



# **Trading on Scarcity: Ecological Progress and Financial Market Innovations**

By Thomas Koellner, ETH Zürich

## **Input Paper**

9th International Sustainability Leadership Symposium  
2008

“Capitalising<sup>3</sup> on Natural Resources:  
New Dynamics in Financial Markets”

10 / 11 September 2008

Swiss Re Centre for Global Dialogue,  
Rüschlikon/Zürich, Switzerland

---

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
<b>2</b>	<b>Scarcities of commodities and the role of financial markets .....</b>	<b>1</b>
	<i>From single commodities to ecosystem services – a shift in natural resource management.....</i>	<i>1</i>
	<i>The response of the financial markets to new scarcities .....</i>	<i>2</i>
<b>3</b>	<b>Financial market innovations for natural resource management .....</b>	<b>3</b>
	<i>Laying the conceptual foundation.....</i>	<i>3</i>
	<i>Conventional commodity markets.....</i>	<i>4</i>
	<i>Environmental commodity markets.....</i>	<i>4</i>
	<i>Capital (equity &amp; debt) markets.....</i>	<i>5</i>
	<i>Real estate markets.....</i>	<i>6</i>
	<i>Insurance markets .....</i>	<i>6</i>
<b>4</b>	<b>From innovations to mass markets .....</b>	<b>7</b>
<b>5</b>	<b>Drivers of sustainable development in financial markets .....</b>	<b>7</b>
	<i>The significance of global issues .....</i>	<i>8</i>
	<i>Environmental and social norms .....</i>	<i>8</i>
	<i>Attractive financial and non-financial return.....</i>	<i>8</i>
	<i>Powerful market participants.....</i>	<i>9</i>
<b>6</b>	<b>Conclusion .....</b>	<b>9</b>
	<i>Acknowledgments .....</i>	<i>10</i>
	<i>Literature .....</i>	<i>10</i>

## 1 Introduction

Population growth, higher incomes and climate change continue to exacerbate the scarcity of conventional commodities (e.g., metals, energy, and food). Very much the same drivers are also responsible for a gradual depletion of environmental commodities, such as biodiversity and ecosystem services, which are of enormous value for human well-being and prosperity.

Sincere hopes are pinned on the recent product innovations introduced by the financial markets designed to incentivise a preservation or sustainable usage of these commodities. However, although often promising in their design, these products are still in their infancy, both with regard to product development and market penetration. To gain relevance and substantially contribute to a sustainable management of conventional and environmental commodities, these innovations need to move from the start-up phase to a strong expansion course. Furthermore, they currently occupy a niche, because they are still complex in their design and sometimes philanthropic or ideological in their intentions. The sustainable financial market innovations need to evolve into “mainstream” products of strategic relevance to their providers and to the financial markets in general.

The goal of the paper at hand is to review the financial market innovations dealing with the sustainable management of resources recently introduced to the market and to explore the essential drivers for inducing a shift both in terms of market penetration and strategic relevance of these products.

## 2 Scarcities of commodities and the role of financial markets

### From single commodities to ecosystem services – a shift in natural resource management

The growing world population and rising income in emerging countries will cause a continuously increasing demand for metals, energy, water and food over the next decades. By 2050, food production needs to increase twofold to satisfy global demand. However, climate change increases the pressure on the availability of water and arable land. These trends will not only lead to a price increase for natural resources<sup>1</sup>, but also threaten biodiversity, ecosystems and human health.

The current challenges associated with the increased production of biofuels illustrate the close and complex interaction between the rising demand for natural resources and their increasing scarcity. Once acclaimed as a solution to combat energy shortage as well as climate change, the massive use of energy crops like palm oil and corn has triggered severe ecological and socio-economic impacts. Managing a single commodity in isolation is insufficient. Instead, responsible resource management has to take a holistic or systemic approach, carefully considering the social, economic and environmental drivers of a sustainable development.

Scarcity in commodities relates not only to tangible goods like timber, food, water and fish, but also to ecosystem services and the loss of biodiversity. Ecosystem services, for instance, comprise functions of the natural environment such as water retention and purification as well as erosion control.

The global management of natural resources requires a systemic view and an appropriate balance of economic, social and environmental goals (i.e. capitalising<sup>3</sup>).

Not only hard commodities (e.g., metals), but also ecosystem services (e.g. flood protection) will experience increasing scarcity and therefore carry a higher value.

---

<sup>1</sup> The food price index has almost doubled between May 2006 and May 2008. It is a global index composed of prices for fats and oils, grains, sugar, meat, fishmeal and some fruits (Commodity Markets Review, June 11, 2008 DECPG, The World Bank).

The increasing severity of hurricanes, surging storm water and exacerbating drought adds urgency to calls for regulating services provided by ecosystems. Furthermore, along with the increasing demand for natural resources, the need for provisioning services such as biomass production is growing. However, according to a survey by the Millennium Ecosystem Assessment (2005), 60% of global ecosystem services are used unsustainably and have suffered degradation.

### The response of the financial markets to new scarcities

In the last decade, the financial markets have responded to the depletion of fossil energy, materials, fish and water, climate change, loss of biodiversity and degradation of ecosystem services with the introduction of innovative financial instruments and products dealing with the management of natural resources. The IRIS model of the New Scarcities, to cite an example from the financial industry, illustrates how a systemic approach to the human and environmental drivers of scarcity translates into new business opportunities (see figure 1). Since the inception of products based on these business opportunities, the financial volume and value of these trades has increased exponentially. Yet, their overall market penetration and also their relevance for sustainable development still remain smaller than it could be.

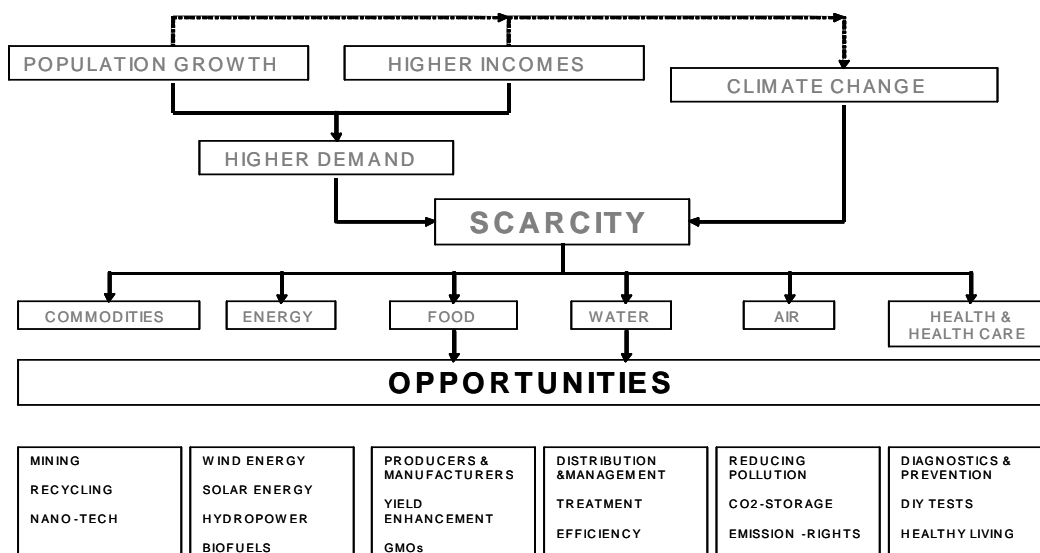


Figure 1: The IRIS Model of the New Scarcities.<sup>2</sup>

By investing in scarcity, however, the financial markets may also have contributed to aggravating market distortions through speculative trades (e.g. with corn, cereals, rice) as illustrated by the recent price hikes for soft commodities and the resulting food scarcity for these products in the southern hemisphere. From a societal point of view, it is thus prudent to ask how the market can avoid such distortions.

Financial markets have come under scrutiny for having responded primarily to the new scarcities with opportunistic strategies aimed at maximizing short-term financial returns. In contrast, market players pursuing a sustainable strategy acknowledge the systemic complexity of conventional and environmental commodities by focusing on long-term financial returns and by balancing them against their potential ecological and social returns.

<sup>2</sup> IRIS Research (2007): Scarcity in Abundance: Investing in New Scarcities. (IRIS is an independent institute for research and investment services, a joint venture of Rabobank and Robeco.)

### 3 Financial market innovations for natural resource management

#### Laying the conceptual foundation

To understand and predict innovations in financial markets, a conceptual understanding of how such markets evolve is essential. Richard Sandor, founder of the Chicago Climate Exchange, has described seven stages through which all financial markets have to pass in their development to maturity (Sandor 2006, for further discussion see Rabinowitz 2006). Recognizing the global environmental challenges, assessing their consequences on society and economy, responding to them through integrated finance solutions and testing them is the first and crucial step towards innovation. Next, legal instruments are derived, creating uniform standards. They enable the trading of such products, first in informal markets and later through formalized exchanges.<sup>3</sup>

1. Structural (*environmental or socio-economic*) change that creates a new demand for capital.
2. Creation of *uniform standards* for a new commodity or security.
3. Development of a *legal instrument* providing evidence of ownership of the commodity or security.
4. Development of *informal spot markets* (for immediate delivery) and forward markets (non-standardized agreements for future delivery) for trading receipts of ownership.
5. Emergence of commodity or security *exchanges* as centralized trading mechanisms.
6. Creation of organized *futures markets* (standardized contracts for future delivery on organized exchanges) and *options markets*.
7. Proliferation of *over-the-counter markets*, allowing trade of securities, which do not meet listing criteria of formal exchanges.

Finally, from a societal point of view it is important to evaluate the ultimately positive or negative consequences of financial innovations on the initial structural change.

Due to their different mechanisms, financial innovations in markets for conventional commodities, environmental commodities, capital (stocks & bonds), real estate and insurance need to be distinguished (Table 1).

Table 1: Coverage of natural resource themes by current financial markets. ✓ current activities, (✓) planned activities

	Conventional Commodity Markets	Environmental Commodity Markets	Capital (Stocks & Bonds) Markets	Real Estate Markets	Insurance Markets
Hard commodities					
• Metals and Minerals	✓		✓		
• Energy	✓		✓		
Soft commodities					
• Food and Fibres	✓		✓	✓	✓
• Timber and Forestry	✓		✓	✓	✓
• Fish and Fisheries	✓	✓	✓		
Environ. commodities					
• Clean Air		✓	✓		
• Clean Water		✓	✓		
• Carbon/Climate		✓	✓		✓
• Biodiversity		(✓)	✓		✓
• Ecosystem Services		(✓)	✓		

<sup>3</sup> Steps 1 to 7 effectively cite Sandor verbatim.

## Conventional commodity markets

Conventional commodity markets dealing with energy (e.g., crude oil and natural gas), raw materials (e.g., gold, copper and phosphates) and soft commodities from agriculture, forestry and fisheries (e.g., wheat, coffee, meat, timber and fishmeal) are mature.

The New York Mercantile Exchange NYMEX, founded in 1882, where these commodities are traded, was initially an exchange for soft commodities such as butter, cheese and eggs. Much later, specialised institutions for energy emerged, e.g., the European Energy Exchange EEX, founded in 2002, where carbon certificates are traded today amongst others. Recently, exchange traded commodities, ETC, (e.g., UBS Bloomberg–Constant Maturity Commodity Index CMCI) have developed. These solutions have the potential for fostering trades of non-institutional investors for commodities, as they do not restrict private investors to short-term futures only.

Exchange Traded Commodities (ETC) will allow private investors to participate in commodity markets.

Markets for hard and soft commodities may prevent regional imbalances but cannot ward off global scarcities. Financial markets may contribute to scarcity through speculation, at least for the majority of consumers, due to increasing prices. However, increasing prices must not be negative per se, because they signal scarcity and may thus stimulate the search for sustainable alternatives. It would also be a contribution to sustainable development if financial markets were to capture the higher quality and the price premium of green commodities like solar energy, organic food and fibres, or certified timber and fish. In the future commodity markets might thus well distinguish between commodities of “green” quality and those of conventional quality.

## Environmental commodity markets

As stated earlier, the financial markets for environmental commodities are still immature. While searching for solutions that go beyond traditional policy instruments, trading schemes and derivatives of rights for the emission, pollution or usage of either carbon, fisheries or water have been developed. Markets for biodiversity and ecosystem services are about to emerge shortly, although these markets are often highly regulated and involve limits or caps which apply an operational scarcity of the environmental commodity to all trade partners.

Sophisticated financial markets for all environmental commodities will evolve, as already demonstrated in the case of carbon.

- *Carbon*: The market for carbon emission rights and project-based carbon credits is the most mature, having progressed through almost all seven market stages. Commoditisation in terms of equivalents of greenhouse gases (CO<sub>2</sub>e) was established based on the scientific knowledge of climate change synthesised by the Intergovernmental Panel on Climate Change (IPCC) as well as extensive legal negotiations under the Kyoto Protocol. The European Union Emission Trading Scheme (EU ETS) has evolved as the largest multinational trading scheme for emissions rights. Meanwhile, formalised exchanges for trading carbon in tCO<sub>2</sub>e and other greenhouse gases exist. Standardised futures and options contracts on emission allowances are traded, and a further market sophistication has been accomplished with the introduction of carbon credits transactions between Certified Emission Reductions under the Kyoto Protocol and EU Allowance Units (CER/EUA Swaps). Since the price of these swaps is closely linked to energy and fossil oil markets, they may serve as a basis for speculative trading.<sup>4</sup> The complexity of this innovative market favours specialized companies for managing the carbon assets (e.g., First

<sup>4</sup> [http://www.co2-handel.de/article102\\_6235.html](http://www.co2-handel.de/article102_6235.html)

Climate<sup>5</sup> or South Pole Carbon Asset Management<sup>6</sup>).

- *Fisheries*: The collapse of the fish and seafood species around the world was the starting point for markets in individual fishing quotas. Like the carbon markets, the quotas are based on a negotiated cap, the total allowable catch (TAC). This cap, combined with the trading of fishery rights, should efficiently ensure sustainable fisheries.
- *Water quantity and quality*: Due to severe water shortages in many countries, financial products targeted at preserving or enhancing water quantity and quality have been developed. According to the Ecosystem Market Place, water is the "next carbon", and schemes for valuing and trading both water usage and water pollution are expected to be formalized soon.<sup>7</sup>
- *Biodiversity*: Market-based financial instruments have been developed to allow industries or public developers to offset damages to ecosystems and biodiversity. Informal or formal markets are not yet established. However, in some countries legislation requires the offsetting of biodiversity damage caused by infrastructure projects (e.g., EC Environmental Impact Assessment Directive). The commoditisation of biodiversity is a major obstacle to the development of formal markets. Unlike carbon, biodiversity is not easily definable as a homogenous commodity, rendering the development of any trading regime challenging.
- *Ecosystem services*: In many countries Payments for Ecosystem Services (PES) have been developed and implemented to financially capture the benefits of ecosystem services. Although not yet a formal market in most cases, this instrument facilitates transactions between the beneficiaries and suppliers of ecosystem services.

### Capital (equity & debt) markets

The capital market has developed a wide spectrum of environmental, ethical and thematic funds. Worldwide, about 700 such funds are currently available.<sup>8</sup> Portfolios of stocks and/or bonds are structured based on a variety of financial and sustainability criteria. While improving the risk-return ratio, they may also contribute to solving global environmental challenges by providing risk capital to enterprises dealing with all types of scarcities in commodities.

- *Indices*: In contrast to the well established equity indices which monitor stocks based on a wide spectrum of sustainability indicators (e.g., Dow Jones Sustainability Index<sup>9</sup>), new indices are emerging which track the stock price of companies dealing with scarcities in timber, food, water, and energy. The S&P Global Timber & Forestry index, for example, includes 25 of the largest publicly traded global stocks representing the timber and forestry investment theme.
- *Equity and equity funds*: In recent years, a variety of equity funds have emerged dealing with environmental scarcities. Until now, thematic funds have focussed mainly on clean energy, carbon and water. However, specialized equity funds for sustainable forestry and sustainable agriculture may develop in the future.

Investors usually lack awareness of the major differences between financial products based on exploitive and sustainable resource management.

Carbon funds traded over-the-counter invest venture capital directly in CDM and JI climate projects, or they invest in stocks of companies addressing the climate issue. Especially for the latter

<sup>5</sup> <http://www.firstclimate.com>

<sup>6</sup> <http://www.southpolecarbon.com>

<sup>7</sup> <http://ecosystemmarketplace.com>

<sup>8</sup> <http://www.srifundsadvice.com>

<sup>9</sup> <http://www.sustainability-index.com>

type, the differences compared with new energy funds are blurring (e.g., Sarasin New Energy Funds and Vontobel Fund Global Trend New Power), since both types of funds invest in the same companies. In addition, water funds addressing business opportunities for utilities, infrastructure and equipment in this water sector have recently been launched.

- *Bonds and bond funds*: Small loans to farmers or forest owners, which comply with sustainability criteria, are securitised as micro credit funds and are traded on formal exchanges (e.g., in Costa Rica FONAFIFO was planning to issue a forest credit fund backed by the World Bank).<sup>10</sup> The investment company Canopy Capital, UK, pursues an even more innovative plan by issuing formally tradable bonds with a maturity of ten years based on ecosystem service certificates. These certificates will securitise only the ecosystem services – such as storing carbon, generating rain and protecting wildlife – of Iwokrama rainforest in Guiana. The property rights for the land remain in the hands of the local owners, but the transaction binds them to a sustainable use of the forest.<sup>11</sup>

### Real estate markets

In the well-established real estate markets, the current activities of high net worth individuals and non-governmental organisations (NGOs) from developing countries are striking, since they have started to buy biodiversity rich property in developing countries in order to conserve it. Douglas Tompkins, founder of The North Face and Esprit, owns 12,000 km<sup>2</sup> of pristine land in Patagonia in Argentina and in Brazil. John Eliasch, CEO of the sports company Head, has bought 1,600 km<sup>2</sup> of tropical forest in the Amazon. The Nature Conservancy, a well-known NGO, is the world's largest land trust purchasing biodiversity rich land in Latin America and other regions.

Biodiversity rich land - like tropical forests - will be subject to rising prices and speculation.

However, these acquisitions still have a mere philanthropic character. Since the remaining tropical forests may well become scarce oases surrounded by devastated land, these acquisitions may potentially increase significantly in value. In the future, funds based on natural infrastructure (i.e., forests or agriculture) may well emerge along with the already planned sustainable real estate funds based on built infrastructure.

A new type of agricultural fund (e.g., currently planned by Credit Suisse) is already moving in that direction. The fund manager buys agricultural land worldwide (ca. 50% North America and Australia/New Zealand, 30% Central Asia and 20% Latin America). Professional companies hired by the fund manager will use the land to produce crops according to integrated pest management. Since an investment is fixed over a runtime of ten years, the investors have an interest in agricultural methods contributing to maintain the production capacity of the soil.

### Insurance markets

Currently, insurance markets provide coverage for agriculture, forest and biodiversity risks. Climate change and the increase of the impact of extreme weather events have triggered new solutions in the insurance business. Weather derivatives protect against financial losses due to climatic risks (Ali and Yano, 2004). In many countries, crop insurance based on weather or vegetation indices have become mainstream products. The World Bank has developed a Monsoon-indexed insurance for smallholders in India to mitigate their financial risks caused by harvest losses. Contracts are written

Climate change risks will trigger the development of sophisticated solutions in the insurance business.

<sup>10</sup> <http://www.fonafifo.com>

<sup>11</sup> <http://canopycapital.co.uk>

against specific rainfall outcomes such as drought or flood recorded at a local weather station.

Recently, innovations in insurance markets have been stimulated by EU legislation. The EC Environmental Liability Directive, ELD, requires the European insurance industry to develop products, which allow for covering damage to biodiversity in Natura 2000 sites caused by hazardous activities of industries.<sup>12</sup>

#### 4 From innovations to mass markets

According to Sandor's model, financial markets for *hard and soft commodities* differ widely with regard to their stage of development. Innovations have been developed in different markets, which aim to sustainably manage commodities such as energy, timber, fish etc. In contrast, financial markets for *environmental commodities* such as clean water, ecosystem services or biodiversity are still in a start-up phase. However, the development of innovative financial products and the increase in financial market sophistication has grown considerably. The prominent activities of governmental organisations (GOs), NGOs and public banks indicate a convergence of financial and non-financial goals.

However, will financial products aimed at the sustainable management of commodities remain niche-products or will they become mainstream and evolve into mass products? Sustainable innovations can only benefit sustainable development in a meaningful way if they fully penetrate the market and if their volume surpasses a certain threshold.

The transition from sustainable niche to mass markets requires that agents shift from an opportunistic to a strategic long-term approach.

The transition from the start-up to an exponential growth phase requires that a sufficient number of market players move from the currently prevailing opportunistic approach to a strategic long-term approach. To implement such a strategic shift, the market players need to adopt an operational decision-making approach meeting the following requirements:

- Understanding the complexity and the interdependence of the financial/economic, social and ecological systems
- Focusing on long-term financial returns
- Acknowledging the non-financial return of their financial activities, i.e. evaluating the environmental and social impacts.
- Balancing the financial with the non-financial returns.

To shed light on this transition, it is important to understand the socio-economic drivers of sustainable market development.

#### 5 Drivers of sustainable development in financial markets

The sustainable development of financial markets for commodities is driven by strategic and operational decision-making on the part of market players, legislators and other stakeholders. Four socio-economic key drivers illustrate and support the emergence and growth potential of sustainable financial markets: the significance of global environmental and socio-economic issues, the emergence of environmental and social norms, the expected financial and non-financial returns and the relative power of market players, legislators and other stakeholders.<sup>13</sup>

<sup>12</sup> [http://ec.europa.eu/environment/liability/white\\_paper.htm](http://ec.europa.eu/environment/liability/white_paper.htm)

<sup>13</sup> Freely adapted from Anthony Giddens (1984) *The Constitution of Society. Outline of the Theory of Structuration*. Cambridge: Polity. In environmental management literature, this theory is used to explain the development and maintenance of socio-economic structures in companies.

### The significance of global issues

To transform a global environmental and socio-economic issue into a financial product innovation, a sufficient number of market players conversant with the issue and its significance for economy and society, either now or in the future, are required. High-profile reports on relevant global developments and their consequences for the environment are vital for turning specialist knowledge into mainstream public opinion, as highlighted by the perception of the IPCC-Reports, the Stern Review (2006), the Millennium Ecosystem Assessment (2005) and the Sukhdev Report (2008). However, due to their complexity, financial markets might fail to understand the commercial potential of global issues. If market agents lack an appropriate understanding of the value of biodiversity or ecosystem services, they are unlikely to develop or buy financial products designed for these themes. Science is required to thoroughly research the financial implications of global change and share its findings with the key players in the financial market in order to support them in their decision-making.

The significance and proper understanding of environmental problems by market agents, legislators and other stakeholders is key to triggering financial market solutions.

### Environmental and social norms

The development of environmental and social norms is an important precondition to fostering financial market innovations. Implicit norms of investors and managers have triggered new products such as SRI funds. However, a larger market penetration will only develop if many market players share these norms. More effectively, explicit norms, i.e. regulation or legislation, will lead to the development of new products and market segments. According to the survey "Responsible Investment Landscape 2008", almost half of the surveyed asset managers (49%) believe regulators are one of the prime catalysts for change in the direction of responsible investments. The force of legislation is also visible in insurance markets. The recent EC Environmental Liability Directive (2004/35/EC) requires European insurers to offer insurance solutions to clients whose products potentially harm natural ecosystems. Explicit environmental norms are especially vital for the development of financial products based on environmental commodities (e.g., carbon markets), as these products are often imposed by legislation and regulation – sometimes even at fixed prices.

### Attractive financial and non-financial return

Attractive short-term financial returns are an essential incentive and precondition for the emergence of new financial solutions. However, short-term incentives need to be balanced against the public interest in non-financial and immaterial benefits, potentially translating into socio-economic benefits over the longer term. Since sustainable innovations are often only profitable over time, public-private partnerships may help to share the initial financial burden. Such partnerships may also contribute to boosting market capacity and to institutionalising trading activities based on environmental commodities. In particular, public and semi-public banks such as the World Bank or the German KfW provide essential impulses for a shift towards an environmentally and socially responsible strategy as they balance financial with non-financial interests strategically.

Public-private partnerships are very important in designing and implementing market innovations for natural resource management.

Ultimately, understanding and quantifying the extent to which market innovations and increasing penetration contribute to addressing major global environmental or socio-economic issues remains a key challenge. If a "green innova-

The measurement of the non-financial returns will gain importance.

tion” is just a watermelon, green packaging and conventional content, it might contribute to higher sales and fees but not to sustainable development. Consequently to be able to discern such “watermelons”, responsible investors need to be capable of understanding and quantifying both the financial and the non-financial return of their products.<sup>14</sup>

In well-diversified markets, independent rating agencies play an important role in increasing transparency. They use a set of financial and sustainability criteria for evaluating stocks (e.g., Asset4, SAM Group, SiRi Group, Trucost, or<sup>15</sup>), mutual funds (e.g., SRI Funds Advice<sup>16</sup>) or carbon projects (e.g., IDEAcarbon<sup>17</sup>).

### **Powerful market participants**

A successful introduction of innovations for sustainable resource management to the financial market and an enhancement of their market penetration are only possible if market participants have sufficient power to drive change on their own. However, “green innovators” often only have limited operational responsibilities within large companies. Their personal commitment is a prerequisite for the development of innovative financial products, but their abilities to act as green entrepreneurs in the market might be limited. As a consequence, many innovations are initiated in a start-up environment with the help of governmental organizations or NGOs, but still need to take the next step of becoming mainstream products in the large retail and investment banks.

## **6 Conclusion**

A multitude of innovative products addressing the issue of a sustainable management of natural resources has been introduced to the financial markets. Some of these products, e.g. thematic equity funds, have proven their commercial viability and contribution to ecological and societal objectives. However, most financial innovations in this field still have to break out of their niche segments to capture the large mass market if they are to play a significant role in mitigating key global environmental and socio-economic issues. Currently, financial innovations for environmental commodities predominately complement or replace traditional policy instruments (e.g., command and control) and markets instruments (e.g., labelling), improving their cost-effectiveness or their efficiency. It remains to be seen if the time is ripe for these products to become commonplace in financial markets.

The success of a product will be possible if all four socio-economic drivers mentioned are fine-tuned. This is not merely a task for commercial banks, but requires the coordinated action of all market actors, i.e. regulators, NGOs, commercial banks and public banks as well as the investors. Based on their individual views, we need to understand and manage opportunities and barriers to allow these innovative products to become commonplace. Only this will contribute in a meaningful and lasting way to sustainable natural resources management.

---

<sup>14</sup> Koellner et al. (2007) used formalized environmental impact assessments to allow for such a sustainability evaluation of equity funds. Mäder et al. (in prep) calculated their carbon intensity.

<sup>15</sup> <http://www.trucost.com>, <http://www.siricompany.com>, <http://www.asset4.com>

<sup>16</sup> <http://www.srifundadvice>

<sup>17</sup> <http://www.ideacarbon.com>

## Acknowledgments

I would like to thank the following individuals for their valuable input and discussion of earlier drafts of this paper: Bernd Schanzenbächer (Credit Suisse), Inge Schumacher-Hummel (UBS), Christina Ulardic (Swiss Re), Joachim Sell (First Climate), Christoph Sutter, (South Pole Carbon Asset Management), Daniel Skambracks (KfW), Olaf Weber (GOE), Henner Alms, Kai-Uwe Schanz (both Dr. Schanz, Alms & Company) and, last but not least, Thomas Streiff and Kolja Leiser (both The Sustainability Forum Zürich).

## Literature

- Ali, P. A. U. and Yano, K. (2004). *Eco-Finance: the legal design and regulation of market-based environmental instruments*. Kluwer Law International: The Hague.
- Koellner, T., Suh, S., Weber, O., Moser, C. and Scholz, R. (2007) Environmental impacts of conventional and sustainable investment funds compared using Input-Output Life-Cycle Assessment. *Journal of Industrial Ecology* 11, 41-60.
- Mäder, D., Maillard, Y., Wirth, P. and Koellner, T. (in prep) The carbon intensity of equity funds. Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press: Washington, DC.
- Rabinowitz, R. (2006) *Accounting for sustainability. PART II: Developments in the public and private sectors and environmental markets* A report from the Accounting for Sustainability Group convened by HRH The Prince of Wales
- Sandor, R. (2006) *Creating New Markets*. The Chicago Climate Exchange. In Kaul, I., and Conceição, P. (eds.), *The New Public Finance: Responding to Global Challenges*. Oxford University Press: New York, Oxford.
- Stern, S. N. (2006) *Stern Review: The Economics of Climate Change*. London. Cabinet Office - HM Treasury London.
- Sukhdev, P. (2008) *The economics of ecosystems and biodiversity*. European Communities.