



## Greener energy: Issues and challenges for Pakistan-hydel power prospective

Abdul Waheed Bhutto<sup>a</sup>, Aqeel Ahmed Bazmi<sup>b,c</sup>, Gholamreza Zahedi<sup>b,\*</sup>

<sup>a</sup> Department of Chemical Engineering, Dawood College of Engineering & Technology, Karachi, Pakistan

<sup>b</sup> Process Systems Engineering Centre (PROSPECT), Chemical Engineering Department, Faculty of Chemical Engineering, Universiti Teknologi Malaysia, Skudai 81310, Johor Bahru (JB), Malaysia

<sup>c</sup> Biomass Conversion Research Centre (BCRC), Department of Chemical Engineering, COMSATS Institute of Information Technology, Lahore, Pakistan

### ARTICLE INFO

#### Article history:

Received 8 February 2011

Accepted 18 February 2012

#### Keywords:

Green energy

Hydral energy

Mini-hydral

Sustainable development

Pakistan

### ABSTRACT

Water is a vital resource that supports all forms of life on earth. Progressive release of greenhouse gases (GHG) from increasing energy-intensive industries has eventually caused human civilization to suffer. During the past two decades, the risk and reality of environmental degradation have become more apparent. Renewable Energy provides an effective option for the provision of energy services from the technical point of view while hydropower, a major source of energy in the, appears an important renewable source of energy, its viability for large-scale energy production. Hydropower is renewable, reliable, clean, and largely carbon-free, and represents a flexible peak-load technology. With most of the world's hydropower potential available for near future development, it is local interests and sovereign states that decide how to manage their water resource base. In Pakistan the availability of power had been continually falling short of the demand of 24,474 MW and as a result, the country is experiencing power shortages of varying degrees in different parts of the country. Geographically, Pakistan has been blessed with river flows that are naturally supportive to electricity generation. Considering the large potential and the intrinsic characteristics of hydropower in promoting the country's energy security and flexibility in system operation, government is tried to accelerate hydropower development through number of policy initiatives. This paper investigates the progress and challenges for hydel power generation in Pakistan according to the overall concept of sustainable development and identifies the region wise potential of hydel power in Pakistan, its current status. Barriers are examined and Policy issue and institutional roles and responsibilities are discussed.

© 2012 Elsevier Ltd. All rights reserved.

### Contents

1. Introduction.....	2733
2. Dams and barrages.....	2734
2.1. Run-of-river project.....	2734
2.2. Reservoir projects.....	2734
3. Regional development in hydel sector.....	2734
4. Hydropower in Pakistan's electricity sector.....	2736
5. Power sector institutions in Pakistan.....	2738
6. Hydropower development in Pakistan.....	2738
7. Government's policy initiatives.....	2739
7.1. Energy security.....	2741
7.2. Economic benefits.....	2741
7.3. Social equity.....	2741
7.4. Environmental protection.....	2741
8. Large hydropower in Pakistan.....	2742
9. Small hydropower in Pakistan.....	2742
10. Mini and micro hydropower project in Pakistan.....	2743

\* Corresponding author. Tel.: +607 553583, fax: +607 5566177.

E-mail addresses: [grzahedi@cheme.utm.my](mailto:grzahedi@cheme.utm.my), [grzahedi@yahoo.com](mailto:grzahedi@yahoo.com) (G. Zahedi).