«Энергетическая политика: (энергетический) поворот в германо-российских отношениях?» / Зимняя школа 31.01.2022 – 04.02.2022

https://polit.msu.ru/meeting/energeticheskaya-politika-energetich/

https://politiq.ru/2021/12/15/zimnyaya-shkola-politiq-energeticheskaya-politika-energeticheskij-povorot-v-germano-rossijskih-otnosheniyah/

DEUTSCH-RUSSISCHES FORUM E.V.
ГЕРМАНО-РОССИЙСКИЙ ФОРУМ

CENTERO
Research Association

МГИМО
УНИВЕРСИТЕТ

LOMONOSOV MOSCOW STATE UNIVERSITY

Россия Deutschland 2020/2022
DEUTSCH-RUSSISCHES JAHR
WIRTSCHAFT UND NACHHALTIGE ENTWICKLUNG
РОССИЙСКО-ГЕРМАНСКИЙ ГОД
ЭКОНОМИКА И УСТОЙЧИВОЕ РАЗВИТИЕ

POLIT IQ

Организаторы: Германо-Российский Форум в сотрудничестве с образовательной программой PolitIQ, МГУ, МГИМО и Исследовательская ассоциация CENTERO; зимняя школа «Энергетическая политика: (энергетический) поворот в германо-российских отношениях?» для студентов и аспирантов политологов и экономистов в рамках Российско-Германского перекрестного года «Экономика и устойчивое развитие» 2020-2022.

Выступали на открытии Школы

- **Беате Гжески, полномочный министр и постоянный заместитель посла Германии в России,**
- **Томас Брух, председатель попечительского совета Германо-Российского Форума (и руководитель сети гипермаркетов «Глобус»),**
- **Мартин Хоффманн, исполнительный директор и член правления Германо-Российского форума,**
- **Андреа фон Кнооп, почетный президент Российско-Германской внешнеторговой палаты,**
- **Юлия Хельд, координатор фонда «Глобус» Россия,**
- **Максим Вилисов, генеральный директор исследовательской ассоциации CENTERO,**
- **Интигам Мамедов, заместитель декана факультета политологии МГУ им. М.В.Ломоносова.**

Участие НИЛВИЭ

- **Лекция «UN Sustainable development goal #7 – energy» (О.А. Синюгин, 31.01.2022**).
- **Лекция «Renewable Energy Sources and Their Role in the Global Energy Transition. Prospects for Renewable Energy Development in Russia» (К.С. Дегтярев, 31.01.2022).**
- **Круглый стол** «Углеродный налог в ЕС и в России: драйвер развития или инструмент сдерживания?» (Экономический факультет кафедра государственной политики) (01.02.2022, 14.00). https://vk.com/wall-127854154_3423
- **Семинар. Часть 1. Экспертные дебаты о стратегиях низкоуглеродного развития. (04.02.2022, 11.00). Модератор** В.И. Якунин, заведующий кафедрой государственной политики факультета политологии МГУ им. М.В. Ломоносова.

UN Sustainable Development Goal #7 - Energy

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31 January 2022

UN 17 Sustainable development goals (SDGs), 2015 - 2030

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

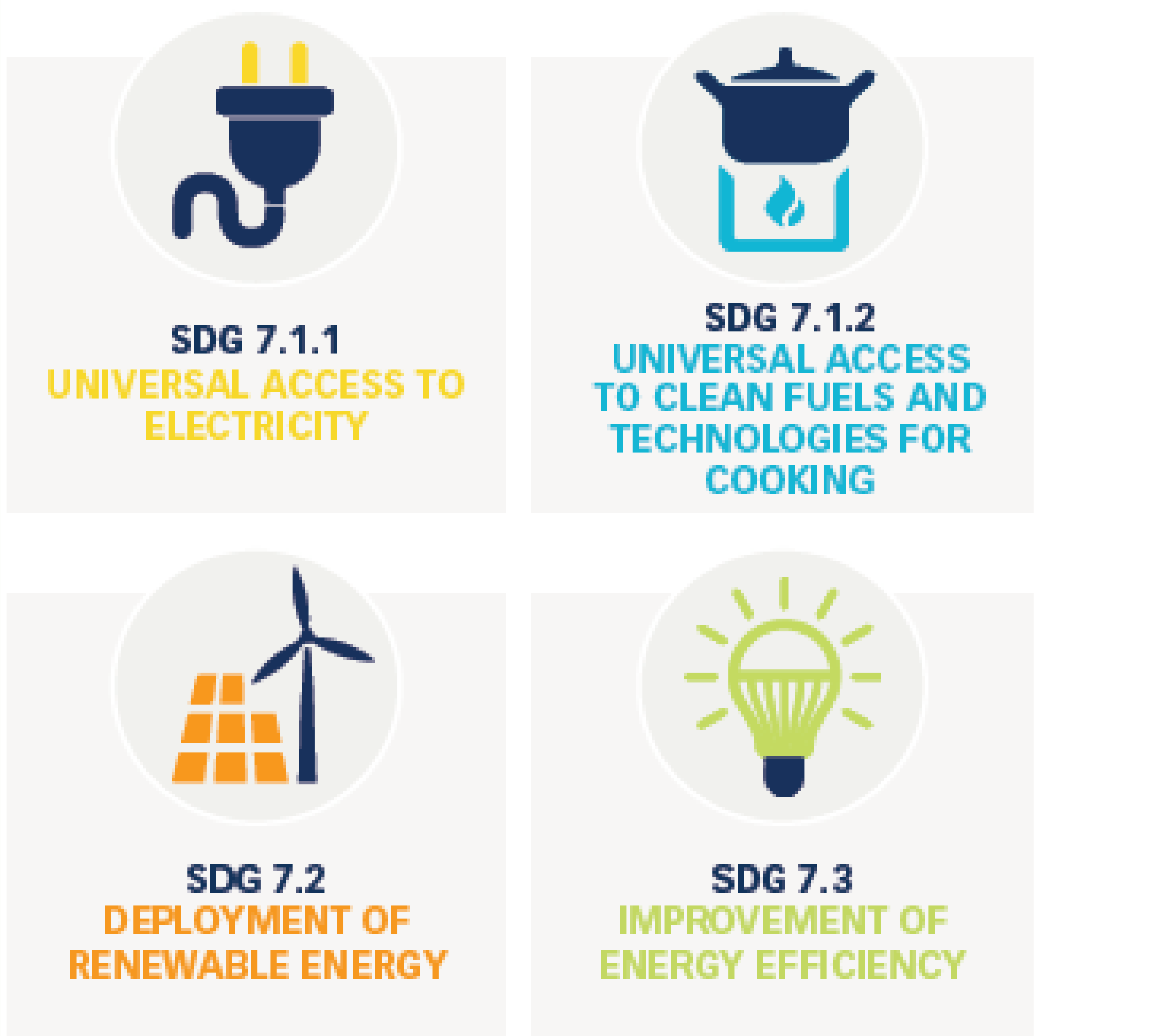
- Goal 10. Reduce inequality within and among countries
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12. Ensure sustainable consumption and production patterns
- Goal 13. Take urgent action to combat climate change and its impacts
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Goal 7 targets

- 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services
- 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix
- 7.3 By 2030, double the global rate of improvement in energy efficiency
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states, and land-locked developing countries, in accordance with their respective programmes of support

AFFORDABLE AND CLEAN ENERGY



2010	2017
1.2 billion people without electricity access	**840 million** people without electricity access
2.96 billion people without clean cooking	**2.90 billion** people without clean cooking

7.1 ELECTRIFICATION. CLEAN COOKING.

- Number of people living without electricity dropping from 1.2 billion in 2010 to 840 million in 2017.
- The global electrification rate reached 89 percent and 131 million people gained access to electricity each year on average since 2010.
- However, without sustained and stepped-up efforts, 650 million will still live without access to electricity in 2030

- Access to clean cooking has increased from 57% in 2010 to 61% in 2017. To reach the target of universal access by 2030, the pace of recent progress would have to accelerate six-fold.
- Around 3 billion people continue to cook by burning biomass, like wood and charcoal. The resulting indoor air pollution leads to approximately 4 million premature deaths each year from indoor air pollution, primarily among women and children.
- Access to clean cooking did not improve substantially in Sub-Saharan Africa, remained stable in Latin America, and showed only slow process in developing Asia between 2010 – 2017.

SDG 7.2 RENEWABLE ENERGY *SDG 7.3* ENERGY EFFICIENCY

- In 2016, the share of renewables in total final energy consumption increased at the fastest rate since 2012 and reached almost 17.5%. 10.2% was made of modern renewable energy (e.g. biofuels, hydropower, wind and solar), while the remainder was traditional uses of biomass
- electricity generation, where over 25% came from renewables in 2016, thanks to the rapid expansion of solar PV and wind.
- The use of modern renewables for heat and transport remains limited — reaching shares of 9% and 3.3% respectively. Considering that these last two end-uses represent 80% of total final energy consumption, particular efforts are needed in these to accelerate the uptake of renewables.
- Global primary energy intensity has been falling at an accelerated annual rate of 2.3% since 2010, up from 1.3% between 1990 and 2010. However, this still lags behind the rate of improvement to 2030 targeted by SDG 7.3, which now exceeds 2.7%.
- Asia has seen the largest improvements in energy intensity, with rates above the global average. China has had the fastest rate of improvement amongst these countries, with strong improvement well above the global average also observed in United Kingdom, Japan, Indonesia, and India.

Sustainable Development

- Development that meets the needs of the present without compromising the ability of future generations to meet their own needs

- UN, UNEP, 1972 Stockholm, Agenda-21, Rio-1992, UNDP, MDG
- Sum: resources, investments, technology, institutions, human capital
- ^ Energy Services -> ^ Social Welfare
- v future resources , v environment quality

- Do not overload carrying capacity of ecosystems. Eco-footprint.
- do not compromise the ability of future generations to meet their energy needs

- Principal Strategies:
- 1) Efficient use of resources (EE)
- 2) Clean conversion processes
- 3) Inexhaustible supply options: timely NRE, nuclear breeding, fusion

Energy Poverty

- Lack of access to affordable, reliable energy
- 2B - fuelwood based, 0.7B no electricity
- Constraint on development
- Old energy use patterns depress nutrition, health, productivity
- 1 kW/cap <-> EU living standards 70’s
- Poverty line $2/day - global

- Poverty alleviation str: macroeconomic growth, human capital, wealth re-distrib

Access

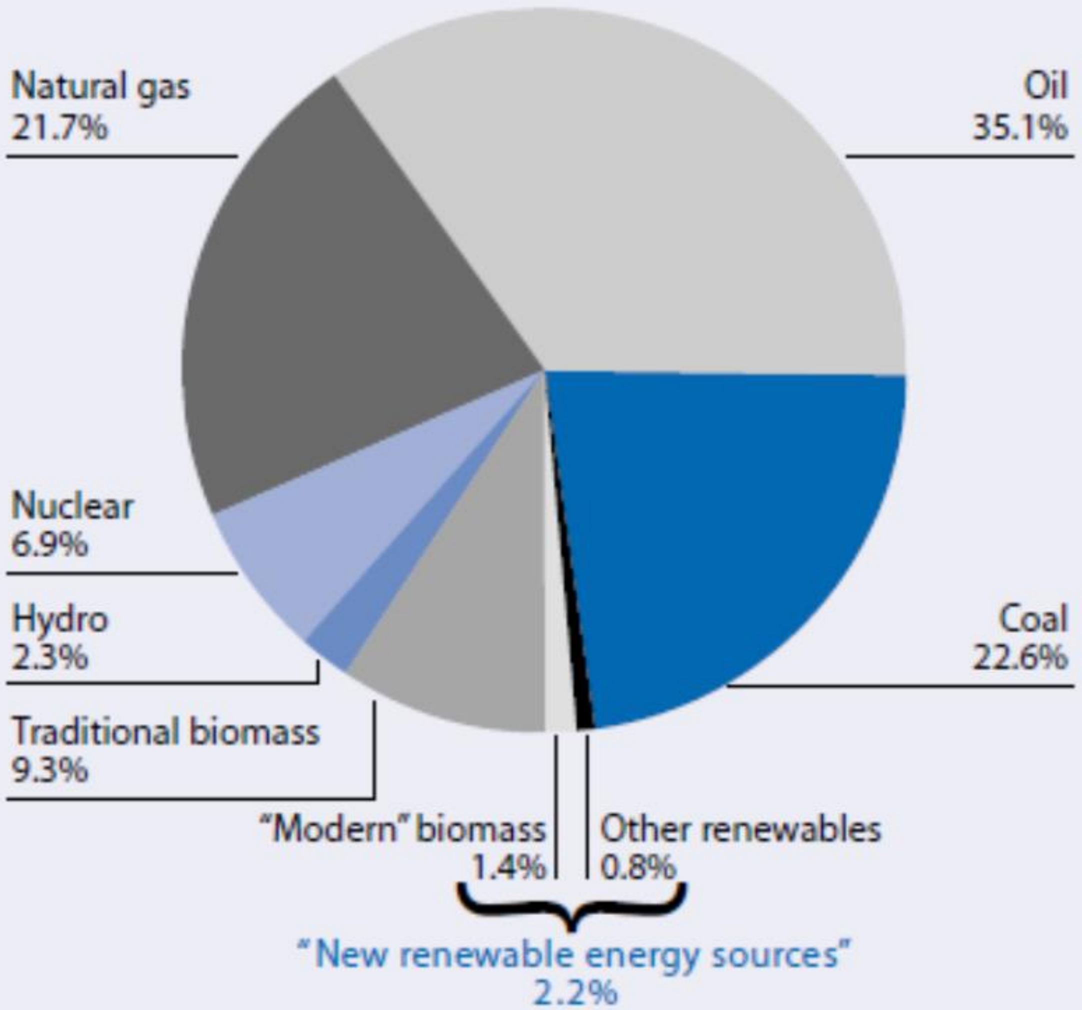
- 2018 edition of the World Bank’s Regulatory Indicators for Sustainable Energy (RISE) reveals that basic, subsistence-level electricity consumption (30 kilowatt-hours [kWh]/month) is unaffordable (costs more than 5% of monthly household income) for the poorest 40% of households in half of the access-deficit countries, representing 285 million people.

- With a regional access rate of 44%, Sub-Saharan Africa’s access deficit remains the largest: about 573 million people lacked access to electricity in 2017. Burundi, Chad, Malawi, the Democratic Republic of Congo, and Niger were the four countries with the lowest electrification rates.

Energy Ladder

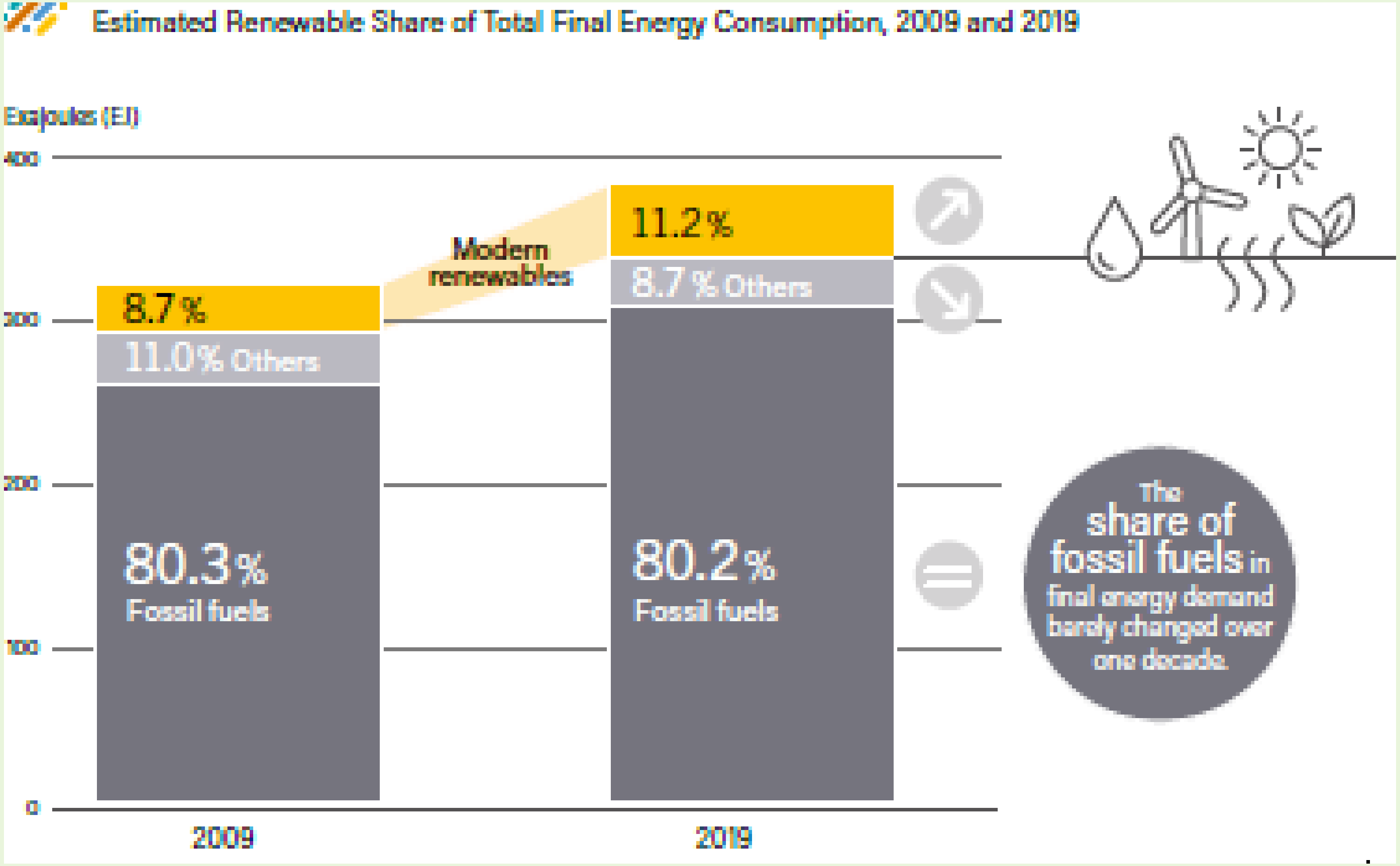
- move from traditional to modern energy, substitution
- higher efficiency from 1% - to 20-40% and more
- less emissions
- fuel choice depending on income
- liquids (LPG), gases, electicity
- Tech. Option: skip the rungs in energy ladder for 1.5 B – 2 B people
- Hi-technology driven energy sector
- Post-industrial structure

FIGURE 5. WORLD PRIMARY ENERGY USE, BY ENERGY SOURCE, 2001 (SHARES OF 10.2 GTOE)



Population: 6.102 billion
Total energy use: 10.2 Gtoe
Per capita energy consumption: 1.67 toe

GSR 2021 Report



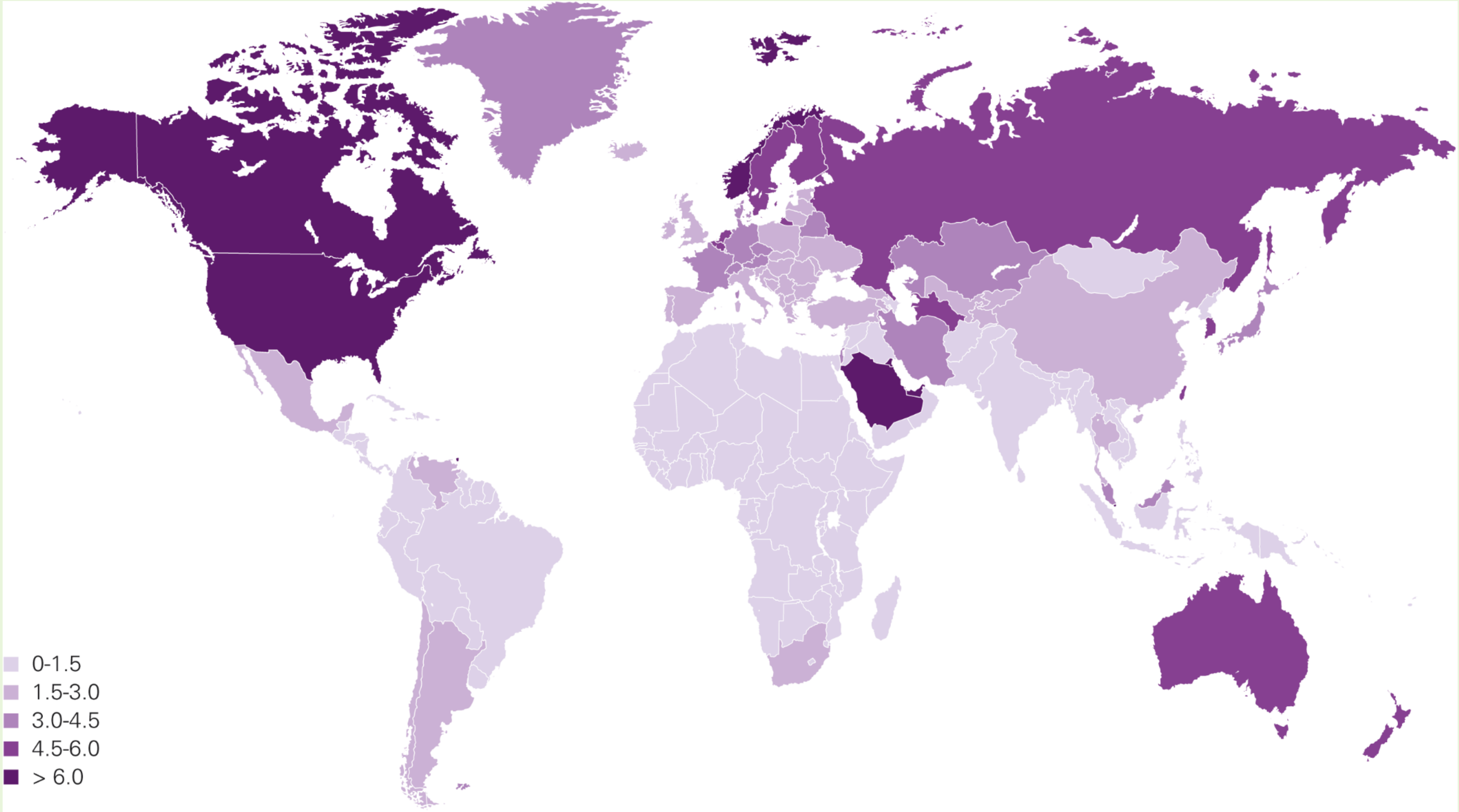
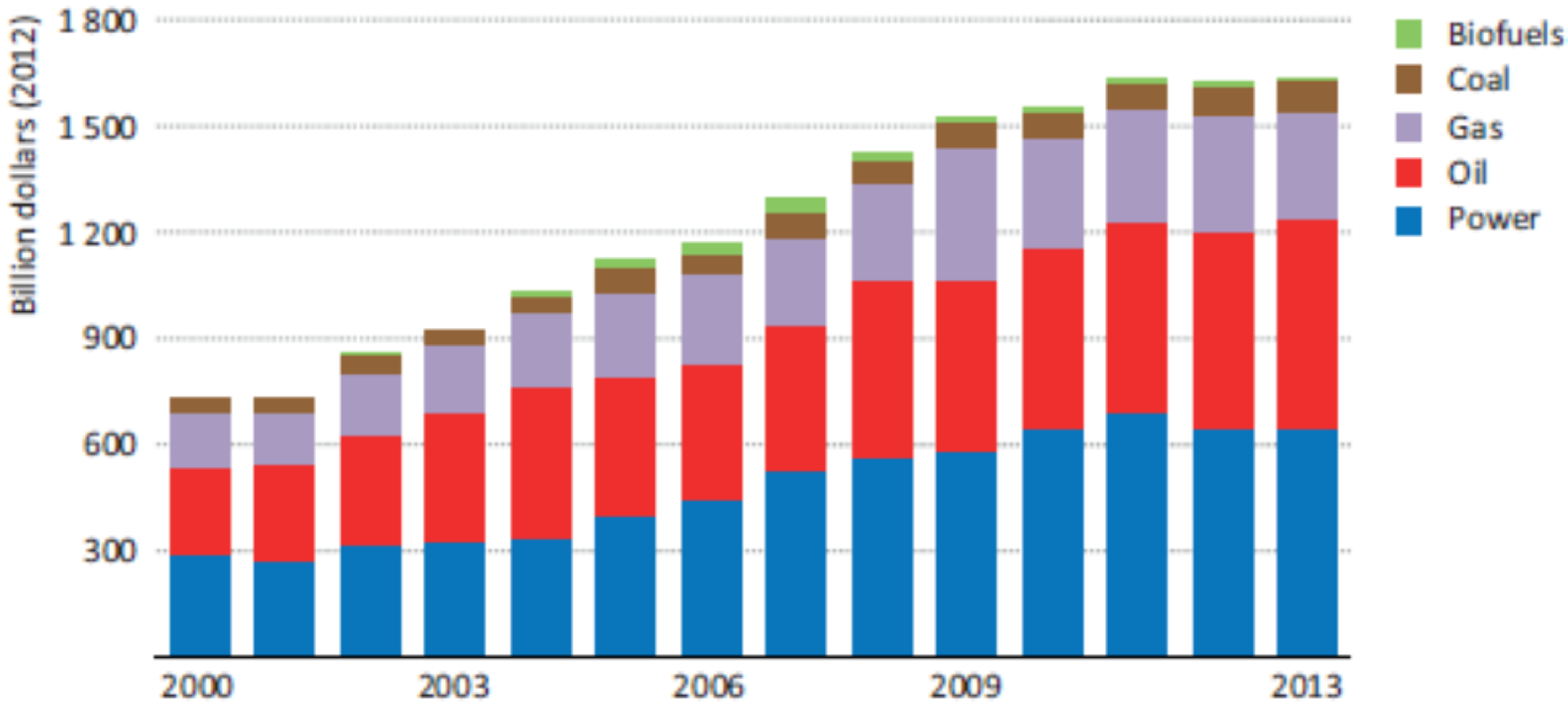

0-1.5
1.5-3.0
3.0-4.5
4.5-6.0
> 6.0

Figure 1.1 ▷ Investment in global energy supply



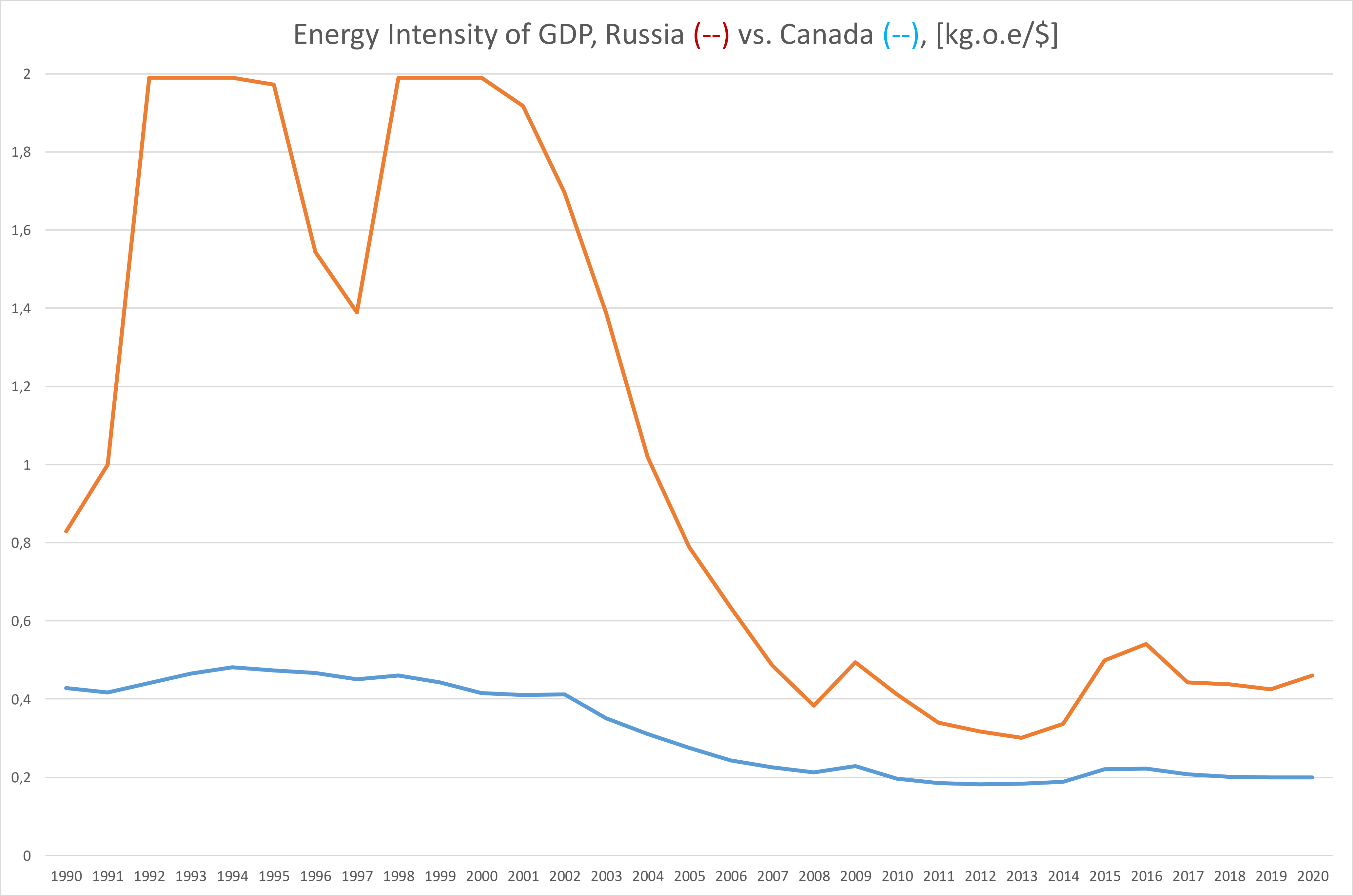
Dmitry Mendeleev, 19 cen.
Periodical Table of Chemical Elements

- “To burn oil – it is the same as if you feed the furnace with banknotes”
- Raw materials for chemical organic synthesis

Energy Intensity

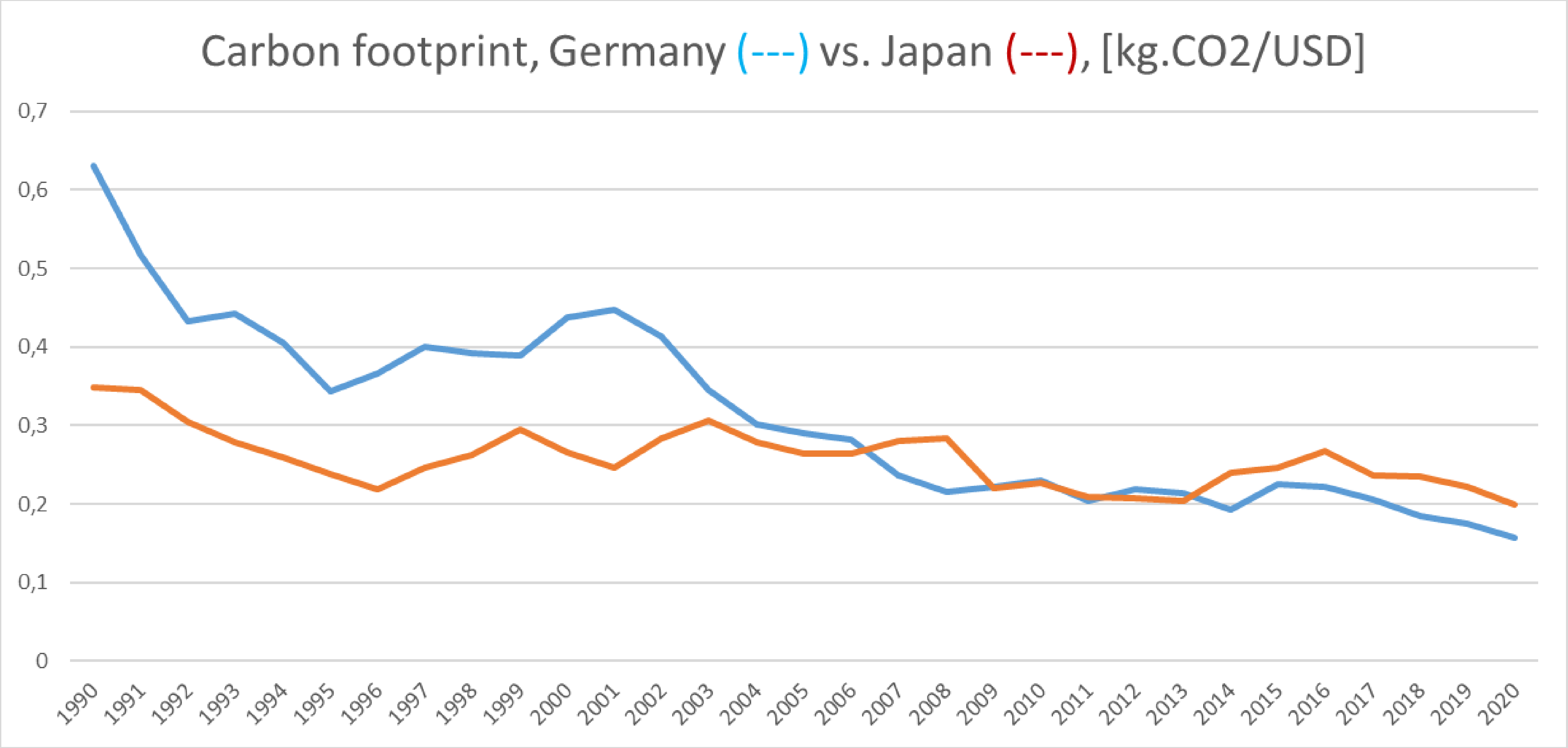
- Due to a lack of better indicators, reduction in energy intensity of national economies typically is used as a proxy for improvements in energy efficiency at the national or global level. Energy intensity is calculated as units of energy consumed per unit of economic output, or gross domestic product (GDP), [kg.o.e / $].

- Changes in energy intensity can reflect changes in energy efficiency of an economy, but they also reflect the impact of other factors, such as structural changes in the economy to less energy-intensive activities and the effect of fuel substitution. Factor analysis correction..



Energy Intensity of GDP, Russia (--) vs. Canada (--), [kg.o.e/$]
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

$70 / ton CO2, EU, 2021



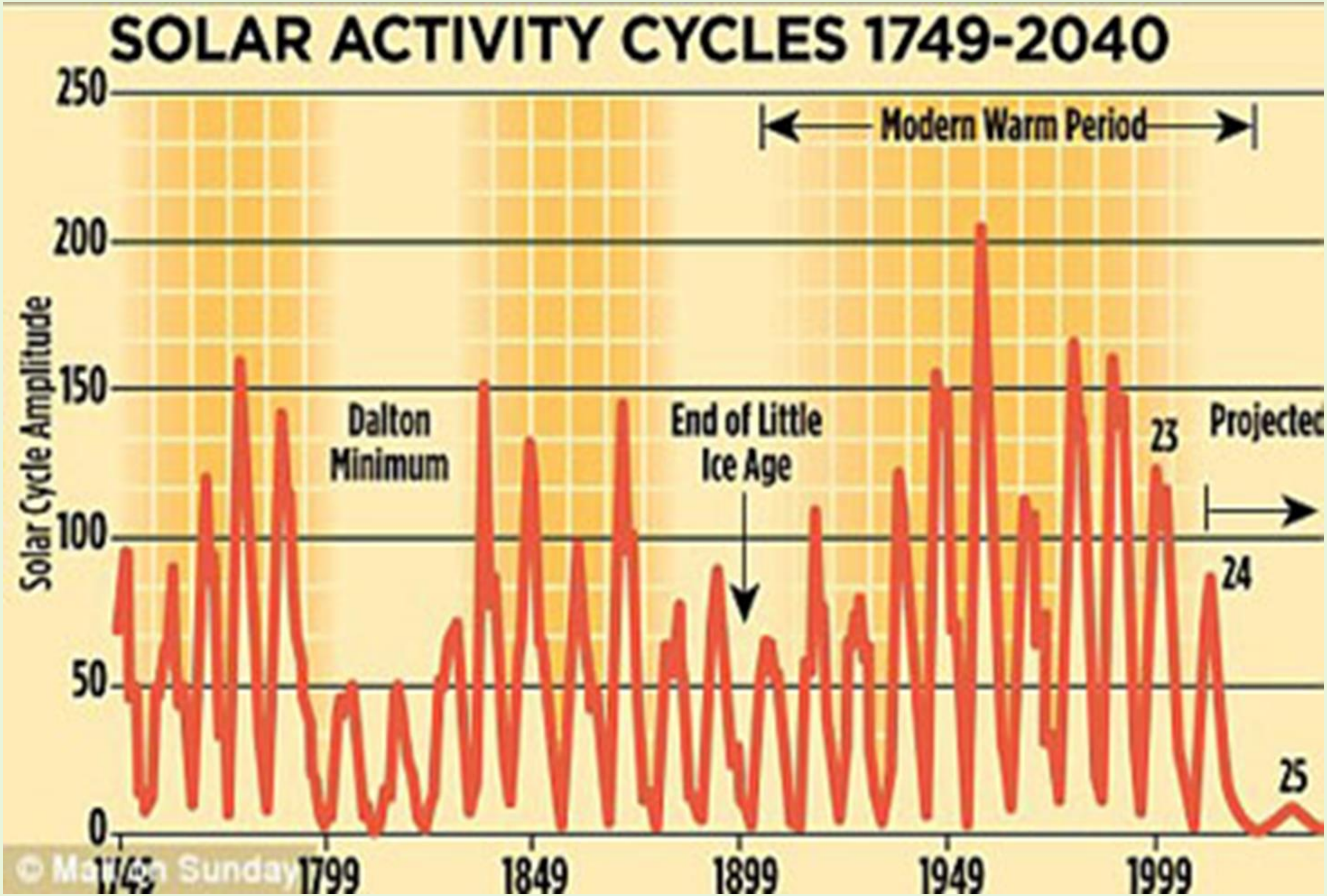
Energy Transition

- Paris Agreement Dec. 2015. National Determined Contributions (NDC). National Energy and Climate Plans (NECP).
- New industrial revolution declared Q4 2020 as a follow up. Complete decarbonization US, EU – 2050, Russia, China – 2060, India – 2070.

- Achieving net zero emissions (NZE) requires an increase in clean energy investment. In the NZE, annual investment in clean energy rises to USD 4 trillion by 2030,more than tripling from current levels (IEA).
- In the NZE, the combined size of the market for wind turbines, solar panels, lithium-ion batteries, electrolysers and fuel cells represents a cumulative market opportunity to 2050 worth USD 27 trillion.

Energy transition costs

- study, IPCC 2007 Report, Nicolas Stern, estimates low carbon energy transition costs at 1% GDP / year
- *New Climate Economy Report* (NCER 2018) finds that there is actually a net benefit of 26 trillion dollars in the 2018- 2030 period from transitioning from the business-as-usual trajectory to a low carbon economy.
- study, *Energy Transition Outlook (2020),* indicates that shifting 2-3% of GDP will get us to a zero-carbon economy by 2050.



SOLAR ACTIVITY CYCLES 1749-2040
Solar Cycle Amplitude
250
200
150
100
50
0
Modern Warm Period
Dalton
Minimum
End of Little
Ice Age
23
Projected
24
25
1799
1849
1899
1949
1999

Solar facts

- Solar radiation constant – 1360 watt/m2 above the atmosphere +- 0.1%
- Annual energy consumption by humanity - 15 Billion tonnes oil equivalent
- Solar E. = 10000 * Human E.
- Solar irradiation : +- 0.4% at the Earth surface due to atmosphere and climate events
- Humidity [kg.H2O/m3] up +7% along with +1.1 C temperature rise since 1850
- [CO2] 290 → 420 ppm
- Vegetation (biomass) +6%
- Paleo-fuels → Paleo-climate

Renewable Energy Sources and Their Role in the Global Energy Transition. Prospects for Renewable Energy Development in Russia

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Content

What is energy transition?

"The energy transition is a pathway toward transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century. At its heart is the need to reduce energy-related CO_2 emissions to limit climate change. Decarbonization of the energy sector requires urgent action on a global scale, and while a global energy transition is underway, further action is needed to reduce carbon emissions and mitigate the effects of climate change"

Source: https://www.irena.org/energytransition

It not the first energy transition in the history

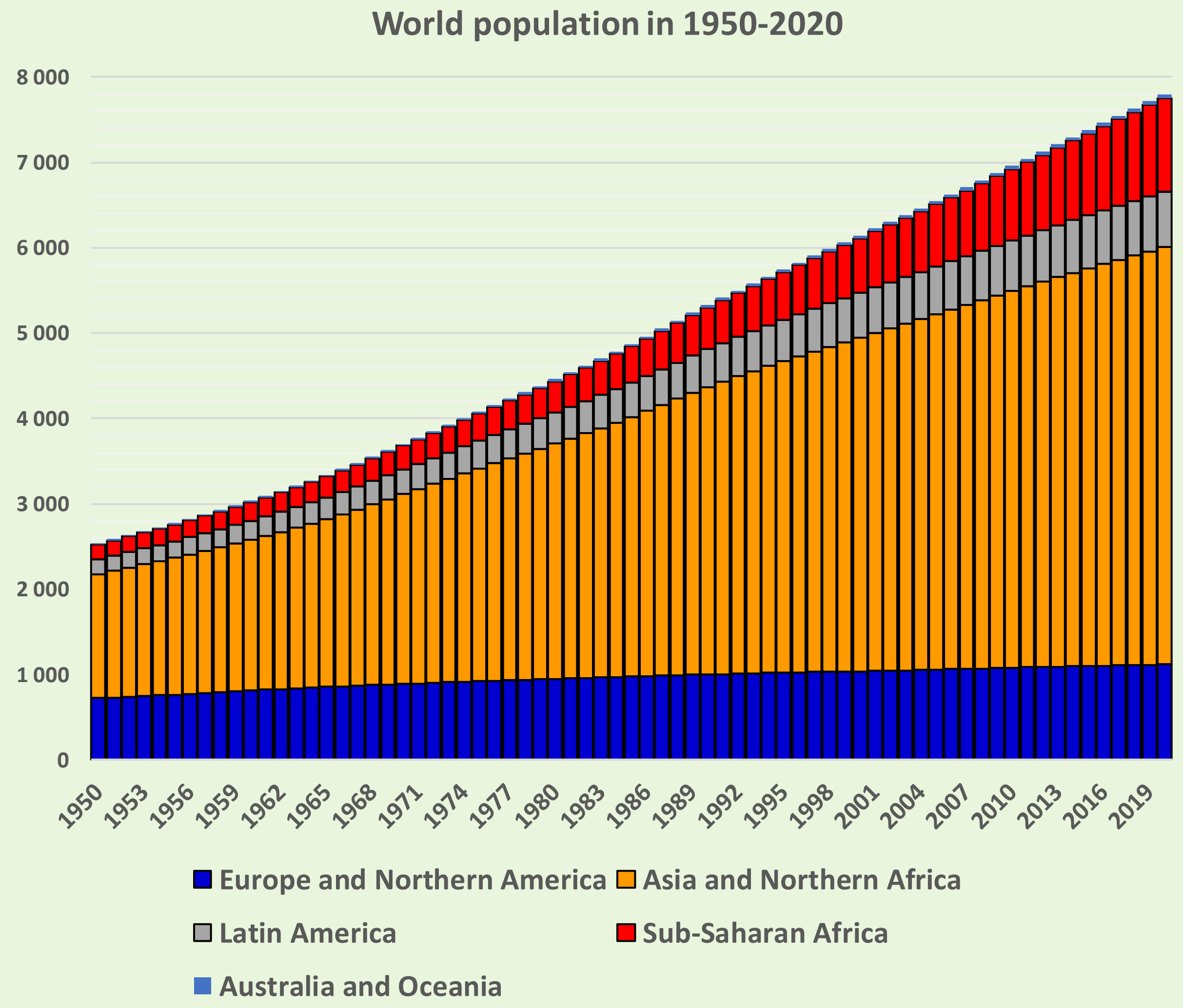
XVIII-XIX centuries – shift from firewood to coal, later – also to oil and gas.

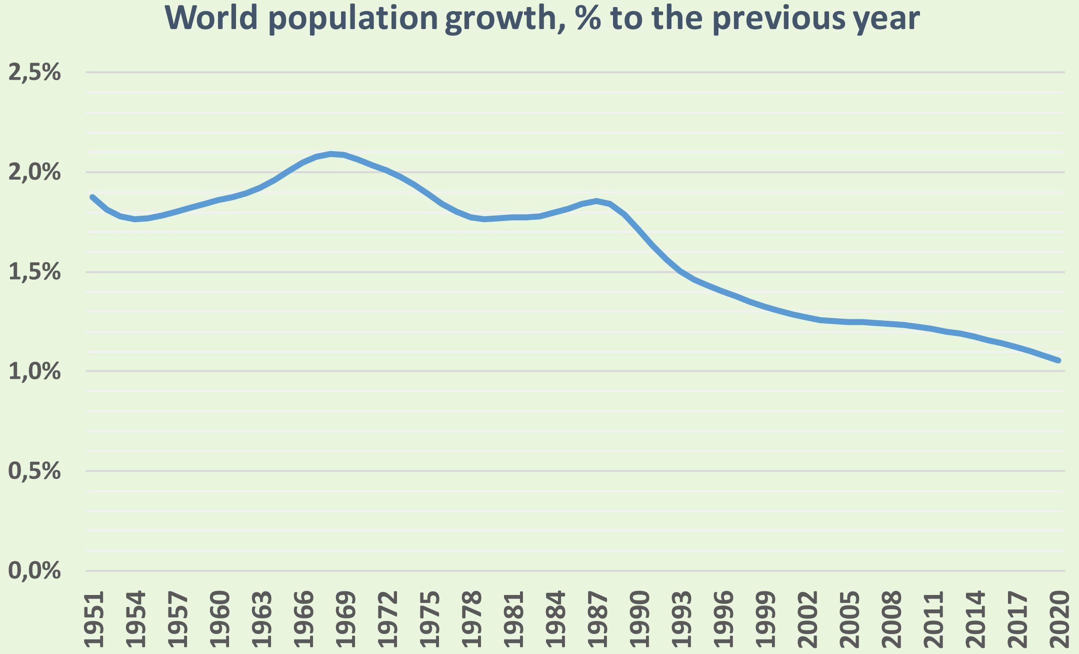
(may be, it prevented deforestation and saved the environment)

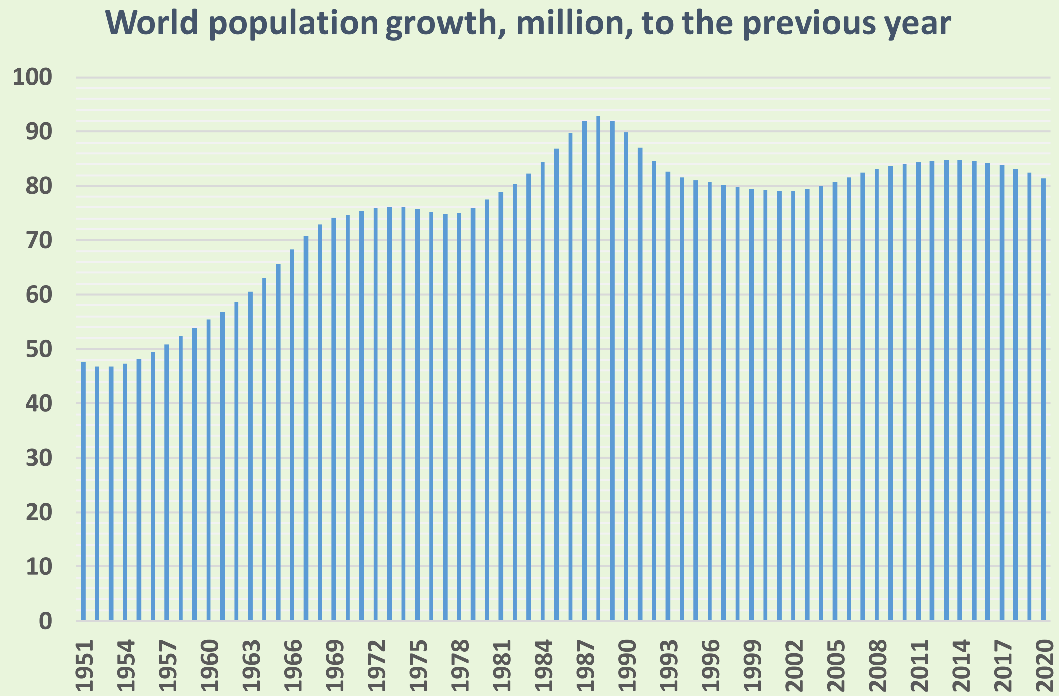
But this transition has not been yet completed – up to 3 billion people of the world (or almost 40%) still use firewood for cooking or heating.

Source: https://clck.ru/aoHTz

World population growth since 1950



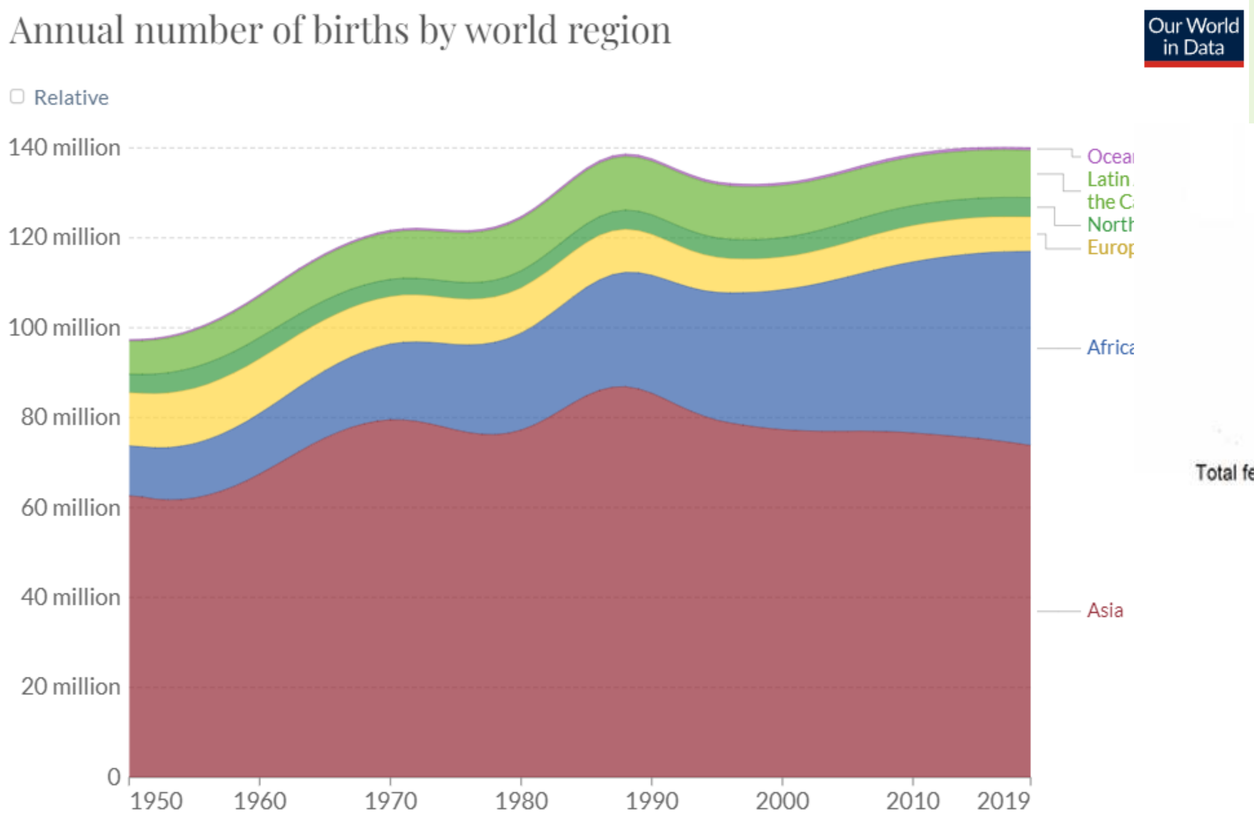


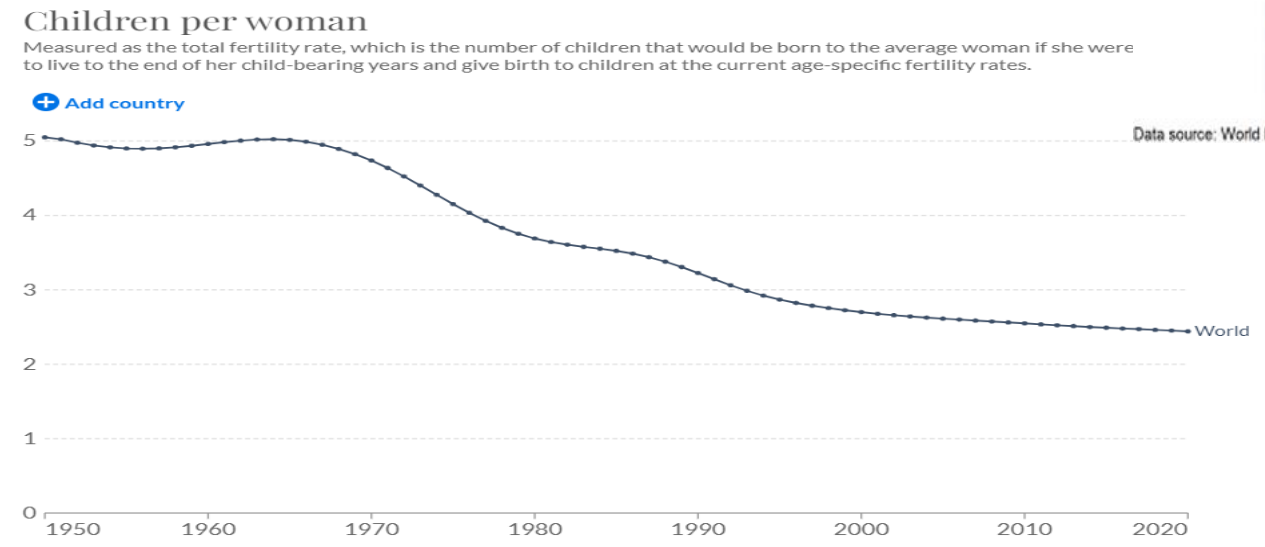


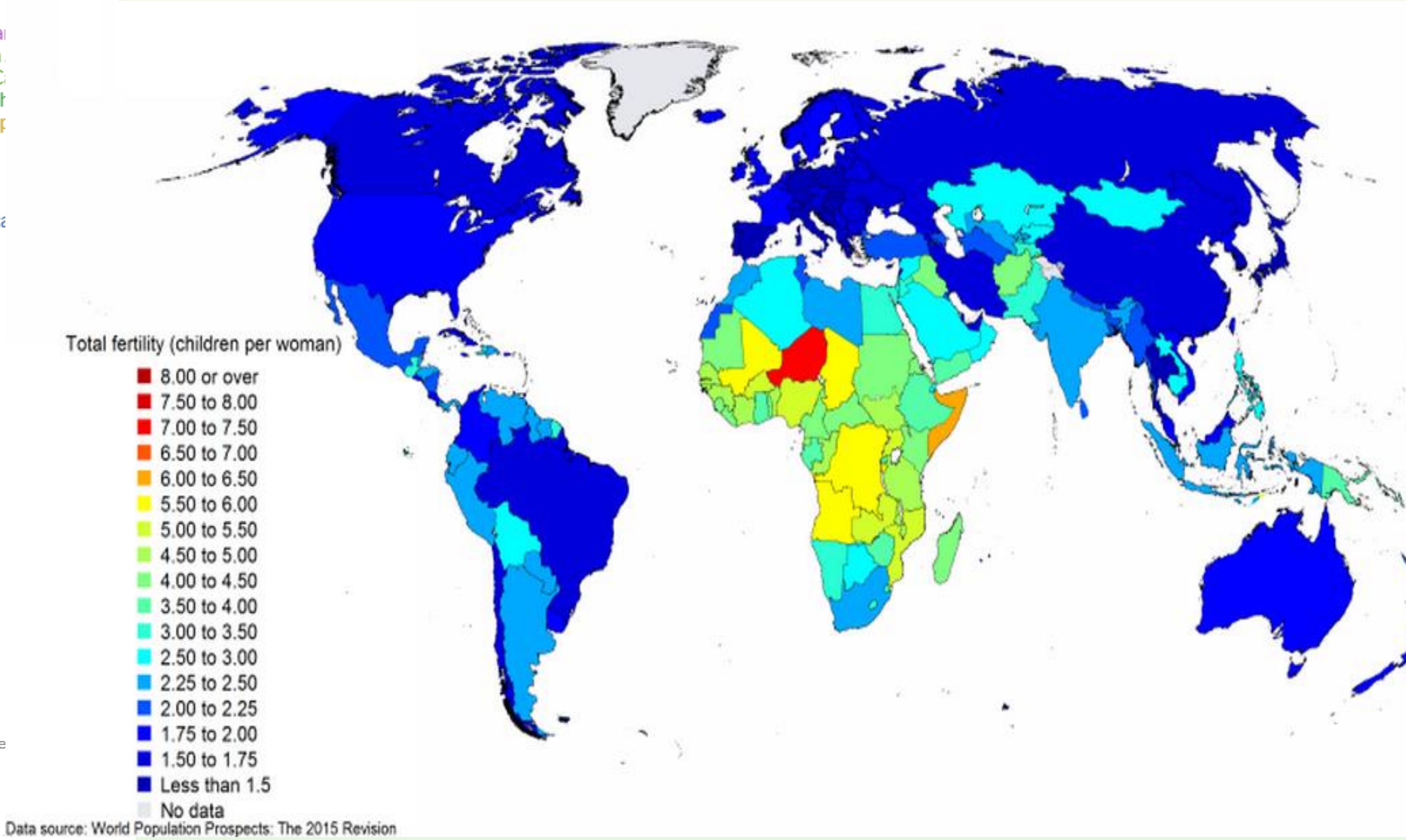
Although the world population grew since 1950 from 2500 million to 7800 million – more than 3 times, the growth rate has been slowing down since 1970-ies. Since 1990-ies even the absolute growth has decreased.

Source: UN, https://www.un.org/en/global-issues/population

Fertility Ratio

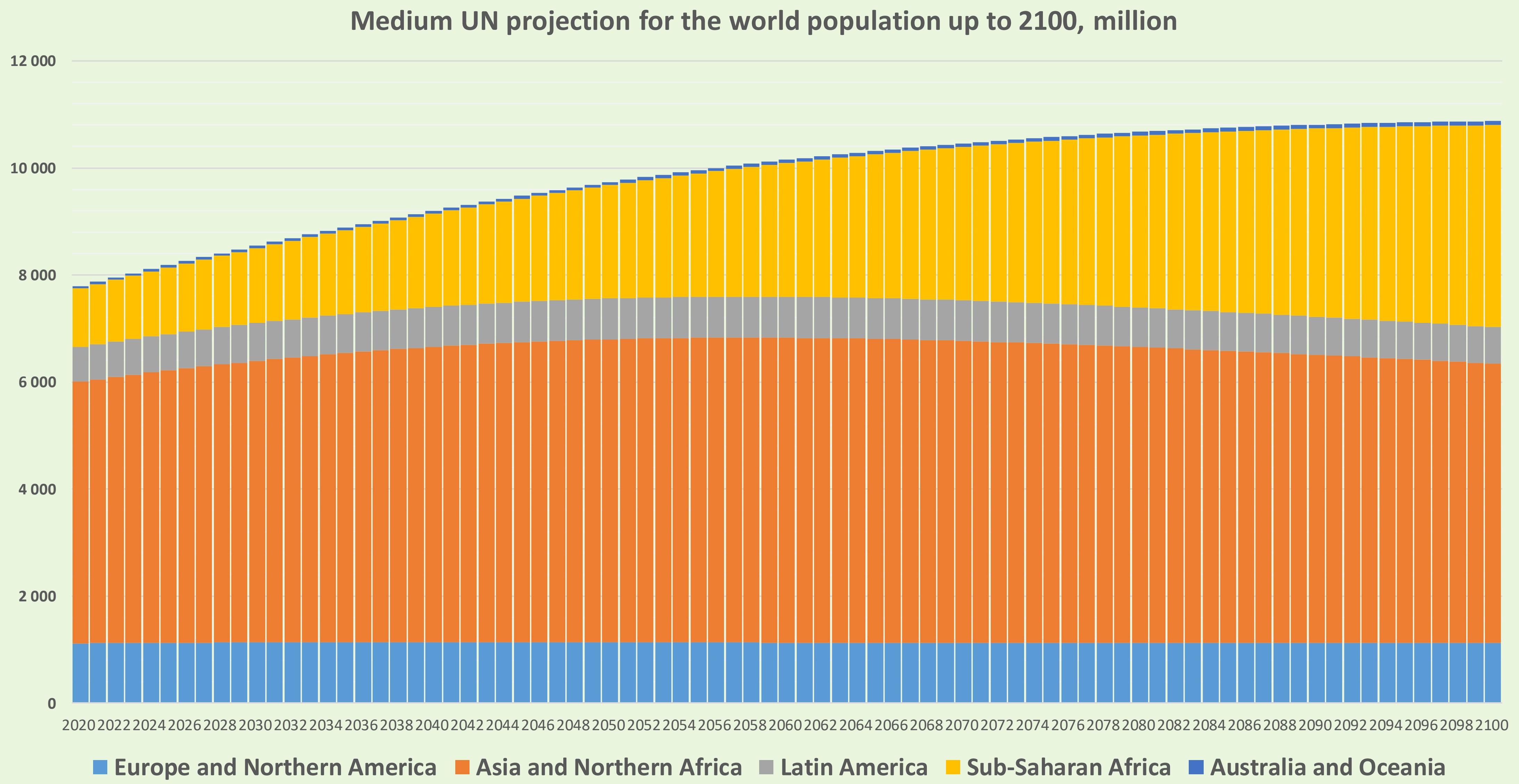






UN world population projections

As we can see, by 2050-ies the world population will grow up to some 10 billion from the current 8 billion and than stop everywhere except Sub-Saharan Africa. All the population growth in the World since the middle of the century will take place only due to this region – in the rest of the World the growth will change for depopulation. By 2100 the World population will add 1 billion more (plus 1.8 billion in Sub-Saharan Africa and minus 0.8 billion in the rest of the World) to 11 billion, than stopped.

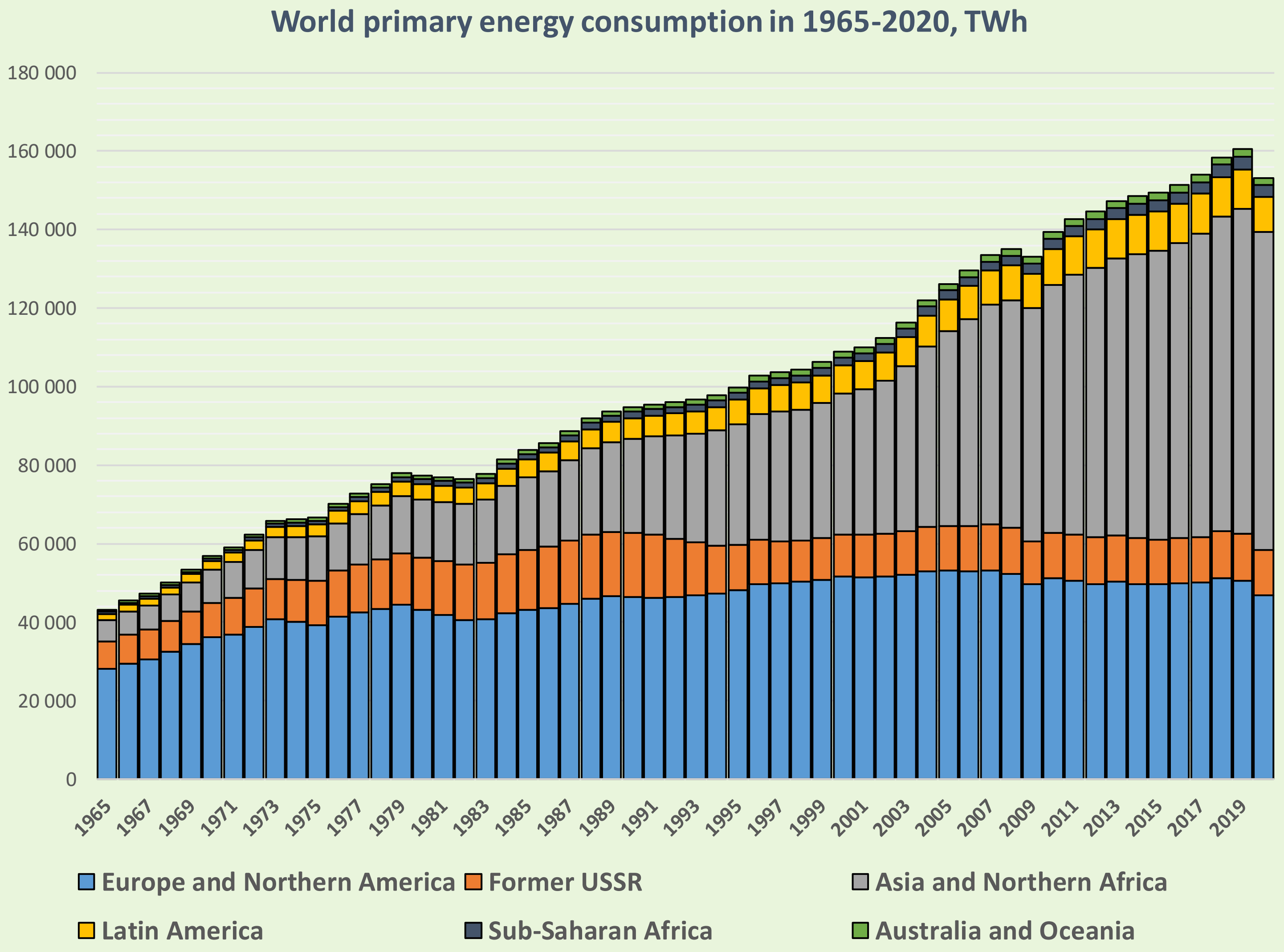


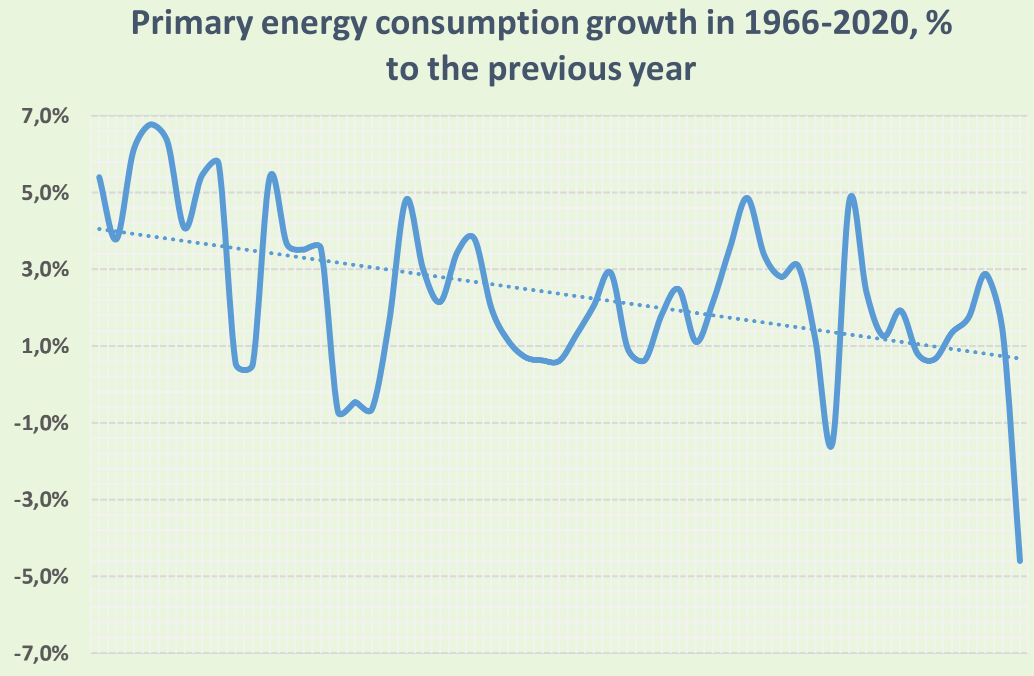
World Energy Balance

Input	Output
Annually the world produces: **Oil – 4 500 million tons;** **Gas – 4 000 billion m^3;** **Coal – 7 000 million tons.** **Using for energy aims:** **Oil – almost all 4500 million tons;** **Gas – some 3 700 billion m^3;** **Coal – some 5 400 million tons.** **Totally – 12 000 million tons of oil equivalent** **(The rest is used in industry)** **Totally in energy equivalent it is some 135 000 terawatt-hours (TWh).** **Some 25 000 TWh more give non-carbon sources (nuclear, hydro-, and other renewables)** **Totally some 160 000 TWh**	There are three principle positions: 1. **Electricity** production – consumes almost 50% of all energy: some 70 000 - 80 000 TWh input, and 25 000 – 27 000 TWh output. 2. **Transport** vehicles, transportation – consumes 25%-30% of all energy. 3. **Heating** and other residential and business use – consumes 20%-25%
Energy use by sources: • **Oil is used mainly for transport;** • **Gas is used: 40% for electricity production; more than 55% - for heating; less than 5% is used for transport** • **Coal: 80% is used for electricity production; 20% is used for heating.** • **Nuclear and renewables are mainly used for electricity production**	***Sources: iea.org, eia.gov, bp.com***

World energy consumption

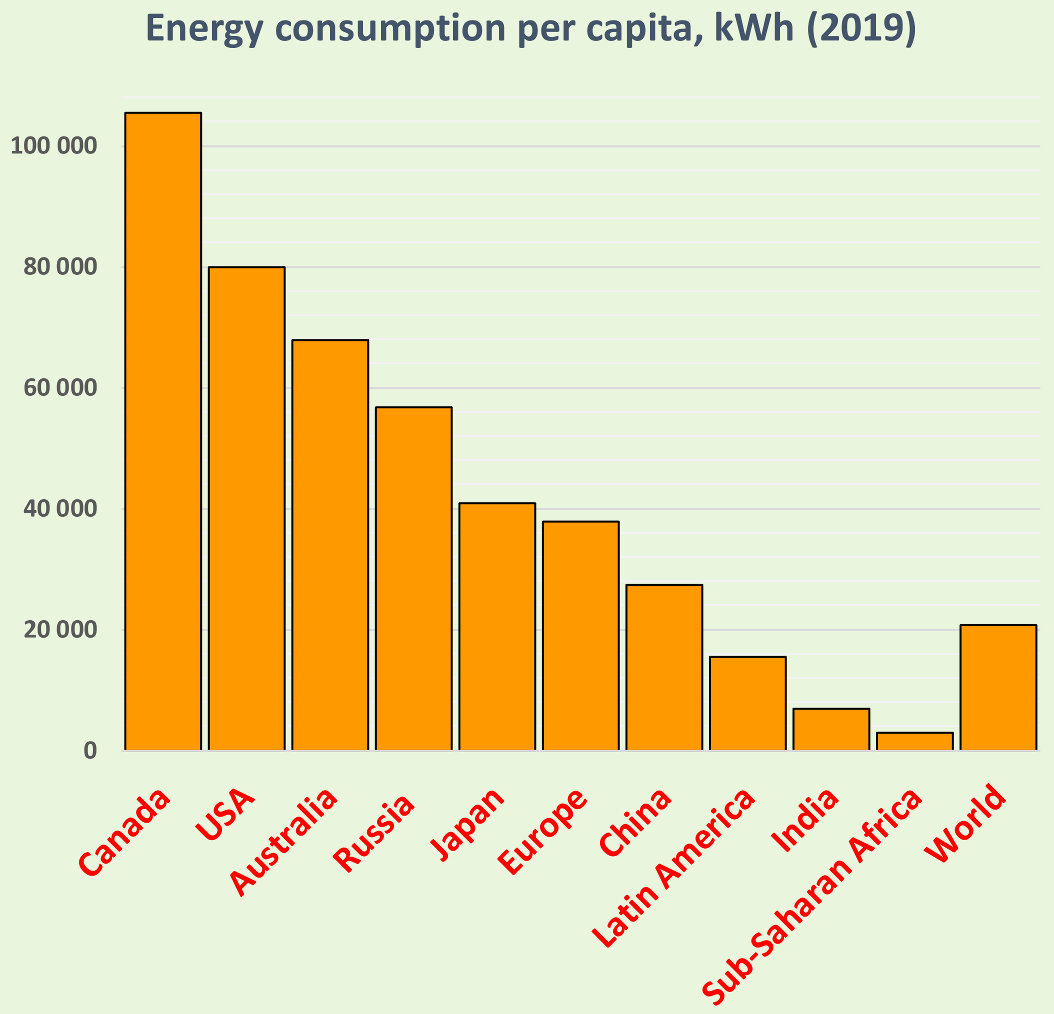
World primary energy consumption in 1965-2020 grew from 40 000 TWh to 160 000 TWh – 4 times, although its growth is slowing as well as the world population growth.



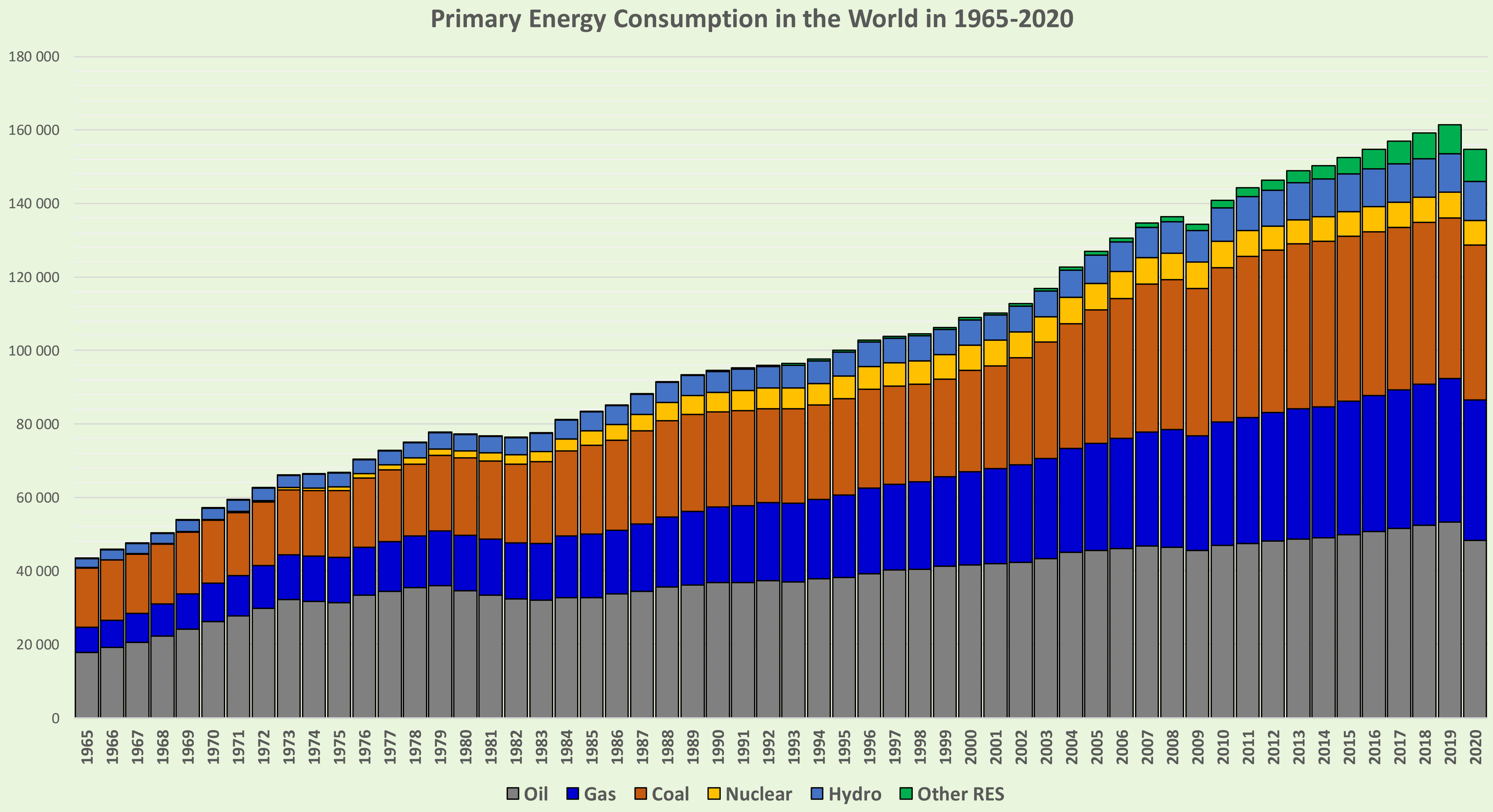


Energy Consumption per Capita by regions

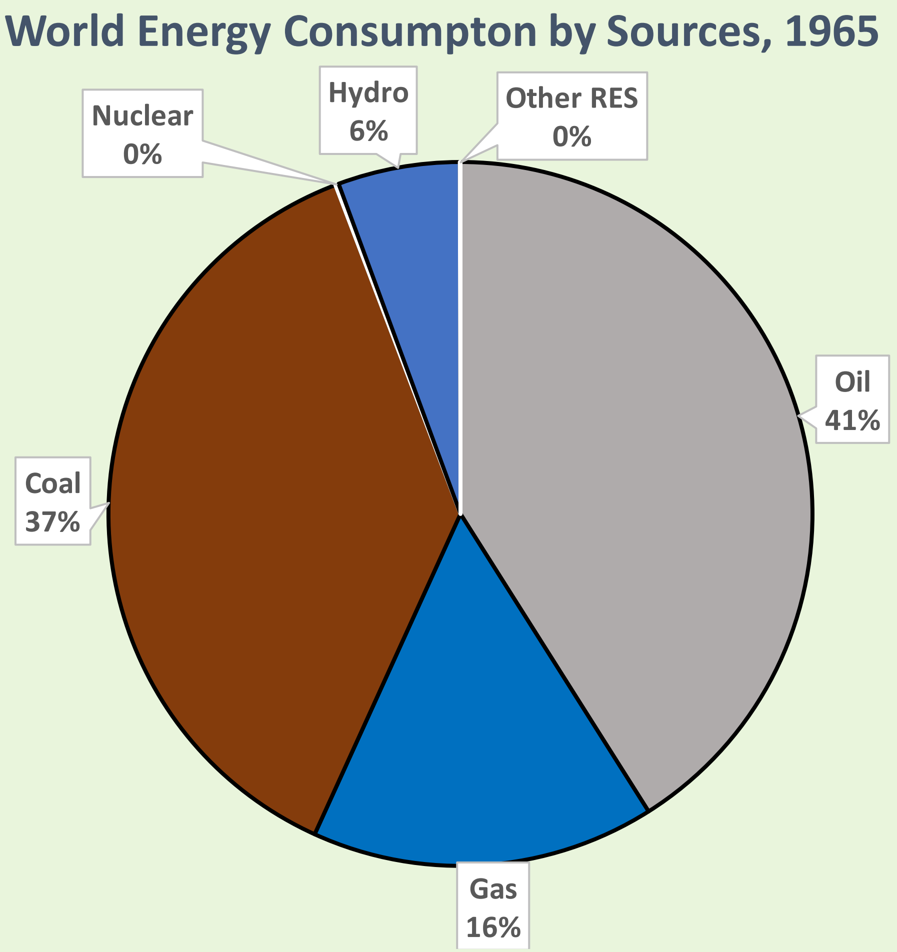
Country or region	Population, million (2019)	Share in the world population, %	Energy consumption, TWh (2019)	Share in the world energy consumption, %	Energy consumption per capita, kWh
USA	329	4,3%	26 291	16,4%	79 897
Canada	37	0,5%	3 948	2,5%	105 540
Europe	538	7,0%	20 355	12,7%	37 846
Russia	146	1,9%	8 279	5,2%	56 707
other former USSR	148	1,9%	3 703	2,3%	25 090
China	1 434	18,6%	39 361	24,5%	27 452
India	1 366	17,7%	9 461	5,9%	6 924
Japan	127	1,6%	5 187	3,2%	40 889
Other Asia and Northern Africa	1 843	23,9%	28 609	17,8%	15 524
Latin America	648	8,4%	10 092	6,3%	15 570
Sub-Saharan Africa	1 066	13,8%	3 183	2,0%	2 985
Australia and New Zealand	30	0,4%	2 035	1,3%	67 865
other world	1	0,0%	0	0,0%	0
Total World	7 713	100,0%	160 503	100,0%	20 808

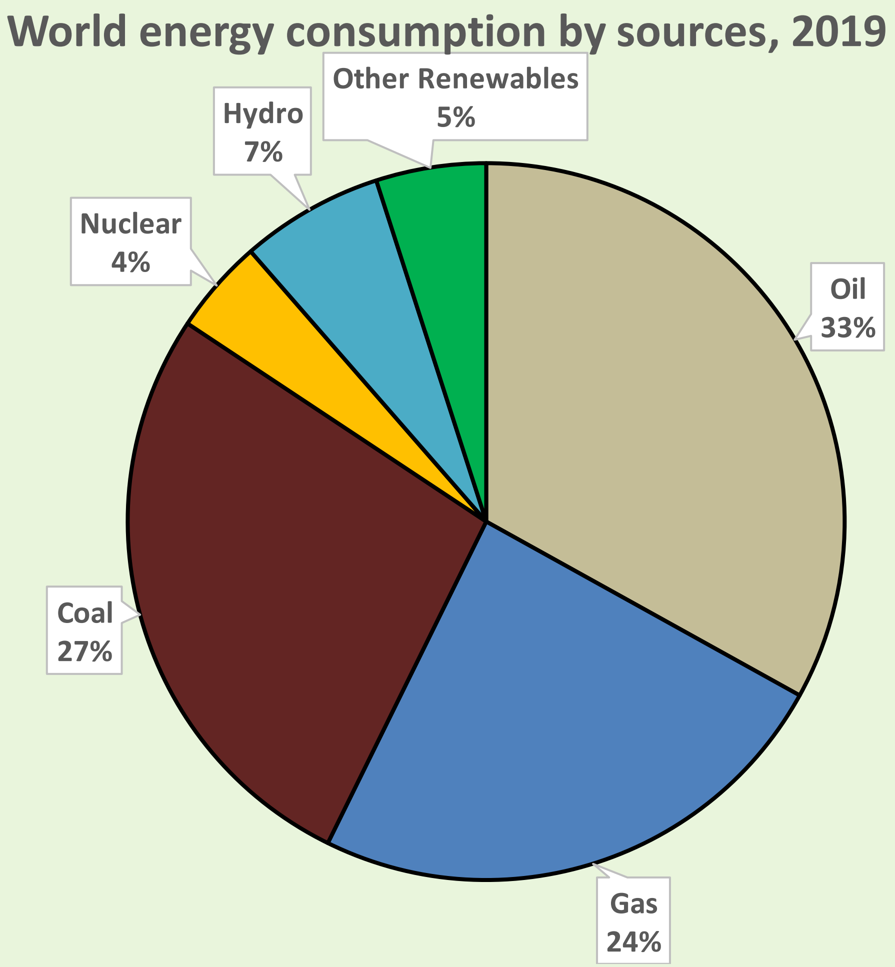


Growth of World Energy Consumption by fuel



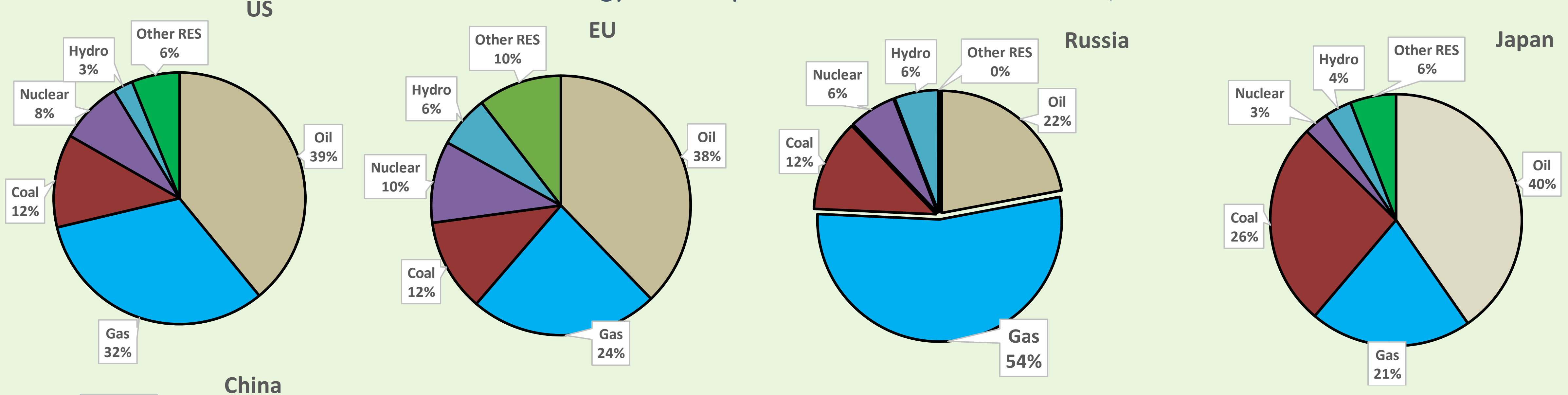
Structure of World Energy Consumption

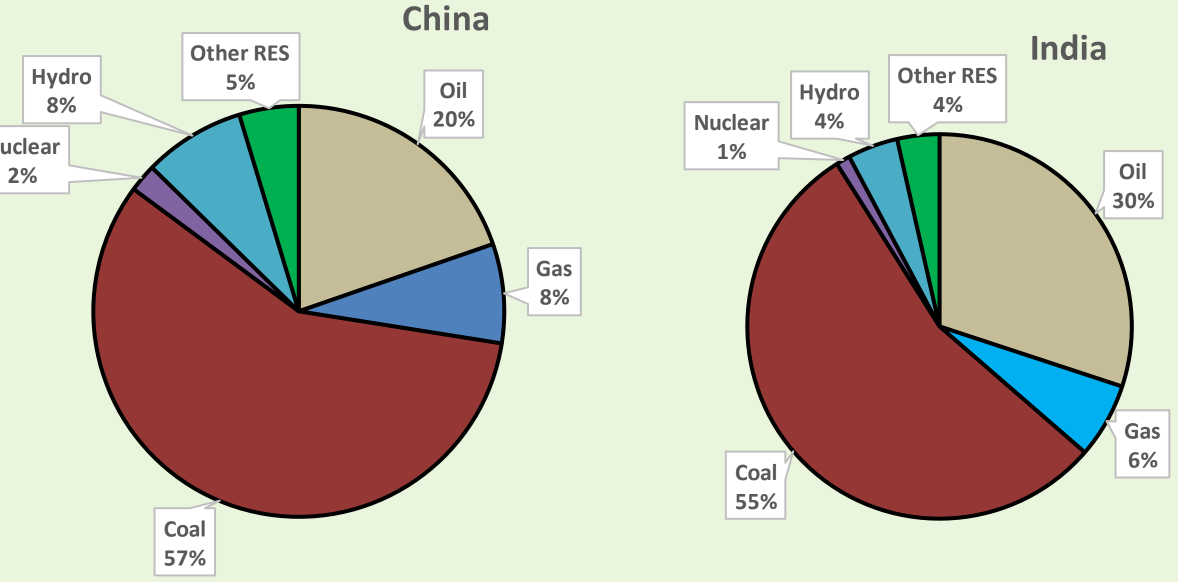


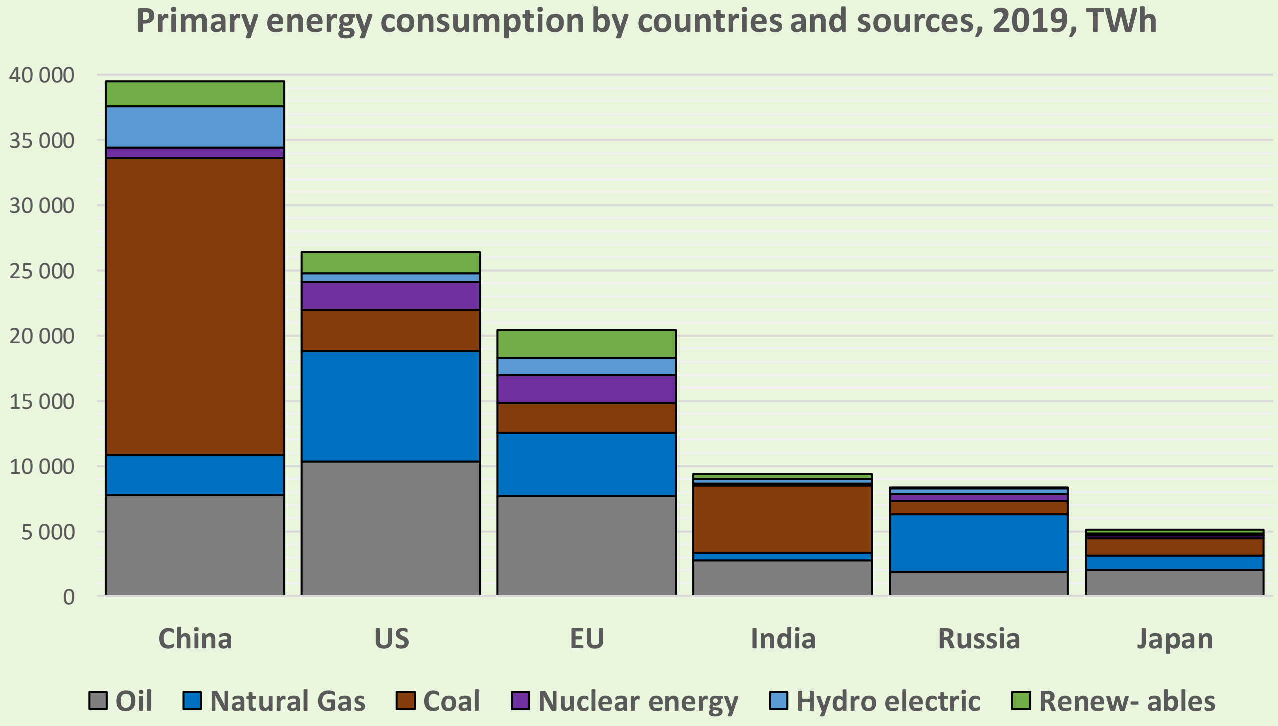


In 1965 The share of carbon fuels (oil + gas + coal) was 94%, in 2019 – 84%. It was almost 50/50 due to nuclear energy (+4%) and hydro+other RES (1%+5%).

Structure of energy consumption in the different countries, 2019

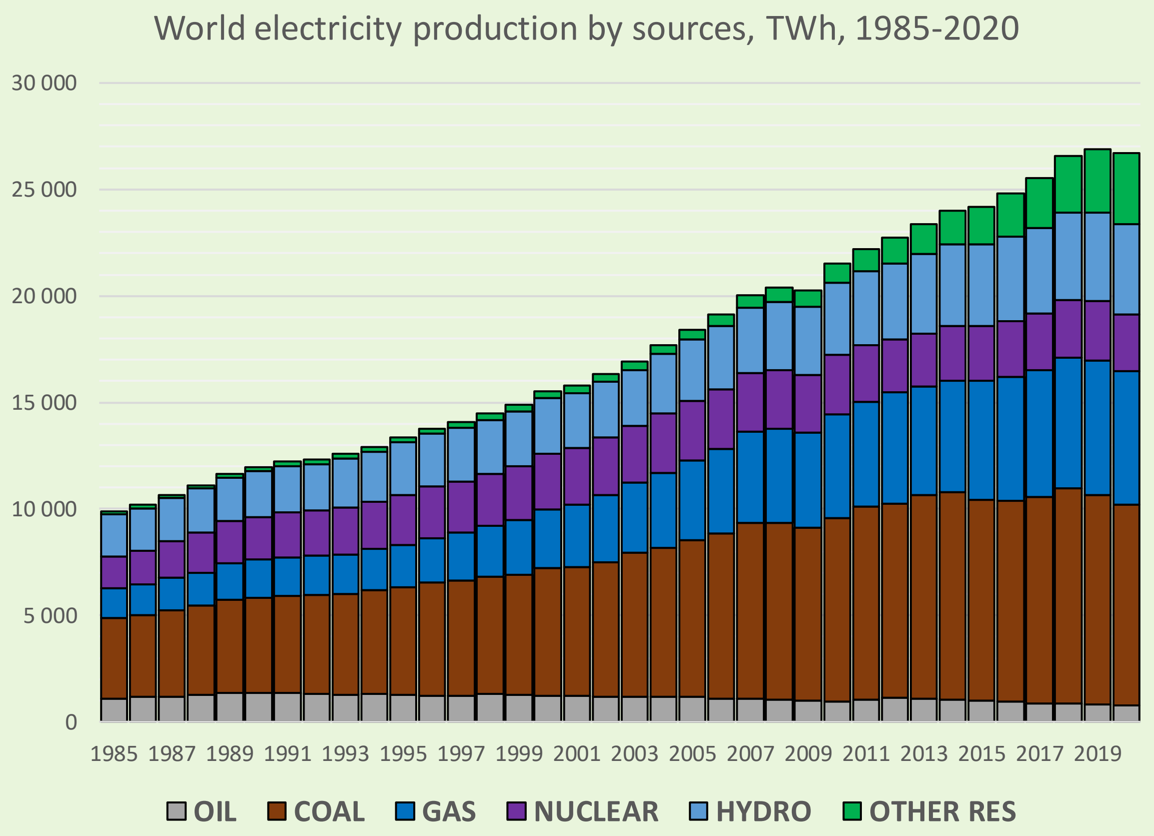


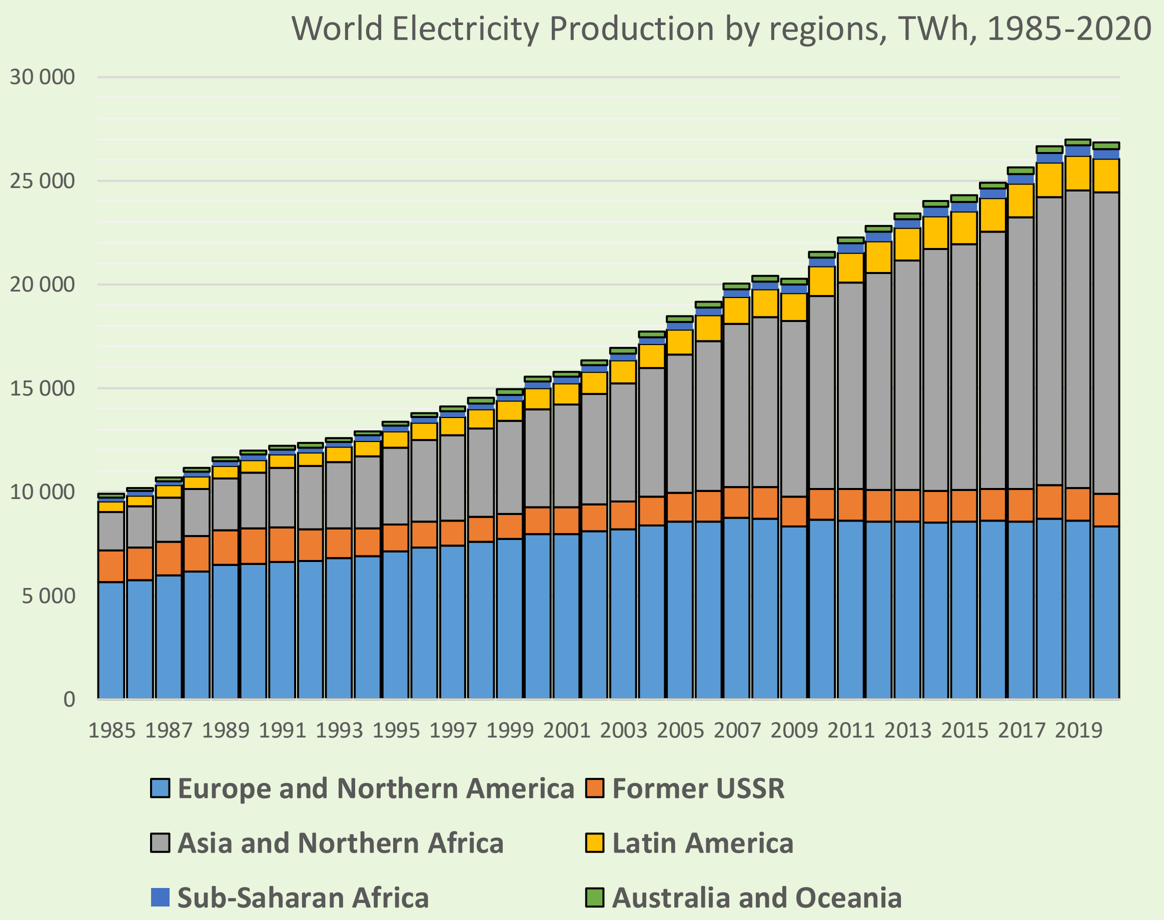




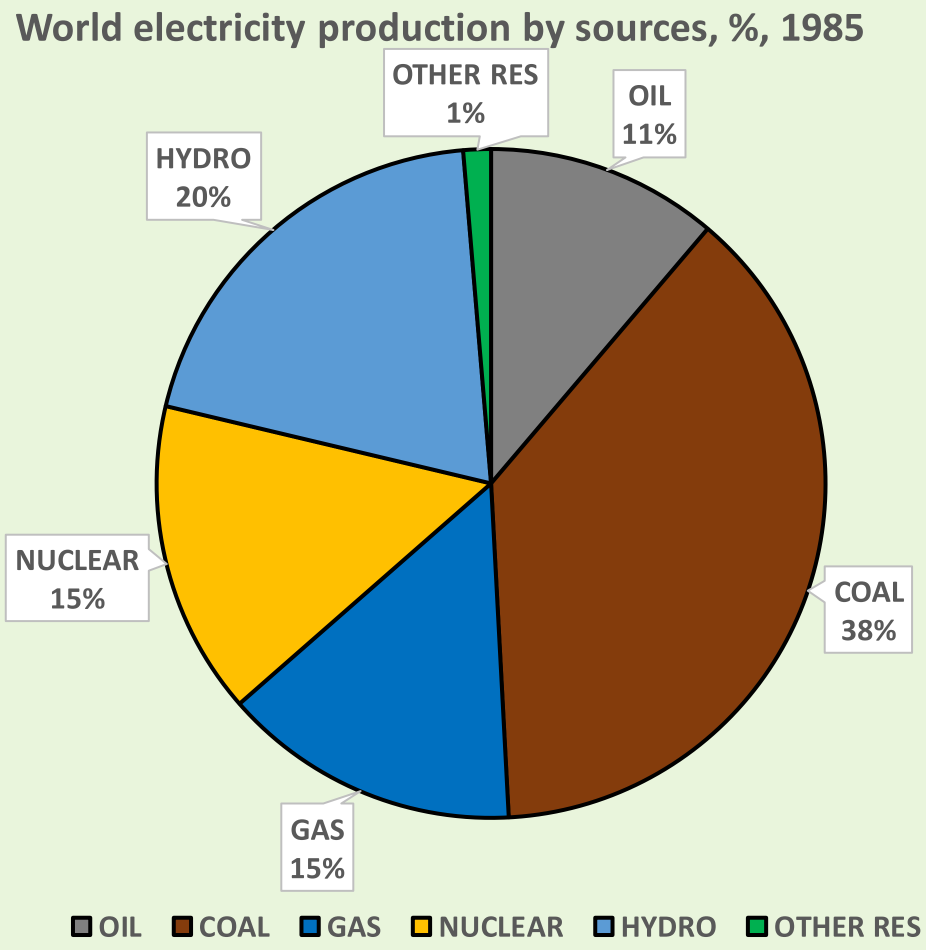
Share of fossil fuel in energy consumption: EU – 74%, US – 83%, China – 85%, Japan – 87%, Russia – 88%, India – 91%.
In Russia the largest share of gas – 54%, in China and India coal – 57% and 55% respectively.

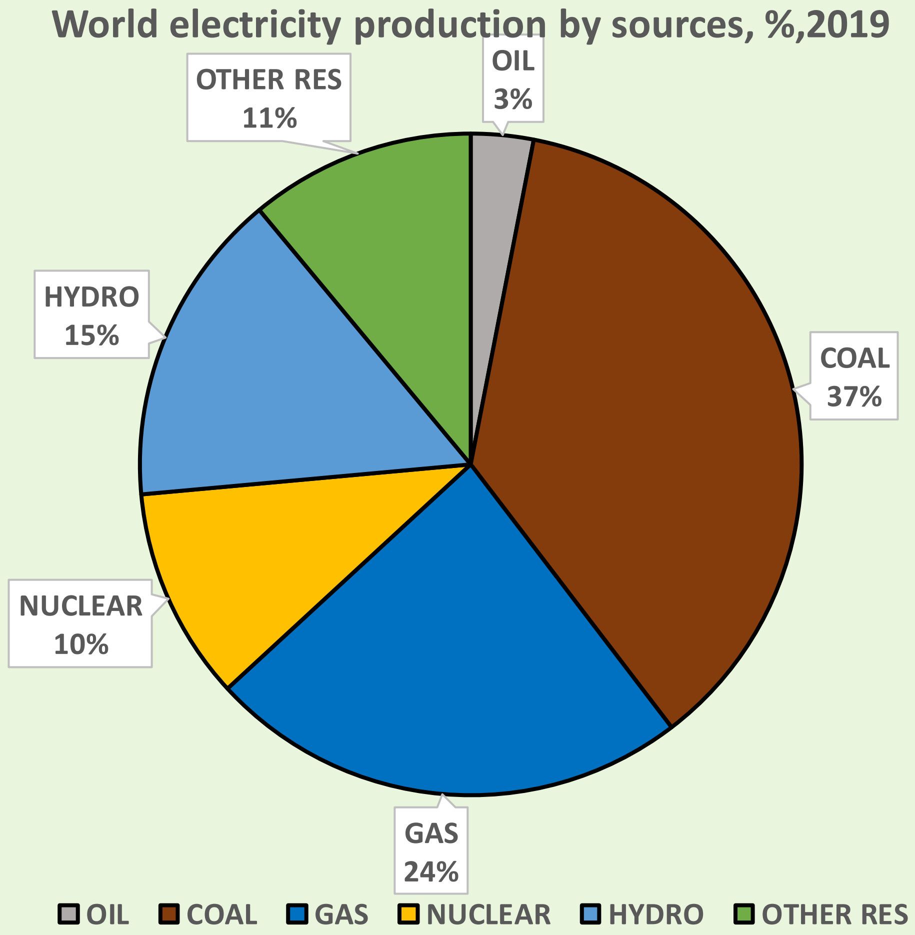
Structure of World Electricity Production





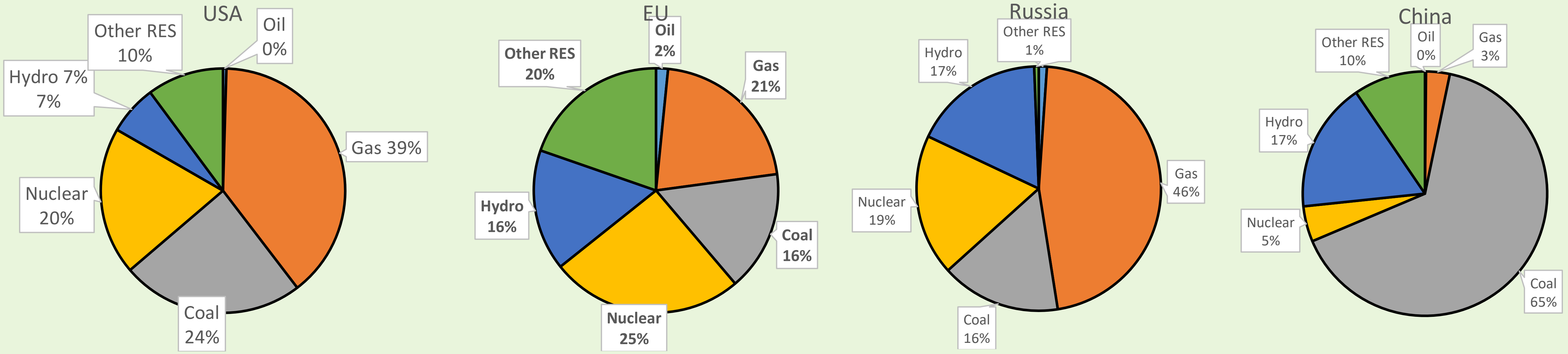
Structure of electricity production, 1985 and 2019

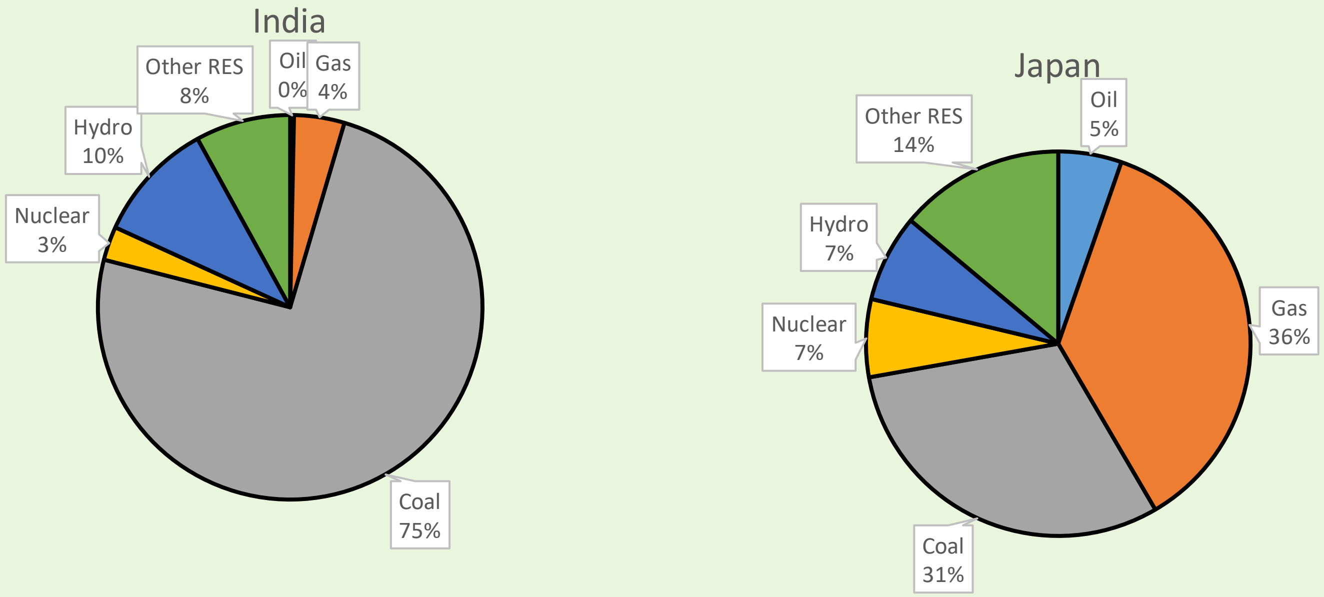


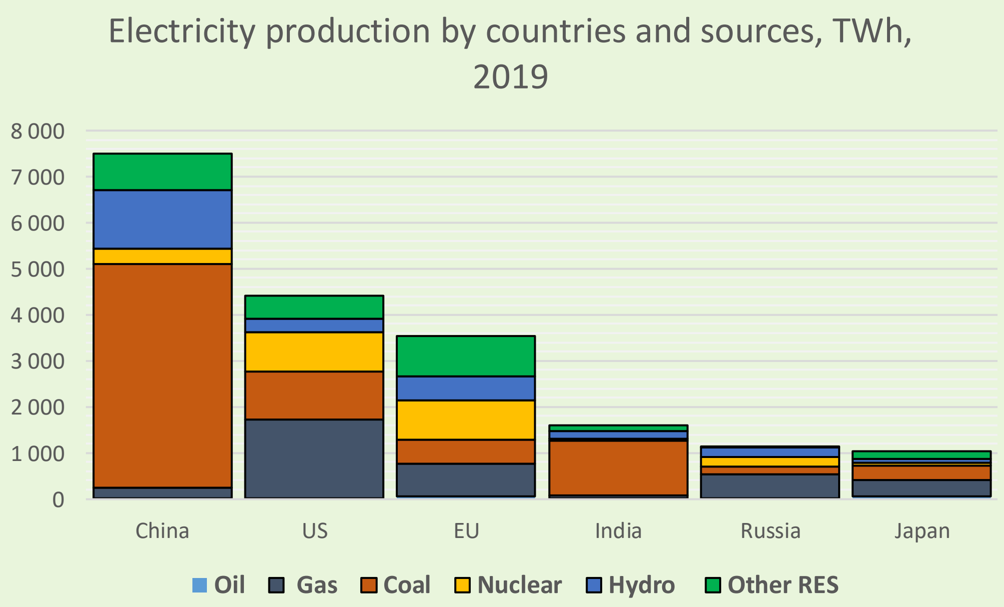


In 1985 fossil fuels accounted for 64% of electricity production, by now they have the same share - 64%. The share of solar and wind energy has grown, but hydro and nuclear energy have lost some of their position.

Structure of electricity production in the different countries







Shares of fossil fuels in electricity production: EU – 39%, Russia – 62%, US – 63%, China – 68%, Japan – 72%, India – 79%

How much energy we'll consume by 2050?

Now the world consumes some 160 000 TWh (and 84%, or 135 000 TWh - at the account of fossil fuels). Their use per capita:

- **World average – 20 000 kWh;**
- **Europe, Russia, Northern America, Japan, Australia, the most of Middle East countries – some 40 000 kWh or even more (EU – 37 000; US – 90 000)**
- **Sub-Saharan Africa – less than 3 000 kWh;**
- **The rest of the world – between 5 000 and 30 000 kWh (India – less than 6000; China – 27 000).**

Now the population is 8 0000 billions. By 2050 it is to be 10 000 (plus 1 000 billion in Sub-Saharan Africa and plus 1 000 in the rest of the world). What energy consumption should we expect be the middle of the century?

Anyway, the most of countries need economic development, especially Sub-Saharan Africa and Southern Asia, and their energy consumption must rise.

Assume, that only in Sub-Saharan Africa's per capita energy consumption will rise to 20 000 kWh (today's world average). At the same time its population will rise by 2050 from 1 billion to 2 billion. In this case, only at the account of Sub-Saharan Africa the total energy consumption will increase by 40 000 TWh. The same in India (growth to 20 000 kWh and to 1,6 billion) will add 20 000 more. Totally it will add 60 000 TWh, or 37%, to the world energy consumption. Together with the countries of South-East Asia and Latin America it will add at least 50% - to some 250 000 TWh.

Is it possible to supply all this amount of energy only with non-carbon sources, when now they give only 15% of energy supply?

Is total decarbonization possible? How much does it cost?

There are different estimations, how much transition to carbon neutrality would cost.

There is, according to one of them, some $100 trillion.

We can count it roughly even by ourselves.

Lets begin with electricity. Now more than 16 000 TWh of electricity are produced on fossil fuel, and we have to replace it by solar, wind etc. stations. To produce it, we need, at capacity factor of 30% (really less), more than 5 000 GW (5 TW) of facilities.

Average investment costs for 1 GW are some $1 billion ($1000/kW). So, construction of 5 000 GW requires $ 5 trillion.

How to make possible heating and transportation on the renewables only – its much more complicated to assess.

But we can simply expand this approach. Now some 135 000 TWh of energy consumption is at the expense of fossil fuels. To replace all this with renewables, we need some 45 000 GW, and it is $45 trillions.

And imagine, that by 2050 our energy needs are 1,5 times higher than now (see above). It means $65-70 trillion.

Really it will be much more because a number of associated costs.

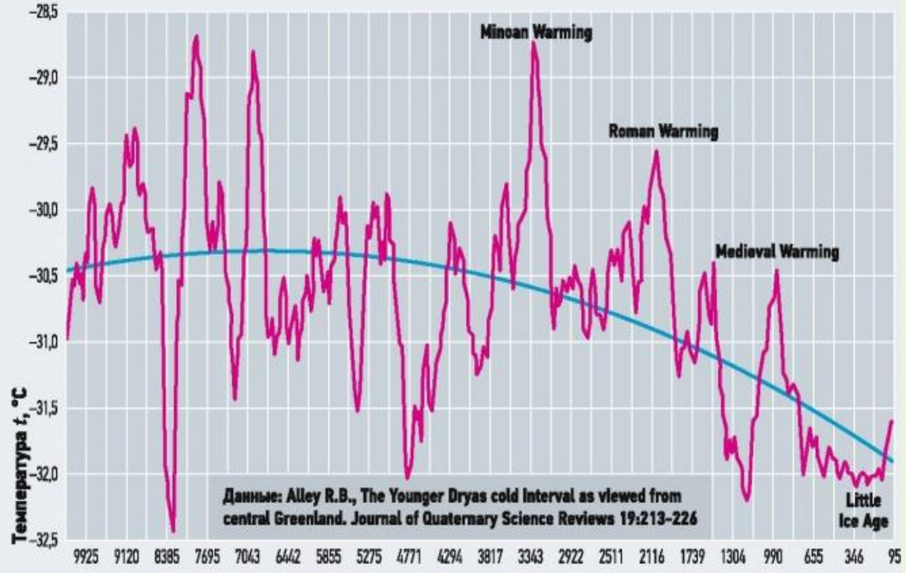
And the problem is not money as such.

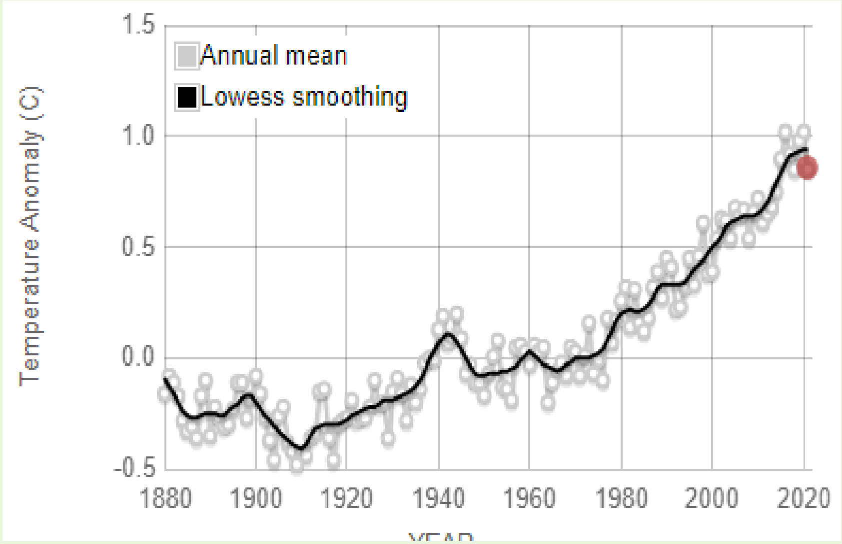
We may have neither materials nor space for construction all these renewable capacities. Renewables are very material consuming. For example, a wind engine of 1.5 MW weighs 50 tons (more than 30 tons/MW), when a nuclear reactor of 1000 MW – 1000 tons (1 ton/MW).

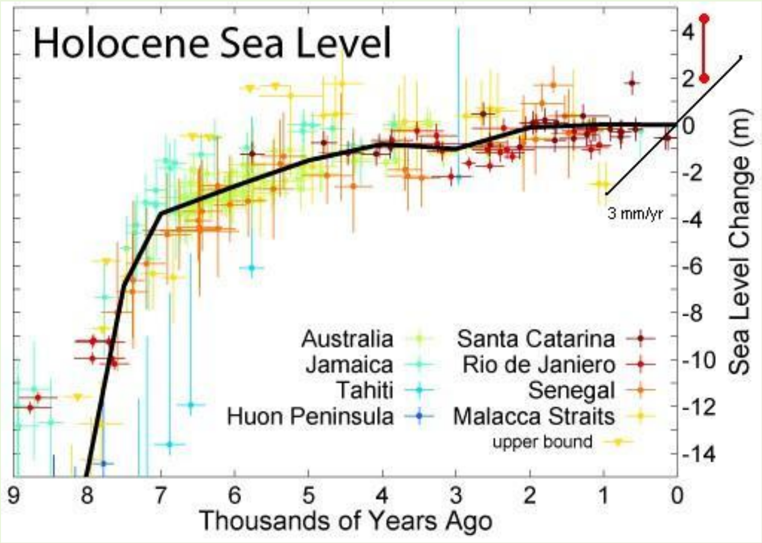
Climate changes, counteract or adopt?

Three principal points in connection with this:

1. **There can be two strategies: counteract to climate and environmental changes or adapting to them; and may be better to focus more on adapting.**
2. **Any climate change has its own both advantages and disadvantages, and now we can see also the positive consequences of climate changes and of carbon dioxide growth. That makes adapting to climate changes easier.**
3. **We really don't know clearly why climate changes, which factors – natural and anthropogenic, are stronger.**







A better strategy is to accommodate to the climate changes and decrease our impact step by step, basing not only on renewables, but on a kind of triad:

1) **Renewables;**
2) **Nuclear;**
3) **Gas** (that gives carbon emissions of about 2 times less, than coal)

Also, possible directions of energy industry:

- **controlled thermonuclear fusion;**
- **use of free natural hydrogen**

Advantages and disadvantages of renewable energy sources

1. No carbon footprint, low external costs;
2. No variable operation costs due to free energy carriers;
3. Renewable are potentially inexhaustible energy carriers
4. Autonomy; independence on external fossil energy sources on different levels from countries to households
5. More evenly distribution around the earth surface; better transparency (easier to assess resources)
6. Contribution to diversity of energy carriers.
7. New industrial direction, new technologies, a driver for general economic and technological development, new jobs; an instrument for regional development.

1. Dependency on natural conditions, daily, seasonal, yearly, and long-term variability. As a sequence – low average capacity factor and instability.
2. Need for large areas. A wind farm of 1000 MW requires an area of about 100 km^2, a solar station of the same capacity – about 20-30 km^2, when a fossil fuel plant of the same capacity will occupy an area up to 20-30 ha and produce 2-3 times more electricity due to 2-3 times higher (70%-80% against 20%-30%) capacity factor.
3. Because of large areas and design features – higher fixed operation costs, difficulties in services, and vulnerability to natural and technological disasters.
4. High material consumption. For example, the mass of a wind tower is up to 5000-6000 tons (for engines with capacity of 7-8 MW).
5. Problems of utilization and processing at and of lifecycle.
6. «Aesthetical pollution» of a territory, change of traditional cultural and natural landscapes.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When use of renewable sources is preferable

- **Natural parameters - territories with higher concentration and diversity of RES, for example:**
- **lower (subtropical, tropical and equatorial) latitudes with higher solar radiation;**
- **zones of stable and strong winds (coastal and piedmont zones, opened steppe areas);**
- **areas with higher rainfall;**
- **in its turn, combination of solar radiation and high rainfall creates higher bio-productivity and better conditions for bio-energy;**
- **zones with higher flow of geo-thermal energy (tectonically active, predominantly mountain areas);**
- **zones with higher potential of tidal energy (oceanic areas with indented coastlines).**

Economic-geography and social-economic parameters:

- **Low population density and high dispersion of settlements, large areas that can be used;**
- **Remoteness from fossil energy sources; low energy availability of a region, energy deficit;**
- **Poor economic development of a region, need to develop new sectors of economy and create new jobs;**
- **Industries, creating much waste (agriculture and forestry; household waste of large cities), that can be used for bio-energy.**

Specificity of Russia

- High energy needs, caused by natural conditions and long distances;
- At the same time, Russia has a deficit of energy supply, relatively to the comparable countries – our annual energy consumption per capita (MWh): Russia – 57, US – 90, Canada – 107, Australia – 70. And it is directly connected with economic development that is in Russia lower, than in these countries
- Relatively low solar and wind energy in the most of the country's area;
- At the same time, high hydro and bio (connected with forestry, timber processing and agriculture) energy potential on the significant part of area;
- In the certain zones – high geothermal and tidal potential;
- Great variety and heterogeneity of conditions for renewable energy development; really it's impossible to talk about Russia "as a whole", 'in general";
- Developed united system of electricity supply on the base of fossil, nuclear, and large hydro station;
- At the same time there are huge areas with high disperse of settlements and remote from this energy supple system (Northern territories, Siberia, Far East, and a lot of rural districts and settlements in the other parts of the country).

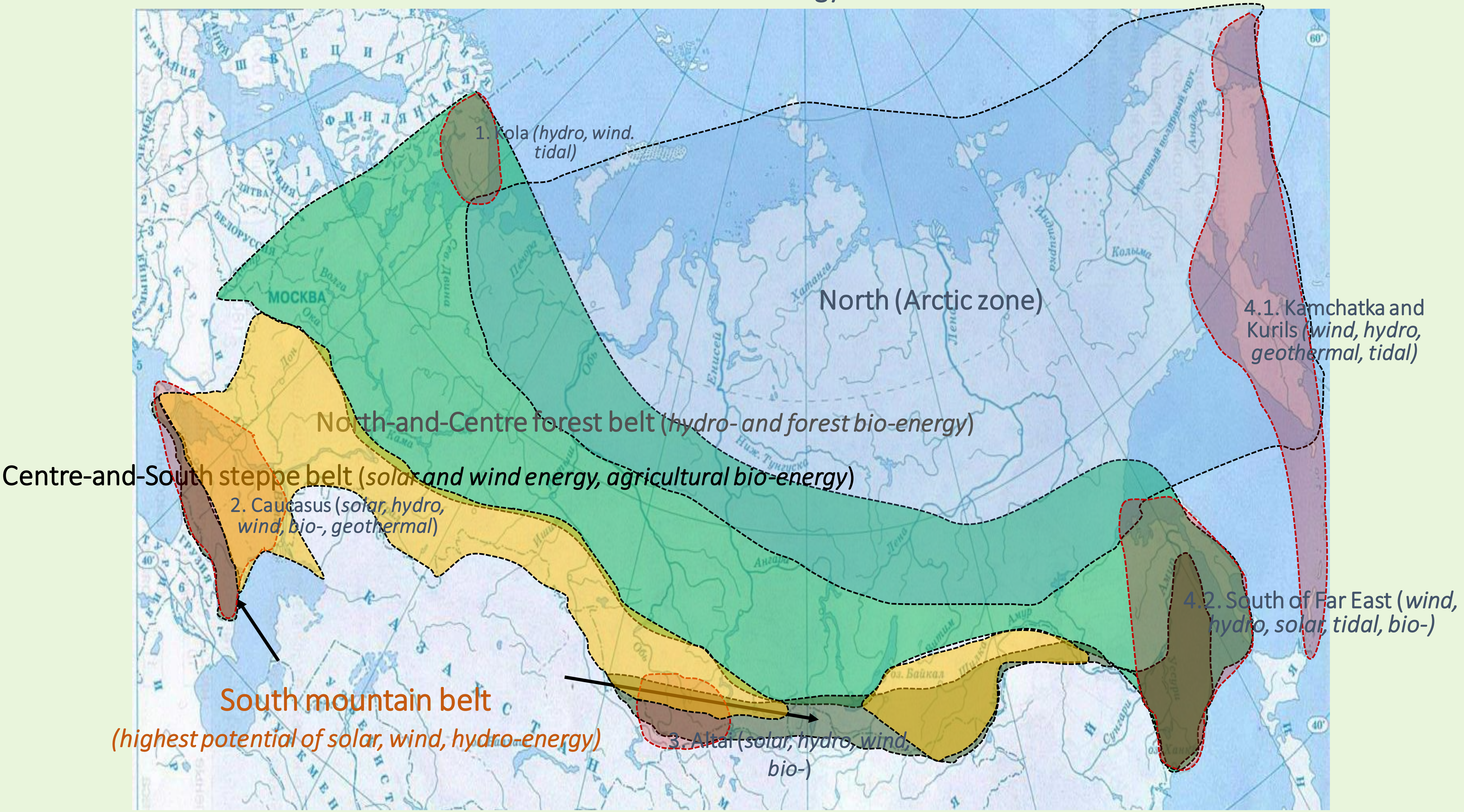
And what about our "cheap oil and gas" and "oil-and-gas lobby" which we often talk about as a barrier on the way of renewable energy development – really it is pretty much a myth, because:

1. For our oil and gas producers it is more profitable to export their production, that supply to the domestic market;
2. Nowadays the largest renewable energy projects in Russia are really promoted by major energy corporations with much financial resources.

Russia – territorial differences of renewable energy

Belt	Territory	Specificity
North (Arctic zone)	Far North of European part of Russia, the most of Siberian and Far East area	Locally high natural potential of RES. Low density of population and disperse of settlements, remoteness from centralized energy sources
North-and-Centre forest	North and Centre of European part, Upper and Middle Volga, North and Middle Urals, middle part of Siberia, southern part of Far East	High potential of hydro-energy and bio-energy on the base of forest biomass, peat, and timber processing, locally – agriculture. Low solar and wind potential. High disperse of rural settlements on the most of area.
Centre-and-South steppe	Centre and South of European part, Lower Volga, South Urals, southern parts of Siberia	High solar and wind potential, and bio-energy potential on the base of agriculture. Low hydro potential. High share of rural population that often faces problems with energy supply.
South mountain	Crimea and Caucasus, mountains of South Siberia, South of Far East	Maximal in Russia solar and wind potential, hydro and geothermal potential, high agricultural bio-energy potential, locally – on forestry base. High share of rural population that often faces problems with energy supply.
Areas of higher concentration and diversity of renewable energy (*marked with red shading on the map*)		
1. Kola	Kola peninsula and adjacent aquatories	Higher potential of hydro, wind, and tidal energy. Closeness to export markets.
2. Southern	Caucasus, Crimea, and adjacent areas	Higher solar, wind, hydro, geothermal, and bio- (agriculture and locally forestry) potential
3. Altai	Mountains and piedmont areas of Altai	Higher solar, wind, hydro, geothermal, and bio- (agriculture and forestry) potential
4.1. Kamchatka-and-Kurils	Kamchatka peninsula, Kuril islands, and adjacent aquatories	Повышенный потенциал геотермальной, приливной, гидро- и ветровой энергии
4.2. Primorie-and-Sakhalin	South of the Russian Far East	Higher solar, wind, tidal, and bio- (forestry and locally agriculture)

Territorial division of Russia in terms of RES and background for development of renewable energy



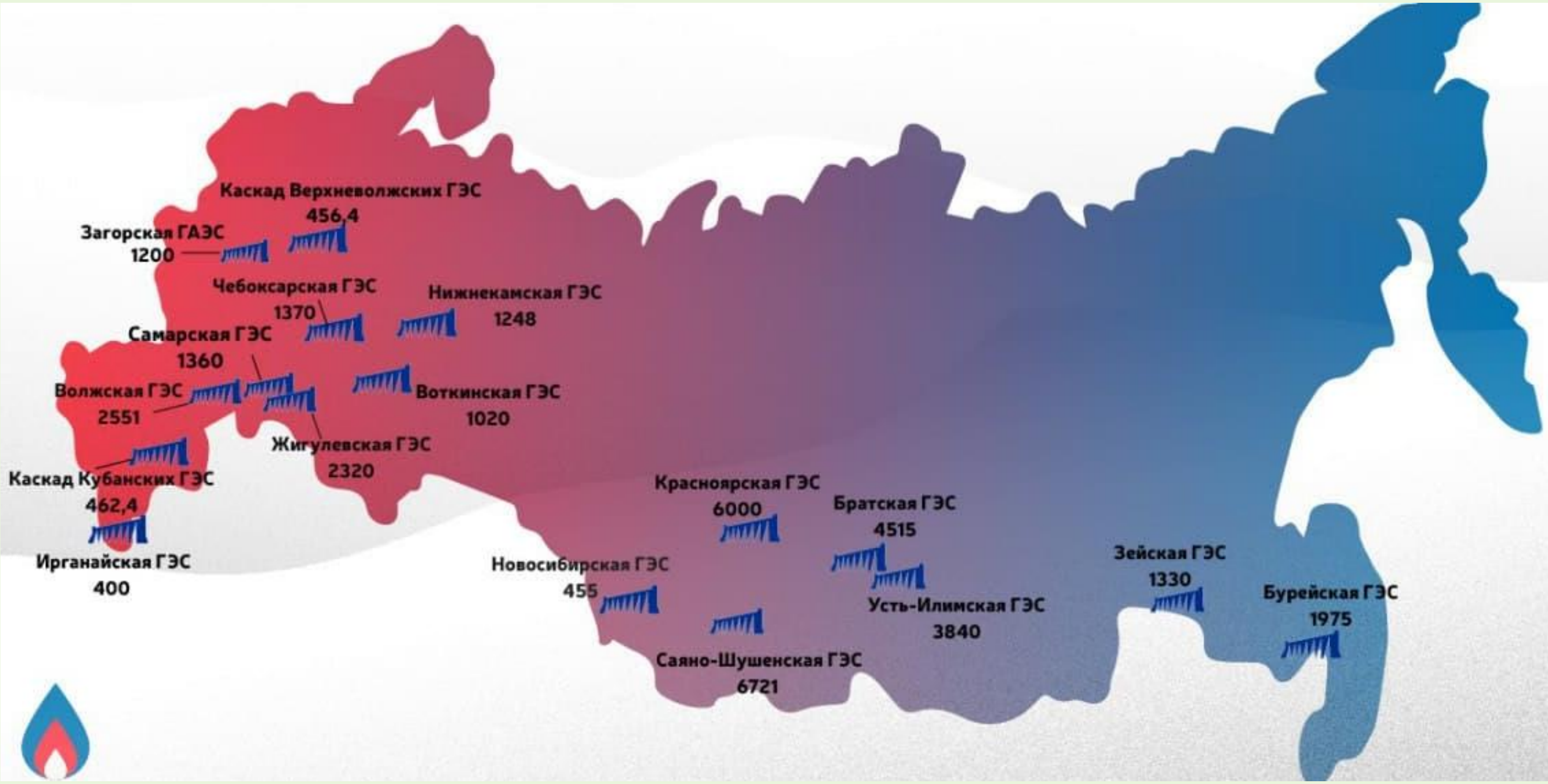
History of renewable energy use in Russia in brief

- End of 19 – beginning of 20 century: the first hydropower stations and peat power stations;
- 1920-ies – 1930-ies: development mainly on the base of hydro energy; first wind power plants (Crimea, Kazakhstan); first R&D works in solar energy; use of geothermal energy for heating (Caucasus);
- Since 1950-ies - 1960-ies: use of photovoltaic modules (on the first Earth's satellites etc.), first tidal (Kola peninsula) and geothermal (Kamchatka peninsula) power plants; R&D works in bioenergy; construction of the largest hydro power plants

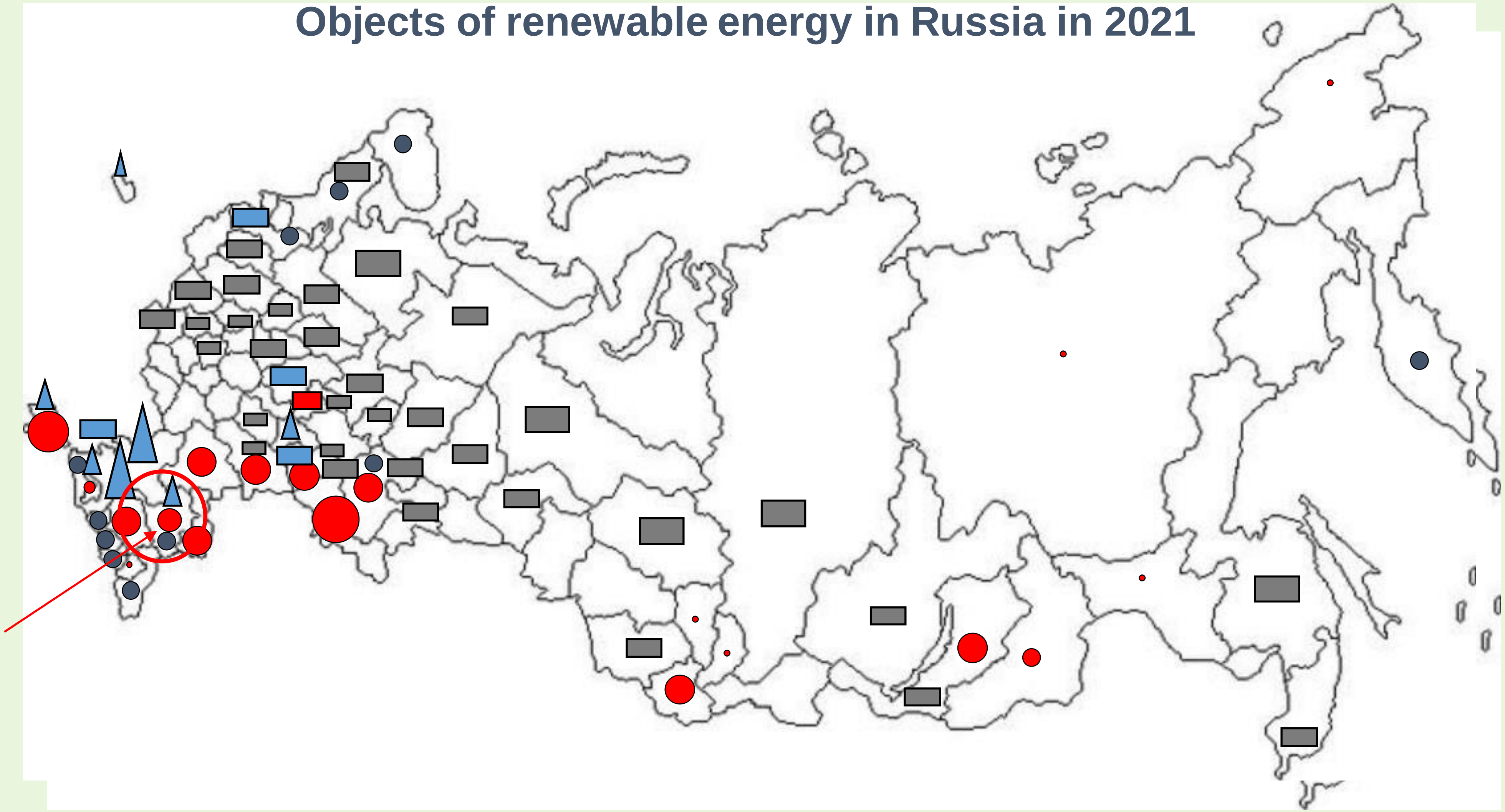
………..

- 2000-ies - 2010-ies – renewal of large-scale interest to renewables; development of the legislative base for renewable energy development; construction of the first large wind farms and solar stations in a number of Russian regions, mostly in the South of country

The largest hydro power stations in Russia; HPPs account for 18% of electricity production in Russia



Objects of renewable energy in Russia in 2021



Kalmykia – 94% of electricity solar and wind power stations produce

- Total capacity of the solar plants >1700 MW Plans to 2024 – more than 3000 MW.
- Hevel is the largest in Russia solar module producer
- Total capacity of wind stations – 2000 MW. Plans to 2024 – 4000 MW.
- Largest equipment plants for wind energy
- Small hydro power stations
- Wood pellet plants, total capacity more than 3 million ton a year

What can be the future prospects for renewable energy development in Russia?

Two principle directions of renewable energy development:

- **Large power plants;**
- **Small autonomous energy supply in rural areas.**

The first direction include:

- **large solar wind farms in the southern belt of Russia from Crimea to Baikal and further to the South of Far East;**
- **large wind plants also in the southern belt and coastal areas of Baltic, White, and Barents seas;**
- **growth of wood fuel production in the North, Siberia, and Far East;**
- **hydro plants – first of all, in Caucasus, North-Western areas, piedmont areas of Siberia, and Far East;**
- **tidal plants on Barents and White seas, and the seas of Far East, including mega-projects on the Sea of Okhotsk – Penzhina bay and Tugur bay.**

These renewable capacities can be used in a long term to produce green hydrogen both for domestic market and for exports to Western Europe and Eastern Asia.

The other direction is energy supply of rural areas, small settlements, farms and the other small consumer on the base of local renewable resources. Moreover, totally it is a huge potential market with dozens million consumers and in Russia it may be even more promising direction than large plants.

Also, we have a strong research and technological base and experience to produce equipment for renewable energy, including for exports.

Thanks for your attention! Спасибо! Danke schön!

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ЯПОНСКОЕ МОРЕ
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залив Шелихова
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$1 per capita a day = 365 = 365*300 000 000 = $100 billion*30 = $ 3 trillion

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