Comparison of Environmental Performance of the Regions of Czech Republic from 2006 to 2012

EBO TAWIAH QUARTEY[1], PETRA LEŠÁKOVÁ[2], ILONA OBRŠÁLOVÁ[2]

[1]Dep. of regional and business economics, [2] Inst. of Administrative and Social Sciences

[1]Mendel University, [2] University of Pardubice

[1]tř. Generála Píky 7, Brno, [2] Studentská 95, Pardubice

CZECH REPUBLIC

ebo.quartey@mendelu.cz, petra.lesakova@student.upce.cz, ilona.obrsalova@upce.cz

Abstract: This paper presents a systematic method for calculating regional level Environmental sustainability by using the sustainable value approach. The quest for achieving sustainability has led to the development of various tools and measures for structuring and conducting sustainable development policy analyses and the metrics used for the measurement of sustainability are still evolving. Sustainable Value approach is another simple tool for measuring sustainability performance. In general, Sustainable Value integrates the three dimensions of sustainability: the economic development, environmental sustainability and social development. This paper uses the principles of the sustainable value approach to calculate the environmental sustainability of the regions of the Czech Republic.

Key-Words: Environmental Sustainability, Regional Sustainability, Regions of the Czech Republic, Sustainable Development, Sustainable Value

1 Introduction:

The concept of Sustainable development emerged out of the effort to reconcile the competing demands of development and environmental protection, beginning with the 1972 Stockholm Conference on the Human Environment and the 1980 World Conservation Strategy of the International Union for the Conservation of Nature. Sustainable development became a formal world aspiration in 1987 with the report of the World Commission on Environment and Development entitled Our Common Future (also known as the Brundtland Report) that defined the concept as development that meets the need of the present without compromising the needs of the future generation. [19] The philosophy of sustainable development stresses the priority of the characteristics of the value creation. According to this philosophy, the preservation of the nature is the most important common objective of humanity. It invites us to stop exploiting the nature and begin to cooperate with the beauty that surrounds us. The European model of economic growth, like the rest of the world, incorporates the implementation of the principles of sustainable development at enterprise level and at all levels of economic activity sectors and of the national economies as a whole.

During the last decade countries are experiencing a progress in its Sustainable Development policy planning. Approaching the issues of sustainability at the national government level was characteristic of the 1990s, motivated by the requirements of the international community – the UN Conferences in Rio de Janeiro and Johannesburg. In many countries, this approach has resulted in the development of national Sustainable Development strategies. Nevertheless it is evident that the strategies face serious problems like insufficiently defined priorities for individual topics, unclear definition of relations between Sustainable Developement pillars, missing quantification of financial costs and administrative requirements needed to achieve the targets. These deficiencies have resulted in a very weak practical effect of the SD strategies. [11]

The European Commission has shown increasing interest in Sustainable Development, not only in the context of environmental but also economic and social in all levels of the union through its principle of integration. The policy context of Sustainable Development in the EU can be traced back to 1992, and the Maastricht Treaty on the European Union. This treaty added further environmental objectives into the original objectives of the Treaty of Rome. In 1993 the adoption of the Fifth Action Programme on The Environment strengthened the position of SD in EU policies and recently adopted the seventh Action Programme to further the agenda of sustainable development. The treaty of Amsterdam

ISBN: 978-1-61804-368-9

in 1998 went further by adopting the threefold definition of sustainable development and stating that the Union's financial instruments should work, simultaneously and in the long-term, towards economic growth, social cohesion and the protection of the environment. After the adoption of a Sustainable Development Strategy at the European Council on Gothenburg (July 2001), sustainable development has become a core interest in all EU policy-making. As a result of this development the reform of the EU Structural Fund programmes has seen Sustainable Development criteria being added to the standards of evaluation. [6][15]

The Czech Environment Act (No. 17/1992 Coll.) defines sustainable development in society as development which maintains the ability to satisfy the basic living needs for current and future generations, which does not reduce the diversity of nature and which maintains the natural functions of eco-systems. [5] The Czech Republic adopted its Sustainable Development Strategy through Government Resolution No 1242 of 8 December 2004 after two unsuccessful attempts. Its primary role is to provide timely warning of any existing or potential problems that might endanger the Czech Republic's transition to sustainable development, and to initiate measures designed to prevent such threats or at least mitigate their impact (Czech SDS). Planning and evaluation of sustainable development at various levels of public administration is becoming a highly desired and preferred topic worldwide.

2 Environmental sustainability

The Bruntland definition of sustainable development uses the three pillars approach to express, the relationship between economic growth, standard of living and environmental protection. In other words sustainable development is often been interpreted as social and economic development that should be environmentally sustainable [2] but in the period since the Bruntland definition was first published, it has slowly become accepted that environmental sustainability has its own merits. [12][14] Environmental sustainability refers to the maintenance of the integrity of different environmental media and systems to ensure that their functions and beneficial uses are upheld for present and future generations. The sustainable use of natural resources and sink capacities is one of the key challenges for developed and developing countries in the 21st century [18][14] asserts that a society devoid of functioning life-support systems cannot thrive; an absence of supportive social structures and institutions prevent economies from flourishing.

The Organisation of Economic Co-operation and Development (OECD) advance the concept of environmental sustainability with the publication of environmental strategy for the first decade of the 21st century, in 2001 in which they defined four specific criteria for environmental sustainability. [16][13]

1. Regeneration – renewable resources shall be used efficiently and their use shall not be permitted to exceed long-term rates of natural regeneration.

2. Substitutability – non-renewable resources shall be used efficiently and their use limited to levels which can be offset by substitution with renewable resources or other forms of capital.

3. Assimilation – releases of hazardous or polluting substances into the environment shall not exceed their waste assimilative capacity.

4. The avoidance of irreversibility.

The following five inter-linked objectives for advancing environmental policies in a sustainable development according to OECD (2001) based on their four specific criteria for environmental sustainability:

1. Maintaining ecosystem integrity via the efficient management of natural resources.

2. Decoupling of environmental pressures from economic growth.

3. Enhancing quality of life.

4. Improving global environmental interdependence by improving governance and co-operation.

5. Measuring progress, particularly using environmental indicators and indices.

The environmental sustainability concept can be further developed through the use of an ecosystem services perspective, as this reinforces the value pertaining to non-monetary ecological qualities and functions, all of which are necessary for the OECD′s five inter-related objectives to be met. Daily discusses 'nature's services' to be comprised of a global life-support system (such as the climate system or hydrological cycle), goods provided by the geosphere (such as mineral resources), and open space (such as land on the planet's surface, plus the space above and below it). [3] In meeting the OECD′s five objectives for environmental sustainability, human well-being is maintained or advanced. On this basis, ecosystem services can be

ISBN: 978-1-61804-368-9

considered a fundamental component of human well-being. Therefore that environmental sustainability may be defined as the maintenance of nature's services at a suitable level. [13] This requires ecosystem services on a local, national and international scale to be kept in a healthy state and requires governance systems to have a duty of care and regulatory impact on environmental infrastructure.

3 Methodology

3.1 Study Area and Source of Data

Purpose of this paper is to analyze environmental performance of the14 regions of the Czech Republic. All data were collected from the Czech Statistical Office (regional and national GDP, acreage of arable land, electricity consumption) and Czech Hydrometeorological Institute (data about the REZZO 1-4 emissions), so the resources follow the same definition and measurement rules through the paper.

3.2 Measuring environmental sustainability

Sustainability measurement is the quantitative basis for the informed management of sustainability. The quest for achieving sustainability has led to the development of various tools and measures for structuring and conducting sustainable development policy analyses and the metrics used for the measurement of sustainability are still evolving. They include indicators, benchmarks, audits, indexes and accounting, as well as assessment, appraisal [4] and other reporting systems which are applied over a wide range of spatial and temporal scales. [9][1] Most of these tools and measures emphasize the importance of frameworks that synchronize the principles and dimensions of sustainable development.

Evaluating the environmental sustainability performance of a nation is complex task and selecting meaningful and effective tools, or metrics, for measuring the environmental consequences and activities is becoming increasingly important. The simplicity and generic qualities of environmental indices currently necessitates a much broader analysis in order to evaluate any nations genuine environmental sustainability credentials-ultimately the development of a synthetic Environmental Sustainability Index is required to fulfil this task. [14]

3.3 The Sustainable Value approach

Sustainable Value (SV) approach is another simple tool for measuring sustainability performance. The concept was developed by Prof Frank Figge of Queen's University Belfast and Dr Tobias Hahn of (IZT) Institute for Futures Studies and Technology Assessment in Berlin. [7][8][17] The whole performance of any entity depends not only financial resources but also environmental and social resources and Sustainable Value integrates these three dimensions of sustainability: the economic development, environmental sustainability and social development. The sustainability framework is primarily used to assess corporate sustainability performance in monetary terms. Value is generally created by an entity if the profitability exceeds the costs incurred shown by the formula below which generally is the measure of the economic performance.

$$Value = Profitability - Costs. \quad (1)$$

SV approach extends the above basic rule of calculation to find the value created with environmental and social resources by expressing the charges related to environmental and social impacts in monetary terms. The logic of the SV approach is to *determine the value created by the use of such or such environmental or social resource (or the emission of such or such environmental resource and compare the profitability of alternative uses of these resources (Opportunity Costs) when the same resources are used otherwise how additional value can be created?* [17]

A value is created only if the profitability exceeds the opportunity costs. Opportunity costs or economic opportunity cost is the value of the next best alternative foregone as a result of making a decision. The notion of opportunity costs plays a crucial part in ensuring that scarce resources are used efficiently. The SV approach compares the use of resources by an entity to the use of resources by a benchmark and defines the cost of the resource by its opportunity cost. It expresses subsequently the sustainable performance in monetary terms. [17] In this paper, the SV approach is used to assess environmental performance of the regions of the Czech Republic by using traditional concept of SV calculation and focusing only on the value created

ISBN: 978-1-61804-368-9

based on selected environmental indicators in the regions.

3.4 Calculation of Environmental Sustainable Value

The calculation SV is generally by five steps. [9] Each step is defined by a question. As will be shown below, we will follow these steps to calculate environmental sustainable value of the regions of Czech Republic.

Step 1: How many resources does the region use?

The initial step is to determine the quantity of resources used the entity during the time period, usually a one year period. The concept usually adopts the Triple-Bottom-Line indicators (economic, social and environmental) however in this paper since we are only concern with environmental performance we only considered environmental indicators for the environmental resources the regions used to create value in the second step. The chosen indicators for this paper are those of the environmental resources used by the regions of the Czech Republic to demonstrate their environmental performance. These selected Environmental indicators are given in Table 1 below.

Table 1 Chosen Environmental indicators

Arable Land (ha)
Electricity (MWh)
Particulate matter-emissions (t)
SO_2-emissions (t)
NO_x-emissions (t)
CO-emissions (t)
VOC-emissions (t)
NH_3-emissions (t)
Waste generated by enterprises (t)

Source: Authors

Step 2: How much return does the region create with its resources?

The second step is to establish the return the regions created with the environmental resources determined in the previous step. In this paper the return considered is the regional income and output of a given region's economy measured by the Gross Domestic Product (GDP). The GDP is the value of goods and services produced within a country's borders in a given year. The following are key in the second step:

- Gross Domestic Product (GDP) is defined as a return for each region and year.
- To calculate regional resource efficiency, each indicator in a concrete year is divided by appropriate GDP.

The results show how much each region creates per unit of each resource.

For example, in 2006 the Pardubice region emitted 18 487, 1 tons of CO and had a GDP of 5 031 569 376 Euros therefore the CO efficiency of the Pardubice region in 2006 is calculated as:

$$\frac{GDP}{Resource} = \frac{5\,031\,569\,376\,€}{18\,487\,t} = 272\,168\,€/t \quad (2)$$

Step 3: How much return would the benchmark have created with these resources?

This step focuses in establishing the return the benchmark (in this paper Czech Republic) would create by using the environmental resources of the country. It is assumed that each environmental resource can only be used once so it is not possible to benefit from both returns (the return a region creates and the return the benchmark would create). The resource efficiencies of the benchmark are calculated by dividing the GDP of Czech Republic by the total amount of each environmental resource used during the year. The efficiency of the benchmark shows how much value is created by the benchmark per unit of environmental resource. Benchmark environmental efficiency is analogically calculated (Table 2).

Table 2 Benchmark Efficiencies (2006 - 2012)

	2006	2007	2008	2009	2010	2011	2012
Arable Land (EUR/ha)	40 115	45 372	33 671	47 081	50 288	49 392	51 109
Electricity (EUR/MWh)	2 732	3 044	3 070	3 178	3 334	3 215	3 322
Particulate matter (EUR/t)	1 929 523	2 060 621	2 202 267	2 319 756	2 411 288	2 601 462	2 551 378

ISBN: 978-1-61804-368-9

SO_2 (EUR/t)	578 354	635 372	807 292	813 260	888 142	870 804	991 281
NO_x (EUR/t)	435 293	485 844	539 756	563 624	635 469	657 737	723 515
CO (EUR/t)	253 356	271 202	321 335	339 102	379 828	388 032	279 979
VOC (EUR/t)	681 933	791 202	863 709	891 186	1 000 659	1 063 579	1 075 089
NH_3 (EUR/t)	1 921 956	2 296 175	2 498 964	2 078 553	2 198 707	2 253 875	2 383 911
Waste by enterprises (EUR/t)	5 734	6 355	6 425	6 924	7 407	7 440	7 673

Source: Authors

These benchmark efficiencies are then used to calculate the Opportunity Costs (OC). OC are the returns that the benchmark would have created with the resources of the region. Continuing with our example, in order to determine the Opportunity Costs of Pardubice region's CO emissions in 2006, we calculated how much return the benchmark (Czech Republic) would have generated with the region's (Pardubice) emissions by multiplying the Pardubice's 18 487 tons of CO with the CO-efficiency of the Czech Republic 253 356 EUR/t as:

*OC of CO in 2006 = 253 356 * 18 487 = 4 683 792 372 EUR* (3)

It is necessary to know benchmark efficiency and amount of each resource used in the region to calculate OC.

Step 4: Which resources are used by the region in a value-creating way?

Here the return the regions created is compared to the return the benchmark would have created with the environmental resources (Opportunity Cost). The return that the regions create corresponds to its Gross Domestic Product (GDP). The opportunity costs of each resource are subtracted from the Gross Domestic Product of the region. In other words, Value Contribution (VC) of each environmental resource is calculated. VC shows how much more or less a region creates with a resource compared to the benchmark. The Table 3 below show the calculation of value contributions in 2006 of the Pardubice region based on the environmental indicators used and a GDP of 5 031 569 376 Euros.

Table 3 Calculation of Value Contribution for Pardubice Region in 2006

Environmental Indicators	GDP (EUR)	Opportunity Costs (EUR)	Value Contribution (EUR)
Arable Land (in hectar)	5 031 569 376	8 020 392 525	- 2 988 823 149
Electricity (in MWh)	5 031 569 376	5 533 116 868	- 501 547 492
Particulate matter (t)	5 031 569 376	6 521 787 740	- 1 490 218 364
SO_2 (t)	5 031 569 376	8 109 679 788	- 3 078 110 412
NOx (t)	5 031 569 376	8 047 696 984	- 3 016 127 608
CO (t)	5 031 569 376	4 683 792 372	347 777 004
VOC (t)	5 031 569 376	5 900 084 316	- 868 514 940
NH_3 (t)	5 031 569 376	9 277 281 612	- 4 245 712 236
Waste by enterprises (t)	5 031 569 376	2 511 492 000	2 520 077 376

Source: Authors

As can be seen in the table 3 above, Pardubice region used only 2 out of the selected environmental resources in a value-creating way as compared to the benchmark (Czech Republic).

Step 5: How much Sustainable Value does the region create?

To obtain SV of environmental performance, it is necessary to sum all the VC of all environmental resources (calculated in step 4 above) for each year

ISBN: 978-1-61804-368-9

and divide the sum by the number of environmental resources considered. It reflects how much more (positive SV) or less (negative SV) return has been created due to the fact that resources were given to the region rather than to the benchmark. In case of positive SV, the region used its environmental resources in a value creating way. In case of negative SV, the region used its resources less efficiently compared to the benchmark. The table below shows the calculation of SV for the environmental resources used in 2006 for the Pardubice region.

Table 4. Calculation of the SV of the Pardubice Region in 2006

Environmental Indicators	GDP (EUR)	Opportunity Costs (EUR)	Value Contribution (EUR)
Arable Land (in hectar)	5 031 569 376	8 020 392 525	- 2 988 823 149
Electricity (in MWh)	5 031 569 376	5 533 116 868	- 501 547 492
Particulate matter (t)	5 031 569 376	6 521 787 740	- 1 490 218 364
SO_2 (t)	5 031 569 376	8 109 679 788	- 3 078 110 412
NOx (t)	5 031 569 376	8 047 696 984	- 3 016 127 608
CO (t)	5 031 569 376	4 683 792 372	347 777 004
VOC (t)	5 031 569 376	5 900 084 316	- 868 514 940
NH_3 (t)	5 031 569 376	9 277 281 612	- 4 245 712 236
Waste by enterprises (t)	5 031 569 376	2 511 492 000	2 520 077 376
Sustainable Value			**-1 480 133 313**

Source: Authors

That means the region with its return of more than 5 031 million Euros did not cover the total opportunity costs of its environmental resources. In order words the Pardubice R. did not used its environmental resources in a value creating way compared to the Czech Republic on average.

4 Results

This paper analysed the environmental sustainability of the fourteen regions of the Czech Republic for a period of seven years (2006 – 2012). In Table 5 below, Environmental Sustainable Value development from 2006 to 2012 in every region of the Czech Republic is presented. Prague as the capital city is considered to be a special region for this study. Due to its special position (thanks to the high concentration of business activities) it generates twice more return than the second region in order. On the other hand, enterprises in Prague generate significantly greatest amount of waste from all the regions.

Table 5 Environmental SV of the regions of the Czech (in mil. EUR)

Region\Year	2006	2007	2008	2009	2010	2011	2012
Prague	22 139	22 042	26 423	25 939	27 386	26 490	28 248
Central Boh. R.	- 3 621	- 3 238	- 3 554	- 4 582	- 4 954	- 4 833	- 5 491
South Boh. R.	- 1 660	- 1 796	- 2 857	- 3 053	- 3 177	- 2 911	- 3 541
The Plzen R.	- 1 788	- 1 663	- 2 388	- 2 287	- 2 008	- 1 532	- 1 914
The Kar. Vary R.	- 1 306	- 1 669	- 1 486	- 1 157	- 1 456	- 1 222	- 1 410

ISBN: 978-1-61804-368-9

The Usti R.	- 7 955	- 8 288	- 8 399	- 9 849	- 9 973	- 10 456	- 10 262
The Liberec R.	1 222	1 098	378	923	1 004	777	875
The Hr. Kr. R.	- 141	2	- 51	20	- 104	- 12	- 287
The Pardubice R.	- 1 480	- 1 687	- 1 767	- 1 830	- 2 331	- 2 102	- 2 916
The Vysocina R.	- 3 060	- 2 453	- 2 917	- 3 310	- 3 659	- 3 188	- 3 681
The S. Mor. R.	1 925	1 978	2 714	1 929	3 439	3 684	4 167
The Olomouc R.	- 552	- 111	- 90	- 371	- 252	- 391	- 594
The Zlin R.	921	1 025	1 501	1 421	1 238	1 264	1 594
The Mor.-Sil. R.	- 4 644	- 5 342	- 4 390	- 3 998	- 5 173	- 5 424	- 3 883

Source: Authors

The Sustainable Value gives an absolute figure which shows how much more (positive SV) or less (negative SV) return a region generates with a given set of environmental resources in comparison to a benchmark (Czech Republic) and as an absolute monetary figure Sustainable Value depends on the size of region. To take the size of the region into consideration, a Sustainable Value Margin (SVM) was calculated as shown in table 6 below. The indicator which is chosen represents the size of each region is GDP. SVM is calculated by dividing Sustainable Value by Regional GDP of the region. This tackles the problem of size by relating the sustainable value of the region to another indicator representing the size of the country.

Table 6 Calculation of SVM of the Pardubice Region in 2006

	GDP (EUR)	Sustainable Value (EUR)
	5 031 569 376	-1 480 133 313
SVM	**- 0,29**	

Source: Authors

5 Discussion and Conclusion

To measure environmental performance, we used Sustainable Value approach in this paper. Sustainable Value uses Triple-bottom-line (economic, environmental and social indicators) to assess sustainable performance. Generally this methodology is used to measure corporate sustainable performance. However, contribution of this paper lies in application of the framework of SV to measure regional environmental performance where we focused on the environmental aspects using the environmental indicators to see if the regions created value. In our paper SV approach aims to assess how efficiently fourteen regions of the Czech Republic use their environmental resources compared to the benchmark (Czech Republic on average).

One of the final evaluations express which regions created positive value (used its environmental resources in a value creating way compared to the benchmark). These value creating regions are Prague, the South Moravian R., the Zlin R. and the Liberec R. Analysis also shows SV development in all regions over years 2006 to 2012.

References:

[1] Bell, S., Morse, S., *Sustainability Indicators. Measuring the Immeasurable?* Earthscan, 2008.

[2] Bruntland, G. H., *Our common future: the world commission on environment and development*, Oxford Uni.Press, 1987.

[3] Daily, G. C., *Nature's services: societal dependence on natural ecosystems*. Island Press, 1997.

[4] Dalal-Clayton, B., Sadler, B., *Sustainability Appraisal. A Sourcebook and Reference Guide to International Experience*. Earthscan, 2009.

[5] Drhová, Z., Sustainable Development Strategy: A Tool for Strategic Governance? *Central European Journal of Public Policy*, 2011, pp. 86–97.

[6] European Commission, *MEANS Collection: Evaluating socio-economic programmes*, DG Regio, 1999.

[7] Figge, F., et al., The Sustainability Balanced Scorecard - Linking Sustainability Management to Business Strategy. *Business Strategy and the Environment*. Vol. 11, 2002, pp. 269-284.

[8] Figge, F., Hahn, T., Sustainable Value Added: measuring corporate contributions to sustainability beyond Eco-Efficiency. *Ecological Economics*, Vol. 48 (2), 2004, pp. 173-187.

[9] Hahn, T., Figge, F., Sustainable Value creation among companies in the manufacturing sector. *Int.Journal of Env. Tech. and Man.*, 7.5-6, 2007, pp. 496-512.

[10] Hak, T. et al., *Sustainability Indicators*, SCOPE 67. Island Press, 2007.

[11] Hřebík, Š., Třebický, V., & Gremlica, T., *Manual for planning and evaluation of Sustainable Development at the regional level*. EnviConsult, Ltd., Office of the Government of the Czech Republic, Prague, 2006.

[12] Jordan A. J., Lenschow. A., *Innovation in environmental policy. Integrating the Environment for sustainability*. Edward Elgar Publishing, 2009.

[13] Moldan, B., Janouskova, S., & Hak. T., How to understand and measure environmental sustainability: Indicators and targets. *Ecol Indic*, 17 (1), 2012, pp. 4–13.

[14] Olafsson, S., et al., Measuring countries' environmental sustainability performance – A review and case study of Iceland. *Renewable and Sustainable Energy Reviews*, 2014, pp. 934 – 948.

[15] Olsson, J. A., et al., *Indicators for Sustainable Development*, Discussion paper, European Regional Network on Sustainable Development, 2004.

[16] OECD, Environment Policy Committee, *OECD Environmental Strategy for the First Decade of the 21st Century*. OECD, 2001.

[17] Rhouma, A. B., Sustainable value in Europe: sustainability performance of the Czech Republic versus the Europe of Fifteen. *E+ M*, 3.4, 2010, pp. 16-29.

[18] Stepping, K., *Challenges in measuring the state of the environment in developing countries: a literature review*. Deutsches Institut für Entwicklungspolitik, 2013.

[19] WCED, *Our Common Future*. Oxford Uni. Press, 1987.