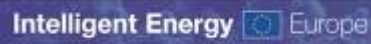


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Promotion of the Efficient Use of Renewable Energies in Developing Countries

Educational Competences Scan – Technology

Lao PDR

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List of Acronyms

CDEA	Community Development and Environment Association
EDL	Electricité Du Lao PDR
ERI	Environment Research Institute
MEM	Ministry of Energy and Mines
MOE	Ministry of Education
MOFA	Ministry of Forestry and Agriculture
NESRP	National Education system reform project
NGO	Non-Government Organization
NPO	Non-Profit Organization
NUOL	National University of Lao PDR
PADETS	Participatory Development and Training Centre
STEA	Science, Technology and Environment Agency
TRI	Technology Research Institute

1 Introduction

Locked in the middle of the Indochina peninsula, Lao PDR is among the poorest least developed countries in South-East Asia region. Economy mainly is dominated by subsistence agriculture and heavily relies on international aids. Private sector has rapidly grown after 1986 economic reform, when centralized planning economy was turned to free market mechanism.



Figure 1: Lao PDR [www.wikipedia.org]

Despite of huge efforts made during nearly two last decades, education status in Lao PDR remained poor in both quantity and quality. Literacy rate of Lao population is around 73% (83 for male and 63% for female). Education level of Lao people is the lowest among ASEAN member countries, particularly in higher education. Only about 1.1 per 100 Lao people has got higher education (national census 2005).

Although private schooling has rapidly grown since the 1986 economic reform, but mainly focusing on kindergarten and general education, business management and foreign languages. There are not yet private institutions in the field of technology and sciences.

Lao education system includes formal and non formal education.

1.1 Formal Education

Formal education comprises of (1) General education; (2) Vocational Education; (3) Higher Education and (4) Post Graduate (figure 2).

1.1.1 General education

General education comprises of Kindergarten (children aged 3-5 years old), Primary (grades 1-5, ages 6-10); Lower Secondary (grades 6-9, ages 11-14)¹ and Upper Secondary (grades 10-12, ages 15-17) (Source: National Education system reform project, MOE 2006). Primary education, as a rule, is compulsory for all children. There is one year pre-primary applied in some rural or hilly areas, where kindergarten has not yet been practiced. Due to the fact that kindergarten system is not yet well established in Lao PDR, attachment of pre-primary class to primary school has become an increasing trend, even as compulsory measure some where.

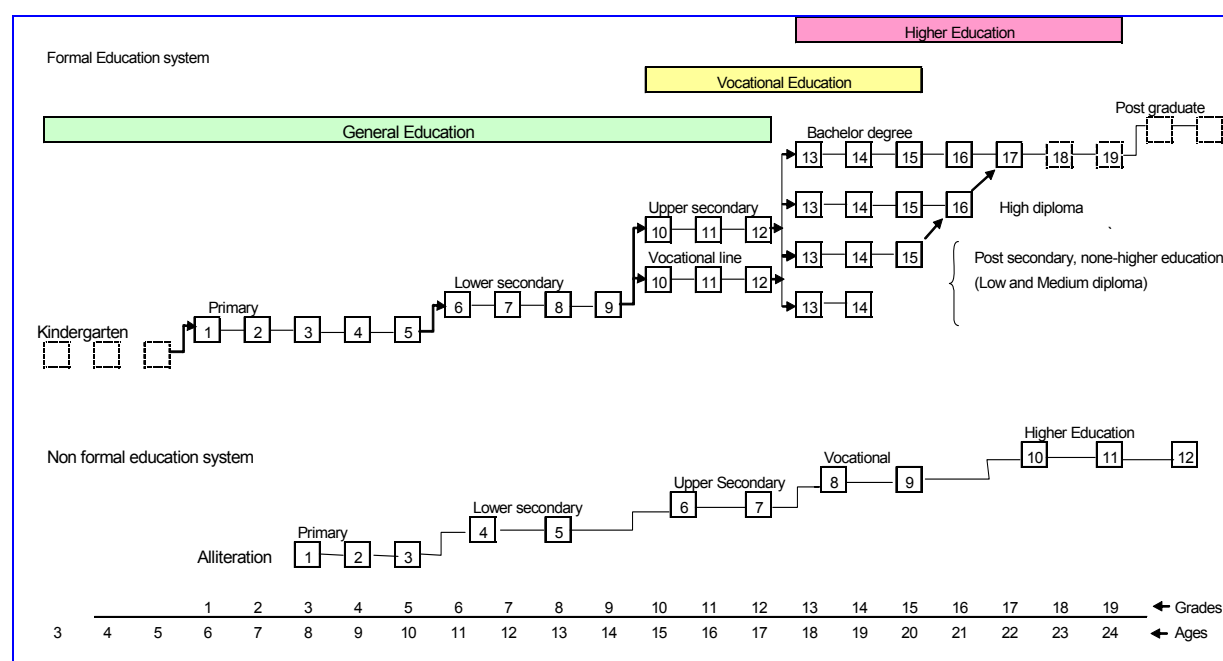


Figure 2: Education system structure in Lao PDR (MOE 2006)

¹ This 4-grades system has just been implemented since 2006-07 academic year, instead of 3-grade lower secondary (source: MOE 2006)

According to national census 2005, about 26.4% Lao people aged 6+ (total 4,760,493 persons) have never enrolled to any schools. The figures for urban, rural with and without road access are 17.7%, 31.1% and 26.8% respectively. Only 15.5% fully completed primary education, while 30.8% not completed it (national census 2005).

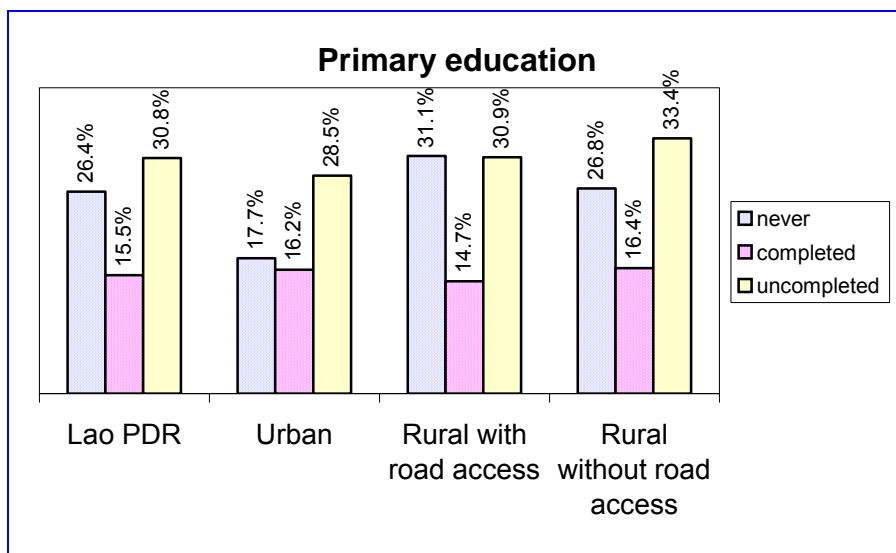


Figure 3: Primary education statistics (national census 2005)

Only 6.1% of Lao people aged 6+ have completed lower secondary, while 7.6% uncompleted it. For urban, rural with and without road access the figures of secondary schooling completion are 7.8%, 5.4% and 5.6% respectively (8.6%, 7.1% and 7.5% of incompleteness, respectively) (national census 2005).

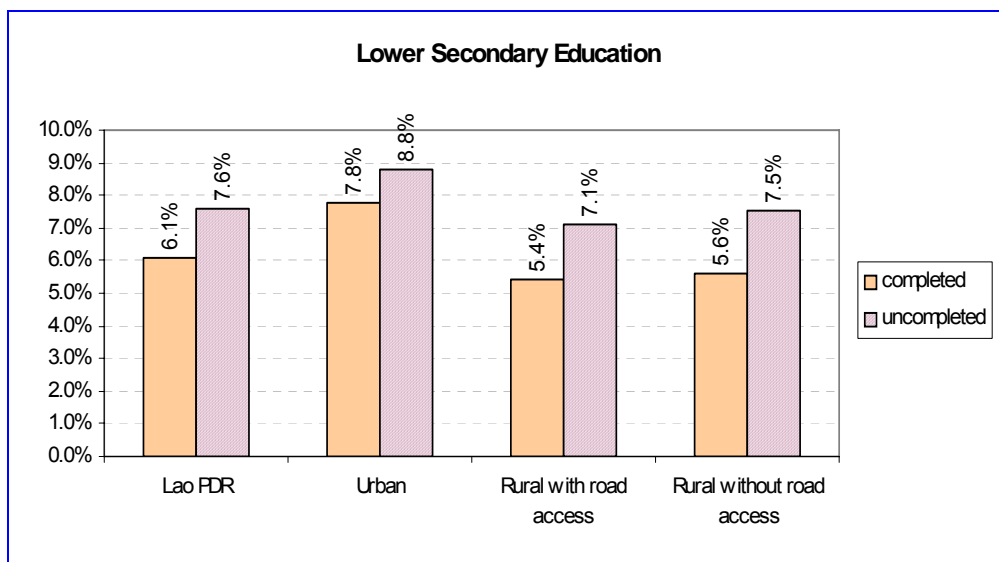


Figure 4: Lower secondary education statistics (National census 2005)

According to results of national census 2005, 5.1% of Lao population aged 6+ have completed upper secondary education, 3.1% enrolled to upper secondary, but not completed it (figure 5).

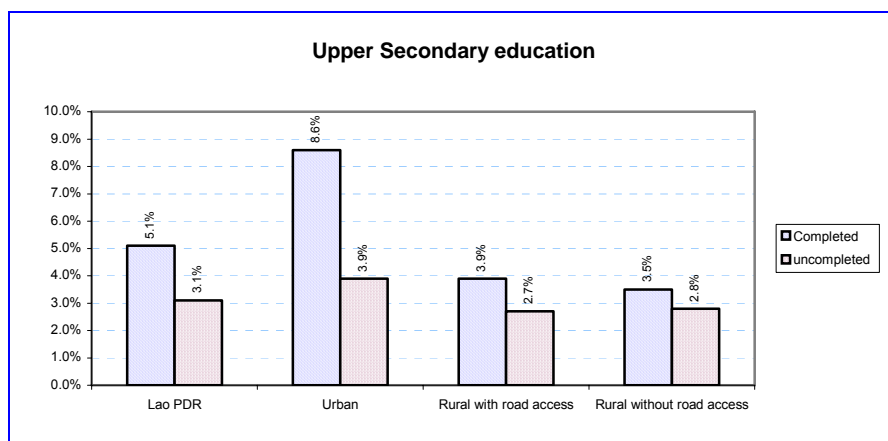


Figure 5: Upper Secondary Education Statistics (National census 2005)

1.1.2 Vocational education

In formal education system, after completion of lower secondary education, students can either enter to common Upper secondary or Professionalized secondary education, obtaining grades 10-12 (NESRP, MOE 2006). After this stage, vocational students may enroll to University or higher level of vocational education, e.g., post secondary low and medium diploma. The medium diploma holders then can able to upgrade to high diploma and higher degrees afterwards (Figure 2, formal education).

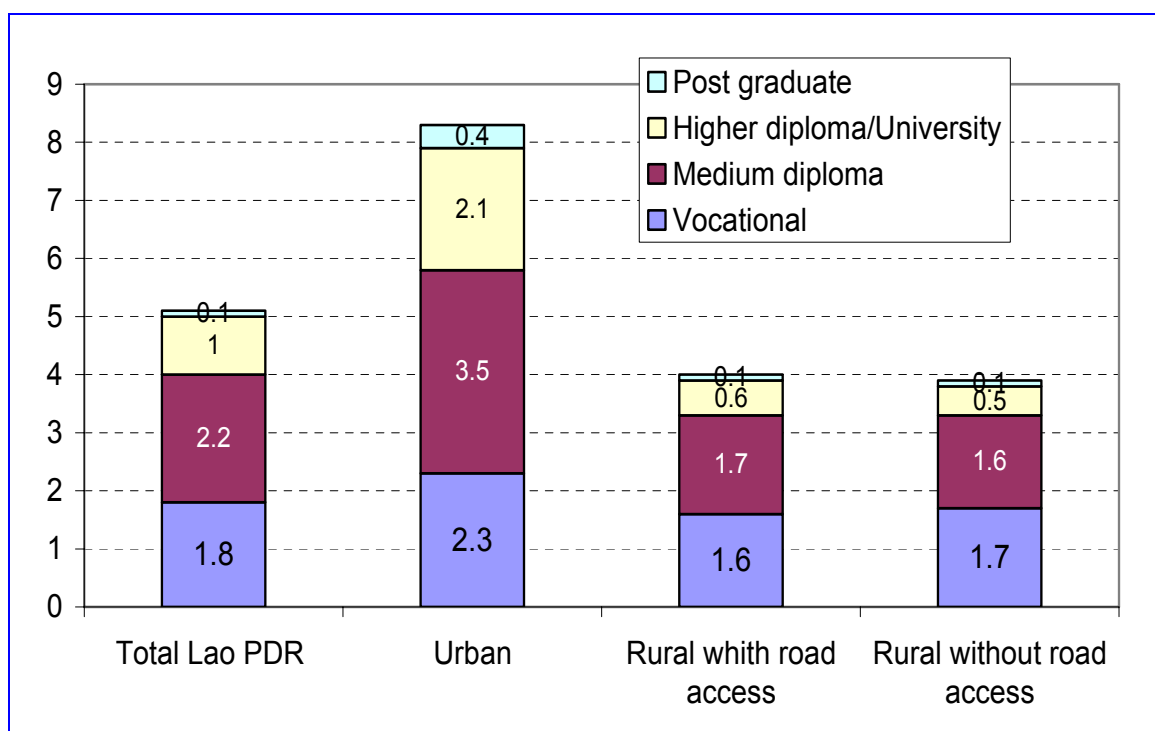


Figure 6: Vocational and higher education statistics of Lao PDR (National census 2005)

Vocational Education in Lao PDR currently is offered mainly by state technical colleges, which are mostly concentrated in Vientiane capital and some larger cities (Luangprabang in

the North, Savannakhet and Champasak in the South). Involvement of private sector in this area of education is still negligible small. As seen from figure 2, about 1.8% of population aged 6+ got vocational education by 2005.

Besides, there are also special ministerial colleges, offering special training programs. Examples of such colleges are Teacher training colleges of MOE, Financial colleges (MOF), Public Health colleges (MOH).

1.1.3 Higher education and post graduate

In Lao PDR, higher education includes High Diploma and Bachelor degree. As a rule, higher education is offered by universities, special institutions and private colleges, including foreign ones. Recently, some technical colleges have started offering high diploma programs.

Despite of the booming increased number of institutions and enrolments for higher education, but the percentage of higher education holders in Lao PDR remains very low, 1.1% of Lao population holding higher education degrees, especially post graduate (0.1%) (figure 6).

1.2 Non Formal education

Non formal education is a teaching-learning process, which does not happen in defined time intervals (figure 2). Non formal education, as a rule, consists of the following categories:

- Preparation of children for education
- Illiteracy abolition
- Non formal general education (primary and secondary)
- Basic Professional training (vocational training)
- Living conditions improvement (obtaining higher education)

Teaching-learning on Energy related technologies are offered at some state technical colleges and higher institutions, mostly regarding some components of energy technologies rather than full courses.

2 Scope of the Technology Education Competences Scan

In order to include right contents and suitable level of knowledge in energy technology in to training manuals, a scan of energy related understandings of targeted trainers, community stakeholders and further project target groups was performed. The results of the scan will serve as input for the energy related technology knowledge of the training manuals and further project decisions.

2.1 Targets Selection

Firstly, the targets were selected by focusing on their relevance and interests to renewable energy promotion and dissemination. Such groups of people in Lao PDR currently are not so many. Besides, renewable energy technologies are known for some relevant ministries and

institutions, few public and private companies, non profit and non-government organizations who have ever participated in different renewable energy related programs.

Secondly, as stated in the project requirements, the targets should be of those people, who are motivated in projects activities. After several discussions and advising with some relevant people, we found that people are interesting in our project ideas and would with pleasure to participate in to our project activities.

Thirdly, in one side, renewable energy technologies often are unknown for majority of Lao people. In the side, many of previous or currently running renewable energy projects in Lao PDR have left bad reputation on its success and sustainability for Lao people. Two these points frighten people - they would be afraid to deal with new unfamiliar business

Based on the above mentioned background, the interviewees can be grouped into following groups:

- Governmental staffs:
 - Ministry of energy and mines: Department of Electricity (divisions: Rural electrification, Social and environment, Planning and development)
 - Ministry of Agriculture and forestry (Departments: Forestry, Agriculture, Live-stock)
 - Provincial Departments of Energy and Mines (PDEM)
- Research institutions: Research institutions: Technology Research Institute (TRI), Environment Research Institute (ERI) (within the Science, technology & Environment Agency, STEA)
- Academic institution: Faculty of engineering, Faculty of Natural sciences, Faculty of Social sciences (National University of Lao PDR)
- Non Governmental Organization and Non Profit Organization (NGO/NPO):
 - NPO: Community Development and Environment Association (CDEA); Association for Organic Products Promotion (OPPA);
 - NGO: Participatory Development & Training centre (PADETC)
- Private sector:
 - Rural energy service provider: Electricité du Lao PDR (EDL), Sunlabob Co., Sengsavang Co.,
 - Food processing: Beer Lao Brewery Company,
 - Farm: Vanis Farm (the largest pig farm in Vientiane capital),
 - Freelance workers (self-employed)

The newly formed Ministry of Energy and Mines is responsible for renewable energy resources promotion and development (figure 7). At least there are two departments in MEM, which deal with energy-related issues:

- Department of Electricity (divisions: Rural electrification (which is also oversees renewable energy resources); Social and environmental management, Electricity management, Power systems Planning);
- Newly created Department for Energy Promotion and Development.

Relevant departments of Ministry of Agriculture and Forestry (MOFA) have deals with forest management, agriculture and livestock production. Some demonstration projects related to renewable energy technology were carried out by these departments, e.g., demonstration biogas projects, saving wood/charcoal cook stove, etc

The staff of research and academic institutions currently play important role in demonstration, research and development of renewable energy technologies.

Selected private companies or NGOs/NPOs are organizations in Lao PDR, who have ever been dealing with or are interested in the promotion of renewable energy technologies in the country.

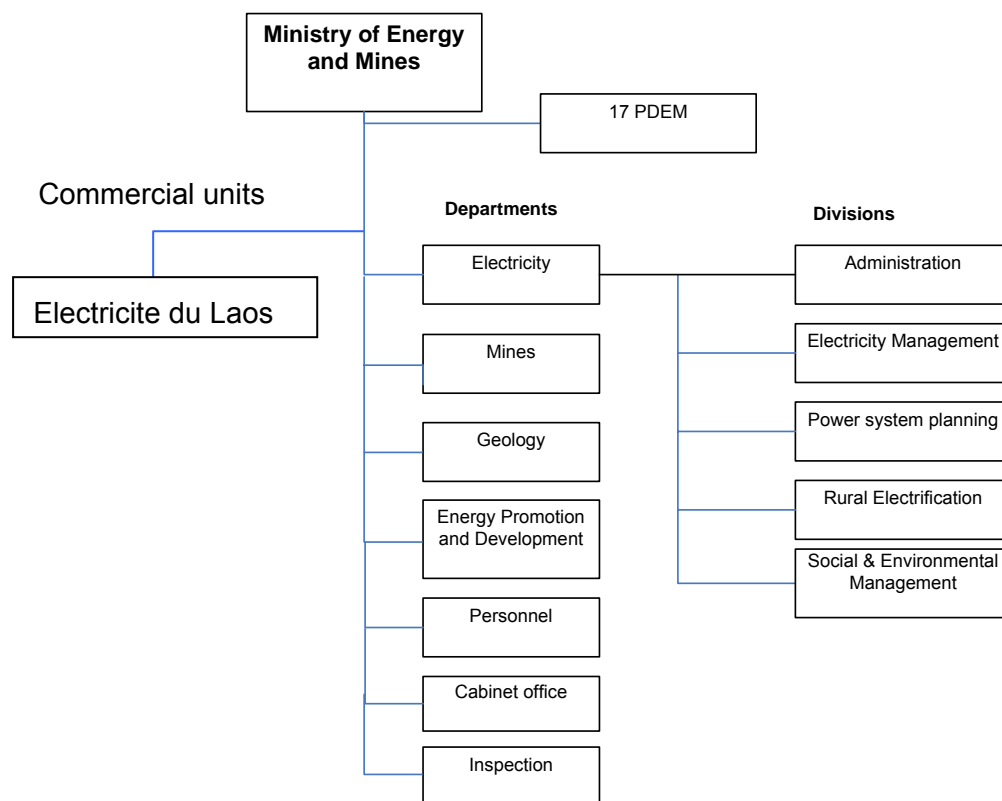


Figure 7: Organizational chart of Ministry of Energy and Mines [MEM, 2007]

Remark: PDEM - provincial department OF Energy and Mines;

Selection of the interviewees: Most of the interviewees were selected according to the following procedure. The dean of the Faculty of Engineering prepared an official letter to relevant organizations, indicating purposes and aims of the project and the current data survey. Referring to this letter and also basing on further explanations of our study team, the head of targeted organizations appointed his staffs as interviewees. Some interviewees were selected just through telephone talks. This is related to staffs of small companies, or persons who have been known for project team before.

2.2 Procedure of the Questionnaire

The questionnaire was translated to Lao language by the NUOL team. The questionnaire action was performed during 20 April – 15 May 2007 by NUOL project team staffs.

Where possible, a meeting between the study team and interviewees was held at their office. Our survey team gave brief explanations on some terms in the questionnaire and how to complete it. The interviewees then were given some time for further careful reading and completing the questionnaire.

For remote Oudomxay province, the questionnaires were forwarded by express mail. The questionnaires action was performed by the staff of the Provincial Department of Energy and Mines, and then were sent back also by express mail.

A complete set of questionnaires (including official letter of the dean, questionnaires, contact addresses) were distributed to staffs of research and academic institutions in Vientiane capital. The completed questionnaires then were collected by our project teams.

Our NUOL team visited the Departments of Energy and Mines of Vientiane and Bolikhamxay provinces, which are situated close to Vientiane capital and easily accessible by car.

3 Results

In general, the questionnaires were successfully performed. Almost all relevant targets actively participated in our interview process.

3.1 General Data

Number of interviewees: 82 interviewees were interviewed, of those only 9 (12.5%) were female (table 1). The interviewees mostly were those who have participated into our previous education competences scan on Finance, economics and management before. The average age of interviewees was 37.6 years, while the youngest and oldest were 22 and 56 years, respectively.

Table 1: General information on interviewees

	Numbers	Percents
Gender		
Male	67	81.71%
Female	15	18.29%
Ages		
Youngest	22 years	
Oldest	56 years	
Average age	36.34 years	

3.2 Fields and Levels of education

Education level: 21 interviewees have got vocational education as highest education level, mainly in business administration (figure 8). Mostly interviewees are bachelor and master degrees holders (55 of 82).

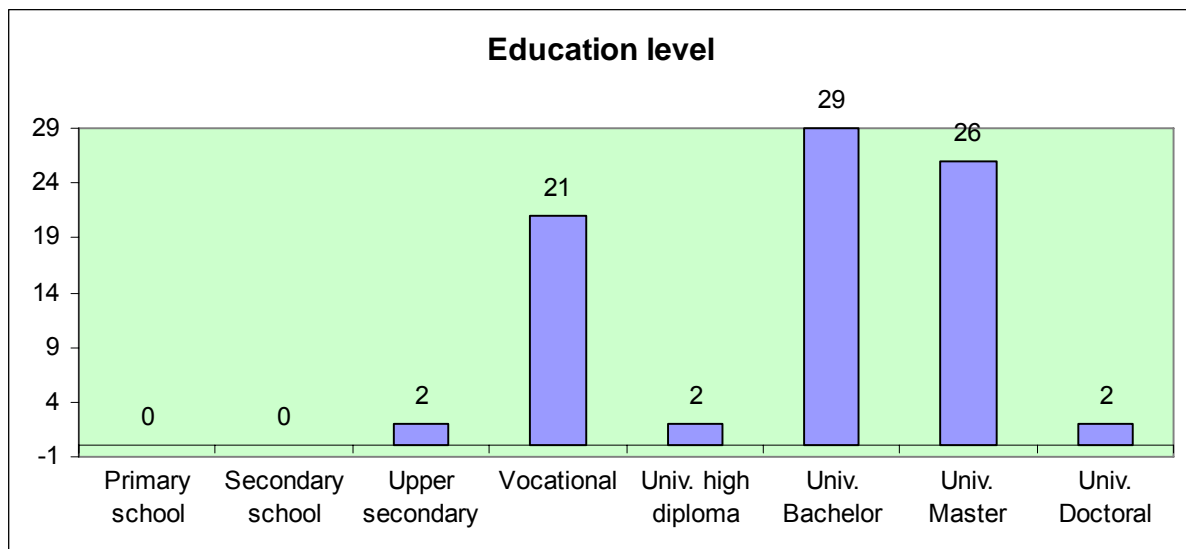


Figure 8: Education levels of interviewees

Field of education: Fields of vocational and university education of interviewed persons are shown in figure 9.

Mostly electrical engineers were interviewed (31 of 82), followed by mechanical engineers (15), natural sciences, business/management and other (7). Some of the interviewees finished university education in natural or social sciences, have been working as teaching staffs before, then obtained additional education in other fields, such as engineering, business administration.

While switching from centralized planning economy to a free market, new skills and knowledge are required. The government of Lao PDR has encouraged its staffs improving their knowledge in economics and administration. Thus, usually with support from international organizations, short-term (from one day up to few months) special courses in economic management, business administration, foreign language (mainly English) are intensively provided for all managing staffs. These courses are compulsory especially for the upper levels of management / leadership.

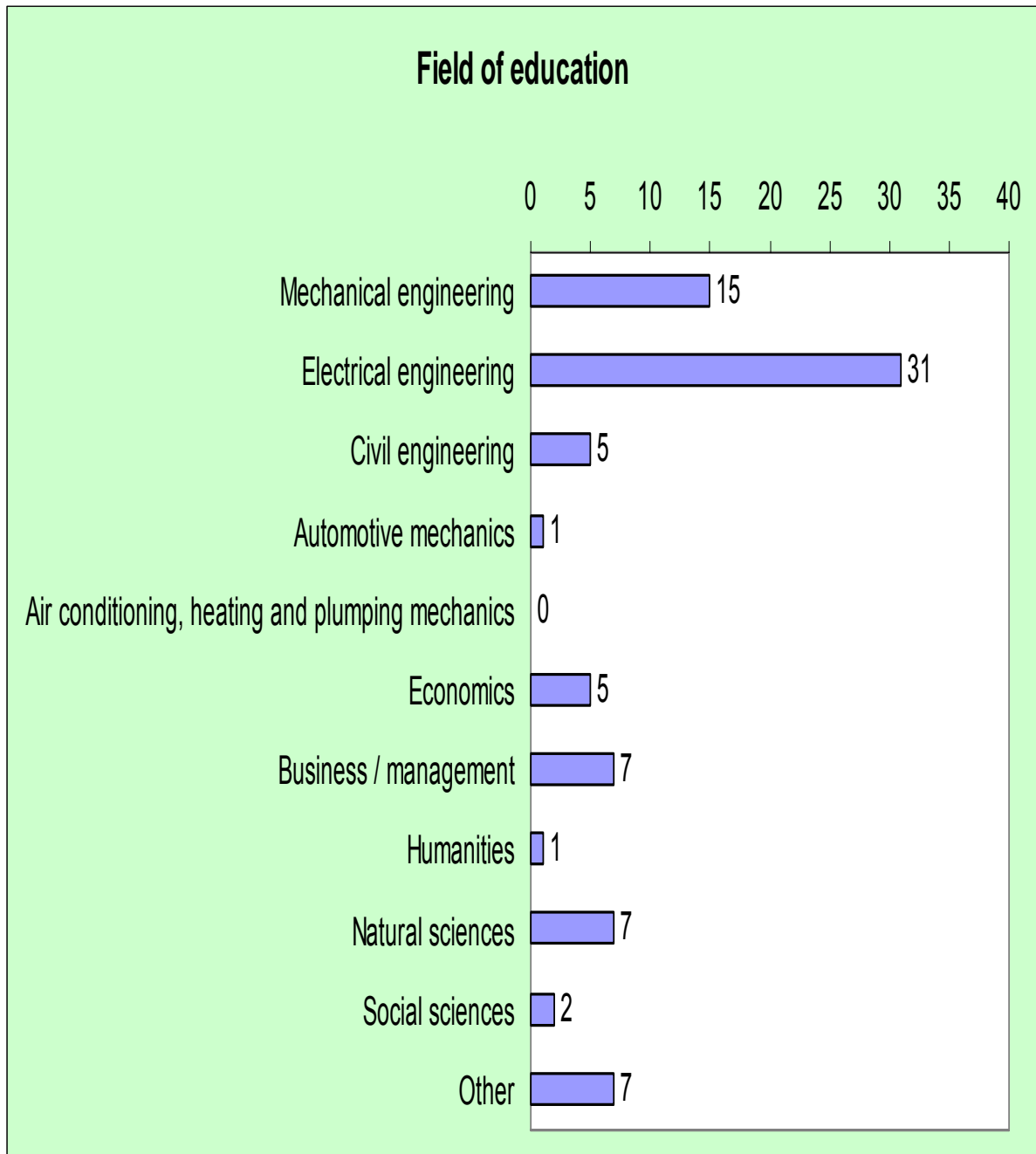


Figure 9: Fields of Vocational and University education (questionnaires evaluation)

As seen from figures 10-13, some of interviewees have attended short term (mostly two – weeks to one month) special training courses, while fewer people attended one-day or long-term training (several months). At these courses, usually participants obtained basic knowledge and understanding of energy related and other engineering / techniques. Fewer interviewees participated in short term courses in Natural sciences and Constructions.

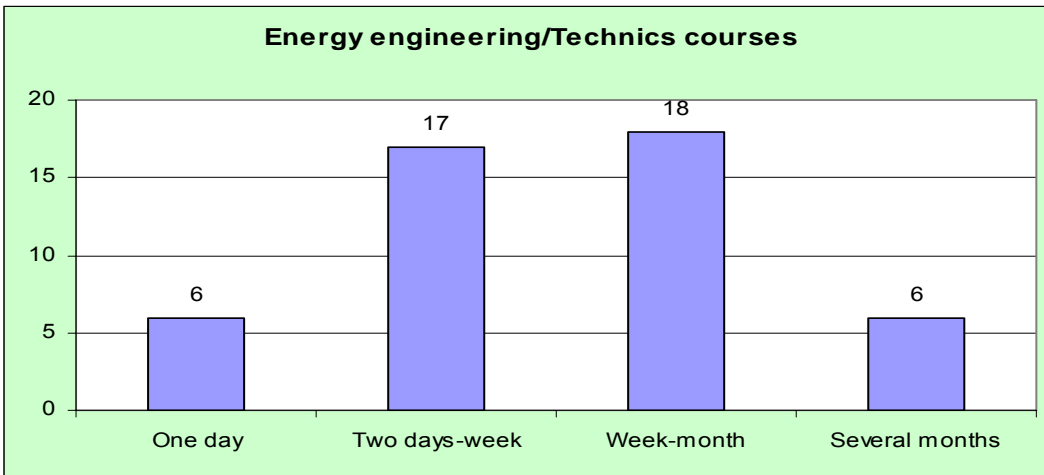


Figure 10: Attendance of energy engineering / technical training courses (questionnaire evaluation)

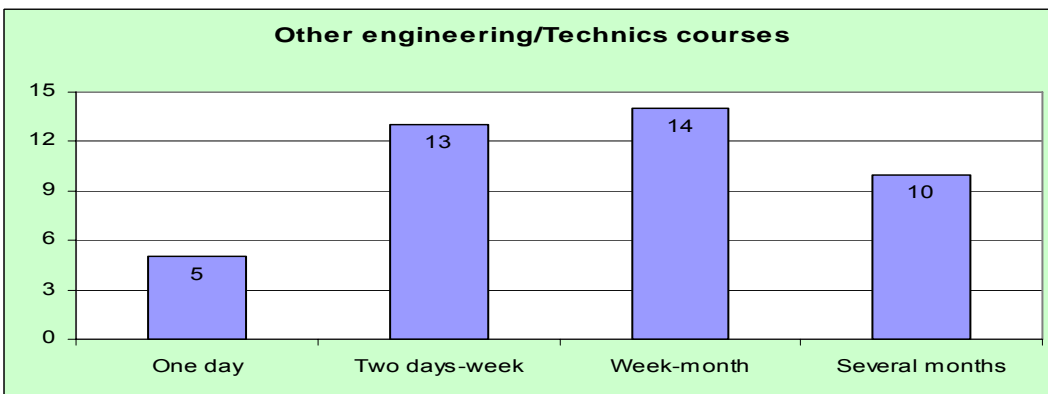


Figure 11: Attendance of other engineering/Technical training courses (questionnaires evaluation)

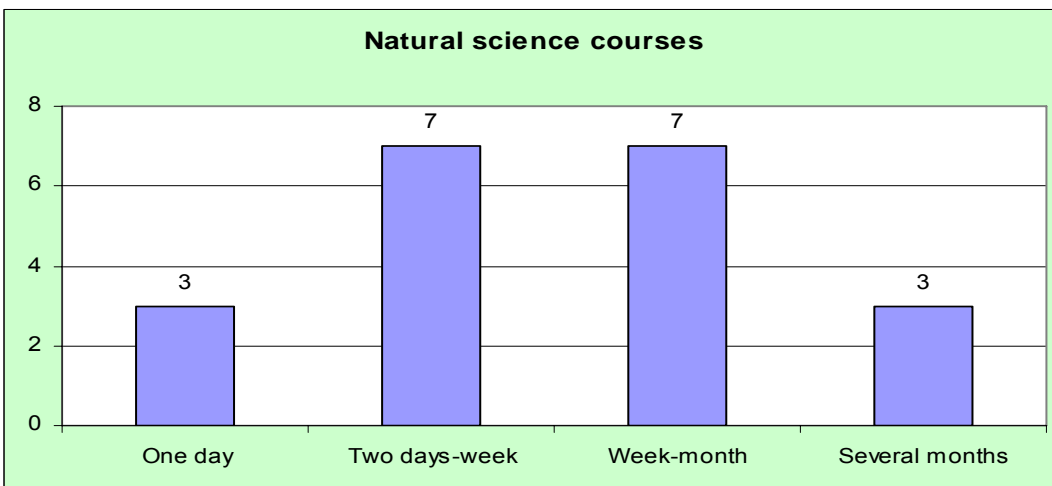


Figure 12: Attendance of training courses on Natural sciences (questionnaires evaluation)

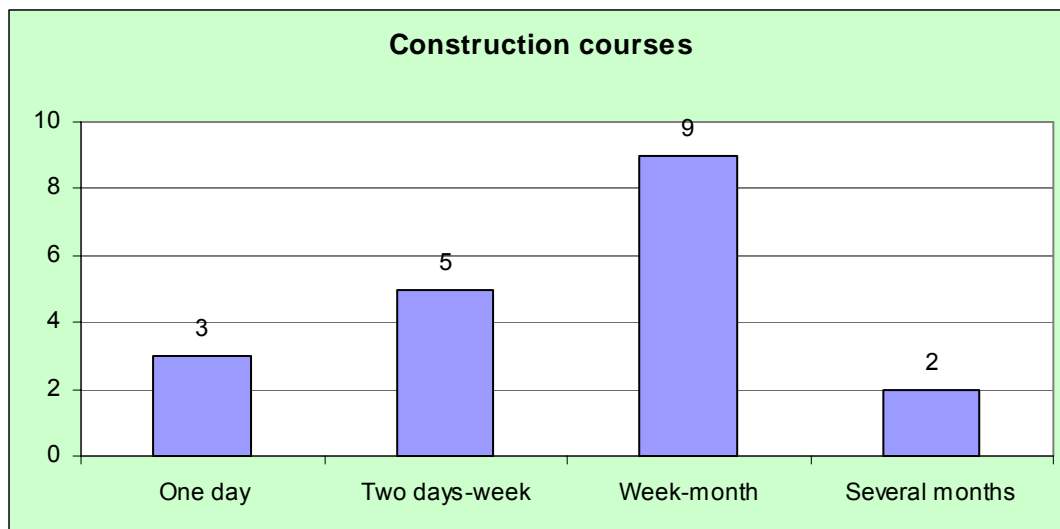


Figure 13: Attendance of training courses on construction (questionnaires evaluation)

3.3 Knowledge, Experience and Competence in energy technology

3.3.1 Hydropower (small scale)

Lao PDR is rich in hydropower resources. Lao government has seen hydropower development as the one of the most important sources of foreign exchanges. Moreover, small scale hydropower has been considered as main energy resources for rural electrification. During two last decades (1985-2005), more than 40 small scale hydropower plants have been constructed in Lao PDR, mostly in Northern provinces, where potential of small hydropower is huge.

Figure 14 shows that mostly interviewees are inexperienced in all aspects of small hydropower: More than half (43, 46 and 47 of 82) interviewees have no any experiences in technical planning, financing and construction, while remainders have some to good experiences.

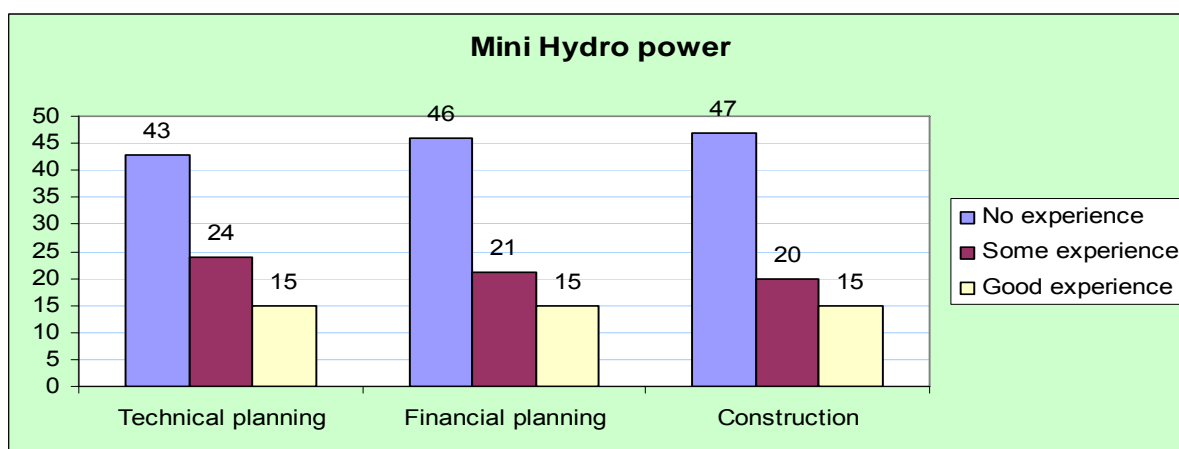


Figure 14: Experience and knowledge in small scale hydropower (questionnaires evaluation)

3.3.2 Photovoltaic PV (Solar power)

Solar photovoltaic (PV) has been introduced in Lao PDR since middle nineties, firstly as technological and feasibility demonstration, and mostly were donated by international organizations. Since then, PV has become more and more popular in off-grid rural electrification in Lao PDR. Main actors in PV dissemination in Lao PDR: from the public sides, Ministry of Energy and Mines (MEM) and its provincial departments of energy and Mines (PDEM); the Science, Technology and Environment Agency (STEA); Faculty of Engineering (NUOL), and from private sector- some private energy service companies (e.g., Sunlabob rural energy system Co. LTD).

As seen from results of the survey, less than one third of interviewees have good experiences in solar PV technology (26%). More than half of interviewees: 63, 63 and 61 of them have no or just some experiences in technical planning, financial planning and construction of PV system, respectively (figure 15).

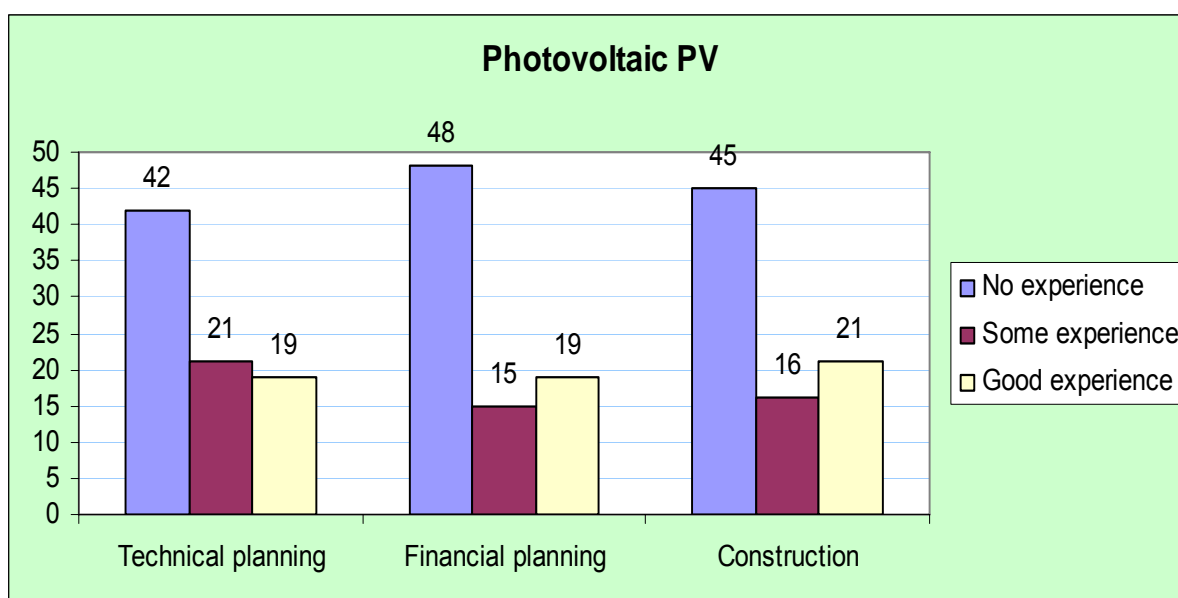


Figure 15: Experience and knowledge in photovoltaic technology (questionnaires evaluation)

3.3.3 Solar Heat

Obviously to say, solar heating technology is unknown for almost all of Lao people, for exception of an open air drying. Basic Solar heating technology was firstly introduced in Lao PDR as elective subjects for students at National Polytechnic Institute (predecessor of Faculty of Engineering, National University of Laos) and some technical colleges in Vientiane capital. With assistance from international organizations, several projects on drying technology were carried out in Lao PDR since middle of nineteen nineties.

Some models of individual passive solar water heating devices have been imported from neighboring China to several Northern provinces of Lao PDR for more than decade. Some research and demonstration projects on drying technology were carried out at Faculty of

Engineering (NUOL) and Technology Research Institute (TRI, STEA). Since 1997, in cooperation with Faculty of Engineering of NUOL, the Participatory Development Training Centre (PADETC) has promoted application of simple solar dryers for drying of agriculture products. With assistance from National University of Singapore and Singaporean Government, the Heat Pump Drying Technology demonstration project was conducted at TRI's Renewable Energy Technology Research Centre.

Although almost all of interviewees are relevant to energy-related matters, but only few of them (less than 6%) have good experiences in solar heating technology (figure 16). Usually people have just heard or seen demonstrated heating technologies.

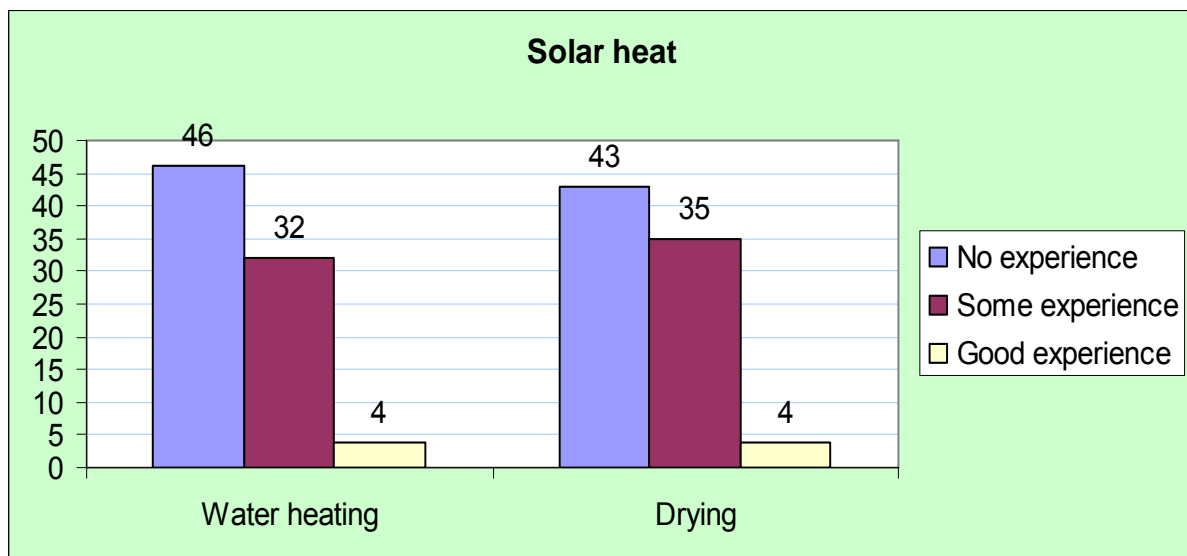


Figure 16: Experiences and knowledge in solar heating technology (questionnaires evaluation)

3.3.4 Wind Power

In general, wind potential is negligible small in Lao PDR, for exception in some hilly areas, where annual average wind speed may reach 3.2 m/s and maximum monthly average – 4.25 m/s in March (Xiengkhouang province, Department of Meteorology, MOFA). The figures for Vientiane capital are 1.7 m/s and 2.0 m/s (May), respectively).

As seen from figure 17, mostly interviewees have no experiences or knowledge of wind power technology. This also reflects a fact that there is no wind power devices installed in Lao PDR yet.

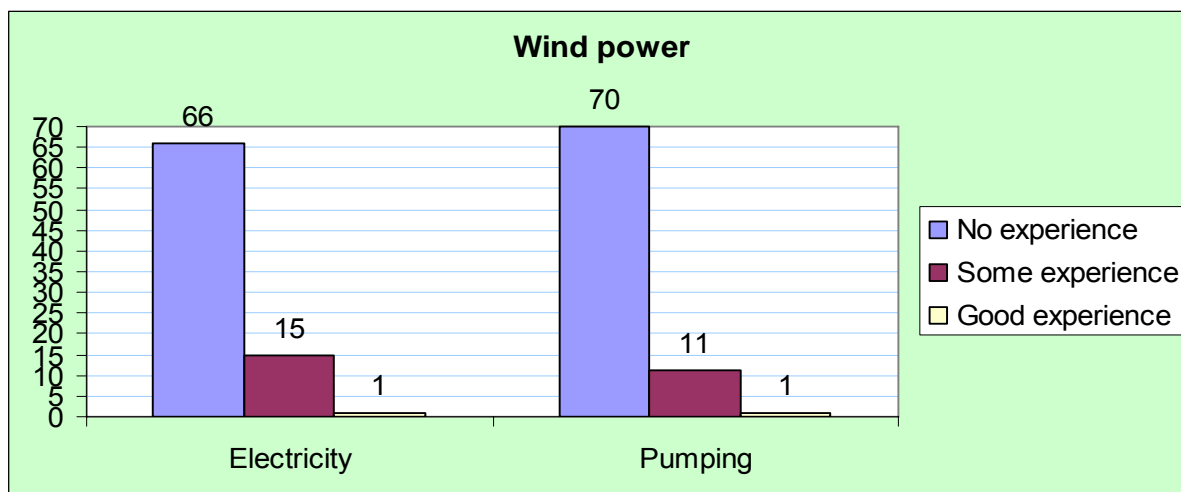


Figure 17: Experiences and knowledge in wind power technology (questionnaires evaluation)

3.3.5 Biomass

According to results national census 2005, non commercial Biomass fuels, such as wood and wood processing wastes, are still dominant in primary energy use for cooking in Lao households. About 99% rural and 89% urban households use wood as main energy sources for food preparation (National census 2005). The bucket (ordinary and improved) wood or charcoal stoves are typical cook stoves in Lao households. Inefficient open fire three-stone stoves are still in use in remote rural areas households.

Majority of interviewees have some to good experiences in wood fuel and charcoal stoves, charcoal kiln making (figure 18).

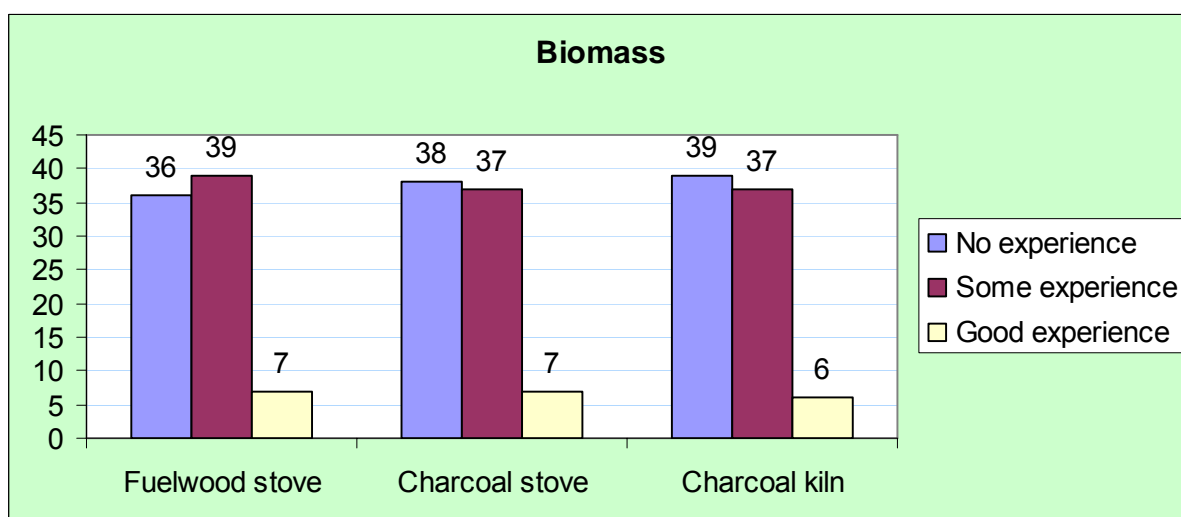


Figure 18: Experiences and knowledge on fuel wood/charcoal technology (questionnaires evaluation)

Modern biomass conversion technology for mechanical works or power generation has not yet been use in Lao PDR. Recently, interests on small scale gasification for power produc-

tion have risen, especially for rural electrification in isolated remote areas. In cooperation with international organizations, family scale biogas generation projects have been recently carried out for feasibility demonstration purposes.

However, experiences or knowledge on modern biomass combustion technologies are still low among interviewees, less than 23% of them are experienced in these matters (figure 19). This pointed to a fact that modern biomass combustion technologies have not yet been widely used in Lao small industry.

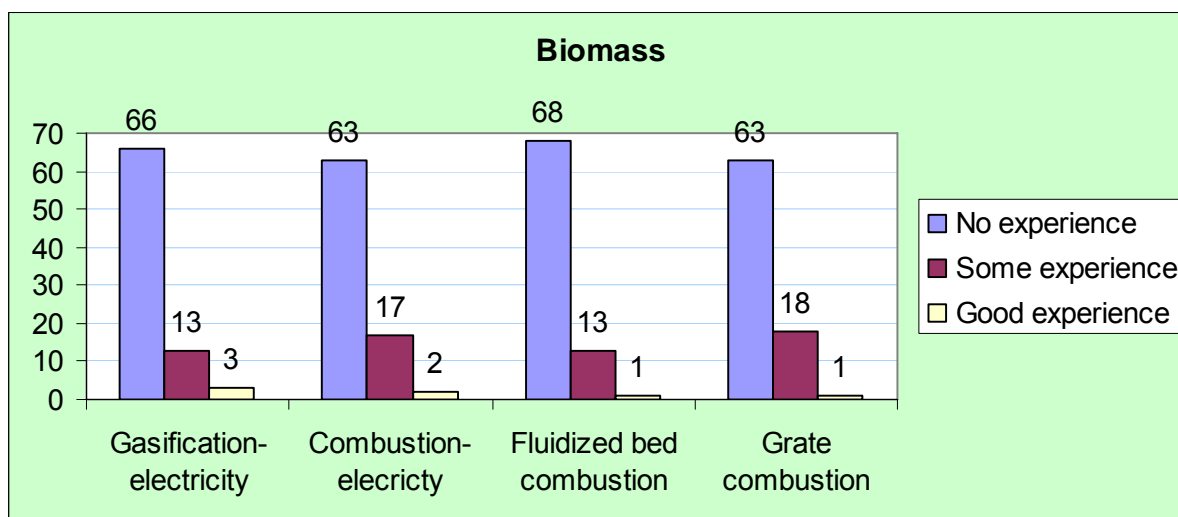


Figure 19: Experiences and knowledge on modern biomass conversion technologies (questionnaires evaluation)

Some interviewees have had some experiences with biogas production (35 of 82) and household use of biogas for lighting and cooking (28/82), (figure 20). Biogas-based Power generation has not yet practiced in Lao PDR.

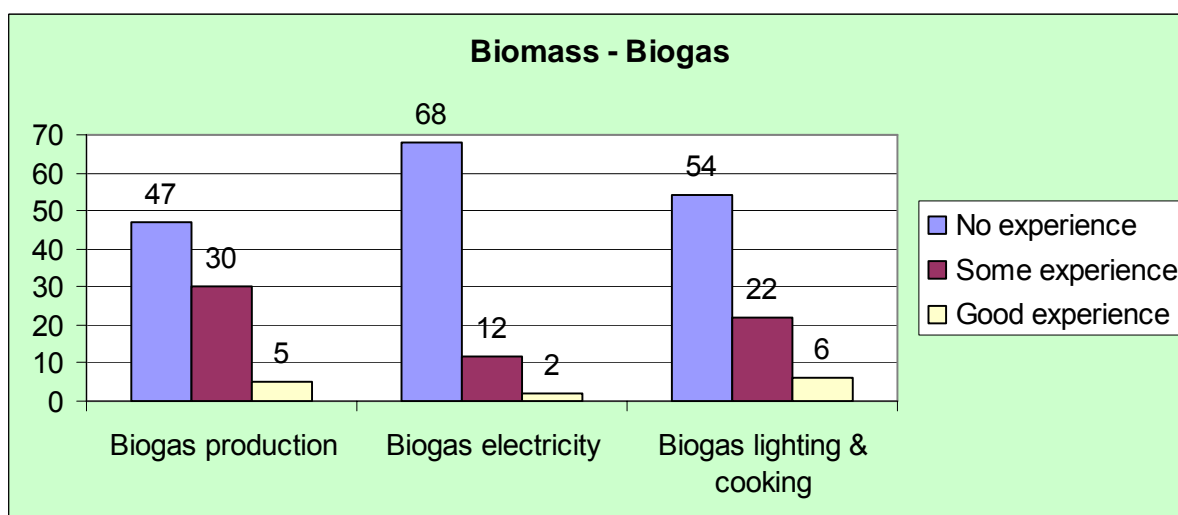


Figure 20: Experiences on biogas based electricity production (questionnaires evaluation)

Recently, bio-fuels production has got significant considerations. Both public institutions (MEM, STEA, MOFA) and private sectors (Kolao Co., Sunlabob Co., etc) have seriously

turned to bio-oil production from Jathropa, Oil Palm, Sun flowers. Some significant projects for bio oil production have been set up. But, as clearly seen from survey results (figure 21), few interviewees are experienced with bio-diesel production (19/82, or 23%) and bio-diesel based electricity generation (10/82, 12%). They are more experienced in oil plants (48/82) and oil trees (41/82).

Interviewees have mentioned some important trees species, which are used for energy in Lao PDR: (1) Jathropa; (2) Oil Palm; (3) Eucalyptus, (4) Pine trees, (5) some local fast growing species, traditionally used as wood fuel and raw materials for charcoal production.

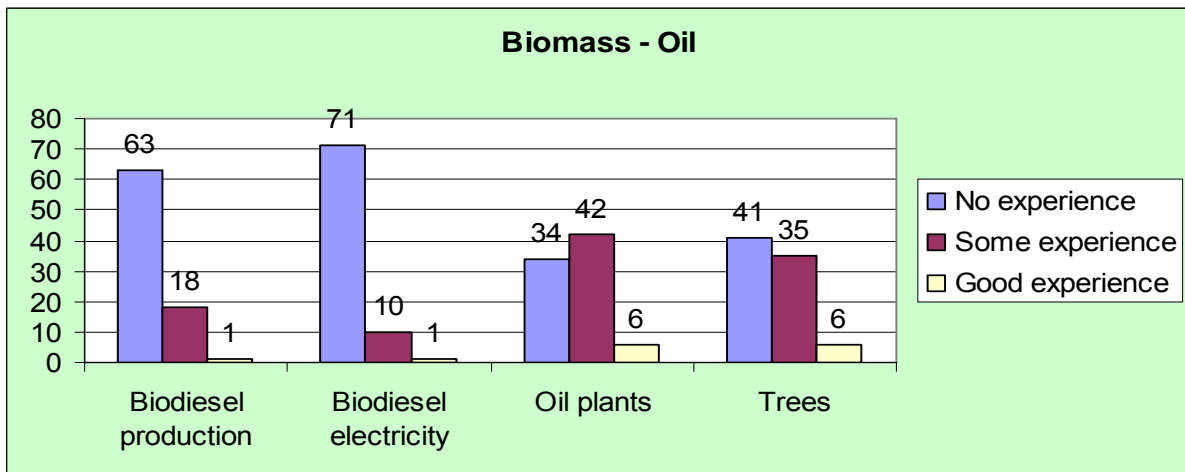


Figure 21: Experiences on bio-diesel based electricity production (questionnaires evaluation)

3.3.6 Electricity

In general, interviewees are more experienced in electricity transmission, distribution and technical planning. About half of them have good experiences and knowledge in financial planning, construction and maintenance (figure 22). This was to be expected because majority of the interviewees are electrical engineers.

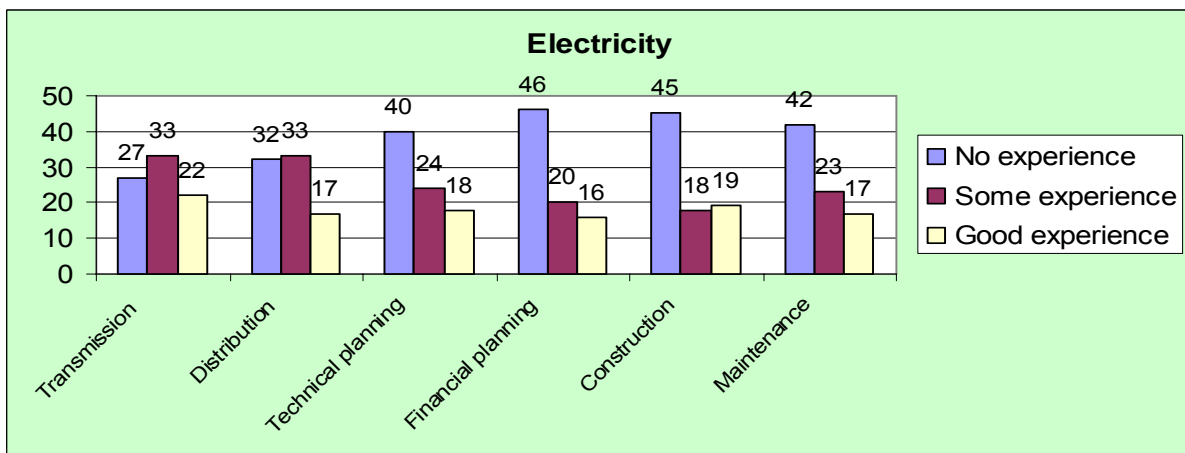


Figure 22: Experiences on electricity-related techniques (questionnaires evaluation)

3.3.7 Energy saving

According to the Power Sector Strategy study (Prepared by Electrowatt for LNCE, 2002), demand side management (**DSM**) and **energy efficiency** are mostly unknown for majority of Lao people. These matters have not yet been seriously considered either by governmental institutions or energy consumers. Energy saving topic has become more and more actual for Lao energy consumers, due to continuously risen oil price and reformed national electric tariff policy.

Majority of interviewees have good or some experiences in energy saving (figure 23). Interviewees have mentioned some important, such as:

- well planned energy consumption
- to use efficient electric appliances
- regular maintenance and checking of appliances
- to turn off appliances when not in use or when not necessary
- use of appropriate appliances
- users' behaviors change
- avoid using high energy consuming devices at the same time

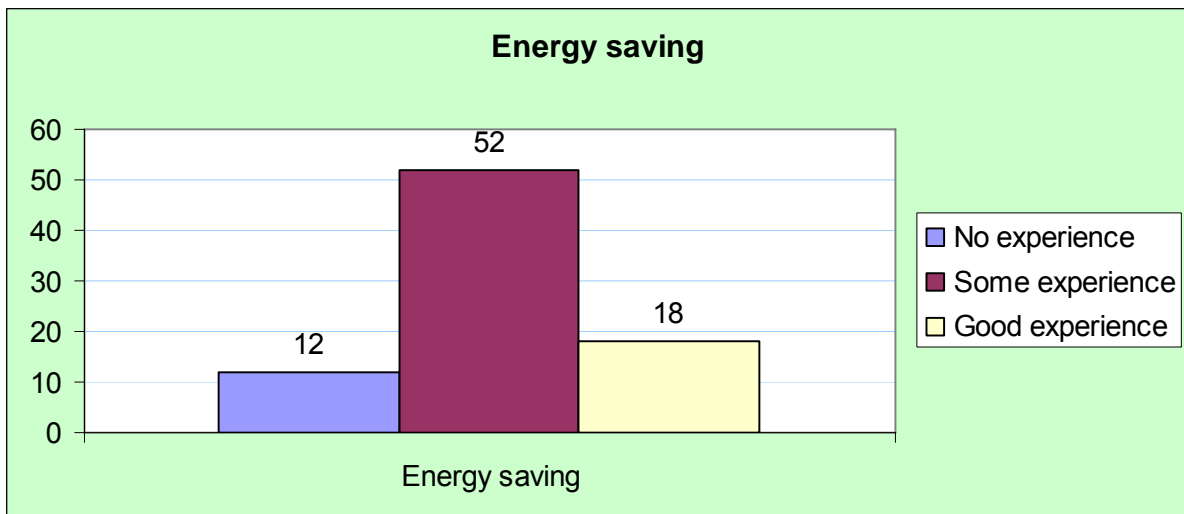


Figure 23: Experiences on energy saving (questionnaires evaluation)

3.3.8 Other relevant engineering skills

More than half of interviewees have some to good other relevant engineering skills (figure 24). Fewer people are skilled in manufacturing process. Interviewees have mentioned some skills, as listed below.

Mechanical skills:

- diesel engines and motor,

- water pumps
- transmission shaft and gear box

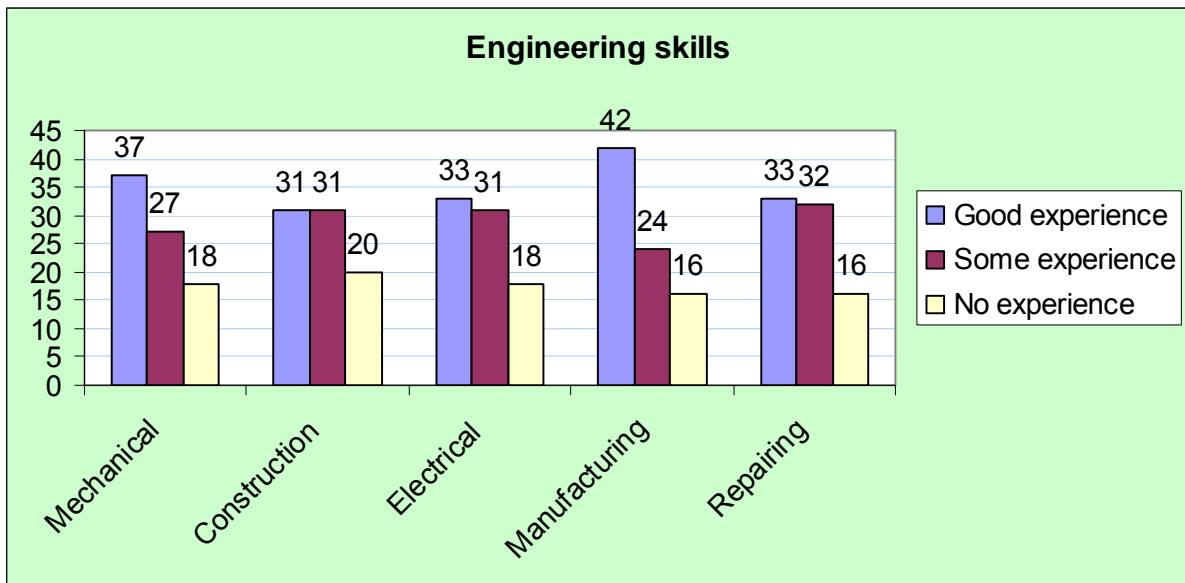


Figure 24: Other engineering skills (questionnaires evaluation)

Construction skills:

- housing
- dam design and construction
- transmission line construction

Electrical skills:

- wiring
- electric machines installation
- solar system installation

Manufacturing skills:

- biogas digestion process
- vegetable oil production
- hydropower generation

Maintenance

- biogas digester maintenance
- electric machine maintenance, repair and fixing
- solar PV system maintenance and spare parts replacement

3.3.9 Energy and Agriculture production

Almost half of interviewees have good experiences in energy related agricultural production (figure 25). Such skills are listed below:

- Agriculture production wastes utilization: combustion, biogas digestion, carbonization,
- Vegetable oil production
- Oily trees planting and harvesting
- agricultural machines use and maintenance
- organic wastes composting
- seeding and nursery
- animal and plants breeding

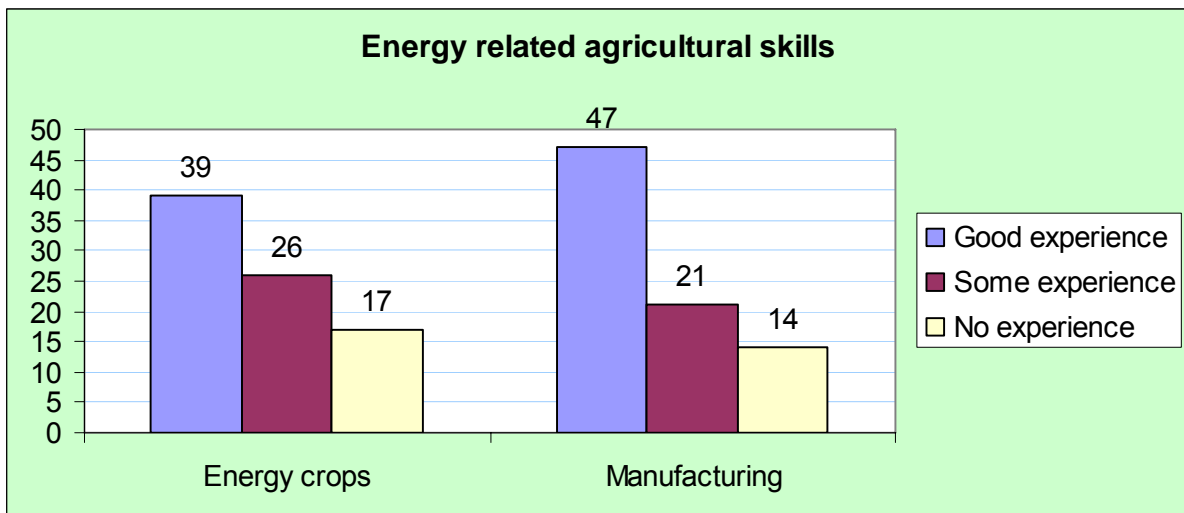


Figure 25: Energy related agricultural skills (questionnaires evaluation)

3.4 Conclusions

Interviewees have relatively good general engineering/technical background, but they are mostly lacking of experiences and knowledge on renewable energy conversion technologies, especially regarding modern biomass technology or specific technological knowledge.

Often renewable energy related knowledge or experiences were obtained through attended special courses rather than from regular academic ones.

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5 Appendices

5.1 Appendix 1: Questionnaire - Educational competence scan – Technological understanding

Introduction

The target of the ‘educational competence scan on technological understanding’ is to find the level of technological understanding and technical competence among trainers, community stakeholders and further target groups. The areas of the scan cover different renewable energy technology alternatives and energy sources as well as related knowledge such as electricity distribution. The report, group ranking and evaluation as well as advice will provide basic information on the appropriate way of technology presentation within the training manuals

Some concepts used in the questionnaire

Hydropower is the capture of the energy of moving water for some useful purpose. Prior to the widespread availability of commercial electric power, hydropower was used for irrigation, milling of grain, textile manufacture, and the operation of sawmills. The energy of moving water has been exploited for centuries.

Photovoltaics, or PV for short, is a solar power technology that uses solar cells or solar photovoltaic arrays to convert light from the sun into electricity.

Wind power is conversion of wind energy into more useful forms, usually electricity using wind turbines. At the end of 2006, worldwide capacity of wind-powered generators was 74,223 megawatts; although it currently produces less than 1% of world-wide electricity use, it accounts for approximately 20% of electricity use in Denmark, 9% in Spain, and 7% in Germany. Globally, wind power generation more than quadrupled between 2000 and 2006.

Biomass, in the energy production industry, refers to living and recently dead biological material which can be used as fuel or for industrial production. Most commonly, biomass refers to plant matter grown for use as biofuel, but it also includes plant or animal matter used for production of fibres, chemicals or heat. Biomass may also include biodegradable wastes that can be burnt as fuel. It excludes organic material which has been transformed by geological processes into substances such as coal or petroleum. It is usually measured by dry weight. Biomass is grown from several plants such as the wood of a tree, agricultural waste (such as rice husk, straw) and different energy crops. Biofuels that are made from biomass include bioethanol, biobutanol, biodiesel & biogas.

Electric power transmission is one process in the transmitting of electricity to consumers. The term refers to the bulk transfer of electrical power from place to place. Typically, power transmission is between the power plant and a substation near a populated area.

Electricity distribution is the penultimate stage in the delivery (before retail) of electricity to end users. It is generally considered to include medium-voltage (less than 50 kV) power lines, electrical substations and pole-mounted transformers, low-voltage (less than 1000 V) distribution wiring and sometimes electricity meters.

Field and level of education

Male † Female †

Age ____ years

Present occupation _____

Main work tasks _____

Work experience in present post _____ years

Previous fields of work experience:

	occupation	main work tasks	years
1			
2			
3			
4			

Education level:

†Primary school (grades 1-6)

†Secondary school (grades 7-9)

†Tertiary education (grades 10-12)

†Vocational education

†University education:

 †Batchelor's degree

 †Master's degree

 †Doctor's degree

Field of education (vocational / university)

†mechanical engineering

†electrical engineering

†civil engineering

†automotive mechanics

†air conditioning, heating and plumping mechanics

†economics

†business / management

†humanities

†natural sciences

↑social sciences

↑other

In addition to the above mentioned education have you taken any special courses in the following fields (give the length of courses):

Energy engineering/techniques

↑one day ↑2 days – week ↑1 week – month ↑several months

Other engineering/techniques

↑one day ↑2 days – week ↑1 week – month ↑several months

Natural sciences

↑one day ↑2 days – week ↑1 week – month ↑several months

Construction

↑one day ↑2 days – week ↑1 week – month ↑several months

Level of knowledge, experience and competence in energy technology:

1. Hydro power (small scale):

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in mini, micro or pico hydro technical planning?

3 2 1

Do you have experience in mini, micro or pico hydro financial planning?

3 2 1

Do you have experience in mini, micro or pico hydro construction projects?

3 2 1

2. Photovoltaic PV (Solar power)

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in Photovoltaic technical planning?

3 2 1

Do you have experience in Photovoltaic financial planning??

3 2 1

Do you have experience in Photovoltaic construction projects?

3 2 1

3. Solar heat

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in solar heat utilization in water heating?

3 2 1

Do you have experience in solar heat utilization for drying?

3 2 1

4. Wind power (small scale)

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in wind power technology for electricity production?

3 2 1

Do you have experience in wind power technology for water pumping or other purposes (mention purpose)?

3 2 1

5. Biomass

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in improved fuelwood stove technology?

3 2 1

Do you have experience in improved charcoal stove technology?

3 2 1

Do you have experience in improved charcoal kiln technology (charcoal production)?

3 2 1

Do you have experience in electricity production based on biomass gasification technology?

3 2 1

Do you have experience in electricity production based on biomass combustion technology (steam generator)?

3 2 1

Do you have experience in fluidized bed biomass combustion technology?

3 2 1

Do you have experience in grate biomass combustion technology?

3 2 1

Do you have experience in biogas production technology?

3 2 1

Do you have experience in electricity production technology based on biogas?

3 2 1

Do you have experience in cook stove and lighting technology based on biogas?

3 2 1

Do you have experience in biodiesel production technology?

3 2 1

Do you have experience in electricity production technology based on biodiesel?

3 2 1

Do you have experience in growing different oil plants for energy purposes (such as Jathropa, Oil palm etc.)?

3 2 1

Do you have experience in growing different tree species for energy purposes?

3 2 1

Mention most important tree species you know that are used for energy:

6. Electricity

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in electricity transmission technology (planning, construction, maintenance)?

3 2 1

Do you have experience in electricity distribution technology (planning, construction, maintenance)?

3 2 1

Do you have experience in off-grid electricity system technological planning?

3 2 1

Do you have experience in off-grid electricity system financial planning?

3 2 1

Do you have experience in off-grid electricity system construction?

3 2 1

Do you have experience in off-grid electricity system maintenance?

3 2 1

7. Energy saving

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have experience in energy saving?

3 2 1

Mention the most important energy saving methods that you know:

8. Other relevant engineering skills

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have energy related **mechanical engineering** skills (diesel motors, pumps, wind turbines, gear boxes, transmission shafts, etc.)?

3 2 1

What type of skills?

Do you have energy related **construction** skills (transmission lines, dams, housing, etc.)?

3 2 1

What type of skills?

Do you have energy related **electrical engineering** skills (wiring, mounting, installation, control systems, generators, etc.)?

3 2 1

What type of skills?

Do you have energy related **manufacturing** skills?

3 2 1

What type of skills?

Do you have energy related **repairing** skills (repairing, fixing, renovating, maintenance, etc.)?

3 2 1

What type of skills?

10. Energy and agricultural production

3 = good knowledge/experience, 2 = some experience, 1 = no experience

Do you have energy related agricultural **production** skills (production of energy crops like jathropa, palm oil, agricultural waste, fertilization, breeding, seedlings, nursery, etc.)?

3 2 1

What type of skills?

Do you have energy related agricultural production technology skills (manufacturing, machinery, maintenance, etc.)?

3 2 1

What type of skills?
