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HEALTH OF GOVERNMENT SCIENCE AND TECHNOLOGY

AGING AND THE AVAILABILITY OF SCIENTIFIC PERSONNEL: THE FEDERAL GOVERNMENT PERSPECTIVE

NOVEMBER 1982

report

rapport

HEALTH OF GOVERNMENT
SCIENCE AND TECHNOLOGY

AGING AND THE AVAILABILITY
OF SCIENTIFIC PERSONNEL:
THE FEDERAL GOVERNMENT PERSPECTIVE

NOVEMBER 1982

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HEALTH OF GOVERNMENT SCIENCE & TECHNOLOGY AGING AND THE AVAILABILITY OF SCIENTIFIC PERSONNEL: THE FEDERAL GOVERNMENT PERSPECTIVE

EXECUTIVE SUMMARY

This study examines the age distribution of scientists and engineers working in the federal government. Given increasing concern over recent declines in the number of university graduates and projected large numbers of scientists nearing retirement age, this work explores the extent to which, and areas in which, new scientists will be needed in the federal government in the next decade.

Age distributions are examined in Chapter II for all major scientific departments and job classifications. It was found that disproportionate numbers of scientists are "near-retirement" age in the following areas:

- Veterinary Scientists (VS), and Research Scientists (SE/RES) in Agriculture Canada,
- Engineers (EN/ENG), Defence Scientists (DS), and Engineering and Scientific Support Staff (EGESS) in the Department of National Defence;
- Research Scientists (SE/RES) in Energy, Mines and Resources;
- Technicians in the National Research Council;
- General Technicians (GT) in the Department of Fisheries and Oceans,
- Engineers (EN/ENG) and Engineering and Scientific Support Staff (EGESS) in the Department of Public Works; and
- Engineers (EN/ENG) in Transport Canada.

The perceptions of individuals in the science departments who are responsible for finding replacements for retiring (or otherwise leaving) scientists and engineers are reported in Chapter III. Based on discussions with both personnel officers and science managers in the various departments, the hardest groups to recruit appear to be Research Scientists and Engineers with advanced degrees. Hiring individuals in the other areas of concern identified in Chapter II is more subject to fluctuations in the total economy and to the competing demands of the private sector. For most of these groups the current availability of personnel appears to be quite good.

Recommendations to address the problem areas and to generally improve the government's capacity to meet manpower needs are made with respect to:

- TBS giving priority to the problems of scientific manpower (as identified in the study) in its broad Human Resources Planning System;
- TBS incorporating supply side inputs into its Human Resources Planning System;
- TBS and PSC reporting to the Science ADMs Committee on progress being made by the science departments' human resource planning efforts to address the points raised by this report;
- MOSST working with PSC and TBS to develop a workshop for the departments on the findings of this work, and the application of on-going planning alternatives to their specific needs;
- coordination with NSERC of information on the areas of demand for scientists and engineers in the federal government departments;
- greater consideration by the science departments to the development of training and scholarship programs with local universities;
- a small pool of person years being allocated by the departments to provide greater flexibility in recruitment and hiring scheduling;
- MOSST further examining the reward structure for Research Scientists.

CHAPTER 1

INTRODUCTION

The "Health of Government Science and Technology" project seeks to identify and explore those aspects of the government milieu which might affect the ability of the federal government to do, and continue doing, sound and cost effective R&D in support of its mission.

A crucial aspect in the health of government S&T is the continued availability of adequately qualified human resources. The age distribution of scientific personnel is of major concern here, because of the impact this could have on retirement rates, and hence, on future personnel requirements. More broadly, consideration has to be given to the government's demand for scientists to fill all vacancies (created by retirement, other departures, or expansions), in relation to the supply of scientists entering the work force. All of these topics are considered in this report.

Chapter II looks at the question of whether, and to what extent, scientists and engineers in the federal government are disproportionately found in older age groups. This issue was identified recently by the Science ADMs' Committee as being of major importance, with concern being raised that a significant portion of the departments' scientific manpower may be approaching retirement at a time when replacements are in increasingly short supply.

In addition to the Science ADMs' Committee interest, several recent studies have noted a potential problem for the future in replacing retiring scientists, or in finding sufficient scientists to meet program requirements. In 1977, for example, the Science Council of Canada's workshop on the optimization of age distribution in university research noted that there were unusually large percentages of older scientists in both universities and government.(1) Workshop discussants also commented that there were decreasing enrolments in science disciplines and increasingly smaller percentages of university scientists who are under age 30.

More recently, in its 1981 Annual Report, the Public Service Commission (PSC) has noted that there is a particularly strong demand within the federal government for engineers and computer scientists.(2) Additionally, the analysis of a 1979 survey by the Economic Council of Canada (ECC) on human resources shows "that the unmet demand for people" in the sciences and engineering "is becoming more serious" (in all sectors of the economy). According to the ECC findings, scientific and engineering positions accounted for 8.8 per cent of all shortage-related vacancies reported for 1977-79, and are estimated to reach 12.1 percent for the 1980-84 period. (3) Lastly, a 1981 series of MOSST Background Papers on engineering manpower has documented both a growing shortage of engineers and an increased demand for their services. (4)

There are several reasons for the Science ADMs' and others' concern over the age distributions of scientific personnel in the federal government. First, it is feared that groups with a high proportion of older scientists may suddenly be facing large numbers of retirements. This may leave an inadequate number of scientists to carry on the work of the affected research organizations, especially if the expected national, scientific manpower shortages materialize.

Second, and more qualitatively, enough high-level expertise may not be available within the federal government research organizations to fill the void left by those retiring from senior scientific positions. Where there is an irregular age distribution of scientists, the retirement of an unsually large age cohort could create difficulties in carrying on research activities at the research manager and senior scientist levels. This differs from the first concern in that it focusses on whether replacements will have the necessary experience and expertise to fill the most senior positions left by retirees, rather than whether adequate numbers of replacements are available.

Finally, a third concern emerges in a minimum growth situation where the small influx of fresh ideas could lead to intellectual stagnation within the research organization, thus affecting both its creativity and subsequent productivity.

In light of this interest, Chapter II examines the present age distributions of scientists in the federal government. These are analyzed on a government-wide basis, within individual departments, and within specific job classifications; the science departments (and specific job classifications within those departments) that have a large percentage of their scientists and engineers nearing retirement age are identified. The departments included in these analyses are: Transport Canada (TC); the Department of Fisheries and Oceans (DFO); the Department of Communications (DOC); Agriculture Canada (AC); Energy, Mines and Resources (EMR); the Department of National Defence (DND); the Department of Environment (DOE); the National Research Council (NRC) and Atomic Energy of Canada, Limited (AECL).

Chapter III considers the problems of meeting the departments' <u>overall</u> demand for scientists and engineers, whether vacancies arise through retirement or for other reasons. Additionally, Chapter III considers the impact that the current, reduced numbers of new graduates in various scientific fields will have on the government's recruitment efforts.

Chapter III is based, in part, on the belief that the aggregate data on age distributions may not reflect the whole situation, or provide the most accurate picture. For example, data that show a large percentage of employees aged 51-55 suggest that the departments involved will face a significant increase in the number of recruits needed in the next ten years. If the labor market for the particular job classification is poor throughout the whole economy, however, government recruitment may be quite easy. In contrast, a department that needs only a few Ph.Ds per year, in fields where there is a strong national demand, may find it difficult to recruit individuals with the right specializations, especially in a period of declining graduate enrolment.

Chapter III relies heavily on input from those individuals in the science departments who are actively involved in the recruitment efforts. Meetings were held with personnel officers and senior scientists and engineers in the various science departments to discuss the age distribution patterns presented in Chapter II, and also related questions on supply, demand and recruitment procedures. More specifically, information was sought on:

- manpower planning requirements arising from age distribution patterns,
- experience with respect to early retirements,
- overall demand for scientists and engineers,
- primary areas of recruitment,
- areas of most concern in terms of staffing,
- competition for personnel with industry,
- practices in filling positions internally and transferring between classifications, and
- recommendations toward solving recruitment problems.

The government's demand for scientific personnel must also be viewed in light of the supply and availability of such talent. Information on the supply of highly qualified manpower, made available by the University Branch of MOSST and Statistics Canada, is therefore incorporated into Chapter III.

Lastly, Chapter IV reviews the analyses in this report in its conclusion section.

FOOTNOTES

CHAPTER I

1) Science Council of Canada. Papers for Discussion for the Workshop on the Optimization of Age Distribution in University Research, (Ottawa: the Science Council of Canada) June 13, 14, 1977.

2) Public Service Commission, Annual Report 1981, (Ottawa: Minister of Supply and Services), 1982, p.9.

3) Betcherman, Gordon, for the Economic Council of Canada, Meeting Skill Requirements: Report of the Human Resources Survey (Ottawa: Minister of Supply and Services), 1981, p. 23.

4) MOSST Background Papers: No. 18, "The Requirements for Engineering Graduates to 1985"; No. 17, "Research Manpower Requirements Arising From Accelerated Expenditures on R&D"; No. 16 "The Stock of Research Trained Personnel"; No. 15, "University Enrolment Projections to 2000"; and No. 14, "Recent Trends in Degrees Awarded and Enrolments at Canadian Universities." (1981).

CHAPTER II
AGE DISTRIBUTIONS OF GOVERNMENT SCIENTISTS AND ENGINEERS

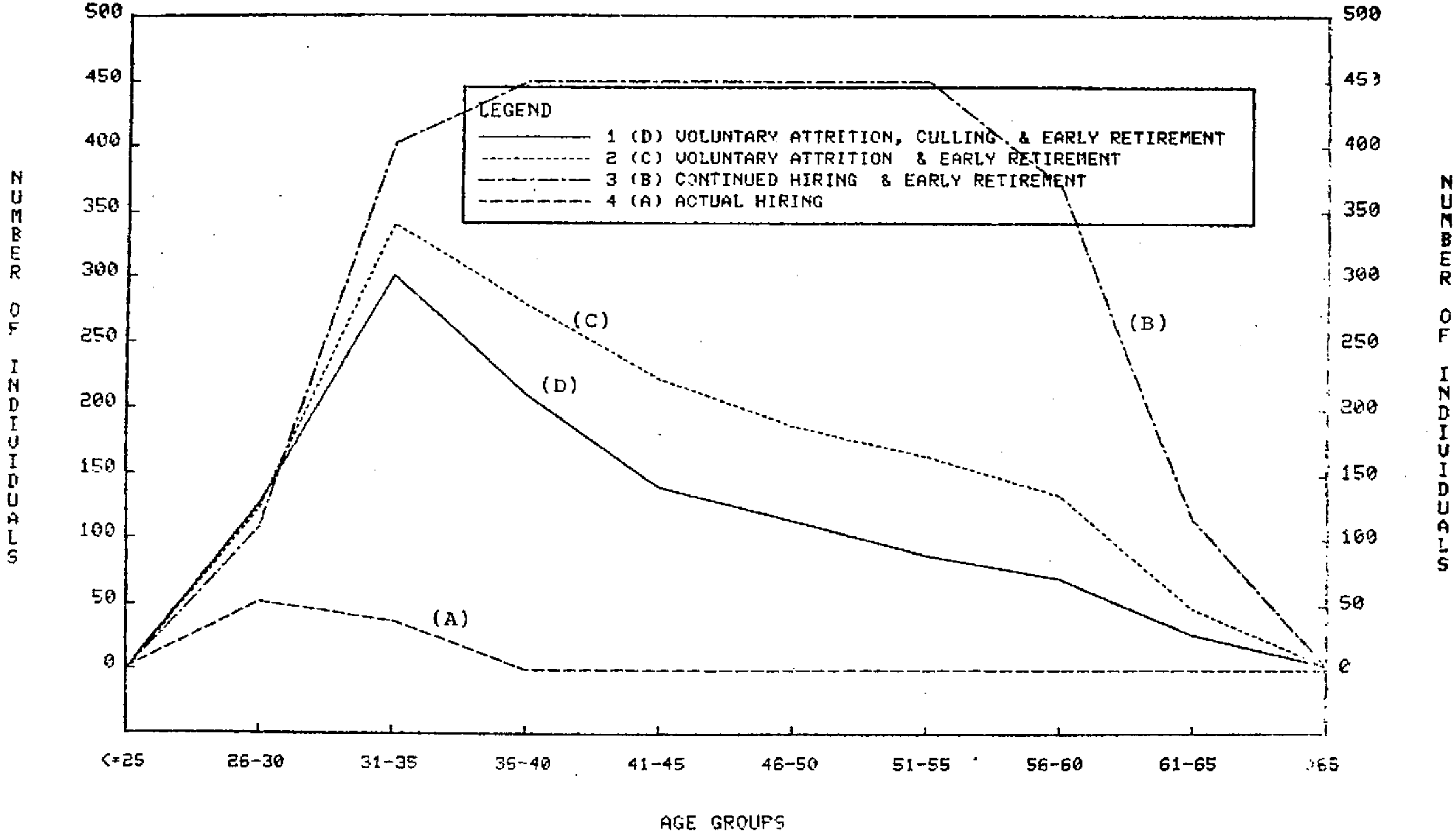
I. BACKGROUND THEORY ON AGE DISTRIBUTION

Industrial labor studies have examined the effect of various age distribution patterns among scientists, usually with an emphasis on a lessening of creativity and innovation among older scientists. (1) Some of the processes found in industry which tend to encourage the desired age distributions and avoid a predominance of older scientists include:

- culling (whereby unsuitable employees are identified and their employment terminated),
- voluntary attrition (whereby employees leave by their own choice),
- early retirement options, and
- transfer into management positions.

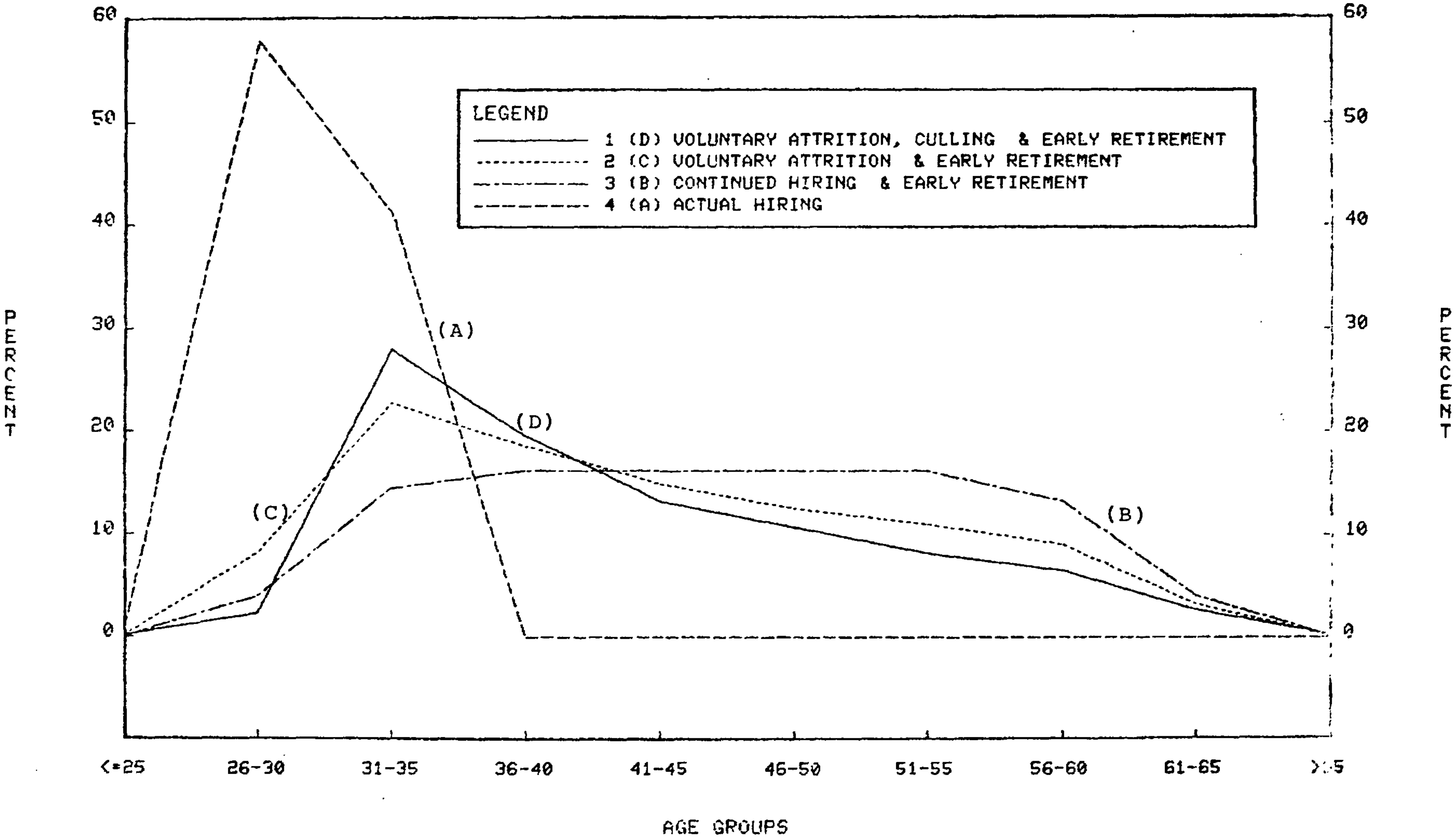
In their study of age distributions and creativity of scientists in U.S. industries and federal laboratories, Decker & Van Atta took a closer look at the effect that the first three of these processes have on age distributions. (2) Figure 1 shows the normal distribution curve (A) for a hiring pattern of 90 new employees per year with an average age of 30. If the same hiring pattern were carried out every year until a steady state existed, then curve B would result (2800 individuals). The effects of culling (assumed to take place through age 40 at a rate of 5.5%/year), and voluntary attrition (to age 55, increasing turnover to 7.9%/year) are shown in curves C (1500 individuals) and D (1080 individuals) respectively. Early retirement policies which also influence the tail end of curves B, C and D (age 55+) are taken into account in these figures. Figure 2 shows the same distributions as in Figure 1, but with the data translated into percentages of employees falling into the different age cohorts.

While these age distribution curves are theoretical, they do, according to Decker and Van Atta, closely resemble actual patterns at Lawrence Livermore Laboratory in the early 70's. For comparative purposes, the age distributions of scientists and engineers in other research organizations were sought. A variety of Canadian and U.S. firms and research organizations cooperated with MOSST in this effort, which confirmed that the Decker and Van Atta distribution curve was



SOURCE : W.D. DECKER AND C.M. VAN ATTA, IN RESEARCH MANAGEMENT, JANUARY 1973

FIGURE 1: AGE DISTRIBUTION OF SCIENTISTS AND ENGINEERS ACCORDING TO DIFFERENT PERSONNEL POLICIES



SOURCE : W.D. DECKER AND C.M. VAN ATTA, IN RESEARCH MANAGEMENT, JANUARY 1973

FIGURE 2: PERCENTAGE AGE DISTRIBUTIONS OF SCIENTISTS AND ENGINEERS ACCORDING TO DIFFERENT PERSONNEL POLICIES

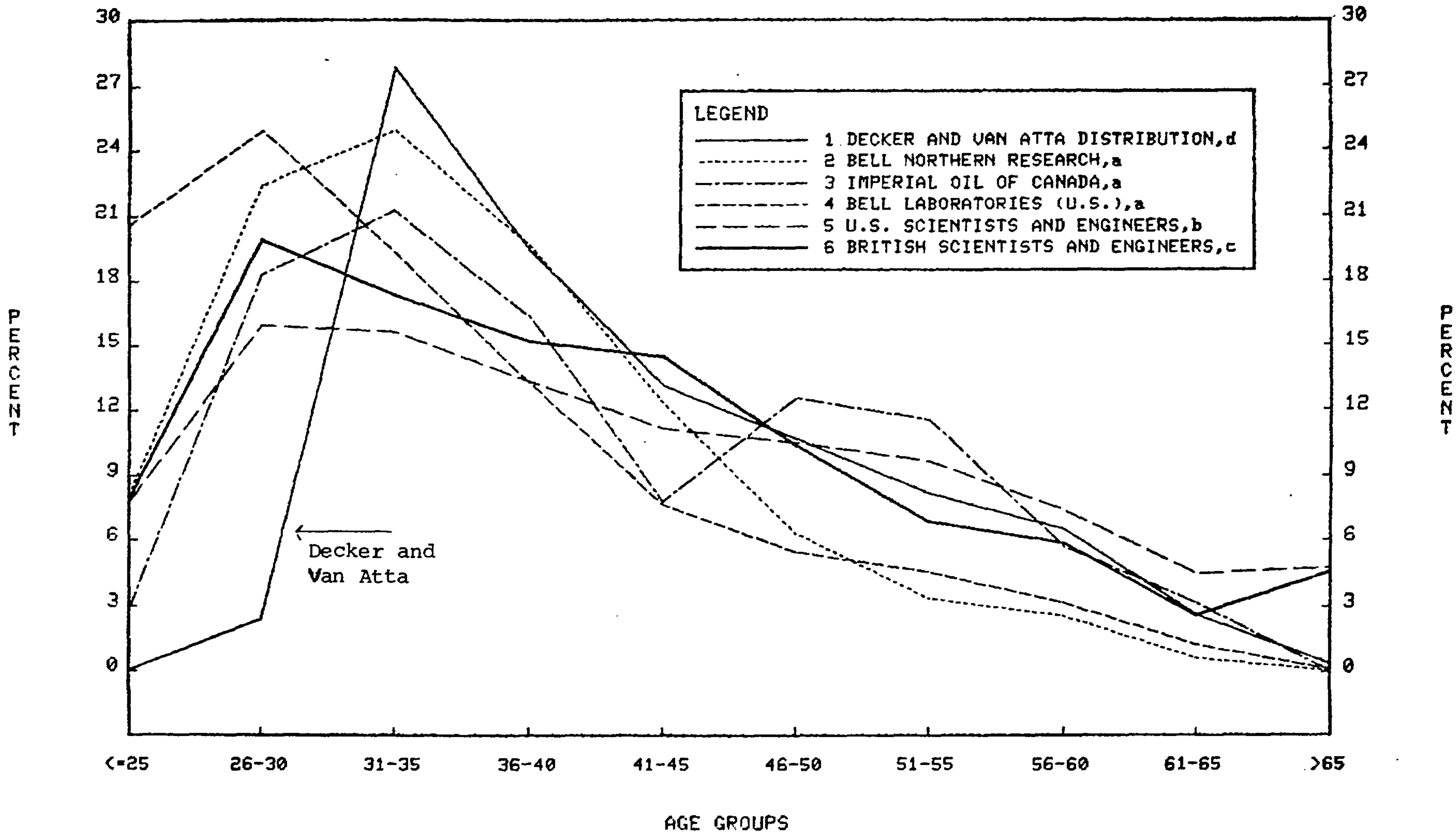
in fact very close to the average of all groups considered. (See Figure 3.)

Among these other groups, all show age distributions that are fairly similar (although Imperial Oil has a second peak) to that identified by Decker and Van Atta when culling, voluntary attrition and early retirement are taken into account (Figure 2: Curve D). While somewhat larger percentages of younger scientists and engineers are found in the other distribution curves, comparisons of the ratios of those over age 50 to the totals in each data set show that the Decker and Van Atta distribution is close to the midpoint of the ratios for all these other data sets. (See Table 1.) Consequently, the Decker and Van Atta curve is cited throughout this study as a reasonable basis for comparing the age disbribution of older cohorts of scientists. This should not be taken to mean, however, that the Decker and Van Atta distribution is viewed as "ideal," or as an absolute target or model, especially as culling and attrition processes within government may be quite different from those which

TABLE 1. RATIO OF SCIENTISTS AND ENGINEERS OVER AGE 50 COMPARED TO TOTAL

. Bell Northern Research (R&D Personnel 1982)		.06
. Bell Laboratories (R&D personnel, 1982)		.09
. British Scientists (1971 Survey)		.16
	mean=	.16
. Decker and Van Atta Distribution (theoretical distribution)		.18
. Imperial Oil of Canada (R&D personnel, 1982)		.21
. U.S. Scientists and Engineers (National Science Foundation Estimates, 1978)		.26

occur in industry, and the extent to which government profiles do (or can) match those of industry must not be presumed. Moreover, the employee age distribution curve that is desired in the private sector may be different from that for public sector. (3)



a . 1982 DATA

b . NATIONAL SCIENCE FOUNDATION ESTIMATES, 1978

c . SURVEY OF PROFESSIONAL SCIENTISTS, 1971. DEPARTMENT OF TRADE AND INDUSTRY AND THE COUNCIL OF SCIENCE AND TECHNOLOGY INSTITUTES (LONDON, 1973).

d . W.D. DECKER AND C.M. VAN ATTA, IN RESEARCH MANAGEMENT, JANUARY 1973

FIGURE 3: AGE DISTRIBUTION OF SCIENTISTS AND ENGINEERS IN VARIOUS ORGANIZATIONS

It should also be noted that, for the present, this work does not address the creativity issue. Instead, the emphasis is on identifying areas of potential scientific manpower shortages within the government.

II. DATA ON THE AGE OF SCIENTISTS

A. The Data

In this study, MOSST has had access to three separate data sets containing information on the age of the federal government scientific population. These data sets do not all cover the same agencies, nor do they all describe the same aspects of the scientific population. Therefore, they are not directly comparable. They do, however, have enough similarities that together they can provide a more comprehensive picture of the situation than can be derived from any one of the data sets.

The first set is comprised of age distribution data which was obtained from the PSC. These figures show the total number of scientists and engineers employed by the federal government during the first quarter of 1981, broken down by age, job classifications, and departments. PSC data are also available for 1976 through 1981, providing a five year time span in which to assess temporal changes.

PSC data cover all schedule A departments; however, only 10 departments are discussed here as they contain almost all of the scientific personnel employed by Treasury Board (TBS). NRC and AECL are "separate employers" and are not covered in the PSC data.

The following scientific job classifications are considered in this paper:

(AG)	Agriculture
(BI)	Biological Sciences
(CH)	Chemistry
(DS)	Defence Scientific Services
(EN/ENG)	Engineering - Engineers
(EN/SUR)	Engineering - Surveyors
(FO)	Forestry
(MT)	Meteorology
(PC)	Physical Scientists
(SE/REM)	Scientific Research - Research Manager
(SE/RES)	Scientific Research - Research Scientist
(SG)	Scientific Regulation
(VS)	Veterinary Science.

Age distributions of scientists in these job classifications are divided into 5 year age cohorts (i.e., 25-29, 30-34 etc.).

A second data set has been made available to MOSST by the Natural Sciences and Engineering Research Council (NSERC). This data was compiled during the summer of 1981, when NSERC requested from several science departments the age profiles of their research staffs, and the profiles of earliest possible retirements.

The NSERC data covers the following departments and agencies: NRC, AC, DND, DFO, DOC, EMR, AECL and DOE. These figures are not broken down by job classifications, but rather show the total population of scientific researchers within the departments. Further, the data cover only those scientists who have university degrees -- which does not include all personnel conducting research. (4)

The third data set was obtained from the TBS Official Languages Information System (OLIS), through MOSST's participation in the TBS Task Force on Francophone Participation in the Scientific and Professional Categories. OLIS forms, which contain information on position, classification, occupation, date of birth, region, department and language qualifications, are completed and submitted to TBS for all personnel in Schedule A departments and agencies. (NRC and AECL are again excluded.)

OLIS data have been compiled every year since 1975; June, 1981 data are used in this paper. As shown in Appendix A, the PSC and TBS data sets are quite similar.

B. Differences Among the Data Sets

Table 2 below compares the three data sets. As shown, the NSERC data is clearly the most focussed of the three. For example, the TBS and PSC data include all individuals in scientific job classifications, regardless of the work they perform, while the NSERC survey specifically asked only for information on the ages and retirement profiles of research staff (thereby possibly including technicians or excluding project managers or policy advisors). Unlike the PSC and TBS data, the NSERC data only includes scientific degree holders, while the other two include all employees in scientific classifications regardless of academic credentials. The figures in Table 3 below reflect these differences.

Unfortunately, direct comparisons between the TBS and NSERC data are further limited by the fact that the NSERC data are not broken down by classifications. Thus, only aggregated, department-wide comparisons can be made using NSERC data.

TABLE 2. PARAMETERS OF AVAILABLE DATA ON THE AGE OF SCIENTISTS WITHIN THE GOVERNMENT.

Age of scientists shown for:	TBS	NSERC	PSC
-individual departments	yes	yes	yes
-all schedule A departments	yes	no	yes
-NRC and AECL	no	yes	no
-scientific job classifications	yes	no	yes
-research staff only	no	yes	no
-all scientists	yes	no	yes
-degree holders only	no	yes	no

TABLE 3. NUMBER OF SCIENTIFIC PERSONNEL SHOWN IN THE NSERC, TBS AND PSC DATA SETS BY DEPARTMENT

	NSERC (Nov. 1981)	TBS (June, 1981)	PSC (Sept. 1981)
AC	685	1842	1859
DOC	201	274	307
DOE	352	1967	2020
EMR	628	926	941
DFO	236	861	872
DND	556	883	935
NRC	962	--	--
TC	--	522	528
NHW	--	619	619
AECL	536*	--	--
DPW	--	401	422
DIAND	--	159	171
Totals	4156	8454	8674

*Note: Data supplied to NSERC by AECL only listed 178 scientific researchers. This larger number includes engineers not included in the 178 figure. Other departments may have also deleted the engineers from the figures supplied to NSERC, further explaining the smaller numbers in the NSERC data.

III. ANALYSIS OF DATA

A. Analysis on a Government-Wide Basis

Data from the three sources were first analyzed on a government-wide basis, aggregating all science classifications for all departments. This analysis was aimed at identifying any general trends, especially any large population cohorts that might be retiring in the near future.

Comparing:

- The TBS data (for all schedule A departments, aggregated),
- the NSERC data (for those science departments included in that data set, aggregated (5)), and
- the PSC data (for all scientific classifications in all schedule A departments, aggregated),

we find distribution curves (for the percentage of the total population in each cohort) which have neither the sharp peak of 31-35 year olds, nor the smooth decrease in the number of individuals nearing retirement that are seen in the reference curves developed by Decker and Van Atta. (See Appendix A1.)

These government-wide distribution curves give some indication that an unusually large percentage of scientists and engineers is nearing retirement age. The proportion of scientists and engineers over age 50 is 27.3% for the PSC data, 30.0% for the TBS data and 31.6% for the NSERC data. For comparison, the Decker and Van Atta distribution only had 17.5% over age 50.

The extent of this older scientific population is further emphasized when scientists and engineers in the federal government are compared to all public service employees. While 27.3% of all PSC scientists and engineers are over age 50, only 20% of all PSC employees are over 50. (See Appendix A2.) PSC data further shows that the annual retirement rate for scientists and engineers steadily increased between 1976 and 1979 (1.5% to 2.5%). The 1980 figure (2.2%) shows a slight drop from 1979 rates, but is not as low as the 1978 rate (1.8%). Given recent trends regarding when scientists and engineers choose to retire (6), the current age distribution data suggests that, on average, 2% are likely to retire annually through 1986, followed by an increase to 2.6% annual average retirements between 1987 and 1996. This means that, starting in 1987, roughly 208 positions will be vacated per year due to retirements, up from approximately 160 per year during the immediately preceeding five year period. (9)

This aggregated data, however, is not sensitive enough to distinguish the true nature or impact of this situation. The following sections of this paper, consequently, break the data down further, by departments and by job classifications, in order to see if the problem of replacing retirees may be worse for certain groups.

B. Analysis on a Departmental Basis

The NSERC, PSC and TBS data bases have six departments in common and, as shown in Appendix B, are quite similar for each of these departments. Variations that do occur between data sets can probably be explained by the fact that NSERC data includes only those personnel described by the departments as doing scientific research (which AECL, at least, interpreted as excluding engineers and which other departments may have taken to include only researchers and not managers with research classifications). NSERC also only requested data on the ages of those with scientific degrees. Any variations between the totals of these departmental figures and the government-wide data presented above are the result of including here only those departments that have 40 or more scientists and engineers.

In these departmental data, we can begin to isolate some potential problem areas, where large groups of individuals will be nearing retirement in the next 10-15 years. In this respect, Agriculture Canada (Appendix B1) and DND (Appendix B2) have the most evident peak groups at higher ages. DOE, DFO, and EMR may also have some problems here. (See Appendices B3-B5). DOC, in these comparisons, does not seem to have an overall aging problem. (See Appendix B6).

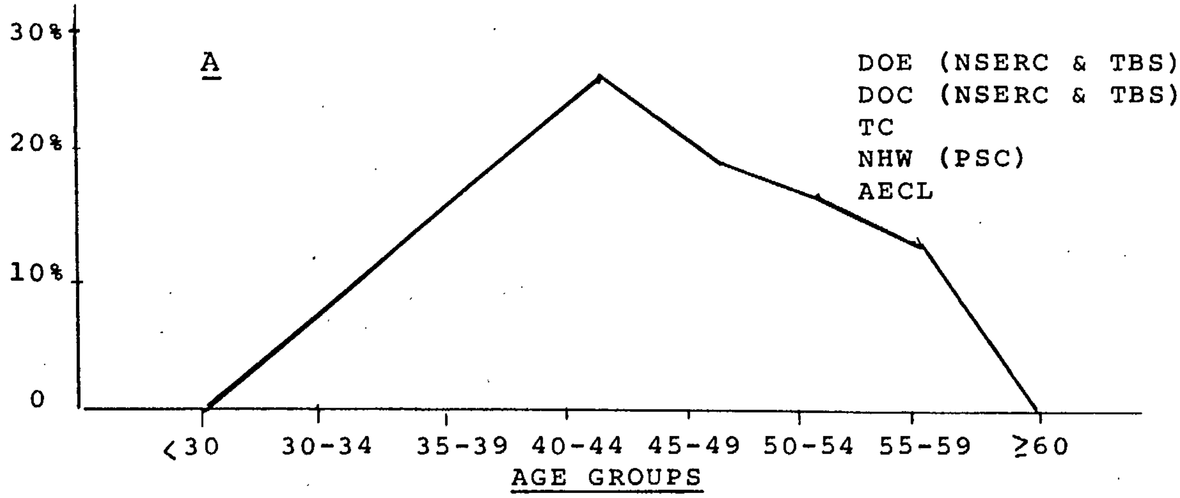
Appendix B also shows the aggregated age distributions from just the TBS and PSC data sets for the Department of Public Works (DPW), National Health and Welfare (NHW), Transport Canada (TC), and the Department of Indian Affairs and Northern Development (DIAND) (Appendices B8-B11), as well as the NSERC data for NRC and AECL (Appendices B13-B14). In these additional department-wide distributions we see that TC most closely approaches the Decker and Van Atta reference curve, with its early high peak and gradual trailing off until retirement. The others, however, are not like this reference curve. Within DPW and DIAND there are three peaks of fairly even size. In NHW, two plateaus are seen, indicating that fairly consistent hiring has taken place during each of two 15-year periods.

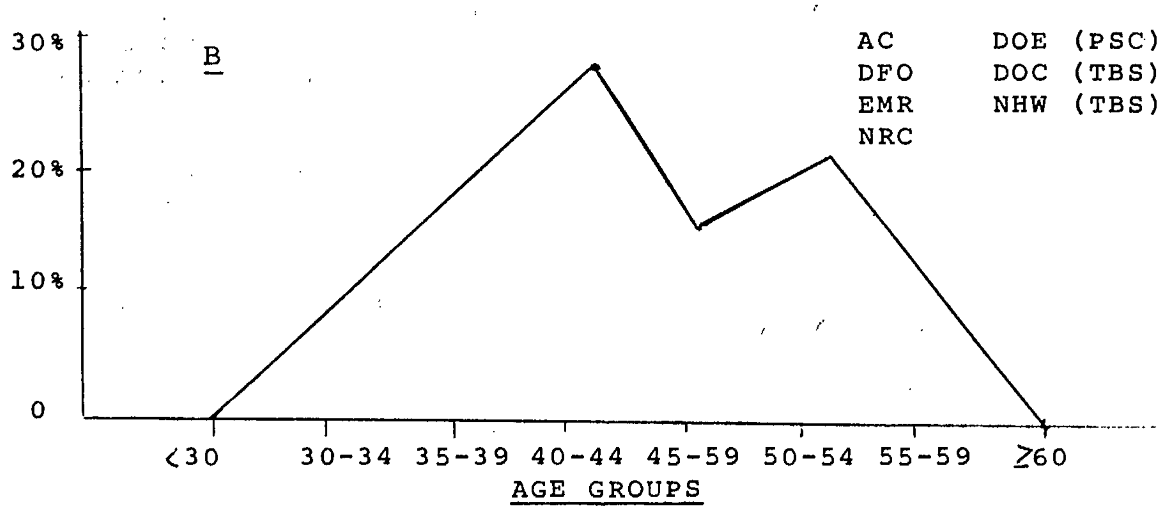
From the NSERC data, AECL closely resembles the reference curve, except that the "young" peak is at age 41-45 instead of 31-35. In fact, the whole distribution is 10 years older than the reference distribution. Lastly, NRC has two roughly equal peaks -- a somewhat flat one at age 31-45, and another for those 51-55 years of age.

Broadly speaking, there are three basic patterns among these age distribution curves. These are illustrated in Figure 4. The distribution pattern shown in Figure 4A, is most similar, apart from the "leveling off" or "shoulder", to the reference curve that was described in Section I. Accordingly, departments having data sets typified by Figure 4A, are not likely to experience problems in maintaining manpower levels (assuming the supply of new recruits does not prove problematic), as replacements for retirees can be drawn from the next youngest groups, and the numbers required in future years for replacements will not be unusually large. Data sets characterized by Figures 4B and 4C, however, suggest that there may be problems in the affected departments when the larger than average 51-60 age cohorts move to retirement in the near future. In these cases, larger than normal recruiting efforts will also be required to fill vacancies, and there may probably be shortages of qualified personnel ready to assume senior and management level jobs.

The magnitude of the aging problem is shown for each department in Table 4, using the percent of scientists and engineers in each group who are over age 50. It will be recalled from Table 1, that the ratio for the Decker and Van Atta reference distribution was 0.18, and for Bell Northern Research, with its even younger staff, the ratio is 0.06. (The smaller ratios, therefore, indicate that the "soon-to-retire" group is a less prominent portion of the overall staff, and fewer replacements will be needed.)

FIGURE 4: AGE DISTRIBUTION PATTERNS





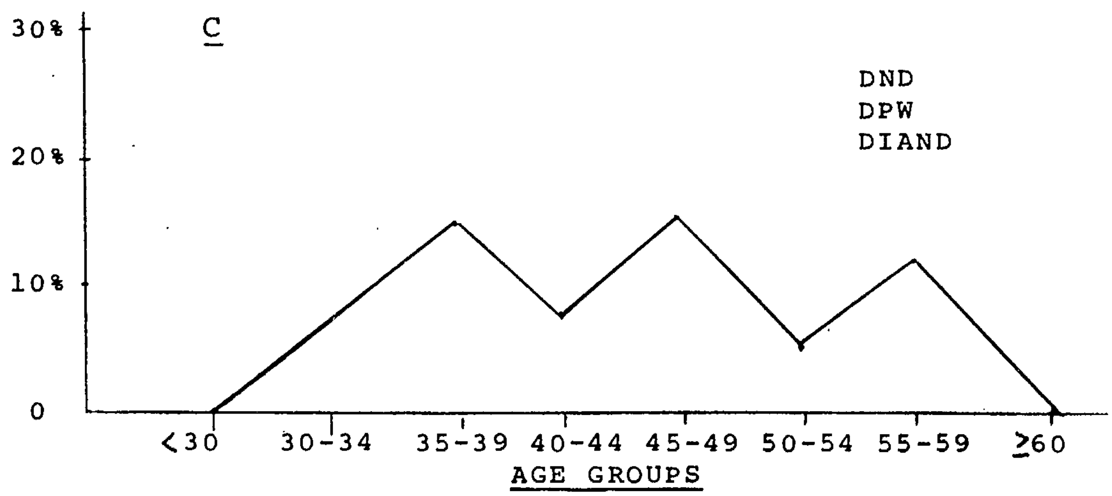


TABLE 4: RATIO OF SCIENTISTS OVER AGE 50 COMPARED TO THE TOTAL POPULATION OF SCIENTISTS BY DEPARTMENT

DEPARTMENT	DATA SOURCE	RATIO	
AC	TBS	759/1842	.41
	PSC	644/1859	.35
	NSERC	288/ 685	.42
DOC	TBS	46/ 213	.22
	PSC	41/ 307	.13
	NSERC	33/ 201	.16
DOE	TBS	433/1967	.22
	PSC	404/2020	.20
	NSERC	105/ 352	.30
DFO	TBS	148/ 861	.17
	PSC	112/ 872	.13
	NSERC	59/ 236	.25
DND	TBS	315/ 883	.36
	PSC	277/ 935	.29
	NSERC	145/ 556	.26
EMR	TBS	320/ 926	.35
	PSC	265/ 941	.28
	NSERC	194/ 628	.31
DPW	TBS	155/ 401	.39
	PSC	135/ 422	.32
DIAND	TBS	44/ 159	.28
	PSC	36/ 171	.21
TC	TBS	121/ 522	.23
	PSC	104/ 528	.20
NHW	TBS	174/ 619	.28
	PSC	146/ 619	.24
NRC	NSERC	325/ 962	.34
AECL	NSERC	51/ 178	.29

PSC data	total of 10 departments	2164/8674	.25
TBS data	total of 20 departments	2515/8393	.30
NSERC data	total of 8 departments	1200/3798	.32
Decker and Van Atta distribution		191/1080	.18

The following departments have (in order) the highest proportion of older scientists:

- Agriculture Canada,
- Department of Public Works,
- National Research Council,
- Energy, Mines and Resource,
- Department of National Defence, and
- Atomic Energy of Canada, Limited.

All of the departments (except DOC and DFO), however, have a higher percentage of their scientists and engineers over age 50 than was the case in the Decker and Van Atta distribution.

As indicated in Section II.A. of this chapter, potential staffing problems caused by large scale retirements are not always clearly visible at the government-wide level. While the present section has revealed that age distribution problems do exist within certain science departments, not all of these departments share the same distributions. To take this one step further, the following section considers specific job classifications within the science departments, in order to ascertain whether the replacement problems are likely to be concentrated within specific fields or areas of training.

C. Analysis of Particular Groups

Both the TBS and PSC data show the age distributions of scientific personnel by department and by scientific group. As the PSC data have been available for both 1976 and 1981, and as temporal comparisons are made in the next section of this chapter, PSC data are relied on for this discussion.

Each of the graphs found in Appendix C plots the age distributions for scientists by job classification and department. It should be noted, though, that only those departments that have forty or more scientists in a particular classification are included.

Several of the classifications within specific departments appear to have extraordinarily large percentages of scientists near retirement age - thereby causing potential replacement problems. Table 5 below considers each of these classifications according to the same measure used in the last section (the ratio of those over age 50 to the number in the total group). Each of the following classifications has a higher percentage of older scientists than was seen in the PSC departmental data (i.e., over .25). As the SE/REM classification is made up of research managers who tend to be older individuals, it is not surprising to find them in this group. (See Figure 5 for government-wide age distributions of the SE/REM classification.)

TABLE 5: RATIO OF SCIENTISTS AND ENGINEERS OVER AGE 50 TO ALL SCIENTISTS AND ENGINEERS IN EACH CLASSIFICATION BY DEPARTMENT (PSC DATA, 1981)

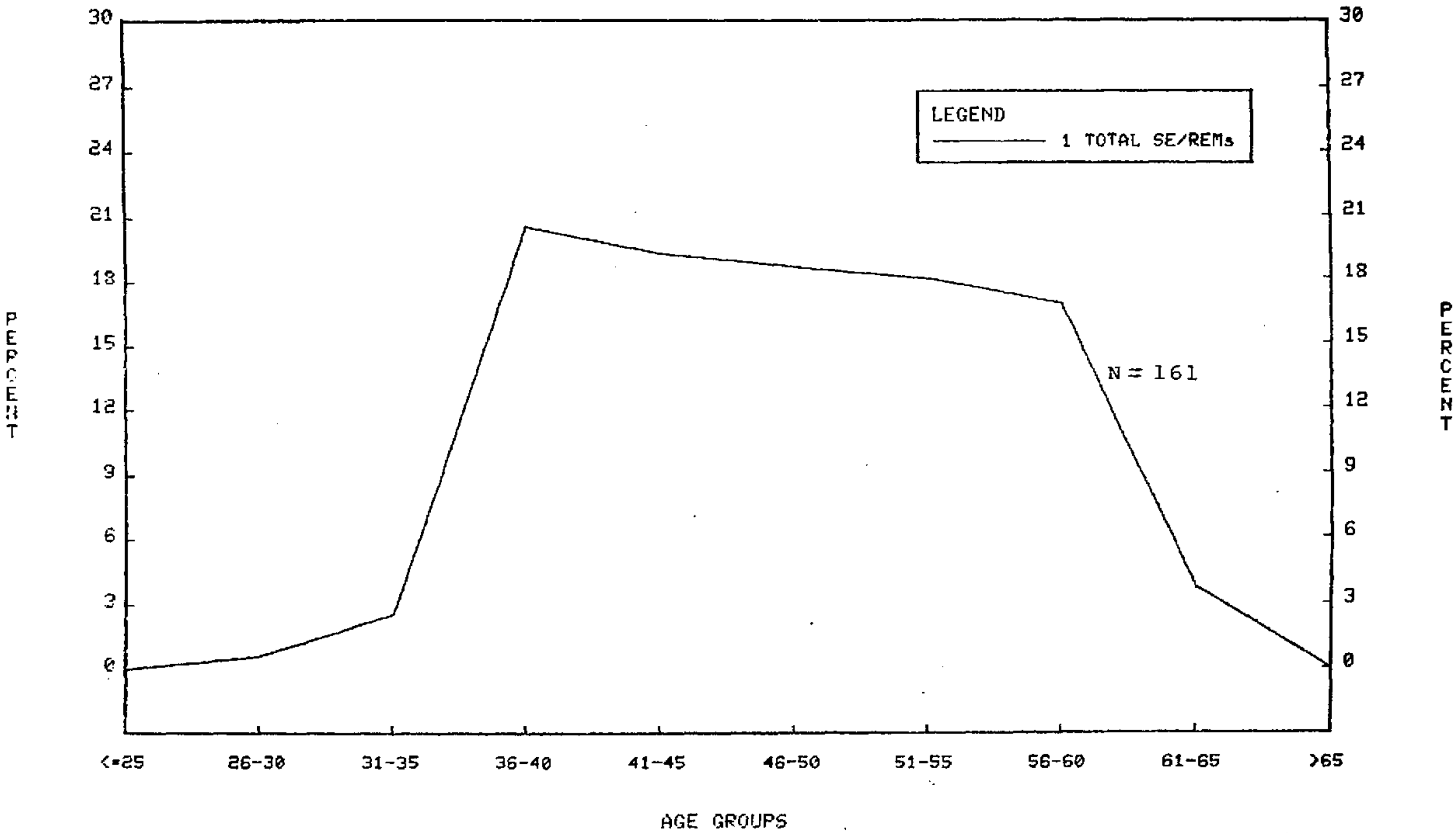
CLASSIFICATION	DEPARTMENT	RATIO	
AG	AC	79 /297	.27
BI	AC	38 /202	.19
BI	DFO	14 /332	.04
BI	DOE	17 /252	.07
BI	NHW	42 /146	.29
CH	DFO	4 / 42	.10
CH	DOE	8 / 67	.12
CH	NHW	22 /150	.15
DS	DND	141/562	.25
EN/ENG	DOC	31 /237	.13
EN/ENG	DFO	14 / 80	.18
EN/ENG	DND	122/336	.36
EN/ENG	DOE	74 /342	.22
EN/ENG	DPW	129/397	.32
EN/ENG	EMR	18 / 77	.23
EN/ENG	DIAND	24 /105	.23
EN/ENG	TC	103/516	.20
EN/SUR	EMR	41 /118	.34
FO	DOE	13 /.76	.17
MT	DOE	97 /581	.17
PC	DFO	6 / 70	.09
PC	DOE	12 /213	.06
PC	EMR	46 /270	.17
PC	DIAND	4 / 41	.10
SE/REM	DOE	21 / 53	.40
SE/RES	AC	270/698	.39
SE/RES	DOC	6 / 55	.11
SE/RES	DFO	61 /245	.25
SE/RES	DOE	94 /365	.26
SE/RES	EMR	127/403	.32
SE/RES	NHW	24 / 93	.26
SG/SRE	DFO	9 / 70	.13
SG/SRE	NHW	40 /177	.23
VS	AC	233/579	.40

DND	-	EN/ENG(Appendix C5)
AC	-	AG (Appendix C1) SE/RES(Appendix C11) VS (Appendix C13)
EMR	-	EN/SUR(Appendix C6) SE/RES(Appendix C11)
DOE	-	SE/REM (8)(Appendix C10) SE/RES(Appendix C11)
NHW	-	BI (Appendix C2) SE/RES(Appendix C11)
DPW	-	EN/ENG(Appendix C5)

The following additional groups also have a higher percentage of older scientists than was seen in the Decker and Van Atta distribution (i.e., .18 - .25). Comparisons of these classification groups and the Decker and Van Atta distibution curve are presented in Appendix D, further illustrating their irregular distribution patterns.

DFO	- EN/ENG SE/RES	(Appendix C5) (Appendix C11)
EMR	- EN/ENG	(Appendix C5)
DIAND	- EN/ENG	(Appendix C5)
TC	- EN/ENG	(Appendix C5)
AC	- BI	(Appendix C2)
DOE	- EN/ENG	(Appendix C5)
NHW	- SG/SRE	(Appendix C12)
DND	- DS	(Appendix C4)

Looking more closely at these classification groups with disproportionate numbers over age 50, great variation is seen to exist. The problem is not uniform for these groups as the total number of individuals in each group is not the same. Table 6 below shows the number of individuals over age 50 for each of the potential problem groups with a ratio of .18 or more. Clearly, replacing 18 engineers over 15 years in EMR will not pose the same problem as replacing 272 research scientists and 232 veterinary scientists in Agriculture Canada, or 140 defence scientists in DND.



SOURCE : PUBLIC SERVICE COMMISSION, 1981

FIGURE 5: RESEARCH MANAGERS (SE/REM) CLASSIFICATION AGE DISTRIBUTION IN EIGHT DEPARTMENTS

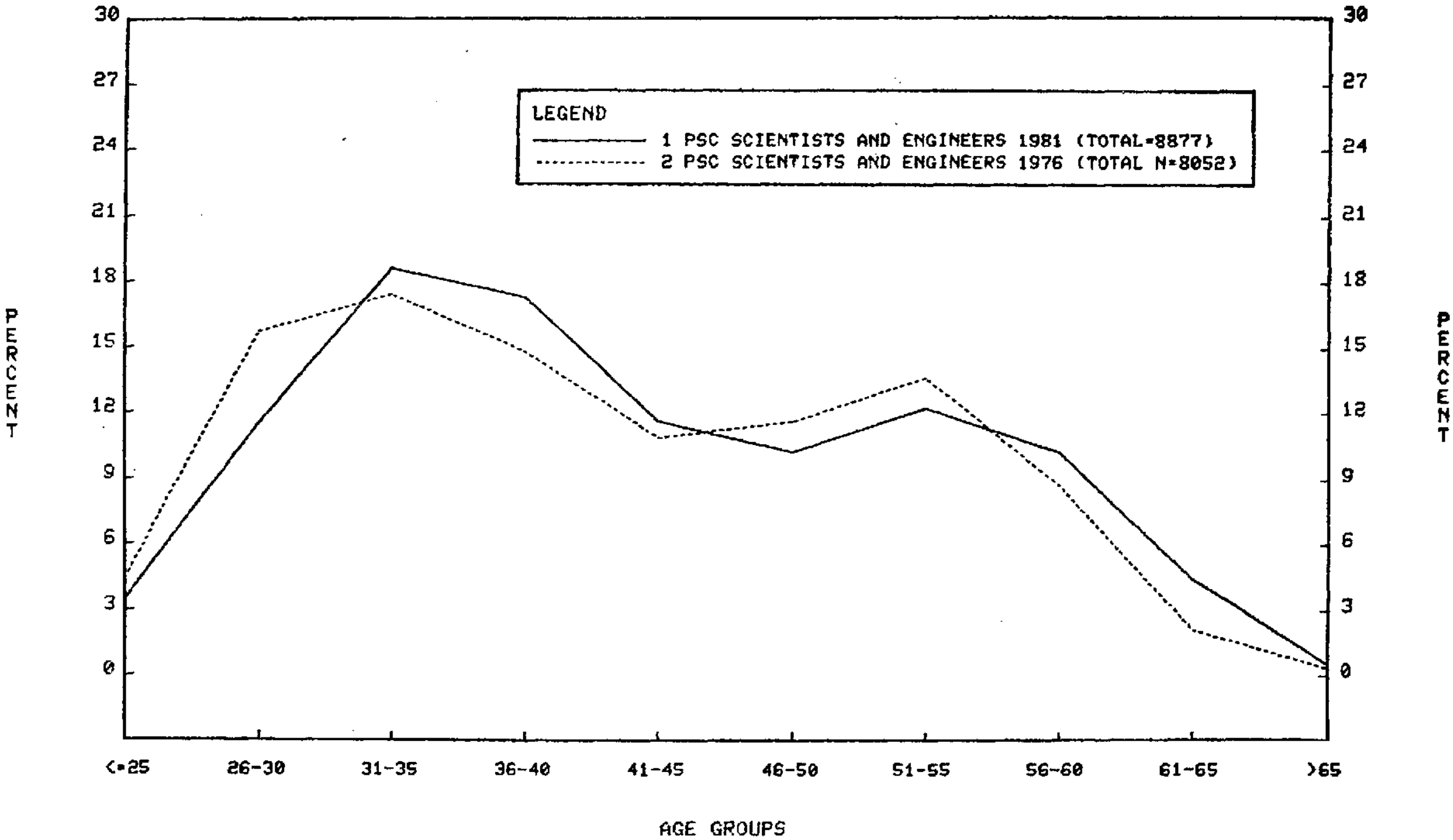
TABLE 6: NUMBER OF SCIENTISTS AND ENGINEERS OVER AGE 50 BY DEPARTMENT AND JOB CLASSIFICATION, 1981.

Department	Classification	Percent over age 50	Number over age 50
AC	SE/RES	39%	270
AC	VS	40	233
DND	DS	25	141
DPW	EN/ENG	32	129
EMR	SE/RES	32	127
DND	EN/ENG	36	122
TC	EN/ENG	20	103
DOE	SE/RES	26	94
AC	AG	27	79
DOE	EN/ENG	22	74
DFO	SE/RES	25	61
NHW	BI	29	42
EMR	EN/SUR	34	41
NHW	SG/SRE	23	40
AC	BI	19	38
DIAND	EN/ENG	23	24
NHW	SE/RES	26	24
DOE	SE/REM	40	21
EMR	EN/ENG	23	18
DFO	EN/ENG	18	14

D. Changes Over Time

The PSC data have also been examined for the five year time span 1976-1981. Data for these years are presented in Figure 6. In 1981, there were larger percentages of scientists and engineers in the federal government between the ages of 31 and 45, and over age 55 than there were in 1976. There were, however, smaller percentages in 1981 who were age 30 or less, or between ages 46 and 55. Reasons for these fluctuations may well include recent hiring restraints, which have limited the intake of younger scientists, and the combination of an aging population with a reduced number of early retirements.

Looking more specifically at those classifications that were found in the previous section to have potential age distribution problems, there is very little difference between 1976 and 1981 in the size of the peaks in the "near-retirement" age groups. (See Appendix E.) In a few classifications -- including DND's EN/ENG group (Appendix



SOURCE : PUBLIC SERVICE COMMISSION, 1976, 1981

FIGURE 6: AGE DISTRIBUTION OF SCIENTISTS 1976 and 1981

E4), AC's AG(E1) and SE/RES (E3) groups, DOE's SE/REMs (E9), and EMR's SE/RESs (E6) -- the peak group has actually decreased as a percentage of the total over the five year period.

In all but the SE/RES and EN/SUR groups in EMR (E6 and E7) and the SE/RES and SE/REM groups in DOE (E10 and E9), the peak group has shifted from the 51-55 cohort to the 56-60 cohort. As many in these peak groups may be currently eligible for early retirement, the problem of finding adequate replacements is an immediate one. For the SE/RES group in EMR, the peak for the 61-65 cohort in 1976 has been pushed back to the 56-60 cohort in 1981. The problem, however, is still a current one. Lastly, in the EN/SUR group of EMR and the SE/RES and SE/REM groups in DOE the peak in both 1976 and 1981 was the 51-55 cohort, though it did decrease in size over this period. For these three groups, then, it appears that high retirement rates may not be as much of a problem. (9)

IV. AGE DISTRIBUTION OF TECHNICIANS

The age distribution of technicians in the federal government has also been examined in this study. Two technician classifications -- the Engineering and Scientific Support group (EGESS) and the General Technician group (GT) -- were identified as the ones primarily involved scientific research. PSC data for these groups were examined for those departments that hired over 40 people for the classification (i.e., 9 departments for the EGESS group and 6 departments for the GT group). The Technician group at NRC was also examined, using data provided by NRC.

Appendix F shows the age distributions of these technicians by classification within the various departments. As illustrated, great variation is seen to exist. Significantly older populations are evident in DND's EGESS and GT groups (Appendix F3), while DOE's GT classification (F4) and DFO's EGESS group (F2) show much younger employees.

Table 7 below shows the proportion in each group which is over age 50. The range goes from a low of .11 to a high of .49 with a mean of .22. Recalling that the same ratio for the Decker and Van Atta reference distribution was .18 and that the average ratio for the scientists and engineers classifications in 10 departments (according to PSC data) was .25, we see that these technician classifications are in fact slightly younger than the scientists and engineers in government, but are still a bit older than the reference distribution. The range among departments for the percent of technicians over age 50 is only slightly larger than was shown for the scientists and engineers (i.e., .11-.49 vs. .04-.40).

Table 7: RATIO OF TECHNICIANS OVER AGE 50 (PSC data, 1981)

DEPARTMENT	CLASSIFICATION	NUMBER >50/TOTAL	RATIO >50/TOTAL
DND	GT	56/ 115	.49
DND	EGESS	369/ 875	.42
DPW	EGESS	310/ 908	.34
NRC	technicians	304/ 951	.32
mean		2174/9976	.22
DIAND	EGESS	24/ 111	.22
DFO	GT	118/ 550	.21
TC	EGESS	75/ 360	.21
EMR	EGESS	92/ 457	.20
Decker and Van Atta sample			.18
TC	GT	107/ 626	.17
DOE	EGESS	320/2017	.16
AC	EGESS	177/1130	.16
NHW	EGESS	70/ 466	.15
DPW	GT	10/ 73	.14
DIAND	GT	11/ 87	.13
DFO	EGESS	78/ 676	.12
DOE	GT	63/ 574	.11

While large percentages of technicians are over age 50 in: DND (GT&EGESS), DPW (EGESS), NRC, DIAND (EGESS), DFO (GT), TC (EGESS), and EMR (EGESS); unusually large numbers of older technicians are found in: DND (EGESS), DOE (EGESS), DPW (EGESS), NRC, (EGESS), DFO (GT), and TC (GT). As for the scientists and engineers, the replacement of 369 technicians in the EGESS group at DND will be more difficult than replacing 24 EGESS retirees or 11 GT retirees in DIAND, no matter what percent of the total population these workers represent. Given the length of time required for training, however, technician replacement may be easier than the replacement of scientists and engineers.

For the departments and classifications where large numbers of technicians (over 100) are over age 50, there has been little change in the past five years. As shown in Table 8 the percentage of those over age 50 did not change much between 1976 and 1981.

TABLE 8: TECHNICIAN GROUPS WITH LARGE NUMBERS OF OLDER INDIVIDUALS

Department*	Classification	1981 Ratio > 50/total	1976 Ratio > 50/total	Difference
DND	EGESS	.42	.48	-.06
DOE	EGESS	.16	.13	+.03
DPW	EGESS	.34	.35	-.01
AC	EGESS	.16	.17	-.01
TC	GT	.17	.20	-.03

* DFO data are not supplied here as the 1976 data are not available (due to the newness of the department); also, 1976 data for NRC are not available.

V. SUMMARY

First indications of the age distribution of scientists and engineers in the federal government (i.e., those derived from the government-wide data analysis) point to a relatively large percentage of older scientists and engineers who are nearing retirement age. This initial evaluation is reinforced when comparing the age distributions of government scientists to all government employees (under PSC). Scientists and engineers are significantly older than the rest of the governments' workers.

Several departments and job classifications have also been identified in this chapter as having an unusually large percentage of individuals over age 50. While the next chapter looks at the supply and availability of highly qualified manpower to fill these positions (10), the identification of "peak" groups, near retirement age, has represented a necessary examination of the demand side.

Specifically, the following departments and classifications were found to have disproportionate percentages of individuals over age 50:

AC	SE/RES	NHW	SG/SRE
AC	VS	AC	BI
DND	DS	DIAND	EN/ENG
EMR	SE/RES	NHW	SE/RES
DPW	EN/ENG	DOE	SE/REM
DND	EN/ENG	EMR	EN/ENG
AC	EN/ENG	DFO	EN/ENG
DOE	SE/RES	DND	EGESS
DFO	EN/ENG	DOE	EGESS
NHW	BI	DPW	EGESS
EMR	EN/SUR	NRC	Technicians
AC	EGESS	DFO	GT
TC	GT		

In terms of numbers of actual individuals and positions, however, the most severe problems are seen for:

- veterinary scientists and research scientists in Agriculture Canada,
- defence scientists in the Department of National Defence,
- research scientists in Energy, Mines and Resources, and Agriculture Canada,
- engineers in the Department of Public Works, the Department of National Defence, and Transport Canada,
- engineering and scientific support group in the Department of Public Works and the Department of National Defence,
- general technicians in the Department of Fisheries and Oceans, and
- technicians in the National Research Council.

For most of these groups the peak age cohorts are curently 56-60 years old, with the option of early retirement being imminent.

FOOTNOTES

CHAPTER II

1) W.D. Decker and C.M. Van Atta, "Controlling Staff Age and Flexible Retirement Plans," Research Management. January 1973, pp 16-21; Edward B. Roberts, "The Problem of Aging Organizations: A Study of R&D Units," Business Horizons. Vol. 10, No. 4 Winter 1967, pp. 51-58; Ralph, Katz "High Performance Teams: The Influence of Group Longevity," The Warton Magazine. Spring 1982, pp. 29 - 34.

2) Decker and Van Atta, op. cit.

3) Government scientific research may opt for hiring older individuals with private sector experience. Additionally, rates of transfer, turnover and promotion to administrative positions are likely to vary between the two sectors.

4) MOSST Background Paper 16, "The Stock of Research Trained Personnel", shows Statistics Canada data to the effect that 7.9% of the federal government R&D personnel in 1971, and 5.4% in 1974, held no degrees.

5) It should be noted here that the NSERC data grouped scientists into the following five-year age cohorts: 25, 25-29, 30-34 .... The TBS and PSC data, however, used 25, 26-30, 31-35, 36-40, ... for its categories. Where NSERC data is presented with the other two data sets, this difference is not indicated, but should be recognized. Where NSERC data are listed or discussed alone, the actual category headings for the data will be used.

6) In 1976-80, roughly one half of the scientists and engineers employed by PSC retired before age 60, and one half between 61 and 65.

7) These calculations will necessarily change if in the future the mandatory retirement age is extended past 65.

8) Other departments with SE/REM classifications were not considered separately here due to the small number of individuals involved. The age distribution of all REMs, is however, presented in Appendix D.

9) It should be noted, however, that such decreases are in terms of the percentage found within the age cohort. Actual numbers of individuals in age cohorts may or may not have changed over this same period.

10) In the Chapter that follows the technician groups are not consistently addressed. This is due to the fact that technician replacement is not as serious a problem as replacement of scientists and engineers in most departments. A few of the personnel officers and research managers who were interviewed in this work did identify technician groups as problem areas. In these cases the availability of individuals to replace retiring technicians is introduced into the discussions.

CHAPTER III

SUPPLY AND DEMAND FOR SCIENTISTS AND ENGINEERS

Aging of government scientists, and the identification and solution of potential problems presented by large scale retirements, cannot be isolated from the broader consideration of the supply and demand of scientific personnel. Other factors which must be recongized here include:

- departments' personnel needs and expectations arising from program requirements;
- the supply of scientists graduating from the universities; and
- the federal government's ability to successfully recruit scientists to meet its needs.

The first of these - the needs of the science departments - must be elaborated in order to further and more accurately define the problem areas. The age distribution data presented in this paper provide useful information on one aspect of future personnel needs, but cannot indicate program managers' plans or anticipated cut-backs, expansions or shifts in programs. The second area -- the expected supply of graduates -- is a crucial indicator of where potential problems could be pressing; and the final issue -- recruitment -- points toward some of the ways in which university-government manpower planning does and can address identified problems. All of these concerns are reviewed in this chapter.

In order to obtain reactions to the age distribution studies reported in Chapter II, and to seek information and views on the departments' demand, supply, recruitment and related concerns, discussions were held with personnel officers and senior scientists in the science departments. Section I of this chapter reviews the relevant inputs of personnel officers in DND, DFO, DOE, DOC, TC, EMR, NHW, AC, NRC and AECL. Section II reports the views of selected senior scientists' in the same departments. Throughout both sections, data on the supply of scientists and engineers for all sectors of the economy are incorporated into the discussion.

MOSST's University Branch has compiled data on the numbers of current graduates by discipline, and projections on the number of graduates through 1985. For background purposes, these figures are presented in Table 9. As shown, 845 Ph.Ds were granted in the natural and physical sciences

TABLE 9: PROJECTION OF SCIENTIFIC AND ENGINEERING DEGREES AWARDED

Discipline		1978	1980	Adjusted Level (1)	Projection (2) 1981-1985
Agriculture	(B.S.)	914	880	850	4250
	(M.S.)	156	163	180	900
	(Ph.D.)	51	49	50	250
Biochemistry	(B.S.)	430	385	400	2000
	(M.S.)	22	26	25	125
	(Ph.D.)	24	26	25	125
Biology	(B.S.)	3093	2661	2800	14,000
	(M.S.)	267	223	225	1125
	(Ph.D.)	80	77	85	425
Botany	(B.S.)	63	42	40	200
	(M.S.)	30	26	25	125
	(Ph.D.)	18	10	10	50
Zoology	(B.S.)	463	279	280	1400
	(M.S.)	90	109	95	475
	(Ph.D.)	48	33	35	175
Vet. Medicine	(B.S.)	244	256	270	1350
	(M.S.)	28	16	20	100
	(Ph.D.)	12	7	10	50
Other Agric. and Reltd.	(B.S.)	12	62	65	325
	(M.S.)	2	1	2	10
	(Ph.D.)	3	2	2	10
Engineering	(B.S.)	5105	6214	6525	32,625
	(M.S.)	1016	967	920	4600
	(Ph.D.)	218	179	180	900
Forestry	(B.S.)	271	451	500	2500
	(M.S.)	48	42	45	225
	(Ph.D.)	6	9	10	50
Chemistry	(B.S.)	810	757	750	3750
	(M.S.)	171	152	150	750
	(Ph.D.)	133	145	145	725
Computer Science	(B.S.)	952	1126	1300	6500
	(M.S.)	216	152	155	775
	(Ph.D.)	31	25	30	150
Geology	(B.S.)	446	474	490	2450
	(M.S.)	133	136	135	675
	(Ph.D.)	53	42	45	225
Mathematics	(B.S.)	1471	1577	1575	7875
	(M.S.)	159	148	145	725
	(Ph.D.)	60	46	40	200
Physics	(B.S.)	478	420	400	2000
	(M.S.)	162	150	140	700
	(Ph.D.)	95	63	60	300
Other Math & Physical Science	(B.S.)	163	11	10	50
	(M.S.)	36	29	30	150
	(Ph.D.)	13	13	20	100

Notes: (1) Adjusted to an average rate based on enrolment trends and 1980 levels of graduation by field of study.

(2) Adjusted levels multiplied by 5 years.

and engineering (excluding health sciences) in Canada in 1978, while only 726 were awarded in 1980. (1) These figures do, however, include foreign students who return to their countries after graduation. Statistics Canada data for 1978-79 claimed visa students accounted for: 17.9% of all graduate students in Agriculture and Biological Sciences, 30.3% of all graduate students in engineering and applied sciences, 28.0% of all graduate students in mathematics and physical sciences, and 10.2% of all undergraduate students in engineering.(2) The number of graduates potentially available to fill Canadian public sector positions is, therefore, substantially reduced.(3)

I. PERSONNEL OFFICERS

Personnel officers throughout the science departments are fairly consistent in their views regarding problems in staffing scientists' and engineers' positions. The major difficulties in their minds, stem from more than just large numbers of retirements, or potential retirements. The real issues are the overall vacancy situation (resulting from retirement, terminations for a variety of reasons, and the creation of new positions) and the relationship of this vacancy situation to shortages of talent in particular areas. This last issue - the supply of scientists and engineers - is viewed as a particularly crucial variable.

A. Areas of Shortage

Throughout the government, the hardest group to recruit (among scientists and engineers) appears to be the Research Scientists (RES) classification. These positions require Ph.D. degrees, which are being granted by universities to fewer individuals than previously. As noted above, in recent years the annual number of Ph.D. degrees granted has dropped by 50-60 per year in science and engineering fields across Canada.

Difficulties finding Ph.D.-level scientists with the particular specializations needed by individual departments can mean that positions remain vacant for up to two years. Agricultural economists with Ph.Ds are in short supply according to Agriculture Canada, for example, while Ph.Ds in geology, hydrogeology, some specializations of chemistry and waste management are problem areas for AECL recruitment.

The Engineering classification (EN/ENG) also poses current problems for many departments, although with the depressed state of the economy and cutbacks in major engineering projects, the situation now is generally thought to be better than nine months ago (particularly for Bachelors degree holders). Nevertheless, engineers with advanced training (Masters and Ph.D. degrees) are still quite difficult to find and recruit. Difficulties also exist in finding individuals with Bachelors degrees in certain engineering fields. DND, in particular, notes problems finding engineers in avionics, explosives and marine engineering.

The recruitment to other scientific classifications requiring only Bachelors degrees for entry-level positions (e.g., CH, BI, PC, FO, MT, VS, AG) is, understandably sensitive to the economy and the competing demands from other sectors for a relatively constant supply. For instance, there is a fairly constant supply of veterinary scientists available from three universities across Canada that might fill VS positions within Agriculture Canada. The availability of these individuals to the government is very much dependent on the fluctuations of the private sector's demand. Even though Agriculture Canada's needs are currently high, the economy is such that veterinary scientists can be found fairly easily at the moment. (See Appendix G for data on fluctuations in degrees awarded by discipline.) An economic turnaround, however, could significantly affect this.

In their efforts to meet the equal opportnity and official languages requirements, many of the science departments have experienced difficulties; shortages of female and francophone scientists and engineers are generally perceived to exist. One exception to this, however, has recently been seen in DOE, where recruitment at Laval University and elsewhere has resulted in numerous applications from both females and francophones for a limited number of positions. (4) The problems of finding such talent are not universal and are most likely to be experienced when searching for individuals with some specific specializations.

Attracting scientists and engineers to work in certain locations remains a real problem for recruiters. Rural locations throughout Canada, and certain cities where the cost of living is high, pose particular staffing difficulties.

B. Focus of Recruitment

The science departments vary quite extensively in the methods they use for recruitment. Four of the departments considered here (DFO, DOC, DND for its DS group, and AC) concentrate to a large extent on university recruiting, seeking new graduates who can then be trained internally for the particular work they will do. Three departments (TC, NRC, and AECL) seek experienced personnel from industry, while three others (EMR, DOE, and DND for ENG positions) have found it increasingly difficult to recruit the experienced people they prefer, and, when necessary, have turned to the universities to find their staff. The type of work to be performed by the recruits seems to dictate to some extent where they are sought; the education levels desired seem to be a less important factor.

C. Overall Demand

Six of the nine departments provided general information on their levels of demand for scientists and engineers. In Agriculture Canada roughly 40 Ph.Ds per year are needed for RES positions -- whereas, the total supply in this area coming out of Canadian universities is thought by AC's manpower planning group to be about 70 individuals per year, 25% of whom are foreign students. (MOSST University Branch figures show an even greater shortage, as only 49 Agriculture Ph.Ds were granted in Canada in 1980.) Agriculture Canada also requires roughly 22 Bachelors level agriculture scientists per year. (In 1980 there were 880 Bachelors degrees awarded in the agriculture sciences in Canada).

EMR with its 403 Research Scientists (RES) had a turnover rate (i.e., vacancy rate) of 5.4% in 1981 (22 positions). The creation of new positions, however, resulted in 32 additional RES positions being filled, along with 26 engineers (EN/ENG), 12 survey engineers (EN/SUR) and 37 physical scientists (PC).

NRC had 47 terminations to fill in 1981 (mostly Ph.Ds). AECL has had greater problems, though, trying to recruit 150-200 scientists and engineers last year; all educational levels were involved, but 100 of these positions required Ph.Ds.

The Defence Scientist group (DS) at DND requires roughly 40 highly trained people per year. Of these positions, roughly 20 are developmental engineers, 4 are in mathematics and computer science, 8 are in physics, 4 in chemistry, 2 in biology, and 2 in the social and behavioral sciences. With the exception of the engineers who are recruited at the Bachelor's degree level, the other positions here require advanced degrees. Additionally, the Engineering group (EN/ENG) in DND required 10 new Bachelors level engineers last year.

D. Early Retirement

Early retirement is not considered a major problem in any of the departments contacted. Where total retirement rates were known, 8% was a high figure, and early retirements were felt to be a small fraction of this. Personnel officers in Agriculture Canada did believe early retirements were increasing there (especially for the non-RES classifications), but almost every department expressed the opinion that early retirements tended to be taken between ages 62 and 65.

E. Competition with Industry

Competition with industry for recruits was viewed by the personnel officers to be especially important in regard to engineers. Half the departments thought this situation was improving with the decline in oil exploration and the termination or postponment of mega projects; nevertheless, competition is still felt to be a problem.

Several departments believed that there may be a more fundamental problem affecting the supply of engineers. The high salaries being offered to all new engineering graduates provides little incentive for them to go on for graduate training. This, in turn, guarantees both

- a low supply of engineers with graduate degrees for industry and government, and

- little or no increase in the supply of engineers qualified to teach (which in turn limits expansion of engineering programs and the future supply of available engineers).

As long as salaries for engineers remain high, this situation of short supply is likely to continue.

Competition with industry for Ph.Ds also seems to be a particular problem for EMR, AECL and AC. The higher salary levels in industry attract Ph.Ds away from government, in addition to attracting people into industry before they have undertaken graduate work. In this latter case, potential candidates are lost because government recruiting aimed at Ph.Ds is <u>much</u> too late.

F. Recommendations of Personnel Officers

A number of recommendations for meeting the government's need for scientists and engineers were proposed by the personnel officers. In addition to these recommendations a number of ideas that had been tried in specific departments seemed to meet needs recognized in others. The suggestions offered can be grouped into two areas:

1) recruiting strategies and planning, and

2) program options.

1) Recruiting Strategies and Planning

In several departments, comments were made that the federal government could, and often does, offer better career planning and long-term career options than does industry. This is an attraction that often balances the effect of lower government salaries. Career planning potentials should therefore be better highlighted in recruitment efforts.

The Department of Communications has proposed a computerized personnel system for identifying in-house talents. Containing comprehensive information on employees' education, work experience and interests, the system will permit DOC managers to identify in-house personnel who can be considered for transfers, and thus may reduce the need of going through longer external competitions. Other departments might wish to consider developing such systems, both to enhance to efficiency of the recruiting process, and to help facilitate career planning (as suggested above) for departmental personnel.

It was also suggested by one department that manpower planning could be coordinated with data on promotion schedules for developing a recruitment strategy. Like the talent bank being developed by DOC, the thought here is that the integration of additional planning data (in this case promotion plans for existing personnel) with the personnel recruiting process would enhance the latter, as well as assist individuals' career planning efforts.

Personnel officers generally did not feel that PSC recruitment procedures resulted in abnormal time-delays. They believed that science managers were used to a two month minimum to hire someone. Two departments even recognized that they had their own self-imposed delays, superimposed on PSC requirements, by requiring such things as security clearances before hiring.

One department did not believe that the PSC recruitment system was useful or appropriate for identifying and attracting Ph.Ds. Both timing delays and the system of posters were thought to be ill-suited for recruiting researchers used to a "word-of-mouth job identification process."

2) Program Options

Interdepartmental program action was perceived by some as an answer to problems in finding appropriate talent. It was suggested that an exchange of engineers between departments be facilitated to provide efficient use of the talents and exposure to different work for the individuals involved. This option was seen as more probable and efficient when applied to recent graduates than to other more senior, and more specialized individuals.

Another suggestion was that technician positions should be upgraded to scientist positions (for qualified individuals) as the focus of the job changes. Such shifts are likely to take place as more sophisticated equipment is applied to the work.

Improved linkages with universities and industry were seen as a key area by many of the personnel officers. Recognizing that individual science managers often had professional contacts throughout the universities, personnel officers felt that these contacts could be used to develop more systematic and regular communication programs for recruitment. Grant programs or exchange programs were two such options mentioned.

Lastly, internal departmental scholarship programs were seen as a way to get individuals with graduate training in needed areas. Agriculture Canada, for example, is currently initiating such a program so that 20 individuals with Masters degrees can go back to school to get Ph.Ds. Their dissertations will be done at the department's facilities under supervision of departmental scientists. For 1982-83, 12 of the individuals involved are current employees wishing to further their education and move into RES positions.

DND will similarly send Defence Scientist personnel with Bachelors degrees back to school for Masters degrees. Depending on the extent of funding received, students are committed to work for the department for one to two years for each year in school. DND feels that this is frequently the only way to attract good candidates who might otherwise not go on for graduate training. Among other departments, AECL offers both in-house training in cooperation with the University of Ottawa and on-campus training for Masters degrees. NRC and DND, with respect to its ENG group, have at times assisted the further education of staff members, though there are no formal programs for this purpose.

II PROGRAM MANAGERS

Meetings were also held with program managers in seven of the science departments in order to ascertain their views of the aging and recruitment issues. The individuals who contributed to this effort are Directors General and Directors of scientific research groups. They were identified to MOSST as appropriate contacts by their respective departmental representatives on the Office of Comptroller General (OCG) Research and Development Working Group.

The program managers who were interviewed tended to have different concerns (than personnel officers) when it comes to replacing and hiring scientists and engineers. They recognized the shortages in supply of highly trained individuals and the difficulties in finding and recruiting them, but they have an even larger concern over the impact that the quota system has on advancement in the RES classification and on scientists' consequential disposition toward government research work.

A. RES Quota System

The RES quota system was consistently the most prominent concern of the program managers who were interviewed. Ultimately the problems cited relate to the age distribution within the RES group, though there are other factors involved

The RES group has four levels, and under the quota system only 5% of the RESs within a department can be at the 04 level, and only 25% can be at 03 level.(5) Originally devised as a way to maintain stability and to limit promotions, the quota system was a replacement for an earlier merit pay system that rewarded RESs with above average performance and decreased salary levels for those with below average performance.

However, while there are quotas for different levels, aspects of the former merit system continue to exist. Thus, the work of individual RESs is also reviewed annually to determine whether advancement to the next level is warranted, should an opening become available. This means that, unlike most other classifications, the RESs cannot compete for higher level positions if they feel they are qualified. In fact, RES positions are usually advertised as RES 1-3, and a successful applicant accepts the position at his/her existing level (if not approved for advancement).

The annual review of RESs' performance is done first within the department, and then in comparison to other departments through an interdepartmental committee, thereby ensuring that the basic qualifications for advancement are consistent throughout the government.

This quota system, as designed, will effectively serve its purpose of maintaining a progressive hierarchy if:

a) the population of RESs is sufficiently diverse in age, so that one age group does not advance into higher level positions and stay there for long periods of time, thereby blocking the only path of advancement open to other RESs, and

b) the population of RESs is sufficiently large so that position vacancies are numerous enough and frequent enough for individual scientists to perceive that they have realistic possibilities for career development.

Almost all of the research managers who were interviewed agreed with the system of rewarding research scientists on the basis of professional merit. However, when this is coupled with the quota system, and the current age distribution patterns, certain problems are created. Most of the departments recognized that at the start of the RES quota system, large numbers of individuals were promoted into the 03 level, earlier than they might have otherwise. These large numbers of relatively young RESs will, therefore, stay in their positions for unusually long periods of time, with the result that more recently hired RES 02s are denied advancement by the quota system, despite high performance. Newer, important areas of scientific research within a department may also have disproportionately fewer higher level scientists.

Individuals who are selected for advancement by their departments and the interdepartmental review committee also face the problem that they may lose their high performance-advancement rating at the next annual review, if a position has not been available for them to move into in the mean-time. The professional performance rating is only guaranteed for a year, thereby further limiting career development of the RESs. As noted by the research managers, the current system tends to only evaluates professional performance in one direction (i.e., reviews of good work, worthy of promotion. It generally does not incorporate evaluations (or demotions) based on other individuals; inabilities to maintain their professional.

The barrier, beyond which RESs have difficulty advancing, is for most departments between the 02 and 03 levels. For Agriculture Canada, however, there are sufficient numbers of RESs that vacancies regularly arise within the 03 level (i.e., 25% = 175 positions). According to those interviewed, scientists at the 02 level perceive that they have a chance to move up to 03; but at the 04 level, with only 5% (35) of the RES positions, a barrier situation is still perceived.

Science managers in the Department of Communications do not perceive a barrier between the 02 and 03 levels either; but for different reasons than their counterparts in Agriculture Canada. Despite its small number of RESs (55), DOC's age distribution is such that younger scientists can move into the top RES positions. If the oldest people in DOC filled all the top positions, then some RES's age 41-45 would be in those positions. In contrast, if the same situation existed in EMR, only those age 51 and above would hold those positions. With their younger age distribution, DOC Research Scientists' advancement will come sooner.(6)

The "barrier" situation, therefore, seems to develop when a department has a large percentage of its RESs in older age groups. In the context of this study, however, the situation can also amplify recruitment requirements. As the frustrations mount for RESs who cannot move into higher level positions (despite meeting the professional work criteria), they are increasingly leaving government service and are, thereby, further increasing the government's demand for highly trained scientists. Individuals from all but one of the departments commented that this "barrier" is resulting in more and more bright, young scientists leaving government research.

B. Hiring and Recruitment Concerns

The research managers also identified a number of other factors that they feel are affecting the overall environment for scientific research in the government, and, hence, the desire among scientists and engineers to work in that environment. With varying degrees, they perceive that the environment for and reputation of government science is becoming worse. (7)

Restraints on international recruitment which promote the hiring of Canadians first are felt to be based on good theory and principles. They do, however, cause difficulties for the advancement of scientific research when the only people trained in the needed field are outside of Canada, and administrative requirements to hire such individuals seem to be a mountain of red tape. Current systems for the approval of conference travel (which have become even more stringent since the interviews) are also thought to be administered so as to make it difficult for scientists to work with individuals from other countries and to share ideas. The personal performance review of RESs includes authoring and giving conference papers, and the difficult administrative procedures to obtain approval for conference travel are thus viewed as an anomaly.

Delays in hiring also make scientific research more difficult. The fact that replacements cannot start work until the position has been vacated was noted as a problem for continuity in research. The creation of one or two person years (PYs) for the sole purpose of allowing some overlap was suggested as a means to relieve this situation.

While one department with a large number of RESs and other scientific personnel believed that staffing delays were a result of there being too few staffing and classification officers, another smaller department viewed the delays as the result of too many administrative and personnel people contributing to the staffing process. Both may be justifiable comments for the particular departments. A third department offered another suggestion for decreasing the staffing delays -- having the classification of positions reviewed periodically so that this step is already taken care of before individuals announce their departure.

Increased numbers of highly trained personnel could partially relieve recruitment problems; but there is also a regional dimension of the problem to be considered. Those interviewed noted that federal science departments have found it continually difficult to attract individuals to regions of the country other than where they have lived or have gone to school. Geographic mobility seems to remain low (especially for francophones, but also for individuals from Eastern and Western Canada who might be qualified for positions elsewhere). The availability of specialized people and highly trained minorities is more than a training problem; it is also a problem of training individuals from the areas where jobs will be located.

A number of other concerns were raised by the research managers which are beyond the scope of the present report, but which will be addressed in subsequent parts of MOSST's "Health of Government Science" project. These includes: the appraisal criteria presently used for research scientists, as well as scientists' and science managers' views on performance criteria; and the ability of performance assessments for RESs to recognize work on the management of contracts.

III Summary

Throughout the interviews with personnel officers and research managers that are reviewed in this Chapter, the aging situation was not the main focus of concern; rather overall demand for scientists (created only in part by retirements) was the overriding issue. The interviews have proved to be good sources for identifying the most pressing areas of recruitment and the most pressing problems connected to replacing and hiring scientists and engineers.

Focussing on specific areas, the RES group was identified as having the most serious recruitment difficulties, with the EN/ENG and DS classifications also being large problem areas. While personnel officers tended to offer suggestions that focused on external efforts (e.g., scholarship programs, improved recruitment through universities, career planning for candidates, and personnel exchange options), the research managers tended to focus their comments on internal administrative topics that affect: the environment of government scientific research, the consequent likelihood of scientists and engineers staying in the government, and the resulting demands for highly trained personnel.

FOOTNOTES

CHAPTER III

1) This is also consistent with Statistics Canada data (Catalog 81-220 Annual), which shows 773 individuals receiving Ph.Ds in 1979 in the agriculture and biological sciences, engineering and applied science and mathematics and physical scientists. Only 720 are recorded there for 1980 and 660 for 1982.

2) Statistics Canada, Cat. No. 81-204. Annuals 1972-73 to 1978, and Special Tabulations on Foreign Student Enrolment, April, 1978.

3) Data are not available for Canadians currently obtaining graduate educations outside of Canada.

4) DOE recently received over 180 applications from Laval University's forestry students for 10 bilingual imperative positions. Since Laval's forestry department only graduates about 120 per year, the applications were found to represent members of the previous two years' classes.

5) These quotas an reviewed annually by TBS.

6) The Department of Communications, however, may well experience this quota barrier for its youngest (current) RESs in 10-15 years.

7) Government scientific laboratories are in many cases still perceived to be the best place to do certain types of research, but even here the environment is perceived to be deteriorating.

CHAPTER IV

CONCLUSIONS

I. CONCLUSIONS

A. Introduction

The original focus of this study was on concerns that there is an unusually large block of older scientists in the federal government, and on the potential difficulties that could be involved in replacing these scientists when they retire. The age distribution patterns in the science departments, and in the various job classifications, were therefore reviewed in an attempt to determine which departments and classifications will face the most difficulty in replacing retirees. Retirements, however, are only one source of science and engineering vacancies, and the actual number, or percentage, of needed scientists and engineers is not the only important factor in determining the difficulty of finding replacements. The study therefore addressed, in addition to aging, factors such as the available supply of qualified graduates, the level of competition with other sectors, recruiting procedures and strategies, and career potential within the government, all of which affect the prospects for finding replacements.

B. Age Distribution

The analysis of age distributions indicates that there are disproportionately large numbers (and percentages) of older scientists and engineers across the government as a whole -- relative to, for example, the private sector. Particular departmental breakdowns show Agriculture Canada and DND to have the largest groups of older scientists and engineers; but DPW, NRC, DOE, DFO, EMR and AECL also have large proportions of their highly trained personnel who are over age 50.

More specifically within these departments, it was found that disproportionate percentages of older scientists and engineers are currently working in:

- the engineering classification (EN/ENG) within DND, EMR, DOE, DIAND, TC and DFO;
- the defence scientist classification (DS) within DND;
- the agriculture scientist classification (AG) within Agriculture Canada;

- the research scientist classification (SE/RES) in Agriculture Canada, EMR, DFO DOE and NHW;

- the veterinary scientist classification (VS) in Agriculture Canada,

- the survey research group (EN/SUR) in EMR;

- the biologist classification (BI) in NHW, and Agriculture Canada;

- the scientific regulation group (SG/SRE) in NHW; and

- the research manager classification (SE/REM) in DOE.

With respect to technician classifications, the study shows that the GT group in DND and DFO; the EGESS group in DND, DPW, and DIAND; and the technicians within NRC are also disproportionately older.

As a result of the identified age distribution patterns, it is expected that retirement rates among government scientists and engineers will increase significantly over what they were in the late 1970s (about 1.8% retiring per year), and should reach an average annual rate of 2.6% by the period 1987 to 1996.

Aging and retirements, however, are only part of the problem. As noted earlier, vacancies arise for several reasons (e.g., career changes, health and maternity leaves, transfers to other government positions and program expansions), and scientists and engineers must be recruited for all the positions that are opening. Furthermore, it should also be noted, in anticipating the future government demand that:

- a number of current vacancies are going unfilled for lack of appropriate specialized talent,

- university enrolments and degrees awarded are dropping in the sciences (especially for graduate degrees), and

- current government policy to increase R&D expenditures to 1.5% of the GNP are likely to stimulate a higher demand for scientists and engineers, across all sectors.

C. Areas of Shortage

Areas in which current supply-side shortages have been identified by personnel officers include: Master's and Ph.D.

level engineers, and Ph.Ds in particular fields of geology, agricultural economics, waste management, hydrology and chemistry. For many of these fields the supply is thought to be decreasing, as fewer degrees are being awarded. It has been estimated that between 1981 and 1985 the number of degrees awarded in Canada for Master's and Ph.D. level engineers will drop 9.4% and 17.4% respectively over 1978 figures. This will mean that by the mid-80's only 60% of the total estimated demand for all sectors will be trained by Canadian universities. Similarly, in the 1981-85 period Ph.Ds in geology are expected to graduate at rates more than 15% lower than in 1978.

It appears that current recruitment in other areas like agriculture, forestry, and veterinary scientists is relatively easy. It should be remembered, however, that the state of the economy and private sector hiring have a large influencing role. Areas where major problems do not currently exist may well experience hiring difficulties if an economic upturn leads to increased private sector employment; and if this coincides with heavy retirement periods in the government, recruitment could be even harder.

It has been projected that current enrolments will only meet 50% of the total estimated government demand for agricultural scientists by the mid-80's. Annual degrees awarded for agriculture sciences between 1981 and 1985 will be 7% fewer than in 1978 for Bachelors degrees and will see little-to-no growth at the Master's and Ph.D. levels. Veterinary scientists will see 10% growth in their numbers at the Bachelor's degree level, but a 29% drop is expected at the Master's level and a 17% drop at the Ph.D. level. In forestry, a relatively constant supply is being produced at the graduate level, and it is expected that only about 40% of the projected government need for forestry will be filled.

D. Recruitment and Human Resource Planning

A number of recruiting strategies and manpower planning techniques have been suggested - or are being tried - by the individual departments to address the problem of a diminishing supply of talent. These include. computerized personnel systems, recruitment/promotion coordination, making recruiting efforts more suitable for Ph.D.-level scientists, upgrading of technician positions (for those qualified), improved linkages with universities and industry to bring about more systematic recruitment, and scholarship or in-house training programs to encourage individuals to obtain graduate training in needed areas.

In addition, flexible use of a small pool of person years within departments can be a means of easing recruitment schedules, ensuring placement for exceptional recruits, and allowing some overlap among entering and leaving personnel. Such pools are currently being used by some departments to facilitate the hiring of quality personnel in minority groups when they are found, and in DND for exceptional engineers. Lapsed person years, where they exist on a continuing basis, could be used as one source of the person years required for this purpose.

One of the other above items -- scholarship or in-house training programs -- has proven to be a useful strategy for some of the science departments. As noted in Chapter III, Agriculture Canada, DND and AECL have established formal programs for funding individuals to go back to school for advanced degrees in needed areas or for in-house training in conjunction with local universities. These programs appear to be important elements in the departments' efforts to meet their personnel needs, and they also appear to be a useful information channel by which the universities can identify areas of need and of research interest in the government. Other federal government science departments may find them equally valuable, both for general recruiting and to meet specific regional needs.

While some of the items mentioned above have proven useful in meeting particular problems of individual departments, there appears to be a need for more systematic recruiting and manpower planning throughout the science departments. Work in three general areas would help to meet these needs:

1) improved communication between departmental human resource planning staff and science research managers,

2) improved communications between the science departments and the universities, regarding both the demand for and supply of scientists and engineers, and

3) improved communication and coordination between the science departments and the PSC, so that government-wide planning can be developed further.

MOSST officers have discussed these conclusions with representatives of the central agencies which are responsible for human resource planning initiatives within the government. In all cases, an enthusiastic response was received, both to the broad conclusions and to the recommendations which follow below.

Among those consulted was the Manager of Treasury Board's Task Force on Human Resource Management. This group is developing a "Human Resource Management" (HRM) system for the Public Service, which will focus on a broad range of human resource requirements for <u>all</u> departments. The present MOSST study is restricted to the special needs of the <u>science</u> departments, and has indicated problem areas which might well be given priority in the implementation of the HRM System. Indeed, in this context, the Manager of the Task Force has expressed the opinion that the MOSST study findings are valuable indicators of the HRM system's relevance to the science departments.

To date, a proposal for the HRM System has been submitted to TBS by the Task Force, and has been approved for implementation. (Implementation will begin this year with a few departments and will expand over the following two years to include all departments.) An Interdepartmental Committee on Human Resource Planning will also be established to review the progress of the system and emerging needs on an on-going basis. In addition, a series of interdepartmental workshops on human resource planning will be held by T.B.S, and a small staff of liaison officers will be established to work with individual departments in developing planning operations for their individual needs.

The general theme in these activities is one of improving communications within government (e.g., between human resource planners and managers, and between the departments and central agencies). This is consistent with two of the general conclusions of the present work, indicated above. It should be noted, however, that the TBS Task Force plans do not focus on supply assessments or communications between government departments and universities -- the third general conclusion listed above.

The second central agency that was consulted was PSC, or more specifically PSC's Human Resource Planning Division (within the Staffing Branch). It has a mandate to serve the departments as human resource planning consultants and is expanding its efforts in such areas as reviews of the labor supply.

The PSC Human Resources Planning Division has been particularly enthusiastic in its response to this study, and has encouraged MOSST to work with it and TBS in staging one of their workshops for departmental human resource planners and research/program managers. PSC, which would supply support personnel for the workshop, believes that by sharing the findings of this study with all departments, broad discussions of manpower planning options can be initiated. Moreover, alternative solutions to particular recruitment and manpower planning problems of individual departments -- science-based or otherwise -- might be developed.

In addition to TBS and PSC, NSERC also has an interest in manpower planning for highly qualified personnel. With its mandate to administer Highly Qualified Manpower Training and Development Scholarships and fellowships, and to support university science and engineering through research grants, NSERC is a vital link in the long-term human resource planning/development process. NSERC officials have indicated to MOSST project officers that systematic information on the science departments' areas of greatest demand, as well as recruitment difficulties, would be a useful input to their planning activities.

E. Research Scientists

Although this study did not intend to address the creativity-related problems associated with aging, strong representations were received to the effect that the age structure of the research scientists (RES) group is stifling younger scientists. This seems to be causing morale and creativity problems, which in turn are leading to additional recruitment requirements. The problems are most evident in the RES classification, but they may also exist in varying degrees for other groups as well.

As discussed previously, the limits on advancement imposed by the RES quota system discourage the scientists in lower levels who cannot advance, despite being judged capable of promotion by their peers. This situation is starting to stimulate a greater number of departures and vacancies. In many cases, research managers believe that those who are leaving are precisely those younger scientists with specializations that are uncommon and in high demand. They are, therefore, the scientists who are the hardest to recruit, and their departures may have a serious impact on future government research, especially in new areas of science.

Three alternative approaches might be considered to help rectify this situation. These include:

- adjustments in the number in levels of the RES classification so that greater movement is available,
- adjustments in the range of pay for the various steps within the four existing levels or
- periodic evaluations of individuals in the RES 03 and RES 04 levels to insure they continue to meet the standards of their position, and the down-grading of those who don't, enabling other more qualified individuals to move up.

Further work in this area should also take note that NRC's procedures for research officer advancement apparently have not resulted in the same morale problems as the PSC's

RES system, despite the fact that there is a similar age structure. NRC's experience and procedures for scientific appraisal and advancement, and its success in avoiding a rigid quota system in this regard, would thus provide a useful reference point for further study of the RES problem.

II RECOMMENDATIONS

Recommendation 1: It is recommended that an interdepartmental committee be established to: 1) encourage the communication of human resource plans, strategies and requirements within and among departments, and 2) coordinate the gathering and dissemination of supply and demand data on human resources in the scientific and engineering fields. This committee would be chaired by MOSST, and would include representative science managers (supported by senior personnel branch officers) from each of the science departments, as well as members from TBS, PSC and NSERC. Wherever possible, the activities of this committee should be integrated with the work of the TBS Human Resource Management System. In particular, the committee would be responsible for:

- developing and using a systematic method for the collection and monitoring of data on the federal government's demand for scientists and engineers; (This should be integrated with any departmental data collection systems already in use; it should permit particular attention to be placed on those areas where recruitment has been difficult in the past; and it should provide an early warning system for identifying the human resource implications of emerging programs and program shifts.)

- monitoring the demand for scientists and engineers in other sectors of the Canadian economy, as well as the available and projected supply of scientists and engineers in Canada and elsewhere;

- ensuring that the above information on the supply and demand of scientists and engineers is made available on a systematic basis to the science departments (particularly to the human resource planning staffs therein) and to NSERC, TBS and PSC;

- developing interdepartmental awareness of human resource planning options being tried by individual departments and, where it is desirable to do so, helping to explore the feasibility of implementing such options within specific departments. (The training and retraining of specialists in shortage areas, the identification and communication of human resource requirements within and among departments, and the increased flexibility of hiring procedures to recruit needed specialists are three areas in which options should be reviewed.)

Recommendation 2: MOSST, PSC and TBS should stage a workshop for departmental human resource planning officers and research managers to:

- discuss the findings and implications of this study; and
- work towards improved communication of human resource plans within and among departments.

Recommendation 3: In consultation with the Interdepartmental Advisory Committee for the Scientific Research Group (IAC), TBS and the science departments, MOSST (not the committee of Recommendation 1 above) should further examine the problems related to the appraisal and advancement of scientists in the SE/RES classification. Recommendations should be made to the central agencies, particularly TBS, and to the IAC on policy measures to alleviate these problems. In particular, this work should address difficulties arising from the application in the SE/RES group of both a merit review and a quota system. Consideration should be given to:

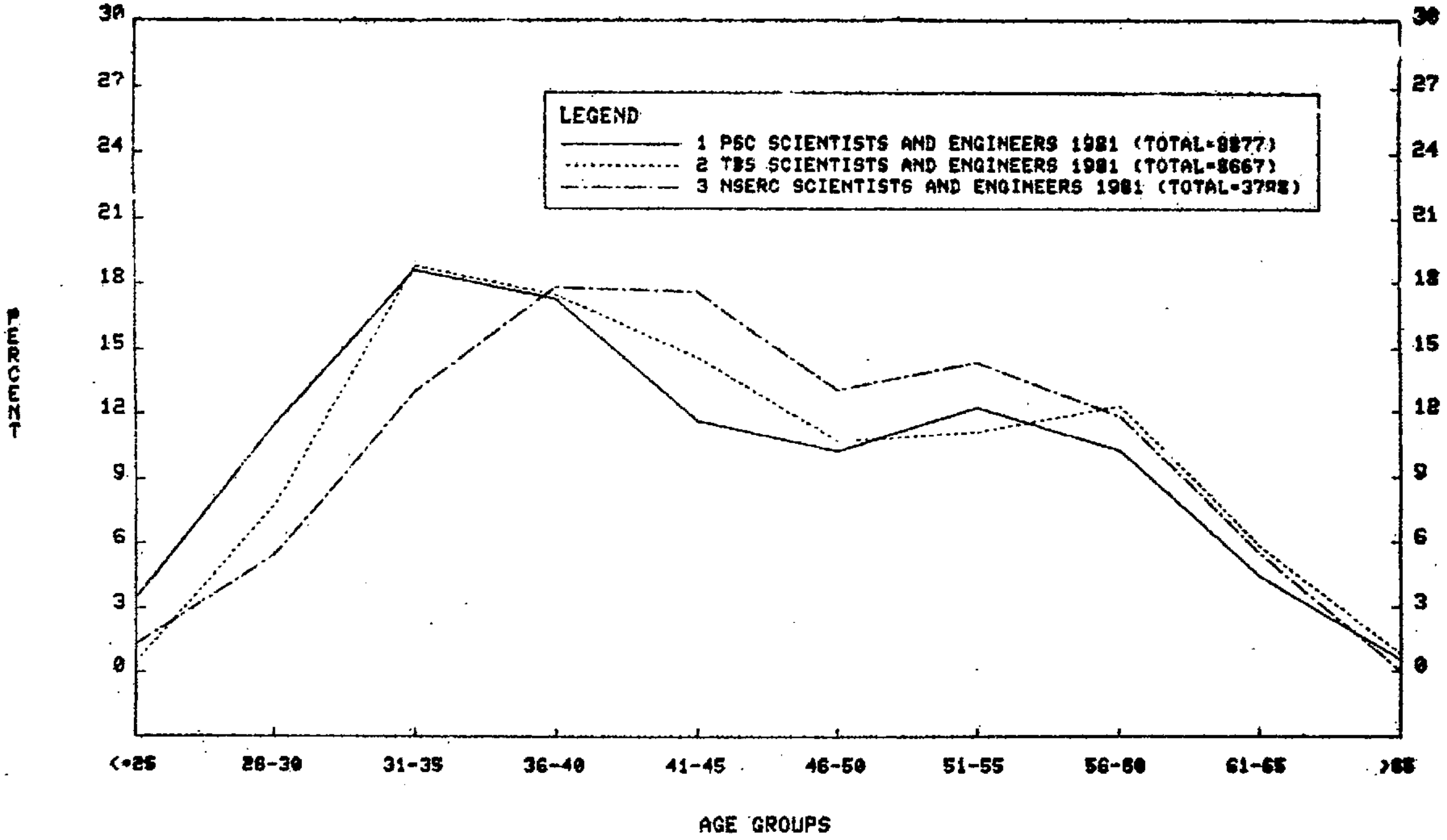
- identifying the range and extent of concerns with the current RES promotion system, and how these vary among departments;
- examining the reasons for using a quota system for the RES classification, and reviewing:
  - whether those reasons are sufficient justification, and
  - why the quota system exists for research scientists but not for other classifications;
- examining the criteria used in merit reviews, and the extent to which there are demands on the scientists' time for which they are not evaluated; and
- identifying alternatives for those aspects of the existing system that are thought to be problems.

APPENDICES

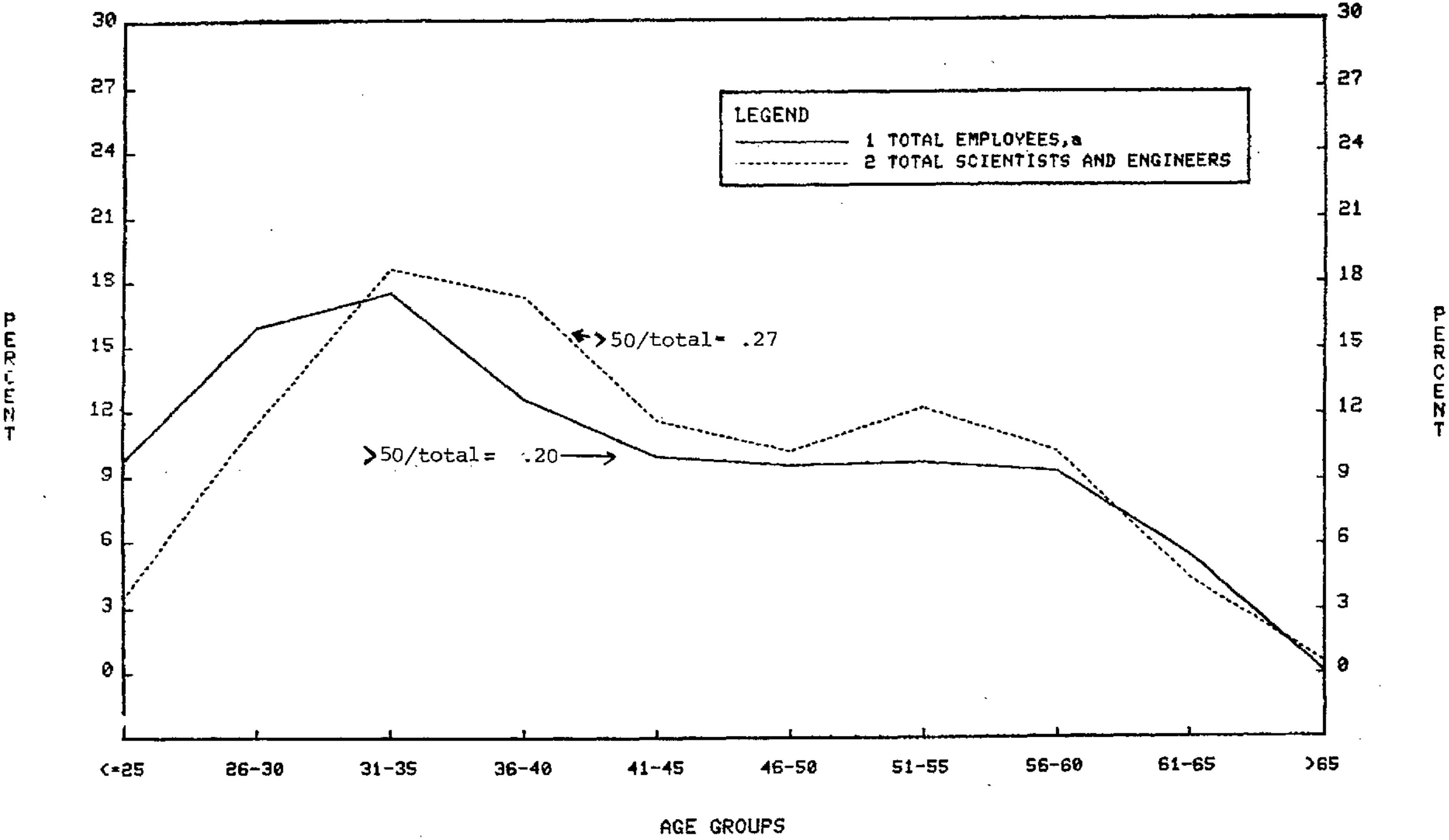
APPENDIX A

SCIENTISTS AND ENGINEERS IN THE FEDERAL GOVERNMENT

TOTAL EMPLOYEES COMPARED TO TOTAL SCIENTISTS AND ENGINEERS



SCIENTISTS AND ENGINEERS IN THE FEDERAL GOVERNMENT.

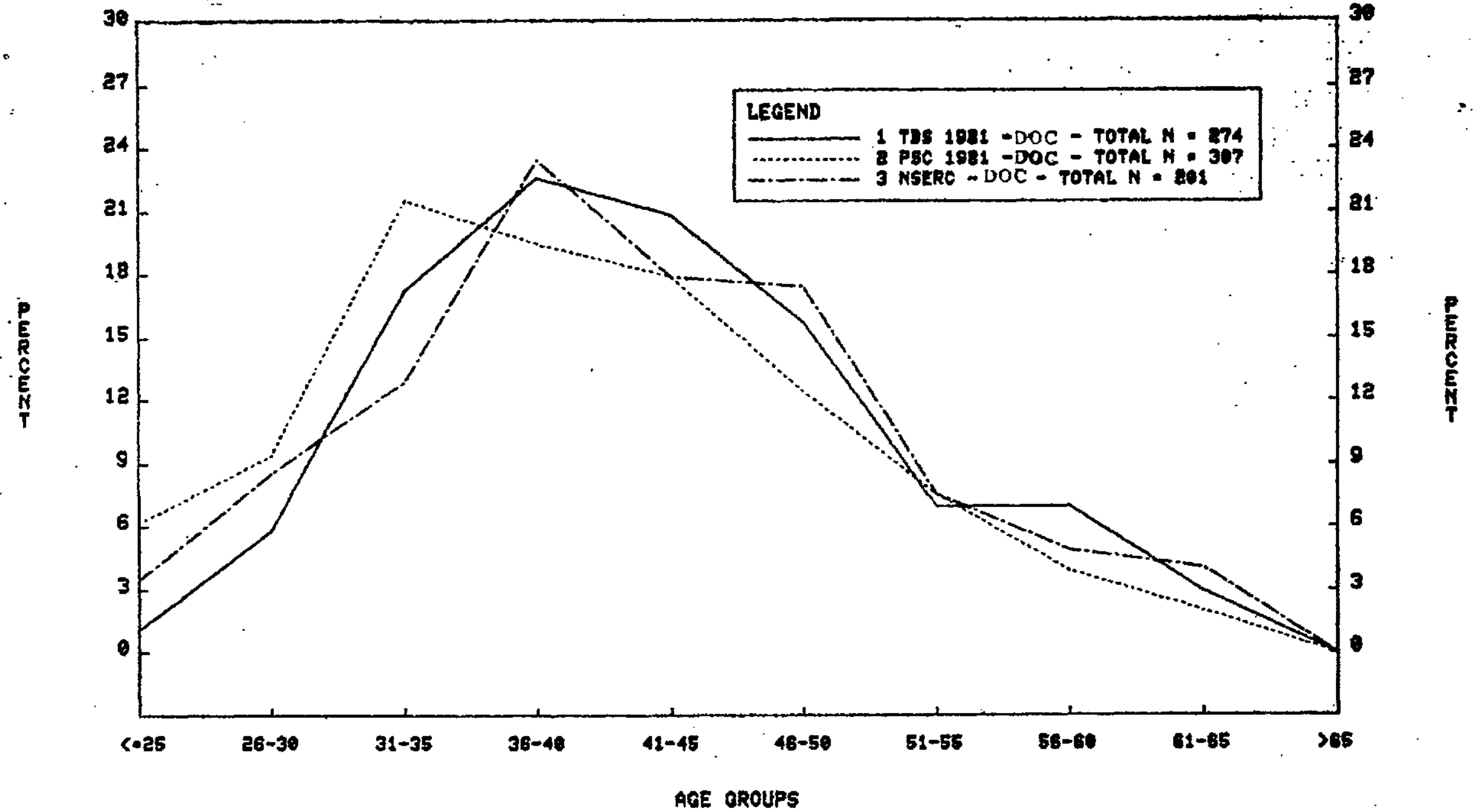


a . DATA HERE ARE FOR AGE COHORTS ONE YEAR YOUNGER THAN FOR OTHER DATA (i.e., FIGURES ARE FOR <25,25-29, 30-34, etc.).

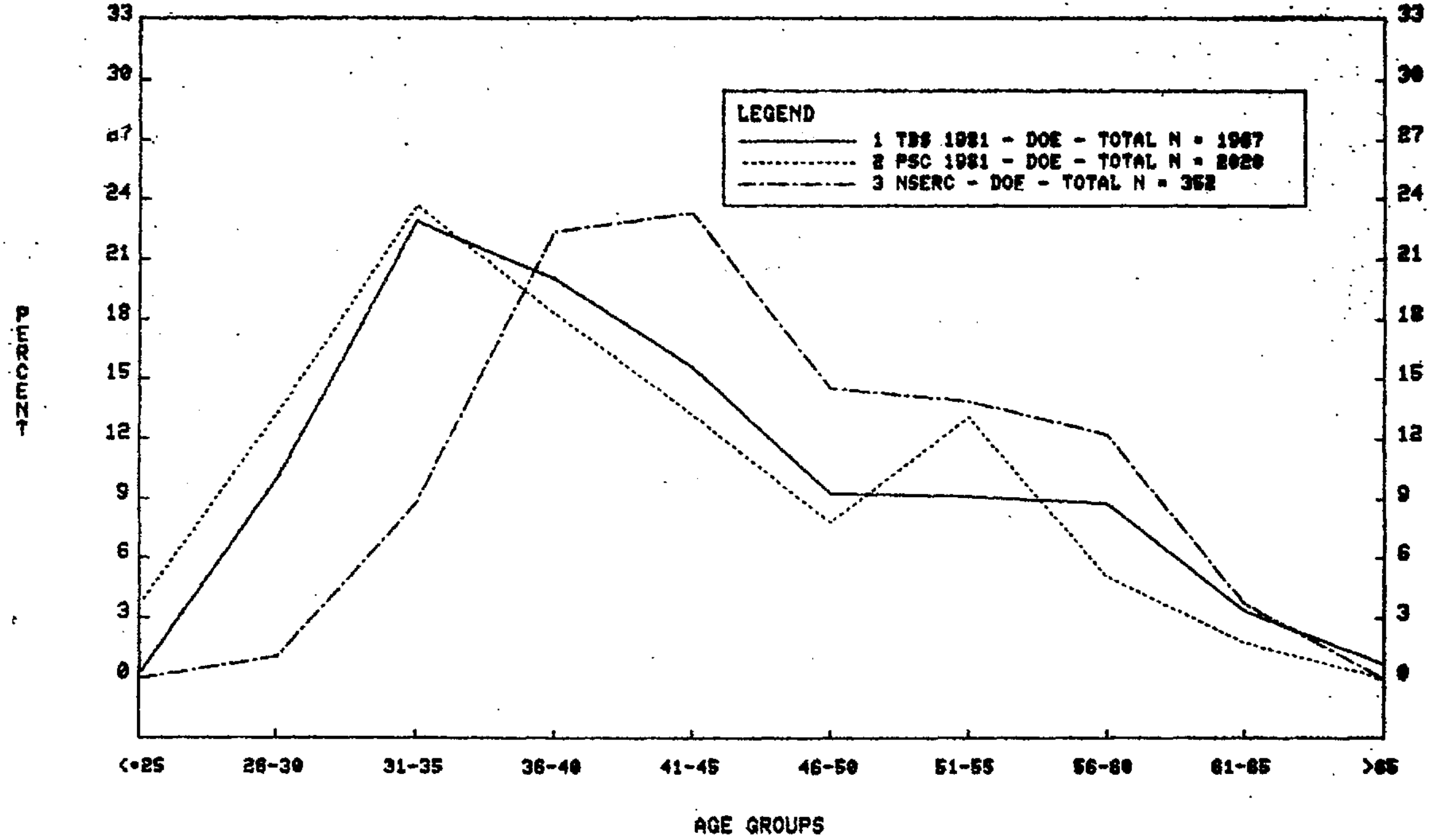
TOTAL EMPLOYEES COMPARED TO TOTAL SCIENTISTS AND ENGINEERS EMPLOYED BY THE CANADIAN PUBLIC SERVICE. (PSC, 1981).

APPENDIX B

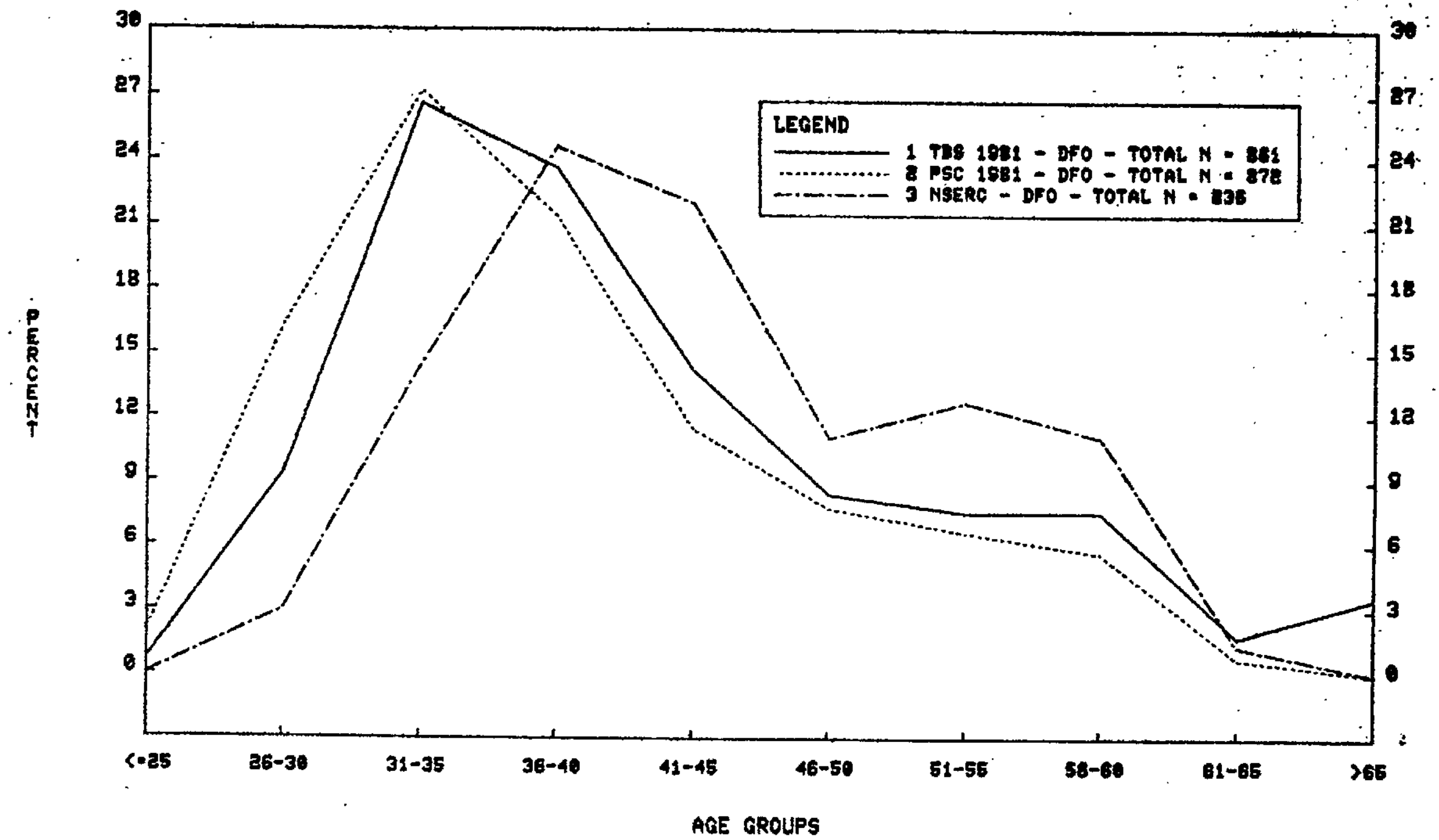
DEPARTMENTAL AGE DISTRIBUTIONS OF SCIENTISTS AND ENGINEERS



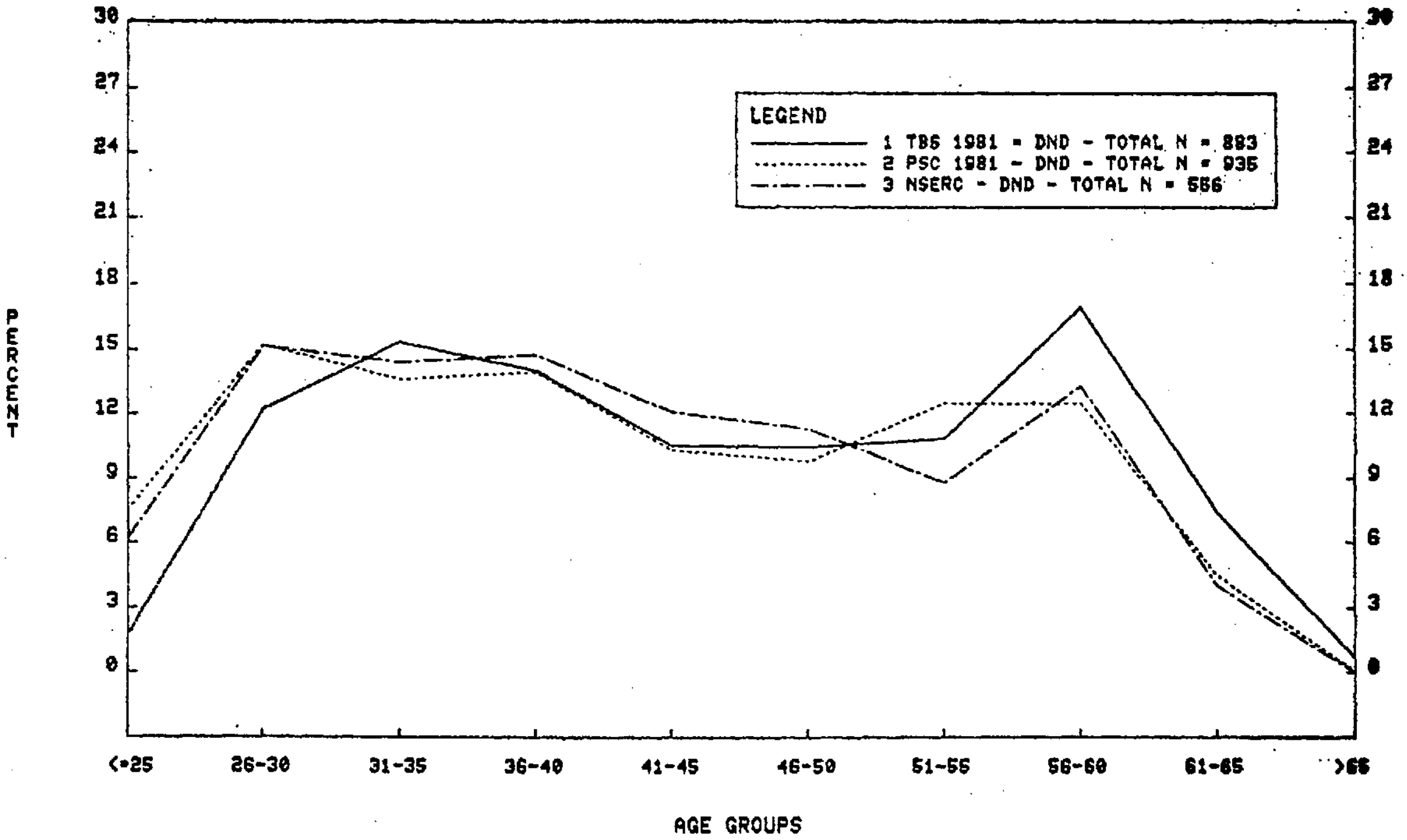
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF
IN THE DEPARTMENT OF COMMUNICATIONS



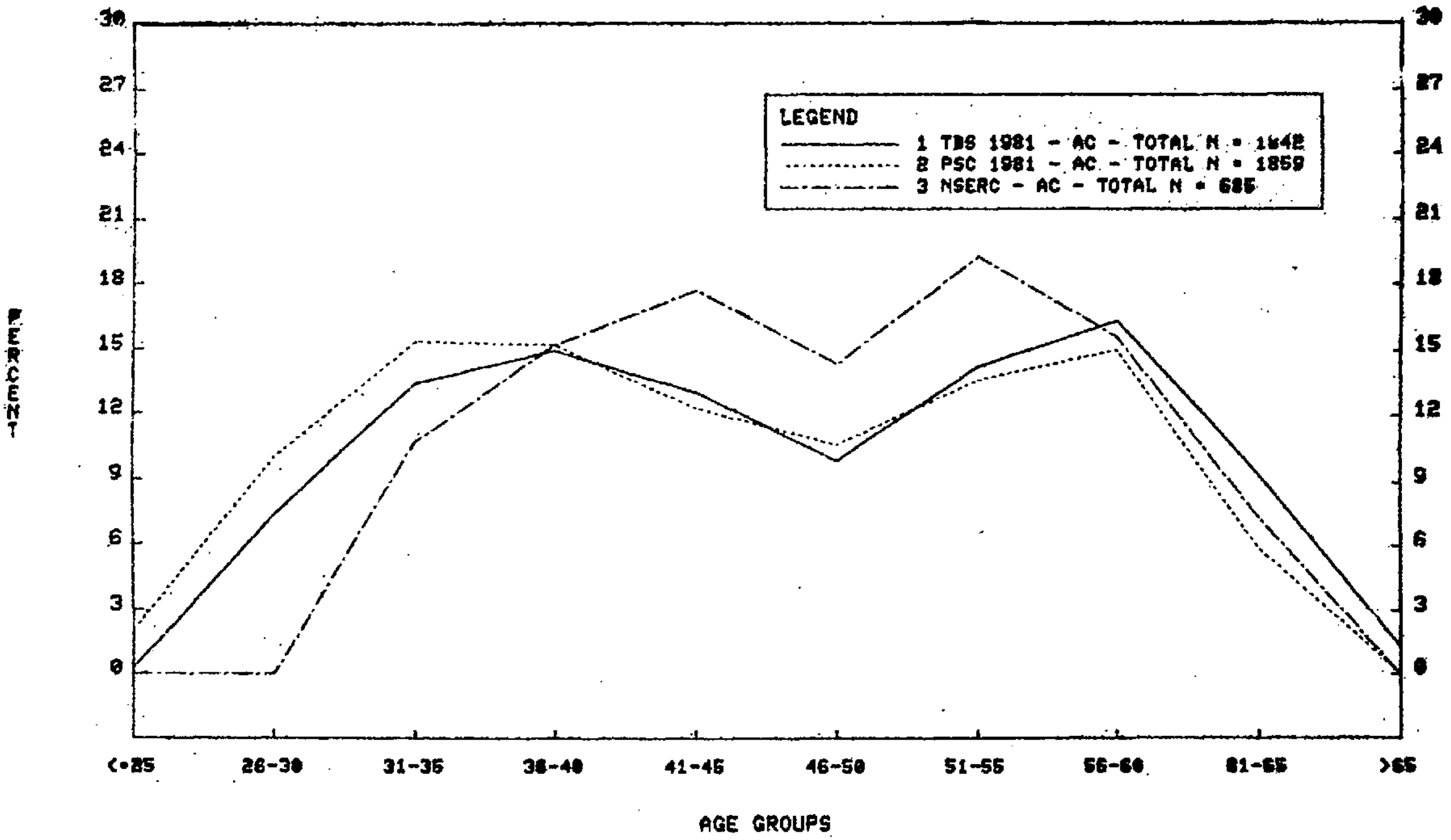
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF
IN THE DEPARTMENT OF ENVIRONMENT



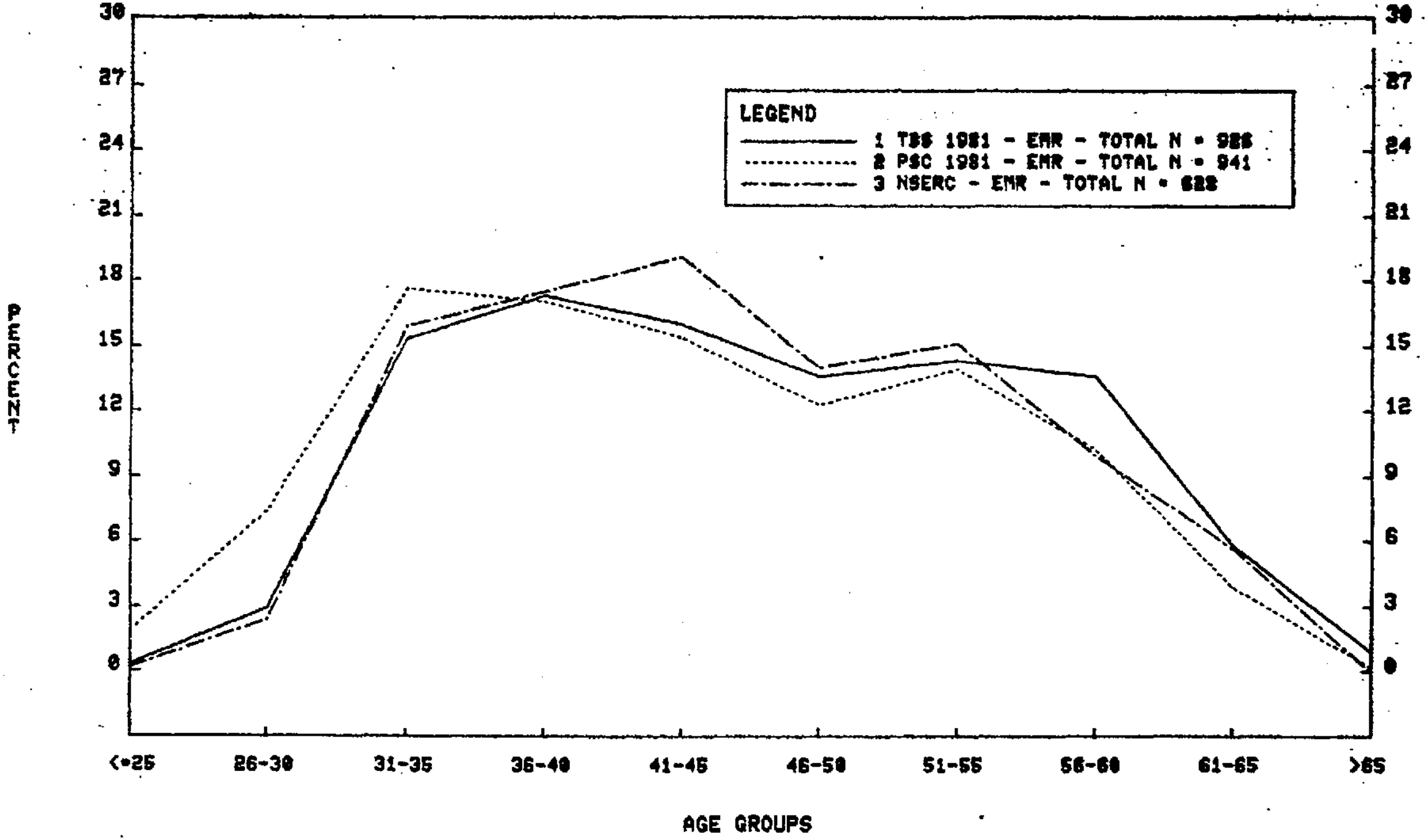
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF
IN THE DEPARTMENT OF FISHERIES AND OCEANS



AGE DISTRIBUTIONS OF SCIENTIFIC STAFF IN THE DEPARTMENT OF NATIONAL DEFENCE



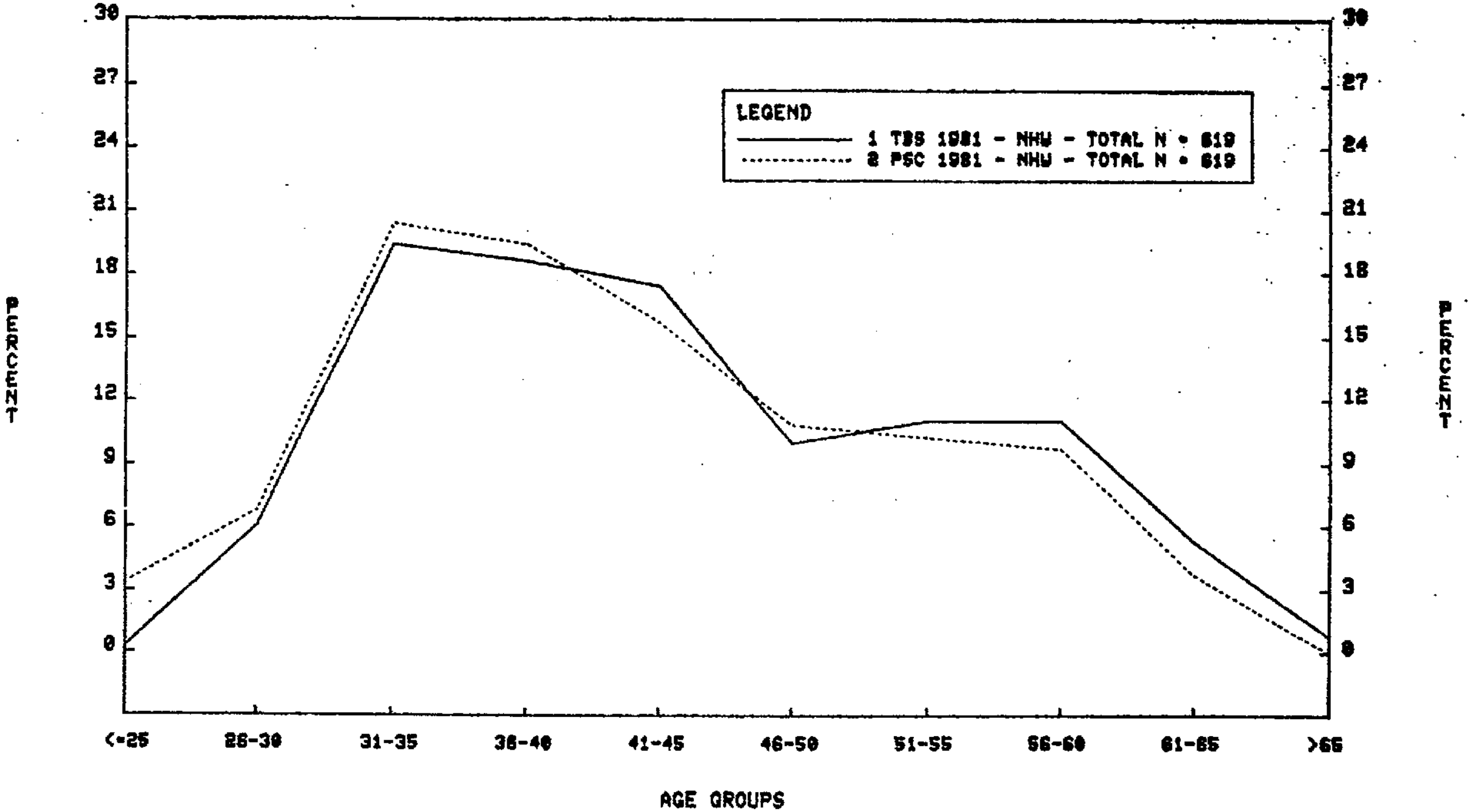
AGE DISTRIBUTION OF SCIENTIFIC STAFF
IN AGRICULTURE CANADA



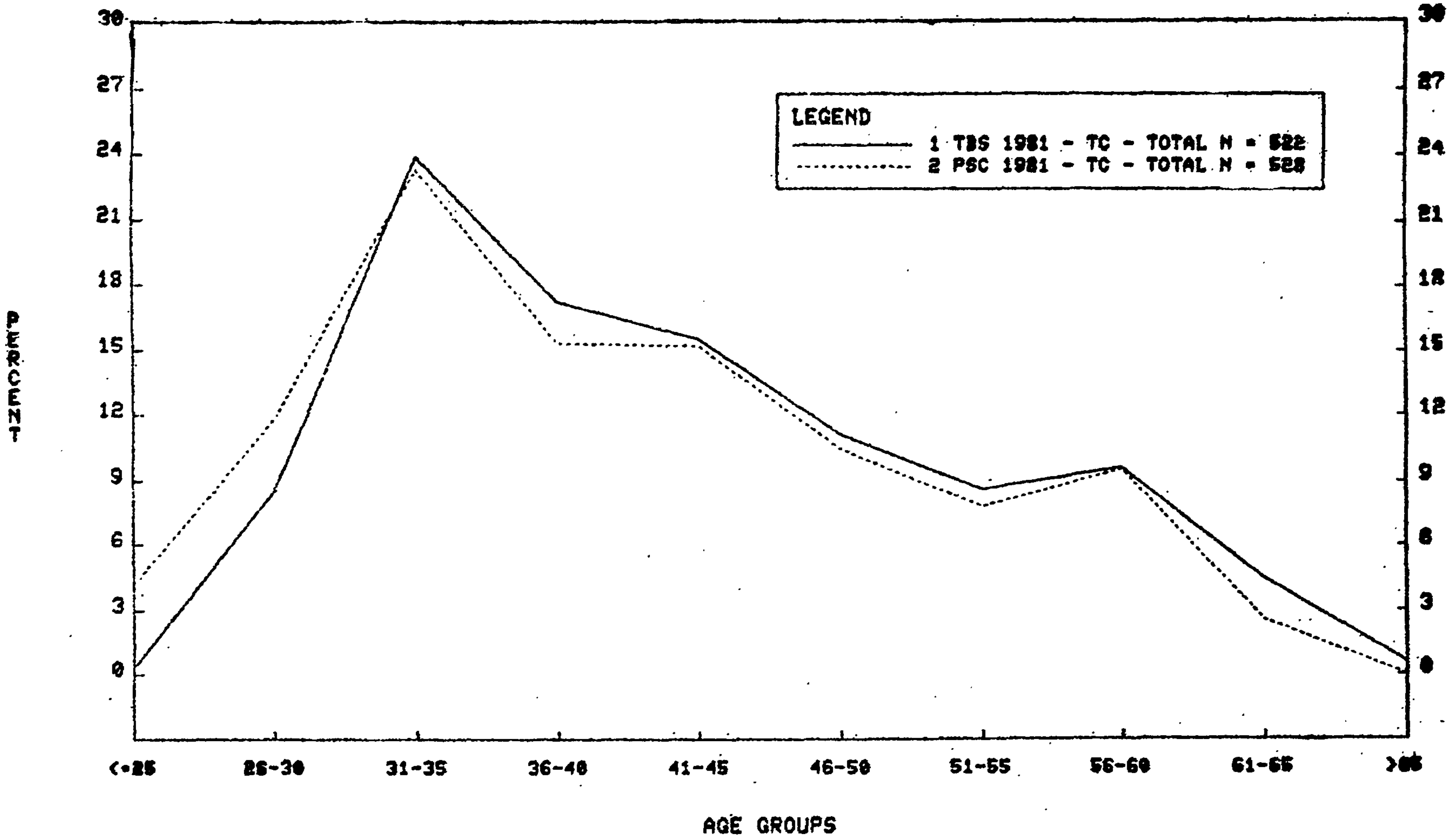
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF IN THE DEPARTMENT OF ENERGY, MINES AND RESOURCES

CROSS-COMPARISONS OF PSC, NSERC and TBS DATA BY DEPARTMENT

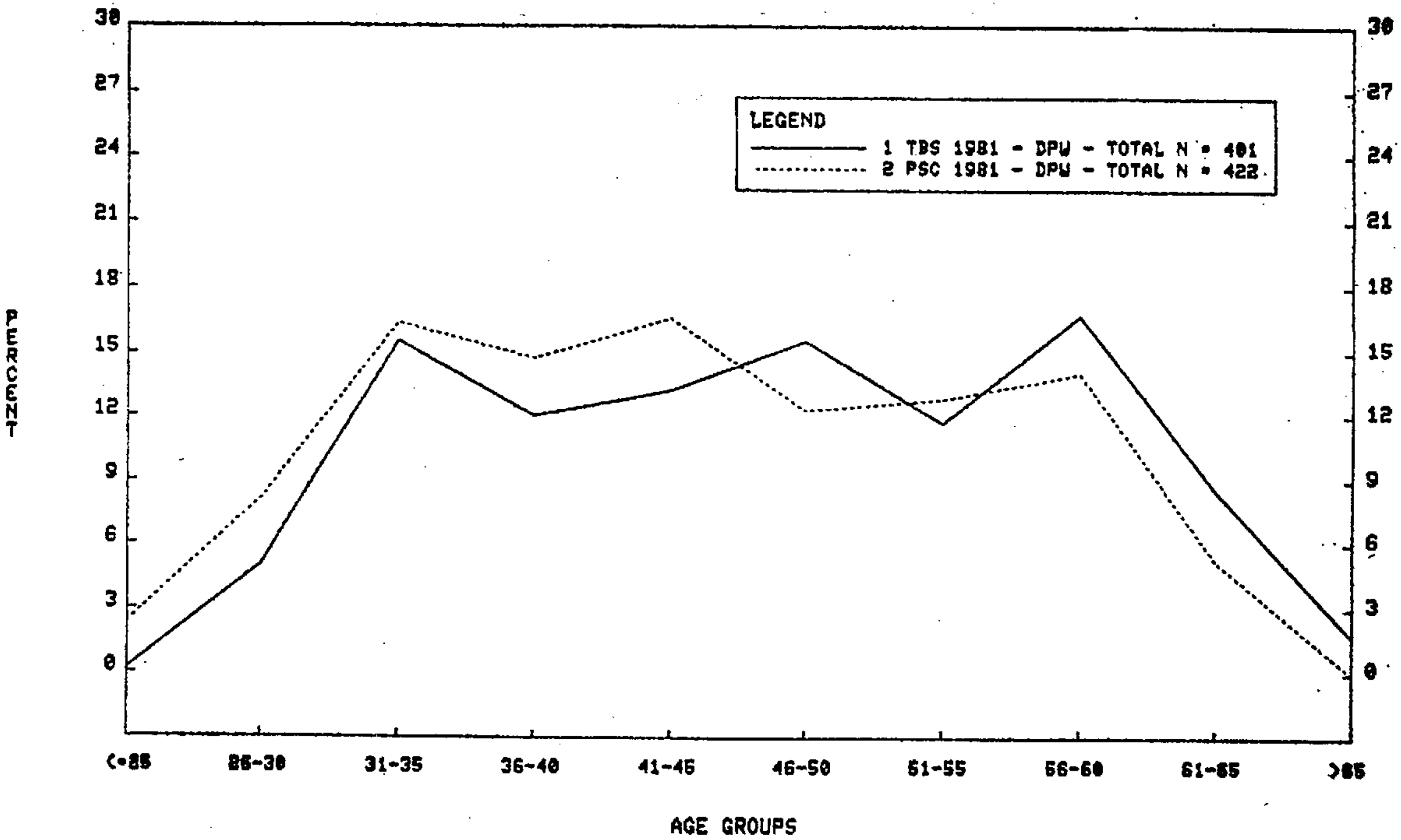
	≤25 (%)	26-30 (%)	31-35 (%)	36-40 (%)	41-45 (%)	46-50 (%)	51-55 (%)	56-60 (%)	61-65 (%)	>65 (%)	Total
Agriculture											
TBS	.3	7.3	13.4	14.9	13.0	9.9	14.2	16.3	9.3	1.3	1842
PSC	2.1	10.0	15.3	15.2	12.3	10.6	13.6	15.0	5.9	.1	1859
NSERC	0.0	0.0	10.7	15.2	17.7	14.3	19.3	15.6	7.3	0.0	685
Communication											
TBS	1.1	5.8	17.2	22.6	20.8	15.7	6.9	6.9	2.9	0.0	274
PSC	6.2	9.4	21.5	19.5	17.9	12.4	7.5	3.9	2.0	0.0	307
NSERC	3.5	8.5	12.9	23.4	17.9	17.4	7.5	4.9	4.0	0.0	201
Environment											
TBS	0.3	9.9	22.9	20.0	15.6	9.3	9.1	8.8	3.4	0.7	1967
PSC	3.7	13.2	23.7	18.3	13.2	7.8	13.1	5.1	1.8	0.0	2020
NSERC	0.0	1.1	8.8	22.4	23.3	14.5	13.9	12.2	3.7	0.0	352
Fisheries & Oceans											
TBS	0.7	9.4	26.6	23.6	14.2	8.4	7.5	7.5	1.7	3.5	861
PSC	2.1	16.4	27.2	21.4	11.4	7.7	6.6	5.6	0.7	0.0	872
NSERC	0.0	3.0	14.4	24.6	22.0	11.0	12.7	11.0	1.3	0.0	236
National Defence											
TBS	1.8	12.2	15.3	14.0	10.5	10.4	10.8	16.9	7.4	0.7	883
PSC	7.6	15.2	13.6	13.9	10.3	9.8	12.5	12.5	4.5	0.1	935
NSERC	6.3	15.1	14.4	14.7	12.1	11.3	8.8	13.3	4.0	0.0	556
Energy, Mines & Resources											
TBS	0.3	2.9	15.3	17.3	16.0	13.6	14.3	13.6	5.8	0.9	926
PSC	1.9	7.4	17.6	17.0	15.4	12.3	13.9	10.2	3.9	0.2	941
NSERC	0.2	2.4	15.9	17.5	19.1	14.0	15.1	10.0	5.7	0.0	628



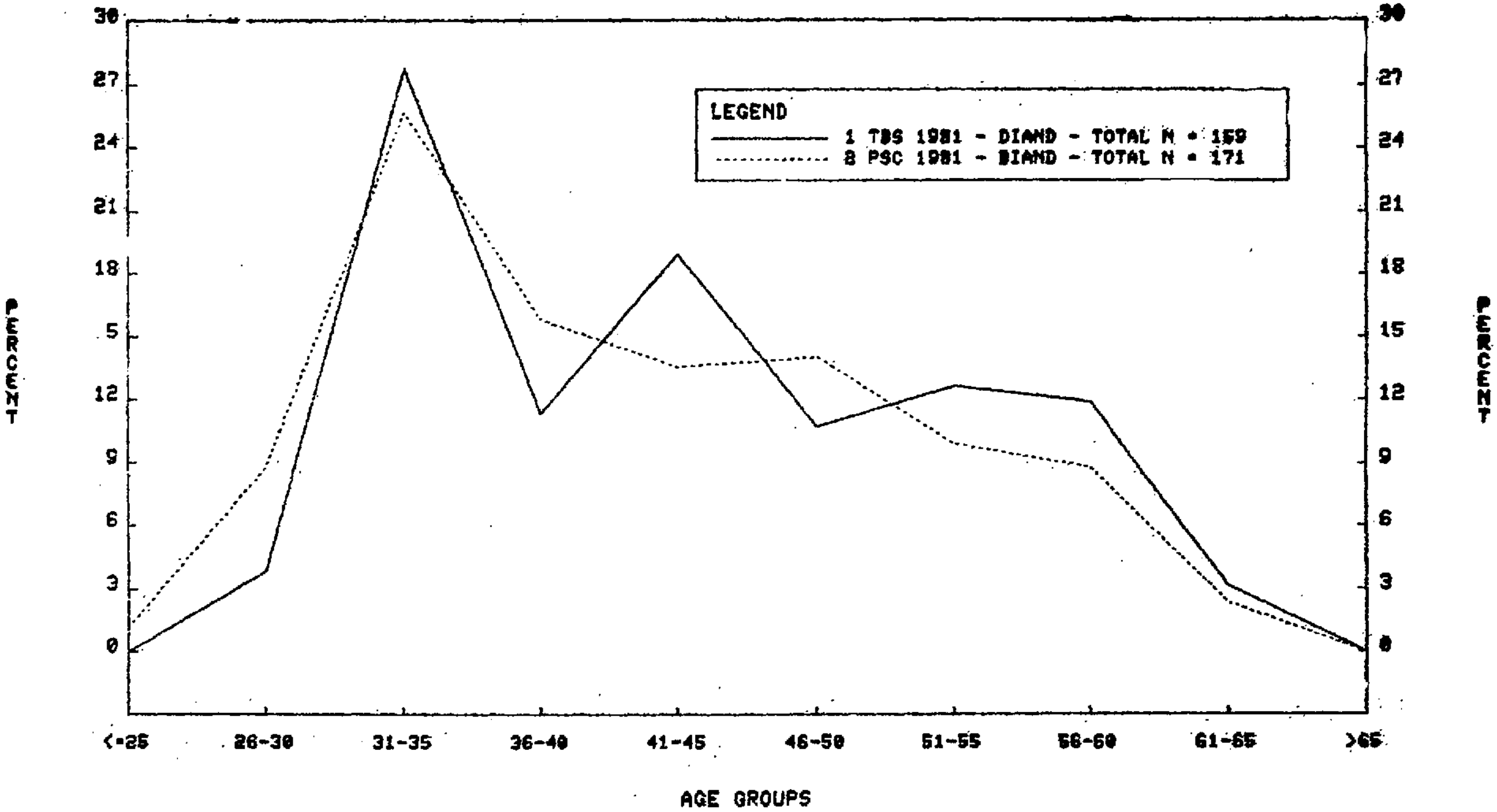
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF IN THE DEPARTMENT OF NATIONAL HEALTH AND WELFARE



AGE DISTRIBUTIONS OF SCIENTIFIC STAFF
IN TRANSPORT CANADA



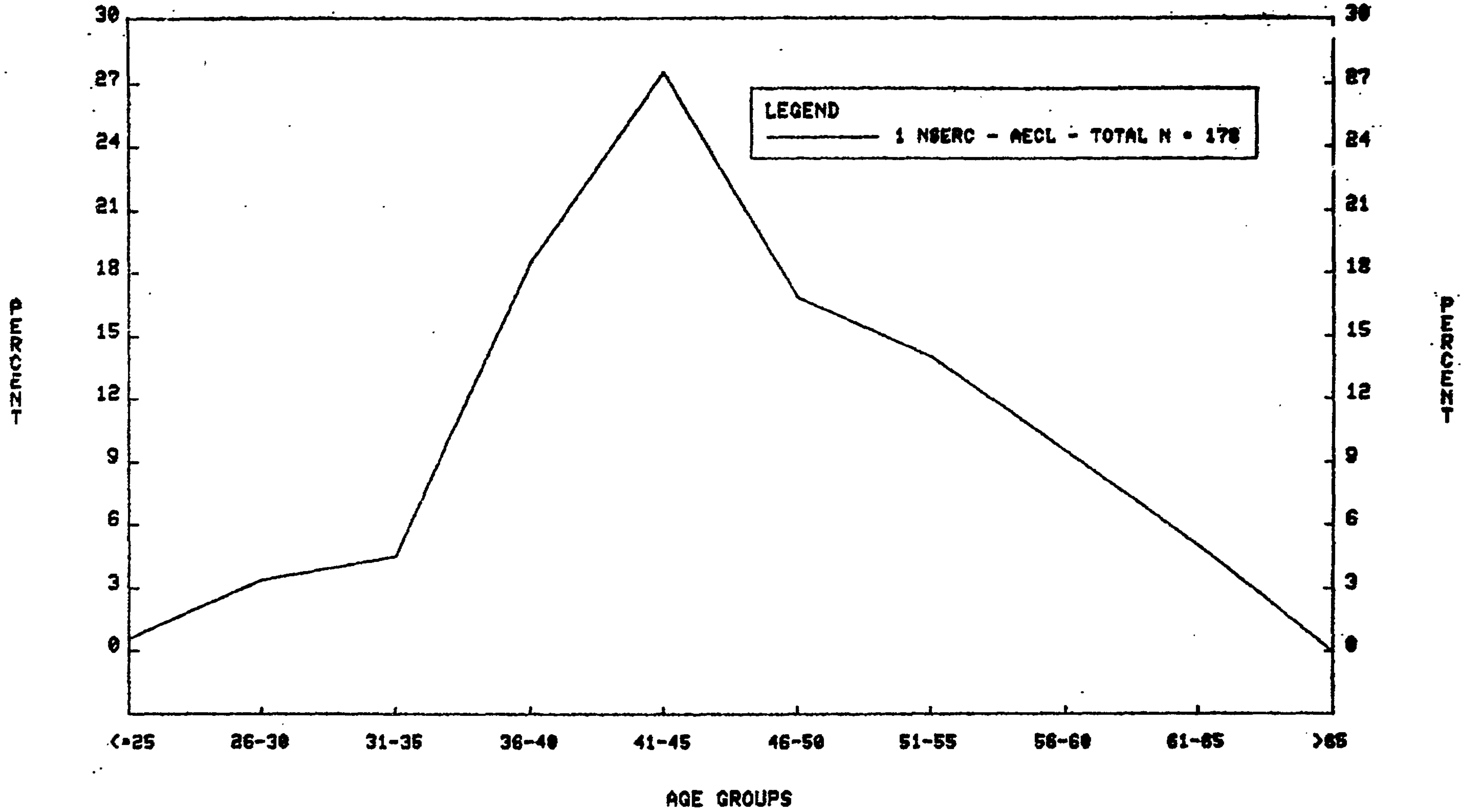
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF
IN THE DEPARTMENT OF PUBLIC WORKS



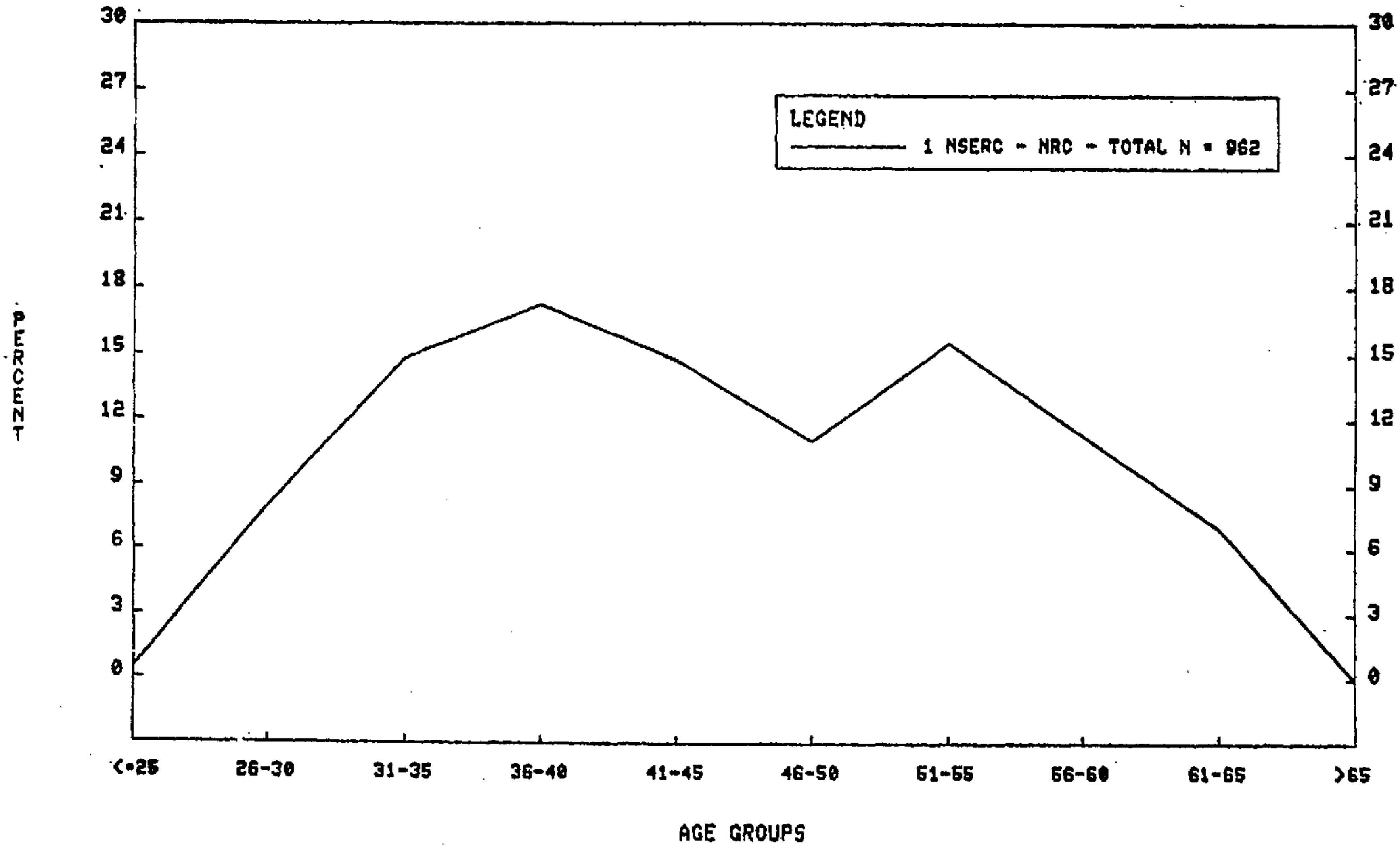
AGE DISTRIBUTIONS OF SCIENTIFIC STAFF IN THE DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

CROSS-COMPARISONS OF TBS AND PSC DATA BY DEPARTMENT

	≤25 (%)	26-30 (%)	31-35 (%)	36-40 (%)	41-45 (%)	46-50 (%)	51-55 (%)	56-60 (%)	61-65 (%)	>65 (%)	Total
Health and Welfare											
TBS	0.3	6.1	19.4	18.6	17.4	10.0	11.0	11.0	5.3	0.8	619
PSC	3.4	6.8	20.4	19.4	15.7	10.8	10.2	9.7	3.7	0.0	619
Transport											
TBS	0.4	8.6	23.9	17.2	15.5	11.1	8.6	9.6	4.4	0.6	522
PSC	4.2	11.9	23.3	15.3	15.2	10.4	7.8	9.5	2.5	0.0	528
Consumer & Corporate Affairs											
TBS	0.5	4.7	13.6	12.2	14.6	12.7	15.4	14.6	11.7	0.0	213
PSC	1.0	5.9	11.8	13.8	16.3	12.3	14.8	14.3	7.9	2.0	203
Public Works											
TBS	0.2	5.0	15.5	12.0	13.2	15.5	11.7	16.7	8.5	1.7	401
PSC	2.4	8.1	16.4	14.7	16.6	12.3	12.8	14.0	5.2	0.0	422
Indian Affairs and Northern Development											
TBS	0.0	3.8	27.7	11.3	18.9	10.7	12.6	11.9	3.1	0.0	159
PSC	1.2	8.8	25.7	15.8	13.5	14.0	9.9	8.8	2.3	0.0	171



AGE DISTRIBUTION OF SCIENTIFIC STAFF
IN ATOMIC ENERGY OF CANADA, LIMITED



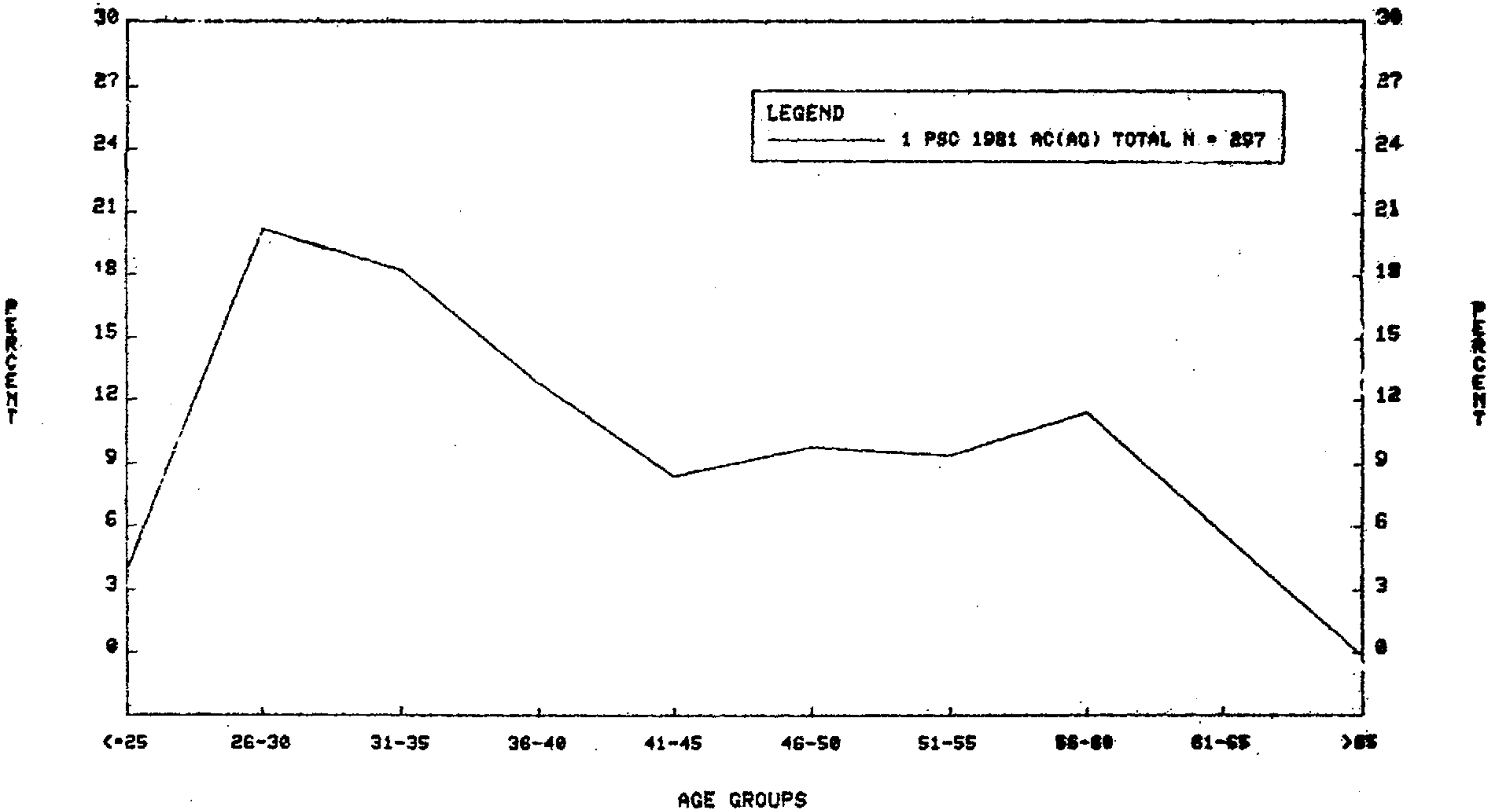
AGE DISTRIBUTION OF SCIENTIFIC STAFF
IN THE NATIONAL RESEARCH COUNCIL

NSERC DATA BY DEPARTMENT

	≤25 (%)	26-30 (%)	31-35 (%)	36-40 (%)	41-45 (%)	46-50 (%)	51-55 (%)	56-60 (%)	61-65 (%)	>65 (%)	Total
AECL NSERC	0.6	3.4	4.5	18.5	27.5	16.8	14.0	9.5	5.0	0.0	178
NRC NSERC	0.5	8.0	14.8	17.2	14.7	11.0	15.5	11.3	7.0	0.0	962

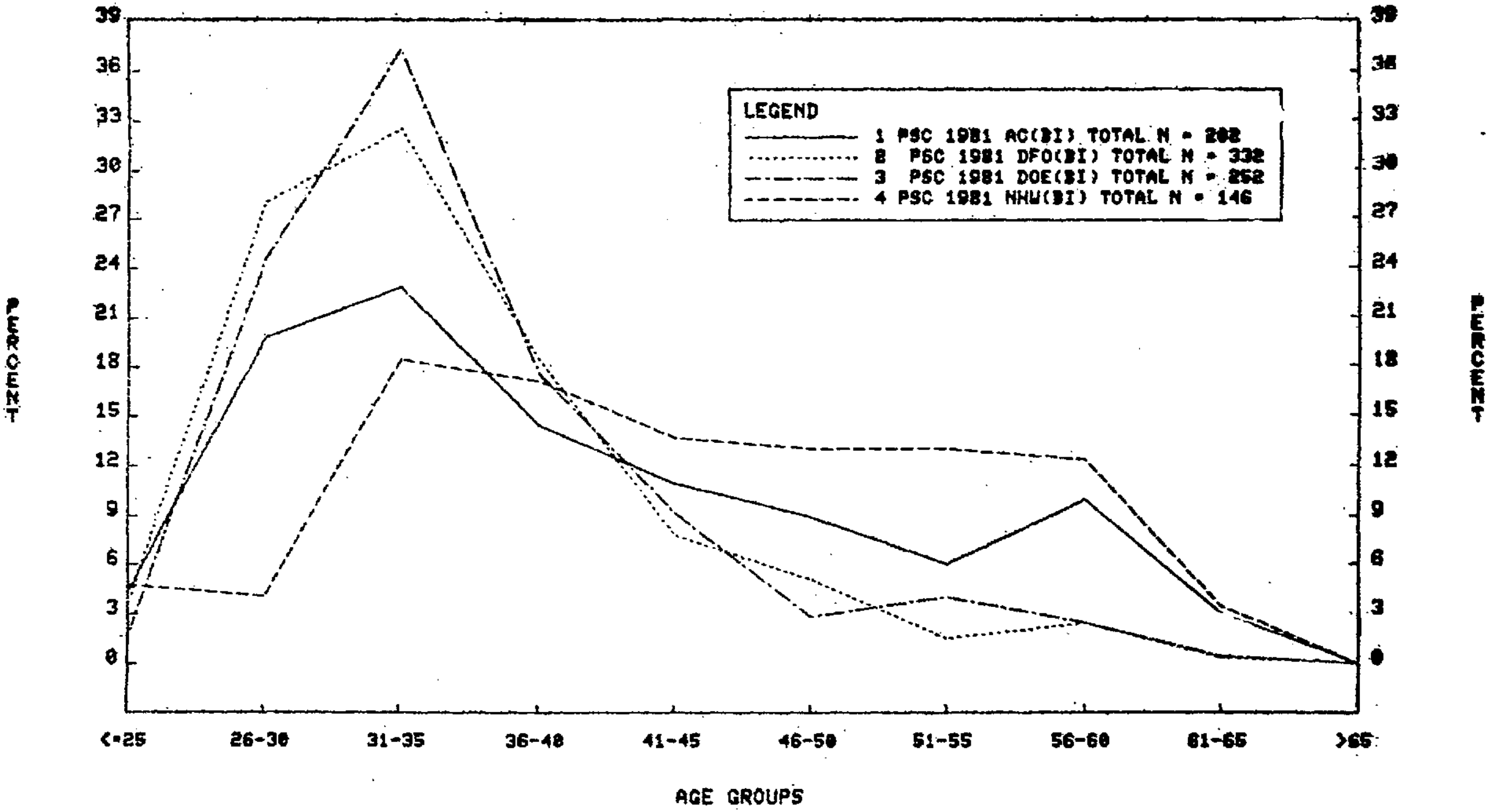
APPENDIX C

AGE DISTRIBUTIONS OF CLASSIFICATION GROUPS ACROSS DEPARTMENTS



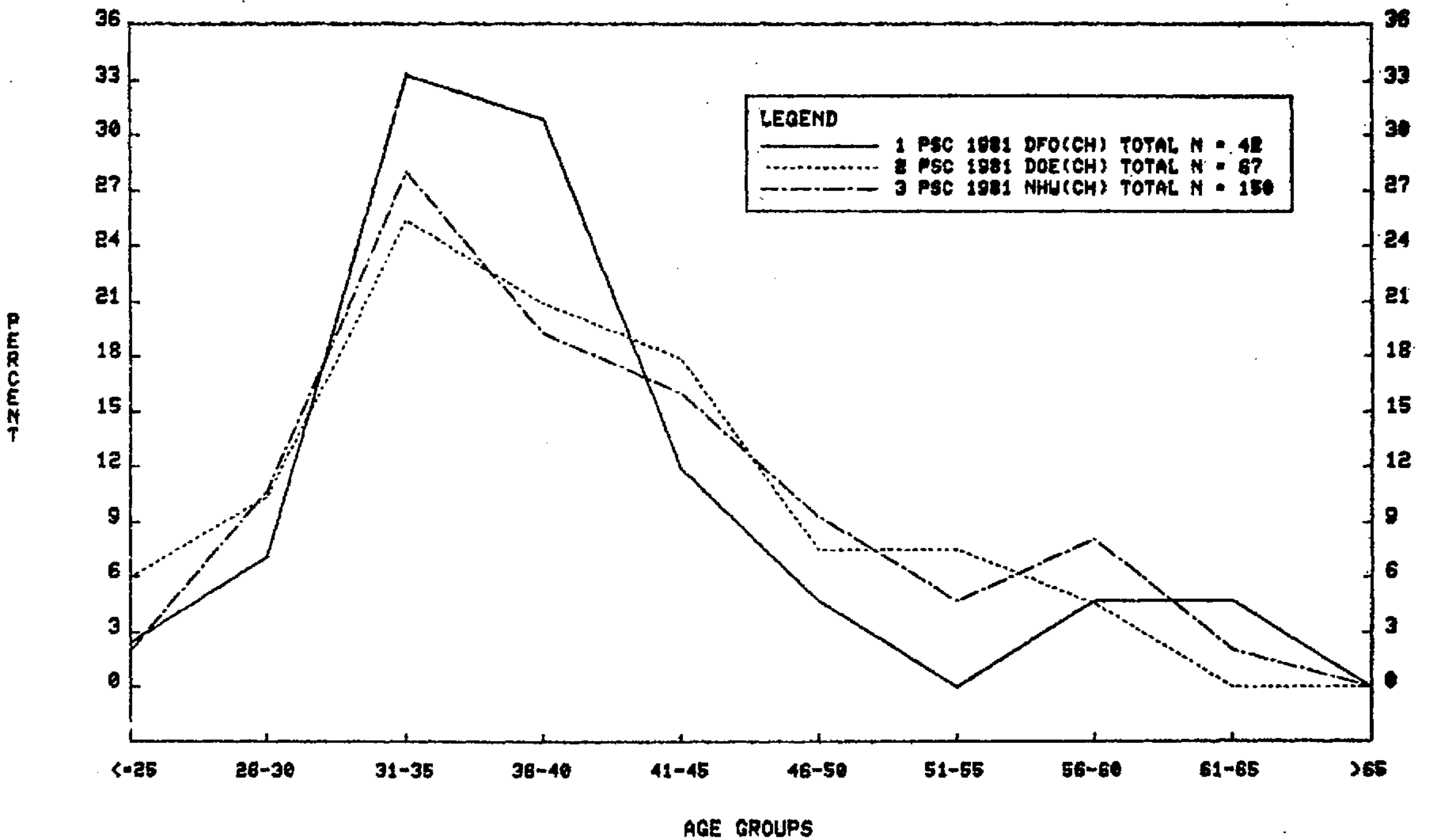
SOURCE : PUBLIC SERVICE COMMISSION, 1981

AGRICULTURE SCIENTISTS (AG) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



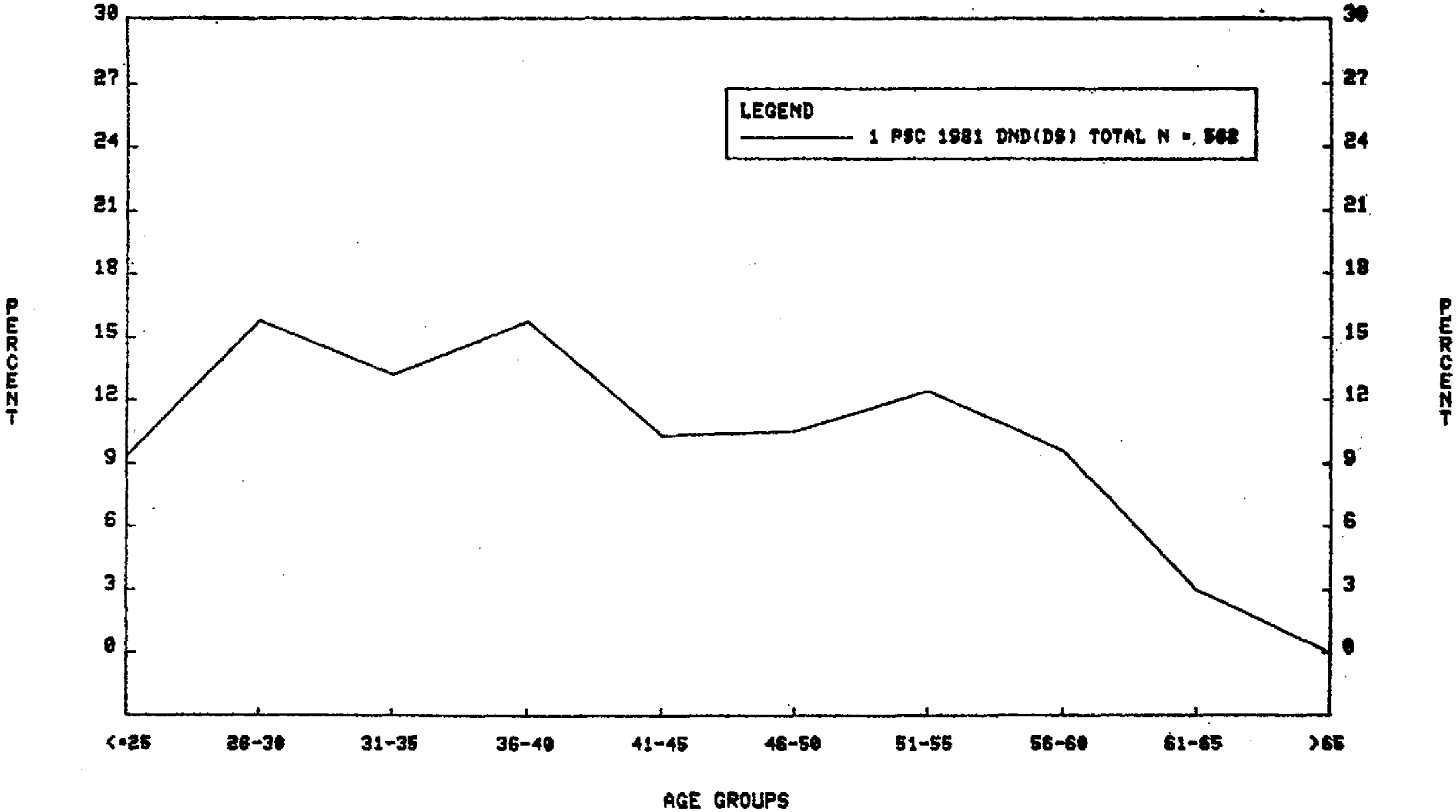
SOURCE : PUBLIC SERVICE COMMISSION, 1981

BIOLOGIST (BI) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



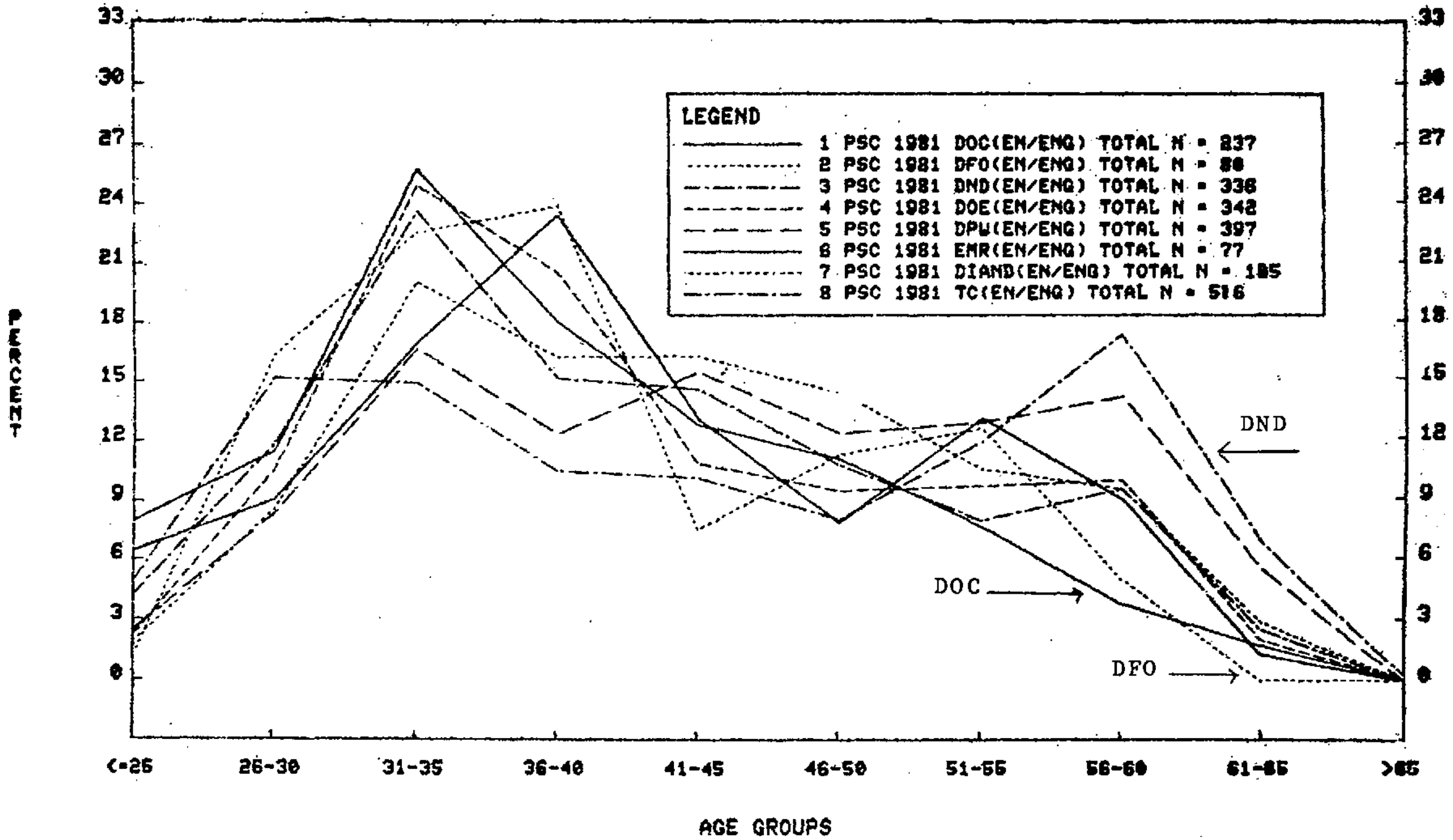
SOURCE : PUBLIC SERVICE COMMISSION, 1981

CHEMIST (CH) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



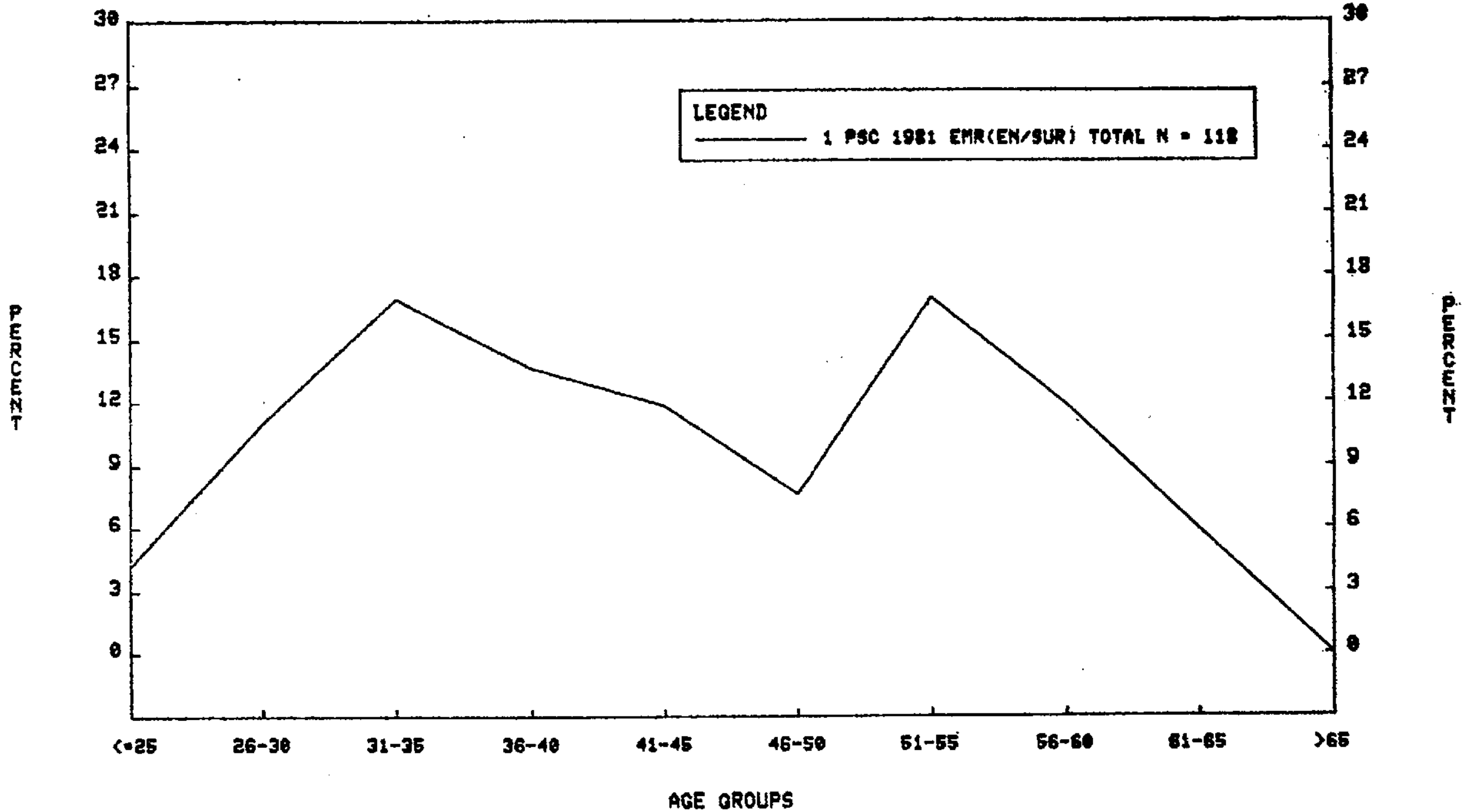
SOURCE : PUBLIC SERVICE COMMISSION, 1981

DEFENCE SCIENTISTS (DS) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



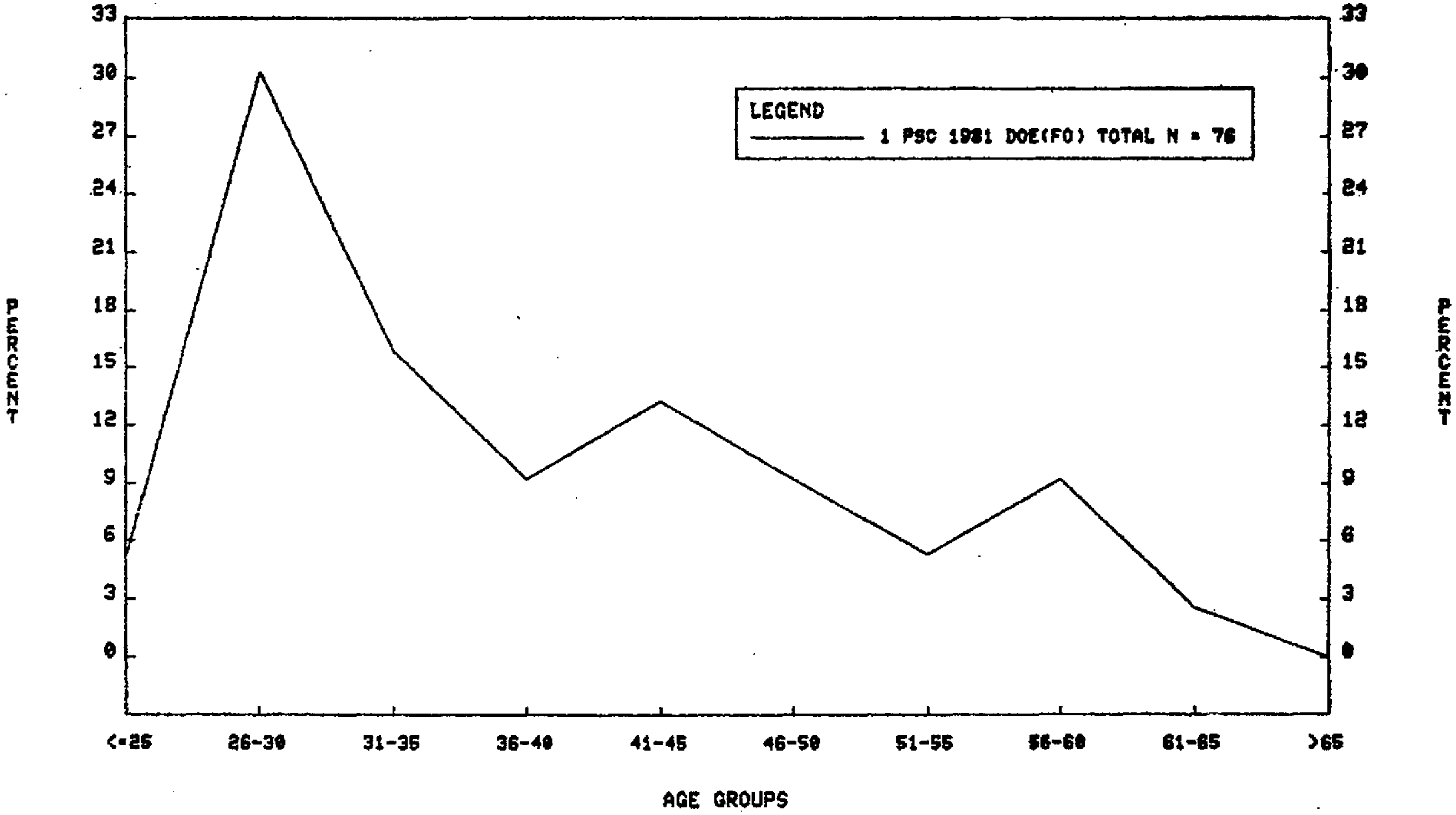
SOURCE : PUBLIC SERVICE COMMISSION, 1981

ENGINEERING (EN/ENG) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



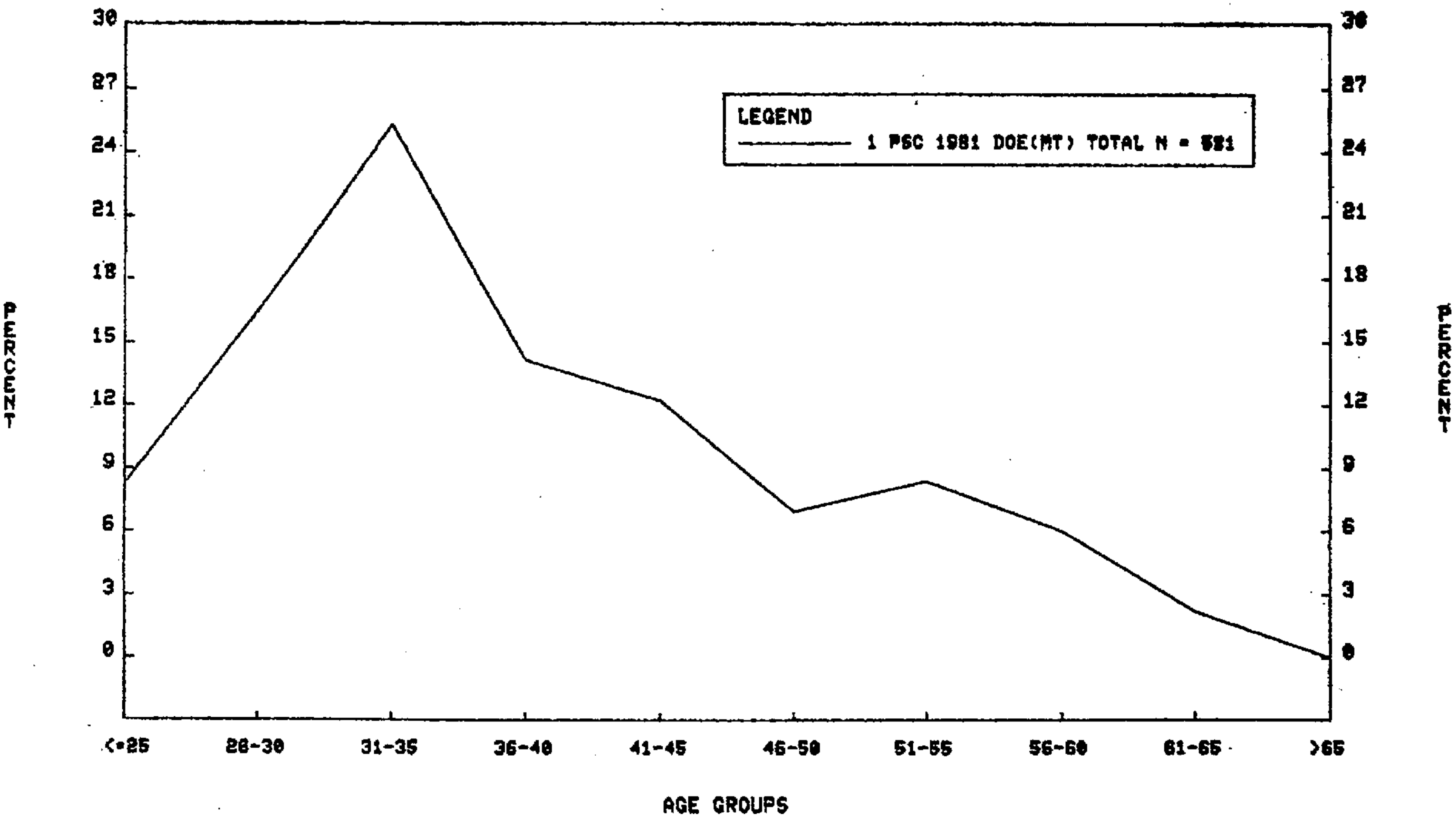
SOURCE : PUBLIC SERVICE COMMISSION, 1981

SURVEYOR (EN/SUR) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



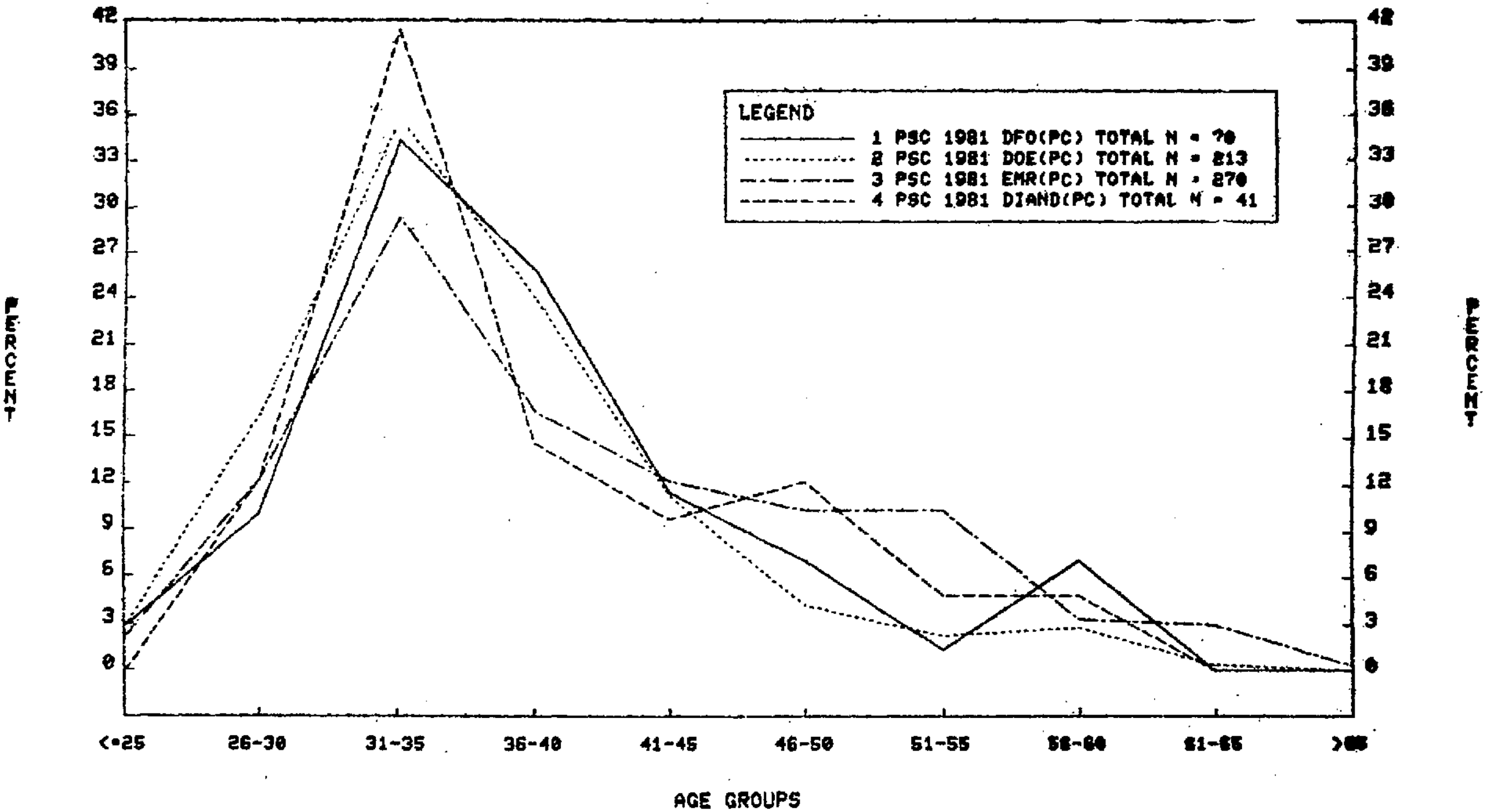
SOURCE : PUBLIC SERVICE COMMISSION, 1981

FORESTRY (FO) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



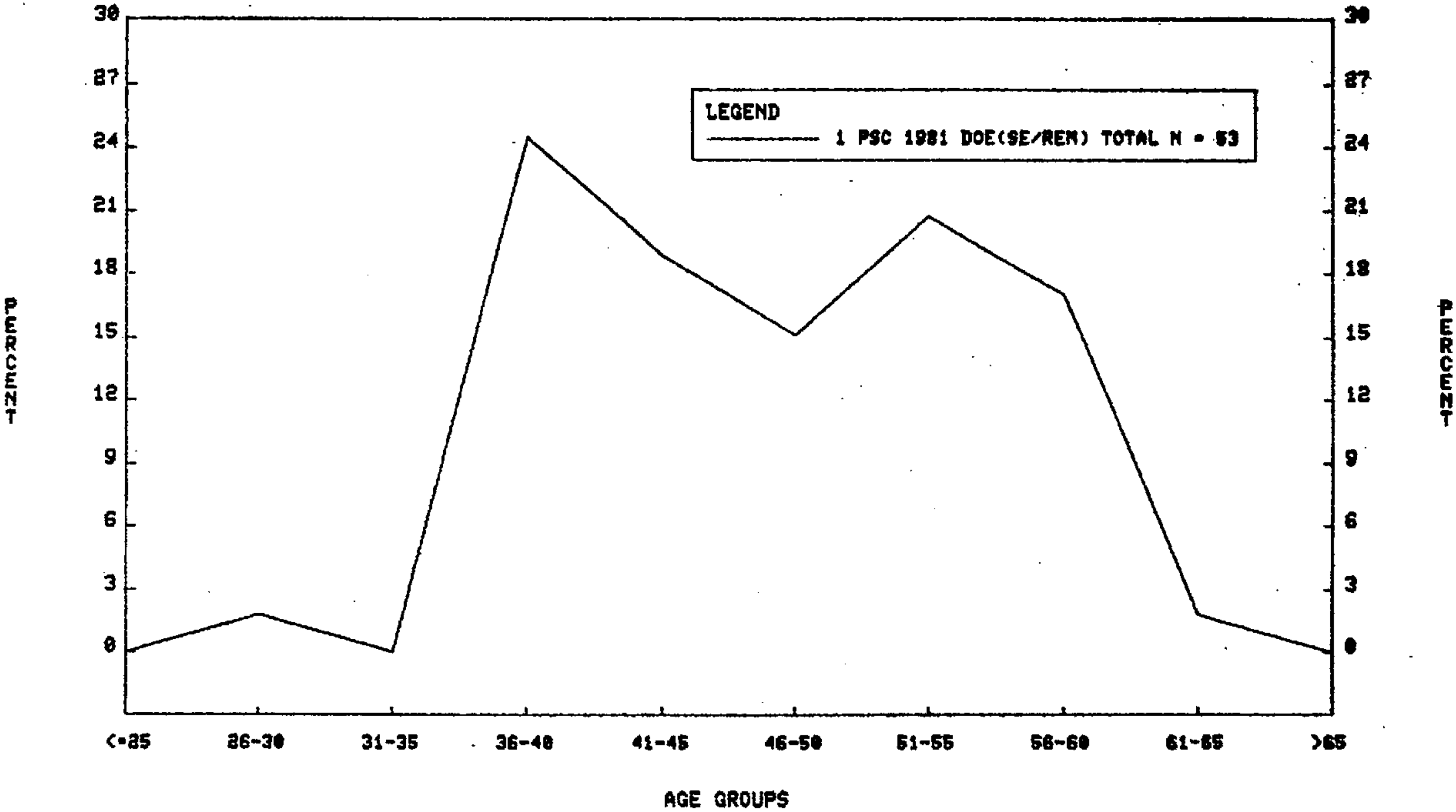
SOURCE : PUBLIC SERVICE COMMISSION, 1981

METEOROLOGISTS (MT) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



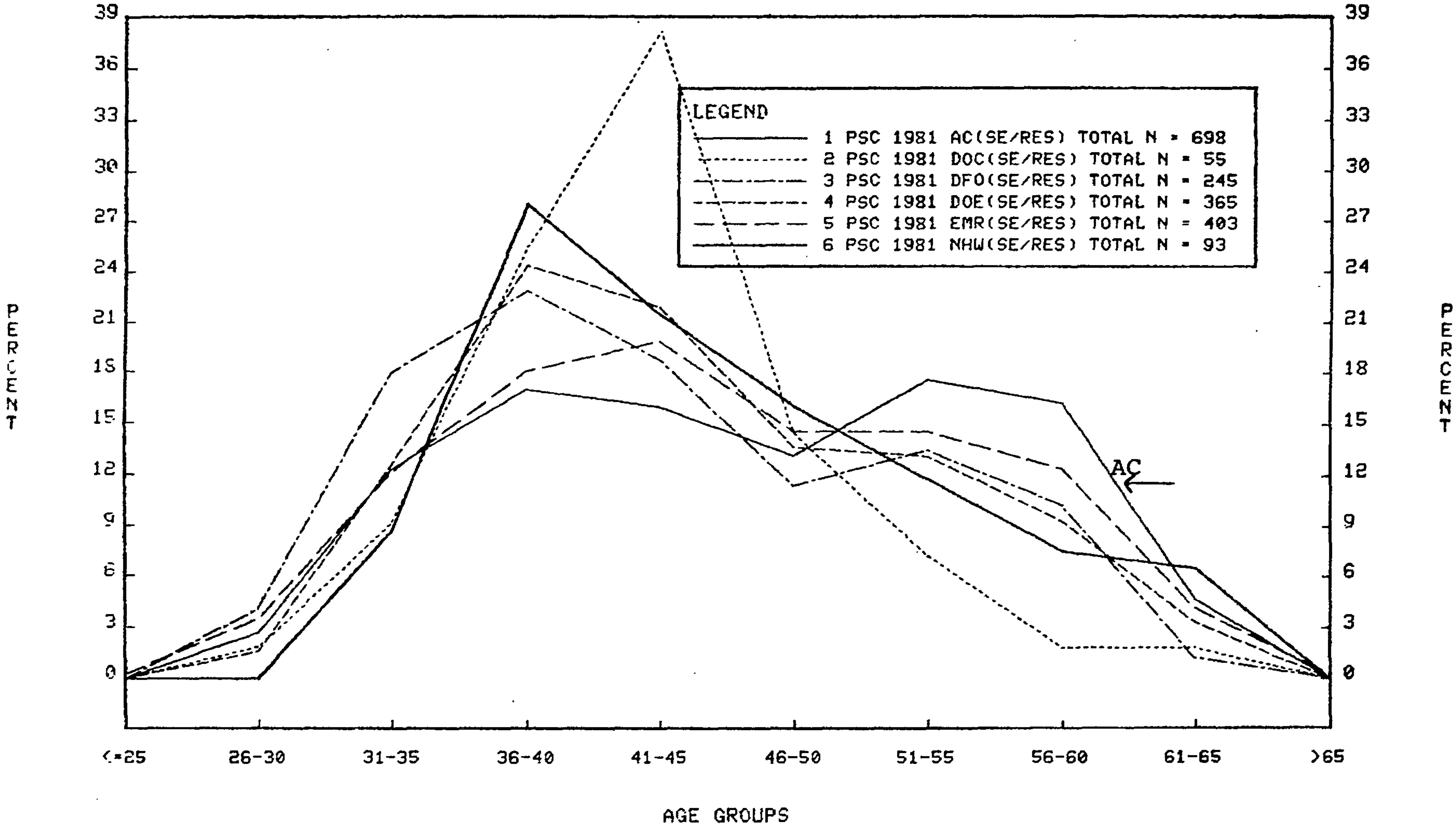
SOURCE : PUBLIC SERVICE COMMISSION, 1981

PHYSICAL SCIENTIST (PC) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



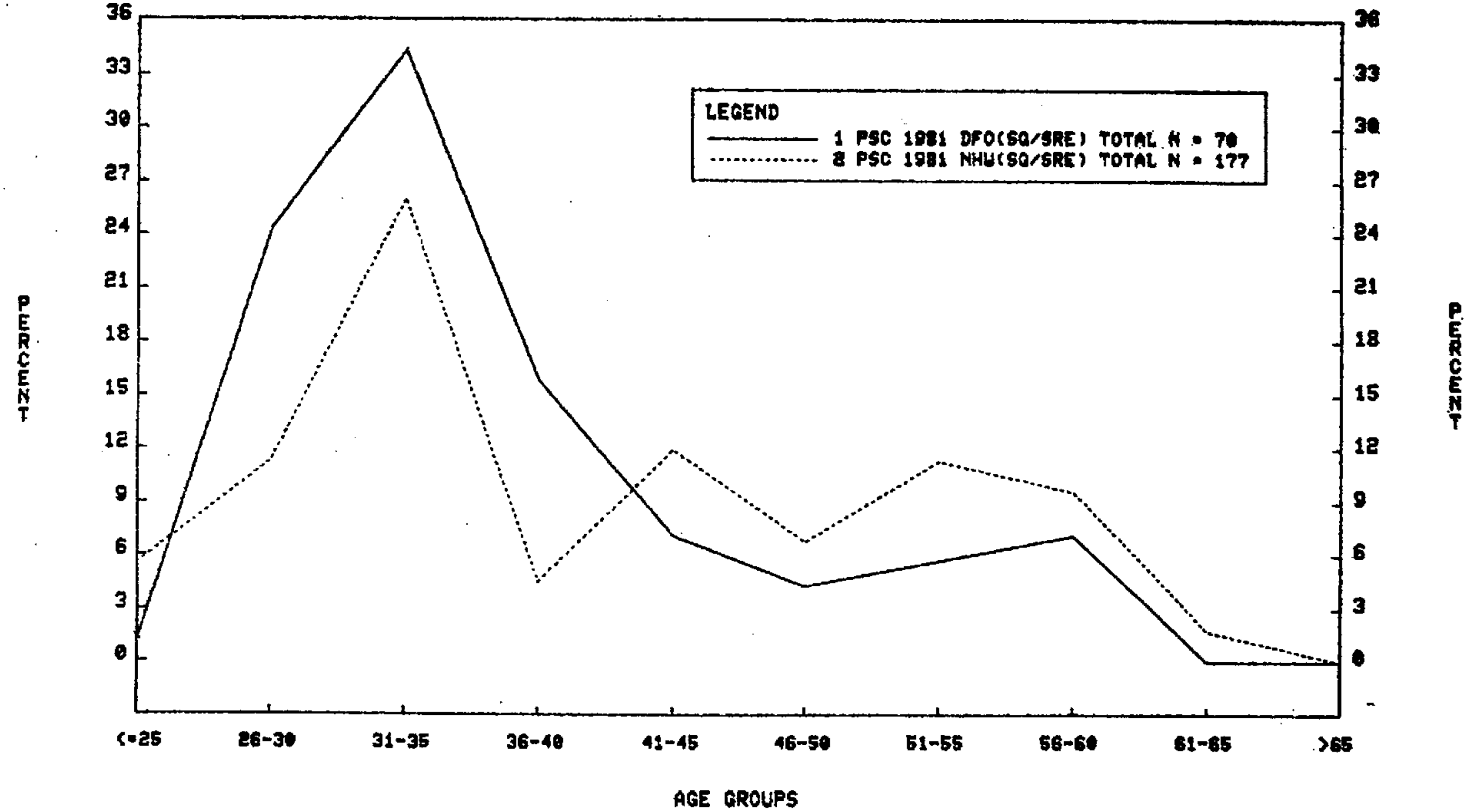
SOURCE : PUBLIC SERVICE COMMISSION, 1981

RESEARCH MANAGERS (SE/REM) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



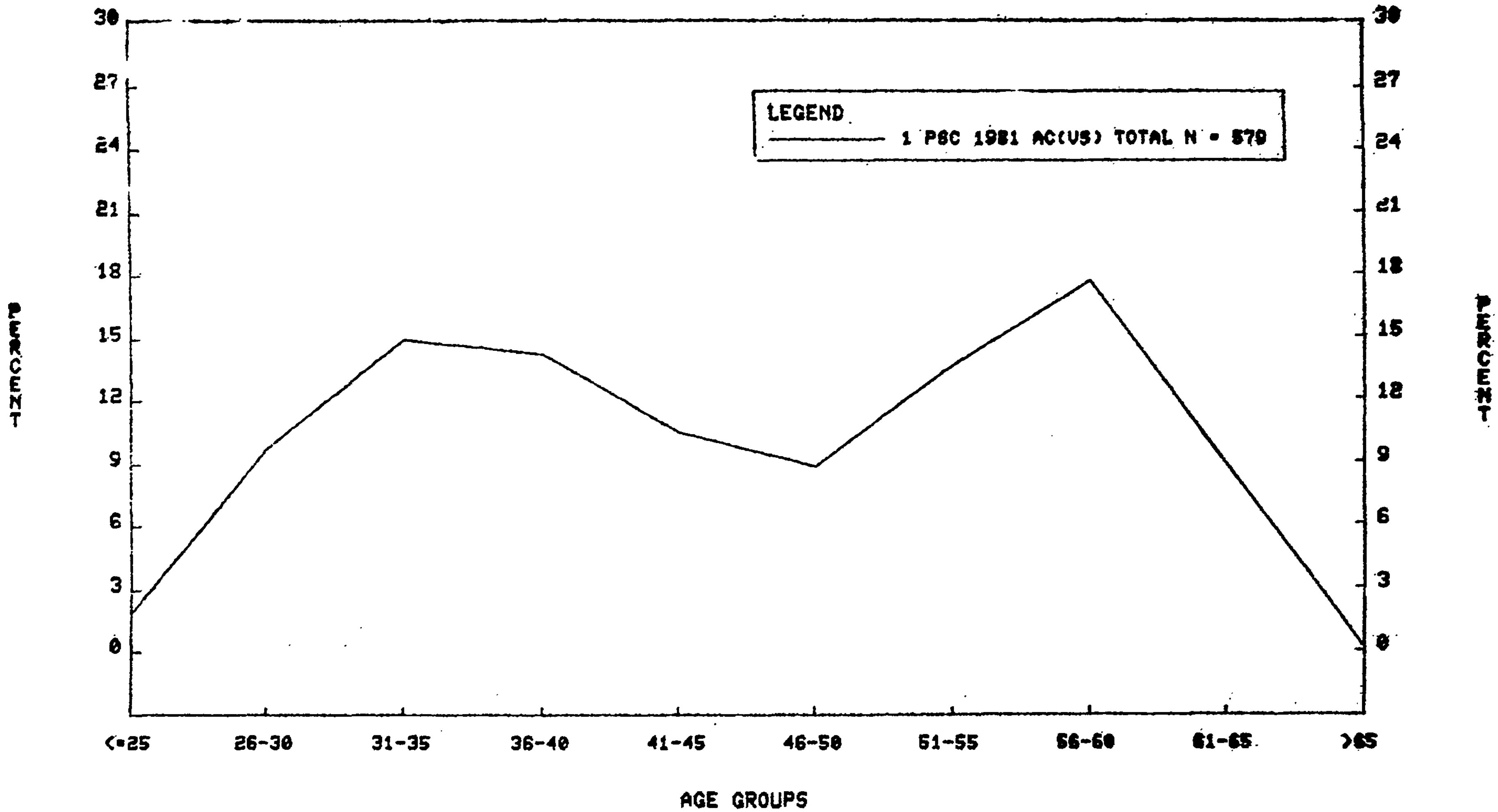
SOURCE : PUBLIC SERVICE COMMISSION, 1981

RESEARCH SCIENTISTS (SE/RES) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT



SOURCE : PUBLIC SERVICE COMMISSION, 1981

SCIENTIFIC REGULATION (SG/SRE) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT

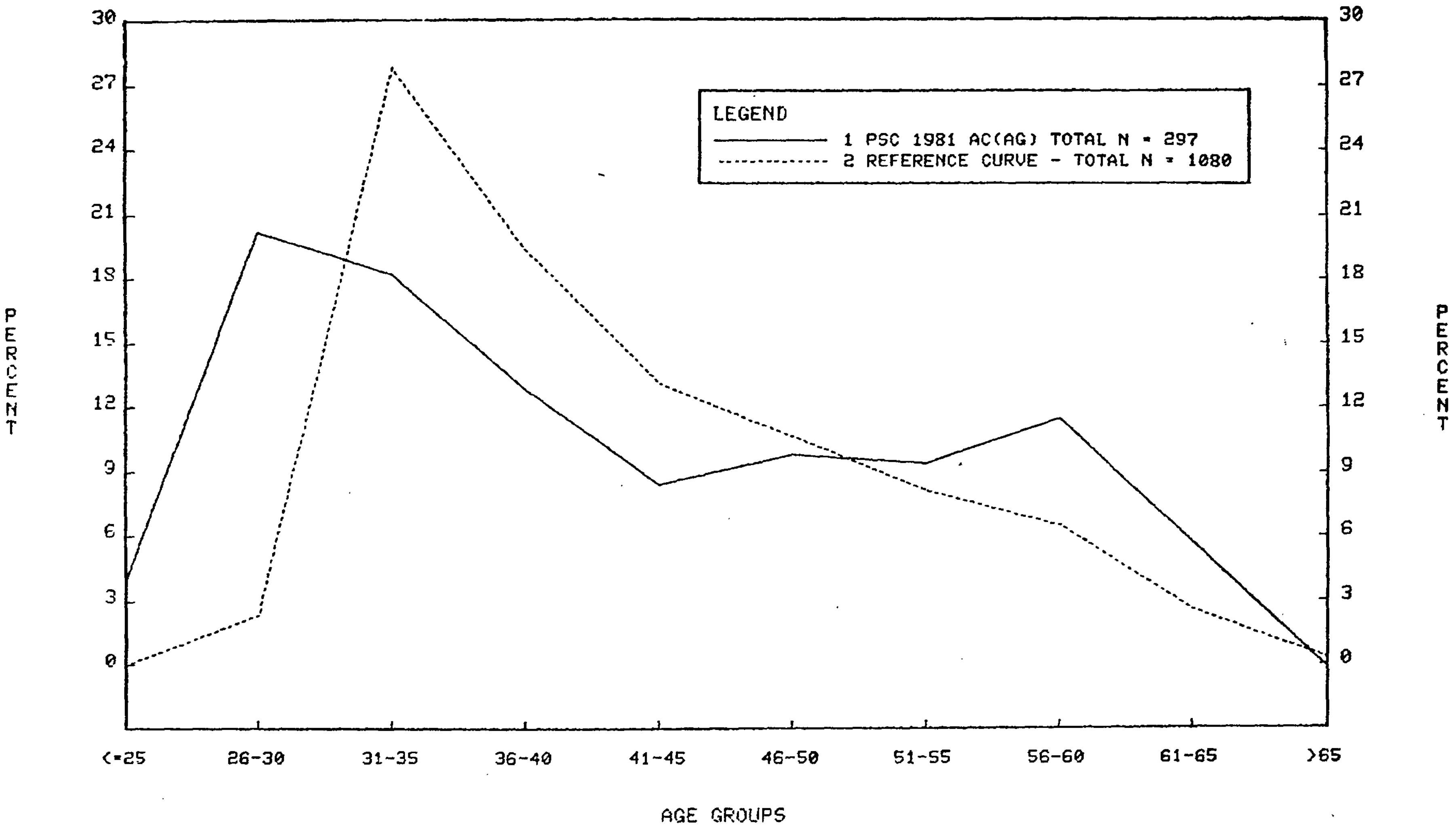


SOURCE : PUBLIC SERVICE COMMISSION, 1981

VETERINARY SCIENTISTS (VS) CLASSIFICATION
AGE DISTRIBUTION BY DEPARTMENT

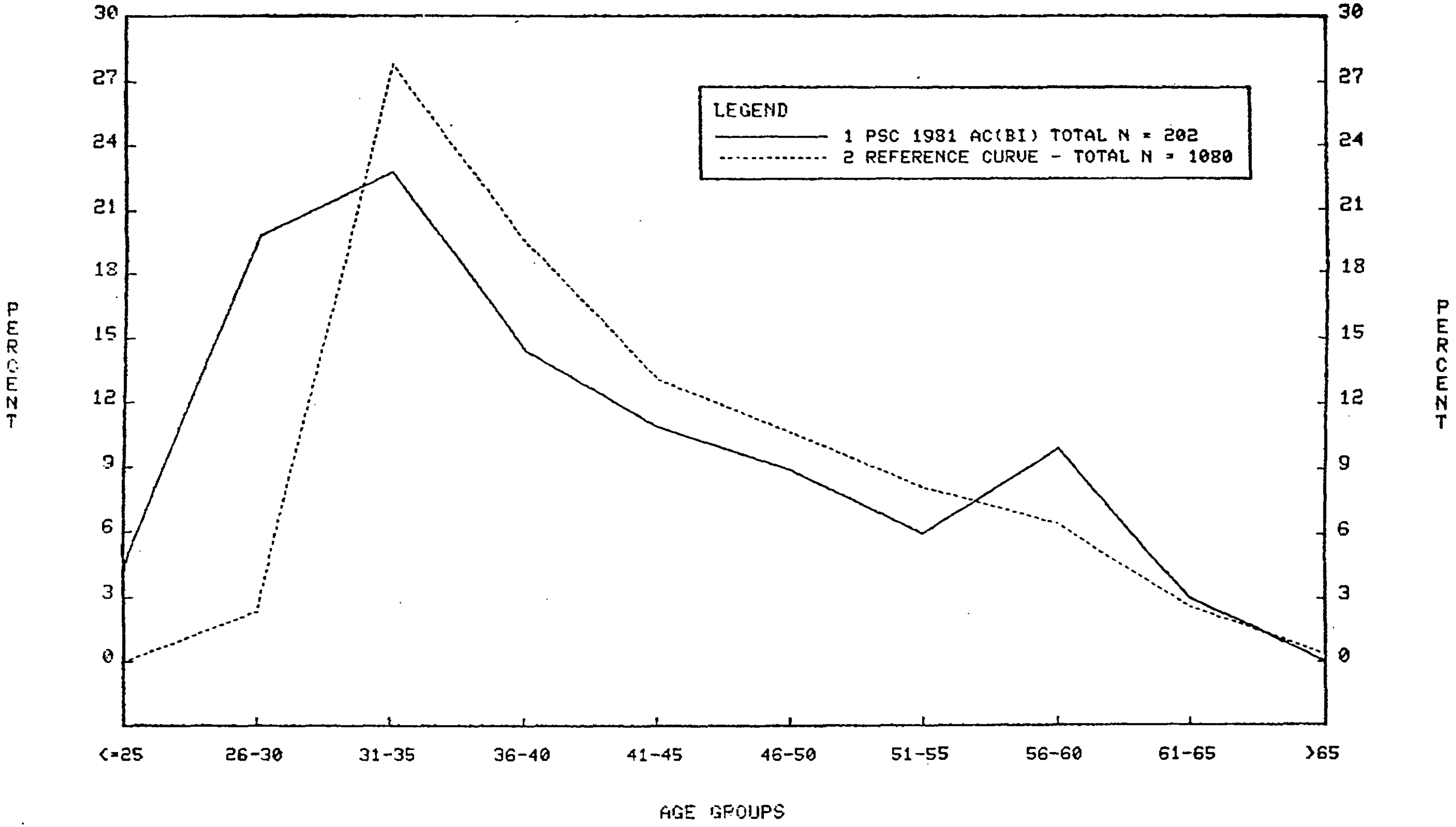
APPENDIX D

COMPARISON OF AGE DISTRIBUTIONS BY CLASSIFICATION WITH REFERENCE CURVE



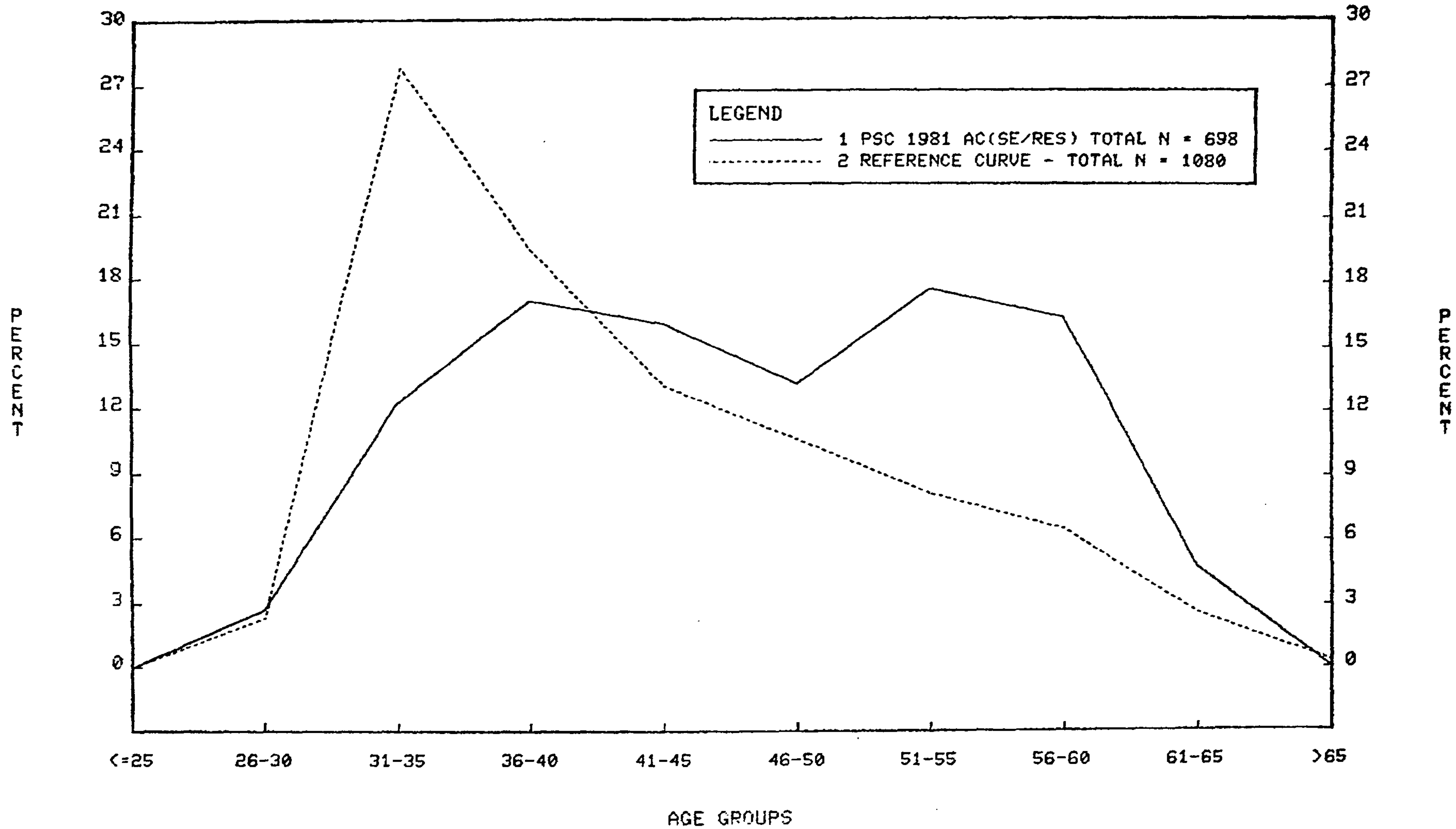
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973

AGRICULTURE CANADA: AGE DISTRIBUTION OF AG CLASSIFICATION COMPARED TO REFERENCE CURVE



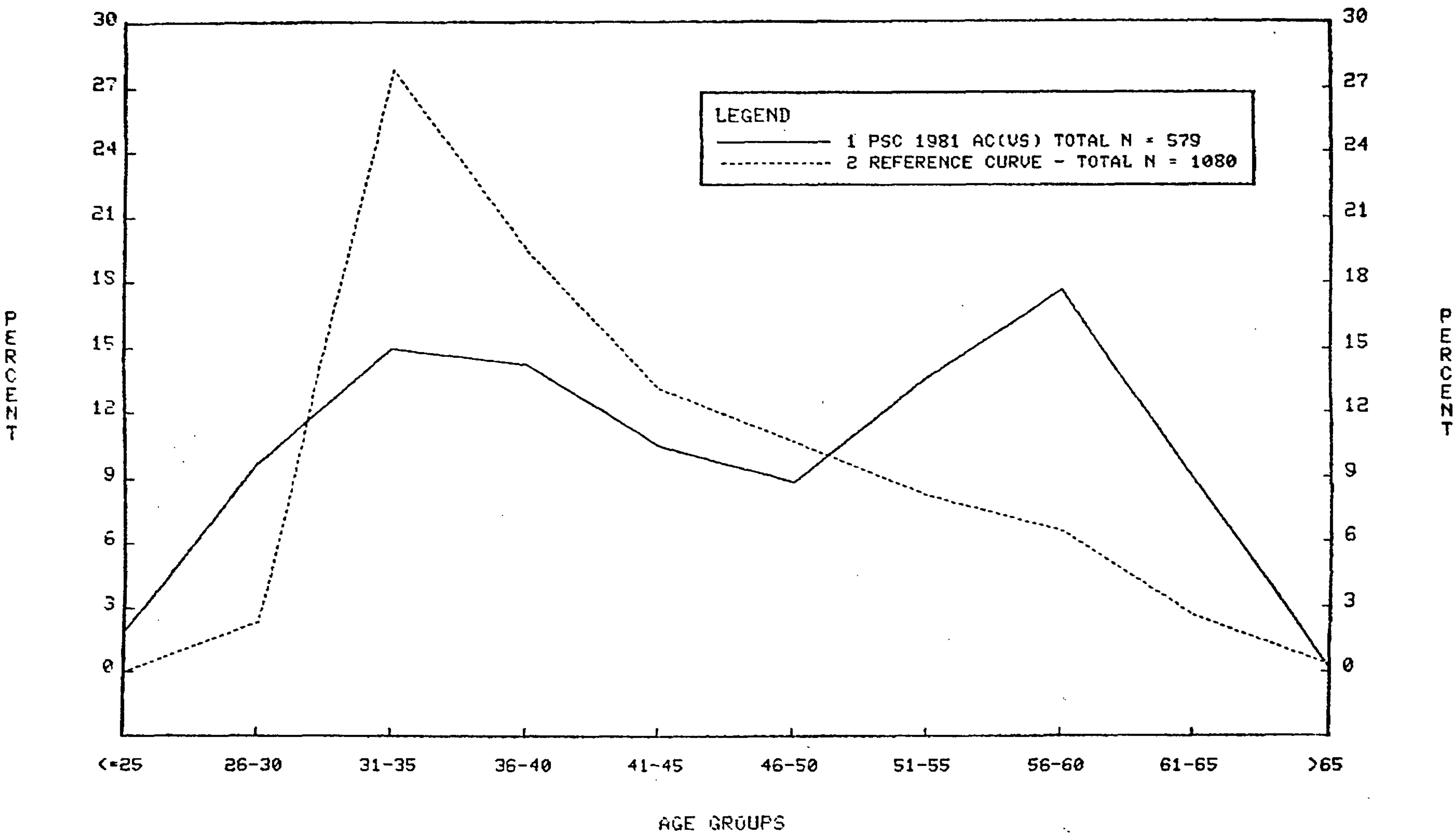
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973.

AGRICULTURE CANADA: AGE DISTRIBUTION OF BI CLASSIFICATION COMPARED TO REFERENCE CURVE



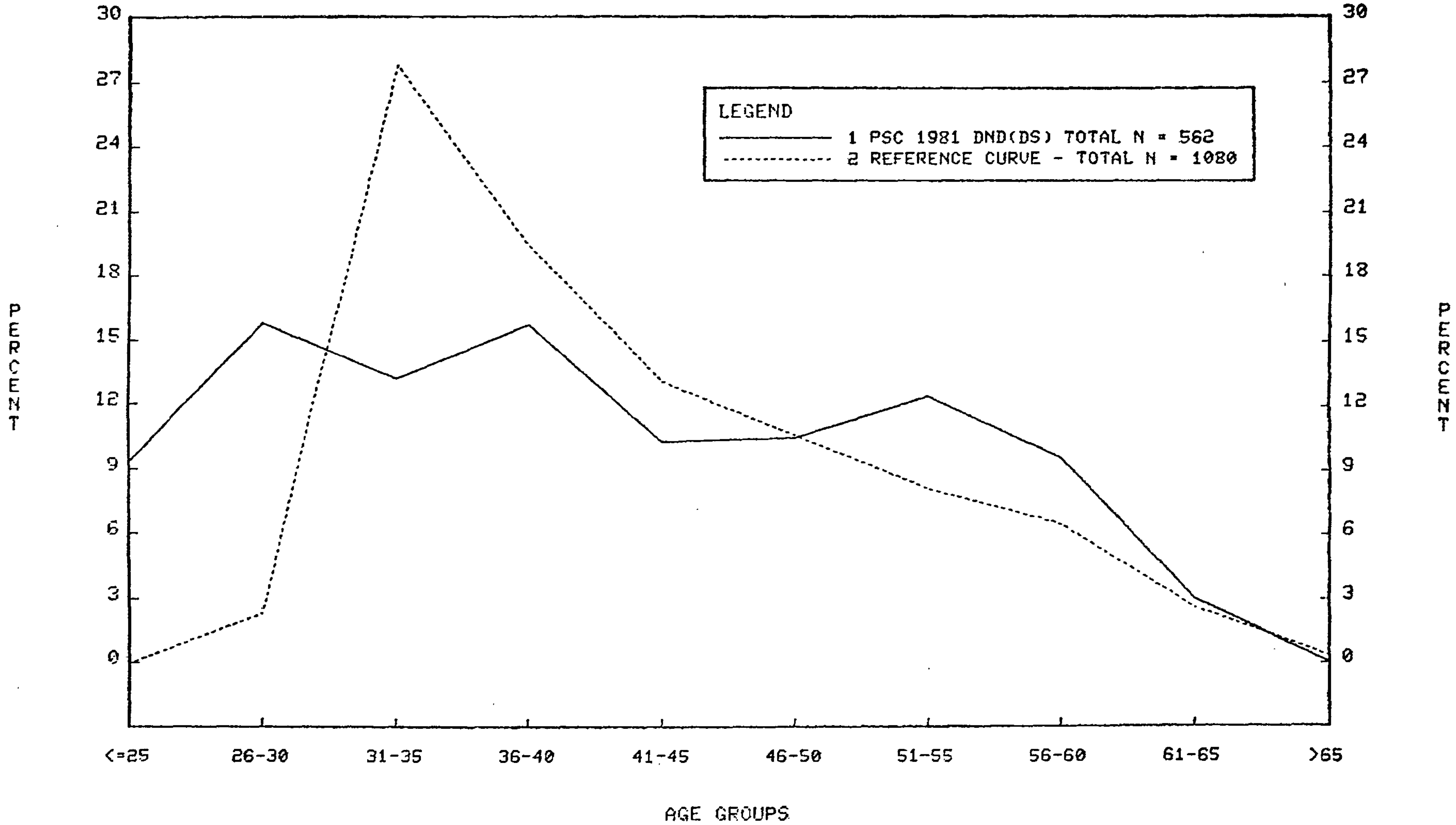
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973

AGRICULTURE CANADA: AGE DISTRIBUTION OF SE/RES CLASSIFICATION COMPARED TO REFERENCE CURVE



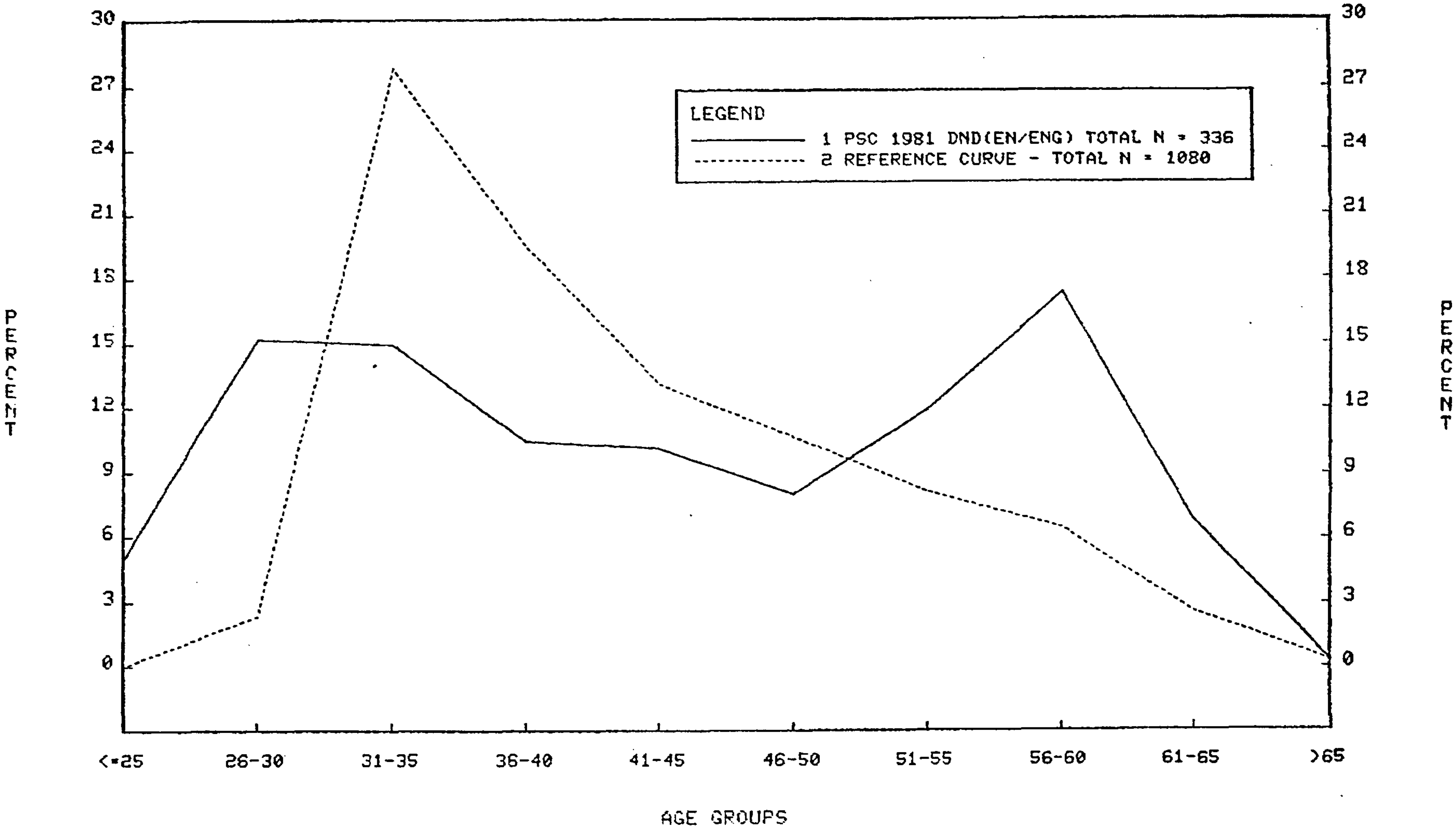
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973

AGRICULTURE CANADA: AGE DISTRIBUTION OF VS CLASSIFICATION COMPARED TO REFERENCE CURVE



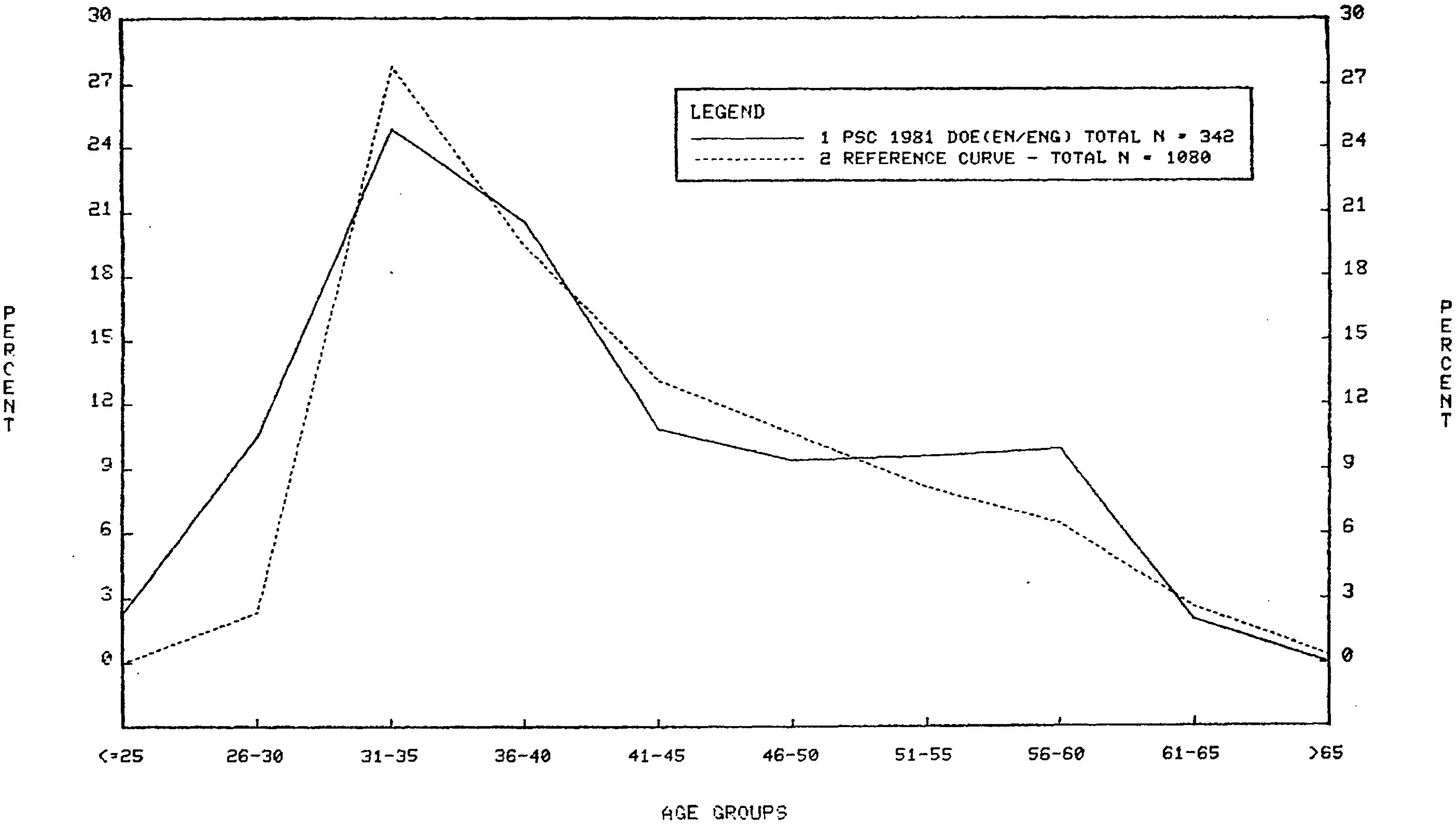
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973.

DEPARTMENT OF NATIONAL DEFENCE: AGE DISTRIBUTION OF DS CLASSIFICATION COMPARED TO REFERENCE CURVE



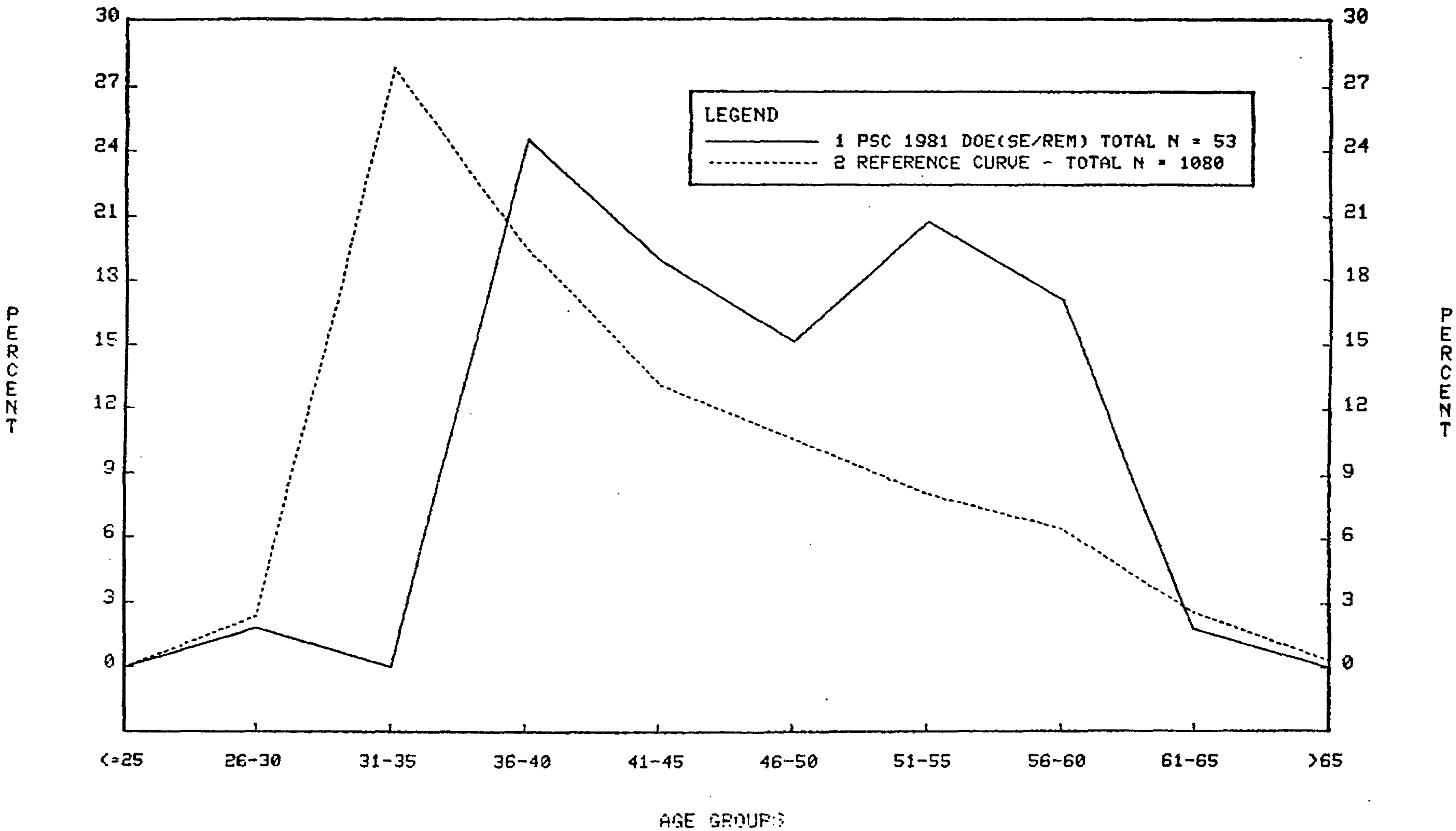
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973

DEPARTMENT OF NATIONAL DEFENCE: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



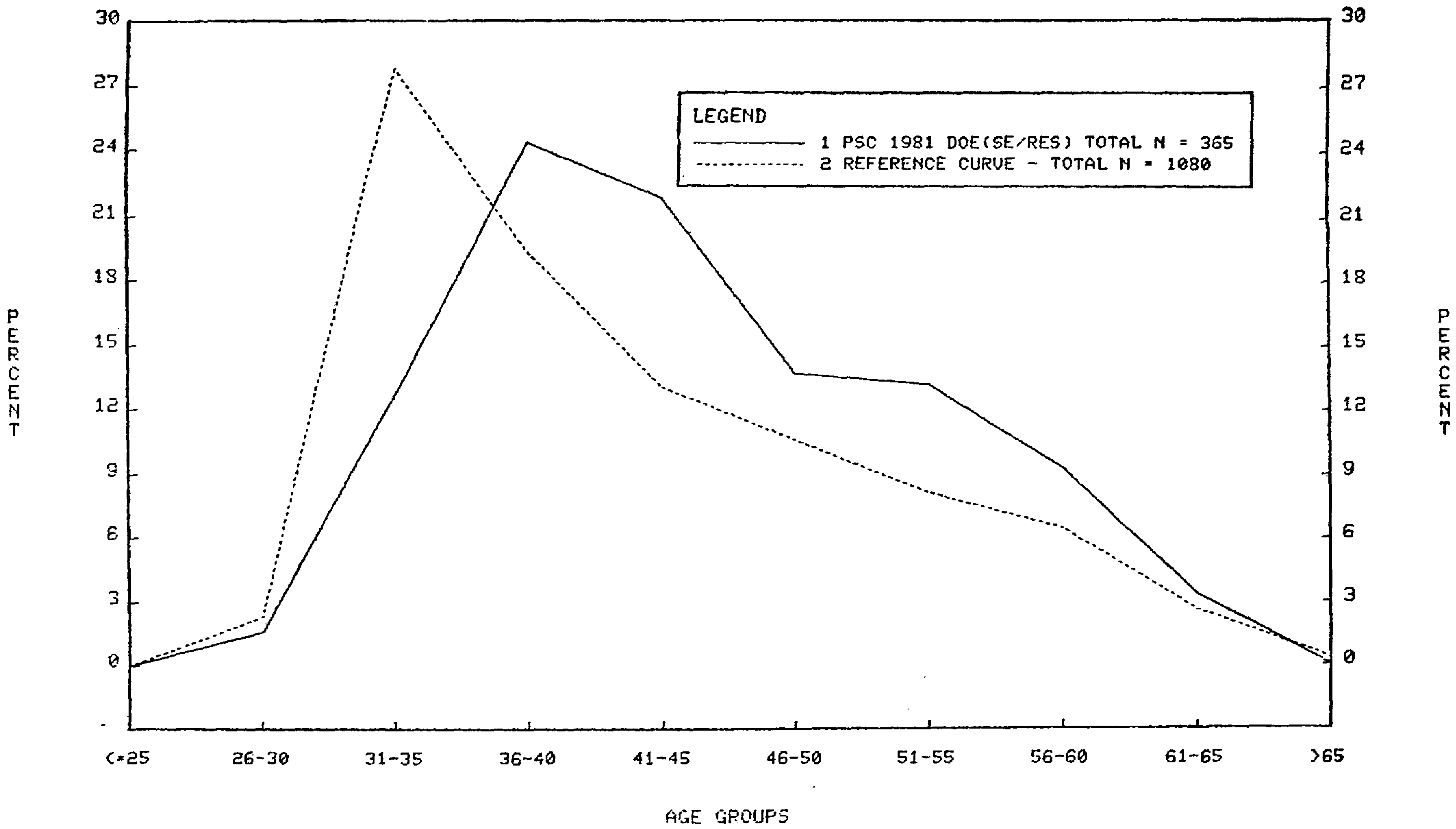
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

DEPARTMENT OF ENVIRONMENT: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



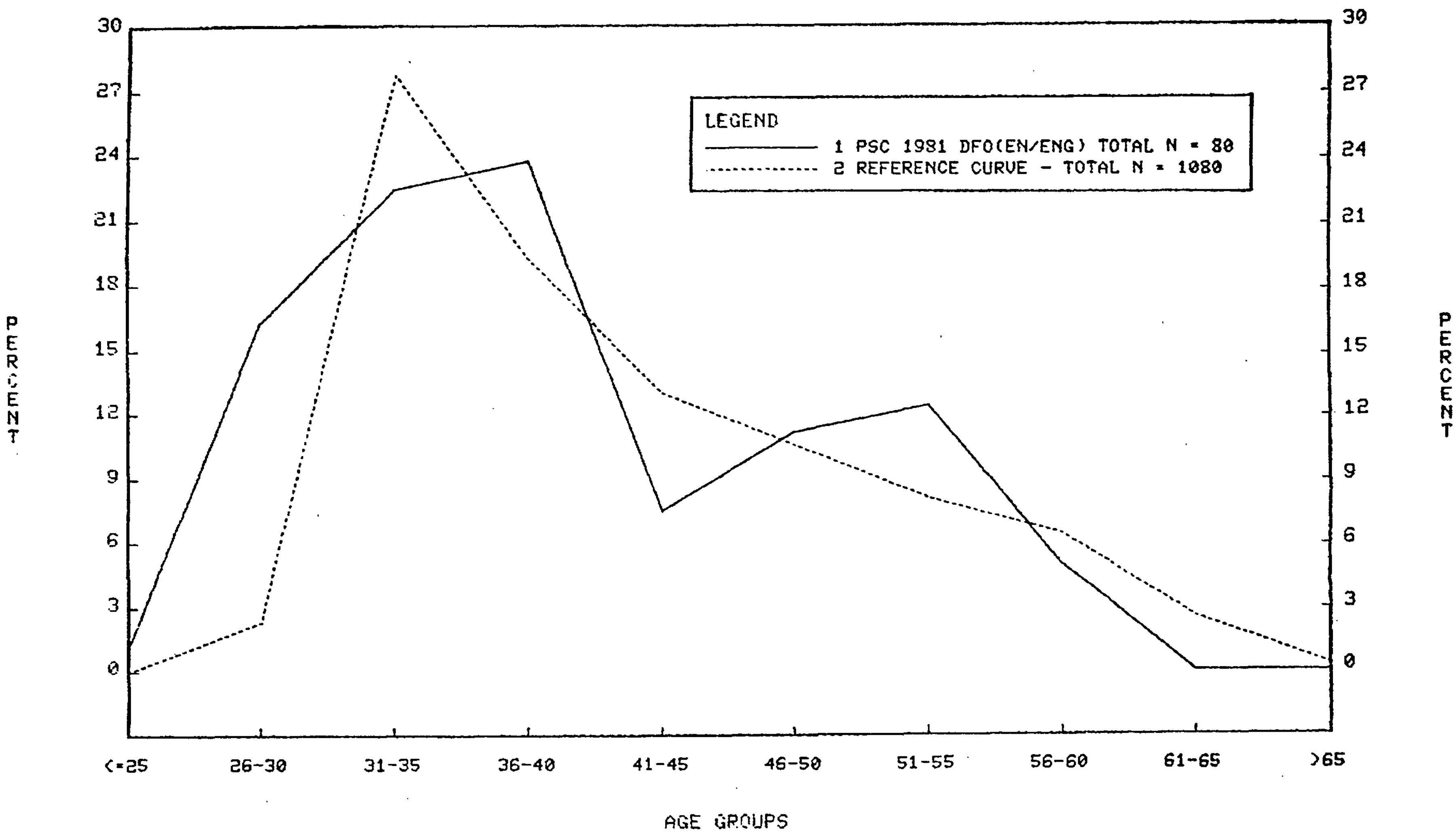
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

DEPARTMENT OF ENVIRONMENT: AGE DISTRIBUTION OF SE/REM CLASSIFICATION COMPARED TO REFERENCE CURVE



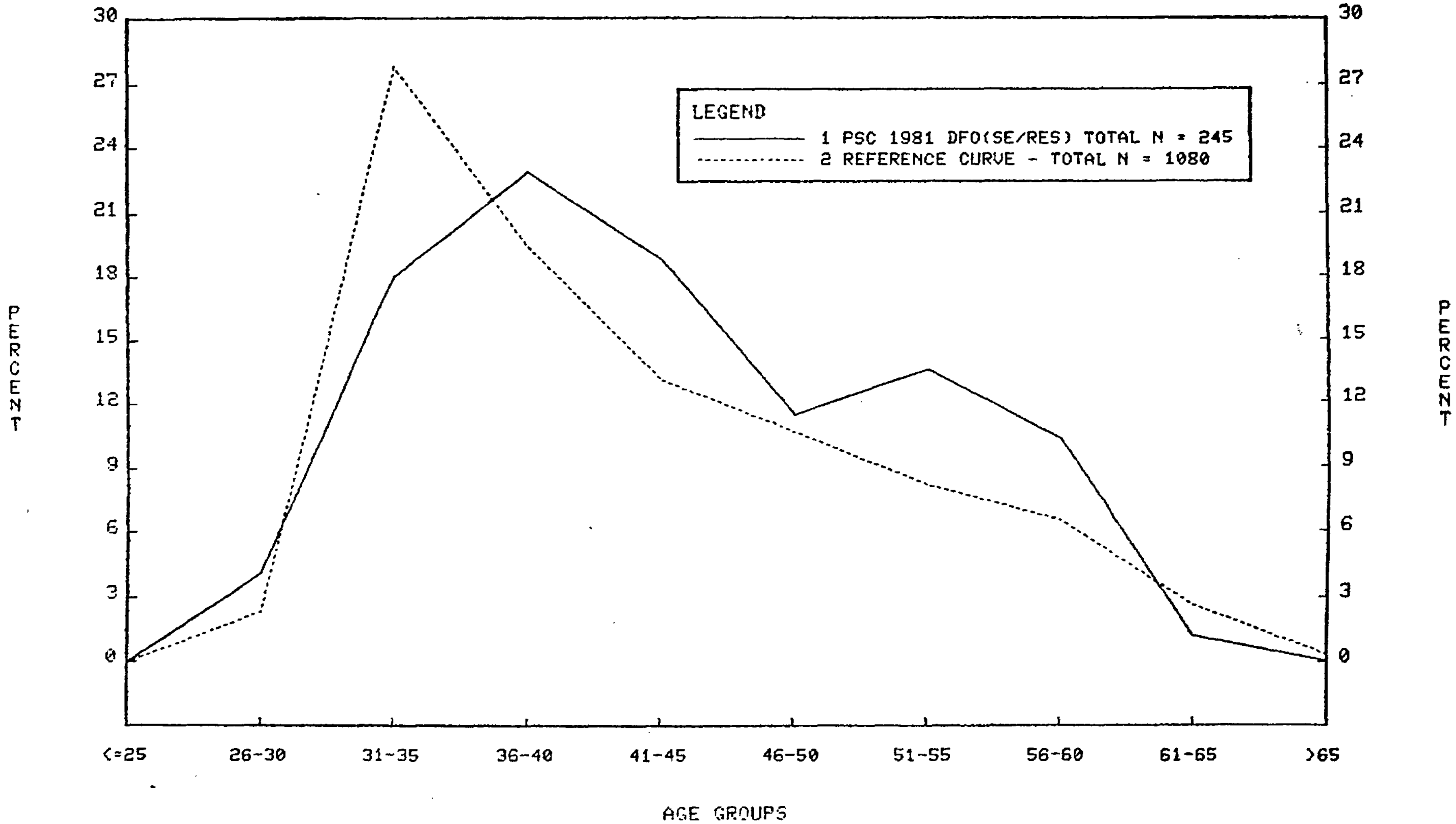
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973

DEPARTMENT OF ENVIRONMENT: AGE DISTRIBUTION OF SE/RES CLASSIFICATION COMPARED TO REFERENCE CURVE



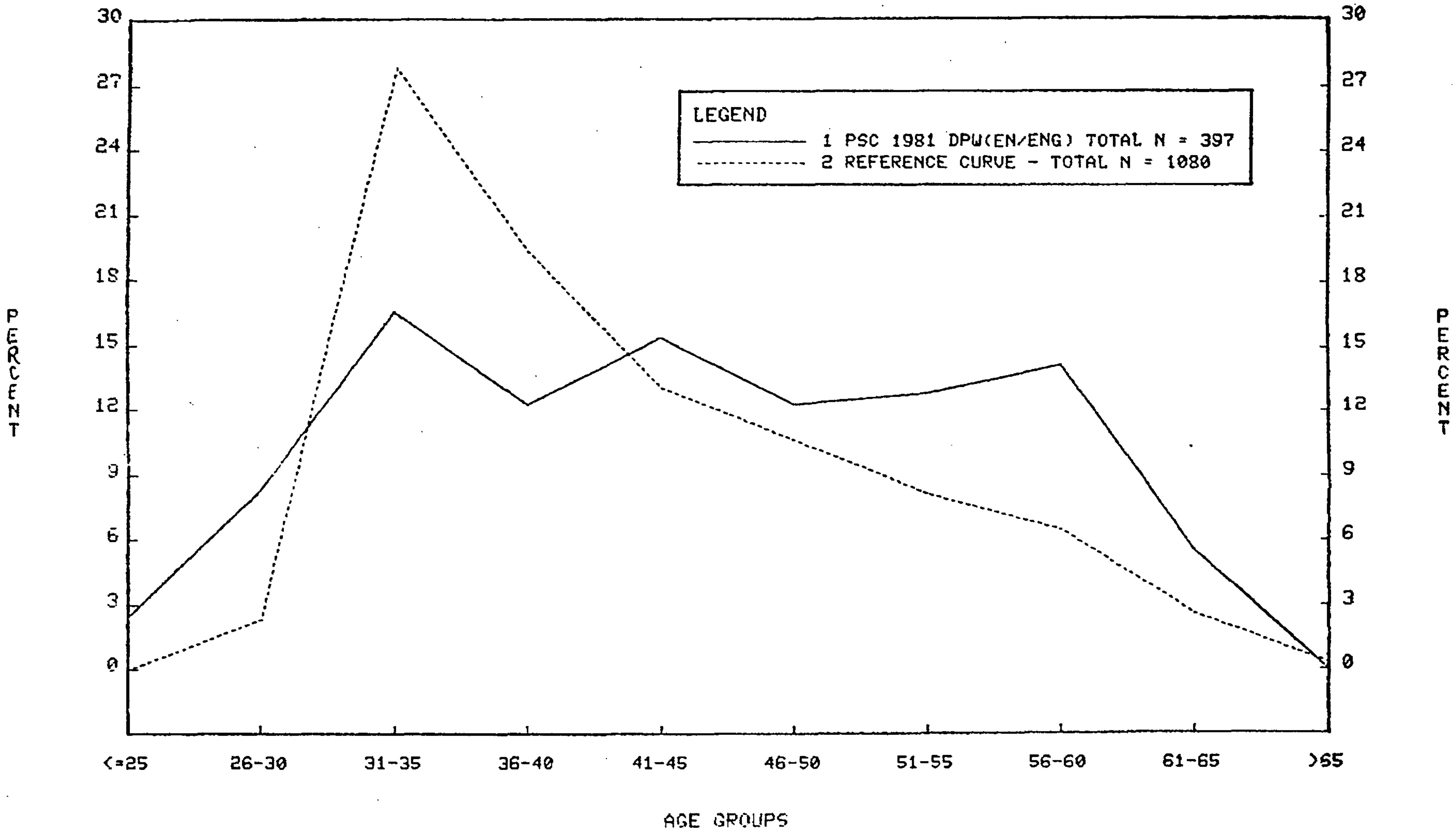
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973.

DEPARTMENT OF FISHERIES AND OCEANS: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



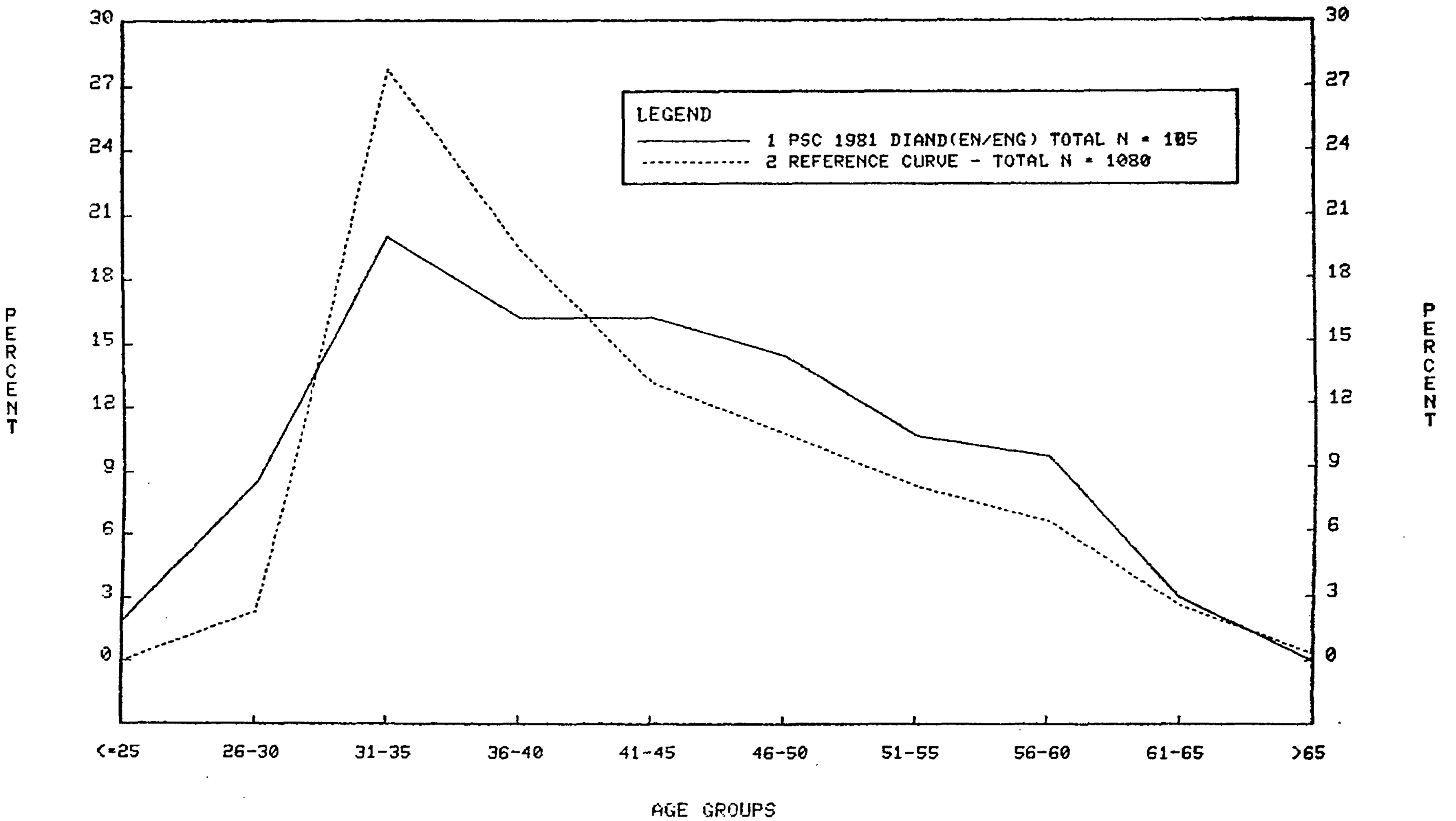
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

DEPARTMENT OF FISHERIES AND OCEANS: AGE DISTRIBUTION OF SE/RES CLASSIFICATION COMPARED TO REFERENCE CURVE



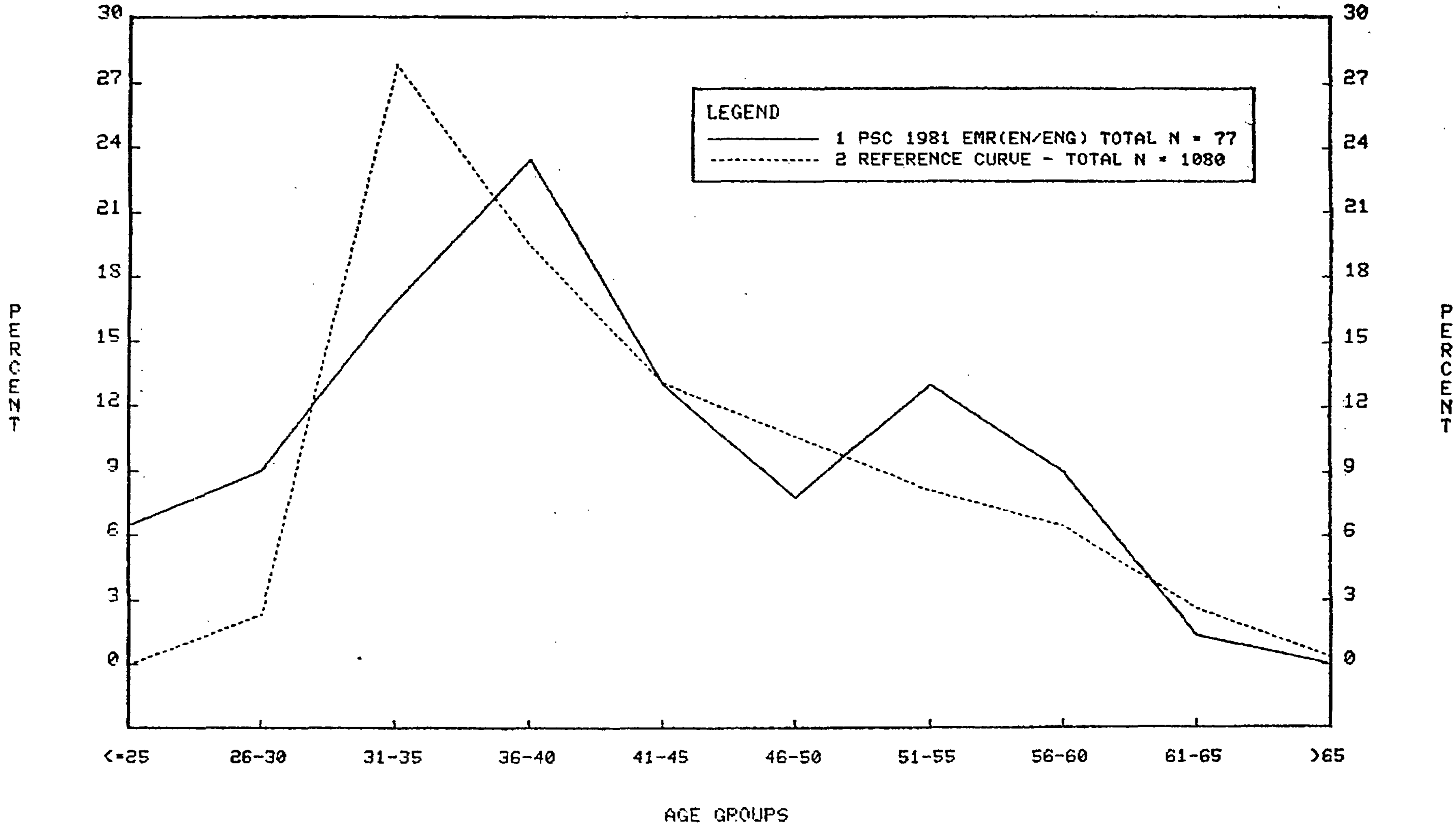
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

DEPARTMENT OF PUBLIC WORKS: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



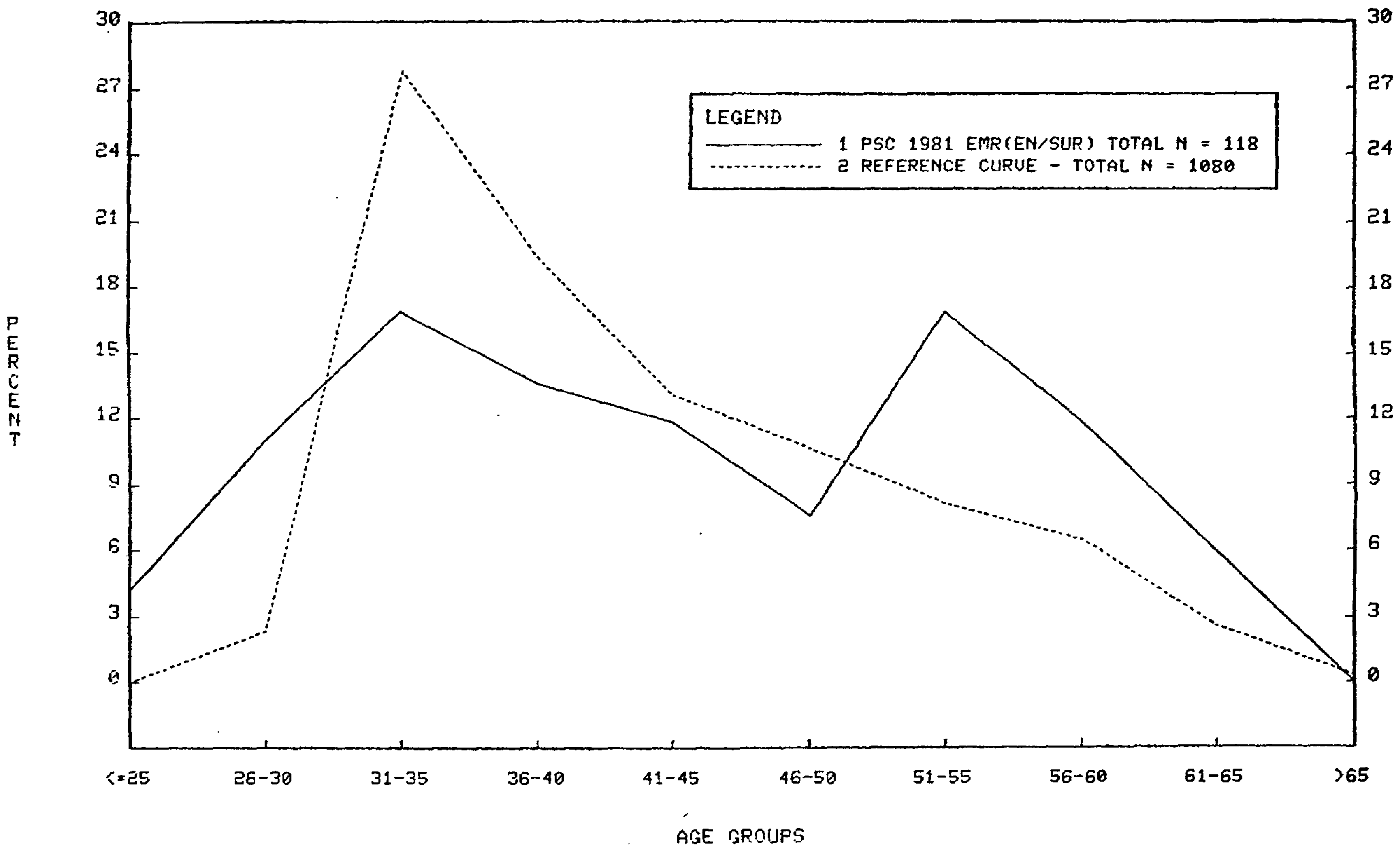
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973.

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



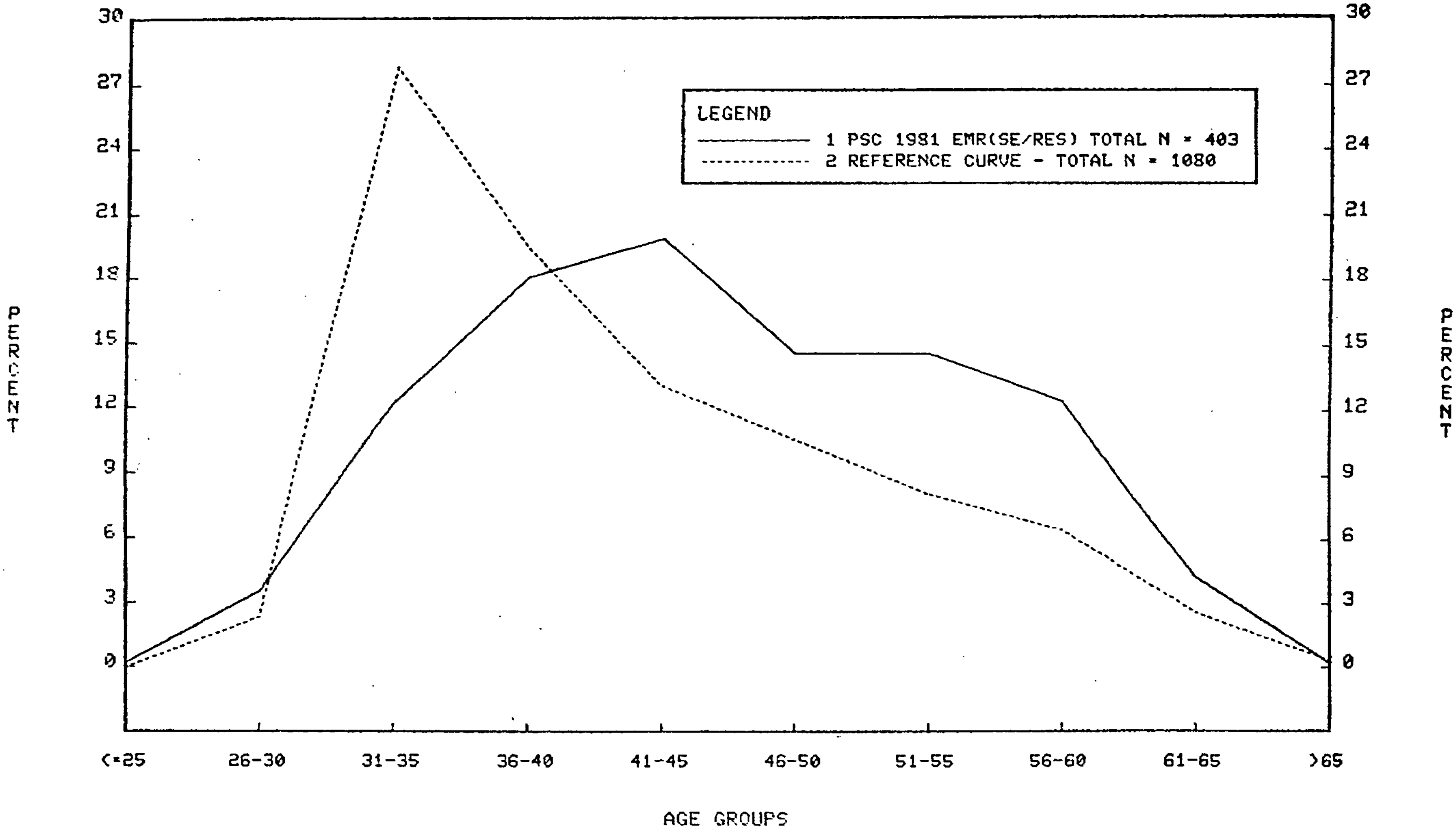
SOURCE :PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

ENERGY, MINES AND RESOURCES: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE



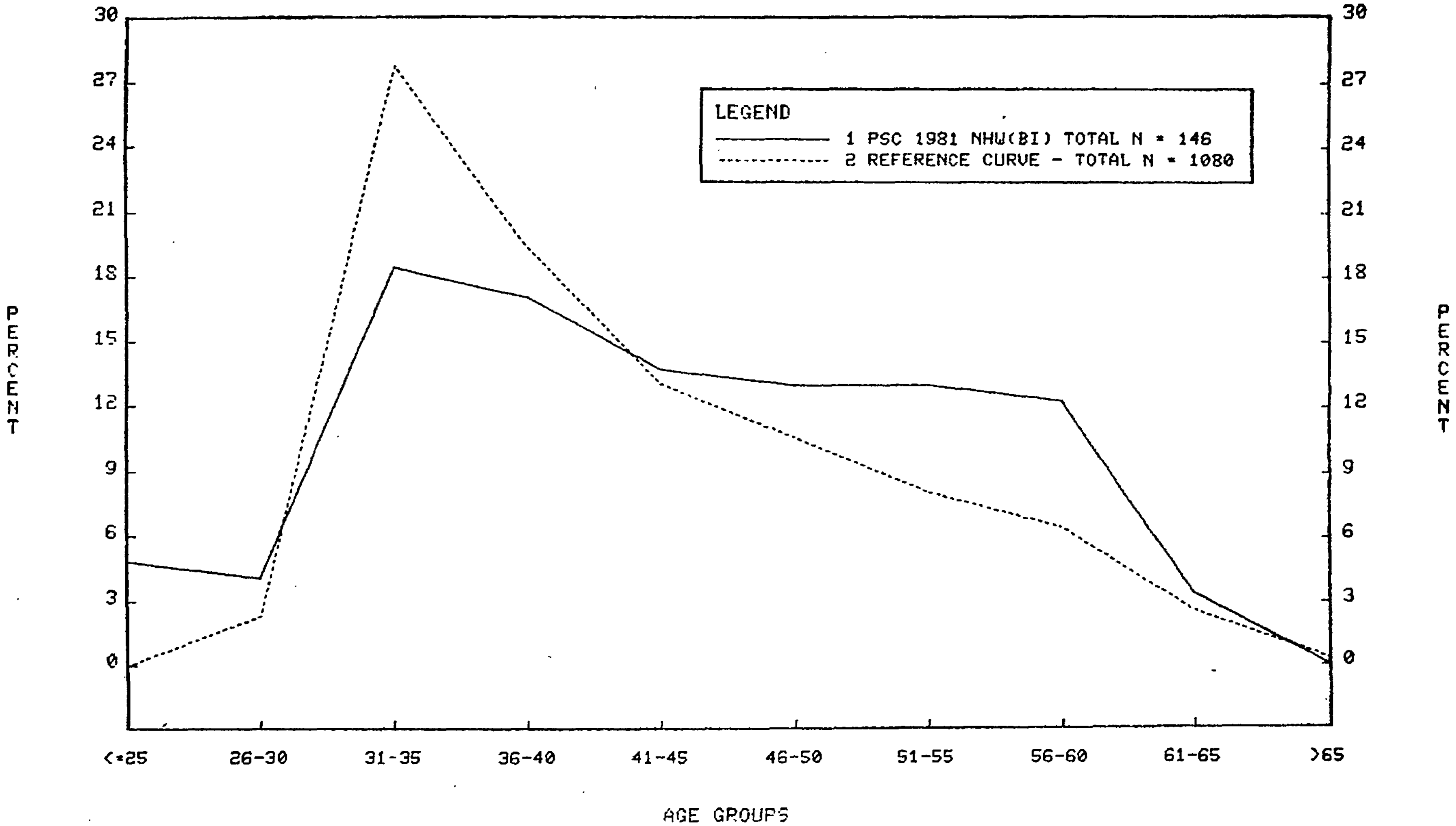
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

ENERGY, MINES AND RESOURCES: AGE DISTRIBUTION OF EN/SUR CLASSIFICATION COMPARED TO REFERENCE CURVE



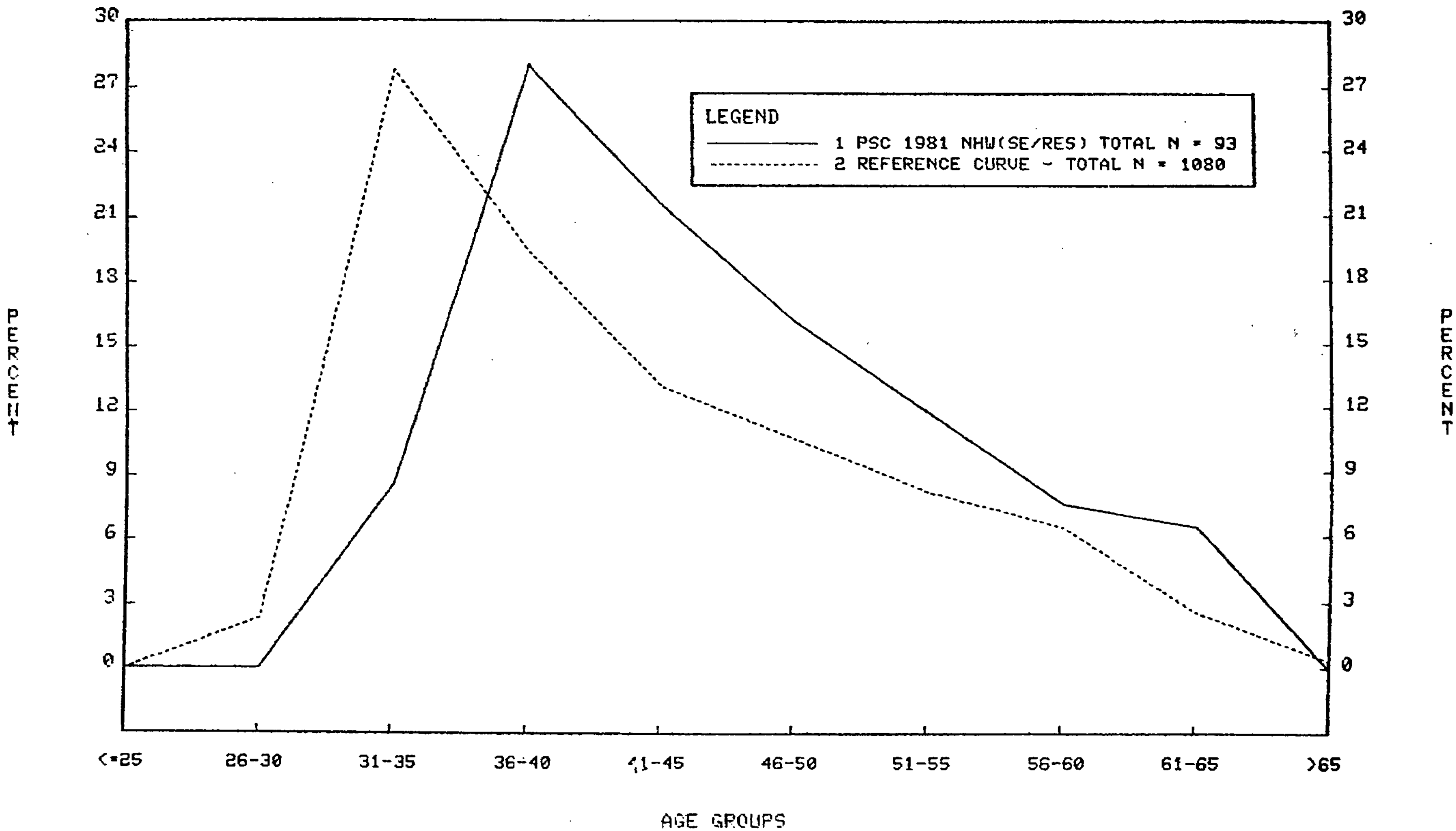
SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

ENERGY, MINES AND RESOURCES: AGE DISTRIBUTION OF SE/RES CLASSIFICATION COMPARED TO REFERENCE CURVE



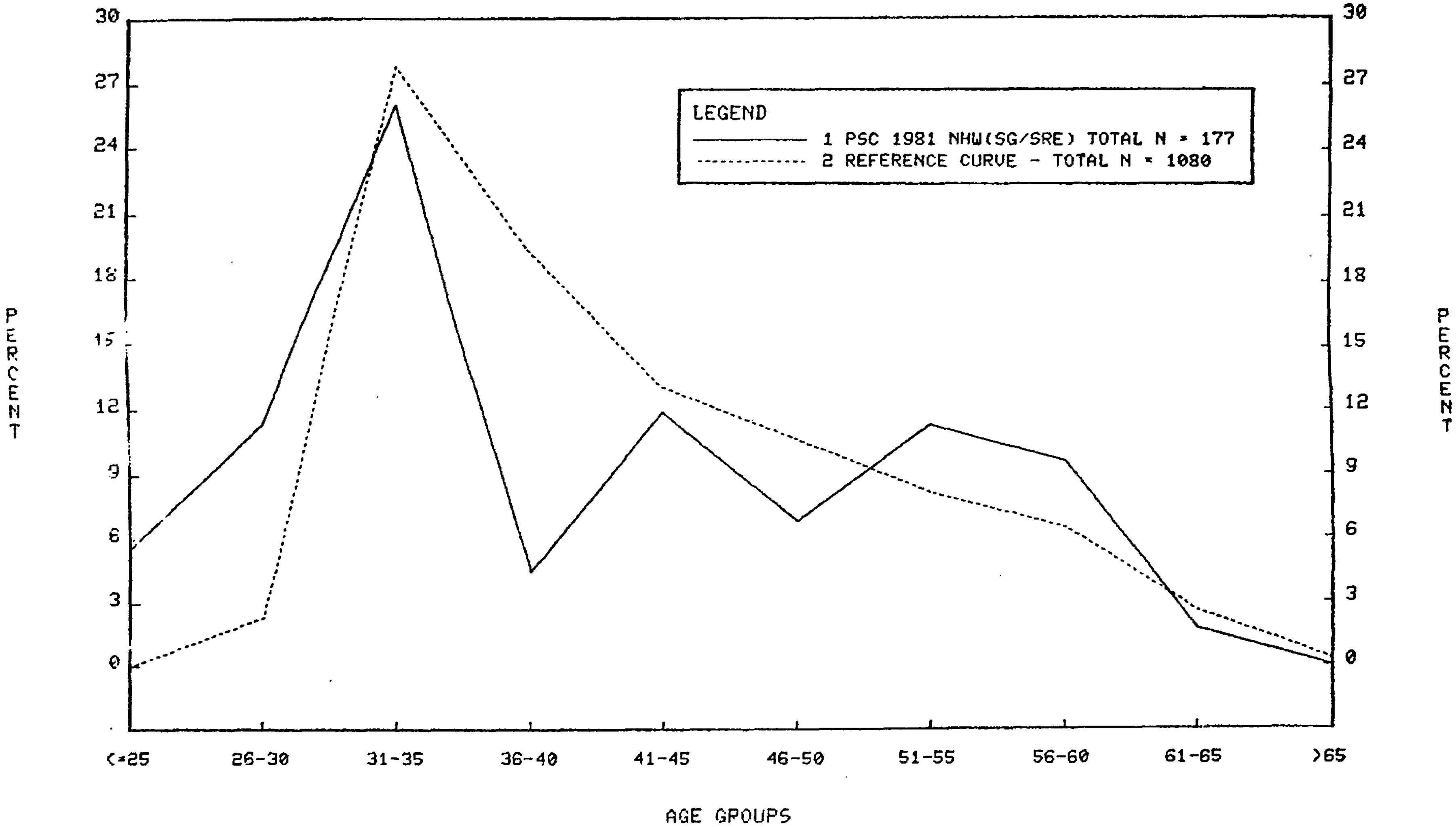
SOURCE : PUBLIC SERVICE COMMISSION, 1981
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

NATIONAL HEALTH AND WELFARE: AGE DISTRIBUTION OF BI CLASSIFICATION COMPARED TO REFERENCE CURVE



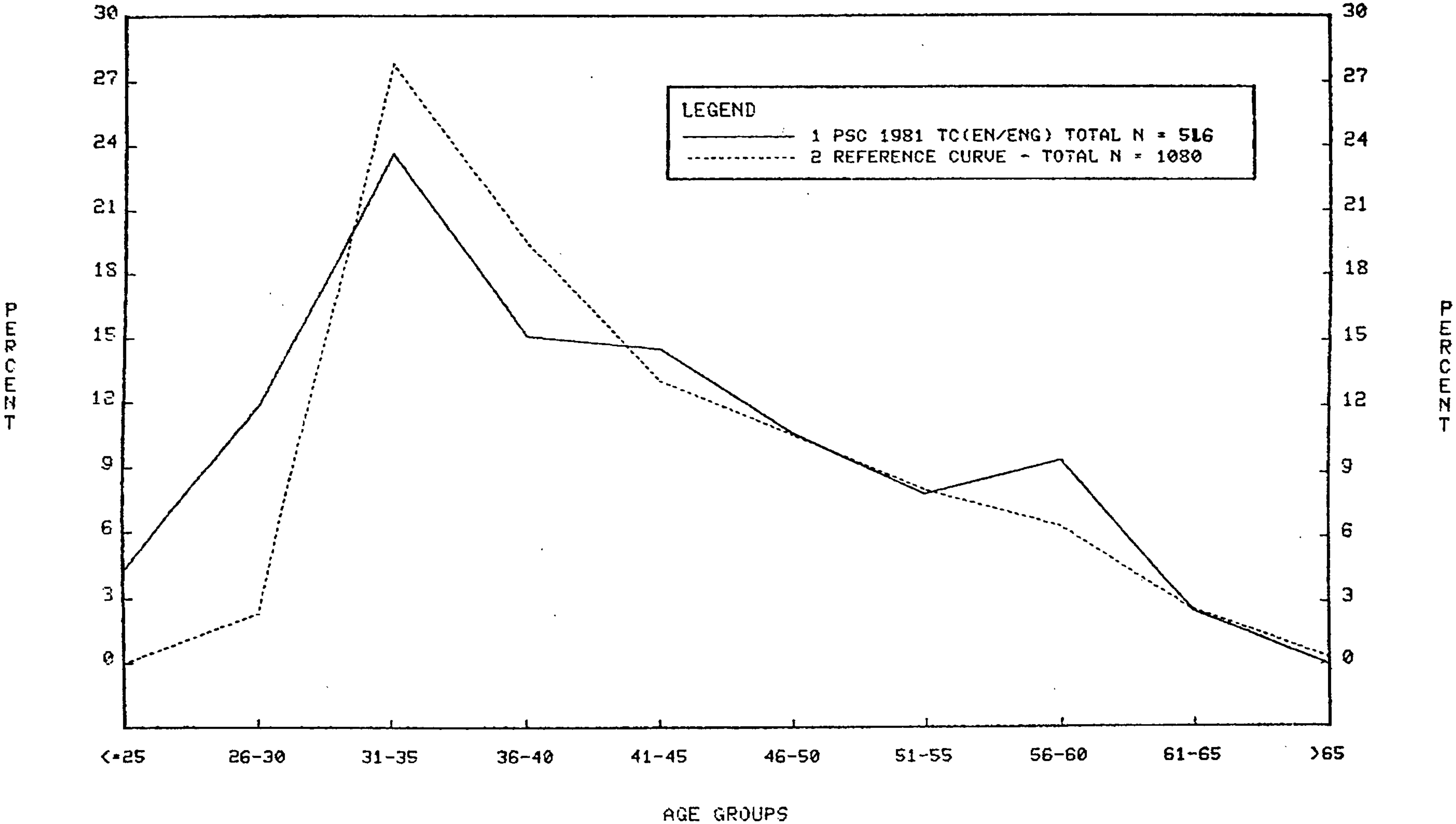
SOURCE : PUBLIC SERVICE COMMISSI ., 1981;
DECKER, W.D. and C.M. V N ATTA, in <u>RESEARCH MANAGEMENT</u>, January, 1973.

NATIONAL IEALTH AND WELFARE: AGE DISTRIBUTION OF SE/RES CLASSIFICATION COMPARED TO REFERENCE CURVE



SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

NATIONAL HEALTH AND WELFARE: AGE DISTRIBUTION OF SG/SRE CLASSIFICATION COMPARED TO REFERENCE CURVE

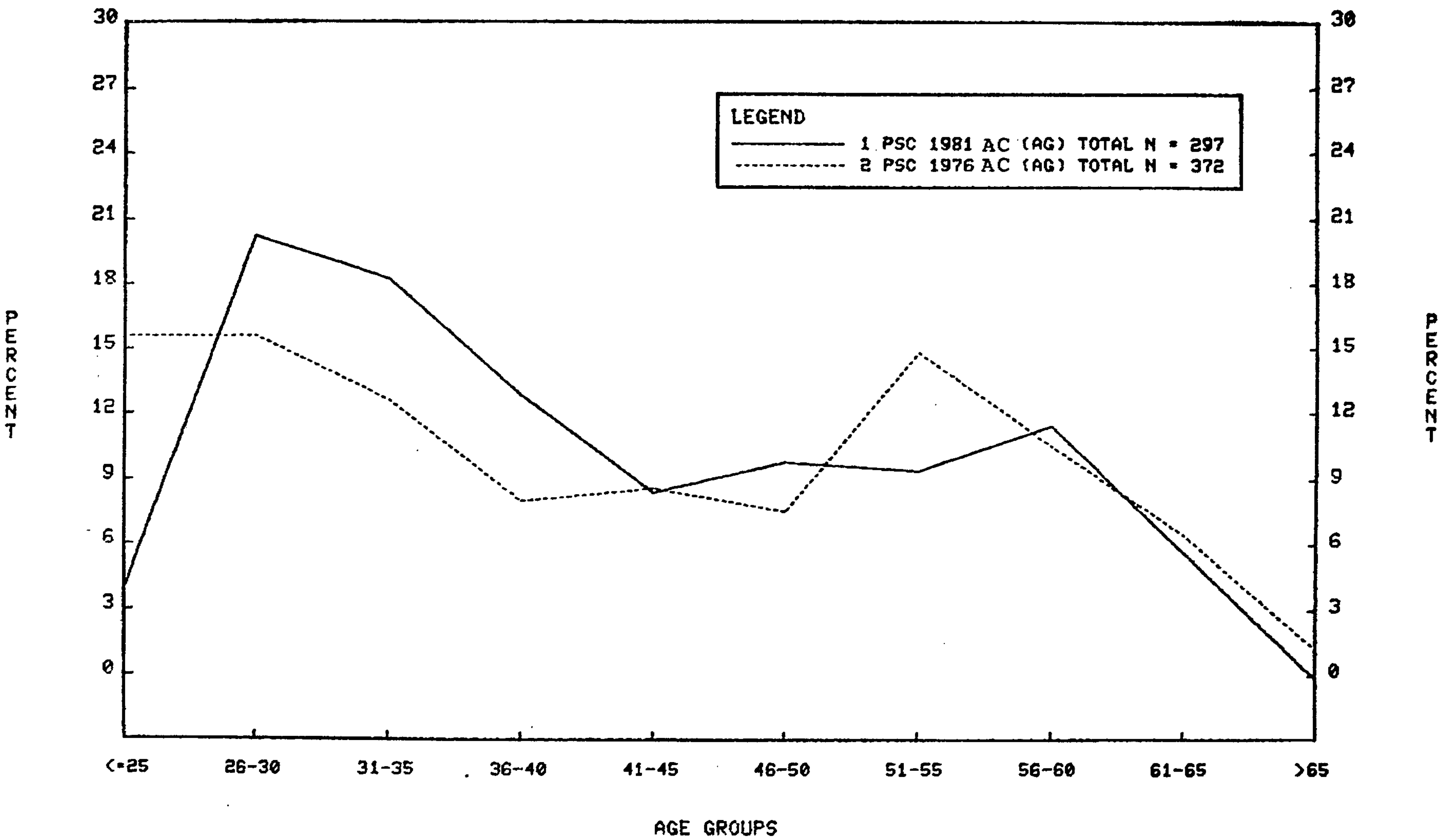


SOURCE : PUBLIC SERVICE COMMISSION, 1981;
DECKER, W.D. and C.M. VAN ATTA, in RESEARCH MANAGEMENT, January, 1973.

TRANSPORT CANADA: AGE DISTRIBUTION OF EN/ENG CLASSIFICATION COMPARED TO REFERENCE CURVE

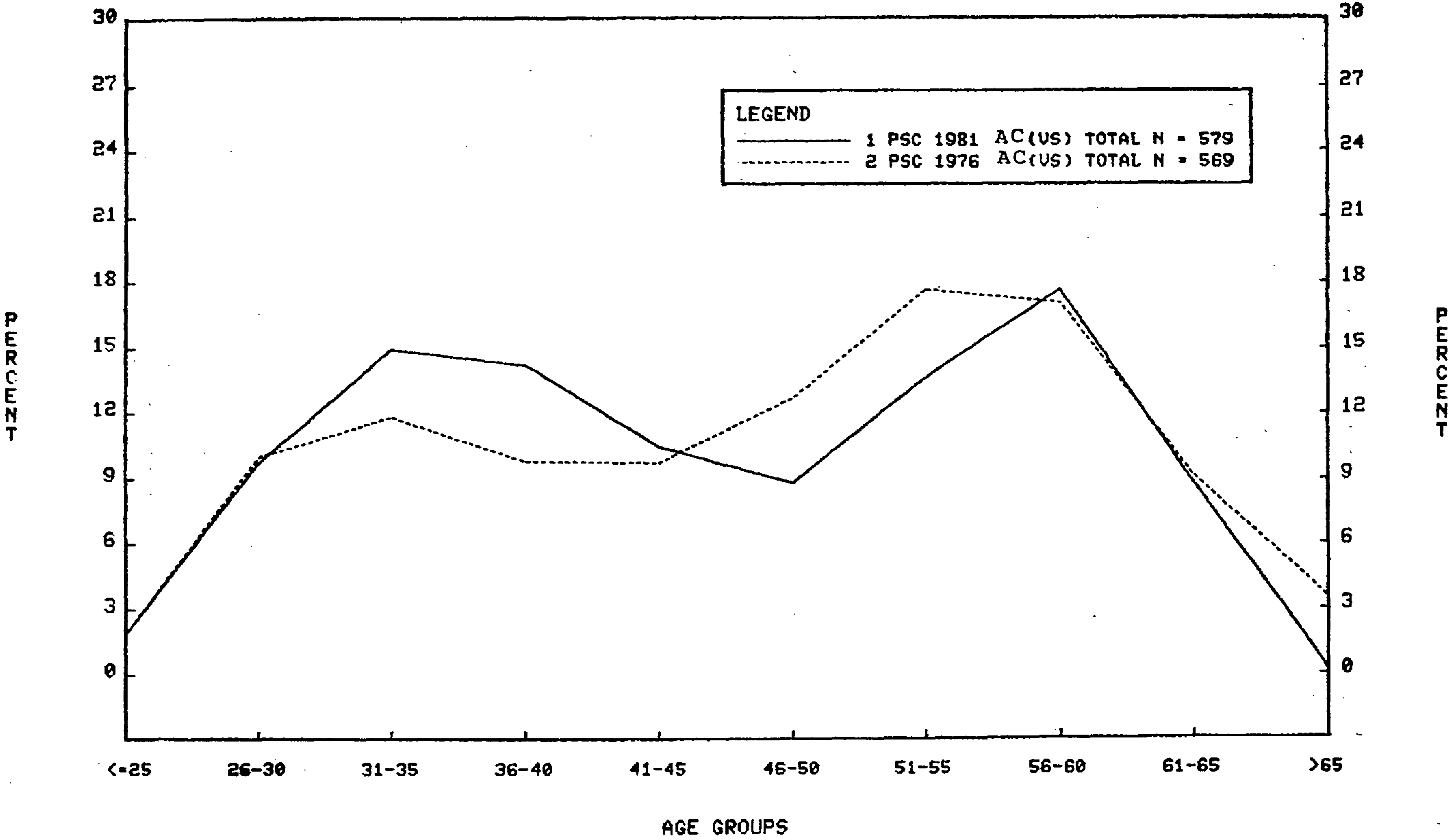
APPENDIX E

1976 AND 1981 COMPARISONS OF AGE DISTRIBUTIONS



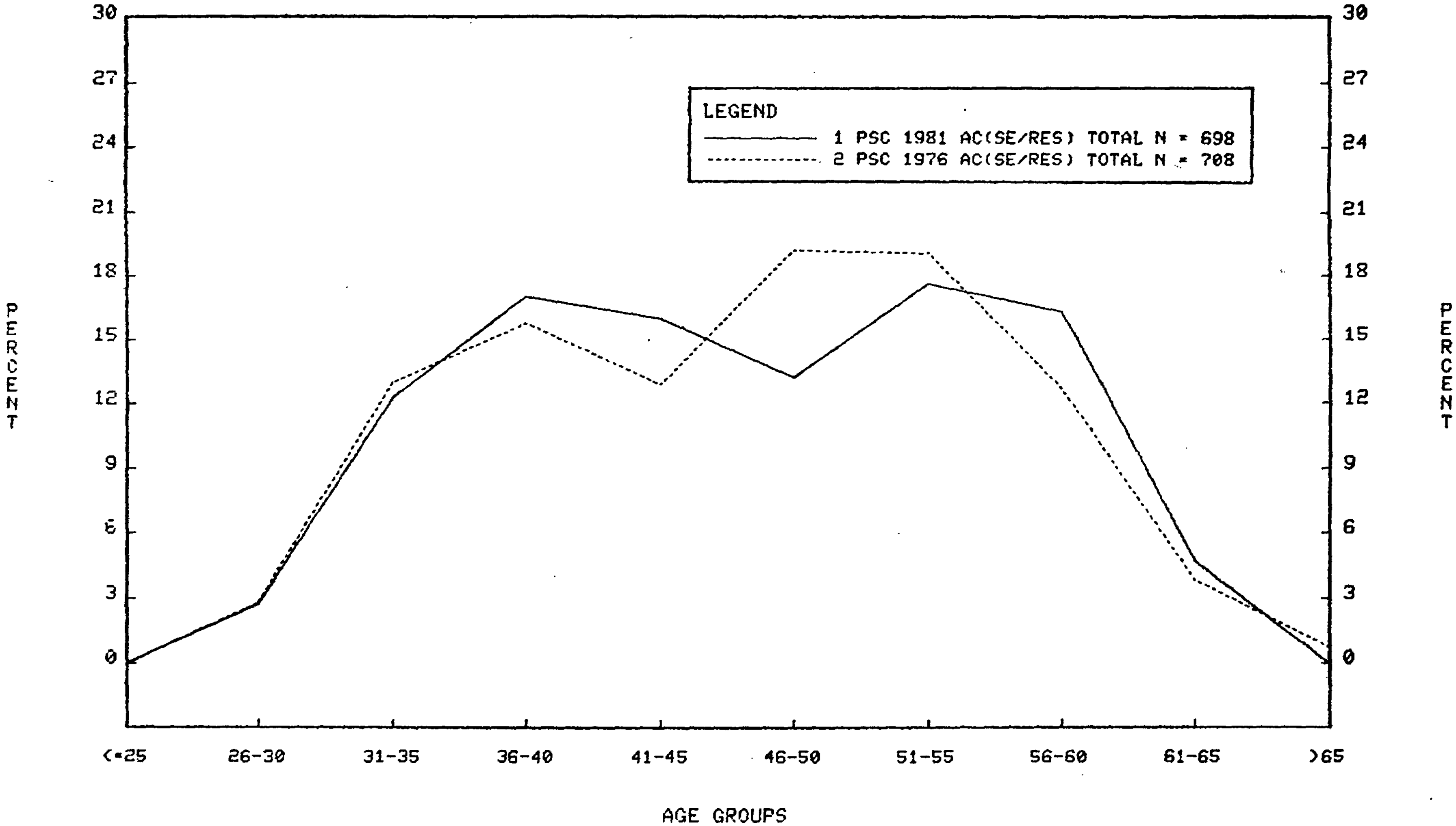
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

AGRICULTURE CANADA - AG CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



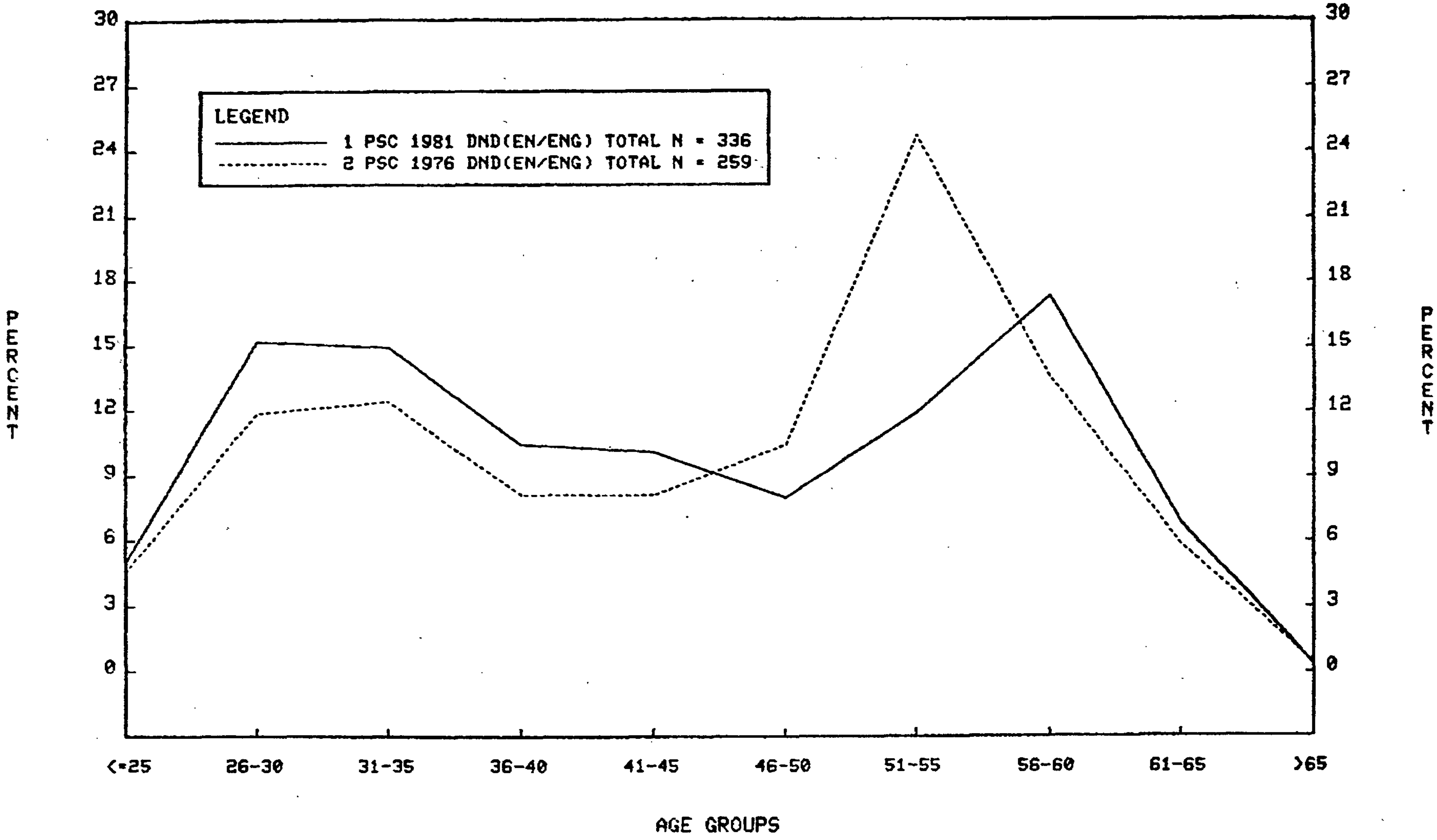
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

AGRICULTURE CANADA - VS CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



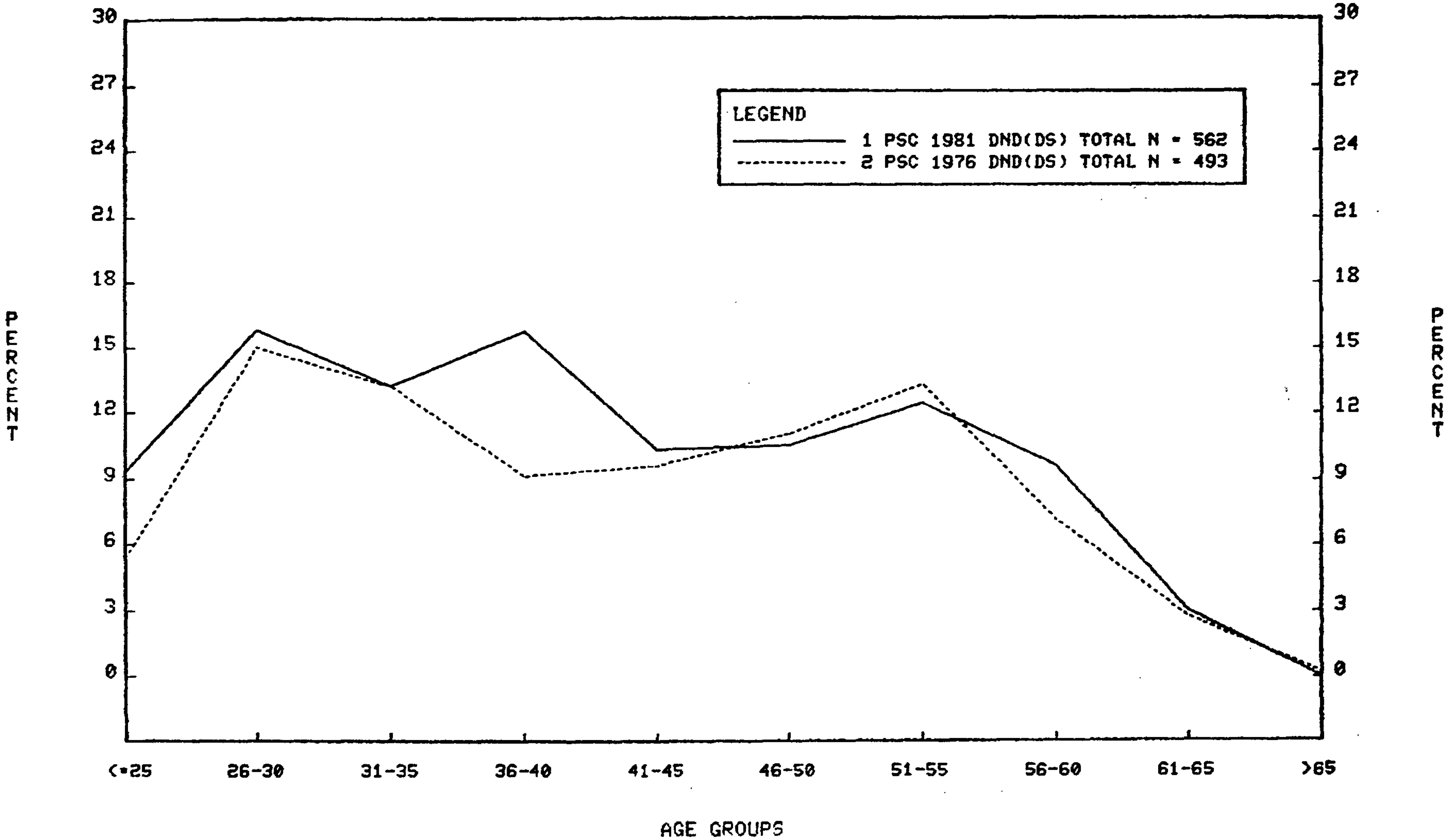
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

AGRICULTURE CANADA - SE/RES CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



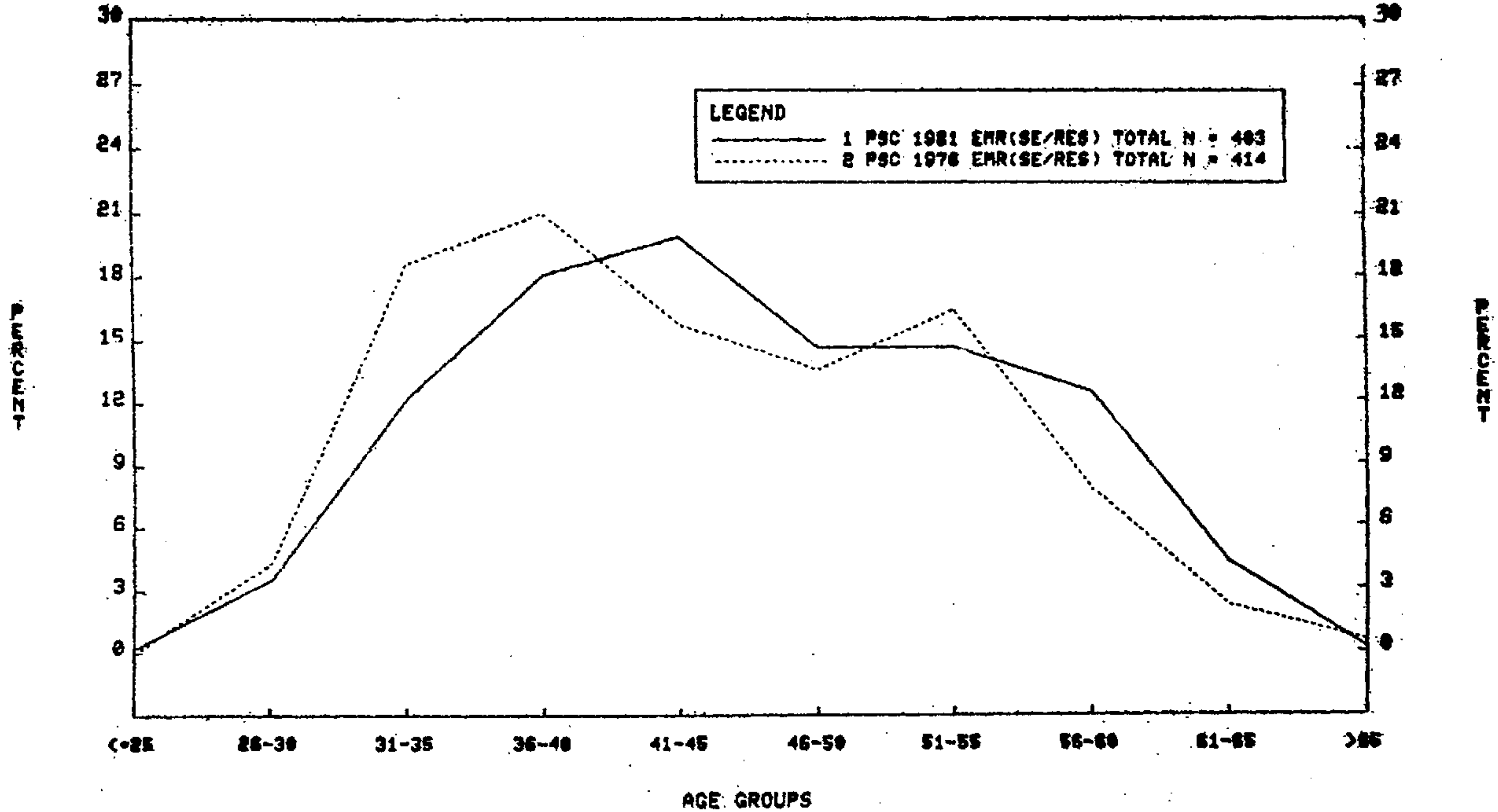
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

DEPARTMENT OF NATIONAL DEFENCE -
EN/ENG CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



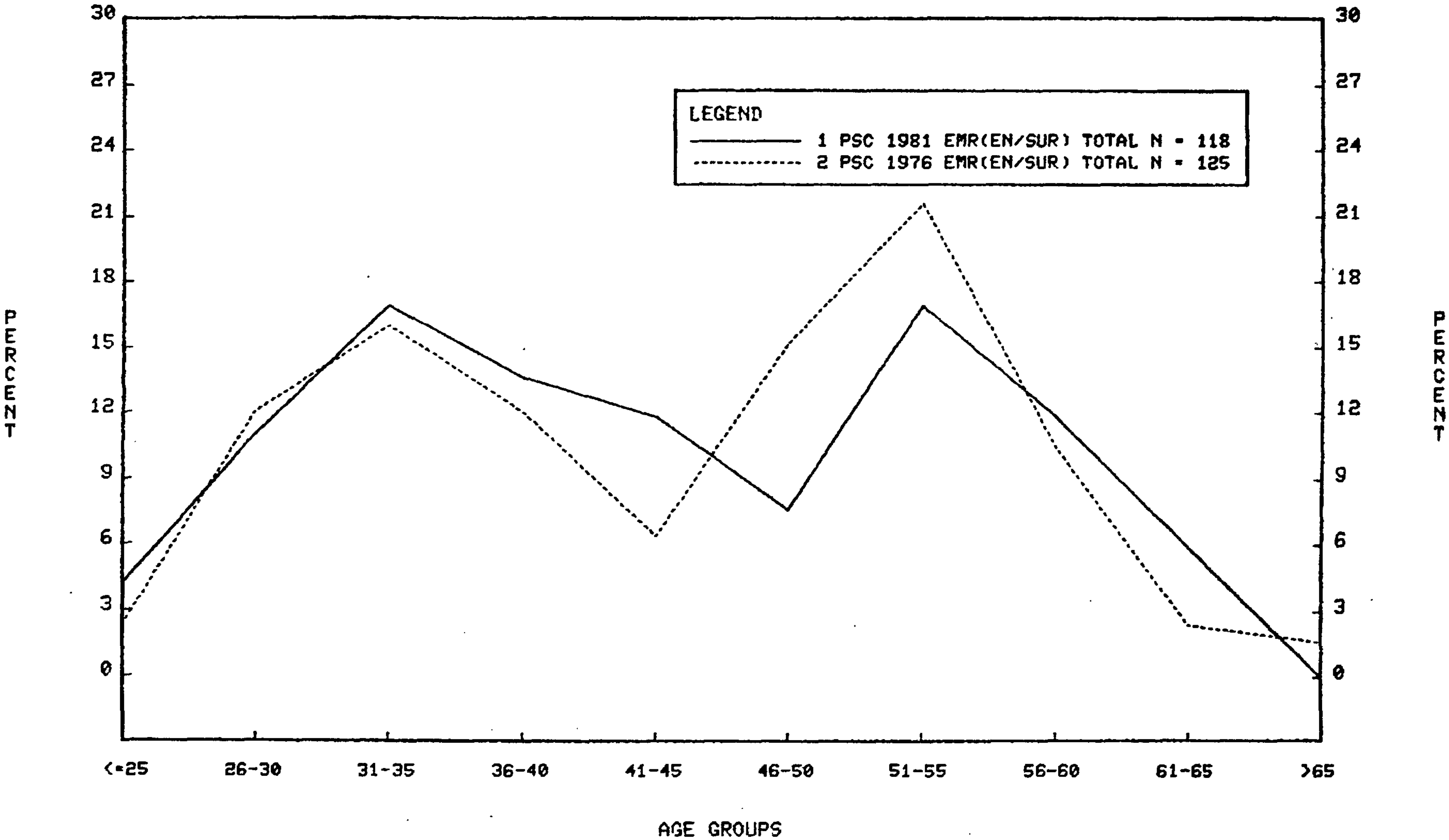
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

DEPARTMENT OF NATIONAL DEFENCE -
DS CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



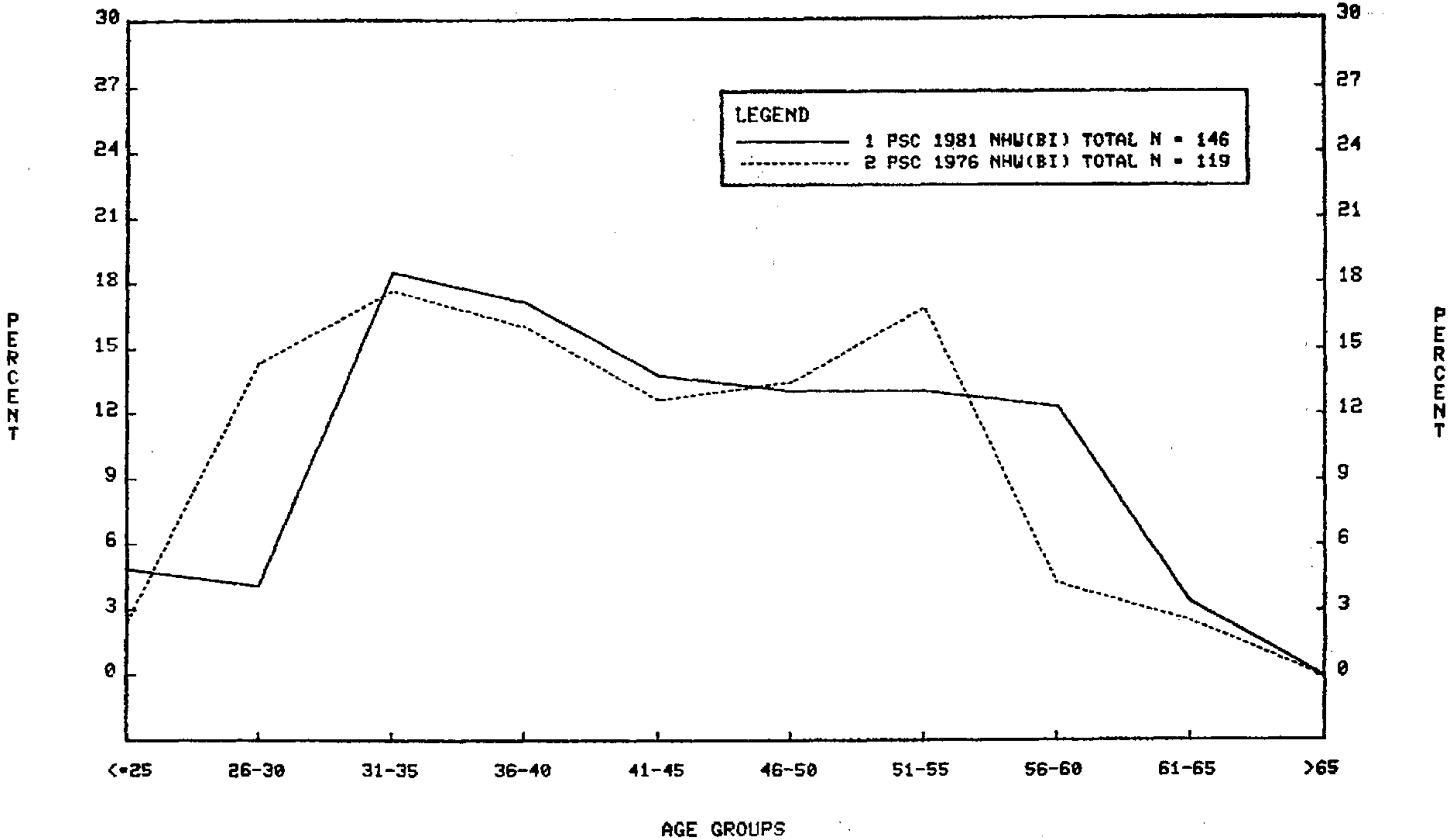
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

ENERGY, MINES AND RESOURCES -
SE/RES CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



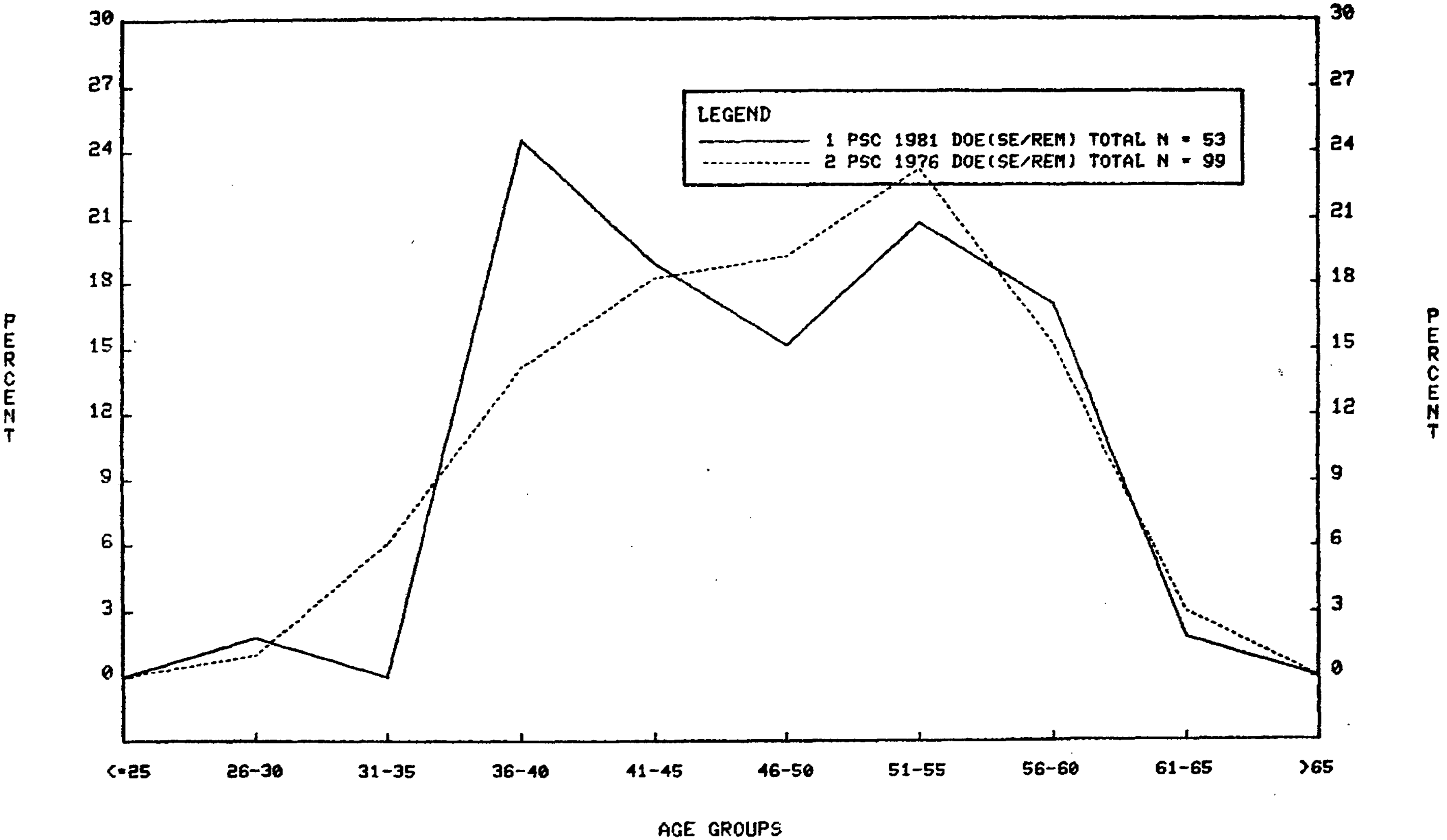
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

ENERGY, MINES AND RESOURCES -
EN/SUR CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



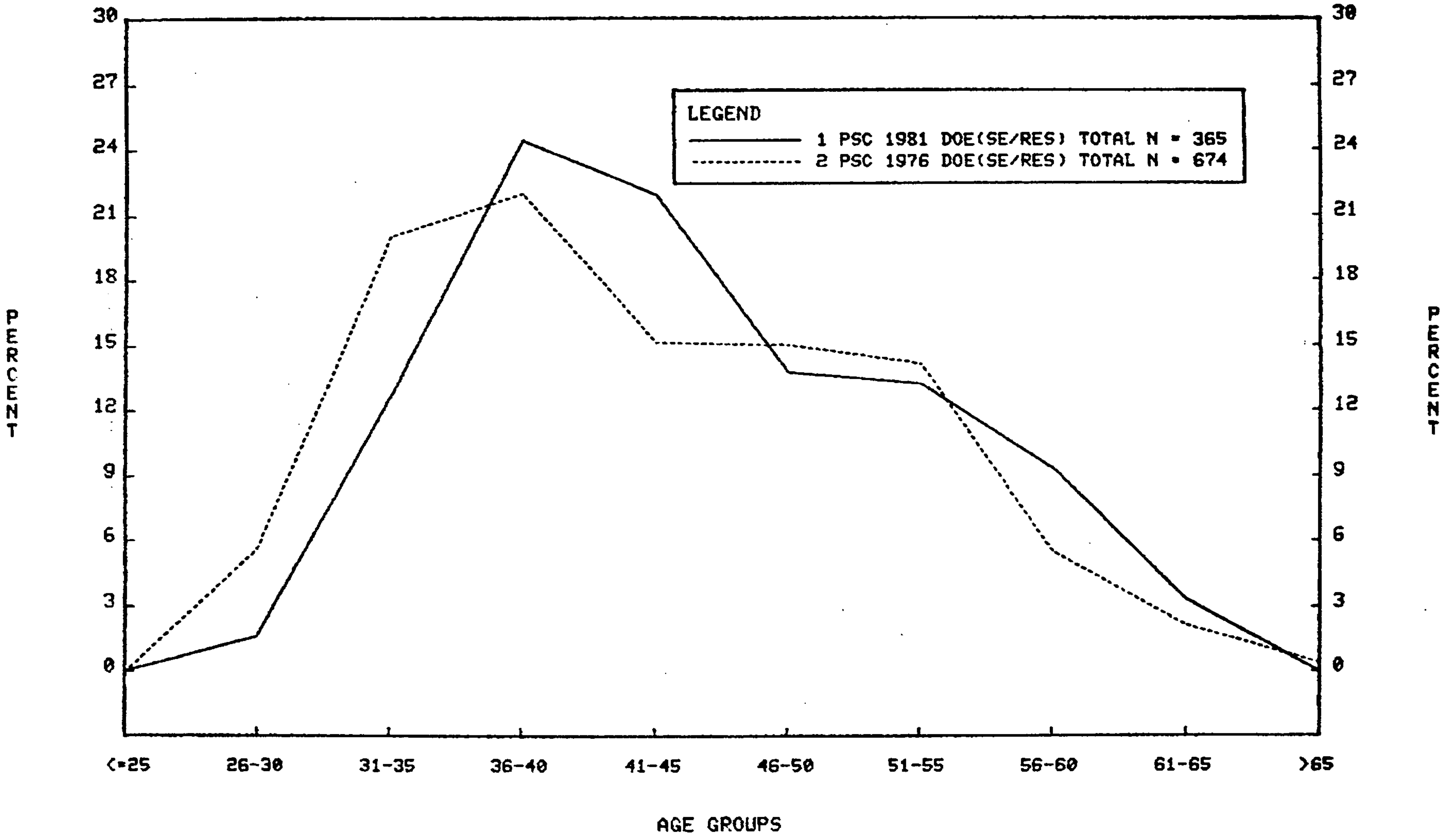
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

NATIONAL HEALTH AND WELFARE -
BI CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



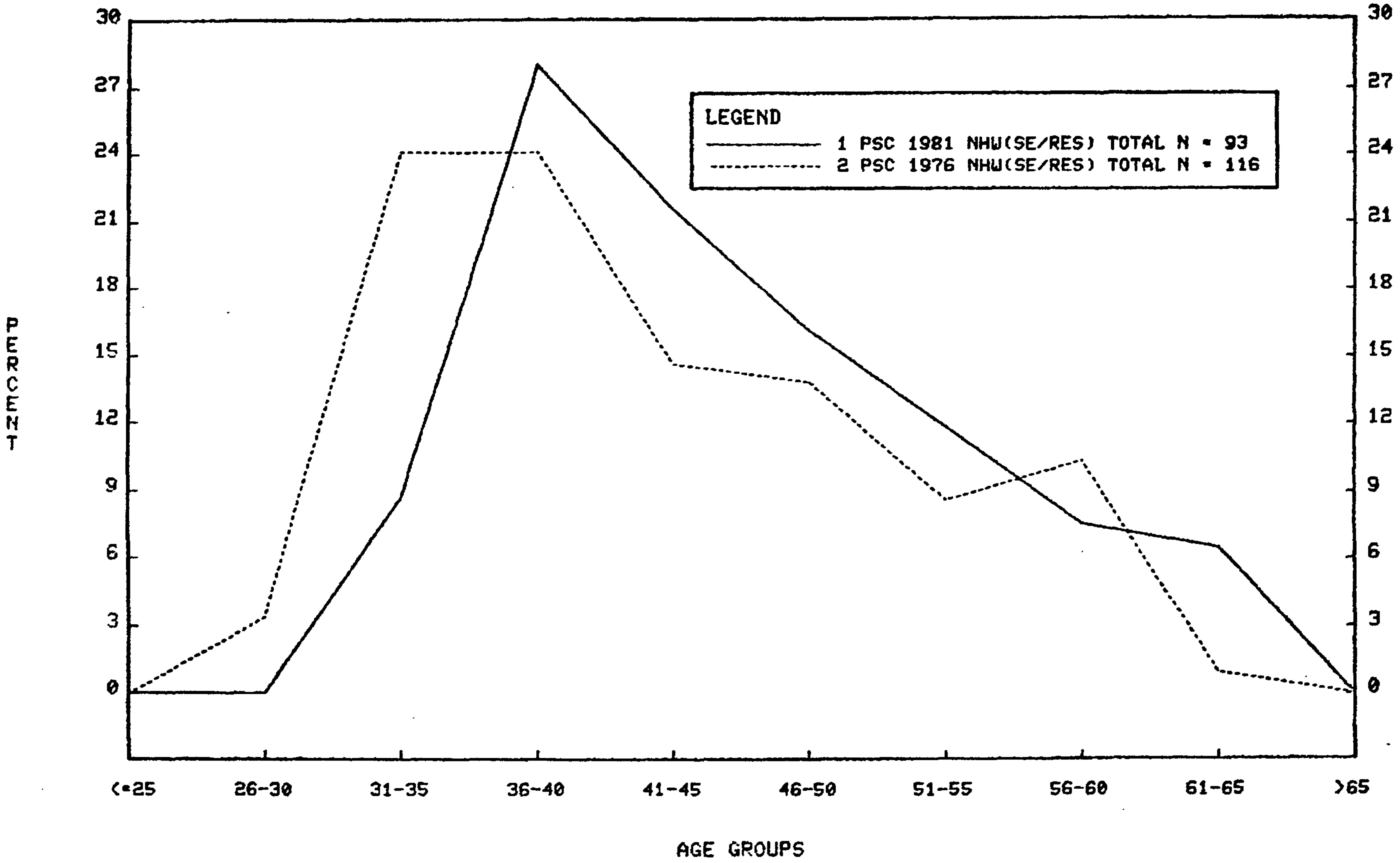
SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

DEPARTMENT OF ENVIRONMENT - SE/REM CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

DEPARTMENT OF ENVIRONMENT - SE/RES CLASSIFICATION
AGE DISTRIBUTIONS, 1976 and 1981



SOURCE : PUBLIC SERVICE COMMISSION, 1976 and 1981

NATIONAL HEALTH AND WELFARE -
SE/RES CLASSIFICATION
AGE DISTRIBUTION, 1976 and 1981

AGE DISTRIBUTION OF SCIENTISTS IN THE FEDERAL GOVERNMENT BY DEPARTMENT AND JOB CLASSIFICATION (1981)

(CLASSIFICATION)	DEPARTMENT	AGE GROUPS										
		<=25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	>65	TOTAL N
(AG)	AGR	12	60	54	38	25	29	28	34	17	0	297
(BI)	AGR	9	40	46	29	22	18	12	20	6	0	202
(BI)	DFO	13	93	108	61	26	17	5	8	1	0	332
(BI)	DOE	5	62	94	44	23	7	10	6	1	0	252
(BI)	NHW	7	6	27	25	20	19	19	18	5	0	146
(CH)	DFO	1	3	14	13	5	2	0	2	2	0	42
(CH)	DOE	4	7	17	14	12	5	5	3	0	0	67
(CH)	NHW	3	16	42	29	24	14	7	12	3	0	150
(DS)	DND	53	89	74	88	58	59	70	54	17	0	562
(EN/ENG)	COM	19	27	61	43	30	26	18	9	4	0	237
(EN/ENG)	DFO	1	13	18	19	6	9	10	4	0	0	80
(EN/ENG)	DND	17	51	50	35	34	27	40	58	23	1	336
(EN/ENG)	DOE	8	36	85	70	37	32	33	34	7	0	342
(EN/ENG)	DPW	10	33	66	49	61	49	51	56	22	0	397
(EN/ENG)	EMR	5	7	13	18	10	6	10	7	1	0	77
(EN/ENG)	IAN	2	9	21	17	17	15	11	10	3	0	105
(EN/ENG)	MOT	22	61	122	78	75	55	41	49	13	0	516
(EN/SUR)	EMR	5	13	20	16	14	9	20	14	7	0	118
(FO)	DOE	4	23	12	7	10	7	4	7	2	0	76
(MT)	DOE	48	96	147	82	71	40	49	35	13	0	581
(PC)	DFO	2	7	24	18	8	5	1	5	0	0	70
(PC)	DOE	6	35	76	51	24	9	5	6	1	0	213
(PC)	EMR	6	33	79	45	33	28	28	9	8	1	270
(PC)	IAN	0	5	17	6	4	5	2	2	0	0	41
(SE/REM)	DOE	0	1	0	13	10	8	11	9	1	0	53
(SE/RES)	AGR	0	19	86	119	112	92	123	114	33	0	698
(SE/RES)	COM	0	1	5	14	21	8	4	1	1	0	55
(SE/RES)	DFO	0	10	44	56	46	58	33	25	3	0	245
(SE/RES)	DOE	0	6	46	89	80	50	48	34	12	0	365
(SE/RES)	EMR	1	14	49	73	80	59	59	50	17	1	403
(SE/RES)	NHW	0	0	8	26	20	15	11	7	6	0	93
(SG/PEM)	CCA	1	3	9	22	26	18	23	28	14	4	148
(SG/SRE)	DFO	1	17	24	11	5	3	4	5	0	0	70
(SG/SRE)	NHW	10	20	46	28	21	12	20	17	3	0	117
(US)	AGR	11	56	86	82	60	51	79	102	51	1	579

SOURCE: PUBLIC SERVICE COMMISSION

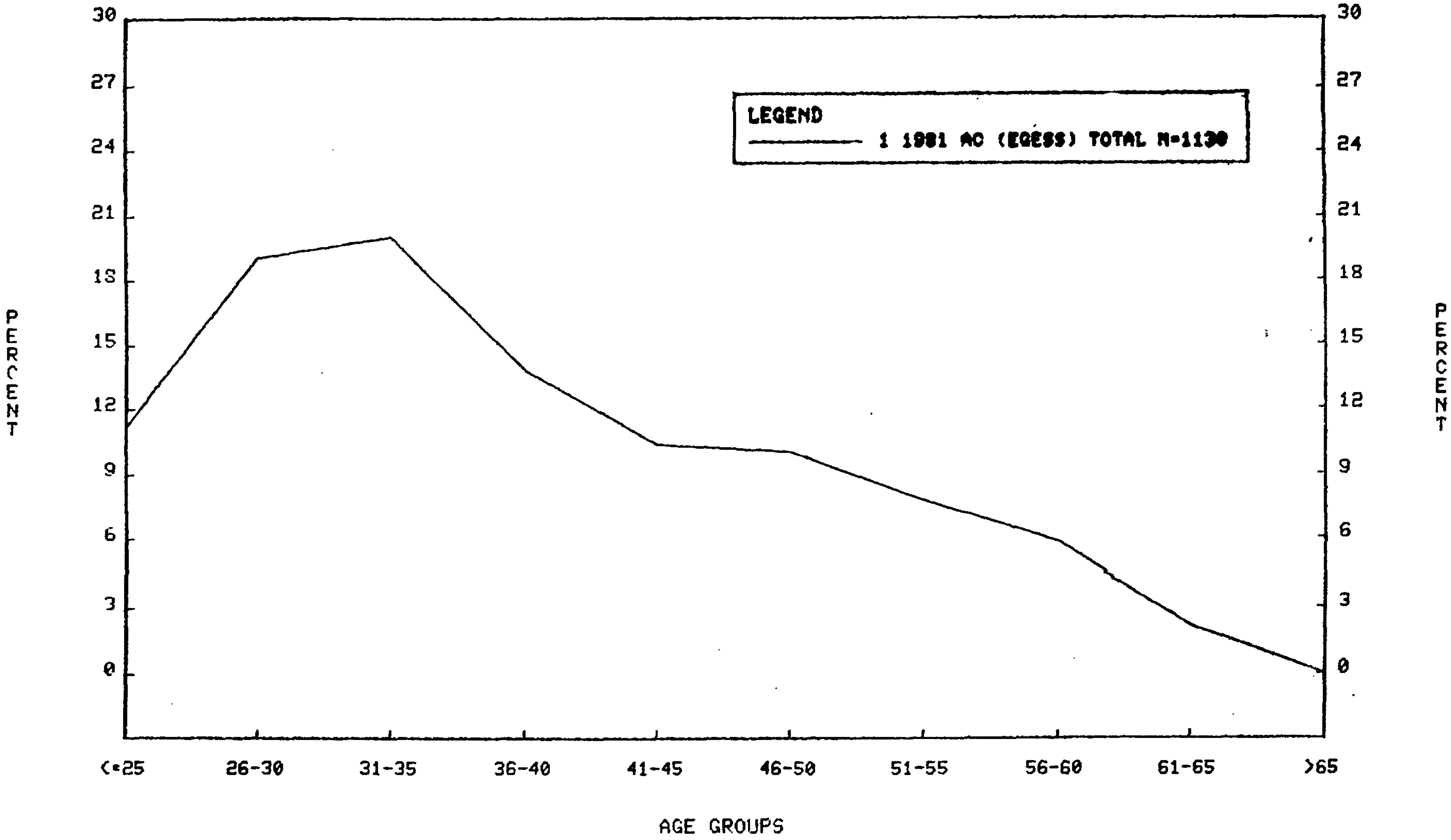
AGE DISTRIBUTION OF SCIENTISTS IN THE FEDERAL GOVERNMENT BY DEPARTMENT AND JOB CLASSIFICATION, 1976

(CLASSIFICATION)	DEPARTMENT	AGE GROUPS <=25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	>65	TOTAL N
(AG)	AGR	58	58	47	30	32	28	55	39	24	1	378
(BI)	AGR	7	28	31	20	18	21	26	15	9	1	176
(BI)	DOE	29	139	113	56	21	15	18	9	2	0	402
(BI)	IAN	9	49	15	9	3	1	0	2	0	0	88
(BI)	NHW	3	17	21	19	15	16	20	5	3	0	119
(CH)	DOE	3	32	35	21	12	2	8	7	1	0	121
(CH)	NHW	8	43	38	24	18	9	15	10	4	0	169
(DS)	DND	27	74	78	54	57	65	79	42	16	1	493
(EN/ENG)	COM	8	35	47	30	29	15	18	4	0	0	186
(EN/ENG)	DND	12	31	32	21	21	27	64	35	15	1	259
(EN/ENG)	DOE	22	93	98	59	38	43	34	16	4	0	407
(EN/ENG)	DPW	17	58	48	65	60	50	66	42	12	1	419
(EN/ENG)	EMR	4	12	13	9	3	10	7	2	2	0	62
(EN/ENG)	IAN	4	39	21	26	25	22	33	11	4	0	185
(EN/ENG)	MOT	35	145	99	88	63	46	58	32	9	0	575
(EN/SUR)	EMR	3	15	20	15	8	19	27	13	3	2	125
(FO)	DOE	10	8	20	22	10	7	12	5	0	0	94
(MT)	DOE	64	149	90	78	42	57	59	47	17	0	603
(PC)	DOE	12	54	62	32	18	8	14	4	3	1	208
(PC)	EMR	16	78	52	33	26	25	12	18	2	1	263
(SE/REM)	AGR	0	0	1	1	3	16	25	11	6	0	63
(SE/REM)	DOE	0	1	6	14	18	19	23	15	3	0	99
(SE/REM)	EMR	0	0	0	4	4	12	9	12	2	0	43
(SE/RES)	AGR	0	20	92	112	91	136	135	90	27	5	708
(SE/RES)	COM	0	0	14	24	13	6	6	3	0	0	66
(SE/RES)	DOE	0	38	135	149	102	101	95	37	14	3	674
(SE/RES)	EMR	0	18	77	87	65	56	68	62	9	0	414
(SE/RES)	NHW	0	4	28	28	17	16	10	12	1	0	116
(SG/PEM)	CCA	2	6	21	28	19	19	34	31	14	0	174
(SG/SRE)	CCA	3	14	3	3	5	8	1	4	1	0	42
(SG/SRE)	DOE	9	29	18	6	4	7	10	6	0	0	89
(SG/SRE)	NHW	17	56	33	26	13	24	22	8	6	1	206
(US)	AGR	11	57	67	56	55	72	100	97	52	2	569

SOURCE: PUBLIC SERVICE COMMISSION

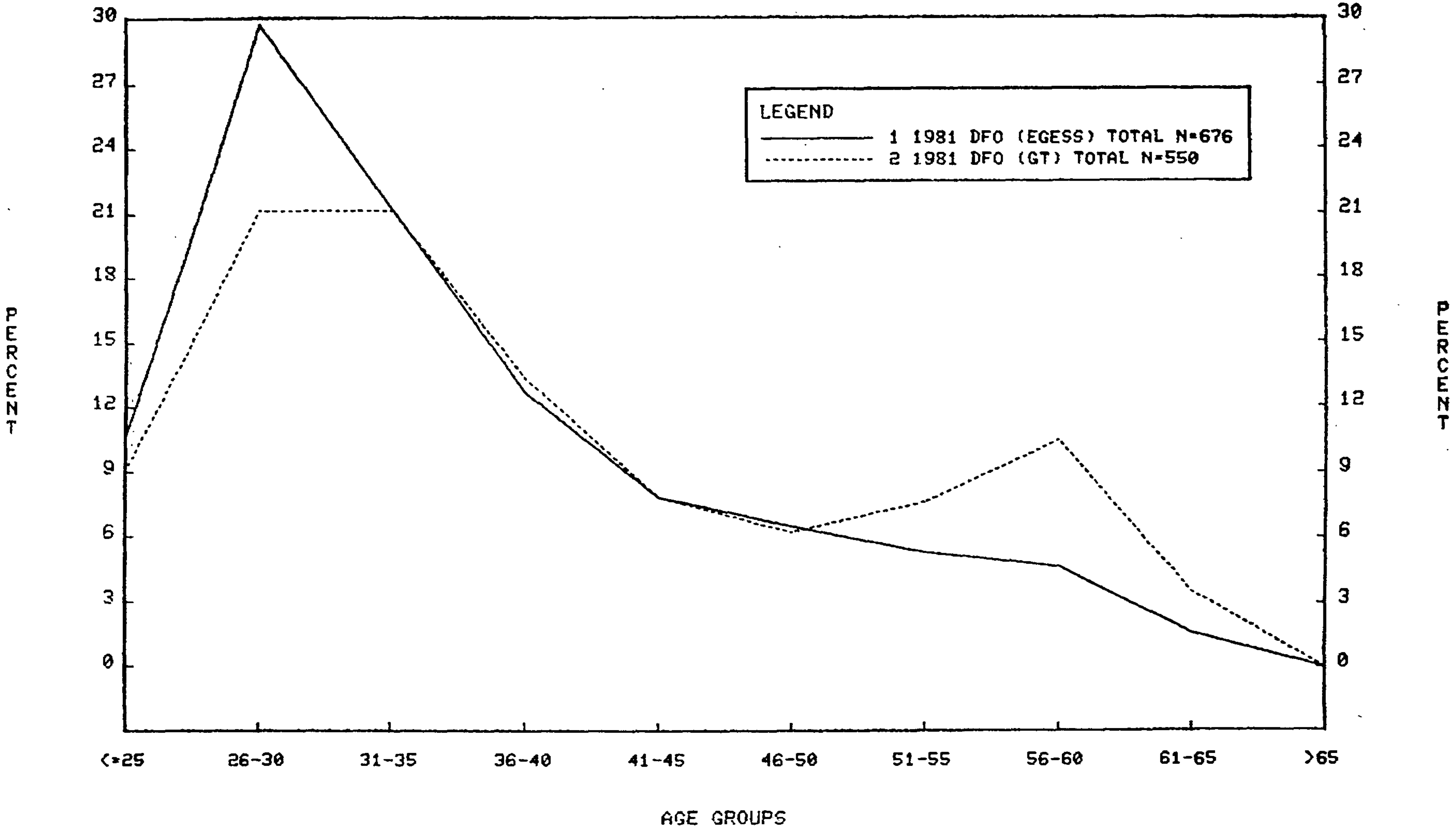
APPENDIX F

AGE DISTRIBUTIONS OF TECHNICIANS BY CLASSIFICATION AND DEPARTMENT



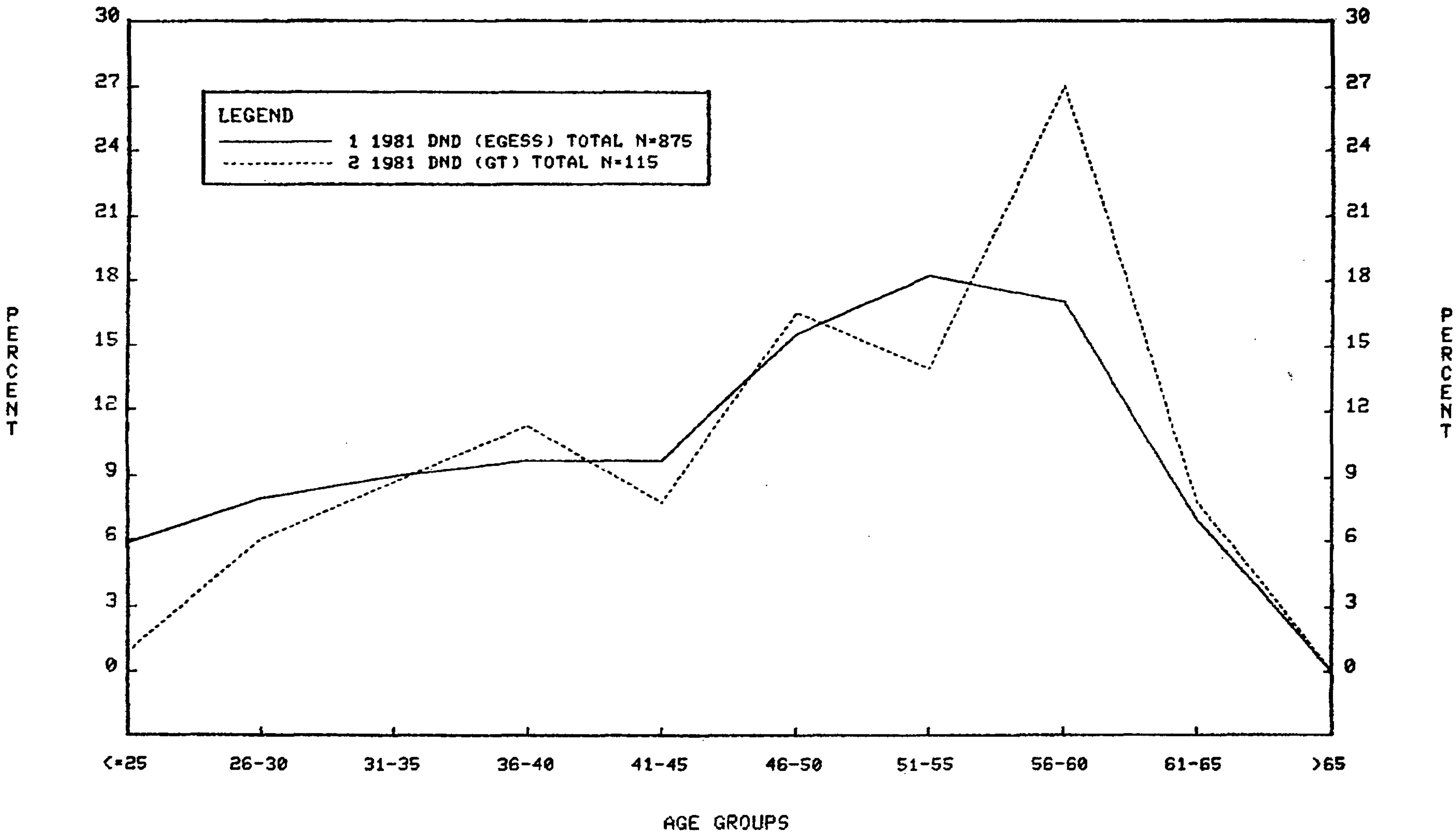
SOURCE : PUBLIC SERVICE COMMISSION

AGRICULTURE CANADA -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS CLASSIFICATION)



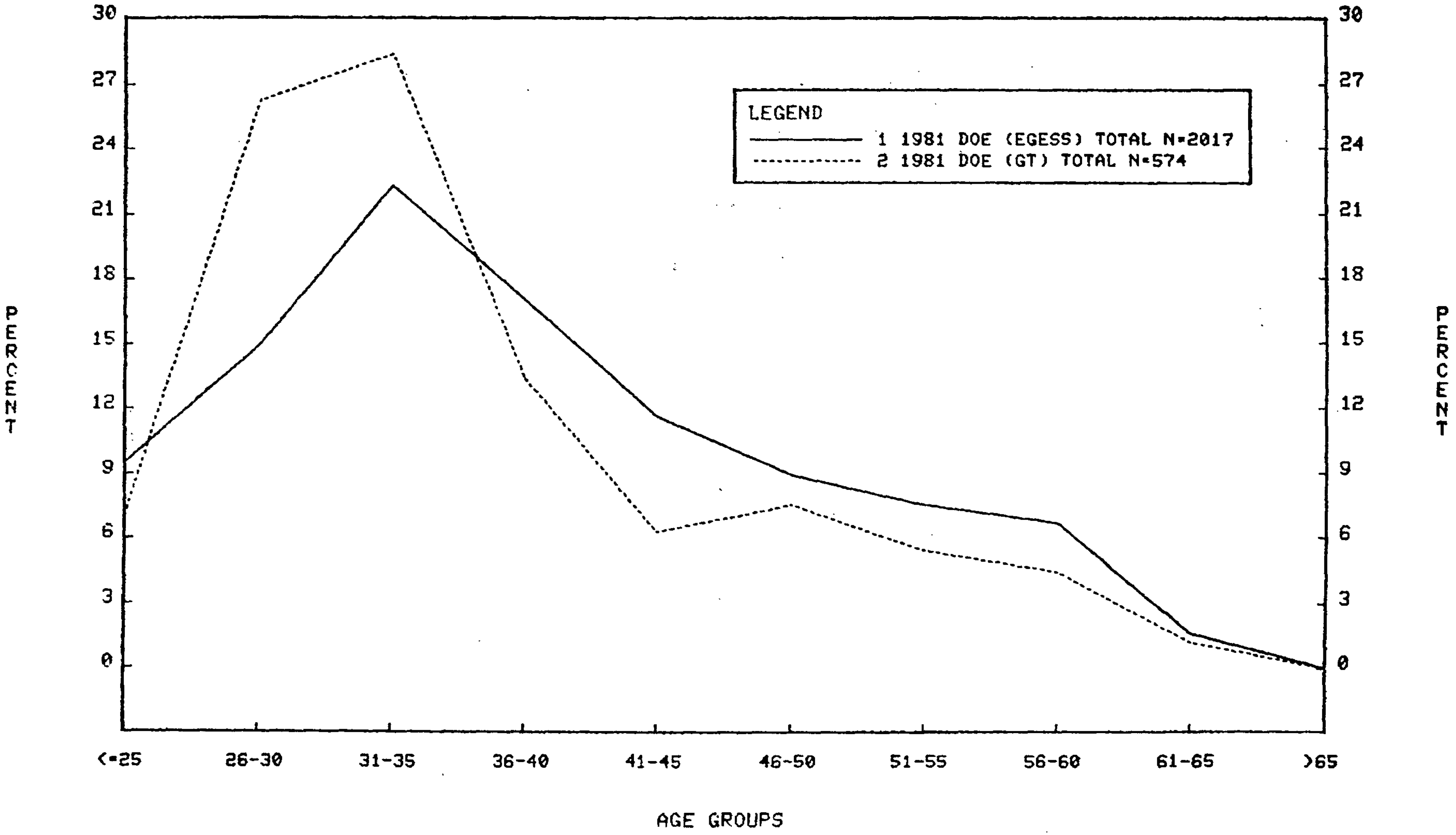
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF FISHERIES AND OCEANS -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS AND GT CLASSIFICATIONS)



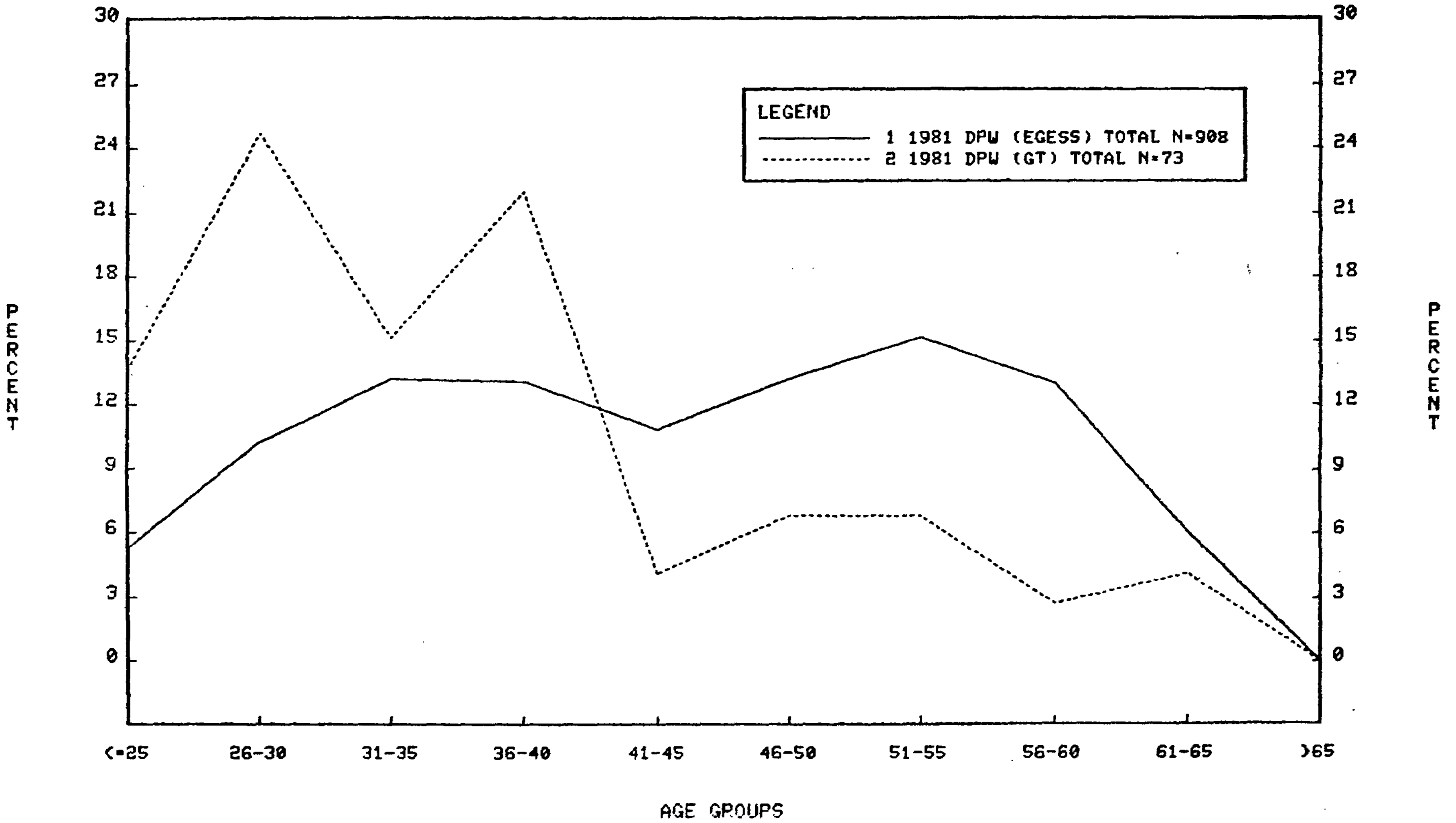
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF NATIONAL DEFENCE -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS AND GT CLASSIFICATIONS)



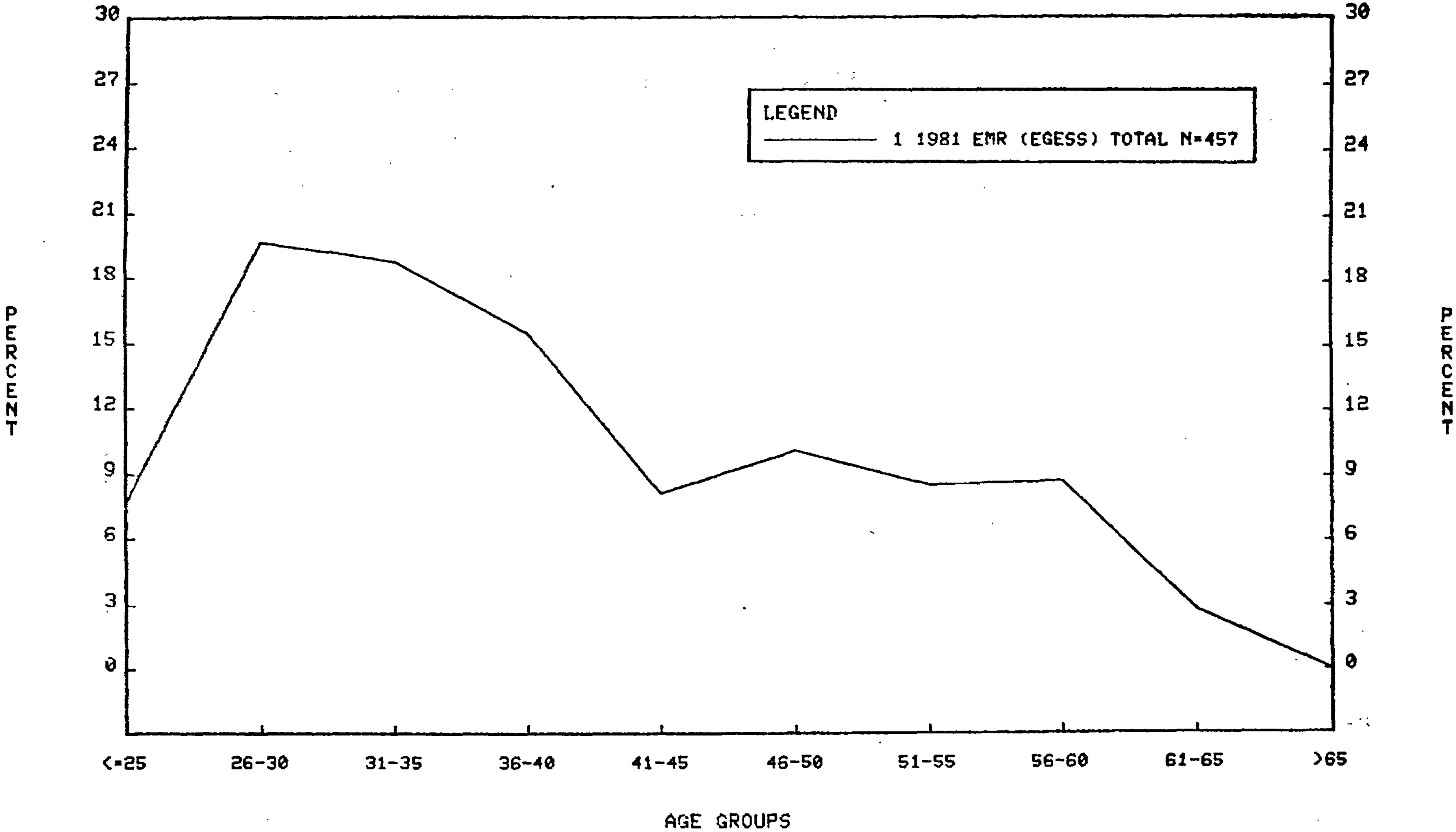
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF ENVIRONMENT -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS AND GT CLASSIFICATIONS)



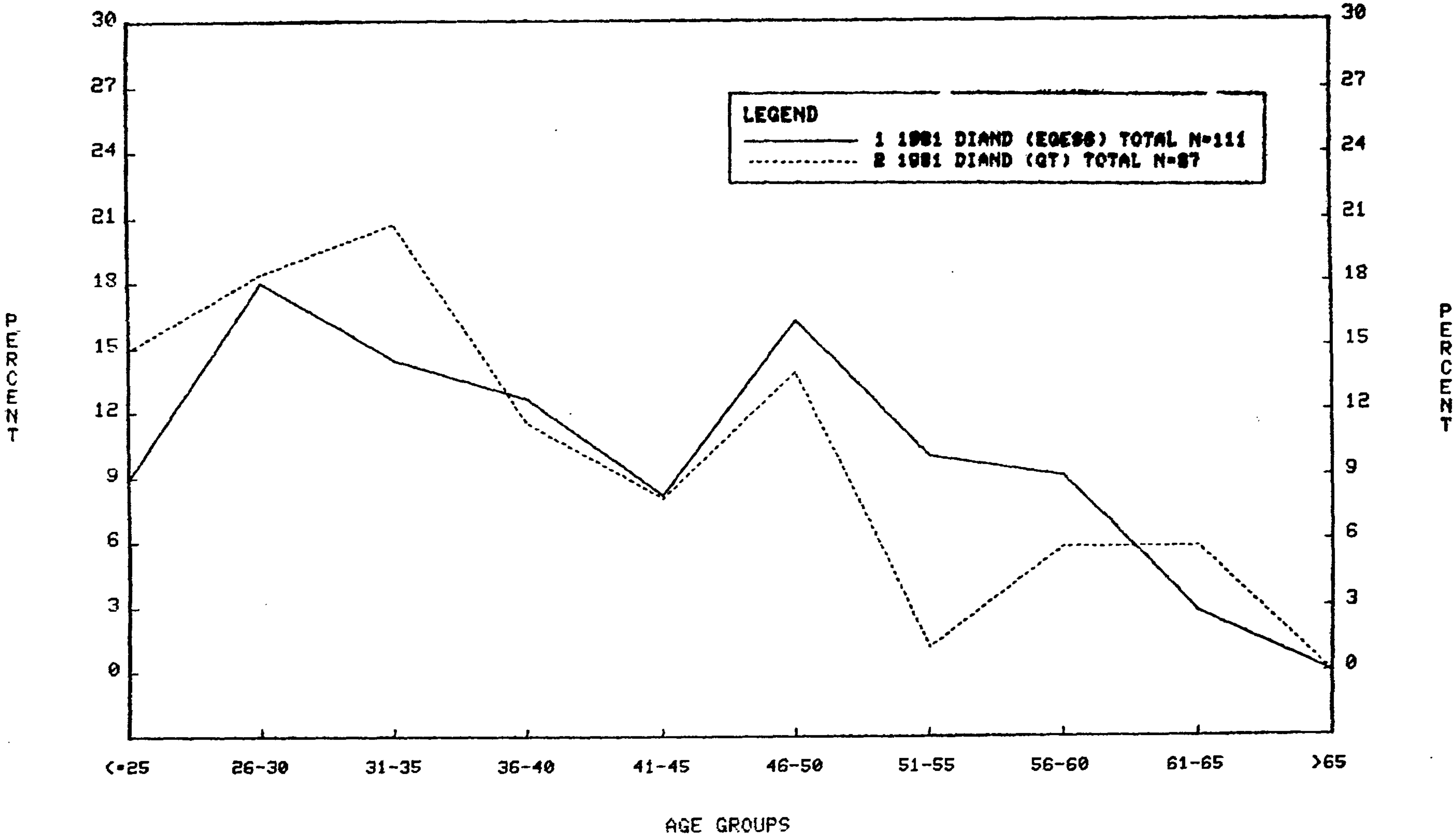
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF PUBLIC WORKS -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS AND GT CLASSIFICATIONS)



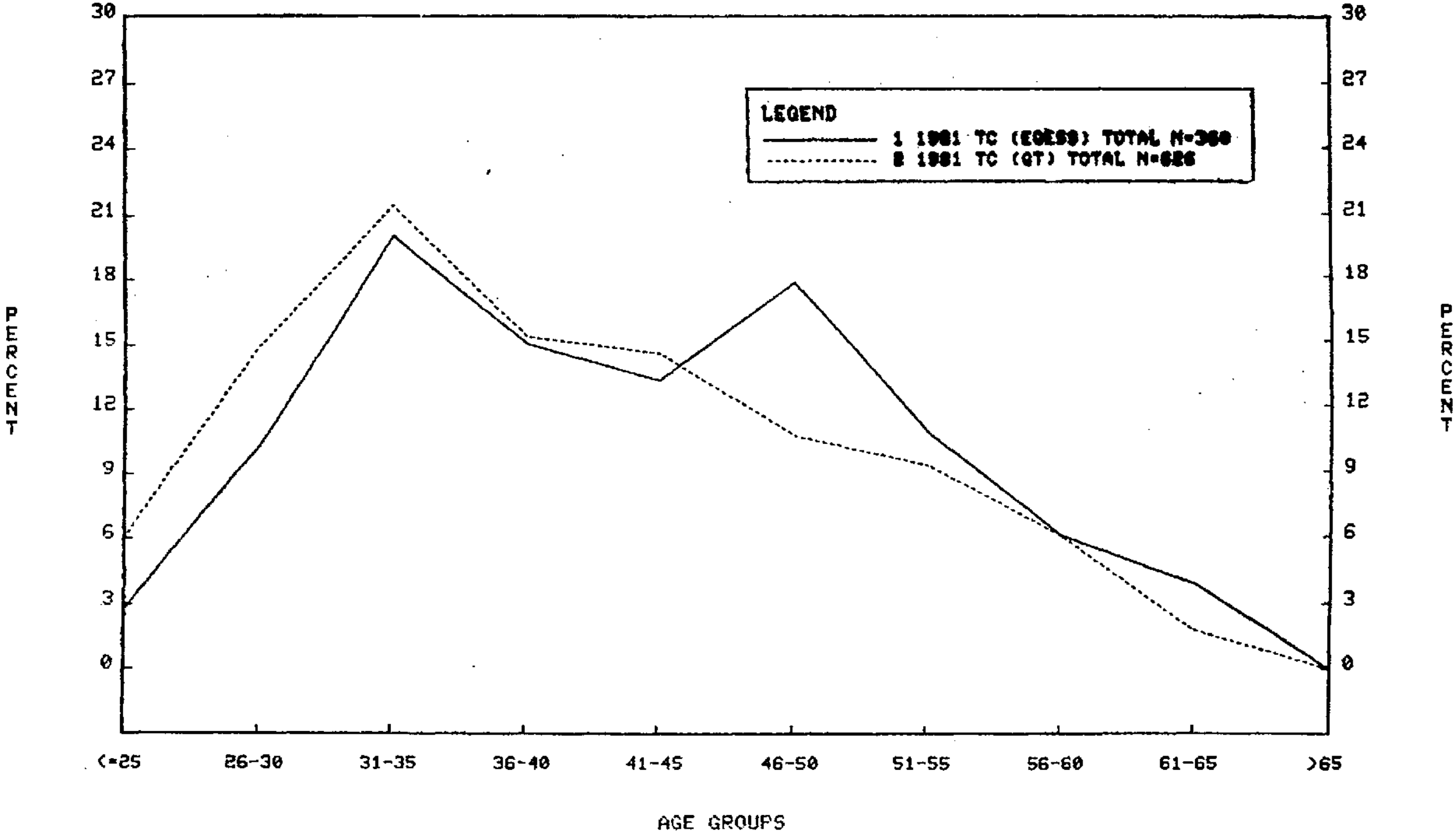
SOURCE : PUBLIC SERVICE COMMISSION

ENERGY, MINES AND RESOURCES - AGE DISTRIBUTION OF TECHNICIANS (EGESS CLASSIFICATION)



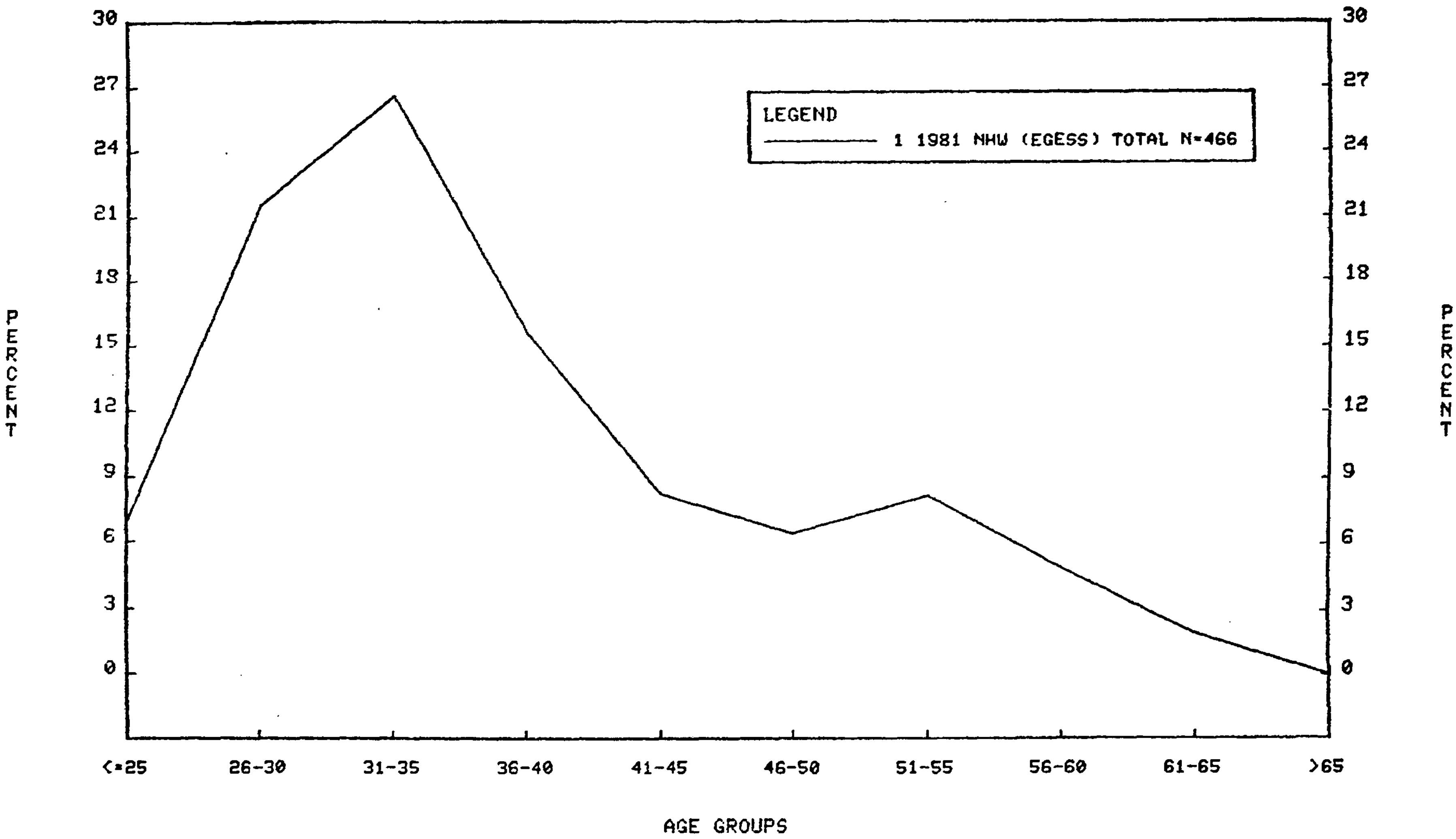
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT - AGE DISTRIBUTION OF TECHNICIANS (EGESS AND GT CLASSIFICATIONS)



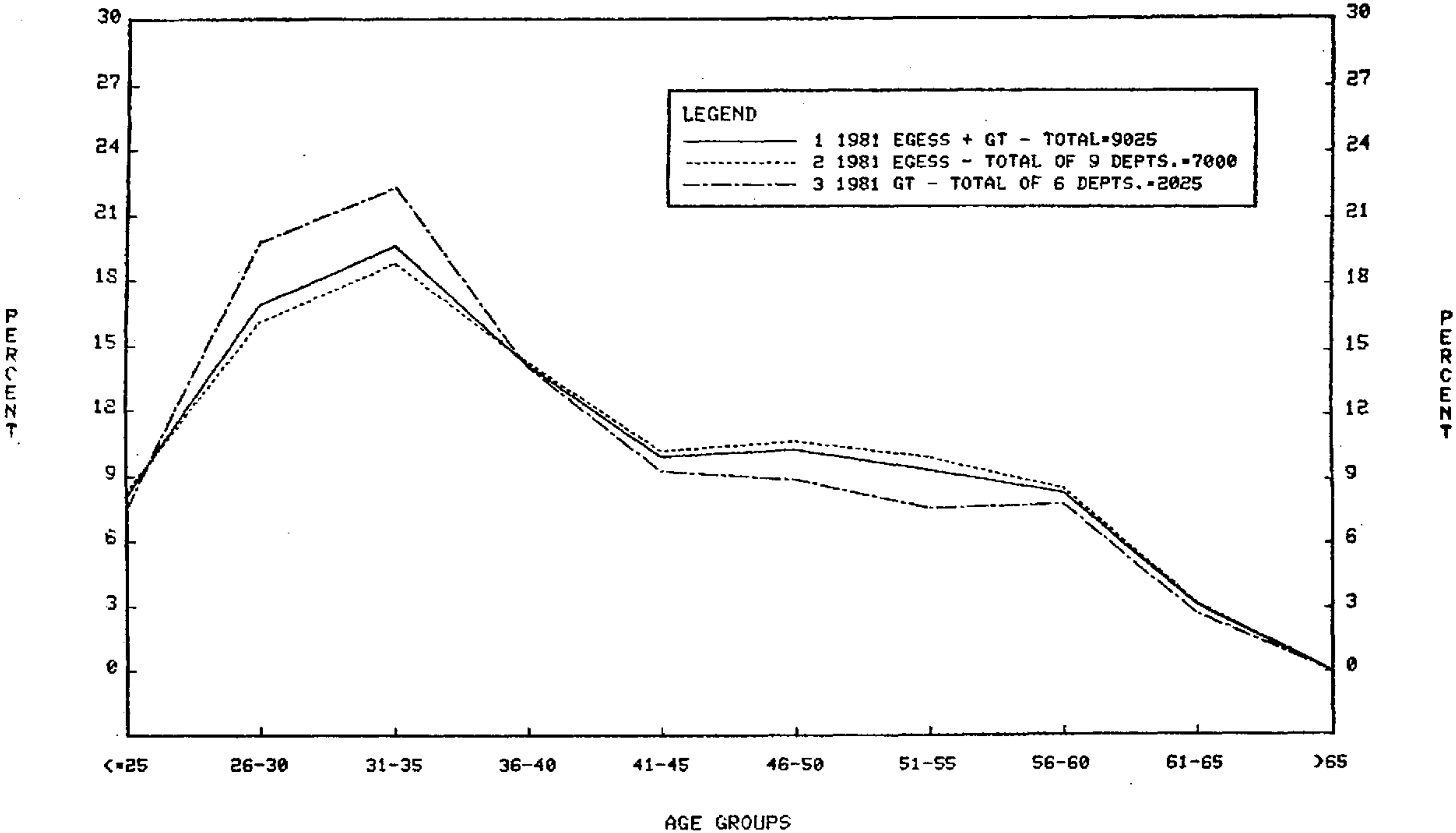
SOURCE : PUBLIC SERVICE COMMISSION

TRANSPORT CANADA -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS AND GT CLASSIFICATIONS)



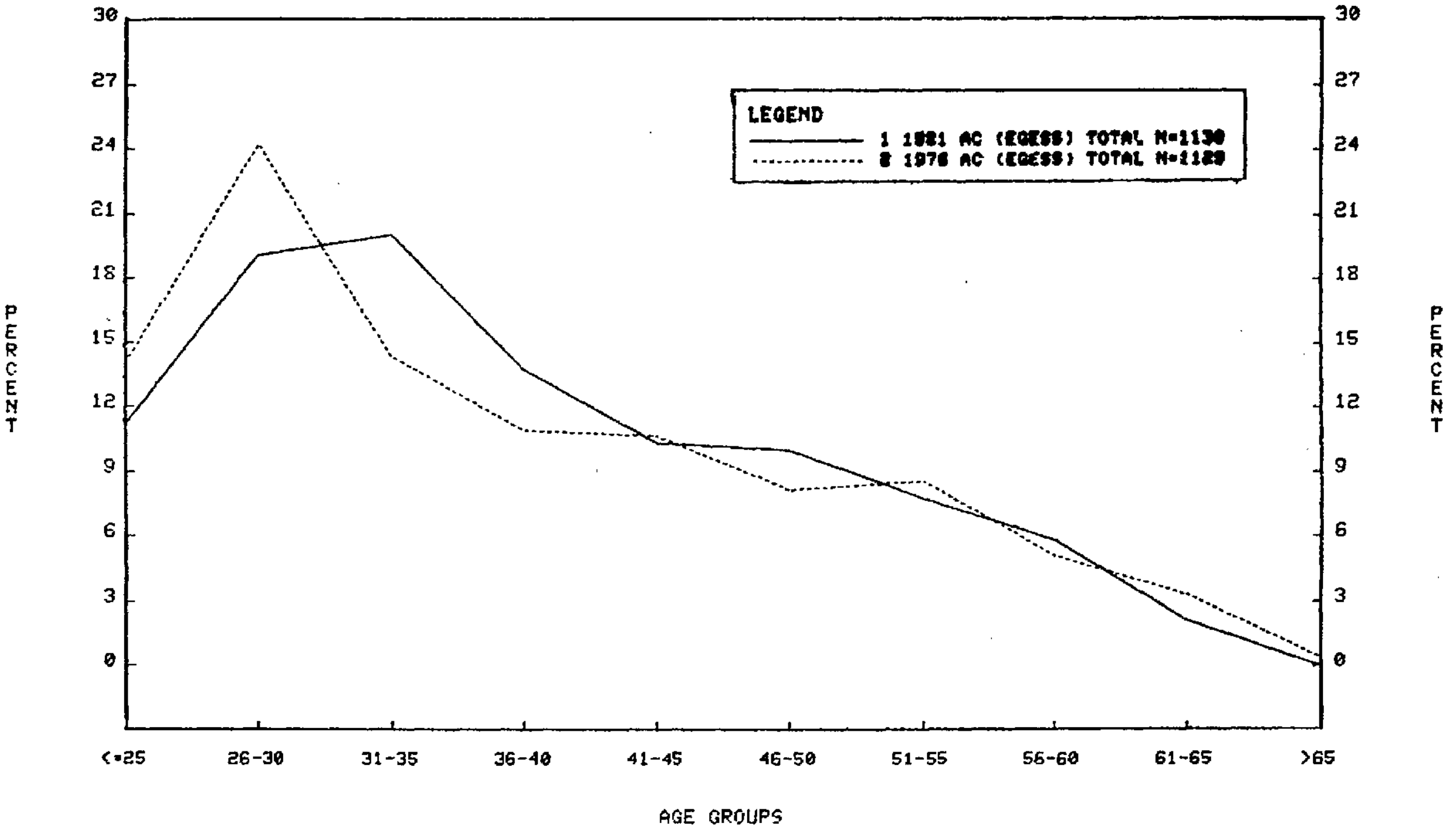
SOURCE : PUBLIC SERVICE COMMISSION

NATIONAL HEALTH AND WELFARE -
AGE DISTRIBUTION OF TECHNICIANS
(EGESS CLASSIFICATION)



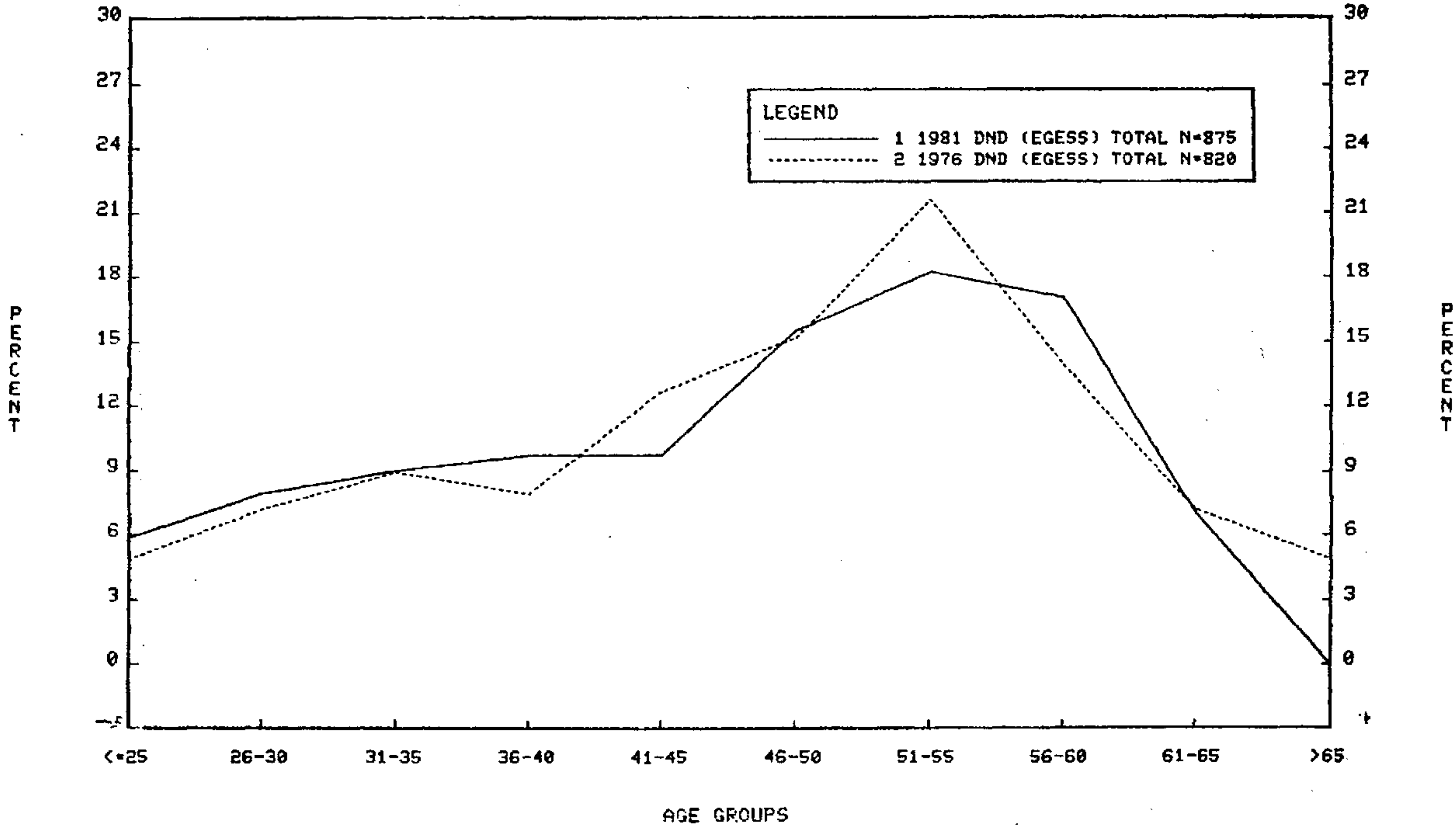
SOURCE : PUBLIC SERVICE COMMISSION

AGE DISTRIBUTION OF TECHNICIANS
GOVERNMENT-WIDE, BY CLASSIFICATION



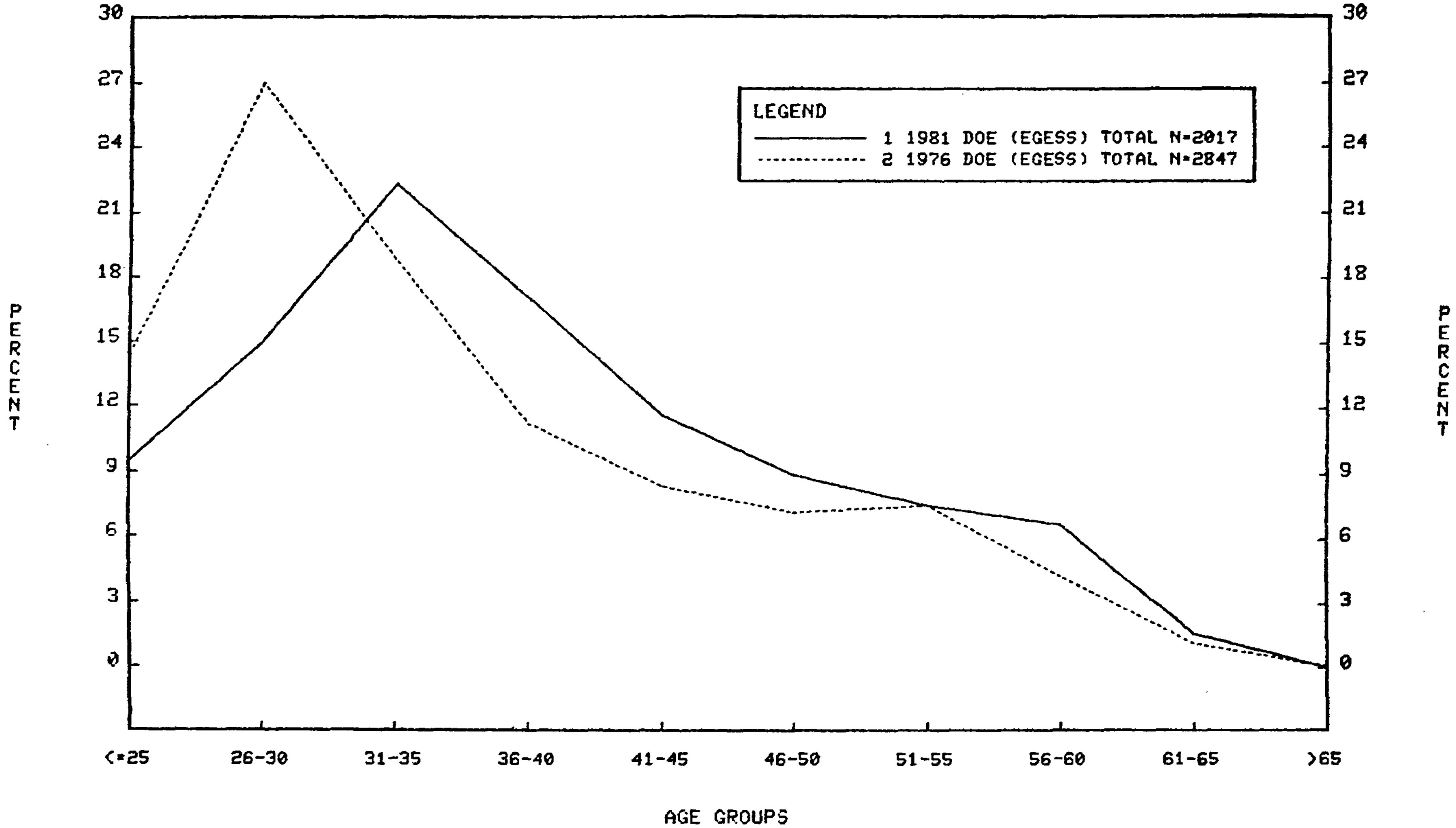
SOURCE : PUBLIC SERVICE COMMISSION

AGRICULTURE CANADA –
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



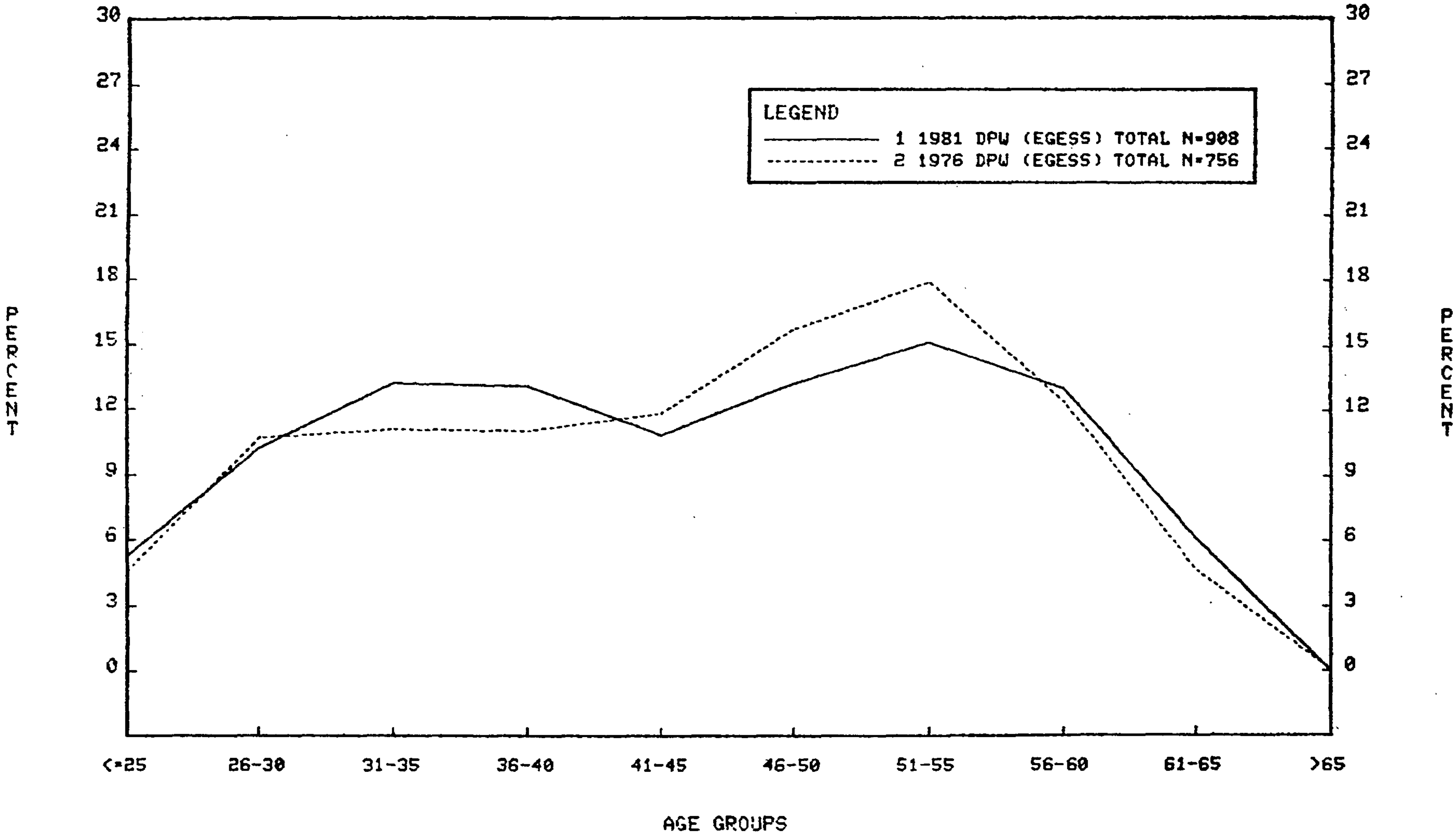
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF NATIONAL DEFENCE -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



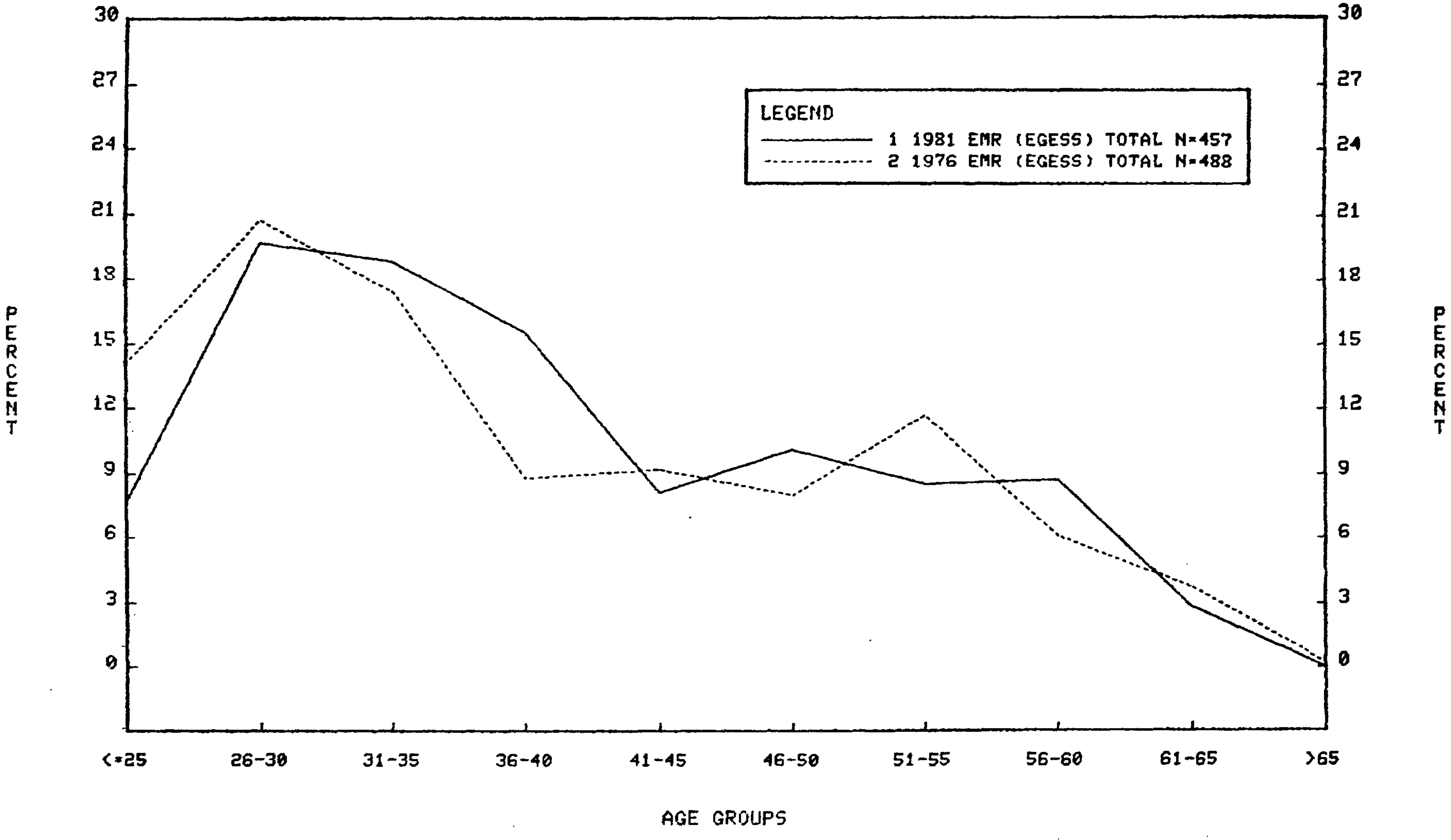
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF ENVIRONMENT -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



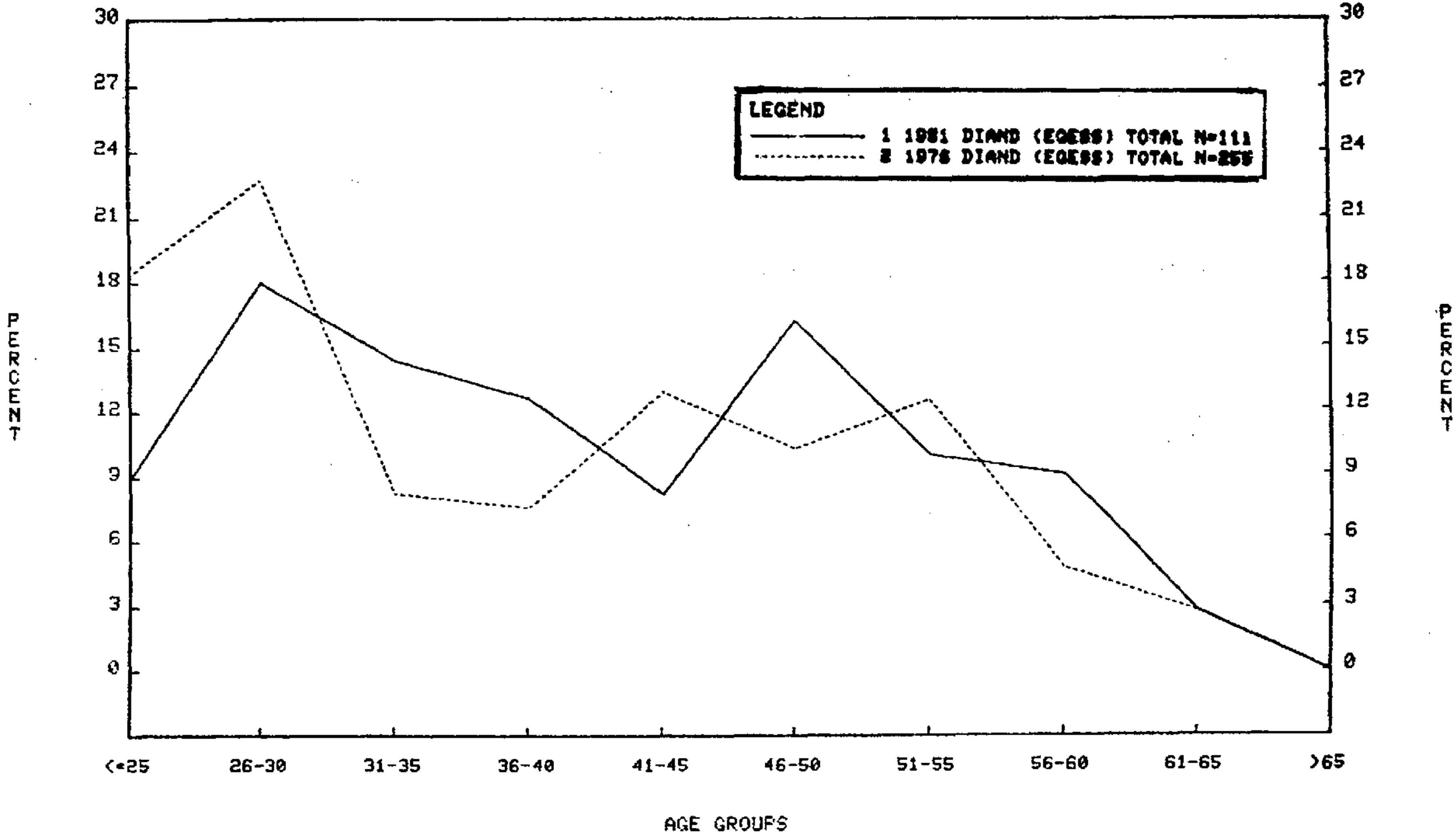
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF PUBLIC WORKS -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



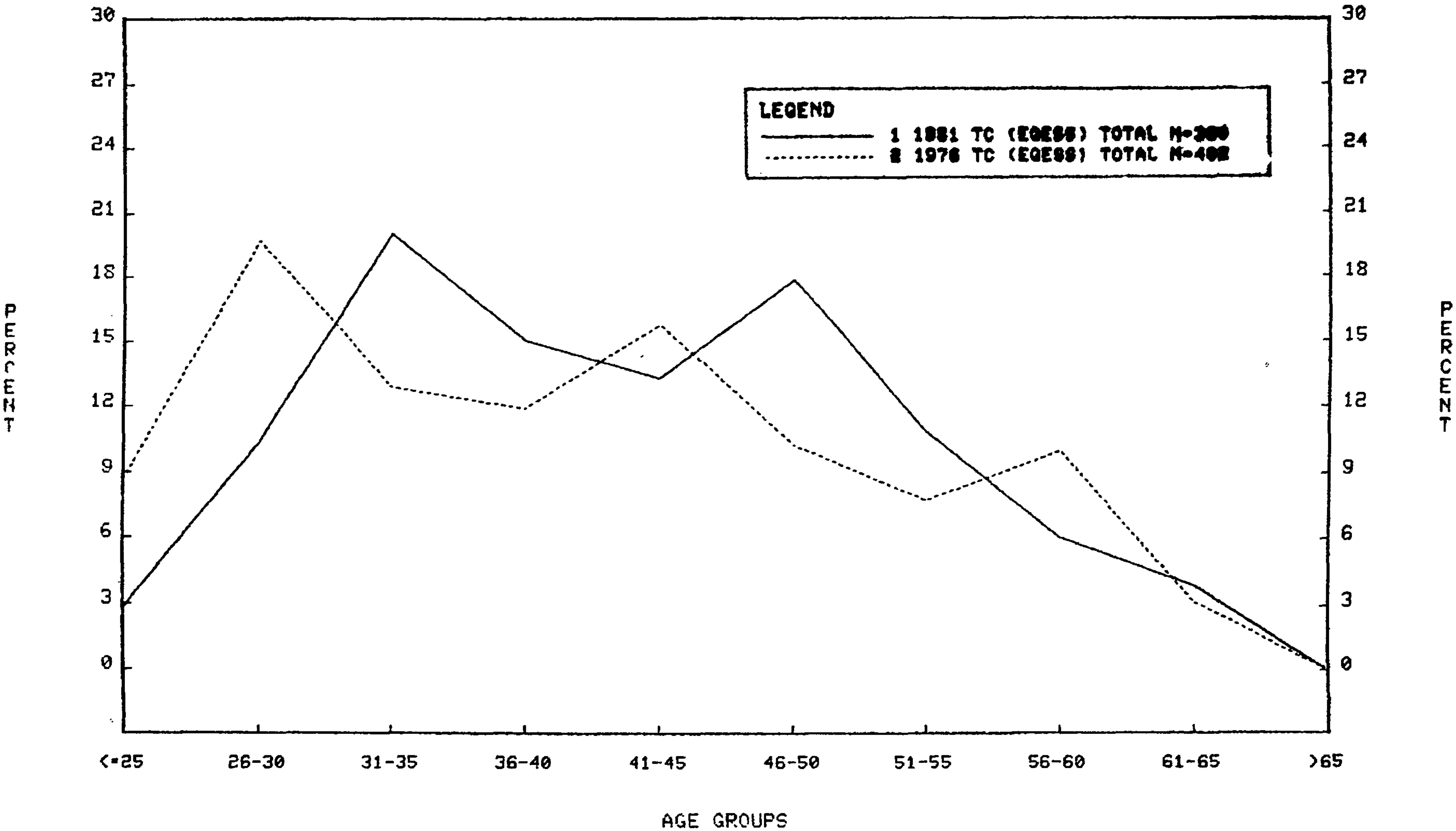
SOURCE : PUBLIC SERVICE COMMISSION

ENERGY, MINES AND RESOURCES -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



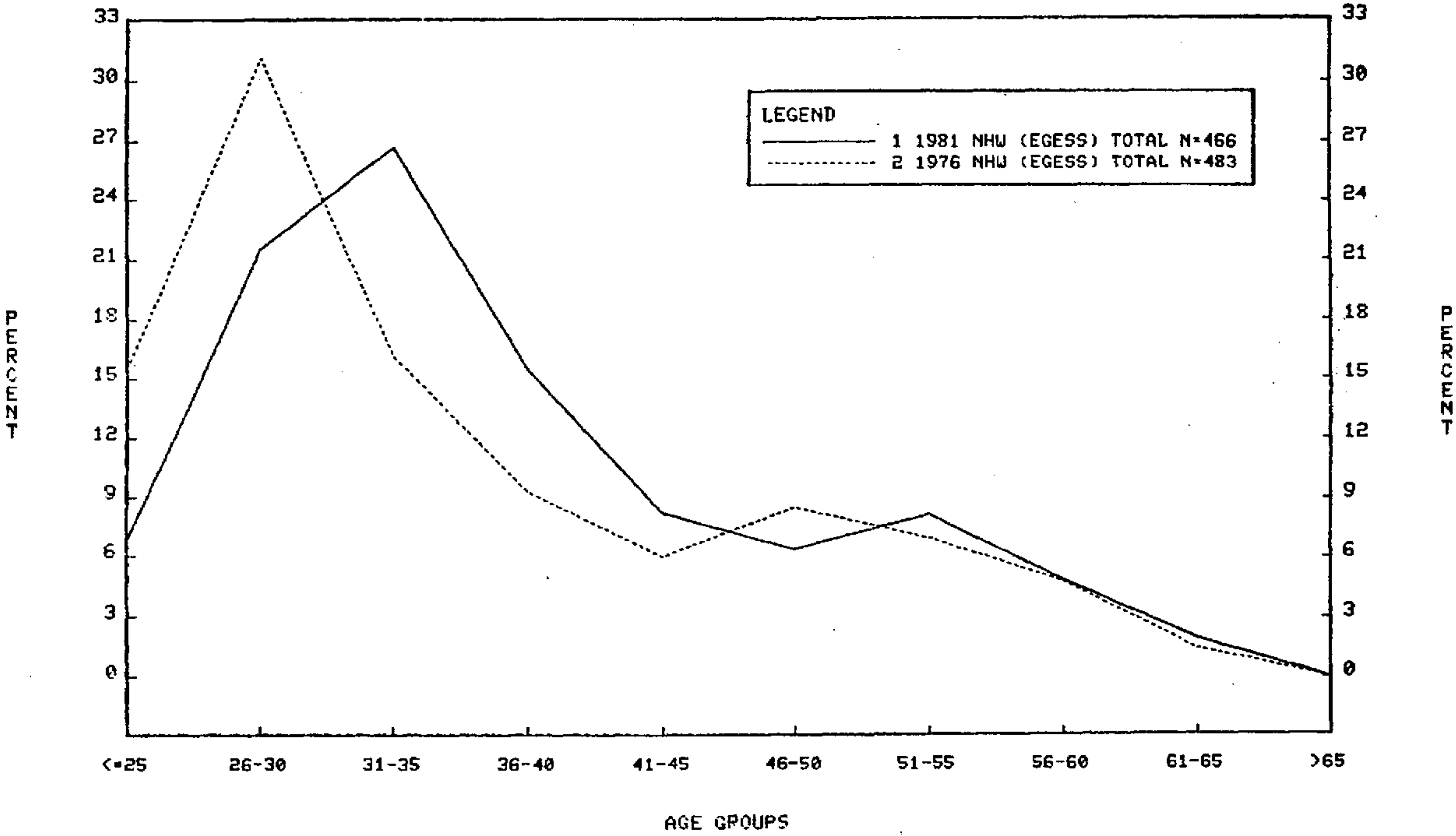
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT -
AGE DISTRIBUTION OF EGESS TECHNICIANS, 1981 and 1976



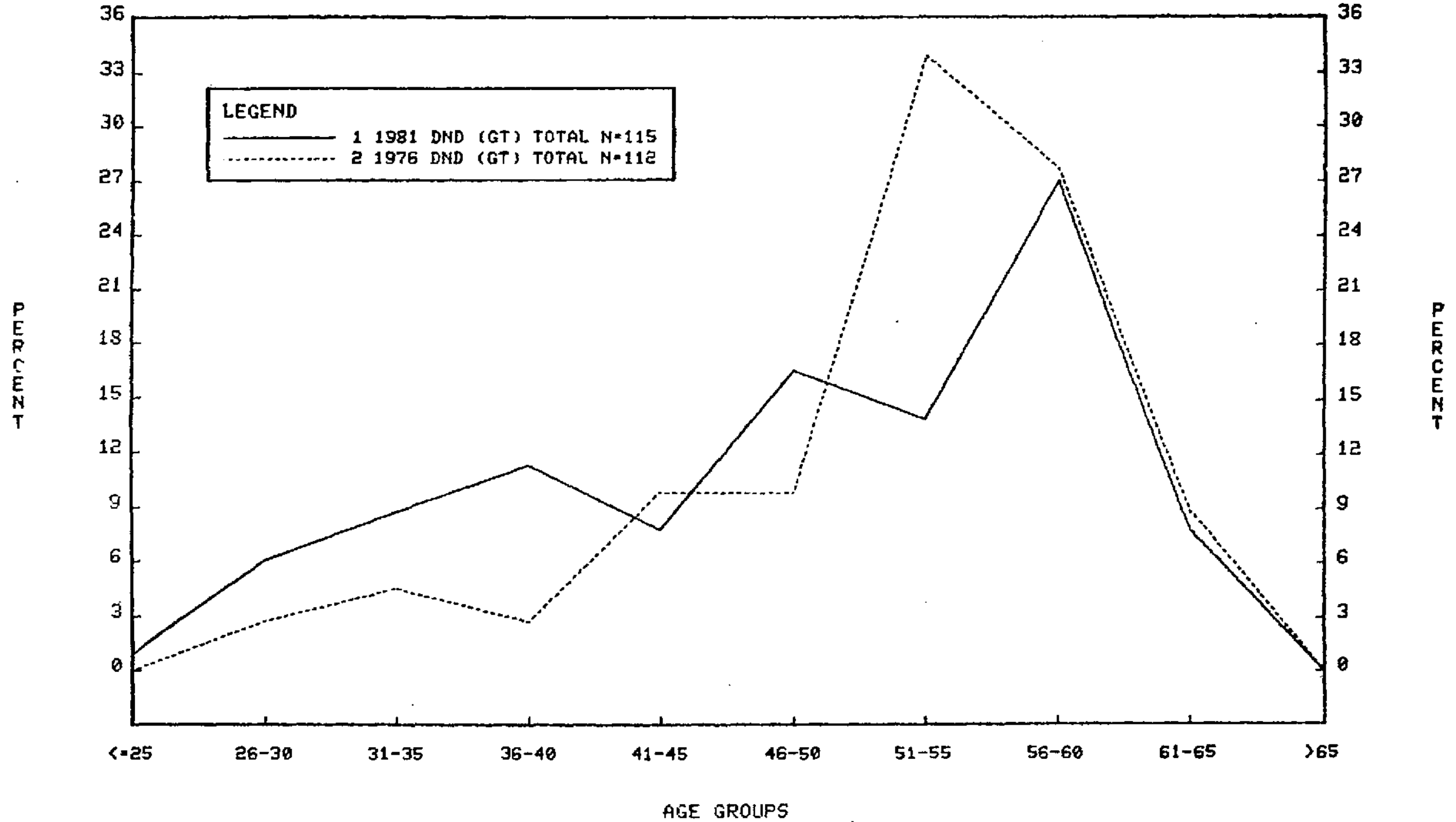
SOURCE : PUBLIC SERVICE COMMISSION

TRANSPORT CANADA -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



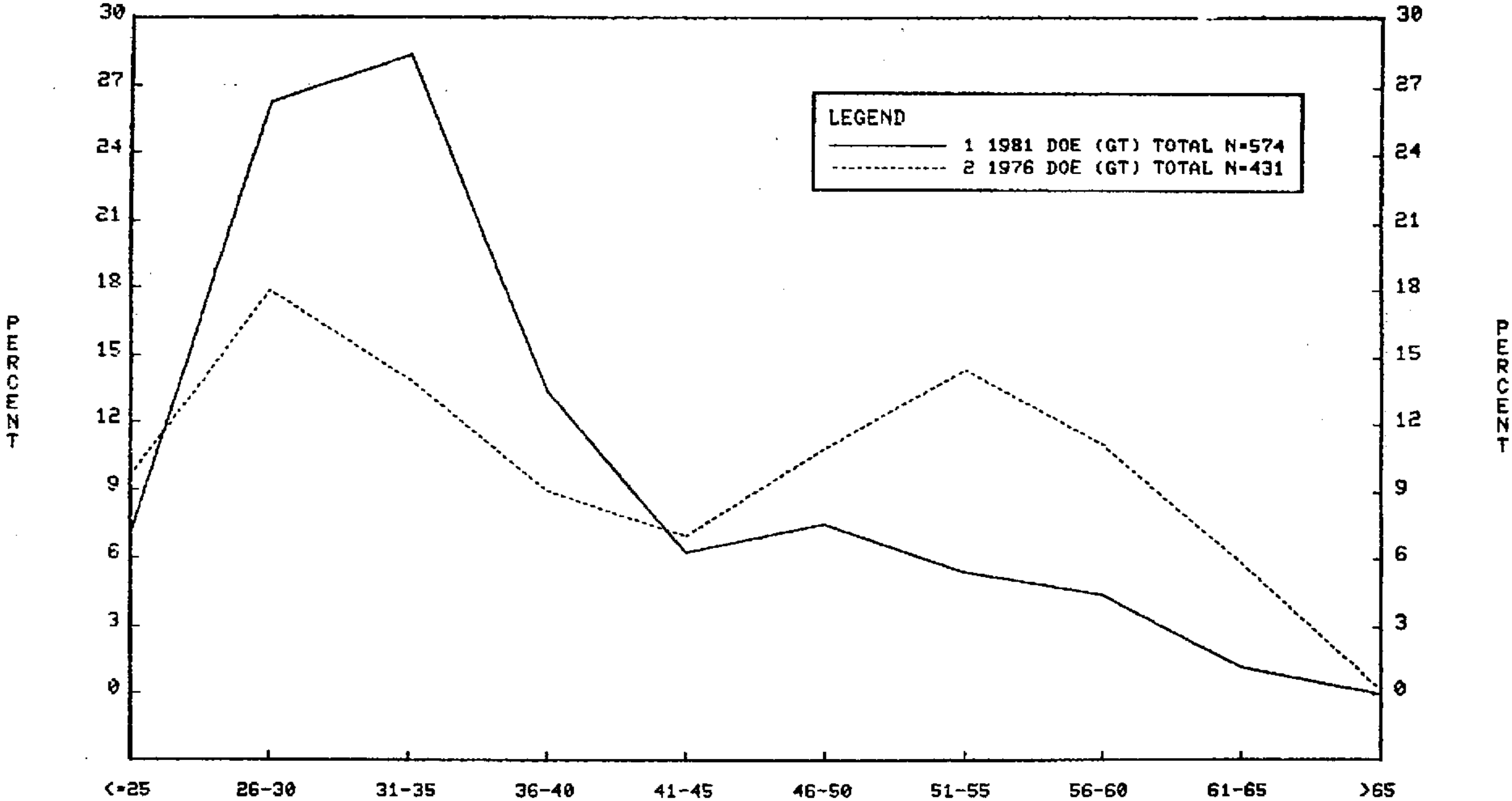
SOURCE : PUBLIC SERVICE COMMISSION

NATIONAL HEALTH AND WELFARE -
AGE DISTRIBUTION OF EGESS TECHNICIANS
1981 and 1976



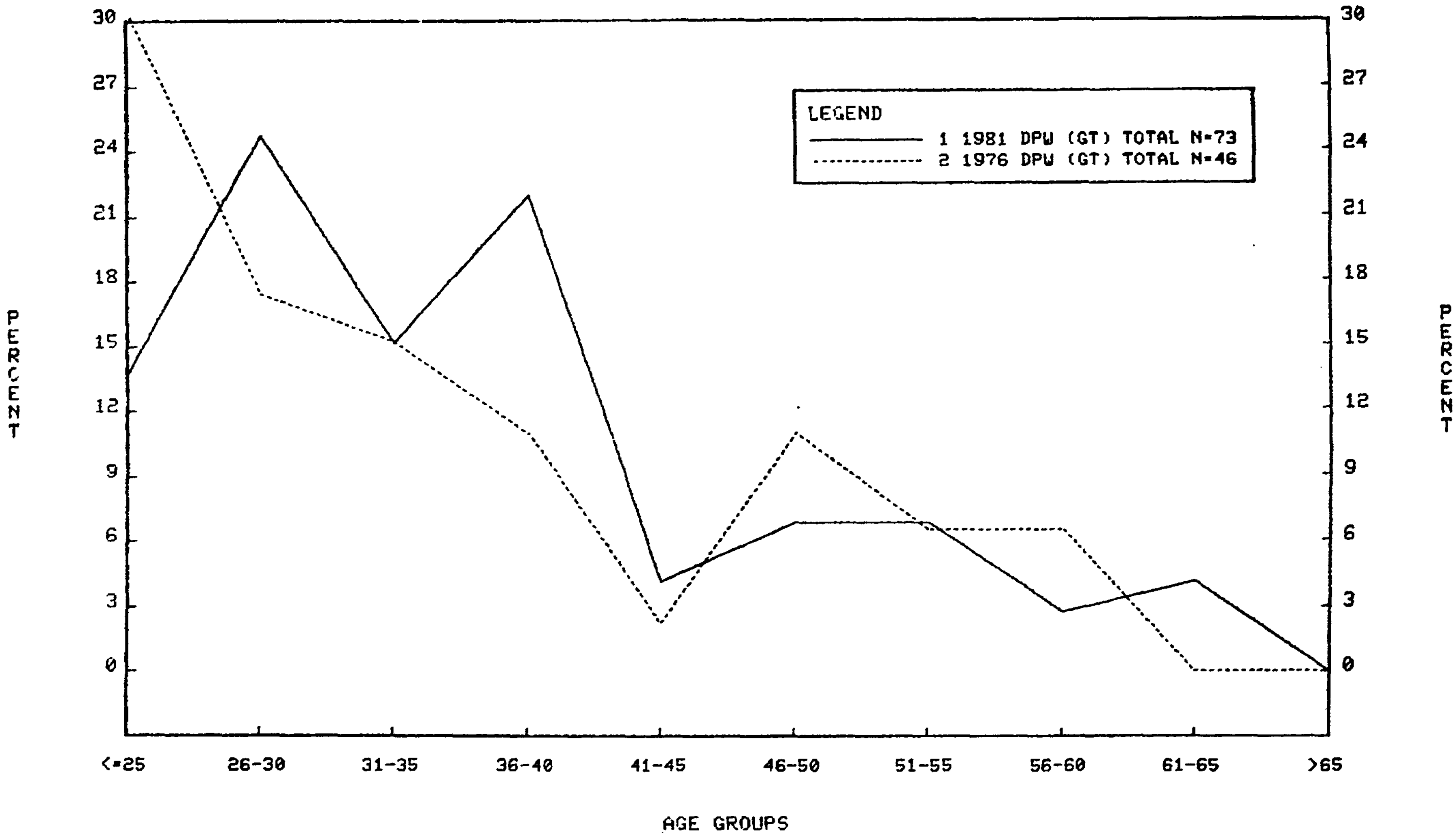
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF NATIONAL DEFENCE -
AGE DISTRIBUTION OF GT TECHNICIANS
1981 and 1976



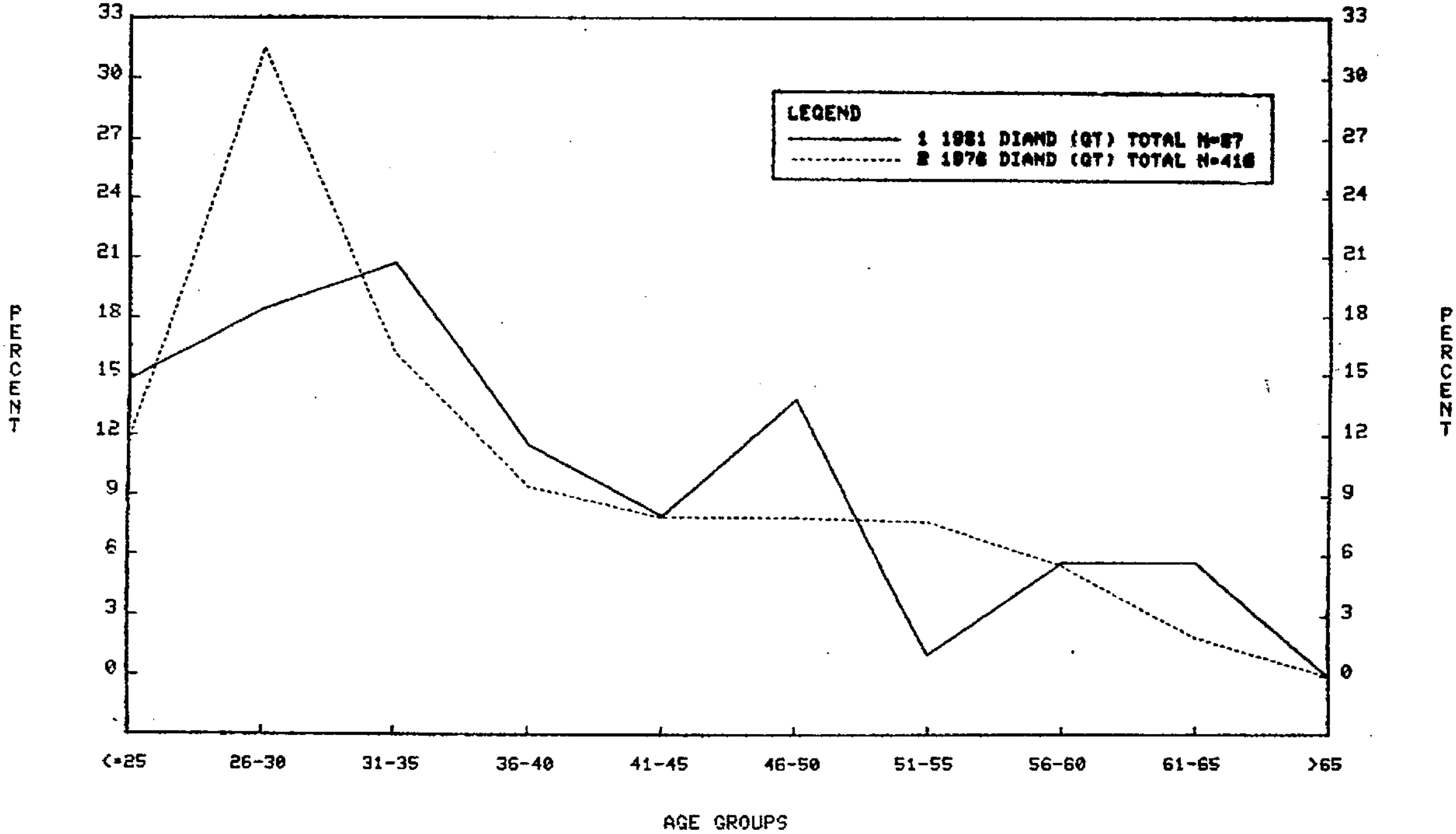
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF ENVIRONMENT -
AGE DISTRIBUTION OF GT TECHNICIANS
1981 and 1976



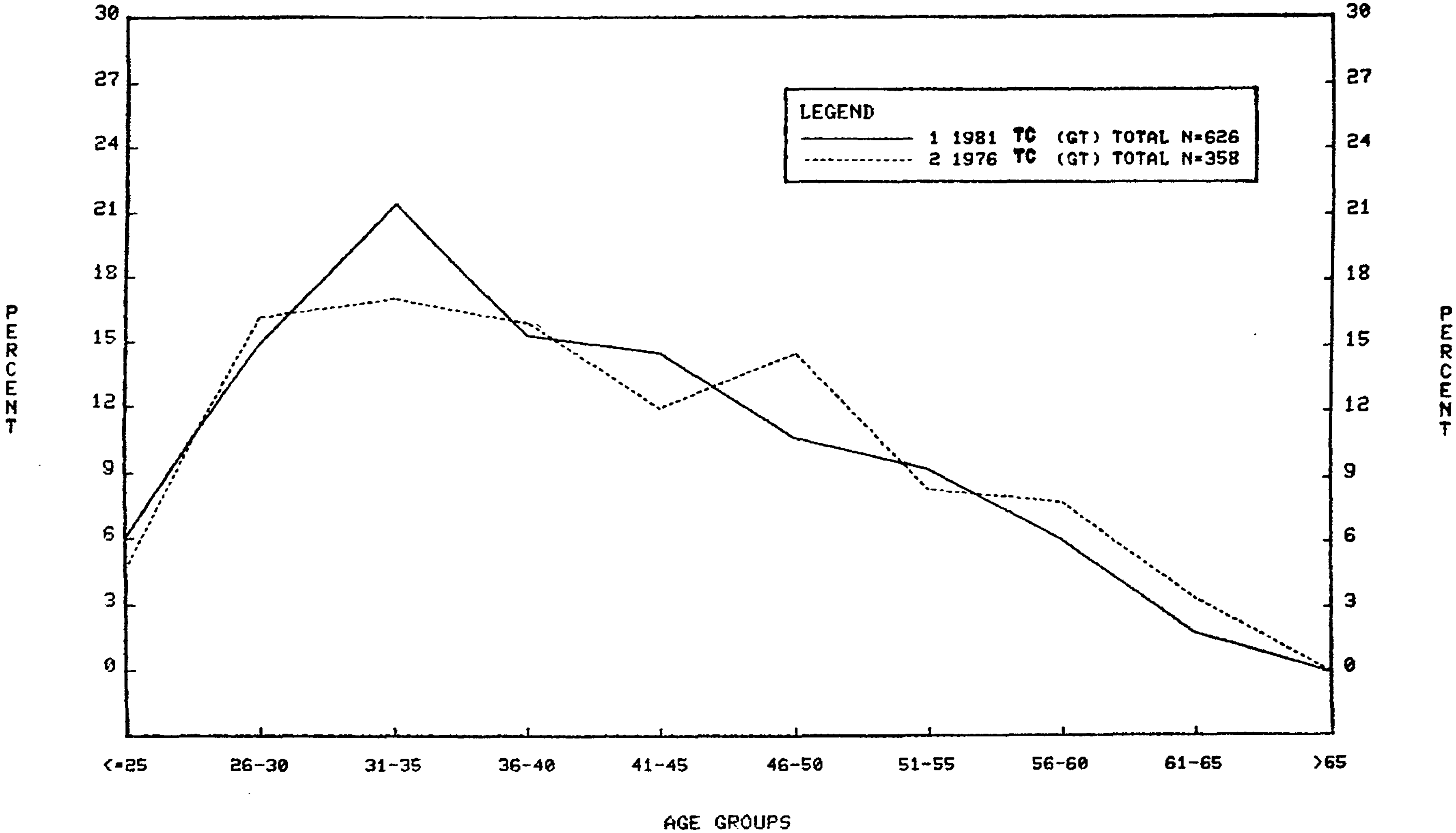
SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF PUBLIC WORKS -
AGE DISTRIBUTION OF GT TECHNICIANS
1981 and 1976



SOURCE : PUBLIC SERVICE COMMISSION

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT - AGE DISTRIBUTION OF GT TECHNICIANS, 1981 and 1976



SOURCE : PUBLIC SERVICE COMMISSION

TRANSPORT CANADA -
AGE DISTRIBUTION OF GT TECHNICIANS
1981 and 1976

APPENDIX G

FLUCTUATIONS IN THE NUMBER OF DEGREES AWARDED BY CANADIAN UNIVERSITIES BY DISCIPLINE, 1978-1980

FLUCTUATIONS IN THE NUMBER OF BACHELORS DEGREES AWARDED BY CANADIAN UNIVERSITIES BY DISCIPLINE, 1978-1980

Discipline	1978 Degrees	1980 Degrees	Difference in Number of Degrees	Percent Change of Difference from 1978 figures
Agriculture	914	880	- 34	- 3.7%
Biochemistry	430	385	- 45	- 10.4%
Biology	3093	2661	- 432	- 14.0%
Botany	63	42	- 21	- 33.3%
Zoology	463	279	- 184	- 39.7%
Vet. Medicine	244	256	+ 12	+ 4.9%
Other Agriculture Sciences	12	62	+ 50	+ 416.7%
Engineering	5105	6214	+ 1109	+ 21.7%
Forestry	271	451	+ 180	+ 66.4%
Chemistry	810	757	- 53	- 6.5%
Computer Science	952	1126	+ 174	+ 18.3%
Geology	446	474	+ 28	+ 6.3%
Mathematics	1471	1577	+ 106	+ 7.2%
Physics	478	420	- 58	+ 12.1%
Other Math and Physical Sciences	163	11	- 152	- 93.3%