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Worker participation in energy and natural resources conservation

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I. Introduction

There is probably no factor more critical for the survival of any economy than adequate supplies of energy and natural resources. The research project described in this article [1] addressed the problem from an industrial relations and human perspective, rather than from the usual purely technical angle, by focusing on the contribution employee participation in workplace decision-making can make towards conserving energy and natural resources.

In recent years there has been a good deal of interest in joint labour-management approaches to problem-solving. Spurred in part by the success of the Japanese quality circles movement, a range of programmes have been adopted in many establishments in the United States and other countries. These fit into the general category of "employee involvement" (EI). Specific models include quality circles, quality of working life programmes, autonomous work groups, labour-management committees and participation schemes entailing financial incentives (e.g. Scanlon plans). The premise underlying these various programmes is that employees' ideas and support constitute an untapped (or insufficiently tapped) human resource in many work organisations and that job satisfaction and overall productivity can be increased by involving them more extensively in workplace decision-making. In this article, the abbreviation "EI" will refer to employee involvement programmes generally.

In the United States conservation efforts in industry were focused initially on energy management, engineering and improved technology. Later, in response to two successive oil shocks and increasing foreign competition, many establishments set up energy conservation committees. More recently, some enterprises have been involving non-supervisory, non-managerial employees in conservation activities through worker participation programmes and labour-management committees.

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In Japan, on the other hand, where participative management has developed considerably since the 1950s, both the joint labour-management consultation system and the plant-level quality circles (or "small-group activities") have traditionally emphasised industrial energy conservation. Large industrial concerns such as Nippon Steel and the Toyota Motor Company report substantial energy savings as a result of employee involvement.

The current industrial relations environment would appear to favour collaborative approaches to conservation. At present, however, little specific information is available concerning the degree and extent of employee involvement in this area, the techniques and methods used to promote it, or the result achieved at workplaces. The purpose of the present inquiry was accordingly to gather and report such information.[2]

The United States and Japan were chosen for this study because of the particular characteristics of each country. The United States has an extremely high energy consumption level and has recently begun to develop a broad array of employee involvement programmes. Japan is very dependent on imported energy sources and has highly developed employee involvement activities in the major industries.[3]

II. Employee participation in conservation in the United States

The United States survey concentrated on the energy conservation committee (ECC) system and employee involvement (EI) programmes. The data showed a clear association between the degree of employee participation in conservation activities and the results achieved.

Effectiveness of conservation activities and degree of employee participation

For the purposes of the inquiry the establishments surveyed were divided into four groups according to their degree of employee participation. An important test for measuring this was the presence or absence in each establishment of the two major tools of employee participation in conservation activities – ECCs and EI programmes. The four groups consisted of: establishments with both an ECC and an EI programme; those with an EI programme only; those with an ECC only; and those with neither. Within each of the four groups establishments were rated according to the following four criteria: extent of energy conservation; extent of natural resources conservation; extent to which investment projects recommended by employees were adopted; and extent of adoption of operational changes so recommended. The scores achieved by each of the four groups of establishments under each of these criteria were expressed as index figures representing a mean score for each group. The results are set out in table 1.

Table 1. Conservation results by degree of employee participation (United States)

Degree of employee participation	Energy conserved		Natural resources conserved		Investment projects		Operational changes	
	N	Index V	N	Index W	N	Index I	N	Index C
ECC and EI	62	8.22	51	2.80	74	14.39	75	8.16
EI only	59	6.48	56	2.57	13	9.94	13	6.56
ECC only	14	7.43	10	1.75	71	10.62	72	5.77
No ECC or EI	8	4.11	16	1.78	18	7.78	18	3.78

Note: N = number of establishments; ECC = energy conservation committee; EI = employee involvement programme; index V = extent of energy conserved; index W = extent of natural resources conserved; index I = extent to which investment projects recommended by employees were adopted; index C = extent to which operational changes recommended by employees were adopted. For the calculation of these indices see notes 4, 5, 7 and 8. The index figures shown here are the mean values for the group of enterprises concerned.

Energy conservation. Questioned about the extent to which they conserved energy from nine specific sources, respondents most frequently cited electricity, natural gas and oil. Based on the data thus obtained on conservation of individual energy sources, index V was prepared, summarising for each establishment the extent to which energy was conserved thanks to employee participation.[4] As can be seen, the highest level of energy conservation occurred in establishments with both an ECC and an EI programme and the lowest level in establishments with neither.

Natural resources conservation. The extent of natural resources conservation was also related to the degree of employee participation, although less strongly. The most frequently cited resources conserved by respondents were water, ferrous metals, wood, petroleum fuel stocks and non-ferrous metals. Index W summarises the extent to which a variety of resources were conserved by each organisation thanks to employee participation.[5] The highest levels of conservation were again found in establishments using both approaches and the lowest levels in those with only an ECC or neither an ECC nor an EI programme.

Investment projects. In order to assess the contribution to conservation made by investment projects recommended by employees and subsequently adopted, respondents were given a list of 15 types of projects and asked how frequently each had been recommended by employees and adopted. The projects most frequently recommended and adopted concerned such matters as insulation, new lighting, more efficient heating and cooling equipment, and automatic controls. Such projects tended to rely essentially on first-hand familiarity with work processes and equipment suitable for use in improving conditions at the worksite level. System-wide technological changes such as the introduction of co-generation, solar equipment or alternative fuels were less likely to be recommended and adopted.[6] Index I, which measures the

extent of conservation investments recommended and adopted in each establishment,[7] was highest for establishments with both an ECC and an EI programme, intermediate for establishments with only one of these, and lowest for establishments with neither.

Operational changes. Respondents given a list of ten types of operational changes reported reduced lighting, reduced temperature levels and better scheduling of equipment use as the changes most frequently recommended and adopted. The least frequently adopted changes concerned scheduling of shifts, redistribution of labour and use of transportation fleets. Index C was computed to measure the extent of operational changes recommended and subsequently adopted.[8] Table 1 shows again that the highest mean scores occurred in establishments with both an ECC and an EI programme, and the lowest in those with neither.

Dollar savings achieved. Respondents were asked to estimate the average annual dollar savings made thanks to employee involvement in energy conservation. In 30.2 per cent of the establishments responding, the reported average savings were over $100,000 per year, while 9.5 per cent made savings of over $1 million and only 6.9 per cent made less than $1,000 a year.

To understand more fully the pattern of establishments' savings, the relationship between the level of energy intensity of the various establishments and the dollar savings per employee was analysed. Among respondents providing usable data, there were substantial savings ($458 per employee) among establishments with high energy intensity (i.e. the 21 whose energy costs per employee exceed $2,000 per year), while establishments with low energy intensity (37 establishments with energy costs per employee below $2,000 per year) averaged $82 per employee.

Thus the data suggest that employee involvement easily pays its way in an energy-intensive establishment, but may do so less obviously in an establishment with low energy intensity, where such factors as the quality of the conservation effort and the technical backup available will also have a bearing on its cost-effectiveness.

The survey further showed that the level of dollar savings in the establishment tends to increase where managerial staff involve themselves personally in energy conservation efforts, in particular where top and middle management are represented on ECCs. Such management representation makes for a better-informed committee and enhances its authority, particularly in budget matters, as well as its expertise.

Employee involvement programmes

The survey revealed that EI programmes still attach relatively low priority to conservation, even though evidence from a small number of organisations underscores their potential contribution in that area. Unions

Table 2. Number and frequency of types of EI programmes surveyed (United States)

Type	Establishments operating the specified type of EI programme	
	No.	%
Suggestion systems	105	53.8
Quality circles	93	46.5
Labour-management committees	72	36.0
Quality of working life programmes	30	15.3
Financial incentive plans	27	13.8
Other	11	32.4

[1] Data were available for differing numbers of establishments. Percentages add up to more than 100 because many establishments had more than one type of programme.

offer another means of increasing employee participation in conservation. Currently, labour organisations are participating to some degree in EI programmes geared towards conservation, but could do so to a much greater extent.

EI programmes were reported to exist in 159 (81.1 per cent) of the 196 establishments for which data were available. Most establishments ran more than one type of programme: the various types are shown in table 2. Participation in many of the programmes is still fairly low; many were started only in the early 1980s, and it is likely that participation has not yet reached its peak.

Role of trade unions. While trade unions were involved to some extent in the EI programmes studied, the general level of participation was not high. In unionised establishments there was no union involvement in 24 (27.3 per cent) of the EI programmes. In eight other programmes (9.1 per cent) unions were involved only to the extent of being kept informed. They were equal participants in 28 (31.8 per cent) of the programmes, and had a predominant role in four of them (4.5 per cent). No correlation was observed between the level of union involvement and the level of savings achieved.

Extent of EI programme emphasis on conservation. In the EI programmes studied, energy and natural resources conservation received less attention than issues of productivity, worker safety and work environment, but it should be borne in mind that matters not specifically concerned with conservation also have conservation implications. Table 3 shows the percentage of EI programmes concerned with each of the different issues.

To permit a more accurate assessment of the place of energy conservation in these programmes, respondents were asked to report the percentage of themes or projects in their EI programmes that dealt with energy conservation. Over half reported that only 1 to 10 per cent of such projects

Table 3. Number and percentage of EI programmes dealing with various issues (United States)

Type	EI programmes dealing with the specified issue[1]	
	No.	%
Safety	142	87.7
Quality of product or service	140	87.5
Work environment	131	80.9
Production problems	130	80.2
Efficiency	123	75.9
Energy conservation	115	71.0
Natural resources conservation	64	39.8

[1] Data were available for differing numbers of programmes.

dealt with conservation, but 11.4 per cent of establishments reported conservation as the focus of more than one-quarter of their projects.

Respondents were also asked to estimate the proportion of all energy conservation recommendations attributable to the involvement of employees. In 9.2 per cent of establishments there were none, and in a further 58.5 per cent of establishments, between 1 and 10 per cent of such recommendations were perceived as attributable to employee involvement, but in the remaining 32.3 per cent of establishments the figure was over 10 per cent.

Recent inclusion of conservation in EI programmes. Curiously, very few EI programmes in the United States included energy conservation until very recently. Seventeen (12.4 per cent) of the programmes for which data were available made energy conservation an EI issue in the aftermath of the first oil crisis, but most programmes made it a major focus at a much later date, 63 (46 per cent) including it only since 1981.

Data were gathered on when the EI programmes were started, and analysis showed this to be an important variable. The longer a programme was in place, the greater the likelihood of its being involved in energy-related projects. Thus the proportion of programmes in which more than 10 per cent of the themes or projects dealt with energy was only 29 per cent in those established since 1981, but as high as 47.1 per cent in those introduced after the first energy crisis of 1973-75.

Assistance to conservation activities in EI programmes. Training and other types of assistance were found to be an important source of help to conservation activities under EI programmes. Just under one-half of the establishments provided the EI groups with training in problem-solving. About 35 per cent provided group dynamics training and approximately 29 per cent technical training in energy conservation. Respondents rated

programmes that included training as more effective than those without it. The data also showed that EI programmes were receiving engineering and organisational assistance from within the establishment as well as information on energy conservation initiatives in other units of the organisation.

Energy conservation committees

Another means of increasing employee participation in conservation is to set up a special committee to spearhead and co-ordinate energy conservation efforts. The setting up of such a committee constitutes a less far-reaching organisational change than the introduction of an EI programme, and a correspondingly weaker means of increasing employee participation. On the other hand, while the EI programmes surveyed were found to place a low priority on energy conservation, the committees were for the most part focused exclusively on that objective, and the data suggest that this approach pays off, since establishments with ECCs had achieved higher levels of conservation than those without them.

Ninety-three establishments (48.2 per cent) had energy conservation committees. In 66 cases such bodies were set up at both the establishment level and a higher, e.g. corporate, level. Twenty-six organisations had only a higher-level committee. Analysis showed that, on the average, the combination of a higher-level ECC with an establishment-level committee was more successful than an establishment-level committee operating alone. While not statistically conclusive, the data indicated that, where there is no establishment-level committee, a corporate-level one is better than no conservation committee at all. Since the questionnaire focused on establishment-level committees, all the information that follows refers only to this type.

The committees ranged in size from two or three members to more than 50, with an average membership of 4.88. Their size was found to be positively and significantly correlated with the four outcome indices (V, W, I and C) described earlier, and also with average annual dollar savings. No doubt this is in part because the organisations with the largest committees tend to be those where management devotes more time to conservation activities and where there is better co-ordination between EI programmes and ECCs. More research is needed, however, to understand how decisions on committee size are arrived at and what constitutes the optimum size for an ECC in different situations.

Trade union involvement. Trade union representatives sat on only seven (11.9 per cent) of the 59 ECCs in unionised establishments for which data were available. Yet the unions represent an untapped source of grass-roots ideas and support from which ECCs in unionised establishments might well benefit. Sixty of the 73 unionised establishments with conservation committees also had EI programmes, and the unions participated at some level in 29 of these. Participation in EI programmes provides a basis for extending union representation to more ECCs.

Committee composition, authority and budget. ECCs were found to vary a great deal in terms of the functions or departments that were represented on them. Maintenance was most frequently represented (in 83.5 per cent of cases) and the personnel section least frequently (20.9 per cent), with the following in between: engineering (81.1 per cent), operations or production (80.2 per cent), energy management (76.9 per cent), accounting and finance (44.0 per cent), environmental control (38.5 per cent) and safety (29.7 per cent).

The extent and specific areas of authority of the ECCs varied widely. The function most frequently exercised by the committees surveyed was "to advise as requested" (88.8 per cent), followed by "to monitor and evaluate programmes" (80.9 per cent), "to plan on a regular basis" (74.4 per cent) and "to implement on a regular basis" (53.4 per cent). Only 40.3 per cent of the ECCs had the authority to make final decisions; in these cases top management was likely to be represented on the committee.

In further examining the patterns of authority characterising different committees, it was found that in only 10.2 per cent of cases did the committee exercise a single form of authority while in 25 per cent it was entrusted with all five of those covered by the inquiry. When an ECC was authorised to "make final decisions", it was most likely to have its own budget, although committees with a budget of their own were comparatively few (22.2 per cent).

ECCs have other resources available to them besides money, but the pattern of resources used was found to vary from one committee to another. Engineering assistance was most frequently available (in 88 per cent of cases), research and development assistance least frequently (40.4 per cent). Other resources used include general staff support (84.8 per cent of cases), computer assistance (63.7 per cent) and consulting services (56 per cent).

Training. Training in energy conservation techniques was provided to 62.5 per cent of the committees. Group skills training of various kinds – organisation and conduct of meetings (43.7 per cent), small-group problem-solving (41.4 per cent) and group dynamics (24.1 per cent) – was less frequent. Almost two-thirds (63.1 per cent) of the committees had been given training in both energy conservation techniques and group skills in some form or other. Significant positive correlations were observed between committees receiving training in the latter and the extent of co-ordination between EI programmes and ECCs.

Co-ordination of energy conservation efforts. Table 4 illustrates how far, and in what ways, ECCs seek to involve other employees in conservation efforts.

In only 36.8 per cent of the establishments with ECCs were the committees found to involve other employees through structured problem-solving on energy issues. This again indicated unrealised potential for linking the activities of ECCs and EI programmes, bearing in mind the importance of

Table 4. Use by ECCs of various means of involving employees in their work (United States)

Means used	Committees for which data were available	Committees using the specified means of involvement	
		No.	%
Making suggestions	91	86	94.5
Monitoring and evaluating energy conservation programmes	88	59	67.0
Recommending new work processes or designs	90	57	63.3
Recommending new technologies or machinery	88	54	61.4
Conducting energy audits	87	52	59.8
Publicity and promotional campaigns	86	49	57.0
Participating in structured problem-solving on energy issues	87	32	36.8
Other (respondent asked to specify)	76	3	3.9

co-ordinating employee participation in an establishment's conservation efforts in cases where such participation assumes a variety of forms.

More generally, the inquiry highlighted the importance of co-ordinating all forms of action aimed at conserving energy. The data brought out the contribution that good co-ordination between EI programmes and other energy conservation efforts can make towards increasing dollar savings and showed, in addition, that EI programmes and energy conservation activities are better co-ordinated in establishments with ECCs than in others. By and large, the responses disclosed that there is considerable room for improvement in these areas.

III. Employee participation in conservation in Japan: Comparison with the United States

In terms of energy and natural resources as well as industrial relations, the United States and Japan are very different. The United States, despite widespread concern about the use of imported resources, still has extensive natural resources, including energy, at its disposal whereas in the case of Japan these resources are very limited.[9] To some extent the United States is still imbued with a "frontier spirit", which views natural resources as freely available for promoting economic expansion. Japan, by contrast, is very much aware of its limitations, and the Japanese are more likely to seek a harmonious and respectful relationship with the environment. The United States industrial approach is far less consensual and less oriented to the long

term than that of the Japanese.[10] All of these factors have a strong bearing on the present subject.

Among those involved with energy conservation, the Japan Energy Conservation Center places emphasis on a network of management approaches which begin with the energy manager, include energy committees and involve "small group activities" such as those of the quality circles.[11] At the national level unions are involved in thinking through the employment implications of energy policy, notably in the aluminium industry.[12]

Japanese industry can be said to have been remarkably effective in achieving operational advantages through employee participation. Similarly, the Japanese energy conservation record is excellent. What seems to be lacking is sufficient awareness of the specific interaction between the two at the policy level.

None the less, the contribution that employees in Japanese companies make in this vital area is plain to see and easy to account for. In many ways Japan is a model conserver society, and this cultural trait is one predating the nation's industrial prominence. To conserve, whether in society at large, at home or at work, is the Japanese way; and while efforts at quality control require more conscious direction, conservation remains a deeply ingrained tradition of Japanese society.

Effectiveness of conservation programmes and degree of employee participation

Savings. The conservation results in Japan are impressive, with 47.6 per cent of the establishments surveyed reporting savings of more than US$100,000 per year thanks to employee involvement. This result is even more significant in that it represents long-term savings: in almost half of the responding Japanese firms energy conservation had been a central preoccupation for more than ten years. Such results refute a widespread tendency to dismiss new energy conservation ideas as mere "quick fixes".[13]

Nature of employee suggestions. In both the United States and Japan the suggestions most frequently made for energy savings concerned improved insulation, automatic equipment controls and more efficient heating and cooling systems. The survey data indicated that Japanese workers were more likely than their American counterparts to make suggestions in the "frontier" areas of conservation, e.g. co-generation, solar equipment, recycling and alternative fuels. In the United States workers tended instead to make recommendations for technological monitoring and changes in workplace procedures. This may be attributable to the fact that the older the tradition of employee involvement is in a given country, the more advanced the solutions put forward are likely to be: many of the "first generation" recipes for achieving energy savings have already been applied in Japan.

Investing in EI recommendations. The reasons cited for the rejection of employees' recommendations gave further evidence of the differences in

Table 5. Major reasons for rejecting EI groups' recommendations

Reason for rejection	Japan (N = 336)		United States (N = 170)	
	No.	%	No.	%
Lack of capital	24	7.1	64	37.6
Unwillingness to allocate capital	26	7.7	44	25.9
Inadequate payoff	160	47.6	104	61.2
Insoluble technical problems	147	43.8	49	28.8
Disagreements about importance	72	21.4	50	29.4

Note: Percentages add up to more than 100 because some firms rejected recommendations for more than one reason.

approach in the two countries. The data are summarised in table 5, which indicates that, while "inadequate payoff" was the major reason for rejection in both countries, capital outlay questions played a far more important part in the United States, and technical problems in Japan. Japanese management, in particular, proved less concerned about the "payback" period for capital investment and more willing to invest for the long term.

In comparison with those of the United States, Japanese achievements in promoting employee participation are impressive. For example, while the average number of employee participation groups per company surveyed in the United States was 10.7, the number in Japan was 143.9. In the United States the average number of projects completed each year by an EI group was one and a half, compared with six in Japan. The average total number of projects per Japanese firm was 914 a year, or almost 60 times more than in the United States (15.4). It should be noted that the firms surveyed were of comparable size and the projects of comparable scope and importance.

The percentages of projects dealing with energy or natural resources conservation in each country were fairly similar. In the United States 53.7 per cent of the establishments reported that between 1 and 10 per cent of EI group themes dealt primarily with energy and natural resources issues. In Japan the corresponding figure was 67.1 per cent. The disparity was larger in the case of firms reporting no themes concerned with conservation: in Japan only 3.3 per cent of the firms came under this heading (cf. table 3). What these figures fail to reflect, moreover, is the far higher aggregate level of savings achieved by the Japanese, owing to the large number of suggestions made in establishments and the broad application of EI programmes in Japan.

The high degree of employee involvement in Japan has a definite impact on conservation. A review of prize-winning efforts in a national competition for industrial energy conservation projects indicated that a large number of the ideas were submitted by EI groups.[14]

One illustration of this was a case study conducted at Nippon Kokan, the giant steelmaker. It was found that over 15 per cent of EI projects in the enterprise dealt with energy in a substantial way, about 16,000 suggestions having been adopted in this field.[15] An example is a suggestion made in Ohgishima, where the workers in the strip mill proposed the installation of a heat-conserving device between the rolling machines in order to prevent heat from escaping. The technical department said that this was impossible, but the workers persevered and their idea is now saving the company over 100 million yen (approximately $4 million) per year. In many Japanese companies with high energy consumption, energy often ranks second or third behind quality and productivity as a subject of employee suggestions. In the Kyowa Hakko petrochemical plant, examined in another case study, 31 per cent of the suggestions emanating from the small group activities related to energy conservation.[16]

Co-ordination of conservation efforts and EI. In general, energy conservation efforts and employee involvement in Japan were found to be very closely co-ordinated, with 47.6 per cent of the establishments rating the co-ordination as better than "moderate" (on a five-point scale ranging from "none" through "moderate" to "very good"). In the United States, only 12.1 per cent of the establishments rated co-ordination as better than "moderate".

Sharing of benefits. Financial benefits were shared with employees in 124 (59 per cent) of the Japanese firms replying to this question. Companies with a high level of savings achieved through employee involvement in conservation tended to share benefits more readily than those with lower levels. Fifty-eight (70.7 per cent) of the establishments which reported savings of over $100,000 per year shared benefits, compared with 47 (51.6 per cent) of those with savings of less than $100,000. (The remaining 19 firms that shared benefits with employees did not report the level of savings achieved.)

Whether sharing of benefits encouraged greater savings or whether it was the amount of savings that facilitated the introduction of sharing is not clear. What is certain is that the stronger the union role in the EI programme, the more likely it is that there will be sharing. In cases where the union was not involved or was merely kept informed of developments, 35 of the establishments (53 per cent) shared benefits. By contrast, three of the four reporting a predominant union role shared benefits, as did 17 (77.3 per cent) of those in which unions were reported to be associated on an equal footing in EI programmes, and 49 (59 per cent) of those reporting a minor union role in the programmes.

Energy conservation committees

Conservation committees are sanctioned by law in most large Japanese companies.[17] In the sample studied 69.5 per cent (i.e. 232 companies) had

ECCs, and the data showed that the larger the establishment the more likely it was to have a committee. Of the establishments with over 5,000 employees, 87 per cent had committees.

Irrespective of the size of the firm, the committees made a very significant impact on the savings achieved through employee involvement. Savings of over $100,000 were reported in 54.4 per cent of the companies with ECCs, but in only 25.1 per cent of those without. Savings of more than $500,000 were achieved in 26.3 per cent of companies with ECCs, as against only 8.4 per cent of those without.

The ECCs surveyed in Japan had an average of 17 members – almost four times the size of the United States committees. Over half (53.1 per cent) of the committees included top management, 84.9 per cent middle management, and 62.8 per cent supervisors. Such broadly based representation is typical of Japanese industrial relations.

Union members and energy conservation. In general, committees with union membership were found to be more likely to have broad responsibilities than those without. Only on those responsible for conducting energy audits and for monitoring and evaluating energy conservation were union members less likely to be represented.

In Japan 152 (66.7 per cent) of the committees included union members, either with the formal status of union representatives or as regular members of the committee. This was in sharp contrast with the situation in the United States where, as mentioned above, unions participated in only seven (11.9 per cent) of the committees surveyed. Table 6 illustrates the relationship between the forms of authority exercised by the ECCs in Japan

Table 6. Trade union participation in the various forms of authority exercised by ECCs (Japan)

Form of authority exercised	Committees exercising the specified form of authority					
	All committees (N = 228)		Committees with union members (N = 152)		Committees without union members (N = 76)	
	No.	%	No.	%	No.	%
To plan on a regular basis	144	63.2	109	71.7	35	46.1
To advise as requested	140	61.4	101	66.4	39	51.3
To monitor and evaluate programmes	134	58.8	90	59.2	44	57.9
To make final decisions	130	57.0	87	57.2	43	56.6
To implement on a regular basis	104	45.6	82	53.9	22	28.9

Table 7. Use by ECCs of various means of involving employees in conservation efforts, as related to union member participation (Japan)

Means of involvement	Committees using the specified means					
	All committees (N = 228)		Committees with union members (N = 152)		Committees without union members (N = 76)	
	No.	%	No.	%	No.	%
Publicity campaigns	167	73.2	121	79.6	46	60.5
Structured problem-solving	161	70.6	112	73.7	49	64.5
Making suggestions	152	66.7	108	71.0	44	57.9
Monitoring or evaluating programmes	96	42.7	60	39.5	36	47.3
Recommending new technology	82	36.0	62	40.8	20	26.3
Recommending new work processes	43	18.9	31	20.4	12	15.8
Conducting energy audits	27	11.8	16	10.5	11	14.5

and union participation in their work; in this case 310 (92.3 per cent) of the establishments responding were unionised. Union involvement appears to have a very strong impact on the authority and role of the committees. Those with union participation were much more likely to implement and plan on a regular basis and to "advise as requested". They were slightly more likely to monitor and evaluate programmes and make final decisions, suggesting that a union presence did not inhibit the exercise of these forms of authority.

Table 7 indicates the major means used by committees to involve employees in conservation efforts. The corresponding data for the United States, as presented in table 4, show an almost inverse pattern. Table 7 further illustrates the relationship between the use made of these various means in Japan and union participation in energy conservation committees.

In Japan there is another avenue for union involvement in conservation besides the ECCs and small group activities, inasmuch as the joint consultation system provides a mechanism at the enterprise level for discussions with the union on energy questions linked to new technology, work processes and procedures.[18]

IV. Implications for labour-management relations

Labour-management relations in advanced industrial countries have felt the strain of the recent economic recession, which many believe was caused

in large part by an international energy crisis. "Concession bargaining" entailing worker sacrifices on wages and working conditions has exacerbated tensions between unions and employers, and often between union leaders and a good many of their members. As enterprises have laid off workers in order to become "meaner and leaner" and to improve their domestic and international competitive position, the threat to union members' job security has further heightened these tensions. In such circumstances a co-operative approach to conservation can have a markedly positive impact on union-management relations.

Employee involvement in conservation efforts at the workplace can yield tangible savings, and these may increase over time. As the comparison made here between the United States and Japan indicates, continued attention to conservation by properly trained employee groups can lead to more sophisticated involvement in redesigning work processes and developing solutions to energy utilisation problems. The cost savings thus obtained are just as valuable as savings realised through productivity. In fact, it can be argued that these resource efficiency approaches *are* a form of enhanced labour productivity.

Both labour and management can benefit from co-operation in reducing energy and natural resources costs. To the extent that unions can work with managers in reducing production costs by saving energy, the individual enterprises can become more competitive without the adverse employment effects often associated with increased labour productivity.

Workplace energy conservation may, of course, have some negative employment impact outside the establishment concerned. Successful conservation efforts may reduce (at least in the medium term) the number of construction jobs required for expanding energy capacity. On the other hand, there is the example of the US Sheetmetal Workers Union which, having promoted solar power as an energy conservation technology, is now reaping the benefit of more jobs for its members. Used wisely and widely, conservation can lead to a net gain in jobs.

In addition, energy savings can in the right circumstances result in, or be tied to, a negotiated benefit-sharing programme. Employees can be compensated for their efforts on an individual, group or establishment-wide basis.

The co-operative energy conservation approach can be a first step towards building up a more general participative or problem-solving and decision-making structure. In the United States many EI programmes appear to lose some of their appeal after two or three years of initial enthusiasm and development:[19] energy conservation could be a new and important theme for many participation groups, helping to sustain their interest by opening up fresh areas for participative problem-solving.

The emphasis on conservation at the workplace may also heighten awareness among employees of the cost of energy and impel them to reduce energy consumption in their homes. Some enterprises attempt to link workplace and home conservation efforts and to create a mutually reinforc-

ing behaviour pattern. Employees who become effective conservers can stretch their incomes as consumers. A recent case study on the Maryland Department of Mental Health discusses this and other educational aspects of energy conservation.[20]

Government policy, too, relying on information, education, technical assistance and other means, should be geared to encouraging individual enterprises to change their criteria for what constitutes an acceptable "payback" period.[21]

Labour, management and government can also combine resources for conservation research and training efforts. An example of just how important this is was given by Robert E. Dragoo, director of industrial-business applications for Honeywell, Inc., when he declared that "... the number one energy drain is employee equipment use. . . . Over one-half of steam boiler operators in the US don't know how to use them efficiently."[22] In 1980 the United States Department of Energy funded a unique materials development and training programme to tackle this problem. Sponsored by the International Union of Operating Engineers, it is designed for maintenance staff, e.g. workers who operate the boiler rooms or central energy production units of buildings and other facilities. The union has now produced a comprehensive manual on conserving energy which has been developed and tested and is being used to teach journeymen and apprentices how to conserve energy more efficiently in their jobs.[23]

V. Concluding remarks

The data presented here were gathered in two very advanced industrial countries. It would be a mistake, however, to restrict the lessons of the project solely to such countries.

If developing countries – which are predominantly energy-poor – are to achieve their industrial development objectives, significantly expanded energy consumption will be required. Energy conservation can play an important role in helping these countries meet their energy needs.

In all countries entrepreneurs have to make decisions about how to manage their resources and energy budgets. In capital-rich countries it is reasonable that capital-intensive and technologically sophisticated approaches to energy use will be high on the agenda. Unfortunately, few developing countries find themselves in this situation. They need to seek answers that are less costly and less reliant on expensive and often imported technology. Employee participation in conservation, which has demonstrated its capacity for reducing material or energy costs, has great potential for helping poorer countries to meet their overall development objectives more efficiently.

Considerable effort has been invested in devising technical solutions to the problem of conservation in workplaces. However, the data gathered in the United States and Japan strongly indicate that energy conservation

should not be treated as a purely technical matter, but as a problem that can best be addressed by the human beings who actually produce and consume energy – and who can be motivated to conserve it as well.

Notes

[1] This article is based on a study financed by a grant from the United States-Japan Foundation. The report on the study is available under the title *Employee participation in conservation: The US and Japan experience* (Ann Arbor, Institute of Labor and Industrial Relations, University of Michigan, 1984). The authors wish to express their thanks to all those who contributed to the project and the research it entailed, and in particular to Roger Kerson, Michael Lesnick, Robert Cole, Marc Ross, Cynthia Burton, Karen Roe, Lise Anderson, Junji Noguchi, Joji Kato and Nobuo Sueki.

[2] The projects was sponsored by the Institute of Labor and Industrial Relations (ILIR); co-sponsors were the School of Natural Resources (SNR) and the Center for Japanese Studies at the University of Michigan, and ECR Associates, a United States labour-management consulting firm.

[3] The research was carried out in both countries through (1) a survey of a sample of workplaces, (2) selected case studies to permit in-depth assessment of participative activities dealing with conservation, and (3) the development of a theoretical model demonstrating the relationship between participation and conservation in workplaces. The 76-question survey instrument, developed in the United States and translated for use in Japan, was designed to gather data about the nature, degree and extent of employee involvement in energy and natural resources conservation, the methods and practices used, and the results achieved. In Japan a computerised list of firms operating quality circle programmes, drawn up with the assistance of the Union of Japanese Scientists and Engineers, was used to obtain a sample of 690 establishments; of these, 336 (48.7 per cent) responded. In the United States the problem of finding establishments likely to practise employee involvement in conservation matters was somewhat more challenging. Using various publicity and population targeting methods, a list of some 500 establishments was drawn up, survey questionnaires were mailed to them, and the 198 responses gave a 39 per cent return rate. In both countries the survey was conducted from January to May 1983. The unit of analysis was a plant or office, i.e. an "establishment". Eight of the responses in the United States came from multi-establishment enterprises and were included in the data base. Researchers visited selected establishments and interviewed labour and management personnel involved in participation or conservation efforts, or both. Six case studies were carried out in Japan by the Japan Productivity Center. In the United States research on three case studies was carried out by the ILIR, the SNR and ECR Associates.

[4] Index V is the sum of scores for each of the energy sources listed in the question: electricity, natural gas, oil, petroleum gas, coal, external steam, wood, other biomass and internal hydroelectricity. Respondents indicated for each source whether the extent of conservation was not at all (=0), a little (=1), or a lot (=2). The sum of the scores for each establishment was weighted by a coefficient obtained by dividing the maximum number of scores recorded in any establishment in the survey (six) by the actual number of scores recorded in the establishment concerned.

[5] Index W is the sum of the scores for the ten natural resources or raw materials listed in the question: water, ferrous metals, wood, non-ferrous metals, petroleum fuel stocks, precious minerals, other minerals, sand, clay and biomass. This index was constructed in the same way as index V. The lower scores, as compared with index V, result from the fact that the establishments surveyed conserved more energy than natural resources. The explanation is partly that they were selected on the basis of their own claims to being engaged in energy conservation activities and partly that, generally speaking, less emphasis was placed on natural resources or raw materials conservation than on energy conservation.

[6] Many United States respondents indicated that employees-suggested projects which did not meet a one-year "payback" criterion (i.e. the new measures should pay for themselves within this period) were rejected. But the case study of a California firm showed that an important step in developing a very successful energy conservation programme had been to extend the expected

payback period from one to three years. (See Michael Lesnick: "Energy conservation and employee involvement in the canning industry: A case study of Tri-Valley Growers, Inc., Modesto, California", in *Employee participation in conservation: The US and Japan experience - Three United States case studies*, (Ann Arbor, Institute of Labor and Industrial Relations, University of Michigan, 1984).) It is interesting to note that after Tri-Valley had thus extended its payback period, scarcity of capital moved the company to join with T-F Energies, an energy investment firm, in launching an innovative programme for more ambitious energy conservation projects. T-F put up the capital and shares the energy savings, of which it receives a declining proportion each year. Under this scheme Tri-Valley has the option to buy out T-F in the seventh year at 15 per cent of capital costs (ibid., p. 21).

[7] Index I is the sum of scores for 15 types of investment projects. Respondents reported for each type of project whether it had been recommended not at all (=0), with some frequency (=1), or very frequently (=2). These scores for each type of investment project were added up to yield the index I score for each establishment. Respondents were also asked whether other types of investment projects had been recommended by employees and adopted, but this yielded very little additional information.

[8] Index C is the sum of scores for the ten listed types of operational changes. This index was constructed in the same was as index I.

[9] *The Energy Situation in Japan* (Washington, DC, Japan Economic Institute), No. 14A, 15 Apr. 1983

[10] William Ouchi: *Theory Z* (Reading, Massachusetts, Addison-Wesley Publishing Company, 1981).

[11] Speech to the Asian Productivy Organisation by Yukio Nozaki, International Co-operation Department, Japan Energy Conservation Center, 1981.

[12] As members of the committee on this industry attached to the Ministry for International Trade and Industry, unions are involved in this discussion.

[13] In 46.6 per cent of the firms, energy saving had been included in their EI programmes before the 1973 oil shock. Only in 8.5 per cent of them had energy been introduced as a focus since 1981 whereas, as we saw earlier, the corresponding figure for the United States was 46 per cent. While this reflects the relative age of EI programmes in the two countries, it also reveals the difference in strategies during and before the oil shocks.

[14] *Successful cases of energy conservation* (Tokyo, Japan Energy Conservation Center, 1983).

[15] *Case study on Nippon Kokan, Ltd., Keihin works: A case study of an energy conservation program and quality circles* (Tokyo, Japan Productivity Center, 1984).

[16] *Kyowa Hakko Co., Ltd.: A case study of energy conservation done by Upward "KIC Movement"* (Tokyo, Japan Productivity Center, 1984)

[17] Law respecting rational use of energy (Law No. 49, 1979), dated 22 June 1979.

[18] Productivity Research Institute: *A review of labor-management relations and employees' involvement in conservation through joint labor-management consultation and small group activities* (Tokyo, Japan Productivity Center, 1983).

[19] See P. S. Goodman: "Quality of work projects in the 1980s", in *Proceedings of the Thirty-third Annual Meeting of the Industrial Relations Research Association* (Madison, Wisconsin, IRRA, 1981), pp. 489-491.

[20] See Cynthia Burton: "Case study on Maryland Department of Health and Mental Hygiene", in *Employee participation in conservation: The US and Japan experience - Three United States case studies*, op. cit.

[21] This is consistent with the recent study *Industrial investment in energy efficiency: Opportunities, management practices, and tax incentives* (Washington, Alliance to Save Energy, 1983). The study found that while some firms undertake all projects identified as profitable, most undertake only those identified as *extremely* profitable. It also found that investment tax incentives did not significantly change the pattern.

[22] B. Horovitz: "When to send for the energy doctor", in *Industry Week* (Cleveland), 9 Aug. 1982, p. 66.

[23] *Energy management handbook for building operating engineers* (Washington, International Union of Operating Engineers, 1979).