

## Small Hydropower ---- One of Renewable Energies to Adapt Climate Change

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# CONTENT

- Global Renewable Energy Demand
- SHP is a Key Renewable Energy
- World SHP Development Status
- Chinese SHP Development Experiences
- ICSHP-Promoting SHP Worldwide



## 1, Global Renewable Energy Demand

- Worldwide, approximately 2.7 billion people rely on traditional biomass for cooking and heating, and about 1.4 billion have no access to electricity.
- Current patterns of energy production and consumption are unsustainable and threaten the environment on both local and global scales.
- The "energy-poor" suffer the health consequences of inefficient combustion of solid fuels



- from Sustainable Energy for All (E4ALL)



# No electricity , no modern civilization .....



Africa Asia Latin America

- By 2030, there is an opportunity for the world to be well on its way to a fundamental transformation of its energy system.
- Allowing developing countries to leapfrog current systems in order to achieve access to cleaner, sustainable, affordable and reliable energy services.
- This change will require major shifts in regulatory regimes in almost every economy; vast incremental infrastructure investments etc.



#### Which Energy we can rely on?

- At the global level, the energy system supply, transformation, delivery and use – is the dominant contributor to climate change, representing around 60 per cent of total current greenhouse gas (GHG) emissions.
- World Energy Sustained?
  - Coal: 160yrs
  - Oil: 40yrs



- Gas: 70yrs
- G. thermal: limited.



#### **Renewable and Sustainable Energy is urgent demand**

- UN-Energy, Goals by 2030:
  - Ensuring universal access to modern energy services
  - Doubling the rate of improvement in energy efficiency
  - Doubling the share of renewable energy in the global energy mix.





## 2, SHP is a Key Renewable Energy

- Renewable Energy
  - Solar
  - Wind
  - Hydropower
  - Biomass
  - Ocean and Tide





- Renewable energy, including hydropower, instead of fossil energy is a trend/strategy in the world.
  - Less carbon release
  - Fossil energy reduce
- Hydropower is a succeeded technology. After Fukushima nuclear power station disaster, hydropower were recalled high attention.



- Renewable Energies: 17.9% (Hydro: 16.1%, Wind, Solar, Geothermal, Bio-energy: 1.8%) of global electricity supply
- That means Hydro is **90%** of total renewable energy.
- Hydropower is the dominant renewable energy



- Hydropower supplies electricity in **161** countries.
- China hydropower installation is 230 GW (about 16% of total power installation), which is at the first position in the world, is over 90% of renewable energy in the country, and still has big potential to develop hydropower, including **small hydropower**





**Definition:** there is not unique definition for SHP worldwide. In generally, SHP means that the installation is less than **10**MW.

- Mini/Micro Hydro are much smaller.
  - In China, SHP classification has been changing based on economic development.

#### **SHP Definitions**

Various definitions, because of supporting policies and economic development



	Dominican Republic, Guatemala, Macedonia	< 5 MW
	Italy	< 3 MW
	Mauritius	0.01-0.05 MW
	Maroqu	2- 8 MW
	Afghanistan, Burundi, Iran, Malaysia, Mali, Nepal, Norway, Sri Lanka, Tunisia, Uganda, Zambia	1-10 MW
	Armenia, Austria, Croatia, Montenegro, Nigeria, Turkey, Serbia, Slovenia, Switzerland	<10 MW
	Azerbaijan	50 kW – 10 MW
	Cambodia, Philippines	mini
	Indonesia	5-10 MW
	Senegal	2.5-10 MW
	Georgia	≤ 13 MW
	Bangladesh, Laos	1-15 MW
	Thailand	6—15 MW
	El Salvador, Peru	< 20 MW
	Bhutan	1-25 MW
	India	2 - 25 MW
	Argentina, Brasil, Mexico	≤30 MW
	Benin	10-30 MW
	United States	1-30 MW
	Canada, China, Pakistan	< 50 MW
	New Zealand	1-50 MW

### • SHP Characteristics:

- Successful technology
- Related low investment
- Good B/C
- Environmental Controllable– And Less inundation







**3, World SHP Development Status** 

Total global installed capacity of around 75 GW.

\*EU, only includes planned instead of potential. Africa many countries not fully assessed yet in particular in the SHP range.

#### **Global Summary**



## 4, Chinese SHP Development Experiences

• Before 1980, China's electric power construction mainly was concentrated in the cities and its surrounding areas, unable to meet the development of rural production and farmer masses aspirations for a better life. Most rural areas were without electricity.



• From 1980s, SHP stimulated policies, such as three-self policies, issued with financial support, local governments and farmers were enthusiastically involved to develop small hydropower on their own efforts, which makes a rural electrification development mode with Chinese characteristics.



• Appropriate policies support, local people participation, financial aid and other relevant efforts made electrification in rural area changed afterwards.

### **SHP Policies Stimulated Development**

1) "Three-self" Policy : Self-Construction, Self-Management, Self-Consumption

2) "Six-local" Policy : Local People, SHP Resources, Available Funds, Technologies, Materials, Consumption

3) Decentralized Administration Policy: Local Grid, County as Basis

4) "SHP Generates SHP" Policy: Levy 2 Cents for Each kWh, Business Tax 17% down to 6%



5) Technology Oriented Policy: Open, Appropriate, Costeffective; Simplification, Standardization, Automation

6) Training Priority Policy

#### **Technical Development**

• At the initial stage of Small hydropower development, electrical and mechanical equipment are non-standard production, so the technical key and applied research is to combine local actual situation, for example, to obtain raw material locally to build earth dam, rockfill dam, concrete pressure pipes.





## **SHP functions**

 According to the policy of "self-construction, self-management and self-consumption" since 1970s, a rural population of over 300 million in China, have enjoyed electrification through SHP now. 1/2 land, 1/3 counties (about 800) and 300 million farmers electricity supply are based on SHP.



- Now, China has become the world's small hydropower technology exporter and pilot, and effectively promotes international exchange and cooperation in small hydropower development.
  - There are more than 300 SHP equipment manufacturers in China, which produces more than 6,000 MW SHP equipment each year. SHP equipment manufactured by China can be found in many countries with SHP resources.



• The household electricity access rate of electrification counties rose from less than 40% in 1980 to 99.8% in 2010, the average annual power consumption increased from less than 200 kwh to 800 kwh, the power quality and reliability was greatly improved, which further promoted the development of prefectural region economy.



#### **SHP Potentials and Development**

SHP is an abundant resource in China, widely distributed in more than 1700 counties in over 30 provinces, regions and municipalities, mainly in western area.

- With a total potential capacity of 128 GW according to the latest survey.
- China ranks first in the world for SHP potential.

The total number of SHP is 45,000 stations with installation capacity of 65GW by the end of 2012, which is about 50% of SHP resources have been developed.



## 5, ICSHP - Promoting SHP Worldwide

#### **ICSHP** is a non-profit international organization, it's tasks:

- To promote SHP development through TCDC
- To exchange information on SHP
  development and management
- To provide practical, technical advice to the membership on developing bank fundable SHP proposals
- To undertake joint training, research and technology transfer among members
- To organize assistance to support selected SHP projects in developing countries, as appropriate
- To advise developing countries in the formulation of an appropriate legislative framework to encourage private investment in the development

- To assist in the development of world-wide markets for SHP technology and expertise
- To set up IN-SHP Trust Fund to give financial aid to activities in SHP field



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- Strong support from China's Government since IN-SHP's foundation in 1994
- Serving host country is one of IN-SHP's priorities
- Policy study for government
- Project evaluation for national "Sending Electricity to Villages" Program
- A pioneer in RE of China (Initial researcher on electricity industry deregulation, first institute to start CDM for SHP)
- A bridge between China and other countries on SHP

## **ICSHP** Activities

- To assist IN-SHP members to develop capacity of SHP development
- Large SHP potential remains untapped in developing countries
- SHP technology: open, appropriate, cost-effective
- Popularize SHP technology to other developing countries





## **ICSHP in Promoting SHP Worldwide**

Implemented SHP projects by ICSHP through many ways, including on turnkey basis

Directly led by IC-SHP, design document evaluation, research, policy making, project design, promoting development

Having 3 umbrellas: IN-SHP, 300 members, 60 countries CNAMSM, over 100 SHP equipment manufacturers Expert: over 200 noted national experts Training over 600 engineers from 50 countries, consultation in over 40 countries, evaluating 226 SHP project design documents, developing projects in China & abroad, equipment export to over 40 countries



### **Pilot SHP project in Zambia**





- Shiwang'andu SHP project in Zambia

   Commissioning was held on 5
  - December 2012

## **ICSHP in Promoting SHP Worldwide**





#### **Capacity building as priority:**

- Training project engineers in China with new SHP technologies
- Invite local government officials, stakeholders & private investors to visit similar SHP projects & local grid in China to get firsthand experiences
- Training operators at site during construction & installation
- Make special management regulations for operation & maintenance
- Policy research for sustainable SHP development in member countries

Developing indigenous manufacturing of SHP equipment

