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HEAVY OIL PROCESSING

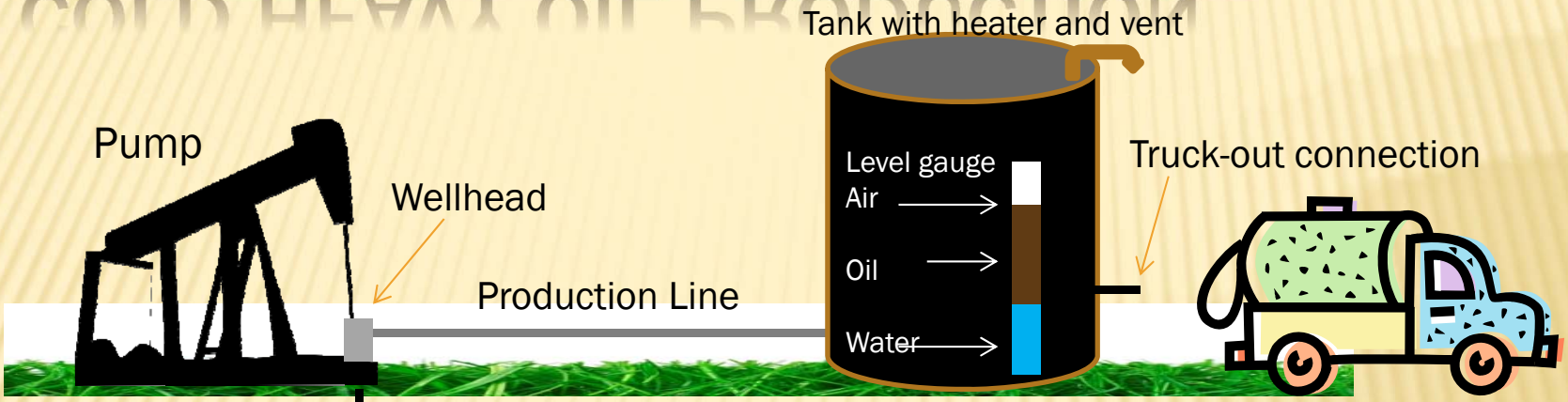
WHAT IS HEAVY OIL?

- Any type of crude oil which does not flow easily
- API gravity less then 20°
- Bitumen is heavier ~API gravity less than 10°

HEAVY OIL EXTRACTION TECHNOLOGIES

- Cold Production (~1%-5% recovery)
- Enhanced Oil Recovery (~60% recovery)
  - Steam (SAGD, CSS)
  - Vapor extraction(VAPEX)
  - New technologies (THAI, In-Situ Upgrading, Molten Salt, etc)
- Open Pit Mining (up to 100% recovery)

COLD HEAVY OIL PRODUCTION

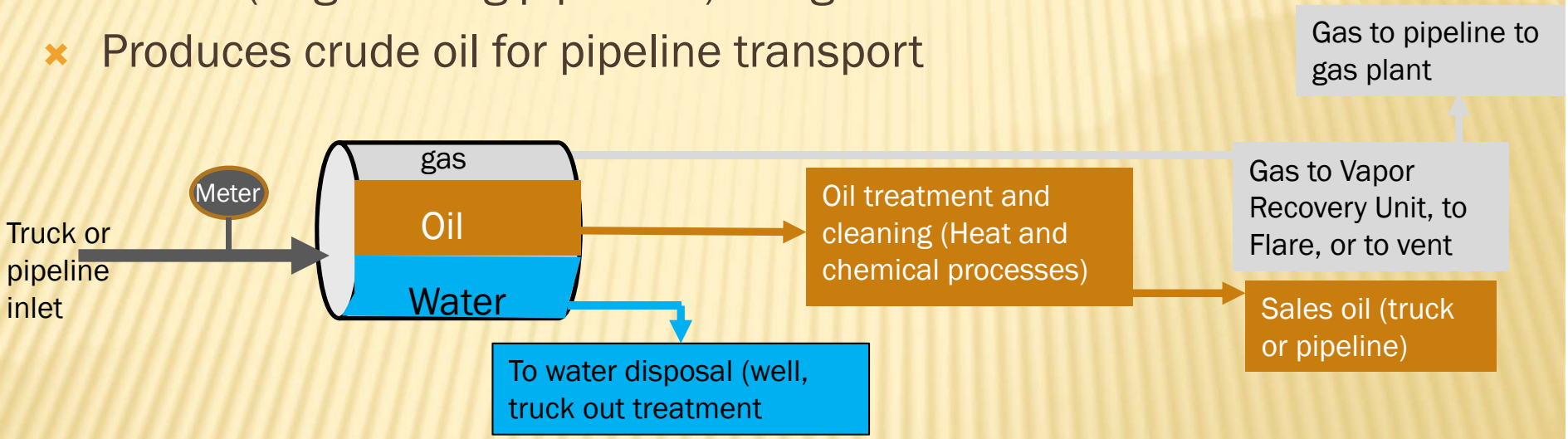


Well

- Well produces emulsion (sand, oil, water, gas mix)
- Emulsion sits in heated tank and separates into components
- Truck sucks out each phase (using level gauge) and trucks to Oil Battery for further treatment
- Occasionally, sand is removed from tank bottom using a special truck
- Produced gas is either vented, flared, or gathered

OIL BATTERY

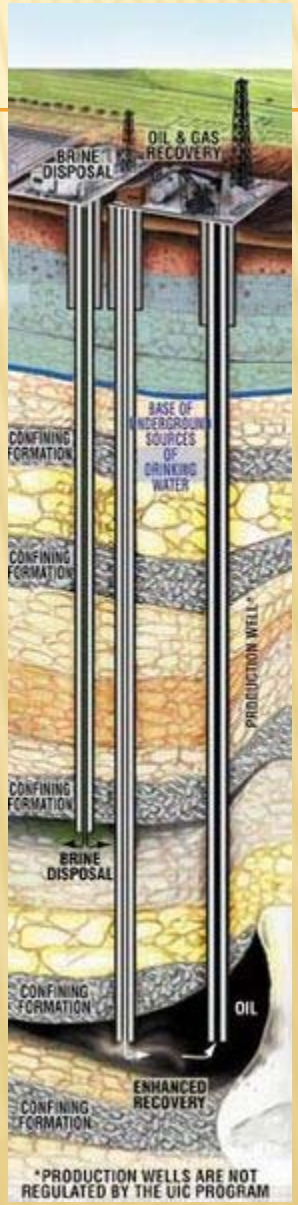
- Trucks (or gathering pipelines) bring in oil
- Produces crude oil for pipeline transport



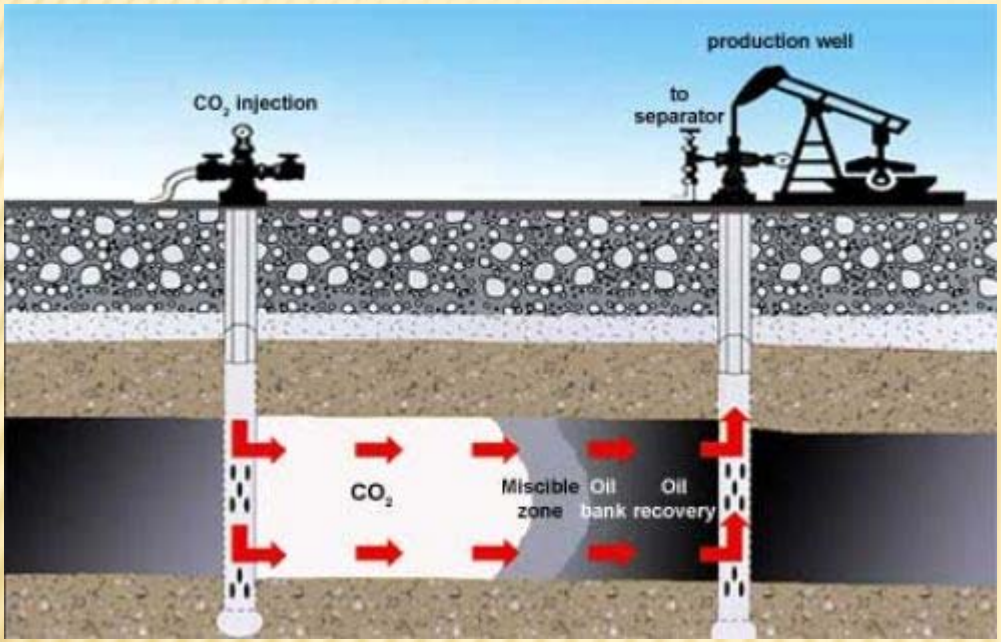
- A tank battery may or may not include gas transportation equipment (i.e. dehydration and compression) – depends on gas rates

ENHANCED OIL RECOVERY (EOR)

- EOR is a term for techniques that increase the amount of oil that can be extracted
- Also called “improved oil recovery” or “tertiary recovery”
- Typically means thermal recovery (cyclic or continuous steam), chemical or gas injection.



CHEMICAL OR GAS INJECTION



Gas (CO2, N2 or natural gas) is injected into the reservoir

Injected gas dissolves in the oil, reducing viscosity so that it can flow and increases pressure, pushing the oil up the well

Gas is typically recovered in the production stream

Chemical injection works by creating “soap” subsurface that lubricates the movement of oil through the reservoir rock

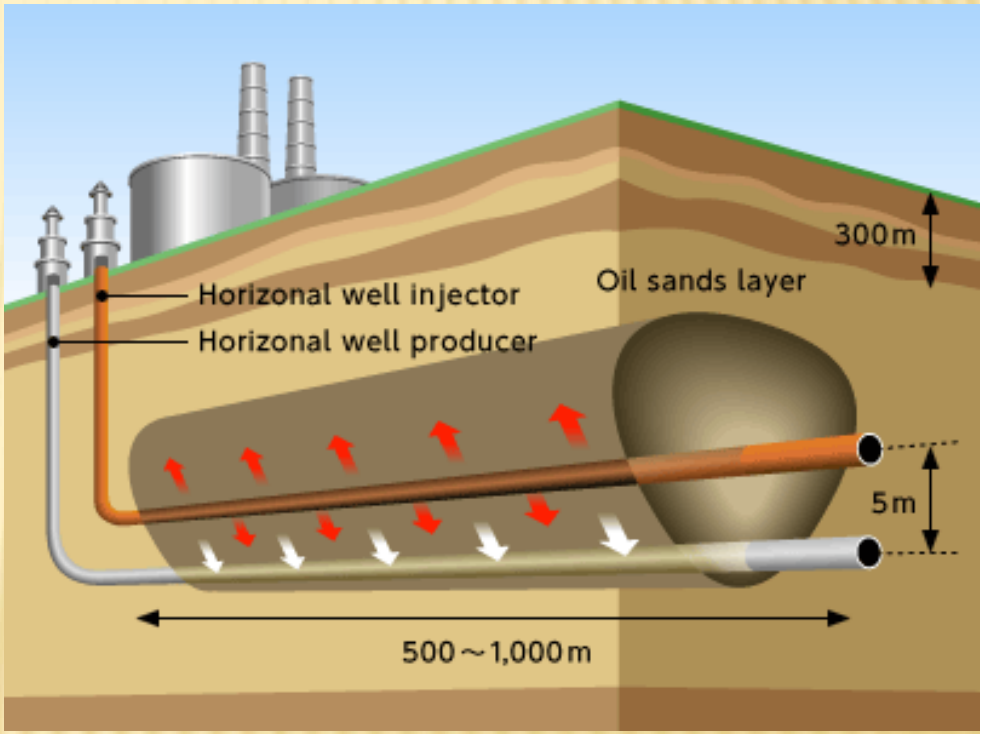
Chemical injection pump at well

THERMAL PROCESSES - SAGD

Heat is added to reservoir to make oil flow

Steam Assisted Gravity Drainage (SAGD)

- 2 parallel wells – injector and producer
- Steam is injected in injector well, emulsion produced from producer well
- "Gravity Drive" mechanism (as opposed to pressure drive) as well as thermal effect
- Typically highest level of ultimate recovery of all thermal processes
- Only works for specific reservoir conditions



THERMAL PROCESSES - CSS

Heat is added to reservoir to make oil flow

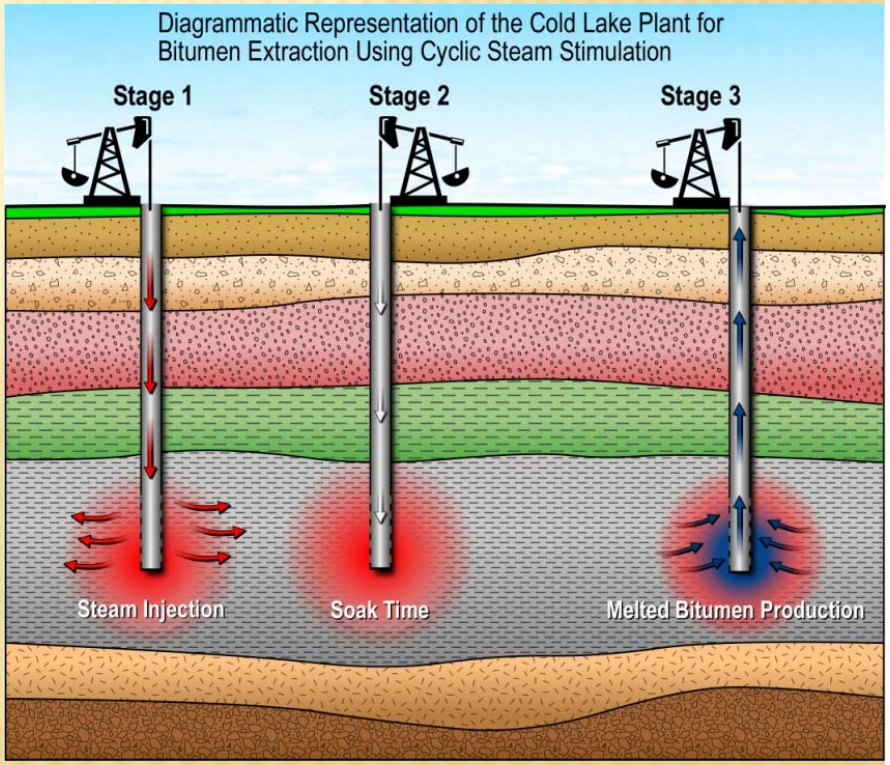
Cyclic Steam Stimulation (CSS)

•Steam is injected, then oil is produced all from one well

•Typically yields quicker production than other thermal methods

•“Pressure Drive” mechanism as well as thermal effect

•Suitable only for certain reservoir conditions



THERMAL PROCESSES – IN SITU COMBUSTION

Heat is added to reservoir to make oil flow

In-Situ Combustion

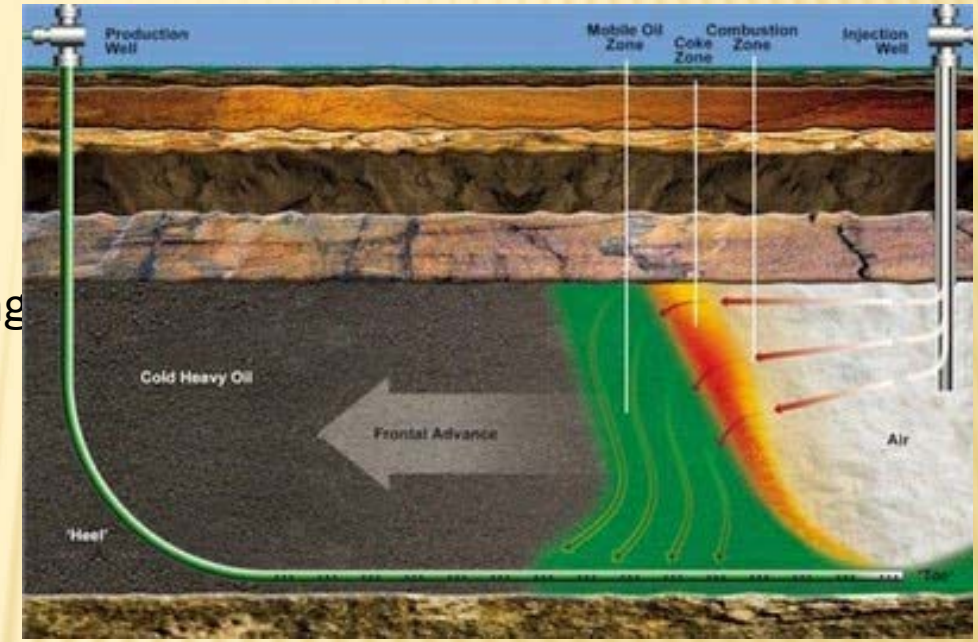
•Light oil on fire, lighter oil is produced and heavy ends (coke) stay underground

•Holy Grail of in-situ production – is still being proven for commercial viability

•THAI – Toe to Heel Air Injection

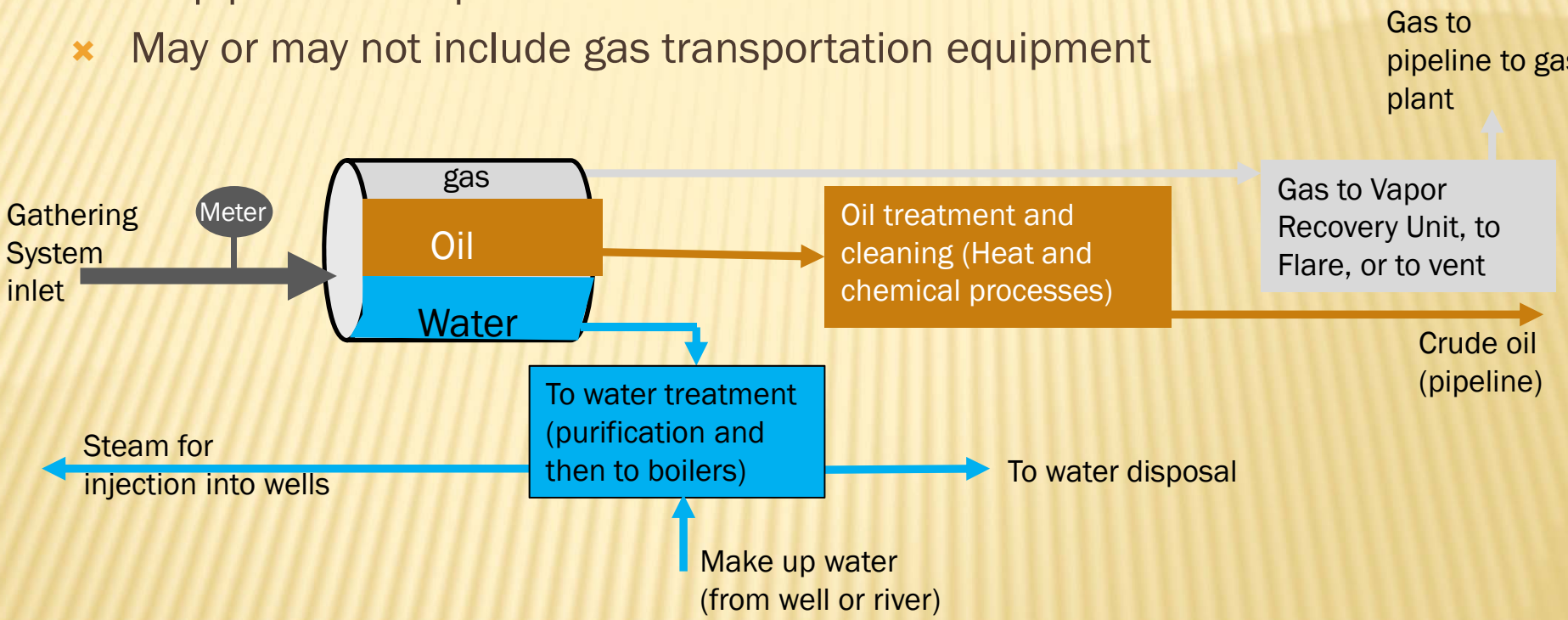
•Two wells – one for air injection, one for production

•Relies on air and an ignition source to complete the "Fire Triangle"



THERMAL FACILITIES

- Gathering pipelines bring in oil, water and emulsion; produces crude oil for pipeline transport
- May or may not include gas transportation equipment

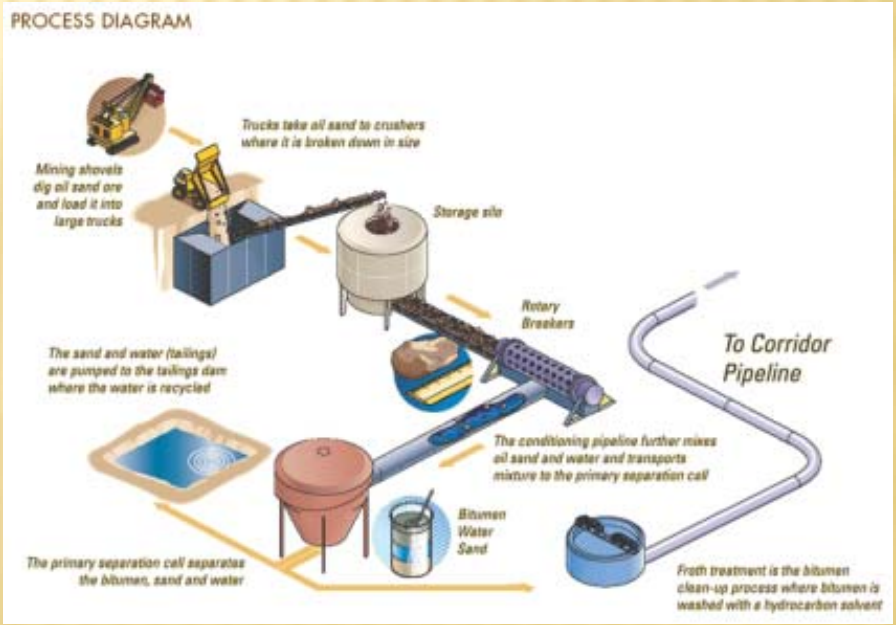


- Difference between thermal and cold facilities is primarily in the size and complexity of the water treatment train

MINING

- Oil sand is transported by truck to facility where oil and sand are separated, typically using water
- Tailings ponds allow solids to settle out, water is recycled
  - Environmental issues with Tailing Ponds

- Sand is used for construction and reclaimation
- Bitumen is transported to an upgrader

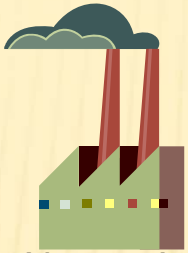


HEAVY OIL TREATMENT

Heavy Oil Production (either by well or by mining)

Diluent

Add diluent (light oil) to bitumen



Upgrader

Heavy ends

To waste treatment (solids) or blending (liquids

Crude oil

Refinery

Gasoline

Diesel

Other products