A MARKET SEGMENTATION STRATEGY
FOR THE INDUSTRIAL WOOD ENERGY MARKET

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Abstract.—An approach for segmenting the industrial wood energy market is presented. This is part of a broader study which hypothesizes that there are constraints which prevent non-forest products industries and institutions from using wood energy. There are three objectives in the study: first, to identify the competitive segments of the industrial wood energy market; second, to identify constraints to wood energy use among industries and institutions; and third, to identify public policy which will remove constraints to wood energy production.

The competitive segments of the industrial wood energy market are defined from two information sources. The information sources are a mail survey of current wood energy users in the continental United States and the National Emissions Data System (NEDS). The factors which represent the bases of the competitive segments are: type of industry; location with respect to long-term, wood fuel supply; combustion processes; size of boilers; and multi-fueled boiler capabilities.

Additional keywords: Wood energy market, segmentation methodology.

INTRODUCTION

An approach for segmenting the industrial wood energy market is presented. It is the first phase of a broader study which attempts to determine the factors that constrain industrial wood energy use in the southeastern United States. The two steps to segment the industrial wood energy market are: first, to identify wood energy users in the energy market as a whole, and second, to identify key factors that determine why a firm uses wood energy.

In the overall study, it is hypothesized that constraints exist which prevent institutions and non-forest products industries from using wood energy. Given this hypothesis, or problem definition, there are three objectives in the study: first, to identify the competitive wood energy segment of the industrial and institutional energy market; second, to identify constraining factors to industrial wood energy production; third, to identify public policies which will remove constraining factors to wood energy production.

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The study focuses on institutions and non-forest products industries because it is assumed that this sector has the greatest potential for increased wood energy production, relative to current use levels. Current wood fuel consumption by this sector, as a percentage of total fuel consumption, is estimated to be between two and three percent. In contrast, the forest products industries have significantly increased their use of wood energy in recent years. In the last ten years the lumber and wood products industry has doubled its use of wood energy (Salo et. al., 1978; Goetzl, 1983). In 1982, the industry derived 78 percent of its energy needs from wood (Goetzl, 1983). In 1983, the pulp and paper industry derived 50 percent of its energy needs from unconventional fuels, which were mostly spent pulping liquors (American Paper Institute, 1984). Given their strategic position with respect to the raw material, potential wood energy utilization by this sector is 100 percent of total energy needs if conventional energy prices should soar. However, future increases in wood energy production by this sector would be small relative to present use levels.

The intent of this paper is to outline the methodology used to segment the wood energy market. Information sources used to define the bases of the market segments and variables which comprise the bases are discussed.

METHODS

The approach used follows contemporary marketing theory by applying the concept of market segmentation to define a market (Assael and Roscoe, 1976; Bell, 1979; Cravens, et. al., 1980; and Kotler, 1984). The focus of this analysis is concentrated on the industrial and institutional energy market. The first step distinguishes institutions and non-forest products industries using wood fuel from the energy market as a whole. The second step in the segmentation aggregates those industrial and institutional wood energy users on the basis of similar characteristics (e.g. boiler size, location, type of industry, etc.). Industries and institutions that are not currently using wood fuel but have characteristics similar to wood energy users would be expected to have a competitive advantage of using wood fuel, relative to conventional fuels. The continental United States is used as the study area for defining the market segment. A mail survey of manufacturers, institutions, and utilities using wood energy was conducted from November, 1984 to March, 1985. Industries which were primary forest products manufacturers (Standard Industrial Classification Code 24 and 26) or furniture manufacturers (SIC Code 25) were excluded from the survey.

2/ Personal Communication: Dr. Collin High, Dartmouth College. 1984.
Firms surveyed were selected from the National Emissions Data System (NEDS).\textsuperscript{3} An extensive review of other information sources was made before selecting NEDS as a primary data source (e.g. state data bases, U.S. Dept. of Energy data bases, American Boiler Mfg. Assoc. data bases, etc.). NEDS was found to be the best data base given the needs of the study. The NEDS data base provides information such as: type of industry (4 digit SIC code), geographic location (street address and contact), boiler size (MMBTU/hr), and annual fuelwood consumption (tons). The NEDS data base and the mail survey are the information sources used for defining the market segment. Both information sources satisfy one of the key requirements for effective segmentation, the ability to measure the characteristics of the segment (Bell, 1979; Cravens, et. al., 1980; and Kotler, 1984).

Ninety respondents completed the mail survey representing a response rate of 76 percent. Sixty-one percent of the respondents are wood energy users. Eight percent of the respondents have converted from wood to an alternative energy source. The remaining 31 percent of the respondents have never used wood as an energy source, or were no longer in business.

Survey Procedures

The mail survey incorporates the concepts of the Total Design Method (TDM).\textsuperscript{4} The purpose of the survey was to collect information in three areas: (1) factors influencing the decision to use wood energy; (2) source of wood fuel; and (3) type of wood energy system.

Two types of data were collected on the factors influencing the decision to install a wood fueled energy system. The first type of data pertained to the incentives considered to be important in the decision to install a wood fueled energy system. A ranking technique was used to distinguish among incentives. The second type of data pertained to constraints that had to be overcome before a wood energy system could be adopted. A ranking technique was used to determine the significance of various constraints. The key purpose of the first section of the survey was to determine if public information programs were considered an important incentive in converting to wood energy.

\textsuperscript{3}The U.S. Environmental Protection Agency National Emissions Data System (NEDS) is a computerized data handling system that accepts, stores, and reports on the latest available information relating to sources of air pollutant emissions of particulates, SO\textsubscript{2}, NO\textsubscript{x}, CO and hydrocarbons. (U.S. Environmental Protection Agency, 1980).

\textsuperscript{4}The Total Design Method (TDM) is a concept in mail and telephone surveys which identifies each aspect of the survey process that may affect response quantity or quality and shapes them in a way that will encourage good response. The TDM rests on both a theory of response behavior and an administrative plan to direct its implementation (Dillman, 1978).
Data were collected in the second section of the survey on sources of wood fuel. Respondents were asked the source of wood fuel, form of wood fuel, hauling distance, contract length, and terms for procuring wood fuel. The purpose of this section was to gather information on the logistics of wood fuel supply.

In the final section of the survey, data were collected on the engineering specifics of the wood energy systems currently being used. Four types of data were collected: (1) type of combustion process and energy produced by the system; (2) the number of wood fueled and multi-fueled energy producing units; (3) the percentage of total annual fuel consumption supplied from wood energy; and (4) the total end-product cost to produce energy.

RESULTS AND DISCUSSION

Incentives and Constraints to Using Wood Energy

The respondents did not consider any of the incentives listed in the mail survey to be important in their decision to use wood energy (Table 1). The only incentive which had a consistently high ranking was an open-ended "other" category. In this category, respondents listed readily available wood fuel supply and low cost of wood fuel as important incentives to using wood energy.\(^2\) State and federal tax incentives had the next highest mean ranking. Responses to the incentives question indicate that current wood energy users did not perceive public programs and policy, if they exist in the respondents state or region, as an incentive when making the decision to use wood energy.

Constraints that had to be overcome before wood energy could be adopted were classified in the questionnaire in four types: (1) institutional; (2) technological; (3) financial; and (4) environmental (Table 2). Among the institutional constraints, both "Finding a wood fuel supply source" and "Availability of long-term supply" were inconclusive. Both had high response rates: in "not important", and "extremely important". The key factor listed by respondents to an opened ended constraint question listed availability of long-term supply as most difficult to overcome. "Management's acceptance of a wood fuel system" was considered to be a moderately to very difficult constraint to overcome.

Under technological constraints, "Proper operation" and "Maintenance of the wood energy system" were considered to be very difficult constraints to overcome. "Wood fuel handling" and "Storage" were only moderately difficult. The data were inconclusive regarding the "Efficiency of the wood fuel system". Among technological constraints, "Proper operation of the wood fueled system" had the highest mean rank.

\(^2\) Incentives pertaining to the low cost of wood fuel were not included in the questionnaire because it was assumed that competitive fuel cost would always be the most important incentive of using wood fuel.
Table 1. Incentives of using wood energy and the level of importance as perceived by current wood energy users.

<table>
<thead>
<tr>
<th>Incentive</th>
<th>Not Important</th>
<th>Slightly Important</th>
<th>Moderately Important</th>
<th>Very Important</th>
<th>Extremely Important</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of excess electricity to public utilities</td>
<td>90</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>1.18a</td>
</tr>
<tr>
<td>Technical assistance from state and federal programs</td>
<td>83</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>1.29ab</td>
</tr>
<tr>
<td>Public financing incentives</td>
<td>84</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>0</td>
<td>1.35abc</td>
</tr>
<tr>
<td>Private financing incentives</td>
<td>78</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>5</td>
<td>1.55bcd</td>
</tr>
<tr>
<td>State and federal tax incentives</td>
<td>68</td>
<td>15</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>1.58bcd</td>
</tr>
<tr>
<td>Other 1/</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>17</td>
<td>72</td>
<td>4.44</td>
</tr>
</tbody>
</table>

1/ The majority of "other" responses listed the competitive cost of wood fuel as a major incentive.

2/ Mean values based on a 5-point response format, where 1 = not important and 5 = extremely important. Means with the same superscript are not significantly different at the 0.05 level.
Table 2. Constraints that had to be overcome among current wood energy users and their perceived level of importance.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Not Important</th>
<th>Slightly Important</th>
<th>Moderately Important</th>
<th>Very Important</th>
<th>Extremely Important</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institutional:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding a wood fuel supply source</td>
<td>38</td>
<td>9</td>
<td>13</td>
<td>13</td>
<td>27</td>
<td>2.82</td>
</tr>
<tr>
<td>Availability of long-term supply</td>
<td>28</td>
<td>13</td>
<td>11</td>
<td>17</td>
<td>31</td>
<td>3.09</td>
</tr>
<tr>
<td>Management's acceptance of system</td>
<td>18</td>
<td>7</td>
<td>30</td>
<td>27</td>
<td>18</td>
<td>3.21</td>
</tr>
<tr>
<td><strong>Technological:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency of wood fueled system</td>
<td>22</td>
<td>21</td>
<td>22</td>
<td>22</td>
<td>13</td>
<td>2.84</td>
</tr>
<tr>
<td>Proper operation of wood fueled system</td>
<td>2</td>
<td>4</td>
<td>15</td>
<td>41</td>
<td>38</td>
<td>4.07</td>
</tr>
<tr>
<td>Maintenance of wood fueled system</td>
<td>4</td>
<td>11</td>
<td>23</td>
<td>49</td>
<td>13</td>
<td>3.55</td>
</tr>
<tr>
<td>Wood fuel handling</td>
<td>7</td>
<td>16</td>
<td>27</td>
<td>32</td>
<td>18</td>
<td>3.39</td>
</tr>
<tr>
<td>Wood fuel storage</td>
<td>9</td>
<td>17</td>
<td>37</td>
<td>24</td>
<td>13</td>
<td>3.15</td>
</tr>
<tr>
<td><strong>Financial:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital cost of installation</td>
<td>11</td>
<td>9</td>
<td>18</td>
<td>29</td>
<td>33</td>
<td>3.64</td>
</tr>
<tr>
<td><strong>Environmental:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost to comply with air pollution regulations</td>
<td>11</td>
<td>13</td>
<td>23</td>
<td>23</td>
<td>30</td>
<td>3.49</td>
</tr>
<tr>
<td>Cost and problems of ash disposal</td>
<td>24</td>
<td>39</td>
<td>20</td>
<td>13</td>
<td>4</td>
<td>2.35</td>
</tr>
</tbody>
</table>
The only financial constraint listed in the questionnaire was "Capital cost of installation relative to traditional energy systems". Respondents considered this constraint to be very-to-extremely difficult.

In the environmental constraint category, "Costs to comply with air pollution regulations" were considered to be moderately to extremely difficult. The "Cost and problems of ash disposal" were not considered difficult. The "Cost to comply with air pollution regulations" had a higher mean rank than "Cost and problems of ash disposal". The costs to comply with air pollution regulations may be a constraint that is created directly by the regulations of the Clean Air Act. Among all constraints, "Proper operation of a wood fueled system" had the highest mean rank, followed by "Capital cost of installation" and "Maintenance of wood fueled system".

Results of the questionnaire indicate that public programs and policies to encourage the use of wood energy are either not available in certain areas, or if available, are not incentives to using wood energy. This suggests that a change in current wood energy policy may be necessary if public policy is to encourage its use. In addition, results indicate that the key constraints to wood energy use are technological and market oriented. This may indicate a particular area for targeting public programs and policy.

Wood Fuel Supply

Data collected on wood fuel supply were: form of wood fuel; percent of total wood fuel by supply source; transportation distance; and length of wood fuel contract.

The majority of the respondents use hogged fuel. Of those using hogged fuel, a large share use hog fuel with sawdust and mill residues. Of the respondents which process on-site, 84 percent were hogging wood fuel. The majority of the respondents' total wood fuel supply came from wastewood from another company's production of wood products.

Among respondents which arranged for transportation of wood fuel, the average hauling distance was 31 miles. The average of the longest hauling distances among respondents was 78 miles.

Fifty-six percent of the respondents purchased wood fuel through a contract. Sixty-five percent had a contract with a forest products firm, twenty-seven percent had a contract with a wood fuel broker, and six percent had a contract with either loggers or wood pellet manufacturers. Seventy-seven percent of the contracts had a term of less than three years. Questionnaire results indicate that the majority of the respondents are relatively close to a source of supply and that the wood fuel is generally obtained through a short-term contract (i.e. less than 3 years) with a forest products firm.

6/Hogged fuel is defined as wood which has been processed to a specific size, i.e. wood chips (Georgia Institute of Technology, 1984). A hog is a machine used for reducing the size of wood slabs, edgings, bark, and other materials (North Carolina Department of Commerce, 1982).
Type of Wood Energy System

Eighty-eight percent of the respondents use wood energy for direct combustion. The majority of respondents produce either process steam or some combination of process steam, space heat and process heat.

Sixty-four percent use one or more wood-fired boilers as the primary energy system. Twenty-nine percent use one or more multi-fueled boilers as the primary energy source. Respondents with multi-fueled boilers use natural gas or oil as alternative fuels. The average number of energy producing units (i.e. boilers) were three units per respondent.

Respondents with multi-fueled boilers indicated that, on average, seventy-five percent of annual fuel consumption is supplied by wood. Forty-nine percent of the respondents burn green wood fuel and 42 percent burn dry wood fuel. The remaining nine percent burn a combination of green and dry fuel.

Thirty-three percent of the respondents have used wood fuel for less than five years. Twenty-seven percent have used wood fuel for more than 20 years (Figure 1). Most recent adopters of wood energy (less than 5 years) were utilities and institutions.7/ Seventy-eight percent of the respondents have boiler capacities of less than 50 MMBTU/hr (Figure 2).8/ The distribution of boiler capacities among respondents are significantly skewed toward small capacities.

In general, results of the questionnaire indicate that a large share of the respondents use wood energy for direct combustion specifically for the production of process steam. One-third of the respondents have multi-fueled boiler capabilities, and use natural gas or oil as alternative fuels. It is important to note that Gordon, et. al., 1979, found that market penetration in the wood fuel market is likely to be most rapid in the boiler sector that is fired by oil or gas.

CONCLUSION

Attributes of current wood energy users indicate that one basis for segmentation of the wood energy market is the type of industry. Wood energy

7/ The National Emissions Data System (NEDS) indicates that wood energy use among the non-forest products industries is concentrated among Electric Gas, and Sanitary Services (SIC 49), Food and Kindred Products (SIC 20), Chemicals and Allied Products (SIC 28), and Health and Educational Services (SIC 80 and 82) industries (Young, et. al., 1984).

8/ MMBTU/hr is defined as million British Thermal Units per hour. One MMBTU/hr is equivalent to 714.29 steam lbs/hr (U.S. Environmental Protection Agency, 1980).
users are concentrated among institutions, and the following industries: Electric, Gas, and Sanitary Services; Food and Kindred Products; and Chemicals and Allied Products.

A second basis for market segmentation is that wood energy users are relatively close to a supply source (i.e. 30 miles), and located in a region with an active forest products industry. Conversion to wood energy will most likely occur in regions that have these wood fuel supply attributes.

A final basis of the market segment is that wood energy users have boiler capacities less than 50 MMBTU/hr coupled with a large demand for process steam. Potential wood energy users will have a higher probability of converting to wood energy if they have multi-fueled boiler capabilities rather than single fueled boilers.

The results of the mail survey indicate that public programs and policy, if available, may not be incentives to using wood energy. This suggests that current public programs, where available, are either not meeting the expected target groups or are inappropriate for promoting wood energy use. Key constraints that potential wood energy users will have to overcome are: the proper operation and maintenance of a wood fueled energy system; capital cost of installation; and the cost to comply with clean air regulations.

Given the results of the mail survey and NEDS, the following form the bases for segmenting the industrial wood energy market: type of industry; location with respect to long-term, wood fuel supply; type of combustion processes; size of boilers; and multi-fueled boiler capabilities. Firms that do not use wood but have these attributes will be expected to have a competitive advantage of using wood fuel, relative to conventional fuels.

The next phase of the study will be to identify those non-wood energy users which have these attributes but are presently not using wood. The NEDS data base will be used to select these candidates. Non-wood energy users within this market segment, as well as a sample of non-wood energy users outside the market segment will be surveyed to determine additional constraining factors to using wood energy. The final phase of the project will be to identify policy for removing or modifying the constraints to wood energy production.

LITERATURE CITED

