

Fakultet kemijskog inženjerstva i tehnologije  
Zavod za termodinamiku, strojarstvo i energetiku



# ENERGETIKA

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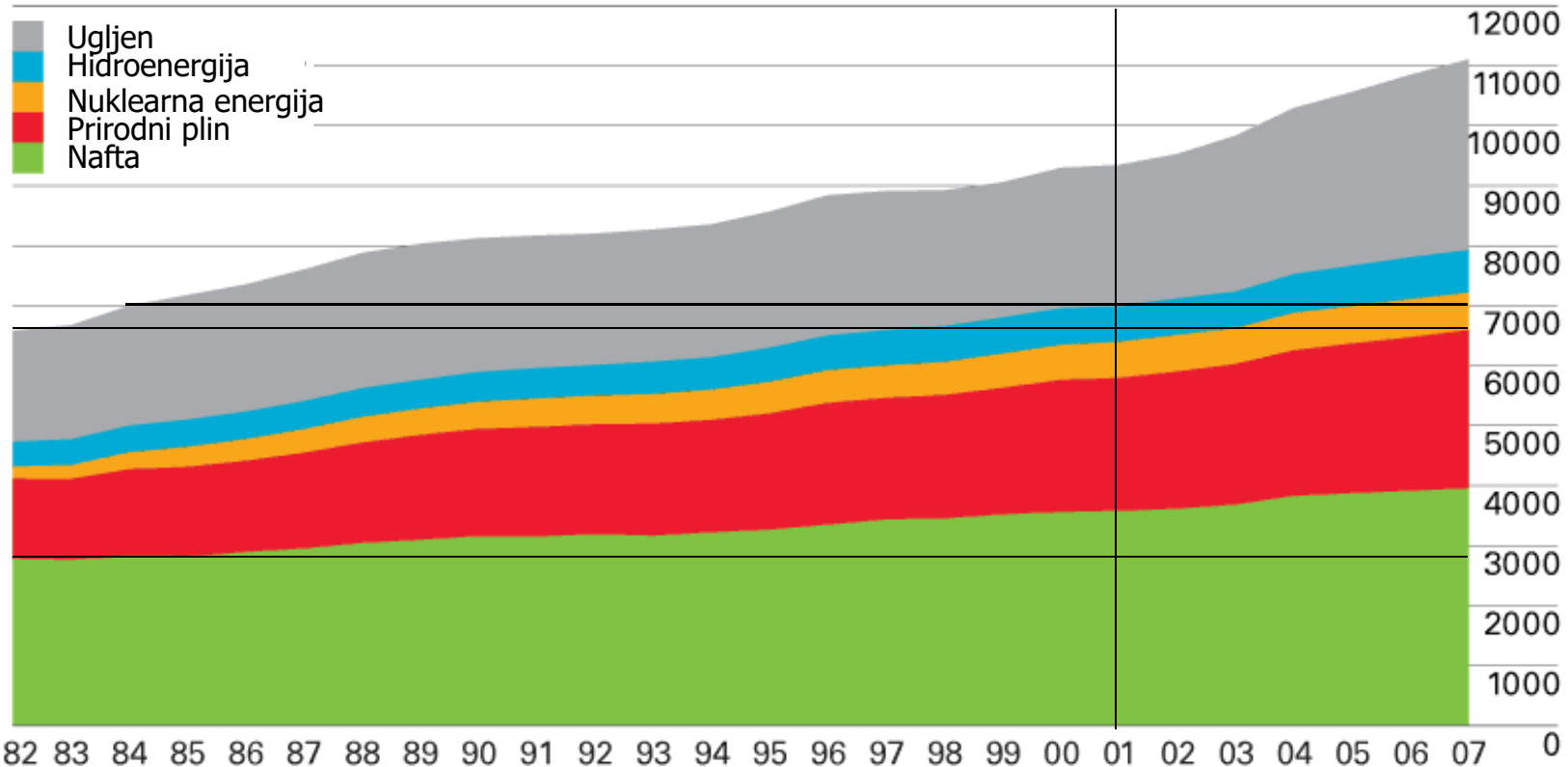
Studij: Kemijsko inženjerstvo (V semestar)

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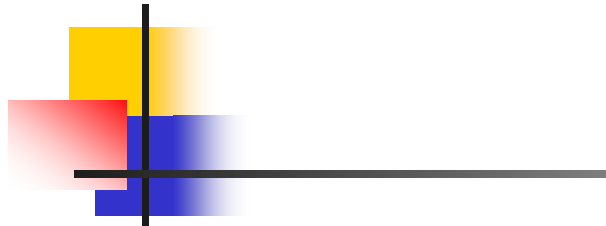
## Potrošnja primarne energije u Svijetu

BP Statistical Review of World Energy 2008.

Svjetska potrošnja, mil. toe



Svjetska potrošnja primarne energije usporila je rast 2007., iako je rast od 2,4% još uvijek iznad 10 godišnjeg prosjeka. Potrošnja ugljena najbrže je rasla, dok je porast potrošnje nafte usporen. Nafta je i dalje najzastupljenije gorivo ali je u šest uzastopnih godina izgubila udio na globalnom tržištu dok je ugljen u šest uzastopnih godina povećao udio na globalnom tržištu.



Starost fosilnih goriva –  
Hrvatski prirodoslovni  
muzej, Demetrova 1,  
Zagreb

GEOLOŠKA RAZDOBLJA		STAROST U MILIJUNIMA GODINA POČEV OD DANAS			
K E N O Z O I K	K V A R T A R	HOLOCEN	0.01	Homo sapiens	
		PLEISTOCEN	1.64	Krapinski pračovjek Plin u Jadranu	
	M I O C E N	PLIOCEN		5.3	Ugljen u sjevernoj Hrvatskoj
		PONT		7.1	
		Pliocen		11.5	Nafta
		Sarmat		13.0	Podravini →
		Baden			Poravini
		Karpat		16.4	
		Oltang		17.2	Plisko jezero
		Eggenburg		18.0	
		Eger		20.5	Ugljen u Hrvatskom Zagorju →
				23.8	
	P A L E O G E N	OLIGOCEN		33.7	Ugljen u Siveriću →
		EOCEN		56.5	Benkovački kamen →
PALEOCEN		65.0			
M E Z O - Z O I K	K R E D A			Brački mramor*	

## Nafta-osnovne činjenice



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Nafta (kao primarni izvor energije) se dijeli na:

- konvencionalnu i
- nekonvencionalnu (teška nafta, bitumen, naftni pijesci, nafta u škriljavcima)



## Koliko ima još nafte? Nitko ne zna!?

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### Konvencionalna nafta:

- 1939. godine tvrdilo se da su zalihe u SAD-u za još 13 godina (sic!)
- 1950. godine tvrdilo se da su zalihe 1 bilijun bbl, a 68 godina kasnije (2008. g.) te su se zalihe čak i povećale (1,238 bilijuna bbl)

## Total proved reserves

	At end 2000 Thousand million barrels	At end 2010 Thousand million barrels	At end 2019 Thousand million barrels	At end 2020			
				Thousand million barrels	Thousand million tonnes	Share of total	R/P ratio
Canada	181.5	174.8	169.1	<b>168.1</b>	<b>27.1</b>	9.7%	89.4
Mexico	24.6	10.4	6.1	<b>6.1</b>	<b>0.9</b>	0.4%	8.7
US	30.4	35.0	68.8	<b>68.8</b>	<b>8.2</b>	4.0%	11.4
<b>Total North America</b>	<b>236.5</b>	<b>220.3</b>	<b>243.9</b>	<b>242.9</b>	<b>36.1</b>	<b>14.0%</b>	<b>28.2</b>
Argentina	3.0	2.5	2.5	<b>2.5</b>	<b>0.3</b>	0.1%	11.3
Brazil	8.5	14.2	12.7	<b>11.9</b>	<b>1.7</b>	0.7%	10.8
Colombia	2.0	1.9	2.0	<b>2.0</b>	<b>0.3</b>	0.1%	7.1
Ecuador	2.7	2.1	1.3	<b>1.3</b>	<b>0.2</b>	0.1%	7.4
Peru	0.9	1.2	0.8	<b>0.7</b>	<b>0.1</b>	•	15.5
Trinidad & Tobago	0.9	0.8	0.2	<b>0.2</b>	<b>†</b>	•	8.7
Venezuela	76.8	296.5	303.8	<b>303.8</b>	<b>48.0</b>	17.5%	*
Other S. & Cent. America	1.3	0.8	0.7	<b>0.8</b>	<b>0.1</b>	•	10.9
<b>Total S. &amp; Cent. America</b>	<b>96.0</b>	<b>320.1</b>	<b>324.0</b>	<b>323.4</b>	<b>50.8</b>	<b>18.7%</b>	<b>151.3</b>
Denmark	1.1	0.9	0.4	<b>0.4</b>	<b>0.1</b>	•	16.2
Italy	0.6	0.6	0.6	<b>0.6</b>	<b>0.1</b>	•	14.7
Norway	11.4	6.8	8.5	<b>7.9</b>	<b>1.0</b>	0.5%	10.8
Romania	1.2	0.6	0.6	<b>0.6</b>	<b>0.1</b>	•	22.7
United Kingdom	4.7	2.8	2.5	<b>2.5</b>	<b>0.3</b>	0.1%	6.6
Other Europe	2.1	1.9	1.6	<b>1.6</b>	<b>0.2</b>	0.1%	14.9
<b>Total Europe</b>	<b>21.0</b>	<b>13.6</b>	<b>14.2</b>	<b>13.6</b>	<b>1.8</b>	<b>0.8%</b>	<b>10.4</b>
Azerbaijan	1.2	7.0	7.0	<b>7.0</b>	<b>1.0</b>	0.4%	26.7
Kazakhstan	5.4	30.0	30.0	<b>30.0</b>	<b>3.9</b>	1.7%	45.3
Russian Federation	112.1	105.8	107.8	<b>107.8</b>	<b>14.8</b>	6.2%	27.6
Turkmenistan	0.5	0.6	0.6	<b>0.6</b>	<b>0.1</b>	•	7.6
Uzbekistan	0.6	0.6	0.6	<b>0.6</b>	<b>0.1</b>	•	34.7
Other CIS	0.3	0.3	0.3	<b>0.3</b>	<b>†</b>	•	17.3
<b>Total CIS</b>	<b>120.1</b>	<b>144.2</b>	<b>146.2</b>	<b>146.2</b>	<b>19.9</b>	<b>8.4%</b>	<b>29.6</b>
Iran	99.5	151.2	157.8	<b>157.8</b>	<b>21.7</b>	9.1%	139.8
Iraq	112.5	115.0	145.0	<b>145.0</b>	<b>19.6</b>	8.4%	96.3
Kuwait	96.5	101.5	101.5	<b>101.5</b>	<b>14.0</b>	5.9%	103.2
Oman	5.8	5.5	5.4	<b>5.4</b>	<b>0.7</b>	0.3%	15.4
Qatar	16.9	24.7	25.2	<b>25.2</b>	<b>2.6</b>	1.5%	38.1
Saudi Arabia	262.8	264.5	297.6	<b>297.5</b>	<b>40.9</b>	17.2%	73.6
Syria	2.3	2.5	2.5	<b>2.5</b>	<b>0.3</b>	0.1%	158.8
United Arab Emirates	97.8	97.8	97.8	<b>97.8</b>	<b>13.0</b>	5.6%	73.1
Yemen	2.4	3.0	3.0	<b>3.0</b>	<b>0.4</b>	0.2%	86.7
Other Middle East	0.2	0.3	0.2	<b>0.2</b>	<b>†</b>	•	2.6
<b>Total Middle East</b>	<b>696.7</b>	<b>765.9</b>	<b>836.0</b>	<b>835.9</b>	<b>113.2</b>	<b>48.3%</b>	<b>82.6</b>

## Total proved reserves

	At end 2000	At end 2010	At end 2019	At end 2020			
	Thousand million barrels	Thousand million barrels	Thousand million barrels	Thousand million barrels	Thousand million tonnes	Share of total	R/P ratio
Algeria	11.3	12.2	12.2	<b>12.2</b>	<b>1.5</b>	0.7%	25.0
Angola	6.0	9.1	7.8	<b>7.8</b>	<b>1.1</b>	0.4%	16.1
Chad	0.9	1.5	1.5	<b>1.5</b>	<b>0.2</b>	0.1%	32.5
Republic of Congo	1.5	2.0	2.9	<b>2.9</b>	<b>0.4</b>	0.2%	25.7
Egypt	3.6	4.5	3.1	<b>3.1</b>	<b>0.4</b>	0.2%	14.0
Equatorial Guinea	0.8	1.7	1.1	<b>1.1</b>	<b>0.1</b>	0.1%	18.7
Gabon	2.4	2.0	2.0	<b>2.0</b>	<b>0.3</b>	0.1%	26.4
Libya	36.0	47.1	48.4	<b>48.4</b>	<b>6.3</b>	2.8%	339.2
Nigeria	29.0	37.2	36.9	<b>36.9</b>	<b>5.0</b>	2.1%	56.1
South Sudan	n/a	n/a	3.5	<b>3.5</b>	<b>0.5</b>	0.2%	56.4
Sudan	0.3	5.0	1.5	<b>1.5</b>	<b>0.2</b>	0.1%	47.9
Tunisia	0.4	0.4	0.4	<b>0.4</b>	<b>0.1</b>	*	32.7
Other Africa	0.7	2.3	3.7	<b>3.8</b>	<b>0.5</b>	0.2%	33.2
<b>Total Africa</b>	<b>92.9</b>	<b>124.9</b>	<b>125.0</b>	<b>125.1</b>	<b>16.6</b>	<b>7.2%</b>	<b>49.8</b>
Australia	4.9	3.8	2.4	<b>2.4</b>	<b>0.3</b>	0.1%	13.9
Brunei	1.2	1.1	1.1	<b>1.1</b>	<b>0.1</b>	0.1%	27.3
China	15.2	23.3	26.0	<b>26.0</b>	<b>3.5</b>	1.5%	18.2
India	5.3	5.8	4.7	<b>4.5</b>	<b>0.6</b>	0.3%	16.1
Indonesia	5.1	4.2	2.5	<b>2.4</b>	<b>0.3</b>	0.1%	9.0
Malaysia	2.1	3.6	2.7	<b>2.7</b>	<b>0.4</b>	0.2%	12.5
Thailand	0.5	0.4	0.3	<b>0.3</b>	<b>†</b>	*	1.7
Vietnam	2.0	4.4	4.4	<b>4.4</b>	<b>0.6</b>	0.3%	58.1
Other Asia Pacific	1.3	1.1	1.4	<b>1.3</b>	<b>0.2</b>	0.1%	17.4
<b>Total Asia Pacific</b>	<b>37.7</b>	<b>47.8</b>	<b>45.3</b>	<b>45.2</b>	<b>6.1</b>	<b>2.6%</b>	<b>16.6</b>
<b>Total World</b>	<b>1300.9</b>	<b>1636.9</b>	<b>1734.8</b>	<b>1732.4</b>	<b>244.4</b>	<b>100.0%</b>	<b>53.5</b>
of which: OECD	262.7	238.5	261.5	<b>260.0</b>	<b>38.3</b>	15.0%	25.2
Non-OECD	1038.2	1398.3	1473.3	<b>1472.4</b>	<b>206.1</b>	85.0%	66.9
OPEC	833.0	1137.7	1214.7	<b>1214.7</b>	<b>171.8</b>	70.1%	108.3
Non-OPEC	468.0	499.1	520.1	<b>517.7</b>	<b>72.6</b>	29.9%	24.5
European Union	3.9	3.2	2.4	<b>2.4</b>	<b>0.3</b>	0.1%	16.8
Canadian oil sands: Total	174.9	169.2	162.4	<b>161.4</b>	<b>26.2</b>	9.3%	
of which: Under active development	11.7	25.9	19.9	<b>18.9</b>	<b>3.1</b>	1.1%	
Venezuela: Orinoco Belt	-	220.0	261.8	<b>261.8</b>	<b>42.0</b>	15.1%	

Source of data – the estimates in this table have been compiled using a combination of primary official sources, third-party data from the OPEC Secretariat, World Oil, Oil & Gas Journal and Chinese reserves based on official data and information in the public domain.

† Less than 0.05.

\* Less than 0.05%.

n/a not available.

\* More than 500 years.

**Notes:** Total proved reserves of oil – generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions. The data series for total proved oil reserves does not necessarily meet the definitions, guidelines and practices used for determining proved reserves at company level, for instance as published by the US Securities and Exchange Commission, nor does it necessarily represent bp's view of proved reserves by country.

**Reserves-to-production (R/P) ratio** – if the reserves remaining at the end of any year are divided by the production in that year, the result is the length of time that those remaining reserves would last if production were to continue at that rate.

Canadian oil sands 'under active development' are an official estimate. Venezuelan Orinoco Belt reserves are based on the OPEC Secretariat and government announcements.

Reserves and R/P ratio for Canada includes Canadian oil sands. Reserves and R/P ratio for Venezuela includes the Orinoco Belt. Saudi Arabia's oil reserves include NGLs from 2017.

**Reserves include gas condensate and natural gas liquids (NGLs) as well as crude oil.**

**Shares of total and R/P ratios are calculated using thousand million barrels figures.**

## Oil: Production in thousands of barrels per day\*

Thousand barrels daily	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Growth rate per annum		Share 2021
												2021	2011-21	
Canada	3515	3740	4000	4271	4388	4464	4813	5244	5372	5130	<b>5429</b>	5.8%	4.4%	6.0%
Mexico	2940	2911	2882	2792	2593	2461	2227	2072	1921	1912	<b>1928</b>	0.8%	-4.1%	2.1%
US	7890	8931	10103	11807	12783	12354	13140	15310	17114	16458	<b>16585</b>	0.8%	7.7%	18.5%
<b>Total North America</b>	<b>14345</b>	<b>15583</b>	<b>16986</b>	<b>18869</b>	<b>19765</b>	<b>19278</b>	<b>20180</b>	<b>22625</b>	<b>24407</b>	<b>23500</b>	<b>23942</b>	<b>1.9%</b>	<b>5.3%</b>	<b>26.6%</b>
Argentina	667	657	644	638	646	610	590	591	620	601	<b>627</b>	4.4%	-0.6%	0.7%
Brazil	2179	2145	2110	2341	2525	2607	2731	2691	2890	3030	<b>2987</b>	-1.4%	3.2%	3.3%
Colombia	915	944	1010	990	1006	886	854	865	886	781	<b>738</b>	-5.5%	-2.1%	0.8%
Ecuador	501	505	527	557	543	548	531	517	531	479	<b>473</b>	-1.4%	-0.6%	0.5%
Peru	159	157	171	175	153	141	136	139	144	131	<b>128</b>	-2.8%	-2.1%	0.1%
Trinidad & Tobago	136	117	116	114	109	97	99	87	82	76	<b>77</b>	0.5%	-5.6%	0.1%
Venezuela	2755	2704	2680	2692	2864	2566	2220	1631	1022	640	<b>654</b>	2.1%	-13.4%	0.7%
Other S. & Cent. America	144	147	152	155	146	135	133	128	122	186	<b>225</b>	20.9%	4.5%	0.2%
<b>Total S. &amp; Cent. America</b>	<b>7456</b>	<b>7375</b>	<b>7411</b>	<b>7662</b>	<b>7991</b>	<b>7589</b>	<b>7295</b>	<b>6649</b>	<b>6297</b>	<b>5925</b>	<b>5909</b>	<b>-0.3%</b>	<b>-2.3%</b>	<b>6.6%</b>
Denmark	225	204	178	167	158	142	138	116	103	72	<b>65</b>	-10.2%	-11.7%	0.1%
Italy	110	112	114	120	113	78	86	97	89	112	<b>100</b>	-10.0%	-0.9%	0.1%
Norway	2040	1917	1838	1886	1946	1997	1971	1851	1762	2003	<b>2025</b>	1.1%	-0.1%	2.3%
Romania	89	83	86	84	83	79	76	75	75	72	<b>70</b>	-3.6%	-2.4%	0.1%
United Kingdom	1114	947	865	854	964	1015	1005	1092	1118	1049	<b>874</b>	-16.6%	-2.4%	1.0%
Other Europe	336	336	344	339	331	313	303	308	302	290	<b>286</b>	-1.3%	-1.6%	0.3%
<b>Total Europe</b>	<b>3913</b>	<b>3600</b>	<b>3426</b>	<b>3450</b>	<b>3596</b>	<b>3623</b>	<b>3579</b>	<b>3538</b>	<b>3449</b>	<b>3597</b>	<b>3420</b>	<b>-4.9%</b>	<b>-1.3%</b>	<b>3.8%</b>
Azerbaijan	932	882	888	861	851	838	793	796	775	714	<b>722</b>	1.2%	-2.5%	0.8%
Kazakhstan	1684	1664	1737	1710	1695	1655	1838	1904	1919	1806	<b>1811</b>	0.3%	0.7%	2.0%
Russian Federation	10533	10656	10807	10927	11087	11342	11374	11562	11679	10667	<b>10944</b>	2.6%	0.4%	12.2%
Turkmenistan	234	244	256	263	271	270	269	259	254	219	<b>252</b>	15.3%	0.8%	0.3%
Uzbekistan	80	72	69	63	60	57	61	64	67	61	<b>60</b>	-2.2%	-2.8%	0.1%
Other CIS	36	35	35	35	36	36	37	38	39	39	<b>40</b>	1.0%	1.0%	•
<b>Total CIS</b>	<b>13500</b>	<b>13553</b>	<b>13791</b>	<b>13859</b>	<b>13998</b>	<b>14198</b>	<b>14371</b>	<b>14622</b>	<b>14733</b>	<b>13506</b>	<b>13829</b>	<b>2.4%</b>	<b>0.2%</b>	<b>15.4%</b>

Svjetska proizvodnja sirove nafte povećala se za 1.4 milijun b/d u 2021. s udjelom OPEC+ zemalja od tri četvrtine u tom povećanju.



## Oil: Production in thousands of barrels per day\*

Thousand barrels daily	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Growth rate per annum		Share 2021
												2021	2011-21	
Iran	4452	3810	3609	3714	3853	4578	4854	4608	3399	3084	<b>3620</b>	17.4%	-2.0%	4.0%
Iraq	2773	3079	3099	3239	3986	4423	4538	4632	4779	4114	<b>4102</b>	-0.3%	4.0%	4.6%
Kuwait	2918	3173	3134	3106	3069	3150	3009	3050	2976	2695	<b>2741</b>	1.7%	-0.6%	3.0%
Oman	885	918	942	943	981	1004	971	978	971	951	<b>971</b>	2.2%	0.9%	1.1%
Qatar	1824	1868	1887	1881	1805	1790	1756	1793	1727	1714	<b>1746</b>	1.9%	-0.4%	1.9%
Saudi Arabia	11079	11622	11393	11519	11998	12406	11892	12261	11832	11039	<b>10954</b>	-0.8%	-0.1%	12.2%
Syria	353	171	59	33	27	25	25	24	34	43	<b>96</b>	123.2%	-12.2%	0.1%
United Arab Emirates	3300	3425	3566	3603	3898	4038	3910	3912	3999	3693	<b>3668</b>	-0.7%	1.1%	4.1%
Yemen	220	178	197	153	63	43	71	94	95	88	<b>67</b>	-23.7%	-11.2%	0.1%
Other Middle East	201	184	208	214	213	214	208	207	214	188	<b>191</b>	1.1%	-0.6%	0.2%
<b>Total Middle East</b>	<b>28007</b>	<b>28426</b>	<b>28096</b>	<b>28404</b>	<b>29893</b>	<b>31670</b>	<b>31233</b>	<b>31559</b>	<b>30026</b>	<b>27609</b>	<b>28156</b>	<b>2.0%</b>	<b>0.1%</b>	<b>31.3%</b>
Algeria	1642	1537	1485	1589	1558	1577	1540	1511	1487	1330	<b>1353</b>	1.7%	-1.9%	1.5%
Angola	1670	1734	1738	1701	1796	1745	1671	1519	1420	1318	<b>1164</b>	-11.6%	-3.5%	1.3%
Chad	114	101	91	89	111	117	98	116	127	126	<b>116</b>	-7.7%	0.2%	0.1%
Republic of Congo	301	280	243	253	234	232	270	330	336	307	<b>274</b>	-10.7%	-0.9%	0.3%
Egypt	714	715	710	714	726	691	660	674	653	632	<b>608</b>	-3.8%	-1.6%	0.7%
Equatorial Guinea	301	320	282	284	260	223	195	176	160	158	<b>140</b>	-11.7%	-7.4%	0.2%
Gabon	236	221	213	211	214	221	210	193	218	207	<b>181</b>	-12.7%	-2.6%	0.2%
Libya	516	1539	1048	518	437	412	929	1165	1228	425	<b>1269</b>	198.4%	9.4%	1.4%
Nigeria	2459	2409	2276	2273	2199	1898	1968	2005	2101	1828	<b>1626</b>	-11.1%	-4.1%	1.8%
South Sudan	-	31	100	155	148	137	147	144	172	165	<b>153</b>	-7.3%	-	0.2%
Sudan	291	103	118	120	109	84	70	74	72	63	<b>64</b>	1.1%	-14.0%	0.1%
Tunisia	73	73	68	63	57	54	46	44	41	37	<b>45</b>	21.3%	-4.6%	0.1%
Other Africa	200	208	242	247	276	270	317	315	348	331	<b>293</b>	-11.5%	3.9%	0.3%
<b>Total Africa</b>	<b>8516</b>	<b>9271</b>	<b>8613</b>	<b>8218</b>	<b>8123</b>	<b>7661</b>	<b>8123</b>	<b>8269</b>	<b>8362</b>	<b>6928</b>	<b>7286</b>	<b>5.2%</b>	<b>-1.5%</b>	<b>8.1%</b>
Australia	479	472	401	420	378	353	322	342	453	453	<b>435</b>	-3.9%	-1.0%	0.5%
Brunei	165	159	135	126	127	121	113	112	121	110	<b>107</b>	-3.2%	-4.3%	0.1%
China	4074	4155	4216	4246	4309	3999	3846	3802	3848	3901	<b>3994</b>	2.4%	-0.2%	4.4%
India	937	926	926	905	893	874	885	869	826	771	<b>746</b>	-3.2%	-2.3%	0.8%
Indonesia	952	917	871	847	838	873	837	808	781	742	<b>692</b>	-6.8%	-3.1%	0.8%
Malaysia	659	663	627	649	696	726	718	713	672	616	<b>573</b>	-7.0%	-1.4%	0.6%
Thailand	429	471	466	464	481	489	486	475	475	421	<b>398</b>	-5.3%	-0.7%	0.4%
Vietnam	316	347	346	325	352	317	284	257	236	207	<b>192</b>	-7.2%	-4.8%	0.2%
Other Asia Pacific	302	291	274	296	298	281	273	234	230	208	<b>199</b>	-4.7%	-4.1%	0.2%
<b>Total Asia Pacific</b>	<b>8314</b>	<b>8401</b>	<b>8263</b>	<b>8279</b>	<b>8372</b>	<b>8033</b>	<b>7765</b>	<b>7610</b>	<b>7642</b>	<b>7428</b>	<b>7335</b>	<b>-1.3%</b>	<b>-1.2%</b>	<b>8.2%</b>
<b>Total World</b>	<b>84050</b>	<b>86208</b>	<b>86584</b>	<b>88741</b>	<b>91737</b>	<b>92053</b>	<b>92546</b>	<b>94874</b>	<b>94916</b>	<b>88494</b>	<b>89877</b>	<b>1.6%</b>	<b>0.7%</b>	<b>100.0%</b>
of which: OECD	19517	20460	21673	23594	24612	24011	24811	27236	29056	28198	<b>28405</b>	0.7%	3.8%	31.6%
Non-OECD	64534	65749	64911	65147	67126	68041	67735	67638	65860	60296	<b>61471</b>	1.9%	-0.5%	68.4%
OPEC	34402	35851	34767	34703	36364	37467	37206	36995	34957	30839	<b>31745</b>	2.9%	-0.8%	35.3%
Non-OPEC	49648	50358	51818	54038	55373	54586	55340	57879	59959	57655	<b>58131</b>	0.8%	1.6%	64.7%
European Union	600	572	560	552	535	471	465	448	415	393	<b>366</b>	-7.0%	-4.8%	0.4%

Source: includes data from FGE Iran Service.

\*Includes crude oil, shale oil, oil sands, condensates (lease condensate or gas condensates that require further refining) and NGLs (natural gas liquids – ethane, LPG and naphtha separated from the production of natural gas).

Excludes liquid fuels from other sources such as biofuels and synthetic derivatives of coal and natural gas. This also excludes liquid fuel adjustment factors such as refinery processing gain.

Excludes oil shales/kerogen extracted in solid form.

\*Less than 0.05%.

**Note: Annual changes and shares of total are calculated using thousand barrels daily figures.**

Growth rates are adjusted for leap years.

## Oil: Consumption in thousands of barrels per day\*

Thousand barrels daily	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Growth rate per annum		Share 2021
												2021	2011-21	
Canada	2400	2426	2422	2420	2443	2453	2424	2501	2491	2191	2229	1.7%	-0.7%	2.4%
Mexico	2065	2063	2034	1960	1939	1950	1883	1836	1698	1313	1350	2.9%	-4.2%	1.4%
US	17993	17581	17992	18111	18499	18593	18845	19417	19424	17183	18684	8.7%	0.4%	19.9%
<b>Total North America</b>	<b>22458</b>	<b>22090</b>	<b>22448</b>	<b>22491</b>	<b>22881</b>	<b>22996</b>	<b>23153</b>	<b>23753</b>	<b>23613</b>	<b>20687</b>	<b>22264</b>	<b>7.6%</b>	<b>-0.1%</b>	<b>23.7%</b>
Argentina	612	647	688	678	694	675	670	640	572	518	598	15.4%	-0.2%	0.6%
Brazil	2434	2519	2656	2729	2488	2370	2407	2293	2303	2134	2252	5.5%	-0.8%	2.4%
Chile	371	376	362	353	355	377	364	379	383	349	365	4.4%	-0.2%	0.4%
Colombia	259	279	277	292	312	320	313	322	340	277	349	26.0%	3.0%	0.4%
Ecuador	226	233	247	260	254	239	236	255	249	202	247	22.5%	0.9%	0.3%
Peru	211	211	222	221	235	250	260	267	278	210	266	26.3%	2.3%	0.3%
Trinidad & Tobago	42	40	45	41	45	47	44	41	32	28	25	-10.4%	-5.0%	•
Venezuela	721	785	835	746	697	537	493	410	339	277	289	4.3%	-8.7%	0.3%
Central America	366	369	372	386	420	435	444	423	454	382	433	13.5%	1.7%	0.5%
Other Caribbean	637	617	591	581	604	624	611	622	617	511	569	11.3%	-1.1%	0.6%
Other South America	186	189	193	193	198	210	216	223	225	211	229	8.4%	2.1%	0.2%
<b>Total S. &amp; Cent. America</b>	<b>6066</b>	<b>6264</b>	<b>6491</b>	<b>6481</b>	<b>6302</b>	<b>6085</b>	<b>6057</b>	<b>5877</b>	<b>5791</b>	<b>5100</b>	<b>5622</b>	<b>10.2%</b>	<b>-0.8%</b>	<b>6.0%</b>
Austria	244	244	252	242	241	249	252	255	265	229	236	2.8%	-0.4%	0.3%
Belgium	624	602	624	620	641	644	653	693	651	568	638	12.4%	0.2%	0.7%
Bulgaria	80	83	77	84	94	95	99	98	102	91	96	5.4%	1.8%	0.1%
Croatia	72	65	63	65	68	68	73	71	69	59	65	9.8%	-1.1%	0.1%
Cyprus	55	51	46	45	46	51	52	52	52	44	45	3.3%	-1.9%	•
Czech Republic	191	189	181	192	184	172	205	207	209	181	200	10.6%	0.5%	0.2%
Denmark	165	153	152	153	155	153	152	154	154	127	128	1.1%	-2.5%	0.1%
Estonia	27	32	31	29	29	29	30	30	27	28	29	3.7%	0.6%	•
Finland	202	194	208	197	196	206	200	200	199	178	178	-0.4%	-1.3%	0.2%
France	1686	1609	1596	1544	1544	1529	1540	1538	1528	1307	1424	9.0%	-1.6%	1.5%
Germany	2294	2276	2336	2273	2269	2307	2374	2255	2270	2049	2045	-0.2%	-1.1%	2.2%
Greece	350	305	282	281	294	293	298	294	304	246	249	1.5%	-3.3%	0.3%
Hungary	138	129	128	142	153	150	164	175	176	161	171	6.3%	2.2%	0.2%
Iceland	14	14	15	16	17	19	21	23	19	13	13	2.2%	-1.1%	•
Ireland	147	138	138	137	143	149	149	155	153	130	133	2.0%	-1.0%	0.1%
Italy	1465	1367	1261	1196	1264	1255	1274	1300	1259	1039	1156	11.2%	-2.3%	1.2%
Latvia	33	33	33	34	35	36	37	34	38	33	34	2.0%	0.3%	•
Lithuania	52	53	52	51	55	60	62	66	66	61	64	4.6%	2.1%	0.1%
Luxembourg	60	58	57	55	54	54	57	60	61	49	51	3.6%	-1.7%	0.1%
Netherlands	962	916	889	856	826	843	818	843	812	740	742	0.3%	-2.6%	0.8%
North Macedonia	20	19	19	19	20	22	21	21	22	20	24	16.0%	1.9%	•
Norway	222	215	226	216	217	210	212	221	213	204	199	-2.3%	-1.1%	0.2%
Poland	574	552	520	521	542	594	646	663	679	640	687	7.4%	1.8%	0.7%
Portugal	249	225	235	241	238	241	240	239	247	202	208	3.2%	-1.8%	0.2%
Romania	186	186	170	184	186	195	206	212	221	205	225	9.5%	1.9%	0.2%
Slovakia	78	72	72	67	73	76	86	87	83	82	86	4.9%	1.1%	0.1%
Slovenia	54	53	50	49	49	52	53	55	52	44	47	6.8%	-1.5%	•
Spain	1330	1237	1169	1165	1209	1252	1260	1286	1287	1056	1169	10.7%	-1.3%	1.2%
Sweden	295	292	291	285	279	289	286	273	292	255	270	5.9%	-0.9%	0.3%
Switzerland	234	238	249	224	226	214	219	212	216	179	181	0.9%	-2.5%	0.2%
Turkey	672	702	748	771	915	973	1022	989	999	913	939	2.9%	3.4%	1.0%
Ukraine	291	287	274	244	215	228	230	240	239	227	237	4.4%	-2.0%	0.3%
United Kingdom	1561	1508	1490	1491	1538	1587	1594	1569	1522	1172	1236	5.5%	-2.3%	1.3%
Other Europe	320	299	297	294	305	326	342	338	347	314	322	2.7%	0.1%	0.3%
<b>Total Europe</b>	<b>14927</b>	<b>14396</b>	<b>14232</b>	<b>13980</b>	<b>14321</b>	<b>14622</b>	<b>14928</b>	<b>14903</b>	<b>14831</b>	<b>12846</b>	<b>13527</b>	<b>5.3%</b>	<b>-1.0%</b>	<b>14.4%</b>
Azerbaijan	89	92	101	99	100	98	99	104	105	91	95	4.3%	0.7%	0.1%
Belarus	174	213	160	164	138	147	147	171	174	167	159	-4.3%	-0.9%	0.2%
Kazakhstan	270	288	297	304	289	304	313	338	345	302	327	8.3%	2.0%	0.3%
Russian Federation	3094	3140	3163	3300	3197	3275	3280	3310	3376	3210	3407	6.1%	1.0%	3.6%
Turkmenistan	125	129	137	143	145	143	144	145	146	140	146	4.5%	1.6%	0.2%
Uzbekistan	104	88	83	82	83	86	87	95	95	83	90	8.8%	-1.5%	0.1%
Other CIS	65	75	78	76	78	86	82	96	89	77	84	8.6%	2.5%	0.1%
<b>Total CIS</b>	<b>3920</b>	<b>4025</b>	<b>4020</b>	<b>4168</b>	<b>4029</b>	<b>4140</b>	<b>4152</b>	<b>4259</b>	<b>4331</b>	<b>4069</b>	<b>4307</b>	<b>5.9%</b>	<b>0.9%</b>	<b>4.6%</b>

## Oil: Consumption in thousands of barrels per day\*

Thousand barrels daily	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Growth rate per annum		Share 2021
												2021	2011-21	
Iran	1715	1762	1879	1765	1580	1579	1656	1728	1784	1673	1690	1.0%	-0.1%	1.8%
Iraq	564	619	688	650	630	687	720	847	720	629	722	14.8%	2.5%	0.8%
Israel	233	274	212	199	211	216	226	229	231	200	209	4.6%	-1.1%	0.2%
Kuwait	467	467	477	488	475	449	470	481	471	441	450	1.9%	-0.4%	0.5%
Oman	146	157	178	185	184	187	224	232	224	190	209	9.8%	3.6%	0.2%
Qatar	244	260	303	312	356	369	335	347	369	296	311	5.1%	2.5%	0.3%
Saudi Arabia	3285	3451	3444	3779	3901	3962	3870	3762	3691	3552	3595	1.2%	0.9%	3.8%
United Arab Emirates	723	766	847	858	927	1021	1006	1004	972	855	952	11.4%	2.8%	1.0%
Other Middle East	735	696	653	652	566	535	570	552	541	482	502	4.1%	-3.7%	0.5%
<b>Total Middle East</b>	<b>8112</b>	<b>8451</b>	<b>8681</b>	<b>8989</b>	<b>8829</b>	<b>9005</b>	<b>9078</b>	<b>9182</b>	<b>9004</b>	<b>8318</b>	<b>8640</b>	<b>3.9%</b>	<b>0.6%</b>	<b>9.2%</b>
Algeria	349	370	387	401	425	412	408	416	431	385	403	4.7%	1.4%	0.4%
Egypt	740	750	759	791	810	836	801	721	686	598	648	8.3%	-1.3%	0.7%
Morocco	275	277	282	272	268	275	291	287	293	258	286	10.8%	0.4%	0.3%
South Africa	532	542	552	544	601	576	575	575	569	465	502	7.9%	-0.6%	0.5%
Eastern Africa	447	466	492	513	559	569	604	626	626	549	588	7.1%	2.8%	0.6%
Middle Africa	230	251	284	298	290	267	252	251	262	239	257	7.6%	1.1%	0.3%
Western Africa	543	573	594	555	563	623	679	787	801	790	856	8.4%	4.7%	0.9%
Other Northern Africa	263	332	347	358	318	295	303	308	318	269	326	21.0%	2.1%	0.3%
Other Southern Africa	49	51	54	56	57	56	57	58	59	54	56	3.4%	1.3%	0.1%
<b>Total Africa</b>	<b>3428</b>	<b>3612</b>	<b>3752</b>	<b>3788</b>	<b>3891</b>	<b>3910</b>	<b>3970</b>	<b>4030</b>	<b>4046</b>	<b>3608</b>	<b>3922</b>	<b>8.7%</b>	<b>1.4%</b>	<b>4.2%</b>
Australia	980	1001	1031	1025	1015	1016	1063	1076	1064	916	943	3.0%	-0.4%	1.0%
Bangladesh	104	110	108	120	127	138	156	178	171	156	179	14.6%	5.6%	0.2%
China	9630	10061	10563	11018	11890	12297	13003	13642	14321	14408	15442	7.2%	4.8%	16.4%
China Hong Kong SAR	360	344	352	335	367	380	428	434	408	285	255	-10.5%	-3.4%	0.3%
India	3475	3674	3717	3832	4147	4544	4724	4974	5150	4701	4878	3.8%	3.5%	5.2%
Indonesia	1530	1612	1572	1572	1505	1454	1565	1616	1578	1398	1471	5.2%	-0.4%	1.6%
Japan	4410	4676	4499	4283	4116	3983	3949	3815	3692	3269	3341	2.2%	-2.7%	3.6%
Malaysia	696	757	802	803	753	839	797	804	868	749	763	1.8%	0.9%	0.8%
New Zealand	152	150	152	155	161	165	175	174	178	147	144	-1.9%	-0.6%	0.2%
Pakistan	414	402	442	458	505	566	589	498	446	437	503	15.1%	2.0%	0.5%
Philippines	292	301	316	336	384	413	445	450	459	378	412	9.1%	3.5%	0.4%
Singapore	1208	1202	1217	1259	1329	1372	1405	1432	1403	1343	1330	-1.0%	1.0%	1.4%
South Korea	2388	2466	2476	2473	2586	2811	2804	2800	2789	2630	2813	6.9%	1.6%	3.0%
Sri Lanka	102	109	94	106	111	134	130	126	135	123	119	-3.3%	1.5%	0.1%
Taiwan	961	950	987	1017	1041	1047	1032	1039	986	946	989	4.5%	0.3%	1.1%
Thailand	1140	1201	1216	1227	1265	1294	1336	1362	1374	1214	1214	•	0.6%	1.3%
Vietnam	358	362	375	397	482	524	552	581	599	493	464	-5.8%	2.6%	0.5%
Other Asia Pacific	322	333	352	378	424	432	434	486	510	524	546	4.2%	5.4%	0.6%
<b>Total Asia Pacific</b>	<b>28522</b>	<b>29709</b>	<b>30273</b>	<b>30795</b>	<b>32211</b>	<b>33410</b>	<b>34586</b>	<b>35486</b>	<b>36131</b>	<b>34117</b>	<b>35806</b>	<b>4.9%</b>	<b>2.3%</b>	<b>38.1%</b>
<b>Total World</b>	<b>87433</b>	<b>88547</b>	<b>89897</b>	<b>90592</b>	<b>92464</b>	<b>94169</b>	<b>95924</b>	<b>97490</b>	<b>97747</b>	<b>88746</b>	<b>94088</b>	<b>6.0%</b>	<b>0.7%</b>	<b>100.0%</b>
of which: OECD	45155	44716	44746	44317	45026	45522	45952	46420	46070	40360	42941	6.4%	-0.5%	45.6%
Non-OECD	42278	43831	45151	46275	47439	48647	49972	51070	51677	48386	51147	5.7%	1.9%	54.4%
European Union	11637	11157	10955	10749	10913	11090	11319	11345	11307	9853	10421	5.8%	-1.1%	11.1%

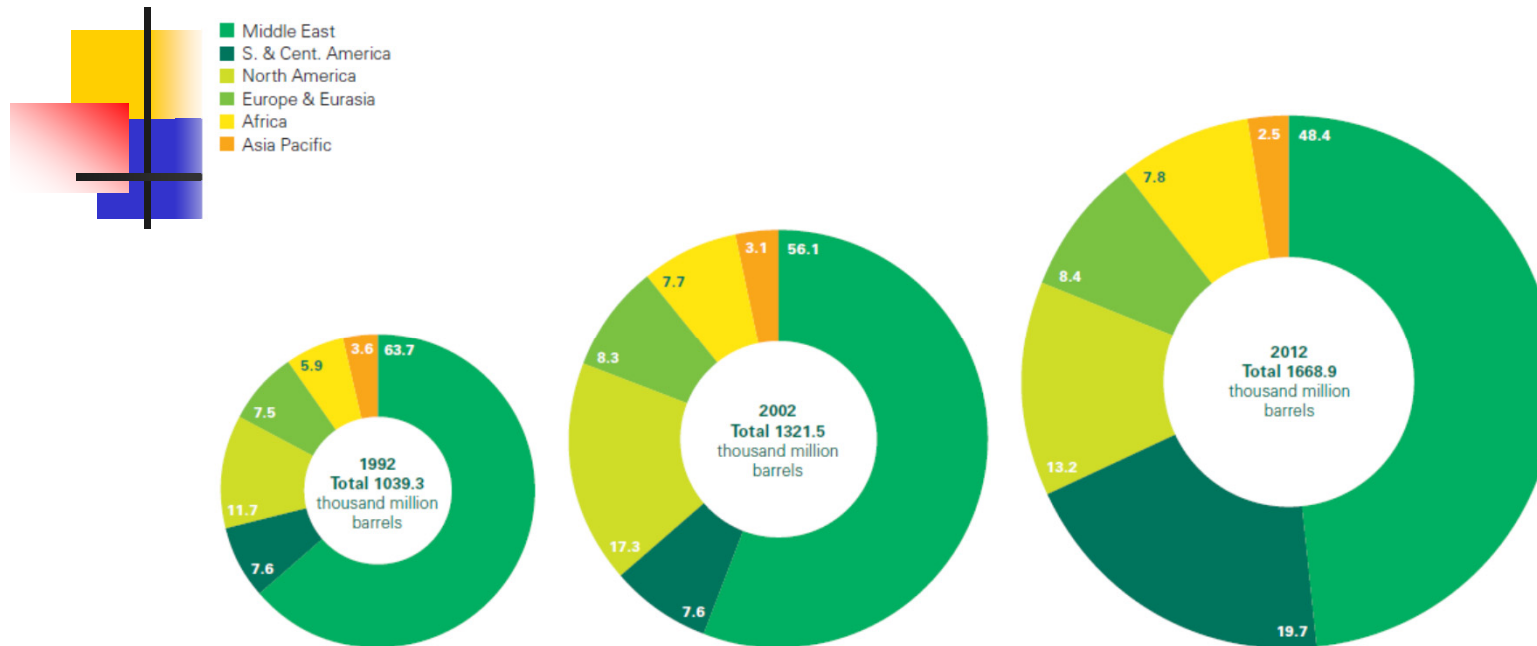
\*Inland demand plus international aviation and marine bunkers and refinery fuel and loss. Consumption of biogasoline (such as ethanol), biodiesel and derivatives of coal and natural gas are excluded. Derivatives of coal and natural gas are included.

•Less than 0.05%.

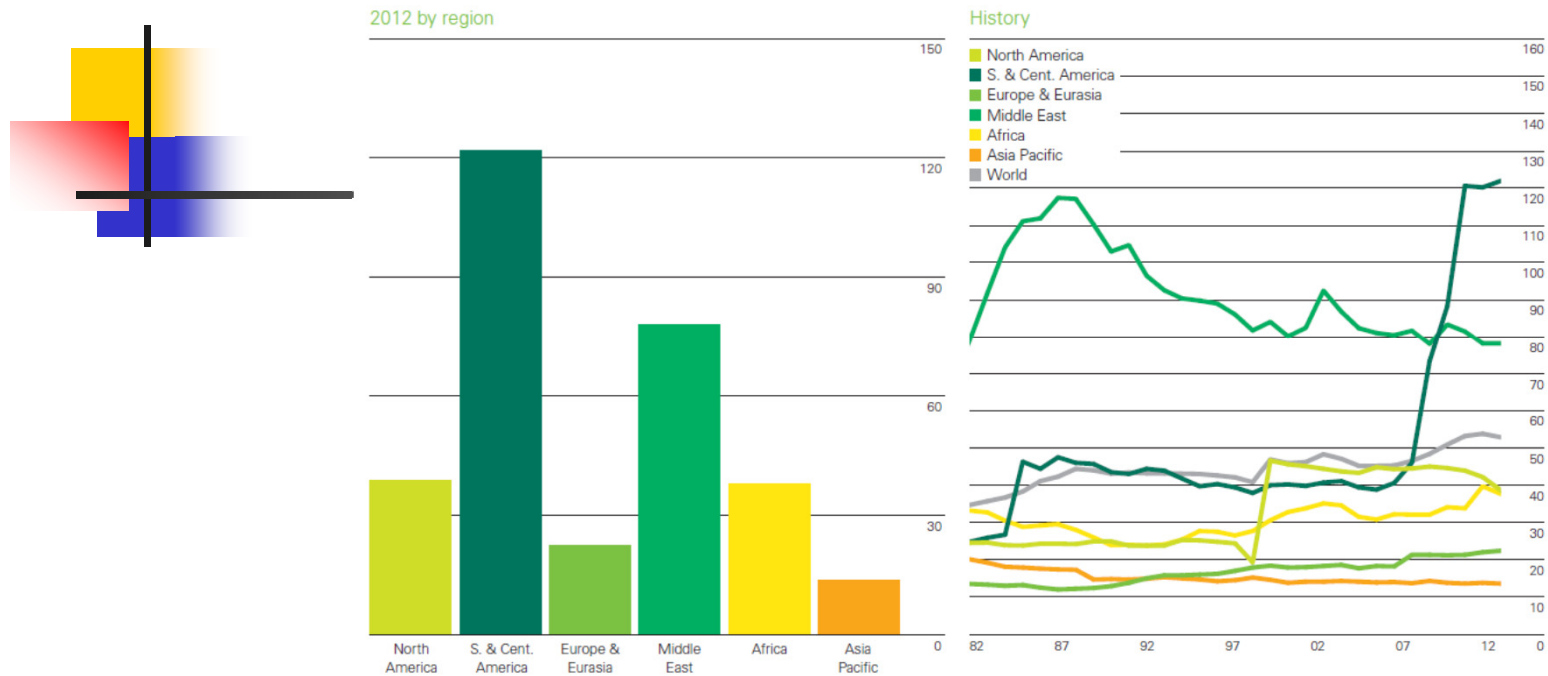
**Notes:** Differences between these world consumption figures and world production statistics are accounted for by stock changes, consumption of non-petroleum additives and substitute fuels, and unavoidable disparities in the definition, measurement or conversion of oil supply and demand data.

**Annual changes and shares of total are calculated using thousand barrels daily figures.**

Growth rates are adjusted for leap years.



Udio pojedinih svjetskih regija u zaliham konvencionalne nafte s pregledom ukupnih zaliha (izvor: BP Statistical Review of World Energy 2013.)

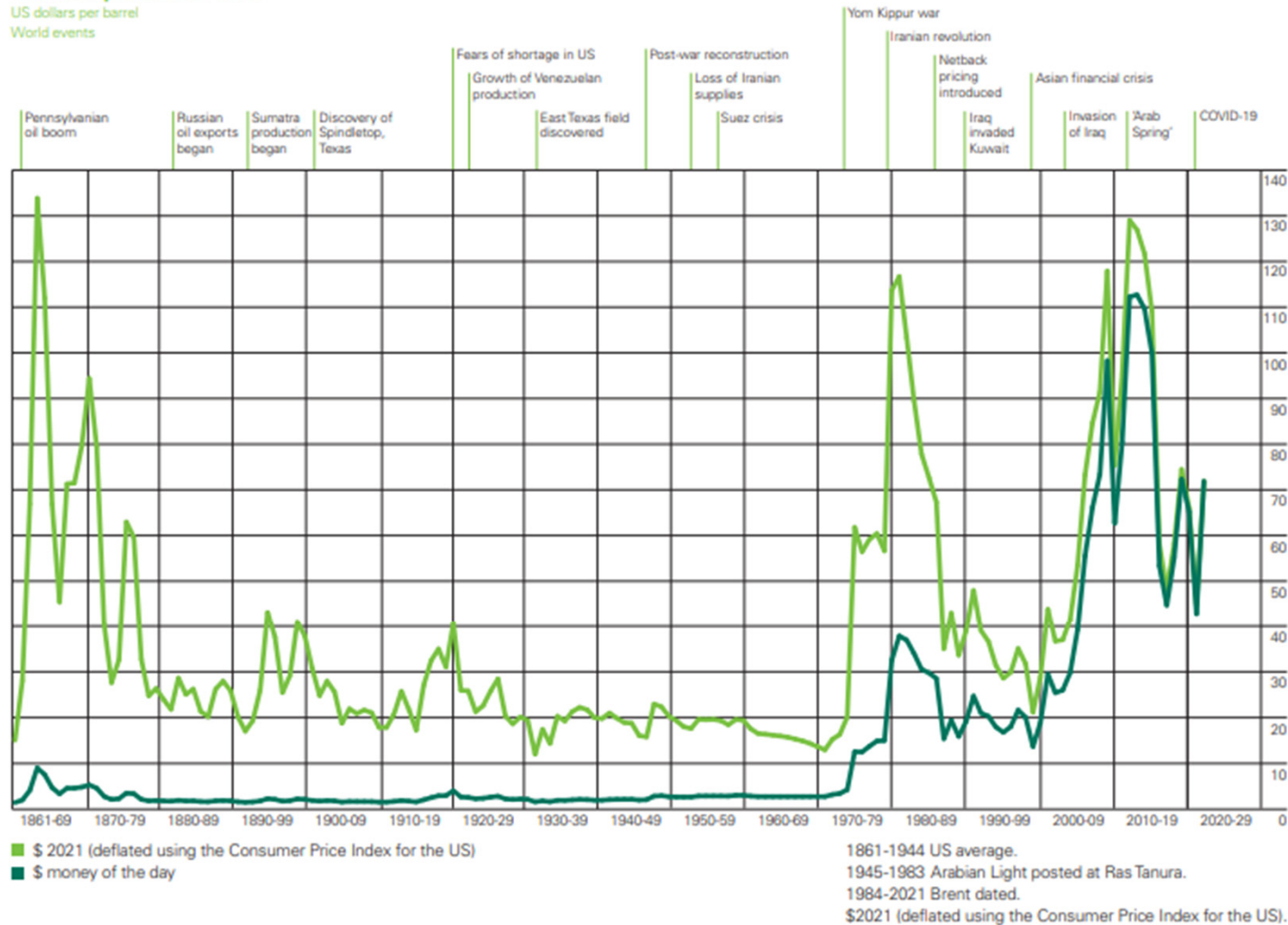


R/P omjer pojedinih svjetskih regija (izvor: BP Statistical Review of World Energy 2013.)

## Crude oil prices 1861-2021

US dollars per barrel

World events



. Utjecaj raznih čimbenika na cijenu nafte kroz modernu povijest eksploatacije nafte (izvor: BP Statistical Review of World Energy 2021.)



## Spot crude prices

US dollars per barrel	Dubai \$/bbl*	Brent \$/bbl†	Nigerian Forcados \$/bbl	West Texas Intermediate \$/bbl‡
1985	27.53	27.56	27.75	27.98
1986	13.10	14.43	14.46	15.05
1987	16.95	18.44	18.39	19.19
1988	13.18	14.92	15.00	15.98
1989	15.65	18.23	18.30	19.67
1990	20.26	23.73	23.85	24.46
1991	16.63	20.00	20.11	21.53
1992	17.17	19.32	19.61	20.57
1993	14.93	16.97	17.41	18.45
1994	14.74	15.82	16.25	17.21
1995	16.10	17.02	17.26	18.42
1996	18.52	20.67	21.16	22.16
1997	18.23	19.09	19.33	20.61
1998	12.21	12.72	12.62	14.39
1999	17.25	17.97	18.00	19.31
2000	26.20	28.50	28.42	30.37
2001	22.81	24.44	24.23	25.93
2002	23.74	25.02	25.04	26.16
2003	26.78	28.83	28.66	31.06
2004	33.64	38.27	38.13	41.49
2005	49.35	54.52	55.69	56.59
2006	61.50	65.14	67.07	66.04
2007	68.19	72.39	74.48	72.20
2008	94.34	97.26	101.43	100.06
2009	61.39	61.67	63.35	61.92
2010	78.06	79.50	81.05	79.45
2011	106.18	111.26	113.65	95.04
2012	109.08	111.67	114.21	94.13
2013	105.47	108.66	111.95	97.99
2014	97.07	98.95	101.35	93.28
2015	51.20	52.39	54.41	48.71
2016	41.19	43.73	44.54	43.34
2017	53.13	54.19	54.31	50.79
2018	69.51	71.31	72.47	65.20
2019	63.43	64.21	64.95	57.03
2020	42.41	41.84	42.31	39.25
2021	68.91	70.91	69.76	68.10

\*1985 Arabian Light, 1986-2021 Dubai dated.

†1985-2021 Brent dated.

‡1985-2021 Spot WTI (Cushing) prices.

Source: S&P Global Platts, © 2021, S&P Global Inc.

## Oil: Trade movements

Thousand barrels daily	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Growth rate per annum		Share 2021	
												2021	2011-21		
<b>Imports</b>															
US	11338	10587	9859	9241	9451	10056	10147	9928	9142	7869	<b>8478</b>	7.7%	-2.9%	12.7%	
Europe	12489	12721	12920	12957	14024	14342	15012	14473	14396	13206	<b>13522</b>	2.4%	0.8%	20.2%	
China	6295	6675	6978	7398	8333	9215	10241	11028	11861	12932	<b>12724</b>	-1.6%	7.3%	19.0%	
India	3823	4168	4370	4155	4396	4945	4920	5196	5394	4898	<b>5325</b>	8.7%	3.4%	8.0%	
Japan	4494	4743	4637	4383	4332	4180	4142	3940	3780	3310	<b>3350</b>	1.2%	-2.9%	5.0%	
Rest of World	17634	17812	20012	21193	22913	28491	25629	25819	25320	22701	<b>23559</b>	3.8%	2.9%	35.2%	
<b>Total World</b>	<b>56072</b>	<b>56706</b>	<b>58776</b>	<b>59328</b>	<b>63449</b>	<b>71230</b>	<b>70090</b>	<b>70383</b>	<b>69893</b>	<b>64916</b>	<b>66958</b>	<b>3.1%</b>	<b>1.8%</b>	<b>100.0%</b>	
<b>Exports</b>															
Canada	2798	3056	3296	3536	3837	3889	4233	4499	4678	4425	<b>4666</b>	5.5%	5.2%	7.0%	
Mexico	1487	1366	1347	1293	1321	1405	1289	1307	1254	1251	<b>1234</b>	-1.3%	-1.8%	1.8%	
US	2495	2882	3563	4033	4563	5077	5878	7037	8003	8128	<b>7892</b>	-2.9%	12.2%	11.8%	
S. & Cent. America	3755	3830	3790	3939	4106	5735	3976	3736	3451	3452	<b>2987</b>	-13.5%	-2.3%	4.5%	
Europe	2139	2181	2545	2467	3064	4907	3387	3405	3236	2732	<b>3041</b>	11.3%	3.6%	4.5%	
Russia	7448	7457	7948	7792	8444	8824	8992	8117	8122	7778	<b>8234</b>	5.9%	1.0%	12.3%	
Other CIS	2180	1962	2166	2092	2045	2097	2236	2060	2127	2089	<b>2120</b>	1.5%	-0.3%	3.2%	
Saudi Arabia	8120	8468	8365	7911	8008	8729	8352	8574	8348	7904	<b>7696</b>	-2.6%	-0.5%	11.5%	
Middle East (ex Saudi Arabia)	12188	11742	12242	12699	13977	15902	16205	16069	14678	13531	<b>14074</b>	4.0%	1.4%	21.0%	
North Africa	1951	2602	2127	1743	1747	1735	2600	2748	2783	1844	<b>2664</b>	44.5%	3.2%	4.0%	
West Africa	4759	4724	4590	4849	4891	4458	4523	4558	4619	4223	<b>3942</b>	-6.7%	-1.9%	5.9%	
Asia Pacific (ex Japan)	6088	6299	6307	6450	5896	6348	6556	6442	6602	6058	<b>6566</b>	8.4%	0.8%	9.8%	
Rest of World	663	338	491	524	1550	2124	1863	1831	1993	1502	<b>1842</b>	22.7%	10.8%	2.8%	
<b>Total World</b>	<b>56072</b>	<b>56706</b>	<b>58776</b>	<b>59328</b>	<b>63449</b>	<b>71230</b>	<b>70090</b>	<b>70383</b>	<b>69893</b>	<b>64916</b>	<b>66958</b>	<b>3.1%</b>	<b>1.8%</b>	<b>100.0%</b>	

**Notes:** Unless otherwise stated, this table shows inter-regional trade based on the regional classification in the table 'Oil trade in 2020 and 2021'.

Bunker fuel use is not included as exports. Intra-area movements (for example, between countries within Europe) are excluded.

**Annual changes and shares of total are calculated using thousand barrels daily figures.**



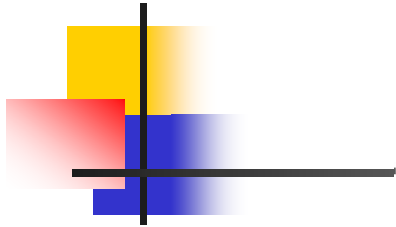
## Oil: Inter-area movements 2021

From	To															Total
	Canada	Mexico	US	S. & Cent. America	Europe	Russia	Other CIS	Middle East	Africa	Australasia	China	India	Japan	Singapore	Other Asia Pacific	
Canada	-	-	187.1	0.7	4.1	-	-	†	†	-	3.9	0.6	-	†	1.0	197.4
Mexico	-	-	29.0	0.1	7.6	-	-	0.1	-	-	0.4	7.9	0.1	-	7.7	52.9
US	15.5	-	-	8.3	51.4	†	†	0.4	0.4	0.6	11.5	20.5	0.9	3.9	25.1	138.5
S. & Cent. America	0.6	†	29.2	-	11.2	†	-	1.1	0.4	-	57.6	10.5	2.5	6.0	5.0	124.1
Europe	0.1	-	4.4	0.5	-	†	0.1	0.2	0.2	†	21.2	3.6	0.2	0.3	5.8	36.4
Russia	-	-	9.9	0.7	138.7	-	15.7	-	-	0.3	79.6	4.5	4.4	0.6	9.1	263.6
Other CIS	0.6	-	0.9	0.1	67.0	†	-	3.5	1.0	0.2	4.8	1.2	0.1	†	7.7	87.1
Iraq	-	-	7.6	0.7	47.5	†	†	0.9	1.3	-	54.1	52.0	0.4	0.8	10.8	176.1
Kuwait	-	-	1.0	-	†	-	-	†	2.6	0.1	30.2	13.6	10.5	0.5	29.8	88.4
Saudi Arabia	3.5	-	17.7	3.2	28.5	-	0.1	10.9	8.9	-	87.6	34.3	48.7	4.7	75.3	323.2
UAE	-	-	0.8	†	0.1	†	-	†	0.5	4.2	31.9	23.0	41.6	13.2	30.6	146.1
Other Middle East	-	-	0.1	†	1.0	-	†	†	†	†	53.9	7.4	10.8	7.3	16.4	97.0
North Africa	0.1	-	5.4	1.6	57.8	-	0.1	0.9	†	0.4	6.7	4.5	0.5	0.5	7.0	85.4
West Africa	3.5	-	9.7	5.6	51.7	†	†	3.5	6.6	1.5	59.9	24.5	-	3.1	17.6	187.4
East & S. Africa	†	-	0.4	0.1	0.9	†	-	†	†	-	0.7	1.7	0.2	0.1	0.5	4.8
Australasia	†	-	-	†	†	-	-	0.2	†	-	0.5	-	0.2	2.5	5.7	9.2
China	-	-	-	-	-	-	-	-	-	-	-	0.1	-	0.1	1.4	1.6
India	-	-	-	†	†	-	-	†	†	†	-	-	-	†	†	0.1
Japan	†	-	-	†	†	-	-	-	†	-	-	0.1	-	-	0.3	0.4
Singapore	-	-	-	†	†	-	-	†	†	0.6	-	-	-	-	0.4	1.0
Other Asia Pacific	†	-	1.2	†	0.1	-	-	0.2	0.1	6.9	21.7	3.7	1.0	3.3	-	38.2
<b>Total imports</b>	<b>23.9</b>	<b>†</b>	<b>304.7</b>	<b>21.8</b>	<b>467.7</b>	<b>†</b>	<b>15.9</b>	<b>21.8</b>	<b>22.1</b>	<b>14.9</b>	<b>526.0</b>	<b>213.7</b>	<b>122.1</b>	<b>47.0</b>	<b>257.1</b>	<b>2058.9</b>

From	To															Total
	Canada	Mexico	US	S. & Cent. America	Europe	Russia	Other CIS	Middle East	Africa	Australasia	China	India	Japan	Singapore	Other Asia Pacific	
Canada	-	0.2	27.9	1.6	0.4	†	†	†	†	†	1.2	†	1.7	†	0.5	33.5
Mexico	†	-	6.1	0.9	0.1	-	†	†	0.1	†	†	†	-	1.0	†	8.2
US	25.0	55.6	-	71.0	26.4	†	†	1.6	7.6	1.0	14.4	9.5	12.4	1.6	18.2	244.4
S. & Cent. America	0.2	0.5	6.6	-	3.9	†	†	0.4	3.1	†	1.0	0.1	0.9	4.8	2.2	23.6
Europe	4.7	1.5	23.2	10.0	-	0.3	1.0	12.2	42.2	0.1	1.3	1.6	0.8	6.5	5.1	110.5
Russia	0.3	†	22.6	3.3	75.9	-	4.7	8.8	4.4	†	3.2	2.1	0.6	3.7	10.8	140.7
Other CIS	†	†	0.7	0.1	13.8	0.9	-	0.3	0.7	†	0.3	0.1	-	†	0.8	17.7
Iraq	†	-	0.3	†	1.4	†	†	0.5	†	-	0.5	2.9	0.1	2.4	4.3	12.3
Kuwait	†	-	0.6	0.1	2.3	-	†	3.6	2.4	†	1.8	2.5	2.0	0.5	8.5	24.3
Saudi Arabia	†	-	3.5	1.1	10.9	†	†	5.6	12.5	†	2.9	7.9	1.7	2.2	9.5	57.7
UAE	†	-	1.1	2.0	6.4	†	†	8.9	12.9	0.6	7.3	10.0	4.4	8.9	24.3	86.7
Other Middle East	0.1	†	1.7	1.0	6.0	†	0.9	10.3	6.8	†	7.7	7.1	5.0	2.7	13.2	62.4
North Africa	†	-	2.6	0.7	30.8	†	†	0.8	0.4	†	1.9	0.1	0.7	2.6	4.8	45.4
West Africa	†	†	1.2	1.8	1.5	†	†	†	0.6	†	2.7	†	-	0.2	0.8	8.6
East & S. Africa	†	†	†	0.2	0.2	†	†	1.3	0.5	†	0.3	†	†	0.2	0.1	2.7
Australasia	†	†	-	0.1	0.9	†	†	0.1	0.1	-	1.3	0.1	1.4	0.8	0.7	5.4
China	0.2	0.5	0.2	5.7	3.3	†	0.1	1.7	4.5	0.1	-	0.6	0.7	10.5	32.6	60.6
India	0.1	†	4.8	3.5	8.3	†	†	16.1	12.5	2.7	0.5	-	1.1	5.2	14.6	69.3
Japan	†	0.2	1.0	0.6	0.7	†	†	†	†	0.1	1.2	0.1	-	1.8	5.2	11.0
Singapore	†	0.2	1.5	0.6	0.7	†	†	1.2	1.1	8.5	7.0	1.8	0.3	-	45.9	68.9
Other Asia Pacific	0.1	0.2	7.3	1.9	3.8	0.5	0.2	3.4	5.8	13.0	46.9	2.8	9.2	36.2	-	131.2
<b>Total imports</b>	<b>30.6</b>	<b>59.0</b>	<b>112.9</b>	<b>105.8</b>	<b>197.5</b>	<b>1.9</b>	<b>6.9</b>	<b>76.9</b>	<b>118.0</b>	<b>26.2</b>	<b>103.4</b>	<b>49.4</b>	<b>43.0</b>	<b>91.8</b>	<b>202.1</b>	<b>1225.2</b>

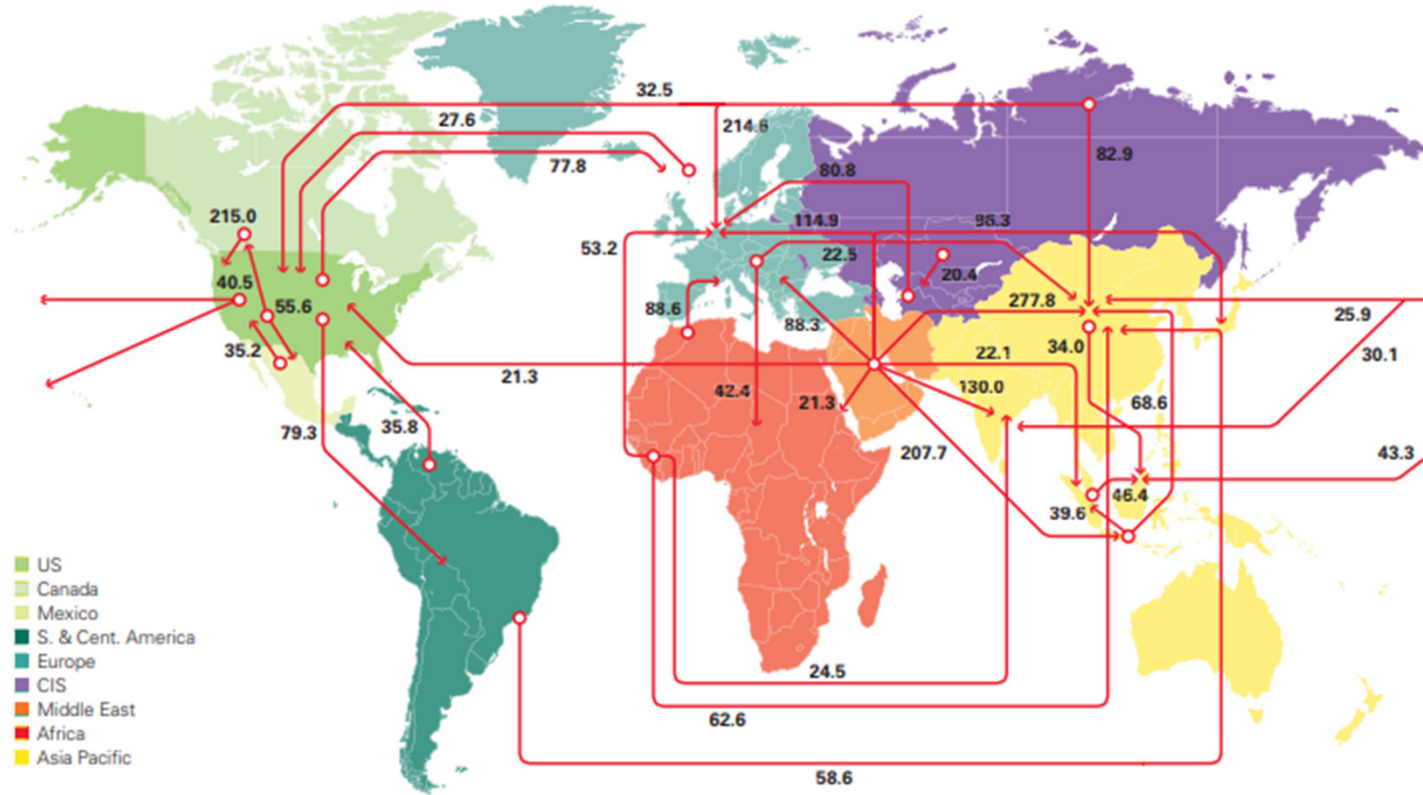
†Less than 0.05.

**Notes:** Does not include biofuels trade. Bunker fuel use is not included as exports. Intra-area movements (for example, between countries within Europe) are excluded. Crude imports and exports include condensates.



Glavni svjetski tokovi trgovine naftom (izvor: BP Statistical Review of World Energy 2022.)

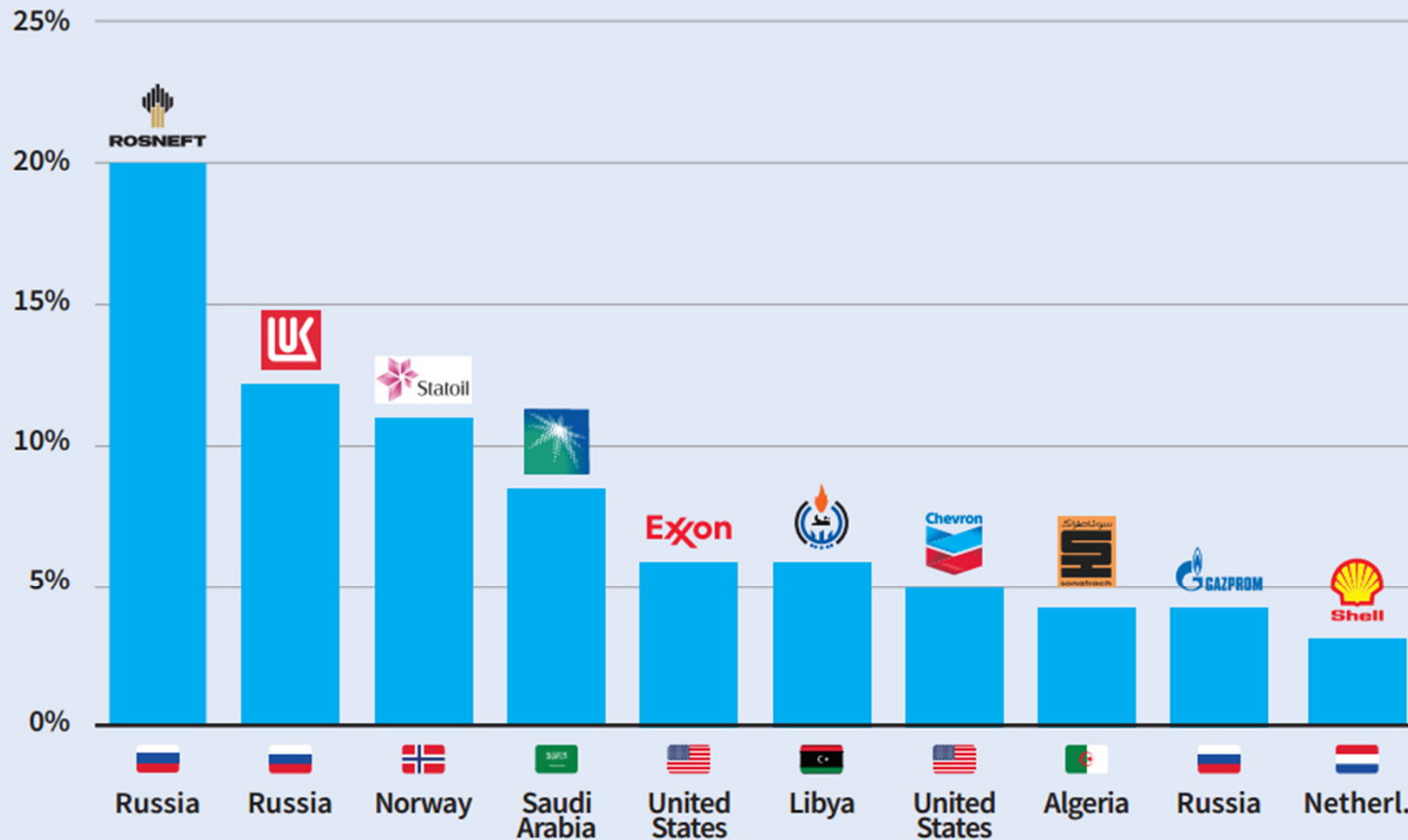
Major trade movements 2021  
Trade flows worldwide (million tonnes)



CIS - Commonwealth of Independent States (ZND-Zajednica Neovisnih Država)

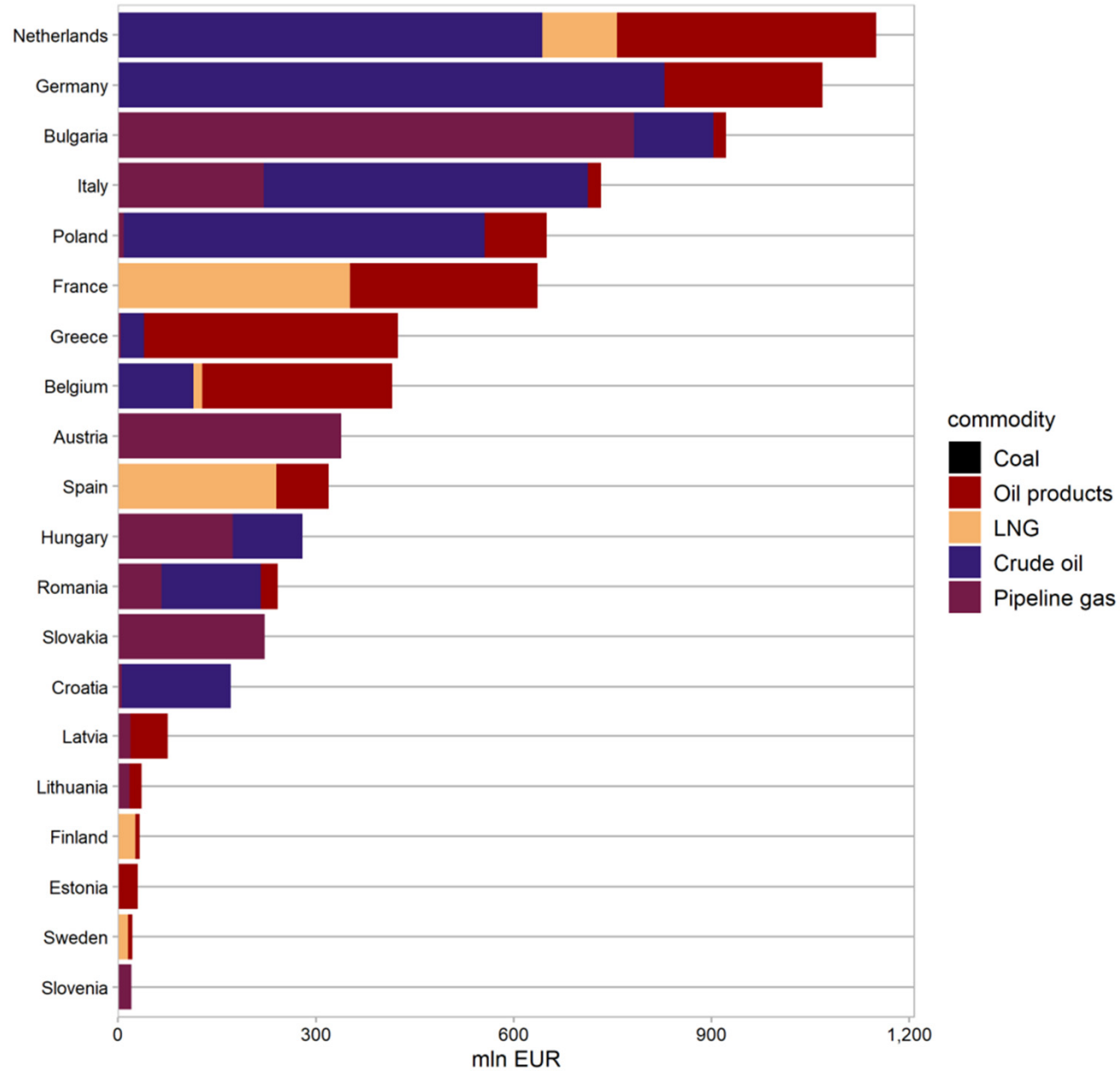
# Who supplies Europe's oil?

8 of the top 10 oil suppliers are non-European companies



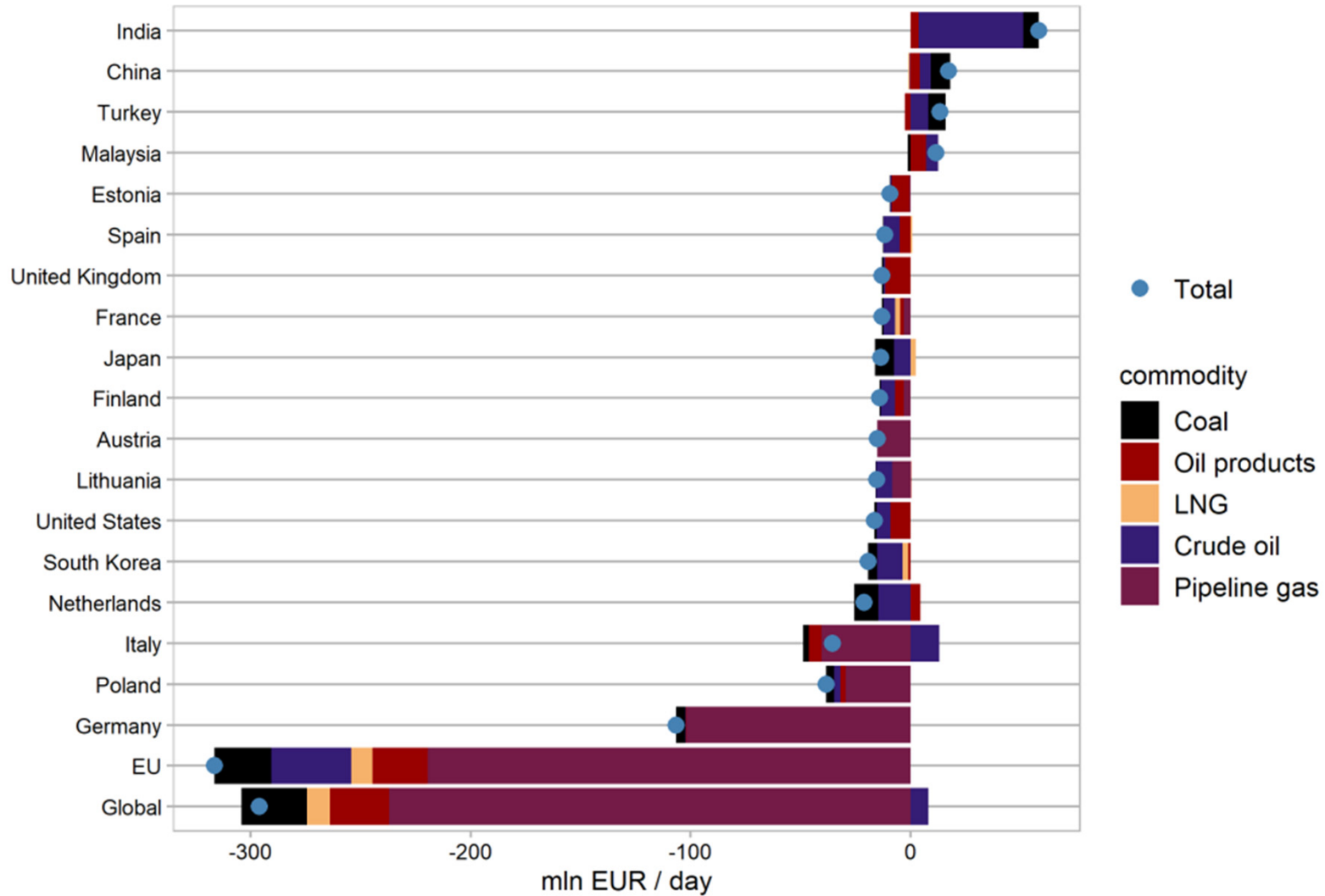
# Largest EU importers of fossil fuels from Russia

in September

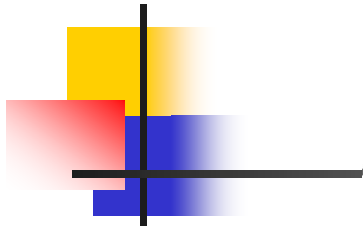


# Changes in monthly import volumes from Russia

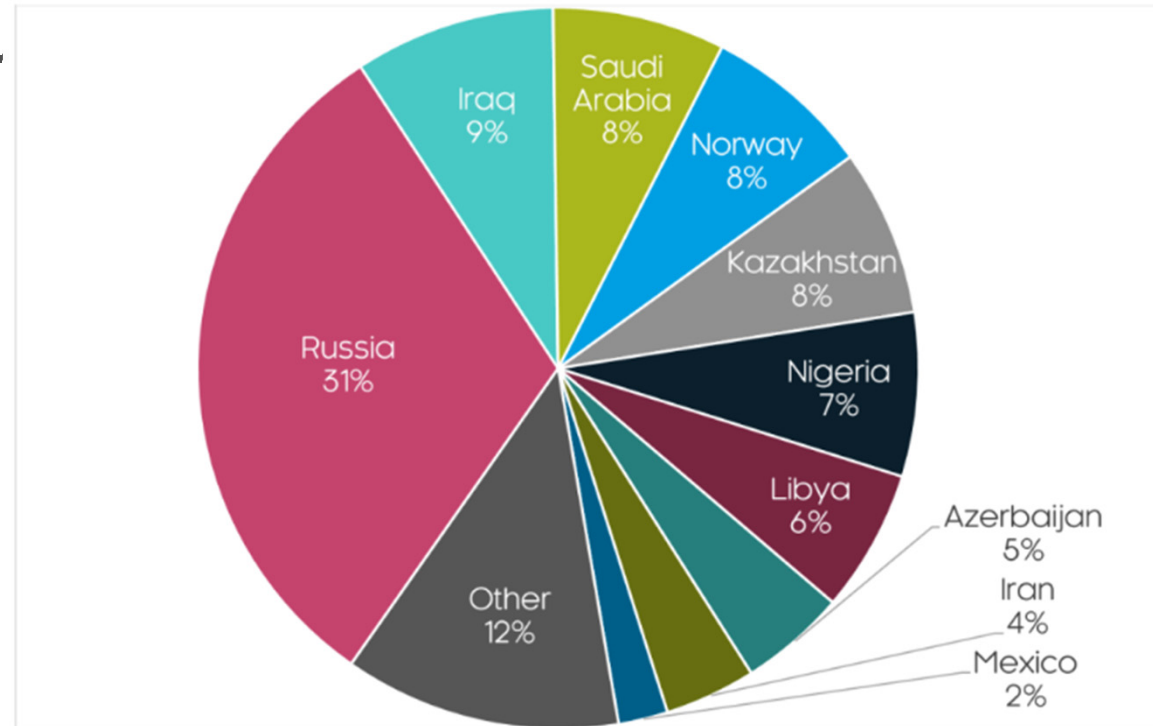
September 2022 compared to February-March 2022, seasonally adjusted



Values are seasonally adjusted and calculated at constant prices

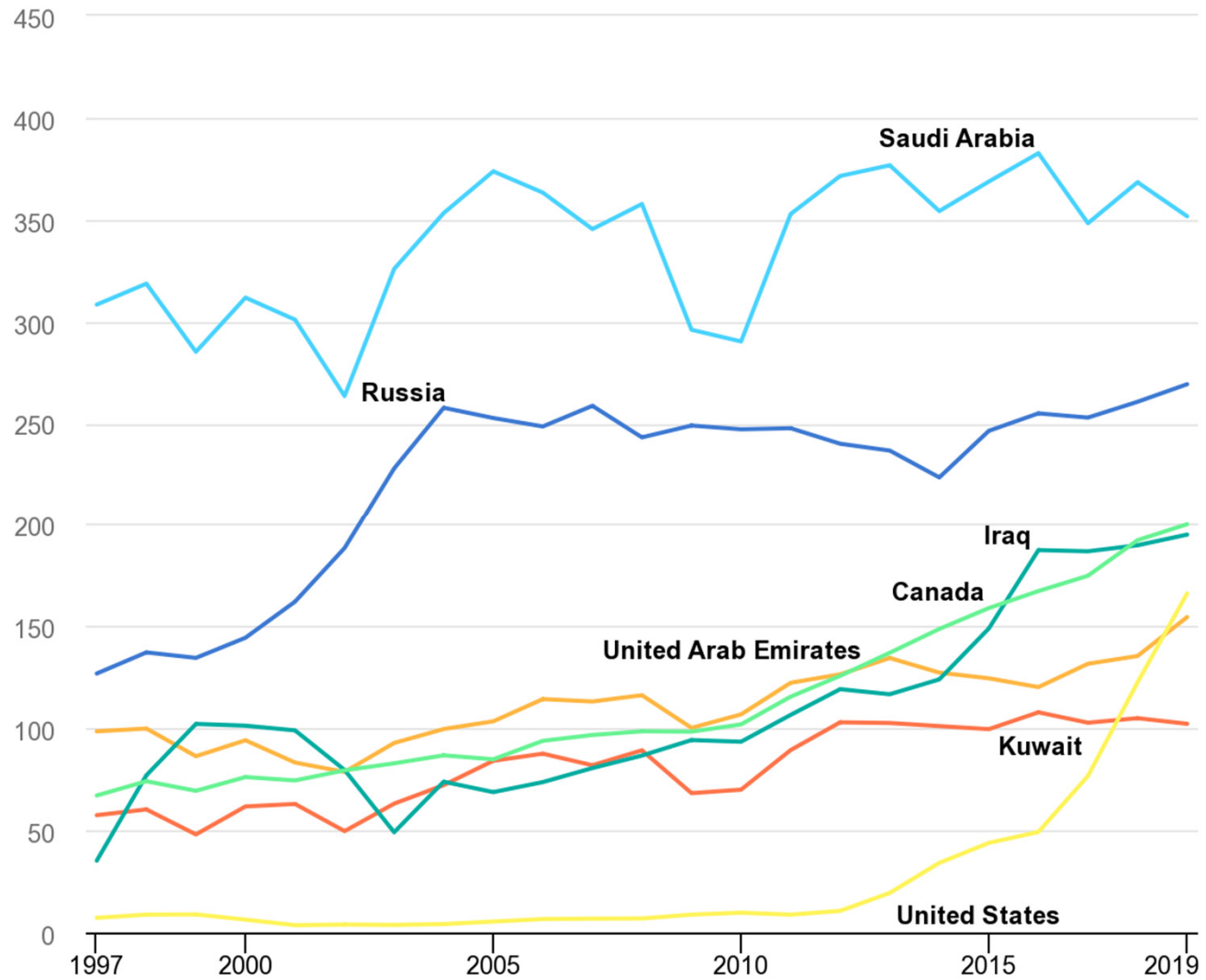
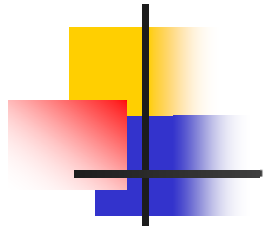


**Figure 2.2: Sources of EU crude oil imports, 2018**



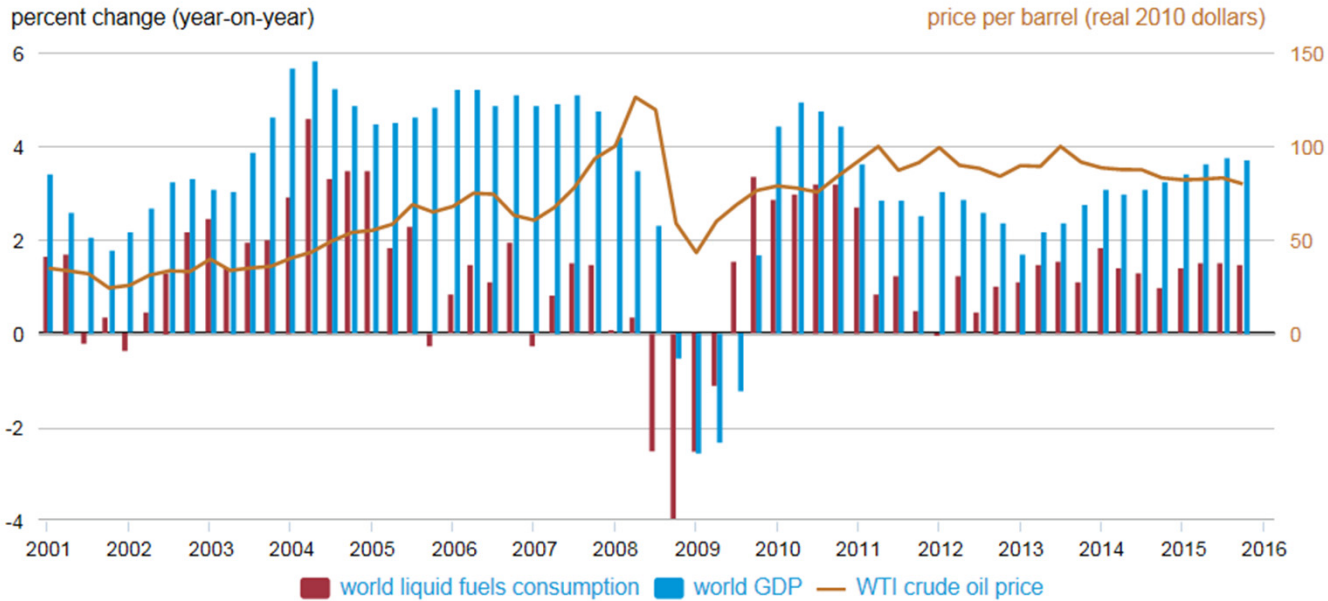
Source: Eurostat Energy Balances

**Figure 2.3: Share of extra-EU crude oil imports sourced from Russia, 2018**

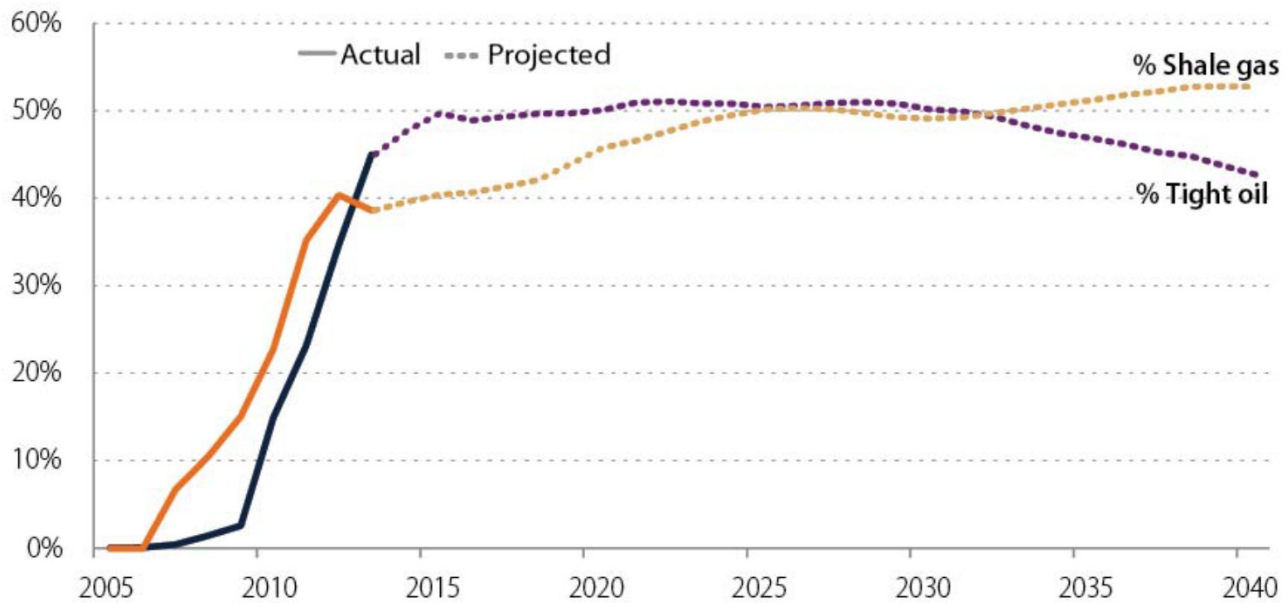


IEA, World top crude and NGL exporters, 1997-2019, IEA, Paris  
<https://www.iea.org/data-and-statistics/charts/world-top-crude-and-ngl-exporters-1997-2019>

## World liquid fuels consumption, world GDP, and WTI crude oil prices



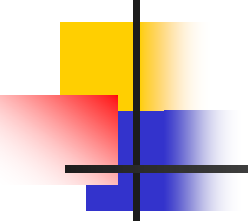
Source: U.S. Energy Information Administration, Thomson Reuters  
 Updated: Monthly | Last Updated: 2/11/2014



Udio proizvedenih  
 količina  
 nekonvencionalne nafte  
 (tight oil-slabopropusne  
 formacije) i prirodnog  
 plina (shale gas - plin iz  
 šejlova - škrljevaca)  
 (Izvor: U.S. Energy  
 Information  
 Administration, Annual  
 Energy Outlook 2014.)



Neka objašnjena uz prethodnu tablicu.



OPEC – Organization of the Petroleum Exporting Countries (Organizacija zemalja izvoznica nafte).

Osnovan je 1960. godine u Bagdadu, Irak.

Članice (13 država): Alžir, Angola, Ekvador, Indonezija, Iran, Irak, Kuvajt, Libija, Nigerija, Katar, Saudijska Arabija, UAE i Venecuela.

OPEC+-Azerbajdžan, Bahrajn, Brunej, Kazahstan, Malaysia, Mexico, Oman, Rusija, South Sudan and Sudan

EOR – Enhanced Oil Recovery – metode povećanja iscrpka nafte

Predviđa se dominacija konvencionalne nafte do 2030. godine.

## Nafta u Hrvatskoj

Nafta i kondenzat Oil and Condensate	2002.	2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.
Rezerve (1 000 m <sup>3</sup> ) Reserves (1 000 m <sup>3</sup> )	10 152,7	10 356,1	11 794,0	9 330,9	9 690,1	11 719,1	11 472,5	10 823,6	10 481,6	11 554,0	11 531,6
Proizvodnja (1 000 t) Production (1 000 t)	1 108,5	1 052,1	1 001,0	946,0	917,4	879,1	835,4	776,2	720,4	664,4	599,9

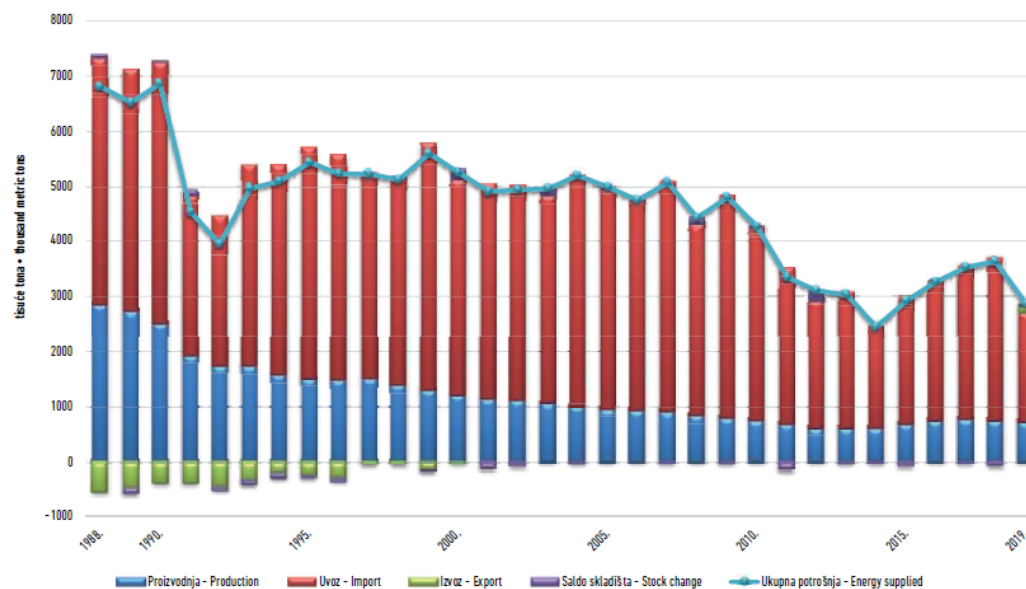
Nafta i kondenzat Oil and Condensate	2009.	2010.	2011.	2012.	2013.	2014.	2015.	2016.	2017.
Rezerve (1 000 m <sup>3</sup> ) Reserves (1 000 m <sup>3</sup> )	10 823,6	10 481,6	11 554,0	11 531,6	13 471,1	12 597,8	11 932,1	11 027,0	10 230,3
Proizvodnja (1 000 tona) Production (1 000 tons)	776,2	720,4	664,4	599,9	600,7	593,2	670,2	804,0	744,5

Izvor: Ministarstvo gospodarstva i održivog razvoja • Source: Ministry of Economy and Sustainable Development

Zalihe nafte i kondenzata i njihova proizvodnja u Hrvatskoj od 2002.-2017.

Slika 3.3.1. Raspoloživa sirova nafta u Hrvatskoj

Figure 3.3.1 Crude oil supply in the Republic of Croatia



Raspoloživa sirova  
nafta u Hrvatskoj  
(Izvor: EIHP)

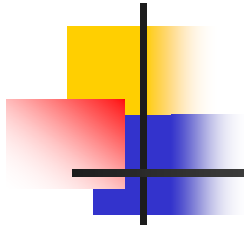
Izvor: EIHP • Source: EIHP

Tablica 3.2.1. Kapaciteti prerade u rafinerijama nafte u Republici Hrvatskoj

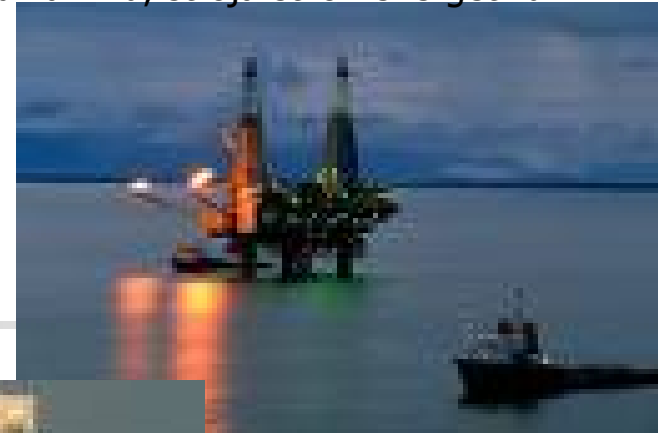
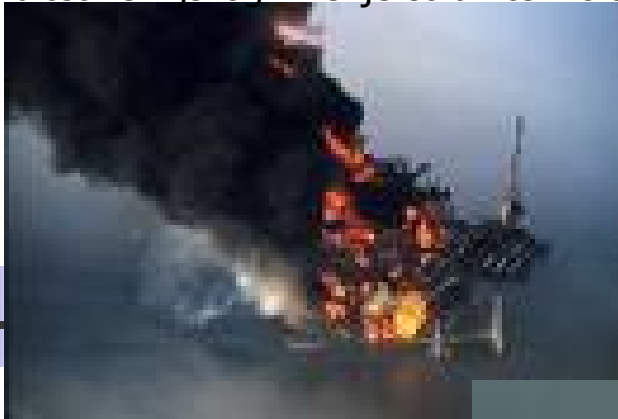
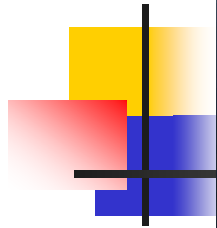
Table 3.2.1 Processing capacities of oil refineries in the Republic of Croatia

Kapaciteti prerade • Processing capacities	Instalirani (1 000 tona/god.) • Installed (1 000 tons/year)
<b>1. RAFINERIJA NAFTE RIJEKA (URINJ) • OIL REFINERY RIJEKA (URINJ)</b>	
atmosferska destilacija • atmospheric distillation	4 500
reformiranje • reforming	563
FCC • FCC	689
visbreaking • visbreaking	600
izomerizacija • isomerization	235
HDS/MHC • HDS/MHC	1 204/622
hidrokreking • hydrocracking	2 600
<b>2. RAFINERIJA NAFTE SISAK • OIL REFINERY SISAK</b>	
atmosferska destilacija • atmospheric distillation	3 800
reformiranje • reforming	670
FCC • FCC	490
koking • coking	280
vakum destilacija • vacuum distillation	895
izomerizacija • isomerization	240
bitumen • bitumen	200
<b>3. MAZIVA ZAGREB d.o.o. • LUBE REFINERY ZAGREB Ltd.</b>	
maziva • lubricants	60

Izvor: INA – Industrija nafte d.d. • Source: INA

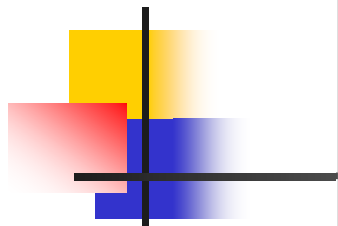


- Nafta se eksploatira na kopnu (on shore) ili moru (off shore)
- Eksploatacija s većih dubina ovisna je o tehnološkom razvoju
  
- Nafta se transportira kopnenim putem – naftovodima ili
- morskim putem tankerima



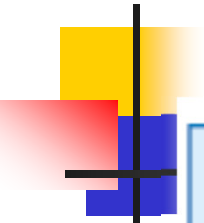
## Eksploatacija i transport sirove nafte





## Janaf – Jadranski naftovod

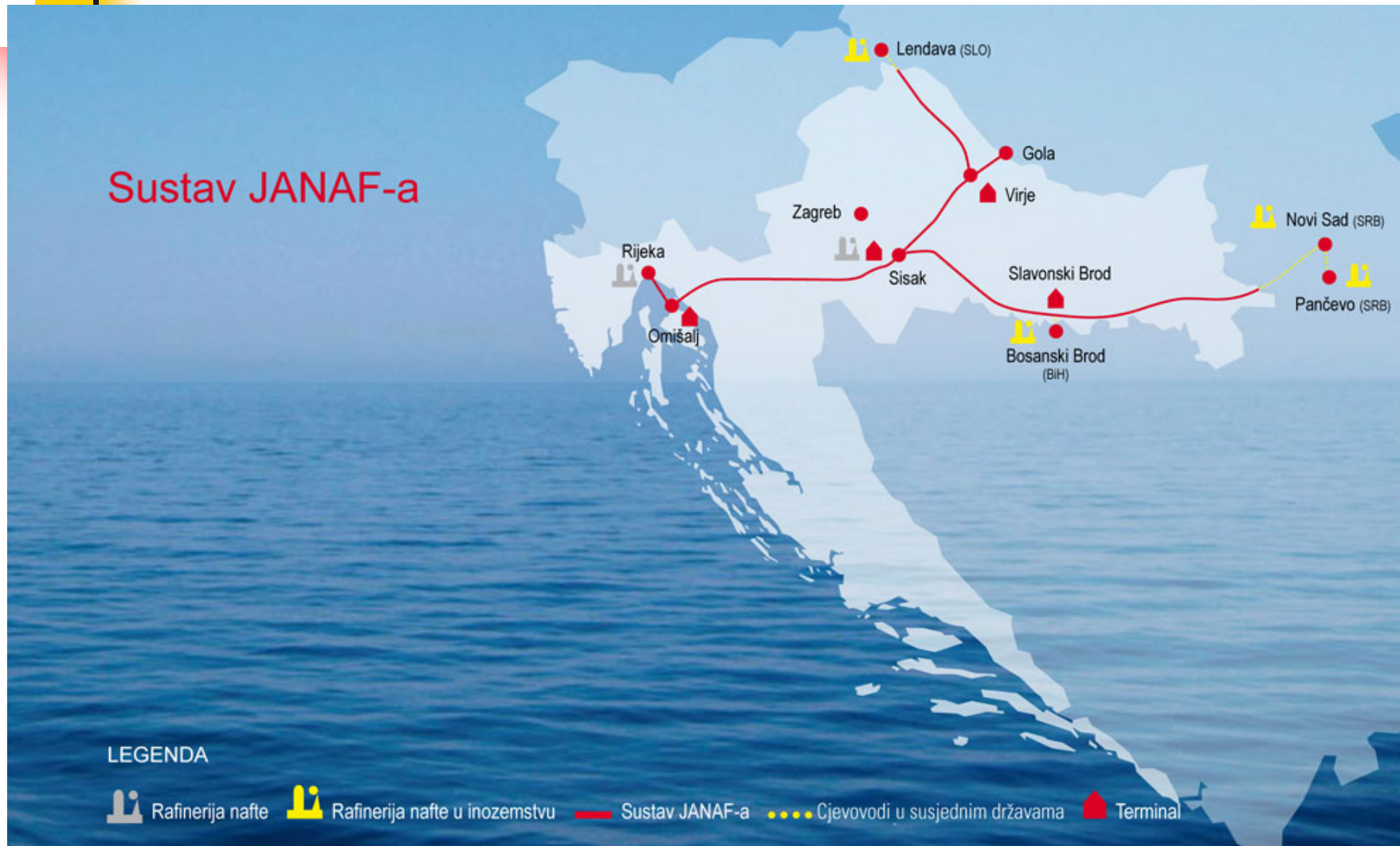
Trase JANAF naftovoda



Trasa Route	Promjer Diameter (")	Duljina Length (km)
Omišalj-Sisak	36	180
Omišalj-Urinj	20	7,2
Sisak-Virje-Gola (hrvatsko-mađarska granica / Croatian-Hungarian border)	28	109
Virje-Lendava	12	73
Sisak-Slavonski Brod	28	156
Slavonski Brod - Bosanski Brod (BiH / Bosnia and Herzegovina)	26	13
Slavonski Brod – Sotin (hrvatsko-srpska granica / Croatian-Serbian border)	26	84

Izvor: JANAF

## Jadranski naftovod-"JANAF"

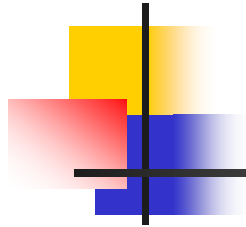




## Terminal u Omišlju na Krku







### Prosječni elementarni sastav nafte (maseni udjel):

- ugljik 84-87 %
- vodik 11,0-14,0 %
- sumpor 0,1-3,0 % (najviše 7%)
- dušik 0,1-0,6 % (najviše 3%)
- kisik 0,1-0,6 % (najviše 2%)
- teški metali: 0,01-0,03 %
- (oko 40 elemenata: V, Ni, Cr, Fe, Al, Si, Ca, Mg, K....)



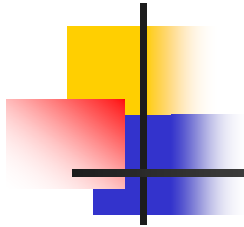
## Najzastupljeniji kemijski spojevi u nafti su:

---

- n-alkani i izoalkani
- cikloalkani (nafteni)
- aromatski ugljikovodici
- sumporni spojevi i dušikovi spojevi
- kisikovi spojevi
- anorganske nečistoće

Nafta se sastoji od približno 3000 ugljikovodika, od kojih se većina pojavljuje u tragovima

Udjel ugljikovodika ovisan je o porijeklu nafte, od 50% u "teškoj meksičkoj nafti do 98% posto u "lakoj" pensilvanijskoj nafti

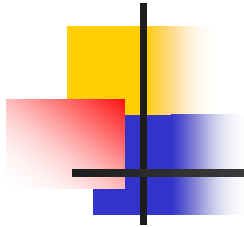


Sastav nafte obično se iskazuje udjelom triju najvažnijih skupina ugljikovodika:

- parafina
- cikloparafina
- aromatskih ugljikovodika

## Svojstva nafte ovise o njenom sastavu

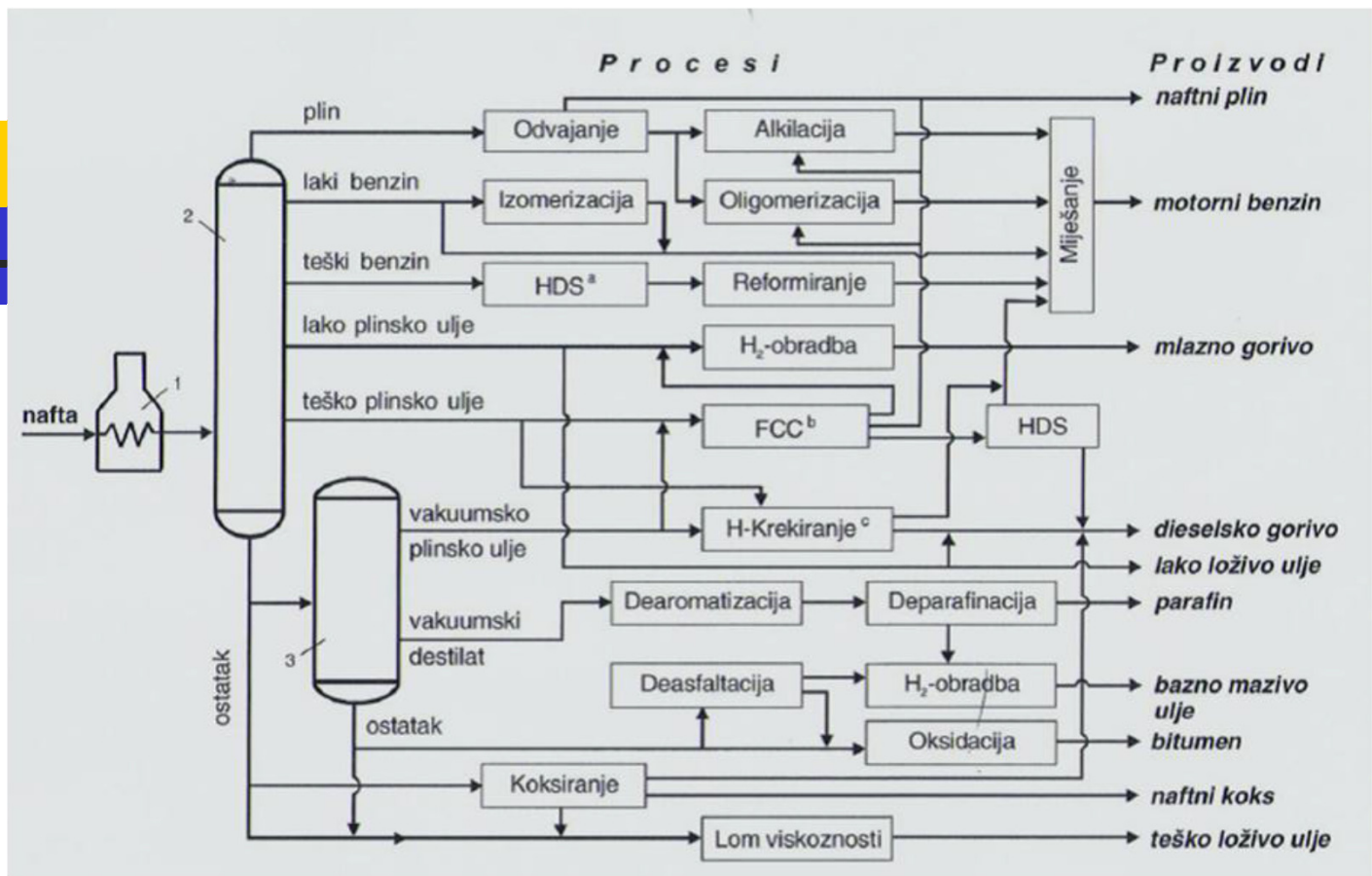
- *lake nafte* sadrže veći udjel niževrijućih ugljikovodika – vrijedniji spojevi
- naftama s većim udjelom neugljikovodika, prije svega sumpora (više od 0,5%) prethodno se moraju ukloniti sumporovi spojevi (merkaptani, disulfidi, tioeteri, tiofen)
- Nafta koje se sada prerađuju imaju veću gustoću (manji udio lakovrijućih frakcija) i veći udio sumpora-prerađuje se sve nekvalitetnija nafta.



Nafta se sastoji od vrlo velikog broja ugljikovodika i drugih spojeva od kojih svi imaju različita svojstva između ostalog i različite temperature vrelišta (20 do 700°C).

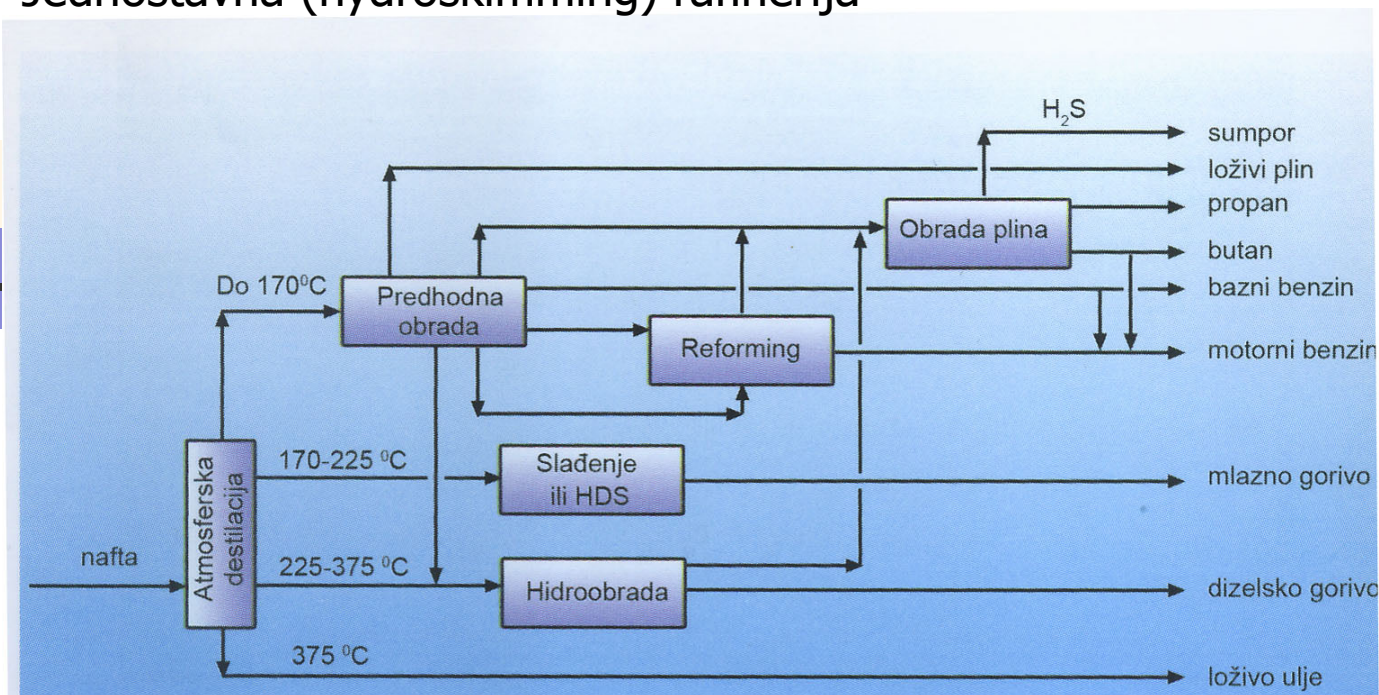
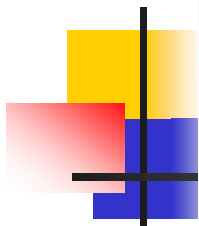
Zbog toga je naftu potrebno preraditi izdvajanjem pojedinih grupa spojeva – destilacijskih frakcija u užem području temperatura vrelišta.

Dobiveni proizvodi koriste se izravno ili služe kao sirovina za druge proizvode.

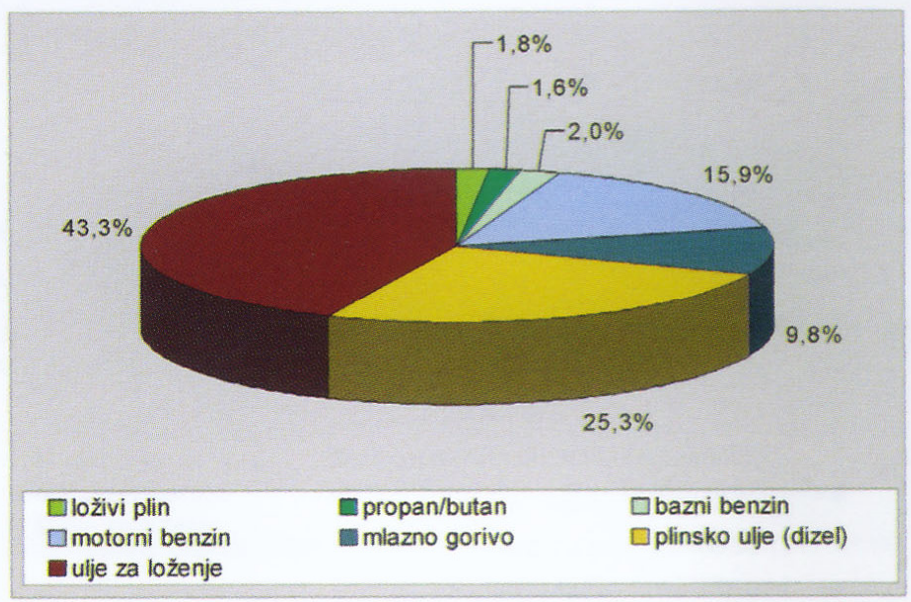




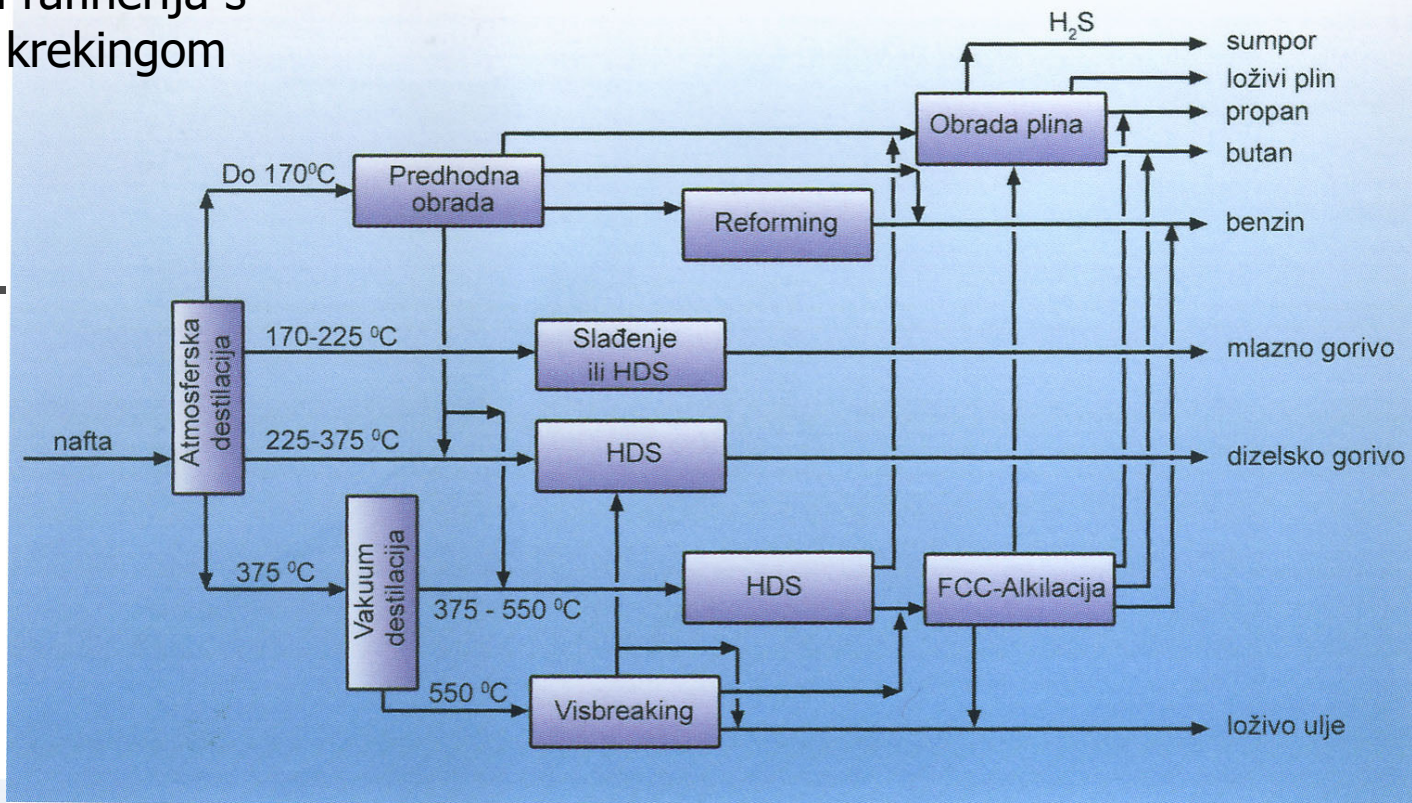
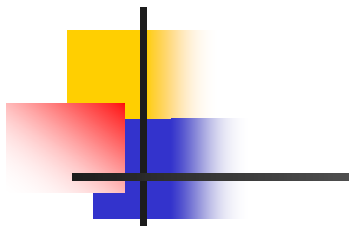
Fakultet kemijskog inženjerstva i tehnologije, Zavod za termodinamiku, strojarstvo i energetiku  
**Jednostavna (hydroskimming) rafinerija**



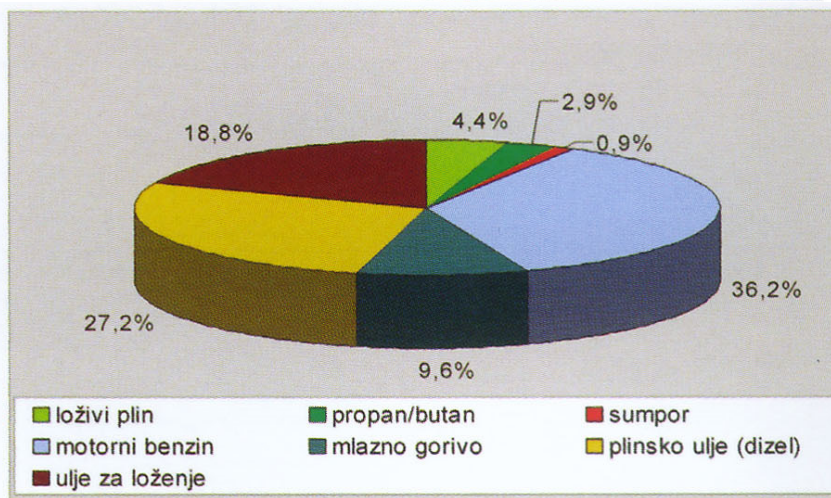
Proizvodi	% m/m
Loživi plin	1,8
Propan/butan (UNP)	1,6
Bazni benzin	2,0
Motorni benzin	15,9
Mlazno gorivo	9,8
Dizelsko gorivo	25,3
Ulje za loženje	43,3



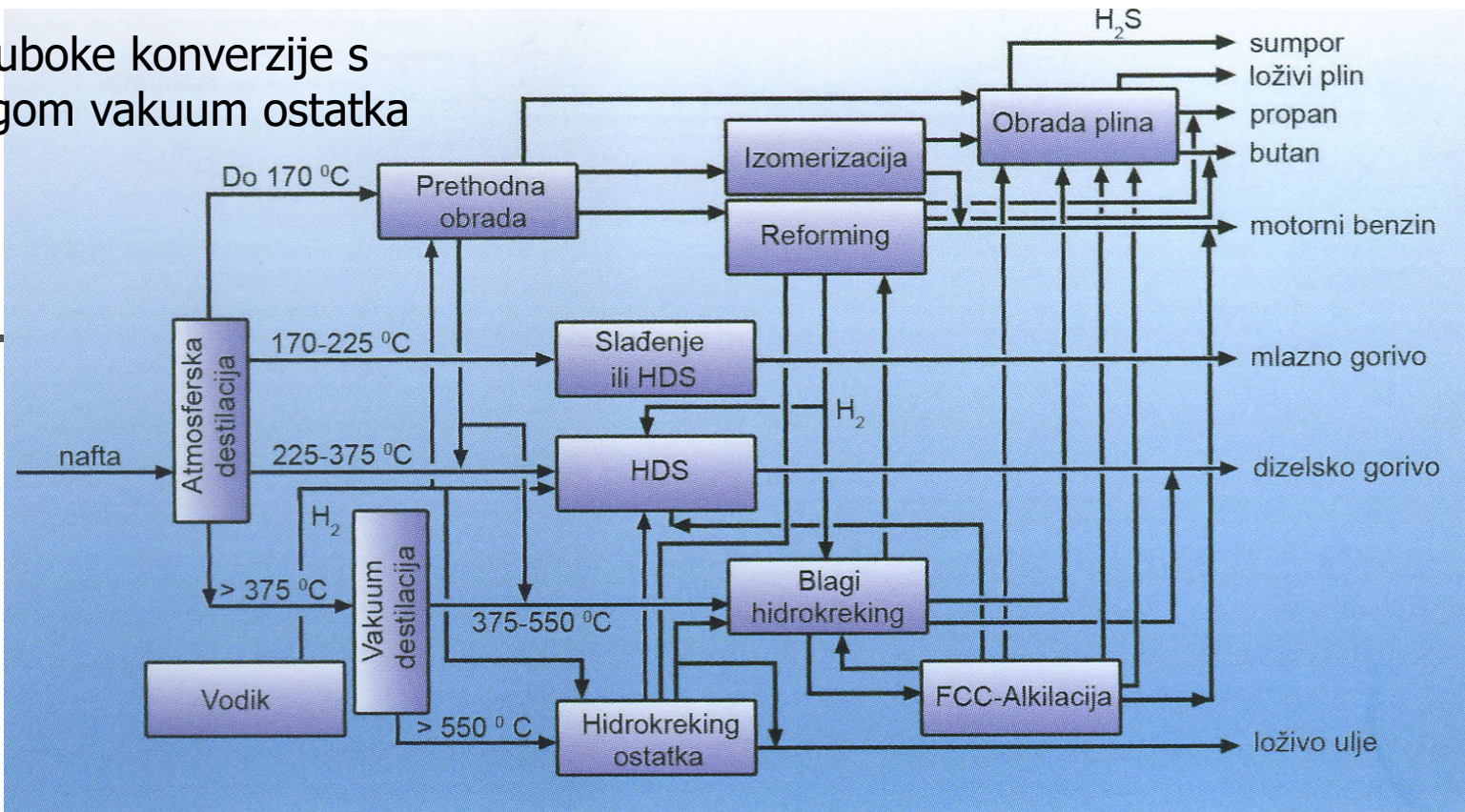
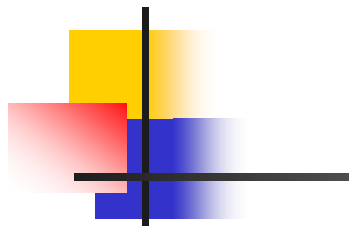
Fakultet kemijskog inženjerstva i tehnologije, Zavod za termodinamiku, strojarstvo i energetiku  
**Kompleksna rafinerija s katalitičkim krekingom**



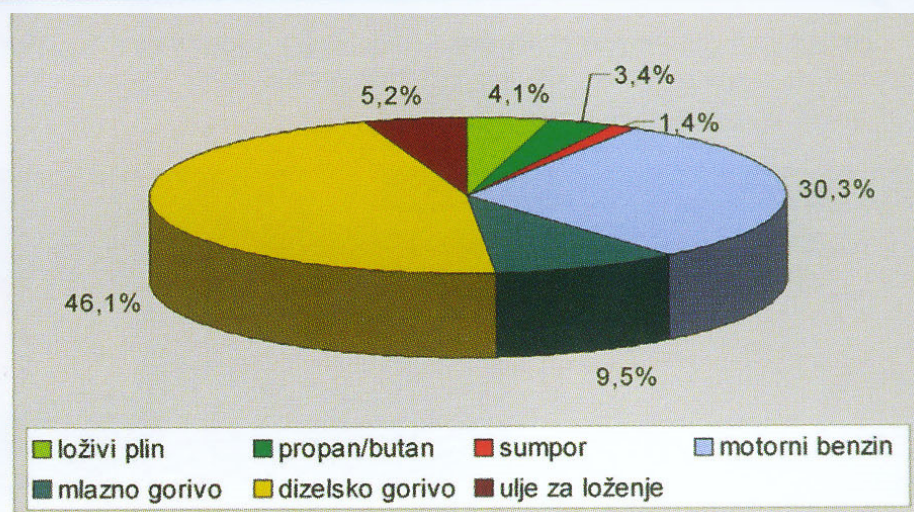
Proizvodi	% m/m
Loživi plin	4,4
Propan/butan (UNP)	2,9
Motorni benzin	36,2
Mlazno gorivo	9,6
Dizelsko gorivo	27,2
Ulje za loženje	18,8
Sumpor	0,9

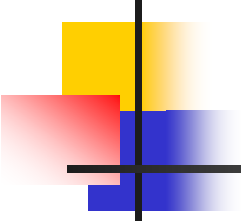


# Rafinerija duboke konverzije s hidrokrekingom vakuum ostatka



Proizvodi	% m/m
Loživi plin	4,1
Propan/butan (UNP)	3,4
Motorni benzin	30,3
Mlazno gorivo	9,5
Dizelsko gorivo	46,1
Ulje za loženje	5,2
Sumpor	1,4





Proizvodi, % maseni	Tip rafinerije		
	jednostavna	kompleksna	duboke konverzije
loživi plin	1,8	4,4	4,1
propan/butan/UNP	1,6	2,9	3,4
bazni benzin	2,0		
motorni benzin	15,9	36,2	30,3
mlazno gorivo	9,8	9,6	9,5
dizelsko gorivo	25,3	27,2	46,1
<b>ulje za loženje</b>	<b>43,3</b>	<b>18,8</b>	<b>5,2</b>
sumpor		0,9	1,4


## Temeljni naftni proizvodi

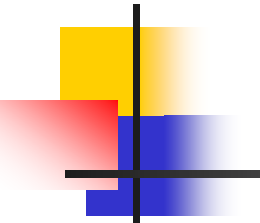
- Motorni benzin je smjesa ugljikovodika, a dobiva se miješanjem primarnog benzina i benzina dobivenih katalitičkim krekiranjem, reformacijom i alkilacijom i dr.
- Potpunim izgaranjem benzina oslobađa se velika količina topline (egzotermna r.) cca. 43700 kJ/kg
- nepotpunim izgaranjem nastaju CO i zaostali ugljikovodici, najviše aromatski ugljikovodici, te  $\text{NO}_x$  i  $\text{SO}_x$  - ekotest
- oktanski broj govori o kvaliteti benzina obzirom na jednolikost izgaranja, uobičajene vrijednosti su od 90 do 105,
- Aromatski ugljikovodici imaju visoke vrijednosti OB, ali su otrovni, benzen do 0,1%, ukupni do 42%, a od 2005. do 35%,
- sumporovi spojevi su nepoželjni u gorivu jer stvaraju s. okside (zagađenje), a smanjuju i djelotvornost katalizatora (CO u  $\text{CO}_2$ , i  $\text{NO}_x$  u  $\text{NO}_2$ ), u EU do 2003. 150ppm (maseni), a od 2005. 50ppm



- Zrakoplovni (avionski) benzin služi kao gorivo za zrakoplove i helikoptere s klipnim benzinskim motorom,
- ima nižu vrijednost staništa ( $-60^{\circ}\text{C}$ )(stanište-smanjenje tečljivosti pri nižim temperaturama, dolazi do izlučivanja i kristalizacije parafinskih ugljikovodika i prestanka tečenja),
- mora imati veliku kaloričnu vrijednost

- Zrakoplovno (avionsko) mlazno gorivo koristi se kao gorivo za mlazne motore,
- frakcija je benzina i petroleja iz primarne (atmosferske) destilacije nafte.
- mora imati veliku kaloričnu vrijednost

- 
- dieselsko gorivo služi za pogon dieselskih motora,
  - smjesa je petrolejske frakcije i frakcije lakog plinskog ulja
  - cetanski broj ukazuje na sklonost zapaljenju, veća vrijednost veća sklonost zapaljenju
  - propisi EU postrožuju kvalitetu, uz ostalo do 2005. sumpor <150ppm, a nakon toga <50ppm. , CB>51.

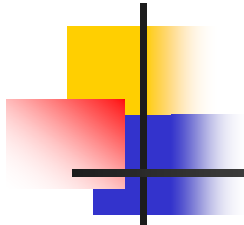
- 
- loživo ulje čini smjesa ugljikovodika visokoga vrelišta i najviše se koristi kao visokokalorično gorivo za loženje,
  - dobivaju se nakon odvajanja benzina i drugih "lakih" sastojaka ili su izravan ostatak pri atmosferskoj ili vakumskoj destilaciji.
  - *destilacijska loživa ulja odn. plinska loživa ulja (lako i teško)*-manje gustoće i viskoziteta i manj udjela S spojeva za grijanje domaćinstava, škola i sl.,
  - *ostatna loživa ulja- lako, srednje i teško*-nastaju frakcioniranjem naftnih destilacijskih ostataka-viskozna su , gusta i tamno obojena. Najpoznatije je teško loživo ulje - mazut ili bunker ulje za pogon velikih brodskih motora i termoenergetskih objekata





- Maziva mineralna ulja – maziva dobivena miješanjem baznih ulja i odgovarajućih dodataka (5 do 20%)
- bazna mineralna ulja smjesa su viših ugljikovodika dobivenih višestrukim postupcima prerade nafte.

- Parafinski vosak zajednički naziv za.
- čvrsti parafin,
- cerezin,
- vazelin (medicinski i kozmetički)



- Bitumen – smolasta, viskozna, tamno obojena tvar smjesa je pretežito aromatskih heterocikličkih ugljikovodika, nalazi se i u prirodi, a najviše se dobiva obradom rafinerijskih ostataka nafte.
- u širem smislu bitumeni su većina organskih tvari u zemljinoj kori; nafta, prirodni plin, bit. ugljen, škrljavci i prirodni asfalt,
- ima više vrsta bitumena koji se razlikuju u svojstvima
- najpoznatiji je *asfaltni bitumen* za proizvodnju asfalta u kombinaciji s agregatima kamena – služi u građevinarstvu



## Euro norme

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Homologacijskim propisima (u Europi ECE – pravilnici i EEC – smjernice) određene su dopuštene granice emisija štetnih tvari i propisane metode ispitivanja sljedećih štetnih sastojaka:

- ugljikovog monoksida (CO),
- ugljikovodika (HC) i
- dušikovih oksida (NO<sub>x</sub>).

Kod Diesel motori dodatno je još ograničena i

- količina čestica PM (engl. Particulate Matter; najveći dio njih čini čađa),
- neprozirnost ispušnih plinova i nemetanski ugljikovodici (NMHC).

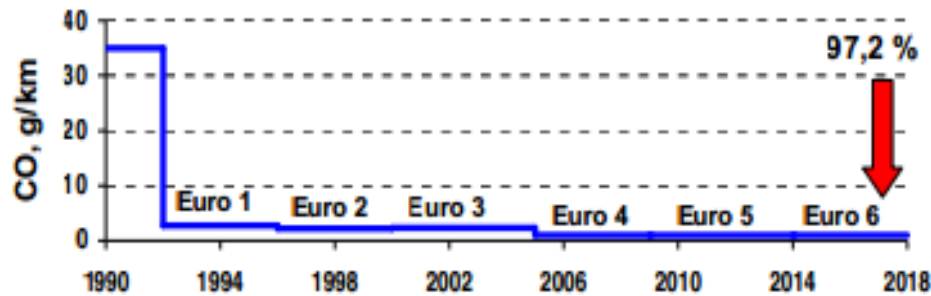
Kod vozila na pogon stlačenim prirodnim plinom ograničena je i količina metana (CH<sub>4</sub>) u ispušnim plinovima. Također je ograničena i količina hlapljivih tvari koje vozilo ispušta u okoliš iz spremnika i sustava za gorivo.

Smanjivanje emisija štetnih tvari provodi se kontinuiranim poboljšanjima procesa izgaranja u cilindru motora, pročišćavanjem ispušnih plinova nakon što izađu iz motora, poboljšavanjem kvalitete goriva (prvenstveno smanjivanjem sadržaja sumpora), smanjivanjem otpora vožnje i optimiranjem upravljanja radom motora i vozila u cjelini.

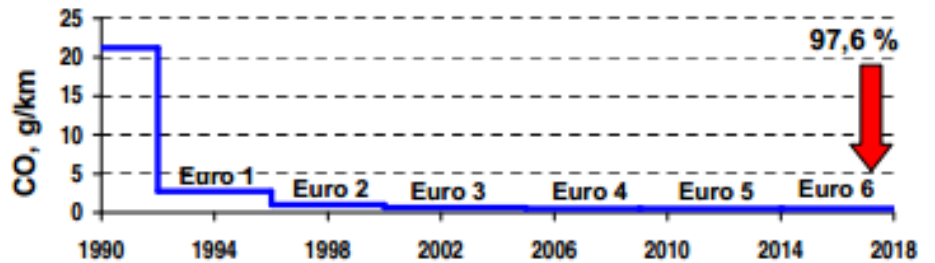
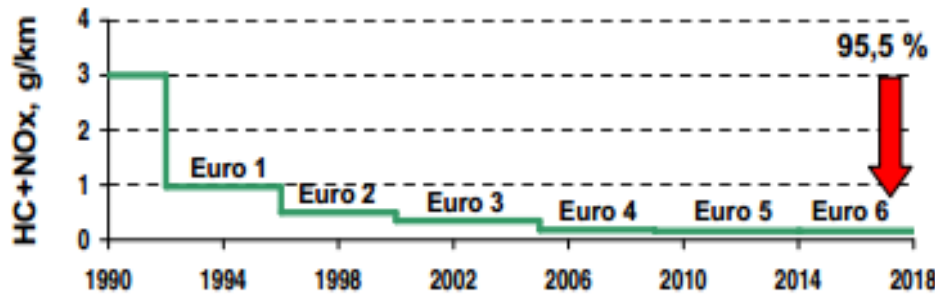
U početku je u Europi u ispušnim plinovima automobilskih motora bila ograničena samo emisija CO, od 1970. godine ograničena je i emisija HC.

Od 1977. ograničena je emisija NO<sub>x</sub> samo za Otto motore, a od 1988. ograničena je i količina čestica (PM) kod Diesel motora.

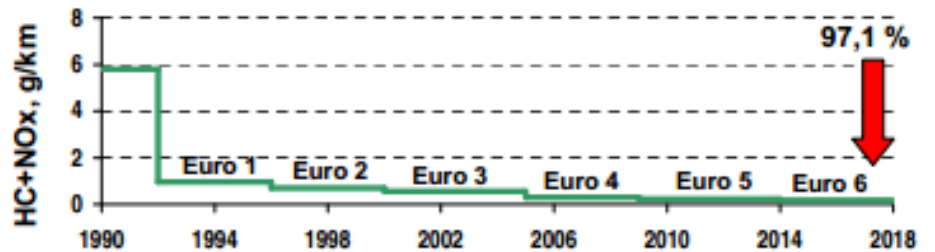
**Od 1992. godine pojedine razine dopuštenih emisija štetnih tvari nose naziv Euro.**



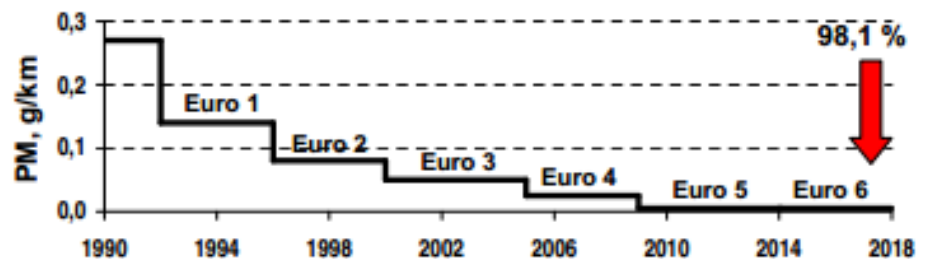
Smanjenje emisije Otto motora vozila kategorije osobna vozila



Smanjenje emisije Diesel motora vozila kategorije osobna vozila



- CO-ugljični monoksid
- HC-ugljikovodici
- NO<sub>x</sub>-dušični oksidi
- PM-kruće čestice (particulate matter)-većinom čađa
- NMHC-nemetanski ugljikovodici

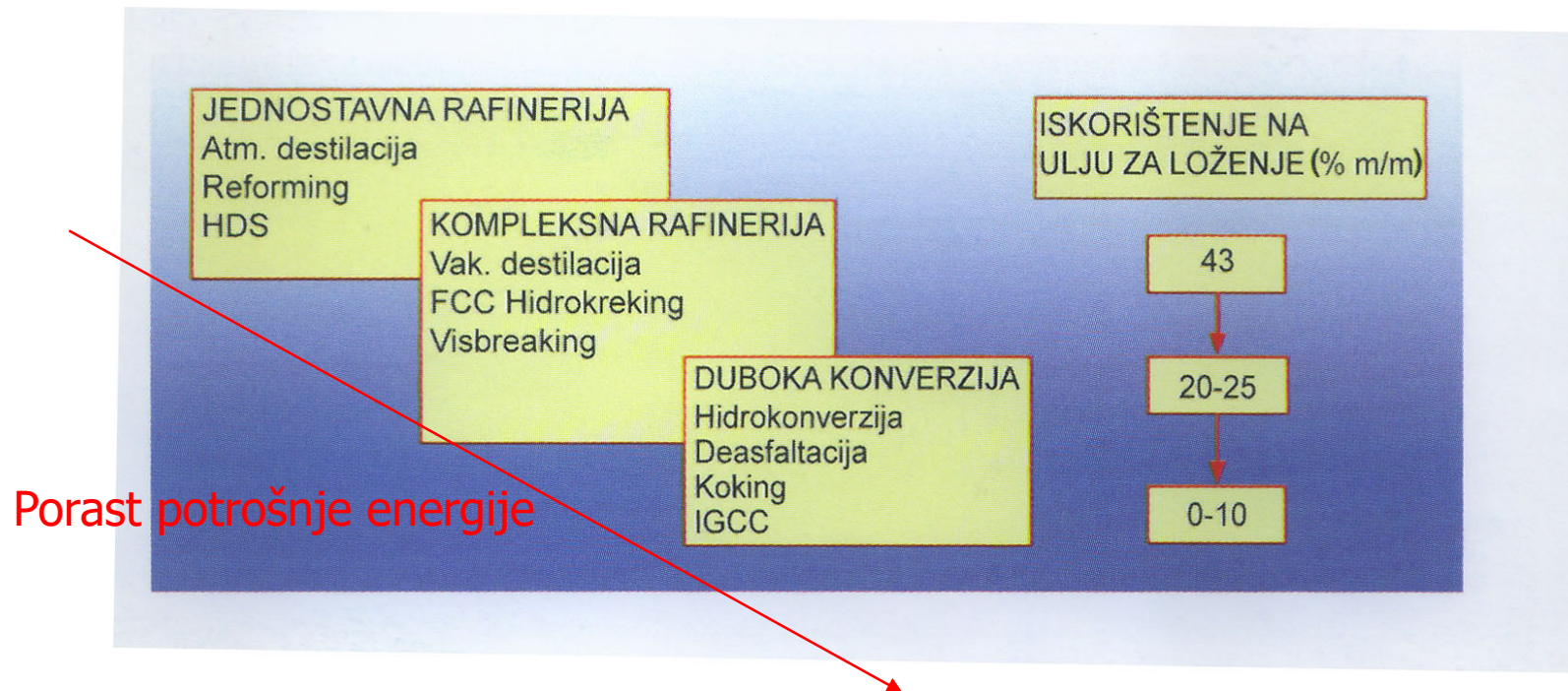
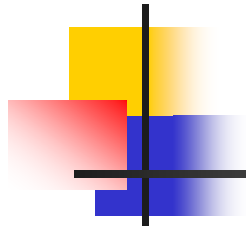


## Maksimalne dopuštene količine (g/km) pojedinih štetnih tvari za osobna vozila\*

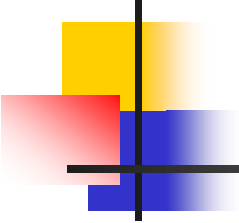
	Datum stupanja na snagu	CO	HC	NMHC	NO <sub>x</sub>	HC + NO <sub>x</sub>	PM
Dieselovi motori							
Euro 1	Srpanj 1992	2.72 (3.16)	-	-	-	0.97 (1.13)	0.14 (0.18)
Euro 2	Siječanj 1996	1.0	-	-	-	0.7	0.08
Euro 3	Siječanj 2000	0.64	-	-	0.50	0.56	0.05
Euro 4	Siječanj 2005	0.50	-	-	0.25	0.30	0.025
Euro 5	Rujan 2009	0.500	-	-	0.180	0.230	0.005
Euro 6	Rujan 2014	0.500	-	-	0.080	0.170	0.005
Ottovi motori							
Euro 1	Srpanj 1992	2.72 (3.16)	-	-	-	0.97 (1.13)	-
Euro 2	Siječanj 1996	2.2	-	-	-	0.5	-
Euro 3	Siječanj 2000	2.3	0.20	-	0.15	-	-
Euro 4	Siječanj 2005	1.0	0.10	-	0.08	-	-
Euro 5	Rujan 2009	1.000	0.100	0.068	0.060	-	0.005**
Euro 6	Rujan 2014	1.000	0.100	0.068	0.060	-	0.005**

\* Prije Euro 5 norme, osobna vozila koja su imala masu veću od 2500 kg ulazila su u kategoriju malih komercijalnih vozila.

\*\* Vrijednosti koje vrijede samo za vozila s motorom sa direktnim ubrizgavanjem

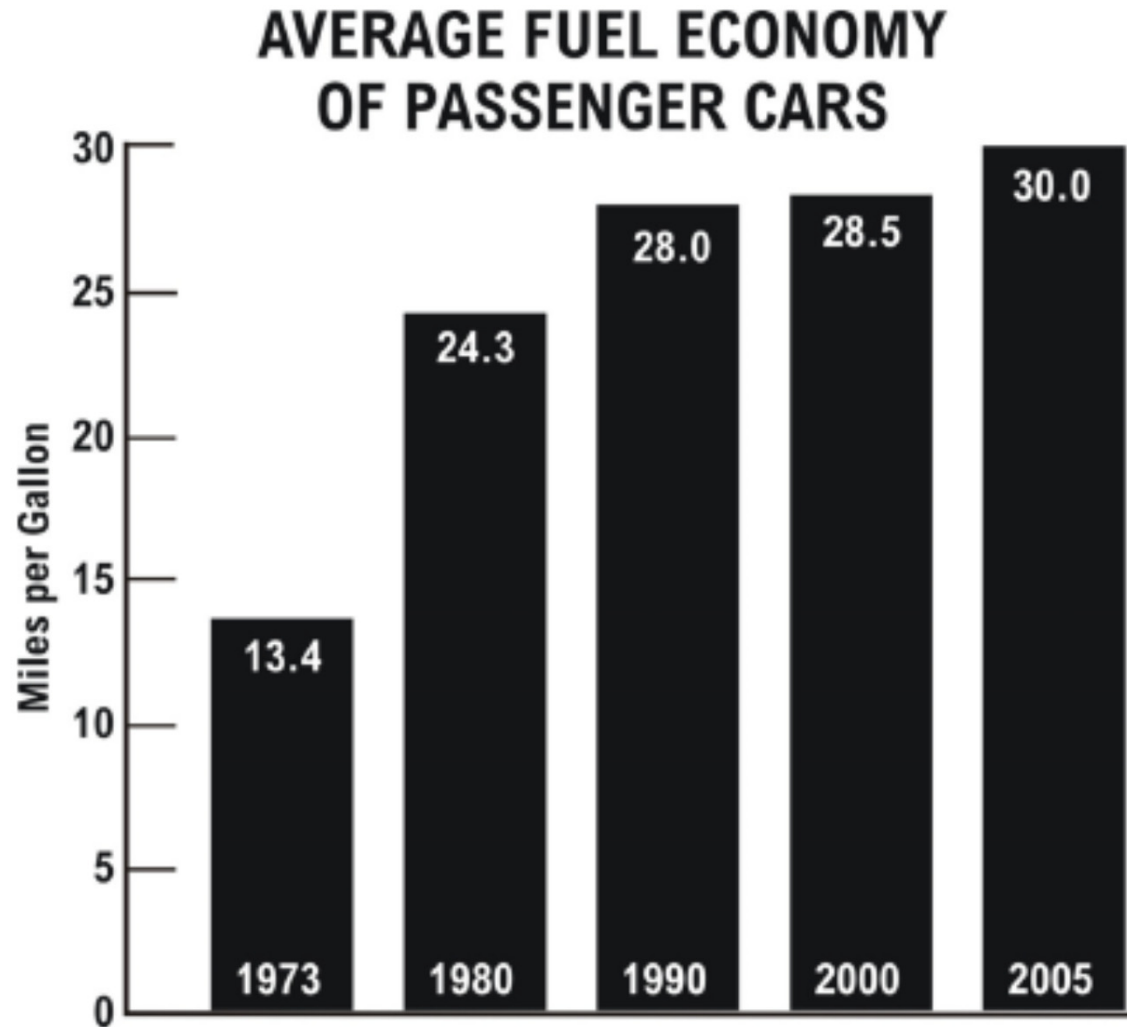
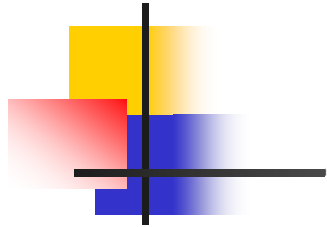


## Prerada nafte energetski je intenzivan proces

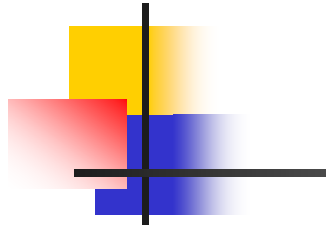
- 
- U prosjeku se 7 do 15% energetskog ekvivalenta ulazne sirovine (sirove nafte) troši se u rafinerijskim procesima.
  - dvije najveće NL rafinerije izvjestile su o 7% (1995.)
  - u SAD-u izvjestile su o 15%, a trenutno 9 do 10%

“Shell” navodi povećanje emisije CO<sub>2</sub> od 18MtC u 2003. godini u odnosu na godinu prije, a također se navodi da je prerada nafte u Californiji energetski intenzivnija nego u drugim saveznm državama SAD-a **samo zbog strožih propisa odnosno nižeg sadržaja sumpora u gorivu.**

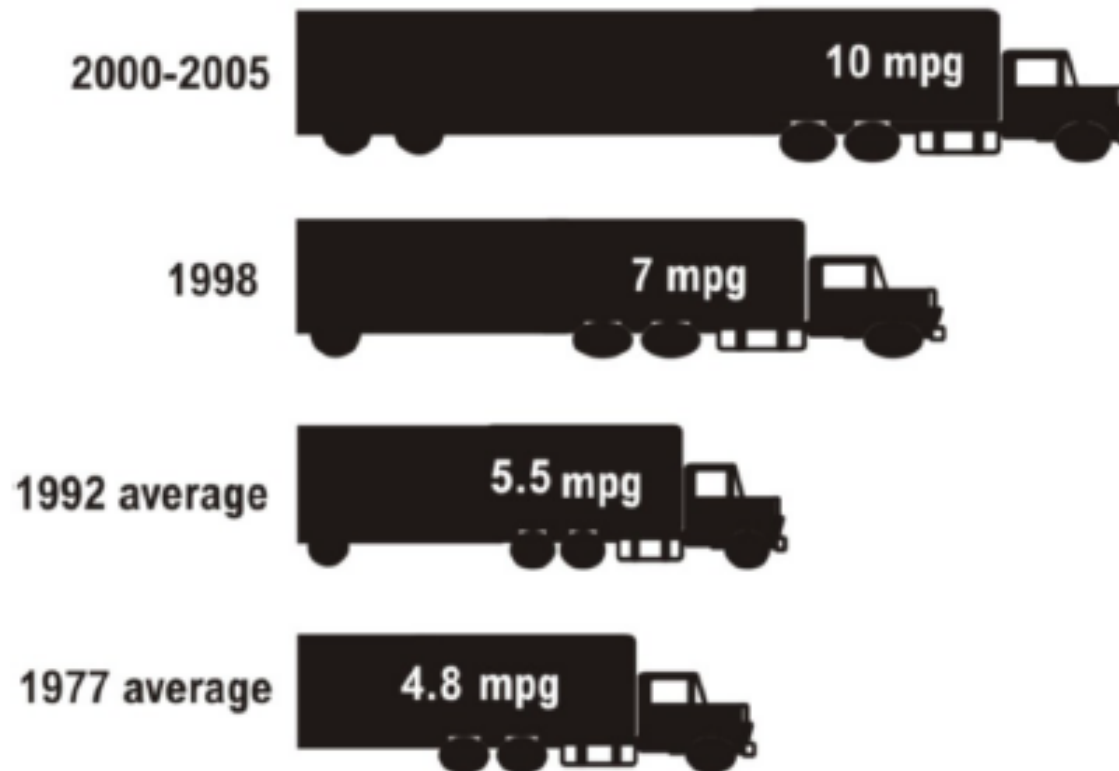
## Nužno se mora povećavati energetska učinkovitost

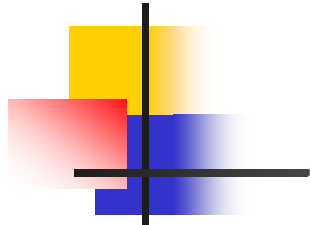






## TRACTOR TRAILER TRUCK MILEAGE





## AIR TRANSPORTATION FUEL ECONOMY

PASSENGER MILES PER GALLON OF JET FUEL

