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U.S. Hydropower Resource Assessment for Vermont

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ABSTRACT

The Department of Energy is developing an estimate of the undeveloped hydropower potential in this country. The Hydropower Evaluation Software (HES) is a computer model that was developed by the Idaho National Engineering Laboratory for this purpose. The software measures the undeveloped hydropower resources available in the United States, using uniform criteria for measurement. The software was developed and tested using hydropower information and data provided by the Southwestern Power Administration. It is a menu-driven software program that allows the personal computer user to assign environmental attributes to potential hydropower sites, calculate development suitability factors for each site based on the environmental attributes present, and generate reports based on these suitability factors. This report details the resource assessment results for the State of Vermont.

CONTENTS

FIGURES

TABLES

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INTRODUCTION

In June 1989, the U.S. Department of Energy initiated the development of a National Energy Strategy to identify the energy resources available to support the expanding demand for energy in the United States. Public hearings conducted as part of the strategy development process indicated that undeveloped hydropower resources were not well defined. As a result, the Department of Energy established an interagency Hydropower Resource Assessment Team to ascertain the undeveloped hydropower potential. In connection with these efforts by the Department of Energy, the Idaho National Engineering Laboratory designed the Hydropower Evaluation Software (HES), which has been used to perform a resource assessment of the undeveloped conventional hydropower potential in over 30 states. This report presents the results of the hydropower resource assessment for the State of Vermont. Undeveloped pumped storage hydropower potential is not included.

The HES was developed as a tool to measure undeveloped hydropower potential regionally or by state. The software is not intended to provide precise development factors for individual sites, but to provide regional or state totals. Because the software was developed as a generic measurement tool encompassing national issues, regional and state totals must be considered judiciously; various local issues may skew undeveloped hydropower potential totals. The information for the resource assessment was compiled from the Federal Energy Regulatory Commission's Hydroelectric Power Resources Assessment database and several other sources. Refer to DOE/ID-10338, the *User's Manual* (Francfort, Matthews, Rinehart 1991) for the specifics of the software and to DOE/ID-10430.1, the *Status Report* (Conner, Francfort, Rinehart 1996) for an overview of all resource assessment activities to date.

Model Development

Hydropower Evaluation Software, both a probability-factor computer model and a database, is a menu-driven software program that is intended to be user-friendly. Computer screens and report generation capabilities were developed to meet the needs of users nationwide. The software uses environmental attribute data to generate an overall project environmental suitability factor (PESF) between 0.1 and 0.9, where 0.9 indicates the highest likelihood of development and 0.1 indicates the lowest likelihood of development. The suitability factors are dependant on the unique environmental attributes of each potential site. They reflect the considerations that (a) environmental concerns can make a potential site unacceptable, prohibiting its development (for a suitability factor of 0.1), or (b) if there are no environmental concerns, there is no effect on the likelihood of site development (for a suitability factor of 0.9). A combination of attributes can result in a lower suitability factor because multiple environmental considerations would reduce the likelihood that a site may be developed to its physical potential.

Model Goal

The goal of the HES is to assemble an accurate resource database of all sites with undeveloped hydropower potential in the United States for use as a planning tool to determine the viable national hydropower potential. Undeveloped hydropower potential is not limited to the development of new sites; it also includes the development of additional hydropower generating capacity at sites that currently have hydropower but are not developed to their full potential. This undeveloped hydropower potential is a source of nonpolluting, renewable energy available to meet the growing

power needs of the United States. The HES should help make this goal obtainable and ensure a set of uniform criteria for national assessment.

Dam Status

The effects of environmental attributes vary by dam status. The dam status classifications used are

W = Developed hydropower site with current power generation, but the total hydropower potential has not been fully developed. Only the undeveloped hydropower potential is discussed in this report.

W/O = Developed site without current power generation. The site has some type of developed impoundment or diversion structure, but no developed hydropower generating capability.

U = Undeveloped site. The site does not have power generation capability nor a developed impoundment or diversion structure.

ASSESSMENT RESULTS

Summary Results

A total of 149 sites (Table 1) have been identified and assessed for their undeveloped hydropower potential. The HES results for individual site capacities range from 5 kilowatts (KW) to 73 megawatts (MW). A majority of the sites (83%) have potential capacities of under 1 megawatts (Figure 1).

Table 1. Undeveloped hydropower potential summaries for Vermont. The table contains the non-modeled undeveloped name plate potential, as well as the HES-modeled undeveloped hydropower potential totals.

	Number of Projects	Name plate potential (MW)	HES modeled potential (MW)
With Power	29	69.2	31.8
W/O Power	70	261.4	130.1
Undeveloped	50	90.1	11.7
State Total	149	420.7	173.6

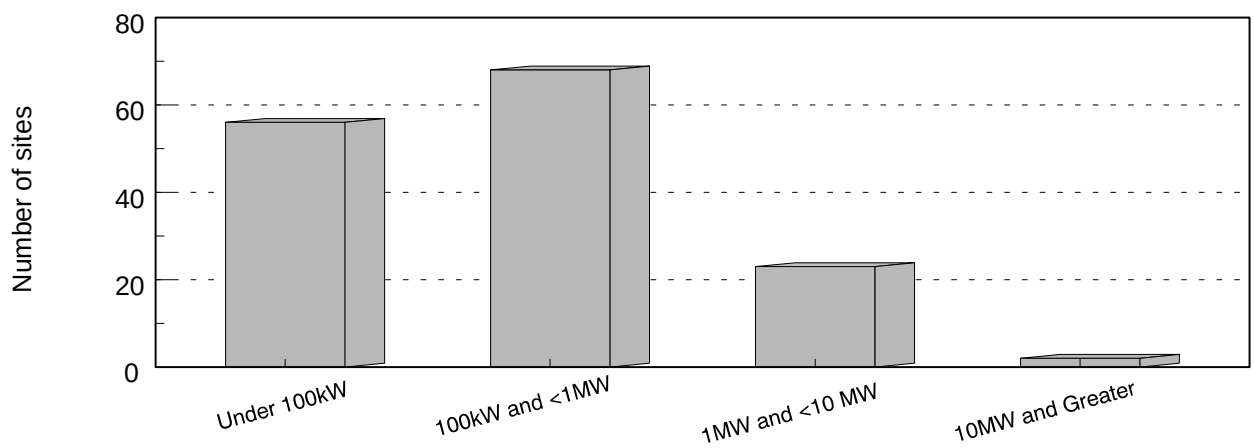

Figure 1. Number of sites, by capacity groups, with HES-modeled undeveloped hydropower potential.

The non-modeled undeveloped hydropower potential total for Vermont was identified as 421 MW. The HES results lowers this estimate about 59% to 174 MW. The greatest reduction in undeveloped hydropower potential, by MW, occurs at sites with some type of structure in place, but no current generation of power present (without power category). These sites have an HES-modeled undeveloped hydropower potential of 130 MW, a 131 MW reduction in the estimated undeveloped hydropower potential (Figure 2). The undeveloped sites have the greatest percentage decrease in modeled undeveloped potential capacity. The unadjusted potential is 90 MW, and the modeled capacity is 12 MW, a 87% decrease in capacity (Figure 2). The number of sites does not change, only the identified undeveloped hydropower potential is reassessed (Figure 3).

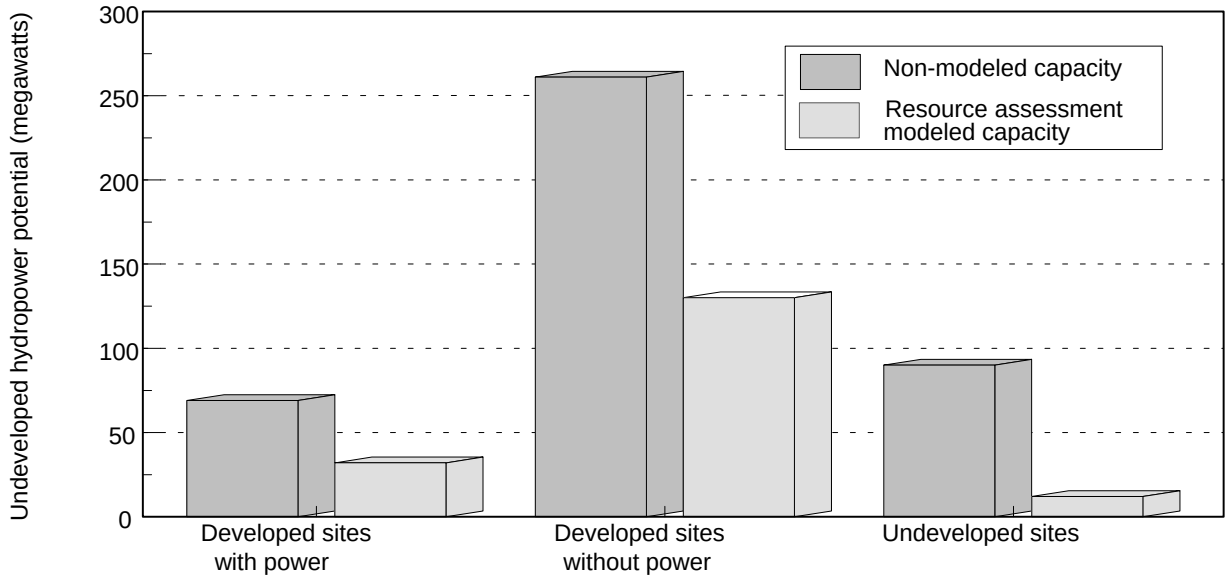

Figure 2. The HES-modeled undeveloped hydropower potential and the non-modeled undeveloped hydropower potential.

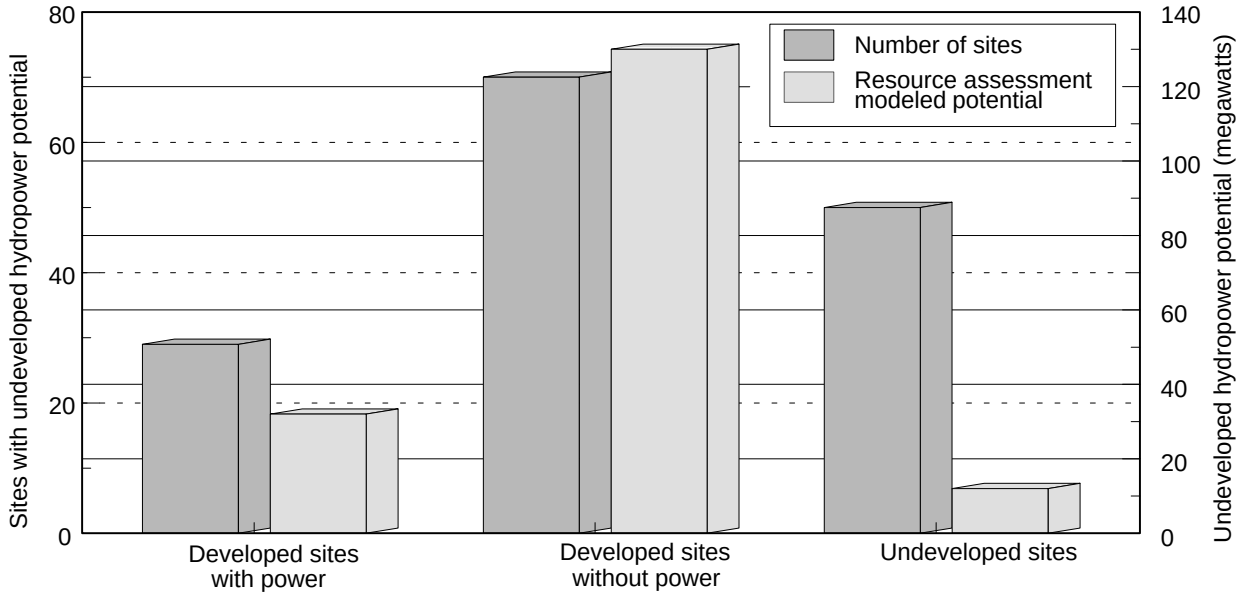

Figure 3. The number of sites with undeveloped hydropower potential and the total MW of HES-modeled undeveloped hydropower potential.

The 149 identified sites are located within 4 major river basins. The number of sites per major river basin range from 1 in the Hudson River Basin, to 73 sites in the Connecticut River Basin (Figure 5). The Connecticut River Basin has the most undeveloped hydropower potential (129 MW) of the Vermont river basins (Figure 6). It should be noted that 72.5 MW, of the 129 MW, is located at one site, the Williamsville site.

Detailed Results

The appendices contain, in the form of HES-generated reports, detailed information of the undeveloped hydropower potential in Vermont. The appendices contain the following information:

Appendix A — The undeveloped hydropower potential is summarized by dam status groups. The number of sites, non-modeled undeveloped hydropower potential, and HES-modeled undeveloped hydropower potential is provided based on the dam status.

Appendix B — The hydropower resource assessment by river basin includes the project number, project name, stream name, dam status, non-modeled undeveloped hydropower potential, and the HES-modeled undeveloped hydropower potential for each of the individual sites. Subtotals are provided for each river basin.

Figure 4. Example of a developed hydroelectric plant in Vermont. This hydroelectric plant was build on an existing dam and has a hydropower capacity of 8.8 MW. It is located at Bolton Falls on the Winooski River.

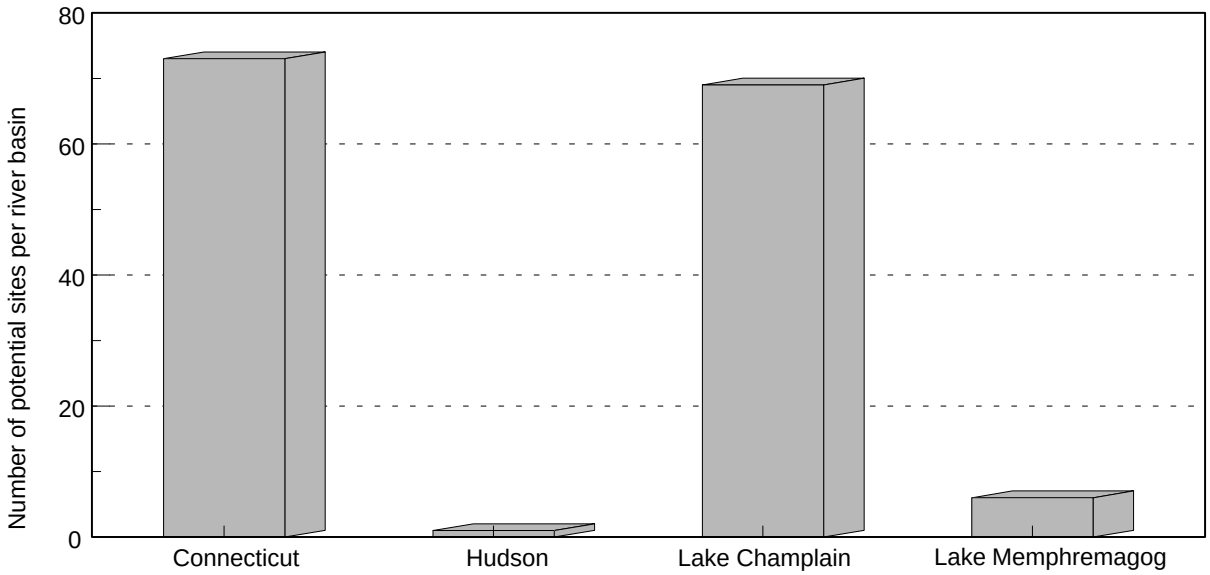

Figure 5. Number of sites with undeveloped hydropower potential in each of the Vermont river basins.

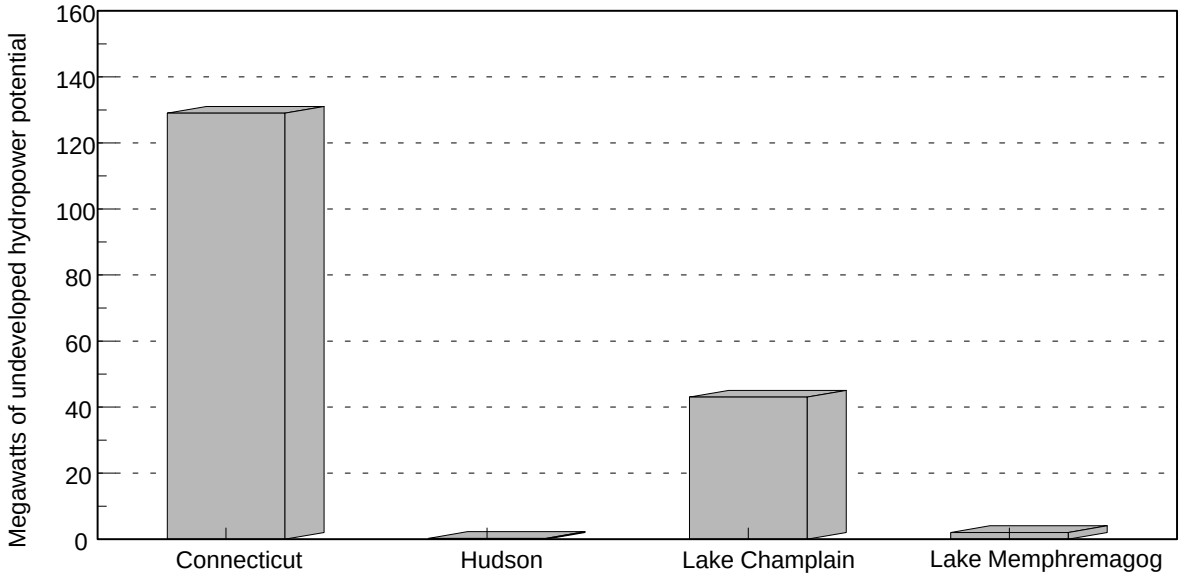

Figure 6. MW of HES-modeled undeveloped hydropower potential in each of the Vermont river basins.

Appendix C This is a listing of the project numbers, plant name, stream name, if a site is Federally owned, non-modeled undeveloped hydropower potential, and HES-modeled undeveloped hydropower potential. The sites are grouped by dam status.

Appendix D This section contains a resource database listing for each of the 149 sites in Vermont. Information includes plant name, stream, state, county, river basin and owner names, project number, name plate and HES-modeled undeveloped hydropower

potential, the unit and plant types, dam status, latitude, longitude, and the environmental factors that the HES uses to determine the project environmental suitability factor.

OBTAINING INDIVIDUAL STATE INFORMATION

Additional copies of the hydropower resource assessment results for individual states are available and can be obtained by writing or calling the authors or the National Technical Information Service (NTIS).

Telephone Orders – (703) 487-4650. NTIS sales desk and customer services are available between 8:30 a.m. and 5:00 p.m., Eastern Standard Time.

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ADDITIONAL HYDROPOWER EVALUATION SOFTWARE INFORMATION

Additional information concerning the HES can be obtained by contacting Ben Rinehart or Jim Francfort at the addresses provided below. Copies of the software and the User's Manual may also be obtained from these individuals.

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(208) 526-1002

Jim Francfort
Idaho National Engineering Laboratory
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Idaho Falls, ID 83415-3830(208) 526-6787

Information concerning the State of Vermont's involvement with the resource assessment or about the identified sites may be obtained by contacting:

Kathleen S. Fallon
State of Vermont
Agency of Natural Resources
Water Quality Division
103 South Main Street, Building 10 North
Waterbury, VT 05671-0408
(802) 241-3770

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