SENEGAL SEDIMENTARY BASIN

Offshore Petroleum Potential & Discoveries
THE COUNTRY
Official Name: Republic of Senegal.
Capital: Dakar.
Currency: Franc CFA (1 Euro = 655.96 Francs CFA and 1 US Dollar = about 550 Franc CFA).
Official: French.
Area: 196,722 km²
Population: About 13 millions
Main Rivers: Senegal River
Gambia River
Casamance River
SEN EGAL NATIONAL OIL COMPANY « PETROSEN »
MISSIONS

**Upstream**
- Periodic Evaluation of the Petroleum Potential of the Basin;
- Promotion of this potential to the International Oil & Gas Market;
- Participation with the companies to E&P activities;
- Technical Control of Petroleum Operations.

**Downstream**
- Participation in joint venture to the Downstream Activities.
THE SEDIMENTARY BASIN EXPLORATION & PRODUCTION HISTORY
The Senegal sedimentary basin occupies the central part of the large North-Western African coastal basin called MSGBC (Mauritania – Senegal – Gambia – Bissau – Conakry), which extends from Reguibat shield in its Northern limit to Guinea fracture zone to the South.

Total surface area: 230,000 square kilometers
Exploration: from 1952 to Present

**Seismic Acquisition**

- 60,900 km of 2D seismic
- 27,150 km² of 3D seismic

**Exploration Wells**

- A total of 173 exploration & Appraisal wells (most of the wells are drilled in the Dakar/Thies area and offshore south)
- The basin is under explored
Hydrocarbon shows and Production

- **Diam Niadio in 1961**
  Many small oil and gas fields in the Maastrichtian section

- **Dome Flore & Gea in 1967**
  About 1 billion barrels of heavy oil in the Oligocene limestone

- **Gadiaga in 1976 / 1997**
  Very important gas reserves in Campanian and Senonian sandstones.

- **Sangomar Offshore Profond in 2014, 2017**
  4 oil & gas discoveries in the Cenomanian & Albian.

- **Saint Louis offshore Profond in 2015, 2016, 2017**
  3 great gas discoveries in the Cenomanian & Albian
Crude Oil Production: 1987 to 2000

Crude Oil & Condensate Production between 1987 and 2000

- 62,500 barrels of crude oil (34° API)
- 35,600 barrels of condensate
Hydrocarbons Production

Diam Niadio

- 62,500 barrels of crude oil (34° API)
- 35,600 barrels of condensate

Diam Niadio: 235 000 000 Nm3 of natural gas (8.8 BCF) from 1987 to 2000

Gadiaga/Sadiaratou: 311 999 000 Nm3 of natural gas (11.7 BCF) from October 2002 to present
Gas distribution Network
Discoveries, Prospects and Leads

- Four oil discoveries and three gas discoveries since 2014
- Many prospects and Leads to be drilled
Rufisque Offshore, Sangomar Offshore & Sangomar Offshore Profond License

- 2014 exploration wells: FAN-1 and SNE-1
- Appraisal wells: SNE-2, SNE-3, SNE-4, BEL-1, SNE-5, VR-1 and SNE-6
- Reserves Estimate (2C): 563 MMSTB oil + 1.3 tcf gas associated and non associated
- Oil 31° API
- First oil: 2021 – 2023

- FAN South Discovery: 152 millions barils
- SNE North discovery: ~83 millions barils and 378 Bcf of gas
Sangomar Offshore Profond Block

- FPSO moored at the East
- Daily production: About 100,000 barrels/day
- About 20 + production and injection wells for phase 1
- First oil: 2021 - 2023
Sangomar Offshore Profond Block

**Timeline**

- **Discovery**
  - 2014

- **Appraisal Drilling**
  - 2-4 years

- **Concept Select**
  - 3-5 years

- **FEED**

- **Detailed Design & Fabrication**

- **First Oil**
  - 2021-2023

- **Production**
Grand Tortue/Ahmeyin (GTA)

- 3 wells drilled: Tortue-1 (Aymeyin-1) et Aymeyin-2 in Mauritania and Geumbeul-1 in Senegal

Gas reserves: About 15 trillion cubic feet (TCF)

Téranga-1 (Cayar Offshore Profond block)

Drilled between end March to May 2016

Ressources en place: 5 Tcf

Yakaar-1 (Cayar Offshore Profond block)

Drilled between end March to May 2016

Ressources en place: 15 Tcf
Saint Louis Offshore Profond - GTA

Phase 1: 2.5 MTPA of LNG
35 mmcf/d for domestic gas

Phase 2: 3.8 MTPA of LNG

Phase 3: 3.8 MTPA of LNG
PLAN SENEegal Emergent (PSE)
The energy sector is a major support for the development of the economy

Senegal's ambition to guarantee broad and reliable access to cheap energy.

The PSE objectives:

- Have a perfect availability of energy in sufficient quantity and quality;
- Have a price of electricity among the lowest in the subregion (~ 60 to 80 FCFA / kWh) to support economic competitiveness;
- Reduce by half the household electricity bills
Power Sector

An2017
88.83%
8.86%
2.31%

An2020
34.72%
10.01%
16.24%
39.03%

An2025
35.03%
16.02%
41.35%
7.60%
0.00%

An2030
54.58%
12.40%
27.13%
5.89%
0.00%
Average Retail Power Tariff by Country 2016

Source: World Bank, KPLC and EWURA
GAS MONETIZATION
A Master plan for the use of oil and gas

For the use of gas

- in industry (Cement plants, Mining etc.)
- in the retail and service sectors, and in the non-commercial sector,
- in households,
- for the generation of power,
- Fertilizer and petrochemicals,
- as a motor fuel in the transport sector (CNG)
Gas Monetization

NATURAL GAS (CH4) EXTRACTION AND PROCESSING

- POWER GENERATION
  - PIPELINE TRANSPORTATION & LOCAL GAS GRIDS
    - NATIONAL POWER GRID
      - DISTRIBUTED POWER GENERATION
        - LNG (LIQUEIFFIED NATURAL GAS)
          - CNG (COMPRESSED NATURAL GAS)
            - GTL (FISCHER-TROPSCH PROCESS)
              - GAS SYNTHESIS
            - METHANOL SYNTHESIS
          - AMMONIA SYNTHESIS
        - LNG EXPORT
          - TRANSPORT FUEL
            - LUBRICANT BASE OILS
              - CHEMICAL INDUSTRY
            - TRANSPORT FUEL
              - CHEMICAL INDUSTRY
                - DME (LPG SUBSTITUTE)
            - COOKING HEATING
              - POWER GENERATION
                - TRANSPORT FUEL
                  - UTILIZATION
                    - CARS
                      - BUSES & TRUCKS
                        - TRAINS
                          - BOATS/BARGES
        - DOMESTIC & COMMERCIAL INDUSTRIAL
          - CNG
            - LNG
          - TRANSPORT FUEL
            - LUBRICANT BASE OILS
              - CHEMICAL INDUSTRY
            - TRANSPORT FUEL
              - CHEMICAL INDUSTRY
                - DME (LPG SUBSTITUTE)
          - COOKING HEATING
            - POWER GENERATION
              - TRANSPORT FUEL
                - UTILIZATION
                  - CARS
                    - BUSES & TRUCKS
                      - TRAINS
                        - BOATS/BARGES
        - DOMESTIC, COMMERCIAL & INDUSTRIAL
          - COOKING
            - HEATING
              - COOLING
                - PULP & PAPER
                  - TEXTILES
                    - GLASS
                - STEEL
                  - PLASTIC
                    - PAINT
                - CARS
                  - BUSES & TRUCKS
                    - TRAINS
                      - BOATS/BARGES
                - GLOBAL GAS MARKETS
                  - ULTRA CLEAN DIESEL
                    - KEROSENE (JET FUEL)
                  - NAPHTHA
                  - COOKING
                    - HEATING
                      - POWER GENERATION
                        - TRANSPORT FUEL
                          - UTILIZATION
                            - FERTILIZER (UREA)

SHELL, 2017
## Power Production

<table>
<thead>
<tr>
<th>Owner</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>SENELEC</td>
<td>557.93</td>
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<tr>
<td>IPP</td>
<td>413.9</td>
</tr>
<tr>
<td>Regional (OMVS and OMVG)</td>
<td>75</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1046.83</strong></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Type of combustible</th>
<th>Capacity (MW)</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Thermal, Diesel (HFO/LFO, Natural gas)</td>
<td>782.83</td>
<td>74.78%</td>
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<tr>
<td>Thermal steam</td>
<td>87.5</td>
<td>8.36%</td>
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<tr>
<td>Solar</td>
<td>101.5</td>
<td>9.70%</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>75</td>
<td>7.16%</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1046.83</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
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The need by 2030: about 2 000 MW

Senelec
Gas pipe network to be build to provide the gas to
-the power companies (Senelex, IPPs
-The Industry (cement plant, etc.)
SNE natural gas

Production: about 60 mmscfd for domestic gas
GTA natural gas

Phase 1: 35 mmscfd for domestic gas

KOSMOS, 2016
WHY INVEST IN SENEegal EMERGENT
Oil and Gas Potential

Deep offshore and ultra-deep offshore potential

- About 40 TCF of gas
- More than 500 million barils of oil
## Opportunities to monetize gas

*With an economic and social impact to the Country*

<table>
<thead>
<tr>
<th></th>
<th>Gas to Power</th>
<th>Industrial feedstock and power</th>
<th>City Gas</th>
<th>LNG</th>
<th>Fertilizer</th>
<th>Methanol</th>
<th>Gas to Liquids</th>
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<tr>
<td>Employment generated</td>
<td>2</td>
<td>1</td>
<td>3</td>
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<td>2</td>
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<td>Monetary Value</td>
<td>$$</td>
<td>$$</td>
<td>$</td>
<td>$$$</td>
<td>$$</td>
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<tr>
<td>Capital Intensity</td>
<td>☹</td>
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*SHELL, 2017*