

"Trust the science!", they say... "The science is settled!", they say... yeah, well, even physicists are wrong sometimes, and the climate activists in white lab coats masquerading as climatologists (which we know as climastrologists) are seemingly intentionally so, seemingly paid to be so in order to push a leftist narrative.

Here's a modern example of a physicist being wrong. He lost a \$10,000 bet.

https://www.youtube.com/watch?v=yCsgoLc_fzI

We're losing our rights and freedoms. Object lesson: **Don't be wrong.**

Newton, in explaining partial reflection from a transparent object, proposed that light did not actually reflect off the first surface it encounters, but instead a complementary wave was set up which traveled along with the photons (what Newton called 'corpuscles of light') and which set up 'fits of reflection and transmission' on the second surface of the transparent object (as the light was leaving the object out the other side). This, of course, failed to explain, for instance, reflection off the surface of bodies of water coterminous at their bottom by nothing but dirt (thus having no 'second surface'). In reality, partial reflection occurs at any interface where c (the speed of light) changes, akin to an impedance change interface in an electrical circuit partially reflecting a changing voltage.

Arrhenius completely discounted convection, advection, specific heat capacity and latent heat of vaporization (which transit ~76.2% of all energy away from the planet's surface) in formulating his incorrect radiative CO₂ warming hypothesis upon which hangs the entire modern CAGW charade; and his experiments used 9.7 μm radiation (while CO₂ absorbs mainly at 14.98352 μm) and he over-estimated the absorption coefficient of CO₂ by 253%, forcing him to later revise his estimate (which was still wrong) of temperature forcing from CO₂...

Maxwell in his "Theory of Heat" (starting on p. 320) predicted that a column of atmosphere would be isothermal, and indeed claimed a column of atmosphere forming a gravitationally-induced thermal gradient would violate 2LoT (proven incorrect... Loschmidt was correct, a lapse rate always evolves due to Kelvin-Helmholtz gravitational auto-compression in an atmosphere sufficiently dense to be gravitationally compressed)...

Boltzmann sided with Maxwell that no atmospheric lapse rate could exist...

Carnot erred in assuming that heat is never consumed as work...

Clausius in his first memoir erred in attributing 'heat' to the energy density of an object ('heat' is definitionally an energy flux, 'temperature' is a measure of radiation energy density)...

Kirchhoff in formulating his original version of Kirchhoff's Law of Thermal Radiation used the term '*absorptive power*' when he actually meant '*absorptivity*'; and in attempting to expand Kirchhoff's Law from idealized blackbody cavities to all materials he cheated a bit by using a graphite or carbon thermalizer in perfectly-reflecting cavities (which cannot otherwise exhibit a blackbody spectrum). Further, he took the ideas of Balfour Stewart (published a full year before Kirchhoff published) without attribution, only receiving recognition because he cheated enough (by utilizing a graphite or carbon thermalizer in perfectly-reflecting cavities) to get his mathematics to work, whereas Stewart hadn't yet fleshed out his mathematics (because he couldn't, because he didn't cheat as Kirchhoff did).

Planck (a former student of Kirchhoff and his successor as lecturer at Berlin's Friedrich Wilhelms University) erred in confusing '*temperature*' and '*heat*' in *The Theory of Heat Radiation* [5, § 46], and in failing to properly validate Kirchhoff's Law (from which he derived his equation). His attempt at validating Kirchhoff's Law in his book is filled with errors... he had to redefine blackbodies to be predicated upon transmissivity (except idealized blackbodies *by definition* are opaque, zero transmissivity); he ignored absorptivity at the interface of the blackbody (he claimed that the state of photons on the surface and inside the material were identical, and that as a photon traversed through a material, it was successively absorbed); he used polarized light in his experiments (whereas thermal radiation is never polarized) and thus misused Brewster's Law; and he, like Kirchhoff, cheated a bit by using a small chunk of graphite or carbon as a thermalizer (what he called a 'catalyst') in a perfectly reflecting cavity (which cannot otherwise exhibit a blackbody spectrum because the radiation field can do no work upon the walls nor the walls upon the radiation field). In short, Planck held a weird view of what photons were and how they interacted with matter. His definition of a blackbody didn't even coincide with Kirchhoff's definition (nor with the standard definition). Planck also erred in clinging to a long-debunked radiative model (Prevost Theory of Exchanges and its core tenet, Prevost's Principle), and his follow-on assumptions stemming from that led to his treating real-world (graybody) objects as though they radiatively emit willy-nilly without regard to the radiation energy density gradient.

Planck correctly stated:

*"Conduction of heat depends on the temperature of the medium in which it takes place, or more strictly speaking, on the non-uniform distribution of the temperature in space, as measured by the **temperature gradient**."*

In other words, Planck correctly stated that energy can only flow (the definition of '*heat*') via conduction if there is a temperature (and therefore, for solid objects, an energy density) gradient (it's more complicated for gases, because they can equilibrate their energy density to the pressure ($1 \text{ J m}^{-3} = 1 \text{ Pa}$) for constant-pressure processes, and thus convert their energy density to a change in volume (see below)).

Where Planck erred is in his clinging to the Prevost Theory Of Exchanges (and its core tenet, the Prevost Principle) in regard to radiative energy, which led him to eschew scientific reality (that energy only flows if there is an energy density gradient), to wit:

*"But the empirical law that the emission of any volume-element depends entirely on what takes place inside of this element holds true in all cases (**Prevost's principle**)."*

The immediate corollary to Prevost's Principle is that $E = e...$ that the actual emission is equal to the disposition to emit, which is false, implying that an object must emit all energy it absorbs (the definition of idealized blackbody objects, which do not and cannot exist).

A further corollary to Prevost's Principle is that $A = I * a...$ that the actual absorption is equal to the intensity of the incident beam times the disposition to absorb, which is again false, implying that excited quantum states have the same disposition to absorb as do unexcited quantum states (again, the definition of idealized blackbody objects, which do not and cannot exist). Of course, Prevost, in 1791, didn't know of quantum states, so he couldn't have known that the corollaries to Prevost's Principle were incorrect.

Prevost's Principle was used by Gustav Kirchhoff to develop Kirchhoff's Law of Thermal Radiation, which is likewise false because it is based upon a false premise (see below). Likewise, much of what Planck developed based upon Kirchhoff's Law of Thermal Radiation loses its universal applicability, specifically Planck Length, Planck Time, Planck Mass and Planck Temperature are now merely human-invented units of measure, rather than fundamental units of reality.

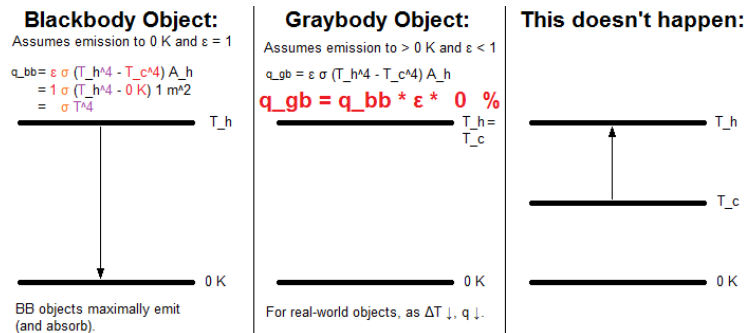
The long-debunked Prevost Theory of Exchanges (first replaced by the Kinetic Theory of Heat, then by Quantum Thermodynamics) assumed that energy flowed without regard to radiation energy density gradient, because only an object's internal state determined radiant exitance. This led Planck to make the further incorrect assumption in keeping with the Prevost Theory of Exchanges:

"We shall now introduce the further simplifying assumption that the physical and chemical condition of the emitting substance depends on but a single variable, namely, on its absolute temperature T."

He correctly stated that energy transfer via conduction was predicated upon there being an energy density gradient, but for radiative energy exchange, he clung to the Prevost Principle (core tenet of the Prevost Theory of Exchanges, a long-debunked hypothesis from 1791 which was predicated upon the long-debunked Caloric Theory and which postulated that radiant exitance of an object was solely determined by that object's internal state, thus that energy could flow willy-nilly without regard to radiation energy density gradient).

Except the Prevost Principle would only work for an idealized blackbody object, and they don't actually exist... they're idealizations. And the object would have to be in an isolated system, and they don't actually exist... they're idealizations.

A graybody object's radiant exitance isn't solely determined by that object's internal state, as the Stefan-Boltzmann (S-B) equation plainly shows:



<https://i.imgur.com/QErzYW.gif> (animated version of above image)

Idealized Blackbody Object (assumes emission to 0 K and $\epsilon = 1$):

$$q_{bb} = \epsilon \sigma (T_h^4 - T_c^4) A_h$$

$$= 1 \sigma (T_h^4 - 0 K) 1 m^2$$

$$= \sigma T^4$$

Graybody Object (assumes emission to $> 0 K$ and $\epsilon < 1$):

$$q_{gb} = \epsilon \sigma (T_h^4 - T_c^4) A_h$$

The 'A_h' term is merely a multiplier, used if one is calculating for an area larger than unity [for instance: $>1 m^2$], which converts the result from radiant exitance ($W m^{-2}$, radiant flux per unit area) to radiant flux (W).

Temperature is equal to the fourth root of radiation energy density divided by Stefan's Constant (ie: the radiation constant).

$$e = T^4 a \quad a = 4\sigma/c \quad e = T^4 4\sigma/c \quad T^4 = e/(4\sigma/c) \quad T = \sqrt[4]{e/(4\sigma/c)} \quad T = \sqrt[4]{e/a}$$

$$q = \epsilon_h \sigma (T_h^4 - T_c^4)$$

$$[1] \therefore q = \epsilon_h \sigma ((e_h / (4\sigma / c)) - (e_c / (4\sigma / c)))$$

Canceling units, we get $J sec^{-1} m^{-2}$, which is $W m^{-2}$ ($1 J sec^{-1} = 1 W$).

$$W m^{-2} = W m^{-2} K^{-4} * (\Delta J m^{-3} / (W m^{-2} K^{-4} / m sec^{-1}))$$

$$[2] \therefore q = (\epsilon_h c (e_h - e_c)) / 4$$

Canceling units, we get $J sec^{-1} m^{-2}$, which is $W m^{-2}$ ($1 J sec^{-1} = 1 W$).

$$W m^{-2} = (m sec^{-1} (\Delta J m^{-3})) / 4$$

One can see from the immediately-above equation that the Stefan-Boltzmann (S-B) equation for graybody objects is all about subtracting the radiation energy density of the cooler object from the radiation energy density of the warmer object.

$$[3] \therefore q = (\epsilon_h * (\sigma / a) * \Delta e)$$

Canceling units, we get $W m^{-2}$.

$$W m^{-2} = ((W m^{-2} K^{-4} / J m^{-3} K^{-4}) * \Delta J m^{-3})$$

You will note that $\sigma = (a * c) / 4$... the S-B Constant equals Stefan's Constant multiplied by the speed of light in vacua divided by 4.

$$[4] \therefore q = (\epsilon_h * ((a * c) / a) * \Delta e) / 4 = (\epsilon_h * c * \Delta e) / 4$$

Canceling units, we get $J sec^{-1} m^{-2}$, which is $W m^{-2}$ ($1 J sec^{-1} = 1 W$).

$$W m^{-2} = (m sec^{-1} * \Delta J m^{-3}) / 4$$

Note that [2] and [4] are identical, arrived at via two different avenues.

So radiant exitance at its most simplified (and thus the S-B equation at its most simplified) is just the emissivity of the warmer object (because *emissivity* only applies to objects which are *emitting*, and only the warmer object will be emitting... the colder object will be unable to emit in the direction of the warmer object because energy cannot spontaneously flow up an energy density gradient) multiplied by the speed of light in vacua, multiplied by the energy density differential, all divided by 4.

For graybody objects, it is the radiation energy density differential between warmer object and cooler object which determines warmer object radiant exitance. The climate alarmists misinterpret the S-B radiant exitance equation for graybody objects. Warmer objects don't absorb radiation from cooler objects (a violation of 2LoT in the Clausius Statement sense and Stefan's Law); the lower radiation energy density gradient between warmer and cooler objects (as compared to between warmer object and 0 K) lowers radiant exitance of the warmer object (as compared to its radiant exitance if it were emitting to 0 K). The radiation energy density differential between objects manifests a radiation energy density gradient, each surface's radiation energy density manifesting a proportional radiation pressure.

Thus, the climastrologists cling to the long-debunked Prevost Principle (*whether they know it or not... and if they don't know it, then they really have no business being anywhere near anything related to science*) when they claim that energy can radiatively flow without regard to radiation energy density gradient... and that leads to all manner of unscientific drivelry... 'backradiation', 'Global Warming Potential', 'carbon footprint', the incorrect usage of the S-B equation in the K-T (Kiehl-Trenberth) diagram and even in instruments such as pyrgeometers and FTIR spectrometers, and ultimately in their core narrative: CAGW.

Even worse is that they then further misuse the S-B equation by converting it into what they call a "forcing formula", used in IPCC AR6:

$$4 \epsilon \sigma T^3$$

... which builds-in a warming trend:

 For 288 K, a 1 K negative temperature change, $\epsilon=0.93643$ (ref: NASA ISCCP program): $4 \epsilon \sigma T^3 = 5.07369679087621 \text{ W m}^{-2}$
 For 288 K, a 1.00525093764635 K negative temperature change, $\epsilon=0.93643$: $\epsilon \sigma T^4 = 5.07369679087621 \text{ W m}^{-2}$

For 288 K, a 1 K positive temperature change, $\epsilon=0.93643$ (ref: NASA ISCCP program): $4 \epsilon \sigma T^3 = 5.07369679087621 \text{ W m}^{-2}$
 For 288 K, a 0.99474906235365 K positive temperature change, $\epsilon=0.93643$: $\epsilon \sigma T^4 = 5.07369679087621 \text{ W m}^{-2}$

So their bastardized equation gives the result for a warming of 0.99474906 K while claiming it's a warming of 1 K, and gives the result for a cooling of 1.00525093 K while claiming it's a cooling of 1 K.

And that's likely *why* they bastardized the S-B equation... to hide the fact that they continue to treat real-world graybody objects as idealized blackbody objects, and to build-in whatever warming trend they possibly could in order to help sustain their alarmist narrative.

It is all based upon mathematical fraudery, none of it is correct, none of it is physical, none of it is scientific. CAGW is nothing but a complex mathematics-based scam, a rigged mathematical game of thimblery, and few are quick-witted enough to catch the climastrologists palming the pea as they shuffle the thimbles. It is Zohnerism taken to its extreme, using twisted facts and contorted concepts to lead the scientifically-illiterate to false conclusions in order to garner support for the implementation of policies which would otherwise stand no chance of being enacted.

1) The climate alarmists are, as usual, **provably diametrically opposite to reality.**

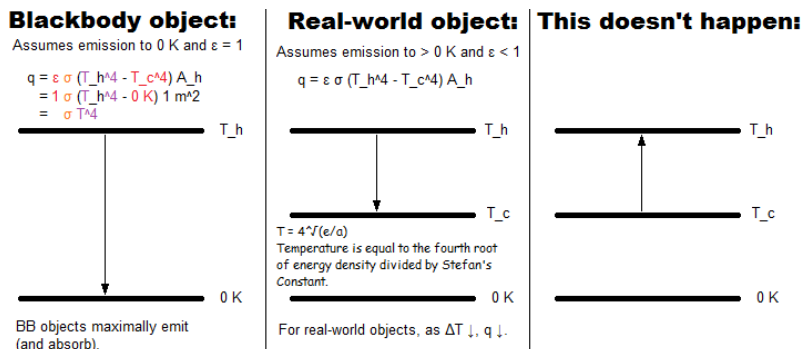
The climate alarmists misuse the S-B equation, using the form meant for idealized blackbody objects upon graybody objects:

$$q = \sigma T^4$$

... and slapping ϵ onto that (sometimes) ...

$$q = \epsilon \sigma T^4$$

Their misuse of the S-B equation inflates radiant exitance far above what it actually is for all graybody objects, necessitating that they carry that error forward through their calculations and cancel it on the back end to get the equation to balance, essentially subtracting a wholly-fictive 'cooler to warmer' energy flow from the real (but calculated incorrectly and thus far too high) 'warmer to cooler' energy flow... which leads especially scientifically-illiterate climate alarmists to conclude that energy actually can flow 'cooler to warmer' (a violation of 2LoT and Stefan's Law).



The S-B equation for graybody objects isn't meant to be used to subtract a fictive 'cooler to warmer' **energy flow** from the incorrectly-calculated and thus too high 'warmer to cooler' **energy flow**, it's meant to be used to subtract cooler object radiation **energy density** (temperature is a measure of radiation energy density, the fourth root of radiation energy density divided by Stefan's constant) from warmer object radiation **energy density**. Radiant exitance of the warmer object is predicated upon the radiation **energy density gradient**.

Their problem, however, is that their take on radiative energy exchange necessitates that at thermodynamic equilibrium, objects are furiously emitting and absorbing radiation (this is brought about because they claim that objects emit only according to their temperature (rather than according to the radiation energy density gradient), thus for objects at the same temperature in an environment at the same temperature, all would be furiously emitting and absorbing radiation... in other words, they claim that graybody objects emit > 0 K), and they've forgotten about entropy... if the objects (and the environment) are furiously emitting and absorbing radiation at thermodynamic equilibrium as their incorrect take on reality must claim, why does entropy not change?

The second law states that there exists a state variable called entropy S . The change in entropy (ΔS) is equal to the energy transferred (ΔQ) divided by the temperature (T).

$$\Delta S = \Delta Q / T$$

Only for reversible processes does entropy remain constant. Reversible processes are idealizations. **All real-world processes are irreversible.**

The climastrologists claim that energy can flow from cooler to warmer because they cling to the long-debunked Prevost Principle, which states that an object's radiant exitance is dependent only upon that object's internal state, and thus they treat real-world graybody objects as though they're idealized blackbody objects via: $q = \sigma T^4$.

... thus the climate alarmists claim that all objects emit radiation if they are above 0 K. In reality, idealized blackbody objects emit radiation if they are above 0 K, whereas graybody objects emit radiation if their temperature is greater than 0 K above the ambient.

But their claim means that in an environment at thermodynamic equilibrium, all objects (and the ambient) would be furiously emitting and absorbing radiation, but since entropy doesn't change at thermodynamic equilibrium, the climastrologists must claim that radiative energy transfer is a **reversible process**. Except radiative energy transfer is an **irreversible process**, which *destroys* their claim.

In reality, at thermodynamic equilibrium, **no energy flows**, the system reaches a quiescent state (the *definition* of thermodynamic equilibrium), which is why entropy doesn't change. A standing wave is set up by the photons remaining in the intervening space between two objects at thermodynamic equilibrium, with the standing wave nodes at the surface of the objects by dint of the boundary constraints (and being wave nodes (nodes being the zero crossing points, anti-nodes being the positive and negative peaks), no energy *can* be transferred into or out of the objects). Should one object change temperature, the standing wave becomes a traveling wave, with the group velocity proportional to the radiation energy density differential (the energy flux is the energy density differential times the group velocity), and in the direction toward the cooler object. This is standard cavity theory, applied to objects.

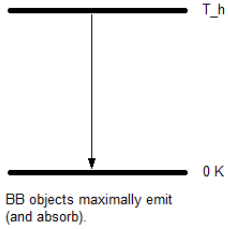
All **idealized blackbody objects** above absolute zero emit radiation, assume emission to 0 K and don't actually exist, they're idealizations.

Real-world **graybody objects** with a temperature greater than zero degrees above their ambient emit radiation. Graybody objects emit (and absorb) according to the radiation energy density gradient.

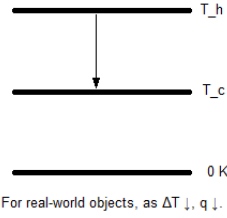
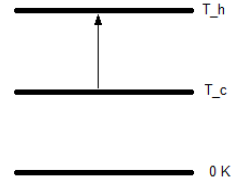
It's right there in the S-B equation, which the climate alarmists fundamentally misunderstand:

Blackbody object:Assumes emission to 0 K and $\epsilon = 1$

$$\begin{aligned}
 q &= \epsilon \sigma (T_h^4 - T_c^4) A_h \\
 &= 1 \sigma (T_h^4 - 0^4) 1 \text{ m}^2 \\
 &= \sigma T_h^4
 \end{aligned}$$

**Real-world object:**Assumes emission to > 0 K and $\epsilon < 1$

$$q = \epsilon \sigma (T_h^4 - T_c^4) A_h$$

**This doesn't happen:**

All real-world processes are irreversible processes, including radiative energy transfer, because radiative energy transfer is an entropic temporal process.

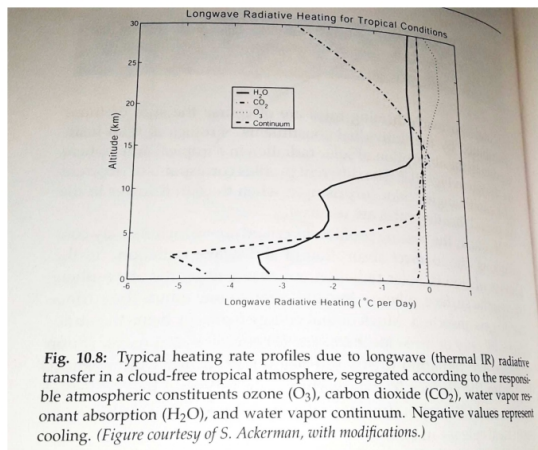
"If your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation."

- Arthur Eddington: The Nature of the Physical World. (1929)

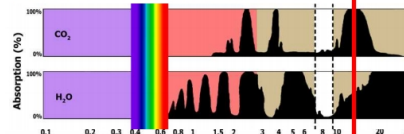
Their mathematical fraudery is what led to their 'energy can flow willy-nilly without regard to radiation energy density gradient' narrative (in their keeping with the long-debunked Prevost Principle), which led to their 'backradiation' narrative, which led to their 'CAGW' narrative, all of it definitively, mathematically, scientifically proven to be fallacious.

2) CO₂ isn't a 'global warming' gas... it acts as a net atmospheric radiative *coolant* at all altitudes except a negligible warming at the tropopause.

Longwave radiative cooling in tropical conditions



- CO₂: only little cooling until 15km (small heating) due to high opacity of pressure broadened 15 micron band: radiation emitted at one level is reabsorbed at nearby level at almost same temperature. Above 15km, pressure broadening much weaker and band breaks open: effective cooling to space
- H₂O: not as well mixed as CO₂ and concentrated in lower troposphere; cooling to space is more effective and peaks twice in troposphere; less opaque than CO₂ around 15 micron, more opaque at around 3 and 5 micron; cooling (emission) modest >15km where there is very little H₂O
- H₂O continuum: very sensitive to pressure, mass absorption coefficient drops rapidly with height.



The image above is from a presentation given by Dr. Maria Z. Hakuba, an atmospheric research scientist at NASA JPL.

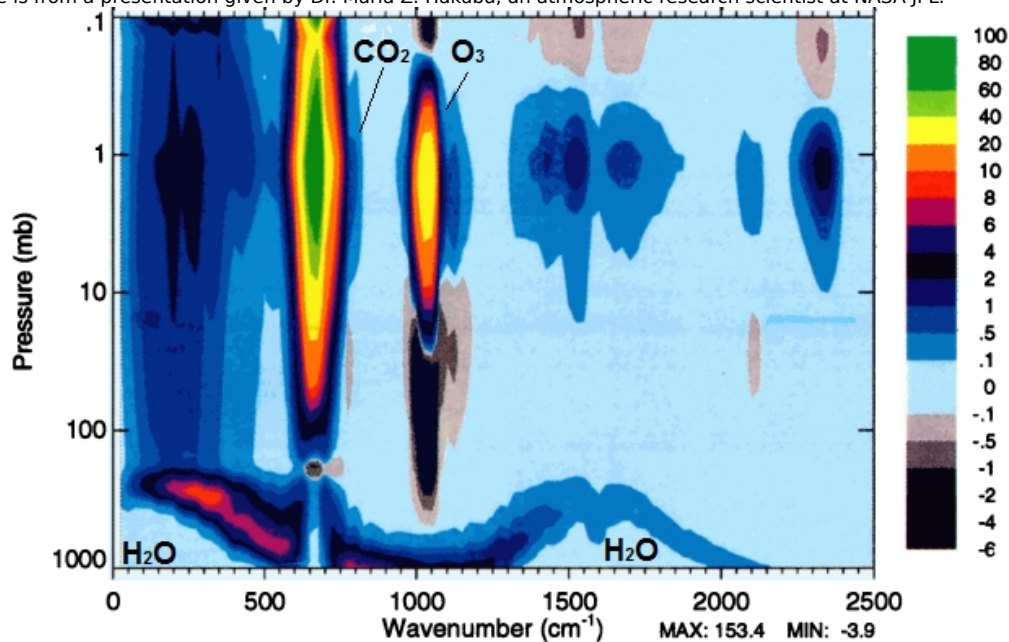


Plate 2. Spectral cooling rate profile for H₂O, CO₂ (355 ppm), and O₃ as a logarithmic function of pressure for the MLS atmosphere. The results are spectrally averaged over 25 cm⁻¹. Color scale $\times 10^{-3}$ is in units of K d⁻¹ (cm⁻¹)⁻¹.

The image above is adapted from the [Clough and Iacono study, Journal Of Geophysical Research, Vol. 100, No. D8, Pages 16,519-16,535, August 20, 1995.](#)

Note that the Clough & Iacono study is for the atmospheric radiative cooling effect, so positive numbers at right are cooling, negative numbers are warming.

Gee... adding more of the predominant upper-atmospheric radiative coolant causes more emitters per unit volume, which causes more emission per unit volume, which causes more emission to space, which causes a larger loss of energy from the system known as 'Earth', which causes cooling... who knew?

It is the monoatomics and homonuclear diatomics which are the actual 'greenhouse' gases... remember that an actual greenhouse works by **hindering convection**.

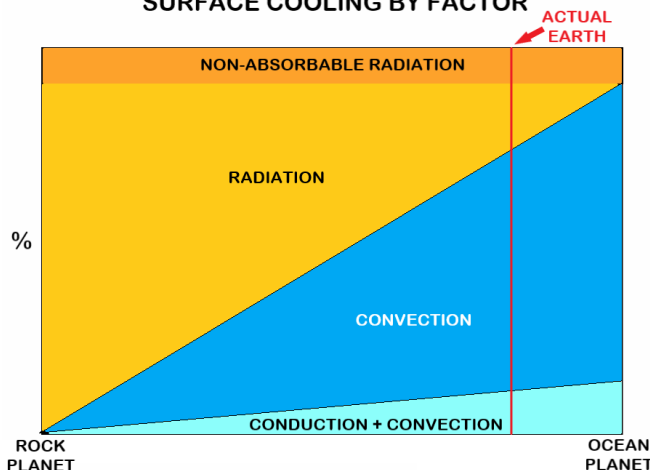
Monoatomics (Ar) have no vibrational mode quantum states, and thus cannot emit (nor absorb) IR. Homonuclear diatomics (O₂, N₂) have no net electric dipole and thus cannot emit (nor absorb) IR unless that net-zero electric dipole is perturbed via collision.

In an atmosphere consisting of solely monoatomics and homonuclear diatomics, the atoms / molecules could pick up energy via conduction by contacting the surface, just as the polyatomics do; they could convect just as the polyatomics do... but once in the upper atmosphere, they could not as effectively radiatively emit that energy to space, the upper atmosphere would warm, lending less buoyancy to convecting air, thus hindering convection... and that's how an actual greenhouse works, by **hindering convection**.

The environmental lapse rate would necessitate that the surface also warm, given that the lapse rate is 'anchored' at TOA (Top of Atmosphere... that altitude at which the atmosphere effectively becomes transparent to any given wavelength of radiation... it is different for different wavelengths, with the Effective TOA being the mean of all wavelengths' TOAs).

The surface would also have to warm because that ~76.2% of energy...

SURFACE COOLING BY FACTOR



... which is currently removed from the surface via convection and evaporation would have to be removed nearly solely via radiation (there would be some collisional perturbation of N_2 and O_2 , and thus some emission in the atmosphere).... and a higher surface radiant exitance implies a higher surface temperature.

Think about it... below we calculate $591.5465210084 \text{ W m}^{-2}$ average surface solar insolation and $450.757928 \text{ W m}^{-2}$ able to do work upon the planet's surface to warm it up, which corresponds to a **maximum** surface temperature (assuming emission to a 255 K atmosphere and $\epsilon=0.93643$ (per NASA ISCCP program)) of $335.81432868651865 \text{ K}$ (144.79579164 F , 62.66432869 C)... that maximum temperature is very close to empirical reality.

Now, what would happen if there were no radiative polyatomics to remove that ~76.2% of all surface energy which is currently removed via convection and evaporation? Well, that $450.757928 \text{ W m}^{-2}$ must then be removed via surface radiant exitance (in actuality, there would be some collisional perturbation of N_2 's and O_2 's net-zero electric dipole and thus some emission by N_2 and O_2 in the atmosphere)... meaning the surface would be emitting the same $591.5465210084 \text{ W m}^{-2}$ it is receiving... and that corresponds to a **maximum** surface temperature of $352.09524526533085 \text{ K}$ (174.10144 F , 78.945245 C). Those saying that the so-called 'greenhouse gases' (CO_2 , H_2O) increase surface temperature **must** be incorrect.

The chance of any N_2 or O_2 molecule colliding with water vapor is ~3% on average in the troposphere, and for CO_2 it's only ~0.042%. Logic dictates that as atmospheric concentration of CO_2 increases, the likelihood of N_2 or O_2 colliding with it also increases, and thus increases the chance that N_2 or O_2 can transfer its translational and / or vibrational mode energy to the vibrational mode energy of CO_2 , which can then shed that energy to space via radiative emission. (And yes, t-v and v-v collisional processes do occur from N_2 to CO_2 ... that's how CO_2 lasers work. The mechanism of excitation of N_2 is different (in the atmosphere, via v-v collisional energy exchange with solar insolation-excited O_3 ; in a CO_2 laser via electron impact), but the energy exchange mechanism remains the same... in fact, the $N_2\{v1(1)\}$ vibrational mode quantum state and the $CO_2\{v3(1)\}$ vibrational mode quantum state are very nearly resonant when accounting for N_2 anharmonicity, centrifugal distortion and vibro-rotational interaction. Studies available upon request.)

Thus, common sense dictates that the thermal (kinetic) energy of the ~95.94 - 99.74% (depending upon humidity) of the atmosphere which cannot effectively radiatively emit (N_2 , O_2 , Ar) must be transferred to the so-called 'greenhouse gases' (CO_2 being a lesser contributor below the tropopause and the largest contributor above the tropopause; water vapor being the main contributor below the tropopause) which can radiatively emit and thus shed that energy to space.

So can anyone explain how increasing the concentration of the major radiative coolant gases (H_2O , CO_2) in the atmosphere (and thus increasing the likelihood that Ar, N_2 and O_2 will transfer their energy to those radiative coolant gases and then out to space via radiative emission) will result in more 'heat trapping', causing global warming? I thought not.

3) Water vapor isn't a 'global warming' gas... it acts as a literal **refrigerant** (in the strict '*refrigeration cycle*' sense) below the tropopause.

The refrigeration cycle (*Earth*) [*AC system*]:

A liquid evaporates at the heat source (*the surface*) [*in the evaporator*], **it is transported** (*convected*) [*via an AC compressor*], **it gives up its energy to the heat sink and undergoes phase change** (*emits radiation in the upper atmosphere, the majority of which is upwelling owing to the mean free path length / altitude / air density relation*) [*in the condenser*], **it is transported** (*falls as rain or snow*) [*via that AC compressor*], and **the cycle repeats**.

That's kind of why, after all, the humid adiabatic lapse rate (~ 3.5 to ~ 6.5 K km⁻¹) is lower than the dry adiabatic lapse rate (~ 9.81 K km⁻¹).

The *effective* emission height is ~ 5.105 km. That also happens to be where atmospheric pressure is $1/2$ that at sea level, which isn't a coincidence.

7 - 13 μm :	>13 - ≤ 17 μm :	>17 μm :
>280 K (near-surface)	~ 220 K (near the tropopause)	~ 260 - ~ 240 K (~ 5 km in the troposphere)

The emission profile is equivalent to a blackbody object with a temperature of 255 K, and thus an *effective* emission height of 5.105 km.

The lapse rate is said to average ~ 6.5 K km⁻¹. $6.5 \text{ K km}^{-1} * 5.105 \text{ km} = 33.1825 \text{ K}$. **That is not the 'greenhouse effect'**, it's the *tropospheric lapse rate due to Kelvin-Helmholtz gravitational auto-compression*. The climate alarmists have conflated the two.

Polyatomic molecules (CO₂, H₂O) reduce the adiabatic lapse rate (ALR), not increase it (dry ALR: ~ 9.81 K km⁻¹; humid ALR: ~ 3.5 to ~ 6.5 K km⁻¹) by dint of their higher molar heat capacity and/or latent heat capacity convectively transiting more energy (as compared to the monoatomics and homonuclear diatomics), thus attempting to reduce temperature differential with altitude, while at the same time radiatively cooling the upper atmosphere faster than they can convectively warm it... they increase thermodynamic coupling between heat source and sink... they are *coolants*.

$9.81 \text{ K km}^{-1} * 5.105 \text{ km} = 50.08005 \text{ K}$ (dry adiabatic lapse rate, due primarily to homonuclear diatomics and monoatomics), which would give a surface temperature of $255 + 50.08005 = 305.08005 \text{ K}$. Sans CO₂, that number would be even higher.

Water vapor (primarily) reduces that to 272.8675 K - 288.1825 K, depending upon humidity. Other polyatomics (CO₂) contribute to cooling, to a lesser extent. The higher the concentration of polyatomics, the more vertical the lapse rate, the cooler the surface.

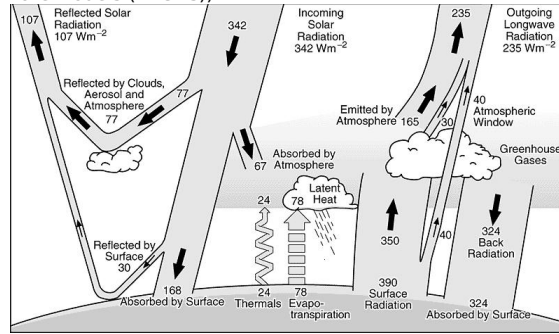
Also remember: the atmosphere is stable as long as actual lapse rate is less than ALR... and a greater concentration of polyatomic molecules reduces ALR... thus convection increases.

That's why neither CO₂ nor H₂O are used as a filler gas in dual-pane windows... if they were such terrific '*heat trapping*' gases, they'd be used as such. They're not. Low DOF (Degrees of Freedom), low specific heat capacity monoatomics generally are.

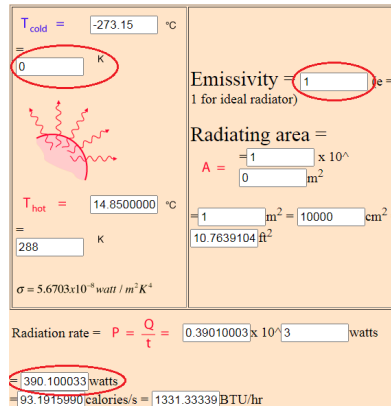
So one could say that in regards to water, we live **inside** the equivalent of the evaporator of a gigantic world-sized A/C unit, with water as the refrigerant, with other polyatomics acting as less efficient coolants, and with the monoatomics and homonuclear diatomics playing the same role as noncondensable gases would play in an A/C system... a reduction in the efficiency at which energy is transported due to low molar heat capacity of those monoatomics or homonuclear diatomics and their inability to effectively radiatively emit.

4) Empirical examples:

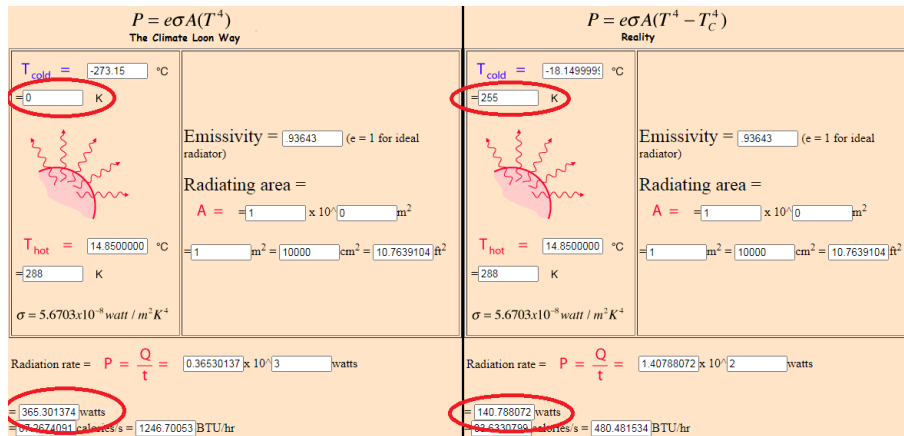
In fact, the Kiehl-Trenberth diagram and all subsequent similar diagrams (which are a graphical representation of the results of the mathematics used in Energy Balance Climate Models (EBCMs))...



... does exactly as I stated... it treats a real-world (graybody) surface as if it were an idealized blackbody object, with emission to 0 K ambient and $\epsilon = 1$. That's the only way that diagram can get to 390 W m⁻² surface radiant exitance:



That's proof-positive that they've misused the S-B equation to fit their narrative. Had they used the actual emissivity (0.93643, per the NASA ISCCP program), they couldn't have arrived at 390 W m⁻² (see below, left), and had they used the proper form of the S-B equation for graybody objects, they'd not have even gotten close to 390 W m⁻² (see below, right).



Subsequent 'Earth Energy Balance' graphics (remember that those graphics represent the results of the mathematics used in their Energy Balance Climate Models) bump that number up to 398 W m⁻², **which isn't even physically possible** at their claimed 288 K, even when treating the graybody surface as though it were an idealized blackbody with emission to 0 K and $\epsilon = 1$ in order to artificially inflate radiant exitance. In order to keep their alarmist narrative at a fever pitch, they're forced to bump those numbers up, and thus they've now verged into **physical impossibilities**.

This seems to make more sense:

It is no coincidence that atmospheric temperature at 5.105 km (the calculated altitude that most closely matches the blackbody radiation curve of Earth) is **~255 K**, and we know that ~76.2 % of all surface energy is removed via convection and evaporation ([see chart in Section 2 above](#)), leaving only ~23.8 % for surface radiant exitance.

We assume 1000 W m⁻² surface solar insolation for a cloudless day with the sun directly overhead, but knowing the above allows us to roughly calculate the true average surface solar insolation, which is affected by the sphericity of our planet (the sun is not directly overhead at all places on the planet's surface at once), cloud cover, dust, etc.

Going off that $140.788072 \text{ W m}^{-2}$ radiation rate from the graphic above, $140.788072 \text{ W m}^{-2} / 0.238 = 591.54652100840 \text{ W m}^{-2}$ average surface solar insolation, accounting for all effects (planetary sphericity, cloud cover, dust, etc.), or $591.5465210084 \text{ W m}^{-2} / 1000 \text{ W m}^{-2} = 59.15465210084 \%$ of total solar insolation reaching the sun-facing surface.

<https://data.giss.nasa.gov/modelE/ar5plots/srlocat.html>

"On a global annual basis, about 57% of insolation is incident on the Earth's surface."

For a rough calculation, a difference of only 2.15465210084 % is pretty close, given that the error bars on NASA's own calculations are at least $\pm 2 \%$ due to the error bars on albedo (see below).

That leaves $591.5465210084 \text{ W m}^{-2} - 140.788072 \text{ W m}^{-2} = 450.757928 \text{ W m}^{-2}$ to do work upon the planet's surface to warm it up. Assuming emission to that 255 K atmosphere and $\epsilon=0.93643$ (per NASA ISCCP program), that gives a maximum temperature of 335.81432868651865 K (144.79579164 F, 62.66432869 C). The official highest recorded temperature is 329.82 K (134 F, 56.7 C), taken at Furnace Creek, Death Valley on July 10, 1913; and an unofficial measurement of 331.15 K (136.4 F, 58 C) taken in 1923 at Al Azizia, Libya exists; as well as a 328.15 K (131 F, 55 C) reading at Kebili, Tunisia recorded July 7, 1931. Obviously this could only happen in an extremely low-humidity locale, and I'd surmise it would also likely require a high-pressure dome which hinders convective surface cooling.

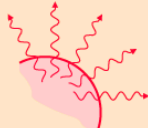
Thus Earth's albedo must be approximately $591.5465210084 \text{ W m}^{-2} / 1000 \text{ W m}^{-2} / 2$ (to account for surface radiant exitance from the dark side of the planet) = 0.2957732605042, or 29.57732605042 %.

<https://www.sciencedirect.com/book/9780128215753/climate-change> (2021)

"Satellite observations made continuously during the past 20 years indicate that albedo is relatively constant at $29 \pm 2\%$ [9,10]. These measurements are close to previous estimates of 30% [11] and 31% [12]."

Now, you'll remember above the graphic showing that $\sim 76.2 \%$ of all surface energy is removed via evaporation, convection and advection... $450.757928 \text{ W m}^{-2} / 591.5465210084 \text{ W m}^{-2} = 76.19991192435 \%$

And all in accord with the Stefan-Boltzmann equation for graybody objects, with no need to invoke fictional 'backradiation' (which is literally a manifestation of the misuse of the S-B equation) nor to invent new formulae (such as the IPCC AR6 'forcing formula'):

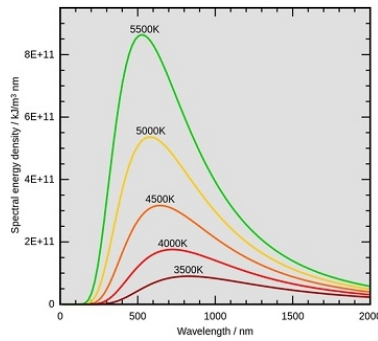
$T_{\text{cold}} = -18.14999999 \text{ }^{\circ}\text{C}$
 $= 255 \text{ K}$

 $T_{\text{hot}} = 14.849999870 \text{ }^{\circ}\text{C}$
 $= 287.99999987 \text{ K}$
 $\sigma = 5.6703 \times 10^{-8} \text{ watt / m}^2 \text{ K}^4$
 Emissivity = 0.93643 (e = 1 for ideal radiator)
 Radiating area =
 $A = 1 \times 10^0 \text{ m}^2$
 $= 1 \text{ m}^2 = 10000 \text{ cm}^2 = 10.763910416 \text{ ft}^2$
 Radiation rate = $P = \frac{Q}{t} = 1.40788072 \times 10^2 \text{ watts}$
 $= 140.788072 \text{ watts}$
 $= 33.633079789 \text{ calories/s} = 480.48153212 \text{ BTU/hr}$

Of course, to truly do this justice, we'd have to calculate the energy density at all wavelength bands, then calculate the surface radiant exitance at all wavelength bands, then calculate the surface solar insolation at all wavelength bands, then aggregate all of those calculations into surface temperature vs. angle of solar insolation... but the above comes eerily close to empirical measurement already.

Their use of the wrong form of the S-B formula increases radiant exitance of graybody objects far above what it actually is, which necessitates that they carry those incorrect values through their calculation and subtract a fictional 'cooler to warmer' energy flow from the real (but calculated for emission to 0 K and thus too high) 'warmer to cooler' energy flow.

Thus, the climate alarmists come to believe that energy actually can flow 'cooler to warmer'. This violates 2LoT in the Clausius Statement sense... energy cannot radiatively flow from lower radiation energy density to higher radiation energy density without external energy doing work upon the system to push that system energy against the radiation energy density gradient.

Do remember that a warmer object will have higher radiation energy density at all wavelengths than a cooler object because temperature is a measure of radiation energy density (equal to the fourth root of radiation energy density divided by Stefan's Constant).



The equation for the radiation energy density is Stefan's Law and 'a' is Stefan's constant.

$$e = aT^4$$

$$\therefore T = \sqrt[4]{(e/a)}$$

In other words, **temperature is equal to the fourth root of radiation energy density divided by Stefan's constant** per Stefan's Law. It is a measure of radiation **energy density**.

Keep in mind that Stefan's constant above equals $4\sigma/c$ (which is sometimes known as the radiation constant).

Which is why: $U = T^4 4\sigma/c$

The above formula is the Stefan-Boltzmann relation between radiation energy density and temperature.

If $\Delta U = 0$, then $(\Delta U * c/4\sigma) = 0$, thus no energy can flow. U has the same physical units as pressure ($J m^{-3}$) and $U \propto T$. That is **radiation pressure**, which sets up the radiation energy density gradient via the EM field between objects.

This agrees with Planck's Law: $\rho(T) = aT^4 = T^4 4\sigma/c$. The S-B equation integrates Planck's Radiation Formula (which calculates the radiation energy density for a given wavelength) over all wavelengths.

$$F = U - TS + PV$$

Where: F = Free Energy; U = internal energy; T = absolute temp; S = final entropy; TS = energy the object can receive from the environment; PV = work done to give the system final volume V at pressure P

If $U > TS + PV$, $F > 0$... energy *must* flow from object to environment.

If $U = TS + PV$, $F = 0$... no energy *can* flow to or from the object.

If $U < TS + PV$, $F < 0$... energy *must* flow from environment to object.

Free energy is defined as the capacity to do work. Work is defined as the application of a force over a distance. This is why, for instance, photons are considered the force-carrying gauge bosons of the EM field, and virtual photons the force-carrying gauge bosons which mediate magnetic fields.

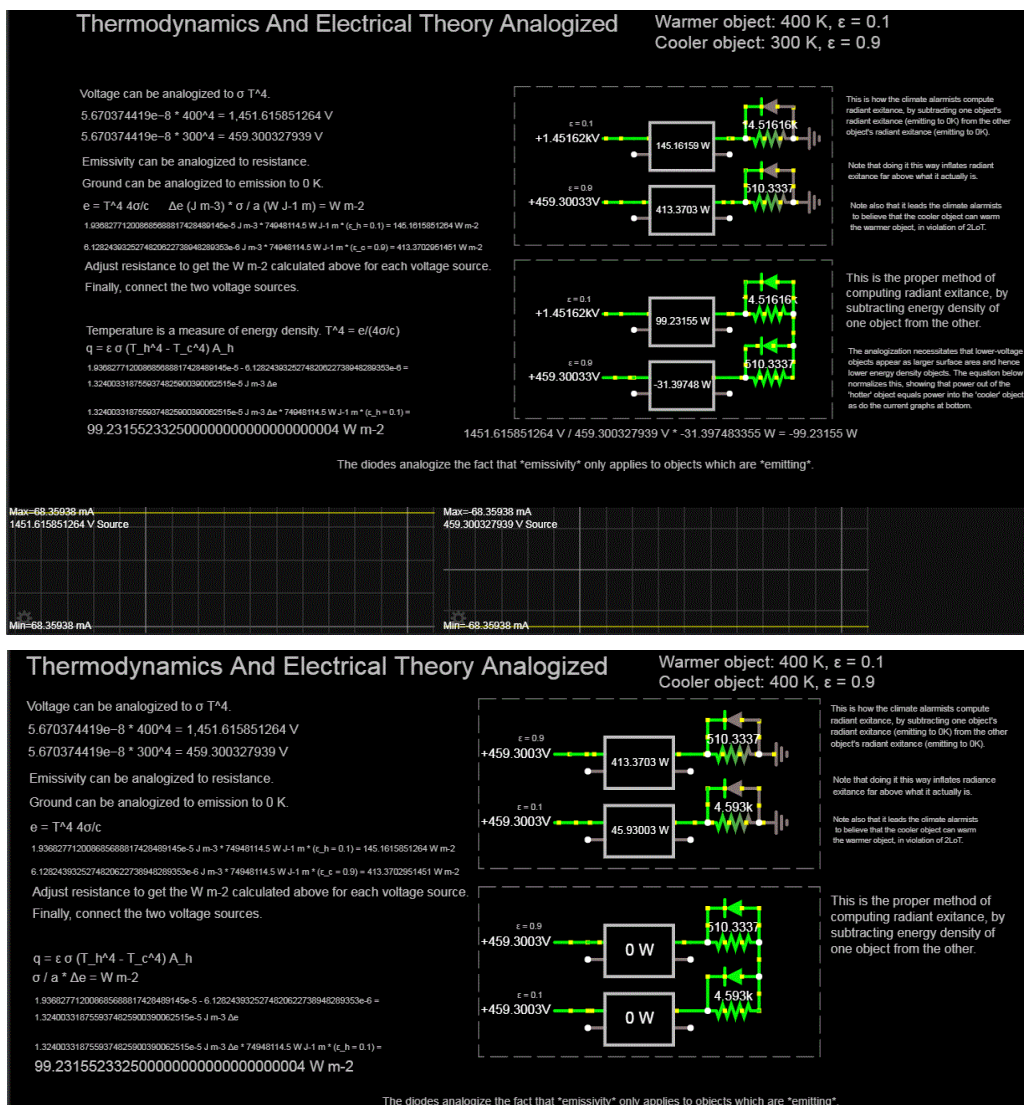
If $U = TS + PV$, $p_{\text{photon}} = \frac{U}{3} = p_{\text{object}}$... energy cannot flow because no work can be done. Free Energy is **zero**. Photon chemical potential is **zero**. The work done is $W = -p$ for a constant volume, where $p = \frac{U}{3}$, the radiation pressure.

So in the real world, the radiation energy density gradient determines radiant exitance, energy does not radiatively flow willy-nilly without regard to radiation energy density gradient and [2LoT applies always and everywhere](#).

5) Analogization of Thermodynamics to Electrical Theory

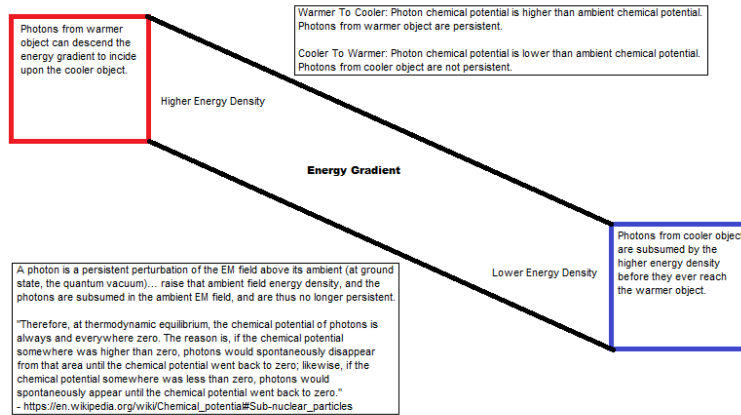
One can use electrical theory to arrive at the same conclusions...

[1] Images of circuit simulator:



[2] Circuit simulator: <https://tinyurl.com/yzo8hak9>

The bottom circuit in the circuit simulator is how reality works... objects interact via the EM field. That interaction through radiation pressure determines radiant exitance of each object. So while the climate alarmists claim that there's no way a photon could possibly 'know' the temperature of an object within the photon's path, it absolutely does 'know' because that photon must pass through the EM field (the photon being nothing but a quantum of EM energy; per QFT, a persistent perturbation of the EM field above the average field energy density) between objects, and thus the radiation energy density gradient between objects... and if the EM field energy density gradient is such that the chemical potential of the EM field due to that radiation energy density gradient becomes higher than the chemical potential of the photon from a cooler object, that photon likely won't even be emitted by the cooler object, and if a photon which is emitted by a cooler object happens to be in the path of a moving, warmer object, it won't even reach the warmer object... it will be subsumed into the background EM field (there is no law of conservation for photon number).



You'll note that the top two circuits in the circuit simulator are how the climate alarmists calculate radiant exitance... (ie: they put each object into its own separate system that doesn't interact with other objects via the EM field, and they essentially claim all objects emit to 0 K, equivalent in electrical terms to discharging to ground... sometimes with a resistance (the analogy of emissivity) but often not). That's not how reality works, and their doing so leads them to conclude that a lower-temperature but higher-emissivity object can radiatively warm a higher-temperature but lower-emissivity object... in fact, their conclusions lead one to believe that wrapping an ice cube in aluminum foil (with the foil at 600 K!) will radiatively warm the foil and cool the ice, which is ludicrous.

Ice has an emissivity of 0.96 - 0.99. We'll use 0.96, with the ice temperature at 273.15 K. Aluminum foil has an emissivity of 0.04. We'll put the temperature of the aluminum foil at 600 K.

Now, we'll do the calculations **as the climate alarmists do them**, using their assumption that the objects are emitting to 0 K. That treats the objects as though they're idealized blackbody objects (ie: emission to 0 K), just with $\epsilon < 1$. Remember, the climate alarmists claim **all** objects > 0 K emit, and that radiant exitance is not affected by ambient radiation energy density.

Aluminum foil: $q = \epsilon \sigma T_h^4 = 0.04 * 5.670374419e^{-8} \text{ W m}^{-2} \text{ K}^{-4} * 129,600,000,000 \text{ K}^4 = 293.95220988096 \text{ W m}^{-2}$
 Ice: $q' = \epsilon \sigma T_c^4 = 0.96 * 5.670374419e^{-8} \text{ W m}^{-2} \text{ K}^{-4} * 5,566,789,756.30100625 \text{ K}^4 = 303.03150940877251107800754 \text{ W m}^{-2}$

$q - q' = -9.07929952781251107800754 \text{ W m}^{-2}$

Yes, folks, the climate alarmist method, faithfully applied, leads one to the conclusion that ice at 273.15 K (32 F, 0 C) can radiatively warm aluminum foil at 600 K (620.33 F, 326.85 C). In effect, they claim that if you wrap an ice cube in aluminum foil, it'll warm the aluminum foil as the ice cube radiatively cools to 0 K (because remember, they claim all objects > 0 K emit radiation).

Now, let's do it correctly:

$\sigma = (2 \pi^5 k_B^4) / (15 h^3 c^2) = 5.67037441918442945397099673188923087584012297029130e^{-8} \text{ W m}^{-2} \text{ K}^{-4}$

Where:

σ = Stefan-Boltzmann Constant

k_B = Boltzmann Constant ($1.380649e^{-23} \text{ J K}^{-1}$)

h = Planck Constant ($6.62607015e^{-34} \text{ J Hz}^{-1}$)

c = light speed ($299792458 \text{ m sec}^{-1}$)

$\sigma / a = 74948114.502437694376419756266673 \text{ W J}^{-1} \text{ m} (\text{W m}^{-2} / \text{J m}^{-3})$

$a = 4\sigma/c = 7.5657332500339284719430800357226e^{-16} \text{ J m}^{-3} \text{ K}^{-4}$

$T = \sqrt[4]{e/(4\sigma/c)} \quad e = T^4 4\sigma/c \quad e = T^4 a$

$T_h = 600 \text{ K} \quad \epsilon_h = 0.04 \quad e_h = 9.8051902920439712996382317262965e^{-5} \text{ J m}^{-3}$

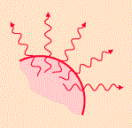
$T_c = 273.15 \text{ K} \quad \epsilon_c = 0.96 \quad e_c = 4.2116846355194792664142496540057e^{-6} \text{ J m}^{-3}$

$\Delta e = e_h - e_c = 9.3840218284920233729968067608959e^{-5} \text{ J m}^{-3}$

$\sigma / a * \Delta e * \epsilon_h = \text{W m}^{-2}$

$74948114.502437694376419756266673 \text{ W J}^{-1} \text{ m} * 9.3840218284920233729968067608959e^{-5} \text{ J m}^{-3} * (\epsilon_h = 0.04) =$

281.32589699807796293422245006253 W m⁻²

$T_{\text{cold}} = $ <input type="text" value="0"/> °C $= 273.15$ K		Emissivity = <input type="text" value="0.04"/> (e = 1 for ideal radiator)
$T_{\text{hot}} = $ <input type="text" value="326.85"/> °C $= 600$ K		Radiating area = $A = $ <input type="text" value="1"/> $\times 10^{$ <input type="text" value="0"/> m^2 $= $ <input type="text" value="1"/> $m^2 = $ <input type="text" value="10000"/> $cm^2 = $ <input type="text" value="10.7639104"/> ft^2
$\sigma = 5.6703 \times 10^{-8} \text{ watt / m}^2 \text{ K}^4$		
Radiation rate = $P = \frac{Q}{t} = $ <input type="text" value="2.81322204"/> $\times 10^{$ <input type="text" value="2"/> $ \text{watts}$		
$= $ <input type="text" value="281.322204"/> kwatts $= $ <input type="text" value="61.2864655"/> $\text{calories/s} = $ <input type="text" value="960.096420"/> BTU/hr		

The 0.00369218013936293422245006252754 W m⁻² differential is due to rounding on the [Hyperphysics webpage](#).

In fact: (281.3222048179386 / 5.6703e⁻⁸ * 5.67037441918442945397099673188923087584012297029130e⁻⁸) - 281.32589699807796293422245006253 = 0.000000000000038296252608059909436235031870212 W m⁻²

That's a precision of 3.8 parts per 100 **trillion** between my calculation and the S-B equation, just by accounting for the rounding of σ on the Hyperphysics page. And the remaining differential is *still* due to rounding (of the final result) on the Hyperphysics page.

So as one can see, if one properly uses the S-B equation and the underlying fundamental physical laws, Catastrophic Anthropogenic Global Warming is shown to be so fallacious as to be laughable.

6): Mass Heat Capacity vs. Molar Heat Capacity and Their Associated Lapse Rate Calculations

You will note that for this exercise, I had to derive the molar heat capacity form of the lapse rate equation. I've never seen it online.

The lapse rate calculation, in either its mass heat capacity or its molar heat capacity form, is fundamentally flawed. It treats all atoms and molecules the same, as though monoatomics and homonuclear diatomics can radiatively emit to space just as the polyatomic (radiative) molecules can. Both forms of the lapse rate equation assume that once energy is removed from the surface, it is ejected from the system known as 'Earth'. That is not always the case, as monoatomics and homonuclear diatomics are not radiative atoms and molecules.

The worst of the two lapse rate calculations is the mass heat capacity form. The mass heat capacity calculation gives a decrease in calculated heat capacity with an increasing CO₂ concentration. The mass heat capacity form of the lapse rate calculation over-weights mass and under-weights DOF (and completely discounts whether or not a molecule can radiatively emit and thus shed energy to space), thus giving a larger increase in lapse rate (and thus a larger surface warming) for an increasing CO₂ concentration.

Thus the climastrologists use the mass heat capacity calculations to show that an increasing atmospheric CO₂ concentration decreases bulk atmosphere heat capacity. Then they claim that a parcel of air with a reduced heat capacity will convectively transit less energy from surface to upper atmosphere, thus the temperature differential with altitude will be greater, thus the lapse rate will increase, thus the surface will warm. Using mass heat capacity for their lapse rate calculations is the bedrock of the claim that CO₂ is a 'heat trapping, global warming' gas.

They could also make the claim using the molar heat capacity form of the lapse rate equation, but just barely. At least the molar heat capacity calculation shows an increase of atmospheric molar heat capacity with an increasing CO₂ concentration, but it still shows a very slightly increasing lapse rate with increasing CO₂ concentration because it doesn't take into account the fact that an increasing CO₂ concentration (which would primarily displace the higher-concentration N₂, O₂ and Ar) is primarily displacing nonradiative homonuclear diatomics and monoatomics with a radiative polyatomic. Neither form of the lapse rate equation accounts for this.

We can do the calculation to determine the mass heat capacity of air to demonstrate this point:

$$C_{p\text{mixture}} = (m_1 / m_{\text{mixture}}) C_{p1} + (m_2 / m_{\text{mixture}}) C_{p2} + (m_3 / m_{\text{mixture}}) C_{p3}, \text{ etc., etc.}$$

NOTE: The N₂ concentration below has been adjusted downward to arrive at a 100% total. Currently-used concentrations exceed 100%.

Symbol:	Molar Mass:	Molar Heat Capacity:	Mass Heat Capacity:	Percent of Atmosphere:
N ₂	28.0134 g mol ⁻¹	29.12 J mol ⁻¹ K ⁻¹	1.0395025 J g ⁻¹ K ⁻¹	78.0784748%
O ₂	31.9988 g mol ⁻¹	29.38 J mol ⁻¹ K ⁻¹	0.9181594 J g ⁻¹ K ⁻¹	20.9435%
Ar	39.948 g mol ⁻¹	20.7862 J mol ⁻¹ K ⁻¹	0.5203314 J g ⁻¹ K ⁻¹	0.9332%
CO ₂	44.0095 g mol ⁻¹	36.94 J mol ⁻¹ K ⁻¹	0.8393642 J g ⁻¹ K ⁻¹	0.042%
Ne	20.1797 g mol ⁻¹	20.7862 J mol ⁻¹ K ⁻¹	1.0300549 J g ⁻¹ K ⁻¹	0.001818%
He	4.002602 g mol ⁻¹	20.7862 J mol ⁻¹ K ⁻¹	5.1931718 J g ⁻¹ K ⁻¹	0.000524%
CH ₄	16.04246 g mol ⁻¹	35.69 J mol ⁻¹ K ⁻¹	2.2247211 J g ⁻¹ K ⁻¹	0.00015%
Kr	83.798 g mol ⁻¹	20.95 J mol ⁻¹ K ⁻¹	0.2500059 J g ⁻¹ K ⁻¹	0.000114%
SO ₂	64.0638 g mol ⁻¹	39.87 J mol ⁻¹ K ⁻¹	0.66379416 J g ⁻¹ K ⁻¹	0.0001%
H ₂	2.01588 g mol ⁻¹	28.82 J mol ⁻¹ K ⁻¹	14.2964859 J g ⁻¹ K ⁻¹	0.000055%
N ₂ O	44.0128 g mol ⁻¹	38.6 J mol ⁻¹ K ⁻¹	0.87701759 J g ⁻¹ K ⁻¹	0.0000325%
CO	28.0101 g mol ⁻¹	29.1 J mol ⁻¹ K ⁻¹	1.03891096 J g ⁻¹ K ⁻¹	0.00001%
O ₃	47.9982 g mol ⁻¹	39.22 J mol ⁻¹ K ⁻¹	0.81711397 J g ⁻¹ K ⁻¹	0.00001%
Xe	131.293 g mol ⁻¹	21.01 J mol ⁻¹ K ⁻¹	0.16002376 J g ⁻¹ K ⁻¹	0.0000087%
NO ₂	46.0055 g mol ⁻¹	37.2 J mol ⁻¹ K ⁻¹	0.80859897 J g ⁻¹ K ⁻¹	0.000002%
I ₂	253.80894 g mol ⁻¹	54.43 J mol ⁻¹ K ⁻¹	0.21445265 J g ⁻¹ K ⁻¹	0.000001%

Now, we construct a 1 mol atmosphere comprised of the above consisting of 6.02214076e²³ particles mol⁻¹.

We calculate the mass of each constituent of that 1 mol atmosphere:

N ₂	28.0134 g mol ⁻¹	*	0.780784748 mol	=	21.8724354596232 g
O ₂	31.9988 g mol ⁻¹	*	0.209435 mol	=	6.701668678 g
Ar	39.948 g mol ⁻¹	*	0.009332 mol	=	0.372794736 g
CO ₂	44.0095 g mol ⁻¹	*	0.00042 mol	=	0.01848399 g
Ne	20.1797 g mol ⁻¹	*	0.00001818 mol	=	0.000366866946 g
He	4.002602 g mol ⁻¹	*	0.00000524 mol	=	0.00002097363448 g
CH ₄	16.04246 g mol ⁻¹	*	0.0000015 mol	=	0.00002406369 g
Kr	83.798 g mol ⁻¹	*	0.00000114 mol	=	0.00009552972 g
SO ₂	64.0638 g mol ⁻¹	*	0.000001 mol	=	0.0000640638 g
H ₂	2.01588 g mol ⁻¹	*	0.00000055 mol	=	0.000001108734 g
N ₂ O	44.0128 g mol ⁻¹	*	0.000000325 mol	=	0.00001430416 g
CO	28.0101 g mol ⁻¹	*	0.0000001 mol	=	0.00000280101 g
O ₃	47.9982 g mol ⁻¹	*	0.0000001 mol	=	0.00000479982 g
Xe	131.293 g mol ⁻¹	*	0.000000087 mol	=	0.000011422491 g
NO ₂	46.0055 g mol ⁻¹	*	0.00000002 mol	=	0.00000092011 g
I ₂	253.80894 g mol ⁻¹	*	0.00000001 mol	=	0.0000025380894 g

Now, we input all of that to the website below because doing the mass heat capacity calculation manually is an involved process:
<https://thermtest.com/thermal-resources/rule-of-mixtures>

That gives us **1.00462 J g⁻¹ K⁻¹**.

Now, we can double CO₂ atmospheric concentration:

$$\text{CO}_2 \quad 44.0095 \text{ g mol}^{-1} \quad * \quad 0.00084 \text{ mol} \quad = \quad 0.03696798 \text{ g}$$

To do so, we'll assume the largest constituent of the atmosphere had the largest percentage reduction in concentration due to displacement by the increased concentration of CO₂:

$$\text{N}_2 \quad 28.0134 \text{ g mol}^{-1} \quad * \quad 0.780364748 \text{ mol} \quad = \quad 21.8606698316232 \text{ g}$$

That gives us **1.0045 J g⁻¹ K⁻¹**.

$$1.0045 \text{ J g}^{-1} \text{ K}^{-1} < 1.00462 \text{ J g}^{-1} \text{ K}^{-1}$$

This is how the climatologists claim that an increasing atmospheric CO₂ concentration will cause CAGW, how they claim that CO₂ is a 'heat trapping, global warming' gas.

Now, let's do the calculation using molar heat capacity, for a volume containing 1 mol of atmosphere at atmospheric pressure... it's actually very simple. Whereas with mass heat capacity, one must use the relatively complicated equation:

$$C_{p\text{mixture}} = (m_1 / m_{\text{mixture}}) C_{p1} + (m_2 / m_{\text{mixture}}) C_{p2} + (m_3 / m_{\text{mixture}}) C_{p3}, \text{ etc., etc.}$$

... using molar heat capacity one only need use:

$$C_{p\text{mixture}} = (\text{Molar Heat Capacity}_1 * \text{percentage of composition}) + (\text{Molar Heat Capacity}_2 * \text{percentage of composition}), \text{ etc., etc.}$$

(29.12 J mol ⁻¹ K ⁻¹ * 0.780784748)	+
(29.38 J mol ⁻¹ K ⁻¹ * 0.209435)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.009332)	+
(36.94 J mol ⁻¹ K ⁻¹ * 0.00042)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.00001818)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.00000524)	+
(35.69 J mol ⁻¹ K ⁻¹ * 0.0000015)	+
(20.95 J mol ⁻¹ K ⁻¹ * 0.00000114)	+
(39.87 J mol ⁻¹ K ⁻¹ * 0.000001)	+
(28.82 J mol ⁻¹ K ⁻¹ * 0.00000055)	+
(38.6 J mol ⁻¹ K ⁻¹ * 0.000000325)	+
(29.1 J mol ⁻¹ K ⁻¹ * 0.0000001)	+
(39.22 J mol ⁻¹ K ⁻¹ * 0.0000001)	+
(21.01 J mol ⁻¹ K ⁻¹ * 0.000000087)	+
(37.2 J mol ⁻¹ K ⁻¹ * 0.00000002)	+
(54.43 J mol ⁻¹ K ⁻¹ * 0.00000001)	=
	29.099786225134 J mol⁻¹ K⁻¹

What's the calculated molar heat capacity of air? [29.19 J mol⁻¹ K⁻¹ for air at "typical room conditions"](#), [29.07 J mol⁻¹ K⁻¹ for dry air](#)

Now, let's double CO₂ concentration and decrease N₂ concentration by the same amount to account for CO₂ displacing N₂ (the most prevalent and thus most affected molecule in terms of concentration) within that 1 mol of air:

(29.12 J mol ⁻¹ K ⁻¹ * 0.780364748)	+
(29.38 J mol ⁻¹ K ⁻¹ * 0.209435)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.009332)	+
(36.94 J mol ⁻¹ K ⁻¹ * 0.00084)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.00001818)	+
(20.7862 J mol ⁻¹ K ⁻¹ * 0.00000524)	+
(35.69 J mol ⁻¹ K ⁻¹ * 0.0000015)	+
(20.95 J mol ⁻¹ K ⁻¹ * 0.00000114)	+
(39.87 J mol ⁻¹ K ⁻¹ * 0.000001)	+
(28.82 J mol ⁻¹ K ⁻¹ * 0.00000055)	+
(38.6 J mol ⁻¹ K ⁻¹ * 0.000000325)	+
(29.1 J mol ⁻¹ K ⁻¹ * 0.0000001)	+
(39.22 J mol ⁻¹ K ⁻¹ * 0.0000001)	+
(21.01 J mol ⁻¹ K ⁻¹ * 0.000000087)	+
(37.2 J mol ⁻¹ K ⁻¹ * 0.00000002)	+
(54.43 J mol ⁻¹ K ⁻¹ * 0.00000001)	=
	29.103070625134 J mol⁻¹ K⁻¹

$$29.103070625134 \text{ J mol}^{-1} \text{ K}^{-1} > 29.099786225134 \text{ J mol}^{-1} \text{ K}^{-1}$$

Increasing CO₂ atmospheric concentration increases molar heat capacity of the atmosphere, just as increasing H₂O atmospheric concentration increases molar heat capacity of the atmosphere.

The advantage of the molar heat capacity calculation is that one can then easily add in water vapor at any desired concentration:

H ₂ O		18.01528 g mol ⁻¹		75.327 J mol ⁻¹ K ⁻¹		4181.2838 J kg ⁻¹ K ⁻¹
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You'll note that water vapor significantly increases the molar heat capacity of the atmosphere, as common sense would dictate.

Hence water vapor drastically increases the ability of the atmosphere to convectively transit energy from surface to upper troposphere, thus that attempts to decrease temperature differential with altitude, reducing the lapse rate (humid adiabatic lapse rate: ~3.5 to ~6.5 K km⁻¹; dry adiabatic lapse rate: ~9.81 K km⁻¹)... while *at the same time* radiatively cooling the upper troposphere faster than it can convectively warm it.

In other words, water vapor is a net atmospheric coolant, a **refrigerant** in the strict "refrigeration cycle" sense.

The refrigeration cycle (Earth) [AC system]:

A liquid evaporates at the heat source (the surface) [in the evaporator], it is transported (convected) [via an AC compressor], it gives up its energy to the heat sink and undergoes phase change (emits radiation in the upper atmosphere, the majority of which is upwelling owing to the mean free path length / altitude / air density relation) [in the condenser], it is transported (falls as rain or snow) [via that AC compressor], and the cycle repeats.

That's kind of why, after all, the humid adiabatic lapse rate (~3.5 to ~6.5 K km⁻¹) is lower than the dry adiabatic lapse rate (~9.81 K km⁻¹). You'll note that the dry adiabatic lapse rate (which would imply a very warm surface) is due to the monoatomic atoms and homonuclear diatomic molecules, which are the true 'global warming' gases. They can pick up energy via conduction by contacting the surface just as the polyatomics can do; they can convect just as the polyatomics can do... but once in the upper atmosphere, they cannot as effectively radiate that energy to space. Thus in an atmosphere consisting solely of monoatomics and homonuclear diatomics, the upper atmosphere would

warm, which would reduce buoyancy of convecting air parcels, which would hinder convection... and that's how an actual greenhouse works, by hindering convection. And that hindered convection would cause the surface to warm.

In effect, we live **inside** the equivalent of the evaporator of a world-sized AC unit, with water acting as a literal refrigerant. Other polyatomics (radiative molecules) contribute to the cooling... the more DOF a molecular species has, the more that molecular species contributes to the surface cooling.

There is a reason the climatologists have chosen the mass heat capacity calculation, rather than the molar heat capacity calculation, for their lapse rate calculations, despite it being more complicated, and more difficult to add in water vapor. The mass heat capacity calculation is their bedrock... it shows bulk atmospheric heat capacity decreasing for an increasing CO₂ atmospheric concentration because it over-weights mass and under-weights DOF.

That is part and parcel of their claim that CO₂ is a 'heat trapping, global warming' gas. Do away with that and force them to use the proper molar heat capacity calculation, and they're forced to admit that an increasing CO₂ atmospheric concentration increases bulk atmosphere molar heat capacity.

And with that admission of higher bulk atmosphere molar heat capacity comes the admission that each parcel of higher CO₂ concentration air will convectively transit more energy than a lower CO₂ concentration parcel of air, which reduces the lapse rate (just as water vapor reduces the lapse rate due to its relatively higher specific heat capacity and latent heat capacity).

And with that comes the admission that more energy transited from surface to upper atmosphere, along with the increased number of radiative molecules allows the upper atmosphere to be radiatively cooled faster than it can be convectively warmed by that increased CO₂ atmospheric concentration.

And with that comes the admission that CO₂, like all radiative molecules in our atmosphere, are coolants... the contribution to the cooling predicated upon the DOF of each molecular species.

And with that comes the destruction of CAGW in its entirety. If the lapse rate took all of these factors into account, we'd be able to show this. A new lapse rate equation is being developed.

We can ascertain that we've successfully approximated the dry atmosphere:

N ₂	28.0134 g mol ⁻¹	*	0.780784748 mol	=	21.8724354596232 g	+
O ₂	31.9988 g mol ⁻¹	*	0.209435 mol	=	6.701668678 g	+
Ar	39.948 g mol ⁻¹	*	0.009332 mol	=	0.372794736 g	+
CO ₂	44.0095 g mol ⁻¹	*	0.00042 mol	=	0.01848399 g	+
Ne	20.1797 g mol ⁻¹	*	0.00001818 mol	=	0.000366866946 g	+
He	4.002602 g mol ⁻¹	*	0.00000524 mol	=	0.00002097363448 g	+
CH ₄	16.04246 g mol ⁻¹	*	0.0000015 mol	=	0.00002406369 g	+
Kr	83.798 g mol ⁻¹	*	0.00000114 mol	=	0.00009552972 g	+
SO ₂	64.0638 g mol ⁻¹	*	0.000001 mol	=	0.0000640638 g	+
H ₂	2.01588 g mol ⁻¹	*	0.00000055 mol	=	0.000001108734 g	+
N ₂ O	44.0128 g mol ⁻¹	*	0.000000325 mol	=	0.00001430416 g	+
CO	28.0101 g mol ⁻¹	*	0.0000001 mol	=	0.00000280101 g	+
O ₃	47.9982 g mol ⁻¹	*	0.0000001 mol	=	0.00000479982 g	+
Xe	131.293 g mol ⁻¹	*	0.000000087 mol	=	0.000011422491 g	+
NO ₂	46.0055 g mol ⁻¹	*	0.00000002 mol	=	0.00000092011 g	+
I ₂	253.80894 g mol ⁻¹	*	0.00000001 mol	=	0.0000025380894 g	
					M _{gas} = 28.96599225582808 g mol ⁻¹	

The stated molar mass of dry air is 28.9647 g mol⁻¹. We have successfully approximated the dry atmosphere.

The Universal Gas Constant R = Boltzmann Constant (1.380649e⁻²³ J K⁻¹) * Avogadro Constant (6.02214076e²³ mol⁻¹)

The Specific Gas Constant is the Universal Gas Constant (R) divided by the molar mass (M) of the given gas or gas mixture:
 $R_{\text{gas}} = R / M = 8.31446261815324 \text{ J mol}^{-1} \text{ K}^{-1} / 28.96599225582808 \text{ g mol}^{-1} = 287.04221642814031338006327065823 \text{ J kg}^{-1} \text{ K}^{-1}$

The stated gas constant for dry air is 287 J kg⁻¹ K⁻¹. We have successfully approximated the dry atmosphere.

Now, we can use the mass heat capacity and molar heat capacity to calculate the lapse rate:

The **mass heat capacity** form of the lapse rate for current CO₂ concentration dry atmosphere:

$$\Gamma = g / c = 9.80665 \text{ m s}^{-2} / 1004.62 \text{ J kg}^{-1} \text{ K}^{-1} = 9.7615516314626425912285242181123 \text{ K km}^{-1}$$

The **mass heat capacity** form of the lapse rate for a doubled CO₂ concentration dry atmosphere:

$$\Gamma = g / c = 9.80665 \text{ m s}^{-2} / 1004.5 \text{ J kg}^{-1} \text{ K}^{-1} = 9.7627177700348432055749128919861 \text{ K km}^{-1}$$

Obviously the mass heat capacity form of the lapse rate equation is fundamentally flawed. First, the mass heat capacity calculation shows a decreasing atmospheric heat capacity with increasing CO₂ concentration, and the mass heat capacity form of the lapse rate equation shows an increased lapse rate, implying surface warming with increasing CO₂ concentration.

Idealized dry gas **molar heat capacity** lapse rate:

If we take $\gamma = 1.404$, $g = 9.80665 \text{ m s}^{-2}$, $R = 8.31446261815324 \text{ J mol}^{-1} \text{ K}^{-1}$ and $M = 28.9647 \text{ g mol}^{-1}$, then:

$$dT / dh = -0.4 / 1.404 * (((0.0289647 \text{ kg mol}^{-1}) * 9.80665 \text{ m s}^{-2}) / 8.31446261815324 \text{ J mol}^{-1} \text{ K}^{-1}) = -9.7330377706482238008458858152373 \text{ K km}^{-1}$$

The stated molar isobaric heat capacity for dry air is $C_p = 7/2 R$: $7 / 2 * 8.31446261815324 \text{ J mol}^{-1} \text{ K}^{-1} = 29.10061916353634 \text{ J mol}^{-1} \text{ K}^{-1}$

Therefore we can use the equation above for the molar heat capacity at current and doubled CO₂ concentration, based upon our modeled dry atmosphere:

The **molar heat capacity** form of the lapse rate for current CO₂ concentration dry atmosphere:

$$29.099786225134 \text{ J mol}^{-1} \text{ K}^{-1} / 7 * 2 = 8.3142246357525714285714286 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$dT / dh = -0.4/1.404 * (((0.02896599225582808 \text{ kg mol}^{-1}) * 9.80665 \text{ m s}^{-2}) / 8.3142246357525714285714286 \text{ J mol}^{-1} \text{ K}^{-1}) = -9.7337506149566456238977917233163 \text{ K km}^{-1}$$

The **molar heat capacity** form of the lapse rate for doubled CO₂ concentration dry atmosphere:
 $29.103070625134 \text{ J mol}^{-1} \text{ K}^{-1} / 7 * 2 = 8.3151630357525714285714286 \text{ J mol}^{-1} \text{ K}^{-1}$

$$dT / dh = -0.4/1.404 * (((0.02897271061782808 \text{ kg mol}^{-1}) * 9.80665 \text{ m s}^{-2}) / 8.3151630357525714285714286 \text{ J mol}^{-1} \text{ K}^{-1}) = -9.7349095094643238672155364814496 \text{ K km}^{-1}$$

Now, obviously, the lapse rate equation (in either of its forms) is flawed. We can ascertain this by performing the lapse rate calculation for the polyatomic H₂O (a radiative molecule and literal refrigerant in the troposphere) vs. the homonuclear diatomic H₂ (a nonradiative molecule and one of the true 'global warming' gases):

100% H₂O atmosphere (isentropic ratio for 20 C):

$$dT / dh = -0.4/1.330 * (((0.01801528 \text{ kg mol}^{-1}) * 9.80665 \text{ m s}^{-2}) / 21.522 \text{ J mol}^{-1} \text{ K}^{-1}) = -2.4688085646511036442514147090615 \text{ K km}^{-1}$$

100% H₂ atmosphere (isentropic ratio for 20 C):

$$dT / dh = -0.4/1.410 * (((0.00201588 \text{ kg mol}^{-1}) * 9.80665 \text{ m s}^{-2}) / 7.0956604559795225906303946663492 \text{ J mol}^{-1} \text{ K}^{-1}) = -0.56054991677662967137690736391597 \text{ K km}^{-1}$$

That implies that H₂ would reduce the lapse rate even more than water vapor would, and thus dramatically cool the surface. But homonuclear diatomics cannot emit (nor absorb) radiation unless their net-zero electric dipole is perturbed via collision. They can pick up energy via conduction by contacting the surface, just as the polyatomics can; they can convect just as the polyatomics can; but once in the upper atmosphere, they cannot as effectively radiatively emit that energy to space. So while H₂ is used as a coolant (for example, in electrical generators), its ability to more effectively transit energy in such a case is due to conduction (and its use is also due to the fact that it does not affect the materials of the generator), whereas in the atmosphere it would have to radiatively emit that energy to space, which it is incapable of doing.

By the same token, monoatomics have no vibrational mode quantum states, and thus cannot emit nor absorb IR radiation. Thus, while they can obtain energy via conduction by contacting the surface just as the polyatomics can; and they can convect just as the polyatomics can; once in the upper atmosphere, they cannot effectively radiatively emit that energy to space.

And that's the only way our planet can cool... radiative emission to space. Thus in an atmosphere consisting of only monoatomics and homonuclear diatomics, the upper atmosphere would warm, lending less buoyancy to convecting parcels of air, thus hindering convection, thus hindering convective cooling of the planet's surface, thus warming the surface. And that is how an actual greenhouse works... by hindering convection.

Do remember that convection and evaporation currently removes ~76.2% of all surface energy. If the atmosphere cannot as effectively convect and advect that surface energy away because convection is inhibited, that means surface radiant exitance must increase to remove that energy... and a higher surface radiant exitance implies a higher surface temperature.

Another problem is that it is assumed that the lapse rate is 'anchored' at the planet's surface, that for a changing atmospheric composition we calculate the change in surface temperature as compared to the surface temperature under current conditions. That is not the case, the lapse rate is 'anchored' at TOA (Top Of Atmosphere, that altitude at which air density is reduced sufficiently such that the air is no longer opaque to any given wavelength of radiation... it's different for different wavelengths, the 'Effective TOA' being the mean of all TOAs at all wavelengths). So any change in the lapse rate due to a changed atmospheric composition must also calculate the new Effective TOA altitude, the new TOA temperature, **then** calculate the surface temperature due to that Kelvin-Helmholtz gravitational auto-compression temperature gradient.

And still another problem is that the Effective TOA is only a mean average of the TOAs at all wavelengths... it would be more accurate to calculate the contribution of each wavelength and the flux at that wavelength to the lapse rate gradient starting at each wavelength's TOA altitude individually.

Obviously we need a new lapse rate calculation which takes into account a molecule's ability (or inability) to radiatively emit. The current lapse rate calculations (in either the mass heat capacity or the molar heat capacity form) are not suited to purpose. A new lapse rate calculation is being developed.

7): Atmospheric Temperature Correlated to Solar Insolation, Gravitational Acceleration and Number of Electrons per Mole of Atmosphere

One can show that atmospheric temperature is a function of the number of moles of electrons in a mole of atmosphere, the solar insolation received and the gravitational acceleration of a planet. This has been extended to other planets, arriving at the exact temperatures of those planets at an altitude such that atmospheric pressure corresponds to one Earth atmosphere (101325 Pa), for planets with atmospheres dense enough that Kelvin-Helmholtz gravitational auto-compression takes place. All one need do is account for the atmospheric composition and gravitational acceleration of that planet.

Millikan and Fletcher devised an ingenious method to measure the elementary charge of the electron by calculating the amount of electrostatic force required to suspend a tiny oil droplet against the force of gravity. Hence, the Millikan and Fletcher oil drop experiment has gravity on Earth baked-in because the experiment was done on Earth.

The energy necessary to lift one mol of electrons by a potential of 1 volt is the Faraday Constant (which we now know cannot be a constant throughout the universe because its very definition is predicated upon elementary charge, which bakes-in Earth's gravitational acceleration).

Expressed in units of Ah mol⁻¹, on Earth that is 26.801481145363894 Ah mol⁻¹.

Expressed in units of J mol⁻¹, on Earth that is 96485.3321233100184 J mol⁻¹.

Expressed in units of J electron⁻¹, on Earth that is 1.602176634e⁻¹⁹ J electron⁻¹.

On Venus, it would be (1.602176634e⁻¹⁹ J electron⁻¹ / (8.858 m sec⁻² * (6051.8 km / 6101.3 km)²)) * 9.80665 m s⁻² = 1.8028974262830440917201245594353e⁻¹⁹ J electron⁻¹ = 108573.02076918215121624940621652 J mol⁻¹.

Faraday's constant can be derived via the product of the elementary charge times Avogadro's Constant:
 $F = e * N_A = 1.602176634e^{-19} \text{ C} * 6.02214076e23 \text{ mol}^{-1} = 96485.3321233100184 \text{ C mol}^{-1}$ (exact, SI)

Now, obviously, the number of electrons per mol isn't going to change. So what must be changing is the elementary charge, which affects the number of electrons per Coulomb (ie: the Faraday). Remember that Millikan and Fletcher's experiment balanced gravitational acceleration and electrostatic force to arrive at the elementary charge, hence baking-in Earth's gravitational acceleration.

The elementary charge is the coupling factor to all manner of electromagnetic interactions. For example, the electric charge of a particle is a coupling constant that characterizes an interaction with two charge-carrying fields and one photon field (hence the common Feynman diagram with two arrows and one wavy line). Since photons mediate the electromagnetic interaction, this coupling determines how strongly electrons 'feel' such a force. And we know already that this coupling factor changes when we get into higher-energy regimes. But this text shows that it also changes for lower-energy regimes.

Now, **how** does the elementary charge change?

Well, the fine structure constant, which quantifies the strength of the electromagnetic interaction between elementary charged particles is:

$$\alpha = (e^2 / ((h / 2 \pi c) * (4 \pi \epsilon_0))) = ((\mu_0 c e^2) / 2 h)$$

Where:

e = elementary charge

h = Planck constant

$\epsilon_0 = 1 / \mu_0 c^2$ = permittivity of vacuum

μ_0 = permeability of vacuum

The energy necessary to lift one mole of electrons by a potential of 1 volt is the Faraday Constant (which we now know cannot be a constant throughout the universe because its very definition is predicated upon elementary charge, which bakes-in Earth's gravitational acceleration).

Expressed in units of J electron⁻¹, on Earth that is 1.602176634e⁻¹⁹ J electron⁻¹.

On Venus, it would be (1.602176634e⁻¹⁹ J electron⁻¹ / (8.858 m sec⁻² * (6051.8 km / 6101.3 km)²)) * 9.80665 m s⁻² = 1.8028974262830440917201245594353e⁻¹⁹ J electron⁻¹

Invariant-mass matter (such as planets) increase local energy density, expand space, slow down time, reduce the speed of light.

As $c \downarrow$, $e \downarrow$. Venus's lower gravitational acceleration reduces c less than does Earth's, thus e reduces less than on Earth. Thus e on Venus must be greater than e on Earth, thus Faraday's 'Constant' must be greater on Venus than on Earth.

"But c is the speed of light! It doesn't change!", you may say. Yeah, no. That only applies to Einstein's first attempt at a theory of relativity, Special Relativity. In General Relativity, c is only constant in a constant gravitational field (which doesn't exist anywhere in the universe due to the Inverse Square Law and the gravitational interaction being a long-range force) and in an inertial frame of reference.

Einstein reiterated this fact many times, a few examples of which are below:

1913: "I arrived at the result that **the velocity of light is not to be regarded as independent of the gravitational potential. Thus the principle of the constancy of the velocity of light is incompatible with the equivalence hypothesis.**"

The Equivalence Principle states that there is no functional difference between actual translational acceleration and gravitational acceleration.

1916: "In the second place our result shows that, **according to the general theory of relativity, the law of the constancy of the velocity of light in vacuo, which constitutes one of the two fundamental assumptions in the special theory of relativity and to which we have already frequently referred, cannot claim any unlimited validity.**"

1920: "Second, this consequence shows that **the law of the constancy of the speed of light no longer holds, according to the general theory of relativity, in spaces that have gravitational fields. As a simple geometric consideration shows, the curvature of light rays occurs only in spaces where the speed of light is spatially variable.**"

This is how gravitational lensing (ie: the curvature of light rays around a gravitating body) occurs, which was what originally corroborated Einstein's theory.

Moving on...

We can use the model dry atmosphere consisting of 16 constituent molecular species to calculate the number of electrons per mole of air particles (atoms or molecules).

N ₂	14 e ⁻	*	78.0784748% of atmosphere	+
O ₂	16 e ⁻	*	20.9435% of atmosphere	+
Ar	18 e ⁻	*	0.9332% of atmosphere	+
CO ₂	22 e ⁻	*	0.042% of atmosphere	+
Ne	10 e ⁻	*	0.001818% of atmosphere	+
He	2 e ⁻	*	0.000524% of atmosphere	+
CH ₄	10 e ⁻	*	0.00015% of atmosphere	+
Kr	36 e ⁻	*	0.000114% of atmosphere	+
SO ₂	32 e ⁻	*	0.0001% of atmosphere	+
H ₂	2 e ⁻	*	0.000055% of atmosphere	+
N ₂ O	22 e ⁻	*	0.0000325% of atmosphere	+
CO	14 e ⁻	*	0.00001% of atmosphere	+
O ₃	24 e ⁻	*	0.00001% of atmosphere	+
Xe	54 e ⁻	*	0.0000087% of atmosphere	+
NO ₂	23 e ⁻	*	0.000002% of atmosphere	+
I ₂	106 e ⁻	*	0.000001% of atmosphere	=
14.45946106 mol _{electrons} mol ⁻¹ _{particles} * 6.02214076e ²³ mol ⁻¹ = 8707690981705880560000000 electrons mol ⁻¹ _{particles} (atoms or molecules)				

There are 14.45946106 moles of electrons in a mole of dry atmospheric particles (atoms or molecules). That is also the average number of electrons per atmospheric particle (atom or molecule).

$$1.602176634e^{-19} \text{ J electron}^{-1} * 8707690981705880560000000 \text{ electrons mol}^{-1}_{\text{particles}} = 1395125.902698168329362683504 \text{ J mol}^{-1}_{\text{particles}}$$

$$\text{Checking our math: } 14.45946106 \text{ mol}_{\text{electrons}} \text{ mol}^{-1}_{\text{particles}} * 96485.3321233100184 \text{ J mol}^{-1} = 1395125.902698168329362683504 \text{ J mol}^{-1}_{\text{particles}}$$

Using Faraday's Constant [F(Ah)]:

$$26.801481145363894 \text{ Ah mol}^{-1} * 14.45946106 \text{ mol}_{\text{electrons}} \text{ mol}^{-1}_{\text{particles}} = 387.53497297171342482296764 \text{ W m}^{-2}$$

Using the S-B equation:

$$\sigma = (2 \pi^5 K_B^4) / (15 h^3 c^2) = 5.67037441918442945397099673188923087584012297029130e-8 \text{ W m}^{-2} \text{ K}^{-4}$$

Where:

σ = Stefan-Boltzmann Constant

K_B = Boltzmann Constant (1.380649e⁻²³ J K⁻¹)

h = Planck Constant (6.62607015e⁻³⁴ J Hz⁻¹)

c = light speed (299792458 m sec⁻¹)

$$(287.52445649918761281451967994314 \text{ K})^4 * \sigma = 387.53497297171342482296764 \text{ W m}^{-2}$$

Assuming 1 hour (to cancel Wh) and assuming each mole of particles forms a 1 m² surface:

$$1395125.902698168329362683504 \text{ J mol}^{-1}_{\text{particles}} / (1 \text{ J sec}^{-1} \text{ W}^{-1} * 3600 \text{ sec hour}^{-1}) = 387.53497297171342482296764 \text{ Wh} / 1 \text{ hr} * 1 \text{ m}^2 = 387.53497297171342482296764 \text{ W m}^{-2}$$

"But you can't use 3600! That's arbitrary!", some have claimed. Yeah, no.

In fact, we can show that 3600 is entirely justified in being used (in our assumption of 1 m² and 1 hour) via the three equations above.

You'll note the 1st and 2nd equations don't use 3600, but arrive at the same exact answer as the 3rd equation, **to 23 decimal places**. If an answer arrived at by three equations (one using 3600 as a unit conversion, two not) is exact to 23 decimal places, then 3600 is entirely justified in being used, and in fact, its use exposes something very interesting... that time is baked-in to the thermodynamic equations.

In fact, by combining the 2nd and 3rd equations, the relation can be seen more easily here:

$$1395125.902698168329362683504 \text{ J mol}^{-1}_{\text{particles}} / ((287.52445649918761281451967994314 \text{ K})^4 * \sigma) = 3600 \text{ seconds}$$

So that's the SI unit of energy per mole (J mol⁻¹) of material, divided by the temperature (K) to the fourth power times the Stefan-Boltzmann Constant (W m⁻² K⁻⁴). And out of that comes time. **Time is baked-in to the thermodynamic equations.**

Likewise:

$$1395125.902698168329362683504 \text{ J mol}^{-1}_{\text{particles}} / 26.801481145363894 \text{ Ah mol}^{-1} * 14.45946106 \text{ mol}_{\text{electrons}} \text{ mol}^{-1}_{\text{particles}} = 3600 \text{ seconds}$$

$$\therefore \text{J mol}^{-1} / (\text{K}^4 * \sigma) = \text{J mol}^{-1} / (F(\text{Ah}) * \text{mol}_{\text{electrons}} \text{ mol}^{-1}_{\text{particles}}) = 3600 \text{ seconds}$$


$$\therefore (\text{K}^4 * \sigma) = (F(\text{Ah}) * \text{mol}_{\text{electrons}} \text{ mol}^{-1}_{\text{particles}}) = \text{radiant exitance (W m}^{-2}\text{)}$$

Moving on...

So we calculate 287.52445649918761281451967994314 K from the 387.53497297171342482296764 W m⁻² above.

The stated average temperature of Earth is 287.64 K, but that was arrived at by the climastrologists misusing the S-B equation, treating a graybody planetary surface as though it were an idealized blackbody, emitting to 0 K and with emissivity = 1 as I described prior. They *must* have also used a dry atmosphere.

If we use the actual temperature of space (2.7255 K) and Earth's emissivity of 0.93643 as calculated from the NASA ISCCP program and plug those into the Stefan-Boltzmann equation, we get 292.285578309603 K:

$T_{\text{cold}} = -270.424491^\circ\text{C}$ $= 2.7255 \text{ K}$	$T_{\text{hot}} = 19.1355783^\circ\text{C}$ $= 292.285578 \text{ K}$
	Emissivity = 0.93643 (e = 1 for ideal radiator) Radiating area = $A = 1 \times 10^0 \text{ m}^2$ $= 10000 \text{ cm}^2$ $= 10.7639104 \text{ ft}^2$
$\sigma = 5.6703 \times 10^{-8} \text{ watt / m}^2 \text{ K}^4$	
Radiation rate = $P = \frac{Q}{t} = 0.38753497 \times 10^3 \text{ watts}$ $= 387.534972 \text{ watts}$ $= 92.5788277 \text{ calories/s} = 1322.57935 \text{ BTU/hr}$	

... which corresponds to:

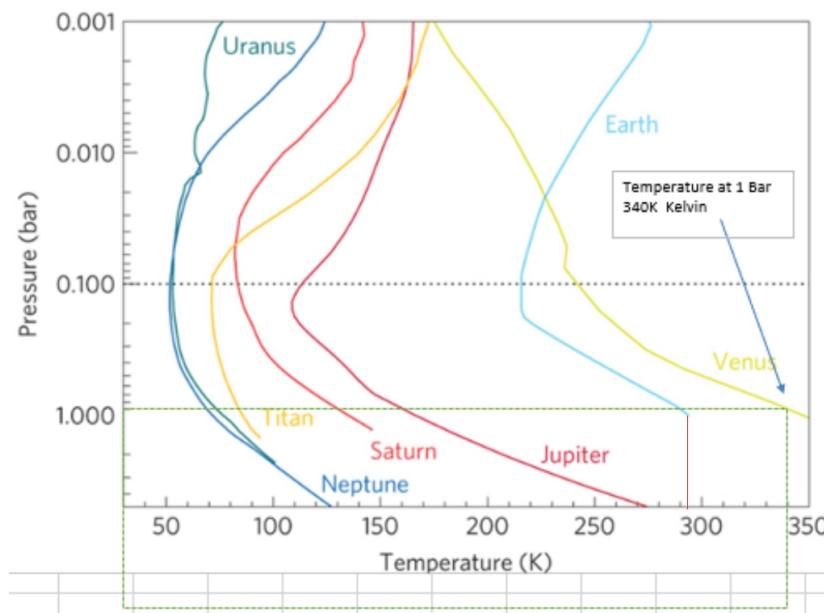


Image adapted from "[On the Apparent Relationship Between Total Solar Irradiance and the Atmospheric Temperature at 1 Bar on Three Terrestrial-type Bodies](#)" (Holmes 2019).

Voltage can be analogized to σT^4 . Using the 287.52445649918761281451967994314 K we calculated above...

$$\sigma = 5.67037441918442945397099673188923087584012297029130 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$$

$$(287.52445649918761281451967994314)^4 \times \sigma = 387.53497297171342482296764000002 \text{ W m}^{-2}$$

$$V = P/I$$

Assuming 1 amp, that's 387.53497297171342482296764000002 Watts.

Assuming 1 m², that's 387.53497297171342482296764000002 W m⁻².

What does the Kiehl-Trenberth graphic get? 390 W m⁻².

Of course, that's assuming emission to 0 K and emissivity = 1, but we can work around that via the S-B equation as we did above.

$$P = I \times V$$

If we instead assume 1 V (since we're calculating for a 1 V rise in bound electron potential) and consider the answer to be in units of amps, we still get the 387.53497297171342482296764000002 W m⁻² we calculated.

An interesting mathematical 'coincidence':

If we take the $387.53497297171342482296764000002 \text{ W m}^{-2}$ calculated above, and divide it by Faraday's Constant on Earth ($26.801481145363894 \text{ Ah mol}^{-1}$): $387.53497297171342482296764000002 \text{ W m}^{-2} / 26.801481145363894 \text{ Ah mol}^{-1} = 14.45946106$

What is the number of 'moles of electrons' per 'mole of atmosphere' we calculated above?

"There are 14.45946106 moles of electrons in a mole of atmospheric particles. That is also the average number of electrons per atmospheric particle (atom or molecule)."

Another interesting mathematical 'coincidence':

The majority of the dry atmosphere (~99%) consists of homonuclear diatomics (N_2 , O_2), with two atoms per molecule. In an atmosphere consisting of solely homonuclear diatomics, the 'atoms per particle' ratio would be 2. Obviously, monoatomics (especially Ar) and polyatomics (especially H_2O) skew the 'atoms per particle' ratio a bit (1.991069298 for the dry atmosphere).

If we take the molar mass of the atmosphere ($28.96599225582808 \text{ g mol}^{-1}$) and divide it by the average number of atoms per particle (atom or molecule) in a mole of atmosphere (1.991069298), we get $14.547957866119474461405712459537$.

Not quite the 14.45946106 moles of electrons per mole of atmospheric particles that we calculated, but very close. What makes up the difference?

Well, if we displace N_2 , O_2 and Ar in the atmosphere with water vapor, and solve for 14.45946106, it gives **1.1512951958965%** water vapor, when dividing the total molar mass of the atmosphere by the atoms per particle of the dry atmosphere.

And yet another amazing mathematical 'coincidence':

If we take the average number of electrons per dry atmospheric particle times the average number of atoms per dry atmospheric particle:

$14.45946106 \text{ electrons particle}^{-1} * 1.991069298 \text{ atoms particle}^{-1} = 28.78978898219253588$

What is the molar mass of the dry atmosphere? $28.96599225582808 \text{ g mol}^{-1}$

So we can calculate the percentage of atmospheric water vapor necessary to arrive at the first number in units of molar mass (water vapor has a lower molar mass and displaces primarily N_2 , O_2 and Ar which reduces the molar mass of the atmosphere, which is why humid air is lighter and thus more buoyant than dry air)... essentially the atmosphere is telling us how much water vapor it needs with that number. Lo and behold, that comes out to **1.1512951958965%**.

1.1512951958965% of $28.96599225582808 \text{ g mol}^{-1}$ is $11.512951958965 \text{ g}_{\text{H}_2\text{O}} \text{ kg}^{-1}_{\text{atm}}$, which corresponds to a temperature at 100% RH of 289.538316 K .

Radiant Exitance =

$$= \epsilon_h \sigma (T_h^4 - T_c^4)$$

$$= (\epsilon_h * (\sigma / a) * \Delta e) / 4$$

$$= (\epsilon_h c (e_h - e_c)) / 4$$

$$= (\epsilon_h * c * \Delta e) / 4$$

$$= \text{Faraday's Constant (Ah)} * (\text{Molar Mass of Atmosphere} / \text{Ratio of Atoms Per Particle})$$

$$= \text{Faraday's Constant (Ah)} * \text{Moles of electrons per Mole of atmospheric particles}$$

$$= (((\text{Faraday's Constant (J electron}^{-1}) * \text{Number of Electrons per Mole of Atmosphere}) / 3600) / \text{Stefan-Boltzmann Constant})^{0.25}$$

$$= (((\text{Faraday's Constant (J mol}^{-1}) * \text{Moles of Electrons per Mole of Atmosphere}) / 3600) / \text{Stefan-Boltzmann Constant})^{0.25}$$

There's no way that's a mere coincidence.

But therein lies the lapse rate problem... it assumes that once the energy is removed from the surface by conduction (when the atmospheric atoms and molecules contact the surface) and convection, it is removed from the system by emittance to space.

The line above:

$$\text{Radiant Exitance} = (\text{Molar Mass of Atmosphere} / \text{Ratio of Atoms Per Particle (Atom or Molecule)}) * \text{Faraday's Constant (Ah)}$$

... is strictly **not true** for an atmosphere consisting of solely monoatomics and homonuclear diatomics.

Monoatomics (Ar) have no vibrational mode quantum states, and thus cannot emit (nor absorb) IR. Homonuclear diatomics (O_2 , N_2) have no net electric dipole and thus cannot emit (nor absorb) IR unless that net-zero electric dipole is perturbed via collision.

In an atmosphere consisting of solely monoatomics and homonuclear diatomics (ie: no polyatomic radiative molecules), the atoms / molecules could pick up energy via conduction by contacting the surface, just as the polyatomics do; they could convect just as the polyatomics do... but once in the upper atmosphere, they could not as effectively radiatively emit that energy, the upper atmosphere would warm, lending less buoyancy to convecting air, thus hindering convection... and that's how an actual greenhouse works, by hindering convection.

For homonuclear diatomics, there would be some collisional perturbation and thus some emission in the atmosphere, but by and large the atmosphere could not effectively emit (especially at higher altitudes, because the chance of collision decreases exponentially with altitude).

Thus the surface would have to radiatively emit that ~76.2% of all surface energy which is currently removed from the surface via convection and evaporation... and a higher radiant exitance implies a higher surface temperature.

That's why I'm attempting to create a lapse rate equation which takes into account the ability of polyatomic molecules to emit (and monoatomic atoms and homonuclear diatomic molecules not to emit).

8) Dehadronization In An Artificially-Low Quantum Vacuum Energy Density Environment

Below is the decay chain to completely unwind invariant-mass matter (starting at Osmium-192) back into energy (because $E^2 = m^2 c^4 + p^2 c^2$). The same can be done to any element, making this a handy means of disposing of nuclear waste and hazardous waste. All that remain are the technological hurdles of creating large, well-shielded Casimir cavities to bring this technology to fruition.

We know that it is the non-zero expectation value of the EM component of the quantum vacuum which sustains bound electrons at their usual ground-state orbital radius as they emit Larmor radiation (a point charge undergoing acceleration (in this case, angular acceleration) in relation to its electric field will emit Larmor radiation in the form of virtual photons):

[1] <https://sci-hub.se/10.1103/physrevd.11.790>

[2] <https://web.archive.org/web/20190713220130/https://arxiv.org/ftp/quant-ph/papers/0106/0106097.pdf>

[3] https://web.archive.org/web/20190713225420/https://www.researchgate.net/publication/13330878_Ground_state_of_hydrogen_as_a_zero-point-fluctuation-determined_state

"We show here that, within the stochastic electrodynamic formulation and at the level of Bohr theory, the ground state of the hydrogen atom can be precisely defined as resulting from a dynamic equilibrium between radiation emitted due to acceleration of the electron in its ground-state orbit and radiation absorbed from zero-point fluctuations of the background vacuum electromagnetic field, thereby resolving the issue of radiative collapse of the Bohr atom."

[4] <https://web.archive.org/web/20180719194558/https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150006842.pdf>

"The energy level of the electron is a function of its potential energy and kinetic energy. Does this mean that the energy of the quantum vacuum integral needs to be added to the treatment of the captured electron as another potential function, or is the energy of the quantum vacuum somehow responsible for establishing the energy level of the 'orbiting' electron? The only view to take that adheres to the observations would be the latter perspective, as the former perspective would make predictions that do not agree with observation."

We also know that if we suppress the resonant quantum vacuum wavemodes feeding energy to the bound electron(s), bound electron orbital radius will decrease... and, in the most extreme case, completely blocking the resonant quantum vacuum wavemodes will cause the bound electron(s) to spiral-in to the oppositely-charged proton(s) in the nucleus, causing nuclear transmutation via electron capture decay.

The Klechkowski Rule for electron filling of orbital shells:

1s -> 2s -> 2p -> 3s -> 3p -> 4s -> 3d -> 4p -> 5s -> 4d -> 5p -> 6s -> 4f -> 5d -> 6p -> 7s -> 5f -> 6d -> 7p -> 5g -> 6f -> 7d -> 6g -> 7f -> 6h -> 7g -> 7h -> 8s -> 5g -> 6f -> 7d -> 8p -> 9s

So for Osmium (the most-dense element), its full designation would be:

1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d¹⁰ 4p⁶ 5s² 4d¹⁰ 5p⁶ 6s² 4f¹⁴ 5d⁶

or, in shorthand notation:

[Xe] 4f¹⁴ 5d⁶ 6s²

So Os has 2 + 2 + 6 + 2 + 6 + 2 + 10 + 6 + 2 + 10 + 6 + 2 + 14 + 6 = 76 electrons

It also has 76 protons, and 116 neutrons, giving it an atomic mass of 190.233 u (unified atomic mass units).

116 (neutrons) + 76 (protons) = 192.

So we write it as ¹⁹²₇₆ Os.

Now, if ¹⁹²₇₆ Os underwent electron capture (because we've suppressed resonant quantum vacuum wavemodes sustaining the bound electrons at their usual orbital radius in, for instance, a very well-shielded Casimir cavity), it would have 75 electrons, 75 protons and 117 neutrons.

That's Rhenium-192... 75 electrons, 75 protons and 117 neutrons.

That undergoes electron capture, giving it 74 electrons, 74 protons and 118 neutrons.

That's Tungsten-192... 74 electrons, 74 protons and 118 neutrons.

That undergoes electron capture, giving it 73 electrons, 73 protons and 119 neutrons.

That's an unstable configuration... the nucleus will expel 2 neutrons (which each beta decay to a proton and a W⁻ boson (which decays to an electron and an electron antineutrino) in 879.6 ± 0.8 seconds).

So we're left with Tantalum-190... 73 electrons, 73 protons and 117 neutrons.

We'll now transition to short-hand notation to save space, to wit:

Electrons/Protons/Neutrons XX-012 + e - N neut

where:

'XX-012' is the element's isotope

'+ e' is an electron capture event

'- N neut' is the number of neutrons expelled by the nucleus

73/73/117 Ta-190 + e - 2 neut	→	72/72/116 Hf-188 + e - 4 neut	→	71/71/113 Lu-184 + e - 2 neut	→
70/70/112 Yb-182 + e - 3 neut	→	69/69/110 Tm-179 + e - 0 neut	→	68/68/111 Er-179 + e - 4 neut	→
67/67/108 Ho-175 + e - 2 neut	→	66/66/107 Dy-173 + e - 2 neut	→	65/65/106 Tb-171 + e - 2 neut	→
64/64/105 Gd-169 + e - 2 neut	→	63/63/104 Eu-167 + e - 2 neut	→	62/62/103 Sm-165 + e - 2 neut	→
61/61/102 Pm-163 + e - 2 neut	→	60/60/101 Nd-161 + e - 2 neut	→	59/59/100 Pr-159 + e - 2 neut	→
58/58/99 Ce-157 + e - 2 neut	→	57/57/98 La-155 + e - 2 neut	→	56/56/97 Ba-153 + e - 2 neut	→
55/55/96 Cs-151 + e - 4 neut	→	54/54/93 Xe-147 + e - 3 neut	→	53/53/91 I-144 + e - 2 neut	→

52/52/90 Te-142 + e - 3 neut	→ 51/51/88 Sb-139 + e - 0 neut	→ 50/50/89 Sn-139 + e - 2 neut	→
49/49/88 In-137 + e - 5 neut	→ 48/48/84 Cd-132 + e - 0 neut	→ 47/47/85 Ag-132 + e - 3 neut	→
46/46/83 Pd-129 + e - 7 neut	→ 45/45/77 Rh-122 + e - 2 neut	→ 44/44/76 Ru-120 + e - 2 neut	→
43/43/75 Tc-118 + e - 3 neut	→ 42/42/73 Mo-115 + e - 0 neut	→ 41/41/74 Nb-115 + e - 1 neut	→
40/40/74 Zr-114 + e - 3 neut	→ 39/39/72 Y-111 + e - 3 neut	→ 38/38/70 Sr-108 + e - 2 neut	→
37/37/69 Rb-106 + e - 4 neut	→ 36/36/66 Kr-102 + e - 1 neut	→ 35/35/66 Br-101 + e - 7 neut	→
34/34/60 Se-94 + e - 2 neut	→ 33/33/59 As-92 + e - 3 neut	→ 32/32/57 Ge-89 + e - 3 neut	→
31/31/55 Ga-86 + e - 3 neut	→ 30/30/53 Zn-83 + e - 3 neut	→ 29/29/51 Cu-80 + e - 0 neut	→
28/28/52 Ni-80 + e - 5 neut	→ 27/27/48 Co-75 + e - 3 neut	→ 26/26/46 Fe-72 + e - 3 neut	→
25/25/44 Mn-69 + e - 2 neut	→ 24/24/43 Cr-67 + e - 2 neut	→ 23/23/42 V-65 + e - 2 neut	→
22/22/41 Ti-63 + e - 2 neut	→ 21/21/40 Sc-61 + e - 1 neut	→ 20/20/40 Ca-60 + e - 1 neut	→
19/19/40 K-59 + e - 5 neut	→ 18/18/36 Ar-54 + e - 2 neut	→ 17/17/35 Cl-52 + e - 3 neut	→
16/16/33 S-49 + e - 2 neut	→ 15/15/32 P-47 + e - 3 neut	→ 14/14/30 Si-44 + e - 1 neut	→
13/13/30 Al-43 + e - 3 neut	→ 12/12/28 Mg-40 + e - 1 neut	→ 11/11/28 Na-39 + e - 5 neut	→
10/10/24 Ne-34 + e - 3 neut	→ 9/9/22 F-31 + e - 3 neut	→ 8/8/20 O-28 + e - 3 neut	→
7/7/25 N-25 + e - 3 neut	→ 6/6/16 C-22 + e - 1 neut	→ 5/5/16 B-21 + e - 5 neut	→
4/4/12 Be-16 + e - 3 neut	→ 3/3/10 Li-13 + e - 3 neut	→ 2/2/8 He-10 + e - 3 neut	→
1/1/6 H-7 + e - 7 neutrons	→ End		

So we're left with the Hydrogen-7 isotope... 1 electron, 1 proton and 6 neutrons.

That undergoes electron capture, giving it 0 electrons, 0 protons and thus nothing holding the remaining 7 neutrons together in the nucleus... all 7 neutrons (6 from the nucleus, one converted from the sole remaining proton and electron) then each beta decay to a proton and a W^- boson (which decays to an electron and an electron antineutrino) in 879.6 ± 0.8 seconds.

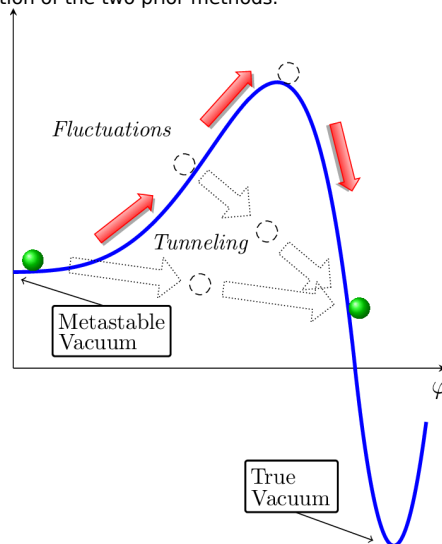
Further, every single proton is comprised of two Up quarks (charge $+\frac{2}{3}e$) and one Down quark (charge $-\frac{1}{3}e$), giving it a total charge of $+1$... without the energy of the quantum vacuum providing the gluons to hold the quarks together (ie: hadronization), the proton dehadronizes into free quarks and energy. The free quarks, unable to form invariant-mass matter in the artificially-suppressed quantum vacuum energy density of a well-shielded Casimir cavity, unwind into energy (free quarks cannot exist below the deconfinement scale), being nothing more than a persistent perturbation in a quantum field to begin with, which are now unable to sustain persistence.

The universe is almost certainly in a false vacuum (meta-stable) state:

<https://sci-hub.se/10.3389/fspas.2018.00040>

"One of the most striking results of the discovery of Higgs boson (Aad et al., 2012; Chatrchyan et al., 2012) has been that its mass lies in a regime that predicts the current vacuum state to be a false vacuum, that is, there is a lower energy vacuum state available to which the electroweak vacuum can decay into (Degrassi et al., 2012; Buttazzo et al., 2013). That this was a possibility in the Standard Model (SM) has been known for a long time (Hung, 1979; Sher, 1993; Casas et al., 1996; Isidori et al., 2001; Ellis et al., 2009; Elias-Miro et al., 2012)."

Normally, we study a false vacuum by adding energy to get it up and over the barrier, or we attempt to induce it to tunnel through the barrier to the true vacuum state, or a combination of the two prior methods.



There is another way... create an artificially-lower quantum vacuum energy density by blocking resonant quantum vacuum wavemodes which sustain the bound electron at its usual orbital radius. That essentially puts that 'bubble' of space-time into the true vacuum state (or any vacuum state you wish which is lower energy density than the false (meta-stable) vacuum state)... and in so doing, the conditions prevalent in that new vacuum state prevail. In this case, the conditions would be dehadronization of invariant-mass matter back into the energy from whence it came (because $E^2 = m^2 c^4 + p^2 c^2$).

So we've unwound invariant-mass matter into energy and electrons. How much energy? Well, we know:

$$E = m c^2 = 1 \text{ kg} * (89875517873681764 \text{ m}^2 \text{ sec}^{-2}) = 89875517873681764 \text{ J} = 24965421632 \text{ kWh kg}^{-1}$$

As a comparison, 2.336565 kg of invariant-mass matter would produce as much energy as the largest nuclear weapon ever tested (50 megaton Tsar Bomba). In other words, 2336.565 grams (5.15 pounds) of invariant-mass matter, unwound back into energy, contains as much energy as 50 million tons of TNT.

But the above equation, while accurately describing the amount of energy necessary to convert to mass, doesn't take into account the mass defect nor isotopic considerations for conversion of mass to energy. We must get away from a generic 'kilogram of mass', and instead use atomic mass units.

We know that 1 u (unified atomic mass unit) = $1.6605390666 \times 10^{-27}$ kg. We know that Osmium is 190.233 u, so one atom has a mass of $3.158893282565178 \times 10^{-25}$ kg.

$3.158893282565178 \times 10^{-25}$ kg * $(89875517873681764 \text{ m}^2 \text{ sec}^{-2}) = 2.8390716967823991434632116001399 \times 10^{-8} \text{ J atom}^{-1} = 7.88631026884 \times 10^{-12} \text{ Wh atom}^{-1}$

$6.02214076 \times 10^{23} \text{ atoms mol}^{-1} * 2.8390716967823991434632116001399 \times 10^{-8} \text{ J atom}^{-1} = 17097289385755646.732438894137707 \text{ J mol}^{-1}$

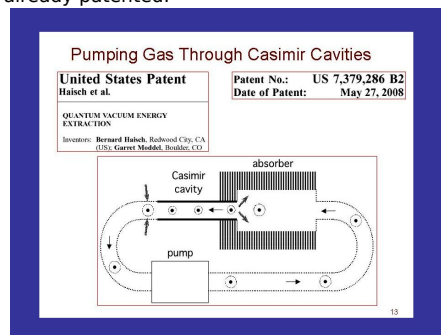
$6.02214076 \times 10^{23} \text{ atoms mol}^{-1} * 7.88631026884 \times 10^{-12} \text{ Wh atom}^{-1} = 4749247051598.79219184 \text{ kWh mol}^{-1}$

What is the mass of one mol of Osmium? $190.233 \text{ u} * 6.02214076 \times 10^{23} \text{ atoms mol}^{-1} = 114560990319708000000000000 \text{ u mol}^{-1} = 0.1902329999342595579045528 \text{ kg mol}^{-1}$

That's 4.74924705159879219184 TERAWATT HOURS from 190.2329999342595579045528 grams of matter.

For reference, humanity used 173340 TWh of energy in 2019. That would require ~6944 kg (~15309 pounds) of invariant-mass matter per year to produce that amount of energy (not accounting for inefficiencies and losses). That amounts to ~19 kg (~42 pounds) per day of invariant-mass matter. That may seem like a lot, but more than 5200 tons of micrometeorites fall to Earth every year from space (~28,500 pounds per day).

Now, one needn't go to such extremes as the dehadronization of invariant-mass matter... suppressing quantum vacuum energy density sufficiently to cause bound electron orbital radius to decrease such that the bound electron emits a photon (which is captured and put to use) will suffice. Then the atom exits the Casimir cavity and the bound electron regains its usual orbital radius by absorption of energy from the quantum vacuum, as Haisch and Model have already patented.



And **that** is the technology we need to power the world and move us up the Kardashev scale.

The problem for both approaches is that Casimir cavities are, by necessity, tiny, so it's difficult to scale. Two methods of making them larger but still effective at lowering quantum vacuum energy density have been proposed by this author, but no experiments have yet been conducted. Other methods (which are more easily scalable) of artificially reducing bound electron orbital radius (artificial Lamb Shift) via stealing the bound electron's orbital momentum are being investigated.

9) On the Validity of Kirchhoff's Law of Thermal Radiation for Graybody Objects

Kirchhoff's Law of Thermal Radiation states that absorptivity and emissivity are equal at thermodynamic equilibrium... and while Gustav Kirchhoff attempted to extend the idealized blackbody object case to all other materials, he did so by including a graphite or carbon particle in the cavity he was conducting experiments with... which is a thermalizer. In a perfectly-reflecting cavity, the cavity could not exhibit a blackbody curve except for that thermalizer being present. So in reality, Kirchhoff was working with the idealized blackbody object case all along.

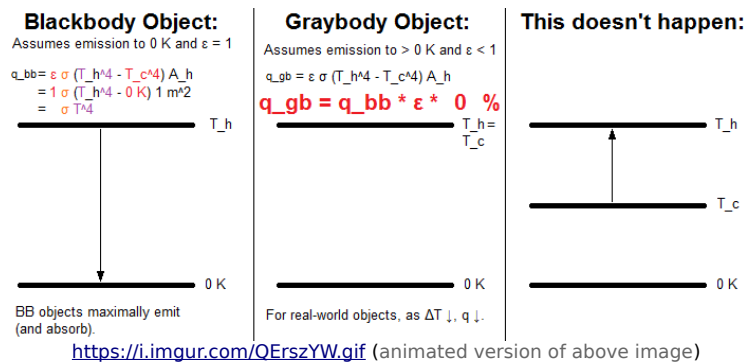
The problem is, at thermodynamic equilibrium, both absorptivity and emissivity are zero for graybody objects (the only reason they are both equal), which leads to Kirchhoff's Law of Thermal Radiation giving a result which is indeterminate in the one case in which it applies, when applied to graybody objects.

Do remember that idealized blackbody objects are idealizations and provable contradictions. They do not and cannot exist. The closest we can come to that is a laboratory approximation of an idealized blackbody object at certain wavelength bands. So Kirchhoff's Law of Thermal Radiation does not apply to any real-world object. It is said that it applies to idealized blackbody objects, which do not and cannot exist, but as I'll show, even then it cannot apply.

The definition of emissivity: *The ratio of the total emissive power of a body to the total emissive power of a perfectly black body at that temperature.*

The definition of absorptivity: *The ratio of the absorbed to the incident radiant power.*

We can ascertain that emissivity of a graybody object is zero at thermodynamic equilibrium thusly:



While an idealized blackbody object emits when its temperature is $> 0 \text{ K}$, a graybody object emits when its temperature is $> 0 \text{ K}$ above its ambient. This is plainly evident in the animated version of the graphic above.

Do remember that temperature (T) is a measure of radiation energy density (e), equal to the fourth root of radiation energy density divided by Stefan's Constant.

As $\Delta e \rightarrow 0$, $\Delta T \rightarrow 0$, $q \rightarrow 0$. As $q \rightarrow 0$, the ratio of graybody object total emissive power to idealized blackbody object total emissive power $\rightarrow 0$. In other words, **emissivity $\rightarrow 0$** . At thermodynamic equilibrium for a graybody object, there is no radiation energy density gradient and thus no impetus for photon generation.

As $\Delta e \rightarrow 0$, $\Delta T \rightarrow 0$, photon chemical potential $\rightarrow 0$, photon Free Energy $\rightarrow 0$. At zero chemical potential, zero Free Energy, the photon can do no work, so there is no impetus for the photon to be absorbed. The ratio of the absorbed to the incident radiant power $\rightarrow 0$. In other words, **absorptivity $\rightarrow 0$** .

α = absorptivity = absorbed / incident radiant power
 ρ = reflectivity = reflected / incident radiant power
 τ = transmissivity = transmitted / incident radiant power

$$\alpha + \rho + \tau = 100\%$$

For opaque surfaces $\tau = 0\% \therefore \alpha + \rho = 100\%$

If $\alpha = 0\%$, $0\% + \rho = 100\% \therefore \rho = 100\%$... **all incident photons are reflected at thermodynamic equilibrium for graybody objects.**

This coincides with standard cavity theory... applying cavity theory outside a cavity, for two graybody objects at thermodynamic equilibrium, no absorption nor emission takes place. The photons remaining in the intervening space set up a standing wave, with the wavemode nodes at the object surfaces by dint of the boundary constraints. Nodes being a zero-crossing point (and anti-nodes being the positive and negative peaks), no energy **can** be transferred into or out of the objects. Photon chemical potential is **zero**, they can do no work, photon Free Energy is **zero**, they can do no work. Should one object change temperature, the standing wave becomes a traveling wave with the group velocity proportional to the radiation energy density gradient and in the direction of the cooler object.

Now, if energy cannot spontaneously flow when there is **zero** energy density gradient (ie: thermodynamic equilibrium), it *certainly* cannot spontaneously flow **up** an energy density gradient.

Even Planck tacitly admitted to the non-universality of Kirchhoff's Law of Thermal Radiation. Planck used the coefficients of emission and absorption, which correspond to emissivity and absorptivity, writing: $K_\nu = e_\nu / a_\nu$. In Section 48 of his book, Planck admits that this equation (in Section 26) cannot be used when $e_\nu = 0$ and $a_\nu = 0$ (ie: at thermodynamic equilibrium) because it results in $0/0$ which is **indeterminate**.

The thing is, at thermodynamic equilibrium, emissivity and absorptivity *are* zero for graybody objects by their very *definitions*... and Kirchhoff's Law of Thermal Radiation only applies at thermodynamic equilibrium, so for the one condition to which Kirchhoff's Law of Thermal Radiation applies, its result is **indeterminate** for graybody objects, as Planck tacitly admits.

If you doubt me, look up the definition of 'thermodynamic equilibrium'... it is *defined* as a **quiescent state**. There is no radiation energy density gradient so there is no impetus for photon generation, and there is no photon chemical potential by which photon absorption can take place.

The state of thermodynamic equilibrium is defined as a minimum of Free Energy. When Free Energy reaches a minimum, the quiescent state of thermodynamic equilibrium has been attained.

$$F = U - TS + PV$$

Where: F = Free Energy; U = internal energy; T = absolute temp; S = final entropy; TS = energy the object can receive from the environment; PV = work done to give the system final volume V at pressure P

If $U > TS + PV$, $F > 0$... energy *must* flow from object to environment.

If $U = TS + PV$, $F = 0$... no energy *can* flow to or from the object.

If $U < TS + PV$, $F < 0$... energy *must* flow from environment to object.

Free energy is defined as the capacity to do work. Work is defined as the application of a force over a distance. This is why, for instance, photons are considered the force-carrying gauge bosons of the EM field, and virtual photons the force-carrying gauge bosons which mediate magnetic fields.

If $U = TS + PV$, $p_{\text{photon}} = \frac{1}{3} p = p_{\text{object}}$... energy cannot flow because no work can be done. Free Energy is **zero**. Photon chemical potential is **zero**. The work done is $W = -p$ for a constant volume, where $p = \frac{1}{3}$, the radiation pressure.

Idealized blackbody objects can never attain the quiescent state of thermodynamic equilibrium except at 0 K because all idealized blackbody objects emit when their temperature is > 0 K and they must absorb all radiation incident upon them... emission and absorption is not quiescence... one of the contradictions which make idealized blackbody objects an impossibility, especially in light of Kirchhoff's Law of Thermal Radiation which postulates that emissivity and absorptivity of idealized blackbody objects are equal at thermodynamic equilibrium.

Except emissivity and absorptivity of idealized blackbody objects are pinned to 1 *all the time* by definition (idealized blackbody objects maximally emit and absorb)... so Kirchhoff's Law of Thermal Radiation describes the *definition* of idealized blackbody objects in only one case (at thermodynamic equilibrium, which idealized blackbody objects cannot even attain except at 0 K), while that definition applies to idealized blackbody objects *all the time* by the very definition of idealized blackbodies.

Planck erred in failing to properly validate Kirchhoff's Law (from which he derived his equation)... his attempt at validating Kirchhoff's Law in *The Theory of Heat Radiation* is filled with errors... he had to redefine blackbodies to be predicated upon transmissivity (except idealized blackbodies by *definition* are opaque, zero transmissivity); he ignored absorptivity at the interface of the blackbody (he claimed that the state of photons on the surface and inside the material were identical, and that as a photon traversed through a material, it was successively absorbed); he used polarized light in his experiments (when thermal radiation is never polarized) and thus misused Brewster's Law; and he, like Kirchhoff, cheated a bit by using a small chunk of graphite or carbon as a thermalizer (what he called a 'catalyst') in a perfectly reflecting cavity (which cannot otherwise exhibit a blackbody spectrum because the radiation field can do no work upon the cavity walls, nor the walls upon the radiation field). In short, Planck held a weird view of what photons were and how they interacted with matter. His definition of a blackbody didn't even coincide with Kirchhoff's definition (nor with the standard definition).

Kirchhoff specified two conditions by which Kirchhoff's Law of Thermal Radiation applied:

- 1) thermal equilibrium must exist
- 2) the entire system's energy must be contained within the radiation field in the cavity space

It is condition number 2 which necessitates either a perfect absorber / emitter (an idealized blackbody, which must emit all radiation that it absorbs and which must absorb all radiation that is incident upon it) or a perfect reflector (which has absorptivity and emissivity of 0, so it cannot absorb any of the radiation), as no energy can be in the cavity walls. But a perfect reflector cannot equilibrate the radiation to a blackbody spectrum. In other words, the photons must be able to do **work** upon the cavity walls, and the walls must be able to do **work** upon whatever radiation spectrum we introduce to the cavity (even if that radiation is at a single wavelength) to convert it to a blackbody spectrum.

Thus, in the case of perfectly-reflecting cavity walls, the radiation we inject into the cavity can do no work upon the cavity walls, and no work can be done upon the radiation by the walls, and thus it cannot be converted to a blackbody spectrum. Thus, because Kirchhoff's Law of Thermal Radiation is purported to extend to all materials, this alone invalidates it. *Kirchhoff's own conditions invalidate Kirchhoff's Law of Thermal Radiation.*

Only idealized blackbody walls and perfectly reflecting walls could hold no energy so all energy is in the radiation field in the cavity space. Only idealized blackbody walls can have work done upon them by the radiation field and do work upon the radiation field necessary to equilibrate the radiation to a blackbody spectrum while holding no energy so all the energy is in the radiation in the cavity space.

So Kirchhoff's Law only holds for idealized blackbody walls... and idealized blackbody objects are idealizations... they don't actually exist.

The existence of resonant cavities and band-pass cavities (especially closed cavities such as radar resonators, wherein the energy is extracted via a resonant wire loop and injected via a triode vacuum tube inside the cavity) further invalidates the claim that a cavity will contain blackbody radiation regardless of the cavity wall material. The quality of the cavity depends very heavily upon the wall material.

Another perfectly-reflecting cavity which can be (and has been) done is with [quantum dark states](#)... an atom or molecule cannot absorb off-resonance radiation, it will perfectly reflect it (for opaque objects) or that radiation will pass the atom or molecule by (for gases that aren't so dense that transient inter-molecular oscillating dipoles allow blackbody radiation absorption rather than spectral absorption to predominate). A dark state occurs using laser light to induce transitions between energy levels, when atoms or molecules can spontaneously decay into a state that is not coupled to any other level by the laser light, preventing the atom or molecule from absorbing or emitting light from that state. The incident radiation is perfectly reflected.

So this law cannot be a law...

1) The conditions for Kirchhoff's Law of Thermal Radiation preclude it applying to any but idealized blackbody objects... which do not and cannot exist. It can **only** apply to idealized blackbody objects (not perfect reflectors nor graybody objects), because only idealized blackbody objects can do work upon the radiation field (and the radiation field do work upon the walls) to thermalize the radiation into a blackbody spectrum while the walls hold none of the system energy.

2) For idealized blackbody objects, it describes objects which do not and cannot exist (they are idealizations), cannot attain the quiescent state of thermodynamic equilibrium (except at 0 K, because idealized blackbody objects emit and absorb at temperatures > 0 K; emission and absorption are not quiescence) and already have emissivity and absorptivity equal to 1 at all times by definition (idealized blackbody objects maximally emit and absorb) and thus Kirchhoff's Law of Thermal Radiation doesn't describe anything about them that isn't already in their very definitions.

3) For graybody objects at thermodynamic equilibrium (Kirchhoff's Law of Thermal Radiation only applies at thermodynamic equilibrium), its result is indeterminate because both emissivity and absorptivity go to zero at thermodynamic equilibrium for graybody objects.

It is, at best, a hypothesis... which has failed the most basic of tests, and which self-invalidates.

The words "fact", "theory", "hypothesis" and "law" have very specific definitions in science:

Hypothesis: A tentative explanation of an empirical observation that can be tested. It is merely an educated guess.

Working hypothesis: A conjecture which has little empirical validation. A working hypothesis is used to guide investigation of the phenomenon being investigated.

Scientific hypothesis: In order for a working hypothesis to be a scientific hypothesis, it must be testable, falsifiable and it must be able to definitively assign cause to observed effects.

Null hypothesis: Also known as nullus resultatum. In the case of climate science, the null hypothesis should be that CO₂ does not cause global warming.

A Type I error occurs when the null hypothesis is rejected erroneously when it is in fact true.

A Type II error occurs if the null hypothesis is not rejected when it is in fact false.

Fact: An empirical observation that has been confirmed so many times that scientists can accept it as true without having to retest its validity each time they experience whatever phenomenon they've empirically observed.

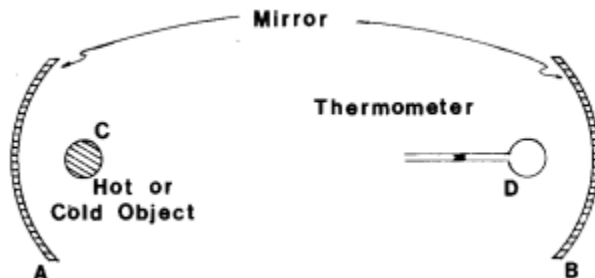
Law: A mathematically rigorous description of how some aspect of the natural world behaves.

Theory: An explanation of an empirical observation which is rigorously substantiated by tested hypotheses, facts and laws. Laws describe how things behave in the natural world, whereas theories explain why they behave the way they do.

For instance, we have the law of gravity which describes how an object will behave in a gravitational field, but we're still looking for a gravitational theory which fits into quantum mechanics and the Standard Model and explains why objects behave the way they do in a gravitational field.

10) The ultimate proof that energy only spontaneously radiatively flows if there is a radiation energy density gradient, cannot spontaneously radiatively flow if there is no radiation energy density gradient, and most certainly will not spontaneously radiatively flow against a radiation energy density gradient.

Pictet devised an experiment in 1800 which purported to show the transmission of 'cold'... what Pictet actually proved is that energy only flows down an energy density gradient.



Most physicists, on seeing it demonstrated for the first time, find it surprising and even puzzling because the education they've received hasn't instilled in them the necessary foundational knowledge such that they can instantly recognize it for what it is... energy flowing from the warmer temperature measurement device at the focal point of one mirror to the cooler object at the focal point of the other mirror (and in losing energy, the temperature measurement device registers a lower temperature), said mirrors creating a view factor wherein object and temperature measurement device can only 'see' each other and nothing else.

Most people cannot think in terms of energy, energy density and energy density gradient. We need to analogize to something they're familiar with. Thus, just as, for instance, water only spontaneously flows down a pressure gradient, energy only spontaneously flows down an energy density gradient. That's 2LoT in the Clausius Statement sense, in a nutshell. So one tack to take is to ask people if water can ever spontaneously flow uphill. Of course they'll say, "No, water cannot flow uphill on its own." Then show them dimensional analysis.

mass (M), length (L), time (T), absolute temperature (K), amount of substance (N), electric charge (Q), luminous intensity (C)
We denote the dimensions like this: [M_x L_x T_x K_x N_x Q_x C_x] where x = the number of that dimension

Force:	[M ¹ L ¹ T ⁻²]	/
Area:	[M ⁰ L ² T ⁰]	=
Pressure:	[M¹ L⁻¹ T⁻²]	/
Length:	[M ⁰ L ¹ T ⁰]	=
Pressure Gradient:	[M¹ L⁻² T⁻²]	

Explain to them that Pressure is Force / Area, and that Pressure Gradient is Pressure / Length. Remind them that water only spontaneously flows down a pressure gradient (ie: downhill). Then introduce energy. Tell them that energy is much like water. It requires an impetus to flow, just as water requires an impetus (pressure gradient) to flow. In the case of radiative energy, that impetus is a radiation energy density gradient, which is analogous to (and in fact, literally is) a radiation pressure gradient.

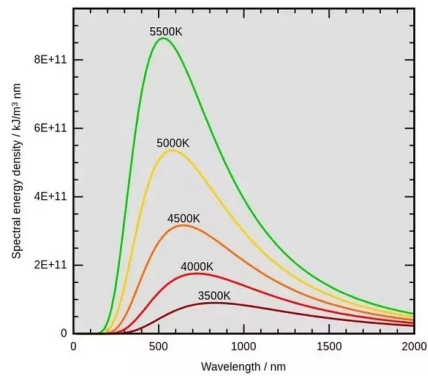
Energy:	[M ¹ L ² T ⁻²]	/
Volume:	[M ⁰ L ³ T ⁰]	=
Energy Density:	[M¹ L⁻¹ T⁻²]	/
Length:	[M ⁰ L ¹ T ⁰]	=
Energy Density Gradient:	[M¹ L⁻² T⁻²]	

Explain to them that Energy Density is Energy / Volume, and Energy Density Gradient is Energy Density / Length. Highlight the fact that Pressure and Energy Density have the same units (**bolded above**). Also highlight the fact that Pressure Gradient and Energy Density Gradient have the same units (**bolded above**).

So we're talking about the same concept as water only spontaneously flowing down a pressure gradient (ie: downhill) when we talk of energy (of any form) only spontaneously flowing down an energy density gradient. Energy density is pressure, an energy density gradient is a pressure gradient... for energy.

It's a bit more complicated for gases because they can convert that energy density to a change in volume ($1 \text{ J m}^{-3} = 1 \text{ Pa}$), for constant-pressure processes, which means the unconstrained volume of a gas will change such that its energy density (in J m^{-3}) will tend toward being equal to pressure (in Pa) (see below). This is the underlying mechanism for convection. It should also have clued the climatologists in to the fact that it is solar insolation and atmospheric pressure which 'sets' temperature, not any 'global warming' gases.

Since a warmer object will have higher radiation energy density at all wavelengths than a cooler object (because remember, temperature is a measure of radiation energy density, equal to the fourth root of radiation energy density divided by Stefan's Constant):



... 'backradiation' can do nothing to warm the surface because energy cannot spontaneously radiatively flow from lower to higher radiation energy density, and thus CAGW is nothing more than a complex mathematical scam perpetrated to obtain multiple billions of dollars in funding for trough-grubbing line-toeing 'scientists' and to push a Marxist One World Government "Build Back Better" agenda.

"But they've measured backradiation!", some may claim. Yeah, no.

<https://claesjohnson.blogspot.com/2011/08/how-to-fool-yourself-with-pyrgeometer.html>

As Professor Claes Johnson shows in that article on his website, pyrgeometers (the instrument typically used to 'measure' backradiation) utilize the same sort of misuse of the S-B equation as the climastrologists use. The bastardized form of the S-B equation used by pyrgeometers [usually some form of $q = (\sigma T_h^4 - \sigma T_c^4)$ or equivalently $L_d = U_{\text{emf}}/S + \sigma T_b$, as outlined in the documentation for the instrument, with U_{emf}/S being negative in sign] apriori assumes a subtraction of 'cooler to warmer' energy flow from 'warmer to cooler' energy flow, which as has been shown in this paper, is fallacious.

Do remember that photons, each a quantum of energy, are considered the **force-carrying** gauge bosons of the EM interaction.

Going back to dimensional analysis:

We start with Energy: [M1 L2 T-2] -
 Force: [M1 L1 T-2] *
 Length: [M0 L1 T0] = [M0 L0 T0]

We are left with nothing on the 'transmitting' end... [M0 L0 T0]. In other words, that Energy is used to apply a Force along a Length. **It's obvious then, that if an equal and opposing Force were applied along that Length, no energy can flow...** this is just as true radiatively as it is mechanically.

That Force applied along a Length gives us (on the 'receiving' end):

Force: [M1 L1 T-2] *
 Length: [M0 L1 T0] =
 Work: [M1 L2 T-2]

You'll note that Energy and Work have the **same units**:

Work: [M1 L2 T-2] = Energy: [M1 L2 T-2]

For those who want to put it in terms of Momentum:

Momentum: [M1 L1 T-1] *
 Velocity: [M0 L1 T-1] =
 Work: [M1 L2 T-2]

That means Energy Expended = Force * Length = Momentum * Velocity = Work

There's a reason for that. Free Energy is defined as that energy capable of performing work. This is reflected in the equation for Free Energy (represented here as a single object and its environment):

$$F = U - TS + PV$$

Where: F = Free Energy; U = internal energy; T = absolute temp; S = final entropy; TS = energy the object can receive from the environment; PV = work done to give the system final volume V at pressure P

If $U > TS + PV$, $F > 0$... energy *must* flow from object to environment.

If $U = TS + PV$, $F = 0$... no energy *can* flow to or from the object.

If $U < TS + PV$, $F < 0$... energy *must* flow from environment to object.

Of course, if we were talking about a system with only two objects with the same physical parameters and nothing else in the system, we could represent the Free Energy as: $F = U_1 - U_2$

Which is better represented as internal energy over volume to get energy density (since internal energy is an extensive property), converting the calculation to that of an intensive property and thus allowing us to compare dissimilar-sized objects: $F = U_1/V_1 - U_2/V_2 = e_1 - e_2$

And that's exactly what the S-B equation does. Remember that temperature is a measure of radiation energy density, equal to the fourth root of radiation energy density divided by the radiation constant (Stefan's Constant). Remember that I wrote above:

$$\therefore q = (\epsilon c (e_h - e_c)) / 4$$

Canceling units, we get $\text{J sec}^{-1} \text{m}^{-2}$, which is W m^{-2} ($1 \text{ J sec}^{-1} = 1 \text{ W}$).
 $\text{W m}^{-2} = (\text{m sec}^{-1} (\Delta \text{J m}^{-3})) / 4$

One can see that the S-B equation is all about subtracting the radiation energy density of the cooler object from the radiation energy density of the warmer object (to arrive at the radiation energy density gradient) because Free Energy is all about subtracting the energy density of one object from the energy density of the other object (no matter the form of that energy).

Our atmosphere is trading one form of energy density for another... volumetric energy density (units: J m^{-3}) for work/volume, and given that volume = mass / air density, that affects air density, which affects buoyancy, which affects convection.

This is because $1 \text{ J m}^{-3} = 1 \text{ Pa}$. This is also why temperature drops as altitude increases (and thus air pressure decreases).

Energy Density: [M1 L-1 T-2] ... has the same units as:

Pressure: [M1 L-1 T-2] ... which translates to:

Work: [M1 L2 T-2] ... over:

Volume: [M0 L3 T0] ... a change in volume. Volume equals:

Mass: [M1 L0 T0] ... over:

Air Density: [M1 L-3 T0] ... a change in density, which is caused by:

Mass: [M1 L0 T0] ... flowing:

Rate Of Flow: [M0 L3 T-1] ... over:

Time: [M0 L0 T1]

As an example, let us take air at 288 K:

$$M = 28.96599225582808 \text{ g mol}^{-1} = 0.02896599225582808 \text{ kg mol}^{-1}$$

Molar kinetic energy density:

$$(3/2) * 1.380649\text{e}^{-23} \text{ J K}^{-1} * 288 \text{ K} = 5.96440368\text{e}^{-21} \text{ J particle}^{-1} * 6.02214076\text{e}^{23} \text{ particle mol}^{-1} = 3591.84785104219968 \text{ J mol}^{-1}$$

$$v = \sqrt{((3 \text{ kT}) / m)} = \sqrt{((3 * 1.380649\text{e}^{-23} * 288) / 4.8099161760257626392645129736223\text{e}^{-26}))} = 498.00047690129095975808793374231 \text{ m sec}^{-1}$$

Checking our math:

$$1/2 m v^2 = (1/2) * 0.02896599225582808 \text{ kg mol}^{-1} * (498.00047690129095975808793374231 \text{ m sec}^{-1})^2 = 3591.84785104219968 \text{ J mol}^{-1}$$

One can use the Maxwell-Boltzmann Speed Distribution Function to see that the particle speed above corresponds to the Root Mean Square speed. This speed is directly proportional to the square root of temperature, and inversely proportional to the square root of mass.

Since dry air consists of ~99.9551748% monoatomics and homonuclear diatomics, we can treat the dry atmosphere as if it consisted of homonuclear diatomics, which have a maximum of 6 DOF, but at Earthly temperatures, one DOF is frozen out, so there are 5 DOF (3 translational mode, 2 rotational mode).

Molar rotational mode energy density:

$$(2/2) * 1.380649\text{e}^{-23} \text{ J K}^{-1} * 288 \text{ K} = 3.97626912\text{e}^{-21} \text{ J particle}^{-1} * 6.02214076\text{e}^{23} \text{ particle mol}^{-1} = 2394.56523402813312 \text{ J mol}^{-1}$$

Translational mode + rotational mode molar energy density:

$$3591.84785104219968 \text{ J mol}^{-1} + 2394.56523402813312 \text{ J mol}^{-1} = 5986.4130850703328 \text{ J mol}^{-1}$$

$$C_p = 5986.4130850703328 \text{ J mol}^{-1} / 288 \text{ K} = 20.7861565453831 \text{ J mol}^{-1} \text{ K}^{-1} / 0.02896599225582808 \text{ kg mol}^{-1} =$$

$$717.60554107035078345015817664557 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$p = (101325 \text{ Pa} * (0.02896599225582808 \text{ kg mol}^{-1})) / (20.7861565453831 \text{ J mol}^{-1} \text{ K}^{-1} * 288 \text{ K}) = 0.49027341140914566609965954925333 \text{ kg m}^{-3}$$

$$V_m = 1/p = 2.0396782218431880151359048100067 \text{ m}^3 \text{ kg}^{-1} * 0.02896599225582808 \text{ kg mol}^{-1} = 0.05908130357829097261287934863064 \text{ m}^3 \text{ mol}^{-1}$$

Checking our math:

$$V_m = 5986.4130850703328 \text{ J mol}^{-1} / 101325 \text{ Pa} = 0.05908130357829097261287934863064 \text{ m}^3 \text{ mol}^{-1}$$

We can then change the temperature of that air and derive the pressure and volume.

$$\text{From Gay-Lussac's Law: } P_1 T_1 = P_2 T_2$$

$$101325 \text{ Pa} * 288 \text{ K} = 97272 \text{ Pa} * 300 \text{ K}$$

$$\text{And from Boyle's Law: } P_1 V_1 = P_2 V_2$$

$$101325 \text{ Pa} * 0.05908130357829097261287934863064 \text{ m}^3 \text{ mol}^{-1} = 97272 \text{ Pa} * 0.06154302456071976313841598815692 \text{ m}^3 \text{ mol}^{-1}$$

$$5986.4130850703328 \text{ J mol}^{-1} / 0.05908130357829097261287934863064 \text{ m}^3 \text{ mol}^{-1} = 101325 \text{ J m}^{-3} \text{ at } 101325 \text{ Pa pressure and } 288 \text{ K}$$

$$5986.4130850703328 \text{ J mol}^{-1} / 0.06154302456071976313841598815692 \text{ m}^3 \text{ mol}^{-1} = 97272 \text{ J m}^{-3} \text{ at } 97272 \text{ Pa pressure and } 300 \text{ K}$$

The air in this instance, warmed from 288 K to 300 K at the surface, would attempt to convect to an altitude of ~360 m, where the pressure is 97272 Pa.

As one can see, as temperature increases, the volume occupied by each mole parcel of air attempts to increase while maintaining the energy density in J m^{-3} equal to the atmospheric pressure in Pa. It does this by varying the volume each mole parcel of air occupies, which affects air density, which affects buoyancy, which affects Convective Available Potential Energy (CAPE), which affects the rate of convection. If surface and near-surface atmospheric temperature were to increase, convection would increase to remove that surface energy, convectively transport it to the upper atmosphere, and radiatively emit it to space.

Thus CO_2 is not (cannot be) the singular 'control knob' for atmospheric (and thus surface) temperature... gravitational acceleration and solar insolation are the predominant 'control knobs'... gravitational acceleration largely determines what atmospheric pressure will be, for a given temperature... and solar insolation largely determines what temperature will be. CO_2 is a net atmospheric radiative coolant at all altitudes except for negligible warming at the tropopause (where it absorbs a greater proportion of cloud-reflected solar IR insolation), but the largest 'control knobs' of atmospheric (and thus surface) temperature are gravitational acceleration and solar insolation.