

# ARMENIA ENERGY SYSTEM DEVELOPMENT: OPPORTUNITIES FOR CLEAN AND EFFICIENT INFRASTRUCTURE INVESTMENTS

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**IFC**

**International  
Finance Corporation**

WORLD BANK GROUP

# IFC AT A GLANCE

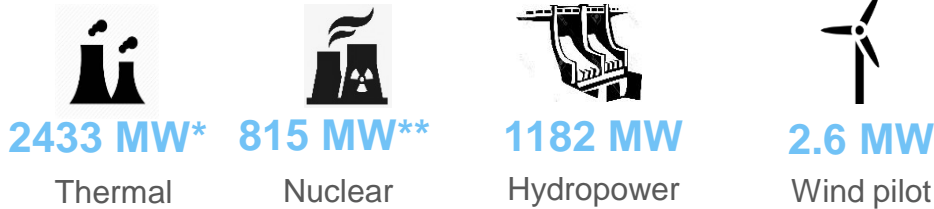
*IFC: A member of the World Bank Group with a private sector focus*

	<b>IBRD</b> International Bank for Reconstruction and Development	<b>IDA</b> International Development Association	<b>IFC</b> International Finance Corporation	<b>MIGA</b> Multilateral Investment and Guarantee Agency
<b>Role</b>	To promote institutional, legal and regulatory reform	To promote institutional, legal and regulatory reform	<b>To promote private sector development</b>	To reduce political investment risk
<b>Clients</b>	Governments of middle-income and creditworthy low-income countries	Governments of poorest countries	Private companies in member countries	Foreign investors in member countries
<b>Products</b>	<ul style="list-style-type: none"> <li>• Technical Assistance</li> <li>• Loans</li> <li>• Policy Advice</li> </ul>	<ul style="list-style-type: none"> <li>• Technical Assistance</li> <li>• Interest Free Loans</li> <li>• Policy Advice</li> </ul>	<ul style="list-style-type: none"> <li>• Early stage Equity</li> <li>• Equity / Debt</li> <li>• Risk Management</li> <li>• Advice for sustainable development</li> </ul>	<ul style="list-style-type: none"> <li>• Political Risk Insurance</li> </ul>

- ✓ Unparalleled access to governments, parliaments, consultants and other stakeholders;
- ✓ A broad range of products available to our clients (Partial risk guarantees, Political risk coverage);
- ✓ Cooperation between public and private counterparties which is crucial to moving transactions forward.

# RENEWABLE ENERGY POTENTIAL OF ARMENIA ENERGY SYSTEM MAY HELP TO MEET FUTURE ENERGY DEMAND, IMPROVE EFFICIENCY AND RELIABILITY

## Armenia Energy System



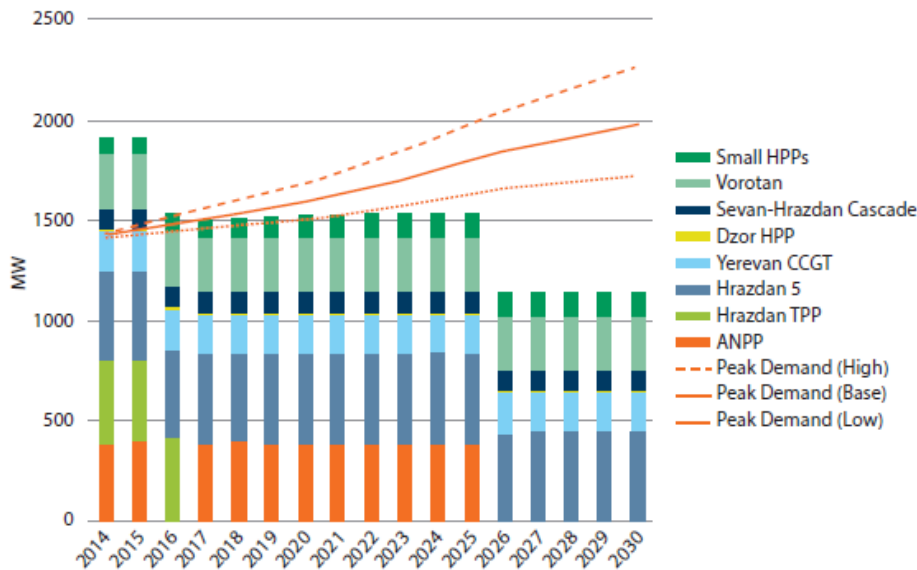
### Generation capacities > 4.3GW

175 generation companies, many of them are small hydro facilities; ~2/3 of capacities are state-owned

HPPs provide daily load regulation; thermal plants operate to cover peak demand in winter time and as a backup for the periods of NPP maintenance.

~50% of the generation facilities are more than 40 years old;

### Forecasted gap between peak demand and installed capacity may require additional 830 MW of generation capacities by 2026



Source: "In-Depth Review of the Energy Efficiency Policy of Armenia", Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects, 2017

**Transmission:** The transmission network operator in Armenia is CJSC High Voltage Electricity Networks (CJSC) and mostly consists of 220 kV single-circuit lines

**Electricity Trade and Distribution:** Electricity Networks of Armenia (ENA) acts as the single buyer of electricity through contracts with generating companies at regulated rates.

**Targets set for renewable energy:** 400+MW till 2020 and 600+ MW till 2025, incl. small hydro, wind, geothermal, and solar PV; accommodating 20% of RE in the energy system

**Incentivizing mechanisms:** feed-in tariffs to stimulate investments in renewable energy. New plants sign 15-year power purchase agreements, under which ENA is obliged to purchase all the power produced. FiTs are adjusted annually according to inflation and the USD/AMD exchange rate.

\* - 1380 MW available;

\*\* - 407.5 MW available

# IFC PROVIDES COMPREHENSIVE UPSTREAM SUPPORT FOR ENLARGING THE PIPELINE SUSTAINABLE ENERGY INFRASTRUCTURE PROJECTS

## Sample “early stage” project preparation gaps and risks:

Sound regulatory & contractual framework? Technically sound and proven? E&S? Offtake risk? Other?

## Full set of advisory solutions for clean and sustainable energy infrastructure projects pipeline development

### Government

- Remove policy and regulatory barriers to private sector participation
- Promote transparency and a level-playing field
- Build the capacity to engage and support private sector participation

### Companies

- Preparation of technically, environmentally and financially sound projects;
- Off-taker and all PPA-related risk analysis,
- Facilitation of knowledge sharing through B-to-B events, support to associations, other

### Industry Players

- Conduct market assessments and develop market entry strategies
- Scale project development and help sponsors navigate the local environment

## Outcomes

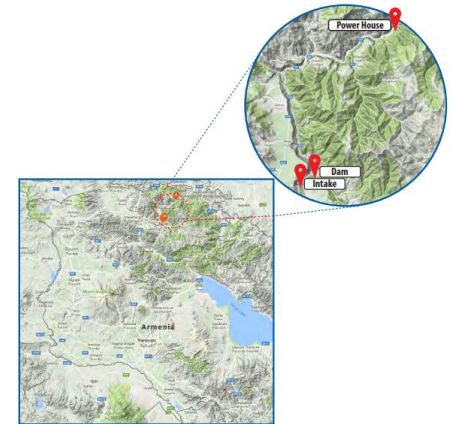
- ✓ Improved investment climate;
- ✓ Equal risks allocation mechanisms between public and private stakeholders;
- ✓ Projects are designed according to best practices;
- ✓ Strong pipeline of bankable infrastructure projects;
- ✓ Risks affecting project feasibility and bankability are addressed;
- ✓ Incentivize interest in project financing local banks

# CASE STUDY: LLC “DEBED HYDRO”, ARMENIA

## Client Needs

LLC “DEBED HYDRO” is planning to design, finance and construct 70+ MW Shnogh hydropower plant project in the Republic of Armenia that would position the Client as a leading Independent Power Producer in the country. HPP Shnogh is designed as a run-of-river plant, utilizing the inflows of Debed, Martsiget and Kistum Rivers at the available gross head of up to 300 m.

In order to ensure implementation of best international practices on the Shnogh project, the Client has engaged IFC to assist with pre-transaction advisory activities to support the development of the Project.



## IFC Advisory Services

Technical review of the following reports:

- Inception report,
- Memo on alternatives,
- Hydrology report,
- Water resources planning & reservoir operation studies,
- Geology & engineering geology;
- Construction material report;
- Feasibility design report; and
- Technical summary report.

## Expected Results

- HPP feasibility study and design, in line with international best practices;
- Ensuring alignment among all HPP design-related project components;
- Accuracy of technical proposals and calculations performed;
- Identification of design gaps, if any, and
- Recommendation of measures to meet those gaps.

The Shnogh hydropower plant was initially developed in the 1960s as part of the Lonberd-Shnogh HPP cascade. Over the last few decades, despite of few updates to the initial HPP design, the project preparation activities, including the development of the feasibility study as per best international standards, were still required, to meet the criteria of international financing institutions.

# CASE STUDY: ELECTRIC NETWORK OF ARMENIA

## ENA SYSTEM CHARACTERISTICS

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1. More than 985,000 end users.

### 2. Main Substations

Owned by ENA 110kV to 35 or 10/6kV	102
Operated by ENA 110kV	24
Owned by ENA 35kV to 10/6kV	226
Operated by ENA 35kV	127
ENA - Distribution Switching Substations:	261
<b>Total</b>	<b>740</b>

### 3. DISTRIBUTION SUBSTATIONS

ENA Distribution Substations 35/10/6 to 0.4kV	8,465
Private Distribution Substations 35/10/6 to 0.4kV	3,582

### 4. DISTRIBUTION LINES

Facility	110 kV	35kV	10/6 kV	0.4 kV
ENA- Overhead lines, km	2,800	2,300	8,280	12,800
ENA- Underground lines, km	-	100	3,300	2,400

# ENA INVESTMENT PROGRAM

#	Programs	Part I	Part II	Total
1	Replacement and modernization of equipment in the networks with a voltage of 6(10)/0.4 kV	38.2	184.9	223.1
2	Replacement and modernization of the electrical power transmission lines in the networks with a voltage of 35 – 0.4 kV	26.8	198.2	225.0
3	Expansion of the network and connection of new subscribers	44.5	50.2	94.7
4	Other non-current emergency recovery works and reconstruction works	5.5	7.5	13.0
5	Implementation of the automatic electrical power metering system in the networks with a voltage of 0.4 kV	75.0	69.6	144.6
6	Implementation of international management standards and automatic electrical power metering systems	2.3	2.0	4.3
7	Other investments	9.0	2.4	11.3
	<b>Total</b>	<b>201.2</b>	<b>514.8</b>	<b>716.0</b>

## BENEFITS OF THE INVESTMENT PROGRAM

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- ENA identifies the following benefits that will be made possible through implementation actions of the new investment:
- Increase efficiency and safety of operations;
- Reduction of electricity losses and improvement of quality of supplies;
- Meet future demand;
- Increase customer satisfaction;
- Facilitate faster connections of new customer;
- Improve Doing Business rating for the Country.



## **Project Services Agreement has been signed with ENA in Nov, 2017**

**Activity 1.** Preliminary identification of early investment packages for the initial two (2) years (the “Phase 1”) of investment program;

**Activity 2.** Preparation of a model and tool for an electricity demand forecast;

**Activity 3.** Development of an integrated distribution system plan (“IDSP”), and optimization of balance of investment program;

**Activity 4.** Introduction of ADMS – Advanced Distribution Management System;

## ACTIVITY 1 - PRIORITIZATION OF INVESTMENT PACKAGES

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- Ranking methodology and model for the evaluation of projects
- Carry out sample network physical inspections and define investment packages (including required works, equipment and material) for the initial two (2) years of the investment plan
- Prioritize defined implementation packages for procurement and execution

# ACTIVITY 2 – DEMAND FORECAST

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## DEMAND FORECAST – What is in the TOR

1. **Bankable Model for market liberalization** This model together with ADMS will cover the day ahead, Month, Quarter, Year ahead market requirements by market system operator
2. **Low accuracy demand forecast model** lead to serious financial consequences.
3. **A great advantage with IPOs and Financiers.** They may not impose these requirements but are notes as substantial plusses
4. **Current method of simple historic based prediction not suitable for tomorrow.**
5. **Fundamental to enable full Integrated Distribution System Planning** producing optimum system development;
6. **Enable timely Decisions.** New, methodology and model will allow company management, planning and operating personnel as well as financial institutions in making proper and timely decisions.

### **INTEGRATED DISTRIBUTION PLANNING (IDSP)**

- 1. ENA undertakes the largest ever investment in the Armenian Distribution system.**
- 2. Current System was designed well , but this was long time ago - lifetime of assets is mostly expired.**
- 3. System designed for a much higher and of different nature load– Industry, low domestic etc., and current system demand requirements are now quite different.**
- 4. Design parameters for system development should be defined for a state of the art system.**
- 5. SMART grid needs to be built into the current system**
- 6. Rehabilitation / replacement principle needs to be fine tuned with the future system operations and design requirements for an optimal performance.**
- 7. ENA will be implementing reactive power compensation program.**
- 8. Develop credible design standards. ENA will select and adopt up-to-date planning standards and system design criteria as well as develop a new Master Development Plan, for the next generation.**

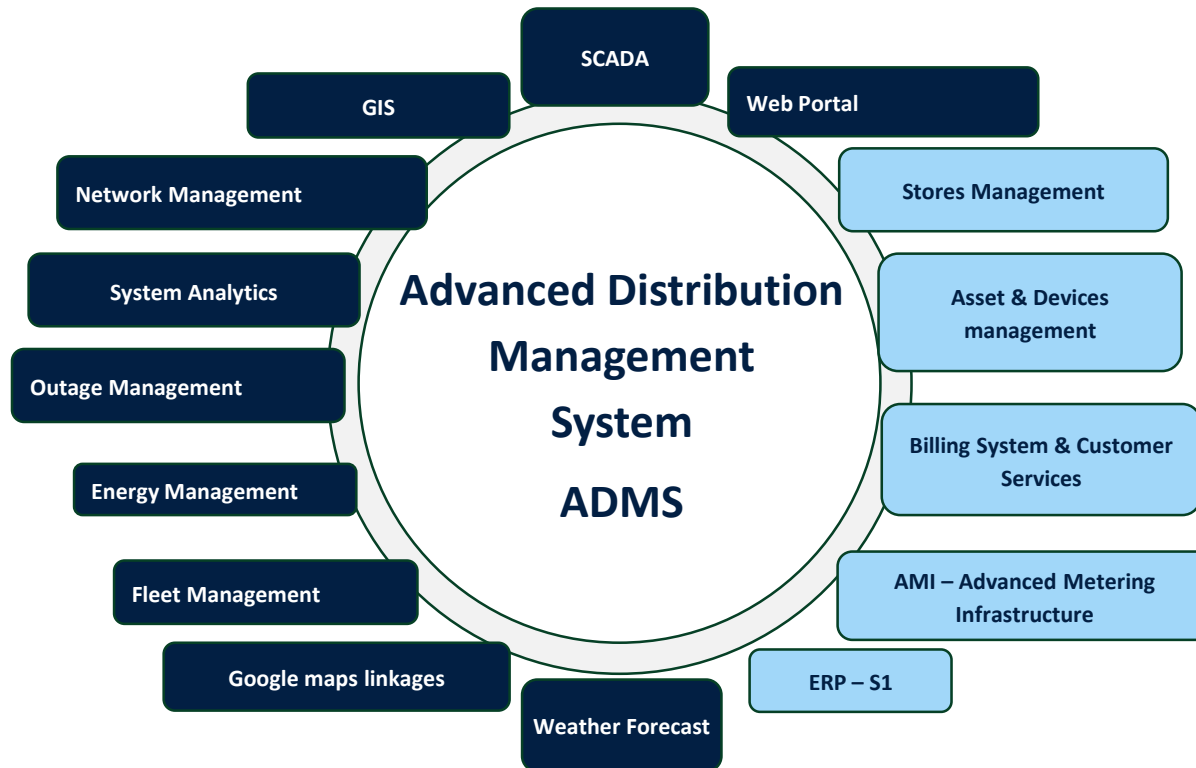
## ACTIONS – NEXT STEPS – 4-ADMS

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1. **The biggest investment and a new system requires a state of the art Advanced Distribution management System (ADMS)**
2. **It will combine the state of the art systems** to enable remote control and supervision of substations and smart grid, will connect with customer data and use a GIS environment with good customer communication and fast response to system events
3. **A fast track process is adopted for the introduction of ADMS**
4. **Expression of Interest (EOI)** issued and a number of leading companies are presenting the capabilities of their systems to ENA engineers.
5. **In parallel a consulting company is being sought to help ENA with the design, specifications and preparation of bidding documents.**
6. **ENA plans to engage the consultants and the manufacturers at the short possible time**

# ADMS OVERVIEW

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# CONTACTS

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# Annexes

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# IFC INVESTMENT OPTIONS

## Loans

- Project and corporate financing
- On-lending through intermediary institutions

## Equity

- Direct equity investments
- Private equity funds

## Trade and Commodity Finance

- Guarantee of trade-related payment obligations of approved financial institutions

## Syndications

- Capital mobilization to serve developmental needs
- Over 60 co-financiers: banks, funds, DFIs

## Derivative and Structured Finance

- Derivative products to hedge interest rate, currency, or commodity-price exposures of IFC clients

## Blended Finance

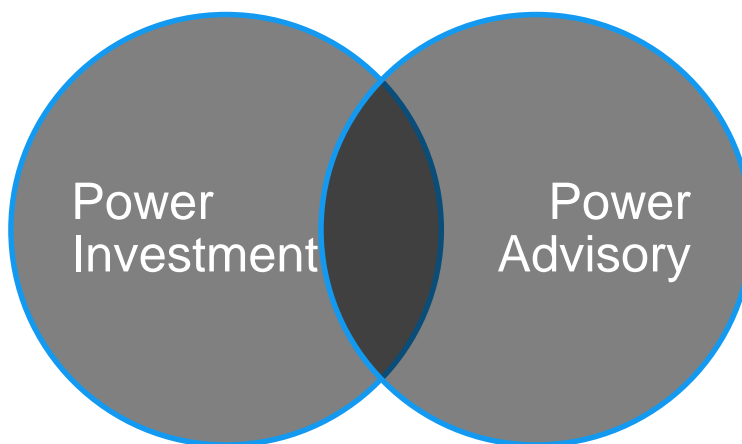
- Augmenting IFC resources with donor funds

# IFC BUSINESS MIX AND THE POWER SECTOR

IFC's business consists of three complementary pillars that support its mandate and strategic priorities. It blends investment with advice and resource mobilization to help the private sector advance development.

TECHNICAL  
ADVICE + INVESTMENT

- Financed 40 GW+ of electricity generation in emerging markets, plus transmission and distribution investments and support for integrated utilities
- Nearly \$4 billion invested across more than 200 projects since 2005



- Focus on pre-investment activities, market entry support, and project preparation to manage market risks and complete due diligence.
- Improving the investment climate, assisting in the corporatization of SOEs, facilitating project financing, and boosting infrastructure investments.

# IFC Power Advisory

## With Governments

- Remove policy and regulatory barriers to private sector participation
- Promote transparency and a level-playing field
- Build the capacity to engage and support private sector participation

- Conduct market assessments and develop market entry strategies
- Scale project development and help sponsors navigate the local environment

## With Industry Players

## With Companies and Developers

- Improve the bankability of their projects by providing project development support through technical feasibility studies, financial bankability assessments, project structuring, power sector and regulatory framework reviews, off-taker risk analysis, and all aspects of power purchase agreements
- Support power grid development, increased renewable grid integration, T&D loss reduction, and T&D efficiency improvement
- Provide targeted training to private investors, industry associations, financial institutions, and government organizations.