PEREZ-GUERRERO TRUST FUND FOR ECONOMIC AND TECHNICAL COOPERATION AMONG DEVELOPING COUNTRIES

(G77 Project)

Final Report

on

Fee-for-service Pico hydro: model for providing power to remote, low-income households

INTERNATIONAL CENTRE ON SMALL HYDRO POWER

JUNE 2012, HANGZHOU, CHINA

I. Project Overview

1. **Project Title**: Fee-for-service Pico hydro: model for providing power to remote, low-income households
2. **Abstract**: This project is designed to establish a sustainable, replicable financing model to provide remote, low-income households in India and Sri Lanka with affordable, reliable electricity from innovative Pico Hydro systems on a rental basis. This project will create community service providers to provide efficient, serviced Pico hydro units through a fee-for-service programme. Removing the prohibitive capital cost of efficient systems, this project will enable an increasing amount of users to benefit from serviced Pico hydro energy against a modest fee. The business model will allow the providers to cover all expenses, including replacement costs as well as further installations without the need for additional external funds. The project will demonstrate innovative low-cost Pico hydro technology, provide training on promoting income-generating activities and create communication centers.
3. **Background Analysis**: Despite global rural electrification efforts, the poorest, most remote communities look set to remain un-electrified for logistical and financial reasons for a long time. Pico hydro is a proven technology, capable of supplying clean, renewable (sustainable) electricity to remote, low-income communities worldwide. Studies show that over 500,000 families could benefit from pico-hydro in India. And worldwide there is an estimated market of over 4 million families. The cheapest pico-hydro systems are affordable to target families, but due to poor quality and inadequate maintenance, they are not viable. Efficient systems cost between $100-150 and represent a capital expenditure which is simply too high for the target communities which could benefit most from the technology.

Despite being cheap, these are still well above what target communities can afford. In order to reduce capital costs, the project seeks to provide efficient, serviced pico hydro units to these families through a rental/fee for service. Fee-for-service has proved successful with other technologies, such as solar power, but never previously with hydro power. However considering the low capital costs associated with Pico Hydro Systems and the ease and flexibility of installation, PHS present a very attractive and replicable technology for the fee-for-service electricity model in rural areas. In the longer term, investors can provide necessary capital funds to instigate such projects, but grants are required to successfully launch the first fee-for-service pico-hydro service delivery programme. Removing the prohibitive capital cost of efficient PHS, this project would enable users to benefit from the benefits of PHS while paying a modest monthly fee. The company would own the systems, provide users with a crucial maintenance service, upgrade or downgrade installed capacity, and users would not pay when systems were out of order. Furthermore, village communities would be created to manage the local rent collection and training would be provided on essential maintenance and promoting productive uses.

This project proposes to provided pico-hydro systems of 200/500W available to remote, low-income communities not targeted by grid extension or other rural electrification schemes. It is planned to 100 pico-hydro systems in India and Sri Lanka where abundant pico hydro resources can be found. The system should are efficient, reliable, easy to operate/maintain and have a lifespan of approximately 5-years. Importantly however by implementing a fee-for-service system, this project will be able to sustain itself beyond the funding phase, solely through the income generated by PHS rental fees. As soon as the equipment is purchases and installed, the project will start to accrue income from the rental fees. Precise rental costs will depend on selected systems and communities but are expected to be around $2-3/month/system. As such monthly income once all systems have been commissioned will be around $400-500/month, which will cover operational costs, maintenance activities, expertise and travel sand subsistence fees for 3 visits to each community each year. The business plan estimates that by the end of the fourth year, income will be able to cover the cost of 300 replacement systems. The systems have an estimated lifetime of 5-10years, so this project can continue to provide electricity through pico-hydro systems, without the need for additional external funds. The excess income will be gradually reinvested into further systems. Assuming an average system of 7 years, the business plan that following the four year business estimates that after 7 years, another 120 systems could be purchased and installed.

II. Implementation

Potential: The project will collaborate with the Kerala State government of India and the Sri Lankan Energy Managers Association.

The project can be divided into four distinct stages; only the first three stages are relevant to this current project document, with the remaining two stages representing ongoing strategies into the future.

• The first phase of the project involves the selection and establishment of sites. The selection of suitable sites will be carried out by local counterpart agencies and will be based on adequate water resources and the presence of target communities i.e. remote and low-income as well as community interest in the fee-for-service program and ability to pay. Following this a reconnaissance site visit will be conducted by INSHP and local counterpart agencies. This 14-day visit will confirm relevant parameters, including site hydrology, community interest and suitability (community income, stability). The final part of this first stage includes the purchasing and shipping of the equipment. The budget is base on the purchase of 50 PowerPal systems of 200W and 50 Pico+ systems of 250W.

• The second phase of the project involves the training of staff and the initial installation:
Over 30 days, ICSHP and the its partners will provide training to local communities in:

a. Operation of the programme and financial responsibilities of users
b. Operation, installation, maintenance and security issues of systems
c. Applications of electricity: educational, recreational uses, as well as productive and mechanical uses to promote income-generating activities
d. Communication equipment (computer, internet) and applications

The project will also select and train a village society, who will be responsible for the operation of the programme. They will be trained notably in:

a. Rent collection (including how to deal with late payments etc)
b. Detailed installation, operation and maintenance of equipment
c. General programme management including reporting difficulties to local government, accommodating new customers etc

2. Benefits:

- 100 high quality 200W PHS installed
- 300 remote, low-income families provided with electricity for lighting, entertainment services and productive uses and the following benefits:
  - o Reduced CO_2 emissions and respiratory/eye problems through kerosene displacement
  - o Education: light to study in evenings, education through TV/radio
  - o Economic: increased production as chores done at night, awareness raising of savings and income generating uses like battery charging, eco-tourism etc
- 3 village committees created leading to
  - o Gender empowerment as women responsible for rent collection in village committee
  - o Training of locals in system maintenance and operation

III. Completed Activities in the First Stage

Activity – 1

Time: June 2011
Location: Zhejiang Province
Implementation: Sri Lanka SHP delegation visited IC-SHP for discussion on small hydropower project development as well as site selection and equipment purchase. IC-SHP engineers and programme officers helped to select proper sites for SHP project, and invited manufacturer for purchase of equipment specifically for the project. Besides, Sri Lanka delegation, alone with IC-SHP, visited small hydropower stations and SHP equipment manufacturers. Approximately 20 potential sites has been selected for the first batch of the project, and 40 units has been ordered for the feasible sites in first stage of the project.
Participants: Sri Lanka SHP delegation, IC-SHP

Activity – 2
Time: July 2011
Location: IC-SHP
Implementation: India SHP delegation visited IC-SHP for site selection, equipment purchase as well as technologies communication specifically for the project. ICSHP senior engineers and programme officers discussed in details with India delegation regarding to implementation of the project in India. 52 proper sites has been selected and 16 units has been ordered for the first batch of the project implementation. Manufacturer has also been invited for purchase of SHP equipment meeting the demands of the sites specifically.
Participants: India SHP delegation, IC-SHP

Activity – 3
Time: August 2011
Location: India, Sri Lanka
Implementation: IC-SHP sent small hydropower experts, senior engineers and representatives of manufacturer to India and Sri Lanka for site selection and guide on equipment installation for next stage of the project implementation. IC-SHP team worked along with local partners for carrying out on-site survey and reconnaissance, feasibility analysis as well as outlined design.
Participants: IC-SHP, India and Sri Lanka local partners

Activity – 4
Time: September 2011
Location: Hunan Province
Implementation: IC-SHP and its Chenzhou Base organized a training workshop for rural small hydropower and sustainable development in developing countries. Representatives from India and Sri Lanka were particularly invited for relevant training on small hydropower technologies specifically for the project implementation. The representatives also visited demonstrating small hydropower stations for further communication and on-site guides on small hydropower technologies and experiences for reference.
Participants: IC-SHP, India and Sri Lanka representatives

Activity – 5
Time: November 2011
Location: Zhejiang Province
Implementation: IC-SHP had a meeting with its domestic bases and manufacturer of small hydropower equipment specifically for the project. The meeting concluded the completed tasks in the first stage of implementation, and also planned for missions in the next stage of the project. IC-SHP planned to organize more SHP experts, engineers and technicians both from bases and manufacturer for continuous tasks of the project. Besides, IC-SHP and manufacturer signed agreement on purchase and order of small hydropower equipment specifically for implementation of the project in next stage. SHP technological training and communication will be continued and emphasized.
Participants: IC-SHP, SHP manufacturer

IV. Completed Activities in the Second Stage

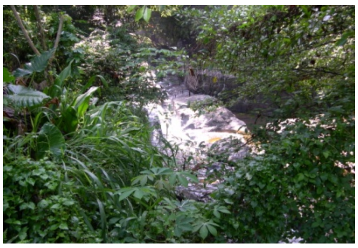
Activity – 1

Time: February 2012

Location: India， Sri Lanka

Implementation: IC-SHP small hydropower delegation of experts and engineers conducted a mission of site reconnaissance and site selection in both India and Sri Lanka for project implementation. IC-SHP staffs worked closely with local counterparts including the India sub-centre and Sri Lanka small hydropower development association for selection of proper sites of community centres as well as evaluation of joint feasibility studies.

Participants: IC-SHP, India sub-centre, Sri Lanka small hydropower development association


Activity – 2

Time: March, 2012

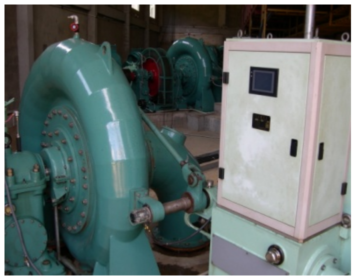
Location: Zhejiang Province

Implementation: Based on the result of reconnaissance and selection of potential feasible sites in target countries, the ordered and purchased small hydropower equipments mainly turbine generator units have been finalized with proper specifications which perfectly meet the demands of the selected sites according to the parameters particularly. In the meantime, ICSHP took the responsibility of assisting and representing the local partners of target countries for coordination and monitoring.

Participants: ICSHP, manufacturer



Activity – 3
Time: April 2012
Location: India, Sri Lanka
Implementation: IC-SHP organized expert and engineer as well as technical representatives from the manufacturer to conduct on-site technical guide and operational training for equipment installation. According to the feedbacks of some small hydropower projects in the first stage, ICSHP team and local counterparts went to several sites which were still under construction to provide technical consultation and guide particularly. The technical representatives helped local technicians for installation guide and operational training.
Participants: ICSHP, manufacturer, local counterparts


Activity – 4
Time: May 2012
Location: IC-SHP Chenzhou Base
Implementation: A training workshop on rural small hydropower and renewable energy for sustainable development for developing countries was particularly organized for the

project. The workshop was held in ICSHP Chenzhou base and supported by Chinese Ministry of Commerce and local government in Hunan province. Over 30 participants from 25 countries including the target countries involved this training in which detailed sessions mainly focused on SHP technologies, system maintenance and project operation. By such training course, local technicians of target countries particularly were promoted on capacity building of small hydropower and would be competent to follow up the project.
Participants: ICSHP, local technicians of target countries


Activity – 5
Time: June 2012
Location: China, India, Sri Lanka
Implementation: Ongoing strategies and follow-up activities of the project including SHP programme consultation, technical communication, project operation, financial raising as well as capacity building will be carried out by joint implementation of IC-SHP and local partners in continue. ICSHP will keep close cooperation with local counterparts, local government and local stakeholders on small hydropower development in target countries.
Participants: IC-SHP, local counterparts


V. Financial Costs and Expenses

The project costs for activities are strictly based on the financial budget. IC-SHP organized financial staffs specifically for evaluation and review of the economy for the project. Project leaders are also responsible for monitoring of cost for each activities regarding to the project and required for submission of periodical report to the Director General of IC-SHP for processing and stage of the project.

No.	Items	PGTF Fund	ICSHP Fund	Total
1	International travel	2,000 USD	28,788 USD	30,788 USD
2	Equipment purchase	30,000 USD	20,000 USD	50,000 USD
3	Experts fees	0	6,349 USD	6,349 USD
4	Trainings	2,000 USD	1,327 USD	3,327 USD
5	Meetings	200 USD	500 USD	700 USD
6	Domestic travels	0	1,536 USD	1,536 USD
7	Administration fee	0	1,000 USD	1,000 USD
8	Unpaid PGTF fund	3,800 USD	0	3,800 USD
	Total	38,000 USD	59,500 USD	97,500 USD

VI. Project Management and Monitoring

The project is implemented by the International Center on Small Hydropower (IC-SHP). The Chinese government appointed the Ministry of Water Resources (MWR) to ensure that national support for research and development of SHP. Chinese governments & the PGTF will co-finance the proposed consultation missions, case study on the selected SHP projects, seed money for project construction. IC-SHP(in-kind) & PGTF will co-finance the trainings. IC-SHP will provide 'in-kind' assistance for projects, which will form part of the budget contributed by the Chinese government. Progress and monitoring will be done by China International Center for Economic and Technical Exchanges, Ministry of Commerce, the People's Republic of China. 6-monthly progress report will be provided.

VII. Appendix

The attached lists and tables are small hydropower sites of target countries in which ICSHP carried out varieties of activities including technical consultation, reconnaissance, survey, site selection, design report, feasibility study, equipment installation and capacity training for implementation of the project. All the sites were selected and recommended by local counterparts for meeting growing demand of power supply to local people. The lists and tables of these sites are all under implementation of different statuses. From technical point of view, all these sites have been covered by professional assistance of ICSHP and its manufacturing base with varieties of SHP activities. However, due to limited joint funding sources of PGTF and ICSHP, not all the sites can be supported financially for equipment. Instead, some typical sites have been funded with facilities for demonstration of the project. In addition, this project will not be finished by time. The tasks and missions have been completed, but the follow-ups of the project will still be going on. ICSHP will keep close links with local counterparts in target countries for follow-ups and promotion of new projects as well as set up demonstration of small hydropower development for extensive developing countries in Asia, Africa and even Latin America.

Stations	Specification	capacity KW/ units	Installed capacity	Head / flow
Urumi II	HL153-WJ-50	800×3	2400 KW	H＝55m Q＝1.77m³/s
Kadvi	HL820-WJ-105	1600×1	1600 KW	H＝25m Q＝7.5m³/s
Kumbhi	HL820-WJ-110	2500×1	2500 KW	H＝32m Q＝9.77m³/s
Patgaon	HL820-WJ-120	2500×1	2500 KW	H＝28.08m Q＝10.42m³/s
Chitri	HLA616-WJ-92	2000×1	2000 KW	H＝40m Q＝5.87m³/s
Brenwar Project	CJA237-W-145/2×12.8	2500×2	5000 KW	H＝206m Q＝1.5m³/s
Brenwar Project	CJA237-W-145/2×14	3200×1	3200 KW	H＝206m Q＝1.87m³/s
DammAGuDum.MHP	GZJ735B-WS-420	4000×6	24000 KW	H ＝4.8m Q＝101.37m³/s

Stations	Specification	Capacity KW/ units	Installed Capacity	Head / flow
Kabaragala	CJ-W-62/2×6.5	630KW×2	1260 KW	H=255m Q=2x0.8 M^3/S
Atabga Power station	HLA550-WJ-55 HLA687-WJ-50	630KW×3 320KW×1	1890 KW 320 KW	H=78m Q=4M^3/S H=78m
	ZDT03-LH-140	630KW×2	1260 KW	
Lower Ritigala Oya	ZD560-LH-60 ZD560-LH-60	125KW×2 100KW×1	250 KW 100 KW	H=11m H=11m
Lower Guruk Oya	HLA339-WJ-60	1000KW×1	1000 KW	H=81m Q=1.52 M^3/S
Kelelgamu Power station	CJA237-W-90/1X12.5 HLA687-WJ-71	630KW×1 1250KW×2	630 KW 2500 KW	H=132m H=135m
Labuwawa Power station	HLD46-WJ-60	1000KW×2	2000 KW	H=68m Q=2x1.8 M^3/S
Samangiri Project	CJA237-W-70/2×9	800KW×3	2400 KW	H=178m Q=3x1.7 M^3/S
Kolapatana Power station	HL110-WJ-60	800KW×1	800 KW	H=88m Q=1.2 M^3/S

Ritigala Oya Phase Ⅱ	XJA-W-Z60/1×15.5	400KW×1	400 KW	H=76.5m Q=0.7 M^3/S
Hashhee Power station	HL687-WJ-50 XJA-W-40/1×10	200KW×1 100KW×1	200 KW 100 KW	H=58m H=55.5m
	CJ22-W-70/1×9.6	630KW×2	1260 KW	H=193m Q=2x0.417 M^3/S
Superba Project	XJA-W-42A/1×10	320KW×1	320 KW	H=124m Q=0.34 M^3/S
HILL Project	XJA-W-63/1×16	630KW×2	1260 KW	H=105m Q=2x0.773 M^3/S
Agra Oya Hydro	HL110-WJ-60A XJA-W-55/1×14.5	1000KW×1 600KW×1	1000 KW 600 KW	H=114m Q=1.108 M^3/S H=114m Q=0.7 M^3/S
Madura Oya Shuice	ZZJ550-LJ-190	2500KW×2	5000 KW	H=16.5m Q=2x17.6 M^3/S
Eagel power	GZ007-WZ-200	2000KW×1	2000 KW	H=11m Q=22.4 M^3/S
Eagel power	GZ008-WZ-200	600KW×1	600 KW	H=4m Q=19.3 M^3/S
Jennet Valley	HL820-WJ-60	500KW×2	1000 KW	H=25m Q=2x2.411 M^3/S
Koladeniya	HAJ551C-WJ-78	630KW×2	1260 KW	H=23m Q=3.61 M^3/S
Wallawaya	HLA520-WJ-60 XJA-W-551×13.5	800KW×1 800KW×1	1600 KW	H=93m Q=0.587 M^3/S
WWII	HLA855-WJ-66	1669KW×2	3338 KW	H=82m Q=2.3 M^3/S

Sl. No.	Name of the Scheme	District	Basin	Installed capacity (MW)	Annual energy Generation (Mu)
1	Parakkadavu	Kottayam	Pamba	10.00	21.58
2	Kalladathani	Kollam	Ithikkara	3.50	9.50
3	Adakkathode	Kannur	Valapattanam	2.50	7.70
4	Kokkamullu	Kannur	Valapattanam	2.00	4.80
5	Onipuzha	Kozhikkode	Onipuzha	1.50	3.16
6	Mundakayam	Kottayam /Idukki	Manimala Ar	1.25	3.08

7	Chathamala	Kannur	Valapattanam	1.00	2.08
8	Peruva	Kannur	Peruva	2.00	5.00
9	Thirunelli	Wynad	Bharathapuzha	1.20	2.60
10	Madatharuvi	Pathanamthitta	Madatharuvi	1.00	2.00
11	Malothi II	Kasargod	Malothi puzha	0.80	1.50
12	Kakkadampoyil Stage-I	Kozhikkode	Chaliyar	21.00	52.22
13	Kakkadampoyil Stage-II (8+3MW)	Kozhikode	Chaliyar	11	19.87
14	Arippara	Kozhikkode	Chaliyar	3	10
Detailed investigations done					
15	Kozhiyilakuthu	Idukki	Pooyankutty	1.00	4.57
16	Panamkudantha	Pathanamthitta	Pamba basin	0.50	1.69
17	Kishumam	Pathanamthitta	Pamba basin	3.00	7.78
18	Malothi I	Kasargod	Malothi puzha	2.00	4.70
19	Perimpala	Kannur	Perumpuzha	0.80	1.94
20	Kuthirachattam #	Kasargod	Payaswini	2.00	10.20
21	Malothy III	Kasargod	Malothi puzha	0.45	0.92
22	Fulongkara	Kannur	Kilikattthode	0.35	1.04
23	Pilachikkara	Kasargod	Pilachikkara	0.35	1.00
24	Odanpuzha	Kannur	Bharathapuzha	0.30	0.98
25	Peruthody #	Kasargod	Chandragiri	0.85	1.95
26	Pathankayam	Kozhikkode	Iruvanchi puzha	4.00	10.62
27	Anakampoil	Kozhikkode	Iruvanchi puzha	6.75	21.98
Preliminary investigation done					
28	Keezharkuthu	Idukki	Kaliyar basin	15.00	49.80
29	Chittur upper**	Idukki	Chittur	6.00	14.24
30	Kuliramutty	Kozhikkode	Perumboola	3.00	6.58
31	Urulikuzhi (Mamalakandam)	Ernakulam	Periyar basin	3.00	7.82
32	Thoniyar**	Ernakulam	Thoniyar	2.60	8.40
33	Urumbini	Pathanamthitta	Kakkad	2.20	10.97
34	Thuval	Idukki	Eastern Kallar	1.00	3.00
35	Thanniyadi	Kasargod	Kuyangad thodu	0.50	1.57
36	Haritheerthakkara	Kannur	Peruvamba	0.10	0.25
Feasibility studies conducted					

37	Kaithakolli diversion	Wynad /Kannur	Kaithakolli	10.00	25.01
38	Kanjirakolly	Kannur	Urumbinipuzha	5.00	11.18
39	Ezhamthala	Pathanamthitta	Pamba /Kallar	3.50	16.47
40	Mukkadavu	Kollam	Mukkadavu Ar	2.25	5.83
41	Anakkal	Kottayam	Azhutha	2.00	8.64
42	Kazhuthurutti	Kollam	Kazhthuruthi river	2.00	2.27
43	Meenmutti	Wynad	Kabani	1.50	3.30
44	Muthappanpuzha	Kozhikkode	Iruvanki puzha	1.50	3.59
45	Uruttipuzha	Kannur	Cheruthi puzha	1.00	3.43
46	Lower Marmala	Kottayam	Meenachal	0.90	4.20
47	Kozhichal	Kannur	Kariyamkode	0.75	1.82
48	Cheruvakkilchola	Thrissur	Mangad	0.74	
49	Aruvikkal	Ernakulam	Valiathodu	0.50	1.36
50	Anavilasam	Idukki	Periyar	0.30	1.15
Other Identified schemes					
51	Chembukatti	Palakkad	Palakkuzhipuzha	6.50	14.32
52	Koodam	Palakkad	Siruvani/Kallanthode	4.00	9.76
53	Inchavarakuthu	Idukki	Periyar	3.00	6.00
54	Chemmannar	Idukki	Chemmannur	1.00	2.62
55	Kangapuzha	Idukki	Panniar	0.75	3.00
56	Randamkadavu	Kannur	Randamkadavu	0.50	0.99
57	Aruvikuzhipara/ Marangattupally	Kottayam		0.30	1.32
			Total MW/Mu	**165.49**	**443.35**

BALANCE POTENTIAL SITES IDENTIFIED BY PEDA FOR SETTING-UP OF SMALL HYDRO PLANTS (YET TO BE ALLOTTED)

Total Sites : 45

Sr. No	RD in Ft.	Fall (Mt.)	Discharge (Cumecs)	Tentative Power Potential (KW)	Name of the Site	District
1.	2.	3.	4.	5.	6.	7.
I. UPPER BARI DOAB CANAL SYSTEM:						
a)	**Main Branch Upper**					
1	123653	3.16	32.50	850	Aliwal	Gurdaspur
	Total			**850KW**		
b)	**Main Branch Lower**					
2	75000	0.40	30.00	100	Fatehgarh Sukarchak	Amritsar
3	113400	2.4	30.00	600	Doburji	Amritsar
	Total			**700 KW**		
c)	**Kasur Branch Upper**					
4	0 to 900	1.40 0.30 1.70	108.67	1350	Tibri	Gurdaspur
5	20540	0.59	108.67	516	Manchopra	Gurdaspur
	Total			**1866 KW**		
d)	**Kasur Branch Lower**					
6	0	1.887	37.84	600	Sathiali	Gurdaspur
7	11200	1.95	36.11	580	Kalabila	Amritsar
8	29540	2.68	48.88	610	Kalu Sonal	Amritsar
9	46288	2.50	45.28	310	Rampur Dhima	Amritsar
10	75860	2.13	41.03	520	Panj Garain	Amritsar
11	108260	2.13	37.00	300	Bhoewal	Amritsar
12	134070	1.21	24.91	250	Tarsikka	Amritsar
13	148900	0.304	24.71	60	Gehri	Amritsar
14	168400	0.304	22.30	60	Jandiali	Amritsar
15	178150	0.914	21.34	160	Jandiali	Amritsar
16	195660	2.045	19.55	330	Pakhoke	Amritsar
17	229601	1.753	11.13	160	Muradpur	Amritsar
18	257753	0.564	11.08	50	Chotala	Amritsar
19	273674	1.146	10.77	100	Jaura	Amritsar
	Total			**4090KW**		
e)	**Sabraon Branch**					
20	0	0.70	53.30	300	Sathiali	Gurdaspur
21	34160	2.42	43.00	850	Tugalwala	Gurdaspur
22	54000	1.75	41.60	600	Harchowal	Gurdaspur
23	72400	1.52	35.75	450	Sukhwal	Gurdaspur
24	94780	2.05	29.29	500	Ladha Munda Attwal	Gurdaspur
25	114750	1.83	27.34	400	Buttar	Gurdaspur
26	127250	1.68	26.70	375	Ghaggar Bhana	Gurdaspur
27	155750	1.798	15.22	230	Rayya	Gurdaspur
28	199459	1.932	7.45	120	Nagoke	Gurdaspur
29	242660	0.396	7.36	20	Khanchabri	Gurdaspur
	Total			**3845 KW**		
	Grand Total of UBDC System			**11351KW**		

II.	**SIRHIND CANAL SYSTEM**					
a)	**Abohar Branch Canal**					
30	360000	2.387	5.27	100	Sibian	Faridkot
	Total			**100 KW**		
b)	**Bathinda Branch Canal**					
31	371000	0.27	34.04	80	Gobindpura	Bathinda
32	411329	0.97	22.05	180	Bathinda	Bathinda
33	448000	1.30	21.68	230	Teona	Bathinda
34	476560	0.097	15.24	10	Jangirana	Bathinda
	Total			**500 KW**		
c)	**Sidhwan Branch Canal**					
35	0	1.18	49.63	490	Manpur	Ludhiana
36	72500	1.003	43.96	370	Jawadhi	Ludhiana
	Total			**860 KW**		
d)	**Kotla Branch**					
37	0	0.46	86.56	330	Bharthiala	Sangrur
38	342850	0.24	12.75	30	Maur Khurd	Bathinda
39	368500	1.25	11.10	120	Jodhpur	Bathinda
40	426128	1.56	6.14	30	Kot Bakhtu	Bathinda
	Total			**510 KW**		
	Grand Total of Sirhind Canal System			**1970 KW**		
III	**Ghaggar Link / Ghaggar Branch**					
a)	**Ghaggar Link**					
41	57590	1.37	38.09	430	Rothi	Patiala
	Total			**430 KW**		
b)	**Ghaggar Branch**					
42	118000	2.40	26.13	500	Gujjran	Sangrur
43	135000	2.72	10.20	230	Sullar	Sangrur
44	172000	2.68	7.53	170	Dialpura	Sangrur
	Total			**900 KW**		
	Grand Total of Ghaggar Link & Ghaggar Branch			**1330 KW**		
IV	**Holy Bein**					
45	Kanjli	2.50	11.33	200	Kanjli	Kapurthala
	G.Total Potential			**14851KW**		

Grand Total Potential of Balance 45 sites = 14851KW

Say 14 MW

Power Projects in Kerala

Sl. No.	Name of Station	Installed Capacity (MW)		Firm annual Generation Capability
		Nos	MW	MU
Hydro Electric Projects (KSEB)				
1.	Idukki	6 x 130 MW	780	2398
2.	Sabarigiri	5 x 55MW + 60 MW	335	1338
3.	Idamalayar	2 x 37.5 MW	75	380
4.	Sholayar	3 x 18 MW	54	233
5.	Pallivasal	3 x 4.5 MW + 3 x 8 MW	37.5	284
6.	Kuttiyadi	3 x 25 MW + 3 x 50 MW	225	583
7.	Panniar	2 x 15 MW	30	158
8.	Neriamangalam	3 x 17.55 MW + 25 MW	77.65	295
9.	Lower Periyar	3 x 60 MW	180	493
10.	Poringalkuthu & PLBE	4 x 8 MW +16 MW	48	244
11.	Sengulam	4 x 12 MW	48	182
12.	Kakkad	2 x 25 MW	50	262
Sub Total (HEP)		**49 Nos**	**1940.2**	**6850**
Small Hydro Electric Projects				
13.	Kallada	2 x 7.5 MW	15	65.00
14.	Peppara	1 x 3 MW	3	11.50
15.	Malankara	3 x 3.5 MW	10.5	44.00
16.	Madupatty	1 x 2 MW	2	6.40
17.	Malampuzha	1 x 2.5 MW	2.5	5.60
18.	Lower Meenmutty	1 x 0.5 MW +2 x 1.5 MW	3.5	7.63
19.	Chembukadavu - 1	3 x 0.9 MW	2.7	6.59
20.	Chembukadavu - 2	3 x 1.25 MW	3.75	9.03
21.	Urumi -1	3 x 1.25 MW	3.75	9.72
22.	Urumi -2	3 x 0.8 MW	2.4	6.28
23.	Kuttiyadi Tail Race	3 x 1.25 MW	3.75	15.00
24.	Poozhithode SHEP	3 x 1.6 MW	4.8	
Sub Total (SHEP)		29 Nos	57.65	186.75
Total (Hydel units)		**78 Nos**	**1998**	**7036.8**