Calculating costs and risks

From 2013 on utilities will have to buy up their full requirement of European Emission Allowances via auctions. Assuming an average carbon price of € 23 in 2013, European public electricity and heat producers will be burdened with additional annual costs of approximately € 32 billion. One way to reduce their requirement, and thus costs, will be to generate CO_2 certificates from CDM project participation.

In a joint project called "Carbon-Scout", the Technische Universität Braunschweig and Munich´s utility company Stadtwerke München are analysing the costs and risks associated with the participation in Clean Development Mechanism (CDM, see infobox, page 183) projects. As a result of this cooperation, a model for the evaluation of CDM projects in different technology and region clusters is being developed.

The main selection criterion for the definition of focus technology is the number of registered CDM projects. In addition, technology-specific evolution stages are considered. The most relevant source for this analysis is the so-called UNEP Risoe CDM pipeline which collects information on all CDM projects. As of January 2010, about 4,800 projects are listed that either have already been registered with the UN or are in the process of registration.

Selection of technology and country

More than 75 % of the current project base belongs to the field of renewable energies and methane avoidance). Methane (CH4) has a greenhouse gas emission factor which is 21 times greater than CO2 and is thus even worse for the climate. In total, 1,599 biomass projects are in the registration process or already registered with the UN. These projects can be broken down into the fields of combustion, methane avoidance, fuel generation and biogas utilisation (see figure 1, page 181). The majority of biomass projects have been implemented in the field of combustion and methane avoidance. 628 residue combustion projects represent the largest group, followed by 327 manure and 286 landfill gas projects. These technologies are selected as biomass focus clusters. They constitute 77 % of all CDM biomass projects.

Basically, all plants containing lignocellulose can be used as material for electricity generation through combustion. Major groups include food residues (straw, rice husks, bagasse), forest biomass (wood, sawdust) and palm oil solid waste. The combustion of bagasse and rice husks represents the greatest portion among the residue group. A significant advantage of both materials is their homogeneous availability at the sugar refinery and the rice mill, respectively. They are considered as focus materials for residue combustion in the study. The number of granted Certified Emission Reductions (CER) for residue combustion CDM projects is calculated based on the reduced CO_2 emissions from the feed-in of electricity into the electrical grid.

In the field of methane avoidance, there are two major project types dealing with landfill gas and Animal Waste Management Systems (AWMS). Methane from landfills can be collected by covering the landfill site with an impenetrable foil or layer of earth. The gathered

methane can then either be used for electricity generation or merely converted to CO_2 in a flaring process. In any case, CERs are granted for the saved greenhouse gas emissions compared to the unhindered methane elusion. If electricity is generated from methane, additional CERs can be issued from electricity feed-in.

AWMS refers to methane collection and reduction from anaerobic decomposition of manures. The number of granted CERs depends on various factors such as animal type, food composition, manure collection system and average temperature. Within AWMS there is a focus on excrements from swine. Similar to landfill gas systems, collected methane can either be flared or used for electricity generation.

There are four main selection criteria for focus country definition. First, countries that cannot host CDM projects are discarded. Secondly, countries are ranked according to their application potential per focus technology. In addition, the number of implemented CDM projects within a technology group is determined. The analysis is concluded with an investigation of available financial support mechanisms for all countries.

A combination of strong application potential, current CDM activity and availability of financial support mechanisms leads to focus country selection. For example, combined with the number of current CDM projects, China, India, Indonesia, Vietnam, Thailand, the Philippines and Brazil can be defined as focus countries for the rice husk analysis (see figure 2 on the right side).

Evaluation model

From a compliance investor's perspective, CDM project participation can only be beneficial when the expected revenues from CER generation are greater than occurred costs. In addition, project risks need to be in accordance with company-specific investment behaviour. This implies that a decision model for the evaluation of CDM projects needs to comprehensively consider expected revenues, costs and risks (see figure 3).

Based on an extensive data set, CDM profitability and risk analyses are carried out before being consolidated in a final and integrated assessment. The project profitability analysis indicates the cost effectiveness of CDM project participation from the project developer's point of view, based on an investment Net Present Value (NPV) calculation.

Analysis of CDM risks

Investors face risks in all forms of project participation. Risks may lead to a commissioning delay, a reduction in the expected output or even culminate in the termination of the whole project. CDM risk is defined as the risk of CER loss and shortfall. It is modelled with the quantitative indicators "Probability of Termination" (TP), "Expected CER Shortage" (ECS) and accompanied by a semi-quantitative country risk assessment.

The probability of termination provides the probability of a total project failure, whereas the expected CER shortage indicates the forecast CER reduction.

Technologies in CDM biomass projects

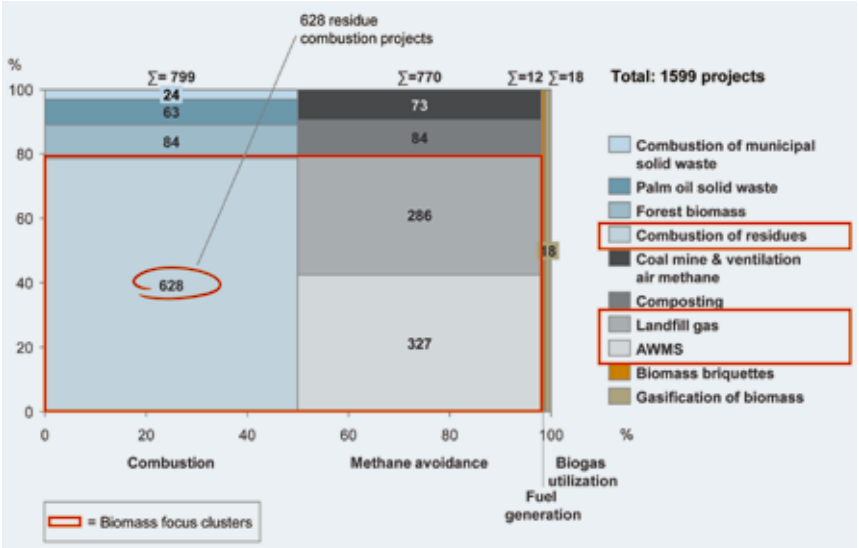

Figure 1: Breakdown of current CDM biomass projects before registration, or already registered with the UN
Source: UNEP Risoe CDM pipeline, Carbon-Scout analysis

Focus countries

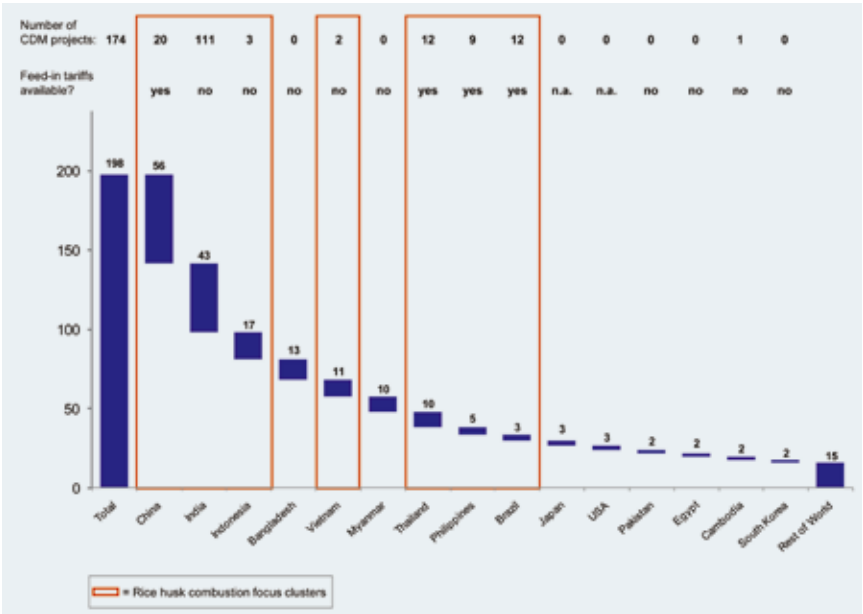

Figure 2: Analysis of electricity generation potential from rice husks
The bars indicate the maximum amount of electricity production possible from available materials per country.
Source: FAOSTAT Agriculture database, UNEP Risoe CDM pipeline, Carbon-Scout analysis

Evaluation structure

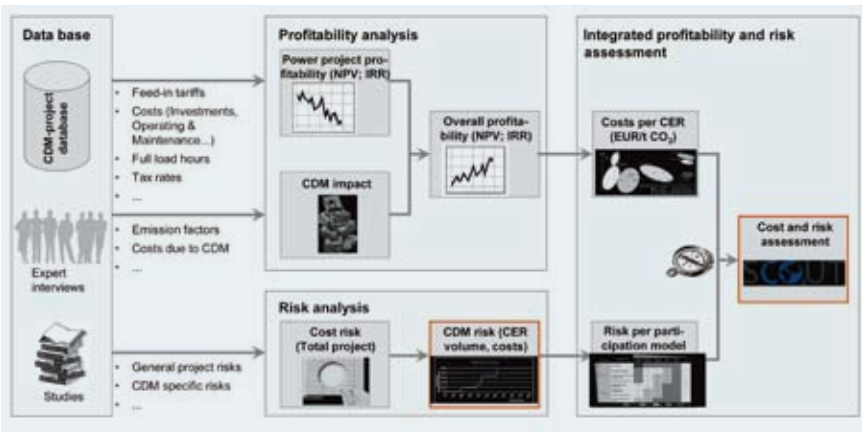

Figure 3: An investor should check profitability and risks of his CDM project.
NPV – net present value, IRR – internal rate of return
Source: Carbon-Scout

Risk fact sheet

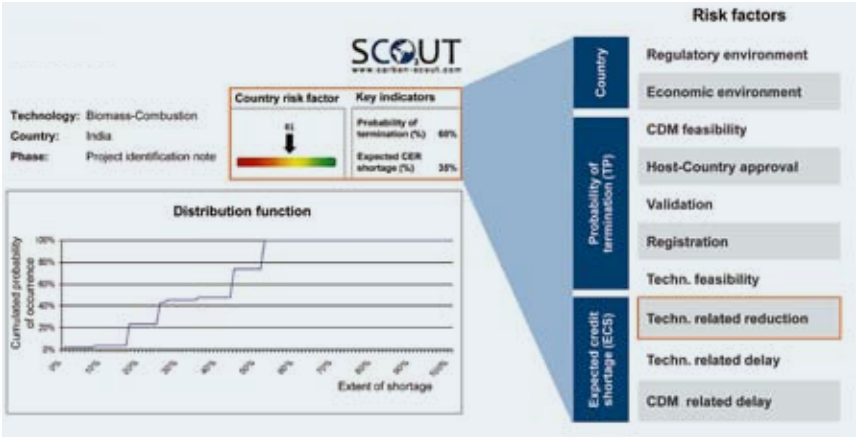

Figure 4: An exemplary model result sheet for residue combustion in India at the stage of project identification. Source: Carbon-Scout

Both indicators are calculated based on statistical analyses of underlying technological and CDM-specific risk factors. Technological risks consider technically induced malfunctioning or output reduction. CDM risks are related solely to the CDM process.

TP includes all risk factors that may lead to a failure of the whole project. These consist of CDM feasibility, host country approval, validation and registration as well as technological feasibility risks. A TP of 60 % indicates that more than half of all project ideas are expected to be dismissed at the stage of project identification or during the following CDM process steps. Compared to other renewable energy technologies (e.g. wind projects), this share is fairly high. The main reason is that the success of bagasse and rice husk combustion projects is very much linked to the well-being of the mill itself. In the past, for example, price variations on the sugar market have required shutdowns of sugar mills, leading to biomass combustion project terminations. Furthermore, political decisions against monocultures have a significant impact on TP as well.

ECS covers all risk factors having an impact on CER output volume. These include technologically related reduction and delays as well as CDM-related delays. ECS is computed as the balance point of the distribution function shown at the bottom of figure 4. The distribution function is the result of a statistical analysis answering the question of which CER shortage can be expected with a specific level of confidence. For the Indian residue cluster the risk fact sheet provides an ECS indicator of 35 %. Thus, due to the underlying risk factors, investors face an expected CER shortage of more than a third. The main reasons are the delay of plant component deliveries as well as reductions resulting from output overestimation and negotiation concessions regarding grid connection, water supply and disposal. Furthermore, all biomass projects are highly weather-dependent. For example, extreme weather conditions may destroy a whole year's harvest.

Technologically related reduction

Technologically related reduction is defined as the technically induced reduction of project output. It is a technical performance indicator and measured ex post as the ratio of actual performance to planned output due to technical constraints. Residue combustion plants provide a moderate predictability of technological performance. 57 % of projects produce less output than expected, whereas 43 % achieve or overachieve the target. The average underperforming project is short by 27 %. Combustion plants are based on an established technology. For bagasse and rice husks, the above-mentioned criteria lead to moderate technologically induced risks.

In contrast, AWMS and landfill gas projects provide weaker predictability. In the past, 93 % of AWMS and 95 % of landfill gas projects have shown underperformance and fulfilled an output expectation of about 38 %. In fact, forecasts of expected methane emissions in both cases are very difficult. For landfill gas systems the consistency of waste can hardly be foreseen and changes over time. Furthermore, small unrecognised leakages in the methane gas collection system may have a huge impact on the overall level of methane collection. Indeed, deviations of up to 75 % of output expectations are not exceptional.

These findings lead back to the overall ECS result

Profitability and risk analysis matrix

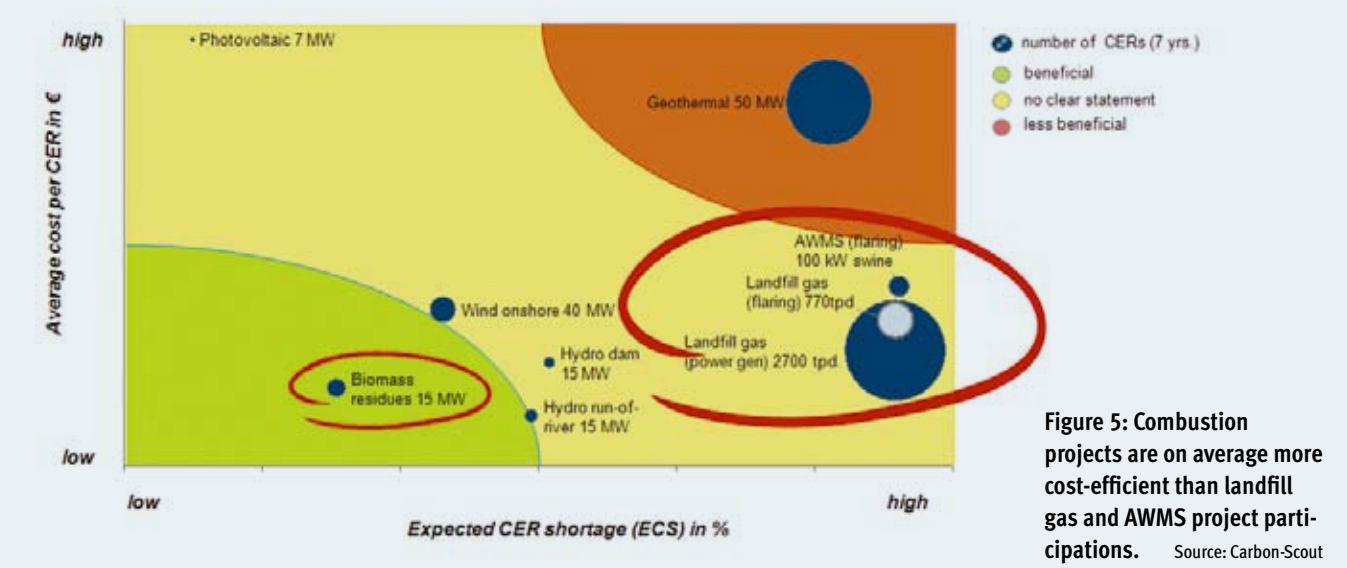

Figure 5: Combustion projects are on average more cost-efficient than landfill gas and AWMS project participations. Source: Carbon-Scout

Clean Development Mechanism and the EU Emission Trading Scheme

The Clean Development Mechanism (CDM) has been installed by the United Nations (UN) as a measure for carbon emission reduction in developing and emerging countries. The underlying intention is to stimulate greenhouse gas emission reduction around the world. Through the CDM, investments can be encouraged in countries where the application of clean technology is most cost efficient.

After a CDM project has been registered with the UN, every ton of CO_2 reduction is honoured with a so-called Certified Emission Reduction (CER). CERs can either be cashed in at the carbon stock market or utilised to fulfil CO_2 compliance requirements within the European Emission Trading Scheme (EU-ETS). In 2009, so-called secondary CERs were traded at an average price of approximately € 12. One CER permits the emission of one ton of CO_2. CERs are equivalent to the so-called Emission Allowances (EUA) being distributed by European governments to EU-ETS compliance companies.

for residue combustion shown in Figure 4. It can be concluded that technologically related reduction contributes the most to the ECS value of 35 %. In fact, only minor risk contributions have to be added from the other risk factors of technologically and CDM-related delay.

Profitability and risk assessment

As shown in Figure 3, the overall model result provides an integrated evaluation of profitability and risk analysis results. Both outcomes may be plotted in a profitability and risk analysis matrix (see figure 5, page 182). All focus technologies are plotted according to their average CER cost and ECS level.

The matrix enables investors to make a first assessment on overall cluster attractiveness. Beneficial clusters are located in the lower left corner of the matrix representing low risks and low costs. Less attractive clusters can be found in the upper right corner showing higher ECS and costs.

Landfill gas and AWMS have a greater ECS than biomass residue combustion. Solar photovoltaics is the only renewable energy with a lower ECS than biomass residue combustion. The analysis of the cost axis concludes that combustion projects are on average more cost-efficient than landfill gas and AWMS project participations. Only hydro run-of-river CDM projects provide a smaller average cost base, while other renewable energies are typically more expensive.

Concluding, at this stage of the analysis, biomass residue combustion projects seem to be a promising cluster for CDM investments. However, before final investment recommendations can be made, the evaluation has to be broken down to country levels, including region-specific TP and more detailed, site-specific technical analyses.

Peter Wiedenhoff, Tobias Bruns

Further information:
Scout: www.carbon-scout.com
Point Carbon: www.pointcarbon.com
Stadtwerke Muenchen: www.swm.de
Technische Universitaet Braunschweig: www.htee.tu-bs.de
UNEP Risoe: cdmpipeline.org