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## Hydropower Investment Promotion Project (HIPP)

# HYDROPOWER INVESTMENT OPPORTUNITIES

## Summary of Cluster Development Proposals

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(HIPP)

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IN COLLABORATION WITH BLACK & VEATCH AND PIERCE  
ATWOOD ATTORNEYS LLC.

USAID/CAUCASUS OFFICE OF ENERGY AND ENVIRONMENT

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# HYDROPOWER INVESTMENT OPPORTUNITIES

## Summary of Cluster Development Proposals

There are a large number of potential hydropower sites in Georgia. Individual project opportunities range from a few kilowatts to 740 MW. Many of the sites have been studied at some level. The Ministry of Energy has compiled available information on many of these sites. That information for small- and medium-size developments is summarized in a database posted on the Ministry's web site, and information on larger sites can be requested. The database is located at:

<http://hpp.minenergy.gov.ge/index.php?lang=eng>

This summary report highlights three project clusters that are proposed for development:

- Kvirila River
- Upper Rioni River
- Upper Tskhenistskali

A low-impact run-of-river project, in the small and medium size classes (between 10 MW and 100 MW), is proposed for each of these sites. A number of projects can be clustered – to give an overall project capacity of 100 MW or more (see tables below).

Some of the sites described are listed in the Ministry database and some are newly identified. The level of detailed information currently available varies from site to site.

## **KVIRILA RIVER UPSTREAM CLUSTER**

The Kvirila River rises on the west slope of the watershed divide between the Caspian and Black Seas, and flows through the City of Zestaponi before entering the Rioni River south of Kutaisi. Average rainfall in the upper basin generally exceeds 1,000 mm per year. The main river above Zestaponi, and several of its tributaries, include a number of attractive hydropower development sites. A few small projects have been studied to some extent and are included in the Ministry's database. A number of larger opportunities have recently been identified by HIPP, and are listed here.

Access to the sites is generally excellent, with roads and/or railroad lines nearby.

The Kvirila River main stem parallels a railway serving the manganese mines above Chiatura, for about 40 km upstream of Zestaponi. This eliminates any possibility of storage projects or larger diversion dams in this reach, but run-of-river projects will be possible. Upstream of Sachkhere and on tributaries, there are relatively fewer limitations on development alternatives.

The Dzirula River, the main tributary, is a very steep stream that generally follows Highway 1 as it descends westward from the Rikoti Tunnel.

The characteristics of the proposed sites are shown in the tables below.

## Kvirila River

Name	Database ID Number	Catchment Area km <sup>2</sup>	Installed Capacity MW	Average Annual Energy GWh	Plant Factor	Gross Head m
Jria*	23	162	9.2	53.1	.66	180
Chala†	65	312	9.1	45.6	.57	74
Salieti‡	none		9.0	49.6	.66	37
Boslevi‡	none		18.7	109.4	.66	52
Shovopani ‡	none		19.4	113.8	.67	50
<b>Total</b>			<b>47.1</b>	<b>272.8</b>		

\* Layout in the database includes a trans-basin diversion and a small reservoir.

† Layout in the database includes a small reservoir.

‡ Preliminary results of an analysis dated October 2010

## Dzirula River Sub-Basin

Name	River Name	Database ID Number	Catchment Area km <sup>2</sup>	Installed Capacity MW	Average Annual Energy GWh	Plant Factor	Gross Head m
Boriti	Dumala	8	29	4.6	18.6	.46	370
Khunevi*	Dzirula	76	200	11.3	61.6	.62	220
Vertkhvila‡	Dzirula	none	tbd	19.5	103.4	.62	98
Dzirula‡	Dzirula	none	tbd	12.5	64.9	.60	65
Tseva‡	Dzirula	none	tbd	11.0	59.5	.62	55
<b>Total</b>				<b>43.0</b>	<b>227.8</b>		

\* Layout in the database includes a modest-size reservoir.

‡ Preliminary results of a new analysis by HIPP, totals are from these plants. There are minor overlaps between river reaches developed by these plants and Boriti and Khunevi developments, to be resolved during continuing studies.



**View of a Section of the Dzirula River**

## UPPER RIONI CLUSTER

The Rioni River Basin is one of the largest in Georgia. There are a large number of existing and proposed hydropower projects along its length and on tributaries to the main river. Most of the projects that are operating or are under active development are located on the lower reaches of the river, below Ambrolauri. However, there are many potential projects on the upper reaches of the river and on the upper tributaries. The development potential has been studied at several times in the past, and slightly different schemes have been proposed. One alternative presented here is based on a recent update of studies previously conducted by employees of the Georgian Hydropower Institute (now the privatized Hydroproject Ltd.). It is summarized in the following table.

Name	Database ID Number	River Name	Catchment Area km <sup>2</sup>	Installed Capacity MW	Average Annual Energy GWh	Plant Factor	Gross Head m
Jejora	21	Jejora	280	15.8	86.6	.63	119
*	none	Jejora	tbd	15.5	61.2	.45	134
Somitso	50	Jejora	380	24.3	144.3	.68	154
Oni 1	none	Rioni	707	59.8	251.7	.48	137
Utsera	none	Rioni	627	77.3	325.7	.48	195
<b>Total†</b>				<b>176.9</b>	<b>782.9</b>		

\*Develops the same reach of river as #21; figures for this development alternative have been used in the totals.

†Does not include the Sori site.

A second alternative has been developed during recent studies by consulting firms Gross Energy and Pöyry for the Ministry of Energy. It is known as the Oni Cascade, and a pre-feasibility study was completed during 2009. Detailed information on the alternative is presented on the Cascade web site at: <http://www.onicascade.com/>. Summary information is shown in the table below.

Name*	Database ID Number	River Name	Catchment Area km <sup>2</sup>	Installed Capacity MW	Average Annual Energy GWh	Plant Factor	Gross Head m
Chantchakhi	none	Chantchakhi	154	3.7	18	.52	50
Utsera†	none	Rioni, Chanchakhi	577	70.0	497	.81	280
Garula	none	Garula	89	2.0	9	.51	55
Oni	none	Rioni, Garula, Sakaura	891	72.0	411	.65	175
<b>Subtotal</b>				<b>147.7</b>	<b>935</b>		
Sori	none	Rioni, Lukhunistskali	1699	134.0	621	.53	155
<b>Total</b>				<b>281.7</b>	<b>1,556</b>		

\* Pöyry AS, ECON, and Gross Energy; *Georgia Oni Hydropower Cascade Pre Feasibility Study*; May 6, 2009.

†Includes a large storage reservoir, impounded by a 115-m-high dam.

## UPPER TSKENSTSKALI BASIN CLUSTER

The Tskhenistskali River Basin is also one of the largest in Georgia. It flows into the Rioni near Samtredia. Only one hydropower project has been built in the basin – the 111.9 MW Lajanuri plant, which takes water from the Tskhenistskali and Lajanuri Rivers and discharges into the Rioni near Alpana. The project is now owned and operated by Energo-Pro.

The upper basin receives total average annual precipitation ranging from approx 1,000 mm in some rain-shadow areas, to approx 2,500 mm at higher elevations.

The reach of river from Lentekhi to Tsageri (where the Lajanuri diversion occurs) has high flows and a gross head drop of about 240 m. No studies of this resource have been uncovered to date. It appears that one or more run-of-river projects, or projects with reservoirs, would be attractive.

The river splits into two main branches above Lentekhi – the upper Tskhenistskali to the east, and the Kheledula River to the west.

The Upper Tskhenistskali has been studied only at a reconnaissance level. An initial map and desk review of that work shows that there may be several very attractive run-of-river project sites along its length. HIPP has just started an update of the earlier studies, so the numbers from the older work are presented here. Field work by HIPP geology subcontractors has just been completed. Some minor changes in layouts are expected to be recommended to avoid troublesome areas, but the overall cluster scheme seems sound.

Three sites on the Kheledula are listed in the Ministry of Energy's database of potential projects. Information from the database is summarized in the following table. Placeholders for the other projects mentioned above are included as well, but no details have been determined to date.



<b>Name</b>	<b>Database ID Number</b>	<b>River Name</b>	<b>Catchment Area km<sup>2</sup></b>	<b>Mean Daily Flow Est m<sup>3</sup>/s</b>	<b>Design Flow m<sup>3</sup>/s</b>	<b>Gross Head m</b>	<b>Installed Capacity MW</b>	<b>Average Annual Energy GWh</b>	<b>Plant Factor</b>
Lentekhi†	none	Tskhenistskali				320	<b>150.0†</b>	<b>533.8†</b>	.41†
Tskhenistskali 1	none	Tskhenistskali				100	1.3	5.9	.52
Tskhenistskali 2	none	Tskhenistskali				130	2.0	8.9	.52-
Tskhenistskali 3	none	Tskhenistskali				150	5.0	22.5	.51
Tskhenistskali 4	none	Tskhenistskali				70	6.5	30.0	.53
Tskhenistskali 5	none	Tskhenistskali				80	7.7	35.0	.52
Tskhenistskali 6	none	Tskhenistskali				60	10.1	46.0	.52
Lamaria (Tsk 7)	none	Tskhenistskali				80	15.0	79.7	.61
<b>Subtotal</b>							<b>47.6</b>	<b>228.0</b>	
Zeskho 1‡	none	Zeskho				250	3.5	16.0	.52
Zeskho 2‡	none	Zeskho				90	2.0	9.0	.51
<b>Subtotal</b>							<b>5.5</b>	<b>25.0</b>	
Akhashuri 1‡	none	Akhashuri				260	2.0	9.0	.51
Akhashuri 2‡	none	Akhashuri				370	3.0	14.0	.53
<b>Subtotal</b>							<b>5.0</b>	<b>23.0</b>	
Kheledula 1*	69	Kheledula	96			374	18.8	94.3	.57
Kheledula 2*	70	Kheledula	281			144	21.6	102.8	.54
Kheledula 3*	71	Kheledula and Laskadura	447			220	44.3	229.4	.59
<b>Subtotal</b>							<b>84.7</b>	<b>426.5</b>	
<b>Total</b>							<b>302.0</b>	<b>1,502.5</b>	<b>.57</b>

†Lentekhi figures are based on a revised, but still very rough, analysis from late November 2010 that shows lower energy production than the October 2010 analysis

‡Less than 5 MW installed capacity, will be dropped or replaced by larger combined developments for future studies

\* Information for Kheledula is from the Ministry of Energy Database



**View of the Tskhenistskali River between Lentekhi and Tsageri, Sept 2010**



**View of the Kheledula River, September 2010**

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