Climate Change Rating of Countries

Joseph Nowarski, M.Sc., ME – Energy Conservation Expert

Abstract

This work proposes a system of Climate Change Rating of countries (CCR). The parameters included in the rating are CO2 emissions per capita and per GDP, cumulative CO2 emissions in the last 30 years, and change of emissions in the last 10 years.

The parameters are compared to the world averages. The rating is related to the specific CO2 emissions, lower value results in a better rating.

The CCR for 2020 includes 192 countries, 99.6% of the global CO2 emissions.

The A-G labels are according to groups of countries, each group with a limited number of countries, 10 countries with the best rating (A) and 10 countries with the worst rating (G). The average 2020 rating of group A is 37% and of group G - 309%. The world average CCR value is 100% equivalent to group F.

Glossary

ΣGDP	cumulative GDP in last 30 years, $GDP
Ave	average
CCO2	global cumulative CO_2 emissions according to publication [1] [2], CO_2 emissions produced from fossil fuels and cement production only – land use change is not included, tCO_2
CCp$$	country's cumulative CO_2 emissions in the last 30 years per cumulative GDP in the same period
CCp$$W	weight of parameter CCp$$
CCR	Climate Change Rating of countries according to this work
CO2	emissions of Carbon Dioxide, CO_2
Cp$	country's CO_2 emissions per GDP in the last year, $tCO_2/\$GDP$ (ton CO_2 per year, per $GDP 2017 per year)
Cp$10	country's change in Cp$ in last 10 years, $tCO_2/\$GDP$
Cp$10W	weight of parameter Cp$
Cp$W	weight of parameter Cp$
CpC	country's CO_2 emissions per capita in the last year, $tCO_2/y,cap$
CpC10	country's change in CpC in last 10 years, $tCO_2/y,cap$
CpC10W	weight of parameter CpC10
CpCW	weight of parameter CpC
GDP	Gross Domestic Product, constant international $ 2017, $GDP/y
Global Warming	global surface temperature change over land+ocean above 1850-1900 baseline, °C
ktCO2/y	kilo-ton CO_2 = 1,000 metric tons of CO_2 per year
MtCO2/y	Mega-ton CO_2 = 1,000,000 metric tons of CO_2
OWID	Our World in Data – Internet site [1] [2]
Ref	reference

tCO2   metric ton of CO2

tCO2/y,cap   metric ton of CO_2 per year, per capita

WB   World Bank

WCCp$$ world cumulative CO2 emissions in last 30 years per cumulative GDP, tCO2/$GDP

WCp$ world CO2 emissions per GDP in the last year, tCO2/$GDP

WCp$10   world change in Cp$ in last 10 years, tCO2/$GDP

WCpC   world CO2 emissions per capita in the last year, tCO2/y,cap

WCpC10   world change in CpC in last 10 years, tCO2/y,cap

Parameters Included in the Rating

Table 1 - <u>Parameters included in the rating</u>

Parameter	Country Symbol	World Symbol	Unit
CO2 emissions per capita	CpC	WCpC	tCO2/y,cap
CO2 emissions per GDP	Cp$	WCp$	tCO2/$GDP
Cumulative CO2 in the last 30 years per cumulative GDP in the same period	CCp$$	WCCp$$	tCO2/$GDP
Change in CpC in the last 10 years	CPC10	WCPC10	tCO2/y,cap
Change in Cp$ in the last 10 years	CP$10	WCP$10	tCO2/$GDP

Weights of the CCR Parameters

Table 2 -   <u>CCR parameters weight</u>

Parameter	Parameter Symbol	Weight	Weight Symbol
Cumulative CO2 in the last 30 years per cumulative GDP in the same period	CCp$$	20%	CCp$$W
CO2 emissions per capita	CpC	25%	CpCW
CO2 emissions per GDP	Cp$	25%	Cp$W
Change in CpC in the last 10 years	CpC10	15%	CpC10W
Change in Cp$ in the last 10 years	Cp$10	15%	Cp$10W
Σ		100%	

Climate Change Rating of Countries

Formula 1 - <u>Climate Change Rating of a country</u>

$$CCR =$$
$$= [CCp\$\$W * CCp\$\$ / WCCp\$\$] +$$
$$+ [CpCW * CpC / WCpC] +$$
$$+ [Cp\$W * Cp\$ / WCp\$] +$$
$$+ [CpC10W * CpC10 / WCpC10] +$$
$$+ [Cp\$10W * Cp\$10 / WCp\$10]$$

CCR	Climate Change Rating of a country
CCp\$\$W	weight of parameter CCp\$\$
CCp\$\$	country's cumulative CO_2 emissions in the last 30 years per cumulative GDP, tCO_2/\$GDP
WCCp\$\$	world cumulative CO_2 emissions in the last 30 years per cumulative GDP, tCO_2/\$GDP
CpCW	weight of parameter CpC
CpC	country's CO_2 emissions per capita in the last year, tCO_2/y,cap
WCpC	world CO_2 emissions per capita in the last year, tCO_2/y,cap
Cp\$W	weight of parameter Cp\$
Cp\$	country's CO_2 emissions per GDP in the last year, tCO_2/\$GDP
WCp\$	world CO_2 emissions per GDP in the last year, tCO_2/\$GDP
CpC10W	weight of parameter CpC10
CpC10	country's change in CpC in the last 10 years, tCO_2/y,cap
WCpC10	world change in CpC in the last 10 years, tCO_2/y,cap
Cp\$10W	weight of parameter Cp\$
Cp\$10	country's change in Cp\$ in the last 10 years, tCO_2/\$GDP
WCp\$10	world change in Cp\$ in the last 10 years, tCO_2/\$GDP

A higher value of the calculations' result means worse CCR (more CO_2 emissions, lower rating).

Sources of Data

The datasets are from the following sources:

- OWID [1] [2] CO2 emissions produced from fossil fuels and cement production only – land use change is not included
- World Bank (WB) [3] GDP, PPP (constant 2017 international $)

CO2 emissions are without international transport.

More details regarding the datasets may be found in the publication [4].

Table 3 -   Dataset [1] [2] [3] [4]

	CO2 emissions	GDP
Source of data	OWID	World Bank
Reference	[1] [2] [4]	[3] [4]
Countries	192	192
From year	1990	1990
To year	2020	2020
CO2 from fossil fuels	Yes	
CO2 from cement production	Yes	
CO2 from other sources	No	
Other GHG	No	
Land use change	No	
International transport	No	
Units	MtCO2/y	Constant International $ 2017
Resolution	1 ktCO2/y	1 Constant International $ 2017

Table 4 -   World data [4]

Parameter	Symbol	Unit	World
GDP		$GDP/y	126,318,951,010,345
Population			7,794,798,725
Cumulative CO2 emissions in the last 30 years		tCCO2	861,261,540,806
Cumulative GDP in the last 30 years		$GDP	2,629,956,174,159,650
Cumulative CO2 in the last 30 years per cumulative GDP in the same period	WCCp$$	tCCO2/$GDP	0.000327
CO2 emissions in 2020		tCO2/y	33,803,026,586
CO2 emissions per capita	WCpC	tCO2/y,cap	4.34
CO2 emissions per GDP	WCp$	tCO2/$GDP	0.000268
CpC before 10 years		tCO2/y,cap	4.64
Cp$ before 10 years		tCO2/$GDP	0.000334
Last CpC to CpC before 10 years	CpC10	tCO2/y,cap	94%
Last Cp$ to Cp$ before 10 years	Cp$10	tCO2/$GDP	80%

Example for Israel

Table 5 -   Basic parameters for CCR for Israel in 2020 [4]

Parameter	Symbol	Unit	Israel	World	Israel to World
GDP	GDP	$GDP/y	359,908,802,382	126,318,951,010,345	
Population			8,655,541	7,794,798,725	
Cumulative CO2 emissions in the last 30 years	CCO2	tCCO2	1,751,133,000	861,261,540,806	
Cumulative GDP in the last 30 years	ΣGDP	$GDP	6,938,109,888,713	2,629,956,174,159,650	
Cumulative CO2 in the last 30 years per cumulative GDP in the same period	CCp$$	tCCO2/$GDP	0.000252	0.000327	77%
CO2 emissions in 2020	CO2	tCO2/y	56,351,000	33,803,026,586	
CO2 emissions per capita	CpC	tCO2/y,cap	6.51	4.34	150%
CO2 emissions per GDP	Cp$	tCO2/$GDP	0.000157	0.000268	59%
CpC before 10 years		tCO2/y,cap	9.30	4.64	
Cp$ before 10 years		tCO2/$GDP	0.000265	0.000334	
Last CpC to CpC before 10 years	CpC10	tCO2/y,cap	70%	94%	75%
Last Cp$ to Cp$ before 10 years	Cp$10	tCO2/$GDP	59%	80%	74%

Table 6 -   CCR Indexes for Israel in 2020

Parameter	Parameter Symbol	Value	Weight	Index
Cumulative CO2 in the last 30 years per cumulative GDP in the same period	CCp$$	77%	20%	15%
CO2 emissions per capita	CpC	150%	25%	38%
CO2 emissions per GDP	Cp$	59%	25%	15%
Change in CpC in the last 10 years	CpC10	75%	15%	11%
Change in Cp$ in the last 10 years	Cp$10	74%	15%	11%
Σ			100%	90%

The Climate Change Rating (CCR) of Israel for 2020 is 90%, which means 10% better than the world average (100%-90%). Israel has 4 CCR indexes better than the world average. CO2 emissions per capita are 50% above the world average.

Israel country page on the website [5]

Nowagreen Climate Change Rating of Countries Online (2020)

country: Israel (ISR) 2020

country	Israel
country code	ISR
CCR year	2020
CO2 emissions per capita (CpC), tCO2/y,cap	6.51
CpC to World	150%
CpC weight	38%
CO2 emissions per GDP (Cp$), tCO2/$GDP	0.000157
Cp$ to World	59%
Cp$ weight	11%
cumulative CO2 emissions in the last 30 years per cumulative GDP (CCp$$), tCO2/$GDP	0.000252
CCp$$ to World	77%
CCp$$ weight	15%
change in CO2 emissions per capita in the last 10 years (CpC10), tCO2/y,cap	70%
CpC10 to World	75%
CpC10 weight	11%
change in CO2 emissions per GDP in the last 10 years (Cp$10), tCO2/$GDP	59%
Cp$10 to World	75%
Cp$10 weight	11%
CCR Rating a lower number means less CO2 and a better rating	90%
country position in the CCR list of a total 192	116
A-G CCR label	E

CCR list sorted by country code (2020)

CCR list sorted by CCR Rating (2020)

Rating A-G

Rating A-G includes 7 groups.

Currently, the dataset includes 192 countries. On average there may be 27 countries in each group.

Following is a proposal for the A-G groups

Table 7 -   A-G groups in 2020

Group		Σ
A	10 best countries	10
B	20 next countries	30
C	35 next countries	65
D	35 next countries	100
E	35 next countries	135
F	all the rest = 47	182
G	10 worst countries	192

CCR Labels

Proposed details on the CCR country label

- o The year of the rating
- o Country Flag
- o Country ISO Code
- o Country Name
- o The country rating A-G, A is the best
- o The number on the countries list, starting with the best and number of all countries in the list
- o Value of the rating, indicating that a lower value means less CO_2 emissions
- o Table of CCR parameters of the country and the world
- o Table of CCR indexes

Proposed colors of CCR Labels (A-G groups)

- o A – Green
- o B – Blue
- o C - Orange
- o D - Violet
- o E – Brown
- o F – Grey
- o G - Black

Table 8 -   CCR values for labels (A-G groups) in 2020

Group	Min CCR	Ave CCR	Max CCR
A	27%	37%	43%
B	44%	50%	55%
C	55%	62%	69%
D	69%	75%	82%
E	82%	90%	98%
F	98%	135%	220%
G	226%	309%	583%

Climate Change Rating of Countries on the Website

The Climate Change Rating of countries for 2020 (CCR2020) according to this work is available on the website nowagreen.com/ccr.php [5].

Climate Change Rating of Countries on the website [5]

Nowagreen Climate Change Rating of Countries sorted by country code (2020)				
to CCR list sorted by CCR Rating (2020)				
for more details click on country code				
country code	country	CCR	position in CCR list	A-G Rating
ABW	Aruba	100%	138	F
AFG	Afghanistan	61%	44	C
AGO	Angola	44%	11	B
ALB	Albania	62%	50	C
ARE	United Arab Emirates	152%	168	F
ARG	Argentina	77%	91	D
ARM	Armenia	78%	94	D
ATG	Antigua Barbuda	94%	127	E
AUS	Australia	171%	178	F
AUT	Austria	89%	113	E
AZE	Azerbaijan	112%	147	F
BDI	Burundi	65%	57	C
BEL	Belgium	94%	126	E
BEN	Benin	62%	48	C
BFA	Burkina Faso	59%	40	C
BGD	Bangladesh	61%	43	C
country code	country	CCR	position in CCR list	A-G Rating
BGR	Bulgaria	105%	141	F
BHR	Bahrain	226%	186	G

Versions

Changes in version 2.1.1
- o The parameter "GDP per capita" removed
- o Weights of parameters CpC and Cp$ changed from 20% to 30%

Changes in this version
- o Weights of parameters CpC and Cp$ changed from 30% to 25%
- o Weights of parameters CpC10 and Cp$10 changed from 10% to 15%

References

1. Hannah Ritchie, Max Roser, Edouard Mathieu, Bobbie Macdonald and Pablo Rosado - Data on CO_2 and Greenhouse Gas Emissions by Our World in Data
    https://github.com/owid/co2-data#data-on-co2-and-greenhouse-gas-emissions-by-our-world-in-data

2. Our World in Data, Cumulative CO_2 emissions, 2020
    https://ourworldindata.org/grapher/cumulative-co-emissions

3. GDP, PPP (constant 2017 international $) - World Bank, International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme

4. CO2 Emissions per GDP – Joseph Nowarski, DOI:10.5281/zenodo.7264411

5. Nowagreen Climate Change Rating of Countries
    https://nowagreen.com/ccr.php

* * *