Seminar on Small Hydro in Georgia

Georgia, Tbilisi, Hotel „Tori“
5 May 2005

Seminar Proceedings

Within the framework of the Project SHYCA -
“Promotion of Small Hydro Power
Retrofitting and Implementation in the
Caucasus and Carpathian Region”

Organisers:

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Contents

Summary

1. Introduction

The Seminar on Small Hydro in Georgia was the first of three seminars planned in the framework of SHYCA. The other two will take place in Yerevan, Armenia in September 2005 and Odessa, Ukraine in April 2006.

Main goal of the Seminar was to clarify the situation in the field of Small Hydro in Georgia; compare it with the situation in Armenia, Azerbaijan and Ukraine; and find out which financing opportunities are there for Small Hydro in Georgia.
The Participants of the seminar were: SHYCA Partners, energy experts, the Ministry of Environment of Georgia, NGOs and financial institutions.

2. Opening

In the opening session, the European partners of SHYCA made their presentations.

Dr. Christian Epp from WIP - Renewable Energies (SHYCA project coordinator) welcomed the participants and presented the project, its objectives and strategies. Many participants expressed the will to cooperate with SHYCA.

Maria Laguna from ESHA presented small hydropower policy and market development in Europe, underlining the necessity of further encouragement of small hydro.

3. Small Hydro in Georgia, Armenia, Azerbaijan and Ukraine

In the beginning of the second session, extensive discussion concerning the situation in Georgia took place. Many participants expressed that in their view, the present state of Small Hydro is not satisfactory, especially in view of the long history and high potential of the sector in Georgia.

Victor Dundua resumed the situation in Georgia. He reported that about 30 small HPSs are operating in Georgia nowadays, for comparison 220 small HPSs with total capacity of around 50000 kilowatt were operating in the early 60s. He also mentioned the technical potential of small rivers in Georgia which exceeds 8 TWh per year. He presented a successful project of construction of a small hydro power station in Bolnisi region and talked about the circumstances in which a small hydro project can be feasible.

Revaz Sulaberidze presented a fundamental survey made in early 90s, which clearly highlighted the enormous potential of Small Hydro in Georgia.

Levon Aghekian from Institute of Energy reported about the situation in Armenia, where Small Hydro is rapidly developing. 18 new small HPPs were constructed during the last 5 years and licenses for 19 new ones were issued, mostly due to well coordinated governmental support.

The situation in Azerbaijan was presented by Rauf Mustafaev, director of Azerbaijan Research Institute of Energetic and Energy Design (AzRIED), he underlined the advantages of Small Hydro and reported a big potential in Azerbaijan: 164 new small HPPs with total output of 3.2 billion kWh/year could be built on the rivers and water supply installations.

Sergei Artemenko from Solar Energy Centre Odessa (SEC) described state of affairs in Ukraine, a big amount of statistical information was reported to the seminar participants: 7.9% of electricity produced in Ukraine is produced by hydro power stations, overall hydropower capability of small rivers in Ukraine is 3.7 TWh per year, total economical potential of small rivers in Carpathian region is 1901 min kWh per year.

4. Stakeholder reports

After the intense discussion about the differences and similarities in Small Hydro state of affairs in different countries, important stakeholders in the field of Small Hydro in Georgia made their contribution to the Seminar.

Paata Janelidze made a detailed and very informative presentation, about CDM (Clean Development Mechanism) possibilities for Small Hydro in Georgia. He reported about the situation in the specific sector, alluded to the political situation and mentioned some projects which aim to support the development of Small Hydro in Georgia.

The Caucasus consultant of KfW, Gerald Hübner, presented the project: “Programme to Promote Renewable Energies” which is being implemented under Trilateral Co-operation of: GEF (through UNDP), government of Germany (through KfW) and Government of Georgia (through Ministry of Energy and Fuels and Ministry of Environment). The project with a total budget of 13,15 million USD aims to create an revolving found for promotion of Small Hydro and Geothermal Power in Georgia.

The representative of PA Consulting Group George Ramishvili reported about the projects in the field of small hydro implemented by PA Consulting and financed by USAID: Energy Efficiency/Renewable Energy Program 2000/2003 and Georgia Energy Security Initiative 2003/2006.

Participant List

ABULASHVILI G.	Energy Efficiency Centre (EEC)	Georgia
AGHEKIAN L.	Institute of Energy	Armenia
ARTEMENKO S.	Solar Energy Centre (SEC)	Ukraine
BIRKADZE S.	Georgian Hydro Power Ltd.	Georgia
CHKHARTISHVILI L.	PA Consulting Group	Georgia
DADIANI M.	Energy Efficiency Centre (EEC)	Georgia
DUNDUA A.	Autoenergo Ltd.	Georgia
DUNDUA V.	Hydro-Solar association	Georgia
EPP C.	WIP Renewable Energies	Germany
GABITSINASHVILI G.	GTU	Georgia
GIGIBERIA G.	GRIPEPS	Georgia
HÜBNER G.	KfW	Germany
JANELIDZE P.	Climate Change Department	Georgia
JAPARIDZE G.	Autoenergo Ltd.	Georgia
JAPARIDZE V.	Autoenergo Ltd.	Georgia
KAPANADZE S.	GTU	Georgia
KEKELIA B.		Georgia
KHACHIDZE E.	energouzrunvelkopa Ltd.	Georgia
LAGUNA PEREZ M.	ESHA	Belgium
LOMIDZE I.	Tbilaviamsheni	Georgia
MACHARASHVILI S.		Georgia
MIZANDARI I.	Hydro-Solar association	Georgia
MUSTAFAEV R.	AzRIED	Azerbaijan
QASIMOV A.	AzRozMontazh Ltd.	Azerbaijan
RAMISHVILI G.	PA Consulting Group	Georgia
SULABERIDZE R.		Georgia
TSIKARISHVILI G.	Tbilaviamsheni	Georgia

AGENDA

SHYCA-Seminar, 5 May 2005. Hotel "Tori", G. Chanturia str. 10, 0108 Tbilisi, Georgia

Opening		
10.30 – 12.00	**Welcome and Introduction** **Presentation of SHYCA** **European Policy in Small Hydro sector**	**Dr. Christian Epp** WIP Renewable Energies **Maria Laguna** ESHA
coffee break		
Small Hydro in Georgia, Armenia, Azerbaijan and Ukraine		
12.20 – 14.20	**Overall discussion** **Survey on Small Hydro in Georgia** **Small Hydro in Armenia** **Small Hydro in Azerbaijan** **Small Hydro in Ukraine**	All participants **Revaz Sulaberidze** **Levon Aghekian** Institute of Energy **Rauf Mustafaev** AzRIED **Sergei Artemenko** Solar Energy Centre
Lunch break		
Stakeholder reports		
15.40 – 17.30	**CDM market for renewable energies** **KfW project in Georgia** **PA Consulting Group activities in Georgia**	**Paata Janelidze** Climate Change Department **Gerald Hübner** Caucasus consultant of KfW **George Ramishvili** PA Consulting Group
coffee break		
Closing session		
17.45 – 19.00	**Small Hydro in Georgia – resume** **Closing discussion**	**Victor Dundua** Association "Hydro-Solar" All participants

Abstracts of presentations

Small Hydro in Georgia

Victor Dundua,
Association "Hydro-Solar"

Development of Small Hydro in Georgia

Small Hydro has a very long history in Georgia, the first HPS with electrical capacity of 220 kilowatt was built in 1898 in Borjomi region. The construction of small HPSs went on and by the begin of the second WW there where about 55 small HPSs with the overall electrical capacity of around 14000 kilowatt.

In years 1945-1951 about 130 small HPSs were built, this were mostly very small ones. The average Electrical capacity of the HPSs built in these years is about 50 kilowatt.

In the early 60es the whole energy system of the Soviet Union was restructured. Small HPSs where declared economically not feasible and strategically unimportant. Most of them where put out of operation. At that time Georgia had about 220 small HPSs with overall capacity of around 50000 kilowatt.

Potential of Small Hydro in Georgia

Georgia has a big amount of small rivers, the technical potential of these rivers is about 8 TWh per year. This rivers are mostly placed in mountain areas of Georgia, which suffer from severe energy shortages. So Georgia has both: Hydro potential and the need to use it. Furthermore, Georgia has good human resources in the field of Small Hydro, school of energetic was always strong and there still are many good specialists in the country.

Present state of Small Hydro

As already mentioned, nearly all Small HPSs where put out of operation in the early 60es, but in the early 90es after the fall of Soviet Union Small Hydro became yet again important for the country. In this years there was severe energy crisis in Georgia and the rehabilitation of Small HPSs could strongly help to overcome it, but money shortage and high corruption rate in the government prevented the full revival of this very important branch.

Today there are about 30 operational Small HPSs in Georgia, others need to be rehabilitated. In different cases a refurbishment of different complicity is required. Some must be practically fully new built, most of the HPSs require fundamental refurbishment.

Example of the successful Small Hydro project

That Small Hydro projects can be feasible in Georgia is proven by the following example:

In 2003 micro HPS was built in Bolnisi. The construction was ordered by the boarder defence department. Electrical capacity of the HPS is 50 kilowatt; average annual production – 349 500 kWh per year. Total costs of construction equal to: 112456 GEL ~ 47 000 €. Price of electricity produced in a year – 28000 GEL ~ 11 500 € (price of 1 kWh – 0.08 GEL). The HPS will produce the amount of electricity value of which will cover the construction costs in 47 000 : 11 500 ~ 4.1 years.

The main reason why this project is so economically feasible is that in this case the department fully consumes whole electricity produced by Bolnisi HPS and there are no intermediaries between the energy production and energy consume.

Possible example of feasible small hydro projects in Georgia

Scenario A: **construction** of a small hydro power station.

Total costs of construction	100 000€
Electrical capacity of the HPS	100 kilowatt

Annual electricity production	800 000 kWh
Price of 1 kWh	0.065 GEL (Price assumes autonomous operation)
Costs per kilowatt:	
Loan costs	0.06 GEL
Maintenance costs	0.005 GEL
Gross income per year	0.065 x 800 000 = 52 000 GEL
Annual loan repayment	0.06 x 800 000 = 48 000 GEL = 20 000 €

Scenario B: **rehabilitation** of an existing hydro power station.

Total costs of rehabilitation	100 000€
Electrical capacity of the HPS	200 kilowatt
Annual electricity production	1 500 000 kWh
Losses	20 % ~ 300 000 kWh
Price of 1 kWh	0.077 GEL
Costs per kilowatt:	
Loan costs	0.04 GEL
Maintenance costs	0.005 GEL
Distribution costs	0.032 GEL
Gross income per year	0.077 x 1 200 000 = 92 000 GEL
Annual loan repayment	0.04 x 1 200 000 = 48 000 GEL = 20 000 €

Financing by a low interest rate credit.

Loan	100 000€
Loan duration	6,5 years (78 months)
Interest rate	5%
Repayment frequency	every 6 months
Repayment sum	10 000€
Grace period	6 months

Table of repayments

	6-monthly repayments	Repayments on loan amount	Interest due
1	**2 500**	-------	2 500
2	**10 000**	7 500	2 500
3	**10 000**	7 750	2 250
4	**10 000**	7 881	2 119
5	**10 000**	8 078	1 922
6	**10 000**	8 280	1 720
7	**10 000**	8 487	1 513
8	**10 000**	8 700	1 300
9	**10 000**	8 917	1 083
10	**10 000**	9 140	860
11	**10 000**	9 368	632
12	**10 000**	9 602	398
13	**6 455**	6 297	158

Conclusion: Both projects could completely pay back their loans within 6.5 years.

The State of Small Hydro Power in Armenia

Levon Aghekian
Institute of Energy

1. From the number of all small HPPs in Armenia only two are state-owned. All the others are private. From 25 small HPPs constructed in the 80s, 16 are privatised, the others are not privatised because of their technical-economical characteristics and they are in not - operational order. The total capacity of these 16 small HPPs is equal to 32 MW, the total calculated output of electricity is about 100 mln. kWs. From these 16 small HPPs at least 12 need repairs.
In the result of the conducted state policy for creation and enlarging of the private sector in the sphere of energy for last 5-6 years 18 new HPPs with total capacity of 15 MWs are built and 4-6 are in the stage of construction. According to the plans of hydraulic power engineering development, putting into production of all the feasible hydro potential of Armenia is envisaged, which comprises 3.5 bln. kWhs.

2. In 1991, the "Scheme of Small HPPs of Armenia" was elaborated. In 1996 with the assistance of the European Community it was improved envisaging the utilization of the feasible energy potential of the small rivers in Armenia. According to this scheme, it is supposed to construct in Armenia 300 small HPPs with total capacity of 270 MW and total output of 700 mln. kWh. On the basis of this scheme, the list of first rate HPPs was prepared, which was submitted to the European Community for investment attraction. The project design financing for these HPPs is supposed by the European financial structures, and in the future the financing of the construction of HPPs is envisaged.
In 2003-2004, in the framework of TACIS programme "Substitution of the Nuclear Power through the Development of the Hydropower Capacity of Armenia" the German company Fichtner elaborated the feasibility study of one large and four small HPPs which were included in the Scheme.

3. The main curbing factor of the small hydro energy development in Armenia is the shortage of financial means. The bank system of Armenia do not provide credits in such volumes and in those conditions which are necessary for construction of small HPPs.
The repairs of small HPPs requires investments from several ten thousands up to millions of USA dollars depending on the state of the power plants.

4. For the repairs of the HPPs in Armenia, the necessary construction basis is existing comprising construction materials, machines and mechanisms, and the industrial basis having corresponding machine-tools and equipment is sufficiently developed. Besides, there are specialised enterprises such as "EnergoRepairs" OJSC and "Energonaladka" CJSC, which can provide the required reconditioning repair and adjustment works. Referring to certain volumes and costs of repair works, the latter depends on certain HPP. The answer to this question demands detailed studies of the HPPs being subject to repairs, information about the conditions of financing and discussion with the owners of these HPPs.

5. In 2001, in Armenia the new Law on Energy was adopted according to which during 15 years (until 2016) the electricity generated in the small HPPs will be bought by its 100 %. For small HPPs on natural watercourse, the tariff of 4.5 c/kWh (without VAT) is defined and the tariff of 3c/kWh is defined in the case of utilization of already constructed hydraulic engineering objects. This brought to the construction of 18 new small HPPs during last 5 years and licenses for 19 new ones were issued.

CDM Market for Renewable Energies

Paata Janelidze,
Manager of the UNDP/GEF-KfW Project "Georgia – Promoting the Use of Renewable Energy Resources for Local Energy Supply"

Present situation in the field of Renewable Energies in Georgia

Climate change mitigation is one of the main priorities of environmental policies of Georgia. Implementation of GHG abatement policy through investment projects facilitates sustainable development of the National Economy. Georgia has ratified following important conventions in this filed: Convention on Biodiversity; Convention on Trans-boundary Air Pollution; Convention on Desertification.

Development of Renewable Energy Resources is one of the main GHG Abatement Measures and there is a high technically exploitable potential of RE resources in Georgia. Nevertheless RER are practically unused in Georgia, except for hydro resources. Barriers to develop RER in Georgia are:

- High capital investment needed;
- Limited access to the advanced technologies;
- Absence of attractive financing schemes;
- Changes in legislative and regulatory framework are needed in order to create favorable environment;
- Lack of highly educated project developers, managers, operators.

There are two big projects which aim to promote Renewable Energy in Georgia.

The name of the first one is: "Georgia – promoting the use of renewable energy resources for local energy supply". This project is finances by: GEF (through UNDP) – USD 4.3 million; Government of Germany (through KfW) – EURO 5,112,918; Government of Georgia – USD 150,000; Other local sources – USD 3.4 million.

Main objectives of the project are.

- Removing the key barriers to the increased utilization of local renewable energy resources. The initial focus will be on promoting the use of geothermal resources for hot water supply and the use of small hydro power for local electricity production
- The activities are designed to be replicated in a regional context for countries in the Caucasus and in the broader CIS region
- A specific emphasis throughout the project implementation will be placed on leveraging additional financial resources for the capitalization of the proposed Renewable Energy Fund

Second project is "Dept for environmental swap in Georgia". The project is not being implemented yet. Selected potential project pipelines under "Debt for environmental swap in Georgia" are:

- Rehabilitation of existing and construction of new mini hydropower plants;
- Biogas production from animal wastes;
- Solid waste management in medium and small settlements along the coastal areas and Kura-Aras basin.

CDM in Georgia

Georgia satisfies all three CDM eligibility criteria:

- Georgia has ratified Kyoto Protocol in 16.06.1999
- Georgia has several times expressed its intention on voluntary participation as a Party in CDM

- The Ministry of Environment Protection and Natural Resources of Georgia is designated as the CDM national authority.

Following is written in the recently adopted Economy Development and Poverty Reduction Program of Georgia: "In conformity with the requirements of the Kyoto Protocol, efforts will be made to establish the Clean Development Mechanism". Importance of participation in CDM is also emphasized in Draft of the National Renewable Energy Strategy of Georgia. So it can be said that CDM is deeply integrated in Development Plans of the Georgian Government.
Important CDM market players in Georgia are:
•Host country:
✓Government of Georgia;
✓DNA;
✓Industries;
✓Project Developers
•Investors/Buyers of CER:
✓Government of Denmark;
✓EBRD;
✓WB Carbon Funds;
✓Private companies (Germany, Netherlands)

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Survey: "Concept of development of Small Hydro"

Revaz Sulaberidze
GRIPEPS

Information on the survey
The survey "Concept of development of Small Hydro" was accomplished according to the order of the council of ministers in year 1991. Following specialists participated in this work: N. Emukhvari (Ltd. Tbilhydroproecti); G. Qoridze (Ltd. Tbilhydroproecti); T. Ashba (Ltd. Tbilhydroproecti); R. Sulaberidze (Ltd. Saqenergo); O. Solomonia (Georgian Research Institute of Power Engineering and Power Structures) and M. Berelashvili (Ltd. Saqtskalproeqti).

Results and conclusions
As the result of the survey 362 Small HPSs were listed, 278 of them are to be built others are existing HPSs that require refurbishment. Overall electrical capacity of these 362 HPSs is 2.68 million kilowatts, average annual electricity production – 13.4 billion kWh. Only small HPSs (with electrical capacity < 10 MW) from this list have overall electrical capacity of 932,6 thousand kilowatt and average annual electricity production – 5,88 billion kWh. Social, economical and environmental issues were also analysed in the framework of this survey.

Following conclusions were made:

- Georgia possesses an enormous potential for development of Small Hydro
- Nowadays only a very small part of this potential is being used
- Development of Small Hydro will positively affect social, economical and environmental situation in Georgia

The State of Small Hydro Power in Azerbaijan

Rauf Mustafaev
Azerbaijan Research Institute of Energetic and Energy Design (AzRIED)

It is well known, that the European Community countries obtain about 16% of electric power from renewable sources. The hydraulic power engineering ranks high among them, and within last years the interest for small hydraulic power engineering significantly grows. It is quite natural, because small hydro power unlike the big hydro power has its own number of advantages:

a) Simplicity and cheapness of hydraulic constructions- in practice all small hydraulic power plants (HPP) are of diversion type;
b) Quick construction;
c) Possibility of autonomous utilization;
d) Solving the social problems of remote areas.

For all this, while the sources of small capacities from tens and hundreds of kilowatts to tens of megawatts power are used in them, the cost of 1 kWh power output does not much exceed the same, produced by big HPPs (for a maximum version 0.1 doll./kWh as against 0.08 doll./kWh).
Small hydraulic power engineering development has its retrospective in Azerbaijan. According to available data in 1951 year 45 rural HPPs were operating in republic, 22 of them were of up to 50 kW capacity, 23 of more than 50 kW, 13 small HPPs were in building process in this period and 3 HPPs were planned to build. Within the period of up to 70s years of last century small HPPs of 36.7 mW total capacity generated about 167 million kWh electric power. In this years, in connection with big HPPs and thermal power plants inputting into operation and centralized power supply development, the small HPPs' construction was not only stopped, but also the existing small HPPs fell into decay, and presently they all are in a state of neglect and their equipment needs to be fully replaced and constructions rehabilitated.

During last years the definite preconditions on development of the new stage of hydraulic power resources assimilation with the help of small HPPs construction and rehabilitation are outlined. It is necessary to note once more the advantages of small HPPs - the possibility to supply the consumers of remote areas with electric power; raising the power availability per man of local consumers; improving the local inhabitants' living standard; the possibility to build and rehabilitate of HPPs at the expense local labour and material resources; short term of construction and rehabilitation, needlessness for new lands flooding.

According to preliminary data 164 new small HPPs with total output of 3.2 billion kWh/year could be built on the rivers and water supply installations.
And now I will present you the list of privatizing small HPPs in Azerbaijan and also the characteristics of small HPPs, planned to build in nearest time.

LIST
OF PRIVATIZING SMALL HPPs IN AZERBAIJAN

N°N° In succession	HPPs name	Place name	HPPs location	HPPs type	River flow rate m^3/s		HPP discharge m^3/s	HPP head m	Characteristic of regulated run-off, integrated hydro- scheme's duty
					50% availability; average over many years	85-90% availability; average over many years			
1	2	3	4	5	6	7	8	9	10
1	Sheki HPP	Kishchay river	Sheki town	Diversion	2.48	1.82	1.25	165.0	Complex power water supply
2	Cusar HPP	Samur-Absheron canal	Cusar district SDC settlement		Q_{max} of canal 50 m^3/h	26.0		7.0	Irrigation, power engineering
3	Cuba HPP	Kudialchay river	Cuba town		6.82	4.4	3.54	45	Power engineering
4	Mugan HPP	Main Mugan canal	Imishli district		63.0	36.5	63.0	7.8	Irrigation, power engineering
5	Zurnabad HPP	Gyanjachay river	Zurnabad village Khanlar district		4.25	2.99	4.14	87.5	Power engineering, irrigation
6	Zeykhur HPP	Higher Zeykhur irrigation channel	Zeykhur village Cusar district		69.0	49.9	9.5	107.5	Power engineering, irrigation
7	Chinarli HPP	Shamkhorchay river	Chinarli village Shamkhor district		8.24	5.95	1.0	31.2	Power engineering, irrigation
8	Belocan HPP	Belocanchay river	Belocan town		4.37	3.12	0.9	30.0	Power engineering, irrigation
9	Neygedi HPP	Karachay river	Neygedi village Cuba district		2.24	1.64	0.75	69.5	Power engineering, irrigation

HYDRAVLIC CHARACTERISTICS OF PLANNED FOR SMALL HPPS CONSTRUCTION THE DIVERSION CANALS AND WATER STORAGES.

I. DIVERSION CANALS

1. Samur- Absheron canal:
   a) Cuba chute H=18 m; Q=40 m^3/s
   b) Divichi chute H=25 m; Q=35 m^3/s

2. Higher Shirvan canal:
   a) Karamaryam chute H=30 m; Q=55 m^3/s

3. Higher Karabakh canal:
   a) Agjibedi chute H=40 m; Q=100 m^3/s

4. Mugan canal (Imishli): H=7 m; Q=60 m^3/s

5. Mill canal (Fizuli): H=80 m; Q=40 m^3/s

5. Urvi canal (Gusari): H=180 m; Q=4 m^3/s

II. WATER STORAGES:

1. Kazakh water storage: V=55 million m^3 H=40 m; Q=4 m^3/s

2. Lencoran water storage: V=54 million m^3 H=54 m; Q=8 m^3/s

3. Masalli water storage: V=45 million m^3 H=30 m; Q=6 m^3/s

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The State of Small Hydro Power in Ukraine

Dr. Sergey Artemenko
Solar Energy Centre, Odessa (Ukraine)

Basic Information about Ukraine
Population of Ukraine is 47,425,336,
Total area: 603,700 sq. km
GDP growth rate: 12 %
Industrial production growth: 15.8%
Electricity
– production: 180 billion kWh
– consumption: 132 billion kWh
–Electricity production by source: Nuclear – 43.5%; Fossil fuel – 48.6%; Hydro – 7.9%

Small Hydro potential in the Ukraine

Quantity of small rivers in Ukraine exceeds 63 000, total length of these rivers is 135.8 10^3 km and the hydropower capability is 3.7 TWh/a.

The total technical potential of the small rivers in Carpathian region is 4188 min kWh/a, the economical potential – 1901 min kWh/a.

State acts to support RES

National energy program for the period till 2010 (1996)

–According to the program non-traditional and renewable energy will cover 10% of the total energy demand of the national economy in 2010.

The Law of Ukraine № 555-IV *"On alternative sources of energy"* (2003)

–It is only framework Law, which defines legislative, economic, ecological and organizational basis for the utilization of alternative sources of
energy and promotion for their use in fuel-energy complex.

Kyoto Protocol ratification (2004)

Energy Strategy of Ukraine till 2030. Draft version.

–2010 – RES use is 6.6 mtoe (4.7% of Primary Energy Consumption)–2030 – RES use is 21.8 mtoe (17% of Primary Energy Consumption)

Law of Ukraine *"On corrective action to the Law of Ukraine "On power energy".*

Draft version. This draft Law was developed according the schedule of works on adaptation of Ukrainian legislation to EU legislation.

The Main Barriers for the Small Hydro development in Ukraine are: Uncertainty with energy objects privatization; Domestic lobbying; Insufficient promotional activities; Low-level of economic schemes to support the RES utilization; Absence of monetary support.

The key players in the field are: Ministry of Fuel and Energy, Kiev; Institute of Renewable Energy, Kiev; Local authorities in regions; "Oblenergos" (regional energy structure); NGOs; *Foreign agencies (Austrian Energy Agency, GTZ)*

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Presentation of SHYCA

Dr. Christian Epp
WIP renewable energies

The exploitation of the vast small hydro potential in the NIS offers enormous socio-economic and environmental benefits. Consequently, small hydro power generation has a long tradition in these countries. Due to neglect in favour of a more centralised energy supply during the Soviet period, one third of existing small hydro plants are now out of operation.

The SSA "SHYCA" aims to revive the existing know-how and infrastructure for small-hydro energy generation in NIS. The Caucasus and Carpathian region are ideal starting locations, with a high potential for small hydro and severe electricity shortages. The revival of the small hydro sector has already begun and urgently requires external support.

The proposal SHYCA will perform a complete technical and socio-economic assessment of small hydro retrofitting and construction using extensive, existing, but dispersed data. The consortium includes strong and competent players in Georgia, Armenia, Azerbaijan and Ukraine, who have

detailed knowledge on the existing and planned small hydro capacity of 670MW. The SSA SHYCA will systemise and update this existing data. Cost effective plans for retrofitting and for constructing new plants will be formulated. In parallel a comprehensive analysis of socio-economic and political framework conditions will be performed as well as an extensive stakeholder analysis with emphasis on experienced NIS manufacturers and key European actors.

A Compendium for Small Hydro Power Action including all relevant technical and socio-economic data and including 3 feasibility studies will be compiled, and used as a tool for involving EU actors in small hydro actions in the region, and support political and economic decision-makers.
A broad dissemination and exploitation of project results throughout NIS will be ensured with a broad PR campaign in Russian language.

Through this carefully planned action, the Caucasus and Carpathian regions will serve as a platform to re-launch the small hydro sector in the entire NIS.

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Small Hydropower Policy and Market Development in Europe

Maria Laguna
European Small Hydropower Association (ESHA)

EUROPEAN SMALL HYDROPOWER ASSOCIATION

Approximately 70% of the earth's surface is covered with water, a resource that has been exploited for many centuries. The exploitation of hydropower has been characterized by continuous technical development, making it the leading renewable energy source in the EU. Hydro power now accounts for around 84% of electricity generated from renewable sources in the EU-15, and 13% of total electricity There is no consensus on the definition of SHP, but here it will be defined as any small scheme with an installed capacity up to 10 MW. This is the definition adopted by the European Small Hydropower Association (ESHA), the European Commission and the International Union of Producers and Distributors of Electricity (UNIPEDE). SHP has a huge, as yet largely untapped potential, which should enable it to make a significant contribution to future energy needs, offering a very good alternative to conventional sources of electricity, not only in Europe but also in developing countries.

Policy Framework in Europe
SHP has a key role to play in the development of Europe's renewable energy resources, and an even greater role in developing countries. In the face of increasing electricity demand, international agreements to reduce greenhouse gases (such as the Kyoto Protocol), environmental degradation from fossil fuel extraction and use, and the fact that, in many European countries, large hydro power sites have been mostly exploited, there is an increasing interest in developing SHP.

This trend has been enhanced by the European Commission's White Paper on renewable energy[1] and by the EU renewable energy Directive[2] (RES-e Directive) both of which give a clear signal that the use of renewable energies must increase in order to reduce environmental impacts and create a sustainable energy system. The Directive sets quantified national targets for consumption of electricity from renewable energy sources, promotes national support schemes (plus, if necessary, a harmonized support system), simplifies national administrative procedures for authorization, and guarantees access to transmission and distribution of electricity from renewable energy sources. The White Paper calls for 12% of energy from renewables, while the Directive sets specific goals to reach 22% of electricity use from renewables in the EU by 2010. For SHP, this means achieving an ambitious target of 14 GW of installed capacity by 2010 14 GW, generating 55 TWh of electricity (see Table 1). As well as setting out a Community strategy and action plan to double the share of renewable energy from 6% to 12% by 2010, the White Paper establishes sub-targets for various sectors, preserves flexibility in how these targets are to be met in view of Community enlargement, and introduces a tri-annual review process. The action plan includes internal market measures, reinforcement of EU policies, and improved co-ordination between Member States.

TABLE 1. White Paper SHP scenario for 2010

Feature	**2010 scenario**
Installed capacity	> 4500 MW
Electricity generation	55 TWh
Gross energy consumption	4.75 Mtoe

Small Hydropower market development depends on a coherent, predictable, supportive political & legal framework.

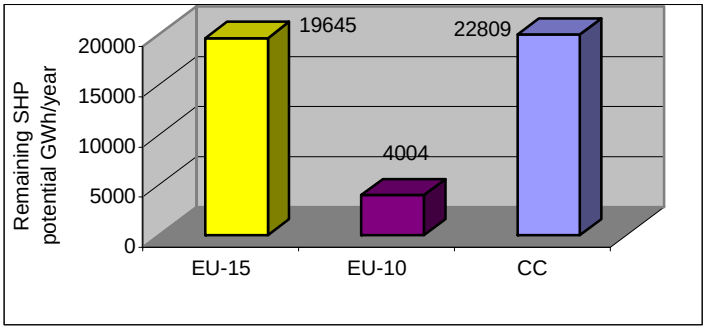
Plant Profile

In 2002 there were 14,488 plants in the EU-15, mostly located in Germany (42.8%), France (11.9%), Austria (11.7%), Sweden (11.1%) and Italy (10.4%), 2700 in the New Member States (EU-10) and 380 in the candidate Countries (CC). The average capacity of an SHP plant in the EU was about 0.7 MW in Eu-15, 300MW EU-10 1.6 MW in EU-CC.

Installed capacity, electricity generation and Potential

The total installed capacity of SHP plants in New Member States and CC (1400 MW) is at least 10 times smaller than in the former EU-15 (10 000 MW). Electricity generation by SHP plants in the former EU-15 (40 000 GWh/year) is considerably higher by comparison to the EU-10 (2300 GWh/year and the CC (1200 GWh/year); production is nearly 15 times bigger than in the EU-10 and 30 times than in the CC.

The remaining economically feasible potential amounts to some 20 TWh/year in EU-15. 26 TWh/year in the New Members States and CC. The majority of this potential (roughly 80% or 19 300 GWh/year) is located in Turkey. Poland and Romania rank second, having indicated potential 6 to 10 times lower than that of Turkey



EU-10: New Member States since 2004
CC: Candidate Countries

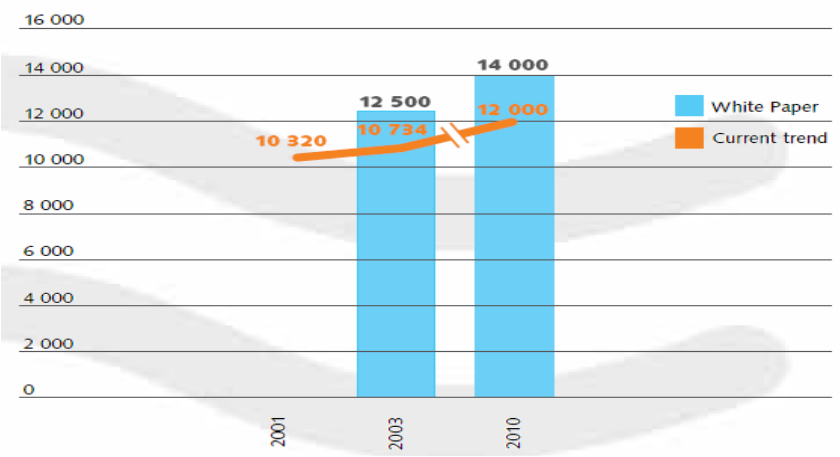
SHP only represented 9% of the RES electricity generation in the EU-15 in 2002. This contribution is similar to wind and lower than biomass. In almost all New MS and CC hydropower is the dominant source of energy in RES-E production

Costs

Power production costs for SHP-generated electricity will not fluctuate much in the future for being a mature technology. Further development will therefore focus on installation costs. Two potential areas of improvement exist, the first concerning cost reductions for heads smaller than 15 meters, the second for developments supplying less than 250 kW. Large proportion of the potential in Europe involves low-head plants

Trends for the future

Following the annual growth rates of 2%/year in the last 10 years, the European SHP installed capacity would be around 12 000 in 2010. This figure is clearly far short of the European Commission White Paper target of 14000 MW.



Barriers for further development

Since the RES-E Directive is in force a further development of SHP has taken place. Due to the implementation of support schemes, which establish more favourable tariffs for the electricity produced by SHP However the real barriers the SHP has to cope with are: Administrative and Environmental. Indeed, At present, numerous institutional barriers still stand in the way, mainly resulting from the difficulties inherent in gaining permission to abstract water from rivers, but also due to the perception that hydro plant adversely affect fishing. Difficulties in gaining affordable connections to the grid are also common, although this situation is tending to improve.

At the same time, pressure from environmental groups – which can oppose SHP for its negative local environmental impacts on river ecosystems – hinders progress in many developed countries. Sometimes no distinction is made between the impact of large hydro and that of small hydro schemes. Such opposition is often related to specific cases and should not be applied to SHP across the board. However, new technology and improved methods of operating SHP are steadily reducing its adverse environmental impacts, while involving local communities in the planning, design and management process is helping to change negative perceptions of SHP.

The SHP industry has been affected by exaggerated criticisms of negative environmental impacts which ignore its important environmental and social benefits. These include: replacing fossil fuels, thus reducing greenhouse gas emissions, air pollution and resource depletion; and boosting the local

economy of isolated populations. Since SHP provides autonomous and reliable energy, it is suitable for co-operative or communal ownership; and combined with irrigation systems it is an appropriate solution in developing countries. In the last few years, much emphasis has been put on the environmental integration of SHP plants into river systems in order to minimize impacts to the ecosystem and enhance the quality of the aquatic environment.

Necessary Conditions and Solutions

A sustainable market for SHP requires a number of conditions:

In European policy:
•Establishment of legally binding targets
•Raise Awareness
•Reduce adminsitrive barriers
•Change of subsidies policy
•Increase R&D for renewables and grid integration

And for outside Europe:
•Combine energy and development policy
•Shift towards RES in international financial institutions
•International collaboration a must
•CDM an opportunity

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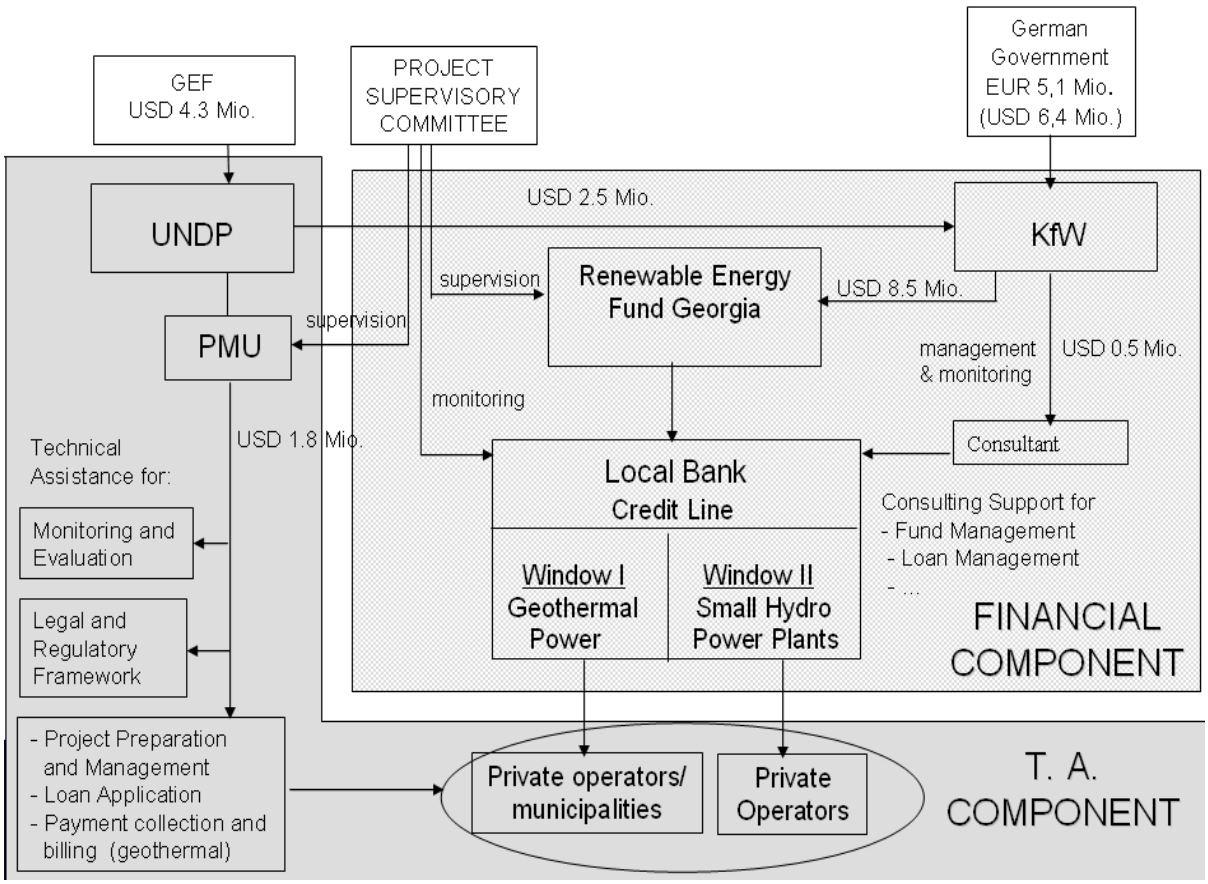
Programme to Promote Renewable Energies

Gerald Hübner
KfW Entwicklungsbank

The Project - Key Features

- Trilateral Co-operation
  GEF/UNDP, Germany/KfW, Government of Georgia / Ministry of Energy and Fuels / Ministry of Environment
- other key Stakeholders
  private commercial Banks / private owners of small hydels who wish to invest in their plants / Georgian power sector (wholesale market, GNERC)
- Volume
  some 5 to 7 projects - total volume some EUR 11 Mio. – external contributions as grant
- substantial Technical Assistance
  project related and geared at improving the legal and institutional framework conditions
- two sectors
  small hydro / geothermal power

Project Structure



Costs and Financing

	Share of the owners	**German Grant**	**GEF/ UNDP**	**Total**
Investment / Rehabilitation	**3,40**	**6,44**	**2,00**	**11,84**
Consultant			**0.50**	**0.50**
TA – Programme			**1,80**	**1,80**
Total	**3.40**	**6.44**	**4.30**	**13.15**

in USD million

Roles of the Banks
Project preparation based on Sponsors ideas:
based on risk considerations and strength of potential borrower
Extension of Loans:
Banks take the credit risk -> Extension of loans will be the ultimate decision of the banks
Fund Administration:
details to be decided
Conditions:
in foreign exchange or GEL
terms to banks (tenor, interest rate, redemption free years)
terms to final borrower (tenor, interest rate)
PPA with large consumers:
should be concluded and approved by GNERC
Contracts with guarantees:
e.g. guarantees regarding completion, performance (e.g. rated output)
fixed term contracts without price revision
Sponsors own contribution:
at least 30% of investment cost / drawn down equity vs debt / pari passu
TA Support :
to Appraise Projects

Requirements of the Banks
The Banks shall have:

- audited financial statements according to IAS standards;
- a minimum risk-weighted capital adequacy ratio of 12%;
- an adequate asset size and credit portfolio to handle loans in the range of USD 1 million;
- sound credit policies preferably with international consultants or staff presence in the Board or Credit committee
- experience in project financing based on business plans and cash flow projections with similar loan sizes; and
- an active loan portfolio in the energy sector.

KfW‘s Responsibilities
KfW will on behalf of Georgia (Based on an Agency Agreement):

- select the Georgian Banks and negotiate the Framework Financing and Management Agreement;
- select an independent consultant who shall assist and train the Georgian Bank and negotiate the relevant consulting agreement;
- monitor and supervise the execution of the Project concerning the setting up and operation of the Fund by the Georgian Bank and related consulting services.

Project Supervisory Committee
Tasks:

- General Policy Guidance
- Supervision of Funds Administration (notably Utilization of Funds)
- Supervision of TA Program on Improvement of Legal and Regulatory Framework

Representation in the Supervisory Committee:

- Government of Georgia (Ministries of Finance, Energy, Environment)
- Foreign Investment Advisory Council
- UNDP
- KfW

PA Consulting Group activities in the field of small hydro

George Ramishvili
PA Consulting Group

In the course of the year 2002 and 2003 in Georgia, six small-scale hydroelectric generation demonstration projects were developed through out the country within USAID Energy Efficiency & Renewable Energy program. This paper describes the procedure of program preparation and construction with USAID funding and participation of local Georgian counterparts.

The goal of promoting renewable energy in the rural areas in Georgia is that Georgia cannot afford to generate and import enough energy and maintain the distribution network so that to satisfy the demand of the people living in the remote rural locations. Another not less significant effect will be the positive environmental impact. The Georgia Energy Security Initiative (GESI) followed the program 2002/2003 EE/RE program, four years program also financed by USAID, which among other tasks focused on the Community Development activities, which would be based on the improved and reliable energy supply preferably from the locally available renewable energy sources, mostly from hydro.

Topics covered:

Georgian energy crisis.
Fuel data for Georgia.
2000/2003 EE/RE program preparations.
Required trainings.
Selection of project sites.
Construction
Anticipated results.
Benefits.
2003/2006 GESI program description
Required trainings.
Selection of project sites.
Construction
Anticipated results.
Benefits.

Total costs for the both programs were just over $2 300 000. According to preliminary data, the simple paybacks of the projects vary from three to seven years. Local engineers, contractors and community-based organizations did all works. As for the equipment and materials the majority of them were manufactured and purchased locally. This paper shows an example of how a country can begin improving its energy situation with minimal outside help.