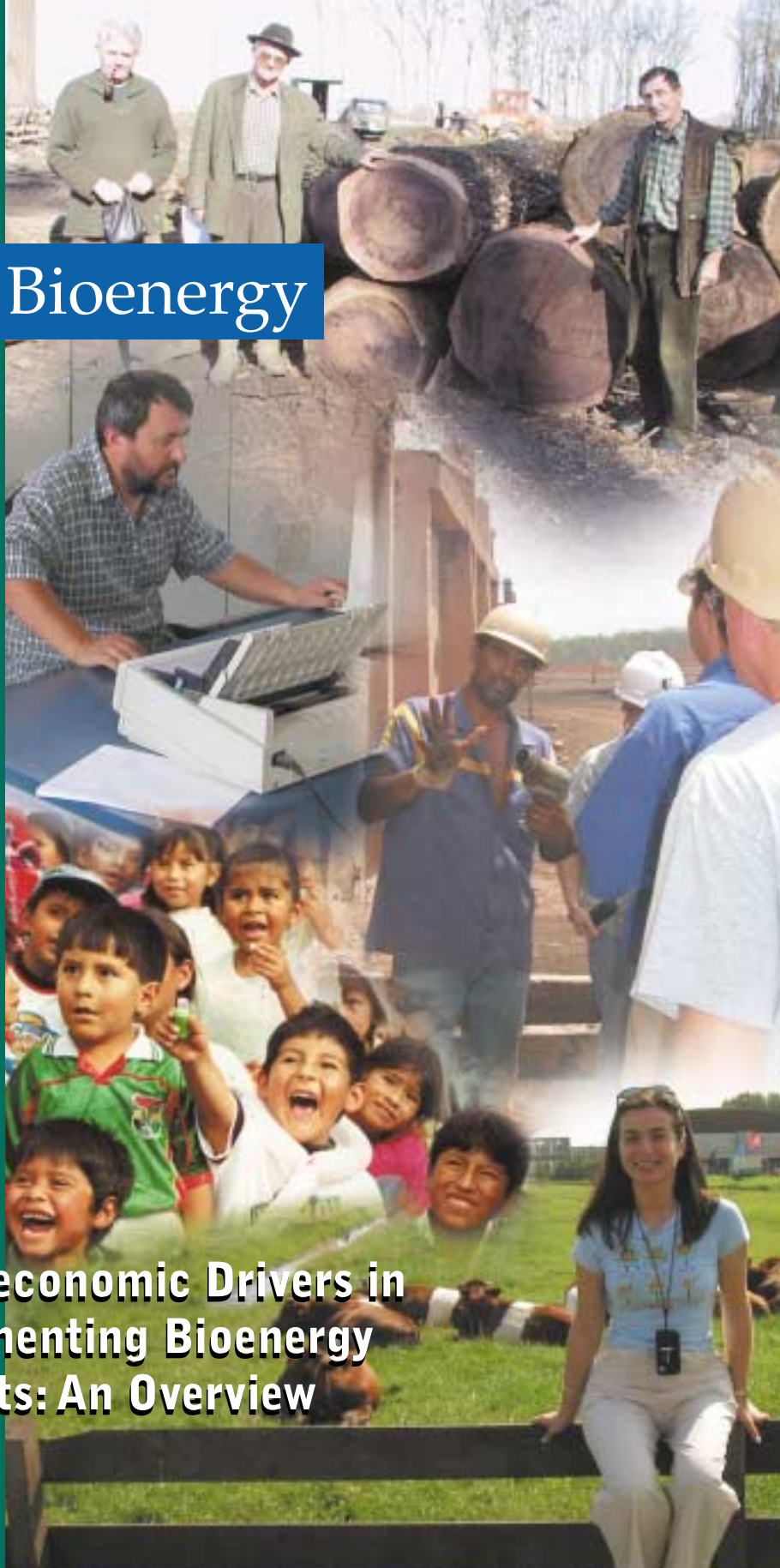
IEA Bioenergy



Socio-economic Drivers in Implementing Bioenergy Projects: An Overview

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Socio-economic Drivers in Implementing Bioenergy Projects

This overview describes some of the most important socio-economic issues concerning bioenergy systems as well as their linkage and overall impact on biomass utilisation. The article was prepared by Julije Domac and Keith Richards on behalf of the participants in Task 29 and draws on the work of the collaborating researchers in Austria, Canada, Croatia, Japan, Sweden and United Kingdom, as well as associated networks.

Introduction

Within the international community there is considerable interest in the socio-economic implications of moving society towards the more widespread use of renewable energy resources including bioenergy. Such change is seen to be very necessary but is often poorly communicated to the people and communities who need to accept it. Biomass can provide heat, electricity, transportation fuels and solid fuels, but it is frequently overshadowed by other, more glamorous 'space-age' renewable energy technologies. The environmental, economic and social benefits of bioenergy are often poorly recognised or appreciated. There are however, pockets of activity across the world exploring various approaches to understanding the multiplicity of relationships involved and several models have been developed and tested in order to examine the socio-economic aspects of bioenergy and other renewable energy projects. However, most of these models address the technical and economic aspects of projects without undertaking or seeking to analyse their social implications.

Re-emergence of the power of the local economy and local choice in the guise of a farmers' market - Gajnice, Croatia. (Courtesy J. Domac, Croatia)

Task 29 uniquely includes the exchange of results and information among the normally discrete research areas of social, economic, techno-engineering/engineering-economic and environmental issues. The Task also provides a platform for the integration of research in all of these areas (see Table 1).

Table 1: Socio-economic issues associated with biomass production and utilisation [1]

Dimension	Benefit
Social	Increased standard of living
	Environment
	Health
	Education
	Social cohesion and stability
	Migration effects (mitigating rural population)
	Regional development
	Rural diversification
Macro Level	Security of supply/risk diversification
	Regional growth
	Reduced regional trade balance
	Export potential
Supply Side	Increased productivity
	Enhanced competitiveness
	Labour and population mobility (induced effects)
	Improved infrastructure
Demand Side	Employment
	Income and wealth creation
	Induced investment
	Support of related industries
Institutional Aspects	Democratic decision processes
	Participatory problem solving
	Local problem solving

[1] *Source: Domac, J. and Richards, K. Final Results from IEA Bioenergy Task 29: Socio-economic Aspects of Bioenergy Systems, 12th European Conference on Biomass for Energy and Climate Protection, Amsterdam, 2002: 1200-1204.*

Key among the many separate aspects that need to be taken into account when analysing the socio-economic aspects of bioenergy systems are: stakeholder involvement, local income generation, public acceptance, local non-government organisation (NGO) involvement, long-term support (e.g. low interest loans), technology transfer, technology diffusion, distribution of benefits, fuel substitution aspects, policy perspective, education, capacity building, definition of collateral effects, market development in relation to timber and non-timber product markets (e.g. shift of income or changes in financial sources for sustainable development), institutional development, the nature and role of local and co-operative energy services companies (ESCOs) in propagating community actions, and other means relevant to securing long-term success, the minimisation of 'leakage' and maximising additionality of projects.

This plethora of related themes and issues confirms the importance of seeking an integrated approach when studying this topic. Typically, socio-economic implications

are measured in terms of economic indices, such as employment and monetary gains, but in effect the analysis relates to a number of other important aspects, which include social, cultural, institutional, and environmental issues. The problem lies in the fact that these latter elements are not always tractable to quantitative analysis and, therefore, have been excluded from the majority of impact assessments in the past, even though at the local level they may be very significant.

The Social Dimension of Bioenergy Systems

In many ways the social implications of local bioenergy investment represent the 'woolly' end of impact studies. Nevertheless they can be broken down into two categories: those relating to an increased standard of living or 'quality of life' and those that contribute to increased social cohesion and stability.

Social cohesion - partnership between rural and urban populations - is an important benefit which results from biomass utilisation. (Courtesy K. Richards, United Kingdom)

In economic terms the 'standard of living' refers to a household's consumption level, or its level of monetary income. However, other factors contribute to the 'standard of living' but have no immediate economic value. These include such factors as education, employment opportunities, the surrounding environment and healthcare, and accordingly, they should be given equal consideration.

Moreover, the introduction of a net employment and income-generating source, such as bioenergy production, can help to stem adverse social cohesion trends (e.g. high levels of unemployment, rural depopulation, etc). It is evident that rural areas in some countries are suffering from significant levels of outward migration, which mitigates against population stability (usually, it is the younger and artisan population that moves on resulting in aging communities). Consequently, given bioenergy's potential in rural locations, the deployment of bioenergy plants may have positive effects upon rural labour markets by, firstly, introducing direct employment and, secondly, by supporting related industries and the employment therein. For example, supporting the farming community, local/regional renewable energy technology providers, installers and service providers.

Finally, it is often possible to achieve significant and sustained development of local initiatives given genuine local involvement of key stakeholders. The emergence and cultivation of local champions is an essential area for study.

A landowner who heats the family home and farm buildings with a wood-fired system will probably harvest the fuel supply from the family's own woodlot using the family's own labour. There are no wages involved, only 'sweat equity'. (Courtesy R. Madlener, Austria)

Macro-economic and Supply Security/Diversity Effects

There are many examples of 'urban bioenergy' projects, such as this CHP plant in Enköping, Sweden. Local people are strong supporters and beneficiaries of such schemes. (Courtesy P. Westergård, Sweden)

Bioenergy contributes to many important elements of a country or region's development including: economic growth through business expansion (earnings) and employment; import substitution (direct and indirect economic effects on GDP and trade balance); and diversification and security of energy supply. Other benefits include support of traditional industries, rural diversification, rural depopulation mitigation and community empowerment.

The increased use of bioenergy, which exhibits both a broad geographical distribution and diversity of feedstock, could secure long-run access to energy supplies at relatively constant costs for the foreseeable future. An example of the need for this is the economic 'disruption' caused by fluctuations in the price of energy products in the European market. The tripling of the price of crude oil in 1999 and its effect on the price of natural gas had a significant impact on the energy bill and economies of the European countries. This increase in the price of crude oil led to a net transfer from the European Union of an extra 22.7 billion euro between January and May 2000. This effect combined with the fall of the euro has increased the inflation rate by 1%. Economic growth is feeling the effect but growth in GDP remains around 3%. The current situation is leading to a drop in growth rate: 0.3% in 2000 and 0.5% in 2001 and loss of confidence among market operators and consumers. Current events also show that increases in fuel prices can cause serious social disruption. The strike in autumn 2000 by those particularly affected by the rise in oil prices, notably truck drivers, is an example of just how seriously this can manifest itself.

Delivery of pellets to a villa in Växjö, Sweden. (Courtesy P. Westergård, Sweden)

In addition, the use of indigenous resources implies that much of the expenditure on energy provision is not only retained locally but it is also re-circulated within the local/regional economy.

Supply Side Effects

Supply side effects are rather subjective in regional impact studies, as they are commonly deemed to be those impacts which are the result of improvements in the competitive position of the region, including its attractiveness to inward investment. These effects are likely to differ in kind and will depend upon the development, but generally such 'economies of speculation' relate to changes and improvements in regional productivity and enhanced competitiveness, as well as any investment in resources to accommodate inward migration that may result from the development.

More than 500 people are producing fuelwood stoves made from soapstone in a factory located in Eastern Finland. This unique stove follows and supports a constant growth of biomass use in Finland but also in many countries around the world where they export their products under the motto: 'The Forms of Warmth!' (Courtesy J. Domac, Croatia)

Taken together, these effects may result in the establishment of complementary economic activity, where related and often local industries mushroom in response to increases in local demand. Accordingly, supply side effects have a much broader scope, and are much more speculative. Despite this caveat, some projects have been justified purely on the grounds that they may have significant long-term supply side effects, even if they are difficult to quantify with any confidence prior to the development.

Demand Side Effects

Demand side effects constitute the focal point of the majority of socio-economic impact studies, and are concentrated upon for several reasons. Most notably, they are relatively easy to define and the scale of the investment's impact can be quantified with reasonable accuracy. Moreover, it is the economic impact that is most important to regional developers and decision makers.

Demand side effects are primarily quoted in terms of employment and regional income. They can be categorised accordingly into:

- direct effects
- indirect effects
- induced effects
- displacement effects

The derivation of the above should form the basis of socio-economic analyses. However, the extent to which these effects can be totally captured at a local level will depend on the quality of the information available.

Considerable effort should be made to determine the extent and direction of capital flows both within the region under analysis and, more importantly, out of the region. If this 'leakage' element is ignored, predictions about future employment and income gains will be spurious. Furthermore, consideration should be given to the duration of the impacts, and only then can a tentative evaluation of the wider effects pertaining to some, or all, of the other factors be attempted.

Bioenergy and its Employment-creation Function

Bioenergy has provided millions of households with livelihoods (including employment and income). The essence of sustainability of bioenergy projects from a social aspect is how they are perceived by society, and how different societies benefit from this activity. Avoiding carbon emissions whilst providing environmental protection and security of energy supply on a national level are all added bonuses for local communities, but the driving forces are much more likely to be employment or job creation, contribution to the regional economy and income improvement. Such benefits will result in increased social cohesion and stability that stem from the introduction of a local employment and income-generating source. Among other renewables, bioenergy is the most labour-intensive technology and has the highest and most diverse employment-creation potential. Jobs created range from extensions to existing agricultural and forestry activities through to specialised engineering and electronic functions.

Many farmers would welcome the opportunity to sell residues or purpose-grown wood to long-term, steady consumers. Producing biomass provides a new source of revenue and helps farmers to diversify. This reduces their vulnerability to crop failures or declining crop prices, especially if the biomass is derived from tree crops – a secure standing asset that can be harvested on demand. Tree planting has additional rewards in terms of improved agricultural productivity and environmental benefits. Sometimes, participants in the forestry and bioenergy sectors learn new skills they can transfer to other profitable projects.

Briquette production in Belisce, Croatia. Many new jobs are being created in rural and city areas to service the growing interest in bioenergy. (Courtesy EIHP, Croatia)

What can bioenergy offer in terms of employment generation? In Europe, policymakers recognise that there are added economic benefits from renewables such as bioenergy, especially in terms of the potential for employment creation and the development of a

Using local sources of biofuel can provide security of energy supply in times of uncertainty, improve the national trade balance and provide new job opportunities. Ethanol production contributes some 700,000 jobs in Brazil. (Courtesy J. Domac, Croatia)

strong export industry. The renewable energy industry is one of Europe's fastest growing sectors. In this region, countries encourage the deployment of renewables as an alternative, indigenous energy source with low environmental impacts.

From the perspective of bioenergy projects, what does the term employment mean? Direct employment results from operation, construction and production. In the case of bioenergy systems, this refers to the total labour necessary for crop production, construction, operation and maintenance of conversion plants, and for the transportation of biomass. Indirect employment is jobs generated within the economy as a result of expenditures related to biomass fuel cycles. Indirect employment results from all activities connected, but not directly related, such as supporting industries, services and similar. The higher purchasing power, due to increased earnings from direct and indirect jobs may also create opportunities for new secondary jobs, which may attract people to stay or even to move in. These latter effects are referred to as induced employment. The main issue is whether the bioenergy project will provide earnings that are high enough for long enough to make it worthwhile to mobilise local resources for implementation.

This CHP plant uses waste material from forestry to produce heating and electricity for the city of Växjö. (Courtesy VEAB, Sweden)

Table 2 (see facing page) provides estimates of bioenergy sector employment in various developing countries. The figures are approximations of employment in production and distribution of bioenergy resources. Hektor[7] and Remedio[6] have provided more detailed accounts of job creation, earnings and employment in bioenergy projects (see Tables 3 and 4). Three types of systems are demonstrated: intensive production in marginal lands; woodfuel production with intensive inter-cropping; and large-scale woodfuel production on previously forested lands. Total employment per unit of energy in person-years was derived for the activities of establishment, weeding, harvesting, chipping and administration. The information is a collation of results from studies done in several Latin American and Southeast Asian countries with particular reference to the Thailand Master Plan for Dendro Thermal Power Programme.

Table 2: Estimated employment figures for developing countries from various source documents

Country	Estimated employment in person years	Description and nature of employment	Source
Pakistan	600,000	Wholesalers and retailers in the wood fuel trade. Many are involved in production, conversion, and transportation. About three-quarters are full time, the rest part time. The ratio of traders to gatherers is 1:5	FAO-RWEDP 1998 [2]
India	3 to 4 million	The wood fuel trade is the largest source of employment in the energy sector	FAO-RWEDP 1998 [2]
Philippines	700,000 households (production) 140,000 households (trade)	Biomass energy production and trade	UNDP/WB ESMAP 1992 [3]
Brazil	800,000 200,000	Ethanol industry Charcoal industry	Hall, D. and Calle, F.R. 1998 [4]
Kenya and Cameroon	30,000	Charcoal production only	UNDP 1996 [5]
Ivory Coast	90,000	Charcoal production only	UNDP 1996 [5]

[2] Source: Anon. Images of wood and biomass energy in industries in Thailand. Regional Wood Energy Development Programme in Asia GCP/RAS/154/NET. FAO-RWEDP 1998. Field Document No. 52.
[3] Source: Anon. Philippines: Defining an Energy Strategy for the Household Sector. Results of a Joint Study by ESMAP and the Philippines Office of Energy Affairs. UNDP/WB ESMAP 1992. Vol I: Main Report.
[4] Source: Hall, D. and Calle, F.R. A New strategy for the FAO wood energy programme: The way ahead after Kyoto. 1998 Unpublished report to the Forest Products Division-Wood Energy, Food and Agriculture Organisation of the United Nations, Rome, Italy.
[5] Source: Anon. Sustainable Energy Strategies: Materials for Decision-Makers. UNDP Initiative for Sustainable Energy. United Nations Development Programme. New York. UNDP 1996.

Wood Fuel collection in central Brazil. (Courtesy J. Domac, Croatia)

Table 3: Bioenergy employment from selected studies [6]

Person years/PJ	Intensive production, farmers	Intensive inter-cropping	Large scale "energy forestry"
Establishment	112	71	34
Weeding	338	196	59
Harvesting	248	251	85
Transport	70	71	51
Chipping	13	13	13
Administration	19	19	11
Total	799	620	252

[6] Source: Remedio, E. Socio-economic aspects of bioenergy: A focus on employment. 2000 Unpublished report to the Forest Products Division - Wood Energy, Food and Agriculture Organisation of the United Nations, Rome, Italy.

Table 4: Bioenergy earnings from selected studies [6]

Earnings $ per PJ	Intensive production, farmers	Intensive inter-cropping	Large scale "energy forestry"
Establishment	82,305	54,870	17,147
Weeding	205,761	126,886	27,435
Harvesting	257,202	257,202	37,723
Transport	68,587	68,587	20,576
Chipping	13,717	13,717	13,717
Administration	68,587	68,587	34,294
Total	696,159	589,849	150,892

[6] Source: Remedio, E. Socio-economic aspects of bioenergy: A focus on employment. 2000 Unpublished report to the Forest Products Division - Wood Energy, Food and Agriculture Organisation of the United Nations, Rome, Italy.

Another analysis is shown in Table 5 (see facing page), which considers multiplier effects (indirect and induced). In previous examples, employment and earnings are held constant. In the real world, woodfuel production effectively catalyses other activities (indirect/induced) and this further translates into more earnings and more opportunities.

(Courtesy J. Domac, Croatia)

Table 5: Employment and earnings per PJ annual fuel consumption among selected European projects [7]

Biomass source/ technology	MWth	Direct jobs	Indirect jobs	Induced jobs	Total jobs	Labour earnings euro (000)	Other earnings euro (000)	Multiplier	Country
SRC, gasifier	2	51	11	36	98	1,116	1,114	1.25	UK
Miscanthus, heat	0.13	321	0	214	534	7,054	4,142	1.21	Belgium
Forest residues, CHP	40	52	33	30	115	1,566	227	1.30	France
Triticale, proc. Heat	2	134	60	28	222	3,858	-473	1.33	Germany
Artichoke, heat	1	269	19	93	380	1,745	-478	1.50	Greece
SRC, gasifier	5	36	21	23	80	1,010	400	1.29	Ireland
Ind. Residues, CHP	17	41	11	13	65	974	-263	1.46	Italy
Waste etc. CHP	5	13	2	27	42	240	2,450	1.18	Netherlands
Logging Residues, heat	10	52	2	21	76	724	1,028	1.26	Sweden

[7] Source: Hector, B. Forest fuels - rural employment and earnings. Department of Forest Management and Products, SLU, SE-750 07, Sweden, 2000.

'Would an investment in renewables lead to more jobs and economic growth?' was the question that challenged the study carried out in 1998-99 to evaluate and quantify the employment and economic benefits of renewable energy in the European Union (EU). The study funded by the European Commission through the ALTENER Programme was initiated by the European Forum for Renewable Energy Sources (EUFORES) and carried out by a consortium of organisations led by ECOTEC Research and Consulting Ltd. The study provided a complete analysis of employment impacts from renewable energy (including bioenergy) taking into account jobs created both directly and indirectly as more renewable plants are manufactured, installed and operated. It also considered jobs displaced in conventional (fossil or nuclear) energy plants, or jobs lost because of subsidies provided to renewables that could otherwise fund employment in other sectors of the economy. Highlights derived from the conclusions were that the use of renewable energy technologies will more than double by 2020 and will lead to the creation of about 900,000 jobs by 2020. Approximately 500,000 of these jobs will be in the agricultural industry in order to provide primary biomass fuels (see Table 6 over page).

Small is beautiful. Modern biomass fuelled district heating plant in Austria – a new image for an 'old-fashioned' fuel. (Courtesy H. Scheuer, Austria)

Table 6: Impact of renewable technologies on employment in the European Union (new net jobs FTE employment relative to base in 1995) [8]

Technology	2005	2010	2020
Solar thermal heat	4590	7390	14, 311
PV	479	-1769	10,231
Solar thermal electric	593	649	621
Wind onshore	8690	20,822	35,211
Wind offshore	530	-7968	-6584
Small hydro	-11,391	-995	7977
Bioenergy	449,928	642,683	838,780
TOTAL	453,418	660,812	900,546

[8] Source: ECOTEC Research and Consulting Ltd. The impact of renewables on employment and economic growth. Directorate General for Energy, European Commission, 1999. Available on the Internet: www.eufores.org/Employment.htm

Conclusions and Further Information

In developing countries bioenergy is a source of fuel for people surviving at the subsistence level. It is also a source of income of particular importance during the off-harvest season. Many of the practices currently used by these countries are, however, unsustainable due to a variety of factors. It is sometimes suggested that modernising traditional bioenergy may turn it into a more sustainable venture. This hypothesis needs further investigation. Certainly the potential for generating employment opportunities in modern bioenergy applications among developing countries is worth serious study. It is vital to understand the implications and impacts of these claims from the socio-economic point of

Charcoal production contributes some 200,000-300,000 jobs in Brazil. (Courtesy J. Domac. Croatia)

view as they touch on fundamental aspects of the ways in which people live. The issues include gender, health, environment, poverty and rural development.

Deployment of bioenergy brings major benefits in terms of job creation, energy security and greenhouse gas mitigation. (Courtesy VTT Process, Finland)

In developed countries, particularly in the EU, bioenergy (together with the other renewable energy technologies) is being promoted due to its potential contribution to energy security and environmental benefits (both local and global). Moreover, there is the realisation that deployment of bioenergy has the potential for job creation, improved industrial competitiveness, regional development and the development of a strong export industry. Experiences gained among EU member countries relating to employment generation in particular should be disseminated not only within the energy community but also to a much larger audience in terms of lessons learned, techniques derived, and case study experiences.

The 1990s have seen a substantial diffusion of many renewable energy technologies, often showing two-digit growth rates. In most cases, however, this growth is not sustained. Apart from a lack of cost competitiveness, for which policymakers try to compensate by means of subsidies or quota targets, there are numerous socio-economic and institutional barriers that need to be identified and tackled. In addition, there are a number of external net benefits that are not accounted for in the decision-making process.

Education, education, and more education - a unique answer to many barriers associated with biomass understanding and utilisation. Chinese experts on a study tour in Styria, Austria. (Courtesy H. Scheuer, Austria)

Task 29 has produced a comprehensive brochure in Frequently Asked Question (FAQ) format. This is intended for non-technical audiences. For more technically oriented individuals, focused experts and scientists, there are a number of reports from participating

countries, overviews of the existing tools for socio-economic modelling, reports setting out the possibilities for using management/business type approaches, minutes of Task meetings, proceedings of workshops and a large selection of papers presented during the last triennium at international workshops, conferences and seminars. These can be accessed at www.iea-bioenergy-task29.hr

Biodiesel production site in Mureck, Austria. Apart from rape seed, waste oil from restaurants is also used as a raw material. Collection is co-ordinated by a local company and school children actively participate which is highly educational. (Courtesy H. Scheuer, Austria)

Task 29 has made a good start in giving detailed consideration to the value of bioenergy when viewed in the broader context of society, environment and the economy. The boundaries of the Task have been deliberately wide in order to be as inclusive as possible without becoming unmanageable. The first working period for Task 29 finished at the end of 2002, but the Executive Committee of IEA Bioenergy has decided to prolong the Task to 31 December 2005. Country participation for this period has increased to include Ireland and Norway. Co-operation with the FAO and other international institutions, networks and projects is being developed as a major theme of future work.

For further information, readers should visit www.iea-bioenergy-task29.hr or contact the Task Leader, Julije Domac, jdomac@eihp.hr or the Associate Task Leader, Keith Richards, keith.richards@tvenergy.org.

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