

Terms of Reference impact evaluation of Netherlands supported programmes in the area of Energy and Development Cooperation in Rwanda

Version 01 March, 2011.

1 PURPOSE, RATIONALE AND SCOPE OF THE EVALUATION

The world today is confronted with interrelated challenges concerning poverty reduction, climate and energy. Access to energy, and increasingly *renewable* energy, is internationally considered a fundamental issue in poverty reduction, as expressed in –amongst others- the United Nations, G8 meetings and climate negotiations.¹ It is considered one of the prerequisites for achieving the Millennium Development Goals (MDGs).

The Netherlands' energy programme, launched in the early 1990s, provides both incentives to establish an enabling environment for access to energy and to activities that facilitate access to energy for the poor in developing countries. Over time, the focus of the energy and development policy, both in the Netherlands and internationally, shifted from an output-orientation with different technical options to a *renewable* energy perspective.² In 2004, the minister for development cooperation of the Netherlands formulated an output target of 10 million people being supplied with access to energy by 2015 as part of the Dutch action plan towards the MDGs. The current policy on environment and renewable energy of the Netherlands' Ministry of Foreign Affairs (July 2008) announced an extra input of € 500 million for renewable energy in developing countries through the "Promoting Renewable Energy Programme" (PREP)³. The ultimate goal of this investment is "to promote the use of renewable energy in developing countries, what will propel poverty reduction, gender equality and a mitigation of the negative effects of the use of energy on the climate".⁴

In 2008 the PREP started by supporting four - interlinked - activities:

1. Investing directly in the production of and access to renewable energy in priority countries and regions;
2. Improving the sustainability of production of biomass for energy purposes;
3. Influencing policy of partners responsible for investment in renewable energy;
4. Developing capacity and knowledge in developing countries with regards to renewable energy.

PREP is a *container structure* encompassing an array of sub-funds, programmes, projects and activities. The majority of these sub-funds and programmes has been either made available to special regional (or global) funds, or has been delegated or outsourced to third parties for either administration and/or implementation. It also encompasses energy-related Public Private Partnerships and projects by non-governmental organizations (NGOs). By 2009, PREP funded activities in 33 countries, of which 18 in Africa, 8 in Asia and 7 in Latin

¹ For example, the Kyoto Protocol (United Nations 1997) and the World Summit on Sustainable Development (WSSD, United Nations 2002).

² Dankers and Rijs (2007), *Evaluatieve inventarisatie Energie en Ontwikkeling*, commissioned by the Ministry of Foreign Affairs, DGIS. November 2007.

³ € 375 million can be considered as 'additional' financial resources.

⁴ Ministry of Foreign Affairs, DMW (2008), *Beleidsnotitie milieu en hernieuwbare energie in ontwikkelingssamenwerking*: The Hague, July 2008, p.10.

America. Not all activities are necessarily restricted to the administrative boundaries of a country.

In September 2009, the Policy and Operations Evaluation Department (IOB) of the Netherlands Ministry of Foreign Affairs elaborated framework Terms of Reference (ToR) for the evaluation of Netherlands supported programmes in the area of Energy and Development Cooperation. This is an overarching framework for a series of impact evaluations of renewable energy and development programmes supported by the Netherlands, with a focus on the medium and long term effects of these programmes on end-users or final beneficiaries. Due to budget restrictions imposed early 2011, these framework ToR can not be fully adhered to.

A characteristic of these studies is the use of quantitative research techniques ('rigorous methods') in combination with qualitative techniques, to get insight in the magnitude of effects. The purpose of the impact evaluations is to account for the assistance provided, as well as to draw lessons from the findings for improvement of both policy and policy implementation. The results of these impact evaluations will be input to a policy evaluation of the "Promoting Renewable Energy Programme" (PREP) to be concluded in 2014.⁵

1.1 CENTRAL EVALUATION QUESTION

The central research question for the impact evaluations is⁶: "*What have been the effects – positive or negative, intended or not – on living conditions of target groups of the energy and development cooperation programmes and projects supported by the Netherlands and how sustainable are the results achieved*"?

'Access to energy' is defined from a demand perspective to include energy services that improve living conditions (e.g. electricity for lighting and fuel for cooking) and enables social services and economic production (e.g. cooling of medicines, communication, manufacturing).⁷

The evaluations will focus on different types of direct investments in both production and improved access to energy, amongst them *biogas, electrification, solar lanterns and efficient cooking stoves*. The unit of analysis includes affected individuals (m/f), households⁸, public facilities and small enterprises. The impact on macro variables, such as the climate, is not subject to own research but will be covered, if possible, in the descriptive part of the programme evaluations.

⁵ The framework ToR envisaged the finalisation in 2013, but the period has been extended in January 2011.

⁶ Reference Framework Terms of Reference impact evaluation of Energy and Development Cooperation supported by the Netherlands, Sept 2009.

⁷ Chapter 1.1. access to Energy. W.J.Cornelissen. SEOR (2008), *Accountable in Silence. Evaluation Dutch/German Partnership Energising Development* report to Environment and Water Department (DMW), Ministry of Foreign Affairs, the Netherlands.

⁸ The concept "household" is not internationally uniform. The concept should be made operational for Rwanda on the basis of documentation, standards used by the National Institute of Statistics Rwanda (NISR) and experts' opinions.

For the series of impact evaluations two⁹ countries with a concentration of Netherlands' supported activities have been selected, notably Indonesia and Rwanda. Initially there was a selection of five countries, for which the following criteria were used: (i) the priority of the region / country in the PREP programme, (ii) the concentration of Netherlands supported activities; (iii) the coverage of the main types of intervention and (iv) the implementation through a mix of partners.¹⁰ The evaluations of selected interventions in the energy sector in these countries will be documented in a single synthesis report, scheduled for 2014. Next to this report, country specific reports for Indonesia and Rwanda will be elaborated, encompassing an analysis of the entire package of interventions within the context of the national policies and institutions. The present terms of reference is restricted to impact evaluation of Netherlands' supported programmes in the area of Energy and Development Cooperation in **Rwanda**.

2 ENERGY INTERVENTIONS IN RWANDA

2.1 ENERGY CONTEXT

As in many African countries, energy consumption in Rwanda is dominated by biomass: a total of 86% of primary energy is derived from biomass sources. Of the remaining 14%, petroleum products account for 11% (used mainly in the transport sector) and electricity 3%.¹¹ The Government of Rwanda (GoR) foresees a dramatic change in this pattern over the years to come. Striving for achieving substantial growth of the national economy in a sustainable and environmentally sound manner, the development of the energy sector receives a prominent role in Rwandan policy.

Rwanda's current socio-economic goals are formulated in the Economic Development and Poverty Reduction Strategy (EDPRS) which covers the period 2008-2012 and is the follow-up of the country's first PRSP. This strategy sets the framework for achieving the country's longer term development goals as formulated in Rwanda's *Vision 2020*. The *Vision 2020* forecasts the transformation of Rwanda into a middle-income country, making a shift from a subsistence agriculture economy to a knowledge-based society whereby 35%¹² of the population will have access to electricity by 2020 (up from 6%) and the consumption of fuel wood will have decreased by then to 50%.¹³

The main objective of the energy sector is to contribute to this accelerated socio-economic development by powering the social and economic sectors in order to improve well-being and

⁹ Up to January 2011, Burkina Faso, Ethiopia and Senegal were also selected. Budget constraints urged for a reduction to two country studies complemented by separate studies in Burkina Faso and Senegal.

¹⁰ Framework terms of Reference Impact evaluation of Energy and Development Cooperation supported by the Netherlands. Section 5. September 2009. In January 2011 the selection criteria used to reduce of the number of countries were: (i) implementation Agreements already signed (ii) likelihood that countries will remain on the list of partner countries of the Netherlands' development assistance (iii) costs of the envisaged studies per country.

¹¹ Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*, Kigali, January 2009.

¹² The Ministry of Infrastructure is currently even considering a more ambitious target of 50% by 2020 (Interview MININFRA, July 2010).

¹³ Ministry of Finance and Economic Planning (2000), *Rwanda Vision 2020*. Kigali, July 2000.

the quality of life of the population. Four specific objectives have been identified to achieve this main objective¹⁴:

1. Increase access to electricity for enterprises and households;
2. Reduce cost of service in the supply of electricity and introduce cost reflective electricity tariffs;
3. Diversify energy supply sources and ensure security of supply;
4. Strengthen the governance framework and institutional capacity of the energy sector.

Recognizing the need to develop a strong policy and institutional framework to address the country's development aspirations, the Ministry of Infrastructure (MININFRA) has developed a National Energy Policy and National Energy Strategy 2008-2012. The National Energy Policy, which is an update of the 2004 Energy Policy statement, positions the energy policy within Rwanda's long-term development vision. The energy policy pays special attention to the requirements for a progressive development of the electricity sector and to household energy demand. In line with objectives formulated in the EDPRS, the Energy policy not only stresses the importance of availability of affordable energy, but also the rational and efficient use of it in an environmentally sound manner. In contrast to the 2004 energy policy, the GoR expresses its commitment regarding private sector participation and regional cooperation in energy issues. The National Energy Strategy describes the key interventions needed to achieve these policy aims and elaborates on a range of renewable energy resources, amongst them (large and micro) hydro plants, biogas, methane gas, solar and wind resources¹⁵. To minimize dependence on imported petroleum products the exploitation of indigenous energy sources is stressed, which relates both to renewable energy sources and oil exploration activities in Rwanda.

The Rwandan government closely collaborates with donors in the energy sector. In May 2008 a Memorandum of Understanding was signed between the GoR and some development partners¹⁶ which formed the basis of a sector wide approach in the energy sector.¹⁷ Within this SWAp the donors agree to support "the energy sector's development and reform programmes that are based on Rwanda's Vision 2020 and the EDPRS". A Joint Energy Sector Review, led by MININFRA is held annually, reviewing progress in the previous year and identifying the resources available and gaps existing for the activities to be undertaken in the coming year.

The support to the Rwandan energy sector encompasses: (i) electricity; (ii) biomass; (iii) hydrocarbons¹⁸. The electricity segment has initially received the main attention given the budgetary implications. The 'Investment Prospectus- Electricity Access Roll-Out Programme (EARP) was developed in 2008 to identify the required funding for the plan and provide the details on the geographical expansion of the grid (for further information see below). The EARP is concentrates specifically on improving access to electricity. The energy "Master Plan" sets out the long-term development of the electricity system in Rwanda, focusing on

¹⁴The Republic of Rwanda (2007), Economic Development and Poverty Reduction Strategy (EDPRS). September 2007.

¹⁵ Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*: Kigali, January 2009, p.1.

¹⁶ Next to the Netherlands: World Bank, the European Union, the African Development Bank, Belgium, JICA, OPEC Fund for International Development (OFID), Arab Bank for Economic Development in Africa (BADEA) and Saudi - African Development Bank.

¹⁷ Memorandum of Understanding between the Government of the Republic of Rwanda and the Development Partners for a Sector Wide Approach in the Energy sector, May 2008.

¹⁸ Since the Dutch focus is on renewable energy, the Netherlands support the first two pillars only.

generation development and strengthening and extension of the high voltage transmission network.

In Rwanda in 2007, electricity was mainly generated from thermal sources (54%), followed by net imports (33%) and hydro power (13%). The increased demand for electricity due to extension of the grid is being complemented by hydro power sources (also serving off-grid connections) and thermal power (foreseen to shift from heavy fuel to methane gas extracted from Lake Kivu).¹⁹ The methane gas extraction from Lake Kivu is expected to provide up to a total of 50-70 MW by 2012.²⁰ The Hydropower Atlas (2007) identified 333 existing and potential future hydro sites with a combined capacity of 96 MW.²¹ Apart from these domestic sites also several major regional hydro plants have been identified such as the Rusizi (I-IV) power plants bordering the Democratic Republic Congo (DRC) and Burundi.

To address the high consumption and increasing pressure on forest resources, the Ministry of Natural Resources (MINIRENA) developed its “Five-Year Strategy 2009-2013”²² embedded in the Vision 2020 and directly linked to the medium term expenditure framework. The national policy for the conservation and protection of environment was enacted in 2003, later linked to the National Energy Policy adopted in November 2004. This policy sets the long-term vision for development and subsequent management of energy resources at the national and local levels. Environmental impacts (EIAs) are conducted for Energy Projects, although it is widely acknowledged that there is need to promote understanding of the role of EIA in sustainability of energy projects which goes beyond merely fulfilling the regulatory requirement. Moreover the Designated National Authority (DNA) for registering Carbon Credits (Certified Emission Reductions) derived from renewable energy projects under the United Nations Framework Convention on Climate Change is managed by the Rwanda Environmental Management Authority (REMA) and therefore requires close coordination with MININFRA.

The Ministry of Infrastructure (MININFRA) is the leading Ministry for energy matters. MININFRA is responsible for advising on policy issues, electricity sector planning and negotiating with private investors on gas concessions and power purchase agreements.²³ It is planned to establish a separate implementation unit, the ‘National Energy Development Agency’ (NEDA) which will separate policy-making from implementation.²⁴ The Ministry of Finance and Economic Planning (MINECOFIN) is in charge of funding investments and providing subsidies as well as representing the Government as owner of the electricity utility. The publicly-owned Rwanda Electricity Corporation (RECO)²⁵ is in charge of the execution of the electricity policy, and is responsible for the transmission and distribution of electricity

¹⁹ Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*: Kigali, January 2009, p.40.

²⁰ Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*: Kigali, January 2009, p.42-43

²¹ Castalia Strategic Advisors (2009), *Rwanda Electricity Sector Access Programme. Volume I: Investment Prospectus*, p.33; Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*: Kigali, January 2009, p.40

²² Ministry of Natural Resources. *Five-Year Strategic Plan for the Environment and Natural Resources Sector (2009-2013)*. June 2009

²³ Castalia Strategic Advisors (2009), *Rwanda Electricity Sector Access Programme. Volume I: Investment Prospectus*, p.11.

²⁴ Ministry of Infrastructure (2009), *National Energy Policy and National Energy Strategy 2008-2012*, Kigali, January 2009.

²⁵ Until 2008 constituting together with the Rwanda Water and Sewerage Corporation (RWASCO), the former ‘Electrogaz’.

through the national grid. Off-grid schemes are either operated by RECO or by private developers. The Rwanda Utility Regulatory Agency (RURA) is responsible for the technical regulation of the electricity sector as well as for related energy sub-sectors and contract negotiations.

Concerning biomass, the National Forest Authority (NAFA) within the Ministry of Mines and Forestry (MINIRENA) is in charge of supervision and follow-up of forestry policy and ensures the incorporation of forestry issues into the national development plans. The NAFA is also involved in conducting research and monitoring activities related to forestry management.²⁶

2.2 PREP FUNDED PROGRAMMES AND ACTIVITIES IN RWANDA

A preparatory mission to Rwanda²⁷ elaborated the (mid-2010) inventory of the energy activities funded directly or indirectly with PREP resources. The main aim of the preparatory mission was to consult and coordinate with the authorities of the GoR, the Embassy of the Kingdom of the Netherlands in Kigali and the main implementing agencies of energy activities on the proposed impact evaluation and to obtain an understanding of the main problems related to energy supply, access and use in the country and to what extent the (in part) Netherlands' funded programmes and projects address these problems.

Twelve different programmes and projects in the area of renewable energy in Rwanda -funded by PREP- were identified. Not all of these had started implementation already. These are:

- Electricity Access Roll-out Programme (MININFRA/RECO);
- PAREF II (BTC);
- National Domestic Biogas Programme (GIZ-SNV);
- Micro Hydro Plants (GIZ);
- Sustainable Energy Development Project (World Bank-GEF);
- Giciye hydro project (Rwanda Mountain tea);
- Charcoal production chain (Adenya);
- Rusizi II Hydro Plant (FMO);
- CATALIST-SEW (IFDC);
- Lighting Africa, Lights for Life - Millennium Villages Project Rwanda;
- Lighting Africa, Personalized solar lighting (G24 Innovations & Great Lakes Energy Ltd).
- Regional Electricity network Interconnection (AfDB, NBI and NELSAP) .

A brief overview of these programmes and the corresponding Dutch funding is presented in Annex 1.

Above mentioned programmes and activities will be subject to evaluative assessment based on desk research and secondary sources only. In accordance to the framework ToR of

²⁶ www.minirena.gov.rw

²⁷ A preparatory mission visited Rwanda between 3 and 10 July 2010. The team comprised the following members: Willem Cornelissen (team leader IOB); Ms. Jolijn Engelbertink (IOB); Gunther Bensch (RWI) and Dr. Lorenzo Pellegrini (ISS).

September 2009, out of these 12, three activities were selected for in-depth (impact) analysis²⁸:

1. Electricity Access Roll-Out Programme;
2. Sustainable Energy Development project (World Bank & GEF);
3. Personalised Solar Lighting Programme (G24 Innovations & Great Lakes Energy Ltd.)²⁹.

These three illustrate a broad range of activities: from a sector programme (the Electricity Access Roll-Out Programme) to a project that did not receive any Dutch funding directly (the solar lighting programme was awarded by the Lighting Africa Development Market Place Award of the World Bank Lighting Africa programme, which is co-funded by AFREA resources).

Within the qualitative assessment of all PREP funded activities (see section 3.2), particular attention will be paid to the National Domestic Biogas Programme. In the case additional budget becomes available, the evaluation of this component will be conducted by using quantitative techniques.

2.3 PROGRAMMES AND PROJECTS IN RWANDA SELECTED FOR IMPACT ANALYSIS

2.3.1 ELECTRICITY ACCESS ROLL-OUT PROGRAMME

The Electricity Access Roll-Out Programme (EARP) was developed in 2008 to achieve the targets set for access to energy by the Economic Development and Poverty Reduction Strategy (EDPRS). EARP has ambitious goals that have to be achieved at the national level by 2013³⁰:

- a) the total number of household and enterprise connections increases from 100,000 to 350,000;
- b) 100% of health facilities having access to reliable energy for lighting, technology applications and refrigeration;
- c) 50% of schools having access to reliable energy for lighting;
- d) 100% of government offices at sub-national level having access to reliable energy.

²⁸ The selection was initially (July 2010) based on the following pre-determined criteria:

- the relevance of the activity to GoR's energy policies;
- the relative importance of the same type of intervention in (one of) the other four selected countries;
- the number and relative concentration of the installations and/or beneficiaries (including the geographical distribution over rural and urban areas);
- the existing and planned activities concerning a particular form of energy;
- the mix of actors;
- the feasibility to apply quantitative impact methods.

Early 2011, the selection was reconsidered on the basis of financial affordability. This resulted in scaling back the scope of the planned studies and in one case (biogas programme) switching from a quantitative study to a qualitative study.

²⁹ In the December 2010 round of the Daey Ouwens Fund, a comparable project ("Toughstuff") was presented for funding. In the case this project will receive a subsidy for its operations, IOB may consider to change the Great Lakes Energy project for this Daey Ouwens Fund project if and when convenient.

³⁰ Castalia Strategic Advisors (2009), *Rwanda Electricity Sector Access Programme. Volume I: Investment Prospectus*, p.7.

Overall, the percentage of households in Rwanda connected to the grid is expected to increase from 6% (in 2009) to 16% by 2012.³¹ A detailed implementation plan was developed, in which the geospatial expansion of the grid has been developed according to a least cost model.

EARP is supported by donors within a sector-wide approach (SWAp). Apart from the Netherlands, also the World Bank (lead donor), Belgium, the European Union, the African Development Bank, JICA, OFID, BADEA and the Saudi Fund join the donor consortium. The total budget for the programme sums to USD 377 million³², of which 80% is covered by the development partners, 10% by RECO and 10% by the GoR. The donor support encompasses off-grid activities already funded by donors for an amount of USD 35.7 mln.³³ The Netherlands is the single donor providing basket-funding, close to budget support, hence using MININFRA procedures.³⁴

The EARP focuses on connecting (rural) households to the national grid although it does include off-grid connections for remote areas as well. The determination of the preferred technology for a certain region is based on cost models. To 5% of the target population off-grid connections are the least cost option (for 4.5% electricity generated by micro hydro and 0.5% electricity generated by either diesel generation or solar PV household systems). Eventually, those areas served by the diesel generation or the solar household systems will be connected to the grid. Whether the areas served by micro hydro systems will be grid connected depends on the proximity of the installations to the grid at the time the hydro resource is being developed³⁵

As far as it concerns the electrification of social facilities, such as schools, administrative centres and health centres, the use of solar PV units is foreseen. Several donors earmarked part of their contribution to off-grid electrification of these facilities.³⁶

The management of EARP rests with RECO, which has a separate ‘Access Programme Management Unit’, consisting of around 20-30³⁷ full time staff. Although RECO is a public utility, it has sufficient autonomy to implement a market based approach. In order to strengthen RECO’s capacities to manage the implementation of the EARP, several measures have been taken. Firstly, RECO has entered into a partnership with the Société Tunisienne de l’Electricité et du Gaz (STEG), the Tunisian national energy utility³⁸ and secondly, technical capacity will be built through partnerships with the Kigali Institute of Science and Technology (KIST) and through technical assistance provided by GIZ.

³¹ MININFRA website (http://mininfra.gov.rw/index.php?option=com_content&task=view&id=114&Itemid=142) ; World Bank (2009), *Project Appraisal Document on a proposed credit in the amount of SDR 45.1 million (USD 70 mln equivalent) to the Republic of Rwanda for a Rwanda Electricity Access Scale-Up and Sector-Wide Approach (SWAP) Development Project*. Washington: AFTEG, p.2.

³² Energy Sector Progress Report February 2010, p.12.

³³ This includes a contribution of The Netherlands of USD 0.3 mln for micro-hydro.

³⁴ Interview Embassy of the Kingdom of the Netherlands in Kigali, July 2010.

³⁵ Castalia Strategic Advisors (2009), *Rwanda Electricity Sector Access Programme. Volume I: Investment Prospectus*, p.24.

³⁶ Presentation Y. Uwamahoro, *National Electricity Access Scale Up Program 2009-2012*; Castalia Strategic Advisors (2009), *Rwanda Electricity Sector Access Programme. Volume I: Investment Prospectus*, p.34-38.

³⁷ The number of staff is expected to increase with the expansion of the programme.

³⁸ World Bank (2009), *Project Appraisal Document on a proposed credit in the amount of SDR 45.1 million (USD 70 mln equivalent) to the Republic of Rwanda for a Rwanda Electricity Access Scale-Up and Sector-Wide Approach (SWAP) Development Project*: Washington: AFTEG, p.4-5.

2.3.2 SUSTAINABLE ENERGY DEVELOPMENT PROJECT

The Sustainable Energy Development Project was developed under the Global Environment Facility (GEF)-3 and addresses various GEF Strategic Objectives simultaneously, in particular those referring to reducing the greenhouse gas emissions through market transformation; the strategic objective to promote on-grid renewable energy; and the objective to promote the use of renewable energy for the provision of rural energy services (off-grid). The explicit objectives of the Sustainable Energy Development Project are to: a) improve policy and institutional framework of the renewable energy and energy efficiency sub-sectors; and b) increase private sector participation in the renewable energy sector. The GEF Sustainable Energy Development Project is a grant to the Government of Rwanda to support renewable energy development. A key mechanism for sustainable development comprises the emphasis on the private sector as the main delivery vehicle.

There are five components to the project:

- i) the strengthening of renewable energy policy, strategy and management. The main objective of this component is to assist MININFRA in streamlining and coordinating activities by supporting the development of operational guidelines for project design and implementation;
- ii) the efficient utilization of biomass resources. The aim of this component is to increase the efficiency in the charcoal value chain by promoting more efficient stoves and charcoal production methods;
- iii) the sustainable development of micro hydro resources. The scope of the component is to provide transparent market regulation and guidelines to facilitate small distributed power production and distribution services while building local private sector capacity that can plan, design, implement, and operate the plants;
- iv) the development of the market for solar water heaters (SWH) in Rwanda. Due to the small market size the support will focus on building early market incentives and promotions including support for market surveys, technical specifications and guidelines for procurement, advice on appropriate taxes incentives and capacity building of private sector companies;
- v) the fifth component is the energy efficiency strategy development.

The programme is implemented by RECO (previously Electrogaz). The total GEF contribution sums to € 3.8 million out of the total project costs of € 8.3 million. The Agreement between the Government of Rwanda and the World Bank was signed in February 2010. At the moment of the preparatory mission (July 2010) the activities had not started yet.

Only few components can be evaluated by applying rigorous methods. The component iv) solar energy, has been identified for evaluation using quantitative techniques. Solar energy has been selected, since it allows making comparisons with the evaluation of solar devices (see 2.3.3). The options for conducting quantitative evaluation of programme components will be further explored once the activities are being implemented and private sector agents have started (for example, the sales of stoves and solar home systems). Evaluation of the SED programme may provide an insight in the complementarity between on-grid and off-grid energy provision, as well as the differences among similar forms of energy provision (i.e. solar energy).

2.3.3 SOLAR DEVICES- GREAT LAKES ENERGY

Great Lakes Energy is a Rwandan solar energy small enterprise (SME) established in 2005. It is the partner organisation of a Welsh company named G24 Innovations Limited. G24 Innovations aims at cutting-edge technology based on G-cell, a dye-sensitized solar cell which is flexible, lightweight and indestructible. G24 promotes the use of this solar cell in all kind of appliances. The G-cell is particularly suitable for personalised solar lighting equipment for Africa. Solar equipment producers (amongst them Barefoot in Australia) make use of these cells in their products. Great Lakes Energy is an outlet of these products in Rwanda. Great Lakes Energy is dedicated to deliver solar home lighting solutions to rural Africa, through innovative product design and sustainable distribution. Thereto, Great Lakes Energy develops and trains a distribution network of rural businesses in Rwanda through a ‘train the trainers’ method. Great Lake Energy uses a brand name (Akira Urumuri = “receive the light”) for the products, although these may be produced by different manufacturers. By July 2010, there were 148 dealers spread over the country. The business is risky, since credit is provided to the retailers and also displays are provided to the retailers. The company provides full credit up to USD 200-500 per distributor. The company monitors stock levels at the retailers. Almost no default has been registered so far (only 2 out of the 148 retailers).

The World Bank programme AFREA has enabled Lighting Africa to organise a competition among private initiative proposals. In 2009, G24 Innovations was awarded a Lighting Africa Award³⁹, based on a proposal that encompassed the Great Lakes Energy as partner for the sales of particular light equipment that combines a Gcell solar charger with a battery and high efficiency Lemnis LEDs. The novelty was in the option to a modular set-up with options for increasing the system according to the finance available to the client. In 2009, the expectation was that by the end of year two, 25,000 units would have been sold. If this were the case, these lamps would replace an annual consumption of approximately 600,000 litres of kerosene. The programme itself envisages an evaluation by the end of year 2 (2011).

The challenge to Great Lakes Energy is to identify retailers and ‘early adopters’. This could be grocery shops or suppliers of electrical equipment. Key can be that traditional leaders, including imams, become involved. In July 2010, the sales summed to 5-10 products / month/ dealer, with few exceptions (over 80 products per month in one case), accumulating to approximately 3,000 appliances sold up to July 2010. To a retailer, the business of selling these products becomes profitable if he/she achieves to sell over 10 products per month.

3 EVALUATION QUESTIONS

The overarching evaluative question is mentioned in 1.1. The specific evaluation questions vary according to the level of analysis and the type of energy intervention. These questions can be grouped into three clusters:

I: General and contextual questions concerning the energy sector and its institutions in Rwanda.

³⁹ The Netherlands funded the competition, not the award itself.

- II. Evaluative questions concerning the Netherlands funded renewable energy activities in Rwanda.
- III. Specific questions concerning the impact of selected programmes / projects in Rwanda.

I. General and contextual questions concerning the energy sector and its institutions in Rwanda.

II. Evaluative questions concerning Netherlands funded renewable energy activities in Rwanda.

III. Evaluative questions at the level of the selected interventions:
 1 Grid Connection
 2 Solar energy in SED programme
 3 Solar lamps

3.1 GENERAL AND CONTEXTUAL QUESTIONS CONCERNING THE ENERGY SECTOR AND ITS INSTITUTIONS IN RWANDA

The energy programmes and activities in Rwanda are influenced by and embedded in a policy and institutional environment. GoR applies an active policy to provide access to energy to its population. In addition its policy aims at doing so increasingly by renewable energy sources. The establishment of new executive bodies in the area of renewable energy or the shift towards a more active involvement of the private sector in implementing programmes in the area of renewable energy, are important contextual factors to success or failure of developing (renewable) energy activities. The evaluation will analyse GoR's policies and efforts to establish an enabling environment for the different interventions in the energy sector.

Problems and context:

- What are the key problems in the energy sector in Rwanda and to which extent are these problems gender specific?
- At a national level, what are the main characteristics of the energy sector; its main economic and environmental characteristics; its recent developments in terms of access to different sources of (renewable) energy?
- What is government's main policy regarding energy in general and renewable energy in particular and how have these evolved over time?
- What are the main features of the SWAp in the energy sector?
- What are the major institutions involved in the energy sector; to which extent are these public or private institutions?
- What are the features of existing market mechanisms when it comes to provision of energy to households (fuel wood, charcoal, gas, stoves, kerosene, electricity)?

(Institutional) sustainability:

- Are the roles of the public sector institutions directly involved in (renewable) energy clearly defined and fulfilled?

- Is there a rational choice for the type of energy supply (for example sequencing from pre-electrification to connection to the grid)? What is the effect on the sustainability of the various programmes in this regard?
- Do the institutions concerned have the required capacity for increasing access to renewable energy for the poor in the long term?

3.2 QUESTIONS CONCERNING ALL NETHERLANDS FUNDED RENEWABLE ENERGY ACTIVITIES IN RWANDA

The inventory of renewable energy activities presented in Annex 1 is a ‘snap shot’ made mid 2010 and may experience -most likely- changes over time. The inventory will be updated in 2012. Out of all these activities, specific attention will be paid to the description and analysis of the National Domestic Biogas Programme (see Annex 1). All activities will be described and assessed based on the following evaluative questions:

Input and policy relevance:

- What are the objectives of the PREP supported programmes/projects identified in Rwanda? What was the envisaged target group for each of these programmes?
- What are the key problems addressed by the programmes/ projects supported by the Netherlands? To which extent are the key problems gender specific?
- To what extent are the Netherlands supported programmes and projects aligned to the Rwandan energy policies? To which extent are these programmes/projects relevant to the Rwandan policy on renewable energy?
- Are the energy activities supported by the Netherlands (and/or their results) strengthened or reinforced by policies, structures, systems, programmes and projects supported by government?
- Are the energy activities supported by the Netherlands (and/or their results) strengthened or reinforced by programmes and projects by other donors?
- What activities/ interventions have been undertaken in practice? In what phase is the project being implemented (pilot, roll-out, scaling up)?
- Which organisations were involved (private/public) in each of these programmes/projects? Did the approach build on existing channels of implementation, using existing capacity and knowledge? If not, why not?
- Have monitoring and evaluation systems been put in place?

Output and results:

- What have been the main outputs? Have the output targets been achieved according to monitoring information? Is gender specific information on outputs available?
- According to monitoring information: (if and when applicable) how many devices were installed and how many are still in use? If they are not in use: why not?
- According to monitoring information, what has been the change in the number of individuals (m/f), households, communities and/or other beneficiaries that have access to and use the energy-related products and/or services provided in the target area?

(Institutional) sustainability:

- What are the linkages between the programmes / projects and the public institutions in Rwanda?

- Was a (financially) self-sustaining market for the energy sources established and how? How sustainable are the service providers (companies)?
- Do the institutional arrangements provide for monitoring of quality of services and sustainability, and follow-up of issues derived from monitoring data?
- To which extent have the (12 or more) programmes / projects contributed to the fourth objective of PREP, being “developing capacity and knowledge with regards to renewable energy” in Rwanda?

3.3 QUESTIONS AT THE LEVEL OF THE INTERVENTIONS SELECTED FOR IMPACT EVALUATION

IOB selected three interventions for in-depth (impact) evaluation: (i) Electricity Access Roll-out Programme, (ii) Sustainable Energy Development programme – solar component and (iii) Personalized Solar Lighting Programme-Great Lakes Energy. Apart from the evaluative questions described in 3.2, for these three activities additional questions have been formulated in the following sections.

3.3.1 ELECTRICITY ACCESS ROLL-OUT PLAN (EARP)

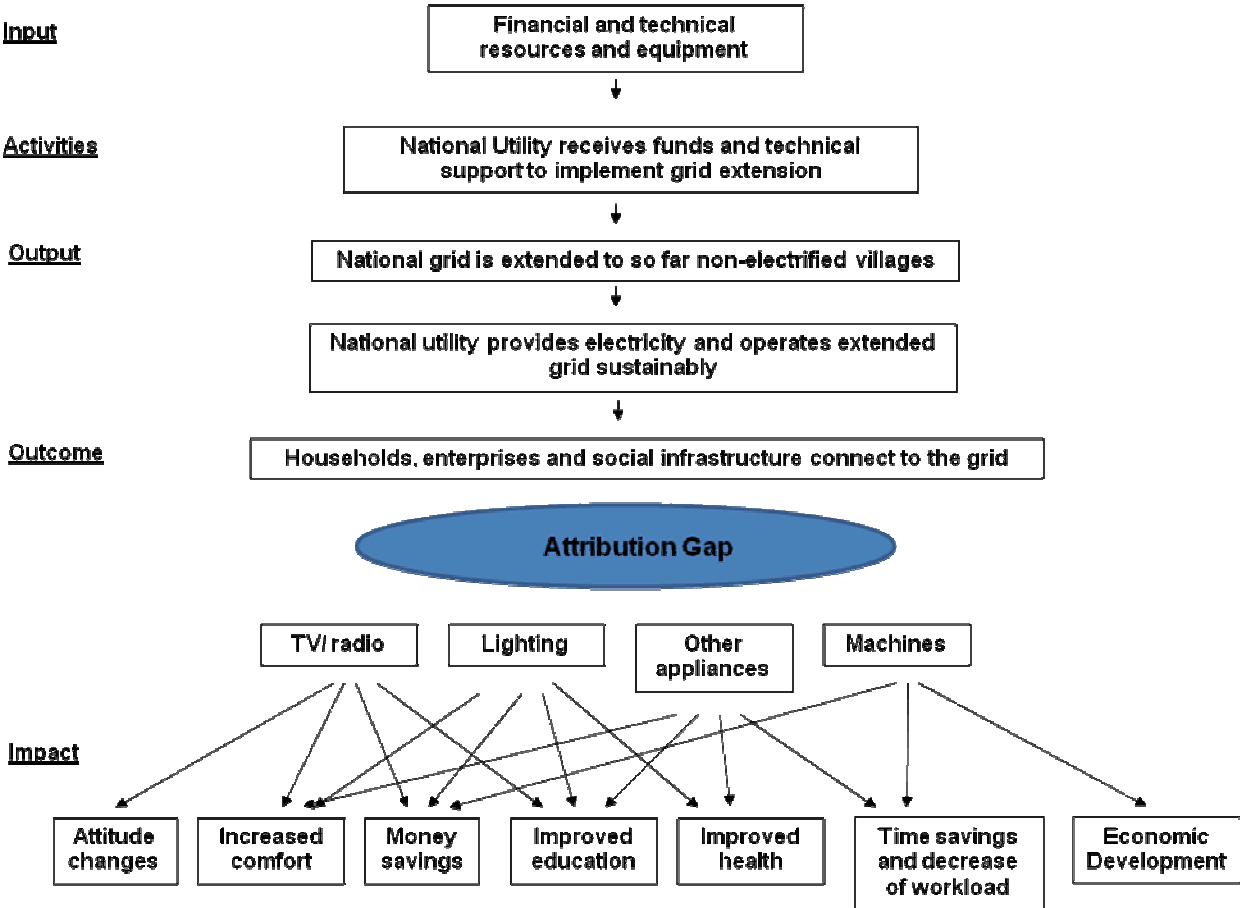
The GoR development policy stresses that energy is a precondition to economic growth and social welfare, ultimately reducing poverty. Access to energy at the household level is envisaged to be mainly in the form of electricity. GoR has formulated the objectives of the national electricity access roll-out programme in generic –macro- terms only. The macro level impacts have been taken into consideration in the results chains presented in figure 1 below.

The chain assumes that electricity is not only available, but also used by households and social facilities. Both the provision of electricity and the sustainable operation of the grid is the *output* of the intervention. The connection of households and other users is the aim of the EARP, and therefore the *outcome* of the intervention. What people effectively do with the fact of being connected to electricity is beyond the so-named ‘attribution gap’ from the intervention’s perspective. Hence, the *impact* level starts with the actual use of electricity, which is, amongst others, expressed by the availability of light bulbs or the use of electrical appliances. The ultimate impacts are on the different levels of life that could be affected by electricity access. It cannot be taken for granted, though, that changes on these levels occur; and if change were observed, it cannot be automatically attributed to the intervention, as other factors might interfere as well. For example, better educational performance can be enabled by electrical light, but light alone does not lead automatically to better school performance (it is even no guarantee that children study at home after night falls). Domestic electric appliances may contribute to time savings or other forms of household efficiency, while radio and TV provide for a different form of access to information. Both refrigerators and lighting increase the hygiene in the household, while light may contribute to security in and around the house.

Households may have more liquidity as a result of having access to electricity, since it replaces usually more expensive sources of energy like kerosene (whether this is really the case is subject of evaluation). On the other hand, access to electricity also could invite to

buying electrical appliances that induce both investment costs (not made in absence of electricity) and higher levels of energy use. In consequence, households' expenditures might change in either direction as a result of the access to electricity.

Figure 1: Results chain for subsidized electricity grid extension



Source: Own illustration

Indicators for the evaluation will be the take-up and effective use of electricity; the extent and duration in which appliances are being used. Other indicators are time use (such as the time that children at school age study at home or the time needed to obtain or purchase fuels) and related behavioural factors. In addition, lighting may contribute to security in and around the house as well have positive effects on health thanks to reduced indoor air pollution. However, the main source of indoor pollution is cooking on firewood. As electricity will -most likely- not be used for cooking purposes, the effects on air pollution will be small. Also the replacement of current lighting sources that may cause some pollution, such as kerosene lanterns and candles, is expected to be quite small. Changes in expenditures for energy will be detailed and assessed. It should be kept in mind that some impacts might require a longer period of time to occur.

Electricity supply and use at social institutions like schools and health posts will be measured as well. Here, evening courses in schools might be delivered thanks to improved lighting or

improved cooling or sterilising facilities in health posts might improve the quality of the health services.

The evaluation of the roll-out programme will address the following questions:

Input and policy relevance:

- What have been the total (development and recurrent) costs and the costs per main output and beneficiary? To what extent are costs covered by contributions of the users/consumers?
- What attempts have been made to target and include women at all stages in the programme/project cycle?
- What are the financing mechanisms for the programme/project and does this include measures to ensure equity in access to energy (e.g. access to credit for female headed households)?

Output:

- How has the grid roll-out evolved over the period taken into consideration? How many villages and households have been connected that prior to the intervention were not connected to the grid?
- How cost-effective is the connection, taking into consideration the inputs in terms of equipment, personnel, technical assistance (“value-for-money”). What benchmark can be used?

Outcomes:

- What is the connectivity rate of households, enterprises and social infrastructure institutions in the project area?
- How reliable is electricity supply (frequency of outages)? How many hours per day or week is electricity being used?
- Which socio-economic groups (incl. poor/non-poor) benefit from availability of electricity?
- Who (gender specific) in the household has made the decision to connect to the electricity grid?

Impacts:

- For what purpose and by whom in the household is electricity being used; what are the main electric appliances used by households, enterprises and social infrastructure institutions?
- What is the change in expenditure (at household level, per time interval) between the energy sources used prior to the extension of the grid (candles, kerosene, batteries) and current expenditures?
- To what extent has (the perception of) safety changed?
- To what extent has comfort/convenience changed, disaggregated by gender? What monetary value do households attribute to this increased convenience?
- To what extent have the household’s activities during evening hours changed? Have study hours/reading time of children changed? Do women (and children) enjoy more or less rest?
- To what extent has indoor air pollution been reduced (according to the perception of dwellers)?

- Has the availability of electricity triggered new economic activities or displaced old ones?
- How have, in response to the possibly increased media exposure, attitudes and behaviours, such as women's status, fertility, children's school enrolment changed?
- Has the school attendance changed as a result of use of electricity in the school?
- How are benefits distributed across different income groups? Has the activity had an effect on gender equity in access to, use of and benefits from energy sources?
- What (if any) positive and/ or negative unintended effects occurred?

Sustainability

- Has there been a shift from non-renewable to renewable energy sources? If so, what are the likely effects on CO₂ emissions?
- To what extent is the Rwandese government capable of continuing the roll-out and maintaining the stock of a nation-wide electricity network?
- To what extent do national strategies take into account the eventual exit of donor support to the EARP programme?
- To which extent has government a sustainable (financial) capacity to provide incentives (tax benefits or direct subsidies) to both private sector suppliers and customers alike in the energy sector?

3.3.2 SUSTAINABLE ENERGY DEVELOPMENT PROJECT

The objective of the solar energy component of the SED project is to provide initial support to develop a market for solar water heaters (SWH) in Rwanda. Due to the small market size the support will focus on building early market incentives and promotions including support for market surveys, technical specifications and guidelines for procurement, advice on appropriate tax incentives and capacity building of private sector companies. Hence, the intended output of the project is that private sector outlets have been established and that water heaters are being installed. The outcome is that these devices are being used in both an urban and rural environment.

Most likely, to customers the major impact is increased convenience and comfort, i.e. having warm water for bathing and washing. The evaluation will encompass a module to assess the customer's satisfaction with the services provided. Solar heater programmes claim to have a positive effect on health as a result of reduced indoor air pollution, less respiratory diseases among young children and less diseases in general thanks to more frequent body care.

Input and policy relevance:

- What are the financing mechanisms for the programme (both retailers and clients) and does these encompass measures to ensure equity in access to energy (e.g. access to credit for female headed households or female retailers)?
- What attempts have been made to target at women in the design stage and marketing strategy of the programme?

Output:

- What have been the dynamics in time of the sales of the solar devices?
- What have been the total (development and recurrent) costs and the costs per main output (retailers and beneficiaries)?

- How cost-effective is the supply of solar equipment, taking into consideration the inputs in terms of supplies, personnel, technical assistance (“value-for-money”). What benchmark can be used? To what extent are costs covered in the price to the consumers or end users?

Outcome

- For what purpose and by whom in the household (m/f, children) is the heater used?
- Which socio-economic groups (incl. poor/non-poor, m/f) benefit from increased access (retailers and end-users)?
- Who (gender specific) in the household has made the decision to buy a solar water heater?
- To what extent has the use of warm water changed in terms of purpose, frequency and quantity?
- What has been the change in the consumption of the energy source previously used for water heating?

Impacts

- How have expenditures for energy (per period) changed? For example as result of using less firewood or gas?
- How have expenditures for water –or time for water fetching- changed as a result of the use of the water heater?
- How are benefits distributed among households across different income groups? Has the activity had an effect on gender equity in access to, use of and benefits from energy sources?
- To what extent has comfort/convenience changed, disaggregated by gender? What monetary value do households attribute to this increased convenience?
- To what extent do activities during the day change? Is more or less time required for body care or for washing clothes? Do women (and children) enjoy more or less rest?
- To what extent has indoor air pollution been reduced (according to the perception of dwellers)?
- What (if any) are the un-intended and/or negative impacts?

Sustainability

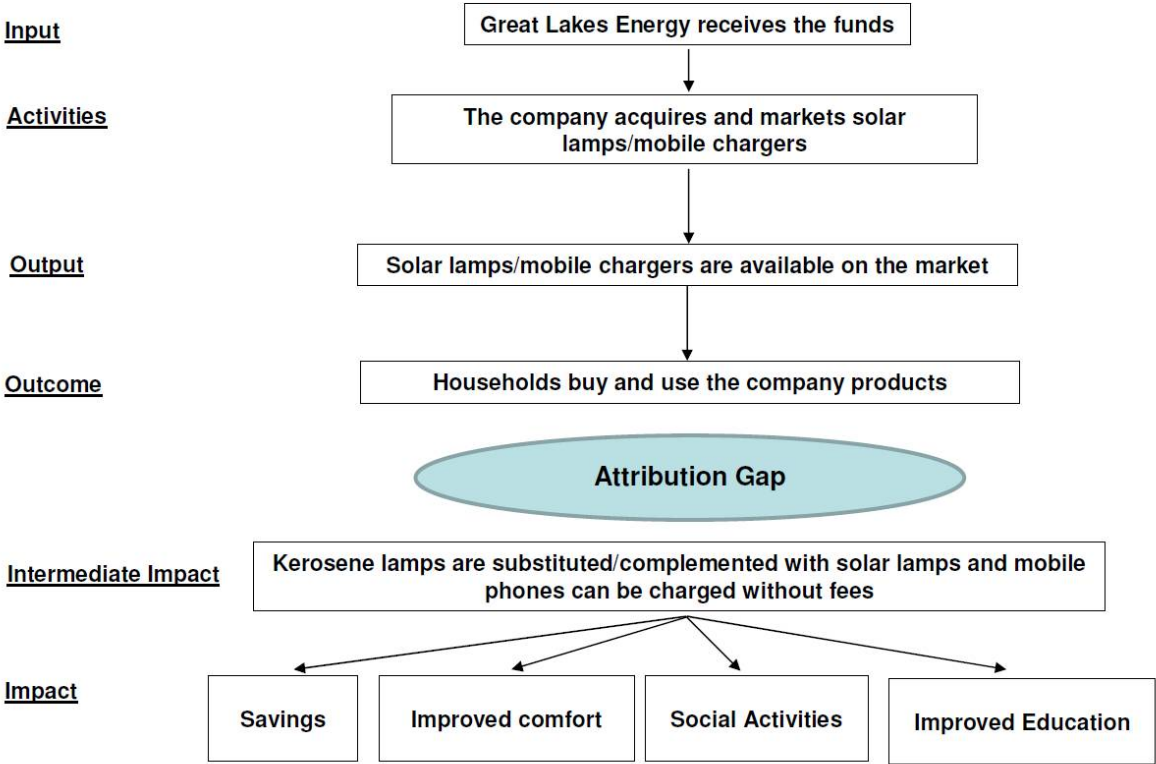
- How reliable is the solar heater throughout the year?
- Has there been a shift from non-renewable to renewable energy sources? If so, what are the likely effects on CO₂ emissions?
- To which extent continuous support will be required (i.e. tax benefits or direct subsidies) to the private sector suppliers or will a market develop without public sector incentives?

3.3.3 GREAT LAKES ENERGY (SOLAR DEVICES)

The results chain for Great Lakes Energy can be developed from different angles. The intervention strategy of the Lighting Africa Marketplace Award is to provide an incentive to promote the use of the G-cell in solar equipment and to market these products in Rwanda. Hence, the outcome envisaged of the award granted to G24 Innovations Limited in combination with Great Lakes Energy is the establishment of a market in Rwanda for solar devices (lanterns that also function as mobile phone chargers) and the impact could be the

increase in the application of –and sales of- the G-cell. The marketplace awards have as underlying motive the promotion of solar devices among poor households in Africa. Hence, the outcome is also that households actually buy and use the products. And if these are used, the impact is that these lamps either replace –or are being used complementary to- traditional forms of lighting. Figure 2 presents the results chain from this latter perspective.

Figure 2: The Great Lakes Energy Results Chain



Source: Own illustration

The benefits deriving from the availability of the products in the market require that households actually buy and use products that either substitute or complement traditional light sources for those households not connected to the electricity grid. The use of these lamps may result into cash savings (in terms of reduced expenses for kerosene and charging of mobile phones); and may improve comfort and opportunities for social activities. Furthermore, one may expect improvement in indoor air quality in the case the solar lamps substitute energy sources that generate pollutants through combustion. Since the lamps provide longer –and more constant- lighting time, the use of the lamps may enable children to read (more) and to do homework during evening hours.

Input and policy relevance:

- What attempts have been made to target and include women at all stages in the programme/project cycle?
- What are the financing mechanisms for the programme/project and does this include measures to ensure equity in access to energy (e.g. access to credit for female headed households)?

Output:

- What have been the dynamics in time of the sales of the solar devices?
- What have been the total (development and recurrent) costs and the costs per main output (retailers and beneficiaries)?
- How cost-effective is the supply of solar lamps/devices, taking into consideration the inputs in terms of supplies, personnel, technical assistance (“value-for-money”). What benchmark can be used? To what extent are costs covered in the price to the consumers?

Outcomes:

- Who (gender specific) in the household has made the decision to buy the solar lamp?
- For which purpose, for how much time and where are the lamps being used? To which extent inside/ outside the house?
- What proportion of the total lighting hours used in the household is provided by the solar lamps? What other sources are being used? Is there a relation between the lighting source and the use of light?
- What has been the change in the production and consumption of the energy source previously used for lighting?
- What has been the change in expenditures (at household level) for energy consumption?

Impacts:

- How have expenditures for energy (per period) changed (lighting and fees to charge mobiles)?
- To what extent has (the perception of) safety changed?
- Has there been a change in activities during the evening and night? (Children studying at home; other –or more- social activities; income generating activities)?
- Is there a perceived improvement in indoor air quality?
- To what extent has comfort/convenience changed, disaggregated by gender? What monetary value do households attribute to this increased convenience?
- Has the solar lamp been an incentive to consider the purchase of other solar devices, amongst them a solar home system?
- How are benefits distributed among households across different income groups? Has the activity had an effect on gender equity in access to, use of and benefits from energy sources?
- What (if any) are the un-intended and/or negative impacts?

Sustainability:

- How reliable is the lighting source?
- What is the (perceived) lifetime of a solar lamp. What is the likelihood that
- Has there been a shift from non-renewable to renewable energy sources? If so, what are the likely effects on CO₂ emissions?

4 METHODOLOGY, RESEARCH DESIGN AND DATA SOURCES

The overall Terms of Reference for the impact evaluation of Netherlands supported programmes in the area of Energy and Development Cooperation (October 2009) indicate methodological requirements concerning the selection of forms of energy supply subject to

impact evaluation, such as an urban / rural mix and research techniques to be applied (incl. variables, baseline, counterfactual, drawing of samples and sample sizes).

To evaluate the activities in Rwanda a mixture of qualitative and quantitative methods will be used. *Qualitative* methods will be used for the contextual analysis; the descriptive components of each programme / project funded with PREP resources in Rwanda; the (institutional) sustainability analysis as well as in the impact evaluations, where qualitative methods are indispensable for understanding the context, capturing potentially unintended impacts and validating the results of the quantitative research. Qualitative methods will also be used for the analysis of the biogas programme. Qualitative methods will comprise desk research of secondary sources (inputs and outputs) in particular literature study and documentation and interviews with project/programme staff and other stakeholders. In addition, qualitative focus group discussions and interviews with key informants such as village chiefs, beneficiaries or local NGO representatives will be conducted. The focus groups discussions will be held with households within the control and treated areas. These focus groups will be drawn on the basis of certain criteria, such as gender, social categories (rich or poor) and other pre-defined criteria.

Quantitative techniques will be used to measure the relationship between intervention and effect variables, and how much each of the interventions contributed to the effects, while controlling for other factors that might have had an impact on the selected effect variables.⁴⁰ Depending on the scope of intervention and quality of data, existing statistical data (such as household surveys, demographic and health surveys, administrative data) will be used next to baseline surveys for primary data collection.⁴¹ Quantitative research methods will also be used for the measurement of sustainability aspects at the level of the energy users for the evaluation of the extension of the grid (EARP). A structured questionnaire will cover pre-selected socio-economic aspects of the household. This includes housing conditions, education, agricultural and non-agricultural revenues, activities, assets, energy consumption, and gender and health issues. The quantitative studies (EARP and the solar device project) will specifically address the use of lighting and (small) household electrical devices, like the solar heaters and lamps.

4.1 METHODOLOGY FOR THE GENERAL AND CONTEXTUAL QUESTIONS CONCERNING THE ENERGY SECTOR AND ITS INSTITUTIONS IN RWANDA.

The general and contextual questions concerning the energy sector and its institutions in Rwanda will be addressed using qualitative techniques. Basic information has been gathered in preparation to and during the field mission in July 2010.

Further description and analysis will be based on desk research by means of documentation, web search and semi-structured interviews (mainly in the Netherlands) with the responsible stakeholders for the various PREP components. In the margin of missions for the impact

⁴⁰ For example, beneficiaries of the electrification roll-out programme are not selected at random, but the selection of the villages to be connected to the grid might be related to certain criteria (e.g. existing public infrastructure). Apart from these –observable- characteristics, there might be other –unknown- implicit selection characteristics as well.

⁴¹ Standard household surveys are not very detailed when it comes to energy use. These data however, can be useful for identifying samples and for benchmarking.

evaluation interviews with key informants will provide supplementary information. Towards the end of the evaluation period (2013) a verification mission is foreseen, which can be used to verify and update the data collected from the Netherlands (see also the next section).

Specific and detailed Terms of Reference for the contextual study will be elaborated at a later moment in time, since critical areas or issues are supposed to be detected in the preliminary results of the evaluations of the various activities.

4.2 METHODOLOGY FOR EVALUATIVE QUESTIONS CONCERNING ALL NETHERLANDS FUNDED RENEWABLE ENERGY ACTIVITIES IN RWANDA, INCLUDING QUESTIONS ON SUSTAINABILITY

The evaluative questions concerning all Netherlands funded energy activities in Rwanda will be addressed on the basis of a review of programme and project documentation, in particular design and appraisal documents, progress and monitoring reports and –if available- evaluation reports. Basic information has been gathered in preparation to and during the field mission of July 2010, but will be updated from mid 2012 onwards. This will encompass file research at the offices of most implementing agencies (GIZ, SNV, HIVOS and Agency NL). Further description and analysis will be based on web search and interviews with key informants both in the Netherlands and in Rwanda. The sequencing of inputs and outputs will be highlighted in short intervention histories. A separate two-three week mission will be held in 2013 to verify the findings concerning sustainability aspects and to follow up on relevant questions that will emerge from the desk review.

In general terms the concept sustainability can be disaggregated into seven components: technical; political (strategic); financial; economic; social (human); institutional (organisational); and environmental sustainability. These aspects will all be dealt with, but in varying degree of intensity.

In this evaluation, sustainability questions relate to two levels. The first one concerns sustainability at the level of the energy users. This relates to sustainability at a technical and a (household) financial level (e.g. will and can the biogas digester be replaced or fixed when broken). The second level relates to sustainability at institutional level, e.g. are the national institutions conducive to the programme (e.g. what will happen with the programme after donor funding ends).

Sustainability questions relating to the energy users will be grasped by quantitative methods (with regard to the EARP programme) as well as qualitative methods (focus groups, interviews with different stakeholders). Institutional sustainability concerning all Dutch funded energy programmes will be assessed at national and local government level and concerns both the human capability aspects (Knowledge) and the management and organisational aspects (planning, budget, human resource management, monitoring).

Detailed ToR for the desk and context study will be elaborated at a later moment in time.

4.3 METHODOLOGY FOR THE INTERVENTIONS SELECTED FOR IMPACT EVALUATION

The following sections detail the evaluation approaches for those programmes selected for in-depth impact evaluation.

4.3.1 ELECTRICITY ACCESS ROLL-OUT PROGRAMME (EARP)

The activities of the Roll Out Programme EARP have started in 2009 and are planned to finalise in 2013. According to the policy document Vision 2020 and statements by the Ministry of Infrastructure the programme is among GoR's top priorities. Nearly 140,000 households are planned to be connected during 2011-2012 (see Table 1).

Table 1: Planning figures on the Electricity Access Roll Out Programme

Description	2009	2010	2011	2012	2013
Number of new connections	37,000	57,000	65,000	71,000	71,000
Connected households in total	147,000	204,000	270,000	338,000	409,000
Investment Cost (Million USD)	56.1	78.9	84.2	92.1	95.0

Source: MININFRA (2010)

The research approach is to apply quantitative ('rigorous') methods to determine changes in socio-economic outcomes among households in communities that got connected to the electricity grid.

For that end, a baseline survey will be conducted in 2011 followed by a survey in 2012. Both surveys will cover as *treatment region* EARP villages that will be connected during 2011 and as *control regions* EARP villages that will not be connected prior to the follow-up survey, i.e. not earlier than late 2012. This design enables to apply a difference-in-difference (DD) approach, i.e. an approach that can account for all possible confounding factors that are time-invariant.⁴² Furthermore, general (political, economic, pricing) changes in Rwanda that affect the entire population and that might have effects on the outcome variables can be netted out. EARP is supported through a sector wide approach by various donors, amongst them the Netherlands. The Dutch contribution is not earmarked for any specific geographical area, but there is preference for the renewable sources of energy. Nevertheless it is –in the spirit of the sector wide approach- assumed that any part of the EARP is part of the joint efforts, including the Netherlands.

The envisaged sample size will be approximately 1,500 households in two 'waves' (baseline and follow-up survey). The sample size is based on the fact that the target group for the EARP is very diverse. The roll-out programme is intended to reach households in different socio-economic categories and the survey will need to 'catch' all these different categories. Both the number of villages and the regional (geographical) coverage of the survey will be determined

⁴² Motivation or openness of the household might be examples. As long as they do not change over time, they are differenced out in this approach.

early 2011, based on complementary information from MININFRA. In principle, approximately 40 villages will be selected and around 30-40 households per village.

The main research tool is a structured household questionnaire covering the socio-economic dimensions with a focus on energy use patterns. The application of a willingness-to-pay analysis⁴³ assesses the *true* value that people assign to electricity and lighting. While the main focus of the study is measuring impacts at household level, the impacts on enterprises, schools and health institutions will also be assessed although no quantitative techniques (in a narrow sense) will be applied. The same applies to the level of communities, since the relatively small village sample size (approximately 40), does not allow accounting for regional differences. In addition, complementary qualitative information will be gathered through interviews with key informants and by means of focus group discussions. Focus group discussions will be organised in order to obtain local contextual information and identify potential impacts unknown to the researchers, as well as to test the completeness and appropriateness of the questionnaire.

Potential risks to the evaluation approach arise from the fact that the planning of the Ministry of Infrastructure might either not advance swiftly enough or will be changed in between the baseline survey and the follow-up survey. By July 2010, no reliable plan for the years 2011 and 2012 existed. In July 2010, MININFRA employees indicated to expect the plans to be ready late 2010. A private company was to be contracted (September 2010) to schedule the roll out.⁴⁴ In the case the extension of the grid is postponed in the treatment region or brought forward in the areas envisaged for the control group this may cause methodological problems. In general, this programme has a very high priority to MININFRA and political pressure for a realization in time is high.

Since the approach compares electrified with non-electrified areas, biases in the impact assessment could result from the selection process determining which village will be electrified and which one not. For example, one could imagine that the extension of the grid follows certain patterns that are influenced by factors like economic potential, political patronage or existing public infrastructure. The information regarding the MININFRA selection criteria can be used to account for village differences and can be stratified accordingly (Castalia 2009). Even if patronage affects the sequence in timing, this will be netted out by the difference-in-difference approach as long as the effects and patronage patterns are constant over time.

The MININFRA expressed its interest about the evaluation of the Roll Out Programme. According to the cooperation agreement, the sector support programme will be subject to internal evaluation as well. IOB will contact the lead partner (World Bank) to look for opportunities for joint efforts and/or for complementarities.

4.3.2 SUSTAINABLE ENERGY DEVELOPMENT PROJECT

At the moment of the preparatory mission, the Sustainable Energy Development project had not come into operation yet. In consequence no detailed information is available –at this

⁴³ See, for example, Devicienti, Klytchnikova, and Paternostro (2004) and Whittington (2002).

⁴⁴ In early 2011 the plan has however still not been concretized. Nevertheless, the construction of the medium and low voltage lines has proceeded in some parts of the country

moment in time (February 2011) - about the market for construction, import and sales of the devices, the regional distribution of sales outlets or the urban – rural balance in users of the solar water heaters, and whether the customers live (predominantly) in areas connected to the electricity grid, or precisely in areas outside the reach of the electricity grid.

In addition, the methodology chosen for research also depends on the availability of financial resources to that end. At this moment in time, no funds are available for the evaluation of this component and its implementation depends on either additional resources from the Ministry of Foreign Affairs or from third parties in co-funding arrangement of the evaluation⁴⁵.

In the margin of the implementation of the baseline survey for the EARP in 2011 (or alternatively in 2012), further information will be collected on the SED implementation and the precise evaluation methodology will be determined.

4.3.3 LIGHTING AFRICA DEVELOPMENT MARKETPLACE AWARD/ GREAT LAKES ENERGY

Up to July 2010, Great Lakes Energy had sold 3,000 solar powered lamps in Rwanda. These lamps can also serve as mobile phone chargers. Since these customers are not geographically concentrated, the share of households using solar lanterns is so low that an ordinary survey would not yield a sufficient number of users. Given that the lamps are relatively inexpensive (around 20 USD) a methodologically more sound approach could be pursued, being a randomised controlled trial (RCT). The solar lamps will be randomly assigned at the time of a baseline survey. The impacts are subsequently assessed by using a follow-up survey 6-12 months later. The focus of the evaluation will be on lighting usage and its purposes.

From a methodological perspective, a RCT is the best technique to conduct an impact evaluation – given that it avoids any selection into the treatment. The straightforward approach of RCTs is to avoid selection-into-treatment from the outset. For that reason the treatment is assigned randomly: it is simply left to chance whether a household receives the treatment or not. People cannot self-select into the treatment and, as a consequence, unobserved characteristics such as motivation or modernity cannot distort the impact assessment afterwards.

As example, consider children's reading hours at night as an intermediate impact. It can be expected that certain characteristics of households imply that these are more inclined to buy a solar lamp than others. For example, more *modern* households are keener on having electric light than others. At the same time, more modern households might also urge their children to read – more than non-modern households. As a consequence, in an observational study (“in the real world”) among solar lamp users it is likely that the more modern households have more lamps and their children read more.

While RCTs are considered a methodologically sound approach, there are reservations as well, amongst others from an ethical perspective.⁴⁶The present case is less vulnerable to

⁴⁵ An amount of € 150,000 has been requested from the portfolio that the Netherlands' ministry of Foreign Affairs transfers to the World Bank for the implementation of AFREA activities.

⁴⁶ See, for example, Banerjee and Duflo (2009), Burtless (1995), and Duflo, Glennerster, and Kremer (2007) for the pro-RCT view and Ravallion (2009) and Deaton (2008) for RCT scepticism.

constraints of an ethical nature since solar lamps are relatively cheap (for example as compared to bio-digesters) and can be counter valued by donations of comparable monetary value (see next paragraph). Furthermore, thanks to the low cost, a larger number can be distributed ad random. Since a solar lamp represents a small gift only, it will attract less attention than for example the donation of a biogas digester.

Nevertheless, the RCT should address some challenges: people should not notice that they are part of a ‘special group’ since this may alter their behaviour. Thereto, the randomization will be done in combination with the follow-up survey in the EARP control regions. All respondents in the survey will be informed that they are invited to participate in a lottery as reward for taking the time to answer the questionnaire.⁴⁷ This also addresses as second challenge: the randomly assigned lamp should not be perceived as a gift, but as a reward. Through combining it with the EARP survey, it is a reward, a compensation for participating in the survey.⁴⁸ The third challenge deals with the ethical concern: randomly determining winners and losers may induce uncomfortable feelings. But this can be eliminated by a full reward system to all respondents: they receive either a lamp (“the winner”) or a comparable small gift (“the losers”).⁴⁹ A fourth challenge results from the tradable character of the lamps: “winners” might simply sell the lamps. One option to face this is to offer the winning households right from the beginning a second lamp (or any other reward) if they still possess the lamp at the time of the follow up survey. This creates a clear incentive not to sell the lamp in the meantime – but has budgetary implications. Not least, it might happen that the randomization does not succeed in creating balanced samples of treatment and control households.

Great Lakes Energy is currently trying to expand its market coverage. The spread of the solar lamps –6-12 months from the baseline to the follow up survey– to members of the control group would blur the demarcation between the control and the treatment group. The same potential problem exists if in the future other companies will penetrate the Rwandese market in a massive scale and provide similar lamps in the areas where the baseline surveys were carried out. Both problems –based on the knowledge of July 2010– seem relatively unlikely to occur, since the market penetration by Great Lakes has remained quite modest (3,000 lamps sold country-wide in two years) and the company has not experienced significant competition from other providers. Another challenge is associated with the fact that the treatment group will receive the lamps for free and there might be a risk that the lamps might be under-appreciated as compared to those had to pay the market price of the lamps (around 20 USD). In order to avoid that the Great Lakes Energy market is spoiled by the randomized lamps we will limit the sample size of treated (i.e. winning) households to 100-150.

5 ORGANISATION

The impact evaluation will be conducted by the Policy and Operations Evaluation Department of the Netherlands’ Ministry of Foreign Affairs (IOB) in close collaboration with the

⁴⁷ The exact design of the lottery will be elaborated in close cooperation with local experts using the experiences from other field experiments and those gained during pre-tests. Both cultural traits and fraud potentials (??) have to be taken into account.

⁴⁸ This implementation design follows the approach presented in De Mel, McKenzie, and Woodruff (2008) and was also applied in a RCT with improved cooking stoves in Senegal (Peters and Bensch 2010).

⁴⁹ In Senegal, a similar approach implied a compensation with a small sack of rice to those that were not awarded with the RCT “prize” (see Peters and Bensch 2010).

Rwandese authorities and implementing agencies. IOB has contracted the services of the Rheinisch Westfälisches Institut für Wirtschaftsforschung (RWI) in association with the International Institute of Social Studies (ISS) to conduct the quantitative impact evaluations. Communication mechanisms will be established with the Ministry of Infrastructure to ensure the direct involvement in the EARP analysis.

Overall supervision for the evaluation rests with Rita Tesselaar, inspector IOB, supported by Willem Cornelissen, evaluator IOB and Jolijn Engelbertink, researcher IOB. On behalf of RWI and ISS, the first responsible for the evaluations in Rwanda is Jörg Peters. Contacts with local partners and the survey implementation will be handled by Lorenzo Pellegrini and Luca Tascotti (both ISS), Gunther Bensch and Maximiliane Sievert (both RWI). A junior researcher from RWI / ISS will supervise the data collection process for the surveys in the field. A substantial involvement of national researchers is envisaged, both in the design of the questionnaires, the data collection in the field and in the first data processing.

Both the “General and contextual description and analysis concerning the energy sector and its institutions in Rwanda” and the “Description of the Netherlands funded renewable energy activities in Rwanda” will be conducted directly by IOB, with collateral support by RWI and ISS⁵⁰. The impact evaluations of the Electricity Access Roll-out Programme and Lighting Africa / Great Lakes Energy as well as the eventual evaluation of the Sustainable Energy Development project will be responsibility of RWI and ISS. In the case sufficient financial resources become available, RWI and ISS will also conduct a quantitative evaluation of the biogas programme. are responsible for the reporting to the IOB in such a way that the report constitutes an integral chapter for the final country evaluation report.

The draft final report will be presented for comments to the pertinent authorities in Rwanda, to the embassy of the Kingdom of the Netherlands in Kigali, to the department responsible for renewable energy in the Netherlands Ministry of Foreign Affairs, to the implementing agencies of the programmes and projects involved and to the Reference Group. The Reference Group will be strengthened with two members from Rwanda⁵¹. The draft report will be further commented on by two evaluators/ co-readers of IOB. A workshop will be organised in Rwanda to present and discuss the study findings and issues identified.

5.1 TIMING

The timing of the elaboration of the contextual and institutional analysis as well as the inventory and descriptive evaluation of all activities funded with PREP resources in Rwanda is an ongoing process that may experience change if and when new programmes or projects (funded by PREP resources) start in Rwanda. The analysis will have to be completed not later than the first quarter of 2014.

The timing of the impact evaluations in Rwanda is in part determined by the seasons. Both baseline surveys and repeat surveys will be conducted during the same season; leaving 2 years

⁵⁰ Detailed ToR will be elaborated in due time.

⁵¹ At the moment of elaboration of these ToR contacts with potential candidates have been established, but no formal agreement had been signed yet.

(if possible) between baseline and follow-up survey for the EARP programme, and 1 year between baseline and follow-up survey of the solar device programme.

The tentative overview in time is presented in the following graph:

Time-line-graph for Rwanda study

	2011												2012												2013												
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Module A: EARP Grid extension Preparatory mission: baseline survey (Training of enumerators, pre-tests, focus-group discussions) Data collection baseline survey Data cleaning and set up of baseline data base Analysis of baseline data Draft Baseline Report Preparatory mission: follow-up survey Data collection follow-up survey Data cleaning and set up of data base (follow-up survey) Impact evaluation and report writing Draft evaluation report				■	■																								■	■							
Module B 1: Sustainable Energy Development - solar heating Module B 2: Biogas to be determined during 2011 or 2012 conditioned by availability of funding from external sources																																					
Module C: Randomized Solar Lamps Preparatory mission: randomization survey (Training of enumerators, pre-tests, focus-group discussions) Randomization and data collection baseline survey Data cleaning and set up of baseline data base Analysis of baseline data Draft Baseline Report Preparatory mission: follow-up survey * Data collection follow-up survey* Data cleaning and set up of data base (follow-up survey)* Impact evaluation and report writing* Draft evaluation report*																	■	■											■	■							
Module D: Institutional and sustainability analysis Mission Draft report																			■										■		■						

* Note: The timing of the EARP follow up survey remains to be determined. The decisive factor is MININFRA's grid roll-out plan: The control villages are also target regions of EARP but will be connected after the treatment group villages. If this happens before 2013 the follow-up survey has to be conducted in 2012.

5.2 BUDGET

The overall budget required for the various studies has been estimated at € 436,100. This encompasses the costs for the consortium of external consultants RWI and ISS; the costs for local surveyors and the costs for an institutional and sustainability analysis (to be conducted jointly by RWI/ISS and IOB staff)⁵².

6 EXPECTED DELIVERABLES

The studies and evaluations mentioned in this ToR will produce the following deliverables in the English language. Although certain documents (questionnaires) might have to be translated to French (and if required in Kinyarwanda), the deliverables are expected to be elaborated in the English language. Since the deliverables depend on the availability of different funding sources, at this stage only the following deliverables are expected.

October 2011

A working document detailing the methodology applied and the first results obtained from the baseline survey on the (future) **EARP** beneficiaries.

June 2012

Preliminary report on desk study of all Dutch funded activities in the energy sector.

July 2013

Draft chapters concerning the context and institutional sustainability assessment in combination with the descriptive analysis of all **PREP funded activities** in Rwanda.

September 2013

Report on the verification of Dutch funded activities in Rwanda and context analysis

November 2013

Draft chapter on the results obtained from the impact analysis among **EARP** beneficiary households.

February 2014:

A draft final report at country level integrating the chapters mentioned above. This report will be published as 'stand alone' IOB report in the English language.

At a later moment in time in 2014, a synthesis and policy evaluation report concerning the energy and development cooperation policy of the Netherlands will encompass the Rwanda experience. This final product does not pertain to the present ToR.

⁵² Costs for IOB staff, the Reference group members, the verification mission by IOB staff, the dissemination seminar and the costs for publication of the final report have not been included, since these will be covered from different budget lines.

Annex 1: Renewable Energy programmes funded through the PREP in Rwanda

	Financing modality	Brief description of main activities	Current situation (July 2010)	DGIS funding in EUR
National				
Electricity Access Roll out Plan	Bilateral Energy sector support to MININFRA	Roll-out plan to increase connection to the grid and providing off-grid electrification all generated by renewable sources.	In June 2009 the agreement with MININFRA was signed. 160.000 households connected.	EUR 30 mln ⁵³
PAREF II	Funding provided to BTC, implemented by MINIRENA	Reforestation programme, ensuring access to firewood	Contract for PAREF II was signed in 2008. 1739 ha of trees have been planted.	EUR 10 mln
Biogas programme (NDBP)	Delegated partnership DGIS-BMZ. Implemented through MININFRA. SNV/GIZ provide TA.	The installation of bio digesters, to be used for cooking and lighting purposes for households in rural areas.	650 bio digesters have been constructed.	EUR 3.2 mln
Micro-Hydro Plants	Silent partnership DGIS-BMZ. Implemented through GIZ.	The development of MHP plants to provide electricity through support to private developers	1 plant completed: 2 under construction	EUR 1.8 mln
Sustainable Energy Dev. (SED) Project	Funded through ESMAP-AFREA, implemented by RECO	Increase private sector participation in the renewable energy sector and improve policy and institutional framework of the RE sector.	Agreement signed in February 2010. Activities have not started yet.	EUR 3.07 mln ⁵⁴
Giciye hydro project	Funded through Daey Ouwens Fund, implemented through Rwanda Mountain Tea	Grant to support the creation of a hydro power plant for use by Rwanda Mountain Tea and local communities	Construction is planned to be started by the end of 2010.	EUR 2.247.000
Lights for Life	Partly funded through 'Lighting Africa Development Marketplace Award' as part of the WB Lighting Africa Programme, implemented by Millennium Villages Project	Production and sale (through local entrepreneurs) of solar lanterns in the Millennium Village	1300 solar lanterns have been produced and are in use in households.	EUR 161.21655 (WB funding)
Personalized solar lighting	In part funded by 'Lighting Africa Development Marketplace Award' as part of the WB Lighting	Training retailers to sell small solar devices to be used for home and business lighting.	3000 products have been sold with an average of 5-10 per month per retailer (148 retailers)	EUR 160.83956 (WB funding)

53 The Netherlands has also allocated a total of EUR 2 mln for the development of SWAP prospectii in Rwanda, Kenya and Ethiopia through the ESMAP- AFREA programme.

54 Using rate 20/05/10. In project appraisal document USD 3.8 mln

55 USD 199.275 (converted 20/05/10)

56 USD 198,925 (converted 20/05/10)

	Africa Programme. The LADM is co-funded by AFREA. The implementation of the award winning products rests with Great Lakes Energy			
Kitchen Energy reliability Cooker	Partly funded through Biomass Energy Initiative Africa (BEIA), funded through ESMAP-AFREA. Implemented by Adenya.	Creating a legal organised charcoal production chain by providing environmental education to 120 charcoal producers and introducing a more efficient stationary kiln	Grant approved in January 2010 but funds not received yet.	EUR 90.49757
Regional				
Rusizi II Hydro Power Plant	Funded through FMO	Regional fund for the rehabilitation of the Rusizi II power plant.	Reconstruction work in progress.	EUR 5 mln
CATALIST/SEW	Funding provided to IFDC.	Regional reforestation programme	End 2010 trees will be planted. Wood harvest expected in the next 5-7 years.	EUR 20 mln
Regional Electricity network Interconnection	Funded through the AfDB, NBI and NELSAP	Creation of a transmission line between Burundi and Rwanda.	Feasibility study is now being conducted, on the basis of which the Netherlands will determine the final contribution	EUR 25 mln

National Domestic Biogas Programme

The National Domestic Biogas Programme in Rwanda (NDBP)⁵⁸ is implemented by MININFRA with the support of SNV and GIZ according to an Implementation Plan endorsed by the GoR dated Sept. 11, 2006. The NDBP launches a country-wide programme aimed at developing a commercially viable and environmentally sustainable market-oriented biogas sector. The market should deliver high quality digesters lasting for at least 20 years. The programme promotes digesters of different size, but for domestic use (cooking and with the option of using one gas lamp) about 1.2 m³ gas is needed per day and a 6-10 m³ digester. Since the uptake of bio digesters was less than envisaged, experiments started with smaller – and hence cheaper- digesters of 4m³. The target group of the biogas plants are rural households owning a minimum of 2 cows. According to the original Implementation Plan, by late 2011 about 15,000 family-sized quality biogas plants would have been built, but a mid-term review (late 2009) reduced the target to 5,000. Later, during the 2010 Rwandan National Leadership Retreat, a target of 3,000 digesters has been proposed. Initially, the programme started off in 5 districts only, but due to GoR pressure the programme was opened up to all 30 districts. By July 2010, 682 biogas digesters had been installed.

⁵⁷ USD 111,590 (converted 20/05/10)

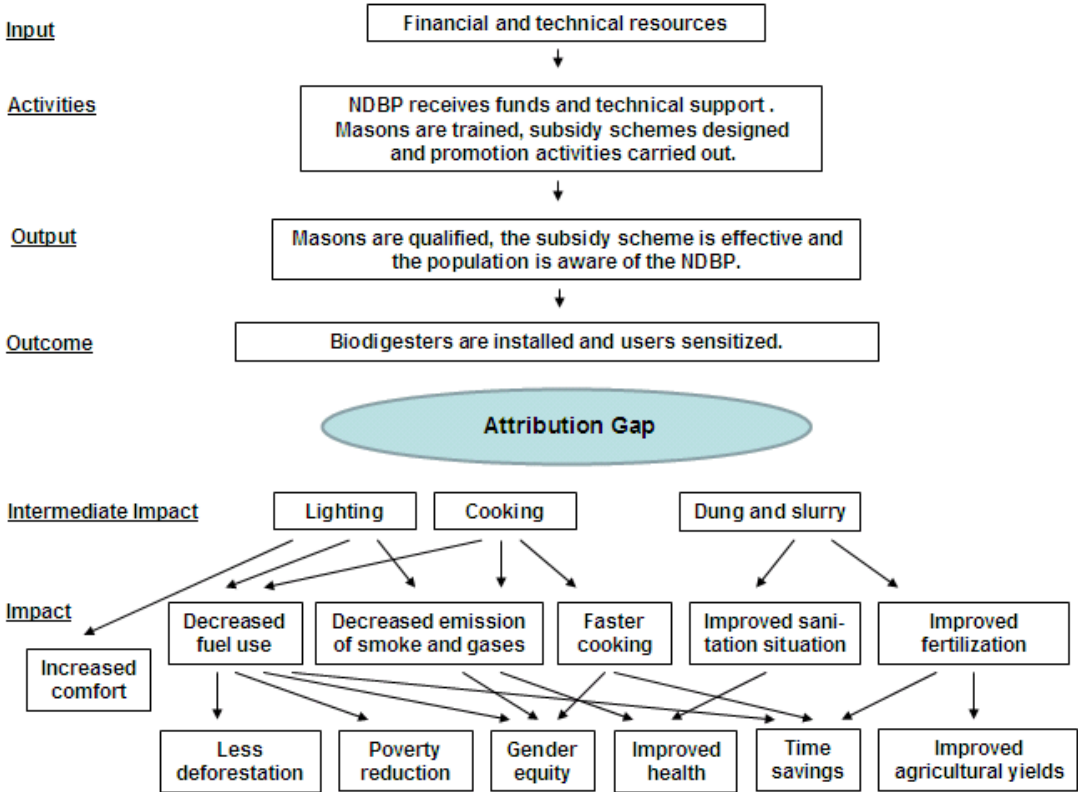
⁵⁸ If and when financial resources allow constraints however, caused a downgrading of the evaluation methodology to a desk study with verification in the field, based on qualitative methods.⁵⁸

The availability of credit facilities happens to be critical to the uptake of bio digesters. In 2009 the Banque Populaire (BPR) and the Netherlands Development Finance Company (FMO) signed an Agreement for an amount of € 4 million, in order to provide 3-year credits to households interested in buying a bio digester. The NDBP stresses the importance of increasing the marketing/ promotion of these campaigns. Two companies have been contracted to promote the digesters nationwide. Up to mid 2010, the project has trained over 200 masons and technicians, while approximately 30 companies are actively involved in the programme.

Households receive a 1 year guarantee on the bio digester. During this period the field technician visits the installation three times and checks its operation. The costs of these visits are included in the price for the digester as after-sales service. Once the bio digester has been operative for a year, the construction company receives the final disbursement.

NDBP’s comprehensive approach encompasses biogas research and training. Concerning research, NDBP is cooperating with the Kigali Institute of Science and Technology (KIST) and the Higher Institute of Agriculture and Animal Husbandry (ISAE), most notably on the use of the slurry for farming practices. Training of trainers approaches are being implemented with technical colleges (2 of 5 Integrated Polytechnic Regional Centres (IPRC)) and the Workforce Development Authority (WDA).

Figure 1: NDBP results chain



Source: Own illustration