



# 2015 SRI FIELD TRIP TO CANADA

ROYAL DUTCH SHELL  
September 15, 2015



# DEFINITIONS AND CAUTIONARY NOTE



The *New Lens Scenarios* referred to in this presentation are part of an ongoing process used in Shell for 40 years to challenge executives' perspectives on the future business environment. We base them on plausible assumptions and quantification, and they are designed to stretch management to consider even events that may be only remotely possible. Scenarios, therefore, are not intended to be predictions of likely future events or outcomes and investors should not rely on them when making an investment decision with regard to Royal Dutch Shell plc securities.

Reserves: Our use of the term "reserves" in this presentation means SEC proved oil and gas reserves.

Resources: Our use of the term "resources" in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Resources plays: our use of the term 'resources plays' refers to tight, shale and coal bed methane oil and gas acreage.

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# HEAVY OIL SUSTAINABLE DEVELOPMENT

Chris Harrison  
VP Heavy Oil Sustainable  
Development & Regulatory



# LEADERSHIP IN ENVIRONMENTAL MANAGEMENT



CO<sub>2</sub>

Aspiration

Equivalent intensity to average barrel refined in US

Fresh Water

Aspiration

Minimize use of river water

Land/Tailings

Aspiration

Net neutral land disturbance



- Shell pursues several paths to improved environmental performance, including **operational excellence** and **technology development**, within an **effective regulatory framework**
- Realizing the business benefits of improved environmental performance requires effective engagement with various stakeholders

# KEY AREAS OF ENVIRONMENTAL FOCUS



Shell has developed an Environmental Performance Improvement Programme to deliver results in all of these areas.

This includes long and short term goals to drive focused performance

## WATER



~80% of water is recycled in our oil sands operations and we continue to look for ways to reduce the need for water from the Athabasca River

## LAND



Land disturbed by our operations will be reclaimed to a condition that supports a self-sustaining, locally common boreal forest, as required by law

## TAILINGS



Technology focus is on speeding up drying process to reduce land disturbance and progress reclamation

## CO<sub>2</sub>

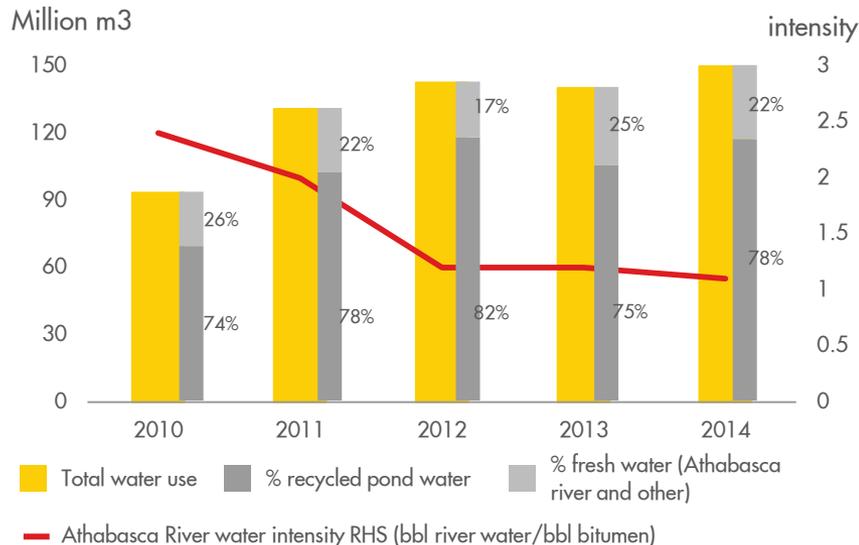


As we increase production, emissions also increase. We focus on innovation to improve energy efficiency and unlock technologies that help bring down emissions in a sustainable way



- Mining, in-situ and upgrading operations require water for separating bitumen from sand, producing hydrogen and steam, and for cooling hydrocarbon streams
- Shell recycles its water and continues to look for ways to optimize water usage

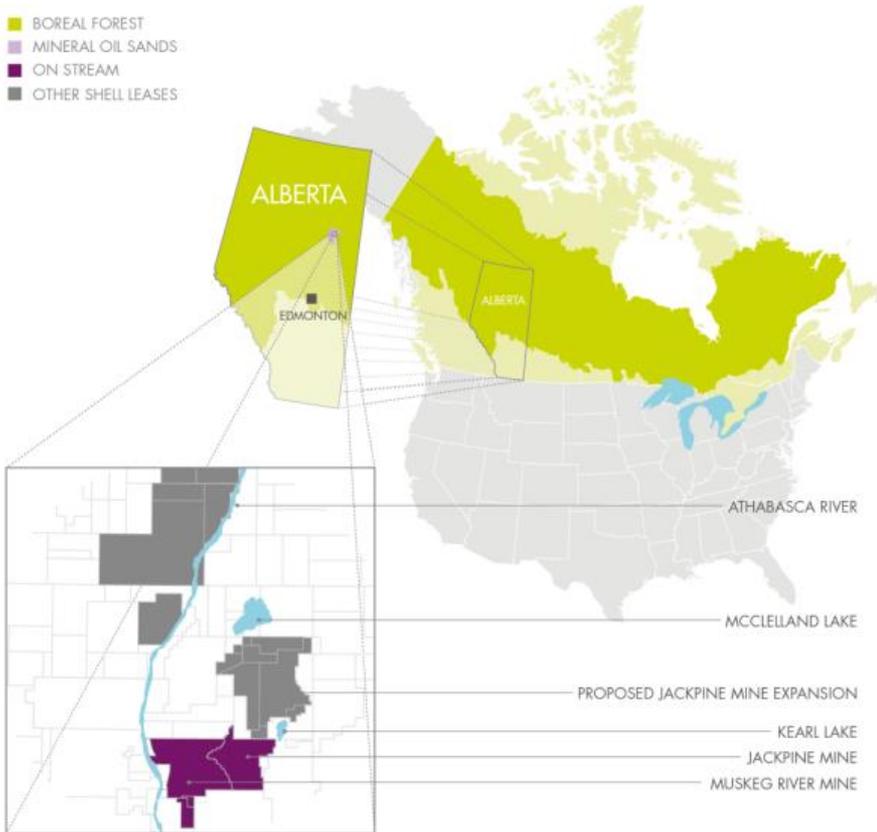
## Mine water use



- Permits to withdraw 0.6% of the Athabasca River's annual average flow (we used less than 0.08% in 2013)
- ~80% of water used in mining operations is recycled from tailings, supplemented by river water
- ~90% of waste water from the upgrading process is reused in operations
- For Carmon Creek, 'produced water' (co-produced with the bitumen) will be recycled to create steam. If needed, 'make-up' water is taken from underground formation containing non-potable water
- Water projects at Albion
  - Converted gland water pumps from river water to recycled water (reducing river intake by at least ~3 million m<sup>3</sup>/yr)
  - Use of MRM Cell 1 (vs MRM ETF) as main water source; upgraded reclaim return system



- BOREAL FOREST
- MINERAL OIL SANDS
- ON STREAM
- OTHER SHELL LEASES



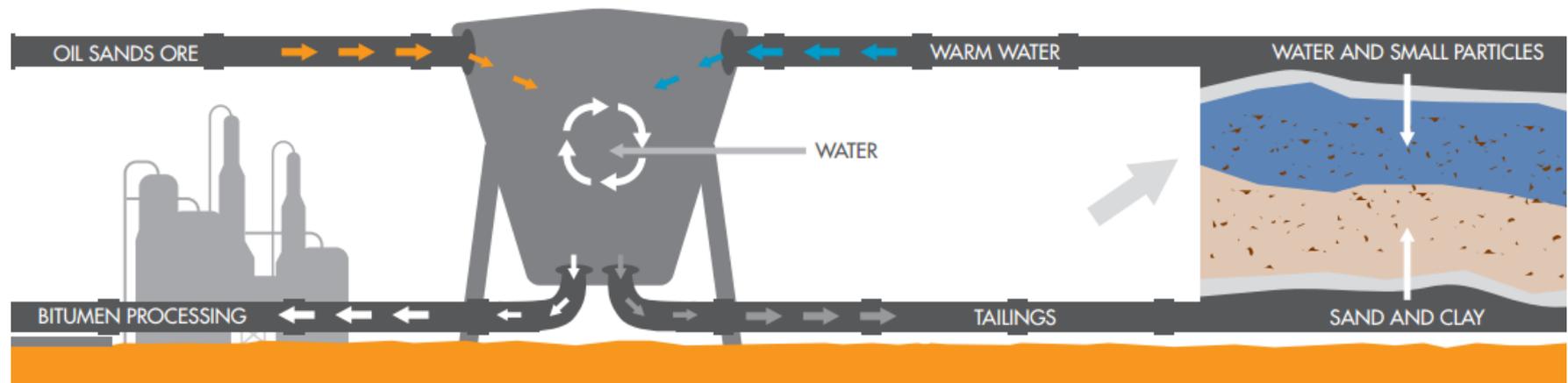
- Only about 20% of total recoverable resource is mineable; remainder is in-situ
- Reclamation work is underway from beginning of mine life
  - E.g. Top soil protection at start of mining activities
  - Staged process, takes decades to complete
- Shell committed to starting large scale reclamation within 20 years of first development
- Some of the of the early industry mines have started to achieve certified reclamation
- Traditional Environmental Knowledge (TEK) an important input to our development and reclamation plans

# TAILINGS



- Sand, water, naturally occurring chemicals and small amounts of residual bitumen remaining that needs to be stored
- Not unique to oil sands mining – tailings exist across many mining industries
- Integral part of the operation enabling recycling of roughly 80% of the water used

## Shell Tailings overview



# TAILINGS ENVIRONMENT + RECLAMATION



- Dried tailings can be blended and treated to produce material suitable for use in land reclamation
- In the next decade, reclamation of external tailings facilities at Muskeg River Mine will begin, as more tailings materials are deposited in-pit as part of the in-pit backfilling process

## IN-PIT TAILINGS PROCESS

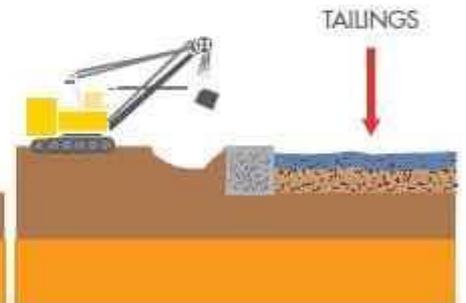
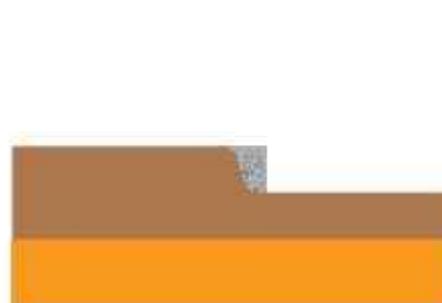
Shovel and truck mining out the oil sands ore.

Advanced mining whereby a 'dyke' or containment wall could be built.



Containment wall being built to create a 'cell'.

Tailings being deposited into a 'cell' while mining continues on the other side of the containment wall.





## Wildlife concerns



- Residual bitumen collects at edges of the pond, causing a hazard to wildlife that may come into contact with it
- Shell uses sophisticated bird deterrent systems to deter birds from landing on the ponds

## Fines drying time and reclamation



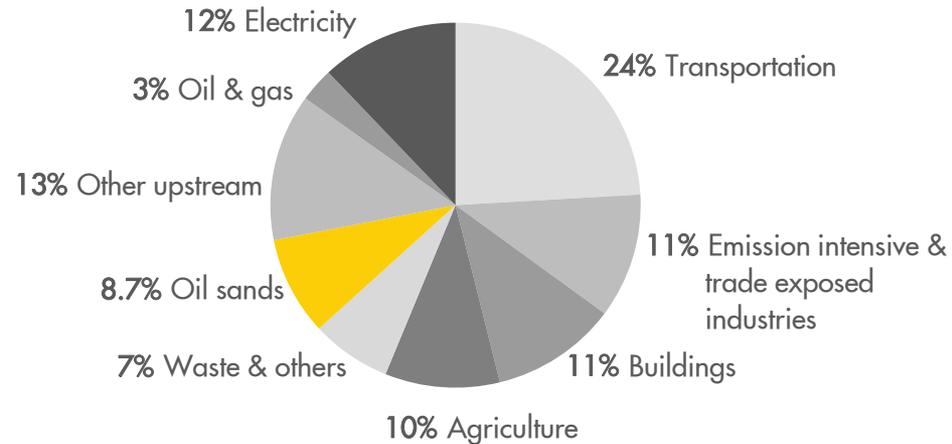
- Small clays or 'fines' suspend in the water and take several years to settle
- Working to advance technologies that speed up the drying to enable faster reclamation
  - Centrifuge
  - Atmospheric Fines Drying

# INDUSTRY EMISSIONS - GHG



- Oil Sands derived crudes are 4-23% more GHG intensive than average North American crude
- Oil sands account for 8% of Canada's GHG emissions, and 0.1% of global GHG emissions
- Industry GHG's per barrel have decreased by 28% from 1990 to 2014
- Emissions in oil sands are due to:
  - Mining: truck fuel + heat to warm the water for separation
  - In-situ: steam for injection into reservoir
  - Upgrading: hydrogen manufacturing

Canada's GHG emissions by sector (2012)<sup>1</sup>

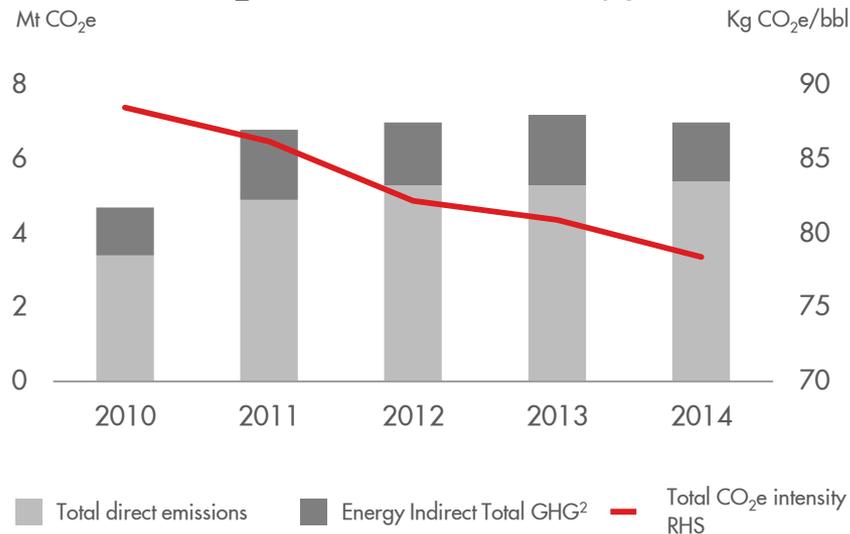


<sup>1</sup> Source: CAPP Facts on Oil Sands

# SHELL CANADA OIL SANDS EMISSIONS



Oil Sands CO<sub>2</sub> emissions<sup>1</sup> (MRM, JPM, upgrader, in-situ)



- Shell uses cogeneration to reduce GHGs and is working on technology & operational efficiency options for future emissions reductions
- Quest, will remove 1 million tonnes per year CO<sub>2</sub> from the Upgrader

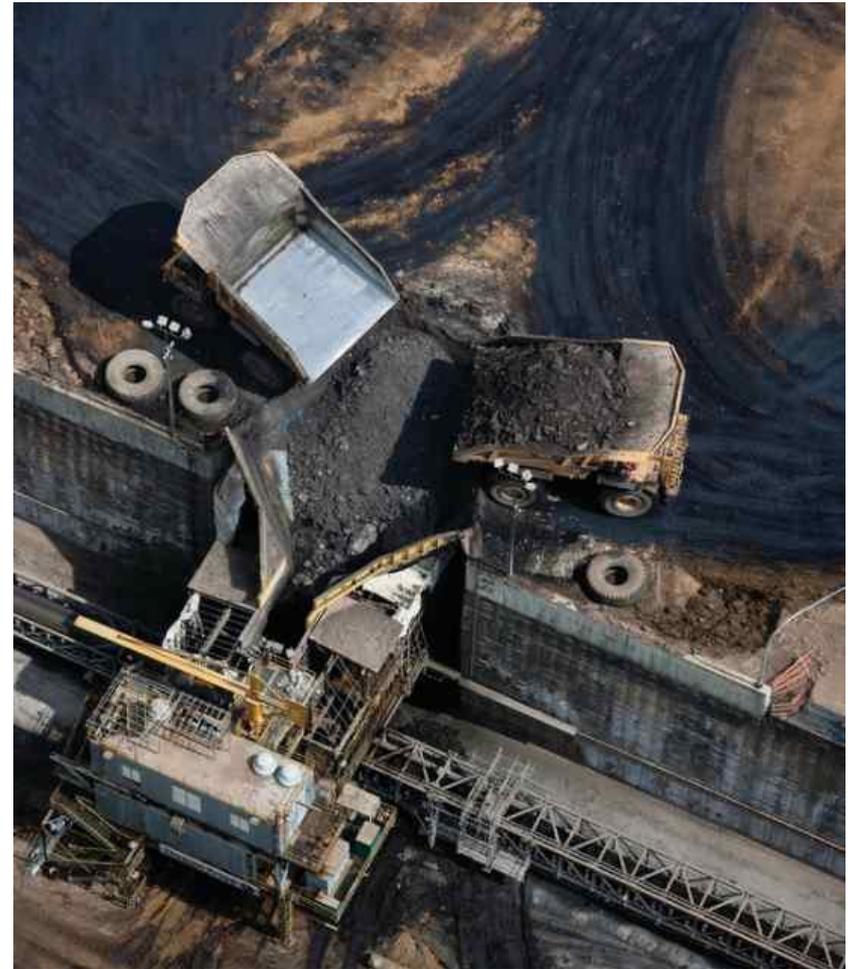
<sup>1</sup> Data is full AOSP + in-situ operations (100%)

<sup>2</sup> Energy Indirect Total GHG includes import electricity and steam/heat

# OIL SANDS OPERATIONS + REGULATIONS



- Transparent and thorough provincial and federal regulatory process for Oil Sands
- A 2014 CAPP study comparing leading oil & gas producing regions consistently ranked Alberta in the top 3 with regard to stringency of environmental policies and laws, compliance and transparency
- Regulations are protective of environment and society, while regulator is willing to work with industry to ensure operations remain competitive, both economically and environmentally



# COMPETING ECONOMICALLY + ENVIRONMENTALLY



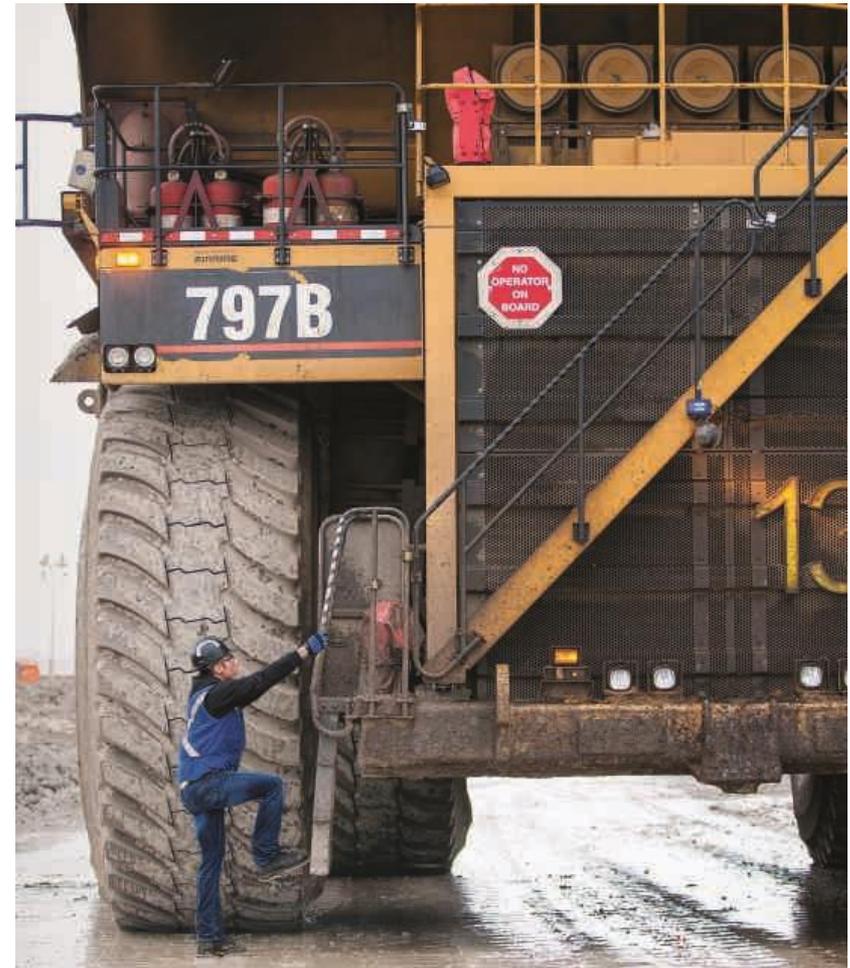
## Examples in practice

### Tailings

- Prescriptive regulation despite different mining profiles
- Drove operators to fastest compliance solution, rather than most efficient
- D74 replaced by new TMF: offers flexibility – less GHGs, less cost, encourages technology development

### Bitumen Recovery

- Regulation (D82) dictates minimum recovery from all ore (>90%)
- Achieving 90% from poorly processing ores drives cost and GHGs for minimal benefit
- Pilot project showing significant potential





## What is COSIA?

- Formed in 2012, first of its kind collaboration among 13 oil sands companies to improve environmental performance
- Sharing environmental technologies
  - ~228 projects at a cost of over C\$400M in development
  - 777 technologies shared, valued at almost C\$1 billion
  - Shell leading or involved in 52 active projects
- Minimizes duplication of effort and investment risk associated with testing numerous technologies

## How Shell has benefitted from COSIA:

- Shell's tailings centrifuge accelerated based on lessons learned from other oil sands operators
- Participating in a major water technology research centre that would not be practical as a single researcher
- Quest learning and information shared with other COSIA companies



**cosia**<sup>®</sup>  
CANADA'S OIL SANDS  
INNOVATION ALLIANCE



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