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OPTIONS FOR LAND-USE AND BIOENERGY PROJECTS UNDER A GIS IN ROMANIA

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- Green Investment Scheme: Case Study on Hungary. Sharmina, M., Urge-Vorsatz, D. & Feiler, J.
- Options for GIS Bioenergy Projects Under GIS in Bulgaria. Tuerk, A. & Frieden, D.
- Options for Land-Use and Bioenergy Projects Under a GIS in Romania. Tuerk, A., Frieden, D. & Blujdea, V.

Abstract

Countries that ratified the Kyoto Protocol committed to a maximum emissions level of the so called greenhouse gases (GHG) by 2012. In order to meet these commitments, countries receive emission allowances corresponding to their maximum emissions level, so-called Assigned Amount Units (AAU). These units may partly be sold if countries reach a lower emissions level than foreseen. Buyers will be countries which are obliged to acquire additional emission rights because their emissions exceed their commitment.

A number of Central and Eastern European countries, including Romania, have large amounts of surplus allowances due to dramatic declines in their greenhouse gas (GHG) emissions during the nineties -- i.e., after their emissions targets had been set. Potential buyers of these allowances request seller countries to invest the corresponding proceeds in so-called Green Investment Schemes (GIS). The idea behind a Green Investment Scheme is to ear-mark these revenues for use in climate change related projects in the seller countries. Romania is currently implementing a Green Investment Scheme. About 100 million Assigned Amount Units (AAUs), each corresponding to the emission of one ton of CO_2, can potentially be sold over the 2009-2012 period. This paper starts by describing the institutional requirements for establishing a GIS in Romania. It then assesses concrete land-use and bio-energy project types, considering a range of implementation options. Furthermore, it compares the Kyoto mechanism Joint Implementation (JI) to GIS in order to assess their differences and overlapping in detail. Suitable GIS project types in the land-use and bio-energy sector in Romania include the reforestation of cut but not regenerated private forest areas or the rehabilitation of district heating systems. The paper illustrates that land-use and biomass projects would bring about large socioeconomic co-benefits for the country. While for the proposed bioenergy projects there are pros and cons to carrying them out either under JI or a GIS, for projects in the land-use sector major barriers under JI could be removed under a GIS.

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1 Background on Climate Policy and GIS in Romania

1.1 Climate Policy and emission trends in Romania

Romania has ratified the United Nations Framework Convention for Climate Change (UNFCCC) in 1994 and the Kyoto Protocol in 2001. It committed to reduce 8% of its Greenhouse Gases (GHG) in the first commitment period from 2008 to 2012 compared to the baseline emissions in 1989. Romania's actual GHG emissions from 1989 to 2006 compared to the Kyoto target are shown below.

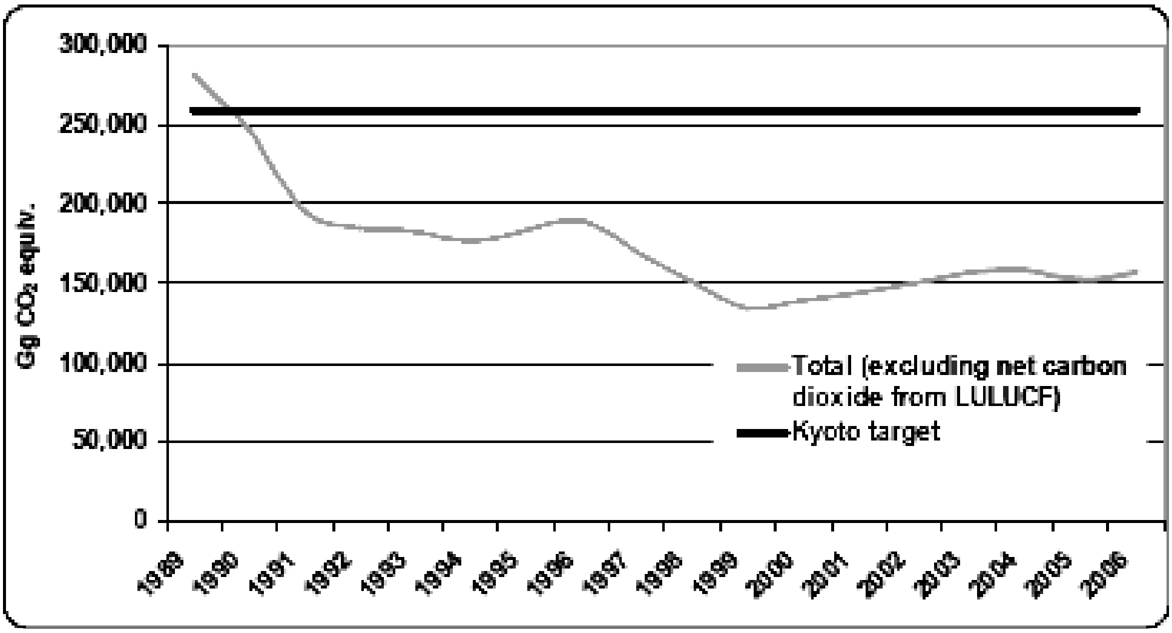

Figure 1: Total GHG emissions vs. Kyoto Target in Romania (Romania's GHG Inventory, 1989-2006, submission to the UNFCCC, Ministry of Environment and Sustainable Development 2008)

Figure 1 shows the strong decrease in GHG emissions after 1990. This reduction occurred, like for the other Central and Eastern European countries, due to the breakdown of the economy in the beginning of the 1990s. Compared to the 8% commitment from 2008 to 2012, Romania reduced its total GHG emissions already by 41% from 1989 to 2004 (without sinks, Andrei et al. 2006). Romania's Governmental Program 2005-2008 emphasizes specific priorities for the reductions of GHG emissions. A National Strategy on Climate Change was adopted in 2005, as well as the National Action Plan on Climate Change.

1.2 Romania's Assigned Amount Unit Potential

In the Kyoto Commitment Period Romania's AAU surplus has been estimated to be at least 50 million tons CO_2eq annually (Andrei et al. 2006). Out of this amount, over the whole period 100 million AAUs can potentially be sold under GIS, taking into account a reserve for Romania's compliance and for JI projects.

1.3 Current status of a GIS in Romania

Romania is currently finalizing the establishment of a GIS in the country. The Romanian government furthermore is identifying and approving projects and finalizing the database of possible GHG emissions reduction projects (JI and GIS). The eligibility from the UNFCCC was received officially on 1st September 2008.

1.4 Priority areas for GIS in Romania

The priority areas for GIS in Romania are as follows (Trusca, 2008):

- the rehabilitation of district heating systems
- the construction of small co-generation installations (non-ETS)
- fuel-switching in energy productive installations (non-ETS)
- the recovery of methane generated by urban waste landfills
- the reduction of non-CO_2 emissions in industrial installations
- energy efficiency in buildings (public and private)
- the construction/rehabilitation of renewable energy productive installations (hydro, geothermal, wind, solar, biogas, biomass)
- the reduction of GHG emissions in agriculture and transports
- afforestation and reforestation

2 Possible GIS architectures in Romania

2.1 Institutional set-up

This chapter addresses the potential institutional set-up of a GIS in Romania. As other CEE countries, the Romanian government plans to accommodate the GIS within the already existing institutions through the building of expertise of their staff and improving information flows between them. The Environmental Fund or a specialized unit in the Ministry will manage the GIS[1] .

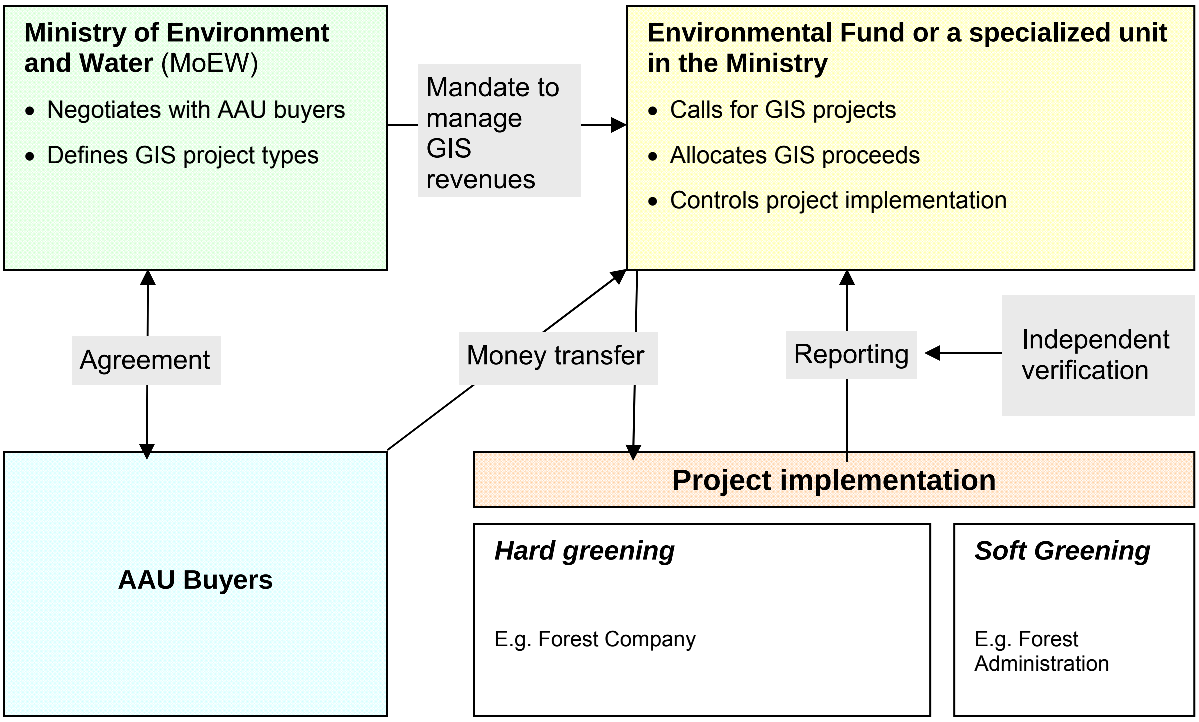

Figure 2: Institutional set up for GIS in Romania

Figure 2 illustrates the simple structure for the implementation of a GIS as envisaged by the Romanian Government. The Environmental Fund or a specialized unit in the Ministry would be the manager of the GIS[2], while the Ministry of Environment and Water would negotiate with AAU buyers and define GIS project types. The manager of the GIS would control the project implementation. The verification of the project implementation and of emissions reductions, however, should be carried out by an independent verifier to guarantee transparency of the use of GIS revenues, which is required by the buying countries.

[1] Personal Communication, Vlad Trusca, Nov 2008

[2] Ibid

2.2 Options and modalities for a GIS in Romania

This chapter describes country specific modality choices as being envisaged by the Romanian government and project specific modalities suggested by the authors.

Hard and soft greening: Under a GIS approach, two different kinds of Green Investment are being discussed. Hard greening refers to projects that result directly in quantifiable emission reductions or increases in carbon stocks. This is for instance the case for a switch from electricity to biomass-based heating. Soft greening refers to activities such as awareness raising and information that are expected to lead to emission reductions but where there is no immediate expectation of quantifying such reductions. Soft greening includes for instance information and awareness raising or administrative costs (e.g. the setup of a GIS management unit). **Romania takes a mixed approach with 5-10 % soft greening[3].**

Funds distribution: For land-use activities with low economic return (for example for basic land-use activities such as afforestation) a grant would be appropriate. Soft loans would be suitable for activities with a higher and sooner rate of return such as short rotation forestry.

Budgetary option: The money can go to the state budget and be consolidated with other funding. It can go to a special budget without consolidation or directly to a special fund. In Romania the revenues will go into a special budget of the Environmental Fund or a specialized Unit and are coordinated by the Ministry of Environment[4].

Beneficiaries: The beneficiaries of a GIS in Romania would be local authorities, companies, central authorities, non-profit organizations and physical persons.

Project selection process: The selection process can follow national priority areas depending on government decisions (Top-down) or involve project-proposals from organizations, individuals and local authorities (Bottom-up). Romania chooses a combined approach including tenders for projects[5].

Program approach vs. project approach:
According to the concept of a programmatic approach under the CDM, activities under a program of activities can occur either simultaneously or throughout the duration of the program. In contrary to a bundling of activities, there is no ex-ante identification of the project sites. A large number of potential participants, which are not known at the beginning, can participate in the program; they can be added to the program at any time. Only the entity implementing the program represents the project activity and not every project participant. A programmatic approach under GIS, however, would not need to follow the strict CDM guidelines. **The Romanian government plans to implement projects and programs[6]**.

Timeframe of the GIS: Especially land-use activities need long crediting periods as it takes several years till significant sequestration begins. Therefore the crediting period would have to be extended for these projects to post-2012.

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[3] Personal Communication, Vlad Trusca, Nov 2008
[4] Ibid
[5] Ibid
[6] Ibid

3 Background on land-use and bioenergy activities under a GIS in Romania

Currently, land-use activities in Romania are governed by key political, economical and social factors, such as land restitution, existing funding to support land-use activities, the energy challenge, sustainable development and a favourable environment for rural investments, as well as the structural transformation processes of the society. These factors would heavily influence any new funding mechanism, as is the case with GIS. The restitution of land is almost completed, so that most land is private, with only a small share remaining state owned (which is mostly leased for long periods, i.e. 50 years). Any initiative on degraded land requires the will and appropriate awareness of the owner. Significant property fragmentation, lack of forest ownership experience, small owners' limited administrative capacity, and their reluctance to develop owners associations, as well as delayed revenues from forestry, make it even more difficult to implement afforestation programs.

The Romanian society has been undergoing a structural change process over a short period of time, from a totalitarian system to a democratic, decentralized one. This strongly impacts upon society's capacity to adapt and approach innovative ways, especially in rural areas. A significant driver of change was the joining of the EU which has brought about financial, technological, administrative and environmental standards and inputs.

With this background in mind, there are several important factors for the land-use activities of a likely Romanian GIS:

- significant funding opportunities for rural development projects are available (including land-use activities) under measures of the National Rural Development Plan 2008-2013, which has now been officially approved;
- there is increased decentralization of the administration of natural resources in rural areas (i.e. arable, forests, grazingland);
- in principle, GIS beneficiaries may be private land owners (i.e. their associations), but their own co-financing capacity and interest in afforestation or other activities that do not immediately generate income is minimal;
- land prices are increasing and agricultural use is more financially attractive than forest use (especially under the EU rural development scheme);
- despite a current program of acquisition of degraded private lands by the National Forest Administration (NFA) "Romsilva", it would appear that owners are unwilling to sell. "Romsilva" therefore has no land available for afforestation measures under its own Forest Regeneration Fund;
- environmental concerns (including biodiversity and protected areas, wildlife, land degradation).

Suitability of land-use and bioenergy activities under GIS in Romania

The question raised in this chapter is which possible land-use and bioenergy projects are "ideal" GIS projects. According to Ürge-Vorsatz et al. (2007) a GIS project should fulfill the following criteria:

- difficult/impossible to cover by business-as-usual-policies
- environmental, economic and social co-benefits
- efficient in terms of cost/mitigation effect relation (not necessarily as first priority)

Based on these criteria and due to reasons explained above, the implementation of a GIS in Romania should focus on land-use activities which are economically interesting for (industrial) raw material and energy production as well as on forest management. Low priority is on afforestation/reforestation or re-vegetation as long as they come along with economically unattractive land use change. The proposed activities in addition generate significant environmental, economic and social benefits in rural areas of the country, such as biomass for energy use, raw material for industries (pulp, bioethanol) or improved forest management for degraded private forests (cut and non-regenerated). As biomass and raw material projects are based on the same types of plantations they are summarized under the project type "fast growing woody crops" in the following chapter.

Table 1 provides an overview of the project types proposed in this study including their characteristics in regard to the criteria mentioned above.

Table 1: Appropriateness of different potential GIS land-use project types

	Difficulty to cover by business-as-usual-policies	Environmental, economic and social co-benefits	Cost-efficiency
Short rotation plantations for biomass use (e.g. willow crops)	• Lack of financial /cofinancing resources on the side of the land owners	• Benefits on the level of wood use: Improved energy/heat supply, decreased energy production costs • Environmental impacts have to be assessed on project level	• Relatively high mitigation costs due to frequent harvesting and replanting
Short rotation plantations for industrial use (e.g. 7-12 years cycle of poplar plantations for paper industry)	• Lack of financial resources on the side of the land owners	• Benefits on the level of wood use: Support of e.g. the declining paper industry and the corresponding employment by providing local cheaper raw material • Lower need for paper imports • Environmental impacts have to be assessed on project level • Protection of natural riverine forest , while supplying industry from plantations • Jobs creation over whole chain of paper production	• Relatively high mitigation costs due to frequent harvesting and replanting
Forest Management	• Lack of financial resources on the side of the land owners	• Direct ecological benefits of the reforestation activities. Areas become increasingly valuable for land owners as they might achieve medium/long-term economical benefits (in particular when supplied/enriched with precious woods, both for fuel and other uses). • Restore the landscape with improved balance of land uses (arable, forest, pastures)	• Lower mitigation costs: investment only in the first years, sequestration over a long period of time
Biomass cogeneration plants (including the rehabilitation of existing DH systems)	• A GIS may give a decisive financial incentive for investment	• Increased independence from imported fuels • Enhanced energy efficiency • Decreased energy (heat) prices • Development of the wood market and processing (chips, pellets) • Jobs creation over whole chain	• Relatively high mitigation costs

3.1 Biomass potential for a GIS in Romania

Total biomass potential in Romania

According to the strategy for the use of renewable energy sources[7], Romania's energetic biomass potential is estimated at about 7,594 thousand metric tons oil equivalent (ktoe)/year, which is around 19% of total primary resource consumption in 2000.

The strategy mentions the following biomass sources[8]:

- wood residues (1,175 toe, equivalent to 3,654 thousands tons of raw wood[9])
- wood waste products (487 ktoe),
- cereals (agricultural) waste products (4,799 ktoe),
- biodegradable biomass waste (588 ktoe), and
  urban waste (545 ktoe).

Potential quantitative contribution of woody biomass under a GIS in Romania

The Romanian national statistics give the total volume of annually exploited wood, on cut types: principal production (wood resulting from cut of forest at end of cycle), secondary cut (wood resulting from forest works) and sanitary operations (wood removed because the trees are affected by different causes: dieback, decline, insect attacks, etc)[10]. These statistics are available at county and regional level (i.e. at Development Regions level). In the following section, we identify available wood resources and quantify them in order to establish the potential for their sustainable use in green electric energy production. The quantification of available biomass relies on forestry statistics, annually published by the Romanian National Institute of Statistics.

In this chapter already available and potentially created wood resources are identified and quantified in order to assess their sustainable use in energy production. Two types of woody biomass are analyzed regarding their suitability for energy production:

- woody residues, and
- biomass crops.

It has to be said that this estimate does not reflect the overall biomass potential of Romania since, for example, industrial wood waste is not included. Data was collected at county level and aggregated to country level. The methodology for the data calculation can be found in Annex I. The potential quantitative contribution of woody biomass under a GIS should take into account the following criteria:

- *Accessibility* by tractors and existence of tracks, in order for residues to be removed and consequently used. The assumption is that if logs are able to be removed, then the residues may be removed too.

[7] Strategy for the use of renewable energy sources (HG 1535/2003)
[8] Ibid
[9] Assuming that: 1 ton of fuel wood = 0,3215 toe (tone oil equivalent)
[10] This data is available at: http://www.insse.ro/cms/files/pdf/en/cp14.pdf

- *Availability* – takes into account the practice of collecting all forest residues for local need. In plain areas there are no residues left in oak and robinia stands. In spruce stands all of these are left in the forest.
- *Acceptability* – in terms of the dimension of residues for collection. Small pieces of wood (as thin twigs) cannot be removed, but entire branches (which have at least one thick end) can.
- *Predictability* – availability of having that biomass at a certain time in future
- *Sustainability* – the use of biomass must not exceed a level which would endanger wood supply in the future

Wood residues

All three different cut types (principal production, secondary cut and sanitary operations) have been taken into account in estimating the total wood residues potential. Currently, the total available biomass residues vary between 240,000 and 290,000 tons DM/year. In fresh status (natural air dried, 40% humidity) the biomass amount is almost double. Assuming no "collection" by local people and integrated harvesting of wood residues, the total biomass would vary between 710,000 and 850,000 tons DM/year.[11]

Table 2 shows the amount of wood residues that can be expected to be available on an area basis.

Source of forest biomass residues	Tree species/ group of species	Amount of biomass accountable (t DM) at unit of stand area (1 ha)
Principal	Coniferous	9
	Beech	8
	Oaks	6
	Soft woods	8
Secondary	Coniferous	1.5
	Beech	3
	Oaks	1.5
	Soft woods	3.5

The amount of accountable biomass on different works and stand types allows the correlation between forest management plans, predictability of biomass and size of the installation capacity of the biomass plants to be developed.

Plantations for energy wood production

There is a great potential, as well as need, in Romania for an increased availability of biomass also by specialized crops of fast growing species. Appropriate woody crops may be based on willow or poplar, as there is no experience with other species. Increase of woody crop area for wood energy production is one of the proposed GIS land-use projects (see 4.1 for details).

[11] See Annex I for the origin of the data.

Total energy production potential by woody biomass

In energetic terms, 1 ton of dry wood (0% humidity) is equal to 20 GJ. Thus the total annual biomass potential of wood residues in Romania (predictable, accessible out of currently not used forest residues, available and acceptable, see explanation above) is between 4.8 and 5.8 x 10^6 GJ. If no collection by private users would occur (or under full harvesting), the biomass production potential would be 3 times higher, between 14.2 and 17 x 10^6 GJ. The dedicated fast growing crops may have a potential between 1.4 and 6.4 x 10^6 GJ. **Romania's total electric energy potential from wood residues and willow-based energy plantations is thus between 6.2 – 12.2 x 10^6 GJ/year assuming that collection by private users will continue.**

3.2 Funds related to land-use projects in Romania

For the use of GIS means, the focus should always be on measures which could not be realized by a business as usual scenario in order to guarantee additionality. This is the case where either no other funding is available or where the available funding is not sufficient for triggering the investment. GIS could then be used to reach the threshold which makes projects attractive and realizable.

Currently, **several schemes for financing** projects in the land-use sector in Romania are in place such as

- The Land Reclamation Fund – managed by the Ministry of Agriculture and Rural Development
- The EU Rural Development Fund – managed by the Agency for the Payments on Rural Development and Fishing under the authority of the Ministry of Agriculture and Rural Development
- The Environmental Fund – managed by the Ministry of Environment
- The Forest Regeneration Fund – managed by the National Forest Administration (NFA)

If land is degraded (i.e. marginal agricultural or pasture), 100 % funding from the Land Reclamation Fund is available in order to recover it. This fund is available to all categories of owners; it has a successful implementing history and allows for the recovering of up to 10,000-20,000 ha per year (out of which 50 – 60 % for non-afforestation activities of land improvement, i.e. drainage, pastures improvement, etc). If the land is agriculturally productive it may still be afforested under specific measures of the Rural Development Fund of the EU, which covers up to 75 % of the costs and compensates owner's harvest losses for a period of 15 years. The Environmental Fund covers approximately 50 % of the land recovery costs. The Forest Regeneration Fund may cover 100% of the afforestation with the particularity that the land must be state owned and administered by the National Forest Administration. An overall picture of available financing for afforestation is summarized in Annex II. Some funds may exclude the combination with other public financing such as from a GIS. It will have to be assessed for each project or program type which combination of financial sources can be applied.

4 Proposed Land-use and bioenergy projects

4.1 Hard greening land-use projects

Support for improved forest management in "cut-not-regenerated" forest areas

In 1991 the "law regarding the land" (Law 18/1991') was the first step towards the forest ownership restitution in Romania. Some of these forests were cut during the period 1992-1998 and not regenerated. During that period, owners were under numerous pressures: weak state institutions (police, local authorities, forest authorities) and lack of governance; lack of legislation and institutions to advise private owners on forestry; massive theft and illegal cutting of private forests; early transition and peoples' fears that communism would return. At the beginning of 2007, the area of "cut-and-not-regenerated" forests was estimated at 32,524 ha (according to data from the Ministry of Agriculture and Rural Development; MARD). Out of these not regenerated areas 30 % may have been cut before 1998, namely 10,000 ha (while the rest later). The project activity would consist in the support of re-plantings on these areas. It may be combined with assisting natural regeneration and an enrichment with valorous tree species. The estimation of net climatic benefit (in terms of both CO_2 and non-CO_2 GHG) could be methodologically complex, while additionally could not be accounted for compliance under the Kyoto Protocol. The GIS project could be carried out under a programmatic approach taking into account the large number of geographically dispersed small participants involved. The projects would be assisted by the Territorial Forest Inspectorate (ITRSV). The allocation of grants should be made based on projects submitted by forest land owners associations. MARD should establish an inventory methodology of all "cut-not-regenerated" forestlands between 1992 and 1998. Furthermore, the support should focus on areas which are under climatic stress (i.e. drought).

According to Romanian law, land owners bear full responsibility for their own forests.[12] It is not the government's responsibility to improve the condition of these areas. There is a manifest will of land owners to improve their "cut-not-regenerated" forests, but they do not have any capacity to take action. In contrary to the past, land owners begin to be organized in associations and the relevant state institutions are stronger, but still owners don't have the financial capacity to invest in reforestation. The support scheme would be designed as an incentive to re-green cut areas and thus regain ecological balance on these lands. The grants would be open to all interested groups concerned, but keeping the restriction of the forest cut period. In return to investing on these private lands it may be considered to restrict the use of the lands e.g. through putting it under the state administration or declaring it as protected area. This could include giving limited rights to the land owners to use their land, such as dead wood, but excluding cuttings of wood beyond planned forestry operations. Thus sustainable management could be facilitated in the future and a financial return to the administration may be reached through the selling of harvested wood.

<u>Benefits:</u> The CO_2 net removal benefit generated by improved forest management of degraded/cut forests in plain areas is significant. The delay in "reforestation" of a cut area generates emissions from carbon ecosystem pools which are not anymore under steady

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[12] Governmental Ordinance 139 / 2005, as well promoted as such in the new "Forest code", currently under approval

state conditions (soil, dead organic matter) and leads to a delay in atmospheric CO_2 absorption and accumulation. Over the transition period there is a continuous loss of carbon from all carbon pools. Annex III illustrates this carbon loss using a Robinia stand as an example. Under a GIS project implemented in 2009, it would have to be conservatively assumed that the emissions from previous disturbances would need to be balanced by growing trees until 2014 when the sink becomes predominant.

Fast growing woody crops

***Details of the proposed project activity*:**
Under this category, woody fast-growing plantations for production of raw material in industry (i.e. pulp) and biomass for energy production or biofuels may be included, eventually in integrated chain approaches: biomass production – energy/industry's delivery chain. It may include the biomass production of non-woody crops, the quantitative potential of which is not taken into account here. There is a great need in Romania for an increased availability of biomass, giving this project type a high priority. For such crops knowledge and technology is already available as they have been extensively cultivated in the past (i.e. willow for basketry). Willow is an annual, while poplar is a multiannual crop. While poplar cultures have specific site requests, willow crops may be extensively introduced in the country, especially under irrigation and fertilization schemes. In addition, poplar is traditionally used in the pulp or furniture industry and not as firewood (at least not industrially due to its low energetic value). We therefore focus here on the production potential of willow. The GIS project could be carried out under a programmatic approach to take account of the large number of entities involved which would significantly reduce the transactions costs.

A quantitative estimation in terms of suitable areas cannot easily be given. Available lands may be arable lands along irrigation channels on terraces (bringing dual benefits: mitigation of evaporation and watering the plantations), low productive arable lands in polders along Danube, Big Island of Braila or in areas with available irrigation systems. These plantations may fit perfectly into existing cropping systems, possibly to be established in different shapes (starting from individual row to groups, woody belts).

In order to ensure full compatibility with existing support schemes, the GIS should mainly focus on those types of woody crops not covered by Measure 121 of the National Program of Rural Development (PNDR). The GIS would support projects of woody fast-growing crops with a rotation cycle longer than 5 years and include "non-energy" crops (i.e. pulp for celluloses). The fast -rowing crops with a rotation period of less than 5 years should be maintained with lower priority, as covered by PNDR measures. Key to this measure is to maintain unchanged previous land to avoid additional costs and enable the return to previous use after any cycle of woody biomass production.

Benefits: It will benefit the environment by contributing to the mitigation of the pressure on natural remnants of riverine forests from the Danube valley, and by promoting the naturalization of appropriate areas (islands, treasures of birds, areas for fish population regeneration).

In addition to decreased energy supply costs through energetic biomass use, socio-economic benefits would include a predictable wood supply for the declining paper industry and a reduction of paper imports. So far, there are no selected species or clones under use and there is no established woody crop production for bioenergy in the country. Annual biomass production of willow is estimated to be between 4.5 and 20 tons DM/ha/year depending on the stand and the intensity of irrigation and fertilization.[13]

Table 2: Estimation of willow biomass production potential

Grade of suitability	County	Estimated crop area (ha)	Estimated annual amount of biomass (to DM/year)	
			Min (4.5 t DM/ha/y[14])	Max (20 t DM/ha/y)
High	Tulcea, Braila, Galați, Vaslui, Iasi, Ialomita, Calarasi, Giurgiu, Olt, Dolj, Timis, Arad	11,000	49,500	220,000
Medium	Gorj, Vâlcea, Argeş, Dâmbovița, Prahova, Buzău, Vrancea, Botoşani, Cluj, Sălaj, Bihor, Constanța, Ilfov	5,000	22,500	100,000
Total		16,000	72,000	320,000

The areas included here would mainly be partly abandoned and generally private agricultural land. The combining of agricultural crop fields with biomass belts (6-8 m wide) should be considered in order to allow for benefits from irrigation and fertilization.

Afforestation/reforestation and Revegetation

Afforestation/Reforestation consists of creating forest plantations changing the land use from non-forest to forest. Re-vegetation involves forest tree plantations that do not meet the forest definition and are therefore not associated with a land-use change. For reasons already explained in chapter 3, this activity should have minimal priority under GIS.

[13] DM = Dry Matter at zero per cent humidity

4.2 Soft greening land-use projects

Awareness program for the implementation of hard greening activities

The above proposed hard greening projects should be accompanied by information and support measures especially for private land owners. This would also serve to raise interest in the project opportunities and to increase the willingness of land owners to apply for GIS-funded measures.

Awareness program for initiating the establishment of a national shelterbelt system in drought affected areas of the country

The establishment of a national forest belt system was enforced by the governmental decision 273/2004, but has had limited practical impact (i.e., so far less than 100 ha of forest belts established[15], while effective forest belts require 300 000 thousand ha at the country level). All legal and institutional responsibilities are in place. With available funding, seedling and relevant capacity both in the NFA-Romsilva and private sector, Romania could easily start implementing such a system.

The support should focus on: 1) enhanced and improved continuous communication with land owners 2) assuring land owners and communities that they will be involved, consulted and supported in developing a flexible (close-to-nature) system, not a rigorous grid-like, un-natural and unfriendly shelterbelt 3) designing and demonstrating models for the administration of shelterbelts.

<u>*Benefits*</u>: The establishment of a national system of forest belt would benefit the local and regional environment, agricultural production and the local economy and infrastructure (i.e. roads, irrigation channels).
Estimated emission reduction: The establishment of the system would lead to additional CO_2 removal of more than 1,000,000 tons of CO_2 in 20 years if a pace of establishment of 1000 ha a year is achieved, considering a very conservative reduction of 5 tons CO2/yr/ha. The reduction of emissions from agricultural activities (fuel, fertilizers) that were developed on these lands should be added, which corresponds to a direct emission reduction of 50,000 tons of CO_2 in 20 years. For the current commitment period the reduction would be around 100,000 tons of CO_2.

<u>Support needed:</u> The support needed would be 200,000 € in 4 years. This measure cannot, at the outset, begin with related hard greening. Hard greening cannot even be guaranteed and the acceptable share of soft greening under GIS is very limited. A possible approach may be to first combine this measure with other hard greening projects on a small scale. If successful, the activities could be enhanced and enlarged with hard greening components.

[15] Note: for a complete protection against eroding or dry winds, necessary cover with forest belts of a land is 2 - 3 % of concerned area

4.3 Bioenergy projects

Within this project following potential GIS bioenergy project have been identified:

- **Construction of small co-generation plants** smaller than 7 MW with substitution of fossil fuels and/or co-combustion. This application plays a strong role for the transformation of existing installations and re-technologization of old systems. Biomass for electricity and heating could be especially valuable for small towns and villages that don't have the infrastructure for district heating. Such applications may be developed where resources are available and there is an option for private sector investment. The entire available amount of woody biomass is currently used for inefficient heating of households. 89% of the heating and cooking (i.e. food preparation) in rural areas is ensured by woody biomass[16] .
- **District heating** About 30% of Romania's total building stock receives its heat and hot water from district heating systems, a figure that rises to 58% in urban areas. About 70 towns and cities have district heating networks[17]. The project activity would comprise a fuel switch to biomass in several district heating networks. This project type, however, has already been implemented in Romania under JI. Pros and cons of carrying out this project type under JI or GIS are discussed in chapter 5.
- **(Small) Industry:** Fossil fuels (i.e. oil) for local heating or temperature operating processes could be replaced.

First identification of suitable project locations

A next step towards a more concrete project potential would be to analyze the suitability of towns and their existing infrastructures for fuel switches or biomass plant installations as well as the distribution of wood resources and availability potentials. In mountainous regions biomass is generally available, while there is more potential land available for woody biomass crops in the plain. The forest capacity to supply biomass depends on tree species and stand age, accessibility, availability of labor, type of forest works and local collecting practice.

4.4 Mitigation potential of the bioenergy sector

The actual mitigation very much depends on the concrete projects being implemented. As presented above, there is a variety of possible project types in Romania's biomass sector, some of which are prioritized by the government. This study doesn't have the potential to go into the details of each project type. For this reason, as an example we base our calculations on the existing JI Sawdust 2000 project which rehabilitated existing district heating systems and switched their fuel supply to biomass[18]. Taking one example as a reference of course has limited validity. The calculations below therefore have to be seen as a rough estimate

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16 www.acad.ro/com2005/pv1031/Marginean.doc (Marginean Ioan, Condițiile de viață din mediul rural)

17 http://www.ecee.org/pubs/romania.htm

18 JI project with a crediting period of 14 years, primarily methane reduction project (removal of wood residues piles), about 20% CO_2 reduction from the fuel switch to sawdust and rehabilitation of the supply system. Heating only. Total mitigation of 715,000 tons CO_2eq for 5 project components (plants between 4 and 12 MW) in the period 2004-2017

and may in particular not be precise when other project types are considered. Nevertheless, the rehabilitation of existing power plants is one of the priorities for a GIS as formulated by the Romanian government. The total energy potential from biomass has already been calculated above. The calculation of the possible mitigation needs to include the efficiency of the currently used and the possible new plants. Table 3 shows figures for the systems under the Sawdust 2000 project.

Table 3: Estimated heat losses in existing and new District Heating systems under the Sawdust 2000 project (Grue & Hornstrup Consulting, 2002)

Heat Losses Existing District Heating Systems	Oil		Natural Gas		New biomass DH system	
	%	Net energy available after looses in the previous systems	%	Net energy available after looses in the previous systems	%	Net energy available after looses in the previous systems
Boiler Plant	20	0,80	15	0,85	15	0,85
Network	30	0,56	30	0,60	10	0,77
Piping under buildings (in basements)	7	0,52	7	0,56	5	0,73
Total heat losses	48		45		27	
Net Energy supplied	52		55		73	

Based on this data the potential net energy supply from wood residues and woody crops and the corresponding quantity of oil or gas with their CO_2 emissions can be calculated:

Table 4: Calculation of the annual CO_2 emission reduction potential through DH rehabilitation including fuel switch to biomass[19]

		Wood (fuel quantity in thousand tons DM)	Gas (fuel quantity in million Nm3)	Oil (fuel quantity in thousand tons)
Fuel quantity (per year)	Min	312	249	218
	Max	610	491	428
Gross energy supply (PJ/year)	Min	6.20	8.23	8.70
	Max	12.20	16.19	17.13
Useful energy (Net energy supplied) (PJ/year)	Min	4.53	4.53	4.53
	Max	8.91	8.91	8.91
CO_2 emission (Thousand tons/year)	Min	–	**461**	**644**
	Max	–	**907**	**1,267**

The annual CO_2 mitigation potential through fuel switch to wood residues and woody energy crops in DH systems can be estimated to be between about 460 and 900 thousand tons for natural gas and 644 or 1,267 thousand tons for oil.

[19] The calculations start with the useful energy which is set equal for all fuel types and represents the total energy potential from wood residues and woody biomass crops combined. The energetic value is estimated to be 33 GJ/1000 Nm3 for gas and 40 GJ/ton for Oil, the emission factor used is 56 tons CO2/TJ natural gas and 74 tons/TJ light oil distillate fuel (Grue & Hornstrup Consulting 2002: 38). The difference between the gross energy supply and the useful energy is based on Table 3.

The number shows that with the existing biomass potential only a small part of the available AAUs can be greened under a GIS in Romania.

It should be considered that the capacity of the currently operating oil and gas plants is in many cases not used to a degree which allows heating and hot water supply to be satisfying. This is mainly due to the lack of financial resources for purchasing fuel (Grue & Hornstrup Consulting, 2002). In consequence, an increase of living standard in the framework of a biomass project would aim at a net energy supply higher than the current net supply by oil or gas. For taking this into account, the recent fuel consumption baseline should be converted to a “would have been needed” quantity on which the emission reduction calculation will then be based.

4.5 Financial assessment of the proposed projects

An overview of the potential proceeds from GIS has been given under 1.2. This chapter gives an overview of the project and thus mitigation costs in the area of land-use and bioenergy.
It is generally in the interest of the buyers to have a high share of hard greening projects and a high amount of GHG reductions. We refer to a “1:1” greening ratio which would mitigate one ton of CO_2 for one AAU bought. Nevertheless, this should not be a strict criteria for GIS projects as particularly the projects which are not covered by other means may have quite high mitigation cost but come along with a couple of positive co-effects (see chapter 4.1). The greening ratio may also be improved through co-funding from other sources than the selling of AAUs.

Forest management on “cut-not-regenerated” land
In a GIS financing scheme we here consider only the plantation costs and propose to let the rest of the work for the achievement of plantations canopy closure (land and soil preparations, 2-3 years plantation maintenance) be covered by the land owners as a contribution in cooperation with the forest administration. In order to increase land owners responsibility and to avoid that the areas are abandoned after the plantation work it may also or alternatively be considered to let the owners contribute to the plantation work and/or seedling cost. This of course has to take into account the limited financial resources of the owners.

Project costs: afforestation of 1 ha will have costs of around 3000 € (including seedlings and plantation work), in total 30 million € for the 10,000 ha.

Mitigation cost: The plantations may have an average CO_2 removal of 9 tons CO_2/ha/year. Assuming a project period of 20 years (180 tons CO_2/ha), the mitigation cost would be at 3,000 €/180 tons CO_2 = 16.6 €/ton CO2. Given an estimated GIS income of 8-12 €/AAU, about 0.5-0.75 tons of removals could be offered for one AAU bought. This would however have to be verified for the specific projects.

Fast growing crops

Project costs: We assume a relatively short rotation period of 10 years. The first plantation should generate revenues sufficient for continuing the land use for short rotation crops regardless whether the management and the wood selling is done by the landowners or e.g. the forest administration. Therefore we base the calculation on the assumption that one plantation takes place. For poplar, the plantations price is at approximately 3000 euro/ha, for willow 4000€, a non-intensive management about 20€/ha which we assume here. An intensive management (fertilization, irrigation) would be much more costly.

Investment poplar non-intensive management:
3000 € + 20 € x 10 years = 3200 €/ha

Investment willow non-intensive management:
4000 € + 20 € x 10 years = 4200 €/ha

Mitigation cost: We estimate the mitigation to be at about 10 tons CO_2/ha/year within one rotation period. For taking into account the uncertainty of the real sequestration we use a failure rate of 20% which leads to a theoretic sequestration of 8 tons CO_2/ha/year. As the wood is regularly cut, half of the stock (80 tons for a "conservative" 10 years rotation period) is for a rough estimation considered as permanent. The sequestration from the woody biomass therefore is about 40 tons CO_2, independent from the project duration. Given the potentially different local conditions for each project (e.g. CO_2 stock on the land before the plantation, temperature, precipitation…) we here ignore the fact that CO_2 is also accumulated in the soil and dead organic matter (e.g. litter). The above calculated 3200 respectively 4200 €/ha divides through 40 tons result in a mitigation cost of 80 €/ton CO_2 for poplar and of 105 €/ton CO_2 for willow which is about six to 13 times the expected AAU price (8 to 12 €). This makes it very important to combine the GIS means with other funding possibilities or to combine the projects with other project types. We here propose the combination with biomass plant installations which would also serve as an integrated production-combustion approach.

As the land owners can expect an income from the plantations it would be possible to involve them more in the project financing than it is the case for forest management. Given the general lack of available financial resources on the side of the land owners, the possibility of loans or arrangements with the forest administration on the management and income from the wood should be assessed.

Bioenergy - Rehabilitation of district heating systems

As an example for a possible bioenergy project type we calculate the abatement cost for district heating rehabilitation and fuel switch projects based on the project Sawdust 2000.

Project cost: The total investment costs were at about 14 million € (Trusca 2007) for approx. 32 MW installed in total (for all the 5 plants). This means costs of about 437,500 € per installed MW.

Mitigation cost: The crediting period is 14 years, approximately 20 % of the total expected emission reductions (700,000 tons) are CO_2 reductions due to the fuel switch (Trusca, 2007). The rest are methane reductions through the removal of wood residues stock piles which can not be expected to occur within each project. This leads to a mitigation cost of about 100 € per ton CO_2 reduced. If projects similar to Sawdust 2000 are implemented including the use of wood residues from stock piles to the same amount, the mitigation cost could be reduced to one fifth – 20 € per ton CO_2 reduced.

Energy Production cost

The Sawdust 2000 experience showed that heat was produced at a much lower price (approx. 29 €/Gcal for the Gheorgheni plant) than through the majority of other thermal power plants (approx. 48-57 €/Gcal). Based on the regulated national reference price of approx. 30 €/Gcal at that time it appears that no national or local subsidies were needed for the biomass-produced heat (CEE Bankwatch Network 2007: 21).

It anyway has to be emphasized that the fuel for the “Sawdust 2000” plants is mostly received for free (wood waste). The price of heat production based on woody crops can be expected to be much higher. The question how this compares to oil or gas prices is not easy to answer: The biomass price depends on various factors which may differ to an important degree due to local conditions. This makes it difficult to calculate a reasonable average biomass price on which the energy price could be based on. These factors include especially the origin and the type of wood:

- Private or community land
- Wood residues or biomass plantations
- Distribution of the wood resources (distance to the plant)

Conclusions

Different project types significantly vary regarding their mitigation cost. Co-funding may decrease the investment needed from the AAU buyer for generating the same mitigation (improved greening ratio). Where the greening ratio highly varies between different project types, a combination (bundling) to a “project package” may lead to an average and more acceptable investment-mitigation relation from the buyer’s point of view.

4.6 Monitoring and verification

A much simpler monitoring approach than under JI may be adopted under GIS. For the proposed land-use projects no carbon stock assessment would have to be done in the field but an estimation of the sequestration in the project design will be followed by monitoring the presence of intact forest. The proposed land-use projects fall at least for the forest land under the inventories which are periodically done by the forest administration. For non-forest land, owners or the land/project administrator would have to establish the appropriate documentation.

5 Options for GIS to address existing barriers under JI

This chapter compares GIS to the two tracks of JI, Track 1 and Track 2. JI Track 1 and international emissions trading, on which also GIS is based, have the same eligibility criteria. Track 1 JI gives the host country significant freedom regarding Monitoring, Reporting and Verification (MRV) and the definition of additionality whereby it is in principle closer to GIS than JI Track 2. However, there is still a requirement for measurable and real emission reductions.

Whether a project may better be carried out under JI Track 1 or under GIS depends on the specific project type and the country. In Romania, the adopted Track 1 procedures are similar to Track 2, as this alignment of JI Track 1 with JI Track 2 was required by a number of buyers of the credits.

In the following, some differences of JI and GIS are discussed in more detail.

- A main barrier for JI projects in the EU member countries are the limitations posed by the Linking Directive. To avoid double counting with the EU-ETS, it has practically excluded from JI all energy and heat related activities affecting installations which fall under the EU ETS. There is currently no regulation to address double counting under GIS. If possible, however, double counting through direct investments in the ETS sectors should be avoided as this may distort the EU competition rules.

- In contrary to JI Track 2 there is no strict additionally criterion under GIS. However, neither is there a formulated additionality criterion in the case of JI Track 1. However, in order to guarantee the environmental integrity and to address concerns of buyer countries not to invest in projects that are clearly non-additional, this criterion should be a guiding factor in the choice of projects under a GIS.

- JI (and CDM) failed to address projects involving a large number of small entities. The high transaction cost and time consuming procedures under JI didn't stimulate small size projects. Theoretically, there is the possibility to bundle several similar small projects under JI/CDM. However, when a large number of small units are geographically dispersed, such as it may be the case with short-rotation plantations, a programmatic approach is more appropriate. While programmatic approaches can also be implemented under JI, it is unlikely that they will play a role in CEE countries, as JI is developed by the private sector which has little incentive to carry out complex project types if there is potential for more simple ones.

- AAUs may have some comparative advantages for buyers, including greater flexibility, lower project risk, and potentially lower transaction costs in the future. Advantages of the JI ERUs include greater private demand, hence higher prices, mainly because unlike AAUs—ERUs can be traded under the EU ETS.

Specific advantages for land-use projects under a GIS

There is only one LULUCF[20] JI project under implementation worldwide, the project called "Afforestation of degraded land in Romania" [21] , implemented by National Forest Administration and the World Bank Prototype Carbon Fund. LULUCF projects face significantly more hurdles than other project types under JI and the CDM. While under the CDM only afforestation and reforestation projects ("A/R projects") are permitted, under JI it depends on which additional activities the host country has selected under the Kyoto Protocol's Article 3.4 (Article 3.4 activities are forest management, cropland management, grazing land management and re-vegetation). ERUs can only be issued for those activities that a host has elected to account for. Romania for example has elected forest management. By contrary, under a GIS any land-use activity is eligible; therefore the full potential of this sector can be exhausted.

Other barriers specific to CDM/JI land-use projects are the need for large upfront investments and long crediting periods which lead to a delayed rate of return. Trees need several years to grow until they can generate a significant amount of credits. Also this barrier can be addressed under a GIS as AAUs can be sold now for emission reductions and removals being generated in the future. Under a GIS any crediting period can be implemented, while under JI a longer crediting period can only be implemented in the form of late crediting which is allowed by some of the JI countries.

Finally under GIS land-use projects much easier and cheaper monitoring requirements can be applied than under JI. Even though JI land-use projects do not necessarily follow approved AR methodologies for monitoring and estimation of net removals under the CDM, the need for full integrity of emission reduction of the project poses a serious burden on project implementers in terms of costly intensive monitoring systems, as well as validation and verification by independent entities. Under a GIS, forest indicators currently used by the forest administrators would be enough to assess the progress in activity performance.

[20] LULUCF (Land Use, Land-Use Change and Forestry (LULUCF)) is used in the context of the flexible mechanisms of the Kyoto protocol.

[21] http://wbcarbonfinance.org/Router.cfm?Page=PCF&ft=Projects

6 Conclusions

Romania can potentially sell around 100 million AAUs over the 2009 to 2012 period. The country could invest the revenues of the AAU sales into project types with high socioeconomic benefits, such as land-use and bioenergy projects. There is large potential for land-use projects, such as the regeneration of forests which have been cut in the nineties. Also using a GIS to subsidize biomass plantations could be very beneficial for the country, which has an increasing need and low availability of biomass resources. This activity may be linked to the construction of bioenergy plants. Simple institutional structures are required to implement a GIS in Romania. While JI failed in the area of land-use projects, a GIS could be a suitable framework to implement them. There are several significant barriers for JI land-use projects. These include the restriction of eligible project types. Further barriers specific to land use projects that can be removed under a GIS, include the need for large upfront investments and a delayed rate of return. The proposed bioenergy projects could be implemented in general in a very similar way also under JI. However, as Romania implements JI Track 1 similarly to the Track 2 procedures, the potentially higher degree of freedom under JI Track 1 regarding additionality as well as Monitoring, Reporting and Verification (MRV), cannot be used. Implementing the proposed projects under a GIS could simplify the procedures and thus lower the transaction costs. In addition, the combination of biomass production and –use within one program could help to build an efficient integrated system.

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Annexes

Annex I: Quantification of available woody biomass from forest residues for electricity production

The calculation of forest biomass available for energy production relies on the following assumptions:

- Wood cut quota is constant and systematic on annual basis;
- The analysis refers to wood volume cuts in two subsequent years, one showing a minimum (1997) and another one a maximium (1998) of annually harvested quota over the1990-2005 period. We consider that these particular annual quotas represent the real potential for Romanian forest, reflected in national statistics. As these quotas have been reported just before massive retrocession of the forest land to private owners, a quota harvested within this range is considered sustainable;
- Calculation of available biomass for electricity production is made upon official statistics in a conservative way. Annual available biomass amount is given on wood types (principal, secondary, sanitary), on counties and on species/group of species (resinous, beech, oaks, softwood, hardwood);
- The calculation takes into account the local practices on wood collection (i.e. gathering of residues for housekeeping) which is different on regions and forest types
- Biomass used for heating purposes is factored out, the actual calculation considers only the biomass which is not affected or does not affect the thermal purposes of wood in the country (actually all "energy" wood reported in Romanian statistics is used for heating), so we count what is out of any other use;
- Available biomass is computed based on "commercialised" wood volume, which means the wood volume sold to industrial sector, as this may generate forest residues. The wood sold to local population as standing trees (all part of trees are removed integrally from forest by the buyers) is factored out from the analysis as non-currently available (but potentially available in the future, once the living standard increases);
- The share of branches (%) and wood residues is computed as corresponding to 3rd production class, a medium productivity class for forests in Romania. Percentages of branches, crown tops, corks are available by species and published in "Biometria arborilor şi arboretelor din România", Ed. V. Giurgiu, Ceres, 1972 (Forest yield book in Romania);
- Wood density for transformation of these wood residues in biomass is considered minimal (as for juvenile wood, whatever the species, of 400 kg/m3);
- Computation of available biomass has been made taking into account the following principles: *availability* (no harvesting restriction and no conflict with other wood uses), *predictability* (certainty of availability for harvesting in a certain amount on annual

basis), *accessibility* (this biomass is related to the accessibility of wood for cutting), *acceptability* (corresponding to certain harvesting restrictions: like twigs are collected adherent to bigger branches, easier to harvest).

Quantification of principal cut's available biomass resources[22]

The total volume of the final cut is between 6.5 – 9.5 million m^3 per year. 4-5 % out of this total volume is left on the spot in the forest, as exploitation residues and it decomposes naturally. Based on questionnaires sent to exploitation companies within the country, it has been found out that 50 - 60 % of this residue is removed from forests (both harvested and collected by local people) in plain and hilly areas, while in mountains nothing is removed from the forest. Under these circumstances it is considered that this share may constitute a biomass resource that may be harvested for energetic purposes. This biomass is *available*, *predictable, accessible* and *acceptable.* The county distribution of this resource is shown in table 1.

Table 1: Distribution of principal cut's biomass, potentially available for energy production (min, max, tons DM /year)

County	Resinous	Beech	Oak	Hardwood	Softwood	Total
Alba	1352 -1840	1318 - 1413	32 - 46	18 – 50	6 - 8	2869 - 3215
Arad	26 - 46	1238 - 1374	839 - 866	376 – 485	104 - 166	2583 - 2938
Arges	392 - 491	1701 – 1806	283 - 319	42 – 131	16 - 31	2574 - 2638
Bacau	1846 - 2384	2390 - 2741	37 -122	66 -150	55 -109	4480 - 5421
Bihor	432 - 478	512 - 984	112 - 179	97 -155	41 - 48	1196 - 1839
Bistrita-Nasaud	2800 - 3886	856 - 1205	43 - 96	14 – 17	1 - 6	3766 - 5157
Botosani	0	250 - 301	54 - 58	62 – 95	44 - 50	420 - 494
Brasov	1054 - 1643	2368 - 3088	192 - 211	114 – 137	6 - 20	4360 - 4474
Braila	0	0	0	1 – 14	570 - 602	570 - 617
Buzau	514 - 758	981 - 1006	95 - 113	113 – 137	11 - 14	1758 -1984
Caras-severin	350 - 648	4611 - 6280	272 - 294	268 – 326	236 -288	5790 - 7785
Calarasi	0	0	8 - 10	152 – 163	366 - 444	527 - 617
Cluj	1173 - 1384	208 - 341	17 - 23	8 – 11	13 - 29	1435 - 1772
Constanta	0	0	0	8 – 38	374 - 450	383 - 488
Covasna	5093 - 11699	1770 - 1930	64 - 66	10 – 35	13 - 28	7148 - 13558
Dambovita	2 -14	274 - 312	330 - 336	104 – 113	36 - 90	768 - 840
Dolj	0	2 - 21	238 - 287	95 -112	535 - 479	881 - 886
Galati	0	0	1 - 3	248 – 358	208 - 257	456 - 616
Giurgiu	0	0	168 -176	11 – 94	149 - 215	400 - 410
Gorj	61 - 96	1114 - 1925	83 - 215	13 -107	1 - 30	1272 - 2372
Harghita	11704 - 13080	203 - 405	1 - 3	5 – 7	2 - 10	11917 - 13500
Hunedoara	698 - 603	2589 - 2880	30 - 46	107 -118	4 - 6	3439 - 3642
Ialomita	0	0	5 - 8	116 – 124	412 - 422	535 - 554
Iasi	14 -16	237 – 302	61 - 107	186 – 238	287 - 403	904 - 933
Ilfov	0	0	19 - 71	121 - 152	42 - 46	215 - 238
Maramures	1478 - 1971	2830 - 3581	65 - 90	101 - 132	8 - 11	4508 - 5760
Mehedinti	6 -18	1430 - 1450	175 - 354	229 - 362	187 - 269	2140 - 2340
Mures	3746 - 5651	582 -1082	36 - 70	48 - 74	10 - 23	4994 - 6327
Neamt	4419 - 4797	2182 - 2469	52 - 101	127 - 148	80 - 122	7330 - 7168

[22] Based on data provided by Romanian National Institute of Statistics

Olt	0	0	162 - 204	62 - 66	71 - 173	340 - 401
Prahova	571 - 934	891 - 1163	67 - 78	22 - 37	94 - 96	1935 - 2024
Satu mare	16 - 21	154 - 269	208 - 260	48 - 142	13 - 16	534 - 611
Salaj	2 - 11	216 - 286	36 - 54	30 - 44	10 - 14	327 - 377
Sibiu	587 - 606	998 -1253	355 - 421	86 - 202	6 - 12	2033 - 2494
Suceava	7805 - 8053	1520 - 1736	8 - 37	95 -106	40 - 48	9488 - 9966
Teleorman	0	0	58 - 84	130 -169	151 - 175	365 - 402
Timis	98 -112	714 - 714	414 -436	151 - 193	31 - 53	1471 - 1504
Tulcea	0	0	54 - 57	108 - 132	768 - 776	940 - 958
Vaslui	0	165 - 178	55 - 61	43 - 155	108 -194	458 - 502
Vilcea	563 - 600	1818 - 2315	210 - 224	131 - 139	66 - 76	2788 - 3354
Vrancea	552 - 821	1026 - 1234	26 - 42	36 - 43	20 - 28	1660 - 2167

Quantification of secondary cut's available biomass resources [23]

The total wood volume available of intermediary cut is between 1.3 – 1.6 million m^3 per year. Due to small dimension of trees (i.e. from thinning), the percent of wood volume left in the forest is 80-100 % for the biomass with dimension of less than 5 cm diameter. For the wood with diameter higher than 5 cm, 20 % in oak, beech, softwood and hardwood is left in the forest, and for resinous 100 %. Branches and tops (< 5 cm diameter) and so called "wood fire" (> 5 cm diameter) resulting from secondary products account as permanent, predictable, accessible and may be subject for systematic harvesting. The county distribution of this biomass resource is shown in table 2.

Table 2: Distribution of intermediary cut's biomass potentially available for electric energy production (min, max, tons DM /year)

County	Resinous	Beech	Oak	Hardwood	Softwood	Total
Alba	64 -152	402 -768	16 - 127	91 - 121	18 -27	741 -1044
Arad	10 - 20	908 - 1329	840 - 1156	1905 - 2601	480 - 835	4142 - 5941
Arges	62 - 82	1526 - 1975	158 -174	877 - 927	710 - 844	3420 - 3916
Bacau	636 - 856	1236 - 1891	8 - 111	464 - 978	551 - 941	2894 - 4777
Bihor	36 – 39	796 - 899	111 - 127	575 -937	107 -133	1666 -2089
Bistrita-Nasaud	474 - 572	393 - 599	0	50 - 141	53 - 151	971 - 1463
Botosani	0	0	0	0	0	0
Brasov	300 - 306	1198 -1582	16 - 55	1048 - 1502	728 - 737	3345 - 4128
Braila	0	0	0	0	71 -107	71 - 107
Buzau	294 - 376	1423 - 2284	135 - 206	867 - 1250	790 - 1066	4320 - 4370
Caras-severin	46 - 74	1142 - 1226	48 - 198	514 - 635	320 - 346	2069 - 2480
Calarasi	0	0	0	0	124 - 284	124 - 284
Cluj	82 -110	28 - 47	8 - 24	20 - 30	53 - 133	245 - 290
Constanta	0	0	0	0	1 - 18	1 - 18
Covasna	1532 - 1798	346 - 552	16 - 24	272 - 464	355 - 488	2522 - 3326
Dambovita	4 - 30	477 - 505	103 - 182	323 - 514	355 - 497	1480 - 1511
Dolj	0	0	127 - 214	1 - 10	98 - 151	234 - 365
Galati	0	0	44 - 48	121 - 292	453 - 844	621 - 1183
Giurgiu	0	0	87 - 111	60 - 81	2 - 53	168 - 225
Gorj	0	84 - 197	8 - 71	1 - 10	1 - 27	92 - 305
Harghita	2296 - 3192	206 - 1909	0	20 - 40	71 - 133	3489 - 4379

[23] Based on data provided by Romanian National Institute of Statistics

Hunedoara	100 - 120	590 - 1095	24 - 40	212 - 635	62 - 80	987 - 1970
Ialomita	1 - 4	1 - 524	1 - 95	1 - 1079	98 - 1607	98 - 3309
Iasi	1- 4	1 - 346	1 - 127	1 - 1008	1 - 1359	1 - 2844
Ilfov	0	0	16 - 79	60 - 131	160 - 213	236 - 423
Maramures	92 - 96	608 - 2303	1 - 16	232 - 595	44 - 62	983 - 3071
Mehedinti	1-4	365 - 374	1 - 79	131 - 212	329 - 417	827 - 1083
Mures	768 - 850	1198 - 1395	285 - 396	1310 - 1986	773 - 968	4416 - 5512
Neamt	1226 -1348	1338 -2069	48 - 79	1169 -1552	1678 -1749	5491 - 6766
Olt		0	1-198	0	1 - 9	1 - 207
Prahova	340 - 348	768 - 1685	103 - 277	363 - 605	488 - 799	2070 - 3714
Satu mare	0	12 - 94	32 - 95	20 -101	0	132 - 209
Salaj	46 - 90	374 - 384	8 - 55	282 - 413	231 - 266	998 -1152
Sibiu	216 - 168	468 - 814	71- 238	796 - 968	204 - 249	1756 - 2436
Suceava	3222 - 3652	2443 - 2518	16 - 24	413 - 544	222 - 240	6334 - 6960
Teleorman	0	0	87 - 111	10 - 91	1 - 18	139 -178
Timis	6 -18	431 - 1376	380 - 420	433 - 1008	258 - 373	1635 - 3067
Tulcea	0	0	1 - 8	101 - 151	586 - 1110	695 -1261
Vaslui	0	75 - 328	63 - 182	474 - 544	844 - 870	1601 - 1779
Vilcea	126 -154	393 - 927	40 - 87	272 - 564	169 - 346	1028 -2051
Vrancea	18 - 28	1095 - 1264	63 - 87	181 - 202	186 - 533	1544 - 2113

Theoretically the share of “wood fire” is around 20 % in resinous and 50 % in broadleaved. In practice, the tending operations that provide such wood are not executed, because of increasing costs and limited labour availability, as well as very limited commercialization.

Quantification of sanitary cut’s available biomass resources[24]

Total volume of sanitary cut[25] varies annually between 1.0 – 1.3 million m^3. This sanitary amount would be anyway extracted as intermediary/secondary wood products, so it may be accounted as available biomass. The county distribution of this resource is shown in table 3. These trees are affected by decline and dieback or insect attacks. The percent of wood volume left in the forest is 10 % for the biomass with dimension of less than 5 cm diameter (which accounts for between 11-19 % of whole tree volume, depending on species), and for the wood with diameter higher than 5 cm it is 20 % (which accounts for 50 % out of total tree volume). This biomass is fluctuating and predictable with high uncertainty.

Table 3: Distribution of sanitary cut’s biomass potentially available for electric energy production (min, max, tons DM /year)

County	Resinous	Beech	Oak	Hardwood	Softwood	Total
Alba	446 - 569	721 - 852	494 - 523	100 - 257	22 - 28	1940 - 2071
Arad	20 - 23	360 - 417	1767 - 2173	714 - 833	66 -116	3036 - 3456
Arges	159 - 164	1133 - 1390	1113 - 1849	505 - 519	193 - 293	3103 - 4214
Bacau	490 - 554	1170 - 1750	421 - 503	495 - 833	204 - 381	2781 - 4022
Bihor	80 - 87	744 - 847	489 - 760	419 - 690	44 - 99	1783 - 2480
Bistrita-Nasaud	315 - 392	618 - 983	165 - 198	29 - 43	11 - 44	1137 - 1660

[24] Based on data provided by Romanian National Institute of Statistics

[25] Sanitary cut – a cut which is made with the purpose to remove affected trees in the periods when no tending operation is scheduled by management plans. This operation is made when a significant number of tree in the stand have crown severely affected (> 50 %).

Botosani	2 - 11	140 - 145	436 - 624	650 - 662	182 - 193	1431 - 1626
Brasov	239 - 367	997 - 1053	397 - 402	205 -233	39 - 83	1949 - 2065
Braila	0	0	29 - 39	181 - 228	563 - 607	817 - 830
Buzau	145 - 151	328 - 482	281 - 402	381 -509	66 - 166	1206 - 1710
Caras-severin	51 - 77	449 - 683	223 - 334	157 - 200	77 - 99	983 - 1367
Calarasi	0	0	68 - 106	228 - 286	397 - 640	790 - 937
Cluj	212 - 289	66 - 88	213 - 252	57 - 62	44 - 83	624 - 751
Constanta	0	0	10 - 15	81 - 138	11 - 33	102 - 186
Covasna	188 - 192	168 - 356	92 - 126	152 - 214	121 - 144	748 - 1009
Dambovita	38 - 46	187 - 243	789 - 1404	338 - 576	226 - 469	1578 - 2738
Dolj	2 - 46	0	852 - 1641	857 - 1128	248 - 436	1959 - 3251
Galati	0	0	44 - 53	295 - 428	61 - 105	399 - 587
Giurgiu	0	0	271 - 508	500 - 438	99 - 210	870 - 1156
Gorj	78 - 82	903 - 1175	2304 - 2420	347 - 657	193 - 149	4139 - 4173
Harghita	1427 - 2271	505 - 679	73 - 97	67 - 119	66 - 77	2387 - 2993
Hunedoara	159 - 244	571 - 632	329 - 436	309 - 409	28 - 50	1396 - 1771
Ialomita	0	0	82 - 102	162 - 169	524 - 613	788 - 862
Iasi	2 - 5	47 - 51	97 - 106	152 - 238	61 - 132	371 - 520
Ilfov	0	0	600 - 615	395 - 443	132 - 166	1142 - 1208
Maramures	339 - 661	903 - 1746	174 - 329	76 - 90	17 - 61	1510 - 2887
Mehedinti	5 - 8	290 - 398	2052 - 2585	566 - 647	248 - 177	3245 - 3734
Mures	367 - 413	454 - 753	382 - 624	228 - 371	61 - 88	1539 - 2205
Neamt	635 - 776	1100 - 1399	106 - 165	233 - 357	170 - 179	2309 - 2815
Olt	0	0	881 - 750	219 - 228	127 - 199	1096 - 1308
Prahova	241 - 426	618 - 697	474 - 499	433 - 490	287 - 309	2155 - 2320
Satu mare	15 - 30	328 - 431	469 - 726	81 - 105	50 - 55	1075 - 1219
Salaj	16 - 20	140 - 211	416 - 687	157 - 214	50 - 182	780 - 1314
Sibiu	226 - 348	417 - 435	353 - 547	390 - 452	44 - 66	1614 - 1665
Suceava	2199 - 2550	1090 - 1348	110 - 116	471 - 814	199 - 254	4388 - 4769
Teleorman	0	0	402 - 557	233 - 376	61 - 155	696 - 1087
Timis	33 - 89	178 - 332	799 - 871	405 - 390	50 - 66	1464 - 1749
Tulcea	1 - 2	0	310 - 503	486 - 690	270 - 293	1066 - 1488
Vaslui	0	23 - 33	232 - 590	190 - 295	110 - 166	661 - 979
Vilcea	110 - 164	1062 - 1128	987 - 1810	419 - 457	155 - 204	2837 - 3659
Vrancea	397 - 443	992 - 1147	257 - 286	171 - 257	160 - 326	2206 - 2228

Quantification of total cut's available biomass resources on counties[26]

Cumulative, total available biomass, calculated by summing up the available biomass on types of cuts (table 4).

Table 4: Distribution of total biomass potentially available for electric energy production (min, max, tons DM/year)

County	Total biomass (to DM/year)	County	Total biomass (to DM/year)
Alba	5550 - 6330	Hunedoara	5822 - 7382
Arad	9761 - 12334	Ialomita	1494 - 4651
Arges	9161 - 10704	Iasi	1453 - 4119
Bacau	10155 - 14220	Ilfov	1593 - 1869
Bihor	4645 - 6409	Maramures	7000 - 11718
Bistrita-Nasaud	5874 - 8281	Mehedinti	6212 - 7157
Botosani	1851 - 2120	Mures	10949 - 14044
Brasov	9654 - 10667	Neamt	15474 - 16404
Braila	1494 - 1518	Olt	1648 - 1704
Buzau	7560 - 7787	Prahova	6413 - 7804
Caras-severin	8842 - 11632	Satu mare	1818 - 1962
Calarasi	1441 - 1838	Salaj	2155 - 2793
Cluj	2304 - 2812	Sibiu	5403 - 6595
Constanta	484 - 692	Suceava	20689 - 21217
Covasna	10418 - 17893	Teleorman	1236 - 1630
Dambovita	3826 - 5090	Timis	4603 - 6287
Dolj	3079 - 4497	Tulcea	2718 - 3689
Galati	1477 - 2386	Vaslui	2898 - 3082
Giurgiu	1440 - 1791	Vilcea	6652 - 9064
Gorj	5503 - 6850	Vrancea	5411 - 6509
Harghita	19289 - 19377	**Total**	**241452 - 288904**

Currently, total available biomass varies between 240 000 and 290 000 tons DM/year, at the country level. In fresh status (natural air dried, 40 % humidity) this biomass amount is almost double. Under the assumption that the "collection" by local people would not happen and wood residues would be integrally harvested, the total biomass would vary between 710 000 and 850 000 tons DM/year.

[26] Data provided by Romanian National Institute of Statistics

Annex II: Available funds for land-use improvement activities in Romania

Funding sources	Land Reclamation Fund (LRF)	Forest Conservation and Regeneration Fund (FRF, National Forest Administration)	Local authorities' budgets (LA)	EU Rural Development Fund (PNDR)	Environmental Fund	Private sector
Funding amount	100% for degraded land, 6-10 thousand ha per year	Up to 100% Same areas as for the LRF, dedicated to 1) reforestation after cut and 2) afforestation of lands under forest administration (and then recovered from land owners) or 3) afforestation of bought lands (under law with purpose of afforestation), 4) forest belts on state lands. GIS would help: a) increasing the area planted per year, b) allow to allocate money for other Romsilva activities (which the fund is dedicated to, like roads, chalets, investment) which have mitigation impact too, c) to increase the share of native species (oak, …)	Depending on the decision of the local council	50-75% for agriculturally productive lands	Up to 50% of eligible land recovery costs (site and soil preparation, seedlings, plantation, maintenance till canopy closure)	Depending on the specific agreement
Remarks	Funding includes new planting areas, as well as maintenance of previous plantations till canopy closure. Short rotation crops cannot be funded by LRF	Interest to finance poplar plantations (little willow) but lack of land Romsilva has the capacity to implement large projects	Public private partnership may be developed, with multiple financing, but the approach must be analyzed case by case		Special case as the Environmental Fund could serve as GIS Fund as well	Land owners and their associations or large farms/industry (i.e. paper sector) may be a target

Annex III: Yearly loss of carbon from soil organic matter and dead organic matter in "cut and not regenerated areas"

(based on a CO_2fix simulation, Robinia stands slash is not considered)

Year since the forest cut	**Loss of carbon (to C/ha/yr)**	**Comments**
1^{st}	4 - 14	Includes litter and dead organic matter (70 %)
2^{nd}	1 - 5	Includes remaining litter and dead organic matter (30 %)
3^{rd}	0,5 – 2	Include emissions from soils
4^{th} –5^{th}	< 0,5	
6^{th}	< 0,3	

Under business as usual circumstances (current approach: no tree regeneration, occasional root-sprouts are entirely grazed, collection of sprouts by owners), the loss of carbon in Robinia stands may reach 60 - 80 t C/ha on a period of 20 years, including 50 tons of C in tree biomass of a stand at the end of a 30 years rotation period which is equivalent to 220 – 290 tons of CO_2/ha. This gives a general reference of the impact of deforestation on the carbon stock. The forests concerned here may defer from this. Especially the original carbon stock in the wood varies according to the stand condition at the moment of the cut.

Annex IV: Existing policies relevant to biomass

This chapter should give a brief overview of key national documents (laws, acts, and ordinances) and international regulation (directives) transposed into national legislation relevant to biomass.

In the last years the EU legislation on energy was transposed into Romanian legislation. There are several normative acts that regulate the energy sector in Romania, which directly address the Directive 2001/77/EU. A number of additional normative acts refer to promotion of renewable energy which is not part of regulating bundle for energy.

The primary legislation referring to production of energy from renewables is:

- Law on Electric Energy regulates the activities related to electric energy in Romania. It considers that a major objective in the energetic sector is „promotion of use of new and renewable energy sources", where the technical conditions of its use and trade, applicable incentives and operation of the national energetic system are regulated.

- HG 443/2003 regulates the legal framework for promoting the program for an increased contribution of renewable resources to the country's energetic balance. It establishes the national target for the use of renewables, responsibilities for achieving the target, sets the guarantees regarding the origin of electric energy and access to power networks. A target of 30 % of electric energy in the total consumption in 2010 should be from renewables, while a target of 11 % of electric energy from renewables out of total electricity used.

- HG 1535/2003 approves the „Strategy for use of renewable energy resources" in Romania, which brings to life the relevant objective set in the Electric Energy Law. It makes a full inventory of the potential for renewable resources and establishes the strategic objectives, as well as the ways and means of promoting key specific resources.

- HG 1429/2004 approves the Rulebook for certification of origin for electric energy produced from renewables, necessary documents, eligibility criteria for guaranteeing the origin.

- HG 1892/2004 establishes the modality for the promotion of electric energy from renewables – systems of mandatory quota combined with green certificates system.

- HG 1395/2003 approves the Program of action for stimulation of production and consumption of electric energy from renewables.

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