Capacity Development for Scaling Up Decentralized Energy Access Programmes

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Capacity Development for Scaling Up Decentralized Energy Access Programmes

Lessons from Nepal on its role, costs, and financing

Elisabeth Clemens, Kamal Rijal, Minoru Takada
with contributions by Adonai Herrera-Martinez, Megha Shukla

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Photo credits – front cover: Functional Group Meeting at Chhahare Khola Micro-Hydro site showing powerhouse, penstock, and forebay; and woman using improved cook stove in hills of Nepal. Credit: AEPC/Energy Sector Assistance Programme (ESAP).

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Foreword

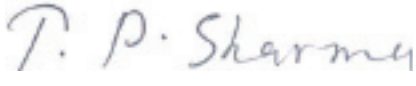
The Ministry of Environment of the Government of Nepal and the United Nations Development Programme are pleased to have collaborated on this important study, which presents lessons from Nepal concerning the role of capacity development in increasing access to modern energy services for rural and remote communities.

Nepal is graced with immense water resources and potential for micro-hydropower development. Over the past decades, this abundant source of energy has helped hundreds of thousands of Nepalese people in rural areas overcome barriers to economic development, empowering them to build a better future for themselves and their communities.

Similarly, the development and dissemination of improved cooking stoves designed to emit less smoke and burn fuels more efficiently, has improved health, enhanced the quality of living conditions, and saved time and labour for millions of people in Nepal.

These remarkable achievements were made possible by the vision and hard work of many dedicated Nepalese, as well as long-term commitments and support from the Government of Nepal, UNDP, the World Bank, DANIDA, and other development partners. Their joint efforts have enabled Nepal to develop highly effective national programmes that have been successfully scaled up to bring clean, modern, decentralized energy technologies to rural communities throughout the country. The models established by these programmes have provided a sustainable approach to improving living conditions and achieving economic development for thousands of poor people.

It is now our privilege to share sustainable energy lessons from Nepal in some detail, in order to inform the development community about how this was accomplished. We hope that this report will inspire other developing countries to plan and budget for their own rural energy initiatives to help rural communities break free from poverty and isolation and achieve progress towards the Millennium Development Goals.



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Preface

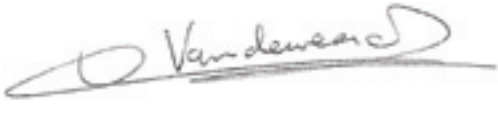
Reaching the world's three billion energy-poor people is often regarded as a particularly daunting aspect of meeting the twin challenges of development and climate change. Yet, experience has shown that decentralized options are technically feasible for delivering basic modern energy services for the poor and can be financed and delivered with negligible impact on the climate. The challenge now is to make it happen at scale and at speed to accelerate achievement of the Millennium Development Goals.

The following report looks at a fundamental step in putting an end to energy poverty: enhancing the capacity of countries to deliver modern energy services to the poor in remote, rural areas. The reality on the ground is that many countries face significant barriers in attracting needed investments in energy technologies and systems that can provide modern, clean, and affordable energy services for the rural poor. These countries need support to help them elaborate policies and strategies, identify technology and financing options, and build institutional capacity to deliver modern energy services.

The report takes a close look at capacity development activities in the context of two national programmes that are successfully delivering modern energy services to poor men and women in remote rural areas of Nepal. The analysis demonstrates the central importance of these activities in the successful scale-up of rural energy access. It documents the costs of capacity development activities, their significant share in overall programme expenditures, and the crucial necessity of fully accounting for these costs in programme planning and budgets.

The authors show that, while considerable upfront public investment is needed to develop local and national capacities for scaled-up rural energy service delivery, once made these investments can attract substantial financing from private sources at later programme stages. Indeed, for the two programmes studied, the contributions of households, communities, and other private sources often made up a significant portion of the overall financing needs.

UNDP believes that the challenge of eliminating energy poverty is surmountable and can be achieved in our lifetime. This report provides vital insights into concrete measures that can help countries develop the capacity to expand clean, affordable energy services to those who are not served today. We look forward to continued dialogue with national governments and other development partners as we join forces to make universal access to modern energy services for poor men and women a global reality.



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Acronyms and abbreviations

ADB/N	Agricultural Development Bank of Nepal
ADDCN	Association of District Development Committees, Nepal
AEPC	Alternative Energy Promotion Centre
CBO	Community-Based Organization
CD	Capacity Development
CM	Community Mobilizer
CMC	Community Mobilizer Coordinator
CO	Community Organization
CRT/N	Centre for Rural Technology, Nepal
DANIDA	Danish International Development Agency
DCC	District Coordination Committee
DDC	District Development Committee
DEA	District Energy Advisor
DEC	District Energy Committee
DEES	District Energy and Environment Section
DKK	Danish Kroner
DEEMC	District Energy and Environment Management Committee
EDO	Energy Development Officer
EEG	Environment and Energy Group
ESAP	Energy Sector Assistance Programme
FG	Functional Group
GoN	Government of Nepal
ICS	Improved Cooking Stove
kW	Kilowatt
LDO	Local Development Officer
LPO	Local Partner Organization
MHFG	Micro-Hydro Functional Group
MHS	Micro-Hydro System
MoE	Ministry of Environment
MoF	Ministry of Finance
MoFSC	Ministry of Forest and Soil Conservation
MoWCSW	Ministry of Women, Children and Social Welfare
NAVIN	National Association of Village Development Committees in Nepal
NGO	Non-Governmental Organization
NOK	Norwegian Kroner
NORAD	Norwegian Agency for Development Cooperation
NPC	National Planning Commission
NPD	National Project Director
REDP	Rural Energy Development Programme
REDS	Rural Energy Development Section
RESC	Rural Energy Service Centre
SNV	Netherlands Development Organization

SO	Support Organization
UN-DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
VDC	Village Development Committee
WB	World Bank
WDO	Women's Development Office

Summary

This study examines the role of capacity development in scaling up energy service delivery in rural and remote areas of developing countries. It presents an analysis of field experiences from two successfully scaled-up national programmes in Nepal – the National Micro-Hydropower Programme and the National Improved Cooking Stoves Programme. Specifically, the study applies UNDP's Capacity Assessment Framework to evaluate the programmes' capacity development efforts with regard to key functional and technical capacities. It also analyses the costs and sources of financing for capacity development.

This analysis of capacity development in the context of decentralized energy access programmes is intended to assist policy makers in addressing the challenges of energy poverty. Close to three billion people lack modern fuels for cooking and heating, while one and half billion people still live in darkness, over 80 per cent of them in South Asia or Sub-Saharan Africa. Moreover, two million deaths annually are associated with the indoor burning of solid fuels in unventilated kitchens. We cannot be effective in reaching the Millennium Development Goals – reducing poverty, ensuring food security, addressing gender inequality, improving health and education, and also making the transition to environmentally sustainable, climate-resilient communities – without taking concrete action to provide poor men and women with access to modern energy services.

The main findings of the report are summarized here.

Capacity development is central to successful scaling up of rural energy access programmes

Decentralized energy-access plans and budgets often do not adequately take into account the capacity development activities required for adoption of off-grid energy technologies by poor and rural populations, especially in areas where traditional delivery mechanisms, such as central utilities, are limited by geographical remoteness and small and/or fragmented markets. In such circumstances, national governments, local authorities, private entities, civil society organizations, and communities, all need substantial guidance regarding assessment of opportunities, mobilization of financing and resources, and design, implementation, and monitoring of energy access programmes.

Key capacity development efforts for the two Nepal programmes have focused on: (1) planning, oversight, and monitoring; (2) policies and regulations; (3) situational analysis; (4) stakeholder dialogues, communication, and community mobilization; (5) setting up and enhancing institutions; (6) training programme implementers and community members; and (7) implementation and management. Developing capacities in all these areas is essential for making the scale-up of rural energy access a reality.

Capacity development costs represent a significant portion of the overall costs of decentralized energy access programmes, especially in the initial stages, and must be fully taken into account in planning programme budgets.

Capacity development costs amounted to well over half of the total programme costs for both the Nepal programmes. Total programme costs for the Micro-Hydropower Programme over the study period (i.e., 1996–2006) were USD 14.3 million (at USD 110

per beneficiary, on average). Capacity development costs represented 56 per cent of the total costs. For the Improved Cooking Stoves Programme, total costs were USD 1.5 million between 1999 and 2004 (at about USD 2.6 per beneficiary, on average). Capacity development costs accounted for 68 per cent of the total.

Reductions in per-unit programme costs over time were driven by progressive declines in capacity development costs. For the Micro-Hydropower Programme, the total programme cost per installed kW fell by 73 per cent between 1996 and 2006 (from more than USD 17,300 per kW to about USD 4,600 per kW). During that period, capacity development costs were reduced by 84 per cent, while hardware costs fell by only 33 per cent. Trends were similar for the Improved Cooking Stoves Programme: the cost per stove fell by about 60 per cent during the study period (from USD 27 in 2000 to USD 11 per stove in 2004), with a decline in per-unit capacity development costs of 70 per cent, compared with a reduction in hardware costs of only 20 per cent.

Upfront public investments are needed to develop national and local capacities for scaling up rural energy services delivery, and can catalyse private financing

For both the Nepal programmes, funding from public sources played a dominant role at the very beginning (well over 90 per cent), much of which was dedicated to capacity development. The share of public financing gradually declined to about 50 per cent at a later stage, suggesting that the pivotal role of public investments in developing national and local capacities subsequently attracted private financing.

Following the publicly financed capacity building, communities and households made significant contributions to implement rural energy systems and pay for the energy services. Communities provided cash, took out bank loans, and supplied in-kind labour contributions, for example by digging channels and collecting sand, stone, and wooden poles for micro-hydropower systems. These contributions often made up a significant part of the overall financing needed for micro-hydro systems.

Scaling up of decentralized energy access programmes to meet their full potential is financially within reach, particularly with greater participation from the private sector

The total investments needed to meet the full potential for the Nepal programmes are financially modest. Estimates made by this study suggest that for the Micro-Hydropower Programme, reaching the target of an additional 150 MW by 2030 would require an additional investment of about USD 435 million (about USD 70 per beneficiary). The Improved Cooking Stoves Programme would require a total investment of USD 18 million (about USD 1.70 per beneficiary) to deliver an additional 2 million improved stoves by 2030. Of the total investments required, the estimated public investment needed to catalyse private financing would amount to about USD 200 million (or USD 30 per beneficiary) for the Micro-Hydropower Programme, and USD 7 million (or only USD 0.70 per beneficiary) for the Improved Cooking Stoves Programme – modest sums in view of the large economic development benefits that can be expected from significantly expanded access to modern energy services.

It is expected that private funding will gradually account for a greater portion of the overall investments. For both programmes, it is estimated that private funding sources

could make up about 60 per cent of future funding needs, compared with the 30–40 per cent that has been the average to date. Encouraging a greater participation of the private sector requires promoting productive uses of energy services even more, in order to help raise people's incomes and encourage other activities that yield large development benefits. As has been proven in the Micro-Hydropower Programme in Nepal, productive uses of energy can spark rural economies and significantly increase the chances of attracting private investments, including microfinance. New financing sources, such as carbon financing, could also play an increasingly important role, especially for disseminating improved cooking stoves.

The analysis of these two energy programmes in Nepal indicates that scaling up rural decentralized energy programmes is a long and challenging process. Proactive steps taken by the government of Nepal, such as the establishment of a dedicated agency to lead and coordinate rural energy programmes, made scaling up a reality. Clearly, public investments in capacity development by the Government of Nepal and its partners have been critical to strengthening local and national leadership and creating conditions for successfully scaling up its energy access programmes in rural areas.

CHAPTER 1

Introduction

Context and objectives

To reduce poverty and achieve sustainable development, access to basic modern energy services[1] in rural and remote areas of developing countries must be expanded. Meeting the Millennium Development Goals (MDGs) will require major improvements in the quality and quantity of energy services available to poor men and women in the developing world. Without access to clean, reliable, and affordable energy services, substantial social and economic development simply cannot occur.

Investment in capacity development both at the national and local level is a prerequisite to improve and ensure sustained efforts to expand energy access in developing countries. This is particularly true when energy access programmes target poor and rural populations through off-grid energy technologies, where traditional delivery mechanisms, such as central utilities, are highly constrained to take on these challenges due to geographical remoteness and small and/or fragmented markets. In such circumstances, more innovative delivery mechanisms are needed, where a variety of local actors – including local authorities, local private entities, civil society organizations, and communities – necessarily play a central role in delivering energy services to people. Since their capabilities are highly uneven, it is imperative to provide substantial capacity building to help them assess opportunities, mobilize finance and in-kind resources, and design, implement, and monitor energy access programmes. In addition, governments need to have adequate capacity to set national visions, facilitate political commitment, and establish enabling policies, regulations, and incentives, which are required to ensure greater participation of private actors in rural energy access programmes.

Taking action on decentralized energy access programmes cannot proceed without massive capacity development efforts. Yet, experiences show that development planning and programmes for decentralized energy access often do not take capacity development needs sufficiently into account in programme planning and budgeting. Addressing this problem requires an evidence-based analysis that is intended to inform policy makers on the roles, costs, and financing of capacity development in the context of decentralized energy programmes in developing countries, an endeavour that heretofore has not been undertaken in a comprehensive manner.

The purpose of this report is to contribute to increased understanding of the role of capacity development in scaling up programmes aimed at expanding access to modern energy services in rural and remote areas of developing countries. This first-of-its-kind analysis examines the role, costs, and financing of capacity development in the context of two successfully scaled-up programmes that are delivering energy services to remote, rural developing-country populations.

It aims to address such questions as:

- What types of capacity need to be developed to scale up decentralized energy access programmes for rural populations?

- What is involved in doing capacity development well?
- How much does developing capacities cost?
- What level of investment and involvement is required from the public and private sectors – now and in the future – to scale up energy-service delivery in rural areas?

It is hoped that this study will provide a foundation for future analytical work in this area, feeding into the next level of thinking on the role of capacity development, and that it will be complemented by additional, future research from other countries and on other programmes to further advance the development community's understanding of capacity development.

Scope of this study

This analysis is a case study based on field data obtained from currently implemented decentralized energy programmes on the ground. It examines the role, costs, and financing of capacity development for two national programmes that are successfully delivering rural energy services in Nepal – the National Micro-Hydropower Programme, where this study examines the micro-hydro systems[2] implemented by the Rural Energy Development Programme (REDP), and the National Improved Cooking Stoves Programme, where this study examines the improved cooking stoves implemented by the Centre for Rural Technology, Nepal (CRT/N). They were chosen for several reasons.

First, these are highly regarded programmes that are often held up as examples for other countries to emulate. They have had notable success in expanding access to modern energy services as well as improving utilization of existing traditional energy sources in rural Nepal, and they have proved to be sustainable over time.

Box 1. Energy access and enabling conditions in Nepal

Nepal is a small, landlocked, mountainous country, located between the world's two most populous countries, China and India. It has a population of 29 million, with about 30 per cent of the population living below the national poverty line. Currently, Nepal's Human Development Index is 0.553, giving it a ranking of 144th of 179 countries.[3]

Nepal has one of the world's lowest rates of per capita electricity consumption, with an average of 86 kWh annually. Some 88 per cent of the population relies on traditional biomass fuels for cooking and heating, and only about 40 per cent of the rural population has access to electricity.[4] Many remote areas with rugged mountainous topography are forecasted to be without electricity access through 2010 or beyond.

Yet, Nepal is rich in water resources. Untapped hydropower potential totals about 83,000 MW, of which some 43,000 MW are economically viable for development.[5]

Enabling conditions already in place:
Nepal has been engaged in efforts to expand access to modern energy services in its remote, rural areas for several decades, and has already taken many steps to create an enabling environment for the further expansion of such access. These steps include: enactment of a rural energy policy in 2006; development of a rural energy subsidy policy; establishment of national, district, and community rural energy funds; and exemption of micro- and mini-hydropower systems (up to 1,000 kW) from certain taxes, royalties, and licensing requirements.

Both programmes were established after decades of experiences: the development of micro-hydropower systems (MHS) has been underway in Nepal since the 1970s, and programmes to promote the use of improved cooking stoves (ICS) were first rolled out in the 1980s, as part of the national Community Forestry Programme, aimed at reducing deforestation. These programmes have each benefited from the long-term commitment of both the Government of Nepal and external donors.

In addition, both programmes have well-audited cost data, available over suitable timeframes for the analysis of capacity development costs and their relationship to overall programme costs and outputs.

For more details on the energy access situation and institutional and policy-enabling capacities in Nepal, see Box 1.

Overview of Nepal's National Micro-Hydropower Programme

Nepal's National Micro-Hydropower Programme aims to enhance rural livelihoods through the promotion of rural energy technologies, primarily using community-managed micro-hydropower systems (MHS) as the entry point for holistic development and poverty reduction. The primary actor in this national programme is the Rural Energy Development Programme (REDP), under the Alternative Energy Promotion Centre (AEPC), an autonomous organization within the Ministry of Environment.

Launched in 1996 as a pilot in five districts, with financial and technical assistance from UNDP, REDP was replicated in five additional districts in 1998. The programme scaled up again in 2000, adding five more districts, for a total of 15 districts. In 2003, the World Bank joined UNDP as a partner organization in providing financial assistance to the Government of Nepal and the AEPC for replicating MHS activities in an additional 10 districts. By the end of 2006, the programme covered a total of 25 districts.

Between 1996 and 2006, the programme installed some 185 MHS, totalling almost 2,500 kW. These systems reached 24,000 households, or 130,000 beneficiaries (see Figure 1).

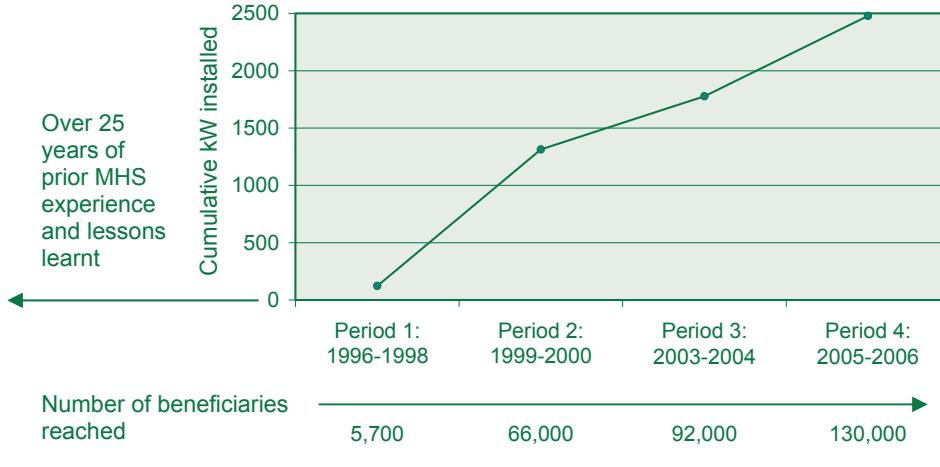


Figure 1. Cumulative power (kW) installed by REDP and the number of beneficiaries reached during the period analysed

Using MHS as an entry point, the programme also installed other rural energy systems (see Table 1), including toilet-attached biogas plants (more than 4,000 by the end of 2006), solar home systems (more than 2,000 by the end of 2006), and improved cooking stoves (almost 10,000 by the end of 2006).

Table 1. Total number of energy systems installed by REDP as of December 31, 2006

Rural Energy Systems (as of December 31, 2006)	Total
Micro hydro schemes	185 (2477.2 kW)
Toilet attached bio-gas plant	4,022
Solar home systems	2,119
Improved cooking stoves	9,795

Since September 2007, the programme has focused on scaling up further to cover a total of 40 districts, with support from the Government of Nepal/AEPC, UNDP, and the World Bank. As of December 2009, the programme had installed a total of 267 MHS, with a combined capacity of more than 4,453 kW. This constitutes about 1 per cent of all installed hydropower in Nepal; for systems of 5–100 kW, the programme accounts for some 40 per cent of the national total.

The programme plans to be present in all 75 of Nepal's districts by 2012, and the MHS capacity installed by the programme in 52 districts is anticipated to grow by a further 6,000 kW, supplying electricity and mechanical power to some one million people.

The programme has also taken advantage of the Clean Development Mechanism (CDM) market in order to generate additional revenues that can be funnelled into energy projects. A proposed CDM project (yet to be registered) is aimed at mobilizing carbon financing to install a total of 15 MW of new MHS capacity, of which REDP would contribute 6.5 MW. An Emissions Reduction Purchase Agreement (ERPA) has been signed between AEPC and the Community Development Carbon Fund (CDCF)/World Bank, enabling CDM revenues to help meet unfinanced programme implementation costs.

REDP practises a holistic development approach, featuring a community mobilization process based on six fundamental principles commonly known as *Mul Mantras*. These principles are: organization development, skill enhancement, capital formation, technology promotion, environment management, and vulnerable community empowerment. Key elements of the approach include:

- *Community mobilization* to encourage and support them in undertaking productive activities resulting in strong social capital, economic growth, and environmental sustainability. In order to sustain the micro-hydro systems as well as to ensure equal ownership, community people are motivated and encouraged to undertake various social, economic, and environmental activities. Even the poorest of poor households are made capable to own, use, and pay a tariff for the electricity consumed, like any other household.

- *Broad-based participation* to ensure transparency and a consensus-based decision-making process by all households of the community, irrespective of caste, creed, sex, or economic status. Various incentives and interventions are used to ensure participation and equal benefit-sharing.
- *Support for institution building* to help District Development Committees (DDCs) through the creation of District Energy and Environment Sections. This helps institutionalize bottom-up participatory planning and management of the rural energy sector, in line with the Local Self Governance Act.
- *Training* for local NGOs, community groups, and the private sector to strengthen their technical and managerial skills to deliver and manage micro-hydro systems and energy services.

For more details on the institutional arrangements for REDP, see Annex 1.

Overview of Nepal's National Improved Cooking Stove Programme

Nepal's National Improved Cooking Stove Programme aims to increase access to modern cooking devices for the poor. The programme was proposed in 1998 by the Centre for Rural Technology, Nepal (CRT/N), a non-governmental organization (NGO) dedicated to developing and promoting 'appropriate rural technologies to meet the basic needs of the rural communities and improve their life support system'. Joining with CRT/N in the proposal was Nepal's Department of Women's Development, as well as other NGOs and community-based organizations (CBOs). Technical and financial support were provided by the Energy Sector Assistance Programme (ESAP)[6] and funded by the Danish International Development Agency (DANIDA) and the Government of Nepal (AEPC).

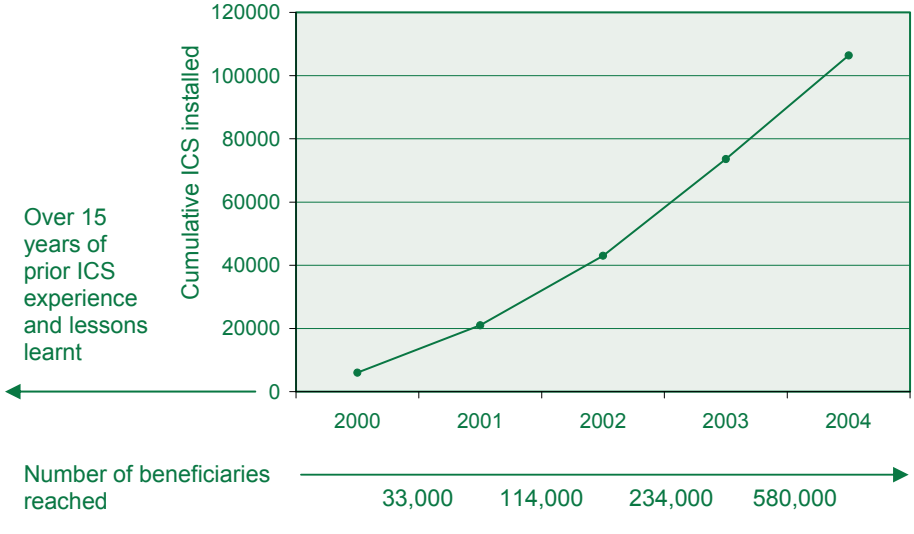


Figure 2. Cumulative number of ICS installed by CRT/N and the number of beneficiaries reached during the period analysed.

CRT/N was the primary programme implementer during the period analysed in this study. Programme formulation and planning were carried out in 1999, followed by the programme's launch in 2000 in five pilot districts. In 2001, four more districts were added. Further scale-up took place in 2003, adding another 11 districts, for a total of 20 districts by the end of 2004.

In 2005, CRT/N changed its business model and transitioned from being primary implementer to training other NGOs to implement. Thus, the years covered by this analysis include 1999 through 2004. During this period, CRT/N installed more than 106,000 ICSs, reaching nearly 572,000 beneficiaries (see Figure 2).

CRT/N is currently engaged in designing a new type of stove that uses briquettes for fuel as well as providing training on the manufacture of more fuel-efficient briquettes. It is also participating in a registered carbon offsets programme with The Offset Carbon Company (TOCC), based in the United Kingdom. Under an agreement with TOCC, CRT/N worked with local partners and promoters[7] to install 1,500 ICSs beginning in June 2007. The total project grant was about USD 18,100,[8] and estimated carbon reductions are 1.75 tons CO_2 equivalent per ICS, or more than 2,600 tons of CO_2 equivalent overall.

Methodology for data collection and analysis

The study was carried out over a period of two years. First, an analytical framework was developed and field-based data collection was carried out. The data were reviewed, verified, and carefully analysed. These activities have entailed dedicated time and effort from individuals from AEPC, REDP, CRT/N, and UNDP, as well as national and international consultants, who conducted extensive field missions, desk reviews, and discussions between 2007 and 2009.

The process involved six key steps: (1) development of a framework for data collection; (2) data collection and review; (3) categorization of cost data; (4) development of a timeline of analysis; (5) analysis of costing data; and (6) analysis of financial data.

Step 1: Development of framework for data collection

The data collection framework developed for this study encompasses the costs of all the activities and hardware needed to implement each of the programmes analysed. These costs include project expenditures as well as the value of in-kind contributions, for example, the contribution of labour from community members to dig canals for MHS installation. The framework was developed through a series of consultations with national stakeholders, including AEPC, UNDP, REDP, and CRT/N staff members (see Table 2).

The final framework specifies that for each item of expense, data are collected and recorded on: the annual cost expenditure (or value of in-kind contribution); the level at which the cost was incurred (community, district, or national); and the sources of financing. For each year, the number of beneficiaries, households, villages, and districts reached are noted, as are the number of units (i.e., MHS or ICS) installed.

Table 2. Framework for collecting data

Activity/ hardware	Type	Area of focus	Year 1 cost	Year 2 cost	Etc	Financing source
e.g. Awareness-raising and community mobilization at household level by female and male promoters.	Capacity development	Stakeholder dialogue, Communication & community mobilization	Cost (Nepalese Rupees)	Cost (Nepalese Rupees)		e.g. AEPC
e.g. Generator	Hard cost	Hard cost	Cost (Nepalese Rupees)	Cost (Nepalese Rupees)		
Etc. …						
Number of districts reached			X	X	X	
Number of villages reached			X	X	X	
Number of households/ beneficiaries reached			X	X	X	
Number of units installed			X	X	X	

Step 2: Data collection and review

Once the data collection framework was established, data were collected from AEPC, REDP, and CRT/N. These data and other pertinent information covered the period from programme inception through to the most recent audited data. For non-monetary costs, the value of the item was estimated. For instance, the value of in-kind contributions of labour by community members was estimated by multiplying the average daily labour cost for the year by the number of days required to complete an activity and the number of community members.

As data were collected, activities that had been previously overlooked were added, and activities that were relevant to several activities were broken up or removed to avoid double-counting.

Step 3: Categorization of cost data

All cost data gathered and reviewed in step 2 were then categorized as either hard costs (such as equipment, transport, construction, installation, etc., including value of in-kind contributions) or capacity development costs (cost of 'software' required to implement the programmes).

For the MHS programme, hard costs include electro-mechanical machinery, civil engineering, transportation, and turbines (see Annex 5 for more details).

Capacity development costs were then further categorized according to seven different functional and technical capacities required for the successful implementation and scale-up of programmes delivering decentralized energy services. These functional capacities were adapted from UNDP's Capacity Assessment Framework (see chapter 2 and Annex 3 for further details).

Step 4: Development of a timeline of analysis

A timeline for analysis was established for each programme.

For the National ICS Programme, data were analysed on an annual basis. This is appropriate for the ICS programme, which centres on a relatively simple technology that is rather quickly installed. This means that there is a good match between the year in which costs are incurred and the associated output for the year (i.e., number of ICS installed; number of beneficiaries, households, villages, districts reached, etc.). In other words, installed output occurs in the same year as the investment in capacity development and hardware.

The analysis carried out for this study covers the period between 1999 and 2004, when CRT/N was still scaling up ICS installation. (In 2005, CRT/N changed its business model from primary implementer of the ICS programme to trainer of other NGO implementers; hence, data from 2005 and later are not included in this analysis.)

For the National MHS Programme, data were analysed for four multi-year periods. Analysis of annual data would not be appropriate for this programme because of the complexity of the MHS technology and the longer timeframe required for its installation in a given village or district. It takes a number of months, and as long as two years, to realize an output (i.e., installation of MHS; number of beneficiaries, households, villages, districts reached) from a given investment in capacity development. Thus, an investment in capacity development in one year may not show up in increased programme outputs until a subsequent year. In designating four multi-year periods, we aimed to normalize these discrepancies, but recognize that they cannot be fully eliminated.

The timeline of analysis for the MHS programme is 1996 to 2006. This was divided into four periods,[9] as detailed below.

- Period 1 (1996–1998): initial pilot and replication[10] period. This represents the period when the programme was piloted in five districts, and due to its success, scaled up through replication in five additional districts in 1998.
- Period 2 (1999–2002): period characterized by expansion[11] and replication. This represents a period during which the programme continued to expand in the 10 districts where it was already operating, and then replicated into an additional 5 districts in 2000 (for a total of 15 districts).
- Period 3 (2003–2004): period marking the beginning of the World Bank commitment to provide additional funding. However, due to delays in receiving funds, the installation rate declined while the running costs continued to occur, leading to increased unit costs in this period. In addition, this was a period of scaling up through replication into 10 new districts, increasing the costs of capacity development (such as institution building).

- Period 4 (2005–2006): period characterized by expansion. Unit costs declined significantly, as economies of scale were achieved through expansion in the districts where the programme was already operating (as shown in later chapters).

Micro-hydropower projects in the pipeline as of the end of 2006, but implemented in 2007, were credited backward as output during period 4, to reflect this output as resulting from programme activities and capacity development carried out during period 4.

Step 5: Analysis of cost data

Analysis of cost data was carried out for the periods specified above, that is, annually for the ICS programme and over four multi-year periods for the MHS programme. Cost data in Nepalese rupees were converted to constant 2005 US dollars.

Most of the cost data were also converted into unit costs by dividing them by the associated output (i.e., number of ICSs installed, or kW of power installed) during the same period. Due to the holistic approach taken to development by REDP, there were additional outputs aside from the power installed. However, this analysis takes a conservative approach by using kW as the output unit, since access to electricity through the micro-hydro system is taken as an entry point in the communities.

These data were analysed to examine trends in unit costs over time for both hard costs and capacity development costs. Trends in capacity development costs by different areas of functional capacity were also considered. Finally, the analysis looked at trends in unit costs as a function of output levels, including a forecast of possible future trends in unit costs and economies of scale.

Step 6: Analysis of financing

Extensive financing analysis was carried out, including trends in sources of financing for each programme by institutional type (national government, external grants, and private users and other private, non-state development lending) and by administrative level (i.e., national, district, or community).

The analysis also included a forecast of potential financing sources for each programme through 2030 to characterize a maximum realistic market potential. The objective was to obtain insights about how rapid decline of the unit costs, due to upfront capacity development efforts supported by external grants, might catalyse various financing. In this study, a scenario was used in which the annual rate of growth in installation peaks around 2016, and gradually declines thereafter.

Methodological limitations and caveats

In interpreting the results of this study, the reader should keep in mind several points. First, ensuring data quality was a primary concern. Steps taken to ensure data quality included the development of a solid, detailed data collection framework (see step 1, above) as well as providing a dedicated staff person to oversee data collection and review. However, despite strenuous efforts, some human errors and data errors are likely to remain.

In addition, Nepal has had decades of experience with MHS and ICS technologies, and the costs of capacity development in other settings could be different than those reported

here. As the programmes analysed here were launched, Nepal had already established important institutions, conducive policies, and other enabling conditions (see Box 2). Thus, the costs for similar programmes in other countries where the enabling environment is less well developed could be considerably higher.

Similarly, not all dimensions of capacity development are explicitly addressed in this report. Certain 'core issues' of capacity development – such as leadership, knowledge, and accountability – had already been addressed in Nepal before the programme periods analysed in these reports. Thus, the cost of developing these basic capacities is not reflected in the results of this study.

It is also important to bear in mind that the 'programme costs' analysed and reported here are not just the costs of the main programme actors (REDP in the case of the National MHS Programme and CRT/N in the case of the National ICS Programme). For this study, we have included and analysed total programme costs, reflecting contributions made by several different kinds of programme actors, including national governmental entities, local communities, and external donor agencies. Note that the objective of this study is not to examine the budgets of implementing organizations in isolation and evaluate their cost efficiency. Rather, the purpose is to look at the total costs of achieving successful scale-up and sustainability in programmes to deliver modern energy services to rural communities, as has been accomplished by both of these programmes. This necessarily involves significant investments on the part of many actors, including communities, the national government, and external development partners.

The two programmes analysed here are quite different in the technologies used and in their general approach. The National ICS Programme is targeted specifically at a single, comparatively simple and affordable technology, while the National MHS Programme takes a holistic approach to rural development and poverty reduction, using MHS as an entry point, but also encompassing other energy technologies such as biogas, solar home systems, and improved cookstoves. The objective is not to compare the costs of the two programmes and draw conclusions about the relative cost-effectiveness of the two approaches. Rather, it is to explore the areas of focus for capacity development costs and sequencing of financing needed to produce the notable results achieved by each programme.

Finally, the MHS analysis assumes that electricity is always available from MHS installed by the programme. In reality, there can be cases where the micro-hydro system may be used for productive purposes involving mechanical power only (i.e., without electricity generation). In the early stages of MHS development in Nepal, electricity generators were considered 'add-ons'. However, with the data available, it was not possible to apportion costs between electrical power and mechanical power in the analysis.

CHAPTER 2

Role of capacity development for scaling up modern energy services

This chapter examines the focal areas for capacity development activities in the context of the two energy programmes analysed in this study.

Capacity development is a broad concept. It encompasses the process through which the abilities of individuals, organizations, institutions, and communities to perform functions, solve problems, and set and achieve objectives in a sustainable manner, are obtained, strengthened, adapted, and maintained over time. Because capacity development is so broad, it needs to be dissected into smaller pieces to better grasp what constitutes capacity development activities and outcomes.

For this purpose, this chapter applies the UNDP Capacity Assessment Framework in contextualizing, dissecting, and categorizing the capacity development activities undertaken by the two energy programmes in Nepal. It then identifies the key functional and technical capacities that are not only common to the two energy programmes but could potentially be applicable to decentralized energy access programmes in general in developing countries.

UNDP Capacity Assessment Framework

The UNDP methodology for capacity assessments is the result of years of experience from around the world. Its intent is to help bring a systematic method to assessing existing capacity assets and determining future capacity needs in a variety of contexts, whether for an organization or individual. It provides a method for generating quantitative as well as qualitative data to support the development of a capacity development action plan. (Further details on the UNDP Capacity Assessment Framework can be found in Annex 3.)

The UNDP Capacity Assessment Framework has three dimensions:

- points of entry (i.e., institutional, organizational, or individual level);
- core issues (i.e., institutional arrangements, leadership, knowledge, and accountability); and
- functional and technical capacities (i.e., engage stakeholders; assess a situation and define a vision and mandate; formulate policies and strategies; budget, manage, and implement; and evaluate).

This study focuses on 'functional and technical capacities' as the angle of analysis for the programmes examined. Functional capacities are most closely linked to the main steps involved in normal project/programme development cycles. Thus, focusing on functional and technical capacities can help ensure better linkages between the analytical results and programming activities.

Functional and technical capacities identified in this study

This study identified seven functional and technical capacities that can categorize and fully describe capacity development activities conducted in the context of the two energy programmes in Nepal.

The main activities under each functional and technical capacity are briefly highlighted below. (Annex 4 provides further details on the types of capacity development activities carried out in each of the seven functional capacity areas for the two programmes.)

1. Planning, oversight, and monitoring

This functional capacity includes establishing, overseeing, and monitoring the programme. Devising strategies and actions to successfully execute the programme, selecting staff and partner organizations at national, sub-national, and local levels, and providing oversight and evaluation activities (such as holding annual review meetings), and monitoring are the important activities of programme establishment and scale-up. Specific activities include:

- Overall planning and coordination, including strategic planning, division of labour between national, sub-national, and local levels, and coordination with development partners (e.g., donors).
- Identification of implementation partners (including selection of target districts/ village development committees, potential entrepreneurs, selection of NGOs and other local partner organizations).
- Human resources management including recruitment of programme staff.
- Knowledge codification and sharing.
- Organization of regular and/or ad hoc review meetings, seminars, and workshops.
- Evaluation and monitoring of the programme at different levels to feed the lessons back into planning cycles.

2. Policies and regulation

This functional capacity includes activities that aim to develop, propose, and advise on policies and regulations, and promote financial support to facilitate the establishment of an energy programme and its implementation. Activities for example are:

- Formulation and approval of rural energy policy and regulations.
- Proposing and recommending energy policies and regulations to promote MHS.
- Facilitating and supporting the design of fiscal measures (such as self-governing energy funds by REDP).
- Holding meetings of the national advisory team to give advice on policies and regulations.

3. Situational analysis

This functional capacity includes the ability to undertake and guide a study (or studies) and in-depth analysis of an energy programme's geographical, political, socio-economic,

and technological context, including energy needs appraisal(s) for local communities and end-users, as well as the district energy assessment and project development planning. Activities include:

- Resource and needs assessment at the local and district level.
- Preparation of energy balance studies, energy situation reports, rural energy master plans, and annual energy plans at the district level.
- Identification of local energy needs and supply options (e.g., technology and site selection).

4. Stakeholder dialogue, communication, and community mobilization

This functional capacity includes one or several institutions to facilitate dialogue(s) between stakeholders involved in the energy programme, from local communities to institutional partners. It also includes raising awareness on programme-related issues among local communities, through intensive mobilization (see Box 2), media communication, and dissemination of information on achievements, benefits, and lessons. Specific activities include:

- Advocacy, raising awareness, and carrying out informational campaigns on rural energy issues.
- Sharing knowledge by organizing energy planning workshops and meetings and educating on potential development benefits of (productive) use of modern energy services.
- Collecting data for preparation of pre-feasibility reports.
- Exchange visits for selected promoters and field coordinators with neighbouring districts.

Box 2. Community mobilization in Nepal's national MHS Programme

Nepal's MHS programme places a strong emphasis on *community mobilization*. It works to ensure that MHSs are installed by community members in close cooperation with District Development Committees (DDCs) and Village Development Committees (VDCs). Local NGOs are developed and nurtured to act as support organizations (SOs), which carry out the process of community mobilization.

Within the MHS Programme, the process of community mobilization is guided by six basic principles (known as the 'Mul Mantras'), which include organization development, skills enhancement, capital formation, technology promotion, environmental management, and empowerment of vulnerable groups and communities. The SOs support the villagers to establish community organizations (COs) and ensure that at least one male and one female from each household are members of a community organization of the target VDC or settlement.

Multiple COs are then supported to form various functional groups (FGs) based on their common interests, ranging from micro-hydro FG (MHFG), income generation FG, or forestry FG, to biogas FG or poultry farming FG, and so on. These functional groups are made up of representatives from all COs, ensuring representation from males, females, and vulnerable groups.

The MHFG is the key body at the village level for establishment, operation, and management of MHSs. Once the community-managed MHS has been running successfully for at least six months, the community groups are encouraged to convert the MHFG into a legal entity, such as an MH cooperative, to encourage long-term sustainability.

5. Setting up and enhancing institutions

This functional capacity includes creating and enhancing institutions and facilities that are necessary for implementing energy programmes and delivering energy services. Activities include provision of physical sites as well as the establishment, enhancement, or development of institutions coordinating the programme activities. Activities include:

- Establishment of Rural Energy Service Centres and formation of District Energy Committees;
- Supporting communities to form Community Organizations and Functional Groups to manage and implement the programme (in the case of the micro-hydropower programme);
- Establishment of district programme promotion centres (in the case of the ICS programme);
- Establishment of an informal district network of ICS promoters (i.e., stove builders and installers); and
- Establishment of technology outreach centres to facilitate programme scale-up as well as to test technologies.

6. Training of community members and programme implementers

This functional capacity includes various levels of training in the form of formal instruction, practical exercises, exchange workshops, or country study tours. These include trainings:

- For end-users at the local level on how to install and operate an energy system (e.g., micro-hydropower, ICS).
- To institutions (i.e., their staff) working at local, sub-national, and national levels on how to set up and manage organizations and other institutions to develop the capacity necessary for the successful implementation of an energy programme.
- On business development, environmental management, organization and leadership, group dynamics, bookkeeping, and training of trainers on various related issues.
- On energy and gender issues.
- To local communities on application of MHS for income generation.
- For promoters (i.e., stove builders and installers) on ICS installation and kitchen management, orientation, and demonstration of ICS.

7. Implementation and management

This functional capacity includes such activities as installing, operating, and managing an energy programme on site. These functions can, in many cases, be outsourced or decentralized to trained private entities, NGOs, or CBOs. Activities include:

- Procurement of technical services to implement and manage the programme.
- Hiring sub-contractors to implement and manage the programme.
- Organizing seminars and workshops to share programme implementers' experiences.

CHAPTER 3

Results of cost analysis

This chapter presents the key findings from the costs analysis of the two programmes covered by this study. It presents findings on total programme costs, proportion of costs allocated to capacity development and hard costs, and trends in programme costs over time. The chapter also includes a detailed look at the costs of capacity development by functional capacities and an analysis of how they have evolved over time.

What does 'total cost' mean?

Understanding the total cost of providing energy access for a certain target population in developing countries is more complex than many may realize. 'Total cost' is commonly equated to 'capital cost' plus 'recurrent cost', where 'capital cost' is the cost of land, buildings, technology/equipment, transportation, construction/installation, and other ancillary activities (such as feasibility studies). This approach falls short of capturing the full cost of implementing a project/programme in most developing countries because many additional costs, such as the cost of creating an enabling environment, leadership, knowledge, etc. is not included. In other words, many costs related to capacity development are not accounted for.

This study attempts to capture total cost in a different way. It defines the total cost as the 'capacity development cost' plus 'hard costs' required to implement and successfully scale up a project/programme and excludes 'recurrent costs'[12]:

Total programme cost = Capacity development cost + Hard cost

The *capacity development cost* comprises the costs to undertake various functional and technical activities relating to the implementation of the programmes (refer to chapter 2 for more details), whereas the *hard cost*[13] relates to the 'hardware' required and comprises the cost of technology/equipment, transportation, construction, and installation, including those costs that are paid for in-kind, such as the cost of a villager contributing his/her time and effort into building a canal for a micro-hydro system.

Programme costs encompass not only the costs incurred by the main programme implementers (i.e., REDP and CRT/N), but also other key programme actors, including AEPC, community members, external donors, etc. The National MHS Programme has several outputs in addition to MHS (e.g., solar home systems, biogas plants, ICSs, etc.). However, MHS is by far dominant within the REDP programme. Hence, this analysis attributes all capacity development costs to the MHS programme, rather than attempting to assign partial costs to other programme outputs.

Total programme costs and proportion of costs allocated to capacity development

Total programme costs for the MHS programme between 1996 and 2006 were USD 14.3 million (Figure 3, in 2005 constant dollars). This is the equivalent of about USD 600 per household, or about USD 110 per beneficiary.[14] On a unit basis, this is about USD 5,800 per kW on average over the period analysed. Of this amount, capacity development costs account for 56 per cent (USD 8 million 2005 constant dollars). Hard costs – including electro-mechanical machinery, civil engineering, transportation, and turbines – make up 44 per cent of total programme costs (USD 6.3 million 2005 constant dollars).

For the ICS programme, total programme costs between 1999 and 2004 were USD 1.5 million (Figure 4, in 2005 constant dollars). This amounts to about USD 14 per household and USD 2.60 per beneficiary. On a unit basis, this is USD 14 per ICS on average over the study period. Capacity development costs account for 68 per cent (USD 1 million) and hard costs for 32 per cent (about USD 0.5 million).

Capacity development costs predominate in both programmes, i.e., 56 per cent for MHS and 68 per cent for ICS. As the programmes expand further in the country, the proportion of the costs between hardware and capacity development are bound to change over time. Most likely, as the market grows, hardware will gradually occupy a much larger share. Yet, the study's findings indicate that investment in capacity development is a major programme cost, particularly during early stages of programme implementation, and perhaps the most crucial investment for programmes to successfully scale up. The fact that both the MHS and ICS programmes in Nepal had a long pre-national programme stage (of more than 10 years) further indicates the importance of upfront capacity development efforts and their costs.

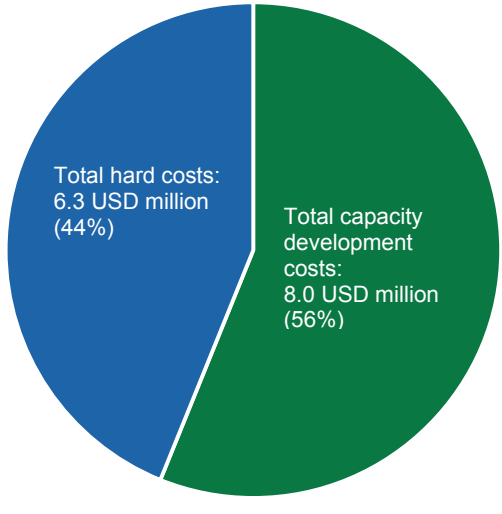


Figure 3. Proportion of total programme costs (USD 14.3 million 2005 constant dollars) occupied by hard and capacity development costs for REDP's MHS Programme, 1996–2006

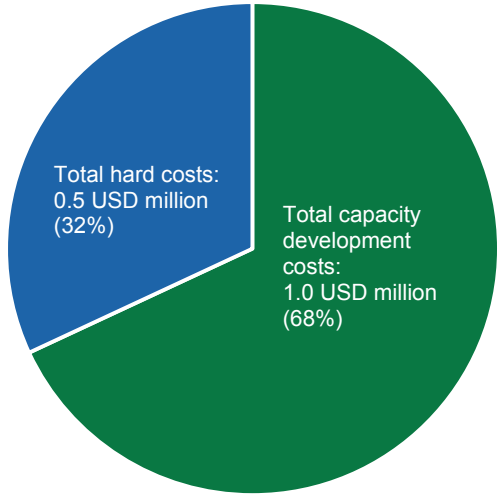


Figure 4. Proportion of total programme costs (USD 1.5 million 2005 constant dollars) occupied by hard and capacity development costs for CRT/N's ICS programme, 1999–2004

Another notable finding is that capacity development accounts for a larger proportion of the ICS programme costs than the MHS programme costs. One reason for this difference is the nature of the technology being promoted by the two programmes. ICS technology involves a very simple cooking stove made from local clay and a few iron rods, and constructed on site by local entrepreneurs. Hard costs are thus relatively inexpensive, and include the costs of installation, iron rods, and in-kind contributions from the user (e.g., time taken to fabricate bricks, collect clay, etc.). On the other hand, the ICS programme requires well-designed, community-level engagement as a prerequisite for success. For this reason, capacity development costs would be expected to make up a larger proportion of total programme costs.

Changes in unit programme costs over time

Figures 5 and 6 show trends in unit costs over time. For both programmes, per-unit programme costs decreased significantly over time, as the programmes expanded. (For MHS, unit costs are referred to in per-kW terms, while for ICS, unit costs are stated as per-ICS installed.)

For both MHS and ICS, total programme costs declined by between 60 and 73 per cent over the study period.[15] For the MHS programme, unit programme costs declined sharply, from about USD 17,300 per kW in period 1 to about USD 4,600 in period 4. During this time, cumulative output grew from 123 kW in period 1 to almost 2,500 kW by period 4.

For the ICS programme, unit programme costs fell from USD 27 per ICS installed in 2000 to USD 11 per unit in 2004. Over this period, cumulative output rose from 6,000 stoves in 2000 to more than 100,000 by 2004.

Declines in per-unit capacity development costs are responsible for most of these trends. For MHS, capacity development costs were about USD 14,000 per kW in period 1,

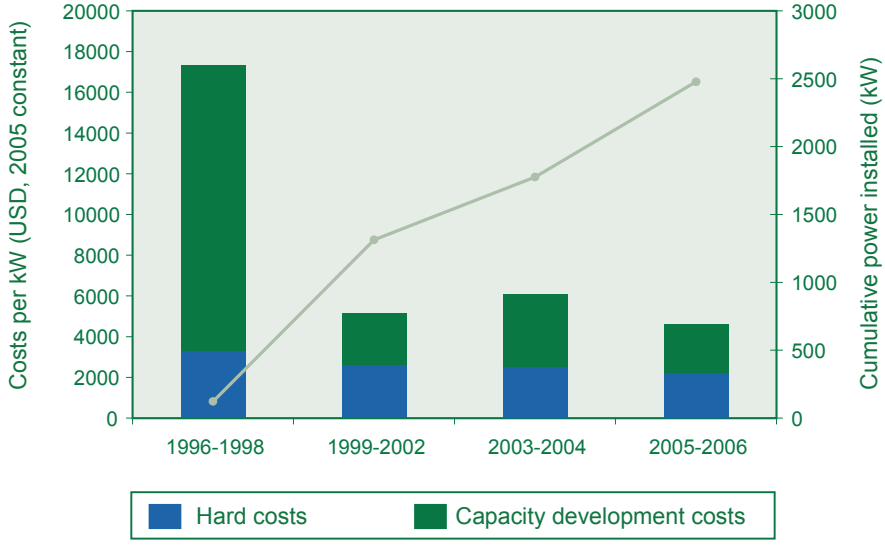


Figure 5. Decreasing per-unit capacity development cost over the period analysed for the MHS programme

but only USD 2,400 per kW in period 4, a decrease of 84 per cent. Per-unit hard costs for MHS also declined, but not nearly so much. Hard costs are about USD 3,300 per kW in period 1, decreasing to about USD 2,200 in period 4, a fall of 33 per cent.

Trends were similar for the ICS programme. Capacity development costs were USD 21 per unit in 2000, falling to less than USD 7 in 2004, a decline of about 70 per cent. Per-unit hard costs decreased from USD 5.50 in 2000 to USD 4.40 in 2004, a fall of 20 per cent.

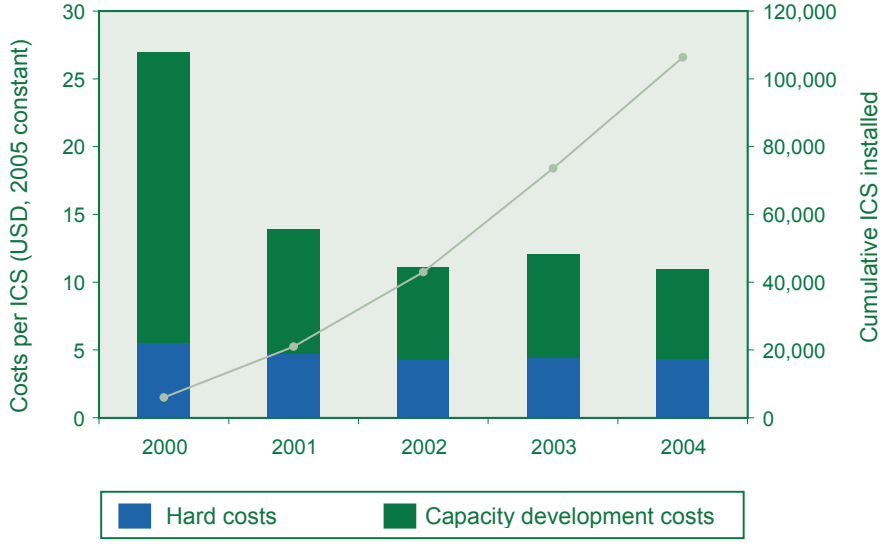


Figure 6. Decreasing per-unit capacity development cost over the period analysed for the ICS programme

The above analysis suggests that significant economies of scale are achieved as programmes mature and gain experience and one-time costs have occurred. While the decrease in unit costs over time is fairly smooth for the ICS programme, the trends are more complex for the MHS programme. This is an expected result, reflecting the greater complexity of the MHS programme and the more complicated trajectory of the programme through periods of expansion within the same geographic area and periods of replication into new areas (see chapter 1 for details).

For instance, MHS's capacity development costs per unit fell to USD 2,500 per kW in period 2. This period was characterized by *expansion* in 10 districts where the programme had already been operating, as well as programme *replication* into five new districts.

However, in period 3, capacity development costs per unit rose considerably, to USD 3,550 per kW. Several factors are likely to have contributed to this result. Delays in receiving funding committed by the World Bank meant that while programme running costs continued to occur, the installation rate declined, thereby increasing costs on a per-unit basis. In addition, period 3 was characterized by scaling up into new districts (replication) more than by expansion within districts where the programme had already been operating. It seems likely that economies of scale in per-unit capacity development (CD) costs differ in degree and kind for programme replication versus programme expansion. With replication into new geographical areas, CD costs for activities such as institution building, needs assessment, resource inventories, etc., are likely to be larger than for programme replication within existing areas of operation.

Changes in hard costs over time

Hard costs for ICS did not change drastically during the period studied (see Figure 6), because the technology had already matured through extensive field work prior to 2000. Thus, this section focuses on changes in the hard costs for MHS.

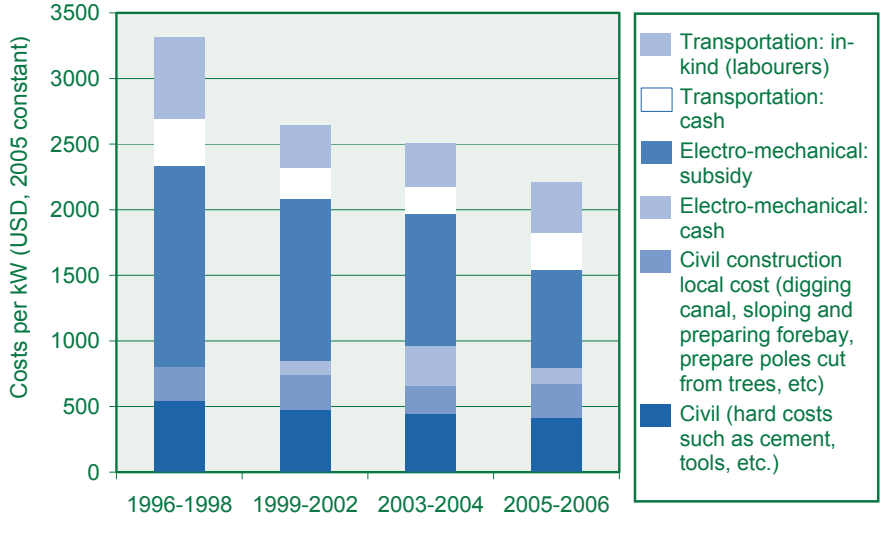


Figure 7. Hard-cost components of micro-hydro systems installed by REDP, 1996–2006

Figure 7 presents findings on hard costs, per unit of output (i.e., kW installed), for each of the four periods covered by the study. Hard costs for MHS are broken out into three subcategories: transportation, electro-mechanical, and civil engineering. Two of these sub-categories – transportation and electro-mechanical – are further broken out into cash expenses, in-kind contributions, and subsidies.

Hard costs per kW of installed MHS decrease over time, from about USD 3,300 per kW in period 1 to about USD 2,200 per kW in period 4. The decline in hard costs is not as steep as the decline in capacity development costs (see Figures 5 and 6 above), but it is still significant.

The most expensive component of hard costs for MHS is the electro-mechanical unit, including both water turbines and generators, which account for about half of total hardware costs. This proportion has not changed much over time. However, the subsidy for the electro-mechanical unit just about halved over the period analysed in this study, decreasing from about USD 1,500 to USD 750.

Overall, per-unit electro-mechanical costs decreased by 33 per cent over the study period. This likely indicates economies of scale achieved with increasing number of units ordered and installed. Also, additional manufacturers began to produce micro-hydro components, thereby encouraging competition.

Costs for capacity development by functional and technical capacities

Figures 8 and 9 present capacity development costs per unit of output (kW and ICS, respectively) by functional and technical capacity, for the seven functional and technical capacities examined for this study. In these figures, the data are presented as absolute costs, stated in US dollars (constant 2005 dollars).

Figures 10 and 11 look at the same costs, but stated as a percentage of total per-unit capacity development costs.

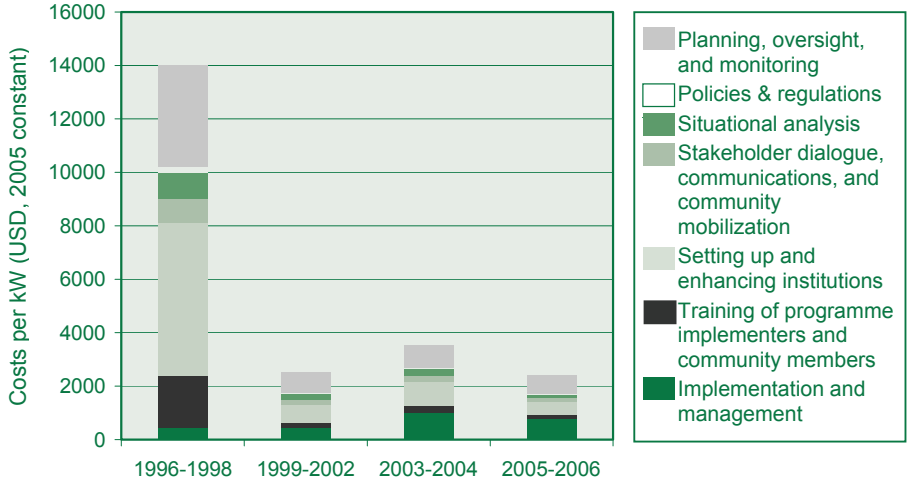


Figure 8. Capacity development cost per unit (kW) over the periods analysed for REDP's MHS programme, by functional capacity

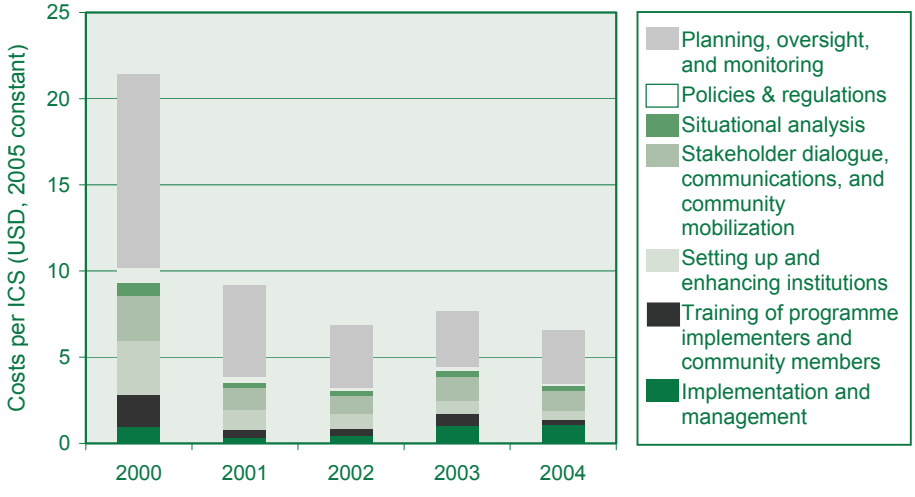


Figure 9. Capacity development cost per unit (ICS) over the years analysed for CRT/N's ICS programme, by functional capacity

For both programmes, the cost for developing functional capacity in *Planning, Oversight, and Monitoring* accounted for a large proportion of capacity development cost. For MHS, these costs amounted to some USD 3,800 per kW in period 1, declining sharply to USD 700–860 in other periods. This is the equivalent of 25–30 per cent of all capacity development cost in each of the periods analysed. For ICS, these costs were USD 11 per unit in period 1, falling to USD 3–5 in later periods. This amounts to 40–60 per cent of total capacity development costs in each period.

Also for both programmes, costs for *Setting Up and Enhancing Institutions* made up a significant share of capacity development costs, particularly in the early portions of the study period. For the MHS programme, these costs dominated in the initial study period (i.e., 1996–1998); over the full study period (i.e., 1996–2006), they were roughly equal to the costs for planning, oversight, and monitoring. For the ICS programme, these costs accounted for the second largest share of per-unit capacity development cost in 2000, and falling steadily as the programme scaled up.

Costs for Implementation and Management are the only functional capacity cost that increased rather than decreased as programmes scaled up.

When costs decrease as the programmes are scaled up, much of this decline appears to occur during periods of programme expansion in the same geographic area as opposed to periods of programme replication in new geographic areas.

For example, note the difference in trends in *Planning, Oversight, and Monitoring* costs for periods of programme *expansion* versus programme *replication*. For MHS, these costs were about USD 770 per kW for a period of expansion within the same geographic area (i.e., period 2), versus more than USD 860 in a period of programme replication to a new geographic area (i.e., period 3).

This indicates that economies of scale may work differently for developing this functional capacity in the context of programme expansion versus replication. In the

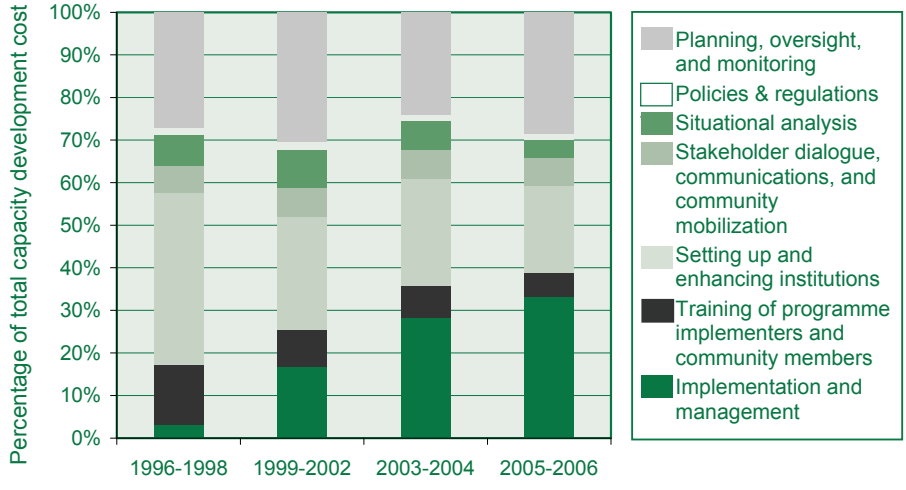


Figure 10. Functional and technical capacities as a percentage of total capacity development cost per unit (kW) over the periods analysed for the REDP's MHS programme

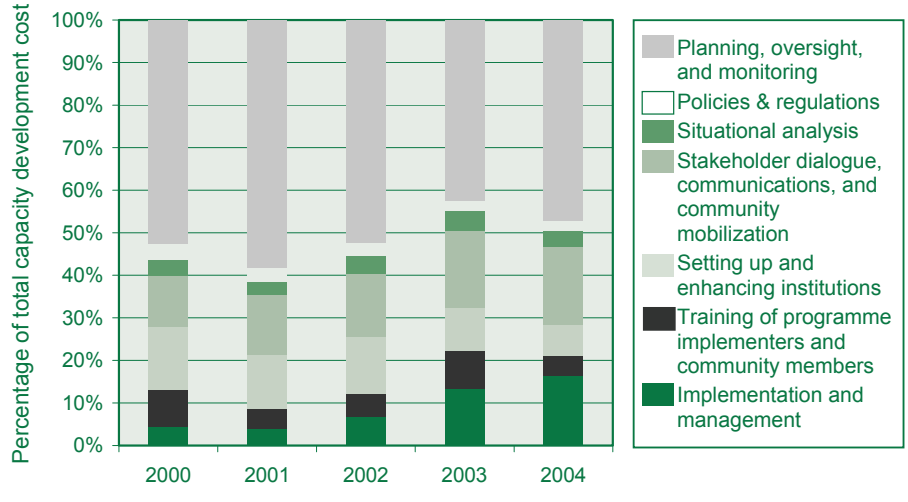


Figure 11. Functional and technical capacities as a percentage of total capacity development cost per unit (ICS) over the years analysed for the CRT/N's ICS programme

case of replication, the selection of new districts as well as conducting additional local needs assessments and resource inventories may require additional CD expenditures, such that economies of scale are smaller than for programme expansion within the same geographic area. Also, setting up and operationalizing new local and district institutions require additional financial support.

Further empirical inquiries might explore whether replication is in fact more costly than expansion and if so, by what factor. Such insights could prove helpful to national planners in designing programmes for optimal cost-effectiveness as well as to ensure that adequate resources are programmed for the kind of programme scale-up (i.e., expansion versus replication) that is envisioned.

Also, while *Planning, Oversight and Monitoring* costs would be expected to be large during early programme periods, for the programmes studied, these costs remain significant, even in later periods. One possible reason is the strong emphasis placed by both programmes on monitoring, especially soliciting feedback from users/communities and incorporating this local feedback to strengthen and improve programmes to better meet local needs. This result implies that the cost of doing monitoring well may be larger than many realize, and perhaps a key component of capacity development costs that many programme developers overlook.

For both programmes, costs for the development of *Policies and Regulations* appear marginally higher in period 1 than in subsequent periods. One possible reason is that there is more to do in initial periods to create an enabling environment for the programme. As lessons are learnt in the field and incorporated into national policies and programming, there may be less to do in this area. However, it should be noted that, by design, the MHS and ICS programmes' contributions to development of policies and regulations were not their primary entry points. Rather, they were meant only to support or advise on government's efforts to do so. This explains why this category accounts for a relatively small portion of the overall capacity development cost.

Nonetheless, supporting policy development has been crucially important to effective scale-up of programmes. For example, the REDP provides an opportunity to mainstream the lessons from community initiatives into the design of national policies. Input from REDP, AEPC, and others to the National Planning Commission proved to be instrumental in the preparation of a pro-poor National Rural Energy Policy for Nepal, which emphasizes the holistic development and poverty reduction processes used in the REDP approach.

Costs for *Situational Analysis* are larger for the MHS programme than the ICS programme, on a percentage basis as well as in terms of the absolute size of expenditures. This is an expected result, due to the complexity of the MHS technology and the scope of the analyses being undertaken. While the costs for situational analysis in the ICS programme are relatively steady, these costs drop off sharply for the MHS programme in later periods. Again, this is an expected result, due to the complexity of the analysis needed to launch the MHS programme. Ongoing costs for situational analysis in the MHS programme are significant, but not as large as the initial costs.

Some would argue that for the MHS programme, the high cost of situational analysis in period 1 includes one-time expenses that benefit the entire programme, such as estimating the total potential for the entire country. From this vantage point, evaluating these costs on a per-unit basis using just the output from period 1 might be considered misleading. However, because this analysis is intended to give countries a realistic picture of what is involved in successfully scaling up this kind of programme (rather than as an evaluation of the cost-effectiveness of any one programme), it seems appropriate to analyse the costs in this way in order to indicate the size and scope of the necessary upfront investment in capacity development.

Stakeholder Dialogue, Communication, and Community Mobilization, while not an enormously expensive activity, is an important and ongoing component of capacity development. Economies of scale do appear to operate here, since costs decline from initial programme periods to later periods. This seems to indicate a need for intensive stakeholder dialogue and communications in the early stages of a programme, as it is being planned and launched. As the programme is scaling up, the need for stakeholder engagement and communications is ongoing, but not as intensive as in the earliest stages. However, on a percentage basis, stakeholder dialogue and communications occupies a growing proportion of total CD expenditure. This is because costs drop more dramatically in other areas, such as planning and institution building, while the decline in stakeholder dialogue and communications is not as sharp.

Costs for *Setting Up and Enhancing Institutions* follow the expected trend of falling over the life of the programme, in both absolute and relative terms. These costs are much larger in both absolute and percentage terms for the MHS programme than the ICS programme. One reason may be the holistic nature of the MHS programme. The MHS programme in Nepal has long advocated and worked to promote other renewable energy sources, such as solar home systems and biogas plants. Much effort is therefore devoted to building and strengthening institutions for longer-term rural energy planning and continued development of the renewable energy sector, beyond the life of the MHS programme. If a technology-based approach were taken, many of the activities included in this category might not be warranted simply to install MHS technology, and the cost would likely be less (but so too would be the additional benefits of the programme in terms of other energy access improvements, poverty reduction, etc.).

CHAPTER 4

Financing sources

This chapter examines sources of financing for each of the programmes analysed for this study. It looks first at financing sources for cumulative programme costs over the entire study period, followed by a breakdown of financing sources, by programme and year(s). The chapter then presents information on programme expenditures by administrative level (i.e., national, district, or community) for each programme and period, which can help orient financing schemes to suit evolving programme activities at various levels.

Historical sources of programme financing

The figures below illustrate three primary sources of funding for the MHS and ICS programmes:

- government funding,
- external donor grants, and
- private household/community.

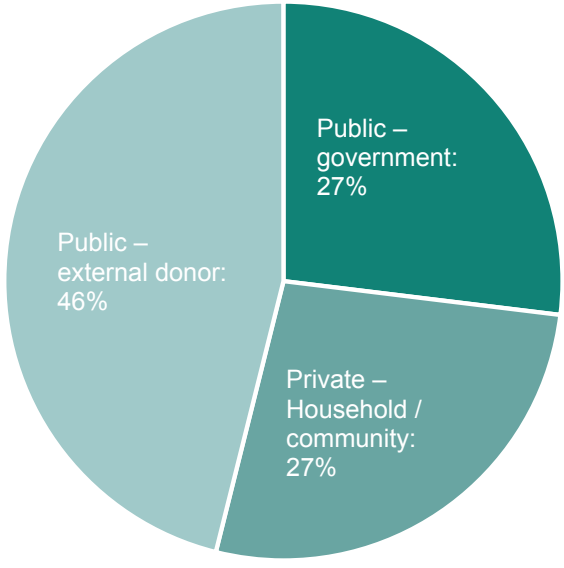
Government funding includes funds provided from central and district levels. External grants are those from bilateral and multilateral organizations. Private sources are composed of contributions from households and communities as well as other sources (such as financing from microfinance organizations).[16] In-kind contributions from household and communities were converted to monetary values based on prevailing labour wages for each location.

For both programmes, the major share of financing comes from the public sector: government funding[17] and external grants[18] together make up about 60–70 per cent of total financing over the course of the study period. However, a significant portion of financing (cash and in-kind contributions, such as labour required for digging channels and collecting sand, stone, and wooden poles) comes from private households and communities, accounting for about 30–40 per cent of total programme financing for the entire study period (Figures 12 (a) and 12 (b)).

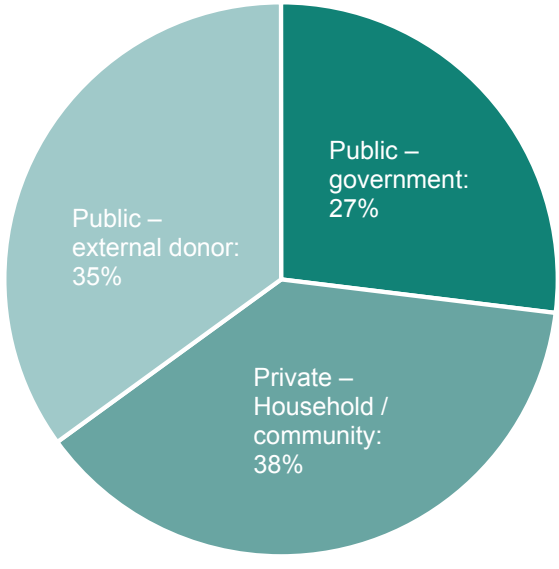
Trends in financing sources over time are presented below in Figures 13 (a) and 13(b). For both programmes, funding from public sources is quite high in the pilot and/or initial stages. As the programmes mature and scale up, public funding declines as a percentage of total funding, as increasing contributions from communities, households, and other private sources are drawn into the programme.

For the MHS programme, public financing sources account for 92 per cent of funding in the initial study period, and then decline to about 60 per cent of funding in the final study period. Conversely, private sources make up 8 per cent in the initial study period, rising to 25–33 per cent in the middle study periods, and reaching 39 per cent in the latest study period.

Total programme cost during analysis period (1996-2006) in 2005 constant dollars for REPD's Micro Hydropower Programme: USD 14.3 million



Total programme cost during analysis period (1999-2004) in 2005 constant dollars for CRT/N's Improved Cooking Stoves Programme: USD 1.5 million



Figures 12 (a) and (b). Sources of financing for the REDP's MHS Programme and CRT/N's ICS Programme

Figures 13 (a) and (b). Sources of financing for REDP's MHS Programme and CRT's ICS programme, as a share of total financing over the periods analysed

For the ICS programme, funding from public sources (national government and external donors) declines from 100 per cent during the pilot period (1999) to about 75 per cent in 2000, and falls to 50 per cent by the latest year examined (2004). This means that contributions from private sources rise over time as the programme scales up, from some 25 per cent of programme funding in 2000, to around 40 per cent during the intermediate study periods (2001–2003), and reaching 50 per cent by 2004.

Government support

Government support comes in the form of technical support as well as direct financial support, usually in the form of subsidies. Given the low cost of improved cooking stoves, the entire hard cost is paid for by users. However, the cost of micro-hydro systems relative to rural incomes is high and must be supported by subsidies in order to make the technology affordable for the target population.

At the same time, the government has encouraged private-sector and community engagement in rural energy development, for example, by exempting rural energy projects from tax and royalty charges. With regard to MHS, the plant is owned by the communities, which have full rights to determine the tariffs, based on Operation & Maintenance costs and bank-loan repayment fees. Cross-subsidies among the households in the community are also introduced, supported by the strong social capital built through community mobilization, to ensure access to electricity for the poorest households.

In addition, REDP plays a facilitation role in encouraging banks to extend community loans[19] for MHS installation for any project that is assessed as financially viable. One example of this facilitation is the relationship between REDP/AEPC and the public Agricultural Development Bank of Nepal (ADB/N), including a Memorandum of Understanding for collaboration on community loans for MHS. ABD/N is a member of AEPC's Technical Review Committee (TRC), which approves the detailed project report required for the release of the government/programme subsidy. (However, the bank could not make loans in areas at high risk during the period of civil unrest. In such cases, the community manages the equity fund available at high interest rates from other sources.)

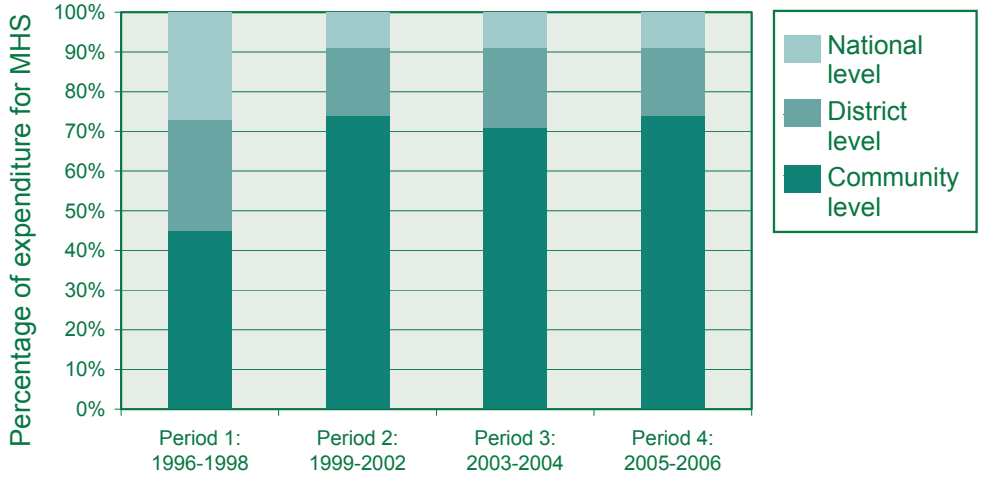
External donor grants

A subsidy to the local communities is currently mobilized from external donor grants through the Rural Energy Fund (REF) for schemes such as micro-hydro systems, solar home systems (SHS), biogas, improved cooking stoves, and improved water mills. In the case of REDP, these resources were mobilized from UNDP for technical backstopping (REDP staff, UNDP support, etc.) as well as for hardware at early stages of the project. Since 2003, UNDP's support has focused on technical backstopping, while the World Bank provided financing for the system hardware, district administration, and productive-use hardware.

External donor support has been both substantial and necessary, especially in the initial years of the programme.

Community contribution

For both programmes, the private-sector share (mostly, contributions made by the households and their community, but also loans they mobilized from other private sources) increases from around 20 per cent in early programme periods to 40–50 per cent in the latest period studied. Community contributions are in the form of in-kind labour contributions, cash, and bank loans taken by the community. For example, in-kind labour contributions are often provided for digging the channels for the micro-hydro system. In-kind contributions are also made in the form of sand, stone, and wooden poles collected



Figures 14 (a). Financing distribution for REDP's MHS Programme over the periods analysed

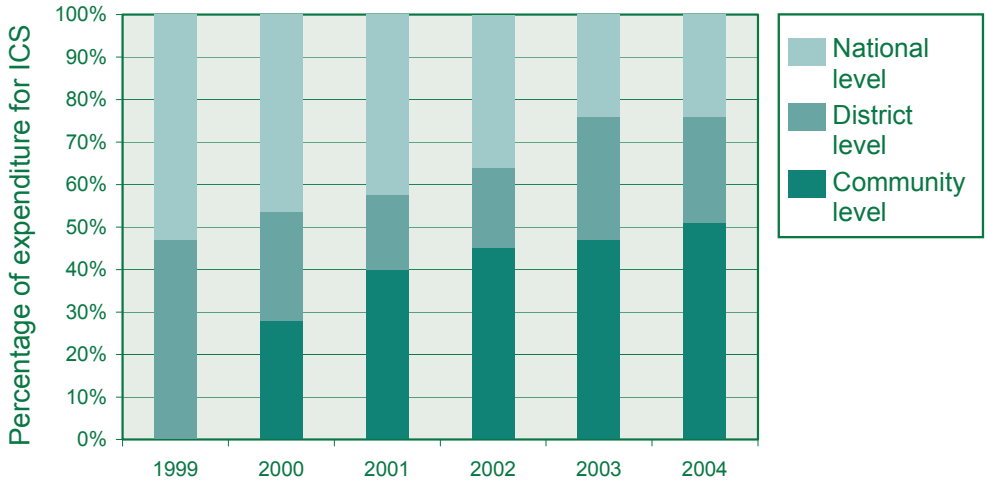
locally by the community people. Cash (or goods that can be converted into cash, such as grain) is contributed for the materials and installation of an ICS.

The benefits of ensuring that community contributions are made towards the cost of providing modern energy services are many. First, it takes some of the financial burden away from the public sector. Secondly, both programmes aim to be demand-driven. If beneficiaries are required to contribute towards receiving energy services and do so willingly, it supports this demand-driven approach. Thirdly, community contributions promote 'ownership' among users, thereby enhancing programme sustainability. Users pay for the entire hard cost of the ICS (i.e., the material and labour costs of installation), totalling about USD 5 per ICS. To benefit from the services provided by an MHS, a community pays a portion of the hard cost (about 40 per cent) using in-kind contributions as well as a loan from ADB/N, community cash/savings, and/or in-kind labour costs. Ownership has proven to be a necessary sustainability component, providing an incentive for users to properly use and maintain the technology.

Trends in programme expenditures by administrative level

Trends in programme expenditures by administrative level (i.e., local, district, or national) closely correlate with the main level at which programme activities are occurring in a given time period (see Figures 14 (a) and (b)). Thus, these trends provide important information to guide and tailor the future orientation of financing schemes in order to best serve evolving programme activities at various levels.

During the initial periods, planning is a major functional capacity for which the associated activities tend to involve extensive commitment by national-level staff, whether working in the field or in central offices. As the programme scales up and implementation occurs in the field, increasingly investments are made at the district and community levels.



Figures 14 (b). Financing distribution for CRT's ICS programme over the periods analysed

For instance, for the MHS programme, programme expenditures at the national level decline from 27 per cent in the first period to 9 per cent in later programme periods, while programme expenditures at the community level rise from 45 per cent in the first period to about 71–75 per cent in later periods. Similarly, for the ICS programme, 53 per cent of programme expenditures is distributed at the national level in the initial programme period (1999), compared with only 24 per cent in the final period studied (2004), while programme expenditures at the community level increases from 28 per cent in 2000 to 51 per cent in 2004.

It is worth noting that the trend toward decreasing unit costs of capacity development (discussed in the previous chapter) coincides with the trend observed here toward increasing programme expenditures at the community level.

CHAPTER 5

Potential future trends in programme costs and financing sources

The following chapter attempts to estimate potential future trends in programme costs – both per unit and in total – and financing sources for the two Nepal programmes. Predicting the future cost and financing sources in any precise manner for the two programmes is beyond the scope of this study. Nonetheless, the data currently available provide various insights into possible future trends in the cost and financing of the programmes.

Capacity development costs

Future scale-up of the two programmes is likely to further reduce their capacity development costs. Of the seven functional and technical capacities, some are expected to maintain a relatively high level of activities and associated costs, while others could diminish in activities and costs.

For example, situational analysis to select sites and conduct technical and market analysis will remain needed as long as new sites are added. Likewise, training of programme implementers and community members will remain essential. Costs for on-site implementation and management of energy systems will also remain essential, but will likely decrease as the programmes gain practical knowledge and improve efficiency. Governments will also need to maintain a certain level of involvement in terms of planning, oversight, and monitoring.

On the other hand, other capacity development efforts may diminish significantly. Developing policies and regulations as well as setting up and enhancing institutions can be considered 'upfront' capacity development activities. Stakeholder dialogue, communications, and community mobilization will remain important, but when sufficient scale is achieved, awareness would have been raised, even enough for communities to proactively mobilize themselves, when necessary training is provided.

Based on the line of thinking outlined above, the following assumptions are applied in estimating future capacity development costs:

- Per-unit capacity development costs for situation analysis and for training of programme implementers and community remain the same.
- Per-unit capacity development costs related to policies and regulations; setting up and enhancing institutions; and stakeholder dialogue, communications, and community mobilization will reduce to zero over time.
- In the case of the MHS programme, per-unit capacity development costs for implementation and management can be reduced considerably, given a steep decline in associated activities at the national level as well as some activities at the district level (particularly related to strategy development and knowledge management). Judging from the current proportion of these activities within the implementation/management category, a 50 per cent cost reduction would not be unreasonable. In

the case of the ICS programme, per-unit costs for implementation and management have already stabilized and thus are likely to remain at the same level in future.

- Per-unit costs for planning, oversight, and monitoring are mostly related to central/local governments, and therefore, can be assumed to be inversely related to the number of districts each programme covers. Assuming that the scaled-up programme for MHS would cover all 75 districts in Nepal, by simply extrapolating current trends, the future cost for planning, oversight, and monitoring would be estimated at about USD 175 per kW for MHS,[20] about one-fourth the cost in 2005–2006. In the case of the ICS programme, the per-unit cost for planning, oversight, and monitoring stabilized at about USD 3 per ICS during the final years surveyed, despite programme expansion into more districts. As such, this value would be expected to remain the same in the future.

Figures 15 (a) and (b) show the resulting estimations of how capacity development costs might be reduced in future, compared with actual costs during the 2005–2006 period for the MHS programme and during 2004 for the ICS programme.

For the MHS programme, the estimates indicate that the capacity development costs decline to around USD 800 per kW, more than a 65 per cent reduction compared with the 2005–2006 period. For the ICS programme, the capacity development costs could be reduced to just less than USD 5 per ICS, about a 30 per cent reduction from the corresponding 2004 value. While these are only rough estimates, they point to the potential scope and magnitude of future cost reductions for capacity development.

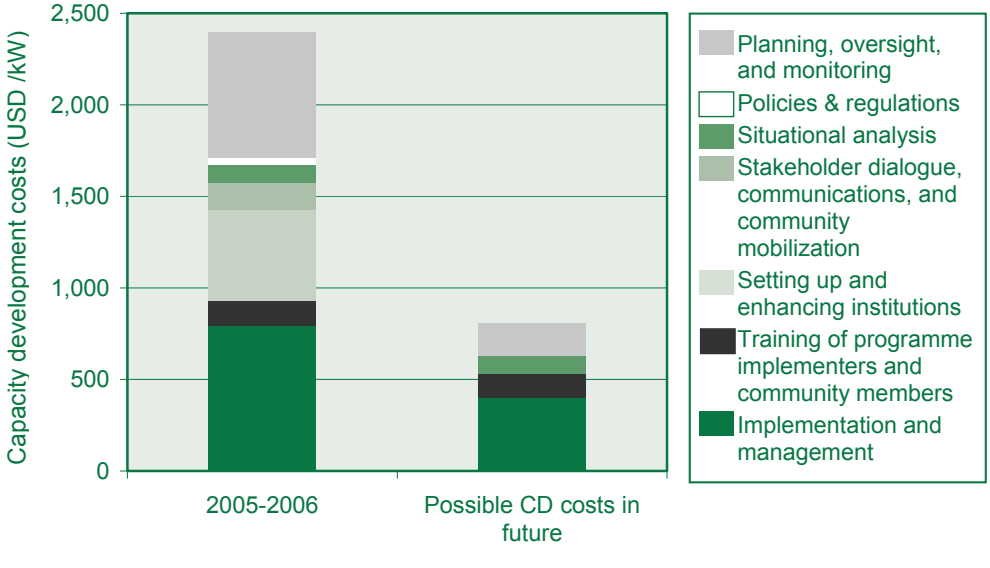


Figure 15 (a). Potential future capacity development costs for Nepal's National MHS Programme

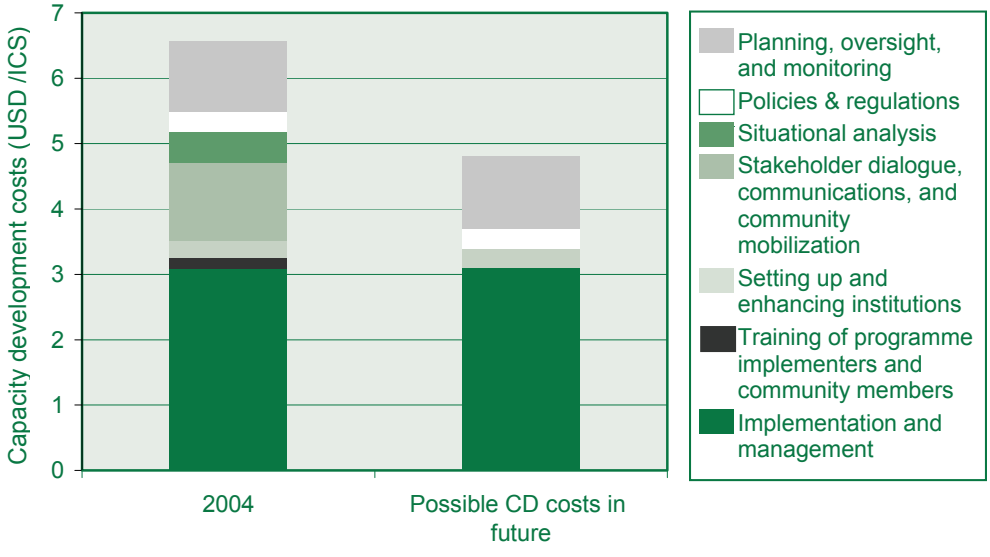


Figure 15 (b). Potential future capacity development costs for Nepal's National ICS Programme

Total programme costs

For both programmes, experience curves were developed based on historical unit-cost data (Figures 16 (a) and (b) for the MHS and ICS programmes, respectively). In the figures, these trends are extrapolated until capacity development costs reached a practically minimum point, that is, where they reached the future capacity development cost estimates as indicated in the previous section.

For the MHS programme, total programme cost per unit would decline to about USD 2,900 per kW, when capacity development cost would be at its minimum point. This represents a cost reduction of 50 per cent compared with the 1996–2006 period, when total programme cost per unit was USD 5,800 per kW. If current trends continue, employing the same technology options and institutional modalities, this point might be reached before cumulative MHS installation reaches 7.5 MW.

Of the total MHS programme cost of USD 2,900 per kW, the hard-cost component would be close to USD 2,100 per kW, while the capacity development cost would be about USD 800 per kW. This means that the ratio of hard costs to capacity development costs would be reduced to 1:0.4, compared with 1:1.25 during the 1996–2006 period as a whole (as shown in Figure 3).

For the ICS programme, the total programme cost would be reduced to around USD 9 per ICS in future, compared with USD 14 per ICS on average during the 1999–2004 period. If current trends continue, this minimum cost might be reached when cumulative installation of ICS reaches around 150,000.

Of the total ICS programme cost of USD 9 per ICS, the hard cost would be about USD 4 per ICS. This is basically the same as the current hard cost, suggesting that the ICS programme in Nepal may already have come close to the least-cost point. The ratio of

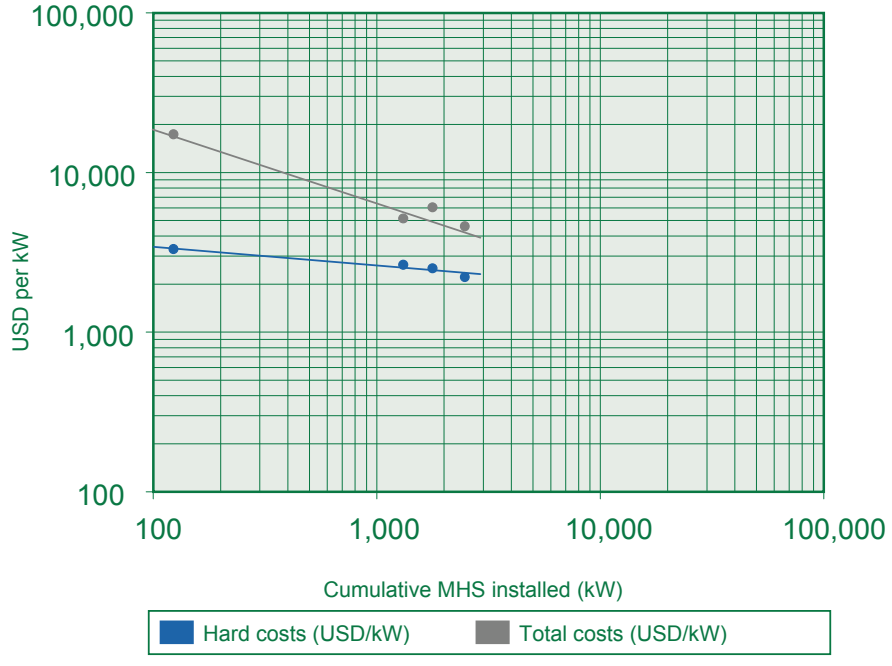


Figure 16 (a). Potential future trends in programme costs based on historical data for REDP's MHS Programme

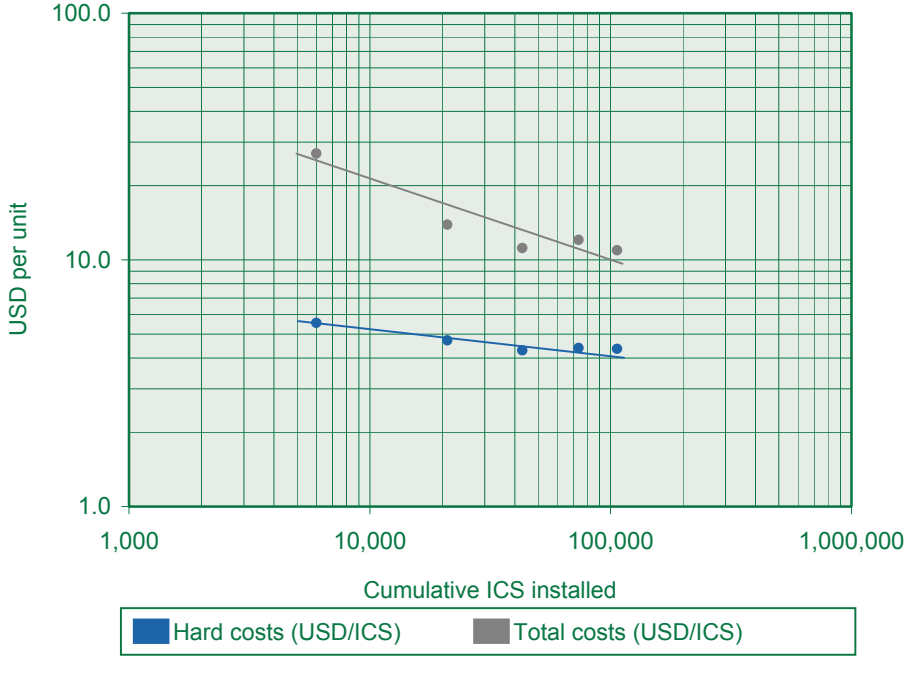


Figure 16 (b). Potential future trends in programme costs based on historical data for CRT/N's ICS Programme

hard costs to capacity development costs would approach 1:1, compared with 1:2 during the 1999–2004 as a whole (as shown in Figure 4).

These estimates are based on current technological options and programme approaches employed by the two programmes in Nepal. Further cost reductions are possible, but would likely require innovations in technological options and/or programme approaches. This might entail, for example, support for R&D to bring improved technology options into the market, diversification of technology options (e.g., larger micro-hydro systems), transfer or adaptation of new technology components or systems, and/or dramatically more efficient institutional models of delivering energy services to rural people.

Considering these findings in perspective, scaling up the MHS programme to install an additional 150 MW by 2030,[21] reaching about 15 per cent of the total population in Nepal, is estimated to cost an additional USD 435 million (based on a unit cost of USD 2,900 per kW). This amounts to a cost of USD 70 per beneficiary in the future, a reduction of about 40 per cent compared with the average cost of USD 110 per beneficiary during the 1996–2006 period (Figure 17 (a)).

Similarly, scaling up the ICS programme to install an additional 2 million ICS by 2030,[22] reaching about 25 per cent of the total population in Nepal, would cost an additional USD 18 million (based on a unit cost of USD 9 per ICS). This amounts to about USD 1.70 per beneficiary for the ICS programme in the future, a cost reduction of about 35 per cent compared with USD 2.60 per beneficiary for the 1999–2004 period (Figure 17 (b)).

Financing sources

What would be the funding sources in the future when the total programme cost per unit reaches a minimum (i.e., the costs shown in previous section)?

This section attempts to provide an answer to this question. First, it estimates the proportion of financing sources based on a simple assumption that the private sector (mainly community users for these two programmes) will continue to pay the same amounts per unit as they did in the latest period surveyed, that is, the 2005–6 period for MHS, and 2004 for ICS. It also assumes that the remainder of needed funding will be provided by public resources (government and external donors combined). Then, using the estimates as a baseline case, it explores ways of increasing the share of funding from private sources.

In the case of the MHS programme:

- Funding from private sources would account for about 55 per cent of the total in the future, compared with 30 per cent during the 1996–2006 period, as shown in Figure 18 (a).
- Financing scale-up of the MHS programme to its maximum potential is achievable, particularly when the government and external donors work together effectively. Additional public funding (both government and external grants) of about USD 200 million could help realize the full MHS potential in Nepal by 2030, assuming that public funding accounts for 45 per cent of the total investment cost of USD 435 million. This is equivalent to a one-time public investment of about USD 30 per beneficiary – a modest amount, compared with the large development benefits expected from access to modern energy services through micro-hydro systems.

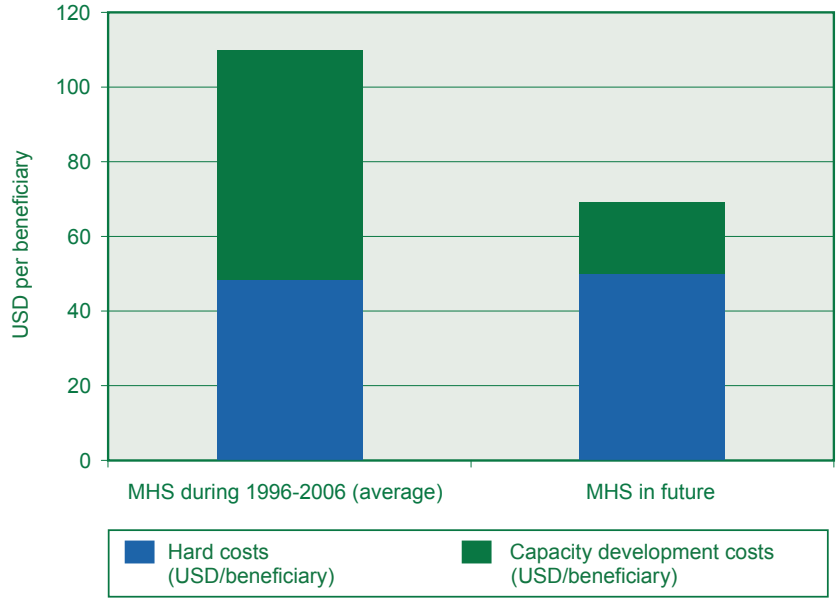


Figure 17 (a). Potential future trends in programme costs based on historical data for Nepal's National MHS Programme[23]

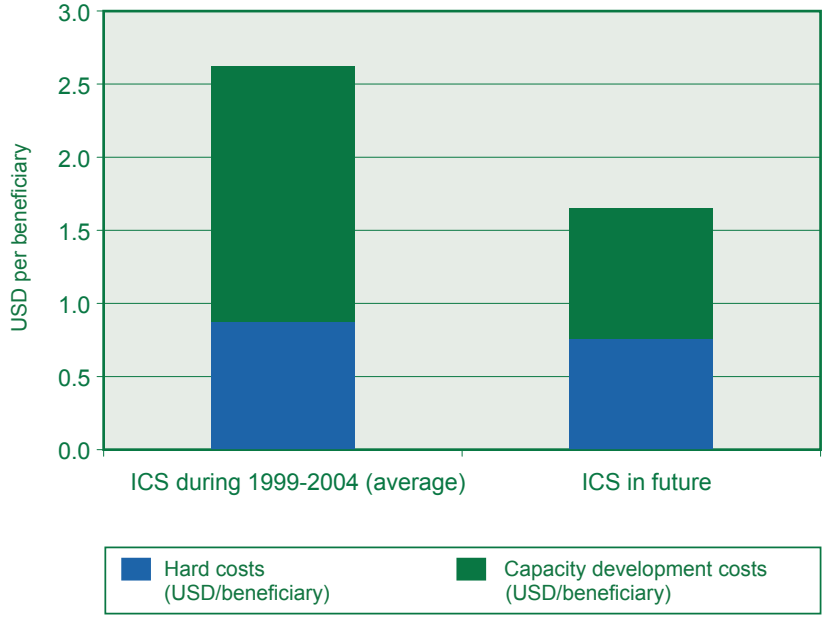


Figure 17 (b). Potential future trends in programme costs based on historical data for Nepal's National ICS Programme

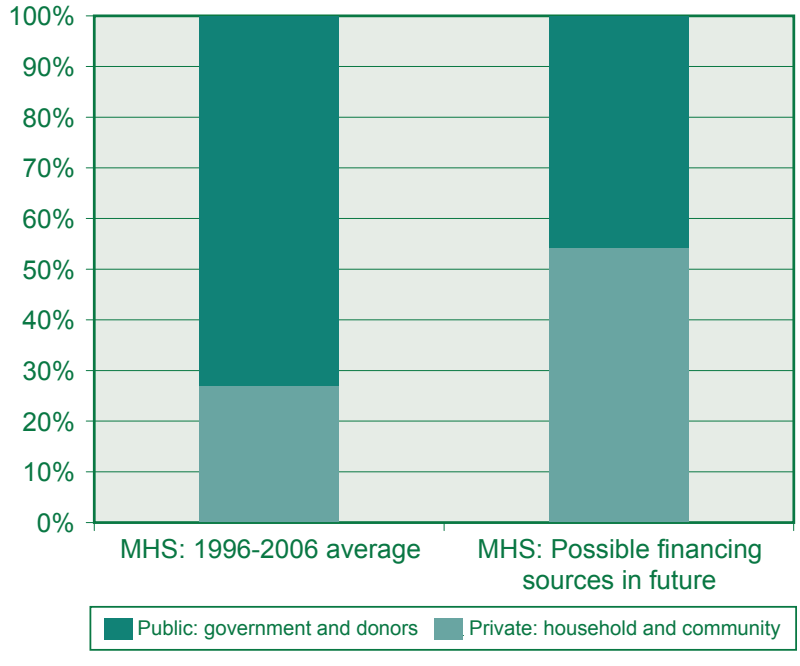


Figure 18 (a). Potential future funding sources for Nepal's National MHS Programme

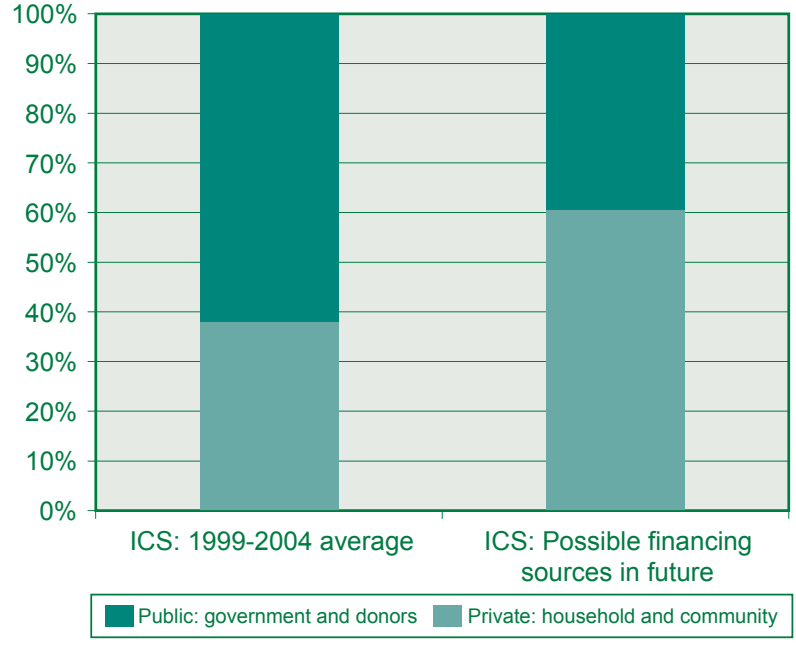


Figure 18 (b). Potential future funding sources for Nepal's National ICS Programme

- There is considerable scope for increasing the share of private sources. For example, the programme should promote productive uses of energy services even more, in order to help raise people's incomes and encourage other activities that yield large development benefits. As already proven by the MHS programme in Nepal, productive uses of energy can spark rural economies and significantly increase the chances of attracting private investments, including microfinance. Additionally, diversification of micro-hydro technology options (such as applying slightly larger system sizes) to optimally fit local market conditions could help attract more private investments. Moreover, new financing sources such as carbon financing can play an increasingly important role.
- Public financing should increasingly be targeted to develop national and local capacities to promote productive uses and mobilize private financing such as microfinance and carbon financing.

Regarding the ICS programme:

- Funding from private sources would account for as much as 60 per cent of the total in the future, compared with 40 per cent during the 1999–2004 period, as shown in Figure 18 (b).
- Countrywide scale-up of the ICS programme is a very modest and cost-effective intervention in view of the large development impacts that ICS can bring about. Additional public funding of USD 7 million, or only USD 0.70 per beneficiary, would be required to realize the full potential, assuming that 40 per cent of the total funding is from public sources.
- There is considerable scope for increasing the share of private sources, particularly through carbon financing, which has increasingly been mobilized in many ICS programmes. Public financing should help develop national and local capacities to mobilize private financing, such as carbon financing.

CHAPTER 6

Conclusions

Capacity development is critical for successful implementation and scale-up of rural energy programmes. It goes far beyond traditional notions of capacity building typically defined by 'training' and/or 'management'. A diverse array of functional capacities – from planning, oversight, and monitoring to situational analysis, facilitation of stakeholder dialogue, training, implementation capacities and management support, and provision of policy advice – must be developed and put in place.

Upfront, long-term investment of public funding is essential to developing the different functional capacities necessary to bring rural energy programmes up to scale and to the point where market transformation can take place. When capacity development is informed by systematic assessments, programme successes and maturation over time can attract substantial funding from the private sector, including financing from carbon offsets.

It is critical for capacity development to occur at all levels – local/community, district, and national – to successfully scale up programmes aimed at expanding access to decentralized modern energy services. Indeed, community mobilization is particularly key in rural and remote areas. Community mobilization forms an important entry point to successfully deliver and scale up modern energy services to poor men and women in remote rural areas.

Institution building and enhancement is a key aspect of capacity development that may warrant greater attention from programme planners and developers. The scope and complexity of the different institutions, committees, councils, centres, and informal groups, created at different levels and time periods by the two programmes analysed for this study, was quite striking and likely an important aspect of their success and sustainability.

Monitoring is another component of capacity development that perhaps deserves increased emphasis from programme planners. The two programmes examined for this study are notable for the extent of their effort devoted to monitoring programme implementation and results, by different actors, using participatory approaches and diverse means to feed local input back into programme management at district and national levels to improve and strengthen programme implementation and development impact.

Policy development and advice is a functional capacity that generally makes up a small proportion of capacity development cost. However, this is a vital activity that plays a major role in ensuring programme success and sustainability.

Finally, further research is needed on economies of scale in capacity development. In particular, additional research should examine differences in the development of economies of scale for programme *replication* in new geographic areas compared with programme *expansion* in the same geographic area. Further understanding of how these scale effects come into play, including their specific nature and timing, could help inform future programme planning and mobilization of external funding.

Annex 1: Nepal's National Institutional Set-up

Nepal Electricity Authority (NEA) and the Alternative Energy Promotion Centre (AEPC)

Many entities – including the government, non-governmental organizations, international organizations, and private institutions – are involved in promoting renewable and rural energy service delivery in Nepal.

Overarching authority for electrification efforts is provided by the Nepal Electricity Authority (NEA), established under Nepal's Electricity Authority Act of 1984. NEA's primary objective is to generate, transmit, and distribute adequate, reliable, and affordable power by planning, constructing, operating, and maintaining all generation, transmission, and distribution facilities in Nepal's power system.[24] Thus, NEA's engagement in rural electrification is primarily through the national grid system.

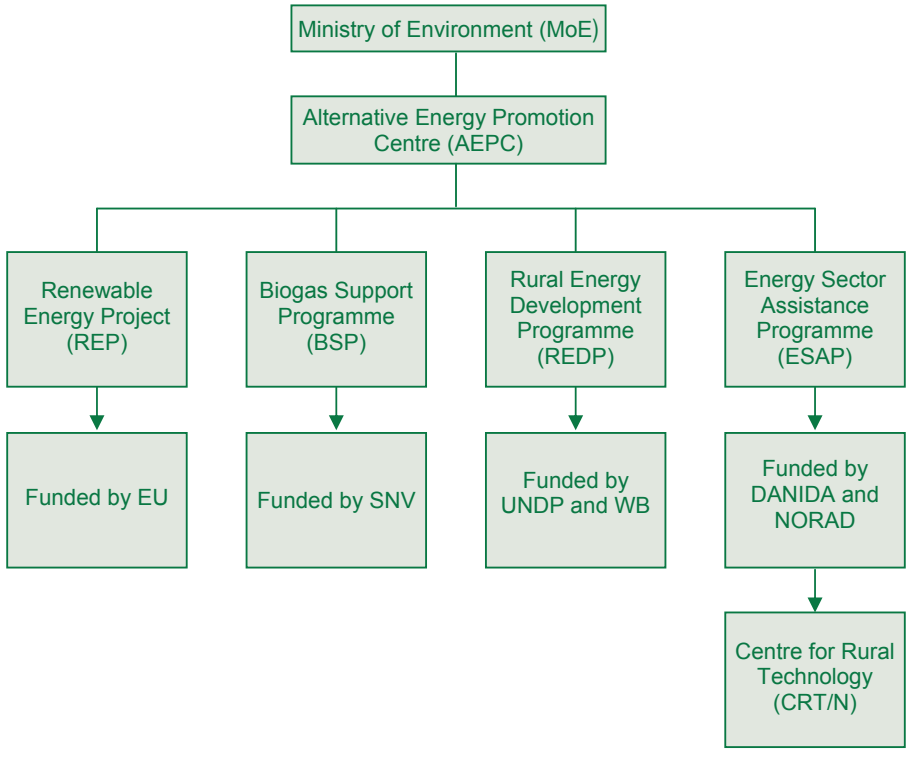


Figure 19. Institutional flow chart for rural electrification in Nepal

Off-grid, decentralized energy service provision is led by the Alternative Energy Promotion Centre (AEPC), established in 1996 as an autonomous agency within the Ministry of Environment (MoE). AEPC presides over various rural energy projects, including the Rural Energy Development Programme (REDP), funded by UNDP and the World Bank, and the Energy Sector Assistance Programme (ESAP), funded by the Governments of Denmark and Norway. REDP was established in 1996, and ESAP in 1998. They are the primary rural energy service provision programmes under AEPC's management. AEPC also manages the Biogas Support Programme (BSP) and the Renewable Energy Project (REP).

The overall objectives of AEPC Programmes are to:

- popularize and promote the use of renewable energy technology to raise the living standard of the rural people, protect the environment, and develop commercially viable alternative energy industries,
- provide and suggest national policy and programme formulation to the Government of Nepal,
- coordinate all organizations involved in alternative energy technology,
- standardize alternative energy technology equipment,
- act as a facilitator in the alternative energy sector, and
- seek financing from international donor agencies for its development.[25]

Annex 2: REDP and CRT/N's management arrangements

The Rural Energy Development Programme

REDP operates at three levels: community, district, and national.

At the community level, activities focus on planning, implementation, operation, and maintenance of community-based energy systems.

The social mobilization process takes place first, closely followed by group formation and establishment of savings and credits systems. REDP supports community people, both men and women, to form Micro-Hydro Functional Groups (MHFG) from the community organizations (COs). The MHFG deposits revenue (grant, subsidy, charity, loan, equity, and tariff) into a Community Energy Fund (CEF) and makes payments for the MHS's operation management, repairs, and maintenance. The installation, operation, and management of the MHS is done entirely by the community, which takes full ownership based on transparency, participation, inclusion, and consensus-based decision-making process.

REDP helps communities to make their own savings and credit system for primarily undertaking on-farm and off-farm income generating activities both at the household and micro-enterprise level. Communities have adopted the motto 'One Household, One Enterprise' for generating additional income to pay for electricity tariff and meeting other household expenses. REDP also supports capacity building at the local level by providing skills development training and ensures women's empowerment through equal participation of women in all community-based development works.

At the district level, activities focus on institutionalization of rural energy systems by building capacity to plan, manage, and monitor the rural energy development process.

The Rural Energy Development Section (REDS) has been established under the DDC in all programme districts to provide support for institutionalizing energy development at the local level. REDS is responsible for participatory planning, programming, budgeting, fund (subsidy/grant/equity) flow, coordination, resources mobilization, monitoring, and evaluation. To this end, other committees created under the DDC are the District Energy Fund (DEF) and District Energy Committee (DEC). For sustained repair, maintenance, and technical support systems, local entrepreneurs are encouraged to establish Rural Energy Service Centres (RESCs) and the REDP provides initial support for training and skill enhancement both on business management and technology development.

At the national level, activities focus on policy support and coordination based on lessons learnt from decentralized local operations.

REDP, with the support of the government,[26] carried out programme activities, including the preparation of feasibility studies for proposed MHS as well as coordination, documentation, and sharing of the lessons learnt. With representation from the government and civic organizations, the Programme Management Committee (PMC) provides policy guidance, approves work plans and budgets, and monitors progress.

Similarly, the Technical Review Committee (TRC) appraises and approves detailed project reports on technical feasibility, environmental assessment, and vulnerable community development. The REDP also advocates and lobbies at the national level to provide guidance and guidelines.

Centre for Rural Technology

The National Improved Cooking Stoves Programme is coordinated by AEPC, and receives technical and financial support from the Energy Sector Assistance Programme (ESAP). CRT/N was initially the lead implementation agency for this programme and continues to be a key ICS Service Provider under ESAP (see Box 3).

Box 3. Energy Sector Assistance Programme

The Energy Sector Assistance Programme (ESAP) Phase I focuses on rural energy and was approved in 1998 and implemented from 1999 to 2006. The Programme assisted in developing sustainable energy solutions with micro-hydro installations (off-grid), solar energy home systems, and energy-efficient household cooking stoves. The total grant provided by DANIDA for the first phase was DKK 191.3 million (just over USD 30 million).

The second phase of the energy programme (ESAP II) was approved in November 2006 under a government-to-government agreement. ESAP II is financed by Denmark, Norway, and the Government of Nepal. Denmark contributes DKK 150 million (around USD 25 million), Norway contributes NOK 125 million (about USD 18 million), and the Government of Nepal contributes DKK 44 Million (about USD 7.5 million).

Decentralized implementation strategy

REDP has proven to have one of the most effective models for decentralized energy solutions in Nepal. REDP's community-based approach to energy planning and managing rural energy systems provides an attractive alternative to what has historically been a weak and centralized government approach to rural energy development. REDP has contributed towards institutionalizing rural energy service delivery within the government's decentralized structure that operates at the local level through the Village Development Committee (VDC) and at district level through the District Development Committee (DDC).

Similarly, CRT/N took a demand-driven, decentralized, and women-focused approach, working with the Department of Women's Development and community-based organizations (CBOs). Due to its decentralized approach, it relied heavily on CBOs and local partner organizations (LPOs) and their village-level work. Unlike previous programmes, it did not provide end-user subsidies, and each household is responsible for paying for the hard costs of ICS.

Given that past attempts had focused mainly on the ICS hardware, CRT/N worked on the premise that this had largely been taken care of. CRT/N focused instead on the 'software', that is, the user-needs, taking a more demand-driven, qualitative approach, focused on enhancing local capacity. CRT/N considered cooking to be a woman's business,

since women are the primary collectors and managers of natural resources and the main cooks in the household.

Key elements of the programme are that it:

- is participatory and demand driven,
- provides no end-user subsidy,
- utilizes effective and appropriate technology, and
- focuses on women as a the key managers of household energy use and cooking.

The new approach focused on providing stoves with a flexible design suitable for local needs and preferences and on educating the end-user, especially women who spend much of their time in cooking-related activities.

Annex 3: UNDP Capacity Assessment Framework[27]

The UNDP Capacity Assessment Framework has three dimensions (see Figure 20):

- points of entry;
- core issues;
- functional and technical capacities.

Points of entry

UNDP recognizes that capacity resides on three levels – the enabling environment, the organizational, and the individual. Each of these can be the point of entry for a capacity assessment.

Capacity assessments sometimes begin with the enabling environment, which is sometimes called the societal or institutional level. The enabling environment is not necessarily synonymous with the national level, as it also exists at the sub-national and community levels. The enabling environment comprises elements that can facilitate or constrain the development of capacity. These include policies, rules, and norms; values governing mandates; priorities; modes of operation; and culture. Such elements exist within and across sectors. They create incentives or constraints that determine the 'rules

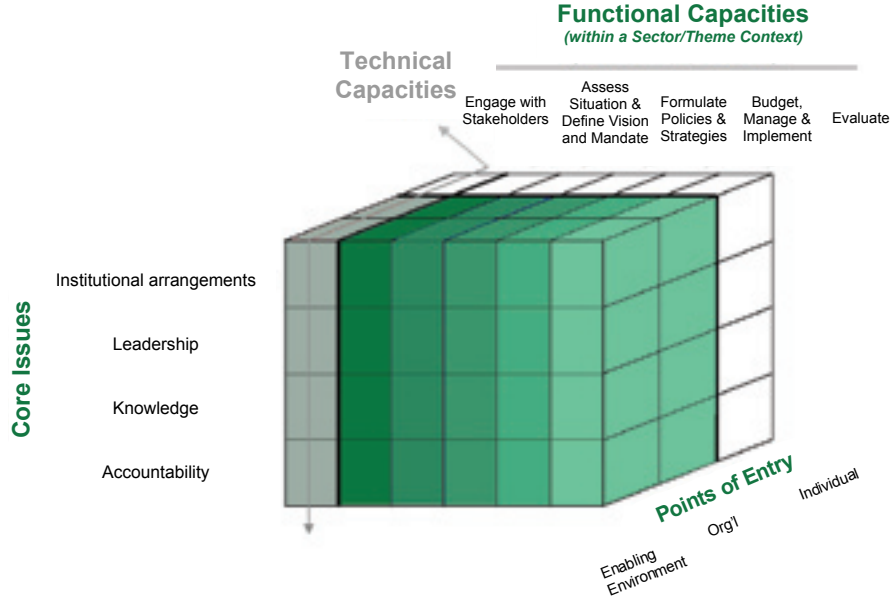


Figure 20. UNDP Capacity Assessment Framework

of the game' for interaction among sectors and can affect the performance of one or more organizations within a sector.

Organizations provide the framework for individuals to work together for a common vision and act on a shared set of goals. Capacity assessments are most commonly conducted at the organizational level. An assessment at this level usually focuses on the organization's internal workings and may be motivated by the need to establish or improve specific capacities.

Individual assessments usually take place within the context of an organizational assessment, for example to identify programme champions or change agents. Wide-scale individual performance appraisals are generally carried out through performance management systems and are the responsibility of the countries and organizations concerned.

Core issues

UNDP sees four core issues that are most commonly encountered across sectors and levels of capacity: (1) institutional arrangements; (2) leadership; (3) knowledge; and (4) accountability. Capacity assessment teams should consider all of these issues as it defines the scope of an assessment, although the final assessment need not address all four. They can be amended, removed, or replaced by others, depending on the needs of the client and the situation.

Institutional arrangements refer to the policies, procedures, and processes that countries have in place to legislate, plan, and manage the execution of development, rule of law, measure change, and such other functions of state. By its nature, the issue of institutional arrangements shows up in every aspect of development and public sector management. Whether these are ministries of finance or planning, or offices of disaster risk reduction, or whole sectors such as justice and health, the imperative of functioning and efficient institutional arrangements remains a strong driver of capacity and therefore, ultimately, of performance. Also by its nature, the parameters of change within institutional arrangements often lie in all three capacity levels. Human resources management, for example, is inextricably linked at all levels – at the level of the individual, at the level of the organization/sector, and then at the level of the enabling system such as through their centrality within civil services by-laws etc. Capacity assessments frequently reveal inefficiencies across all of government because of suboptimal institutional arrangements. For example, intra-government coordination mechanisms are frequently remiss; human resources arrangements are ad hoc; or different agencies use different monitoring and evaluation frameworks, and so on.

Leadership is the ability to influence, inspire and motivate people, organizations and societies to achieve, and go beyond, their goals. An important characteristic of good leadership is the ability to anticipate (sometimes catalyse), be responsive to, and manage change to foster human development. Leadership is not synonymous with a position of authority; it can also be informal and manifest itself in many ways and at different levels. Although leadership is most commonly associated with an individual leader, from a village elder to a country's prime minister, it can equally reside within a government unit that takes the lead in implementing public administration reform, or in large social movements that bring about society-wide change. What aspects of leadership are

important across these different levels? A key determinant of leadership is whether it is able to rally others around a common goal. Does it have the capacities to create a vision and manage implementation of this vision? Does it set the example for ethical conduct?

Knowledge refers to the creation, absorption, and diffusion of information and expertise towards effective development solutions. What people know underpins their capacities and hence capacity development. Knowledge needs can be addressed at different levels (national/local/sector, primary/secondary/tertiary) and through different means (formal education, technical training, knowledge networks, and informal learning). While the growth and sharing of knowledge is primarily fostered at the level of the individual, it can also be stimulated at the level of organizations, for example, through a knowledge management system or an organizational learning strategy. At the level of society, knowledge generation and exchange are supported, for example, through educational policy reform, adult literacy campaigns, and legislation on access to information.

Accountability exists when two parties adhere to a set of rules and procedures that govern their interactions and that are based on a mutual agreement or understanding of their roles and responsibilities vis-à-vis each other. Put differently, it exists when rights holders and duty bearers both deliver on their obligations. This manifests itself in day-to-day engagements, such as in the relationship between a service provider and a client, between a teacher and a student, between an employer and an employee, between a state and its citizens, between a provider of development aid and its recipients, and so on.

Functional and technical capacities

Functional and technical capacities make up the third dimension of the UNDP Capacity Assessment Framework. Functional capacities are needed to create, manage, and review policies, legislation, strategies, and programmes across levels of capacity (enabling environment, organizational, individual) and core issues (institutional arrangements, leadership, knowledge, accountability). They are key to 'getting things done' and are not associated with any one particular sector or theme. The five functional capacities are: (1) engage stakeholders; (2) assess a situation and define a vision and mandate; (3) formulate policies and strategies; (4) budget, manage, and implement; and (5) evaluate. Various technical capacities may also need to be assessed, depending on the situation; they may be added to the set of functional capacities as needed.

Functional and technical capacities adapted to the programmes analysed in this study

For the purposes of this study, the above UNDP-defined functional capacities were used as a starting point. Once the energy delivery programme activities had been analysed, these functional capacities were then adapted to better fit the functional and technical capacities observed in the programmes. For details, refer to Annex 4.1 and 4.2

Annex 4: Functional and technical capacities and associated activities

Table 3 provides a more detailed orientation of the types of actors and institutions involved in ensuring the success of the Rural Energy Development Programme.

Table 3. Actors and institutions involved in REDP's MHS Programme

Central/national level	District level	Community level
Ministry of Environment /AEPC National Executive Agency **Project Management Support Unit** Professional and support staff responsible for implementation **Programme Advisory Committee (PAC)** Made up of Secretary of MoE Chair, and representatives from Ministry of Finance, Ministry of Local Development, Ministry of Energy, Ministry of Forests and Soil Conservations (MoFSC), National Planning Commission (NPC), Department of Women and Development of MoWCSW, the World Bank, ADDCN, NAVIN, and UNDP. Provides overall policy direction, assesses progress and achievement. **Programme Executive Board (PEB)** NPD (Chair and Project Executive role), ARR, Energy, Environment and Disaster Management Unit, UNDP (Senior Supplier role) and representatives of MoF ADDCN, and NAVIN (Senior Beneficiary role). Responsible for making consensus-based management decisions, including approval of programme revision and work plans. **Technical Review Committee (TRC)** Technical, financial, social and environmental evaluation and endorsement of each MHS. **Agricultural Development Bank of Nepal, Ltd. Nepal (ADB/N)** Provision of loans for MHS purchase. **Micro Hydro Private companies/suppliers** Engaged in manufacturing, supply, and installation of micro-hydro turbines, including other electro-mechanical components.	**District Development Committee: Rural Energy and Environment Section (DDC: REDS/DEES)** Planning, management and implementation activities. **District Energy Fund (DEF)** Fund mobilization and utilization **District Energy Committee (DEC)** Related line agencies conducting coordination and resource mobilization. **DEEMC** DDC Chair, LDO, and Energy Development Officer (EDO) for day-to-day implementation activities. **Support Organization (SO)** Local NGOs implementing the community mobilization process at community level **Regional Energy Service Centre (RESC)** Private sector organization providing technical (survey, fabrication, repair and maintenance) support for the micro-hydro system technology.	**Community Organization (CO)** Broad-based grassroots organization of community people. There are separate COs for men and women. **Micro-Hydro Functional Group (MHFG)** Users' group specifically for planning and management of micro-hydro. Made up of members from the COs, ensuring equitable participation. **Community Energy Fund (CEF)** Mobilization and utilization of fund, including grant, equity, loan and monthly electricity tariff collected from consumers.
Micro Hydropower Manufacturers Association of Micro Hydropower Manufacturers/Producers		

Annex 4.1 National Micro-Hydro Programme

1. Planning, oversight, and monitoring

This functional role includes activities that aim to establish, provide general oversight, and monitor the energy programme. This might mean devising strategies and actions to successfully execute the programme and selecting staff and partner organizations at national, sub-national, and local levels.

National level:

- *Staff Recruitment*: The MHS programme (REDP) supports the recruitment of EDOs and other staff and orientation for the REDS (now called DEES) of the local government (DDC)) [1996–2006].
- *Knowledge Sharing for Planning and Monitoring*: Seminars and workshops are organized by the programme at the national level. These meetings' proceedings are published to codify the acquired lessons and maintain a track of the MHS Programme's progress [1996–2006].
- *Knowledge Codification for Planning and Monitoring*: The programme captures and shares programme knowledge by developing community mobilization guidelines, technical guidelines for MHS installation, environmental assessment guidelines, MHS management and implementation guidelines, etc. [1996–2006].
- *Programme Status Reporting*: The programme publishes annual reports on the status of the MHS Programme and its achievements [1996–2001]. After 2001, REDP continued to prepare the annual reports, which were submitted to UNDP for publication [2001-2006].
- *Evaluation*: The main governmental programme coordinating agency (AEPC) organizes a Technical Review Committee, which conducts technical and financial appraisal/ evaluation and endorsement of the MHSs. REDP was evaluated by independent external experts prior to each replication and/or expansion phase [2003–2006].
- *Knowledge Codification to Track Programme Progress*: Seminars and workshops are organized by the main governmental programme coordinating agency (AEPC). Proceedings of the meetings are published to codify the acquired lessons and maintain a track of the MHS Programme progress [2005–2006].

District level:

- *Village Selection*: The local government (DDC) selects the VDCs that will participate in the MHS Programme, following a pre-established set of criteria (needs-based, technical parameters, access to resources, etc.) [1996–2006].
- *Selection of NGOs*: The programme (REDP) identifies and pre-selects district NGOs (or in some cases village-level) to become SOs based on their community mobilization and people management skills. These SOs will support COs in implementation of the MHS programme [1996–2006].

- *Knowledge Sharing and Codification for Planning and Monitoring*: Seminars and workshops are organized by the programme (REDP) at the district level through DEES. Proceedings of the meetings are published to codify acquired lessons and maintain a track of the MHS Programme progress [1996–2006].
- *Organizing Review Meetings*: The programme (REDP) conducts district activities reviewed through district rural energy management committee meetings, also through DEES and DEEMC [1996–2006].
- *Knowledge Sharing for Planning and Monitoring*: The SOs participate in the monthly meeting with REDS and annual/bi-annual review with REDP aimed at sharing programme implementers' experiences, learning from past lessons, planning and improving the programme [1997–2006].

Community level:

- *Staff Recruitment*: The programme (REDP) identifies potential entrepreneurs from communities with the support of the community itself to be trained as operators and technicians, through an application system and a rigorous screening process [1996–2006].
- *Conducting Meetings*: The programme (REDP) conducts weekly meetings through CMs for implementation of community mobilization to facilitate, motivate, monitor and improve the performance of community mobilization activities [1996–2006].

2. Policies and regulation

This functional role's activities include developing, proposing, lobbying, and otherwise advising on policies and regulations, and promoting financial support to facilitate the establishment of an energy programme and its implementation. These activities mostly occur at national and district levels, where policymaking bodies operate.

National level:

- *Formulating and Approving Rural Energy Policy*: The government coordinating agencies, National Planning Commission and Alternative Energy Promotion Centre (AEPC), under the Ministry of Environment (MoE), prepares and submit the Rural Energy Policy to Cabinet for approval. GoN approved Rural Energy Policy in 2006.
- *Proposing Policy and Regulation Advisory Services*: The governmental programme coordinating agency Alternative Energy Promotion Centre (AEPC), under the Ministry of Environment (MoE), proposes and recommends energy policies and regulations to promote the MHS Programme, with support from REDP [2003–2006].

District level:

- *Proposing Policy and Regulation Advisory Services*: The programme (REDP) facilitates and supports setting up DEES and self-governing energy funds (e.g., District

Energy Fund) by advising on policies and regulations to the District Development Committees/ Councils [1996, 1998, 2000, and 2003].

3. Situational analysis

This functional role includes a study (or series of studies) and in-depth analysis of an energy programme's geographic, socioeconomic, and technological context. It includes energy needs appraisal(s) for local communities and end-users, which are necessary to support the success and sustainability of the programme, as well as a regional energy assessment and strategic planning.

District level:

- *District Energy Planning*: The District Energy Advisors (DEAs, prior to 2002) and Energy Development Officers (EDOs, 2002 onwards) conduct district energy planning based on an energy balance study, following bottom-up energy planning process guidelines (analysis of supply versus demand for every district and village cluster). [1996, 1998, 2000, and 2003].
- *District Energy Situation Reporting*: The programme (REDP) supports the local government (District Development Council (DDC)) to prepare the District Energy Situation Report, which is drafted by the DEA/EDO [1996–2006].
- *Annual Rural Energy Planning*: The programme (REDP) supports the local government (DDC) to prepare the Annual Rural Energy Plan through the District Energy Committee (DEC). The DEA/EDO contributes to drafting this strategic document, which takes into account the results presented in the District Energy Situation Report and formulates potential regional energy strategies [1996–2006].
- *Rural Energy Master Planning*: The programme (REDP) supports the local government (DDC) in preparing the Rural Energy Master Plan. Drafted during the initial phase of the MHS Programme in each district, this document codified the energy situation analysis and devised energy strategies to reach the target energy supply goals for each district [1996, 1998, 2000, and 2003]. This activity was attempted but did not have the intended impact and was therefore stopped after 2003.

Community level:

- *Identifying Local Energy Needs and Supply Options*: The programme (REDP) uses REDS to study local energy needs and analyse supply options. In the case of MHSs with capacity exceeding 20 kW, REDS hires sub-contractors and consultants to conduct/ assist with these studies [1996–2006].
- *Resource and Needs Assessment*: CMs, hired by SOs, identify local energy resources and household energy needs via a household survey and participatory rapid appraisal (PRA). The results of these surveys are codified in the form of technical pre-feasibility studies [1998–2006].
- *Sites Selection*: The programme (REDP) and the local government (DDC) support local communities involved in the MHS Programme to identify potential micro-hydro sites. At a later stage, pre-feasibility studies for the selected sites are prepared [1998–2006].

4. Stakeholder dialogue, communications, and community mobilization

This functional role's activities include dialogue(s) between stakeholders involved in an energy programme from local communities to institutional partners, as well as raising awareness on programme-related issues among local communities, media communication and the dissemination of achievements and benefits of the proposed programme.

National level:

- *Promoting Programme Advocacy and Raising Awareness*: The programme (REDP) promotes MHS programme advocacy and raising awareness on energy-related issues (renewable energy benefits, potential gains brought about by MHS in terms of human welfare and business development) by organizing seminars, publishing articles, posters and reports, and appearing in national media [1996–2003].
- *Promoting Programme Advocacy and Raising Awareness*: The programme (REDP) supports national and district Non-Governmental Organizations (NGOs) in MHS Programme advocacy and raising awareness. At this level, the main partner NGOs is the National Association of Village Development Committees in Nepal (NAVIN) and the Association of District Development Committees in Nepal (ADDCN) [2003–2006].

District level:

- *Village Selection*: A dialogue is established to define a final list of VDCs for the MHSs between the EDO, DEC (who ranks the district VDCs based on their energy planning), and the local government (DDC) [1996, 1998, 2000 and 2003].
- *Knowledge Sharing to Improve Communication*: Energy planning workshops are organized annually to exchange ideas among MHS stakeholders in each district. The programme (REDP) supports the Rural Energy Development Section (REDS) of the local government (DDC) to prepare these workshops [1997–2006].
- *Knowledge Sharing to Improve Communication*: DEES/SOs organize seminars and workshops, aimed at sharing stakeholders' and implementers' experience, learn from past lessons and plan and improve the programme [1997–2006].
- *Promoting Programme Advocacy and Raising Awareness*: The programme (REDP) supports district and national NGOs in MHS Programme advocacy and awareness-raising. At this level, the main partner NGO is the District Energy Network (DENET) [2003–2006].

Community level:

- *Sharing Knowledge under Functional Groups*: Functional Groups (FGs) representing the COs that are formed; female and male groups have equal an number of members and voting power. The FGs work on different energy technologies or related activities (e.g., there are FGs on MHS, Forestry, Income Generation, etc.). These FGs manage and implement the programme at the community/village level [1996, 1998, 2000, and 2003].

- *Training on Energy Services*: The SOs conduct community-based public campaigns and training on productive use of modern energy services. These are often tailored to suit specific skills in different communities which is conducted by DEES (e.g., using lighting for Thanka painting, a traditional skill in some areas, or rural carpentry) [1996–2006].
- *Applying for Financial Aid*: Communities, with support from DEES/CMs, meet to plan and apply for financial aid (loans) from the Agricultural Development Bank of Nepal (ADB/N) [1996–2006].
- *Conducting Meetings*: The programme (REDP) conducts monthly CM review meetings [1996–2006].
- *Awareness Raising and Resolving Issues*: CMs, under the SOs contracted by District Development Committee with support of REDP, continuously engage with locals (CMs live in the villages, but must be from a different village to avoid conflict of interest, during the MHS implementation and for up to two years from the project's inception) to raise awareness on energy-related issues (renewable energy benefits, potential gains brought about by MHS in terms of human welfare and business development), and to resolve any problems as they arise [1997–2006].
- *Awareness Raising*: Locals show the area around the village (in-kind contribution) to CMs and other members of the SOs. These visits contribute to the awareness raising efforts at local communities and to the collection of data for pre-feasibility studies [1997–2006].
- *Knowledge Sharing for Programme Improvement*: Communities meet once per week under COs and once per month under FG as the mass meeting to discuss general and MHS-related issues (maintenance, tariff, problems, etc.) [1997–2006].

5. Setting up and enhancing institutions

This functional role includes activities that aim to create/set-up and enhance/build institutions and facilities that are necessary to implement an energy programme. Activities include construction and provision of physical sites as well as establishing or enhancing administrative institutions that are coordinating, providing oversight and monitoring the programme.

National level:

- *Establishing Rural Energy Service Centres*: The programme (REDP) sets up a Rural Energy Service Centre (a private service provider) in each district and trains its staff on the technical and managerial aspects of the MHS as well as of other energy technologies such as biogas, peltric set, ICS, Solar home system [1996, 1998, 2001 and 2003].

District level:

- *Forming District Energy Committees*: The programme (REDP) organizes meetings with the Government of Nepal (GoN) district representatives from related ministries

(line agencies) and other related institutions to form the District Energy Committee (DEC), the MHS district level coordinating agency [1996–2006].
- *Preparing Enterprise Development Plan*: The programme (REDP) develops the necessary institutional arrangements to facilitate and maintain strategic marketing linkages and prepares an Enterprise Development Plan [1996–2006].

Community level:

- *Recruitment of CMs*: Support Organizations (SOs) hire Community Mobilizers (CMs) to support communities to form Community Organizations (COs), which are the main MHS Programme village implementers and managers. These CMs live and continuously develop their work in the village [1996, 1998–2001, 2003, 2005–2006].
- *Setting up Institutions*: As per the needs, SOs hire sub-contractors and consultants to contribute to setting up institutions and structuralize the MHS Programme at this level [1997–2002].

6. Training of community and programme implementers

This functional role includes different levels of training: (i) provided to end users at the community level, for example, training on how to install and operate an energy system; and (ii) training to institutions (their staff) working at district and national levels on how to set up and manage organizations and other institutions to develop the capacity necessary for the successful implementation and completion of an energy programme. Additionally, income generation training for business development, and subsequent training of actors on various issues; both of these are essential to achieve programme sustainability. All forms of training may come as formal education as well as practical exercises, exchange workshops or country study tours.

National level:

- *Orientation Training*: The programme (REDP) conducts orientation training to newly recruited EDOs, TOs, Administrative and Finance Associates, CMs and CMCs. These officers and staff members contribute to the planning and management of the MHS Programme within the district [1996, 1998, 2000, 2003, and 2005].
- *In-service Technical Training*: The programme (REDP) conducts in-service technical training for Technical Officers. These officers coordinate and manage the MHS installation in several VDCs within a district [1996–2006].
- *Training in Social Mobilization*: The programme (REDP) provides training in social mobilization at the community level to Community Mobilizer Coordinators (CMCs) and Community Mobilizers (CMs) [1996–2006].
- *Accounting Training*: The programme (REDP) provides accounting training to the Administrative and Finance Associate who will be responsible for accounting and financing in the Rural Energy Development Section (REDS) within the local government (DDC) [1996–2006].

- *Training on System Operations*: The programme (REDP) provides training, first on electro-mechanical operation and later on agro-processing mill operation. Mills are only operated by a limited number of certified technicians (those who have taken the course) [1996–2006].
- *Training on Programme Management*: The programme (REDP) provides training to MH managers on programme management and technical operation (175 MH managers in 25 districts) [1996–2006].
- *Training on System Operations and Monitoring Techniques*: The main programme implementer (REDP) provides training to MH operators on micro-hydro technical operation and monitoring techniques (285 MH operators in 25 districts) [1996–2006].
- *Staff Training*: The programme (REDP) provides training to RESC Staff.
- *Providing Technical Training and Monitoring Support*: External programme implementers (i.e., National Micro Hydro Development Association, NMHDA) and various other training institutes become partners of REDP to provide technical service. This service is aimed to strengthen the capacity of officers, staff members and community members through technical training and monitoring support [2002–2003].

District level:

- *Training on Technical Capabilities*: The programme (REDP) provides training to the local government (DDC) technicians on technical capabilities/capacity required to monitor and provide back-up technical support during and after the project completion [1996–2006].
- *Training on Energy and Gender Issues*: The programme (REDP) provides training on energy and gender, and gender mainstreaming to the local government (DDC) and the District Energy Committee (DEC) [1996–2006].
- *Organizing Study Tours*: The programme (REDP) organizes in-country study tours for members of COs and COs from each district, to learn 'in-situ' from the MHS Programme implementation in different districts [1996–2006].
- *Training on Programme Management*: The programme (REDP) provides training and orientation to VDCs on MHS Programme management and on the role of VDCs in promoting energy technologies [2003].

Community level:

- *Training*: CMs, with support from REDP, provide training on gender mainstreaming, resource mobilization, planning, management, and decision-making to COs [1996–2006].
- *Institutional Development Training*: The programme (REDP) provides institutional development training to COs and VDCs on accounting, bookkeeping, gender mainstreaming and general institutional development [1996–2006].
- *Training on MHS Applications*: The programme (REDP) provides training to local communities on potential MHS applications for income generation, and particularly on the use of electric and mechanical power from MHS for business development [1996–2006].

- *Organizing Study Tours*: The programme (REDP) organizes in-country study tours for VDC members, local entrepreneurs and cooperatives to learn and exchange lessons from peers' experiences in implementing the MHS Programme [1996–2006].

7. Implementation and management

This functional role is usually outsourced and/or decentralized and can be foreseen to eventually include activities that will be absorbed by the private sector when market transition takes place. This could include activities that aim to administer, operate and manage the energy programme.

National level:

- *Hiring Sub-contractors to Implement and Manage*: The programme (REDP) hires sub-contractors and consultants on specific assignments to work on devising strategies, implementing and managing the programme at national level [1996–2006].
- *Hiring Sub-contractors to Implement and Manage*: The main governmental programme coordinating agency (AEPC) hires sub-contractors and consultants to work on strategizing, implementing and managing the MHS Programme. Before 2005, the national programme coordination was performed by the Ministry of Local Development (MoLD) [2005–2006].

District level:

- *Hiring Sub-contractors to Implement and Manage*: The programme (REDP) hires sub-contractors and consultants to work on specific assignments such as devising strategies, and implementing and managing the MHS Programme at district level, if needed [1996–2006].
- *Knowledge Sharing for Programme Improvement*: Seminars and workshops are organized by DEES/SOs at the district level. These meetings' aim to share programme implementers' experience, learn from past lessons and plan (strategise) and improve the programme, based on those experiences [1997–2006].
- *Staff Recruitment*: The local government (DDC) hires an Office Assistant and a Messenger as Support Staffs of REDS to manage office and establish a link and communication between VDCs and the district government, thus improving programme implementation and coordination [2001–2006].

Community level:

- *Hiring Sub-contractors to Implement and Manage*: SOs hires sub-contractors and consultants to contribute to the MHS Programme local management in specific cases like conducting training on income generation and micro enterprise establishment [1997–2002].

Annex 4.2 National Improved Cooking Stoves

1. Planning, oversight and monitoring

This functional role includes activities that aim to establish, provide general oversight as well as monitor the energy programme. This might mean devising strategies and actions to successfully execute the programme and selecting staff and partner organizations at national, sub-national and local levels.

National level:

- *District Selection*: A district selection process is performed, supported by the main governmental programme coordinating agency (AEPC) and hosted by the main programme implementer (CRT/N). It includes a stakeholders' workshop, a prioritization list and a district ranking. The National ICS Programme is subsequently implemented in the districts recommended by through this district selection process/ranking [1999 and 2003].
- *Staff Recruitment*: The main programme implementer (CRT/N) hires sub-contractors and consultants to monitor and assess the programme's implementation and progress, mostly at national level, but also in the districts [1999–2003].
- Selection of Programme Implementers: External programme implementers (RUCODES and CSD) become part of the National ICS Programme to provide technical service to enhance the capacity of LPOs, monitoring support and technical training [2002–2003].
- *Knowledge Sharing for Planning and Monitoring*: The main governmental programme coordinating agency (AEPC) organizes seminars and workshops to exchange information and provide a continuous programme evaluation. These meetings' proceedings codify acquired lessons and maintain a track of the National ICS Programme's progress [2005].
- *Resource and Needs Assessment*: Action research is conducted to monitor end-user requirements because of regional idiosyncrasies (fuel used and constructing material available, energy needs, cooking requirements). Depending on the results of this research, the stove design is periodically modified or developed to better suit end-users' needs [2005–2006].

District level:

- *Selection of LPOs*: The main programme actors at this level (DDC, WDO and CRT/N) select the LPOs that will participate in the National ICS Programme implementation. These LPOs are responsible for the promotion and implementation of the National ICS Programme at the community level [2000, 2002–2003].
- *District Selection*: The DDC, WDO and other district-level stakeholders, such as LPOs, select the National ICS Programme VDCs, following a set of criteria previously defined, such as local energy requirements, gender and environmental impacts, potential business development etc. [2000, 2002–2003].

- *Knowledge Codification for Planning and Monitoring*: Information materials, including field test results, are designed, developed and published, to consolidate the ICS Programme achievements, and are sub-contracted to the Nepal Forum for Environmental Journalists. This activity is of great relevance to promote the programme [1999 and 2003].
- *Monitoring*: The National ICS Programme Coordination Committee meetings are held quarterly. These meetings aim to incorporate local feedback to district level coordination from other National ICS Programme stakeholders. This process benefits from the interaction among community actors fed into the programme implementation at the district level [2000–2003].
- *Knowledge Sharing for Planning and Monitoring*: The main programme implementer (CRT/N) organizes seminars and workshops to exchange ICS Programme information mostly at the district and national levels. These meetings' proceedings are published to codify the acquired lessons and maintain a track of the programme's progress [2000–2001].

Community level:

- *Monitoring*: Promoters monitor 100 per cent of the ICSs they have installed. This is included in the ICS installation price as a post-installation service. This service is given to monitor the ICS performance and address any possible installation flaws [2000–2006].
- *Monitoring*: The main programme implementer (CRT/N) and LPOs monitor at least 25 per cent of the stoves installed by the ICS promoters to assess their operation and quality of installation [2000–2006].
- *Monitoring*: CRT/N and LPOs staff test 5 per cent of the ICS installed, to assess their operation and the quality of their installation. The costs incurred by this monitoring comprise tools, equipment and testing materials necessary for the tests [2000–2006].
- *Monitoring*: Participatory monitoring is carried out by all stakeholders to review and further improve the ICS Programme. This review is additional to the other monitoring activities and is conducted from the first year of the National ICS Programme implementation, as a cross-checking programme monitoring activity [2000–2006].
- *Knowledge Sharing for Planning*: Periodic promoters' meetings are conducted (usually monthly). The promoters share information and exchange experiences among their colleagues during the meeting, reporting on the number of ICS installed and the problems faced [2000–2006].
- *Knowledge Sharing and Codification for Planning and Monitoring*: Promoters' interaction workshops are conducted on a regional basis some years after the ICS Programme starts in that district. These meetings serve to exchange ideas, success cases and understand different issues faced by the promoters within the region. The end goal of these workshops is to codify the lessons learned after some years of National Programme implementation [2004–2005].

2. Policies and Regulation

This functional role's activities include developing, proposing, lobbying and otherwise advising on policies and regulations, and promoting financial support to facilitate the establishment of an energy programme and its implementation. These activities mostly occur at national and district levels, where the ruling bodies passing these policies are present.

National level:

- *Proposing Policy and Regulation Advisory Services*: The National Advisory Team meets twice per year to give advice on policies and regulations to facilitate the implementation of the National ICS Programme. This team also reviews the programme's progress, solicits comments for improvement, and writes down and circulates the minutes of the meetings [1999–2006].
- *Hiring Sub-Contractors to Develop Policies and Regulations*: The main programme implementer (CRT/N) hires sub-contractors and consultants to work on developing policies and regulations, mostly at national level but also at the sub-national/district level [1999–2003].

District level:

- *Proposing Policy and Regulation Advisory Services*: The District Coordination Committee (DCC) meets to propose policies and regulations aimed to enhance the deployment and implementation of the National ICS Programme. The DCC is composed of major district actors, e.g., District Development Committee (DDC), Women's Development Office (WDO), District Forests Office (DFO), District Health Office (DHO) and Local Partner Organizations (LPOs) [2000].

3. Situational analysis

This functional role primarily includes a study (or series of studies) and in-depth analysis of an energy programme's geographic, socioeconomic and technological context. It includes energy needs appraisal(s) for local communities and end-users, which are necessary to support the success and sustainability of the programme, as well as a regional energy assessment and strategic planning.

District level:

- *Needs Assessment*: The evaluation of end-users' energy needs is carried out, focusing on the demand for fuel (wood), its availability and the regional demographic and environmental characteristics. This assessment is carried out via Rapid Rural Appraisal (RRA) exercises by the regional and district Promotion Centres and CRT/N staff with support from selected Village Development Committee (VDCs) members [1999, 2002–2003].

- *Local Energy Needs Assessment*: Community representatives (VDC members) participate in RRAs. These representatives bring their experience and knowledge to the local energy needs assessment [1999, 2002–2003].

4. Stakeholder dialogue, communication and community mobilization

This functional role's activities include dialogue(s) between stakeholders involved in an energy programme from local communities to institutional partners, as well as raising awareness on programme-related issues among local communities, media communication and the dissemination of achievements and benefits of the proposed programme.

District level:

- *Dialoguing to elicit Feedback*: ICS Programme Coordination Committee meets quarterly to, among other objectives, bring local feedback to district level coordination and allow for interaction among local partners. This process facilitates programme monitoring within the community and strengthens overall district programme implementation [2000–2003].
- *Awareness Raising*: Information campaigns are carried out through radio, wall newspapers, posters, hoarding boards, local newspapers, song contests, user manuals, newsletters and other promotional materials. This campaign is aimed to mainstream the National ICS Programme and to publicise its benefits (e.g., in terms of health, environment, efficiency, time, comfort) to the general public and potential users supporting user demand creation [2000–2006].
- *Social Mobilization Training*: Regional and District Promotion Centres provide capacity development support on social mobilization to LPOs. This support includes demand creation, system promotion and programme implementation. This activity also contributes to the identification of new LPOs once a new district is selected for programme implementation [2000, 2002–2004].
- *Evaluation and Knowledge Sharing on Programme Implementation*: Selected ICS promoters and Field Coordinators exchange visits to neighbouring districts, share their experiences and study the National ICS Programme implementation in those districts. This activity holds an important value for evaluating the programme's progress, acquiring lessons from peers' experience and developing an ICS District Network [2001, 2003].

Community level:

- *Social Mobilization and Awareness Raising*: Female and male promoters perform social mobilization and awareness-raising activities at the household level. These promoters visit village households and community centres, demonstrating the benefits of the ICSs, in terms of health, fuel efficiency, daily schedule and environment, to community men and women [2000–2006].

5. Setting up and enhancing institutions

This functional role includes activities that create/set-up and enhance/build institutions and facilities that are necessary to implement an energy programme. Activities include construction and provision of physical sites as well as establishing or enhancing administrative institutions that are coordinating, providing oversight and monitoring the programme.

National level:

- *Selecting Programme Coordinating Team*: An ICS Programme Coordinating Team is set up with the support from the main programme implementer (Centre for Rural Technology, CRT/N). This team includes a Programme Manager, Monitoring Officer, Accounting Officer, Regional Coordinators and Field Coordinators. This activity includes recruitment costs, and is followed by the orientation and training of the team [1999–2006].
- *Strengthening Coordinating Capacity*: The main programme donor (Danish International Development Agency, DANIDA) financially supports enhancement of the main governmental programme coordinating agency (Alternative Energy Promotion Centre AEPC). This institutional strengthening is required to increase the operational capacity of this coordinating agency [1999–2006].

District level:

- *Establishing Regional and District ICS Programme Promotion Centres*: The costs entailed by this activity included furniture, computers and office supplies. These centres are meant to coordinate the promotion of the ICS Programme in several districts (regions) [1999, 2002–2003].
- *Establishing District Network*: Main programme implementer (CRT/N) develops an informal district network (ICS Network) to maintain stockholders' interaction and cooperation once the implementer phases out from the district. After two years of programme implementation in a district, ICS promoters (stove builders and/or installers) are organized into groups, so they collectively promote the stoves. This is a critical activity for successful capacity development and for the achievement of sustainability via market transformation [2001, 2004].
- *Establishing Technology Outreach Centres*: These centres are established in regions and districts by the main programme implementer (CRT/N) to facilitate the ICS Programme scale up and test other biomass-based technologies. These centres are also meant to supply technical assistance and training services, and to deliver new technologies for increasing or changing energy needs [2005–2006].

6. Training of community and programme implementers

This functional role includes different levels of training: (i) provided to end users at the community level, for example, training on how to install and operate an energy system; and (ii) offered to institutions (their staff) working at district and national levels on

how to set up and manage organizations and other institutions to develop the capacity necessary for the successful implementation and completion of an energy programme. Additionally, income generation training for business development and training for subsequent training of actors on various issues are also important to achieve programme sustainability. All forms of training may come as formal education as well as practical exercises, exchange workshops or country study tours.

National level:

- *Performing Observation Visits*: Selected staff members from the National ICS Programme implementing agencies perform observation visits to partner national organizations in other neighbouring countries. The purpose of these visits is to learn about similar energy programmes implemented in those countries, extracting useful lessons from their successes and mistakes, and to create a Regional Country Development Network [1999–2006].
- *Strengthening LPO Capacities*: External programme implementers (i.e., Rural Community Development Society, RUCODES, and the Centre for Self-help Development, CSD) become part of the National ICS Programme to provide technical service. This service is aimed to strengthen the capacity of LPOs through technical training and monitoring support [2002–2003].

District level:

- *Training of LPOs*: Regional and District Promotion Centres provide capacity development support and training to LPOs. This training includes programme implementation, social mobilization and monitoring [2000, 2002–2004].

Community level:

- *Training of Local Entrepreneurs*: The main programme implementer (CRT/N) provides training to local entrepreneurs in awareness-raising, advocacy and social mobilization. This training is aimed to enhance the capacity of local promoters to expose the problems presented by traditional cooking. It also contributes by demonstrating the benefits that can be brought about with a relatively small investment in ICSs, in terms of health, fuel efficiency, daily schedule and environment [2000–2006].
- *Promoters' Training*: LPOs provide promoters in each VDC with hands-on training in ICS installation and kitchen management. This is a key step towards programme sustainability, because it transfers the technical know-how from NGOs and externally funded agencies to local entrepreneurs, contributing to market transformation [2000–2006].
- *Local Community Training*: Promoters provide village-level ICS orientation and demonstration programmes. In these events local entrepreneurs train the local community (mostly women) in the use of the ICSs and demonstrate their benefits and technical simplicity. They also address any technical issues that may arise. These promoters are supported by LPO staff and CRT/N Field Technicians [2000–2006].

7. Implementation and management

This functional role is usually outsourced and/or decentralized and can be foreseen to eventually include activities that will be absorbed by the private sector when market transition takes place. This could include activities that aim to administer, operate and manage the energy programme.

National level:

- *Hiring Sub-Contractors to Implement and Manage*: The main programme implementer (CRT/N) hires sub-contractors and consultants to work on devising strategies, and implementing and managing the ICS Programme [1999–2003].
- *Hiring Sub-Contractors to Manage*: The main governmental programme coordinating agency (AEPC) hires sub-contractors and consultants to coordinate and manage the National ICS Programme [2001–2006].

District level:

- *Hiring Sub-Contractors to Coordinate and Manage*: Programme Coordination Committee meetings are held quarterly. These meetings are meant to, among other objectives, coordinate the programme implementation based on local feedback. This process benefits from the programme monitoring at the community level and local actors' dialogue [2000–2003].

Annex 5: Hard cost programme components

For the MHS Programme, hard costs occur at the community level and are composed of the following:

- The GoN, with the financial support of the WB from 2003, provides subsidies for the civil work hardware items required for the MHS programme implementation. These items include tools used to perform the work, cement and other building materials, etc. [1998–2006].
- The GoN, with the financial support of the WB from 2003, also subsidize the labour costs for the civil works for the MHS programme. These labour costs include digging the channels, sloping and preparing the forebays, preparing poles, cutting trees, etc. [1998–2006].
- The communities bear the financial costs of material transportation from the supplier to each village and from the village to the power production point. These costs vary depending on the remoteness of each site [1998–2006].
- The communities also supply the in-kind labour related to the material transportation from the supplier to each village and from the village to the power production point [1998–2006].
- The GoN, with the financial support of the WB from 2003, also provides subsidies for material transportation from the supplier to each village and from the village to the power production point [1998–2006].
- The ADB/N provides loans to communities for acquiring electro-mechanical hardware necessary to set up the MHS. These elements include turbines, power generations, transformers etc. [1998–2006].
- The GoN, with the financial support of the WB from 2003, provides subsidies for acquiring electro-mechanical hardware necessary to set up the MHS. These elements include turbines, power generations, transformers etc. [2001–2006].
- The GoN, with the financial support of the WB from 2003, provides subsidies for the technicians' salaries and material costs for setting up the wiring connecting the electricity production centre to each household [1998–2006].

For the National ICS Programme, hard cost components are much simpler. Costs occur at the community level and are comprised of the following:

- End-users provide the raw material to build the ICS. This is catalogued as an in-kind contribution. The end-users collect the raw material (clay, argil etc.) required to build the ICS and, if necessary, fabricate the bricks and stock these materials in the household before the promoter comes to construct the ICS [2000–2006].
- Promoters construct and install the ICS in each household [2000–2006].
- Iron rods used by the promoter to construct the ICS in each household [2000–2006].

- In some cases, additional elements and tools are provided with the ICS to make agricultural products, for example, equipment required for producing *khowa* (boiled milk) for selling [2000–2006].
- Space heating components are also installed in some cases to use the excess heat from the ICS to heat up the household [2006].

Endnotes

1 The term 'energy services' refers to the benefits produced by using energy supplies. Energy services include lighting, heating, cooking, motive power, mechanical power, transport, and telecommunications. These services can be generated from a variety of primary energy sources, including oil, gas, coal, or renewables. They can be delivered by different energy carriers and systems for the transformation and transportation of energy, ending with the delivery of energy services within the operation and regulation of energy markets.

2 In general, micro-hydropower systems have a capacity of less than 100 kW, and are typically used for providing power for a small community or rural industry in a remote area. Very small micro-hydropower (i.e., less than 5 kW) is also referred to as pico-hydropower.

3 HDR 2009 Statistical Update-Country Fact Sheets-Nepal. Online at: http://hdrstats.undp.org/en/countries/country_fact_sheets/cty_fs_NPL.html [accessed on 20 April, 2010]

4 Ministry of Health and Population (MOHP) [Nepal], New ERA, and Macro International Inc. (2007). Nepal. *Demographic and Health Survey 2006*. Kathmandu, Nepal: Ministry of Health and Population, New ERA, and Macro International Inc.

5 Note that this estimate refers mainly to large hydropower potential, and does not include all the country's capacity for small-scale hydropower development.

6 The Energy Sector Assistance Programme (ESAP) was created in 1999 through an agreement between the Governments of Nepal and Denmark. The programme's objective is to improve the living conditions of the rural Nepalese population by enhancing access to and affordability of rural energy systems that are environmentally friendly and that address social justice.

7 'Promoter' is a colloquial term used among those working with the ICS programme to describe community-level programme implementers, including local coordinators, ICS installers, village trainers, and women promoting the use of ICSs and supporting the implementation of the ICS Programme.

8 GBP 11,250, exchanged on October 8, 2009 at a rate of USD 1 = GBP 0.6214.

9 The national micro-hydro programme in Nepal has evolved through a number of 'periods' corresponding to different levels of focus and outcomes as the programme evolved over many years. For analytical purposes, however, this study focuses on the four periods indicated above.

10 In this study, programme replication refers to the process of scaling up by using the same process (or a similar one) in a new geographic location (increasing the number of districts). When a programme's activities are replicated, a programme normally does not change its methodology. Some lessons can be learned and therefore efficiencies gained, but often setting up local institutions and capacity building still need to take place.

11 In this study, programme expansion refers to the process of expanding a programme in its current geographic location. Programme expansion normally means the use of existing institutions whilst increasing the number of units (MHSs or kW) installed. Minimizing institutional building costs can lead to significant economies of scale during periods of programme expansion.

12 Recurrent costs may include, annual operation and maintenance costs.
13 Hard cost is in essence 'capital cost' less the cost of feasibility studies and land, and does not include variable costs. Feasibility studies are instead included in capacity development costs (under the functional activity of 'Situational Analysis') and no land is purchased for either the MHS or ICS programmes analysed in this study.
14 On average, 5.4 people per household.
15 Note that, for the ICS programme, analysis of costs per unit of output is not possible for the year 1999, as actual installation of ICS began in 2000. All costs incurred in 1999 were for capacity development only.
16 This study did not disaggregate various private sources of funding. This will be an area of further study.
17 For the Improved Cooking Stoves Programme, the government financing component includes funds from AEPC and WDO. For micro-hydro, the government financing component includes funding from AEPC (grant component of the World Bank Power Development Fund) and equity investments of DDCs and VDCs. No GoN/AEPC funding is provided for subsidies, which are funded 100 per cent by external donors (i.e., UNDP and the World Bank).
18 For the ICS programme, the external grant includes funds from ESAP/DANIDA and, for later years of the study period, also NORAD. For the MHS programme, the external grant includes funds from UNDP (primarily for REDP and the district and community organizations and NGOs that it sub-contracts) and the World Bank (primarily for hard costs).
19 Typically wealthier households that own land provide their land as collateral for a community bank loan, with the understanding that all members of the community will repay the loan. In some instances, there may be a landlord–tenant relationship between landowners and members of the community.
20 In the case of the MHS programme, which covered 5 districts by 1998, 10 districts by 2000, and 25 districts by 2006, the corresponding costs for planning, oversight, and monitoring cost were USD 3,810 per kW, USD 767 per kW, and USD 687 per kW, respectively (see chapter 3 for details). An extrapolation of this trend curve to cover all 75 districts in Nepal yields an estimate of about USD 176 per kW for potential future reduction in this component of capacity development cost.
21 This is the full potential for MHS estimated by this study, covering about 50 per cent of the hill population as of 2009, or about 15 per cent of the projected population in 2030 (i.e., 6.3 million out of a projected 42 million people in 2030).
22 This is the full potential for ICS estimated by this study, covering about 50 per cent of the hill and terrain population as of 2009, or 25 per cent of projected population in 2030 (i.e., about 10.5 million out of a projected 42 million people in 2030).
23 This study assumes that the number of people to be covered per kW is about 42 people per kW in the future, while it was about 52 people per kW during the 1996–2006 period, taking into account that a larger number of smaller villages may have to be dealt with in the future. This is the reason why in Figure 17 (a), the hard cost per person may appear stable, while the hard cost per kW would decline sharply (from about $ 2500 per kW during 1996-2006 to about $ 2100 per kW in the future).
24 http://www.nea.org.np/neaintro.php [accessed on 22 April 2010]
25 http://aepc.gov.np/index.php?option=com_content&view=category&layout=blog&id=62&Itemid=87 [accessed on 20 April 2010]
26 REDP Office, Nepal.
27 This discussion is drawn from the 'UNDP Capacity Assessment Practice Note', October 2008.

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