EIE-06-256 REEPRO

Promotion of the Efficient Use of Renewable Energies in Developing Countries

Educational Competences Scan – Technological Understanding in Cambodia

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List of Acronyms

COMPED	Cambodian Education and Waste Management Organization
RGC	Royal Government of Cambodia (RGC)
IDA	International Development Association (IDA)
GEF	Global Environment Facility (GEF)
LDC	Least Developed Country (LDC)
GDP	Gross Domestic Product (GDP)
PMU	Project Management Unit (PMU)
REE	Rural Electricity Enterprise (REE)
REF	Rural Electricity Fund (REF)
TA	Technical Assistance (TA)
REEPRO	Promotion of the Efficient Use of Renewable Energies in Developing Countries

1 Introduction

1.1 General

The Kingdom of Cambodia (Khmer: transliterated: Preăh Réachéanachâkr Kâmpŭchea) is a country in Southeast Asia with a population of almost 15 million people, with Phnom Penh being the capital city [www.wikipedia.org].

The country shares a border with Thailand to its west and northwest, with Laos to its north-east, and with Vietnam to its east and southeast. In the south it faces the Gulf of Thailand. The geography of Cambodia is dominated by the Mekong river (colloquial Khmer: Tonle Thom or "the great river") and the Tonlé Sap ("the fresh water lake"), an important source of fish. The low geography of Cambodia's fertile areas means much of the country sits nearly below sea level, and consequently the Tonle Sap River reverses its water flow in the wet season, carrying water from the Mekong back into the Tonle Sap Lake and surrounding flood plain.

Cambodia's main industries are garments and tourism. In 2006, foreign visitors had surpassed the 1.7 million mark. In 2005, oil and natural gas deposits were found beneath Cambodia's territorial water, and once commercial extraction begins in 2009 or early 2010, the oil revenues could have a profound impact on the future of Cambodia's economy [www.wikipedia.org].

Figure 1: Cambodia [www.wikipedia.org]

1.2 Economy

Cambodia is classified as a Least Developed Country (LDC) which ranks amongst of the poorest in the world. The country's official Gross Domestic Product is US$ 278 per person and year. Agriculture accounts for more than half of GDP, with another 15% from garment exports which has benefited from quotas in the USA and Europe. These quotas are to be removed at the end of 2004. Cambodia's economy is still highly dependent on foreign assistance which accounts for some 14% of GDP. Cambodia has joined the World Trade Organisation (WTO) but the implications of this for the economy are as yet unclear.

1.3 Technical Assistance

The Royal Government of Cambodia (RGC) has financing from the International Development Association (IDA) and Global Environment Facility (GEF) toward the cost of establishing a Rural Electrification Fund (REF) as part of the above project. The main objectives of the REF are to engage the private sector to improve electricity services in rural areas and to link this to income producing activities in order to reduce rural poverty.

Assignment numbers (A) and (B) will be expected to start early 2005 while the other assignments are expected to start in the second quarter of 2005. Assignment (A) is only open to individual consultants; all other assignments will require teams consisting of either a local consulting firm, or a partnership between both a local and an international firm. Interested consulting firms may express their interests for any number of TA packages. Interested consultants must indicate which particular package(s) they are interested in, however the REF PMU reserves the right to limit the total number of packages awarded to any single firm.

1.3.1 Technical In-house Advisor (A)

An individual consultant will be hired to assist the REF Secretariat with the establishment and day-to-day operations of the REF. Activities will include assisting with REF staff recruitment procedures; assisting with procurement associated with the establishment of the REF, including other Technical Assistance (TA) consultants and some equipment; technical training of REF Secretariat staff; advising REF staff in finalizing the operational manual and technical specifications for use by the REF; assisting REF staff with review and selection of REF project proposals; supporting REF staff with monitoring and evaluation activities within the REF ; liaising with industry on technical aspects of the REF. The Technical In-House Advisor will report initially to the interim Project Management Unit (PMU) and eventually to the REF Executive Director, once he/she has been recruited. This consultant will be procured on a two-year contract, with an option to extend for a further year dependent on performance.

1.3.2 Project Pipeline Development Team (B)

This consulting firm will be hired to assist developers and communities to prepare high quality proposal for REF funding, by supporting the identification, assessment and development of potential rural electrification projects. Each project will be developed in partnership with a private developer who will contribute to the cost of developing their project proposals. The Consultant may help with all activities necessary to develop the project, including design, feasibility studies, business plans and seeking financing. The Consultant will also provide technical and business training to existing and potential REF project developers. The Consultant will develop and maintain a database to track the REF project pipeline, and will report initially to the interim Project Management Unit (PMU) and eventually to the REF Executive Director, once he/she has been recruited. The term of this contract will be two years.

1.3.3 Rural Income Generation Promotion Team (C)

This consulting firm will be hired to develop end-use activities in order to increase income-generation opportunities in rural areas and enhance productive uses of renewable energy. The activities to promote such rural economic development may include facilitation of rural village and commune-level energy planning, awareness-raising and training on electricity-based rural income-generation options demonstration of relevant technologies for rural businesses, assessment of rural products, and linking rural businesses with markets. The term of this contract will be two years.

1.3.4 Rural Electricity Enterprise (REE) Development Team (D)

This consulting firm will be hired to assess the capacity and needs of REEs with respect to their technical standards and business management, and then to design and implement activities to build this capacity. Such activities may include training for strengthening management, technical and operating capacity, raising awareness of international and regional best practice, benchmarking, demonstration of appropriate new technologies, and building cooperation with their stakeholders, the industry regulator and among REEs. A key area for development will be improving the safety, quality and affordability of REE services, and improving the viability and efficiency of REE businesses. The contract term will be two years.

1.3.5 REF Promotion and Awareness Team (E)

This consulting firm will be hired to assess the level of awareness and technical capacity among REF stakeholders and to design and implement activities to raise it to the levels required for the REF to be effective in promoting rural electrification and the commercialization in Cambodia of renewable energy technologies which have been proven elsewhere. The activities will include production of a media and communications plan, community demonstrations, advertising, workshop series for renewable energy technicians, promotional materials, case study reports, and facilitation of appropriate study tours by REF stakeholders. The contract term will be two years.

1.3.6 Financial Institution Capacity Building Team (F)

A consulting firm will be hired to help improve the loan appraisal and supervision capacities of financial institutions for projects involving renewable energy technologies. This will be achieved through activities such as training workshops, study tours and assessment of both existing projects and real REF proposals. The term of this contract will be 2 years.

The Ministry of Industry, Mines and Energy now invites eligible consultants to indicate their interest in providing the services. Interested consultants must provide information indicating that they are qualified to perform the services (brochures, description of similar assignments, experience in similar conditions, availability of appropriate skills among staff, etc.). Consultants may associate to enhance their qualifications [www.recambodia.org/ta.htm].

2 Scope of the Educational Competences scan

A scan of education related to technological understanding was performed within the target groups such as trainers and community stakeholders. The results of the scan will serve as input for technology knowledge related sections of the training manuals and further processing in the project.

3 Targets Selection

Following the discussion about suitable groups for Educational Competences Scan – Technological questionnaire, COMPED has decided to deliver 60 copies of the questionnaires to following the groups of interviewees such as farmers, workers and enterprises. These people live in Phnom Penh, Kandal, Takeo, Kompong Chhnang, Pursat, and Battambang province. The selection is focused on persons who have electricity background such as electricity contractors and the persons involved with electricity business, such as battery charge and electricity material sellers. Instead of farmers and workers are just for cultivation and using the energy or electricity. All of the interviewees knew about the project ‘’Promotion of efficient uses of Renewable Energies in Developing Countries’’ (REEPRO) by explanations from COMPED staff.

4 Procedure of the Questionnaire

The questionnaire of Educational Competences Scan – Technological understanding was received on 08 June 2007 and completely translated to Khmer by COMPED on 16 July 2007. After that, the survey was performed by COMPED staff which in two stages, the first stage from 17 to 20 July 2007 in Kompong Chhnang, Pursat, and Battambang province and second stage from 23 to 26 July 2007 in Phnom Penh, Kandal and Takeo province. In the first stage, COMPED looked for suitable locations for the interviews, therefore, the people should be interviewees are farmers (fuel wood stove, cultivation, charcoal stoves…) and some enterprises in Kompong Chhnang province, teachers (physics, chemistry and mathematics) in Pursat province, hospital, offcial, community management , and agricultural farm in Battambang provinces. The second stage, a car garage, an iron smith shop (both use

much of energy) in Phnom Penh, enterprises related to electricity (electricity contractor) in Kandal and Takeo province. All interviewees received a brief explanation about the questionnaire and COMPED reached them directly at their place. Likewise, most of them were interested in the training approach due to they would like to improve their skill in electricity. As the result, 60 persons were definitely interviewed. 15 persons in Kompong Chhnang, 10 persons in Pursat, 16 persons in Battambang, 5 persons in Phnom Penh, 8 persons in Kandal and 6 persons in Takeo.

5 Results

As the result, the questionnaires were successfully performed. Almost all relevant target groups actively participated in the interview process.

5.1 General data

Number of interviewees: 60 persons were interviewed. 54 (90%) were male and 6 (10%) were female. 16 (26.66%) interviewees aged between 21-29 years were male and 1 (1.66%) female, 20 (33.33%) of the interviewed with an age of 30-40 years were male and 3 (5%) female, 16 (26.66%) interviewees aged between age 41-50 were male and no female. The age of 51 up, 2 were (3.33%) male and other 2 (3.33%) female. The average was 37 years, while the youngest and oldest interviewees were 23 and 70 years, respectively.

Table 1: General information on interviewees

	Numbers	**Percents**
Gender		
Male	54	90%
Female	6	10%
Ages		
≤40 years old	40	66.66%
41-50 Years old	16	26.66%
>50years old	4	6.66%
Youngest	23 years	
Oldest	70 years	
Average age	37 years	

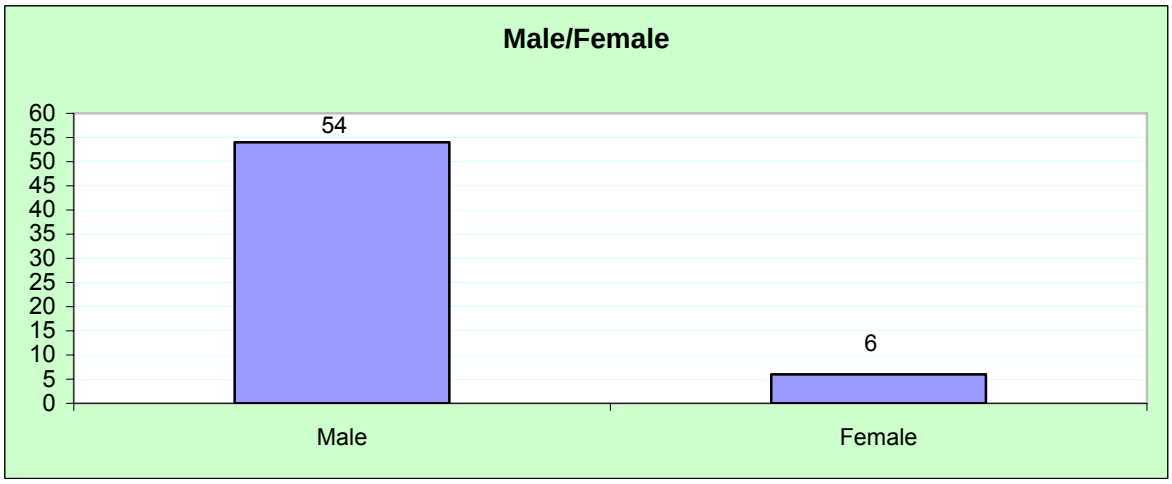

Figure 2: Number of male and female

Occupation: Figure 3 shows that most of the interviewees are electricity contractors (small, medium and big enterprises) with 20 (33.33%) of the persons, followed by farmers (fuel wood, charcoal stove, cultivator) and workers (teacher, health professionals, communal employees) were 15 (25%) of the persons. 6 persons were (10%) battery charge sellers, while car garage and iron smith were the lowest with 2 (3.33%) of the interviewed persons.

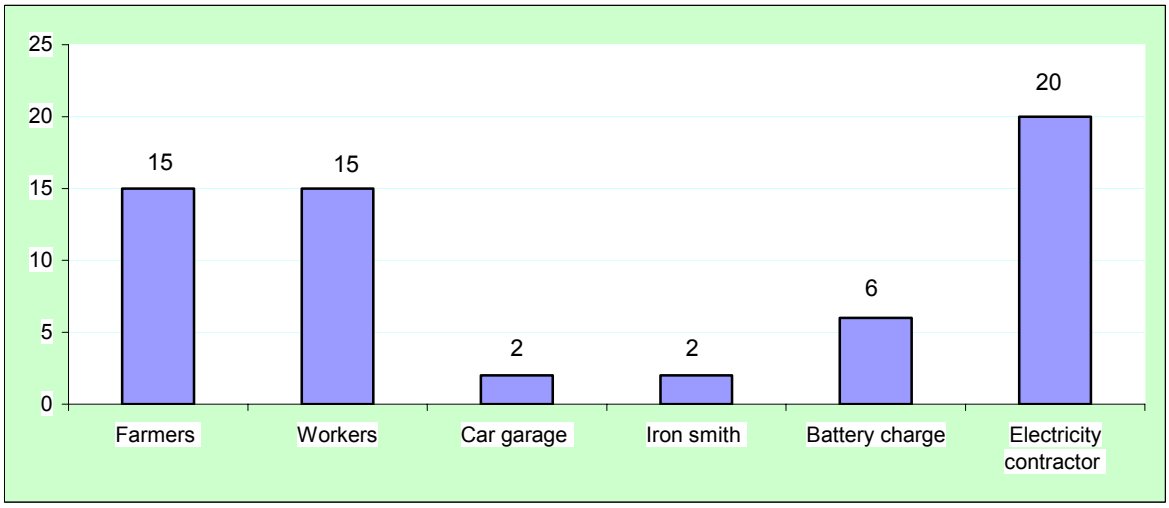

Figure 3: Present occupation of interviewees

Work experiences: 1 person = 1.66% among of the 60 interviewees had the longest experience with 24 years, while the most 44 persons = 73.33 % have less experience than 10 years, followed by 15 persons = 25% which have experience between 10-20 years. The shortest experience is 1 year.

Table 2: Work experience

Work experiences in present post	Numbers	Percents
Minimum	1 year	4 (6.66%)
Maximum	24 years	1 (1.66%)
Average	7 years	
<10 years	44	73.33%
10-20 years	15	25%
> 20 years	1	1.66%
Experience in previous work in average	6 years	

Main working field: the survey showed that most of the interviewees operated their business as managers. The people interviewed are farmers and workers. Farmers cultivate agricultural plants i.e. rice, corn, and papaya kind of hollyhock etc., and stove makers produce fuel wood stoves and / or charcoal stoves. Workers including teachers with specifics skill of mathematic, physical and chemistry, as well as pharmacist, doctor, and government officers who have been using photovoltaic in their house.

5.2 Field and level of education

Educational level: 19 (31.66%) of the interviewees have completed secondary school, 17 (28.33%) completed primary school and 9 (15%) finished tertiary school. 6 persons (10%) possessed a vocational, 8 (13.33%) bachelor degree, and 1 (1.66%) of interviewed person had a master degree.

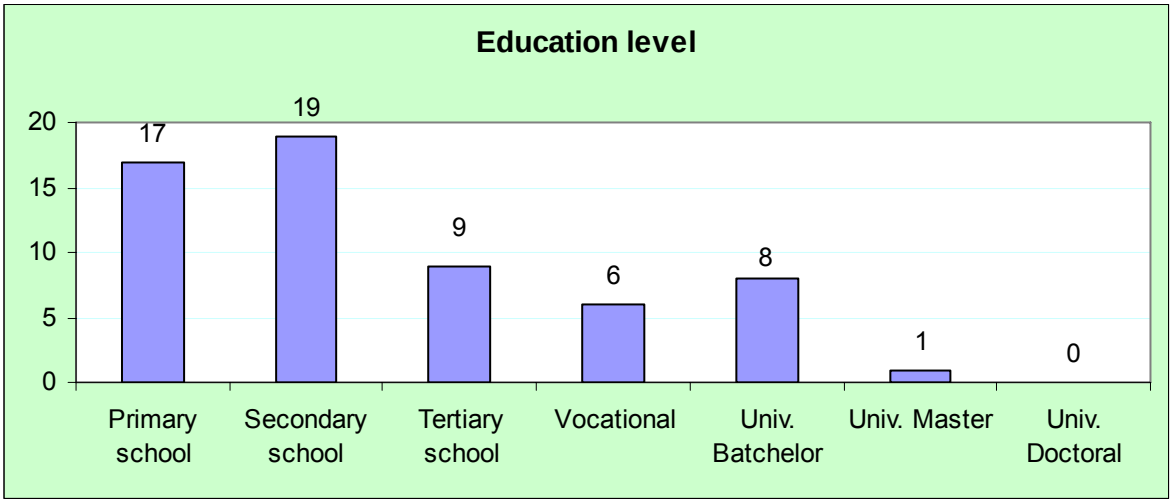

Figure 4: Education levels of interviewees

Field of education: Fields of vocational and university education of the interviewed persons are shown in Figure 5. It can be seen that 5 persons (8.33%) possessed education in business/management, and at least 4 (6.66%) have automotive mechanic skills, 2 (3.33%) have skills in natural sciences, other 6 (10%) have mechanical engineering skills, and knowledge in electrical engineering, civil engineering and air conditioning, heating and plumping me-

chanics. 43 persons (71.66%) had other types of education, e.g. repairing, set up a pole, supervision and the remaining part of them it did not mention anything.

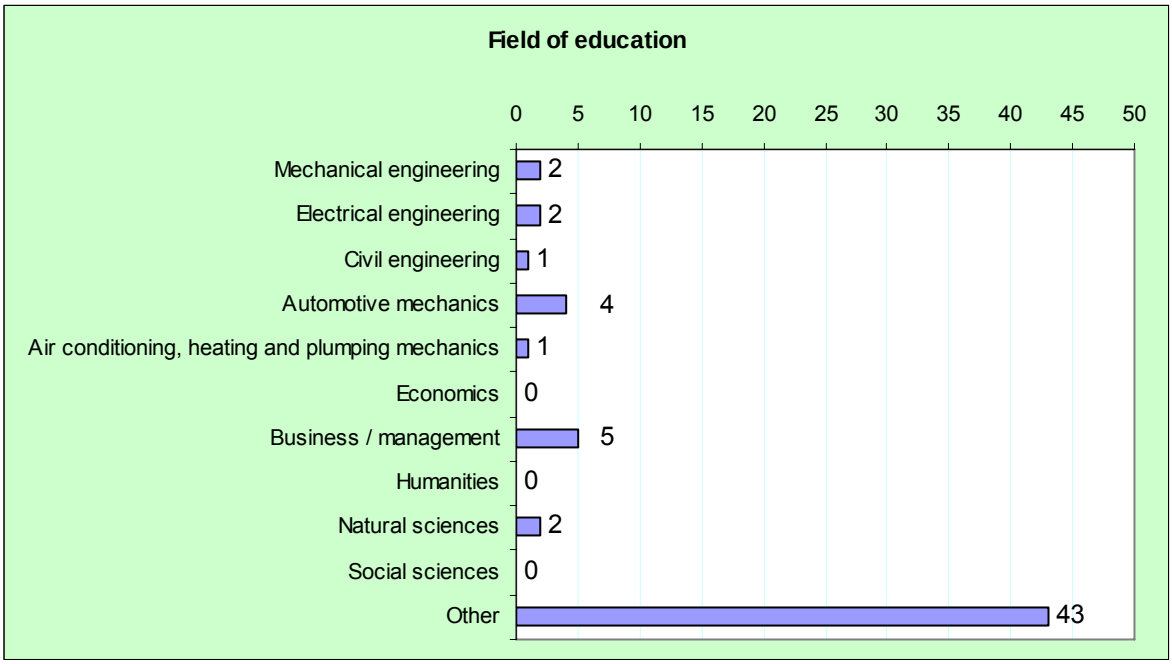

Figure 5: Fields of Vocational and University education

Figures 6 and 7 provide information about the attendance of the interviewees at special training courses. 9 (15%) of interviewed persons attended special courses on energy engineering/techniques for several months. 4 (6.66%) persons attended one week to one month courses related to energy engineering/techniques. 3 (5%) persons of the interviewees attended courses on natural sciences for 1 week to 1 month. Only 1 person possessed very little knowledge and understanding about energy engineering/techniques. Beside these, 43 (71.66%) made training activities at their own also did not attend any courses.

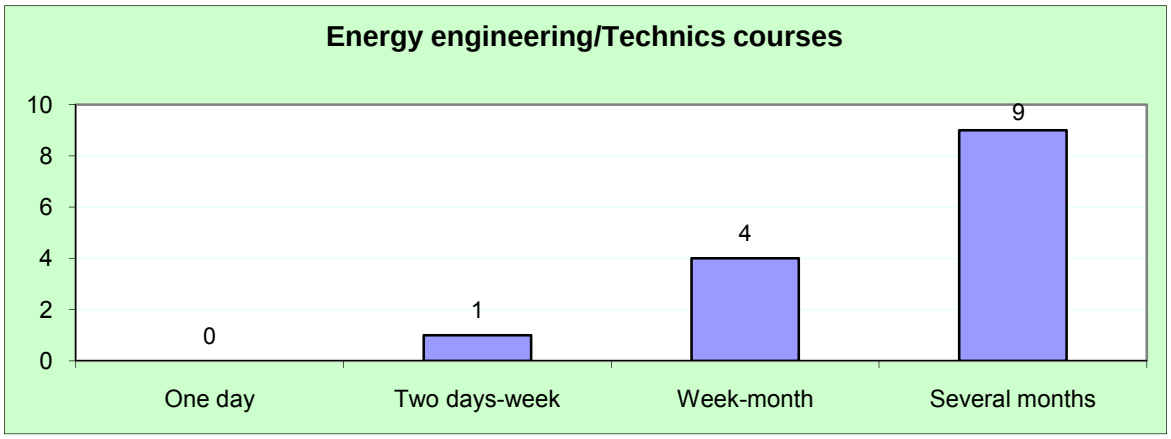

Figure 6: Attendance of energy engineering/technical training course

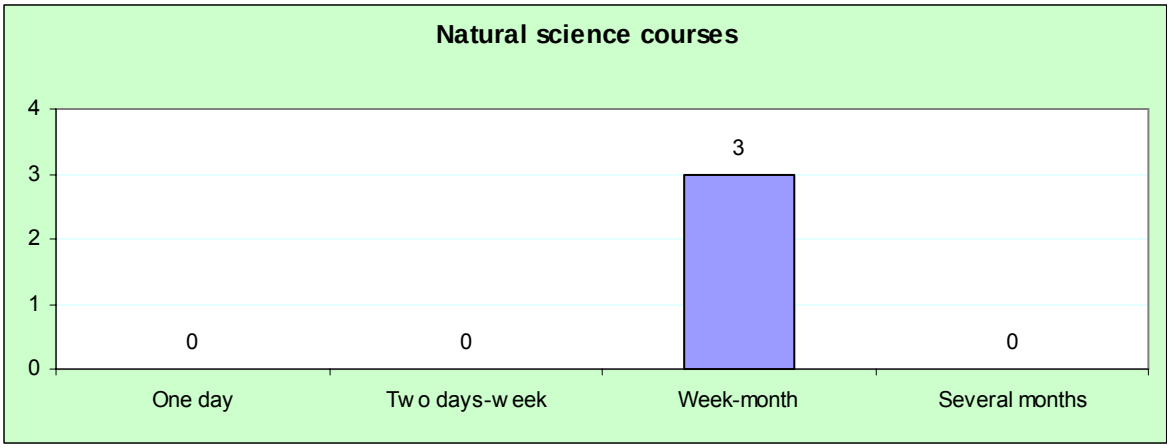

Figure 7: Natural engineering science courses

5.3 Level of Knowledge, Experience and Competence in Energy Technology:

5.3.1 Small Scale Hydro Power

Results of the survey showed that some of interviewees had excellent knowledge about hydro power. Virtually, almost all of the interviewees knew about it but had no knowledge or experience with it. In Table 3, the interviewees just emphasized about the level of knowing and understanding on hydro power.

Table 3: Experiences and knowledge in hydro power (small scale)

Hydro power (small scale), experience	Good	Some	No
Experience in mini, micro or pico hydro technical planning	16	16	28
Experience in mini, micro or pico hydro financial planning	15	17	28
Experience in mini, micro or pico hydro construction projects	12	19	29

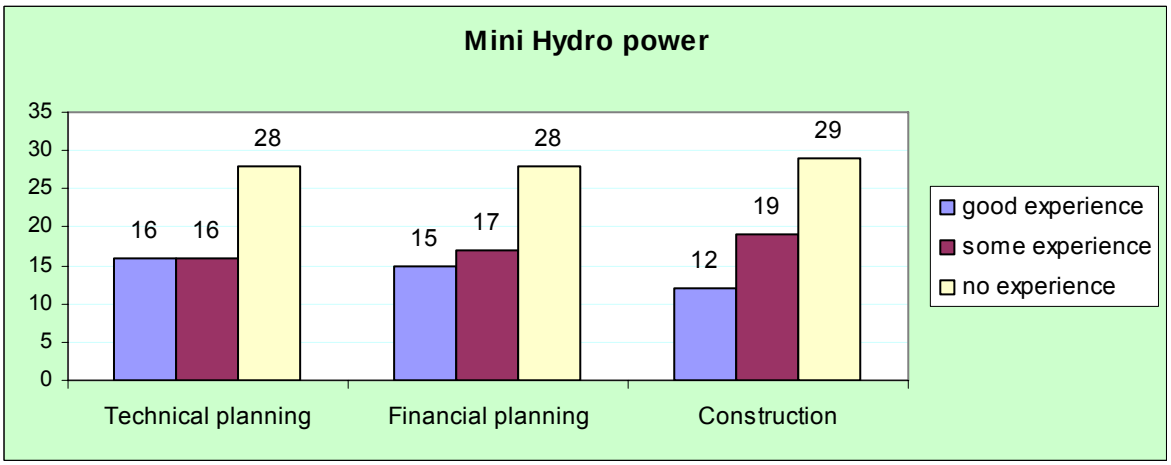

Figure 8: Mini Hydro power

5.3.2 Photovoltaic PV (Solar power)

Surprisingly, most all of interviewees had some knowledge and experience about photovoltaic PV solar due to the existence of solar PV installations in Cambodia. This equipment is imported by companies and especially used in province regions. Nevertheless, the amount of person interviewed has no experience with photovoltaic PV solar still at high level. Table 4 showed the level experience of the interviewees.

Table 4: Experience and knowledge in photovoltaic PV (Solar power)

Photovoltaic PV (Solar power), experience	Good	Some	No
Experience in Photovoltaic technical planning	2	39	19
Experience in Photovoltaic financial planning	3	24	33
Experience in Photovoltaic construction projects	3	20	37

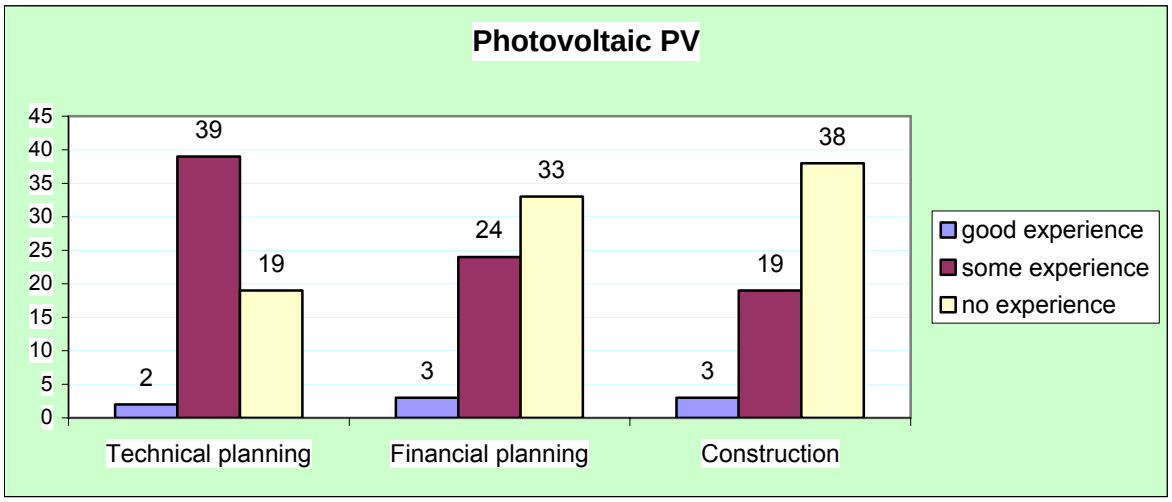

Figure 9: Photovoltaic (Solar power)

5.3.3 Solar Heat

Solar heat is not widely known by interviewees. More than half of the interviewees did not possess any experience or knowledge related to it. There is no one who has good experience with this item.

Table 5: Experience and knowledge in solar heat

Solar heat	Good	Some	No
Experience in solar heat utilization in water heating	0	13	47
Experience in solar heat utilization for drying	0	15	45

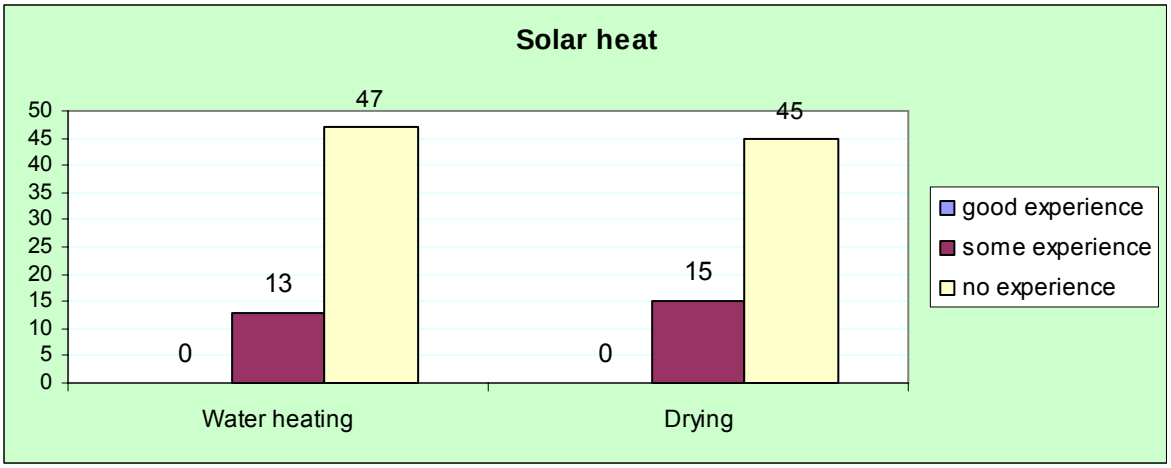

Figure 10: Solar heat

5.3.4 Wind power (small scale)

About the wind power is nearly the same to solar heat but at least 4 persons have a good experience about it.

Table 6: Experience and knowledge in wind power (small scale)

Wind power (small scale), experience	Good	Some	No
Experience in wind power technology for electricity production	2	26	32
Experience in wind power technology for water pumping or other purposes	2	24	34

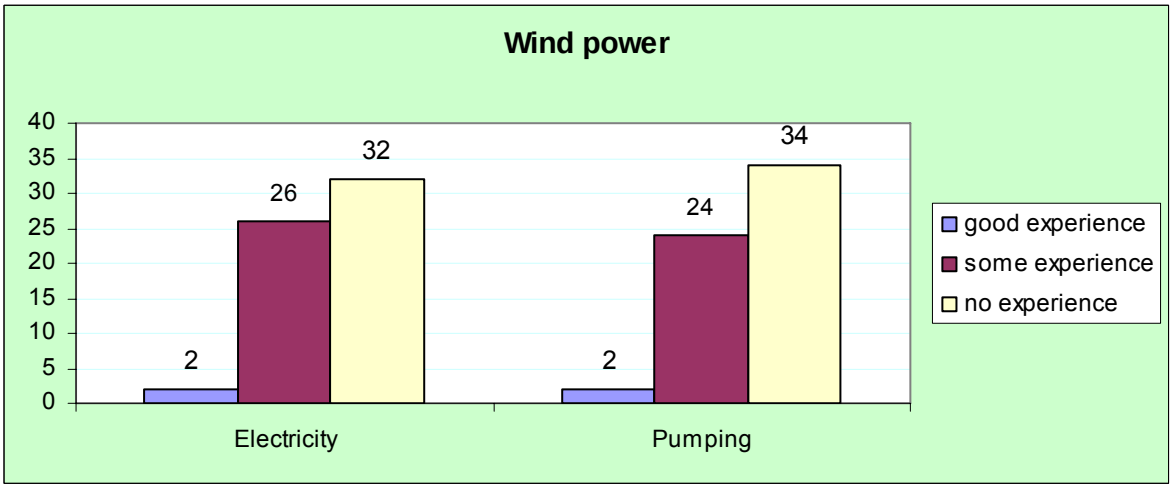

Figure 11: Wind power

5.3.5 Biomass

Biomass is the major topic in Cambodia as the royal government runs a project providing loan funds from Asian Develoment Bank (ADB) and Global Environment Facility (GEF).

Table 7 showed that only the first two questions provided resluts of good experience, more than half had no experience.

Table 7: Experience and knowledge in biomass

Biomass, experience	Good	Some	No
Experience in improved fuelwood stove technology	32	15	13
Experience in improved charcoal stove technology	31	14	15
Experience in improved charcoal kiln technology (charcoal production)	0	7	53
Experience in electricity production based on biomass gasification technology	2	6	52
Experience in electricity production based on biomass combustion technology (steam generator)	1	4	55
Experience in fluidized bed biomass combustion technology	0	8	52
Experience in grate biomass combustion technology	1	9	50
Experience in biogas production technology	1	10	49
Experience in electricity production technology based on biogas	2	6	52
Experience in cook stove and lighting technology based on biogas	1	5	54
Experience in bio diesel production technology	0	9	51
Experience in electricity production technology based on bio diesel	0	8	52
Experience in growing different oil plants for energy purposes (such as Jathropa, Oil palm etc.)?	14	16	30
Experience in growing different tree species for energy purposes	5	18	37

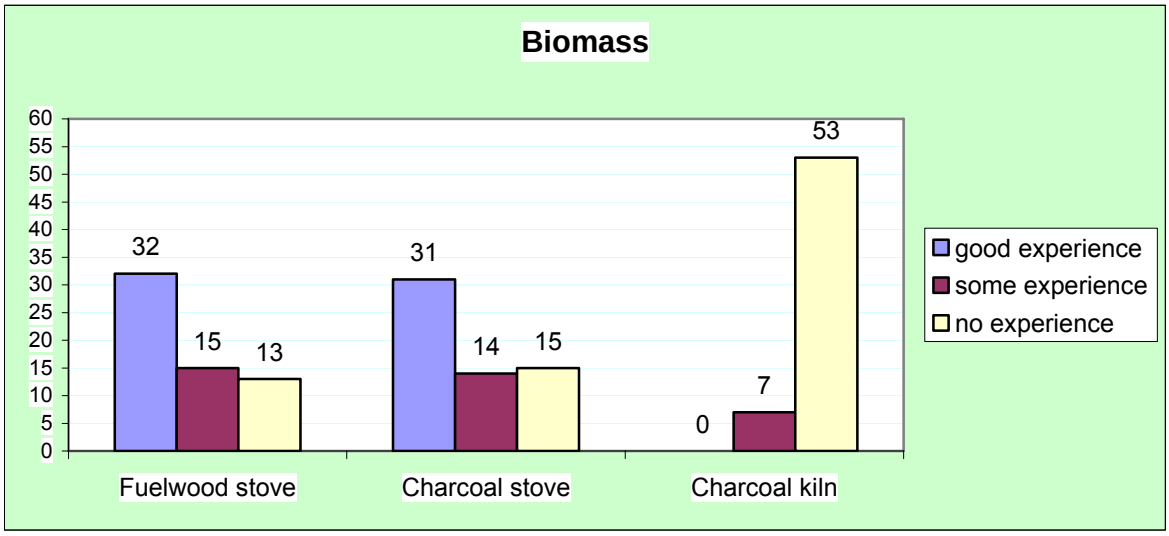

Figure 12: Biomass

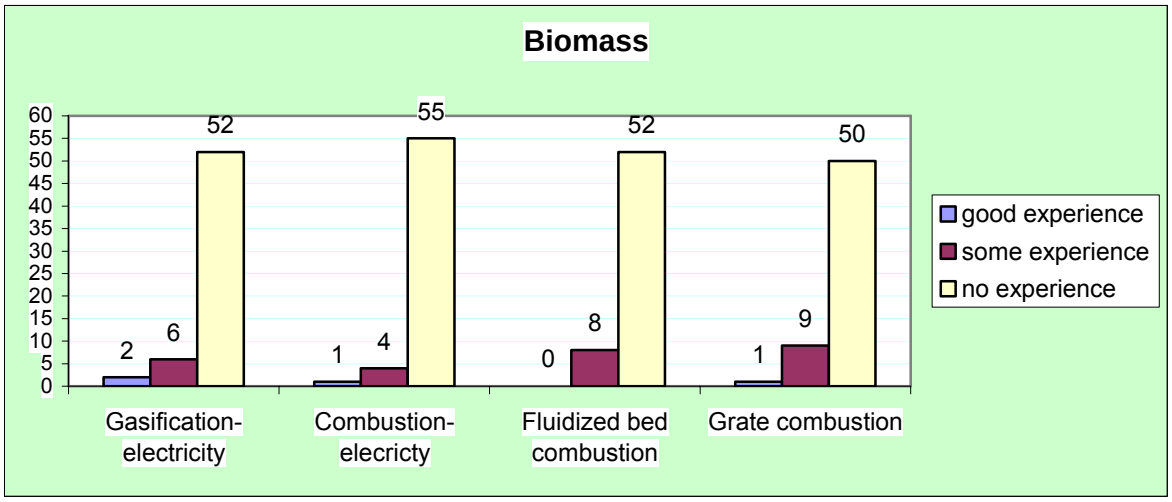

Figure 13: Biomass

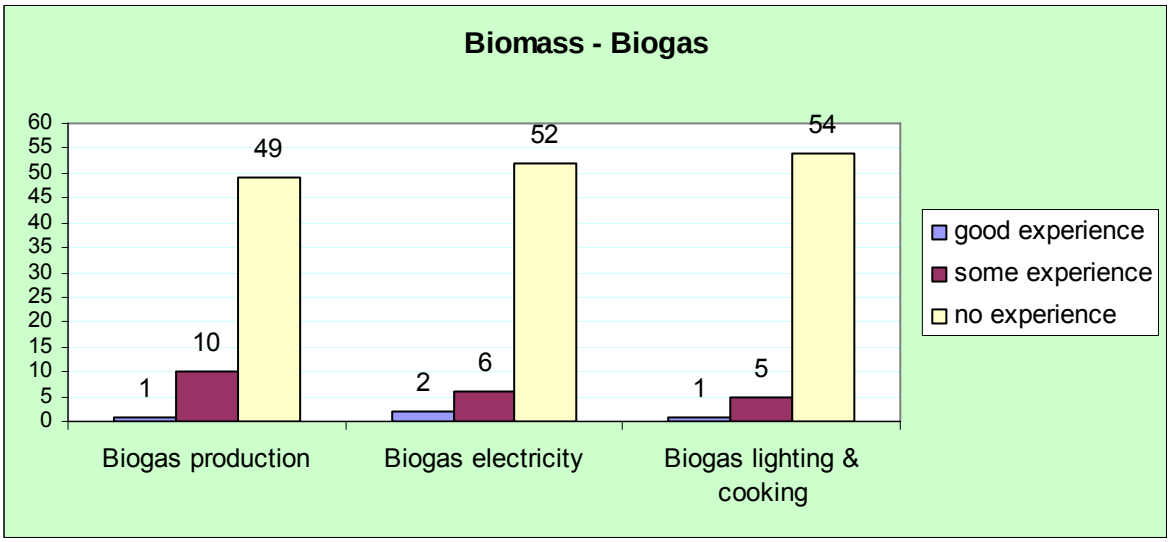

Figure 14: Biomass - Biogas

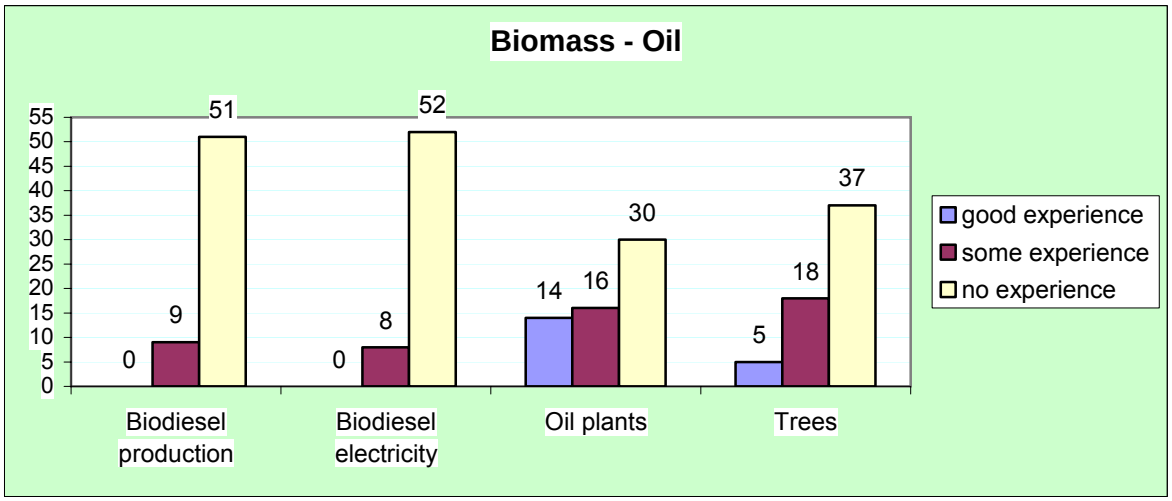

Figure 15: Biomass - Oil

5.3.6 Electricity

According to the target group selection, COMPED had chosen the interviewees related to electricity such as battery sellers and electricity contractors which can be reached 6 battery charge and 20 electricity contractors. Table 8 showed that nearly the half of the persons interviewed had a good experience related to electricity matters, around 15 – 19 persons have some experience and around 15 – 18 persons had no experience through those questionnaires.

Table 8: Experience and knowledge in electricity

Electricity, experience	Good	Some	No
Experience in electricity transmission technology (planning, construction, maintenance)	28	15	17
Experience in electricity distribution technology (planning, construction, maintenance)	26	19	15
Experience in off-grid electricity system technological planning	27	16	17
Experience in off-grid electricity system financial planning	28	14	18
Experience in off-grid electricity system construction	27	15	18
Experience in off-grid electricity system maintenance	27	17	16

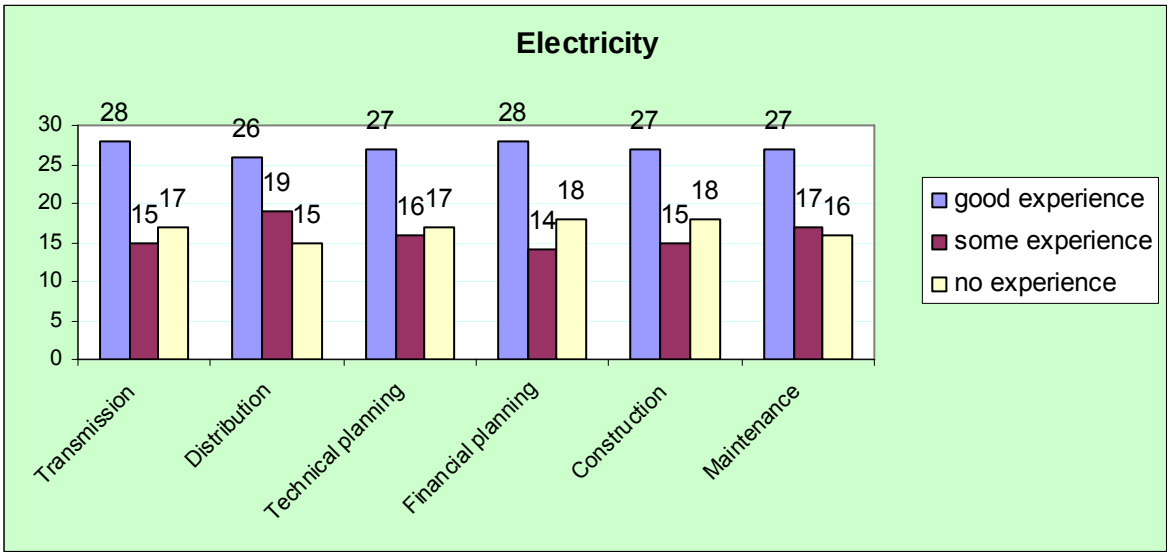

Figure 16: Electricity

5.3.7 Energy Saving

In this section, almost all of interviewees had knowledge on how to save the energy. Table 9 showed the level of their experience. The experiences they had are for example that they switch off the electricity in the morning and turn on in the evening, the limitation of using electricity capacity following contractor announced if has overloaded using electricity in each household.

Table 9: Experience and knowledge in energy saving

Energy saving, experience	Good	Some	No
Experience in energy saving	30	21	9

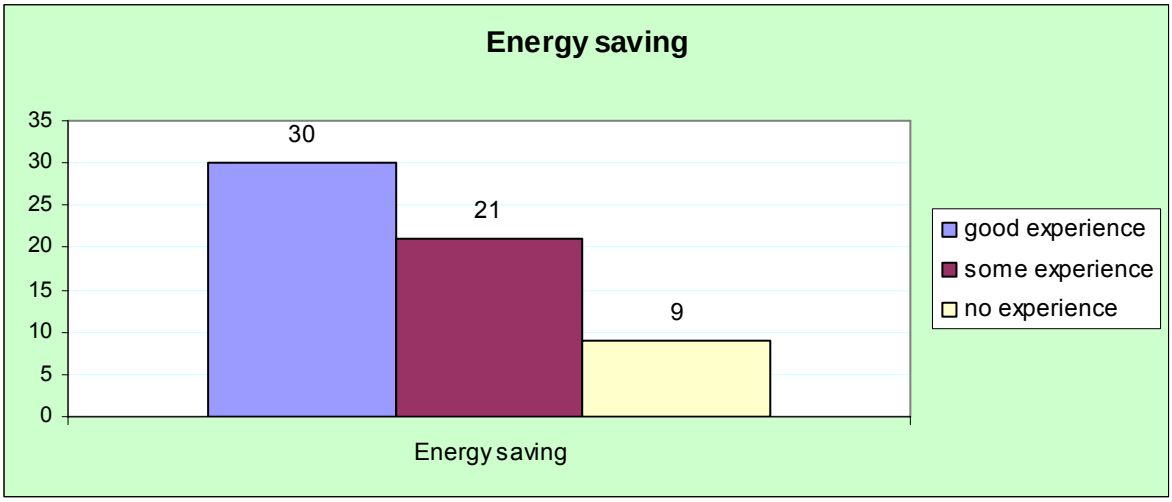

Figure 17: Energy saving

5.3.8 Other Relevant Engineering Skills

Other relevant engineering skills are necessary need for them. It can be seen in Table 10 that interviewees around 20 have good experience.

Table 10: Experience and knowledge in other relevant engineering skills

Other relevant engineering skills, experience	Good	Some	No
Energy related mechanical engineering skills (diesel motors, pumps, wind turbines, gear boxes, transmission shafts, etc.)?	15	20	25
Energy related construction skills (transmission lines, dams, housing, etc.)	20	12	28
Energy related electrical engineering skills (wiring, mounting, installation, control systems, generators, etc.)?	22	20	18
Energy related manufacturing skills	12	17	31
Energy related repairing skills (repairing, fixing, renovating, maintenance, etc.)	22	9	29

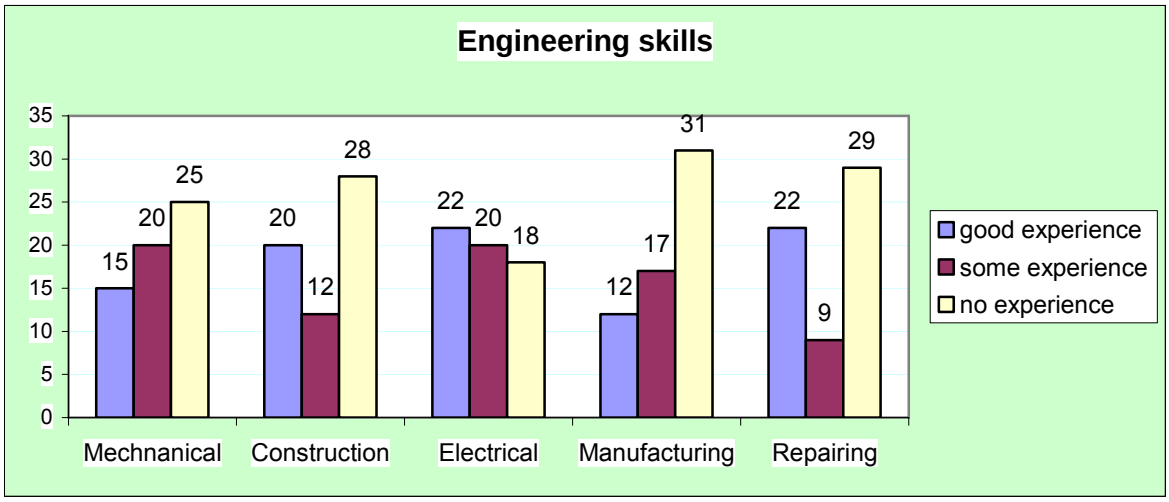

Figure 18: Engineering skills

5.3.9 Energy and agricultural production

Energy and agriculture production questions resulted in the fact that few interviewees had a good knowledge and experience. No experience still at high level in Cambodia. Table 11 showed the results of these questions.

Table 11: Experience and knowledge in energy and agricultural production

Energy and agricultural production	Good	Some	No
Energy related agricultural production skills (production of energy crops like jathropa, palm oil, agricultural waste, fertilization, breeding, seedlings, nursery, etc.)	15	11	34
Energy related agricultural production technology skills (manufacturing, machinery, maintenance, etc.)	4	16	40

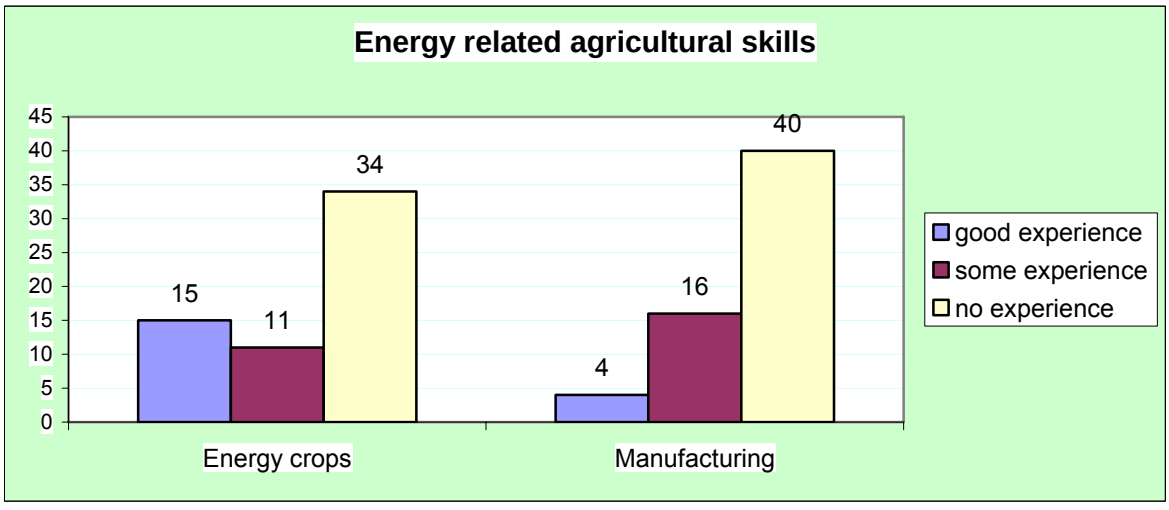

Figure 19: Energy related agriculture skills

6 Conclusions

All persons of the target groups received professional school education. Most of them left school after the primary, secondary, tertiary or vocational level. Only few interviewees obtained higher degrees, like bachelor or master.

All of the interviewees have huge experience in their present occupation, 7 years in the average and 10 years in their preliminary work. More than half of them trained themselves, on their field education, in special training courses like energy engineering/techniques, other engineering/techniques, natural sciences, and construction but only a few of the interviewees have entrance the course for one day or several days as shown in Figures 6 and 7.

Anyway, many have some knowledge and experience about the hydro (small scale), photovoltaic, instead of solar heat, and wind power no one has any experience about that. Those of the questionnaires, most of the interviewees have emphasized that they got information about it by magazines, television, and hearing from other persons. Especially questions related to hydro (small scale) and wind power were answered that they have just known about it, so the measurement of experience can not be considered valid.

Related to the questions of biomass, half of interviewed persons have good experience in two important questions, especially, in improvement fuel wood stove and charcoal stove technology. Nevertheless, 80% of interviewed persons have no experience with biomass energy.

Most participants of the target group are electricity contractors, therefore, their working experience related to electricity, energy saving and other relevant engineering skills are good, as they are familiar with these techniques by their actual daily work.

Only farmers have a good knowledge and experience with agricultural production. Most of them, plant crops which are used for their daily needs though few of them know about how to plant crops for energy using e.g. rice husk, corn, and papaya, kinds of hollyhock, sawdust, and corncob.

The interviews showed that most of the people have rather spare experience in biomass, hydro, photovoltaic PV solar, and solar heat because of they don’t have comprehensive knowledge. Since many of the topics do not obviously concern their daily work, their experience and knowledge are low. As a result of the survey it can be seen, that it is important to improve the knowledge in the renewable energy matters. With more experience in these topics, the people could enlarge their business and deal with big companies with less risk, caused by the lack of knowledge.

7 Appendices

7.1 Appendix 1: Questionnaire

Educational competence scan – Technological understanding

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, are 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.

Questionnaire
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:
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

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

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

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

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:

_____

_____

_____

_____

_____

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

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:

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?

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?

8 References

Survey of questionnaires through 60 households

Websites

http://www.adb.org

www.wikipedia.org

http://www.recambodia.org