



**FROM THE MILLENNIUM DEVELOPMENT GOALS
TOWARDS A GENDER-SENSITIVE ENERGY POLICY
RESEARCH AND PRACTICE:
EMPIRICAL EVIDENCE AND CASE STUDIES**

Synthesis report

ENERGIA/DfID Collaborative Research Group on Gender and Energy (CRGGE)

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Seven Policy Recommendations of the Collaborative Research Group on Gender and Energy (CRGGE)

Gender matters in energy projects and programs in some significant ways, this empirical research shows. Modern energy services are important for the empowerment of women because they improve women's health and make their lives easier so that women can participate more fully in development. They reduce women's time poverty (and sometimes, consumption poverty), and give women more options in their work and more knowledge from media, and this can help women negotiate for their strategic needs both in the household and the community. Each of the case studies includes recommendations pertinent to energy practice in their own countries and regions. The evidence is clear but not as extensive as may be needed to convince policymakers in all areas (see Table 6), and more research is needed. But many of the key findings of these studies have immediate policy implications that can be acted upon, e.g.:

- 1. Invest in energy infrastructure technologies and end-uses that directly meet poor women's energy demands and make their labour more productive, in order to have a significant positive impact on women's practical needs, family welfare and development. High potential technologies include (see sections 3.3, 3.5 and 4.):*
 - improved cooking stoves and fuels and other household energy interventions;
 - food processing technologies such as grinding mills;
 - drinking water pumping and transport; and
 - electric lighting and media.
- 2. For highest impact, promote sustainable livelihoods through modern energy services that permit poor women to increase their productivity and income and hence the value of their labour, and therefore encourage adoption of modern energy services in the home. Two strategies shown here as high impact, justifying the investment of public funds, are:*
 - women's involvement on the supply side, in producing and marketing new energy resources and services; and
 - support to women's micro-enterprises in accessing and using modern energy services and complementary business inputs (see section 3.3).
- 3. Do not restrict poor women in their choice of cooking fuel because of the profligacy of Northern industrialised countries. Current cooking energy use in developing countries has severely negative impacts on the health of women and children, via low birth weights and infant mortality, and substituting these fuels with more efficient biomass or fossil fuels would add little to global emissions. MDG 5 on reducing child mortality cannot be met without improvements in the household energy system (section 3.6).*

4. *Prioritise complementary inputs for gender equality.* The issue of “complementary inputs” is familiar in energy and development – it is the lack of these inputs that often determine whether access to modern energy services will do or does not have an impact. Modern energy services are most likely to produce benefits for women if they are implemented in the context of one or more of the following (section 4.4):
- a deliberate gender strategy in project planning, implementation and institutions that ensures women’s access;
 - a supportive policy and/or institutional environment for women’s needs;
 - a community-based organisation with women’s effective participation;
 - existing or changing gender relations that value women’s labour compared to men’s; and/or,
 - industry objectives coincide with women’s interests.

At least the first two can be influenced by project practitioners and policymakers respectively. Energy projects that effectively involve women have been a source of their increased voice and participation in development (see section 3.5). Seeking synergies with one or more of the above conditions can be an efficient way to enhance benefits for women from modern energy services.

5. *Seriously think about how to integrate operationally (in energy but also other development sectors) some key areas where evidence is incomplete but highly suggestive:*
- Increased girls’ education and electrification and labour-saving energy services (see section 3.4);
 - HIV/AIDS – both quality of care and transmission – and the availability of modern energy services (see section 3.7);
 - Sexual violence and fuelwood collection (see section 3.5).
6. *Include and document gender analysis at each step of policy, programme and project planning, implementation, monitoring and evaluation.* This research project was greatly hindered by the lack of disaggregation of data and information by gender in the energy and development literature. Engendering the logframe can only improve our understanding and effectiveness of how modern energy services can contribute to development.
7. *Build capacity of women to work in the energy sector and of both women and men to engage with gender issues in energy systems.* Our research showed a need for capacity building at all levels, ranging from training for poor rural women who need skills to operate energy technologies and businesses, to female and male energy practitioners, researchers and policymakers who need tools to engage effectively with gender. Improving linkages and networks among researchers, the grassroots, and policymakers is a powerful means for generating self-confidence and increasing visibility at every level.

***Strengthening gender-sensitive energy policy research in the new millennium:
A checklist for analytical work based on the CRGGE experience***

A major goal of the CRGGE was to push forward analytical frameworks and capacity to provide gender-sensitive policy and operational research in order to improve energy project design and policymaking. The four elements below provide our experience on what gender-sensitive energy policy research looks like. Gender-sensitive analytical work can provide the basis for, for example, feasibility studies for the design of energy projects; policy background papers and dialog with institutions; monitoring and evaluation of impacts on women and men; operational case studies of approaches and strategies, as well as for more conventional academic research.

1. ***Establish partnerships and a process for interaction between key gender researchers, policy makers and stakeholders in the country, and key energy researchers, policy makers and stakeholders, as team preparation for carrying out the analytical work. Multidisciplinary teams are essential. Joint workshops and capacity building can help engage partnerships in an active dialog to “speak the same language.” How the research is organized and carried out, and experiences of working together, can be as significant as the substantive findings, in changing “ways of thinking” (see section 5.1).***
2. ***Link micro research to the macro policy level: Identify the gender-energy-poverty nexus in the country and project area under study. What is the intersection between current energy policy questions and the specific gender challenges in the country (the needs of women, the policy environment, the causes of poverty and livelihood opportunities)? Using the micro level description and analysis of gender and energy issues to inform critical and current energy policy concerns for the governments, utilities, and private sector players in the country is critical. The background and historical poverty-gender context needs to be understood, as well as the energy supply, consumption and policy situation in the country, by first reviewing literature on both gender and on energy, and building on past research, project and policy experience in the country. These then need to be related to one another, to make clear how energy policy is influencing and could be influenced by the poverty-gender challenge (see section 5.2).***
3. ***Choose and combine appropriate research frameworks and methods from gender and from energy research. Gender analysis was the basic framework for analysis in all of our work. Although this seems obvious, disaggregation and analysis of data by gender (men and women, boys and girls) has not routinely been done in the energy sector. Treating gender as a separate category of analysis focuses attention on the subordination of women. Sustainable livelihoods framework was also valuable for our research, in focusing attention on energy for women’s productive uses, and their control over assets, including energy-producing assets. CRGGE researchers found useful a wide variety of data-gathering tools and methods, with the most important being policy and institutional analysis, the use of both qualitative and quantitative data, and the inclusion of people’s perceptions (see section 5.3).***

4. *Ask the right questions: Focus on opportunities for transformation.* The conclusion of the CRGGE was that while points 1 to 3 above were important steps towards a gender-sensitive energy policy analytical framework, the most critical function of our research was determining the right questions to ask. Our research started by asking whether gender relations were a key variable in determining the impact of energy policies, projects and programmes; and inversely, how could energy interventions most effectively contribute to the process of empowering women? The case studies helped us focus these broad questions in four areas where analytical work can assist in both operations and policy dialog:

- a) *Evidence about impacts on women and men of energy projects and changing access is needed as part of every energy project and policy's planning, monitoring and evaluation.* Under what conditions are impacts positive or negative, both conditions over which implementing energy agencies have little control – such as culture, land rights or the status of women – and conditions which can be influenced, such as credit and institutional arrangements, skill building and information access, and hiring of staff and workers, as part of their energy policy and operations? Impact assessment is needed in particular to cover a wider range of technologies and to provide models of gender mainstreaming in larger-scale operational energy projects and policies.
- b) *Rhetoric gap between policy and practice in energy policy, budgets and implementation.* Gender audits of budgets and investment portfolios can expose the gap between energy policy rhetoric and the reality of women's lives. Do energy budgets, policy statements and project practice reflect women's as well as men's needs? Do poverty documents such as PRSPs reflect the reality of women's energy situation? The collection of gender-disaggregated data was found in the CRGGE research to be the single most powerful and essential tool in being able to provide evidence to policymakers to motivate them to engender energy policy, as well as for the actual process of integrating gender into energy planning and implementation.
- c) *Culture and ideology in gender relations.* Understanding the ideologies that influence gender relations and women's empowerment in the energy sector was found to be unavoidable in understanding the reasons behind changes in gender relations and how energy access affects or how it is affected by those changes. Gendered labour relations and the relative opportunity costs of women's and men's labours; new legislation on women's rights and its enforcement by police; the ideology of home economics; and sexual violence, sexual harassment, and power relations in the household and society were aspects of culture and ideology found to affect energy security and the energy transition in the CRGGE case studies.
- d) *Political economy of change in gender and energy: What are the "Drivers of Change"?* What incentives and disincentives face the various participants – at the household, community and societal levels - and how can these be modified? What political power relations are involved between the various factions? What coalitions or alliances for "pro-poor" and "pro-women" change can be effective in the energy sector? Who is likely to support pro-women energy policy and who opposes it? Why would the state or a utility want to respond to women's needs? In terms of analytical work, this might lead to the need to examine the concerns of the opposing factions and to "put our work in their language". In terms of policy dialog, key gender and energy stakeholders need to be active participants in direct and formal energy decision-making processes and structures.

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Preface

This report is the result of two years' work. We were fortunate in bringing together some of the world's foremost experts on gender and energy in a Collaborative Research Group on Gender and Energy. The group included policy researchers from France, Kenya, India, the Netherlands, the Philippines, South Africa, Sri Lanka, Uganda, the UK and the US, who further involved other researchers in their networks and countries in the endeavour. The challenge was to move towards a framework for gender and energy policy research in the 21st century, to build capacity in our own institutions and networks, and to influence the international energy policy research agenda as well as practice. Working on the project was rewarding, because it provided the basis for continuous (and continuing) interaction among researchers, practitioners and networks on their research, and their practical policy and program work, related to gender and energy.

Bringing a gender perspective to energy policy research faces two intertwined challenges of credibility. First, what evidence is there that energy has a key role to play in gender and poverty? The first half of this synthesis report addresses this question by reviewing empirical evidence, from a gender perspective, on linkages between energy and the first seven Millennium Development Goals: measurable progress on poverty, education, gender equality, child mortality, maternal health, HIV/AIDS, and environmental sustainability.

Second, how can gender be shown to be a key variable in energy interventions? Development of a credible analytical framework for gender-sensitive energy policy research, through an iterative process involving expert meetings and eight case studies by a Collaborative Research Group on Gender and Energy (CRGGE), is the focus of the second half of this report. How can current research frameworks such as sustainable livelihoods and gender analysis be used to more effectively analyse gender as a key variable in energy interventions? What are the key elements and the "right questions" to ask in gender-sensitive energy policy research in the new Millennium?

Thanks are due to DfID, which provided the majority of the funding. ENERGIA and ETC deserve thanks for funding parts of the project and for so ably hosting and coordinating the project through Sheila Oparaocha. Wendy Annecke and AFREPREN/FWD are to be thanked for the meetings that they coordinated in Cape Town and Nairobi respectively. Giles Stacey is thanked for copy editing the CRGGE final case study reports and Chesha Wettasinha and Odile Beckers are thanked for coordinating the publication of ENERGIA Newsletter based on the outputs of the project, ENERGIA News Volume 8 Issue 2. All the CRGGE researchers who contributed to the project, and their institutions, went well beyond the call of duty and the limited funds available. Their commitment to gender-sensitive energy policy research has enriched the work and made the CRGGE rewarding for all of us.

Elizabeth Cecelski
Principle Investigator

List of acronyms

AFREPREN/FWD	African Energy Policy Research Network/Foundation for Woodstove Dissemination
AIT	Asian Institute of Technology
APPROTECH	Asian Alliance of Appropriate Technology Practitioners
ARI	Acute respiratory infections
ASTAE	Asia Technical Unit for Alternative Energy, World Bank
CO ₂	Carbon dioxide
COPD	Chronic obstructive pulmonary disease
CSD	United Nations Commission on Sustainable Development
CRGGE	Collaborative Research Group on Gender and Energy
DfID	United Kingdom Department for International Development
EDI	Energy Development Index of the IEA
EnPoGen	Energy, Poverty and Gender Project of ASTAE, World Bank
GDI	Gender-related Development Index of the United Nations
GEP	Gender-Energy-Poverty Index
GDP	Gross Domestic Product
GHG	Greenhouse gas
GEM	Gender Empowerment Index of the United Nations
GVEP	Global Village Energy Partnership
HDI	Human Development Index of the United Nations
HEDON	Household Energy Development Network
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IAP	Indoor air pollution
ICIMOD	International Center for Integrated Mountain Development
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IRADe	Integrated Research & Action for Development
LPG	Liquefied Petroleum Gas (propane and butane)
MDG	Millennium Development Goal
MHP	Micro hydro-power
NGO	Non-governmental organisation
OECD	Organisation for Economic Cooperation and Development
PLWHA	Persons living with HIV/AIDS
ProBEC	Programme for Biomass Energy Conservation, Southern Africa, GTZ
PRSP	Poverty Reduction Strategy Program (World Bank)
PV	Photovoltaic
SEWA	Self-Employed Women's Association, India
SHS	Solar home systems
SL	Sustainable Livelihoods
TB	Tuberculosis
TERI	The Energy and Resources Institute, India
UNDP	United Nations Development Program
UNIFEM	United Nations Development Fund for Women
USAID	United States Agency for International Development
WHO	World Health Organisation
WSSD	World Summit for Sustainable Development

Executive summary

Background and objectives

This synthesis report presents the results of an ENERGIA/UK Department of International Development (DfID) research project on “Gender as a key variable in energy.” The project brought together some of the world’s foremost experts on gender and energy in a Collaborative Research Group on Gender and Energy. The group included policy researchers from France, Kenya, India, the Netherlands, the Philippines, South Africa, Uganda, the UK and the US, who further involved other researchers in their networks and countries.

Gender equality and women’s empowerment are viewed as key drivers in achieving the Millennium Goals. They have not however been seen as key drivers in the energy sector, nor has energy been viewed as critical to the gender and poverty discussion, partly due to the failure to engage both gender and energy researchers and practitioners in the same debate.

The challenge was to move towards a framework for gender and energy policy research and practice in the 21st century, a framework that would be credible both for energy and for gender researchers and practitioners, and that would contribute to the overall goal of strengthening energy policy, programme, and project linkages with the Millennium Development Goals, with a focus on gender. We also wanted to build capacity in our own institutions to do policy research on gender and energy, and to influence the international energy policy research agenda as well as practice. Working on the project was rewarding, because it provided the basis for continuous (and continuing) interaction among researchers, practitioners and networks on their research, and their practical policy and program work, related to gender and energy.

Structure of the project and the report

Bringing a gender perspective to energy policy research faced us with two intertwined challenges in credibility. First, what evidence is there that energy has a key role to play in gender and poverty? An empirical review addressed this question by reviewing the evidence from a gender perspective on linkages between energy and the first seven Millennium Development Goals: measurable progress on poverty, education, gender equality, child mortality, maternal health, HIV/AIDS, and environmental sustainability. Chapter 3 summarises the findings of this study and identifies areas where there is “good evidence”, “some evidence” and “insufficient evidence” to convince policy makers.

Second, development of a credible analytical framework for gender-sensitive energy policy research through an iterative process involving expert meetings and eight case studies by CRGGE members was the focus of the second part of the project, in Chapters 4 and 5. How can current research frameworks such as sustainable livelihoods and gender analysis be used to more effectively analyse gender as a key variable in energy interventions? What are the key elements and the “right questions” to ask in gender-sensitive energy policy research in the new Millennium?

Past approaches to gender in energy policy research¹

Most women and energy research and practice from the 1970s through the 1990s remained largely within a “women in development” framework. Energy services were presumed to benefit women as members of households and to contribute to their welfare, even if women did not participate in

¹ Cecelski, E. (2004), Re-thinking Gender and Energy: Old and new directions, ENERGIA/EASE Discussion Paper. Report to DfID KaR R-8346 Gender as a key variable in energy.

decision making or implementation. Later, women began to be viewed instrumentally by the energy sector, as energy consumers whose views needed to be taken into account to ensure adoption of new energy sources, or as promoters who could contribute to meeting targets for dissemination of improved stoves or renewable energy technologies. Since 2000, the energy sector has been obliged by new development thinking including the Millennium Development Goals, to consider more seriously poverty alleviation and gender equality as goals in their own right to which energy access can contribute.

Raising the visibility of gender in the sector has been a valuable outcome of earlier approaches, but recent energy, poverty and gender frameworks go further in asserting the transformation of gender relations and human rights as essential to the energy mandate. Sustainable livelihoods, gender analysis, and feminist political ecology offer new ways of understanding linkages among gender, energy and poverty and new criteria for gender-sensitive energy policy research. These have been explored and applied in the eight case studies under this project.

Energy, gender and the Millennium Development Goals: Empirical evidence for linkages

The Millennium Development Goals (MDGs) were adopted in 2000 at a United Nations Assembly summit as a set of time-bound, measurable goals and targets to be achieved by 2015. In September 2005, they were re-endorsed at a World Summit to review progress. Although there is no MDG on energy, the independent commission UN Millennium Project report has identified energy, including electricity and safe cooking fuels, as an essential infrastructure service and part of the “means to a productive life.”

While many assumptions have been made about the linkages between energy and the MDGs, not many empirical studies are available that provide convincing evidence for policymaking. The present study sought to conceptualise indicators and then to collect empirical evidence – preferably quantitative data – on linkages among gender, energy and the individual MDGs on poverty, education, gender equality, child mortality, maternal health, HIV/AIDS and major diseases, and environmental sustainability. Table 1 shows the indicators that were assessed in this empirical review.

Table 1. Indicators of energy as a key variable from a gender perspective for the Millennium Development Goals

Millennium Development Goals	Gender & energy perspective indicators relate energy access with impact on:
Goal 1. Eradicate extreme poverty & hunger by 50%	<ol style="list-style-type: none"> 1. Time & effort spent (M/F, B/G) in cooking & fuel collection and in food processing; and use of time saved 2. Income generation (M/F):direct applications in agriculture, home industry, extension in work hours through lighting, energy entrepreneurs 3. Reduction in household expenditures on energy 4. Improvement in social capital Income generation
Goal 2. Achieve universal primary education of boys and girls	<ol style="list-style-type: none"> 1. School attendance (B/G) 2. Hours of study (B/G) 3. School performance (B/G)

Millennium Development Goals	Gender & energy perspective indicators relate energy access with impact on:
Goal 3. Promote gender equality and empower women	<ol style="list-style-type: none"> 1. Literacy (M/F) 2. Leisure time (M/F) 3. Access to information through media & telecommunications 4. Transformation of gender roles in the household (M/F) 5. Control over & access to modern energy services (M/F) 6. Voice and participation of women 7. Violence against women in energy sector 8. Employment of women in the energy sector
Goal 4. Reduce child mortality (by 2/3 the <5 mortality rate) Goal 5. Improve maternal health (reduce mortality by ¾)	<ol style="list-style-type: none"> 1. Indoor air pollution (IAP) exposures and acute respiratory diseases due to biomass fuel use (M/F, B/G) 2. Low birth weight due to IAP and maternal overwork 3. Quality of primary health care and vaccination 4. Women's workload and child care 5. Burns and kerosene poisoning 6. Fuel scarcity, water boiling and cooked foods
Goal 6. Combat HIV/AIDS, malaria, other	<ol style="list-style-type: none"> 1. Recommended health behaviours (e.g. cooking food) for persons living with HIV/AIDS (PLWHA) 2. Reduced women's burden of care for PLWHA 3. Reduced drudgery for women LWHA 4. Reduced exposure to disease vectors for women LWHA 5. Sterilisation of equipment in clinics 6. Risk of infection from violence collecting fuel 7. HIV/AIDS induced poverty and deforestation from increased natural resources dependency
Goal 7. Ensure environmental sustainability incl safe drinking water and slum dwellers	<ol style="list-style-type: none"> 1. Deforestation & fuel collection 2. Climate change & traditional biomass use 3. Access to clean water & sanitation 4. Access to cooking energy and electricity by slum dwellers (M/F)

MDG 1: Extreme poverty and hunger²

Women's time is a key constraint to agricultural production, income-earning and family nutritional status of the poor. There is good evidence in the studies reviewed for time and effort savings of 1 to 4 hours daily in cooking, fuel collection and food processing, when energy is made available for these tasks; but there is insufficient evidence on how these time savings are used. There seems to be a positive correlation between the availability of electricity and time spent on fuel collection and cooking – but we don't understand exactly why.

Better energy access could directly help women's income-earning activities. We know from anecdotal evidence that women use biomass energy in their micro-enterprises, especially food processing, and use electricity to extend the working day for home industries and agriculture. But we don't know how much income these improved fuels and lighting result in generating, nor how much control women have in decisions on the use of increased incomes. Donor-supported projects have illustrated how "energy enterprises" that manufacture or sell energy equipment, such as cook

² Dutta, S. (2005), Energy as a key variable in eradicating extreme poverty and hunger: A gender and energy perspective on empirical evidence on MDG #1, draft. Report to DfID KaR R-8346 Gender as a key variable in energy.

stoves, or produce energy for sale, such as the multi-purpose platform, can be successfully owned and operated by women. But mostly, women's energy enterprises have operated at small scale and their sustainability under market conditions is not known.

Savings in energy costs and energy efficiency could effectively increase household income and food consumption. There is good evidence for reduction in household expenditures on energy of 20-50% with more efficient and lower cost cook stoves and lighting fuels. But it is not clear whether these savings are used to increase food consumption or are rather offset by increased energy use.

MDG 2: Universal primary education³

Access to modern energy could free up time for girls to go to school or to spend time on homework. Most studies found focused on electrification. Increased school attendance by girls is associated with electrification, and there is some evidence too of better school performance by girls. Hours of study are also possibly increased, but the latter data is not available for boys and girls separately.

There is some evidence for an increase in girls' schooling when their time in domestic chores, especially water fetching, is reduced. The effects of saving women's time (in general) and of adoption of improved stoves and cooking fuels (specifically) on girls' education, are not known though.

MDG 3: Gender equality and women's empowerment⁴

Women's well-being, empowerment, and education are driving factors in other MDGs, such as reducing children's malnutrition. There are good examples where energy access has empowered women by giving them more choices about how to organise their work more effectively. Most studies show that women usually choose to devote their extra time (due to reduced drudgery or a longer day with electric lighting) to increasing their other productive and reproductive work hours. Although women do sometimes increase their time in leisure (an important indicator of women's empowerment), entertainment or social recreation, the studies reviewed show that this is more likely for men.

There is good evidence that in electrified households, women's access to information has been increased through TV and other media, and there are cases where this can be said to have led to empowerment. There is a little evidence for increased reading by women with electrification. It would be useful to know more about this and also the potential for TV and media to promote family bonding and gender cooperation, as hinted by some studies.

Changing gender roles in the household and voice and participation by women in the community in energy transitions tend to be extremely variable and likely depend on many factors that we would like to know more about. There are examples of changing gender roles in the household with new energy sources, with men sharing domestic technology use more. But there are many examples of the opposite. There is mixed evidence on control over and access to modern energy equipment, with men normally remaining in the decision making seat. In energy projects where a strategy to involve women has been deliberately pursued, this has often improved their status and voice in the community as well.

³ Panjwani, A. (2005), Energy as a key variable in achieving universal primary education: A gender and energy perspective on empirical evidence on MDG #2, 2005. Report to DfID KaR R-8346 Gender as a key variable in energy.

⁴ Panjwani, A. (2005), Energy as a key variable in promoting gender equality and empowering women: A gender and energy perspective on MDG #3, draft. Report to DfID KaR R-8346 Gender as a key variable in energy.

There is little evidence of an association between modern energy and indicators of women's empowerment such as increased access to paid work, or better representation of women as energy professionals or in energy decision-making bodies. There are only a few studies on women professionals in the energy sector, but evidence is that women face the same obstacles as in other scientific and technological professions: they are greatly outnumbered by men, who take up most management and leadership positions, and face sexual harassment, both in the North and South. However this has been little studied.

Evidence on sexual violence in fuel collection is anecdotal, but this is a problem that deserves further investigation.

MDGs 4 and 5: Child mortality and maternal health⁵

Child mortality and maternal health are clearly improved by modern cooking fuels, with good evidence on reduced acute respiratory infections (ARI) and reduced drudgery affecting neonatal survival (though the latter has not been specifically related to energy). There is some evidence too on their association with lower birth weights. The reasons for differences in ARIs between men and women, boys and girls, are still speculative, though. Access to electricity and to modern cooking fuels both correlate in macro studies with reduced infant mortality, even controlling for income.

Electricity's role in the provision of primary health services has been documented, but generally not specifically related to health outcomes. One study in Uganda did relate better communications through solar energy, with improved maternal health. There is little evidence that electrification makes rural health clinics more attractive to staff.

Little is known about the importance of energy in avoiding diarrhoea (by boiling water), nor its role in nutrition (e.g. making nutrients in cooked food more available, affecting food choice), beyond anecdotal evidence.

MDG 6: HIV/AIDS, Malaria and other major diseases⁶

There were virtually no studies found on the relation between energy availability and gender issues in HIV/AIDS, malaria and other major diseases, but the possible links are highly suggestive and worthy of investigation, especially in Africa. Acute respiratory infection (associated with biomass cooking) is known to activate tuberculosis, the most common HIV/AIDS opportunistic infection. Inadequate sterilization may be a factor behind the transmission of HIV/AIDS, especially to pregnant women, in health clinics, that is being documented. Fuelwood collection rape may also be a transmission vector.

Given the importance of rest, hygiene, and practices such as eating cooked foods and boiling water, adequate energy availability is likely to be important in improving the quality of life for persons living with HIV/AIDS (PLWHA); in reducing women's burden of care for PLWHA; and in enabling self-care for women LWHA. Work by GTZ ProBEC in Malawi with improved stoves uses an integrated framework to help alleviate impacts of HIV/AIDS on households and women in particular.

⁵ Matinga, M. (forthcoming), Energy as a key variable in reducing child mortality: A gender and energy perspective on empirical evidence on MDG #4. Report to DfID KaR R-8346 Gender as a key variable in energy.

⁶ Matinga, M. (2005), Energy as a key variable in reducing HIV/AIDS and major diseases: A gender and energy perspective on empirical evidence on MDG #6. Report to DfID KaR R-8346 Gender as a key variable in energy.

MDG 7: Environmental sustainability

There is good evidence that improved stoves save thousands of tonnes of fuelwood, and where large quantities of wood are used in urban areas or locally deforested rural areas, this could be significant in reducing deforestation (target 9). The evidence is that in most rural areas though, women's collection of household fuel does not cause deforestation. More importantly, women in their role as forest managers and in tree planting do contribute to reforestation.

The use of more efficient household cooking fuels has been estimated to contribute to greenhouse gas reductions, though compared with the total amount, it is not significant.

Some correlation of access to clean water (target 10) with electrification has been found, but the role of *energy* specifically in the provision of safe drinking water in relation to women's roles has been little studied. Energy has also been linked with improving the lives of women slum dwellers (target 11), but again, its precise role is not well understood.

Correlations and causality: Macro studie⁷s

There is a strong relationship between energy and economic growth, and some evidence that energy can be a driver of economic development for developing countries, especially at the industrial stage. There is a strong correlation between per capita energy consumption and human development indicators such as life expectancy, literacy and school enrolment used in the UN's Human Development Index (HDI), though whether this is causal or simply linked by rising incomes, has not been demonstrated. HDI also correlates strongly with the new IEA composite indicator, the Energy Development Index (EDI).

None of these correlations have addressed the question of a relationship between energy, and gender equity and empowerment, however there are global studies that show a relationship between energy and various socio-economic indicators of importance to women. Commercial energy access has been plotted by the IEA and found to be correlated with the UN indicators of extreme poverty: life expectancy, probability of not surviving to age 40, school enrolment, and underweight in children. A significant positive relationship was found by one study between traditional biomass fuel use and infant and child mortality, life expectancy (with a larger effect for females), fertility rates and crude birth rates, independent of both income per capita and income equality in a country. Indoor air pollution exposures have been related with child and adult morbidity and mortality on a global basis; though the global figures do not disaggregate effects on girls and boys, most impact on adults is assumed to be on women cooks. An eight-country study found that the fuel transition to hydrocarbon cooking fuels is strongly correlated in these countries with access to other infrastructure represented by variables for education, urbanization, and electrification. Access to clean water – especially important for reducing women's work burden – has been plotted against electrification, but the curve shows considerable diversity; other factors may be significant (cite).

An examination of the UNDP's Gender-related Development Index (GDI) versus per capita energy consumption shows that the relationship is close, and even modest increases in energy and electricity consumption could be associated with much larger improvements in gender-related development defined as equality in life expectancy, literacy and school enrolment. This is consistent with what is known about the effects of energy access on women's "practical" needs to reduce work burden and access services.

⁷ Cecelski, E. (2005), *Energy, development and gender: Correlations and causality*. Report to DfID KaR R-8346 Gender as a key variable in energy.

However the relationship between energy consumption and the UN's Gender Empowerment Index (GEM), which measures gender inequality in economic and political spheres of activity, is much less clear. Gender empowerment likely depends more strongly on other factors, such as legal, social and policy frameworks. Other conditions in addition to energy access are necessary to meet women's "strategic" needs including the transformation of gender roles and relations.

A composite Gender-Energy-Poverty Index (GEP), based on data available for 55 countries, was developed for the present study, by adding the three UN and IEA indicators on human development, energy development, and gender-related development together. The GEP Index could be used in future to measure gender-energy-poverty vulnerability and identify priority countries for action, and to compare progress across countries and regions as well as shifts over time.

Conclusions on gender, energy and the MDGs

There is good evidence for a number of linkages between energy, gender and the MDGs, ranging from time savings and reduced household expenditures, to increased school attendance by girls, empowerment through having more choice in organizing work and through access to TV and media, to acute respiratory illness, maternal health and reduced infant mortality, to deforestation and GHG emissions. There are many areas though where evidence is suggestive but needs to be more convincing for policy and planning, including on HIV/AIDS, energy's role in women's income generation, maternal and child health outcomes, and voice and participation by women.

A major challenge in carrying out the empirical review was that it is only recently that there has been much emphasis in energy projects on incorporating gender concerns and reporting on the impacts of energy interventions on MDG indicators. Even worse, data has seldom been disaggregated to show the differential impacts on women and men. For every study found that showed the impacts of an energy project on women and men, perhaps ten others were reviewed that either did not provide quantitative information on impacts at all, or mentioned only "people", "households" or "children", and did not give the impacts on women and men or boys and girls separately. In many "studies", generalizations about benefits for women were made without data or empirical support.

From a gender perspective, what emerges most strongly from the evidence, in fact, is that while energy may have important effects on women in relation to the MDGs, this varies greatly according to the social and economic environment, which necessitates a different strategy for women's involvement in the energy intervention. It is critical therefore to delve more deeply into the dynamics of *under what conditions* energy "makes a difference" in the linkages between gender and energy, through case studies and in operational project implementation.

Applying new approaches to gender in energy policy research

In the eight case studies carried out by the CRG, creative research approaches are used by leading gender and energy researchers to explore a pressing policy issue in the gender-energy-poverty nexus in their country or region. Although the case studies were not planned to be comparative, and draw on diverse approaches, they can be loosely grouped into three thematic areas: Impacts on women and men; gender in energy policy; and energy transitions and gender relations.

Impacts on women and men

Three case studies looked at the differential impacts on women and men of renewable energy projects that generate electricity. In *Sri Lanka*,⁸ new bioenergy initiatives based on using the country's large biomass resource for electricity generation, were examined by Anoja Wickramasinghe in terms of the effects on women and men in two schemes, one community-based and run by users, and the second providing feedstock for the national grid. The study reveals that modern "dendro-energy" plants can create enterprise opportunities for farm biomass production as well as generating clean energy for rural electrification. The impacts on the poor and women in these two cases depend primarily on how supply of the feedstocks is organized, but also on whether the local community receives the electricity supply themselves. In the commercial, grid-connected project, supply of biomass feedstock is handled by landowners and capital investors rather than by women who are the traditional suppliers of woodfuel. The community-level plant provides wider opportunities for women through the community organization and its focus on households supplying feedstocks for generating electricity for themselves. In this model, modern dendro-energy plants do have potential to provide a strategic means of reducing poverty while addressing women's needs.

In the *Philippines*,⁹ APPROTECH-Asia explored how gender and renewable energy interact. In a community micro-hydro in an indigenous area of Kalinga, respondents report effects on women's and men's economic roles, on their health and well-being, and on their socio-cultural and political situation. Two rice mills reduced women's drudgery in rice pounding, and cooperation with another village around the MHS is believed to have eased tribal conflicts. Women played leadership roles related to their involvement in the church organization implementing the project.

In a PV battery-charging project in Southern Leyte, electricity motivated women to better organise their household work at night and explore livelihood and income activities as well as making families feel more secure and safe.

In *Uganda*,¹⁰ a deliberate gender strategy improved the impact of solar home systems and a solar-PV battery charging station, by ensuring that women were targeted for credit and sales, according to May Sengendo's study. Gender analysis by solar companies and village banks resulted in significant benefits for women as well as men, and supported women's empowerment, especially as combined with support and encouragement to income-generating activities. Spouses often pooled resources and cooperated in order to finance loans and women became more active in joint businesses. Both men and women were trained in maintenance, battery charging and usage. Girls education benefited from being able to study later at night after completing domestic chores.

Gender in energy policy

Two case studies examined gender aspects of energy policy: The first, in Himachal Pradesh, India, studies the impact of clean fuel access policy on women's empowerment; and the second, in four countries in East and Southern Africa, analyses the role of gender research in power sector policy.

⁸ Wickramasinghe, A. (2005), Gender, Modern Biomass-Energy Technology And Poverty: Case Study In Sri Lanka. Report to DfID KaR R-8346 Gender as a key variable in energy.

⁹ APPROTECH-Asia (2005), Gender And Renewable Energy in the Philippines: Community-based Hydro in Kalinga and PV-Battery Charging Station in Southern Leyte. Report to DfID KaR R-8346 Gender as a key variable in energy.

¹⁰ Sengendo, M. (2005), Institutional and Gender Dimensions of Energy Service Provision for Empowerment of the Rural Poor in Uganda. Report to DfID KaR R-8346 Gender as a key variable in energy.

In *Himachal Pradesh, India*,¹¹ Jyoti Parikh examines the hypothesis that the state policy of kerosene and LPG subsidies is related to the empowerment of rural women and their health in the traditional fuel system. Empowerment level and access to modern energy services are in fact correlated in Himachal Pradesh. Both of these are higher than the all-India averages. Even within H.P., the two districts with different access to fuels have correspondingly different levels of women's empowerment. But though there has been fuel-switching especially in towns, women still largely bear the drudgery of cooking with traditional fuels. The main obstacle is affordability, not availability, which is good. But woodfuels are cheaper. It is not possible to conclude that better access to modern energy services has actually caused women's relatively high empowerment levels in Himachal Pradesh, since these depend on many factors.

In *Eastern & Southern Africa*,¹² the inclusion (or non-) of gender in national power sector policy is examined by AFREPREN/FWD researchers in four countries, and how gender and energy research can influence this. Power sector reform in the region has not considered differential impacts on women and men. A review of energy sector policy documents revealed that there appears to be a growing awareness among policy makers and in policy statements that the power sector will only achieve sustainable development if gender analysis is integrated into policy formulation but that this is backed only by vague policy objectives. Policy making in the energy sector in the region has been male dominated and had little consultation with end users and producers. Gender research could have a more effective impact on the policy process through a thorough understanding of the sector and interests; credible, relevant messages; and appropriate alliances and "chains of legitimacy" between beneficiaries, gender researchers, NGOs, and policymakers.

Energy transitions and gender relations

Three case studies explored changes in gender relations associated with the transition to modern fuels. In *China and other parts of rural Asia*,¹³ Govind Kelkar and Dev Nathan link women's and men's labour force participation and status to the adoption of new fuels and appliances in a number of countries. Low opportunity cost of women's labour limits the adoption of improved stoves and women's entry into income-earning activities would promote a fuel transition. While the severely negative health impacts of biomass fuels make public subsidy of alternatives desirable, this will not necessarily result in fuel switching by households so long as the value of women's labour remains low. This is shown in fieldwork from Yunnan, China and a number of other Asian countries. The critical area of intervention is likely to be in providing commercial fuels for women's income-earning activities.

In an urban township in *South Africa*,¹⁴ changes in domestic roles including cooking are related to gender equity in the new constitution, by Wendy Annecke. The challenge is, are women's domestic burdens released through saving women's labour (practical needs), or by sharing the gender division of labour within the household (strategic needs)? The findings of this study are that access

11 Parikh, J. (2005), The Energy Poverty and Gender Nexus in Himachal Pradesh, India: The Impact of Clean Fuel Access Policy on Women's Empowerment. Report to DfID KaR R-8346 Gender as a key variable in energy.

12 AFREPREN/FWD (2005), Engendering Power Sector Policy In Eastern And Southern Africa. Report to DfID KaR R-8346 Gender as a key variable in energy.

13 Kelkar, G. and D. Nathan (2005), Gender Relations and the Energy Transition in Rural Asia. Report to DfID KaR R-8346 Gender as a key variable in energy.

14 Annecke, W. (2005), Whose turn is it to cook tonight? Changing gender relations in a South African township. Report to DfID KaR R-8346 Gender as a key variable in energy.

to modern energy services (in this case, electricity) can facilitate shifts in gender roles and responsibilities in the domestic sphere – if backed by serious institutional support for gender equality. The reasons for this are two-fold: firstly women know they have legal backing to assert their rights, and men are pushed by the legal system to accept this. Secondly, electricity makes it easier for men to perform domestic chores because they are not too burdensome or demeaning.

Lessons are drawn by Michel Matly from experience with rural electrification in *Europe and the US*,¹⁵ on the ideology of women's electrification and how this may apply in developing countries today. Rural electrification came 30 years later in the US than in Europe, but quickly reached urban levels. In Europe, rural electrification was used mainly for lighting, radio and some farm equipment. In the US, federal funding was used not only to develop grids but to provide access to electric productive equipment and domestic appliances. The latter quickly became the bigger success. Rural electric cooperatives were able to cut costs by 30-50% compared to the existing large private and public utilities, and showed that the poor could pay. Women's desire for home appliances drove the rural market and high load, bolstered by home economics, a ready-made ideology for the electricity industry. Electric appliances relieved women of hard burdens and allowed them to work more efficiently in their homes, and go out to paid work. Developing countries should also consider this model of "women's electrification."

Is gender a key variable in energy? Is energy a key variable in gender?

Positive impacts of the energy interventions on women were found in all the cases, ranging from time saving and drudgery reduction, to income generation, to social and economic empowerment; these impacts could be negative as well as positive however. Benefits for women as well as men were more likely to be found in the following instances however, where:

- A deliberate gender strategy was followed in project planning and implementation (Uganda);
- The policy and/or institutional environment supported energy policies and programmes favorable to women's needs (South Africa, Himachal Pradesh, eastern and southern Africa);
- A community-based organization in which women already actively participated was involved in the project (Philippines, microhydro site; Sri Lanka, decentralised site); or
- Existing or changing gender relations in the society valued women's labour and favored women's equal participation in the energy intervention (Philippines, PV battery-charging site; Mosuo, Yunnan).
- Industry objectives coincided with women's interests (US rural electrification).

Where gender relations (or attention to gender relations) are a key variable in energy interventions, it is more likely that energy will have a significant impact on gender equality and indeed on household and community poverty as well. Where energy interventions address (or at least do not discourage) women's equal participation, the potential for benefits is much higher.

15 Matly, M. (2005), Women's Electrification. Report to DfID KaR R-8346 Gender as a key variable in energy.

A checklist for gender-sensitive energy policy research¹⁶

Energy policy research can use a variety of approaches in mainstreaming gender. While it was beyond the scope of this project to develop a detailed methodology or manual,¹⁷ our experience is that four elements are essential to defining a gender-sensitive energy policy research framework.

1) Partnerships and a process for experts on gender and experts on energy to work together

A central part of the ENERGIA/KaR research project was the creation of a Collaborative Group on Gender and Energy (CRGGE) of leading experts who were also involved in policy advocacy. Researchers included both women and men, and both energy researchers (with an interest in gender and poverty) and gender and poverty researchers (with an interest in energy), who had shown a long-term commitment – through the ENERGIA network – to policy research on gender and energy. The goal was to create a safe but challenging space to share experiences, give and receive mentoring, and contribute to the project research process through their own research and case studies. A key element in this effort was the engagement of the CRG in an active dialog to “speak the same language”. Two physical meetings to develop methodology and review results together, technical and institutional backstopping by ENERGIA, peer review of outputs within the group, capacity-building of junior researchers, the integration of results into other institutional and network activities, and group definition of partnerships and research needs were all part of the process.

2) Linking research to policy by understanding the gender-energy-poverty nexus

Many studies on gender and energy have been at the micro and household level, descriptive of women’s problems and obstacles. While valuable, this information has not always been related to specific policy issues of relevance to energy policy in the country. Fundamental in the CRG approach was how to link micro and household-level research on gender and energy with critical and current energy policy concerns for the governments, utilities and other big players in the country or region. The background and historical poverty-gender context needed to be understood, as well as the energy supply, consumption and policy situation in the country, by first reviewing literature on both gender and on energy, and building on past research in these areas. Then these were related to one another, to make clear how energy policy is influencing and could be influenced by the poverty-gender challenge.

3) Using appropriate research frameworks and methods from gender and from energy research

Gender analysis was the most used framework for analysis in all of the case studies. Although this seems obvious, disaggregation of data by gender (men and women, boys and girls) has not routinely been used even in some gender and energy studies. Gender analysis methods started by gathering data about the gender division of labour and women’s access to and control over resources and benefits. The *sustainable livelihoods framework* helped to focus attention on energy for women’s productive uses, and their control over assets. The researchers also found it useful for poverty and gender experts to take a fresh look at energy issues, as outsiders. Sustainable livelihoods was found

16 Dutta, S. (2004), Inception Meeting of the Collaborative Research Group On Gender And Energy (CRGGE), Gender as a Key Variable in Energy Interventions: Are We Asking the Right Questions? Meeting Report. Report to DfID KaR R-8346 Gender as a key variable in energy.

Banda, K. and M. Matinga (2005), Review Meeting Of The Collaborative Research Group On Gender And Energy (CRGGE), Gender as a Key Variable in Energy Interventions: Are We Asking the Right Questions? Meeting Report. Report to DfID KaR R-8346 Gender as a key variable in energy.

17 This might be considered as an extension of this project that would be useful in particular to practitioners and for use in operational projects and training courses.

to be weak though in understanding women's reproductive roles, and the interactions between reproductive and productive labour that may be mediated by energy access; and this may be because SL is not systematic in using gender analysis tools including time allocation study and intra-household analysis. Combining elements of sustainable livelihoods with gender analysis proved effective. *Feminist political ecology* relates the gendered use of natural resources to institutions, policy, and macro-economic systems. Some elements were taken for use in specific case studies as relevant.

CRG researchers used a wide variety of tools and methods. Most important in all of the studies were policy and institutional analysis, the use of both qualitative and quantitative data, and the inclusion of people's perceptions. The importance of drawing on a range of methods from a number of disciplines through the use of interdisciplinary teams was evident to the group, but case studies were sometimes weak in terms of their economic and financial analysis on the one hand, and their energy analysis on the other. This would need to be strengthened in future research.

Some of the case studies showed how important insights could be gained from analysis of the energy supply chain, in addition to the more usual end use analyses in gender and energy research (e.g., analysis of biomass feedstock supply in Sri Lanka, kerosene depots in India).

4) *"Asking the right questions" about gender, energy and poverty*

What are the "right questions? At the final review meeting, CRG researchers contributed to developing a set of "right questions" that can be an agenda for gender-sensitive policy research in the future, questions about:

- *Evidence about impacts on women and men of energy projects and changing access.* This gender-sensitive "research" should be an operational part of every energy project's monitoring and evaluation design. Have energy projects or better access improved the well-being of women as well as men? Have they met women's welfare and practical needs? Have they gone beyond this and transformed gender relations in the household, community and/or national level? Has energy had an impact on gender equality and women's empowerment? Up to now, there is a scarcity of good models of gender-sensitive approaches in large-scale or mainstream energy projects, that practitioners can draw on and replicate.
- *Rhetoric gap between policy and practice on gender and energy.* Exposing the gap between energy policy rhetoric and the reality of women's lives is a critical function of gender-sensitive energy policy research – do energy budgets, policy statements and project practice reflect women's needs? Do poverty documents such as PRSPs reflect the reality of women's energy situation? The collection of gender-disaggregated data was found in the CRG research to be the single most powerful and essential tool in being able to provide evidence to policymakers to motivate them to engender energy policy, as well as for the actual process of integrating gender into energy planning and implementation.
- *Culture and ideology in gender relations in energy.* What are the ideologies that influence gender relations and women's empowerment in the energy sector? That is, what are the reasons behind changes in gender relations and how does energy access affect or how is it affected by these changes? In the case studies, these ranged from the way that women's labour is economically valued, to the political climate and legislation on human rights, to the home economics ideology in rural electrification, to sexual violence and the power relations between women and men.

- *Political economy of change in gender and energy.* What are the “Drivers of Change” (a label that DfID has given to research on the political economy of change) in gender and energy? What incentives and disincentives face the various participants, and how can these be modified? What coalitions or alliances for “pro-poor” and “pro-women” change can be effective in the energy sector? In terms of research methods this might lead to the need to examine the concerns of the opposing factions and to “put our work in their language”. In terms of policy impact, gender and energy researchers and advocates need to be active participants in direct and formal energy decision-making processes and structures. Networks such as ENERGIA and other women’s networks and organisations can help nurture a “new deal” for women in representation in the energy sector. Bringing men on board will be key to their accepting gender equality in the energy sector as elsewhere.

In all the “right questions” above, the “potential for transformation” is the critical element. A bargaining model of the household and society is assumed in the gender analysis, with both conflict and cooperation analysed as important forces. Property relations, social relations, labour relations, and decision-making relations are important at the household, community and national level. Possibilities for women to change their power and position through negotiation are explored. What is the potential for transformation of gender roles in any energy transition or project? That is the fundamental question in gender-sensitive energy policy research in the new millennium.

1. Introduction

1.1. Background

Women/gender and energy has successfully emerged on the international agenda, and is widely viewed as one of the critical pathways for linking energy interventions to the Millennium Development Goals (MDGs), for example to goals on women's education and employment, maternal health, child mortality, and even on income and hunger.

- Recognition of the enormous health burden of indoor air pollution – now estimated to kill 2 million women and children in developing countries every year – is one of the drivers stimulating what may be increased attention to household energy interventions in the coming years, counter-acting recent neglect.
- Productive uses of renewable energy are more and more viewed as necessary to the successful dissemination as well as development impact of renewable energy interventions, though the link to women's income generation and human capital building is only beginning to be considered seriously.
- Rural electrification is enjoying a revival in interest, in particular decentralised sources. Inter-sectoral synergies, poverty and gender linkages are receiving some attention.
- A number of energy programmes in both North and South are starting to pay closer attention to gender and have launched important initiatives. Energy interventions are generally seen as potentially beneficial to both women and men in a number of ways, and there are now some specific experiences and documentation of some projects that have effectively involved both women and men as staff and entrepreneurs as well as beneficiaries.

Yet despite many efforts, energy poverty is still widespread, and gender inequality persists at every level of the energy sector. Energy and gender/poverty discourses remain, in most venues, far apart. Gender-sensitive energy projects and research are still the exception rather than the rule. The importance of bringing a gender perspective to energy policy analysis and design is still not widely understood, and the conceptual basis for doing this is still lacking. Nor have the lessons from past energy projects as regards gender and poverty been fully integrated by national policy makers or multilateral or bilateral agencies. While many are sympathetic, gender is still commonly viewed as a political agenda, not central to questions of efficiency or effectiveness in the energy sector.

At the same time, most poverty assessments and research exclude energy, except, sometimes, in as regards rural electrification infrastructure. In social development sectors, energy proponents are frequently (and often correctly) suspected of having a hidden environmental or technology dissemination agenda. Working relationships between energy macro-economists/engineers and other social scientists have been slow to develop, with different “ways of thinking”. Most distressing, has been the difficulty in convincing sector experts that gender (for energy projects) and energy (for gender/social development projects) are key variables in project success.

While enormous quantities of empirical evidence on gender and sustainable energy have been generated in recent years, much is undigested, and frameworks for analysis are weak. Why is this important perspective not better integrated into mainstream energy research? Why have researchers and, by extension, policy makers and planners – who may indeed recognize the importance of these issues – yet not been entirely successful in making convincing linkages to their own work? What approaches could help make these linkages convincing? Perhaps it is time to review and examine: Are we asking the right questions?

This project has sought to initiate movement towards the development of a framework for research on gender and energy that would be credible in both gender and energy communities. Most past

gender and energy research has seen its primary audience as the energy community and has sought to respond to energy imperatives and frameworks. This research seeks to address both energy and gender audiences, and to explore the usefulness of gender theory in better explaining linkages among gender, energy and development.

1.2. Objectives of the study

A conceptual review of past and present approaches to gender in energy policy research, eight case studies by partner institutions applying new frameworks, an empirical review of evidence on linkages between gender and energy and the Millennium Development Goals, two workshops, and this synthesis paper were undertaken with the purpose of improving understanding, policy, and capacities in gender, poverty, and energy policy research. This would contribute to the overall goal of strengthening energy policy, programme, and project linkages with the Millennium Development Goals, with a focus on gender.

Specific objectives of the study were:

1. To push forward analytical frameworks for understanding and measuring linkages between gender, poverty and energy, that would be credible in both gender/poverty and energy terms, with a view to improving project design;
2. To influence the international research agenda and programme and project practice on gender, poverty, and energy, both by analytically “looking backward” at concepts and empirical evidence, and by critically “looking forward” at “the right questions”;
3. To increase and strengthen gender, poverty and energy research in key developing country institutions, and to partner and coordinate research.

1.3. Organisation and methodology of the study and the synthesis report

Following this Introduction in Chapter 1, Chapter 2 provides an historical context to approaches to gender in energy policy research, based on a background paper prepared early in the project.¹⁸ It starts with the welfare and instrumentalist approaches that were successful in increasing women’s visibility in the energy sector between the oil crisis of 1973 and 2000, and continues with the new poverty and gender directions in the new millennium that focus on women’s strategic needs, human rights and empowerment.

The DfID-supported study consisted of two major elements that were carried on simultaneously. First, an empirical review of linkages between the Millennium Development Goals and energy, from a gender perspective, was carried out to establish the evidence for impacts of improved energy access on gender aspects of poverty. This is the subject of Chapter 3 of this report. Background literature reviews on energy as a key variable, from a gender perspective, were prepared on hunger and poverty; education; gender equality and women’s empowerment; child mortality and maternal health; HIV/AIDS; and environmental sustainability. A full list of these papers is included in the Annex.

Second, new approaches to gender and energy policy research were developed at a planning workshop and applied in eight case studies. Chapter 4 includes summaries of the case studies, according to three themes: Impacts of energy interventions on women and men; gender and national energy policies; and energy transitions and gender relations. It also presents the study conclusions on the original research questions on gender as a key variable in energy interventions, and on energy as a key variable in gender.

¹⁸ With support from ENERGIA and the ETC EASE project.

Table 2. CRG case studies

CRG responsible author & affiliation	Country(ies)	Energy technology	Title of case study
Wendy Annecke, Gender & Energy Research & Training	South Africa (urban township)	Cooking energy transition	Whose turn is it to cook tonight? Changing gender relations
Stephen Karekezi & Jennifer Wangeci, AFREPREN/FWD	Botswana, Kenya, Tanzania, Zimbabwe	Power sector	Engendering power sector policy in Eastern & Southern Africa
Feri Lumampao, APPROTECH-Asia	Kalinga and Southern Leyte, The Philippines	Community micro- hydro power system; PV battery-charging station	Gender & renewable energy
Govind Kelkar & Dev Nathan, IFAD- Asia Gender Mainstreaming Project, UNIFEM	China and rural Asia (a number of villages)	Cooking energy transition	Gender relations & the energy transition in rural economies in Asia
Michel Matly, MARGE, France	Europe and the USA	Rural electrification	Women's electrification
Jyoti Parikh, Integrated Research & Action for Development (IRADe)	Himachal Pradesh, India	Cooking energy	Energy, poverty & gender nexus: Impact of clean fuel access policy on women's empowerment
May Sengendo, East African Energy Technology Development Network (EAETDN)	Uganda (two sites)	Solar home systems; solar-wind battery- charging station	Institutional & gender dimensions of energy service provision for empowerment of the rural poor
Anoja Wickramasinghe, Department of Geography, University of Peradeniya	Sri Lanka (three sites)	Decentralised electricity generation with biomass feedstock	Gender, modern biomass energy technology & poverty

A full list of the case study reports are included in the Annex, and summaries of their findings can also be found in a special issue of *ENERGIA News* 8.4 published in December 2005. The eight case studies are listed in Table 2 above. Two case studies (Sri Lanka and Philippines) were supported by ENERGIA core research funds, with the remainder supported by the DfID research project.

It must be emphasized that the case studies are not in any way “representative” of all energy interventions in developing countries. They are skewed towards provision of electricity, with five of the case studies having electricity as the energy end supply, and three looking primarily at cooking fuels (China and rural Asia; Himachal Pradesh; and South Africa). There is more focus on successful projects than on failures.

Seven of the studies focused on developing countries, while one study drew lessons from the electrification experience in Europe and the US. Four case studies were done in Asia and three in Africa. One of the African studies was regional, covering Botswana, Kenya, Tanzania and Zimbabwe. One of the Asian studies was also regional, drawing on village studies in Yunnan, China, Laos, Vietnam, India and other countries. Mainly English-speaking countries are covered.

Three of the case studies (Philippines, Sri Lanka, and Uganda) looked at the differential impacts on women and men of renewable energy projects. Two others (Himachal Pradesh and East and Southern Africa) examined the interaction of gender and regional or national energy policies. Although all of the studies to some extent explored gender relations, three of the studies placed particular emphasis on the relationship between changes in gender relations and energy interventions (in South Africa; China and rural Asia; and Europe/US).

An integral part of the study was the formation of a Collaborative Research Group on Gender and Energy (CRGGE), composed of leading national and international policy researchers and institutions working on gender and energy, who participated in the research and/or provided backstopping and interaction. The CRG met twice during the study, at a planning meeting and at a review meeting, and communicated through a listserv in the interim.

Chapter Five presents a proposal for strengthening gender-sensitive energy policy research in the new millennium, with four key elements, based on work by the CRG at the review meeting: Partnerships and process; linking micro research to macro policy level; combining research frameworks and methods gender and energy; and asking the right questions about opportunities for transformation.

2. Approaches to gender in energy policy research¹⁹

Most women and energy research and practice from the 1970s through the 1990s remained largely within a “women in development” framework. Energy services were presumed to benefit women as members of households and to contribute to their welfare, even if women did not participate in decision making or implementation. Later, women began to be viewed instrumentally by the energy sector, as energy consumers whose views needed to be taken into account to ensure adoption of new energy sources, or as promoters who could contribute to meeting targets for dissemination of improved stoves or renewable energy technologies. Most recently, the energy sector has been obliged by new development thinking, to consider more seriously poverty alleviation and gender equality as goals in their own right that energy access can contribute to.

2.1. Old directions 1973-2000: welfare and instrumentalist approaches increase women’s visibility in the energy sector

Historically pre-2000, two major “ways of thinking” about women in the energy sector can be identified: the “other energy crisis” of biomass energy and cooking; and the “real energy crisis” of women’s work. These are examined here in turn as examples of past approaches to gender in energy policy research and practice.

2.1.1. *The “other energy crisis”: biomass energy and cooking*

Shortly after the first oil crisis in 1973, the “other energy crisis” of biomass drew attention to the importance of traditional fuels and cooking and the household energy sector, with as much as 80% of energy in poor countries being biomass and much of this used for cooking and heating by women. Attention to biomass energy, and a focus on the household as the unit of analysis, opened the first window on women’s roles in the energy sector. The starting point was the gender division of labour: Women’s roles in the energy sector were described, as users and collectors of fuelwood, and as victims of environmental deterioration and energy scarcity. Surveys suggested long hours for fuel collection and for cooking, with these costs in women’s (and children’s time and effort increasing as deforestation worsened. Negative impacts on family health and nutrition were identified (Cecelski, 1987).

As time went on, the literature sought to document not only the burdens suffered by women as ‘victims’, but also women’s roles as efficient managers of forest and fuel resources, knowledgeable about cooking properties of different species and fuel-efficient stove use and even stove-building and design, as well as in tree planting and conservation of forest resources.

In common with most approaches to women in development at the time, the focus was almost completely on women (and sometimes children), with men and their energy activities virtually excluded from the picture. Little attention was given initially either to differences among women such as age, ethnicity, class and income; women were treated as an undifferentiated group.

Improved stoves projects initially treated women as passive beneficiaries of improved stoves designed by (male) technicians. Later, as stoves failed to be adopted, women were seen as useful sources of information about stove design and contributors to meeting targets for stove dissemination that would reduce deforestation. Still, it has frequently been taken for granted that women’s interests and those of improved stoves projects coincide, or at least are complementary. Indicators of success have included reduced fuelwood use or numbers of improved stoves

¹⁹ Based primarily on E. Cecelski, *Rethinking gender and energy: Old and new directions*, ENERGIA/EED/EASE Discussion Paper, May 2004.

disseminated, a target-oriented approach rather than an impact approach. On the contrary, though, there has often been an implicit conflict between project goals – usually benefits external to households, such as reducing fuel consumption and hence deforestation (and more recently, greenhouse gas emission) – and women’s own interests in internal household benefits, for example, labour-saving, reduced smoke, improved safety, or time-saving. Women’s own agency, and gender relations (as opposed to gender roles) have largely been ignored. Such conflicts have often been at the root of problems with acceptance of stove designs.

Furthermore, there has been only minimal participation by women at higher levels, in planning and management of stoves projects. Decision-making bodies such as energy planning commissions continue to be dominated by men, as does research on biomass and improved stoves, in both technical and economic areas. Men typically control higher-status and more remunerative commercial activities as well, for example as soon as fuelwood and charcoal production and trade grow to be a profitable commercial activity, they pass from women’s to men’s control. Stove production has been dominated by male artisans, with some notable exceptions.

As development priorities moved from the privatization and economic growth orientation of the 1980s, to a mandate for poverty alleviation in the 1990s, the household energy community began to make linkages between energy efficiency goals and poverty alleviation. The 1995 HEDON publication on Household Energy and Agenda 21 details the numerous benefits of household energy interventions for other development sectors. A more comprehensive view of household energy developed – recognizing the household as a center of production and including not only improved biomass cooking stoves, but also cooking practices, kitchen and housing design, food preparation, fuel substitution, wood fuel supply and pricing as potential household energy interventions. A multi-sectoral and institution-building approach was developed by the GTZ and popularized in GTZ assistance throughout Africa. As a consequence, many improved stoves programs have been increasingly integrated in other development sector activity such as forestry, agriculture, or home economics. Commercial approaches have been successful in many countries, especially in urban areas.

Concern over the health effects of indoor air pollution from traditional biomass stoves, on the one hand, and interest in reducing greenhouse gas emissions from biomass cooking, on the other, have stimulated recent interest and attracted new actors and support for household energy action from the health sector and climate change advocacy. Documentation of the magnitude of the health effects (mainly eye and respiratory illness) of IAP has been raised since the 1980s, and in 2002 this problem was ranked the 4th largest health problem in developing countries by the World Health Organisation. Major efforts are going into quantitative technical studies to document the problem and link exposure with disease (Ezzatti and Kammen, 2003), as well as to quantify the impact on greenhouse gas emissions of switching to modern cooking fuels (Bailis, Ezzatti & Kammen, 2005). In this scenario, still, women are presented largely as the victims of indoor air pollution and household energy supply and use problems, with little attribution of women’s own knowledge and agency.

The lack of resources devoted to household energy has been cited as a sign of gender bias in the energy sector due to the fact that cooking is a major area of women’s invisible work and women are the main group affected (Parikh, Smith and Laxmi, 1999). Others have pointed out that even attention to stove improvement can be a “comfortable” way for the energy sector to marginalize women to their traditional domestic and reproductive work, while ignoring women’s productive and decision making roles in e.g. traditional fuels production and trade, as well as gender issues in energy efficiency, rural electrification, and macro-economic energy policy issues.

For example, in forestry projects, men have often been involved in forestry and marketing aspects, while women have been relegated to stoves activities. Even more fundamentally, focusing on household fuels and stoves in isolation risks missing other important aspects of gender and poverty.

2.1.2. *The “real energy crisis”: women’s work*

In the 1970s, rural energy needs were identified primarily with biomass fuel needs. By the 1980s, though, it was clear that women’s energy needs were broader and more complex than improved stoves and woodlots. Gender experts, notably Irene Tinker (1990)²⁰, began to argue that women’s time was the “real energy crisis”. Women’s long and arduous workday in the subsistence economy constrained their participation in forestry and improved biomass projects as well as in every other development activity. Providing improved mechanical energy sources (including renewable energy and electricity) to replace muscular human energy, was therefore advocated as a major priority.

These arguments were buttressed by time allocation studies that were becoming available in the late 1970s and early 1980s, revealing a complex and rich picture of labour allocation in rural areas. These studies showed (and continue to show) that women worked longer hours compared to men, but that much more of their work was unpaid. Certain tasks such as weeding, child care, cooking, fuel collection, food processing and water carrying, were typically done by women, while other tasks such as ploughing and home repair were usually done by men. Other tasks were frequently shared or varied. These studies documented women’s important role in agriculture and in home industries as well.

Water and fuel collection were shown to vary by location, season and terrain, in arid areas taking up to 3 hours daily per household; distances traveled could be 10 km or more. Rural transport was recognized as a significant task, with 80% of all transport in Tanzania performed by women. Food processing was revealed as drudgerous and time-consuming, with e.g. 84-150 woman hours per week seasonally used in shelling 600 kg maize in kenkey production in Ghana, and 110-220 woman hours using mortar and pestle to dehusk 1100 kg of rice weekly in Sierra Leone (Ahmed, 1985).

Time spent in water collection, transport, agriculture, and food processing (including cooking) were seen as acting as a constraint on women’s ability to take care of their families and participate themselves in development. Furthermore, women and energy researchers pointed out, these survival tasks (with the exception of fuel collection and cooking) were largely invisible in energy balances, resulting in inadequate budget and program attention compared to “men’s” energy concerns.

The energy sector was slow to incorporate human energy saving and women’s invisible and unpaid labour into its analysis however. These considerations did not reach the macro-level in energy policy research in the 1980s and 90s, and the focus remained on the rural, household level, and the measurement and documentation of women’s burdens and victimization. Rather, labour-saving technologies for household tasks such as water supply, grain grinding, and transport, emerged in appropriate technology (AT) and later, mainstream development activities in the water and agricultural sector, rather than the energy sector. Gender and technology paradigms and approaches to gender analysis (e.g. the differential impact of new technologies on women and men) were never really applied much in the energy sector. Benefits for women of both rural electrification and renewable energy were largely presumed, while negative effects were considered too far-fetched to take seriously. For the energy sector, the main congruence with women’s labour-saving needs has remained improved stoves and fuels.

²⁰ Tinker’s “The real rural energy crisis: Women’s time” was published formally as a book chapter in 1990, but various earlier versions were circulating in the energy community from 1979.

2.2. New directions for the new millennium: poverty and gender focus on strategic needs and empowerment

2.2.1. Energy, gender and sustainable livelihoods²¹

Energy, poverty and gender inter-linkages began to receive considerable attention at the turn of the millennium, as development assistance focused on the UN's Millennium Development Goals and the energy sector sought to link to multi-sector development. The new focus on poverty resulted in the World Bank's Energy, Poverty and Gender (EnPoGen) research²² which yielded empirical data as well as some better understanding of the complexities of the relationships, using a sustainable livelihoods framework (IDS, 2003; Masse, 2003; Matly, 2003). DfID sponsored research on gender and energy, and on poverty, that suggested ways to bring gender and energy into poverty and sustainable livelihoods discussions (Clancy, Skutsch & Batchelor, 2003; Meikle, 2004). A UNDP project carried out a series of case studies on projects involving women in sustainable energy development (UNDP, 2001).

Sustainable livelihoods energy research under EnPoGen has contributed a number of insights for gender and energy policy research and practice. First, the importance of disaggregating data (for example, on needs, uses and technologies) was shown as key for showing the different and unequal needs and priorities, which are reflected in women's different energy needs. This includes disaggregation of both direct and indirect gender benefits.

Secondly, the need for women's "voice" in determining energy options and priorities was recognized, in order to influence energy end use choices. Thirdly, it was seen that energy programs need to address women's unequal access to the necessary "livelihood assets", including credit, extension, and training. Fourth, a relational approach to gender was suggested, as well as focusing on women as a specifically affected group, for example taking into account common interests and trade-offs within households.

Still, the sustainable livelihoods framework was found by these researchers to have weaknesses for addressing both gender and energy issues.²³ Detailed time allocation data, so critical for

²¹ The Sustainable Livelihoods (S.L.) framework promoted by Chambers and Conway (1992) as adopted by UK-DfID and UNDP comprises three elements:

- human capabilities (education, skills, health);
- access to tangible and intangible assets (both financial/capital assets, and "social capital" of services, information, kinship and community and political networks); and
- economic activities.

S.L. focuses on households but "looks both outwards, to examine the relationships between households, community organizations, local government and other actors; and inwards, to examine intra-household relationships for example between men, women, children and the elderly." (IDS, 2003)

²² The Energy, Poverty and Gender initiative (EnPoGen) was carried out between 2000 and 2003 by the Asia Alternative Energy Program (ASTAE) of the World Bank. The objective was to improve the World Bank's rural and renewable energy projects through gaining a better understanding of their impacts on poverty alleviation and gender equity. Three case studies were supported, in China, Sri Lanka, and Indonesia; a methodology for monitoring and evaluating the impacts of rural and renewable energy projects on poverty alleviation and gender equity was developed; and several synthesis reports prepared. The author of this paper wrote an initial background paper for EnPoGen and also participated in the peer review group for the case studies. A special issue of ENERGIA News disseminated findings and a CD-ROM.

²³ The energy critique of the Sustainable Livelihoods approach (IDS, 2003) includes:

- the lack of a specific emphasis on small and micro enterprise development (believed to be a result of S.L.'s emphasis on agriculture and natural resources);
- the lumping of energy supply and use with physical capital, which appears to gloss over distinctions between ownership and access; and
- the inability to "deal adequately with the indirect nature of the demand for energy services and the complexities introduced by the fact that some energy systems are privately and individually owned (such as the

understanding women's roles, is difficult to collect using the rapid-appraisal case study approach. Time use and time poverty required special additions to the EnPoGen China study, for this reason, both to better address interactions between productive and reproductive work, and to focus on labour shortages as a cause of rural poverty in China. The sustainable livelihoods approach "focuses attention on productive activities and away from reproductive activities or reproduction-production linkages and thus [does] not adequately reflect the social and gender divisions of labour in households." (IDS, 2003) The question is raised too, of how to link the mostly micro work on gender and energy, with the policy and institutional level.

Other criticisms are made by Cecelski (2004), principally that gender analysis methods have not always been systematically used or documented in this sustainable livelihoods energy research. Gender is viewed as a subset of poverty in SL, and women receive attention because they constitute the majority of poor people, not as an analytical class. Essentially a welfare approach is often taken with gender equality not really considered as an objective. The focus is on the household rather than intra-household dynamics, with the interests of men and women generally assumed to be unitary or complementary, rather than divergent.

Research sponsored by DfID (Clancy, Skutsch & Batchelor, 2003) has argued for energy as a core dimension of poverty. These arguments put gender/women in the first place in the gender-energy-poverty nexus in energy and sustainable livelihoods. The main emphasis is on disaggregating information about impacts and benefits by gender. Generally, however, gender is treated, as in EnPoGen, as a subset of poverty and the justification for attention to gender is the high rate of poverty among women. A strong point is the identification of possibilities for improving the position of women through practical, productive, or strategic approaches using electricity, improved biomass supply and conversion technology, or mechanical energy. The focus is on women's productive roles and needs, both in using energy, and in the energy sector itself. The authors suggest that standard gender analytical tools in use in the agriculture, health and water sectors could be useful in the energy sector as well. They urge more involvement of women in the energy sector at different levels, a focus on energy services, and more micro-level research on linkages.

Other DfID-sponsored research on energy and sustainable livelihoods has documented the socio-economic impacts of energy sector reform (Meikle & Bannister, 2003). Meikle and North (2004) explore the impact of energy use on women's livelihoods – in particular on education and gender equality – in Arusha, Tanzania, using a participatory approach and examining household decision-making.

UNDP's case studies (2001) look at new approaches to the use of energy as a means of addressing both poverty alleviation and the advancement of women, two of UNDP's major priorities. The underlying assumption is that reduced drudgery for women and girls – through better access to modern energy services for lighting, cooking and productive activities – can have dramatic effects on women's education, literacy, nutrition, health, economic opportunities, and involvement in community affairs, with significant benefits for their families and communities as well. A particular focus in the "lessons" learned is on the policy environment for women in energy, both gender policy and national energy policy. The relationship between gender equality in all economic sectors and the participation of women and women's groups in national and local policy formation processes is emphasized.

self collection of woody biomass for use in cooking) whereas others are best provided either at the level of the community (small hydro systems) or the nation (large electricity systems or the supply of paraffin and LPG)."

Attention to productive roles and income generation from sustainable energy efforts is urged as a means of targeting women and paying for new energy equipment, together with effective marketing strategies, financing and credit arrangements. Women's potential as business entrepreneurs for promoting new energy services is pointed out.

Still, success factors are primarily concerned with using women's capabilities and organizations to increase the success of decentralized energy projects and their financial viability. The provision of welfare benefits for women is also featured. The analysis or transformation of gender relations is not a strong focus, and most references are to women rather than gender. Still, some of the case studies (notably those from Bangladesh, Mali and South Africa) do address gender and strategic issues in women's participation, and this is reflected to some extent in the policies and lessons.

In sum, the sustainable livelihoods approach contributes a number of useful concepts to gender-sensitive energy policy research. In particular, it focuses attention on women's productive roles and the potential for improved energy access to increase women's income and improve their welfare. It is weaker in understanding women's reproductive roles, and the interactions between reproductive and productive labour that may be mediated by energy access; and this may be because SL is not systematic in using gender analysis tools including time allocation study and intra-household analysis. A difficulty is linking micro work on gender and energy, with national policy and institutional level. Recent applications by UNDP and DfID have emphasized income generation and financing as means of making new energy sources affordable and more disseminated. While this may appear to remain in the welfare and instrumentalist framework of women in development, their parallel attention to national gender and energy policy and women's representation, and to strategic issues in women's participation, shows a movement towards the new thinking on gender and poverty in development policy research.

2.2.2. Gender, poverty and environment

Gender equality has been accepted as a goal in itself in current development thinking, and also as central to meeting poverty alleviation targets, based on various efficiency rationales. Nonetheless, gender critiques of poverty assessment methods discover bias in the process and lack of a systematic approach. Gender comments are often isolated to the domestic economy, and appropriate gender-disaggregated data not collected. Some of the same limitations apply to energy, poverty and gender assessments.

New thinking on gender and poverty (Kabeer, 2003) insists rather on: differentiation of groups of women rather than treating women as a homogenous group; gender as an important category for analysis rather than just a variant of poverty; and the bargaining model of the household as a site of both conflict and cooperation. The IFAD-Asia gender analysis approach to gender and poverty (Kelkar & Nathan, 2005) – which emphasizes women's strategic as well as practical needs and the transformation of gender roles – is found to have relevance in the energy sector (Cecelski, 2004). But it is difficult to find examples of the application of all four gender analysis tools²⁴ in a systematic manner in the energy sector, either in operations or in research.

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- ²⁴ The Sexual/Gender Division of Labour: paid and unpaid work, and how it is organized; how a project will reinforce or challenge this.
 - Access to and Control over Resources and Benefits: assessing these, and how a project will increase women's access to and control over resources and benefits.
 - Practical Needs and Strategic Needs: "Practical needs are linked to women's condition, can be readily identified, and relate to unsatisfactory living conditions and lack of resources. Strategic needs are less obvious and less readily identified by women. These are closely related to women's position."
 - Potential for Transformation in Gender Relations: Does a project contain the seeds of change?

New frameworks on gender and environment have considerable relevance for gender and energy analysis (Joekes & Leach, in Jackson & Pearson, 1998). In the energy sector, a similar critique has been made of earlier women and development approaches as welfare-oriented and instrumentalist, though valuable in raising the visibility of women. Other themes of gender and environment frameworks seem to fit gender and energy as well. Women have varying interests in energy sector objectives according to their social situation (rather than inevitably having complementary interests, such as in fuel efficiency). Not only gender roles but also gender relations are relevant to energy access. Participation by women in energy projects is not the same as benefits, given intra-household and intra-community decision-making processes. And energy is only one factor in the macro context.

Feminist political ecology (Rocheleau, Thomas-Slayter & Wangari, 1998) offers perspectives for analysis on: environment and survival as a North-South issue; the impact of large economic and social systems on localities; gender-based asymmetrical entitlements; the value of local knowledge; gendered space; realignment of rural-urban spaces and production systems; and women's collective struggle. When applied in the energy sector, these perspectives appear to have the potential to complement the sustainable livelihoods approach and to offer valuable insights into gender, energy and poverty inter-linkages as well.

Sustainable livelihoods, gender analysis, and feminist political ecology together offer a new perspective on gender, energy and poverty, that can help in understanding and addressing linkages with the new poverty focus of the Millennium Development Goals.

3. Energy, gender and the MDGs: Empirical evidence

3.1. Energy, gender and the Millennium Development Goals

The Millennium Development Goals (MDGs) were adopted in September 2000 at a United Nations Assembly summit as a set of time-bound, measurable goals and targets to be achieved by 2015. They address challenges in poverty reduction, hunger, health, gender equality, education, and environmental sustainability and have been placed at the center of the United Nations' global agenda. They are increasingly viewed as basic human rights – to health, education, shelter, and security. In September 2005, 191 heads of states met again at a World Summit to review progress and endorsed an action plan for international security and achieving the MDGs by 2015.

Although there is no MDG on energy, the World Summit for Sustainable Development (WSSD) held in Johannesburg in 2002 agreed that energy, especially access to modern energy services, should be given more attention. Specifically, a commitment was made “to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the Millennium Development Goals, including the goal of halving the proportion of people in poverty by 2015, and as a means to generate other important services that mitigate poverty, bearing in mind that access to modern energy services facilitates the eradication of poverty.” (CSD, 2002)

This renewed political commitment and support for achieving the MDGs has led to more serious attempts to conceptualise the role of energy in development. The importance of having quantifiable indicators to measure achievement of the MDGs has led to a number of efforts to define and monitor indicators for projects in the energy sector, by DfID, by UNDP, by GVEP, and by the UN Millennium Development Project. The MDG focus also made explicit the goal of gender equality, in MDG #3, and this drew the attention of the energy sector. Empirical evidence to support linkages between MDGs and energy supply is still relatively sparse, however, and little of the available evidence is gender-disaggregated or focused.

This section 3.1 reviews how energy and gender have been conceptualized and linked with the MDGs over the past five years. The next section 3.2 explains how the present research project collected empirical information and selected a matrix of indicators on gender, energy and each MDG. In following sections 3.3-3.8, a gender perspective on linkages between energy and each MDG is then presented, based on empirical review papers carried out under the present research project. Section 3.9 deals with macro statistical studies. Finally, in 3.10, some overall conclusions about the evidence and gaps are given.

Energy for the poor: Underpinning the Millennium Development Goals (DfID, 2002)

In 2002, as preparation for WSSD, the UK Department for International Development (DfID) pioneered work to illustrate the linkages between energy and the MDGs in *Energy for the Poor*. It argued that energy can play a crucial role in improving the lives of poor people and that lack of access to modern energy services is a severe constraint on development. Poor people, it was argued, see access to modern energy services as a priority and pay high prices for energy. Not only electricity, but biomass, kerosene and other sources are important to meet energy needs of the poor. A matrix on energy and the MDGs suggested some direct and indirect contributions of energy to achieving each goal, citing case studies to support these contributions. For the gender equality MDG #3, freeing women's time from survival activities (gathering firewood, fetching water, cooking etc.), home study, and access to educational media were cited as direct contributions, while lighting in schools for education, street lighting for safety, and energy for women's enterprises were

cited as indirect ones. Freeing girls' time was also cited as a contribution to MDG #2 on education and reducing the workload of pregnant women as a contribution to MDG #5 on maternal health.

Linking women and energy at the local level to global goals and targets (UNDP, 2003)

In 2003, UNDP drew on the DfID matrix to conceptualise the gender specificity of the links between energy and each of the Millennium Development Goals (Havet, 2003). Starting from the ways identified by DfID that energy contributes to achieving goals and targets, a gender perspective on each of these was added. For example, reducing the time and share of household income spent on domestic energy, with more efficient fuels and technologies (contributing to Goal 1, Target 1, reducing poverty) would specifically benefit women and girls since they are generally responsible for the provision of energy for household use, either gathering or paying for fuel. This is generally at the conceptual level, but one real-life example of the gender specific impacts of a specific energy intervention, the Mali Multi-Purpose Platform Project, is given, based on a socio-economic impact study. For example, the Mali project contributed to Goal 1 on reducing poverty and hunger through women's time in agricultural processing as well as increasing output, and saved men's time in battery charging and welding.

Impact cycles and indicators for rural energy programmes (GVEP)

The Global Village Energy Project (GVEP) Interest Group on Monitoring and Evaluation of Rural Energy Programs is attempting to create an evaluation tool box for measuring the effect of rural energy programmes on development, and to create a mechanism for sharing methodological findings and evaluation results among partners in GVEP. In a working document²⁵, categories corresponding to the MDGs are defined and effects of rural energy projects on each field are described, based on the DfID *Energy for the Poor* document above. Positive effects of energy access are hypothesized, and an "impact cycle" conceptualized for direct and indirect effects. On this basis, a list of measureable indicators are developed that would permit these concepts to be evaluated in a quantitative manner.

For gender equality, the basic hypothesis is that access to modern energy services will lead to better health, education and income that will improve women's opportunities, status and living conditions, and lead to gender equality. Empirical evidence is not supplied, but energy projects implemented by GVEP member organizations have been selected to use this framework to evaluate their MDG achievements.

The UN Millennium Project

Energy was firmly placed on the MDG agenda in January 2005, when the independent advisory body Millennium Project published its report to the UN Secretary-General, *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals*, a comprehensive operational framework and investment strategy that would allow meeting the MDGs by 2015. Energy is notably integrated into each MDG in the report and into many of the individual task force report prepared by experts.²⁶ Energy, including both electricity and safe cooking fuels, is identified as an essential infrastructure service and part of the "means to a productive life". Investing in core infrastructure, together with human capital and good governance, is viewed as a means to convert

²⁵ GVEP Interest Group, Monitoring & Evaluation of Rural Energy Programs, Working Document, Impact Evaluation Methodologies Review and Indicators Development, EdF Access-EDEME, 2003.

²⁶ Though there was no task force on energy, a wide-ranging paper addressing the role of energy in the poorest countries was commissioned for Task Force 1 on poverty and hunger. "Energy services for the poor", written by Vijay Modi of Columbia University, was presented to many of the task forces and greatly raised the visibility of energy in the Millennium Project.

subsistence farming to market-oriented farming, establish the basis for private sector-led diversified exports and economic growth, enable a country to join the international division of labour in a productive way, and set the stage for technological advance and eventually an innovation-based economy.

Most notably, the UN Millennium Project proposes that countries adopt the following specific targets for energy services to help achieve the Goals by 2015:

- Reduce the number of people without effective access to modern cooking fuels by 50 percent and make improved cook-stoves widely available.
- Provide access to electricity for all schools, health facilities, and other key community facilities (this target is also included in the list of “Quick Wins” for rapid action).
- Ensure access to motive power in each community.
- Provide access to electricity and modern energy services for all urban and peri-urban poor.

If adopted in national poverty strategies, this would be the first time that energy targets have been explicitly included as MDG goals. In addition, the Millennium Project report emphasizes that energy investments need to be included in MDG-based poverty reduction strategies, and estimates that out of total MDG investment needs of \$80 per capita in 2006 (rising to \$124 in 2015), energy costs would need to be about \$13 per capita in 2006 (rising to \$18 in 2015).

Furthermore, energy appears explicitly in the report of the UN Millennium Project Task Force on Gender Equality on *Taking Action: Achieving gender equality and empowering women* (2005), a focus of Beijing+10 review in New York in March 2005. Energy appears explicitly in strategic priority 3, where investment in energy infrastructure is seen as an important means to reduce women’s and girls’ time burdens in fuelwood collection and transport.²⁷ One of the 12 (expanded from 4 previously) indicators proposed for monitoring progress towards Goal 3 on gender equality is the hours per day women and men spend fetching water and collecting fuel.

3.2. Objectives and organisation of the empirical review

While many assumptions have been made in the literature about the linkages among energy and the MDGs, in fact not many empirical studies have been done that would provide evidence convincing to policy makers and practitioners on the benefits of energy for women or for gender equality. The present review aimed to conceptualise indicators and then to collect empirical evidence – preferably quantitative data – on linkages among gender, energy and the MDGs. Assumptions and myths in the literature could be checked against the available data and evidence. This broader review would complement the narrower country and sub-regional case studies in the research project. Four researchers divided the MDGs among themselves and prepared review papers or sections with a gender and energy perspective on each MDG (see Annex for full titles of review papers), as follows:

MDG 1: Poverty and hunger
MDG 2: Education

Soma Dutta
Anja Panjwani

²⁷ The task force sets seven strategic priorities to ensure that Goal 3 on gender equality is met by 2015:

1. Strengthen post-primary education opportunities for girls while meeting universal primary education commitment
2. Guarantee sexual and reproductive health and rights
3. Guarantee women’s and girls’ property and inheritance rights
4. Invest in infrastructure to reduce women’s and girls’ time burdens
5. Eliminate gender inequality in employment by decreasing women’s reliance on informal employment, closing gender gaps in earnings, and reducing occupational segregation
6. Increase women’s share of seats in national parliaments and local governmental bodies
7. Combat violence against women and girls

MDG 3: Gender equality	Anja Panjwani
MDG 4: Child mortality	Margaret Matinga
MDG 5: Maternal health	Margaret Matinga
MDG 6: HIV/AIDS & major diseases	Margaret Matinga
MDG 7: Environmental sustainability	Elizabeth Cecelski

The papers first, reviewed the previous work on energy and the MDGs described in 3.1 above – especially that related to gender issues – in order to develop a set of likely indicators. Evidence was then sought from the literature, including library searches, journal databases and internet searches with key words. Major depositories of documents were visited, such as AIT, ICIMOD, TERI, and the World Bank. The researchers based in the regions (Matinga in Malawi and Dutta in India) focused on documents in those regions. The selected indicators were adjusted throughout the review, according to the availability of evidence. The focus is on the presentation of evidence, rather than on recommendations.

A number of challenges were encountered. Each MDG could have been a study in itself. The literature proved far more extensive and difficult to access than anticipated by the resources available for the project, largely because quantitative data needed to be sought from studies in other fields rather than in “gender and energy” or even “energy” literature per se. Much literature had to be read only in order to find that it did not include the relevant information on impacts or by gender. In Malawi, international resources were not well accessible and internet connection was poor. Mainly English language literature was accessed and Latin America and West Africa are severely under-represented. It was sometimes difficult for the present researchers to “stick to the data” and refrain from advocacy or speculation, since many of the sources leaned in this direction. And confronting gender issues in our own research, two of the four researchers became pregnant and took maternity leave during the course of the project, necessitating travel constraints and work rescheduling.

The review papers, summarized here, begin by sketching the relationships previously assumed between gender, energy and each MDG. A set of indicators is suggested for measurement. Empirical evidence for each indicator is presented, together with some case study examples. Detailed tables with the evidence and references for each indicator are annexed and an extensive bibliography is included. Some conclusions and priorities for research on gender, energy and each MDG are set forth at the end of each paper. The complete papers can be found online.

Table 3 sets out the seven MDGs included in the study, their targets, and the gender-energy indicators covered in the empirical review papers. These are discussed in more detail in the following sections.

Table 3. Indicators of energy as a key variable from a gender perspective for the Millennium Development Goals

Millennium Development Goals	Gender & energy perspective indicators relate energy access with impact on:
Goal 1. Eradicate extreme poverty & hunger by 50%	<ol style="list-style-type: none"> 1. Time & effort spent (M/F, B/G) in cooking & fuel collection and in food processing; and use of time saved 2. Income generation (M/F): Direct applications in agriculture, home industry, extension in work hours through lighting, energy entrepreneurs 3. Reduction in household expenditures on energy 4. Improvement in social capital
Goal 2. Achieve universal primary education of boys and girls	<ol style="list-style-type: none"> 1. School attendance (B/G) 2. Hours of study (B/G) 3. School performance (B/G)
Goal 3. Promote gender equality and empower women	<ol style="list-style-type: none"> 1. Literacy (M/F) 2. Leisure time (M/F) 3. Access to information through media & telecommunications 4. Transformation of gender roles in the household (M/F) 5. Control over & access to modern energy services (M/F) 6. Voice and participation of women 7. Violence against women in energy sector 8. Employment of women in the energy sector
Goal 4. Reduce child mortality (by 2/3 the <5 mortality rate) Goal 5. Improve maternal health (reduce mortality by ¾)	<ol style="list-style-type: none"> 1. Indoor air pollution (IAP) exposures and acute respiratory diseases due to biomass fuel use (M/F, B/G) 2. Low birth weight due to IAP and maternal overwork 3. Quality of primary health care and vaccination 4. Women's workload and child care 5. Burns and kerosene poisoning 6. Fuel scarcity, water boiling and cooked foods
Goal 6. Combat HIV/AIDS, malaria, other	<ol style="list-style-type: none"> 1. Recommended health behaviours (e.g. cooking food) for persons living with HIV/AIDS (PLWHA) 2. Reduced women's burden of care for PLWHA 3. Reduced drudgery for women LWHA 4. Reduced exposure to disease vectors for women LWHA 5. Sterilisation of equipment in clinics 6. Risk of infection from violence collecting fuel 7. HIV/AIDS induced poverty and deforestation from increased natural resources dependency
Goal 7. Ensure environmental sustainability incl safe drinking water and slum dwellers	<ol style="list-style-type: none"> 1. Deforestation & fuel collection 2. Climate change & traditional biomass use 3. Access to clean water & sanitation 4. Access to cooking energy and electricity by slum dwellers (M/F)

3.3. MDG 1: Poverty & hunger²⁸

Even though hunger has declined globally, more than 852 million people are still chronically or acutely under-nourished, according to the UN Millennium Project task force on hunger and poverty. Most are in Asia, especially India (221 million) and China (142 million), and Sub-Saharan Africa counts 204 million, which is increasing. Hunger is seen as both a cause and an effect of poverty, and closely linked to all the other MDGs. The target is to halve world hunger by 2015. (Sanchez, et al, 2005)

Gender inequality, HIV/AIDS and climate change are seen by the task force as three key factors that exacerbate vulnerability to hunger. “Due to existing social inequalities, women are often disproportionately vulnerable to hunger. Although they are responsible for the bulk of food production – more than 80 percent in Africa – they continue to be bypassed by most agricultural programs. Women should be empowered and supported in their multiple roles as food producers, household nutrition managers and caregivers, marketers and traders, and so on. Gender equality is not simply socially desirable; it is a central pillar in the fight against hunger.” (Ibid.)

From a gender and energy perspective, the most important linkages with MDG 1 are first through women’s time – a key factor in food production and the nutritional status of the family – where drudgery/time saved can be re-invested in activities ranging from agriculture to income-earning and building social capital. Secondly, better energy access could improve women’s productivity and income directly, as an input to their agricultural tasks, off-farm activities and home industries. Thirdly, women’s control over energy assets in enterprises could be a source of income. Finally, savings in expenditures on household energy by using new cooking technologies could effectively increase household income available for food.

The many possible linkages between gender and energy, and MDG 1 on poverty and hunger, are shown in Table 4 below.

Table 4. Gender and energy linkages with MDG 1 on poverty and hunger

Contribution towards MDG 1	Gender and energy linkages
Time and effort saving	<ul style="list-style-type: none"> ▪ Energy can reduce drudgery of arduous tasks, undertaken by women, such as agro-processing, grinding, milling and food preparation, increase opportunity for enterprise and income generation. ▪ Reallocation of time saved in fuel and water collection to engage in income generating activities, including food production ▪ Women are typically responsible for the high drudgery, low-technical input tasks like weeding, planting, and hoeing, in agriculture, which can be made easier through energy inputs.
Using energy services for income generation	<p>a) <u>Increase in agricultural productivity</u></p> <ul style="list-style-type: none"> ▪ Energy inputs in irrigation can improve agricultural productivity and help in diversification of crop choices. Women in developing countries provide the bulk of agricultural labour, up to 60%. In Africa for example, women perform about 90% of processing food crops and providing water and fuelwood, 80% of food storage and transportation from farm to village, 90% of hoeing and weeding and 60% of harvesting and marketing. ▪ Efficiency improvements in women’s tasks can increase agricultural productivity ▪ Mechanized agro processing can increase food supply, with reduced effort ▪ Biogas slurry can help improve agricultural productivity.

²⁸ Summarised from Soma Dutta, “Energy as a key variable in reducing hunger and poverty: A gender and energy perspective on MDG 1,” Draft literature review, Report to ENERGIA/DfID Kar Research Project R8346, October 2005. References, case studies and descriptive tables are included in the full text, available at www.energia.org/crgge

Contribution towards MDG 1	Gender and energy linkages
	b) <u>Increased income for women through energy enterprises</u> <ul style="list-style-type: none"> ▪ Access to modern energy services facilitates emergence of new micro-enterprises, livelihood activities, and employment generation. ▪ Many of the informal sector enterprises are owned and operated by women, which can benefit from improved access to modern energy services ▪ More efficient fuel conversion technologies can reduce energy costs in rural industries. ▪ Lighting and thermal energy can enable rearing of piglets and chicks which require controlled but warm temperatures through out the night.
Access to modern energy services can contribute towards increase in social and human capital	c) <u>Lighting can extend working hours in the evenings</u> <ul style="list-style-type: none"> ▪ Reduced time spent on household chores allows women to play greater roles in public domain. ▪ Radio and other communication technology powered by energy improves access to outside world. ▪ Girls, when freed from household chores like fuelwood collection can attend school. ▪ Street lighting improves women's safety ▪ Reliable energy services offer scope for women's enterprises.
Direct saving in household expenditures by using more efficient fuels	<ul style="list-style-type: none"> ▪ Reduction in share of household income spent on cooking, lighting and heating by introducing clean, efficient fuels ▪ Reduction on expenditure in health related to biomass use (indoor air pollution)
Access to quality energy services can lead to improved quality of life.	<ul style="list-style-type: none"> ▪ As modern lifestyles become more rushed, women need more cooking and energy options to aid their work. ▪ Availability of efficient equipment for cooking, heating, water supply, lighting ▪ Savings in time and labour expenditure for men and women

Source: Dutta, 2005.

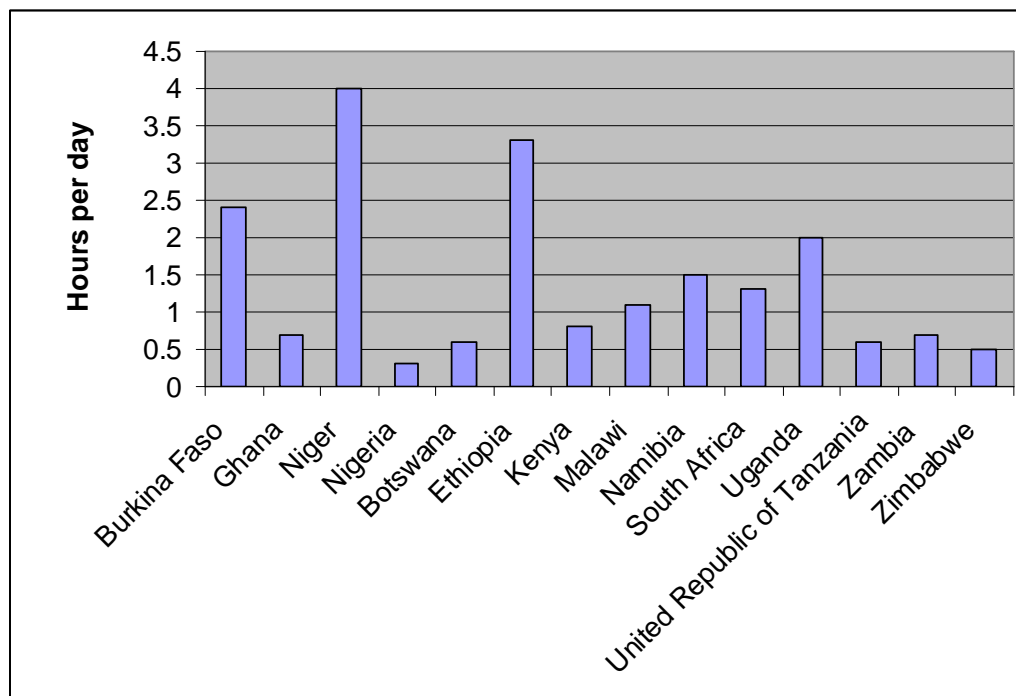
The empirical evidence for the main linkages is reviewed below.

Time and effort saving from modern energy

Numerous studies have explored the time allocation of women and men in developing countries and show that lack of time is a serious constraint for rural women. Women shoulder a heavier and more diverse workload than do men. They manage the housework; take care of the children; nurse the sick and the old; collect water, fodder and fuelwood; take care of smaller livestock; work on crop fields; handle manual post-harvest operations; and often develop cash-earning activities to add to family income. Workdays of 11-14 hours and more for women are not uncommon, compared with around 10 for men. For example, the EnPoGen study in Sri Lanka (Masse and Samaranayake, 2002) revealed that women get up earlier and are awake for 16 hours or more, of which 13 hours were work, compared with 10 for men. The rise in migration by men and in the number of female-headed households, adds to this burden and time constraint.

Fuel collection and cooking are among the most time-consuming activities carried out by rural women using their own labour, with food processing and water carrying also important. All of these activities can be made easier, faster, and safer with access to modern energy. Figure 1 gives time spent in fuel collection in a number of countries. It varies greatly and is site-specific according to environmental conditions, social set-ups and distance to forest/wasteland resources, but ranges in these studies from 1 (probably on average) to as high as 5 (in parts of Nepal) or 6 (in parts of India) hours per household per day.

Figure 1. Hours spent in fuel collection, time use studies in Africa



Source: Dutta, 2005 (figure created by WHO).

Fuelwood collection is not only time-consuming but drudgerous. Distances travelled on foot to collect fuel reported in these studies range as high as 4-8 kms. Loads carried are reported as high as 50-70 kg (Ethiopia) and 75 kg (Yunnan, China), though averages are closer to 10-20 kg (Laos).

Time savings are frequently reported for improved cook stoves and fuels, due to reductions both in the collection of fuelwood and to faster and more convenient cooking. Cooking time is saved because of being able to use two pots at the same time, quick raising of temperature, higher heating efficiency, and so on. Time saved in cleaning pots and the kitchen have also been reported. Time saving is probably the most important benefit mentioned by women who adopt new cooking technologies.

These time savings are often mentioned but less often quantified; when estimated, they amount to as much as half of time spent in fuel collection, or up to 100% when biogas is used. Since most households continue to use multiple fuels and do not abandon fuelwood entirely, this may be exaggerated however. One survey in India documented an average of about 8 minutes saved daily in cooking time after introduction of improved cook stoves (Barnes & Sen, 2003).

Women's time is reported saved with electric lighting in Nepal, when only a switch needs to be turned on rather than procuring kerosene and filling and lighting lanterns in each room (Mahat, 2004). Even though electricity is not used directly for cooking, its presence correlates with a reduction in time spent for fuelwood collection in studies in India, Bangladesh & Sri Lanka (Barnes & Sen, 2003; Chakrabarta and Chakrabart, 2002; Masse & Samaranayake, 2002); this phenomena needs more investigation to be explained though.

Grinding mills and other food processing facilities can save large amounts of women's time and in particular, drudgery. In a microhydro project in Nepal, women used to wake up around 4 am and hand process grains for at least two hours; now they spend around half an hour on processing activities, excluding travel and waiting times of one hour (Mahat, 2004), considered more restful. In

Mali, a socio-economic survey showed time savings of 2.5 hours per day per woman due to a multifunctional diesel engine platform that could mill cereals and dehusk rice (Porcaro & Takada, 2005).

Time in livestock care can also be saved, as in a village in Hubei province in China, where mechanization of pig fodder cutting and corn grinding reduced women's and men's time spent preparing food for pigs. This allowed men to migrate to earn cash income (IDS, 2003).

Use of time-savings

Most studies reviewed (12 out of 18) reported that women used freed-up time for income-generation activities such as handicrafts, sewing, other home-based work and agriculture, as well as for the poorest households, waged labour. Only two reported that saved time was used for rest or leisure. Where income opportunities exist, households have been more eager to adopt (women's) labour-saving technologies such as improved stoves. The household then has an incentive to make its energy system as efficient as possible. In Laos, for example, when the sale of woven fabric became a regular source of income, families started to plan wood collection and stockpiling in large amounts using carts or rented cars. Men also took over household tasks from the fast weavers.

The extension of the working day through electrification is both a plus and a minus for women. It adds flexibility – highly valued – and sometimes income, but at the cost of leisure and sleep and an even longer working day. One of the few gender-disaggregated studies on rural electrification (Barkat et al 2002) reported that rural women felt that while electricity had not brought any real reduction in workload, it gave them greater flexibility and choice in the organization of their work patterns. In households with solar home systems in Lampun province of the Philippines, women were able to do their household chores at night so their productive activities increased by 2.2 hours – and men's decreased by 1.2 hours – compared with non-SHS users (Laksono et al 2003).

In general, however, it appears that when more efficient energy sources do save time, men are more likely than women to use these savings for recreation and leisure, whereas women are likely to redirect them to household chores and income-generation. On the whole, time-savings do not usually reduce the workload of women, but gives them flexibility to schedule their work according to convenience. The new technologies make work both easier and more productive of family well-being. In Sri Lanka, for example, women considered that electricity gave them about two extra hours of useful time, which were invested primarily in better housework and care of the children, but also in time to rest, socialize and watch television and occasionally to develop income-generating activities (Matly, 2003).

Many examples can be found of women as well as men using electricity for income-generation. In Bangladesh (Barkat et al 2002), women in the electrified compared to non-electrified households re-allocated their saved time to more household-level income-generation activities. In Nepal, handicraft work was practiced at night by women, weaving baskets, mattresses, etc. (Mahat, 2004). Women developed a cold storage facility for seafood following Muana micro hydro plant in Solomons (Saturaga, 2004). The most widely experienced use of electricity for income-generation by both women and men seems to be the extension of the working day through lighting at night. However, only a small proportion of households typically develop businesses at all, as a direct result of improved lighting/any other energy service.

There are a number of examples of “energy enterprises” operated by women, where women manufacture energy equipment or control energy-producing assets that are the basis of a business:

- In Uganda, more than fifty women's groups use solar dryers to supply dried pineapples, bananas and mangoes to the Fruits of the Nile company formed to export to Europe. In 1995, the company exported more than 40 tonnes of dried fruit (UNDP, 2000).
- In Sonora, Mexico, a group of women from one of the poorest neighborhoods built a commercial-size solar oven with NGO assistance, and established a bakery business that provides them with income to buy shoes and clothes for their children and send them to school.
- A women's rural cooperative on an island in Bangladesh is manufacturing and selling fluorescent lights and learning about quality control, business development & marketing.
- Rural women in Mali and other countries in West Africa rent out services of the multifunctional platform.
- In Kenya, women potters manufactured liners for improved stoves.
- The Vietnam Women's Union is promoting solar home systems and collects payments from customers. Many of the local technicians responsible for installing the solar home systems are women (UNDP, 2003).

Often, women choose an energy business that provides services that women in the community need and that they themselves can use at home as well as sell. As users, they may be more sensitive to women's needs, and also be able to more effectively market to other women.

Direct saving in household expenditures by using more efficient fuels

Since women in the household are typically responsible for paying for both cooking fuel and food, savings in expenditures on cooking fuel can have a direct impact on food consumption. Savings in expenditures through not having to purchase fuelwood for cooking is reported by many studies. In those that quantify savings, 20-50% is typical (Anderson, 1992; Barnett et al, 2002; Dang, 1998; ESMAP, 2003; Maharjan, 2005; Shailaja, 2000) and as high as 63% is mentioned for a biogas plants in Nepal (Keizer, 1993).

Electricity connection also can reduce expenditure on kerosene for lighting, dry batteries for sound equipment, and car batteries for television (HLF, 2001; Bryce and Soo, 2004; Laksono, 2003; Masse & Samaranayake, 2002, Sauturaga, 2004). The EnPoGen study reported that newly electrified households in Sri Lanka may cut their energy bills in half, and in Indonesia up to 70 per cent (Ramani & Heijndermans, 2003). In Bangladesh average monthly expenditures on kerosene in electrified households were only Tk. 28.3 compared with Tk. 65 in non-electrified household (Barkat, Khan et al, 2002). However in the medium and long-term, these savings are offset by increased electricity consumption from greater appliance use. This represents greater benefits as well but it is not known how this then interacts with food consumption.

Conclusion

Reducing poverty and hunger is linked to women's ability to have the time and effort available to participate in development. There is good evidence that women can save time and effort from improved access to modern energy services for their traditional responsibilities of cooking, water fetching and food processing. Modern cooking fuels but also electricity reduce the time that women spend on drudgerous tasks. How this time is allocated depends though on many factors, especially market and income-earning opportunities.

In most cases, women use "saved" time – including time added by the extension of the working day with electric lighting – to work rather than for rest and leisure. Women are more likely to use their time savings to take advantage of income-earning opportunities or devote increased time to agricultural work in order to contribute to the family income; they may catch up on household and child care, and thus improve family quality of life and hygiene.

Many examples can be given of women using biomass fuels, modern cooking fuels, and electricity for income generation. However only a small proportion of all households usually start a business when energy access improves. There are quite a number of examples of “energy enterprises” operated by women and women’s groups. Women manufacture and/or market energy equipment such as improved stoves (Kenya), solar home systems (Vietnam) and lighting (Bangladesh); they control energy-producing assets that are the basis of a business, such as solar dryers (Uganda), solar ovens (Mexico), and diesel engine platforms (Mali). These businesses often aim at other women consumers. Most have been set up under special (project) conditions.

There is good evidence of savings in expenditures on cooking fuels as well as lighting due to more efficient and lower cost modern fuels. In theory, these energy savings could result in increased food consumption. However evidence was not found either for or against this. There is evidence that savings due to the replacement of kerosene by electricity are usually quickly offset by increased electricity consumption.

3.4. MDG 2: Education for all and gender parity in education²⁹

MDG 2 has the global goal of universal primary education and gender parity at all levels of education by 2015. According to the UN Millennium Project task force report on education (Birdsall et al, 2005),

More than 100 million children of primary school age are not in school, with the worst shortfalls in Africa and South Asia. Girls are disproportionately affected, particularly in Sub-Saharan Africa, South Asia, and East Asia and the Pacific, where 83 percent of all out-of-school girls live....In Africa,...just 51 percent of children (46 percent of girls) complete primary school. In South Asia 74 percent of children (and just 63 percent for girls) do so.

Poor children – and poor girls – are even less likely to attend school.

The challenge of bringing out-of-school children into the educational system, and reforming educational institutions, is enormous. What evidence is there of linkages between education and energy, from a gender perspective? Most commonly recognized is that access to modern energy services could free up time for girls to go to school or to spend time on homework. Another linkage generally assumed is that improved energy services at schools or walking to school can create a more child-friendly environment in terms of improved water and sanitation facilities, lighting and space heating/cooling. Girls are more likely to benefit from an environment perceived as secure, giving parental concerns about their safety. What is the empirical evidence for these linkages?

School attendance by girls and electrification

Various studies show that girls, more than boys, are responsible for assisting their mothers in reproductive tasks in the household, and that they do save time on their chores when they have access to improved energy services. However the link with education is not often made and especially changes in school attendance are frequently not disaggregated by boys and girls.

Some studies of the impacts of electrification have shown effects on school attendance by girls. In the well-documented Mali Multi-Purpose Platform project, not only women’s but girls’ time was saved in agro-processing and other tasks, leading not only to increased attendance of girls in

²⁹ Summarised from Anja Panjwani, “Energy as a key variable in education for all and gender parity for education: A gender and energy perspective on MDG 2,” Draft literature review, Report to ENERGIA/DfID Kar Research Project R8346, October 2005. References and descriptive tables are included in the full text, available at www.energia.org/crgge

primary schools, but also to their improved school performance (Brew-Hammond and Crole-Rees, 2004; Porcaro, 2005). In Bangladesh, somewhat higher school attendance of girls in electrified villages was associated with the availability of electricity in schools and with the provisioning of fans for comfort (Barkat et al, 2002). Drop out rates were also lower in electrified villages. In Tunisia, families felt that girls were safer walking to school in early morning, due to street lighting, and school administrators felt that this was an important factor in increased school attendance by girls (Cecelski et al 2005).

Water provision – which requires energy – appears especially crucial in enabling girls to attend school. In Morocco, where electrification increased school attendance by both girls and boys, girls were more benefited by investment in clean water facilities, while boys benefited more from investment in irrigation and advanced crop technology, reflecting their different responsibilities (Khandker et al, 1994). Access to water was also found to be critical in Peru, where having water in the dwelling decreased girls' chores by over 90 minutes per week and raised their hours in school by a similar amount. In the Mali Multi-Purpose Platform project, though all villages benefited, the village which used the platform for water pumping showed the most dramatic increases in girl-to-boy ratios in primary school (Porcaro & Tanaka, 2005).

Hours of study and school performance of girls with electrification

Evidence exists that links access to electricity, especially at home, to increased hours of study and reading by children, either at night or in the morning, in West Bengal, India, the Philippines, Bangladesh, Indonesia, Sri Lanka, and Ghana (Chakrabarti, 2000; Porcaro, 2005; Khan, 2001; Madon, 2003; Mensah-Kutin, 2002). Studies also found improved school performance by children, in Tunisia, Solomon Islands, and Bangladesh (Chaieb and Ounalli, 2001; Sauturaga, 2004; Barkat et al, 2003). Most studies do not provide disaggregated information for boys and girls, however, but treat children as a homogeneous group.

One of the case studies carried out under the present project, in Uganda (Sengendo, 2005) did find that girls' studying and school performance benefited particularly from the availability of electricity. This was because girls needed to complete their domestic tasks before having time to study, and by the time they were finished the fuel in the paraffin lamp would have run out. Boys could study earlier because they did not have domestic duties. With (solar) electricity, the girls could stay up later and study even if their brothers were asleep. According to teachers, the number of students passing in first grade increased, with the number of girls passing more than doubling.

Improved school performance by girls was also found in the Mali platform project, with the total number of students who passed the yearly exam of entry to secondary education increasing and the proportion of girls entering secondary education increasing from 31 to 38 percent (Porcaro and Takada, 2005).

Conclusions

Most of the studies found focused on the impacts of electrification. There is evidence that electric lighting – in schools, streets and homes – can have a positive impact on girls' schooling, most strongly on increased school attendance and hours of study. There is some evidence for improvement in girls' school performance too.

However in most studies, impacts on girls and boys are not disaggregated. This has been true even for studies that examine gender and energy.

An area that would be of interest to study is whether improved energy sources that increase women's income and save women's time, lead to better educational outcomes for girls (and boys); the Mali study hints at this. Effects of the adoption of improved cooking fuels and technologies on girls' and boys' education would also be important to know.

3.5. MDG 3: Gender equality³⁰

The third MDG has as its goal to promote gender equality and empower women. The UN Millennium Project task force report affirms that gender equality is central to achieving all of the Millennium Development Goals. For example, women's well-being, empowerment, and education are the driving factors in reducing children's malnutrition (Sanchez et al, 2005). The gender equality task force report (Grown et al, 2005) identifies seven strategic priorities to: 1. strengthen opportunities for post-primary education for girls; 2. guarantee sexual and reproductive health and rights; 3. invest in infrastructure to reduce women's and girls' time burdens; 4. guarantee women's property and inheritance rights; 5. reduce gender inequality in employment; and 6. increase women's representation in political bodies.

This section explores empirical evidence for possible linkages between energy and these strategic priorities for gender equality and women's empowerment, and whether the energy sector has a contribution to make to this MDG. Expanded access to modern energy services could enable women to follow literacy and numeracy classes, and read more. Labour-saving energy technologies could affect women's leisure and rest and their ability to participate in a variety of development activities. Energy could improve access to information through radio and TV. New energy sources could transform gender relations by changing the gendered division of labour in the household, as men take up domestic responsibilities. This depends partly on whether women partake in decision-making, paying for and control over new energy technologies. When women participate in energy projects and develop more confidence through training or gaining income, this could give them a greater voice in the household and even the community. But violence and harassment in the energy sector can affect women's security. There is also the question of the status of women professionals in the energy sector.

The very important reduction of women's and girls' time burdens through energy infrastructure investment has already been discussed at length under MDG 1 on poverty. This section focuses more directly on how women's time savings from improved energy access are actually used and whether this results in increased gender equality and women's empowerment.

Electricity and women's literacy

Several studies show that women's ability to participate in literacy classes depends on a variety of factors besides the availability of lighting. However there is anecdotal evidence of women saving time through grinding mills in Kenya and Cameroon, who used part of the time gained for literacy classes (Malmberg-Calvo, 1994). A biogas project in Yemen (Obaid and Saleh, 1997) and the multi-functional platform project in Mali (Brew-Hammond and Crole-Rees, 2004) specifically included literacy and numeracy training for women in support of the energy activities.

Women's literacy has been found to be significantly higher (by 22 percent) in electrified households in Bangladesh (Barkat et al, 2002) and closer to men's literacy rates as well. Electricity was also found to be a factor in women's reading in an ESMAP survey in India which found that women in

³⁰ Summarised from Anja Panjwani, "Energy as a key variable in gender equality and women's empowerment: A gender and energy perspective on MDG 3," Draft literature review, Report to ENERGIA/DfID Kar Research Project R8346, October 2005. References and descriptive tables are included in the full text, available at www.energia.org/crgge

electrified houses read (and watch TV) more (Barnes and Sen, 2003). Bryce and Soo (2004) found that women in the Solomon Islands appreciated being able to read at night following electrification.

Time-savings used for leisure due to access to improved energy sources

How do women spend the time they save due to improved energy sources? The UN task force report suggests that women's daily maintenance tasks due to the gender division of labour are a limitation on women's and girls' ability to empower themselves economically and politically by going to school and engaging in productive and civic activities. Access to leisure is considered a good indicator for women having time to devote to empowerment activities.

There is considerable evidence for time-savings by rural women as a result of powered water pumps and cereals mills (see Annex 2, Panjwani, 2005). Improved biomass stoves and modern cooking fuels also save time. Time is also "gained" through the extension of the working day by electricity. How "extra" time is spent varies considerably. The saved time may be used to:

Take advantage of income-earning or food production opportunities. With electric lighting, women may work longer in agriculture or carrying out a craft activity at night. In rural Thailand, women could do housework at night with electricity, allowing them to work longer in the fields. In Laos, electricity enabled earning more income by weaving at night under electric lights. In Ghana, saved time with more efficient smoking ovens was reinvested to increase output. The use of energy for income generation depend on marketing and production opportunities, and has not been as common as hoped for. However it is increasingly recognized that other uses of saved time may also be productive in social and health terms.

Catch up on housework and child care, and thus improve family quality of life, hygiene and health. For example, in the United States during rural electrification spent as much time on household duties as un electrified households but the tasks were both easier and "more" (Hawthorne, 1996). In Central America, improved biomass stoves allowed women to cook two different dishes simultaneously and carry on with housework while cooking (ESMAP, 2003).

Leisure and rest. In South Africa, Green (2003) found that women were not interested in using time saved for new activities; they were tired and harassed and wanted to rest. In Mali, time to rest was an important benefit of the multifunctional platform (Brew-Hammond, op cit, 2004) and in the ENSIGN project in Asia, child care, recreation and social activities were increased (Ramani, 2002). An ESMAP study in India found that in households with access to LPG or electricity, women enjoyed a more balanced life between arduous tasks and leisure compared to women who use biomass. They spent less time collecting fuel, fetching water and cooking, and more time reading and watching TV (Barnes and Sen, Op.cit.). Leisure is often combined with entertainment, as in listening to the radio or watching TV – better, because it is more difficult to combine with household chores, and often makes a focal point for family bonding together. Recreation and social activities are often a chance to build social capital and participate in community organisations.

Essentially, saved time gives women the opportunity to choose how to best use their time, a chance that may allow them to better take advantage of development opportunities and empower themselves.

Access to information through media & telecommunications

A number of studies show that women have increased access to TV and radio with the arrival of electricity, and that this improves their situation through access to information, which frees them from social isolation. Access to television and media was the most appreciated benefit by rural

women in Bangladesh (Barkat, 2004), and women's knowledge of gender equality issues was higher in electrified households in (Halim, 2004). In Sri Lanka (Masse, 2003), both men and women felt that watching TV was a way to get information to improve women's situation. In Tunisia, too, watching TV was a means for women to become informed about politics and their rights, sometimes even better informed than men, increasing their self-respect and status (Cecelski et al. 2001).

Gender roles in the household

Improved energy services do in some cases lead to a change in the gender division of labour. In particular, when women earn income as a result of new energy access and become co-providers for the family, men become more involved in domestic tasks (Berthaud, 2004; LWU-GRID, 2001; Prathoumvanh, 2000; Muchiri and Gitonga, 2000). Income opportunities for women in a PV-lamp cooperative induced husbands to share household duties (ESMAP-Bangladesh). Both Mahat (2004) and Rana-Deuba (2001) found that in a microhydro project in Nepal, men became involved in household tasks such as carrying grain to the nearest mill or looking after babies while women were being trained. Masse (2003) in Sri Lanka found that sharing of household chores such as ironing became more acceptable to men after they were electrified.

In South Africa (Anneck, 2005), some men felt resentment that under the new democratic order, they can no longer use force to compel their partners to perform domestic duties; backed by this strong institutional support for gender equality, access to modern energy services (in this case electricity) has facilitated shifts in gender roles and responsibilities in the domestic sphere.

Changes in the household division of labour are not universal however. In studies of electrification in Bangladesh, and biogas plants in Nepal, no changes in the gender division of labour were found (Halim, 2004 and Opdam, 1997). And in the US, with the acquisition of new household appliances, men have actually reduced the time they spend in housework and certain tasks that were shared have become solely the responsibility of the woman (Hawthorne, 1996).

Control over & access to improved energy services

Most of the studies reviewed show that decisions on access to and control over new energy technologies remain the prerogative of men. Men usually pay for new appliances and also exercise control over them. A good example is given by Mathee and de Wet (2001 for South Africa. When asked which electrical appliance they would like to acquire first upon electrification, the majority of women respondents (63%) said they would buy an electric cooker. In a nearby village that had been electrified for 3-1/2 years, however, cooking appliances were in fact among the last electrical appliances to be purchased. Similar results have been found in Malawi (Matinga, 2004) and many other countries.

In Nepal, Mahat (2003) found that men were more involved than women in the construction of improved cookstoves and women were not given the chance to address any technical problems concerning their use. Sometimes women destroyed the stoves because they did not find them convenient.

In female-headed households, the situation may be different. Madon (2003) found in Indonesia that women-headed households gave more importance than male-headed ones to the purchase of domestic appliances and the same was seen by Mensah-Kutin (2002) in Ghana, though advice was often asked from male relations or friends.

In other cases, men may only have the appearance of decision-making. In the EnPoGen study in China (IDS, 2003), men were said to make the decisions about building improved stoves. In reality it was the women who persuaded their husbands, after having heard about the stoves from relatives in their mothers' villages.

Voice and participation of women

The studies reviewed strongly support the assumption that energy projects can lead to increased confidence in women and their greater voice and participation in community affairs. There are examples of projects with a deliberate gender strategy but also some projects without such a strategy, where women's empowerment was improved. Either through training, and thus increasing women's skills, or by actively involving women in the project, women take up new roles, get more of a say in the household and community, and may even take up leadership positions, from India to Kenya to Peru (see e.g. Bryce and Soo, 2004; Khuller, 2002; Khamati-Njenga, 2001a; Oliveros, 1998). This has a positive effect on women's position, status, and role in society, and on women's empowerment.

A typical example is from the Solomon Islands, where women were trained in microhydro technology, which gave them a feeling of pride to know how electricity was generated and distributed. They also participated in the Village Hydro Management Committee and began to collect and bank the monthly electricity tariff. As a result they gained village men's respect and encouragement to take up new initiatives (Bryce and Soo, 2004).

Interestingly, all three of the EnPoGen energy, poverty and gender studies carried out by the World Bank, in China, Sri Lanka and Indonesia, showed that electrification did not result in greater voice or empowerment of women in community affairs (IDS, 2003; Madon, 2003; Masse, 2003). Clearly, women's empowerment as a result of energisation is not automatic.

Violence against women in the energy sector

Women collecting firewood outside of their homes and villages not infrequently experience sexual violence and harassment. Two situations are noted in the literature:

- In protected forest areas, where poor women are obliged to seek fuel illegally and suffer sexual violence and harassment from forest guards. For example, women fuelwood carriers in Addis Ababa, Ethiopia have been harassed and forced to pay bribes to be able to collect wood and risk sexual assault, placing them under high HIV/AIDS risk (World Bank, 2004; Tadesse, 2002). In Nepal protected forests, there have been similar reports (RWEDP/AIT, 2001).
- In refugee situations, where militias attack women who must venture out of camps to collect fuelwood. Such situations have been reported in Somalia and, most recently, in Darfur Sudan, where women have been reported systematically beaten and raped when moving out of their villages looking for fuelwood, water and food. Men who venture out are killed, so women and girls are sent out, knowing they face rape but not death (Dixon, 2004). Between October 2004 and mid-February 2005, Médecins sans Frontières (MSF) reported that almost 500 women and girls who had been raped in West and South Darfur treated (MSF, 2005) and 82% of the rapes they treated occurred when women left the towns and displaced persons camps in search of firewood, water or grass for animal fodder. Similarly, Kagwanja (2000) reports that women in refugee camps in Kenya were subject to sexual violence and 90% of the 200 rapes reported between 1996 and 1997 took place the women were gathering firewood or tending to livestock.

There are also reports of bride suicide in India due to inability to meet family fuelwood needs (Agarwal, 1986).

On the positive side, improved gender relations and less violence in the household have been cited as a result of electrification. In Kerala, India, the adoption of solar home systems led to a decrease in the drinking problem in villages due to the ability for men to undertake basket-weaving in the evenings (Khuller, 2002). In Uganda and the Philippines, watching television together in the evenings promoted family discussions and bonding, and men spending more time at home (Sengendo, 2005; APPROTECH, 2005).

Employment of women in the energy sector

The share of women in the formal energy sector appears very modest from the evidence, but very little gender-disaggregated data is available, and most is from the North. The development of a gender action strategy in Bangladesh showed only five female Deputy Directors out of 25, one assistant engineer out of 152, and one senior manager out of 591 rural cooperative officers (Clancy, et al, 2004). In the Tunisian utility STEG, women are better represented at management levels than at implementation levels, with women in all categories of executive positions except the top two, and this is expected to grow (STEG, 2005).

In several African countries, women have reached high-level policy positions including ministerial and sub-ministerial level. This has sometimes encouraged attention to gender issues and women in the ministries.

But professional women have also faced discrimination and sexual harassment in energy industries, as some reports from Pakistan (oil and gas industry) and Bangladesh (rural electric utility) show.

In the North, women are also not well represented in the energy sector, especially in technical positions. In Australia, women make up 20% of the work force in the electricity, gas and water sectors, but occupy less than 5% of technical posts. In Germany, around 6% of technical staff in the electricity industry are female and even fewer are in management (Clancy, Oparaocha and Roehr, 2004).

Conclusions

The evidence shows a rather mixed picture of the impact that improved energy services have on gender equality and women's empowerment. These relationships have not received much research attention in the past, and information is relatively scarce.

Electrification and other modern fuels do not appear to lead immediately to increased leisure time for women. In most of the studies reviewed, women extended their working hours or used time saved to improve their productive or reproductive work outputs. There is some evidence that women in electrified households do spend more time on watching TV and listening to the radio, and in several studies this was found to result in their increased empowerment. Too little research has been done on energy access and women's reading and literacy, to draw firm conclusions.

Where energy programmes provide training to women and place them in an environment outside the household, women's confidence has grown and they dare speak up in the household and the community. Women's roles, status and position in society changes, often with men's support. In some cases, women take up leadership positions.

The picture for change in gender relations within the household is not so clear. Some but not all studies do show men taking up more household activities after an energy intervention. It is still mostly men who take the decision about acquiring energy technologies.

There are several anecdotal reports of sexual violence against women collecting fuelwood.

Studies on women professionals in the energy sector give evidence that women face the same obstacles as in other scientific and technological professions: they are greatly outnumbered by men, who take up most management and leadership positions, and face sexual harassment, both in the North and South.

3.6. MDGs 4 and 5: Child mortality and maternal health³¹

The challenge

Approximately 10.8 million children under the age of five die each year, 4 million of them in their first month of life, according to the UN Millennium Project task force report on child and maternal health (Freedman, et al, 2005). In parts of sub-Saharan Africa, child mortality is on the rise. Most of the decline in mortality since the 1970s is due to reduction in deaths from diarrhoeal and vaccine-preventable diseases. Other major killers such as pneumonia and acute respiratory infections, have shown far less reduction. Malnutrition is a contributing factor to about 56 per cent of all child mortality.

Overall levels of maternal mortality are believed unchanged in the past 15 years, with the latest estimates of deaths about 530,000 per year. While global total fertility rate has declined from 5.0 to 2.7 births per woman between 1960 and 2001, there are still up to 80 million unintended pregnancies each year in developing countries. Violence and sexually transmitted infections including HIV/AIDS are factors as well.

MDG 4 aims at reducing by two-third the child mortality rate by 2015, while MDG 5 has the goal of reducing the maternal health mortality rate by three-quarters during the same period. According to the task force, the primary health interventions to address most of these conditions are known. The task force cites the Bellagio Study Group on Child Survival, which estimated that with 99 percent coverage of proven effective interventions, 63 percent of child mortality could be averted; and the World Bank, which calculated that if all women had access to interventions (especially emergency obstetric care), 74 percent of maternal deaths could be averted (Ibid.) The task force hence urges tackling the social, economic and political context in which people live and in which health institutions are embedded and taking a “rights-based” approach to addressing health care.

Energy and child mortality and maternal health

Child mortality and maternal health are closely related, and energy access can influence them in a number of ways. On the technical dimension, the task force recommends that highest priority be given to strengthening the primary healthcare system. Addressing maternal and neonatal deaths implies that every birth takes place with a skilled birth attendant and in an integrated health care system that can refer emergencies. WHO defines a functional health facility as one that has among other things, electricity and running water. Electrification could support lighting and sterilization for health care facilities. For children, the task force suggests that much can be accomplished outside of the health sector to reduce the incidence of the most common childhood diseases, by improving

³¹ Summarised from Margaret Matinga, “Energy as a key variable in child mortality and maternal health: A gender and energy perspective on MDGs 4 and 5,” Draft literature review, Report to ENERGIA/DfID Kar Research Project R8346, November 2005. References and descriptive tables are included in the full text, available at www.energia.org/crge

water and sanitation and by reducing indoor air pollution. Cleaner cooking fuels, and energy for drinking water pumping and treatment, could play a key role.

An important way that child mortality and maternal health are linked, is through the ability of women to provide adequate child care, and to have sufficient leisure and rest to care for themselves during pregnancy and after childbirth. Energy access that reduces working hours and drudgery could play an important role.

These linkages are intuitive, and we now examine the empirical evidence to support them.

*Indoor air pollution, acute respiratory infections (ari), and low birth weight*³²

About 3 billion people globally rely on biomass fuels (wood, charcoal, crop residues and dung) for cooking and heating. During cooking, women in developing countries are usually accompanied by or carry on their backs, their young children. Both the women and the children are exposed to high levels of biomass related pollutants and known health hazards including particulate matter, carbon monoxide, nitrogen dioxide, sulfur oxides (mainly from coal), formaldehyde, and polycyclic organic matter. Diseases associated with indoor air pollution include acute respiratory infections (ARI), otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and eye diseases such as cataract and blindness. Most epidemiological studies have focused on the first three. However there is increasing evidence on the role of maternal exposure to IAP in low birth weight (Ezzati and Kammen, 2002; Mishra, 2004).

According to Ezzati and Kammen (2002), exposure to indoor air pollution (IAP) from the combustion of solid fuels has been demonstrated to be an important cause of morbidity and mortality in developing countries. Conservative estimates of global mortality due to IAP from solid fuels show that in 2000, between 1.5 and 2 million deaths were attributed to this cause. This is concentrated among women and children in poorer households and rural populations.

Respiratory infections are an important cause of death among children less than 5 years of age, accounting for about 4 million deaths annually. In a comprehensive review of 13 studies in developing countries, where confounding factors were controlled for, Smith et al (2000) found indoor pollution from biomass fuel use to increase the risk of ARI in children by about 2-10 fold.

Some studies have found higher incidence of ARI associated with smoke exposure in girls, and speculated that girls are kept in kitchens with their mothers until older ages; others have found higher incidence in boys, and suggest that young boys may be more likely to be carried around in some cultures, or that illness in girls may be under-reported (Matinga, 2005).

There is good evidence that cooking with improved cookstoves can reduce incidence of ARI in under-five children.³³ A study in Kenya (Bailis, 2005) showed 44% decrease in ARIs incidence among under-five children when households shifted from the open fire to improved cookstoves and another study in Kenya (Wafula, et al, 2000) showed a 61% reduction. A study in Guatemala has shown similar results (Boy, 2002). In Kenya, a smoke hood introduced by ITDG reduced respirable particulates by 80% (ITDG, 2005). Even more clean air benefits are found by switching to fossil fuels such as kerosene and especially LPG. Econometric modeling studies (Wang, 2003; Wang and Van der Klauuw, 2003) estimate that providing clean fuels to all households in India can save 26.5 lives per thousand five year old children.

³² This section draws both on the Ezzati and Kammen (2002) review and on Matinga, 2005.

³³ Though critics point out that improved stoves may save fuel but that not all improved stoves necessarily reduce emissions adequately and can even increase them, especially if improperly operated.

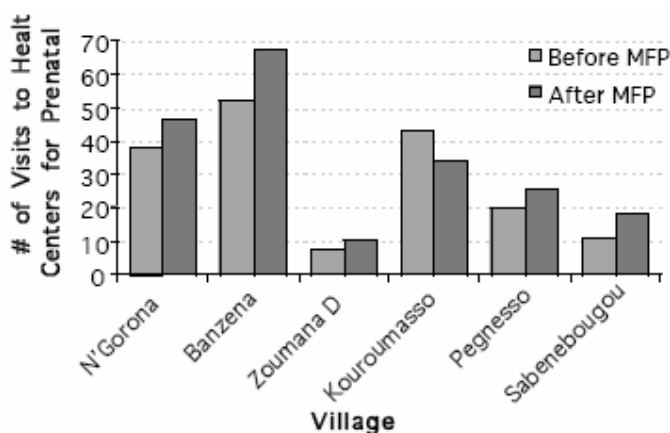
For adult women, there is evidence that indoor air pollution has a causal or aggravating relationship with various ARIs including COPD, chronic bronchitis, asthma and in older women, tuberculosis; and substantial anecdotal evidence that using clean energy services such as LPG or electricity decreases incidences of asthma, coughs, hayfever and itchy eyes associated with using kerosene or biomass fuels.

The energy system and neonatal outcomes

The goal for reduction of child mortality cannot be met without reduction of neonatal deaths, according to the UN task force. This makes linkages between the energy system, and low birth weights and still births which affect neonatal mortality, important to assess. Low birth weights are caused by many factors, including women’s nutritional and health status during pregnancy, high work load, and physical environment factors. There appear to be two energy-related vectors here: exposure of women to smoke from cooking during pregnancy; and overwork that could be alleviated by improved energy sources.

There are some studies on fuel use and pregnancy outcomes that show that exposure to biomass-related indoor air pollution may be a factor in low birth weight and still birth (Parikh, 2002; Kebede, 2004; Boy et al, 2002; Mavalankar et al 1991; Mishra 2004). However there are many studies that have associated urban outdoor pollution and environmental tobacco smoke – with much lower concentrations of pollutants than cooking with biomass stoves – with both low birth weight and early infant death.

Figure 2. Changes in pre-natal visits before and after the Multifunctional Platform, Mali



Source: Pocaro and Takada, 2005.

Women’s heavy workloads during pregnancy can have a negative impact on pregnancy outcomes, resulting in among other things, low birth weights (Shaw, 2003; Agarwal et al, 2001). Furthermore, time spent in cooking (followed by fetching water) was the activity rated as number one and most frequently in terms of conflict with pre-natal visits in a South African study (McCray, 2002). There are numerous studies showing that improved energy access can save women’s time and drudgery, but only one was found relating this to pre-natal visits and none to neonatal outcomes: five out of six villages studied using the time-saving Multifunctional Platform in Mali reported increases in pre-natal visits following introduction of the Platforms. Rest is also important, especially in late pregnancy.

Of course, women's work burden has a direct impact on their reproductive health and child birth complications, e.g. obstruction of birth canal and incidences of back injury. Ecchari and Forriol, (2002) found that women wood bearers in Congo suffered from spinal deformations resulting from long term wood bearing. In Ethiopia, Tedesse reported increased chances of miscarriages among women wood bearers. Similar findings are reported by Dasgupta (1998) in Nepal, who also reports on their linkages with uterus prolapse (Dasgupta, 1998 in World Bank, 2002). Similarly, carrying heavy water loads is linked to utero-vaginal in Nepal (KMH, 2005). Haile (1992) found that women fuel carriers in Addis Ababa carry loads that are beyond the weights recommended by the ILO and experience back pains, eye and chest problems and high rates of miscarriage (Haile, in Bryceson and Howe, 1992). In Malaysia (Kettel, 1996) reported 400% increases in miscarriages as result of water shortages during periods of disruptions in the state of Malacca. These miscarriages are thought to have been a result of water carrying by [pregnant] women who could not find or afford help.

Electrification, quality of primary health care and vaccination

Both quality of primary health care and vaccination are cited by the UN task force as critical needs in meeting the goals for child mortality and maternal health. There is some evidence that electrification can contribute to these.

Anecdotal evidence was found on lack of electricity as one of the constraints to provision of emergency obstetric care in Kenya, Rwanda, Southern Sudan and Uganda, leading to delayed delivery and still birth or death of newborns. Electric lighting in clinics improves delivery condition, allowing provision of health services at night. In Makeni, Sierra Leone, the installation of an electric pump contributed to increases in women seeking medical assistance for obstetric complications (Leigh et al, 1997). Other interventions included staff training. In Tunisia, good results in reducing child and maternal mortality were achieved by providing electricity at the same time as clean water and well-equipped and well-staffed health clinics, in an integrated rural development approach. Health clinics have lights, a refrigerator, negatoscope, sterilizer, popinel, fans, oil heaters, radio, TV and sometimes video. In the Philippines, women in electrified health clinics were more likely to give birth with a skilled health attendant.

Compelling evidence also emerges from Bangladesh where maternal and child mortality were significantly lower in households and villages with electricity. Factors contributing to this included access to information, cleaner water, better nutrition partly attributed to incomes from electricity dependent businesses and electrification of clinics in the area (Bharkat, 2002).

Lack of refrigeration for vaccines and sterilization facilities have been cited as an obstacle in vaccination campaigns in Mozambique and other countries. In Tunisia, the availability of refrigeration for vaccines and medicines was credited in some health clinics with reducing childhood diseases, diarrhoea and poisoning. There is anecdotal evidence too that solar refrigeration has enabled increased outreach of vaccination in remote areas in Botswana, Guatemala, and Colombia. In Indonesia some 5,500 clinics replaced kerosene- and diesel-powered with solar powered refrigerators; globally the Cold Chain Program has provided solar powered refrigerators in remote areas of Africa and Asia; the USAID program on solar light for Africa has provided power and light to 1,500 facilities in rural East Africa. These are cited as enabling preservation of vaccines because of LPG gas supply and availability problems. However it has to be recognized that there are many factors besides refrigeration that determine the success of vaccination campaigns, and there are no studies that link the availability of power directly with increased numbers of immunized children.

Electricity can provide access to mass media which is an important route of health education. Battery-operated radios are the most available and used but television has also been effective in vaccination campaigns. In Tunisia, videos are used in health clinic waiting rooms to present programs on public health, family planning and disease prevention.

Emergency communications are critical for obstetric and neonatal care in case of life-threatening complications. In Uganda, a project that aimed to improve maternal health services delivery through communications and quality health services delivery found that electric power supply was a constraint to telecommunications, and provided solar-powered fixed, mobile and vehicle VHF radios to improve health service delivery (World Bank, 2002). The study reported increased number of deliveries under trained personnel and increased referrals to health units, which led to a reduction of about 50 percent in the maternal mortality rate in the Iganga district over three years.

The evidence does not bear out the frequent suggestion that electrification might make rural health clinics more attractive for staff. The evidence is that low wages and lack of equipment are the main factors in health staff preferring urban areas, with perceived lack of opportunities for children being a contributing factor. Lack of equipment could be partly related to the availability of electricity though.

At the household and community level, electrification appears to work in a variety of ways to improve health, including increasing food production resulting from irrigation and income from other activities enabled by electrification. A large sample survey study in Bangladesh (Barkat et al, 2002) that controlled for other auto-correlating factors such as income and education, found that households with electricity were more likely to seek assistance from medically competent persons and more likely to have ante-natal and post natal check ups and receive vaccinations. Infant mortality in electrified household was 42.7/1000 live births compared to 53.8/1000 for non-electrified households in electrified villages and 57.8/1000 for households in non-electrified villages. This is 25% less than the national infant mortality rate and 35% less than the rural average.

Women's workload and child care

Women are estimated to average 11 to 14 hour work days cooking, collecting fuelwood and water, processing food, carrying out agricultural work and income-earning activities. Child care is usually simultaneous with these, but overwork often affects the frequency and quality of feeding. Only 16% of sample children in a Mali study were exclusively breastfed and 58% of women resumed their normal workload within four weeks of delivery because existing social systems failed to provide adequate support for accomplishing household tasks, taking care of other children, and supplying agricultural labour. In the Mali study, a lack of functioning borehole wells and cereal mills compounded women's overload. (Tefft et al, 2003) Similarly in Tanzania, women spent less time cooking and children were fed less often in the seasons of hard field work (Wandel and Holmboe-Ottesen, 1996). In a study in Iran (Rabiee and Geissler, 1996), regardless of income, children of mothers with heavy workloads had lower energy intake and higher prevalence of diarrhoea during the field work season. Women with heavier workloads were also less likely to boil water for preparing milk. The authors suggest that other factors in the higher frequency of diarrhoea come from the inability of the mothers to supervise children in a contaminated environment and the growth of bacteria from food kept without refrigeration.

Strategies such as leaving children in the care of their siblings can also increase the risk of injury. Reed and Conradie (2000) found that one-fifth of the children admitted for paraffin [kerosene] poisoning in their study were in the care of another child at the time of ingestion.

Some studies of time savings through improved energy access do show that women use part of the saved time for more child care and household work, leisure and recreation (Ramani, 2002; Parikh, 2002). However electric lighting, in particular, can lead to longer rather than shorter workdays, as household chores can be extended into the evening (Ding, 2002). In the gender and energy literature, a higher value has often been attached to the use of time-savings for production in agriculture or home industries; however from the point of view of MDGs 4 and 5, a new and more valuable light is thrown on the use of saved time for child care and rest.

Women's work load affects not only neonatal mortality but women's own health and well-being, of course. The energy system itself is a source of environmental health issues in addition to indoor air pollution, whose effects are differentiated by gender. A World Bank review (Listordi and Doumani, 2004) identifies several of these and notes that they do not yet have a strong literature base:

- injuries from gathering and using biomass fuels, from burns to miscarriages (by carrying heavy loads);
- vector-related diseases from hydro-power production, mainly malaria and schistosomiasis;
- diseases and conditions besides acute respiratory infections, e.g., chronic respiratory infections, tuberculosis, asthma, cancers, and cataracts, that can be simultaneously targeted with the same measures to reduce ARI.

Increased (and repeated) time spent in contact with contaminated water during washing is linked to the prevalence of schistosoma in women, which is then linked to anaemia, which is particularly dangerous in pregnant women. Preventing hookworm and schistosoma through clean piped water may result in reduction on the prevalence of anaemia and may even contribute to reductions of child mortality related to anaemia.

To which can be added the exposure of women to other disease and injury vectors (wild animals, snakes, injuries) and sexual violence and the transmission of sexual diseases during fuelwood collection.

Paraffin [kerosene] poisoning and burns

Paraffin [kerosene] poisoning and burns are not among the major causes of childhood mortality, but they appear to be widespread in some African countries, related to fuel choices due to energy poverty, affect children and women disproportionately, and are sometimes fatal.

Most evidence relating burns and paraffin ingestion and poisoning to energy poverty come from South Africa, where accidental paraffin ingestion results in at least 200 deaths a year and 16,000 hospital admissions, mostly of children under 5. More than 90% of children admitted for paraffin ingestion in a South African study (Malangu et al, undated) were under the age of 5 years. In India, paraffin poisoning has also been documented as a major cause in hospitalized children.

Paraffin ingestion by children is related to energy poverty. In both India and South Africa, poor families cannot afford LPG and buy paraffin in smaller batches to suit the constraints of their budget. This is then often stored in used and previously discarded soft drink containers. These have no childproof caps but are affordable "recycled" containers. In the Indian study, for example, soft drink containers were used 70% of the time to store paraffin.

Burns were the leading external cause of death in children under one year of age, and the second leading cause for children aged between 1 and 4 years in South Africa (Butchart, 2000), with 143,000 ingestion cases reported (Lloyd, 2002). Burns incidence in South Africa is mainly attributed to poorly designed paraffin stoves, which overheat and explode after long periods of

cooking or tip over. Burn incidence in Ethiopia was also found highest in children under the age of five (Nega and Lindtjorn, 1999). In Zimbabwe, burns were found second to falls as the most frequent type of injury among children (Matanhire, 1994).

Some studies examine improved energy sources from the point of view of improved safety. One study in Guatemala (Bruce et al, undated) found that the introduction of Plancha improved stoves halved the burn incidence. Lloyd (2002) reports that in South Africa annual injury incidents relating to LPG are at least two orders of magnitude lower than paraffin-related injuries, for comparable quantities sold. Safety and reduction of burns are frequently mentioned by women as benefits of improved stoves and modern fuels. Annecke (2005) has suggested that hospitals could monitor cases as an indicator.

Fuel scarcity, water boiling and cooked food

In areas of acute fuelwood scarcity and where there is shortage of female labour to fetch firewood, boiling water to destroy bacteria and cooking food to make it more digestible can be affected.

An estimated 5,000 children die every day and million die every year from water-borne and sanitation-related diseases (WHO, 2003- check MP report). Most of these diseases can be combated by a combination of hygiene practices such as drinking boiled and hygienically stored water, and having adequate clean water supplies. The provisioning of safe drinking water is discussed in more detail under MDG 7, since it is a specific target there. No studies were found documenting a direct linkage between boiling drinking water and fuelwood scarcity, though the ability to heat water is often cited by women as a benefit of improved stoves and fuels. However, Cairncross and Cliff (1987) show that people carrying water for longer distances do use significantly less than others (Cairncross and Cliff 1987) and that availability of water improves hygiene.

Cooked starchy foods, which are vital for energy, are 2 to 12 times more digestible than raw starch (Kataria and Chauhan, 1988). Cooking improves the digestibility of legumes, wheat and rice (Oste, 1991; Bradbury, 1984). Reduced frequency of cooking beans due to fuel scarcity has been reported in Malawi (Roth, 2005; Brower, 1997) as has renewed cooking of beans on a regular basis following introduction of energy-efficient clay stoves (Roth, 2005). Cooking only once or twice per day, heating up leftovers, and eating cold food has also been widely reported. In a Peru study (Skar, 1982), households in the area with the most fuel constraints cooked fewer meals than in areas where fuel constraints were not as high. Reducing cooking is only one of many coping strategies that may be followed by households, however, with adopting fuel-saving cooking behaviors and using inferior fuels such as crop residues (or even plastic and other manufacturing wastes) the more common strategy in the studies reviewed.

Conclusion

The evidence appears conclusive that improved cooking fuels and appliances have an important role to play in reducing child mortality from acute respiratory infections, a major cause of infant mortality, as well as probably in neonatal survival caused by low birth weight. The question is whether improved biomass stoves can provide sufficient relief, or whether cleaner fossil fuels need to be provided to reach healthy emissions levels.

The role of energy in ensuring safe (boiled) drinking water and thus reducing diarrhoea – another major cause of infant mortality – is less well studied. An important vector for both pregnancy outcomes and neonatal survival appears to be through improved energy access reducing women's drudgery and time in fuelwood collection, cooking, food processing, and other tasks, since women's overwork is a key factor in child care and the ability to follow hygiene practices.

Modern energy services play a role in the provision of primary health care services, of course in necessary conjunction with adequate staff, equipment, transport and so on. Electricity appears especially key for lighting, sterilization, powering equipment, emergency communications and refrigeration of vaccines and at the household level has been linked with reduced infant mortality. Solar-powered refrigeration and emergency communications have been shown to be effective in enabling vaccination and improved maternal health respectively in areas un-served by the grid.

Both the electrification of rural households and the use of modern cooking fuels correlate with reduced infant mortality. A major sample survey in Bangladesh is clear that infant mortality is reduced by having electricity in the household or (though less) in the village. Global correlations show that use of biomass fuels correlate with higher infant mortality.

Though not a major cause of mortality, both biomass fuels and kerosene are implicated in burns, and kerosene in accidental ingestion and poisoning, so LPG and electricity emerge as the safest cooking fuels.

There is evidence (see 3.5 above) that fuelwood collection is a major risk factor in sexual violence against women in conflict situation. This sexual violence is a risk factor in maternal mortality (linked to unsafe abortions and pregnancy of young girls) and HIV/AIDS.

3.7. MDG 6: Combating HIV/AIDS, malaria and major diseases³⁴

The Human Immunodeficiency Virus (HIV), the virus that causes Acquired Immune Deficiency Syndrome (AIDS), tuberculosis (TB) and malaria, collectively kill an estimated 6 million people annually. About 95% of the more than 45 million people infected with HIV globally live in developing countries. The annual death rate from HIV/AIDS related illnesses is about 3 million per annum and AIDS is now the fourth leading cause of death in the world. There about 8 million cases of TB and about 2 million TB related deaths annually, 90% of which occur in low- and lower-middle-income countries.

MDG 6 aims to halt by 2015 and begin to reverse the spread of HIV/AIDS, malaria and other major diseases like tuberculosis. Like most health issues, HIV/AIDS, malaria and TB have differential impacts on women and men due to underlying gender inequalities. Prevailing gender inequalities skewed in favour of men for example have been associated with increasing HIV/AIDS infection rates among women, particularly young women. Health-seeking behaviours as well as patient prescriptions have also been found to be affected by gender. Women are found to be more likely to delay seeking health care due to work burdens or the need to consult their husbands. Most cultures allocate care for sick persons to women, and orphans are more likely to be taken in by women-headed households. Thus, these illnesses have critical impacts on gender relationships, the household environment, resource usage and allocation, including survival responsibilities such as water and fuelwood collection and use, food processing, and the division of labour in the household. Workloads can be increased, especially for women and girls, by the presence of sick persons or due to the death of productive adults. Time is taken out of production, for care-giving. Financial resources are diverted to illness and funeral expenses.

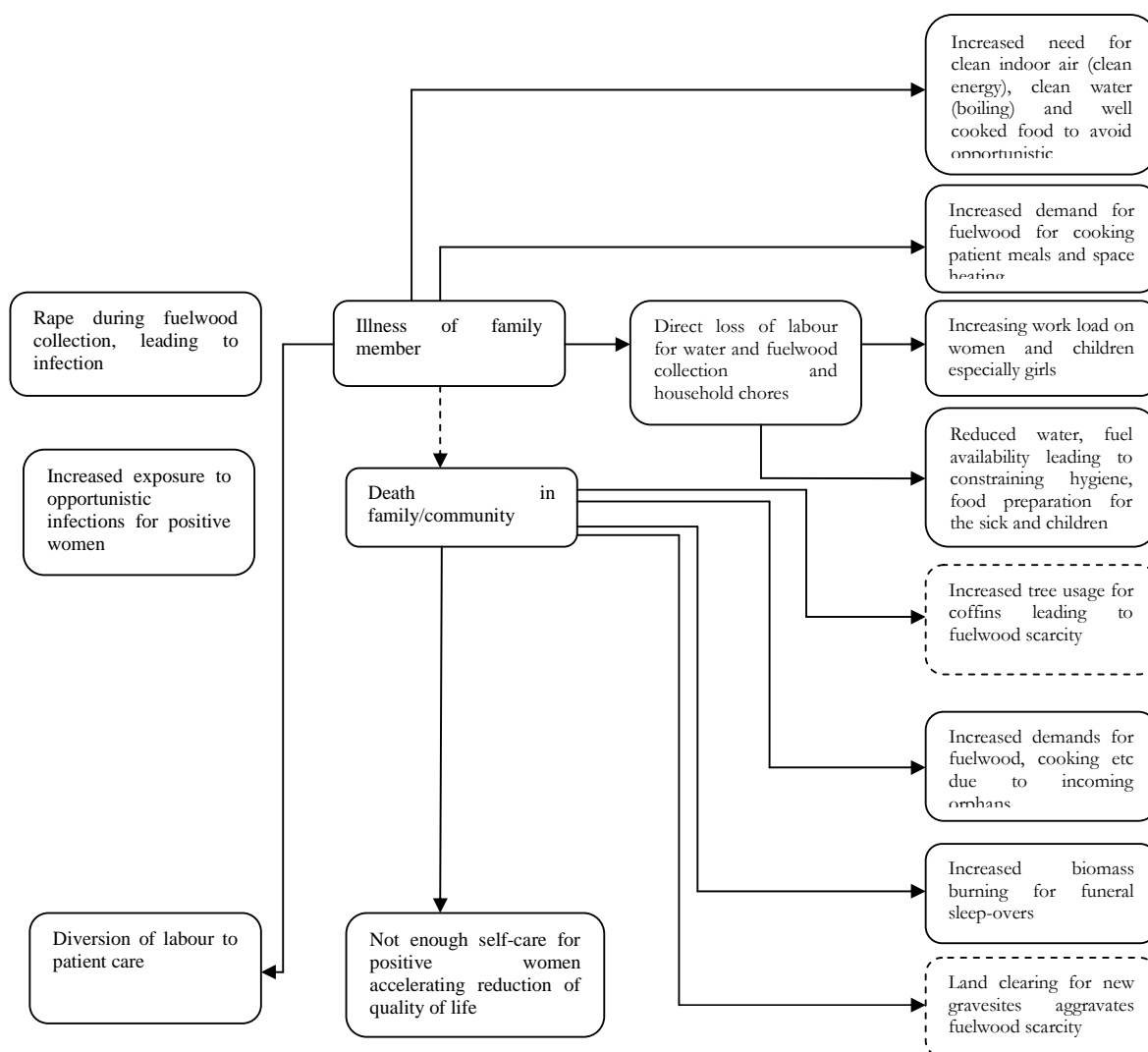
On the other hand, reducing exposure to disease vectors and harmful environments, through adequate energy access, can mitigate the vulnerability of sick persons. From the energy perspective, this can be achieved through improving access to clean water to limit exposure to water borne

³⁴ Summarised from Margaret Matinga, "Energy as a key variable in combating HIV/AIDS, malaria and major diseases: A gender and energy perspective on MDG 6," Draft literature review, Report to ENERGIA/DfID Kar Research Project R8346, November 2005. References and descriptive tables are included in the full text, available at www.energia.org/crgge

disease vectors; improving access to clean fuels to improve air quality and reduce indoor air pollution-related respiratory and other diseases; and reducing drudgery to ensure adequate time for respite and self care, by providing labour saving energy technologies such as grain mills and water pumps.

Figure 3 shows selected linkages between gender, energy and HIV/AIDS.

Figure 3. Framework of selected linkages between gender, energy and HIV/AIDS



Source: Matinga, 2005.

This study focused on empirical evidence from developing countries, with the bulk of the data coming from subSaharan Africa, since this region accounts for 75% of HIV/AIDS case loads as well as the bulk of malaria cases. The literature search to provide this evidence was mainly through internet search engines and databases, and targeted English language publications and grey literature.

No empirical studies were found on the impacts of modern energy or lack of it on HIV/AIDS infected population; and none specifically on the connections between gender, energy and major diseases. Much of the discussion here is therefore speculative. There are a number of studies

however on linkages between gender, energy and respiratory infections, linked with indoor air pollution, and these connections have been examined in this study.

Linkages between gender, energy and combating HIV/AIDS, malaria and major diseases
1. Improved energy services can help improve the quality of life for PLWHA by enabling recommended health behaviours for PLWHA.*
2. Modern and improved energy services can reduce women's burden of care for PLWHA.
3. Modern energy services can enable respite and self care for women living with HIV/AIDS by reducing the need to collect water, fuelwood and to undertake other arduous tasks.
4. Improved energy services can reduce exposure of women living with HIV/AIDS to disease vectors and triggers, thereby delaying the onset and acceleration of opportunistic infections.
5. Electrified clinics can provide better and safer health services.
6. Infection risk associated with fuelwood collection can be reduced.
7. Forest resources can be threatened by higher fuel needs to deal with the consequences of HIV/AIDS, exacerbating gender-based poverty burdens through fuelwood scarcity and its related issues.
*Persons Living With HIV/AIDS.

Improved energy services can help improve the quality of life for PLWHA by enabling recommended health behaviours for PLWHA³⁵

In order to improve the quality of life for PLWHA, various organizations have developed guidelines for care of food and drink which are vital for nutrition and in reducing exposure to infection. Measures include eating cooked, hot foods; boiling drinking water; and washing hands with hot water to reduce infection; refrigeration; and pasteurization of dairy products. No studies were found exploring the linkages with energy. Affordable energy access could play an important role in enabling these measures, but health behaviors are affected by many factors, including women's overall workload.

Modern and improved energy services can reduce women's burden of care for PLWHA

Women bear the brunt of care and management of patients as well as orphans. AIDS underscores and exacerbates the unequal gender divisions of labour and responsibilities that are already inherent in households. Women can become more burdened by fuelwood collection, water fetching and household tasks. In a focus group in Malawi, women expressed considerable interest in ethanol stoves because they would be fast and portable to

“carry it to homes with PLWHA, ask them what they need whilst we are boiling bath water, cook and quickly move to the next house. At the moment we ask what the patients want to eat then come back to cook. Even when we have a patient at the hospital, we can quickly cook cleanly and avoid the smoky shelter where women cook in. It makes us cough and then we end up with two patients instead of one. When this stove comes on the market, we must be the first to know, because AIDS takes up all your time as a woman. There is no end to cooking and boiling water for bathing and hot compresses.”

Clearly for these women, a more modern energy source assists greatly in time management.

³⁵ Persons Living with HIV/AIDS.

Modern energy services can enable respite and self care for women living with HIV/AIDS by reducing the need to collect water, fuelwood and to undertake other arduous tasks

Persons with immune systems that have been compromised by HIV and other diseases need appropriate care and rest to optimize health. Poverty and gender norms often require HIV/AIDS infected and sick women to continue undertaking arduous household work such as walking long distances to collect firewood and water, manual food processing, and continued management of the home, thereby missing out on rest which is vital for PLWHA, as fatigue and body pains are among the syndromes of HIV/AIDS. Strenuous work for PLWHA can further stress the immune system and accelerate the onset of opportunistic infection.

Studies on PLWHAs and work have concentrated on the formal economy, so the impacts of working in the household and informal sector, where the majority of poor women work, are not well documented. No studies were found on the energy aspects of household work, and HIV/AIDS, though improved energy sources could obviously play a role in reducing workload and stress.

Improved energy services can reduce exposure of women living with HIV/AIDS to disease vectors and triggers, thereby delaying the onset and acceleration of opportunistic infections

More than men, rural women are directly exposed through their household work to environmental hazards such as water-borne diseases, polluted rivers and ponds, and indoor smoke, disease vectors or triggers that can trigger serious illnesses due to weakened immune systems. Use of traditional biomass is now well known to have a causal relationship with a range of Acute Respiratory Infections (ARIs), even in healthy women. The weakening of lungs from biomass smoke may also make persons with inactive TB progress to active TB; Mishra (1999) concludes that about 51% of active TB is attributable to biomass usage in one study, since TB was 2.6 times more prevalent among biomass users. Tuberculosis is among the most common opportunistic infections and cause of death among PLWHA, accounting for about a third of AIDS-related deaths. Studies have also shown causal linkages between coal burning emissions and lung cancer.

Electrified clinics can provide better and safer health services that reduce likelihood of transmission of HIV/AIDS

Clinics that have electricity can more easily provide emergency services and undertake safe surgical procedures and sterilization of equipment more efficiently than those without electricity. There are emerging studies that indicate iatrogenic transmissions of HIV/AIDS through health care, particularly among women; health care for pregnant women may be a risk factor for transmission. Inadequate sterilization may be a factor, e.g. in remote areas, syringes and scalpels may need to be sterilized and re-used. Women are especially victims of iatrogenic infections during childbirth and when accessing reproductive health care such as family planning injections (intravenous contraceptives).

Infection risk associated with sexual violence during fuelwood collection can be reduced

In order to meet fuelwood needs for their families, women leave the safety of homes and communities and travel to isolated areas such as forests which not infrequently exposes them to rape and sexual harassment, with reports of sexual violence from a variety of sources: assaults by forest wardens for trespassing government land in Nepal; gang rapes by British soldiers on training in Kenya of women on their way to collect firewood or water; and rape and beatings of refugee women who must leave camps to seek fuel in Darfur, Sudan. Doctors Without Borders/Medecins Sans Frontieres treated almost 500 rape victims in numerous locations in South and West Darfur between October 2004 and February 2005, women who were collecting wood, fetching water or

working their fields. There seem to be no studies that quantify the extent of HIV/AIDS transmissions resulting from sexual violence.

Forest resources can be threatened by higher fuel needs to deal with the consequences of HIV/AIDS, exacerbating gender-based poverty burdens through fuelwood scarcity and its related issues

HIV/AIDS threatens livelihoods and interacts with biomass systems in ways that can exacerbate gender inequalities. Once a forest is designated as a gravesite, fuelwood collection becomes culturally inappropriate. Funerals take place over a number of days and a fire is kept burning throughout the night. According to Mika (2001), in Malawi and Zimbabwe, mourning lasts 2 to 3 days and wood logs are used to provide warmth and cooking fuel for the mourners. Wood is also needed for coffins.

AIDS impoverishes households and natural resources are exploited to compensate. Increasingly, selling firewood or producing charcoal is a way of coping with the economic impacts of HIV/AIDS.

Conclusion

No studies exist specifically on the linkages among gender, energy and combating HIV/AIDS, malaria and major diseases. The scanty evidence on potential linkages discussed above is highly suggestive however and these areas merit further research. Collaboration among gender experts, energy professionals, and the health sector is needed. Already it is clear is that women in refugee camps and other risk situations need energy as well as other solutions to sexual violence.

Energy programs in impacted areas have only begun to be designed to help contribute to the alleviation of the adverse impacts of HIV/AIDS and TB, particularly to reduce work burdens of women and provide cleaner indoor environments for PLWHA. In recognition of the inter-linkages between HIV/AIDS and the biomass system, GTZ's Program for Biomass Energy Conservation (ProBEC) in Malawi has implemented a fuel saving program that uses an integrated framework to help alleviate impacts of HIV/AIDS on households and women in particular. Common disease complications and recommended practices as they relate to energy have been identified and an energy intervention program developed that includes dissemination of locally made improved cookstoves to reduce IAP and cooking times, and Hot Bags (fireless cookers) for keeping food warm for patients. Not only do these technologies improve patient care, but they allow women PLWHA to participate in meetings while organizing food preparation.

3.8. MDG 7: Ensuring environmental sustainability

It is well established that environmental degradation, which is the primary cause of energy scarcities in developing countries, hits women the hardest. The most obvious burden from an energy perspective is that as fuel resources become increasingly scarce, women must walk longer distances and invest a greater portion of time in gathering fuelwood and water. Poor rural women are more directly exposed than are men to environmental hazards such as water-borne diseases, and to the pollution of rivers and ponds, because of their involvement in fetching water for various domestic uses and animal care, washing clothes in ponds, canals and streams, and so on. The burden of family ill-health associated with water pollution likewise falls largely on women who take care of the sick.

However, the converse is not so well defined, how gender and energy interventions can positively influence the three targets of MDG 7 on ensuring environmental sustainability. Women's involvement in MDG 7 has hardly begun to be explored. Energy has been implicated in target 9

(reversing the loss of environmental resources) through deforestation (including loss of biodiversity), energy consumption, and carbon dioxide emissions, and women's role in household fuel use is critical in the fuel transition here. Safe drinking water (target 10) is of course a primary concern and responsibility of women and energy can play an important role in improving water supply. Energy's role in improving the lives of slum dwellers (target 11), including women, has recently begun to be studied.

Deforestation

A key question is whether fuelwood collection causes or contributes to deforestation, which the FAO estimates is proceeding at 13 million hectares per year. Initially, poor rural women collecting fuelwood were often blamed for deforestation. Studies have shown though that most fuelwood collected at household level is deadwood or from home gardens; fuelwood and charcoal trade for urban and industrial markets and especially land clearing for agriculture are the largest sources of deforestation, which then actually produces the fuelwood scarcity that rural women face (FAO, 2005).

In deforested areas, fuelwood collection may contribute to further environmental deterioration, though this is very site-specific. One of the first studies to talk about the location specificity of forest depletion was in Sri Lanka (Howes and Endagama, 1995), where six different biomass supply areas were distinguished in the country, ranging from overall biomass deficit areas, through fuelwood-deficit areas, to self-sufficient areas and then those that could potentially export rubberwood or other fuelwood. Modi (2005) cites Mahiri and Howorth (2001) who review two decades of fuelwood crisis in Kenya and confirm the local specificity of forest depletion. They suggest that in Kenya the problem of indiscriminately felling trees and resulting environmental degradation may exist near urban centers. However, in rural areas the situation is intricately tied in with land use and control, where those who can consolidate land by building a fence are able to increase their wood supply, but those who cannot have declining access to fuelwood.

Most deforestation is due to agricultural expansion though, not fuel collection. The UN Millennium Project task force on environmental sustainability (Melnick, et al, 2005) calculates that 70 per cent of all forest destruction is driven directly by the expansion of agriculture. Modi (2005) draws attention to a meta-study by Geist and Lambin (2002) reviewing 152 case studies for the frequency of proximate causes and underlying driving forces of deforestation. Although multiple causes were most frequent, agricultural expansion was by far the leading land-use change associated with deforestation, including forest conversion for permanent cropping (especially for food-crop cultivation) and colonization agriculture. Pasture creation for cattle ranching and road construction were important in South America, and commercial wood extraction in Asia. In Africa, the harvesting of fuelwood and poles by individuals for domestic uses was more important than commercial extraction, although agricultural expansion remained the most important cause. However only 19 cases were reviewed by Geist and Lambin in Africa, compared with 55 in Asia and 78 in Latin America. The limited number of studies in Africa is in itself rather interesting, given that deforestation in Africa is a serious development issue.

While rural women's fuel collection does not appear to be heavily implicated in deforestation, there is no doubt that rural women's role in forestry is important in reversing deforestation and increasing fuelwood supplies. Women's roles as major actors in forestry have been documented throughout the world. Women and children are the primary collectors of fuel and fodder for home use, giving them a major interest in management and conservation of forest resources. Women have also been a powerful lobby for forest improvements and management schemes, when benefits for the household were clear, and a force against destruction of forests, as in the Chipko movement in India in the 1980s which applied pressure on the government to investigate and eventually impose a 10-year ban

on logging in the affected area. And in Kenya, the Green Belt Movement has mobilized more than 80 000 women to plant more than 30 million trees. Women's expertise about the use and management of trees has been useful in forestry projects, and they have provided much of the labour force in forest industries: nurseries, plantation establishment, logging and wood processing. They manage home gardens and agroforestry to produce not only fuel but cash-crop trees and minor forest products such as fruit for sale. Women have been increasingly active in the successful involvement of local communities in forest planning and management.

What role do improved cook stoves play in reversing deforestation? Even if fuelwood collection in rural areas is not a major cause of deforestation, improved stoves and fuel substitution – especially in urban areas, where charcoal may be used and pressure put on rural wood supplies – can be a significant source of wood savings. Yao (1998) reviewed the environmental impacts of the renewable energy programme in China and reported that from 1983 to 1996, improved stoves disseminated in 177 million households represented a savings of about 13.62 million tons of wood annually. GTZ conducted a macro-economic analysis of benefits from 126,000 improved stoves sold in Kenya in the early 1990s and estimated 165, 564 tonnes of fuelwood or the equivalent of nearly 3,000 ha of natural forests or over 8,000 ha of savannah bush were saved (Habermehl, 1994).

Use of improved stoves can also enable less use of crop residues and manure as cooking fuels, instead returning them to the soil and replacing nutrients. A study in China reported that an improved cookstoves project led indirectly to an increase in the yield of rice by 149 kg per mu (1 mu=0.0667 ha) and an increase in the organic matter in soil (Liu, 1992). Biogas slurry itself is known to improve soil productivity. 31% of the respondents in a large study on the biogas programme in India (Dutta 1997) reported an increased agricultural productivity after use of biogas slurry in the fields. The value of the digester residue as a high grade fertilizer (Barnett 2002).

Climate change

Carbon dioxide emissions are of concern as greenhouse gas emissions have been implicated in global warming and climate change. Emissions from cooking in developing countries are hardly significant in the total: Kirk Smith (2002) has estimated that even if all 2 billion people using solid fuels for cooking shifted to LPG for household fuel, it would add less than 2% to global greenhouse gas (GHG) emissions from fossil fuels. The health benefits would be tremendous.

Still, improved stoves and fuel switching could contribute to reducing carbon dioxide emissions in developing countries. Women's key role in household energy is well known.

A study on improved cookstoves programmes in Sri Lanka and Kenya indicated that their adoption led to emissions reductions of around 200 kilotonne of CO₂ per year in Sri Lanka and 1000 kilotonne per year in Kenya, translating into 3% and 15% respectively of national CO₂ emissions in the two countries (Hogg et al 2001).

A study by researchers at the University of California, Berkeley and the Harvard School of Public Health (Bailis et al, 2005) finds that a transition from biomass fuels to kerosene and LPG would be more desirable from a greenhouse gas point of view but nearly equal from a household health point of view as a transition from wood fuels to charcoal for cooking. Each meal cooked with charcoal has 2-10 times the global warming effect of cooking the same meal with firewood and 5-16 times the effect of cooking the same meal with kerosene or LPG.³⁶

³⁶ Depending on the gases included in the analysis and the degree to which wood is allowed to regenerate.

However charcoal cooking can lead to reductions in concentrations of pollutants like particulate matter by 88% compared with open wood fires. Women need to participate in discussing the costs and benefits of these alternative household fuel options.

*Safe drinking water*³⁷

At least 1.1 billion people lack access to safe water and 2.6 billion lack access to basic sanitation, resulting in the deaths of 3900 children per day, according to the UN Millennium Project task force on water and sanitation. A lack of access to water affects women and girls more profoundly than men, due to their responsibilities for water fetching and transporting, hygiene and cleanliness in the household, and waste management and sanitation.

Lack of ready access to water increases women's and girls' workload; it precludes many girls from pursuing an education, it excludes women from participating in income-generating aspects of the economy, and it increases the vulnerability of women and girls to assault and abduction. These effects are similar to the effects of time drudgery in fuel cycle activities, and some studies have shown that both household fuel and water supplies need to be improved in order to reduce women's overall time in domestic tasks (Barwell, 1996). According to the UNDP, women and female children spend more than ten million person-years carrying water for household use each year. Women are also responsible for maintaining family health and hygiene, making them crucial actors in fighting health-related disease.

Energy is required to make use of water – to lift, move, process and treat water supplies. While diesel and grid-electrified pumping are still most common, photovoltaic and wind powered pumping have become more used, especially in remote areas where diesel is not obtainable. World Vision reports that solar energy is most useful for small-scale water pumping in the Sahel and that 25 women's associations in Senegal working with more than a thousand women have been successful in vegetable growing as a result (Diarra, email, 2005). In a PV water pumping project in Zaka district in Zimbabwe, clean and safe drinking water was provided, which in turn enabled households to undertake vegetable cropping and enhanced their nutritional levels; cases of diarrhoea and bilharzias were also reduced (Madau, 1998). In a water project in Gujarat, women were able to use their time and energy gains to start micro-enterprises (Francis and Verhagen, 2005).

Energy is also needed to boil and treat water. A simple solar water treatment has been developed and women are involved in disseminating this approach in Latin America (Salas & Torres, 2001).

A special issue of *ENERGIA News* recently explored the interactions among gender, energy and water. Because of the centrality of the female experience in relation to water issues, many actors working in the international freshwater policy arena have initiated a gender approach to water management. This approach supports engaging communities (both men and women) in participatory water management solutions. Women and men often have different priorities for water pumping: women frequently prioritise drinking water, while men prioritise irrigation. Women's relative access to and control over water (and other key resources linked to water, such as land, credit, and extension services, and including energy services), as well as gender biases within public institutions, greatly effect the degree to which women can take part in and benefit from water management and development schemes. Energy solutions aimed at improving water supply effectively and sustainably need to address these realities and take a similar community approach (*ENERGIA News* 8.1, April 2005, various articles).

³⁷ Based primarily on articles in the special issue of *ENERGIA News* on Gender, Water and Energy, 2005.

Both water and energy are basic social services whose provision can be a focal point for community action and social mobilization, and a valuable entry point for the promoting women's empowerment. Having a leadership role in community management of water supplies and energy provision can increase women's social capital as well as their bargaining power within the household. Improving energy for water supply has had positive impacts on the reduction of drudgery for women and their increased access to water for drinking, cooking and productive purposes; it has had dramatic effects on women's levels of empowerment, education, literacy, nutrition, health, economic opportunities and involvement in community activities. Energy and water both play critical roles in underpinning efforts to achieve the Millennium Development Goals and improve the lives of poor people.

Improving the lives of slum dwellers

More than 900 million people live in urban slums and that number is growing, according to the UN Millennium Project task force on improving the lives of slum dwellers (Garau, et al, 2005). Providing cooking and electrical energy for slum dwellers is a critical need for improving their lives. Recent studies have focused more attention on energy in the urban system, including from a gender perspective. About 40% of the world's poor living in urban areas lack access to modern energy services.

A number of studies have shown how "energy affects all aspects of poor urban households' livelihoods and changes in the accessibility and cost of fuel can have significant impacts not only on the more obvious physical and financial assets but also on social, natural and human assets and household livelihood strategies and aspirations." (Meikle, 2005; Meikle and Bannister, 2003; Barnes, 2005). Gender aspects were analysed in a study in Arusha, Tanzania, sponsored by DfID, and found that women complained of high cost and availability of electricity and kerosene, and the health effects of biomass fuels. They tried to use strategies such as cooking or buying in large quantities, changing stoves or fuels, but affordability constrained poor households' choices.

Another DfID study (Clancy et al, 2005) in urban areas of three countries (Nigeria, Philippines and Brazil) examined in particular the role of energy services in urban poor livelihoods and enterprise viability, using micro-analysis and gender-disaggregated data. Preliminary findings indicate that energy-intensive micro-enterprises operated by women are the main source of income for these households in Nigeria, and contribute to household income in the Philippines and Brazil.

An ITDG study on energy and street food (Tedd, et al, 2003) found that 70-90% of street food vendors (owners or employees) in some countries are women and that energy was an important factor of production in resulting income. In the Sri Lanka case, most of the vendors were men but the women prepared food in the home. Clancy (Ibid.) points out that the ITDG case study in Bangladesh showed improvement in the livelihoods of street food vendors through better household energy supplies – since the production of food for sale is a family-based activity and a large part of food production takes place within the household.

A recent study of innovative approaches to slum electrification (USAID, 2005) found that while electricity is almost universally available in even the poorest slums, it is mostly stolen which results in poor quality service provided at very high prices and extremely dangerous conditions. One of the success factors found in the successful provision of electricity to slum dwellers was the involvement of women. The utility in Ahmedabad used a women's organization, SEWA, as one of its intermediary. SEWA campaigned for houses to be put in women's names so that they could not be evicted. In South Africa, 80% of the prepayment vendors were women. COELBA in Brazil used women as their agents in the community, since women were perceived to communicate more easily than men, to be more familiar with the neighborhood, and to pose little threat to the consumers. The

increase in women-headed or women-maintained households in most of the case studies led the study to recommend a gender perspective to household electricity supply in order to meet the requirements of the primary users.

Conclusions

Gender and energy has linkages with each of the targets of MDG on ensuring environmental sustainability. In general rural women's fuelwood collection has been shown not to be a major factor in deforestation (target 9). But in urban areas and locally specific rural areas, the reduction in biomass energy use through adoption of more efficient stoves and fuels has been shown to save thousands of tonnes of fuelwood. As important is probably women's documented role in forest management and tree planting, in reversing deforestation and increasing fuelwood supplies.

Carbon dioxide emissions have been reduced by more efficient biomass cooking stove programs, according to studies. A recent study shows that they could be reduced even further by a transition from biomass fuels to kerosene and LPG for cooking. However even shifting all 2 billion people using solid fuels for cooking to LPG would only increase GHG emissions by 2 per cent (Smith, 2002)

The provision of safe drinking water (target 10) affects women more than men since it is their task to fetch and purify water. Drinking water supply can be improved in many ways, including through gravity-fed systems and changes in human behavior. There are many examples of energy use in water pumping. But there is not much evidence available on sources of energy used and their relative benefits for women. The use of energy to treat and purify drinking water has also received little attention. There is considerable experience in the water sector with involving women effectively and measuring benefits for women and men, that could be related to the energy sector.

Urban energy use (target 11) has been shown to be linked with livelihoods and micro-enterprises especially street foods. There are some examples of women's effective involvement in slum electrification in Brazil and South Africa.

3.9. Correlation and causality: Macro studies³⁸

The previous sections have examined empirical and especially quantitative evidence on the impact of energy access by gender on each of the UN Millennium Development Goals. This section specifically explores global statistical studies and their evidence on correlation and causality in the linkages among energy, development and gender. There is a strong relationship between energy and economic growth, and some evidence that energy can be a driver of economic development for developing countries, especially at the industrial stage. There is a strong correlation between per capita energy consumption and human development indicators such as life expectancy, literacy and school enrolment used in the UN's Human Development Index (HDI), though whether this is causal or simply linked by rising incomes, has not been demonstrated. HDI also correlates strongly with the new IEA composite indicator, the Energy Development Index (EDI) (IEA, 2005).

None of these correlations have addressed the question of a relationship between energy, and gender equity and empowerment, however. This study did so by looking first, at some available statistical analyses of energy access versus some key human development indicators of particular importance to women; and secondly, by carrying out some simple correlations between energy consumption and United Nations gender-related development indicators.

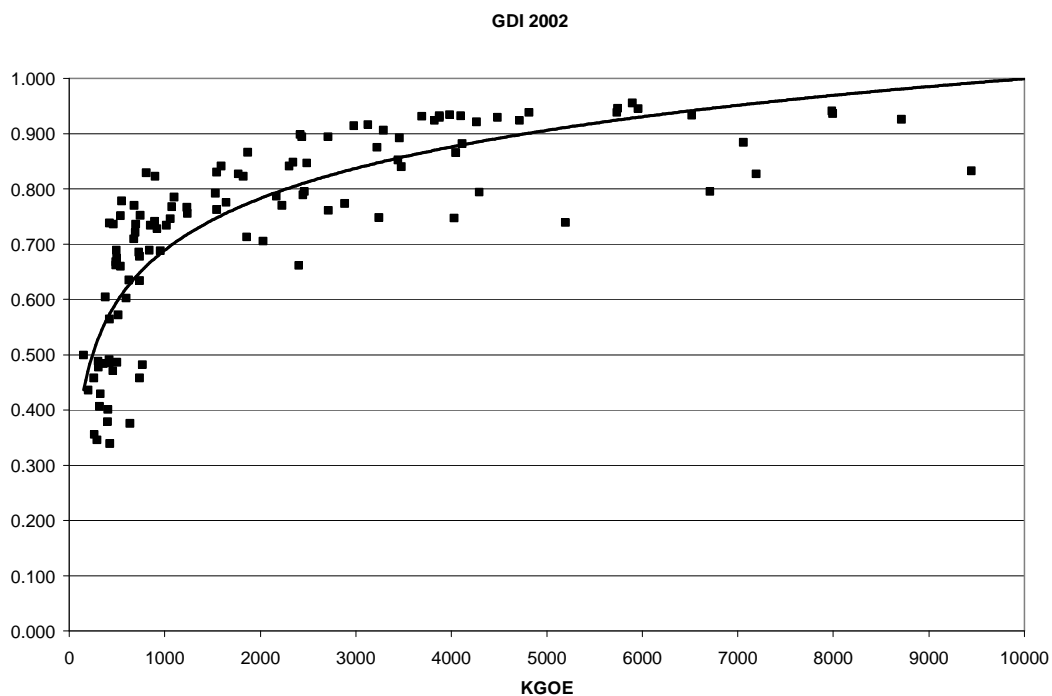
³⁸ Based on E. Cecelski, Energy, development and gender: Global correlations and causality, Report to ENERGIA/DfID Kar R8346, October 2005.

Commercial energy access has been plotted by the IEA and found to be correlated with the UN indicators of extreme poverty: life expectancy, probability of not surviving to age 40, school enrolment, and underweight in children (IEA, 2005). A significant positive relationship was found by Bloom, et al (ESD reference) between traditional biomass fuel use and infant and child mortality, life expectancy (with a larger effect for females), fertility rates and crude birth rates, independent of both income per capita and income equality in a country. Indoor air pollution exposures have been related with child and adult morbidity and mortality on a global basis; though the global figures do not disaggregate effects on girls and boys, most impact on adults is assumed to be on women cooks (ENERGIA News 4.4, 2001). An eight-country study found that the fuel transition to hydrocarbon cooking fuels is strongly correlated in these countries with access to other infrastructure represented by variables for education, urbanization, and electrification. Access to clean water – especially important for reducing women’s work burden – has been plotted against electrification, but the curve shows considerable diversity; other factors may be significant (cite).

Hence access to modern energy services does seem to correlate on a macro basis with a number of these key social and economic indicators of special importance to women. However the lack of gender disaggregation in most of the statistical studies limits the usefulness of these correlations in determining differential impacts on women and men, or girls and boys, and particularly in assessing their relationship with gender equity and empowerment.

For this reason, an attempt was made in this study to use UN gender-related indices to explore whether energy access is related to gender equity and empowerment. It shows that per capita energy consumption does correlate closely with the UN’s Gender Development Index (GDI, in a similar non-linear relationship as HDI).

Figure 4. Gender-related Development Index (GDI) versus per capita energy consumption (kgoe), 2002

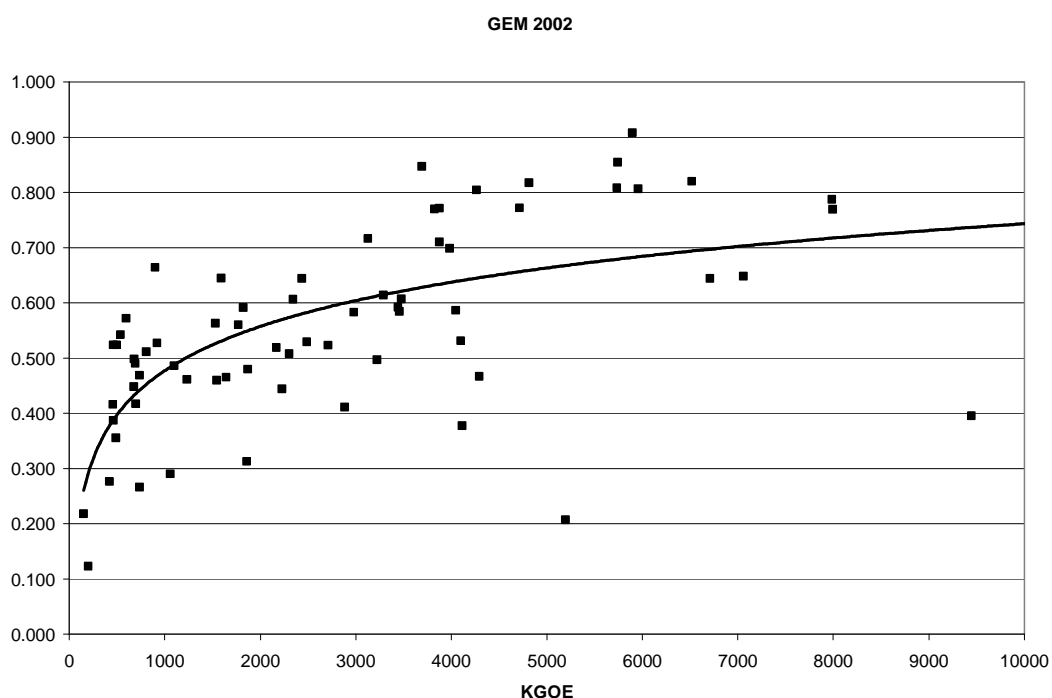


Source: World Development Indicators, 2004; personal communication, Henry Lucas, IDS/Sussex.

It appears that even modest increases in energy and electricity consumption could be associated with much larger improvements in gender-related development defined as equality in life expectancy, literacy and school enrolment. This is consistent with what is known about the effects of energy access on women’s “practical” needs to reduce work burden and access services.

However the relationship between energy consumption and the UN’s Gender Empowerment Index (GEM), which measures gender inequality in economic and political spheres of activity, is much less clear.

Figure 5. Gender Empowerment Measure (GEM) versus per capita energy consumption (kgoe), 2002



Source: World Development Indicators, 2004; data analysis provided by Henry Lucas, IDS/Sussex.

Gender empowerment likely depends more strongly on other factors, such as legal, social and policy frameworks. Other conditions in addition to energy access are necessary to meet women’s “strategic” needs including the transformation of gender roles and relations.

Further, an attempt was made as part of the DfID project to develop a Gender-Energy-Poverty Index (GEP) based on data available for 55 countries. A simple composite indicator was developed by adding the three UN and IEA indicators on human development, energy development, and gender-related development together. This index could be used to measure gender-energy-poverty vulnerability and identify priority countries for action, and to compare progress across countries and regions as well as shifts over time.

Table 5. Gender-Energy-Poverty (GEP) Index in 57 countries

Country	GDI	Rank	EDI	Rank	HDI	Rank	GEP	Rank
Costa Rica	0.823	8	0.896	3	0.995	1	2.714	1
Israel	0.906	1	0.773	7	0.908	2	2.587	2
Singapore	0.884	2	0.608	23	0.902	3	2.394	3
Argentina	0.841	3	0.698	12	0.853	5	2.392	4

Country	GDI	Rank	EDI	Rank	HDI	Rank	GEP	Rank
Trinidad&Tobago	0.795	9	0.728	9	0.801	9	2.324	5
Uruguay	0.829	6	0.640	18	0.833	8	2.302	6
Malaysia	0.786	10	0.711	11	0.793	10	2.290	7
Iran	0.713	28	0.834	5	0.732	27	2.279	8
Venezuela	0.770	12	0.716	10	0.778	12	2.264	9
Tunisia	0.734	24	0.772	8	0.745	22	2.251	10
Brazil	0.768	14	0.609	22	0.867	4	2.244	11
Algeria	0.841	4	0.693	13	0.704	29	2.238	12
Thailand	0.766	15	0.677	17	0.768	16	2.211	13
Lebanon	0.755	16	0.683	15	0.758	17	2.196	14
Jordan	0.734	25	0.686	14	0.750	21	2.170	15
Panama	0.785	11	0.589	26	0.791	11	2.165	16
Colombia	0.770	13	0.609	21	0.773	13	2.152	17
Philippines	0.751	17	0.594	25	0.753	18	2.098	18
Ecuador	0.721	27	0.635	19	0.735	26	2.091	19
China	0.741	19	0.603	24	0.745	23	2.089	20
Dom. Rep.	0.728	26	0.617	20	0.738	25	2.083	21
Paraguay	0.736	22	0.541	29	0.751	20	2.028	22
Peru	0.736	23	0.532	31	0.752	19	2.020	23
Egypt	0.634	37	0.679	16	0.653	36	1.966	24
El Salvador	0.709	29	0.489	32	0.720	28	1.918	25
South Africa	0.661	34	0.588	28	0.666	35	1.915	26
Bolivia	0.674	32	0.538	30	0.681	32	1.893	27
Sri Lanka	0.738	21	0.409	37	0.740	24	1.887	28
Morocco	0.604	38	0.589	27	0.620	38	1.813	29
Indonesia	0.685	31	0.412	36	0.692	30	1.789	30
Vietnam	0.689	30	0.409	38	0.691	31	1.789	31
Honduras	0.662	33	0.420	34	0.672	33	1.754	32
Guatemala	0.635	36	0.458	33	0.649	37	1.742	33
Nicaragua	0.660	35	0.326	41	0.667	34	1.653	34
Namibia	0.602	39	0.414	35	0.607	39	1.623	35
India	0.572	40	0.332	40	0.595	40	1.499	36
Ghana	0.564	41	0.304	42	0.568	41	1.436	37
Pakistan	0.471	50	0.387	39	0.497	46	1.355	38
Bangladesh	0.499	42	0.267	45	0.509	42	1.275	39
Cameroon	0.491	43	0.253	46	0.501	45	1.245	40
Zimbabwe	0.482	48	0.251	47	0.491	49	1.224	41
Sudan	0.485	46	0.229	50	0.505	43	1.219	42
Haiti	0.458	51	0.244	48	0.463	52	1.165	43
Nigeria	0.458	52	0.238	49	0.466	51	1.162	44
Togo	0.477	49	0.176	54	0.495	47	1.148	45
Senegal	0.429	53	0.280	44	0.437	53	1.146	46
Nepal	0.484	47	0.131	55	0.504	44	1.119	47
Kenya	0.486	45	0.124	56	0.488	50	1.098	48
Ivory Coast	0.379	55	0.290	43	0.399	55	1.068	49
Congo	0.355	57	0.189	52	0.494	48	1.038	50
Benin	0.406	54	0.205	51	0.421	54	1.032	51
DR of Congo	0.488	44	0.118	57	0.365	57	0.971	52
Zambia	0.375	56	0.179	53	0.389	56	0.943	53
Mozambique	0.339	59	0.107	58	0.354	59	0.800	54
Ethiopia	0.346	58	0.037	59	0.359	58	0.742	55

Source: Calculated from IEA, 2004; World Development Indicators 2004.

Rural women are worst off in countries where all three types of disadvantage are strong and reinforce each other, as in poor countries such as Mozambique and Ethiopia. These countries

probably warrant special attention in terms of schemes which give poor women greater control over economic resources in general and energy resources in particular. Women's active participation in energy development will be especially important not only for improving family welfare but for ensuring the success of energy interventions and meeting gender equity goals.

Women are best-off where all three types of disadvantage are weak, as in Costa Rica, Malaysia and Tunisia, and needs for interventions may not be as pressing – though it must be remembered that the indices do not disaggregate between the rural and urban situation, or rich and poor women; traditional biomass use may still be widespread in spite of high rates of rural electrification and the availability of fossil fuels.³⁹

It is apparent that gender-energy-poverty vulnerability often varies from HDI and in some countries HDI may not reflect the urgency of gender-energy problems. For example Sudan, Togo, Kenya and Congo have considerably lower rankings for GEP than for HDI, possibly indicating that the gender-energy situation needs urgent attention.

This gender review of statistical studies on energy access and development indicators suggests that future studies should most importantly, disaggregate data collection and analysis by women and men, and girls and boys. Furthermore, global studies are dependent on the availability of gender-disaggregated data at the national and project level.

3.10. Conclusions on empirical evidence on gender, energy and the MDGs

This chapter has reviewed the evidence for linkages between access to modern energy services, and each of the MDGs, from a gender perspective. In 3.2 to 3.8, the empirical evidence for linkages with each individual MDG is reviewed separately. In 3.9, the evidence for correlations from macro studies is assessed. A number of linkages are found to have good support, while for others the evidence is more mixed. Further investigation is needed to ascertain whether or under what conditions, these linkages hold.

The table below summarises the findings of the empirical reviews of MDG-energy linkages from a gender perspective. “Good evidence” means that there are sufficient strong data and case studies to make a good case to policy makers and practitioners for this linkage; we can use this evidence to support recommendations for action. “Some evidence” means that there is evidence but the case may not be strong or much data available. “Little evidence” means that it may be difficult to convince policy makers and practitioners on the basis of what we can show. The latter two do not mean that there is no linkage (surely energy provision is necessary for safe drinking water!⁴⁰), but that there is not good quantitative evidence for this at our fingertips that can be used for advocacy.

As regards how energy access could decrease *poverty and hunger*, there is good evidence for time and effort savings of 1 to 4 hours daily in cooking, fuel collection and food processing, when energy is made available for these tasks; but there is insufficient evidence on how these time savings are used. Access to electricity is correlated with time spent on fuel collection and cooking – but we don't understand why. We know that women use biomass energy in their micro-enterprises, and use electricity to extend the working day for home industries and agriculture, but we don't know how much income improved fuels and lighting results in generating. Donor-supported

³⁹ In Tunisia, for example, though energy access is rated high and rural electrification is approaching 100%, it is not uncommon to observe women in rural areas cooking on open fires outside fully electrified homes.

⁴⁰ This may seem obvious, but in fact many safe drinking water initiatives do not actually involve improved energy sources. Diesel engines and existing grid electricity probably power most water pumping. And many improvements involve rehabilitation of pipes or use of gravity-fed systems. Furthermore, according to water & sanitation sector experience, a key factor in “safe” drinking water is human behavior, e.g. use, maintenance, hand washing, etc.

Table 6. Energy-MDG linkages, from a gender perspective: Good evidence, some evidence and insufficient evidence

Millennium Development Goals	Good evidence	Some evidence	Insufficient evidence
Goal 1. Eradicate extreme poverty & hunger by 50%			
	Time & effort savings of 1-4 hours daily in cooking, fuel collection and food processing due to improved energy access <i>for these tasks</i> .		How time savings from improved energy access are used.
		Electricity access correlates with time spent on fuel collection.	Why does electricity reduce time spent on fuel collection?
		Increased agricultural work by women with improved energy access.	
		Income generation by women using biomass energy in businesses. Income generation by women using electricity to extend working hours.	Amount of income generated due to improved lighting and fuels. Women's control over investment decisions from increased income Role of energy in women-operated enterprises.
		Income generation by women from energy enterprises supported by donors.	Scale & sustainability of women's energy enterprises under market conditions.
	Reduced household expenditures of 20-50% on energy due to more efficient and lower cost cooking and lighting fuels.		Use of energy cost savings to increase food consumption.
Goal 2. Achieve universal primary education of boys and girls			
	Increased girls' school attendance due to electrification.		
		Increased children's hours of study due to electrification.	Increased girls' and boys' hours of study due to electrification.
		Increased girls' schooling due to their reduced time in food processing & water fetching.	Effects of saving women's time in energy system on girls' education.
		Better girls' school performance due to electrification.	Effects of adoption of improved stoves and cooking fuels on girls' education.

Millennium Development Goals	Good evidence	Some evidence	Insufficient evidence
Goal 3. Promote gender equality and empower women			
	More choices for women in how to organise their work effectively.		Increased leisure time with modern energy.
	Increased access by women to information through media with electrification.		Potential for TV and media to promote family bonding & gender cooperation.
		Increased reading by women with electrification.	
			Increased access to paid work with modern energy.
			Position of women professionals in the energy sector.
		Changing gender roles within the household.	Control over & access to improved energy services by women.
		Increased voice & participation by women in energy projects that effectively involve women.	
			Violence against women in the energy sector
Goal 4. Reduce child mortality (by 2/3 the <5 mortality rate) Goal 5. Improve maternal health (reduce mortality by ¾)			
	Reduced acute respiratory infections in women and under-fives due to modern cooking fuels.	Reduction in lower birth weights as cause of neonatal mortal, due to modern cooking fuels.	Reasons for differential ARIs in men and women, boys and girls.
	Reduced drudgery by women linked to neonatal survival.		Energy access leading to reduced women's drudgery that improves pregnancy outcomes and neonatal survival.
	Electricity & modern cooking fuels associated with reduced infant mortality.		
		Electricity's role in provision of primary health services.	No evidence that electrification makes rural health clinics more attractive to staff.
			Energy role in boiling water and reducing diarrhoea.
			Energy availability role in nutrition (cooked food).

Millennium Development Goals	Good evidence	Some evidence	Insufficient evidence
Goal 6. Combat HIV/AIDS, malaria, other major diseases			
	Reduced acute respiratory illness (ARI) vector that worsens HIV/AIDS and tuberculosis.		
			Recommended health behaviors for PLWHA enabled by energy (e.g. boiled water)
			Energy services enable self-care for women LWHA.
		Energy services reduce women's burden of care for PLWA.	
			Sterilisation reduces HIV/AIDS transmission through health clinics.
			Risk of HIV/AIDS transmission through rape in fuelwood collection.
		Forest resources used for funerals & coffins.	
Goal 7. Ensure environmental sustainability incl safe drinking water and slum dwellers			
	Women's household fuel collection does not by and large cause deforestation however urban and specific rural areas do affect deforestation. Improved stoves save thousands of tonnes of fuelwood.		
	Women contribute to improving and protecting forest resources.		
	Use of improved household cooking fuels contributes to GHG reductions.		
		Some correlation of access to clean water with electrification.	Role of energy in provision of safe drinking water.
		Energy is linked with improving the lives of women slum dwellers (e.g. reducing indoor air pollution).	Role of energy in lives of women slum dwellers.

projects have documented how energy enterprises can be successfully owned and operated by women, but their scale and sustainability under market conditions is not known.

There is good evidence for reduction in household expenditures on energy of 20-50% with more efficient and lower cost cook stoves and lighting fuels; but it is not clear whether these savings are used to increase food consumption or are offset by increased energy use.

Concerning *education*, increased school attendance by girls is associated with electrification, and there is some evidence too of better school performance by girls; hours of study are also possibly increased, but the latter data is not available for boys and girls separately.

There is some evidence for an increase in girls' schooling when their time in domestic chores is reduced. The effects of saving women's time (in general) and of adoption of improved stoves and cooking fuels (specifically) on girls' education, is not known though.

On *gender equality*, there is good evidence that energy access has empowered women, by giving them more choices about how to organise their work effectively. With time savings from reduced drudgery or a longer day with electric lighting, women take advantage of agricultural, off-farm or home industry income-earning opportunities; they catch up on housework and child care, improving family health and well-being; and less often, they rest and socialise. Leisure is an important indicator of women's empowerment.

Women's access to information has been increased through TV and other media, with electrification. There is a little evidence for increased reading by women with electrification, too. It would be useful to know more about the potential for TV and media to promote family bonding and gender cooperation, as hinted by some studies.

Changing gender roles in the household and voice and participation by women in the community tend to be extremely variable and likely depend on many factors that we would like to know more about. There are examples of changing gender roles in the household, with men sharing domestic technology more. But there are many examples of the opposite. There is mixed evidence on control over and access to modern energy equipment, with men remaining in the decision. In energy projects where a strategy to involve women has been pursued, this has often improved their status and voice in the community as well.

There is little evidence of an association between modern energy and indicators of women's empowerment such as increased access to paid work, or better representation of women as energy professionals or in energy decision-making bodies. However this has been little studied.

Evidence on sexual violence in fuel collection is anecdotal, but this is a problem that deserves further investigation.

Child mortality and maternal health are clearly improved by modern cooking fuels, with good evidence on reduced acute respiratory infections (ARI) and reduced drudgery (though the latter has not been specifically related to energy) affecting neonatal survival, and some evidence on their association with lower birth weights. The reasons for differences in ARIs between men and women, boys and girls, are still speculative, though. Access to electricity and to modern cooking fuels both correlate in macro studies with reduced infant mortality, even controlling for income.

Electricity's role in the provision of primary health services has been documented, but not specifically related to health outcomes. There is no evidence that electrification makes rural health clinics more attractive to staff.

Little is known about the importance of energy in avoiding diarrhoea (by boiling water), nor its role in nutrition (e.g. making nutrients in cooked food more available, affecting food choice), beyond anecdotal evidence.

There were virtually no studies found on the relation between energy availability and *HIV/AIDS, malaria and other major diseases*, but the possible links are worthy of investigation, especially in Africa. Acute respiratory infection (associated with biomass cooking) is known to activate tuberculosis, the most common HIV/AIDS opportunistic infection. Inadequate sterilization may be a factor behind the transmission of HIV/AIDS, especially to pregnant women, in health clinics, that is being documented. Fuelwood collection rape may also be a transmission vector.

Given the importance of rest, hygiene, and practices such as eating cooked foods and boiling water, energy availability is likely to be important in improving the quality of life for persons living with HIV/AIDS (PLWHA), in reducing women's burden of care for PLWHA, and in enabling self-care for women LWHA.

Environmental sustainability linkages with energy from a gender perspective have been little explored. There is good evidence that improved stoves save thousands of tonnes of fuelwood, and where large quantities of wood are used in urban areas or locally deforested rural areas, this could be significant in reducing deforestation. The evidence is that in most rural areas though, women's collection of household fuel does not cause deforestation. More importantly, women in their role as forest managers and in tree planting, do contribute to reforestation.

The use of more efficient household cooking fuels has been estimated to contribute to greenhouse gas reductions, though compared with the total amount, it is not significant.

Some correlation of access to clean water with electrification has been found, but the role of *energy* specifically in the provision of safe drinking water in relation to women's roles has been little studied. Energy has also been linked with improving the lives of women slum dwellers, but again, its precise role is not well understood.

A major challenge in carrying out the empirical review was that it is only recently that there has been much emphasis in energy projects on reporting on the impacts of energy interventions on MDG indicators. Even worse, data has seldom been disaggregated to show the differential impacts on women and men. For every study found that showed the impacts of an energy project on women and men, perhaps ten others were reviewed that either did not provide quantitative information on impacts at all, or mentioned only "people", "households" or "children", and did not give the impacts on women and men or boys and girls separately. In many "studies", generalizations about benefits were made without data or empirical support.

From a gender perspective, what emerges most strongly from the evidence, in fact, is that while energy may have important effects on women in relation to the MDGs, this varies greatly according to the social and economic environment, as well as the strategy for women's involvement in the energy intervention. It is useful therefore to delve more deeply into the dynamics of *under what conditions* energy "makes a difference" in the linkages between gender and energy, in the case studies in the next chapter.

4. Applying new approaches to gender and energy policy research: case studies

As the historical review of approaches to gender in biomass and labour-saving energy technology research and policy in the chapter 2 illustrates, gender and energy analysis as well as project planning and policy have remained largely within a women and development (WID) framework – welfare-oriented and instrumentalist. In the WID framework, energy access for women is *welfare-oriented*: aimed at increasing women’s (and their families’) well-being, by relieving women’s burdens, improving their health, and helping them to earn income. There is little emphasis on women’s voice, power and influence, nor on their economic agency.

Initial attempts to involve women in the energy sector have also generally been *instrumentalist*. Women’s participation in energy projects is usually an instrument for increasing the efficiency of energy use and production. From an energy sector perspective, women’s participation can make energy projects more “successful,” for example by enabling wider dissemination of more stoves or solar home systems, or by ensuring their proper use and maintenance.

Raising the visibility of gender in the sector has been a valuable outcome of these approaches, but recent energy, poverty and gender frameworks go further in asserting the transformation of gender relations and human rights as essential to the energy mandate. Sustainable livelihoods, gender analysis, and feminist political ecology offer new ways of understanding linkages among gender, energy and poverty and new criteria for gender-sensitive energy policy research. These have been explored and applied in the eight case studies under this project.

In the eight case studies carried out by the CRG, creative research approaches are used by leading gender and energy researchers to explore a pressing policy issue in the gender-energy-poverty nexus in their country or region. The present chapter summarises the case studies, their findings, and their policy recommendations. The full case studies are available online and are published as a special issue of *ENERGIA News*.⁴¹

The eight case studies had several objectives in addition to their specific findings. They were a means of exploring the most policy-credible research frameworks, themes, indicators and data collection for gender-sensitive energy policy research. They were also a way to build capacity and partnerships within research networks such as AFREPREN/FWD and APPROTECH and a way for the CRG to begin to build trust and work together. Finally, the case studies were intended from the beginning for use in policy advocacy at the national level.

The policy issues selected were highly diverse and selected by the partner researchers both to address the gender and energy issues judged by them as most important in their countries or regions, and to make use of their own personal and research strengths. Although the studies were not planned to be comparative, and draw on diverse approaches, they can be loosely grouped in three thematic areas:

1) Impacts of energy projects on women and men

- In Sri Lanka, new bioenergy initiatives based on using the country’s large biomass resource for electricity generation, are examined by Anoja Wickramasinghe in terms of the effects on

⁴¹ *ENERGIA News*. 8.4 on Gender, Energy and the MDGs: Towards Gender-Sensitive Energy Policy Research and Practice.

women and men in two schemes, one community-based and run by users, and the second providing feedstock for the national grid.

- In the Philippines, APPROTECH-Asia discovers how community micro-hydro in an indigenous area affects women's and men's roles, and a PV battery-charging project influences women's livelihoods.
- In Uganda, a deliberate gender strategy improved the impact of solar home systems by ensuring that women were targeted for credit and sales, according to May Sengendo's study.

2) Gender in energy policy

- In Eastern & Southern Africa, the inclusion (or non-) of gender in national power sector policy is examined by AFREPREN/FWD researchers in four countries, and how gender and energy research can influence this.
- In Himachal Pradesh, India, the policy of kerosene and LPG subsidies is related to the empowerment of rural women and their health in the traditional fuel system by Jyoti Parikh.

3) Energy and gender relations

- In South Africa, the impact of electrification is linked to changes in domestic roles which are in turn related to gender equity in the new constitution, by Wendy Annecke.
- In China and other parts of rural Asia, Govind Kelkar and Dev Nathans link women's and men's labour force participation and status to the adoption of new fuels and appliances in a number of countries.
- Lessons are drawn by Michel Matly from experience with rural electrification in Europe and the US, on the ideology of women's electrification and how this may apply in developing countries today.

4.1. Impact of energy interventions on women and men

Three studies looked at the impact on women of renewable energy projects aimed at providing electricity: from biomass feedstocks in Sri Lanka; from micro-hydro and photovoltaic battery-charging in the Philippines; and from solar home systems and solar-wind battery-charging in Uganda.

4.1.1. Sri Lanka: Decentralised electricity generation from biomass feedstocks

Background

Due to the high cost of fossil fuels and limited hydropower potential in Sri Lanka, renewable energies including biomass are being explored as a means to expand beyond the 65% of the population connected to the national grid. Two modes of biomass electricity generation are supported by state policy: Generation for the national grid and community level off-grid generation. This case study examines two representative sites, as well as a control site with no dendro-energy project. It looks at the role of gender relations in the projects, and whether/how the projects contribute to women's well-being and empowerment.

Biomass is the primary source of energy in rural Sri Lanka, and the sole source of cooking energy. The non-forest production system (mosaics of homegardens including individual gardens, live fences, hedges, riparian agroforests, and ribbon belts of planted trees) are the major sources of biomass supply. Commercialization of wood fuel as feedstock affects both traditional cooking fuel supplies, and the agriculture-based rural livelihood system; it can positively or negatively link the rural economy with the modern energy sector. The gender implications of this transition are of tremendous importance.

Methodology

The case study used gender analysis as the basic framework and indicators on gender relations, energy interventions, well-being, and resource stewardship. A variety of data collection methods ranging from field surveys, questionnaires, rapid rural appraisal, and focus groups were used. All methods were gender-disaggregated.

Grid-connected electricity supply project

In Kumabalgamuwa, a grid-connected electricity supply project is operated as a commercial enterprise by the Bio-Energy Association of Sri Lanka. Farm households provide biomass feedstock (*Gliricidia*) to a dendro-energy plant which sells electricity to the grid. The rural households themselves do not receive electricity. Landowners with relatively large farm holdings have benefited as suppliers, whereas the poor with small farmlands have not been involved in providing feedstocks and the landless have not benefited at all.

Men dominate the supply chain of feedstock, and their decisions on biomass supply have marginalized women from their conventional roles. Men reap most of the benefits of the stocks maintained by women on family lands and also the labour opportunities for preparing and selling feedstock to the plant. Women have low interest in the project, since it does not contribute to local energy needs nor to food production. In fact, by shifting control over woodfuel to the cash economy, women have lost not only sources of woodfuel but also their leading decision making role in family farming. Thus the contribution of this intervention to alleviating poverty and empowering women is insignificant.

Community off-grid project

In Wadagahakiwla, a community off-grid development project, a pilot is implemented by a non-governmental organization, The Energy Forum, in support of the state policy on decentralisation and promotion of grassroots partnership in energy development. This is the first community level project under that policy, established only in 2004 and designed to provide 250W of electricity to 100 households in a private-public-civil society partnership. The project has involved the community successfully in assessing their energy needs and potential to provide feedstock, in forming the community level Wadagahakiwla Dendro Power Electricity Consumer Society to facilitate and manage the project, and in selecting the plant site. All the households are responsible for supplying feedstock from their own farms and for making decisions on management and service supply. Generation of electricity for household lighting and their ability to cover the cost of electricity through their share of feedstock gives households a feeling of ownership and control.

Women are represented in the community organization, and play roles as producers and suppliers of feedstock to the energy plant. Both women and men perceive benefits from the plant. Even though their cooking needs are not addressed by the project, women appreciate several aspects of electricity more than men, as shown in table 7.

Table 7. Some gender specific impacts/implications of the dendro-thermal project perceived by men and women, Sri Lanka

Aspect/category	Nature of benefit	% responded & endorsed	
		Men	Women
Energy services	Lighting – from 5-7 in the evening		
	• Increased efficiency in attending to domestic chores	21	96
	• Reduced risks of using kerosene lamps	100	100
	• Enhanced mobility inside the house	100	100
	• Stimulating children for education	100	100
	• Reading/learning opportunities	82	61
	• Social interactions/work	86	41
	Accessing Media		
	• Receiving information/news	63	63
	• Leisure	78	56
Social	Household electrical appliances		
	• Ironing	31	82
	• Boiling water	04	04
	Building social capital		
	• Community level organisation for common goals	100	100
	• Equal opportunities for men & women	82	31
	• Building reciprocity	100	100
	• Building managerial skills	80	60
	• Equal opportunities for the villagers for improving quality of life	42	30
	• Membership in energy focused organisation	91	09
• Organizing production as suppliers	100	81	
• Building cohesiveness	72	92	
Empowerment			
• Cash returns for family	82	82	
• Equal opportunities for the households	100	100	
• Democratic decisions on leadership/decision	42	63	
• Building competencies	64	98	
Economic benefits			
• Getting value for farm/household produced (Nanchi)	100	100	
• Potential for starting village/home-based industries	60	20	
• Farm intensification by growing more Nanchi	44	30	
• Farm intensification by adding pepper vine	56	60	
• Eliminating expenses on Kerosene	53	64	
• Getting income from Nanchi to cover energy cost	100	100	
Environmental	• Maintaining kerosene smell and smoke-free intra-household conditions	100	100
	• Enhanced perennial vegetal cover	63	80
	• Potentials to enrich soil	90	90
	• Potentials to conserve water & reduce water scarcity	72	60
	• Reducing soil erosion	96	93

Interestingly, some of the most important impacts perceived involve building social capital and feelings of empowerment. Clearly, this initiative has contributed directly and indirectly to poverty reduction and community empowerment, in the views of both women and men.

Conclusion

The study reveals that modern “dendro-energy” plants can create enterprise opportunities for farm biomass production as well as generating clean energy for rural electrification. The impacts on the poor and women in these two cases depend primarily on how supply of the feedstocks is organized, but also on whether the local community receives the electricity supply themselves. In the commercial, grid-connected project, supply of biomass feedstock is handled by landowners and capital investors rather than by women who are the traditional suppliers of woodfuel. The community-level plant provides wider opportunities for women through the community organization and its focus on households supplying feedstocks for generating electricity for themselves. In this model, modern dendro-energy plants do have potential to provide a strategic means of reducing poverty while addressing women’s needs.

4.1.2. Philippines: Community-based micro-hydro and photovoltaic battery-charging station

Background

This case study carries out gender analysis of the impacts of two renewable energy systems in the Philippines:

- a community-based microhydro power system in an indigenous upland area of Tinglayan, Kalinga, implemented by NGOs; and
- a solar photovoltaic battery-charging system in Malitbog, Southern Leyte, implemented under the Barangay Electrification Project of the Department of Energy.

Both case study sites were excluded from the grid rural electrification programs of the local electric cooperatives or public/private power distributors, either because of the distances or due to rugged terrains.

The report documents the role of women in these renewable energy projects and their impacts on women in the areas of production, reproduction, and community participation.

Community micro-hydro plant in an upland indigenous area

More than 100 microhydro (1-99 kW) systems have been installed in the Philippines, mostly by government agencies, as a means of meeting electricity needs of remote communities. Community-based systems have had most success in the upland communities of the country, among indigenous peoples, with a tradition of cooperativism. A 33 kW microhydro power system was installed five years ago in Kalinga, one of the poorest provinces in the Philippines, with technical assistance by SIBAT, a technology NGO, assistance from EDNL (the church), and funding by KEEP of Japan. The Tulgao Farmers Association represented the community and undertook the operation and management of the project.

The study used qualitative methods to gather data: semi-structured interviews with men and women in households and key informants including women leaders; focus group discussions with women, men and mixed group; and a caselet on an indigenous woman who used electricity in her productive work.

Prior to the installation, lighting was primarily with pithwood, with only 40% of households even using kerosene lamps; a diesel generation gave limited operation. The community desired better lighting, cheaper and cleaner than kerosene, and a rice mill to lessen the workload on women and children of rice pounding. Indeed, the microhydro project now provides lighting and small appliance use to over 300 households as well as the church, school and health clinic. Two rice mills and a sugarcane press are also powered during the day. Less than ten percent of the households have invested in small appliances, mainly CD and TV, and use them as an income source by charging (mainly children) to see a video showing. The project is managed by a Board of Directors composed of 3 women and 4 men and managed by the pastor of the church.

The micro-hydro is believed by respondents to have had an impact on women's and men's economic roles, on their reproductive roles, on their health and well-being, and on their socio-cultural and political situation, as shown in table 8.

**Table 8. Impact of community-based micro-hydro plant on women and men,
Kalinga province, Philippines**

Economic impacts
<i>Economic impacts on women</i>
Women are the main farmers, agriculture does not benefit directly.
Rice bran from milled rice feeds pigs, women can undertake expanded pig raising.
Savings & increased income improve sense of stability in cash-poor households, especially for women in charge of budgeting.
One woman has tailor activity with sewing machine.
<i>Economic impacts on men</i>
Men are the main income earners – higher earnings from increased earnings from basket weaving in the evening.
<i>Economic impacts on the household/community</i>
Earnings from rice mill go to operators employed, church, community development fund and MHP project.
Savings from kerosene and pine pithwood for light.
Increase from less than 10 to 15 retail sari-sari stores (both m/f).
Impacts on women’s reproductive roles
Most important: Women and children save time on rice pounding, about an hour a day, results in more time for other household chores and farm work.
Work in fields and then complete household work at night, increasing workload for some. But women’s work at home easier “more work can be done with the feeling of satisfaction because work is more easily accomplished”, work early in the morning to prepare food.
Washing clothes is easier due to less soot from kerosene, save time and soap.
Impact on health, education & family life.
Reduction in respiratory and eye diseases, according to barangay health worker.
Family can “breathe” better because no more dark soot from pithwood.
Child delivery easier, especially as women give birth alone or with minimal assistance.
Increased access to news and info.
Children can read and study at night.
Family has longer time to sit and talk in the evening, bonding family members.
Impact on the environment
Less pine pithwood used for fuel.
Replanting project.
Increased appreciation of forests.
Impact on social-cultural and political situation
Abatement of warrior tribal conflicts between the Tulgao and DANanao tribes as direct outcome of the development and community-based nature of the MHP.
Meetings and festivities can be conducted in the evening longer.
Improved socialization and greater participation of women in community affairs, time freed.
Improved sense of peace and order, from street lights.
Negative: children resort to thievery to get cash or in kind cost required to watch a film; and may copy what they see (violence and sex).

Most community affairs involve both women and men, but women are mainly active in household, school and church decision making, while decision making on political and tribal conflicts is part of men’s traditional warrior role. Community labour for waterworks construction is traditional to men but in the MDP women – especially widows – shared in manual tasks such as hauling as well as in food preparation. Women did not participate however in planning, due to tradition and their long farm work days, though men did say that they consulted with their wives and tried to reflect their views.

Three out of seven officers of the project board are women, which is not typical but arose probably from women's active role in the church, which sponsored the project. However the male manager, the pastor, has the most important role in decision making. Women function as bookkeeper, cashier and in payment collection, while operation and repair is by men, who have received the technical training.

Photovoltaic battery-charging station in Southern Leyte

Under the Barangay Electrification Project, the Department of Energy has installed a solar photovoltaic battery charging station in two barangays as part of its drive for total barangay electrification by 2006, known as the O'Haw Program, which integrates all rural electrification efforts of the DOE. Barangay electrification had reached 89% by 2003. These two barangays can only be reached with four-wheel drive or motorcycles during the dry season. Raising pigs, chicken, cattle and vegetables, and producing single abaca twine and cut flowers are the main sources of livelihood.

Table 9. Impacts of PV battery charging station on women and men, Southern Leyte, Philippines

Impacts on women
Household tasks can be done at night – extend working hours to do household chores
More time to do weaving, sewing, etc. rather than sleeping
“Reducing idle time”, making blankets, helping husbands preparing seeds during planting time.
Motivating women to be more involved in more activities, want more trainings on livelihood activities, explore more projects to benefit them.
Impacts on men
More time to repair farm tools (extend working hours)
Impacts on children
Children perform their homework at night – better light for studying
Children spend more time at home especially after dark.
Impacts on households, community
Reduces anxiety over mischief and fire at night
Kerosene lamps now longer used in one barangay
Emergency situations can be responded to
Family bonding occurs
Barangay entertainment & ball games possible at night
Household needs increased as well as the needed funds by earning money to meet needs

Men were involved in assisting the supplier with heavy work in the installation, such as hauling materials and equipment; women prepared food for the workers. The utility operated the system. The tasks of collecting fees and monthly dues, and record keeping, were assigned to women. In the households, women were responsible for the operation and maintenance of the household system, deciding when to switch the light on and off, and caring for the battery by cleaning the surface and monitoring that the battery needed to be recharged.

4.1.3. Uganda: Solar home systems and solar-wind battery-charging station

Background

Electricity supply shortages in Uganda have led to a shift from public sector provision to collaborative and partnership ventures between the public and private sector, and an interest in using renewable energy to generate electricity. In two renewable energy projects, this case study

examines how energy service interventions can most effectively contribute to the process of empowerment of women as well as taking into consideration differences in needs for women and men; and the challenges that private sector energy service providers face in considering gender as a key change agent in their activities. The key finding is that a deliberate use of gender analysis and a specific gender strategy by solar companies and village banks can result in significant benefits for women as well as men, and support women's empowerment, especially if combined with support and encouragement to income generating activities.

Gender strategy

Both projects sought to involve the private sector, but the solar home system project, the Uganda Photovoltaic Pilot Project for Rural Electrification (UPPRE), had more government involvement. The solar-wind battery-charging project on the Bufumira Islands in Lake Victoria relied more on the private sector. The latter had explicit attention to the involvement of women, while the former did not.

The UPPRE solar home system project was undertaken to involve private companies, who were believed to be working more directly with energy users. Gender was realized to be one of the key elements for effective intervention, and capacity building in gender planning for energy service provision was included. A financial mechanism created linkages with micro-finance institutions and village banks that enabled access to credit by both female and male solar home system buyers. Solar companies were also facilitated with loans for scaling up their operations.

These financial and institutional mechanisms were replicated in the second project examined in the case study, a solar-wind project demonstration of electricity generation for battery charging, lighting for households and schools, fish preservation, and other uses of electricity in the Bufumira Islands.

The level of awareness about energy technologies was high among both men and women in the project areas, especially from radio/TV programs and from the local credit institutions. Households chose solar energy because they could receive more favorable credit than for the grid. Spouses often pooled their resources in order to make the 30% down payment and pay off the loan, and for some households this was a new way of working together. An analysis of household decision making shows that women's involvement in decision making about the solar energy interventions was greater than their involvement in general household decisions before the installation, perhaps for this reason.

Both men and women received training in maintenance, battery charging and usage; but most solar energy technicians were men as this was considered "a man's work." An area of conflict was the time of switching off the solar panel at night, since women's heavy workload meant that they wanted to use the TV and lighting later at night, while men had already finished their relaxation time and wanted the lights switched off to go to bed. Girls' education also benefited from keeping the lights on later (see table 10).

Table 10. Perceptions of benefits from photovoltaic systems in two sites in Uganda

<i>Benefits for women</i>
Lighting for cooking
Increased access to media programs
Several commercial enterprises set up such as 2 widow-owned shops using night lighting & refrigeration to attract customers, and 3 households providing battery and phone-charging services, jointly owned and operated by husband and wife.
Income gaps between men & women decreased, nearly equalizing their incomes (due to increased co-ownership and increased number of household income-generating activities).
<i>Benefits for men</i>
Lighting
Entertainment
Reading at night
<i>Benefits for children</i>
Academic performance of girls (number of pupils who passed first grade) improved, catching up with that of boys, attributed to the extension of the working day so that girls could complete their domestic work and still have light to study (compared with boys who did not have these domestic responsibilities and could study earlier)
<i>Benefits for households</i>
Inside house lighting
Reduced expenditures on transport for battery charging (as well as the risk of loss and damage during transport) in one site; and for paraffin [kerosene] and radio cells in the other site.
Reduced expenditures by men on outside entertainment & more time with family, so better family relationships.
Increased access to mass media on women's empowerment & income generating project ideas led to more household level income generating activities, often cooperatively by both spouses, which led to increasing trust and co-ownership.
Income activities increased & diversified. The improvement in reliability having the battery-charging at hand was important in business sustainability. Women used their increased income to improve housing.
Household health expenditures decreased for both men and women.
<i>Benefits for community</i>
School saved considerably in lighting expenditures
Village banks benefited by increasing their number of clients and share capital as well as earning "good public reputation and trust" and a role in other district financial projects.
Bank staff members were trained to educate female clients about savings, women's empowerment, and how to start up their own small income-generating activities and obtain credit, based on women's existing good credit payment record (of 51 defaulters, only 9 were women).

Changes in gender relations

This study highlights a number of changes in gender relations that took place after installation of the solar systems. It appears that women and men within households were encouraged to cooperate by the attractive credit opportunity presented of purchasing the systems, and the need to pool income in order to access this opportunity. In one site, for example, poultry keeping turned from a largely male-owned activity to a jointly owned and managed one, when electricity could be used for chick brooding. Men spending more time at home and watching TV together gave more opportunities for discussion of household issues.

In the battery-charging area, where a gender strategy was explicit, income-generating activities increased and diversified. Fishing with solar energy was by men, and most other household level activities were by women: shop/bar/eating place management, poultry keeping, piggery, hair dressing and craft making. Both men and women contributed start-up capital but women operated the enterprises as men were often absent. The improvement in reliability having the battery-charging facility near at hand was important in business sustainability. Women used their increased income to improve housing.

The solar systems were introduced using a deliberate gender strategy carried out by both solar companies and village banks, and women were explicitly targeted for information, training and employment creation. Thus the new energy service provided grounds for cooperation as well as conflict between women and men, and bargaining and negotiation was key in the households.

4.2. Gender and national energy policies

Two case studies examined gender aspects of energy policy: The first, in Himachal Pradesh, India, studies the impact of clean fuel access policy on women's empowerment; and the second, in four countries in East and Southern Africa, analyses the role of gender research in power sector policy.

4.2.1. Himachal Pradesh, India: Clean fuel access policy and women's empowerment

Background

This case study “examines the hypothesis that when women are given energy on a sustainable basis, they are empowered and freed from daily drudgery; they move ahead in human development indicators and find new ways to enrich life.” Himachal Pradesh is one of the four most advanced states in India in terms of transport, health and education infrastructure, but 93% of the population still relies on biomass fuels for cooking. H.P. has a specific policy to allocate 25 liters quota of clean fuels (LPG, kerosene) in hilly areas to prevent deforestation, compared with 5 liters elsewhere in India. So access to clean fuels for rural households is as high as 40% compared to only 7% in Rajasthan and Uttar Pradesh. The question is whether this policy has made an impact on gender indicators such as literacy, health and income?

Compared with India as a whole, H.P does have higher than average indicators of empowerment of women (female literacy rate, exposure to mass media, decision making power), and lower domestic violence, even though socio-economic conditions are poorer. Household durables ownership includes fans (60%), radio/tape recorder (52%), and kerosene stoves (49%).

Women's health and the energy system

In spite of the higher than average indicators of empowerment, women still bear the drudgery of cooking with traditional fuels. According to the sample survey of 712 households in 54 villages in 9 districts, women walk on average 30 kms per month and spend 40 hours during 15 trips averaging 2.7 hours each, to collect fuelwood. Fuelwood is the main cooking fuel with average consumption of 7.4 kg per household, mostly gathered wood; most households (67%) use a combination of firewood and modern fuels. An average cooking time of 3 hours 25 minutes per day was found.

In fuelwood collection, women cite health problems such as the physical strain of backache, bruises, head and neck ache, and encounters with snakes and wild animals; in fuel use, coughing and burning eyes. Households using traditional fuels are at twice the risk of reporting respiratory symptoms compared to those using clean fuels. Higher risk is correlated with higher age, illiteracy, low education levels, and low household income as well as with the number of hours cooked each day with biofuels.

The study also revealed a link between health impact and gender for various age groups: girl children below the age of 5 years and females aged 30-60 years (the chief cooks) are at higher risk of the effects of indoor air pollution than males in the same age group. Women above 45 years, even if they are not cooks currently, are most likely to suffer from respiratory diseases due to accumulated exposure in the past.

Why don't households use clean fuels?

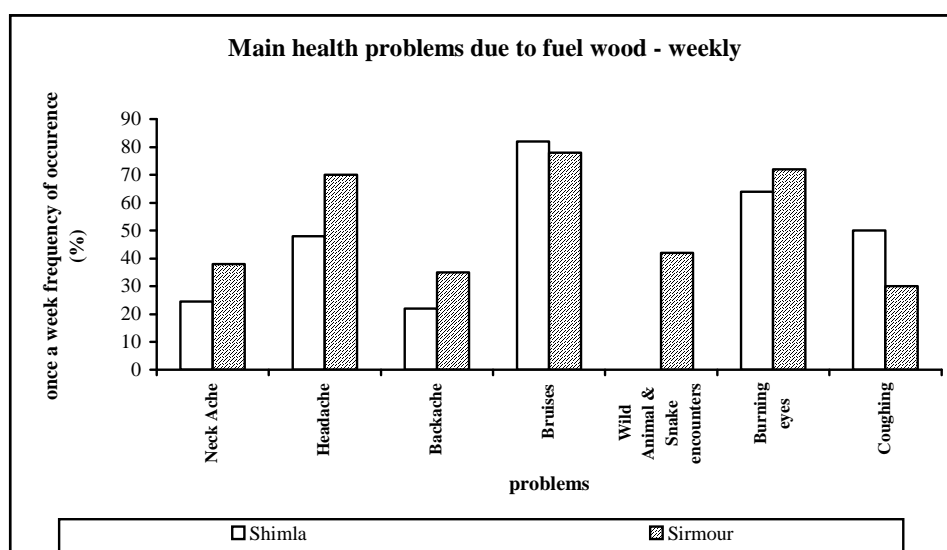
Despite good availability of kerosene through the public distribution system in H.P., and relatively wide ownership of kerosene stoves, multiple reasons were given for not using clean fuel: the most important by far (64%) is affordability, with concerns about safety second (22%) and availability a distant third (12%). Conjectures often made in the literature, such as concern about kerosene changing the taste of the food or preferring woodsmoke for its insecticidal properties, were not supported by the survey results. Though at least 49% have kerosene stoves, only 31% cook with kerosene. Higher income groups are more likely to use kerosene.

According to the state policy, families having no LPG cylinder are entitled to receive 20 liters of kerosene and families with one cylinder, 3 liters. A survey of kerosene oil depot retailers revealed their belief that in the rural area, Sirmour, households do not draw their full quota due to the availability of freely collected fuelwood, the distance from the shop, and the expense of kerosene. In the urban area, Shimla, they believe it is due to the presence of preferred LPG.

Gender and empowerment

A more in-depth sample of 80 households in two villages in two districts explored gender and empowerment aspects specifically. The main problem with wood fuel collection mentioned by respondents was the time taken, followed by searching and gathering and carrying heavy loads. In the urban area, Shimla, households had shifted to kerosene and LPG due to easy availability, time saving and cleaner households. In the rural area Sirmour, LPG is unaffordable, and distances to the depot are long over wildlife infested forests, so children cannot be sent to fetch kerosene and an adult male must go, were reasons given for not using these fuels. Figure 6 gives the main health problems due to fuelwood collection and use, in the rural area, Sirmour, and the urban site, Shimla.

Figure 6. Comparative graph of two districts of once a week frequency of occurrence of health problems, Himachal Pradesh, India



In answer to the research question originally posed, empowerment level and access to modern energy services are in fact correlated in Himachal Pradesh. Both of these are higher than the all-India averages. Even within H.P., the two districts with different access to fuels have correspondingly different levels of women's empowerment. But nonetheless, it is not possible to

conclude that better access to modern energy services has actually caused women's empowerment, which depends on many factors.

4.2.2. Eastern and Southern Africa: Power sector policy and the role of gender research

Background

Access to modern energy services in Eastern and Southern Africa is not only constrained by physical shortages but by unequal power relations between women and men, is the assumption of this regional study that reviewed energy policy documents and energy policy making processes in Botswana, Kenya, Tanzania and Zimbabwe to assess the gender dimensions. The study focused on the electricity sector and examined how gender research could best influence power sector policy making in Eastern and Southern Africa.

Power sector reform has arisen in Africa from dissatisfaction with poor technical and financial performance of state-owned electricity utilities and their inability to mobilize sufficient investment capital for the electricity sector's development and expansion. Little consideration has been made of the differential impact of reform on women and men. On the assumption that electricity is necessary for development, governments have tended to finance the power sector and, in many countries, subsidise electricity to keep prices low, although the benefits accrue to less than 30% of the population – mainly the urban middle and upper income groups and the commercial and industrial sub-sector. Household electrification in rural areas remains low.

Integration of gender analysis in energy policy?

A review of energy sector policy documents revealed that there appears to be a growing awareness among policy makers that the integration of gender analysis into power sector policy would enhance the electricity industry's contribution to sustainable development. Table 11 shows that there are a number of statements about women or gender in policy statements and measures in Botswana, Kenya, Tanzania, and Zimbabwe. However, this growing awareness is backed only by either vague policy objectives that are difficult to measure, or narrow, welfare-oriented policy objectives that are not integrated into any gender approach. Interviews with policymakers demonstrated that they either failed to perceive any need for gender mainstreaming or were just unfamiliar with gender issues.

Table 11. Summary of gender dimension of national energy policy documents

Country and Summary of Gender Policy	Number of Times Gender/Women is Mentioned	Number of Gender Specific Policy Statements/Measures
<u>Botswana</u> Strong statements of commitment to gender equity. Acknowledges women's roles and problems but no framework to address them.	Gender (5) Women (14)	Policy statements (1) Policy measures (1)
<u>Kenya</u> Strong statements of commitment to redressing gender imbalance. Limited educational and welfare goals planned.	Gender (6) Women (6)	Policy statements (0) Policy measure (1)
<u>Tanzania</u> Strong statements of commitment to gender equality. Welfare measures planned. Participation of women encouraged but not required.	Gender (11) Women (16) Female (1)	Policy statements (5) Policy measures (0)

Country and Summary of Gender Policy	Number of Times Gender/Women is Mentioned	Number of Gender Specific Policy Statements/Measures
<u>Zimbabwe</u> Limited mention of gender issues in energy documents. No explicit policy measures to address gender issues or women's interests.	Gender (0) Women (0)	Policy statement (1) Policy measures (0)

Source: Ministry of Energy, 2002; Ministry of Energy and Minerals, 2003; Ministry of Energy and Power Development, 2000; Ministry of Minerals, Energy and Water Resources, 2004

In general, policymaking in the energy sector in the region has been male dominated and has had little consultation with end users and producers, including women. The direct representation of women's interests by women users and producers as well as indirect representation by elected representatives, community based groups, non-government organizations, and researchers, is suggested.

Influence of gender research

Research, and especially gender research, has thus far had limited impact on power sector policy formulation. Indeed, major shifts in power sector policy in all four countries appear to have emerged out of political and ideological change rather than research. Some specific research influences were identified: In Botswana, energy policy documents cite research references, and consultant studies contributed; in Kenya, market research shed light on household electricity consumption; and in Zimbabwe, research was used to design efficient energy strategies.

Still, the potential role of gender research on power sector policy making could be considerably expanded. Gender researchers could have a more effective impact on the policy process if they plan a strategy based on a thorough understanding of external influences, national vested interests and attitudes, and windows of opportunity. Key messages need to be relevant, credible, convincing and well-represented; and appropriate links, alliances and 'chains of legitimacy' should be established between beneficiaries, gender researchers, NGOs, policymakers and other stakeholders.

A critical question for researchers is: What evidence is required to motivate policy makers to engender power sector policies, and for the actual process of gender integration? An important tool is the collection of gender disaggregated data. This needs to be country-specific, timely and relevant, and packaged and presented in appropriate ways.

Appropriate links need to be forged between different stakeholders before gender can be integrated into power sector policy. Women's representation needs to be improved, whether in the power sector directly, in associated task forces, in intermediate bodies, in scientific and technical institutions, and in policy making bodies. This can be done by formally including women's organization in power sector structures; by joining and nurturing networks that promote the integration of gender into the power sector; and by institutionalizing relationships between the power sector and gender researchers with legitimate links with women's organizations and/or women's stakeholders and can act as intermediaries in voicing their concerns.

4.3. Energy transitions and gender relations

Three case studies explored changes in gender relations associated with the transition to modern fuels: in China and rural Asia, changing cooking fuels in relation to the opportunity cost of women's labour; in an urban township in South Africa, in relation to gendered domestic roles and change; and in Europe and the United States, in relation to the gendered ideology of rural electrification.

4.3.1. China and Rural Asia: Gender relations and the energy transition

Background

This case study builds on the proposition that the low opportunity cost of women's labour limits the adoption of improved stoves and that women's entry into income-earning activities would promote a fuel transition. This is examined through fieldwork in 3 villages of the Mosuo community and 3 villages of the Naxi community, both in Yunnan, China. This is supplemented by other fieldwork in Laos, Vietnam and India, along with some available secondary material from the IDS (2003) EnPoGen study of 6 Chinese villages, and Nepal and other case studies in the UNDP (2001) volume.

Gendered responsibilities

The fieldwork shows that women's overwork in rural developing countries in Asia is derived from their gender responsibility for providing cooked food as a household public good. When the opportunity cost of men's labour is much lower than that of women (for example when women have income-earning opportunities that men do not), it promotes substitution of men's for women's unpurchased collection of fuel. Gender responsibilities are rigid but not completely fixed and they do respond to changes in the comparative economic position of women and men. But this does not promote a fuel transition. A fuel transition to (less unhealthy) fossil fuels is promoted by a situation where the household purchases its fuel requirements, as a result of which wood fuel becomes an inferior commodity.

The severely negative health effects of wood fuel and related biomass fuels (dung, crop residues) makes public subsidy for household adoption of cleaner, fossil fuels desirable. Subsidising the equipment cost of fossil fuels will not necessarily result in fuel switching by households that rely on non-purchased fuels, however.

Increasing the productivity of women's labour

The critical area of intervention is likely to be in providing commercial fuels for women's income-earning activities. Increased profitability would raise the opportunity cost of women's labour and hence the need to economise on women's (and household) labour, thus promoting the fuel transition process: the adoption of improved biomass technologies, the commercialization of wood fuel, and the switch to cleaner fossil fuels, with their attendant health benefits. The key factor is to increase the productivity of women's labour.

The Mosuo case study of a tourism-intensive indigenous village in Yunnan, China, for example, shows how the increase in productivity of women's income-earning labour with rising tourism led, after some time, to a complete rural fuel transition. When women's labour became a constraint, there was a switch to LPG for domestic cooking to save women's labour time. The sequence need not be first raising productivity and then saving fuel; but there should be an income opportunity that would justify the household investment in changing the fuel collection and use system. In a Nepal

case, the rural micro-hydro development programme reduced time in preparing and processing food; but the time saved could be used in a poultry business. It made sense to invest household income in buying a pressure cooker, since the time saved in cooking could be used in the poultry business, which more than compensates for the cost of the pressure cooker.

Similarly, the small diesel engine used to generate electricity in the “Multi-functional Platform” in Mali is used to increase productivity of income earning activities; this pays for the cost of the energy service. Both men and women could increase their production. Processing time was reduced and the recovery of the final product also increased. Women’s control of their own income from shea butter not only paid for the production energy use, but could pay for milling corn. Women could reduce their own burden and increase their rest. But all this depended on the higher productivity in income activities.

As women’s economic roles change, there is also likely to be a greater assertion by women of their role in household decision making. This has been observed in many micro-credit activities. Thus, higher productivity and income of women in the household is likely to be translated into an improvement in their conditions of acquiring fuel and cooking food (reducing workload, better health conditions).

A similar increase in household income through higher productivity and income of men only, is not likely to bring about a fuel transition. So long as women’s participation in income-earning activities is low, there will continue to be greater reliance on collected rather than purchased fuel and a rural fuel transition is unlikely to come about.

Energy indicators of well-being

Energy indicators can be used to assess the well-being of women, in ascending order, as shown in Table 12. Not only does women’s well-being rise when fuels are purchased rather than collected, but sharing cooking tasks with men and having access to cooking equipment are also indicators.

Table 12. Energy indicators of the well-being of women

Increasing women’s well-being	Energy indicators
1	Collected biomass fuels with conventional stoves
2	Collected biomass fuels with improved stoves
3	Collected biomass fuels with men sharing the labour of collecting fuel and preparing food
4	Purchased biomass fuels
5	Purchased fossil fuels and electricity, with the necessary cooking equipment (rice cooker, pressure cooker, etc.)

Public investment in energy and in women

In order to promote a rural fuel transition, the authors advocate for greater stress on investing public money in providing energy based on fossil fuel or electricity to increase the productivity of women’s labour in income-earning activities, rather than in public subsidy of domestic fuel consumption. The rural household fuel transition also depends on an increase in men’s labour absorption, so that lower-priced men’s labour does not simply replace higher-priced women’s labour in collection fuel. But the key factor is to increase the productivity of women’s income-earning labour in order to bring about a tightness in the use of women’s labour and thus induce a change in the household energy use system.

Hence energy policies should address gender asymmetries in capabilities, control and ownership of assets, and participation in community governance. Rural women need to learn new skills such as accounting, marketing managing an enterprise or knowing about various energy technologies and their operation and maintenance. This would create the conditions for rural women having the ability to demand, manage and use energy services. Regular interaction with women's energy networks and other women's organizations can be a powerful tool for generating self-confidence and increasing social visibility among rural women. This could lead too to a substantial increase in the proportion of women in energy use and management governance.

4.3.2. South Africa: Whose turn is it to cook tonight?

Background

This study is set in an urban area, in a township called Khayelitsha near Cape Town, where poverty, violence and unemployment are endemic. Since the new democratic order came to power in South Africa in 1994, there have been efforts made to deliver basic services to such areas, and an extensive electrification programme has seen 75% of the formal houses and shacks in Khayelitsha electrified on a pre-payment meter system. The other important change since 1994 has been the introduction of legislated gender equality with some machinery to enforce this.

This study uses cooking as the domestic chore that epitomizes traditional gendered domestic relations to explore the hypothesis that when women have access to modern energy services and can use these on a sustainable basis, they are freed from some of the daily drudgery associated with being a woman and are able to improve their own lives. The challenge is to determine the most effective leverage points: are women's domestic burdens relieved through meeting women's practical needs and reducing their physical burdens, or by shifting and sharing the gender division of labour within the household? If effected would these changes lead to a shift in power relations, thereby addressing women's strategic needs, or are women more effectively empowered through assistance to meet their productive needs and produce an income?

Gender benefits and impacts

The survey showed that electricity was the energy of choice of women and men for all purposes except space heating (where kerosene was preferred because of electricity's expense). Both women and men preferred to cook with electricity, with women showing a marked preference for stoves with plates and an oven, whereas men were satisfied with electric hotplates. Only 14% of households had made a full transition to using electricity for all their needs although 73% said they use electricity 'most of the time', while 86% still used kerosene, batteries and some wood during each month. A wide variety of appliances was found. More than 90% of households had electric lights, irons, kettles and televisions, 86% had electric stoves and more than 60% had fridges and paraffin stoves and lamps. Under 50% had washing machines, microwaves and music/dvd players.

Women said they buy small appliances without consultation, men buy televisions and large appliances, but such decisions are usually joint ones. Televisions were desired by both men and women for their own entertainment and to keep children at home and safe. Women used their fridges for income generating activities. Men said they tended to buy leisure appliances instead of tools to use for income-generating purposes. While they saw the lack of these tools as a constraint to setting up their own businesses, they said there were other constraints too, such as an unreliable electricity supply, customers who couldn't pay and the possibility of part time jobs. The energy contribution to informal income generation was difficult to measure and informal incomes do not appear to enable households to escape poverty.

Women manage electricity much as they managed kerosene and wood: they supply the money, they walk to buy credits for the pre-payment meters, and they are the heaviest users of electricity for cooking and ironing since they still do most of the chores. However in most households men assist with some tasks, most often cleaning the house, washing up, cooking or buying groceries and doing household maintenance. Everyone was thought to benefit from electricity, mentioning television, better education, improved health and safety as well as more leisure for men and women. Men seemed relieved to be able to use electricity to heat water for shaving and make their own tea and simple meals.

Table 13. Who manages the electricity, Khayelitsha township, Cape Town

	Who supplies the money	Who charges the meter	Who goes to the vendor (n=250)
Female	129	148	140
Male	111	96	104
PNE (This h/h is a vendor)	1	0	0
No answer	9	6	6
TOTAL	250	250	250

Source: Annecke, 2005

Gendered relations and responsibilities

Women do most of the chores and they are grateful that electricity makes these less burdensome. Most women enjoy doing the cooking, but they would like their efforts to be appreciated more, and 24% would like more help. Men see helping with domestic chores as a favour which they should be able to withdraw at will, but feel under pressure to help because women are earning the money and/or insisting that men share some of the work. Men blame the new constitution for promoting 'cheeky women' and for men losing the power and privileges that they had ten years ago. They complained that if they want to use the old ways of resolving differences (i.e. beating), their wives 'run to the police' who 'are very unsympathetic to men' and lock them up 'for nothing'. On the other hand battered women say they cannot do their chores or look after their children or engage in income generating activities when they are bruised, afraid and cannot think clearly. Domestic violence, particularly on the scale revealed in this study, undermines women's agency and empowerment.

Traditional stereotypes prevail in terms of technical competence, with the majority of women lacking confidence when it comes to simple tasks such as changing light bulbs and plugs. It is argued that more effort should be made by service providers to educate their customers.

There is significant anecdotal evidence of the health and safety benefits of electricity. The reduction in shack fires, burns and poisonings should be monitored to provide indicators of this. HIV/AIDS patients also benefit from electricity through having warm water and refrigeration for food and medication, and not having to breathe kerosene fumes.

Conclusion

The conclusion of this study is that access to modern energy services (in this case, electricity) can facilitate shifts in gender roles and responsibilities in the domestic sphere – if backed by serious institutional support for gender equality. The reasons for this are two-fold: firstly women know they have legal backing to assert their rights, and men are pushed by the legal system to accept this. Secondly, electricity makes it easier for men to perform domestic chores because they are not too burdensome or demeaning.

4.3.3. Europe and the US: Women's rural electrification

Background

In Western Europe, electrification was completed in the mid-1930s, while at that time only 10% of US farmers had access to the grid. Rural electrification was only begun in the 1930s and completed in the US in the 1960s. But while US electrification appeared to be two decades behind European electrification in terms of coverage, many American households got access to domestic electric services at least two decades before European ones. This experience has lessons for application in developing countries that are electrifying their rural areas today.

Government backing varied in Europe and the US. Rural electrification in France, a country paradoxically best known for its major public utility, was realized through private investment, then through public investment and private management, and was 95% complete at the time of nationalization. Small enterprises, local governments and NGOs played a major role in other European countries' rural electrification. In the US, the cooperative movement filled a gap that neither private nor public utilities of the day were interested in filling. The main initiative in both Europe and the US came from the local, decentralized level – the people who had the greatest interest in acquiring electricity.

The US experience had other lessons. First, the rural electric cooperatives showed that they could be more cost effective than the existing large private and public utilities and cut costs by 30-50%. Second they showed that the poor could pay. The US rural electric administration set up rules imposing minimum – not maximum – tariffs, at least 20% higher than those of the utilities, in order to protect the newborn rural cooperatives from local and political demagoguery.

Men's electrification in Europe versus women's electrification in US

European success in rural electrification came early, but was used mainly for lighting, radio and some farm equipment and did not raise much interest among farmers (unlike the arrival of piped water or domestic appliances after World War II, which were strongly welcomed). On the contrary, rural electrification in the US raised considerable enthusiasm, because it came with many services and changed farmers' way of life. Federal funding came not only to develop grids but to provide access to electric productive equipment and domestic appliances – and the latter quickly became the quicker and larger success. Rural electrification came 30 years later than in Europe, but quickly reached urban levels in the US and surpassed European ones. In the US, the household market potential was recognized early by marketing specialists and industry leaders.

While European governments focused on spatial expansion of electrification, the highly concentrated US electric industry gave priority to raising its load factor in both urban and rural areas, including through sales of appliances by its own companies. Minimum sales of electricity were needed to balance the accounts at the rural electric cooperatives and to pay back federal loans. Indeed, US rural electrification was mainly financed by soft loans while European electrification was heavily subsidized.

Furthermore, the European electricity business was always male-oriented: conflicts and compromises between public and private, central and local level executives, all men; even inter-war advertising of electric appliances was aimed at department stores and male retail resellers rather than female consumers. Women play an early crucial role in the US power sector development: as consumers but also as decision makers, executives and professionals in private industry and the cooperative movement.

An ideology for electrification

Home economics was a ready-made ideology for the electricity industry in the 20th century. Deprived of paid activities, women were to be converted to efficient managers of the domestic sphere. They would modernize the home, pave the way for dissemination of electric services and equipment, and so make electrification more cost-effective and profitable. The private sector organization NELA encouraged utilities to recruit women – especially home economists – to promote domestic uses of utilities. The public Rural Electrification Agency built up a female home economist team; imposed joint husband-wife participation in cooperative meetings and one-third women in rural electrification boards; and promoted women in federal and local high executive ranks. “Women power is the load factor.” This approach produced a rapid growth in load, as shown in the table 14 below.

Table 14. Diary of Elbert and Erma Cassel, Verden, Oklahoma electric cooperative members 1939-50

July 27, 1939	Signed for [cooperative membership]
June 1, 1940	Uncle Lark wire house
August 8, 1940	Got electricity:
August 26, 1940	Bought a washer
October 29, 1940	Bought a radio
January 6, 1941	Wired milk farm
July 25, 1941	Bought iron
September 19, 1941	Bought refrigerator
January 21, 1942	Wired Dutton church
December 3, 1942	Bought mixer, radio
December 31, 1948	Bought deep freezer
August 30, 1950	Bought sewing machine

Source Oklahoma Electric cooperative (2002), quoted by Wolman (2004) *The new deal for electricity in the United States, 1930-1950*

Appliances did give women better opportunities, when these became socially recognized, to enter paid work and community responsibilities, if only because it made it humanly possible to combine these activities with home management. Electric appliances may not have changed the nature of home work (there is little time gain, since each appliance generates new needs), but they relieved women of hard burdens and allowed them to work more efficiently in their homes. The modernization of household work allows a larger house, more clothes, and better educated children.

Implications for developing countries

This meaning of rural electrification seems to have been lost in Third World markets, where the old European model of prioritizing expansion with subsidies rather than the US model of high load, balancing finances, seems to be followed. Why shouldn't rural women have washing machines? Both rural women and electric utilities should have a common interest in promoting appliance ownership and higher load. Gender specialists and home economists have a role to play in this model of “women's electrification.”

4.4. Is gender a key variable in energy? Is energy a key variable in gender?

The eight case studies cover a diversity of energy technologies, policies, research approaches, and countries, in addressing the broad research questions posed at the beginning of the project about the relationship between gender and energy. Being case studies, they cannot answer the questions definitively, but they do offer interesting insights. Each question is addressed in turn below.

Gender as a key variable in energy: Do gender relations constitute a key variable in determining the impact of energy policy, programmes and projects?

The eight case studies approached this question in differing ways. Most agreed that gender relations – or attention to gender relations by an energy intervention – would influence project impact and success. But it was difficult to address this question as a hypothesis in an individual case study, because in most of the cases, no specific gender strategy had been used in the intervention under study, so the assumption could not be tested. However certain conditions can be identified where gender relations positively influence the impact of energy policy, programmes and projects.

A deliberate gender strategy

In the study of two photovoltaic sites in Uganda, the first PV project was implemented initially with no specific gender strategy but later adopted one; and the second had a deliberate gender approach through solar companies and village banks extending credit and training. The application of gender analysis and concerns by the service providers was found to be important in the success of the solar home system and PV and wind-battery charging station studied, in terms of impacts on poverty and gender indicators. The cooperative way that women and men pooled resources to take advantage of the favourable credit arrangements, meant that explicit targeting of women by the project provided benefits for both genders and the household.

Community-based organizations

In the Sri Lanka case, while no specific gender strategy was followed, women were able to participate actively through a community-based approach at one of the dendro-thermal plant sites, and this site was more successful in achieving poverty and gender benefits and sustainable production. Women are represented in the community organization, and play roles as producers and suppliers of feedstock to the bio-energy plant. As a result, both women and men perceive economic and social benefits from the plant. Some of the most important benefits involve building social capital and feelings of empowerment.

In the Philippines, even though men were traditionally dominant in decision making in the warrior society of the tribe, women's active participation in the church organization that sponsored a community-based micro-hydro plant was probably a principle factor in their representation (3 of 7 members) on the board of the energy project and in the choice of end uses: electrifying two rice mills provided the greatest benefits to women by saving time in rice pounding.

Hence, in these cases, gender relations both influenced and were influenced by the energy intervention. These impact studies emphasise the need to consciously address the participation, access and benefits of women, in order to realize the full benefits of new energy systems. In the Philippines and Sri Lanka, the energy projects were community-based, women were already active participants in the community organizations, and the energy intervention reproduced women's involvement in the energy project as well. In Uganda, only one solar project was community-based but in both solar projects, an explicit gender strategy was used to involve both women and men. So while current gender relations – whether within community organizations or not – can influence the impact of energy policy, programs and projects, it is also clear that gender strategies (or their absence) in energy interventions can either support or subvert positive impacts on both women and men.

Existing gender relations

In the PV-battery charging project in Southern Leyte, Philippines, women tended to represent the household in meetings while men were farming; and women had most other operations and maintenance tasks as well as collecting fees and keeping record. Men assisted in the heavy installation work while women prepared food. Gender relations are fluid in this society and both men and women share livelihood tasks; this is reflected in the organization of the PV project. The main benefit has been the extension of the working day, and both women and men have taken on more income-earning activities as a result; production and income have increased. Still, the desire to pay for more electricity is pushing households to use electricity for other sources of livelihood, but there are transport and marketing constraints.

In Himachal Pradesh, a subsidy strategy for kerosene and LPG has not been able to overcome existing gender relations in energy roles and responsibilities, with biomass cooking and its attendant health effects still prevalent in rural areas. In the rural area studies, women walk on average 30 kms per month and spend 40 hours during 15 trips averaging 2.7 hours each, to gather fuelwood. The main problem with wood fuel collection mentioned by respondents was the time taken, followed by searching and gathering and carrying heavy loads.

The study of villages in China and rural Asia suggests that existing gender relations strongly influence the type of energy and its use due to the gender division of labour; and that changes in gender relations may be necessary to secure a transition to cleaner fuels. So long as the opportunity cost of women's labour remains low, there will be little incentive to purchase commercial fuels and stoves. In rural areas where the productivity of women's income-earning labour improved – such as in the Mosuo case study of a tourism-intensive indigenous village in Yunnan, China – the need to economise on women's household labour arose, and there was a switch to LPG for domestic cooking to save women's time. Similarly, in the Laos villages, women's (but not men's) earning possibilities went up substantially with the commercialization of weaving, resulting in the adoption of mechanical milling as well as some substitution of men's for women's labour in wood fuel collection and even cooking. Importantly, the study finds that a similar increase in household income through higher productivity and income of men only, is not likely to bring about a fuel transition given existing gender relations.

Policy frameworks

A new legal framework on gender equality and domestic violence in South Africa has influenced gender relations including in energy roles and responsibilities in the urban township of Khayelitsha near Cape Town. Electricity makes it easier for men to perform domestic chores because they are not too burdensome or demeaning. But the shift has only occurred because there is serious institutional support for gender equality. Women know that they have legal backing to assert their rights, and men are pushed by the legal system to accept this.

In the AFREPREN/FWD study in eastern and southern Africa, researchers assumed that gender would be a key variable for success in the power sector and based their study of power sector documents on this assumption. AFREPREN/FWD researchers were surprised to discover little empirical evidence for this assumption available in the region, and determined as a result to gather evidence as a separate research activity, as a basis for further work. Still, a growing awareness was found among policy makers that the integration of gender analysis into power sector policy could enhance the electricity industry's contribution to sustainable development. There are a number of general statements about women or gender in policy statements and measures in Botswana, Kenya, Tanzania and Zimbabwe. However they are not backed by specific objectives or plans. They are oriented towards women's practical needs but do not go so far as women's strategic needs for

empowerment. Interviews with policy makers showed that they often were unfamiliar with gender issues and any need for gender mainstreaming.

Industry objectives coincide with women's interests

The importance of gender relations was in fact assumed in US electrification, according to the case study on industrial countries. Women were seen as natural marketing targets of electrification by utilities and rural electric cooperatives, and indeed domestic uses drove US rural electrification far more than did agricultural load from the 1930s-1950s. Investing in the kitchen and electrical appliances involved the family and women in particular in the consumption economy, since the electric home consumes more (refrigerated) food, washes and irons and buys more clothes, is cleaned more since it is well-lighted and so on. The “home economics” ideology gave women the task of home management and transforming family life, even more strongly postwar when women became seen by industry as the main vector of modernity. Rural areas participated in this push nearly as much as did urban. This was not the case however in most of Europe, where rapid expansion was emphasized pre-1930s to the detriment of load promotion to rural consumers, and the ideology of “domestic science” did not really catch on.

Energy as a key variable in gender: Do/how can energy interventions most effectively contribute to the process of empowering women?

The answer to the question of whether energy could contribute to the process of empowering women was a definitive “yes” in all the case studies.

Reduction of drudgery

In the three case studies (six sites in the Philippines, Uganda, and Sri Lanka) on impacts of renewable energy interventions, positive impacts were found ranging from time savings to economic and social empowerment. Similarly, from the urban township in South Africa to the hills of Himachal Pradesh and in the many sites analysed in China and rural Asia, women benefit from reduced drudgery, more time available, and better health when cleaner, more efficient fuels were used. This is similar to the experience in the industrial countries, though in Europe and the US, the eventual effect appears to have been to increase the quality of the family's life and ease of housework, rather than reducing time spent.

Reduction of drudgery is due to household appliances such as irons (Sri Lanka), rice mills eliminating pounding (Philippines, Laos), and generally the ease of use of modern fuels, especially electricity, which makes life more convenient (see below). This gives more time for other household, farm and income activities (Philippines), as well as leisure (South Africa).

Electric lighting and media

Electric lighting is appreciated largely because it is convenient and clean (Philippines, Uganda), but also safer than alternative sources (Sri Lanka). The extension of the day is an important benefit that allows women in particular to organise their day and household chores more efficiently (Sri Lanka, Philippines, US/Europe) – though it may mean longer working hours – and hence to participate in more social and economic activities.

Lighting is also seen as making it easier for children to study (Philippines). In Uganda, electric lighting had a specific impact on girl children's education, with first grade pass rates of girls increasing, because previously, by the time girls had completed their domestic chores, light was inadequate to study by.

Media was appreciated as a source of information and news (Uganda), as well as a means of leisure (Sri Lanka, Philippines). In Uganda and South Africa, men stayed home more to watch TV and families bonded, laying the basis in some households for business cooperation between spouses. Bonding family members was also seen as a benefit in the Philippines, when the family has a longer time to sit and talk in the evening.

Health benefits

The reduction of smoke in households was perceived as a benefit by previously kerosene-using households in Sri Lanka, Philippines, Himachal Pradesh. In Uganda, household health expenditures decreased for both men and women. In the South Africa township environment, reduction in shack fires and burns and poisonings, as well as benefits for HIV/AIDS patients of modern fuels, were considered important but perhaps would be better measured through public services authorities than by a household survey. In the US and Europe, women had more time to put a value on better hygiene, cleanliness and child care as households gained domestic appliances.

Cooking energy transition

In only three of the studies (Himachal Pradesh, South Africa, China and rural Asia), were cooking needs addressed directly by the energy interventions.⁴² In H.P., cleaner cooking kerosene and LPG are appreciated and relatively accessible but not always used, so long as woodfuel is freely available and clean fuels are considered “unaffordable”. LPG is preferred to kerosene but even less affordable. In the Yunnan and rural Asia studies, the choice of cooking fuel was found to be determined largely by the involvement of women in income earning activities and whether their time could be more productively used than in time-consuming traditional wood collection and cooking. A step-by-step transition was found, from collecting and then sharing collection and finally purchase of biomass fuels and improved stoves, through to purchase of modern fuels and appliances. In South Africa, cooking epitomizes traditional gendered domestic relations and these have shifted somewhat with more convenient energy source for cooking that men also use, but only because of the conjunction with strong support from a new legal framework on women’s rights. Even so, and in spite of their working and earning significantly compared with men, women still do most of the chores. This also continues to be true in the industrial countries, according to the study on rural electrification in Europe and the US.

Effects on income

Economic benefits begin with the reduction of expenditures on more expensive fuels like kerosene (Sri Lanka) as well as savings on transport to charge batteries (Uganda). However livelihood opportunities from the new energy sources were quickly exploited by many women and men, including providing feedstocks to the energy plant (Sri Lanka), starting village and home-based industries using the improved energy source (Sri Lanka, Uganda, Philippines), and being able to work longer and intensify agricultural and traditional activities due to the extension of the working day (Sri Lanka, Philippines). The rural Asia study also found that the existence of business opportunities could spur investments in saving women’s labour, such as the purchase of pressure cookers or fuel-switching. Being able to pay the electric bill was a motivation to use electricity for livelihood activities in the Philippines. In the US rural cooperatives, investing in home appliances was a motivation to earn and save.

In Uganda, income gaps between men and women decreased, nearly equalizing their incomes, due to more joint co-ownership and a higher number of household income-generating activities. These

⁴² In Uganda, cooking was perceived as made easier by better lighting.

were encouraged too by mass media programmes about women's empowerment and ideas for income generating projects.

In the Sri Lankan case, the impacts on the poor and women in the two cases depended primarily on how supply of the feedstocks is organized, but also on whether the local community receives the electricity supply themselves. In the commercial, grid-connected project, supply of biomass feedstock is handled by landowners and capital investors rather than by women who are the traditional suppliers of woodfuel. The community-level plant provides wider opportunities for women through the community organization and its focus on household supplying feedstocks for generating electricity for themselves. In this model, modern dendro-energy plants do have potential to provide a strategic means of reducing poverty while addressing women's needs.

Negative effects

That energy interventions could also have negative effects on women, was shown in the other Sri Lanka case, the grid-connected dendro-thermal project. Here, men dominate the supply chain of feedstock, and their decisions on biomass supply have marginalized women from their traditional roles. Men reap most of the benefits of the stocks maintained by women on family lands and also the labour opportunities for preparing and selling feedstock to the plant. Women have low interest in the project, since it does not contribute to local energy needs nor to food production. Landowners with larger farm holdings have benefited most as suppliers, whereas the poor with small farms and the landless have not been involved in providing feedstocks. Thus while electricity is produced for the grid the contribution of this intervention to alleviating poverty and empowering women is insignificant.

Social capital and empowerment

Building social capital and empowerment were frequently unintended side effects of reduced drudgery, improved lighting, and economic participation by women (Sri Lanka, Philippines, Uganda). Participation of women through community organizations was an important feature in Sri Lanka and the Philippines, enhanced by their time being freed up. Women had important roles in maintenance (Philippines), in bill collection and record keeping (Philippines), and even in decision making (Philippines). They received training (Uganda) and built up managerial skills and other competencies (Sri Lanka). The rural Asia study found that as women's economic roles change, there is also likely to be a greater assertion by women of their role in household decision making about energy as well as in other areas. As the opportunity costs of women's and men's labour change, there can be many opportunities to renegotiate gender roles within the household (e.g. shared responsibilities, women's attendance at meetings, timing of meals), as many micro-credit schemes have shown.

In the US and Europe, investing in the home – and specifically in the kitchen, a new phenomena – meant investing in the family and in women in particular. Being able to work more efficiently in the home enabled women to maintain their position as home manager while still working outside the home – though with some stress.

Community benefits

Women shared in community benefits as well. Street lights provided an improved sense of peace and order in the Philippines, and lighting makes it more easier to respond to emergency situations. In both the Philippines and South Africa, electric media played a role in keeping children at home after dark, particularly a concern in the dangerous urban township near Cape Town. Lighting for ball games and festivals also promoted safe community activities (Philippines).

In Uganda, a significant side effect was that village bank staff members were trained to educate female clients about savings, women's empowerment, and how to obtain credit and start up their own small income-generating activities.

Causality

All of the case studies on impacts faced the issue of causality in documenting all of the impacts mentioned. Some hypotheses, such as that indicators of higher empowerment of women in Himachal Pradesh than in other states of India would be related to women's better access to clean fuels in that state, could not be proven in a causal way. H.P. has a policy to allocate 25 liters of clean fuels (LPG, kerosene) in hilly areas to prevent deforestation, compared with 5 liters elsewhere in India. So access to clean fuels for rural households is as high as 40% compared to only 7% in Rajasthan and Uttar Pradesh. Himachal Pradesh does have higher than average indicators of empowerment of women (female literacy rate, exposure to mass media, decision making power) and lower domestic violence, even though it is one of the poorer Indian states. But a direct causal relationship between access to clean fuels and empowerment is difficult to show.

Conditions for positive impacts on women

Positive impacts of the energy interventions on women were found in all the cases, ranging from time saving and drudgery reduction, to income generation, to social and economic empowerment; these impacts could be negative as well as positive however. Positive impacts on women were more likely to be found in the following instances however, where:

- A deliberate gender strategy was followed in project planning and implementation (Uganda);
- The policy environment supported energy policies and programmes favorable to women's needs (South Africa, Himachal Pradesh, eastern and southern Africa);
- A community-based organization in which women already actively participated was involved in the project (Philippines, microhydro site; Sri Lanka, decentralised site); or
- Existing or changing gender relations in the society valued women's labour and favored women's equal participation in the energy intervention (Philippines, PV battery-charging site; Mosuo, Yunnan).
- Industry objectives coincided with women's interests (US rural electrification).

Thus both hypotheses turn out to be related: where gender relations (or attention to gender relations) are a key variable in energy interventions, it is more likely that energy will have a significant impact on gender equality and indeed on household and community poverty as well. Where energy interventions address (or at least do not discourage) women's equal participation, the potential for benefits is much higher.

5. Strengthening gender-sensitive energy policy research in the new millennium: A checklist

A major goal of the DfID/ENERGIA research project was to push forward analytical frameworks for understanding and measuring linkages between gender, poverty and energy, that would be credible in both gender/poverty and energy terms. As important, a specific objective was to increase and strengthen gender, poverty and energy research in key developing country institutions, and to partner and coordinate research. Both of these goals required not only research, but a process to bring together both gender and energy policy researchers and thinking. The intent was to move forward with the capacity to provide both gender-sensitive policy and operational research in order to improve energy project design and policymaking.

This chapter gives a checklist for gender-sensitive energy research, consisting of four critical elements:

- Partnerships and a process for experts on gender and experts on energy to work together;
- Linking research to policy by understanding the gender-energy-poverty nexus;
- Using appropriate research frameworks and methods from gender and from energy research; and
- “Asking the right questions” about gender, energy and poverty.

There is no “ideal” gender-sensitive energy policy research framework. However these four elements provide our experience on what gender-sensitive energy policy research looks like.

5.1. Partnerships and process: The Collaborative Research Group on Gender and Energy (CRGGE)

Partnerships and a peer review process were key to creating an effective dialog between gender researchers and energy researchers that could develop new ways of working on gender, energy and poverty research. A central part of the ENERGIA/KaR research project was the creation of a Collaborative Group on Gender and Energy (CRGGE), made up of leading researchers, institutions and networks from Kenya, Uganda, South Africa, Senegal, India, Sri Lanka, the Philippines, the US, France, the UK and the Netherlands. Researchers included both women and men, and both energy researchers (with an interest in gender and poverty) and gender and poverty researchers (with an interest in energy), who had shown a long-term commitment – through the ENERGIA network – to policy research on gender and energy. The goal was to create a safe but challenging space to share experiences, give and receive mentoring, and contribute to the project research process through their own research and case studies. A key element in this effort was the engagement of the CRG in an active dialog to “speak the same language”.

How the research was organized and carried out was thus as significant as the substantive findings, and constituted an important learning experience in “what does gender-sensitive energy policy research look like?” Partnerships and capacity-building were pursued in a number of ways. Technical backstopping was provided throughout by the Principle Investigator with assistance from other senior researchers, and ENERGIA provided a supportive institutional base and networking support for the CRG. Two physical meetings allowed in-depth interaction and discussion.

At the inception meeting for the project in Cape Town in May 2004, some of the leading exponents presented analytical frameworks on energy and sustainable livelihoods, on energy and gender analysis, and on feminist political ecology, and their pros and cons for gender-sensitive energy research. CRG members reflected on the presentations made on the analytical frameworks, and identified elements that they would like to explore in their respective case studies. Possible

measurable, indicators of gender equality, data collection approaches, and themes were also mapped, and research questions reformulated. A proposed framework for research was developed as a joint activity. At the second meeting in Nairobi in May 2005, researchers reported on which research approaches and methods had been most useful in their case studies, and the analytical framework was further refined.

Case study proposals were prepared by eight CRG members and discussed and revised at the inception meeting. Promising junior researchers were engaged to participate in the case studies and in the preparation of the MDG review papers, with backstopping by senior researchers. A listserv and email linked the group between the two meetings. Peer review by CRG members of all project research outputs contributed both to improved research outputs, and perhaps as important, to sharing of thinking and ideas within the CRG. Each research output was reviewed by three to five other members of the CRG in writing; at the review meeting, a panel of two researchers commented on and led discussion about each paper.

The group evaluation at the review meeting emphasized that the collaboration should continue, with cautious expansion of membership to Latin America and the Caribbean. The way of working together was greatly appreciated, in particular the peer review process and the access to other experts. Meeting once a year as a group was considered essential.

All the CRG group members were already closely involved in national, regional and international networks and advocacy, including as government advisers, so research findings and experience could be integrated in their ongoing work. For example, for AFREPREN/FWD, the research experience enriched the AFREPREN/FWD Gender and Energy theme group; several researchers from utilities and government participated in the research team. In India, research by several CRG members was used as the basis for a presentation to the Energy Policy Committee of the Planning Commission, to bring gender aspects of energy into the planning cycle. APPROTECH-Asia, as GVEP secretariat in the Philippines, brought findings into the action plan under development. CRG members presented findings in national and international workshops for policymakers, and publicized work on their institutional web sites.

Many other advocacy, dissemination and capacity-building activities were proposed by CRG members but would need to be resourced, for example, the training of energy engineers in Philippines, India and Malawi; a toolkit for engendering energy policy; and panels at international workshops. More than twenty research and exchange partnerships were proposed at the review meeting, and CRG members hope to continue to work together on these.

5.2. Linking micro research to macro policy level: the gender-energy-poverty nexus

Many studies on gender and energy have been at the micro and household level, descriptive of women's problems and obstacles. While valuable description and documentation of women's plight, this information has not always been related to specific policy issues of relevance to energy policy in the country. An important question has been how to link micro and household-level research on gender and energy to the macro level where energy policy is developed and implemented. Gender itself needed to be differentiated within the energy system, so that the different realities faced by poor, middle income, and richer women, or by women in different ethnic and age groups, could be analysed.

Linking the micro level description and analysis of gender and energy issues with critical and current energy policy concerns for the governments, utilities and other big players in the country or region was fundamental to the CRG approach. Gender-sensitive energy policy research started by describing the gender-energy-poverty nexus in the country or region, in order to inform both the

policy research, and the research questions. The background and historical poverty-gender context needed to be understood, as well as the energy supply, consumption and policy situation in the country, by first reviewing literature on both gender and on energy, and building on past research in these two (or three, including poverty research) areas. Then these were related to one another, to make clear how energy policy is influencing and could be influenced by the poverty-gender challenge.

The intersection of gender, energy, and poverty varied widely in the case studies. Women's drudgery in the traditional energy system was common to all however. The studies focus on energy policy interventions that may have potential for change in women's position. In both the Philippines and Sri Lanka, decentralized rural electrification has been adopted by the government as a strategy to provide electricity in rural areas. Women have traditional roles in the energy systems that are affected. In Uganda, a deliberate gender strategy in the provision of solar home systems was of interest to study. The differential impacts of decentralized electricity generation projects on women and men in these three case studies suggest approaches that would be more likely to ensure benefits for both women and men as well as project effectiveness.

In the China and rural Asia case study, investment in cooking energy systems is related to changes in the opportunity costs of women's and men's labour in a number of villages, and proposals made for facilitating the transition to modern fuels. In the study on rural electrification in Europe and the US, lessons from the industrial country experience are used to suggest how to involve women successfully in electrification in developing countries.

In South Africa, the new legal rights of women under the new constitution, have opened avenues for the energy transition to modern fuels in urban slums, to change gender relations in domestic roles including cooking. In the four countries of eastern and southern Africa, the question was how gender research had and could better influence power sector policy; analysis of power sector reform showed little involvement of women despite the differential impacts on women and men. In India, a state was selected for study where biofuels were prevalent in cooking energy consumption, affecting women's time and workload, and in order to arrest deforestation, an aggressive kerosene and LPG distribution policy had been adopted. Would this increase women's empowerment?

5.3. Combining research frameworks and methods: gender *and* energy

Clearly, the three frameworks for gender-sensitive energy research introduced at the beginning of the study (gender analysis, sustainable livelihoods, and feminist political ecology) overlap considerably. After exploring their usefulness in the case studies, the CRG suggested which frameworks and approaches proved most useful in their own research. What particular or additional insight does each provide?"

Gender analysis

Gender analysis was the most used framework for analysis in all of the case studies, drawing on IFAD-UNIFEM gender mainstreaming principles (Kelkar & Nathans, 2005) and other sources (Kabeer, 2003). Although this seems obvious, disaggregation of data by gender (men and women, boys and girls) has not routinely been used even in some gender and energy studies. Energy and poverty research usually prioritises poverty with gender as a subset. Treating gender as a separate category of analysis focuses attention on the subordination of women. Basic principles of gender-sensitive research such as interviewing women as well as men, and use of female as well as male enumerators to gather information, are also not always systematically followed. So the importance of gender analysis bears repeating.

Gender analysis methods start by gathering data about the gender division of labour and women's access to and control over resources and benefits. Such information can be a starting point for determining women's practical welfare needs and to help energy projects identify how women can be instrumental in making energy projects more effective, by marketing energy technologies or being involved in technology design, for example. Other gender and poverty perspectives that proved useful in the case studies were differentiating between rich and poor women (rather than treating women as a homogeneous category); distinguishing between participation and actual benefits; the differential impact of energy technologies and policies on women and men; and analyzing both women and men's roles and perceptions.

Sustainable livelihoods

Sustainable livelihoods framework, it was agreed, helps to focus attention on energy for women's productive uses, and their control over assets, and the earlier work on gender, energy and sustainable livelihoods was useful to our work (Clancy et al, 2003; IDS, 2003; Masse, 2003; Matly, 2003; Meikle, 2004; UNDP, 2001). Livelihood asset analysis, human and social capital, livelihood strategies and outcomes, vulnerability context, and analysis of policies, institutions and processes were concepts that were used in many of the case studies and seen as strengths of the sustainable livelihoods framework for energy policy research. The researchers also found it useful for poverty and gender experts to take a fresh look at energy issues, as outsiders. Sustainable livelihoods was found to be weak though in understanding women's reproductive roles, and the interactions between reproductive and productive labour that may be mediated by energy access; and this may be because SL is not systematic in using gender analysis tools including time allocation study and intra-household analysis. Combining elements of sustainable livelihoods with gender analysis proved more effective.

Feminist political ecology

Feminist political ecology relates the gendered use of natural resources to institutions, policy, and macro-economic systems (Rocheleau, Thomas-Slayter & Wangari, 1998; Joekes and Leach in Jackson and Pearson, 1998). This framework was found to be a more general application of gender analysis; but some elements were taken for use in specific case studies as relevant: The intersection of the reproductive and productive economy in energy use and supply, gendered space in the kitchen, and gender-based asymmetrical entitlements to energy resources, were found particularly relevant in the energy sector. Other concepts from feminist political ecology that were used by some researchers were relating North-South issues; the impact of large economic and social systems on localities; the realignment of rural-urban spaces; women's collective struggles; and the value of local knowledge.

Quantitative versus qualitative methods

CRG researchers used a wide variety of tools and methods, which are listed in table 15. Most important in all of the studies were policy and institutional analysis, the use of both qualitative and quantitative data, and the inclusion of people's perceptions.

Table 15. Some useful tools and methods in the CRG case studies

Literature review
Interviews
Case study analysis
Country comparisons
Gender as an analytical tool
Time budget, time use study
Resource links
Gendered space
Transects
Questionnaires
Focus group discussions
Observations
Multi-sectoral, stakeholders input
Baseline survey, secondary data
National policies on gender, energy, environment
Story-telling at night

Balancing quantitative and qualitative methods and tools produced useful results in the case studies. While quantitative evidence was believed to be more important in convincing policymakers, some CRG researchers thought that more understanding of the “why and how” was gained from in-depth interviews and focus groups.

Multidisciplinary research teams

The importance of drawing on a range of methods from a number of disciplines through the use of interdisciplinary teams was evident to the group, but this was not always successful in the case studies. In particular it was felt essential that research teams included both gender specialists and energy specialists. But case studies were sometimes weak in terms of their economic and financial analysis on the one hand, and their energy analysis on the other. This would need to be strengthened in future research.

Some of the case studies showed how important insights could be gained from analysis of the energy supply chain, in addition to the more usual end use analyses in gender and energy research (e.g., analysis of biomass feedstock supply in Sri Lanka, kerosene depots in India).

5.4. Asking the right questions: opportunities for transformation

Establishing the CRG partnerships and process; studying the gender-energy-poverty nexus and identifying the intersection between the specific gender challenges in the country or region (the needs of women, the policy environment, the causes of poverty and livelihood opportunities), and current energy policy questions; and choosing appropriate research frameworks and methods, were important steps towards gender-sensitive energy policy research. These led the CRG to focus on what the group concluded was the most critical function of their research: Asking “the right questions.”

Initial research questions

Framing appropriately the research question on linkages between gender and energy was the subject of much discussion at the inception meeting. Does gender have an impact on energy? Does energy have an impact on gender? These basic formulations needed considerable definition. *Gender*

relations, it was decided, would be a better term than *gender equality*, to define the term *gender*. Initially, researchers hoped to relate *attention to gender* to project *success*; however definition of both *attention to* and *successful* was seen as difficult. The ultimate objective of energy project success would be people improving their well-being and getting out of poverty. One side of our research would be: ***Do gender relations constitute a key variable in determining the impact of energy policies, projects and programmes?***

Looking at the other side of the coin – whether energy could be a key variable in improving gender equality and empowerment – also required definition. Energy was seen as an input but not a sufficient condition for women’s *empowerment*. Indicators for women’s empowerment could be women’s visibility, participation, economic, social and political inclusion. Some other elements suggested to consider were both men’s and women’s perceptions, family, community, investment and attitude to the future, the politics of hope and aspirations, time availability and leisure, and socializing. These indicators imply that women not only play their roles more efficiently (which could trap them in these roles), but also are enabled to negotiate a way out of their traditional roles. Interventions that are solely technological energy interventions are unlikely to be able to do this. For energy interventions, especially important indicators of women’s empowerment could be women’s perceptions on time gains and leisure; their unmediated access to modern energy services and in particular ownership of energy assets; and the enabling of social networks through energy access for example by media and telecommunications. In terms of the MDGs, enabling access to education by women and girls, improving access to paid work, and increased voice and participation in national and local level are also important indicators of women’s empowerment.

Hence the following question was proposed as a way to approach assessing gender as a key variable: ***How can energy interventions most effectively contribute to the process of empowering women?***

Leading to “asking are the right questions”

What are the “right questions? The two initial research questions on gender-energy linkages were broad. There was no clear topic, rather the focus had to be drawn from the gender-poverty-energy context in the country, region and/or institution or network. This was both difficult and stimulating. By struggling with how to frame the policy and research problem in their own context, CRG researchers contributed to developing a set of “right questions” that can be an agenda for gender-sensitive policy research in the future, questions about:⁴³

- Evidence about impacts on women and men of energy projects and changing access;
- Rhetoric gap between policy and practice on gender and energy;
- Culture and ideology in gender relations in energy; and
- Political economy of change in gender and energy.

Evidence about impacts on women and men

Evidence is needed about the impacts of energy transitions, projects and policies on women and men, boys and girls. This gender-sensitive “research” should be an operational part of every energy project’s monitoring and evaluation design. Have energy projects or better access improved the well-being of women as well as men? Have they met women’s welfare and practical needs? Have they gone beyond this and transformed gender relations in the household, community and/or national level? Has energy had an impact on gender equality and women’s empowerment?

⁴³ Govind Kelkar and Andrew Barnett in particular contributed to distilling these questions at the CRG review meeting.

Measurable quantitative and qualitative evidence as well as case studies and models of success and lessons of failure are needed. Furthermore, more understanding is necessary of the conditions under which impacts are positive or negative: both conditions over which implementing energy agencies have little control – such as culture, land rights or the status of women – and conditions which they *do* control, such as credit and institutional arrangements, skill building and information access, and hiring of staff, as part of their energy policy and operations. We have some examples for guidance, but each energy project needs to understand in its own context the points where energy policy and project design can “make a difference” in improving both energy project effectiveness and gender relations.

CRG case studies in the Philippines, Sri Lanka and the Philippines found both positive and negative impacts on women of the decentralized energy installations studied. They suggest some of the conditions under which women can benefit from such energy projects, and strategies that can be effective.

The technologies covered in the CRG studies were however limited (solar home systems, dendro-thermal energy, micro-hydro, and PV-wind battery-charging). Some important areas, such as gender issues in mechanised/motorised transport, have not been addressed at all in this study. And, most importantly, the scale of the projects was mostly fairly small. Many of the “successes” are community-based, or women’s energy enterprises supported by donor projects rather than market-oriented.

Impact studies are needed to cover a wider range of energy technologies and in particular to examine larger-scale operational projects. Based on what we know now, efforts need to be made to scale-up successful approaches to involving women through community-based projects and women’s energy enterprises, and to operationalise gender in conventional energy projects. These efforts need to be solidly implemented and well-documented. Up to now, there are few good models of gender-sensitive approaches in large-scale or mainstream energy projects, that practitioners can draw on and replicate.

Rhetoric gap between policy and practice

Exposing the gap between energy policy rhetoric and the reality of women’s lives is a critical function of gender-sensitive energy policy research – do energy budgets, policy statements and project practice reflect women’s needs? Do poverty documents such as PRSPs reflect the reality of women’s energy situation?

Energy budgets for example have been shown to emphasise power generation and oil and gas, while skimping on household energy. Gender audits can show whether women’s needs are included and where investment of public money is needed. Recognising gender equality at a policy level is a first step, to be followed by institutional change.

Poverty programs tend to neglect energy. Is this because women’s energy needs are not being made visible?

The collection of gender-disaggregated data was found in the CRG research to be the single most powerful and essential tool in being able to provide evidence to policymakers to motivate them to engender energy policy, as well as for the actual process of integrating gender into energy planning and implementation. In the CRG case study in eastern and southern Africa, an examination of policy statements and interviews with policymakers showed that gender issues were not being reflected in the power sector. In India, a pro-women clean fuels policy in one state was examined to see whether it did indeed improve women’s well-being and empowerment.

Culture and ideology in gender relations

What are the ideologies that influence gender relations and women's empowerment in the energy sector? That is, what are the reasons behind changes in gender relations and how does energy access affect or how is it affected by these changes?

These issues were explored in two case studies. In the China and rural Asia case, gendered labour relations and the relative opportunity costs of women's and men's labours were seen as determining factors in the cooking fuel transition. In South Africa, new legislation on women's rights – and its enforcement by police – made up part of the picture that enabled the energy transition in an urban township to change gender roles in domestic chores.

Questions were raised in the case studies and the MDG review papers, about sexual violence, sexual harassment, and power relations in the household and society in relation to energy security. The South Africa paper proposed looking at women's "emotional security" as an indicator of well-being. Some evidence from CRG research suggested that lighting and media could affect family bonding and gender cooperation in the household and reduce violence. Talk of human rights and democracy is "in the air" and pervade much discussion about MDGs and the future of developing countries. These could profitably be brought into gender and energy discussions.

Political economy of change in gender and energy

What are the "Drivers of Change" (a label that DfID has given to research on the political economy of change) in gender and energy? What incentives and disincentives face the various participants, and how can these be modified? What political power relations are involved between the various factions? What coalitions or alliances for "pro-poor" and "pro-women" change can be effective in the energy sector?

Who is likely to support pro-women energy policy and who opposes it? Why does the state (or elements within the state) want to improve the role of women? Why would a power utility want to respond to women's needs? In terms of research methods this might lead to the need to examine the concerns of the opposing factions and to "put our work in their language". In terms of policy impact, gender and energy researchers and advocates need to be active participants in direct and formal energy decision-making processes and structures. Networks such as ENERGIA and other women's networks and organisations can help nurture a "new deal" for women in representation in the energy sector. Bringing men on board will be key to their accepting gender equality in the energy sector as elsewhere.

In the DfID case study in Europe and the US, the rural cooperative electrification movement in the US was successful partly because of an alliance between the interests of power utilities the interests of power utilities to manage the load factors on their systems and the interest of women in end use technology that met women's needs for energy service. Similarly, if women are more reliable managers of money, utilities would benefit from enabling women to gain control over energy purchases, and credit related to the purchase of appliances. An element of this research approach might be to consciously link the research to key government policies. Involving women more effectively may be one way to reduce the public cost of infrastructure programmes.

In all four sets of research questions above, the "potential for transformation" is the critical element. A bargaining model of the household and society is assumed in the gender analysis, with both conflict and cooperation analysed as important forces. Property relations, social relations, labour relations, and decision-making relations are important at the household, community and national

level. Possibilities for women to change their power and position through negotiation are explored. What is the potential for transformation of gender roles in any energy transition or project? That is the fundamental question in gender-sensitive energy policy research in the new Millennium.

Annex: List of documents, DfID/Energy Kar Research Project R-8346 on “Gender as a Key Variable in Energy Interventions: Are We Asking the Right Questions?” (<http://www.energia.org/dfiddocs/index.html>)

Background paper

Cecelski, E. (2004), Re-thinking Gender and Energy: Old and new directions, ENERGIA/EASE Discussion Paper.

Case studies

Anneck, W. (2005), Whose turn is it to cook tonight? Changing gender relations in a South African township.

AFREPREN/FWD (2005), Engendering Power Sector Policy In Eastern And Southern Africa.

APPROTECH-Asia (2005), Gender And Renewable Energy in the Philippines: Community-based Hydro in Kalinga and PV-Battery Charging Station in Southern Leyte.

Kelkar, G. and D. Nathan (2005), Gender Relations and the Energy Transition in Rural Asia.

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Parikh, J. (2005), The Energy Poverty and Gender Nexus in Himachal Pradesh, India: The Impact of Clean Fuel Access Policy on Women’s Empowerment.

Sengendo, M. (2005), Institutional and Gender Dimensions of Energy Service Provision for Empowerment of the Rural Poor in Uganda.

Wickramasinghe, A. (2005), Gender, Modern Biomass-Energy Technology And Poverty: Case Study In Sri Lanka.

MDG empirical review papers

Dutta, S. (2005), Energy as a key variable in eradicating extreme poverty and hunger: A gender and energy perspective on empirical evidence on MDG #1, draft.

Panjwani, A. (2005), Energy as a key variable in achieving universal primary education: A gender and energy perspective on empirical evidence on MDG #2, 2005.

Panjwani, A. (2005), Energy as a key variable in promoting gender equality and empowering women: A gender and energy perspective on MDG #3, draft.

Matinga, M. (forthcoming), Energy as a key variable in reducing child mortality: A gender and energy perspective on empirical evidence on MDG #4.

Matinga, M. (2005), Energy as a key variable in reducing HIV/AIDS and major diseases: A gender and energy perspective on empirical evidence on MDG #6.

Cecelski, E. (2005), Energy, development and gender: Correlations and causality.

Meeting reports

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