International Institute for Environment and Development

ecosystem services for poverty alleviation

Biomass energy – optimising its contribution to poverty reduction and ecosystem services

Report of an international workshop

Parliament House Hotel, Edinburgh

19-21 October 2010

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Executive summary

The percentage of biomass energy within the total share of different energy sources is set to treble from 10% to 30% by 2050 according to the International Energy Agency – with major potential impacts (both positive and negative) for poverty reduction and the protection of ecosystem services. An international consortium drawn from the India, Kenya, Malawi and the UK met to design a research proposal that would deliver both excellent multi-disciplinary science and actually make a real positive impact in reducing poverty and conserving ecosystem services relating to biomass energy.

The workshop was structured in three sections. The first day was devoted to information sharing from each of the consortium members – drawing on five background reports for the workshop that had been prepared by Chancellor College - Malawi, IIED - UK, Practical Action-Kenya, Rothamstead Research – UK and TERI – India. The second day involved a detailed analysis of the underlying causes of the suboptimal use of biomass energy for poverty reduction and ecosystem services – and the development of a theory of change for India and African contexts to address those underlying causes. The third day was devoted to planning the impact pathway in order to ensure that desired changes actually occurred within the timeframe of the project (and within a longer 30 year time horizon). Concluding sessions focused in on the main elements of, and institutional responsibilities for, the research project framework.

The outcome of the workshop was a strong consensus about the need to address four interrelated problems: poor biomass resource governance; resulting loss of the biomass energy resource itself, unequal distribution of benefits from existing biomass energy business value chains; and finally, inefficient biomass energy conversion and consumption.

Four research objectives and detailed work packages were discussed to address these inter-related problems: (i) Integrated biomass energy policies in India, Malawi and Kenya; (ii) Spread of more efficient and sustainable production methods of biomass energy by the poor; (iii) Pro-poor formalization of biomass energy business/delivery models; (iv) More efficient / less emitting consumption of biomass energy through the widespread adoption of appropriate technologies. The details of the subsequent proposal will be developed in an iterative and participatory manner by the consortium partners in dialogue with key target audiences.

Objective

To share information on global overviews and biomass energy use in India, Kenya and Malawi, identify research activities to improve its impact on ecosystem services and poverty, design a conceptual framework for that research with appropriate criteria and indicators of success, develop an impact plan, agree a monitoring and evaluation process, assign institutional responsibilities and agree plans to present a full proposal to ESPA.

Background

Biomass energy makes up 77% of the world primary renewable energy mix – or 10% of the total world energy mix (3% in OECD and 22% in non-OECD countries). As a major and increasing component of land use, biomass energy systems therefore have significant impacts on both ecosystem services and poverty. In the North, emerging opportunities for energy security through biomass are being developed fast. In the South, biomass energy is often viewed as 'inefficient and non-commercial', 'a health hazard', 'a cause of deforestation' or 'a poverty trap', often legislated to be 'illegal' as a result.

Yet for many Southern countries forestry is primarily an energy business in volume and value terms, not a timber business and at a domestic level it dominates energy supply (>80% in most non-OECD countries). While a substantial proportion of biomass energy is burnt directly for domestic heat and cooking, especially in the South, there are also various conversion routes towards other forms of energy such as transferable heat, electricity, liquid biofuels or gases, developed primarily in the North. As a result of these advances in conversion technology, many of which are in commercial or near commercial stage of development, the International Energy Agencies latest predictions suggest that biomass energy is likely to make up one third of the total world energy mix by 2050. Much of this will be 'efficient', 'clean', 'sustainable and near carbon-neutral' comprising ' decent green jobs'.

Clearly it is how the transition toward biomass energy takes place that will be decisive for its impacts (e.g. on health through the Products of Incomplete Combustion, poverty reduction, climate change mitigation, biodiversity conservation, watersheds and water availability etc). In order for increasing biomass energy use to have positive impacts on poverty reduction and ecosystem services, innovative interdisciplinary research is needed to map out transition pathways that optimize these impacts.

This project aims to develop, through its six objectives, a South-South-North partnership and project to reshape the impact of a predicted large-scale expansion in global biomass energy use towards greater poverty reduction and maintenance of ecosystem services in developing countries. The consortium of partners represents leading biomass energy researchers from multiple disciplines. Together, a conceptual framework on biomass energy will be designed with clear indicators for 'reshaping' impacts on poverty reduction and ecosystem services. For example, in assessing the impact of future biomass energy use we will explore multi-disciplinary indicators and supply and demand factors: resource carrying capacities, demand by most needy for energy, security in access and supply, impact on food security, impact on land and resource rights, decency of work in its provision, broader social contributions, impact on ecosystem services (carbon, biodiversity and resilience, watersheds, landscape beauty) and enhancement of cultural identity. At this planning meeting from 19-21 October 2010, this framework and evidence of technological and economic projections for biomass energy will be discussed.

Leaderships teams will form to develop research plans, analysis tools and procedures both for assessing biomass energy developments themselves, and for conducting poverty impact assessments and evaluations of carbon, biodiversity and watershed ecosystem sustainability. Visiting researchers (from India, Kenya and Malawi) will help design appropriate research, communication and impact strategies for their different contexts. Innovative business and value chain models will be analysed to test the impact of different options for transition towards increasing biomass use. Policy analyses will be formulated so that research findings can be targeted towards changing particular policies and institutional practices.

Restatement of the aims of this ESPA Biomass energy consortium

This ESPA Partnership and Project Development action targets ESPA's forest theme, where the expected outcome is "enhanced contribution of forest ecosystem services to poor people's livelihoods and sustainable growth processes in the context of environmental and climate change". The overarching objective of this proposal is to develop a world class interdisciplinary South-South-North research partnership and strategy that reshapes the impact of a predicted large-scale expansion in global biomass energy use towards greater poverty reduction and maintenance of ecosystem services in developing countries. The action has a number of subsidiary objectives which in order of priority are as follows:

(i) develop a relevant conceptual framework - by organizing a South-South-North participatory planning meeting to refine a conceptual framework with clear evidence of demand, indicators of success and monitoring, reporting and verification processes. A participatory process in Southern partner countries prior to a three day planning meeting will refine the legitimacy of objectives and indicators of success along with research inputs.;

(ii) establish sound technological and economic projections as a baseline for promoting impact - by gathering evidence on the technological and economic projections for biomass energy in order to identify where impacts on poverty and ecosystem services are likely to be greatest (both positive and negative). For example, we will collate agro-ecological and socio-economic data from India, Kenya and Malawi looking at both domestic biomass energy options for cooking, heat and even electricity generation and industrial opportunities for gaseous, liquid fuels and electricity generation;

(iii) develop research plans, analysis tools and procedures - by identifying and drawing together leadership teams that will explore together how to quantify and assess possible transitions towards greater biomass energy use - and how to use results to optimize impacts on poverty and ecosystem services. This will be done in India, Kenya and Malawi, chosen on account of current energy-forest pressure, experience of approaches to address this, and the desire for geographical spread to improve relevance of findings. A sufficient range of disciplinary expertise will join in specific partnerships to model biomass crop dynamics and assess different impact categories such as: multi-faceted poverty, carbon sequestration, biodiversity and ecosystem resilience, watershed dynamics and flows, landscape beauty;

(iv) identify in partner countries specific political change agents, communications strategies and impact plans – by working with visiting researchers from India, Kenya and Malawi to understand not only the scale of biomass use, but also the social and political economy of decision making in particular contexts and the pathways by which a transition towards biomass energy provision could occur that contributes most to poverty reduction and ecosystem services;

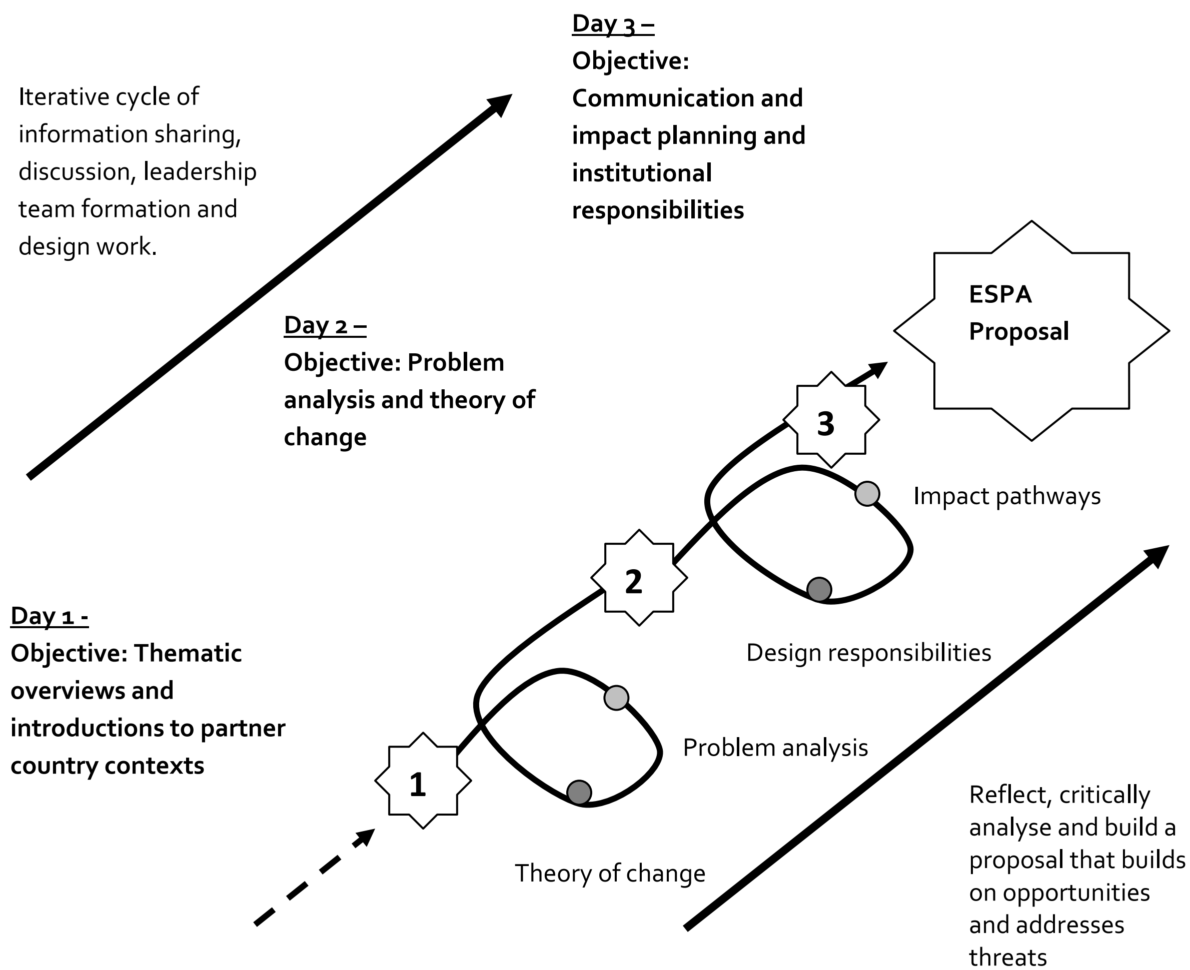
(v) evaluate innovative business and value chain models to test transition options towards increase biomass energy use - by collecting data, employing analytical tools and developing conceptual optimization models to evaluate in India, Kenya and Malawi the structures that govern, or might govern, woody biomass energy. We will consider quantitative models for bioenegy crops to improve yields and reduce food competition, community dynamics in biomass production, best-bet business models and a range of policy incentives.

(vi) develop a full ESPA proposal with a strategy to fill knowledge and capacity gaps - by working together in an equitable South-South-North partnership that involves appropriate mentorship, training and other strategies to build capacity-through-involvement. The ultimate end-point will be clear policy recommendations about which transition pathways should be pursued in search of poverty reduction and conserved ecosystem services.

Provisional agenda for the meeting

The overall structure of this meeting will involve an iterative approach to developing a full ESPA proposal (see Figure 1)

Figure 1 – Process summary



Day 1: Tuesday 19 October 2010

9.00 Duncan Macqueen (IIED)

Introductions to each other and the consortium

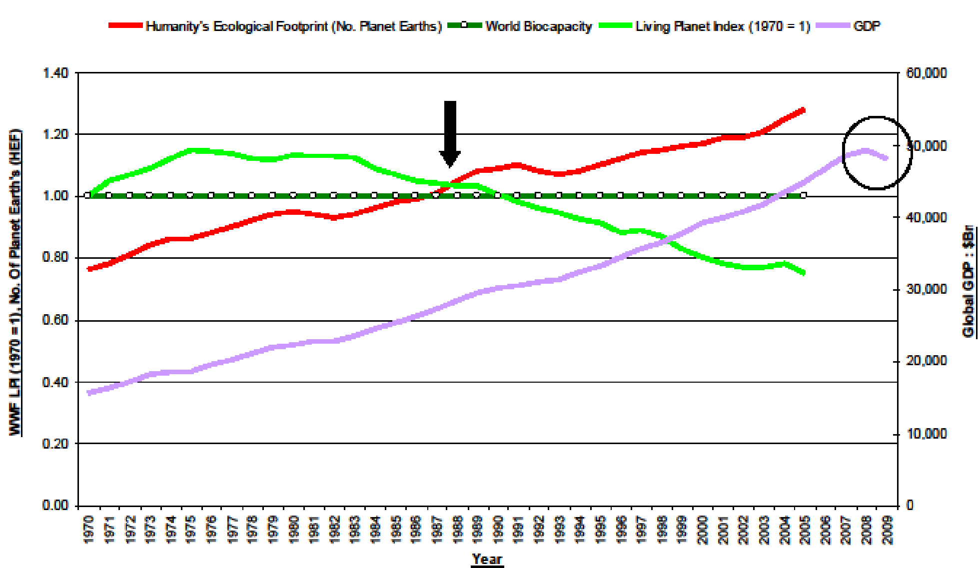
Each of the consortium members introduced themselves. The main methodology for the first day was discussed. Each of the following presentations lasted 20 minutes – followed by a panel discussion. Three different members from the consortium were asked to form a panel to review each different presentation, changing each time, focusing on three areas (i) facts that deserve emphasis in a full ESPA proposal (ii) emphases / approaches / research methodologies that deserve inclusion in a full ESPA proposal and (iii) Gaps in knowledge / expertise that a full ESPA proposal needs to address.

9.30 Duncan Macqueen (IIED)

Global overview of biomass energy, environment and development

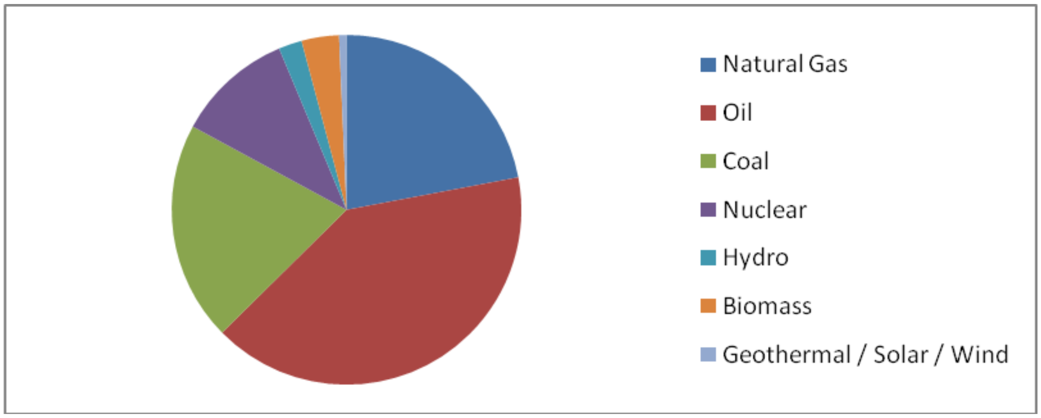
This presentation focused on (i) a snap shot of the global scale and trends of biomass energy use, (ii) an assessment of the advantages of biomass energy use for environment and development; (iii) an overview of renewable energy technologies and programmes for development; (iv) cost comparisons for renewable alternatives; (v) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

The global context is one in which new greener energy sources are urgently needed:

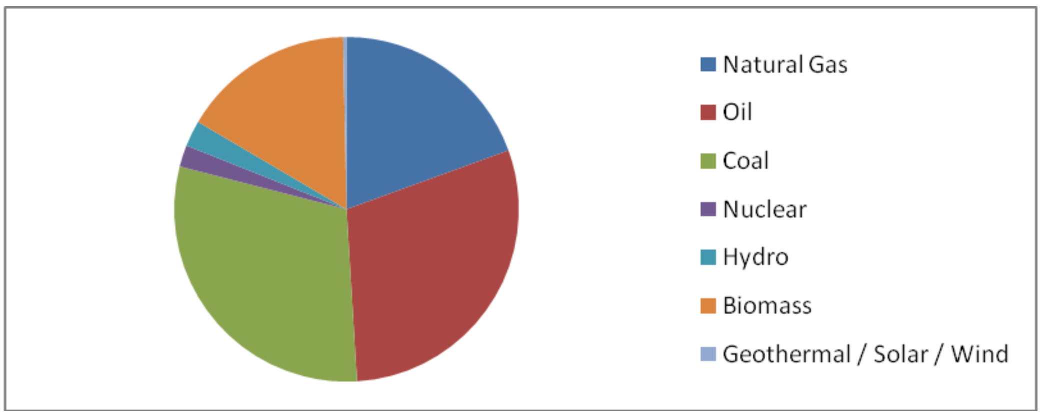


Current sources in the global primary energy mix show heavy biomass dependence in non-OECD countries:

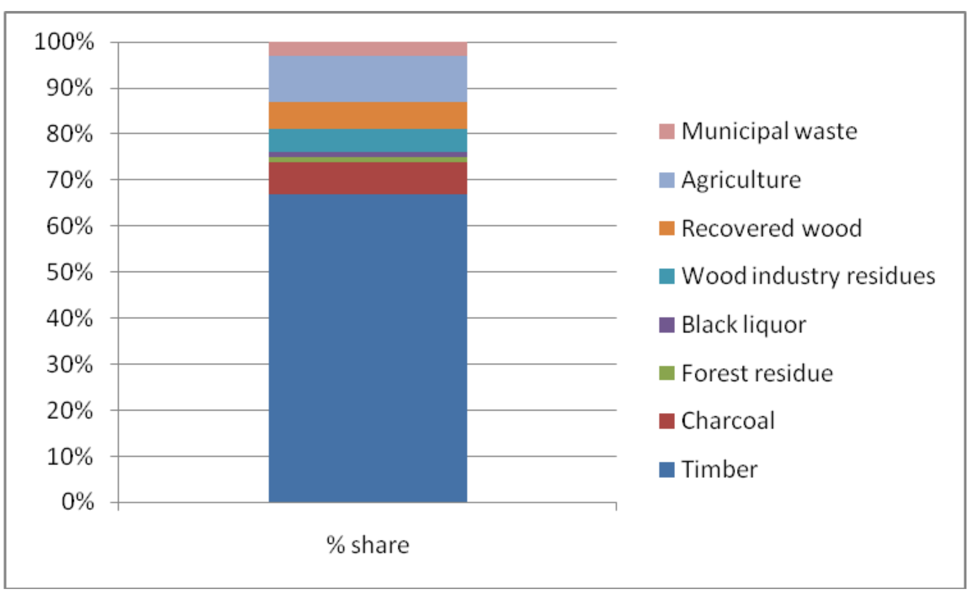
OECD:



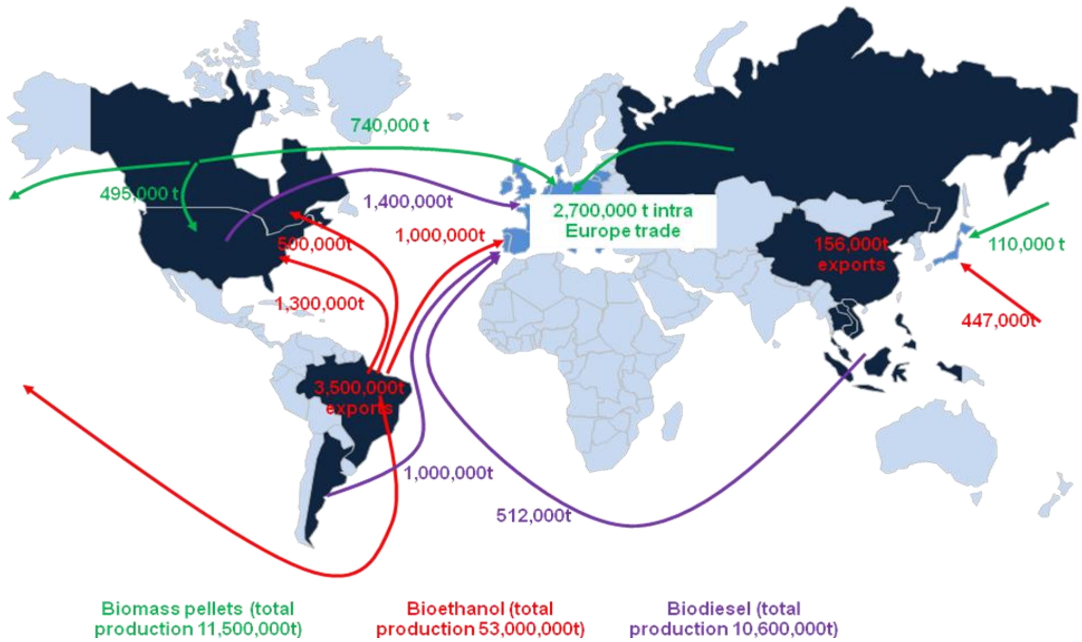
Non-OECD:



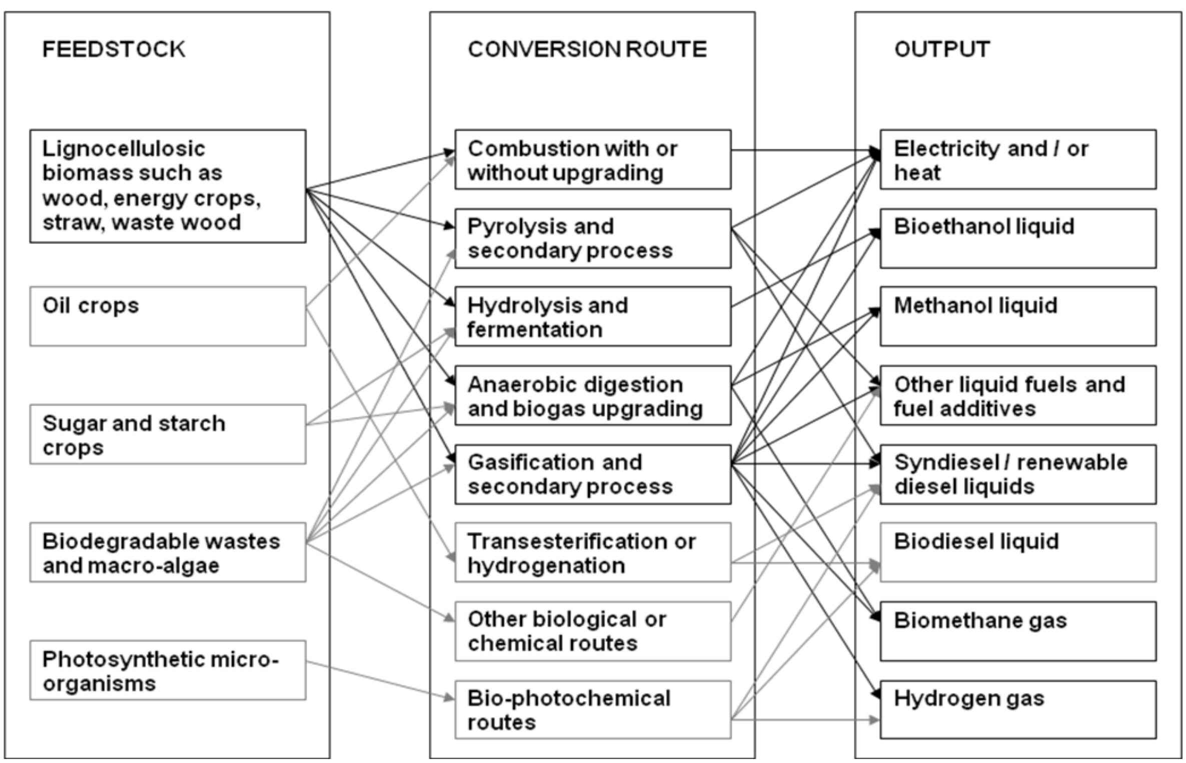
Existing biomass energy is primarily forest based:



There is a growing trade in liquid and solid biomass fuels:



IEA predicts biomass will rise to 30% of global energy by 2050 with ever increasing options for biomass conversion and use:



Biomass energy globally is a tale of two sides – OECD high tech biomass boom and Non-OECD biomass criminalisation

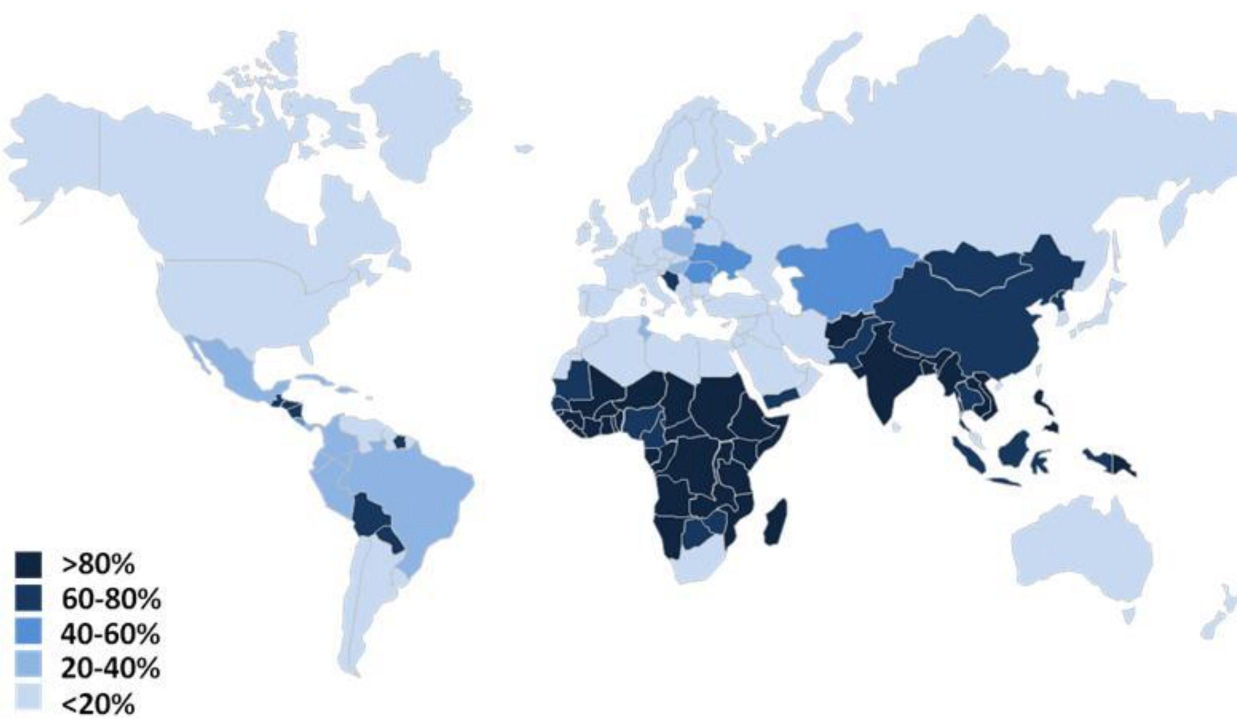
<PIE CHARTS, MAP & CHART: UK ENERGY 2009 AND 2020>

- 1 million tonnes of biomass in electricity plants now
- 3 GW of large biomass electricity approved (20-25 million tonnes required)
- 4 GW of small to medium biomass electricity (30-35 million tonnes required)
- Total 50-60 million tonnes required.
- UK total = 10 million tonnes

<PIE CHARTS, MAP & CHART: MALAWI ENERGY 2009 AND 2020>

- 1.2 million tonnes of biomass currently used
- Under most likely scenario – this will still rise to 2.1 million tonnes by 2020 despite investment in coal and hydro-power
- North – Demand 23% of supply
- Centre – Demand 95% of supply
- South – Demand is 11% of supply

Biomass dependency in non-OECD countries deserves better more sophisticated treatment:



Correlation between biomass dependency and high deforestation does not need to be causal:

<MAP DEFORESTATION HOTSPOTS>

Advantages:

- Accessibility? But poor access to raw material / technology?
- Sustainability? But incentives to reinvest profit in management? Biodiversity?
- Energy security? But local and national balance of supply and demand?
- Carbon neutrality? But conversion efficiencies and time scale?
- Production flexibility? Feed stocks and conversion technology to heat, gas, liquid, electricity?
- Labour intensity? But quality of jobs?
- Cost competitiveness? But unfair subsidies to other energy sources?

<GRAPH: OPERATION AND MAINTENANCE JOBS>

Costs, such as electricity:

- Depends on energy carrier
- Indian duel fuel (DF) biomass gasifiers (run together with diesel) are competitive with diesel, for capacities of 20 kW+ at an operating load of 100%.
- Ugandan 25 kW wood-based gasifiers are cheaper (US$ 0.11 /kW) compared with solar panels (US$ 0.19 /kW) or diesel generators (US$ 0.39 / kW)

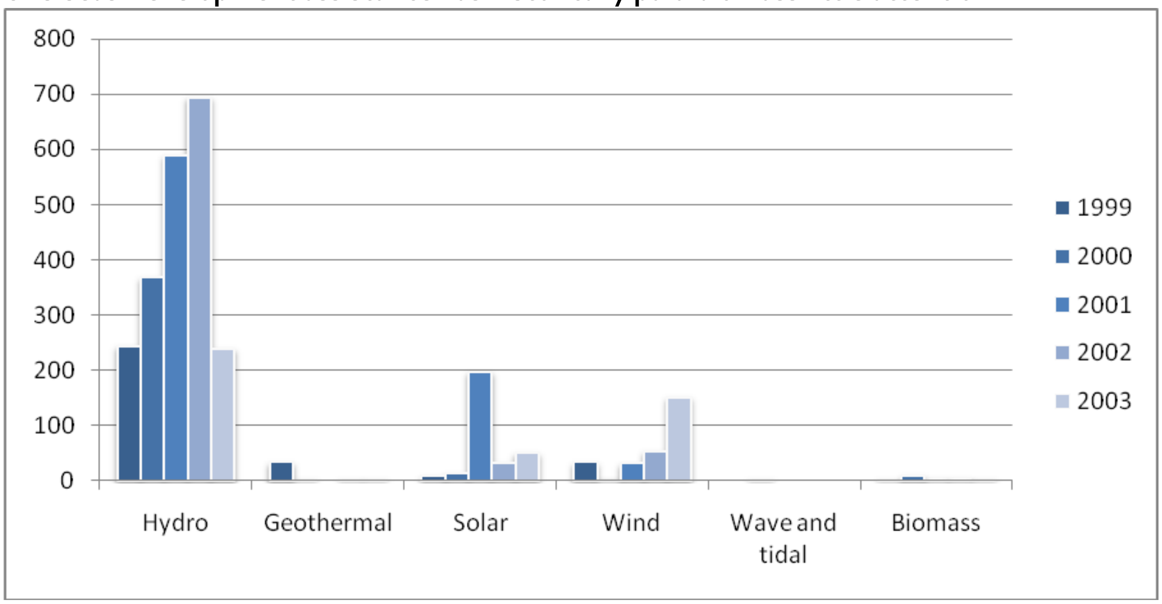
<GRAPH: LEVELISED UNIT COST FOR ELECTRICITY PRODUCTION>

Renewable energy alternatives:

Energy services	Income generating value	Renewable energy options
Irrigation	Better yields; higher value crops; greater reliability; growing during periods when market prices are higher	Biomass, wind, solar photovoltaic (PV)
Illumination	Increased working hours	Biomass, wind, solar photovoltaic (PV), micro-hydro, geothermal
Grinding, milling, husking	Creation of value added processing from raw agricultural commodity	Biomass, wind, solar, photovoltaic (PV), micro-hydro
Drying, smoking (heat preservation)	Creation of value added product; preservation of produce for higher value markets	Biomass, wind, solar photovoltaic (PV), micro-hydro, geothermal
Refrigeration, ice-making (cold preservation)	Preservation of produce to allow sale to higher value markets	Biomass, wind, solar photovoltaic (PV), micro-hydro, geothermal
Extraction	Production of refined oils or distillates from biomass, seeds or fruit	Biomass, Solar thermal
Transport	Access to markets, service providers and policy makers; public transport	Biomass (biofuels)

Telecommunications (computer, telephone, internet)	Access to market news, business and financial service providers and policy processes; coordination of suppliers and distributors; entertainment; weather information	Biomass, wind, solar photovoltaic (PV), micro-hydro, geothermal
Battery charging	Wide range of services for end users	Biomass, wind, solar photovoltaic (PV), micro-hydro, geothermal

Overseas Development assistance has historically paid biomass little attention:



Renewable energy alternatives to involve and reach poor:

- Hydro – strongly promoted but well rehearsed problems
- Micro-hydro - technologically mature, simple to maintain, low energy costs, operating life of at least 20 years, high potential for local manufacture, not intermittent but location specific
- Wind – cost competitive, from simple mechanical to electricity, can be manufactured locally, but vulnerabilities and intermittency
- Solar – water heaters, lamps and solar PV widely pushed but initial capital costs and technological production issues
- Biomass – flexibility - simple stoves to biogas, liquid biofuels, steam turbines to gasifiers for electricity – not intermittent but dependent on feedstock availability and technology with substantial gains from conversion efficiencies (e.g. kilns, fuel efficient stoves etc)

Making more of biomass:

<FLOWCHART: INDIA BIOMASS GASIFIER ELECTRICITY SYSTEMS>

How?

- Investigate alternatives to secure tenure rights
- Compile and promote reasons to de-stigmatise / decriminalise biomass
- Research systems that optimise poverty / ES impacts

- Develop models to incentivise transitions to efficient sustainability
- Investigate governance / tax / investment support options

ESPA research could redefine the political economy of biomass…promoting:

- a central place in strategies for national energy security with effective sustainability criteria
- a central role in plans to mitigate and adapt to climate change
- comprehensive data on production and use in national energy statistics and planning
- clear institutional mandates for policy and sector development
- fair treatment alongside other energy sources
- secure biomass tenure based on sustainable management
- incentives for efficient conversion and use
- support for investment in newer biomass technologies
- an active programme of research and development

10.00 Goetz Richter / Mairi Black (Rothamstead Research / Imperial)

Biomass energy crops and climate change

This presentation focused on (i) an overview of global dedicated biomass energy crop potentials; (ii) some principles of best practice in their use; (iii) an assessment of the impacts of the use of such crops on climate change and vice versa (vi) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

Objectives of Background Report:
This presentation was based on a background report: "Global assessment of biomass energy crops and climate change" that aimed to:

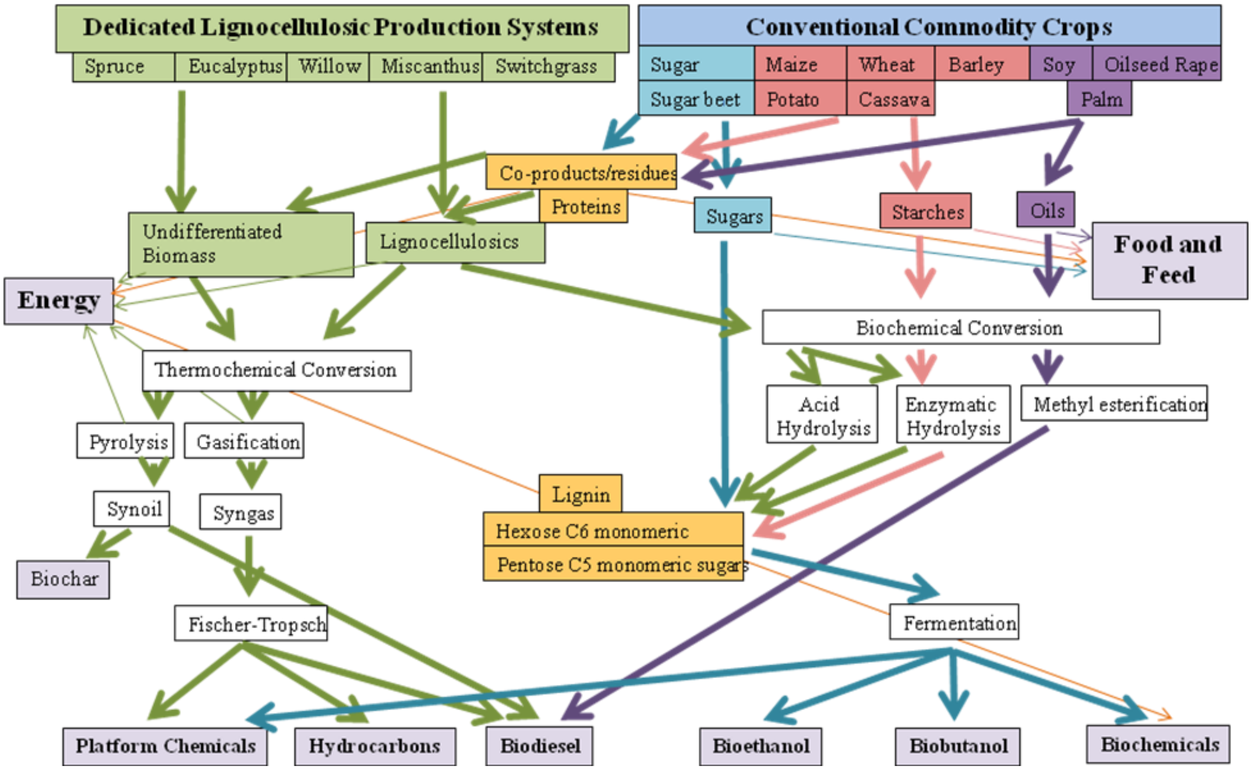
i. To give an overview of dedicated biomass energy crop potentials (as global as possible)
ii. To lay down some principles of best practice in the use of bioenergy
iii. To review the impact assessment for the use of such crops on climate change and vice versa
iv. To draw some conclusions on the components of a research framework to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem service

When considering biomass potential for bioenergy production need to think of both:

- Theoretical, technical or economic concepts
  - Theoretical potential: physical possibilities of biomass production (NPP, AEZ, etc.)
  - Technical potential: availability, accessibility and efficiency of conversion processes
  - Economic feasibility of conversion processes, affected by external market factors such as fossil fuel prices and fiscal incentives.
- Implementation potential
  - Affected by technical, [socio-]economic potential and policy interventions.
  - Considers practical outcomes of bioenergy scenarios based on available understanding of technical and economic aspects and
  - the likelihood of scenario development for particular supply chains in a given geographic location (constraints!).

Technologies for feedstock conversion are advancing- both energy carriers and end uses/markets:

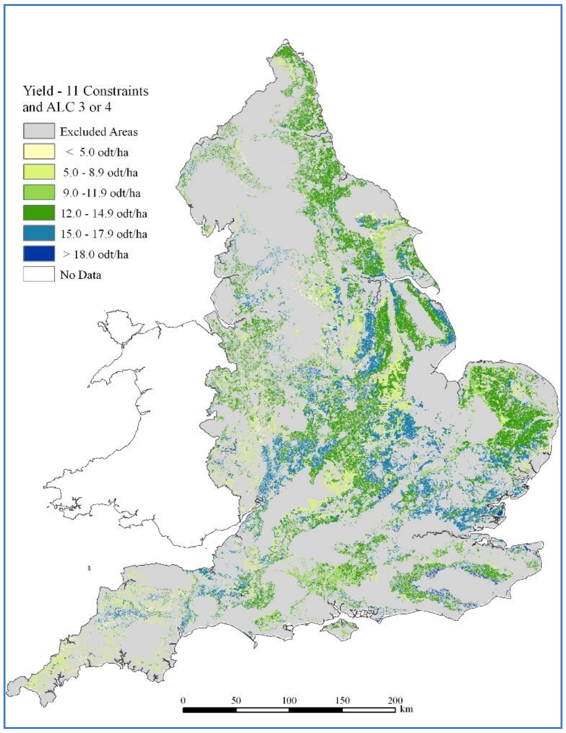
- Thermo-chemical pathways
  - combustion,
  - gasification and
  - pyrolysis
- Bio-chemical pathways
  - digestion,
  - fermentation,
  - methylesterification,
  - hydrogenation



Key questions are:
Where would biomass for bioenergy be acceptable?
Which land would be most suitable?
What alternative routes could be taken optimising tradeoffs for energy?

These questions have been substantially addressed by mapping land use constraints – e.g. In England:

- Yield map England for all soils except organic (~ 10 M ha)
- Yield map for 9 (primary) constraints (E-C9 <8 M ha)
- Yield map 11 (secondary) constraints (E-C11 <5 M ha)
- Yield map for E-C11 & ALC 3&4 (~ 3 M ha)

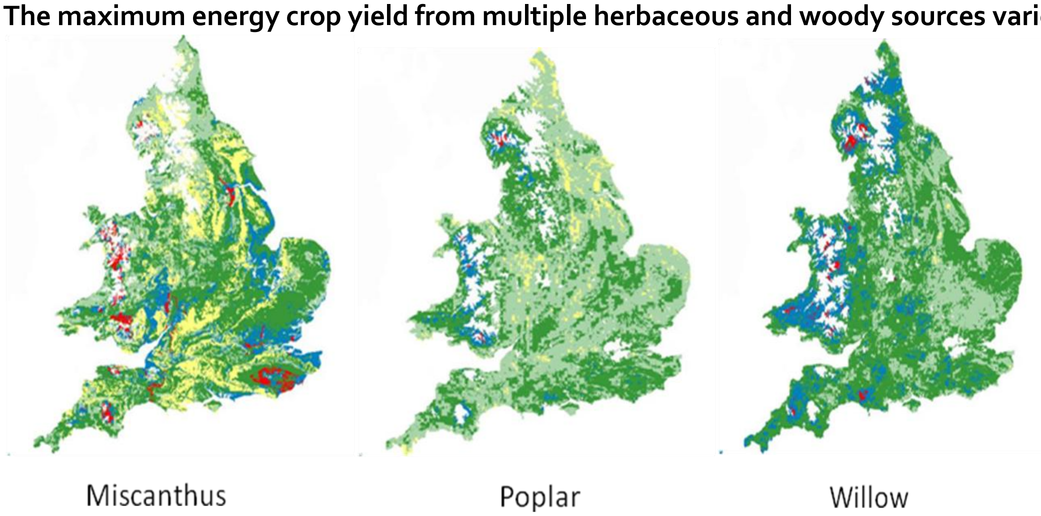


Regional availability of land suited to biomass crops can be a major issue:
<MAP: INC. PIE CHARTS>

- Regional contrasts occur in the importance of different constraints
- Areas with highest yields co-locate with important food producing areas
- On average, Miscanthus yields 12.5 odt ha^{-1} on suitable land (ALC 3 or 4)
- Between 10 and 40% are likely to be below an economic threshold of 9 t/ha

Bauen et al.(2010) Modelling supply and demand of bioenergy from short rotation coppice and Miscanthus in the UK. *Bioresource Technology* (on-line: doi:10.1016/j.biortech.2010.05.002)

The maximum energy crop yield from multiple herbaceous and woody sources varies by species:



It is therefore possible to calculate the cost-based optimum energy crop:
<MAPS SIMILAR TO THOSE ABOVE>

But there are other issues also to consider in decision making – e.g.:

- Carbon sequestration /GHG-emission (TSEC-Biosys – Hillier et al, 2009)
- Bio-diversity in perennial energy crops (RELU-Biomass)
- Ecological impacts/benefits –ecosystem services

Yield mapping & application:
Examples and maps were given of:

- GHG-Balance of 1st and 2nd generation bio-energy crops:
- Soil organic carbon under perennials:
- Biodiversity:
  - 24 commercial fields each crop
  - Flora
    - Seedbank
    - Weeds (counts & biomass)
    - Seed rain
  - Invertebrates
    - Ground & plant active
    - Pollinators (bees & butterflies)
    - Moths
    - Aerial/canopy
  - Identified to species level
  - Same protocols as FSE project
  - Allows cf. break crops and cereals

Take-home messages:

- All indicators significantly higher in short rotation crop willows cf. Miscanthus
- Indicators significantly greater in both biomass crops cf. arable crops

Plants

- 3 x > in SRC willows than in Miscanthus
- 4 x > (Miscanthus) and 11 x > (SRC) than in cereals

Invertebrates

- 1.5 x ground and plant active inverts in SRC willows than Miscanthus
- 2.5 x canopy insects in the SRC willows than Miscanthus
- 13 x > inverts in SRC c.f. arable crops

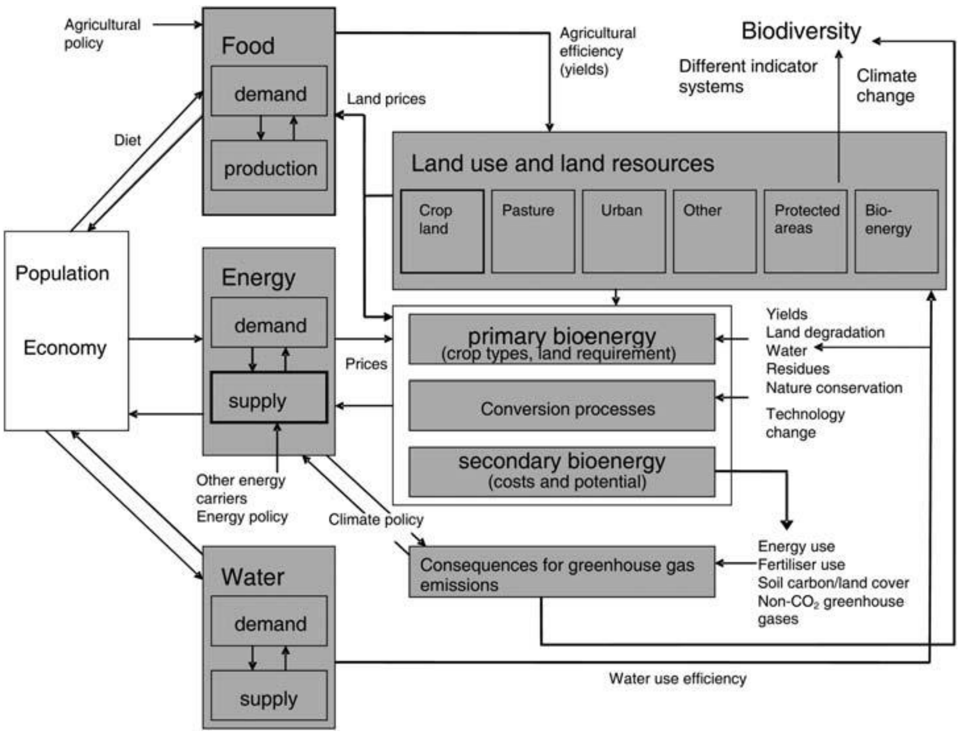
Birds

- SRC positive for many birds; Miscanthus –neutral
- Birds needing open spaces/winter flocking may be disadvantaged

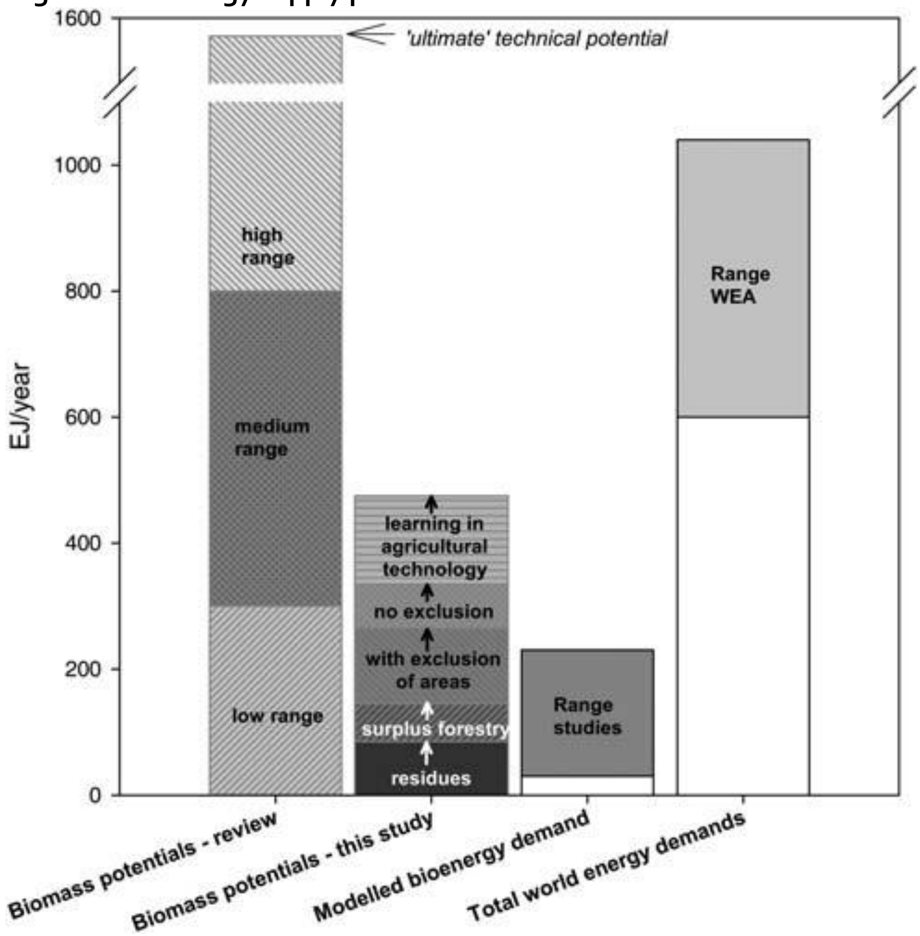
Haughton et al. (2009) J. Appl Ecol 46: 323-333
Sage et al. (2010) Ibis 152: 487-499

GLOBAL PERSPECTIVE

Key factors for potential bioenergy supply have been laid out by Dornburg et al. (2010):



Comparing biomass energy supply potentials:



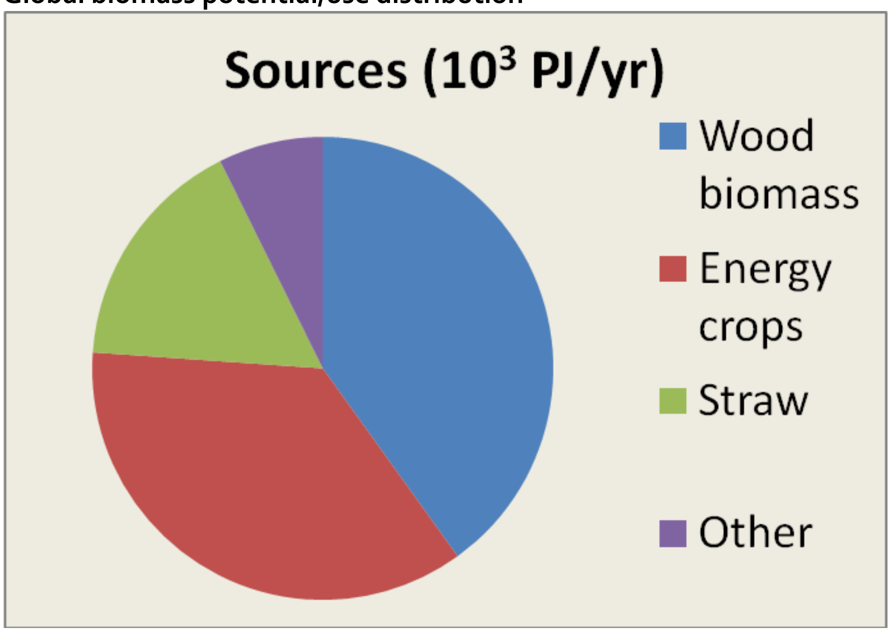
- Range assuming

- different intensities (1st bar)
- With lignocellulosic biomass (2nd bar)
- modelled primary bioenergy demands (3rd bar)
- estimate range for the total global primary energy demand from the World Energy Assessment (4th bar)

Policy implications for implementing sustainable biomass potentials:

- Competition between food, feed and fuels could be avoided if the increased production of biomass for energy is balanced by improvements in agricultural management and by growing perennial ligno-cellulosic crops on degraded and marginal areas.
- At the same time, key environmental concerns, including biodiversity, soil quality and water availability, should be addressed. This can be achieved by selecting appropriate bioenergy systems and applying adequate land use planning.
- Positive GHG balances of bioenergy systems can be secured by choosing suited biomass sources (e.g. using residual biomass and perennial crops), while preventing direct and indirect land use changes that lead to high greenhouse gas emissions.
- Overall sustainability should be guaranteed by implementing suitable policy frameworks that cover the above, for example by means of developing biomass certification schemes.

Global biomass potential/use distribution



<TABLE: Global biomass potential from different sources and its regional use (10^3 PJ/year)>

Key question is then what land to use?

One option might be abandoned agricultural land (crop/pasture):
(Field et al., 2008)

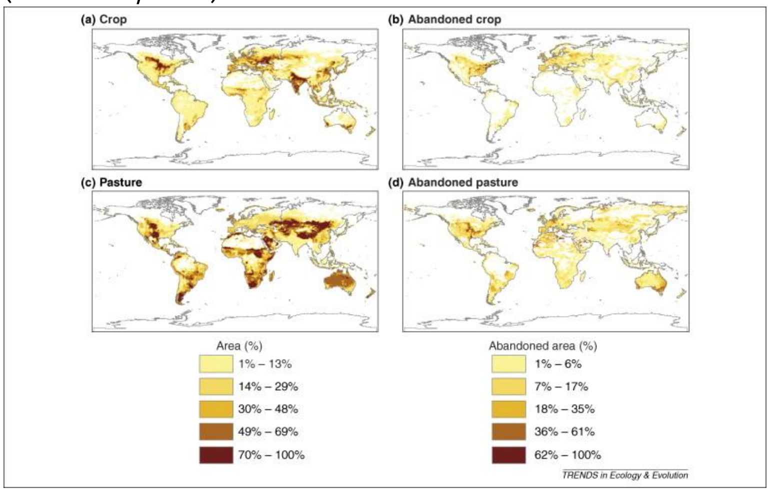
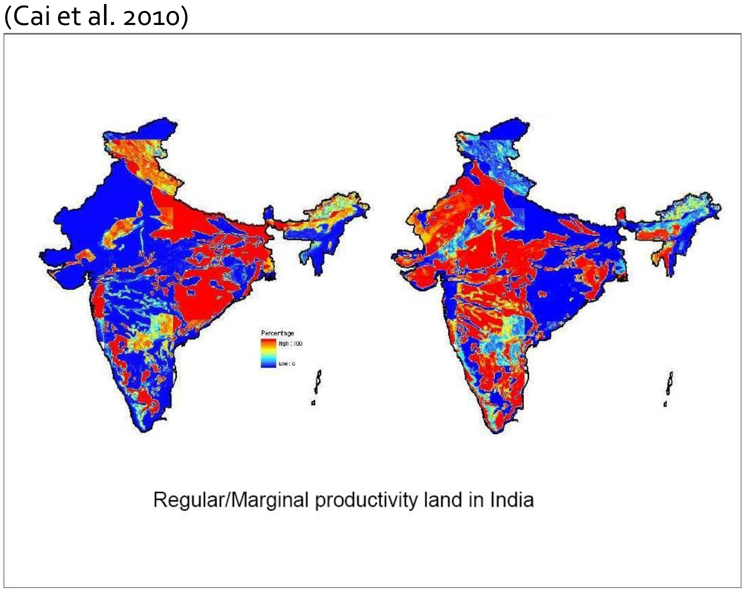


Figure 2. … as estimated from the HYDE 3 land-use change database, with a spatial resolution of 5' [45]. Crop and pasture areas are for the year 2000. Abandoned areas are the positive differences between the pre-2000 maximum areas and the 2000 areas. This estimate misses areas where crops or pastures were shifted from one place to another, without a change in area, but the relatively high spatial resolution of the HYDE 3 dataset means that it should capture shifts of more than 10–20 km.

- Potential global above-ground plant growth on abandoned agricultural lands has an energy content representing 5% of world primary energy consumption in 2006.
- The global potential for biomass energy production is likely to replace only a few percent of current fossil fuel usage.
- Increasing biomass energy production beyond this level would probably reduce food security and exacerbate forcing of climate change.

Another option might be to enhance biomass energy on marginal agricultural land:
(Cai et al. 2010)



Key issues to discuss

- Top-down vs bottom-up approach
- Down-scaling energy demand and up-scaling of energy supply
- Rural economy development

An example was given of decentralised energy planning (DEP) – a case study of Tumkur district in India

acc to Hiremath et al. (2010)

- The approach adopted was bottom-up (village to district) to allow a detailed description of energy services and the resulting demand for energy forms and supply technologies.
- Different scenarios are considered at four decentralized scales for the year 2005 and are developed and analyzed for the year 2020.
- Decentralized bioenergy system for producing biogas and electricity, using local biomass resources, are shown to promote development compared to other renewables.
- Apart from meeting energy needs, multiple goals could be achieved such as self-reliance, local employment, and land reclamation apart from CO_2 emissions reduction.

Decentralized Energy Planning (DEP):

Hiremath et al. (2010)

DEP model requires the following set of data:

- Socio-economic features
- Land use: forests land, wasteland, cropping pattern, etc.
- Energy; activities, end-use devices, efficiency of devices
- Biomass production for energy; area under forests and plantations, biomass productivity, production and availability of crop residue for energy
- Energy efficiency, energy conversions, energy use
- Energy: renewable energy technologies (RET) and fossil fuel (FF) technologies
- Cost of energy systems operation and maintenance cost and financial value of energy and products.

DEP at different levels:

- Biogas is viable only at **village scale** due to inability to liquefy it
- Biomass demand can be met by raising wood fuel on degraded or waste land
- Gasification plant location at **Panchayats scale** depends on supply of land & biomass, transport and distribution costs
- At **block level**, 27-45% of the waste land is needed for energy production under *business as usual scenario*
- The different energy needs in the **district** (10 blocks) have can be met by allocating 12% of the wasteland (assuming yield of 8 t/ha/ year) under *sustainable development scenario*

Review impact assessment of bioenergy crops on climate change and vice versa:

Points to discuss here are:

- Positive effects of carbon sequestration under perennial crops
- Land reclamation for degraded, eroded soils
- Negative GHG balances from false allocation of energy crops
- Water use benefits and hazards
- Change of the energy balance due to land cover changes
- Increase or decrease in yield and yield uncertainty

- Pests and diseases

Conclusions for a research framework to promote biomass energy within ESPA:

- Inventory of land use and land resources
- Bio-diversity inventory and conservation areas
- Agro-ecological zoning in terms of productivity at regional and sub-regional scale
- Water and energy balance modelling
- Bio-resource inventory – food, feed and fibre supply and demands
- Calculation of the bioenergy potential differentiated acc to form and usage
- Integration and analysis of multi-crop/multi-purpose production systems
- Supply chain analysis acc to feedstock diversification, demand and infrastructure

References:

Field CB, Campbell JE and Lobell DB (2008) Biomass energy: the scale of the potential resource. Trends in Ecology and Evolution 23 (2): 65-72

Cai XM, Zhang X, Wang DB (2010) Combining marginal cropland and grassland may meet the world's biofuel demand . UIUC (unpublished)

10.30 Ibrahim Rehman / Abhishek Kar (The Energy Resources Institute, TERI)

Biomass energy use in India

This presentation focused on (i) a quantified analysis of biomass use in India; (ii) a description of what is known of the impact of biomass energy use on poverty reduction and ecosystem services in India; (iii) a description of the main policies, institutions and individuals that currently define biomass use in India; (iv) innovative initiatives in the sector and why they have succeeded or failed to date and (v) a theory of change about what a desirable biomass energy 'transition' in India would look like and how to bring it about.

India's energy profile – setting the scene:

- Rising demand
  - Per capita energy consumption in India has risen by 28.25% in the period 1997-2007
  - Expected to be more than three to four times the current level in another 25 years
- Import dependence for commercial fuel sources
  - 76% of Crude oil is imported
  - 29% of Natural gas is imported
- Non-commercial energy sources, predominantly fuel wood, chips and dung cakes, contribute around 30% of the total primary energy

Power shortages frequent:

- Provision of electricity through extension of grid in remote areas with scattered settlements characterized by:
  - High transmission and distribution (T&D) losses
  - Frequent disruption in supply of grid power
  - Financial un-viability of extending grid to remote and inaccessible areas
- 5% of urban and 40% of rural households depend primarily on kerosene for lighting

Role of bio-energy in energy basket

- Biomass is the primary residential energy source: It delivers 90% of energy in rural and 40% of energy in urban households to meet cooking, water heating and space conditioning needs
- Dependence on biomass is expected to continue
  - projected increase in rural population in absolute terms
  - continued lack of access to commercial fuels in rural areas particularly for cooking like LPG
  - Planning Commission estimates share of bioenergy in total household energy consumption would be over 50% in 2031-32

Bioenergy usage characteristics

- 85% of rural and 24% of urban households use traditional mud stove fuelled by unprocessed solid biomass
- Due to poorly ventilated kitchens, IAP levels in rural households are often much higher than outdoor air pollution in cities
- Characterized by low efficiency (10-15%) as compared to LPG (65%)
- 40% of acute respiratory infections (ALRI), 20% of chronic obstructive pulmonary disease (COPD), & 3% of DALYs are caused by IAP from burning of solid fuels

Bioenergy resources and use – an overview:

- Biomass Energy:
- Availability
  - Agricultural residue
  - Wasteland produce
  - Forest produce
- Utility
  - Cooking and heating fuel
    - Direct combustion
      - Unprocessed solid biomass
      - Processed biomass
    - Biogas
  - Biomass gasification based power/co- generation
  - Biofuel for transportation

Land-use in India and potential for biomass expansion:

- Geographical area – 328.7 Mha.
- Forest – 69.8 Mha (22.9%) to be increased to 33% under NAPCC
- Not available for cultivation – 42.5 Mha (13.9%)
- Uncultivated land excluding fallow land – 26.9 Mha. (8.8%)
- Fallow land – 24.2 Mha. (7.9%)
- Net sown area – 141.9 Mha (46.5%)

Biomass from forests

Sl. No.	Parameter	Symbol	Factor	1995	2005
1	Growing stock of country in Mm^3	GS		5842.32	6218.28
2	Mean biomass expansion factor	EF	1.575		
3	Ratio (Below to above ground biomass)	RBA	0.266		
4	Above ground biomass (volume)	AGB = GS X EF		9201.65	9793.79
5	Below ground biomass (voume)	BGB = AGB X RBA		2447.64	2605.15
6	Total biomass (volume)	TB = AGB + BGB		11649.29	12398.94
7	Mean density	MD	0.7116		
8	Biomass in Mt	GS X MD		8289.63	8823.09

Source: Technical paper; India's forest and tree cover, 2009

(source: TERI 2009)

Biomass from agri-residue

Crop	Economic produce	Gross cropped area	Total economic production	Total residue production	Residue to total economic produce ratio	Type of residue	Moisture %	
		Mha	MT	MT (air dry)			At harvest	At use
Rice	Food grain	42.6	85.7	154.3	1.8	Straw+Husk	30	10
Wheat	Food grain	26.5	70.3	112.5	1.6	Straw	30	10
Jowar	Food grain	9.0	7.1	14.3	2.0	Stalk	30	10
Bajra	Food grain	9.3	8.2	16.3	2.0	Stalk + cobs	30	10
Maize	Food grain	7.4	14.0	35.1	2.5	Straw	30	10
Other Cereals	Food grain	3.2	3.7	7.4	2.0	Stalk	30	10
Red Gram	Food grain	3.5	2.4	12.0	5.0	Waste	20	10
Gram	Food grain	6.8	5.5	8.8	1.6	Waste	20	10
Other pulses	Food grain	12.1	5.5	15.9	2.9	Shell + waste	20	10
Ground nut	Oil seed	6.2	6.4	14.7	2.3	Waste	30	10
Rapeseed and Mustard	Oil seed	6.3	6.7	13.3	2.0	Waste	20	10
Other oil seeds	Oil seed	16.1	14.9	29.8	2.0	Waste	20	10
Cotton	Fiber	8.4	16.0	55.9	3.5	Seeds + waste	20	10
Jute	Fiber	1.0	11.0	17.6	1.6	Waste	30	10
Sugarcane	Sugar	4.3	279.0	111.6	0.4	Bagasse + leaves	30	30
Total		162.7		619.4				

(source: TERI 2009)

Current use of agri-residue

Crop	2010		
	Fodder	Fuel	Other
Rice	124.7	17.2	12.4
Wheat	97.3	0.0	15.3
Jowar	14.3	0.0	0.0
Bajra	14.7	0.0	1.7
Maize	28.4	6.7	0.0
Other Cereals	7.4	0.0	0.0
Red Gram	0.0	9.4	2.6
Gram	0.0	8.8	0.0
Other pulses	0.6	7.7	7.6
Ground nut	0.0	1.9	12.7
Rapeseed and Mustard	0.0	13.3	0.0
Other oil seeds	0.0	29.8	0.0
Cotton	0.0	55.9	0.0
Jute	0.0	17.6	0.0
Sugarcane	13.2	45.7	52.7
Total	300.5	214.0	105.0

(source: TERI 2009)

Availability of agri-residue

Crop	2010	
	MT	PJ
Rice	29.6	383.6
Wheat	15.3	198.5
Jowar	0.0	0.0
Bajra	1.7	21.5
Maize	6.7	86.0
Other Cereals	0.0	0.0
Red Gram	12.0	154.7
Gram	8.8	114.1
Other pulses	15.4	200.2
Ground nut	14.7	200.5
Rapeseed and Mustard	13.3	182.7
Other oil seeds	29.8	34.1
Cotton	55.9	838.4
Jute	17.6	261.8
Sugarcane	98.4	1553.7
Total	319.0	4229.8

(source: TERI 2009)

Wasteland

SL. No	Category of wasteland	Suitability
1	Gullied and/or ravenous land (Shallow)	suitable
2	Land with scrub	suitable
3	Land without scrub	suitable
4	Land affected by salinity/alkalinity (Slight)	suitable
5	Shifting cultivation area (Abandoned Jhum)	suitable
6	Shifting cultivation area (Current Jhum)	suitable
7	Under utilized/degraded notified forest land	suitable
8	Under utilized/degraded notified forest land (Agri.)	suitable
9	Degraded pastures/grazing land	suitable
10	Degraded land under plantation crop	suitable
11	Gullied and/or ravenous land (Medium)	moderately suitable
12	Waterlogged and Marshy land (Seasonal)	moderately suitable
13	Land affected by salinity/alkalinity (Strong)	moderately suitable
14	Land affected by salinity/alkalinity (Moderate)	moderately suitable
15	Sands-(Levees)	moderately suitable
16	Sands-(Coastal Sand)	moderately suitable
17	Sands-(Semi Stab.-Stab.>40m)	moderately suitable
18	Sands-(Semi Stab.-Stab Moder. High 15-40m)	moderately suitable
19	Sands-(Semi Stab.-Stab. Low<15m)	moderately suitable
20	Sands-(Closely Spaced Inter-Dune Area)	moderately suitable
21	Mining wastelands	moderately suitable
22	Industrial Wastelands	moderately suitable
23	Gullied and/or ravenous land (Deep)	unsuitable
24	Waterlogged and Marshy land (Permanent)	unsuitable
25	Sands-(Flood Plain)	unsuitable
26	Barren Rocky/Stone Waste/Sheet Rock Area	unsuitable
27	Steep Sloping Area	unsuitable
28	Snow covered and/or Glacial Area	unsuitable

Classification of wasteland	Area (in Mha)
Wastelands suitable for land conversion	32.6
Wastelands moderately suitable for land conversion	5.0
Wastelands unsuitable for land conversion	12.0
Total wasteland available in India	49.6

(source: TERI 2009)

Power Potential from Biomass

Type of Resource	Area (kha)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Agri-residue	16423	95512	43162	5984
Forestland	64570	89119	59678	8355
Wasteland	54253	66355	44369	6212
TOTAL	**135246**	**250986**	**147210**	**20551**

National vision for biomass:

- Efficient utilization of existing biomass surplus
  - Power generation to reduce deficit
  - Replace fossil fuel in transportation
- Improve biomass yield by fully utilizing available land resource

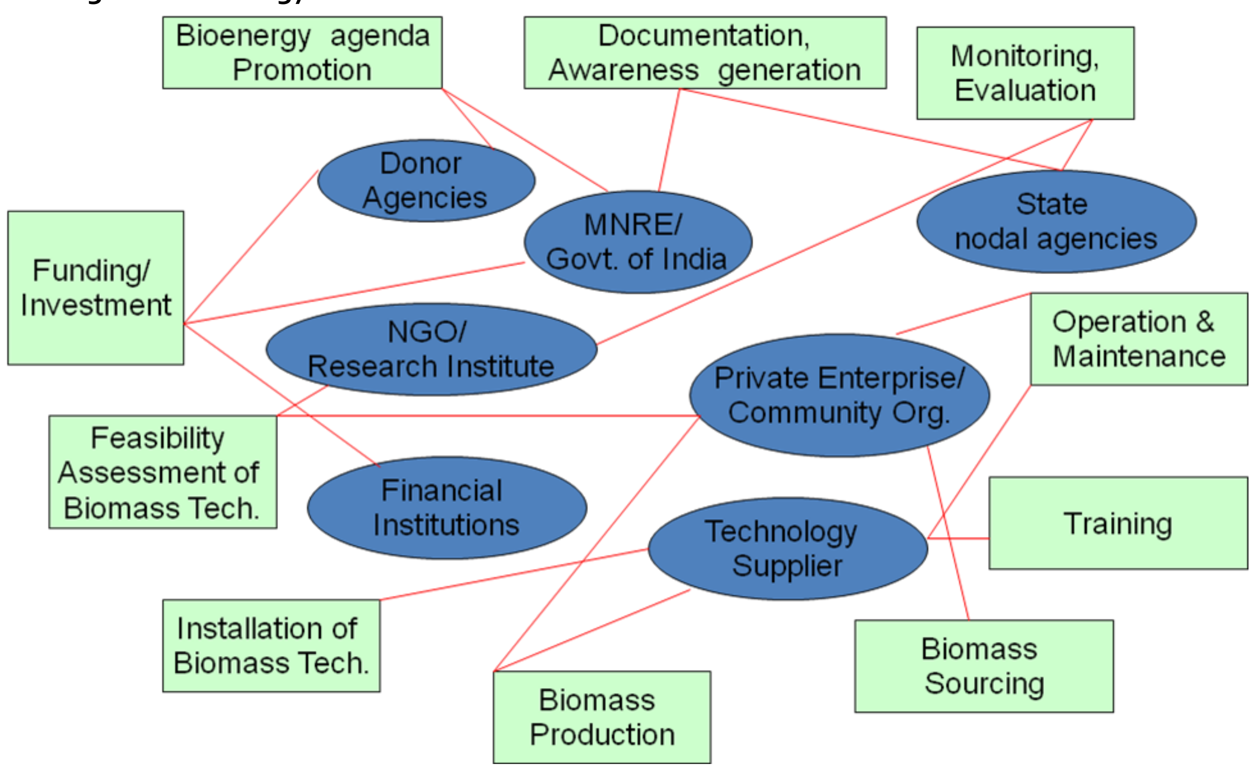
Potential versus achievement to date:

S.No.	Source/system	Estimated potential	Achieved as on 31st March 2010
A	Grid Interactive renewable power	(MW)	(MW)
1	Bio power (agro residues and plantations)	16881	861
2	Bagasse cogeneration	5000	1338.3
B	Captive/combined heat and power/distributed renewable power		
1	Biomass/cogeneration (non bagasse)	N.A.	232.17
2	Biomass gasifier	N.A.	122.14
3	Family type biogas plants*	12,000,000	4,185,000

Policy Review

- Earlier perspective (Pre- 1990s)
    - Biomass viewed as traditional fuel for meeting rural energy needs
    - Supply-side push with market instruments having little role in biomass policies
    - Mostly government and NGO initiatives in programme/ project mode
- Current perspective
    - Biomass is a competitive energy resource, which can be pulled through energy markets
    - Promote technologies and private investment for optimum biomass resource utilization for power generation
- Focus Areas
    - Power Generation
        - Direct combustion and co-generation for power generation (ex. Sugar Industry)
        - Biomass gasifier for rural power requirements
        - Biogas based power generation
    - Cooking Fuel
        - NPIC, recently launched National Biomass Cook stove Initiative
        - National Project on Biogas Development
- Incentives to invite private players
    - Central Financial Assistance (CFA) in the form of capital subsidy and/ or interest subsidy
    - 80% accelerated depreciation
    - Concession in import duty
    - Excise duty exemption on equipments
    - Tax holiday
    - Preferential feed in tariffs along with renewable purchase obligation

Existing biomass energy stakeholder framework



Bio-energy and Poverty Alleviation

- Employment Generation: Labor intensive biofuel/energy plantation would generate 100 times more workers per unit energy production as compared to technology-intensive fossil fuel industry
    - Unskilled employment generation
    - Must be studied in greater detail as it can mobilize political support for bio-energy
- Distributed Power:
    - Rural community face unreliable power scenario due to national deficit of >10%
    - Bioenergy technologies like biomass gasification can bridge deficit
    - Provision of quality power helps in enterprise development and competitiveness
- Fuel wood saving:
    - Average rural household conume1800 kg of fuel/year
    - Improved cook stoves have potential of reducing fuel consumption by almost 30% to 45% leading to monetary saving
    - Food V. Fuel: Biomass production could compete with food production on a local/ regional scale and lead to regional food supply shortage or price volatility
    - Threat to land rights: Mono-culture and un-monitored entry of private investors

How does this relate to the MDGs? E.g. 4a, 5a, 6c: Reduce…child ..maternal mortality….Halt…incidence of major diseases…

- 3 billion people dependent on direct burning of biomass
- Approx 150 million rural households adversely impacted by biomass based cooking in India
- Close to 2 million people die globally due to indoor air pollution – chief cause of ALRI
- *Monitoring of IAP*
    - *A few thousand improved cookstoves installed*
    - *SHGs for manufacturing and marketing of stoves*
    - *Current commercial options cost around $80*
    - *Focus on cost reduction to bring it down to $ 20*
    - *Focus on real time monitoring of cooking to claim C credits*

Bio-energy and Climate Change

- The life-cycle carbon balance of bioenergy critically depends
    - Choice of feedstock
    - Management of land resources
    - Land-use changes induced by cultivation, conversion and processing methods
    - Type of fossil energy carrier which is replaced
    - Efficiency of energy end-use.
- Potential for significant GHG abate potential:>100 million ton C/year
    - Sustainable harvesting?
    - Alternative land usage?
- Water footprint of biofuel:
    - Jatropha (600 m3/GJ) Vs Rapeseed (400m3/GJ)
    - Conflict with water for food crop
- Loss of bio-diversity with mono-culture?

Case Study : SKG Sangha

- Technology: 2 cubic meter Deenbandhu (DB) model in brick masonry sufficient for family size of 4-6 people, owning 3-4 cows

- Cost: 18,000 INR ~ 400 USD
- Target Beneficiary: Rural women
  - who own cattle
  - have sufficient space for installation of biogas plant
- 1993-2008: 64000 plants installed
- Success rate of 95% functionality after 5 years of operation against national average of 42%
- International Ashden Award for Sustainable Energy – 2007
- Beneficiary Contribution in cash and kind
  - sense of ownership will be instilled
  - increase in accountability
    - Biogas plants are functional
    - Regularly repaired and maintained.
- Quality control
  - All material used purchase material directly from factories – cheaper & better quality
- Addressed main identified reasons for past failures in biogas programmes
  - Local level supervisors
  - Adequate training of implementing staff
  - Reliable and Prompt After sale services:
    - 100% guarantee for all plants for 5 years
    - All service costs borne by SKGS for life of plant
    - 100% replacement for technical faults
  - Awareness and capacity building of beneficiaries

Some examples of innovation:

- Creation of Linkage between biogas and vermi-compost
  - 200 no. of 30 kg bags of vermiculture manure a year produced from each biogas plant
  - Sale of manure @INR 3/kg yields yields economic benefit
- Beyond government subsidies:
  - CDM and VER being explored as opportunities for future financing
  - In process of implementing quality projects under CDM and VER

Benefits from biomass energy

- Economic
  - Generation of employment for local youth as supervisors, technicians and masons
  - Additional income from vermin-composting
  - Indirect non-monetized benefits
    - Time saved: 3-4 hrs in fuel collection
    - Reduction in expenditure on health due to reduction in IAP
    - Reduction in expenditure on firewood and kerosene for cooking etc.
- Environmental
  - 3.56 tCO2e annual reductions per household
  - Saving of 3.56 tonnes of fuel wood/household/year
  - Improvement in soil fertility by using vermi-compost
  - Improvement in indoor air quality and reduced smoke in kitchens
- Social
  - Capacity building of local manpower especially youth
  - Reduced drudgery of women and children: 2-4 hours traveling 2-3 kilometres a day to collect fire wood

  - Women empowerment: income generation through vermin-composting, health benefits, awareness and capacity building

Scope of improvement

- Need to attempt quantification of benefit of fuel wood saving, reduced health cost, opportunity cost of time saved
- Documentation of technical and other problems
  - Maintain a member card
  - Update date and type of problem faced, date and rectification measure, person undertaking rectification
    - Demonstrate prompt problem rectification
    - Analysis of types of problems to understand general trend over a time period

Recommendations

- Dovetailing: Create linkage between existing programmes and bioenergy technologies
  - NREGA and energy plantation
  - Dairy and biogas
  - Afforestation with biomass gasification
- Promotion of technology transfer: Role of donor agencies in lobbying with respective governments
- Compulsory financing of viable BE technologies by commercial banks
- Reduce policy uncertainties with specific roadmap: Clear national and state level legislations (not draft policy or draft guidelines as current trend suggests)
- Encourage small-scale community based Jatropha initiatives like agro-forestry with Jatropha intercropping for in-situ usage like lighting fuel or as fuel for running water pumps.

11.00 Coffee

11.30 Steven Hunt (on behalf of Practical Action, Kenya)

Biomass energy use in Kenya

This presentation focused on (i) a quantified analysis of biomass use in Kenya; (ii) a description of what is known of the impact of biomass energy use on poverty reduction and ecosystem services in Kenya; (iii) a description of the main policies, institutions and individuals that currently define biomass use in Kenya; (iv) innovative initiatives in the sector and why they have succeeded or failed to date and (v) a theory of change about what a desirable biomass energy 'transition' in Kenya would look like and how to bring it about.

Sources of energy in Kenya
According to a national study of 2000, Kenya depends on the following forms of energy:

- Biomass – 68% (includes crop residues)
- Petroleum fuels – 22%
- Electricity – 9%
- Others (e.g. Solar and wind) – 1%

Fuelwood as a source of energy in (2000)

- URBAN – 7% - 691 kg/capita/year
- RURAL – 89% - 741kg/capita/year
- NATIONAL – 34.3m Tonnes – 15.1m Tonnes of fuelwood and 16.5m Tonnes wood for charcoal

Charcoal as a source of energy in Kenya

- URBAN HOUSEHOLDS – 82% - 52 kg/capita/year
- RURAL HOUSEHOLDS – 34% – 156 kg/capita/year
- NATIONAL CONSUMPTION - 2.4 million tonnes per year

Current sources of biomass energy

- Farmlands exotic and remnant natural vegetation – 39%
- Closed Forests, Woodlands, Wooded grasslands, Bushlands – 45%
- Plantations – 7%
- Agricultural wastes and Industrial wastes – 9%
- Sustainable wood yields meet only 43% of the total demand. The balance of 57% is drawn from standing stock – leading to deforestation.
- The key sinks for GHG are the oceans and the forests.
- Harvesting wood unsustainably for energy therefore contributes to climate change which in-turn contributes to food insecurity and increased poverty

Cost of energy/HH/year

Type of Energy	Cost in US $/hh/Year
Charcoal	150
LPG (Gas)*	397
Electricity	740
*Remarks	a) Non-renewable, b) Imported c) Subject to international market prices and political forces – therefore unreliable - charcoal use will therefore continue for the short and medium term

Jobs created per tera joule – in person days

Type of Energy	Jobs Created in Person Days
Charcoal	200 – 300
LPG (Gas)	80-110
Electricity	10-20
Kerosene	10

End use of all wood harvested in the country

Type of End Use	Estimated Proportion
Woodfuel	94%
Poles	4%
Timber	2%

National annual requirement for woodfuel (ha) and estimated investment cost for wood production for sustainable supply of energy (US$)

Type of Fuel	Estimated Area (Ha)	Estimated Value (US $)
Fuel wood	298,000	196,680,000 (660/Ha)
Charcoal	240,000	156,400,000
Total	538,000	353,080,000 (Ksh. 26.5 billion)

Biomass energy balance situation by provinces 2000

Province	Biomass Energy Deficit/Tons/Year	% Deficit
Nairobi	2,304,903	-99.55*
Coast	1,540,367	-51.21*
North Eastern	253,394	-21.23
Eastern	2,247,187	-39.02*
Central	3,300,154	-71.30*
RiftValley	3,431,392	-39.67*
Nyanza	3,887,661	-72.07*
Western	3,130,047	-75.04*
National	20,095,106	-57.22*

Policies and legislation governing biomass energy use in Kenya

- Energy Policy of 2004
- Energy Act of 2006
- Forest Act of 2005
- Environmental Management and Coordination Act 1999
- Draft Environmental Policy – Final touches
- Draft Forest Policy – In parliament

Examples of successful projects for biomass energy supply and use in Kenya

- Kakuzi Charcoal Production Enterprise
- RAFDIP – Charcoal Production Model
- Mumias Electricity Generation from Biomass
- GTZ-Ministry of Energy Biogas Project

Kakuzi charcoal production enterprise

Activity	Est Cost/Bag (Ksh)
Tree growing	75
Kiln construction	20
Harvesting of wood	39
Operational cost	11
Handling cost	12
Store & stock	3
Total cost	159

Rafdip charcoal production model
<IMAGE>

- Current area of land and charcoal woodlots 220 ha
- 100 tons of round wood or 30 tons of charcoal per ha after 6 years

Mumias electricity generation from biomass use in Kenya

- Mumias Sugar Company generates 34 MW of power from bagasse
- 6 MW consumed internally
- Sells balance of 28MW to the National Electricity Grid

GTZ-Ministry of Energy biogas project in Kenya

- In **1997,1100 biogas plants** were estimated to be in operational mostly constructed under the Ministry of Energy's Special Energy Programme sponsored by GTZ.
- Most systems found in Kenya are between 4-16 cubic metres. 3 cubic metres of gas is considered sufficient to meet the cooking and lighting needs of a family of 5 persons in Kenya. The per capita daily consumption of biogas is 0.6 cubic metres, which translates to an annual per capita consumption of 219 cubic metres of biogas.
- Uptake of biogas technology in Kenya has remained very low due to **high capital costs for not only the plant, but also for the modified burners and lighting units.**
- **Inadequate maintenance and management support services** required have further impeded uptake because plants are prone to cracking and leaking yet their operations require that they be air and water-tight.
- **Lack of adequate water supplies**, which is normally added in a ratio of between one and three parts water to one part feedstock, has also been an impediment.

Possible future trend for biomass energy

- Kenya's increasing urban population (7.4%) per year
- Rural population (3.0%) per year
- Unreliability of the fossil fuels – LPG and Kerosene
- Demand for charcoal and fuelwood is expected to increase proportionately.
- Unemployment will also increase.
- There is need to increase biomass energy supply, which will also create more employment
- Investment in extensive **commercial farm forestry**, plantation and management of dry land woody resources for sustainable fuel wood and charcoal production offers hope for energy supply, employment creation, and ecosystem services
- Expanded adoption of **efficient biomass utilization technologies** will reduce the demand for wood energy hence contribute to reduced deforestation, land and environmental degradation.
- Develop the **carbon markets** so that farmers can earn an income from the trees they plant as they protect the environment.

Political / policy interventions

- Lobby the President/Prime Minister and other key offices to actively **facilitate and monitor implementation** of the forest and energy policies in the country
- Carry out **advocacy for tree planting** for the Ministry of Finance (Treasury) to allocate more money for investment in the sub-sector this will ensure energy security and also contribute to employment

- Using scientifically proven facts, lobby parliamentarians to give sufficient **priority to afforestation and energy conservation programmes** – all the way up to their constituencies

Market / finance interventions

- **Develop woodfuel markets** to promote tree growing as a cash crop for the market
- Encourage NGOs and CBOs to support **farmers to invest in commercial agroforestry** for income, food, employment and ecological stability
- **Create an Afforestation Fund** at the newly formed Counties – and or increase funding for afforestation through the Forest Conservation Fund (of KFS), Constituency Development Fund or Local Authority Transfer Fund of the Local Government – e.g. for 10-20 years to expand tree planting and also ensure improved land productivity
- Seek for resources for tree planting from the **private sector including commercial banks**
- **Establish a large corporation** or company for producing charcoal on commercial basis for the urban and rural market and/or especially for educational institutions, tea factories and other fuelwood using industries e.g. paper manufacture

Land / supply interventions

- **Target afforestation of Local Authority land** – The Forests Act (legislation) provides for establishment of new forests by Local Authorities
- **Target the idle rural land of urban dwellers** for commercial tree planting through an affordable investment scheme.
- **Invest in promoting natural regeneration** of the woodlands in the arid and semi-arid areas by developing and implementing appropriate woodland management plans.

Demand side interventions

- Promote the use of **energy efficient charcoal kilns** to reduce the wood used for charcoal production by more than half – current adoption level of efficient kilns is about 1%.
- Promote the use of **efficient charcoal and fuelwood stoves** to reduce the wood resources consumed by more than half.

Individual interventions

Key stakeholders (including individuals) should be encouraged to:

- Adopt a group to support in tree planting
- Adopt a tree nursery to support in supply of seeds and polytubes
- Adopt a school for enhanced tree planting

Capacity interventions

- **Provide extension services** to a community e.g. advice on the number of trees that should be planted on each farm for their biomass energy needs?
- **Train extension support providers** at the community level e.g. train volunteer forest assistants in each location e.g. 1 per village and attach them to the Chief or Assistant Chief for implementation of afforestation programmes at the village level.
- **Package extension information** from scientific conferences for farmers to use
- **Build capacity of Community Forest Associations** to coordinate tree planting and efficient utilization of the wood resources

12.00 Patrick Kambewa (University of Malawi)

Biomass energy use in Malawi

This presentation focused on (i) a quantified analysis of biomass use in Malawi; (ii) a description of what is known of the impact of biomass energy use on poverty reduction and ecosystem services in Malawi; (iii) a description of the main policies, institutions and individuals that currently define biomass use in Malawi; (iv) innovative initiatives in the sector and why they have succeeded or failed to date and (v) a theory of change about what a desirable biomass energy 'transition' in Malawi would look like and how to bring it about.

Background information

- Population 13 million
- Population distribution (50 percent in the south, 38 percent center and 12 percent in the north)
- Over 80 Percent living in the rural areas
- 40 percent living below poverty line
- 85 percent dependent on agriculture

Biomass energy supply and use

- Biomass accounts for 97% of total primary energy supply
  - 59% is used in its primary form as firewood (52%)
  - Residues (7%)
  - 41% are converted into charcoal

Table 1: Annual Use of Roundwood in Malawi, 2007

Forestry Resource Use	Total Consumption(thousand m^3/year)	Percent (%)
Charcoal	1,999	13
Firewood	11,644	78
Poles	975	7
Sawnwood	280	2
Total roundwood	14,895	100

Table 2: Total National Energy Demand in Malawi, by Sector and Fuel Type
Source: Malawi BEST (2009)

Sector	***Energy demand by fuel type (TJ/yr)***					
	Biomass	***Petroleum***	***Electricity***	***Coal***	***Total***	
Household	127,394	672	1,798	5	129,869	83.4%
Industry	9,664	3,130	2,010	3,481	18,285	11.7%
Transport	270	5,640	35	15	5,960	3.8%
Service	452	558	477	174	1,661	1.1%
Total	137,780	10,000	4,320	3,675	***155,775***	
	88.5%	6.4%	2.8%	2.4%		

Integrated household survey findings

- Biomass represented about 98% of total household energy demand

<IMAGE>

Figure 2: Energy sources for household lighting in Malawi

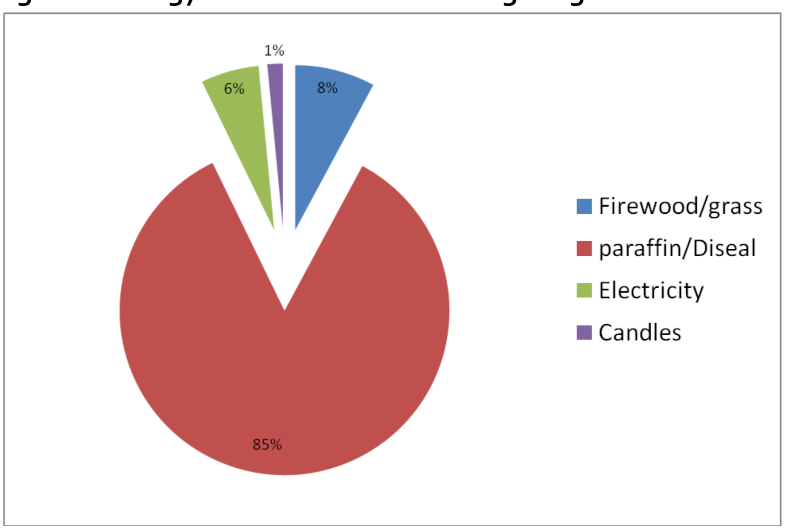


Figure 3: Energy sources for household cooking in Malawi

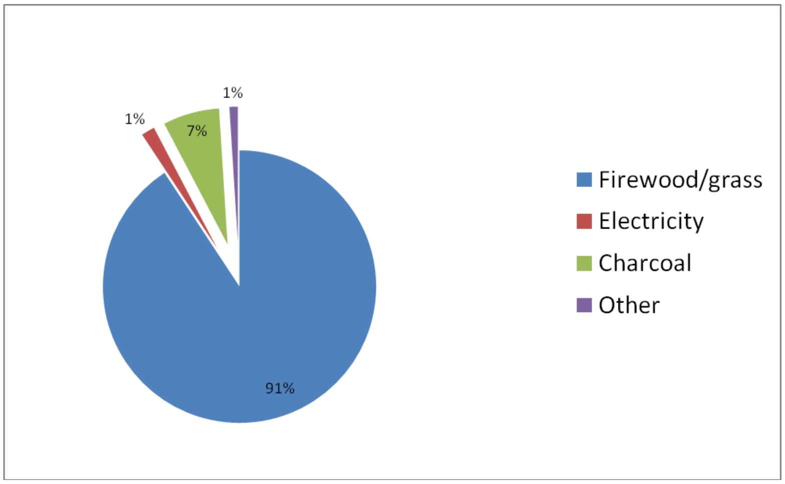
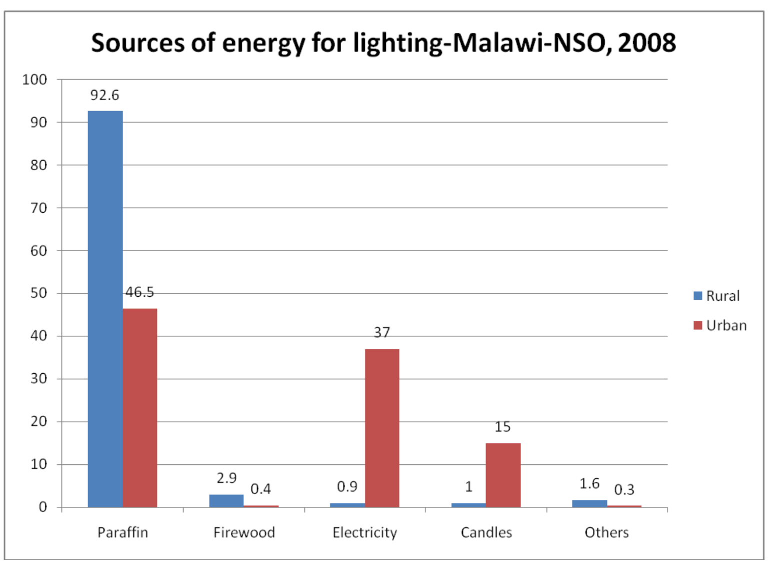
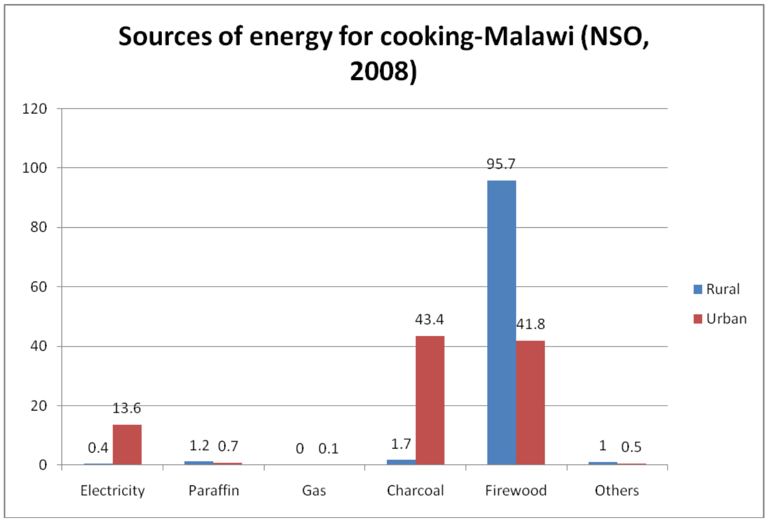
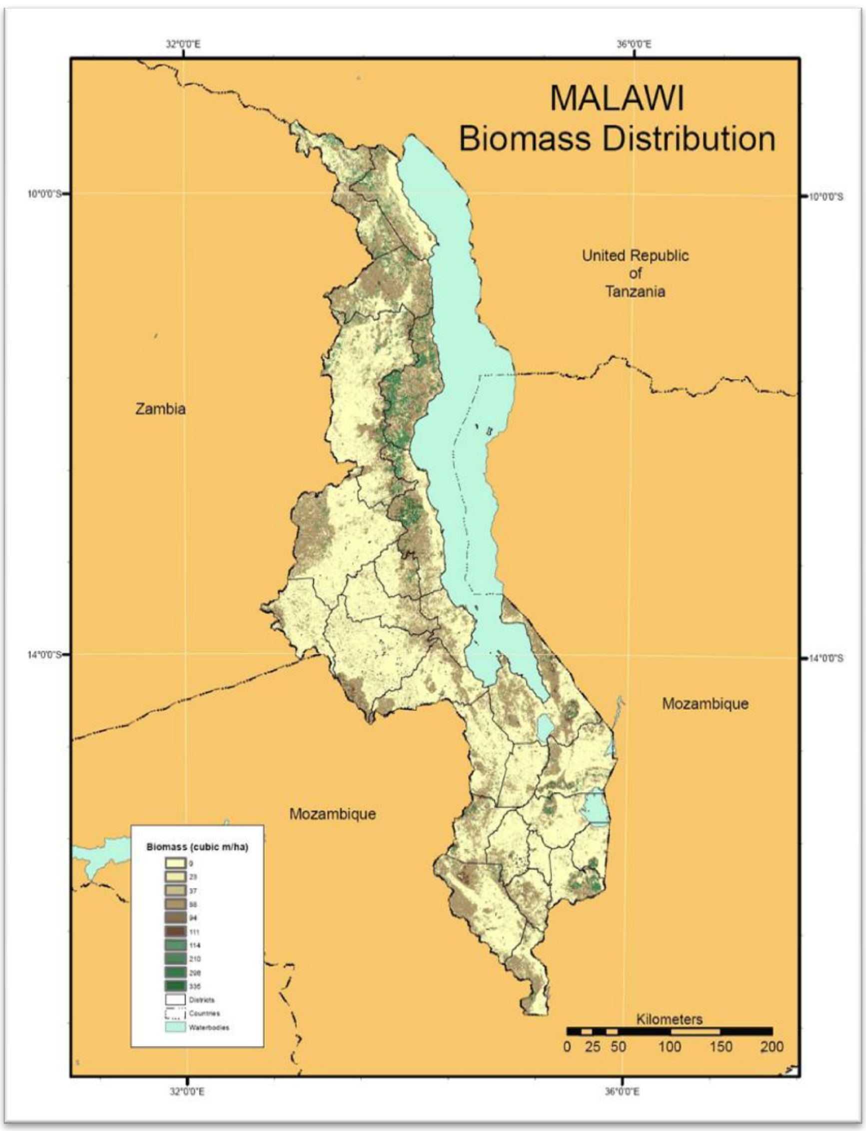


Table 3: Household Energy Consumption in Rural and Urban Malawi in 2008 (TJ/yr)

Source of Energy	Rural Areas *(TJ per Year*)	%	Urban Area (*TJ per Year*)	%
Firewood	105,320	91	10560	9
Charcoal	2,360	27	6,340	73
Residue/dung	2,980	100	11	0
Electricity	70	4	1,728	96
Paraffin	240	36	430	64
Coal	0	0	5	100
LPG	0	0	2	100
Total	110,970	85	19,076	15




Sources of energy for cooking-Malawi (NSO, 2008)
120
100
80
60
40
20
0
0.4
13.6
1.2
0.7
0
0.1
1.7
43.4
95.7
41.8
1
0.5
Electricity
Paraffin
Gas
Charcoal
Firewood
Others
Rural
Urban


MALAWI
Biomass Distribution
United Republic
of
Tanzania
Zambia
Mozambique
Mozambique
Biomass (cubic m/ha)
Kilometers
0 25 50 100 150 200

Impact of current biomass use on poverty reduction

- Supply side impacts
  - Openshaw (1997) and Lowore (2006) reported that trade in wood fuel in the country's four cities provided 55,000 part time employments valued at US$43.7 million.
  - The Malawi BEST (2009) estimated that the forestry sector, employed about 29,000 people with 20,000 in the informal sector and 130,000 people involved in fuel wood
  - Malawi BEST (2009) estimated that labour costs for charcoal and firewood sold in the urban sector was valued at US$148 per day
  - Kambewa et al. (2007) reported that 92,800 people were involved in the value chain of charcoal as producers, transporters and wholesale and retail traders for the country's four cities
- Demand side impacts
  - Biomass energy as a source of more affordable and accessible energy
  - Unreliability of electricity supply

Impact of Current Biomass use on Carbon Sequestration

Figure 3: Overall biomass supply and demand projections

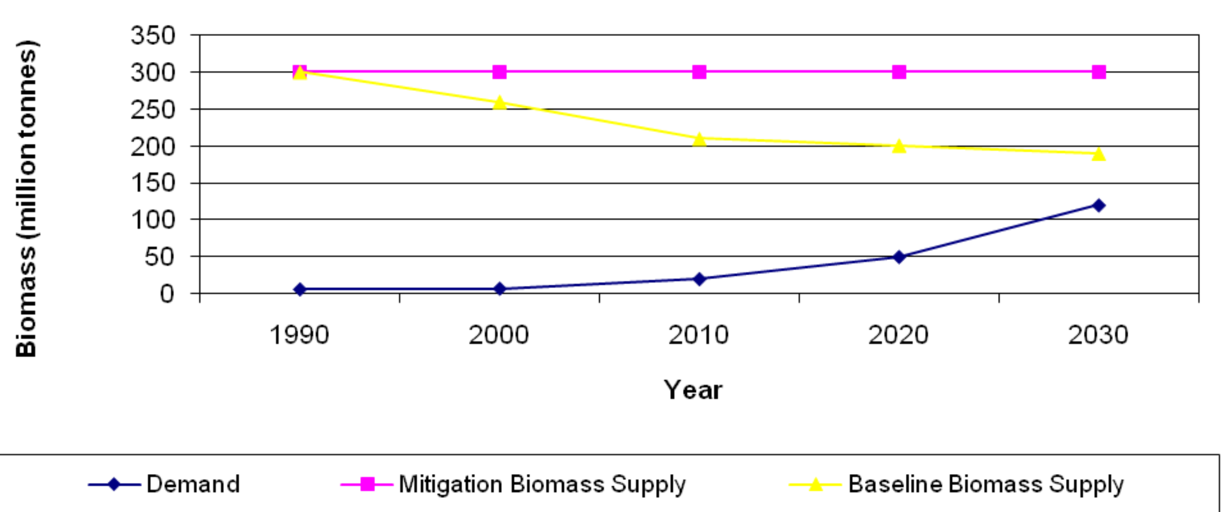


Table 4: Cost effectiveness and benefits of three mitigation options
(Source: Kambewa et al. (2003))

Scenario	Net Present Value		Benefit from Reducing Atmospheric Carbon (BRAC)	Endowment PV cost	
	K/t-C	K/ha	K/t-C/year	K/t-C	K/ha
Natural regeneration	-548.35	-10,490	-4.112	0	0
Protection	-1.58	-110	-0.119	56.31	3903
Short rotation	-2,376.10	-29,730	-17.821	2506.9	32, 042

Impact of biomass use on biodiversity and ecosystem resilience

- Effect of charcoal on preferred species (Kambewa et al, 2007, and Ngalande undated)
- Effect on soil erosion in mid-Shire region (Yaron et al. 2010)

Impact of Biomass Use on Watershed dynamics and flows (off-site effects)

<IMAGE>

- Impact of silting on hydroelectricity generation (US$10 million or 1.9 percent of the country's GDP)
- Cost the Blantyre Water Board US$415,949 in 2008
- Impact on irrigation

Policies that govern biomass use

- The National Energy Policy, 2003
  - improve efficiency and effectiveness of the commercial energy supply industries;
  - improve the security and reliability of energy supply systems;
  - increase access to affordable and modern energy services;
  - stimulate economic development and rural transformation for poverty reduction;
  - improve energy sector governance; and mitigate environmental, safety, and health impacts of energy production and utilisation
- The Forestry Policy, 1996
  - sustainable production and conservation of wood resources and recognises the importance of wood fuels in the national energy supply and the need to bring about improvements in their sustainable production and supply
  - a reduction in the dependence on woodfuel as a source of energy through switching to alternative sources of fuel and adopting woodfuel-saving devices
- The Malawi Biomass Energy Strategy, 2009
  - Increase the supply of sustainable woodfuels;
  - Increase the efficiency of energy use ; and
  - Create the institutional capacity to manage the biomass energy sector
- Other policies/strategies affecting the governance of biomass use and supply
  - Land Policy

  - The Malawi Growth and Development Strategy (conservation of natural resources such as fisheries, forestry and the environment)

Institutions and individuals affecting the biomass use and supply

- **Regulators of production and use of biomass energy**
  - Malawi Energy Regulatory Authority (MERA)
  - Department of Energy
  - Department of Forestry
- **Producers of biomass energy and alternative energy sources**
  - Smallholders/estates
  - ESCOM
  - PIL
- **Users of biomass energy**
  - Households, estates, industry and others
- **Advocacy organizations**
  - Forest Governance Learning Group and its allied NGOs and international partners
- **Parliamentary Committee on Agriculture and Natural Resources**

Innovative Projects in Biomass Use

- Blantyre Fuelwood Project (1986)
- Gelfuel project
- Improved Forest Management for Sustainable Livelihoods
- Community Based Natural Resource Projects

Emerging Issues

- Biomass energy sources are pro-poor from supply and demand perspectives
- Use of biomass (harvesting especially charcoal) still remains stigmatized making it a pariah sector
- Challenge is to make the production of biomass energy as attractive and as legitimate as possible
- Use of alternative sources other than indigenous trees should be explored
- Can production of biomass energy sources be made an attractive business?
- Need to document lessons from various initiatives to isolate driving factors for success and/or failure.

13.00 Lunch

14.00 Steven Hunt (Practical Action UK)

Biomass energy and poverty reduction

This presentation will focus on (i) an introduction to the various ways in which biomass energy is being used to meet poor people's demand for energy and involve them in its supply; (ii) specific case studies of successful initiatives drawn from the PISCES programme and beyond; (iii) appropriate technologies that improve biomass use efficiency especially for the big two - charcoal and fuelwood (iv) policy frameworks that provide options for sustainable commercial use of biomass by the poor (v) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

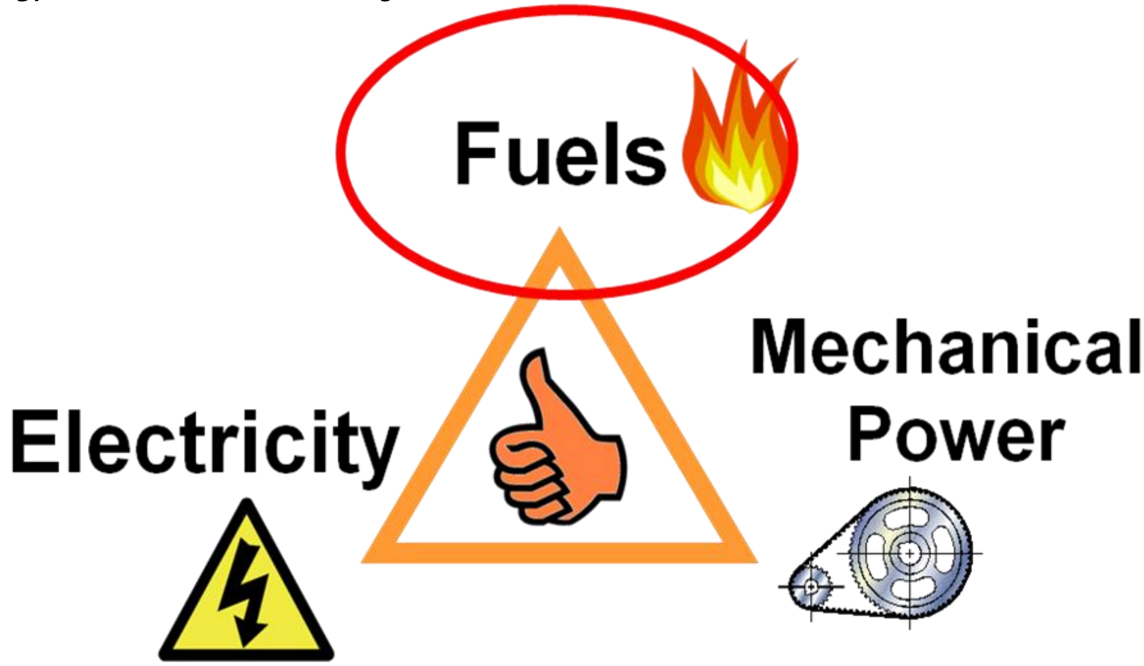
Energy Access and the MDGs

- Poverty
  - Energy as a basic need and for economic activities
- Hunger and drinking water
  - Energy to process and cook food, and pump water
- Child, maternal mortality and disease
  - Energy for lighting, refrigeration, sterilisation, transport
- Education and Equality
  - Energy for basic tasks, home study, security, ICTs
- Environmental Sustainability
  - Reducing emissions, local resources

Energy Services and carriers – biomass has a particular relevance to those marked in red

		Energy Carriers		
		Fuels	**Electricity**	**Mechanical Power**
Energy Services	Lighting	X	XXX	
	Cooking/water heating	XXX	XX	
	Space heating	XXX	XX	
	Cooling	X	XXX	
	ICTs		XXX	
	Irrigation	XXX	XX	XXX
	Agro-processing	XX	XX	XXX
	Manufacturing	XX	XX	XXX
	Lifting–crossing		XX	XXX

Energy carriers – the three main ingredients:

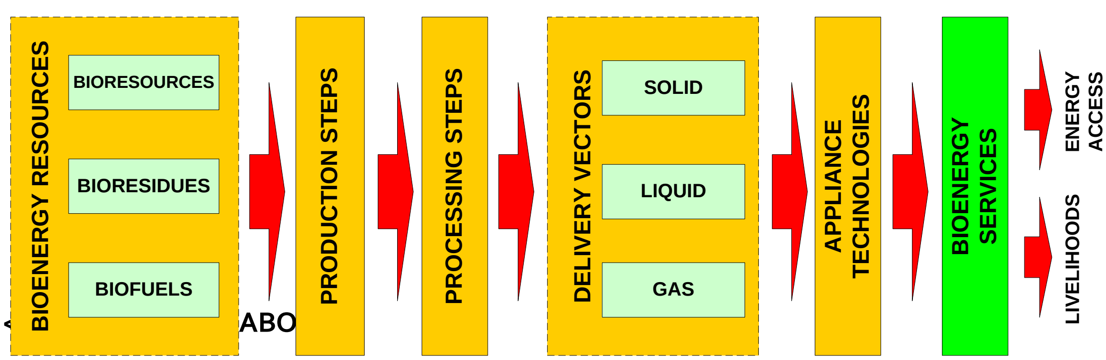


"A reliance on traditional biomass" has been couched as a 'problem'.

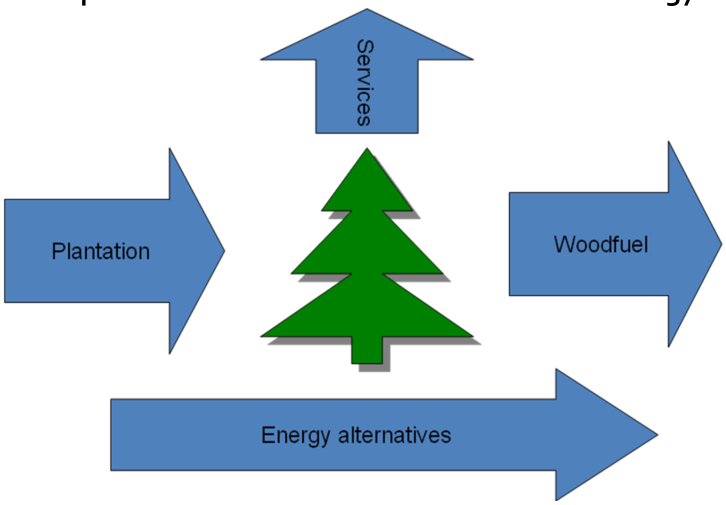
What the 'fuelwood problem' is perceived to be:

- Drudgery
- Deforestation
  - Reducing availability
  - Environmental Damage
- Smoke
  - IAP Kills 1.5M per annum (WHO)
  - CO_2 and Black Carbon
- No access to "modern" energy
  - Safety, cost, security
  - Basic services, ICTs

PISCES Bioenergy Framework



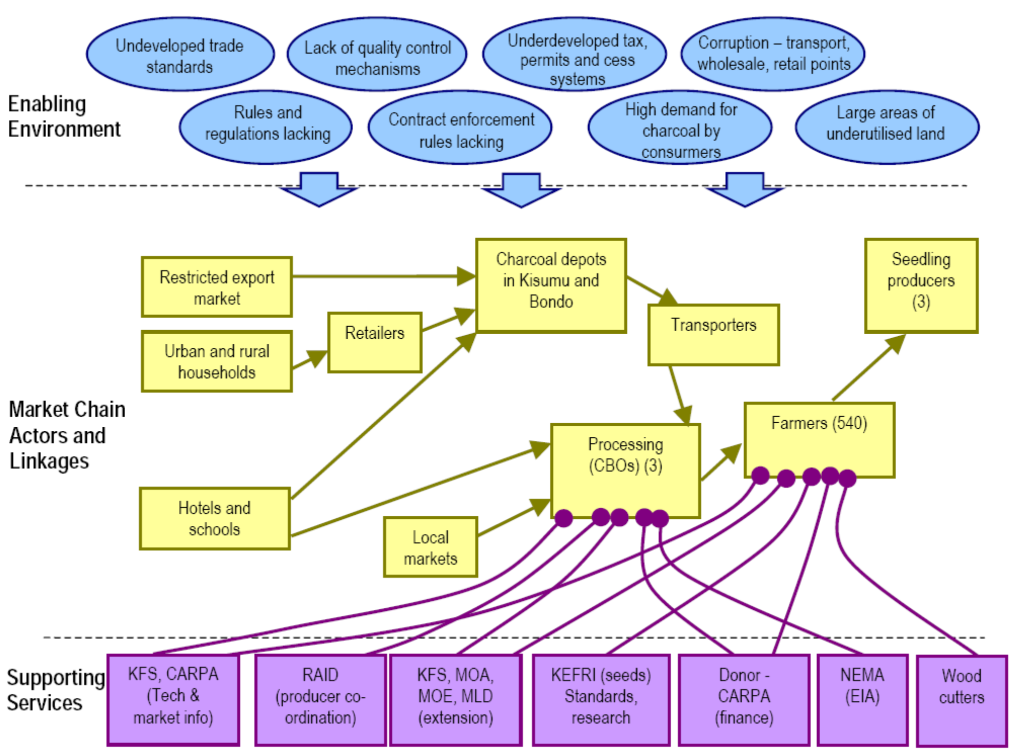
Conceptual framework of link between biomass energy and forest related ecosystem services:



Examples were given of:

- Appliances
- Alternative Fuels
- Whole chain approaches
- Biomass for rural industry

A value chain approach was recommended as one way of improving impacts:



Policy research issues

- Land rights and ownership
- Technologies and capacity
- Standards and certification
- Financing and taxation
- Planning and regulation
- Communication and enforcement
- Monitoring and verification
- Sustainable market development

14.30 Alan Bond (University of East Anglia)

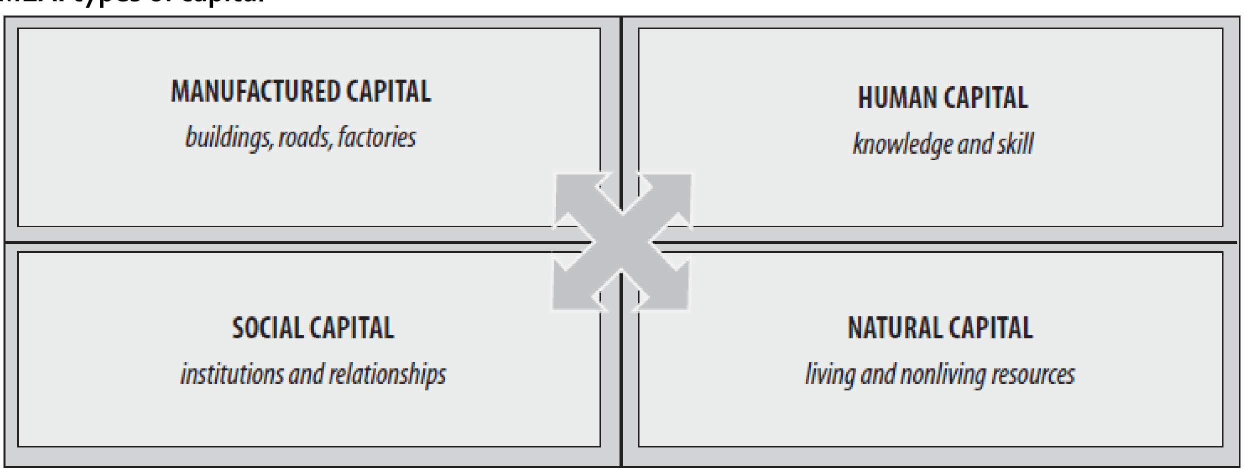
Biomass energy and ecosystem services assessment

This presentation focused on (i) an introduction to ecosystem services as defined in the Millennium Ecosystem Assessment (ii) an introduction to a system for Environmental Impact Assessments (EIAs) of projects, and for Strategic Environmental Assessments (SEAs) or Sustainability Appraisals (SAs) for biomass energy crops - together with RRes as appropriate (iii) current examples of the use of such frameworks in biomass energy initiatives (vi) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

Millennium ecosystem assessment: Introduction

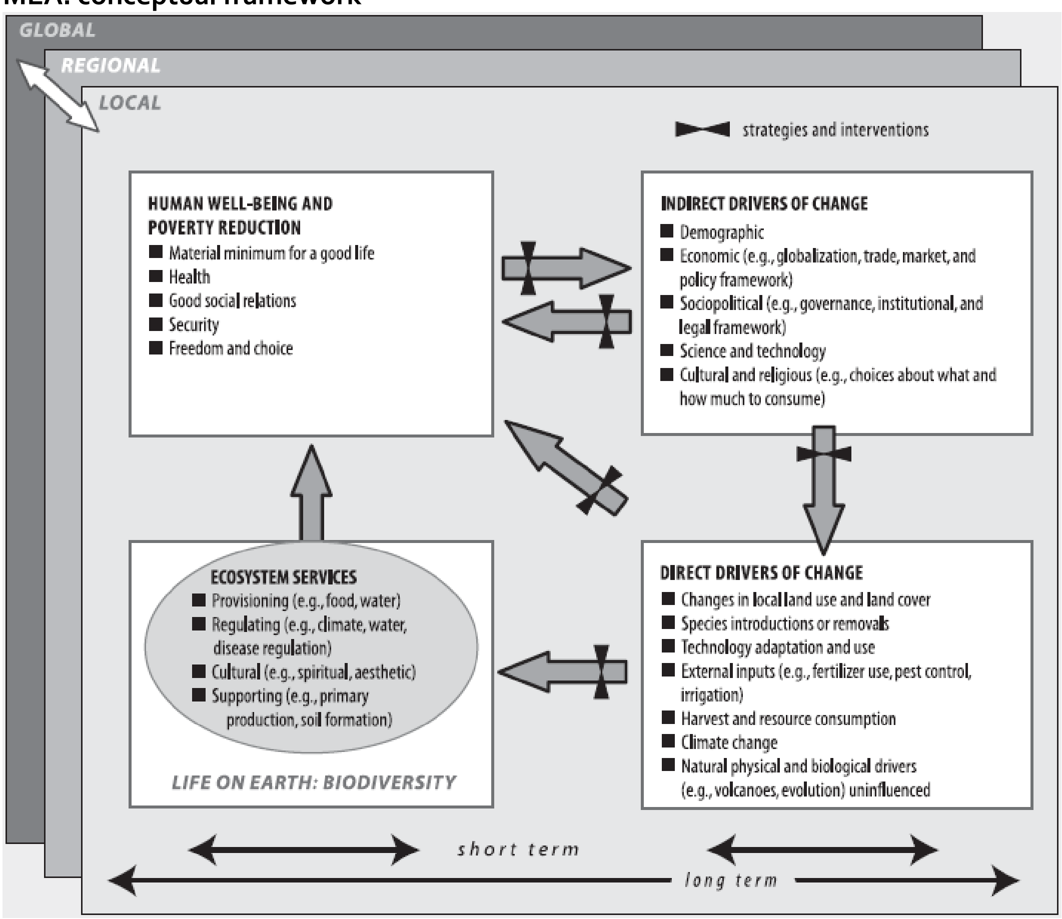
- MEA called for by the United Nations Secretary-General Kofi Annan in 2000 (initiated 2001)
- Objective to "assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being"

MEA: types of capital



MEA: Ecosystem Services

MEA: conceptual framework



MEA: overview

- Human health and well-being focused
- Trade-offs common in order of provisioning; regulating; cultural services (Rodriguez et al. 2006)
- Four scenarios tested and suggest need for (Carpenter et al. 2006):
    - Resilience building
    - Adaptive management
    - Green technology

Introducing environmental impact assessment (EIA) for biomass energy

- EIA since 1970 in USA
- Most countries in world have EIA legislation
- Usually refers to agriculture and forestry projects
- In practice – limited EIA takes place (agriculture permitted development in UK – no obvious decision points)
- End use tends to be subject to EIA

EIA focus

- EIA originally designed to redress socio-economic bias
- EU Directive focuses on:
    - human beings, fauna and flora;
    - soil, water, air, climate and the landscape;
    - material assets and the cultural heritage;
    - the interaction between the factors mentioned in the first, second and third indents

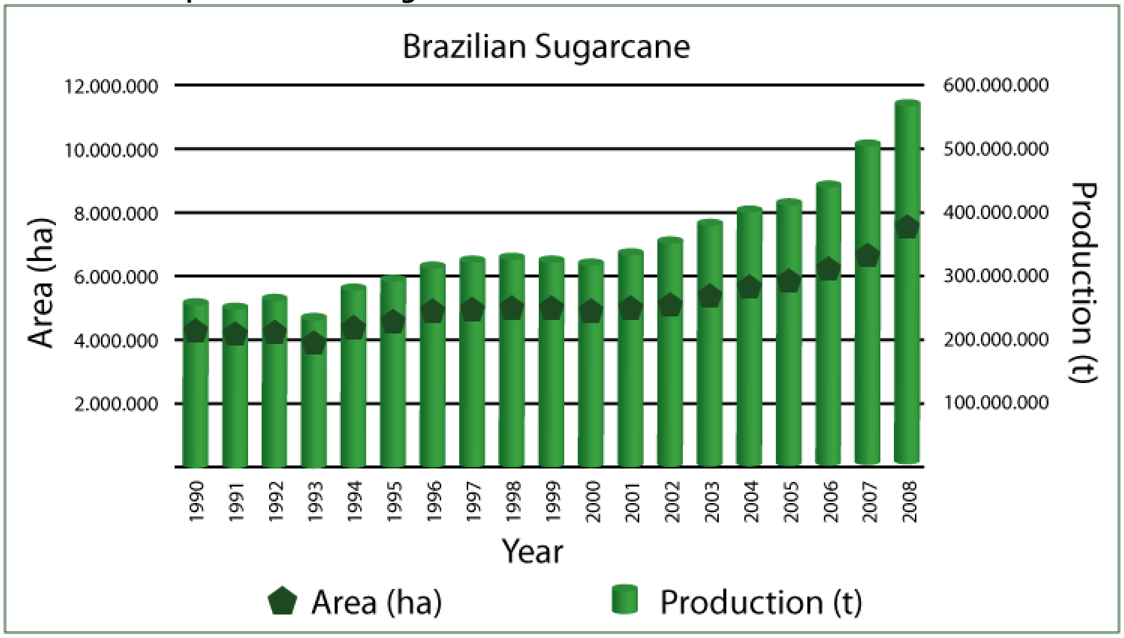
EIA practice (UK example)

- For power stations: guidance that requirement starts at 50MW output (in practice it is lower)

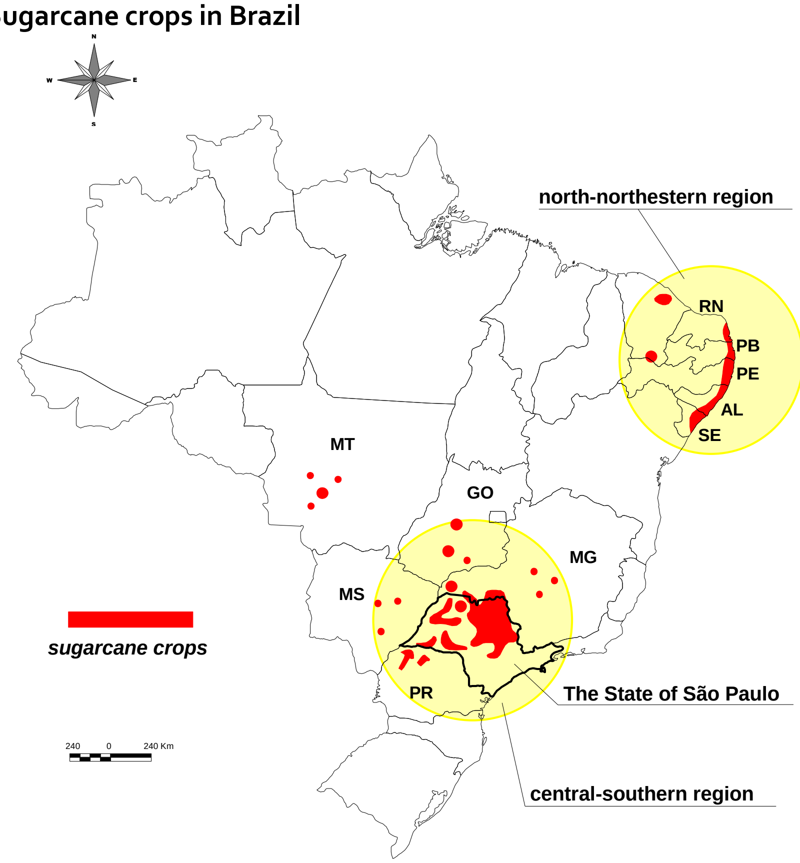
What is Sustainability Appraisal / Assessment (SA)?

- Broad assessment of social, economic and environmental implications of doing something
- Practice in England, Western Australia, Canada, South Africa
- Application level (policies, plans, programmes, projects) varies
- In England – SEA is subsumed with SA

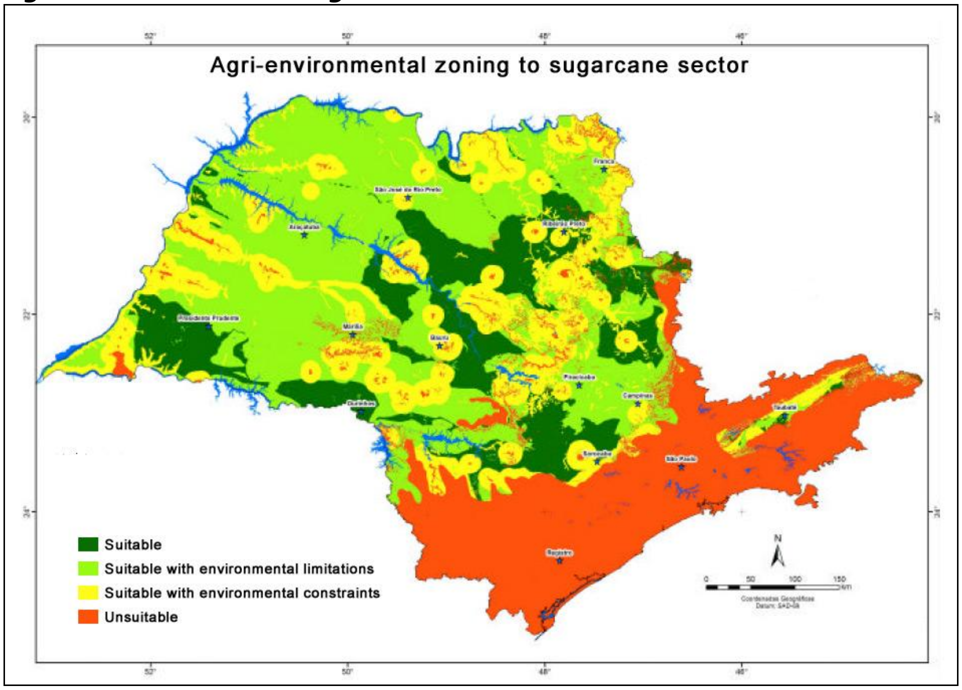
EIA case example – Brazilian Sugarcane



Sugarcane crops in Brazil



Agri-environmental zoning



Requirements for the approval of new projects in São Paulo

Type of zoning	Main requirements
In suitable areas	▪ appropriate environmental study (PER or EIS) in accordance with Resolution SMA 42/2006 ▪ Maximum water consumption 1 m^3 per ton of processed sugarcane ▪ Rehabilitation of riparian vegetation
In areas considered as suitable with environmental limitations	▪ EIS ▪ Continuous air emissions monitoring (particulate matter and NOx) ▪ Detailed study of aquifer vulnerability ▪ Underground water monitoring and target of maximum nitrate concentration of 5 mg/L ▪ Maximum water consumption 1 m^3 per ton of processed sugarcane ▪ Full protection of remaining natural vegetation stands and wetlands ▪ Landscape ecology studies to support any request to fell isolated remaining trees
In areas considered as suitable with environmental constraints	▪ As above and ▪ Establishment of ecological corridors ▪ Fauna monitoring during operation ▪ Maximum water consumption 0.7 m^3 per ton of processed sugarcane ▪ Detailed landscape ecology and ecological studies
In unsuitable areas	New projects are forbidden

EIA in Brazil – effectiveness

- Mismatch between impacts studied and those which are significant
  - Socio-economic impacts largely missing (not an issue with badly done EIA necessarily)
- Project EIA works on too small a scale for land use change impacts
- More strategic assessment with a broader focus needed
- Human rights issues?

Case example – the Relu-Biomass project

- Land use under biomass crops is expected to expand
- Perennial Biomass crops are:
  - In the ground for circa 25 yrs
  - Harvested in winter/spring
  - Dense, tall crops

Potential implications for:

- Landscape
- Tourist income
- Farm income
- Water
- Biodiversity
- Soil

Sustainability Assessment case study: Relu-Biomass

- Both SRC willow and Miscanthus
- Two contrasting regions studied (SW England and E-Midlands)
- Utilised existing data & generated new data to fill knowledge gaps
  1. GIS-based suitability mapping and landscape visualisations
  2. Public surveys (n=490), stakeholder and focus groups
  3. Biodiversity assessments (24 fields of each crop)
  4. Water use assessments (over the year in both crops)
  5. Economic assessment from farm to wider scale

Sustainability Appraisal Framework

- What do we want the area to be like in the future (our objectives)?
- How do we measure this (indicators)?
- Objectives and indicators should be established through critical examination of existing policies/objectives and pressures in the given sector/area
- They should be agreed by as many stakeholders as possible

Typical objectives and indicators

- Protect and enhance biodiversity
  - Bird population indices (a) farmland birds
  - Characteristic plant and invertebrate species/groups
  - Butterfly abundance
- Enhance viability of farming
  - Average duration of product supply contracts
  - Number of farms with alternative enterprises
  - Farm profitability

Sustainability Appraisal process – some issues?

- Typically 20-30 objectives
- Typically at least 3 indicators per objective
- Likely to be testing each scenario / option / alternative against over 100 indicators
- Multiple interpretations of sustainability
- Different framings of effectiveness (substantive, transactive, process)
- Reductionist

Scenarios development

SOUTH WEST

1. LAND COVER

SW Scenario

1a) 43,000 Ha of Miscanthus planting

1b) 18,000 Ha of Miscanthus planting

1c) "Extreme" 130,000 Ha of Miscanthus planting

2. BIOMASS END-USE

2a) Small-scale CHP (Based on 8MW CHP units)

2b) Large-scale co-firing (Based on 100MW-biomass units)

2c) Dedicated Biomass (Based on 40MW units)

3. LANDSCAPE MANAGEMENT: SW

3a) Monocrop Miscanthus - Heavily aggregated

3b) Monocrop Miscanthus - Realistic scenario

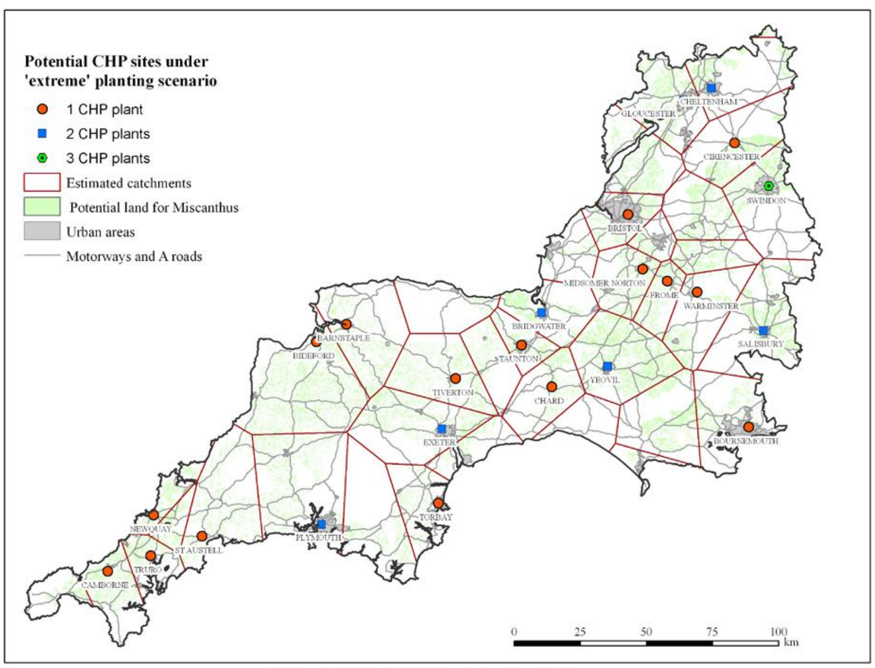
3c) Monocrop Miscanthus - Evenly spread

4. FIELD MANAGEMENT

4a) 4m

4b) 10m

Scenarios – developed to actual locations



EM-SW-zonal2/SW/SW-Final-PowStat-map.mxd 7.2.09

Biomass crops in the landscape

- Most people were unconcerned –thought crops would fit in well
- More concerns over lorry movements and where the power stations would be
- Wider margins and smaller, scattered fields were slightly more favoured

Biomass crops and water use

- SRC willow and Miscanthus roots grow no deeper than deep rooting annual crops.
- SRC willow water use is similar to that of a cereal crop, higher than permanent grass and lower than that of mature woodlands
- Miscanthus water-use approaches that of woodlands.

Biomass crops and biodiversity

- More butterflies in the field margins of both energy crops
- SRC has positive effect on farmland and woodland birds Miscanthus more variable
- More weed biomass and invertebrates in SRC than Miscanthus
- Certain important species may be negatively affected
- Plantation design and management are important

Stakeholder concerns / concerns about stakeholders!

- SA is a tool that can lead to perverse decisions because of trade offs (e.g. planting on SSSIs) – constraints mapping
- 'Experts' have insufficient grasp of local issues to be trusted to interpret SA results
- Scale is a critical issue – statutory consultees tend to work on a national, not regional scale

Impacts on alternative land-use

- Yield map for all soils except organic (~ 11 M ha)
- Yield map for 9 absolute eco-environmental constraints (<8 M ha)
- Yield map 2, secondary, constraints (<5 M ha)
- Yield map for all constraints plus ALC 3 & 4 (~ 3 M ha)

Ways forward?

- Accommodating pluralism is key
- Correct spatial scale is large
- Ecosystem services a nice concept – but potential for poor trade-offs
- No set list of indicators applicable everywhere
- Have to work for those who will directly use the ecosystem services
- Have to be creative over alternative means of 'service' provision

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15.00 Jonathan Finch – (Centre for Ecology and Hydrology)

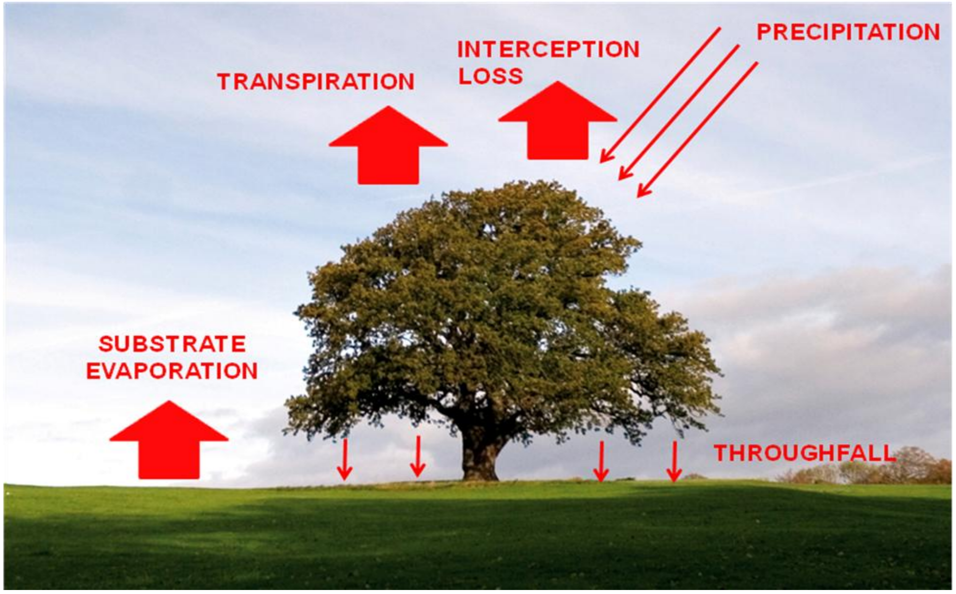
Biomass energy and watershed management - considerations for dedicated energy plantations and biomass from natural forests

This presentation focused on (i) a general introduction to the hydrological effects of biomass energy plantations and / or natural forest (ii) specific case studies of how the use of biomass energy has affected hydrological services (iii) monitoring techniques that might be used to evaluate impacts (iv) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

The Issues

- Water quantity – how is the water balance of a catchment changed with consequences for resources and hazards?
- Water quality – e.g. fate of agri-chemicals, soil erosion
- Water is a directional ecosystem service – the impacts do not necessarily coincide spatially with the production

Vegetation Water Use



Constraints on Evaporation

Climate	Vegetation type	Evaporation constraint
wet temperate	tall	air turbulence
	short	plant physiology and sunshine
dry temperate	tall	plant physiology and sunshine
	short	plant physiology and soil water availability
dry tropical	tall	soil water availability
	short	soil water availability
wet tropical	tall	rainfall intensity and sunshine
	short	sunshine

Water Use of Forestry

There is a sizeable body of literature on the impact of forests on water quantity:

- Forestry almost inevitably leads to higher annual evaporation losses.
- There is no evidence that forests "attract" rainfall.
- Forests are more likely to decrease dry weather flows than increase them.
- Forests' ability to moderate floods is much less than often claimed – small storm magnitudes and limited catchment sizes.

Water Use of Biomass Crops

- The majority of studies come from the USA and Europe.
- The focus has been on short rotation coppice and "energy grasses", e.g. Miscanthus and switchgrass
- A limit to some of the research has been that they quantify the water use only during the growing season – hydrologists need the annual budget.
- The results suggest that the annual water use of biomass crops is higher than conventional crops but lower than forestry.
- It is difficult to directly compare the results from measurements studies – models allow us to do this.

Water Quality – Soil Erosion

- Natural forests tend to have lower erosion than agricultural and pasture.
- Managed forests – poor practices can result in high erosion rates, e.g. clear fell, roads, drainage ditches etc.
- Perennial biomass crops might be expected to act like managed forests, but there are very few studies.
- It is difficult to scale up from the plot to the catchment – barriers and pathways

Water Quality – Agricultural chemicals

- Managed forests do not usually have agri-chemicals applied
- Perennial crops generally have a low requirement – herbicides sometimes applied during crop establishment, low rates of fertiliser applications.
- Limited research in the literature.
- Agri-chemicals normally breakdown in the top few metres of the soil, but the rainfall regime is important.
- Further changes occur during transportation to water bodies – dilution and dispersion.

Impact of Land Use Change

- Very dependant on what replaces what and what the climate is.
  - e.g. a higher evaporation loss might be desirable, Australian wheat belt
- Also the baseline selected for deciding whether a change is beneficial or detrimental.
- Heterogeneity of the landscape is challenging.
- Models exist that can be used but major research issues are spatial scales and quantifying the uncertainties.

Impact of Processing the Biomass

- Comparatively little information except for biofuels.
- Industrial scale processing could have a significant impact but it will be dependant on a variety of factors, e.g. scale, efficiency, handling of raw materials.
- Water quality may be more important than water quantity – effect of waste effluent.

15.30 Tea

16.00 Richard Tipper (Ecometrica)

Importance of remote sensing and ground based surveys in the design, implementation and monitoring of biomass energy projects and carbon

This presentation focused on (i) an introduction to GIS remote sensing and ground based surveys for biomass assessments (ii) guidance on building local capacity to monitor relevant quantitative aspects of biomass (iii) suggestions on how biomass energy might (or might not) be able to capitalise on the carbon markets and (iv) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

Where is intervention required / worthwhile?

- In most rural areas of developing countries, biomass in form of wood is the default / mainstream form of heating and cooking energy.
- There may be a case for intervention in technologies such as improved stoves for health and social welfare.
- But from resource management perspective, communities and families are able to organise adequately and there may be no substantive requirement for formal / expensive monitoring and control systems.
- Don't think of traditional bioenergy in terms of projects.

So, where and when are more formal (technical) monitoring systems appropriate?
Biomass constraints and resource problems tend to occur where urban demand for charcoal and woodfuel exceeds sustainable production capacity over a wide area. Cities, large towns, industrial plants, traditional energy intensive industries (e.g. fish smoking, tobacco curing). Intervention may also be required in context of 3 Cs

- Climate – climate change affecting biomass production or causing change in demand (migration)
- Capital – changes in local economic system, investment, new demands
- Conflict – migration, reduced access to resources

What is context of Using RS and Ground-based measurement?

- Regional assessments of potential
- Project level feasibility / investment studies
- Project due diligence, IEA
- Monitoring

Commercial Bioenergy / Biofuels

- On-going monitoring
- Controls

Traditional bioenergy

What are the characteristics of <u>useful</u> monitoring systems?

- Must be needed
- Need must be widely accepted
- Must be part of a system responding to signals through controls or other actions
- Response could include increased production as well as constraining consumption
- Response could also include improved use efficiency

Key Challenges for measurement and monitoring systems
Commercial systems
- Must be linked to investment and formal controls

Traditional bioenergy
- Legitimacy and effectiveness of controls (corruption)
- Local dependence on licence revenues promote unsustainable use
- Difficult to change / improve informal systems

Technical Monitoring Issues
- Affordability
- Resolution
- Timeliness (repeat cycle; processing time; distribution time)
- Spectral coverage
- Linkage with ground based data
- Cross-reference with other info (ownership, licences.....)

Choosing optical RS data requires trade-offs
- Spatial resolution
    - pixel size
- Spatial coverage
    - scene size
- Repeat frequency
    - satellite orbit
    - continuous/specified acquisition

- Spectral resolution
    - width of bands
    - no. of bands
- Signal-to-noise ratio
- Sensor characteristics
- Conditions (ground, atm.)
- Cost

Higher resolution images show more detail
LANDSAT 30m>
Aster 15m → e.g. sharper edges, forest canopy structure >

LANDSAT 30m>
Ikonos 1m e.g. individual trees>
... and cost more!
e.g.
- Landsat (30 m) → £0/km² (1978)
- Aster (15 m) → ~ £0.02 /km² (2000)
- SPOT 5 (5 m) → ~ £0.65 /km² (2002)
- Ikonos (1 m) → ~ £15 /km² (2000)

Applications of RS to bioenergy / biofuels

- **Identification and mapping of ecosystems** in and around potential biofuel production areas
- Definition of **historic land use** and ecosystem change prior to any biofuel feedstock production
- **Planning of ecosystem conservation**, restoration and management within and around production areas
- **Monitoring of changes** to productive and natural ecosystems

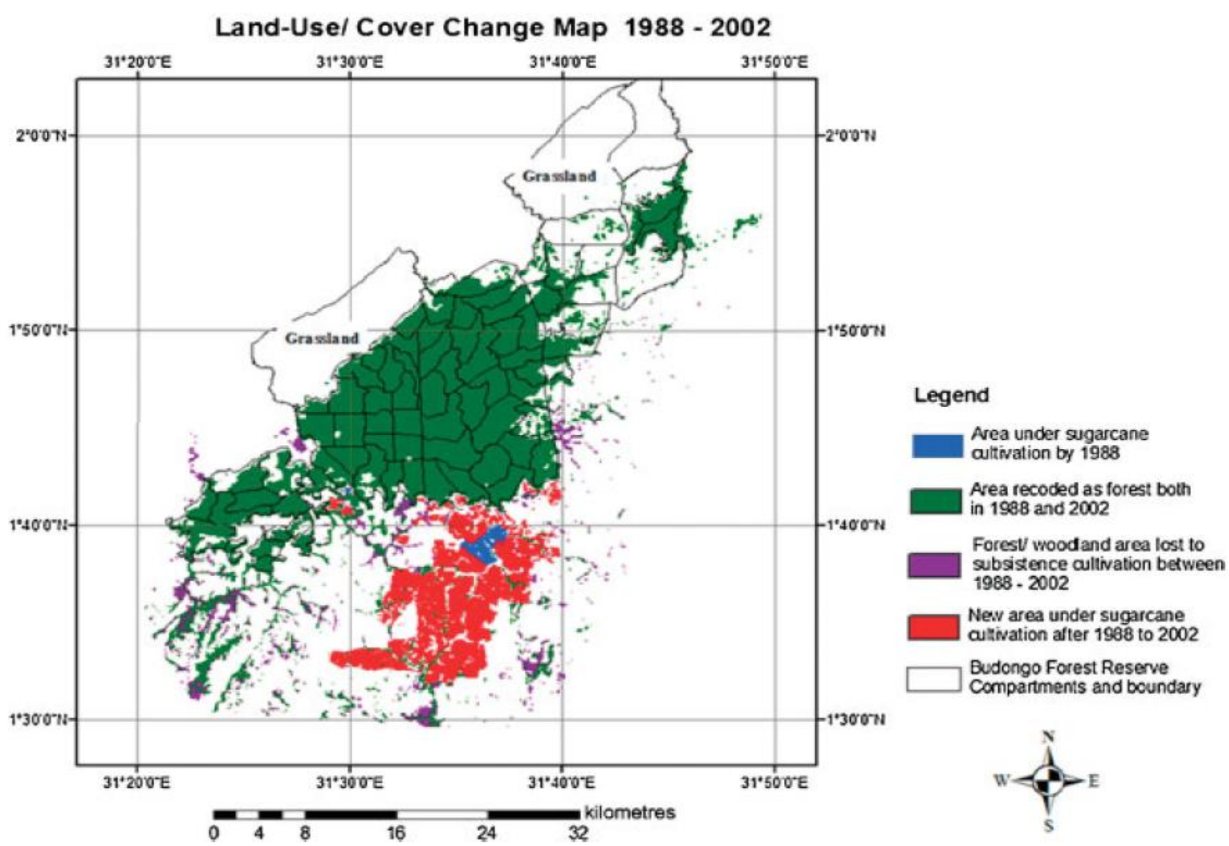
Monitoring change in vegetation / biomass resources

This can be achieved by:

- Acquiring RS data at frequent intervals during the project period (LC classification)
- Combine field data from permanent monitoring plots with this RS data (e.g. to show increase in biomass/biodiversity)

Example: LUC from sugarcane

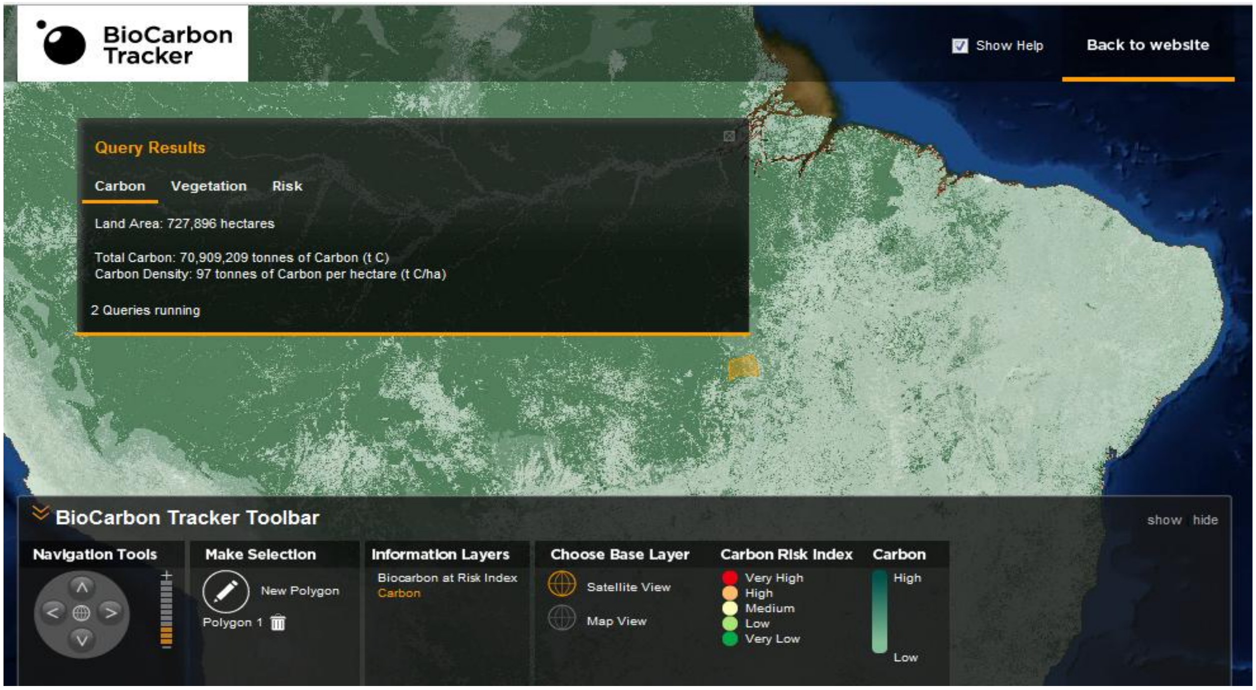
Multi-temporal Landsat data to monitor the encroachment of sugarcane on the Budongo forest reserve, Uganda



Proposed Technologies to Test

- Participatory, web based monitoring (mobiles - licences)
- Auto download RS data (found to be effective at reducing activity in Brazil)
- Example: www.biocarbontracker.com

BioCarbon Tracker



Carbon / Biomass Markets

- Still immature, and uncertain beyond 2012
- May be linkages to Renewable Energy Directive via supply chain requirements, but these will be for specific locations in vicinity of export biomass areas.

16.30 Wendolin Aubrey (Bioclimate Research and Development)

Community biomass energy project development

Providing (i) an introduction to necessary steps in the development of community access to energy (ii) processes of developing community capacity to assess different energy options - including biomass (iii) useful frameworks to develop biomass energy pilot projects and (iv) conclusions on the components of a research framework that might be necessary to promote a transition towards biomass energy that reduces poverty and detrimental impacts on ecosystem services.

Community engagement

- BioClimate
- Community context
- Appropriate project?
- Project development framework
- Transition to bioenergy

Community-driven land management and sustainable bioenergy projects

Senegal

- Efficient cookstoves
- Afforestation & reforestation, agroforestry, avoided deforestation

Nepal

- Fuel efficient cookstoves
- Afforestation & reforestation, agroforestry

Cameroon

- Methane capture, solar cookers, solar lamps
- Avoided deforestation, agroforestry, sustainable agriculture

Uganda

- Woodlots

Community context – What is the context with respect to community, livelihoods and resource use

- Poverty, labour
- Land ownership, tenure, resource use rights
- Culture and structure of community
- Natural resource use
- Partnerships
- Markets
- Energy access
    - Resources
    - Uses
    - Needs

Opportunities

- People involved (actors in input-production-output chain)
- Access to finance, credit
- Women, ethnic groups

Constraints

- Technology
- Market access
- Input supply
- Finance
- Policy
- Management and organisation
- Infrastructure – transport
- Large-firm competition
- Social, cultural, legal constraints

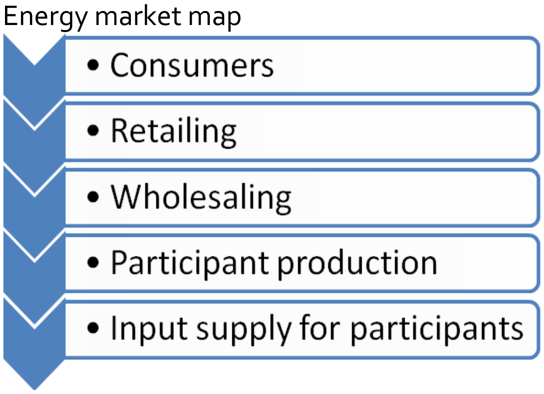
Community context – How to gather information

- Key informant interviews
- Focus groups
- Workshops
- Surveys

How do you know if it is an appropriate project?

- Community capacity
- What can the community run?
- Organisation – collaboration between market supply & demand sides
- Labour – poverty, time, women
- Maintenance
- Technical skills
- Ranking bioenergy technologies
- Attractiveness matrix, weighted ranking
    - Criteria
    - Relative importance of criteria

Energy market map



Project development framework
Participation & capacity strengthening

Do pilot project
Follow implementation steps
Record, maintain, adapt

1) Assess and scope out project idea – work with people who understand the communities
- Identify project opportunity, landscape, potential areas of working
- Carry out community & local stakeholder consultations, field & other research into:
- Ecological aspects
- Landscape, land use, livelihoods
- Social & community aspects
- Policy, legal, institutional aspects
- Participation aspects
- Assess risks & challenges of introducing a bioenergy project and the implications for project design and implementation approach
- Select pilot sites and communities
- Describe project idea

2) Initial preparation and planning
- Define & set up project governance & management structure
- Assess & create plan to strengthen implementation capacity of coordinating organisation
- Draw up overarching project implementation plan & budget
- Obtain funding for project development
- Develop framework for monitoring, reporting & evaluation of programme progress and outcomes

3) Official engagement and support building
- Establish contact with relevant officials, structures & stakeholders to explain & gain support for the project
- Work to align institutional arrangements (e.g. land management rights) & project requirements
- Define opportunities (information sharing, training) & methods of working, build institutional partnerships

4) Community engagement & project design
- Facilitate community consultations to raise awareness and build support for project activities
- Identify, appoint, train & support workers
- Conduct socioeconomic surveys at project sites
- Define project activities & target land areas at each site (waste, existing sustainable resources, bioenergy crops)
- Develop & implement community capacity building programme
- Identify and/or gear up community nurseries (bioenergy crops) for programme activities
- Write project manual

5) Technical development
- Land management – sustainable ecosystem services
- Bioenergy – application of technology
- Draw up technical development plan with steps to address data gaps and meet support needs
- If applicable - Ensure site boundaries and land use & land cover (LULC) types are accurately mapped
- Finalise GIS maps of target areas for project interventions
- Train & do any required biomass (and biodiversity/other) surveys with communities
- If applicable - Define methods and quantify carbon stocks at project start point
- Determine project baselines for each project intervention

- Assess risks to durability of project carbon benefits & determine risk buffer
- Consult communities & write up management plans for each project activity
- Write up technical manual/guide for each project activity

6) Develop monitoring system and payment mechanisms
- Develop monitoring system with payment agreements
- Establish community monitoring teams, provide training & support
- Establish mechanism for managing payments
- Agree community governance arrangements for the management of payments
- Develop project database for managing technical, monitoring & payment data
- Decide how initial funding will be used across sites & activities
- Agree approach for staging payments for each programme activity at each site
- Prepare community contracts linking activities & outcomes

7) Start project activities, monitor, improve
- Agree schedule for implementation of management (activity) plans
- Communities initiate project activities a per implementation plan
- Implement monitoring system for project activities
- Make initial round of service payments
- Assess & improve monitoring systems
- Adapt project as required

Transition to bioenergy

Understand community
- Involve community – cooperation and partnership

Project is community driven
- Learning by doing

Community projects succeed when…
- When projects are developed in a participatory and inclusive way
- When projects start within their means and grow within their means
- When things are made as simple as possible
- Where communities are given the means and support to succeed
- When communities take responsibility and see benefits
- When the national government and policy are supportive
- When the coordinator is strong and capable
- When there is transfer of skills and increased self reliance
- Where the technology works & is appropriate for the community

Partnerships

Central role of the coordinator
- Implementation leader - programme champion and problem solver
- Drives consultation, engagement, facilitation, partnership building
- Must have a strong relationship with all key participants

- Responsible for drawing together key components, management, organisation
    - Technical
    - Administrative
    - Social

17.00

Plenary discussion on interesting facts, approaches and gaps highlighted by review panels

The review panels comments on each presentation (and some discussion points arising are captured in the table below:

PRESENTATION	FACTS TO EMPHASISE	APPROACHES TO USE	GAPS TO ADDRESS
IIED	• Scale of biomass use remarkable • 50 year time horizon. Subsistence → commercial • Ecosystem services/sustainability: how to put biomass into this area/terminology • Land tenure as a key issue	• Demand side research building on political economy	• Transition to sustainable supply in contexts of poor tenure security
Rothamstead Research	Global scale: Lots of research available (Domburg *et al.* 2010) on bioenergy supply • Global biomass potential use is high: • Global biomass used (38% of possible) Least used in Latin America and Middle East • Focus on: "Abandoned land" "Marginal land" (Africa, South America) ~ 700 million ha could be used • Impact assessment → bioenergy on climate change→ "energy balance" (research), carbon sequestration • Land use, land resource mapping is interesting	• "Global assessment": overview, principles, impact assessment • Supply chain analysis: inventories, zoning, water/energy balance modeling, multipurpose production systems • Yield map: miscanthus; water availability vs. yield potential; constraints ([i] cities, moors etc. [ii] grassland, tourism); farmer perceptions (economic gain) →Where to grow + multiple applications (GHG/economic/producers) • Standardised measurements • Analysis of abandoned lands/marginal lands	• Different types of bioenergy → ESS linkages • Need to get beyond "Food + Fuel" • To what extent should we accept "Natural" plantations?" • To what extent should we do planning vs. evolution • Who grows what and why is a key question • Prospects for boosting fertility? • Interaction with local climate versus global climate

PRESENTATION	FACTS TO EMPHASISE	APPROACHES TO USE	GAPS TO ADDRESS
The Energy and Resources Institute, India	• Carbon credits available for cookstove use • India energy consumption expected to rise 3-4 times current levels in next 25 years • Inefficient electricity transmission in remote areas • IAP issues with 85% rural 24% urban mud stove use • Biomass competitive with fossil fuels for energy • Employment impacts not understood at present	• Intrahousehold energy mix (biomass, electricity, etc.) • How do we improve biomass use (technology development) • Household energy choices • Public-Private partnerships in biomass production • Identify households that are using different sources of energy (poor, gender, landless, etc.) • Work out appropriate incentive structures for use and production of biomass	• In terms of efficiency: what are the optimum scales for energy production/ distribution -grid, local but centralised, household • How to engage the feedstock producers • Definition of available land need care
Practical Action, Kenya	• Energy from charcoal, 90% use in rural households and 82% use in urban households • Only 43% of this from sustainable sources • Choice due to low price • Energy – driver of deforestation – proximity to population centres → Ecosystem service links strong • Policy frameworks for sustainability exist but need to be implemented • Source of finance – carbon markets might be one option • Community enterprise versus impacts of largescale-e.g. tea • Reduce resource need through efficiency • Ownership + responsibility for stakeholders	• Approach and methodology for macro/micro level data collection/collation (use of state of the art) – Compare with creation of Biomass Res. Atlas • Approach and methodology to calculate cost of energy (eff. biomass usage) – Compare to India • Policy support for attracting private sector investments • Technology – end use – cost/economics – mapping • Upscaling of biogas/cookstoves • Value chain and delivery models • Monoculture propagation – pros and cons	• Both economic and ecological maximum sustainable production for each source of bioenergy – if biomass is going to be competitive with other energy sources/alternatives • Need to address the negative impacts of afforestation/re-forestation as well: ➔ water cycle, hydrological services of forest ➔ what type of forest to plant? ➔ potential to be part of REDD++ • Too much emphasis on supply side. How about demand?

<table>
<tr><th>PRESENTATION</th><th>FACTS TO EMPHASISE</th><th>APPROACHES TO USE</th><th>GAPS TO ADDRESS</th></tr>
<tr>
<td>University of Malawi</td>
<td>97% of primary energy supply from biomass
98% of household energy from biomass
Urban/Rural divide:
<table><tr><td></td><td>Rural</td><td>Urban</td></tr><tr><td>Firewood</td><td>91</td><td>9</td></tr><tr><td>Charcoal</td><td>27</td><td>73</td></tr></table>
Supply side employment → charcoal making species disappear over time (Kambewa, 2007)
Policy: use of sustainable biomass and alternate fuels
Lack of legitimacy in charcoal
Gender issues/equity/access issue</td>
<td>Energy by sector and fuel type – assessing demand for population against other available sources
Biomass distribution (by admin. region): differentiation between regions (southern deficit)
Survey about people → useful figures for socioeconomic conditions in determining “sustainability” principles
Ecosystem services: preferred species → changes in dominant spp. “dynamics and flow of watersheds”</td>
<td>Excellent statistical base.
Think of poverty as more than income/ energy security/ social resilience, etc.
Positive pilot projects
Political resistance to implementing pilots
Efficient stove work?</td>
</tr>
<tr>
<td>Practical Action</td>
<td>PISCES → whole chain approach useful Energy-dependent services analysis good Electricity (power) – fuel – machine – how about mobility (transport fuel?) Bioenergy: low income, cooling-heating-manufacturing → health hazard, environmental damage, time consumption Waste/resources vs. fuel opportunity Technology to improve energy access and livelihood is key Balance of forest: ecosystem services | managed forests | technology introduction in resource provision and energy efficiency | alternative fuels (LPG, BG)</td>
<td>Value chain analysis well developed i.e. actors, supporting actors and enabling environment
Poverty approaches/methodologies</td>
<td>Sustainable forest management (of existing forests and managed wood lots) for resource use +
Tree planting: native species, timber + fuelwood
Where deforestation + degradation is driven by unsustainable wood harvesting, any alternative bioenergy will help to reduce this pressure
Current information about bioenergy use → check local applicability</td>
</tr>
</table>

PRESENTATION	FACTS TO EMPHASISE	APPROACHES TO USE	GAPS TO ADDRESS
University of East Anglia	• Millennium Assessment – people orientated. Leads to Ecosystem Services – a classification in terms of "managing" – dominantly trade offs • EIA – refers to agricultural + forestry but in reality is limited to large projects Mismatch between impacts studied and those which are significant Project scale too small for land use change impacts • Sustainability appraisal - stakeholder driven – so aspirations → objectives that need indicators - but lots of objectives indicators – so need to reduce - Role of stakeholders critical e.g. recommending exclusion	• Sustainability Appraisal seems a useful method : pluralist • Appraisal – aspirations (20-30) / indicators (x3) • To what extent do we need to zone our work and how? E.g. population density in Malawi	• Assessment of vulnerability of ecosystem and its services to climate change • Sustainable livelihood approach
Centre for Ecology and Hydrology	• Water is a directional ecosystem service • Things will change in rainfall in 50 years • Soil – must integrate water and carbon • Forests don't attract/produce rainfall • Natural forests lower erosion (roots + leaves protect) • Miscanthus is nitrogen fixing. Helps fertility • Right plantations for right conditions	• Limited research thematically and geographically • Studies: different locations/methods. Difficult to compare • Numerical models can be used instead for comparison • Challenges: spatial scales; quantifying uncertainties; specific to researchers • Moving to next generation → sharing of tools • Hydrology component has to depend on focus determined by ESPA team	• Water use for crops outside Europe/USA – validity of existing models? • Understanding of catchment scale processes (e.g. soil erosion) • Agreement on targets needed – what level are we seeking against indicators?

PRESENTATION	FACTS TO EMPHASISE	APPROACHES TO USE	GAPS TO ADDRESS
Ecometrica	• Monitoring vs. modeling (quantifying from measurement) – remote sensing and ground-based methods. • Identifying areas (e.g. around urban areas, industrial/ traditional energy intensive) • Contexts: commercial biofuel/bioenergy; traditional bioenergy → Scale concept • Useful monitoring tactics – must be needed, accepted and with prospects for change to be made • Technical monitoring – affordability, resolution, timeliness (change over time) → link with ground-based data • Understanding trade-offs: relating to technological aspects; resolution based on different GS systems	• Simpler techniques to do monitoring/ assessment should be developed. Advantages: - Reduces transaction cost; hence, more benefit transferred to the rural poor (through REDD); - Employment generation; therefore tackle poverty. • Remote sensing can be used to measure forest degradation	• Not modeling related? → Acceptance? → usefulness/cost? → not academic • Resolution / costs £ 0.02/km^2 → £ 15/km^2 15 day cycle • Query on a series of RS data. RED → monitor request/obligation
BioClimate Research & Development	• Community based vs. community involved? • Different levels: community | town/city | industry/region • Need to work out how to carry out assessment efficiently	• Understanding the community context → What? → How: workshops, surveys, interviews… • Framework: Livelihood/resources | Opportunities | Constraints • Do we follow a project development approach (community-based) or focus on a more entrepreneurial approach?	• Need to explicitly indicate strengths and weaknesses for a project (community livelihoods – resource use), • Stakeholder analysis to identify potential facilitators and constraining persons • Ranking bioenergy technologies: weighed ranking by wealth group, gender • Food security assessment and income to be measured simultaneously • Need to develop an action plan with the community

17.30 Close

Day 2: Wednesday 20 October 2010

9.00 Duncan Macqueen (IIED)

Problem tree analysis to develop indicators of success

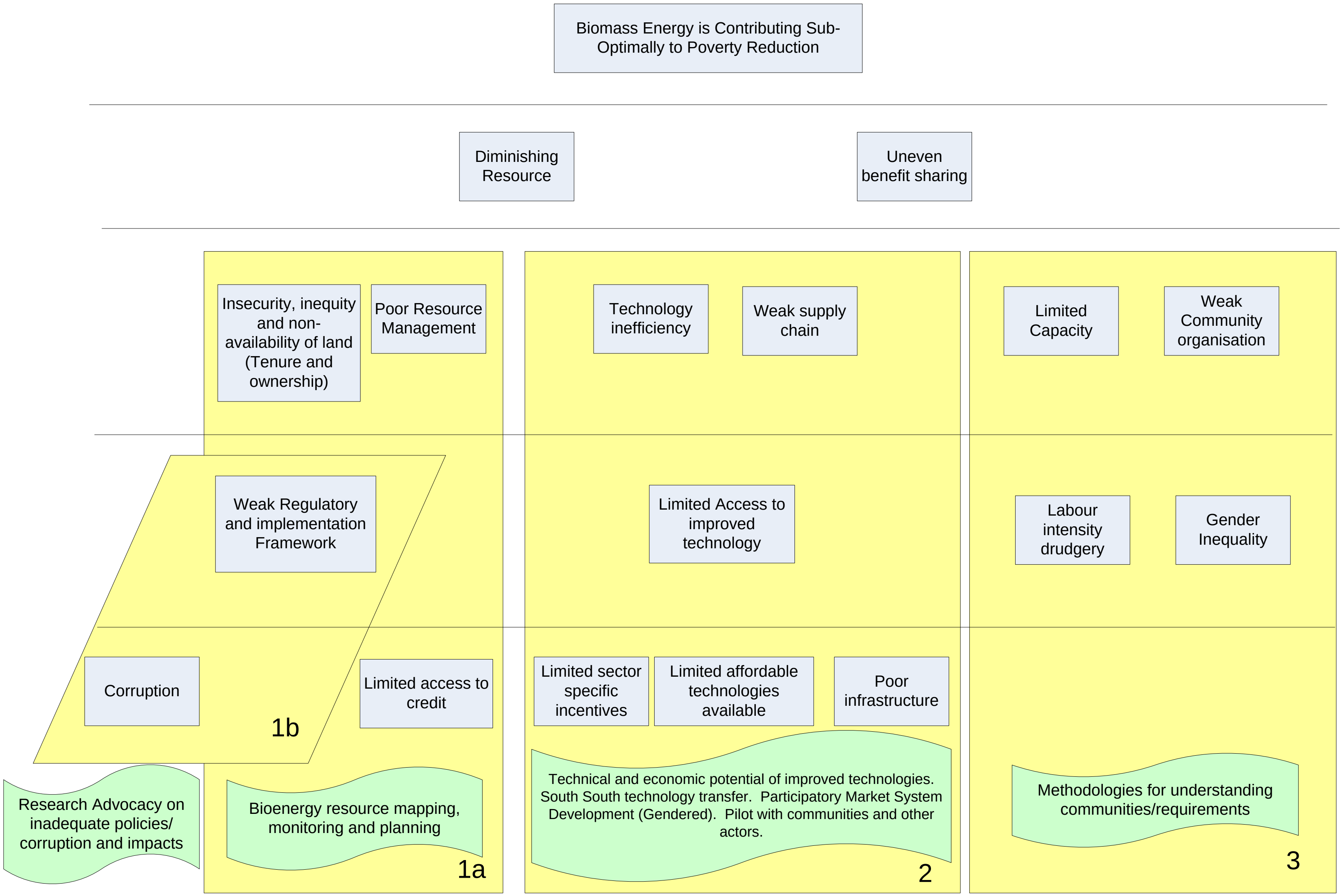
The consortium divided into two groups – each working to define more clearly the underlying causes of two key problems (i) biomass energy is contributing sub-optimally to poverty reduction and (ii) biomass energy is contributing sub-optimally to ecosystem service provision.

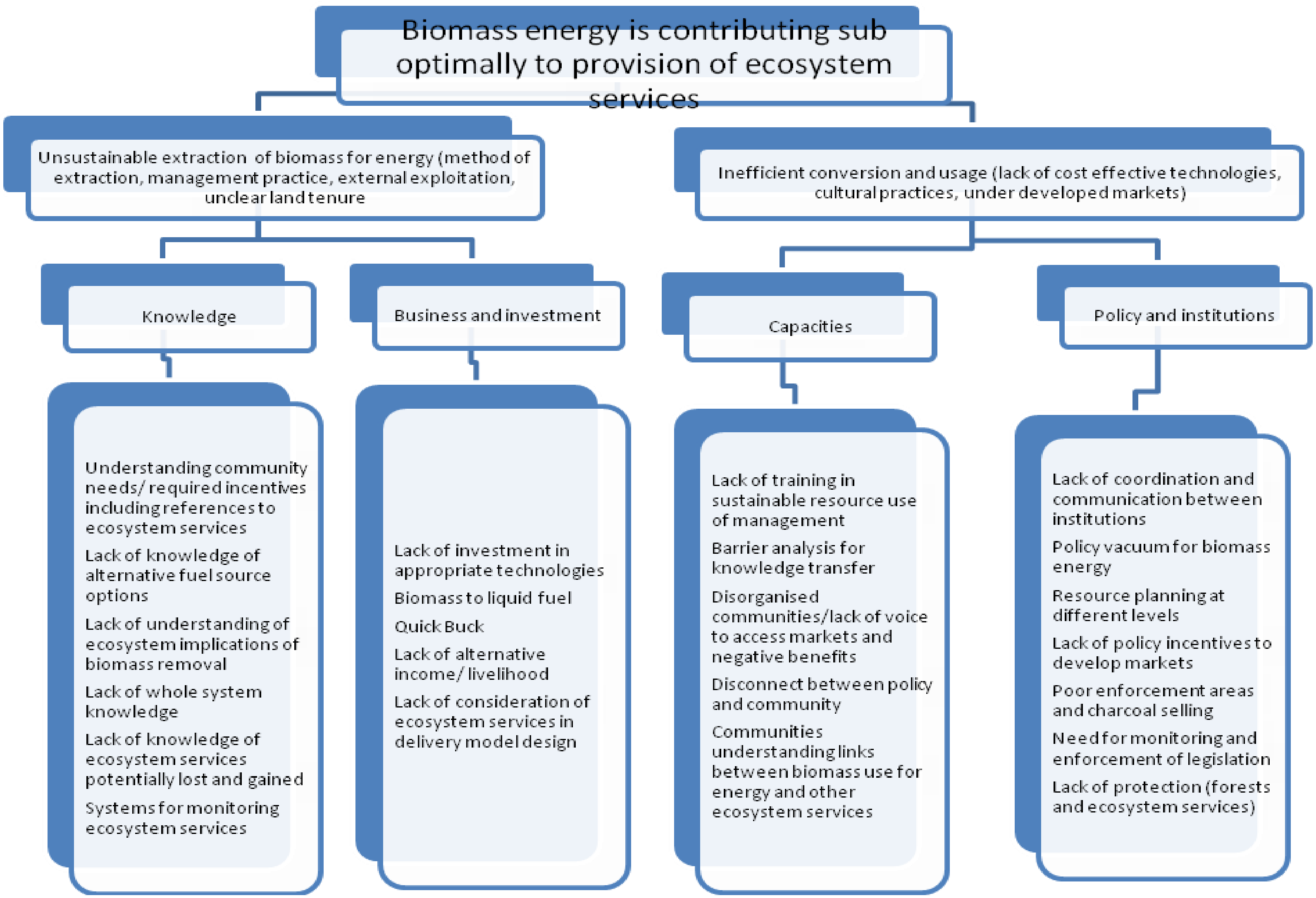
The former group deliberately explored a broad understanding of the elements of poverty to include (e.g.): basic needs, security, social networks, decent work, ecological integrity and cultural identity.

The latter group deliberately explored why current biomass use is suboptimal for supporting ecosystem services (nutrient cycling, soil formation), provisioning ecosystem services (biodiversity and the agricultural production of food and fibre materials and water availability), regulating ecosystem services (carbon emission regulation, hydrological cycles, erosion control, pollination, pests and diseases) and cultural ecosystem services (recreation and tourism, aesthetic values, religious values, national identity and self-sufficiency).

12.00

Feedback from two groups of the causal problems and discussion of interaction between the two




Biomass energy is contributing sub optimally to provision of ecosystem services
Unsustainable extraction of biomass for energy (method of extraction, management practice, external exploitation, unclear land tenure
Inefficient conversion and usage (lack of cost effective technologies, cultural practices, under developed markets)
Knowledge
Business and investment
Capacities
Policy and institutions
Understanding community needs/ required incentives including references to ecosystem services
Lack of knowledge of alternative fuel source options
Lack of understanding of ecosystem implications of biomass removal
Lack of whole system knowledge
Lack of knowledge of ecosystem services potentially lost and gained
Systems for monitoring ecosystem services
Lack of investment in appropriate technologies
Biomass to liquid fuel
Quick Buck
Lack of alternative income/ livelihood
Lack of consideration of ecosystem services in delivery model design
Lack of training in sustainable resource use of management
Barrier analysis for knowledge transfer
Disorganised communities/lack of voice to access markets and negative benefits
Disconnect between policy and community
Communities understanding links between biomass use for energy and other ecosystem services
Lack of coordination and communication between institutions
Policy vacuum for biomass energy
Resource planning at different levels
Lack of policy incentives to develop markets
Poor enforcement areas and charcoal selling
Need for monitoring and enforcement of legislation
Lack of protection (forests and ecosystem services)

13.00 Lunch

14.00

Theory of change methodology to develop conceptual framework

The consortium will again work in two groups (but this time divided into regional India and Kenya/Malawi teams) to discuss (i) what is the desirable change we want to see the project bring about and why?; (ii) how are we going to bring about those changes (what evidence, policies and institutions need to be influenced to make that desirable change happen in India, Kenya and Malawi or more broadly?); (iii) who needs to do what to make that happen? (e.g. research, demonstration projects, communication, advocacy) .

16.30

Feedback from the two groups followed by discussion of the best and most questionable bits of both frameworks

Summary tables from India and Kenya / Malawi on subsequent pages.

Why have we selected those changes?

- Impacting 80% of rural poor: 27% of total are BPL
- Huge implication on gender equity (women and children)
- Change highlighted by problem analysis: *diminishing resources(ES)/ inefficient use, unequal benefit sharing*
- Scaling issues: widespread relevance
- Biomass energy neglected and isolated
- Achievable: precedents in existing policies
- Diminishing access to ES

Why have we chosen these strategies/tactics?

- Emerging policy direction to build on. E.g. new initiative for cookstoves
- Evidence of encouragement of private sector and PPP models. Builds on existing knowledge
- Building on current benchmarking – to include cost economics – poverty
- Builds on proven methodologies and documents. E.g. biomass resources ATLAS/ sustainability appraisal
- Relevance from local to global scale

STRATEGIC ISSUE PROBLEM

"Biomass energy is contributing sub-optimally to poverty reduction and to the provision of ES"

Desired Changes

- Integrated bio-energy policy (excluding but complementary to biofuel policy)
- Business/delivery models orientated towards the poor (BPL)
- Widespread adoption of efficient/ less emitting technologies (households, enterprises, institutions, communities and micro-enterprises) by BPL
- Spread of better forest/NR management and expansion practice (that optimizes ES)
- Efficient management of biomass resources (including forests) for delivery of ES (including carbon)
- Poverty reduction (reduced drudgery, inequality, gender imbalance, insecurity, health problems etc)

How are we going to make those changes?

- *Bio-cultural diversity (?)*
- Bioenergy policy:
  - Review policies
  - Organize workshops
  - Sensitize policy makers
  - Contribute to draft bioenergy policy
- Business/delivery models
  - Review existing models
  - Prepare toolkit/ guidance
  - Pilot test including ES
  - Engaging with finance entrepreneurs etc
- Technology adoption
  - Community/end user preferences
  - Benchmarks: emission/pollution protocols & climate
  - Economics/costs comparisons: stoves, kilns, gasifiers, fuel supply etc
- Better resource management:
  - Survey review existing macro-geographical/ zoning data
  - Select pilot districts
  - Develop pro-poor appraisal of aspirations for ES
- Outreach/ comms:
  - Establish national advisory committee, south-south exchange, guidance modules, M&E

What's the consortium's role in bringing these changes?

[TERI] policy analysis: support from IIED, partner, ICEP
[TERI] PA: business models
[TERI] Imperial Porter Alliance: technology
[TERI] Ecometrica (survey):
IIED

Who else do we need to engage to make these tactics work?

Min. of new and renewable energy; Min. of env. And forests
Financials& EG; State Bank of India;
Local NGOs; manufacturers; local communities (BPL); Panchayats

Why have we selected those changes?

- Generalised solutions based on needs of target countries (e.g. adequate legal framework refers to legalisation of charcoal trade in Malawi)
- Community focus; equitable distribution; foster ownership of ecosystem services
- Changes perceived as achievable within timeframe/ESPA constraints
- Biomass is a diminishing resource; need balance of supply/demand; improve resource utilisation; reduce environmental degradation and poverty; protect people's needs and the ecosystems sustaining them

Why have we chosen these strategies/tactics?

- Achievable/easy to implement
- Desirable (actions/strategies/impacts); is there a real need?
- Affordable/cost-effective, economically attractive to decision-makers
- Time frame 5-50 years
- Measurable impact, including short-term
- Strong element of good research
- High potential to reduce ecosystem degradation and poverty

STRATEGIC ISSUE PROBLEM

"Biomass energy is contributing sub-optimally to poverty reduction and to the provision of ES"

Desired Changes

- Implement **sustainable resource management**, while addressing land rights
- Biomass for energy **produced and utilised in a sustainable and efficient way**
- Ensure **legal framework** for sustainable biomass utilisation is adequate and **implemented effectively**
- **Create formal markets** to deliver energy services from biomass that reduce poverty, while protecting ecosystem services
- Ensure **equitable distribution of benefits** throughout the value chain (for people and ecosystems)

How are we going to make those changes?

Sustainable production and utilisation

- Disseminate information about benefits of integrated systems of food/fuel/agriculture/forestry
- Engagement, participation and understanding of fuel supply and demand issues at relevant scales
- Research into potentially useful technologies and assess relevance in-country (involve communities) – consider technology usage, adoption, development, transfer; promote access to relevant technologies
- Develop criteria for site selection
- Pilot projects to test approaches/methodologies

Adequate legal framework and effective implementation

- [Malawi] Lobby for legalisation of charcoal trade
- Lobby authorities for effective implementation of laws

Creation of formal markets

- Review of finance/investment opportunities; stimulate access to investment (locally/internationally)
- Develop data on investment attractiveness of commercial biomass energy initiatives
- Explore issues around valuation of resources, including feasibility of monetarisation approaches
- Develop economic data and arguments on market transformation
- Action research to implement and analyse market system development approach

Equitable distribution of benefits

- Political economy analysis
- Analysis of competing needs for biomass energy and potential opportunities
- Analysis/awareness raising of energy choices (is biomass No.1 option?)
- Explore ways that value chain analysis/approaches can contribute to poverty reduction and gender equity
- Promote increased income and food security from sustainable biomass energy usage at household level

What's the consortium's role in bringing these changes?

All of the suggested activities can be carried out by the consortium members, in collaboration with other stakeholders. Consortium members propose to fill in their capabilities once a matrix of appropriate actions relevant to specific countries has been established for the ESPA proposal.

Who else do we need to engage to make these tactics work?

Communities as consumers; producers; implementing partners; local expertise on environmental science in the context of forests; enterprise/industry partners; charcoal/wood chain actors; regional departments of land use planning

[Malawi] Dept of Forestry; Dept of Energy; Malawi Energy Regulatory Authority

[Kenya] KEFRI (forest research institute); KEFS (forest service); Ministry of Energy

Day 3: Thursday 21 October 2010

9.00 Duncan Macqueen (IIED)

Communication and impact planning

The consortium divided into two groups by country to conduct a Peapod impact pathway analysis. The PEAPOD acronym was developed to provide a helpful way of thinking through how specifically to engage critical audiences in order to achieve the desired changes highlighted above. The acronym is spelled out below:

- People targeted
- Engagement strategy
- Attention grabber
- Process required
- Objectively verifiable indicators of success
- Deadlines – what has to happen when?

12.00

Feedback from two groups of the impact plan analysis and discussion of best and most questionable features of each

PEAPOD Africa

	People	Engagement	Attention Grabber	Process of Delivery	Objectively verifiable indicators	Deadlines
National State Actors	Min of Envt, forest and wildlife	Personal Contacts Forest learning group (Malawi) Stakeholder Workshops Proposal stage	Filling implementation gaps Evidence base developed Ecosystem services value – contribution to poverty reduction	Policy Briefs/ press releases Reports Websites Media National events/activities International events	Policy change ESPA tools integrated in policy/decision making Ecosystem accounting system	Project end
	M of Energy					
	M of Land					
	M of Local Govt					
	M of Water					
	M of Co-op Development					
	M of Trade					
	M o economic Planning					
Local State Actors	Provincial level					
	District level					
	Village level					
Research Institutes	KEFRI	PhD scholarships Publications North-South Linkages Proposal/Implement	Resources, skills, expertise, collaboration, scholarship	Process delivery partnerships/ collaboration working Scholarships International conference	3 PhDs completed on ESS ESS integrated in curriculum at Univs Bioenergy ESS monitoring system integrated within	
	KEFS					
	MIRTDC					
	Bureau of standards					
	Unis					
	ACTS					

				Membership of learned societies	national actors	
NGO/ civil society	WAFC CURE Greenbelt Movement	Personal contacts FGLG Stakeholder Workshops Proposal stage	Valuation of ES is first step towards bringing financing via COP process Management skills	Training sessions Technical briefs Reports/policy briefs		
Donors	GTZ/EU	Donor co-ordination committee Proposal stage	Better basis/evidence for informed intervention	Case Studies Impact assessments		
Private Actors	Kakuzi Small holder farmers	Chamber of commerce Implementation stage	Economic opportunities from ESS Technology Access	Participatory market mapping/ development Technology fair, forest-based enterprises fair		
Community Actors	District Associations Rural/Urban communities Consumer Assoc CFGs	FGDs During the project	Opportunities for income generation Control of local resources EU visibility	Community meetings/ marketplaces FGDs		

PEAPOD India

People		Engagement	Attention Grabber	Process of delivery	Objectively verifiable indicators	Deadlines
Who to contact (Category)	**Who to contact (Specific)**	**How they will be involved**		**Research process and communication**	**Measure success**	**When they will be involved**
Policy Government Agencies & Officials		Form national level advisory committee to involve national level	India can take a lead position in biomass transition. Evidence of integrated approach biomass energy with poverty alleviation & ecosystem services. Briefing of biomass energy at the global level and increasing dependence, and tailor it to show how India is a technological leader in biomass development.	Bioenergy policy review and formalization. Review documentation to feed into existing policy framework for bioenergy (bioenergy, ecosystem services poverty alleviation).	Participation in advisory meetings, stakeholder workshops, dovetails with ongoing initiatives, signs that ideas from work are included in policies. Recommendations and guiding tools incorporated into ongoing government initiatives. Sensitizing and recognizing issues.	Inception of project
Federal	–Planning commission	Stakeholder workshop at inception stage of project	Initiative opens avenue to get into global biomass technology transfer & global climate change related to biomass energy.			Inception & formal launch
	–Ministry of environment and forest, (MOEF)		NAPCC, national action plan on climate change. Aiming for carbon sequestration as well as emission reductions.			Inception, continuous, review & monitoring meetings (6 months)

	–Ministry of new and renewable energy (MNRE)		Green economy coalition (IIED). Thinking globally about energy provision, environmental NGOs, community groups, companies. Relevant to this work.			
	–Ministry of rural development (MoRD)					
State government – Uttaranchal, Orissa, Jharkhand, Kerala, Rajasthan, Uttar Pradesh State government – Uttaranchal, Orissa, Jharkhand, Kerala, Rajasthan, Uttar Pradesh	Planning commission – Mr Chaturvedi Secretary to gov't of India – Dr Vibha Puri das District forest officers	Stakeholder workshop at inception stage of project	Connect to similar initiatives within the state. Bring value to ongoing & potential initiatives (e.g. Karala total energy security mission)			
Research Institutions	–Indian Institute of Technology, New Delhi –Indian Institute of Science,	Stakeholder workshop at inception stage of project	Exposure to consortium. International publications to open new frontiers for research. Issue on biomass energy (International Forestry Review)	Publications about better resource management.	Journal articles published	Inception, continuous, review & monitoring meetings (6 months)

	Bangalore –Pantnagar University, Uttaranchal					
Experts	Prof Ravindranath, IISC					
	Prof Rajendra Prasad, IIT					
Networks	–GNESD (Global network of energy for sustainable development) –REEEP (Renewable energy and energy efficiency programme) –GVEP (Global village electrification programme)	Stakeholder workshop at inception stage of project	Information exchange platform. Make new information available to help networks.	Continuous updating on information	Information transferred	Inception, continuous, review & monitoring meetings (6 months)
Donors	–SDC (Swiss development corporation)	Stakeholder workshop at inception stage of project Review of what donors are spending on renewable energy. Reviewing forest and climate type	Potential collaboration to expand their mandate and get better outcomes for projects.	Continuous updating on information	Awareness raised, potentially funding secured	

		investment programmes (IIED). Make strategic links.				
Private sector technolog y partners		Stakeholder workshop at inception stage of project	Platform for organized information on potential of bioenergy, tools and methodologies for implementing initiatives. Opportunity for development of value chains.	Business delivery models.	Uptake of tools, approaches, business models. Number of delivery models engaged or impacted. Number of dovetailed pilot projects.	Inception, continuous, review & monitoring meetings (6 months)
	Biomass Gassifier –Chanderpur Works Biomass fuel processing) –BS Fuel Improved Cookstoves –Envirofit –First energy –Philips (cook stoves)	TERI could run incubator program in Malawi and Kenya for these developing countries to advance.	Opportunity to incubate and take forward technology in these countries.		Benchmarking of technologies. Guidance of success factors for bioenergy chains. Resource management for ecosystem services. Guidance from all of these can be shared with other groups.	
NGOs	Centre for Peoples Forestry, Sewa Mandir (Rajasthan) Enviro legal	Stakeholder workshop at inception stage of project	Better understanding and opportunity to work on poverty alleviation and linkage to bioenergy at the local level. Opportunity to benefit from global research on this issue & to be part of bigger network. Capacity building related to local communities and bioenergy.	NGOs involved in assessment for better resource management and widespread technology adoption, contributing to	Involvement	Inception, continuous, review & monitoring meetings (6 months)

	firm			poverty alleviation agenda.		
	Chirag , Myrada (Uttera khand)		Better understanding and capacity building for the linkage between ecosystem services and livelihoods, access to better approaches, methodologies, and tools.			
Local communit y / gov't		Stakeholder workshop at inception stage of project	Poverty reduction, more control over resources, livelihood enhancement, energy security, better quality of life (health issues).	Directly involved in process of developing appraisal of aspiration of ecosystem services, biomass energy, livelihood activities, technology adoption, business delivery pilots, monitoring, & adaptation of tools/approaches.	Involved in project	Inception, continuous, review & monitoring meetings (6 months)
	Village head – Panchayats	Geographical sites selected	Gender and minority issues (disaggregation)			
	Teachers	Engage through PRA - identify needs, participatory rural appraisal	Rights to ecosystem services recognized in exchange for sustainable management.			

	Resource persons		Incubate initiatives - encourage entrepreneurship at community level. Biomass processing can be done through local entrepreneur, which much less exploitive of local ecosystem services.			
Media		Stakeholder workshop at inception stage of project Electronic & print media, local creative communication groups		Media department of TERI, media department of IIED. Media briefs, conference, continuous communication, short films.	Project in publications / radio / TV / etc.	Inception, continuous, review & monitoring meetings (6 months)
	NDTV	Continuous engagement				
	TERI Media	Brochure, pamphlets, case studies, press releases				
Standards bodies	Check appropriateness of existing standards Mr Pandey (Ex Dg Forests) Prof Ramanthan (UCSD)			Review of relevant policies and standards.		Inception, continuous, review & monitoring meetings (6 months)
Financial institutions	State bank of India	Stake holder workshop	Investment opportunities	Business delivery models development, toolkit and guidance includes	Involved in financing businesses	Inception, continuous, review & monitoring meetings (6

				financial institution.		months)	
	State bank of Hydrebad	Review biannual					
	Micro- finance institutions, NABARD						

14.00

Research prioritization exercise

In order to keep this session live and reduce tension we used a game play 'auction' process. The consortium divided into small institutional groups and considered (with a limited imaginary budget) which areas of work they wish to bid for (from those generated on day 2). The aim was to help see which areas of work are broadly felt to be important across the different project partners, which areas of particular interest to particular institutions and which areas are widely considered to be peripheral.

Having divided into four teams each with a hypothetical budget to spend of £100 an auction was run in which each team tried to 'buy' the research ingredients they felt would be most important for an ESPA consortium on biomass energy. The ingredients were drawn up from discussions at the meeting itself. Where two or more groups had to compete for something they felt to be important the value of that ingredient rose – giving a very rough indication of issues which more than one group felt to be priorities. The research ingredients sold at the following prices:

- Community-based ecosystem services and poverty assessment methods (£ 65)
- Advocacy / policy work towards formal biomass market development (£ 58)
- Research on sustainable biomass harvesting / planting options (£ 43)
- Use of geographical information systems and models for biomass energy planning (£ 41)
- Technology benchmarking and standards for different biomass technologies (£ 39)
- Business / value chain analysis and pilot projects for biomass energy businesses (£ 26)
- Economic cost comparisons for different technology options (£ 21)
- Communication / media / education work on biomass energy (£ 20)
- South-South –North technology transfer and incubation (£ 16)
- Policy reviews on biomass energy (£ 10)

15.30 Tea

16.00

Institutional responsibilities and capacity strengthening

We will work in plenary to discuss how research can best be designed to (i) meet in-country needs (ii) strengthen in-country capacity (iii) allow comparative analysis between partner country sites for the development of broader recommendations and (iv) meet the exacting quality standards expected by ESPA.

A discussion was held about the possible framework for an ESPA biomass energy consortium and the institutional responsibilities within that. The initial draft of that framework was then drafted by IIED – but will be heavily modified pending review by partners:

Under the over arching objective of optimizing the contribution of biomass energy to poverty reduction and ecosystem services, this project will target four specific problems with corresponding objectives and work packages:

OBJECTIVE 0. **Management of a consortium that will deliver excellent science and strong impact** in optimizing the contribution of biomass energy to poverty reduction and ecosystem services delivery

Comments: Proposal is that the IIED Forest Team lead on this – in close collaboration with the four work-package leads.

PROBLEM 1. Overarching problem of poor natural resource governance – that results in confused institutional mandates in which forest departments often have disproportionate control over biomass energy which translates into inadequate incentives to develop a pro-poor sustainable biomass energy industry.

DESIRED CHANGE - OBJECTIVE 1. **Integrated biomass energy policies in India, Malawi and Kenya** (complementary to any biofuel policies) that provide an adequate legal framework for pro-poor sustainable biomass energy production and use

CORRESPONDING WORK PACKAGE 1. Application of macro-geographical / land use zoning tools that highlight key issues and opportunities for expected biomass energy expansion in India, Malawi and Kenya used in tandem with rigorous socio-economic policy analysis to involve key decision-makers in policy dialogues and promote or draft reforms that can then be implemented.

Comments: Proposal is that Ecometrica will lead on this using their Biocarbon tracker type technology, working with RRes on yield mapping and marginal lands to develop and apply geographical / land-use zoning tools for policy work in key areas of biomass concern in Malawi, Kenya and India. CDM, TERI and PA-Kenya will collaborate and lead on the policy analysis / engagement (including workshops) with IIED helping to synthesize results.

PROBLEM 2. Diminishing biomass energy resource that has multiple roots in insecure tenure and resource rights, poor management / restoration practices, inefficient conversion technologies and inequitable value chain development

DESIRED CHANGE – OBJECTIVE 2. **Spread of more efficient and sustainable production of biomass energy by the poor** that optimizes ecosystem services identified by the poor as critical through testing with local entrepreneurs and government authorities in India, Malawi and Kenya

CORRESPONDING WORK PACKAGE 2. Gendered participatory perception appraisal to develop an indicators framework for the impact of biomass energy on poverty and ecosystem services at three levels local, national and international levels that is then used as a tool to design and implement pilots for better biomass resource rights, management or plantation practices and institutional support functions that pay attention to stratifications within poor communities with special attention to gender.

Comments: Proposal is that UEA will lead on this – developing a version of sustainability appraisal to gauge perception on ecosystem services desired from biomass energy management – at local national and international levels, with CDM, TERI and PA-Kenya helping to set up field work.

PROBLEM 3. Uneven benefit distribution within existing biomass energy value chains that has its roots in power relations of largely informal economies, the lack of organization and voice of poor communities and actors in the biomass value chains

DESIRED CHANGE - OBJECTIVE 3. **Pro-poor formalization of biomass energy business/delivery models** in such a way that currently marginalized groups derive a more equitable share of ecosystem service values from specific value chains in India, Kenya and Malawi

CORRESPONDING WORK PACKAGE 3. Value chain analysis of a range of pro-poor biomass energy business in India, Kenya and Malawi leading to the development of a widely applicable toolkit / guidance modules on best practice in monetarisation / market development approaches that can be tested in pilots with relevant finance and business support programmes.

Comments: Proposal is that Practical Action Consulting will lead on this in collaboration with the IIED energy team to develop / adapt value chain analysis and in collaboration with BCR&D, develop community-based pilots in the three countries with Practical Action Kenya, CDM and TERI.

PROBLEM 4. Inefficient conversion and usage of biomass energy leading to damaging health and climate emissions that have their roots in current cultural practices, poor knowledge of and access to cost effective technologies and under developed (poorly incentivized) markets to supply them.

DESIRED CHANGE - OBJECTIVE 4. **More efficient / less emitting consumption of biomass energy** through the widespread adoption of technologies (at household, enterprise and institutional levels) among the poorest groups in India, Kenya and Malawi

CORRESPONDING WORK PACKAGE 4. Field analysis of end user preferences that will inform new benchmarking of fuel supply, kiln, stove and gasifier technologies with enhanced economic and emissions comparisons and a programme of communication and appropriate technology transfer within and between India and Africa.

Comments: Proposal is that TERI lead on this but with Imperial bringing in the Porter technology alliance and RRes contributing thoughts on decentralized energy planning and CDM and PA-Kenya helping to host country-country technology exchange.

PATHWAYS TO IMPACT – IIED will lead on this as part of its management function but with TERI, CDM and PA-Kenya having a greater spend in line with their proximity to actual decision makers.

17.30

Evaluation of the workshop

Participants were invited to rank different workshop components as (i) Excellent – centre green (ii) good – light green (iii) OK - orange and (iv) bad - red on the chart below which summarises what participants thought of how things had gone.