BIOENERGY PROJECTS FOR CLIMATE CHANGE MITIGATION: ELIGIBILITY, ADDITIONALITY AND BASELINES

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ABSTRACT: As of today, only few baseline and monitoring methodologies for bioenergy activities[2] have been registered under the Clean Development Mechanism (CDM) of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) and only one has been approved so far. The Bio Carbon Fund (BCF) is expected to become operational in March 2004, while other comparable international financing schemes for climate change mitigation projects, such as CERUPT[3], the PCF[4] or GEF, have mostly focused on industrial processes and their potential for carbon emission reductions through increased energy efficiency and fuel switching. Due to the higher complexity of bioenergy systems, with responsibilities involving a number of different actors and sectors (agriculture, forestry, spatial planning, energy, environment), respective baseline and monitoring methodologies are not readily available, and their development and deployment could entail significant transaction costs.

FAO and other organizations are trying to support developing countries and potential project participants in identifying and formulating projects covering the whole range of bioenergy activities. In this paper, first results of efforts on project identification, baseline and monitoring methodologies and eligibility in the area of flexible financial mechanisms (including CDM) and bioenergy will be analysed with regard to the following topics:

- Different mechanisms – different criteria for eligibility: additionality, differences in relevance for bioenergy and developing countries
- Baseline and monitoring methodologies and the potential role of Life Cycle Analysis
- Key aspects of project feasibility in the context of sustainable development

1 THE MAJOR CARBON FUNDS AND THEIR ELIGIBILITY CRITERIA

1.1 Introduction

The carbon market today originally emerged from the Kyoto Protocol (KP) to the United Nations Framework Convention on Climate Change (UNFCCC). In the KP, agreed upon at COP-3 in the city of Kyoto (Japan) in 1997, the parties to the convention agreed on emission limitations for Greenhouse gases (GHG, including those listed in the KP). These emission limitations were only set for countries listed in the ANNEX I to the KP, comprising all OECD and a number of CEE countries. With regard to differences in their 1990 (per capita) emissions, different emission goals were defined for different countries, with some countries facing real emission reductions compared to 1990 levels and others able to increase there emissions by a certain percentage. To achieve these goals, a set of so called flexible mechanisms was introduced to bring down overall transaction costs, namely, Emission Trading (ET), Joint Implementation (JI) and the Clean Development Mechanism (CDM).

Since the signing of the KP by its parties, the Carbon market has been "developing rapidly" (Venema and Cisse, 2004) hampered however by the slow ratification process and the continuously delayed entry into force of the KP .. The demand side is dominated by key government actors that have established programs for the purchase of carbon credits (or certified emission reductions, CER), but also the private sector is increasingly getting involved. On 20 April 2004, the EU parliament adopted the Linking Directive, which allows the purchase of CERs outside the EU from 2005 and of ERU (Emission Reduction Units) from 2008. EU companies can use these for compliance with the EU Emission Trading Scheme (ETS). In April 2004, CER transactions have been reported in the ¤4.0-¤5.0 range, with exceptional bids as low as ¤2.50 and as high as ¤8.00 (Evolution markets LLC 2004).

Total CER demand estimates range between 300–350 MTCO2-equivalent in the first commitment period (2008–2012), while CERs of about100 MTCO2eq might be demanded from CDM project activities (IETA 2003).

According to the number oft memoranda of understanding signed so far and the geographical distribution of established designated national authorities (DNA) , the majority of CDM projects are expected to be carried out in India, South America, and South-East Asia. China however is very likely also to emerge as a key player.

- India currently boasts world leadership in the overall number of CDM projects in the official pipeline (methodology and validation submissions). Biomass energy is currently the prevailing project type (Point Carbon 13/05/2004)

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[2] These proposed methodologies (which are currently under consideration) cover several methodologies on energy production from agricultural residues (see: http://cdm.unfccc.int/methodologies/process)

[3] CERUPT is a CDM project tender run by Senter International. Senter is an agency of the Ministry of Economic Affairs which implements government policy in the fields of technology, energy, environment, exports and international cooperation http://www.senter.nl/asp/page.asp?id=i001276&alias=erupt

[4] Prototype Carbon Fund of the Worldbank http://prototypecarbonfund.org/router.cfm?Page=Home

- Costa Rica and Chile hosting a combined total of 11 memoranda of understanding, Brazil alone 11
- A total of 84 projects submitted so far, generating ~240 Million CERs (CDM Watch 30/04/2004)
- Thereof in Sub-Saharan Africa (excl. South-Africa): 5 Million CERs = ~2%

1.2 The Clean Development Mechanism

The CDM is tailored toward achievement of the dual goal, the reduction of GHG emissions and sustainable development of developing countries (or *host countries)*. The Marrakech Accords[5] lay down eligibility criteria, requiring proposed project activities to (UNCTAD 2003):

- Be approved by the host country, i.e. the Designated National Authority (DNA);
- Reduce GHG emissions relative to a baseline that has to be defined according to the CDM modalities and procedures (see chap.3)
- Contribute to the sustainable development goals of the host country (as defined by the host country);
- Define exact, physical boundaries of project activities and consider leakage, i.e. emissions occurring outside the project boundaries, related to the project activity
- Provide for stakeholder participation;
- Exclude-nuclear and large hydro technology;
- Prove that no resources are diverted from official development assistance (ODA); and
- Be carried out only by those countries that have ratified the Kyoto Protocol.

1.3 The Worldbank mechanisms

The WB has set up several funds to stimulate the development of the carbon market and it requires all projects to be in line with national and local environmental legislation, and its ten Safeguard Policies, comprising environmental, social and judicial issues. While these are relevant for all WB funds, the portfolio criteria of the different funds naturally differ in terms of their target groups and activities (also with regard to the respective relevance of bioenergy projects), and other eligibility criteria.

1.3.1 Prototype Carbon Fund (PCF)

PCF projects can be in countries with economies in transition and in developing countries. A major emphasis will be directed at development of projects in the area of renewable energy technology such as, but not limited to, geothermal, wind, solar and small-scale hydro energy projects. No more than approximately 10% of the Fund's assets will be invested in land use sector projects, non of which can be placed in developing countries. The PCF's portfolio currently comprises 3 biomass projects, for which *Emission Reductions Purchase Agreements* (ERPAs) have been signed .

1.3.2 The Biocarbon Fund

"The BioCarbon Fund explicitly requires that projects include rural development objectives" as well as climate change mitigation (Lipper and Cavatassi 2004).

Besides Kyoto eligible projects (window 1) the BCF aims at prototyping sequestration in replicable asset classes of high social and environmental value (window 2). These classes are:

- Afforestation and Reforestation, i.a. fuel wood plantings at a commercial scale
- Forest Management , i.a. alternatives to fuel wood for forest/environmental protection
- Cropland Management
- Grazing Land Management
- Biofuels

Categories 1,2 and 3 include explicit reference to bioenergy projects, but also category 3 could include for example the use of crop residues for bioenergy and avoided burning of biomass in the field.

1.3.3 Community Development Carbon Fund (CDCF)*:*

The CDCF targets poorer communities in developing countries, with a minimum of 25% of the portfolio's first tranch to be used for projects in LDCs.. A/o, the CDCF may purchase CERs from biomass fuels including crop-residue fuels such as bagasse, rice and coffee husks, and wood fuels. CDCF projects will comply with the criteria for CDM project activities under Article 12 of the KP. Preference will be given to projects that are compatible with the definition of "small-scale CDM project activities"[6]

1.3.4 The Global Environment Facility (GEF)

"The Global Environmental Facility (GEF) is a source of grant funding for project activities supporting the goals of several mluit-lateral environmental agreements (MEA) and promoting sustainable development. The fund provides financing for activities that generate global environmental goods and services (GEF *2000* www.gefweb.org). (Lipper and Cavatassi 2004).

In the overall GEF portfolio, climate change related projects (i.e. mostly renewable energy projects) represent the second largest group of projects, which " are designed to reduce the risks of global climate change while providing energy for sustainable development" (WB 2004). These projects cover four areas:

- Removal of barriers to energy efficiency and energy conservation;
- Promotion of the adoption of renewable energy by removing barriers and reducing implementation costs;
- Reduction of the long-term costs of low greenhouse gas emitting energy technologies;
- Support of the development of sustainable transport.

1.3.5 Government activities

The biggest program for acquisition of CERs so far is *The Netherlands Certified Emission Reduction Unit Procurement Tender (CERUPT).*Through CERUPT, the Netherlands wants to implement CDM by providing funds for acquisition of CERs. At the moment (April 2004), no carbon credits from projects under the Clean Development Mechanism (CDM) are purchased under CERUPT.

[5] The Marrakech Accords laid down the modalities and procedures for the CDM and were agreed upon at the 7th conference of the parties to the UNFCCC (COP-7), held in Marrakech in 2002.

[6] in accordance with decision 17/CP.7 , adopted by the Conference of the Parties to the UNFCCC at its seventh session and concerning the modalities and procedures for a clean development mechanism and the facilitation of its prompt-start.

ERUPT is the procurement programme under which carbon credits are still purchased, and which covers CEE countries and thus potential CERs under JI. The implementation of the procurement programme follows a tender procedure, which is open for expressions of interest (by companies) at any time. For investments in the following kinds of projects carbon credits may be purchased: renewable energy, energy efficiency, fuel switch, waste management and forestry.

2 BIOENERGY SYSTEMS AND CLIMATE CHANGE MITIGATION

In this section, the potential of bioenergy systems to provide climate change mitigation services on a system or project basis is considered. The discussion in this section covers the key requirements for assessing the carbon mitigation potential of bioenergy project activities, notably additionality, how to define baselines or reference cases, and the role of Life Cycle Analysis (LCA).

2.1 Additionality

For a project activity to be eligible it has to be proven that it generates a reduction in emissions that is additional to that which would have occurred in its absence. This requires the determination of the baseline situation – what would occur in the absence of any payment for emission reductions? The approaches to setting baselines will vary depending on the project type, and whether the analysis is set at a national versus a project level. (Chomitz 1999). The concept of additionality is most directly captured by simulating the investment decision process, and confirming that a project would not be undertaken in the absence of payments for emission reductions. Such an analysis would require consideration not only of the potential returns to an investor, but also consideration of the riskiness of the returns. Using this approach, a first class of projects that are determined to be financially infeasible without emission payments could be considered as additional.
However there are likely to be a second class of energy development projects which are financially feasible, but unlikely to be adopted due to barriers to investment, such as limited access to financing, lack of information about new technologies and a direct but uncertain monetary return to investment Chomitz (1999).
Payments for carbon emission reductions may be sufficient to overcome the barriers.
A third class of projects can also be identified, in which the returns to the investor are negative, even including carbon payments, but other public benefits (social, environmental) associated with the project are high, so that from a public cost benefit perspective the project is beneficial, while from a private investment perspective it is not. Social benefits associated with bioenergy projects could include the provision of electricity to remote and low income populations, reduction in air pollution, employment benefits, etc..

2.2 Setting the baseline

In analysing the potential amount of (indoor, local and transboundary) emission reductions bioenergy system may provide, it is necessary to compare each system with a baseline or reference case. Some controversy exists on how to set the baseline, and methodologies may vary by the type of project and the level of analysis. A major concern in baseline setting is the propensity to set it high (i.e. the original level of emissions is high), so as to maximize the potential emission reductions associated with the project. However an artificially high baseline decreases real mitigation benefit and may at the same time reduce market prices even more, as “hot air” is added to the CER supply side.
According to the Marrakech Accords (MA, Decision 17/CP7, par. 46), three types of baseline methodologies are eligible:”

- Existing actual or historical emissions, as applicable.
- Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment.
- The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 % of their category”

In order to be approved by the CDM methodology panel and executive board, baseline methodologies have to be combined with a monitoring methodology.
The approval of baseline and monitoring methodologies is crucial to the development of further projects, as they are developed in a bottom-up process, i.e. baseline and monitoring methodologies have to be submitted on a case study basis. Once they have been approved, they serve as a law-case like reference and projects following the same methodology, will be eligible, if they comply with all CDM criteria.

2.3 Life cycle assessment to establish carbon abatement potentials

2.3.1 Fuel Switch – substituting fossil fuels with biofuels

The assessment of potential carbon emission credits generated by a bioenergy project requires the comparison of greenhouse gas emissions over the entire life cycle of the energy production process, including the production of raw materials and their conversion to energy. Bioenergy projects may generate carbon emission reductions in two ways: 1) from the sequestration generated by the production of the raw materials and 2) by lower emissions associated with the production and use of the energy, as compared with the fossil fuel. Figure 3-1 gives an example for a simplified LCA of bioethanol and a fossil fuel for transportation.
In figure 3-1, two systems are compared at each major step of their life cycle. In terms of reducing greenhouse gas emissions, results vary according to the emissions at every step in the production chain. For the Brazilian sugar-cane agro-industry it was estimated, that after including all emissions in the production process, it is through the substitution of gasoline by ethanol (~65%) and fuel by bagasse (~35%), that Carbon emissions are reduced by 12.74 Mt C/yr (Hall, House et al. 2000, p.47)CO_2 emissions in the conversion of biofuels to electricity and heat are lower than in reference cases using fossil fuels and constitute *“an important option to reduce net emissions of CO_2 “* (Groscurth et al. 2000, p.1092).

2.3.2 Fuel saving – improving energy efficiency

In the case of many developing countries current patterns of energy production and use (i.e. the baseline) are not fossil fuels, but some form of bioenergy, albeit mostly produced and utilized in an inefficient and environmentally harmful manner. But currently (unsustainable) biomass use as baseline is not included in Annex A to the KP and thus projects that increase the efficiency of bioenergy systems are not eligible under CDM[7] (Schlamadinger and Juergens, 2004). This is however the most common form of energy supply in developing countries at whose sustainable development the CDM is targeted, with some countries, deriving more than 90% from biomass.

One way of crediting the reduced land-use impact of more efficient bioenergy systems is to combine each land-use or sequestration credit with one unit of a certified emission reduction from the bioenergy system, mostly end-use efficiency in SME and households (ibid.). Under the BCF this procedure represents one eligible project type of its non-CDM-compliant window.

Energy efficiency improvements often represent a straight-forward option for emission reductions, as the existing fuel cycles do not have to be changed and thus non-financial barriers to adoption are more likely to be rather low. On the other hand, investment in new equipment and up-front financing are not readily available. In terms of transaction costs, monitoring and the calculation of emission reductions based on for example an LCA could be lower, as the life cycle (and the calculations) stays the same, only differing in terms of emissions at different stages.

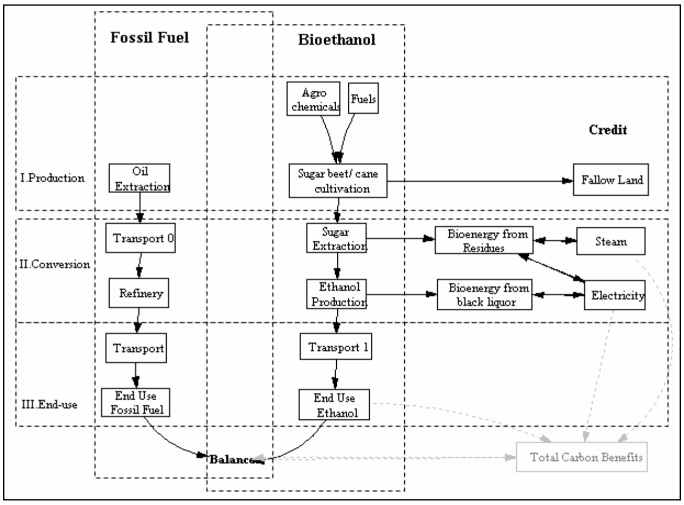

Figure 3-1: Schematic life cycle comparison bioethanol from sugar beet/cane and (fossil) motor fuel (optimum conditions) (Source: Adapted from Reinhardt 2002)

3 KEY FACTORS TO CONSIDER IN AN ANALYSIS OF BIOENERGY SYSTEMS FOR CLIMATE CHANGE MITIGATION AND DEVELOPMENT

The economic benefits associated with bioenergy development would occur primarily in the provision of energy at a lower cost than other alternatives available. Looking at the economic costs from a social perspective, it is necessary to take into consideration the impacts of any distortions at the local or international level in energy markets. For example, price subsidies on fossil fuels, or even more subtle forms of subsidization such as infrastructure development conducive to fossil fuel development and distribution, must also be taken into account in assessing the economic benefits of modern bioenergy adoption.

The social benefits associated with bioenergy development include the increased access to energy among consumers, particularly rural households. In addition, bioenergy development may confer social benefits by improving the access to energy among industrial and commercial consumers, thus creating a more diverse economic base on the potential for employment creation. Bioenergy may also represent an important means of income generation for land users, who could potentially become suppliers of raw materials to a bioenergy industry.

The primary environmental benefit of concern in this paper is potential climate change mitigation associated with modern bioenergy adoption. Above, the potential for mitigation benefits was discussed, noting that a key determinant of the potential is the degree to which modern bioenergy adoption is additional, and how the baseline is set. Aside from climate mitigation benefits, other environmental benefits may be associated with the adoption of modern bioenergy systems. Bioenergy projects have proven to have the potential to generate significant environmental benefits in the form of soil erosion control and waste water management, reductions in air pollution (and associated increases in human health benefits), reductions in land degradation, deforestation and water pollution.

Very successful examples of combining several environmental services from one bioenergy crop are Salix plantations that are used for purification of waste water (Börjesson 1999b; Perttu 1998; Rosenquist 1997). For Sweden, where the economic value of the most relevant environmental benefits was estimated, purification of waste water in energy crop cultivation had the highest economic value (of ~US$ 5/GJ compared to production costs of US$ 5 for Salix (excluding transport)). The estimated economic values varied between US$ 0.1/GJ and US$ 5/GJ for single benefits, but it can be assumed that priority would be given to those cultivations, where several environmental benefits could be obtained at the same time (see the discussion of environmental impacts above)[8].

Of course costs will also be associated with the adoption of modern bioenergy in all of these categories. A key stumbling block in the adoption of modern bioenergy so far has been the associated economic costs, which are frequently higher in comparison to fossil fuel or hydropower systems, particularly in the short run. Social costs associated

[7] The biomass saved through efficiency gains in bioenergy systems is accounted for under Land Use Change and Forestry (LUCF) chapter which is excluded from CDM. However, the modalities and procedures for small-scale project activities leave some space for interpretation, and amendments have been proposed to the methodology panel.

[8] The benefits are calculated as relative benefits from a change in land-use from conventional agricultural crops to energy crops (in this case Salix and reed canary grass). See Börjesson 1999a&b

with bioenergy development occur primarily in the form of foregone opportunities for the land used in producing the raw materials, the labour involved in producing the raw materials and the energy conversion process, and the capital invested in bioenergy. Environmental costs may occur from an increase in non carbon greenhouse gas emissions, acidification and others.

Transactions costs are likely to be equally or more important than actual project costs based on experiences from activities implemented jointly (AIJ) and other carbon projects (Cacho 2002). Transactions costs include project identification, negotiation, validation, and monitoring. From an analysis carried out by the PCF in order to estimate the transaction costs associated with a small scale rural energy CDM project,

> *" it appears that the main component of transaction costs is the price to be charged to the project developer by the operational entity (OE), which will be in charge of the validation and the verification-certification stages. If the OE charges "international rates" (about USD 1,000 per day), the corresponding cost can rise to USD 70,000 , that is, 90% of the total transaction costs (USD 78,058). But if the OE charges only "local rates" (about USD 200 per day) and assuming that the procedures are also further simplified in order to reduce recurrent tasks to be done by OE, the OE cost falls to USD 3,800, that is, 46,5% of the total transaction costs of the most simplified option (USD 8,168)."* (PCF 2003)

In order to determine the social value of adopting a modern bioenergy system, all of these costs and benefits need to be assessed. However in this paper the key concern is the degree to which the climate change mitigation benefits associated with modern bioenergy adoption can contribute to the social and private values of adopting the technology. These mitigation benefits are set within the wider scope of the technology to contribute to sustainable development, which is an important requirement of many potential payment sources for mitigation services. Thus consideration of the wider social and environmental impacts associated with bioenergy will have to be taken into account as well.

4 CONCLUSIONS

This paper has tried to establish the formal links which confirm that there are strong synergies to be captured between climate change mitigation efforts, modern bioenergy development, sustainable development and poverty alleviation.

The adoption of modern bioenergy increases the efficiency of the raw material production and conversion process, leading to lower costs in terms of human health and environmental degradation. Often however financial costs are higher, particularly in the short run.

An important class of cc mitigation projects likely to be important to the poor and developing countries are those where bioenergy adoption is economically better than the alternative, but adoption would have been prevented by some barrier, most commonly an investment constraint. Carbon payments can play an important role in overcoming this constraint.

Another class of projects which is likely to be very important are those which have a high social value, but which generate positive economic costs. Carbon payments in this scenario would not be sufficient to make the project economically viable, but they would contribute towards reducing the social burden of making the investment. This kind of project might occur if modern bioenergy development leads to an increase in energy availability compared to the baseline, and thus an actual increase in emissions rather than decrease.

In particular, bioenergy development and utilization can strongly benefit from the new financial avenues available for climate change mitigation options. Although many bioenergy applications are now economically feasible, others require the integration of environmental and social benefits to make them economically and financially attractive. The paper has tried to contribute to a better understanding of those new windows of financial opportunities.

The versatility of bioenergy options regarding scale, ecosystems, social adaptability and markets makes it one of the most important alternatives for the futures of the energy, agricultural and forestry sectors in both developing and industrialized countries.

The demand for credits from CDM projects will depend on the effectiveness of domestic policies and measures, and other trading opportunities available through both joint implementation and international emissions trading. (Venema and Cisse, 2004, p.120)

For the different key aspects discussed in his paper, the following conclusions can be drawn:

For the demand side of the carbon market

- Carbon market still a buyers' market, with the public sector still the strongest buyer, mainly through government (carbon credit purchase) programmes
- With compulsory emission goals for energy intensive sectors, private companies are increasingly entering the market. Voluntary agreement in Japan.
- The demand for credits from CDM projects will depend on the effectiveness of domestic policies and measures, and other trading opportunities.
- Buyers need to be made aware of the strong potential synergies between bioenergy and sustainable development and it will be important for the viability and q1uality of bioenergy projects, whether there will be a high price market segment for high quality projects contributing to sustainable development.

For the supply of carbon mitigation options from bioenergy:

- Large climate change mitigation potential of bioenergy fuel-switch and efficiency improvements
- Project developers, national authorities and communities need to be involved in the process and understand the potential of carbon credits for bioenergy development.
- Implications for sustainable development should be considered and used to promote bioenergy. Life-cycle analysis offers a flexible (modular) and transparent tool.
- There is more to bioenergy services than energy and climate change mitigation, and other environmental and social benefits and impacts should be incorporated into project assessments and CBA, in order to evaluate the real impact of bioenergy projects on sustainable development.

For the regulatory side

- CDM rules are not clear enough about the eligibility of *Efficiency improvements of bioenergy systems,* hampering the biggest share of potential small-scale projects in developing countries
- Baseline and monitoring methodologies need further development, to include bioenergy efficiency and additional benefits (i.e. countries' sustainable development goals).
- There is more to the carbon market than the CDM

For international collaboration

- Currently, the majority of CDM projects will take place in Latin America (Costa Rica and Chile hosting a combined total of 11) and South-East Asia
- Technology has to be transferred and capacity developed
- Important role for UN and private (bio) energy sector
- A joint effort between all sectors concerned is necessary – including the rural (agriculture, forestry, ...) and the energy sector – in order to grasp this opportunity
- Current market prices are relatively low, but there is a large potential market for bioenergy technology in developing countries due to increasing availability of financing for CC mitigation activities

While benefits of modern bioenergy systems per se and of synergies with other domains are clear, there are policy and institutional capacity barriers to be breached. The following are considered key areas of attention to exploit these synergies:

- national authorities involved with energy development need to be involved in the process and understand the potential implications of carbon credits to the financial viability and attractiveness of bioenergy development versus other alternatives.
- international carbon emission reduction purchasers also need to be made aware of the strong potential synergies between bioenergy development and sustainable development.
- more work needs to be done on defining the baselines and additionality criteria, particularly in the areas of increasing efficiency in bioenergy systems.
- simplified modalities need to be further developed to allow project developers, national authorities or even communities to prepare and implement bioenergy carbon projects.

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