

# Subsea Processing, A Holistic Approach to Marginal Field Development

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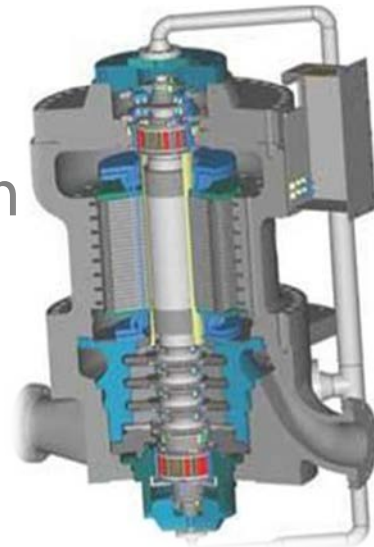
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# Prospects for Subsea Processing

- ✚ Subsea Processing Technology is Maturing for Field Developments
- ✚ Gained wide Acceptance in the Offshore Industry
- ✚ Huge Benefits to develop Marginal Fields
- ✚ Techno-Economic barriers hindering Field developments can be Broken

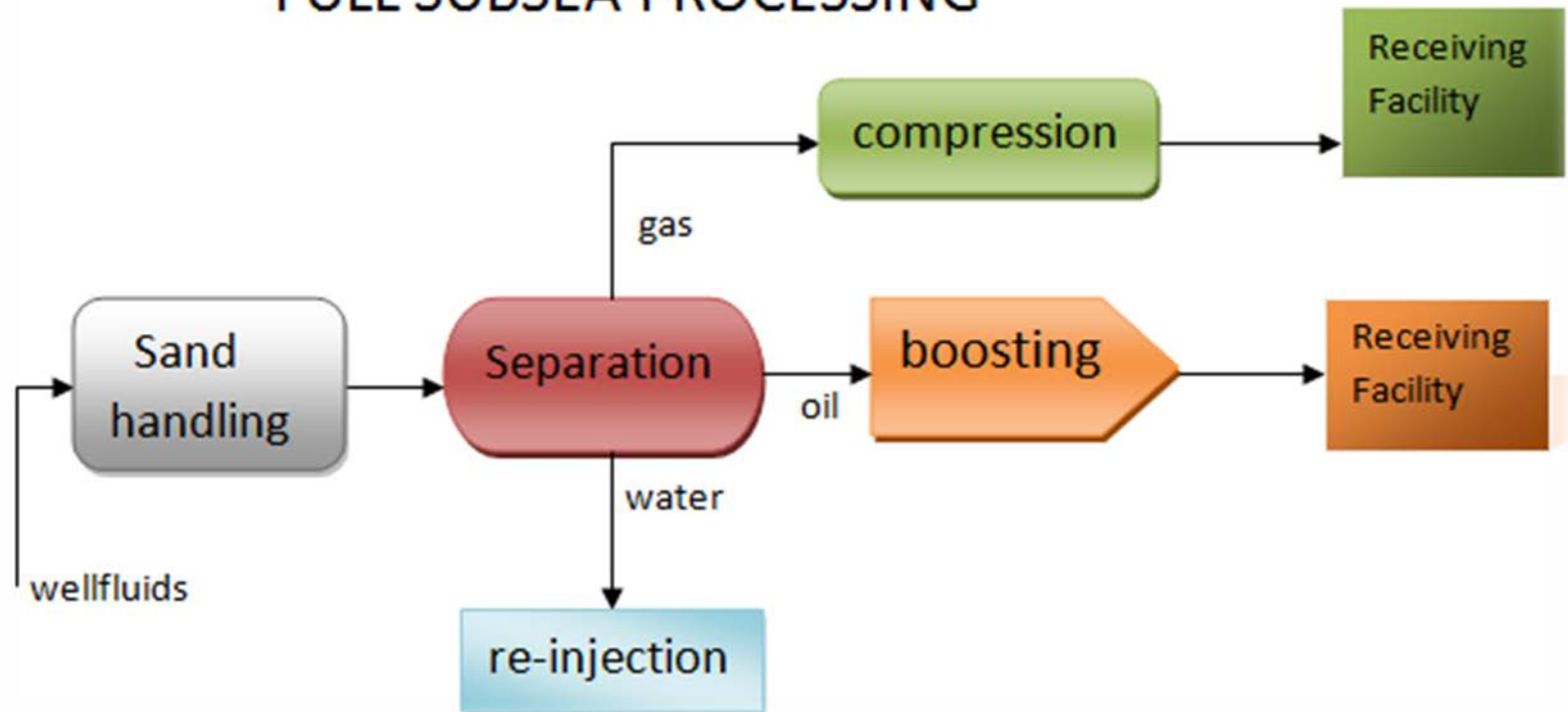
# Technology Gaps

- ✚ Quality of Separation is less than that for Topsides
- ✚ Compression Technology under Development and Qualification Testing
- ✚ Current Boosting Technology cannot cover 80Km
- ✚ Controls and Power Transmission needs to be Improved for Greater Step-out Distance



# Fundamental Building Block for Subsea Processing

## FULL SUBSEA PROCESSING



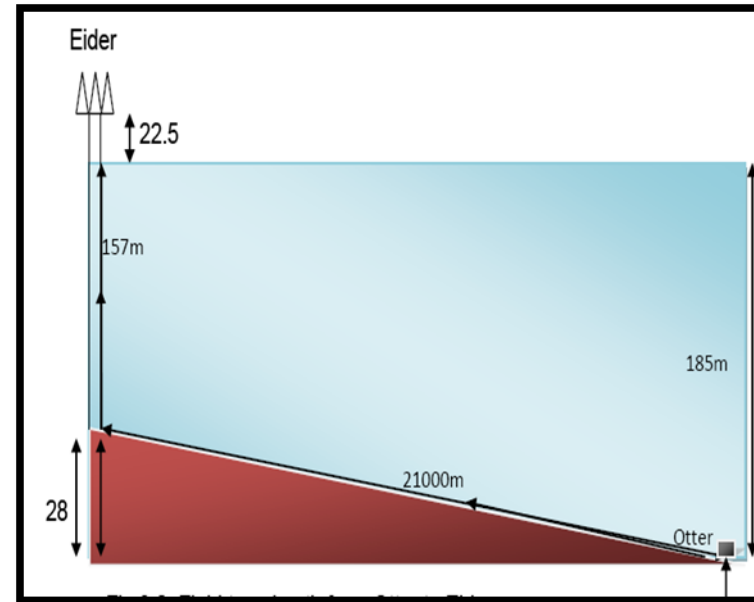
# Design Life for Subsea Processing

Systems	Depth (m)	Design Life (yrs)
Troll Pilot Subsea	349	25
Tordis SSBI	210	26
Tyrihans RSWI	270	25
Gulffaks Gas Compression	135	20
Asgard Gas Compression	260	30

Subsea Systems Designed to Operate above 25 years

# Typical Marginal Field with Subsea Boosting (Otter Field)

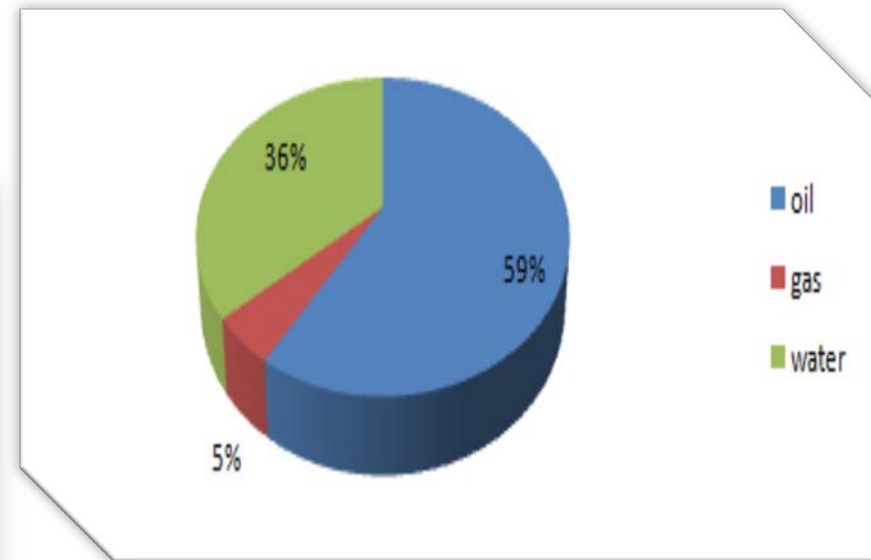
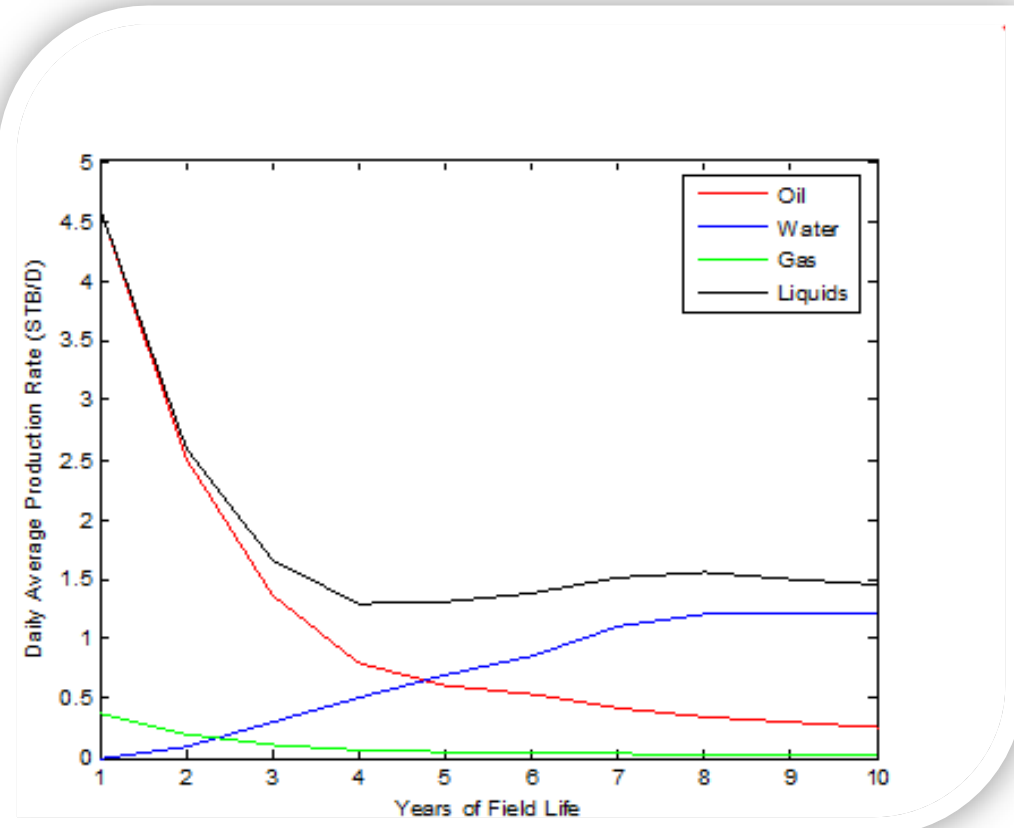
- Field was considered Marginal due to Technological/Economic reasons
- ESPs was used, offered more benefits over Hydraulic Submersible Pumps



Fluid Travel Path from Otter to  
Eider Field

# Economic Evaluation of Marginal Field (Otter Field)

Daily Production Profiles in 10,000 barrels over the Field life

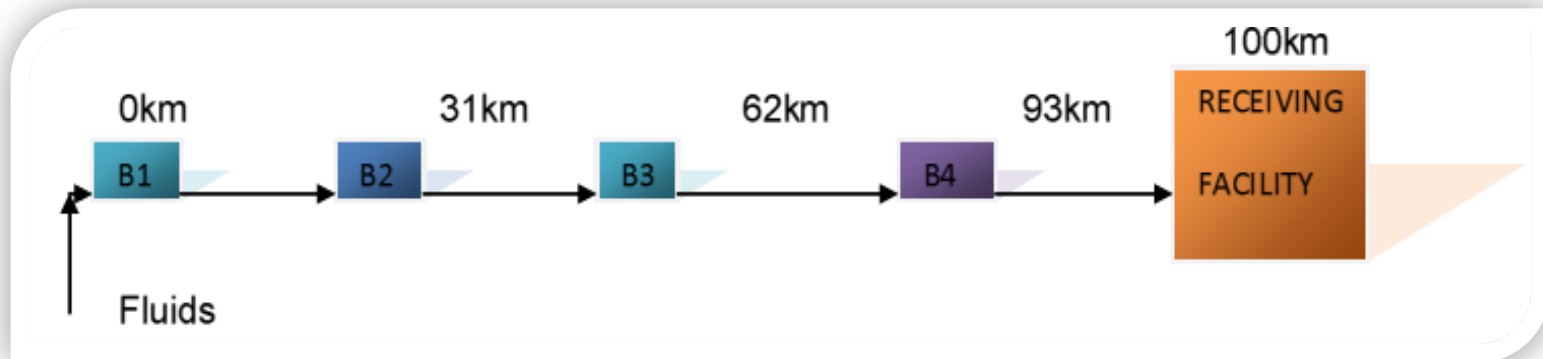


Total Production

# Booster Stations along step out Routes

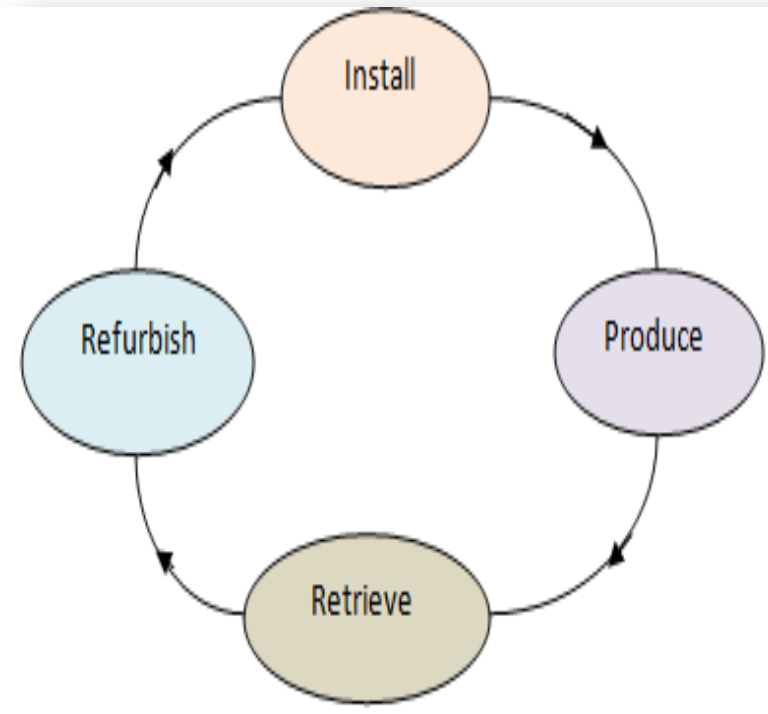
Field	Depth (m)	Distance (km)	Year
King	1700	29	2007
ETAP - Machar	84.5	35.2	1999
Otter	185	21	2002
Tyrihans	270	31	2009

Typical Field Developments Step-out Distance



Proposed Boosting Options with Multiple Booster Stations

# IPRR Novel Concept Method



- ✚ Equipment Manufactured is Installed and Produced till abandoned
- ✚ Then Equipment is Retrieved, Refurbished as necessary
- ✚ Moved onto another Field and Installed again

# Simultaneous Production Method

✚ Produce each Field Separately and Simultaneously with:

5 FSUs

5 FSPSs

Other Equipment re-used in other Developments or  
sold/rented out as Asset

✚ The Profit yielding years of the Simultaneous Method end  
after only 5 years

# Combination Method

- ✚ This combines both IPRR and Simultaneous Method
- ✚ 2 FSUs are acquired instead of 5
- ✚ First FSU is used to produce 3 of the 5 Fields
- ✚ Second FSU is used to produce the remaining 2 Fields
- ✚ Both begin at the same time with IPRR applied

# Field Development Options

Descriptions	SM	Combinational	IPRR
Total Time (yrs)	5	15	25
Average Annual Profit (\$M)	246	131	74
Total Profit (\$M)	1230	1969	1848
Initial CAPAX (\$M)	2230	892	446
Internal Rate of Return (%)	55	220	414

Simultaneous Method, Combinational and IPRR Comparison

# Derivable Results

## Critical Elements for Marginal Field Development:

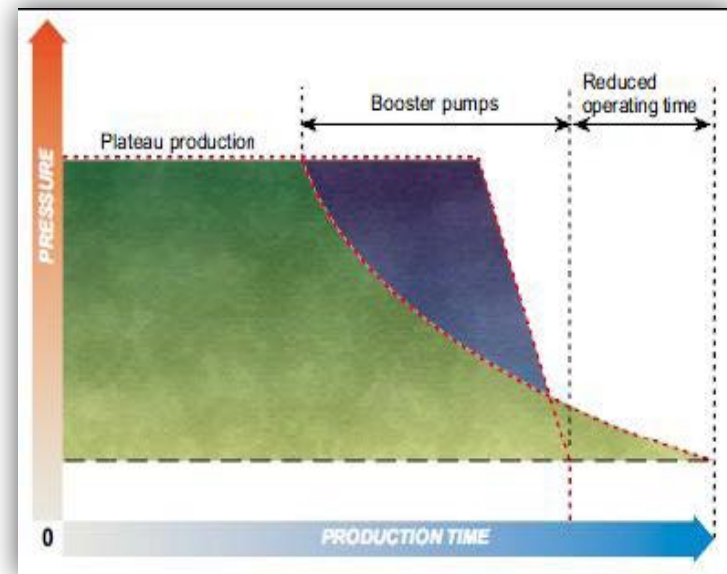
- ✚ Increase Recovery up to about 60% of Reserves

- ✚ Reduce OPEX due to

Less Energy required for Pumping

Reduced Production Time

Materials

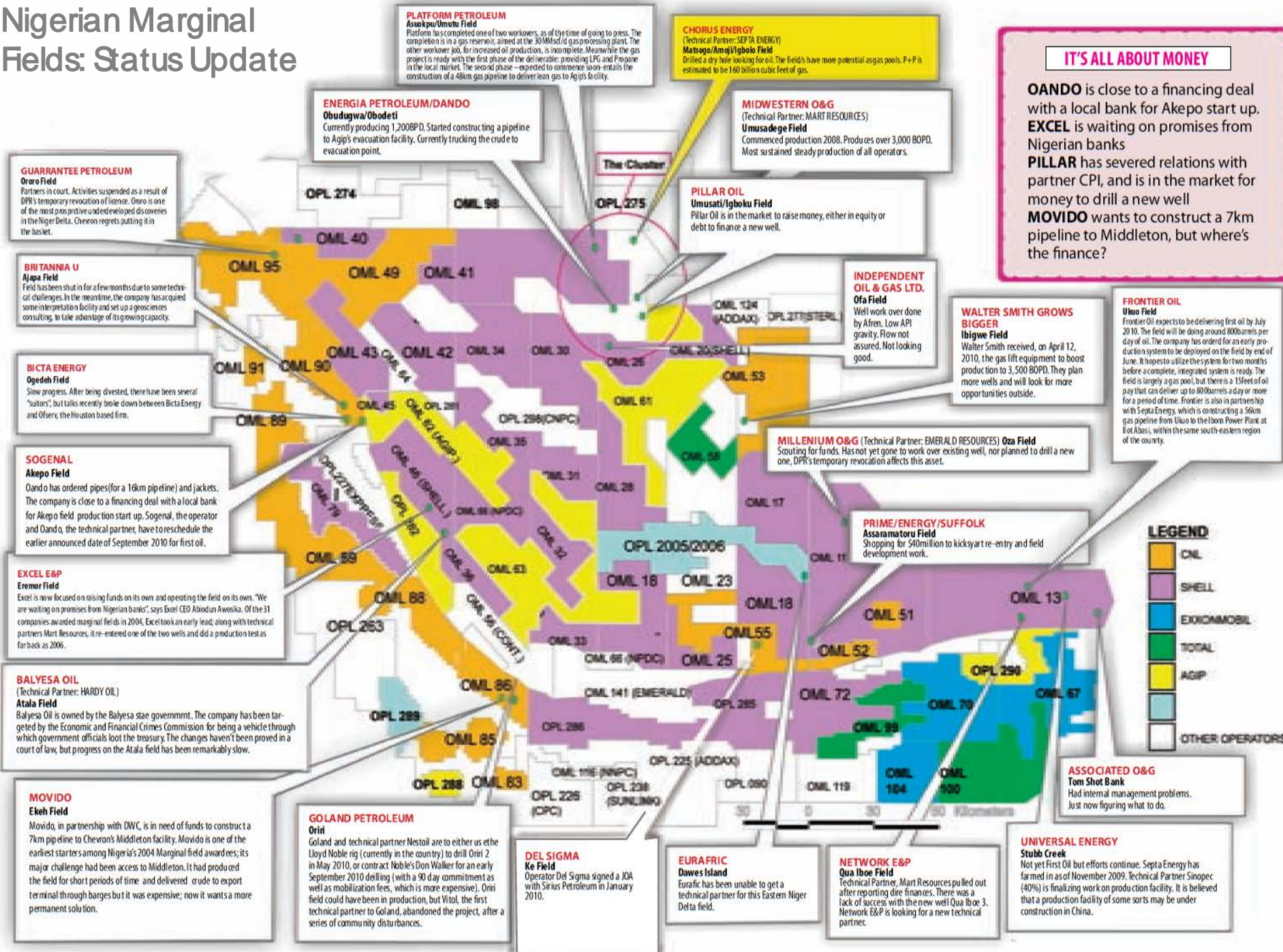


Reduction of total Production Time  
by Subsea Boosting

# Developing Remote Offshore Marginal Fields

- ✚ Adopting a Holistic Approach in developing this Fields
- ✚ Group Fields into Clusters
- ✚ Use FSPS with Long distance Pipeline and IPRR
- ✚ Apply FSPS with Floating Platform and IPRR

# Nigerian Marginal Fields: Status Update



**PLATFORM PETROLEUM**  
**Asokpu/Umuja Field**  
 Platform has completed one of two workovers, as of the time of going to press. The completion is in a gas reservoir, aimed at the 30MMscfd gas processing plant. The other workover job, for increased oil production, is incomplete. Meanwhile the gas project is ready with the first phase of the deliverable: providing LPG and Propane in the local market. The second phase – expected to commence soon – entails the construction of a 48km gas pipeline to deliver lean gas to Agip's facility.

**CHORUS ENERGY**  
 (Technical Partner: SEPTA ENERGY)  
**Matsogo/Amaji/Igbole Field**  
 Drilled a dry hole looking for oil. The field has more potential as gas pools. P+P is estimated to be 160 billion cubic feet of gas.

**ENERGIA PETROLEUM/DANDO**  
**Obudugwa/Obodeti**  
 Currently producing 1,200BOPD. Started constructing a pipeline to Agip's evacuation facility. Currently trucking the crude to evacuation point.

**MIDWESTERN O&G**  
 (Technical Partner: MART RESOURCES)  
**Unusadege Field**  
 Commenced production 2008. Produces over 3,000 BOPD. Most sustained steady production of all operators.

**GUARANTEE PETROLEUM**  
**Ororo Field**  
 Partners in court. Activities suspended as a result of DPR's temporary revocation of licence. Ororo is one of the most prospective undeveloped discoveries in the Niger Delta. Chevron regrets putting it in the basket.

**PILLAR OIL**  
**Umusati/Igboku Field**  
 Pillar Oil is in the market to raise money, either in equity or debt to finance a new well.

**BRITANNIA U**  
**Ajapa Field**  
 Field has been shut in for a few months due to some technical challenges. In the meantime, the company has acquired some in-terpretation facility and set up a geosciences consulting, to take advantage of its growing capacity.

**INDEPENDENT OIL & GAS LTD.**  
**Ofa Field**  
 Well work over done by Afren. Low API gravity. Flow not assured. Not looking good.

**BICTA ENERGY**  
**Ogedegbe Field**  
 Slow progress. After being divested, there have been several "suits", but talks recently broke down between Bicta Energy and Ofserv, the Houston based firm.

**WALTER SMITH GROWS BIGGER**  
**Ibigwe Field**  
 Walter Smith received, on April 12, 2010, the gas lift equipment to boost production to 3,500 BOPD. They plan more wells and will look for more opportunities outside.

**SOGENAL**  
**Akepo Field**  
 Dando has ordered pipes (for a 16km pipeline) and jacks. The company is close to a financing deal with a local bank for Akepo field production start up. Sogenal, the operator and Oando, the technical partner, have to reschedule the earlier announced date of September 2010 for first oil.

**MILLENNIUM O&G** (Technical Partner: EMERALD RESOURCES) **Oza Field**  
 Scouting for funds. Has not yet gone to work over existing well, nor planned to drill a new one, DPR's temporary revocation affects this asset.

**FRONTIER OIL**  
**Uno Field**  
 Frontier Oil expects to be delivering first oil by July 2010. The field will be doing around 8000 barrels per day of oil. The company has ordered for an early production system to be deployed on the field by end of June. It hopes to utilize the system for two months before a complete, integrated system is ready. The field is largely a gas pool, but there is a 15feet of oil pay that can deliver up to 800barrels a day or more for a period of time. Frontier is also in partnership with Septa Energy, which is constructing a 56km gas pipeline from Ukuo to the bomb Power Plant at Ifo Abasi, within the same south-eastern region of the country.

**EXCEL E&P**  
**Eremer Field**  
 Excel is now focused on raising funds on its own and operating the field on its own. "We are waiting on promises from Nigerian banks", says Excel CEO Abiodun Awosika. Of the 31 companies awarded marginal fields in 2004, Excel took an early lead; along with technical partners Mart Resources, it re-entered one of the two wells and did a production test as far back as 2006.

**PRIME/ENERGY/SUFFOLK**  
**Assaramatoru Field**  
 Shopping for \$40million to kickstart re-entry and field development work.

**BALYESA OIL**  
 (Technical Partner: HARDY OIL)  
**Atala Field**  
 Balyesa Oil is owned by the Balyesa state government. The company has been targeted by the Economic and Financial Crimes Commission for being a vehicle through which government officials loot the treasury. The changes haven't been proved in a court of law, but progress on the Atala field has been remarkably slow.

**LEGEND**

- OML
- SHELL
- EXXONMOBIL
- TOTAL
- AGIP
- OTHER OPERATORS

**MOVIDO**  
**Ekeh Field**  
 Movido, in partnership with DWG, is in need of funds to construct a 7km pipeline to Chevron's Middleton facility. Movido is one of the earliest starters among Nigeria's 2004 Marginal field award ees; its major challenge had been access to Middleton. It had produced the field for short periods of time and delivered crude to export terminal through barges but it was expensive; now it wants a more permanent solution.

**GOLAND PETROLEUM**  
**Oriin**  
 Goland and technical partner Nestoil are to either use the Lloyd Noble rig (currently in the country) to drill Oriin 2 in May 2010, or contract Noble's Don Walker for an early September 2010 drilling (with a 90 day commitment as well as mobilization fees, which is more expensive). Oriin field could have been in production, but Vitof, the first technical partner to Goland, abandoned the project, after a series of community disturbances.

**DEL SIGMA**  
**Ke Field**  
 Operator Del Sigma signed a JOA with Sirius Petroleum in January 2010.

**EURAFRIC**  
**Daves Island**  
 Eurafic has been unable to get a technical partner for this Eastern Niger Delta field.

**NETWORK E&P**  
**Qua Iboe Field**  
 Technical Partner, Mart Resources pulled out after reporting dire finances. There was a lack of success with the new well Qua Iboe 3. Network E&P is looking for a new technical partner.

**UNIVERSAL ENERGY**  
**Stubb Creek**  
 Not yet First Oil but efforts continue. Septa Energy has formed in as of November 2009. Technical Partner Sinopec (40%) is finalizing work on production facility. It is believed that a production facility of some sort may be under construction in China.

**ASSOCIATED O&G**  
**Tom Shot Bank**  
 Had internal management problems. Just now figuring what to do.

**IT'S ALL ABOUT MONEY**

**OANDO** is close to a financing deal with a local bank for Akepo start up.  
**EXCEL** is waiting on promises from Nigerian banks  
**PILLAR** has severed relations with partner CPI, and is in the market for money to drill a new well  
**MOVIDO** wants to construct a 7km pipeline to Middleton, but where's the finance?

# Operating Oil Companies

- ✚ Easier to Raise the lower sum (IPRR)
- ✚ Takes 25 years to Complete ....., too long for Small Companies
- ✚ Best Method is to Combine both IPRR and SM
- ✚ Combinational Method with 15 years, most Commercial Option

# Conclusions

- ✚ Subsea Processing Breaks the Techno-Economic Barriers  
Hindering Developments
- ✚ Technical Analysis Reveal Enormous Advantages derivable
- ✚ Increased Recovery and Reduced OPEX have been  
Established
- ✚ Industry will benefit Significantly from Subsea Processing  
Technology

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**THANK YOU**

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