Reducing Gas Flaring: Total E&P Experience in Africa

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Primary energy consumption: The global picture

- 2006 World primary energy consumption: 10.9 Btoe
- 2006 Africa primary energy consumption: 324 Mtoe
- 2006 Africa gas consumption: 76 bcm
- **Annual Gas flared worldwide**: 150 bcm
- **Annual Gas flared in Africa**: 40 bcm

Based on IEA & GGFR reports
Flaring within Total E&P operations

- Since 2000, decrease in flaring despite increase in production
- More than 80% of flaring occurs in Africa
Strong historical presence of TOTAL in Africa

**The origins**
- 1932: 1st exploration in Gabon
- 1946: 1st exploration in Cameroon
- 1950: Discoveries in Egypt

**Expansion of conventional production**
- 1952: 1st Petrofina concession in Angola
- 1955: 1st discovery in Angola (Benfica) and in Cameroon (Logbaba)
- 1956: Discoveries of Hassi Messaoud, Hassi R’Mel and Edjefleh (Algeria)
- 1956: 1st discovery in Gabon
- 1958-1961: Discoveries of Zarzaïtine and Gassi Touil (Algeria)

**Offshore expansion**
- 1962: Discovery of Anguille (Gabon), first drilling and Obagi discovery (Nigeria)
- 1968: Emeraude discovery (Congo)
- 1971: Discovery of Gronfin (Gabon) and Ashtart (Tunisia)
- 1975: Al Jurf discovery (Libya)
- 1982: Pacassa discovery (Angola)
- 1985: Rabi Kounga discovery (Gabon)

**Deep and Ultra-deep offshore acceleration**
- 1995: Moho discovery (Congo) and Mabruk (Libya) start-up
- 1996-2002: 15 discoveries on Block 17 (Angola)
- 1996: El Sharara start-up (Libya)
- 1999: TFT start-up (Algeria)
- 2000: Akpo discovery (Nigeria)
- 2001: Girassol start-up (Angola)
- 2003: Amenam (Nigeria), Jasimim (Angola) and Al-Jurf (Libya) start-ups
- 2003-2005: 5 discoveries on Block 32 (Angola)
- 2004-2005: OPL 222 discoveries (Nigeria -Usan)
- 2005: Akpo and Moho Bilondo launched
- 2005-2006: start-up NLNG trains 4 & 5
- 2006: 3rd discovery on MTPS (Congo)
- 2006: NC191/NC186 (Libya) first discoveries
- 2006: Entered into OML 112/117 and Brass LNG (Nigeria)
- 2006: Mobi M2 (Congo) discovery
- 2006: Dissoni discovery, Bomana and appraisals intake (Cameroon)
- 2006: Block 32 & 17 discoveries and appraisals
- 2006: BBLT and Dalia start-up (Angola)
- 2007: Rosa start-up (Angola)
### Africa: largest production region for Total

- **Algeria**: 1st foreign producer
- **Libya**: 2nd foreign producer
- **Mauritania**: 3rd foreign producer (1st foreign producer based on 2006 production reports)
- **Angola**: 4th foreign producer
- **Nigeria**: 5th foreign producer
- **Cameroon**: 6th foreign producer
- **Gabon**: 7th foreign producer
- **Congo**: 8th foreign producer

#### Production Classification:
- **< 50 kboe/d**
- **> 100 kboe/d**
- **50-100 kboe/d**
- **Exploration only**

#### Production Statistics (2010(e)):

<table>
<thead>
<tr>
<th>Category</th>
<th>Upstream Capital Employed</th>
<th>Proved &amp; Probable Reserve</th>
<th>Group Equity Production</th>
<th>Upstream Capex</th>
<th>Upstream Manpower</th>
<th>2010(e) production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38%</td>
<td>30%</td>
<td>31%</td>
<td>33%</td>
<td>29%</td>
<td>37%</td>
</tr>
</tbody>
</table>

*Based on 2006 production reports*
Total in Nigeria: Gas flaring evolution

- Production operations from onshore and conventional offshore fields.
- Deep offshore to be put on stream in 2008, without continuous flaring.
- LNG plant in operations since 1999.

- All associated gas from onshore fields exported (LNG plant and domestic market) as from 2010.
- Almost all associated gas from conventional offshore either re-injected or exported to LNG plant as from 2010.
- No continuous flaring on new developments.
Total in Nigeria: Reducing gas flaring onshore

- Export Gas
- Condensate
- OBITE
- OBAGI

- Export Liquids
- 25 MMscfd Flared
- 30 bar
- 9 bar
- 4 bar
- 1 bar
Total in Nigeria: Reducing gas flaring onshore

- Export Gas
- Condensate
- OBITE
- OBAGI

- IBEWA HP
- OBAGI Gas Cap
- 100 bar
- 30 bar
- 9 bar
- 4 bar
- 1 bar

- 6 MMscfd Flared
- 2003
Total in Nigeria: Reducing gas flaring onshore

- Export Gas
- Condensate
- OBITE
- OBAGI

- 100 bar
- 30 bar
- 9 bar
- 4 bar
- 1 bar

- IBEWA HP
- IBEWA MP
- OBAGI
- OBAGI

- 2003
- 2010
Total in Nigeria: Reducing gas flaring offshore

1. Ofon Phase 1 in 1995
   A typical offshore development of the 90’s in the Gulf of Guinea

2. New context after Phase 1
   • Gas outlet: NLNG onstream
   • Field redevelopment opportunity
   • Growing concern on GHG emission

3. Ofon Phase 2 Project
   • Expansion of the fields
   • Installation of gas facilities
   • No more flare
   • Laying of gas export pipeline
Production operations from conventional offshore (Bloc 3) and deep offshore (bloc 17).

LNG plant to be put on stream in 2012.

- No continuous flaring on bloc 17 fields.
- 94% of production from bloc 17 fields.
- Bloc 17 associated gas:
  - Currently re-injected
  - Supply of ALNG plant as from 2012

Base 100 : 1996 figures
Angola LNG mindset
from a gas flaring concern to a gas valorization scheme

- **Common Goal**: ensure sustainable oil developments & address gas flaring concerns through a gas valorization scheme

- **Strong Commitment & Alignment of all Stakeholders**: partnership Sonangol - Oil companies

- **Pooling of gas resources**

- **Legal & Commercial Framework** suiting the project characteristics

- **Strong partners** to overcome commercial and technical challenges

- **Start-up**: 2012

Arranging a stable gas supply of 1Bcfd

Phase I: LNG plant AG pipelines

Phase II: 1-4 NAG fields

Phase III: Gas Caps blowdown

Start-up: 2012

Soyo

GIRASSOL

DALIA

Greater Plutonio

Block 2

Bloc 0/14

NAG

Kizomba A

Kizomba B

Kizomba C

200 m
Gas Flaring in other African countries

- **Libya**: Gas re-injection project under development, no more continuous flaring as from 2011.

- **Cameroon**:
  - Mature production, scattered infrastructures (19 flares, 17 satellites).
  - Associated gas used as supply for Malabo LNG plant (under study).

- **Gabon, Congo**:
  - Mature production, scattered infrastructures, far from LNG plants.
  - Gas re-injection implemented on Nkossa (Congo), under study for other assets.
  - Supply (limited) domestic market
The path to gas flaring reduction

- E&P installations are large, complex and costly
  - Re engineering or modifications are difficult
    - First Priority: Design new development with no flaring
      Total company rule since 2000

- Our real issue now is to reduce flaring on existing fields
  - Existing gas markets / outlets are favorable conditions
    Examples: North Sea (no more flare), Nigeria (Ofon ph2)
  - More difficult and lengthy when new gas outlet has to be created
    Examples: Angola (ALNG), Cameroon..
Efforts are rewarding:
Total operated flaring will continue to decrease despite rising operated production

- No flaring on new development
- Flaring Reduction on existing fields
  - Acute Monitoring of flaring
  - Dedicated team
  - Elaboration of Technical & Business solution
- Issues discussed with Partners and Governments

Total's operated fields

![Graph showing production and flaring over years 1998 to 2012]

- Production
- Flaring

- Total target: -50% 2005-2012
- Beyond 2012: Efforts are to be maintained and amplified if we want to keep reducing flaring
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