Scientific Research Publishing

Atmospheric and Climate Sciences, 2022, 12, 264-269
https://www.scirp.org/journal/acs
ISSN Online: 2160-0422
ISSN Print: 2160-0414

Use of Fossil Energy Will Increase Atmosphere and Earth Land Temperature

Mats Lindgren

KTH Royal Institute of Technology Stockholm, Fellow of the Royal Swedish Academy of Engineering Sciences, Stockholm, Sweden
Email: ml@kompositprodukter.se

How to cite this paper: Lindgren, M. (2022) Use of Fossil Energy Will Increase Atmosphere and Earth Land Temperature. *Atmospheric and Climate Sciences*, **12**, 264-269.
https://doi.org/10.4236/acs.2022.122016

Received: January 29, 2022
Accepted: March 14, 2022
Published: March 17, 2022

Abstract

Energy used for industrial production, buildings and transport will be accumulated in Atmosphere and Earth land. Global use of energy is known and documented for a long period of time and proportion of fossil and renewable energy is also known. Calculated accumulated energy in Earth land from 1971 to 2018 corresponds to 40% of IPCC Global Energy Inventory and calculated Atmosphere temperature increase from 1971 to 2018 corresponds to 100% of actual measurements.

Keywords

Use of Energy, Accumulated Energy in Atmosphere and Earth Land, Global Energy Inventory

1. Introduction

The present report is a follower to report [1], Anthropogenic Heat Flux Will Affect Global Warming. When we use energy for industrial production, for buildings and for transport it will end up in heated air and heated Earth land. Energy budget for Atmosphere and Earth land during the period 1971 to 2018 will be calculated and compared with actual measurements. The report will find out whether use of energy is an important factor in these cases.

2. Energy Supply 1971-2018

According to the International Energy Agency [2] the total accumulated energy supply during 1971-2018 distributed on the different energy user sectors is as follows:

Industrial production: 1,116,201 TWh (30%);
Buildings: 894,066 TWh (24%);

Transport: 1,000,378 TWh (26%);

Various: 774,474 TWh (20%).

The energy supply comes from fossil and renewable sources with the following distribution:

Oil: 31%;

Coal: 27%;

Natural gas: 25%;

Nuclear: 4%;

Renewable: 13%;

87% of the total energy supply comes from fossil sources.

See Table 1. Figures according to [2].

Table 1. Use of energy 1971-2018 TWh.

Year	Industrial production	Transport	Buildings	Various	Total
1971	16,253	11,216	11,818	9790	49,077
1972	16,857	11,884	12,257	10,425	51,423
1973	17,843	12,574	12,447	11,053	53,917
1974	17,997	12,462	12,361	11,025	53,845
1975	17,513	12,806	13,301	10,732	54,352
1976	18,492	13,328	13,418	11,508	56,746
1977	19,419	13,808	13,614	11,900	58,741
1978	19,887	14,391	13,990	12,598	60,866
1979	20,809	14,655	14,156	13,055	62,675
1980	20,489	14,491	14,539	12,585	62,104
1981	20,108	14,438	14,600	12,582	61,728
1982	19,454	14,334	14,846	12,449	61,083
1983	19,364	14,479	15,061	12,746	61,650
1984	20,245	14,909	15,739	13,085	63,978
1985	20,034	15,222	16,461	13,246	64,963
1986	20,288	15,792	16,679	13,709	66,468
1987	20,898	16,349	17,055	14,237	68,593
1988	21,532	17,128	17,393	14,786	70,839
1989	21,199	17,621	17,601	14,895	71,316
1990	20,871	18,324	17,576	15,755	72,526
1991	20,779	18,475	17,899	16,149	73,302
1992	20,378	18,868	17,945	15,860	73,051
1993	20,158	19,054	19,627	14,680	73,519
1994	20,120	19,435	19,422	14,918	73,895

Continued

1995	20,777	19,958	19,828	15,072	75,635
1996	20,565	20,755	20,205	15,385	76,910
1997	20,773	21,056	20,196	15,864	77,889
1998	20,780	21,550	20,019	15,727	78,076
1999	20,781	22,169	20,388	16,235	79,573
2000	21,754	22,839	20,715	16,148	81,456
2001	21,731	22,973	20,850	16,321	81,875
2002	21,781	23,592	20,979	16,895	83,247
2003	22,694	24,105	21,485	17,535	85,819
2004	24,420	25,225	21,682	18,395	89,772
2005	26,037	25,814	21,789	18,857	92,497
2006	27,315	26,458	21,864	19,299	94,936
2007	28,383	27,366	21,948	19,831	97,528
2008	28,713	27,531	22,204	19,854	98,302
2009	27,990	27,056	22,148	19,837	97,031
2010	30,728	28,266	22,708	20,659	102,361
2011	31,703	28,739	22,524	20,701	103,667
2012	32,178	29,046	22,428	21,230	104,882
2013	32,407	29,871	23,000	21,617	106,895
2014	32,805	30,401	22,921	22,113	108,240
2015	32,622	31,344	23,010	22,437	109,413
2016	32,384	31,983	23,282	22,954	110,603
2017	32,672	32,801	23,739	23,601	112,813
2018	33,221	33,437	24,349	24,139	115,146
Summary	1,116,201	1,000,378	894,066	774,474	3,785,119

3. Energy Use for Industrial Production, Buildings and Various

Heat Islands is a concept used to describe the energy flux situation especially over big cities where the temperature can be several degrees over the land-temperature outside the city. That is of course the result of energy use in the city. The situation is the same for all energy users like industries and buildings. To some extent heat will accumulate by conduction in the land near the place where the energy use take place, but more important is the heat radiation towards the sky and the resulting radiation back to Earth land due to clouds and greenhouse gases. The radiation down surface will spread the energy over a wide land surface.

Several studies of big cities show energy flux in the range of 10 to 50 W/m^2, to compare with the calculated increased mean global energy flux of 0.7 W/m^2 from 1971 to 2018 according to IPCC AR 6 [3].

Anthropogenic Heat Flux (AHF) of 48 W/m^2 was estimated over New York 2005 [4], AHF of 41 W/m^2 over Tokyo 2013 [5], AHF of 35 W/m^2 over Montreal 2009 [6], AHF of 55 W/m^2 over Seoul 2002 [7] to mention some examples.

AHF from cities, from factories, from production plants, from buildings, from every singel energy user means thermal radiation to the sky and due to greenhouse gases and clouds thermal radiation back to Earth land. The radiation back will spread energy over wide Earth land.

Normally all use of energy will end up in heat, but there are exceptions, for instance production of plastic parts, where energy will be accumulated in the products, but sooner or later also plastic parts will release its accumulated energy to heat.

According to IPCC AR5 [8] and IPCC AR6 [3] thermal radiation up land surface is 398 W/m^2 and radiation from greenhouse gases and clouds down land surface is 342 W/m^2. Then 86% of radiation up surface is returned down Earth land and 14% is accumulated in the trophosphere.

Total accumulated use of fossil energy for Industrial production 1971-2018 is 971,095 TWh and then 835,142 TWh is returned down Earth land and 135,953 TWh is accumulated in the trophosphere.

Total accumulated use of fossil energy for Buildings 1971-2018 is 777,837 TWh and then 668,940 TWh is returned down Earth land and 108,897 TWh is accumulated in the trophosphere.

Total accumulated use of fossil energy for Various 1971-2018 is 673,792 TWh and then 579,461 TWh is returned down Earth land and 94,331 TWh is accumulated in the trophosphere.

4. Energy Use for Transport

Transport on road, which is the dominant mode of transport, use combustion engines of diesel or gasoline type. Diesel engines have an efficency of about 40% and a gasoline engine have an efficency of about 30%. This means that 60% to 70% of used fossil energy for road transport will end up as heated air because engine cooling use air for cooling.

In summary, if 60% - 70% of used fossil energy, 522,197 TWh to 609,230 TWh, will end up as heated air.

5. Combined Effect of Industrial Production, Buildings, Transport and Various

Summary of used energy for Industrial production, Buildings, Various and Transport is 3,785,119 Twh.

Calculated energy that end up as heated air is 861,378 to 948,411 TWh or 23% to 25% of total energy and energy that end up as heated Earth land is 2,344,643 to 2,431,676 TWh or 62% to 64% of total energy.

6. Troposphere Temperature Increase 1971-2018

Temperature will increase when energy is added to the troposphere and the in-

creased temperature will stay for a long time. The situation is described by wikipedia [9] and the reference [10], both in Swedish. Translation follows:

"The troposhere is characterized by decreasing temperature with altitude, about 6˚C/km up to tropopause. Above tropopause there is the stratosphere, characterized by temperature increasing with altitude. Between troposphere and stratosphere there is very small mass exchange, hot air in the troposphere can rise to the tropopause but no further. Mass exchange between troposphere and stratospere is a very slow process."

Then it is motivated to say that used energy will be accumulated.

In this case the accumulated used energy in the troposphere is 861,378 to 948,411 TWh from 1971 to 2018 and the corresponding temperature increase is 0.8˚C to 0.9˚C.

According to NASA [11] temperature increase during this period of time is 0.9˚C. The accumulated energy 861,378 to 948,411 TWh corresponds to 23% to 25% of total used energy which also was the result in paper [1].

7. Accumulated Energy in Earth Land

Above calculated energy that end up as heated Earth land is 2,344,643 to 2,431,676 Twh. In IPCC AR6 [3] chapter 7-179 is accumulated energy in Earth land 21.8 × 10^{21} J given for the period 1971 to 2018. This means that used energy corresponds to 39% to 40% of that amount.

8. Conclusions

When we use fossil energy two different things occur; air and land around us will be heated och CO_2 will be created. Both heat and CO_2 will accumulate in the climate system. As seen in this report global warming is a result of use of fossil energy, not directly of increasing CO_2. Increasing Earth land temperature is to about 40% depending on energy use.

The use of fossil energy has a much more essential impact on the climate system, due to the accumulation, and should therefore be considered. To reduce CO_2 in a process but keeping the same level of energy use will not solve the problem with increasing global warming.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Lindgren, M. (2021) Anthropogenic Heat Flux Will Affect Global Warming. *Atmospheric and Climate Sciences*, **11**, 563-568. https://doi.org/10.4236/acs.2021.113034

[2] https://www.iea.org/data-and-statistics/data-products.

[3] https://www.ipcc.ch/report/ar6/wg1/.

[4] Flanner, M.G. (2009) Integrating Anthropogenic Heat Flux with Global Climate Models. *Geophys. Environmental Research Letters*, **36**, Article No. L02801. https://doi.org/10.1029/2008GL036465

[5] Dong, Y., Varquez, A.C.G. and Kanda, M. (2017) Global Anthropogenic Heat Flux Database with High Spatial Resolution. *Atmospheric Environment*, **150**, 276-294. https://doi.org/10.1016/j.atmosenv.2016.11.040

[6] Bergeron, O. and Strachan, I.B. (2012) Wintertime Radiation and Energy Budget along an Urbanization Gradient in Montreal, Canada. *International Journal of Climatology*, **32**, 137-152. https://doi.org/10.1002/joc.2246

[7] Lee, S.H., Song, C.K., Baik, J.J. and Park, S.U. (2009) Estimation of Anthropogenic Heat Emission in the Gyeong-In Region of Korea. *Theoretical and Applied Climatology*, **96**, 291-303. https://doi.org/10.1007/s00704-008-0040-6

[8] https://www.ipcc.ch/report/ar5/wg1/.

[9] https://sv.wikipedia.org/wiki/Troposfär.

[10] Bogren, J., Loman, G. and Gustavsson, T. (1999) Klimatologi Meteorologi. https://www.studentlitteratur.se/

[11] National Aeronautics Space Administration (2018) Goddard Institute for Space Studies. Global Annual Mean Surface Air Temperature Change. https://data.giss.nasa.gov/gistemp/graphs_v4/