

Integrative approaches towards Zero Emissions regional planning: synergies of concepts

Márton Varga^a, Ruediger Kuehr^{b,*}

^a *The Natural Step International, Garvargatan 9c, 11221 Stockholm, Sweden*

^b *United Nations University (UNU), Zero Emissions Forum, c/o UNU-EHS, UN Campus, Herman-Ehlers-Str. 10, D-53113 Bonn, Germany*

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Abstract

This paper presents four strategic approaches for sustainable regional development: The Natural Step Framework, Zero Emissions, Eco-Industrial Parks, and The Rocky Mountains Institute's Economic Renewal program. An analysis against the requirements of regional planning shows a great synergy potential among these concepts. A joint approach would be advisable, not only on the content side, as the presented concepts differently fulfil the requirements of regional planning, but also on the organisational side, in terms of coordinating efforts and allocating personnel, time and financial resources. However, all four concepts seem to lack two aspects: First, a project must meet the needs of the residents and fit their regional and personal identities in order to get them involved, and second, most development projects need clear monitoring structures. In order to close these gaps, we propose to integrate a tool that helps to understand people's livelihood systems, as well as monitoring tools such as Ecological Footprint accounts, Factor X models or Material Impact calculations.

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1. Introduction

Both the United Nations Conference on Environment and Development (UNCED) in Rio in 1992 and the World Summit for Sustainable Development (WSSD) in Johannesburg in 2002 emphasised the importance of regions for a successful implementation of sustainable development. Although the local or municipal level seems to be too small to organise a spatial balance, levels such as Federal States are too far away from the facts for practical decisions. Moreover, in most parts of the world, the regional level has its own and integrative development perspective across sectors. Thus, the emphasis of sustainable regional development can be a counterpoint against the trends of transnationalisation and globalisation, as well as against a continuing centralisation

of decisions affecting the spatial situation. In addition, the regional view also provides a base to respect the identity and the interests of the people affected in the planning procedure [1].

However, there was no dispute during the WSSD that progress in implementing sustainable development has been extremely disappointing since 1992 [2]. Consequently, progress in the implementation of the paradigm "sustainability" should be dealt with in a more strategic way than has been the case. Although it is clear that changes on a regional level require an appropriate mix of various means and be in support of the population; this paper describes whether and how far large-scale strategic approaches towards sustainability can support the development of regional plans and programmes and their operationalisation and final implementation.

The extensive discussions on sustainable development since the late 1980s have led to an enormous number of frameworks and directives for orientating thinking. Cleaner Production, Clean Technology, Loop Economy, Eco-Profit, Eco-Efficiency,

* Corresponding author. Tel.: +49 228 815 0213; fax: +49 721 151234 313.
E-mail address: kuehr@online.de (R. Kuehr).

Ecological Footprint, Factor 4, Factor 8, Factor 10, Natural Capitalism, Responsible Care, Local Agenda 21 and Zero Emissions are just a few examples of such concepts towards sustainable development. Although each concept has its own justification, the number of scientifically accepted, easy to understand and action-guiding “strategic” approaches towards sustainability is rather limited. In our understanding, a “strategic” approach differs from the vast number of concepts through a holistic and at the same time very practical point of view: It helps to create motivation for innovation, sets clear and reachable goals for sustainability, and offers orientation in decision making towards these aims. Over and above this, a strategic approach for sustainable regional development brings together a scientifically accepted understanding of sustainability with the needs of regional stakeholders in order to guide basic innovations and technological changes.

2. Requirements for regional planning

In regional planning, sustainable development requires integrated strategies instead of solutions for certain sectors such as e.g. agriculture, tourism or mobility [3]. This integrated understanding of planning and development can help to avoid trade-offs between the individual developments, and emphasises synergies between different sectors [4].

In their case-study work with the development of rural regions of Switzerland, Scholz and Stauffacher [5] stress four important requirements of regional planning studies:

- *Local level*: National studies often cannot reach day-to-day problems that are specific for each region.
- *Synthesis*: In complex cases such as regional planning, projects tend to analyse and create solutions only for certain parts of the problems. Integrating these solutions into a complete development strategy is essential for a successful implementation of a project.
- *Scientific methods*: Increase the credibility of a study and the robustness of its outcomes against changes in the cultural and/or economic environment.
- *Transdisciplinarity*: Mutual learning between stakeholders, politicians and scientists for joint planning of the study right from the beginning.

In their study on sustainability on the regional scale, Hübler et al. [1] set up a criteria framework for sustainable regional development approaches. They differ between:

- *Constitutive elements of sustainability*, aiming at describing the character or essence of sustainability: for example integration, longevity, justice and participation;
- *Strategic principles of sustainable development*, aiming at setting a framework for action and a first rough assessment. The following principles are considered as relevant: diversity, efficiency, sufficiency, risk management, consistency, network building, cooperation, transparency, participation in a broader sense, integrative and intergenerational justice;

- *Quality goals*;
- *Action guiding goals*;
- *Indicators*.

Robèrt et al. [6–8] have a similar understanding with their five-level model for strategic sustainable development. According to this model, a complete approach encompasses five hierarchic levels of planning:

1. *System understanding*;
2. *Definition of success within the system*;
3. *Strategy*;
4. *Action*;
5. *Tools*.

Over and above these, many projects stress the importance of considering regional identity as a determining factor for long-term success for development efforts. The term “regional identity” refers to the development potential of a region as a whole; i.e. to the characteristics of and processes within the region, its future development anticipated by its inhabitants, but also its exchange with neighbouring regions.¹ Austria even included strengthening local identity and participation, together with preserving the regional diversity in nature, society, culture and economy among the fundamental guiding principles of its sustainable development strategy [9].

Starting from these sources, at least the following criteria seem to be important for a successful approach of sustainable regional development (Box 1).

3. Four strategic approaches to sustainable regional development

In the following, we discuss four strategic approaches for sustainable regional development: The Natural Step Framework, Zero Emissions, Eco-Industrial Parks, and The Rocky Mountains Institute’s Economic Renewal program. Although all have success stories with regional development to look back on, each of them lays its primary focus on different aspects in the above defined set of criteria.

3.1. The Natural Step Framework

The Natural Step Framework is an integrative approach for sustainable development, initiated by the Swedish physician Karl-Henrik Robèrt. Its main parts were developed by consensus building among leading scientists [10]. The goal of The Natural Step Framework is to combine scientific rigour with everyday practice in the field of sustainability, thus providing a “compass” for strategic sustainable development [11].

In order to instrumentalise this goal, The Natural Step scientists designed the above-mentioned five levels model of sustainable development, and a series of tools that are related to

¹ Personal communication from Norbert Plass, Joanneum Research, Graz, Austria. Telephone interview on October 13, 2005.

Box 1. Success criteria for sustainable regional development

- (i) *Local motivation and participation.* It is possible to design development plans from outside, but mostly, only local ownership leads to long-lasting success.
- (ii) *Reliance on comprehensible principles of sustainable development.* If many stakeholders are participating in the planning process, agreement on basic principles of sustainability will be of utmost importance.
- (iii) *Strategic planning.* Planning mistakes or the lack of implementation support can make the best initiatives suffer and fail.
- (iv) *Implementation along quality and action guiding goals.* Many concepts of sustainable development support the planning, but only a few care about what is really done.
- (v) *Monitoring of progress.* Sustainable regional development is a long-lasting process. In order to maintain the change process and motivate new stakeholders, there is a need for monitoring tools as well as for public relations.

each level of this model. The Natural Step stresses that a thorough *system understanding* must be the basis for successful development planning. From its roots in System Theory, The Natural Step deduced four so-called “System Conditions” that mark the *success* level within the System “sustainable society”. The *strategic* level is represented by “backcasting from principles”, a planning method that enables decision makers to move towards compliance with the success principles while at the same time remaining flexible to react on changing conditions. The Natural Step’s ABCD-Process² formalises the backcasting approach. At the *action* level, The Natural Step features open, participatory processes in order to involve not only decision-makers but also all kinds of stakeholders. The Natural Step uses the above named *tools* together with tools of other organisations, such as Life-Cycle-Assessment (LCA) techniques, Ecological Footprint, Factor X models etc.

The Natural Step Framework, its components and its relationship to other concepts have been introduced in detail in several publications, in the *Journal of Cleaner Production* [6,7], and elsewhere [11–13].

Besides The Natural Step Framework’s success in industrial production [10,14,15], scientific research and university teaching [8], it is also used to foster sustainable regional development. James and Lahti [16] summarise the experience of

more than 60 Swedish eco-municipalities, which adopted The Natural Step Framework for their development. Within the various ways of these municipalities, the authors identified a series of steps that were necessary for successful change [16]:

1. *Finding the “fire souls”:* In most of the cases, change started with five or six enthusiastic and committed individuals.
2. *Raising awareness:* Education about the meaning of sustainability and about how local actions are connected to global trends is essential for a broad endorsement of the goals of sustainable development.
3. *Official endorsement of sustainability:* The work of the “fire souls” must be complemented by an institutionalisation of sustainable development. This step gives officials and citizens a public mandate to move forward in any way they can.
4. *Involving the implementers:* Governmental endorsement does not guarantee successful change. This can only occur if a broad alliance of local officials and citizens is involved and supporting the change process.
5. *Applying the compass: Sustainability framework, inventory, visions, and action plan.* This is the step where the methodical work with the ABCD process can start.
6. *Whole plan endorsement:* The action plans worked out by official departments and/or citizen working groups must be officially endorsed in order to secure their practical implementation.
7. *“Keeping it going”:* A critical part of continuing the change process is ongoing education, training, and efforts to raise awareness about the importance of sustainability. Combining The Natural Step Framework with sustainability indicators, environmental management tools, and municipal planning and regulatory instruments provides ways to monitor progress of the endorsed action plans.

The Natural Step Framework endorses all five criteria for a successful approach of sustainable regional development. However, only the sustainability principles and the strategic planning are “built-in” in the approach itself, the fulfilment of the participation, implementation and monitoring criteria depends on the way The Natural Step Framework is applied. This is also reflected in the process of regional planning with the Framework: If the fire souls cannot be found, or their initiative is not backed up by the official government, or if the governmental commitments do not result in a broader alliance across the boards, the process will stop before it really starts. Nevertheless, James and Lahti [16] stress that the Framework itself provides a good educational instrument in order to convince officials or sceptical citizens. Measured at its own five-level model, The Natural Step Framework places emphasis at the upper three levels, leaving action and the selection of appropriate tools to the implementers. These persons must take the responsibility to complement the Framework with monitoring tools, and to “keep it going”.

3.2. Zero Emissions

In 1994, the United Nations University (UNU) launched a new initiative designed to investigate various approaches

² A four step strategy: (A) Common understanding, (B) Baseline analysis, (C) Search for solutions, (D) Strategy design [9].

and technological breakthroughs that are requisite to the creation of a new type of industrial system [17,18]. A central theme of this system is the complete utilisation of materials in symbiotic flows: One sector's waste should become another's input. The term Zero Emissions describes the idea of continuous improvement towards maximal utilisation of materials and zero emissions of harmful substances. The vision is optimistic that value-added utilisation for waste materials can be found in order to realise double dividends, for the economy and the environment.

Zero Emissions represents a shift from the traditional industrial model in which waste is considered the norm towards integrated holistic systems in which everything has its use. It advocates an industrial transformation where businesses emulate the sustainable cycles found in nature, and where society minimises the load it imposes on the natural resource base and learns to do more with what the earth produces. The Zero Emissions concept envisions all industrial inputs being used in final products or converted into value-added inputs for other industries or processes. In this way, industries are reorganised into clusters, so that each industry's wastes and by-products are fully matched with the input requirements of another industry, and the integrated whole produces no waste [17,19].

Zero Emissions also requires a shift in society as a whole. It is widely recognised that production and consumption are tightly intertwined activities. Thus, implementation of Zero Emissions requires consideration of the larger societal system within which industrial activities take place. Achieving Zero Emissions at a societal level includes addressing issues such as urban and regional planning, consumption patterns, energy conservation, upstream industrial clustering, the reuse, refurbishment and recycling of products, and the interactions of these activities with the local industrial production base [20,21]. Therefore, regional planning towards Zero Emissions includes exploring the material flows of a project region with the aim to identify material of a certain quantity and quality that is considered to be at the end of its life cycle, but could become a resource for further processing.

The Zero Emissions concept works towards a concrete goal of sustainable resource utilisation in society, especially at the

industrial scale. It has achieved remarkable success particularly in Japan, where many businesses, government agencies and local communities adopted it as a basis for their activities to improve environmental performance [22–24]. Results include the development of the idea of the “bio-refinery”, though which input materials for plastics and other organic-based products are derived from plant matter [25]. From 1999 onwards, the UNU adopted a facilitating role in fostering Zero Emissions related activities through formation of a new organisation, the UNU/Zero Emissions Forum (UNU/ZEF). This forum brings together representatives from business, local government, academia and NGOs in order to promote collaborative projects that implement Zero Emissions. The Kawasaki Eco-industrial Park, the Eco-town of Kita-Kyushu but also UNU's “Information Technologies and Environment Initiative” and most recently the Zero Emissions Manual towards the Realisation of a Zero Emissions based Regional Community [26] represent good examples of such collaborative initiatives [27]. In its current form, UNU/ZEF has Japanese and international components, the former involving over 150 representatives from Japanese business, local governments, academia, and NGOs [28].

3.3. Eco-Industrial Parks

An Eco-Industrial Park (EIP) is defined as a community of enterprises located together at the same site, seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials [29]. While the conceptual background of EIP lies in Cleaner Production and Industrial Ecology [29], EIPs are also used as strategies to implement Zero Emissions developments.

EIPs should be integrated into their surrounding natural systems. Additionally, they should close material flows towards cycles and maximise water and energy efficiency through facility design, co-generation, energy cascades, etc. They urge to maintain an optimal mix of enterprises over time and coordinate the construction and rehabilitation of their

Table 1
Starting points for Eco-Industrial Parks [30]

Type of model	Approach
Ex-nihilo model	Designing an Eco-Industrial Park on a green field and “out of nothing”.
Anchor tenant model	Identifying an already existing and interested “core-company” and designing an Eco-Industrial Park that complements this “anchor” by establishing a network of businesses needed to supply materials and use by-products.
Business model	Attracting a number of tenants in order to develop a certain area and then acilitate network linkages.
Stream model	Analysing different material/resource flows in an existing industrial system and creating a (virtual) Eco-Industrial Park by connecting the users of complementing streams.
Business-stream model	A combination of the above-mentioned models: analysing flows in an existing system, networking users and attracting additionally needed businesses to an available development area.
Redeveloping model	Analysing material and energy flows, communication gaps and collaboration possibilities in a fully established industrial park, enhancing environmental performance or cleaning up past pollution.

The ideas stem from Chertow [31] and Lowe, Moran, and Holmes [32].

facilities [29]. As Table 1 shows, there are different starting points and model strategies to build up an EIP:

The most cited example of a successful EIP is in the Danish town Kalundborg [33]. There, the participating enterprises achieved a maximum grade of efficiency: All by-product flows are directed forward to users converting them into products, which then leave the EIP system. Besides Kalundborg, there is a variety of examples in the Philippines, Thailand, India, China, Japan and other areas.

The concept of clustering industries brings about several advantages, not only for the environment, but also for business and in social terms. However, they also harbour potential problems, for example that the concentration of facilities can become an obstacle in the future. From the perspective of global sustainable development, single EIPs only create highly efficient islands in an external flow of material—unless they organise themselves into a worldwide network or they are embedded into development activities at greater regional scale.

3.4. The Rocky Mountain Institute's Economic Renewal Program

With over fifteen years of experience, The Rocky Mountain Institute's (RMI) Economic Renewal Program is one of the pioneers of sustainable community development in the United States. The program offers economic development ideas that are compatible with communities and the environment, and decision-making tools with which communities can chart their own strategies [34].

The Economic Renewal process is a series of town meetings carried out by a team of residents with the help of a larger group of volunteers and sometimes a professional facilitator. Normally, it takes two to six months, not counting the time necessary to carry out the chosen projects. The number of participants in the process varies widely, from 25 to more than 200. Economic Renewal stresses four main principles for community development projects [35]:

- *Plug the leaks*: Do not let the money disappear through an inefficient community.
- *Support existing business*: Locally owned businesses tend to be more responsive to local needs and values and they keep more money circulating in the local economy.
- *Encourage new local enterprise*: A town that plugs leaks and supports existing businesses is an exciting place to start a new enterprise.
- *Recruit compatible new businesses*: Having pursued the previous three steps, a community will be in a strong enough position to recruit new businesses that are compatible with its values and needs.

Based on their experiences, RMI staff worked out nine tools for harnessing the above principles [35]:

- *Ask why*: Shift focus from particular proposals to the goals that unite the community.

- *Manage demand*: Ask what job participants want to be done and find a way to do it.
- *Pursue development, not necessarily growth*.
- *Seek small solutions*: Small solutions are usually faster, more flexible, less expensive, and more manageable than large ones.
- *Find problem-solvers who care*: Local people have a stake in community development.
- *Increase the "multiplier effect"*: Keep money circulating inside the community.
- *Find hidden local skills and assets*: View once the community with a fresh eye.
- *Build social capital*: People are essential to successful development.
- *Organise regionally*: Tie in to the regional economy.

The outcome of the Economic Renewal meetings will be a few realistic projects chosen by the participants. Because many residents will have participated in selecting the projects, or at least followed and understood the process, they will feel some ownership in and commitment to them. Many community residents and leaders, especially those who participated, will better understand the community economy. This experience may lead to effective decisions in the future.

With its focus on participation, the Economic Renewal Program bears similarities to the process of implementing The Natural Step Framework in regional development (see above). The difference lies in the content: While the latter strictly builds on sustainability principles, Economic Renewal gives greatest possible freedom for the participants to re-design their community within the boundaries of economic efficiency. This freedom is not only positive, since Economic Renewal does not provide a means to prevent a community from unsustainable practices. In this point, the RMI can certainly learn from The Natural Step scientists. However, both approaches underestimate the role of action-guiding and monitoring.

4. Synergies between the presented concepts

As established in the beginning, at least five criteria are important for a successful approach of sustainable regional development: (i) local motivation and participation, (ii) reliance on comprehensible principles of sustainable development, (iii) strategic planning, (iv) implementation along quality and action goals, and (v) monitoring of progress. None of the presented approaches fulfils all five criteria at the same time. The Economic Renewal Program is mainly focusing on the local motivation and participation, whereas The Natural Step Framework emphasises mainly reliance on comprehensible principles of sustainable development and strategic planning. The Zero Emissions Concept and EIP concentrate on implementation along quality and action goals, whereas none of the presented has its focus on monitoring.

Rather than perceiving them solely as alternatives or even competing concepts, we analyse the synergies between the presented concepts. Previous work showed that there are no major obstacles against cooperation stemming from the

philosophical standpoints or strategic origins of most of these approaches [7]. In recent studies, the UNU demonstrated the synergetic effects through a close cooperation between all actors involved in regional planning, including these four and few additional approaches towards sustainability, for the Indonesian Regency of Riau (Eastern Sumatra) and the Austrian Federal State of Burgenland [36,37]. The trend of mergers in industry might not be the ultimate ratio; nevertheless, it shows that organisations can use financial, personal, and organisational synergies when they are cooperating. Moreover, a closer cooperation could help to ensure the necessary basis innovations, as a critical mass is faster achieved in cooperation, which also means increased publicity, political influence, and feedback to the organisations themselves.

In order to fulfil all success criteria for sustainable regional development, an approach that joins the strengths from the presented concepts could be promising. With its focus on local motivation and participation, RMI's Economic Renewal Program can provide the necessary basis for a long-lasting regional planning and re-organisation within the boundaries of economic efficiency. This approach allows the greatest possible freedom, but standing alone it would not provide the means to prevent unsustainable developments and practices. The Natural Step Framework is a good supplement in this regard, providing basic principles for sustainability and a strategic planning approach towards a mutually agreed-on target. In addition, The Natural Step Framework, appears to be a good instrument to convince and educate stakeholders on the necessity to work out a joint approach. However, the implementation of the developed action plans would still not be guaranteed by these two concepts. In this regard, Zero Emissions can bring in its practical efforts directly attempting necessary modifications of industrial productions, consumption attitudes and technology development. The clustering of industries in Eco-Industrial Parks closes the loop to regional planning, but also illustrates how implementation can take place while simultaneously testing the progress made.

5. Filling the gaps towards an integrated development approach

Compared with the five requirements of regional planning stated above, even a combined approach of these four concepts will lack two aspects.

Firstly, no participation system can ensure that the local residents really want to participate in a project. The problem of lacking ownership frequently occurs in development cooperation projects that are usually designed by external experts without considering the needs of the residents. Even the Economic Renewal and The Natural Step Framework that actually build on direct local participation might run into difficulties in the context of development cooperation: Their models and decision-making processes are very much based on the Western cultural context and might not work in other regions.

Secondly, the four concepts under analysis here are very capable in generating actions towards sustainability, but leave

the implementers alone with continuing and monitoring their efforts. This is easy to understand, as all of the four concepts are considered as approaches to initiate sustainable development, and in the initiatory phase, monitoring is mostly of subordinate relevance. It is only an additive part of the Economic Renewal Program and The Natural Step Framework. And only in those cases where the Zero Emissions concept is transferred into EIPs, is there a continuous analysis process that provides a critical assessment.

There are methods for both, the successful start and the successful finishing of a project. In the following chapter, we add a methodology to understand people's livelihood systems, which evolved in the context of development cooperation. This tool can help project developers to better fit their ideas to a region's own identity and to its inhabitants' hopes and wishes. Monitoring tools such as Ecological Footprint accounts, Factor X models or Material Impact calculations can help to fill the monitoring gap of our 'integrated sustainable regional development' approach.

5.1. Livelihood systems as a base for development projects

In order to support the India strategy of the Swiss Agency for Development and Cooperation (SDC), the project "Rural Livelihood Systems and Natural Resource Management in Semi-Arid Areas of India" promoted sustainable management of natural resources in the reference frame of rural livelihood systems (RLS).

A livelihood system is made up of innumerable elements which constitute the economic, cultural, social and spiritual "Universe", wherein rural families are bound to make their living. It is a multidimensional "whole", embracing all forces and constraints of a family's life [38]. Decisions that concern the way of living, including the use of natural resources, are never made out of purely economic or purely religious or spiritual motives, but always out of the interaction with the whole livelihood system of the relevant actors. One tool to approach this system is the RLS mandala (Table 2) that separates the livelihood system into nine distinct dimensions.

Although only the residents themselves can provide relevant insights into their livelihood system, the "nine-focal lens" of this tool helps people from outside to broaden their perspective, ask the right questions and thus, understand the meaning of resources, decisions, and development for the local residents.

As the multidimensionality of livelihood systems implies, development coordination projects cannot be successful in the long term if they only import existing solutions for partial problems, while they ignore the inner world of the project region's people. In this view, the key of success in development is that regulations, approaches, strategies from "the top" or from outside meet a genuine initiative from the project region's people. Regulations that are set above their heads will not affect their lives. Even if a development project builds up the best infrastructure available in the world that meets the material criteria of sustainability, the development will not meet the concerns, the

Table 2

The RLS Mandala: nine dimensions of a rural livelihood system [38]

9. Individual Orientation visions, hopes, aspirations, fears, self-image, models.	8. Family Orientation ancestors, caste, social status, aspirations to leadership, education, jobs, aspirations to power, wealth, social mobility.	7. Collective Orientation subsistence agriculture, food security, religion, traditions, state laws, world views, schools, capitalistic values, urbanisation, prosperity.
6. Inner Human Space integrity, identity, awareness, selfishness, compassion, responsibility, affection, curiosity, courage, anxiety	5. Family Space gender relations, nutrition distribution, health, family planning, distribution of work load, solidarity.	4. Socio-economic Space production relations, systems of cooperation, community organisations, governmental institutions, markets of goods, land labour and capital.
3. Emotional Base memories, attachments, feelings, boredom.	2. Knowledge and Activity Base technology, agricultural patterns, experiences, skills, traditional knowledge, labour, crafts, services, modern professions.	1. Physical Base natural environment (topography, climate, etc.) natural resources, animals, habitat, accumulated wealth.

problems, wishes, skills and traditions of the local people. On the other hand, successful development always includes the affected population's visions, hopes, fears, its religion, tradition and world views, the people's identities, their traditional knowledge, experience and skills and their emotional base: in other words, the population's own livelihood system, starting with the definition of the development goals.

The application of this approach in the 1980s led to remarkable results in the Swiss development cooperation in Nepal, where deforestation, along with its consequences of erosion and flooding, had increasingly threatened the living basis of the population [39]. Governmental regulations prohibiting any use of the forest failed to solve the problem, and scientists perceived the rapid growth of the population, and its dependency on forest products as a main cause of deforestation [40,41]. In the 1980s, local farmers' initiatives started to plant forests on private land and even protect pieces of the state-owned forest. The livelihood systems approach helped to convince the government to re-assign the right of utilisation and management to the villagers. Today, Nepalese forests are prospering: Gilmour and Nurse [42] report about a steady afforestation process resulting in a continuous increase in tree-crown cover in the overall landscape. Högger [43] describes an apparent difference between community managed and state owned forest. Thirty-six awarded projects of the first ten years are presented in [44], together with the persons and ideas that provided the basis for their success.

The Livelihood Systems approach emphasises the necessity of local rootedness and participation. It was purposely designed as a counterpoint to conventional land use programs that were too much concerned with resource-based strategies or indicators and did not take sufficient account of livelihood strategies of farmer households and communities. The understanding of these livelihood strategies is a prerequisite of real participation, especially in development projects among different cultures. The action-guiding concepts presented above may profit a lot from the basis laid by a thorough preparation through this approach.

5.2. Concepts to measure sustainability

As easily comprehensible indicators to measure success are missing in all presented approaches, we provide brief summaries of some existing concepts. Of course, such tools will not deliver the design of a sustainable development strategy, but they are indispensable components for any action-oriented approach. The Natural Step Framework has already begun with integrating these concepts into its toolbox [6,7,12,13]. Also UNU-ZEF is employing them within its activities and projects [26,36].

5.2.1. Ecological Footprint

The Ecological Footprint [45,46] estimates how much of Earth's productive land and sea area is used to produce food, materials and energy and to assimilate wastes. As a result, ecologic supply can be compared to human demand on the biosphere. This comparison makes the Ecological Footprint an easily comprehensible tool that visualises the material and energy intensity of a product, a person, family, community, country, or the human population. The purpose of this tool is to assist governments in managing their ecological assets, quantify sustainable development goals and to support their efforts for advancing sustainability.³

5.2.2. MIPS, FIPS, and Ecological Rucksacks: basic tools to measure material and energy intensity

As the human economy requires materials and space (surface area) as main natural resource inputs, Schmidt-Bleek proposed the material input per service unit (MIPS) and specific surface intensity (FIPS) as basic measures for the ecological stress potential of products and services [47].

³ Personal communication from Mathis Wackernagel, E-Mail from February 15, 2004.

In MIPS, the total natural material inputs, including displaced material and material used for making the necessary energy available, are weighed against the service or utility provided by a certain product. The higher the material intensity of a certain product, the higher is the ecological costs per utility unit. Although utility can rarely be quantified, the material input associated with a given service can then be assessed in weight units. The “ecological rucksack” of a product is defined as its material intensity (MI) minus its own weight. With the help of MI factors for raw materials, the MI and the ecological rucksack can also be computed for complex products. Recycled non-renewable materials mostly carry lower rucksacks than virgin materials. The MIPS of products can be lowered—or the resource productivity increased—by societal choice as well as by technical improvements.

Similar to MIPS, the FIPS computes the specific surface intensity of products, crops, buildings, infrastructures, and services (where F stands for “Fläche”, the German word for surface area). F can be measured in units of square meters. The actual area to be used for computing FIPS must be scaled, based on the extent to which its ecological functions have been diminished. For instance, sealing an area completely with asphalt represents maximum disturbance, while using soil for agricultural production diminishes the natural function less [47].

5.2.3. The Factor X concepts

The main idea behind these concepts is to focus the environmental and sustainability discussion on the complete material input into anthropogenic processes instead of single pollution, waste or side effect issues.

In their early concept Factor 4, von Weizsäcker, Lovins and Lovins proposed that the global utilisation of natural resources should be halved and social welfare doubled in order to achieve global sustainability. This factor 4 increase in global resource productivity is considered easily feasible with increased efficiency of industrial processes, and a global awareness of material and energy intensity of lifestyles [48].

Global equity requires that regions with an already high resource throughput make greater efforts in reducing their effect on natural ecosystems than those with low present resource requirements. As less than 20% of humankind consume in excess of 80% of the natural resources, the richer countries need to dematerialise their technical basis of wealth—or increase the resource productivity—by at least a factor 10 on the average [48]. Factor 10 is neither a mathematical answer to the complex environmental crisis, nor an economic model. It is a flexible goal that can be refined as experience with changing life styles grows [48].

In order to assess certain industrial processes, Schmidt-Bleek developed the Factor X tool. It is guided by the following question: “By what factor should present technology-induced flows of natural materials be reduced as a minimum in order to stay within the capacity of the eco-cycles?” ([7], p. 205). Thinking in such big dimensions ensures that the required change in industrial systems does not get lost in marginal improvements.

6. Conclusions

This analysis illustrated that successful regional development requires a mixture of complementary approaches and methods, which may vary depending on the circumstances, needs and capabilities of each region. Relying on several approaches not only brings together complementary experience, but also seems to be the only way to remain flexible enough in order to bring about the necessary innovations for a sustainable, “Zero-Emissions” society. Further research work towards this objective, discussions to initiate it and pilot projects are needed to prove success in practice.

The ecologic movement of the late eighties helped to make societies sensitive to the environmentally harmful ways of life and development. What it did not achieve was to initiate a self-sustaining development towards a sustainable human society, although most of the mentioned concepts and organisations put sustainable development as their main goal. In fact, it seems to be the fragmentation of the ecological movement which did not allow reaching its first-order goal. If the ecological movement is truly to initiate sustainable development, it is time to overcome the partial differences. Many of the intellectual ideas behind these concepts have the capacity to initiate a positive feedback loop towards sustainable development. However, this will only happen if the organisations pull on the same end of the rope.

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Márton Varga graduated in environmental sciences at the Federal Institute of Technology ETH Zürich, based upon studies with The Natural Step Framework. He is currently affiliated with the Austrian Energy Agency in Vienna, Austria.

Ruediger Kuehr has served as the European Focal Point of the United Nations University’s Zero Emissions Forum (UNU/ZEF) since 1999 and since 2005 at the UNU-EHS in Bonn.