より効率的なリソース利用による二酸化炭素の削減

Carbon dioxide reduction through more efficient resource utilization

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The environmental challenges of the 21th century require massive changes in industry, business, and life-style. The forthcoming end of fossil fuel use, which is necessary for stabilizing the earth's climate, will affect all sectors of life. However, changes can be achieved only by the cooperation of stakeholders and population. Managing the process of change with all its imponderables in the interaction of various groups is the main focus of this research.

The most challenging issue of our time is the rise of the atmospheric CO_2 level. With human activities burning fossil fuels, we affect the global carbon cycle over a time span that is much longer than our own life. The reduction of CO_2 emissions requires the termination of the use of gas, oil, coal.

1. Agent-based modeling and stakeholder analysis

In addition to the technical challenges to sustainable technology, there are many socio-economic issues that must be addressed in order to transition to a cleaner energy and material system for human development. At the core of those issues are human behaviors, which can be unpredictable and difficult to understand, especially on the individual level. In aggregate, however, it is possible to identify some underlying behaviors such as consensus building (or lack thereof), diffusion of information, network formation. These group behaviors emerge from individual interactions and decision making. Agent-based modeling is a computational tool designed specifically to explore emergent phenomena such as these, in order to understand the mechanisms by which they occur.

In order to create such a model, preliminary work is done to analyze individual stakeholder values, preferences, and behaviors. This is done through astakeholder census, in which all parties who may either affect or be affected by a given development project are interviewed using questions designed and tested to measure that project's social license to operate (SLO). The stakeholder network is also mapped by asking stakeholders about the quality of their relationships with other stakeholders during the interview. Figure 1 shows an partial stakeholder network built from interviews in an onsen town in the Tohoku region of Japan. This network, along with the associated SLO data is the topographic and mechanistic basis for an agent-based model of geothermal social license in Japan. This model will be used specifically to test policies for equitable development of geothermal resources or other stakeholder consensus as the case may be.

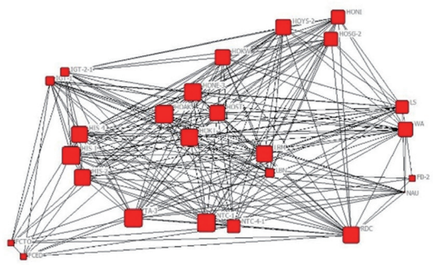

Fig.1 . Partial stakeholder network. Node size reflects the eigenvector centrality of that individual within the network.

2. Ecopoint concept

The global resource consumption is not sustainable. Fossil fuel combustion increases the atmospheric CO_2 level endangering earth's climate. Alternative biomass production requires additional land areas, which are withdrawn from natural habitats. Ores of important metals might be depleted over the next 50 years.

The Ecopoint concept tries to reduce the effects of excessive resource consumption by limiting the use. Ecopoints work as an ecologic currency that is distributed to the world's population for purchasing resources incorporated in products. They are handed from consumers to merchants and manufacturers down to resources producers, acting as mining fees (Fig.2). Every resources has its own Ecopoint value (Tab.1) and resource production cannot exceed the availability of Ecopoints. Furthermore, Ecopoints can be traded between individuals according to their personal requirements. After introduction of the Ecopoint system, resource consumption is reduced by rising resource prices using an intentional inflation rate. This concept allows individuals to gain full control over their own needs. Conflicts as between food crop and energy crop production is avoided since individuals will use their Ecopoints for food before investing in luxury good. This concept reduces CO_2 emissions, limits land use, and reduces poverty.

Resource	Ecopoints/unit	unit
Natural gas	3.881	m^3
Crude oil	4.413	L
	701.7	bbl
Coal	3.690	kg
Arable land	0.3509	m^2 a
Wood	1070	m^3
Aluminium	1.251	kg
Copper	10.24	kg
Gold	102800	kg
Iron	0.1181	kg
Phosphate	0.3245	kg

Tab.1 Resource prices at an annual income of 12 000 Ecopoints per person.


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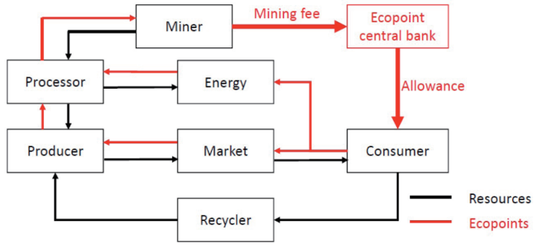

Fig.2 Resource and Ecopoint flow.

3. Capacity Building on Sustainable Environmental Management

Current environmental management practices especially in developing countries such as Indonesia are considered unsustainable. This is usually attributed to high population growth rate and poverty, especially in less developed areas. This is worsen by the climate change phenomena all over the regions. Increase intensity and frequency of environmental pollution, storms, drought, flooding, and precipitation variance have implications for environmental resilience for various uses and sectors.

Sustainable development and environmental management is seen worldwide as the solution to this problem. Although this concept has been accepted widely as an approach to manage environment for achieving public prosperity and sustainable environment worldwide, nevertheless the concept itself is not a common blue-print and so, it is still required comprehensive understanding and some adjustments for the local condition. Ideally, this approach should account for interests relative to environmental conservation and use, for all existing constraints as well as for all major political, legal, administrative, economic, environmental, social and cultural aspects, and the most important things is that we should regard Water-Food-Energy nexus in order to accomplish global sustainable development.

Therefore, the capacity building on the sustainable environmental management is strongly important, such as for graduate program students as an agent of change for better environmental management. Three related subjects have been delivered during last period, namely Introduction to Sustainability, Sustainable Environmental Management and Business, and Environmental Energy System Studies. The approaches to deliver the course content covered a combination of classroom activities and group assignment. Besides, a separated field excursion was carried out to gain more wide-ranging understanding on the importance of environmental management in practical situations of industry and society in an integrated manner.

Fig.3 Classroom Activity of Introduction to Sustainability

Fig.4 Field Excursion on Water Management Practices