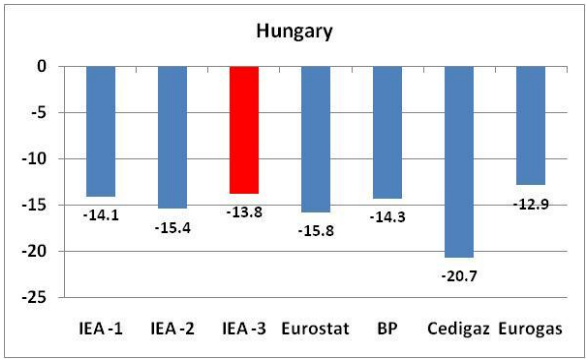



Figure 141: Natural gas demand by month, 2008-2010, in mcm

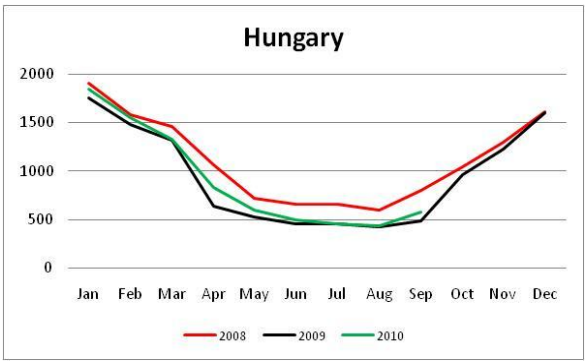



Figure 142: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

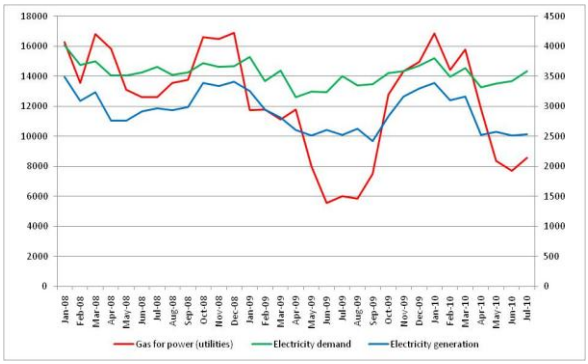



Figure 143: Natural gas use for power (in mcm), 2008-2010

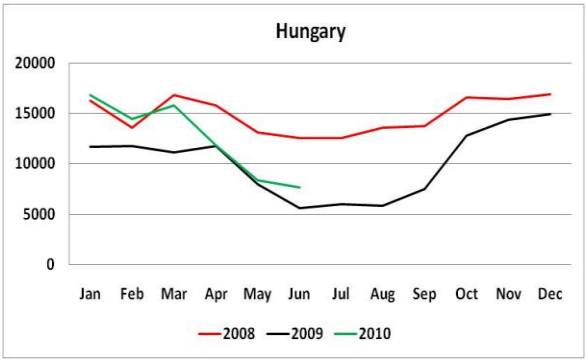



Figure 144: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

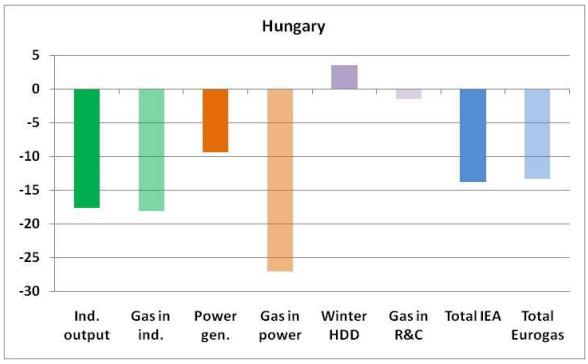


Figure 145: Heating degree-days, 2008-2010

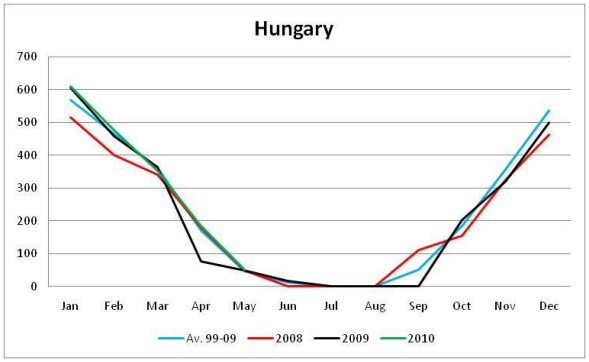



Figure 146: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

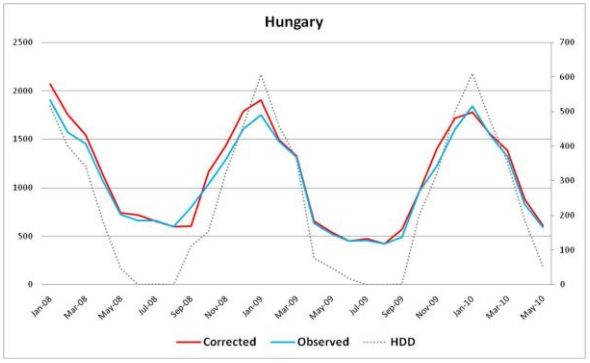
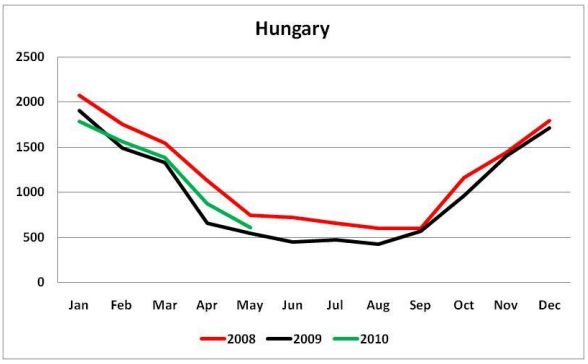



Figure 147: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 13: Ireland

Natural gas consumption in Ireland fell by 3.1 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output and electricity generated from gas seem to be on the rise in 2010. Winter 2009-10 was much colder than 2008-09 and explains higher gas demand in the first quarter. There seem to be signs of gas consumption recovery in summer 2010 despite the expected gloom in GDP recovery.

Figure 148: Natural gas demand by sector in 2008, in percent

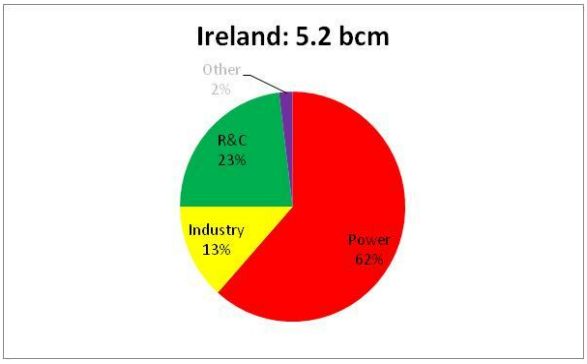



Figure 149: GDP percentage change from previous year, 2006-2012

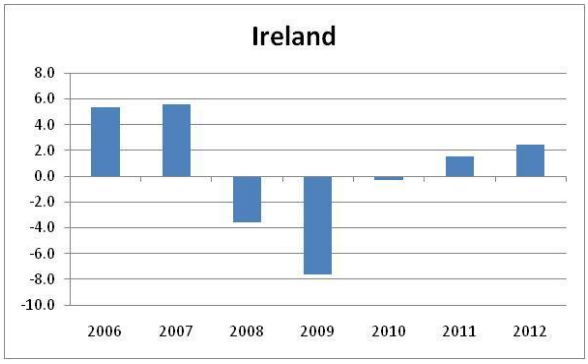



Figure 150: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

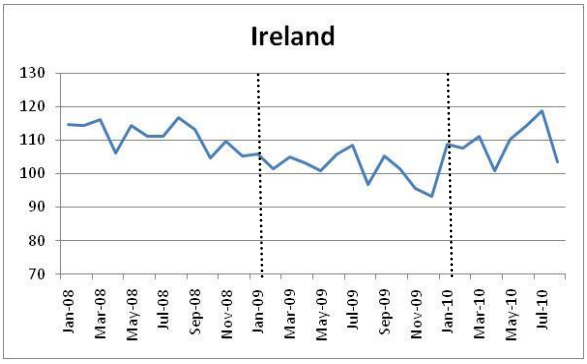



Figure 151: Indigenous electricity generation, in GWh, 2008-2010

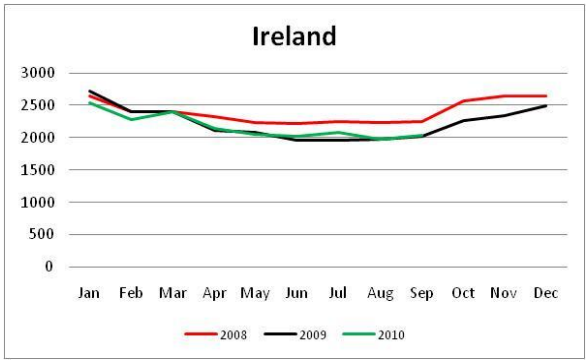


Figure 152: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

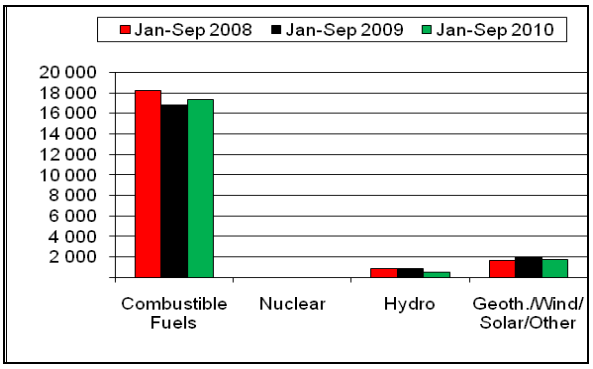



Figure 153: Natural gas demand percentage change, 2008 to 2009, from various sources

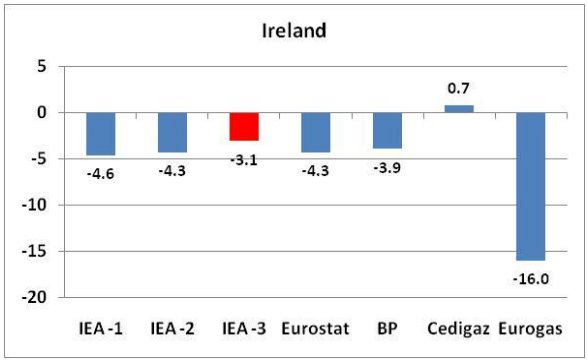



Figure 154: Natural gas demand by month, 2008-2010, in mcm

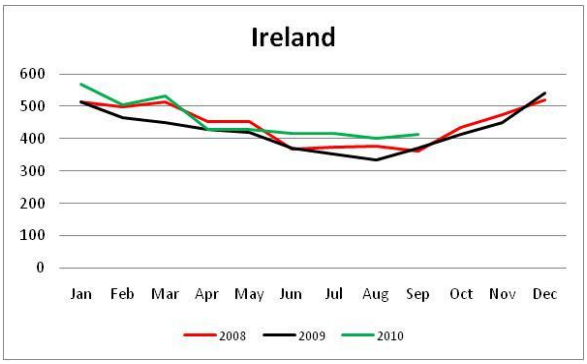



Figure 155: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

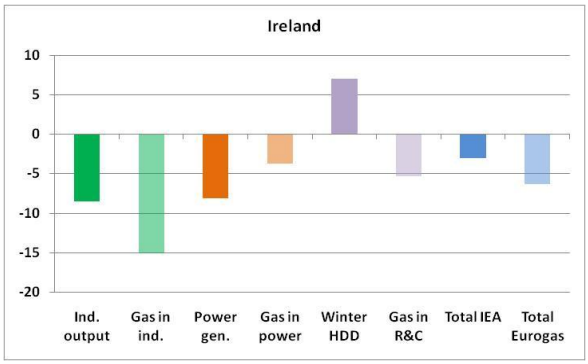



Figure 156: Heating degree-days, 2008-2010

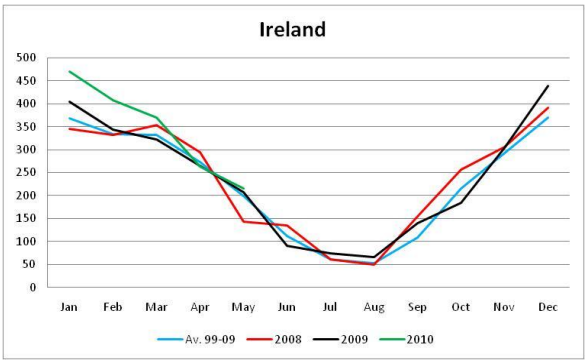



Figure 157: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

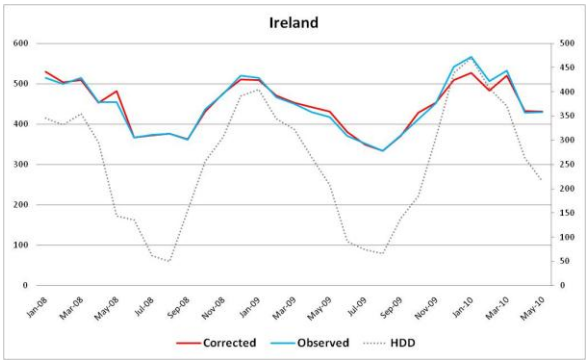
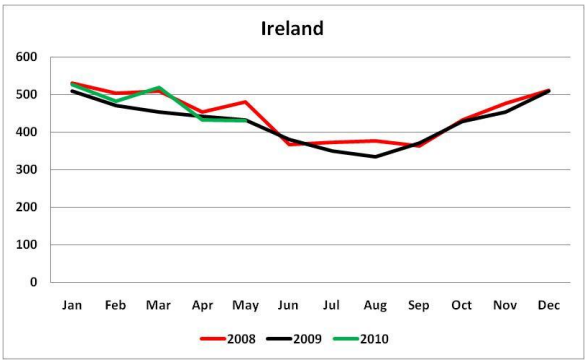


Figure 158: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 14: Italy

Natural gas consumption in Italy fell by 8 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output has been increasing very slowly while electricity generated from gas was flat due to increased use of coal despite 1.3 GW of additional gas power plants that entered operation in 2010. January 2010 was much colder than 2009, but temperatures for the rest of the winter were quite similar. As a result, there is no real expectation for gas demand recovery in 2010.

Figure 159: Natural gas demand by sector in 2008, in percent

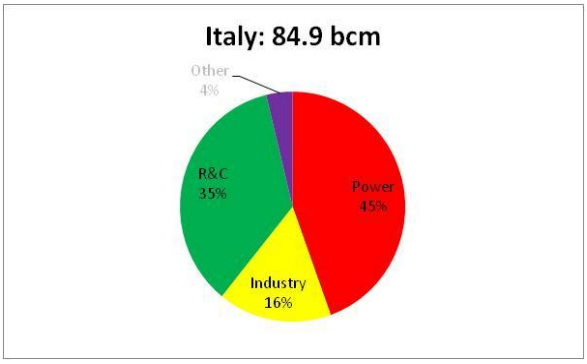



Figure 160: GDP percentage change from previous year, 2006-2012

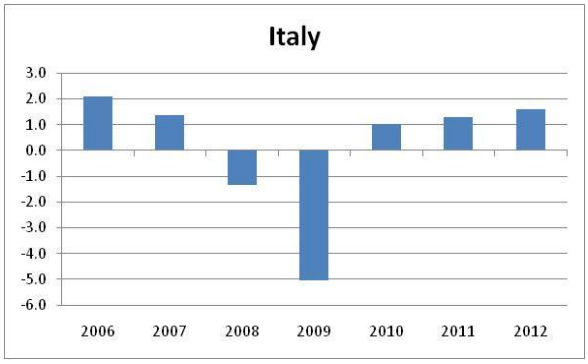



Figure 161: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

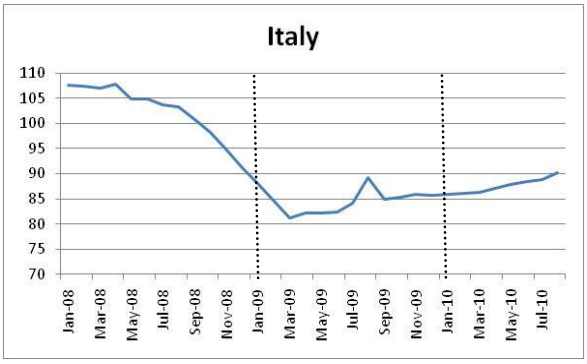



Figure 162: Indigenous electricity generation, in GWh, 2008-2010

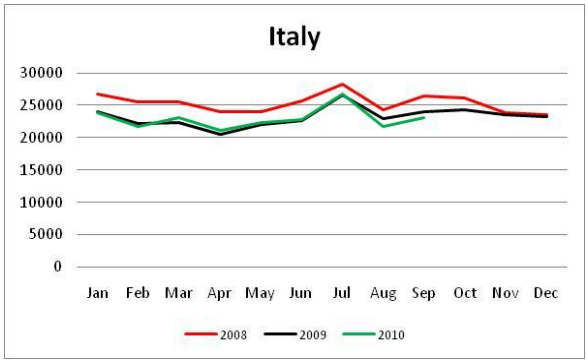


Figure 163: Electricity generation by fuels, 2008-2010, in TWh

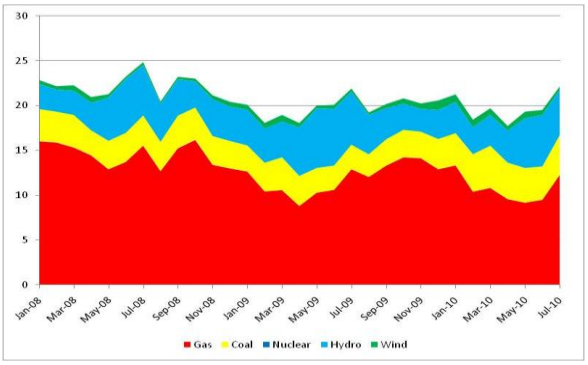



Figure 164: Electricity generation by fuels, 2008-2010, in TWh

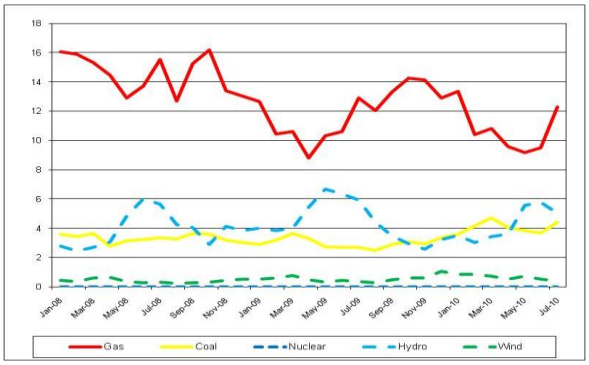



Figure 165: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

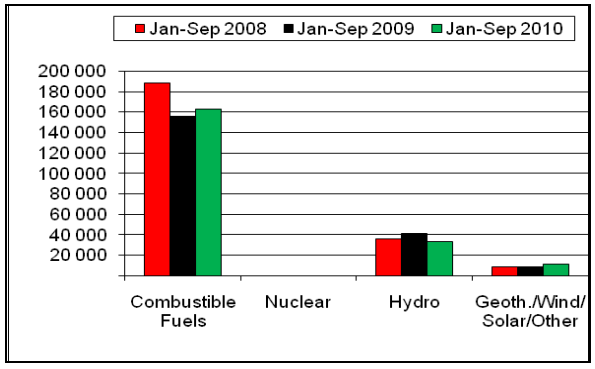



Figure 166: Natural gas demand percentage change, 2008 to 2009, from various sources

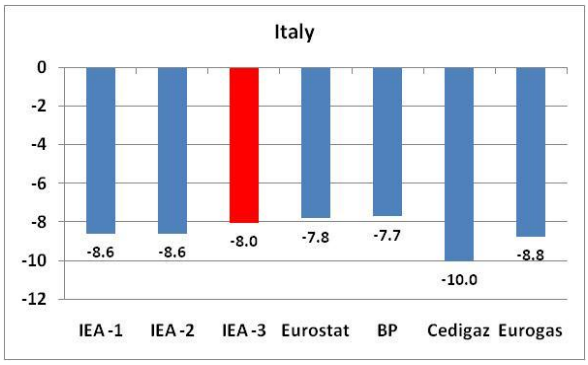



Figure 167: Natural gas demand by month, 2008-2010, in mcm

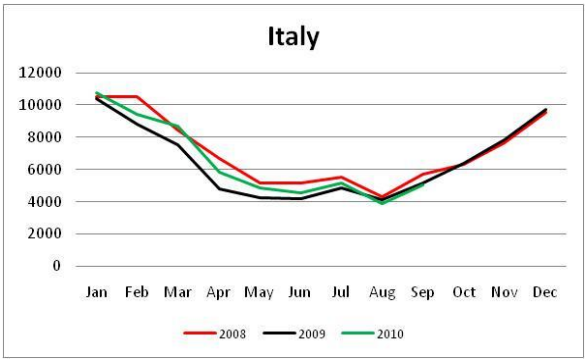



Figure 168: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

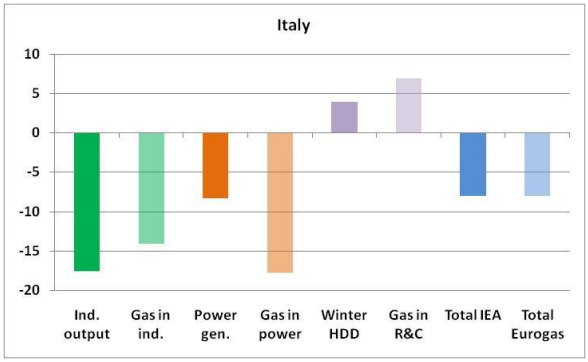


Figure 169: Heating degree-days, 2008-2010

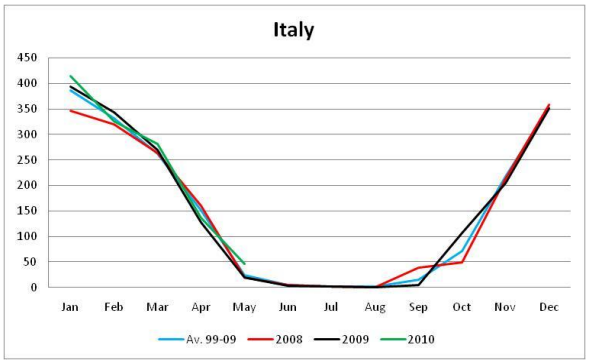



Figure 170: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

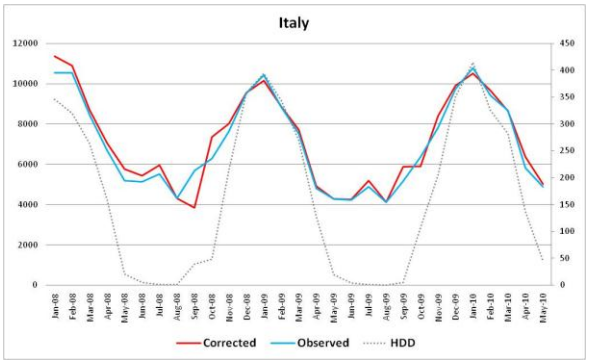
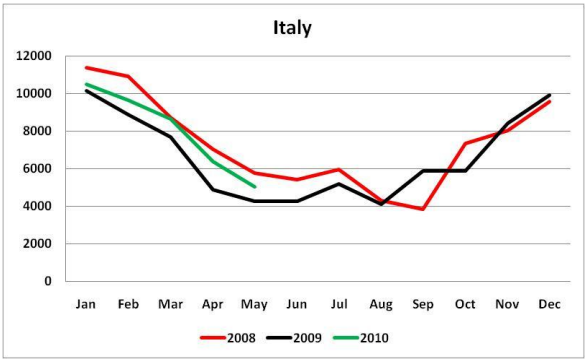



Figure 171: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 15: Luxembourg

Natural gas consumption in Luxembourg grew by 1.1 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output and electricity generated from gas increased again in 2010. Temperatures in winter 2009-10 were very close to the previous winter. As a result, we expect some recovery for gas demand in 2010, albeit slow.

Figure 172: Natural gas demand by sector in 2008, in percent

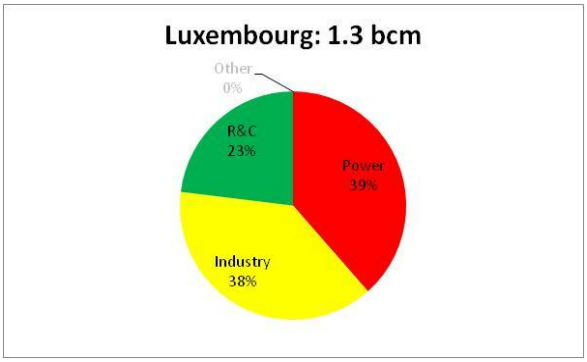



Figure 173: GDP percentage change from previous year, 2006-2012

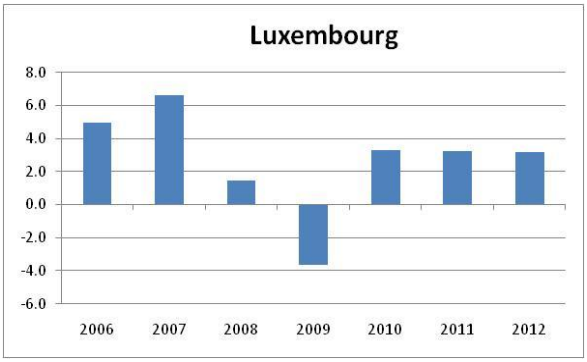



Figure 174: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

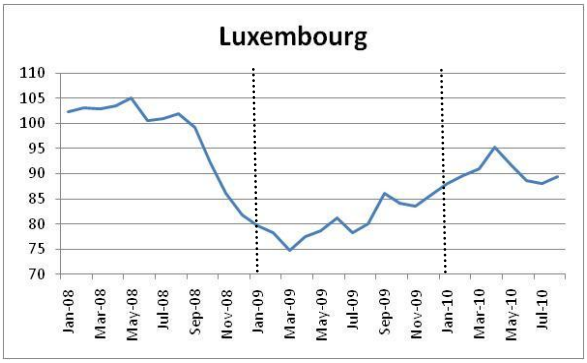



Figure 175: Indigenous electricity generation, in GWh, 2008-2010

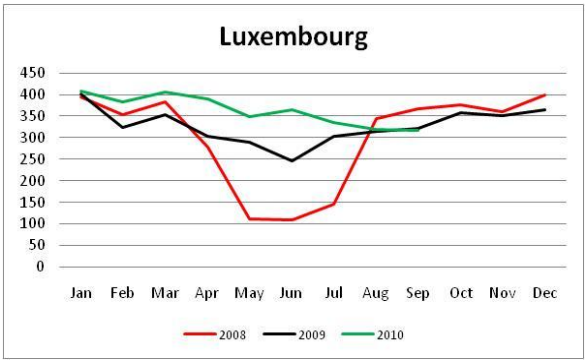


Figure 176: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

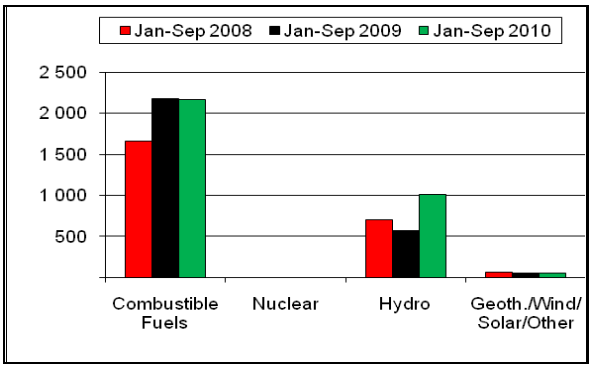



Figure 177: Natural gas demand percentage change, 2008 to 2009, from various sources

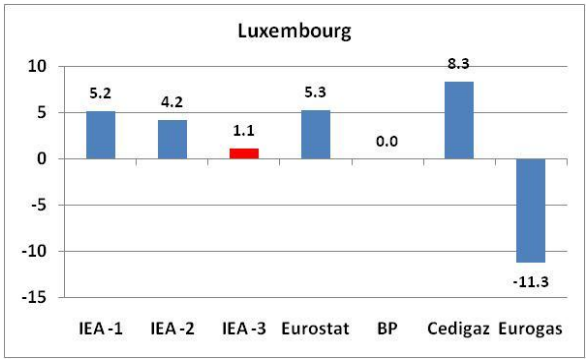



Figure 178: Natural gas demand by month, 2008-2010, in mcm

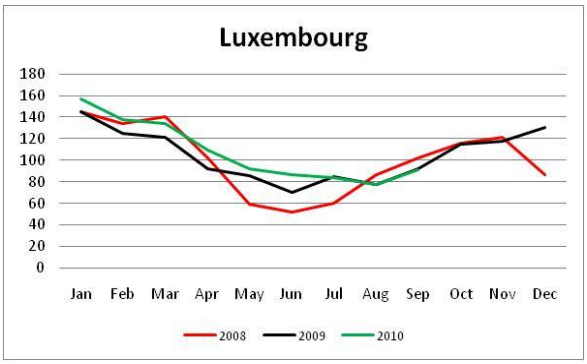



Figure 179: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

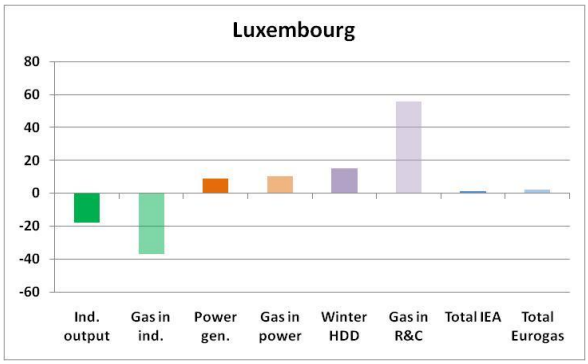



Figure 180: Heating degree-days, 2008-2010

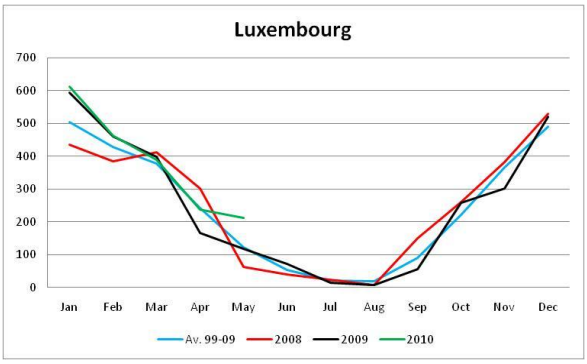



Figure 181: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

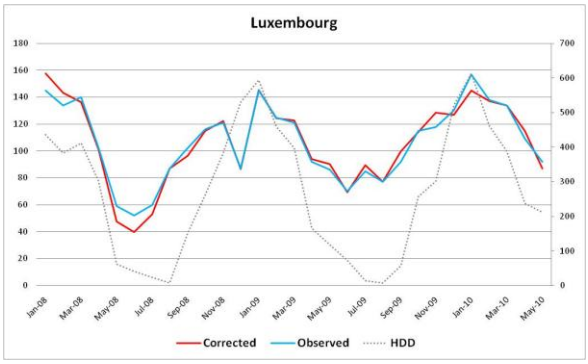
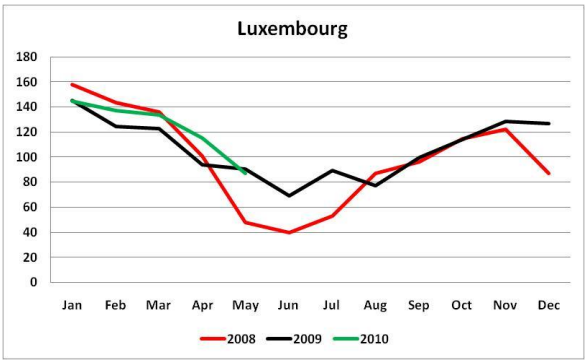


Figure 182: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 16: Netherlands

Natural gas consumption in the Netherlands remained flat in 2009 according to the IEA *Natural Gas Information 2010,* although there are a lot of uncertainties. Industrial output increased in 2009 but has been flat in 2010. Electricity generated from gas has been on the rise since the second half of 2009 due to additional capacity from new gas power plants. Temperatures in winter 2009-10 were much colder than the previous year and explain higher gas demand in 2010. Some gas demand recovery is expected in 2010 thanks to the power sector.

Figure 183: Natural gas demand by sector in 2008, in percent

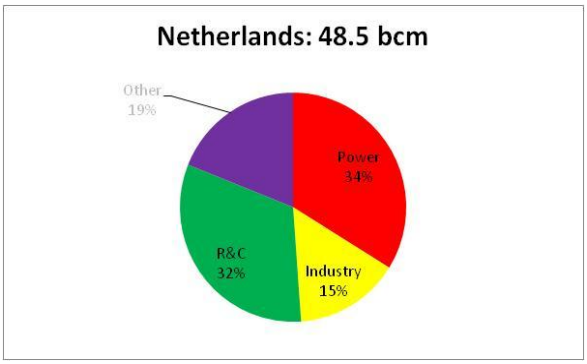



Figure 184: GDP percentage change from previous year, 2006-2012

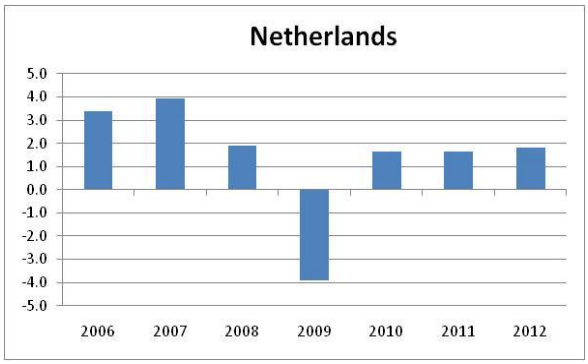



Figure 185: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

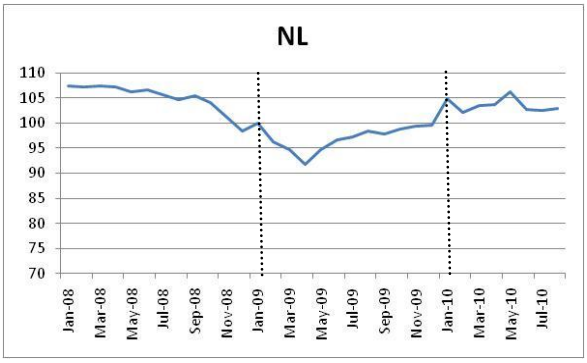



Figure 186: Indigenous electricity generation, in GWh, 2008-2010

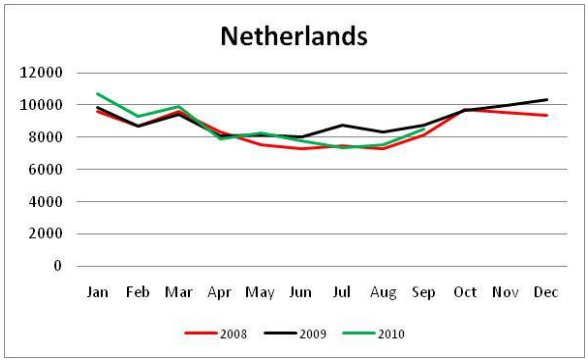


Figure 187: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

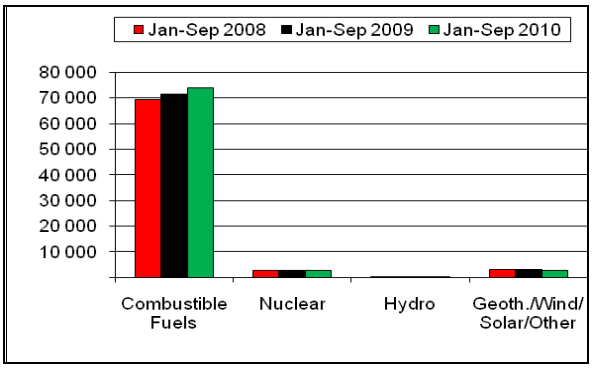



Figure 188: Natural gas demand percentage change, 2008 to 2009, from various sources

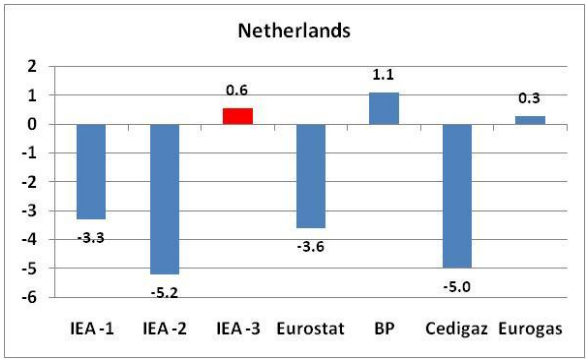



Figure 189: Natural gas demand by month, 2008-2010, in mcm

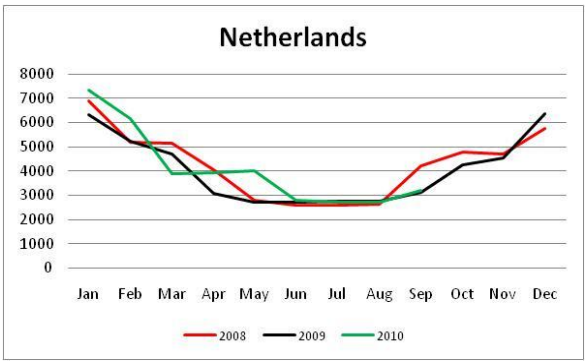



Figure 190: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

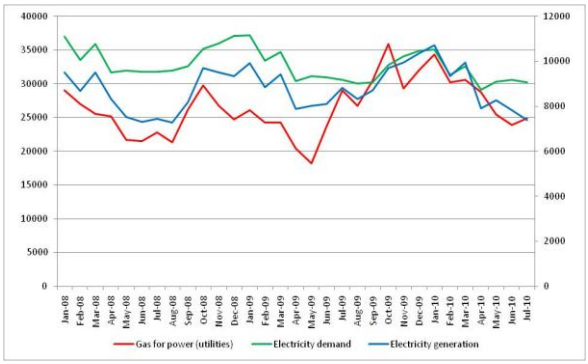



Figure 191: Natural gas use for power (in mcm), 2008-2010

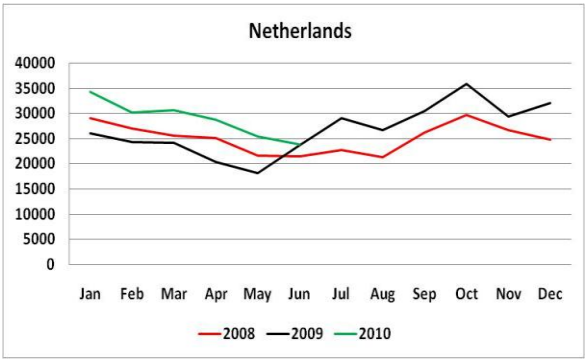



Figure 192: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

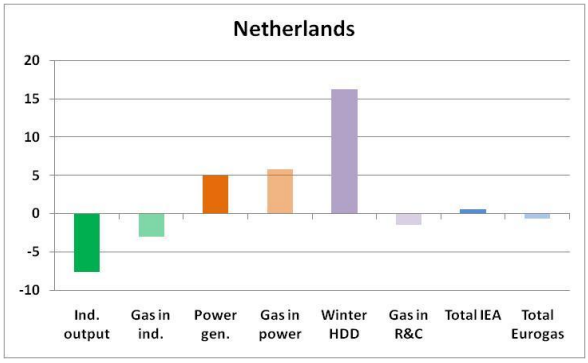


Figure 193: Heating degree-days, 2008-2010

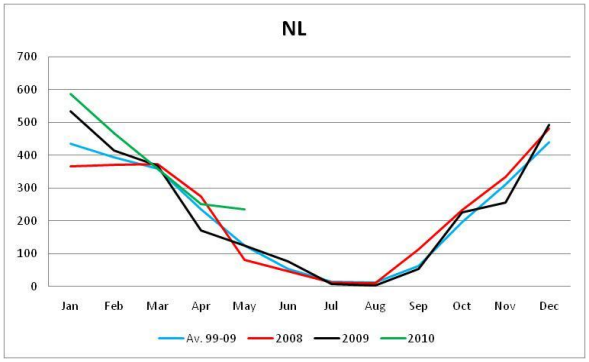



Figure 194: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

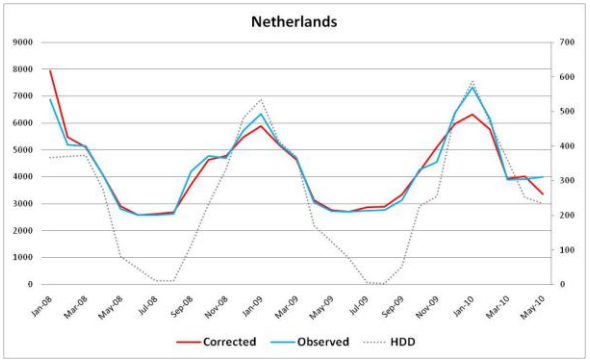
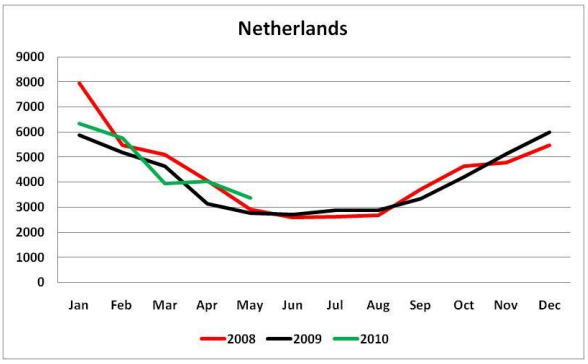



Figure 195: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 17: Norway

Data for monthly gas demand in Norway in the period 2008-2010 was still too confusing at the time of writing to be able to make a sound analysis.

Figure 196: Natural gas demand by sector in 2008, in percent

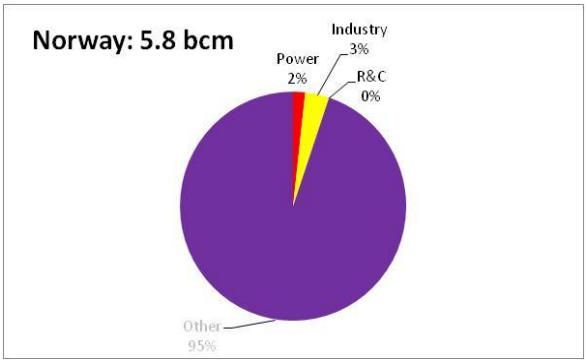



Figure 197: GDP percentage change from previous year, 2006-2012

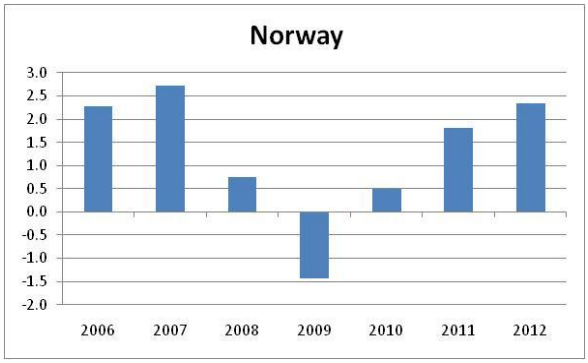



Figure 198: Indigenous electricity generation, in GWh, 2008-2010

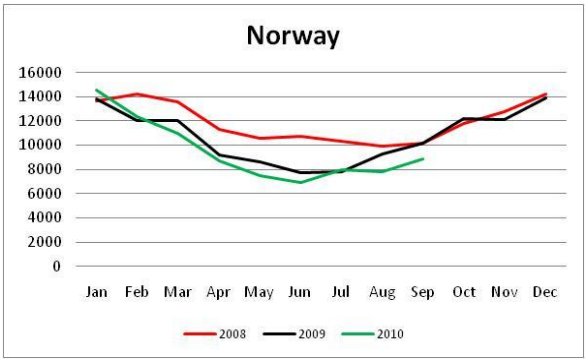



Figure 199: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

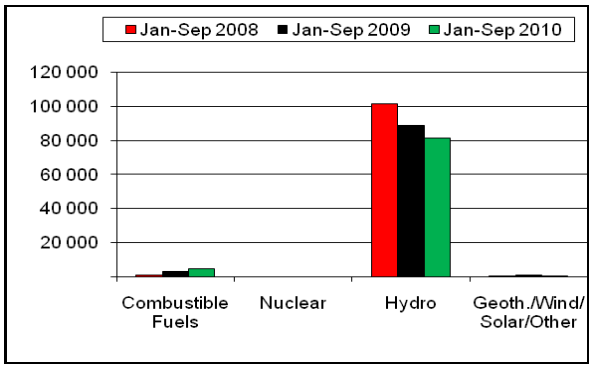



Figure 200: Natural gas demand percentage change, 2008 to 2009, from various sources

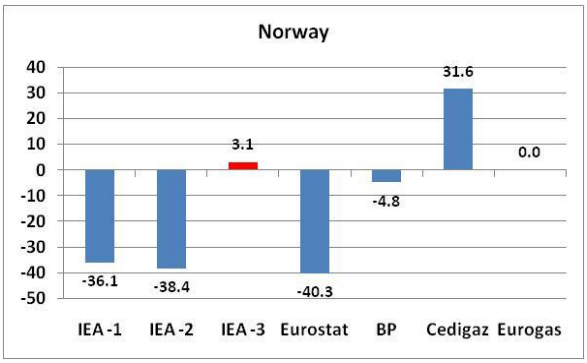



Figure 201: Natural gas demand by month, 2008-2010, in mcm

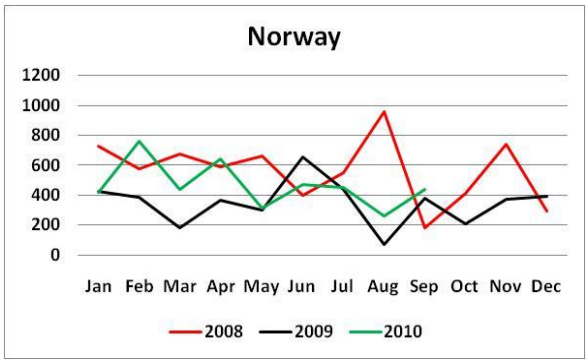


Figure 202: Heating degree-days, 2008-2010

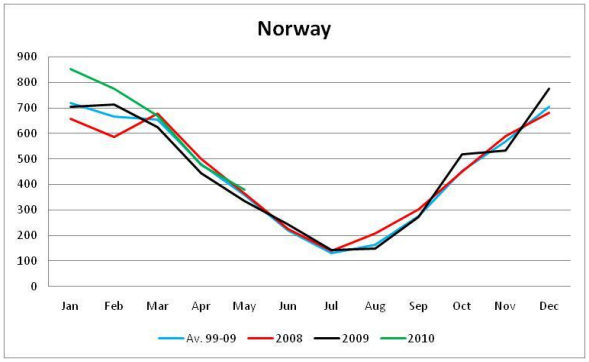



Figure 203: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

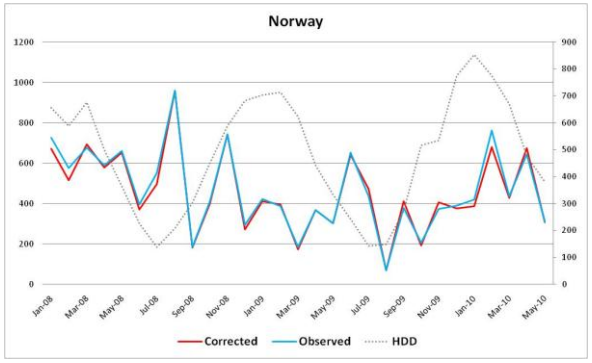
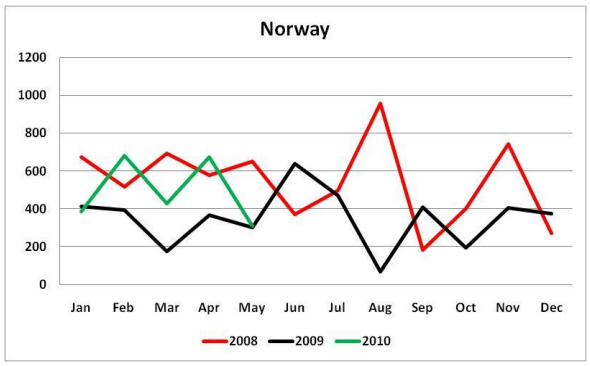



Figure 204: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 18: Poland

Natural gas consumption in Poland remained flat at +0.2 percent in 2009 according to the IEA *Natural Gas Information 2010,* although there are a lot of uncertainties and a wide range from various data. Industrial output increased since the second quarter of 2009, while electricity generated from gas has been limited. Temperatures in January-February 2009-10 were much colder than the previous year and explain higher gas demand for the period. Additional industrial production has not been translating into more gas demand in the first three quarters of 2010, therefore we do not expect major recovery for 2010.

Figure 205: Natural gas demand by sector in 2008, in percent

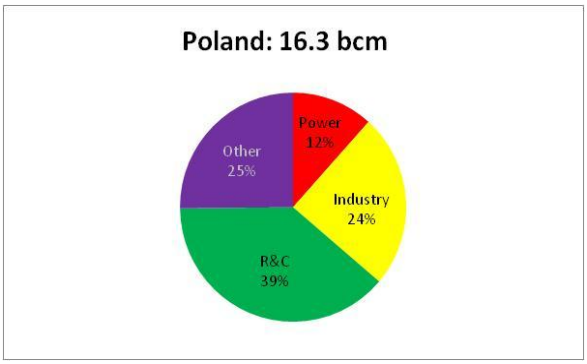



Figure 206: GDP percentage change from previous year, 2006-2012

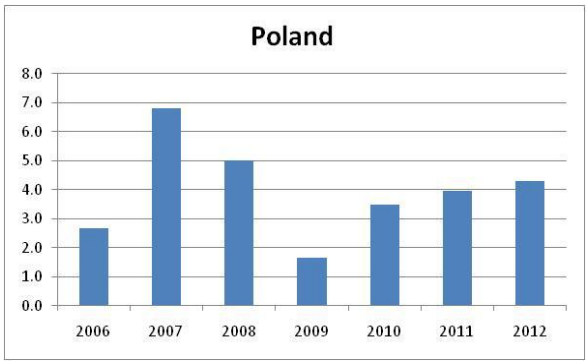



Figure 207: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

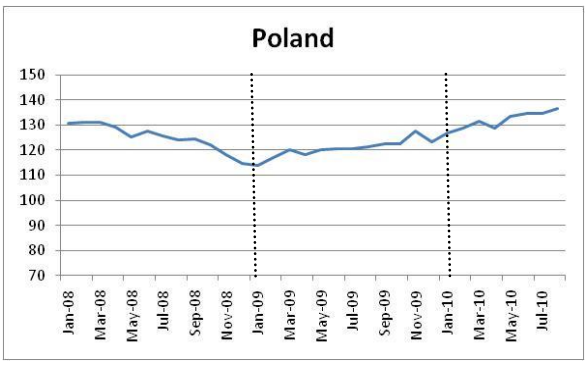



Figure 208: Indigenous electricity generation, in GWh, 2008-2010

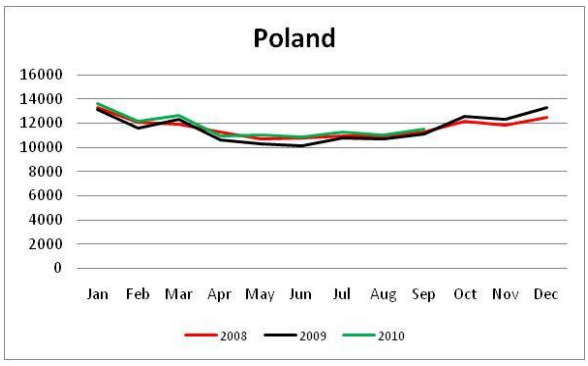


Figure 209: Electricity generation by fuels, 2008-2010, in TWh

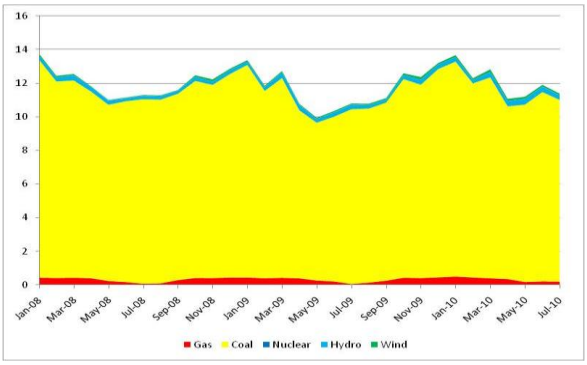



Figure 210: Electricity generation by fuels, 2008-2010, in TWh

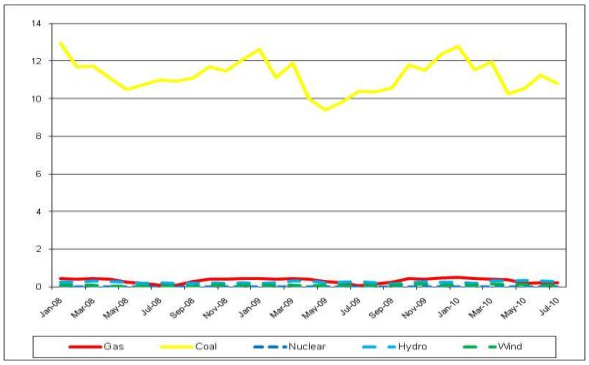



Figure 211: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

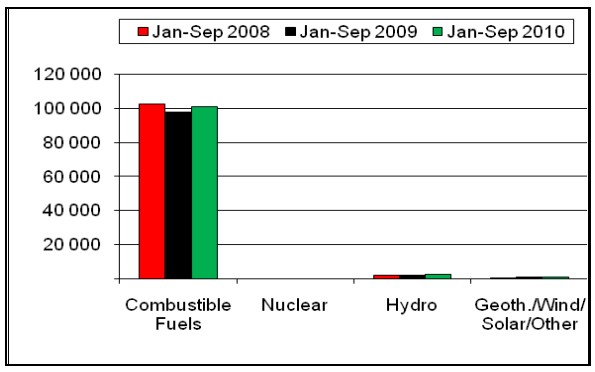



Figure 212: Natural gas demand percentage change, 2008 to 2009, from various sources

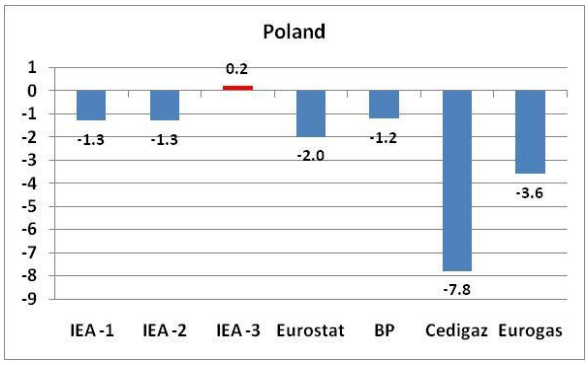



Figure 213: Natural gas demand by month, 2008-2010, in mcm

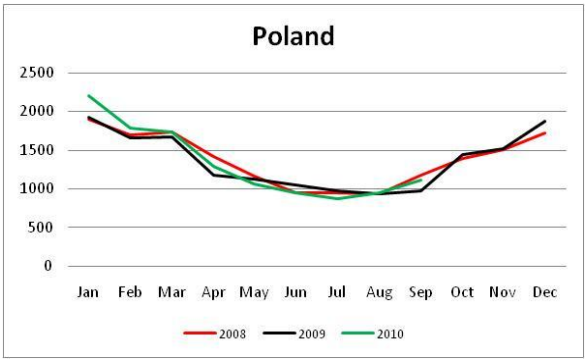



Figure 214: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

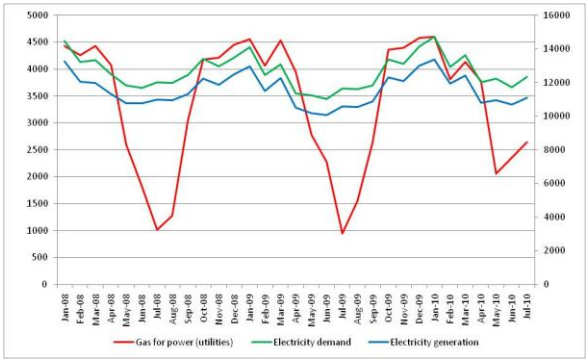


Figure 215: Natural gas use for power (in mcm), 2008-2010

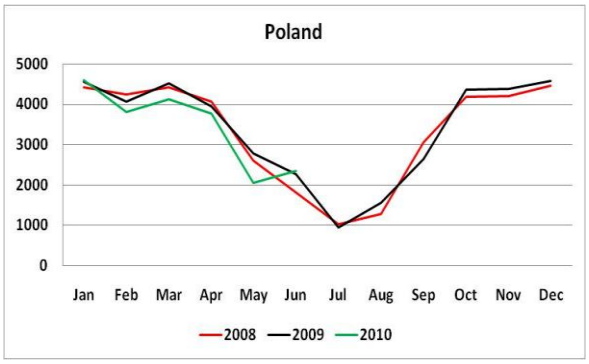



Figure 216: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

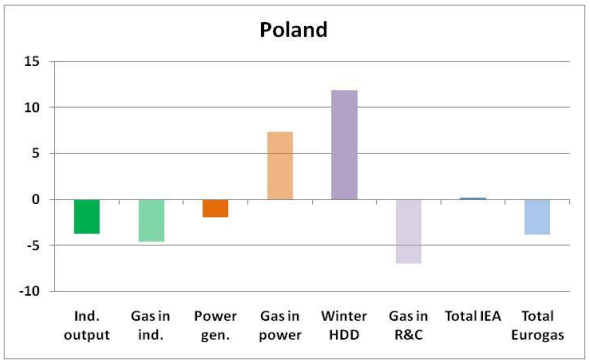



Figure 217: Heating degree-days, 2008-2010

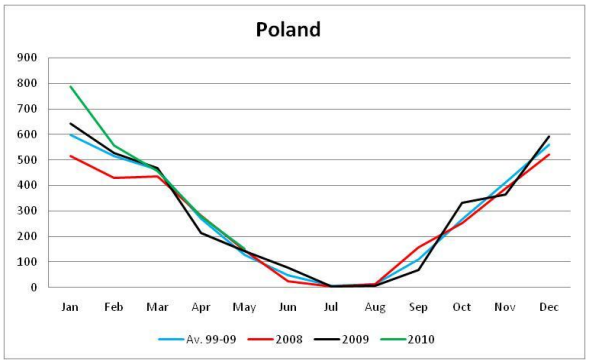



Figure 218: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

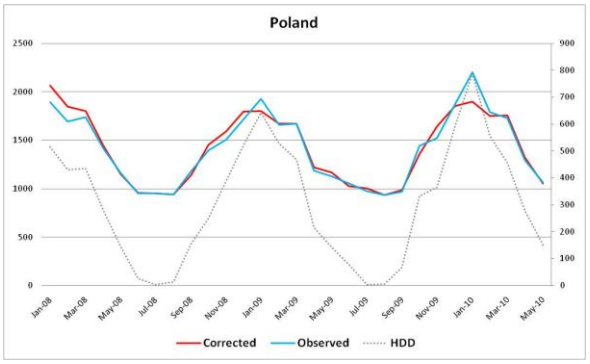
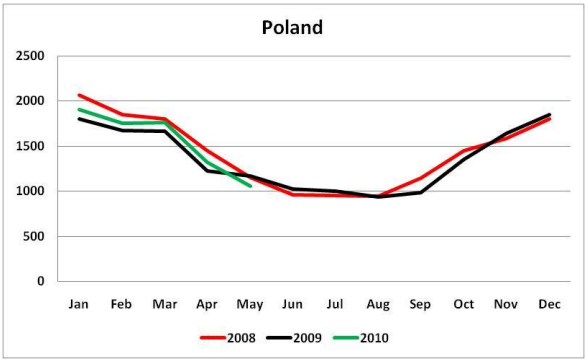



Figure 219: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 19: Portugal

Natural gas consumption in Portugal grew by 2.7 percent in 2009 according to the IEA *Natural Gas Information 2010,* although there are a lot of uncertainties and a wide range. Industrial output increased slowly in 2010. Electricity generated from gas was low in the first quarter due to higher hydro and wind power, but has since recovered. Temperatures in winter have generally no impact on gas demand fluctuations. Gas consumption recovery seemed to be under way since the second quarter of 2010, but may be compromised as hydro and wind power increase again.

Figure 220: Natural gas demand by sector in 2008, in percent

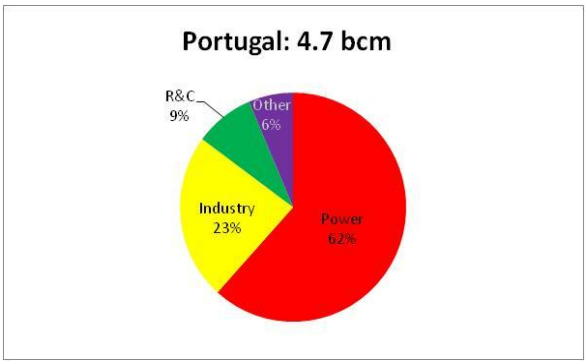



Figure 221: GDP percentage change from previous year, 2006-2012

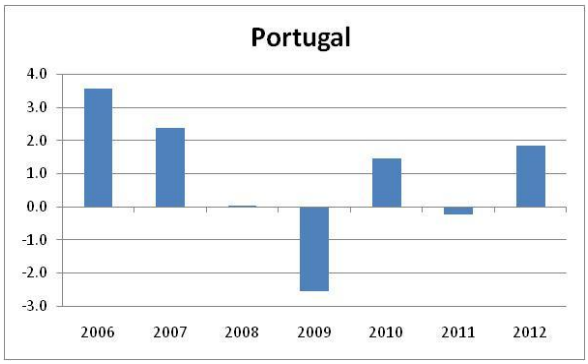



Figure 222: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

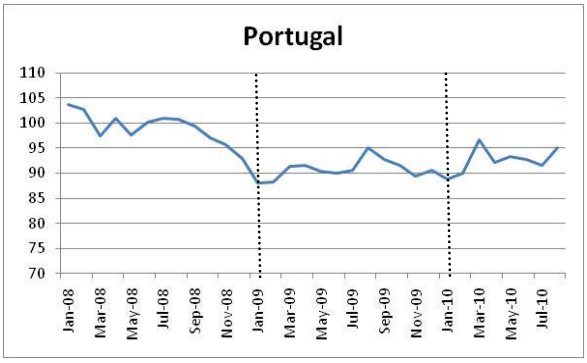



Figure 223: Indigenous electricity generation, in GWh, 2008-2010

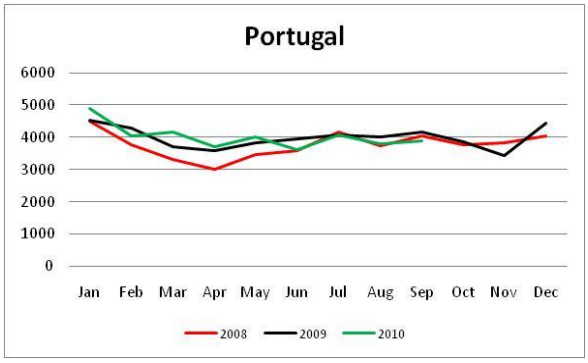


Figure 224: Electricity generation by fuels, 2008-2010, in TWh

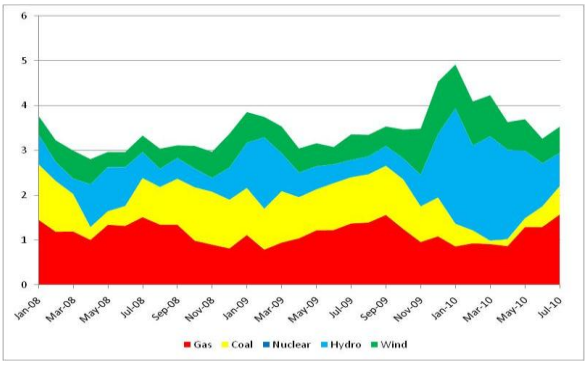



Figure 225: Electricity generation by fuels, 2008-2010, in TWh

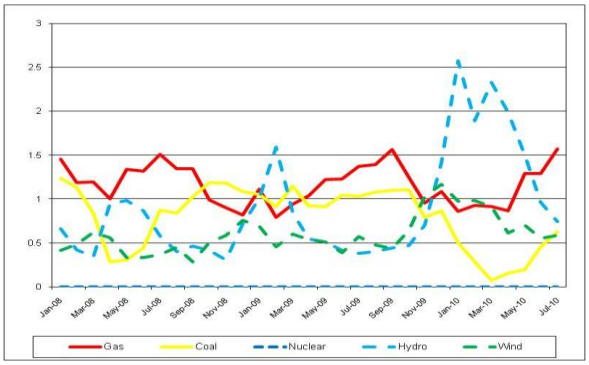



Figure 226: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

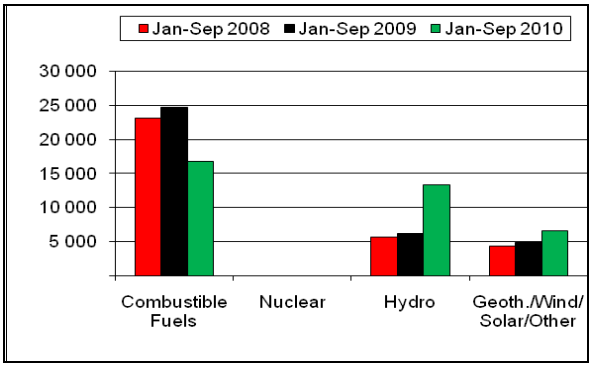



Figure 227: Natural gas demand percentage change, 2008 to 2009, from various sources

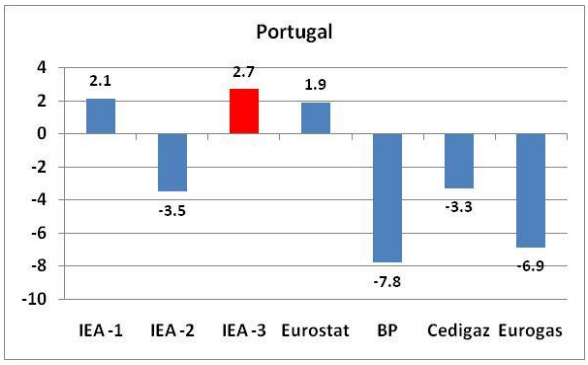



Figure 228: Natural gas demand by month, 2008-2010, in mcm

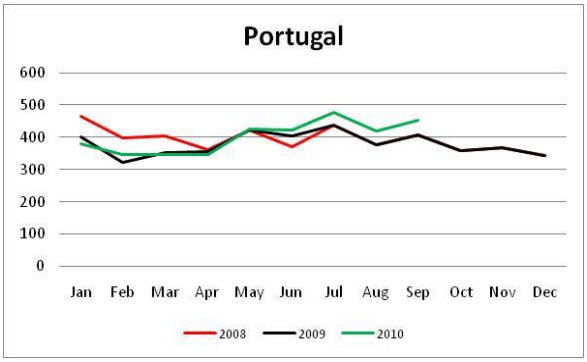



Figure 229: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

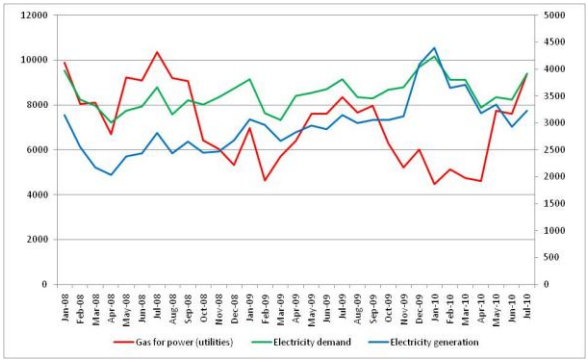


Figure 230: Natural gas use for power (in mcm), 2008-2010

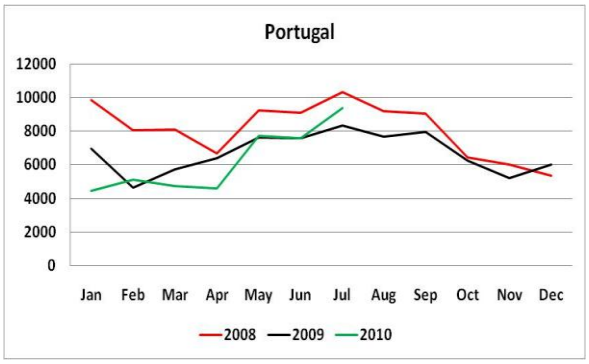



Figure 231: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

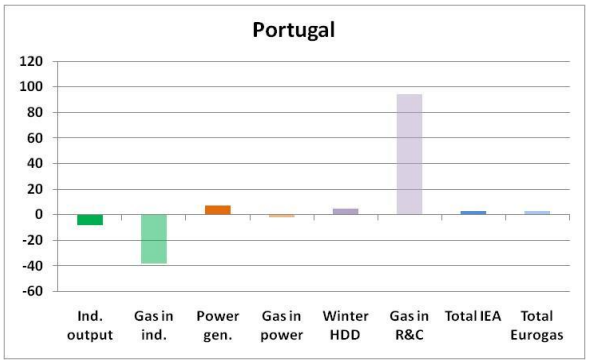



Figure 232: Heating degree-days, 2008-2010

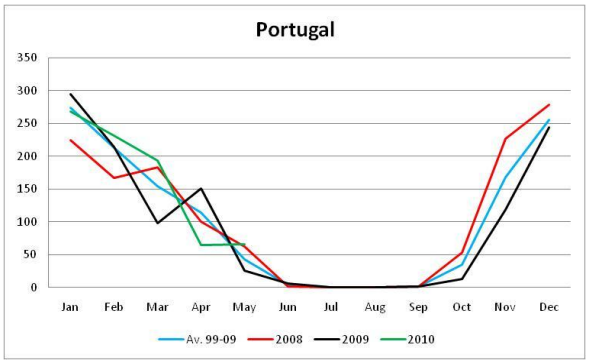



Figure 233: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

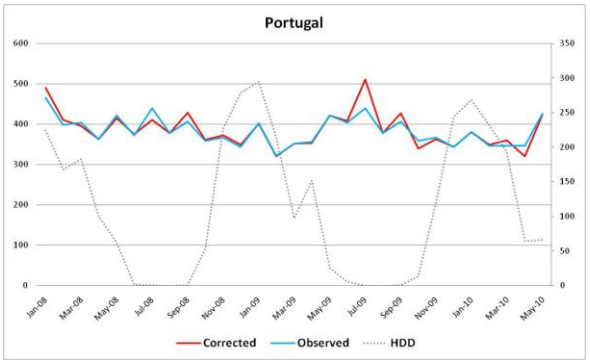
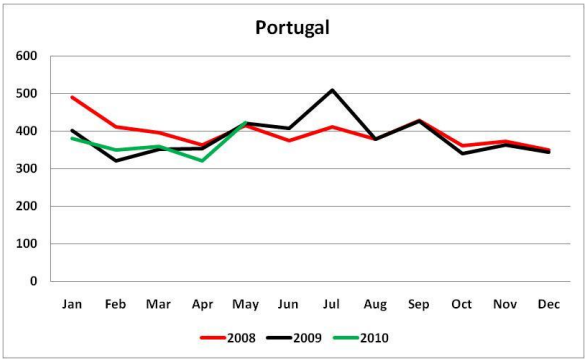



Figure 234: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 20: Slovakia

Natural gas consumption in Slovakia fell by 2.6 percent in 2009 according to the IEA *Natural Gas Information 2010,* although there are a lot of uncertainties. There has been a strong growth in industrial output in 2010, while electricity generated from gas has been lagging behind due to high nuclear and hydro power. Temperatures in winter 2009-10 were fairly similar to the previous year. We expect gas demand recovery in 2010 thanks to the industrial sector.

Figure 235: Natural gas demand by sector in 2008, in percent

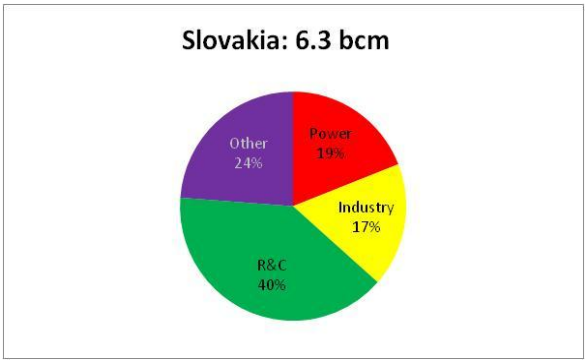



Figure 236: GDP percentage change from previous year, 2006-2012

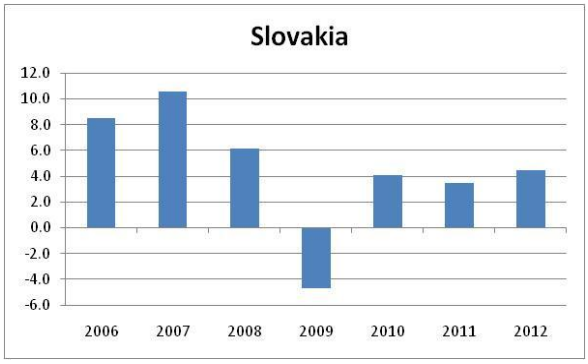



Figure 237: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

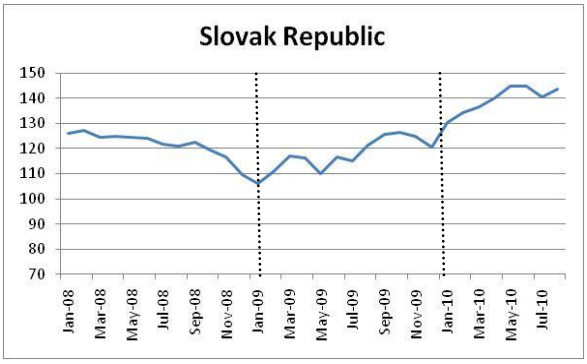



Figure 238: Indigenous electricity generation, in GWh, 2008-2010

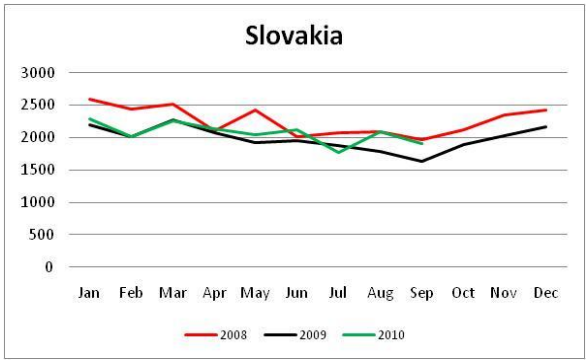


Figure 239: Electricity generation by fuels, 2008-2010, in TWh

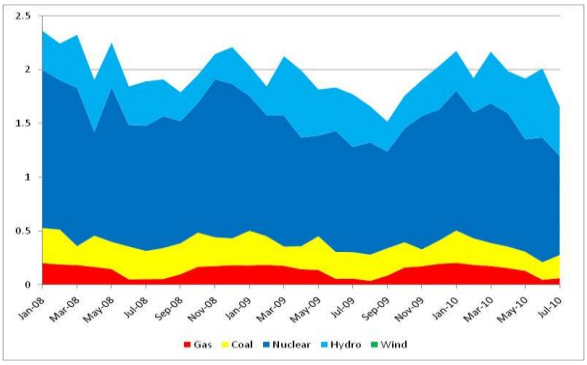



Figure 240: Electricity generation by fuels, 2008-2010, in TWh

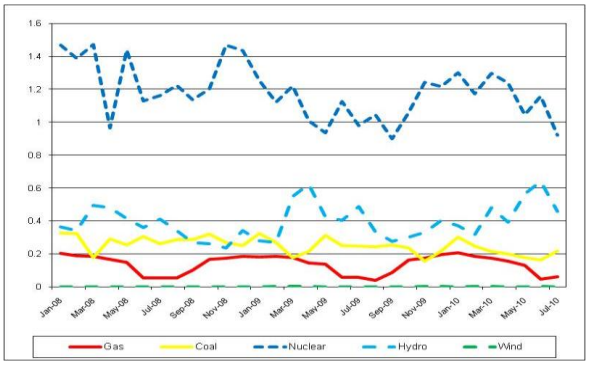



Figure 241: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

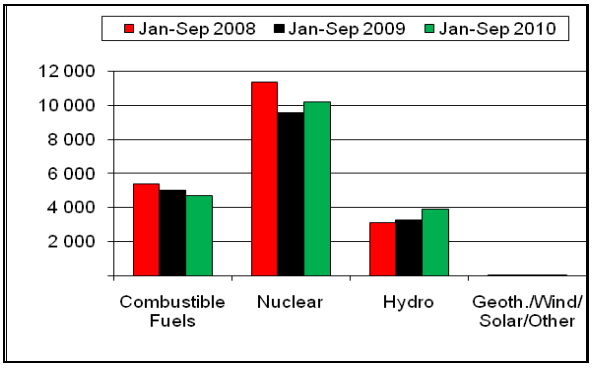



Figure 242: Natural gas demand percentage change, 2008 to 2009, from various sources

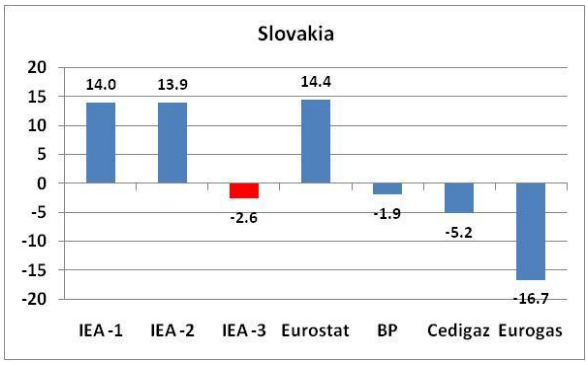



Figure 243: Natural gas demand by month, 2008-2010, in mcm

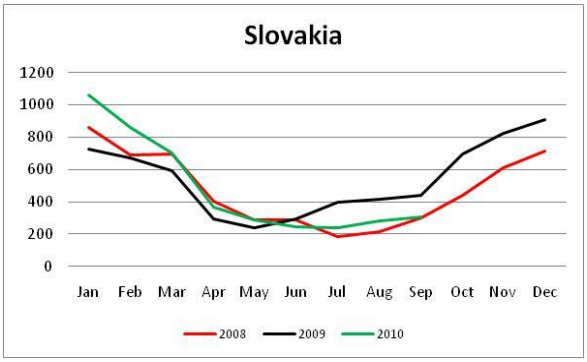



Figure 244: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

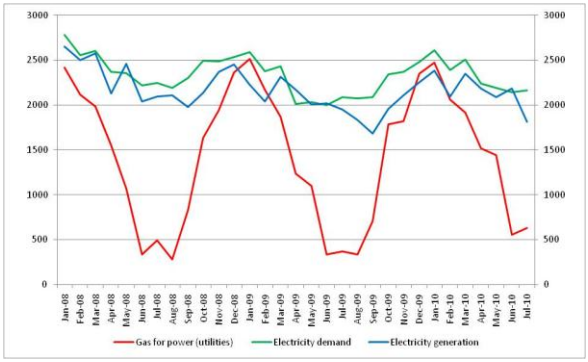


Figure 245: Natural gas use for power (in mcm), 2008-2010

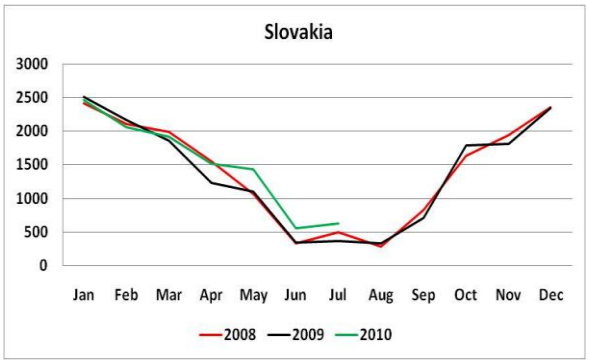



Figure 246: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

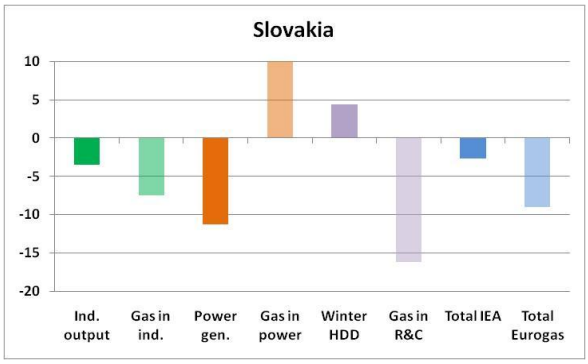



Figure 247: Heating degree-days, 2008-2010

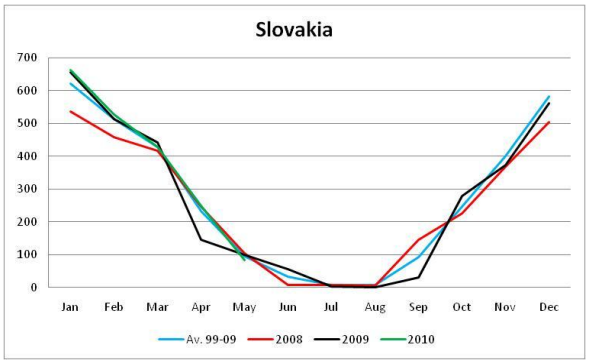



Figure 248: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

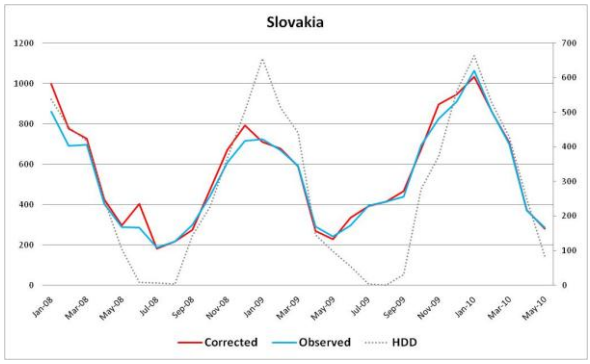
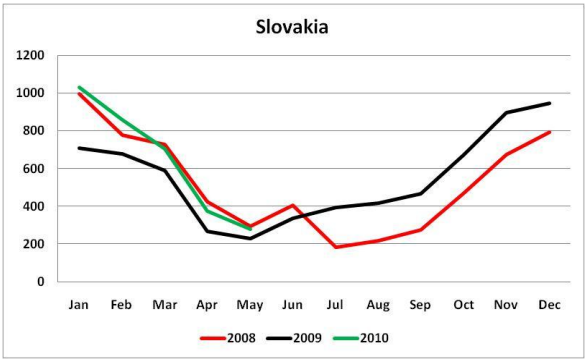



Figure 249: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 21: Spain

Natural gas consumption in Spain fell by a massive 11.4 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output and electricity generated from gas have been flat in 2010 and no gas demand recovery in 2010 seem to be under way and is not expected following gloomy forecast on GDP growth. Higher gas demand in the first quarter of 2010 is explained by colder temperatures than in 2009.

Figure 250: Natural gas demand by sector in 2008, in percent

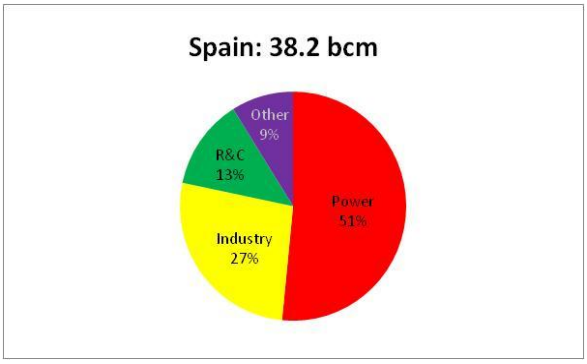



Figure 251: GDP percentage change from previous year, 2006-2012

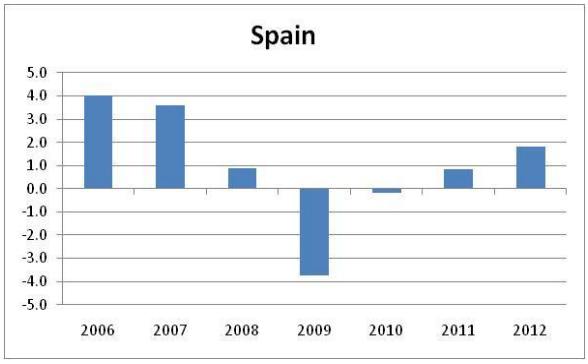



Figure 252: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010




Figure 253: Indigenous electricity generation, in GWh, 2008-2010

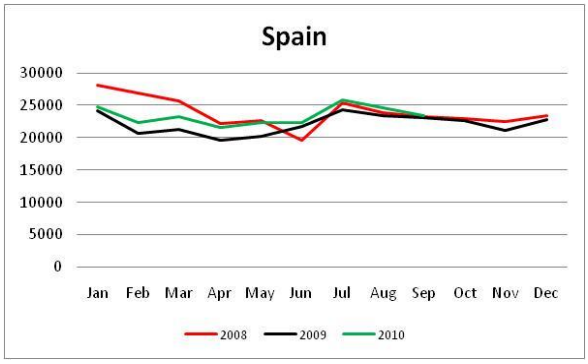


Figure 254: Electricity generation by fuels, 2008-2010, in TWh

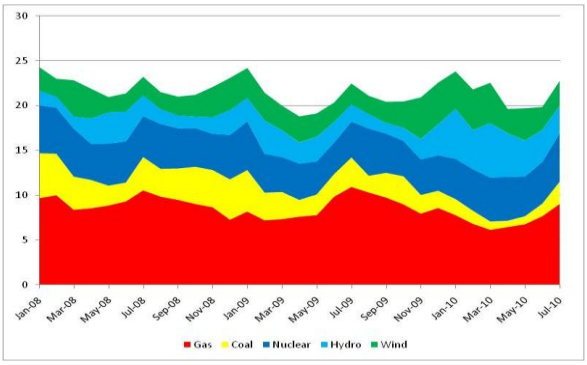



Figure 255: Electricity generation by fuels, 2008-2010, in TWh

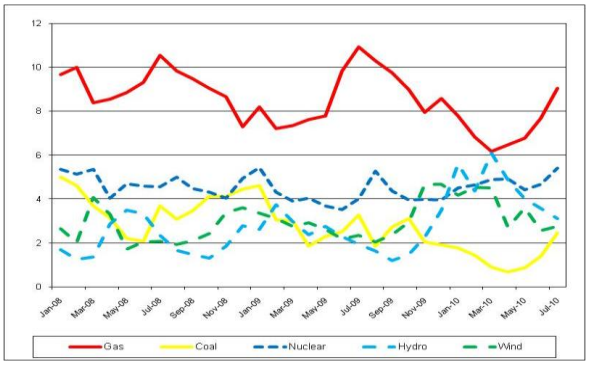



Figure 256: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

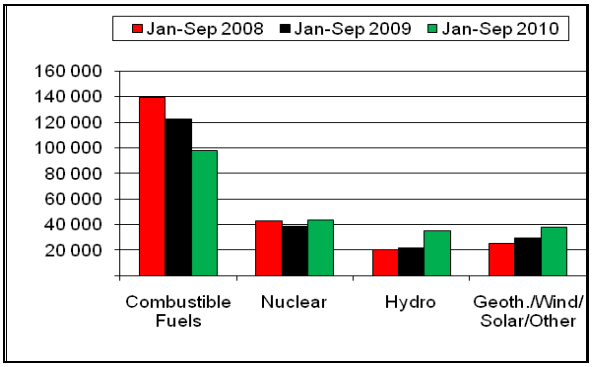



Figure 257: Natural gas demand percentage change, 2008 to 2009, from various sources

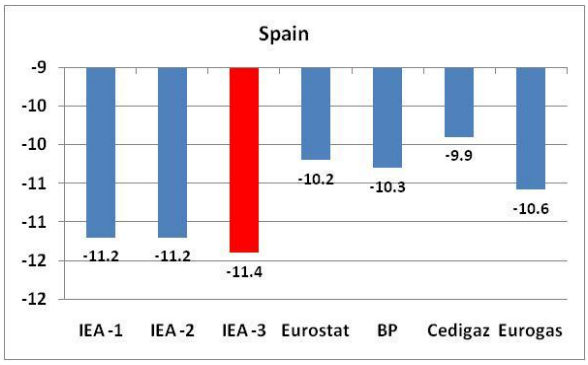



Figure 258: Natural gas demand by month, 2008-2010, in mcm

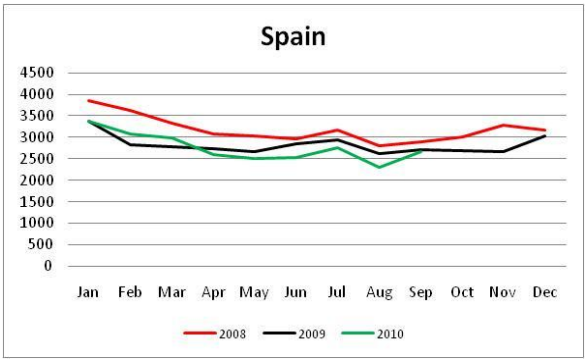



Figure 259: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

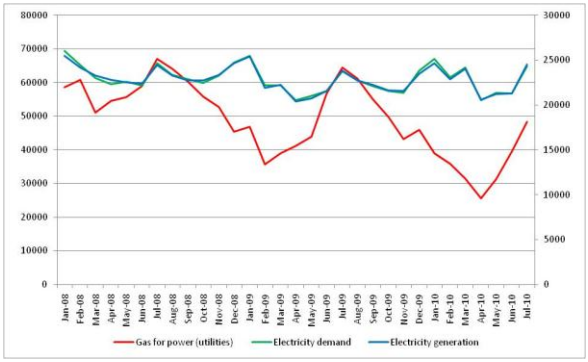


Figure 260: Natural gas use for power (in mcm), 2008-2010

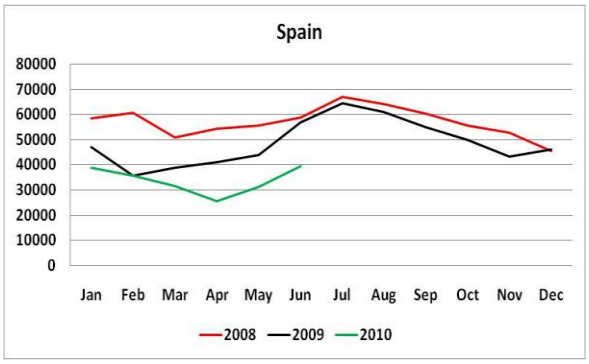



Figure 261: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

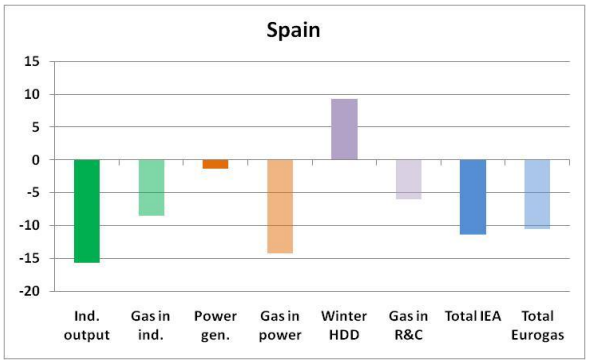



Figure 262: Heating degree-days, 2008-2010

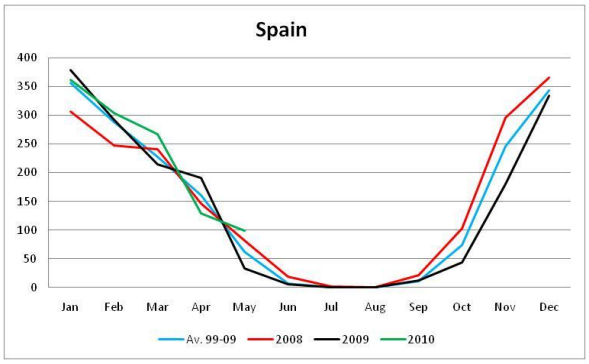



Figure 263: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

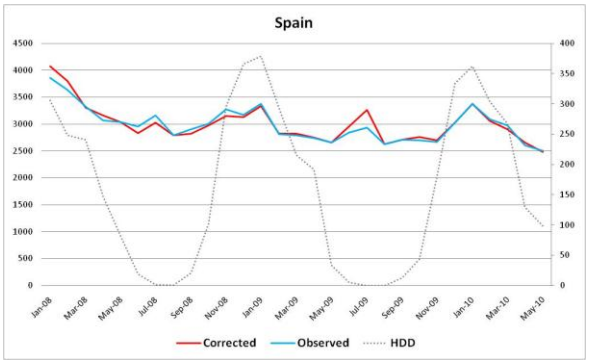
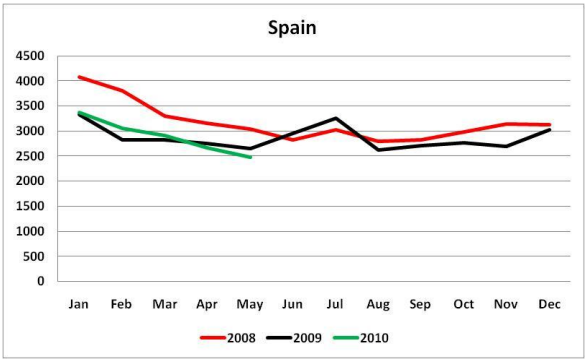



Figure 264: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 22: Sweden

Natural gas consumption in Sweden grew by a whopping 34.6 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output is on the rise in 2010, but the increase is not as impressive as gas used for electricity generation following the addition of 460 MW of additional gas fired capacity in 2009. Temperatures in winter 2009-10 were much colder than the previous year but cannot on their own explain higher gas demand, which is expected to continue in 2010 and beyond.

Figure 265: Natural gas demand by sector in 2008, in percent

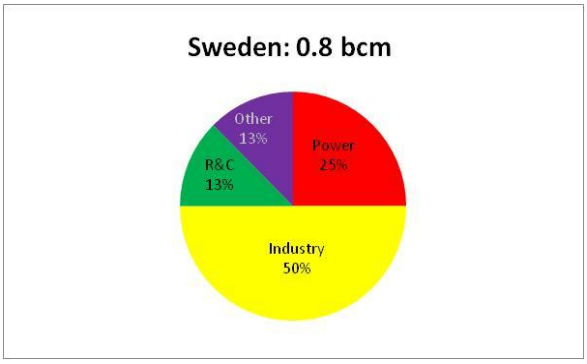



Figure 266: GDP percentage change from previous year, 2006-2012

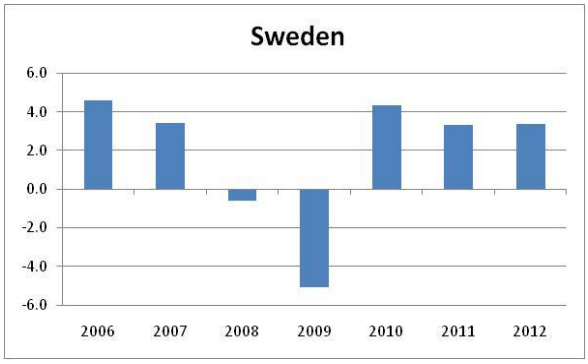



Figure 267: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

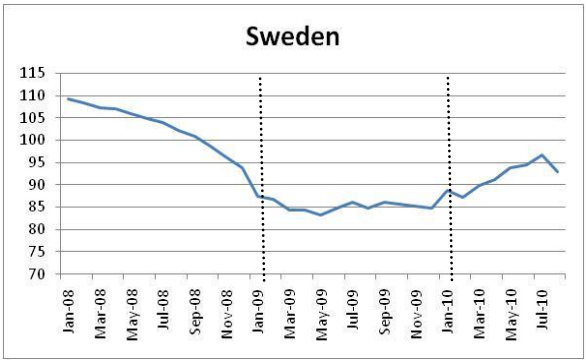



Figure 268: Indigenous electricity generation, in GWh, 2008-2010

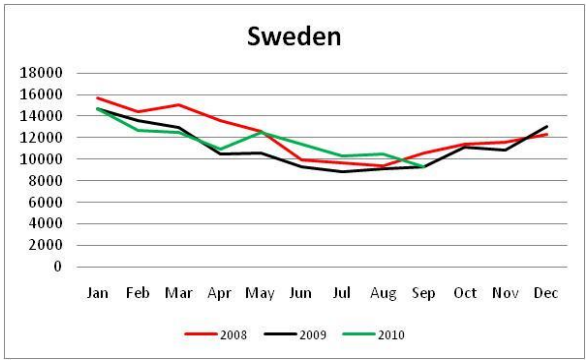


Figure 269: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

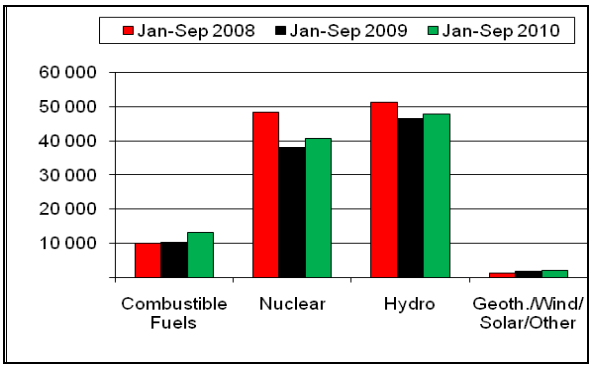



Figure 270: Natural gas demand percentage change, 2008 to 2009, from various sources

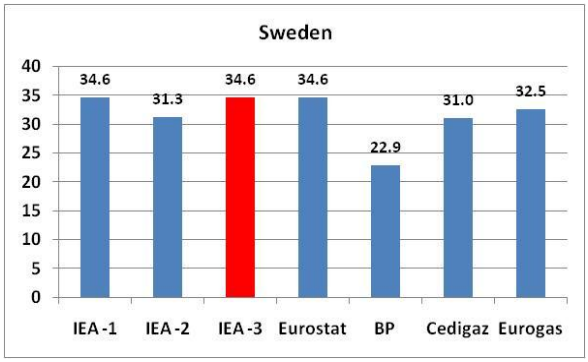



Figure 271: Natural gas demand by month, 2008-2010, in mcm

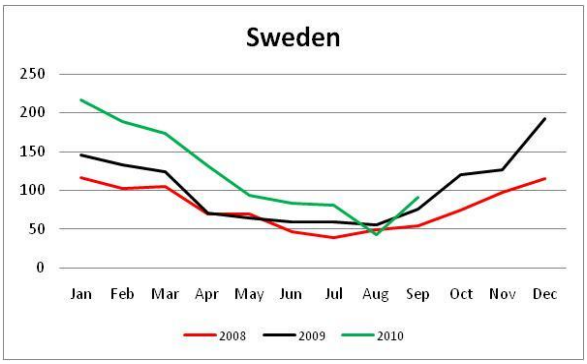



Figure 272: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

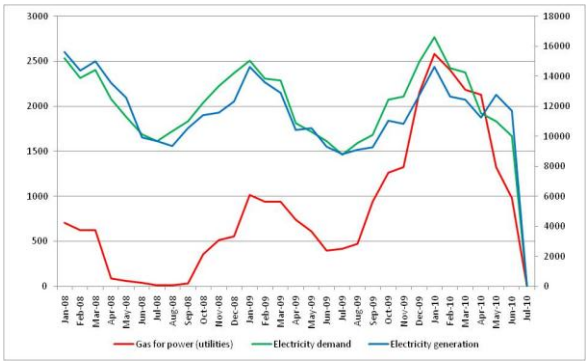



Figure 273: Natural gas use for power (in mcm), 2008-2010

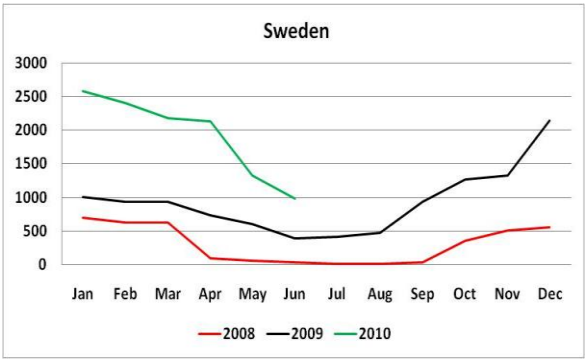



Figure 274: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

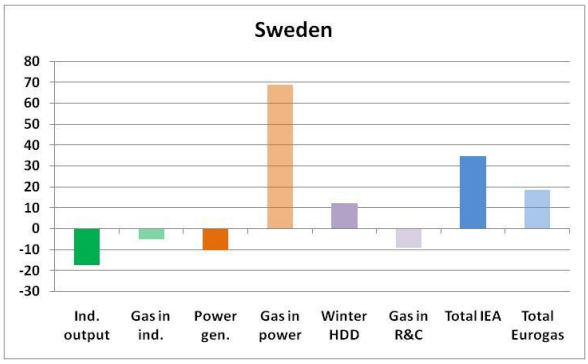


Figure 275: Heating degree-days, 2008-2010

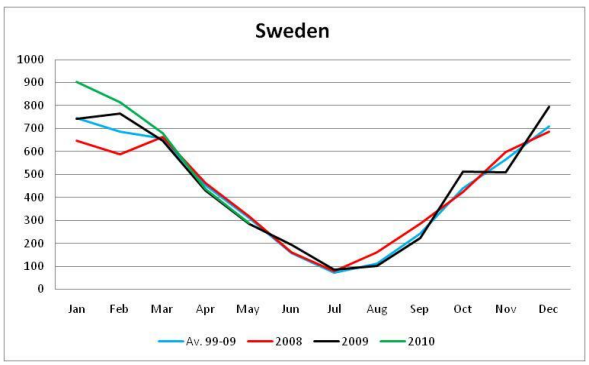



Figure 276: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

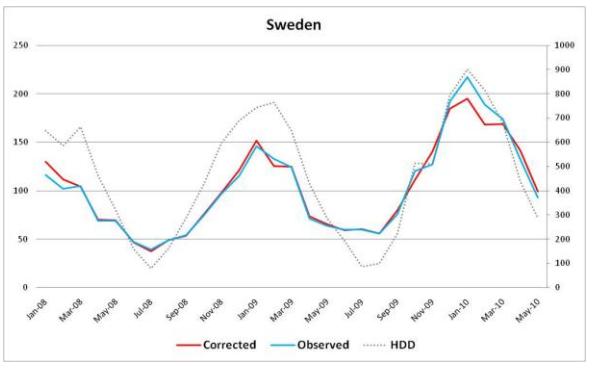
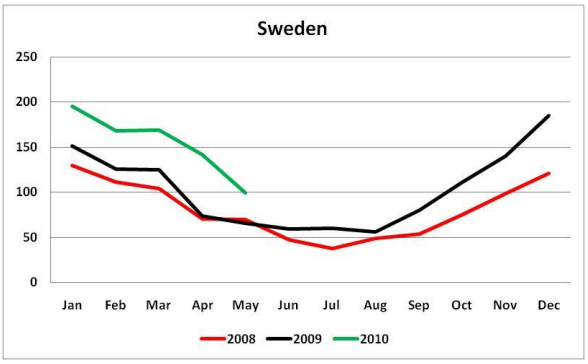



Figure 277: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 23: Switzerland

Natural gas consumption in Switzerland fell by a 4 percent in 2009 according to the IEA *Natural Gas Information 2010*. Due to a lack of data, it is difficult to provide detailed growth pattern, but no recovery for gas demand seemed to be under way in 2010.

Figure 278: Natural gas demand by sector in 2008, in percent

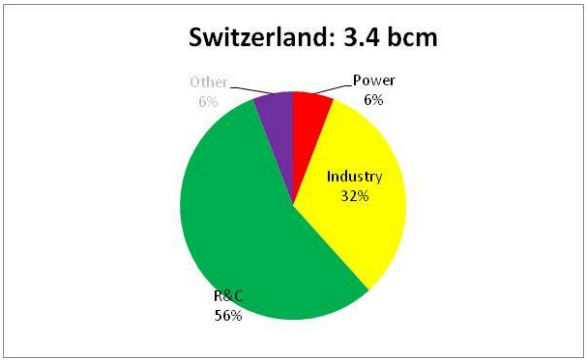



Figure 279: GDP percentage change from previous year, 2006-2012

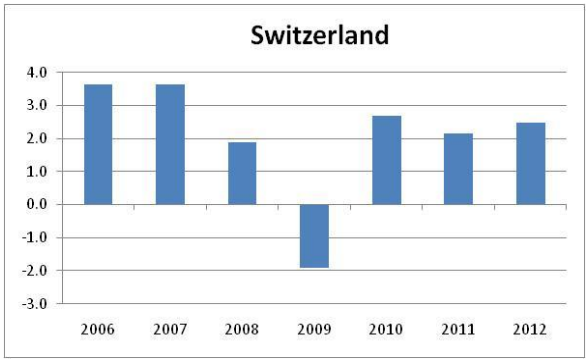



Figure 280: Indigenous electricity generation, in GWh, 2008-2010

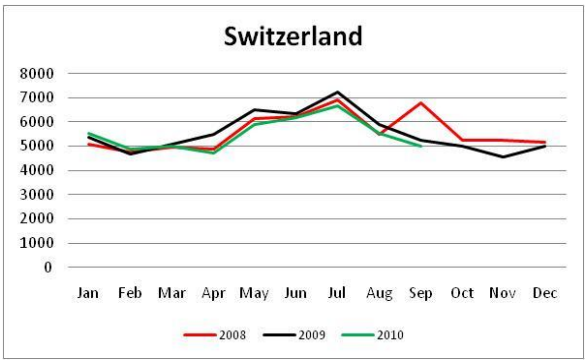



Figure 281: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

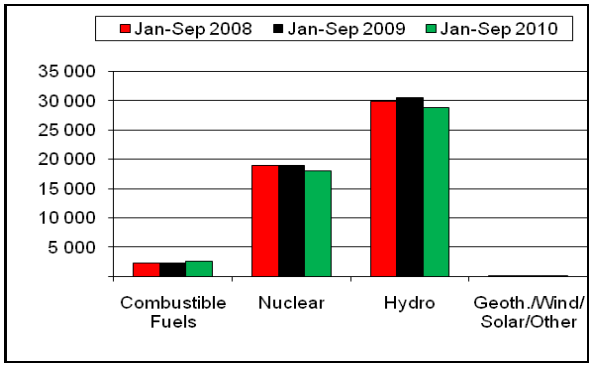


Figure 282: Natural gas demand percentage change, 2008 to 2009, from various sources

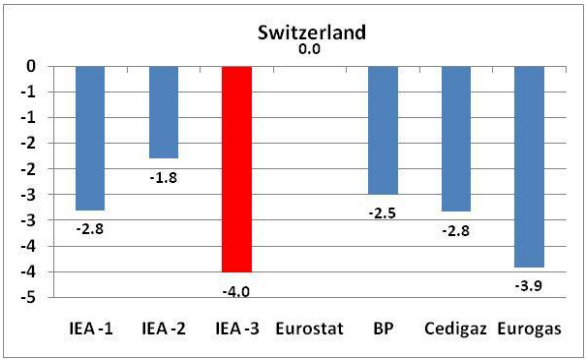



Figure 283: Natural gas demand by month, 2008-2010, in mcm

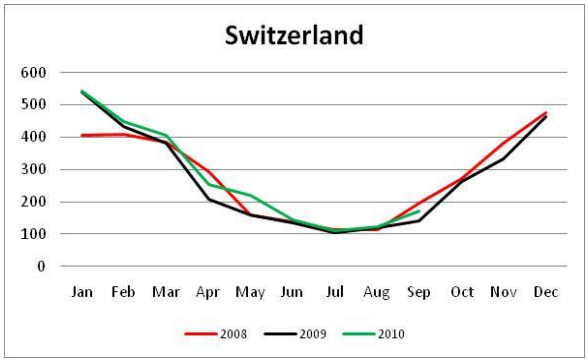



Figure 284: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

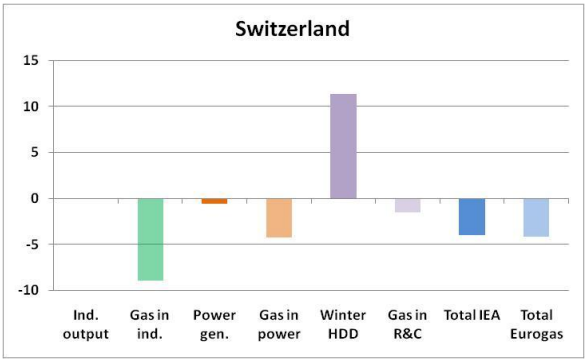



Figure 285: Heating degree-days, 2008-2010

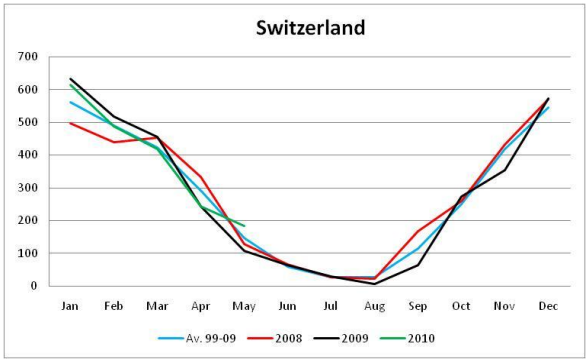



Figure 286: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

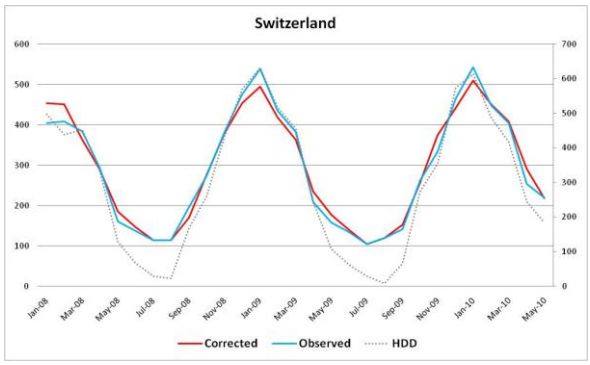
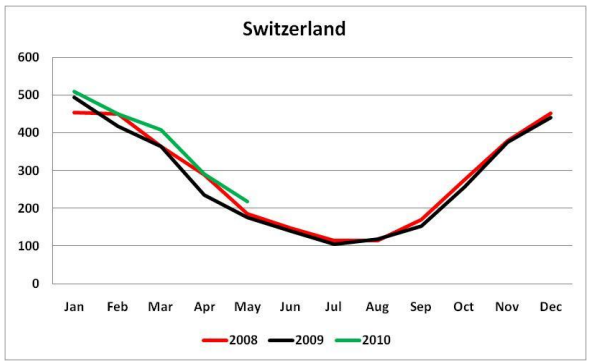



Figure 287: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 24: Turkey

Natural gas consumption in Turkey fell by a 4.3 percent in 2009 according to the IEA *Natural Gas Information 2010*. Temperatures in 2010 were warmer than in 2009, therefore higher gas consumption cannot be explained by heating demand and most probably is a sign of gas demand recovery. This may be coming mainly from the industrial sector, and to a lesser extent, from electricity generation as hydro has been an increased source of electricity in 2010.

Figure 288: Natural gas demand by sector in 2008, in percent

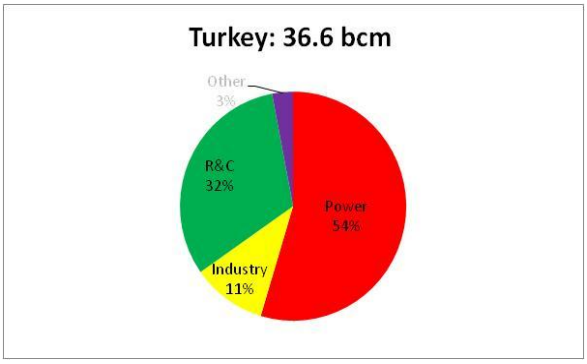



Figure 289: GDP percentage change from previous year, 2006-2012

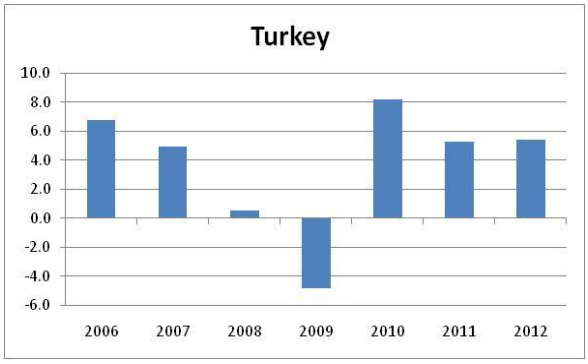



Figure 290: Indigenous electricity generation, in GWh, 2008-2010

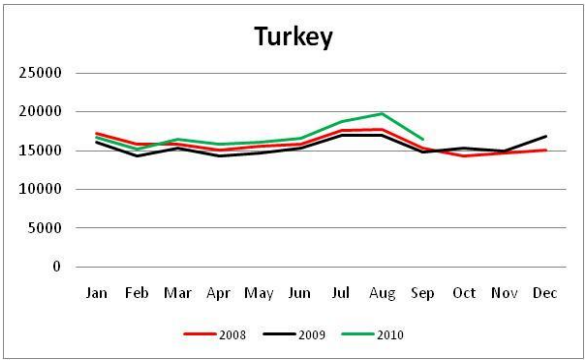



Figure 291: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

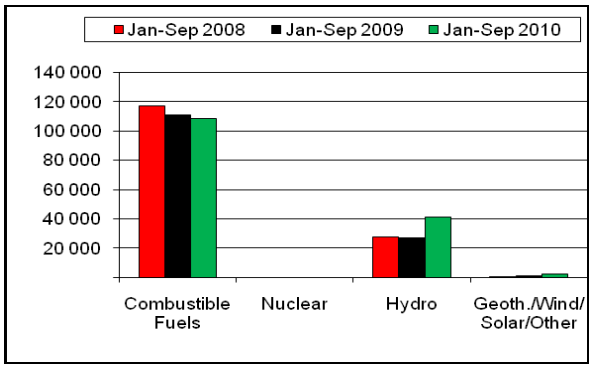


Figure 292: Natural gas demand percentage change, 2008 to 2009, from various sources

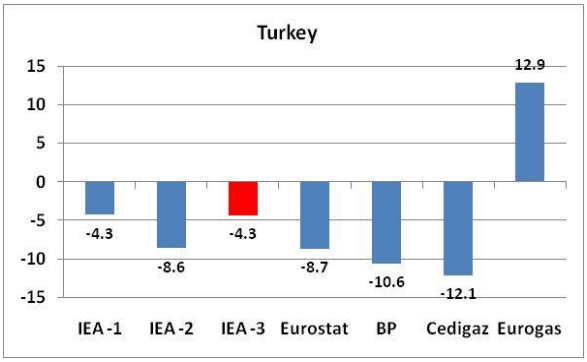



Figure 293: Natural gas demand by month, 2008-2010, in mcm

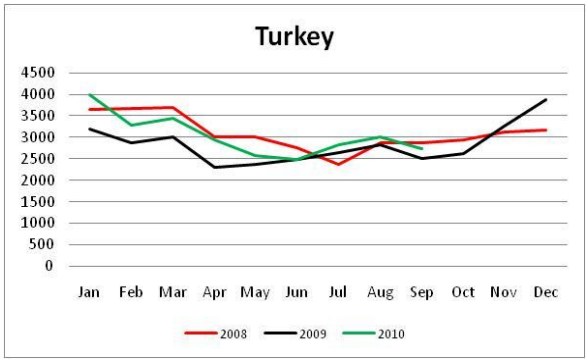



Figure 294: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

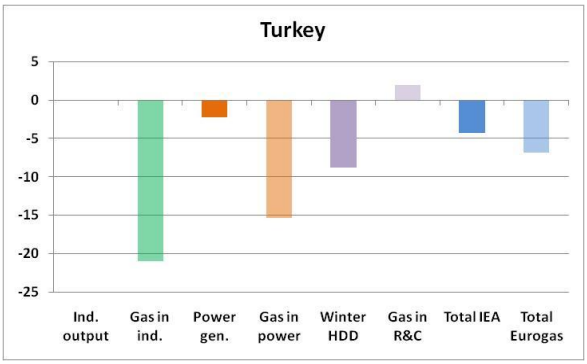



Figure 295: Heating degree-days, 2008-2010

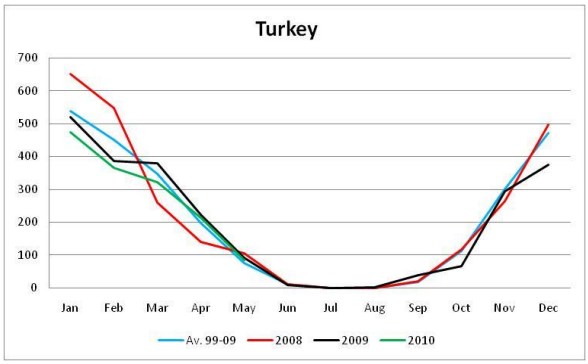



Figure 296: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

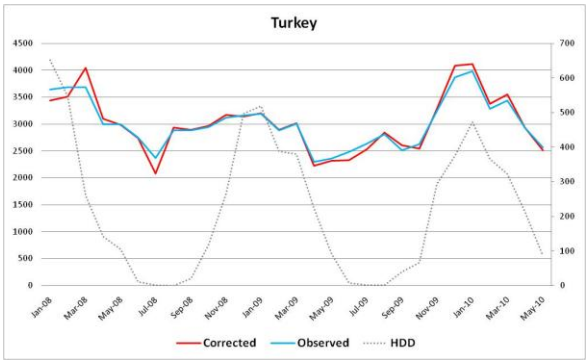
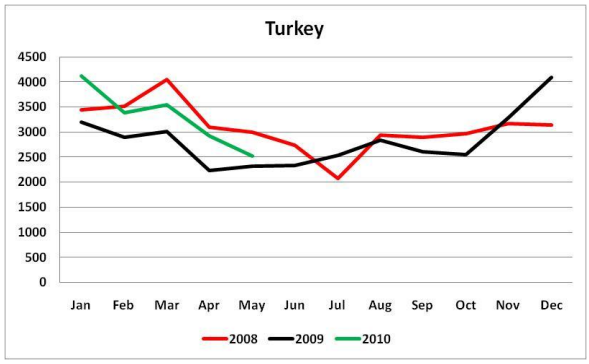



Figure 297: Temperature corrected natural gas demand in mcm, 2008-2009-2010



## Appendix 25: UK

Natural gas consumption in the UK fell by 8.3 percent in 2009 according to the IEA *Natural Gas Information 2010*. Industrial output has been flat in for the most part of 2010. Electricity generated from gas seemed to be on the rise in the first half of 2010 compared to 2009, which could be explained by lower nuclear power and about 2.2 GW of additional gas fired plants capacity installed since the end of 2009. Colder temperatures in winter 2009-10 account for the increase in gas demand in the first quarter of 2010. Apart from the power sector, there are no clear signs of gas demand recovery for 2010 in the UK.

Figure 298: Natural gas demand by sector in 2008, in percent

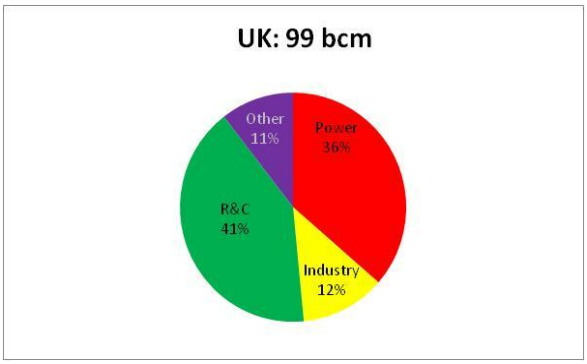



Figure 299: GDP percentage change from previous year, 2006-2012

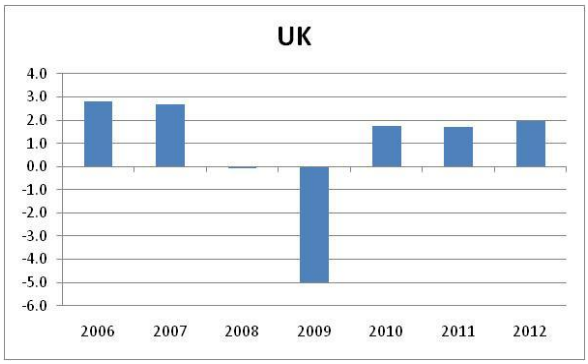



Figure 300: Production indices for industry, seasonally adjusted (base year 2005), 2008-2010

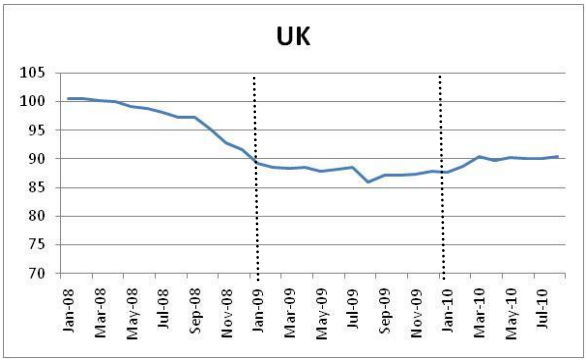



Figure 301: Indigenous electricity generation, in GWh, 2008-2010

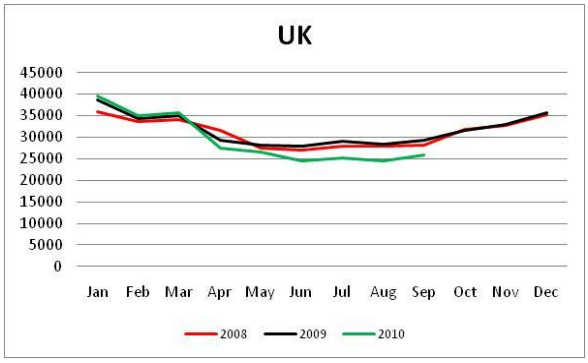


Figure 302: Year to date (Jan-Sept) comparison electricity generation by fuel type in GWh, 2008-2010

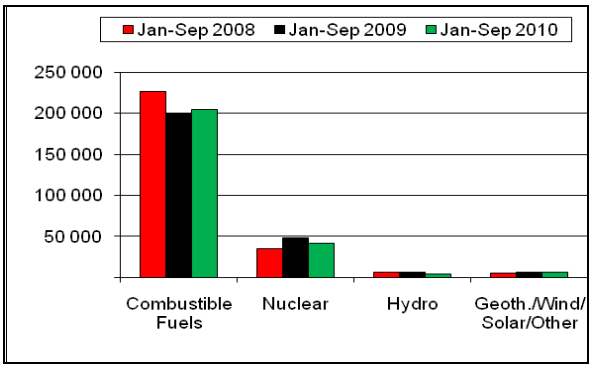



Figure 303: Natural gas demand percentage change, 2008 to 2009, from various sources

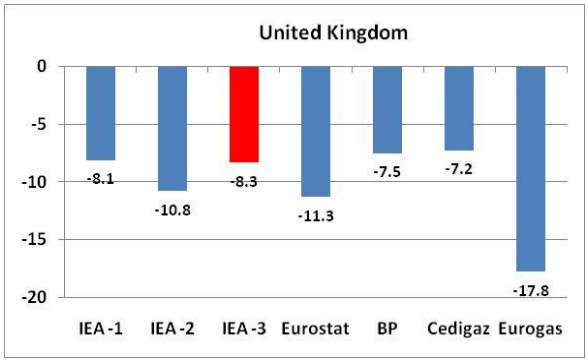



Figure 304: Natural gas demand by month, 2008-2010, in mcm

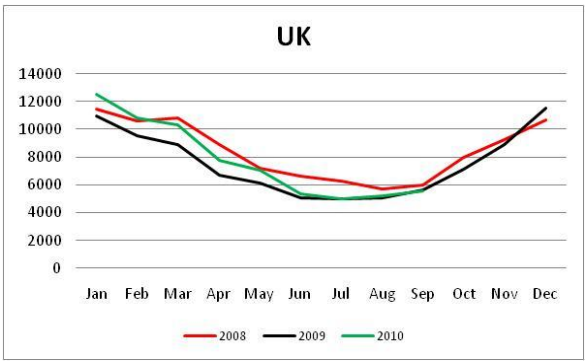



Figure 305: Natural gas use for power (in TJ) and electricity demand and generation (in GWh), 2008-2010

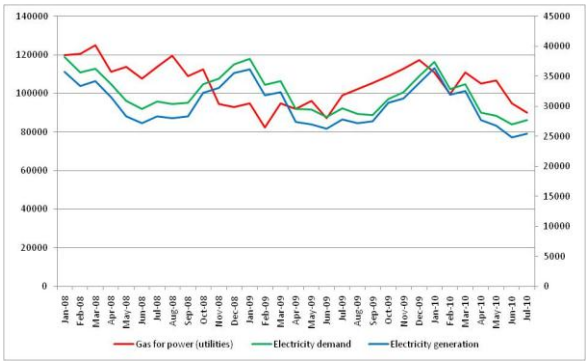



Figure 306: Natural gas use for power (in mcm), 2008-2010

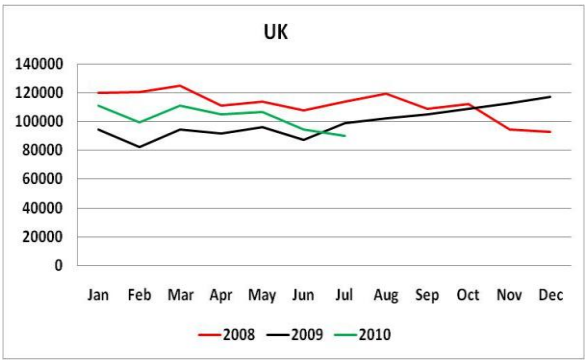



Figure 307: Comparison industry prod., power gen., HDD and gas demand by sector, in percent, 2008 to 2009

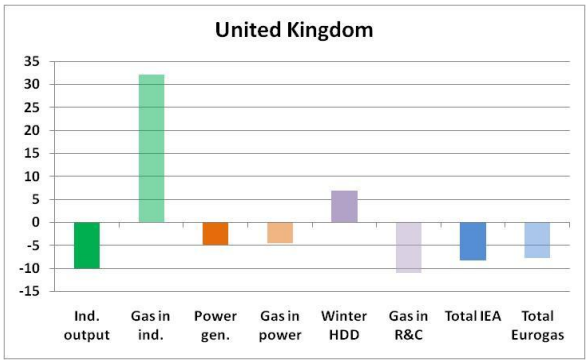


Figure 308: Heating degree-days, 2008-2010

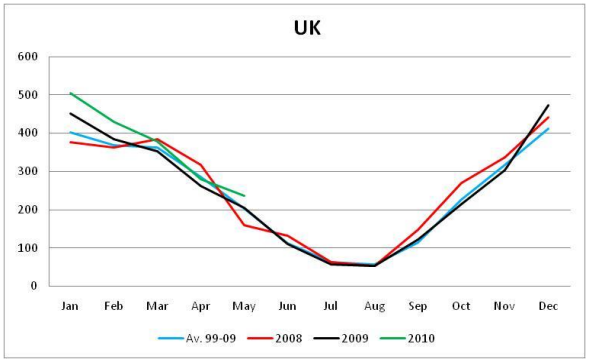



Figure 309: Temperature corrected and observed natural gas demand in bcm and HDD, 2008-2010

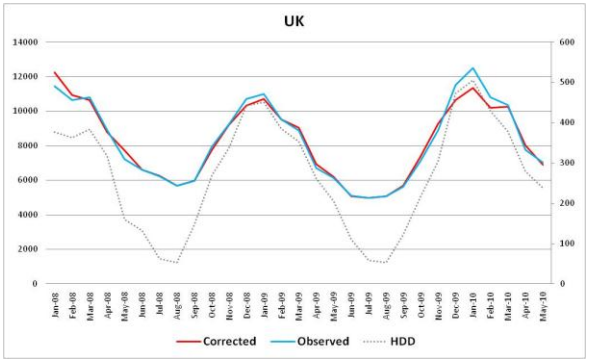
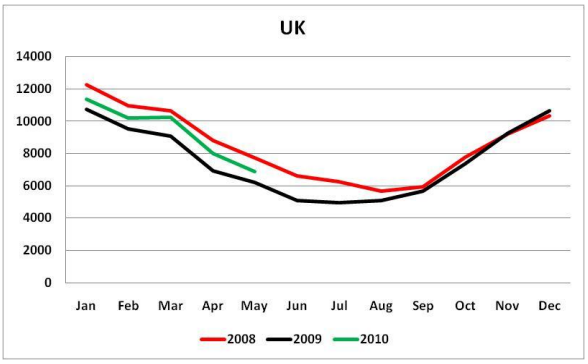



Figure 310: Temperature corrected natural gas demand in mcm, 2008-2009-2010



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