Defining Sustainability and Its Metrics

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In the present world, new kinds of innovations with various technologies and business ideas are being produced every day. In this situation maintaining and developing sustainability has become a crucial matter for everyone in order to ensure the betterment of future generation. Although everyone is aware of the importance of sustainability in the present world, it is challenging to define the metrics of sustainability. Currently, the parameters on which sustainability is measured or defined are not properly clarified. Moreover, we think that present approaches of defining and maintaining sustainability are incomplete. This paper originally illustrates current approaches of defining and maintaining sustainability, common metrics of sustainability and represents a new approach of defining and maintaining sustainability with some additional metrics. Then, it addresses some of the popular philosophical views related to sustainability and represents arguments against those in order to establish the foundation of the new approach.

The remainder of the paper is organized as below: in the first section of this paper, the main ideas of current approaches and the new approach are illustrated. Second section of this paper highlights some popular philosophical ideas about sustainability and represents the arguments. Third section of this paper relates the new philosophical views with the new approach of defining sustainability.

What is the current approach to define sustainability?

1. Current approach considers the sustainability of only one 'element'. It does not consider how the life-cycle of that element is going to impact other elements related to that.
2. In order to maintain sustainability, current approaches have to consider many parameters that are affected by that single element, which is complex to measure and determine.
3. Current approach gives a lot focuses on reducing energy consumption in order to achieve sustainability, which we believe is wrong.
4. Current approach addresses the model based on the metrics in three sectors: Environment, Economy, and Ethics – which sometimes cannot explain long term effects.

What is the proposed approach?

1. The new approach proposes a system of many elements that are related to each other, and considers the impact of one element to other elements.
2. This approach looks to the whole system from a higher level of abstraction. It concentrates only on some focal parameters related to the interaction of elements in that system.
3. New approach believes, more focus should be on detecting the total demand of energy rather than reducing energy consumption. This is because, without defining energy demand, reduction of energy consumption in a particular sector will not bring positive outcome.
4. New approach addresses the model based on the metrics in five sectors: Environment, Energy, Ethics, Economy and Innovations.

Figure: New Approach to Define Sustainability

An Example:

Let's take into account a new technology in order to understand the above ideas with respect to each approach. We have to figure out whether creating that technology is sustainable or not. For example, we can consider a new pdf like technology which helps consumer to read any books online with their phones or laptops with the help of touch screens. We can call it product X. We want to decide if using product X is more sustainable than using books or not.

Current Approach:

1. With current approach we are focusing only on the sustainability of product X. From linear point of view, it is a sustainable product because it is reusable and it is not increasing GHG as creating books do. But we are not thinking how much the manufacturing of product X is affecting the manufacturing of paper production, how many people could be unemployed for this situation etc. Over all, with this approach we are not thinking of other elements, and therefore approaching with a bottom-up point of view where it is not possible to think of many other elements.
2. In order to decide its sustainability we need to think of thousands of parameters on which its manufacturing will be affecting. A few examples of parameters in this case scenario would be how much energy it is producing, how much comfort it is providing to the consumers, is it good economically, how much fossil fuels are in use to manufacture it, is it hampering any other life besides human being etc. Trying to come up with all the parameters and trying to make the product sustainable with respect to all the parameters is very complex with this approach.
3. According to current approach popular philosophy is to give all the focus on calculating how much energy is being created by the manufacturing and use of product X, and trying to reduce the amount of energy consumed during all of those processes.
4. Current approach is only thinking of measuring the sustainability of product X with respect to Environment, Economy and Ethics.

New Approach:

1. Our proposed new approach mainly focuses on a System of many elements which are inter-related to each other, and tries to examine the effects of each element on other elements from the top level or a more abstract level. We are referring to this approach as the Top-down approach of elements. If we consider the situation of product X, our approach points out product X as the main element, and also examines other elements like Paper mills, Minerals, Electricity, Employment etc. It reflects to all the effects that has been made on the other elements by product X, and therefore can make a constructive decision about how to progress with the overall manufacturing. If any other elements or industries are hugely hampered by product X, then it can minimize the production if necessary. For example, if it turns out that production of this technology is going to abolish the remaining gold or any other minerals in near future the whole process can be stopped if necessary. As the system is divided into some main elements, the responsibility of finding out each element's sustainability is divided too. So dealing with many elements is not complicating the process but making it easier.
2. Similarly in this process we are analyzing how the manufacturing of the product is going to affect some main parameters from a top-down view. As we dig deeper into each parameter we will be able to find out more parameters related to the particular parameters. So with the new process there are still thousands of parameters to consider but it is easier to deal with because the responsibility of finding out the effect is divided into only a few parameters.

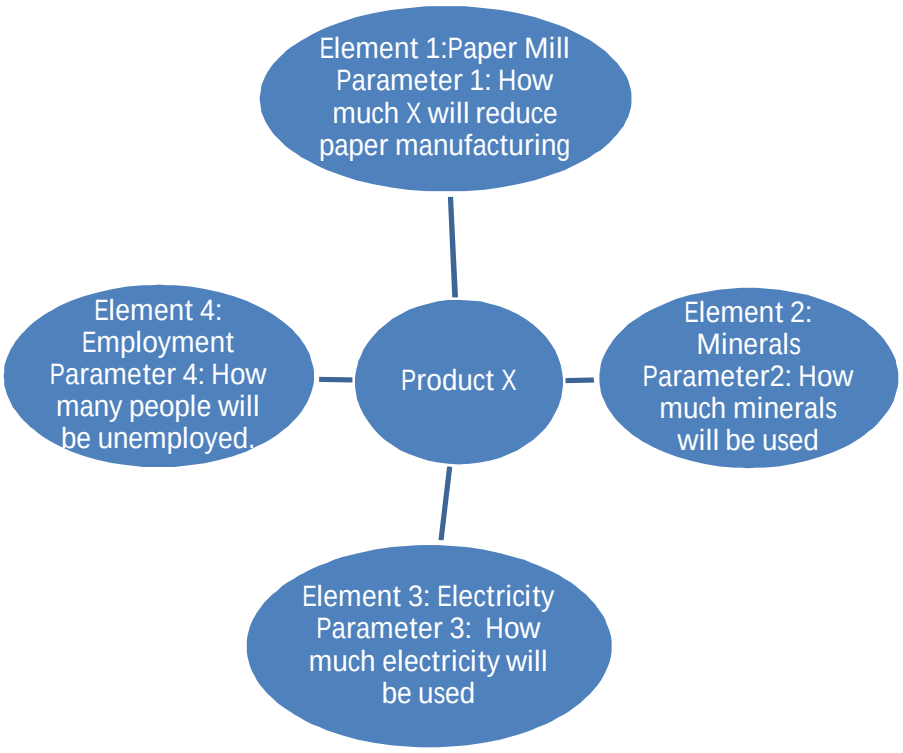

Figure 1: New Approach with many elements and parameters

3. The main focus of the new approach is not reducing the energy consumption of just one product. It calculates the energy production of the whole system including all the elements. Depending on the result it can take a sustainable decision. In the production of the new technology, new approach calculates energy consumption of product X. If product X is reducing energy consumption, then it informs paper mills to reduce their manufacturing of papers slowly within some years and gives a plan for employment options for the employees of the papers mills. This way we ensure that energy consumption of product X is replacing the energy consumption of papers, and so as a whole system we are not creating extra energy.
4. Current approach considers the effect of product X with respect to five sectors: Environment, Industry, Energy, Innovations and Ethics.

To summarize the new approach, we are looking at the facts from the top, where there are systems of inter-related elements. Each element has a lot of parameters to figure out individual sustainability. But a system has just a few parameters because of higher level of abstraction – only the parameters which communicate between the elements are responsible for the system sustainability. We will define all of those system level parameters in order to achieve sustainability of the system. Then we will go in deep of each of those elements and will try to define other parameters. The abstract definition of the parameters will help to sketch the model of sustainability, while the detail level works in an element will strengthen the sustainability of that element. Then, the process will be focusing on the overall demand of energy consumption. Lastly, sustainability of a product/technology/ service is measured with respect to five pillars: its environmental impacts, its impact on industry or economy, overall effects on energy consumption, innovation of this product and further innovation scope in future and people's comfort.

We want to state the fact that, according to the proposed approach, sustainability cannot be defined for a product or a service. It is a process, a philosophy that makes policies for sustainable development of a system of products/services during a certain time.

Explaining the Proposed Approach with Another Example:

Sustainability of one element can affect many other elements. Even it can, sometimes, hamper the sustainability of some other elements. For example, we can consider the situation when a consumer of a sustainable light bulb decides to use the bulb in order to save some energy. With a linear point of view, it might be a sustainable idea to save energy as it saves energy and money. But if we look into the deep of this situation, it might not reduce Green House Gas (GHG) emission. The reason behind this is, other part of the system, meaning the producers of electricity, might not know that some consumers have decided to use less electricity (unless smart grid is implemented). So they produce the same electricity causing more wastage of electricity which results in similar green-house effect. If we take in to consideration the producers of older light bulbs and these newer light bulbs to compete for a certain amount of time, for say two years, the overall industrial chemical disposal and other pollution will increase. So just because, the process of bringing new light bulbs by a new company is not managed and monitored properly, the overall process will bring more bad than good.

So considering such intertwined situations, it is really difficult to define the metrics of sustainability with a linear point of view. But we believe it is possible through a different kind of perspective of considering a system of elements. Rather than looking at one element to measure the sustainability of the overall scenario, we have to look at it from the top with a higher level of abstraction. We can consider a system

of, at least, three elements – electricity producers, old bulb producers and new bulb producers. These elements are inter-related parts of the whole bigger system. The whole system takes into account the amount of energy which is being saved by the new bulbs, the amount of energy which is being produced from the producers and the amount of business loss of the old bulb producers. If the whole system is able to predict and monitor all these parameters, it will be able to define all the metrics where all these elements will have sustainable inter-relation and coexistence in the system.

One thing is very clear that economy, environment and ethics (people's comfort) all these parameters have one parameter as common: energy system. And energy is the greatest cause of environmental pollution. This is the reason why all current definitions of sustainability often work with reducing energy consumption. Industry - the basis of economy - always needs energy, life-style of the consumers depends on energy based products or services and the energy production process emits GHG (Green House Gas) and other substances which pollute the environment. So it is obviously the most influential parameter, but not the only parameter. And because of the focus on reducing energy consumption only, ignoring all other parameters, sustainability could never be defined completely.

We want to consider sustainability as a function of many inter-related terms, energy being at the center of all those. It might be the case that energy plays the most significant role, but unless and until we consider all of the parameters, it will never bring fruit-full sustainability. But as there are hundreds of parameters looking from the bottom, it is almost impossible to define.

To define sustainability more clearly, or to define the metrics for sustainability, we not only have to work with the three sectors of sustainability - economy, environment and ethics - but also have to look into details of each of the parts and their inter-relations. A good example of this concept would be the economic sustainability - economy of a system works very closely with its consumers' life-style, social situations, politics, energy management of the particular country, natural resources, industries, technological innovation etc. other sectors. So when we talk about economical sustainability, it is a complex thing of many other parameters.

I agree with Heidi: “Environmental sustainability could be analyzed through the planetary boundaries as Henri mentioned, but that only covers one part of the sustainability concept”. Henry covers the environmental part very nicely and with more detail work. We can keep that for environmental part. We have to now find the detail metrics for other parameters as well. The only problem here is – environmental metrics could not be measured independently. Because they are very much related with other sectors, we have to consider an ecosystem of all those sectors and then decide the metrics of each of them.

We think that five sectors can complete this ecosystem and can define the sustainability and the metrics of sustainability for a certain element. It gives us a process of sustainable development which is applicable to a system of elements. We call it EIEIE Ecosystem which depends largely on defining the global need of energy.

EIEIE Ecosystem

EIEIE ecosystem is a model which represents a balanced coexistence of different other models, i.e. economy, psychology, environment, politics, philosophy, sociology etc. But mainly, it is the policy-making system which provides solution that is energy-wise, industrially and environmentally sustainable taking in consideration innovation and people's comfort. It is just a probabilistic model that will help make policy adjustment in terms of sustainable development.

As we stated earlier, energy is a very important parameter and we consider sustainability as a function of energy. But at the same time, we want to consider other parameters with equal importance and consider those as well. Our proposed approach does not focus on reducing energy consumption. It focuses on defining the global need of energy consumption.

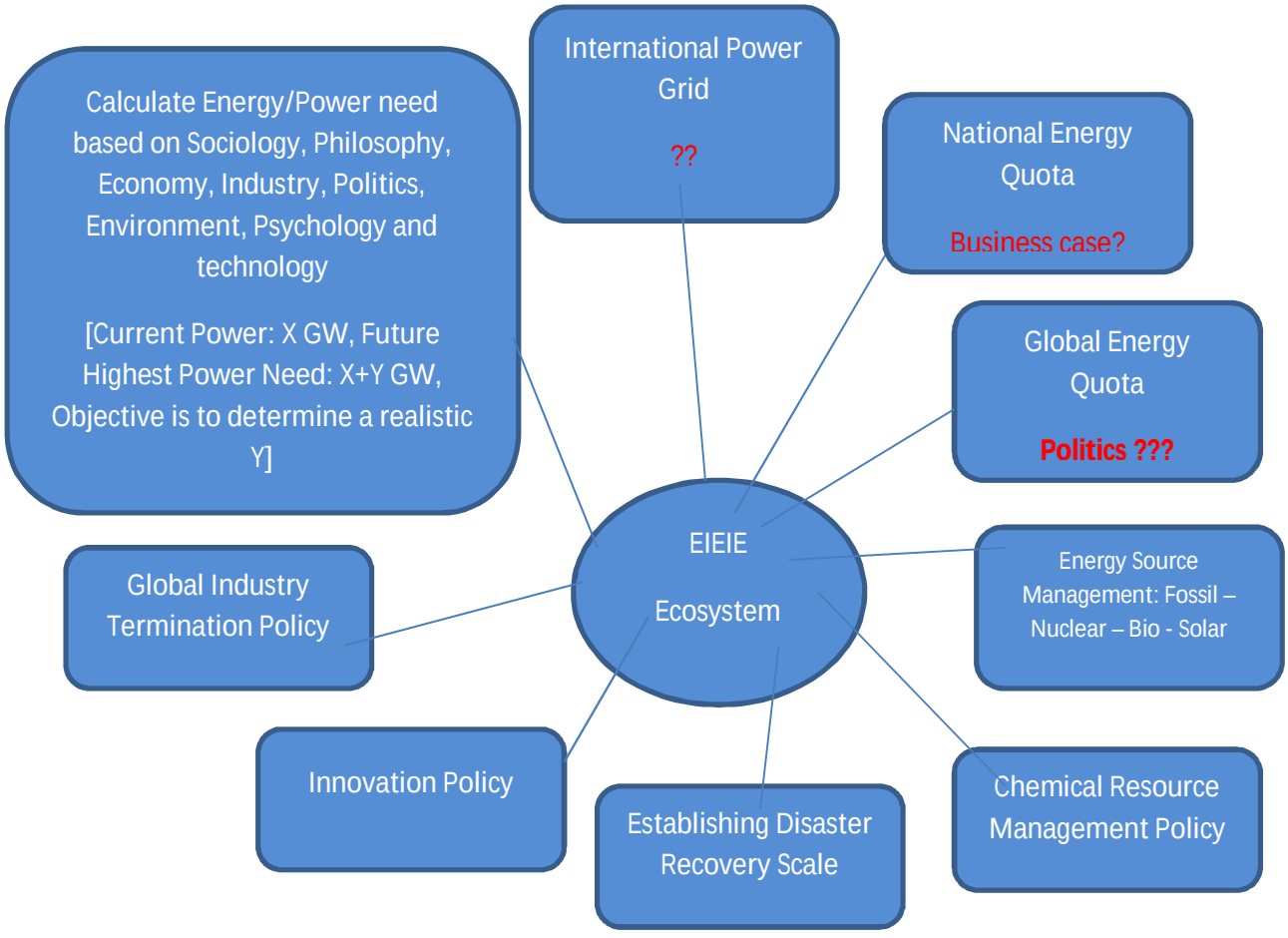

Figure: Defining Energy Need according to the Proposed Approach

Current model of energy production is: if you need energy, produce energy, no matter what the source is – by using fossil fuel or solar resources. If we don't produce energy, the overall industrial growth will be hampered. This model has the fundamental flaw; it never assumes how the source of energy will impact on environment in short and long term. To work with this flaw, first of all, we emphasis on the point that gradual shifting towards solar resources is a must 'do'. At the same time, we want to establish a relation in terms of coexistence of energy, industry, innovation, comfort and environment in the same system-design platform. In this way, we will not produce energy as per our need, and we will not hamper the industrial growth either. The EIEIE ecosystem will ensure the industrial growth in a sustainable way.

Following section will try to establish some argument in support of our proposed model.

Argument of the First Philosophical Point of View - Trying to use extra energy efficiently instead of reducing energy consumption:

We think that an EIEIE ecosystem can achieve sustainability, though it cannot guaranty the reduction of energy usage. As per our thinking, reducing energy usage is not our top most priority; we deem this as a contrary to the human nature of "use-more-habit". This is the most natural and spontaneous instinct of human – that he always demands more. The industry, knowledge and civilization have one thing in common - growth! The growth of the economy, culture, education, science, technology – everything was based on this never ending demand/thirst of human. And to support this growth, energy usage must increase [cradle to cradle] As a result, the very thought of reducing energy usage have been a research/theory model for quite a few years now, but practical implementation has not been possible. That's why we believe, quota/incentive system cannot reduce the use of energy at all. It is just a regulation that can reduce the wastage of energy and can decelerate the growth of energy use.

From a different angle (just to make clear about the importance of EIEIE ecosystem), many people argue on the fact that we have to reduce the use of energy in our daily life to achieve sustainability. It is agreed, but the way it can be achieved is really difficult. That group of scholars thinks that personal incentives to save energy can boost them to reduce their usage. Some of them think that a limitation on personal usage can help the cause. They now want to monitor the usage of a person properly so that a good method of personal incentives/ personal limitation can be figured out. Even they think, incentives can be given in terms of direct money too.

First of all, this is really difficult to devise a proper monitoring system of the usage. Second of all, we think that it will not reduce overall energy consumption. If a person is given some money back as an incentive because of his personal savings of energy or using less than personal energy limit, that person is going to use the extra money in something else. May be he will buy some more chocolate, which will result in more chocolate production of that chocolate company resulting in more energy to produce that extra chocolate. May be he will save his money in a bank, which will result in that bank being more capable of investing more money in some industry, resulting in more demand of energy. In no way, this incentive or personal limit can help the overall energy reduction, the overall sustainability.

Argument of the Second Philosophical point of view - Solar energy cannot be Unlimited!:

As all industries are run on energy, achieving 'sustainable' growth of the industries depends completely on the 'sustainable' availability of energy. If we consider that both fossil and solar energy are 'finite' or limited, we have to understand that all current campaigns/researches/activities in favor of solar energy are not enough. Efficient use of solar energy is a must, we do not argue against this point; shifting from fuel energy to solar energy is important, we do not argue on this point either. But at the same time, it is important to think of the "ecosystem of energy, industry and environment" as an overall system. Unless and until we design a good ecosystem of these three elements, we might get temporary solution to the current danger, but overall sustainability could never be achieved. Rather, always problems will be created as byproducts of the solution.

Now, we want to explain how we could consider solar energy 'finite'. The word 'infinite' is used relatively. Nothing is infinite in this world; everything has a finite measurement. Sea/ocean is not infinite any more for a man, but for an ant, it's still infinite. So the 'infiniteness' completely depends on relative perspective. From this point, the fossil energy is also finite, and so finite is the SOLAR ENERGY!!

It must feel ridiculous to think that solar energy is also limited. But the fact is: one hundred years ago, when industrial revolution occurred, everyone thought fossil energy was unlimited and used it in abundance. After one hundred years, now, we know that fossil fuel is decreasing every single day. There are other good examples too. At the beginning of the internet era, IPv4 was thought to be a lot, but after all we ended up with IPv6 and all the mess due to the transition between v4 and v6! Now, the scientists think that IPv6 is infinite in number, but we want to believe that it is really finite. There is a fixed number. It seems huge now, but who knows, may be in future we will be looking for a v7 (depending on the future use, perspective etc.)!

So, from energy and environmental point of view, while designing a solution of the current problem of climate change, it would be wiser to think that solar energy is also limited. [Even if solar energy is not limited, the materials by which solar energy is converted to electricity (chemicals, solar panels etc.) are of course limited (need to investigate in detail)]. And we have to design the solution of the climate change problem based on this fact. It will help us plan properly for the unseen future.

Argument of the Third Philosophical point of view - Carbon Trading cannot help the situation:

CARBON TRADING [need to investigate in detail] seems to be a viable solution for everyone. It is true that carbon trading creates some progress in industry level. It focuses on reducing the energy usage of individual company. Every company has a quota of its energy usage. If it exceeds that quota, there will be monetary penalty or it needs to buy the extra amount from some other company. If it saves some energy, the amount it will save could be sold to other companies who need it. This is a good way to regulate overall use of energy. It makes big companies care about their energy usage and of course, is better than the previous situation. But it actually focuses only on the energy usage portion. So when needed, big industries will anyway use the extra energy - by giving penalty or by buying from others. As a result, we believe it will not help us achieve sustainability globally.