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PRIORITY A.2.3.: Managing Arid and Semi-arid Ecosystems

Second Periodic Activity Report (01.01.2008 – 31.12.2008)
March 2009

ANNEX 5-2-1: Report on effectiveness of current financing for energy crops and agroforestry activities

Deliverable D5.2 (Lead contractor: ESD, Due date: December 2008)

COMPETE

Competence Platform on Energy Crop and Agroforestry Systems for Arid and Semi-arid Ecosystems - Africa

Responsible Partner:

ESD, 172 Tottenham Court Road, London, WT1 7NS

Project Co-ordinator:

WIP, Sylvensteinstrasse 2, 81369 Munich, Germany

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Project Partners

Partici-pant role	Partici-pant number	Participant name	Participant short name	Country	Date enter project (month)	Date exit project (month)
CO	1	WIP – Renewable Energies, Germany	WIP	DE	1	36
CR	2	Imperial College of Science, Technology and Medicine	Imperial	UK	1	36
CR	3	Utrecht University	RUUTR.STS	NL	1	36
CR	4	Stockholm Environment Institute	SEI	SE	1	36
CR	5	Austrian Biofuels Institute	ABI	AU	1	36
CR	6	Höhere Bundeslehr und Forschungsanstalt für Landwirtschaft, Landtechnik und Lebensmitteltechnologie Francisco Josephinum	FJ BLT	AU	1	36
CR	7	ETA - Energia, Trasporti, Agricoltura s.r.l.	ETA	IT	1	36
CR	8	European Biomass Industry Association	EUBIA	BE	1	36
CR	9	Practical Action	Practical Action	UK	1	36
CR	10	Consiglio Nazionale delle Ricerche	CNR	IT	1	36
CR	11	E+Co, Inc. (not funded)	E+Co	USA	1	36
CR	13	Institute for Sustainable Solutions and Innovation	ISUSI	DE	1	36
CR	14	AGAMA Energy (Pty) Ltd	AGAMA	ZA	1	36
CR	16	Center for Energy, Environment and Engineering Zambia	CEEEZ	ZM	1	36
CR	17	Environnement et Développement du Tiers-Monde	ENDA-TM	SN	1	36
CR	19	Food, Agriculture and Natural Resources Policy Analysis Network of Southern Africa	FANRPAN	ZIM	1	36
CR	20	FELISA Company Limited	FELISA	TZ	1	36
CR	21	Mali-Folkecenter	MFC	Mali	1	36
CR	22	MOI University	MU	Kenya	1	36
CR	24	Tanzania Traditional Energy Development and Environment Organisation	TaTEDO	TZ	1	36
CR	25	UEMOA - Biomass Energy Regional Program (PRBE)	PRBE	BF	1	36
CR	26	University of KwaZulu Natal	UKZN	ZA	1	36
CR	27	University of Cape Town - Energy Research Centre	UCT, ERC	ZA	1	36
CR	28	Chinese Academy of Agricultural Sciences	CAAS	CN	1	36
CR	29	Centro Nacional de Referencia em Biomassa, Brazil	CENBIO	BR	1	36

Project Partners (continued)

Partici-pant role	Partici-pant number	Participant name	Participant short name	Country	Date enter project (month)	Date exit project (month)
CR	30	Indian Institute of Science	IISC	IN	1	36
CR	31	The Energy and Resources Institute	TERI	IN	1	36
CR	32	Universidad Nacional Autonoma de Mexico	UNAM	MX	1	36
CR	33	Universidade Estadual de Campinas	UNICAMP	BR	1	36
CR	34	Winrock International India	WII	IN	1	36
CR	35	Interuniversity Research Centre for Sustainable Development - University of Rome "La Sapienza"	CIRPS	IT	1	36
CR	36	Universitetet i Oslo	UiO	NO	1	36
CR	37	University of Bristol	UNIVBRIS	UK	1	36
CR	38	University of Botswana	UB	Botswana	1	36
CR	39	University of Fort Hare	UFH	ZA	1	36
CR	40	TWIN	TWIN	UK	1	36
CR	41	Joint Graduate School of Energy and Environment	JGSEE	TH	1	36
CR	42	African Development Bank Group (not funded)	AFDB	Int.	1	36
CR	43	Energy for Sustainable Development Ltd.	ESD	UK	1	36
CR	44	Eco Ltd.	Eco	UK	1	36
CR	45	Chinese Association of Rural Energy Industry	CAREI	CN	1	36
CR	46	Food and Agriculture Organisation of the United Nations (not funded)	FAO	Int.	1	36
CR	47	Conservation International Foundation (not funded)	CI	USA	1	36
CR	48	Foederation Evangelischer Kirchen in Mitteldeutschland	EKMD	DE	1	36

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CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CO2e	Carbon dioxide equivalent
DNA	Designated National Authority
EU ETS	European Union Emissions Trading System
GHG	Greenhouse gas
LDCs	Least Developed Countries
NPV	Net Present Value
PDD	Project Design Document
PIN	Project Identification Note
REC	Renewable Energy Certificate
SADC	Southern African Development Community (SADC) countries: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar (membership pending), Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe
TREC	Tradable Renewable Energy Certificate
VCS	Voluntary Carbon Standard

INTRODUCTION

This work has been conducted in the framework of the project COMPETE (Competence Platform on Energy Crop and Agroforestry Systems for Arid and Semi-arid Ecosystems - Africa), co-funded by the European Commission in the 6th Framework Programme – Specific Measures in Support of International Cooperation (Contract No. INCO-CT- 2006-032448).

EXECUTIVE SUMMARY

The main scope of this paper is to discuss the effectiveness of current financing mechanisms for energy crops and agroforestry activities in Africa, and in doing so to review and evaluate both, existing financing mechanisms, as well as their main barriers. This paper applies to Least Developed Countries (LDCs) in general and in particular to the arid and semi-arid areas of Africa. However, as a result of the significant information available on biofuels, but only limited information on the other three types of energy crops (biomass, biogas and bioethanol) and agroforestry, this report has a strong emphasis on biofuels.

The report reflects this approach by structuring it is as follows:

- Section 1: Introduction
- Section 2: Review of existing financing mechanisms for energy crops and agroforestry
- Section 3: Review of barriers, limitations and key gaps in existing funding and market financing / investment
- Section 4: Evaluation of relative effectiveness and magnitude of each financing mechanism
- Section 5: Conclusions

In order to achieve the objectives of Work Package 5, three categories have been defined structuring the financing mechanisms as follows:

- Carbon credits / Green certificates
- Bilateral and Multilateral financing
- International biomass / bioenergy trade

SECTION 2: REVIEW OF EXISTING FINANCING MECHANISMS FOR ENERGY CROPS AND AGROFORESTRY

Carbon financing and green certificates

While carbon financing is based on international protocols -primarily the Kyoto Protocol- for emissions trading schemes, green certificates are more generally based on national/regional markets in countries/states with national/regional targets for renewable energy penetration.

Carbon finance is based on the value associated with a stream of emission reductions arising from an activity which has positive Green House Gas impacts which can be quantified and monitored.

The two key approaches in developing countries for establishing a project as being eligible for carbon emission reductions (and hence carbon finance) are, firstly, the Clean Development Mechanism (CDM) and, secondly, a range of standards for the voluntary carbon markets. The value of emission reductions is primarily a function of the quality of the emission reductions (certified under the UN-administered Kyoto Protocol or in terms of voluntary carbon standards) and the prevailing market conditions. Two examples of relevant standards are the Gold Standard -applicable to both compliance and voluntary markets- and the Voluntary Carbon Standard (VCS) for voluntary offset projects.

Green certificates -also called Green Tags or Tradable Renewable Energy Certificates (TRECs) or Renewable Energy Certificates (RECs)- are records of energy production which allow the non-energy attributes of the associated energy to be valued and traded. They are created by registration at the time of production (under internationally recognised and country-based protocols) and are traded to customers (in voluntary markets) or liable parties (in compliance/mandatory markets) before being redeemed at the time that the 'green' attributes (or benefits) are claimed.

Green certificates are used to support renewable energy policies through the establishment of quotas for renewable energy in the wholesale market (also called portfolio standards). There are both mandatory (e.g. Australia and UK), as well as voluntary (e.g. South Africa and selected states in the U.S.) REC markets.

Both carbon credits, as well as green certificates offer separate and additional revenue streams for a sustainable energy business which can increase the financial viability of the venture. They have been available for less than a decade and while there is some liquidity and market value in the OECD countries, there is very little practical experience with these mechanisms in developing countries, particularly with bioenergy ventures. It is important to note that carbon revenues (which enable carbon financing) and green certificates represent revenue streams which exist separately (but are related) to the underlying clean(er) energy systems with which they are associated. Experience has shown that, under the prevailing market conditions for emission reductions (carbon credits) and green certificates, the revenues arising from the carbon or green certificates constitute a small (<15%) proportion of the overall revenue arising from the associated energy revenues. These additional revenues are consequently often regarded as complementary but not sufficient in their own right to establish the financial viability of an energy project

Bilateral and multilateral financing

There are a number of bilateral and multilateral financing mechanisms supporting, or potentially supporting activities in Africa for biodiesel, bioethanol, bio-energy for fuel switching in industry and agroforestry. These bilateral and multilateral financing mechanisms are divided into four categories, providing a) grants, b) seed capital, c) debt financing or d) other financial instruments to create and support markets.

Key bilateral and multilateral financing activities for bioenergy activities in Africa include GTZ ProBEC (focus on biofuel sector in Mozambique), Shell Foundation (e.g. Gaia ethanol project in Ethiopia and Chardust project in Kenya), Ashden Awards (e.g. Gaia ethanol project in Ethiopia) and DFID (funding of the 5-year PISCES project aiming to provide policy research in bioenergy and biofuels). However, it should be stressed that -as described in more detail in section 3.2-, most donors (especially those working bilaterally) are hesitant in the liquid biofuel sector – given recent negative press and concerns about development impacts – so activities are mainly limited to small scale feasibility studies and small projects.

A list of relevant bi- and multilateral funds is provided in Annex I.

International biomass / bioenergy trade

Overall, the share of African countries involved in international trade of biomass / bioenergy is very small as most of the bioenergy available in Africa is used to meet local cooking and heating needs.

However, there are drivers for international biomass / bioenergy trade, such as policies, supporting schemes and biofuels targets. Examples include the EU biofuels directive which requires EU countries to replace 5.75% of all transport (fossil) fuels with biofuels by 2010. The main beneficiaries of these policies, however, are local markets in the EU and the U.S. with the bulk of support to transportation biofuels being linked to production, mainly through exemptions or rebates of fuel taxes that apply to gasoline and diesel, or (mainly in the United States), volumetric tax credits[27].

However, there are recent examples demonstrating that international bioenergy activities will also benefit Africa:

- China, for instance has asked Zambia to plant 2 million hectares of jatropha for the production of biofuels[1].
- South Africa signed a contract to export between 70% and 90% of output from a planned 400,000 tonnes a year biodiesel plant to Germany. This is part of an initiative by the South African government to encourage export-oriented growth in the country through the attraction of foreign and local investors[2].
- Ghana has attracted the interest of several nations around the world for biofuel production projects, including India, Brazil, Norway, Israel, China, Germany, the Netherlands, Italy and Belgium[3].
- The construction of a bioethanol plant in Mozambique with an anticipated yearly production of 212 million litres of ethanol is planned to start in May 2009. The developing company (Principle Energy) plans to implement further biofuels ventures in Africa[4].

The main financing mechanisms enabling bioenergy trade activities in Africa include traditional equity and debt financing, but also governmental, bi- and multilateral research and development programs, grants, tax cuts and exemptions and investment subsidies.

[1] http://www.biofuels-news.com/industry_news.php?item_id=700
[2] http://www.biofuels-news.com/industry_news.php?item_id=649
[3] http://www.biofuels-news.com/industry_news.php?item_id=659
[4] http://www.biofuels-news.com/industry_news.php?item_id=695

SECTION 3: REVIEW OF BARRIERS, LIMITATIONS AND KEY GAPS IN EXISTING FUNDING AND MARKET FINANCING / INVESTMENT

Carbon financing and green certificates

Carbon finance requires some specific market conditions and regulatory capacity. In many developing countries these conditions and regulatory/administrative capacities are weak and present significant barriers to accessing the carbon revenue which may be available in bioenergy projects.

These barriers include:

- ratification of the Kyoto Protocol by the host country;
- establishment of a Designated National Authority[5] (DNA) in the host country;
- policy support/environment;
- scarce skills;
- very limited experience (although this is changing);
- very limited access to project development funding for Project Identification Notes[6] (PINs) and Project Design Documents[7] (PDDs);
- weak institutional capacity in governments and DNAs;
- lack of available CDM methodologies for bioenergy projects;
- long registration period;
- risk in monitoring;
- lower than expected CER[8] production and risks of shortfalls;

Furthermore, there are two challenges related to determining emissions of bioenergy projects in Africa. Firstly, the difficulties in determining baseline emissions as these are based on traditional bioenergy systems. And secondly, challenges in taking account of lifecycle emissions (which vary according to feedstock and processing methods) in order to determine how biofuel projects will reduce GHG emissions below business-as-usual levels.

The barriers to effective participation in *green certificate* markets are less insurmountable for developing countries than in the case of carbon markets. This is primarily due to the fact that certificate markets are operated primarily within national (or sometimes regional) domains. Secondly, certificate markets are less onerous to define and regulate due to the relative simplicity of the criteria for qualification and ongoing monitoring of eligible projects / businesses, i.e. no additionality requirements in terms of quantified emissions.

[5] The designated national authority (DNA) is the body granted responsibility by a Party to authorise and approve participation in CDM projects

[6] A PIN contains the first set of general information to assess the basic eligibility of CDM projects; details provided include project participants, host country, general project information, project organisation, GHG emission reductions, additionality and sustainability effects; PINs are not a mandatory requirement for possible CDM projects

[7] A PDD is a mandatory requirement to get a possible CDM project registered; its five main areas are general description of project activity; application of baseline and monitoring methodology; duration of project activity / crediting period; environmental impacts; stakeholder comments.

[8] One Certified Emission Reduction (CER) is equal to a reduction of 1 metric tonne of CO2 equivalent. CERs are issued by the UN for emission reductions from CDM project activities

The main barriers to green certificate market opportunities include:

- Lack of policy and regulatory capacity to establish the frameworks for these markets[9].
- Limited access to international markets, hence relatively small domestic volumes;
- Lack of experience and confidence;
- Uncertainty in the overlaps (or not) with carbon markets.

Bilateral and multilateral financing

Apart from the barriers and limitations which are common to project financing in the bioenergy sector in Africa (as described at the end of this section), the following are the main barriers and limitations specific to bi- and multilateral financing of bioenergy projects in Africa:

- Questions and uncertainty as to the merits of biofuels in developing countries: this is of major significance to financing from bilateral and multilateral sources, with the World Bank, UNDP and other major funders questioning whether biofuel projects should be supported, mostly over concerns related to the food versus fuel discussions.
- Many biofuel investments are commercial and do not aim to support development within countries. They thus fall outside the scope of most bilateral and multilateral support. There is certainly some tension with these sorts of projects and support funds. The PISCES project has recently published case studies that concluded that "long local market chains spread out the benefits". While this is undoubtedly the case from a livelihood perspective, long market chains are generally something to avoid from the perspective of business profitability.

International biomass / bioenergy trade

A crucial aspect and barrier for trade in the current supporting schemes is that protectionist policies and tariff barriers are put in place to protect domestic production in OECD countries from cheap imported biofuels from developing countries (see further section 3.3).

The main policy-related barriers affecting trade of bioenergy in Africa include import tariffs, agricultuaral policy regimes (e.g. domestic support and market access) adversely affecting feedstocks, tax reduction and production subsidies. Furthermore, there are technical barriers including certification of and standards for environmentally sustainable bioenergy production and trade. There are also non-tariff barriers, most of all policy-related ones, including standards set to create technical requirement of chemical content or feedstock, agricultural policy regimes, tax reduction and production subsidies.

[9] South Africa has been establishing a government endorsed TREC market since 2003 (http://www.dme.gov.za/energy/renew_TRECS.stm) and a small voluntary market operates in the meantime.

Further very important barriers for international trade of African bioenergy products include:

- the use of liquid biofuels is mainly policy driven and many such measures are temporary and tend to change frequently, which in turn clearly discourages long-term investments, as they are considered too risky.
- the linking of financial instruments, such as feed in tariffs, to sustainability criteria, e.g. through certification systems.

Overall barriers

In addition to the specific barriers for carbon financing, bi- and multilateral financing and international trade in Africa, the more general barriers to market development for all commodities remain as constraints. These include i) policy, procedures and legislation size, ii) structure of national and regional economies, iii) lacking business and technical skills and information and iv) lack of access to and availability of (development) finance.

SECTION 4: EVALUATION OF RELATIVE EFFECTIVENESS AND MAGNITUDE OF EACH FINANCING MECHANISM

Carbon financing and green certificates

The relative effectiveness of carbon finance in developing countries is orders of magnitude greater than for Green Certificates. This is primarily due to the scale of demand in the international market for emission reductions (as a consequence of multi-lateral international and national political commitments) and the associated level of market development support which has been allocated to carbon trading. However, not all countries benefit equally from this as the geographical distribution, China is by far the leading CER sales market with a share of 73% (in 2007). In the same year, Africa only accounted for 5% of the overall CER market[10].

Overall, 2008 saw 4.9 billion tonnes (gigatonnes or Gt) of carbon dioxide equivalent (CO2e) reductions change hands, up 83% on 2007[11]. CDM accounted for 1.6 billion tonnes or 33% of this volume. A rough comparison is indicated by the approximately 0.14 billion tonnes of CO2e reductions due to green certificates *issued* and 0.05 billion tonnes of CO2e reductions due to certificates *traded* in Europe in 2007.

[10] Capoor K and Ambrosi P (2008). State and Trends of the Carbon Market 2008, World Bank
[11] Point Carbon's Market Monitor, 14 January 2009

The effectiveness of Green Certificates in developing countries has the potential to be more immediate and tangible since the overwhelming administrative overheads and delays associated with the CDM and other carbon market instruments are not required.

However, there has been very limited experience with RECs in developing countries. A voluntary market has operated in South Africa since 2004[12] and this market is currently based on RECs issued and traded from bagasse-based cogeneration facilities in the sugar industry.

The overall effectiveness of a green certificate market is limited in the case of voluntary markets (market surveys indicate a 1% take-up by customers in a voluntary regime) but the mandatory markets are seen to be effective if well implemented (as in the case of Australia).

Bilateral and multilateral financing

As discussed in sections 2.3 and 3.2, there are a very limited number of active biofuel activities from multilateral and bilateral funding in Africa. The hesitant provision of grants, seed capital, debt financing and other financial mechanisms is due to the following aspects:

- recent negative press and concerns about environmental and development impacts of bioenergy and particularly of biofuels
- lack of stability and transparency or even inexistence of relevant policy, procedures and legislation
- very limited information, expertise and experience about bioenergy activities in the local and national African financing sectors
- insufficient business and technical skills and information, and mostly
- questions and uncertainty as to the merits of biofuels in developing countries and
- the commercial nature of many biofuel investments which in turn does not support development within African countries.

As a result, the main activities from bi- and multilateral funding in the African bioenergy sectors are generally limited to small scale feasibility studies and small projects.

Given these shortcomings and constraints, bilateral and multilateral financing mechanisms have not been very effective in supporting the sustainable implementation of bioenergy activities in Africa. During 2008, for example, the total level of committed funds for liquid biofuel projects from bilateral and multilateral sources is estimated to be less than 250,000€.

More detailed analysis of the effectiveness of bilateral and multilateral financing has been undertaken using a market transformation / market creation model approach. The main criterion of this approach is that funding can only be effective, if it supports the creation of markets. The approach is based on an analytical framework (developed by the IEA) based on the following three perspectives on market creation:

[12] Tradable Renewable Energy Certificate System Feasibility, DRAFT Final Report, Version 12 (08 Nov 2006)

Technology demonstration and market learning perspective, i.e. technical performance improvement and cost reduction through R&D in private industry stimulated e.g. by market transformation projects (typically 'demonstration projects').

Market barriers perspective, i.e. focusing on the frameworks within which decisions are made by investors and consumers, e.g. understanding barriers and legitimate project actions to reduce them.

Market transformation perspective, i.e. practical steps to build markets for new energy technologies, thereby emphasizing the behaviour and roles of market actors, how their attitudes guide decisions and how these attitudes can be influenced.

The table below summarises positive and negative aspects impacting on the effectiveness of bilateral and multilateral financing of bioenergy activities in Africa using a market transformation / market creation model approach:

Perspective	**Positive and negative aspects impacting on effectiveness of bilateral and multilateral financing of bioenergy activities in Africa**
Technology demonstration and market learning perspective	Positive: i) in bilateral and multilateral financing, co-operation is increasingly fostered by country-level get-togethers of funders, and 'donor co-ordination groups', thereby creating sufficient scale to transform the market Negative: ii) real and perceived complexity of fuel supply creating a major investment disincentive iii) insufficient data to be able to draw conclusions about the scale of technology demonstrations required to produce significant market transformation from bilateral and multilateral funding iv) barriers in information flows, standards, transaction costs, financing and organisation of new technology markets v) lacking specialist governmental in-house expertise (e.g. legal) crucial to building institutional capacity; external expertise is costly

Market barriers perspective	Positive: vi) where market barriers are addressed in an economically efficient way, policies consistent with market principles are created and enforced and market failures -where existant- addressed. vii) prior government willingness to address policy issues as well as project management based within the Government can guarantee projects to produce results and develop policies on a particular subject. Negative: viii) impact of national and local elections in developing countries (taking place every 3-4 years with elected officials changing frequently) resulting in time delays and unexpected costs of biomass projects (which are considered risky from a political standpoint in Africa) ix) in the biomass energy sector, policies frequently do not exist or are uncoordinated, responsibilities are often unclear and the different levels of government (up to 3) sometimes have competing agendas x) conflict of interest and vested interests from different private partners in the project (e.g. equipment suppliers, raw material suppliers) result in disincentives to provide cost effective investment / equipment / operating costs xi) low level of management and business skills xii) challenge of finding private partners willing to invest in projects offering a lower IRR (i.e. biomass projects) xiii) funding windows for bilateral and multilateral projects are usually small, however, significant effort and time is required to secure financing for initial biomass projects xiv) rules and regulations for bilateral and multilateral funding prevent the required flexibility for fund managers and investors to maximise returns, representing a clear barrier in the effective provision of these funding streams.
Market transformation perspective	Positive: xv) By using market creation projects to make biofuels a substantial norm in the market place facilitates the market transformation process. Negative: xvi) Market participants often lack awareness and/or understanding of basic risks, benefits, opportunities, skills and strategies to address common barriers to renewable energy markets

Table 1: Positive and negative aspects impacting on effectiveness of bilateral and multilateral financing of bioenergy activities in Africa

The four main lessons to improve the effectiveness of bioenergy activities of bilateral and multilateral financing are as follows:

- It is essential to get large demonstration projects right the first time since markets can easily be constrained by perceived failures
- Scepticism about biofuels as a clean, sustainable and modern energy source must be persistently addressed in early markets
- Local awareness raising in the locations where demonstration projects will take place are essential to maintaining community buy-in, and technology acceptance
- Targeted awareness raising should start from the outset, before demonstration projects are commissioned

International bioenergy trade

Based on the analysis of three promising African bioenergy export chains, the following summary demonstrates the effectiveness of international bioenergy trade:

Case study 1: The trade of biomass and greenhouse gas emission credits from eucalyptus plantations in Mozambique:

Comparison of the effectiveness of trade of emission credits with physical trade of biomass or biofuels depends on administrative regulatory burden. These two options are compared from from a land use, costs and greenhouse gas mitigation perspective.

Conclusion on effectiveness: The case study results show that direct land use changes can have such a large influence (both positive and negative) on total carbon balances of the trading systems, mainly due to changes in soil carbon, that it would be unadvisable to ignore them (as currently done in physical trading). The implementation of a certification system could ensure that no carbon losses occur during the biomass production. Although carbon changes from land use changes can be taken into account in CDM projects, the chosen timeframe is rather arbitrary and has a large influence on the results as shown in this study

Case study 2: Bioenergy trade: the case of bio-ethanol in Southern Africa:

Many producers in the region are cost-competitive ethanol producers by world standards, reflecting excellent growing conditions for sugar cane and efficient milling operations, but not all have been able to exploit their full potential

The SADC (Southern African Development Community) countries have the potential to become major biofuels exporting regions, without endangering the domestic supply of biofuels.

The table below gives the total estimated costs for exported ethanol arriving at some important ports, in comparison with retail petrol prices in the broader geographical regions that might be served through those ports. The margins between low and high estimates are a proxy of the scope for policy initiatives (e.g. reduced tariffs, tax rebates) to promote bio-ethanol trade.

Port	Volumetric basis (US $/kl)		Energy basis (US $/kl)		Regional pmup prices gasoline (US $/kl)		Margin (% of ethanol price, energy basis)	
Rotterdam (Netherlands)	368	671	526	959	1140	1620	35	208
Los Angeles (USA)	272	398	389	569	540	680	-7	75
Singapore	331	503	473	719	480	1350	-50	185
Santos (Brazil)	265	452	379	646	500	1130	-38	198

Table 2: Bio-ethanol production potential from sugar cane and sweet sorghum (Ml)

Source: Johnson and Matsika, 2006

However, import tariffs imposed by some countries would have to be lowered or eliminated, as they represent in some cases a significant portion of the overall costs.

The table below summarises positive and negative aspects impacting on the effectiveness of bioenergy trade in the case of bio-ethanol in Southern Africa:

Positive
• Some producers in the SADC region have a preference for exports to international markets, particularly the EU, rather than intra-SADC trade, due to the commitments made in those countries for expanding biofuels (bioenergy targets); a reasonably assured market, potentially through long-term contracts, would be an important requirement for investment in the region
Negative
• import tariffs represent a significant portion of the overall costs: import tariffs are applied on *bioethanol* imports by both by EU (0.192 € per litre) and the US (0.1427 US$ per litre); *biodiesel* is subject to much lower import tariffs than bioethanol ranging from 0% in Switzerland to 6.5% in the EU; Tariffs applied by developing countries are generally between 14% and 50% • however, GHG credits do not appear to be a useful incentive for bio-ethanol expansion, unless carbon prices go up and/or if enough credit for co-products can be obtained to create additional value
Neutral
• transportation costs, once the infrastructure is improved, represent a fairly small share of total delivered cost of the product

Table 3: positive and negative aspects impacting on the effectiveness of bioenergy trade in the case of bio-ethanol in Southern Africa

Case study 3: The production of Jatropha in Tanzania for domestic applications and export:

The production and export of Jatropha seed or oil from Tanzania is a potentially promising option. However, the socio-economic viability of such chains depends on various parameters, among others on alternative, competing applications.

Five different applications are investigated. First, the seed can be directly sold to the biofuels industry. Alternatively, oil can be produced using a manual ram press, after which it is filtered and temporary stored in vessels. It can be used for household cooking or for local electricity generation, using a generator. Alternatively, the oil can be used for the production of soap. Finally, the oil can be sold, although there is no local market for Jatropha oil yet. So a local market for pure Jatropha oil as a blend in diesel engines is assumed.

The analysis is done for a Jatropha plantation with intercropping on arable land that would have been used for agriculture in the absence of the project (intercropping) and a Jatropha monoculture plantation on degraded land that would have only been used for grazing in the absence of the project (monoculture). The results, in terms of the Net Present Value (NPV) per hectare, the return on labour and the cost of energy are compared for the various systems and shown in the table below.

		Monoculture	Intercropping
OPTION 1: SEED TRADE			
production cost	US$/tonne	98,45	97,55
return on labour	US$/man-day	1,28	1,32
NPV	US$/ha	-229	-180
OIL PRODUCTION			
production cost	US$/litre	0,73	0,75
annual energy production	GJ/ha/year	30,9	25,8
labour intensity	man-day/GJ	10,1	10,1
annual labour needed	man-day/ha/year	299	252
OPTION 2: COOKING ON OIL			
cost of energy	US$/GJ	19,6	19,98
cost of utilized heat	US$/GJh	44,99	45,83
utilized heat	GJh/ha/year	13,9	-1,179
NPV	US$/ha	-1,361	0,59
return on labour	US$/man-day	0,62	0,59

OPTION 3: TRADING OIL			
NPV	US$/ha	47,02	45,83
return on labour	US$/man-day	1,53	1,41
OPTION 4: ELECTRICITY PRODUCTION			
producton cost of electicity	US$/GJ	166,14	171,85
annual electricity production	kWh/ha/year	2,32	1,933
electrification	households/ha	5,5	4,6
NPV when replacing diesel	US$/ha	2,113	1,616
return on labour replacing diesel	US$/man-day	2,85	2,68
OPTION 5: SOAP PRODUCTION			
production cost	US$/kg	0,92	0,93
NPV when replacing diesel	US$/ha	23,232	19,31
Return on labour	US$/man-day	10,59	10,68

Table 4: Results of the cost/benefit analysis for Jatropha oil production

Source: Wiskerke (2008)

The main conclusion is that the trade of Jatropha oil is more attractive than jatropha seed trade and the use of Jatropha oil as cooking oil, but less attractive compared to electricity production and soap production. Jatropha soap production is by far the most profitable alternative. When investing limited labour and cash, significant value can be added to the Jatropha oil. However, the local market for Jatropha soap is insignificant, whereas, in urban areas there can be a larger market. In Arusha, Tanzania, for example, Jatropha soap is sold as a luxury product. Although it can be expected that a growing and developing market would lead to a decreasing farm-gate price of Jatropha soap because of competition effects.

These results show that the production of Jatropha seed and oil for export is a potentially attractive option in case it is an additional activity. But the results indicate that that is in reality often not case, as conventional agricultural activities are placed. This results in a negative NPV for the production of Jatropha seeds. Furthermore, the results also show that other applications than the export of the Jatropha seed and oil are potentially more attractive.

Overall, financing new businesses in developing countries, especially in Africa, is widely recognised as being extraordinarily difficult, and even more so for the highly complex bioenergy ventures. Therefore, it seems likely that -in addition to the analysed opportunities from carbon financing/green certificates, bi-lateral and multilateral financing and international trade-, it will also be necessary to include the conventional mix of equity (from private equity or venture capital investors), debt (possibly on concessionary terms) and grants in order to find ways of financing new energy crop and agroforestry businesses.

1 INTRODUCTION

Energy crops are crops specifically grown and used for the generation of energy, i.e. heat, electricity and transport fuels. Mostly grown using conventional techniques, they are either burnt directly in stoves and boilers (for heat and electricity) or used as a diesel alternative biodiesel (e.g. blending ratio B-20, i.e. diesel with 20% biodiesel – usable in most trucks) or a petrol alternative bioethanol (e.g. blending ratio E-10, i.e. petrol with 10% ethanol – usable in most cars).

With the heavy reliance on traditional biomass as the main form of energy in Sub-Saharan Africa, in combination with agriculture often being the main economic activity and energy overall playing a very important role in the economic growth of developing countries, the development of sustainable strategies to grow, harvest, process and use/sell energy crops -both food crops and non-food crops- is one of the crucial opportunities for Sub-Saharan Africa for its overall sustainable development.

However, among the main challenges related to the production of energy crops is -in addition to aspects such as water misallocation, deforestation, reduced soil fertility / land degradation and rising food prices- the (in)ability of developing countries to finance these capital intensive and often very risky projects. A number of financing mechanisms exist, but most of them lack the required effectiveness to tackle the shortcomings which hinder the growth of bioenergy in Sub-Saharan Africa.

With the overall objective of this work package being the improvement of existing and the development of new financing mechanisms for the sustainable growth of bioenergy activities in arid- and semi-arid Africa, this paper investigates the effectiveness of existing financing mechanisms.

There are three main parts to this paper:

- Review of existing financing mechanisms for energy crops and agroforestry
- Review of of barriers, limitations and key gaps in existing funding and market financing / investment
- Evaluation of relative effectiveness and magnitude of each financing mechanism

Based on the findings of this paper, the final and most important step of this work package will be tackled, i.e. the improvement of existing and the development of new and innovative tools for the provision of financing for national bioenergy programmes and local bioenergy projects, thereby contributing to the stimulation of sustainable bioenergy implementation activities in arid and semi-arid regions in Africa.

2 REVIEW OF EXISTING FINANCING MECHANISMS FOR ENERGY CROPS AND AGROFORESTRY

2.1 Introduction to existing financing mechanisms

In order to achieve the objectives of this work package, three working groups have been defined dealing with the three main categories of existing financing mechanisms of this work package:

- Carbon credits / green certificates
- Bilateral and multilateral financing
- International biomass / bioenergy trade

These three categories will be used as the main structure throughout this paper to review existing financing mechanisms for energy crops and agroforestry, their barriers, limitations and key gaps and to finally evaluate the relative effectiveness of each of these financing mechanisms.

2.2 Carbon financing and Green Certificates

This section will review the main aspects of the first (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. carbon credits and green certificates.

Carbon financing and green certificates offer separate and additional revenue streams for a clean (or renewable) energy business which can increase the financial viability of the venture. In both cases, they represent commercial opportunities for trading the non-energy attributes associated with particular/specific energy services – such as environmental or social benefits associated with electricity or heat generated from renewable energy resources[13]. They have been available for less than a decade and while there is some liquidity and market value in the OECD countries, there is very little practical experience with these mechanisms in developing countries, particularly with bioenergy ventures.

Carbon financing is based on international protocols (primarily the Kyoto Protocol) for emission(s) trading schemes whereas green certificates are more generally based on national (or, perhaps, regional) markets (albeit using international protocols). Typically, the use of green certificates has been formalised in countries (or states) which have established national targets (or portfolio standards) for renewable energy. In these cases, the trade of RECs[14] has been constrained to the generation (and customer) base in the relevant country to avoid the effective subsidy of another country's investments in RE infrastructure. In addition, the rules for registration, certification and trade (including banking and retirement/redemption) can vary between countries depending on strategic national priorities. Overall, the rules (or protocols) are established for a domain (usually a

[13] B. Schlamadingera, A. Faaijb and E. Daughertya (2004). Should we trade biomass, electricity, renewable certificates, or CO_2 credits?, IEA Bioenergy Task 38 "Greenhouse Gas Balances of Biomass and Bioenergy System"
[14] Renewable Energy Certificate

country) and these protocols are registered with the Association of Issuing Bodies (AIB) in Europe or Center for Resource Solutions (CRS) in the USA.

It is recommended that financing mechanisms for investments should be matched to the effective life characteristics of the underlying assets. In the case of energy crops and agroforestry businesses, the associated assets[15] have longer term life-spans – typically between 10 to 30 years – and carbon financing and green certificates are well suited to these longer term investments as they are directly linked to the operating life of the businesses.

Overall, carbon financing and green certificates are becoming increasingly interesting for clean energy (and bioenergy projects specifically) as the importance of both energy service provision in emerging economies and mitigation of Climate Change are better understood. It is important to note that carbon revenues (which enable carbon financing) and green certificates represent revenue streams which exist separately (but are related to) the underlying clean(er) energy systems with which they are associated. Experience has shown that, under the prevailing market conditions for emission reductions (carbon credits) and green certificates, the revenues arising from the carbon or green certificates is a small (<15%) proportion of the overall revenue arising from the associated energy revenues. These additional revenues are consequently often regarded as complementary but not sufficient in their own right to establish the financial viability of an energy project.

"These trends highlight the extent of the challenge of securing the supply of reliable and affordable energy and effecting a rapid transition to a low-carbon, efficient and environmentally benign energy system. The Reference Scenario, characterised by rising energy prices, increased import dependence and rising greenhouse-gas emissions, is unsustainable – environmentally, economically and socially. Achieving a more secure, low-carbon energy system calls for radical action by governments at national and local levels, and through participation in co-ordinated international mechanisms."[16] (World Energy Outlook 2008)

2.2.1 Carbon financing

Carbon finance is based on the value, or revenue, associated with a stream of emission reductions arising from an activity which has positive Green House Gas impacts (quantified in terms of equivalent carbon dioxide emissions) which can be quantified and monitored. The value of carbon emission reductions has been effected under the evolving framework and administrative capacity of the processes and 'mechanisms' of the UN-administered Kyoto Protocol.

The two key approaches in developing countries for establishing a business, programme or project as being eligible for carbon emission reductions (and hence carbon finance) are, firstly, the Clean Development Mechanism (CDM)[17] and, secondly, a range of standards for the voluntary carbon markets[18]. The value of emission reductions is primarily a

[15]In micro-businesses these assets would typically include hand tools, wheel barrows, carts, spraying equipment whereas in small (and medium) businesses the assets would include land, tractors, ploughs, harvesters, trucks, power plant
[16] http://www.worldenergyoutlook.org/2008.asp
[17] http://cdm.unfccc.int/index.html
[18] Joint Implementation (JI) is another carbon finance mechanism established under the Kyoto Protocol but it is not applicable to developing countries.

function of the quality of the emission reductions (certified under the UN-administered Kyoto Protocol or in terms of voluntary carbon standards) and the prevailing market conditions. The Gold Standard[19] is a Swiss-based non-profit foundation which works in the CDM and voluntary markets to provide a best practice methodology by providing a high quality carbon credit label which acknowledges the value of sustainable development in carbon markets. The Voluntary Carbon Standard (VCS) was released on 19 November 2007 to provide "a robust, new global standard for voluntary offset projects. It ensures that carbon offsets that businesses and consumers buy can be trusted and have real environmental benefits."[20]

The technical and administrative complexity of the two approaches – CDM or voluntary market – is different and generally the latter has been used in emerging economies despite the lower market value of the associated emission reductions. The rules for carbon projects which involve land use changes are particularly complex and fluid – they are under ongoing development. For example, projects will not be approved for emission reductions unless it can be proven that there was no destruction of natural environment to make the land available[21].

The figure below shows a graphical overview of CDM project types.

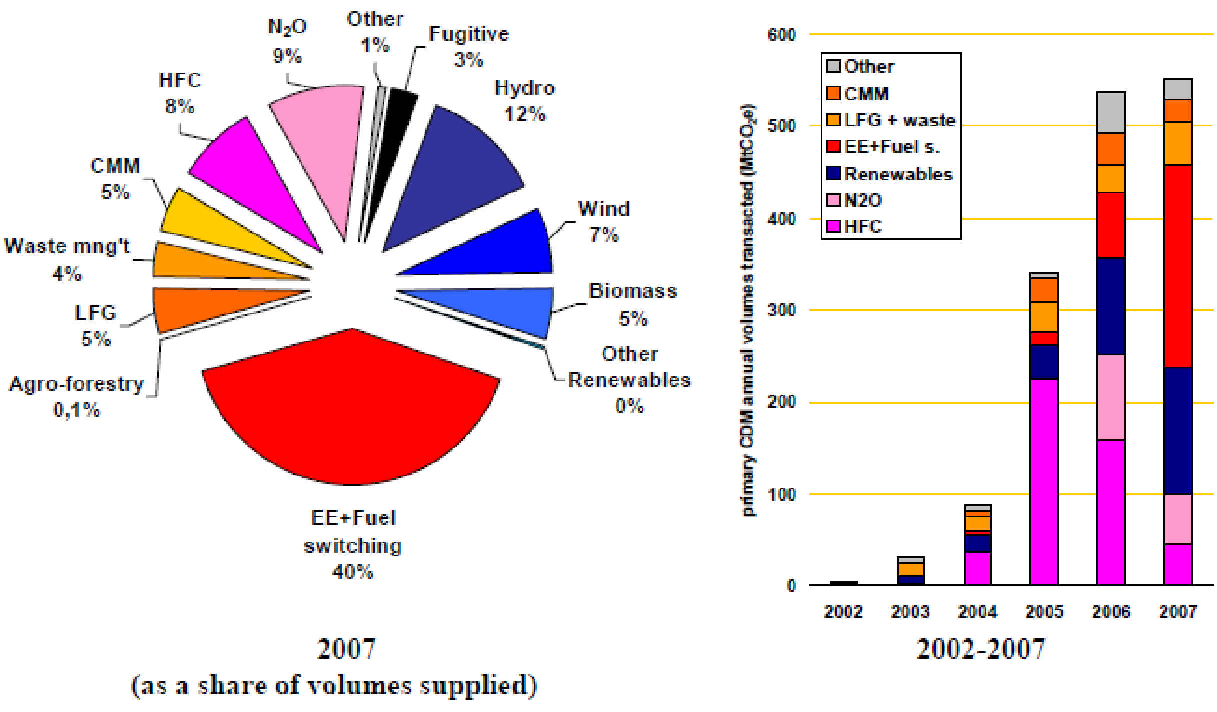

Figure 1: CDM project types[22]

[19] http://www.cdmgoldstandard.org/
[20] http://www.v-c-s.org/
[21] Ian Hamilton, Carbon Positive, Wednesday, 22 August 2007, http://www.carbonpositive.net/viewarticle.aspx?articleID=804
[22] Capoor K and Ambrosi P (2008). State and Trends of the Carbon Market 2008, World Bank

Facilities are being established to encourage and stimulate the carbon markets in emerging economies under Kyoto's CDM and under other carbon offset accreditation standards. An example in the World Bank is The Carbon Partnership Facility (CPF)[23] comprising the Carbon Asset Development Fund (CADF) and the Carbon Fund which are implemented in South America, Latin America and Caribbean, SE Asia and Pacific, Africa and South Asia (in addition to The Forest Carbon Partnership Facility).

While carbon finance is attractive in terms of overall business or project viability, it is ironic that these 'carbon facilities' are required for participants in carbon markets to access project or business development finance which is required for the technical and administrative overheads of registering a carbon project.

2.2.2 Green Certificates

Green certificates – also called Green Tags or Tradable Renewable Energy Certificates (TRECs) or Renewable Energy Certificates (RECs) – are records of energy production which allow the non-energy attributes[24] of the associated energy to be valued and traded. They are created by registration at the time of production (under internationally recognised and country-based protocols) and are traded to customers (in voluntary markets) or liable parties (in compliance/mandatory markets) before being redeemed at the time that the 'green' attributes (or benefits) are claimed[25].

RECs provide a market mechanism for enabling the 'market pull' for cleaner energy production. They are used to support renewable energy policies through the establishment of quotas for renewable energy in the wholesale market (also called portfolio standards). Mandatory REC markets, such as in Australia (under the Mandatory RE Target) and the UK (under the Renewable Energy Obligation), operate under the regulatory oversight of Issuing Bodies which administer the registration of qualifying RE production devices and issuing, transferring and redeeming RECs in terms of the applicable Domain Protocol. Voluntary REC markets, such as in the case of South Africa and selected US States, operate on a similar basis in terms of regulatory oversight but without legislative boundaries or targets.

According to the Association of Issuing Bodies[26], which focuses on the European markets, 446 million RECs have been issued of which 163 million have been transferred and 272 million have been redeemed since 2001.

RECs are generally used for electricity production but can be used for thermal energy too. Experience in Australia with RECs has demonstrated the effectiveness of this approach for solar water heating.

[23] http://wbcarbonfinance.org/Router.cfm?Page=CPF&FID=41756&ItemID=41756&ft=About
[24] Environmental, social and economic attributes (such as de-centralised employment opportunities)
[25] Paul A. U. Ali, Kanako Yano, (2004). Eco-finance: The Legal Design and Regulation of Market-based Environmental Instruments, Kluwer Law International
[26] www.aib-net.org

The figure below provides an overview of the certificates redeemed per technology.

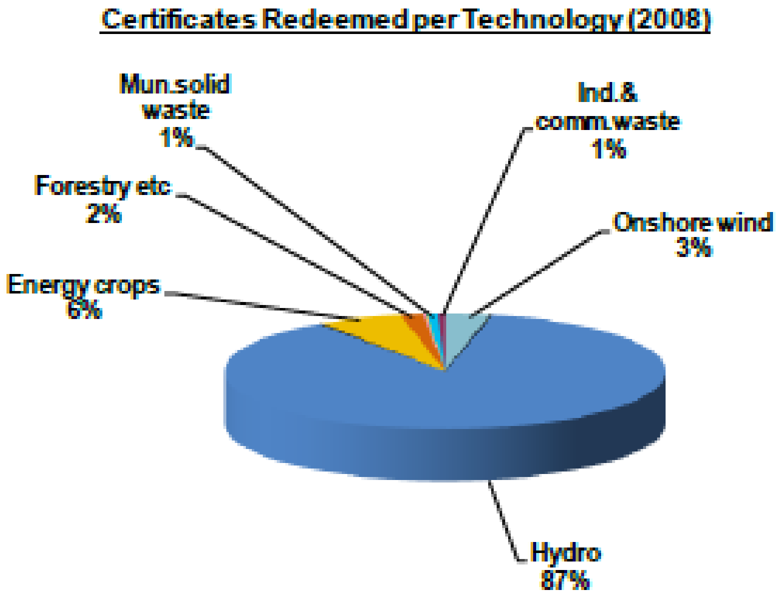

Figure 2: Certificates redeemed per technology

Source: Association of Issuing Bodies: Statistics Bulletin October 2008

2.3 Bi-lateral and multilateral financing

This section will review the main aspects of the second (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. bi-lateral and multilateral financing.

Numerous bilateral and multilateral financing mechanisms exist which support, or potentially support, activities in Africa for biodiesel, bioethanol, bio-energy for fuel switching in industry and agroforestry. The financing mechanisms are divided into those that provide grants, those that provide seed capital and those that provide debt financing or other financial instruments to create and support markets.

While the list below is fairly extensive it should be stressed that, as described in more detail in section 3.2, most donors (especially those working bilaterally) are hesitant in the liquid biofuel sector – given recent negative press and concerns about development impacts – so activities are mainly limited to small scale feasibility studies and small projects. Key activities include:

GTZ ProBEC – has been conducting feasibility studies and providing support in the biofuel sector (mostly focused in Mozambique, and supporting sustainability and “High Conservation Value”).

Shell Foundation has supported the Project Gaia Ethanol project in Ethiopia, and the Chardust project in Kenya.

Ashden Awards has supported the Project Gaia activities in Ethanol.

DFID (UK Department of International Development) is funding the 5-year PISCES project which aims to provide policy research in bioenergy and biofuels. The project partners have recently completed reviews of policies for Jatropha in Kenya, and, in cooperation and with the support of the **FAO**, have completed a detailed series of case studies relevant to the COMPETE project aims. These documents are available on the PISCES website (http://pisces.or.ke/).

A list of relevant bi- and multilateral funds is provided in Annex I.

2.4 International biomass/bio-energy trade

This section will review the main aspects of the third existing financing mechanism for energy crops and agroforestry, i.e. international biomass/bioenergy trade.

The most aggressive bioenergy supporting scheme and the most ambitious bioenergy targets can be found in the EU and the US and are aimed at increasing the use of liquid biofuels for transportation. Currently, the bulk of support to transportation biofuels is linked to production, mainly through exemptions or rebates of fuel taxes that apply to gasoline and diesel, or (mainly in the United States), volumetric tax credits[27].

In Canada, the EU and the USA, the total costs of these measures was equivalent to around US$11 billion in 2006[27]. Table 5 shows the subsidies for first-generation biofuels in the EU and US. For comparison: the production costs of conventional diesel are around US$0.40 per litre for an oil price of US$40 per barrel.

		Ethanol		Biodiesel	
		low	high	low	high
United States	$/l	1.03	1.4	0.66	0.9
European Union	$/l	1.64	4.98	0.77	1.53
United States	$/t$CO_2$ equiv.	na	545	na	na
European Union	$/t$CO_2$ equiv.	590	4520	340	1300

Table 5: Subsidies to ethanol and biodiesel per litre net fossil fuel displaced and per metric ton of CO2-equivalent avoided

Source: Dornbosch and Steenblik, 2007

[27] Doornbosch, R. and R. Steenblik (2007), Biofuels: Is the cure worse than the disease? Organisation of Economic Cooperation and Development, Paris, France, p. 57.

For the use of solid biofuels for heating and electricity production, various and similar support mechanisms exist as for transportation biofuels, such as feed-in premiums, tax exemptions or quotas.

A crucial aspect and barrier for international trade in the current supporting schemes are protectionist policies and tariff barriers which have been put in place to protect domestic production in OECD countries from cheap imported biofuels from developing countries (see section 3.3).

An important financial mechanism that is specifically designed to realise GHG emission reductions in the most cost-effective way is the Clean Development Mechanism (CDM). CDM allows countries to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries or as an alternative to physical trade of biomass or bioenergy carriers. However, the development of CDM bioenergy projects is Africa is slow: only twelve biomass energy or biogas projects in sub-Saharan Africa have so far been approved or are in the validation phase. The table below provides the list of CDM bioenergy projects in Africa.

Host country	Title	Status	Type	Sub-type	First period $ktCO_2eq/yr$	Years
Ivory Coast	Abidjan Municipal Solid Waste-To-Energy Project	Reg. request	Biogas	Biogas power	83	7
Kenya	"35 MW Bagasse Based Cogeneration Project" by Mumias Sugar Company Limited (MSCL)	Registered	Biomass energy	Bagasse power	130	10
Kenya	6 MW Bagasse Based Cogeneration Project	At Validation	Biomass energy	Bagasse power	17	10
Mauritius	Compagnie Thermique de Savannah Limitee (CTSAV) Bagasse-Fuelled Cogeneration Project	At validation	Biomass energy	Bagasse power	298	7
South Africa	PetroSA biogas to energy	Registered	Biogas	Biogas power	30	10
South Africa	Tugela Mill Fuel Switching Project	Registered	Biomass energy	Forest residues: other	56	7
South Africa	Mondi Richards Bay Biomass Project	Registered	Biomass energy	Forest residues: other	185	10
South Africa	Kanhym Farm manure to energy project	Registered	Biogas	Biogas power	33	7
South Africa	Humphries Boerdery (Edms) Bpk, piggery methane capture and electrical generation	At Validation	Biogas	Biogas power	11	7
South Africa	Boskor Renewable Electricity Plant (BREP)	At Validation	Biomass energy	Forest residues: sawmill waste	14	10
Swaziland	RSSC (Royal Swaziland Sugar Corporation) Fuel Switching Project	At Validation	Biomass energy	Bagasse power	64	7
Uganda	Kakira Sugar Works (1985) Ltd. (KSW) Cogeneration Project	At Validation	Biomass energy	Bagasse power	54	7

Table 6: Biomass energy and biogas CDM projects in Africa

Source: UNEP Risoe, 2009

Existing bioenergy and biogas CDM projects are typically small scale and are based on the use of residues and waste – as illustrated in Table 6. Bioenergy CDM projects that are based on dedicated energy crop production and agroforestry systems have, for various reasons, not (yet) been realised in Africa (see section 3.3).

3 REVIEW OF BARRIERS, LIMITATIONS AND KEY GAPS IN EXISTING FUNDING AND MARKET FINANCING / INVESTMENT

3.1 Carbon financing and Green Certificates

This section will review the barriers, limitations and key gaps of the first (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. carbon credits and green certificates.

For both carbon financing and green certificates, there is limited experience with the implementation of these financing mechanisms in developing countries. This is more the case with Green Certificates than with carbon financing due to the limited market opportunities for Green Certificates in developing country economies.

3.1.1 Carbon financing

Carbon finance requires some specific market conditions and regulatory capacity. In many developing countries these conditions and regulatory/administrative capacities are weak and present significant barriers to accessing the carbon revenue which may be available in bioenergy projects.

These barriers include:

- ratification of the Kyoto Protocol by the host country;
- establishment of a Designated National Authority[28] (DNA) in the host country;
- policy support/environment;
- scarce skills;
- very limited experience (although this is changing);
- very limited access to project development funding for Project Identification Notes[29] (PINs) and Project Design Documents[30] (PDDs);
- weak institutional capacity in governments and DNAs;
- lack of available CDM methodologies for bioenergy projects;
- long registration period;
- risk in monitoring;
- lower than expected CER[31] production and risks of shortfalls;

More specifically, CDM-related issues include baseline and emission-related barriers for bioenergy and agroforestry schemes in Africa. Among those is the difficulty to determine baselines and measurement methodologies for biofuels projects, at least when compared to other renewable energy or energy efficiency projects. In other words, there is a significant challenge in determining to what extent biofuel projects will reduce GHG

[28] The designated national authority (DNA) is the body granted responsibility by a Party to authorise and approve participation in CDM projects

[29] A PIN contains the first set of general information to assess the basic eligibility of CDM projects; details provided include project participants, host country, general project information, project organisation, GHG emission reductions, additionality and sustainability effects; PINs are not a mandatory requirement for possible CDM projects

[30] A PDD is a mandatory requirement to get a possible CDM project registered; its five main areas are general description of project activity; application of baseline and monitoring methodology; duration of project activity / crediting period; environmental impacts; stakeholder comments.

[31] One Certified Emission Reduction (CER) is equal to a reduction of 1 metric tonne of CO_2 equivalent. CERs are issued by the UN for emission reductions from CDM project activities

emissions below business-as-usual levels, particularly in view of lifecycle emissions varying according to feedstock and processing methods. Another reason is that baseline emissions in Africa are often based on traditional bioenergy systems, for which it is difficult to determine emissions. Most emissions in traditional bioenergy systems are associated with changes in vegetation cover, which can be significant, but difficult to quantify. The potential for the use of improved traditional bioenergy systems is enormous, as efficiency improvements of 100% are feasible. Furthermore, leakage, -i.e. whether the project will result in higher emissions elsewhere- can also be a methodological bottleneck. Leakage is particularly relevant in the case of land use changes that are induced by the use of land for energy crop production, but are very difficult to quantify.

In addition to the specific barriers for carbon market and CDM opportunities in Africa, the more general barriers to market development for all commodities remain as constraints. These include:

- Size and structure of national and regional economies
- Weak capacity of private developers
- Lack of access to development finance.

The rules for carbon projects involving land use changes are complex and evolving. An example of the complexities is illustrated in the text box below.

When considering the development of AR CDM projects, the project developer may want to check the following PRE-REQUISITES:

- Additionality. The project has to be additional to what would have happened without the CDM: to prove this, project developers have to show that either the project is not the most economically or financially attractive option, or without the income of carbon credits it would not be able to overcome legal, technological or ecological barriers.
- Institutional Pre-requisites. To serve as a host for CDM projects, countries must have ratified the Kyoto Protocol, established a Designated National Authority and determined criteria for sustainable development.
- Land Eligibility. Land is eligible (1) for reforestation activities, if there has been no forest since 31/12/1989 or (2) for afforestation activities if there has been no forest for at least 50 years. The forest land may not be temporarily unstocked as a result of human intervention such as harvesting, nor have the potential to revert to forest without human intervention.
- Forest Definition. Under the CDM, forest consists of trees with at least a height of 2-5 meter, crown density between 10-30%, and area of 0.05-1 hectare. Countries choose values for these parameters1.[1]

Figure 3: Example of complexities involving land use changes for carbon projects

This also represents a barrier to accessing the carbon markets.

Although the rules and regulatory frameworks for voluntary carbon markets are less onerous than for CDM or Gold Standard projects, many of the capacity and business/project development resource issues remain as barriers to accessing the carbon markets for bioenergy projects in developing countries.

3.1.2 Green Certificates

The barriers to effective participation in green certificate markets are less insurmountable for developing countries than in the case of carbon markets. This is primarily due to the fact that certificate markets are operated primarily within national (or sometimes regional) domains. Secondly, certificate markets are less onerous to define and regulate due to the relative simplicity of the criteria for qualification and ongoing monitoring of eligible projects / businesses, i.e. no additionality requirements in terms of quantified emissions.

The main barriers to green certificate market opportunities include:

- Lack of policy and regulatory capacity to establish the frameworks for these markets[32].
- Limited access to international markets, hence relatively small domestic volumes;
- Lack of experience and confidence;
- Uncertainty in the overlaps (or not) with carbon markets.

3.2 Bi-lateral and multilateral financing

This section will review the barriers, limitations and key gaps of the second (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. bi-lateral and multilateral financing.

The barriers and limitations to bilateral and multilateral financing include those common to all project financing, and those specific to this financing source. Those common to project financing in the bioenergy sector include:

Policy, procedures and legislation

- Many African countries do not have clear, long-term, and transparent frameworks for the development of bioenergy projects. This increases the risk for investment in this sector.
- Procedures and standards for the development, permitting, licensing and commissioning of bioenergy investments – in either crops, fuel preparation or use of bioenergy do not exist.
- Particularly for large investments, many countries do not have mechanisms for the purchase or leasing for large areas of land for plantations.

[32] South Africa has been establishing a government endorsed TREC market since 2003 (http://www.dme.gov.za/energy/renew_TRECS.stm) and a small voluntary market operates in the meantime.

Finance

- Local banks have limited access to technical expertise for appraisal. There is limited information about biofuels, resources, and significant misconceptions exist about their technical risks and financial benefits.
- There is no specific marketing for financing bioenergy projects.
- As a result of lack of experience and uncertainties, bioenergy projects incur additional costs in appraisal, due diligence, and monitoring, making them less attractive to finance.
- There is insufficient access to adequate amounts of longer-term funding for bioenergy projects resulting from real and perceived risks: borrowers' tenors beyond the banks' current horizons are necessary for financing these types of projects.

Business and technical skills and information

- There is uncertainty and lack of information about available options, best practice and related financial reward.
- Bioenergy investments are varied in scope and sector, and are difficult to appraise and finance. Technical assistance is required to ensure the pursuit of good lending opportunities that are well assessed.
- Technology and process costs are excessive in new technologies, meaning that biomass is uncompetitive, and "new fuel chains addressing more complex resources, new conversion routes, and new applications" are required.
- Lack of awareness among consumers about the benefits of bioenergy and negative attitudes with some concern regarding pollutant emissions.
- The fuel chain complexity: bioenergy is the only renewable resource which cannot be harnessed free of charge such as wind, solar radiation, running water and hot water from the earth. On the contrary, the delivery of a biomass fuel to a user entails a series of operations that are not only costly but also need to take place often over long periods of time such as planting, managing crops or forest, harvesting, transportation, size reduction, storage and pre-treatment - for solid biofuels – or chemical transformation - for liquid and gaseous biofuels. The consequence is enormous complexity and a need to involve numerous stakeholders. Efforts are needed to streamline the various operations and provide confidence for a sustainable and reliable system for both the farmers and foresters who grow the resource and the users who will use the biomass fuels in their facilities. "Guaranteeing the delivery of large quantities of solid biomass with specific quality and characteristics over long periods of time to large scale users such as utilities is still an area under development."
- Slow market and trade development requiring the development of market tools so that the fuel can become a tradable commodity. Such market tools include quality standards, a specialised trading floor, dedicated transport and storage facilities and functional market distribution systems.

Specific barriers and limitations to bilateral and multilateral financing include:

- Questions and uncertainty as to the merits of biofuels in developing countries: this is of **major** significance to financing from bilateral and multilateral sources, with the World Bank, UNDP and other major funders questioning whether biofuel projects should be supported: "*UN urges biofuel investment halt*: The UN's new top adviser on food has urged a freeze on biofuel investment, saying the blind pursuit of the policy is "irresponsible""[33] and "Secret report: *biofuel caused food crisis*: Internal World Bank study delivers blow to plant energy drive: Biofuels have forced global food prices up by 75% - far more than previously estimated - according to a confidential World Bank report obtained by the Guardian."[34]
- Many biofuel investments are commercial and do not aim to support development within countries. They thus fall outside the scope of most bilateral and multilateral support. There is certainly some tension with these sorts of projects and support funds. The PISCES project has recently published case studies that concluded that "long local market chains spread out the benefits". While this is undoubtedly the case from a livelihood perspective, long market chains are generally something to avoid from the perspective of business profitability.

3.3 International bioenergy trade

This section will review the barriers, limitations and key gaps of the third existing financing mechanism for energy crops and agroforestry, i.e. international biomass/bioenergy trade.

Despite the rapidly increasing use of liquid biofuels for transportation in the EU, the US and other OECD countries, the export of first-generation biofuels is at this moment relatively limited.

A crucial limiting factor is that the use of liquid biofuels is mainly policy driven and many measures are temporary and tend to change frequently. This discourages long-term investments, as they are considered too risky. Furthermore, it is increasingly uncertain if the present supporting schemes and biofuels targets will be maintained, considering the high and rapidly increasing costs and because of concerns about the environmental and socio-economic impacts. The production and use of biofuels in OECD countries was subsidised with US$11 billion in 2006. This figure is estimated to increase to US$25 billion in 2015[27]. The effectiveness of these policies is limited, at least with respect to the GHG mitigation potential of first-generation biofuels, which is an important driver behind the use of biofuels in the EU. For example, according to Steenblik and Doornbos (2007)[27], the costs per tonne CO_2-equivalent avoided of the most commonly used types of liquid transportation biofuels in the EU and US range from US$340 to US$1300, while other GHG mitigation options are generally much less effective. Also from an energy security perspective, which is an important issue in the US, domestically produced first-generation biofuels are inefficient. Moreover, various policies are implemented that are aimed at protecting domestic production from cheap imported biofuels. Three different policy instruments can be distinguished (Junginger et al. 2009[35]):

[33] BBC News, May 2008 http://news.bbc.co.uk/1/hi/world/7381392.stm
[34] http://www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy
[35] Junginger,M., Zarrilli, S., Ali Mohamed, F., Faaij. A. et al. (2009) Inventory of opportunities and barriers for international bioenergy trade (paper in preparation)

1. ***Measures to promote domestically produced biomass over imported biomass for energy purposes***. An example is tax exemptions in France, which are available only for biofuels that are both produced and sold in the French market. Producers from other EU countries are thus excluded, leaving them at a competitive disadvantage (Euractiv, 2008[36]).

2. ***Import tariffs for various biomass commodities***. Examples are the import tarrifs that are applied on bioethanol imports by both by EU (0.19€ per litre) and the US (US$0.14 per litre and an additional 2.5% ad valorem). In general, the most-favoured nation (MFN) tariffs range from roughly 6% to 50% on an ad valorem equivalent basis in the OECD, and up to 186% in the case of India (Steenblik, 2007[37]). Several preferential trade arrangements concluded by the EU with developing countries foresee duty-free or reduced tariffs for ethanol. However, for both the US and the EU, loop holes in legislation have been reported to circumvent import tariffs. For the EU, blending bioethanol with other chemicals and importing it as 'miscellaneous chemicals' has been reported as a loop hole (Desplechin, 2007[38]). For biodiesel, tariffs applied by developing countries are generally between 14% and 50%[37]. Biodiesel feedstocks, however, as agricultural commodities, are generally protected through agricultural support payments and tariffs. Oilseeds, many of which can be used to produce biodiesel, are an exception for the EU, which has an agreement in place to accept oilseeds duty free (Murphy, 2008).

3. ***Export subsidies, intended for domestically-produced biomass***. An example is the subsidies granted in the US to allow US exporters to undercut their European rivals. Biodiesel is bought on the EU market or from low-cost biofuel producers such as Argentina, and then shipped to the US where a small percentage of gasoline is added to the fuel to qualify for the subsidy ($1/ gallon) offered on B99 fuel - 1% gasoline, 99% biodiesel. The fuel is then sent back to Europe and resold at a price lower than the domestic market.

However, despite these barriers, the potential of export of first-generation biofuels from Africa to OECD countries is still significant, even if loop holes are ignored. This is shown by the figures below, which show the production and import of bioethanol and biodiesel production in 2020 in the EU for two scenarios.

[36] Euractiv (2008) Dossier Biofuels, Trade and Sustainability. Last update 16 September 2008. Available at: http://www.euractiv.com/en/trade/biofuels-trade-sustainability/article-171834

[37] Steenblik, R. (2007) Subsidies: the distorted economics of biofuels, Discussion paper No. 2007-3, December 2007. The Global Subsidies Initiative (GSI), International Institute for Sustainable development (IISD), Geneva, Switzerland.

[38] Desplechin, E. (2007) Customs inconsistencies destabilise European bioethanol industry, International bioethanol association, available at: http://www.industrial-ethanol.org/uploads/IEA%20Biofuels%20Article%20Nov%2007.pdf

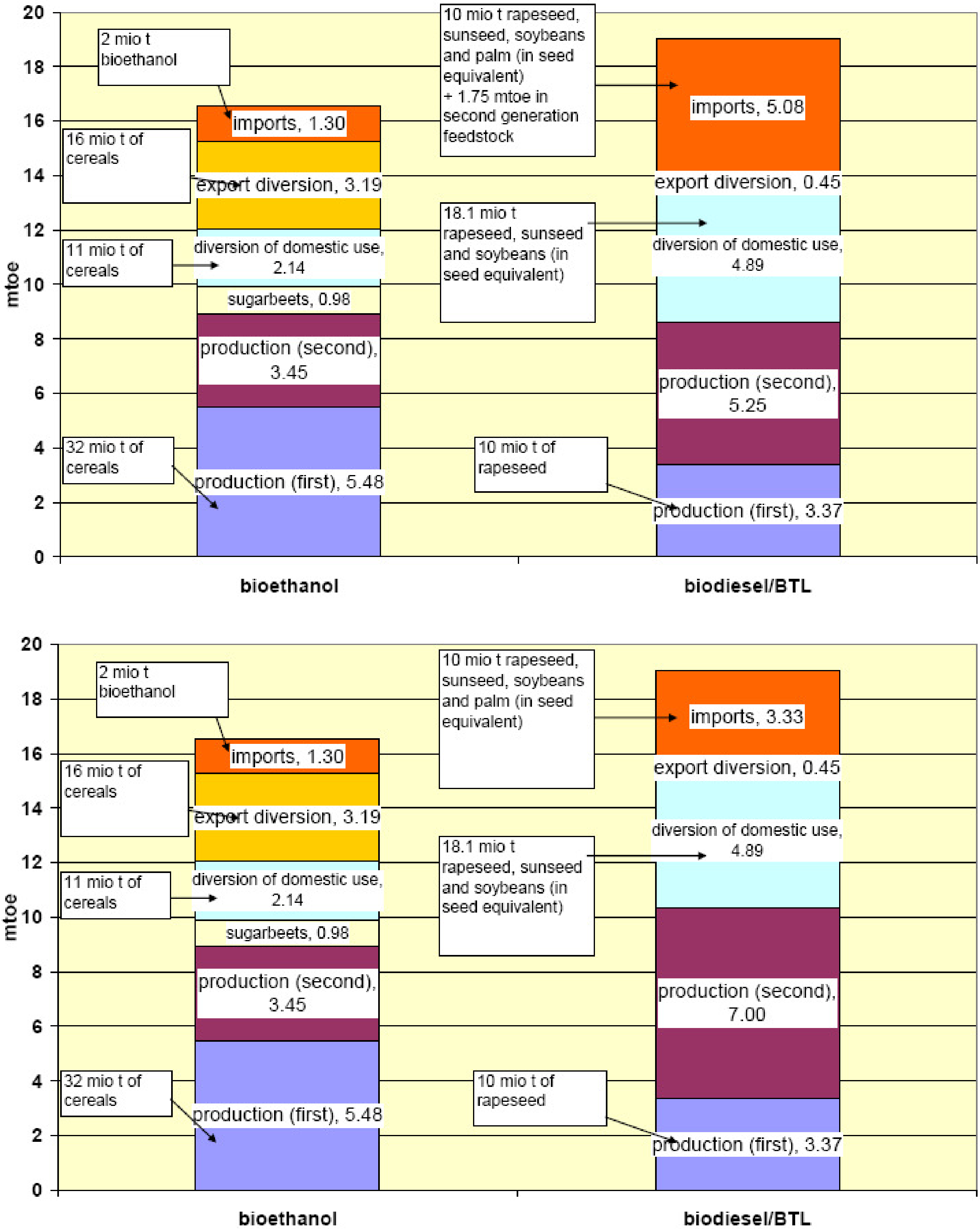

Figure 4. Sources of feedstocks for bioethanol and biodiesel production in 2020 in crude oil equivalent (mtoe) in the default scenario (upper graph) and in the case of a scenario whereby 30% of the biofuels is assumed to be produced from second generation bifouels

Source: EC, 2007

These results show that, assuming that all existing trade barriers, tariffs and supporting mechanisms are kept in place, some 1.3 Mt of bioethanol and 3.3-5.1 Mt of biodiesel will be imported in the year 2020. Furthermore, the import of untreated lignocellulosic biomass is an interesting option, whereby a total production level of 3.5 Mt of ethanol and 5.3-7.0 Mt of biodiesel is projected for the year 2020. Various other studies also indicate that Africa might become an important, low cost producer of biofuels. This applies to first-generation biofuels, but particularly for lignocellulosic biomass that can be used for the production of second-generation biofuels, but also for heat and electricity generation. No or only indirect tariff barriers for wood pellets (or other solid biofuels) have been identified in the literature (Junginger et al., 2009[35]).

The potential of Africa as a biofuel exporting region is shown by the results of Hoogwijk et al., 2009[39], who estimated the potential of energy crops produced on abandoned agricultural land and rest land in the year 2050, as illustrated in Table 7 below. Rest land is thereby defined as all remaining non-productive land, excluding bioreserves, forest, agricultural and urban areas and is calculated after satisfying the demand for food, fodder and forestry products.

[39] Hoogwijk, M., A. Faaij, B. de Vries and W. Turkenburg (2009) Exploration of regional and global cost-supply curves of biomass energy from short-rotation crops at abandoned cropland and rest land under four IPCC SRES land-use scenarios, Biomass and Bioenergy, 33, 1, p. 26-43.

IPCC scenario →	A1				A2				B1				B2			
	<\$1 GJ^{-1}	<\$2 GJ^{-1}	<\$4 GJ^{-1}	potential (EJ yr^{-1})	<\$1 GJ^{-1}	<\$2 GJ^{-1}	<\$4 GJ^{-1}	potential (EJ yr^{-1})	<\$1 GJ^{-1}	<\$2 GJ^{-1}	<\$4 GJ^{-1}	potential (EJ yr^{-1})	<\$1 GJ^{-1}	<\$2 GJ^{-1}	<\$4 GJ^{-1}	potential (EJ yr^{-1})
Canada	0	11,4	14,3	18	0	7,9	9,4	12	0	11,1	12,1	14	0	10	11,1	13
USA	0	17,8	34	53	0	6,9	18,7	33	0	24,5	32,9	36	0	27,6	39,4	49
Central America	0	7	13	17	0	2	2,9	4	0	4,1	7,6	11	0	1,6	3,3	5
South America	0	11,7	73,5	87	0	5,3	14,8	24	0	27,6	60,7	63	0	6,1	32,7	43
Northern Africa	**0**	**0,9**	**2**	**5**	**0**	**0,7**	**1,3**	**4**	**0**	**0,7**	**1,5**	**3**	**0**	**0,7**	**1**	**2**
Western Africa	**6,6**	**26,4**	**28,5**	**50**	**7,9**	**14,6**	**15,5**	**23**	**1,2**	**13,3**	**13,7**	**27**	**1,4**	**4,5**	**4,6**	**6**
Eastern Africa	**8,1**	**23,8**	**24,4**	**41**	**3,6**	**6,2**	**6,4**	**16**	**2,6**	**13,9**	**14,1**	**22**	**0,9**	**1,8**	**1,8**	**5**
Southern Africa	**0**	**12,5**	**16,6**	**43**	**0,1**	**0,3**	**0,7**	**10**	**0**	**11,7**	**12,6**	**29**	**0,1**	**0,2**	**0,4**	**2**
OECD Europe	0	3	11,5	14	0	5,6	12,5	14	0	2,7	9,1	9	0	6,9	15,4	16
Eastern Europe	0	6,8	8,9	9	0	6,2	6,3	8	0	7,9	8	8	0	7,6	8,2	9
Former USSR	0	78,6	84,9	127	0,8	41,9	46,6	68	0	66,9	69	88	0	60,1	61,7	78
Middle East	0	0,1	3	13	0	0	1,3	8	0	0	2	4	0	0	1,4	3
South Asia	0,1	12,1	15,3	27	0,6	8,2	9,8	14	0,1	6,4	8,3	14	0	1,4	2,8	6
East Asia	0	16,3	63,6	107	0	0	5,8	23	0	49,8	61,1	77	0	0	21,4	46
South-East Asia	0	8,8	9,7	10	0	6,9	7	7	0	2,9	3	3	0	2,5	3,5	4
Oceania	0,7	33,4	35,2	55	1,6	16,6	18	34	10,4	28,1	28,6	35	5,5	24,3	24,8	30
Japan	0	0	0,1	0	0	0	0	0	0	0	0,1	0	0	0	0,2	0
Global	16	271	439	675	15	130	177	302	14	272	344	443	8	155	233	316

Table 7: The total estimated potential of energy crops for the year 2050 (EJ), at abandoned agricultural land and rest land and the estimated geographical potential at various cut-off costs for the four land-use scenarios (A1, A2, B1, B2)

Source: Hoogwijk et al., 2009

These results show that Eastern and Western Africa have -globally- the largest potential of lowest-cost energy crops (below US\$1 GJ^{-1}). West and East Africa are also among the four main regions that are thought to be able to produce a significant amount of energy crops at costs below US\$2 GJ^{-1}. At these cost levels, large scale ethanol production is expected to become competitive with conventional gasoline, assuming that technological developments will be stimulated.

Another important phenomenon and potential bottleneck for trade is the linking of financial instruments, such as feed in tariffs, to sustainability criteria. Various efforts have been undertaken aimed at ensuring a sustainable production and supply of biomass through certification systems. Criteria have been developed (or are considered) for either feedstocks (such as palm oil) or for final products. CDM aspects are included, as well, although the existing CDM system lacks sophisticated multi-criteria decision methods for identifying, selecting and assessing project activities from a sustainability perspective. The different standards and regulations under consideration are discussed in more depth by van Dam et al (2008)[40]. Two major potential barriers may be distinguished (Junginger et al., 2009)[35]:

[40] Van Dam, J., Junginger, M., Faaij, A., Jürgens, I., Best, G., Fritsche, U. (2008) Overview of recent developments in sustainable biomass certification. Biomass & Bioenergy, Volume 32, Issue 8, August 2008, Pages 749-780.

1) Criteria, especially related to environmental and social issues, could be too stringent or inappropriate to local environmental and technological conditions in developing countries. Many developing nations therefore view attempts to introduce sustainability criteria as a form of "green imperialism". Furthermore, small stakeholders may have particular difficulties to meet the requirements, also considering the high costs of the certification procedure.

2) The possible proliferation of different technical, environmental and social sustainability standards for biofuels production. With current developments by the European Commission, different European governments, several private sector initiatives, initiatives of round tables and NGOs, there is a real risk that in the short term a multitude of different and partially incompatible systems will arise. According to Steenblik (2007)[37], it is too early to say whether any of the sustainability certification schemes in existence or proposed will on balance enhance or hinder trade.

4 EVALUATION OF RELATIVE EFFECTIVENESS AND MAGNITUDE OF EACH FINANCING MECHANISM

4.1 Carbon financing and Green Certificates

This section will present an evaluation of the relative effectiveness and magnitude of the first (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. carbon credits and green certificates.

The relative effectiveness of carbon finance in developing countries is orders of magnitude greater than for Green Certificates. This is primarily due to the scale of demand in the international market for emission reductions (as a consequence of multi-lateral international and national political commitments) and the associated level of market development support which has been allocated to carbon trading.

Overall, 2008 saw 4.9 billion tonnes (gigatonnes or Gt) of carbon dioxide equivalent (CO2e) reductions change hands, up 83% on 2007[41]. CDM accounted for 1.6 billion tonnes or 33% of this volume. A rough comparison is indicated by the approximately 0.14 billion tonnes of CO2e reductions due to green certificates *issued* and 0.05 billion tonnes of CO2e reductions due to certificates *traded* in Europe in 2007.

The carbon market volume has been driven by the European Union Emissions Trading System (EU ETS) which allows the use of CERs and which amounted to 3 billion tonnes of CO2e in 2007[42].

As illustrated in the figure below, China, India and Brazil have been significant sellers of CERs with China securing 73% of the market share for emission reductions under CDM in 2007 (compared to 54% market share in 2006) and Brazil and India securing 6% each[43]. Africa accounted for 5% for the period under review.

[41] Point Carbon's Market Monitor, 14 January 2009

[42] The EU ETS -launched on 01 January 2005- was a first of its kind and it is the largest multi-country, multi-sector GHG emission scheme worldwide. It is a 'cap and trade' system, i.e. it caps the overall level of emissions allowed but, within that limit, allows participants in the system to buy and sell allowances as they require. The EU ETS currently covers over 10,000 installations in the energy and industrial sectors which are collectively responsible for close to half of the EU's emissions of CO2 and 40% of its total greenhouse gas emissions.

[43] Capoor K and Ambrosi P (2008). State and Trends of the Carbon Market 2008, World Bank

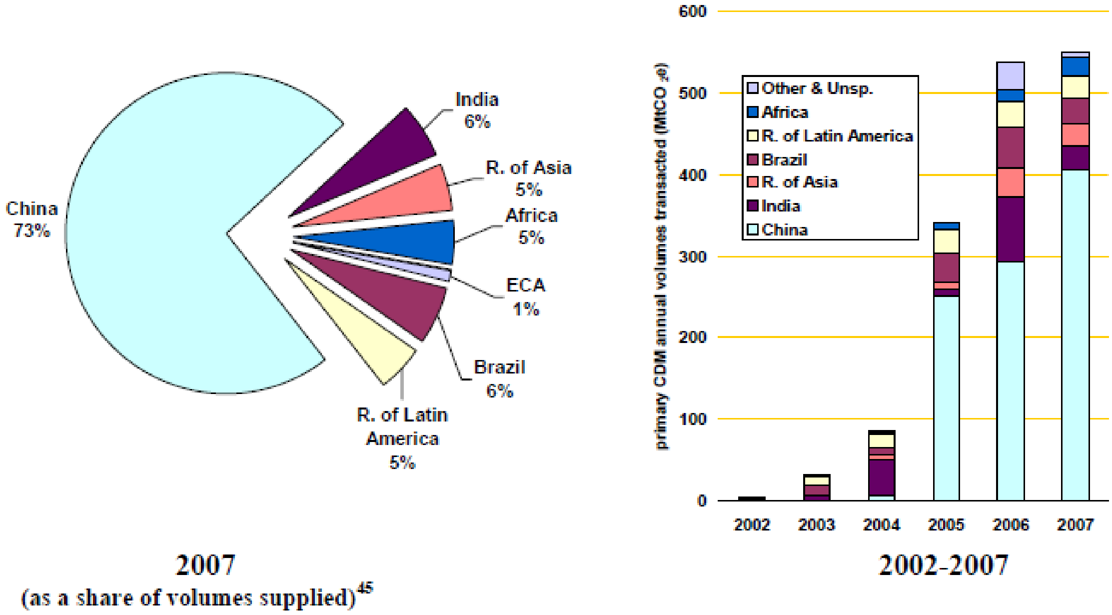

Figure 5: Location of CDM projects 2007[44]

Research undertaken by the World Bank to assess the potential for low-carbon energy projects for development in Sub-Saharan Africa indicates a significant role for emission reductions (64% of the total) from the bioenergy sector[45]

The effectiveness of Green Certificates in developing countries has the potential to be more immediate and tangible since the overwhelming administrative overheads and delays associated with the CDM and other carbon market instruments are not required.

However, there has been very limited experience with RECs in developing countries. A voluntary market has operated in South Africa since 2004[46] and this market is currently based on RECs issued and traded from bagasse-based cogeneration facilities in the sugar industry. The overall market growth is illustrated in the figures below.

[44] Capoor K and Ambrosi P (2008). State and Trends of the Carbon Market 2008, World Bank
[45] de Gouvello C et al (2008). Low-carbon Energy Projects for Development in Sub-Saharan Africa, World Bank
[46] Tradable Renewable Energy Certificate System Feasibility, DRAFT Final Report, Version 12 (08 Nov 2006)

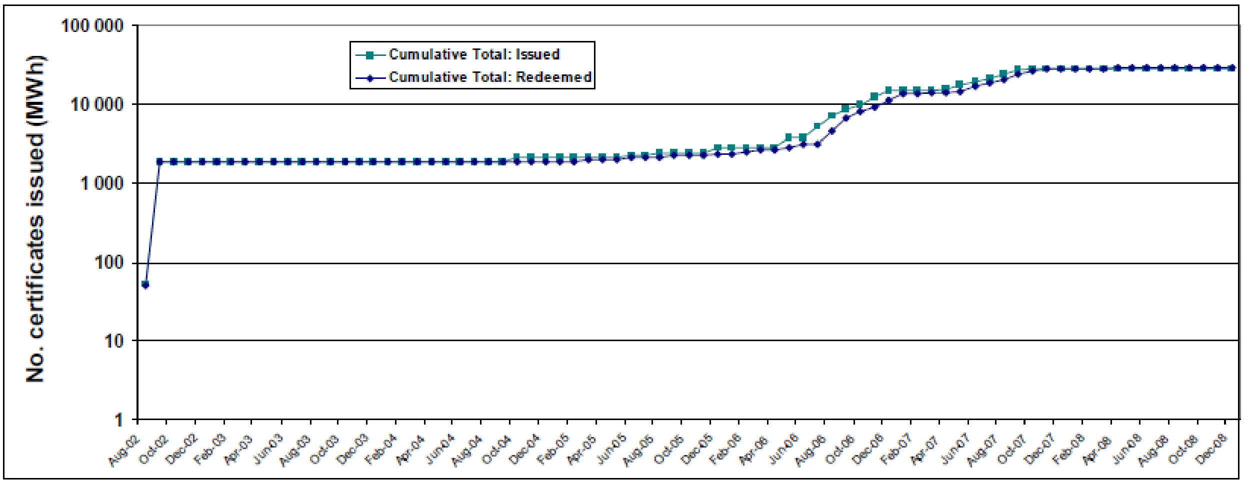

Figure 6: Cumulative REC issue and redemption in South Africa to date

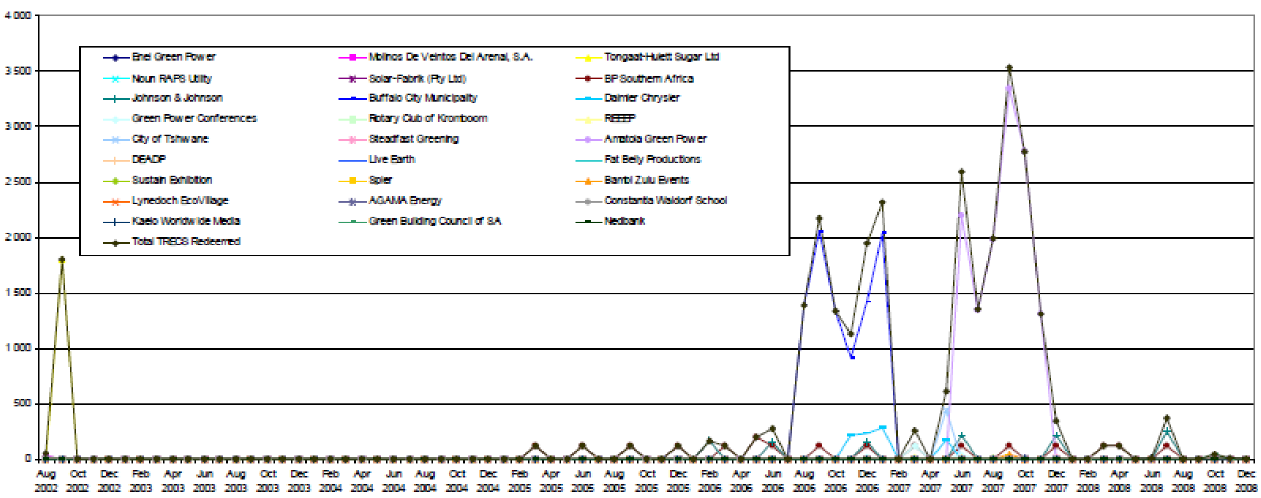

Figure 7: Monthly REC redemption account balances in South Africa to date

The overall effectiveness of a green certificate market is limited in the case of voluntary markets (market surveys indicate a 1% take-up by customers in a voluntary regime) but the mandatory markets are seen to be effective if well implemented (as in the case of Australia).

The experience in Australia is a specific example of how a Green Certificate scheme can contribute to the growth in renewable energy generation in a country. Introduced in 2001, the Mandatory Renewable Energy Target (MERT) scheme's success is based on electricity retailers being required to purchase RECs from renewable energy sourced power stations such as wind, hydro, landfill gas, solar and bagasse[47]. Targets are set in line with overall national energy targets. The 2007 target of 5,600 GWh (which is equivalent to the residential electricity consumption of approximately 900,000 Australian households) was met and subsequent targets will be increasing to 9,500 GWh (2010) and 45,000 GWh (2020).

[47] http://www.orer.gov.au/publications/media-releases/mr28jan09.html

4.1.1 Carbon financing and green certificates - case studies

Apart from landfill gas projects, there are only few published examples of bioenergy and agroforestry projects in Africa which have made use of the carbon finance or green certificate opportunities for project finance and funding. This is not surprising due to the relative novelty of these mechanisms and the complexity of the underlying registration/compliance requirements – especially in terms of the methodologies for determining carbon emission reductions for bioenergy and agroforestry projects. There are projects which could be eligible for registration as carbon projects or as green power production devices but for which the levels of project assistance have been too complicated (and expensive).

Examples of CDM projects in Africa include[48]:

- The Mondi Richards Bay Biomass Project which is a cogeneration and fuel switching project which entails generation of electricity from biomass. The project was registered in 20 May 2007 and implementation has begun.

- The Kanhym Farm Manure to Energy Project which is a bioenergy project which aims at generating electricity from anaerobic digestion of piggery manure at the Kanhym farm. Registered in July 31, 2007 and approved by the DNA but pending approval by the CDM Executive Board.

- The Humphies Boerdery Piggery Methane Capture and Electricity Generation Project which aims at generating electricity from anaerobic digestion of piggery manure at the Humphries Boedery Farm near Bela-Bela, Limpopo Province. The project was registered on September 28, 2007 and approved by the DNA but pending approval by the CDM Executive Board.

- The Meyerton Bio-Diesel Project and the Mafikeng Bio-Diesel Project which both involve the production of bio-diesel from waste vegetable oils. The project idea notes have been registered and approved.

- The Cape Timber Resources Biomass Based Combined Heat and Power Plant involves the building of a biomass fed combined heat and power (CHP) plant to produce electricity. The PIN has been approved.

- Tongaat-Hulett Cogeneration Project which aims to increase electricity generation capacity of the Tongaat bagasseco-generation plant. Project Idea approved and PDD at final stage of preparation.

- Production of electricity from combustion of bagasse, Kwazulu – Natal. The project aims to install a new biomass residue fired power generation plant at a site where currently no power generation occurs. Project Idea approved by DNA and PDD at final stage of preparations. African Biofuels Company (Pty) Ltd.

48 http://www.dme.gov.za/dna/pdfs/South%20Africa%27s%20CDM%20project%20portfolio%20up%20to%2011E%20June%202008.pdf

- Production of Ethanol from Sugarcane, Kwazulu – Natal. The project aims to mitigate greenhouse gas emissions arising from the combustion of petrol used in transportation through the displacement of petrol with bio-ethanol produced from sugar cane. Project Idea approved by DNA. African Biofuels Company (Pty) Ltd

The experience with green certificates from bioenergy is based on projects and markets in Europe, the USA, the UK and Australia. Examples of specific projects in Australia are predominantly located in Queensland (as illustrated below) and the details of these projects are presented on the Australian Government's Office of the Renewable Energy Regulator's website (http://www.orer.gov.au/).

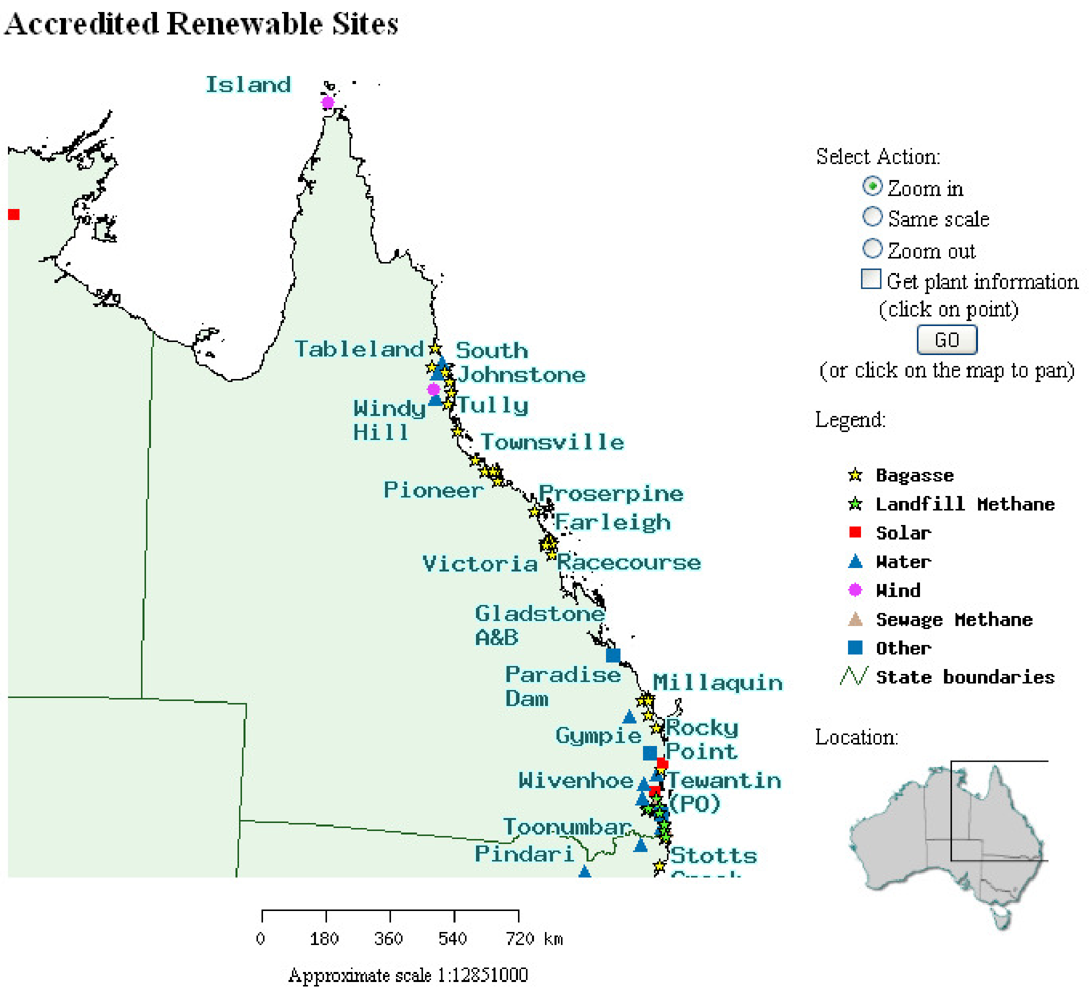

Figure 8: Map of accredited renewable energy sites in Australia

4.1.2 Carbon financing and green certificates – conclusions & outlook

The outlook for developing the understanding of the role for carbon and green certificates in assisting the financing of bioenergy projects will need to explore the strategic (and complementary) roles for these mechanisms. These approaches differ in the degree of conformity with rules and market participation at a multilateral level versus the national (or regional) level and the associated balance between effectiveness in implementation within the context of a transitional (and changing) environment for the valuing and trading of the non-energy characteristics of clean energy projects.

Carbon financing, which is technology neutral and is driven by the markets arising from emissions trading schemes, is complementary to green certificate schemes, which are technology specific and which address the broader benefits of RE in addition to the carbon benefits. It is likely that the opportunities for carbon financing of bioenergy and agroforestry projects will be more significant than for green certificate schemes for the foreseeable future. This is predominantly a function of the levels of resources which are being committed at a multi-lateral and national level to the ongoing agreements under the Kyoto Protocol. Clearly, the shape and emphasis of the carbon market opportunities in Africa will be firmed up in Copenhagen in December 2009. The SADC Energy Ministers meeting in Maputo at the end of April 2009 is the first time that the SADC Energy Ministers have had CDM on their agenda.

Green certificate schemes are inherently more likely to continue to be developed and operated on a national basis under nationally determined Domain Protocols. Furthermore, these schemes are likely to be shaped by the specific needs and opportunities in national economies and consequently the opportunities for bioenergy and agroforestry will be country specific.

4.2 Bi-lateral and multilateral financing

This section will present an evaluation of the relative effectiveness and magnitude of the second (set of) existing financing mechanism(s) for energy crops and agroforestry, i.e. bi-lateral and multilateral financing.

As a result of barriers associated with financing renewable energy projects in general and crop / biofuel projects in particular, current bioenergy financing has not been very effective in Africa. This is demonstrated by the existence of only very limited bilateral and multilateral activities (principally studies) currently underway.

Furthermore, the demand for energy crop-related financing in arid and semi-arid regions in Africa faces severe constraints on the supply side of the financial system in these African countries.

As mentioned in section 2.3 there is a very limited number of active biofuel activities from multilateral and bilateral funders in Africa. The reasons for this have been discussed in section 3.2. Given these constraints, the total level of committed funds for liquid biofuel projects from bilateral and multilateral sources during 2008 is estimated to be less than €250,000.

To evaluate the effectiveness of bilateral and multilateral financing a market transformation / market creation model approach has been taken. The premise is that to be effective, funding should aim to support the creation of markets. This, it is asserted, will be most effective, not creating dependency, and promoting long-term sustainability.

The goal of market creation is not simply to install capacity, but to provide the conditions for creation of a sustained and profitable industry, which will result in increased renewable energy capacity and generation, and will drive down costs. Based on a detailed analysis of market creation projects in OECD countries the International Energy Agency has identified three perspectives on market creation that provide useful insight into approaches, and an analytical framework by which multilateral and bi-lateral funding may be analysed (IEA, 2003). These perspectives are:

1. ***The technology demonstration and market learning perspective,*** which focuses “on the nature of innovation, industry strategies and the learning process associated with new technologies”. Through R&D in private industry which is stimulated by investments in a new technology, and the process of learning-by-doing technical performance is improved and costs reduced. Market transformation projects can play a role in this process by supporting government policies and implementing programmes that support initial deployment of new technologies (typically ‘demonstration projects’).

2. ***The market barriers perspective*** characterises the adoption of a new technology as a market process and focuses on the frameworks within which decisions are made by investors and consumers. The emphasis in this perspective is on understanding barriers and legitimate project actions to reduce them.

3. ***The market transformation perspective*** focuses on what needs to be done in practical terms to build markets for new energy technologies. It emphasizes the behaviour and roles of market actors, how their attitudes guide decisions and how these attitudes can be influenced.

4.2.1 Effectiveness from market learning through technology demonstration

The demonstration of new technologies can lead market actors to learn how to produce and use them more cheaply and more effectively. It is the combination of the physical effect and the learning effect that creates the real impact of energy technology deployment programmes.

Much bilateral and multilateral funding supports just a single project phase, believing that only new innovative activities should be supported. However experience shows that where there is more than one demonstration project / phase, second generation projects can be much more cost effective than first generation projects. A phased approach to demonstration projects allows the project to learn about costs and heat demand, etc. *A learning approach is preferred, with demonstration activities taking place in phases. Projects in which demonstration projects are implemented simultaneously have less chance of benefiting from technology learning. In any case, more than one demonstration activity is required during projects to ensure that risks are spread.*

While the lack of supported projects in biofuels in Africa means that sufficient data to be able to draw firm conclusions about the scale of technology demonstrations that would be required in a market to produce a significant market transformation from bilateral and multilateral funding, it is clear from activities in other regions that sufficient scale is required.

Biomass energy is the most complex of renewable energy alternatives: arranging a reliable, sustainable and affordable fuel supply of sufficient quantity and quality can be challenging, biomass fuels are frequently land and labour intensive and are highly dependent on stable prices, and the project developer is faced with a huge number of alternative technologies. Unlike other renewable sources of energy, biomass energy requires that attention is given to both fuel supply and energy demand. This rather unique characteristic means that biomass projects are uniquely complex in scope, and may involve numerous market and government stakeholders.

Experiences in projects around the world underline the importance of fuel supply with project managers invariably rating fuel supply as being the most or one of the most significant project risks. In addition, the real and perceived complexity of fuel supply is a major disincentive to investment decisions, and these barriers are only overcome through concerted effort, and significant opportunities for technology learning. In contrast, fossil fuel supply – such as diesel, heavy fuel oil or coal – is offered to municipal and industrial clients with simple contracts and favourable terms not available in the biomass sector.

Successful market creation projects seek to maximise impact through co-operation / partnership with other related activities, national and international programmes if they are to have sufficient scale to transform the market. In bilateral and multilateral financing, co-operation is increasingly fostered by country-level get-togethers of funders, and 'donor co-ordination groups'. This without doubt enhances effectiveness of bilateral and multilateral funding.

When biomass residues become a commodity then prices rapidly increase. This has been evident in the case studies carried out by PISCES in 2008.

Any new activity raising demand raises prices, even for waste

It is notable although perhaps unsurprising that in several cases the development of new economic activities around a resource, even if that resource was previously a waste resource, implies an increase in price for that resource. This is particularly marked in bioresidues cases such as the Peru Waste Oil-Recycling and the Senegal Chardust Briquettes examples where success of an initiative using waste leads to more competition for that waste. While from a user and natural resource perspective this is positive, from the perspective of the initiating institutions this is not.

Rising price features like this however are to be expected at national or local level where an increase in economic activity around a resource is occurring. If this increase is occurring, as in these cases, through more effective exploitation of resources this contributes to a positive overall trend as long as prices for the raw material do not rise to a point above the level of viability for the individuals and businesses involved. his should largely be regulated by the market itself but in some of the cases covered, some level of price controls or export restrictions have been a feature of initiatives.

From: Practical Action Consulting (2009). *Small-Scale Bioenergy Initiatives: Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa*. Prepared for PISCES and FAO by Practical Action Consulting, January 2009

Barriers in information flows, standards, transaction costs, financing and the organisation of markets (OECD/IEA, 1997a and 1997b) are strongly present in countries where new technologies or new local technology applications are being introduced. Institutional learning is thus a highly important component of all biofuel market creation projects. Building institutional capacity is crucially important in new markets. For biofuel markets, almost without exception Governments do not have sufficient specialist in-house legal expertise to support the development of such projects, and external expertise, while frequently costly, is essential to enhance effectiveness.

4.2.2 Effectiveness from addressing market barriers

Addressing market barriers in an economically efficient way entails creating and enforcing policies consistent with market principles and address market failures where they exist. A number of lessons may be derived from these project experiences to address market barriers using bilateral and multilateral funds, including

- Policy development work requires prior government willingness to address policy issues: where government are keen to develop policies on a particular subject, the project can effectively assist
- Where governments are not already intending to develop policies and legislation, projects cannot guarantee to produce results,
- Project Management based within the Government have unique opportunities to provide policy support and leadership.

Policies are political, management, financial, and administrative mechanisms with the aim of reaching explicit goals. Most government policies are made at a national level, although regional and municipal governments also develop and implement policies to achieve their administrative and political goals. Local or municipal policies, which in many cases take the form of unstated management, financial and administrative mechanisms, can have significant impacts on the progress and impact of projects.

A significant challenge for bilateral and multilateral funding in the biofuel sector in developing countries is the impact of national and local elections on projects since these take place every 3-4 years, and in some countries elected officials change every election cycle. Project experience shows that in many cases during the first year of a new government no decisions were made by the political leaders and administrative systems since they were ‘settling in’. Equally during the election year (the fourth year of office in many countries) project managers found that municipal decisions in the biomass energy sector became slow and in most cases non-existent (presumably since biomass is risky from a political standpoint). Thus in the experience of all the projects local policies and administrative procedures can have a real impact on projects, and result in time delays and unexpected costs.

In the biomass energy sector, policies frequently do not exist – at both local and national levels – and where they do they are frequently uncoordinated. In many countries in semi-arid and arid parts of Africa, the policy environment is characterized by:

- A lack of co-ordinated strategies
- Little clarity on who is responsible for what
- Three levels of government, each with sometimes competing agendas
- Three ministries responsible for biomass legislation: agriculture, environment and energy/economy
- Frequently changing national and local governments.

Ensuring sound implementation of policies also requires significant support (it is one thing to have the right policy, another to have mechanisms to realise that policy).

The effectiveness of multilateral and bilateral funding is limited by a number of 'financing' issues including:

- The challenge to find private partners that truly want to reduce investment or operating costs (building contractors, equipment suppliers and suppliers of raw materials have a conflict of interest, and may want to maximize investment costs)
- Vested interests in the project (raw material suppliers, equipment suppliers, etc.) meaning that proposals to donors may not be cost effective
- The price of equipment in feasibility studies is usually overestimated when developed by equipment suppliers
- It is challenging to find private partners that are willing to invest in projects offering a lower IRR (in developing country economies there are frequently lots of other places to invest money offering substantial returns on investment)
- A significant risk for investors including donors is the low level of management and business skills (companies do not perform well, and maximise profits, decision-making is poor, this is particularly the case in small companies/projects where a technical expert ends up assuming business responsibilities)
- Significant effort and time is required to secure financing for initial biomass projects, and resource and time are required to address this. For bilateral and multilateral projects this is challenging since funding windows are usually small.
- Effective provision of equity financing relies on flexibility for the fund manager and the investor. Where fund conditions such as the period for the sale of equity is defined in project documents, the fund manager cannot maximise returns. Flexibility is challenging for bilateral and multilateral funding.

4.2.3 Effectiveness from a market transformation perspective

Market transformation refers to a significant shift in the distribution of products in a market, in which a new product substantially displaces an old one. In effect, the long-term objective of the market creation projects is to make biofuels a substantial norm in a market place, thus to facilitate the market transformation process.

A market is a social arrangement that allows buyers and sellers to discover information and carry out a voluntary exchange of goods or services. A simple 'market model' is shown in the figure below with the main market stakeholders shown in bold, together with common barriers to renewable energy markets shown in octagons, and typical project activities to overcome the barriers around the borders.

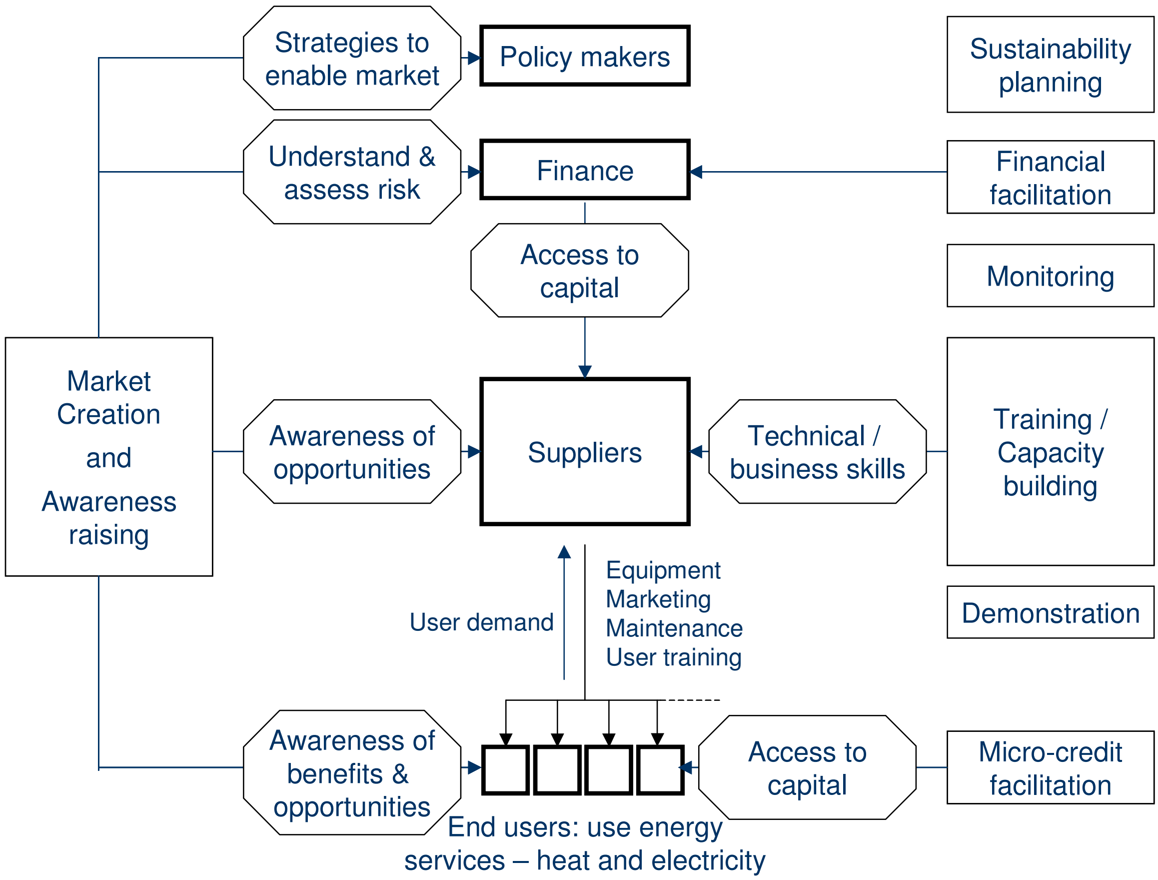

Figure 9: Simplified market model with typical project activities

Source: Eco Ltd.

4.2.4 Effectiveness of bilateral and multilateral financing – conclusions & outlook

To enhance the effectiveness of activities of bilateral and multilateral financing the following lessons have emerged:

- It is essential to get large demonstration projects right the first time since markets can easily be constrained by perceived failures
- Scepticism about biofuels as a clean, sustainable and modern energy source must be persistently addressed in early markets
- Local awareness raising in the locations where demonstration projects will take place are essential to maintaining community buy-in, and technology acceptance
- Targeted awareness raising should start from the outset, before demonstration projects are commissioned

In the next report the emerging lessons and recommendations for bilateral and multilateral funding from the above analysis of effectiveness of these funds will be considered in greater detail.

4.3 International bioenergy trade

By presenting three cases, this section will present an evaluation of the relative effectiveness and magnitude of the third existing financing mechanism for energy crops and agroforestry, i.e. international biomass/bioenergy trade. Each case study analyses a promising African bioenergy export chain. Specific attention is thereby given to the economic viability and effectiveness of different financing mechanisms.

4.3.1 Case study 1: The trade of biomass and greenhouse gas emission credits from eucalyptus plantations in Mozambique

The trade of emission credits is a potentially cost-effective way of reducing emissions. However, the effectiveness compared to the physical trade of biomass or biofuels varies and depends, among other things, on the administrative regulatory burden. Laurijssen and Faaij (2008)[49] compared the effectiveness of physical trade of biomass or biofuels with the trade of emission-credits derived from bio-energy projects based on CDM regulations. These two options are compared from a land use, costs and greenhouse gas mitigation perspective. The production of Fischer-Tropsch diesel from eucalyptus from Mozambique and export to the Netherlands is thereby used as case study. Three systems are defined:

[49] Laurijssen, J. and A. Faaij (2008) Trading biomass or GHG emission credits? Climatic Change (published online; in press)

1. *Physical trading.* The production and harvesting of eucalyptus in Mozambique. After harvest, the biomass is transported to a local gathering point where it is converted to pyrolysis oil. The pyrolysis oil is transported by trucks to the harbour for international shipping. In the Rotterdam Harbour, conversion into Fischer-Tropsch diesel in a large scale Entrained Flow gasification (1000 MW_{th}) plant takes place. Finally, the FT-diesel is distributed to fuel stations where the FT-diesel is used in conventional cars as a substitute for conventional gasoline. Two reference systems are defined:

    a. *Reference system 1A.* In reference system 1a the emissions from land use change are excluded, which is representative of the present situation.

    b. *Reference system 1B.* In reference system 1b the emissions from land use change are included. Two reference types of land are included, namely cropland (C) and pastures (P). Four different accounting methods are applied, namely Stock Change (SC), Average Storage (AS), Ton Year (TY) and Temporary Crediting (TC).

2. *Emission trading.* The production and harvesting of eucalyptus in Mozambique. After harvest, the biomass is transported to a local gathering point where chips are produced. The chips are transported by trucks to a conversion facility where Fisher-Tropsch diesel is produced via Circulating Fluidised Bed (CFB) gasification (387 MW_{th}). The FT-diesel is distributed to fuel stations where the FT-diesel is used in conventional cars. The emissions from changes in land use are also included.

The results are shown in Figure 10 and Figure 11. In Figure 10 the impact of the insurance buffer is also shown. The assurance accounts for the risk of non-delivery, so a certain percentage (approximately 20%) of the credits is reserved in a non-delivery buffer.

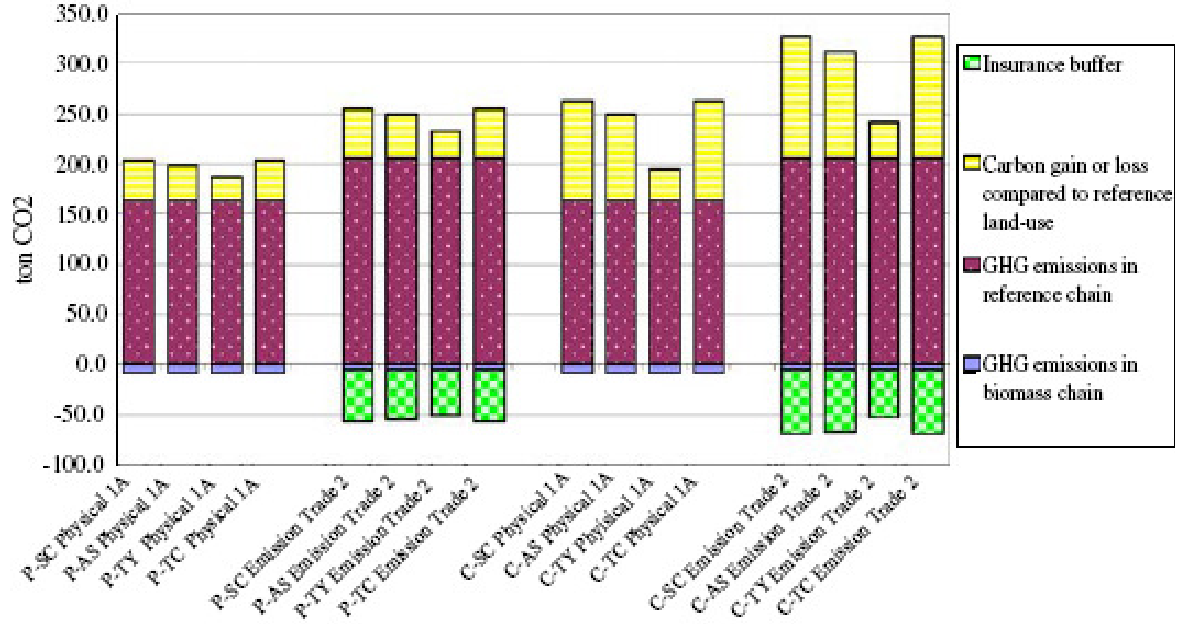

Figure 10: Avoided CO2eq emissions per Mkm driven for two trading systems, two baseline vegetations (cropland (C) and pastures (P)) and four different accounting methods (Stock Change (SC), Average Storage (AS), Ton Year (TY) and Temporary Crediting (TC)).

Source: Laurijssen and Faaij, 2008

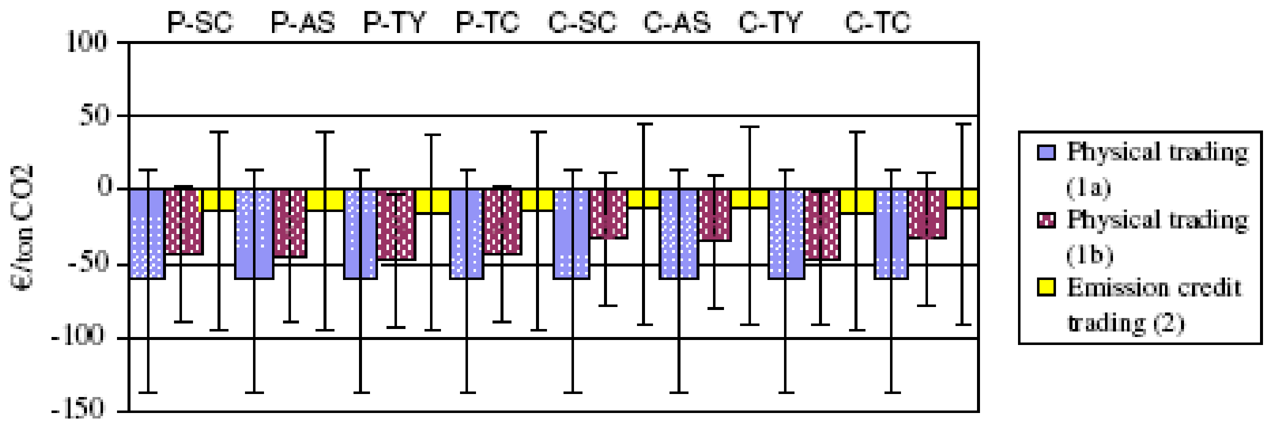

Figure 11: Cost of CO_2 avoidance (€/ton CO_2) for two trading systems, two baseline vegetations (cropland (C) and pastures (P)) and four different accounting methods (Stock Change (SC), Average Storage (AS), Ton Year (TY) and Temporary Crediting (TC) whereby a lifetime of 21 years is assumed)

Source: Laurijssen and Faaij, 2008

The results show that the carbon benefits of physical trading depends largely on the reference system used (1A or 1B). Furthermore, the emission credit trading delivers slightly more credits than physical trading, if the credits from changes in land use are accounted for. The economic performance of the emission credit trading system is, however, much lower than the performance of the physical trading system. This difference cannot be attributed to the extra transaction costs involved in system 2; these have a negligible effect because of the large scale of the projects. The main difference in economic benefits is related to the relatively more expensive production costs of FT-diesel in Mozambique. Even though in the latter system no costs for overseas transport are made, the production costs in Mozambique are still larger. This study also shows that transportation costs have a negligible influence on the financial results in large scale trading systems as explored in this study.

The case study results show that direct land use changes can have such a large influence (both positive and negative) on total carbon balances of the trading systems, mainly due to changes in soil carbon, that it would be unadvisable to ignore them (as currently done in physical trading). The implementation of a certification system could ensure that no carbon losses occur during the biomass production. Although carbon changes from land use changes can be taken into account in CDM projects, the chosen timeframe is rather arbitrary and has a large influence on the results as shown in this study.

4.3.2 Case study 2: Bioenergy trade: the case of bio-ethanol in Southern Africa

Within the Southern African Development Community (SADC[50]) there is an interest in the production and export of biofuels. In this section the prospects for international bio-energy trade within the context of regional integration and sustainable development in the region of southern Africa is investigated (Johnson and Matsika, 2006). The focus is thereby on

[50] The following countries are part of the SADC: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar (membership pending), Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

bio-ethanol made from sugar cane and sweet sorghum. Many producers in the region are cost-competitive ethanol producers by world standards, reflecting excellent growing conditions for sugar cane and efficient milling operations, but not all have been able to exploit their full potential.

First, the potential of the production and export of ethanol from sugar cane and sweet sorghum is estimated, taking into account the domestic demand for bioethanol. Projections are made out to 2025 for demand using assumptions for growth in the different regions. The areas for expansion are constrained to 25 % of the total suitable areas, in light of the relatively short time horizon. The results are shown in the table below.

	2005	2010	2015	2020	2025
SADC total (cane, existing areas)	939	1013	1085	1165	1252
SADC total (cane, new areas)	0	311	844	1882	3925
SADC total (all cane)	939	1324	1929	3047	5177
SADC (sweet sorghum)	0	5119	11858	20603	31819
SADC total (all)	939	6443	13787	23650	36996
SADC demand and projections	2031	2475	4315	6155	8195
Assumed percentage bioethanol	1	10	15	20	25
Remaining allocation for export markets	736	3968	9472	17495	28801
Relative to demand in other regions (volume basis, %)					
China	1	4	9	15	21
Japan	1	7	16	29	48
United States	0	1	2	3	4
EU15	0	2	6	10	16

Table 8: Bio-ethanol production potential from sugar cane and sweet sorghum (Ml)

Source: Johnson and Matsika, 2006

These results show that the SADC countries have the potential to become major biofuels exporting regions, without endangering the domestic supply of biofuels. The volumes of biofuels that are potentially available for export are fairly significant in terms of several key markets: Japan, China, and the EU-15, up to several tens of percent of the biofuels targets can be met by imports from SADC countries. The land required for the expansion is fairly modest: about 1 % of the total agricultural land available and about 5 % of the land already under cultivation in the SADC countries.

Furthermore, the economics of bioethanol production in the SADC region is relatively favourable. Table 9 below gives the total estimated costs for exported ethanol arriving at some important ports, in comparison with retail petrol prices in the broader geographical regions that might be served through those ports. The margins between low and high estimates are a proxy of the scope for policy initiatives (e.g. reduced tariffs, tax rebates) to promote bio-ethanol trade.

Port	Volumetric basis (US $/kl)		Energy basis (US $/kl)		Regional pmup prices gasoline (US $/kl)		Margin (% of ethanol price, energy basis)	
Rotterdam (Netherlands)	368	671	526	959	1140	1620	35	208
Los Angeles (USA)	272	398	389	569	540	680	-7	75
Singapore	331	503	473	719	480	1350	-50	185
Santos (Brazil)	265	452	379	646	500	1130	-38	198

Table 9: Bio-ethanol production potential from sugar cane and sweet sorghum (Ml)

Source: Johnson and Matsika, 2006

However, import tariffs imposed by some countries would have to be lowered or eliminated, as they represent in some cases a significant portion of the overall costs. Import tariffs are applied on bioethanol imports by both by EU (0.192 € per litre) and the US (0.1427 US$ per litre)[35]. For most-favoured nations (MFN) tariffs range from roughly 6% to 50% in the OECD, and up to 186% in the case of India[37]. Biodiesel is subject to much lower import tariffs than bioethanol ranging from 0% in Switzerland to 6.5% in the EU. Tariffs applied by developing countries are generally between 14% and 50%[37]. By contrast, transportation costs, once the infrastructure is improved, represent a fairly small share of total delivered cost of the product. Equivalently, the import tariffs could be lifted for developing countries that are to receive favourable markets. The analysis by Johnson and Matsika (2006) also shows that some producers in the SADC region may have a preference for exports to international markets, particularly the EU, rather than intra-SADC trade, due to the commitments made in those countries for expanding biofuels. A reasonably assured market, potentially through long-term contracts, would be an important requirement for investment in the region. However, GHG credits do not appear to be a useful incentive for bio-ethanol expansion, unless carbon prices go up and/or if enough credit for co-products can be obtained to create additional value.

4.3.3 Case study 3: The production of Jatropha in Tanzania for domestic applications and export

The production and export of Jatropha seed or oil from Tanzania is a potentially promising option. However, the socio-economic viability of such chains depends on various parameters, among others on alternative, competing applications. This is analysed in detail by Wiskerke (2008)[51] who investigated the opportunities of different applications in the region Shinyanga in Tanzania.

Five different applications are investigated. First, the seed can be directly sold to the biofuels industry. Alternatively, oil can be produced using a manual ram press, after which it is filtered and temporary stored in vessels. It can be used for household cooking or for local electricity generation, using a generator. Alternatively, the oil can be used for the production of soap. Finally, the oil can be sold, although there is no local market for Jatropha oil yet. So a local market for pure Jatropha oil as a blend in diesel engines is assumed.

[51] Wiskerke, W. (2008) Towards a sustainable biomass energy supply for rural households in semi-arid Shinyanga, Tanzania. A Cost/benefit analysis. MSc report. Utrecht University, the Netherlands

The analysis is done for a Jatropha plantation with intercropping on arable land that would have been used for agriculture in the absence of the project (intercropping) and a Jatropha monoculture plantation on degraded land that would have only been used for grazing in the absence of the project (monoculture). The results, in terms of the Net Present Value (NPV) per hectare, the return on labour and the cost of energy are compared for the various systems and shown in the table below.

		Monoculture	Intercropping
OPTION 1: SEED TRADE			
production cost	US$/tonne	98,45	97,55
	Tsh/kg	119	118
return on labour	US$/man-day	1,28	1,32
NPV	US$/ha	-229	-180
OIL PRODUCTION			
production cost	US$/litre	0,73	0,75
annual energy production	GJ/ha/year	30,9	25,8
labour intensity	man-day/GJ	10,1	10,1
annual labour needed	man-day/ha/year	299	252
OPTION 2: COOKING ON OIL			
cost of energy	US$/GJ	19,6	19,98
cost of utilized heat	US$/GJh	44,99	45,83
utilized heat	GJh/ha/year	13,9	-1,179
NPV	US$/ha	-1,361	0,59
return on labour	US$/man-day	0,62	0,59
OPTION 3: TRADING OIL			
NPV	US$/ha	47,02	45,83
return on labour	US$/man-day	1,53	1,41
OPTION 4: ELECTRICITY PRODUCTION			
producton cost of electicity	US$/GJ	166,14	171,85
	US$/kWh	0,6	0,62
annual electricity production	kWh/ha/year	2,32	1,933
electrification	households/ha	5,5	4,6
NPV when replacing diesel	US$/ha	2,113	1,616
return on labour replacing diesel	US$/man-day	2,85	2,68
OPTION 5: SOAP PRODUCTION			
production cost	US$/kg	0,92	0,93
NPV when replacing diesel	US$/ha	23,232	19,31
Return on labour	US$/man-day	10,59	10,68

Table 10: Results of the cost/benefit analysis for Jatropha oil production for a plantation size of 1 ha

Source: Wiskerke (2008)

The production cost of Jatropha seeds is higher as the market price, which results in a negative NPV and a return on labour that is lower than the return on labour for conventional crops. The opportunity cost of land is about equal for monoculture or intercropping, because the benefit of intercropping on arable land is levelled out by the lower opportunity cost of degraded land. As a result, the production costs of seeds are to be basically equal for monoculture and intercropping. The NPV per ha differs for monoculture and intercropping, because of differences in spacing. On a monoculture plantation, the spacing is denser so that more seeds are produced per hectare and thus more labour is needed.

The production cost of Jatropha oil in a monoculture plantation is calculated to be US$0.73 per litre. This is roughly equal to the assumed local market price of US$0.75 per litre, so that a slightly positive NPV can be achieved. However, the return on labour per man-day is lower as the baseline. This is caused by the fact that Jatropha oil production is labour intensive.

Cooking on Jatropha oil was found to be uneconomical compared to cooking on fuelwood, because of the cost of utilised heat of Jatropha oil being significantly higher compared to traditional bioenergy systems (results not shown). Furthermore, the Net Present Value of using Jatropha oil for electrification is relative to using diesel as a generator fuel and consists of the difference in cost between diesel and Jatropha oil, minus the costs of adapting the generator. The relatively high NPV and return on labour are caused by the fact that the production cost of Jatropha oil is about 50% cheaper than the market price of conventional diesel in rural Shinyanga. The cost of electricity is US$0.60 per kWh, compared to US$0.79 per kWh, when using diesel, resulting in a cost reduction of 24%. However, US$0.60 per kWh is still about 6 times the (subsidised) cost of electricity in a nearby electrification project.

The main conclusion is, therefore, that the trade of Jatropha oil is more attractive than jatropha seed trade and the use of Jatropha oil as cooking oil, but less attractive compared to electricity production and soap production. Jatropha soap production is by far the most profitable alternative. When investing limited labour and cash, significant value can be added to the Jatropha oil. However, the local market for Jatropha soap is insignificant, whereas, in urban areas there can be a larger market. In Arusha, Tanzania, for example, Jatropha soap is sold as a luxury product. Although it can be expected that a growing and developing market would lead to a decreasing farm-gate price of Jatropha soap because of competition effects.

These results show that the production of Jatropha seed and oil for export is a potentially attractive option if it is an additional activity. But the results indicate that that is in reality often not case, as conventional agricultural activities are placed. This results in a negative NPV for the production of Jatropha seeds. Furthermore, the results also show that other applications than the export of the Jatropha seed and oil are potentially more attractive.

4.3.4 International bioenergy trade – outlook

During the past years concerns have risen about the environmental and socio-economic performance of energy crop and agro forestry practices. In the next report an outlook will be presented of the possibilities and limitations of how developing markets or investors can combine sustainable energy crop and agro forestry practices with financing mechanisms based on international bioenergy trade. Based on the assessment of the issues in this report, it will be endavoured to develop new international bioenergy trade-based financing mechanisms linking sustainability criteria with biofuels supporting schemes.

5 CONCLUSION

The main objective of this paper was to discuss the effectiveness of current financing mechanisms for energy crops and agroforestry activities in Africa, and in doing so to review and evaluate both, existing financing mechanisms, as well as their main barriers.

Three financing mechanisms for energy crops and agroforestry activities have been looked at in more detail, i.e. carbon financing/green certificates, bi-lateral and multilateral financing and international biomass/bioenergy trade.

With respect to ***carbon financing*** (CDM, voluntary carbon market) / ***green certificates*** (RECs), the effectiveness has shown to be very limited. The main reasons are twofold: Firstly, challenges related to determining emissions of bioenergy projects and secondly -and more importantly-, the fact that specific market conditions and regulatory capacity required for carbon markets are weak in Africa, which present significant barriers to accessing the carbon revenue which may be available in bioenergy projects. As a result, Africa only accounted for 5% of the overall CER market in 2007. With respect to green certificates, the barriers to effective participation in green certificate markets are less insurmountable for African developing countries than in the case of carbon markets, however, there has been very little experience with green certificates as these are more generally based on national/regional markets in countries/regions with national/regional targets for renewable energy penetration - of which only very few are already in place. In terms of the scale of the revenue contribution of carbon financing / green certificates, these usually constitute a small (<15%) proportion of the overall revenue arising from the associated energy revenues. These additional revenues are consequently often regarded as complementary but not sufficient in their own right to establish the financial viability of an energy project.

With reference to ***bi-lateral and multilateral financing*** mechanisms, these are divided into four categories, providing grants, seed capital, debt financing or other financial instruments to create and support markets. Their effectiveness, however, has shown to be limited as there are only a very small number of active biofuel activities from multilateral and bilateral funding in Africa. This is based on two main reasons: Firstly, uncertainty as to the merits of biofuels in developing countries, mostly over concerns related to the food versus fuel discussions and secondly, many biofuel investments are commercial and do not aim to support development within countries, thus falling outside the scope of most bilateral and multilateral support. As a result, active biofuel activities from multilateral and bilateral funding in Africa are mainly limited to small scale feasibility studies and small projects.

There are a number of starting points to overcome the bi-lateral and multilateral financing-related barriers to improve the effectiveness of these financing mechanisms. However, apart from the lack of awareness raising in demonstration projects areas and a further strengthening of co-operation among funding institutions ('donor co-ordination groups'), it will be challenging -just as with the carbon-financing/green mechanisms-related barriers- to rectify these issues, as many of them are of a structural nature (e.g. regulatory capacity; relevant bioenergy-related expertise and experience in the local and national financing sectors; lack of stability and transparency or even inexistence of relevant policy, procedures and legislation; insufficient business and technical skills and information).

The golden rule of bi-lateral and multilateral funding is that these mechanisms can only be effective, if they support the creation of markets, thereby not creating dependency, but promoting long-term sustainability by providing the conditions for creation of a sustained and profitable industry, which will result in increased renewable energy capacity and generation, and will drive down costs.

With regards to ***international biomass/bioenergy trade***-related financing mechanisms, these come in various different forms, e.g. rebates of fuel taxes, volumetric tax credits (support to transportation biofuels), but also feed-in premiums, tax exemptions or quotas (use of solid biofuels for heating and electricity production). The most prevalent bioenergy support schemes are in the form of bioenergy targets (e.g. EU, U.S.) aimed at increasing the use of liquid biofuels for transportation. This, however, represents at the same time a major barrier, as the use of liquid biofuels is mainly policy driven and many measures are temporary and tend to change frequently, in turn discouraging long-term investments, as they are considered too risky. A second major barrier to international trade of bioenergy are protectionist policies, tariff barriers (import tariffs) and export subsidies which have been put in place to protect domestic production in OECD countries from cheap imported biofuels from developing countries. Another important phenomenon and potential bottleneck for trade is the linking of financial instruments, such as feed in tariffs, to sustainability criteria (certification systems), as this bears the risk of a possible proliferation of different technical, environmental and social sustainability standards for biofuel production, possibly leading to a situation that in the short term a multitude of different and partially incompatible systems will arise. Measures to promote domestically produced bioenergy over imported bioenergy for energy purposes include tax exemptions available only for bioenergy/biofuels that are both produced and sold in the national market. Regarding the effectiveness of trade-related financing mechanisms, it was shown that a) carbon benefits of physical trading depend largely on changes in land use and b) the implementation of a certification system could ensure that no carbon losses occur during the biomass production.

One of the most encouraging aspects of the analysis undertaken is that Eastern and Western Africa have -globally- the largest potential of lowest cost energy crops (below US$1 GJ^{-1}). West and East Africa are also among the four main regions that are thought to be able to produce a significant amount of energy crops at costs below US$2 GJ^{-1}. At these cost levels, large scale ethanol production is expected to become competitive with conventional gasoline, assuming that technological developments will be stimulated. Furthermore, the analysis also showed that SADC countries have the potential to become major biofuels exporting regions, without endangering the domestic supply of biofuels.

The analysis undertaken has also revealed a number of key aspects to potentially improve the shortcomings in the effectiveness of trade-related financing mechanisms. Firstly, criteria, especially related to environmental and social issues, must not be too stringent or inappropriate to local environmental and technological conditions in African countries. Secondly, import tariffs imposed by some countries would have to be lowered or eliminated, as they represent in some cases a significant portion of the overall costs. Thirdly, a reasonably assured market (e.g. in the form of adequate and reliable biofuel targets, thereby supporting long-term contracts) would be an important requirement for investment in the region. And fourthly, other applications (such as production of electricity or Jatropha soap) can result in more profitable activities than the production and export of seeds or biofuels. However, these other applications would need to be analysed on a case-by-base basis and would again require a stable and large enough target market.

Overall, financing new businesses in developing countries, especially in Africa, is widely recognised as being extraordinarily difficult, and even more so for the highly complex bioenergy ventures. Therefore, it seems likely that -in addition to the analysed opportunities from carbon financing/green certificates, bi-lateral and multilateral financing and international trade-, it will also be necessary to include the conventional mix of equity (from private equity or venture capital investors), debt (possibly on concessionary terms) and grants in order to find ways of financing new energy crop and agroforestry businesses.

ANNEX I

RELEVANT BI- and MULTI-LATERAL FUNDS

Donors (grant financing)

- AFD - Agence francaise de developpement
- Aga Khan Foundation
- AECI - Agencia Espanjola de Cooperacion Internacional
- Ashden Award
- AusAID - Australian Agency for International Development
- Austrian Development Co-Operation (Entwicklungszusammenarbeit Österreich's)
- BADC - Belgian Administration for Development Co-operation
- BMZ - German Federal Ministry for Economic Co-operation and Development
- CIDA - Canadian International Development Agency
- Cottonwood Foundation
- DANIDA - Danish International Development Assistance
- Development Cooperation Ireland
- Development Aid Italy
- Development Aid Luxembourg
- DFID - Department for International Development
- DGIS - Netherlands Directorate-General of Development Cooperation
- Economic Co-operation Fund Portugal
- ESMAP - Energy Sector Management Assistance Programme (World Bank, with funding from DFID and DGIS)
- EU Energy Initiative
- EUEF – EU Energy Facility
- FINESSE - Financing Energy Services for Small-Scale End-users
- FINNIDA - Department for International Development Cooperation
- GEF - Global Environment Facility
- GEF Small Grants Programme
- JICA - Japan International Cooperation Agency
- REEEP - Renewable Energy and Energy Efficiency Partnership
- SIDA - Swedish International Development Authority
- Sustainable Energy Programme - Shell Foundation
- USAID - US Agency for International Development

Seed capital / market development support

- AREED
- FINESSE - Financing Energy Services for Small-Scale End-users
- Solar Development Group - World Bank and US Charitable Foundations

Debt financing (loans)

- AFD - Agence francaise de developpement
- AFRREI - Africa Rural and Renewable Energy Initiative (for electricication)
- AREED
- BMZ - German Federal Ministry for Economic Co-operation and Development
- Emerging Africa Infrastructure Fund
- Empowerment Through Energy Fund
- SEF - Sustainable Energy Facility (SEF) - IFC

References

Desplechin, E. (2007) Customs inconsistencies destabilise European bioethanol industry, International bioethanol association, available at: http://www.industrial-ethanol.org/uploads/IEA%20Biofuels%20Article%20Nov%2007.pdf

Doornbosch, R. and R. Steenblik (2007), Biofuels: Is the cure worse than the disease? Organisation of Economic Cooperation and Development, Paris, France, p. 57.

EC (2007) Impact assessment of the Renewable Energy Roadmap. Impact assessment of the Renewable Energy Roadmap - March 2007. European Commission (EC).

Euractiv (2008) Dossier Biofuels, Trade and Sustainability. Last update 16 September 2008. Available at: http://www.euractiv.com/en/trade/biofuels-trade-sustainability/article-171834.

Jank, M., Kutas, G., Fernando do Amaral, L. and A.M. Nassar (2007) EU and U.S. Policies on Biofuels: Potential Impacts on Developing Countries, German Marshall Fund of the United States, Washington, D.C.

Hamelinck, C.N., R.A.A. Suurs and A.P.C. Faaij (2005) International bioenergy transport costs and energy balance, Biomass and Bioenergy, 29, 2, p. 114-134.

Hoogwijk, M., A. Faaij, B. de Vries and W. Turkenburg (2009) Exploration of regional and global cost-supply curves of biomass energy from short-rotation crops at abandoned cropland and rest land under four IPCC SRES land-use scenarios, Biomass and Bioenergy, 33, 1, p. 26-43.

IEA (2006) Renewables in Global Energy Supply. International Energy Agency, Paris, France.

Junginger,M., Zarrilli, S., Ali Mohamed, F., Faaij. A. et al. (2009) Inventory of opportunities and barriers for international bioenergy trade (paper in preparation).

Laurijssen, J. and A. Faaij (2008) Trading biomass or GHG emission credits?. Climatic Change (published online; in press)

Schlamadinger, B. and I. Jürgens (2004) Bioenergy and the Clean Development Mechanism. 2nd World Conference on Biomass for Energy, Industry and Climate Protection, 10-14 May 2004, Rome, Italy.

Steenblik, R. (2007) Subsidies: the distorted economics of biofuels, Discussion paper No. 2007-3, December 2007. The Global Subsidies Initiative (GSI), International Institute for Sustainable development (IISD), Geneva, Switzerland.

UNCTAD Secretariat (2005) Methodologies, Classifications, Quantification and Development Impacts of Non-Tariff Barriers (Doc. No. TD/B/COM.1/EM.27/2, 23 June 2005), paper prepared for the Expert Meeting on Methodologies, Classifications, Quantification and Development Impacts of Non-Tariff Barriers (Geneva, 5-7 September 2005), United Nations Conference on Trade and Development, Geneva.

UNEP Risoe (2009) CDM/JI Pipeline Analysis and Database. Accessible via: http://www.cdmpipeline.org/. Accessed February 15 2009. United Nations Environmental Programme (UNEP) Risoe Centre on Energy, Climate and Sustainable Development, Copenhagen, Denmark.

Van Dam, J., Junginger, M., Faaij, A., Jürgens, I., Best, G., Fritsche, U. (2008) Overview of recent developments in sustainable biomass certification. Biomass & Bioenergy, Volume 32, Issue 8, August 2008, Pages 749-780.

Wiskerke, W. (2008) Towards a sustainable biomass energy supply for rural households in semi-arid Shinyanga, Tanzania. A Cost/benefit analysis. MSc report. Utrecht University, the Netherlands.

COMPETE Project Coordination
WP7 Coordination - Dissemination

WIP Renewable Energies
Sylvensteinstr. 2
81369 Munich
Germany
Contact: **Dr. Rainer Janssen**
Dominik Rutz
Phone: +49 89 720 12743
Fax: +49 89 720 12791
E-mail: rainer.janssen@wip-munich.de
dominik.rutz@wip-munich.de
Web: www.wip-munich.de

WP1 Coordination – Current Land Use

University of KwaZulu-Natal
School of Environmental Sciences
South Africa
Contact: **Dr. Helen Watson**
E-mail: watsonh@ukzn.ac.za
Web: www.ukzn.ac.za

WP2 Coordination – Improved Land Use

Utrecht University
Dept. Science, Technology and Society
The Netherlands
Contact: **Dr. Andre Faaij**
Dr. Edward Smeets
E-mail: A.P.C.Faaij@uu.nl
E.M.W.Smeets@uu.nl
Web: www.chem.uu.nl/nws

WP5 Coordination – Financing

Energy for Sustainable Development
United Kingdom
Contact: **Michael Hofmann**
Stephen Mutimba
E-mail: michael.hofmann@esd.co.uk
smutimba@esda.co.ke
Web: www.esd.co.uk

COMPETE Project Coordination
WP3 Coordination - Sustainability

Imperial College London
Centre for Energy Policy and Technology
South Kensington Campus, London, SW7 2AZ
United Kingdom
Contact: **Dr. Jeremy Woods**
Dr. Rocio Diaz-Chavez
Phone: +44 20 7594 7315
Fax: +44 20 7594 9334
E-mail: jeremy.woods@imperial.ac.uk
r.diaz-chavez@imperial.ac.uk
Web: www.imperial.ac.uk

WP4 Coordination – International Cooperation

Winrock International India
Contact: **Sobhanbabu Patragadda**
E-mail: sobhan@winrockindia.org
Web: www.winrockindia.org

Stockholm Environment Institute
Contact: **Francis Johnson**
E-mail: francis.johnson@sei.se
Web: www.sei.se

European Biomass Industry Association
Contact: **Stephane Senechal**
E-mail: eubia@eubia.org
Web: www.eubia.org

WP6 Coordination – Policies

Food, Agriculture and Natural Resources Policy Analysis Network of Southern Africa
South Africa
Contact: **Khamarunga Banda**
Dr. Charles Jumbe
E-mail: khamarunga@hotmail.com
charlesjumbe@bunda.unima.mw
Web: www.fanrpan.org

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