



## PATEL<sup>'S</sup> CONCEPT OF GLOBAL WARMING POTENTIALS

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### **Abstract**

*Global warming efficiency is product of concentrations and life time of a greenhouse gas in atmosphere. Its measurement unit is GG. Global warming potential is a product of concentration of a greenhouse gas, its life time and radiative forcing in atmosphere. Its measurement unit is MM (double M) which is the highest 53.34 -320.04 MM for CO<sub>2</sub> among all GHGs contrary to old view of value 1, and the lowest 0.0000015 MM for CF<sub>4</sub>. Global Warming Potential for five greenhouse gases; water, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and CF<sub>4</sub> calculated in this paper. Global warming efficiencies of 5 greenhouse gases in this work are: H<sub>2</sub>O 0.00027 to 0.11621 GG, CO<sub>2</sub> 1.4 to 1.8 GG, CH<sub>4</sub> 0.228 GG, N<sub>2</sub>O 0.00037 to 0.00495 GG and CF<sub>4</sub> 0.00037 GG and Global warming potentials: H<sub>2</sub>O 0.00027 to 0.000013 MM, CO<sub>2</sub> 53.34 to 320.04 MM, CH<sub>4</sub> 0.01518 MM, N<sub>2</sub>O 0.08389 to 0.11038 MM, and CF<sub>4</sub> 0.0000015 MM. Global warming potential of CO<sub>2</sub> is the least of value 1 MM in old concept whereas the highest 320.04 MM in Patel's concept. More huge and cry is about increasing concentration of Carbon-dioxide in atmosphere of the Globe which substantiates true to Patel's concept of global warming. GG is a unit of measurement of Global warming efficiency made in honor of Galileo Galilee and Gabriel Fahrenheit. A unit of global warming potential is MM which is in honor of Mueller B. and Martin J. who invented digital thermometer in 1973.*

**Key Words: Radiative - Forcing, Life - Time, Concentration, Product.**

### **Introduction**

Global Warming Potential (GWP) was developed to allow comparisons of the Global warming impacts of different greenhouse gases [1]. Global Warming Potential is a measure of how much infrared thermal radiation a greenhouse gas added to the atmosphere would absorb over a given time frame as a multiple of the radiation that would be absorbed by the same mass of added Carbon-dioxide [2]. More than 10 definitions / meanings of Global Warming Potential are available in Google search, one of them is 'Global Warming Potential measures how much heat a greenhouse gas (GHG) traps in the atmosphere' [3]. According to me "Global Warming Potential is capacity of a greenhouse gas to warm atmosphere of the Globe in a unit time". Global Warming Potential values of 69 greenhouse gases tabulated for 100 years by Intergovernmental Panel on Climate Change Sixth Report Working group 1 (IPCC WG1 Ch-7 2021). In old concept the least Global Warming Potential is 1 for Carbon-dioxide and the highest is 22,800 for Sulfur hexafluoride (SF<sub>6</sub>) [1]. The percentage of water vapor in surface air varies from 0.01% at -42<sup>o</sup>C to 4.24% when the dew point is 30<sup>o</sup>C [4]. Mean life time of water vapor in atmosphere is 5 days and maximum is 10 days [5]. Life time of Carbon-dioxide usually varies as per reference, two of them are 50 to 200 years [6] [7]. Pre-industrial level of Carbon-dioxide in atmosphere of the Globe was around 280 ppm (0.028%) by volume [8] and in 2023 is around 0.04% [10]. Concentration of Methane in atmosphere is around 1900 ppb [10] and average life time is about 12 years [11]. Nitrous-oxide (N<sub>2</sub>O) in atmosphere lasts in around 114 years [12] to 150 years [13] and concentration is low 335 ppb in 2022 status [14]. Tetrafluoromethane (CF<sub>4</sub>) is the most abundant per fluorocarbon at 74 pptv in atmosphere in 1997 [15] and has the longest life time of around 50,000 years



in atmosphere of the Globe [16]. Radiative Forcing (RF) is a ratio of incoming energy and outgoing energy ( $RF = \text{incoming energy} - \text{outgoing energy}$ ). Radiative forcing of water is less than  $0.05 \text{ Wm}^{-2}$  (watts per square meter) to nearly zero [17]. Radiative Forcing of Carbon-dioxide calculated in the range of 100ppmv to 50,000 ppmv and found the maximum Radiative Forcing  $38.1 \text{ Wm}^{-2}$ . Radiative Forcing of Methane and Nitrous-oxide were calculated in the range of 150bv to 100mv and gave maximum forcing of  $6.66 \text{ Wm}^{-2}$  for  $\text{CH}_4$  and  $22.3 \text{ Wm}^{-2}$  for  $\text{N}_2\text{O}$  [18]. Radiative Forcing of  $\text{CF}_4$  in 2001 was  $4.1 \times 10^{-3} \text{ Wm}^{-2}$  [19]. Some figures rounded off in this paper following Patel's plan of Decimal Clock [20]. Measurement units converted by electronic converters [21], [22], [23], [24].

The Global Warming Potential capacities of various greenhouse gases will be compared from each other in Patel's concept but not relative to Carbon-dioxide. 'Patel's concept of Global Warming Potential' is proposed before the world scientific society for consideration.

### Material and Method

**Global Warming Efficiency (GWE):** Global Warming Efficiency is a product of percentage occurrence in atmosphere and life time in years. Life time of a greenhouse gas is converted into equivalent years. Maximum life time of water is 10 days converted into equivalent 0.02741 calendar years. Maximum Global warming efficiency of water is from 0.00027 GG ( $0.01\% \times 0.02741 \text{ years} = 0.00027 \text{ GG}$ ) to 0.54021 GG ( $4.24\% \times 0.02741 \text{ years} = 0.11621 \text{ GG}$ ). Global Warming Efficiency of  $\text{CO}_2$  is 1.4 GG ( $0.028\% \times 50 \text{ years} = 1.4 \text{ GG}$ ) to 8.4 GG ( $0.042 \times 200 = 8.4$ ) while that of Methane is 0.00228 GG ( $0.00019\% \times 12 \text{ years} = 0.00228 \text{ GG}$ ), Methane's concentration is 1900ppb equivalent to 0.00019% in atmosphere. 335 ppb  $\text{N}_2\text{O}$  equivalent to 0.000033% in atmosphere and lives therein 114-150 years. So Global Warming Efficiency of  $\text{N}_2\text{O}$  ranges from 0.003762 GG ( $114 \text{ years} \times 0.000033\% = 0.003762 \text{ GG}$ ) to 0.00495 GG ( $150 \times 0.000033\% = 0.00495 \text{ GG}$ ). GWE of Tetrafluoromethane ( $\text{CF}_4$ ) is around 0.00037 GG ( $50,000 \text{ years} \times 0.000000074\% = 0.00037 \text{ GG}$ ). Tetrafluoromethane 74 pptv is equivalent to 0.000000074% in atmosphere. GG is a unit of measurement of Global warming efficiency made in honor of Galileo Galilee and Gabriel Fahrenheit.

**Table -1: Global Warming Efficiencies of five greenhouse gases are mentioned below**

S. No.	Greenhouse gas	GWE in GG
1.	Water vapor	0.00027 - 0.11621
2.	Carbon-dioxide	1.4 - 8.4
3.	Methane	0.00228
4.	Nitrous-oxide	0.003762 – 0.00495
5.	Tetrafluoromethane ( $\text{CF}_4$ )	0.00037

### Global Warming Potential (GWP)

Global warming potential of a greenhouse gas is a product of concentration in atmosphere, life time and radiative forcing. ( $GWP = \text{concentration} \times \text{life time} \times \text{radiative forcing}$ ). In other words global warming efficiency multiplied by radiative forcing is equal to global warming potential. A unit of global warming potential is MM which is in honor of Mueller B. and Martin J. who invented digital thermometer in 1973.



**Table -2: Global warming potentials of five greenhouse gases are given below**

S. No.	GHGs	GWP in MM (GWE x RF)
1	Water vapor	0.00027 x 0.05 = 0.0000135 0.11621 x 0.05 = 0.00581
2	Carbon-dioxide	1.4 x 38.1 = 53.34 8.4 x 38.1 = 320.04
3	Methane	0.00228 x 6.66 = 0.0151848
4	Nitrous-oxide	0.003762 x 22.3 = 0.0838926 0.00495 x 22.3 = 0.110385
5	Tetrafluoromethane	0.00037 x 4.1 x 0.001 = 0.0000015

### Result and Discussions

Impact of any greenhouse gas in increasing Global warming depends on its Global warming potential in atmosphere of the Globe. Three properties of a greenhouse gas: concentration, longevity and radiative forcing together with work for Global-warming. Carbon-dioxide has the higher Global warming potential 53.34 to 320.04 MM due to its higher concentration 280ppm (0.028%) to 420 ppm (0.04%), higher life time (about 50 - 200 years) and higher radiative forcing ( $38.1 \text{ Wm}^{-2}$ ). Though maximum concentration of water vapor (4.24%) found sometimes/ somewhere higher than  $\text{CO}_2$  but life span is very short of maximum 10 days and radiative forcing is also less ( $0.05 \text{ Wm}^{-2}$ ). Methane and Nitrous-oxide consist of radiative forcing of  $6.66 \text{ Wm}^{-2}$  and  $22.3 \text{ Wm}^{-2}$  respectively but both these gases are found in part per billion (ppb) concentrations in atmosphere means about 1000 times lesser in concentration than Carbon-dioxide. Tetrafluoromethan has the longest life time of about 50,000 years but this greenhouse gas is found in part per trillion (pptv) concentrations in atmosphere means about thousand thousands times less than Carbon-dioxide. Therefore  $\text{CO}_2$  is the most prevalent greenhouse gas in the atmosphere of the Globe. In old concept: Global warming potential value of Carbon-dioxide is assumed only 1 whereas in Patel's concept its value ranges from 53 to 320 in round figures which are too much greater than previous value 1. The higher concentration 420 ppm and radiative forcing  $38.1 \text{ Wm}^{-2}$  in atmosphere are not proportional of its Global warming potential value 1 in old concept. The global warming potentials of all greenhouse gases other than Carbon – dioxide are less than 1 and less than Carbon-dioxide in old concept. But in Patel's concept global warming potentials of all greenhouse gases other than carbon-dioxide are less than 1 and that of carbon-dioxide is the highest 320 MM table 2. Currently (2023) atmospheric concentration of carbon – dioxide, life time and radiative forcing all are greater than Methane and Nitrous-oxide. Hence lesser global warming potential of Carbon-dioxide than methane and Nitrous –oxide is not justifiable from any angle. According to Patel's concept Carbon-oxide is the highest potent greenhouse gas of value 53 – 320 MM whereas Tetra-fluoro-methane ( $\text{CF}_4$ ) is the least potent of value 0.0000015 MM despite of it's the longer life time of 50,000 years. Since Carbon-dioxide is the highest potent greenhouse gas and absorbed by plants hence Patel's theory of thirty is a solution of problem of increasing global warming [25].

### Conclusion

Old concept of global warming potential should be substituted by Patel's concept in which global warming potentials of all greenhouse gases are corresponding to their concentration, life time and radiative forcing in atmosphere of the globe.

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