Draft Report

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Demand Side Management Project
Package 1: DSM Cell

Results of the Rural CFL Pilot Program

Draft Evaluation Report

FICHTNER / COLENCO

The Working Group Team

Mrs Dang Hoa Khuong	**Institute of Energy (IoE)**
	Phone: + 84 - 4 - 8523742
Mr Nguyen Ngoc Giap	**DSM Cell - EVN**
	Phone: + 84 - 4 - 9347651
Mr Andreas Siegel	**Fichtner**

FICHTNER

Sarweystrasse 3
70191 Stuttgart • Germany
Phone: + 49 - 7 11 - 89 95 - 0
Fax: + 49 - 7 11 - 89 95 - 459

Please contact: **Andreas Siegel**
Extension: **281**
e-mail: siegela@fichtner.de

Office Hanoi

Room 424 MoI
54 Hai Ba Trung
Hanoi Vietnam

Please contact: **Phuong Hoang Kim**
Phone: + 84 - 4 - 934 7720
Fax: + 84 - 4 - 9347721
e-mail: fichtnerdsm@hn.vnn.vn

Table of Contents

1. Background and approach

1.1 Objectives

The general goals and objectives of Demand Side Management (DSM) in Vietnam include:

- to provide cheaper energy services for customers
- to improve profitability for the EVN group
- to ease EVN's effort to cope with rapid demand growth
- to strengthen Vietnamese manufacturing industry
- to achieve energy savings and environmental benefits

In the frame of this DSM Project various DSM pilot programs are carried out in order to collect information before implementing large scale DSM measures in Vietnam. These were selected in the lighting sector for the following reasons:

- good international experience from DSM lighting programs
- strong coincidence in Vietnam between lighting and system peak
- readily available technology on the market
- easy scale up is possible
- the market structure of appliances is relatively simple

The particular goals and objectives of this first Rural CFL Pilot Program include:

- to develop, strengthen and train the skills of the EVN DSM Cell and other participants on the job
- to develop and test a standard procedure and methodology to be followed in further DSM programs, including
  - selection of target markets and areas
  - conceptual design of programs
  - delivery mechanism, monitoring and evaluation
- to test the program ideas on a small scale for subsequent broader application (or adaptation), including
  - acceptance and feasibility of technology
  - economics for customers, EVN, and the Power Companies
  - market barriers and market behavior of customers. As the marketing concept is not appropriate for large-scale application another concept may be tested in a second pilot program.

1.2 Technical specification

Technical appliance of the Rural CFL Pilot Program is the integral (or self-ballasted) Compact Fluorescent Lamp (CFL, see Figure 3-1) with built-in ballast and appropriate screw or bayonet cap to fit a standard incandescent lamp-holder.

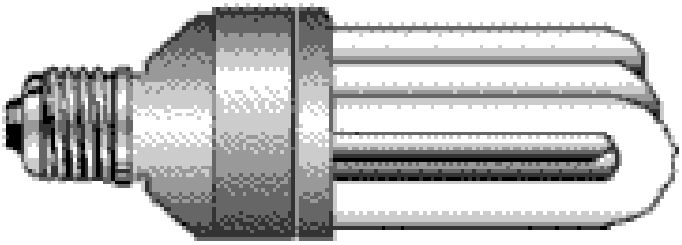


Figure 3-1: Integral CFL for E27 screw socket

As a general rule, comparable total light output from a compact fluorescent scheme may be obtained for only around 20-30% of the wattage required using standard incandescent lamps. The rated life of the compact fluorescent lamps is 5 to 10 times longer than for incandescent lamps. Replacement costs are therefore reduced, although the initial cost of the lamps is higher. Their rated color temperature ranges from 2700 K (warm white similar to incandescent lighting) to 4000 K (daylight). The lamps with integral control gear are designed as direct replacements for many general service incandescent lamps. Their price has dramatically reduced in recent years, making the substitution more profitable.

From the program organization and management point of view it is not efficient and easily practicable to offer CFLs with a range of wattage. A household survey had shown that the average weighted capacity of incandescent lamps is ~60 W. It is proposed to distribute CFL with ~900 Lumen equivalent to 75 W incandescent lamps. On average, customers will get a slightly higher service that they are used to, and only the very small number of 100 W bulbs actually would have a reduced service.

CFL available on the Vietnamese market may be roughly categorized in three different qualities:

- “high”: imports from Europe/US with a efficacy ~ 60 Lm/W, and a lifetime of 10,000 hrs
- “medium”: domestic Vietnamese production and imports from neighboring Asian countries with a efficacy ~ 50 Lm/W, and a lifetime of 5,000 hrs
- “low”: imports from China (“local China”) with a low efficacy, and a lifetime of only 1,000 hrs

It was decided to not further consider the third category because of its low quality, likely customer complaints, and a consequently negative image for DSM, and for EVN and PC Hanoi as implementing agencies. First cost benefit comparisons between high and medium quality CFL indicated that a high quality CFL could not compete with a medium quality CFL in the Vietnamese consumption and tariff conditions. Therefore CFL with medium quality were selected for the pilot program.

1.3 Procedure

The phases of a pilot program may be divided into the Design Phase, the Implementation Phase, the Test and Monitoring phase and the Evaluation Phase. The Design Phase included following main tasks:

- Conceptual Design
- Selection of Target Areas
- Delivery and Marketing concept
- Implementation planning
- Budget and funding

In the frame of this Rural CFL Pilot Program one medium quality CFL per household was distributed and installed in two villages. The consumption and load before and after installation was monitored and a customer survey including interviews with the participants was carried out. The timeline of the program and the main steps were as follows:

- By September 2001 the pilot program design was completed and all implementation tasks including information and involvement of all participants, approval of the program and budget, design of broadcast information leaflets and questionnaires started.
- In early May 2002 the pilot program and budget were finally approved and all necessary leaflets and questionnaires were prepared.
- The CFL were installed in both villages in early June 2002. Before installation the household appliances were recorded and the participants were intervied on their attitude towards CFL.
- The CFL Test and Monitoring Phase in both villages then began and lasted until end of August 2002.
- In September 2002 the participants were interviewed on their experience with CFL and the data collected were analyzed and evaluated

Annex 6.1 presents a more detailed breakdown of the of the Pilot Program schedule.

The electricity consumption in the pilot program villages and comparable villages in the same districts was assessed in the period from May to August. Basis were the monthly consumption data provided by PC Hanoi. In the period from May to August load meters at substations were installed and daily load curves were recorded for both pilot program villages. Comparisons between May (before installation of CFL) and the months June to August - the CFL test phase were carried out both for consumption and load. Following main data were collected:

- The monthly consumption data of the pilot program villages and comparable village
- The load metering data at the substations of both villages
- The customer survey including interviews of the participants before and after the testing of the CFL
- A household survey including the recording of the electrical appliances and their consumption in both villages

1.4 Organization and institutions

A Pilot Program Working Group was established in the frame of the project. The tasks of the working group were to designed and coordinate the implementation monitoring and evaluation tasks of the pilot programs. The working group included members from the DSM Cell of EVN - the national Electricity Company of Vietnam, members of the power system department of the Institute of Energy (IoE), of the local distribution company PC Hanoi and of the Consultant.

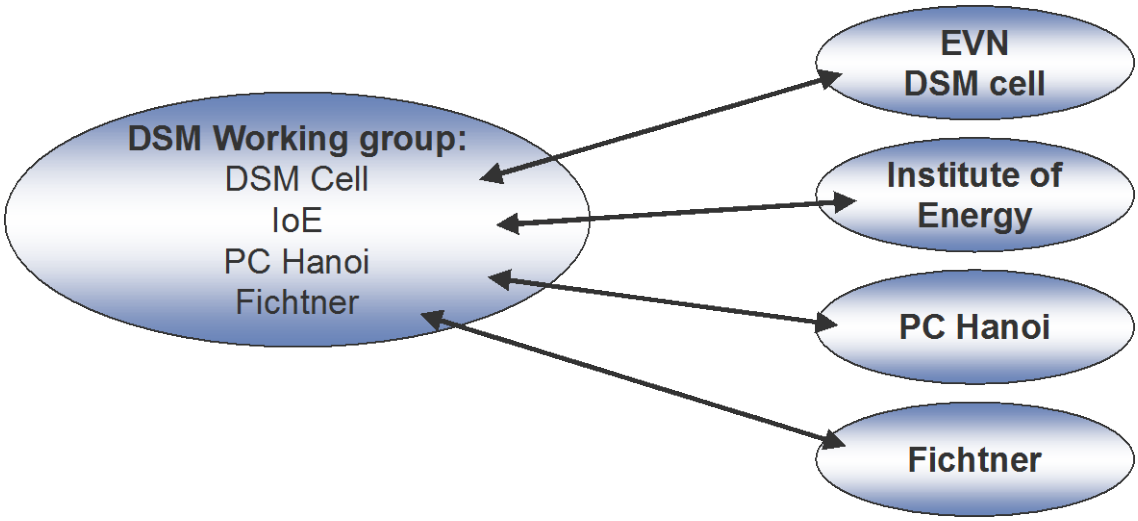


Figure 1-1: Coordination of the Pilot Program

The main responsible institutions for implementation of the pilot programs were the EVN DSM Cell and the Ministry of Industry, as overall project coordinating authority. Additionally several other institutions were involved. These were:

- The Hanoi Power Company with its local branches and departments
    - Dong Anh Province power compay
    - Thanh Tri Province power compay
    - Business Department – Hanoi Power Company
    - Computer Department - Hanoi Power Company

    Hanoi Power Company (PC Hanoi) and its local branches installed the CFL in the villages and carried out the load metering at the substations of both pilot program villages. The business and computer department of PC Hanoi provided the monthly consumption data of the pilot program villages and the comparable villages and the load metering data.

- The local authorities of both pilot program villages
    - Authority of Dong Hoi Village – Dong Anh Province
    - Authority of Ngoc Hoi Village – Thanh Tri Province

    The local authorities and the people in both villages supported the pilot programs and helped to provide the information from interviews of the customer survey .

- The lamp manufacturers
    - RALACO company
    - OSRAM company

    It has to be emphasized that the lamp producers OSRAM and RALACO participated also actively in the pilot program and sponsored their CFL for distribution in the pilot program villages. RALACO donated its CFL in Yen Kien, whereas OSRAM donated its CFL in Hoi Phu.

The realization of the pilot program and collection of all data would not have been possible without all the engagement of above involved parties.

1.5 Target area

It was decided to implement the Pilot Program in cooperation with PC Hanoi, and to select an area where the PC directly sells to the end-users without the interface of an additional retail cooperative. The size of 400 to 500 households was proposed in order

- to implement the pilot on a manageable and financially bearable scale for EVN/PC Hanoi on the one hand, but
- to have a sufficiently large number of participants to be representative, on the other hand.

Further, it was considered to be advantageous to the participants connected to one transformer substations in each village in order to carry out the monitoring data collection based on existing and installed metering equipment. A rural area was chosen mainly because lighting makes up a higher share of rural consumption, and saving effects therefore may be metered and monitored more easily. For the selected households historic metering and billing data as well as individual electricity meters should be available.

Three villages - two in the district Thanh Tri in the south of Hanoi and one in the district Dong Anh in the North of Hanoi represent rural areas directly supplied by PC Hanoi. During the site visits the substations and networks of several hamlets were assessed in order to check the viability of the pilot program. Several household visits were made in both villages in order to assess the electricity equipment and type of lamps used in the households.

The **Figure 1-2** below indicates the location of both selected pilot program villages in the North and the South of Hanoi. The answers of the interviews in the customer survey deviate in some cases at both pilot program villages. This is caused by their different structure:

- Hoi Phu is a rice-farming village near an industrial area. Participants in Hoi Phu are well equipped with electrical devices. The equipment per household for refrigerators and TV, video and audio systems is about 30% higher than in Yen Kien.
- Yen Kien in the south is a more remote rice-farming village. Participants in Yen Kien have less electrical equipment and less income than in Hoi Phu.

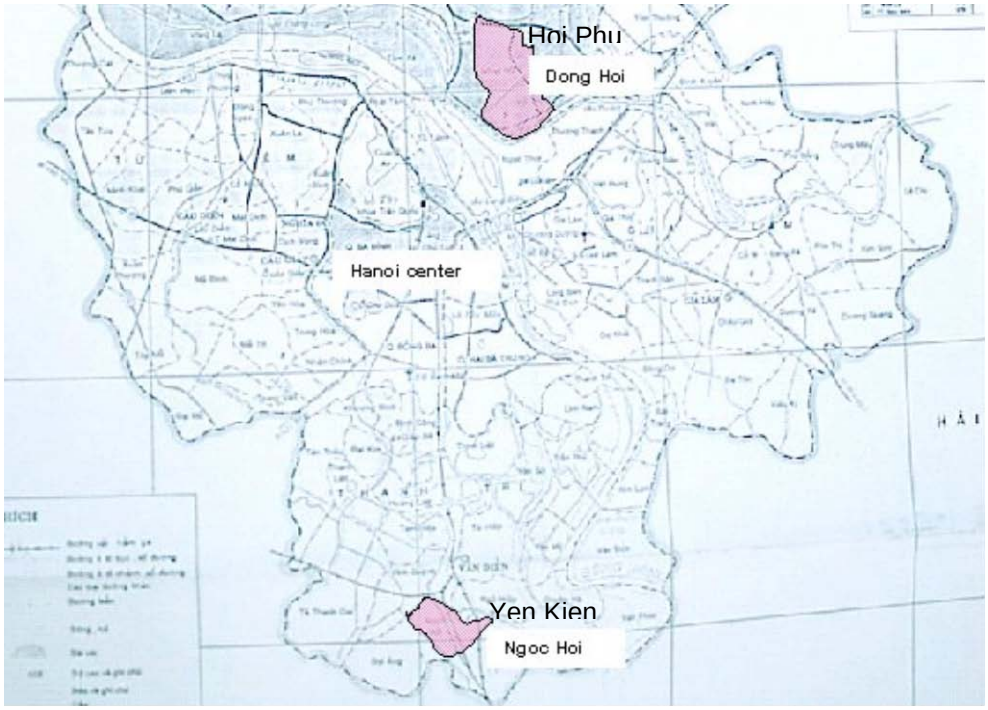


Figure 1-2: Location of the two selected pilot program villages

Figure 1-3: Substation in Hoi Phu where the load was metered

2. Customer survey

In the customer survey the attitude, and knowledge of the participants on CFL was investigated prior to installation of the CFL. After the three months test phase the performance of the CFL and their acceptance by the participants was investigated again via interviews. The interviews are evaluated and summarized below.

2.1 Usage of CFL

In the households incandescent lamps were replaced with a wide capacity range from 25 W up to 100 W. The average capacity of the replaced lamps was about 60 W, what coincides with the assumptions taken at the start of the pilot program (see **Table 2-1**).

At the start of the pilot program after site visits to the villages the main rooms for replacement of incandescent lamps by FTL were assumed to be the kitchens. Actually both in Hoi Phu and Yen Kien most CFL are installed now in the living rooms. In Yen Kien a larger percentage of CFL is installed also in other rooms. The living room with the most used light is considered by the participants to be also the best place for installation of CFL. This is contradictory to the assumptions that the living room in most cases is already equipped with FTL and no CFL to replace an incandescent lamp is needed. The reason for placement of CFL in the living room is considered to be more based on matters of prestige than of replacement needs. This has a higher impact in Hoi Phu with a higher existing standard of household equipment (see **Table 2-1**).

The location “other” for the placement of CFL is in general the lamp at the yard before the living room. This lamp has also a high operation time as during the warm summer evenings life takes place at the yard.

According to the statements of the participants the CFL is operated in average about 2,5 hours. The average operation time of the CFL is higher than expected. This coincides with the situation that CFL are installed more in living rooms than in kitchens (see **Table 2-2**).

If CFL’s are installed in living rooms they actually substitute during operation the light of the FTL (about 40 W) instead of the replaced incandescent lamp (60 W). This means the capacity saving will be lower but due to the longer operating time the consumption saving will be on the same level as expected before.

The number of new purchased household appliances during the test phase is quite low. Thus an effect of new household appliances on electricity consumption can be neglected.

Item	Total answers	The incandescent light was replaced (W): 25	40	60	75	100	Total answers	The CFL was installed in: Living room	Side room	Kitchen	Other
HoiPhu	**279**	33	106	37	82	21	**294**	184	32	30	48
		12%	38%	13%	29%	8%		63%	11%	10%	16%
YenKien	**227**	23	49	31	91	33	**233**	77	44	62	50
		10%	22%	14%	40%	15%		33%	19%	27%	21%
Total	**506**	56	155	68	173	54	**527**	261	76	92	98
		11%	31%	13%	34%	11%		50%	14%	17%	19%

Item	Total answers	In which room is the most used light installed? Living room	Side room	Kitchen	Toilet	Other	Total answers	What do you consider to be the best use CFL? Living room	Side room	Kitchen	Toilet	Other
HoiPhu	**278**	246	14	5	1	12	**249**	207	17	11	1	13
		88%	5%	2%	0%	4%		83%	7%	4%	0%	5%
YenKien	**226**	196	9	8	0	13	**132**	100	15	5	0	12
		87%	4%	4%	0%	6%		76%	11%	4%	0%	9%
Total	**504**	442	23	13	1	25	**381**	307	32	16	1	25
		88%	5%	3%	0%	5%		81%	8%	4%	0%	7%

Table 2-1: Information on placement of CFL

Item	Total answers	How many hours was the CFL turned on each day?				Average hrs/day
		0-1	1-2	2-3	3-4	Calculated
HoiPhu	**265**	40 15%	27 10%	55 21%	143 54%	**2,6**
YenKien	**212**	36 17%	36 17%	51 24%	89 42%	**2,4**
Total	**477**	76 16%	63 13%	106 22%	232 49%	**2,5**

Table 2-2: Usage time of CFL

2.2 Image and customer satisfaction

In most cases in a household the husband is responsible for the equipment and electricity. His task is also to buy the lamps. This is the case especially in the more traditional village Yen Kien. Lamps are bought near the village in local shops or local markets (see **Table 2-5**).

In Hoi Phu about 40% of the participants have heard already about the CFL. In Yen Kien only about 15% have heard about it. This difference may be explained by a preceding marketing campaign in Hoi Phu, where leaflets about CFL were distributed five days before interviewing the households. The information via neighbors or relatives has an important impact on the knowledge about CFL (see **Table 2-6**).

In Hoi Phu about 16% of the participants bought CFL - in Yen Kien 8%. The difference can be explained by the higher income in Hoi Phu (see **Table 2-7**). The purchase prices of about 20.000 VDN per CFL stated by the participants indicate that the cheap Chinese CFL were available and bought up to now. In Hoi Phu participants indicate their readiness to pay also higher prices for CFL with a better quality as the table below indicates.

Item	Total Answers	Would the household buy CFL if the price was? Less than 50,000	Less than 40,000	Less than 30,000	Less than 20,000
HoiPhu	**259**	30 12%	32 12%	64 25%	133 51%
YenKien	**233**	9 4%	1 0%	30 13%	193 83%
Total	**492**	39 8%	33 7%	94 19%	326 66%

Table 2-3: Readiness to pay higher prices for CFL (after test of CFL; prices in VND)

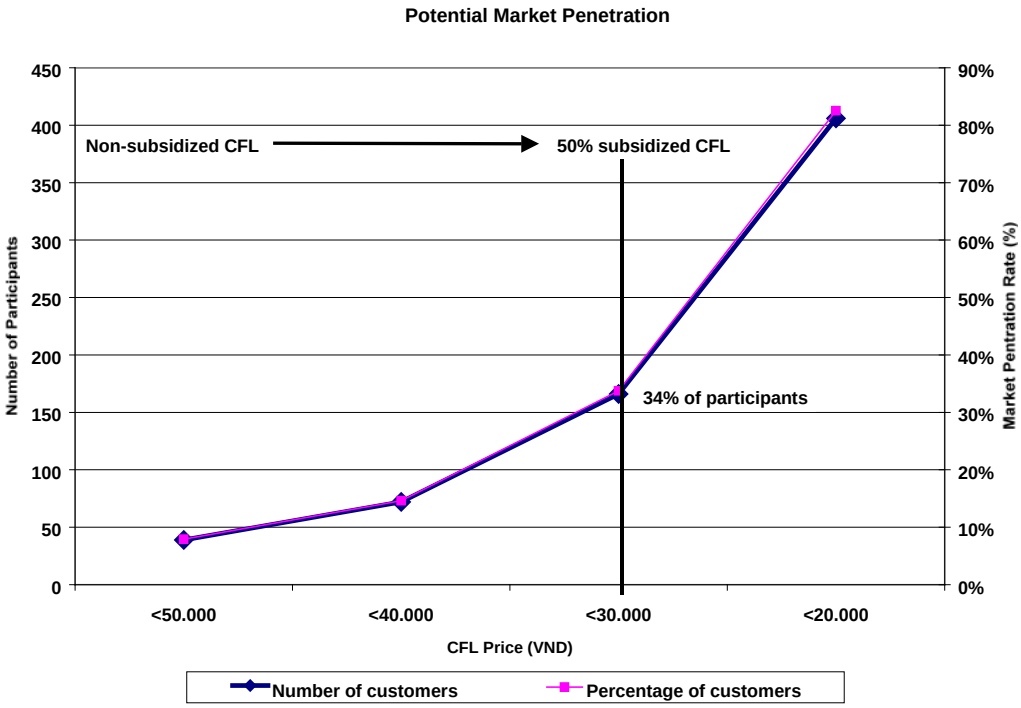


Figure 2-1: Willingnes of the customers to buy CFL

Figure 2-1 shows the potential for willingness of the customers to buy CFL based on the answers stated in **Table 2-3**. About 80% of the participants would buy CFL if the price would be less than 20.000 VND. About 34% would buy CFL if the price would be in the range of 25.000 VND (a subsidization rate for CFL of 50%).

According to the statements of the participants CFL have the image to be modern, to provide a good light and a good lifetime. They are also the most preferred lighting source in households.

Item	Total answers	Which is the prefered lighting source in the household?			
		CFL	Thin FL	Big FTL	Incandescent
HoiPhu	**312**	175	74	63	0
		56%	24%	20%	0%
YenKien	**248**	121	92	35	0
		49%	37%	14%	0%
Total	**560**	296	166	98	0
		53%	30%	18%	0%

Table 2-4: Type of lamp preferences (after CFL test)

The image of CFL is that they are modern and provide a good light what the participants before and after the test phase stated (see **Table 2-8**).

About 7 (1,5 %) of the distributed CFL went defect, mainly in the first week after installation. According to statements weather conditions like heavy rain and lightning during this time were the main cause.

After the test phase about 80% of the participants stated that they would buy CFL and would recommend CFL to others. Most of the participants were satisfied with their experience with the CFL. Only 4% of them stated that their CFL experience was not satisfactory (see **Table 2-9**).

In Hoi Phu Ralaco-CFL with cool light color were installed, whereas in Yen Kien Osram-CFL with warm light color were installed. A few of the participants in both villages (7,8%) did not like the color of the CFL light being for their taste either too cool or too warm.

Item	Total answers	Who buys lamps in general?			Total answers	Where are the lamps purchased?		
		Husband	Wife	Other person in household		Local store/shop	Local market	Store/shop in large city
HoiPhu	**284**	176	64	44	**264**	219	45	12
		62%	23%	15%		79%	16%	4%
YenKien	**229**	189	27	13	**199**	61	138	7
		83%	12%	6%		31%	69%	4%
Total	**513**	365	91	57	**463**	280	183	19
		71%	18%	11%		58%	38%	4%

Table 2-5: Responsibles and sites of lamp purchase (before CFL test)

Item	Total answers	Has the household heard about CFL or seen CFL before?		If yes where?					
		Yes	No	Leaflet *')	Newspaper	Local store	Market	Store in large city	Neighbors or relatives have one
HoiPhu	**297**	124	173	111	0	7	1	2	3
		42%	58%	90%	0%	6%	1%	2%	2%
YenKien	**233**	34	199	3	3	5	8	0	15
		15%	85%	9%	9%	15%	24%	0%	44%
Total	**530**	158	372	115	3	12	9	2	18
		30%	70%	72%	2%	8%	6%	1%	11%

*) In HoiPhu information leaflets on CFL were provided 5 days before the answering of the questionnaire

Table 2-6: Knowledge on CFL (before CFL test)

Item	Total answers	Has the household bought CFL before?		If no, why not?					
		Yes	No	Don't believe they work properly	Too expensive	Not a good light	Don't look good	Not sure about lifetime of lamp	No idea
HoiPhu	**277**	43 16%	234 84%	24 10%	15 6%	1 0%	0 0%	0 0%	197 83%
YenKien	**233**	18 8%	215 92%	4 2%	2 1%	1 1%	1 1%	2 1%	168 94%
Total	**510**	61 12%	449 88%	28 7%	17 4%	2 0%	1 0%	2 0%	365 88%

Table 2-7: Purchase of CFL (before CFL test)

Item	Total answers	Statements on the CFL before implementation					Total answers	Statements on the CFL after implementation			
		modern	attractive	too expensive	good light	long lifetime		modern	attractive	too expensive	good light
HoiPhu	**267**	56 21%	7 3%	4 1%	72 27%	128 48%	**278**	56 20% **278**	0 0%	0 0%	222 80%
YenKien	**126**	23 18%	10 8%	0 0%	59 46%	34 27%	**207**	26 13% **207**	2 1%	0 0%	179 86%
Total	**393**	79 20%	17 4%	4 1%	131 33%	162 41%	**485**	82 17% **485**	2 0%	0 0%	401 83%

Table 2-8: Image of CFL (before and after CFL test)

Item	Total answers	Would the household buy CFL? (Y/N) (1/0)	If the answer was "no", why not?							Would household recommend CFL to (Y/N) (1/0)
			Didn't work, properly	Too expensive	Not a good light	doesn't look good	gets dirty too quickly	Not sure about lifetime	Other	
HoiPhu	**265**	**221**	2 5%	1 2%	16 36%	0 0%	0 0%	1 2%	24 55%	**228**
YenKien	**207**	**165**	0 0%	0 0%	14 33%	0 0%	1 2%	2 5%	25 60%	**182**
Total	**419**	**386**	2 2%	1 1%	30 35%	0 0%	1 1%	3 3%	49 57%	**410**

Table 2-9: Readiness of the participants to buy the CFL (after CFL test)

3. Electricity consumption

3.1 Electricity consumption development

During the monitoring period the electricity consumption increased in both villages (see **Figure 3-1**). This was mainly caused by a higher seasonal demand in the hot months from June to August. This coincides also with the consumption development of the previous year (see **Annex 6.2**).

The consumption of both pilot program villages was compared to villages with similar structure in the same districts. The villages in the same districts as Yen Kien and Hoi Phu have a higher consumption increase than both pilot program villages as **Figure 3-2** and **Figure 3-3** demonstrate. The comparison of consumption increases in the pilot program villages with the comparable villages indicates a reduction of electricity consumption by about 5% for Yen Kien and Hoi Phu after installation of CFL. According to different uncertainties this reduction however can only be considered as an indicative value.

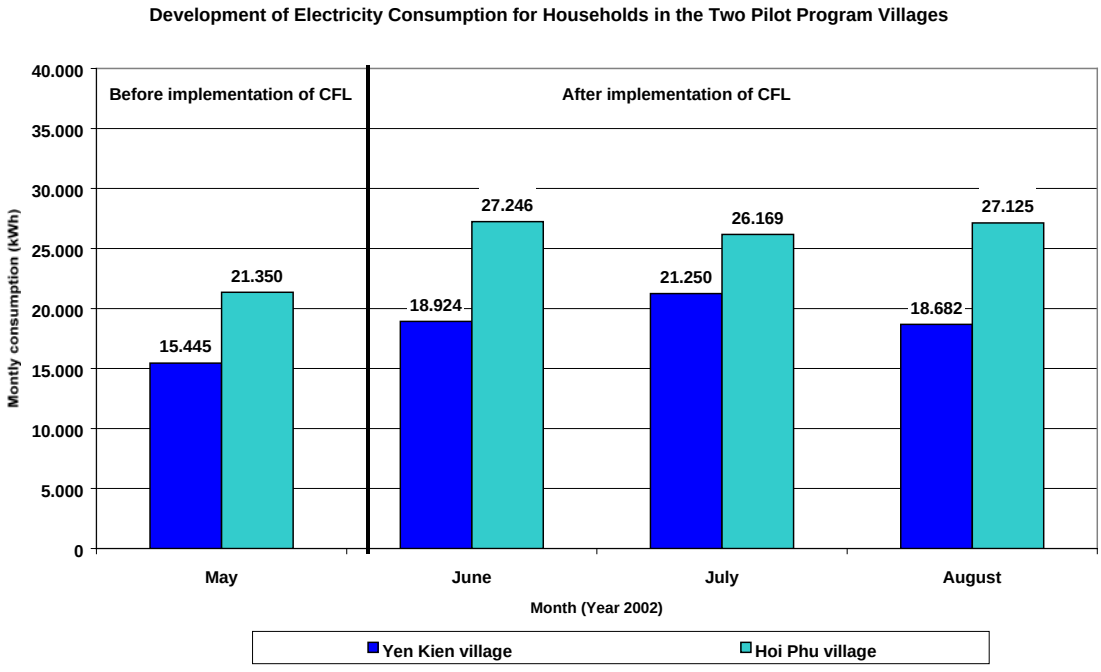
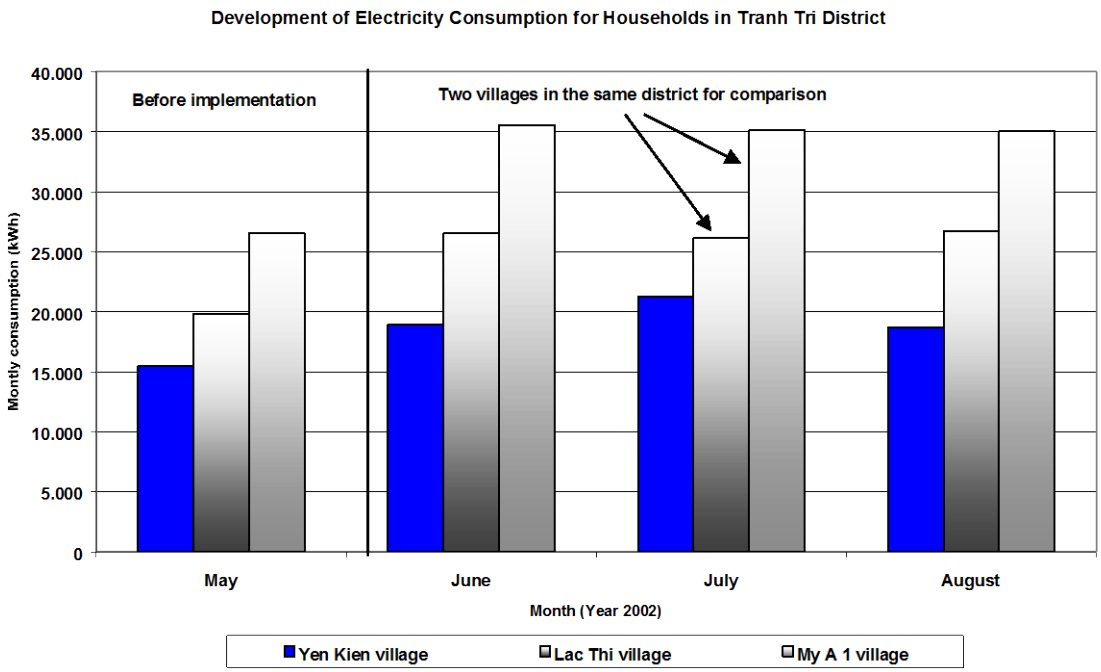


Figure 3-1: Development of household consumption in both pilot villages



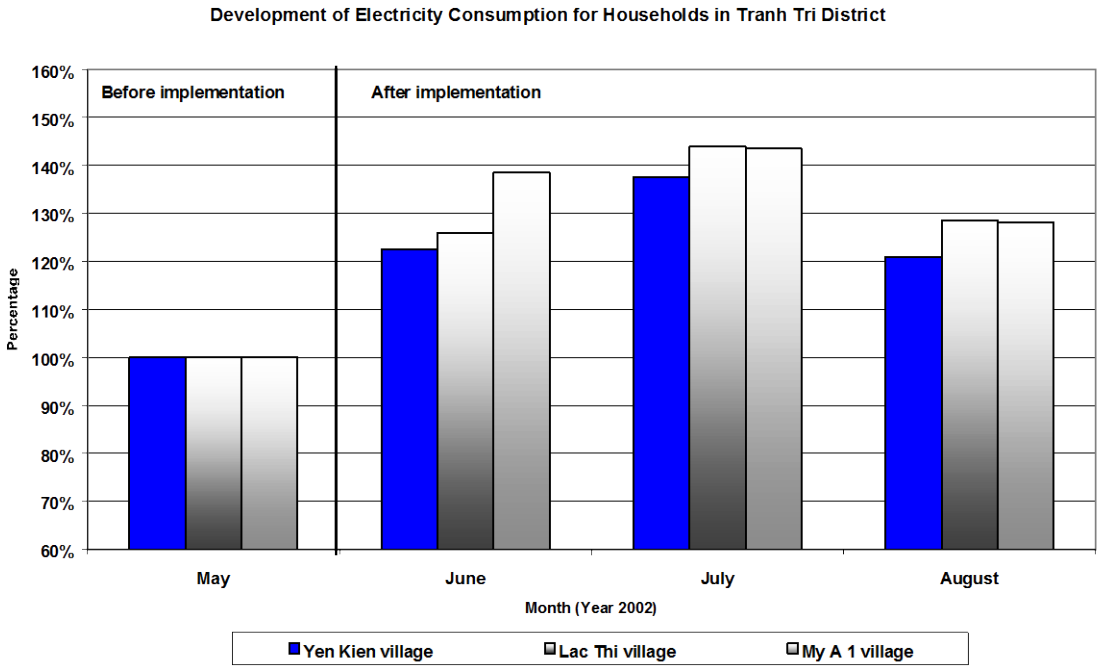
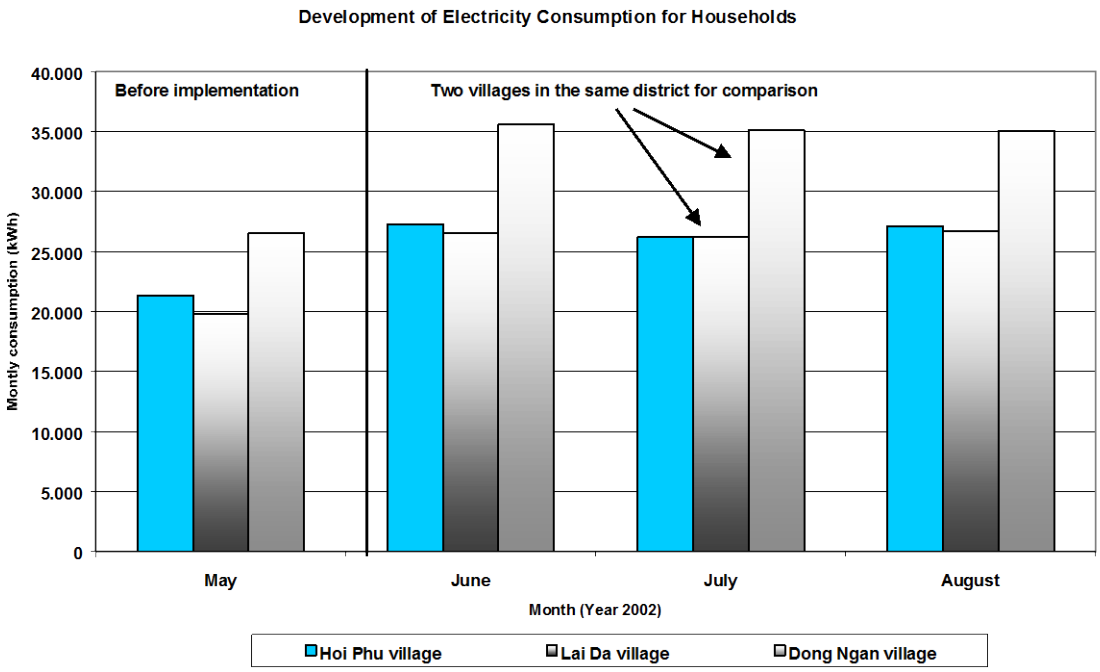


Figure 3-2: Development of household consumption in Yen Kien and comparable villages (absolute figures and percentage related to May)



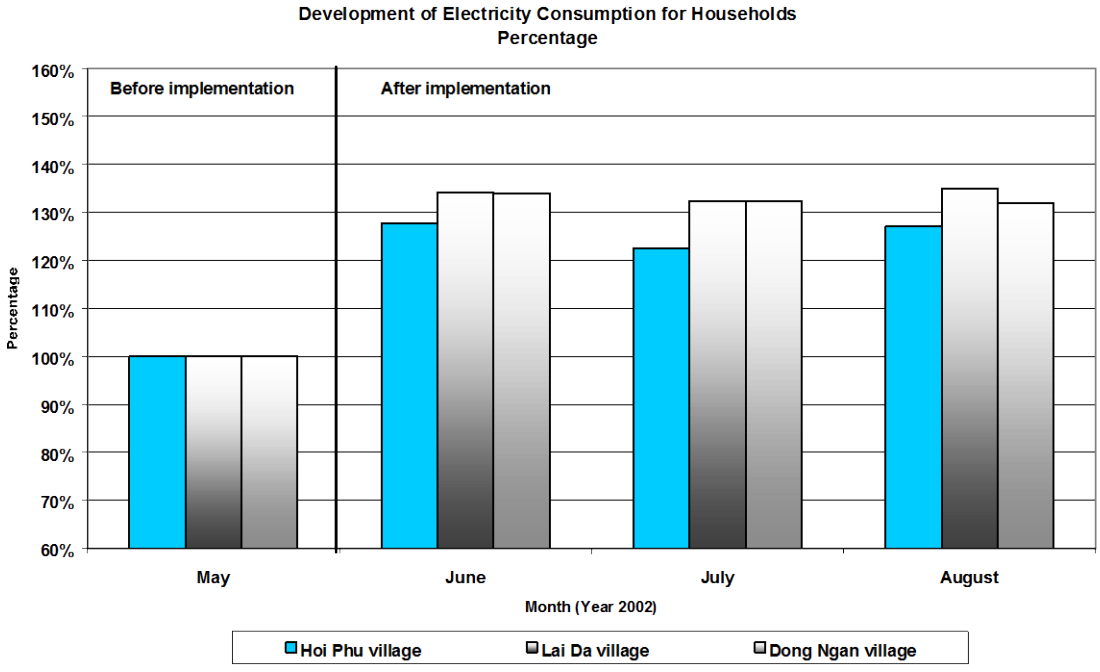


Figure 3-3: Development of household consumption in Hoi Phu and comparable villages (absolute figures and percentage related to May)

3.2 Calculation of electricity savings

In the frame of the customer survey the capacity distribution of replaced lamps and the average daily operation hours of the installed CFL were recorded. Based on the capacity distribution of the replaced incandescent lamps and the operation hours of the CFL the reduced capacity and electricity consumption in the two villages was calculated (see the **Table 3-1** below).

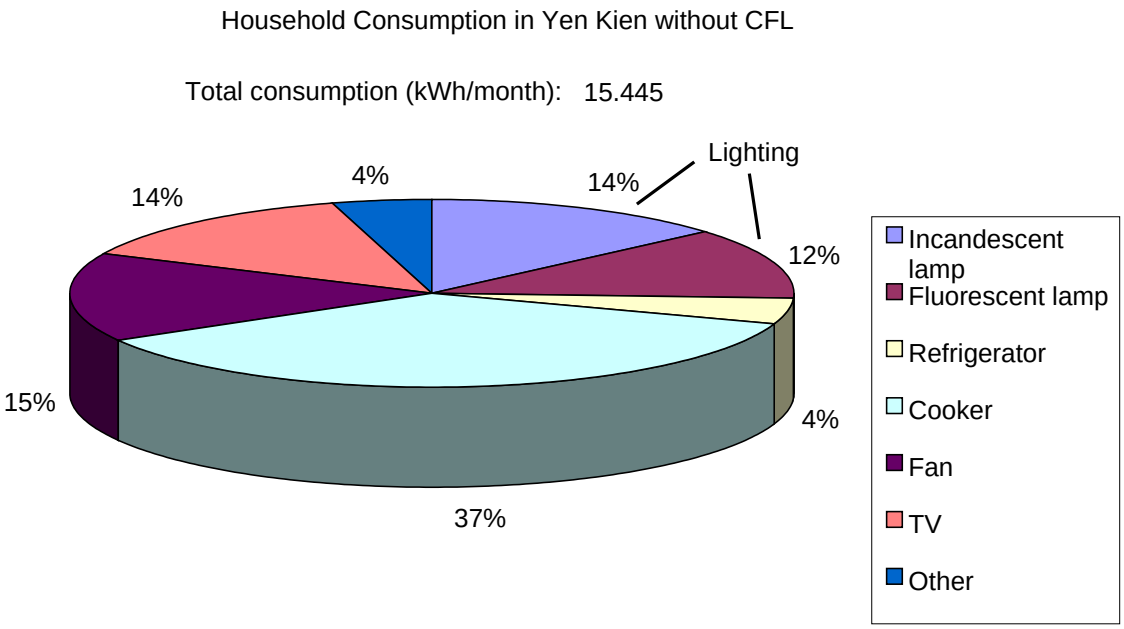
For both villages the installed capacity reduction is about 21 kW and the electricity consumption reduction is about 1.600 kWh/month, which forms a share of about 4% of the consumption in May.

Item	Unit	YenKien	HoiPhu	Total
Data of pilot program				
Electricity consumption (May)	kWh/month	15.445	21.350	36.795
Participating households	HH	227	279	506
Average daily operating time	h/d	2,4	2,6	2,5
Average replaced lamp capacity	W	64	56	59
Capacity of implemented CFL	W	18	17	
Resulting savings				
Installed capacity	kW	10,4	10,8	21,2
Electricity consumption	kWh/month	754	853	1.615
		5%	4%	4%

Table 3-1: Calculated capacity and reduction savings based on customer survey

In the frame of the customer survey the time of operation for all electrical appliances in both villages was assessed. **Annex 6.3** includes the results for both villages with the breakdown of appliances, their electric consumption respectively consumption shares. Based on this household appliance survey the overall monthly electricity consumption of the households can be calculated.

Figure 3-4 and **Figure 3-5** show the electrical consumption of the households in Yen Kien and the shares of lamps, refrigerator, cooker, fan, TV and other appliances. After installation of the CFL the consumption of incandescent lamps decreases and the share of fluorescent lamps including the CFL increases. The overall share of lighting (incandescent and fluorescent) with respect to all other electrical equipment in households consumption decreases by about 4%.



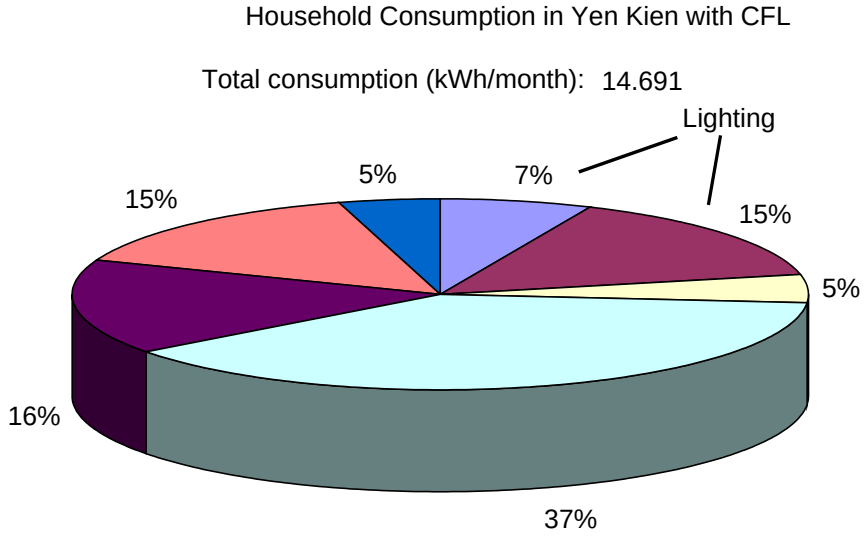
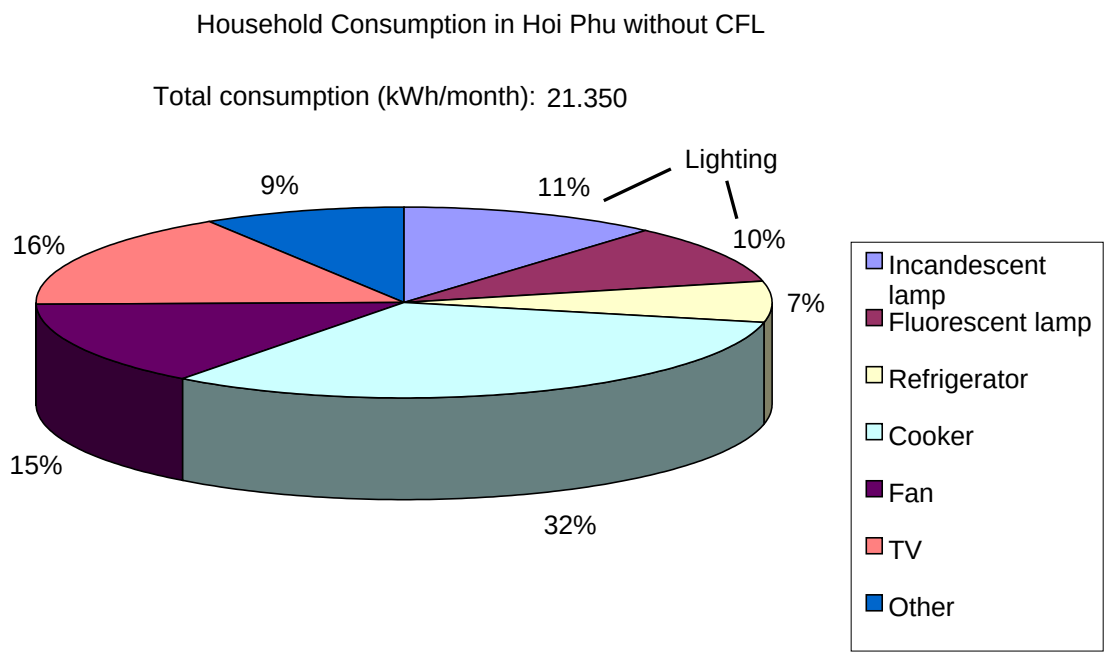


Figure 3-4: Calculated household consumption and shares of different appliances without and with CFL (Yen Kien)



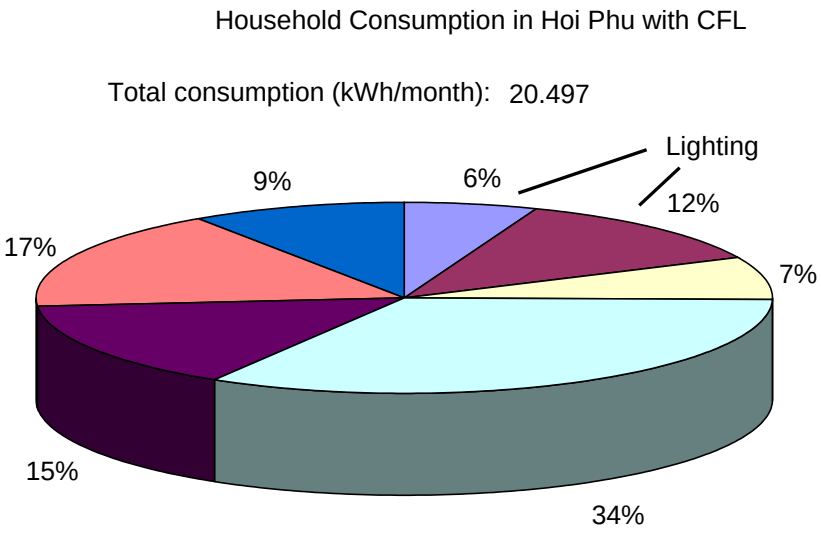


Figure 3-5: Calculated household consumption and shares of different appliances without and with of CFL (Hoi Phu)

3.3 Peak load and load factor

The daily load curves and the peak loads were recorded in both villages in the period from May to August.

In Yen Kien the data recording was quite complete and provided sufficient information for evaluation. In Hoi Phu however the load meter went defect, which had not been noticed, and no recording was available from June until middle of Juli. In Hoi Phu also large consumers (e.g. 2 water pumps with 33 kW each) exceeded substantially the baseline load curves of the household consumption. Therefore only a few days could be used for assessing the implications of installation of CFL on the household consumption. Due to the limited number of data the evaluation can provide merely indicative results for Hoi Phu. Nevertheless they confirm the results of the evaluation in Yen Kien. **Annex 6.4** shows the original load curves recorded in May and during the test period from June to August. **Annex 6.5** shows the adjusted daily load curves that exclude days with failure of load recordings.

Figure 3-6 shows for the example Yen Kien the development of peak loads before and during the test period. Although in this period the electricity consumption increased substantially the peak loads remained on the same level.

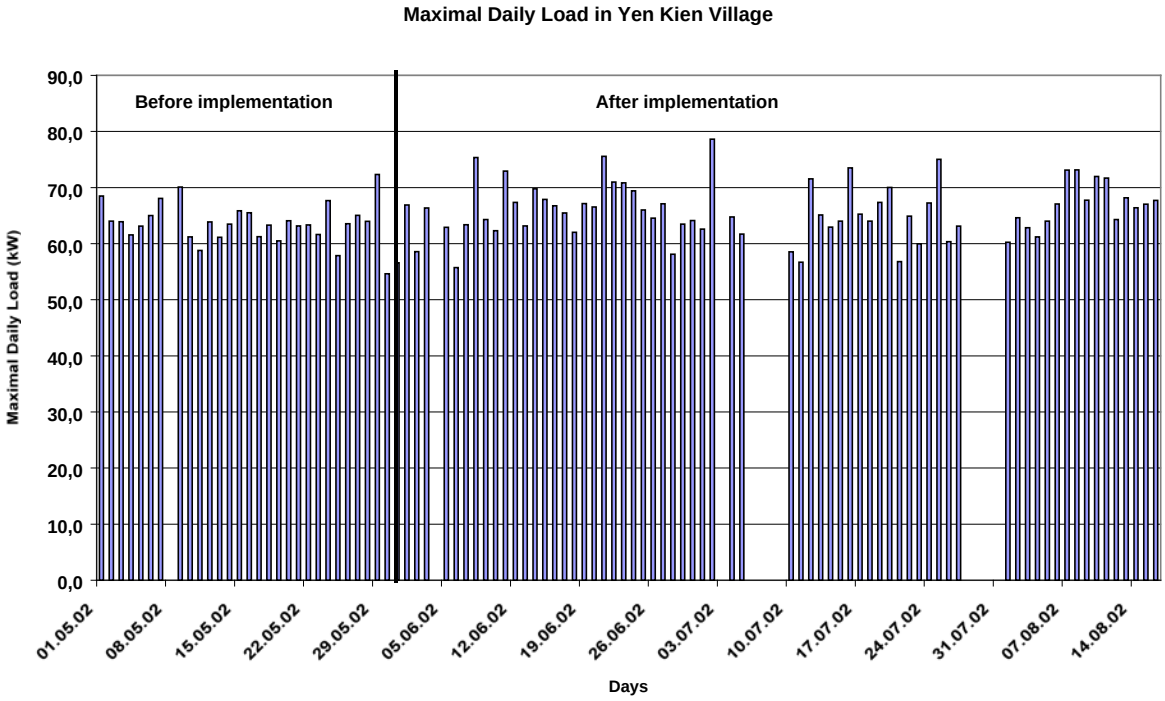


Figure 3-6: Development of peak loads before and after installation of CFL (Yen Kien)

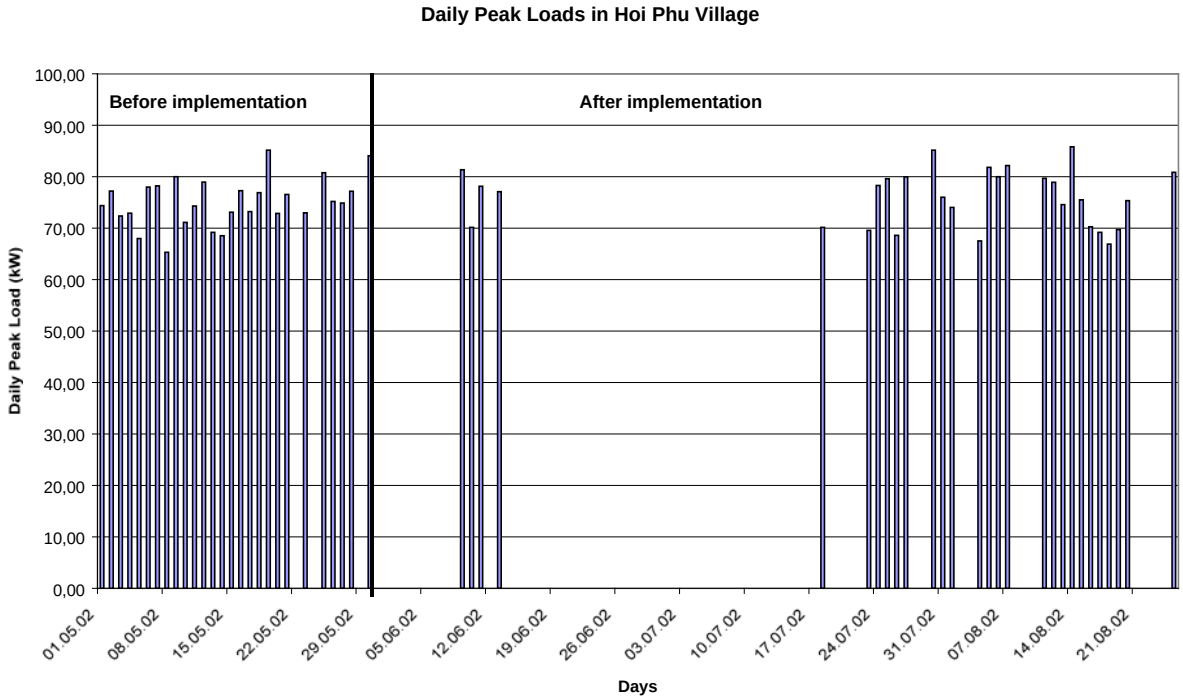
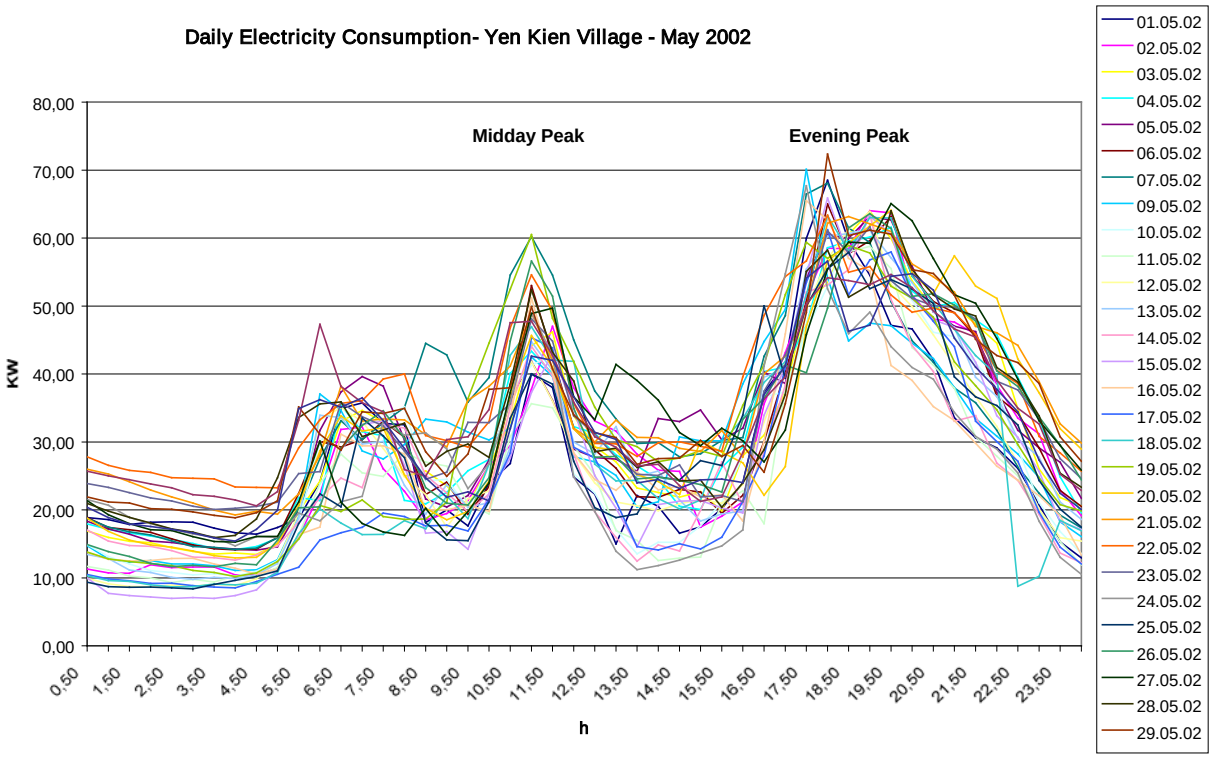


Figure 3-7: Development of peak loads before and after installation of CFL (Hoi Phu)

The daily load curves of both pilot program villages include midday and evening peaks. The midday peak lasts from 10 am to 3 pm. The evening load peak lasts in the period from 5 pm to 10 pm. As **Figure 3-8** indicates the installation of the CFL reduce the level of the evening load peak. In Yen Kien after implementation of the CFL the evening load peak reaches already the same level as the midday load peak.



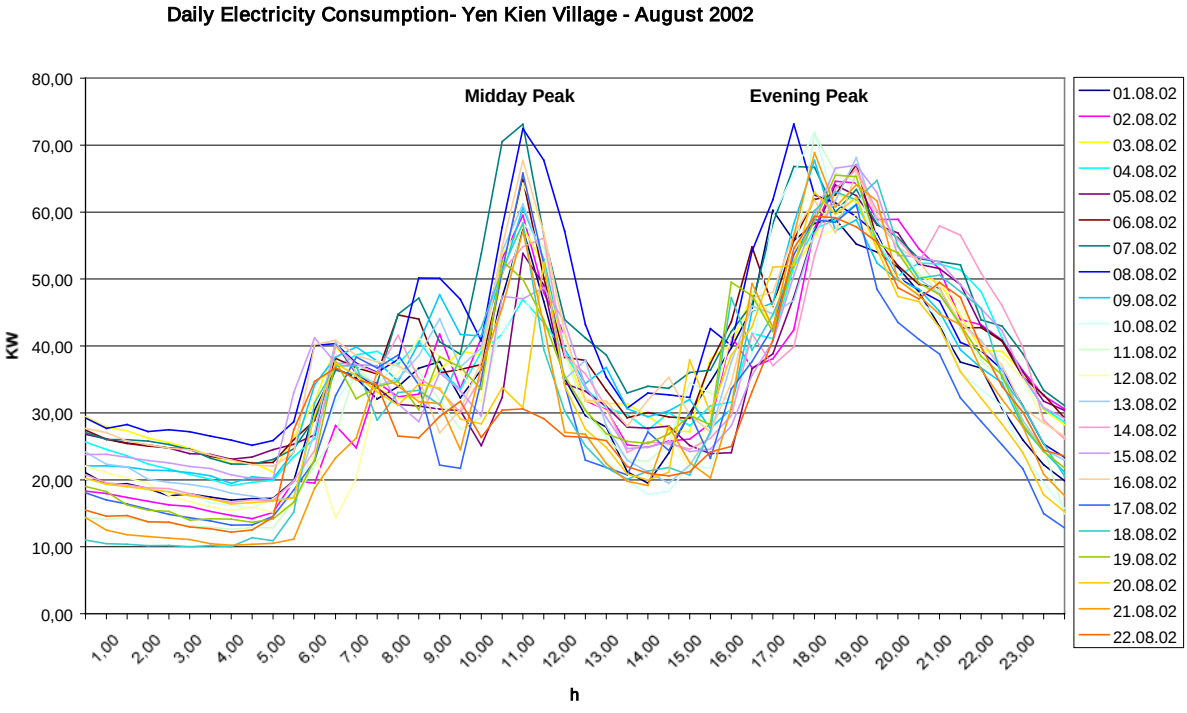
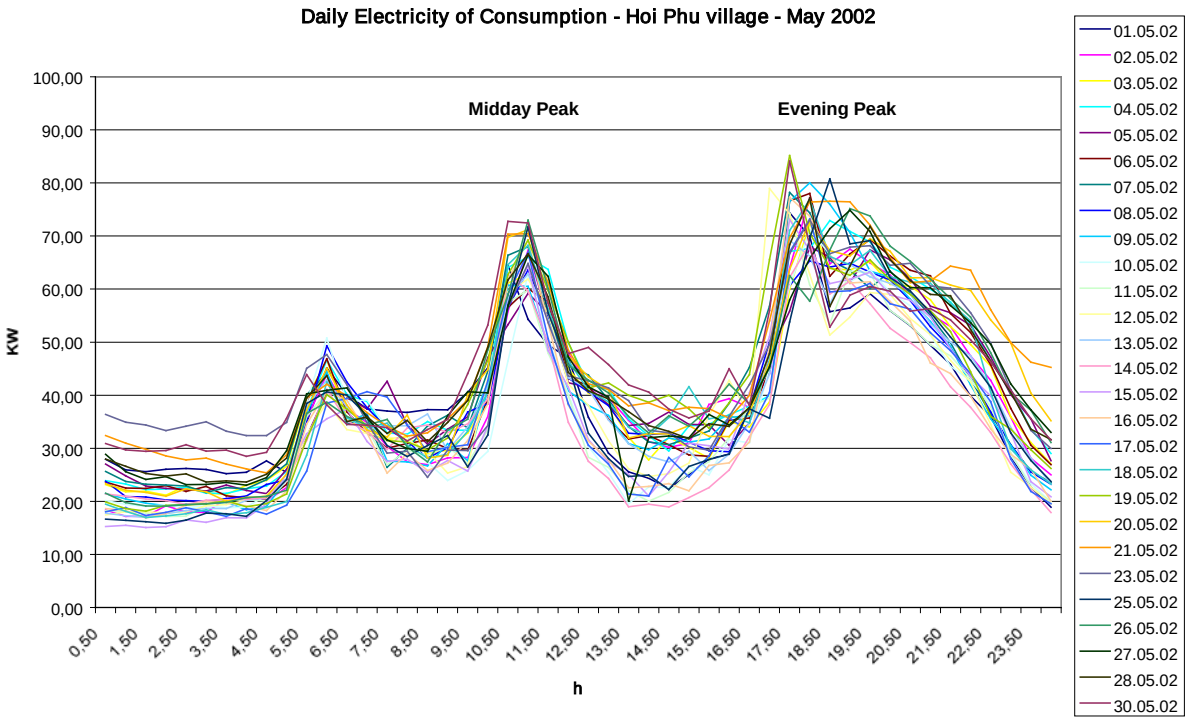


Figure 3-8: Daily load curves in Yen Kien before and after implementation of the CFL



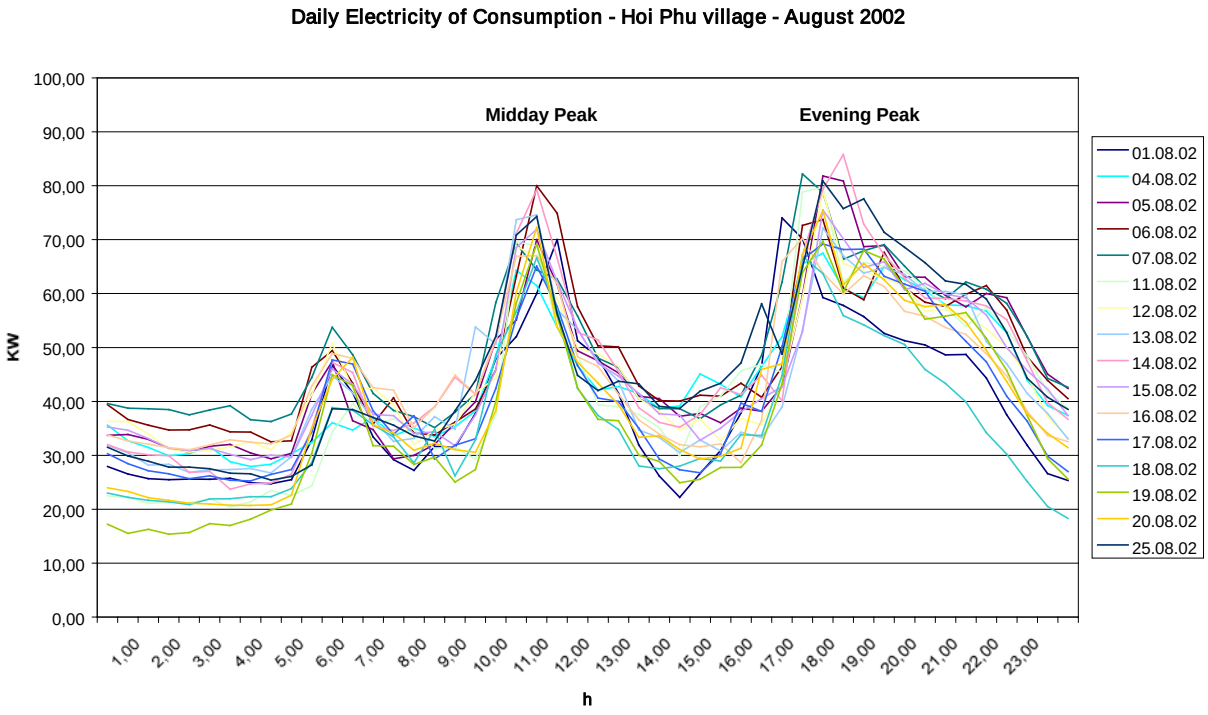


Figure 3-9: Daily load curves in Hoi Phu before and after implementation of the CFL

The load factor [1] improves after the introduction of the CFL. However as the development of the load factors in the considered period for Vietnam indicates there are also seasonable impacts that improve the load factor. For the households the seasonable effect would lead to an expected increase of the load factor by 0,03.

In Yen Kien the load factor increases from 0,42 before to 0,48 after installation of CFL. In Hoi Phu the load factor increases from 0,46 before to 0,51 after installation of CFL. In both villages the load factors increased far above seasonal effects.

The increase of the load factor by installation of CFL is an important result of metering in the pilot program villages. Higher load factors improve the situation of the electricity sector as fewer power stations have to be build to meet the load demand and the existing installed plant capacities can be better used.

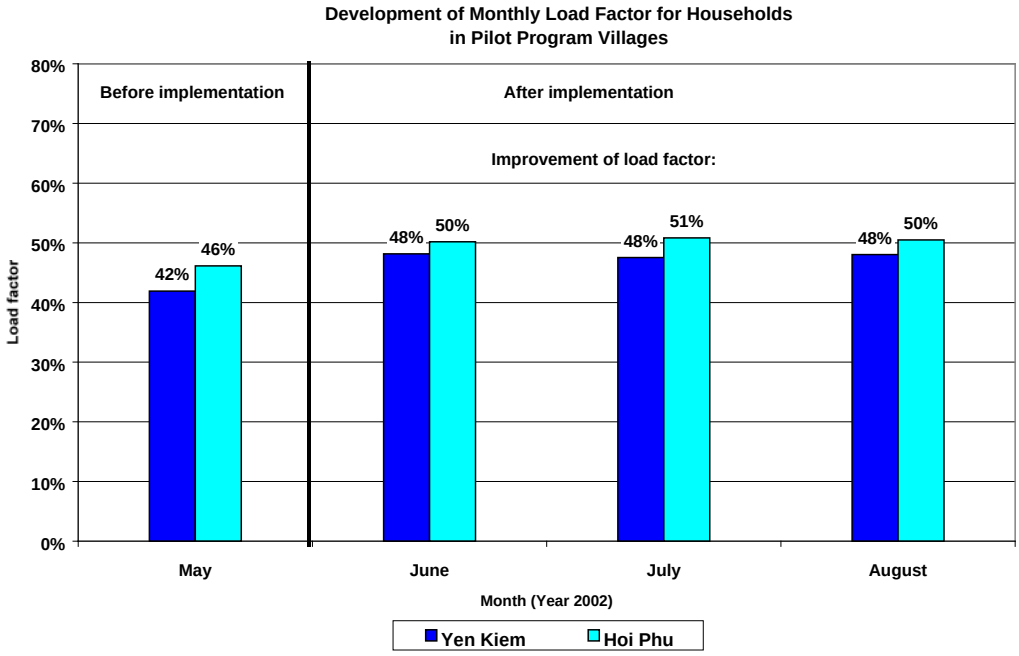


Figure 3-10: Development of monthly load factors in pilot program villages

Under the assumption that without CFL installation the load factor would only change as expected due to seasonal effects the peak load with the expected load factor would be higher than the metered peak load. The average reduction of peak load can be calculated via the difference of the higher expected to the metered peak load (see **Table 3-2**).

[1] The load factor is defined to be the ratio of electricity consumption and the peak load multiplied with the hours of operation.

The average reduction of peak load is about 7,2 kW in Yen Kien and about 5,0 kW in Hoi Phu. The calculated peak load reductions via load factors form indicative values.

Month	Average daily consumption kWh/day	Metered peak load kW	Expected load factor	Peak load with expected load factor kW	Peak load difference kW
May	728	72,3	0,42	72,3	
June	899	75,6	0,45	83,2	7,6
July	922	78,6	0,45	85,4	6,7
August	868	73,1	0,45	80,4	7,2
				Average peak load reduction:	**7,2**

Table 3-2: Calculation of average peak load reduction (example of Yen Kiem)

There is no noticeable change of the ratio reactive to active consumption in the period of consideration. Therefore major impacts of CFL on the power factor can be excluded so far.

3.4 Resulting load and energy savings

Based on the above stated monitored data on average capacity of replaced lamps, on operation time of the CFL and on peak load reduction the load and energy balance is calculated and stated in **Annex 6.6**. The assumptions are explained in the Design Report for the Rural CFL Pilot Program, that was prepared by August 2001.

The Coincidence Factor[2] between capacity reduction and peak load reduction is for both pilot program villages in total about 58%.

Due to impacts of load losses of the network the peak load reduction for EVN at the power gate is slightly higher than on customer side. Due to electricity losses of the network the electricity saving at EVN is also higher than on customer side. **Table 3-3** summarizes the results of this calculation both for the pilot program and specific per installed CFL.

[2] The Coincidence Factor is the peak load reduction on substation level divided by the installed capacity reduction at customer level.

Item	Unit	Pilot Program	Specific
Number of CFL	number	506	1
Load saving			
Capacity reduction customer level	W	21.230	42
Peak load reduction customer level	W	12.200	24
Peak load reduction (power gate)	W	14.353	28
Energy saving			
Consumption saving customers	kWh/year	19.380	38
Equivalent electricity generation	kWh/year	22.800	45

Table 3-3: Load and energy savings in both pilot program villages

4. Cost benefit analysis

The costs of the CFL Rural Pilot Program (excluding investments for CFL and fittings) are summarized in the **Table 4-1** below. The transaction costs include costs for installation of CFL, printing of questionnaires and leaflet and labor costs for the household survey. The specific transaction costs per CFL are on the same level (even higher) as the investments for the CFL.

The load metering and the data collection was carried out for the purpose of this specific pilot program. The costs for this item include the installation of the meters and of communication lines, programming and data collection from the meters. They will not appear in any large scale DSM project. Therefore this cost item is not included in the calculation of the transaction costs. The authorities of both villages organized the distribution of leaflets and the interviews of the customer survey. No extra labor costs were necessary.

Item	Unit	Yen Kien	Hoi Phu	Total
Installed CFL		227	279	506
Load metering and data collection (PC Hanoi) not included in transaction costs !	VND	5.585.103	5.457.212	11.042.315
Installation of CFL (PC Hanoi) excluding investment for the fittings	VND	5.302.037	6.437.322	11.739.359
Questionnaires and leaflets (IoE)	VND	1.615.020	1.984.980	3.600.000
Labour costs household survey (IoE)	VND	5.832.016	7.167.984	13.000.000
	VND			
Total	**VND**	**12.749.073**	**15.590.286**	**28.339.359**
Total in USD (1 USD = 15.000 VND)	USD	850	1.039	1.889
Specific per CFL	**VND**	**56.160**	**55.880**	**56.010**

Table 4-1: Transaction Costs of the Rural CFL Pilot Program

For the cost benefit analysis the investments for CFL are related to their annual electricity and cost savings.

The DSM benefits and tariffs are stated in **Figure 4-1**. The WASP program used by the IoE for the long-term power plan was also used to determine the marginal cost benefits of DSM. The average DSM benefit calculated at the IoE resulted to 10 USC/kWh (1.500 VND/kWh) for 150 MW plants with an operation time of 1.500 h/a. EVN sells electricity during peak time for a tariff of 840 VND/kWh to PC-Hanoi. PC Hanoi sells electricity to the final customers in rural for a tariff of 500 VND/kWh. The margins between benefits respectively purchase prices and sales prices forms the financial benefit of electricity saving for EVN and PC Hanoi.

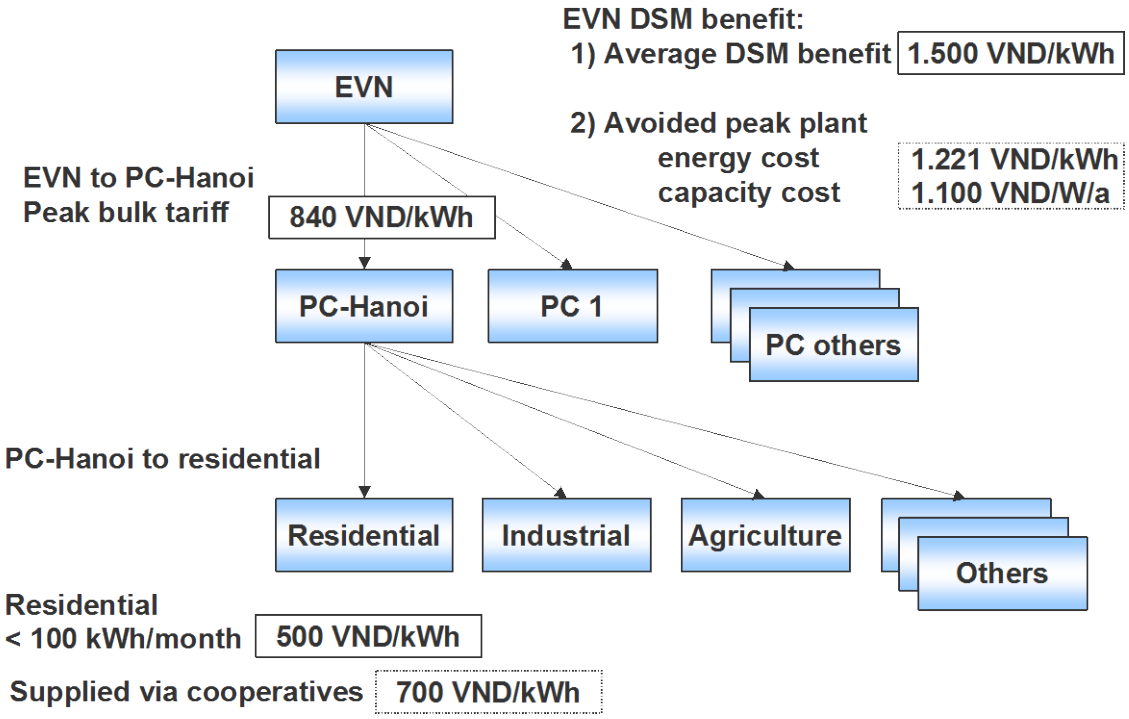


Figure 4-1: Tariff used in the context of the pilot program

Item	Unit	Yen Kien	Hoi Phu	Average
Basic data				
Discount rate		10%	10%	10%
Investment (lamp+socket)	VND/pcs	55.000	67.000	55.485
Transaction (others)	VND/pcs	56.160	55.880	25.196
Average daily operating time	hrs/day	2,4	2,6	2,5
Expected overall lifetime	years	5,8	5,3	3
Electricity savings				
Electricity saving per lamp - residential	kWh/year	40	37	38
Electricity saving per lamp - PC Hanoi	kWh/year	44	41	43
Electricity saving per lamp - EVN	kWh/year	47	43	45
Tariffs/benefits				
Customer tariff - residential (with VAT)	VND/kWh	500	500	500
Customer tariff - residential (without VAT)	VND/kWh	455	455	455
Peak bulk supply tariff - EVN-PC Hanoi	VND/kWh	840	840	840
Average DSM benefit - EVN	USC/kWh	10	10	10
Average DSM benefit - EVN	VND/kWh	1.500	1.500	1.500
Exchange rate VND/USD (01.10.2002):		15.000		

Table 4-2: Input data for the cost benefit analysis

For customers the annual electricity and cost savings related to the price of the CFL and fittings form a simplified pay back period. For EVN the electricity cost saving is reduced by the transaction costs of CFL pilot program and by the energy sales reduction to its customers.

A simplified sensitivity analysis (see **Figure 4-2**) indicates that without subsidization the pay-back time for customers would be below 3 years. This is well below the lifetime of CFL of about five years and CFL are already financially attractive for present tariff levels.

On the other hand a pay-back period of much more than one year would be beyond the scope of perception and risk readiness of the rural households. A subsidization of CFL by e.g. 50% would reduce their pay-back period and improve their financial attractiveness for rural households. As **Figure 4-2** shows a subsidization rate of 50% of the CFL prices by EVN would result to static pay-back periods of less than 1,5 years. This could be attractive for both EVN and customers.

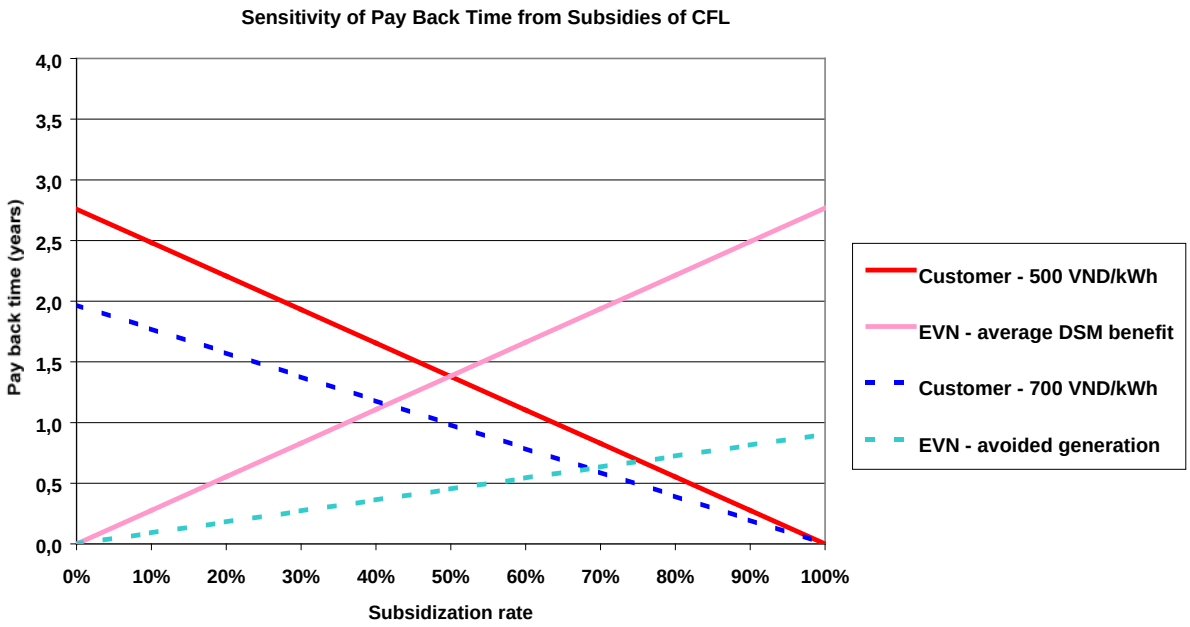


Figure 4-2: Sensitivity of pay back time from subsidisation rate of CFL

In the sensitivity analysis also the impact of two other tariff assumptions is considered:

- For residential customers supplied via retail cooperatives the tariff would be 700 VND/kWh and much higher as the tariff of 500 VND/kWh. This higher tariff reduces the pay-back time and makes CFL for customers mare attractive.
- For calculation of the DSM benefits for EVN the costs at the power gate of a gas turbine peak plant could be assumed additionally. Based on IoE data the avoided energy costs are 8,14 USC/kWh and the avoided capacity costs are 73,3 USD/kW/yr. These are higher than the average DSM benefits and would increase the financial performance for EVN.

The **Table 4-3** below presents the cost benefit analysis for the households of both villages and for EVN under the assumption that the CFL are subsidized by about 50%.

In less than two years the household customers could repay their CFL costs and then save money during the remaining lifetime of the CFL. With new higher tariffs the financial attractivity of CFL will even improve for the customers.

Due to the assumed electricity savings for EVN the subsidisation of 50% of the CFL price would result also to a short pay back time. A timely limited 50% subsidisation program of CFL combined with marketing measures could initiate a widespread market penetration of CFL and have financial advantages both for the customers and EVN.

CUSTOMER TEST **Item**	**Unit**	**Yen Kien** **Specific**	**Hoi Phu** **Specific**	**Total**
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Electricity saving per lamp	kWh/year	36	40	19.380
Annual savings	VND/year	17.960	20.120	9.689.990
Pay back time (static)	**years**	**1,5**	**1,7**	**1,6**

UTILITY TEST - EVN **Item**	**Unit**	**Yen Kien** **Specific**	**Hoi Phu** **Specific**	**Total**
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Electricity saving per lamp	kWh/year	43	48	23.070
Average sales reduction	kWh/year	40	45	21.710
Annual electricity savings	VND/year	51.320	57.480	27.685.690
Average sales reduction	VND/year	-22.530	-25.230	-12.155.120
Average transaction costs	VND/year	-13.290	-14.150	-6.965.650
Surplus (losses)	**VND/year**	**15.500**	**18.090**	**8.564.920**
Pay back time (static)	**years**	**1,8**	**1,9**	**1,8**

Table 4-3: Calculation of costs and benefits for customers and EVN for the example of a subsidisation rate of 50%

In the frame of the present tariff system also PC Hanoi would benefit from electricity savings as it has to pay higher prices for the electricity than it can earn from residential customers (see **Table 4-4**).

PC-Hanoi Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Average sales reduction	kWh/year	40	37	19.295
Average customer sales tariff (without VAT)	VND/kWh	455	455	455
D losses, mainly peak load hours	%	10%	10%	10%
Average purchase reduction	kWh/year	44	40	21.224
Average bulk supply tariff from EVN	VND/kWh	840	840	840
Surplus (losses)	**VND/year**	**18.724**	**17.231**	**9.057.912**

Table 4-4: Calculation of costs and benefits for PC Hanoi

5. Main results and Conclusions

An objective of the Rural CFL Pilot Program was to test the CFL and their assumed savings in the rural area of Vietnam. The participants were interviewed in order to assess the key barriers for purchase and installation of CFL. According to the Program Design & Investment Plan prepared by EVN in October 2001 these key barriers addressed were:

- Low ROI due to low tariffs
- High first costs
- Lack of knowledge and awareness redarding benefits of CFL
- Lacks of understanding of the quality issues (due to low quality Chinese imports)
- Limited product availability
- Perceived risk that CFL fails soon after installation

First cost benefit considerations indicate a pay-back period of nearly 3 years for rural households when they buy CFL. This could already be financially attractive for the existing electricity tariff levels. On the other hand a pay-back period of much more than one year is beyond the scope of perception and risk readiness of the rural households. A subsidization of CFL by e.g. 50% would reduce their pay-back period and improve their financial attractiveness for rural households. Besides subsidization also other financing schemes could overcome the barrier of high first costs for CFL.

The lack of knowledge and awareness redarding the benefits of CFL has been overcome by the demonstration and by the information campaign in both pilot program villages. The information on CFL has to be significantly improved in the rural areas of the whole country in the frame of a large scale DSM program. CFL could also get a bad image by wrong products. This lack has to be overcome by information on better performance and higher lifetime of CFL with better quality.

One market barrier is the limited product availability in local markets. The CFL have to become available also in local shops and markets where in general the rural customers buy their lamps. The perception on the risk that CFL fails soon after installation is relatively low for the interviewed participants. Nevertheless a 6-month guarantee period provided by the CFL producers could overcome this risk.

The barriers for introduction of CFL in the rural areas of Vietnam exist but they can be overcome by means of financing schemes and broad information campaigns.

The main results of the Rural CFL Pilot Program may be summarized as follows:

- The performance of CFL installed in both pilot program villages was good. Only a few CFL went defect after installation.
- CFL turned out to be the preferred lighting source and were accepted by the participants. Over 80% of the participants expressed their willingness to buy CFL in future. A share of the participating households accepts also higher prices for CFL with a better quality.
- The electricity consumption decreased after the installation of the CFL. In both villages electricity consumption savings of about 4 % of the total consumption were calculated
- In both villages the evening peak load decreased after the installation of the CFL and the load factor improved substantially.
- From view of both customers and EVN the installation of CFL with a 50% subsidiy rate could become financially attractive with pay-back periods of less than two years. Also PC Hanoi could benefit from the electricity savings.

The Pilot Program indicates that no major obstacles for a large-scale installation of CFL in rural areas exist. In the rural areas of Vietnam substantial energy and load saving potentials can be realized.

It should also be mentioned that for this first pilot program all organizational and institutional issues were very new. The organization and the communication links had to be developed and established in the context of all involved Vietnamese institutions. The contents and steps of the pilot program had to be presented to and approved by the Ministry of Industry, EVN, the local power companies and the local authorities in both pilot program villages. The financial budgets had to be planned and the approved by EVN and MoI. The two lamp manufacturers Osram and Ralaco that donated their CFL products had been involved in the program as well. The local power companies carried out the metering at the village substations and all various data had to be provided by the various institutions.

In a pilot program working group consisting of members of EVN DSM Cell, the Institute of Energy and the Consultant the pilot programs were designed and all necessary tasks were coordinated. During this first pilot program DSM know-how was transferred and the skills for design, implementation, monitoring and evaluation were established at EVN DSM Cell and the Institute of Energy. The experience learned helps the responsibles to implement more efficiently further DSM programs.

6. Annexes

6.1 Schedule of the Project

6.2 Consumption data for Yen Kien, Hoi Phu and comparable villages

Electricity of Monthly Consumption of Villages implemented pilot CFL program - PCHN- Year 2002						
STT	**Danh môc**	**April**	**May**	**June**	**July**	**August**
I	**Hoi Phu village-Dong Anh District**					
1	ElecConMon (KWh)	28770	27878	31940	36282	
2	E household (KWh)	19745	21350	27246	26169	27125
3	Fien 8 (another)	9025	6528	4694	10113	
4	Number of HH	290	290	290	290	291
II	**Yen Kien village-Thanh Tri District**					
1	ElecConMon (KWh)	16986	19147	23066	25777	23014
2	E household (KWh)	13390	15445	18924	21250	18682
3	Fien 8 (another)	3596	3702	4142	4527	4332
4	Number of HH	213	213	213	213	225

Note: Rate of growth(%) is higher in June because of Increamental of ElecConsumption in June.
The main reason is that in June, July and August (months of Mid-Summer), people use Elec.
Fan more than in May, April (time of use increases from 6 h to 8-9h/day/unit)

Electricity of Monthly Consumption of Villages implemented pilot CFL program - PCHN- Year 2001						
STT	**Danh môc**	**April**	**May**	**June**	**July**	**August**
I	**Hoi Phu village-Dong Anh District**					
1	ElecConMon (KWh)					
2	E household (KWh)	15540	21933	22281	21160	24457
3	Fien 8 (another)					
4	Number of HH	290	290	290	290	291
II	**Yen Kien village-Thanh Tri District**					
1	ElecConMon (KWh)	12797	14181	15114	16228	16576
2	E household (KWh)	10703	11945	14345	14761	14941
3	Fien 8 (another)	2094	2236	769	1467	1635
4	Number of HH	213	213	213	213	225

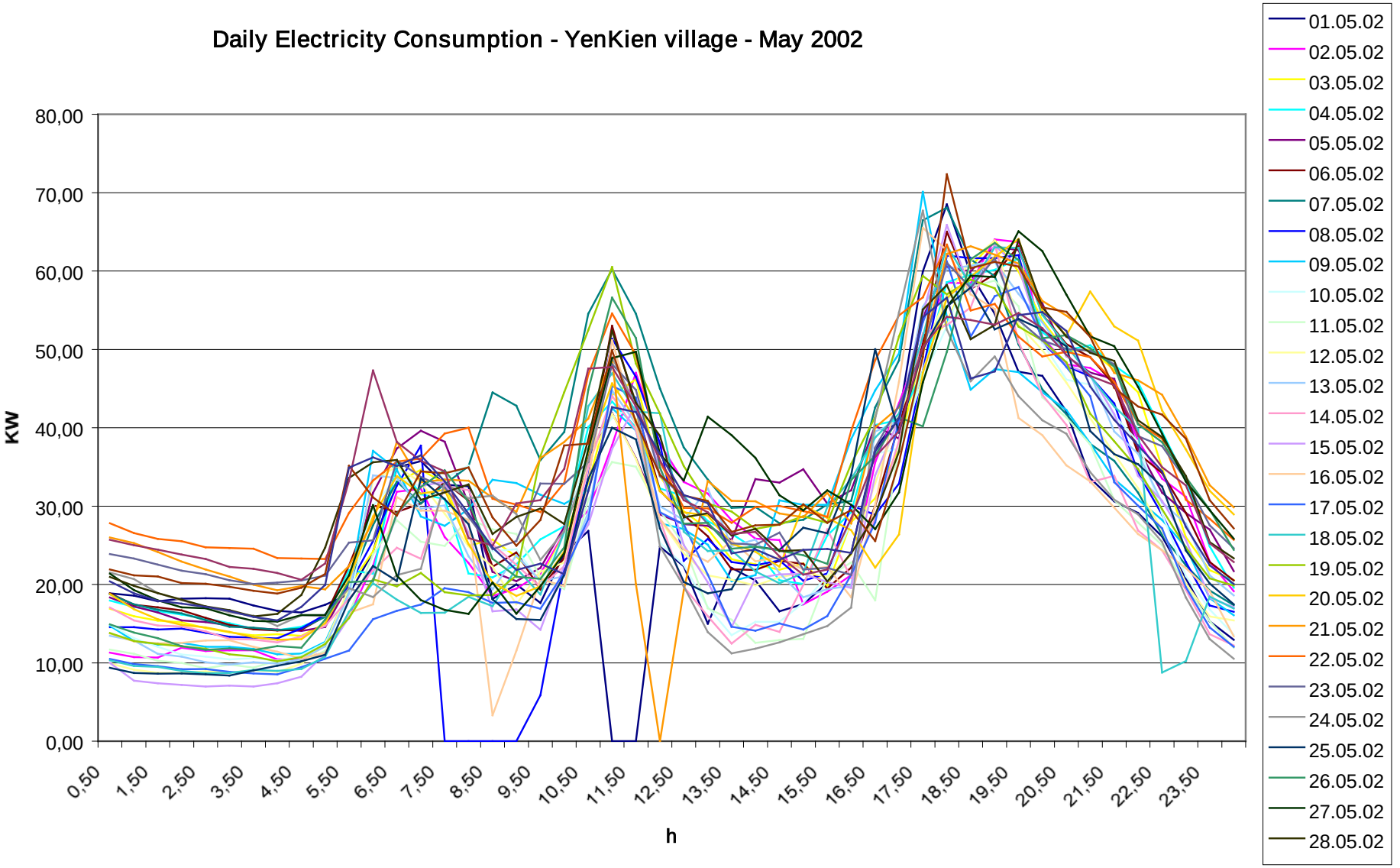
Electricity of Monthly Consumption for no-implemented CFL program villages in **Thanh Tri district** - PCHN - **Year 2002**						
STT	**Danh môc**	**April**	**May**	**June**	**July**	**August**
I	**Lac Thi village**					
1	ElecConMon (KWh)	28948	33750	42875	48859	43703
2	E household (KWh)	28696	33599	42343	48356	43200
3	Fien 8 (another)	252	151	532	503	503
4	Number of HH	702	706	713	716	714
II	**My A 1 village**					
1	ElecConMon (KWh)	9189	8766	10328	12933	10555
2	E household (KWh)	7687	7458	10328	10704	9557
3	Fien 8 (another)	1502	1308		2229	998
4	Number of HH	133	133	132	133	133

Electricity of Monthly Consumption for no-implemented CFL program villages in **Dong Anh district** - PCHN- **Year 2002**						
STT	**Danh môc**	**April**	**May**	**June**	**July**	**August**
I	**Lai Da village**					
1	ElecConMon (KWh)	19073	19786	26534	26184	26724
2	Number of bill	309	315	313	313	314
II	**Dong Ngan village**					
1	ElecConMon (KWh)	25322	26560	35585	35139	35066
2	Number of bill	460	459	464	466	467

6.3 Consumption data for household appliances in Yen Kien and Hoi Phu

Electricity Consumption of Households		Appliances		Consumption		Shares	
		HoiPhu Number	Yen Kien Number	HoiPhu kWh	Yen Kien kWh	HoiPhu %	Yen Kien %
	Billed consumption (May)			**21.350**	**15.445**		
	Calculated (May)	**3.930**	**2.289**	**20.990**	**14.215**	**100,0%**	**100,0%**
I	**Lighting**	**2.075**	**1.286**	**4.488**	**3.678**	**21,4%**	**25,9%**
1	**Incandescent lamp**	**892**	**476**	**2.385**	**1.948**	**11,4%**	**13,7%**
	Incandescent lamp 25 W	161	66	209	100	1,0%	0,7%
	Incandescent lamp 40 W	295	113	650	282	3,1%	2,0%
	Incandescent lamp 60 W	163	87	523	347	2,5%	2,4%
	Incandescent lamp 75 W	221	160	824	843	3,9%	5,9%
	Incandescent lamp 100 W	52	50	180	377	0,9%	2,6%
2	**Fluorescent lamp**	**1.183**	**810**	**2.104**	**1.730**	**10,0%**	**12,2%**
	Fluorescent lamp - big tube 1.2 m	433	350	1.571	1.325	7,5%	9,3%
	Fluorescent lamp - big tube 0.6 m	137	75	173	125	0,8%	0,9%
	Fluorescent lamp - thin tube 1.2 m	15	6	45	25	0,2%	0,2%
	Fluorescent lamp - thin tube 0.6 m	19	1	27	3	0,1%	0,0%
	Ballast M	216	324	156	233	0,7%	1,6%
	Ballast E	363	54	131	19	0,6%	0,1%
II	**Refrigerator - Cooker**	**372**	**203**	**8.145**	**5.788**	**38,8%**	**40,7%**
1	**Refrigerator**	**62**	**36**	**1.451**	**622**	**6,9%**	**4,4%**
	Refrigerator 1 door	22	25	461	459	2,2%	3,2%
	Refrigerator 2 doors	34	11	691	163	3,3%	1,1%
	Freezer	6		299		1,4%	
2	**Cooker**	**310**	**167**	**6.694**	**5.166**	**31,9%**	**36,3%**
	Rice cooker	257	154	5.188	4.716	24,7%	33,2%
	Electric cattle	44	12	1.084	405	5,2%	2,8%
	Electric cooker	9	1	422	45	2,0%	0,3%
III	**Others**	**1.483**	**800**	**8.356**	**4.749**	**39,8%**	**33,4%**
1	**Fan**	**815**	**527**	**3.045**	**2.179**	**14,5%**	**15,3%**
	Fan pedestal	347	111	1.393	486	6,6%	3,4%
	Fan table	376	322	1.097	878	5,2%	6,2%
	Fan ceiling	85	94	547	815	2,6%	5,7%
	Ventilator	7		9			
2	**TV**	**379**	**229**	**3.423**	**1.956**	**16,3%**	**13,8%**
	Color TV	232	155	2.934	1.751	14,0%	12,3%
	Black/white TV	45	10	291	66	1,4%	0,5%
	Video	58	29	73	51	0,3%	0,4%
	CD, VCD, DVD	19	17	44	32	0,2%	0,2%
	Computer/printer	5		12		0,1%	
	Stereo, Video, Karaoke	20	18	70	56	0,3%	0,4%
3	**Water heating**	**14**	**2**	**73**	**24**	**0,3%**	**0,2%**
4	**Washing machine**	**6**	**1**	**60**	**11**	**0,3%**	**0,1%**
5	**Fresh water pumps**	**224**	**27**	**1.545**	**377**	**7,4%**	**2,6%**
6	**Iron**	**29**	**11**	**130**	**106**	**0,6%**	**0,7%**
7	**Others**	**16**	**3**	**81**	**97**	**0,4%**	**0,7%**

6.4 Original load data for Yen Kien and Hoi Phu


Daily Electricity Consumption - YenKien village - May 2002
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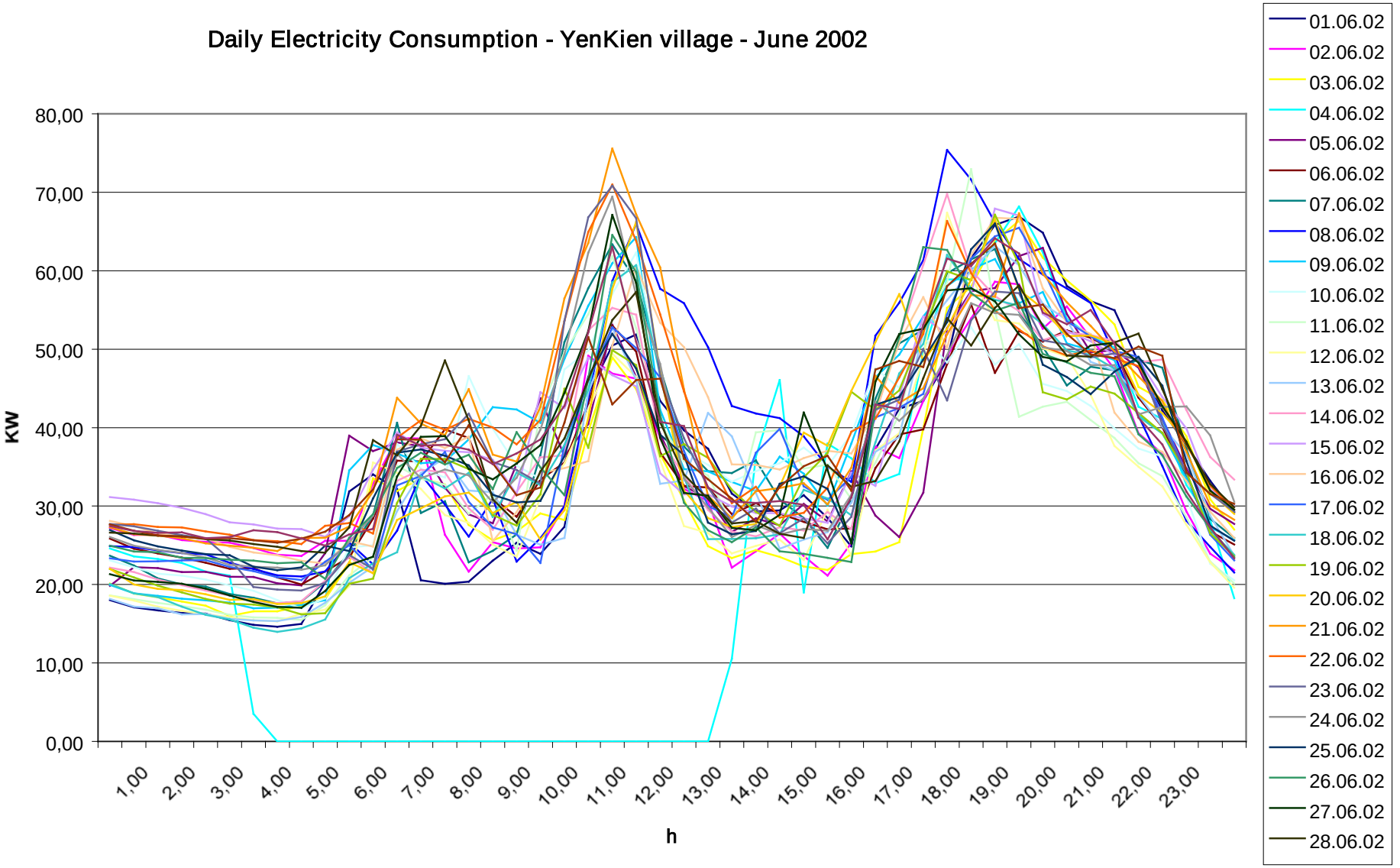
Daily Electricity Consumption - YenKien village - June 2002
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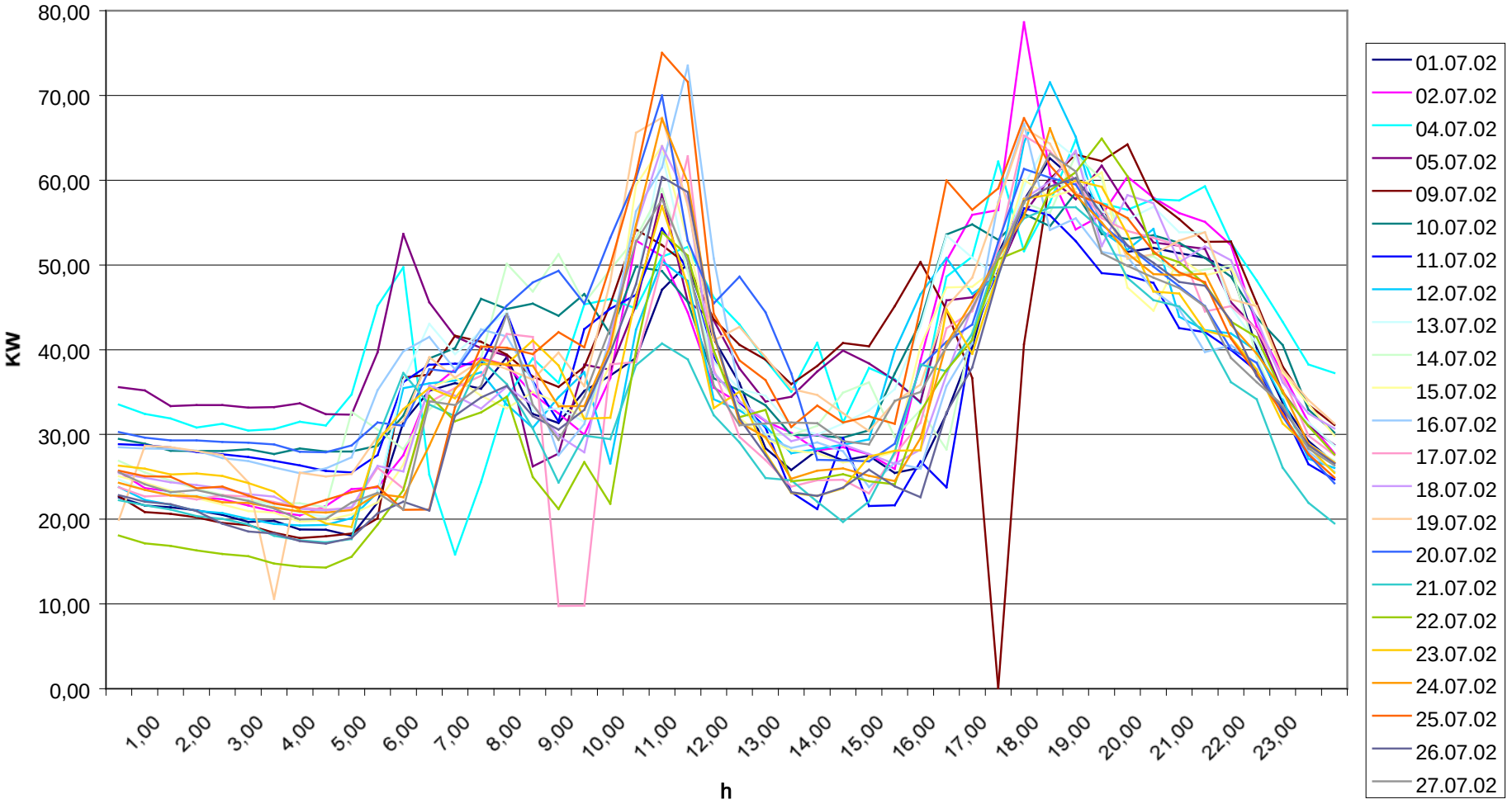
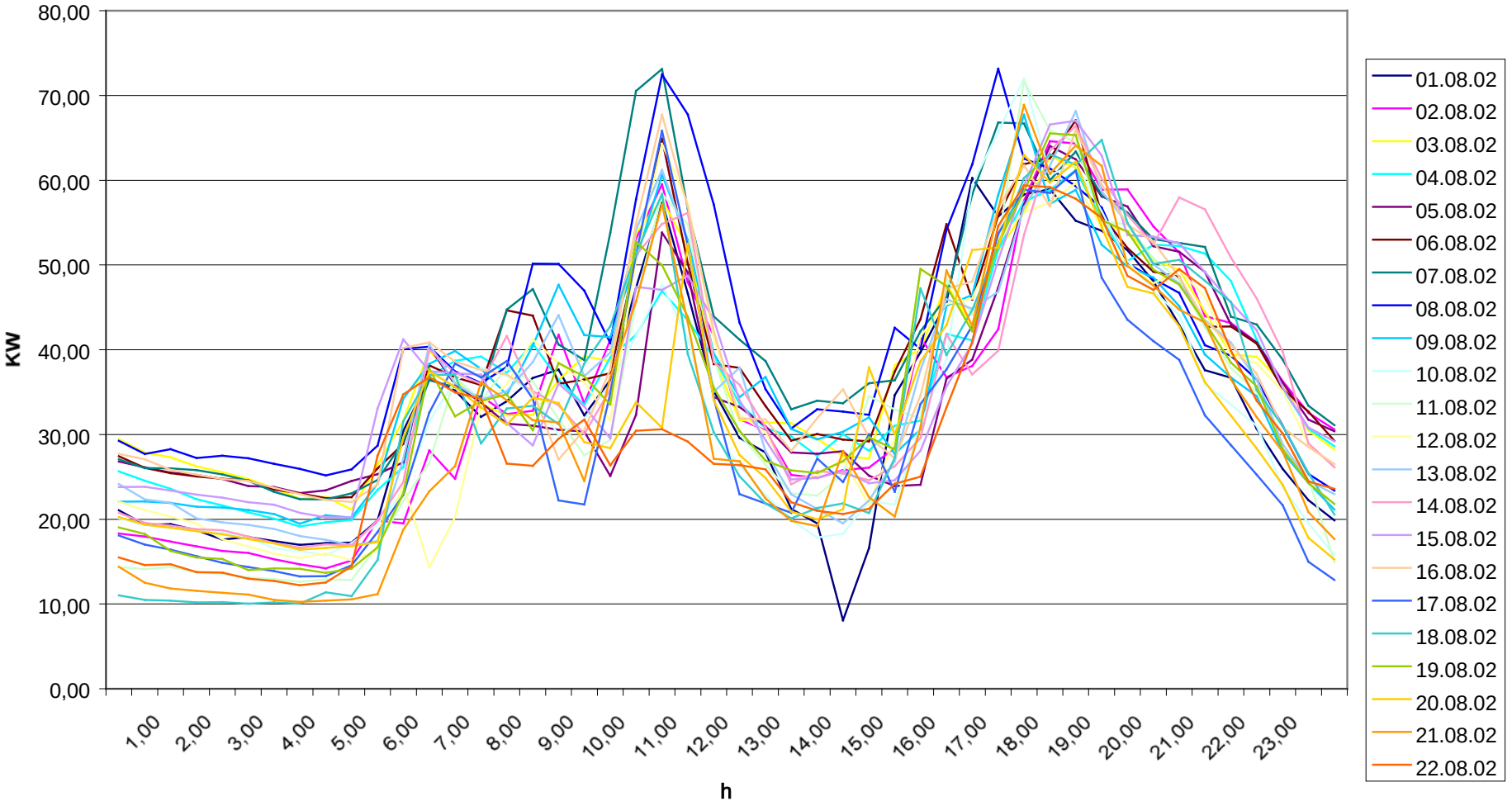
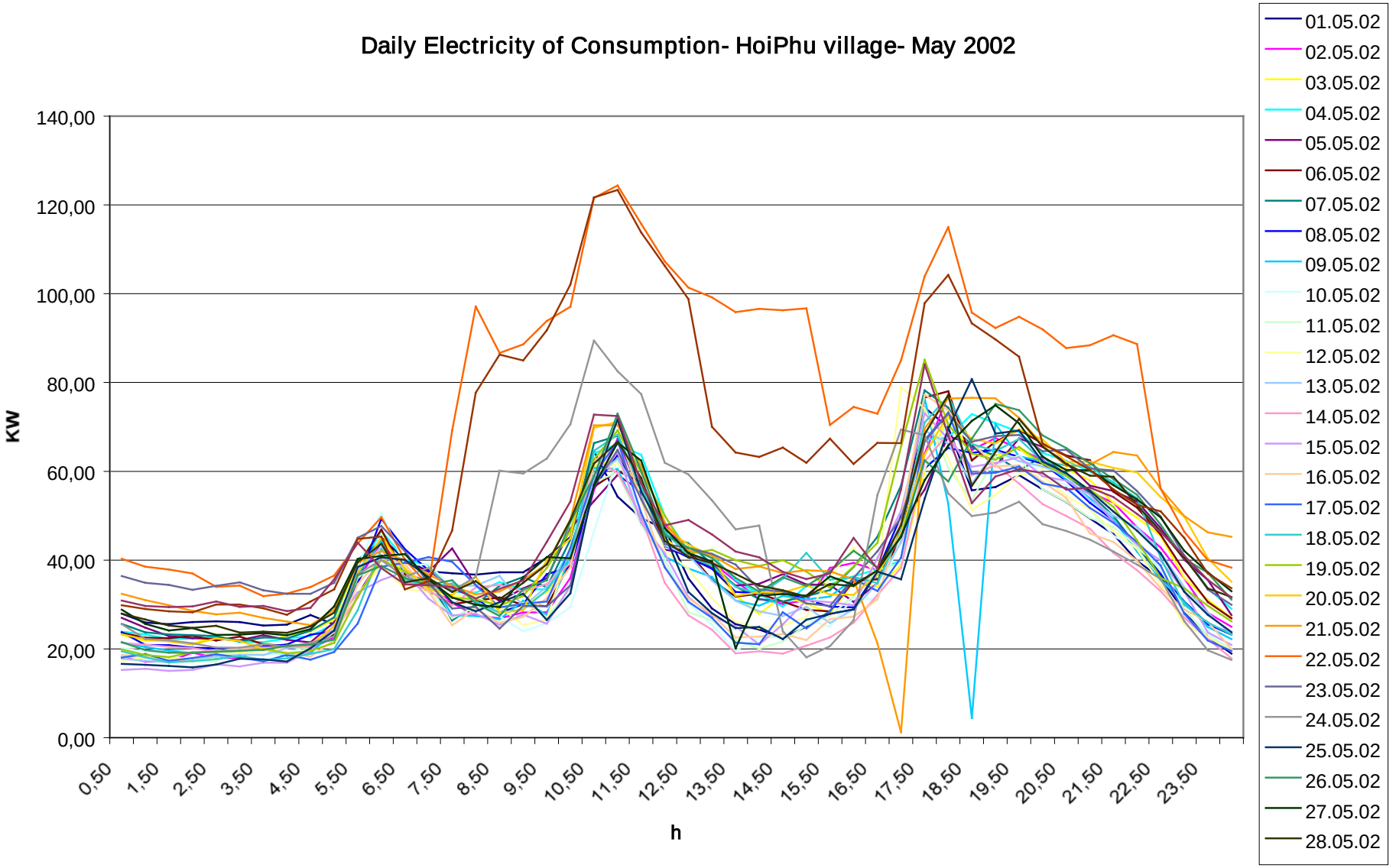
Daily Electricity Consumption - YenKien village - July 2002



Daily Electricity Consumption - YenKien village - August 2002




Daily Electricity of Consumption- HoiPhu village- May 2002
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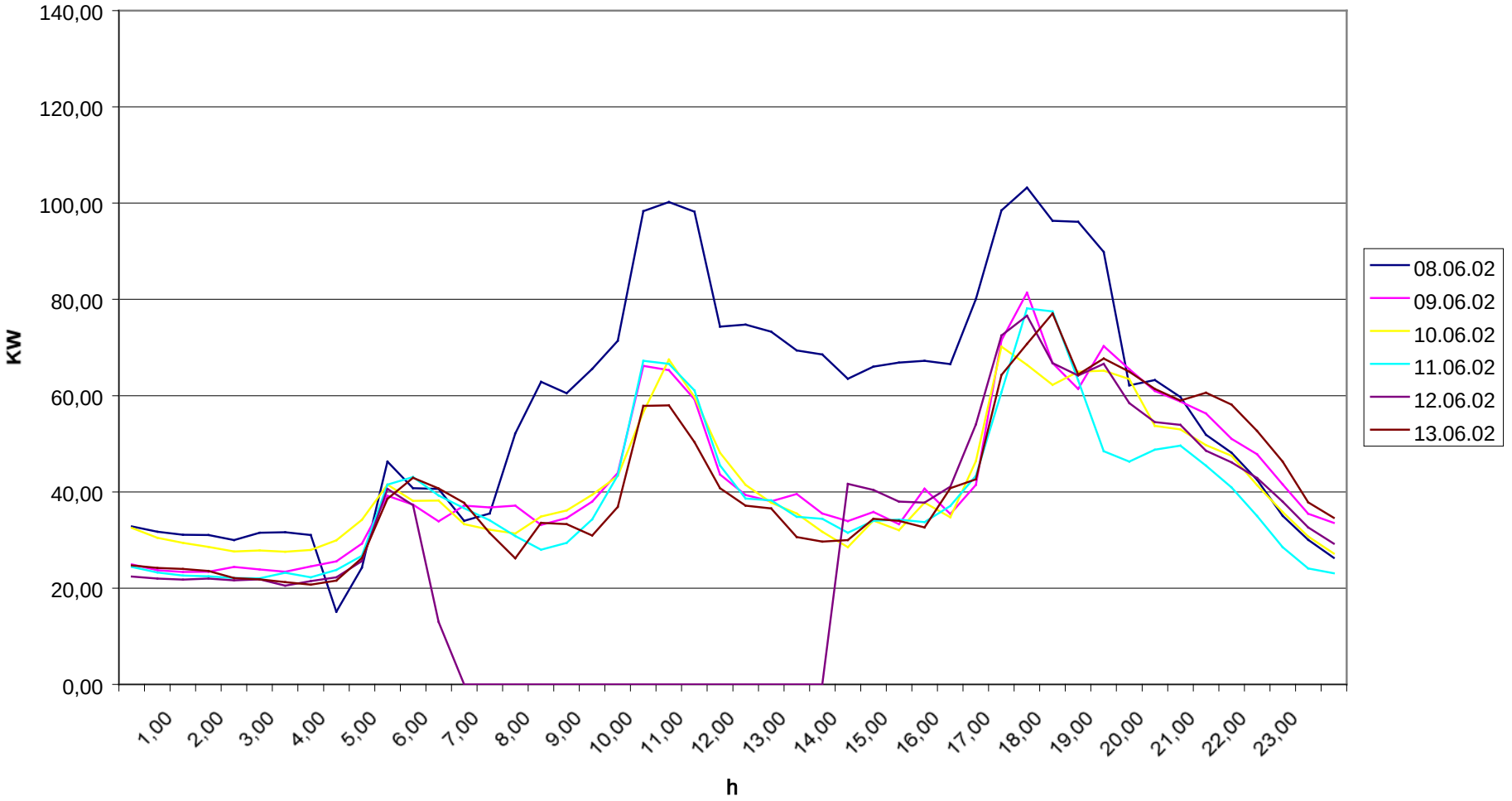
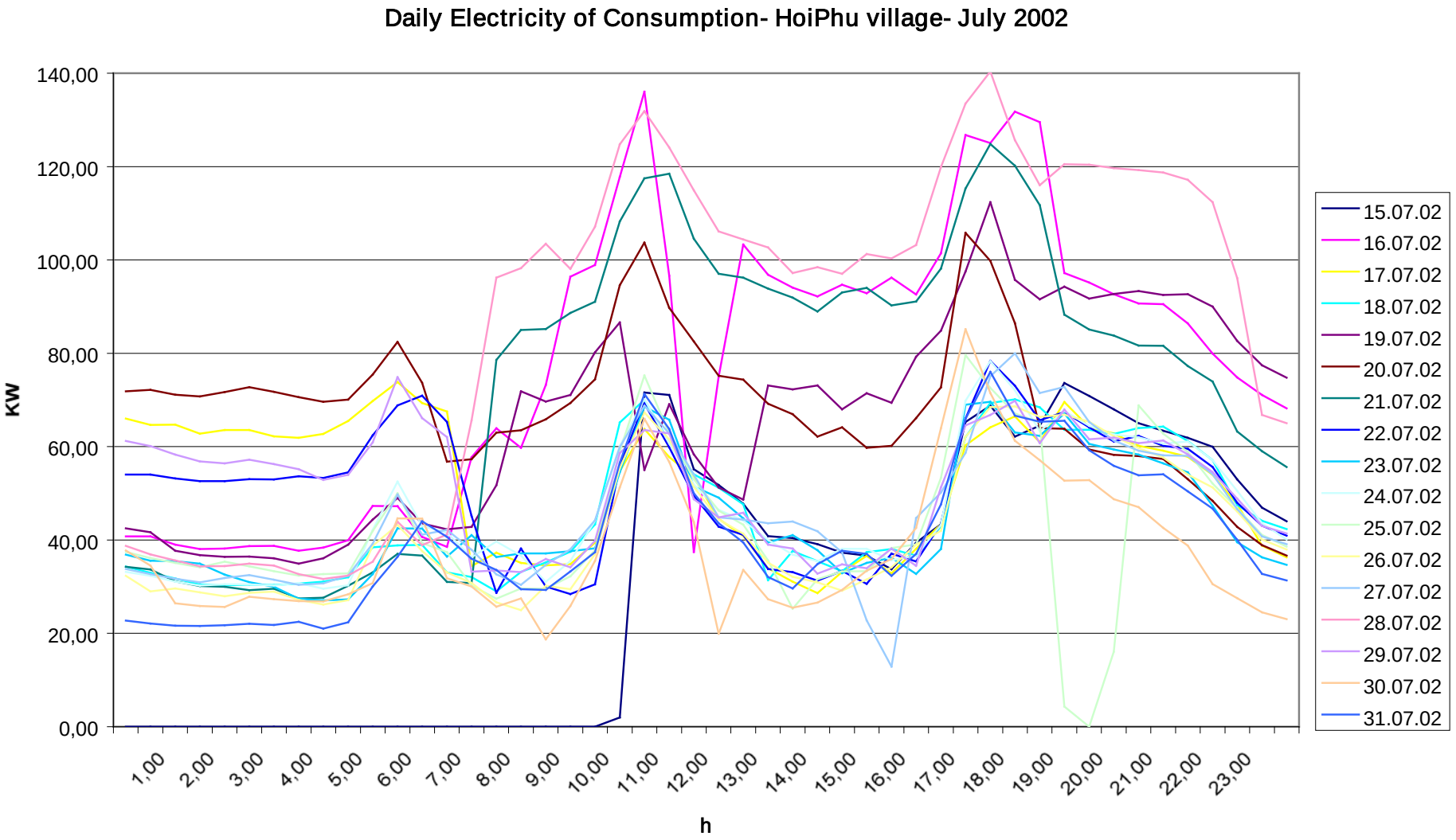
Daily Electricity of Consumption- HoiPhu village- June 2002




Daily Electricity of Consumption- HoiPhu village- July 2002
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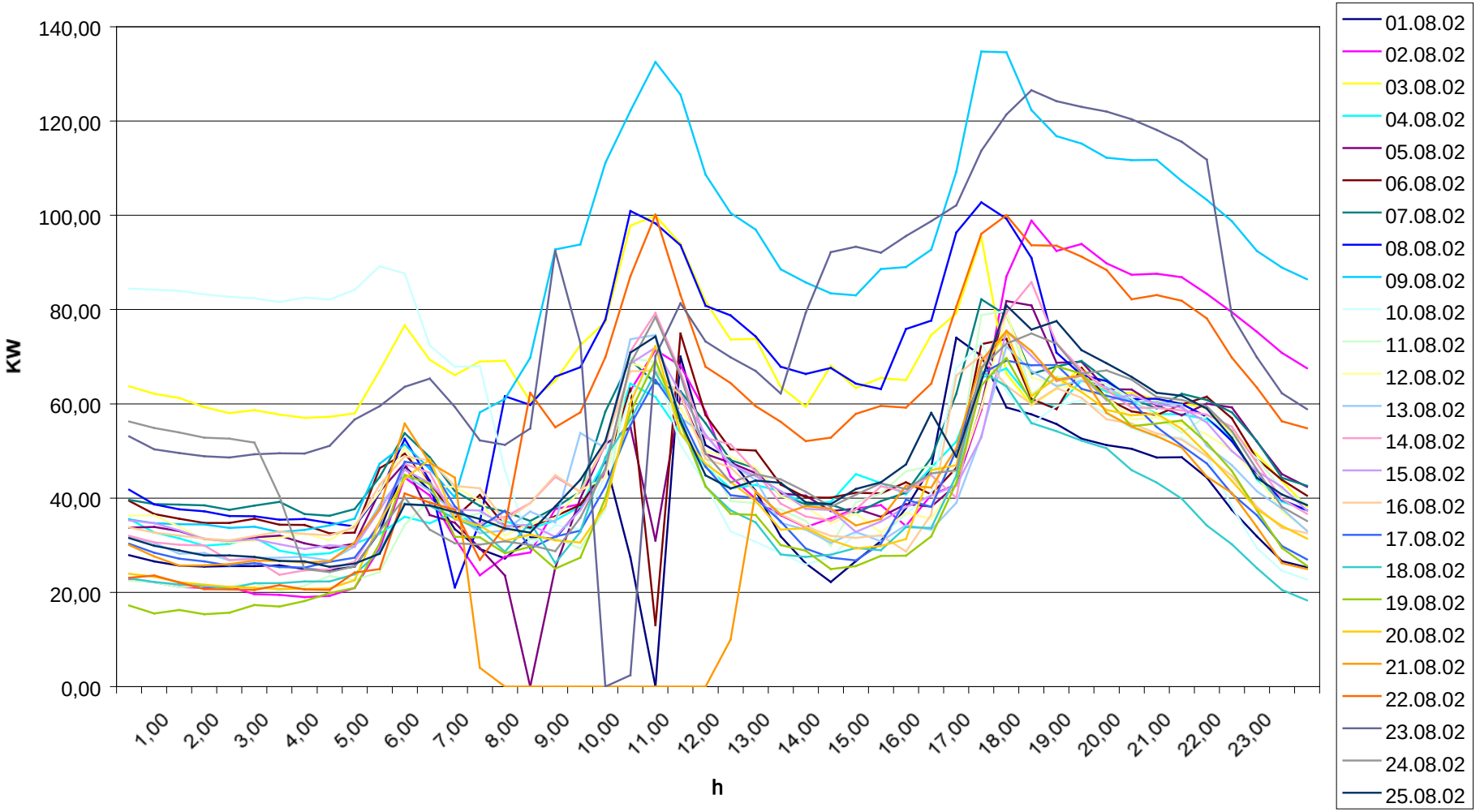
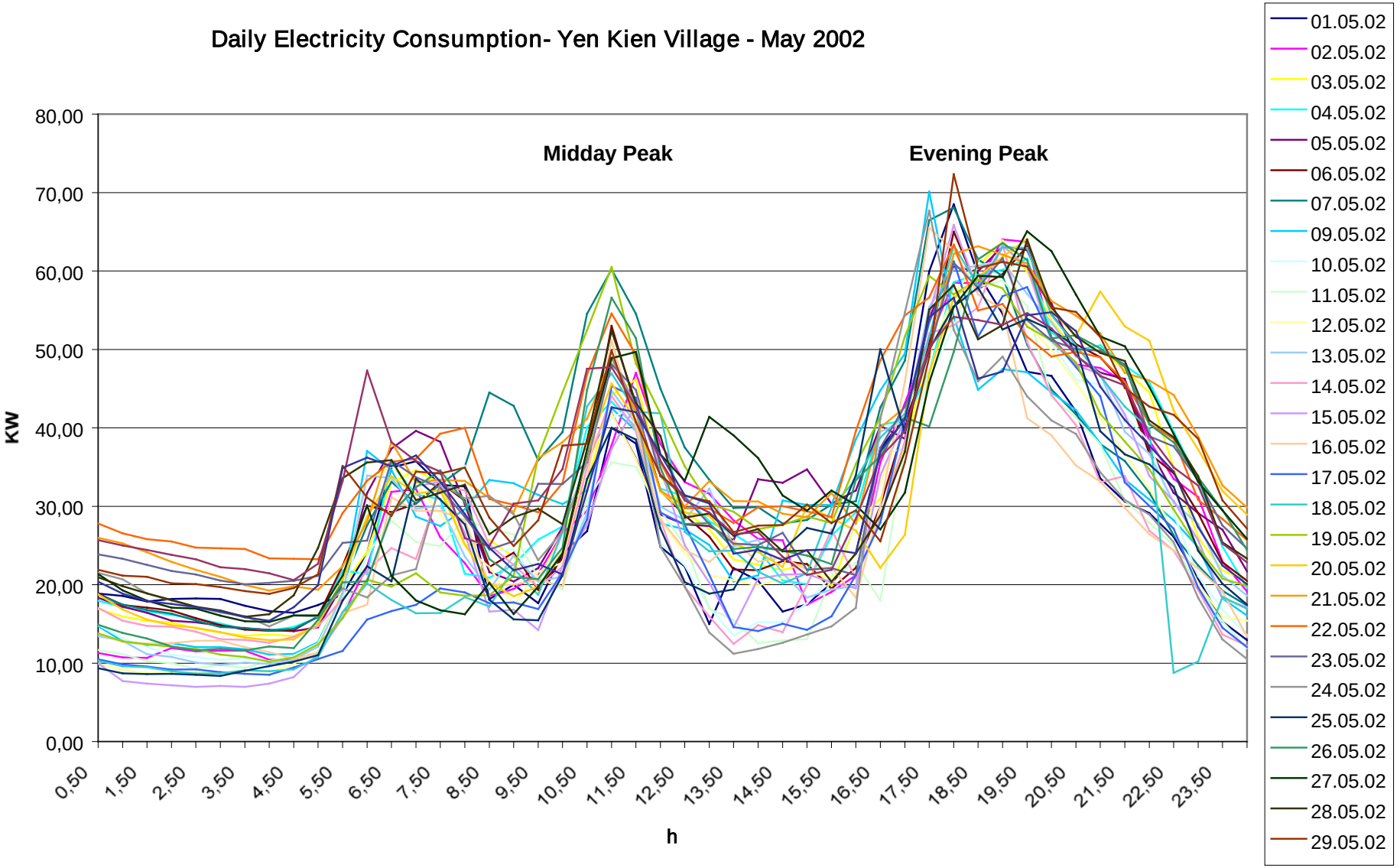
Daily Electricity of Consumption- HoiPhu village- August 2002



6.5 Adjusted load data for Yen Kien and Hoi Phu


Daily Electricity Consumption- Yen Kien Village - May 2002
Midday Peak
Evening Peak
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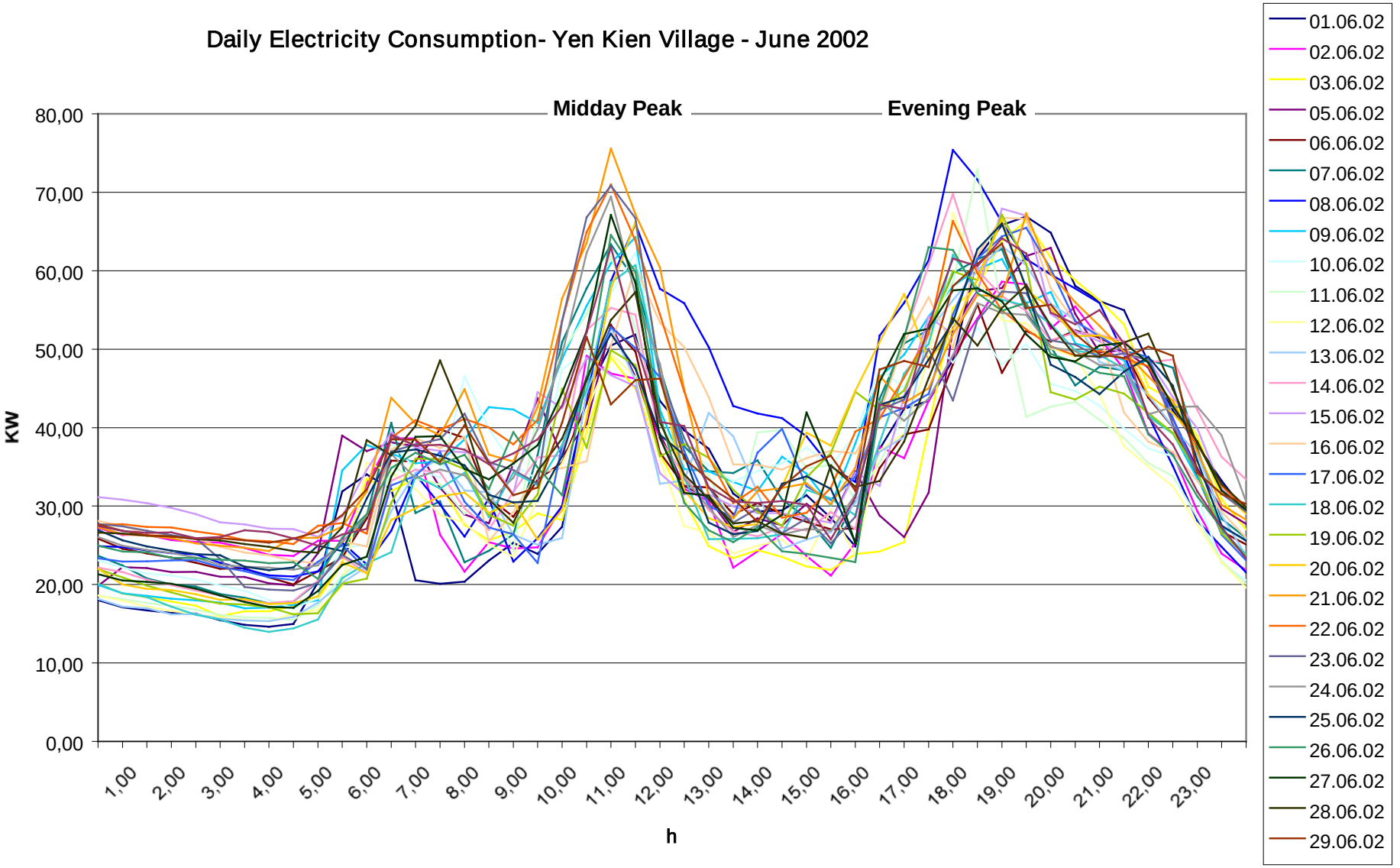
Daily Electricity Consumption- Yen Kien Village - June 2002
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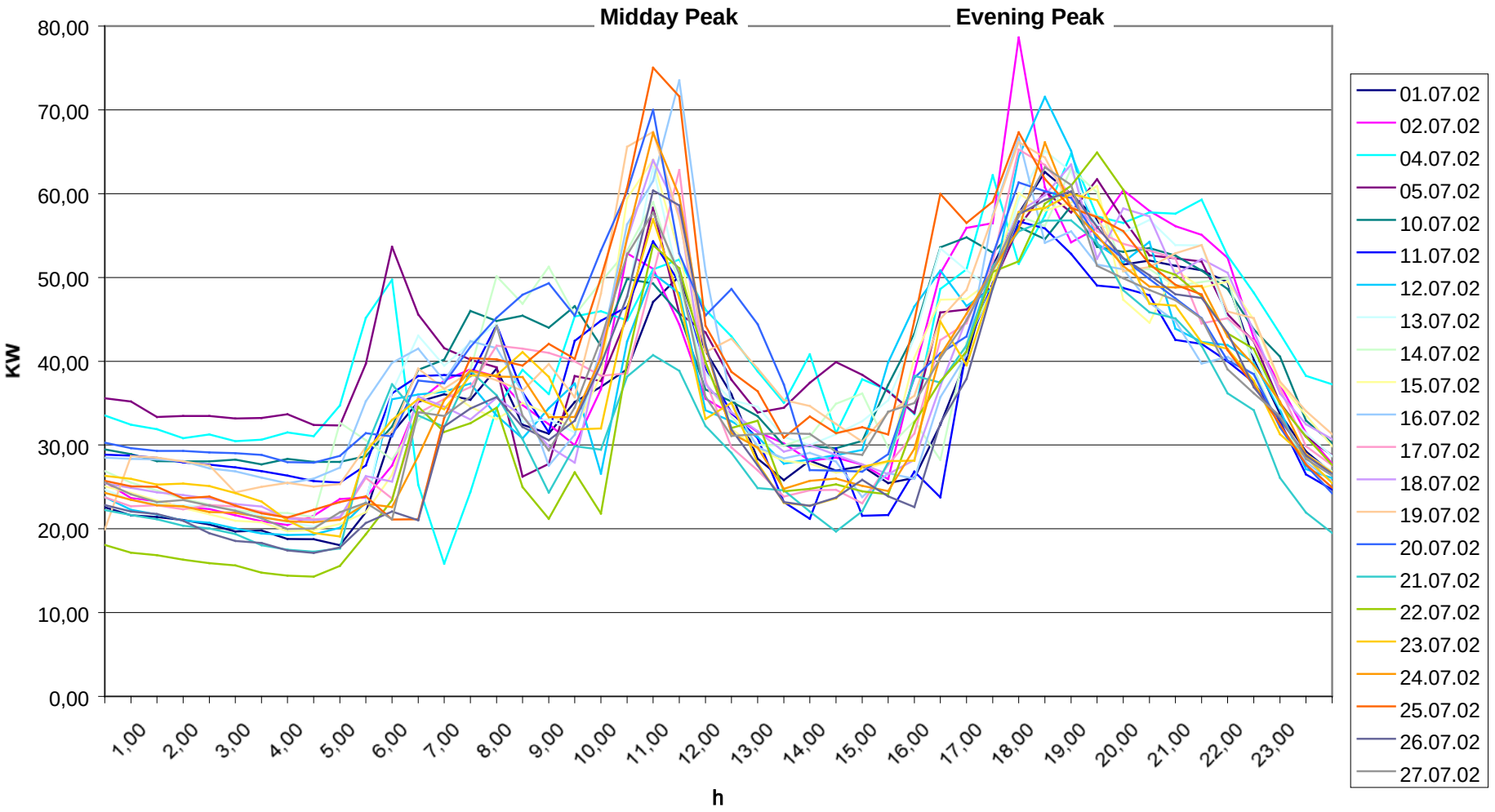
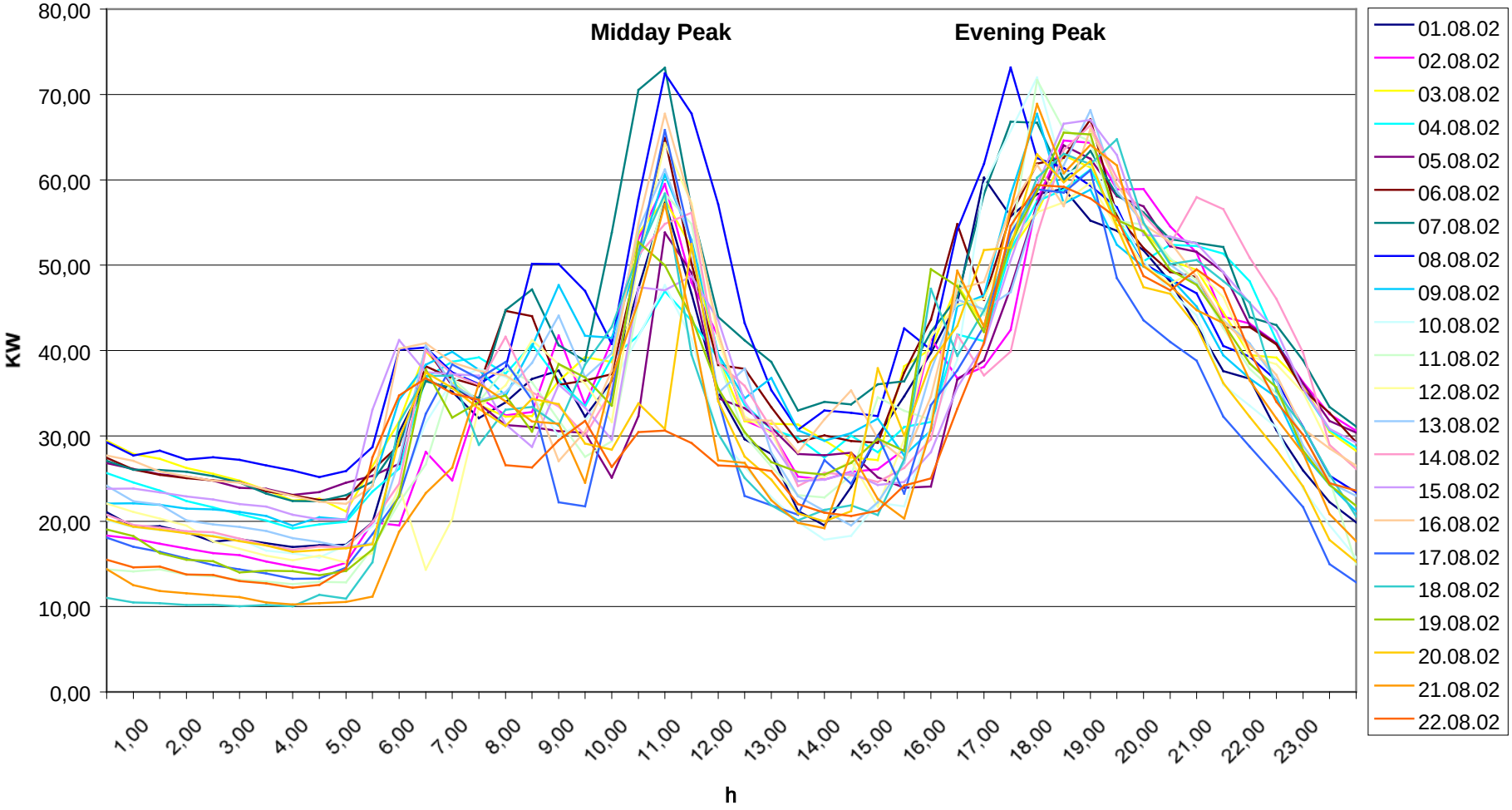
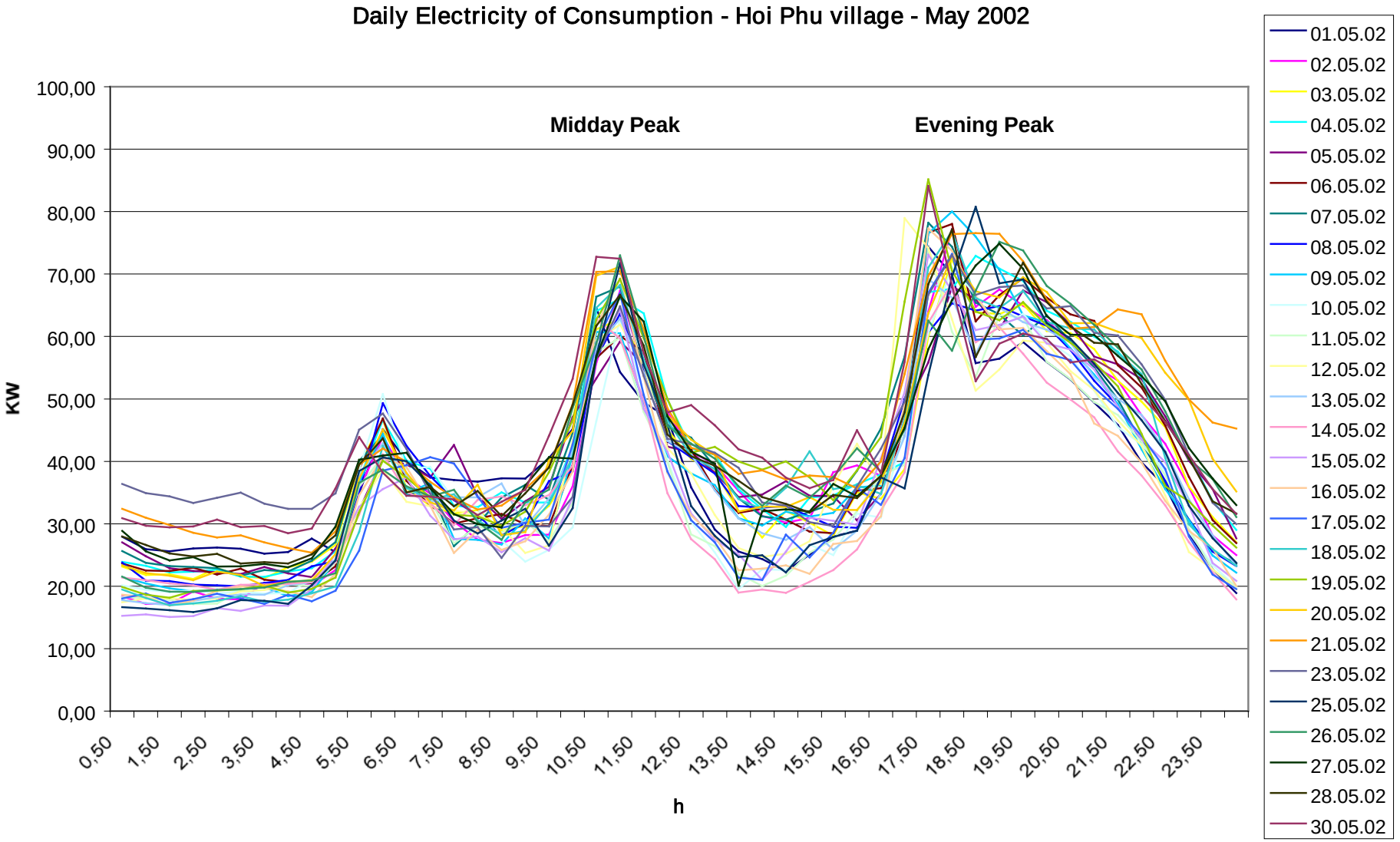
Daily Electricity Consumption- Yen Kien Village - July 2002



Daily Electricity Consumption- Yen Kien Village - August 2002




Daily Electricity of Consumption - Hoi Phu village - May 2002
Midday Peak
Evening Peak
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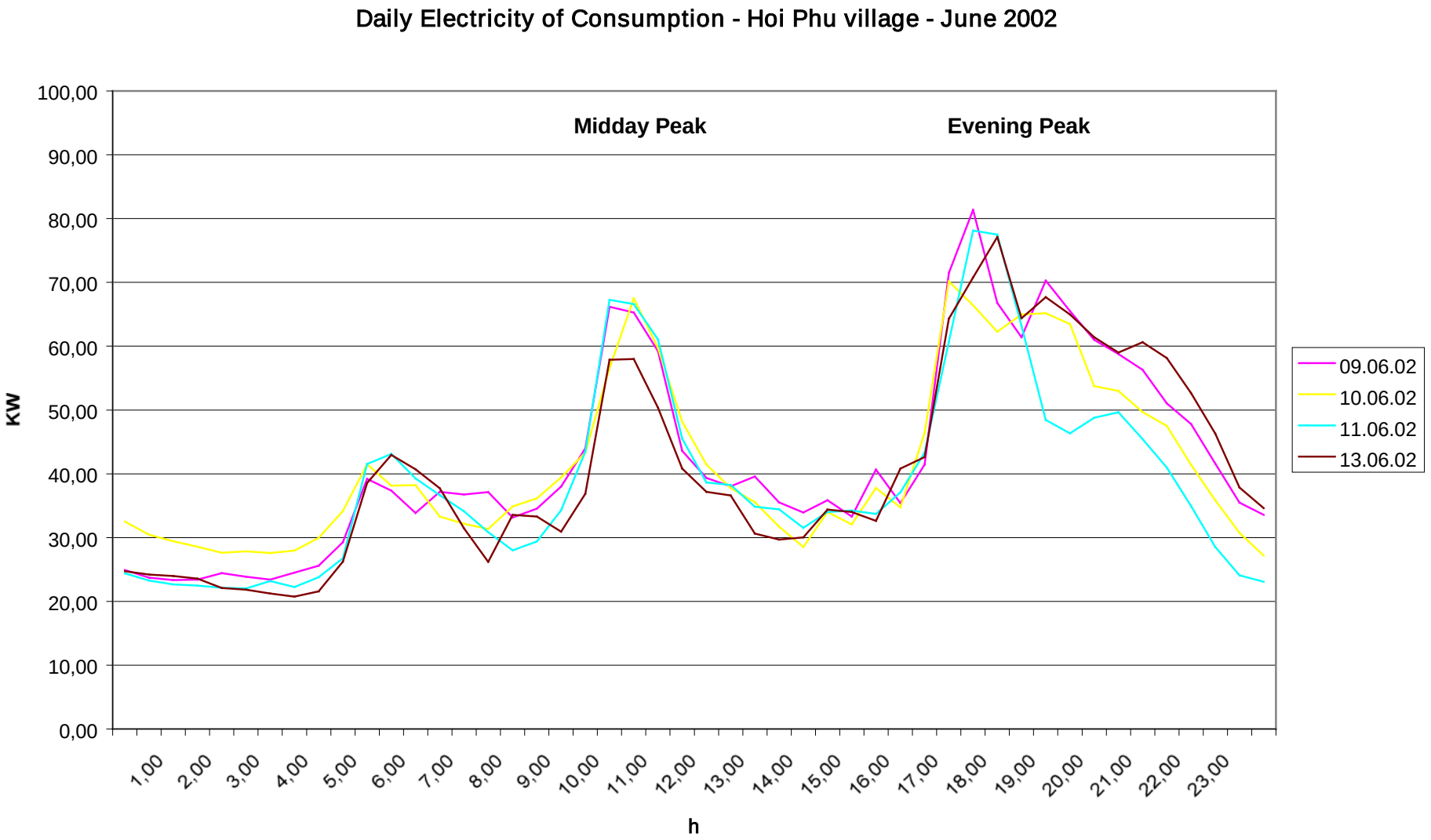
Daily Electricity of Consumption - Hoi Phu village - June 2002
Midday Peak
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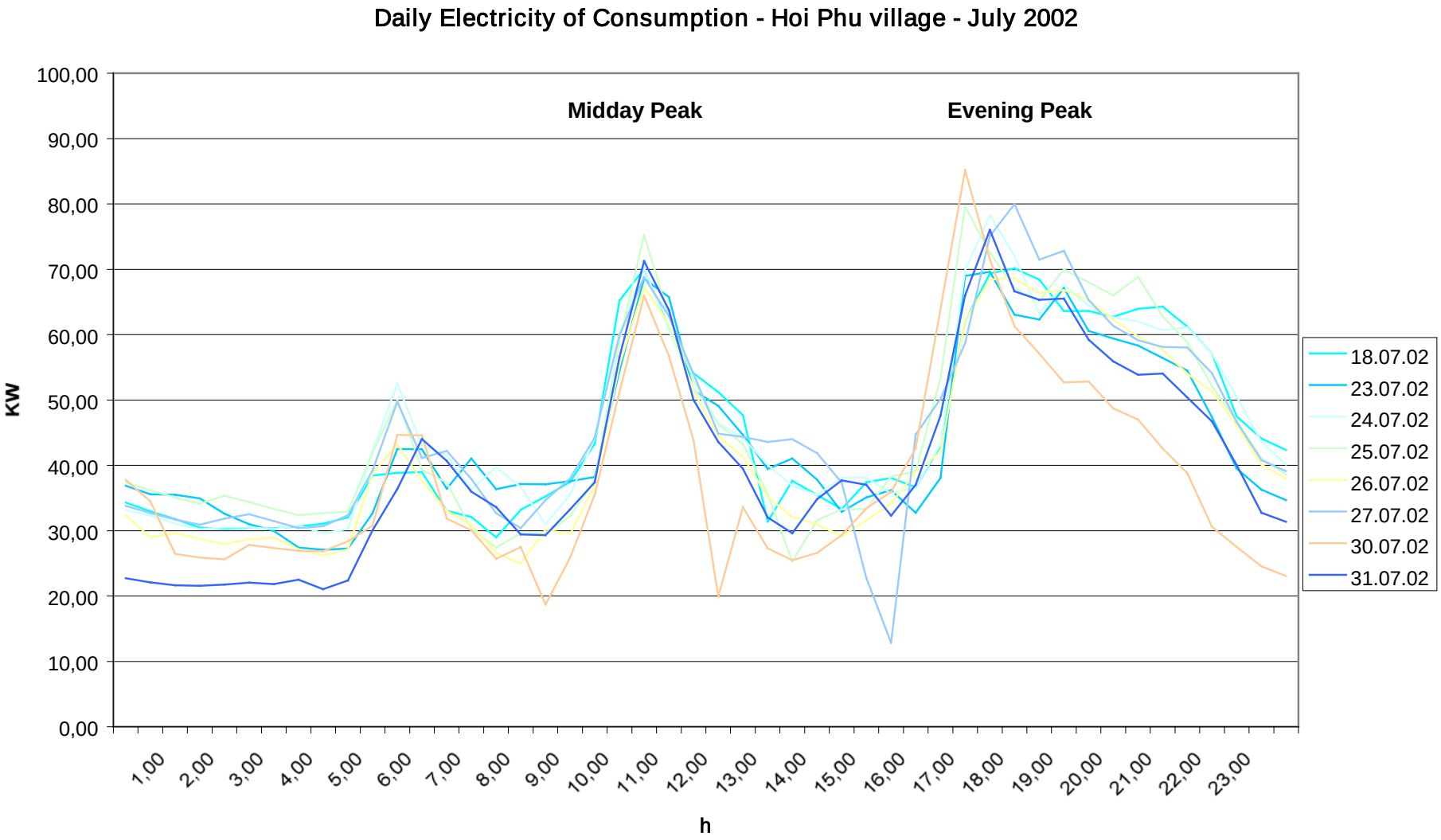
Daily Electricity of Consumption - Hoi Phu village - July 2002
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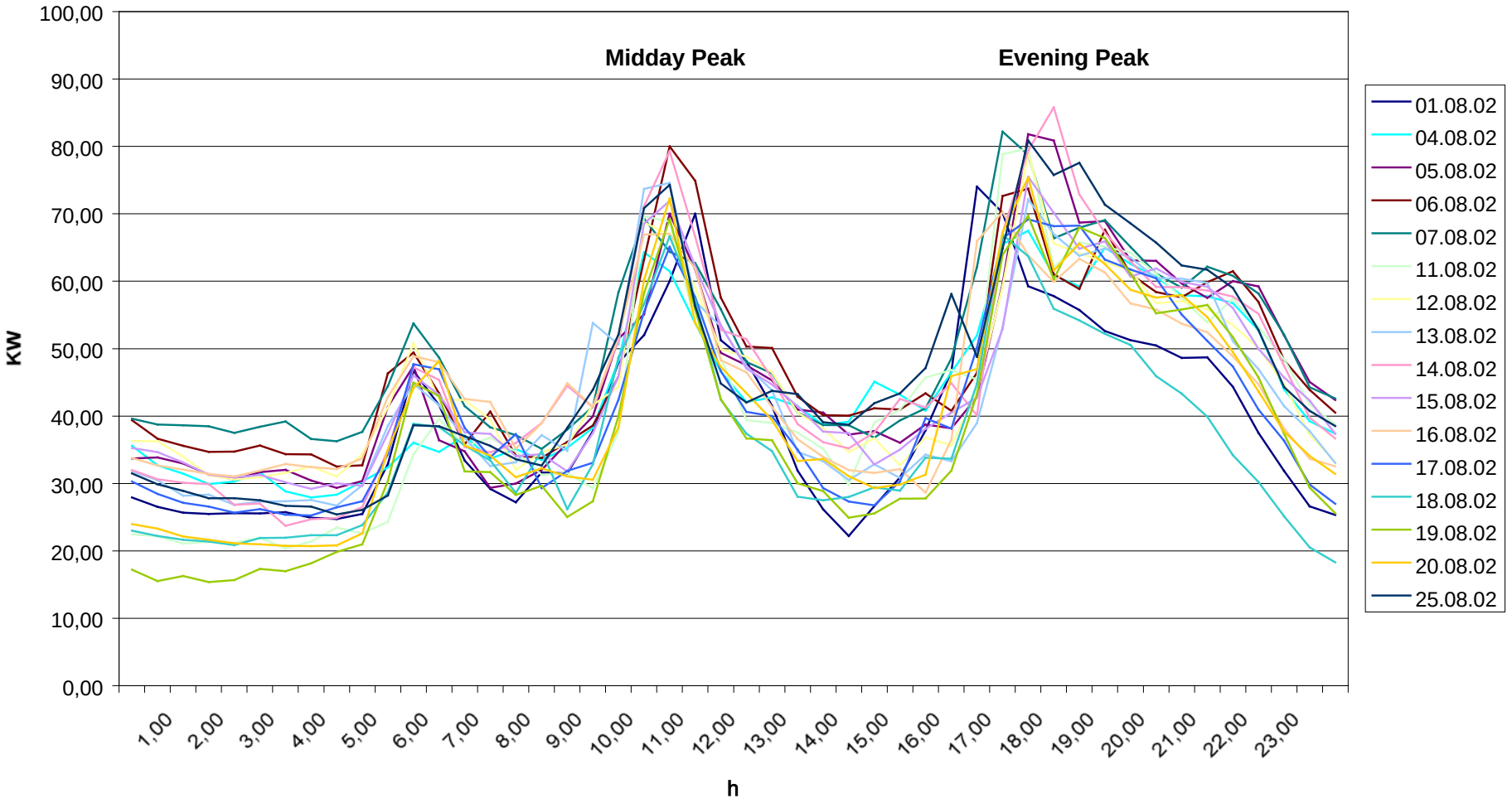
Daily Electricity of Consumption - Hoi Phu village - August 2002
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6.6 Energy and load balance

	CALCULATION BASED ON MONITORED DATA				
Parameter	Unit	DSM Pilot Project			Non-DSM
Hamlet		Yen Kien	Hoi Phu	**Total**	baseline
Number per household	pcs/HH	1	1		
TECHNICAL SPECIFICATION					
"Quality"		"medium"	"medium"	**-**	-
Type	-	CFL	CFL		Incandes.
Luminosity	Lm	~900	~900	**-**	~720
Capacity	W	18	17	**-**	59,4
Luminous efficacy	Lm/W	50	53	**-**	12
Average lifetime	hrs	5.000	5.000	**-**	
Colour rendering index	CRI	85	85	**-**	
Colour temperature	K	4000	4000	**-**	2700
Med screw (fitting)		E27	E27	**-**	E27
SPECIFICATION TARGET MARKET					
Total households in area	HH	230	290	**526**	526
- participating households	HH	227	279	**506**	506
- not eligible households	HH	-	-	**20**	-
BILL OF QUANTITIES					
Lamps per participating household	pcs/HH	1	1	**-**	1,0
Lamps to be supplied by project	HH	227	279	**506**	506
E27 sockets (to replace click-in sockets)	100%	230	280	**510**	-
Capacity of replaced incandescent lamps	W	64,0	55,7		59,4
INVESTMENT BUDGET LIGHTING EQUIPMENT					
Retail price lamps	VND/pcs	48.000	60.000	**-**	2.500
Retail price E27 socket	VND/pcs	7.000	7.000	**-**	-
Lamps on retail price level	mln VND	10,9	16,7	**27,6**	-
Sockets on retail price level	mln VND	1,6	2,0	**3,6**	-
Total for material on retail price level	mln VND	12,5	18,7	**31,2**	-
LOAD BALANCE					
Installed capacity	kW	4,1	4,7	**8,8**	30,1
Capacity reduction customer level	kW	10,4	10,8	**21,2**	
Coincidence peak load	%	69%	46%	57%	57%
Peak load reduction customer level	kW	7,2	5,0	**12,2**	17,3
T & D losses, peak load hours	%	15%	15%	**15%**	15%
Peak load reduction (power gate)	kW	8,5	5,9	**14,4**	20,3
ENERGY BALANCE					
Average daily operating time	hrs/day	2,4	2,6	**-**	2,53
Average annual operating days	day/year	360	360	**-**	360
Annual operating time	hrs/year	868	949	**-**	912
Expected overall lifetime	years	5,8	5,3	**-**	0,0
Consumption on customer level	kWh/year	3.546	4.501	**8.046**	27.426
Consumption saving customers	kWh/year	9.054	10.241	**19.380**	-
T & D losses, mainly peak load hours	%	15%	15%	**15%**	15%
Equivalent electricity generation	kWh/year	10.652	12.048	22.800	32.266

6.7 Cost benefit analysis

Item	Unit	Yen Kien	Hoi Phu	Average
Basic data				
Discount rate		10%	10%	10%
Investment (lamp+socket)	VND/pcs	55.000	67.000	55.485
Transaction (others)	VND/pcs	56.160	55.880	25.196
Average daily operating time	hrs/day	2,4	2,6	2,5
Expected overall lifetime	years	5,8	5,3	3
Electricity savings				
Electricity saving per lamp - residential	kWh/year	40	37	38
Electricity saving per lamp - PC Hanoi	kWh/year	44	41	43
Electricity saving per lamp - EVN	kWh/year	47	43	45
Tariffs/benefits				
Customer tariff - residential (with VAT)	VND/kWh	500	500	500
Customer tariff - residential (without VAT)	VND/kWh	455	455	455
Peak bulk supply tariff - EVN-PC Hanoi	VND/kWh	840	840	840
Average DSM benefit - EVN	USC/kWh	10	10	10
Average DSM benefit - EVN	VND/kWh	1.500	1.500	1.500

Exchange rate VND/USD (01.10.2002): 15.000

CUSTOMER - 500 VND/kWh Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Electricity saving per lamp	kWh/year	40	37	19.295
Average customer tariff	VND/kWh	500	500	55.485
Annual savings	VND/year	19.940	18.350	9.646.030
Pay back time (static)	**years**	**1,4**	**1,8**	**1,6**

CUSTOMER - 700 VND/kWh Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Electricity saving per lamp	kWh/year	40	37	19.295
Average customer tariff	VND/kWh	700	700	700
Annual savings	VND/year	27.920	25.690	13.505.350
Pay back time (static)	**years**	**1,0**	**1,3**	**1,2**

EVN - average DSM profit Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Electricity saving per lamp	kWh/year	47	43	22.699
Average sales reduction	kWh/year	44	41	21.438
Annual electricity savings	VND/year	70.390	64.770	34.049.360
Average lost revenues	VND/year	-37.230	-34.260	-18.009.750
Average transaction costs	VND/year	-13.290	-14.154	-11.538
Surplus (losses)	**VND/year**	**19.870**	**16.356**	**16.028.072**
Pay back time (static)	**years**	**1,4**	**2,0**	**1,0**

EVN - avoided costs peak plant Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Investment (lamp+socket)	VND	27.500	33.500	15.589.000
Peak load saving per lamp	W	37	21	14.353
Electricity saving per lamp	kWh/year	47	43	22.699
Average sales reduction	kWh/year	44	41	21.438
Annual load savings	VND/year	41.030	23.180	15.781.030
Annual electricity savings	VND/year	70.390	64.770	34.049.360
Average lost revenues	VND/year	-37.230	-34.260	-18.009.750
Average transaction costs	VND/year	-13.290	-14.154	-6.965.645
Surplus (losses)	**VND/year**	**60.900**	**39.536**	**24.854.995**
Pay back time (static)	**years**	**0,5**	**0,8**	**0,6**

PC-Hanoi Item	Unit	Yen Kien Specific	Hoi Phu Specific	Total Pilot Program
Average sales reduction	kWh/year	40	37	19.295
Average customer sales tariff (without VAT)	VND/kWh	455	455	455
D losses, mainly peak load hours	%	10%	10%	10%
Average purchase reduction	kWh/year	44	40	21.224
Average bulk supply tariff from EVN	VND/kWh	840	840	840
Surplus (losses)	**VND/year**	**18.724**	**17.231**	**9.057.912**