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UMATAC Industrial Processes Inc.

A Company of ThyssenKrupp Polysius

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Jordan International Oil Shale Symposium 2012

The Alberta Taciuk Process (ATP) for Jordan: Comprehensive Feasibility Study and Scale-Up

Jordan International Oil Shale Symposium 2012

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ThyssenKrupp Polysius

Agenda

- Introduction
- Project Fundamentals
- Area - Ore & Jurisdiction
- Technology – ATP & Hydrotreating
- Project – KIO Al Lajjun
- Questions

Keys to Success

Fundamentals for a project:

Area – the right ore & jurisdiction

Technology – the right technologies

People – experience and expertise to implement the project

Karak International Oil Project

Area - The Ore & Jurisdiction

The next shale oil plant will be located in Jordan:

1. Large, high grade oil shale deposits and projects already advanced.
2. Economic need to reduce energy imports and provide domestic energy security
3. Supportive government & regulatory authorities

THE JORDAN TIMES

Jordan's Oil Shale gains momentum February 14, 2012

Issues:

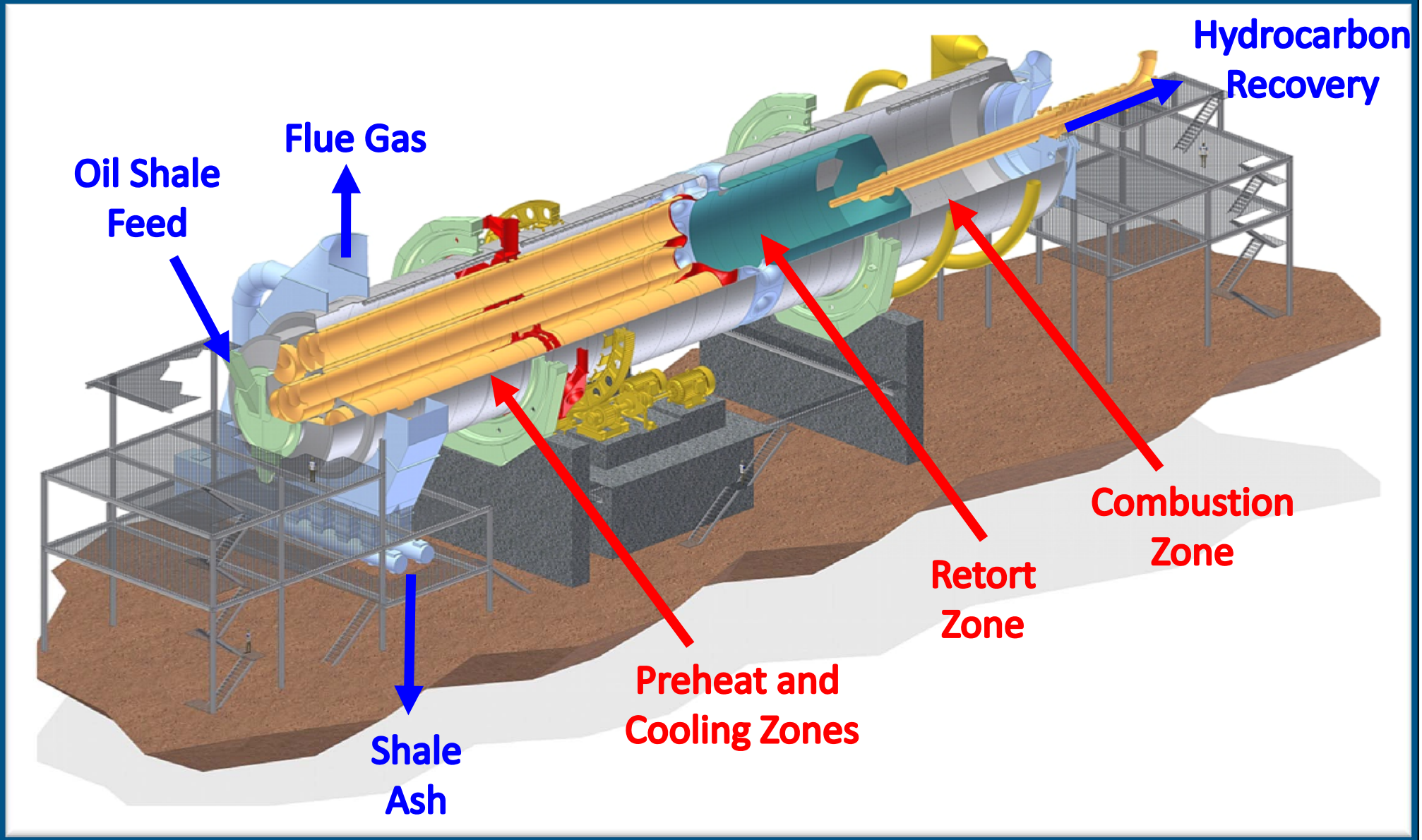
1. High sulphur content
2. Natural gas supply

REUTERS

Jordan to import more fuel oil due to gas pipeline disruption Apr 10, 2012

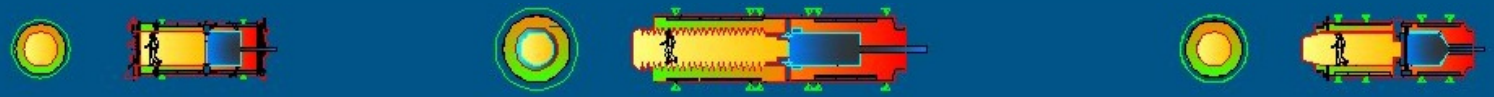
A stable & predictable regulatory regime is essential

Technology - The ATP Processor



Technology - ATP Processor Sizes

1977, 1989, 1991



1997
211 t/h
8.3 m diameter

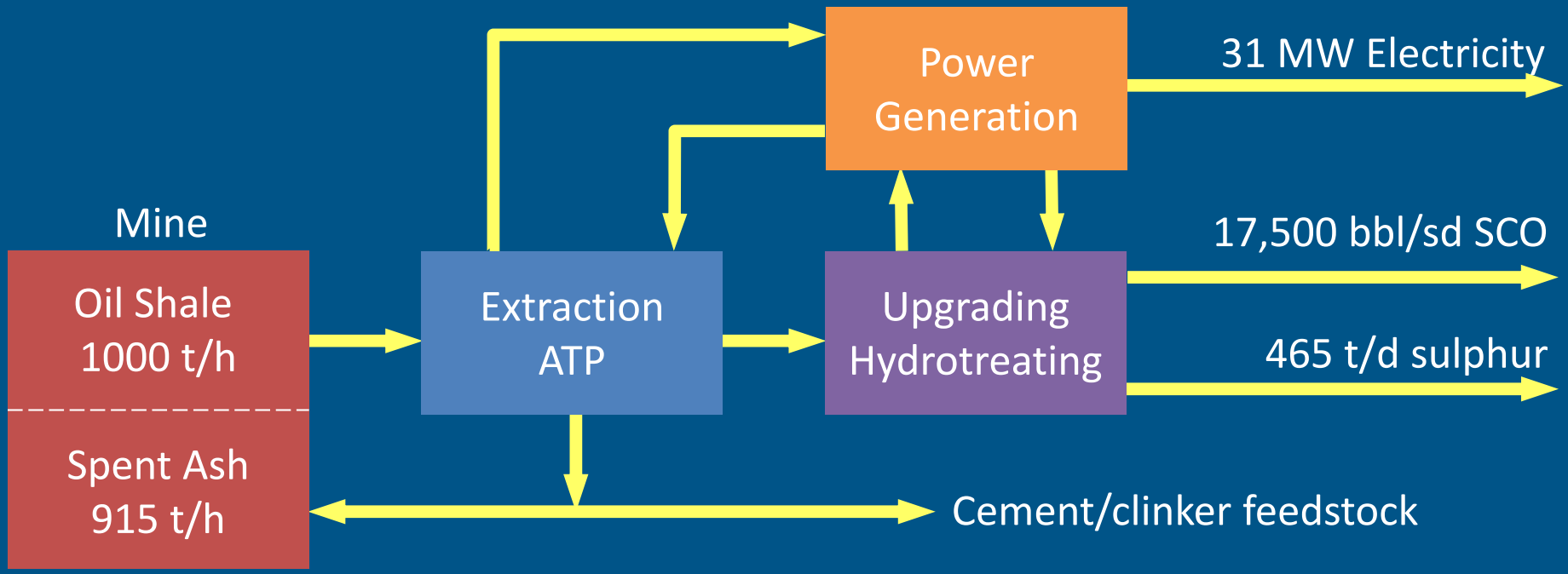
2006
230 t/h
8.3 m dia.

Next…
500 t/h
11.5 m

Project - Karak International Oil

Comprehensive Feasibility Study Completed

Thorough evaluation of technical, economic, environmental, and social aspects of project.



Environmental Impact Assessment (EIA) completed.
Project meets modern environmental standards.

Feasibility Study

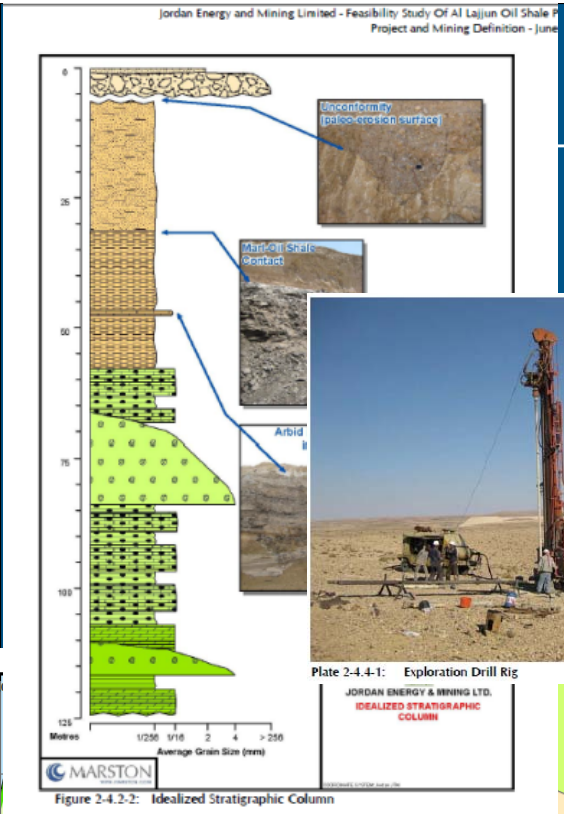
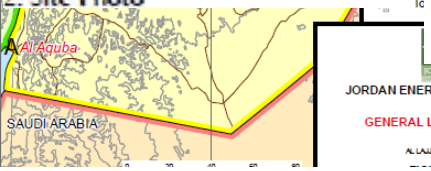


Plate 2-4.4-1: Exploration Drill Rig

Figure 2-4.2-2: Idealized Stratigraphic Column

2: Site Photo



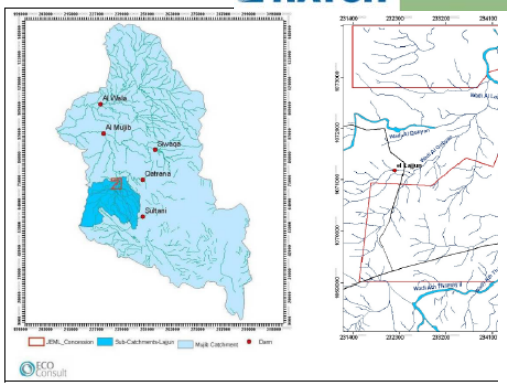
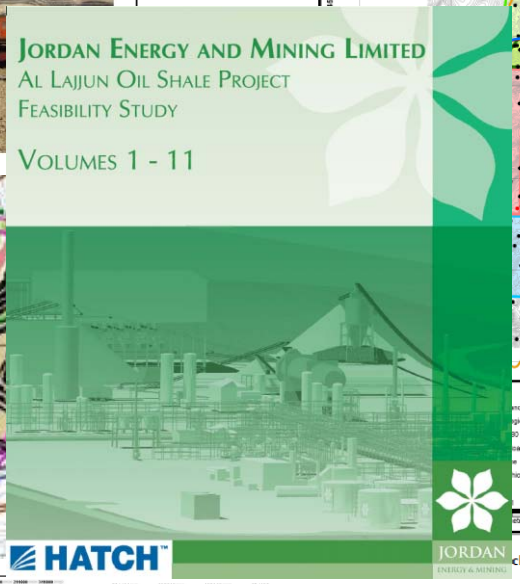
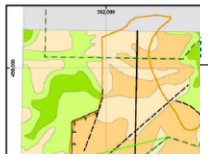
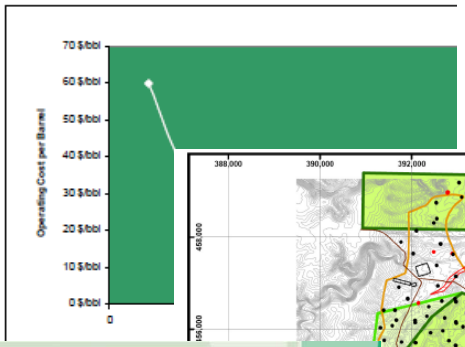


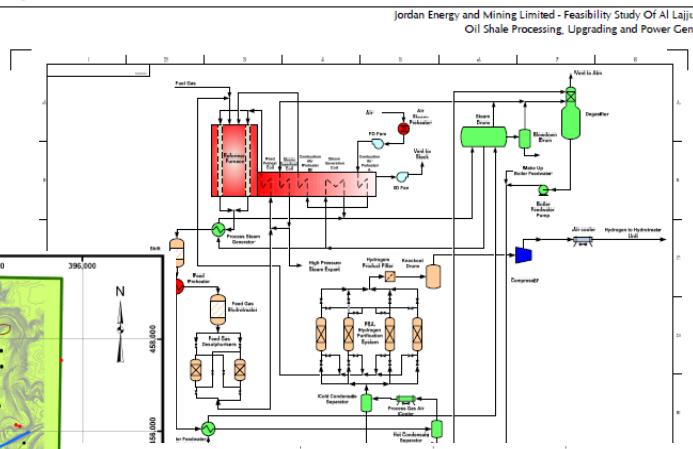
Figure 5-4.4-1: Lajjun Sub-Catchment and Mujib Watershed and Wadis within the Mo

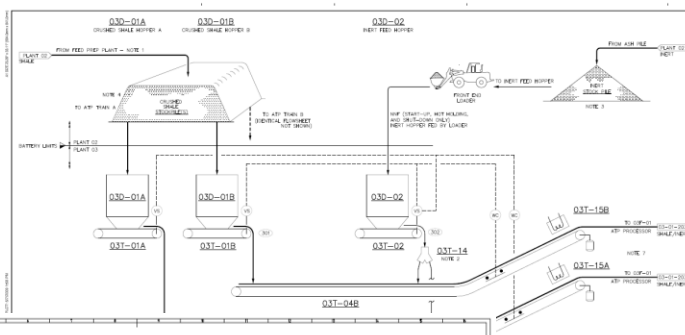


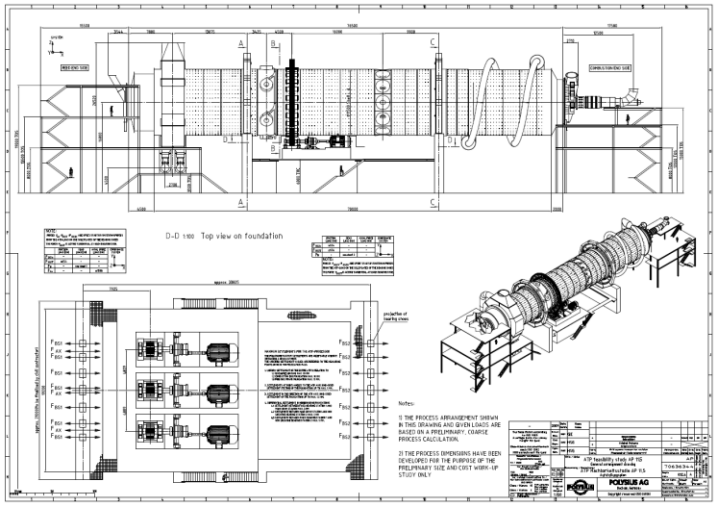


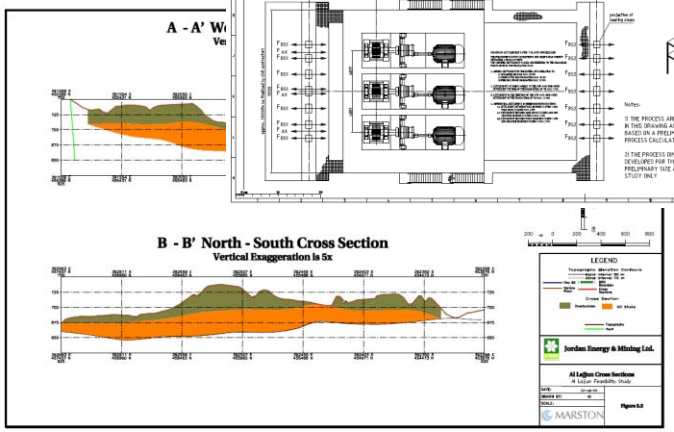
HATCH

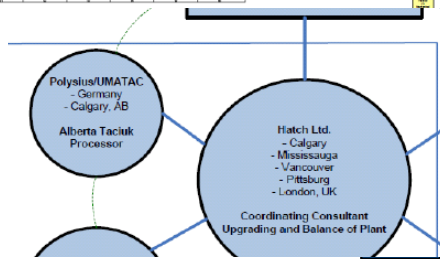








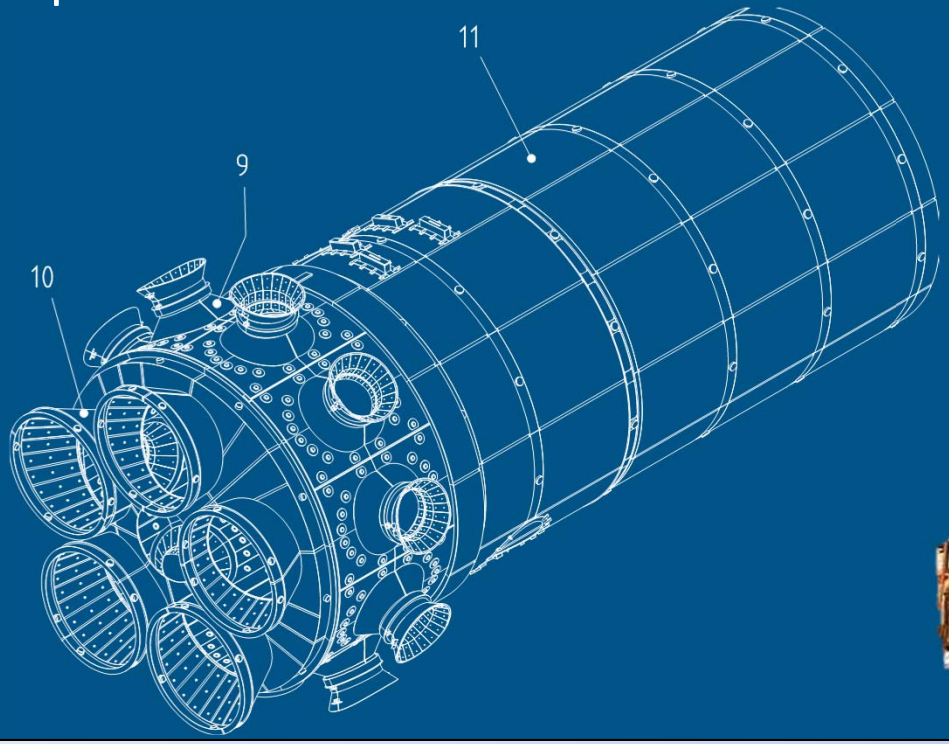




Project - Karak International Oil

ATP System inputs to FS – building the Project's foundation

- ATP System process, mechanical, equipment, civil, electrical design.
- Inputs to EIA & BOP contractors.
- Construction & transportation study.
- ATP pilot plant test program.
- CAPEX & OPEX.

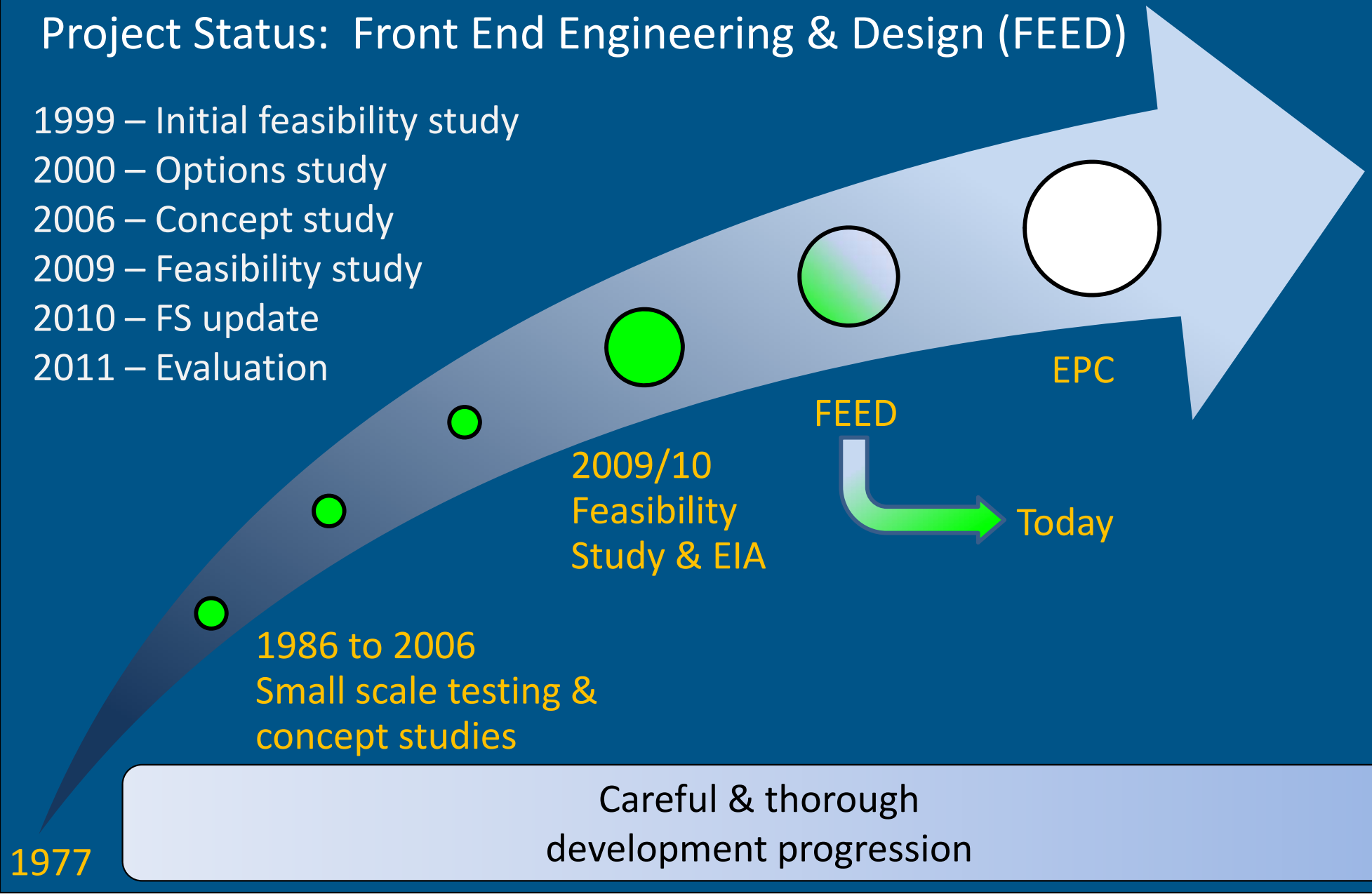


UMATAC & Polysius confirmed ATP System design and performance on Al Lajjun ore sufficient to deliver a firm cost estimate

Project - Karak International Oil

Project Status: Front End Engineering & Design (FEED)

1999 – Initial feasibility study
2000 – Options study
2006 – Concept study
2009 – Feasibility study
2010 – FS update
2011 – Evaluation

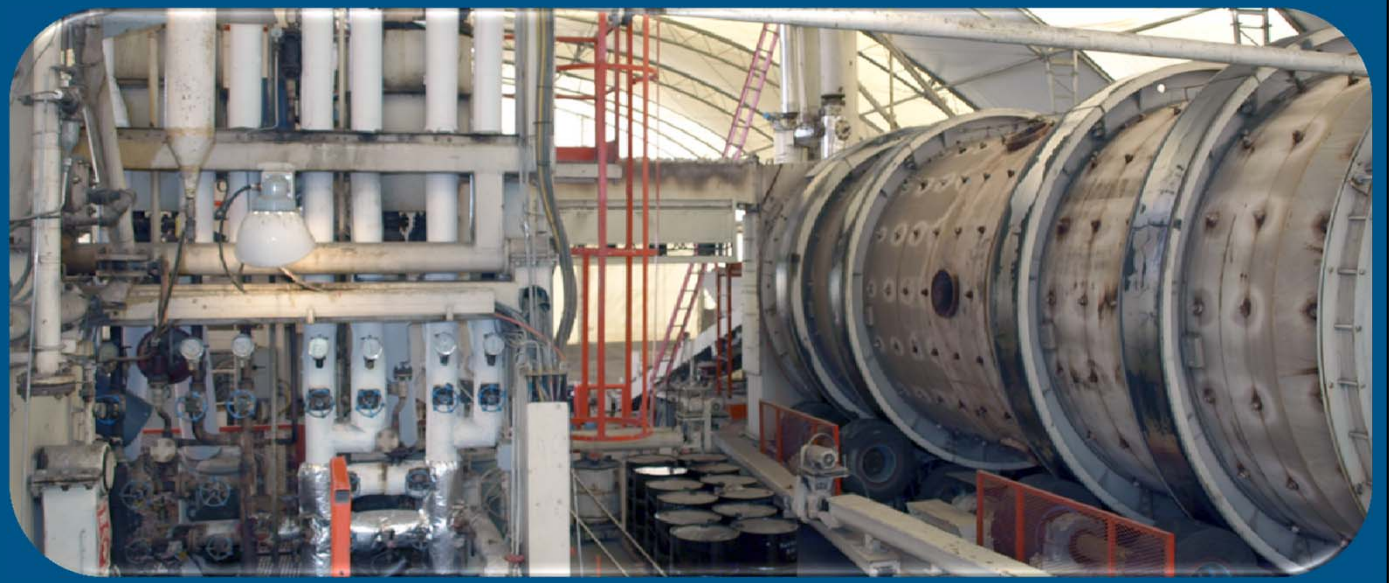


Careful & thorough
development progression

Project - Karak International Oil

Project Development – ATP Pilot Testing

Al Lajjun ore pilot tested in 1998, 1999, 2006, and 2009



Net Yield from Oil Shale

C_4+ Oil	11.4%
C_3- Gas	3.1%
Coke	8.5%

JEML Test Achievements

360 tonne ore sample

- ✓ Fuel self sufficient
- ✓ On-spec oil products

Environmental

- ✓ Ash leachate
- ✓ Emissions
- ✓ Water

Al Lajjun ore processes well in the ATP.
Ore grade is 132 LT0M (12.4% C4+ by MFA).

Project - Karak International Oil

Project Development – Hydrotreating Pilot Testing

Al Lajjun hydrotreating pilot tests in 2000 & 2009

	Before Upgrading	After Upgrading
Density, g/mL (API)	0.92 (21 API)	0.81 (44 API)
Sulphur, wt%	10.8	0.01
Naphtha, %	30	40
Kerosene/diesel, %	44	50
Gas oil, %	25	10

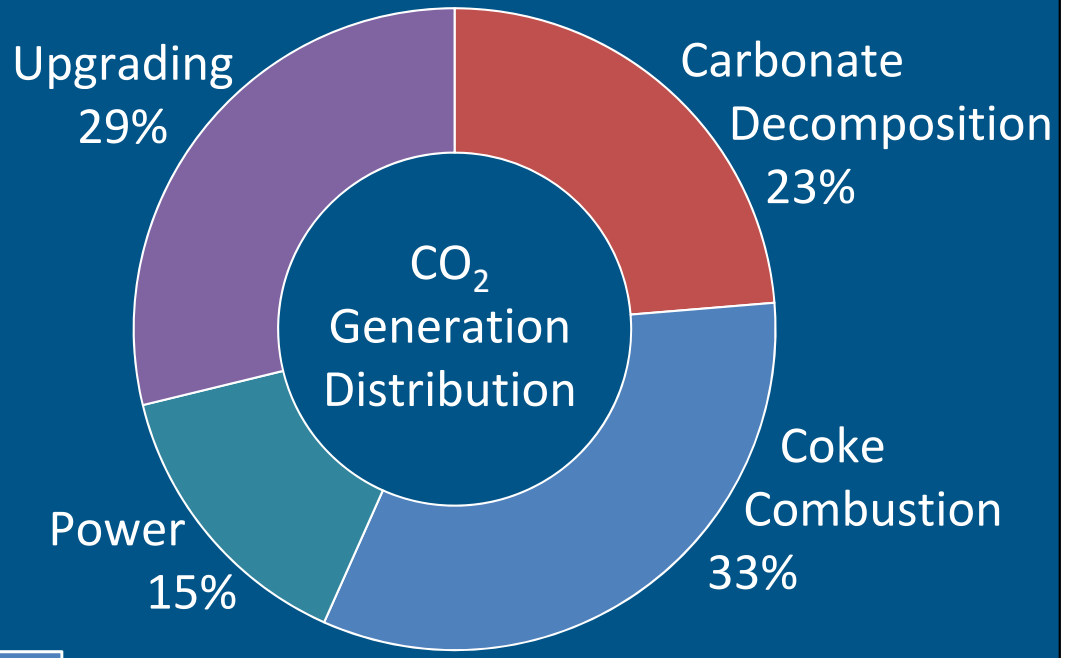
Conventional hydrotreating works well. Sulphur & nitrogen are readily reduced. Weight loss is offset by volume swell.

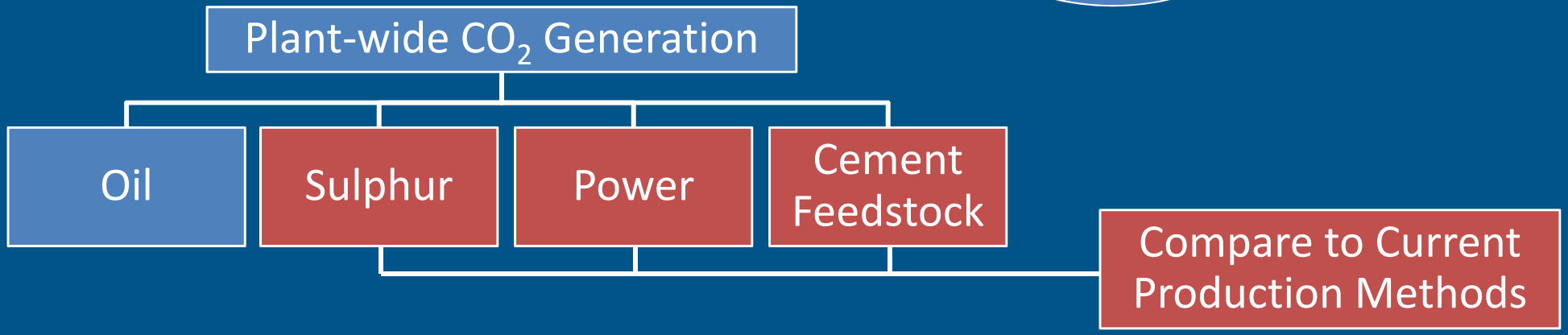
Project - Karak International Oil

CO_2 Accounting

CO_2 emissions estimate for FS is *comprehensive and conservative*.

Pilot testing shows variations in CO_2 production from spent shale combustion – an opportunity?





Offsets account for CO_2 difference between KIO byproducts and current production/transport of byproducts.

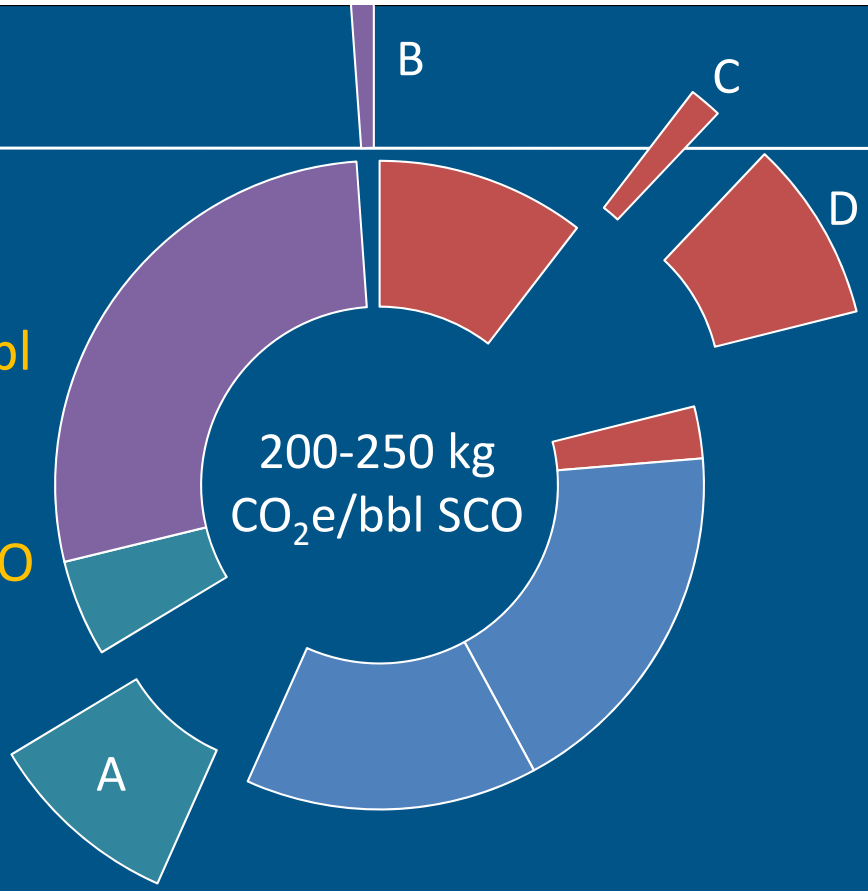
Project - Karak International Oil

CO_2 Accounting

SCO carbon intensity is 200-250 kg/bbl

Comparable to:

Alberta oil sands	233 kg/bbl SCO
OPEC primary recovery	167 kg/bbl
OPEC tertiary recovery	208 kg/bbl



Offsets:

A. Low CO_2 electricity export
B. Offset imported sulphur for fertilizer
C. Phosphate co-mining
D. Shale ash use in cement manufacture

SCO from oil shale has carbon footprint similar to other conventional & non-conventional oils.

Project - Karak International Oil

Water Accounting – Feasibility Study

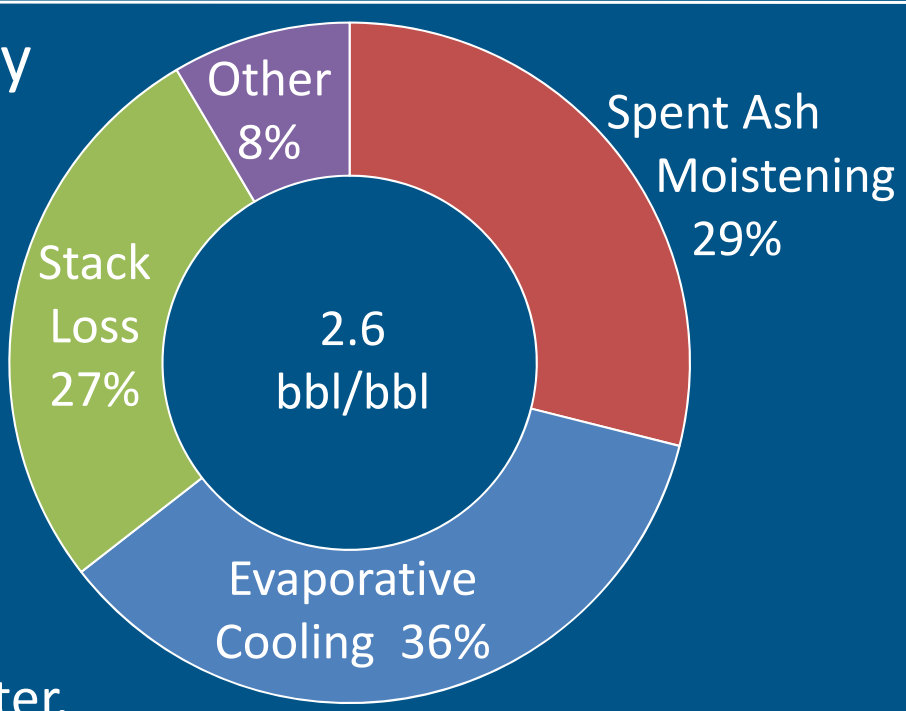
Water usage estimate for FS
is *comprehensive and conservative*.

Project water is allocated from
deep brackish aquifer and does not
compete with potable water supplies.

Shale retorting process uses almost no water.

No water is discharged from the site.

Most water is used for dust control, pollution control, and cooling.



Water is recovered, recycled, and re-used as much as practical.

Project - Karak International Oil

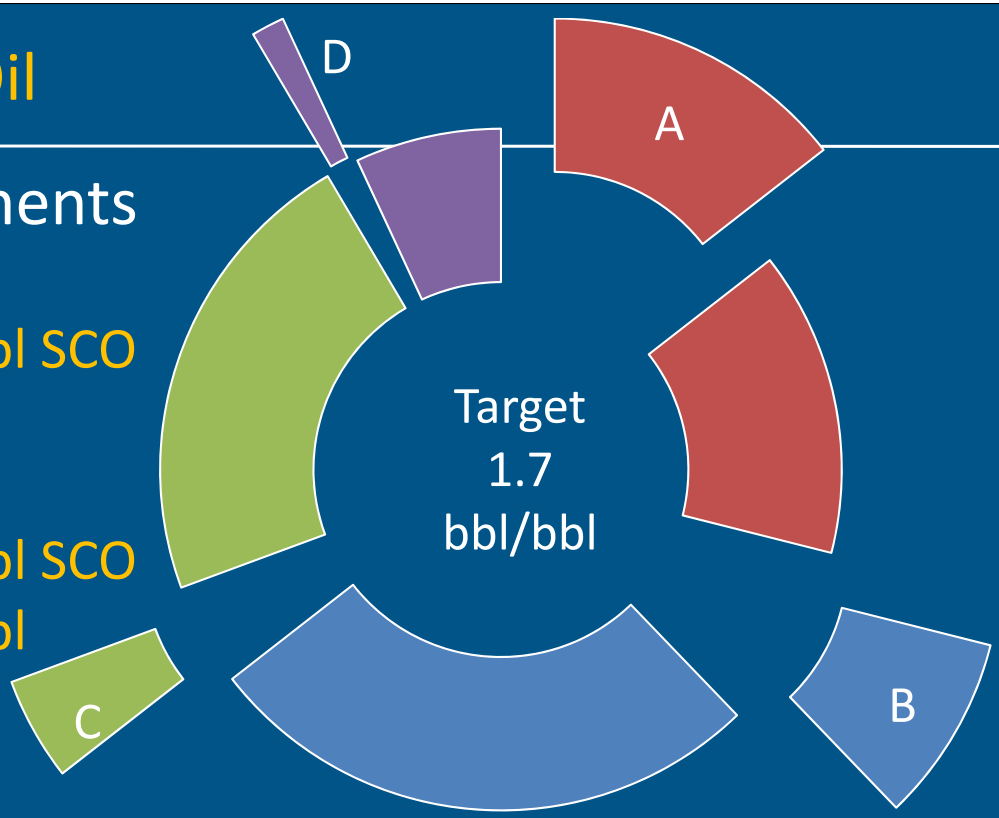
Water Accounting – Improvements

Water use target is: 1.7 bbl/bbl SCO

Comparable to:

Alberta oil sands 3.5 bbl/bbl SCO

Conventional secondary 1.0 bbl/bbl



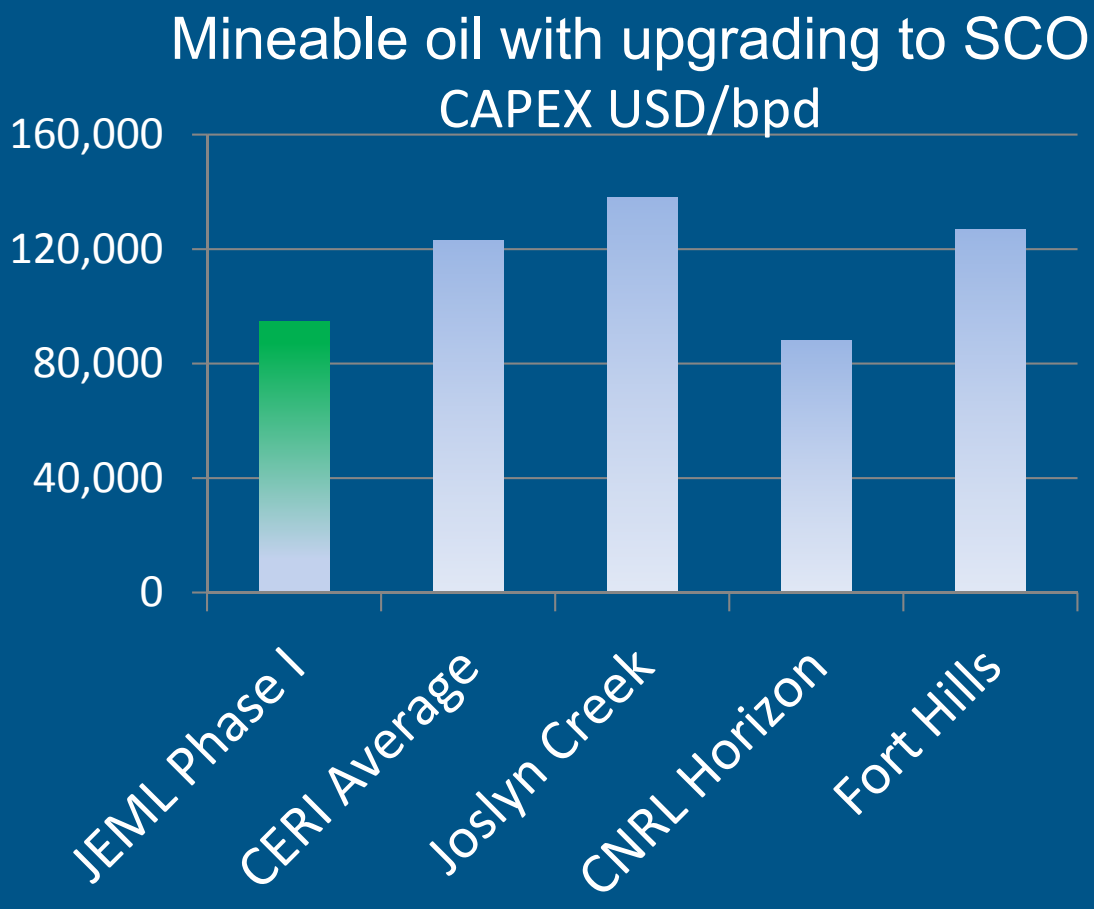
Improvements:

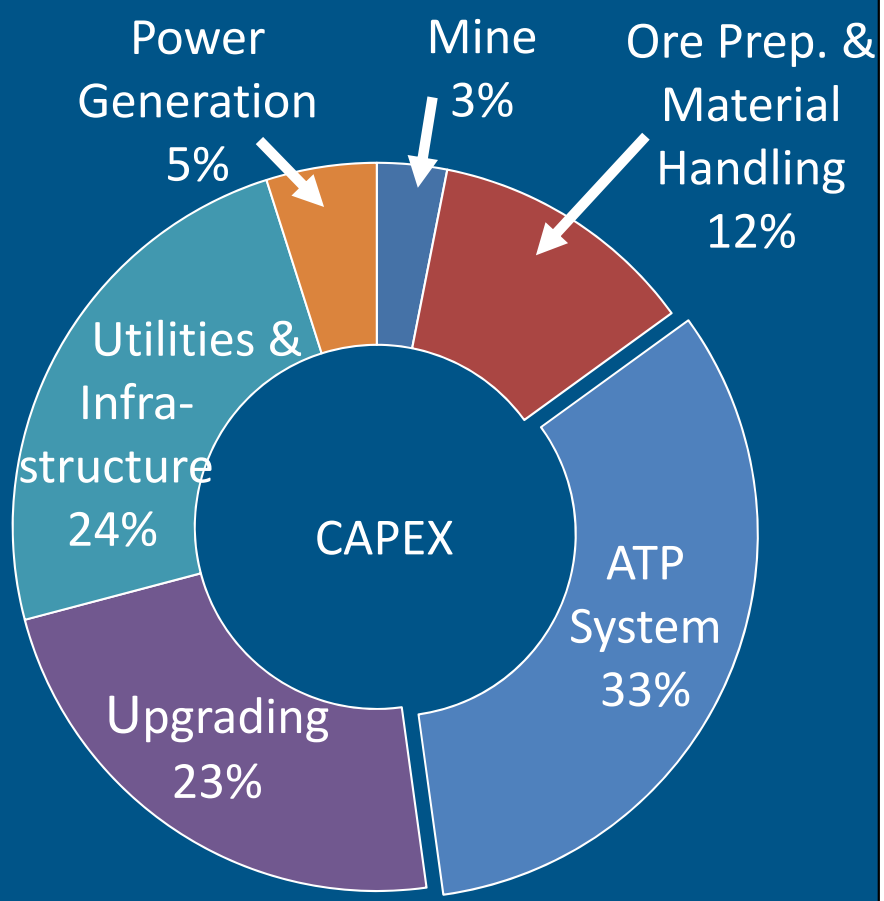
A. Reduce water on ash for dust control
B. Reduce evaporative cooling losses (plant integration)
C. Reduce losses to stack (function of ash quenching & flue scrubbing methods)
D. Reduce steam losses (plant integration)

Water use target is 1.7 bbl H_2O / bbl SCO.

Project - Karak International Oil

CAPEX Distribution





Project costs are comparable to similar projects.

Retorting technology block is only one third of the project!

Project - Scale up from 120 to 6000 to 12000 t/d

75:1 Scale-up Proven at 6000 t/d (250 t/h)

- Process modelling tools are mature.
- Scale-up techniques worked.
- Mechanical design proven.
- Demonstration project completed.

Third Generation ATP Installed in China at 5500 t/d (230 t/h)

- Field machining of tyres proven.
- Reliability and operability improvements implemented.

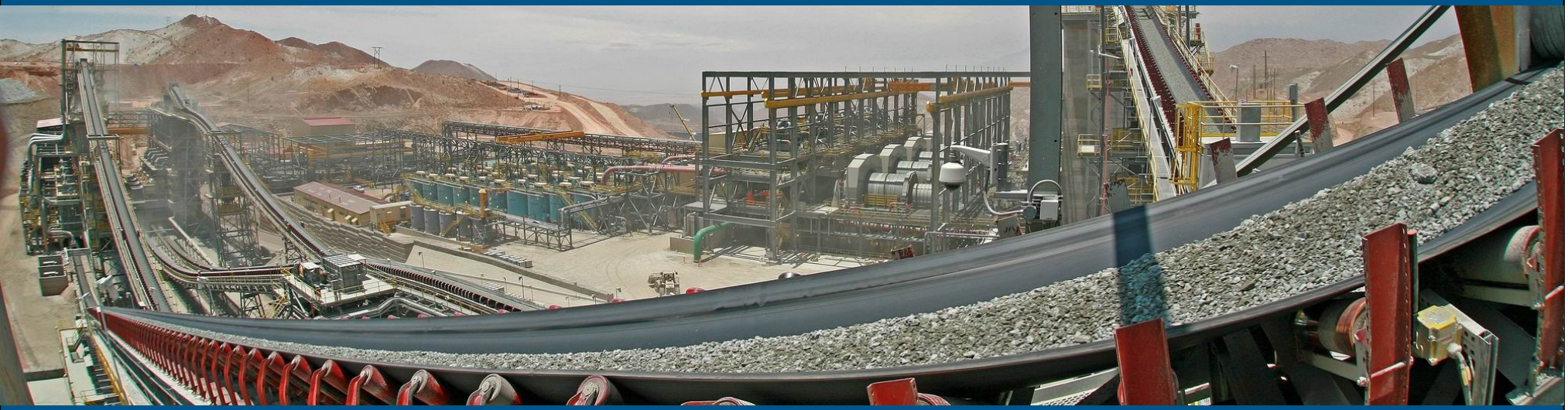
2:1 Scale-up to 12,000 t/d (500 t/h)

- ATP & hydrotreating pilot tests complete.
- Feasibility study complete.
- Front end engineering & design phase.
- Project implementation – large scale greenfield project including upgrading. and power generation plants.

Team - World Class Partners Proven Polysius Technologies

Proven Mechanical Systems for the 500 t/h ATP Processors:

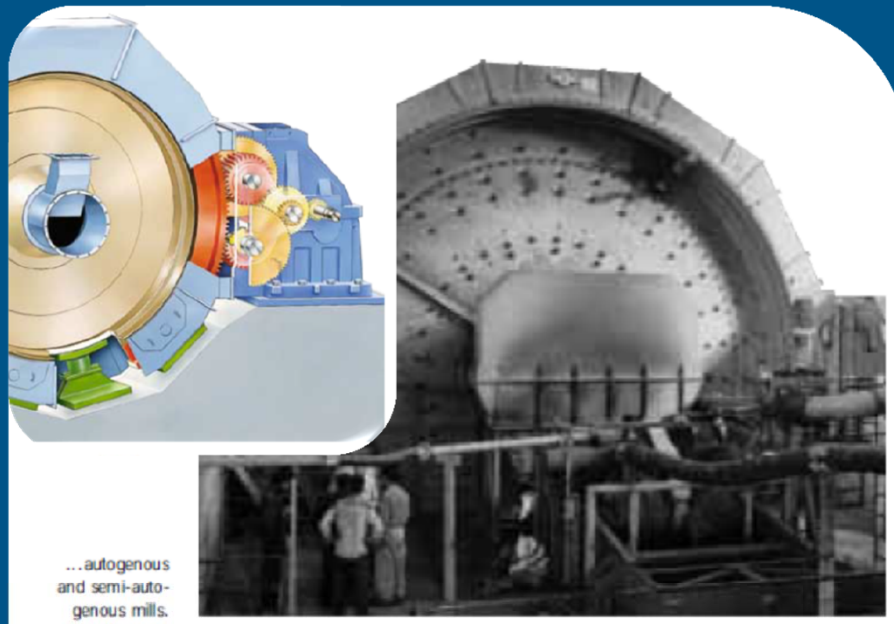
- Slide shoe bearing support system (ATP is 5400 tonnes).
- Ring gear, Combiflex®, or ring motor drives up to 20 MW (ATP is 7 MW).
- Hundreds of kilns and mills built up to 11.0 m diameter (ATP is 11.5 m) and 120 m long (ATP is 76 m long).



Polysius has the proven machinery and experience.
UMATAC has the proven technology and process knowledge.
ThyssenKrupp Technologies has the team to deliver the project.

Team - World Class Partners

Proven Polysius Technologies



...autogenous and semi-autogenous mills.

Di [m]	EGL [m]	P [kW]
8.0	3.9	3800
8.6	4.2	5000
9.2	4.5	6400
9.8	4.8	8400
10.4	5.1	9900
11.0	5.4	12100
11.6	5.7	14700
12.2	6.0	17600
12.8	6.4	21300
13.4	6.8	25400

Competence Centre for Oil Shale Technology in Calgary, Canada

谢谢 Thank You شكرا
Vielen Dank

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