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REPUBLIC OF SURINAME

CENTRAL PLANNING AGENCY
COORDINATING INSTITUTE

UNITED NATIONS CONFERENCE
ON NEW AND RENEWABLE
SOURCES OF ENERGY

NATIONAL PAPER

PARAMARIBO, MAY 1981

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NATIONAL PAPER

Role of New and Renewable Sources of Energy in the Republic of Suriname.

Presentation

The National Paper reflects the evaluation of the energy situation of Suriname and the potential of new and renewable sources of energy. The problem and restrictions thwarting the use of this enormous potential and possible ways of solving these problems are discussed.

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1. FOCAL POINT OF THE NATIONAL ENERGY POLICY

The actual energy situation in Suriname is characterised by the availability of locally produced hydropower (besides some biomass) of which the availability for the non-bauxite sectors is small and a great dependence on imported oil.
Because of its availability and balance of payment problems, the Government's focal point is to substitute the imported oil by local energy sources.
The actions in these fields are:

a. to stimulate the exploration and exploitation of domestic hydrocarbons. The State Oil Company, established in 1980, signed exploration contracts with foreign oil companies.

b. to develop new and renewable sources of energy, by which much attention is paid to hydropower.

2. ENERGY SITUATION IN SURINAME

2.1. Physical and socio-economic features

a. Physical features (see map fig.1.) - Suriname lies on the nothern coast of South America and occupies an area of some 163800 km^2.
Climatically Suriname meets the temperature but not quite the rainfall criteria for a tropical lowland rainforest climate, the long dry season (September - November) being too dry - though rainfall averages above 60 mm per month - in the coastal area and near interior.
The mean annual rainfall is 2000 mm.
Winds averages force 1,2 on the Beaufort scale and sunshine 50 - 75% depending on the season.
Geologically the pre-cambrium basement of the Guiana shield occupies the soutern and central four fifths of the country. Soils are on the whole infertile.
The young coastel plain on the north is very fertile, but agricultural use of these low drying soils requires expensive reclamation including impoldering.
Forests cover 85% of the country. Less than 1% of the total land area

is populated and cultivated.

b. Socio-economic features - The 1980 census showed a population of 352.000. Due to emigration there was no growth the last five years and in fact the population decreased.
50% of the population lives in or around the capital Paramaribo itself and an additional 20% in its vicinity.
10% is living in the interior;this part of the population is relying on renewable sources of energy for most of its energy needs.

As shown by Table 1 the Gross Domestic Product was in 1979 Sf. 1343 million. The G.D.P. per capita was Sf. 3710.
The main sectors of the economy are agriculture, mining, trade and the government.
The agriculture sector contributes 8% to the G.D.P. and employs 14% of the working people. The cultivated area is about 60.000 ha of which ca. 60% for the production of rice. Paddy yield in 1980 was 250.000 ton. Other important agricultural products are bananas, palmoil and sugar. The most important sector of Surinamese economy is the mining sector with bauxite as the main product. It contributes 18% to the G.D.P. and its share in the export is 67% by value. The production in 1978 of respectively bauxite, alumina and aluminium was 5 million ton, 1,3 million ton and 59.000 ton. 6% of the total work force was employed in the mining sector.
The trade sector contributes 17% to the G.D.P. and employs 15% of the population.
The government is the biggest employer with 40% of the employees.
Some 103.000 people are employed in Suriname, in addition 15.000 are unemployed.

Socio-economic features of Suriname that influence its energy use pattern as well as its potential for developing and using new and renewable sources of energy are:

- a small domestic market, which is however accustomed to a diversified assortment of high quality imported goods,
- a consumer attitudes and expectations oriented towards a 'developed' life style,
- a surplus of unskilled labour, but wages are high compared with other third world countries.

New and renewable sources of energy development, must take these factors into account.

2.2. ENERGY POTENTIAL (Table 2)

a. OIL

On-shore oil has been identified in the sixties in the Saramacca area, but because of the low quantity and quality it has never been exploited. Because of the drastic change in the world oil situation in the seventies this area may offer economic possibilities. Off-shore potentials are as well explored.

b. HYDRO-ENERGIE

Macro (see Table 3)- Total potential capacity amounts to some 3040 MW. At this moment 189 MW is installed and a major project scheduled to generate eventually 800 MW is on the programme.

Micro - The rapid-rich rivers of Suriname's interior offer considerable potential for mini-hydropower development, which is now being inventoried systematically.

One mini-hydro project (Poketi) with an installed capacity of 40KW will come onstream soon and the construction of another at Tapawatra (120 KW) will start this year. (see map fig. 1).

c. BIO-ENERGY

Wood from landclearing - 85% or 14 million ha of the country is covered with forest. With an average yield of 100 tons dryweight per ha the potential can be estimated at 1400 million tons of drywood or 2800 million barrel oil equivalent. Even if 0,5% of this potential could be utilised on a sustained basis this forest resource is equivalent to 14 million barrel oil.

Agricultural crop-residue (see table 4) - Ricehusks - The yearly production of 250.000 tons of rice gives 50.000 tons ricehusks per annum, of which 17.000 tons is used for electricity production replacing 17.000 barrels of oil.

Bagasse - The only sugarcane estate with an area of 2300 ha and a sugarcane production of 130.000 tons p.a. produces and burns 24.000 tons of bagasse yearly for the production of steam and some electricity, replacing 50.000 barrels of oil.

Because the alcoholproduction of this factory can nearly meet the consumption of alcohol for human use it cannot play any role in the automotive use of alcohol.
Oilpalm fibre and waste are used for the production of steam. All the 3000 tons is burnt replacing 6000 barrels of oil.
Woodwaste - With a production of 234.000 ton of roundwood per annum 30.000 tons of waste is generated of which, 15.000 tons is burnt to produce heat and electricity, replacing an estimated 30.000 barrels of oil a year.
The total use of crop residue and wood waste replaces some 103.000 barrels of oil a year.

Animal husbandry waste - The one million fowl and 8000 swine produce respectively 46.000 and 8000 tons of manure. There is no energy use of this potential at this moment.

Municipal waste - The 200.000 inhabitants of Paramaribo and surroundings produce 200 tons of waste per day. The potential of the energy part of the waste for steam generation is 35.000 barrels oil equivalent a year.

d. SOLAR ENERGY

The average sunshine during 10 hours a day is 60%. Average irradiation on a horizontal surface is 208 watts/m^2.
The theoretical potential for the whole country is 34 million MW. Even if only o,5 ^{o}/oo of the potential could be effectively used in the distant future this would mean an energy supply of 17.000 MW.

e. GEOTHERMAL ENERGY

There are no data available.

f. WIND ENERGY

Wind velocity rarely exeeds 5-8m/s. The average velocity is 2m/s in the Paramaribo region. From this data it is apparent that the role of wind-energy will be neglectible.

2.3. ENERGY SUPPLY AND CONSUMPTION IN 1978 (Table 5)

a. Energy Supply.

Oil imports amounted to 5206 b.o.e. or 77,9% of the total energy supply. Locally produced hydro-energy (20,6%) and bio-energy (1,5%) supplied the remainder of requirements.

b. Energy Consumption

In 1978 the total energy consumption was 6680 b.o.e.
The energy consumption per capita was 18,4 b.o.e. This figure is very high, but more than 70% of the total energy flow is going to the energy intensive bauxite industry.

The energy balance (Table 5) shows that 73,5% of the total energy flow is going to heavy industry. The bauxite industry consumes 70,8% which 74% imported oil and 26% is hydro-power.

The transport sector which consumes 15,3% relies completely on imported oil. 9.2% of the energy flow goes to the sectors household, commerce, small industry and small scale agriculture.

Finally large scale agriculture consumes 2% of the total energy supply.

Table 6 shows that 2464 b.o.e. (37%) is transformed into electricity. The contributions of hydro, oil and bio-mass are respectively 56%, 43% and 1%.
The above figures refer to 1978; more recent data show basically the same picture.

2.4. FUTURE ENERGY DEMAND

Energy imports increased from 4060 x 10^3 bbls oil equivalent in 1970 to 5357.10^3 bbls in 1980, which means an average yearly increase of 2.6%, whereas the import value went from Sf. 40 million in 1970 to Sf. 283 million in 1980. This increase in value equals 22% per year.
The Surinamese future energy demand is shown in table 7.
As shown in chapter 2.3. b. of this report, our energy is mainly based on hydrocarbons (± 78%) and hydropower (21%); biomass and solar heating are responsible for ± 1% of the energy supply.
Socio-economic developement plans, aim at an annual increase in G.D.P. of 3% in real terms. To achieve this objective, energy consumption in the transportsector will grow by some 3.2% as will thermal electricity

generation.
In the large industries, dominated by bauxite mining and processing, average annual increase will be some 1.7%; and the small consumers will see their requirements rise by 3.1%.
Total oil demand (imports) will follow a pattern of 2.2% increase a year, that a systematic energy conservation programme results in more efficient use of hydrocarbons.

3. N.R.S.E. DEVELOPMENT, RESEARCH NEEDS AND RESEARCH PLANNING

3.1. Criteria for determining development priorities

Estimated potential of new and renewable sources of energy in Suriname has been described in Ch. 2.2.
Tidal energy, ocean temperature gradient and nuclear energy have not been included, because there are either no data available or these sources of energy are not relevant for the country.
Priorities for alternative energy research and development must be determined on the strength of:

- availability
- actual pattern of use
- ease of effecting a substitution for conventional energy
- relevance for the country's social and economic situation.

Relevancy for Suriname means taking into account the observations made in Ch. 2.1. re. expectations of the population, availability and cost of skilled labour, technological and financial resources, and so on.
It will be evident that Suriname should concentrate on alternative energy applications meeting the following requirements:

- operational or nearly so
- involving low or intermediate technology, with possibilities for (partial) local manufacture
- requiring low/moderate initial investments
- easy and cheap to operate and maintain
- not labour intensive
- psychologically acceptable.

From the above criteria it is evident that emphasis should be placed on development of solar energy for heating and drying, possibly biogas, on more efficient use of bio-fuel (wood) for domestic purposes, where applicable, on (wood) gasification and certainly on combined power and steam-generation in situations where large amount of wood or cropwaste are

produced.
Admittedly this is a high investment, high technology application, but the integrated forest- or agro-industries where these conditions apply, have the necessary skills and management available.
Often alternative energy is attractive because of its small-scale features, which makes it adaptable to the needs of isolated communities in the interior, where light and power have to be provided for social reasons. Even if initial expenditure is high in those cases, total owning and operating costs of e.g. mini-hydropower scheme or a wood-driven generator might well be lower than a conventional diesel generating set running on extremely expensive (because of transportation charges) imported fuel.
For this reason Suriname, with aid and assistance from the OAS and EEG, is systematically investigating its mini-hydropower potential, of Ch.2.2.
As evident from Table 3 substantial contributions to Suriname's future energy requirements might be obtained from harnessing some of the country's macro-hydropower potential: a high technology, high cost solution to the energy problem. In addition to financing and limited local construction capacity the rolling Suriname topography provides another constraint to large-scale hydropower development. The country possesses few natural dam sites so hydropower implies creating extensive storage basins, with (partly) submerged forest and corresponding ecological consequences.

3.2. Scope for N.R.S.E. development

Within the framework of overall socio-economic development planning and on the criteria given in the preciding paragraph, research and development planning for new and renewable sources of energy is obviously based on potential availability, actual use and constraints on further development of such sources of energy. R & D planning determines efforts and actual projects in the N.R.S.E. field and these, in turn, the need for external (regional, mondial) assistance in financing, technology transfer, expertise and training.

3.3. Substitution possibilities

After evaluation of N.R.S.E. in term of relevance and availability the possibilities of substituting one form of energy for another have yet to be considered, before the slots may be difined in the overall energy picture where in alternative energy applications might be fitted.
Table 5 shows that the largest single consumer of energy is the bauxite industry, with the integrated Paranam works (bauxite-alumina-aluminum)

alone using some 3 million bbls of bunker C fuel plus the equivalent of 1,2 million bbls in hydropower and smaller quantities of diesel oil and LPG. Of this total quantity of fuel oil around 6½% goes into ore-drying, c.25½% into lime making, calcining, drying and miscellaneous operations, c.20% into electricity production and c.48½% into steam generation for processing.

Theoretically part - or even all of this thermal heat could be supplied from biomass, i.e. wood, e.g. by burning an oil-charcoal slurry or developing large-scale gasification.

In actual fact the quantities involved are so huge as to render this substitution impractical on the short term: even replacing half this amount with fuel wood, at an assumed yield of 150 dry tons p. ha and a heating value of 2 bbls p. ton would involve clearcutting some 5000 ha forest annually a very complicated operation, both from the logistic and the ecological point of view.

The bauxite sector will reduce its dependence on oil imports by rigorously effecting internal savings (as it is doing) and switching to hydro-electricity where and whenever possible.

Fossil fuel use in transportation is, again, difficult to replace, and the same holds for fuel in field operations in forestry and agriculture. The remarks re.alcohol production via hydrolysis of cellulose apply, however.

Examples of actual use of crop waste and wood residues for heat and power generation in forest-based and agro-industry indicate that fuller use should be made of this potential energy source, now literally lying around and posing a disposal problem, in many cases.

Another bio-mass based energy saving potential exists in using wood as a building material instead of imported cement, steel, aluminium etc., which have a (much) higher energy content.

There might be substitution possibilities for LPG and kerosine for domestic consumption with rising oil prices, expecially in the interior, where wood is plentiful. Suitable small charcoal kilns and suitable stoves, to replace kerosine or gas stoves, should be developed and vigorously promoted. It is not expected that many fossil-fuel users will switch back to the traditional wood/charcoal, but a concerted effort may keep the 'traditionalists' from switching to fossil fuel, thereby lowering future oil requirements.

There is an obvious opportunity for using solar heat for domestic, industrial and agricultural purposes: thereby replacing fossil fuel for water

heating and crop drying.
There is scope for replacing diesel oil in small-scale power generation by mini-hydropower, biogas (in connection with annual husbandry projects) or (plantationgrown) wood, in agro-forestry schemes, especially in the interior. Power generation should preferably be through woodgasification and producer-gas engines, in view of simpler technology, lower initial cost and lower demands on labour skills in operation than traditional steam-driven power plants. Potential savings in fossil fuel are not great, yet significant, because diesel oil is an expensive fuel in these applications.
Finally aquatic biomass, esp. water hyacinth offer potential for combined water pursification and energy production (digestion) purposes.
The above evaluation shows clearly that on the short term hydropower is Suriname's most promising renewable energy source, that could replace more imported hydrocarbons than any other potential energy source.
For that reason hydropower development merits priority, as far as financial, technological and ecological considerations permit.

3.4. Research and development needs and research and development planning in the fields of new and renewable sources of energy.

Research and development needs:

- development of solar heat
- developing bio gas for heating and power generation
- developing small scale carbonisation, possibly with collection of byproducts
- development wood gasification power units for small-scale electricity
- developing wood and charcoal burning stoves
- keeping informed about research elsewhere in similar situations.

These investigations will take the form of applied research: development and testing of apporpriate equipment in pilot projects.
This is the course taken by Suriname, where N.R.S.E. energy group in the University of Suriname (esp. Faculty of Natural Resources and Faculty of Engineering) is formulating R & D project proposals, in cooperation with the Central Planning Agency and the Ministry of Development.
Planned research efforts emphasize solar heat, bio-gas, pyrdysis wood gasification, small scale alcohol fermentation. No project is, as yet, beyond the planning stage.

4. INTERNATIONAL COOPERATION

Suriname, with its small population base and corresponding economy and lack of capital and know how recognizes fully the pressing need for regional and mondial cooperation and assistance in the N.R.S.E. field. This cooperation should assist developing countries in an orderly transition from the area of cheap and plentifull fossil energy to a future of relatively scarce and possibly expensive new/renewable energy. It should also ensure that those countries do not see their legitimate aspirations for a better life completely thwarted by unavailable or unaffordable energy.

In this context Suriname wholeheartedly endorses the action programme and the recommendations formulated at the Latin American UNERG preparating Meeting in Mexico City. These recommendations re. UN interagency coordination in the N.R.S.E. field, re. supporting the role of regional energy organisations (e.g. OLADE), re. increased financial support, technology transfer, training and demonstration programmes etc. for appropriate N.R.S.E. development in the third world need not be repeated here.

Finally the developing countries' plea for a New International Economic Order must be voiced again. The 'great energy transition' should not result in oil starved developing countries exchanging their dependence in imported oil and its accompanying balance-of-payment burden for an equal or even greater dependence and foreign exhange burden in the form of imported N.R.S.E. technology and capital equipment, with corresponding royalties, patent rights and licencing fees. Consequently self-reliance capacity should be built up in the developing countries, also in the N.R.S.E. field, with full international assistance.

TABLE I

GROSS DOMESTIC PRODUCT AND EMPLOYMENT BY SECTOR (1979)

SECTOR	G.D.P.*	%	EMPL.	%
1a. Agriculture and Fisheries	113	8	14.200	14
1b. Forestry and Wood Processing	37	3	3.500	3
2. Mining and Bauxite Processing	240	18	6.000	6
3. Manufacturing	98	7	10.400	10
4. Gas, Water and Electricity	34	3	1.100	1
5. Construction	82	6	3.500	3
6. Trade and Tourism	229	17	14.900	15
7. Transportation, Storage and Communication	61	5	3.600	4
8. Financial institutions	64	5	2.100	2
9a. Government	298	22	39.600	39
9b. Other Services (housing, social, private)	87	7	3.700	4
TOTAL	1.343	100	102.600	100

* MILLION Sf.

TABLE 2

NATIONAL ENERGY POTENTIAL

SOURCE	UNIT	POTENTIAL	USE (%)
Hydro-energy	MW	3040	6
Oil	Mill.bbls.	100*	-
Bio-mass	---	considerable	-
Solar energy	---	considerable	-
Wind energy	---	Low	-
Geothermic	---	No data	-

* Possible reserves

TABLE 3

LARGE SCALE HYDROPOWER POTENTIAL

SITE	RIVER	MW
Afobakka (utilised	Suriname	190
Devisfall	Kabalebo/Corantijn	500
Kabalebo-airport	Kabalebo	300
Matapi	Corantijn	150
Kau falls	Corantijn	600
Maopityan falls	Corantijn	500
Soekratipoort	Marowijne	800
TOTAL		3.040

TABLE 4

CROP - RESIDUE AND WOOD WASTE (1980)

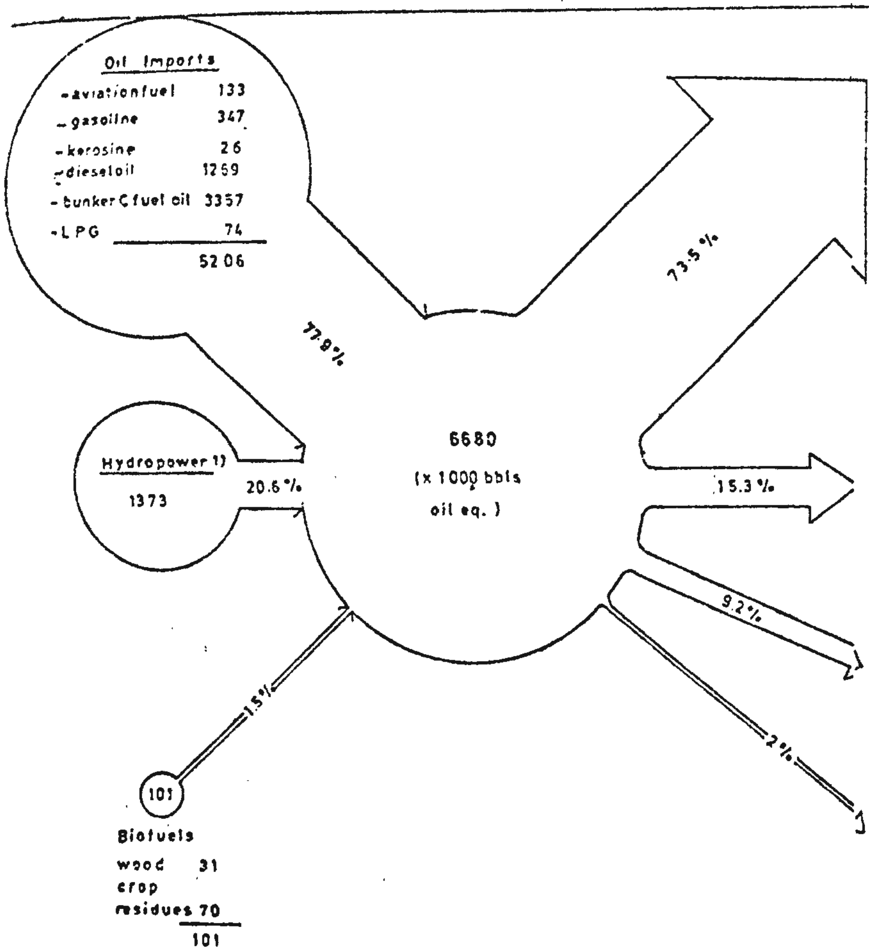
	POTENTIAL (TON/YR)	USED (TON/YR)	b.o.e.
Ricehusks	50.000	17.000	17.000
Woodwaste	55.000	15.000	30.000
Bagasse	24.000	24.000	50.000
Oilpalm residue	3.000*	3.000	6.000
TOTAL	--	--	103.000

* Gradually increasing

Table 5 Estimated Energy Balance Suriname 1978

(in 1000 bbls oil eq.)

Energy Source | Energy consumption



Energy consumption by sector || Energy consumption by region

Sector & use	energy carrier	quantity x1000 bbls		Parbo-Centr.S	E.Sur.	N.W.	Kab.	Interior	
(heavy) industry	4907 = 73.5%								
bauxite industry	70.0%								
(mining, refining, smelting)									
•electricity,	diesel	92	1970	52	40				
	bunker C	647		647					
	hydro	1231		1232					
•processing	diesel	41	2761	41					
	bunker C	2710		2463	247				
	LPG	10		10					
other industry	2.5%								
•electricity	diesel	72	115	70			2		
	hydro	43		43					
•processing	diesel	33	59	33					
	wood	26		26					
transport	1026 = 15.3%								
land									
•mining	diesel	83	646 5)	47	36				
•other	diesel	216		←—	136	—→	80		
	gasoline	347		←—	347	——	——	—→	
water	diesel	249	249	226					
air	aviation fuel	133	133	133 ←—	23	—→			
household, commerce	613 = 9.2%								
& industry, sm. sc. agric.									
•electricity	diesel	229	328	184	11	28	2	4	
	hydro	99		99					
•fuel	diesel	190 9)	285	←—	190	—→			
	kerosine	26		←—	26	——	——	—→	
	LPG	64		←—	64	—→			
	wood	5 10)		2		1		2	
large scale agriculture	134 2.-%								
-electricity	diesel	33	51	10	11	15	4		
	crop residues	18		1		17			
-processing	diesel	31	83	1		25	5		
	crop residues	52		46			6		
	population (sub)urban			200	8	9	-	-	217
	(x1000) semi rural (villages)			69	5	9	-	10	93
	rural			35	4	20	1	20	80
	pop. total			304	17	38	1	30	390

TABLE 6

ELECTRICITY PRODUCTION (x 1000 b.o.e.)

1978		TOTAAL
E.B.S. Paramaribo	(Public plant)	238
District Electrification		50
Paranam	Bauxite Companies	649
Moengo	Bauxite Companies	45
Billiton	Bauxite Companies	51
Wageningen	(Rice estate)	43
Marienburg	(Sugar estate)	12
West - Suriname		2
TOTAL		1.090
HYDRO (AFOBAKA)		1.373
TOTAL		2.464

TABLE 7

ENERGY REQUIREMENT BY SECTOR (in 10^3 bbls. oil equivalent)

SECTOR	1980	1981	1982	1983	1984	1985	1990
Transport	1065	1096	1129	1163	1198	1235	1446
Gasoline	356	366	376	386	397	409	479
Aviation fuel	137	141	145	149	153	157	184
Diesel	560	577	596	615	635	655	767
Lubricants	12	12	12	13	13	14	16
Electricity	1083	1114	1147	1181	1217	1253	1467
Fuel oil	623	639	654	670	687	704	824
Diesel	454	469	486	503	521	539	631
Lubricants	6	6	7	8	9	10	12
Large Consumers	2946	2990	3039	3036	3138	3188	3468
Fuel oil	2794	2835	2878	2921	2965	3010	3275
Diesel	125	128	132	136	140	144	157
L.P.G.	8	8	9	9	11	11	12
Lubricants	19	19	20	20	22	23	25
Small Consumers	150	155	159	164	169	175	204
L.P.G.	68	70	72	74	77	79	92
Diesel	59	61	63	64	66	68	79
Kerosine	19	20	20	21	21	22	26
Lubricants	4	4	4	5	5	6	7
Oil consumption	5244	5355	5474	5594	5722	5851	6585
Hydropower	1423	1450	1475	1500	1500	1500	1500
TOTAL	6667	6805	6949	7049	7222	7351	8085

ABBREVIATIONS

N.R.S.E.	-	New and renewable sources of energy
b.o.e.	-	barrel oil equivalent
bbls.	-	barrels

CONVERSION FACTORS

1 barrel oil	-	571 KwH (e)
1 ton	-	1000 kg.
1 US $	-	Sf. 1.785
1 Sf.	-	US 0.560

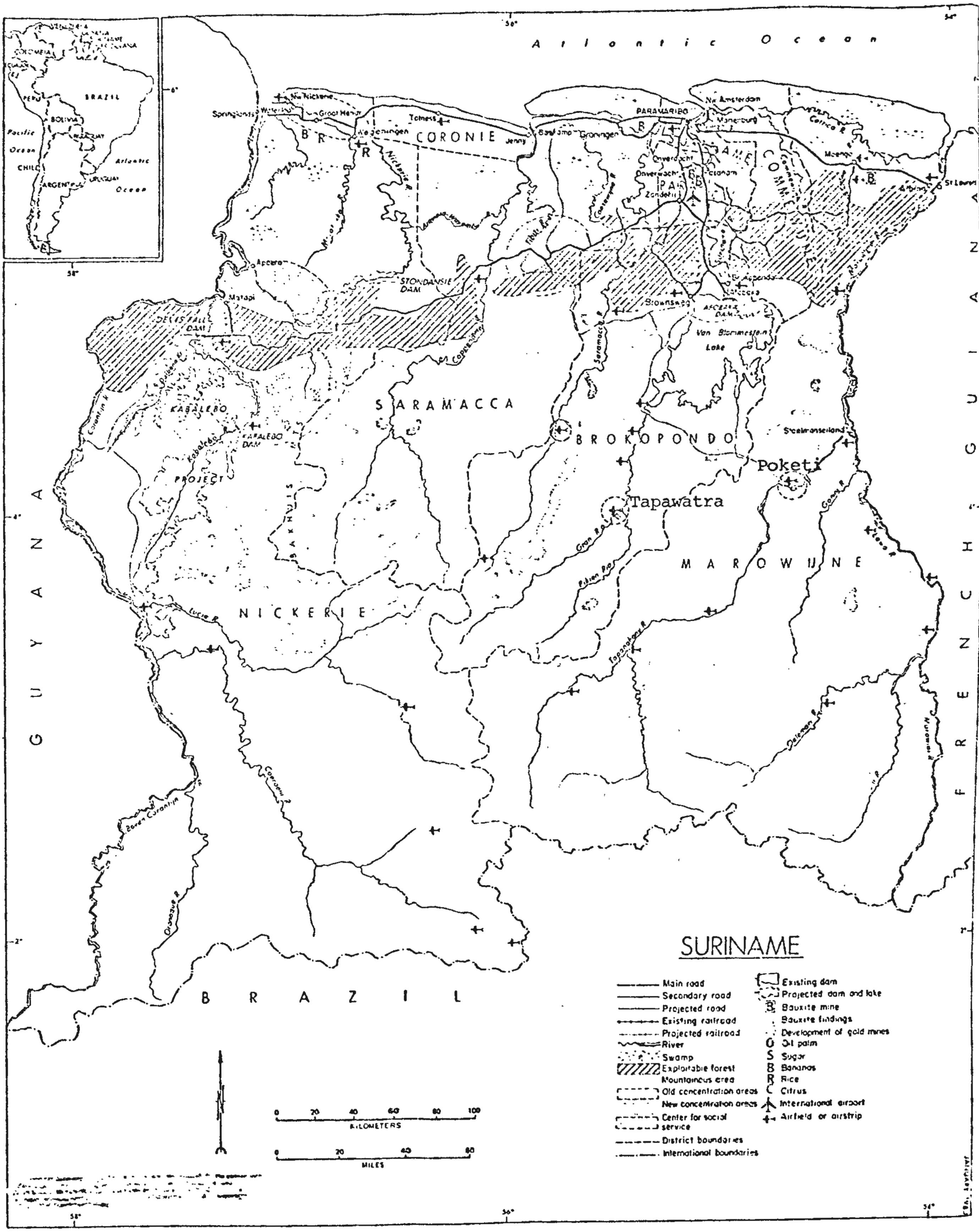

Atlantic Ocean
SURINAME
GUYANA
FRENCH GUIANA
BRAZIL
CORONIE
SARAMACCA
BROKOPONDO
MAROWIJNE
NICKERIE
KABALEBO
PROJECT
PARAMARIBO
Poketi
Tapawatra
Van Blommestein Lake
KILOMETERS
MILES
Main road
Secondary road
Projected road
Existing railroad
Projected railroad
River
Swamp
Exploitable forest
Mountainous area
Old concentration areas
New concentration areas
Center for social service
District boundaries
International boundaries
Existing dam
Projected dam and lake
Bauxite mine
Bauxite findings
Development of gold mines
Oil palm
Sugar
Bananas
Rice
Citrus
International airport
Airfield or airstrip

Fig. 1.