(3) Study of Substation Facilities

(a) Study of Design Criteria and Recommendation for Standardization of Substation Facilities

Bid Documents for Substations by Belgium loan and French loan and for acceleration Project have been obtained during the first field investigations. Comparison was made between the Technical Particular Specifications proposed in the above Bid Documents and those for Surabaya Distribution Project. In general, little difference was apparent, because the substation facilities proposed in the above Bid Documents are to be manufactured on the basis of I.E.C. standards etc. However, small differences were found in the specification of substation facilities. The equipments studied in this Report are transformers, circuit breakers, isolator, voltage transformers, etc. It was confirmed in this first field investigation that the design criteria for the substation facilities were the same as those applied in the East Java Project (I to III stages) by NEWJEC. However, although the differences were discovered in some details, such as structures, dimensions, operation methods, maintenance, etc., the single line connection diagrams for the substations are same for both projects. The foundation drawings and layout of the equipment also differ. Considering the above, standardization of the details is seemed difficult.

In the meantime, the standards applicable to the apparatus should be settled by fully understanding the actual conditions of the equipments and thoroughly reviewing the future variation of procurement methods of the equipments. Some of the existing substations do not have standardized equipment, but the various standards of the equipments originating from a variety of countries, even in the same substation area. For maintenance, overall consistency and substation reliability, it would be desirable to use one system which is proved satisfactory, and if possible, to use the same system from the same manufacturer throughout, at least in the relay facilities.

Most important in the additional installation of the existing substations is to match the equipment for the additional installation with the existing facilities. To obtain efficient construction progress and consistent functioning after completion of construction, the suppliers of the equipment should be required to investigate the existing facilities and to supply their equipments in good fitness with the existing facilities.

(b) The Substation Scale and other Inspections and Studies

The result of studies from the technical and economic viewpoints in the long-term is summarized below.

(i) The dimensions of substations and unit capacities of transformers should be selected not only from the viewpoint of construction costs but also from the overall economic viewpoints including the construction cost of transmission lines and distribution lines. The following specifications are recommended as standard dimensions of substations and unit capacities of transformers.

- Number of transformers in a substation

Transferring transformers	2 - 3 banks
Distribution transformers	3 banks

- Unit capacity of transformers

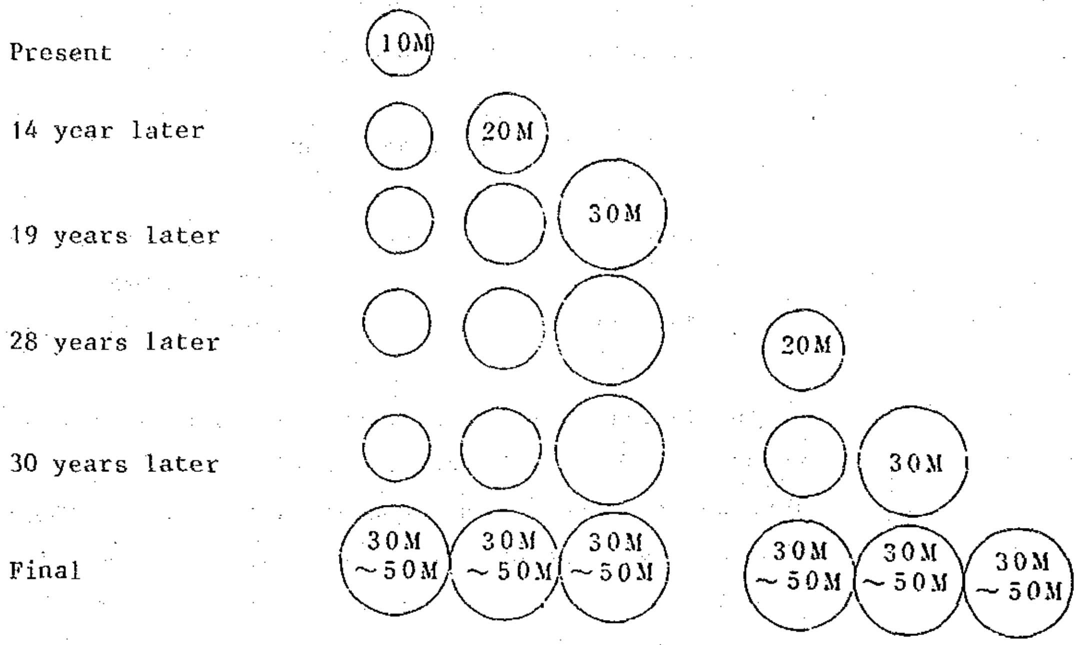
150kV/20kV transformers	100MVA, 50MVA, 30MVA, 20MVA, 10MVA
70kV/20kV transformers	50MVA, 30MVA, 20MVA, 10MVA

In the design of new substations, deliberate countermeasures should be devised to provide for the time lost due to fault of the substation equipment. These should provide adequately for any fault. An economical solution would be to install a transformer with a small capacity than the ultimate capacity for the 1st bank of the new substation and then add another transformer for the 2nd bank in earlier timing. It is recommended that a site suitable for construction of a large capacity substation (100MVA x 3 banks) from which 20 or 25 feeders of 20 kV distribution lines will radiate should be selected for distribution to the highest load area in the center of the large city.

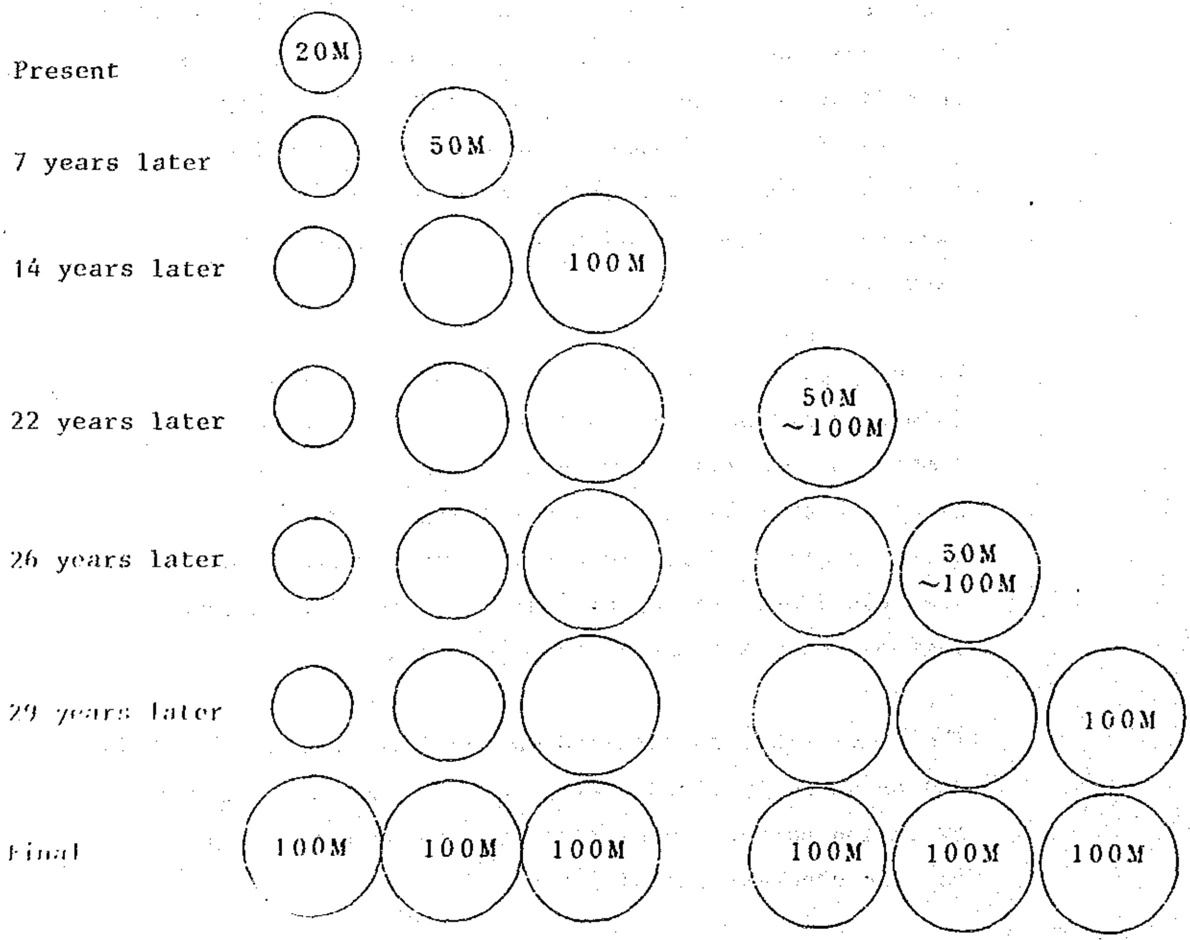
To carry out an economic analysis of the transformer according to its unit capacity, an economic comparison was made between each expansion pattern simulated over 30 years in combination with each unit capacity. This was carried out for each model area considered as representative of rural district, regional city and large city, respectively.

The results are as detailed in the later Section 5.3.2(1) and as shown in Fig.3.3-1(1) to (3), and the following expansion patterns are considered to be the standard for the concrete planning.

— Rural District



— Regional Cities



- Large Cities

Present	50M x 1 = 50MVA + 100M x 1 = 150MVA + 100M x 1		50M x 2 = 100MVA + 100M x 1
20 years later	250MVA	to	200MVA
more than 20 years later	-50 + 100 = 300MVA	to	-50 + 100 = 250MVA -50 + 100 = 300MVA
Final	100 x 3 = 300MVA		

Because of high co-relation between the number of substations and capital cost, it is preferable to give priority not to provision of new substations but to additions to existing facilities. But in this case, compensation for land acquisition, land acquisition for transmission line route, etc. shall be separately considered for installation.

(ii) The bus bar scheme in a substation is determined depending on the scale and importance of the substation. In East Java, the following bus bar scheme is used as the standard. It is recommended that this bus bar scheme should be used throughout.

- The 150 kV and 70 kV bus bars will be of the double bus bar scheme with a bus tie breaker, provided the bus bars will be of the single bus bar scheme in the initial stage of construction.

- The 20 kV bus bars will be of the single bus bar scheme with an auxiliary bus bar.

(iii) For construction of substations in large cities the unit system substation in recommended. Indoor substations or underground substations may be suitable for construction in the most heavily populated areas. The unit system substations are distribution substations which are equipped with only incoming cables and are not provided with outgoing transmission lines. They operate in unit every transformer bank and have the following characteristics.

- The necessary area for site land and building is very small.

- One transmission line and one transformer consist of one set without receiving circuit breaker and primary circuit break of transformer.

- The unit system substations will be protected by circuit breakers at primary side substations.

(iv) The following requirements are going to increase at the recent installation of substations.

- To cope with the social conditions such as difficulty in land acquisition and harmony with environment around substation area.

- To economize man-power for maintenance and operation and to improve safety by this economized man-power.

- To improve the reliability of power facilities themselves

In order to meet the above requirements, a new system of Gas Insulated Switchgear (GIS) was developed in place of atmospheric air dielectric system. This new system has superior dielectric characteristics with sulpher hexafluoride (SF_6) gas. The merits of this system are as below:

- The system is very small and compact.

- The system has high reliability.

- Economization of man-power for maintenance and operation can be expected with this system.

(c) Investigation and Study on Protective Relay System

The system protective relays and equipment protective relays are operated generally in a good condition. However, the following is recommended for further improvement.

. Directional comparison power carrier relays are recommended to be used continuously for 150 kV transmission lines, because they are required to be operated with higher reliability as the system expands.

. Balance relays are recommended to be used additionally for 70 kV transmission lines, in order to improve the reliability and shorten a time required for removal of fault.

. Bus bar protective relays are recommended to be mounted on 150 kV bus bars at key substations.

. At present, ink type automatic oscillographs are used, but it is recommended to use inkless type which is simpler for maintenance.

. There is a tendency in many countries for more use of static type relays for the reason that the working speed of static type relays is higher, the CT burden is less with the static type relays and the prices of the static type and the mechanical type are almost the same. It is recommended, therefore, that technical study and training of operation should be made for adoption of the static type relays.

(4) Study of Distribution Facilities

(a) Study on Up-grading of Consumers Supply Voltage

The up-grading of consumers supply voltage (low-voltage) was authorized in the PLN's Regulations issued in August 1973. Various cases were considered in the implementation schedule and up-grading procedures. The following expenses for up-grading are to be considered from the actual conditions of low-voltage distribution facilities and the facilities in the consumer's premises:

- Replacement cost of the equipment such as pole transformer, W.H.M. and limiter, all of which have no double rated voltage.

- Replacement of the incandescent lamps and the ballasts for fluorescent tubes from 127V to 220V.

- Purchase cost of step-down auto-transformers for 127 kV electric equipments (These transformers are to be lent to the consumers).

The medium voltage (6 kV/20 kV) for the execution of this up-grading work is fixed at 20 kV distribution system, according to the PLN's Regulation. However, some areas are still in 6 kV distribution system. Step-up from 6 kV to 20 kV distribution system is apparently in progress in these areas. In this case, it is desirable to up-grade the consumer's supply voltage and step-up works above-mentioned simultaneously, based on the detailed study and planning.

It is ten years since the PLN's Regulations on the up-grading were issued. According to the data from PLN, the existing 127 V consumers in East Java region comprise approx. 80% of the all low voltage consumers in whole East Java, as of the end of December 1983. PLN is now gradually proceeding the voltage change-over program in the Loss Reduction Project. The effects of the Project would be expected to reduce the energy losses in distribution networks from 20% in 1984 to 13% in 1987/88.

Realization of this up-grading basically makes it possible to improve the distribution lines and to decrease the power loss in distribution facilities. From the long-term viewpoints, an increase in energy sales can be expected due to the distribution loss reduction. Even though the execution of this up-grading project is estimated to require a high construction cost, the up-grading project is considered feasible in the present conditions.

It is recommended that a firm implementation program be prepared yearly as soon as possible and the necessary budget be obtained for the prompt commencement of the project.

(b) Study on Use of Distribution Line

The results of a review of operating capacity of 20 kV distribution lines are summarized below.

(i) Used for the 20 kV distribution system are the loop systems with many feeders or the radial systems with interconnected feeders on densely loaded areas and the radial system without interconnected feeders. In the system with interconnected feeders, the line capacity of one feeder shall be enough to bear the load of another feeder at the time of any fault on it, in order to make it possible to switch the total load of the faulty feeder to the sound feeder.

(ii) The recommended operation criteria for proper operation of the 20 kV distribution feeders are described hereunder. The loop system or the radial system will be used for the feeder system. The standard installed capacity of one feeder will be rated at 400A at an abnormal time and 300A at a normal time. The supply capability of a feeder at a normal time will be determined, taking account of the capacity of the feeder, the interchange of load at the time of interruption of one feeder and the maximum voltage drop. The power to be interchanged at the time of load interchange as specified below.

1. For the 3 circuits radial system

   The total load will be fed by other 2 circuits.

2. For the 2 circuits radial system or the 2 circuits loop system

   The total load will be fed by other 1 circuit.

3. For 1 circuit only

   No interchange power will be available.

(c) Designs of Poles, Wires and Transformers

(i) 2 Circuits Mounting on MV Overhead Line Poles

In East Java, the mounting of 2 circuits on the Midium voltage overhead line poles is carried out by the Vertical Type that one circuit is mounted on the higher part of poles and another circuit on the lower part of poles. This Vertical Type has so many disadvantages in operation and maintenance, for example;

1. Any work for the upper circuit will not be possible, if the lower circuit is live.

2. If arc takes place on the lower circuit, it will spread to the upper circuit which may result in interruption of the both circuits.

3. There is a possibility that OCB relays may malfunction due to inductive current.

In order to avoid such trouble, in principle only one circuit should be mounted on each pole, except on special poles, to promote easy operation and maintenance after completion of construction.

The mounting of 2 circuits on the poles will be limited to places where many outgoing side of a substation. At such places, insulated wires should be used as feeder lines. In addition to the Vertical Type, there are the Flat Type and the Delta Type both types for mounting 2 circuits. The Flat Type can not be constructed in cities, buildings being obstacles to be the Flat Type feeder lines. The connection with a transformer is complicated in the case of Delta Type and will be very difficult to use.

(ii) Wires to be Used for 20 kV Feeders

- Kind of Wires

The wires in use in East Java are AAAC wires just as in West Java. The AAAC wires have better performance in tension strength, electric conductivity and anti-corrosion than the AAC wires. The AAAC wires will cost more for the AAC wires in shorter span. It is recommended that the AAAC wires will be used only for the following sections and the use of AAC wires on other places should be re-studied by PLN.

- for a long span such as river crossing and railway crossing

- on areas exposed to salt contamination

- Size of Wires

  Many sizes of wires are used for PLN distribution lines. Among them, 240 mm^2 and 150 mm^2 are used for main feeders in West Java and 150 mm^2 in East Java. For the 20 kV system, 120 mm^2 will do well from the viewpoints of supplying capacity, voltage drop, economy and ease in stringing work. But larger sizes of wires will be required to cope with the expansion of the supply area and feeder length accelerated by the increase in power load. It is recommended, therefore, that adequate size of wires for all PLN distribution lines should be reviewed and determined for unification referring to the relevant I.E.C. standard.

- Insulation of Wires

  In East Java, bare wires and insulated wires are used. The ratio of insulated wires is estimated about 30%. The insulated wires will be required to be used for distribution lines on urban areas and along roads in order to prevent ground faults, short circuit faults and human injuries caused by wires coming into contact with buildings and trees. It is said that street trees along national roads are prohibited from being cut by Indonesian regulations. It is recommended, therefore, that more insulated wires should be procured for further expansion and a standard on the use of insulated wires shall be established.

(iii) Pole Transformers

The selection of unit size of the pole transformers and their adaptability was economically evaluated with demand density and utilization factor of transformers as a parameter. In principle, it is gainful to utilize the three-phase transformers. It is recommendable to utilize 1 ø transformers only in case it is difficult for the single-phase load to maintain the phase balance by three-phase transformers. And the selection of each unit - 50 kVA, 100 kVA, 150 kVA - of 3 ø transformers is preferably to depend on the demand density, and it is desirable that the load factor of the pole transformers should be over 40%.

(d) Study of Power Loss Reduction of Distribution Facilities

PLN data indicates that the rate of distribution loss in East Java is about 20% and is planned to be reduced to about 13% until 1987 by the execution of step-up work, etc. The rate of distribution loss is rather high. It will be necessary to extract specific feeders with a high loss rate and work out concrete countermeasures to reduce their loss rate.

The most effective method of reducing the distribution loss is the step-up work. A considerable reduction in loss is expected by the scheduled execution of the step-up work. In order to further the reduction of loss rate, more elaborate countermeasures should be taken. An important countermeasure among them is to extract the feeders with a high loss rate and plan an adequate measure based on their characteristics and forms.

By comparison of the sent-out energy from each feeder with the total sold energy to consumers connected to the feeder, feeders with a high loss rate should be extracted. In order to know the exact sold energy, the load from the consumers connected to the feeder should not be switched over to the other feeder.

(e) Study of Interconnection with Distribution Line between East Java and Central Java

The grounding system of distribution lines in East Java is a high resistance grounding system, while that in Central Java is a low resistance grounding system. The interconnection of distribution lines with different grounding systems will be impossible. The boundary area between East Java and Central Java presents a wide secluded area in the mountains. On such area, the interconnection of both distribution lines will be expensive in terms of cost of supply, even if their grounding systems are the same. In Japan, there are no interconnections of distribution lines between two different electric companies, and even the distribution lines belonging to the same electric company are not interconnected to each other between its two branches except for power supply to high demand areas located in-between.

Power supply with low voltage from both East Java and Central Java distribution lines can be made if receiving voltage and phase rotation are fitted each other at the receiving end. However, special care should be taken to avoid the parallel operation of distribution between East Java and Central Java lines.

(f) Study of Overhead Grounding Wire Installation on Distribution Line

The value of IKL in East Java is estimated about 100, which shows a high value peculiar in the tropical zone. The report on interruption dealing with statistics of faults at PLN D.J.T. in November, 1983 and April, 1984 show only 17 interruptions due to lightning in the two months but in records 185 interruptions due to other causes. It seems that many interruptions which should have been classified as those due to lightnings are included among 185 interruptions. Any interruption might not take place on a distribution line immediately after lightning stroke but it might occur after several days. Such interruption might likely be recorded as due to unknown causes. If we assume that about half of interruptions due to other causes in the rainy season are due to lightnings, the total of interruptions due to lightning can be estimated at around 500, which is almost the same frequency as in Japan.

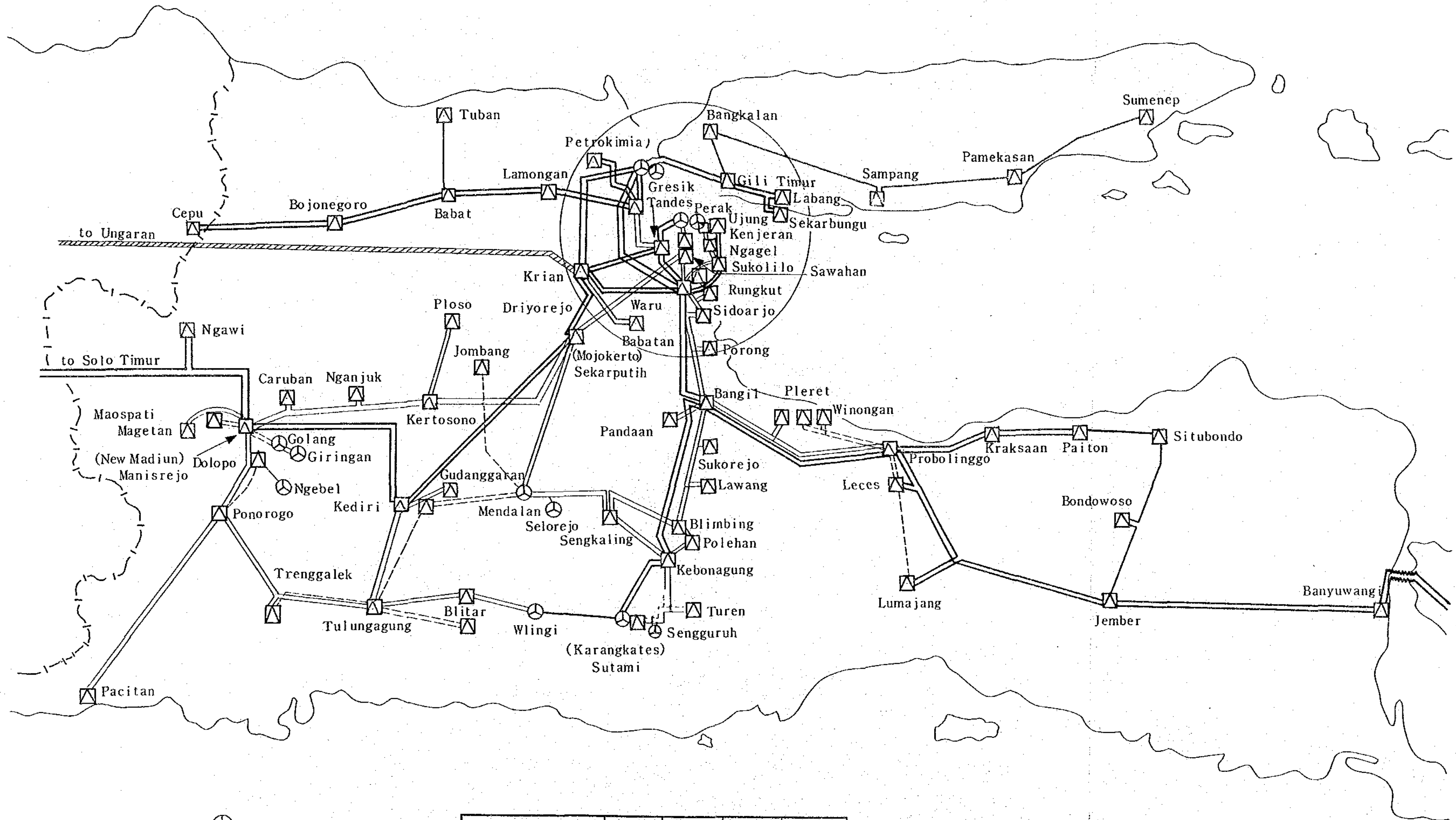
At present ground wires have been installed on distribution lines over the whole East Java since the East Java Transmission and Distribution Network Project 1st Stage started in 1970. Because of lack of data, we could not grasp the effect of ground wire installation for reduction of interruptions due to lightnings. For reference, the record of the Kansai Electric Power Co., Inc., Osaka, Japan dealing with the same problem was reviewed. In the Kansai Electric System, ground wires had not been used over the whole distribution lines but only on limited areas until 1975, because they are expensive. However, installation of ground wires has been promoted by the Kansai Electric since

1976, and in 1983 the distance of its overhead ground wires reached about 30% of the distance of its overhead distribution lines. (82.7% in the Tokyo Electric Power Co., Inc.)

As mentioned above, the installation of overhead ground wires has a good effect for reduction of interruptions, but they are not recommended to be used over the whole area of East Java for reasons of high cost. It is recommended, therefore, that criteria for the application of overhead ground wires should be set up based on the scope of application of overhead ground wires introduced as an example in Section 3.4. and installation of them should be promoted according to the criteria.

It is important to record exact causes of interruptions on high voltage distribution lines for analysis of causes and planning countermeasures for mitigation of causes; exact reports from the field, particularly detailed reports by observation of interruption at the time of occurrence, would be very useful. For reference, the format of reports used in the Kansai Electric for computer processing and an example of report description on the same form are shown in Section 3.4.

East Java Power System Map (1987/88~1988/89 Phase)



Power plant

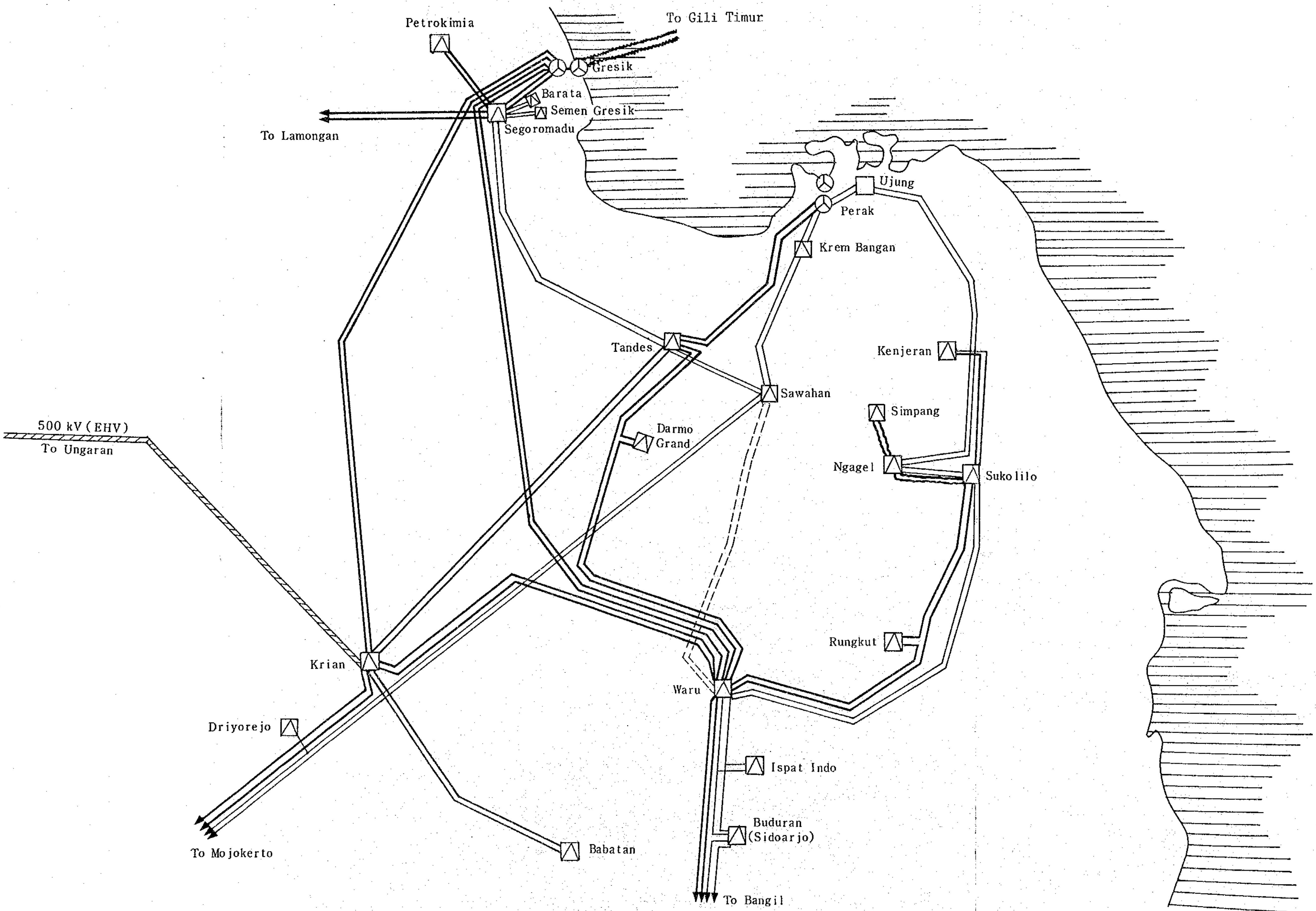
Substation (Existing)

NEW, Construction

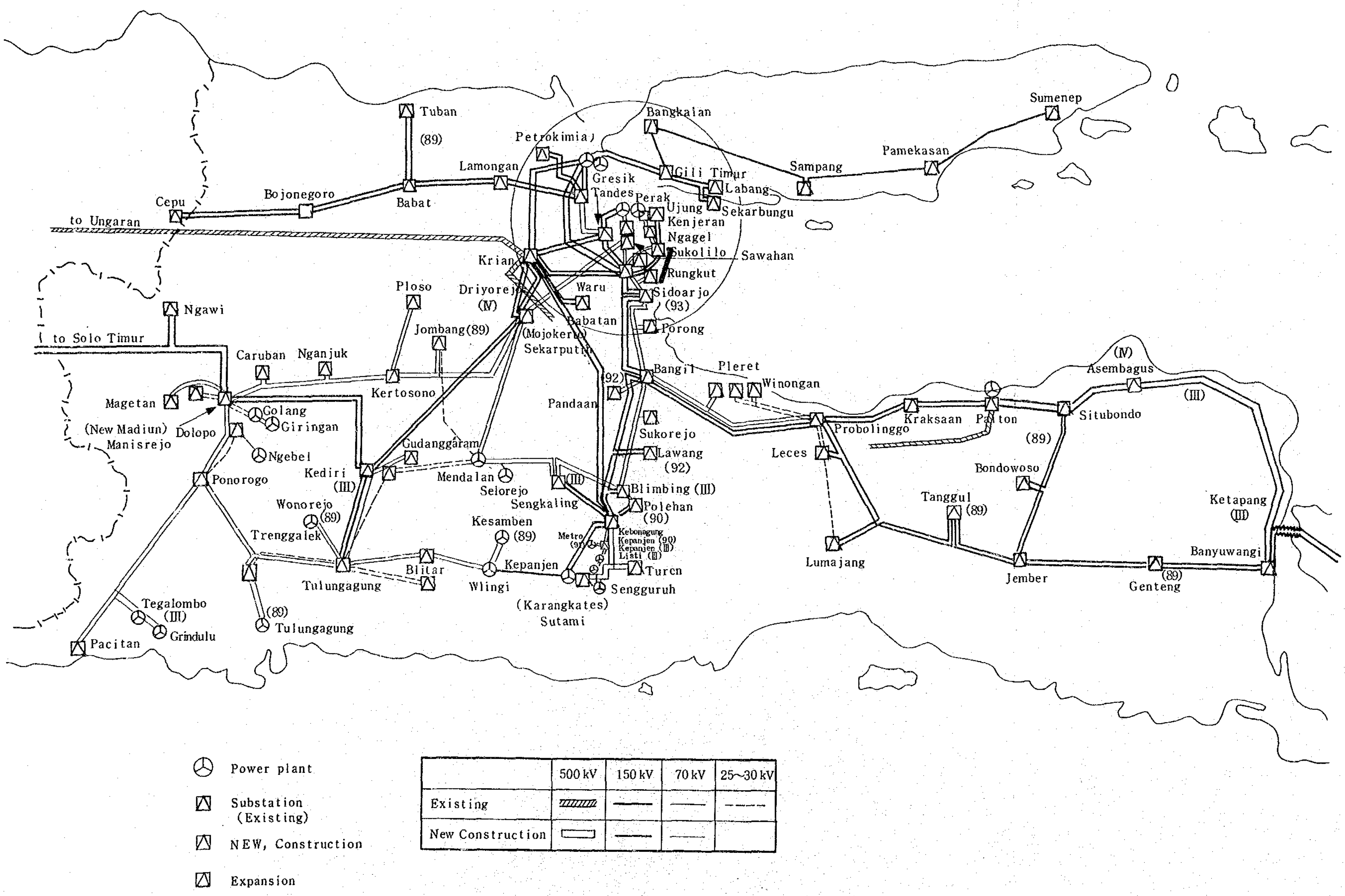
Expansion

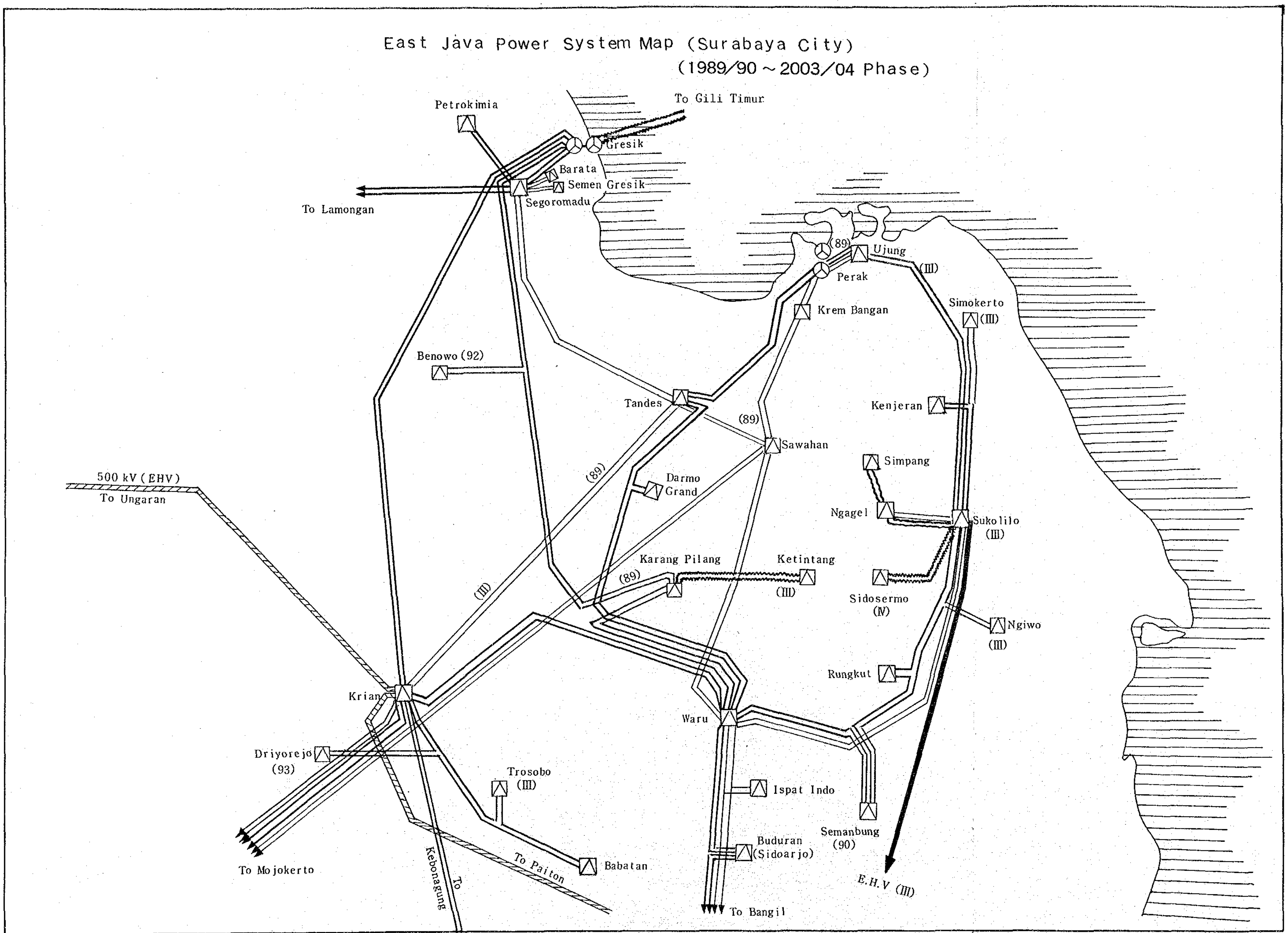
	500 kV	150 kV	70 kV	25~30 kV
Existing	//////	——	——	----
New Construction		——	——	
Rehabilitation			----	

East Java Power System Map (Surabaya City)
(1987/88～1988/89 Phase)



East Java Power System Map (1989/90～2003/04 Phase)




East Java Power System Map (Surabaya City)
(1989/90 ~ 2003/04 Phase)
To Gili Timur
Petrokimia
Gresik
Barata
Semen Gresik
Segoromadu
To Lamongan
(89)
Ujung
Perak
(III)
Krem Bangan
Simokerto
(III)
Benowo (92)
Kenjeran
Tandes
(89)
Sawahan
Simpang
500 kV (EHV)
To Ungaran
(89)
Darmo
Grand
Ngagel
Sukolilo
(III)
Karang Pilang
Ketintang
(89)
(III)
Sidosermo
(IV)
(III)
Ngiwo
(III)
Rungkut
Krian
Waru
Driyorejo
(93)
Trosobo
(III)
Ispat Indo
Semanbung
(90)
Buduran
(Sidoarjo)
E.H.V (III)
To Mojokerto
To Paiton
Babatan
To Kebonagung
To Bangil

CHAPTER 2

DEMAND FORECAST AND SYSTEM PLANNING

CHAPTER 2 DEMAND FORECAST AND SYSTEM PLANNING

2.1. Demand Forecast

2.1.1. Outline of Demand Forecast

Demand forecast in this Report consists of demand forecast by macro approach and demand forecast by micro approach.

(1) Demand Forecast by Macro Approach

Forecast energy of PLN in East Java can be forecasted from the growth rate of GDP for each of the planning term in Indonesia, the elasticity of GDP to the electric energy consumption and the regional coefficient between the growth rate of RGDP in East Java area and the average of that in the whole Indonesia for each term.

(2) Demand Forecast by Micro Approach

This forecast was carried out separately by each Cabang in each category; residential, commercial, public and industrial. Final forecast energy shall be determined by rational adjustment between the forecast energy values obtained by Macro Approach and Micro Approach, so that both values shall be equal.

2.1.2. Demand Forecase by Macro Approach

The increase rate of PLN's total energy sales in East Java can be calculated by the product of the growth rate of GDP, elasticity and regional coefficient.

In this demand forecast, the annual average increase rate of GDP was assumed at 5 %.

The elasticity between the electric energy consumption and GDP is at present estimated to be 2.5, which is considered very large compared to that of developed countries due to following two reasons.

1) The shift from captive power to PLN's power is still on the way

2) The shift from use of the kerocene lump to electric lump is still on the way

Since the above shift phenomena are expected to decrease gradually in the future, the elasticity can be estimated at approx. 2.0 in the end of this forecast.

In the short-term demand forecast, the regional coefficient is assumed 1.25, however, in the future it can be estimated to decrease towards 1.0.

Based on the above assumption, the demand forecast in the specific year during each of the terms was performed by the macro approach, of which result is summarized as follows:

Term	Specific Fiscal Year	Elasticity	Regional Coefficient	Growth Rate(%)	Forecast Energy (GWh)
Actual Record	1982/83				1,798
Short-term	1988/89	2.5	1.25	16.0	4,380
Mid-term	1993/94	2.5	1.1	14.0	8,433
Former Half of Long-term	1989/99	2.25	1.1	12.0	14,862
Latter Half of Long-term	2003/04	2.0	1.0	10.0	23,935

2.1.3. Forecast of Residential Demand

The energy sales for residential use by Cabang was calculated from the product of an unit energy consumption per household, number of households and rate of electrification in a Cabang.

In this demand forecast, above mentioned matters were assumed as follows.

The actual record of an unit energy consumption per household is shown in Fig. 2.1-1. As obviously seen in this Figure, generally it represents a level or slightly decreasing tendency. The reason of this tendency is due to recent big increase in the rate of electrification. However, it is expected in the future that the unit energy consumption per household will be increased in accordance with slow down of the electrification ratio, because new small consumers will decrease in such situation.

Number of households can be calculated as follows:

$$\text{Number of households} = \frac{\text{Population}}{\text{Number of persons per household}}$$

For the forecast of population by Cabang, a modified logistic curve was adopted as described in detail in Subsection 2.1.7. 4.5 persons which were estimated by PLN were adopted as the number of persons per household.

Assuming that the trend of the rate of electrification can be obtained from any of the following growth curves, the trend analysis was made to get the optimum curve. (See Fig. 2.1.-2)

(a) Logistic curve

(b) Modified logistic curve

(c) Gompeltz curve

As the result of the analysis, it came clear that the most matching could be obtained in case of Gompeltz curve. So, Gompertz growth curve was adopted as the rate of electrification. The calculation results of this are shown in Table 2.1-3.

2.1.4. Forecast of Commercial and Public Demand

The commercial and public demands by Cabang can be forecasted by the product of the unit energy consumption, relevant ratio of number of commercial and public consumers to residential consumers, and number of residential consumers. The unit energy consumption by commercial and public consumers by Cabang was estimated based on the recent actual record.

The final estimated unit energy consumption by commercial and public consumers was decided after adjusting base figure, same as the residential demand forecast.

Actual ratio of number of commercial and public consumers to residential consumers is shown in Fig. 2.1.-3. The latest tendency is the gradual decreasing as obviously seen in this Figure, but the recent actual record was adopted as the base of the forecast. The number of residential consumers are as mentioned in Subsection 2.1.3.

2.1.5. Adjustment of Non-industrial Demand

As described in detail in Subsection 2.1.6., forecast of industrial demand is comparatively clear and easy. Accordingly, the difference between macroscopic target figures forecast energy by macro approach and that of industrial demand was decided as the forecast energy of non-industrial demand. Adjustment of based calculated energy is needed to adjust the based calculated energy and forecast energy of non-industrial demand.

As the result of this adjustment of unit energy consumption of non-industrial demand, the adjusted unit energy consumption showed a level in very recent years, but increasing tendency in Mid/Long-term. This tendency, corresponds with that forecasted in Subsection 2.1.3. So, the way of adjustment by using the unit energy consumption of non-industrial demand was adopted. Adjusted unit energy consumption and adjusted non-industrial demand are shown in Table 2.1.-3. and in TAble 2.1.-4., respectively.

2.1.6. Forecast of Industrial Demand

The industrial demand was forecast by steps of macro forecast of industrial demand, analysis of trend of industrial demand and industrial demand forecast by Cabang.

(1) Macro Forecast for Industrial Demand

The industrial demand in a specific year was forecast by the estimated elasticity of industrial electric energy consumption to GDP. The result of macro forecast is shown below:

Industrial Demand by Macro Method

Term	Specific Fiscal Year	Elasticity	Growth Rate of Load (%)	Forecast Energy (GWh)
Short-term	1988/89	4.0	20.0	2,622
Mid-term	1993/94	3.0	15.0	5,274
Former Half of Long-term	1998/99	2.5	12.5	9,504
Latter Half of Long-term	2003/04	2.5	12.5	17,127

(2) Trend of Industrial Demand

In the industrial demand, number of big consumers are not so many, but they have the large percentage in energy sales. In short-term, a plan of new or additional consumption by big consumers can be grasped separately, case by case. But the schedule of new or additional demand by big consumers can not be unknown since mid-term. Accordingly, the industrial demand was forecast based on the following trend since mid-term.

(a) Industrial demand forecast in short-term

As the result of comparison and analysis for industrial demand forecast by PLN and forecast energy in the above item (1), the forecast with an adjustment of one year delay from PLN's original plan was adopted for the forecast of industrial demand in short-term.

(b) Analysis of Trend Formula for Industrial Demand Forecast in Mid/Long Term

Linear growth, exponential growth and power growth are considered as the basis formula of trend of increase in demand. In addition, geometric mean, harmonic mean and the average value between linear and exponential/power are also considered.

Industrial demand was calculated by applying the actual record and forecast value in 1989 to each trend formula above-mentioned. The calculation results and forecast energy value are shown in Fig. 2.1.-4. As obviously shown in this Figure, the demands forecast by the macro method are on the trend of a geometric mean value of the exponential growth and the linear growth. Accordingly, the industrial demands in Mid/Long-term in each year were forecasted by this trend method.

(3) Energy Sales Ratio of Industrial to Residential Demand by Cabang.

Actual record of demand and the forecast of industrial demand in short term include the forecast of individual demand of big consumers, however, it is considered to be difficult to forecast the demand of big consumers individually in the mid and long-term.

Energy sales ratio of industrial to residential demand by Cabang was calculated from actual record of demand and the forecast of industrial demand in short-term and shown in Fig. 2.1.-5. As shown in this Fig., except three Cabang of South Surabaya, Mojokerto and Madiun, energy sales ratio is almost constant. With regard to above three Cabang, it is obvious that energy sales ratio will increase in the annual average increase rate in the specific periods as shown in the following table.

Cabang	Period	Annual Average Increase Rate (%)
South Surabaya	1985-89	23.0
Mojokerto	1985-89	7.83
Madiun	1987-89	4.88

(4) Distribution of industrial demand forecast by Cabang.

From Subsection 2.1.3. above, residential demand by Cabang can be forecasted. Besides, energy sales ratio of industrial to residential demand by Cabang can be calculated based on Subsection 2.1.6.(3).

Therefore industrial energy sales by Cabang can be calculated by product of above two values and this figure obtained by the above formula is defined as the basic industrial energy sales.

On the other hand, the increase of the rate of electrification becomes gradually weakened in the mid and long-term, and therefore the increase rate of residential energy sales becomes slow. The decline of increase rate of industrial energy sales is also shown but it is less than that of a residential ones. Therefore the total basic industrial energy sales in East Java is lower than industrial forecast energy. To reduce the above difference, the industrial energy sales in this Report was calculated by distributing the industrial forecast energy based on the above basic industrial energy sales. The calculation results is shown in Table 2.1.-5.

2.1.7. Forecast of Population by Cabang

The exponential formula was adopted for the population forecast, in the original plan of PLN.

The population forecast by this formula will be overestimated after mid/long-term. The analysis of the population forecast in East Java by Indonesian Statistic Bureau, made it clear that the growth curve would be fit to the population forecast. The calculation results by forecast of population at both South and North Surabaya Cabang, which have great population in East Java, are shown in Fig. 2.1.-6 (1) and 2.1.-6 (2). As obviously shown in this Figure, increase of the population in North Surabaya become larger than that in South Surabaya in the growth curve except modified logistic curve. On the other hand, actually South Surabaya has larger population, and is expected to have promising future. Accordingly, the modified logistic growth curve, by which almost similar results to the above actual condition, can be got, was adopted as the population forecast formula.

The results of the population forecast by Cabang by using the modified logistic curve are shown in Fig. 2.1.-6.

2.1.8. Adjustment of Industrial Demand

The forecast by trend method is not applicable to the cement demand programmed in Pamekasan Cabang the scale of which is very large compared with the industrial demand in general. The cement demand was first forecasted based on the PLN program, and the differences between the above mentioned cement demand and the industrial demand in Pamekasan Cabang calculated by trend method were added to and adjusted accordingly. The adjusted results are shown in Table 2.1.-7. Accordingly, the final industrial demand thus forecasted turned out to be superior to the target figures by 4 - 7%.

2.1.9. Summary of the Demand Forecast in East Java

The demand forecast in East Java is summarized and shown in Table 2.1.-7 and 2.1.-8.

2.1.10. Programme and Input Data for Demand Forecast

The flow of the demand forecast in this Report is as shown in Fig. 7. The forecast energy is settled by macro approach as the 1st step. In 2nd step, various coefficients and optimum relative formula, which are necessary for the demand forecast by micro approach to be made in 3rd step, are found out by analysis of actual record. In 3rd step, demand forecast by micro approach is done by the optimum coefficients and relative formula. In final step, the final forecast energy is decided by the final adjustment between the forecast energy by macro approach and that by micro approach.

Programme used for this Report is divided into two main programmes;

programme for analysis of actual record and that for the forecast of regional demand, as shown in Table 2.1.-9.
Flow chart of each programme is shown in Fig. 2.1.-8. and 2.1.-9.
Input data used for this demand forecast is shown in Table 2.1.-10.

TABLE 2.1-1 DEMAND FORECAST IN EAST JAVA

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 DEC.21,1984

ITEM	UNIT	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
EAST JAVA										
POPULATION	TPSN	30427.3	33565.9	34058.1	34543.5	35022.8	35496.5	35965.0	38240.3	40424.1
NOS OF HOUSEHOLD	TFML	6761.5	7459.1	7568.5	7676.3	7782.9	7888.1	7992.2	8497.8	8983.1
NOS OF PERSON PER HH	PSNS	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
RESIDENTIAL										
ENERGY SALES	GWH	687.5	1495.6	1678.8	1885.7	2083.6	2305.3	2540.0	3790.6	4976.3
NOS OF CONSUMER	TPCS	642.5	1415.6	1577.1	1746.6	1923.5	2107.3	2297.4	3318.9	4403.7
G.R. OF CONSUMER	%	19.748	14.071	11.407	10.747	10.131	9.556	9.018	7.635	5.819
E.S. PER CONSUMER	MWH	1.070	1.057	1.064	1.080	1.083	1.094	1.106	1.142	1.130
CONNECTED CAPACITY	MVA	335.3	716.5	794.3	875.5	959.8	1046.9	1136.5	1611.3	2106.4
C.C. PER CONSUMER	KVA	0.522	0.506	0.504	0.501	0.499	0.497	0.495	0.485	0.478
COMMERCIAL										
ENERGY SALES	GWH	107.3	224.8	251.4	281.3	309.9	341.9	375.7	555.9	726.9
NOS OF CONSUMER	TPCS	31.6	69.4	77.3	85.7	94.5	103.7	113.3	165.0	221.1
G.R. OF CONSUMER	%	9.124	14.004	11.494	10.859	10.264	9.706	9.183	7.824	6.018
E.S. PER CONSUMER	MWH	3.395	3.241	3.250	3.281	3.277	3.296	3.318	3.368	3.288
CONNECTED CAPACITY	MVA	81.1	166.7	184.1	202.2	220.9	240.3	260.2	365.9	477.0
C.C. PER CONSUMER	KVA	2.566	2.403	2.380	2.358	2.336	2.316	2.297	2.217	2.158
PUBLIC										
ENERGY SALES	GWH	145.8	308.4	344.9	386.0	425.1	468.9	515.1	758.9	986.9
NOS OF CONSUMER	TPCS	6.1	14.2	16.0	17.9	19.9	21.9	24.1	36.1	49.2
G.R. OF CONSUMER	%	14.695	15.091	12.408	11.715	11.064	10.454	9.880	8.389	6.406
E.S. PER CONSUMER	MWH	23.788	21.659	21.547	21.588	21.406	21.374	21.369	21.047	20.064
CONNECTED CAPACITY	MVA	69.3	143.5	158.4	174.0	190.2	206.9	224.0	314.4	408.6
C.C. PER CONSUMER	KVA	11.310	10.075	9.899	9.733	9.577	9.430	9.292	8.719	8.307
EXC.INDUSTRY,										
ENERGY SALES	GWH	940.6	2028.9	2275.0	2553.0	2818.6	3116.0	3430.8	5105.5	6690.1
NOS OF CONSUMER	TPCS	680.3	1499.2	1670.5	1850.2	2037.9	2233.0	2434.7	3520.0	4673.9
G.R. OF CONSUMER	%	19.162	14.077	11.421	10.762	10.146	9.571	9.034	7.651	5.835
E.S. PER CONSUMER	MWH	1.383	1.353	1.362	1.380	1.383	1.395	1.409	1.450	1.431
CONNECTED CAPACITY	MVA	485.7	1026.7	1136.9	1251.7	1370.9	1494.0	1620.6	2291.6	2991.9
C.C. PER CONSUMER	KVA	0.714	0.685	0.681	0.677	0.673	0.669	0.666	0.651	0.640
INDUSTRY										
ENERGY SALES	GWH	878.2	2622.1	3032.7	3492.9	4008.7	4587.0	5235.2	9849.5	17938.9
TOTAL										
ENERGY SALES	GWH	1818.7	4651.0	5307.7	6045.9	6827.3	7703.0	8666.0	14955.0	24629.0
G.R. OF ENERGY SALES	%	21.7	16.9	14.1	13.9	12.9	12.8	12.5	11.5	10.5
ELECTRIFICATION RAT.	%	9.503	18.978	20.838	22.753	24.715	26.715	28.745	39.056	49.022
CONSUMER RATIO C/R	%	4.918	4.901	4.904	4.909	4.915	4.922	4.930	4.973	5.020
CONSUMER RATIO P/R	%	0.954	1.006	1.015	1.024	1.032	1.041	1.049	1.086	1.117

TABLE 2.1-2 ELECTRIFICATION RATIO AND CONSUMER RATIO BY CABANG

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 EL.RATIO & CON.RATIO UNIT: %

CABANG	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
ADJUSTED EL. RATIO									
SURABAYA UTARA	27.652	42.234	44.639	47.013	49.349	51.640	53.880	64.167	72.737
SURABAYA SELATAN	30.451	49.186	52.135	54.997	57.762	60.422	62.972	73.976	82.163
BOJONEGORO	2.812	8.133	9.449	10.880	12.422	14.070	15.820	25.795	36.945
MALANG	17.454	33.348	36.248	39.151	42.041	44.900	47.714	60.741	71.468
PASURUAN	9.607	20.471	22.634	24.868	27.159	29.497	31.868	43.847	55.189
KEDIRI	4.852	12.027	13.574	15.214	16.941	18.749	20.630	30.842	41.619
MOJOKERTO	6.885	15.872	17.754	19.724	21.773	23.890	26.065	37.448	48.796
MADIUN	7.186	17.698	19.872	22.140	24.490	26.907	29.377	42.042	54.176
JEMBER	3.929	7.455	8.210	9.009	9.852	10.738	11.667	16.900	22.965
BANYUWANGI	5.752	11.485	12.753	14.090	15.492	16.955	18.476	26.774	35.762
SITUBONDO	9.451	15.724	16.958	18.233	19.545	20.893	22.272	29.547	37.168
PAMEKASAN	3.283	6.577	7.284	8.036	8.833	9.675	10.560	15.614	21.569
EAST JAVA	9.503	18.978	20.838	22.753	24.715	26.715	28.745	39.056	49.022
CONSUMER RATIO C/R									
SURABAYA UTARA	7.000	7.000	7.000	7.000	7.000	7.000	7.000	7.000	7.000
SURABAYA SELATAN	3.923	3.923	3.923	3.923	3.923	3.923	3.923	3.923	3.923
BOJONEGORO	5.755	5.755	5.755	5.755	5.755	5.755	5.755	5.755	5.755
MALANG	3.249	3.249	3.249	3.249	3.249	3.249	3.249	3.249	3.249
PASURUAN	3.953	3.953	3.953	3.953	3.953	3.953	3.953	3.953	3.953
KEDIRI	7.433	7.433	7.433	7.433	7.433	7.433	7.433	7.433	7.433
MOJOKERTO	5.497	5.497	5.497	5.497	5.497	5.497	5.497	5.497	5.497
MADIUN	3.262	3.262	3.262	3.262	3.262	3.262	3.262	3.262	3.262
JEMBER	6.012	6.012	6.012	6.012	6.012	6.012	6.012	6.012	6.012
BANYUWANGI	5.633	5.633	5.633	5.633	5.633	5.633	5.633	5.633	5.633
SITUBONDO	6.139	6.139	6.139	6.139	6.139	6.139	6.139	6.139	6.139
PAMEKASAN	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944
EAST JAVA	4.918	4.901	4.904	4.909	4.915	4.922	4.930	4.973	5.020
CONSUMER RATIO P/R									
SURABAYA UTARA	0.688	0.688	0.688	0.688	0.688	0.688	0.688	0.688	0.688
SURABAYA SELATAN	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427
BOJONEGORO	2.789	2.789	2.789	2.789	2.789	2.789	2.789	2.789	2.789
MALANG	0.599	0.599	0.599	0.599	0.599	0.599	0.599	0.599	0.599
PASURUAN	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044
KEDIRI	1.593	1.593	1.593	1.593	1.593	1.593	1.593	1.593	1.593
MOJOKERTO	1.316	1.316	1.316	1.316	1.316	1.316	1.316	1.316	1.316
MADIUN	1.164	1.164	1.164	1.164	1.164	1.164	1.164	1.164	1.164
JEMBER	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750
BANYUWANGI	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198
SITUBONDO	1.076	1.076	1.076	1.076	1.076	1.076	1.076	1.076	1.076
PAMEKASAN	1.699	1.699	1.699	1.699	1.699	1.699	1.699	1.699	1.699
EAST JAVA	0.954	1.006	1.015	1.024	1.032	1.041	1.049	1.086	1.117

TABLE 2.1-3 ENERGY SALES PER CONSUMER BY CABANG

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 E.S. PER CONSUMER UNIT: MWH

CABANG	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
RESIDENTIAL									
SURABAYA UTARA	1.328	1.339	1.353	1.376	1.385	1.402	1.420	1.482	1.477
SURABAYA SELATAN	1.332	1.343	1.357	1.380	1.389	1.406	1.425	1.487	1.481
BOJONEGORO	0.905	0.913	0.922	0.938	0.944	0.956	0.968	1.010	1.007
MALANG	0.879	0.887	0.896	0.912	0.917	0.929	0.941	0.982	0.978
PASURUAN	0.945	0.953	0.963	0.979	0.985	0.997	1.011	1.054	1.051
KEDIRI	0.932	0.939	0.949	0.966	0.972	0.984	0.997	1.040	1.036
MOJOKERTO	0.944	0.952	0.962	0.979	0.984	0.997	1.010	1.054	1.050
MADIUN	0.810	0.817	0.826	0.840	0.845	0.856	0.867	0.904	0.901
JEMBER	1.046	1.055	1.066	1.085	1.091	1.105	1.119	1.168	1.164
BANYUWANGI	0.787	0.794	0.802	0.816	0.821	0.831	0.842	0.879	0.876
SITUBONDO	0.765	0.771	0.779	0.793	0.797	0.807	0.818	0.854	0.851
PAMEKASAN	0.987	0.995	1.006	1.023	1.029	1.042	1.056	1.101	1.098
EAST JAVA	1.070	1.057	1.064	1.080	1.083	1.094	1.106	1.142	1.130
COMMERCIAL									
SURABAYA UTARA	5.609	5.657	5.717	5.815	5.850	5.923	6.001	6.262	6.240
SURABAYA SELATAN	4.073	4.107	4.151	4.222	4.248	4.301	4.357	4.547	4.531
BOJONEGORO	2.046	2.063	2.085	2.121	2.134	2.160	2.189	2.284	2.276
MALANG	2.712	2.735	2.764	2.811	2.828	2.863	2.901	3.027	3.017
PASURUAN	1.997	2.014	2.036	2.071	2.083	2.109	2.137	2.230	2.222
KEDIRI	1.960	1.977	1.998	2.032	2.044	2.070	2.097	2.188	2.181
MOJOKERTO	2.208	2.227	2.250	2.289	2.303	2.331	2.362	2.465	2.456
MADIUN	2.574	2.596	2.624	2.669	2.685	2.718	2.754	2.874	2.864
JEMBER	2.349	2.368	2.394	2.435	2.449	2.480	2.513	2.622	2.613
BANYUWANGI	1.729	1.744	1.763	1.793	1.804	1.826	1.850	1.931	1.924
SITUBONDO	1.486	1.498	1.514	1.540	1.550	1.569	1.589	1.659	1.653
PAMEKASAN	2.032	2.050	2.071	2.107	2.120	2.146	2.174	2.269	2.261
EAST JAVA	3.395	3.241	3.250	3.281	3.277	3.296	3.318	3.368	3.288
PUBLIC									
SURABAYA UTARA	62.228	62.753	63.419	64.509	64.900	65.710	66.573	69.465	69.224
SURABAYA SELATAN	58.437	58.930	59.556	60.579	60.946	61.707	62.517	65.233	65.008
BOJONEGORO	3.357	3.385	3.421	3.480	3.501	3.545	3.592	3.748	3.735
MALANG	29.396	29.644	29.959	30.474	30.658	31.041	31.449	32.815	32.701
PASURUAN	16.657	16.798	16.976	17.268	17.372	17.589	17.820	18.594	18.530
KEDIRI	8.388	8.458	8.548	8.695	8.748	8.857	8.973	9.363	9.331
MOJOKERTO	10.728	10.819	10.933	11.121	11.189	11.328	11.477	11.976	11.934
MADIUN	16.164	16.300	16.473	16.756	16.858	17.068	17.293	18.044	17.981
JEMBER	12.401	12.506	12.639	12.856	12.934	13.095	13.267	13.843	13.795
BANYUWANGI	8.693	8.766	8.859	9.012	9.066	9.179	9.300	9.704	9.670
SITUBONDO	8.472	8.543	8.634	8.782	8.835	8.946	9.063	9.457	9.424
PAMEKASAN	6.610	6.666	6.736	6.852	6.894	6.980	7.071	7.379	7.353
EAST JAVA	23.788	21.659	21.547	21.588	21.406	21.374	21.369	21.047	20.064

TABLE 2.1-4 ENERGY SALES OF EXCLUDING INDUSTRY BY CABANG

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 ENERGY SALES UNIT: GWH

CABANG	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
RESIDENTIAL									
SURABAYA UTARA	153.495	283.266	311.547	343.434	372.972	406.129	440.982	621.838	788.253
SURABAYA SELATAN	183.250	365.761	402.709	443.528	480.396	520.899	562.439	759.132	906.075
BOJONEGORO	16.813	50.076	58.854	68.982	79.283	90.969	103.659	176.518	252.021
MALANG	91.839	205.867	231.420	260.051	287.203	317.347	348.976	512.148	657.635
PASURUAN	44.615	109.789	125.236	142.809	160.038	179.410	200.125	314.023	427.049
KEDIRI	50.698	138.554	160.217	185.132	210.148	238.530	269.285	445.787	632.826
MOJOKERTO	26.101	67.913	78.107	89.766	101.348	114.425	128.501	207.537	288.406
MADIUN	45.458	116.115	132.174	150.219	167.601	186.877	207.153	311.902	402.706
JEMBER	31.454	66.058	74.603	84.471	94.244	105.436	117.623	189.385	271.654
BANYUWANGI	14.986	33.745	38.525	44.027	49.507	55.749	62.523	101.819	145.002
SITUBONDO	8.744	15.800	17.383	19.176	20.849	22.735	24.728	35.233	45.104
PAMEKASAN	20.090	42.668	47.983	54.070	60.009	66.757	74.030	115.312	159.565
EAST JAVA	687.543	1495.613	1678.758	1885.665	2083.598	2305.263	2540.025	3790.633	4976.296
COMMERCIAL									
SURABAYA UTARA	45.395	83.774	92.138	101.568	110.304	120.110	130.417	183.904	233.120
SURABAYA SELATAN	21.986	43.883	48.316	53.214	57.637	62.497	67.480	91.079	108.709
BOJONEGORO	2.187	6.514	7.656	8.973	10.313	11.833	13.484	22.961	32.782
MALANG	9.201	20.625	23.185	26.053	28.774	31.794	34.963	51.310	65.886
PASURUAN	3.729	9.176	10.467	11.936	13.376	14.995	16.727	26.247	35.693
KEDIRI	7.929	21.669	25.057	28.954	32.866	37.305	42.115	69.720	98.972
MOJOKERTO	3.356	8.732	10.043	11.542	13.031	14.712	16.522	26.685	37.083
MADIUN	4.711	12.034	13.698	15.568	17.369	19.367	21.468	32.324	41.734
JEMBER	4.244	8.913	10.066	11.397	12.716	14.226	15.871	25.553	36.653
BANYUWANGI	1.854	4.175	4.766	5.447	6.125	6.897	7.735	12.597	17.939
SITUBONDO	1.043	1.885	2.073	2.287	2.487	2.712	2.950	4.203	5.380
PAMEKASAN	1.632	3.466	3.898	4.392	4.875	5.423	6.014	9.367	12.962
EAST JAVA	107.267	224.846	251.364	281.332	309.873	341.871	375.746	555.949	726.914
PUBLIC									
SURABAYA UTARA	49.471	91.296	100.411	110.688	120.208	130.894	142.127	200.417	254.052
SURABAYA SELATAN	34.361	68.583	75.512	83.165	90.078	97.673	105.462	142.344	169.897
BOJONEGORO	1.739	5.179	6.087	7.135	8.200	9.409	10.722	18.258	26.067
MALANG	18.402	41.250	46.370	52.107	57.548	63.588	69.925	102.620	131.772
PASURUAN	8.212	20.208	23.051	26.286	29.457	33.023	36.836	57.800	78.604
KEDIRI	7.272	19.874	22.981	26.555	30.143	34.214	38.626	63.943	90.771
MOJOKERTO	3.905	10.161	11.686	13.430	15.163	17.119	19.225	31.050	43.149
MADIUN	10.555	26.961	30.690	34.880	38.916	43.391	48.099	72.421	93.505
JEMBER	6.523	13.699	15.471	17.518	19.545	21.866	24.393	39.275	56.336
BANYUWANGI	1.982	4.463	5.095	5.823	6.548	7.373	8.269	13.466	19.177
SITUBONDO	1.042	1.883	2.071	2.285	2.485	2.709	2.947	4.199	5.375
PAMEKASAN	2.287	4.857	5.462	6.155	6.831	7.600	8.427	13.127	18.165
EAST JAVA	145.751	308.415	344.888	386.027	425.121	468.859	515.059	758.919	986.870

TABLE 2.1-5 ENERGY SALES OF INDUSTRY BY CABANG

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 ENERGY SALES UNIT: GWH

CABANG	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
INDUSTRY									
SURABAYA UTARA	317.276	960.318	1102.116	1260.923	1438.958	1638.675	1862.797	3468.386	6319.876
SURABAYA SELATAN	443.587	1102.147	1266.245	1447.399	1647.379	1868.121	2111.748	3763.480	6456.984
BOJONEGORO	0.259	0.425	0.521	0.634	0.766	0.919	1.096	2.464	5.058
MALANG	35.388	92.596	108.615	126.675	147.010	169.883	195.581	378.994	699.543
PASURUAN	45.035	110.254	131.235	155.316	182.899	214.432	250.416	518.834	1014.230
KEDIRI	6.427	36.865	44.482	53.346	63.631	75.534	89.275	195.141	398.198
MOJOKERTO	23.287	101.425	121.720	145.187	172.250	203.386	239.123	509.937	1018.636
MADIUN	2.895	49.403	58.680	69.217	81.150	94.629	109.819	218.328	405.203
JEMBER	1.580	91.406	107.720	126.587	148.409	173.641	202.801	431.152	888.983
BANYUWANGI	0.555	37.454	44.619	52.922	62.533	73.644	86.468	185.931	380.619
SITUBONDO	0.158	0.340	0.390	0.447	0.510	0.582	0.663	1.247	2.295
PAMEKASAN	1.738	39.494	46.345	54.202	63.212	73.543	85.382	175.605	349.296
EAST JAVA	878.185	2622.126	3032.689	3492.854	4008.708	4586.989	5235.170	9849.499	17938.921

TABLE 2.1-6 POPULATION AND NUMBER OF HOUSE-HOLDS BY CABANG

REGIONAL DEMAND FORECAST 1983/ 3 - 2004/ 3 POPULATION,HOUSEHOLD UNIT: 1000

CABANG	1983/ 3	1989/ 3	1990/ 3	1991/ 3	1992/ 3	1993/ 3	1994/ 3	1999/ 3	2004/ 3
POPULATION									
SURABAYA UTARA	1881.700	2254.282	2321.135	2388.442	2456.196	2524.390	2593.018	2942.453	3301.875
SURABAYA SELATAN	2033.400	2491.810	2561.189	2628.829	2694.709	2758.816	2821.143	3106.404	3349.850
BOJONEGORO	2972.300	3035.545	3038.603	3040.934	3042.722	3044.099	3045.166	3047.882	3048.743
MALANG	2692.900	3132.858	3205.932	3279.050	3352.212	3425.417	3498.662	3865.471	4233.161
PASURUAN	2212.400	2533.510	2586.299	2638.970	2691.524	2743.963	2796.288	3056.254	3313.577
KEDIRI	5047.100	5518.006	5594.375	5670.088	5745.162	5819.618	5893.473	6254.281	6602.258
MOJOKERTO	1807.000	2022.740	2057.943	2092.958	2127.790	2162.444	2196.923	2366.848	2532.964
MADIUN	3513.300	3613.352	3624.693	3635.000	3644.383	3652.938	3660.751	3691.039	3711.103
JEMBER	3442.700	3778.600	3834.268	3889.499	3944.307	3998.703	4052.699	4317.024	4572.748
BANYUWANGI	1489.000	1665.087	1693.923	1722.604	1751.135	1779.519	1807.760	1946.930	2082.975
SITUBONDO	544.500	586.450	591.950	597.112	601.956	606.507	610.784	628.670	642.022
PAMEKASAN	2791.000	2933.681	2947.748	2960.017	2970.737	2980.124	2988.360	3017.006	3032.778
EAST JAVA	30427.300	33565.920	34058.058	34543.503	35022.835	35496.538	35965.027	38240.262	40424.056
NOS OF HOUSEHOLD									
SURABAYA UTARA	418.100	500.952	515.808	530.765	545.821	560.976	576.226	653.878	733.750
SURABAYA SELATAN	451.900	553.736	569.153	584.184	598.824	613.070	626.921	690.312	744.411
BOJONEGORO	660.500	674.566	675.245	675.763	676.160	676.466	676.704	677.307	677.499
MALANG	598.400	696.191	712.429	728.678	744.936	761.204	777.481	858.994	940.703
PASURUAN	491.600	563.002	574.733	586.438	598.117	609.770	621.397	679.168	736.350
KEDIRI	1121.600	1226.224	1243.195	1260.019	1276.703	1293.248	1309.661	1389.840	1467.168
MOJOKERTO	401.600	449.498	457.321	465.102	472.842	480.543	488.205	525.966	562.881
MADIUN	780.700	802.967	805.487	807.778	809.863	811.764	813.500	820.231	824.690
JEMBER	765.000	839.689	852.059	864.333	876.513	888.601	900.600	959.339	1016.166
BANYUWANGI	330.900	370.019	376.427	382.801	389.141	395.449	401.724	432.651	462.883
SITUBONDO	121.000	130.322	131.545	132.691	133.768	134.779	135.730	139.704	142.672
PAMEKASAN	620.200	651.929	655.055	657.781	660.164	662.250	664.080	670.446	673.951
EAST JAVA	6761.500	7459.093	7568.457	7676.334	7782.852	7888.120	7992.228	8497.836	8983.123
NOS OF PERSON PER HH									
SURABAYA UTARA	4.501	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
SURABAYA SELATAN	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
BOJONEGORO	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
MALANG	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
PASURUAN	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
KEDIRI	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
MOJOKERTO	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
MADIUN	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
JEMBER	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
BANYUWANGI	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
SITUBONDO	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
PAMEKASAN	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
EAST JAVA	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500

TABLE 2.1-7 SUMMARY TABLE OF DEMAND FORECAST

Item	Result	Short-term	Mid-term	Long-term Former	Long-term Latter
Target Fiscal Year	82/83	88/89	93/94	98/99	2003/04
Macroscopic Forecost					
Growth Rate of GDP(%)		5.0	5.0	5.0	5.0
Elasticity		2.5	2.5	2.25	2.0
Regional coefficient		1.25	1.1	1.1	1.0
Growth Rate of Energy(%)		*1 16.0	14.0	12.0	10.0
Total Target Energy(GWh)	1,819	4,432	8,533	15,038	24,219
Microscopic Forecast					
Residential					
Population(1000psns)	30,427	33,566	35,965	38,240	40,424
No.of HHS (1000)	6,762	7,459	7,992	8,498	8,983
Electrification Ratio(%)	9.5	19.0	28.7	39.6	49.0
No.of Consumers(1000)	643	1,416	2,297	3,319	4,404
Energy(GWh)	688	1,496	2,540	3,791	4,976
Commercial					
No.of Consumers(1000)	32	69	113	165	221
Energy(GWh)	107	225	376	556	727
Public					
No.of Consumers(1000)	6	14	24	36	49
Energy(GWh)	146	308	515	759	987
Exc.Industry Tl.Energy	941	2,029	3,431	5,106	6,690
Industry					
Elasticity		4.0	3.0	2.5	2.5
Growth Rate of Energy(%)		20	15	12.5	12.5
Target Energy(GWh)	878	2,622	5,274	9,504	17,127
Calculated Energy(GWh)	878	2,622	5,235	9,850	17,940
Adjustment of Pamekasan		95	337	320	220
Adjusted Industrial Energy		2,717	5,572	10,170	18,160
Tl.CalculatedEnergy(GWh)	1,819	4,651	8,666	14,955	24,629
Tl Adjusted Energy(GWh)	1,819	4,746	9,003	15,275	24,849
Average Growth Rate(%)		*1 17.3	13.7	11.2	10.2

Note:*1 shows compound growth rate between 82/83 and 88/89

TABLE 2.1-8 SUMMARY OF DEMAND FORECAST IN EAST JAVA

Item	Unit	1982/83	1988/89	1993/94	1998/99	2003/04
Residential						
Energy sales	GWh	688	1,496	2,540	3,791	4,976
Average growth rate	%		13.8	11.2	8.3	5.6
Commercial						
Energy sales	GWh	107	225	376	556	727
Average growth rate	%		13.2	10.8	8.1	5.5
Public						
Energy sales	GWh	146	308	515	759	987
Average growth rate	%		13.2	10.8	8.1	5.4
Industry						
Energy sales	GWh	878	2,717	5,572	10,170	18,160
Average growth rate	%		20.7	15.4	12.8	12.3
Total energy sales	GWh	1,819	4,746	9,003	15,275	24,849
Average growth rate	%		17.3	13.7	11.2	10.2
Loss rate	%	18	12.7	12.7	12.7	12.7
Required energy	GWh	2,218	5,436	10,313	17,497	28,464
Yearly load factor	%	66	68	70	72	74
System peak at 150kV	MW	384	919	1,682	2,774	4,390

Table 2.1-9 Program List for the Demand Forecast

CODE	Program Name	Input Data	Output Item	Language
PDF 1	Histrical Trend Analysis Program	Historical Data of Population, Number of Consumers,Energy Sales,Connected Capacity by Cabang by Category	Electrification Ratio, Energy Sales per Consumer,Consumer Ratio C/R and P/R by Cabang, Energy Sales Ratio C/R, P/R and I/R by Cabang	FORTRAN
PDF 2	Regional Demend Forecast Program	Outputs of PDF 1 Forecasted Industrial Demend	Energy Sales, Number of Consumers, Connected Capacity by Cabang and by Category	FORTRAN

TABLE 2.1-10 (1)   INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
SURABAYA UTARA							
POPULATION	TPSN	1573.300	1610.000	1678.900	1658.300	1832.900	1881.700
NOS OF HOUSEHOLD	TFML	349.600	357.800	373.300	368.500	407.300	418.100
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.497	4.500	4.500	4.501
RESIDENTIAL							
ENERGY SALES	GWH			98.602	107.965	132.156	153.495
NOS OF CONSUMER	TPCS			74.941	90.635	100.425	115.613
G.R. OF CONSUMER	%			**********	20.942	10.802	15.124
E.S. PER CONSUMER	MWH			1.316	1.191	1.316	1.328
CONNECTED CAPACITY	MVA			42.083	53.296	63.656	72.944
C.C. PER CONSUMER	KVA			0.562	0.588	0.634	0.631
COMMERCIAL							
ENERGY SALES	GWH			27.518	39.155	45.742	45.395
NOS OF CONSUMER	TPCS			6.260	7.497	7.703	8.093
G.R. OF CONSUMER	%			**********	19.760	2.748	5.063
E.S. PER CONSUMER	MWH			4.396	5.223	5.938	5.609
CONNECTED CAPACITY	MVA			18.118	31.780	34.223	34.491
C.C. PER CONSUMER	KVA			2.894	4.239	4.443	4.262
PUBLIC							
ENERGY SALES	GWH			12.024	32.185	39.101	49.471
NOS OF CONSUMER	TPCS			0.461	0.640	0.688	0.795
G.R. OF CONSUMER	%			**********	38.829	7.500	15.552
E.S. PER CONSUMER	MWH			26.082	50.289	56.833	62.228
CONNECTED CAPACITY	MVA			4.063	18.753	18.827	25.552
C.C. PER CONSUMER	KVA			8.813	29.302	27.365	32.141
EXC.INDUSTRY							
ENERGY SALES	GWH			138.144	179.305	216.999	248.361
NOS OF CONSUMER	TPCS			81.662	98.772	108.816	124.501
G.R. OF CONSUMER	%			**********	20.952	10.169	14.414
E.S. PER CONSUMER	MWH			1.692	1.815	1.994	1.995
CONNECTED CAPACITY	MVA			64.264	103.829	116.706	132.987
C.C. PER CONSUMER	KVA			0.787	1.051	1.073	1.068
INDUSTRY							
ENERGY SALES	GWH			235.4	210.1	248.8	317.3
TOTAL							
ENERGY SALES	GWH			373.5	389.4	465.8	565.6
G.R. OF ENERGY SALES	%			**********	4.3	19.6	21.4
ELECTRIFICATION RAT.	%			20.075	24.596	24.656	27.652
CONSUMER RATIO C/R	%			8.353	8.272	7.670	7.000
CONSUMER RATIO P/R	%			0.615	0.706	0.685	0.688

TABLE 2.1-10 (2)   INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
SURABAYA SELATAN							
POPULATION	TPSN	1644.000	1694.700	1805.300	1877.400	1976.800	2033.400
NOS OF HOUSEHOLD	TFML	365.300	376.600	401.200	417.200	439.300	451.900
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			117.067	139.564	167.294	183.250
NOS OF CONSUMER	TPCS			86.148	102.651	121.033	137.608
G.R. OF CONSUMER	%			**********	19.157	17.907	13.695
E.S. PER CONSUMER	MWH			1.359	1.360	1.382	1.332
CONNECTED CAPACITY	MVA			61.844	75.207	91.444	103.182
C.C. PER CONSUMER	KVA			0.718	0.733	0.756	0.750
COMMERCIAL							
ENERGY SALES	GWH			16.922	29.372	31.643	21.986
NOS OF CONSUMER	TPCS			3.404	3.779	4.283	5.398
G.R. OF CONSUMER	%			**********	11.016	13.337	26.033
E.S. PER CONSUMER	MWH			4.971	7.772	7.388	4.073
CONNECTED CAPACITY	MVA			12.122	18.279	20.384	19.441
C.C. PER CONSUMER	KVA			3.561	4.837	4.759	3.602
PUBLIC							
ENERGY SALES	GWH			16.172	32.189	32.968	34.361
NOS OF CONSUMER	TPCS			0.526	0.616	0.642	0.588
G.R. OF CONSUMER	%			**********	17.110	4.221	-8.411
E.S. PER CONSUMER	MWH			30.745	52.255	51.352	58.437
CONNECTED CAPACITY	MVA			5.575	16.447	18.229	19.095
C.C. PER CONSUMER	KVA			10.599	26.700	28.394	32.474
EXC.INDUSTRY							
ENERGY SALES	GWH			150.161	201.125	231.905	239.597
NOS OF CONSUMER	TPCS			90.078	107.046	125.958	143.594
G.R. OF CONSUMER	%			**********	18.837	17.667	14.001
E.S. PER CONSUMER	MWH			1.667	1.879	1.841	1.669
CONNECTED CAPACITY	MVA			79.541	109.933	130.057	141.718
C.C. PER CONSUMER	KVA			0.883	1.027	1.033	0.987
INDUSTRY							
ENERGY SALES	GWH			167.9	196.2	296.4	443.6
TOTAL							
ENERGY SALES	GWH			318.0	397.3	528.3	683.2
G.R. OF ENERGY SALES	%			**********	24.9	33.0	29.3
ELECTRIFICATION RAT.	%			21.473	24.605	27.551	30.451
CONSUMER RATIO C/R	%			3.951	3.681	3.539	3.923
CONSUMER RATIO P/R	%			0.611	0.600	0.530	0.427

TABLE 2.1-10 (3)   INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
BOJONEGORO							
POPULATION	TPSN	2752.900	2781.500	2885.000	2938.100	2958.800	2972.300
NOS OF HOUSEHOLD	TFML	611.800	618.100	641.100	652.900	657.500	660.500
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			5.799	7.892	9.602	16.813
NOS OF CONSUMER	TPCS			8.782	10.443	12.231	18.576
G.R. OF CONSUMER	%			**********	18.914	17.122	51.876
E.S. PER CONSUMER	MWH			0.660	0.756	0.785	0.905
CONNECTED CAPACITY	MVA			3.205	3.962	4.803	7.536
C.C. PER CONSUMER	KVA			0.365	0.379	0.393	0.406
COMMERCIAL							
ENERGY SALES	GWH			2.395	1.530	2.185	2.187
NOS OF CONSUMER	TPCS			1.070	0.912	0.950	1.069
G.R. OF CONSUMER	%			**********	-14.766	4.167	12.526
E.S. PER CONSUMER	MWH			2.238	1.678	2.300	2.046
CONNECTED CAPACITY	MVA			1.425	0.886	0.958	1.124
C.C. PER CONSUMER	KVA			1.332	0.971	1.008	1.051
PUBLIC							
ENERGY SALES	GWH			0.419	1.448	1.434	1.739
NOS OF CONSUMER	TPCS			0.013	0.206	0.225	0.518
G.R. OF CONSUMER	%			**********	1484.615	9.223	130.222
E.S. PER CONSUMER	MWH			32.231	7.029	6.373	3.357
CONNECTED CAPACITY	MVA			0.101	0.681	0.725	0.777
C.C. PER CONSUMER	KVA			7.769	3.306	3.222	1.500
EXC.INDUSTRY							
ENERGY SALES	GWH			8.613	10.870	13.221	20.739
NOS OF CONSUMER	TPCS			9.865	11.561	13.406	20.163
G.R. OF CONSUMER	%			**********	17.192	15.959	50.403
E.S. PER CONSUMER	MWH			0.873	0.940	0.986	1.029
CONNECTED CAPACITY	MVA			4.731	5.529	6.486	9.437
C.C. PER CONSUMER	KVA			0.480	0.478	0.484	0.468
INDUSTRY							
ENERGY SALES	GWH			0.3	0.4	0.3	0.3
TOTAL							
ENERGY SALES	GWH			8.9	11.2	13.5	21.0
G.R. OF ENERGY SALES	%			**********	25.7	20.2	55.3
ELECTRIFICATION RAT.	%			1.370	1.599	1.860	2.812
CONSUMER RATIO C/R	%			12.184	8.733	7.767	5.755
CONSUMER RATIO P/R	%			0.148	1.973	1.840	2.789

TABLE 2.1-10 (4) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
MALANG							
POPULATION	TPSN	2360.800	2383.200	2451.900	2546.500	2647.100	2692.900
NOS OF HOUSEHOLD	TFML	524.600	529.600	544.900	565.900	588.200	598.400
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			57.922	67.341	79.335	91.839
NOS OF CONSUMER	TPCS			58.792	72.446	84.015	104.444
G.R. OF CONSUMER	%			**********	23.224	15.969	24.316
E.S. PER CONSUMER	MWH			0.985	0.930	0.944	0.879
CONNECTED CAPACITY	MVA			24.641	32.962	39.782	55.155
C.C. PER CONSUMER	KVA			0.419	0.455	0.474	0.528
COMMERCIAL							
ENERGY SALES	GWH			9.112	9.286	9.862	9.201
NOS OF CONSUMER	TPCS			2.906	3.086	3.328	3.393
G.R. OF CONSUMER	%			**********	6.194	7.842	1.953
E.S. PER CONSUMER	MWH			3.136	3.009	2.963	2.712
CONNECTED CAPACITY	MVA			5.282	5.950	6.826	6.930
C.C. PER CONSUMER	KVA			1.818	1.928	2.051	2.042
PUBLIC							
ENERGY SALES	GWH			9.770	15.148	17.188	18.402
NOS OF CONSUMER	TPCS			0.510	0.545	0.577	0.626
G.R. OF CONSUMER	%			**********	6.863	5.872	8.492
E.S. PER CONSUMER	MWH			19.157	27.794	29.789	29.396
CONNECTED CAPACITY	MVA			2.959	5.698	4.781	6.022
C.C. PER CONSUMER	KVA			5.802	10.455	8.286	9.620
EXC.INDUSTRY							
ENERGY SALES	GWH			76.804	91.775	106.385	119.442
NOS OF CONSUMER	TPCS			62.208	76.077	87.920	108.463
G.R. OF CONSUMER	%			**********	22.295	15.567	23.366
E.S. PER CONSUMER	MWH			1.235	1.206	1.210	1.101
CONNECTED CAPACITY	MVA			32.882	44.610	51.389	68.107
C.C. PER CONSUMER	KVA			0.529	0.586	0.584	0.628
INDUSTRY							
ENERGY SALES	GWH			18.0	17.5	29.8	35.4
TOTAL							
ENERGY SALES	GWH			94.8	109.3	136.2	154.8
G.R. OF ENERGY SALES	%			**********	15.3	24.6	13.7
ELECTRIFICATION RAT.	%			10.790	12.802	14.283	17.454
CONSUMER RATIO C/R	%			4.943	4.260	3.961	3.249
CONSUMER RATIO P/R	%			0.867	0.752	0.687	0.599

TABLE 2.1-10 (5) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
PASURUAN							
POPULATION	TPSN	1957.400	1972.000	2075.000	2086.800	2173.100	2212.400
NOS OF HOUSEHOLD	TFML	435.000	438.200	461.200	463.700	482.900	491.600
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.499	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			25.882	30.855	37.493	44.615
NOS OF CONSUMER	TPCS			26.267	32.532	38.554	47.230
G.R. OF CONSUMER	%			**********	23.851	18.511	22.504
E.S. PER CONSUMER	MWH			0.985	0.948	0.972	0.945
CONNECTED CAPACITY	MVA			8.404	10.899	13.493	19.600
C.C. PER CONSUMER	KVA			0.320	0.335	0.350	0.415
COMMERCIAL							
ENERGY SALES	GWH			3.539	3.934	4.277	3.729
NOS OF CONSUMER	TPCS			1.612	1.715	1.803	1.867
G.R. OF CONSUMER	%			**********	6.390	5.131	3.550
E.S. PER CONSUMER	MWH			2.195	2.294	2.372	1.997
CONNECTED CAPACITY	MVA			2.320	2.544	2.822	2.755
C.C. PER CONSUMER	KVA			1.439	1.483	1.565	1.476
PUBLIC							
ENERGY SALES	GWH			2.960	4.095	5.857	8.212
NOS OF CONSUMER	TPCS			0.353	0.393	0.476	0.493
G.R. OF CONSUMER	%			**********	11.331	21.120	3.571
E.S. PER CONSUMER	MWH			8.385	10.420	12.305	16.657
CONNECTED CAPACITY	MVA			0.992	1.795	2.360	4.125
C.C. PER CONSUMER	KVA			2.810	4.567	4.958	8.367
EXC.INDUSTRY							
ENERGY SALES	GWH			32.381	38.884	47.627	56.556
NOS OF CONSUMER	TPCS			28.232	34.640	40.833	49.590
G.R. OF CONSUMER	%			**********	22.698	17.878	21.446
E.S. PER CONSUMER	MWH			1.147	1.123	1.166	1.140
CONNECTED CAPACITY	MVA			11.716	15.238	18.675	26.480
C.C. PER CONSUMER	KVA			0.415	0.440	0.457	0.534
INDUSTRY							
ENERGY SALES	GWH			33.9	45.3	56.8	45.0
TOTAL							
ENERGY SALES	GWH			66.3	84.2	104.4	101.6
G.R. OF ENERGY SALES	%			**********	27.1	24.0	-2.7
ELECTRIFICATION RAT.	%			5.695	7.016	7.984	9.607
CONSUMER RATIO C/R	%			6.137	5.272	4.677	3.953
CONSUMER RATIO P/R	%			1.344	1.208	1.235	1.044

TABLE 2.1-10 (6)   INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
KEDIRI							
POPULATION	TPSN	4641.600	4696.600	4810.500	4849.100	4981.700	5047.100
NOS OF HOUSEHOLD	TFML	1031.500	1043.700	1069.000	1077.600	1107.000	1121.600
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			27.751	35.051	42.863	50.698
NOS OF CONSUMER	TPCS			28.488	37.373	45.647	54.420
G.R. OF CONSUMER	%			**********	31.189	22.139	19.219
E.S. PER CONSUMER	MWH			0.974	0.938	0.939	0.932
CONNECTED CAPACITY	MVA			9.384	13.162	16.435	19.983
C.C. PER CONSUMER	KVA			0.329	0.352	0.360	0.367
COMMERCIAL							
ENERGY SALES	GWH			6.011	6.622	7.765	7.929
NOS OF CONSUMER	TPCS			2.885	3.397	3.862	4.045
G.R. OF CONSUMER	%			**********	17.747	13.689	4.738
E.S. PER CONSUMER	MWH			2.084	1.949	2.011	1.960
CONNECTED CAPACITY	MVA			3.643	4.224	4.768	4.982
C.C. PER CONSUMER	KVA			1.263	1.243	1.235	1.232
PUBLIC							
ENERGY SALES	GWH			4.683	5.291	7.291	7.272
NOS OF CONSUMER	TPCS			0.587	0.694	0.748	0.867
G.R. OF CONSUMER	%			**********	18.228	7.781	15.909
E.S. PER CONSUMER	MWH			7.978	7.624	9.747	8.388
CONNECTED CAPACITY	MVA			1.664	2.211	2.945	3.113
C.C. PER CONSUMER	KVA			2.835	3.186	3.937	3.591
EXC.INDUSTRY							
ENERGY SALES	GWH			38.445	46.964	57.919	65.899
NOS OF CONSUMER	TPCS			31.960	41.464	50.257	59.332
G.R. OF CONSUMER	%			**********	29.737	21.206	18.057
E.S. PER CONSUMER	MWH			1.203	1.133	1.152	1.111
CONNECTED CAPACITY	MVA			14.691	19.597	24.148	28.078
C.C. PER CONSUMER	KVA			0.460	0.473	0.480	0.473
INDUSTRY							
ENERGY SALES	GWH			6.8	4.2	5.0	6.4
TOTAL							
ENERGY SALES	GWH			45.3	51.2	62.9	72.3
G.R. OF ENERGY SALES	%			**********	13.1	23.0	14.9
ELECTRIFICATION RAT.	%			2.665	3.468	4.123	4.852
CONSUMER RATIO C/R	%			10.127	9.089	8.461	7.433
CONSUMER RATIO P/R	%			2.061	1.857	1.639	1.593

TABLE 2.1-10 (7)   INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
MOJOKERTO							
POPULATION	TPSN	1625.800	1651.800	1703.300	1724.700	1776.300	1807.000
NOS OF HOUSEHOLD	TFML	361.300	367.100	378.500	383.300	394.700	401.600
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			14.064	17.742	21.859	26.101
NOS OF CONSUMER	TPCS			14.552	19.050	21.988	27.652
G.R. OF CONSUMER	%			**********	30.910	15.423	25.760
E.S. PER CONSUMER	MWH			0.966	0.931	0.994	0.944
CONNECTED CAPACITY	MVA			5.303	7.186	8.470	11.045
C.C. PER CONSUMER	KVA			0.364	0.377	0.385	0.399
COMMERCIAL							
ENERGY SALES	GWH			2.817	3.116	3.327	3.356
NOS OF CONSUMER	TPCS			1.371	1.475	1.500	1.520
G.R. OF CONSUMER	%			**********	7.586	1.695	1.333
E.S. PER CONSUMER	MWH			2.055	2.113	2.218	2.208
CONNECTED CAPACITY	MVA			1.610	1.763	1.849	2.035
C.C. PER CONSUMER	KVA			1.174	1.195	1.233	1.339
PUBLIC							
ENERGY SALES	GWH			2.516	3.248	3.802	3.905
NOS OF CONSUMER	TPCS			0.070	0.297	0.326	0.364
G.R. OF CONSUMER	%			**********	324.286	9.764	11.656
E.S. PER CONSUMER	MWH			35.943	10.936	11.663	10.728
CONNECTED CAPACITY	MVA			0.968	1.828	1.947	2.023
C.C. PER CONSUMER	KVA			13.829	6.155	5.972	5.558
EXC.INDUSTRY							
ENERGY SALES	GWH			19.397	24.106	28.988	33.362
NOS OF CONSUMER	TPCS			15.993	20.822	23.814	29.536
G.R. OF CONSUMER	%			**********	30.194	14.369	24.028
E.S. PER CONSUMER	MWH			1.213	1.158	1.217	1.130
CONNECTED CAPACITY	MVA			7.881	10.777	12.266	15.103
C.C. PER CONSUMER	KVA			0.493	0.518	0.515	0.511
INDUSTRY							
ENERGY SALES	GWH			2.6	2.8	16.2	23.3
TOTAL							
ENERGY SALES	GWH			22.0	26.9	45.2	56.6
G.R. OF ENERGY SALES	%			**********	22.4	68.1	25.2
ELECTRIFICATION RAT.	%			3.845	4.970	5.571	6.885
CONSUMER RATIO C/R	%			9.421	7.743	6.822	5.497
CONSUMER RATIO P/R	%			0.481	1.559	1.483	1.316

TABLE 2.1-10 (8) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
MADIUN							
POPULATION	TPSN	3371.600	3400.600	3432.200	3474.100	3492.100	3513.300
NOS OF HOUSEHOLD	TFML	749.200	755.700	762.700	772.000	776.000	780.700
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			25.119	29.933	37.846	45.458
NOS OF CONSUMER	TPCS			30.235	37.313	47.721	56.104
G.R. OF CONSUMER	%			**********	23.410	27.894	17.567
E.S. PER CONSUMER	MWH			0.831	0.802	0.793	0.810
CONNECTED CAPACITY	MVA			7.947	10.688	14.140	17.248
C.C. PER CONSUMER	KVA			0.263	0.286	0.296	0.307
COMMERCIAL							
ENERGY SALES	GWH			3.446	4.174	4.691	4.711
NOS OF CONSUMER	TPCS			1.446	1.605	1.757	1.830
G.R. OF CONSUMER	%			**********	10.996	9.470	4.155
E.S. PER CONSUMER	MWH			2.383	2.601	2.670	2.574
CONNECTED CAPACITY	MVA			1.830	2.695	3.032	3.198
C.C. PER CONSUMER	KVA			1.266	1.679	1.726	1.748
PUBLIC							
ENERGY SALES	GWH			3.931	8.367	7.017	10.555
NOS OF CONSUMER	TPCS			0.454	0.537	0.610	0.653
G.R. OF CONSUMER	%			**********	18.282	13.594	7.049
E.S. PER CONSUMER	MWH			8.659	15.581	11.503	16.164
CONNECTED CAPACITY	MVA			1.452	4.060	4.473	3.611
C.C. PER CONSUMER	KVA			3.198	7.561	7.333	5.530
EXC.INDUSTRY							
ENERGY SALES	GWH			32.496	42.474	49.554	60.724
NOS OF CONSUMER	TPCS			32.135	39.455	50.088	58.587
G.R. OF CONSUMER	%			**********	22.779	26.950	16.968
E.S. PER CONSUMER	MWH			1.011	1.077	0.989	1.036
CONNECTED CAPACITY	MVA			11.229	17.443	21.645	24.057
C.C. PER CONSUMER	KVA			0.349	0.442	0.432	0.411
INDUSTRY							
ENERGY SALES	GWH			6.0	1.9	2.5	2.9
TOTAL							
ENERGY SALES	GWH			38.5	44.3	52.1	63.6
G.R. OF ENERGY SALES	%			**********	15.0	17.5	22.2
ELECTRIFICATION RAT.	%			3.964	4.833	6.150	7.186
CONSUMER RATIO C/R	%			4.783	4.301	3.682	3.262
CONSUMER RATIO P/R	%			1.502	1.439	1.278	1.164

TABLE 2.1-10 (9) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
JEMBER							
POPULATION	TPSN	0.0	3221.900	3207.500	3336.000	3367.600	3442.700
NOS OF HOUSEHOLD	TFML	0.0	716.000	718.800	748.000	748.300	765.000
NOS OF PERSON PER HH	PSNS	0.0	4.500	4.462	4.460	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			18.244	22.554	26.925	31.454
NOS OF CONSUMER	TPCS			19.127	21.935	24.557	30.059
G.R. OF CONSUMER	%			**********	14.681	11.953	22.405
E.S. PER CONSUMER	MWH			0.954	1.028	1.096	1.046
CONNECTED CAPACITY	MVA			7.700	8.755	9.799	13.096
C.C. PER CONSUMER	KVA			0.403	0.399	0.399	0.436
COMMERCIAL							
ENERGY SALES	GWH			3.410	3.674	4.008	4.244
NOS OF CONSUMER	TPCS			1.483	1.507	1.593	1.807
G.R. OF CONSUMER	%			**********	1.618	5.707	13.434
E.S. PER CONSUMER	MWH			2.299	2.438	2.516	2.349
CONNECTED CAPACITY	MVA			2.251	2.392	2.748	3.075
C.C. PER CONSUMER	KVA			1.518	1.587	1.725	1.702
PUBLIC							
ENERGY SALES	GWH			3.436	4.930	5.891	6.523
NOS OF CONSUMER	TPCS			0.361	0.433	0.470	0.526
G.R. OF CONSUMER	%			**********	19.945	8.545	11.915
E.S. PER CONSUMER	MWH			9.518	11.386	12.534	12.401
CONNECTED CAPACITY	MVA			1.499	2.304	2.588	2.709
C.C. PER CONSUMER	KVA			4.152	5.321	5.506	5.150
EXC.INDUSTRY							
ENERGY SALES	GWH			25.090	31.158	36.824	42.221
NOS OF CONSUMER	TPCS			20.971	23.875	26.620	32.392
G.R. OF CONSUMER	%			**********	13.848	11.497	21.683
E.S. PER CONSUMER	MWH			1.196	1.305	1.383	1.303
CONNECTED CAPACITY	MVA			11.450	13.451	15.135	18.880
C.C. PER CONSUMER	KVA			0.546	0.563	0.569	0.583
INDUSTRY							
ENERGY SALES	GWH			2.2	1.6	1.5	1.6
TOTAL							
ENERGY SALES	GWH			27.3	32.8	38.3	43.8
G.R. OF ENERGY SALES	%			**********	20.3	17.0	14.2
ELECTRIFICATION RAT.	%			2.661	2.932	3.282	3.929
CONSUMER RATIO C/R	%			7.753	6.870	6.487	6.012
CONSUMER RATIO P/R	%			1.887	1.974	1.914	1.750

TABLE 2.1-10 (10) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
BANYUWANGI							
POPULATION	TPSN	1344.400	1349.100	1420.900	1403.300	1469.600	1489.000
NOS OF HOUSEHOLD	TFML	298.800	299.800	315.700	311.900	325.500	330.900
NOS OF PERSON PER HH	PSNS	4.499	4.500	4.501	4.499	4.515	4.500
RESIDENTIAL							
ENERGY SALES	GWH			8.850	10.625	11.844	14.986
NOS OF CONSUMER	TPCS			11.146	12.683	13.406	19.032
G.R. OF CONSUMER	%			**********	13.790	5.701	41.966
E.S. PER CONSUMER	MWH			0.794	0.838	0.883	0.787
CONNECTED CAPACITY	MVA			3.077	3.586	3.785	6.016
C.C. PER CONSUMER	KVA			0.276	0.283	0.282	0.316
COMMERCIAL							
ENERGY SALES	GWH			1.315	1.544	1.587	1.854
NOS OF CONSUMER	TPCS			0.724	0.788	0.834	1.072
G.R. OF CONSUMER	%			**********	8.840	5.838	28.537
E.S. PER CONSUMER	MWH			1.816	1.959	1.903	1.729
CONNECTED CAPACITY	MVA			0.887	0.953	1.012	1.357
C.C. PER CONSUMER	KVA			1.225	1.209	1.213	1.266
PUBLIC							
ENERGY SALES	GWH			1.472	1.649	1.846	1.982
NOS OF CONSUMER	TPCS			0.148	0.167	0.182	0.228
G.R. OF CONSUMER	%			**********	12.838	8.982	25.275
E.S. PER CONSUMER	MWH			9.946	9.874	10.143	8.693
CONNECTED CAPACITY	MVA			0.605	0.721	0.745	0.806
C.C. PER CONSUMER	KVA			4.088	4.317	4.093	3.535
EXC.INDUSTRY							
ENERGY SALES	GWH			11.637	13.818	15.277	18.822
NOS OF CONSUMER	TPCS			12.018	13.638	14.422	20.332
G.R. OF CONSUMER	%			**********	13.480	5.749	40.979
E.S. PER CONSUMER	MWH			0.968	1.013	1.059	0.926
CONNECTED CAPACITY	MVA			4.569	5.260	5.542	8.179
C.C. PER CONSUMER	KVA			0.380	0.386	0.384	0.402
INDUSTRY							
ENERGY SALES	GWH			0.6	0.5	0.4	0.6
TOTAL							
ENERGY SALES	GWH			12.2	14.3	15.7	19.4
G.R. OF ENERGY SALES	%			**********	17.2	9.3	23.6
ELECTRIFICATION RAT.	%			3.531	4.066	4.119	5.752
CONSUMER RATIO C/R	%			6.496	6.213	6.221	5.633
CONSUMER RATIO P/R	%			1.328	1.317	1.358	1.198

TABLE 2.1-10 (11) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
SITUBONDO							
POPULATION	TPSN	497.500	500.400	522.900	523.000	537.900	544.500
NOS OF HOUSEHOLD	TFML	110.600	111.200	116.200	110.200	119.500	121.000
NOS OF PERSON PER HH	PSNS	4.498	4.500	4.500	4.746	4.501	4.500
RESIDENTIAL							
ENERGY SALES	GWH			5.508	6.659	7.641	8.744
NOS OF CONSUMER	TPCS			7.732	8.754	9.509	11.436
G.R. OF CONSUMER	%			**********	13.218	8.625	20.265
E.S. PER CONSUMER	MWH			0.712	0.761	0.804	0.765
CONNECTED CAPACITY	MVA			1.845	2.087	2.307	2.785
C.C. PER CONSUMER	KVA			0.239	0.238	0.243	0.244
COMMERCIAL							
ENERGY SALES	GWH			0.745	0.808	0.917	1.043
NOS OF CONSUMER	TPCS			0.542	0.557	0.562	0.702
G.R. OF CONSUMER	%			**********	2.768	0.898	24.911
E.S. PER CONSUMER	MWH			1.375	1.451	1.632	1.486
CONNECTED CAPACITY	MVA			0.473	0.497	0.509	0.638
C.C. PER CONSUMER	KVA			0.873	0.892	0.906	0.909
PUBLIC							
ENERGY SALES	GWH			0.887	0.985	1.124	1.042
NOS OF CONSUMER	TPCS			0.087	0.090	0.103	0.123
G.R. OF CONSUMER	%			**********	3.448	14.444	19.417
E.S. PER CONSUMER	MWH			10.195	10.944	10.913	8.472
CONNECTED CAPACITY	MVA			0.375	0.393	0.421	0.491
C.C. PER CONSUMER	KVA			4.310	4.367	4.087	3.992
EXC.INDUSTRY							
ENERGY SALES	GWH			7.140	8.452	9.682	10.829
NOS OF CONSUMER	TPCS			8.361	9.401	10.174	12.261
G.R. OF CONSUMER	%			**********	12.439	8.223	20.513
E.S. PER CONSUMER	MWH			0.854	0.899	0.952	0.883
CONNECTED CAPACITY	MVA			2.693	2.977	3.237	3.914
C.C. PER CONSUMER	KVA			0.322	0.317	0.318	0.319
INDUSTRY							
ENERGY SALES	GWH			0.0	0.0	0.0	0.2
TOTAL							
ENERGY SALES	GWH			7.2	8.5	9.7	11.0
G.R. OF ENERGY SALES	%			**********	18.3	14.5	13.2
ELECTRIFICATION RAT.	%			6.654	7.944	7.957	9.451
CONSUMER RATIO C/R	%			7.010	6.363	5.910	6.139
CONSUMER RATIO P/R	%			1.125	1.028	1.083	1.076

TABLE 2.1-10 (12) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
PAMEKASAN							
POPULATION	TPSN	2547.600	2555.200	2690.600	2696.600	2755.800	2791.000
NOS OF HOUSEHOLD	TFML	566.100	567.800	597.900	599.300	612.400	620.200
NOS OF PERSON PER HH	PSNS	4.500	4.500	4.500	4.500	4.500	4.500
RESIDENTIAL							
ENERGY SALES	GWH			11.723	13.703	16.891	20.090
NOS OF CONSUMER	TPCS			13.129	14.479	17.484	20.360
G.R. OF CONSUMER	%			**********	10.283	20.754	16.449
E.S. PER CONSUMER	MWH			0.893	0.946	0.966	0.987
CONNECTED CAPACITY	MVA			4.204	4.697	5.606	6.670
C.C. PER CONSUMER	KVA			0.320	0.324	0.321	0.328
COMMERCIAL							
ENERGY SALES	GWH			1.604	1.511	1.627	1.632
NOS OF CONSUMER	TPCS			0.705	0.741	0.782	0.803
G.R. OF CONSUMER	%			**********	5.106	5.533	2.685
E.S. PER CONSUMER	MWH			2.275	2.039	2.081	2.032
CONNECTED CAPACITY	MVA			0.840	0.863	1.003	1.072
C.C. PER CONSUMER	KVA			1.191	1.165	1.283	1.335
PUBLIC							
ENERGY SALES	GWH			1.977	2.104	2.179	2.287
NOS OF CONSUMER	TPCS			0.253	0.267	0.295	0.346
G.R. OF CONSUMER	%			**********	5.534	10.487	17.288
E.S. PER CONSUMER	MWH			7.814	7.880	7.386	6.610
CONNECTED CAPACITY	MVA			0.623	0.622	0.806	0.970
C.C. PER CONSUMER	KVA			2.462	2.330	2.732	2.803
EXC.INDUSTRY							
ENERGY SALES	GWH			15.304	17.318	20.697	24.009
NOS OF CONSUMER	TPCS			14.087	15.487	18.561	21.509
G.R. OF CONSUMER	%			**********	9.938	19.849	15.883
E.S. PER CONSUMER	MWH			1.086	1.118	1.115	1.116
CONNECTED CAPACITY	MVA			5.667	6.182	7.415	8.712
C.C. PER CONSUMER	KVA			0.402	0.399	0.399	0.405
INDUSTRY							
ENERGY SALES	GWH			0.8	0.9	1.2	1.7
TOTAL							
ENERGY SALES	GWH			16.1	18.2	21.9	25.7
G.R. OF ENERGY SALES	%			**********	13.0	20.3	17.8
ELECTRIFICATION RAT.	%			2.196	2.416	2.855	3.283
CONSUMER RATIO C/R	%			5.370	5.118	4.473	3.944
CONSUMER RATIO P/R	%			1.927	1.844	1.687	1.699

TABLE 2.1-10 (13) INPUT DATA FOR REGIONAL DEMAND FORECAST

ITEM	UNIT	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
EAST JAVA							
POPULATION	TPSN	24316.9	27817.0	28684.0	29113.9	29969.7	30427.3
NOS OF HOUSEHOLD	TFML	5403.8	6181.6	6380.5	6470.5	6658.6	6761.5
NOS OF PERSON PER HH	PSNS	4.5	4.5	4.5	4.5	4.5	4.5
RESIDENTIAL							
ENERGY SALES	GWH			416.5	489.9	591.7	687.5
NOS OF CONSUMER	TPCS			379.3	460.3	536.6	642.5
G.R. OF CONSUMER	%			**********	21.341	16.571	19.748
E.S. PER CONSUMER	MWH			1.098	1.064	1.103	1.070
CONNECTED CAPACITY	MVA			179.6	226.5	273.7	335.3
C.C. PER CONSUMER	KVA			0.474	0.492	0.510	0.522
COMMERCIAL							
ENERGY SALES	GWH			78.8	104.7	117.6	107.3
NOS OF CONSUMER	TPCS			24.4	27.1	29.0	31.6
G.R. OF CONSUMER	%			**********	10.861	7.014	9.124
E.S. PER CONSUMER	MWH			3.230	3.870	4.062	3.395
CONNECTED CAPACITY	MVA			50.8	72.8	80.1	81.1
C.C. PER CONSUMER	KVA			2.081	2.691	2.767	2.566
PUBLIC							
ENERGY SALES	GWH			60.2	111.6	125.7	145.8
NOS OF CONSUMER	TPCS			3.8	4.9	5.3	6.1
G.R. OF CONSUMER	%			**********	27.779	9.355	14.695
E.S. PER CONSUMER	MWH			15.759	22.853	23.530	23.788
CONNECTED CAPACITY	MVA			20.9	55.5	58.8	69.3
C.C. PER CONSUMER	KVA			5.461	11.364	11.016	11.310
EXC.INDUSTRY							
ENERGY SALES	GWH			555.6	706.2	835.1	940.6
NOS OF CONSUMER	TPCS			407.6	492.2	570.9	680.3
G.R. OF CONSUMER	%			**********	20.774	15.974	19.162
E.S. PER CONSUMER	MWH			1.363	1.435	1.463	1.383
CONNECTED CAPACITY	MVA			251.3	354.8	412.7	485.7
C.C. PER CONSUMER	KVA			0.617	0.721	0.723	0.714
INDUSTRY							
ENERGY SALES	GWH			474.4	481.4	658.9	878.2
TOTAL							
ENERGY SALES	GWH			1030.0	1187.7	1493.9	1818.7
G.R. OF ENERGY SALES	%			**********	15.3	25.8	21.7
ELECTRIFICATION RAT.	%			5.945	7.114	8.058	9.503
CONSUMER RATIO C/R	%			6.434	5.879	5.397	4.918
CONSUMER RATIO P/R	%			1.008	1.061	0.996	0.954

FIGURE 2.1-1 ENERGY SALES PER CONSUMER

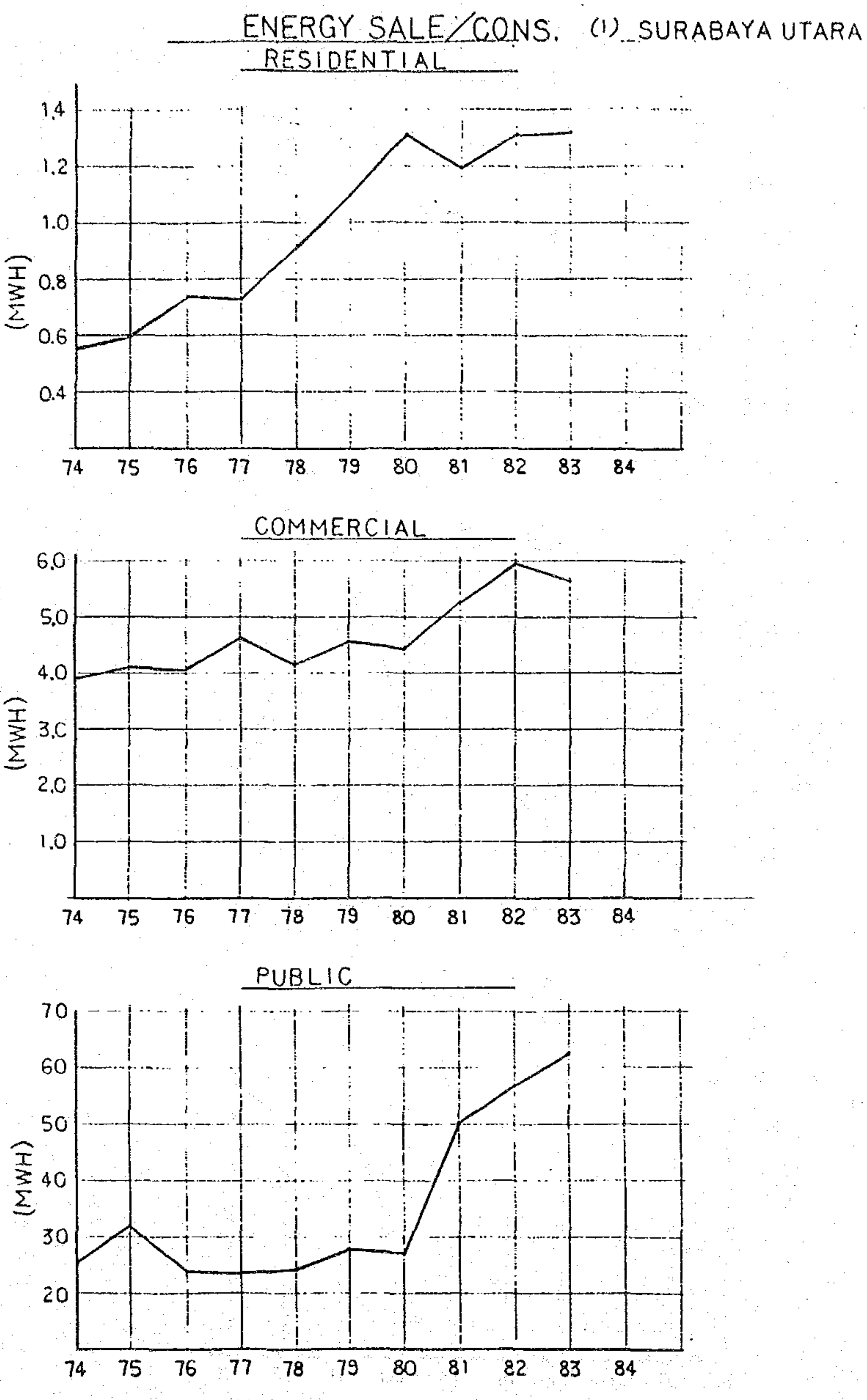


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

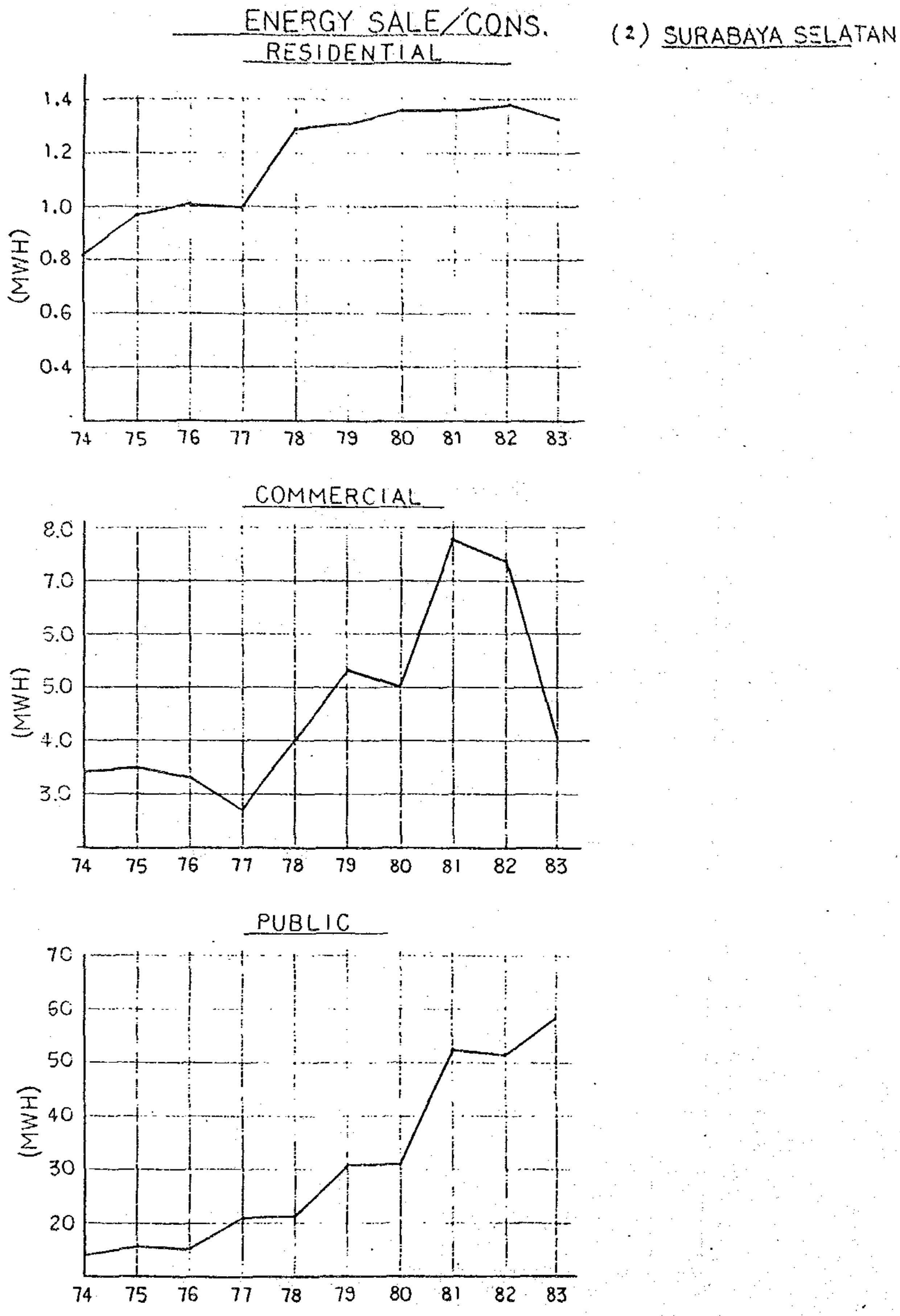


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

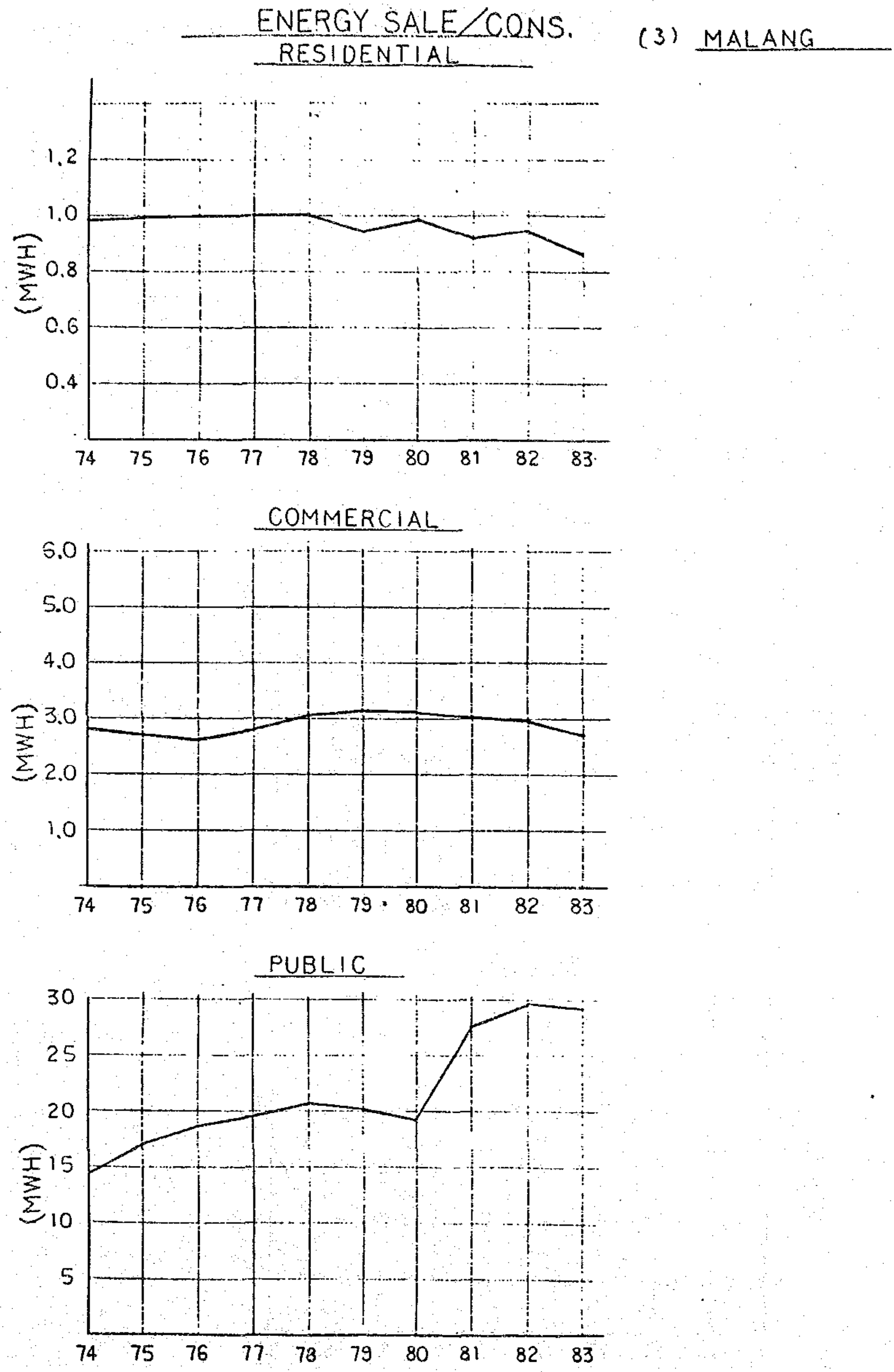


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

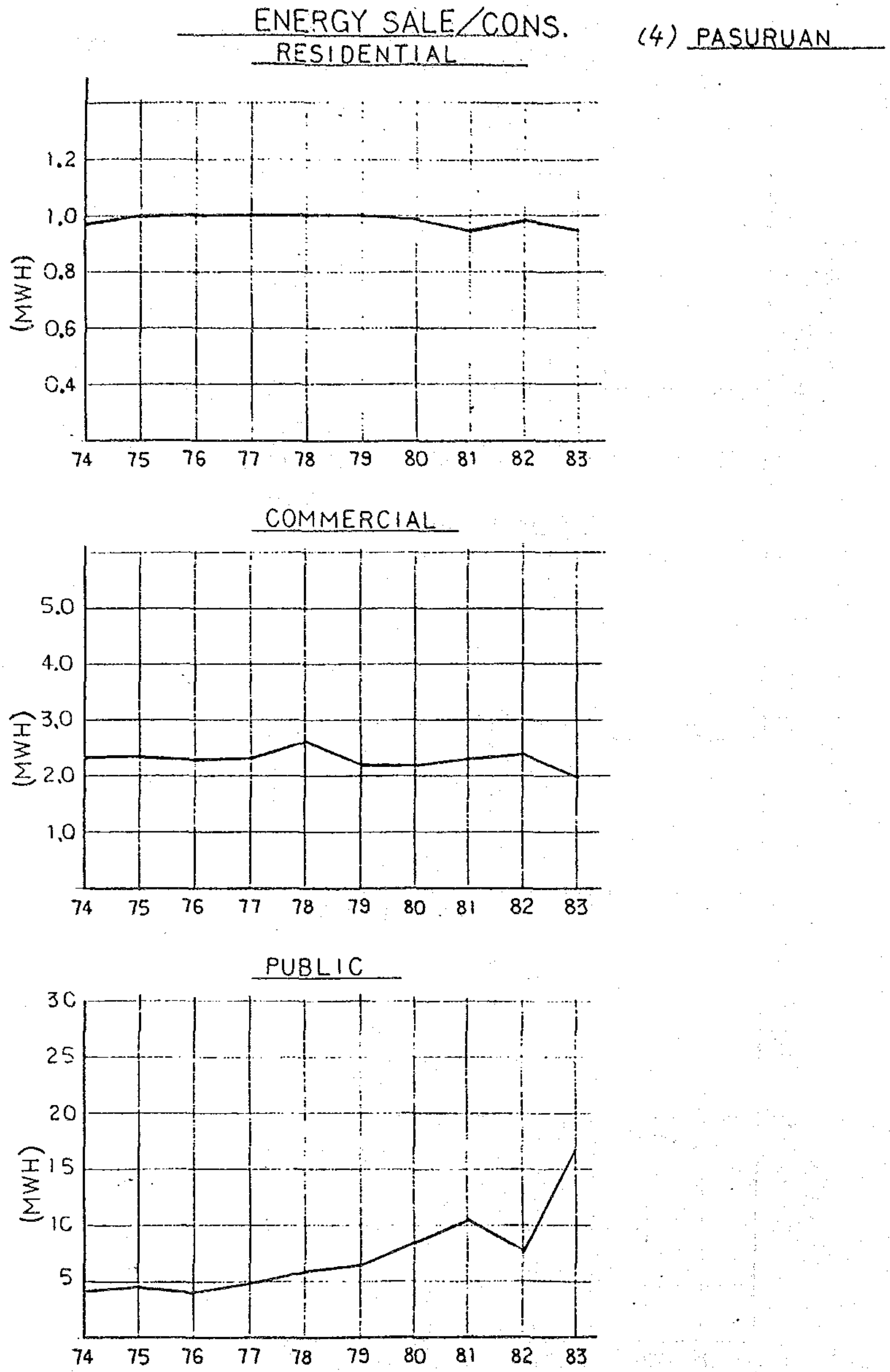


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

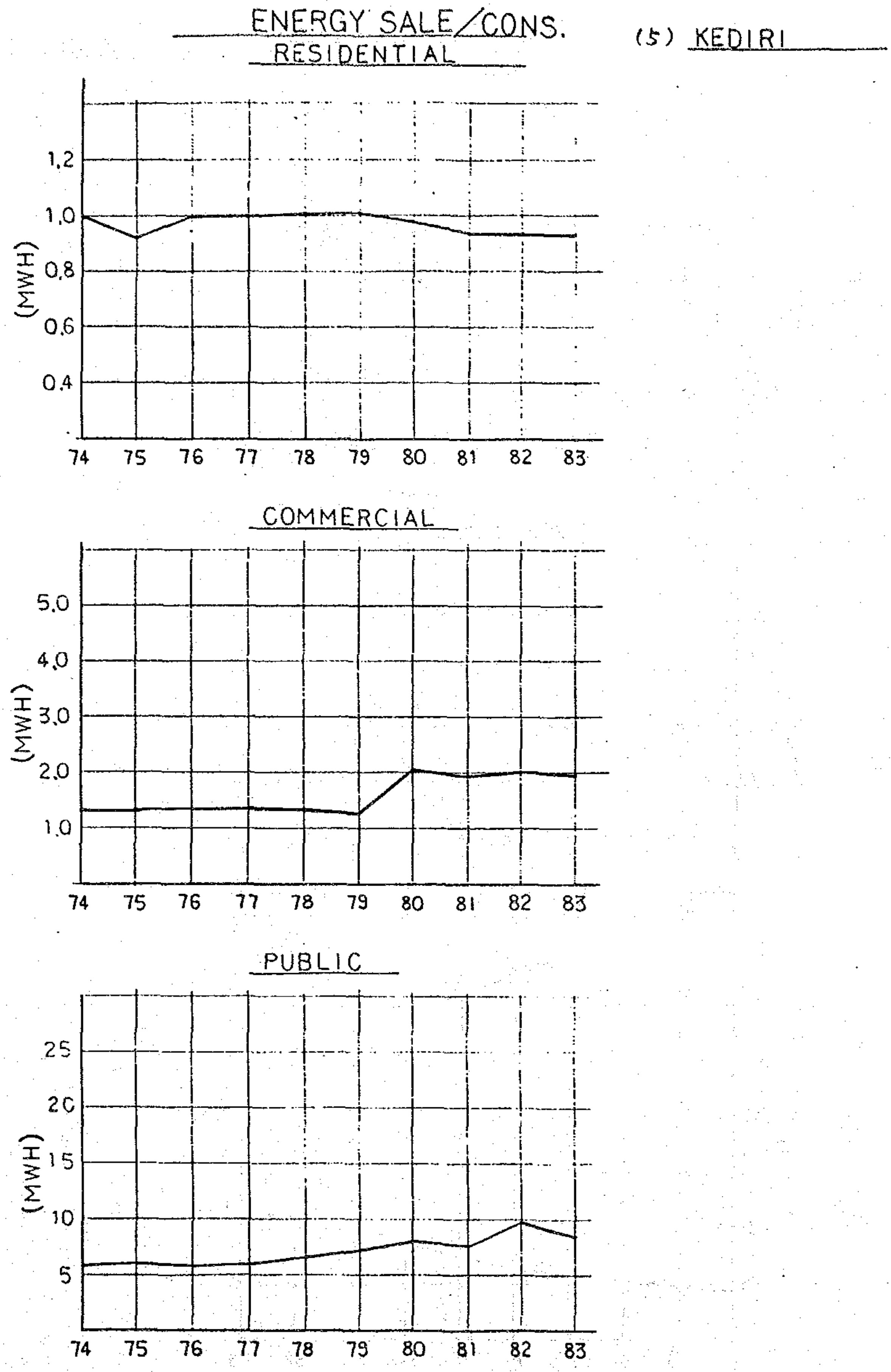


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

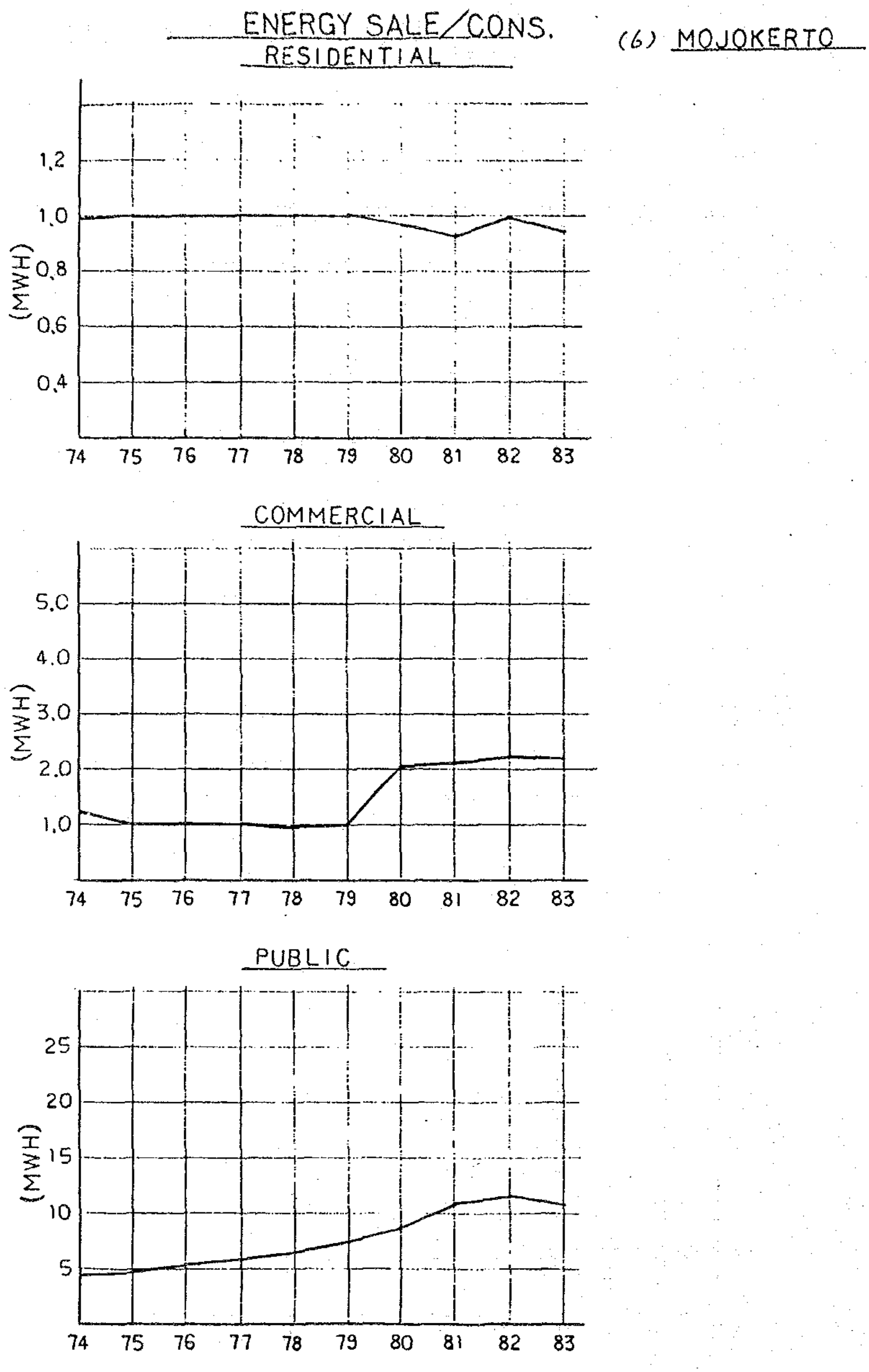


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

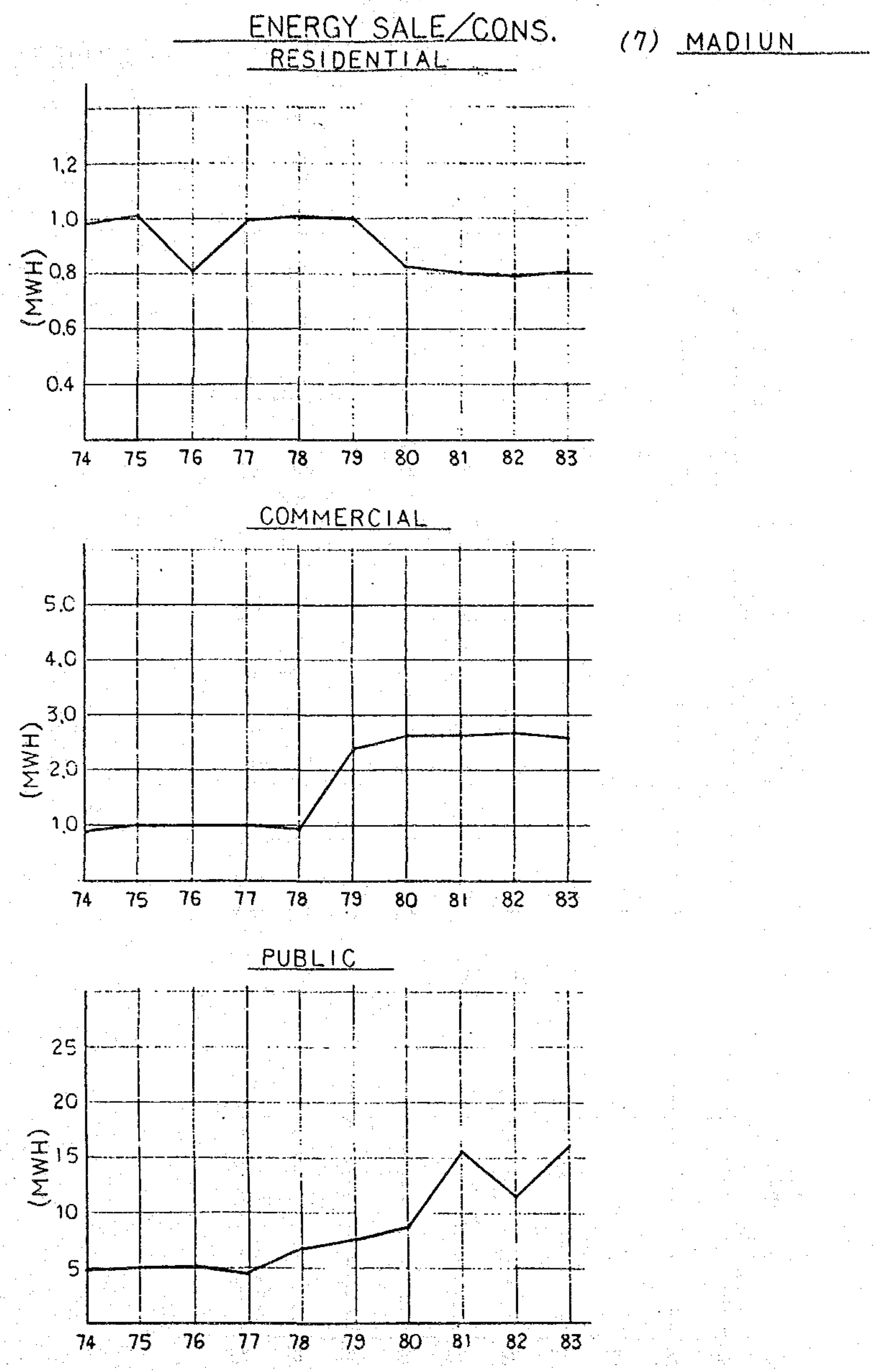


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

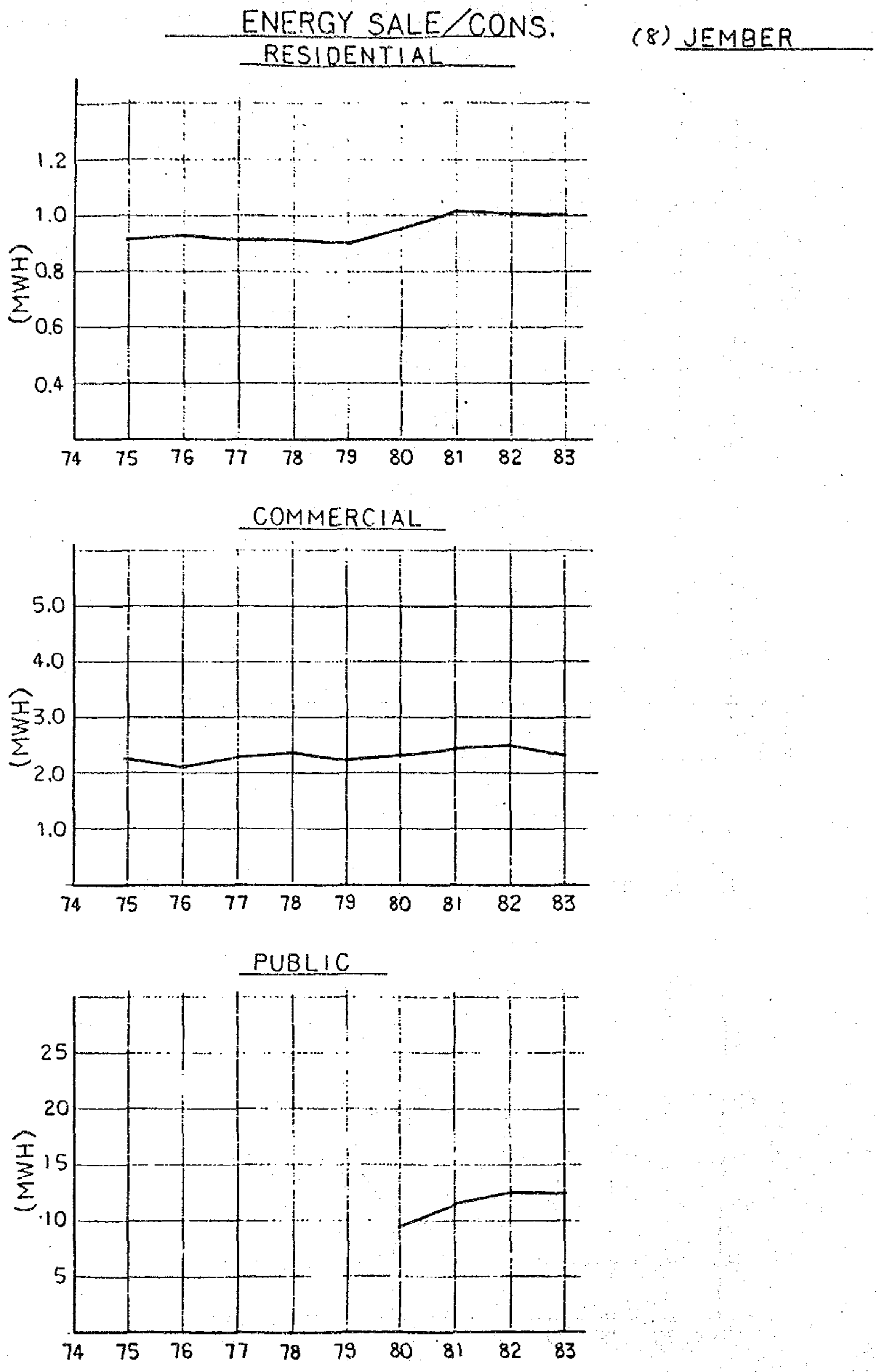


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

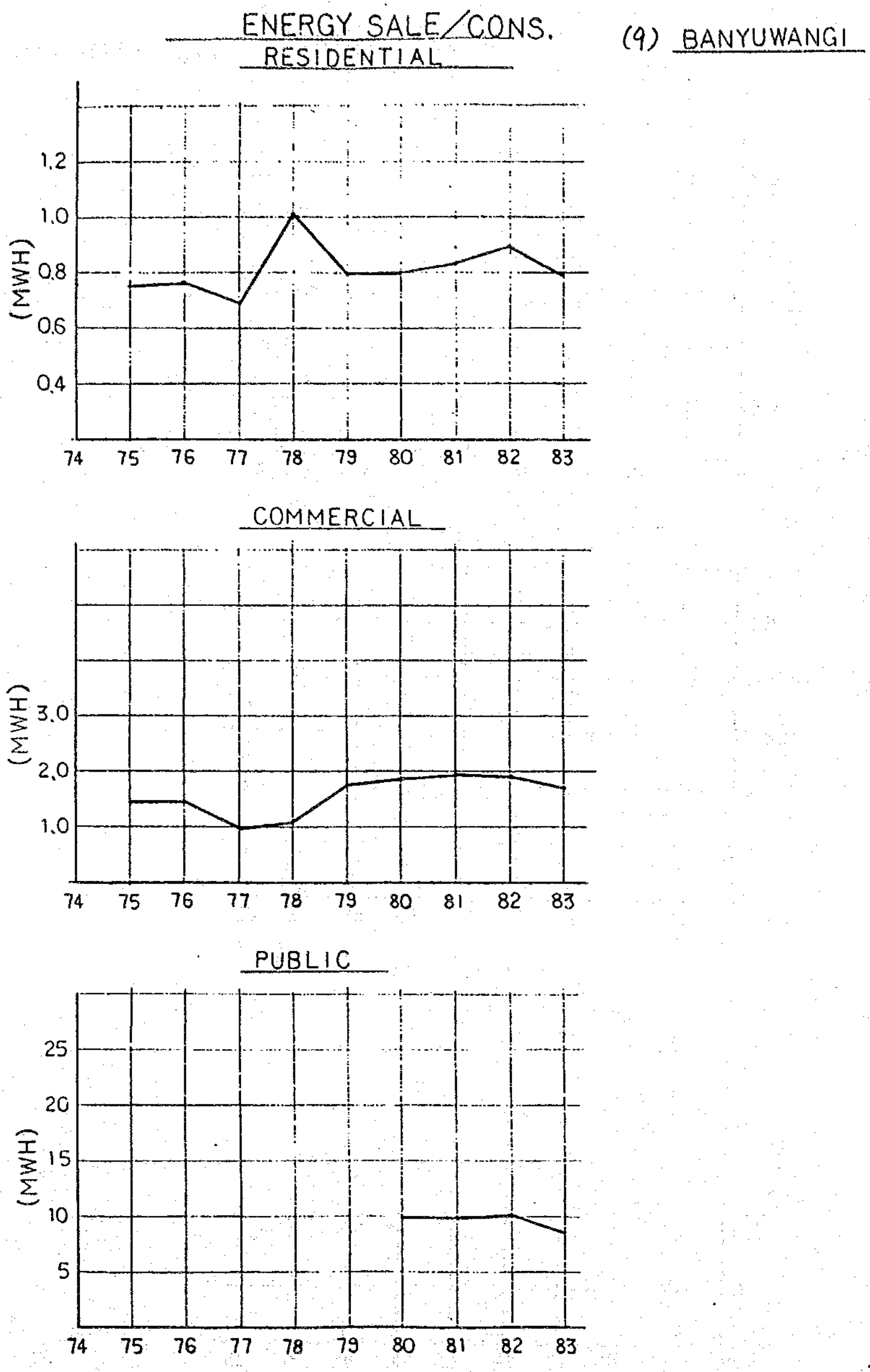


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

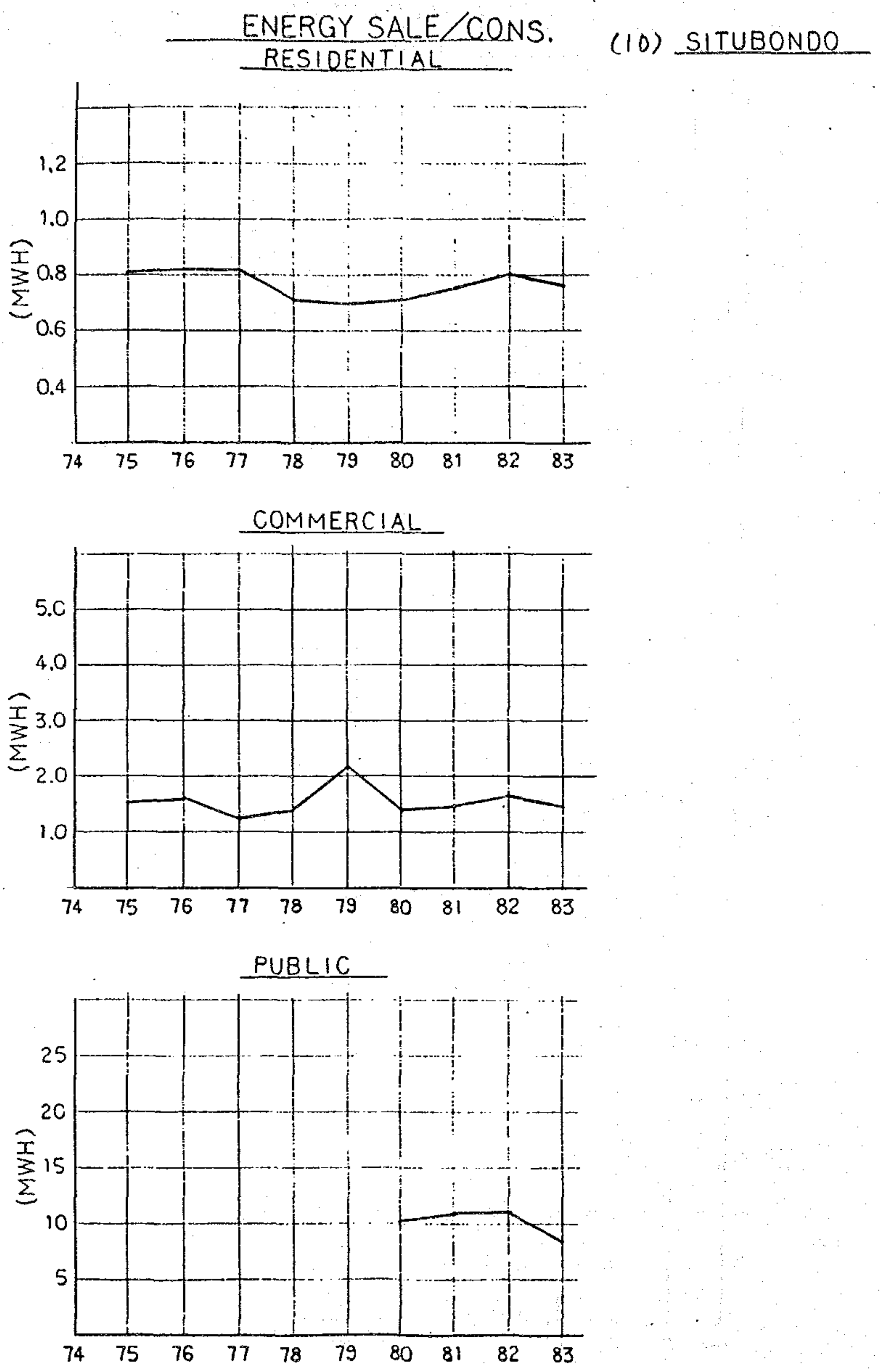


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

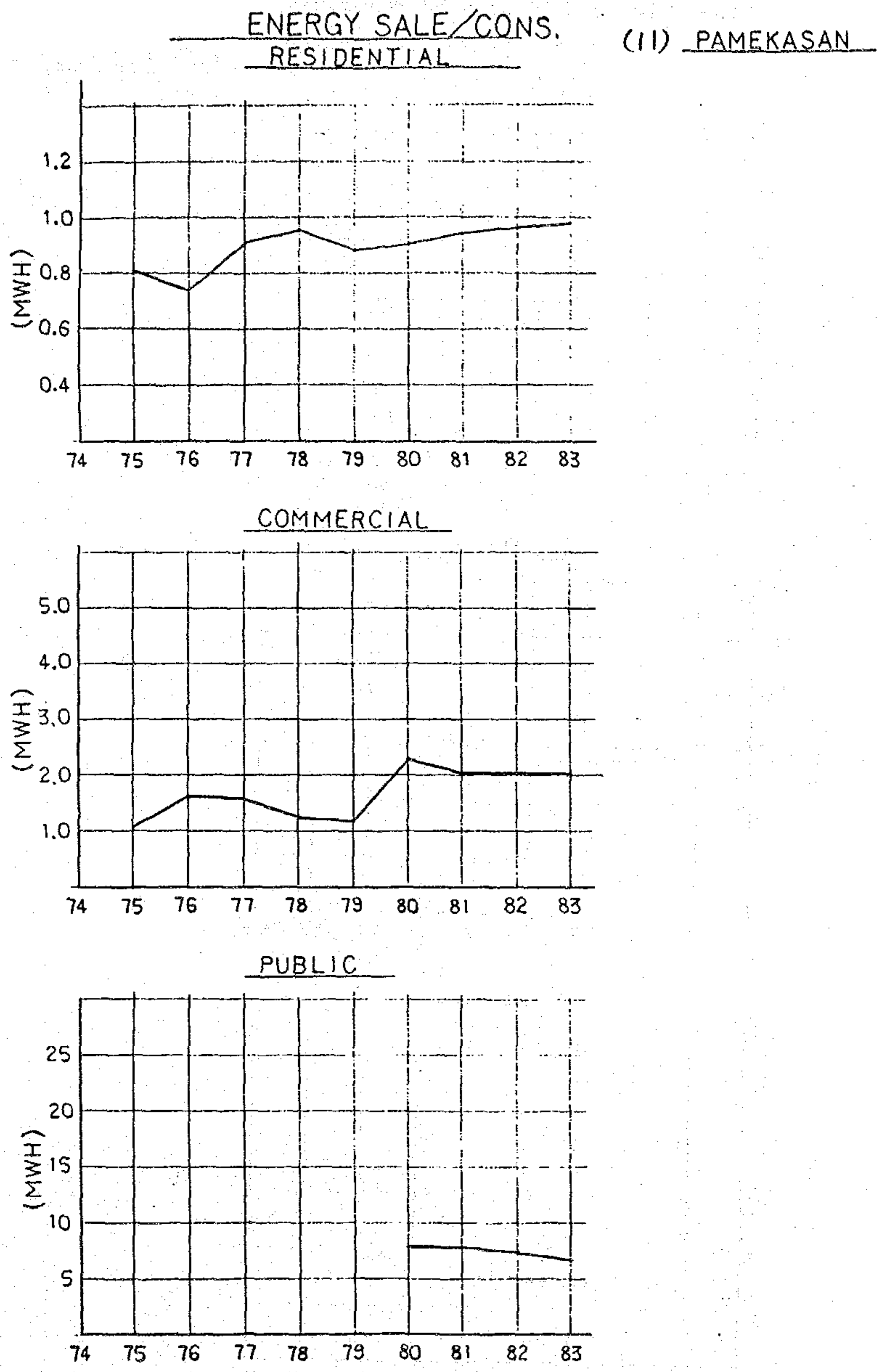
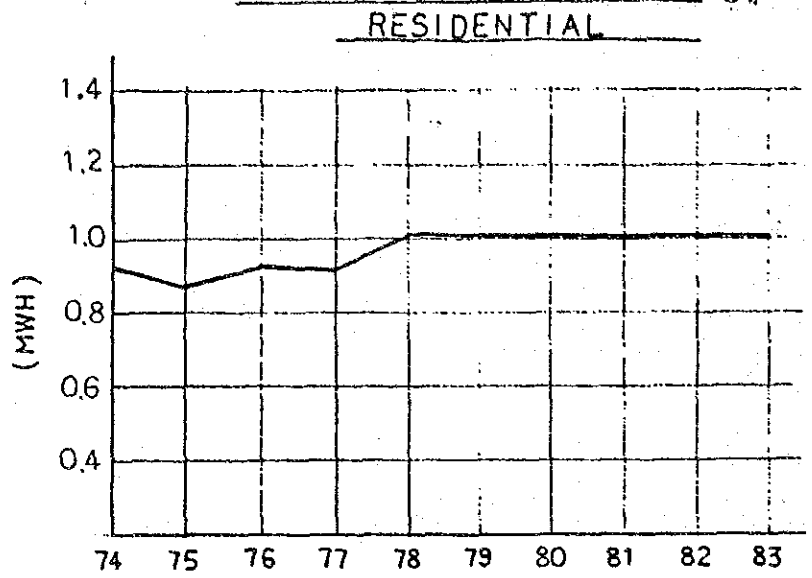
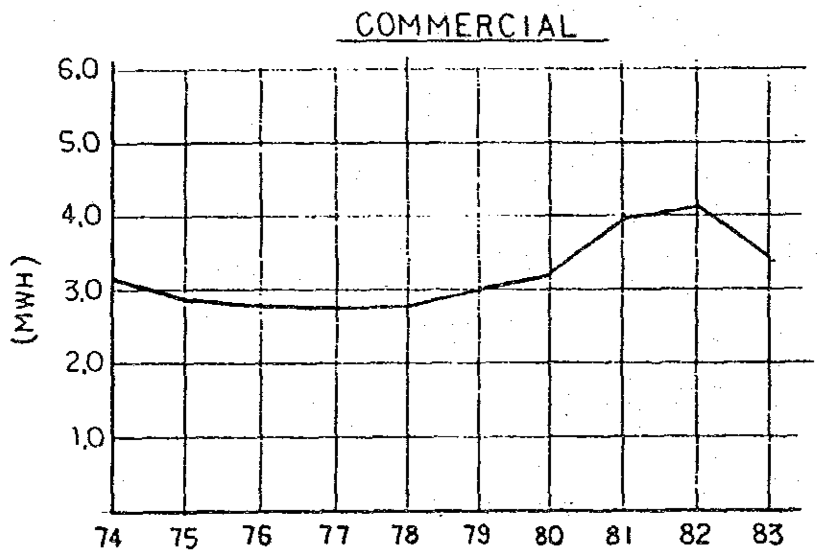


FIGURE 2.1-1 ENERGY SALES PER CONSUMER

ENERGY SALE/CONS. (12) EAST JAVA





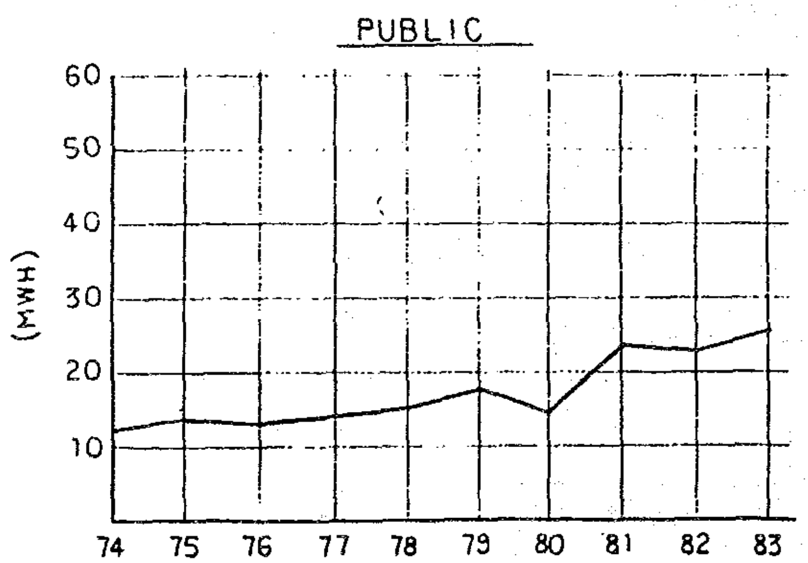
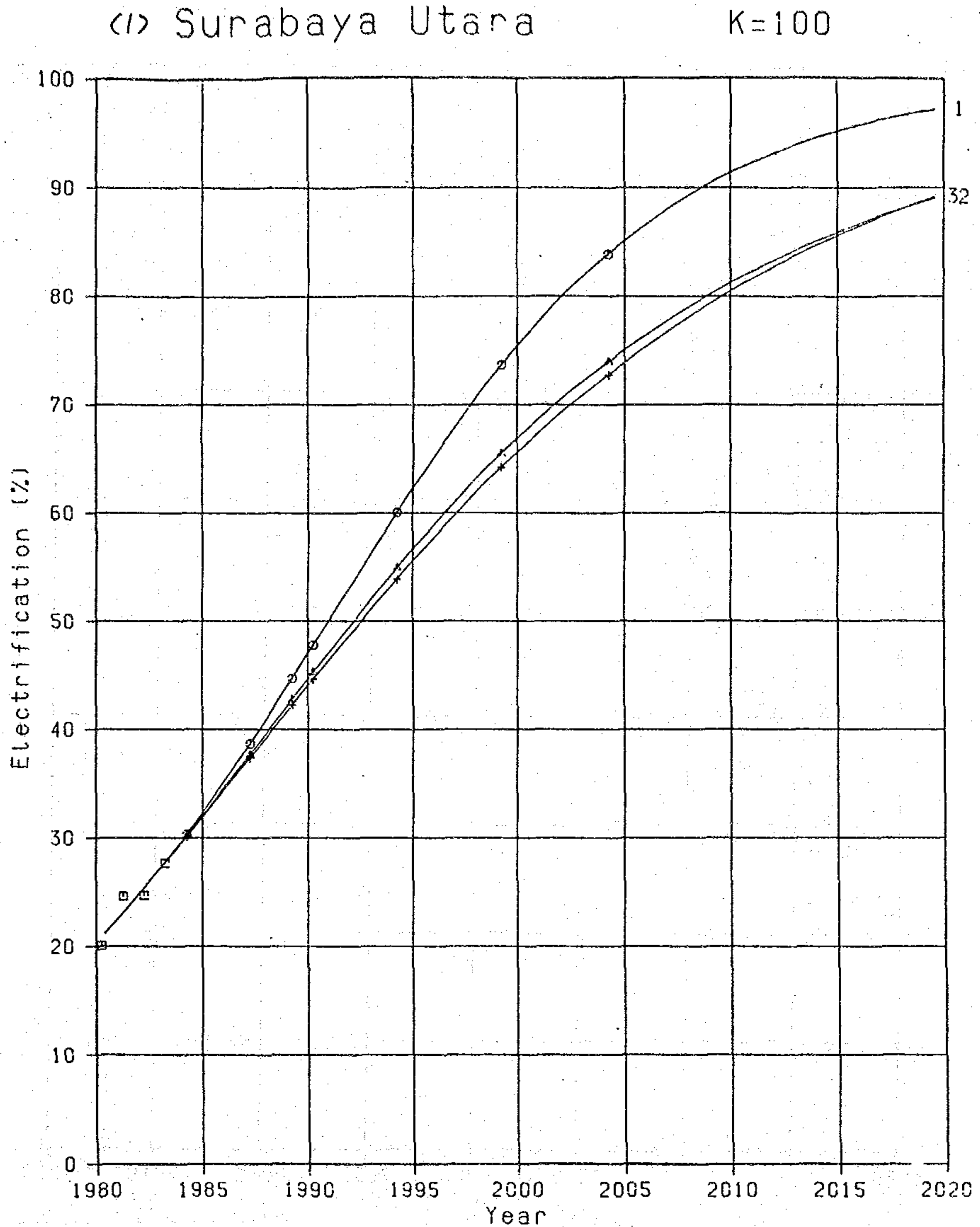


FIGURE 2.1-2 ELECTRIFICATION RATIO

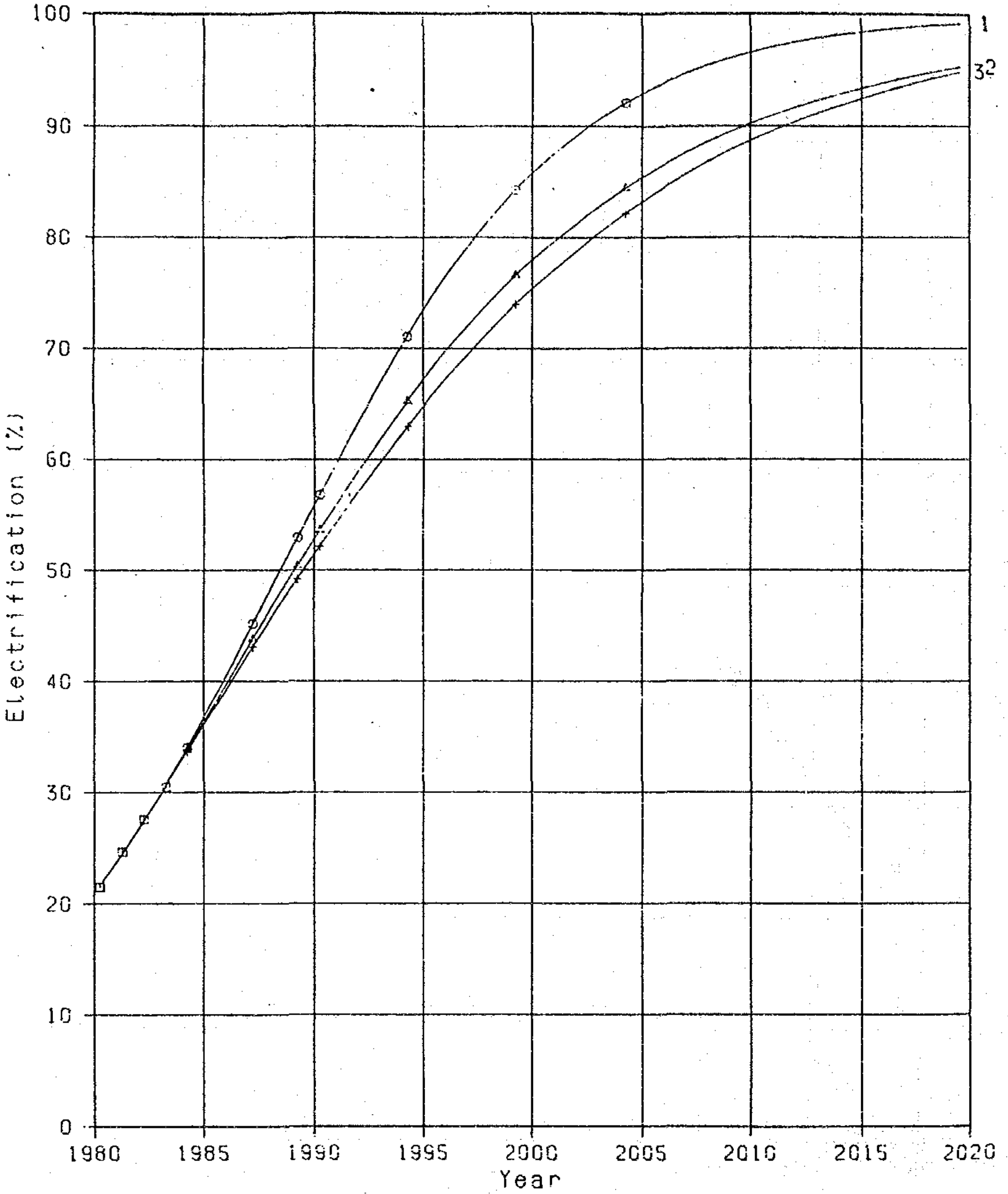


NO.	R	1984	2020	T=Year-1945
1. O	0.9341	30.3	97.4	Y=100.00/(1+EXP(5.703-0.124*T))
2. △	0.9362	30.1	89.4	Y=100.00*(T**(4.571))/(T**(4.571)+4.469E7)
3. +	0.9384	30.1	89.6	Y=100.00/EXP(16.28*(0.936)**T)

FIGURE 2.1-3(1)

FIGURE 2.1-2 ELECTRIFICATION RATIO

(2) Surabaya Selatan K=100

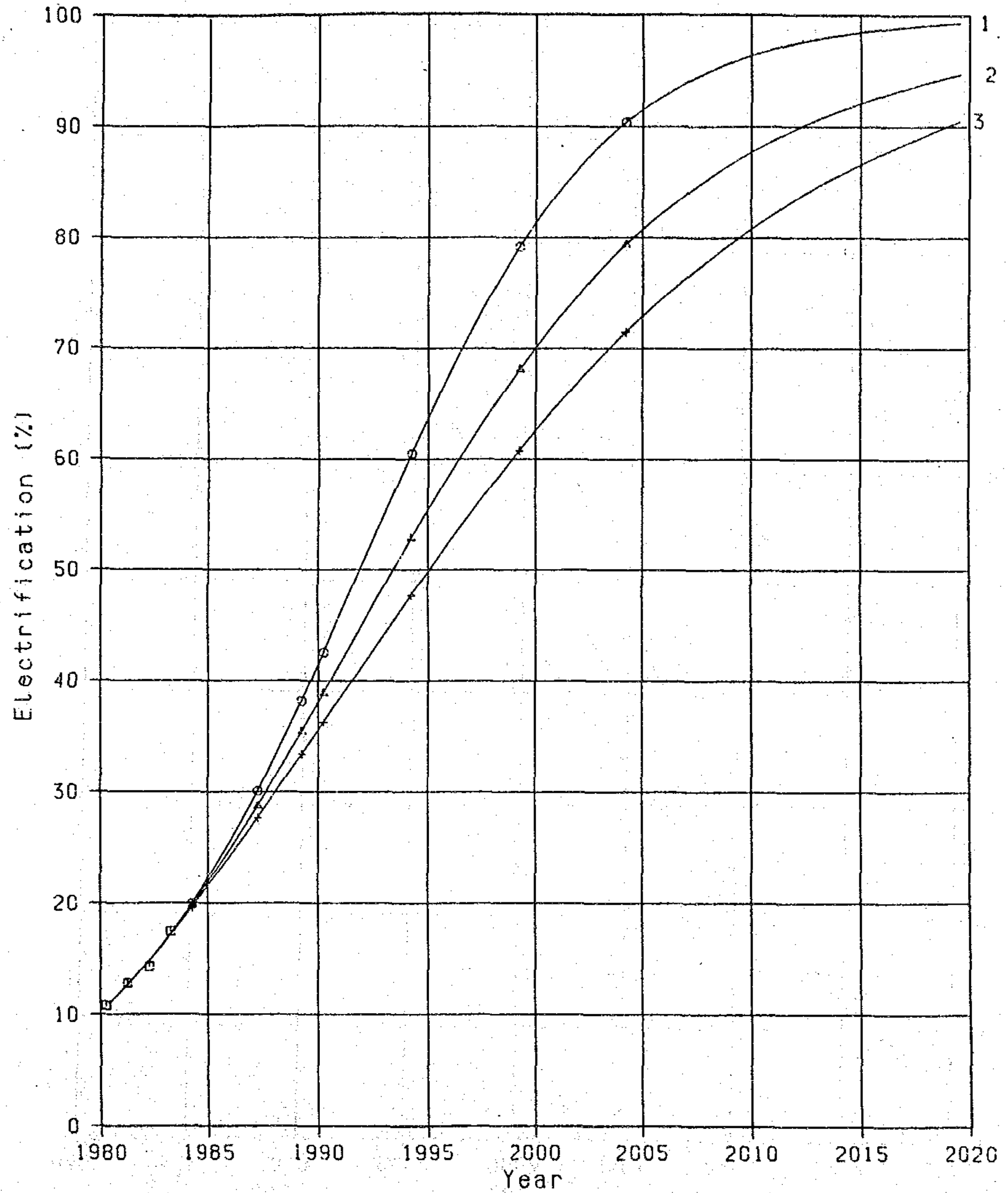


NO.	R	1984	2020	T=Year-1945
1. O	0.9987	34.0	99.3	Y=100.00/(1+EXP(6.784-0.156*T))
2. △	0.9992	33.6	95.5	Y=100.00*(T**(5.736))/(T**(5.736)+2.718E9)
3. +	0.9995	33.7	95.1	Y=100.00/EXP(31.34*(0.918)**T)

FIGURE 2.1-3(2)

FIGURE 2.1-2 ELECTRIFICATION RATIO

(3) Malang K=100

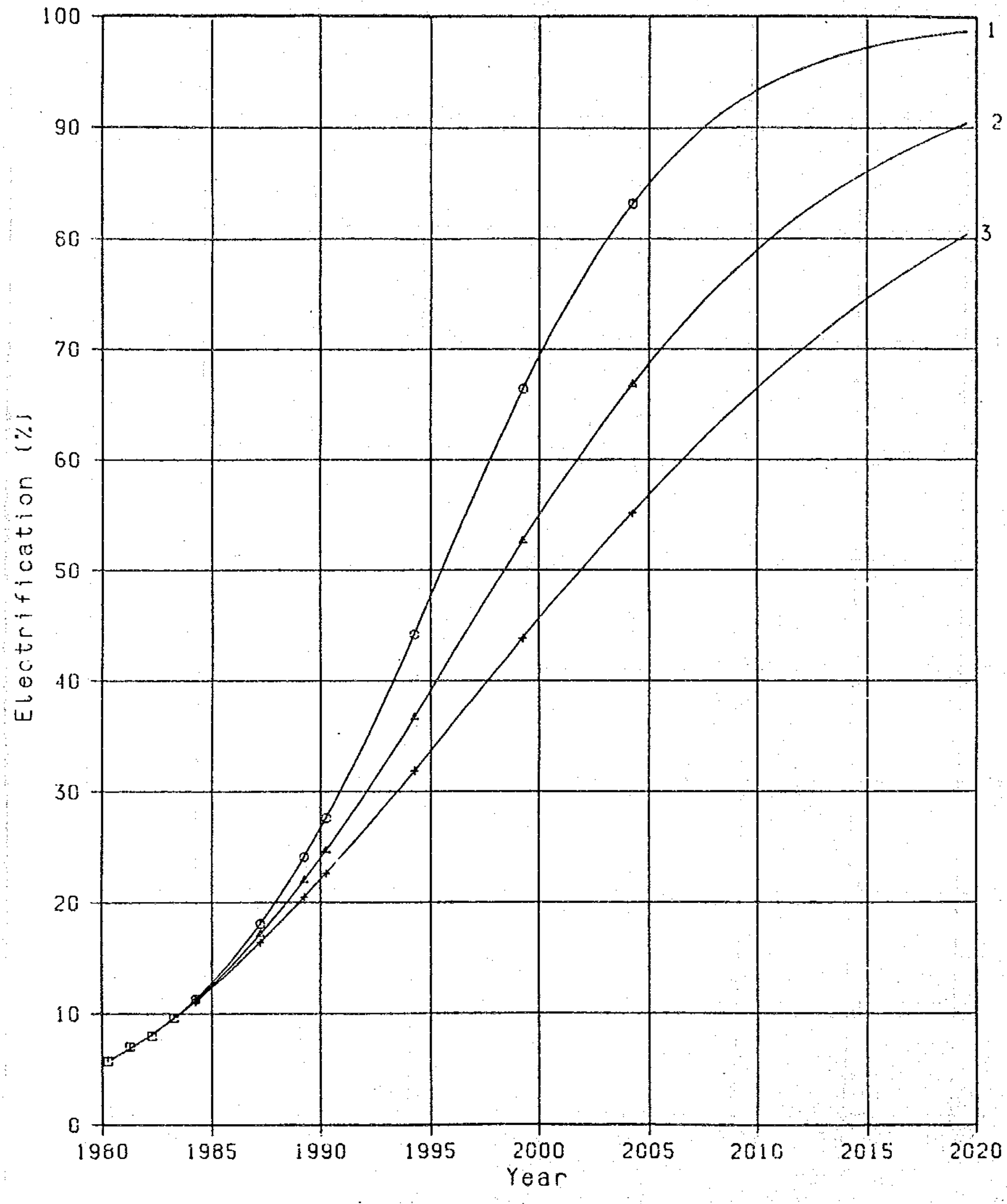


NO.	R	1984	2020	T=Year-1945
1. ʘ	0.9933	19.9	99.4	Y=100.00/(1+EXP(8.517-0.182*T))
2. △	0.9925	19.8	95.0	Y=100.00*(T**(6.674))/(T**(6.674)+1.760E11)
3. +	0.9914	19.6	90.9	Y=100.00/EXP(36.16*(0.924)**T)

FIGURE 2.1-3(3)

FIGURE 2.1-2 ELECTRIFICATION RATIO

(4) Pasuruan n=100

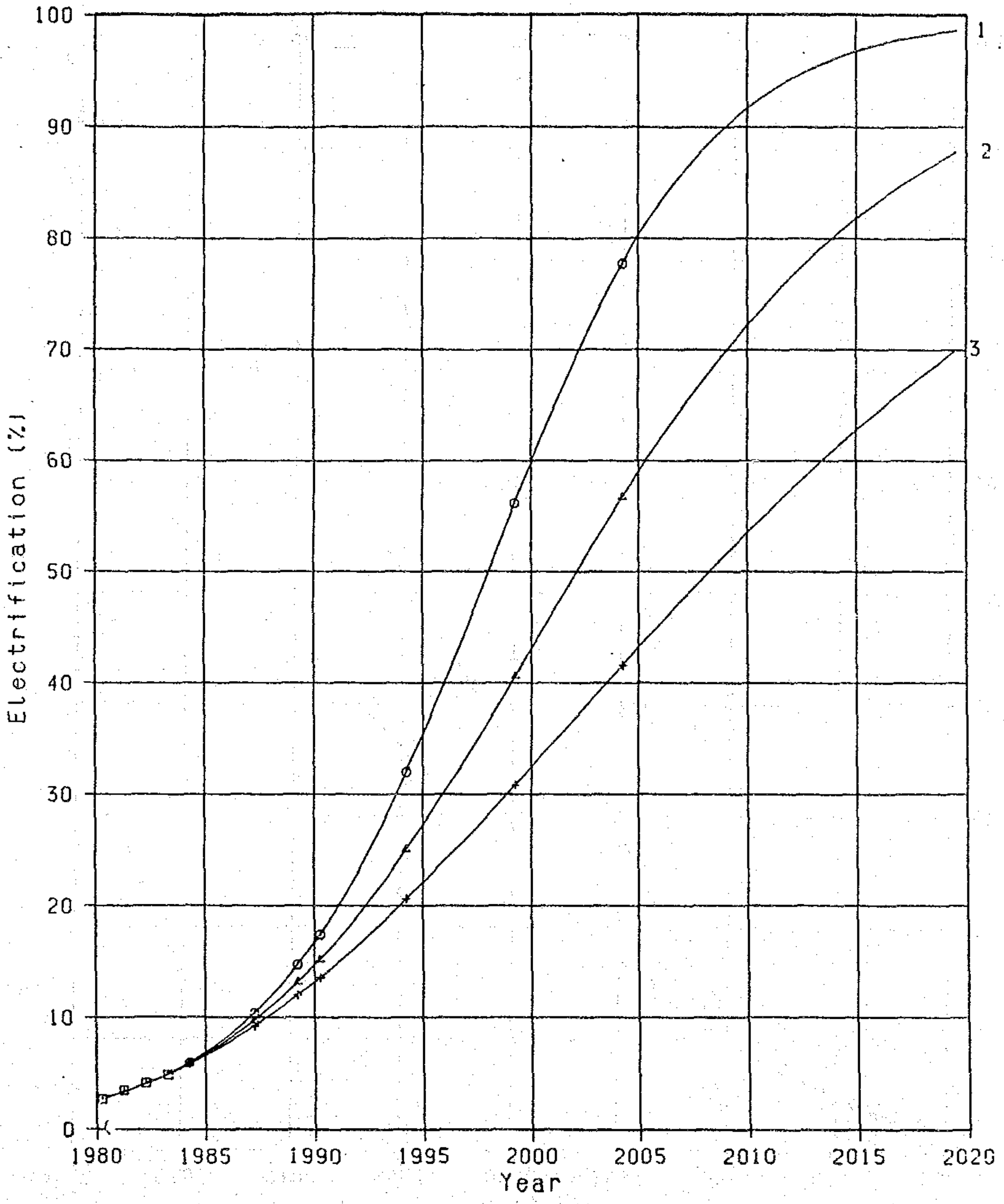


NO.	R	1984	2020	T=Year-1945
1. O	0.9967	11.3	98.9	Y=100.00/(1+EXP(9.241-0.183*T))
2. △	0.9968	11.2	91.0	Y=100.00*(T**(6.731))/(T**(6.731)+4.257E11)
3. +	0.9968	11.1	81.2	Y=100.00/EXP(28.70*(0.937)**T)

FIGURE 2.1-3(4)

FIGURE 2.1-2 ELECTRIFICATION RATIO

(5) Kediri K=100

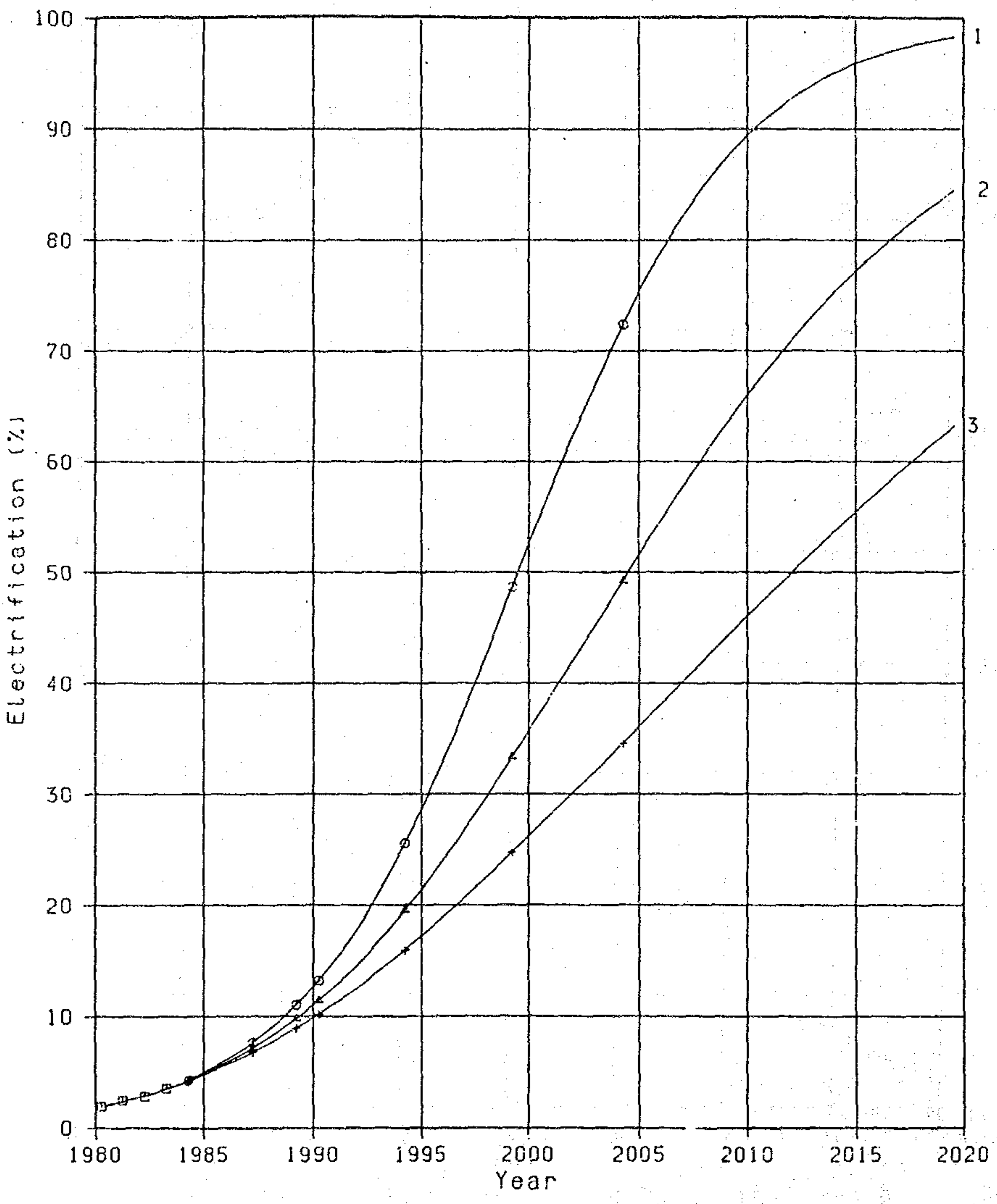


NO.	R	1984	2020	T=Year-1945
1. O	0.9933	6.0	98.9	Y=100.00/(1+EXP(10.63-0.200*T))
2. Δ	0.9945	5.9	88.5	Y=100.00*(T**(7.389))/(T**(7.389)+9.549E12)
3. +	0.9957	5.8	71.0	Y=100.00/EXP(28.58*(0.943)**T)

FIGURE 2.1-3(5)

FIGURE 2.1-2 ELECTRIFICATION RATIO

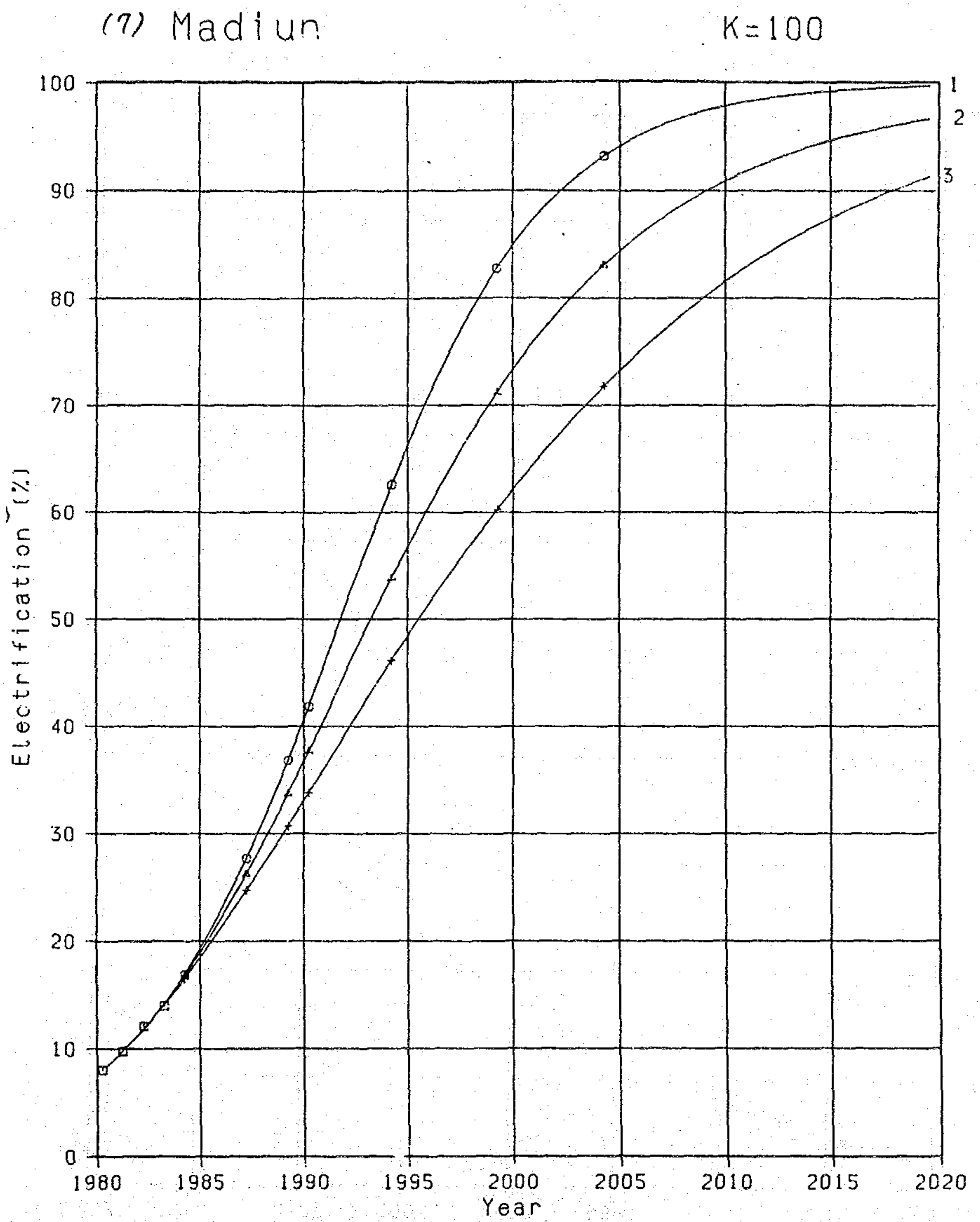
(6) Mojokerto K=100



NO.	R	1984	2020	T=Year-1945
1. O	0.9944	4.3	98.6	Y=100.00/(1+EXP(11.09-0.204*T))
2. Δ	0.9946	4.2	85.3	Y=100.00*(T**(7.494))/(T**(7.494)+1.984E13)
3. +	0.9948	4.2	64.2	Y=100.00/EXP(27.12*(0.947)**T)

FIGURE 2.1-3(6)

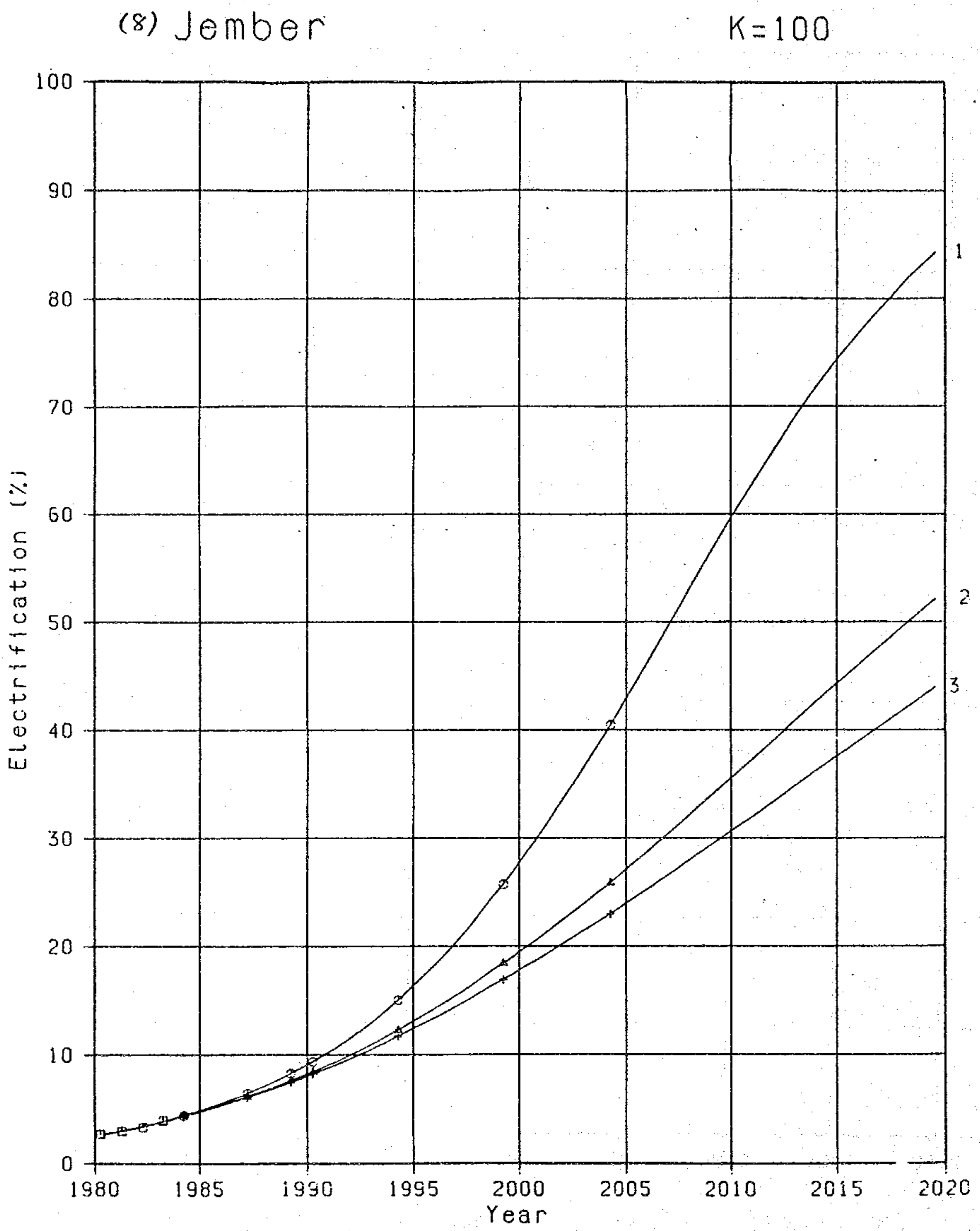
FIGURE 2.1-2 ELECTRIFICATION RATIO



NO.	R	1984	2020	T=Year-1945
1. O	0.9970	16.9	99.8	Y=100.00/(1+EXP(9.854-0.211*T))
2. △	0.9976	16.7	96.9	Y=100.00*(T**(7.750))/(T**(7.750)+1.120E13)
3. +	0.9982	16.5	91.6	Y=100.00/EXP(49.73*(0.919)**T)

FIGURE 2.1-3(7)

FIGURE 2.1-2 ELECTRIFICATION RATIO

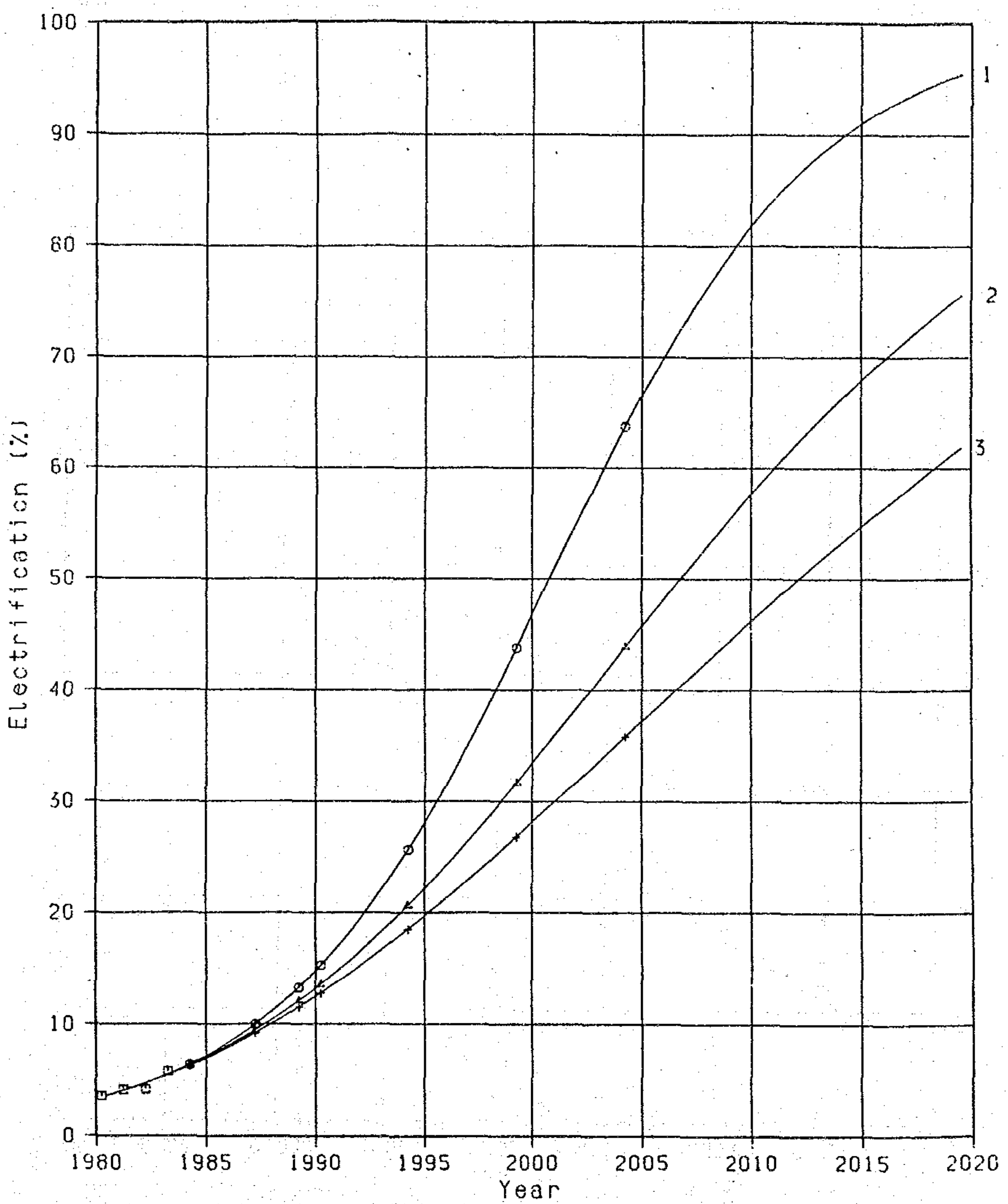


NO.	R	1984	2020	T=Year-1945
1. ⊙	0.9886	4.4	85.4	Y=100.00/(1+EXP(8.371-0.135*T))
2. △	0.9869	4.3	53.2	Y=100.00*(T**(4.947))/(T**(4.947)+1.685E9)
3. +	0.9864	4.3	44.8	Y=100.00/EXP(13.87*(0.963)**T)

FIGURE 2.1-3(8)

FIGURE 2.1-2 ELECTRIFICATION RATIO

(9) Banyuwangi K=100

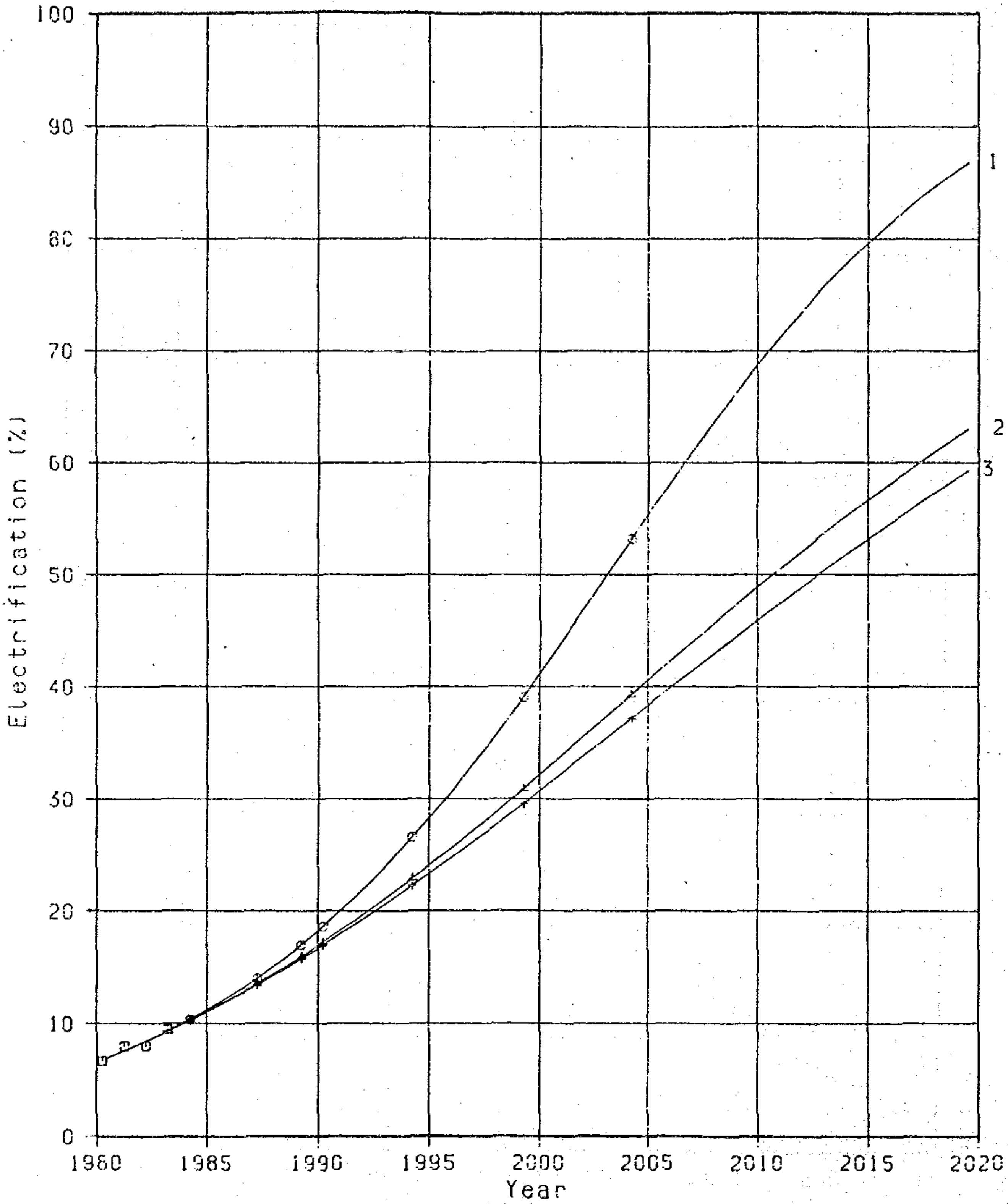


NO.	R	1984	2020	T=Year-1945
1. ⊙	0.9279	6.3	96.0	Y=100.00/(1+EXP(9.080-0.163*T))
2. △	0.9247	6.3	76.5	Y=100.00*(T**(5.968))/(T**(5.968)+4.845E10)
3. +	0.9212	6.2	62.8	Y=100.00/EXP(19.44*(0.952)**T)

FIGURE 2.1-3(9)

FIGURE 2.1-2 ELECTRIFICATION RATIO

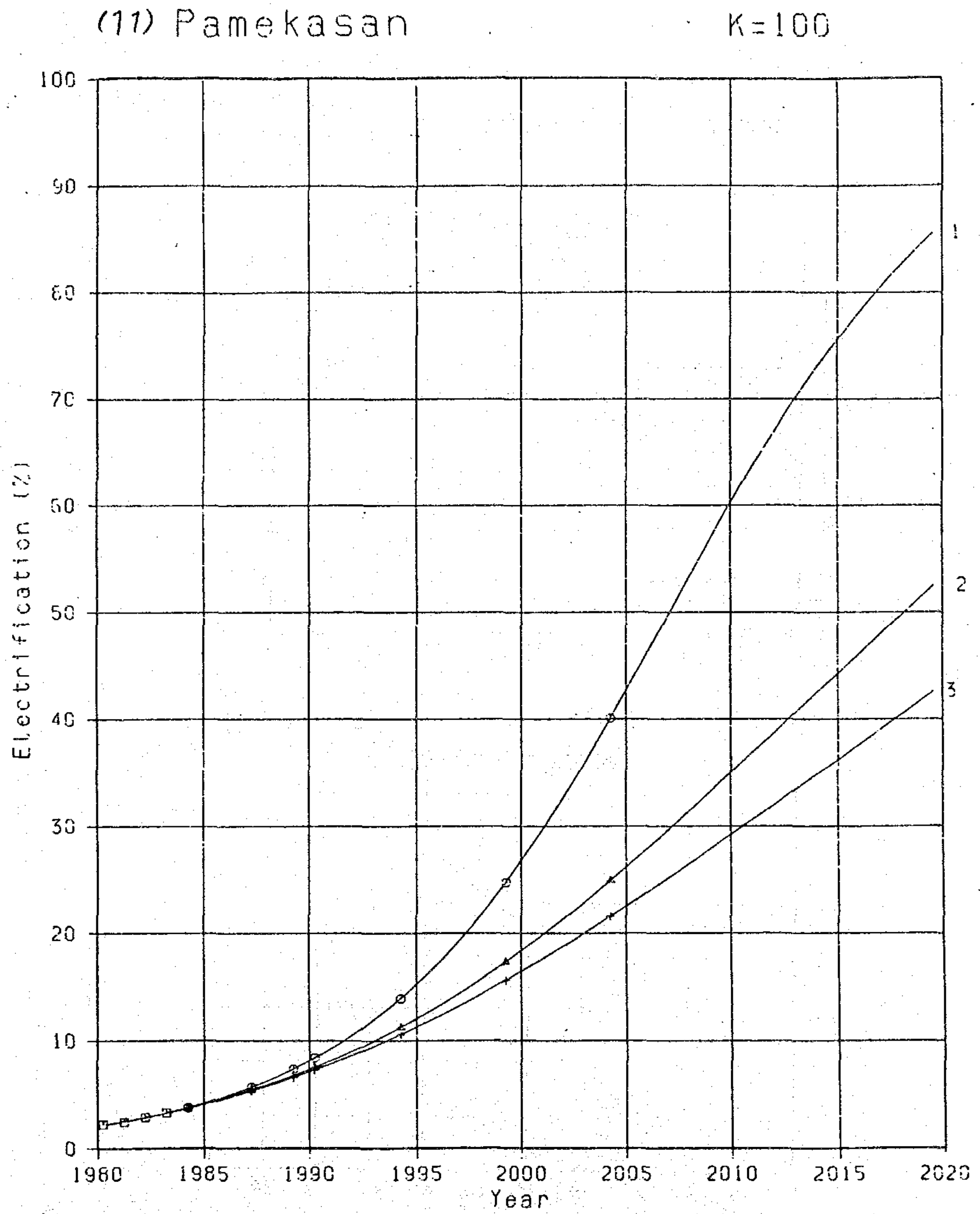
(10) Situbondo K=100



NO.	R	1984	2020	T=Year-1945
1. O	0.9500	10.3	87.6	Y=100.00/(1+EXP(6.655-0.114*T))
2. △	0.9499	10.3	63.9	Y=100.00*(T**(4.209))/(T**(4.209)+4.479E7)
3. +	0.9499	10.2	60.2	Y=100.00/EXP(11.71*(0.959)**T)

FIGURE 2.1-3(10)

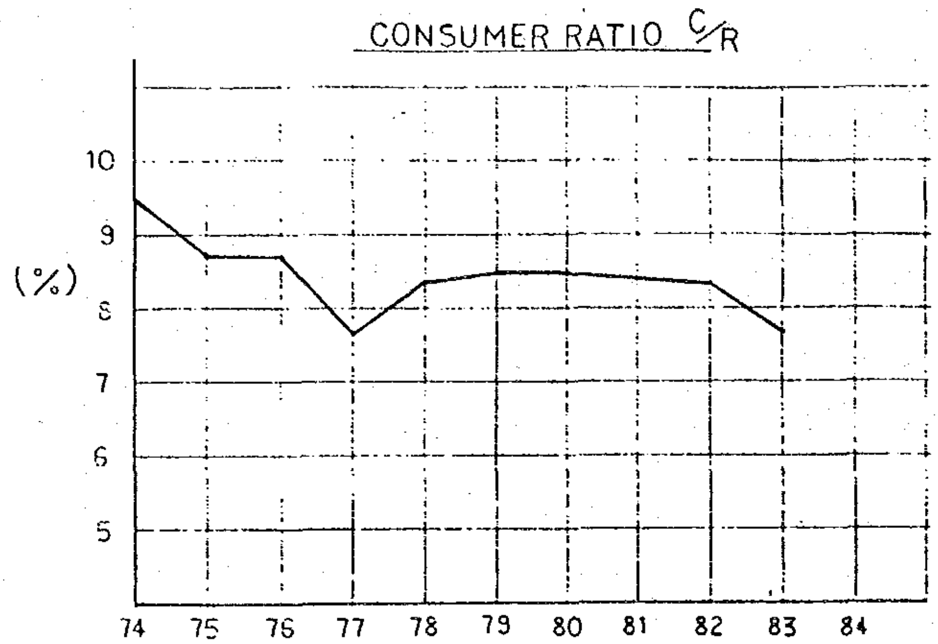
FIGURE 2.1-2 ELECTRIFICATION RATIO

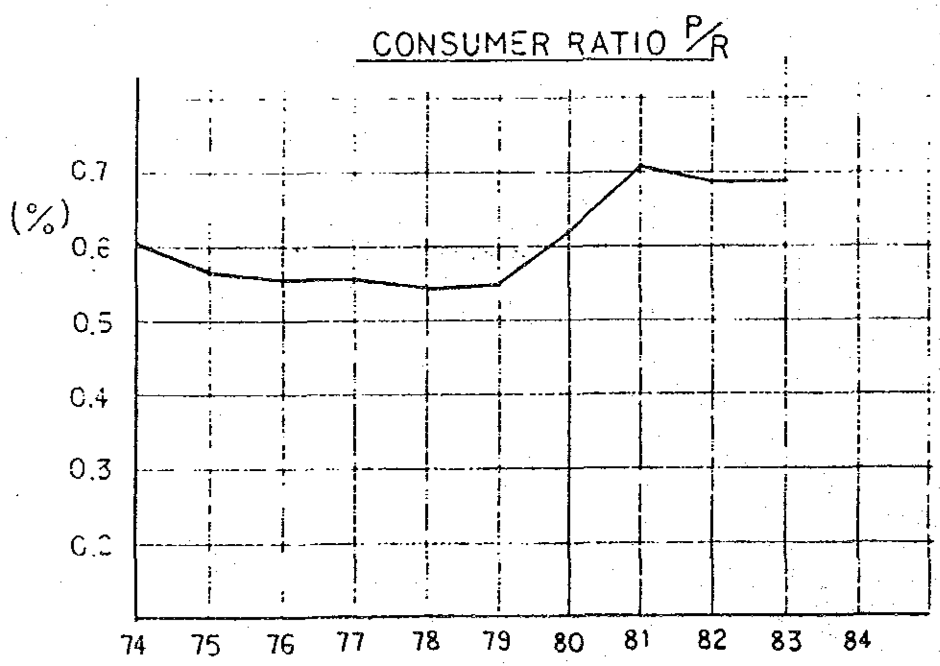


NO.	R	1984	2020	T=Year-1945
1. O	0.9954	3.7	86.7	Y=100.00/(1+EXP(8.626-0.142*T))
2. △	0.9945	3.7	53.6	Y=100.00*(T**(5.224))/(T**(5.224)+5.499E9)
3. +	0.9944	3.7	43.5	Y=100.00/EXP(14.77*(0.963)**T)

FIGURE 2.1-3(11)

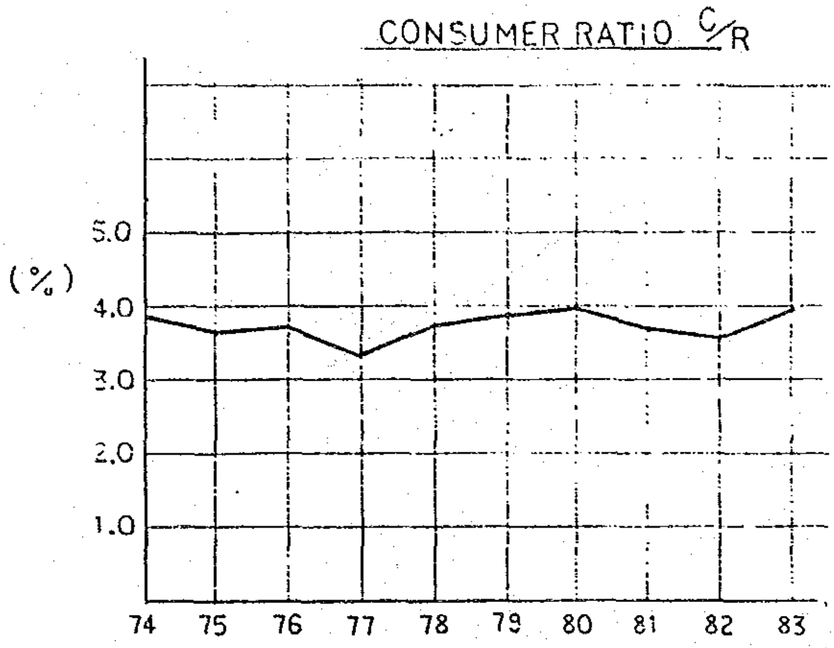
FIGURE 2.1-3 CONSUMER RATIO





(2) SURABAYA SULATAN

FIGURE 2.1-3 CONSUMER RATIO



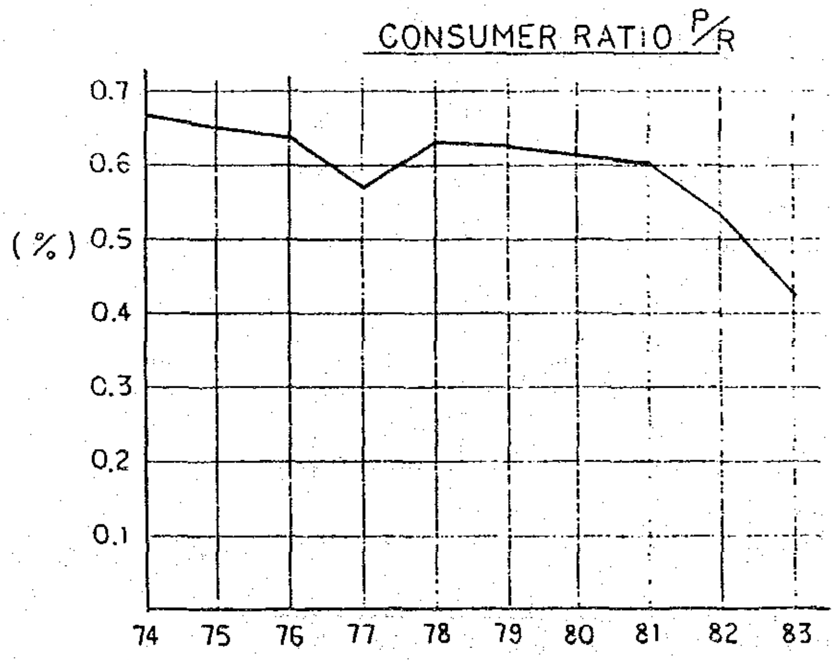
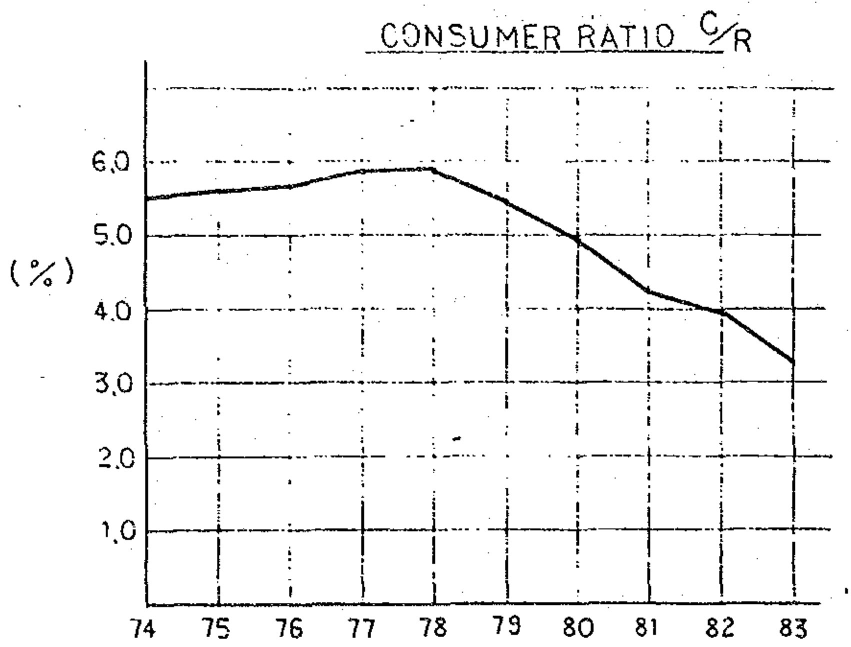
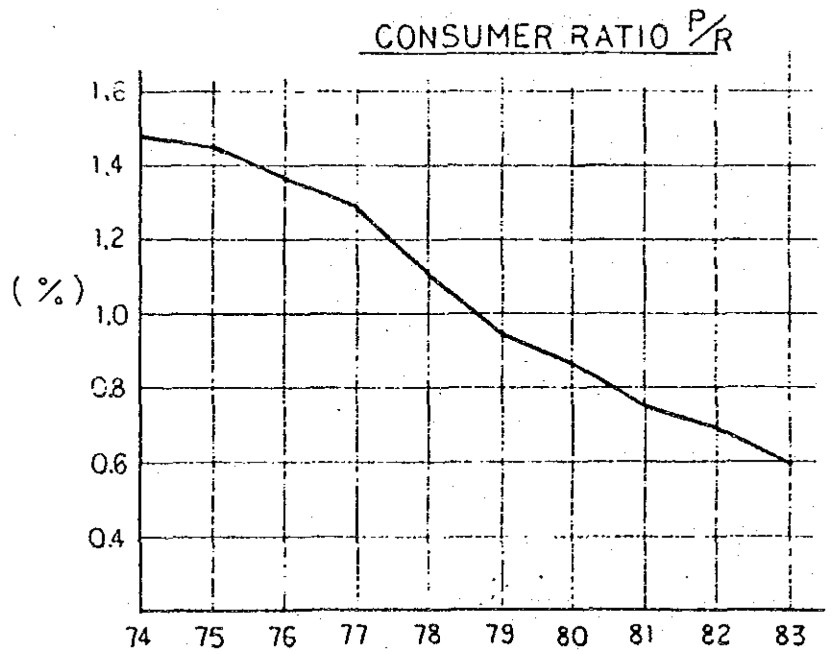


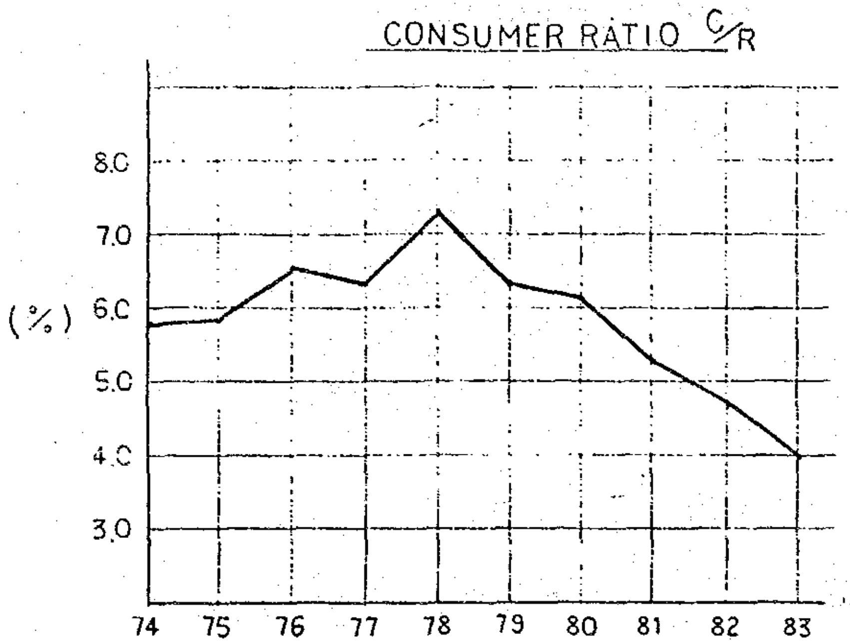
FIGURE 2.1-3 CONSUMER RATIO





(4) PASURUAN

FIGURE 2.1-3 CONSUMER RATIO



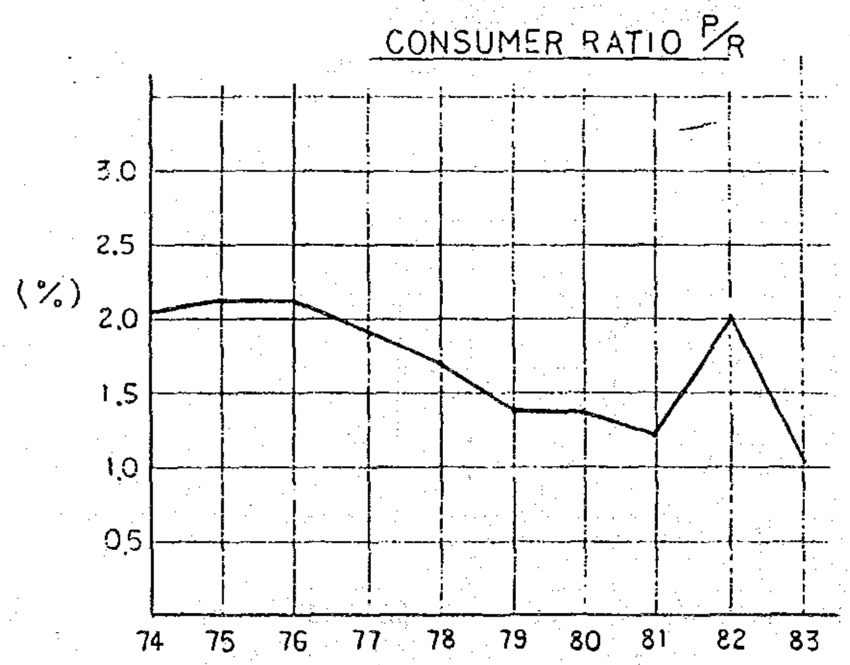
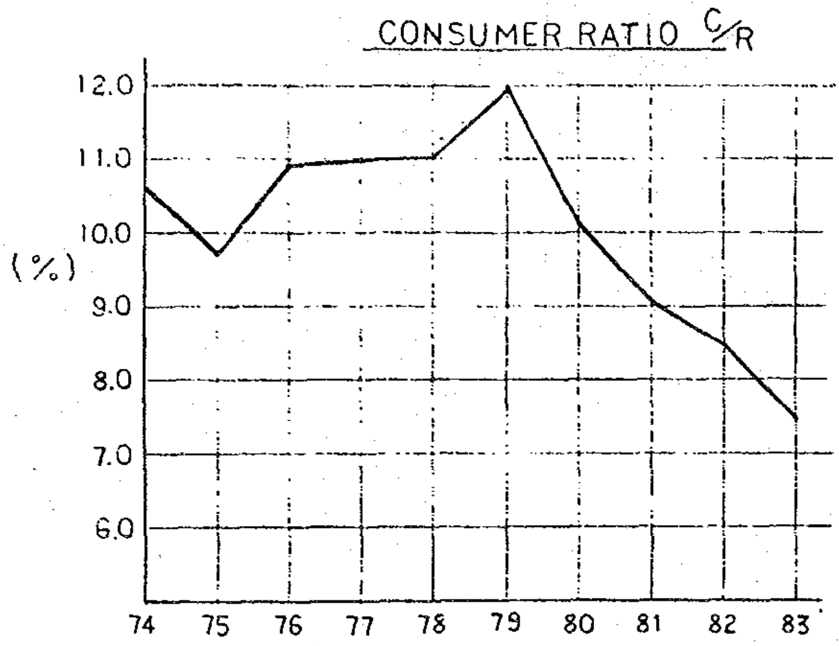


FIGURE 2.1-3 CONSUMER RATIO



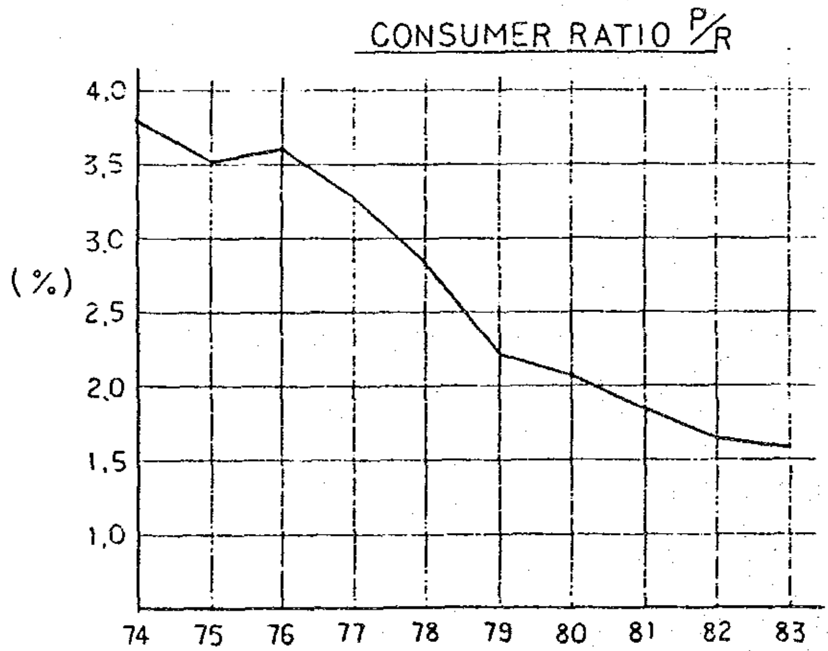
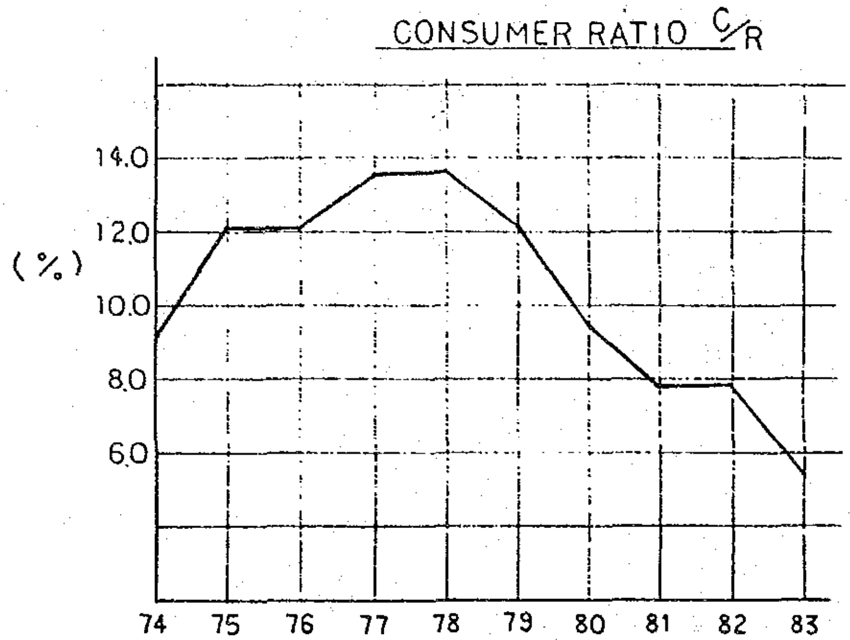


FIGURE 2.1-3 CONSUMER RATIO



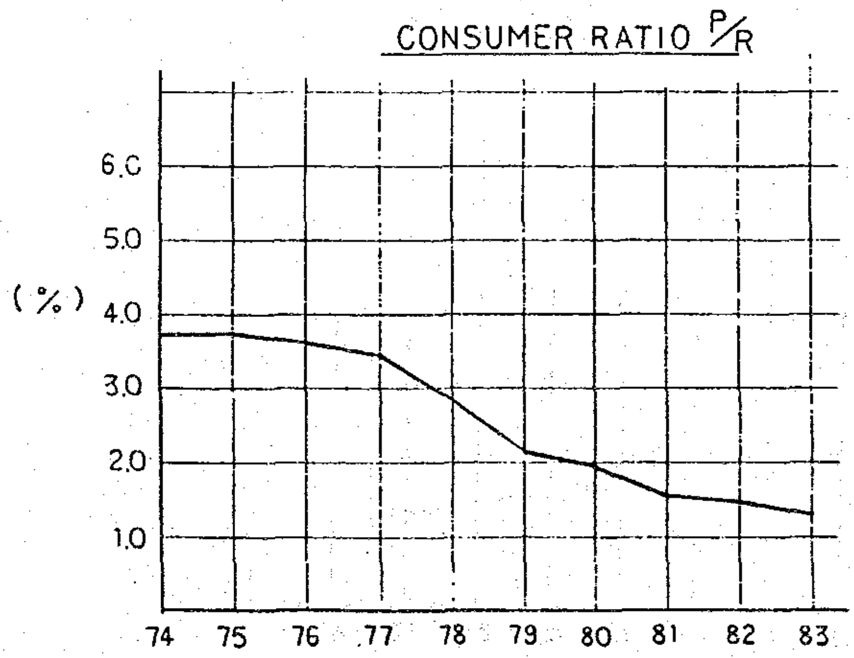
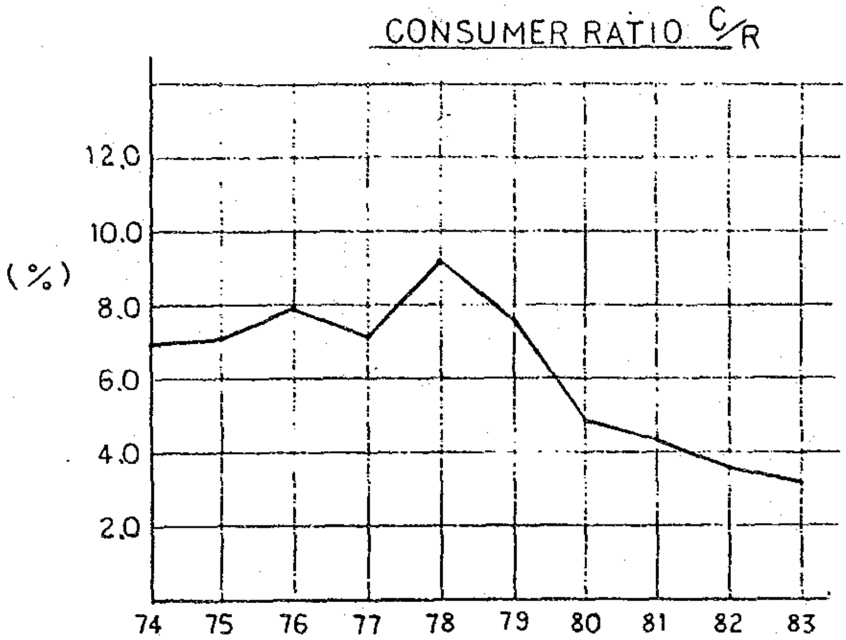
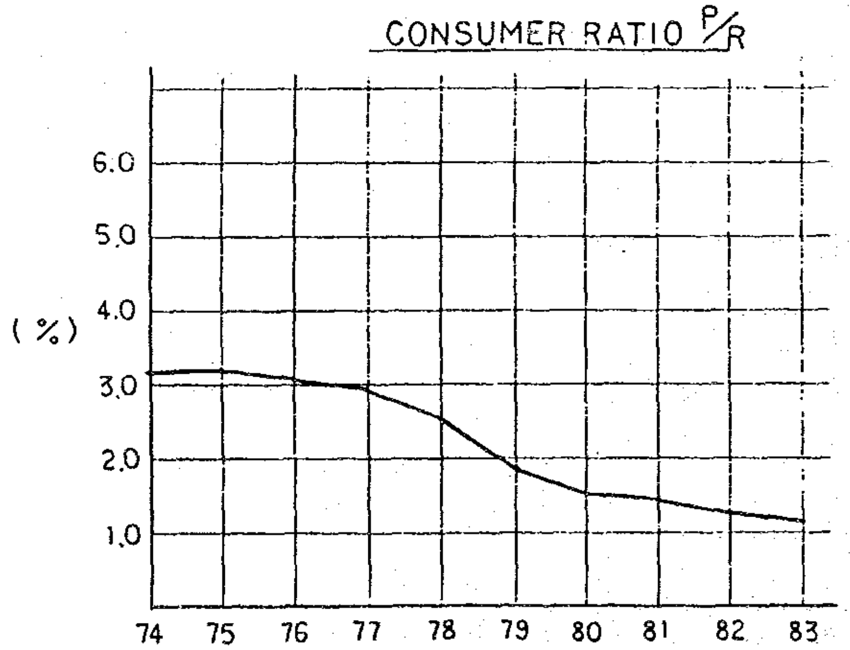


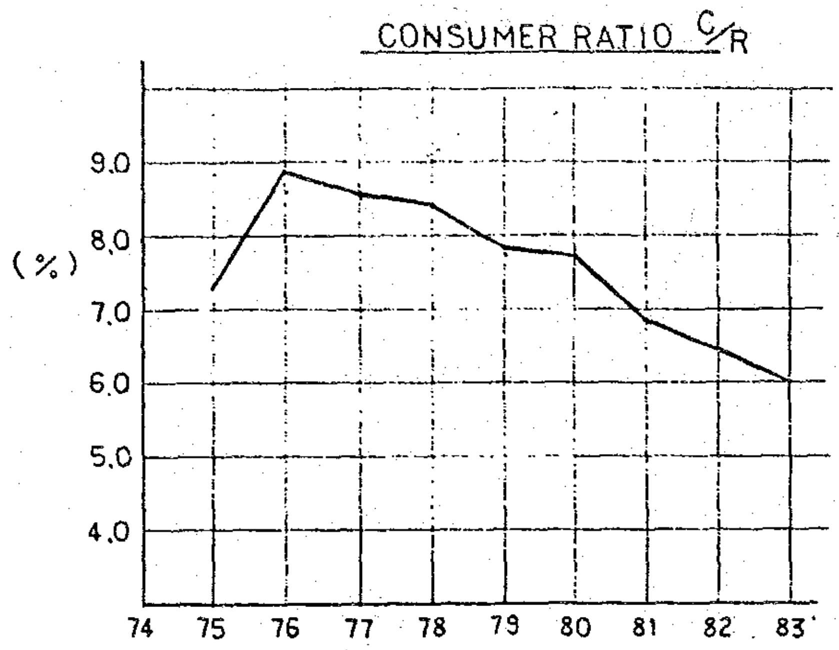
FIGURE 2.1-3 CONSUMER RATIO





(8) JEMBER

FIGURE 2.1-3 CONSUMER RATIO



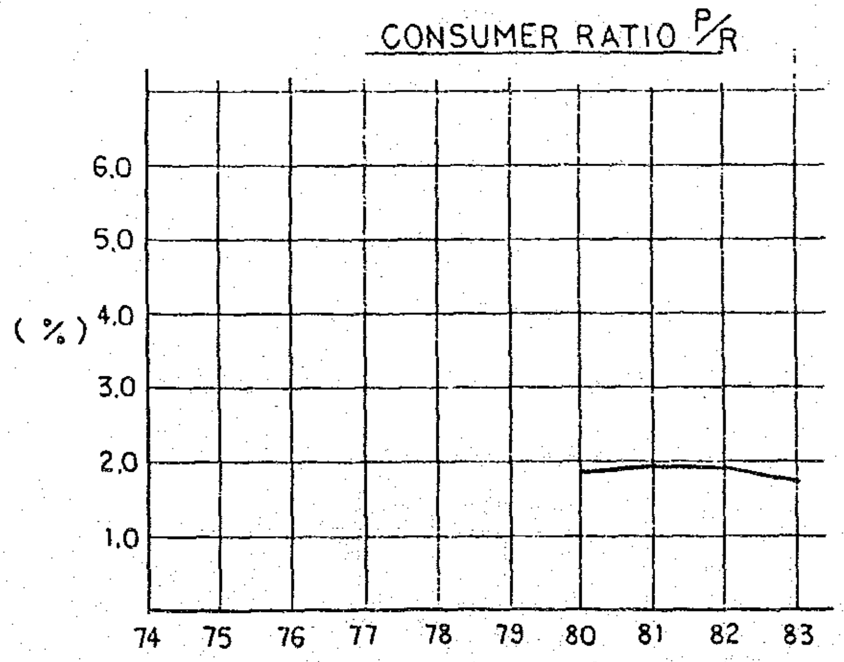
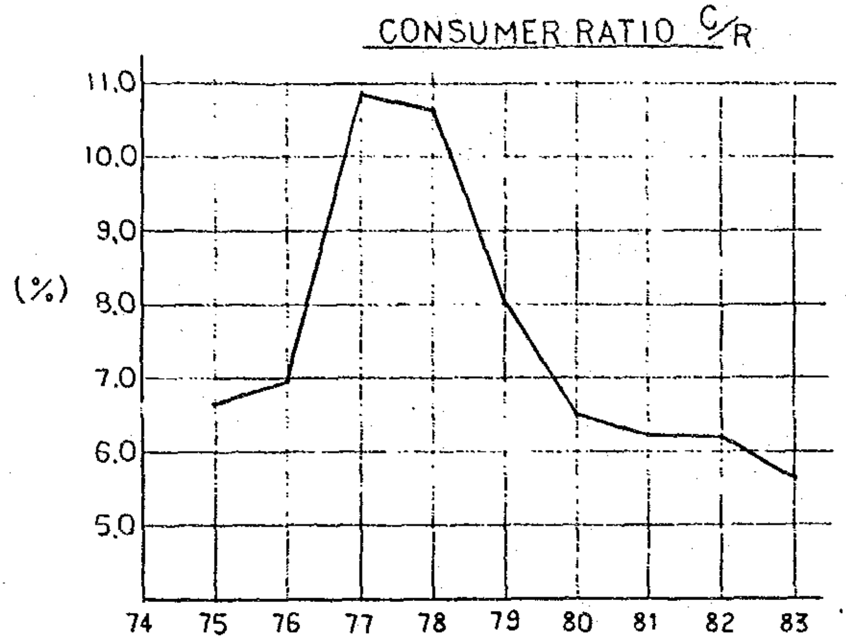
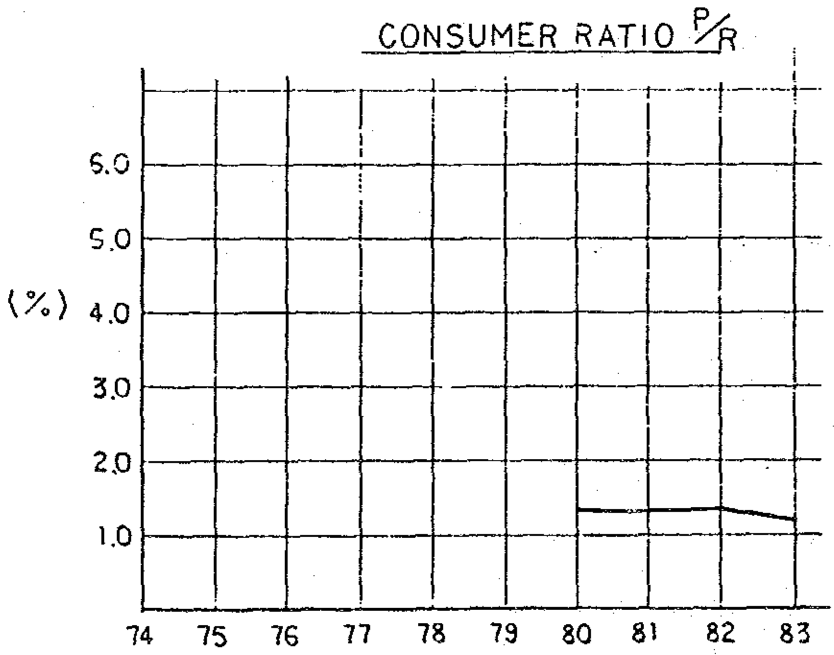


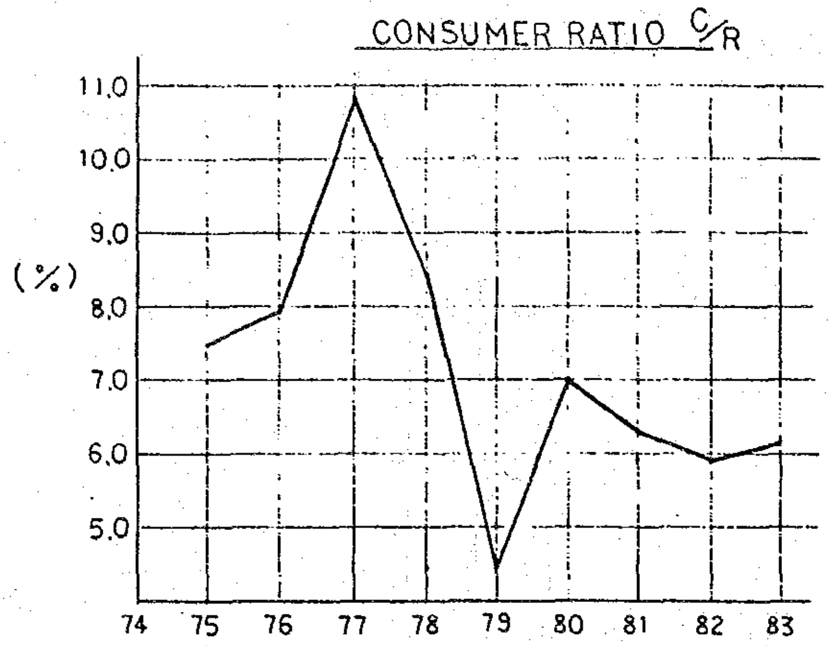
FIGURE 2.1-3 CONSUMER RATIO

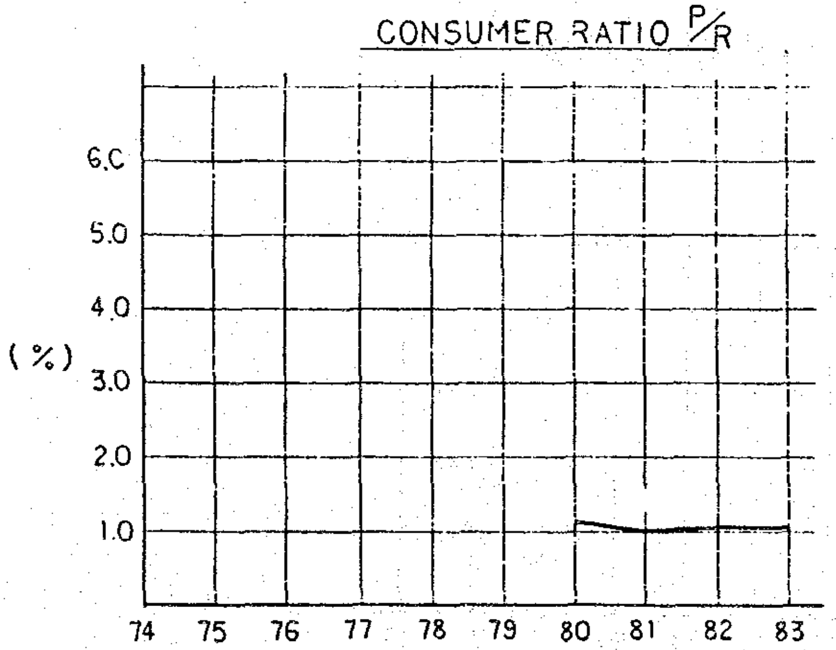




(10) SITUBONDO

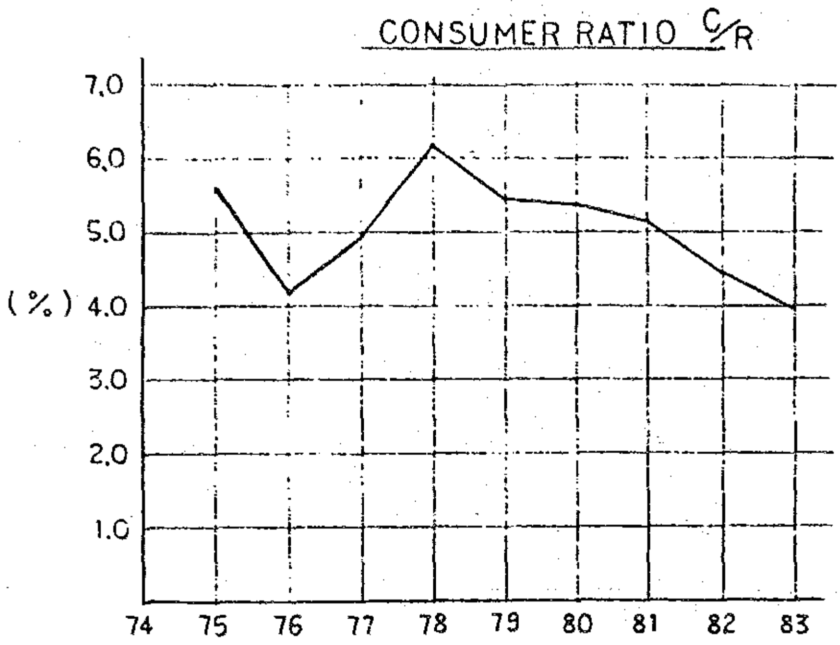
FIGURE 2.1-3 CONSUMER RATIO





(11) PAMEKASAN

FIGURE 2.1-3 CONSUMER RATIO



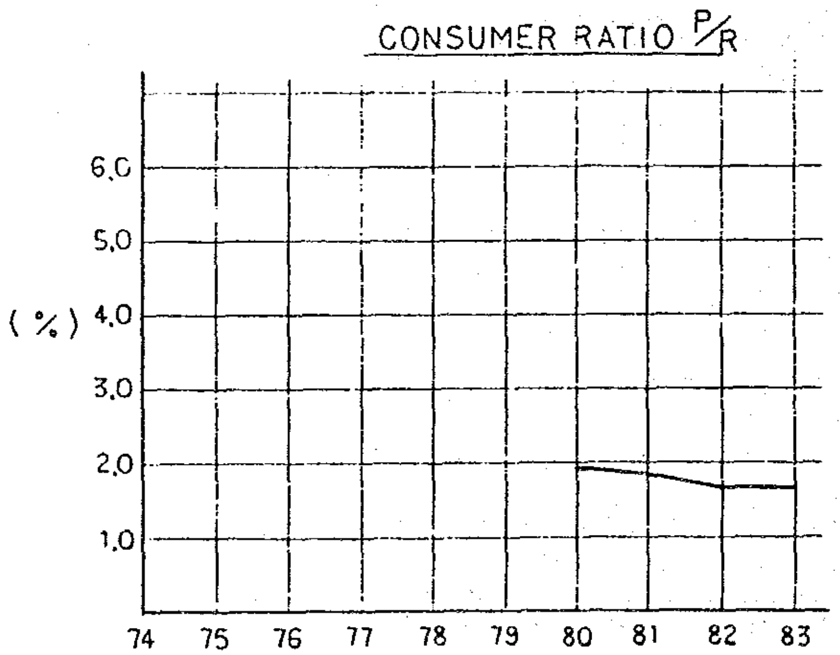
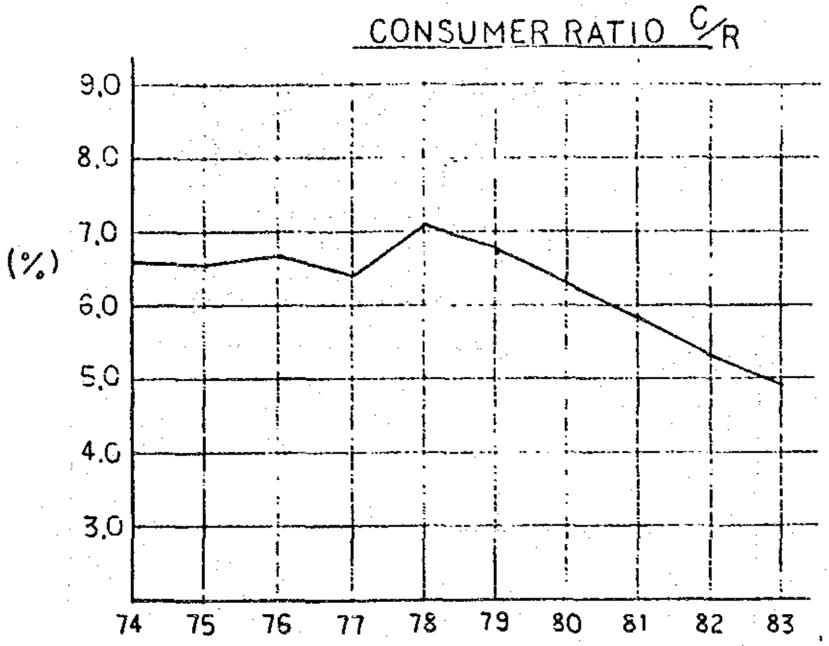


FIGURE 2.1-3 CONSUMER RATIO



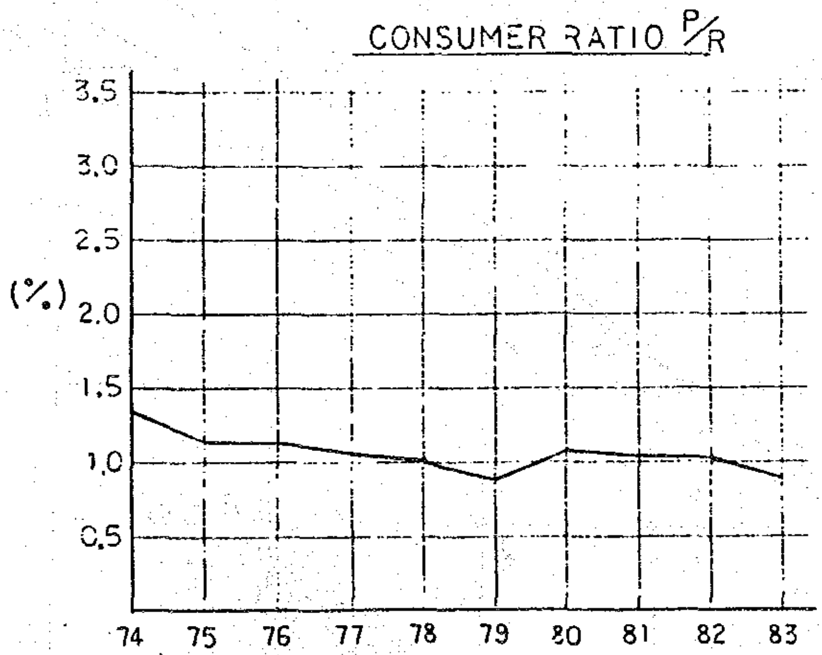


Fig 2.1-4 Growth Trend Forecast for Industrial Electric Demand in East Java

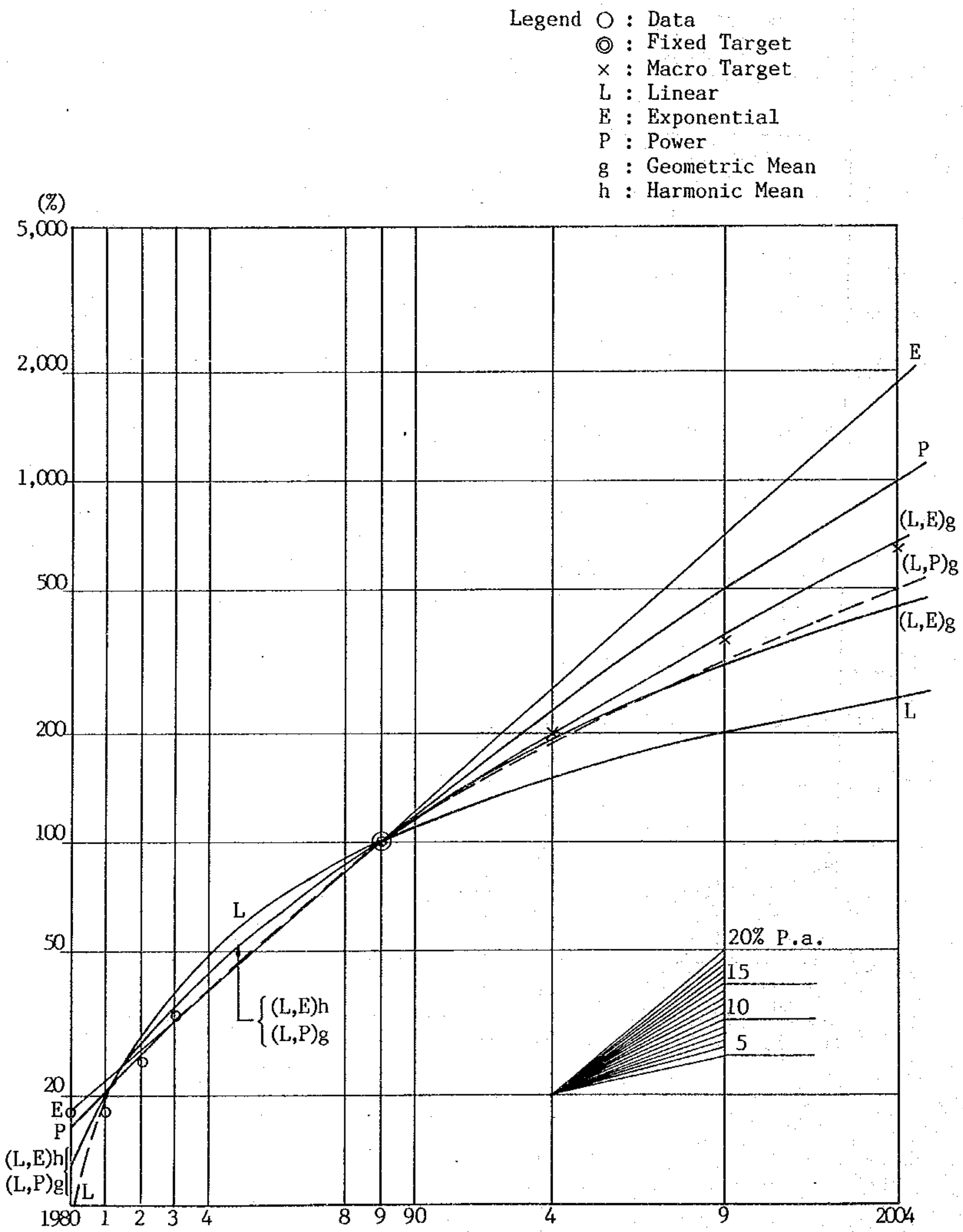


FIGURE 2.1-5(1) ENERGY SALES RATIO

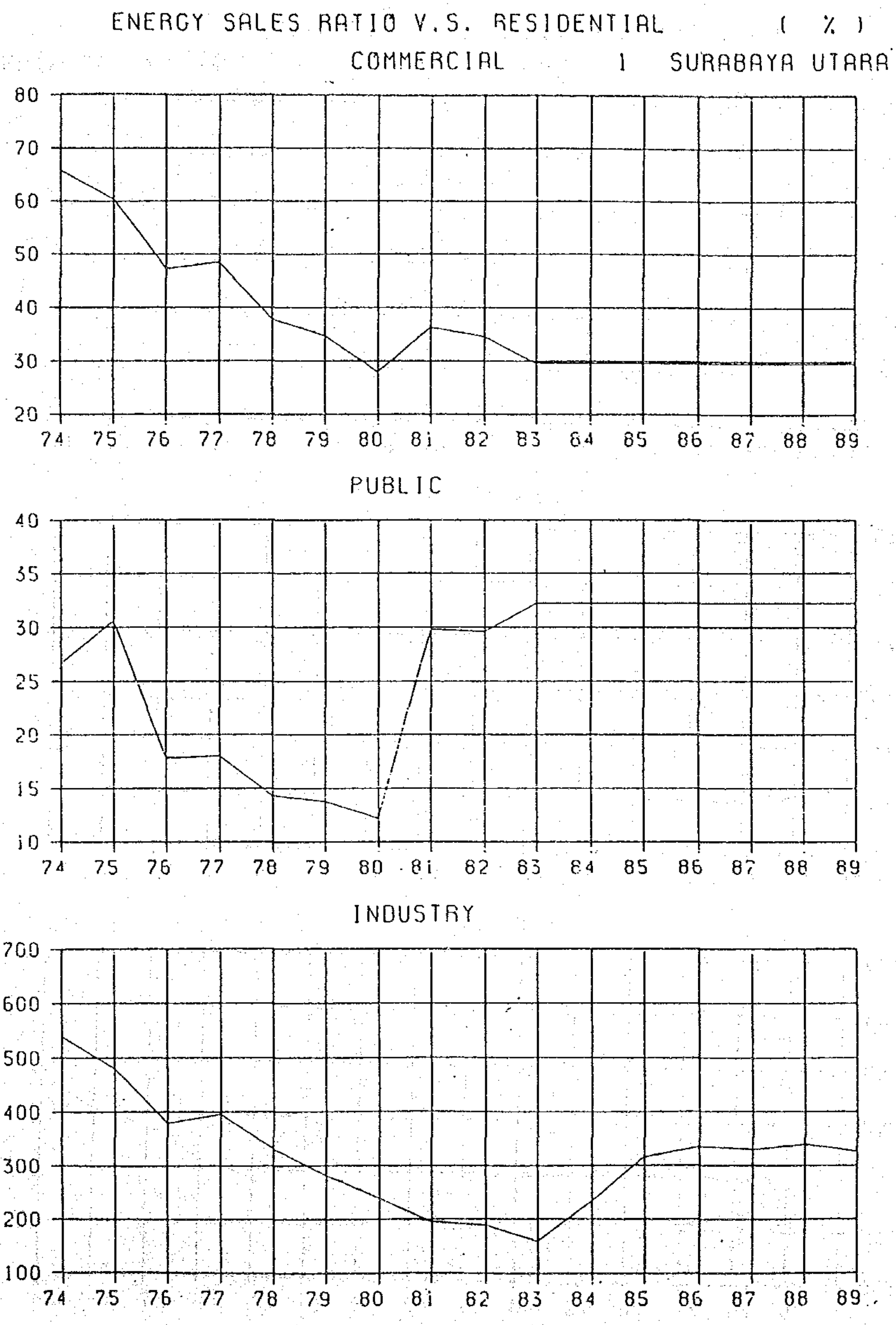


FIGURE 2.1-5(2) ENERGY SALES RATIO

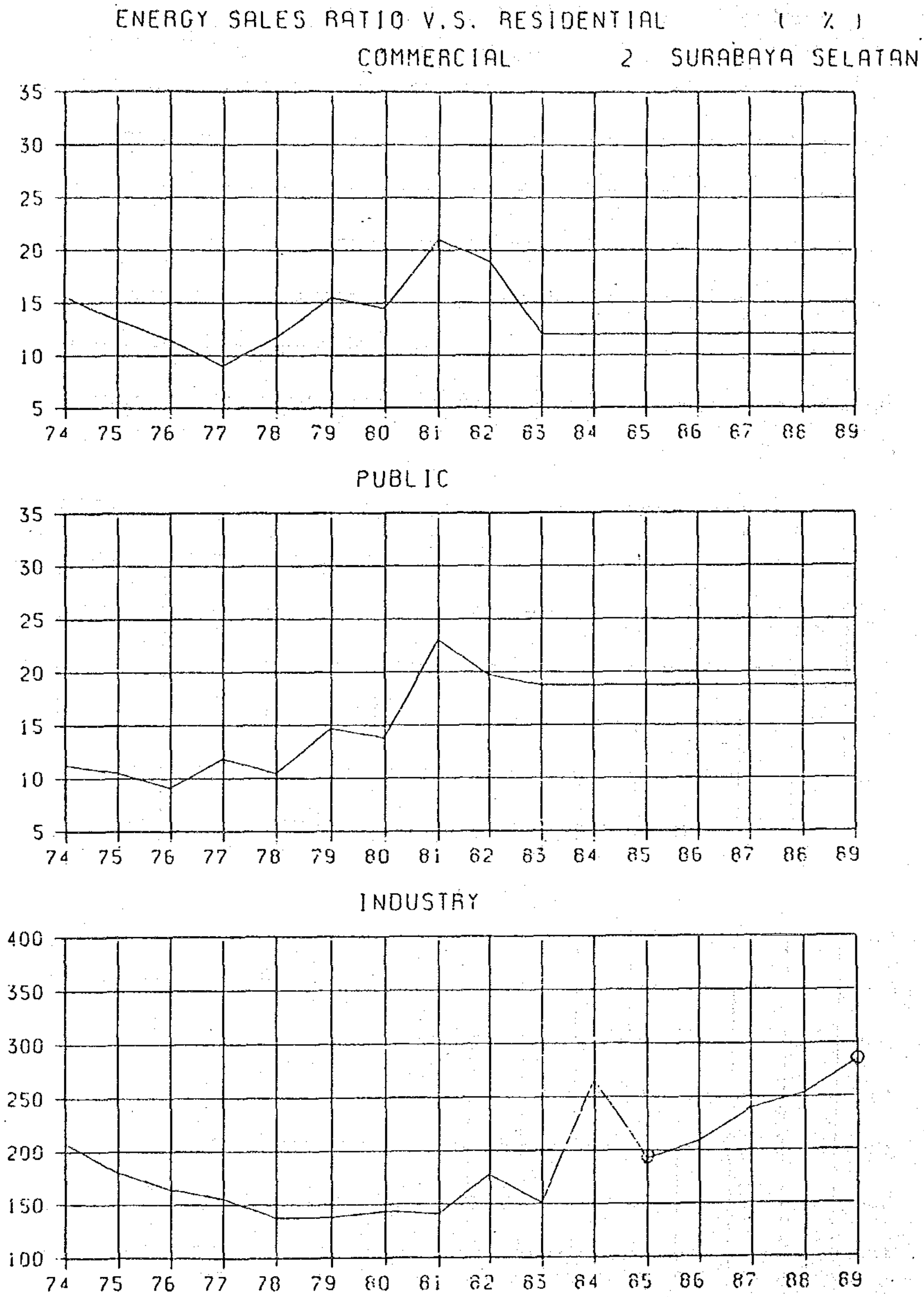


FIGURE 2.1-5(3) ENERGY SALES RATIO

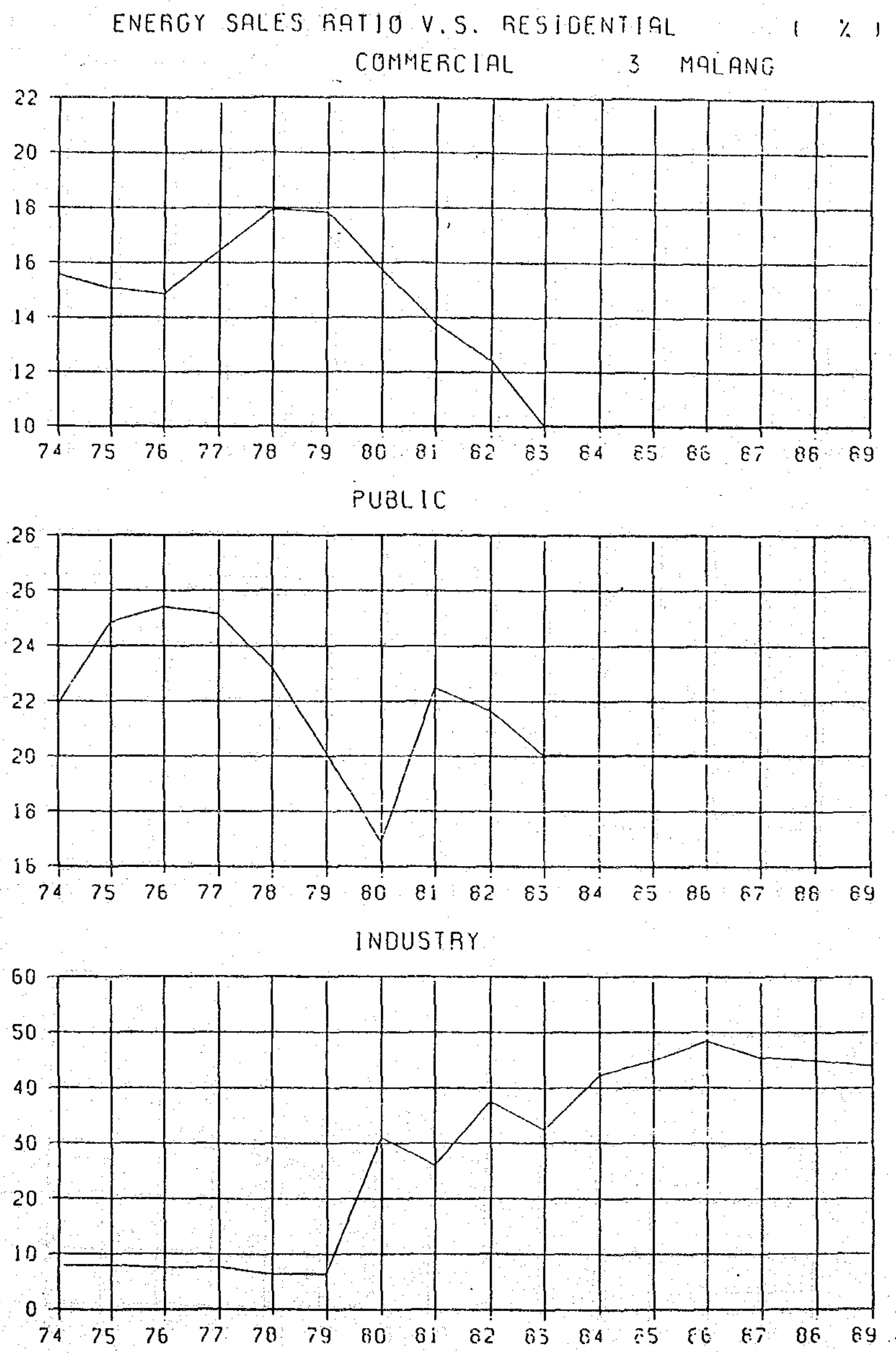


FIGURE 2.1-5(4) ENERGY SALES RATIO

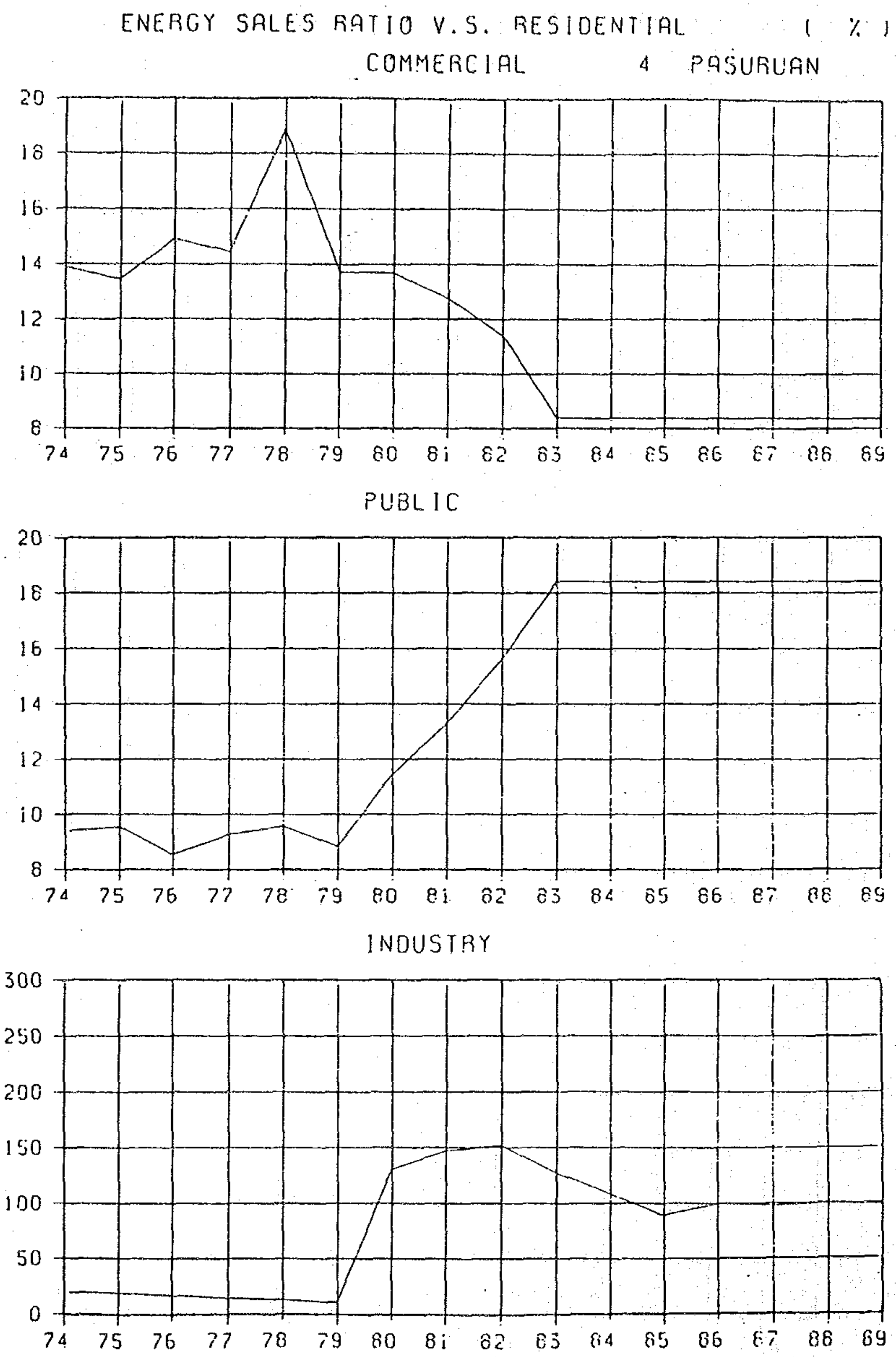


FIGURE 2.1-5(5) ENERGY SALES RATIO

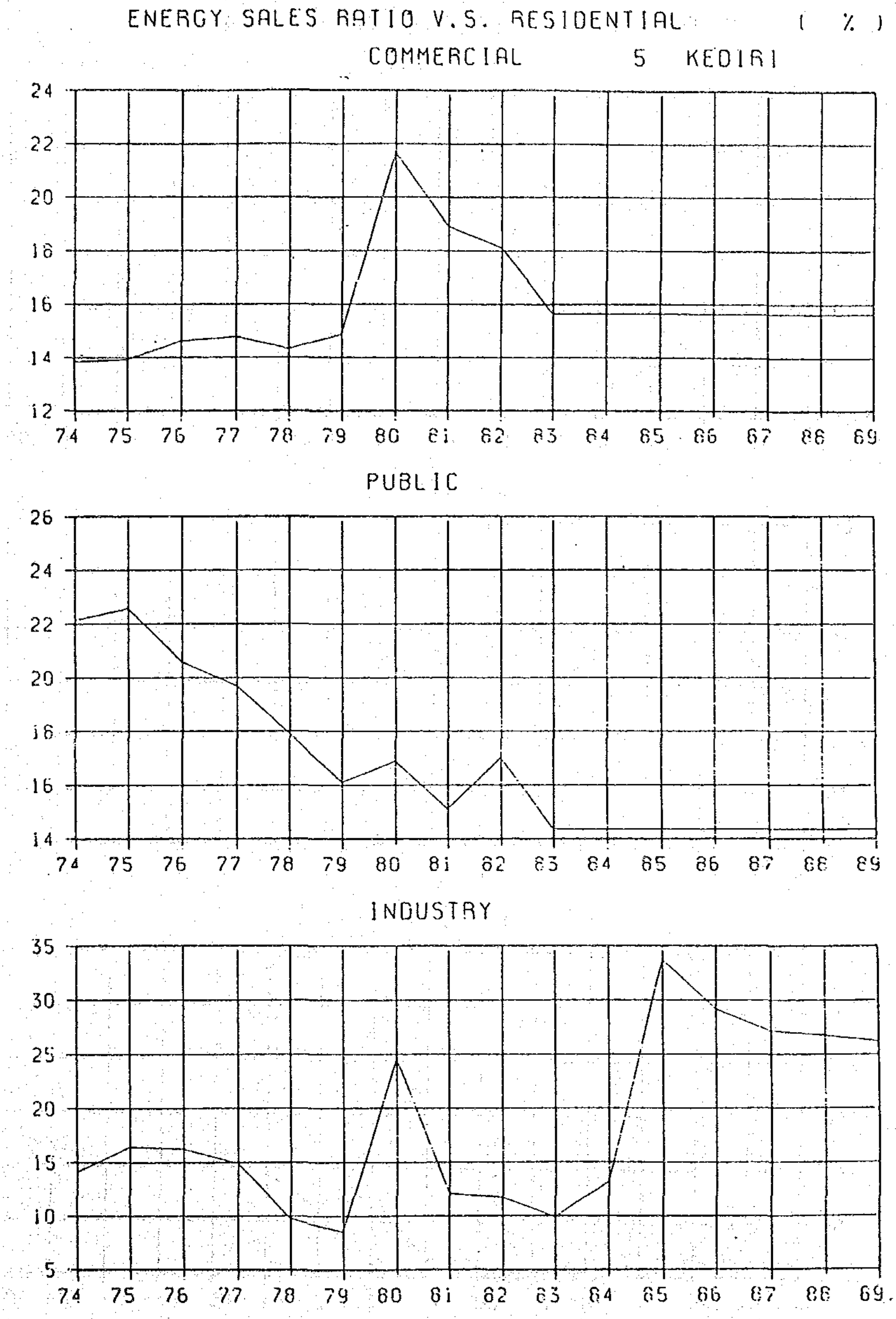


FIGURE 2.1-5(6) ENERGY SALES RATIO

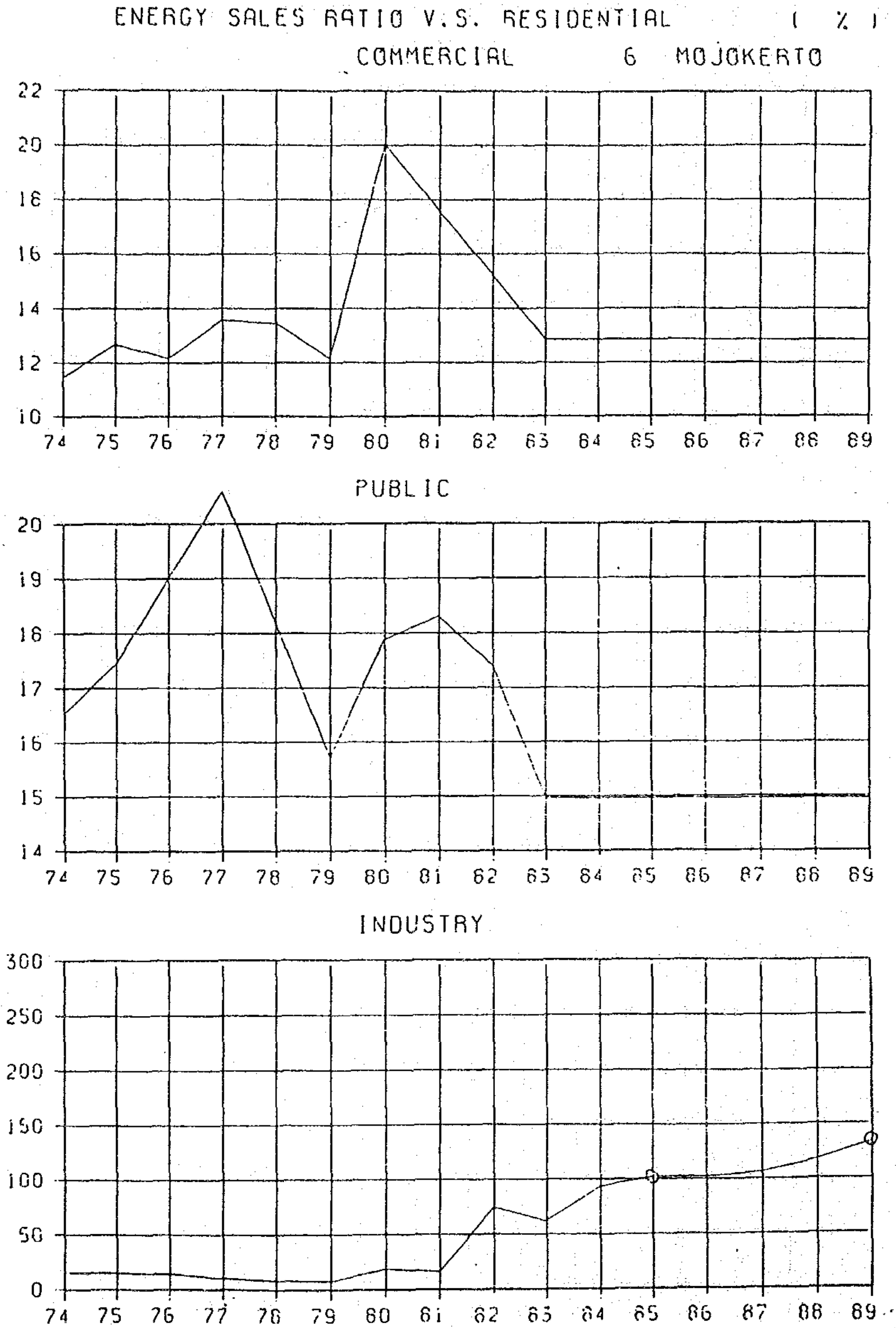


FIGURE 2.1-5(7) ENERGY SALES RATIO

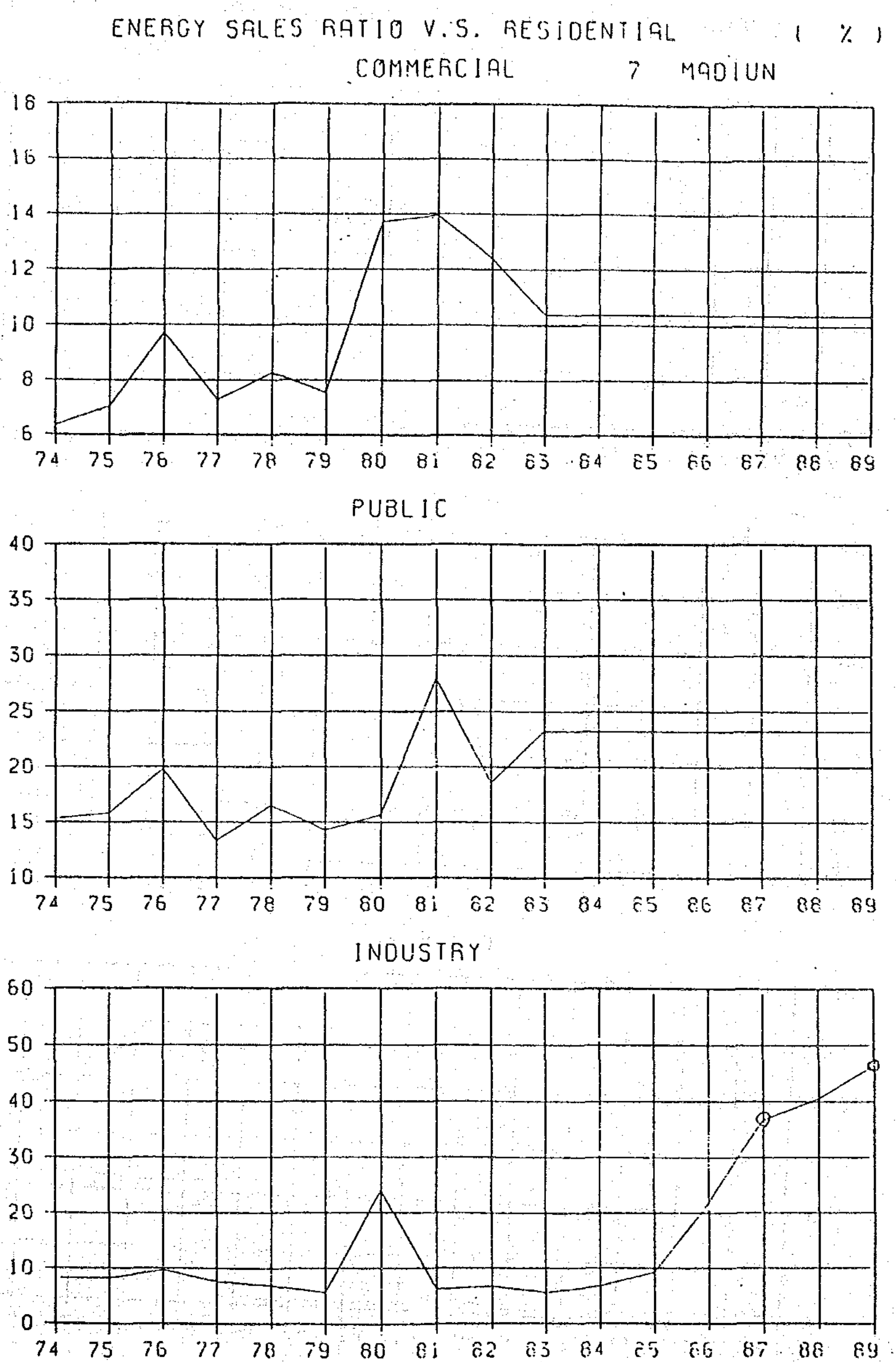


FIGURE 2.1-5(8) ENERGY SALES RATIO

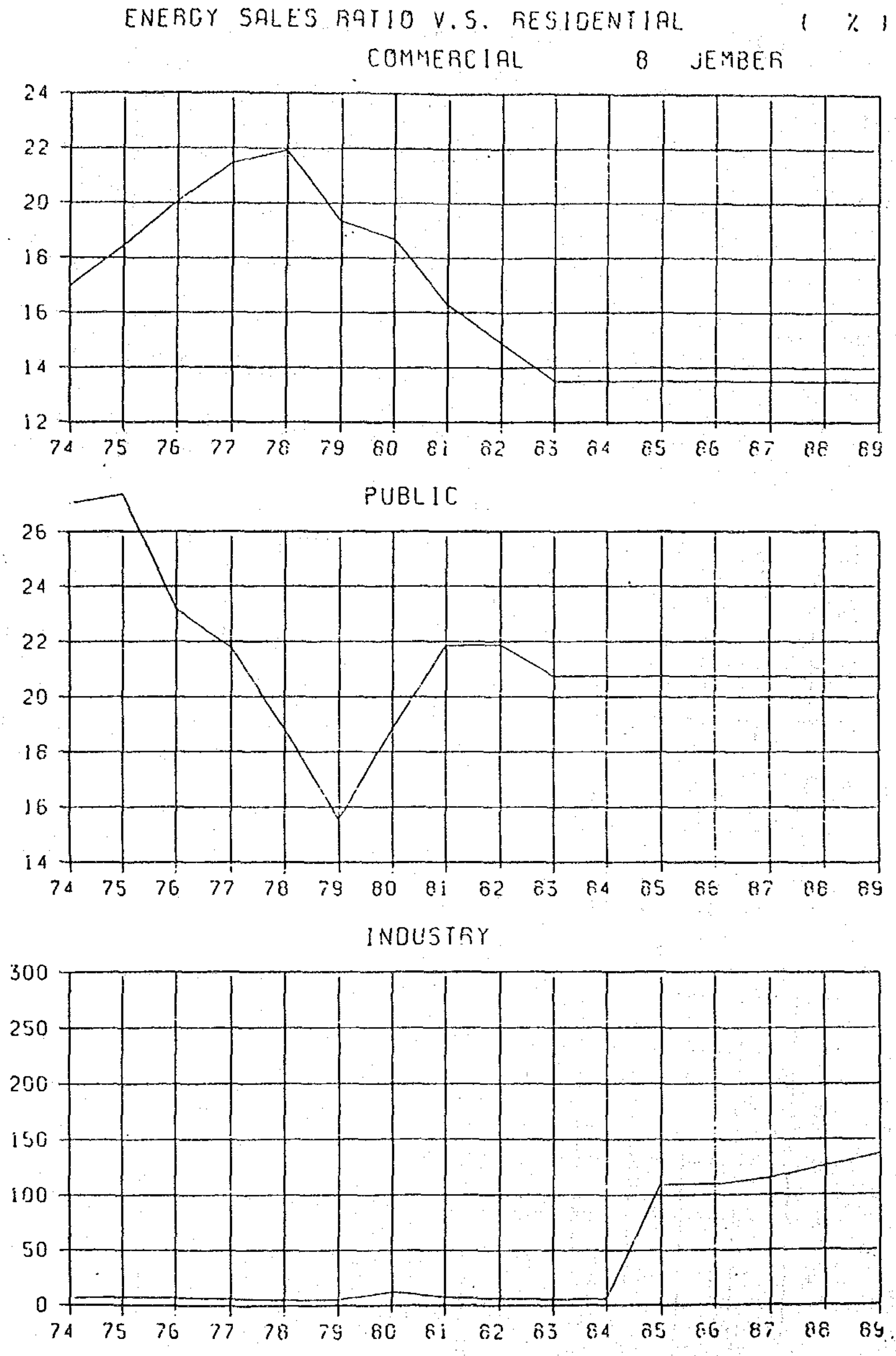


FIGURE 2.1-5(9) ENERGY SALES RATIO

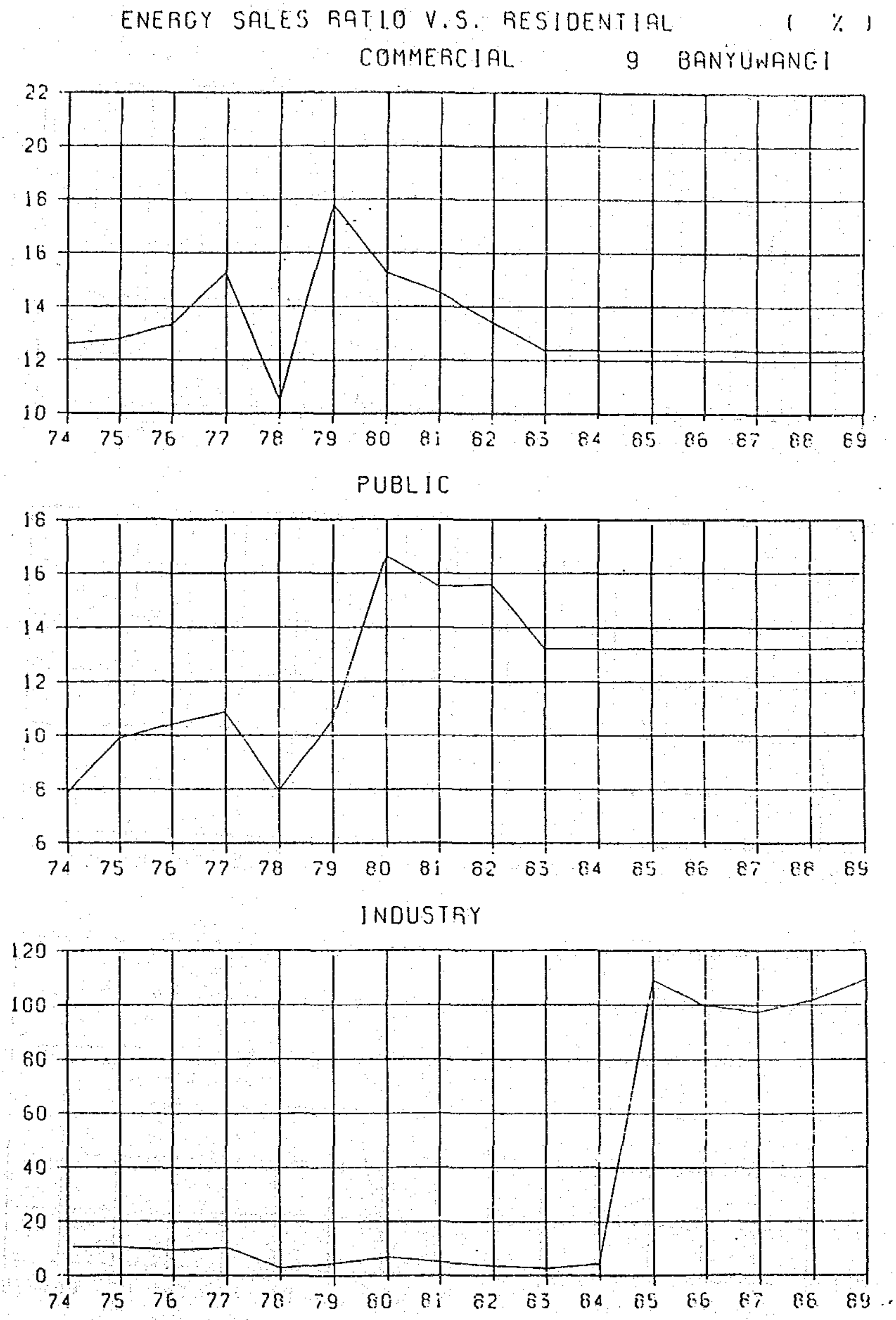


FIGURE 2.1-5(10) ENERGY SALES RATIO

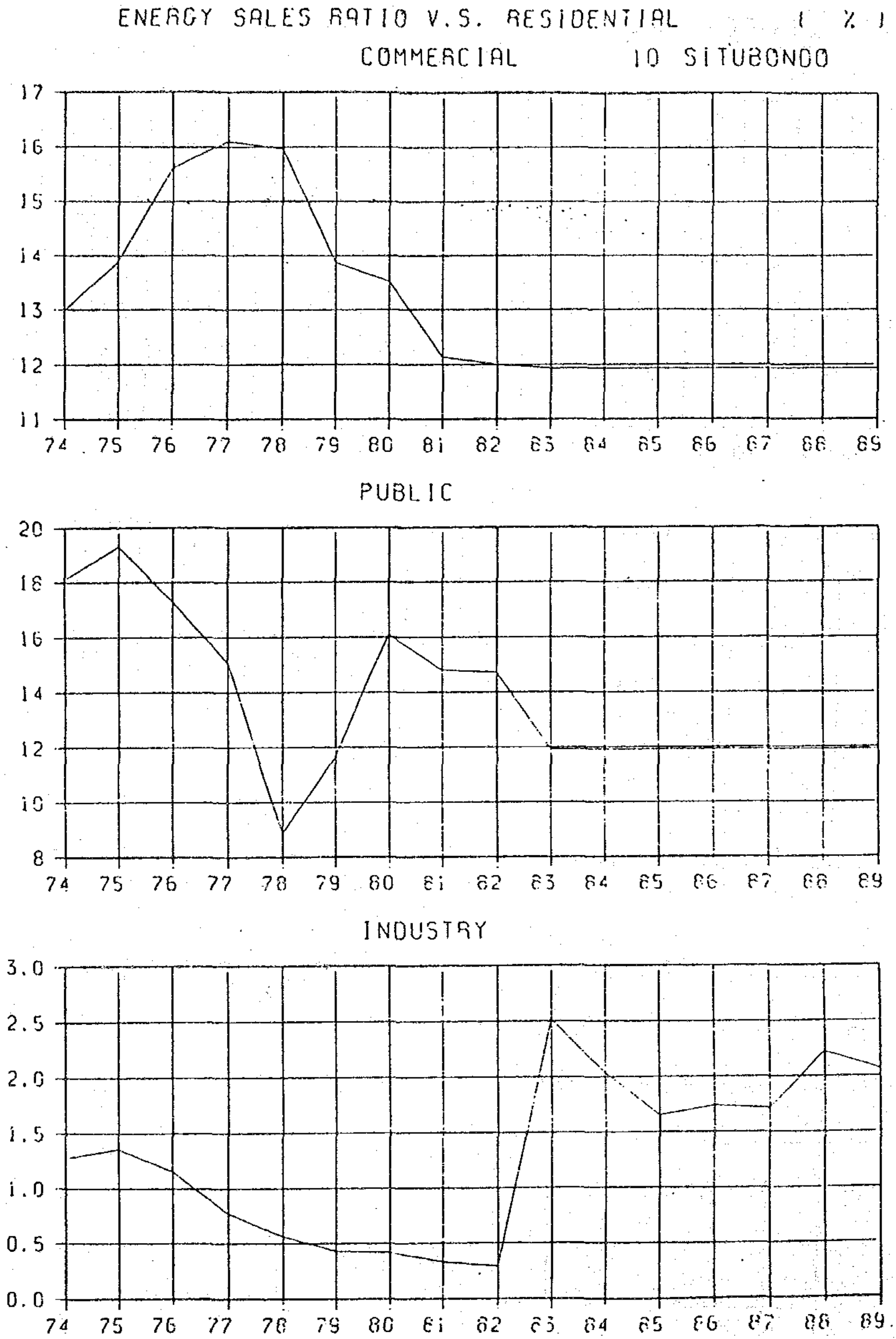


FIGURE 2.1-5(11) ENERGY SALES RATIO

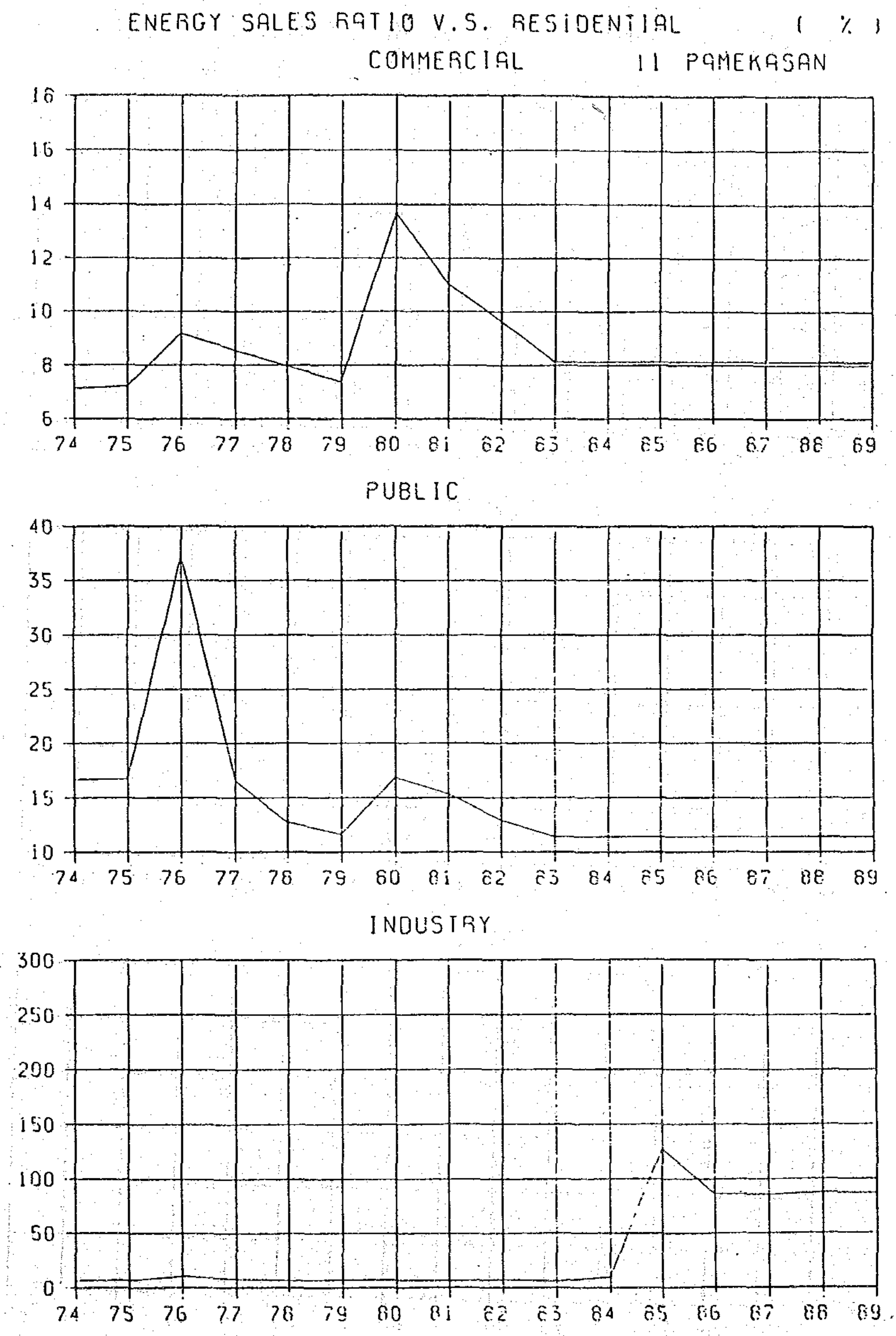


FIGURE 2.1-5(12) ENERGY SALES RATIO

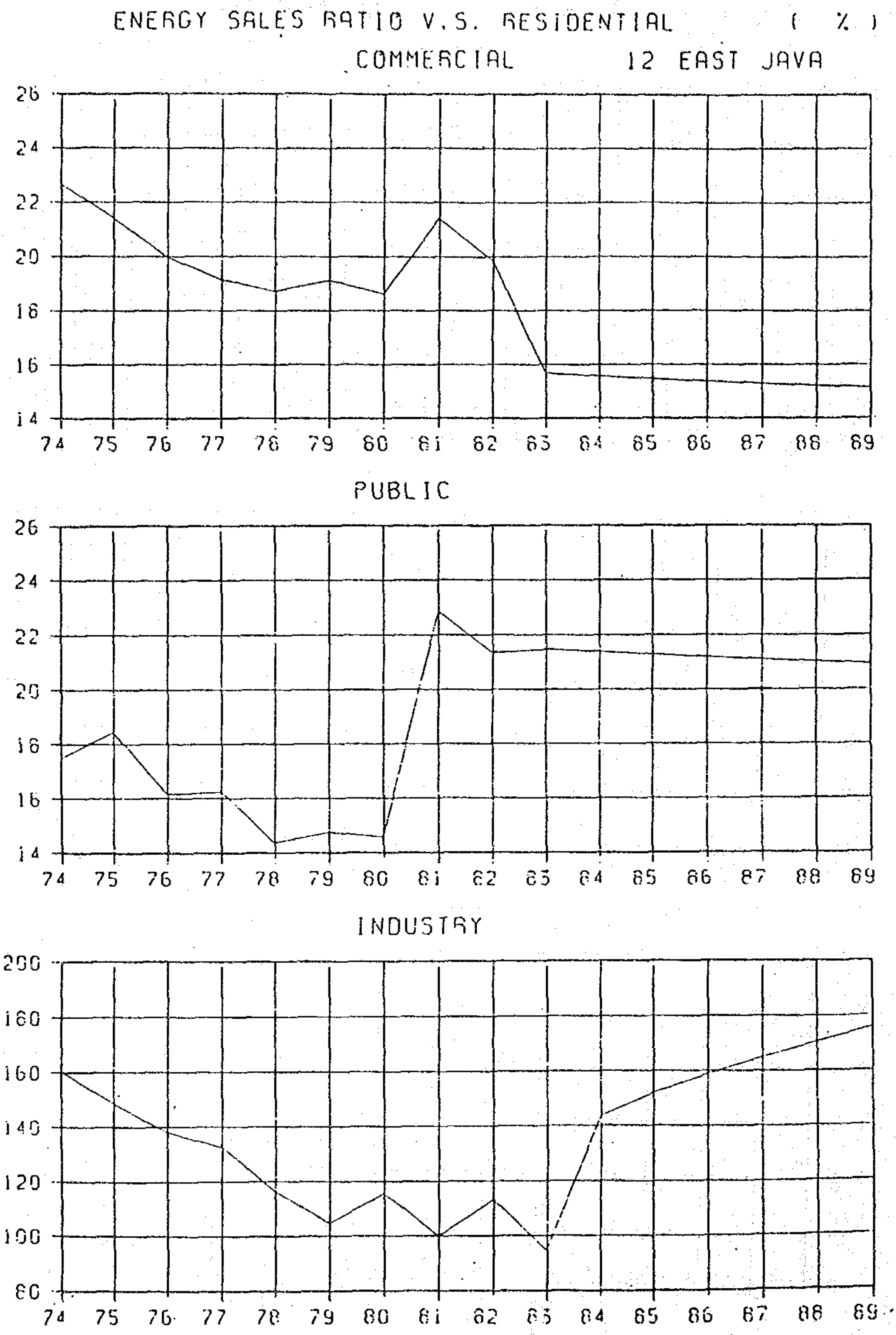
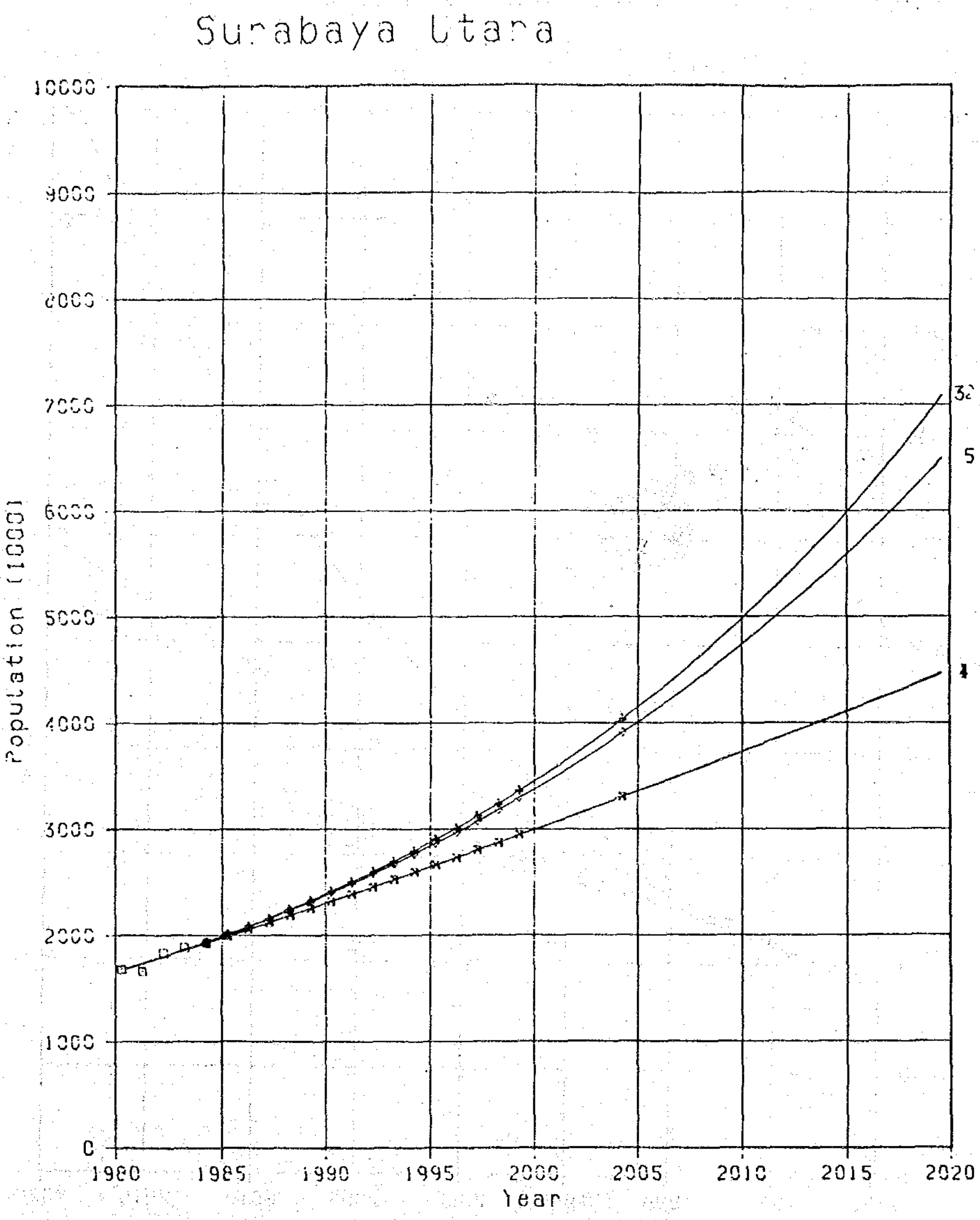
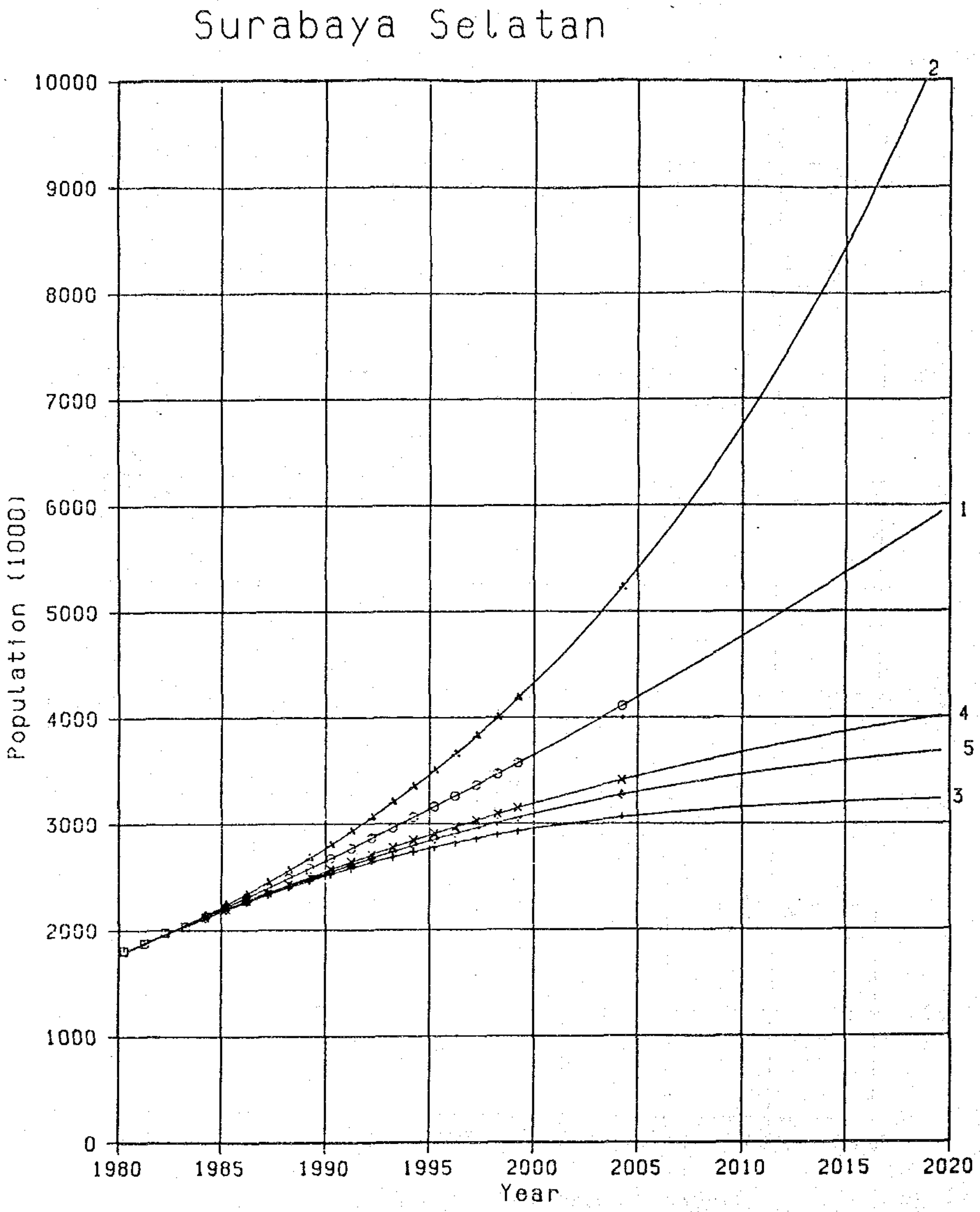


FIGURE 2.1-6 (1) CALCULATED POPULATION IN SURABAYA UTARA



NO.	R	1984	2004	T=Year-1945
1. O	0.9466	1927.1	3302.7	Y=15.85*(T**(1.308))
2. Δ	0.9501	1936.6	4038.1	Y=457.8*(1.037**T)
3. +	0.9501	1936.5	4036.1	Y=1.783E6/(1+EXP(8.268-0.0368*T))
4. X	0.9466	1927.1	3301.9	Y=1.962E6*(T**(1.309))/(T**(1.309)+1.242E5)
5. ◇	0.9496	1935.4	3907.3	Y=9.864E7/EXP(12.36*(0.997)**T)

FIGURE 2.1-6 (2) CALCULATED POPULATION IN SURABAYA SELATAN



NO.	R	1984	2004	T=Year-1945
1. ⊙	0.9958	2131.6	4109.8	Y=6.134*(T**(1.594))
2. △	0.9953	2142.9	5227.0	Y=372.4*(1.046**T)
3. +	0.9961	2118.8	3061.0	Y=3280./(1+EXP(3.393-0.102*T))
4. ×	0.9960	2121.7	3413.0	Y=5231.*(T**(2.458))/(T**(2.458)+1.211E4)
5. ◇	0.9961	2119.6	3273.0	Y=4009./EXP(6.029*(0.944)**T)

FIGURE 2.1-7 SYSTEM FLOW

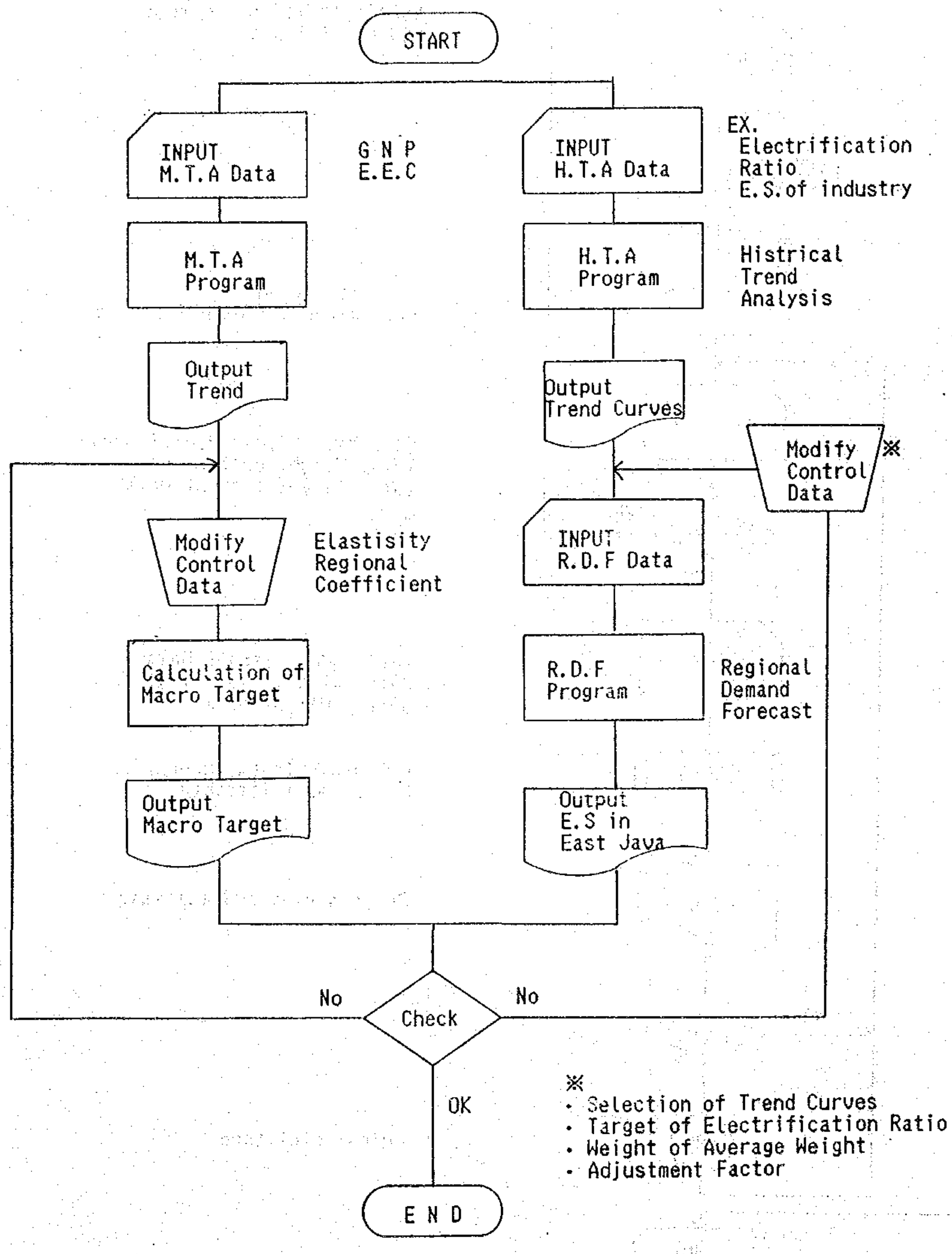
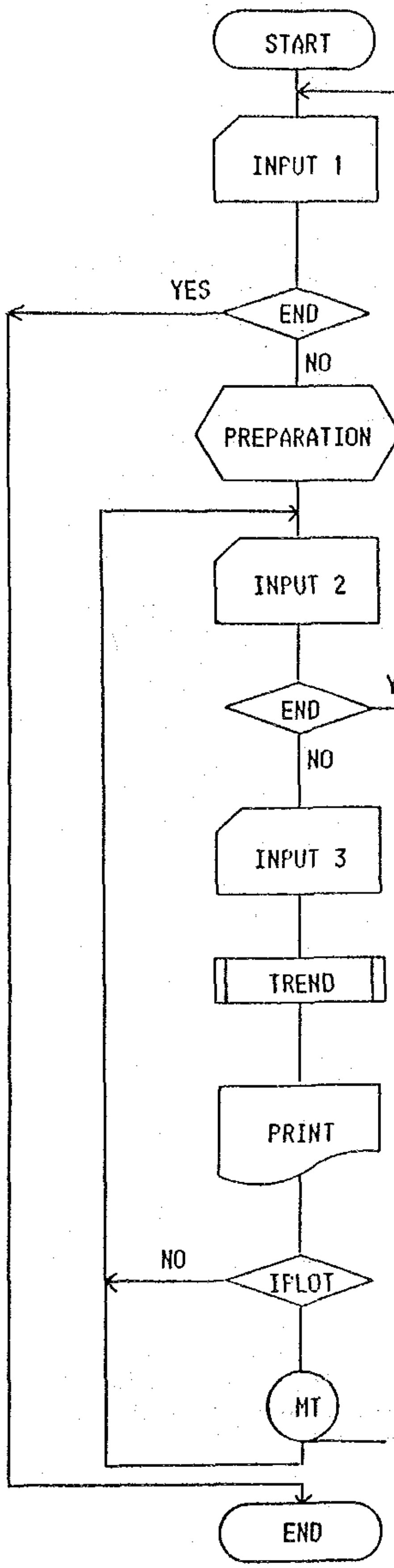


FIGURE 2.1-8 HISTORICAL TREND ANALYSIS FLOW-CHART



N,NN:Nos of input,forecast
NSNEN,NSMDN:Primary point
NSFACT,ICNT1 etc Control Data
NEN,NX (I=1,NNN)

Initialization
XI:X values (from primary P)

Case Name,KX,Max,Min of Axes
IWT : Weight control data
ISY : Target control data

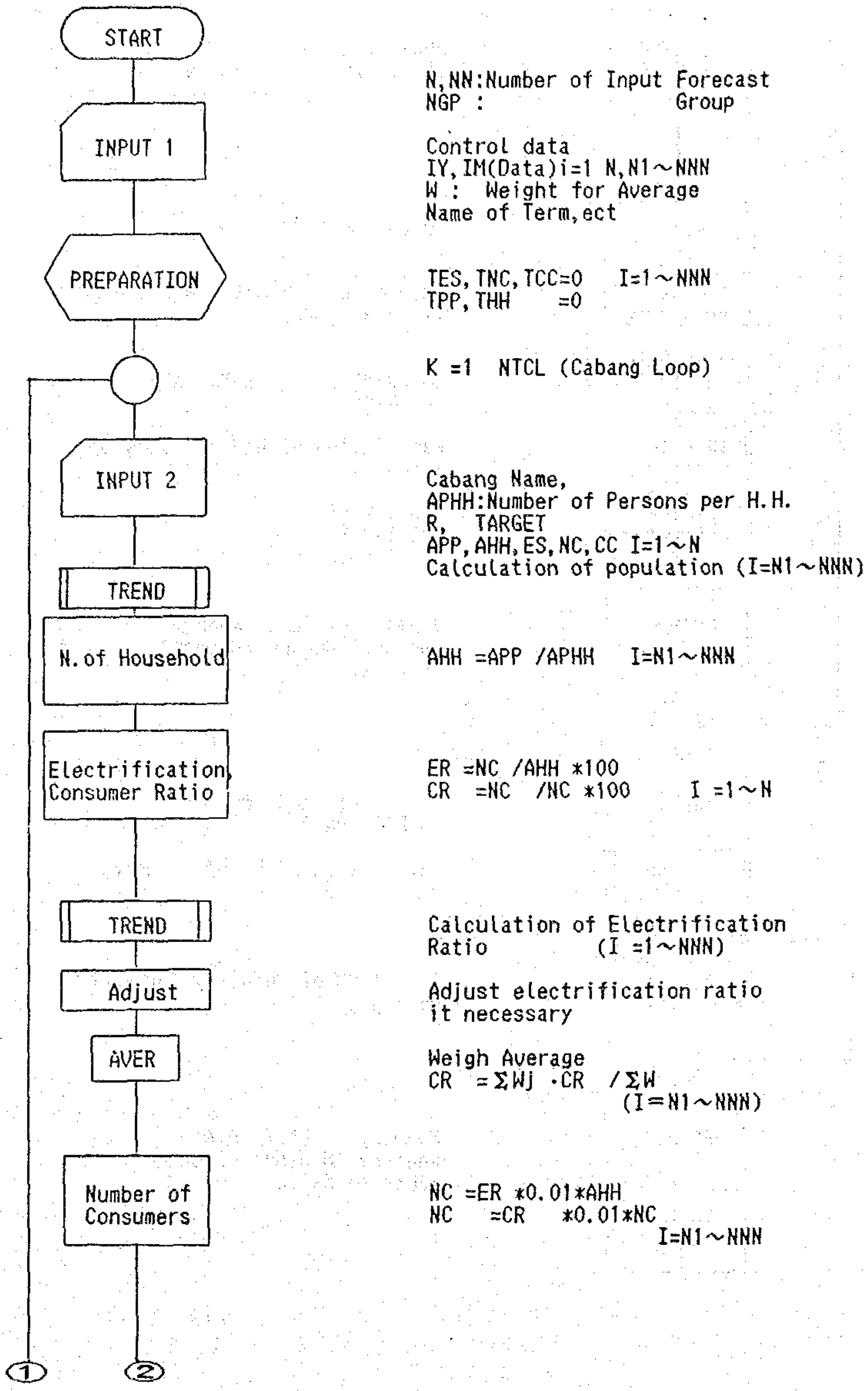
ISYY,ISMM : Target Data
DATA I=1,N : Historical data
WAIT : Weight data

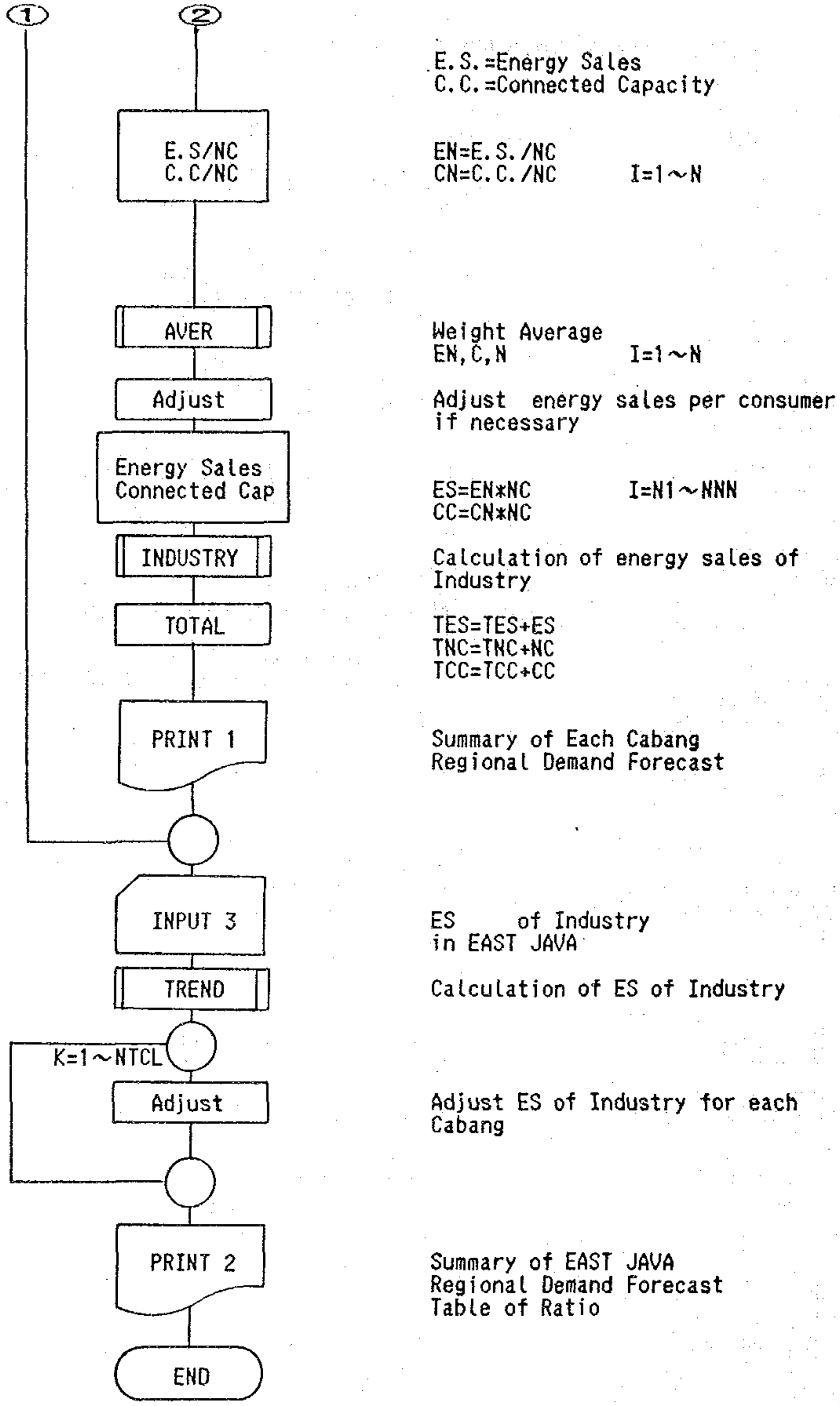
Calculate trend curve
Select most fittable

Results of trend analysis

Output Plot tape

FIGURE 2,1-9 REGIONAL DEMAND FORECAST FLOW-CHART




①
②
E.S.=Energy Sales
C.C.=Connected Capacity
E.S/NC
C.C/NC
EN=E.S./NC
CN=C.C./NC
I=1~N
AVER
Weight Average
EN,C,N
I=1~N
Adjust
Adjust energy sales per consumer if necessary
Energy Sales
Connected Cap
ES=EN*NC
CC=CN*NC
I=N1~NNN
INDUSTRY
Calculation of energy sales of Industry
TOTAL
TES=TES+ES
TNC=TNC+NC
TCC=TCC+CC
PRINT 1
Summary of Each Cabang
Regional Demand Forecast
INPUT 3
ES of Industry in EAST JAVA
TREND
Calculation of ES of Industry
K=1~NTCL
Adjust
Adjust ES of Industry for each Cabang
PRINT 2
Summary of EAST JAVA
Regional Demand Forecast
Table of Ratio
END