Wholesale Gas Price Survey
2021 Edition

A Global Review of Price Formation Mechanisms

2005 to 2020

June 2021
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Message from the President

The International Gas Union is the global voice of the gas industry. With more than 160 members in 85 countries, covering 95% of the global gas market: from exploration and production of natural gas, low and zero carbon gas and technologies, to transit, pipelines and LNG, and through distribution and use of gas, the IGU is the only international association covering the entire supply chain across all continents.

Our international multi-segment membership also serves as foundation for one of the most extensive knowledge networks in the energy industry. Over a thousand professionals participate in IGU’s eleven Committees and three Task Forces. They produce insightful reports and design the Technical Program of one of the biggest global energy events, the World Gas Conference with the next edition in Daegu, Korea, in May of 2022.

I am proud to introduce this 13th annual edition of the flagship IGU Wholesale Gas Price Survey report, extending my special appreciation to the Strategy Committee for bringing it to life.

The report series began in 2005, and it is an authoritative source of information on global trends in gas price formation mechanisms and wholesale gas prices around the world.

The thirteen surveys taken together tell a very compelling story of significant evolution in wholesale price formation mechanisms, during a period of key developments and dynamic changes in the global gas markets.

This 2021 edition of the report covers survey responses from 94 country-level markets, which represent 98% of total world gas consumption.

I hope that you will find the report informative and helpful.

Joe. M. Kang
President, IGU
Section 1: Executive Summary

The thirteenth IGU Wholesale Gas Price Survey, which began in 2005, shows the trend towards gas-on-gas competition (GOG) in the global gas markets, continued in 2020. In the 2020 survey responses were received for 94 out of 113 markets, but these responses covered 98% of total world consumption. The share of GOG rose by 1 percentage point in 2020 from 2019 to reach 49.3%. GOG gained share against OPE, while there was a switch to OPE away from regulated pricing in some countries, leaving the OPE share unchanged at around 18.5%. The rise in GOG was largely driven by a significant shift in LNG imports to GOG and away from OPE. The rise in GOG LNG imports in 2020, reflected another sharp rise in spot LNG cargoes.

<table>
<thead>
<tr>
<th>OPE</th>
<th>Oil Price Escalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOG</td>
<td>Gas-on-Gas Competition</td>
</tr>
<tr>
<td>BIM</td>
<td>Bilateral Monopoly</td>
</tr>
<tr>
<td>NET</td>
<td>Netback from Final Product</td>
</tr>
<tr>
<td>RCS</td>
<td>Regulation: Cost of Service</td>
</tr>
<tr>
<td>RSP</td>
<td>Regulation: Social and Political</td>
</tr>
<tr>
<td>RBC</td>
<td>Regulation: Below Cost</td>
</tr>
<tr>
<td>NP</td>
<td>No Price</td>
</tr>
<tr>
<td>NK</td>
<td>Not Known</td>
</tr>
</tbody>
</table>

The rising trend in GOG in LNG imports was a continuation of the trend over the last three years. The total GOG share of LNG imports in 2016 was 25% and in 2020 that had risen to 44%. The rise between 2016 and 2018 was all due to rising spot LNG imports, while in 2019 the increase was partly spot LNG imports and the rush of LNG to Europe’s traded markets. In 2020, the increase was due to rising spot LNG cargoes. The impact of Covid-19 on the global gas market, while stalling LNG demand, does not appear to have slowed the rise in spot LNG imports.
Spot LNG\(^1\) cargoes are heavily concentrated in the Asian markets. China was the largest spot LNG market in 2020, closely followed by Japan, with India in third place, Turkey fourth and South Korea fifth. Italy, Pakistan, Chinese Taipei and Spain also imported significant spot LNG cargoes, and these nine markets made up 75% of all spot LNG cargoes in 2020, which by then had reached a share of 34.7% of total LNG imports. OPE-priced LNG is mostly Asia Pacific – Japan, Korea and Chinese Taipei, followed by Asia – China, India and Pakistan – and Europe – mainly Spain, Turkey, France, Portugal and Italy.

Between 2005 to 2020, the GOG share of global gas consumption rose from 31.3% to 49.3%, with the OPE share falling from 24.4% to 18.6%. Up until 2016, there was a switch away from regulated pricing mechanisms towards the more “market-based” pricing mechanisms such as GOG and OPE. Since then that move has paused, with the key change in pricing mechanisms being in the non-regulated LNG market. Within the regulated categories, the big changes occurred between 2005 and 2012, with a move away from subsidised pricing or regulated below cost (RBC) to higher prices but still regulated. The changes in shares, at the world level, are a combination of actual changes in price formation mechanisms in each country and a change in the consumption mix between countries. Since 2005 consumption growth has been strong in Asia, especially China, where OPE has gained ground and has declined in Europe where GOG has grown significantly. Without the changes in the consumption mix over the last 15 years, GOG growth at the World level would have been from 31.3% to 55.4%, rather than to 49.3%, and the OPE decline would have been 4 percentage points greater. There would have been little difference in the change in shares of other price formation mechanisms.

Most of the rise in GOG, and decline in OPE, between 2005 and 2017 was driven by changes in pipeline imports in Europe, with OPE almost disappearing in Northwest Europe\(^2\) and Central Europe\(^3\). The remaining enclaves of OPE in Europe are in Turkey, Southeast Europe (including Greece) and the Baltic countries, which are heavily reliant on

\(^{1}\) The definition of Spot LNG in this survey is not the same as the GIIGNL definition of spot and short-term contracts. In this survey, spot LNG excludes the short-term contracts element i.e. contracts over one year but less than four years, of the GIIGNL reports. In this edition, we have attempted to split the LNG being imported into the trading markets of North America and Northwest Europe, between Spot and Traded volumes, to avoid the categorisation of some spot volumes as traded volumes. In addition, in some countries we have also attempted to categorise US cargoes, which are spot and those under contracts with Henry Hub linked pricing, which would be included in the “Traded” category. These changes were also carried back to the results of previous surveys.

\(^{2}\) Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, UK

\(^{3}\) Austria, Czech Republic, Hungary, Poland, Slovakia, Switzerland
Russian pipeline gas, plus Spain and Portugal, reliant on Algerian pipeline gas, and LNG. As noted, the rise in GOG LNG imports since 2016 has largely taken over the trend towards GOG displacing OPE in the global gas market.

Wholesale prices declined again overall in 2020, with an already oversupplied market being further hit by the pandemic, leading to very sharp falls in spot prices around the world, to an average of $3.24 per MMBTU – the lowest global average in all the surveys since 2005.

Globally prices had generally risen between 2005 and 2014, apart from North America because of the shale gas revolutions, before the supply – demand balance and the oil price declines and increases, impacted much of the market. Regions which have a lot of regulated pricing – Africa, the Middle East and FSU – generally experienced rising prices through 2015 before a levelling off, as there was a move away from more subsidised wholesale prices in many countries. This was also the case in the FSU, especially Russia, through 2013, but the decline in US dollar prices since then has largely reflected continued currency weakness, with rouble prices being maintained.

Since 2015, prices in Asia, Asia Pacific and Europe broadly tracked each other, but this link was broken in 2019 as spot prices collapsed which impacted the European market much more than Asia and Asia Pacific where prices barely changed from 2018 levels. These differences widened further in 2020 as spot prices collapsed again. European prices are now much closer to the World average than they have ever been, breaking decisively from Asia and Asia Pacific prices.

There is still a large variation of gas price levels of the markets in this survey. However, there has been a trend of greater global gas price convergence from 2005 through to 2015, but this trend may have stalled somewhat since then as we entered a period of lower prices, notwithstanding the rebound in 2018.

While there have been a number of significant changes over the period of the surveys between the 8 categories,
the changes have been almost wholly within larger groupings of categories, until very recently. The categories of OPE, GOG, BIM and NET can be broadly described as “market” pricing, while the categories of RCS, RSP, RBC and NP can be broadly described as “regulated” pricing.

The total of “market” pricing rose from 62% in 2005 to 71.5% in 2020, mirrored by a decline in “regulated” pricing, from 38% in 2005 to 28.5% in 2019. Changes in percentages between surveys can arise because of actual changes in price formation mechanism or because of more rapid growth in consumption in markets with a specific type of price formation mechanism. The switch to “market” pricing is down to a number of factors, notably the move away from regulated pricing in the Russian market to GOG as the independent producers began to compete with each other and Gazprom to sell gas to the power sector and large industrials; a similar move in Argentina, to GOG, as the eligible market opened up, and more recently in Nigeria.

Since 2013, there was initially a move in China to OPE in 2 provinces away from RCS which in 2014 became nationwide for incremental production over 2012 levels and then in 2015 for all sectors except residential and fertilizers, and halfway through 2018 the move to OPE for residential city-gate pricing. In 2020, Malaysia moved away from RCS to OPE in its domestic pricing.

In addition, there have been pricing reforms in India, beginning in late 2014, moving pricing away from RSP to GOG, and, finally, the rise in new LNG importers, importing at OPE and/or GOG, to enhance or replace domestic production which was regulated.
Section 2: Introduction

2.1 BACKGROUND

The 2020 IGU Wholesale Gas Price survey is the thirteenth to be undertaken in a series which began at the start of the 2006 to 2009 IGU triennium culminating in the World Gas Conference in Buenos Aires. Prior to the 2020 survey, previous surveys were undertaken for the years 2005, 2007, 2009, 2010, and then annually from 2012. The thirteen surveys have confirmed the significant changes in wholesale price formation mechanisms during a period of key developments and upheaval in the global gas market. In the 2020 survey responses were received for 94 out of 113 markets, but these responses covered 98% of total world consumption. Data on the remaining markets, where responses were not received, was researched by the author of the report under the guidance of the IGU’s Gas Pricing Group and/or based on past responses.

2.2 TYPES OF PRICE FORMATION MECHANISMS

In preparation for the initial 2005 survey, a series of discussions were held at the IGU group meetings, in 2006 and early 2007, on the definition of different types of price formation. It was decided to use for categorisation purposes the wholesale pricing mechanisms, summarised below.

2.3 ANALYSING THE RESULTS

In the discussion of regions, the IGU regional definitions are used and there is a map in the Appendix which shows the regions. A key point to note is that the Asia region is China and the Indian sub-continent and Asia Pacific is the rest of what is often called Asia.

2.4 REPORT LAYOUT

Section 3 of the report covers the results at the World level of the 2020 survey, and a comparison of the results across all thirteen surveys, for the different categories – domestic production, pipeline imports, LNG imports, total imports and total consumption. The GOG and OPE categories are also analysed in more detail.

Section 4 of the report covers wholesale price levels including a discussion and analysis of the results of the 2020 survey, by region, price formation mechanism and country, and then comparisons over all surveys.

Section 5 of the report contains an analysis of global gas price convergence over the thirteen surveys.

Section 6 of the report contains a retrospective analysis looking at the key changes between the first survey in 2005 and the 2020 survey.

Appendix A of the report looks at the individual regions (IGU definitions) results for the 2020 survey and comparisons across all surveys for the price formation mechanisms.

Appendix B describes the survey methodology, including the data collection method, the IGU regional definitions, the definitions of the price formation mechanisms and the analytical framework.

The results for previous surveys may, in some cases, appear slightly different from what has been published in previous reports. This reflects mostly revisions to IEA data on consumption, production, imports and exports but can also reflect retrospective changes to price formation classification when survey respondents have a better appreciation of the classification definitions as they reflect upon the results from the surveys overall.

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4 The Wholesale Gas Pricing Group began life as Sub Group 2 of PGCB and was chaired in the period leading up to the 2009 World Gas Conference by Runar Tjersland of Statoil and between 2009 and 2018 by Mike Fulwood, formerly of Nexant, but now a Senior Research Fellow at the Oxford Institute for Energy Studies and a Fellow at the Center on Global Energy Policy at Columbia University. It is now part of the IGU’s Strategy Committee and has been re-titled as the Gas Pricing Group. The 2018, 2019 and 2020 surveys were organised by Mike Fulwood, under the guidance of the IGU Strategy Committee.
### Box 1: Types of Price Formation Mechanisms

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Price Escalation (OPE)</td>
<td>The price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases, coal prices can be used as can electricity prices.</td>
</tr>
<tr>
<td>Gas-on-Gas Competition (GOG)</td>
<td>The price is determined by the interplay of supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or other periods). Trading takes place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). There are likely to be developed futures markets (NYMEX or ICE). Not all gas is bought and sold on a short-term fixed price basis and there will be longer term contracts but these will use gas price indices to determine the monthly price, for example, rather than competing fuel indices. Also included in this category are spot LNG cargoes, any pricing which is linked to hub or spot prices and also bilateral agreements in markets where there are multiple buyers and sellers.</td>
</tr>
<tr>
<td>Bilateral Monopoly (BIM)</td>
<td>The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically one year. There may be a written contract in place but often the arrangement is at the Government or state-owned company level. Usually there would be a single dominant buyer or seller on at least one side of the transaction, to distinguish this category from GOG, where there would be multiple buyers and sellers trading bilaterally.</td>
</tr>
<tr>
<td>Netback from Final Product (NET)</td>
<td>The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.</td>
</tr>
<tr>
<td>Regulation: Cost of Service (RCS)</td>
<td>The price is determined, or approved, formally by a regulatory authority, or possibly a Ministry, but the level is set to cover the “cost of service”, including the recovery of investment and a reasonable rate of return.</td>
</tr>
<tr>
<td>Regulation: Social and Political (RSP)</td>
<td>The price is set, on an irregular basis, probably by a Ministry, on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise – a hybrid between RCS and RBC.</td>
</tr>
<tr>
<td>Regulation: Below Cost (RBC)</td>
<td>The price is knowingly set below the average cost of producing and transporting the gas often as a form of state subsidy to the population.</td>
</tr>
<tr>
<td>No Price (NP)</td>
<td>The gas produced is either provided free to the population and industry, possibly as a feedstock for chemical and fertilizer plants, or in refinery processes and enhanced oil recovery. The gas produced maybe associated with oil and/or liquids and treated as a by-product.</td>
</tr>
<tr>
<td>Not Known (NK)</td>
<td>No data or evidence.</td>
</tr>
</tbody>
</table>

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**Notes:**

- **Oil Price Escalation (OPE):** A pricing mechanism where the price is linked to competing fuels, usually through a base price and an escalation clause. This can include coal or electricity prices.
- **Gas-on-Gas Competition (GOG):** Prices are determined by the interplay of supply and demand, and traded over various periods. Trading can occur at both physical and notional hubs. Futures markets are common.
- **Bilateral Monopoly (BIM):** Prices are set through bilateral discussions between large buyers and sellers, typically for a year. There is often a written contract, and one side is usually the dominant buyer or seller.
- **Netback from Final Product (NET):** The price to the supplier is linked to the price received by the buyer for the final product.
- **Regulation: Cost of Service (RCS):** Prices are formally set to cover the “cost of service,” including recovery of investment and a reasonable rate of return.
- **Regulation: Social and Political (RSP):** Prices are set on an irregular basis, often in response to increasing costs or revenue raising exercises.
- **Regulation: Below Cost (RBC):** Prices are knowingly set below average costs. This can be a form of state subsidy.
- **No Price (NP):** Gas is provided free, possibly as a feedstock or for other purposes.
- **Not Known (NK):** No data or evidence available.
Section 3: World Results

3.1 INTRODUCTION

This section covers the full results and analysis at the World level for wholesale price formation mechanisms and comprises results for the 2020 survey and comparisons and analysis of the results of the surveys from 2005 to 2020 for the consumption allocated to the following categories:

- Domestic Production;
- Pipeline Imports;
- LNG Imports;
- Total Imports;
- Total Consumption.

There is also a sub-section which analyses in more detail the GOG and OPE categories for all the surveys.

3.2 DOMESTIC PRODUCTION

3.2.1 2020 Survey Results

Domestic production in 2020 accounted for some 72% of total world consumption – around 2,830 bcm.

FIGURE 3: WORLD PRICE FORMATION 2020 – DOMESTIC PRODUCTION
The percentage shares of the mechanisms for each region are shown in Figure 4 below.

GOG has the largest share in domestic production at 47%, totalling some 1,322 bcm, with North America accounting for 925 bcm – around 70% of the total. The next largest share is in the Former Soviet Union, where the sales of gas in Russia to the large eligible customers by either Gazprom or the independent producers is classified as GOG (see the section on Former Soviet Union in the regional analysis for further discussion), accounting for some 182 bcm. The balance is in Europe at 83 bcm – principally the UK plus the Netherlands and Romania, Asia Pacific at 42 bcm – Australia and New Zealand, Asia at 37 bcm – India and China (see Appendix A covering regional analysis on Asia for further discussion), and Latin America at 24 bcm – mainly Argentina and Colombia.

OPE has a relatively small share in domestic production at 11%, totalling some 309 bcm, with 171 bcm in Asia – China and Pakistan mainly, 93 bcm in Asia Pacific – Thailand, Indonesia, Vietnam, Philippines, Australia and Malaysia, 25 bcm in Latin America – Brazil and Colombia, the Middle East at 15 bcm in Kuwait and Israel, 4 bcm in Africa, mainly Tunisia, and Europe – small amounts in a few countries.

The regulated categories – RCS, RSP and RBC – in total account for 39% of domestic production, with RCS principally in the Former Soviet Union, Asia and Asia Pacific, RSP principally in the Middle East, Former Soviet Union, Latin America and Asia Pacific and RBC in the Former Soviet Union, Africa, Latin America and the Middle East. A more detailed breakdown of the regulated categories is contained in the regional analysis sections.
3.2.2 2005 to 2020 Comparisons

The main changes in price formation over the thirteen surveys have been the general rise in GOG from 35% in 2005 to 47% in 2020. The share rose slightly between 2019 and 2020, but declined in volume terms as global gas demand fell as a result of the impact of COVID-19. The OPE category is not particularly large in terms of domestic production but actually rose slightly between 2019 and 2020 as China production grew.

Over the period as a whole, GOG has gained share from the three regulated categories which in 2005 totalled some 52% compared to 39% in 2020. Half of this occurred in 2009 and 2010 when the GOG category increased in Russia at the expense of the regulated categories, as the market began to open up to independents more, and there was more effective competition between the independents and Gazprom for power sector and industrial customers. This was followed by the changes in India in 2015, as regulated pricing was replaced with a formula linked to international, predominantly hub, prices for key sectors. There has also been an increase in GOG in Latin America as well, principally in 2007 and 2009.

Within the regulated categories, there have been two main changes, in 2009 when Russia changed from RBC to RCS as prices were finally increased above the cost of production and transportation, and in 2012 when Iran increased prices sharply to move from RBC to RSP. RSP increased again in 2014 as prices to the population in Russia was switched away from RCS. In 2017, there was also a change in Malaysia, away from RSP to RCS. In 2020 there was a switch away from RCS as it declined in Russia, as that was the sector hit by lower demand, and in Malaysia which moved away from RCS to OPE.
3.3 PIPELINE IMPORTS

3.3.1 2020 Survey Results

Pipeline imports in 2020 accounted for some 17% of total world consumption – around 655 bcm\(^5\).

Pipeline imports are split between just three categories – OPE, GOG and BIM\(^6\). The regional breakdown is shown in figure 7 below.

GOG is 65% of all pipeline imports, totalling 423 bcm, with Europe at 282 bcm, North America 130 bcm and the Former Soviet Union 10 bcm (Ukraine imports from Europe). Most of the European gas importing countries, have some element of GOG pipeline imports with the top five countries being Germany, Italy, France, Netherlands and UK.

OPE is around 25% of all pipeline imports, totalling some 165 bcm, with Europe at some 68 bcm – Turkey being by far the largest contributor. Asia accounts for some 52 bcm – China, 20 bcm in Asia Pacific – Thailand, Singapore and Malaysia, and 11 bcm in Latin America – mainly Brazil and Argentina. There are also small quantities in other regions, apart from North America, including countries such as Russia, Iran and Tunisia.

BIM has the balance of 10%, totalling some 66 bcm. This is mainly in the Former Soviet Union and the Middle East.

\(^5\) This figure represents the total effective net pipeline imports for all countries. Many countries will produce gas and import by pipeline and LNG and also export by pipeline from the “pool” of all sources of supply. Gross pipeline imports in total in 2020 were 756 bcm so effectively 101 bcm was “re-exported” by pipeline.

\(^6\) There is a very small amount of RCS in Africa reflecting the regulated transportation tariff element of pipeline gas from Nigeria to Ghana.
3.3.2 2005 to 2020 Comparisons

The main changes in the thirteen surveys from 2005 to 2020 are the continued rise in GOG from 23% in 2005 to 65% in 2020, which has been at the expense of the OPE category. The decline in OPE was partly offset by a switch from BIM to OPE in intra-FSU trade in 2009, and more recently the imports of pipeline gas from Turkmenistan to China, and in 2016, the change in one of the gas contracts from Russia to Turkey. In 2020, the GOG share increased 1.5 percentage points with the volume of OPE imports in Europe declining as total pipe imports fell with some further moves towards GOG.

The rise in GOG at the expense of OPE has been entirely in the European market, up until the Ukraine change during 2015, as the Northwest Europe countries began switching to GOG and more recently the Central Europe countries and, in 2014 and 2017, Italy. In respect of pipeline imports into Europe GOG in 2020 has a 81% share compared to 19% for OPE. This is in marked contrast to 2005 when it was 91% OPE and only 7% GOG.

This decline in Europe in OPE would appear to be confirmed by recent comments from Gazprom’s Elena Burmistrova⁷, that “only 13% of Gazpromexport’s gas sales were under solely oil linked contracts” in 2020, with half of the sales indexed to day-ahead or month-ahead prices, with just under a third to quarterly, seasonal or yearly prices.

⁷ Argus Gas Connections, 19 May 2021
3.4 LNG IMPORTS

3.4.1 2020 Survey Results

LNG imports in 2020 accounted for some 12% of total world consumption – around 458 bcm\(^8\).

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\(^8\) As for pipeline imports, the figure represents total effective net LNG imports for all countries. Gross LNG imports (net of re-exported LNG) were some 478 bcm in 2020, with around 20 bcm being regasified and re-exported as pipeline gas.
LNG imports are split 56% OPE and 44% GOG. The regional breakdown is shown in Figure 10 below.

OPE at some 258 bcm is mostly Asia Pacific – Japan, Korea and Chinese Taipei, followed by Asia – China, India and Pakistan – and Europe – mainly Spain, Turkey, France, Portugal and Italy.

GOG totals some 200 bcm and can be divided into imports into North America and countries such as the UK, Belgium, France and Netherlands, where the domestic market pricing mechanism is GOG, and all other markets which are mainly importing spot and short-term priced LNG cargoes, which is almost every other LNG importing country – Japan taking the largest volume – but also includes countries like China, India, Korea, Turkey, Spain, Argentina and Brazil. In Europe, 63% of LNG imports are now GOG.

![Figure 10: Regional Price Formation 2020 – LNG Imports](image)

3.4.2 2005 to 2020 Comparisons

The main changes in the thirteen surveys from 2005 to 2020 are a rise in GOG from just over 13% in 2005 to 32% in 2012, which was largely at the expense of the OPE category, before it fell back in 2014 to 25%. In 2015 there was a recovery back to a 33% share, a fall in 2016 to 25%, before rising to 29% in 2017, 34% in 2018, 41% in 2019 and to 44% in 2020.

The GOG share is comprised of LNG going to the traded markets of North America and in Europe the UK, Belgium and Netherlands, and spot LNG cargoes to the “traditional” LNG markets in Asia Pacific and Europe and some of the newer markets.

There was a significant increase in GOG between 2005 and 2007, which was principally due to a rise in spot LNG imports in Asia and Asia Pacific and a smaller rise in North American imports. Since 2007, there have been offsetting changes with North American LNG imports – which are all GOG – declining, European imports, principally to the UK increasing in 2009 and 2010 and relatively stability in Asia and Asia Pacific spot LNG imports. In 2012, as Europe’s LNG imports declined, these were more than offset in the GOG category by rising spot LNG imports in Asia and Asia Pacific. The decline in 2013 reflected the fall in the share of spot LNG imports and a decline in LNG imports into the UK, the USA and Canada. The further small decline in 2014 was principally due to lower spot LNG cargoes in Asia.
and Asia Pacific, with correspondingly higher OPE under long term contracts. The rebound in 2015 was largely due to more spot LNG cargoes in all markets but especially Japan and the new markets, as the fall in spot LNG prices preceded the decline in oil-linked contract prices. In 2016, the decline in GOG was a consequence of LNG trade becoming more contracted, with fewer spot LNG cargoes, which benefitted OPE. In 2017 this was reversed as spot LNG cargoes increased, in part due to the rise in Henry Hub priced US LNG exports.

2018 saw a significant change in LNG imports of all the surveys, driven by the continued rise in Henry Hub priced US LNG exports but also by a general rise in spot LNG cargoes. This change was just as large in 2019, rising to over 40% for the first time, with the volume of OPE LNG imports declining for the second year in a row. In 2020, the growth of GOG slowed but still rose to 44%. The rise in GOG was strongest in Asia and Asia Pacific, rising to 46% (up 10 percentage points) and 29% (up 6 percentage points) respectively. These rises offset a five percentage point decline in Europe, largely due to a switch to more OPE volumes in Spain in 2020.

The volume of LNG going to the traded markets had been in decline since 2010, with the decline in US LNG imports, reaching a low point in 2018 as UK imports also declined. In contrast, spot LNG cargoes have increased, especially in 2017 and 2018 in Asia Pacific, Asia and parts of Europe plus the newer LNG importing markets. However, in 2019, the volume of LNG going to the traded markets of Northwest Europe increased markedly, as the abundant supply of LNG sought a home in the only market able to absorb the surplus, declining only slightly in 2020. As Figure 12 shows, the volume of spot LNG cargoes have risen two and a half times in four years, from 63 bcm in 2016 to almost 160 bcm in 2020.

To further illustrate the growth of spot LNG, figure 13 breaks down the data from figure 12, showing Spot LNG separately and the percentage of Spot LNG in total LNG imports.

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9 The definition of Spot LNG in this survey is not the same as the GIIGNL definition of spot and short-term contracts. In this survey, spot LNG excludes the short-term contracts element i.e. contracts over one year but less than four years, of the GIIGNL reports. In this edition, we have attempted to split the LNG being imported into the trading markets of North America and Northwest Europe, between Spot and Traded volumes, to avoid the categorisation of some spot volumes as traded volumes. In addition, in some Asian countries US cargoes have been categorised partly as spot and partly as “Traded” where the Asian buyers directly contract for the LNG with Henry Hub linked pricing. These changes were also carried back to the results of previous surveys.
Unsurprisingly, spot LNG imports are predominant in the Asia and Asia Pacific regions. China is the biggest spot LNG importer, closely followed by Japan. India spot LNG imports are less than half the China figure. The UK is the fourth largest GOG importer but this is mostly into a traded market. South Korea, Italy, Chinese Taipei and Turkey all have spot LNG imports in excess of 5 bcm. The impact of Covid-19 on the LNG market, while reducing LNG demand does not appear to have slowed the rise in spot LNG imports.

### 3.5 TOTAL IMPORTS

#### 3.5.1 2020 Survey Results

Total imports in 2020 accounted for some 28% of total world consumption – 1,113 bcm.

Total imports are the sum of pipeline and LNG imports and comprise the three categories of GOG (56%), OPE (38%) and BIM (6%).
The table below shows the regional and category breakdown in volume terms.

### TABLE 1: WORLD PRICE FORMATION 2020 – TOTAL IMPORTS

<table>
<thead>
<tr>
<th>Region</th>
<th>OPE</th>
<th>GOG</th>
<th>BIM</th>
<th>TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>0.0</td>
<td>133.4</td>
<td>0.0</td>
<td>133.4</td>
</tr>
<tr>
<td>Europe</td>
<td>104.7</td>
<td>343.7</td>
<td>0.0</td>
<td>450.4</td>
</tr>
<tr>
<td>Asia</td>
<td>138.3</td>
<td>65.2</td>
<td>0.0</td>
<td>193.5</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>152.9</td>
<td>54.9</td>
<td>0.0</td>
<td>207.8</td>
</tr>
<tr>
<td>Latin America</td>
<td>16.4</td>
<td>9.9</td>
<td>0.0</td>
<td>26.3</td>
</tr>
<tr>
<td>FSU</td>
<td>6.8</td>
<td>9.5</td>
<td>32.4</td>
<td>48.7</td>
</tr>
<tr>
<td>Africa</td>
<td>4.1</td>
<td>0.0</td>
<td>3.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Middle East</td>
<td>9.7</td>
<td>4.6</td>
<td>29.7</td>
<td>44.1</td>
</tr>
<tr>
<td>Total</td>
<td>423.0</td>
<td>623.2</td>
<td>66.0</td>
<td>1,112.7</td>
</tr>
</tbody>
</table>

### 3.5.2 2005 to 2020 Comparisons

Total imports have only comprised three categories – OPE, GOG and BIM – in all thirteen surveys from 2005 to 2020\(^{10}\). As well as the figure the table below shows the volume breakdown. OPE declined from 63% in 2005 to 59% in 2007 as GOG rose from just over 21% to 28% and then in 2009, OPE gained share rising to 66% as BIM fell from 14% to 6%, with GOG rising to 29%. Since 2009 OPE has lost share by around 27 percentage points and GOG gained a similar share, in large part due to pipeline imports in Europe, but more recently the rising share of GOG in LNG imports. In volume terms, over the period 2005 to 2020, OPE pricing declined by 17% while GOG grew by 275%.

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\(^{10}\) Apart from the very small RCS on the Nigeria to Ghana pipeline since 2010
3.6 TOTAL CONSUMPTION

3.6.1 2020 Survey Results

Total consumption in 2020 was around 3,940 bcm.
GOG has the largest share at 49%, totalling around 1,945 bcm, dominated by North America at 1,058 bcm, followed by Europe at some 429 bcm and the Former Soviet Union at 192 bcm. In all GOG can now be found in 59 markets, in one form or another, and in all regions.

The OPE share at 19%, totals 732 bcm and is predominantly Asia (299 bcm), Asia Pacific (245 bcm) and Europe (106 bcm). OPE is widespread also being found in 54 markets, including around two-third of countries in Europe (although most at very small percentages), and in all regions except North America.

The regulated categories – RCS, RSP and RBC – account in total for some 28%, around 1,116 bcm:

- RCS totals some 348 bcm and is in 16 countries, mainly the Former Soviet Union (Russia and Azerbaijan) and Asia (China and Bangladesh), followed by Africa (Egypt and Nigeria) and Latin America (Argentina);

- RSP totals some 535 bcm and is in 23 countries, with the Middle East dominating – Iran, Saudi Arabia, UAE and Oman – followed by the Former Soviet Union – Russia and Ukraine – and Latin America – Argentina, Bolivia and Peru with some in Asia Pacific – Indonesia;

- RBC totals some 232 bcm and is in 15 countries, mainly the Former Soviet Union – Kazakhstan, Turkmenistan and Uzbekistan, Africa – Egypt and Algeria – and Latin America – Venezuela.

The BIM share at 3% totals some 130 bcm and is in 22 countries, predominantly Middle East – Qatar, UAE, Israel and Iraq, and the Former Soviet Union – in countries importing from Russia.

The NET share at less than 1% totals some 12 bcm in just 1 country – Trinidad.

The NP share at less than 1% totals some 9 bcm in 7 countries, largely Mexico and Brunei, where it is used in the energy industry in refining processes or enhanced oil recovery.

The table below shows the regional and category breakdown for total world consumption and figure 17 the regional breakdown in percentage terms.

### TABLE 3: WORLD PRICE FORMATION 2020 – TOTAL CONSUMPTION

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPE</td>
</tr>
<tr>
<td>North America</td>
<td>0.0</td>
</tr>
<tr>
<td>Europe</td>
<td>106.2</td>
</tr>
<tr>
<td>Asia</td>
<td>299.0</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>245.4</td>
</tr>
<tr>
<td>Latin America</td>
<td>41.0</td>
</tr>
<tr>
<td>FSU</td>
<td>6.8</td>
</tr>
<tr>
<td>Africa</td>
<td>8.2</td>
</tr>
<tr>
<td>Middle East</td>
<td>24.9</td>
</tr>
<tr>
<td>Total</td>
<td>731.6</td>
</tr>
</tbody>
</table>
3.6.2 2005 to 2020 Comparisons

The figure below shows the changes in the price formation mechanisms over the twelve surveys from 2005 to 2020.
The changes between each survey can be summarised as follows:

- Between 2005 and 2007, GOG increased its share by some 2 percentage points and OPE decreased by 2 percentage points reflecting faster growth in consumption in North America than most other regions, a switch from OPE to GOG in Europe, and to a lesser extent in Asia Pacific and Asia, and a very small move from regulated pricing to GOG in Russia and Latin America. RSP also increased its share by half a percentage point reflecting more rapid growth in consumption in the RSP countries;
• Between 2007 and 2009, GOG increased its share by a further 4 percentage points, at a time when total world consumption showed little change, mainly because of the change in Russia from RBC to GOG but also because of the continuing switch from OPE to GOG in Europe. OPE actually gained 1 percentage point with the loss in share in Europe being more than offset by a switch from BIM, which lost 2 percentage points overall, to OPE in intra-FSU trade. The other major change was the decline of 14 percentage points in RBC and a similar gain in RCS, mainly in Russia, but RCS also gained at the expenses of RSP, which lost almost 2 percentage points, as China’s domestic production changed categories as prices increased as a consequence of regulatory change;

• Between 2009 and 2010, GOG increased its share by another 3 percentage points, with the continuing switch from OPE to GOG in Europe and further move in Russia away from RCS to GOG. OPE declined by just under one percentage point with losses in share in Europe being partly offset by gains in shares in Asia, as China began importing pipeline gas and more LNG under contract, and Asia Pacific on the back of rapid growth in demand in Korea, Taiwan and Thailand;

• Between 2010 and 2012, GOG increased its share by almost one percentage point, rising to 41%, with the continuing increase in share in Europe away from OPE, and more spot LNG imports in Asia and Asia Pacific, being partly offset by a decline in share in Russia. OPE declined by 2.5 percentage points, based on the switch to GOG in Europe (and to BIM in Turkey, as a contract changed) coupled with declining European demand, only partly offset by a rising share in pipeline imports in China. RCS increased its share by 1 percentage point, principally in Russia but also as demand grew sharply in China. RSP increased its share by 5 percentage points, principally due to the change in pricing in Iran and rising demand in Saudi Arabia. RBC declined by a similar amount, reflecting the Iran pricing change.

• Between 2012 and 2013, GOG increased its share by over 2 percentage points, gaining from OPE as pricing mechanisms continued to switch in Europe, and from RCS in Russia as the independent producers recovered market share. OPE declined by another one percentage point reflecting the changes in Europe, partly offset by a small gain in the LNG import segment with spot LNG trade declining, and in China with the new pricing regime in two provinces. RCS declined by 1.5 percentage points, largely reflecting the change in Russia towards GOG and in China to OPE. The BIM category regained almost half a percentage point in share reflecting domestic production growth in Qatar.

• Between 2013 and 2014, the GOG share declined marginally as the continued switch away from OPE in Europe and more rapid consumption growth in North America was offset by a decline in the share of GOG in Russia towards regulated pricing, and fewer spot LNG cargoes. OPE was down just under 1 percentage point reflecting the changes in Europe, partly offset by an increase in China. RCS was down by 1 percentage point largely as a result of the switch to RSP in Russia and the RSP category was up by 2.5 percentage points, reflecting the Russia switch but also a change in Nigeria as well, away from RBC, coupled with more rapid consumption growth in RSP countries. RBC was unchanged, with the decline in Nigeria, being offset by rising consumption on Kazakhstan, Turkmenistan and Uzbekistan.

• Between 2014 and 2015, the GOG share increased by over 2 percentage points reflecting rising gas consumption in North America and Europe, together with the continuing move away from OPE in Europe, the change in pricing in India and more spot LNG, partly offset by a decline in Australia as OPE netback contracts began to be introduced, and the switch in Ukraine to imports of hub-priced gas from Europe. OPE’s share increased by just over half a percentage point, with the decline in Europe and lower share of LNG imports being more than offset by the change in the domestic pricing mechanism in China. The RCS share declined by one percentage point reflecting the changes in China, partly offset by moves to RCS in Egypt and Nigeria. RSP was down by one percentage point, principally reflecting the changes in pricing in India and Nigeria. RBC was lower by almost 1 percentage point, reflecting moves away in Bangladesh and partially in Egypt.
• Between 2015 and 2016, the GOG share rose by marginally, with an increase in the share in Europe and the Former Soviet Union, together with growing consumption in North America, being partly offset by declines in Asia and Asia Pacific, reflecting fewer pure spot LNG cargoes. The OPE share increased by just under 2 percentage points, reflecting a small rise in Europe at the expense of BIM (in Turkey), but principally in Asia and Asia Pacific, as the share in LNG imports increased, but also reflecting a rise in domestic production in China, as the full year effect of the change in city-gate pricing came through, and changed domestic production pricing in Kuwait. The RCS share declined by half a percentage point, principally reflecting the changes in China, partly offset by a rise in Iran in gas as a feedstock to petrochemicals, and faster consumption growth in some countries with RCS pricing. The RSP share was down by just under one percentage point as a result of declines in the Middle East – Iran and Kuwait – and the FSU, principally in Russia with switching to GOG and RCS. The RBC share was down very slightly on slower consumption growth.

• Between 2016 and 2017, the GOG share increased by 1 percentage point as a result of a continuing rise in Europe, at the expense of OPE, the rise in Asia as China introduced market pricing for direct sales from upstream producers to large users, the general recovery in spot LNG cargoes. The OPE share was almost unchanged, with the losses to GOG being partly offset by an increase in Asia Pacific, mainly in Malaysia and Indonesia. The BIM share was down almost half a percentage point reflecting the switch in Indonesia to OPE. The RCS share increased by over half a percentage point, largely as a result of the change in Malaysia away from RSP, which was down almost one percentage point. RBC was broadly unchanged.

• Between 2017 and 2018, the GOG share rose by one percentage point largely reflecting the increasing share of spot LNG cargoes in LNG imports and rapidly growing US consumption, more than offsetting the declining share in pipeline imports, as a result of reduced European pipeline imports and increased China pipeline imports. OPE share declined by half a percentage point, with the loss in LNG imports being partly offset by gains in pipeline imports and domestic production in China. RCS was largely unchanged but RSP declined by a quarter of a percentage point, reflecting slower consumption growth in countries with RSP and a switch away in Argentina to RCS. In turn RCS lost share in China to OPE.

• Between 2018 and 2019, the GOG share rose by one percentage point, at the expense of OPE, largely as a result of rising GOG in LNG imports – both traded markets and spot LNG cargoes – and a more rapid decline in OPE pipeline imports in Europe. RCS was down by half a percentage point, while RSP declined by a quarter of a percentage point, a decline in Russia and Ukraine. RBC rose marginally as Turkmenistan eliminated free gas but still maintained subsidies.

• Between 2019 and 2020, the GOG share rose by another one percentage point, largely driven by rising spot LNG imports, at the expense of OPE, together with rising shares in domestic production in Russia and Israel. OPE gained slightly in domestic production in China and Malaysia. RCS declined by one percentage point reflecting the changes in Malaysia. RSP gained slightly in Indonesia.

Overall, over the 2005 to 2020 period, OPE has declined by 6 percentage points, GOG has risen by 18 percentage points, BIM has declined by 2.5 percentage points, RCS has risen by 8 percentage points, RSP risen by 2.5 percentage points and RBC declined by 19 percentage points. In terms of absolute volumes, OPE increased slightly by some 32 bcm, while GOG more than doubled. BIM and NET were also down slightly. The regulated categories in total saw their volume increase by some 50 bcm.

While there have been a number of significant changes over the period of the surveys between the 8 categories, as described above, the changes have been almost wholly within larger groupings of categories, until very recently. The categories of OPE, GOG, BIM and NET can be broadly described as “market” pricing, while the categories of RCS, RSP, RBC and NP can be broadly described as “regulated” pricing. The figure below compares the changes in the “market” and “regulated” categories over the thirteen surveys.
The total of “market” pricing rose from 62% in 2005 to 71.5% in 2020, mirrored by a decline in “regulated” pricing, from 38% in 2005 to 28.5% in 2019. Changes in percentages between surveys can arise because of actual changes in price formation mechanism or because of more rapid growth in consumption in countries with a specific type of price formation mechanism. The switch to “market” pricing is down to the following:

- The move away from regulated pricing in the Russian market to GOG as the independent producers began to compete with each other and Gazprom to sell gas to the power sector and large industrials – this was partly reversed in 2014 with more “regulated” pricing;
- A similar move in Argentina, to GOG, as the eligible market opened up, and more recently in Nigeria;
- The changes, since 2013, in China where there was initially a move to OPE in 2 provinces away from RCS which in 2014 became nationwide for incremental production over 2012 levels and then in 2015 for all sectors except residential and fertilizers – some of this OPE in 2017 switched to GOG – and halfway through 2018 the move to OPE for residential city-gate pricing. In 2020, Malaysia moved away from RCS to OPE in its domestic pricing;
- The pricing reforms in India, which began in late 2014, moving pricing away from RSP to GOG; and
- The rise in new LNG importers, importing at OPE and/or GOG, to enhance or replace domestic production which was regulated.

3.7 ANALYSIS OF GAS-ON-GAS COMPETITION AND OIL PRICE ESCALATION

3.7.1 Gas-on-Gas Competition

The rise in GOG from 31% of total world consumption in 2005 to 49% in 2020 and in which regions, has been discussed in some detail above. It has been noted earlier that GOG is not one homogeneous category and can be considered to comprise the following types of pricing mechanisms:

- Trading – what is generally thought of as GOG where the price is determined by the interplay of supply and demand and is traded over a variety of different periods (daily, monthly, annually or other periods). Trading takes
place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). This will also include longer term contracts into markets where there is little or no trading at hubs, but where the price is linked to hub prices in markets where there is liquid trading.

- Bilateral – there is no trading market or hub but there are multiple buyers and sellers – distinguishing this from BIM – providing the competitive element. This is largely in parts of Australia, Russia, Argentina and now China. In many of these markets, the GOG pricing will be influenced by significant regulated segments.

- Spot LNG – simply spot LNG cargoes into markets where there are no trading hubs, but the price of the cargoes reflects the current supply-demand situation.

The figure below breaks down the GOG percentages over the thirteen surveys into these 3 categories.

**FIGURE 21: CHANGES IN GOG BY TYPE 2005 TO 2020**

The Trading category is by far the largest – dominated by North America and increasingly Europe – and has increased from 30% of total world consumption in 2005 to 38% in 2020 – a rise of 8 percentage points. The Bilateral category has risen from 1.1% to 7.2% - a rise of 6.1 percentage points, while the Spot LNG category has risen from 0.2% to 4% - a rise of 3.8 percentage points. The total rise in GOG between 2005 and 2020 has been 18 percentage points. The rise in 2020 of 1 percentage point reflected rising spot LNG.

Over the period as a whole, around one third of the rise in GOG has come from the Bilateral category and is largely in Russia together with much smaller changes, in volume terms, in Argentina and, latterly, Nigeria and China. The rise in the Trading category is almost entirely due to changes in the European market, both in terms of increased trading volumes and contract renegotiations. This was supplemented at the end of 2014 indexation to hub prices in India, away from RSP for domestic production, and in 2019 by rising LNG imports into Europe. The changes in the Spot LNG category have been variable over time reaching a peak of 2.2% in 2012 before falling back in 2013 and 2014 as the number of spot LNG cargoes declined. The share then rebounded in 2015, as spot LNG cargoes recovered, declined again in 2016 as LNG trade became more contracted, followed by sharp rebounds in the four years to 2020.

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11 In order to emphasise changes the vertical axis starts at 25%
3.7.2 Change in GOG and OPE by Consumption Category

In terms of the three different categories of consumption – domestic production, pipeline imports and LNG imports, the figure below shows the changes in GOG over the thirteen surveys.

Apart from the rise in domestic production share between 2007 and 2010, as a result of the changes in Russia and, to a lesser extent, in Europe, the share of GOG has been relatively stable. Similarly, the share in LNG imports has also not changed much since 2007, fluctuating largely in response to changes in spot LNG cargoes, until the increases in the last four years. The big rise has been in pipeline imports, almost all in Europe, although that has levelled off since 2017, with the rise in LNG imports driving the overall rise in GOG.
The similar chart for changes in OPE, is the mirror image of the GOG chart for LNG imports, and for pipeline imports. For domestic production, the share declined continuously from 2005 to 2013, principally down to the changes in Europe, before recovering by some 3.5 percentage points through to 2016, principally reflecting the pricing changes in China and, to a lesser extent in Australia and Vietnam.

3.7.3 Where are the main OPE areas?

As noted earlier, the share of OPE had fallen to 18.5% of total world consumption in 2020, from 24.3% in 2005. In volume terms, however, there was an increase to 732 bcm from 700 bcm in 2005. Total world consumption grew by 37% over the same period – 1,075 bcm.

Out of the 732 bcm in 2020, some 309 bcm was domestic production, 165 bcm was pipeline imports and 258 bcm LNG imports. Domestic production has grown in volume terms since 2005, but the share in 2020 was only slightly above the share in 2005 – see figure 23 above. Pipeline imports had fallen sharply in volume terms, as a result of the shift away from OPE in Europe, while LNG imports grew in volume terms, with the share declining as already discussed.

42% of OPE in 2020 was in domestic production, and, as shown in the figure below, of this 43% is in China. It is mainly in the Asia and Asia Pacific regions. The categorisation, in some countries, as OPE is not necessarily as clear as the familiar oil indexation in both pipeline imports and LNG imports, and there is often an overlay of regulation involved. China is a good example of this, where city-gate prices from domestic production have been very broadly linked to liquid fuels prices for a number of years, but the decision to change these prices has been overseen by the state. If China continues with pricing reforms then this element of domestic production could change to a different category – possibly GOG – but again this would be a very different GOG from that seen in the North American and European trading markets12.

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12 As for Russia where the large GOG category is very different from European GOG.
Pipeline imports are the more traditional type of oil indexation, seen initially in Europe but now mostly replaced there by GOG. China is the largest OPE pipe importer, with imports from Central Asia, Myanmar and, since the end of 2019, from Russia. In Asia Pacific, Thailand and Singapore imports are also OPE, while in Europe, Turkey and Spain are the largest OPE importers, with smaller volumes in Germany and Italy, while Other Europe is largely Southeast Europe, including Greece, and the Baltic countries.

While the share of OPE in LNG imports has fallen significantly since 2016, as GOG has risen, it still represents the majority of LNG imports. Out of the 258 bcm in 2019, some 204 bcm (or almost 80%) was in just 6 markets – Japan, China, South Korea, Chinese Taipei, India and Spain. The rest of the Asia and Asia Pacific regions added an additional 15 bcm (or some 6%) – half from Pakistan. France and Turkey in Europe accounted for some 15 bcm. Kuwait, Chile, Italy, Portugal, Poland and Greece also have OPE LNG imports.
Section 4: Wholesale Price Levels

4.1 INTRODUCTION

This section covers the full results and analysis on wholesale price levels at the overall World level and comprises:

- The results for the 2020 survey; and
- Comparisons across the thirteen surveys.

In considering wholesale price levels across regions, countries or price formation mechanisms, it should be noted that the wholesale price can cover different points in the gas chain – wellhead price, border price, hub price, city-gate price – so the comparison of price levels is not always “like for like”. Comparisons, therefore, should be treated with utmost caution and taken only as a broad indication.

4.2 2020 SURVEY RESULTS

4.2.1 Price Levels by Price Formation Mechanism

The figure below shows a snapshot of wholesale prices for 2020 by price formation mechanism13.

![FIGURE 27: WHOLESALE PRICES IN 2020 BY PRICE FORMATION MECHANISM](image)

13 It should be noted that on an individual country basis no break down has been made of the price level for different price formation mechanisms within the country, so the same price level is applied to all mechanisms. This simplifying assumption is not considered to have any material influence on the conclusions.
The highest prices, by some margin, are in the OPE category, which, at $6.12 per MMBTU, is more than double the GOG category which is $2.80. While the price level in the GOG category is heavily influenced by the relatively low prices in North America and Russia, the continued fall in spot prices, as a result of Covid-19 has also widened the gap. If North America and Russia were excluded then the balance of GOG prices would be, on average, $4.46, which is still 30% lower, but much closer to the OPE levels.

In the regulated categories, it can be seen that the prices in the RCS category are higher than those in RSP and, in turn, RBC – which were the lowest at $1.46 per MMBTU in 2020.

### 4.2.2 Price Levels by Region and Country

The figure below shows a snapshot of wholesale prices for 2020 by IGU region.

![Fig 28: Wholesale Prices in 2020 by Region ($/MMBTU)](image)

Wholesale prices can obviously vary significantly from year to year. Asia Pacific had prices averaging $6.71 and Asia had average prices at $6.34. OPE is the primary pricing mechanism in both regions. Prices in Europe were significantly lower than those in Asia and Asia Pacific as spot prices dropped again in 2020. Prices in North America in 2020 were below the average for Latin America and even Africa. Prices in the Former Soviet Union, in $ terms, continued to be lower than in the Middle East.

These conclusions are further reinforced when wholesale prices are viewed at the country level. The figure below includes all markets with consumption greater than 8 bcm in 2020.
The highest wholesale prices in 2020 were again found in the main LNG importing markets in Asia Pacific – Chinese Taipei, South Korea and Japan – plus Singapore and China. A mixture of markets from different regions were next, including some from Asia Pacific plus Brazil. Most European countries dropped down the list in 2020, apart from those where OPE remains predominant, such as Turkey. Prices were much lower in the USA, where prices had even dropped below some Middle East and African countries. Prices in Russia have continued to be well below other countries, which, a few years previously, they had been above, as a consequence of the large rouble depreciations. At the bottom of the chart are generally countries where wholesale prices were subject to some form of regulation and often below the cost of production and transportation – Turkmenistan, Algeria and Venezuela – although in the case of Turkmenistan, prices increased significantly in 2020 as some subsidies were withdrawn.
4.3 COMPARISONS 2005 TO 2020

4.3.1 Changes in Wholesale Prices by Price Formation Mechanisms

The figure below compares changes in wholesale price levels across the eleven surveys by price formation mechanisms.

FIGURE 30: WHOLESALE PRICE LEVELS 2005 TO 2020 BY PRICE FORMATION MECHANISM

In 2005 the highest prices by price formation mechanism were for GOG at $8.10 per MMBTU, but these declined between 2005 and 2009, before levelling off at around $4.50, followed by small rise to the $5.30 range in 2013 and 2014. This was followed by sharp declines in 2015 and 2016 reaching $3.04. There was a rise in 2017 to $3.78, with prices rising in all markets, and in 2018 to $4.36, largely driven by rising European hub prices. GOG prices fell sharply in 2019 as spot prices collapsed to their lowest levels since 2016, followed by another – Covid-induced fall in 2020 to $2.80 – the lowest level ever recorded. In contrast OPE prices rose significantly from $5.47 per MMBTU in 2005 to just under $11.00 in 2013, as oil prices increased, remaining around that level through 2014, before declining to around $8.00 in 2015 and $6.00 in 2016, following the oil price fall. OPE prices also rose back in 2017 to $6.58, as oil prices recovered, and to $7.59 in 2018, before declining slightly in 2019 to $7.40, and further to $6.12 in 2020. There were also general increases in prices over time in the regulated price categories as well, through to 2014, although in 2015 and 2016 this trend was reversed, principally due to sharp dollar declines in the FSU as currencies depreciated. These again were reversed in 2017 as some predominantly regulated countries increased prices. Regulated prices levelled off in 2018 and 2019, with weak FSU prices being offset by stronger prices elsewhere, but declined slightly again in 2020.
4.3.2 Changes in Wholesale Prices by Region

The figure below compares changes in wholesale price levels across the thirteen surveys by region.

At the world level, on average, wholesale prices have risen between 2005 and 2013 from around $4.47 per MMBTU to $5.57. This rise was across all regions apart from North America, where the dramatic increase in shale gas supply has led to sharp falls in prices – with a small rebound in 2013. The rise in prices in Europe and Asia Pacific has been well documented and studied, but prices have also risen in Asia, largely due to increases in prices in China, both as more gas was imported and regulated domestic prices increased, and in India for similar reasons.

In 2014, though, prices in Europe began to decline as the market weakened and, in the FSU especially, as the rouble depreciated. This accelerated in 2015, and prices also fell back in North America and Asia Pacific on the back of weak demand, abundant supply and the impact of the sharp fall in oil prices. However, some regions did not see the sharp 2014 and 2015 fall in prices. These were Asia, as pricing reforms and inertia increased and kept prices up in China and India, the Middle East – as regulated prices were increased in Bahrain, Oman and Iran, with other prices staying stable – and Africa – where prices increased in Egypt, Nigeria and Algeria.

In 2016, prices declined further in all regions apart from Africa and the Middle East, with average world wholesale price falling to $3.35 per MMBTU, the lowest level in all surveys, up until then.

In 2017, prices generally rose again in all regions as the global supply – demand situation tightened and oil prices rose. Price also increased, however, in the more regulated regions of the Former Soviet Union, Africa and the Middle East.

In 2018, prices increased in all regions, except for the Former Soviet Union, where Russian prices fell in $ terms. The average world wholesale price in 2018 was $4.38 per MMBTU – the highest average price since 2014.
These rises were reversed in 2019, the average price falling to $3.88 per MMBTU, as global supply raced ahead. Prices across the world declined again in 2020, with the average price reaching its lowest ever level at $3.24. Since 2015, prices in Asia, Asia Pacific and Europe broadly tracked each other, but this link was broken in 2019 as spot prices collapsed which impacted the European market much more than Asia and Asia Pacific where prices barely changed from 2018 levels. These differences widened further in 2020 as spot prices collapsed again. European prices are now much closer to the World average than they have ever been, breaking decisively from Asia and Asia Pacific prices.
Section 5: Global Gas Price Convergence

5.1 INTRODUCTION

In the period since the surveys began in 2005, it is generally recognised that the global natural gas markets have become more integrated through increased LNG trade, increased market related pricing and gas hub development. It might be expected, therefore, that global gas prices would converge, as markets became more integrated. However, the conventional wisdom is that of global gas price divergence, based on a few regional gas price markers such as Henry Hub, NBP and Japanese import prices, especially until 2015. A casual look at figure 31 on wholesale price levels by region would appear to confirm the conventional wisdom, as the differentials between Asia, Asia Pacific and Europe prices, on the one hand, widened compared to most other regions through 2015.

This section contains an analysis of whether gas prices have been converging on a global basis over the years of the survey, using the wholesale price data from the thirteen surveys.

5.2 MEASURING PRICE CONVERGENCE

The wholesale price surveys have resulted in a unique database with data on gas price formation mechanisms, gas volumes, and annual average gas prices of well over 100 markets. The database enables analysis of different subsets of countries, categorized by properties such as price formation mechanism, region, and shares of imports. This has been used to shed more light on the apparent contradiction between the expectation of price convergence based on economic theory and market developments and the conventional market view of gas price divergence. The large number of countries available in the database, as well as the use of the coefficient of variation as a measure for price convergence can provide new insights.

The coefficient of variation of prices of a dataset in a certain year is determined by the standard deviation divided by the mean value of these prices. The amount of absolute price variation (standard deviation) is thus measured relative to the average price in a certain year. A low coefficient of variation indicates a higher level of price convergence and vice-versa. This measure is particularly suitable for datasets with a limited number of data points (in our database 13 years), for a large number of price lines (in our database more than 100 markets), and the ability to subdivide into subsets of countries with different mean gas prices.

5.3 PRICE CONVERGENCE USING THE SURVEY DATA

For the convergence analysis of the “full IGU dataset” in this report as compared to last year’s analysis, we have removed data from the survey of countries with no price, and with no or very limited volumes (< 1 bcm per year). This results in a rather stable set of meaningful gas prices with limited changes in number of countries over the years (87 markets in 2020).
As a background to the methodology used, the graphs of the average price and the standard deviation are included below. The pattern of change over the years of the average price and standard deviation are similar. The level of standard deviation is firstly related to price level. When a correction is made for the price level (standard deviation divided by average price), the resulting coefficient of variation shows the relative variance of prices. This can be used as an indication of the level price convergence.

Comparing the first (2005) and last (2020) years the average prices (unweighted – unlike the regional and global prices in the previous section) were at similar levels – with 2005 actually being slightly lower – but the standard deviation had declined, suggesting more price convergence.

In the period 2005 to 2020 the coefficient of variation of gas prices of this full dataset declined by 16 percentage points, with the sharpest drop between 2012 and 2017, indicating global gas price convergence. There was a small rise in 2018, suggesting a slight divergence, marginally reversed in 2019 and 2020. This trend of a decreasing coefficient of variation is consistent with our expectations based on the economic theory of the Law of One Price and can be seen as an indicator that the global gas markets were converging.

In order to be able to trade to exploit arbitrage opportunities (leading to gas price convergence), countries should be connected to the global gas market. Connectedness to the global gas market could be realized through physical gas imports or through market related pricing. We therefore looked at a subset of countries with a minimum level of gas imports (10%) and a subset of countries with market related prices. The result is as expected, with the coefficient of variation being much lower in countries connected to the global gas market through physical imports and/or market
related prices. Importing countries and market related pricing countries had very similar levels of convergence, with a large overlap in terms of data. As would be expected, the group of countries with both gas imports and market related prices has the lowest coefficient of variation. Because the level of imports of countries, this changes year-by-year, and some countries, in some years above the 10% import threshold and some years below, the population of countries in this particular subset can differ year on year. For example, in 2019 Romania was included in the group of importing countries, with an import level above 10%, whereas in 2020 it was excluded, because only 5% of the gas consumed in the country was imported.

We have defined countries with market related prices as countries where the majority of gas is priced through market related price formation mechanisms – OPE, GOG, BIM and NET – with OPE and GOG having by far the larger share. Non-market related prices mainly include the regulated price formation categories: RCS, RSP and RBC.
When we look within the group of countries with market related pricing, we see that a subset of countries with OPE as the main price formation mechanism shows more price convergence i.e. a lower coefficient of variation. This is not surprising, since these prices are largely all indexed to crude oil, gasoil and/or fuel oil prices. The relative stability of coefficient of variation of the subset of countries with OPE is interesting to note.

As can be seen in above figure the number of markets with a majority of gas consumed priced against GOG has increased considerably. In the first years, the number was too small and dynamic to calculate a meaningful coefficient of variation, but from 2013 the population became large enough to result in a more stable coefficient of variation,
at a level lower than the total group of countries with market related gas prices and approaching the level of price convergence of the group of countries with OPE.

When we look at the different IGU regions, Europe is the only region with sufficient countries to make meaningful convergence calculations. Here we can conclude that there is more price convergence amongst gas importing...
countries with market related prices within Europe than on a global level, since the decline in the coefficient of variation had been greater than in all importing countries with market-based gas prices. This, again, is not surprising since intraregional trade of natural gas is usually easier and less costly than interregional trade. However, in 2019 and 2020 there was less convergence with the gap between OPE and GOG prices widening globally and even within Europe.

In recent years, the shale gas revolution has made the North America region (Canada, Mexico and United States)
virtually self-sufficient with little or no LNG imports, from outside the region. As a result, the region has become effectively disconnected from the global gas market. Looking at a subset of countries, without these three countries, shows that the trend of global gas price convergence is more distinct with no, effectively disconnected, North American countries. In 2018, the influence of the start-up of large LNG exports from the USA cannot yet be seen, with USA and Canadian prices still at much lower levels than market related prices elsewhere. In 2019 and 2020, there was a small sign that the gap between price convergence including and excluding North America was beginning to narrow a little, which might be expected if North America becomes more interconnected with the global market. However, the gap still remains; possibly due to the relatively high LNG export costs (liquefaction and shipping) combined with the low gas prices in North America.

5.4 CONCLUSIONS

This analysis shows that global gas prices have been converging continuously since 2005, indicating further globalisation of the gas markets, at least up until 2018, before resuming the trend in convergence. The trend of price convergence is against the conventional market wisdom of gas price divergence in the years up to 2015, but in line with developments such as the growth of LNG trade and increased market-related gas pricing.

It is also concluded that there is more gas price convergence amongst countries (1) with market related pricing, (2) which are connected with the global gas market through gas imports, (3) with oil-indexed gas prices, and since 2014 with gas-indexed prices, and (4) within Europe. The trend of global gas price convergence in the period 2005 – 2020 is more distinct when we exclude the data of the North American countries, which were effectively disconnected from other markets until the last few years. In 2019 and 2020, prices within Europe diverged as compared to 2018.

Since 2015, however, there does appear to have been some relative stability in the coefficient of variation, other than for 2018, possibly suggesting that the trend of more price convergence has stalled or come to an end. Differences in transportation and marketing costs and also energy policy will always result in price differences. We will maybe see in next year’s report for 2021 prices (probably with increasing average prices again) if the relative stability will be reconfirmed.
Section 6: Key Changes 2005 to 2020

6.1 INTRODUCTION

The last fifteen years have seen significant changes in the pricing of natural gas, at a time when gas demand has also been growing strongly. This section is a brief look back at the overall changes in the global gas market, considering the relative changes in the regional composition of gas demand, the impact these had on the analysis in the survey on price formation mechanisms and looking at the key periods of change over the last fifteen years.

6.2 IMPACT OF CHANGES IN DEMAND

In 2005 global gas demand was some 2,870 bcm and by 2020, had risen to almost 3,950 bcm\(^\text{15}\). This was a growth of some 37 percent - a compound annual rate of just over 2 percent. The growth in gas demand varied greatly across different countries and regions.

In volume terms, the Asia region (including China), the Middle East and North America dominated the growth, with Asia, Middle East and Africa showing the strongest growth in percentage terms. In North America, growth has been concentrated in the last 10 years, on the back of the shale gas revolution. There was little growth in Latin America, not growth in the FSU and a decline in Europe – which would also have been the case comparing 2019 to 2005 i.e. pre the impact of COVID-19.

In much of the discussion in this report, there has been a focus on the changes in the shares of the different price formation mechanisms over time. Notably the fact that the share of GOG rose from 31% in 2005 to 49% in 2020 while the share of OPE went from 24% to 18.5% over the same period. The changes in share at the aggregate level, however, are not only a consequence of changes in price formation mechanisms within particular countries, but also relative changes in demand over time between countries and regions. Asia (China in particular) has grown more

\(^\text{15}\) 2020 was actually down on 2019 because of the impact of COVID-19. 2019 global gas demand was around 4,000 bcm.
rapidly than any other region, so if nothing else in the world had changed, the main price formation mechanism in this region would lead to a gain in the share of the global market, even if there had never been any changes in price formation mechanisms in any country.

**TABLE 5: PRICE FORMATION MECHANISM SHARES 2005 AND 2020**

<table>
<thead>
<tr>
<th>Price Formation Mechanism Shares</th>
<th>OPE</th>
<th>GOG</th>
<th>BIM</th>
<th>NET</th>
<th>RCS</th>
<th>RSP</th>
<th>RBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>24.4%</td>
<td>31.3%</td>
<td>5.8%</td>
<td>0.6%</td>
<td>0.8%</td>
<td>11.3%</td>
<td>25.0%</td>
</tr>
<tr>
<td>2020</td>
<td>18.6%</td>
<td>49.3%</td>
<td>3.3%</td>
<td>0.3%</td>
<td>8.8%</td>
<td>13.6%</td>
<td>5.9%</td>
</tr>
<tr>
<td>2020 with 2005 Demand</td>
<td>14.5%</td>
<td>55.4%</td>
<td>2.5%</td>
<td>0.4%</td>
<td>9.1%</td>
<td>12.1%</td>
<td>5.9%</td>
</tr>
</tbody>
</table>

This regional compositional change in demand can be adjusted by applying the percentage price formation mechanisms for each country for the 2020 survey and applying them to the demand levels by each country in 2005. This removes the regional compositional changes in demand over time.

After these adjustments, the GOG share in 2020 would have been 55% rather than 49% and the OPE share would have been 14.5% rather than 18.5%. This reflects the rapid growth in demand in China in particular but other countries as well, where OPE is a key price formation mechanism in 2020, relative to GOG, and the decline in demand in Europe over the period, where GOG is now the main price formation mechanism.

As shown in the figure below, the adjusted increase in the GOG share between 2005 and 2020 would have been 24% instead of the actual change of 18% and the adjusted decline in the OPE share would have been 10% rather than the actual decline of 6%. The differences in the shares of the other price formation mechanisms were not as great.

**FIGURE 42 CHANGES IN PRICE FORMATION MECHANISM SHARES 2005 TO 2020**

<table>
<thead>
<tr>
<th>Actual Change</th>
<th>Adjusted Change</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIM</td>
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<td></td>
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<tr>
<td>NET</td>
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<tr>
<td>RCS</td>
<td></td>
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<tr>
<td>RSP</td>
<td></td>
<td></td>
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<tr>
<td>RBC</td>
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</tbody>
</table>
6.3 MAPPING THE CHANGES

At the individual country level, the changes over time can be mapped by considering the largest price formation mechanism in each country in different years. The figures below show this for 2005, 2010, 2015 and 2020. The mechanisms shown are for OPE, GOG, Regulated (combining RCS, RSP and RBC) and Other (BIM and NET), where each of these is the largest in each country in the year in question, even if it is only largest by a small amount – essentially “first past the post”.

In 2005 the GOG dominant countries were confined to North America, the UK and Australia and New Zealand; the markets which had led the way in liberalisation. Europe (apart from the UK) was dominated by OPE, which was also dominant in the LNG importing countries of Japan, Korea and Taiwan, a few other Asian countries and Brazil and Chile in Latin America, which were also importing gas. However, large swathes of the world in Asia, the FSU, Middle East, Africa and Latin America were dominated by regulated pricing.

### FIGURE 43 LARGEST PRICE FORMATION MECHANISMS BY COUNTRY 2005

![Map showing largest price formation mechanisms by country in 2005](map.png)
By 2010, there had seemingly been only a few changes. Netherlands and Denmark had moved more towards GOG, Ukraine imports from Russia had become OPE, Colombia as well, and India had turned towards OPE pricing in domestic production as well as LNG imports.

In the five years to 2015, there were more significant changes, however, with many European countries moving towards majority GOG, as contracts were renegotiated and liberalisation proceeded. India also moved to GOG as their domestic pricing changed again to largely link to hub prices in trading markets. The largest price formation mechanism in China was now OPE as much of the domestic pricing at the city gate was linked to competing oil products. Vietnam domestic pricing also moved more to OPE, as did Kuwait’s.

By 2020, there were some further changes with Norway, Hungary, Romania and Switzerland moving more to GOG as well as Nigeria, Colombia and Israel. Malaysia in the meantime had moved almost all its domestic pricing to OPE as a netback from its LNG exports. In 2020, there still remained large swathes of regulated pricing across the FSU, Middle East, Africa and Latin America, although it was declining in Asia. In Europe it is now noticeable that the remaining OPE dominated countries are those non-liberalised markets which are heavily or almost totally reliant on imports from Russia – Southeast Europe and the Baltic states, plus Spain and Portugal with legacy pipeline and LNG contracts linked to oil prices.
Appendix A: Regional Level Results

A.1 NORTH AMERICA

A.1.1 North America 2020 Survey Results

North America consumption in 2020 was some 27% of total world consumption – around 1,060 bcm.

GOG clearly dominates the North American market with fully liquid trading markets in the USA and Canada. The wholesale price in Mexico used to be referenced to prices in the USA, but there are now reference prices based on trades in Mexico. The small amount of NP is in Mexico where Pemex uses the gas in the refinery process and for enhanced oil recovery.

A.1.2 North America Comparison 2005 to 2020

Price formation mechanisms have not changed at all, in effect, in North America over the nine surveys. Apart from the small amount – under 1% - of NP which, as noted earlier, is gas used by Pemex in refinery processes and enhanced oil recovery, North America was all GOG in 2005 and has remained so ever since. In fact, if the surveys had gone back even further, it is likely that the USA at least would have been GOG since the early 1990s.
A.2  EUROPE

A.2.1  Europe 2020 Survey Results

European consumption in 2020 was some 13.6% of total world consumption – around 537 bcm.

GOG remains the largest share in Europe, standing at 80%, totalling around 430 bcm. Some 83 bcm is domestic production, mainly Netherlands and UK, with around 282 bcm being pipeline imports, predominantly all the northwest European countries plus Italy in the Mediterranean area, but also increasingly the central European countries of Poland, Czech Republic, Slovakia, Austria and Hungary. LNG imports now accounts for 63 bcm, of which just under half is deemed as being in the traded category in the trading markets of the UK, France, Italy, Belgium and Netherlands, with the remaining quantities being spot cargoes into those market and the more traditional LNG importing countries.

OPE is now down to 20%, totalling around 106 bcm, and is predominantly pipeline imports (68 bcm) now into only 60% of the European countries, followed by LNG imports (37 bcm) into Spain, France, Italy, Turkey, Portugal, Poland and Greece, with domestic production (1 bcm) in a handful of countries.

RSP also accounts for some 1.5 bcm and is also domestic production in Hungary and Croatia.

A.2.2  Europe Comparison 2005 to 2020

Europe is one of the regions where the most significant changes in price formation mechanisms have taken place. There has been a broadly continuous move from OPE to GOG since 2005, with GOG’s share increasing from 15% in 2005 – when OPE was 78% – to 80% in 2020 – when OPE had declined to 20%. The RCS category – domestic production in Romania – has steadily declined to zero, while RSP declined in 2017 as it disappeared in the Polish market.
The changes have reflected a number of factors over the years; initially a decline in the volume of gas imported under the traditional oil indexed contracts, being replaced by imports of spot gas and increasing volumes traded at hubs, followed by the ending of contracts or the renegotiation of the terms to include a proportion of hub/spot price indexation in the pricing terms, or even a move to 100% hub price indexation, and in some cases, a reduction in the take-or-pay levels. The renegotiations saw the introduction of hybrid contracts\textsuperscript{16}, although it is thought in the last few years even some of these hybrid contracts are now purely hub/spot indexation.

The trend towards GOG and away from OPE, was reinforced by the continued decline in domestic production in the UK in the old legacy contracts, which were in the OPE category, to be replaced by pipeline and LNG imports, all at GOG. In 2019, there was a further rise in GOG as LNG imports surged with rising spot LNG cargoes in many traditional LNG importing markets. In 2020 there was a small fall back in GOG LNG imports as Spain switched more to OPE LNG.

![FIGURE 50: EUROPE PRICE FORMATION 2005 TO 2020](image)

The change in price formation mechanisms in Europe was not universal across the region. The figures below summarise the changes in the key sub-regions.

Northwest Europe\textsuperscript{17} has seen the most dramatic change in price formation mechanisms, with a complete reversal in the ratio of OPE to GOG from 72% OPE and 28% GOG in 2005 to 4% OPE and 96% GOG in 2020, as a result of increased hub trading and contract renegotiations, as noted above.

\textsuperscript{16} Under the pricing formulas, oil indexation is partly maintained but within a price corridor set by hub prices. Such contracts are sometimes called quasi-oil indexed but could equally be referred to as quasi-hub indexed. It is suggested to the respondents to the wholesale price survey that such hybrid contracts are split between GOG and OPE, with the proportion dependent on how narrow the price corridor is. For example, if the price corridor is very narrow, the contract is effectively only notionally linked to oil prices and therefore would be allocated more towards GOG. In contrast if the band is relatively wide then more would be allocated to OPE.

\textsuperscript{17} Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, UK
Central Europe\textsuperscript{18} has also, more recently, seen significant changes. OPE has declined from 85% in 2005 to 14% in 2020, while GOG has increased from almost zero in 2005 to 84% in 2020, principally reflecting increased imports of spot gas, often from Germany, and contract renegotiations. However, in 2017 the GOG increase – 59% to 73% – was mostly down to the switch from RSP in Poland as a result of regulatory reform.

There has been much less change in other areas of Europe such as the Mediterranean\textsuperscript{19}, where OPE has only declined from 100% in 2005 to a low of 47% in 2020, and GOG rising from nothing to 53%. This initially reflected spot LNG imports in the sub-region and some spot pipeline imports into Italy, as well as changes in the pricing of

\textsuperscript{18} Austria, Czech Republic, Hungary, Poland, Slovakia, Switzerland

\textsuperscript{19} Greece, Italy, Portugal, Spain, Turkey
domestic production in Italy. However, in 2014 this was further enhanced by the renegotiation of the main Russian contract into Italy, and in 2017, the change in the Algerian contract into Italy. In 2019 spot LNG imports increased but fell back in 2020 as Spain increased the share of OPE LNG imports.

In Southeast Europe GOG began in 2013 as Romania began liberalising domestic production pricing, moving away from RCS – a process which was completed in 2018. There is also a small amount of GOG in Croatia and Slovenia. The rise in OPE in 2012 reflected a switch from BIM in Bulgaria, where until 2010 there was payment in kind for transit (BIM) which then became a cash payment with the gas being purchased under the same OPE terms as the other imported gas. OPE fell back again in 2013 and 2014 as imports declined in Romania, before stabilising in 2015. 2017 and 2018 saw more declines for OPE, as Romanian imports fell. The OPE share rose again slightly in 2019 as consumption fell in the now predominantly GOG market of Romania, but has fallen back again in 2020, as imports into Romania from Russia declined.

FIGURE 53: MEDITERRANEAN PRICE FORMATION 2005 TO 2020

In Southeast Europe GOG began in 2013 as Romania began liberalising domestic production pricing, moving away from RCS – a process which was completed in 2018. There is also a small amount of GOG in Croatia and Slovenia. The rise in OPE in 2012 reflected a switch from BIM in Bulgaria, where until 2010 there was payment in kind for transit (BIM) which then became a cash payment with the gas being purchased under the same OPE terms as the other imported gas. OPE fell back again in 2013 and 2014 as imports declined in Romania, before stabilising in 2015. 2017 and 2018 saw more declines for OPE, as Romanian imports fell. The OPE share rose again slightly in 2019 as consumption fell in the now predominantly GOG market of Romania, but has fallen back again in 2020, as imports into Romania from Russia declined.

20 Bosnia, Bulgaria, Croatia, FYROM, Romania, Serbia, Slovenia
In Scandinavia and Baltics\textsuperscript{21}, GOG has gained ground in recent years in Sweden, Norway and more recently in LNG imports into Lithuania and had risen to 60% in 2016, almost all at the expense of OPE, which is now down to 40%. The early switch in 2009 from BIM to OPE was in the contiguous Baltic States. The large gain in GOG in 2016 reflected, in part, the switch from NET and to GOG in Norway, but largely the LNG imports into Lithuania linked to NBP prices. In 2017 GOG increased further to 60% with the move away from NP in Norway, as all domestic production was priced at European hub levels\textsuperscript{22}.

\textsuperscript{21} Estonia, Finland, Latvia, Lithuania, Norway, Sweden

\textsuperscript{22} Previously gas used in refineries and gas processing was thought not to be priced so allocated to NP
A.3  ASIA

A.3.1  Asia 2020 Survey Results

Asian consumption in 2020 was some 12% of total world consumption – 473 bcm.

FIGURE 56: ASIA PRICE FORMATION 2020

![Figure showing price formation in Asia with OPE at 63%, GOG at 22%, RCS at 14%, and BIM at 1%.]

OPE at 63% totals some 300 bcm and is principally domestic production, pipeline and LNG imports in China, LNG imports together with a small amount of domestic production in India, and LNG imports and domestic production in Pakistan where the regulator sets gas wellhead prices but linked to the oil price.

GOG at 22%, some 103 bcm, is largely domestic production in India, reflecting the mainly hub linked pricing formula, spot LNG imports into India, China and Pakistan and domestic production in China, reflecting the direct sales of coalbed methane at market prices from upstream producers to large users in power and industry.

RCS accounts for some 14%, totalling around 45 bcm of domestic production in China with around 20 bcm in Bangladesh.

The small amount of BIM at 1% - 4 bcm – is in Bangladesh.

A.3.2  Asia Comparison 2005 to 2020

The changes in price formation mechanisms in Asia have been dominated by China and India. Firstly, there has been an increase in OPE from around 35% to 63% over the thirteen surveys, largely at the expense of the regulated categories and BIM. The move from BIM to OPE reflected the change in the pricing of the Qatar LNG contract to India between 2007 and 2009, while the more recent rise in 2010 and 2012 was due to the start of pipeline imports into China from Turkmenistan, which are oil indexed under the contract. The change from RSP to RCS in
China in 2009 came as the regulator increased prices to economic levels. Finally, there was the further change in domestic production pricing, initially in two provinces in China, before extending nationwide to all sectors except residential and fertilizer, again increasing OPE to 67% in 2016. In 2018, OPE was 68% rising from 64% in 2017, as China extended the pricing reforms to city-gate pricing to residential customers. The rise in GOG in 2015 to some 13.5% reflected the pricing reform in India, linking domestic prices to a basket of market hub prices. GOG increased further in 2017 to 14% and to 17% in 2018, partly as spot LNG imports increased in India and China. GOG share has risen in 2019 and 2020, at the expense of OPE, reflecting a further increase in spot LNG imports across the region.

The changes in RSP – down from 48% in 2005 to almost zero in 2015 was almost all due to the change in price formation in China as regulated prices were increased to economic levels, and the more recent change in India. Initially, RCS was the beneficiary, rising to 44% by 2012, but this has since declined with the pricing changes in China, partly offset by the move to more RCS in Bangladesh. The decline in RBC, from 10% in 2005 to zero in 2016, largely reflected changes in pricing in Bangladesh in 2009 and 2015 to RCS via RSP.
A.4 ASIA PACIFIC

A.4.1 Asia Pacific 2020 Survey Results

Asia Pacific consumption in 2020 was some 10% of total world consumption – 387 bcm.

OPE at 63% totals some 245 bcm, with LNG imports – predominantly in Japan, Korea and Taiwan, but also now including Indonesia, Singapore, Thailand and Malaysia – accounting for 133 bcm. Pipeline imports are some 20 bcm into Singapore, Thailand and Malaysia, while domestic production is 93 bcm – mostly Thailand but also Vietnam, Malaysia, Australia and the Philippines.

GOG at 25% totals some 97 bcm, of which 55 bcm is LNG imports mainly in Japan, Korea and Taiwan – but also some in Singapore and Malaysia, while the balance is domestic production in Australia and New Zealand.

BIM at less than 1% totals some 2 bcm, comprising domestic production in Japan.

RSP at 9% totals some 34 bcm and is domestic production in Indonesia, while RCS at 1% totals 5 bcm and is domestic production largely in Malaysia. NP at 1% or 4 bcm is domestic production in Brunei and PNG consumed in the energy industry.
A.4.2 Asia Pacific Comparison 2005 to 2020

Until 2017, there were only minor changes in price formation mechanisms in Asia Pacific since 2005. GOG had risen from 13% in 2005 to as high as 22% in 2012, while OPE was broadly unchanged, with RSP down from 22% to 15%. After 2012, GOG declined through 2016 as spot LNG imports fell. This has since been reversed by the sharp rises in spot LNG imports in the last four years. The gradual decline in RCS to 2016 reflected the changing pricing in Vietnam towards OPE.

In 2017, however, there were significant changes in Malaysia, with pricing moving to RCS and OPE in domestic production away from RSP, which has fallen from 16% in 2012 to 9% in 2020. In 2020 there was a further significant change in Malaysia which changed almost all its domestic production pricing to OPE, with prices being linked to a netback price from LNG exports.
A.5 LATIN AMERICA

A.5.1 Latin America 2020 Survey Results

Latin America consumption in 2020 was some 4% of total world consumption – around 150 bcm.

OPE at 27% totals some 41 bcm, mainly domestic production in Brazil, pipeline imports into Brazil and Argentina and a proportion of LNG imports into Chile and Argentina.

GOG at 23% totals some 34 bcm, of which 24 bcm is domestic production in Argentina, Colombia and Peru. The balance is LNG imports into Brazil, Argentina, Chile, Colombia, Puerto Rico, Jamaica, Panama and Dominican Republic.

BIM at 3% totals some 4 bcm and is all domestic production to the power sector in Trinidad. NET at 8% totals some 12 bcm and is the balance of domestic production in Trinidad used as a feedstock in petrochemicals.

RSP at 17% totals some 26 bcm and comprises domestic production in Argentina, Peru, Ecuador and Bolivia, plus a small amount in Brazil. RCS at 9% totals some 14 bcm and is domestic production in Argentina. RBC at 12% totals some 18 bcm and is domestic production in Venezuela and a small amount in Chile. NP at 1% or 1 bcm is Cuban domestic production.
A.5.2 Latin America Comparison 2005 to 2020

The changes in price formation mechanisms in Latin America have seen a rise in GOG from 4% to 23%, a decline in RSP from 52% to 17% and a rise in RBC from 0% to 12% - the latter almost all in Venezuela. The rise in GOG in part is due to rising spot LNG imports in Argentina and Brazil, and a switch away from RSP to GOG in Argentina, and, eventually, a complete switch from RCS to GOG in Colombia. In Argentina, this reflected producers and marketing entities, being allowed to sell gas at unregulated prices to large eligible customers, such as power plants.
A.6 FORMER SOVIET UNION

A.6.1 Former Soviet Union 2020 Survey Results

Former Soviet Union consumption in 2020 was some 16% of total world consumption – around 635 bcm.

RCS at 36% is the largest share, totalling some 215 bcm and is almost all the major proportion of domestic production in Russia together with most of the domestic production in Azerbaijan. RBC at 16% or 103 bcm is domestic production in Kazakhstan, Turkmenistan, Uzbekistan and a small amount in Azerbaijan, while RSP at 12% or 74 bcm is a proportion of Russia domestic production (sold to the population) and Ukraine domestic production.

GOG at 30% totals some 192 bcm and is largely domestic production to the eligible large customer market in Russia, but also pipeline imports into Ukraine at hub prices from Europe.

OPE at 1% or 7 bcm is all pipeline imports into Russia, while BIM at 5% or 32 bcm represents other pipeline imports in the FSU region, principally from Russia to Belarus, but also Armenia, Georgia, Kazakhstan, Kyrgyzstan, Moldova and Tajikistan.
A.6.2  Former Soviet Union Comparison 2005 to 2020

The Former Soviet Union is another region, like Europe, where there have been significant changes in price formation mechanisms, largely based around Russia. From having domestic production completely in the RBC category in 2005, there was a switch to GOG as the independent producers began to compete with each other and Gazprom to sell gas to the power sector and large industrials, and the rising Gazprom regulated prices saw a switch from RBC to RCS, although in 2014 the regulated pricing to the population saw a move from RCS to RSP, maintained in 2015 and 2016. The other change was in intra-FSU trade where pricing switched from BIM to OPE, particularly in the Russia to Ukraine trade, and then during 2015 when Ukraine began importing from Europe at hub prices so switch to GOG from OPE. RSP lost share in 2019, with Russia and Ukraine volumes lower, while NP disappeared from Turkmenistan which moved wholly to RBC. In 2020, there was a further switch from RCS to GOG in Russia.
A.7 AFRICA

A.7.1 Africa 2020 Survey Results

African consumption in 2020 was some 4% of total world consumption – around 164 bcm.

RBC at 60% or some 98 bcm, has the largest share and is domestic production in Egypt, Algeria and Libya.

RCS at 19% or some 31 bcm is domestic production in Egypt and Nigeria plus part of pipeline imports from Nigeria to Ghana, Benin and Togo.

RSP at 3% or some 5 bcm is domestic production in Equatorial Guinea, Gabon, Ghana, Morocco, Mozambique and Tanzania.

OPE at 5% or some 8 bcm comprises pipeline imports into Tunisia and Morocco from Algeria, and a proportion of the pipeline imports from Nigeria to Ghana, Benin and Togo, as well as domestic production in Tunisia, South Africa and part of Ivory Coast and Tanzania.

GOG at 7% or some 12 bcm is part of domestic production in Nigeria (sales to the non-power sector).

BIM at 5% or some 9 bcm is pipeline imports into South Africa from Mozambique and the balance of domestic production in Ivory Coast, part of domestic production in Ghana, plus domestic production in Cameroon.

NP at 1% is Angola.
A.7.2 Africa Comparison 2005 to 2020

There was very little change in price formation mechanisms in Africa between 2005 and 2014, apart from the switch to RSP from RBC in 2012 in Nigeria, with some GOG as non-power markets were freed up. However, in 2015, Nigerian domestic production moved again from RSP to RCS as prices to power plants were increased, and also in Egypt there was a similar partial move away from RBC to RCS in some sectors, plus the start-up of spot LNG imports. In 2017, RBC gained at the expense of RCS and NET in Egypt as prices to the power sector were kept down and regulated to fertilizer plants. The main changes in 2018 was a decline in GOG as spot LNG imports into Egypt fell sharply and an increase in RCS in Egypt with more consumption met by domestic production. In 2019 and 2020, OPE and GOG declined as there was less trade, with RCS rising in 2019 as Egyptian production increased. The region remains dominated, however, by RBC, with gas prices largely subsidised.
A.8  MIDDLE EAST

A.8.1  Middle East 2020 Survey Results

Middle East consumption in 2020 was some 14% of total world consumption – around 540 bcm.

FIGURE 66: MIDDLE EAST PRICE FORMATION 2020

RSP at 73% or 395 bcm dominates the region and is domestic production in Iran, Saudi Arabia and the UAE with smaller amounts in Oman and Bahrain.

RBC at 2% or 13 bcm is domestic production in Iraq and Syria.

BIM at 15% or 78 bcm is partly pipeline imports from Qatar to UAE and Oman and domestic production in Qatar and part of Israel domestic production.

OPE at 5% or 25 bcm is largely pipeline imports into Iran from Turkmenistan, some LNG imports into UAE, Jordan and Kuwait, and most of domestic production in Kuwait.

GOG at 4% or 22 bcm includes spot LNG imports into Jordan, UAE and Israel, domestic production delivered to petrochemical plants in Iran, where prices are partly linked to international hub prices, and domestic production in Israel.

NP is less than 1 bcm and is gas consumed in Yemen.
A.8.2 Middle East Comparison 2005 to 2020

The changes in price formation mechanisms in the Middle East have almost totally taken place between 2010 and 2012, when prices were increased significantly in Iran, moving from the RBC category to the RSP category. The other change was in small quantities of OPE and GOG as LNG began to be imported into Kuwait, UAE and, in 2015, into Jordan, plus the change in gas pricing to petrochemical plants in Iran. Kuwait also moved domestic production more towards OPE in 2016. LNG imports are, however, slowly increasing in the region which is introducing more market related pricing in the form of both OPE and GOG. In 2020, GOG increased as a result of changes in domestic pricing in Israel.

FIGURE 67: MIDDLE EAST PRICE FORMATION 2005 TO 2020
Appendix B: Survey Methodology

The idea for a survey of wholesale gas price formation mechanisms arose at the beginning of the triennium leading to the 2009 World Gas Conference. The Strategy, Economics and Regulation Programme Committee (PGCB) had set up a new sub-group to consider gas pricing, with a key remit to carry out a comprehensive analysis of gas price formation mechanisms. The sub-group decided to carry out a survey of current pricing mechanisms around the world, not only for gas traded internationally, but also for gas produced and consumed within countries. IGU members were surveyed and provided the data and the survey responses were collated and analysed by Nexant. The 2009 World Gas Conference in Buenos Aires presented the results of the surveys for the years 2005 and 2007. Two further surveys for the years 2009 and 2010 were undertaken and presented at the 2012 World Gas Conference in Kuala Lumpur. Three surveys were undertaken and presented at the 2015 World Gas Conference in Paris, covering the years 2012, 2013 and 2014. The 2015 was the first in the triennium for the 2018 World Gas Conference in Washington DC, 2016 was the second and 2017 the third. The 2018, 2019 and 2020 surveys were meant to be the three leading up to the 2021 World Gas Conference in Daegu, South Korea, but this has now been postponed until 2022. In the 2020 survey responses were received for around 94 out of 113 countries, covering 98% of total world consumption. Data on the remaining countries, where responses were not received, was researched by the author of the report and/or based on past responses.

B.1 DATA COLLECTION

The focus of the gas pricing sub-group, and the surveys, was very much on wholesale prices, which can cover a wide range. In fully liberalised traded markets, such as the USA and the UK, the wholesale price would typically be a hub price (e.g. Henry Hub or the NBP). In many other countries, where gas is imported, it could typically be a border price. The more difficult cases are countries where all gas consumed is supplied from domestic production, with no international trade (either imports or exports) and the concept of a wholesale price is not recognised. In such cases the wholesale price could be approximated by wellhead prices or city-gate prices. Generally, the wholesale price is likely to be determined somewhere between the entry to the main high-pressure transmission system and the exit points to local distribution companies or very large end users.

The initial data collection was done on a country basis. The data were then collated to a regional level using the standard IGU regions shown in the figure below. Most of the regions are defined along the usual geographic lines, although the IGU includes Mexico in North America, and divides Asia into a region including the Indian sub-continent plus China, called Asia, and another region including the rest of Asia plus Australasia which is called Asia Pacific.

In terms of the allocation between different price formation mechanisms in any country, the general rule is that the wholesale price at the “point of first sale” in the country should be considered. For example, if gas enters a country under an oil-indexed contract and is then re-traded at a hub it is still considered to be in the oil price escalation (OPE) category.
Data for each country were collected in a standard format. As an example, a data collection form for the UK is shown in the figure below. Individual country gas demand may be supplied from a combination of three sources – domestic production, pipeline imports and LNG imports (storage is ignored for the purpose of this analysis). The demand is allocated pro rata to domestic production and imports (price formation of gas exported is not collected, this is collected at the country of import). The volume figures on domestic production and imports allocated to the different price formation mechanisms in this report exclude the gas which is re-exported.

For each of these three sources data was collected separately on what percentage of the wholesale price for that category is determined by each mechanism. In some countries, one single mechanism was found to cover all transactions and that mechanism, therefore, was allocated 100%. In many cases, however, several mechanisms were found to be operating, in which cases estimates were made of the percentages for each price mechanism. The only constraint is that the total for each source of gas – domestic production, pipeline imports and LNG imports – must add up to 100%.

Information was also collected on wholesale price levels. This covered the annual average price and the highest monthly average price and lowest monthly average price. All prices were converted to $ per MMBTU. A comments section was included to identify and acknowledge the source of the information and any other useful information.

All data in the IGU study on gas volumes for consumption, production, imports and exports is taken from the IEA database, supplemented where necessary by any specific country and/or regional knowledge. It should be noted that 2020 volume data is still preliminary and may be adjusted once the final estimates are published later this year by the IEA. In addition, previous years may also be revised. These revisions may lead to small changes in the percentages for each price category when country data is aggregated at both the regional and world level.


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<thead>
<tr>
<th>Country</th>
<th>United Kingdom</th>
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<tbody>
<tr>
<td>Region</td>
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<td>Pipeline</td>
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<thead>
<tr>
<th>Oil Price Escalation</th>
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<tr>
<td>Gas-on-Gas Competition</td>
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<thead>
<tr>
<th>Bilateral Monopoly</th>
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<tr>
<th>Netback from Final Product</th>
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<table>
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<tr>
<th>Regulation: Social and Political</th>
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<table>
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<tr>
<th>Regulation: Below Cost</th>
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<tr>
<th>Estimated 2020 Wholesale Price Range ($/MMBTU)</th>
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<tbody>
<tr>
<td>Average</td>
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<tr>
<td>---------</td>
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B.2 TYPES OF PRICE FORMATION MECHANISMS

In preparation for the initial 2005 survey, a series of discussions were held at the PGCB meetings on the definition of different types of price formation. It was decided to use for categorisation purposes the wholesale pricing mechanisms described in Box 2.

**BOX 2: TYPES OF PRICE FORMATION MECHANISMS**

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Price Escalation (OPE)</td>
<td>The price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases, coal prices can be used as can electricity prices.</td>
</tr>
<tr>
<td>Gas-on-Gas Competition (GOG)</td>
<td>The price is determined by the interplay of supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or other periods). Trading takes place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). There are likely to be developed futures markets (NYMEX or ICE). Not all gas is bought and sold on a short-term fixed price basis and there will be longer term contracts but these will use gas price indices to determine the monthly price, for example, rather than competing fuel indices. Also included in this category are spot LNG cargoes, any pricing which is linked to hub or spot prices and also bilateral agreements in markets where there are multiple buyers and sellers.</td>
</tr>
<tr>
<td>Bilateral Monopoly (BIM)</td>
<td>The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically one year. There may be a written contract in place but often the arrangement is at the Government or state-owned company level. Usually there would be a single dominant buyer or seller on at least one side of the transaction, to distinguish this category from GOG, where there would be multiple buyers and sellers trading bilaterally.</td>
</tr>
<tr>
<td>Netback from Final Product (NET)</td>
<td>The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.</td>
</tr>
<tr>
<td>Regulation: Cost of Service (RCS)</td>
<td>The price is determined, or approved, formally by a regulatory authority, or possibly a Ministry, but the level is set to cover the “cost of service”, including the recovery of investment and a reasonable rate of return.</td>
</tr>
<tr>
<td>Regulation: Social and Political (RSP)</td>
<td>The price is set, on an irregular basis, probably by a Ministry, on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise – a hybrid between RCS and RBC.</td>
</tr>
<tr>
<td>Regulation: Below Cost (RBC)</td>
<td>The price is knowingly set below the average cost of producing and transporting the gas often as a form of state subsidy to the population.</td>
</tr>
<tr>
<td>No Price (NP)</td>
<td>The gas produced is either provided free to the population and industry, possibly as a feedstock for chemical and fertilizer plants, or in refinery processes and enhanced oil recovery. The gas produced maybe associated with oil and/or liquids and treated as a by-product.</td>
</tr>
<tr>
<td>Not Known (NK)</td>
<td>No data or evidence.</td>
</tr>
</tbody>
</table>

23 The Wholesale Gas Pricing Group began life as Sub Group 2 of PGCB and was chaired in the period leading up to the 2009 World Gas Conference by Runar Tjersland of Statoil and between 2009 and 2018 by Mike Fulwood, formerly of Nexant, but now a Senior Research Fellow at the Oxford Institute for Energy Studies and a Fellow at the Center on Global Energy Policy at Columbia University. It is now part of the IGU’s Strategy Committee and has been re-titled as the Gas Pricing Group. The 2018, 2019 and 2020 surveys were organised by Mike Fulwood, under the guidance of the IGU Strategy Committee.
B.3 ANALYSING THE RESULTS

In looking at the different price formation mechanisms, the results have generally been analysed from the perspective of the consuming country. Within each country gas consumption can come from one of three sources, ignoring withdrawals from (and injections into) storage – domestic production, imported by pipeline and imported by LNG. In many instances, as will be shown below, domestic production, which is not exported, is priced differently from gas available for export and also from imported gas whether by pipeline or LNG. Information was collected for these three categories separately for each country and, in addition, pipeline and LNG imports were aggregated to give total imports and adding total imports to domestic production gives total consumption. For each country, therefore, price formation could be considered in 5 different categories:

- Domestic production (consumed within the country, i.e. not exported)
- Pipeline imports
- LNG imports
- Total imports (pipeline plus LNG)
- Total consumption (domestic production plus total imports)

Each country was then considered to be part of one of the IGU regions, as described above, and the 5 categories reviewed for each region. Finally, the IGU regions were aggregated to give the results for the World as a whole.

As well as collecting information on price formation mechanisms by country, information was also collected on wholesale price levels in each country – an annual average price and a range of high and low prices within the year. Comparisons of wholesale price levels, however, need to be treated with caution. The wholesale price can cover different points in the gas chain – wellhead price, border price, hub price, city-gate price – so the comparison of price levels is not always a like for like comparison.