WORLD ENERGY TRENDS
Excerpt from:
ENERGY BALANCES OF NON-OECD COUNTRIES
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INTERNATIONAL ENERGY AGENCY
WORLD ENERGY TRENDS: AN OVERVIEW

Global trends

Mainly due to the rebound from the economic crisis, global energy demand increased by 2.5% in 2013, with OECD countries seeing an increase of 0.9%, due to continued slow economic growth, and non-OECD countries an increase of +3.6%.

Preliminary figures indicate a somewhat different situation in 2014 with global energy demand continuing to grow, although at a slower pace (less than 0.5%) influenced by only a small increase in Non-OECD countries (+0.12%) and a larger decrease in OECD countries (-1.2%). The Non-OECD trends were mainly influenced by increased energy demand in most regions that were balanced by decreased coal demand in China and Non-OECD Europe and Eurasian while the OECD country decrease was influenced mainly by a milder winter in Europe and a decrease in oil demand for power generation in Japan.

Production

Fossil fuels accounted for 81.6% of global energy production in 2013. Between 2012 and 2013, production of coal increased by 4.6%, oil by 0.5% and natural gas increased by only 2.7% (Figure 1).

Among non-fossil sources, nuclear (4.7% of total energy production) saw an increase of 0.7%, with production from other countries compensating for continued low production in Japan, while hydro (2.4% of total production) increased by 3.3% between 2012 and 2013, due mainly to increase precipitation. With a 2.8% increase, biofuels, mainly due to the large part of solid biofuels, (fuelwood, agro-residues), kept their 10% share of global energy production. Other renewable sources (e.g. solar, wind), despite representing only 1.2% of total production, registered the most pronounced growth rates. In 2013, wind generation increased by almost 22%, solar thermal generation by 28%, and solar photovoltaic by 41%.

At a regional level, Asia overtook the OECD as the largest energy producing region, accounting for 30% of global production in 2013, while the OECD was at 29.2%. Moreover, the annual increase in production was much higher in Asia than in OECD; with trends showing an increase in Asia (+5.6%) compared to only 2.8% for OECD (Figure 2).

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1. OECD includes Estonia and Slovenia starting in 1990. Prior to 1990, data for Estonia are included in Former Soviet Union and data for Slovenia in Former Yugoslavia in this publication.
2. As a result of a delay in publishing 2013 energy data from China’s National Bureau of Statistics, data in this publication for China are estimated. As such, care should be used when interpreting energy trends between 2012 and 2013.
3. In this chapter, Asia includes China region unless otherwise specified.
Many countries experienced a major increase in their own domestic production in 2013. This is the case for China, which was a major consumer of energy in Asia. Coal and natural gas production in China are estimated to have increased by 7.9% and 12.8% respectively, nuclear by 14.6%, solar and wind together by 47.8%, and hydro production growing by 5.4%, due mainly to larger precipitation.

In the OECD region, Production growth was mainly influenced by the United States and Canada with 4.2% growth each covering almost 60% of OECD total production. Several smaller countries in OECD experienced decreases in their production, in particular Denmark and Greece, each with 11% decrease in energy production.

The OECD’s share of global TPES has fallen from 60% in 1971 to 39% in 2013, reflecting the steady growth of energy demand in China and India. TPES grew in OECD by 0.9% in 2013, due mainly to increased coal consumption. Within the OECD, the United States represents more than 41% of the regional total in 2013, just a few percentage points less than in 1971.
Outside of the OECD, the most dramatic increase over the years occurred in Middle East, where in 2013 the region consumed more than fifteen times as much energy as in 1971. However, the most prominent emerging region in world energy consumption is definitely Asia, which more than doubled its share of global TPES during the same period and represented 35% of total TPES in 2013.

As shown in Figure 6, Asia increased its TPES by 5.9% between 2012 and 2013, due in part to increased coal demand in India and Indonesia, while Middle East experienced a 1.8% growth, influenced by natural gas, and Non-OECD Europe and Eurasia experienced a decline of 1.9%, which was influenced mainly by decreased coal demand.

[Figure 6: Annual change in TPES by region]

The role of non-OECD countries in the current world energy picture is becoming more and more prominent when ranking countries by Total Primary Energy Supply (TPES), as shown in Table 1. In 2013, China continued to outpace the United States in terms of TPES, with China accounting for 22% of global TPES while the United States accounted for only 16%. India and the Russian Federation ranked third and fourth, respectively. Japan, the second largest OECD consuming country, is in fifth position.

In 2013, the top-five countries of Table 1 produced close to half of global GDP⁴, consumed 53% of total world energy and accounted for 46% of the total population. However, the relative shares of GDP, population and TPES of these five countries significantly varied from one to another, as illustrated in Figure 7.

[Table 1: TPES - top-ten countries in 2013 and 1971]

<table>
<thead>
<tr>
<th>Country</th>
<th>TPES (Mtoe)</th>
<th>Share in world TPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>People's Rep. of China</td>
<td>3 022</td>
<td>22% 7%</td>
</tr>
<tr>
<td>United States</td>
<td>2 188</td>
<td>16% 29%</td>
</tr>
<tr>
<td>India</td>
<td>775</td>
<td>6% 3%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>731</td>
<td>6% N/A</td>
</tr>
<tr>
<td>Japan</td>
<td>455</td>
<td>3% 5%</td>
</tr>
<tr>
<td>Germany</td>
<td>318</td>
<td>2% 6%</td>
</tr>
<tr>
<td>Brazil</td>
<td>294</td>
<td>2% 1%</td>
</tr>
<tr>
<td>Korea</td>
<td>264</td>
<td>2% 0.3%</td>
</tr>
<tr>
<td>France</td>
<td>253</td>
<td>2% 3%</td>
</tr>
<tr>
<td>Canada</td>
<td>253</td>
<td>2% 3%</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>5 002</td>
<td>37% 44%</td>
</tr>
<tr>
<td>World</td>
<td>13 555</td>
<td>100% 100%</td>
</tr>
</tbody>
</table>

It is interesting to note, from Table 1, that the top 10 countries accounted for 63% of global energy demand in 2013, while in 1971 the top 10 accounted for more than 56%. In addition, the major change in demand among these countries has occurred between the United States and China.

[Figure 7: Top-five energy consumers: 2013 relative shares*]

* Relative shares within the top-five, which differ from shares in the world total.

The United States consumed 16% of world energy, with a population of less than 5% of the global total. Conversely, China and India consumed 22% and 6% of global energy demand respectively, together accounting for more energy consumption than the United States (28% of global TPES) but accounted for almost 38% of the global population. In the United States, the large share of energy consumption is associated with a commensurate share of global economic output (17%). India, the Russian Federation and Japan also consumed significant amounts of energy in 2013. However, energy intensities differed significantly. With a GDP almost two times larger than that of the Russian Federation, Japan consumed three times less energy per unit of GDP.

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⁴. In this chapter, GDP refers to GDP using purchasing power parities.
To conclude this global overview, Figure 8 presents the shares of different sectors in total final consumption. Industry is still the largest consuming sector (with a significant fraction derived from non-energy use), followed by the transport sector and the residential sector.

It is notable to observe at a global level that although regional shares of energy consumption have changed over the years, energy consumption by sector has remained relatively constant.

The following sections briefly describe 1971-2013 energy trends in six different regions of the world: OECD, Africa, Non-OECD Americas, Asia, Non-OECD Europe and Eurasia, and the Middle East.

5. In this chapter, each sector of final consumption includes its respective non-energy use quantity.
The OECD energy trends are largely driven by the importance of the United States, which accounts for 41% of regional TPES. Japan and Germany follow, with 9% and 6% of regional TPES. After a short period of decrease in the mid-70s and early 80s, the OECD energy supply has progressed regularly, with an average annual growth rate of 1.1% since 1971. This trend continued in 2013, with TPES increasing by 0.9%, primarily due to increased nuclear energy production and coal consumption. This increase was still not as high as the 1.9% increase in GDP.

Since the oil shocks of the 1970s, the OECD has diversified its energy supply. Consequently, the fuel shares in TPES have evolved, as shown in Figure 9. Although oil remains the main component of TPES, its share decreased from 51% in 1971 to 36% in 2013. The decrease was compensated by a pronounced increase in nuclear (from 1% to 10%) and by an increased penetration of natural gas (from 19% to 26%).

Despite being the second largest energy producing region, the OECD is also the largest importer. In terms of self-sufficiency, the OECD is last among all regions, with a production/TPES ratio of 75%, far behind the closest region, Asia, at 87%.

The trends in electricity generation are even more pronounced than those of TPES, as presented in Figure 10. Electricity production has almost tripled since 1971, increasing on average by 2.5% per year, more than twice as fast as TPES, at a rate comparable to that of GDP. Oil has been almost completely displaced by the dramatic increase of nuclear and natural gas, among non-hydro energy forms. Hydro has progressed very slowly, losing 10% in the share over the time period while coal has maintained the dominant role as electricity source, with a share in 2013 (33%) comparable to that of 1971.

The role of coal in total final consumption (TFC) within OECD countries is much less important than that in electricity generation. In final consumption, oil is the key fuel, as shown in Figure 11. Oil consumption (in the form of secondary products like motor gasoline) had decreased after the oil shocks of the 70s, but since the mid-80s it has grown again. This has also been the trend between 2012 and 2013, with oil consumption increasing by 0.5% during this period. Oil still accounts for about half of the total final consumption within the OECD.

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1. OECD includes Estonia and Slovenia starting in 1990. Prior to 1990, data for Estonia are included in Former Soviet Union and data for Slovenia are included in Former Yugoslavia in this publication.
As illustrated in Figure 12, the driver for oil consumption (47% in 2013) is the transport sector, where total consumption grew by more than 90% between 1971 and 2013. Meanwhile in all sectors, consumption of electricity has increased considerably: it almost tripled between 1971 and 2013.

* In this graph peat and oil shale are aggregated with coal.
Africa

In 2013, Africa produced 8.3% of the world’s energy. African production is dominated by oil (38%), followed by traditional biomass (32%), natural gas (15%) and coal (14%). The production and consumption of biofuels (mainly fuelwood) is significantly higher across Africa (48% of total TPES) than the world average (10% of total TPES).

Production of commercial types of energy are unevenly distributed across sub-regions, as shown in Figure 13. Crude oil and natural gas tend to be concentrated in a few countries of North, West and Southern Africa. In 2013, Nigeria, Angola, Libya, Egypt and Algeria produced together 75% of the crude oil of the region, while Algeria produced alone more than 41% of the regional output of natural gas. Coal is produced almost exclusively in South Africa, the sixth largest coal exporter in the world, and a significant coal consumer itself.

Figure 13: Energy production by sub-region

As shown in Figure 14, TPES in Africa is dominated by solid biofuels (mainly fuelwood), with a share in 2013 (48%) much higher than the world average (10%). The presence of large forests, agro-industry, agriculture, a large rural population, and a low GDP per capita have resulted in a large use of solid biofuels for cooking. Because of the extensive use of wood and charcoal, energy intensity¹ is higher than the world average.

Figure 14: Total primary energy supply* by fuel

<table>
<thead>
<tr>
<th></th>
<th>1971</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>61%</td>
<td>48%</td>
</tr>
<tr>
<td>Nat. gas</td>
<td>1%</td>
<td>13%</td>
</tr>
<tr>
<td>Oil</td>
<td>18%</td>
<td>23%</td>
</tr>
<tr>
<td>Coal</td>
<td>19%</td>
<td>14%</td>
</tr>
</tbody>
</table>

* Excluding electricity trade.
** In this graph peat is aggregated with coal.

However, the share of traditional biomass in TPES decreased significantly between 1971 and 2013, due to increased electrification, and particularly the recent development of power generation from natural gas. Natural gas increased its share in TPES from 1% in 1971 to 13% in 2013. Coal continued to represent an important share of African TPES (14% in 2013), due to the continued high reliance of South African supply on it (68% in 2013).

Figure 15: Electricity generation by fuel

* In this graph peat is aggregated with coal.

In 2013, Africa’s crude oil production decreased compared to 2012 (-6.3%). Among the region’s oil producers, output declined in Libya (-30.8%), Congo (-9.9%) and Nigeria (-6.4%) while it increased in South Sudan (+219%), Sudan (+39.9%) and Mozambique (+40%). Africa represented 10% of world crude oil output and it exported 80% of this production in 2013. Natural gas production decreased by 3.8%, with almost half of the output exported in 2013, both by pipeline and LNG.

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¹ Measured by the ratio TPES/GDP.
power generation, especially in natural gas producing countries, has been remarkable. In 1971 natural gas only produced 1% of electricity in Africa while it now produces 36% of all electricity on the continent, even with a 7-fold increase in the amount of power generated during the period. In 2013, natural gas provided 96% of the electricity in Tunisia, 93% in Algeria and 77% in Egypt. On a regional level, the share was 36%, larger than in the OECD (24%), and only behind Non-OECD Europe and Eurasia (40%) and Middle East (64%). The large share of coal in electricity production is due to the weight of South Africa, which almost exclusively uses coal as an electricity source (94% in 2013). Electricity production reflects the disparity in fossil fuel resources between sub-regions of Africa. In 2013, North African countries plus South Africa, represented only 20% of the population but generated 76% of the electricity in Africa. Electricity remains a grave scarcity for most Sub-Saharan African countries, with electrification rates averaging 30%.

Non-OECD Americas

In 2013, energy production in Non-OECD Americas was 0.6% lower than in 2012, with decreases in energy production in Brazil (-2.2% for oil, -8.7% for nuclear and -5.9% for hydro) and Argentina (-5.3% for oil, -5.2% for gas and -2.4% for nuclear). These drops in production were not completely compensated for by increases in Bolivia (+14.4% for oil, +13.9% for gas and +7.8% for hydro) or Colombia (+5.7% for oil, +5.4% for gas and +7.7% for biofuels).

Figure 16 shows that oil largely remained the dominant fuel in the supply (44% in 2013), followed by comparable shares of natural gas and biofuels (~20%). While the share of natural gas in TPES increased from 8% to 22% between 1971 and 2013, the share of biofuels and waste decreased from 33% to 19% while hydro became an important part of energy supply in the region (9% in 2013). Urbanisation and increases in the purchasing power of citizens explain the move away from traditional biofuels.

As shown in Figure 17, hydro generation developed at an average rate of 6% per year between 1971 and 2013, growing from 3% to 9% of TPES. In 2013, hydro represented 58% of total Non-OECD Americas electricity generation, due mainly to Brazil’s very large share of hydro (69%), and far above the world average of 16%.

Figure 17 also shows some decreases in nuclear and hydro power production between 2012 and 2013, due mainly to the impact of continued security testing of nuclear plants and ongoing drought in Brazil. Similarly, increases in the demand for fossil fuels were affected by the reduced availability of nuclear and hydro power production.

Figure 18 illustrates the sectoral consumption in the region. In 2013, industry accounted for 40% of total final consumption (TFC), followed by transport (34%) and residential (16%). Oil consumption, accounting for almost half of TFC, is driven, as in all countries, by road transport. Still, within transport, Non-OECD Americas has the largest share of liquid biofuels in the world (10%) mostly due to Brazil (15%), the world’s largest exporter and consumer of fuel ethanol from sugarcane.

The difference in the growth of Industry and Transport consumption (~3 times between 1971 and 2013) in comparison to the growth in Residential consumption (an increase of only 2/3 since 1971) can be seen in Figure 18. Although the share of electricity in TFC increased from 7% in 1971 to 18% in 2013, due to a series of structural and regulatory changes to favour access to electricity and to develop interconnections, its impact on consumption in the Residential sector seems to be limited.
Asia

In 2013, Asian total primary energy supply continued its growth of 5.9% over 2012, in line with the strong economic growth for the region, with GDP in the region increasing by 6.6%, dominated by China (+7.7%) and India (+6.9%).

Asia is the largest energy producing region in the world, with almost 30% of global production in 2013. Figure 19 shows the recent steep growth in production, led by China, the largest coal producer in the world, accounting for 77% of Asian production. Moreover, despite this growth, the region as a whole is a net energy importer, as its internal demand is growing even faster than its production. Self-sufficiency has slowly declined over the last twenty years for both China (87% in 2013) and India (68% in 2013). Indonesia, which is still self-sufficient because of its large coal production, became a net oil importer in 2004.

As shown in Figure 20, coal is the main energy source in the region, accounting in 2013 for more than half of the TPES, well above the world average of 29%. Asia consumed about half of the world’s coal in 2013. Figure 21 shows that in 2013 Asia saw an increase in nuclear energy production (almost 10%) and renewables (almost 20%), however the renewables growth is from a very small base of only 1% of TPES. In 2013, China also increased its oil demand by 3%, maintaining its position as the world’s second largest crude oil importer behind the United States and just outpacing Japan.

Increase in per capita GDP, urbanization and electrification programmes have lowered the share of biofuels (predominantly solid biofuels) in the region from 67% in 1971 to 13% in 2013. Due to the expansion of infrastructure, natural gas has become significant in the fuel mix (8%). In 2013, China increased natural gas production by 13%, and also strongly increased its LNG imports (+25%) that had started in 2006.

As shown in Figure 22, Asia has the largest share of coal in the electricity mix among all regions (68% in 2013). Among the largest electricity producing countries, coal provided 76% of electricity in China, 73% in India, 93% in Mongolia and 51% in Indonesia.

In 2013, total electricity generation in Asia increased by 7.6% in large part due to the 9% increase of China. Even if electricity production grew in the region at an average annual rate of 8.3% since 1971, its consumption per capita is still below the world average in 2013.
Non-OECD Europe and Eurasia

With a production/TPES ratio of 161%, it is one of the most energy self-sufficient world regions, with the Russian Federation accounting for 63% of regional TPES in 2013, Ukraine (10%) and Kazakhstan (7%). Moreover, non-OECD Europe and Eurasia represents 8.5% of the world energy supply.

Figure 23 shows the trend over time for regional TPES. In the years after 1990, economic output as well as energy consumption strongly declined (~30%), due to the very sharp decrease in industrial consumption. A slow recovery has occurred since 1999, which was briefly interrupted by the economic downturn in 2009, followed by a short recovery and now a slow downturn in 2013.

Figure 23: Trend in total primary energy supply*

Natural gas and oil are the largest contributors to energy production in the region (40% and 37% respectively in 2013), followed by coal and nuclear. Natural gas production increased in the largest producing country, the Russian Federation, with the 2013 output up by 4% from 2012. In addition, crude oil and hydro production increased by 1% and 9% respectively.

In 2013, nuclear power provided 16% of the electricity of the region, with highest development in Ukraine (43%), Bulgaria (33%) and Armenia (31%). However, it has been the development of natural gas in the region which is the most significant variation in the regional fuel mix over the last four decades, as shown in Figure 24. In 2013, oil, coal and natural gas still accounted together for more than 80% of the supply.

As illustrated by Figure 25, industrial energy consumption decreased by almost 4% between 1971 and 2013 – and decreased by 38% between 1990 and 2013. The decrease between 1990 and 2013 was particularly pronounced in Azerbaijan (-80%), Armenia (-80%) and Georgia (-79%). In recent years, industrial energy consumption has gradually recovered in the region (+13% between 2000 and 2013). Consumption in the transport sector has almost doubled over the last forty years, with growth of 31% between 2000 and 2013, mainly due to increases in the vehicle population.

In 2013, natural gas had the largest share in the regional TFC (30%), followed by oil (27%), heat (20%) and electricity (15%). Natural gas was also the dominant fuel in the regional electricity mix (40%) with coal at 24%. In 2013, coal and oil-generated electricity decreased (-1.3% and -55% respectively) while solar, geothermal and wind electricity generation
increased by more than 60%, now accounting for 0.6% of electricity output for the region.

In 2013 the region saw a 1.9% increase in energy production compared to the previous year. The trend in energy production is evident in Figure 26, which shows the regional production of oil was just above 2012 levels (+0.9%). Production of natural gas increased by 4.2%, with the largest increases in Russia (+4%) and Ukraine (+4%).

Since 2000 the economies of Non-OECD Europe and Eurasia have been expanding at an average rate of almost 5% per year. In 2013 they experienced a 2.4% increase in GDP. In line with GDP growth, energy production has increased by 1.6% per year on average since 1971.

The energy profile of the Non-OECD and Eurasia region is largely influenced by major energy producers and exporters such as the Russian Federation. In 2013, the Russian Federation produced 9.8% of global energy, 19% of global natural gas, and 12% of global oil. A key world energy exporter, the Russian Federation is increasing its production faster than its domestic demand. In 2013, net exports in the region were equivalent to 44% of total production, compared to 32% in 1990. Within the region, the Russian Federation produced 77% of total oil, 75% of total natural gas and 61% of total coal in 2013, keeping its position as largest exporter of natural gas, second exporter of crude oil and third exporter of coal in the world.

Figure 27 shows the penetration of natural gas in final consumption for the Russian Federation (29% in 2013), and the stable share of oil in time, driven by consumption in the transport sector.

Even though the energy intensity of the region has decreased since 2000 (by about two thirds), Non-OECD Europe and Eurasia remains one of the most energy intensive among all regions, with a TPES/GDP ratio almost two times as large as the world average.
Middle East

With a production more than 2.5 times as large as its supply, Middle East is the region with the highest energy self-sufficiency ratio in the world. In 2013, the region produced 13% of global energy, 31% of global oil and 16% of global natural gas. In 2013, production increased in the region for natural gas (+5.8%) but decreased for crude oil (-1.1%), influenced by the production trends of specific large producers.

Figure 28 shows that Saudi Arabia is the largest oil producer in the region (41%), followed by UAE, Kuwait and Iran (12%) and Iraq (11%). Iran is also the second largest producer of natural gas, with 29% of the regional production, following Qatar at 31%. Regional trends for 2013 were dominated by increases in Iraqi and UAE oil output (+1% and +5% respectively), but decreases in Kuwaiti and Saudi oil output (-2% each). Iran and Syria also saw decreases in oil output (-4% and -68% respectively). Increases in Qatari and Iraqi natural gas output (+13% and +21% respectively) also dominated the regional trends. Qatar has developed natural gas production at an average annual growth rate of 16% in the last thirteen years.

The Middle East has also dramatically developed its own energy demand. Over the period 1971-2013, TPES grew on average by 7% per year, faster than in any other region in the world. As shown in Figure 29, the supply is almost exclusively based on oil and natural gas. Natural gas has partly displaced oil, doubling its share between 1971 and 2013.

Key factors for the fast development of natural gas in Middle East are power generation and the petrochemical sector. While the share of oil in electricity production shrank from 54% in 1971 to 33% in 2013, the share of natural gas increased from 27% to 64% in the same period. In 2013, natural gas provided almost all the electricity generated in Bahrain, in the United Arab Emirates, Oman and in Qatar.

Figure 29: Total primary energy supply* by fuel

Figure 30 illustrates the growth of consumption in the transport sector, which relies almost exclusively on oil. Oil is responsible for 48% of total consumption in the region as a whole, 90% in Yemen, and 78% in Iraq. Electricity more than doubled its share in final energy consumption (from 5.6% in 1971 to 14.9% in 2013).

Improving energy efficiency remains a key challenge for the region. The fast growth of supply compared to economic output has pushed energy intensity upwards since the early 80's. With a 2013 ratio almost twice as large as the world average, Middle East is second only to Non-OECD Europe and Eurasia in terms of TPES/GDP.