Electricity will be dominating the entire energy system, with transformers as the key component

How important is sustainability?

ABSTRACT

Sustainability has been the subject to very dynamic discussions in the scientific and technological communities during the last a couple of years. However, as the approach is relatively new, there are still many different views on the topic in terms of what should be covered by this subject, what metrics should be used, what limits should be set, etc.

This article focuses on this topic based on an extensive Transformers Magazine's Industry Navigator research.

What is sustainability?

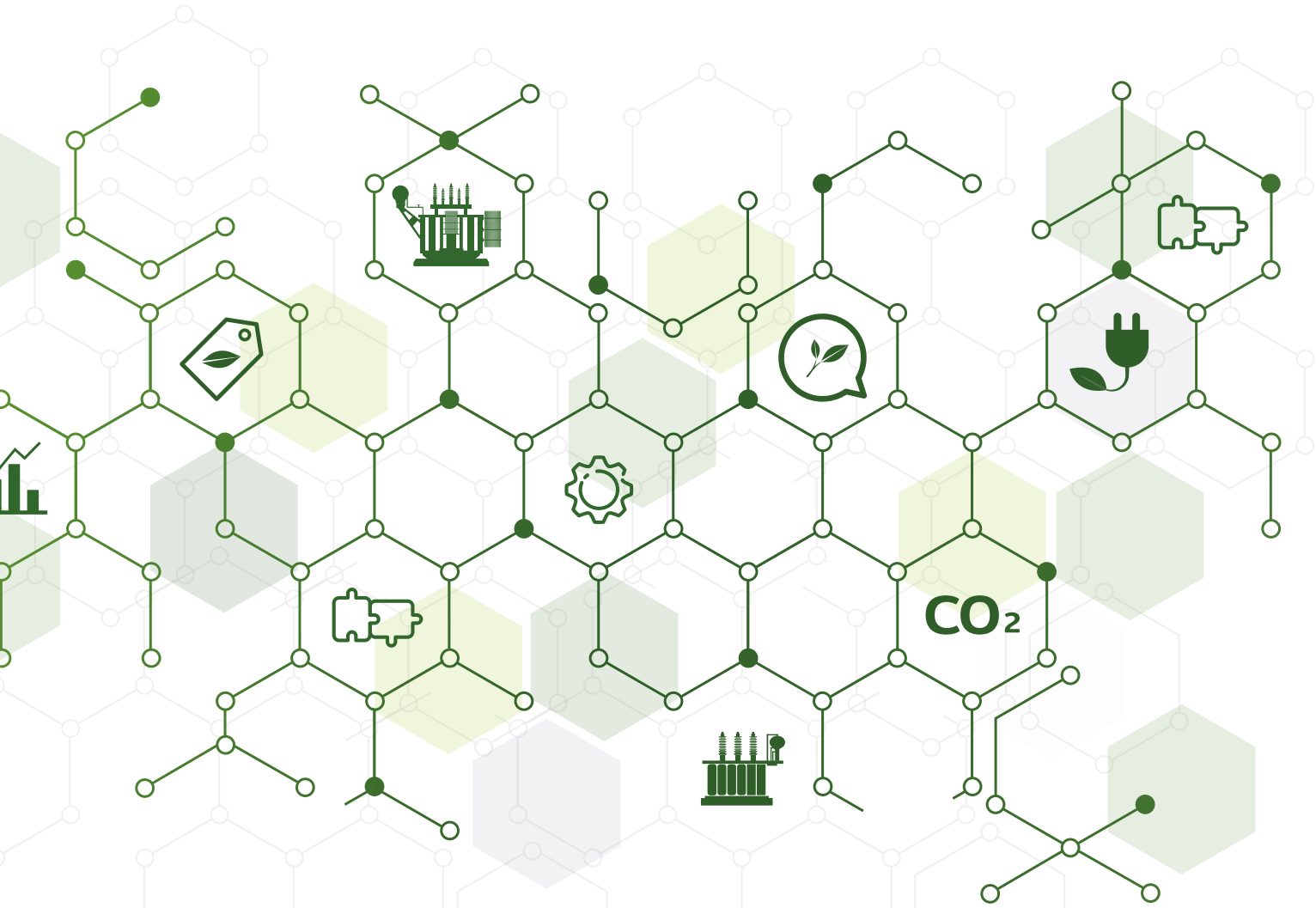
Sustainability has been the subject of very dynamic discussions in the scientific and technological communities during the last couple of years. However, as the approach is relatively new, there are still many different views on the topic in terms of what should be covered by this subject, what metrics should be used, what limits should be set, etc. So, many details still need to be clarified and communicated in order to achieve a common understanding of all stakeholders and use a common approach to improvement of sustainability.

This article focuses on this topic based on an extensive Transformers Magazine's Industry Navigator research, conducted in 2021 [1]. Among other topics, the research has explored a couple of key questions from the framework of sustainability.

How to improve sustainability?

The part of the research covering sustainability was designed with the focus on the entire value chain of transformers, and considering a couple of fundamental assumptions.

The first one is the forecast that, due to an increase in population and also in energy consumption, the electrification will almost double by 2050. This implies that electricity will be dominating the entire energy system, with transformers as the key component.



The second assumption is related to ambitious goals of reducing the carbon footprint, with the ultimate goal of limiting the effects of the global warming (e.g., 1.5 °C above the pre-industrial levels). The International Energy Agency has presented a scenario for power sector emissions with an average decrease by 7.6 % per year until 2030 and a complete decarbonisation by 2040. A major part of the carbon emissions comes for the losses in operation. Transformers, despite having a very high efficiency, even beyond 99 %, contribute to some 5 % of electricity losses, and therefore our research has been strongly focused on losses.

The plans for improvement of sustainability also include protection of local ecosystems, responsible use of resources, enhanced safety, etc.

What are the options?

Therefore, in designing the research, we wanted to gain a better understanding of the importance of sustainability (bio-based carbon content, circularity, etc.). We also presumed that trends and dynamics could be different in developed countries than in developing countries.

However, any discussion about sustainability without a reflection on costs would not provide a complete picture. It is critical to find out how much sustainability costs, and equally important, how much we can afford to invest in sustainability and how much we are willing to pay for it. We also need to determine the focus of our efforts. The options can be: losses, life extension, biodegradable fluids and other materials, digitalization, etc.

Some think that implementation of sustainability could be pushed through the supply chain by implementing certain criteria that are in favour of circular economy. However, the question is how far this should go along the value chain and what would be the right way of measuring sustainability? For instance, how to compare the use of composite materials and materials that are easier to recycle? If we can measure that in a similar way as for the capitalisation of losses, for example, that would be excellent.

Finally, there is one basic, but fundamental question - what is the priority: cost or sustainability?

Based on the above, we can probably agree that the framework of sustainability is still pretty much undefined, but starting to discuss it we can see the impacts this may have on design, selection of materials, end of life, recycling, etc. In any case, we should start discussing this within the industry.

The research

In the Transformers Magazine's Industry Navigator research, we have collected 261 responses. Having a sufficient number of responses provides an opportunity for various analyses.

In this article we will present and discuss results based on responses to three questions on sustainability from this research. All results are provided in the complete report [1], while a conference with indept discussion on the same subject is also available [2].

Implementation of sustainability could be potentially pushed through supply chain by implementing certain criteria that are in favour of circular economy

How do you perceive a green or eco transformer?

The purpose of this question was to better understand the perception of widely used terms green and eco transformers. This could seem a simple question, but as these terms do not have strict definitions and as they are frequently used in written and oral communication, understanding their perception is very important. Possible answers are listed in the left column of Table I, while the results are on the right hand side of the table. There are overall results calculated based on all responses in the research, results of responses relating to small power transformers (SPT column), and results of responses provided by the so-called end-customers (respondents from companies that operate transformers). Results are represented by the score and rank. The score is calculated for each answer using a formula that takes into account the number of times the answer has been selected and rankings of the answer in individual responses. The rank is calculated according to the scores (the answer with the highest score has the ranking 1, the answer with the second highest score has the ranking 2, and so on).

So, we can see that in the overall results 'Transformer with lower losses' is mostly perceived as a green or eco transformer. On the second place, we have 'Transformer filled with biodegradable fluid', and 'Transformer with recyclable materials' holds the third place.

When we observe the responses related to small power transformers, the order is a bit different, with 'Transformer filled with biodegradable fluid' mostly perceived as green or eco transformer.

When we take the responses provided by the end-customers, the first and second answer on the ranking list is the same as in the overall results, but on the third place we have 'Transformer with better maintainability and operation'. The latter option is very low on the ranking list of overall results and the results for small power transformers, and shows how different groups can have different views on the same subject.

Transformer with lower losses is mostly perceived as a green or eco transformer

What should we focus our efforts on in order to improve sustainability?

The purpose of this question was to identify areas where the focus of the industry would yield the best results in improving the sustainability, Table II.

Based on the overall results, the most promising direction of improving the sustainability is to focus on losses, while based on the responses relating to large power transformers (LPT column), biodegradable fluids are the most promising option. Responses provided by people working for transformer manufacturers (OEM column) indicate that digitalisation is a more promising option (rank 3) than in other groups of responses.

What will be your priority in the following five years in terms of balancing between the cost and sustainability?

This is a key question in gaining an insight into priorities –sustainability or cost, Table III. For a vast majority of respondents (55.3 %), sustainability and cost are of the same priority, while sustainability is the priority of 19.4 % respondents, and cost for 14.6 %. However, if we look at the responses relating to power generation, transmission and distribution, we can see some differences. The figures indicate that the sustainability has the highest priority

Table I. Perception of terms green and eco transformer

	Overall		SPT		End customers	
	Score	Rank	Score	Rank	Score	Rank
Regular transformer painted in green	3.16	9	3.36	9	3.71	8
Transformer with lower losses	8.48	1	8.19	2	8.57	1
Transformer with recyclable materials	7.48	3	7.50	3	6.14	4
Transformer filled with biodegradable fluid	8.14	2	8.33	1	7.57	2
Dry transformer	5.11	6	5.19	5	3.57	9
Transformer that can be retrofitted	5.27	4	5.08	6	6.00	5
Transformer with a lifetime of 50 years	5.16	5	5.39	4	5.57	6
Transformer with a modular concept	4.45	8	4.36	8	5.29	7
Transformer with better maintainability and operation	4.98	7	4.69	7	6.29	3
Transformer with a short lifetime which is then fully recycled	2.78	10	2.89	10	2.29	10

Table II. Areas where the industry could best improve the sustainability

	Overall		LPT		OEMs	
	Score	Rank	Score	Rank	Score	Rank
Losses	5.38	1	4.94	2	5.10	2
Biodegradable fluids	5.02	2	5.09	1	5.25	1
Life extension	4.67	3	4.41	3	4.20	5
Digitalisation	3.89	5	4.00	6	4.40	3
Circular economy (more recycling)	3.98	4	4.03	5	4.25	4
Carbon footprint	3.76	6	4.24	4	3.75	6
Something else	1.29	7	1.29	7	1.05	7

Table III. Priorities: sustainability or cost

	Overall		Power generation		Power transmission		Power distribution	
	Pct.	Rank	Pct.	Rank	Pct.	Rank	Pct.	Rank
Cost	14.6%	3	19.5%	3	19.6%	3	17.0%	2
Sustainability	19.4%	2	22.0%	2	25.5%	2	15.1%	3
Cost and sustainability will have the same priority for us	55.3%	1	48.8%	1	47.1%	1	60.4%	1
I don't know or N/A	10.7%		9.8%		7.8%		7.5%	

in power transmission, then in generation, and after that in distribution.

The Transformers Magazine's Industry Navigator research included 52 important questions, and provided valuable insights that can be useful when making important decisions.

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The most promising direction of improving sustainability is to focus on losses

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