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1 INTRODUCTION

1.1 Global situation

The project IMPROVES-RE contractually started in April 1, 2005, but the activities effectively started after the kick-off meeting, which was held at IED, Francheville, France on May 19 and 20, 2005 wherein the European partners were present.

Following this meeting, a kick-off mission was organized in the four countries concerned, marking the effective start date of the activities in each of the countries. The first activity consisted in the organisation of a national kick-off workshop (July 2005 for Mali, November for Burkina Faso and Niger, December for Cameroon). These workshops were dedicated to the programme presentation and its links with the concerned national participants, and to multi-sectorial discussions about information sharing.

This relative time lag between the official project launch and country kick-off workshop has since been caught up with. The only modification to note is that the training activity on Geographical Information Systems, envisaged within the framework of the first semester, was shifted to the second six-month period to take into account the effective status of data-collection in the various countries.

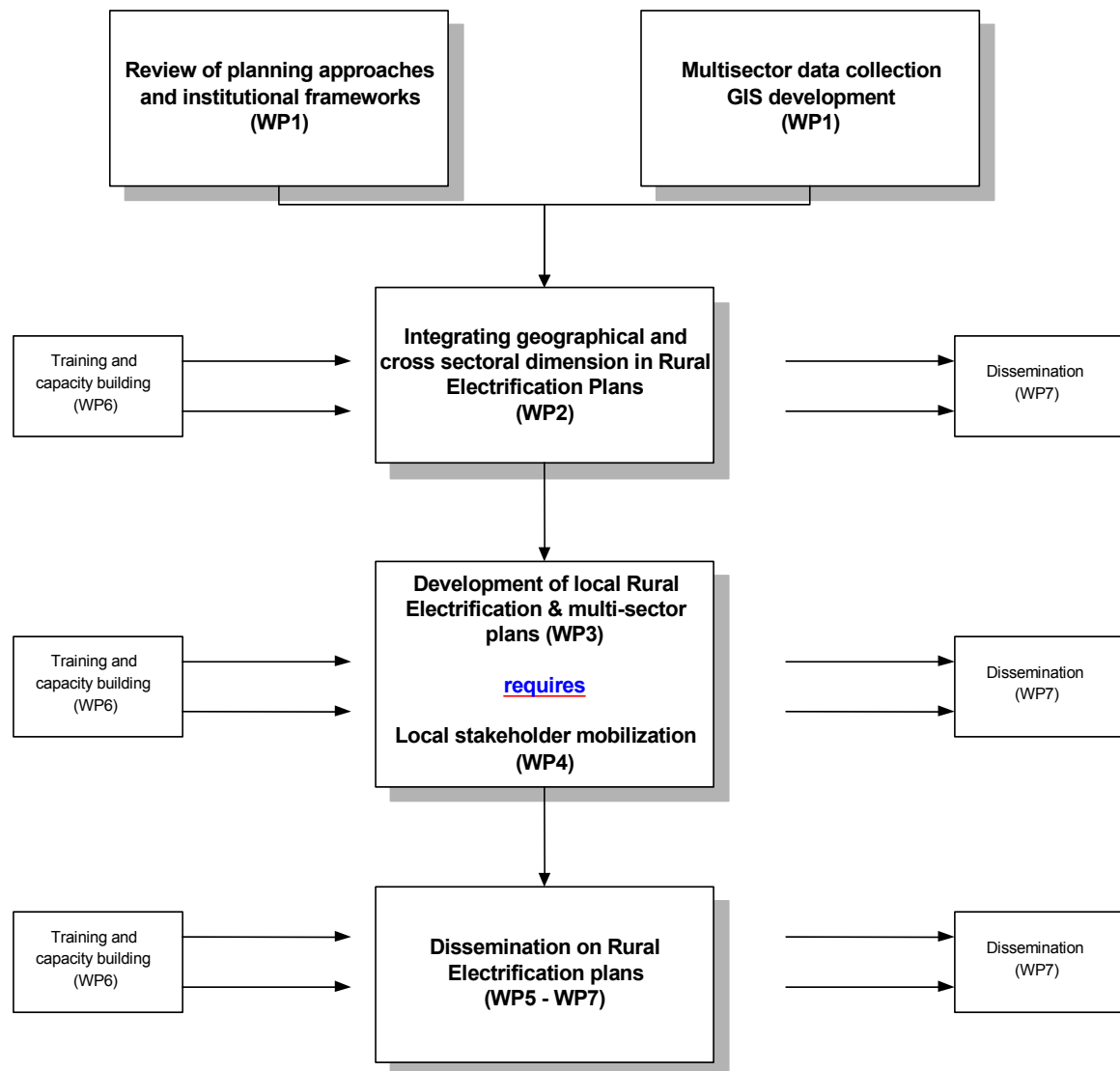
After this first inception phase dedicated to the launching of the project in the four countries and discussion / confirmation of the methodological approach of the project, actual fieldwork was undertaken during the second semester of the project.

The following key activities were then carried out:

- Identification of potential pilot zones for project implementation and validation of the zone by the institutional partners in each country,
- Establishment of a first analysis of the electrification situation,
- Launching of socio-economic investigations in pilot zones,
- Identification and study of "Development poles"
- Analysis of the solvent demand for electricity.

1.2 Reminder on Work Packages arrangement and Project Schedule

Work Packages arrangement



Project schedule

		in months																								Leader
Nº	Work package	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	Review of planning approaches and institutional frameworks, and multisector data collection						D2 D3																			IED
2	Integrating cross sectorial dimension in Rural Electrification Plans												D5													RISOE
3	Development of local Rural Elect. & multisectorial plans																				D7					IED
4	Local stakeholder mobilization																		D6		D9 D10					ETC
5	Internet based visualisation of Rural Electrification plans																				D8 D11					IED
6	Training and capacity building		D1				D4																			IED
7	Dissemination						D12 D14						D12							D12			D13		D12 D14	ETC/IED

Coordination and reporting

[illegible]

1.3 Content of report

This interim report makes a synthetic point on the activities carried out during the first 15 months of the programme. It follows the two progress reports issued up to now for two first 6 months periods:

- Progress report n°1 (April - September 2005)
- Progress report n°2 (October 2005– Mars 2006)

More exactly, it covers the following aspects:

Work Package	Activities	Deliverable
WP1	Review of planning approaches and institutional framework, and multisectorial data collection	
WP1.1	Review of context	D2
WP1.2	Cross sectorial partnerships	
WP1.3	Multi-sector data GIS	D3
WP2	Integrating cross sectorial dimension in Rural Electrification Plans	
WP2.1	Methodology of integrated cross-sectorial rural electrification planning	
WP2.2	Integrating cross sectorial dimension in Rural Electrification Plans	D5
WP3	Development of local Rural Electrification and multi-sectorial plans	
WP3.1	Identification of existing models and software tools	
WP3.2	Selection of pilot area	
WP3.3	Elaboration of local Rural Electrification and multi-sector plans	
WP 4	Local stakeholders mobilization	
WP4.1	Identification of local stakeholders	
WP4.2	Discussion of different rural electrification implementation projects opportunities	
WP5	Internet based visualisation of Rural Electrification Plans	
WP5.1	Internet tool specification and development	D8
WP6	Training and capacity building	
WP6.2.1	Training session in Bamako (MALI) – (D1)	
WP6.2.2	Training session on Geographic information System (GIS)	D4
WP6.3	National Multi-stakeholder workshop	
WP7	Dissemination	
WP7.4	Website	D14
WP7.4 and 7.2	Website (D14), Articles and publication (D12)	D14 & D12
WP 8	Coordination	
	Kick-off meeting in Francheville	
	Consortium meetings	
	In countries missions	
	Financial issues	
	Cross-sectorial partnerships	
	Status of deliverables	

After the first 15 months, the project progress is in line with the schedule, as indicated in the table below:

<i>Project progress after 15 months</i>				
Work Package	Current status	Deliverable	Initially scheduled	Current status
		D1	2 nd month	Completed
1	Completed	D2, D3	6 th m.	Completed
2	Completed	D5	12 th m.	Completed
3	In progress	D7	20 th m.	In progress
4	In progress	D6/ D9, D10	18 th / 20 th m.	In progress
5	In progress	D8, D11	20 th m.	In progress
6	In progress	D1, D4	2 nd / 6 th m.	Completed
7	In progress	D12,D14	24 th m.	In progress

2 STATUS OF IMPLEMENTATION PER WORK PACKAGE

2.1 WP1: Review of planning approaches and institutional framework, and multi-sector data collection

WP1.1: Review of context (D2)

In each of the countries concerned by the project “IMPROVES-RE”, the review of the current approach used for rural electrification and in particular the economic assumptions behind the models used was undertaken: technical options and their costs (network extension, isolated systems, renewable energies, etc.), adoption or not of standards simplified for costs reduction, promotion of practices and technologies as regards energy efficiency, etc.

The objective of this deliverable was to analyse the actual situation and how these various approaches take into account the socio-economic impacts of rural electrification projects.

The examination of the institutional framework makes it possible to identify the principal players of the rural electrification sector, by highlighting those who:

- (i) can have a role to play in the financing or the management of the local electrification system,
- (ii) are responsible for the investments and the management of the local infrastructures,
- (iii) can mainly draw benefit from the improved electricity services, such as small businesses, schools, health centres, Community buildings, telecommunication services, etc.

These various elements, institutional frameworks and approaches to planning, were presented in Bamako by the African institutional partners of IMPROVES-RE. The Consortium also completed this analysis, due to their active role in the majority of the countries concerned, within the framework of rural electrification strategy, planning or project feasibility studies.

See Deliverable D2 for more details

WP1.2: Cross sectorial partnerships

In each country, a workshop has been organised, to present the project to the multi-sector players and those in charge of the production and analysis of socio-economic and geographical data, to open the floor for a sustainable multi-sectorial partnership.

In Burkina Faso, Mali and Niger, the project tried to build links with existing structures of cross sectorial partnerships.

- As mentioned before, a meeting with the multi-sectorial Committee was held in Bamako (Mali) on the 26th July, 2005
- in Burkina Faso, a meeting with the multi-sectorial Committee was held in Ouagadougou on November 08, 2005

- in Niger, a national meeting was held on November 23 and 24, 2005.
- In Cameroon, where there was no existing multi-sectorial Committee, a national workshop to launch the program was held on 16 December 2005. One of the key outputs of this workshop has been the recommendation to establish a permanent multi-sectorial working group. This was made effective with ministerial decision N°000002/MINEE/SG/DEL of January 20, 2006, signed by the Minister in charge of Energy and Water, and the creation of a Multi-sector National Working Group for the follow-up of IMPROVES-RE in Cameroon. Since January 2006, the Multi-sector National Working Group has already held two meetings on data exchange and has been involved in the socio-economic investigation in the pilot zone. Details on the establishment of the multi-sectorial working group in Cameroon are available at: <http://www.improves-re.com/upload/AV21.pdf>

WP 1.3: Multi-sector data GIS (D3)

This deliverable, which also acts as methodological note, went further than what was initially planned. The report presents ways on how to develop alternative models for rural electrification planning, before fixing the minimal framework of multi-sector data to collect. Thus, in addition to the identification of the minimal data needed and the current status of the geographic information system in each country, this deliverable also provides:

- The progress report of the establishment of the multi-sector national teams
- The theoretical elements of the planning model which will be developed within the framework of IMPROVES-RE
- The minimal data to be collected and the progress state of the geographical information system in each country
- The choice of the pilot zones and the proposals of the Consortium

See Deliverable D3 for more details

2.2 WP2: Integrating cross sectorial and geographic aspects in Rural Electrification Plans

WP2.1: Methodology of integrated cross-sectorial rural electrification planning

Analysis of the expected change

The aspects to be considered to enhance the impact of rural electrification are far beyond its direct results, and have to take into account its indirect impacts. Within the perspective of an anticipation of these impacts from the beginning of the planning, the analysis of the change is an important step. Before undertaking the planning, it is necessary to:

- Conduct an inventory of the expected changes, considering expected results and effects with significant and sustainable changes,
- And to establish a common framework for all the considered effects. This framework contains various thematic fields, chosen for their relevance in the studied field.

The anticipation of the socio-economic changes due to the rural electrification: the concept of Human Development Indicator (HDI).

With the objective to anticipate the rural electrification impacts at economic and social levels, the IMPROVES-RE approach proposes to include the analysis of the changes due to the rural electrification within the framework of the dynamics of poverty alleviation and the Millennium Development Goals (MDG). It is proposed to analyse the « economic » and « social » aspects under the concept of the Human Development Indicator (HDI), used as reference system.

Composite indicator established by the United Nations Development Program (UNDP) with a value ranging between 0 and 1, the HDI combines life expectancy, skills level given by the adult literacy rate and the gross enrolment ratio for primary, secondary and tertiary schools, as well as the real GDP per capita adjusted in parity of purchasing power (PPP). (GDPs exceeding the world average are adjusted).

Table 1. HDI and Millennium Development Goals (MDG)

HUMAN DEVELOPMENT INDICATOR (HDI)				
DIMENSION	Longevity and health	Education and access to knowledge		Decent standard of living
CRITERIA	Life expectancy at birth	Adult literacy rate	Education gross rate	GDP per capita
INDEX	Life expectancy index	Education index		GDP index
HDI = 1/3 (Life expectancy index) + 1/3 (Education index) + 1/3 (GDP index)				

Long life and good health Life expectancy index	
Access to education Education index	
Decent standard of living GDP per capita	

Millennium Development Goals (MDG)	
OBJECTIVES	DURATION 1990-2015
Objectives 4, 5 and 6: Reduce child mortality, improve maternal health, combat HIV/AIDS, malaria and other diseases	Reduce by two thirds the mortality rate among children under five
	Reduce by three quarters the maternal mortality ratio
	Halt and begin to reverse the spread of HIV/AIDS
	Halt and begin to reverse the incidence of malaria and other major diseases
Objectives 2 and 3: Achieve universal primary education, promote gender equality and empower women	Ensure that all boys and girls complete a full course of primary schooling
	Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015
Objective 1: Eradicate extreme poverty and hunger	Reduce by half the proportion of people who suffer from hunger
	Reduce by half the proportion of people living on less than a dollar a day

Source: Report on human development 2003

Identification of the rural electrification fields of impact

In order to anticipate them, the analysis of the changes due to rural electrification necessitates first of all to list the fields of impact of the rural electrification on poverty and local development, and therefore to list changes from expected results and effects point of view, and to select the effects leading to significant and sustainable changes. From various experiences in that sector¹, direct results and positive, significant and sustainable effects expected from rural electrification can be presented as follows:

Expected direct results

- The production of a substitute energy at least cost (compared to: fuel used for lighting, batteries, small diesel groups, diesel pumps for irrigation and drinking water supply),
- The enhancement of life standards in rural areas (improved lighting, introduction of domestic electric equipments etc.),
- Electricity supply for productive and economic activities (irrigation, drinking water, shops, craft, farming, etc.),
- Electricity supply for social activities (health, education, drinking water, associative activities, etc.).

Expected significant and sustainable effects

Based on various works undertaken in that field, positive effects expected from rural electrification can be presented as follows:

- Reduction of domestic pollution due to fuel used for lighting,
- Reduction of working hours, especially for women,
- Improvement of habitat (strong construction),
- Enhancement of health cares quality,
- Enhancement of access to drinking water,
- Improvement of adult literacy,
- Enhancement of school results,
- Access to the information, especially through TV,
- Stimulation and strengthening of local economies: enhancement of farming production, of access to local markets, of economic and handcrafted activities,
- Direct and indirect employments creation,
- Improvement of households incomes and savings,
- Reduction of rural exodus.

¹ As various studies from the FAO (www.fao.org), works from ESMAP (www.esmap.org) on economic and social impact of rural electrification. IED made a study on that theme in Ivory Coast in 2004.

Table 2. Grid on potential changes of rural electrification

Aspect	Field
Health and social well-being	Reduction of domestic pollution
	Enhancement of domestic life standards
	Improvement of habitat (strong construction)
	Enhancement of access to drinking water
	Enhancement of health cares quality
Education	Improvement of adult literacy
	Enhancement of school results
	Access to the information, especially through TV
Local economy	Enhancement of farming production
	Development of local markets, economic and handcrafted activities
	Direct and indirect employments creation
	Improvement of households incomes and savings
	Reduction of rural exodus

Development pole notion

As indicated in the table 3 below, the census of the positive potential changes due to rural electrification highlights the fact that competition will appear between localities among which will be chosen those to be first electrified.

Indeed, the global improvements of the HDI, targeted at a given territory scale, necessitate :

- The health and education structures localisation, usually spread randomly on this territory;
- The localisation and the understanding of the local economic dynamics, that must be clearly figured out;
- The cross-reference of the above aspects with the local spatial and demographic dynamics, in order to target the maximum population in the territory considered.

Table 3. Local or territorial dimensions of potential changes of rural electrification

Aspects	Fiels	Inherent to the locality to be electrified?
Health and social well-being	Reduction of domestic pollution	YES
	Enhancement of domestic life standards	YES
	Improvement of habitat (strong construction)	YES
	Enhancement of access to drinking water	YES
	Enhancement of health cares quality	Not necessarily
Education	Improvement of adult literacy	YES
	Enhancement of school results	Not necessarily
Local economy	Enhancement of farming production	Not necessarily
	Development of local markets, economic and handcrafted activities	Not necessarily
	Direct and indirect employments creation	Not necessarily
	Improvement of households incomes and savings	Not necessarily
	Reduction of rural exodus	Not necessarily

In order to maximise the positive effects on the socioeconomic development, high relevance is needed in the selection and the ranking of localities candidates to rural electrification.

It is therefore important to introduce two concepts established under the HDI notion, and that will constitute bases of the IMPROVES-RE approach. They are :

- The **Indicator of Potential of Development (IPD)** : established under the HDI notion (Human Development Indicator), this indicator proposed within the framework of the IMPROVES-RE approach indicates the capacity of a locality to eradicate poverty on the territory including the locality itself and its hinterland. In accordance with HDI characteristics, this capacity to fight against poverty is established through three criteria: access to education, access to health cares and the local economic productivity.
- The concept of **Development Pole**: A Development Pole is a locality with a quite high Indicator of Potential of Development (IPD). It is a place where habitat and activities converge to reach a quite high density. A Development Pole is a place offering employment opportunities in secondary and service sectors, in opposition to the primary sector employments (agricultural) which usually spread over remote places of the territory. For a given territory and locality, the status of Development Pole depends on the inherent value of its IPD considering the sub-indicators used to measure the three criteria presented before, and on the maximal number (n) of Development Poles at the concerned territory scale: localities with the (n) best IPD are the development poles of this territory. The Development Pole notion becomes therefore a relative notion, depending on the territory concerned. This reality will appear to be crucial to understand the local issues to specify the priorities, sometimes different from national priorities and yet relevant in a decentralised context.

The objective of improvement of the socio-economic impact of the rural electrification therefore necessitates to conduct a preliminary socio-economic study at the considered territory scale, as the starting point of the electrification planning. The study objectives are to analyse the health and education structures (localisation, frequenting and origin of the beneficiaries of the services, frequency, etc.), and the local economic dynamics between Development Poles and their hinterlands. The study enables to calculate the Indicator of Potential of Development (IPD), especially in its « local economy» aspect.

The analysis will involve local actors (local communities, administrative authorities, economic actors, NGO, etc.) with the following assumptions:

- People and goods move, especially farming and pastoral and manufactured products, are the main characteristic of an economic “pole-hinterland” relation.
- The study of these flows, including those concerning health and education, enable to review the “pole-hinterland” dynamics at a given territory scale,
- The Development Poles concentrate a growing part of the local economic activity,
- The population size and the demographic growth constitute relative criteria of economic development of a territory,
- An existing market is an essential characteristic of the local economic dynamism,
- The accessibility to a locality impacts positively its economic development and its polarity.

The terms of reference of such a socio-economic study, conducted within the four pilot zones of IMPROVES-RE project are available in D5.

Example of IPD structure and calculation

After Bamako workshop attended by the project team (european consortium and african partners), it was decided that the validation of the IPD structure proposed by the Consortium would be done by the teams in charge of the project implementation in each country. The amendment of criteria as well as the adoption of a weighting system should be ideally done after consultation, within the framework of multi-sectorial working groups.

The proposed formula to calculate the IPD preserves the basic structure of the HDI. It gives equal weight to the three aspects "health", "education" and "local economy", and is calculated using the following formula:

$$IPD = 1/3 (IPD_{\text{health}}) + 1/3 (IPD_{\text{education}}) + 1/3 (IPD_{\text{local economy}})$$

Each aspect of the IPD (health, education, local economy) is established from criteria chosen by the countries, taking into account the availability of necessary data² and the country orientations in terms of land settlement³. For each aspect, the IPD is calculated as follows :

$$IPD_{\text{aspect}} = \sum_{\text{criteria}} (\text{weight} * \text{value})$$

The weight indicates the relative weight of the considered criteria. For each aspect, the sum of relative weights of each criteria equals 1. The value is the value of the sub-indicator allowing to calculate the criteria. It ranges between 0 and 1. The measurement of a criteria may necessitate several sub-indicators. Criteria can change from a country to another, depending on data availability and on specific orientations on land management.

The table below presents the criteria proposed by the Consortium for each aspect of the IPD and submitted to the countries :

Table 4. Proposition of criteria and weighting for the 'IPD

Aspect	Weight	CRITERIA
HEALTH ⁴	1/3	Sanitary trainings
		Access to drinking water
EDUCATION ⁵	1/3	Adult literacy
		Acces to education
ECONOMIE LOCALE	1/3	Population of the locality
		Population of the l'hinterland ⁶
		Market
		Savings and credit possibilities
		Distance to the nearest asphalt road

² The data availability must be effective in each locality

³ It shows the will to develop the administrative units

⁴ It corresponds ONLY to the sanitary training with the highest level of service. The correct typology will depend on each country. Identically, do indicate only the type of access to drinking water with the highest level.

⁵ In accordance with the HDI, it implies adult literacy (2/3) and all education levels (1/3) : primary, secondary and tertiary.

⁶ A method of analysis of the hinterland population is proposed in D5.

The table above must be completed with the list of sub-indicators, their values and the weighting system.

Table 5. Example of detailed structuring for the calculation of the IPD

Aspect	WEIGHT	CRITERIA	WEIGHT	SOUS-INDICATEUR	VALUE	EXAMPLE
HEALTH	1/3	Sanitary training	1/2	None	0	
				Basic Structure (first cares)	0,2	
				Clinic or maternity hospital	0,4	0,4
				Health centre without surgery	0,5	
				Health centre with surgery	0,8	
				Hospital, teaching hospital	1	
		Access to drinking water	1/2	Running water	1	
				Fountain	0,5	0,5
				Well	0,2	
				Other	0	
EDUCATION	1/3	Adult literacy	2/3	Training structure Existence	1	
				No structure	0	0
		Education	1/3	Primary school	0,33	0,33
				Secondaire school	0,33	0,33
				Tertiary school	0,33	
				No school	0	
LOCAL ECONOMY	1/3	Population of the locality	2/9	0-300 inhabitants	0	
				300-1000 inhabitants	0,2	0,2
				1000-5000 inhabitants	0,5	
				More than 5000 inhabitants	1	
		Population of the hinterland	1/9	None	0	
				1-2000 inhabitants	0,2	0,2
				2000-10000 inhabitants	0,3	
				10000-50000 inhabitants	0,5	
				More than 50000 inhabitants	1	
		Market	1/9	Daily market	1	
				Weekly market	0,5	0,5
				Occasional market	0,2	
				No market	0	
		Savings and credit possibilities	2/9	Bank	1	
				Micro-finance structure	0,75	
				None	0	0
		Distance to the nearest asphalt road	1/3	0 km	1	
				0-5km	0,5	0,5
				More than 10km	0	

Village example :

$$IPD_{health} = 0,4x(1/2) + 0,5x(1/2) = 0,45$$

$$IPD_{education} = 0x(2/3) + (0,33 + 0,33 + 0)x(1/3) = 0,22$$

$$IPD_{localeconomy} = 0,2x(1/4) + 0,2x(1/4) + 0,5x(1/4) + 0,5x(1/4) = 0,35$$

$$IPD_{VILLAGE} = (1/3)x0,45 + (1/3)x0,22 + (1/3)x0,35 = 34\%$$

WP2.2: Integrating cross sectorial dimension in Rural Electrification Plans (D5)**Spatial dynamics modelling**

As indicated before, the IPD is a multi-criteria indicator that enables to identify the development poles at a territory scale. However, it is not sufficient to classify localities, with the objective to ensure a better socio-economic impact of electrification.

Within IMPROVES-RE model, electrification priority is given not only to the local development poles, but first of all to those having the highest population in its hinterland benefiting from services and economic opportunities offered by this pole.

The analysis of these « pole-hinterland » dynamics is done through gravity models based on Newton laws; namely Reilly, Voronoï and Huff models, developed in D5.

This models enable (1) to specify the influence zones of the pole, (2) to estimate the moving probability within the territory demarcated by this hinterland, with the purpose to access to a basic social service (school, health centre, etc.), to a market or an employment.

Beyond the internal benefits of the sole locality electrified, the analysis of the potential socio-economic impact of the electrification project will therefore include the indirect benefits observed in the hinterland localities.

Using once more Reilly and Huff models, the population size that will potentially benefit from the electrification conducted in a pole i, called covered population of the pole i, is named POP_{cov_i} and calculated with the following formula:

$$POP_{cov_i} = \sum_j P_{ij} \times POP_j = \sum_j \frac{\lambda_i}{d_{ij}^2 \sum_k \frac{\lambda_k}{d_{kj}^2}} POP_j$$

where j is a locality of i hinterland, POP_j is the population of this locality, P_{ij} is Huff probability, λ_i is the attraction capacity of pole i, proportional to its IPD, k the number of poles on the whole territory considered.

The potential U_j ($U_j = \sum_k \lambda_k / d_{kj}^2$) indicates the quality at point j of the access to infrastructures and services, as well as to economic opportunities (markets, employment, etc.), and can be calculated anywhere, with an infinite theoretical value for the poles. This potential will be used as a justification for pre-electrification projects in various places or zones of the territory, endowed with a very low potential and that will not directly benefit from any electric service before the end of the planning.

According to this model, The N projects of rural electrification with the best potential socio-economic impacts are those which will be conducted in the N poles of development with the highest population size potentially covered.

The table 6 presents the ranking arising from this approach in the pilot zone of Burkina Faso, **with the assumption $\lambda_i = \text{POP}_i$** for the 21 selected poles. From these results, we can make the following observations:

- Beyond the 10 administrative units located in the pilot zone (Pô, Manga, Tiébélé, Gogo, Nobéré, Gombossougou, Béré, Toécé, Bindé, Gnariro), 11 other localities are also selected;
- Among these localities, Nobili et Kaibo are better ranked than some administrative units;
- Although we considered the population criteria to establish the first ranking of the poles, some poles are better ranked because of their geographic situation. That is the case for Manga, better ranked than Pô despite a smaller population.

Table 6. Poles ranking in Burkina Faso pilot zone using Huff method ($\lambda_i = \text{POP}_i$)

CODEPOLE	NOMPOLE	POPPOLE	STATELEC	POPCouv	Rank
BKF7839	Manga	17630	1	70279,16	1
BKF7826	Pô	21538	1	35857,99	2
BKF4004	Tiébélé	16713	0	24499,9	3
BKF7790	Nobili	3144	0	20369,65	4
BKF7698	Gogo	4610	0	19356,76	5
BKF675	Toécé	2870	0	18913,17	6
BKF7658	Béré	3064	0	18690,64	7
BKF7679	Bindé	2817	0	18676,23	8
BKF7789	Nobéré	4190	0	18632,64	9
BKF7681	Kaibo	2653	0	14872,39	10
BKF676	Toudou	1790	0	11732,45	11
BKF3952	Pounkounyan	2588	0	10434,89	12
BKF7724	Gomboussougou	3245	0	10292,51	13
BKF7753	Kougbaga	1489	0	9785,42	14
BKF3957	Tiakané	2128	0	9272,467	15
BKF7742	Zourmakita	2506	0	8503,969	16
BKF648	Dagouma	1770	0	7999,157	17
BKF7710	Tiouyou	2960	0	7604,939	18
BKF7731	Mediga	4191	0	7599,138	19
BKF7795	Séloghin	720	0	4853,163	20
BKF3923	Gnariro	1614	0	2515,353	21

The Graph 1 presents the results of the analysis of the hinterlands in the pilot zone of Burkina Faso. The stars are the Development Poles, and the curves around the poles delineate zones with equal attraction probability, with the corresponding probability given by the figure in the curve.

Considering the intuitive assumption that attraction is proportional to the population size, (IPD), the result got is in adequacy with what was observed on the field during the socioeconomic studies. Manga (in blue) and Pô (in green) attraction limits are much farther from their centres, both poles covering almost the whole territory of the pilot

zone. The third graph presents the relative influence zones of the other poles, very close from results got on the field. Level lines of Manga and Pô are not displayed to avoid to surcharge the graph.

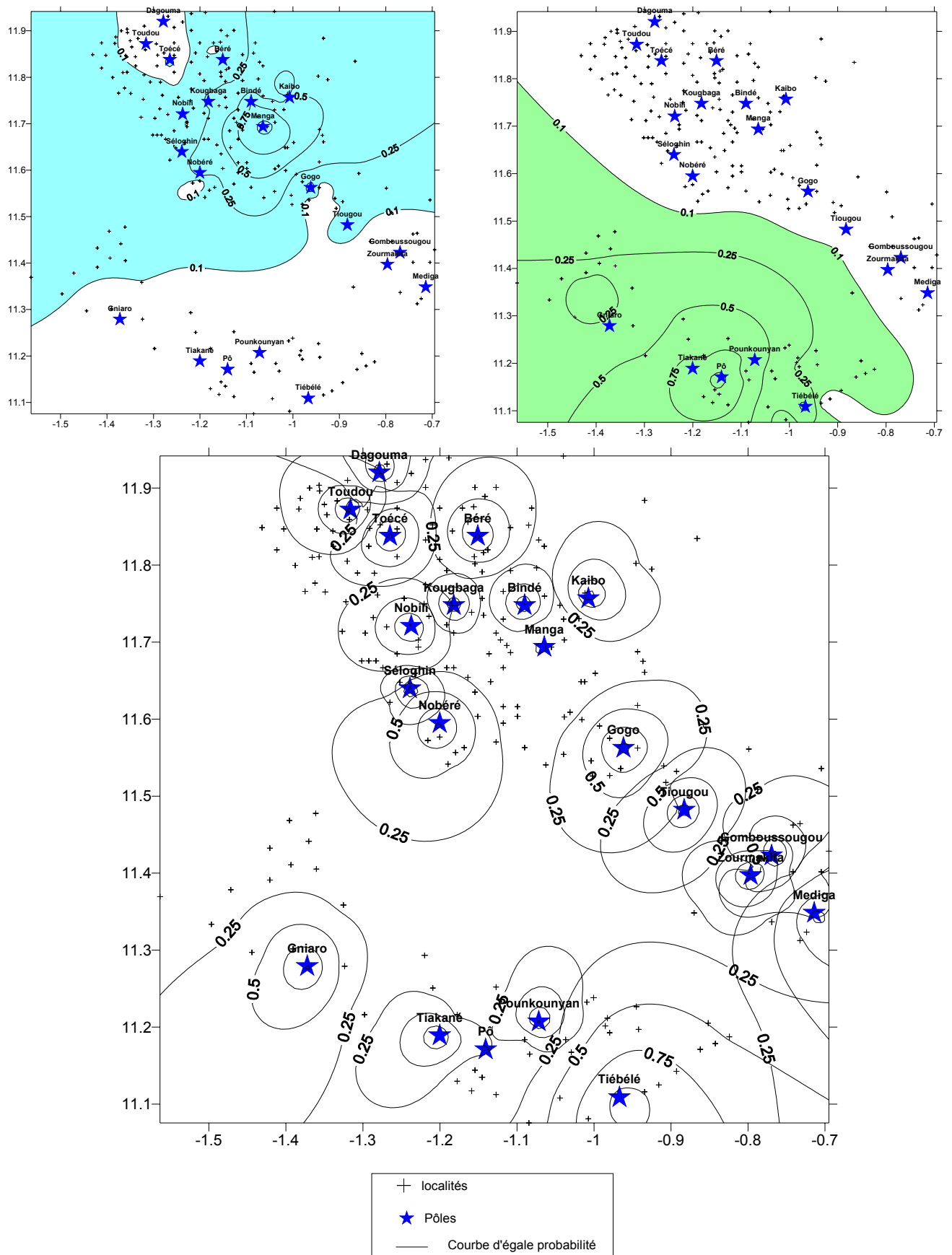
Therefore, a ranking based only on administrative criteria or population size, usually used in localities ranking, would have not enabled to obtain this result. It is an essential result of the IMPROVES-RE approach.

Thanks to this optimisation method, electrification projects can now be ranked according to their socio-economic impact at a given territory scale. This impact is measured in counting the direct results in the electrified locality, but also the indirect effects on its hinterland. The population size that will potentially benefit from access to services (education, health, finances, markets) and to economic opportunities becomes, through this approach, the main ranking criteria.

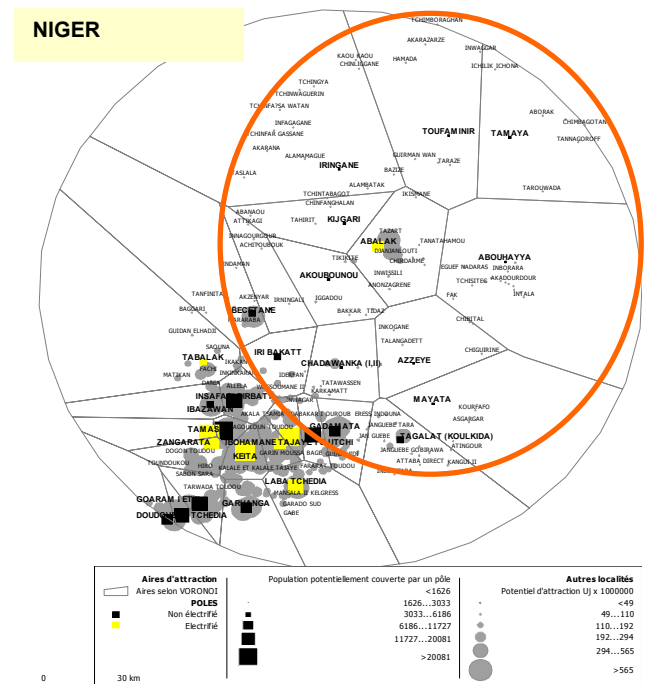
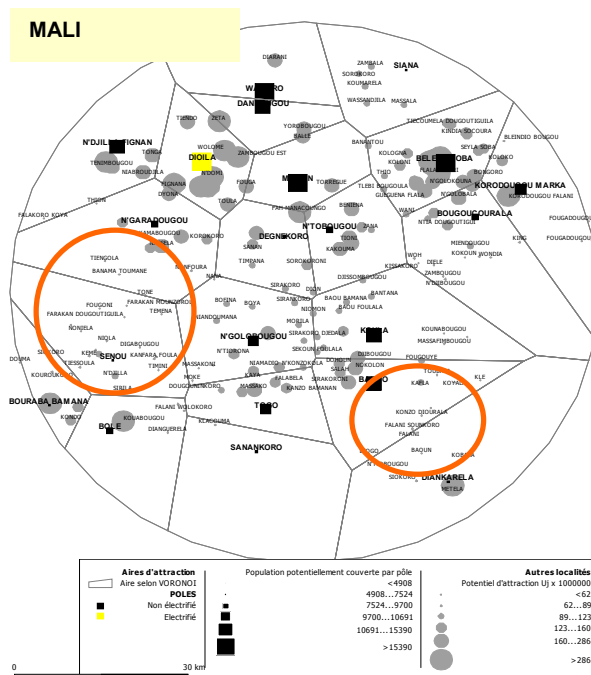
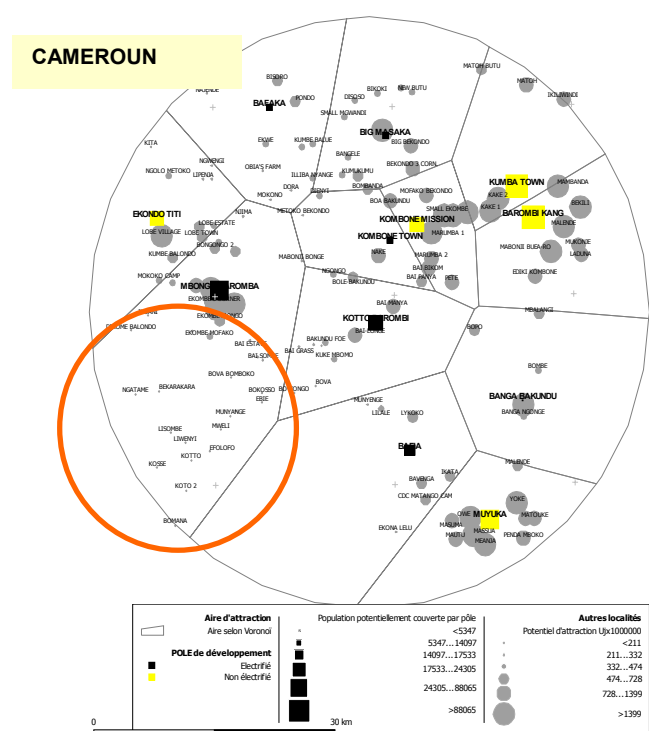
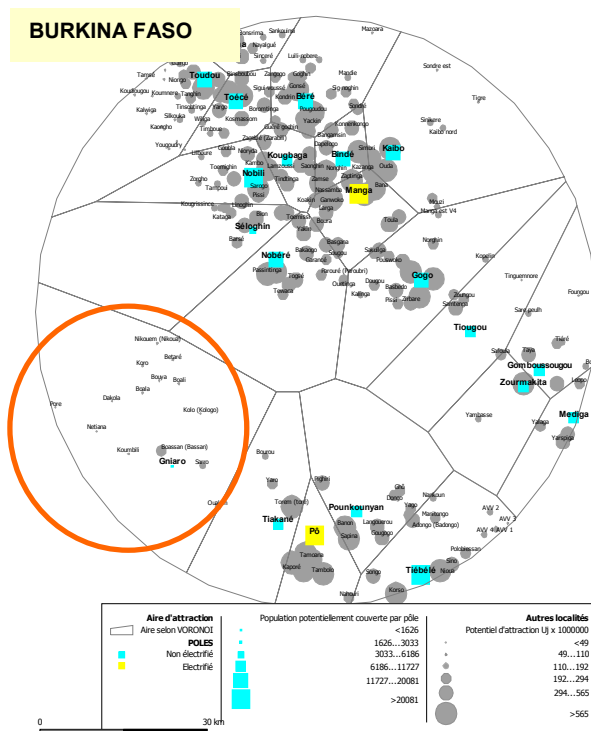
Moreover, the model enables to identify, through the concept of attraction potential U_j , the localities where pre-electrification solutions are highly required, because of the difficulty to access to the development poles. That is mainly the case for remote localities, and those, which would not benefit from a direct electric service before the last year of the planning (Graph 2).

The IMPROVES-RE model therefore enables to give a rational content to this first and essential step of the electrification planning.

Graph 1. Application of Huff model with attraction proportional to population size



Graph 2. Potentials distribution in the four countries, and pre-electrification opportunities



2.3 WP3: Development of local Rural Electrification and multi-sectorial plans

WP3.1: The GIS Master planning tool GEOSIM©

GEOSIM© is a simulation software developed by IED. The assumptions and algorithms at the base of the planning model are presented in D5. These assumptions and analysis relate to:

- The methodology of load forecast model
- General parameters for cost calculations
- Power supply from Generators
- Small hydropower plants
- Economic and Financial Analysis of Least-Cost Projects
- Motive power service and PV packages for isolated localities

The information system is stored in the GIS Master planning tool “GEOSIM” which has been developed by the consultant using the Manifold GIS software. GEOSIM performs many of the calculations needed to produce the master plan and has been programmed such it allows the geographic presentation of the most important input and output data.

GEOSIM allows in particular producing maps which show:

- The location of settlements and their present electrification status.
- The location of potential mini and micro hydro plants.
- The settlements proposed for off-grid electrification and the power supply method.

GEOSIM also stores a range of socio-economic, geographical, infrastructure and resource data, which are used to support maps.

WP3.2: Selection of pilot area

On the basis of criteria already set in Description of work of the IMPROVES-RE project, and refined at the time of the Bamako workshop (July 2005), the project partners have discussed and agreed with the Institutions in charge of rural electrification planning in the four countries on the choice of the pilot zones for the implementation of regional rural electrification and multi-sectorial plan.

The selected pilot zones are as follows:

- **In Mali**, it is a part of the “Cercle” of Dioila in the cotton zone. The zone covers two localities of the PRODER (decennial programme of rural electrification of the AMADER) not yet studied (Wacoro, Maban), with a total population of 193.000 inhabitants, 198 localities including only one electrified (the Cercle capital city). The town of Dioila is located at approximately 150 km from Bamako. Demographic distribution is given below:

Total population	Demographic distribution of the 197 non electrified localities	
193.000	0 to 300 inhabitants	11,7%
Number of localities	300 to 2000	82,2%
198	2000 to 5000 inhabitants	5,1%
	more than 5000 inhabitants	1%

- **In Cameroon**, the selected pilot zone is inside the area covered by the Participative Rural Development Project “Rumpi” co-financed by the African Development Bank and the Cameroonian Government. It is located in the South-West Province. Some potential small hydropower sites are located in this area (new sites and sites for rehabilitation). It will also offer potential for synergies with the RUMPI rural development program. The pilot zone is part of the Departments of Fako, Meme and Ndian, with a total population of 352.214 inhabitants in 138 localities. Demographic distribution is given below:

Total population	Demographic distribution of the 133 non electrified localities	
352.214	0 to 300 inhabitants	35,5%
Number of localities	300 to 2000	43,6%
138	2000 to 5000 inhabitants	17,3%
	more than 5000 inhabitants	3,6%

- **In Niger**, the selected site includes the Departments of Abalak and Keita, in the Area of Tahoua, with a total estimated population of 315.586 inhabitants, in 311 localities including 8 electrified: ABALAK, BARZANGA, IBOHAMANE, KEITA, LABA TCHEDIA, TABALAK, TAMASKE, ZANGARATA. Demographic distribution is given below:

Total population	Demographic distribution of the 303 non electrified localities	
315.586	0 to 300 inhabitants	29,9%
Number of localities	300 to 2000	63,2%
311	2000 to 5000 inhabitants	6%
	more than 5000 inhabitants	0,9%

- **In Burkina Faso**, the pilot zone covers partly the three Provinces of BAZEGA, NAHOURI and ZOUNDWEOGO, in the CENTRE-SUD region, with a total estimated population of 350.780 habitants located in 230 localities, with only two already electrified: MANGA et PO. Demographic distribution is given in the following table:

Total population	Demographic distribution of the 228 non electrified localities	
350.780	0 to 300 inhabitants	7,5%
Number of localities	300 to 2000	77,2%
230	2000 to 5000 inhabitants	14%
	more than 5000 inhabitants	1,3%

In each country, a first mission of identification and test of the questionnaires took place in each pilot zone before launching socio-economic surveys.

WP3.3: Elaboration of local Rural Electrification and multi-sector plans

Socio-economic study in Pilot zones: objectives

The socio-economic study is part of Work Packages n°3 (Development of local Rural Elect. & multi-sector plans) and n°4 (Local stakeholder mobilization), of IMPROVES-RE. Studies were undertaken in the various pilot zones, in order to test the alternative planning approach suggested.

The objectives of the socio-economic study were:

- To validate the structure and to calculate the Indicator of Potential of Development (IPD), particularly in its "local economy" component, according to a fine analysis (quantitative and qualitative inventory) of local infrastructures (health, education) and local economic exchanges analysis between the main localities (designated as "Poles") and hinterlands.
- To analyse and assess the future energy demand and willingness to pay, based on sample field surveys and investigations in localities of the pilot zone.

Socio-economic study in Pilot zones: preparation

Before the beginning of the field work, the Consortium prepared:

- Generic terms of reference, including questionnaires for data collection (D5).
- A first and theoretical structure of the IPD, included in the ToR.
- A first tentative list of sample localities to be surveyed in the pilot zone (which were validated on the field by the surveyors, based on discussion with local authorities).
- Maps, demographic and socio-economic data for the four pilot zones.

It was the sub-contractors responsibility to complete the data collection on the field in the four countries with the support of local authorities and with the participation of various local players (economic players, NGO, development programmes, etc), between February and April 2006. Studies were lead by ETC in Burkina Faso and Mali, and by IED in Cameroon and Niger.

Socio-economic study in Pilot zones: analysis of results and validation with local actors.

Data collection has been completed in the four pilot zones. Data analysis has been finalised and discussed with local actors and members of the respective National multi-

sectorial Committee, during a local workshops for example in Cameroon. The workshops objectives were:

- To present the IMPROVES-RE project to local players, the coverage of the pilot zone, the methodology and the main objectives of the socio-economic study.
- To validate the criteria and weight of the Indicator of Potential of Development (IPD).
- To discuss the conclusions of the socio-economic study (identification of Development centres, energy demand and willingness to pay), according to the opinion of the principal local actors.

Local Rural Electrification and multi-sector plan

Local rural electrification plans will be finalised for each of the selected pilot areas in the D7. First results before validation by local stakeholders have been included in D5 (cf. chapter 3, Overview of current status of deliverables).

2.4 WP 4: Local stakeholders mobilization

First results of the planning

The first simulations enabled to identify 496 rural electrification projects (see D5):

- **71 "conventional" projects, targeting directly :**
 - Isolated diesel (41 projects),*
 - Mini-grid diesel (16),*
 - National grid extension (13)*
 - Small hydropower (1).*
 - 290.100 inhabitants in 157 localities directly targeted*
- **265 projects of schools and health centres electrification through photovoltaic kits**, for all the school infrastructures located in localities not electrified by conventional systems at the end of the planning:
 - 254 schools*
 - 11 health centres*
 - 379.273 inhabitants in 291 localities concerned*
- **160 projects of access to motive, for localities with small access potential to development poles** (remote localities) and that will not be electrified by the end of the electrification:
 - 160 localities*
 - 74.648 inhabitants*

Restitutions workshops of the first results of the plans are scheduled with the local and national actors between August and October 2006, in the four countries for the discussion / amendment and finalisation of these plans and the analysis of opportunities to carry out the projects identified.

WP4.1 and 4.2: Identification of local stakeholders and discussion of different rural electrification implementation projects opportunities

For each pilot area, two categories of local stakeholders have been pre-identified during the socio-economic study:

- Potential promoter of rural electrification project: municipalities, NGO, agro-industrial, small enterprises, individuals, etc.
- Local stakeholder who will benefit from the rural electrification project, with a view at developing cross-sectoral synergies through rural electrification: drinking water supply, health, education, local economy (banking and finance, agriculture, commerce, etc).

At the national level, sustainable multi-sectorial partnership have been established or mobilised for the project. Pre-discussion have been also launched with national authorities counterpart, about the implementation of rural electrification projects (Ministry of Energy in Cameroon and Niger, AMADER in Mali, DGE and FDE in Burkina Faso), but also with national utilities, specially in Cameroon (AES-Sonel) and Niger (NIGELEC).

It is anticipated that a minimum of 10 local stakeholders will participate to the local workshop in each pilot region, and a maximum of 50 stakeholders for the one-day national workshop in each country.

2.5 WP5 : Internet based visualisation of Rural Electrification Plans D8

The specification project for the Internet Interface to visualise the state and the projections of rural electrification in Burkina Faso is part of the Work Package 5, as described below:

In order to allow easy access for any stakeholder (local stakeholder, agencies, ministries, international cooperation organisations...) to data on state and projections of rural electrification, IMPROVES-RE will develop an Internet tool to visualise this information considering Burkina Faso case for demonstration. The first activity will consist in defining a list of indicators to be circulated, including at least the following indicators:

- *Rural electrification state, basic social services and any other infrastructure of each administrative unit – display of this information on a map ;*
- *Rural electrification, basic social services and other infrastructure programmes : identification of localities (list + map).*

The application developed will aim at presenting the rural electrification state in Burkina Faso, in a user-friendly way. Stored on an IED sever, with a http:\\ address, web users will have a direct access. This application will be made using GIS MANIFOLD software. It will be constituted of two main parts:

- An interface for information visualisation, developed on an intranet support using ASP and Javascript.
- Geographic data stored within GIS folders.

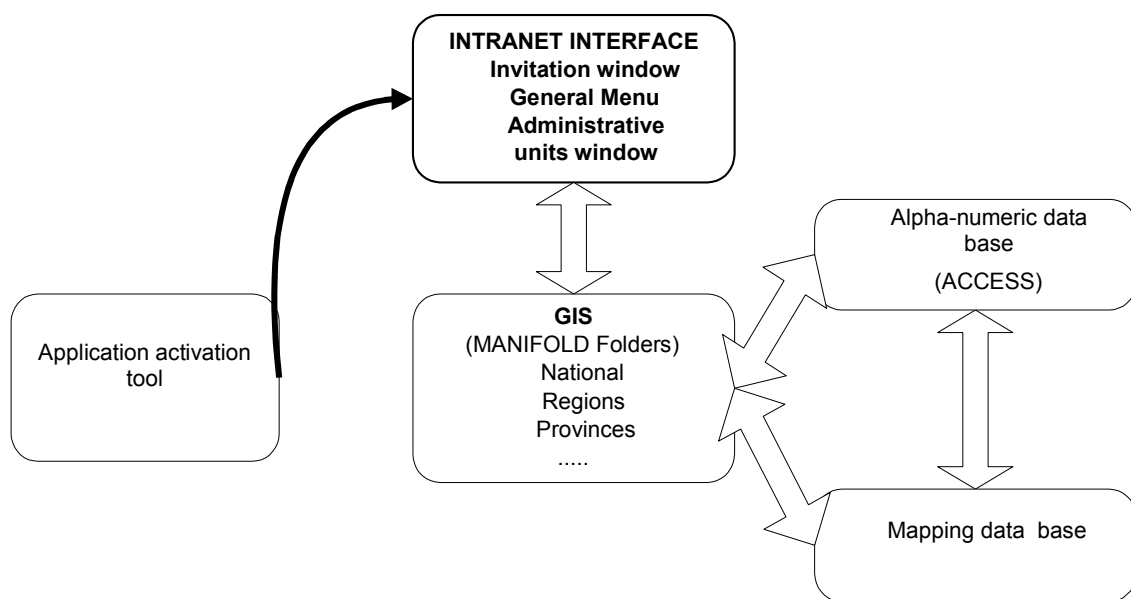


Figure 1: General structure of the application

Draft specifications have been proposed by IED, and discussed with the national partners during a meeting in Ouagadougou on June 1st, 2006. Specifications will be finalised in august 2006. Next steps of the interface development are:

- Processing and consolidation of the data collected within the framework of the WP1 (Mission)
- Data base structuring
- Interfaces development at national, regional, provincial and local levels
- GIS maps delivery for national, regional, provincial and local levels
- Testing and validation of the application
- Finalisation and validation of the application
- Training focused on the updating and the maintenance of the application

2.6 WP6 : Training and capacity building

WP 6.2.1 : Training session in Bamako (MALI) – (D1)

The workshop was held in Bamako from 27th to 29th July, 2005, with support from Malian Agency for Domestic Energy Development and Rural Electrification (AMADER). The training aimed at:

- Defining the existing planning practices, with the joint objective of sharing experiences across regions and acting as a training module,
- Introducing the alternative model which will be developed within the framework of IMPROVES-RE,
- A brainstorming session on the selection criteria of the pilot zones which will be targeted for projects development in each country.

The debates were built around the following axes:

- Re-examined methods of national planning,
- Limits of conventional planning,
- Internal Rate of Return (IRR) and multi-sector dimension,
- Multi-criterion Analysis to reinforce multi-sector synergies.

The workshop profited from the participation of the three European partners (IED, ETC and RISOE), of the country partners representing national structures in charge of rural planning⁷ and the five African subcontractors⁸.

See Deliverable D1 for more details

WP 6.2.2: Training session on Geographical Information System (GIS) (D4)

Initially foreseen during the first 6-month period, due to initial delay in field data-collection activities, this training session has been shifted to the second 6-month period. It took place at IED, Francheville (France) from 28 November to 2 December 2005, with the participation of partners from Burkina Faso, Cameroon, Mali and Niger.

The objectives of the training session were to give a basic training on GIS and the software MANIFOLD and to exercise some practice. A Training manual has been given to each participant. Status of alphanumeric and geographical data-collection in the four countries has been discussed with participants.

Unfortunately, due to Visa problems (Cameroon, Niger) and last minutes constraints (Burkina Faso), some participants have not been able to join the training. A new (restricted) one will be organised during the third 6-month period, most likely in Burkina Faso – tentatively 3rd week of August.

The report on this GIS training session (D4) is available at:
<http://www.improves-re.com/upload/FI299.pdf>

WP6.3: National Multi-stakeholder workshop

A national multi-stakeholder workshop is schedule in each country between august and October 2006 (cf.2.4), for discussion of the first planning results and different rural electrification implementation projects opportunities.

⁷ DGE et FDE (Burkina Faso), AER (Cameroun), AMADER (Mali), DE-ENR (Niger)

⁸ EDENE (Burkina Faso), EED (Cameroun), ICD (Mali), CEH-Sidi (Niger), SOPIE- Business Unit (Côte d'Ivoire)

2.7 WP7 : Dissemination

WP7.4 : Website (D14)

The development and the launching of the online website has been completed by October 31, 2005 and is accessible at the following address:

www.improves-re.com.



Its structure was defined during the first six-month period. It covers:

- Presentation of the project (context, objectives, results awaited, principal activities)
- Presentation of the project partners:
 - European Consortium
 - African institutional Partners
 - African subcontractors
- Agenda: programmed transverse activities (dynamic, regularly updated)
- Country activity: principal activities realized in each country, agenda in the country (dynamic, regularly updated)
- Newsletter: semi-annual newsletter of the project and other articles (dynamic, regularly updated)
- Libraries: references in relation to the subject, deliverables, useful links (dynamics, regularly updated)

WP 7.2: Articles and publication (D12)

- Two Electronic Newsletters “IMPROVES-RE News” (Deliverable 12) have been edited in French, including the following articles:

Newsletter IMPROVES-RE n°1, January 2006

- Project launching in the four countries
- Training workshop n°1: rural electrification planning in Bamako (Mali)
- Training workshop n°2: Geographic Information System (GIS) in Francheville (France)
- Synthesis of the IMPROVES-RE planning methodology
- Socio-economic study in the pilote zones
- Pilote zones selection

Newsletter IMPROVES-RE n°2, May 2006

- Information on project progress
- Indicators of Potential of Development (IPD)
- Projects identification
- Analysis of energy services and socio-economic study in the RUMPI pilot zone in Cameroon

The Newsletters are available at:

<http://www.improves-re.com/improves-re.asp?chapitre=5>

Up to now, one publication was published in the reCOMMEND newsletter (newsletter of the community for energy, environment and development) of July 2006.

Available at: <http://www.energycommunity.org/reCOMMEND/reCommend5.pdf>

2.8 WP 8 : Coordination

Kick-off meeting in Francheville

The first meeting of the European consortium was held in Francheville from 19th to 20th May, 2005. The main issues discussed during this meeting included:

- Presentation of partners: relevant experiences for the project – in the four countries and rural electrification sector
- Presentation and discussion of the project framework
- Presentation of the Project Work packages
- Presentation and discussion of project implementation in each country
- Elaboration of the detailed planning for the first six months of the project
- Strategy and actions for co-financing
- Discussion of the Consortium agreement

Kick off missions in the four countries

Kick-off missions were organized in May and June 2004 in the four countries.

Kick off workshops in the four in countries

Kick-off missions were organized in July for Mali, November for Burkina Faso and Niger, December for Cameroon in June 2005 for:

- The establishment of a framework for collaboration with the institutional partners and the African subcontractors,
- The presentation of the project to the delegations of the European Commission,
- The identification of the principal local players and research for co-financing opportunities.

Cross-sectorial partnerships: see 2.1.2

See 2.1

Consortium meetings

A consortium meeting was held in Francheville in December, 2, 2005. The main issues discussed during this meeting included:

- Status of project implementation

- Thematic discussion on (1) determination of IPD (Indicator of Potential Development) and the “polygons for socio-economic attraction”, (2) preparation of Rural Electrification Plans (D5), and (3) pilot zone selection.
- General issues: (1) financial issues, (2) involvement of RISOE, (3) contractor's meeting on Dec 6-7 (Brussels), and (4) next steps.

The second Consortium meeting took place in ETC's office in Leusden (Netherlands), on April 27, 28, 2006, with the following agenda:

- Update of the project implementation and building a common understanding of the next steps / activities of the project.
- Status of Deliverables
- Re-allocation of task and sub-subsequent reallocation of budget
- Practical issues and miscellaneous

3 OVERVIEW OF CURRENT STATUS OF DELIVERABLES

3.1 D1: Training session in Africa

From Bamako workshop were defined the main principles of the planning alternative model of IMPROVES-RE. A draft synthesis enabled to clarify the next steps, focused on the preparation by each country of a multi-criteria analysis grid adapted to its context and depending on the two following group of activities:

1. Definition and calculation of IPD in each country:
2. Use of the IPD.

Beyond the workshop report, it has been decided that a methodological note including especially the various concepts and the short term objectives would be prepared by the consortium in September 2005, in order to facilitate field work in the countries. This methodological note will be inserted in the D3 report, principally dedicated to multi-sectorial data collection and the setting-up of the Geographical Information System.

3.2 D2: Review of context

The various planning models presented are characterised by an optimisation logic, technical, economic and financial. The model from Niger clearly takes into account a fourth geographic dimension.

These models are especially based on:

- the will to satisfy the various levels of energy demand: domestic needs, social needs (health centres, schools, drinking water pumping, etc.), and needs related to economic activities
- efforts made to take into account a social demand in adapting the service to this demand and in avoiding constraints of the urban electric service,
- efforts to adapt the service to the rural demand and to reduce investment costs.
- Developed within contexts of recent liberalisation of the electric sector and a will of opening to the private sector, these new approaches of rural electrification are therefore oriented towards an enhanced strictness in terms of economic and financial optimisation of the investments.

Essentially based on criteria of economic and financial profitability and often focused on the « locality » unit, the models analysed do not clearly consider global objectives of land settlement or poverty eradication. These various models really highlight the need of having the investment granted by the State, in a rural context where the electrification project is generally in deficit.

3.3 D3: Multi-sector data GIS

As mentioned in 2.1.3, this deliverable, which also acts as methodological note, went further than what was initially planned. The report presents ways on how to develop alternative models for rural electrification planning, before fixing the minimal framework of multi-sector data to collect. Thus, in addition to the identification of the minimal data

needed and the current state of the geographic information system in each country, this deliverable also provides:

- The progress report of the establishment of the multi-sector national teams
- The theoretical elements of the planning model which will be developed within the framework of IMPROVES-RE
- The minimal data to be collected and the progress state of the geographical information system in each country
- The choice of the pilot zones and the proposals of the Consortium

3.4 D4: Training session in Europe

All the beneficiary countries attended the workshop in Francheville through the participation of the institutional partners of the project and/or the sub-contractors consultancy firms. Profiles of the attendants: Economists, Engineers, and Representatives of the Ministries of Energy, Consultants. The objectives of this training session were:

- To give to beginners a basic training on Manifold software
- To enable people already acquainted with GIS to enhance their skills and to get responses to their various questions
- To provide the participants with a training manual

The training addressed the following aspects:

GIS basic concepts

- o Data collection progress in each country
- o GIS basic concepts (geographic and computer notions)

Conception and exploitation of a GIS

- o Preamble on the structural needs
- o GIS conception
- o Data base construction
- o GIS exploitation

MANIFOLD – general presentation, practical works

General presentation of the software

Practical works: Session based on a typical school case, emphasising functionalities of a GIS, while differentiating this example from the project itself.

Objective: use the GIS functionalities to make an application highlighting the usefulness of GIS in general.

3.5 D5: Rural Electrification Plans

The report D5 presents the IMPROVES-RE planning methodology, with the objective to improve the socio-economic impact of rural electrification. It therefore capitalises field and modelling works carried out since Bamako workshop in July 2005, whose theme was electrification planning, and concretises an approach based on a spatial and demographic analysis and a technico-economic optimisation.

The report also presents the results obtained from this planning approach in the selected pilot zones in Burkina Faso, Cameroon, Mali and Niger.

These results, built from field surveys but also from computing tools (©GEOSIM), which were developed, must now be validated by local and national actors, within the framework of a restitution workshop. Two levels of consultation are planned: at pilot zones and national levels.

The results obtained enable to consider the electrification of 157 localities including 84 local development poles, and to directly target 290.100 inhabitants. The whole population of pilot zones benefiting directly or indirectly from this rural electrification is around 1.212.313 inhabitants in 877 localities. Various technical options are considered: isolated diesel, mini-grid diesel, national grid connected, development of small hydro power plants.

From an approach based on the effective accessibility to basic infrastructures (school, health) and to local economic opportunities, pre-electrification options are also considered by IMPROVES-RE, targeting 291 additional localities and 379.273 inhabitants, and allowing access to modern energy services (lighting, audiovisual, medical cold, etc.) for 254 schools and 11 sanitary trainings, through the installation of common photovoltaic kits. Identically, 160 additional localities including 74.648 inhabitants and having a low potential of access to development poles, would also benefit from a motive power project.

Altogether, identified projects directly target 608 localities and 744.000 inhabitants, with a socio-economic impact benefiting to the whole pilot zones, and an investment budget close to 15,1 billions FCFA, out of which 12,7 billions FCFA for “conventional systems” (diesel, grid, hydroelectricity) and 2,4 billions for the common photovoltaic kits and the motive force.

Finally, the report presents several support measures to ensure to the identified projects the expected socio-economic impacts. More specially, it concerns the strengthening of exogenous effects of electricity by putting in place mechanisms of multi-sectorial coordination, promotion and support to productive uses of energy, the setting-up of transparent mechanisms for granting and public-private partnership, the strengthening of project management capacities, the reduction of connexion fees, the adoption of adequate tariffs, and improvement of rural mobility, especially between development poles and localities in their hinterlands.

3.6 D12: Publications, articles and newsletters

Two Electronic Newsletters “IMPROVES-RE News” (Deliverable 12) have been edited in French, including the following articles:

- Newsletter IMPROVES-RE n°1, January 2006
- Newsletter IMPROVES-RE n°2, May 2006

The Newsletters are available at:

<http://www.improves-re.com/improves-re.asp?chapitre=5>

Up to now, one publication was published in the reCOMMEND newsletter (newsletter of the community for energy, environment and development) of January 2006. Available at: <http://www.energycommunity.org/reCOMMEND/reCommend4.pdf>

3.7 D14: Website

The website is updated very regularly, providing information on progress state of the project and on the consortium activities. It offers the certitude that all the partners have access to the latest information and gives them the possibility to react on any aspect they would like to be reviewed or clarified.

3.8 Other deliverables

- D6 is schedule for October 2006
- D7, D8, D9, D10, D11 are schedule for December 2006
- D13 is scheduled for February 2007
- D14 is scheduled for April 2007