# THE EVOLUTION OF UNDERGROUND COAL GASIFICATION

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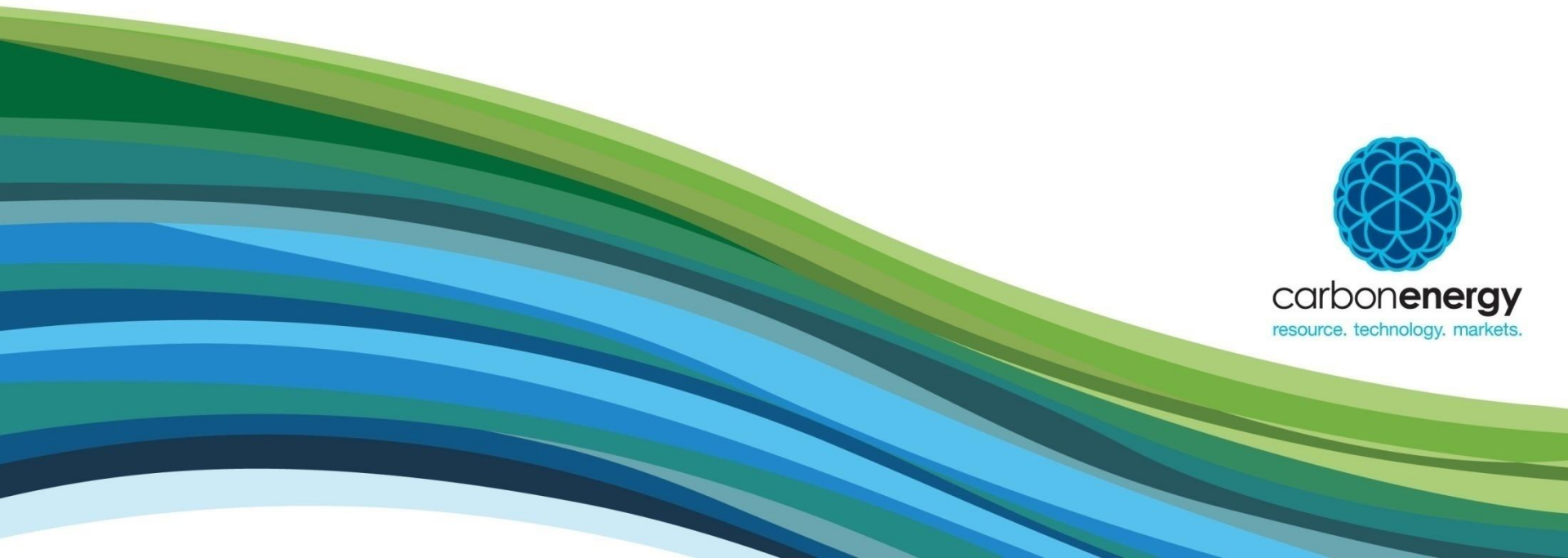

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resource. technology. markets.

# COAL GASIFICATION

150 year history – town gas

Surface retorting of mined coal

Chemical reactions well known



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# UNDERGROUND COAL GASIFICATION

Similar reactions to surface gasification

## Underground Design Challenges

- Make a gasifier vessel as a cavity in coal
- Inject oxidant & extract product gases
- Continuously access fresh coal

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# GASIFIER DESIGNS

## FOR SHALLOW DIPPING COAL

1.Gasifier cavity growing symmetrically between ***fixed*** injection and extraction points

2. Single streaming face gasifier between continually ***retreating*** injection and extraction points



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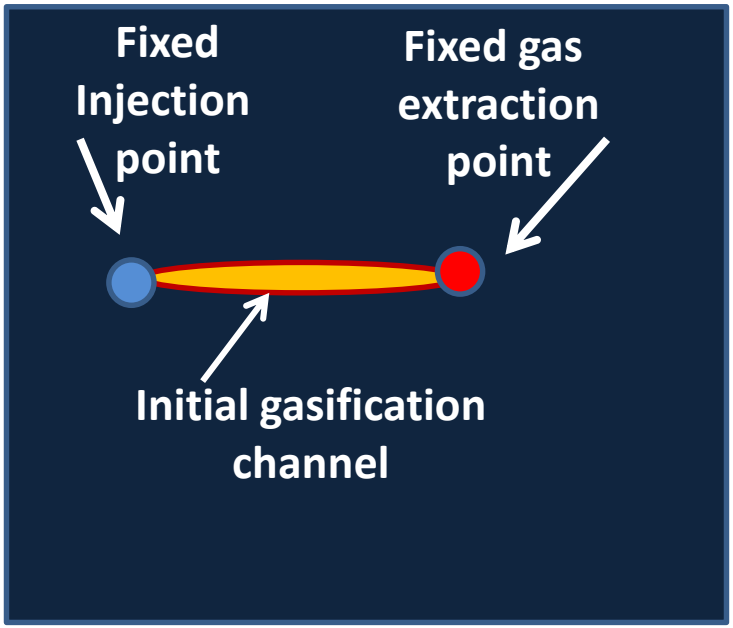
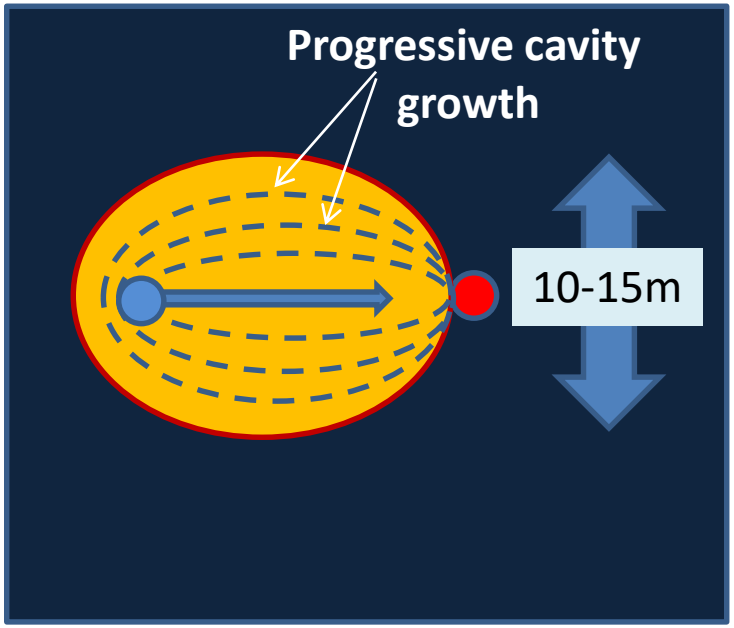
# SINGLE GASIFIER CAVITY

## FIXED INJECTION & EXTRACTION POINTS




**START-UP**

Gasification channel either burnt or drilled

**MATURE**

Cavity grows till gas flow begins to bypass coal

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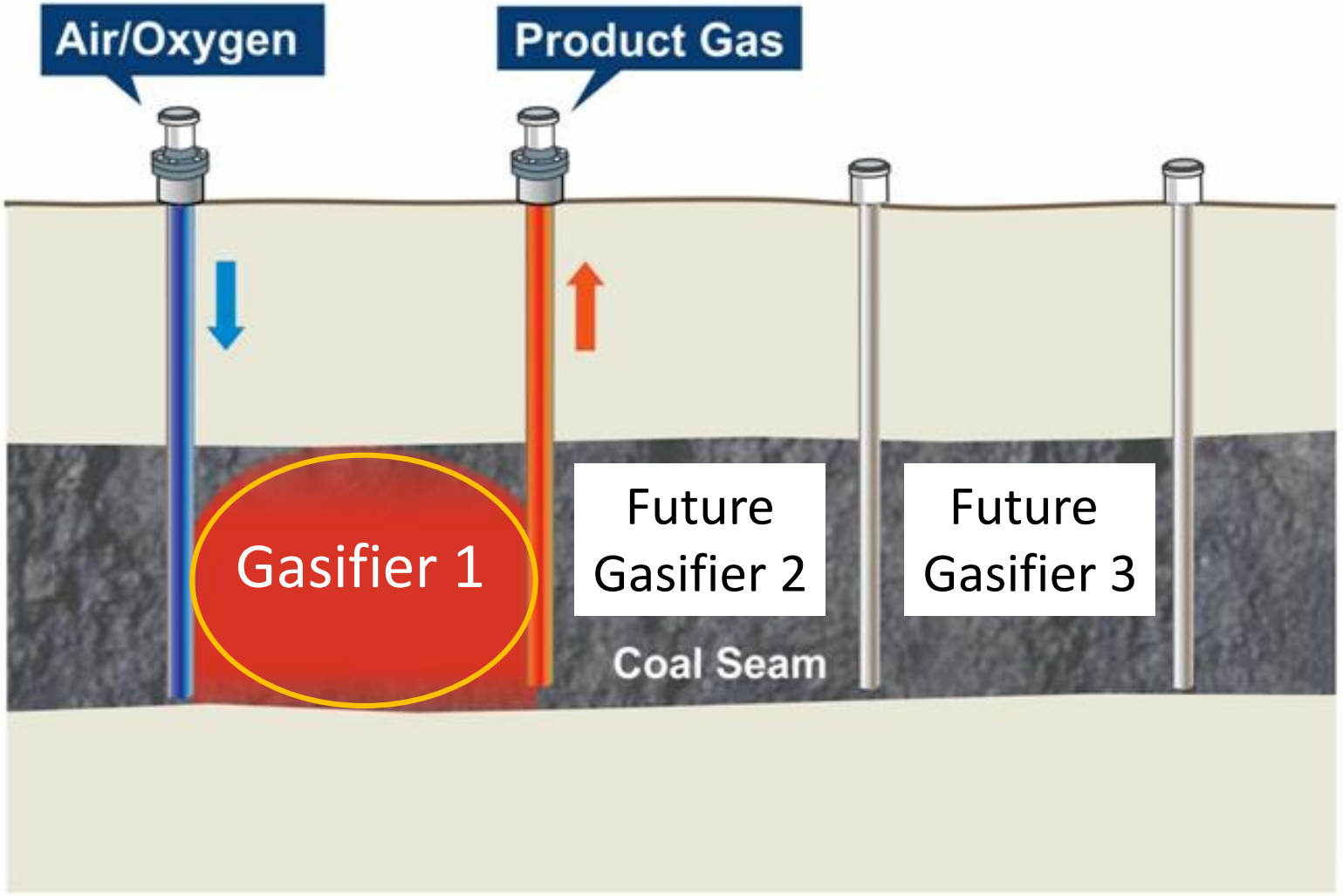
SINGLE GASIFIER CAVITY

# VERTICAL BOREHOLE ACCESS

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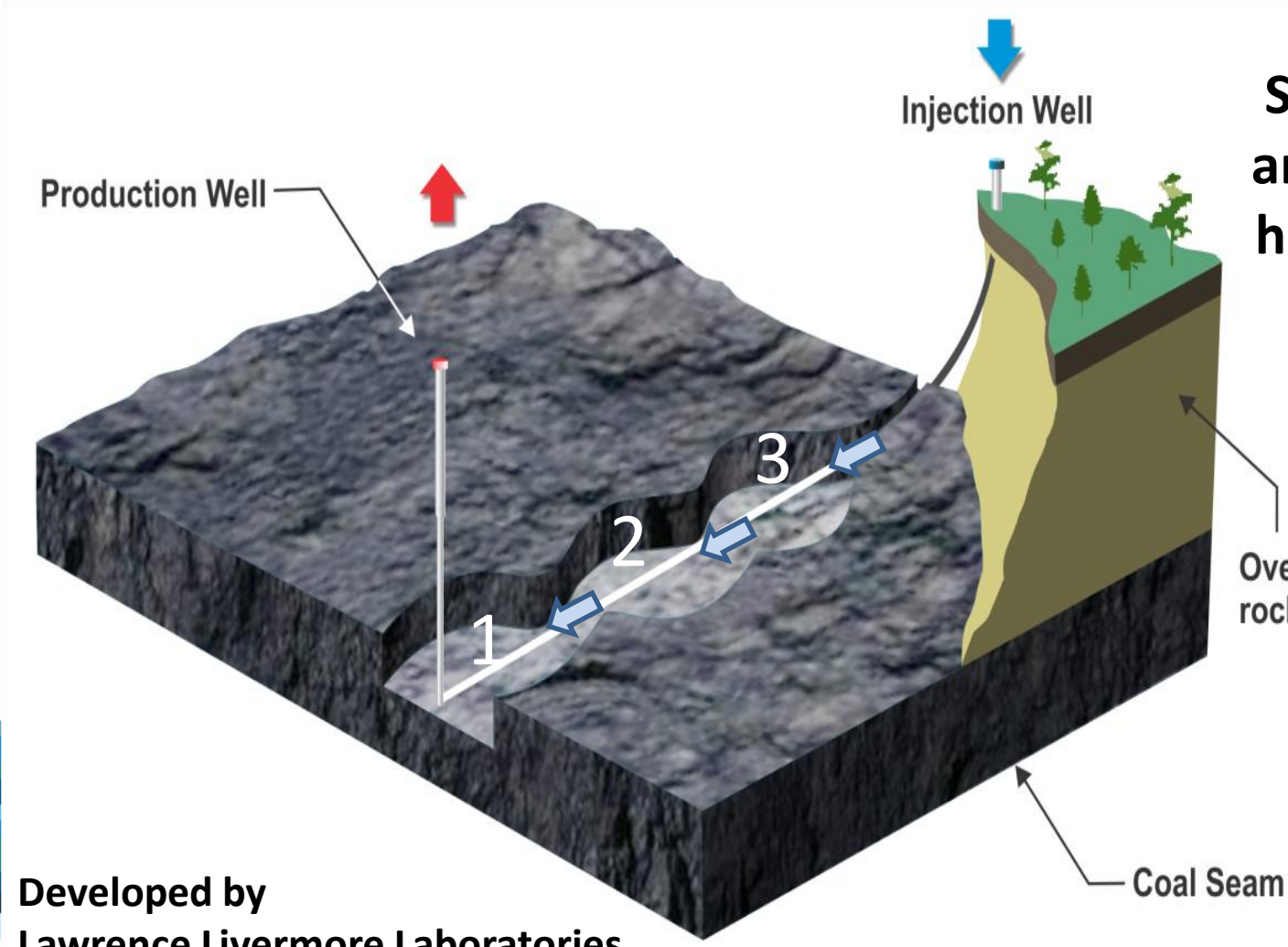
# SINGLE GASIFERS IN SERIES

## LINEAR CRIP

Controlled Retracting Injection Point




**SINGLE GASIFIERS are located along a horizontal in-seam borehole and operated sequentially**

**Developed by Lawrence Livermore Laboratories**

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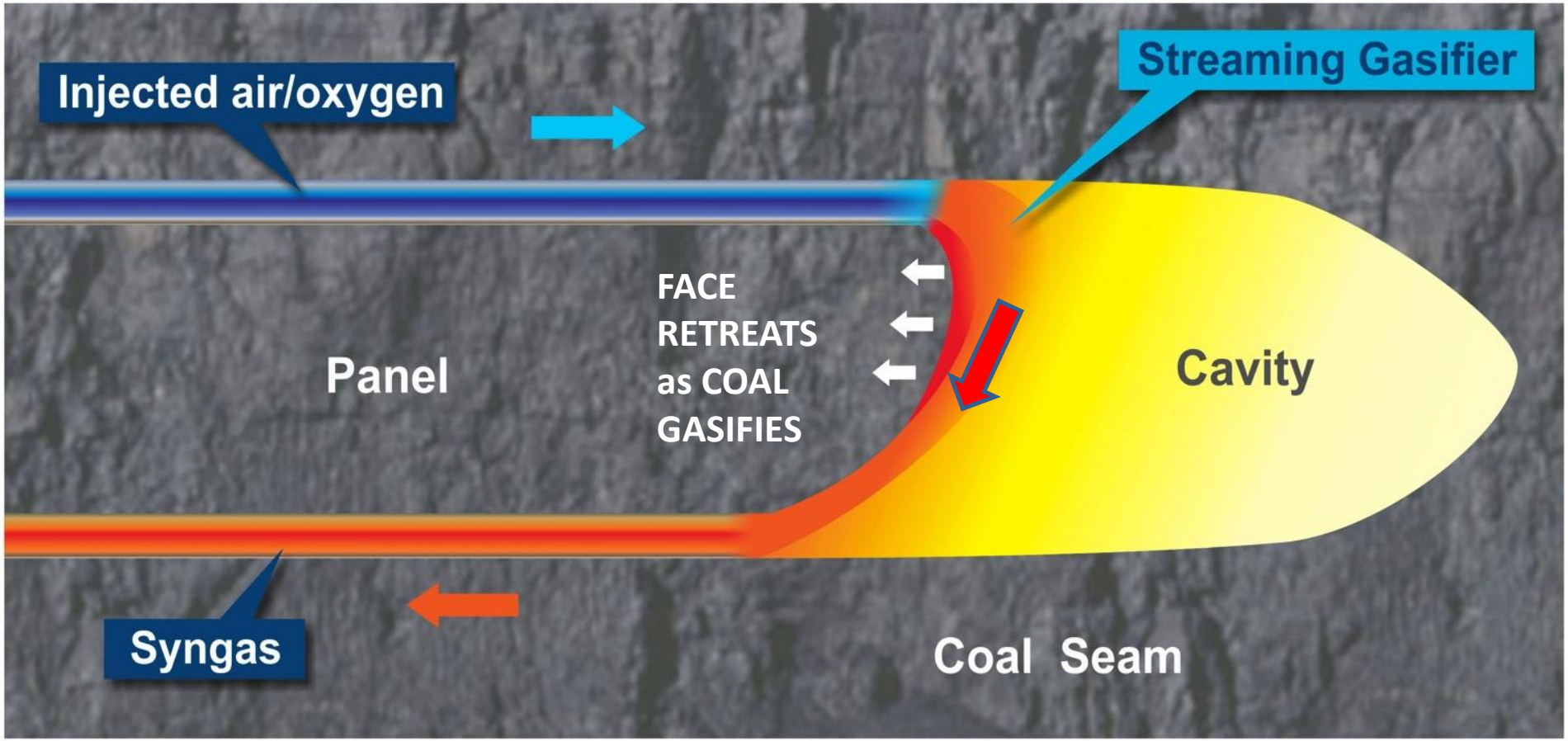
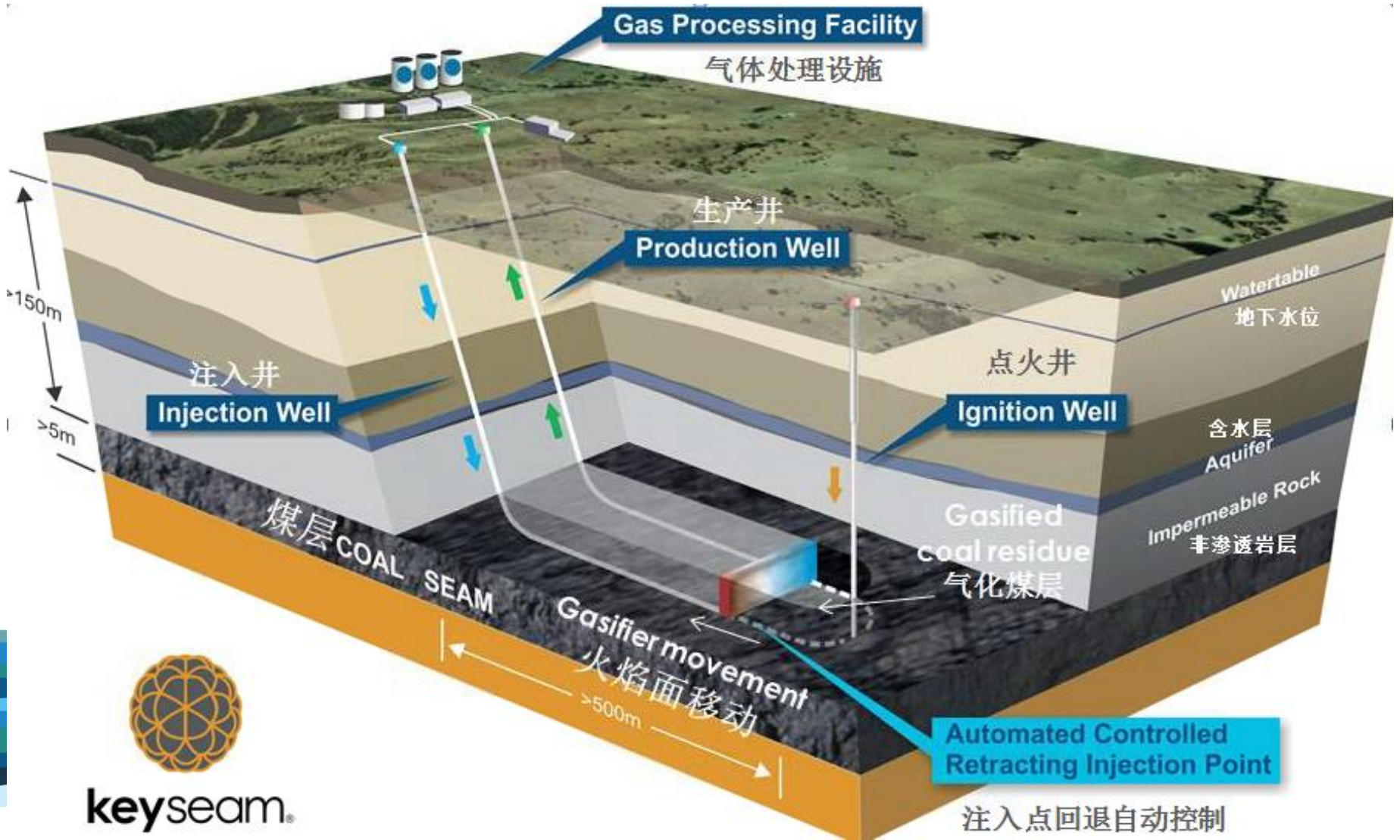
# SINGLE-FACE STREAMING GASIFIER

## PLAN VIEW



# SINGLE FACE STREAMING GASIFIER
# PARALLEL CRIP




keyseam

# GROUND REQUIREMENTS

## SITE SELECTION

Coal and surrounding rocks must maintain the integrity of the gasifier

Remember – Its just a different sort of coal mine



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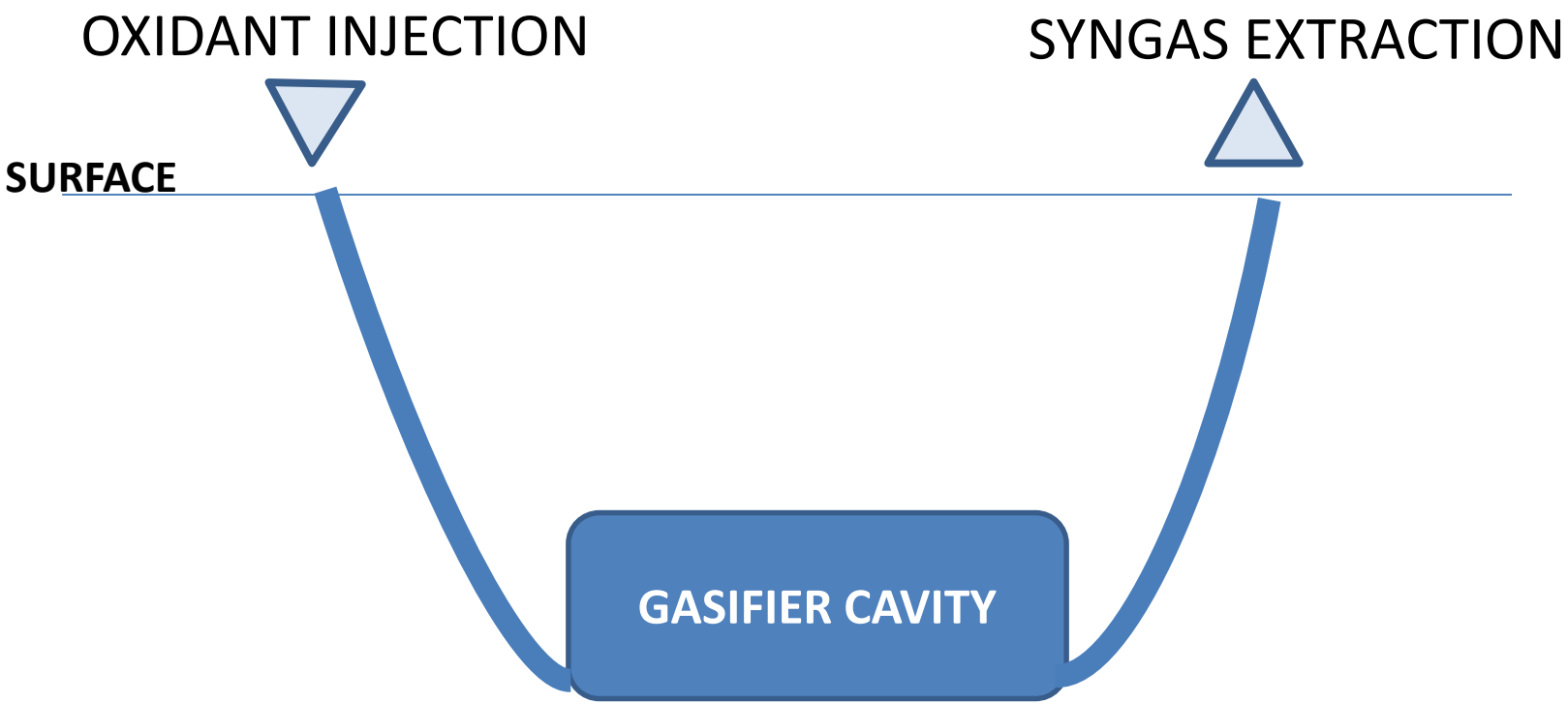
# GASIFIER PRESSURE INTEGRITY
# UNDERGROUND PRESSURE VESSEL




*GASIFIER, INJECTION* and *PRODUCT* lines are a **SINGLE PRESSURE VESSEL**

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# GASIFIER PRESSURE INTEGRITY
# SURROUNDING MATERIALS


The gasifier cavity is overlain by ROCK with side walls of COAL

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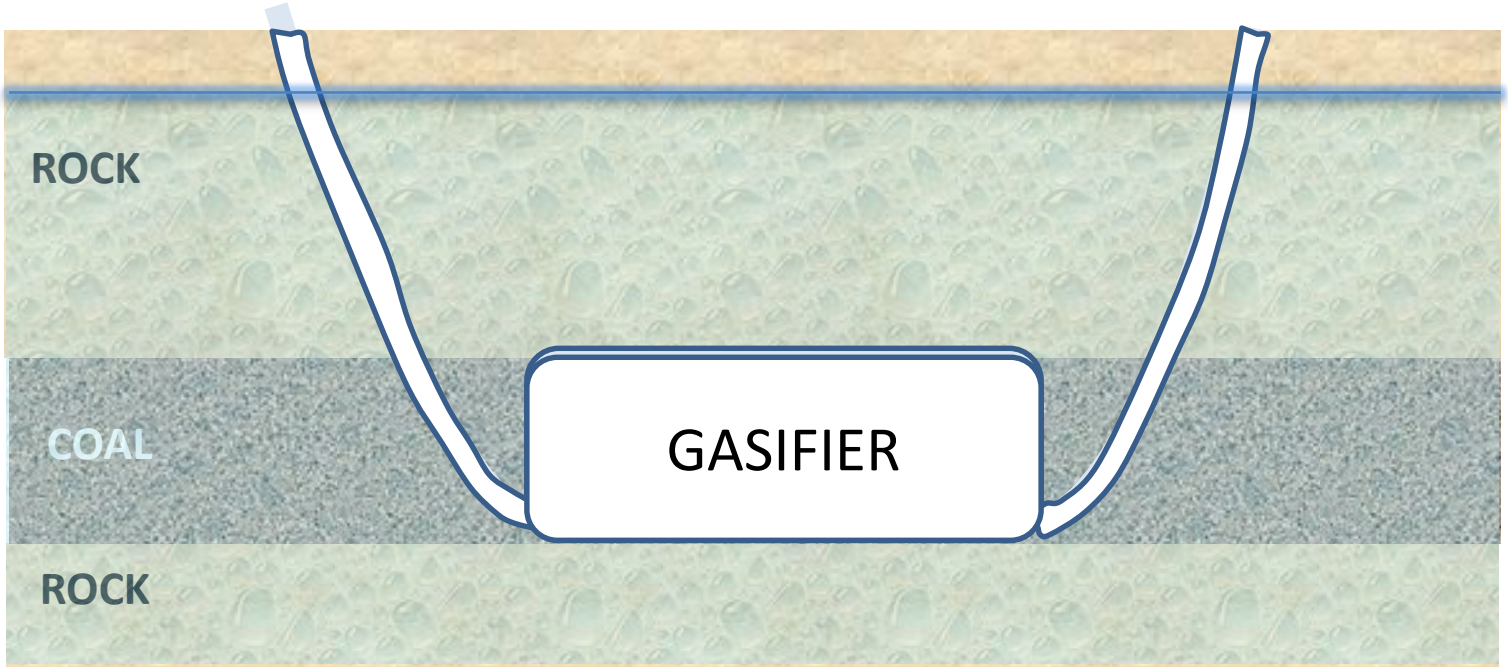
# GASIFIER PRESSURE INTEGRITY

# SURROUNDING GROUNDWATER




The ROCK and COAL are filled with GROUNDWATER

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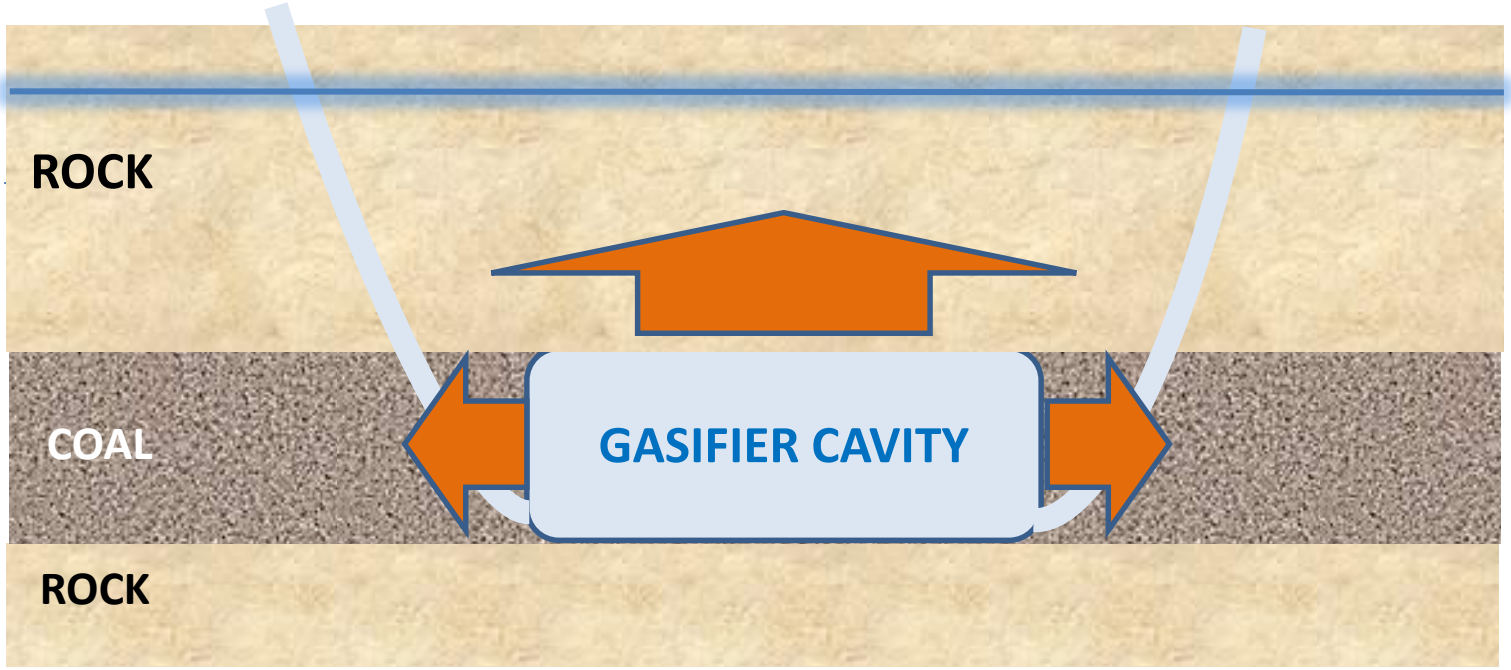
GASIFIER PRESSURE INTEGRITY

# GAS ESCAPE PATHWAYS




GAS flows **UP** towards the surface and **sideways** through COAL fractures

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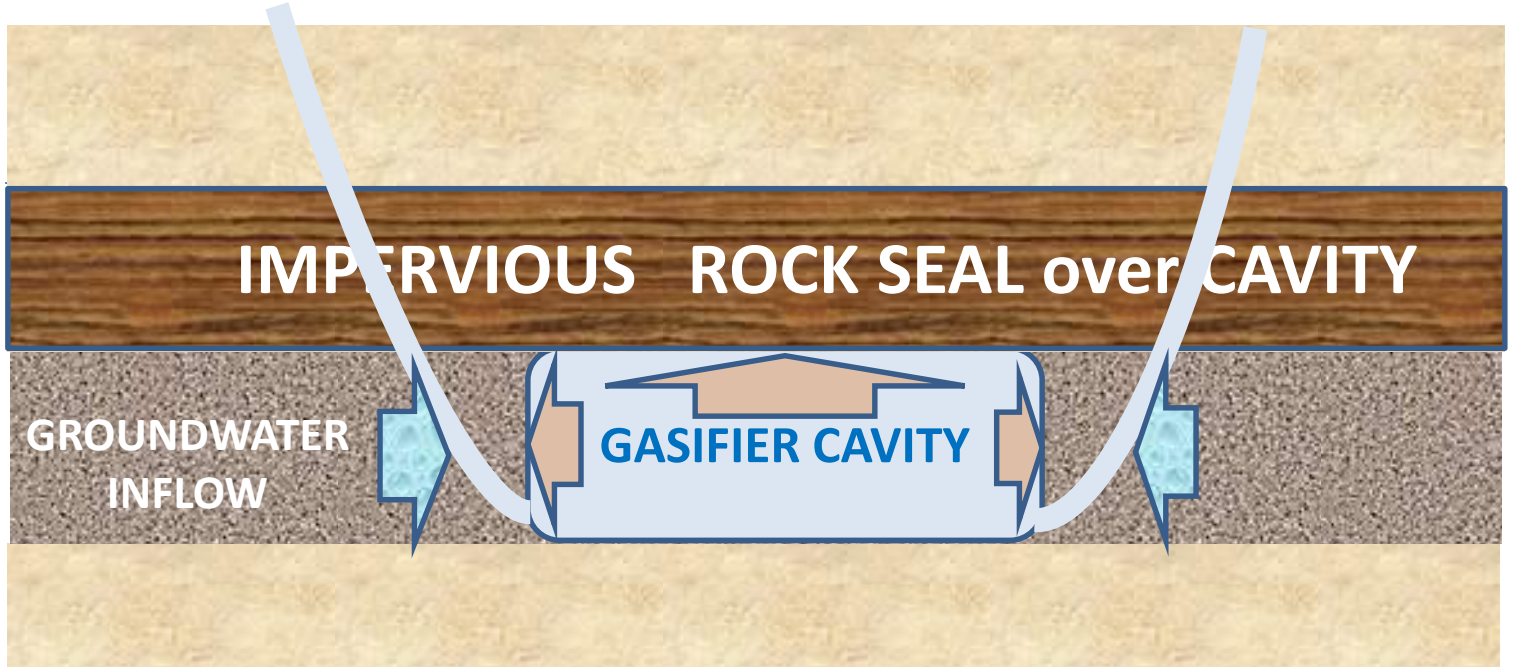
# GASIFIER PRESSURE INTEGRITY

# PREVENTING GAS ESCAPE




**Upward** gas flow stopped by a ROCK SEAL

**Sideways -** water inflow at higher pressure

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# OPERATIONS

## ENVIRONMENTAL CONTROL OF CHEMICAL BY-PRODUCTS

No long term reduction of environmental values for a site



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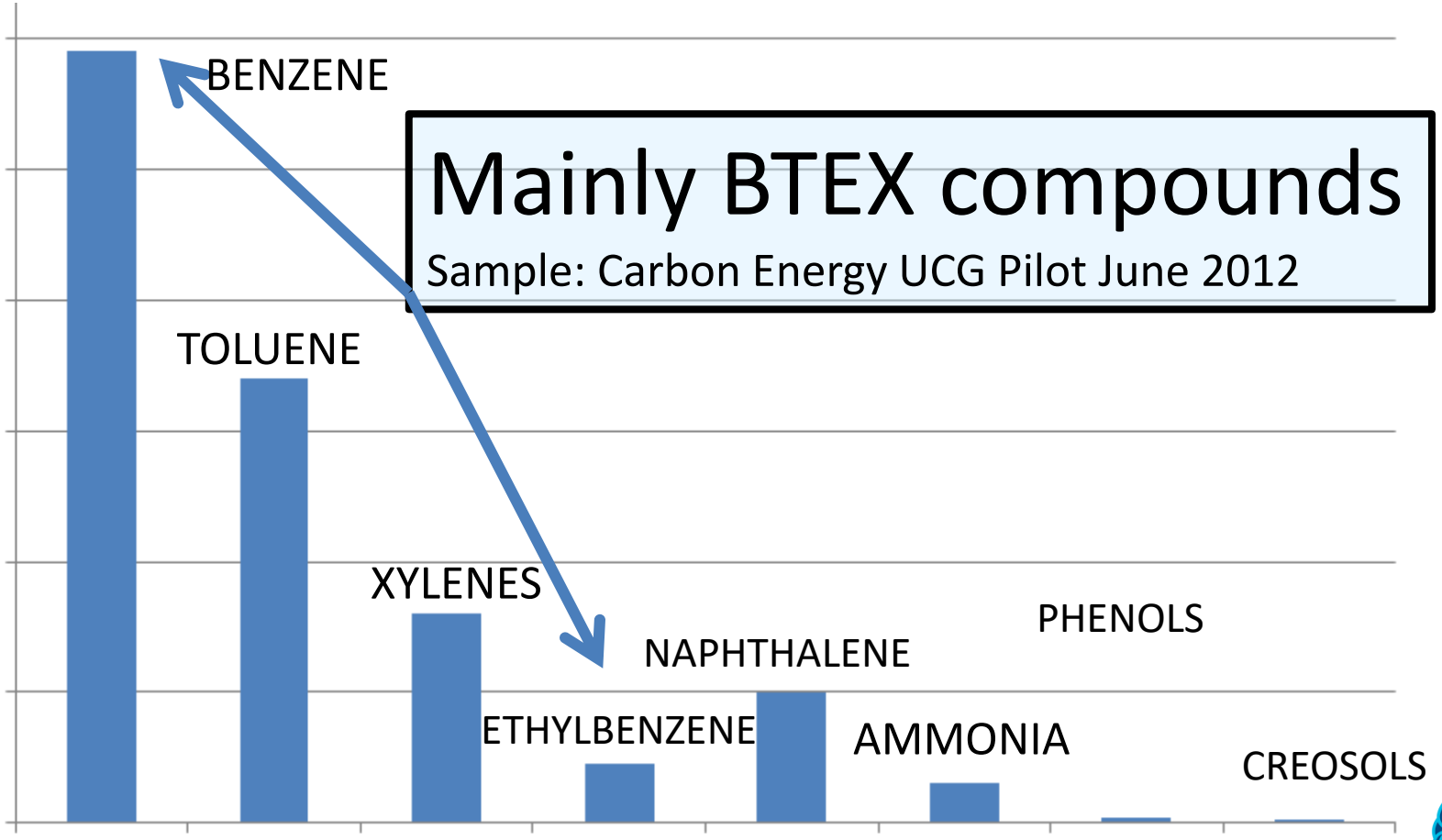
# CONTAMINANTS

## RELATIVE % VOC* IN UCG SYNGAS




* VOC = Volatile Organic Compounds

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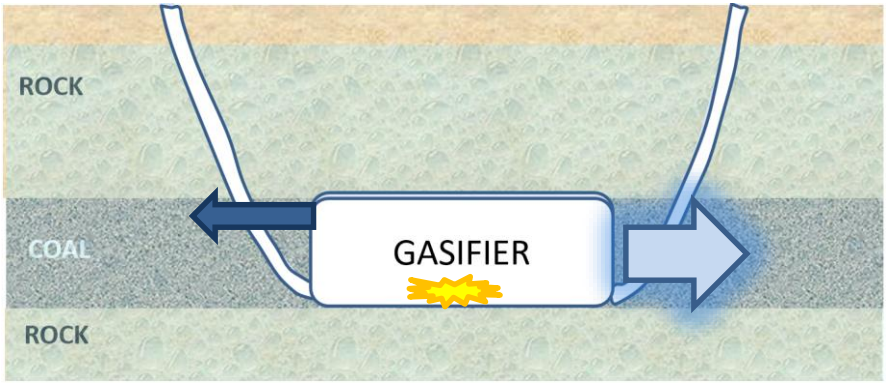
# CONTAMINANTS

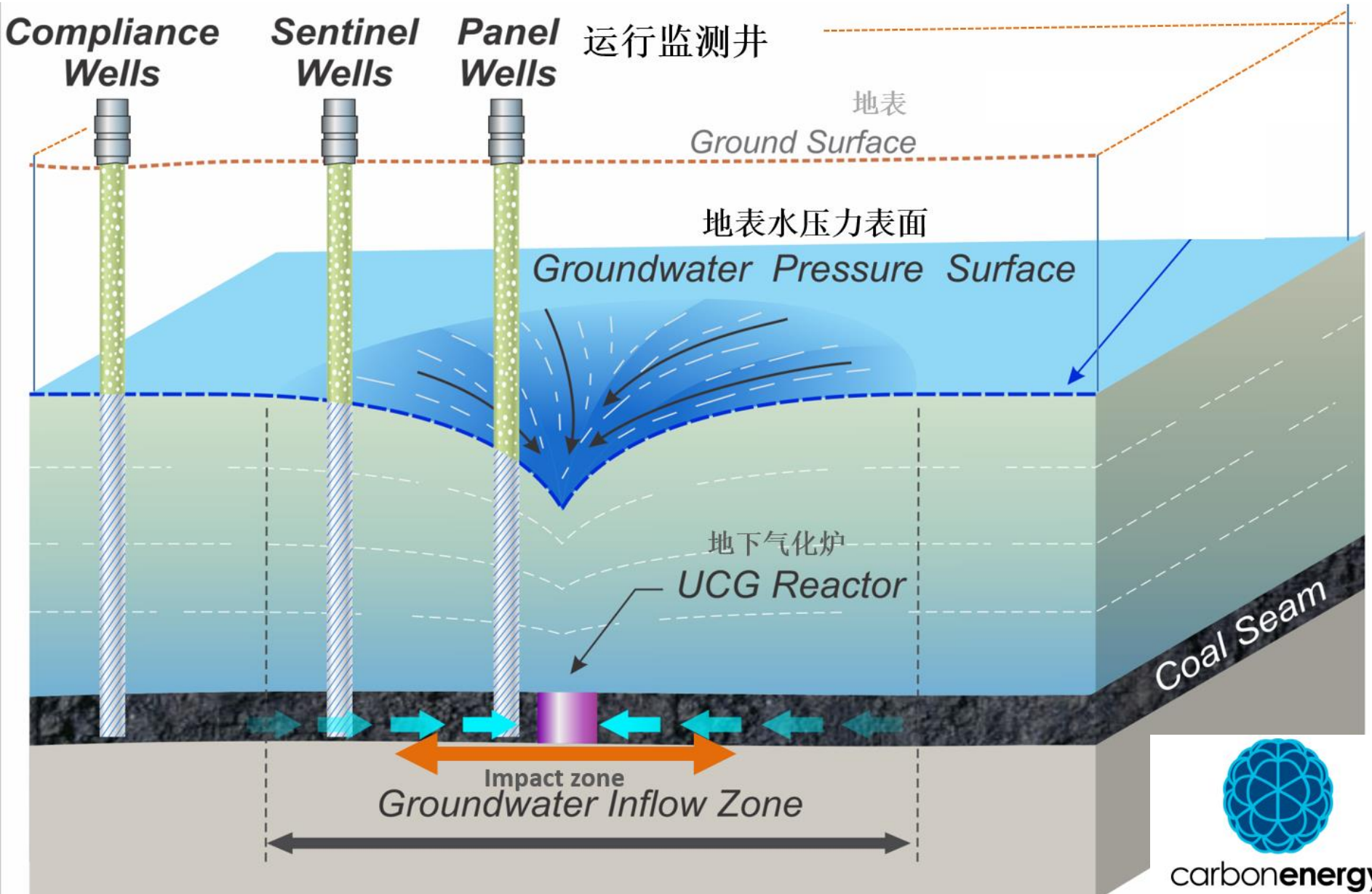
# POTENTIAL DISPERSAL VOC




- Deposited underground in cooler sites
- Diffusion of gases in groundwater
- Advection in escaping water

Most are carried to surface with syngas, extracted and treated with process water

# PROTECTIVE WATER INFLOW ZONE

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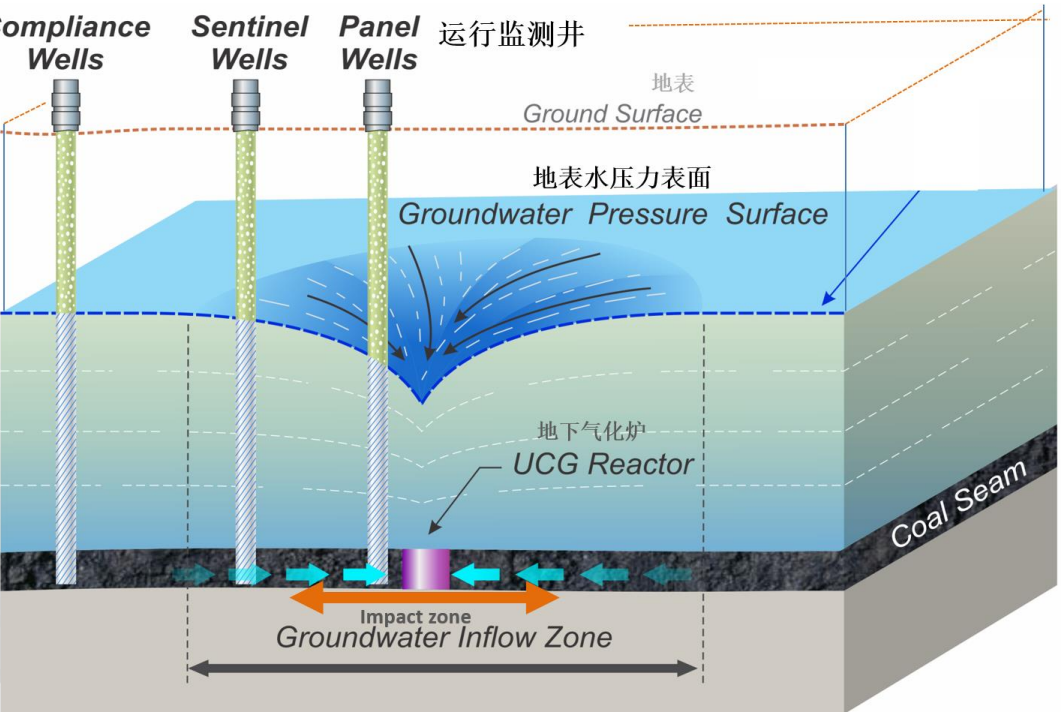
CONTAMINANTS

# CLEAN CAVERN CONCEPT

## ALWAYS keep water flowing into gasifier

UCG Gasifier kept below surrounding groundwater pressure.




*By-products of the process cannot go against the "tide" of groundwater which is always flowing into the Gasifier –*
***No advection of contaminants***

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# DECOMMISSION & CLEANUP

Stop oxidant injection

Drop gasifier pressure

Groundwater inflows turns to steam

Vent steam & stripped chemicals

Example: 92% of insitu chemicals removed

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# PROTOCOLS FOR UCG

Have achieved potential for commercial UCG

- Efficient underground gasifier designs
- Ground conditions for gasifier integrity
- Environmental control of VOC

**Establish International Protocols for UCG**

is a primary target for the UCG Centre

provide standards for regulatory supervision of the industry

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# UCG – FACES A PERFECT STORM

## Negative perceptions of UCG - failures

ANTI-FOSSIL FUEL LOBBY  Social media uses *Alternative Facts* (even before President Trump)

INDUSTRY COMPETITORS  Coal Seam Gas, Surface gasifiers

GOVERNMENT BANS  Queensland, Scotland


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# FUTURE OF UCG - CHALLENGES

## TECHNOLOGY

Establish credibility

***STANDARDS*** for operation

## POLICY

***Innovative*** *Clean* use of COAL

***CO2*** Management advantages

***New industries*** SNG, chemicals, fuels, deep resource access

## FINANCE

***RISK INVESTMENT*** new technology

***COST*** combined UCG and syngas use plant

***DEMONSTRATIONS*** small scale starter plants not profitable

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# CONTACT DETAILS联系方式

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