Energy in the West Region

Diagnostic report

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1. FRAME WORK

Cameroon has adopted a Vision for the Year 2035 (called Vision 2035) and has developed a Growth and Employment Strategy Paper (GESP) to significantly reduce poverty in the country. In order to accomplish this, the Government has chosen to invest greatly in the development of social infrastructure, especially in the energy sector. Also, it has updated the *Rural Electrification Master Plan* to ease access to electricity for several rural households by 2035. In the oil sector, a *Prospective Development Plan of Equipment for Refining, Storage, Transport and Distribution of Oil and Gas Products* has also been developed to promote access to domestic gas in rural areas and especially in sectors with environmental sensitivity.

1.1. Legal and Institutional Framework

1.1.1. Legal Framework

The energy sector is governed by a group of legal texts that govern the functioning and implementation of the various activities. The table below contains, references of the text on energy, oil and gas products.

Table**1** : Some legal texts governing the energy, oil and gas sectors

TEXT REFERENCE	OBJECT
Law No. 2011/22 of 14 December 2011	Law governing the electricity sector in Cameroon, replacing Law No. 98/22 of 24 December 1998.
Law No. 2002/4 of 19 April 2002	Law on the investment charter in the Republic of Cameroon.
Law No. 98/19 of 24 December 1998	Law on the tax regime for public service concessions.
Law No. 98/13 of 14 July 1998	Competition Act.
Law No. 98/15 of 14 July 1998	Law on establishments classified as dangerous, unhealthy or inconvenient.
Law No. 96/12 of 5 August 1996	Framework Law on Environmental Management
Law No. 99/13 of 22 December 1999	Petroleum Code Act
Law No. 2012/6 of 19 April 2012	Gas Code Act
Law N°2011/22 of 14 December 2011	Law on renewable energy in Cameroon
Decree No. 2012/2806 of 24 September 2012	Decree on the system of concessions, licences and authorisations for the production, transmission and distribution of electricity.
Decree No. 2012/0506 of 22 February 2012	Decree on the water licence fee for water storage for electricity production.
Decree No. 2001/021/PM of 29 January 2001	Decree stating the rate, methods of calculation, recovery and distribution of taxes on the activities of the electricity sector.
Decree No. 2000/464/PM of 30 June 2000	Decree governing the activities of the electricity sector.
Decree No. 99-193 of 08 September 1999	Decree on the organization and functioning of the Rural Electrification Agency.
Decree No. 99/125 of 15 June 1999	Decree on the organisation and functioning of the Electricity Sector Regulatory Agency.

TEXT REFERENCE	OBJECT
Decree No. 94/2034/PM of 04 September 2003	Decree laying down detailed rules for the application of Law No 2002/13 of 30 December 2002 on the gas code.
Order No. 00000193/A/MINEE of 28 April 2014	Decree stipulating the composition of files for application of a concession, licence, authorisation and declaration, as well as the related costs.

1.1.2.Institutional framework

The energy sector in Cameroon includes different branches, namely:

- the oil and gas sector;
- the electricity sector, consisting of hydroelectricity and public thermal power plants;
- Renewable energy sector, which includes wood energy, solar energy, wind energy, biofuel and biogas.

These different branches are under the supervision of the Ministry of Energy and Water Resources and other institutions responsible for the implementation of energy policies in Cameroon. The table below shows some institutions and organizations in the energy sector.

Table2 : Some institutions and organizations in the energy sector

INSTITUTIONS / ORGANIZATIONS	ROLES
Ministry of Energy and Water Resources (MINEE)	to develop, implement and evaluate the Government's policy on the production, transmission and distribution of energy and water;
Ministry of Mines, Industry and Technological Development (MINMIDT)	conduct exploration operations, management operations, transportation (through pipelines) and storage (at the level of terminals) on oil and gas fields;
Ministry of Scientific Research and Innovation (MINRESI)	In charge of the energy research laboratory;
Electricity Sector Regulatory Agency (ARSEL)	to regulate, control and monitor the activities, operations and operators of the electricity sector, within the framework of the policy defined by the government;
Energy of Cameroon (ENEO)	Produce, transmit and distribute electricity;
The Rural Electrification Agency (AER)	promote rural electrification by building and monitoring State projects while supervising private operators in the rural sector;
National Electricity Transmission Company (SONATREL)	responsible for the management, maintenance and development of the public electricity transmission system and its interconnections with other systems;
Société Camerounaise des Dépôts Pétroliers (SCDP)	to manage oil reserves and supply approved companies with petroleum products;

2. ELECTRICITY

2.1. Energy situation in the West Region

2.1.1. Production facilities and works

The West Region is supplied by the south interconnected grid (RIS). The generating facilities are the Song Loulou hydroelectric power plant and the Bafoussam thermal power plant. Electric power comes from the Song Loulou hydroelectric power plant; while the Bafoussam thermal power plant (14MW) acts as a relay in the event of power shortage. The reservoir dams, in particular the MAPE dam (capacity of 3.2 billion m3) and the BAMENDJIN dam (capacity of 1.8 billion m3), do not produce energy, but play a role in retaining water and regulating the Sanaga River downstream during the dry season.

2.1.2. Electric power transmission and distribution network in the Region

Starting from the Song-loulou hydroelectric dam, electrical energy arrives in Bafoussam under a 90 kV High Voltage transmission line, which is then transformed into 30 kV and distributed to various households and services. According to information collected from the ENEO Company, the High Voltage Transmission (HVT) network in the Western Region extends approximately over 114.5 km.

With regard to distribution, the three-phase MV grid extends over 1,687 km, while the single-phase MV grid extends over 1,171 km. The number of three-phase transformers is 717, while in single-phase, it is 730. The total installed capacity reduced to three phase's amounts to 97,198 KVA. The details of this information are given in the following table

***Table* 3** : Electrical Energy Distribution in the West Region

HVB/HV substations	HVB/HV transformers	Start name HTA	Number of HTA/BT TRI posts	Number of HTA/BT MONO posts	Mono Installed Power (KVA)	Tri Installed power (KVA)	Total reduced to TRI	HTA TRI Length (KM)	HTA Mono Length (KM)	No. of HV/HV substations
Bafoussam	90/15 KV of 36 MVA	D11 city of Baf	8	0	0	3,900	3,900	7	0	0
		D12 city of Baf	56	0	0	10,460	10,460	16	0	0
		D13 city of Baf	60	0	0	13,480	13,480	17	0	0
	90/30 KV of 36 MVA	D31 Mbouda	158	234	5,985	19,580	21,575	528	323	2
		D32 Foumbot	93	109	2,550	13,150	14,000	407	225	1
		D33 Bangangté	232	305	7,685	21,005	23,567	561	441	1
Bamenda		D36 Mbouda	13	14	350	1,200	1,317	62	48	0
Nkongsamba	90/30KV of 20MVA	D32 Bafang	94	67	1,585	8,063	8,591	76	132	1
MAPE Power plant		D31 Magba	3	1	25	300	308	13	2	0
TOTAL			**717**	**730**	**18,180**	**91,138**	**97,138**	**1,687**	**1,171**	**5**

Source: RDPT Activity report MINEE WE, 2017

Thus, the distribution of electric energy is done from the transformer substations and is divided by division as follows:

- the 90/15 kV transformer substation at Bafoussam supplies the town of Bafoussam
- the 90/30 kV transformer substation at Bafoussam supplies the cities of Mbouda, Foumbot, and Bangangté ;
- the 90/30Kv transformer station in Nkongsamba supplies the city of Bafang
- The city of Magba supplied 120 kv by the Mapé thermal power plant, is not connected to the interconnected grid

Figure 1 : *Extension of the three-phase network in BANDOUMKA Banka district, on the left of the picture/ Reinforcement of the BABOU power line in NDOMGO, in the BANGANGANGTE district on the right.*

2.1.3.Electricity access rates in the West Region

144,270 subscribers in the West Region were registered in May 2016 on the Low Voltage (LV) network, and 83 on the Medium Voltage (MV) network.

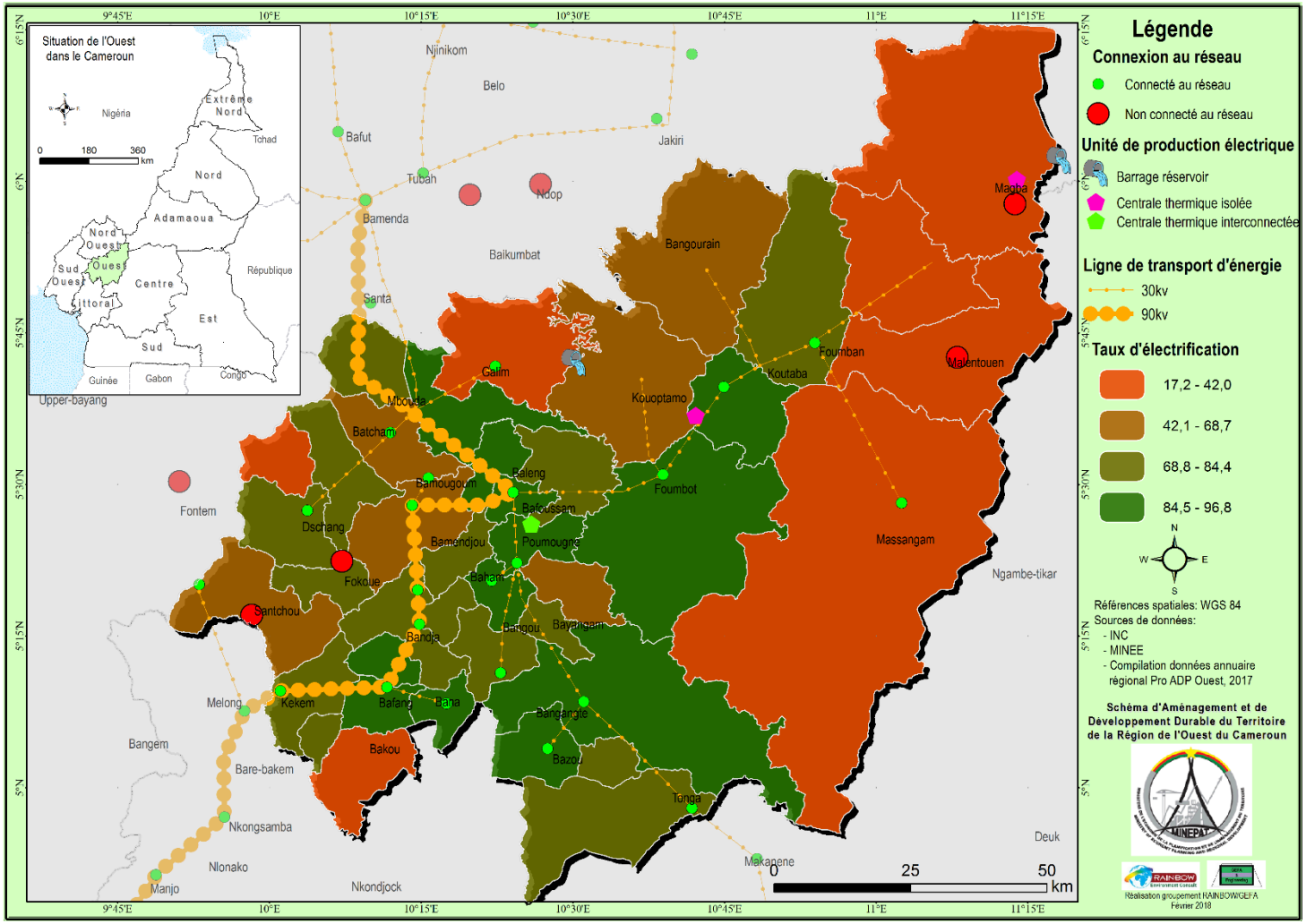
The access rate to electricity in the Region is average, estimated at 74.8%. The Ndé, Mifi and Haut-Nkam divisions are the most electrified, with rates of 89.7%, 89.3% and 85% respectively; while the Noun and Bamboutos divisions have the lowest electrification rates at 61.6% and 69.3% respectively.

Table 1 : Electricity access rates in the West Region

Divisions	Electricity access rates
BAMBOUTOS	69,3 %
HAUT -NKAM	85,0%
HAUT –PLATEAUX	80,8 %
KOUNG-KHI	84,5 %
MENOUA	73,7 %
MIFI	89,3 %
NDE	89,7 %
NOUN	61,6 %
TOTAL	**74,8 %**

Sources : INS, 2018

Figure 2: *Interconnected Electric Transmission Line in the Western Region*



2.1.3.1. Main companies specialised in the maintenance and up keep of power lines

Table4 : Main companies specialized in the maintenance and up keep of power lines.

Companies	Locations	Specialities
ENIG ELECAM	BAFOUSSAMM	Construction and maintenance of LV and HV lines
EROMAT 3I	BAFOUSSAM	Construction and maintenance of LV and HV lines
CHALLENGE SERVICE	BAFOUSSAM	Construction, Maintenance and up keep of HTA overhead lines (1 001-50 000V)
CONSULCO	BAFOUSSAM	Construction, maintenance and up keep of LV lines (≤ 1 000V)
EDIEME	BAFOUSSAM	Construction, Maintenance and up keep of HTA overhead lines (1 001-50 000V)
ETS EREC CAMEROON	BAFOUSSAM	Construction, Maintenance and up keep of LV lines (≤1 000V)
QUI MO CAM SARL	KOUTABA	Construction, Maintenance and up keep of HTA overhead lines (1 001-50 000V)

Source: Cameroon's energy situation, 2015

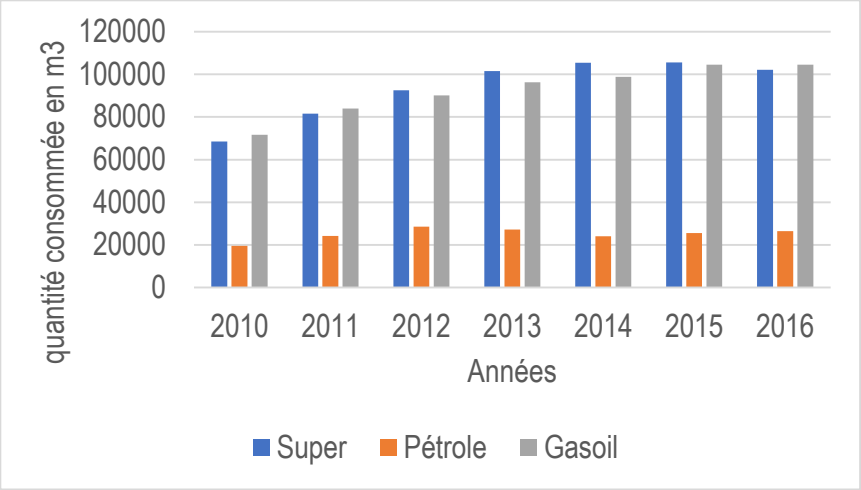
3. PETROLEUM PRODUCTS

Petroleum products are used mainly in transport, but also in cooking and lighting. The petroleum products used in the West Region are:

- The Super and Diesel used in transport;
- Liquefied Petroleum Gas (LPG) used by households for cooking;
- Kerosene used for lighting with kerosene lamps.

Société Camerounaise des Dépôts Pétroliers (SCDP) ware house in Bafoussam stores petroleum products from SONARA for consumption. It has a storage capacity of 18,520 m3 for liquid products and 300 tons for liquefied petroleum gas (LPG). The mixed storage (Gas + Fuels) has 6 cylindrical tanks, with a total capacity of 185 20 m3 for white products on one hand, and on the other hand, a 300 m3 sphere and a 60 m3 cigar, that is a total capacity of 360 m3 of butane and a 10 m 3 underground technical tank. The figure below illustrates the balance of consumption of liquid petroleum products.

Figure 3 : *Consumption chart of liquid petroleum products leaving the SCDP (2010 to 2016).*

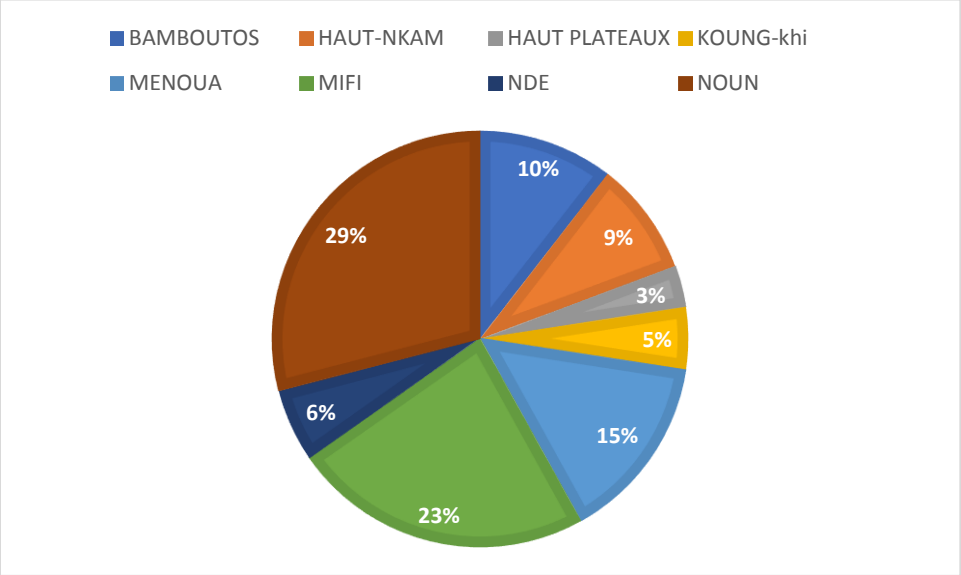


Source: DR/MINEE WE Activity Report, 2017

Till date, the West Region has twenty-four (24) active companies operating in the liquid products sector, for 124 fuelling stations, 115 of which are functional and 9 are still being set up. The main companies are: Total, Camoco, Oilibya, Mrs, Tradex, Bocom, Citzen's and PPSM

Liquefied petroleum gas is produced by refining crude oil. The West Region is supplied with liquefied petroleum gas from Douala by tank trucks. About 50 domestic gas warehouses are licensed to sell domestic gas. These various sale warehouses as well as households obtain their supplies from the SCTM and CAMGAZ, which are storage warehouses.

Figure 4 : *Distribution of petroleum product consumption points per division*



The handling and storage of petroleum products presents enormous risks. These risks include tank leakages, fires and toxicity. The prevention of these risks related to toxic product storage operations should be taken as early as possible in the design phase of storage areas and storage buildings. For a better implementation of the preventive measures established, DR MINMIDT through its inspection

missions ensures the installation of protective equipment against possible risks within the different establishments.

4. RENEWABLE ENERGIES

Renewable energy in the West are found in four forms, namely:

- Hydraulic energy;
- Solar energy;
- Wind energy;
- Energy from biomass

These different forms of energy are presented in the following table with the equipment of the infrastructures already set up.

Table5 : Renewable Energy Production Units in the West Region in 2013

	Small hydro KW	Solar 5 KWC	Wind turbine m/s	Biogas m3
Estimated quantities	70	31.1	1.8	13

Source: Atlas of Environment Statistics, NSI 2016

In this table, small hydroelectricity is 70KW, which is very large given the strong hydroelectric potential of the West Region. Solar energy is 31.1 kWp, which means that this energy source is only useful for domestic and public lighting, biomass energy is very small and is only useful for cooking and heating on farms. As for wind energy, it is only in its experimental phase.

4.1. Hydroelectric power in West Cameroon

Hydroelectricity or hydroelectric power is an energy that exploits the potential energy of water courses (rivers, streams, waterfalls, water currents, etc.). The kinetic energy of the water flow is transformed into mechanical energy by a turbine, then into electrical energy by the lowering of an alternator. Many hydroelectric power plants have been built throughout Bafoussam, Mbouda, Dschang and Foumban.

Table6 : Potential sites for the installation of some hydroelectric power plants in the West Region of Cameroon and its inter-municipal surroundings.

Watercourses	Guaranteed power (MW)
Nkam to Ekom	10.84
Nkam to Bexem	9.7
Atoufi Falls	10.27
- Benada	7.99
- Manyu	10.84
- Nsanakang	8.56
- Edjong	6.8
Lapua Fall	-
Chuoteu Fall	-
- Mouankeu Fall	
- Maya Fall	-

Table7 : Specific potential sites for the installation of some micro hydroelectric power plants in the West Region of Cameroon

Divisions	village	neighbourhood	Watercourse	Fall (m)	Flow rate (L/s)	Hydraulic power (w)
Bamboutos	Balatchi			/	/	
Haut- kam	Baboutcheu			/	/	
Haut-kam	Choungou			14	50	6867
Haut-kam	Bakoven	Meka	Ngoum	5	180	8829
Menoua	Fongo-Tongo			/	/	
Menoua	Batoula-folemo			15	15	2207.25
Menoua	fomopea			20	50	9810
Menoua	Baloum			10	/	
Menoua	Baloum			40	/	
Menoua	tsoten			16	15	2354.4
Menoua	Fotsetsa			15	45	6621.75
Menoua	Fotsa-toula			/	/	
Menoua	Fokoué			18	120	3531.6
Menoua	Fongo-Tongo	Apouh	Mami water	110	50	53955
Menoua	Fongo-Tongo	Toutchouet	Toussa	50	60	29430
Menoua	Fongo-Tongo	allo	Talla	96	150	141264
Menoua	Fongo-Tongo	lefok	Sentse	15	120	17658
Menoua	Fongo-Tongo	fossong	Folepe	70	700	480690
Menoua	Fongo-Tongo	yaguem	Folefok	12	800	94176
Menoua	Fongo-Tongo	Loung	Matsoung	84	950	782838
Menoua	Foto	tsinkop	Lepeh	24	280	65923.2
Menoua	Foto	tsinkop	Setsa	11	40	4316.4
Menoua	South Foto	balefok	Tsifokamezo	105	800	8240400

Divisions	village	neighbourhood	Watercourse	Fall (m)	Flow rate (L/s)	Hydraulic power (w)
Menoua	North Foto	Mintsi	Mintsi	5	80	3924
Menoua	Foréké	minwong	Minwong	16	120	18835.2
Mifi	Baleng	lafe		/	/	
Mifi	Lewog			40	500	196200
Mifi	bamougoum			12	150	17658
Mifi	Baleng	nefolom	Manema	20	400	78480
Mifi	baleng	Sinte	Sinte	100	10	9810
Mifi	Baleng	famtchouet	Megnekie	38	300	111834
Mifi	Badeng	todeng	Tsedeng	8	400	31392
Mifi	bamougoum	Metchié	Metchié	12	750	88290
Noun	Manga			50	1000	465975
			10,971 MW			

Source: Cameroon's Strategic Orientation Document 2014-2020

We notice that in West Cameroon, hydraulic power is very high (10,971 MW).

Most of the electrical energy is produced by hydroelectricity. The following table lists some micro hydroelectric power plants producing electrical energy located in the West.

Table8 : Micro hydroelectric power plants installed in the West Region
Source: SIECAM 2011

Sites	Maximum power (kw)	Construction Date	Financing	Constructors	Operating status
Dschang	1924.72	1944	France	Foreign	Suspended
Fonjumetaw	3217.7	1988	Germany	Foreign	Suspended
Bamougoum	153.4	1997	World bank	Foreign +EDC+local	Suspended
Bapi	441	1998	IEPF	Local	Suspended
Batotcha	478.8	2000	Private	Local	Suspended
Bangang	115	2003	Private	Local	Suspended
Mamarem	979.4	2004	Private	Local	Suspended
Bafoussam 1er	5			ADEID	Suspended
Mamamram	7.5	2004		ADEID	Functional
Tongou	5	2006		ADEID	Suspended
Nefolem (Bafoussan 1)	6.5	2006		ADEID	Functional
Tchouandeng (Dschang)	20	2010		ADEID	Functional

These hydroelectric power plants are suspended mainly because of the obsolescence of their equipment, which has considerably affected the performance of these power plants, and the absence or inadequacy of maintenance systems for the said plants. Since 2016, the NGO ADEID (Action pour Développement Equitable Intègre et Durable) has signed several partnerships with foreigners for the construction of numerous micro power plants in the Region.

Table 9: Micro hydroelectric power plant construction project

Villages	Power (kw)	Constructors	Level of project's progress
Famtchuet	15	ADEID	Waiting for funds
Foumbot	46	ADEID	Waiting for funds
Koutaba	93	ADEID	Waiting for funds
Massagam	116	ADEID	Waiting for funds
Schungou	78	ADEID	Waiting for funds
Bangangté on the South Inter-connected Network (RIS)	90 MW		Negotiation of agreements

Source: ADEID 2018

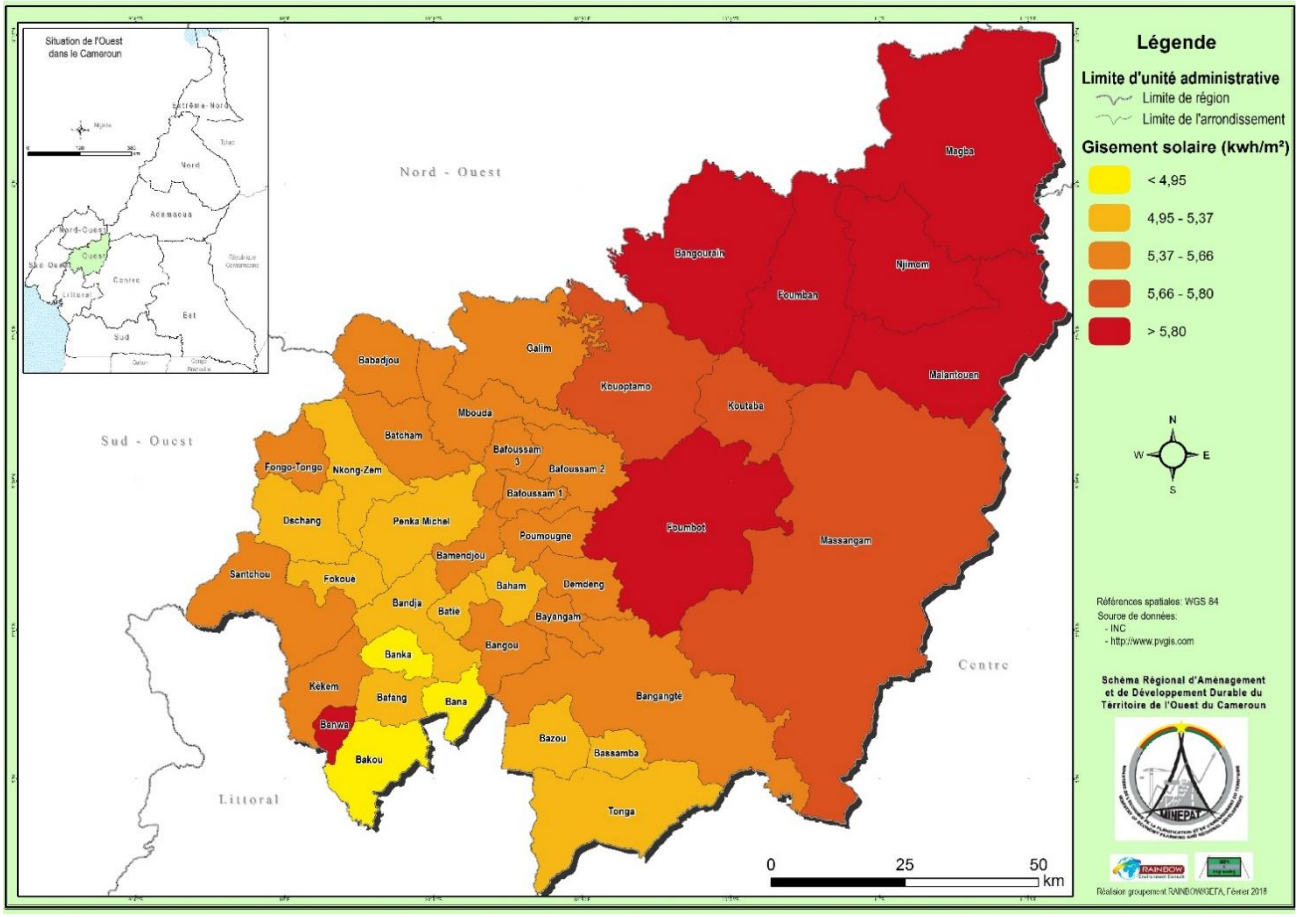
4.1. Solar energy

4.1.1. Solar energy potential in the West Region of Cameroon

Solar energy is the transformation of solar radiation into another form of energy to produce electricity, or domestic hot water. The West Region has a fairly favourable exposure (5.1 KWh/m^2/J) with an estimated production of about 2,250 TWh, the map below shows the evolution of insolation in the Region according to the area where we are located.

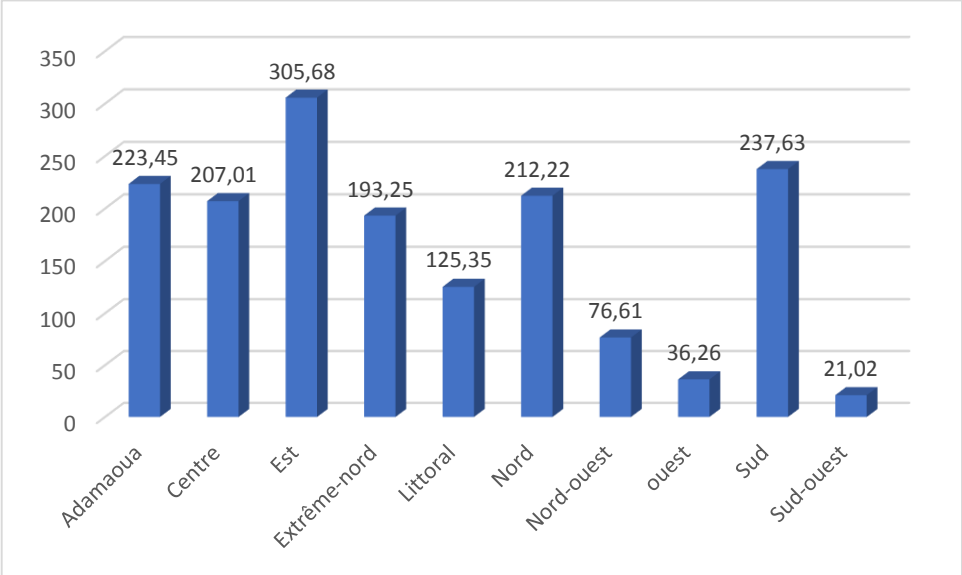
Despite this great potential, exploitation is very limited because a study in 2015 estimated the capacity of the photovoltaic solar infrastructure in kilowatt peak installed per Region in Cameroon, at 1683.47 WC in total (solar street lamps are not taken into consideration), the following graph presents the results obtained.

Figure 5: *Map: Sunshine map of the West Region.*



Source: http://.PVGIS.Com

Figure: *Solar energy production per Region in Cameroon.*



Source: MINEE, 2015

We can see from this diagram that solar energy is not highly exploited in the West despite its potential. In order to reduce the energy deficit, the West benefits from several rural electrification projects based on solar panels.

4.1.1. *Solar Infrastructure Projects in the West Region*

Several projects are on-going such as:

Table 10: Some electrification development projects

Project description	- Installation of solar street lamps; - connection of several households to the local Eneo electricity grid; - Construction of a micro hydroelectric power plant in Batié	- Installation of solar street lamps; - Installation of solar kits in public health centres
Sponsor	European Union	- AIMF (International Association of Female Mayors) - communes (Bagangté and Fokoué)
State of evolvement of the project	- The poles of the solar streetlights are already installed in Bamendjou; - Household registrations are ongoing for connection to Eneo.	- Signing of the procurement agreements with the municipality of Bagangté;
Project cost	2.2 billion CFA francs	458.5 million CFA francs

Source: Bamendjou and Fokoué Commune.2018

- Rural electrification project of 350 villages by photovoltaic system thanks to the cooperation between CHINA and CAMEROON. The estimated capacity to provide the framework for this project is 11.2 MW. The villages in the West Region concerned by the project are presented in the following table (AER, Solar Project Sites List 20170828).

Table 11: Villages concerned by the electrification project by photovoltaic system

	Sub-divisions	Location of the site	Power (kW)	Progress of the project
Noun	Massangan	Mankouombi	100	non-functional
Noun	Massagan	Mantchutbi	100	non-functional
Noun	Massangan	Machatoum	100	non-functional
Noun	Malantoue	Makpa	50	non-functional
Noun	Malantoue	Makoup	80	non-functional
Noun	Malantoue	Njissain	30	non-functional
Haut Nkam	Bakoué	Bekambe	80	non-functional
Menoua	Fokoué	Nzalla	50	functional
Nde	Bazou	Bagnoun	80	non-functional
Bamboutos	Galims	Menfoug	50	non-functional

Source: (report on the energy situation in Cameroon 2015 edition)

The Nzalla village, which was once a non-electrified area, has benefited from this project through a 50 MW photovoltaic installation since 2017. Since then, many infrastructures have been set up, such as welding spots and hairdressing salons. This population had no access to electricity because of its distance from the existing grid (located 15 km from the Fokoué commune, it was never connected to the local grid). The picture below shows us the solar power plant of the NZALLA village

Photo 1: *NZALLA village Solar power plant*

4.2. Wind energy

4.2.1. Wind potential of the West Region

Wind energy is the kinetic energy of wind used to produce electricity through wind turbines. In West Cameroon, the relief is mountainous with many plateaus and plains. It is an accident prone zone and characterized by three main areas:

- The mountainous areas of the North with the main peaks being the Bamboutos Mountains, the Mbam Mountains, Mount Bana, Mount Kogham and Mount Bapit ;

Table 12: Wind potential in the West

Mountains	altitude (m)	Height of the top (m)	Geographic location
Bamboutos	2740	50	N 005^0 41.523' E 010^0 05.556"
Mbam	2263	50	
Col Bana	2700		N 005^0 09.549' E 010^0 19.348"
Kogham	2263		
Bapit	1970		
Nziih		15	N 005^0 32.158' E 010^0 05.060"

Source: WIND RESEARCH PROJECT: CAMEROON, December 2010

Table 13: Average wind speed over the hills (m/s)

Months	BAMBOUTOS	COL BANA
January	7,66	4,69
February	6,60	3,97
March	7,58	4,95
April	8,19	5,03
May	8,69	5,48
June	6,80	4,59
July	5,15	4,60
August	4,43	4,31
September	4,80	3,93
October	7,03	5,35
November	9,38	6,52
December	7,36	5,45
average	6,94	4,85

Source: WIND RESEARCH PROJECT: CAMEROON, December 2010

- The hauts-plateaux whose average altitude is 1,500m and which cover the Mifi, Ndé, Haut Nkam and part of Menoua Divisions;
- The Mbos plain in Menoua, the Noun plain between the Ndé and the Noun and the Mapé basin in the Noun.

On these hills, winds blow at an average speed of 3 m/s, this gives a possibility to install a wind turbine. Indeed, studies conducted on the wind potential of Mount Bamboutos from 2009 to 2010 by a Spanish company have shown that it is possible to build a 40 MW wind farm that can be expanded to 80 MW.

4.2.1. Wind energy production infrastructure

University pilot projects (University of Dschang, National Advanced School of Engineering in Maroua, etc.) have been carried out since 2009 and focus mainly on micro wind turbines.

Table 14: Some wind infrastructure in West Cameroon

Location	Installed capacity (kW)	Date it became operational
Bamboutos	0,6	2005
Menoua	1,8	2009

Source: MINEE 2015 yearbook

- After the installation of these micro wind turbines, further research on Mount Bamboutos led to a new project to install a 75 MW power plant.

Table 15: Ongoing Wind Project

Project description	Construction of a 75 MW wind farm and transmission line
Interest of the project	Improve the quality of service in terms of access to electricity
Progress of the project	Preliminary studies on wind characteristics in progress
Project cost	80 billion CFA francs (estimated cost)
provisional time-frame	2014-2016
Project financing	Funding to be sought Public procurement: privileged ppp

Source: Preparation of Cameroon's participation in the 9th EMA Inves Economic Forum in Geneva.k

4.3. Biomass

4.3.1. Energy obtained by agro-pastoral activity

The West is an area where livestock farming is intense, more specifically poultry and pig farming, an activity that generates enormous amounts of waste. These represent a great potential for biogas. The Ministry of Water and Energy Resources delegation in the West has made an annual estimate of 176,000 tonnes of chicken droppings, or a biogas production of 12496,000 m^3. Similarly, the annual pig production of more than 85 000 heads, which corresponds to more than 15 000 m^3 of pig slurry produced per year, i.e. an average production of 231 000 m^3 of biogas.

Table 16: Energy value of waste

Type of waste	amount	Biogas produced (m^3)	Quantity of electricity produced (kWh)
Pig slurry	176,000 tonnes	12 496 000	15 620 000
Chicken droppings	15 000 m^3	23 1000	288 750
Cow dung	26,805.308 tonnes	53 6106	670 132,5
Goat/sheep dung	2444.44 tonnes	48,88	61 111
Total			**16,640 MW**

Source: RADEC West 2015

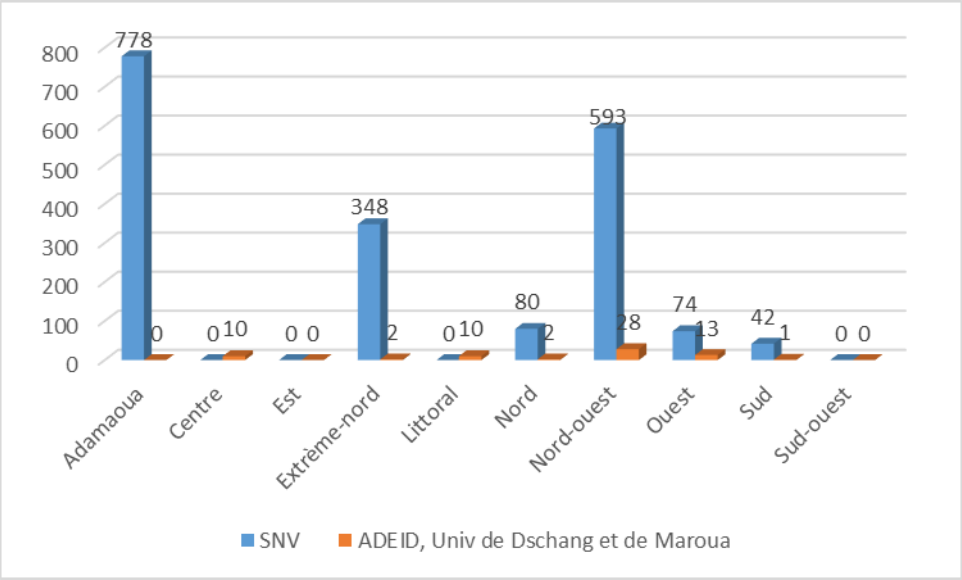
Despite this abundant potential, the West Region remains an area where biogas is not really exploited. In addition to this, there is household waste. However, some processors have been built for biogas production, as shown in the graph below:

Some biogas production projects have been carried out, for the majority of them, by private organizations and NGO partners of the State such as SNV, ADEID, GVC, etc. This could quote the following:

- The bio processors built at the Bafoussam central prison by SNV in 2012, which currently has very limited production capacity;
- The bio processors built at Babété monastery in 2011.

4.3.1. Energy produced by lignocellulosic biomass

Figure 6: *Installed biogas capacity in Cameroon in 2014 and in* ^{m3}



As for lignocellulosic biomass, food processing waste are quite considerable, the table below illustrates these wastes.

Table 17: Crop energy values

Name of crop	Rate of waste products	Electricity production potential per unit (tonne) of waste	Electrical demand of the process	Annual actual production	Effective power generation potential (GWH)
Wood	0.5 m3/m3	120 kWh/m3	35-110 kWh/m3	12 943 ^{m3}	129.430
Sugar cane	290 kg/t	100 kWh/t	25-30 kWh/t	2 144 t	43.52
Palm oil	220 kg/t	40 kWh/t	20-25 kWh/t	5 217 664 t	17 218.29
Maize	210 kg/t	80 -110 kWh/t	25-50 kWh/t	258 655 t	3259.053
Rice	220 kg/t	90 -120 kWh/t	20-60 kWh/t	1 460 t	19.27
total					**20 669.563**

Source: RADEC EST 2015

4.3.2. Wood and energy sector in the West

4.3.2.1. Operators in the wood and energy sector

Studies conducted in the country's various socio-ecological zones (Brainstore Consulting 2013b, Madi 2012, SimoTamo and Ngoungoure Manjeli 2012) show that despite regional specificities, the sector involves four main categories of operators

- **Collectors**, sometimes called **producers,** ensure the availability of wood energy from the various places where the resource is available. This category includes local wood cutters or pickers who are mainly farmers.

- **Transporters** most often ensure the transfer of wood energy from villages to cities. They are often classified according to the means of transport given that they may or may not be motorized.
- **Traders** are distinguished as wholesalers, semi-wholesalers, retailers and sometimes micro retailers. Wholesalers, semi-wholesalers and retailers generally meet in markets where they have large stocks of wood in warehouses.
- **Consumers:** households, craftsmen and promoters of small or micro enterprises are distinguished. Among these are grillers, local beer breweries,

Table 18: Percentage of the population using solid wood fuel

WEST	2001	2007	2014
(%)	93,8	92,3	83,1

Source: NIS, MDG Report 2015

The timber trade begins with the warehouse where the timber is stored after collection, permanent or non-permanent sellers come to buy to sell afterwards. The West Region, which is a highly agricultural region, mainly uses firewood for cooking. A study conducted by CIFOR in 2012 revealed that the selling price of firewood was between 40 and 50 f CFA /kg for Eucalyptus and other so-called yellow woods, costs about 70 F CFA/Kg for kolanut trees and other wild fruit trees. Similarly, charcoal prices for a 40 kg bag vary from 5,600 F CFA to 7,200 F CFA depending on the quality of the charcoal, which depends on the manufacturing process per bag, or on average 140 F CFA/kg of charcoal.

4.3.2.2. Retailers' net income

Retailers buy wood from wholesalers and also face charges related to unloading the truck, renting the site at the market, splitting the wood, and municipal taxes. The total load is estimated at 107,600 CFA francs for the same 3.5-tonne truck (30.7 CFA francs/kg) and sales to consumers are made at an average of 50 CFA francs/kg, i.e. a margin of 19.3 CFA francs/kg. As shown in the table below, is considerable.

Table 19: Net profit of firewood retailers in the West Regions of Cameroon

Region	Consumption (kg/year)	Gross profit (FCFA/year)	Net profit (FCFA/year)
West	81 101 422	4 055 071 107	1 565 257 447

Source: MINFOF 2013 study

4.3.2.3. Wood charcoal

According to data obtained by CIFOR (Center for International Forestry Research) on the charcoal manufacturing process in the West Region (Ngoungouré 2013) and data obtained by giz (Nkolo et al. 2011) giving average yields of different processing processes and related costs, it appears that one tonne of wood produces about 200 kg of charcoal (Nkolo *et al*. 2011) since the method used is still archaic.

Table 20: Estimated costs of charcoal production for supply to cities in the West Region

Region	Consumption (kg/year)	Processing cost (FCFA)	Transport cost (f CFA)
West	58 393 024	3 211 616 317	1 418 950 482

5. SWOT ANALYSIS OF THE ENERGY SECTOR

ELECTRICAL AND RENEWABLE ENERGY	
STRENGTH	**WEAKNESSES**
- *Support for the development of electrical installations provided by certain municipalities;* - *Area equipped with high and medium voltage power lines.*	- *Low electrical energy coverage in rural areas;* - *Aging power grid;* - *Poor maintenance of equipment, infrastructure and the electricity transmission network;* - *Dependence of electrical energy production from the Song loulou hydroelectric dam;* - *The exemption from VAT on solar equipment in accordance with Law 001/Minfi/CAB of 1 January 2012 has not been fully adopted in the municipalities;* - *Little collaboration between the stakeholders involved in this sector;* - *Lack of technology for biomass energy recovery;* - *Theft of network equipment;* - *Fraudulent connection.*
OPPORTUNITIES	THREATS
- *Significant potential in micro hydroelectricity (Construction of micro hydroelectric power plants - managed by the community or intercommunity);* - *Significant wind potential;* - *Increase in government subsidies on solar equipment;* - *Agreements and partnerships ;* - *Project to reinforce the Nkongsamba-Bafoussam line from 90Kv to 225Kv;* - *Construction of the Song loulou-Bangangangté-Bafoussam 225 Kv line;* - *Very wide variety of biomass that can be used for biogas production;* - *Quite favourable insulation for the installation of solar photovoltaic infrastructures.*	- *Lack of foresight on the technical problems related to decentralized electricity production;* - *Low stability of the electricity networks;* - *Halt of some projects due to procedural defects in procurement.*

PETROLEUM PRODUCTS	
STRENGTH	**WEAKNESSES**
- *Presence of 2 gas depots: SCTM and GAMGAZ and several marketers.*	- Insufficient storage infrastructure for liquid products; - Uneven distribution of service stations in the Region;

	- Slow transfer of liquid products from the Douala central warehouse to Bafoussam; - Imbalance between demand and supply; - Fire risks related to the uncontrolled construction of service stations.
OPPORTUNITIES	**THREATS**
/	- Pollution of the environment (water, soil, etc.) by oil waste.

Appendix 1: *Summary of the distribution network*

HVB/HV substations	HVB/HV Transforms[1]	Start name HTA	Number of HTA/BT TRI posts	Number of HTA/BT MONO posts	Mono Installed Power (KVA)	Tri Installed power (KVA)	Total reduced to TRI	Length HTA TRI (KM)	Length HTA Mono (KM)	No. of HV/HV substations
Bafoussam	90/15 KV[2] of 36 MVA	D11 city Baf	8	0	0	3 900	3 900	7	0	0
		D12 city Baf	56	0	0	10 460	10 460	16	0	0
		D13 city Baf	60	0	0	13 480	13 480	17	0	0
	90/30 KV of 36 MVA	D31 Mbouda	158	234	5 985	19 580	21 575	528	323	2
		D32 Foumbot	93	109	2 550	13 150	14 000	407	225	1
		D33 Bangangté	232	305	7 685	21 005	23 567	561	441	1
Bamenda		D36 Mbouda	13	14	350	1 200	1 317	62	48	0
Nkongsamba	90/30KV of 20MVA	D32 Bafang	94	67	1 585	8 063	8 591	76	132	1
MAPE Power Plant		D31 Magba	3	1	25	300	308	13	2	0
TOTAL			**717**	**730**	**18 180**	**91 138**	**97 138**	**1 687**	**1 171**	**5**

Source: DR- MINEE West, 2018

[1] HTB: refers to High Voltage
HTA: refers to Medium Voltage
[2] KV :(kilo volt) unit of voltage equivalent to pressure

Appendix 2: Summary of Marketers per Division

Marketers / Divisions	Total	oilibya	Net oil.P	socamitoil	Blessing	Bocom P	Afrigaz	Mrs Corlay	Alpha oil	Tradex	Citzen's	confexoil	GPSP	Camoco	Petrolex	Afrpetroleum	Green oil	Planet P	BGPetroleum	Global P	Care oil	Capogco	Tank'oil' tank	Sopropec	Grand total
BAMBOUTOS	4	1	0	0	0	0	0	2	0	1	2	1	1	0	0	0	0	0	1	0	0	0	0	0	13
HIGH-NKAM	5	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
HIGH PLATEAU	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	4
KOUNG-KHI	1	1	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6
MENOUA	2	1	0	1	0	3	0	3	1	1	2	0	2	0	0	0	0	0	0	1	0	0	0	0	18
MIFI	7	5	0	0	1	0	0	6	0	3	1	1	1	1	0	2	0	0	0	0	0	0	0	1	29
NDE	3	0	0	1	0	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	7
NOUN	4	1	0	0	0	1	0	0	1	2	0	2	0	14	2	2	2	3	1	0	1	0	0	0	36
Overall Total	**27**	**10**	**1**	**4**	**2**	**8**	**1**	**13**	**2**	**8**	**5**	**3**	**5**	**16**	**3**	**4**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**124**

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