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A COMPARISON OF IMPACTS OF HEATING ALTERNATIVES ON MINORITY EMPLOYMENT FOR NORTHERN U.S. CITIES

by

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DISCLAIMER

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ABSTRACT

This paper examines minority employment effects which result from the construction of alternative energy facilities designed to serve the same final heating demand. The comparison specifically focuses on heating services to the center cities of major northern U.S. metropolitan areas. District heating by cogeneration is compared to coal gasification, liquifaction and electrification. It is shown that significant differences in minority employment will result from differences in placement of capital stock. The district heating system places a much higher proportion of its capital structure within the actual urban service area than do the three alternative technologies. In view of the concentration of minority populations in these urban areas a substantially greater amount of minority employment will occur if the district heating technology is implemented. The district heating system also requires relatively lower occupational skills than do the two alternative technologies. Since minorities are more often in the low skill occupational categories, the district heating technology offers more employment opportunity for minorities. Other positive employment effects of the cogeneration alternative are also noted.

INTRODUCTION

Previous research has indicated that cogeneration-based district heating systems can be built economically to serve the core areas (central business districts and adjacent residential and industrial activity) of major northern U.S. center cities (Refs. 1 to 4). The factors positively affecting the economics of such a system are cold climate and high building density. Fig. 1 illustrates that these features tend to be found in the northern U.S. within the largest metropolitan areas. In this study we confine our discussion to six of the center cities of major metropolitan areas of the Midwest. These cities are Chicago, Cleveland, Detroit, Milwaukee, Minneapolis-St. Paul and St. Louis. The "diamonds" of Fig. 1 denote these cities. In spite of the fact that the Midwest is a natural gas dependent region for heating, it has been estimated that over fifty percent of the core area commercial floor space in these cities is heated by oil (Refs. 2 and 3). Potential oil savings are, therefore, a prime reason for considering use of the cogeneration technology and for examining its attributes.

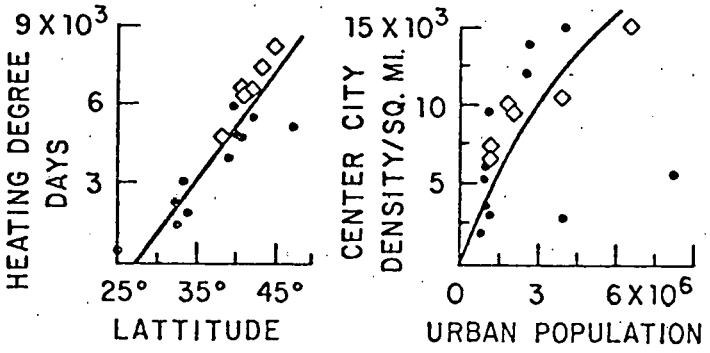

Fig. 1. Factors influencing cogeneration economics

It is the purpose of this paper to consider the attribute of employment. The paper examines employment effects which would result from construction of cogeneration-based district heating to serve the core areas of these six Midwestern center cities. Employment characteristics of the cogeneration system are compared to those of coal gasification, liquifaction, or electrification, assuming that these alternative energy forms would be constructed to provide the same final heating services. It is shown that significant differences in minority employment will result from differences in placement of capital stock. The district heating system places a much higher proportion of its capital structure within the actual urban service area than do the three alternative coal technologies. In view of the concentration of minority populations in these urban areas a substantially greater amount of minority employment will occur if the district heating technology is implemented. The district heating system also requires relatively lower occupational skills than do the alternative technologies. Since minorities are more often in the low skill occupational categories, the district heating technology offers more employment opportunities for minorities. It is also argued that the minority and other employment opportunities provided by the cogeneration option would lead to a greater reduction in (1) government payments for unemployment compensation, (2) youth unemployment, and (3) poverty in poor neighborhoods.

METHODS

Energy Technology Employment Demands

The economic and engineering attributes of the four technologies have been characterized in previous research (Refs. 3 and 4). This paper uses source data from the Energy Supply Planning Model (Ref. 5) for estimation of employment requirements in nearly all cases. Separate employment per dollar of construction cost values were used for each process step, including extraction, conversion, transmission and distribution. The employment requirements of each technology are therefore a cost weighted average value accounting for each process step. The cogeneration system is dominated by transmission and distribution costs. Total employment requirements for these components of the cogeneration system were based on estimates derived from Burns and Roe, Inc. (Ref. 6). Skill breakdowns were based on analagous transmission/distribution system skill requirements from the Energy Supply Planning Model data.

The coal gasification and liquifaction options assumed a conversion plant in North Dakota using strip mined coal. A 750 mile product pipeline carried oil or

gas to the Chicago area. About fifty percent of gas distribution required new construction, while oil distribution was assumed to use tank trucks on existing roads and thus no distribution construction was necessary. The electric option assumed new power plants about fifty miles from the urban core with coal provided from a new nearby deep mine. Transmission and distribution charges were included for the full heating services since few core area buildings use electric heat. The cogeneration process step cost proportions were based on Detroit values as described by Santini, Davis and Marder (Ref. 3).

Population Subgroup Employment Supply for Cogeneration

The location, employment, occupational, and mobility attributes of the white, black, spanish origin, and "other" population groups are based on straightforward manipulation of data from various Census documents (Refs. 7 to 12).

Unemployment Compensation

The Statistical Abstract (Ref. 13) was used to obtain total state and federal unemployment compensation payments per eligible unemployed worker for the twelve midwestern states. These values were regressed against a constant term and the percent urban population in each state to obtain equations for estimation of the difference in urban and rural unemployment compensation payments. These estimates were obtained by substituting into the equations zero percent urban to obtain the rural value and 100 percent urban to obtain the urban value. Equation 1 below is the state equation. Equation 2 is the federal equation. The t-statistics are presented below the coefficient estimates.

$$UC_s = \underset{(10.62)}{2234} + \underset{(4.55)}{16.23M} \qquad R^2 = 0.67 \qquad (1)$$

$$UC_f = \underset{(2.78)}{93.7} + \underset{(5.46)}{3.11M} \qquad R^2 = 0.75 \qquad (2)$$

where: UC = unemployment compensation payments per eligible worker
M = percent of metropolitan population in the state

RESULTS

Unemployment Compensation Effects

In Table 1 we present our estimates of the proportion of construction investment that would occur in rural, metropolitan, and center city locations if the four alternative technologies were each constructed for the purpose of providing heat to one of our Midwestern center cities. This table indicates that gasification or liquifaction investment is over ninety percent rural, since we have assumed a western coal source and plant site. Electricity, while over 75 percent rural, is really nearly metropolitan, since we assume electric plants will be sited within 50 miles of the center city and will use Midwestern coal. The main point, however, is that the cogeneration alternative is completely metropolitan and, in fact, predominantly constructed in the center city itself.

The fact that the cogeneration alternative is built predominantly at the location which it serves has some interesting equity implications. The inconveniences suffered by people during construction of a cogeneration system will be more acceptable since the same people will benefit from the system. The other alter-

natives sometimes run into difficulties because they are not intended to serve the people who suffer inconveniences during the construction period. It is similarly a virtue of cogeneration that taxes on its energy will provide revenue to the same jurisdictional area in which customers reside.

TABLE 1 Estimates of Percent of Construction Expenditure in Rural and Urban Regions for Three Alternative Technologies

	Location		
Technology	Rural	Metropolitan	Center City
Gasification	91.5	8.5	8.3
Liquifaction	99.8	0.2	0.1
Electricity	76.4	23.6	21.4
Cogeneration	0.0	100.0	73.3

In Fig. 2 we show that more of the people not working are likely to consider themselves unemployed in the six center cities than elsewhere in the region. This is an indicator that the propensity to actively seek work when not employed is higher in major center cities. We speculate that this is also an indication of the propensity to seek unemployment benefits, since the acquisition of unemployment benefits generally requires that one actively seek work. Perhaps the increase in the six cities value occurs because big city residents are more sophisticated about seeking unemployment benefits. If so, then any reduction in the size of the group not working (by construction of a cogeneration system, for example) will more effectively reduce unemployment payments when it occurs in big cities.

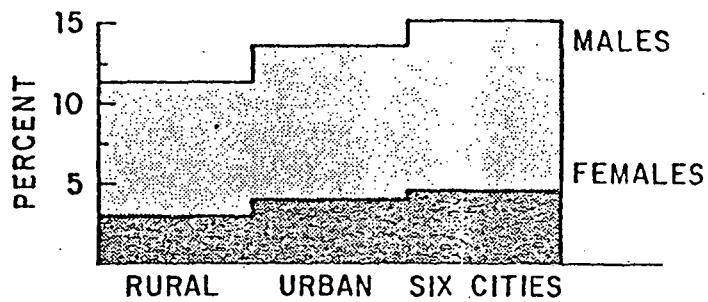

Fig. 2. Percent of those not working in N.C. region listed as unemployed

This argument only applies to the likelihood that one individual will seek unemployment benefits. Another aspect of this issue is the question of the size of unemployment benefit payments when paid. By constructing the two small regression models on 1976 Midwestern states data from the Statistical Abstract (Ref. 13), we have estimated that the average state unemployment compensation payment during the average individual's period of unemployment is $1623 higher in an urban than a rural area. For federal payments the difference is $311. Consequently, a job in an urban area saves more state and federal dollars than a job in a rural area. Thus, the jobs created by cogeneration are more valuable for reducing unemployment compensation than are the jobs created by the three alternatives.

Fig. 3 indicates that minorities within the six center cities probably have a higher prospensity to seek unemployment benefits than does the majority of the population. Thus, if cogeneration construction can effectively employ minorities it should more effectively reduce unemployment compensation benefits. We show later

that cogeneration-based district heating does have the capability to utilize minorities.

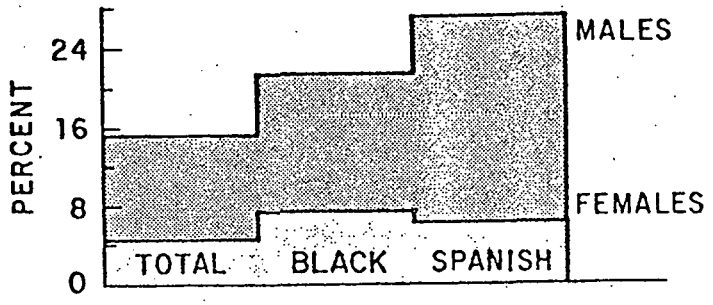

Fig. 3. Percent of those not working in the six cities listed as unemployed

To summarize, cogeneration should reduce unemployment payments more than its alternatives:

(1) because of relatively greater investiment in areas where people more often seek unemployment benefits,

(2) because of relatively greater investment in areas where unemployment compensation payments are higher, and

(3) if affirmative action programs insure that minorities (who more often seek unemployment benefits) are hired.

Availability of Minorities

In the Midwest, a characteristic of the minority populations is that they are disproportionately concentrated in the six center cities under study (Ref. 12). In fact, as of 1970, fifty-three percent of the Midwest's black population was found the the six center cities. This compares to only ten percent of whites. The differences in concentration of whites, blacks, spanish, and other minorities are graphically illustrated by Fig. 4. What this figure illustrates is the unusually high availability of minorities in the six center cities.

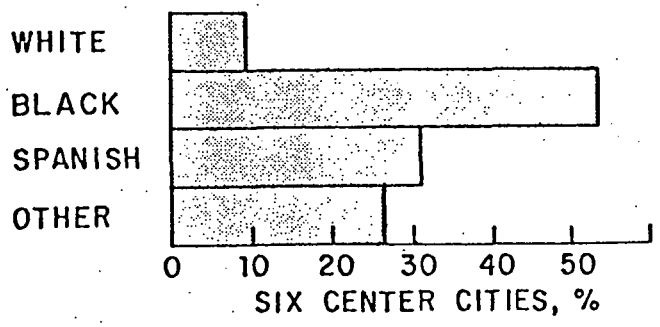

Fig. 4. North central region population groups

Fig. 5 illustrates that, even with their disproportionate concentration within the six center cities, the minority groups still fit the definition of "minority" since there are more whites in the six center cities. Fig. 5 also shows that blacks are by far the largest minority in these cities. Consequently, the term

"minority" throughout this paper is a fair surrogate for black population.

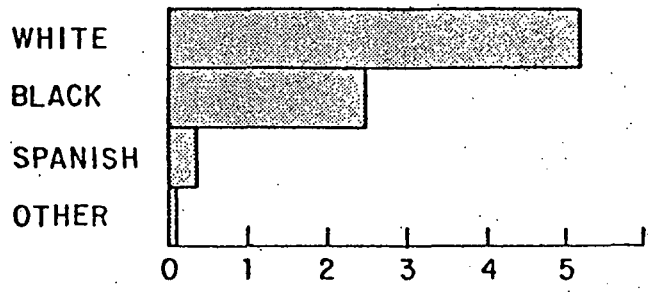

Fig. 5. Millions of persons in the six center cities

Although we have demonstrated the availability of minorities in locations where cogeneration-based district heating might be constructed, we have not demonstrated that they would not make themselves available elsewhere. By using the Census document Mobility for States and the Nation (Ref. 7), we determined that construction workers are generally unlikely to move state to state, and minorities are less likely than whites to do so. Only 6.21 percent of white male construction workers moved state to state from 1965 to 1970, while 5.00 percent of blacks and 5.51 percent of spanish workers did so. Consequently, the construction workers that might be employed in construction of a western coal gasification or liquifaction plant are extremely unlikely to come from one of its six center cities.

To summarize, cogeneration should employ more minorities than its coal alternatives because:

(1) more of its construction will occur in the six center cities where minorities are concentrated, and

(2) minority construction workers are unlikely to move in any significant numbers to the rural sites where alternatives to cogeneration will be constructed.

Matches of Cogeneration and Minority Worker Skills

Table 2 presents estimates of labor requirements per dollar of construction cost for the four energy alternatives under consideration. This Table shows that, when the four systems are economically competitive (i.e. all provide the same final heat output per dollar of investment), cogeneration-based district heat will employ the most workers. By dividing labor into high and low skill categories, Table 2 demonstrates that almost all of the cogeneration alternative's increase in labor intensity is due to its increased use of low skill labor. This is a very important feature of the cogeneration system because, even in times of economic expansion, unemployment of low skill workers is a problem. Since cogeneration's demand for skilled labor is, to the degree of accuracy assured in this study, essentially the same as its alternatives, its construction during an economic expansion would pose no worse of a problem than its competitors. Further, since it would be constructed within a large labor market, there would be no need for relocation of skilled workers. As a result of these labor demand properties, it is fair to say that the nature of labor demand by cogeneration represents more of a benefit to society than the labor demanded by its alternatives.

The fact that the cogeneration alternative creates more low skill jobs than its alternatives is an advantage to minorities. Minority construction workers are much more likely to be laborers than are white construction workers. In 1970, of those males calling themselves construction workers, 17.2 percent of whites were labor-

ers, but 42.5 percent of blacks and 30.8 percent of spanish workers were laborers (Ref. 9 and 10). Cogeneration's percent of low skill workers from Table 2 is most comparable to the minority's percent of laborers.

TABLE 2 Estimates of Labor Intensity for Total and Low Skill Labor for Three Alternative Technologies (Person hrs. per 10^3 $)

Technology	Total Manual Labor	Skilled Labor	Teamsters & Laborers	Percent Teamsters and Laborers
Gasification	12.9	10.8	2.1	16.6
Liquifaction	10.5	9.0	1.5	14.0
Electricity	11.6	10.1	1.5	12.7
Cogeneration	17.1	10.7	6.4	37.5

To support our earlier contention that low skill workers are more likely to be unemployed, and therefore available, we determined from Census data that 16.2 percent of construction craftsmen were unemployed in 1970, while fully 27.8 percent of construction laborers were unemployed (Ref. 9 and 10).

In Fig. 6 we see an interesting property of the percentage construction workers who are laborers. The percentage drops precipitously with age from a quite high teenage level. Since youth unemployment is generally high, and is especially so among blacks, the fact that cogeneration uses many laborers can help to mitigate this problem. In fact, the percentage of 16 to 24 year old laborers among all construction workers is higher for minorities than for whites. The percentages are relatively small, being 3.8 percent for whites, 4.9 percent for blacks, and 4.8 percent for workers of spanish origin (Ref. 9 and 10). Still, the effect is worth mention.

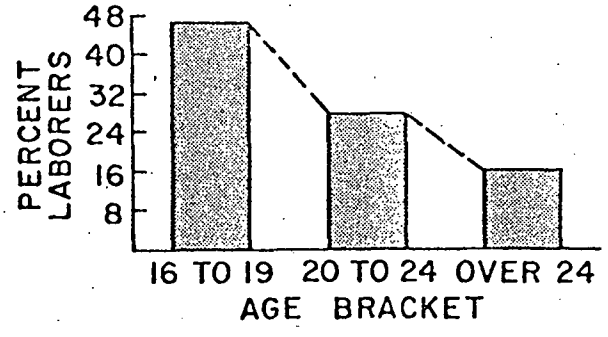

Fig. 6. Percent of male work force who are laborers

Finally, to complete our list of observations about the social advantages of employing low skill construction workers, we note that laborers are more likely to reside in poor neighborhoods than construction craftsmen. As a result, the employment of a laborer is more likely to lead to upgrading of a poor neighborhood. This upgrading would occur through at least some expenditures by the laborer within the neighborhood -- the well known multiplier effect. In Fig. 7 we show that the percentage of laborers living in poor neighborhoods is greater than elsewhere for each population category (Ref. 8).

To summarize, we have indicated that, since cogeneration-based district heating intensively uses low skill labor, a reduction of:

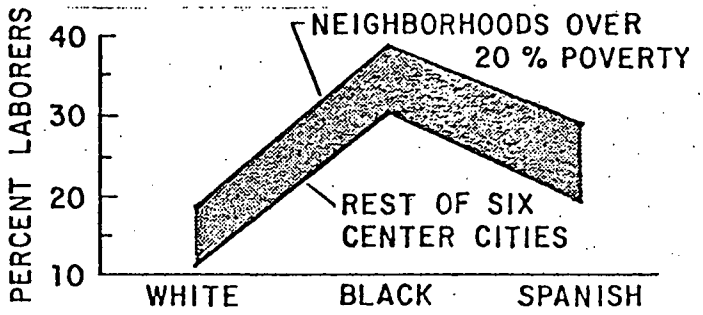

Fig. 7. Employed male construction craftsmen and laborers who are laborers

(1) minority unemployment, (2) youth unemployment, and (3) poverty in poor neighborhoods is likely.

DISCUSSION

This paper has demonstrated that cogeneration-based district heating of core areas of major northern U.S. cities has several employment benefits when compared to three coal based alternatives. These include reductions in minority unemployment, unemployment compensation payments, youth unemployment, and poverty in poor neighborhoods.

REFERENCES

(1) Studsvik Co., unpublished manuscript, Oak Ridge National Laboratory.

(2) Santini, D.J. and S.S. Bernow, Feasibility of District Heating and Cooling of Core Areas of Major Northern U.S. Cities by Cogeneration from Central Station Power Plants, presented at Northeast Regional Science Association Meeting, Amherst, Mass. (May 1979).

(3) Santini, D.J., A.A. Davis, and S.M. Marder, Costs of Urban Area Retrofit to District Heating and Cooling Systems: North Central Cities, Argonne National Laboratory Report ANL/ICES-TM-18 (Nov. 1978).

(4) Bernow, S.S. and R.A. Rosen, An Assessment of the Potential for District Heating in Four Major Eastern Cities: Washington, D.C., Philadelphia, Baltimore, Boston, Argonne National Laboratory Report ANL/ICES-TM-11 (Aug. 1978).

(5) Bechtel Corp., Energy Supply Planning Model, employment requirements data, 1979 supplied by R.G. Zimmerman, Bechtel Corp, San Francisco, Calif.

(6) Oliker, I., Urban Area District Energy System Study, draft Burns and Roe, Inc., Report W.O. 3251-06, Oradell, N.J. (undated).

(7) U.S. Bureau of the Census, Census of Population, 1970, Subject Reports. Final Report PC (2)-2B, Mobility for States and the Nation, USGPO Washington, D.C. (1973).

(8) Op. Cit., USBOC, COP, PC (2)-9B, Low Income Areas in Large Cities.

(9) Op. Cit., USBOC, COP, PC (2)-7A, Occupational Characteristics.

(10) Op. Cit., USBOC, COP, PC (2)-6B, Persons Not Employed.

(11) Op. Cit., USBOC, COP, General Social and Economic Characteristics, PC (1)-C, U.S. Summary & States, USGPO, Washington, D.C. (1972).

(12) Op. Cit., USBOC, COP, General Population Characteristics, PC (1)-B, U.S. Summary, USGPO, Washington, D.C. (1972).

(13) USBOC, Statistical Abstract of the US:1977 (98th ed), USGPO, Washington, DC (1977)