Technical Discussion Paper 4

Engineering NET ZERO with Global Respect Numbers - An engineers guide

Introduction

This document derives from a couple of years trying to understand how the Global community might achieve Net Zero and what in fact, that might actually mean to the average human and business. During that time, I have started and then dissolved a business founded on an electronic innovation for which I was unable to demonstrate or compute Net Zero. I had no idea or information as to how to do it !!!

In order to progress, the greater need to understand how Net Zero could be achieved became the subsequent goal and subject for my research into the subject.

This document aims to explain a Net Zero methodology that is practical, common sense based and uses analogies derived from a previous Global challenge that was tackled with great speed and efficiency.

This engineering based approach centres around Global Respect Numbers and suggests a practical approach for Governments, businesses and people to understand the Net Zero challenge and the route to solving it.

For a general background, it is advisable to first understand the principles of the Global Respect Number (GRN) which are outlined in the document https://www.weld-monitor.com/weldappnotes.html : Technical Discussion Papers 2 & 3. These documents were independently conceived and authored prior to any detailed research.

The good news is that a lot of separate work has already gone into how Green House Gases might be quantified. Standards such as ISO 14064 and others in the ISO1406x series show ways of tallying CO2e content in products and processes.

The bad news is that there is very little in the way of International Standards or agreement as to how such information could, should or might be used. This is where GRNs aim to solve the problem.

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This paper will touch on some engineering principles such as PID control loop theory and pulse width power transfer as a means of explaining natural phenomenon.

If you're interested in understanding the solution but don't yet know what a QUASI-PEAK is, then look no further. Quasi-peak detectors helped to solve a major pollution issue several decades ago.

All will be explained in layman's terms…..

Proof that Net Zero man made constructions are possible

It's perhaps a good thing that COP 27 will be hosted in Egypt.

The Egyptian pharaohs knew how to work with the natural flooding cycle of the river Nile while also building wondrous constructions that they designed and built to last.

Like the Great Wall of China, these things are close to being Net Zero. **GRNs explain why, CO2e totals don't.**

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Reducing Green House Gas Emissions - the easy bit

Global governments all agree that GHG emission reduction is imperative. Clearly, by focusing on domestic energy and general transport emission costs and methods, most people on the planet are quickly engaged and understand the source of these emissions.

That's the easy bit and in terms of planetary engineering control, step changes in these sources can represent the Differential component in a GHG PID control loop. High and fast impact.

(PID stands for Proportional, Integral and Differential, each factor being a contributing control loop mechanism that can be used to steer an automatic control system toward a target. Differential components are those that can react quickly to change).

Unfortunately, these simple aspects might account for say 40% of Global CO2e (GHG) emissions, the rest being made up of all other man-kind activities like making and selling things through business & industry.

Thus for Net Zero to be achievable, Global governing bodies need to engage with the remaining 60% of the problem i.e. Proportional aspects and longer term Integral aspects, and then agree on what makes sense as a solution for the Global CO2e control loop.

The Electro-magnetic spectrum clean up - A lesson from history

Over 30 years ago, the world came together in agreeing that the electromagnetic spectrum (radio, tv and communications airwaves) needed to be protected and preserved. Unregulated electronic equipment was generating unwanted signals (emissions) that were essentially polluting the airwaves and spoiling the operation of other equipment.

The solution was to agree some simple International Standards of Measurement that were legally binding.

Once these regulations were passed, designers and manufacturers frantically set about testing and redesigning their equipment so that it would comply with the rules and not produce unwanted emissions.

Rather like the ozone hole problem over New Zealand, engineers solved the problem within a matter of a few years.

By using Global Respect Numbers, exactly the same type of clean up operation should be possible.

What makes GRNs more usable than simple CO2e totals, is that the measurement system itself is designed to improve design and stimulate sustainable methodologies, thus providing a long term commercial driver for all types of product and process across the globe. It inspires innovation towards Sustainability.

The core additions to the simple CO2e totals are the inclusion of MTBF figures (product/process useful life) and Recycling Capability figures.

(MTBF : Mean Time Between Failure.. This is an engineering design calculation to compute when something is likely to fail.. It's practically the same as a product useful lifetime.)

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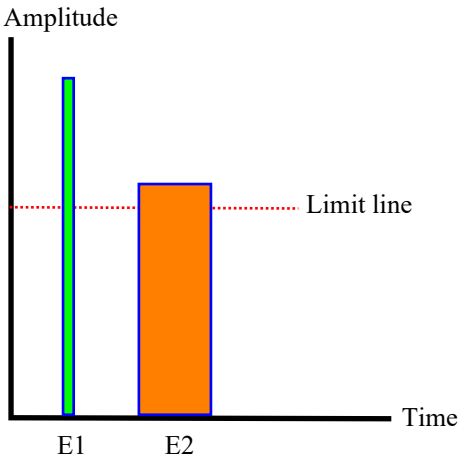
So what is a QUASI-PEAK Detector ??

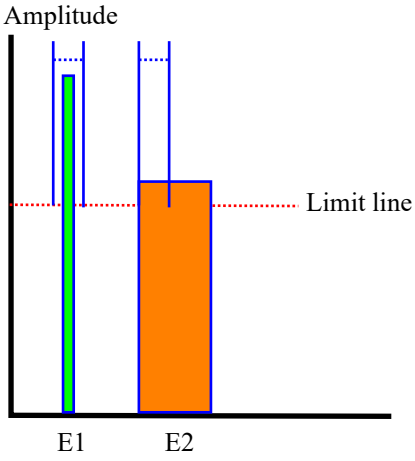
EMC emissions are akin to CO2e emissions. For the world to adopt EMC regulations, mankind had to employ the Quasi-peak detector !!! So what is it..

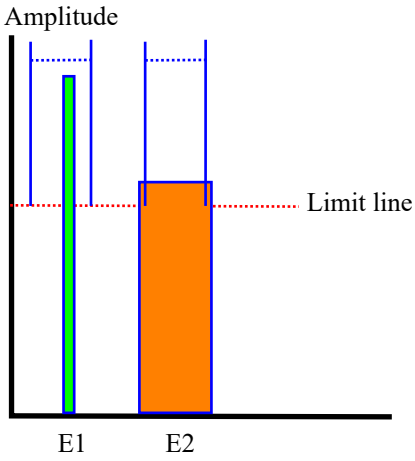


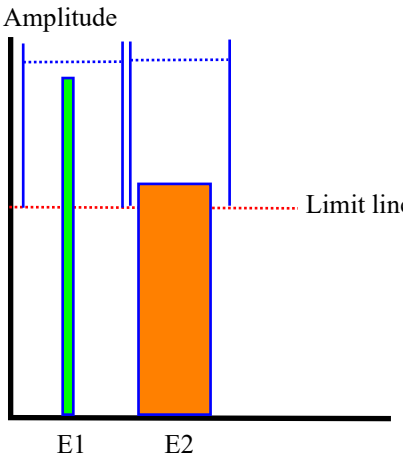
The graph to the left depicts two radio emissions, E1 & E2. We can see that the peak of E1 is significantly higher than the peak of E2, although E2 lasts longer.

The problem for EMC engineers was to determine which emission was more significant as a source of pollution.

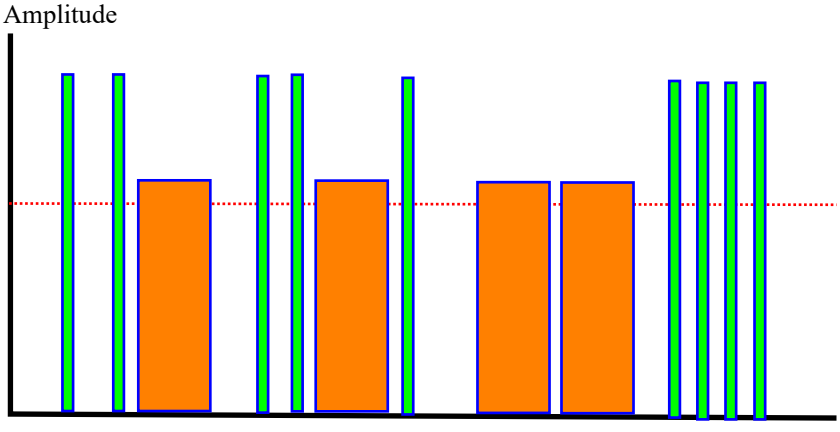
The key dimensional factor was of course TIME and TIME is a crucial consideration when sensibly trying to quantify CO2e emissions.







The three graphs above show three differing Quasi peak detectors, represented by the blue lines. By sampling the total emissions above the Limit line using a time based window, we can see that the E1 emission as a function of time can reasonably be considered less polluting than the lower peak, but longer duration, E2 emission. The quasi level measured depends on both the peak and the sampling period.



The figure to the left shows a more complex set of emissions - so which one is worse ??

The Quasi detector uses a <u>Time Interval</u> to determine a Quasi-peak level.

<u>The GRN system proposes that product lifetime sets the Quasi peak time window.</u>

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MTBF / Product Lifetime provides a good measure of Quality.

A London Brick may be designed to last for 200 years (MTBF = 200 years) and once used, it can be broken up and used for rubble, so perhaps 25% recyclable.

If it takes 1 tonne (1000Kg) of CO2e to make a brick, then using the GRN system, we can effectively compute the equivalent CO2e over time, in this case we'll use the year time scale.

So 1000kg, divide 200 years multiplied by 0.75 = 3.75Kg CO2e per year.

If we now take a plastic food pot that has a useful life of one month and uses 400g of CO2e in manufacture and is perhaps 10% recyclable, then we have

0.4Kg multiplied by 12, multiplied by 0.9 = 4.32Kg CO2e per year.

So despite a brick using 2500 times more CO2e to produce than a food container, this trivial example explains why product lifetime and recycling factor play a crucial role in determining the actual environmental damage done over time.

Common sense questions with a simple answer

Why is a disposable lighter cheaper than a refillable one ?

Why are rechargeable batteries more expensive than disposable ones ?

Why do so many products come wrapped in non recyclable polythene in giant cardboard boxes ?

etc.. etc..

Answer : The current reality is that Internationally agreed standards are hard to derive and broker. Some countries (and groups of Countries) prefer to legislate for specific issues and all will be keen to protect their own interests where possible. (*Slightly illogical in a global economy with a shared atmosphere ?*)

With EMC, the reality was that the electromagnetic spectrum was shared by everyone, so International measurement methods were needed to ensure electronic equipment would be compliant worldwide. The standards were simple, easily understood and hence take up was rapid.

With CO2e, the atmosphere is the shared medium and for International trade to progress in the direction of Net Zero, simple, clear and easy to implement standards and limits are needed.

It is clear all Governments will use taxation tools as a means to counteract GHG emissions, hence the setting and compliance with a measurable is a pre-requisite for both Local and International Law.

Consumption Change Crisis - Plant more trees ??

Planting more trees and cutting fewer down is helpful but is not the cure. Trees and the planet take a finite time to convert CO2e, which is why product/process life spans are an important consideration and should be encouraged to be maximised.

If everything designed and made in the last 10 years had been designed to last twice as long, then imagine the difference that would have made on global emission figures over the last 10 years. ***As an intelligent species, it is both curious and worrying that we have no idea what that difference would be ???***

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Apportioning responsibilities

While some CO2e "standards" suggest that manufacturers should take full responsibility from cradle to grave, there has to be a sense of realism in terms of who owns which process. Other "standards" suggest that it is optional and up to the manufacturer to decide which bits they want to measure and be accountable for !! Furthermore, while a product might be declared 100% recyclable, in reality, it depends on who disposes of it and how. Cheating the measurements and values, is as always, just cheating.

Thus, the process of potential recycling is usually outside the scope of the manufacturer but provides an opportunity for somebody else to effectively create a CO2e balancing contribution. *The EU and others tried a return to sender policy, but it never got going.*

For Net Zero, we need Net Negative contributors to balance the Net positive GRNs e.g. Tree and crop growers, Green energy etc..

A field of crops will absorb CO2e for a finite time (MTBF) with a high recycling factor. Hence, by truly measuring these contributions, net positive GRNs can be offset by all those dynamic assets classified as Net Negative. We simply need to put practical figures on the negative GRN values.

A field of corn in the UK will do the same job as a field of corn in China or the USA, so we already have the basis for natural measurement standards.

Innovation got us in this mess, it can get us out !!

Innovation does not just apply to products and processes, it can also apply to financial and political mechanisms.

While a field of crops may have a generic negative GRN value, those individual values can be improved by honing the processes used to grow those crops, hence an opportunity for localised innovation. As with products, a field of corn with a demonstrably better negative GRN value becomes a more attractive opportunity for investment.

Why are there so many kettle designs ?

In considering how I might find CO2e, MTBF and recycling figures (GRN values) for all the components in my product design, core engineering design skills started to re-surface. (*Like how to compute an MTBF figure*).

I considered my simple kitchen kettle and realised the huge potential for improvement if GRNs formed the core basis of the design process. (*Long lasting replaceable elements for example !*)

To my surprise and from school boy physics, I realised that a kettle designed to heat water to just below boiling point would save the planet vast amounts of electricity in wasted latent heat energy conversion and steam.

That is innovation.. i.e. A fresh and different train of thought that detects and solves problems previously not considered. The broad GRN principle provides a good driver for fresh thought.

The UK NET ZERO Law is simply a demand for Industry Wide Innovation

To get going, everyone needs to be using the same units of measurement

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Primary advantages of the GRN apporach

CO2e emission values for various GHGs are weighted against a CO2 standard. These other gases have multipliers to indicate the comparative damage versus CO2. They also have comparative atmospheric absorption rates against. Thus, it is already intuitive to use scaled comparison numbers and indeed, introduce comparative scaling with time.

The GRN approach offers the intuitive advantage of being able to make immediate comparisons while simultaneously, driving the contributing factors such as design and materials in a direction that is more environmentally friendly. Such a measurement system would automatically promote commercial competition toward Net Zero.

Knowing that a London brick might take 1 tonne of CO2e to make compared to a plastic container that requires 400g of CO2e means very little. It is not intuitive. To compare 3.75 to 4.32 gives an immediate feel for the relative damage of either.

Better processes and design

When a washing machine as 400 watts worth of load to deal with, the designer has the choice of using a 450W motor or perhaps a larger 600W motor.

Current costing methods would tend to favour the "cheaper" and perhaps smaller motor.

In computing an MTBF and GRN, there is a paradigm shift in the way the designer perceives the cost.

With GRNs published with products, consumers can also make informed choices.

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Ultimately mankind (and many other species) will have to pay the cost of environmental damage. It therefore makes sense to start to view "**actual costs**" in a more holistic and understandable way. In doing so, the business and commercial world can begin to talk the same language across the globe.

It is wrong to state that you have cut your emissions by 50%, if you do not have the mathematics to prove what the 100% was in the first place. **Proper measurements and values promote TRUST.**

Redefining our resources and assets

For years, people have grown vines to make wine.

To think of a vine as having additional value by way of a Negative GRN is a recommendation for progress.

CO2e can be likened to a natural resource of which we have too much. Worse still, we keep making more and we're struggling to get rid of the stuff.

For a stable planet, perhaps it's time to put an easy to understand equivalent value on each and every thing that requires or (produces) CO2e.

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Common Sense Examples and Conclusions

The Quasi-peak method essentially relates pollution, emissions or absorptions to time. The GRN method does the same.

To achieve balance (Net Zero), consumption must be balanced with absorption, hence units of measure should include a time related function that is also related to the useful use of the resource.

If we take our global differential control function (fuel / energy), we see that sea freight is lower CO2e than air freight. Why.. because of the rate of consumption.

Consideration 1 : If you take 1Kg of Aluminium that has a fixed total of CO2e in it's manufacture, you could make say 250 Cola cans or 1 bicycle wheel. While you can argue the cola cans might get recycled to some extent, chances are they will last at best a year compared with a wheel that lasts 25 years. It's fairly obvious how the use and misuse of resources has a different effect and as such, it makes sense that consumer product and service prices are adjusted accordingly and in Proportion - (Proportional Control element of PID).

Both products can still exist, but the CO2e effective cost is different and hence should be calculated as such.

Consideration 2 : 200g of plastic might make a bicycle pedal that lasts for 20 years, whereas the same plastic might be used to make throw away butter containers. Do the maths and then ask, how does that compare to butter supplied in a tin foil wrap. Similarly, 200g of plastic could make some throw away Christmas Cracker toys. In all cases, there is a price to pay and it should be proportionate to the useful application of the resource applied and consumed.

Consideration 3 : Does a brewer know the CO2e difference between the beer supplied in a bottle or the beer supplied in a can ?? If not, why not ?

Consideration 4 : What is the effect of putting shaving foam in a pressurised tin compared to that of an old fashioned shaving stick.

Consideration 5 : The world is sensibly fixated on the life time of Nuclear waste, so why not become fixated on the life time use of CO2e using GRN numbers.

Consideration 6 : Car Tyres are available with different grades and ratings. I imagine the CO2e total of each will be quite close for all of them and yet, some will last 50% longer. GRNs would help make that differentiation in terms of waste and recycling.

Consideration 7 : As with car tyres, many items are the same but slightly different e.g. Kettles, Clothes pegs, batteries etc.. The CO2e figures for each category will be quite close, but the long term effect on the planet through efficiency, disposal and recycling will not.

This is why I think **Global Respect Numbers** would make more sense for most people.

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Common Sense Examples and Conclusions

The GRN system is designed to encapsulate that which we already know and have proven with other forms of pollution. It could be applied for other resources and pollutants.

As with energy and fuel, as people start to re-imagine the useful life of the resources they have, the notion of actual cost starts to change. With an agreed measurement system, we can start to relate and regulate these things properly and proportionately to currency and then low and behold, everyone is talking the same language.

The world is a global trading arena where energy and fuel types are interchanged through International Imports and Exports in the crude form as well as encapsulated in converted items. In this regard, energy and fuel related CO2e emissions could be considered as a gradually declining global value. At the same time, the ability for the world to absorb such emissions is a gradually changing global value.

Thus, bean counting CO2e emissions on a per item, per country basis in reality has marginal effect or benefit. Obviously there are political gains and loses, but overall the process is limited.

Global Respect Numbers are designed to make people think and compute the values that will help make a long term reversal and improvement.

Essentially they ask and evaluate the following :-

GRN = GHG x Quality Level x Recycle Factor.

If GHG is a slowly reducing global constant, then QL & Rf are much more important and controllable.

For any item or process…

1. What is it's useful purpose and efficiency ?
2. How long will it last ?
3. How much of it can be recycled ?

It also works for trees, in reverse,

Simple really…..! as an educated opinion.

Mark Aherne : 21st June 2022