

LAPER calculates the most economic master plan for village electrification in rural areas. First, LAPER determines for which villages a connection to the MV network is the most economic solution and which villages shall rather use local power sources such as diesel, micro-hydro or solar panels. Then, for progressively reaching this target solution, LAPER determines the master plan (yearly electrification schedule) considering available yearly budgets as well as some user-defined priority criteria (political, financial, development, ...) which may impact on the villages electrification schedule.

THE PROBLEM DATA

GIS interface

The study uses a digitized map of the region to be electrified. On this map will be located all villages to be electrified and will also be drawn the right-of-ways of the MV network connecting all the villages.

Villages data

Each village shown on the map shall be described by its socio-economic data. The main data are related to the expected power and energy consumption as well as non-technical information (political priorities, ...) having impact on the villages electrification schedule.

Network data

The user draws on the map the "reference" network: i.e. the hypothetical complete network connecting all villages if centralized electrification would be the only considered solution, ignoring the possibly excessive costs of such solution. The objective of LAPER will be to determine the "target" network by eliminating from this "reference" network those branches feeding villages for which local generation (Diesel, Micro-Hydro, Solar) is found to be more economical. In the "target" network will be retained only those MV network branches feeding villages for which central electrified (by network) is the most economic solution.

CALCULATIONS

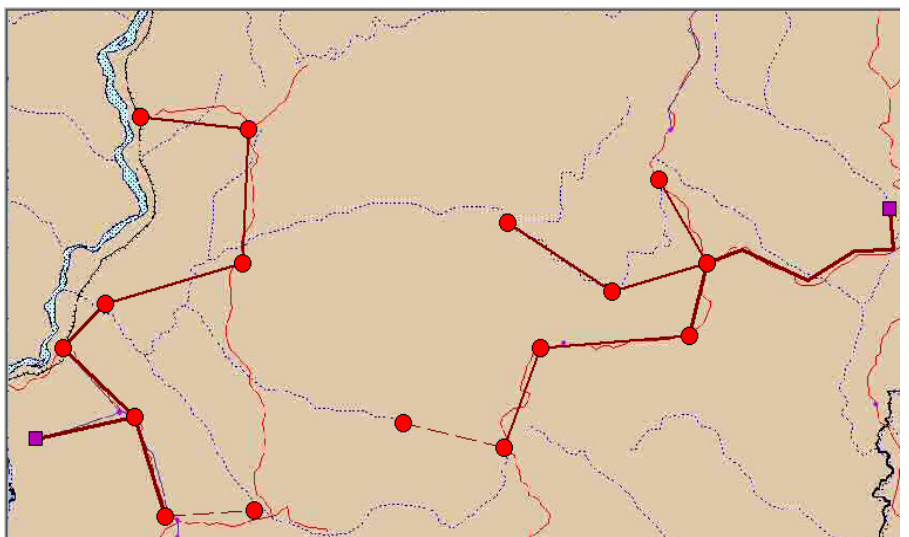
The calculation method consists in comparing for each village several modes of electrification. LAPER determines for which villages it is economically justified to be electrified through MV network extensions, and for which villages a local power source shall be preferred. This is called the "target" solution, yielding the "target" network.

When the ultimate target network is known, LAPER determines the master plan – i.e. the year by year electrification schedule – considering the available yearly budgets as well as several user defined priority criteria which will impact on the sequence of electrification of the villages.

MODES OF ELECTRIFICATION

The various modes of village electrification considered in LAPER are:

- **Centralised electrification:** by connecting the village to the MV network as drawn by the user on the digital map. Investment- and operating costs of the MV network will be shared by all connected villages. Within the village, a MV/LV substation will inject the power in a LV distribution network.
- **Diesel plant** injecting power in a LV distribution network.
- **Wind turbines** combined with a Diesel plant, which allows saving Diesel fuel at periods when wind conditions permit.
- **Micro-hydro plant** installed on a possibly nearby river, also injecting power in a LV distribution network. An MV line with associated transformers is considered between the hydro plant and the village if the distance so requires.
- **Solar Home Systems.** SHS is the only electrification mode that is considered in all villages for clients in the village outskirts. Clients in the centre of villages will get SHS only if this is the best economic solution.



RESULTS

The results of LAPER are:

- The most economic electrification mode for each village
- The master plan, i.e. the yearly investment schedule taking into account the yearly budgets as well as user defined priorities
- Detailed technical and economic results for each village and at the overall study level.

Those results are available in various formats as demonstrated in the figures here below.

Overall results of study | Results for each year

Show result network... Export network to PRAO...
Export global results... Export village results...

Master plan (Discounted sums)

Investments to be committed (Mu) :	92394600.00
Cost of electrification (Mu) :	68797976.00
Operating costs to be committed (Mu) :	24219908.00
Expected income (Mu) :	8772646.00
Number of villages electrified :	47
Missing budget (Mu) :	-6927528.50

Data at the end of the study

Number of customers electrified	5714.00
Total power supplied (kW) :	3608.15
Energy supplied annually (kWh) :	17857.14
HV skeleton length (km) :	47.64
HV derivation length (km) :	11.30
HV swer length (km) :	1.00

Figure 1 : Overall study results

Overall results of study | Results for each year

Year : 7 << Previous Next >>

Investments (Mu) :	9778085.00
Expected income (Mu) :	1102710.50
Operating costs to be committed (Mu) :	3039501.00
Extensions and replacement (Mu) :	1741915.88
Number of villages electrified :	3
Number of customers electrified	159.00
Total power supplied (kW) :	130.80
Energy supplied annually (kWh) :	441.82

List of villages to be electrified :

- Royan
- Strasbourg
- Verdun

Figure 3 : Electrification at a particular year of the study (This example: electrification of 3 villages at year 7)

OVERALL STUDY RESULTS					
Mode	Component	Years:			
		1	2	3	4
Micro-hydro	Center of villages	324303	1277350	0	0
	Outskirts of villages	82298	337074	0	0
	Extensions & renewals	0	1560	11640	11640
	Operation & Maintenance	0	5156	24813	24813
	Revenues	0	14870	69501	73806
	Nbr electrified clients	16	66	0	0
	Total power	40	90	0	0
	Total energy	74	274	0	0
	Nbr villages electrified	1	1	0	0
	MV network	Center of villages	741315	0	997122
Outskirts of villages		307181	0	109468	318105
Extensions & renewals		75994	85551	87436	167675
Operation & Maintenance		537233	624984	640885	921990
Revenues		331373	384302	398337	479423
Nbr electrified clients		55	0	61	47
Total power		76	0	115	105
Total energy		220	0	292	204
Nbr villages electrified		1	0	1	1

Figure 4 : Results exported in Excel: Yearly results per electrification mode (Micro-hydro, MV network, ...)

List of villages in the zone | Results

Village

Village name : Versailles Village identifier : 4
Cost of product (Um/kWh) : 2.82 << Previous Next >>

Values calculated for the village at the year of electrification

Year of electrification : 1
Electrification mode selected : Hydraulic + Photovoltaic

	Heart	Outskirt	Total
Investments (Mu) :	670033.88	426827.09	1096861.00
Annual operating costs (Mu) :	35697.00	3657.15	39354.15
Annual expected income (Mu) :	20231.90	975.24	21207.14
Number of customers electrified :	21.00	16.00	37.00
Number of collective equipment :	1.00		1.00
Total power supplied (kW) :	14.58	8.21	22.79
Energy supplied annually (kWh) :	19996.44	12221.38	32217.82
Cost of annual LV losses (Mu) :	3336.02		3336.02
LV losses (kW) :	0.86		0.86
LV lengths (km) :	0.65		0.65

Figure 2 : Electrification details for a particular village

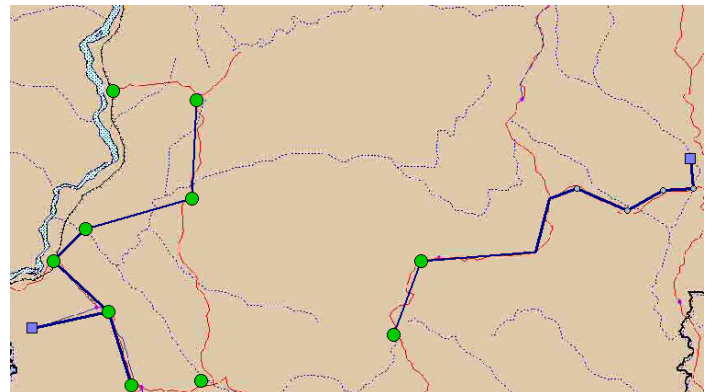


Figure 5 : GIS interface. MV network configuration and electrified villages as of year 7 of the study.