NATIONAL RESEARCH UNIVERSITY

Department of World Economy

GLOBAL ENERGY TRILEMMA*

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The philosophers have only interpreted the world in various ways. The point, however, is to change it.

Karl Marx. Theses on Feuerbach

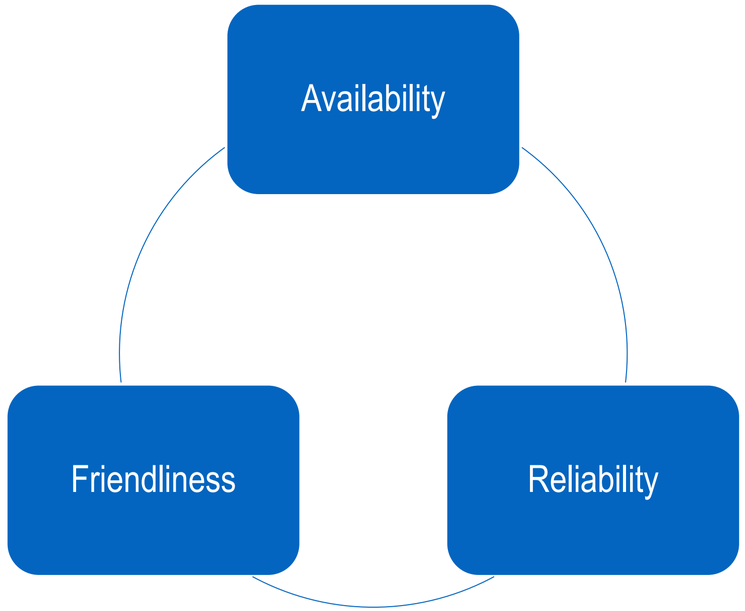
STRUCTURE

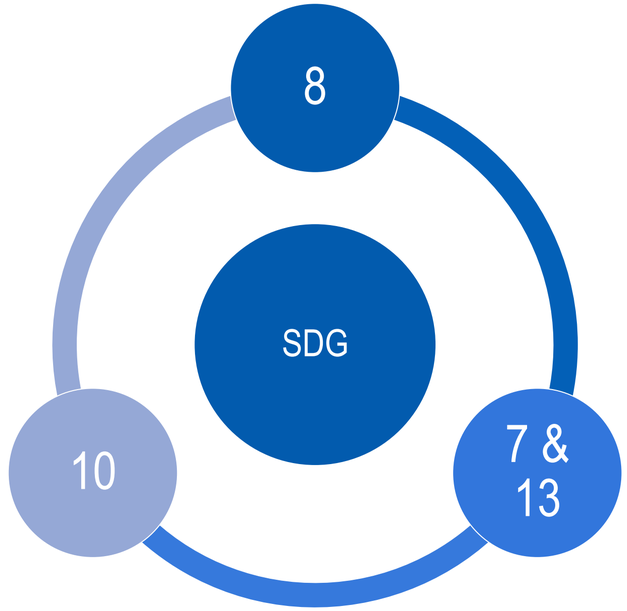
1. Global Energy Trilemma: definitions
2. Energy transition process
3. Where are we now?
4. Global emissions
5. Investment’s angle
6. COVID-19 and the recession as a moment of truth

GLOBAL ENERGY TRILEMMA: DEFINITIONS

World Energy Council:

- to ensure the availability of energy in sufficient quantities and at reasonable prices;
- to ensure the reliability and safety of energy supply;
- to ensure its environmental friendliness (the requirement to minimize the anthropogenic impact of energy systems on the environment.





Our understanding:

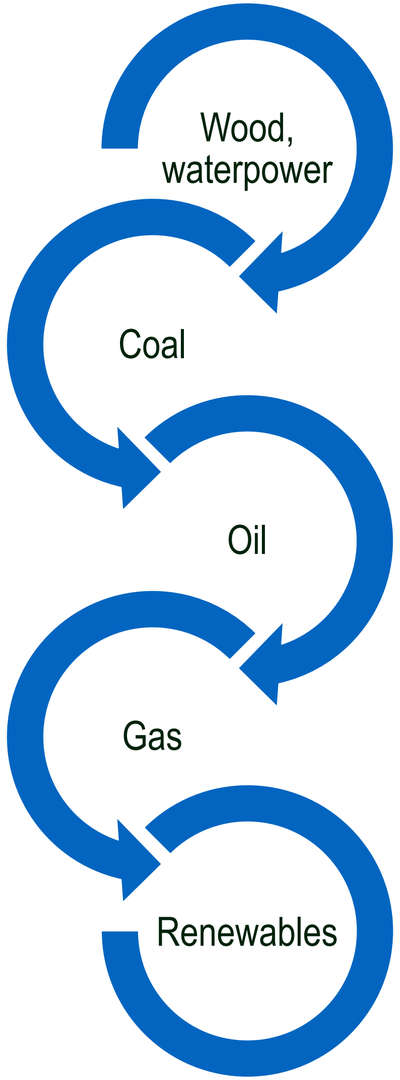
- supporting simultaneously economic growth (and catching up);
- energy and climate change mitigation;
- inequality, including energy poverty.

ENERGY TRANSITION PROCESS

Energy Transition (ET) - a connected policy challenge – success involves managing the three core dimensions: Energy Security, Energy Equity and the Environmental Sustainability of Energy Systems throughout the transition process» (WEC, 2019).

Highlights:

- ET proves to be a slow, complex, but still, a natural process, which involves political, trade and even spatial dimensions.
- An ultimate vanishing of other fuels does not happen, as different types of fuels successfully co-exist in energy balances.
- Structural changes are realized through investment into real assets and technological advances.
- ET is a gradual process, as far as production and restructuring of the existing technology for a new fuel cannot happen at once, as well as building of new infrastructure.



WHERE ARE WE NOW?

GDP PER CAPITA, POPULATION GROWTH AND INEQUALITY, 2000–2019 AND PROJECTION FOR 2040

Country	2000		2010		2019		2040		Income share held by highest 10%
	Population	GDP per capita	Population	GDP per capita	Population	GDP per capita	Population	GDP per capita	
World	6143,5	11,1	6957	13,9	7713,5	16,9	9198,8	28,6	
OECD	1112,3	35,6	1197	39,4	1258	44,7	1319,3	70,1	
United States	281,7	50,2	309	54,4	329,1	62,5	366,6	88,9	30,5
Canada	30,6	37,4	34	45,1	37,4	49,0	43,5	65,1	22,3
Sweden	8,9	41,2	9	48,5	10	53,2	11	76,5	22,3
Germany	81,4	42,9	81	46,9	83,5	53,8	82	78,0	24,6
France	59	39,9	63	42,4	65,1	46,2	67,6	60,3	25,8
Italy	56,7	43,3	59	42,9	60,6	42,4	57,2	45,4	26,7
Spain	40,8	34,8	47	37,4	46,7	40,9	45,2	53,7	25,4
United Kingdom	58,9	38,1	63	42,2	67,5	46,7	72,5	63,3	26,8
Brazil	174,8	11,6	196	14,9	211	14,7	229,1	15,6	42,5
China	1290,6	3,5	1369	8,9	1433,8	16,1	1449	69,1	29,3
India	1056,6	2,6	1234	4,2	1366,4	6,8	1592,7	21,9	31,7
Russia	146,4	14,6	143	24,0	145,9	27,0	139	40,0	29,9
South Africa	45	10,1	51	12,5	58,6	12,5	71,4	14,1	50,5
Selected low-income countries	942,4	3,1	1168	4,4	1425,8	5,5	2050,1	11,3	
Rest of the world	1375,5	9,1	1598	12,3	1813,9	15,0	2348,2	18,5	

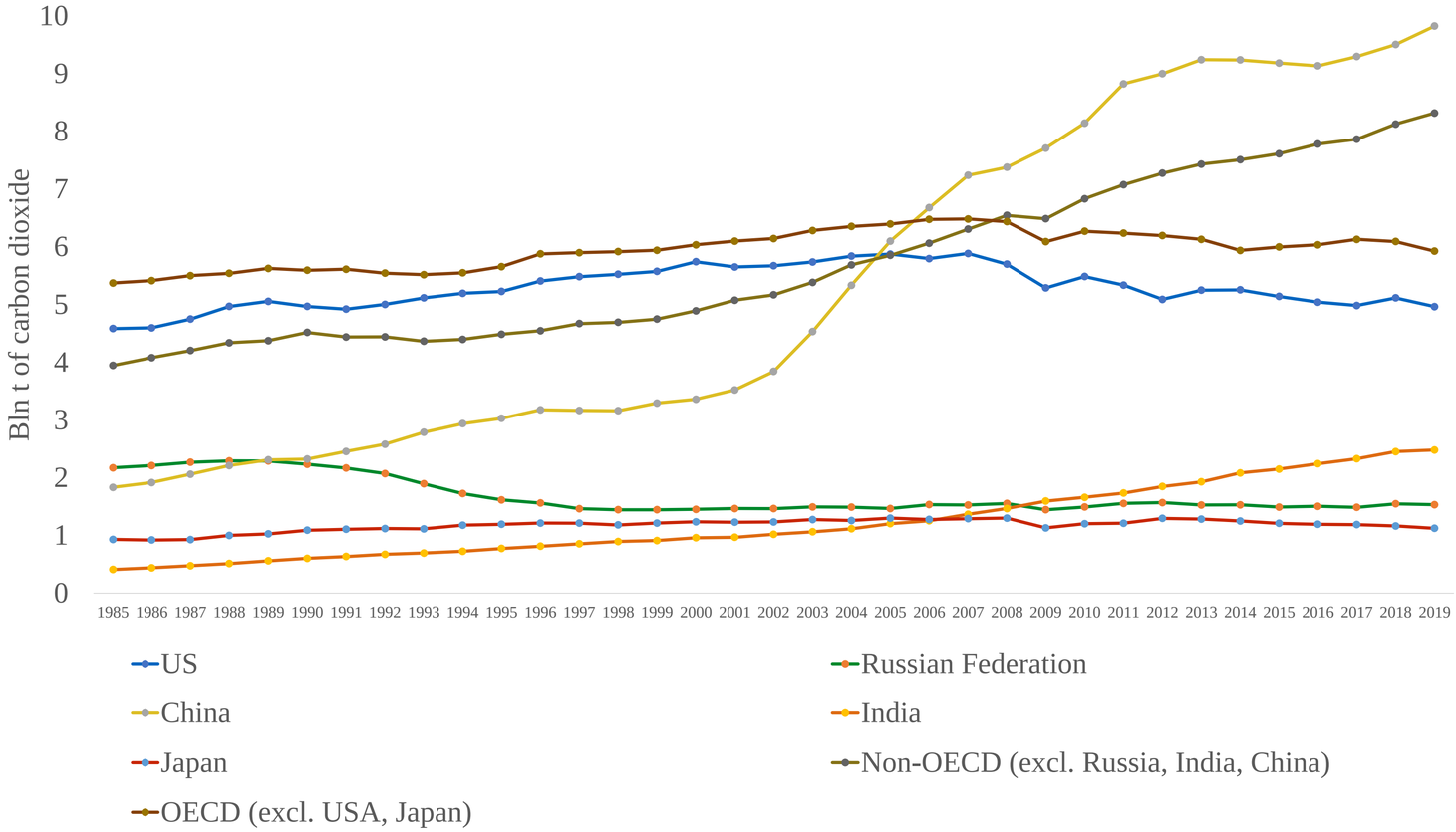
Remarks:

a) we did not account for the recession of 2020 and its consequences;
b) the same GDP growth rates for all countries in the next two decades as in 2010–2019 we consider as an optimistic assumption;
c) we did not show the data for a number of small and/or poor countries, which may not make their way to better life due to resource, or institutional weakness

Sources: Population: UN World population prospects: GDP in PPP (constant 2017 dollars); Income share held by highest 10%: World Bank, World development indicators database. For GDP 2040 PPP (constant 2017 international $) – extrapolation: level of 2019 multiplied by assumed compounded annual growth for 2020–2040 equal to the average growth rate for 2010–2019, divided by Population (UN World population prospects – medium)

GLOBAL EMISSIONS

GLOBAL EMISSIONS BY COUNTRIES AND GROUP OF COUNTRIES, 1985–2019.



The world is still rather far from the turnaround to the green, carbon-free economy in general, even with the apparent encouraging success in new technologies, widening the role of RES in the EU, China and many other countries. Optimistic scenarios are constructed on sectoral, countries' or technological pictures and advanced cases. The big picture is somewhat different.

Source: BP Statistical Review of World Energy, 2020.

GLOBAL EMISSIONS

CORRELATION: GDP PER CAPITA AND EMISSION PER CAPITA, TWO ALTERNATIVE MEASURES, 106 COUNTRIES, 1990 AND 2017.

1990			
Indicator		Production-based emissions per capita, t	Consumption-based emissions, per capita, t
GDP per capita, PPP (constant 2017 international $)	All countries (106)	0,84	0,88
	Developed countries (29)	0,60	0,61
	Developing countries (77)	0,85	0,86
2017			
GDP per capita, PPP (constant 2017 international $)	All countries (106)	0,71	0,89
	Developed countries (29)	0,43	0,80
	Developing countries (77)	0,73	0,91

Sources: GDP per capita, PPP (constant 2017 international $) – World Bank World development indicators database; Production-based emissions, per capita, ton, calculated as Production-based emissions, ton (OurWorldInData database) divided by Population (IMF database); country groups by the UN classification.

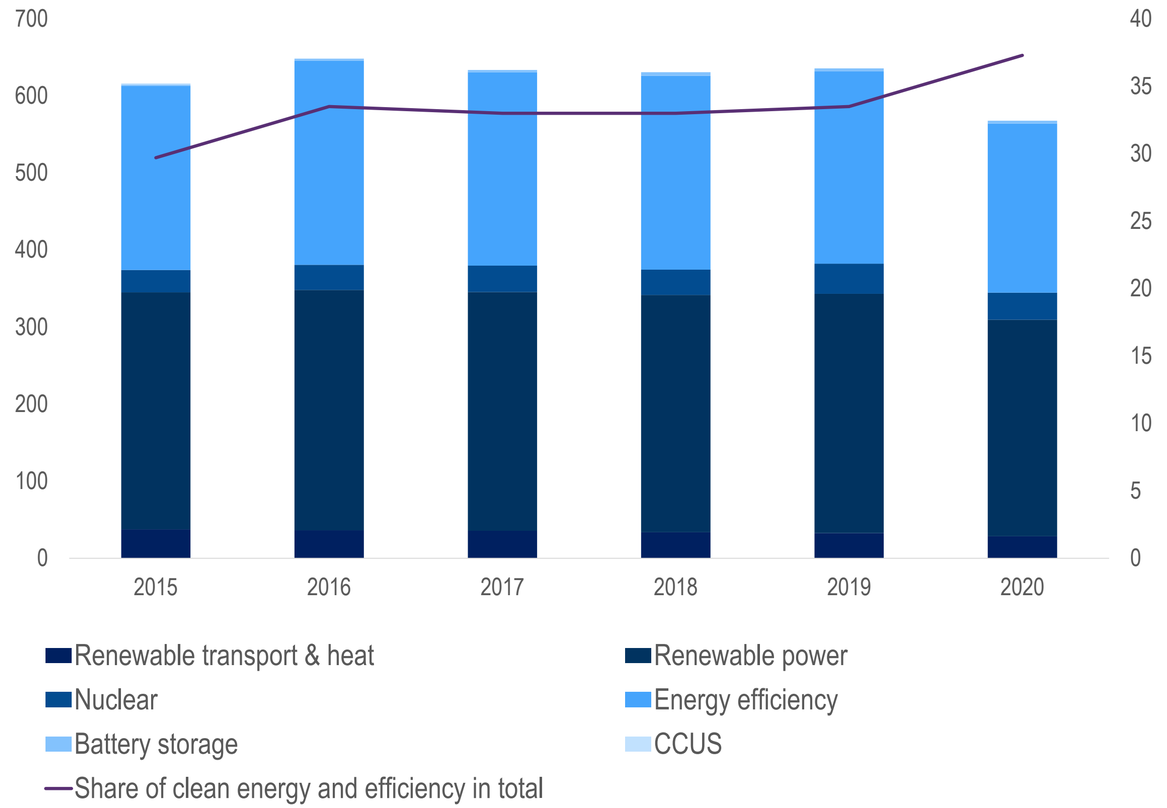
EMISSIONS AND CONDITIONS BY COUNTRIES, 1990 AND 2017

Countries	GDP per capita, PPP const. 2019, th. dollars	Consumption-based CO2 emissions, Mt				Production-based CO2 emissions, Mt				Emissions (production) per capita, t		Coal share in primary energy balance, %		Unconditional pledge, Paris Agreement
		1990	% of total	2017	% of total	1990	% of total	2017	% of total	1990	2017	1990	2017	
World	16,9	21541	100	33537	100	21427	100	33589	100	3,9	4,4	25,2	27,1	-
OECD	44,7	12900	59,9	14200	42,3	12100	56,5	12600	37,5	10,3	8,9	23,6	16,5	
United States	62,5	5100	23,7	5690	17,0	5120	23,9	5270	15,7	19,2	14,9	24,0	15,3	Withdrew
Canada	49	473,7	2,2	591,7	1,8	462,5	2,2	571,1	1,7	15,2	15,5	11,5	5,9	30% of GHG emissions below 2005 level
Sweden	53,2	78,0	0,4	72,0	0,2	57,5	0,3	42,1	0,1	6,1	3,6	5,8	3,9	At least 40% of GHG emissions below 1990 level
Germany	53,8	1160	5,4	894,8	2,7	1050	4,9	798,0	2,4	11,8	8,2	36,6	22,9	At least 40% of GHG emissions below 1990 level
France	46,2	485,5	2,3	458,8	1,4	400,9	1,9	346,5	1,0	5,9	4,4	9,0	4,0	At least 40% of GHG emissions below 1990 level
Italy	42,4	554,2	2,6	467,9	1,4	439,6	2,1	349,0	1,0	6,9	5,2	10,0	6,1	At least 40% of GHG emissions below 1990 level
Spain	40,9	262	1,2	302,3	0,9	231,1	1,1	274,4	0,8	5,2	5,2	21,4	10,0	At least 40% of GHG emissions below 1990 level
United Kingdom	46,7	657,8	3,1	556,5	1,7	600,8	2,8	387,4	1,2	9,6	5,3	30,6	5,4	At least 40% of GHG emissions below 1990 level
Brazil	14,7	234,3	1,1	513,1	1,5	206,9	1,0	463,8	1,4	1,2	2	6,9	5,8	37% of GHG emissions below 2005 level by 2025
China	16,1	2290	10,6	8550	25,5	2420	11,3	9840	29,3	1,9	6,7	60,8	63,7	60-65% of CO2 emissions per unit of GDP below 2005 level
India	6,8	616,6	2,9	2260	6,7	615,5	2,9	2460	7,3	0,6	1,6	30,3	44,3	33-35% of CO2 emission intensity of GDP below 2005 level
Russia	27	2430	11,3	1370	4,1	2530	11,8	1650	4,9	14,6	10,6	21,6	15,5	25-30% GHG emissions below 1990 by 2030
South Africa	12,5	205,9	1,0	340,9	1,0	313,0	1,5	462,8	1,4	6,5	7,4	74,2	74,3	Policies and measures
Rest of the world	9,2	2864,2	13,3	6303	18,8	3241,6	15,1	6112,4	18,2					

Source: Sources: GDP per capita: calculated as GDP, PPP 2017 (World Bank data) divided by Population (UN Population Prospects Data); Emissions per capita, CO2 emissions – IEA Data & Statistics; Coal share in energy balances – calculated from IEA Data & Statistics' Consumption-based emissions, Production-based emissions – OurWorldinData Database; World, Rest of the World – calculated OurWorldInData Database

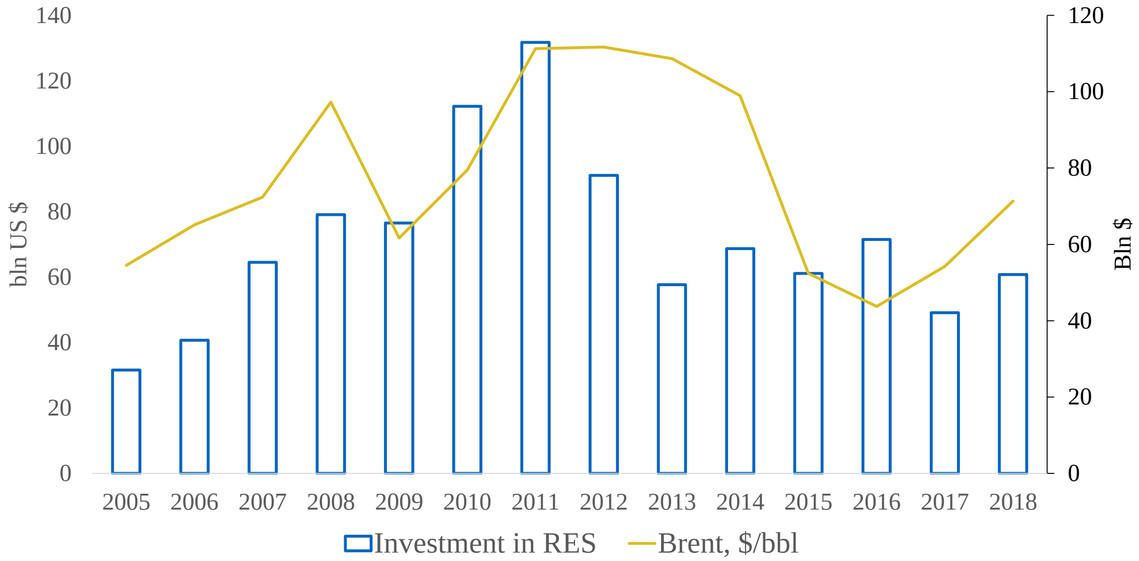
INVESTMENT'S ANGLE

GLOBAL INVESTMENT IN CLEAN ENERGY AND EFFICIENCY AND SHARE IN TOTAL INVESTMENT, 2015–2020, %



Source: IEA, 2020.

EUROPEAN INVESTMENT IN RENEWABLE ENERGY SOURCES (RIGHT AXIS), 2005–2019, BLN $; CRUDE OIL PRICES (BRENT), 2005–2019, $/BBL (LEFT AXIS).



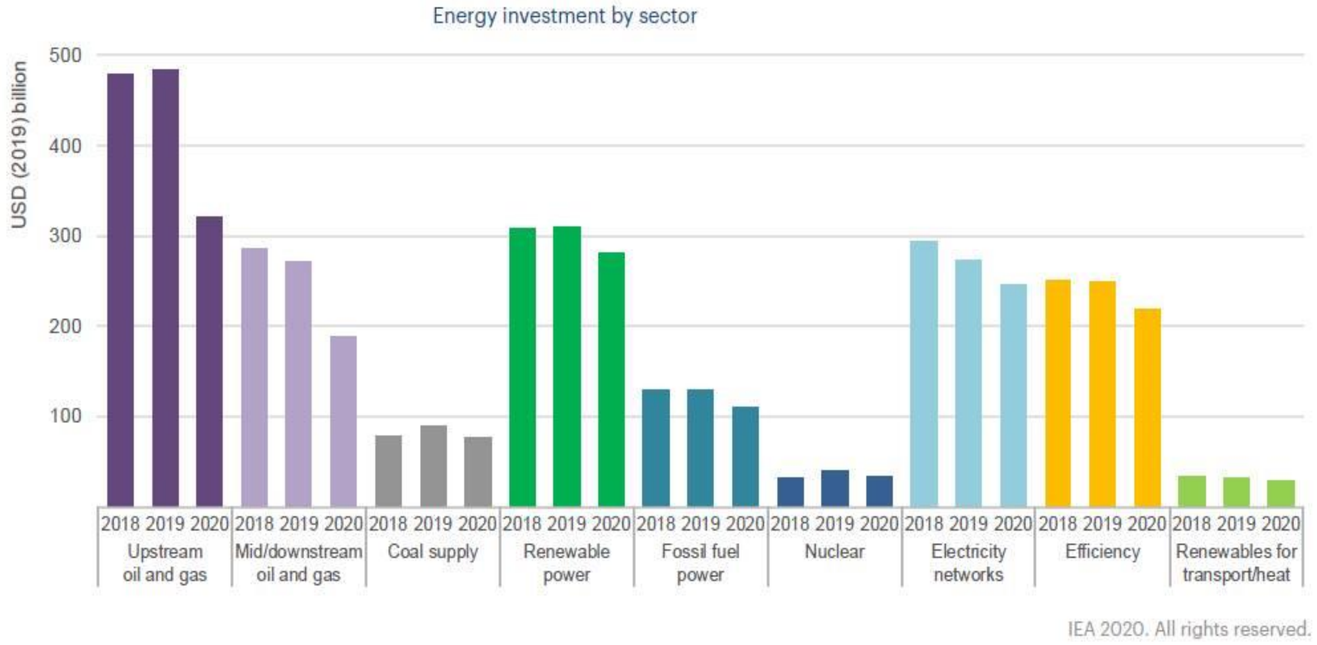
We need to reiterate that these investments are probably very far from being sufficient for transition. Much worse – they were stagnant for a few years, and growing share of clean energy is misleading since its total had declined, especially in 2020 by the estimate. Overall results are straightforward – the world will need to redefine its investment approach to the energy transition.

Source: Frankfurt School–UNEP Centre/BNEF, 2019; OECD Data investment (GFCF).

COVID-19 AND THE RECESSION AS A MOMENT OF TRUTH

ENERGY INVESTMENT BY SECTOR, BLN $.

Fuel supply investments have been hit hardest in 2020 while utility-scale renewable power has been more resilient, but this crisis has touched every part of the energy sector



Implications:

some reduction of an energy intensive consumption in developed countries is unavoidable;

the lifestyle in developed world can be retained with certain costs;

domestic energy transformation will require substantial investment costs;

decent life in developing countries and catching up are starting with eradication of the energy poverty.

bring (back) Energy & Climate problem more closely into the framework of the SDG to make sure we all go to a better and more stable world

Source: IEA, 2020.

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