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Environmental Performance Assessment Model as a Sustainability Decision Tool for Small and Middle Sized Enterprises

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***Abstract*—**Paper deals with environmental metrics and assessment systems devoted to Small and Medium Sized Enterprises. Authors are presenting proposed assessment model which has an ability to discover current environmental strengths and weaknesses of Small and Middle Sized Enterprise. Suggested model has also an ambition to become a Sustainability Decision Tool. Model is able to identify "best environmental decision" in the company, and to quantify how this decision contributed into overall environmental improvement. Authors understand environmental improvements as environmental innovations (product, process and organizational). Suggested model is based on its own concept; however, authors are also utilizing already existing environmental assessment tools.

***Keywords*—**Corporate Social Responsibility, (e)IMPACT model, Environmental metrics, , Small and Middle Sized Enterprises

I. Introduction

NOWADAYS alarming question is not whether we should switch from carbon economy into utilization of direct and indirect energy from the sun or whether we should use more efficient and climate benign technologies. The today's principal problem is how to do it. According to opinion of authors of this paper, a profit based metrics is not an accurate measure of success in the business. Definition of the success in the business must be redesigned (changing GDP into GDWelfare); the whole world strives for complete turnaround in a field of business performance assessment. We must change the basic definitions of success if we want to see companies actively reducing their negative environmental impact. We have to realize the "win-win" solution for both – companies and environment. It must be worth to proceed with environmental friendly innovation – stakeholders must be responsive to environmental performance assessment results, and governmental bodies have to enforce the legislative actions in the same way [1]. Paper introduces a universal model for environmental performance assessment of Small and Middle Sized Enterprises (SMEs). According to annual report on SMEs prepared for European Commission, SMEs represent 99.8% enterprises operating in European Union (EU) and employ 66.9% of European labor force, 58.4% of the total Gross-Value Added produced by private business in the EU in 2010 was accounted for by SMEs [2]. SMEs, the backbone of the EU's economy, are based on different principles and operate under different circumstances than large companies – SMEs are having lower average wages in EU and do not benefit from the division of labor, which means, they cannot afford more specialized employees like large companies [3]. Due to this fact, we can hardly expect that SMEs will start to proactively incorporate Corporate Social Responsibility (CSR) concept into the business strategy. Environmental metrics has numerous approaches and variations, e.g.: Global Reporting Initiative, Life Cycle Sustainability Assessment [4], Energy Efficiency Toolkit for Small and Medium Sized Enterprises (developed by EMAS), etc. Authors of paper assume that SMEs are not capable of searching for proper environmental metrics applicable within their departments, plants, and then applying this metrics under the real circumstances and communicating results to their stakeholders. Suggested universal model has an ambition to do it instead of them, to proceed with pioneering environmental performance assessment. Authors of paper believe that application of suggested universal model will encourage SMEs into further usage of other internationally recognized and accepted assessment tools. It is common belief of more scientists that environmental metrics will have effect only in case the whole assessment process will be fair, exact, and easy to understand and delivering comparable results. Therefore, already existing principles were taken into account during preparatory stage of work – suggested model covers the *triple bottom line of sustainability* (people, planet, profit), respects all *three pillars of sustainability (environmental, economic, social*) and conforms to standardized tools, e.g.: our (e)IMPACT calculation is part of *Life Cycle Impact Assessment.* Paper deals with an assessment of sustainability. Sustainability is not a brand new issue; it was firstly introduced 25 years ago by the World Commission on Environment and Development.

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Today, a new generation of scientists is about to graduate their PhD programmes. They are supposed to come up with new approaches tied into existing needs of the society. They are being provided with an immense help from the side of their predecessors, however, problems they will be exposed to seem to be more complicated. One of the main problems is growth based economy, because infinite growth is impossible with finite resources. During the second Sustainable Development Symposium in Graz, professor Schnitzer from Graz University of Technology presented an opinion that as mankind shifted from *geocentric* into *heliocentric system*, one day we will need to shift from carbon economy into utilization of direct and indirect energy from the sun, to shift from oil based system into post carbon society. According to his opinion, there still will be some crude oil, but fewer and altogether with growing consumption, the whole system will collapse without intervention from the new generation of scientists. Authors of paper presume that the world's stockpiles of fossil fuels are becoming more and more insufficient and scarce, traditional exporters are becoming importers of fuels. Authors have selected Egypt, as in the moment an eye-catching example how to demonstrate growing concern. The gap between exported and imported fuels is narrowing every year, following this trend, Egypt as a traditional exporter will soon become importer of fuels (see table I.). According to *Standard International Trade Classification*, a term *fuels* represents: "Mineral fuels, lubricants and related materials". Imports of fuels represented 33% of total fuel trade (trade between Egypt and rest of the world) in 2008, 39% in 2009 and 48% in 2010. Egypt is becoming more dependent on foreign resources; the import of fuels in 2010 is the highest during the last decade (7129).

TABLE I
MERCHANDISE TRADE

Country	Flow	Commodity	Trade partner	2008	2009	2010
Egypt	Exports	Fuels	World	11533	6885	7551
	Imports			5766	4465	**7129**

Source: [5] **Subject**: Merchandise trade by commodity, **Unit**: US dollar at current prices (Millions)

In this paper, authors are using Egypt as a demonstrative example also in the second table II. The latest data available in World Bank database are discovering another alarming fact: Share of electricity production from fossil fuels is growing; the amount from 2009 is the highest during the last decade, whilst the gap between amounts of electricity produced from renewables and fossil fuels is drastically wide.

TABLE II
ELECTRICITY PRODUCTION

Country	Commodity	Indicator	2005	2006	2007	2008	2009
Egypt	Oil, gas and coal sources	Electricity production from oil, gas and coal sources (% of total)	87.86%	88.28%	86.94%	88.1%	**89.93%**
	Renewable sources	Electricity production from renewable sources, excluding hydroelectric (% of total)	0.51%	0.53%	0.66%	0.71%	0.81%

Source: [6] **Subject**: Electricity production from selected commodities, **Unit**: % of total electricity production

This paper is a description of a way how to exactly measure current environmental impact. E*lectricity production and consumption* was selected as one example of human activities potentially causing depletion of resources, pollution and other harmful effects. Possessing indices from two various databases, it is possible to determine % of population having access to the electricity. Using national electricity consumption in kWh per capita, authors of paper are able to quantify electricity consumption in less developed and more developed regions separately (see chart no. 1). The chart shows that despite significant proportion of population without electricity access in less developed regions, these regions are responsible for 52% of total world electricity consumption. Another possible remark is that less developed regions are having significantly lower electricity consumption per capita. At this point, it is possible to point out two things. *First* - more developed countries must change their consumer behaviour in order to reverse current trends in resource depletion. *Second* - there is a threat that together with improvements in life standards, per capita consumption in less developed regions will be growing and aligning with current levels typical for more developed countries.

Good environmental assessment model is able to track changes in behaviour. Besides classical analysis resulting into chart no. 1, authors of paper are conducting "breakdown structure" analysis in order to discover, which country has a most valuable contribution towards the idea of "*fulfilling our needs without compromising ability of future generation to meet their own needs* [7]". Breakdown structure shows exact country's position in the world, identifies *best performer (Bahamas)* and *worst performer (Tajikistan)*. Supranational institutions should aim their attention on the left bottom corner (see figure no. 1) – where the worst country in a whole world lies (citizens having lowest incomes, almost nobody has access to electricity and electricity consumption of those few having access to national grid is the highest per capita).

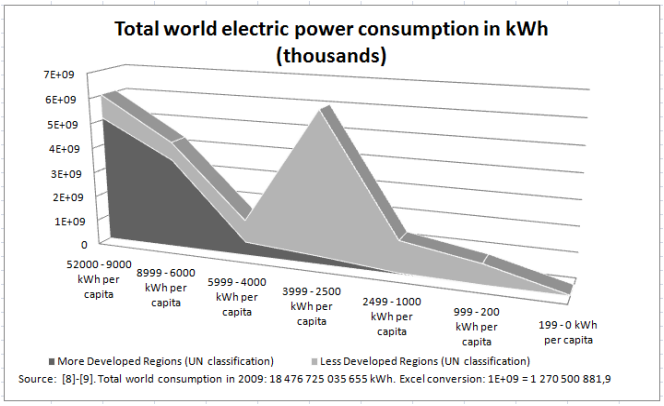


Chart. 1 World electricity power consumption

The main principle of research being conducted by authors of this paper is to deliver overall picture (chart no. 1), together with detailed overview of factors causing final result (figure no. 1). Authors believe that only complex and detailed information enables to take proper corrective action at supranational, national and company level. Principles of

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suggested environmental metrics (*overall picture + detailed overview of influencing factors*) are universal – applicable at supranational, national and company level.

In this introductory part, authors wanted to present their belief, that besides the fact their main concentration are Small and Middle Sized Enterprises, it is impossible to omit related issues. It is necessary to get to know where (geographically) the research is being conducted, because this fact influences final environmental impact. Principles of suggested assessment model are utilizable in both – at company and national level. Thanks to relatedness of these two levels, it is possible to determine, how the change of behaviour of management in companies contributed into country's position at global level. The main arising problem is – *how to change the game, how to change the behaviour of states, business units and end-consumers*. The suggestion team of authors has is – we need generally accepted and recognized environmental metrics in order to measure environmental progress and remunerate responsible entities.

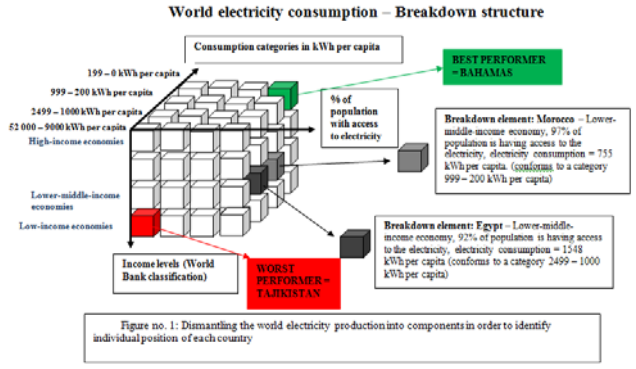


Fig. 1 Breakdown structure – electricity consumption

II. Top-down and Bottom-up approach

A. Basic Principles of Impact Measurement

The world, continent and every business unit strive for cooperative action of researchers – technical engineers, architects, designers, economists and last, but not least – environmental psychologists. Professor Sebastian Bamberg from the University of Applied Science in Bielefeld warns that technological change without change of behaviour will cause rebound effect [10], e.g.: Using eco-engine, which is having lower petrol consumption, results into higher driving distance in case there is no behavioural change going in one hand with environmental innovation. Proper environmental metrics is able to measure all aspects of environmental impact – including behaviour. Summarizing previous statements, environmental performance assessment has to take into consideration:

1) *Composition, content of used material, fuel* – in presented case (table II.), it is necessary to know raw materials used for electricity production. Good assessment model is remunerating usage of climate benign materials.
2) *Behaviour* – there is a need to know operating time, amounts consumed (chart no.1). Assessment model must be able to reflect changes in amounts consumed.

Various initiatives are trying to systematically change the "status quo" in business success measurement; *Top-down approach* includes governmental initiatives (environmental regulations) aimed at *supporting* those who are aligning themselves with Corporate Social Responsibility principles [11]. The same governmental initiatives are (*or should be*) *penalizing* environmental malign behaviour. Generally, there are two sets of governmental instruments: Market based instruments (subsidization, taxation) and conventional approaches towards regulating the environment (Command-and-control approaches) [12]. An example of governmental support of climate benign behaviour could be possible tax avoidance (*not tax evasion*) – in case of environmental taxes are imposed on pollution, subject is less or no taxed when making company processes more climate benign. When setting up a proper tax rate, Marginal Abatement Costs (MAC) are being calculated. MAC represents marginal cost of achieving certain emission target given some level of output [13]. When policy makers implement a tax, the tax rate will be chosen to equal the level of marginal abatement costs of the firms at the level of emission reduction target [14] – because it cannot be cheaper for company to pay the tax than to mitigate the pollution. According to authors of paper, both sets of governmental instruments are not realizable without information about costs company has to sacrifice in order to mitigate pollution, and there are additional costs government or company has to pay in order to measure level of pollution (e.g.: released harmful particles into the air). It is necessary to remark that amounts of harmful particles released into the air and costs of pollution mitigation differ in each industry.

TABLE III
Benchmarking of Environmental Indicators

	Extraction and processing of data needed for Market based instruments, Command & control approaches	*Extraction and processing of data needed for our proposed universal model, e.g.: (e)IMPACT calculation*
Principle used	VARIOUS – even in identical industry, technological processes may be different – it requires completely different methods of data collection under various financial conditions	SAME – principle is the same, in every department, in every company, researcher collects same categories of data (e.g.: Electricity consumption, running time of electric appliances, national electricity footprint, etc.)
Comparability of data	LIMITED – this system didn't develop common base which will help to compare results from various industries – there is no common unit developed	WIDE – model was developed in order to compare environmental performance of business from different industries. Our model has more variations: (e)IMPACT, (w)IMPACT. Data in each variation are expressed in same units, and we do express data from each particular variation in m^2 of consumed earth surface. In case of different character of data, we can still use breakdown structure to do the comparison (see figure no.6).
Utility of gained information	LIMITED - data serves usually only one purpose, there is no general mechanism how to transfer them into categories comparable at international level	WIDE – data our model is processing can be afterwards delivered into a national and international level (e.g.: Total electricity consumption, see also chart no.1, figure no.1)
Data mining benchmark		

It implies that there cannot be unified environmental tax rate and government has to know exactly what the mitigation costs are in every single industry. It may be extremely difficult to determine mitigation costs if a concrete company was not

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lowering its negative environmental impact before. Following benchmark table (table III.) illustrates drawbacks of current system and the (e)IMPACT model in contrary.

B. Our Selected Research Area

Our research team has selected *Bottom-up approach* – our research activities are positioned at a company level. Prime aim was to develop universal model which is able to help to Small and Middle Sized Enterprises (SMEs) to assess their own environmental performance. Secondary goal was to make our database utilizable at national and international level. In figure no. 1, we can see "breakdown elements" – countries. Using breakdown structure, authors of paper are able to depict single companies (e.g.: SMEs) as breakdown elements.

There are 23 million SMEs that operate in the European Union and they form 99% of all enterprises in EU [15]. Only 16-17% of *proactive* SMEs with more than 50 employees actively promote actions to reduce their environmental impact [16]. An easy calculation says that there are 84% of *reactive* SMEs with more than 50 employees under the scope of author's research team. As already presented, SMEs do not have human capacities applicable for information search and environmental assessment techniques development. Ambition of authors of paper is to do it instead of them – to help them to answer: "*QUO VADIS in Corporate Social Responsibility*". There are already existing approaches and principles of sustainability assessments – one major development globally has been the creation of methods and techniques that can measure sustainability, support decision-making toward more sustainable product and process systems [17]. Initiative of paper authors does not make this major development more complicated by adding their own systemic adjustments. As already mentioned, suggested model covers the *triple bottom line of sustainability* (people, planet, profit), respects all *three pillars of sustainability* (*environmental, economic, social*) and conforms to standardized tools, e.g.: our (e)IMPACT calculation is part of *Life Cycle Impact Assessment* – electricity is being considered as a one of the production inputs used in company's processes. Authors of this paper are using generally known indicator – *Ecological footprint* (expressed in m^2) developed by research team from Technical University in Graz, their model is using national electricity footprint from *SPIonExcel* database. It is important, in which country assessed company is based (geographical position) - due to the fact that every country has a different setup of energy production, the footprint m^2 *per kWh* of electricity provision differs [18]. Proposed universal model firstly concentrates on (e)IMPACT calculation as in (1), (2). Authors firstly calculate e(IMPACT) of identical device in a department, then e(IMPACT) of whole department and as a final step – an overall (e)IMPACT of a whole company:

$$X_0 = a_0 * b_0 * c_0 * d_0 \quad (1)$$

$$(e)IMPACT\ (X_0) = Consumption\ rate\ (a_0)[Kwh] * Running\ time\ (b_0)[h] * Number\ of\ identical\ electric\ appliances\ (c_0) * National\ Electricity\ Footprint\ (d_0)[m^2\ per\ Kwh] \quad (2)$$

Suggested model is supposed to be supportive decision making tool and integral part of a strategy how to persuade *reactive SMEs* to proceed with environmental assessment of their processes. Authors provide reader with more detailed description of how (e)IMPACT calculation looks like and how utilizable the outcomes are. Suggested universal model, thanks to logarithmic, functional and integral method, enables to calculate contribution an environmental innovation had in overall negative environmental impact mitigation. It is key information for the determination of the success of a managerial decision. Suggested universal model is easy to proceed with, applicable across industries, delivers utilizable and comparable outcomes (impact is expressed in m^2). (e)IMPACT is supposed to be very first assessment done in *reactive* SMEs. This pioneering assessment will sketch environmental strengths and weaknesses SMEs do possess. Authors' team is then prepared to present Corporate Social Responsibility (CSR) policy as a viable business concept and to show, how to relate CSR policy with key company's competences and goals. Authors believe, that later on, after cooperation with their research team, SMEs that were *reactive* at the beginning will be willing to proceed with another forms of environmental performance assessment. Another, more specialized forms of environmental performance assessment are those, developed and published by another research teams: *Global Reporting Initiative, Life Cycle Sustainability Assessment, Energy Efficiency Toolkit for Small and Medium Sized Enterprises (developed by EMAS)* and other internationally recognized and accepted assessment tools.

III. Universal Assessment Model

A. (e)IMPACT

In this paper, authors are presenting one part of suggested model, which concentrates on electricity consumption. Authors decided for electricity impact measuring for various reasons:

1) Electricity generated by fossil fuel is one of the largest sources of air pollution and air pollution is associated with the rising number of cases of asthma [19]
2) Every company, department, etc., is consuming electricity. Electricity consumption is one of the best indicators for expressions of changes in behavior, managerial decisions (e.g.: organizational and process innovations resulting into lower electricity consumption)
3) A study from the Georgia Institute of Technology was dealing with annual gasoline consumption and mileage statistics for light-duty vehicle fleets. Researchers examined the water consumption for the mining and processing of electricity generation fuels along with the water consumption for electricity generation. Based on

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the same driving distance, electric vehicle systems would use 17 times more water than that of gasoline vehicle systems [20]. (e)IMPACT developed by authors of paper reflects the composition of fuels used for electricity production – setup of electricity production is being accounted in final impact.

Good assessment model must be able to uncover *"fake environmental improvements"* – environmental solutions having negative side effects. For this reason, environmental economists are using "life cycle approach". Taking into consideration phases of life cycle, we will account also character of fuels used for electricity production. As it was already mentioned, suggested model, respecting life cycle approach, is able to track origin of fuels used for electricity production. In figure no.2, we can see projection of entire (e)Impact assessment. Authors firstly concentrate on calculation of (e)IMPACT of identical electric appliances (3) = *Third Tier*, then they calculate (e)IMPACT of all electric appliances within one department (4) = *Second Tier*, and finally, they calculate (e)IMPACT of entire company (5) = *First tier*.

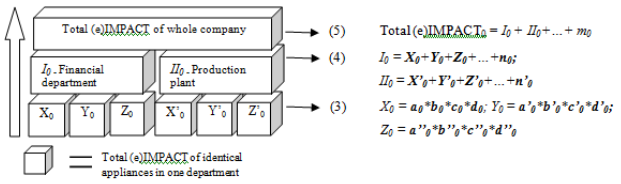


Fig. 2 Dismantling the whole company into tiers

B. (e)IMPACT Assessment – First Tier

Authors categorized their suggested model as a *Sustainability Decision Tool*. Authors are always comparing two time periods and recording a change occurred. Model is able to identify extend into which organizational, process or product innovation is responsible for improved (e)IMPACT. This model is able to quantify influence a concrete managerial decision has on overall (e)IMPACT improvement. Under the term (e)IMPACT improvement, authors of paper understand less m^2 of earth surface consumed. Two sets of elements are being used: Multiplicative elements of equation (3) and additive elements of equation (4,5). Information delivered by suggested model is devoted to company management, to those having decision making power to implement Corporate Social Responsibility concept into company's business strategy. When CEO spots improvement in (e)IMPACT, she/he is logically interested in knowing the reason of this improvement. She/he wants to know, which factor, in this case – environmental innovation, caused the improvement. Model is able to deliver this information, to answer her/his question, therefore authors labeled their suggested model as *the Sustainability Decision Tool*. Authors are able to state, which department had the biggest % contribution into overall improvement (6). Change (%) in total impact caused by Financial department:

$$\Delta(\text{e})\text{IMPACT}_\text{I} = \frac{\Delta I}{\Delta(e)IMPACT} \times 100 \quad (6)$$

Change in m^2 of consumed earth's surface occurred in whole financial department (7):

$$\Delta I = I_0 - I_1 \quad (7)$$

Change in m^2 of consumed earth's surface occurred in whole company (8):

$$\Delta(\text{e})\text{IMPACT} = (\text{e})\text{IMPACT}_0 - (\text{e})\text{IMPACT}_1 \quad (8)$$

C. (e)IMPACT Assessment – Second Tier

First tier assessment has identified, which department is responsible for the biggest contribution towards (e)IMPACT improvement. A company management is then interested what was the reason behind, what enabled this department to become best performing among the others. Processing with second tier assessment, we will define which appliance made biggest contribution towards overall result of entire department (9).

Change (%) in total impact caused by one type of electric appliances:

$$\Delta\text{I}_\text{y} = \frac{\Delta Y}{\Delta I} \times 100 \quad (9)$$

Change in m^2 of consumed earth's surface occurred within group of identical electric appliances, e.g.: Computers (10):

$$\Delta Y = Y_0 - Y_1 \quad (10)$$

Change in m^2 of consumed earth's surface occurred in whole financial department (11):

$$\Delta\text{I} = \text{I}_0 - \text{I}_1 \quad (11)$$

D. (e)IMPACT Assessment – Third Tier

Going deeper into authors' model – into *third tier*, authors are able to measure success of a concrete environmental innovation (product, process or organizational). As an explanatory example, we have selected an idea coming from the manager of financial department – organizational innovation which lowered operating time of computers in a department. Company management, examining results delivered by *sustainability decision tool*, identified financial department as the most significant contributor into overall (e)IMPACT improvement. Having best company's environmental innovation identified, authors of paper are identifying, what was the extent of this innovation (running time of computers) among the other elements (consumption rate, number of computers). If the *source of electricity* consumed in department was the *same for every appliance*, we can exclude ecological footprint from the calculation (because the footprint will not influence overall result in this case). In third tier, we are having multiplicative elements (mathematical operation = multiplication) – which predefine calculation method used. Calculation contains consumption rate (*a*), running time (*b*) and number of identical appliances (*c*). In our

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software, we are using integral method based on integrating the differential (12) according to formula (13).

$$\frac{du}{dt} = \frac{\partial u}{\partial a} \times \frac{da}{dt} + \frac{\partial u}{\partial b} \times \frac{db}{dt} + \ldots + \frac{\partial u}{\partial w} \times \frac{dw}{dt} \quad (12)$$

$$u(t_1) - u(t_0) = \int_{t_0}^{t_1} \frac{du}{dt} \times dt = \int_{t_0}^{t_1} \frac{\partial u}{\partial a} \frac{da}{dt} \times dt + \int_{t_0}^{t_1} \frac{\partial u}{\partial b} \frac{db}{dt} \times dt + \ldots + \int_{t_0}^{t_1} \frac{\partial u}{\partial w} \frac{dw}{dt} \times dt \quad (13)$$

The right side of equation represents desired calculation of partial changes. Third tier calculations in this model are based on principles expressed in equations (12) and (13). Knowing data from two time periods, authors are able to graphically project changes in elements *a*, *b*, *c* (see figure no.3).

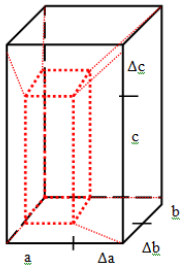


Fig. 3 Changes in elements

IV. Presentation of Results

A. Internal Presentation Within The Company

Results of assessment done have to be understandable and presented in eye-catching mode. One of the main reasons, indicated at the beginning of paper, is the fact that suggested universal model is supposed to be pioneering assessment done very first time in 84% of reactive SMEs in European Union. It is presumed that in such SMEs there is no concept of Corporate Social Responsibility developed yet and for this reason, very first assessment results delivered to company management must attract attention of directors (TOP management) having sufficient decision power for allowing another assessments to be processed and later on, for Corporate Social Responsibility concept implementation. In figure no. 3, we were using *block* in order to present assessment results. However, having four elements (e.g.: Consumption rate [a_0], Running time [b_0], Number of identical electric appliances [c_0] and National Electricity Footprint [d_0]), we have to express the change occurred in a form of triangular prism (see figure no. 4). In case the law of mathematics does not allow researcher to create a triangle, we will use depiction form typically utilized in The European Eco-Management and Audit Scheme [21] (EMAS) – a flow chart (see figure no. 5).

Flow chart is showing the percentage distribution – e.g.: 25 % as the influence production plant had over the overall (e)IMPACT improvement. Using EMAS scheme is evidence that presented model conforms to already existing approaches. Authors' research work tends to be a manifestation that it is possible to build up completely new model on existing principles and tools. It is author's belief that the only possible way towards the sustainable future is cooperation and unification resulting into synergy effect in environmental metrics promotion and utilization.

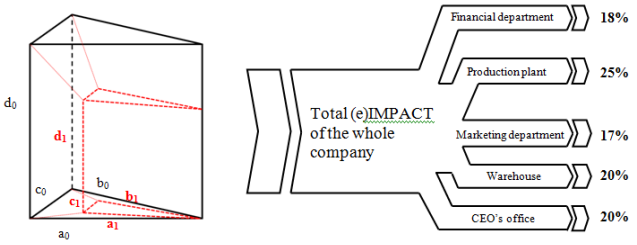


Fig. 4, Fig. 5 Ways of projection of a result

B. External Presentation at National Level

Any kind of assessment model is senseless without ability to deliver exact, understandable and comparable ("benchmarkable") results not only to a company management [22], but also to all stakeholders, general public, etc. Assessment model must be able to export results vertically, to higher level – national and supranational one. We are all living at the same Planet Earth, therefore it is necessary to widespread assessment, because having environmental improvements only in one part of the world is not a solution for the global well-being – the pollution can be blown by a wind, fluxed by a river's current from "irresponsible" into "responsible area". The basic precondition how to make environmental metrics widely used is enabling entities to compare themselves, to show, which one is better and to enable them to compete (*market based approach*). As mentioned at the beginning – (e)IMPACT is only one part of suggested model. Authors are also developing other parts – (w)IMPACT and (h)IMPACT. "W" stands for *water* and "h" stands for *heating*. Authors will measure water used in a department and a heat released. Every variation ((w)IMPACT, (h)IMPACT) is based on same principles of data mining and processing being described in this paper). For public presentation of results, authors would use breakdown structure (see figure no. 6). (e) IMPACT is calculated in m^2 of consumed earth surface. Authors of paper have to point out, that various industries differ in energy intensity, financial requirements, etc. It is therefore welcomed to use individual breakdown structure for every type of industry and geographic location (due to principle of fairness), besides the fact assessment model is able to compare in one breakdown structure all SMEs regardless character of their activities. One of the *advantages of breakdown structure* is the fact that it allows to use multi-criteria comparison – having "under one roof" results of various forms of environmental performance assessments. In our explanatory example, we are ordering SMEs according to results coming from our (e)IMPACT assessment and Economic Performance Indicators (developed and standardized by Global Reporting Initiative [23]). In our model, authors are using following indicators:

1) *Economic Value Distributed (EVD)* – EVD is a result of processing information coming from company's audited financial or profit and loss statement. We firstly calculate Economic Value Generated (EVG) and Economic Value Retained (EVR). Final step is: (EVD = EVG – EVR) / number of employees. EVD shows which portion of generated economic value was redistributed back to the community. Authors of paper tend to use expression – EVD/per capita (employee) in order to prevent discrimination of micro companies.
2) Ratio of standard entry level wage compared to local minimum wage at significant locations of operation (Wage ratio) – entry level wage in a company is being compared with regional, local minimum wage.

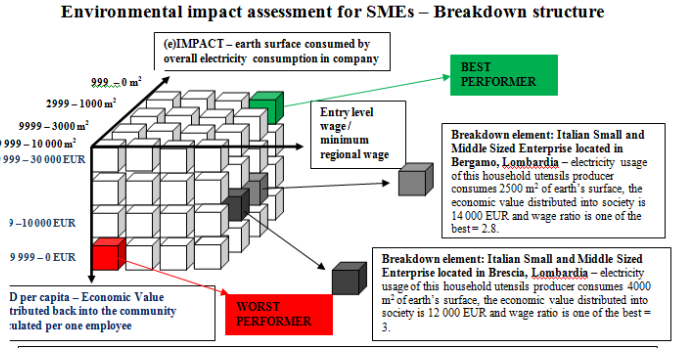


Fig. 6 Breakdown structure – impact assessment

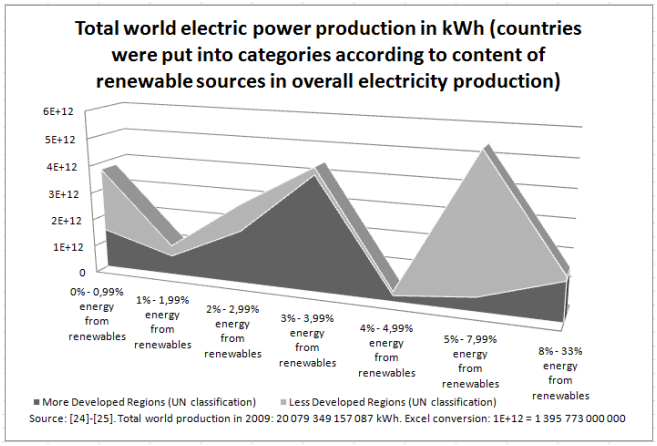


Chart. 2 World electric power production

V. Conclusion

There are already brilliant approaches towards environmental impact assessment developed by research teams. Mission of research team from Bratislava is to incorporate SMEs, as "the biggest polluter" and "The Backbone of European Economy", into environmental performance improvement process. Their research is promoting existing approaches (e.g.: Global Reporting Initiative, Life Cycle Sustainability Assessment, Energy Efficiency Toolkit for Small and Medium Sized Enterprises) by incorporating them into their assessment model. There are very few intentions to help to SMEs to discover their environmental strengths and weaknesses; therefore, Bratislava team has decided to systematically approach this issue. Authors of paper could generally use various incentives (e.g.: Promoting Corporate Social Responsibility concept as a tool which boosts innovativeness, discovers new business potential and which helps to cope with environmental regulations) in order to persuade reactive SMEs to start to think about environment. But until there will not be a universal, fair, exact, generally accepted and internationally standardized environmental metrics, we will not create a "green future" for our children. As it can be seen from the chart no.2, the use of renewables in electricity production is drastically low and surprisingly, less developed regions suppose to be in addition, more responsible. However, chart no.2 itself is not showing us complete picture. There may be deforestation behind the "responsible results" of some countries from less developed regions. Such countries are, according to chart no. 3, *Guatemala* and *Nicaragua*. In these two cases we can see constant deforestation dating back into 90's. Authors of this paper have labeled this problem as "*fake environmental leaders*" and it is a part of their on-going research to be presented during another occasion.

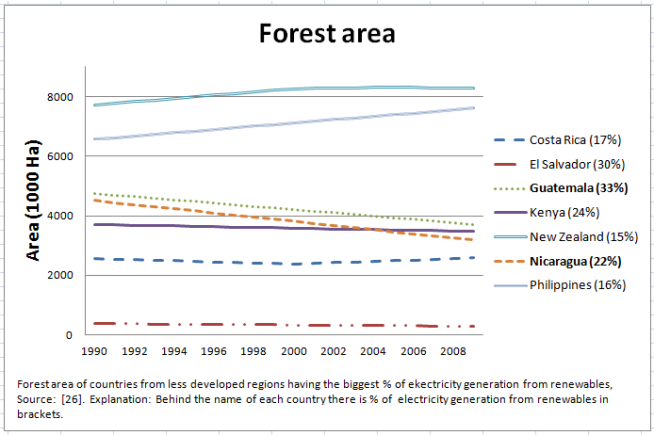


Chart. 3 Deforestation in Guatemala and Nicaragua

The pace of shifting into "*heliocentric system*" must be much faster, we have to aim our attention not on governments primarily, but mainly on those who are personally responsible for depletion – entities like end-consumers, families, individuals, companies, municipalities. However, we can hardly explain them *where to go* without knowing, *where they are*. And in order to find out, *where they are*, research team composed of authors of this paper have developed universal assessment model.

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REFERENCES

[1] MOLNÁR, P. Innovation Management. Bratislava : University of Economics in Bratislava, 2007. p. 11. ISBN 978-80-225-2493-3
[2] WYMENGA, P. – DERBYSHIRE, J. Are EU SMEs recovering? Annual Report on EU SMEs for European Commission. Rotterdam, Cambridge, ECORYS Nederland BV, p.58 2011
[3] BANNOCK, G. The Economics and Management of Small Business : An International Perspective. New York : Routledge, 2005. p. 239 ISBN 0-415-33667-8
[4] VALDIVIA, S. - CIROTH, A. - HILDENBRAND, J. Towards a life cycle sustainability assessment: Making informed choices on products. Paris: United Nations Environment Programme, 2011, pp.86. ISBN 978-92-807-3175-0
[5] http://stat.wto.org/StatisticalProgram/WSDBV
[6] http://databank.worldbank.org
[7] BRUNDTLAND, G. H. (1987), Our Common Future: Report of the world Commission in Environment and Development, Oxford: Oxford University Press
[8] http://esa.un.org/undp/wpp
[9] http://databank.worldbank.org/ddp
[10] BAMBERG, S. – SCHAFER, M. Life Events as Windows of Opportunity for Changing Towards Sustainable Consumption Patterns? In: Journal of Consumer Policy. Springer, 2012, pp. 65-84. Vol. 35 No.1 ISSN 1573-0700
[11] DOLINSKY, M. Corporate Social Responsibility as a Viable Business Concept. In: 1st INTERNATIONAL CONFERENCE ON SUSTAINABLE INTELLIGENT MANUFACTURING. Lisboa : Instituto Superior Técnico, 2011, pp. 423 – 431. ISBN 978-989-8481-03-0
[12] FREEMAN, J. – KOLSTAD, C. Moving to markets in environmental regulation: Lessons from twenty years of experience. New York : Oxford University Press, 2007. pp. 488. ISBN 0-19-518965-5
[13] KLEPPER, G. – PETERSON, S. Marginal Abatement Cost Curves in General Equilibrium : The Influence of World Energy Prices. Milano : Kiel Institute of World Economics, 2004. p.3, http://ssrn.com/abstract=615665
[14] OWEN, A. D. – HANLEY, N. The Economics of Climate Change. New York : Routledge, 2004. pp. 122. ISBN 0-415-28724-3
[15] WYMENGA, P. – DERBYSHIRE, J. Are EU SMEs recovering? Annual Report on EU SMEs for European Commission. Rotterdam, Cambridge, ECORYS Nederland BV, p.59 2011
[16] DIMACHE, A. – MITCHELL, S. - O'DOWD, P. Business sustainability framework for European manufacturing SMEs. In: 1st INTERNATIONAL CONFERENCE ON SUSTAINABLE INTELLIGENT MANUFACTURING. Lisboa : Instituto Superior Técnico, 2011, pp.395 – 405. ISBN 978-989-8481-03-0
[17] European Environmental Bureau, Future of EU Environmental Policy : Towards the 7th Environmental Action Programme, www.eeb.org, 2010
[18] KETTL, K.H. Ecological footprint comparison of different means of transportation based on sustainable process index (SPI) methodology. In: 1st INTERNATIONAL CONFERENCE ON SUSTAINABLE INTELLIGENT MANUFACTURING. Lisboa : Instituto Superior Técnico, 2011, pp.121 – 127. ISBN 978-989-8481-03-0
[19] JOHNSON, J. D. Green plans : Blueprint for a sustainable earth. Lincoln : University of Nebraska Press, 2008, pp. 19 ISBN 978-0-8032-6020-7
[20] BRAS, B. – GULDBERG, T. – YEN, J. Water consumption of automotive vehicle use. In: 1st INTERNATIONAL CONFERENCE ON SUSTAINABLE INTELLIGENT MANUFACTURING. Lisboa : Instituto Superior Técnico, 2011, pp.163 – 170. ISBN 978-989-8481-03-0
[21] EMAS Energy Efficiency Toolkit for Small and Medium Sized Enterprises, Luxembourg : Office for Official Publications of the European Communities, 2004, p. 72. ISBN 92-894-8196-X
[22] MUSOVA, Z. Modern Mareking Concepts Implementation in Slovak Republic. In: Practical Marketing Development. Zilina : University of Zilina, Institute of Management, 2010, pp. 47 - 53. ISBN 978-80-554-0292-5
[23] http://www.globalreporting.org/ReportingFramework
[24] http://esa.un.org/undp/wpp
[25] http://databank.worldbank.org/ddp
[26] HTTP://FAOSTAT.FAO.ORG/SITE/377/DESKTOPDEFAULT.ASPX