



**UP HERE TOO MUCH
CO₂ IS A PROBLEM**

**THE PETERHEAD
CARBON CAPTURE
AND STORAGE PROJECT**



**DEEP DOWN UNDER
THE NORTH SEA
THERE IS A SOLUTION**

CAUTIONARY STATEMENT

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this presentation “Shell”, “Shell group” and “Royal Dutch Shell” are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words “we”, “us” and “our” are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. “Subsidiaries”, “Shell subsidiaries” and “Shell companies” as used in this presentation refer to companies in which Royal Dutch Shell either directly or indirectly has control. Companies over which Shell has joint control are generally referred to as “joint ventures” and companies over which Shell has significant influence but neither control nor joint control are referred to as “associates”. The term “Shell interest” is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management’s current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management’s expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as “anticipate”, “believe”, “could”, “estimate”, “expect”, “goals”, “intend”, “may”, “objectives”, “outlook”, “plan”, “probably”, “project”, “risks”, “schedule”, “seek”, “should”, “target”, “will” and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this presentation, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell’s products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell’s 20-F for the year ended December 31, 2014 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward looking statements contained in this presentation and should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation, 25 March 2015, Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this presentation.

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POPULATION – 2 BILLION MORE PEOPLE BY 2050



Developing World

2015 - 6 billion
2050 - 6 billion



Developed World

1 billion
3 billion

ACCESS TO ENERGY - MAKES ALL THE DIFFERENCE



 forum for
the future

Black Gold

3 large spoonfuls of crude oil =
8 hours of human manual labour

“It’s as if each of us had a team
of slaves working for us for
next to nothing.”
(Colin Campbell)



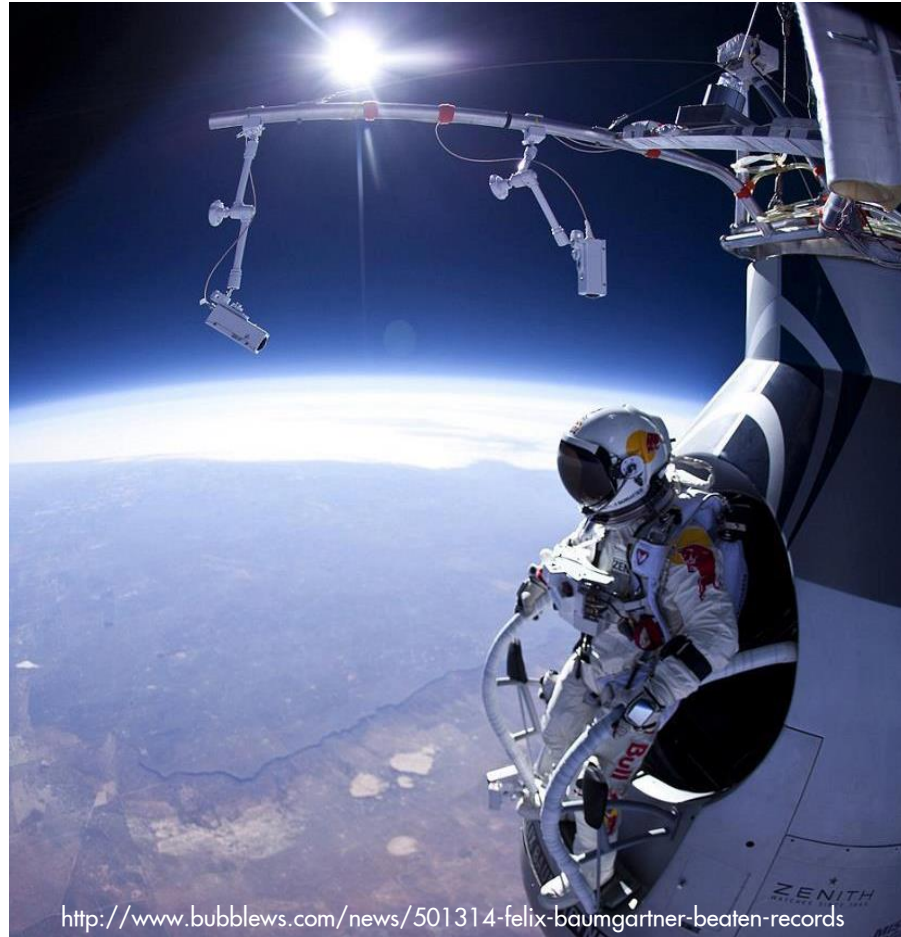
WHAT GOES UP ... MUST COME DOWN ... SURELY?



But CO₂ can remain in the atmosphere for over 100 years



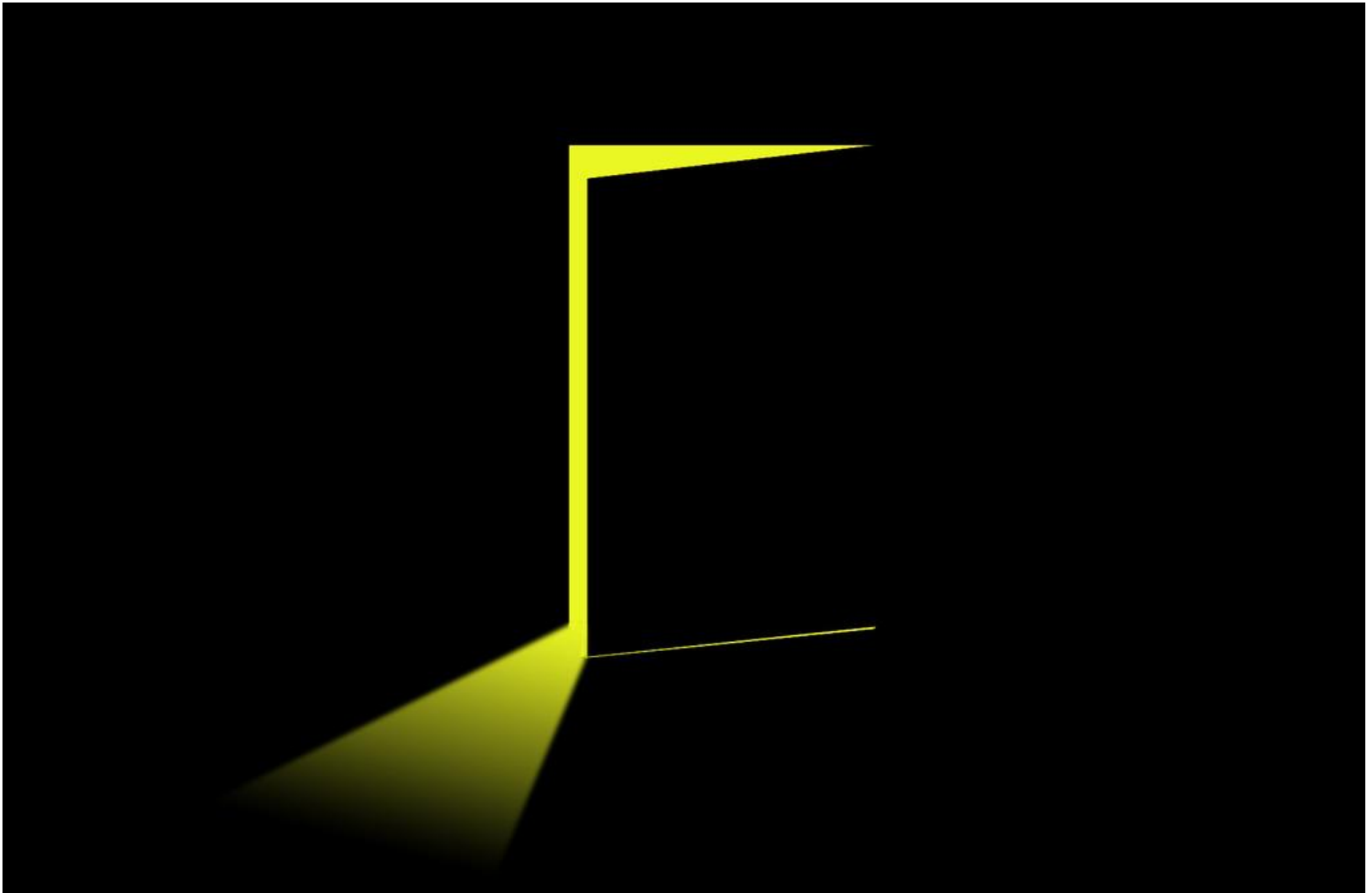
FELIX BAUMGARTNER ... 24 MILES ABOVE THE EARTH



<http://www.bubblews.com/news/501314-felix-baumgartner-beaten-records>

80% of our atmosphere is in the first 10 miles, and CO₂ is rapidly accumulating in it.

THE DOOR TO A 2° (1 Trillion Tonnes) WORLD IS CLOSING




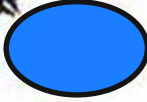

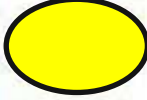

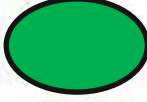

THERE IS NO SILVER BULLET



We need;

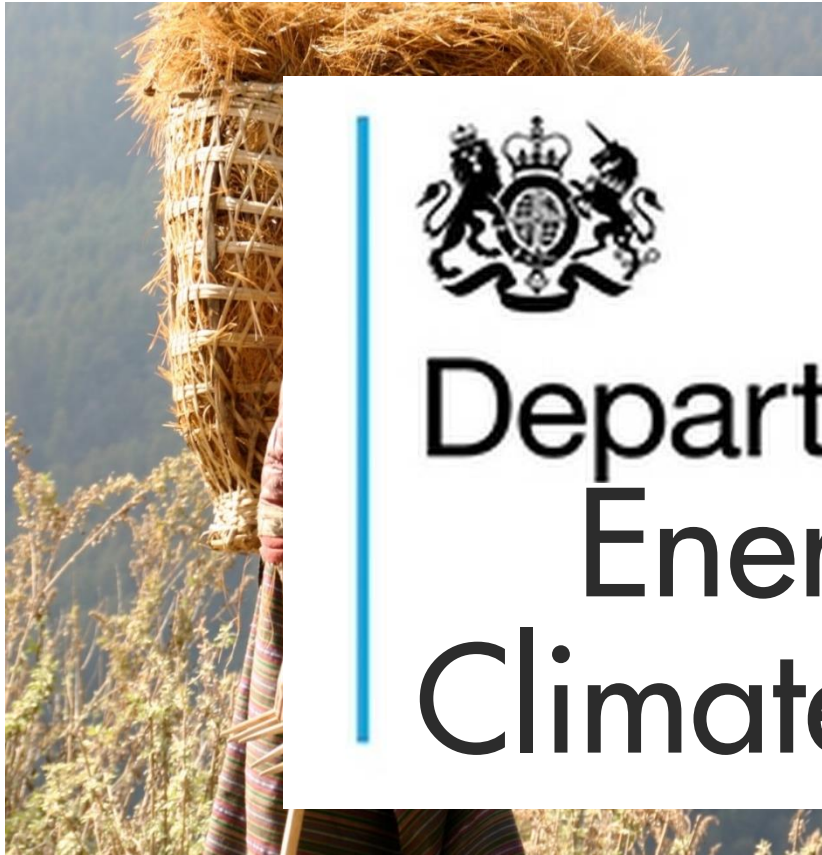
- ~ twice the energy
- &
- ~ half the CO₂

6 'MUST DO' ACTIONS TO AVOID EXCEEDING 2°C

- 
-  Fuel Switching
 -  Renewables
 -  Efficiency
 -  Behaviour Change
 -  Nuclear
 -  Carbon Capture & Storage

Being good at 4 or 5 categories is not good enough

ENERGY & CLIMATE CHANGE ARE INSEPARABLE



Department Energy & Climate Change



<http://www.bubblews.com/news/501314-felix-baumgartner-beaten>

IT IS GOOD FOR THE UNITED KINGDOM

Prize for Britain

32 Billion

£/Annum

Without CCS, the additional costs to run a decarbonised UK economy in 2050 will be £32Billion.

UK Energies Technology Institute

Government Objective

... by the 2020's, private sector electricity companies can take investment decisions to build CCS equipped fossil fuel electricity generation facilities without Government capital subsidy at an agreed contract for difference strike price that is competitive with the strike price for other low carbon generation technologies"

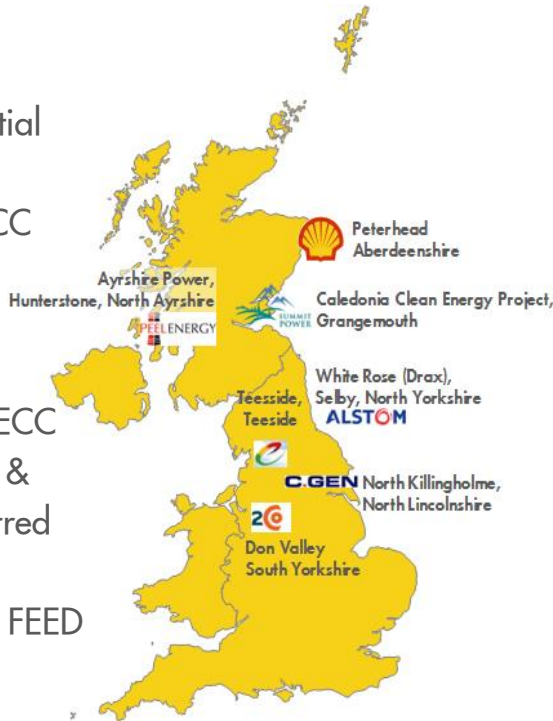
IT IS GOOD FOR THE UNITED KINGDOM

Prize for Competitors & Competition History

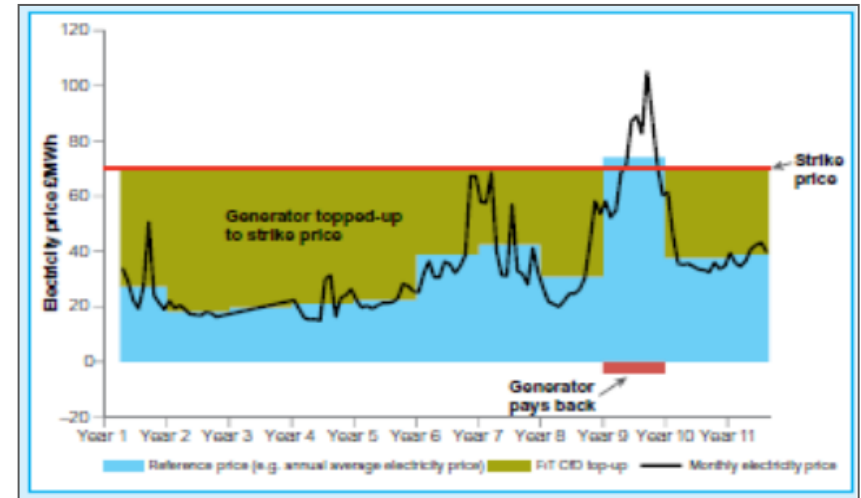
Prize – DECC grants £1 billion capital to project(s)

History

- July 2012 – Eight initial bids
- October 2012 – DECC select four bidders
- January 2013 – Bid Improvement
- 20 March 2013 – DECC announce Peterhead & White Rose as preferred bidders..
- 24 February 2014 – FEED contract signed



Contract for Difference



- Mechanism to guarantee a pre-defined price per MWh which the Generator will receive for its clean electricity ("Strike Price")

CCS IN SCOTLAND & THE UK



“The Scottish Government supports CCS as a critical new technology that can assist Scotland, and other countries, to help meet significant carbon emissions reductions, as well as make a significant contribution to security of supply and promote economic growth opportunities.”

Scottish Government, December 2011

“Today’s announcement moves us a significant step closer to a Carbon Capture and Storage industry – an industry which will help reduce carbon emissions and create thousands of jobs.”

UK Government, March 2013 – on announcing preferred bidders in the CCS Programme Competition



ENERGY & ENVIRONMENT – HIGH ON THE POLITICAL AGENDA



PROPOSED PETERHEAD PROJECT AT A GLANCE

- **World First** –the first full-scale CCS project on a gas-fired power station,
- **Status** – Proposal currently in Front End Engineering Design phase, seeking necessary regulatory approvals and Government funding for capital and operating expenses.
- **Where** – capture at Peterhead Power Station; storage in depleted Goldeneye gas reservoir (100 KM offshore)
- **Impact** –10 million tonnes of CO₂ captured over a ten-year period (90% CO₂ capture from one turbine)
- **Technology** – post-combustion capture using amines



PETERHEAD CONFIGURATION

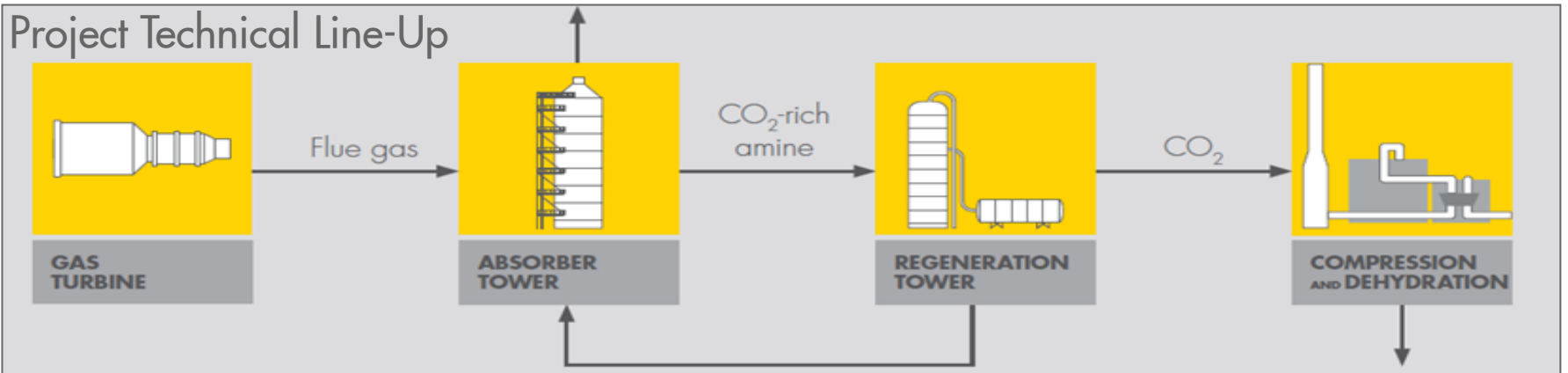
Peterhead Power Station



Goldeneye Platform



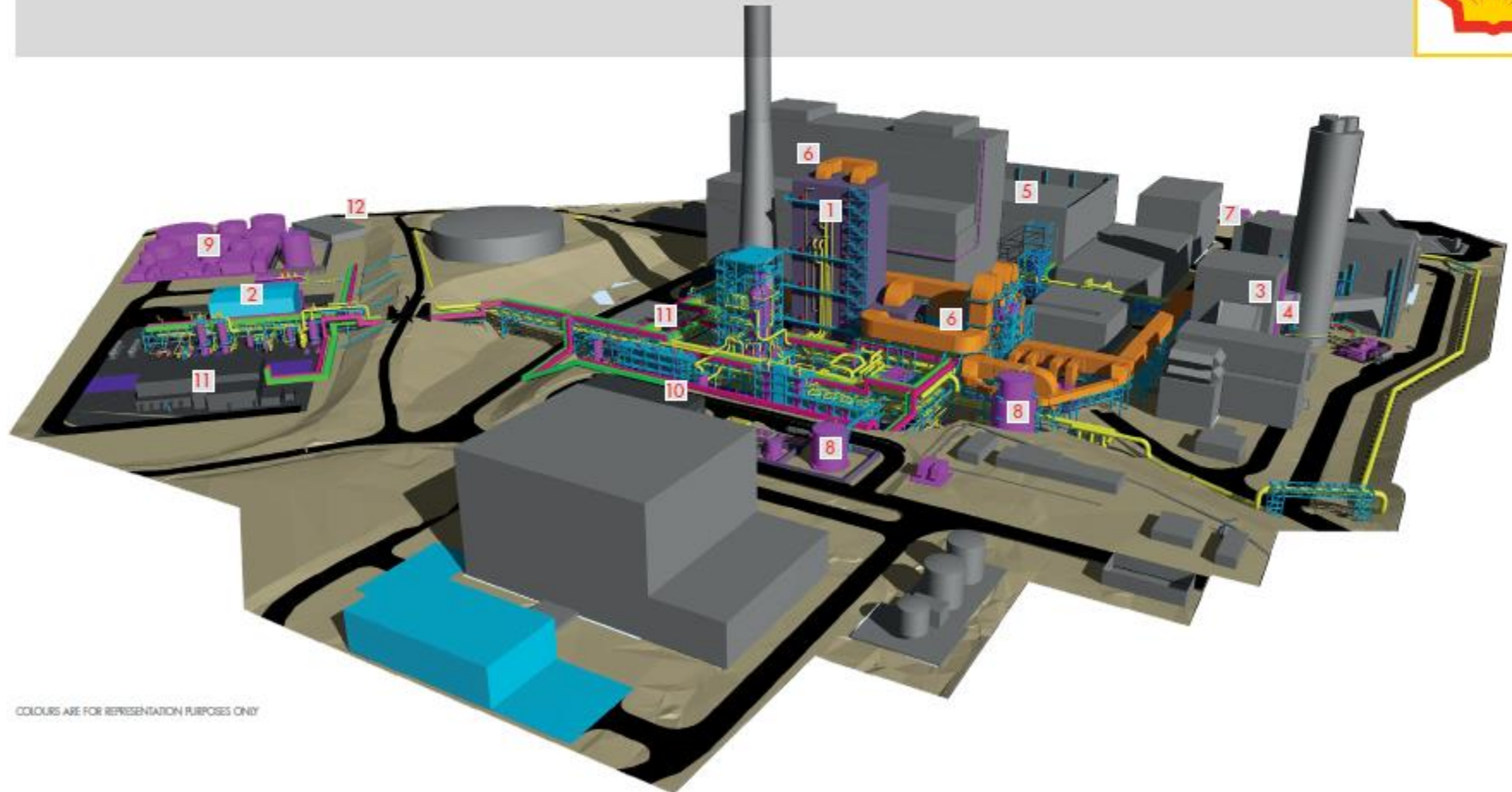
Project Technical Line-Up



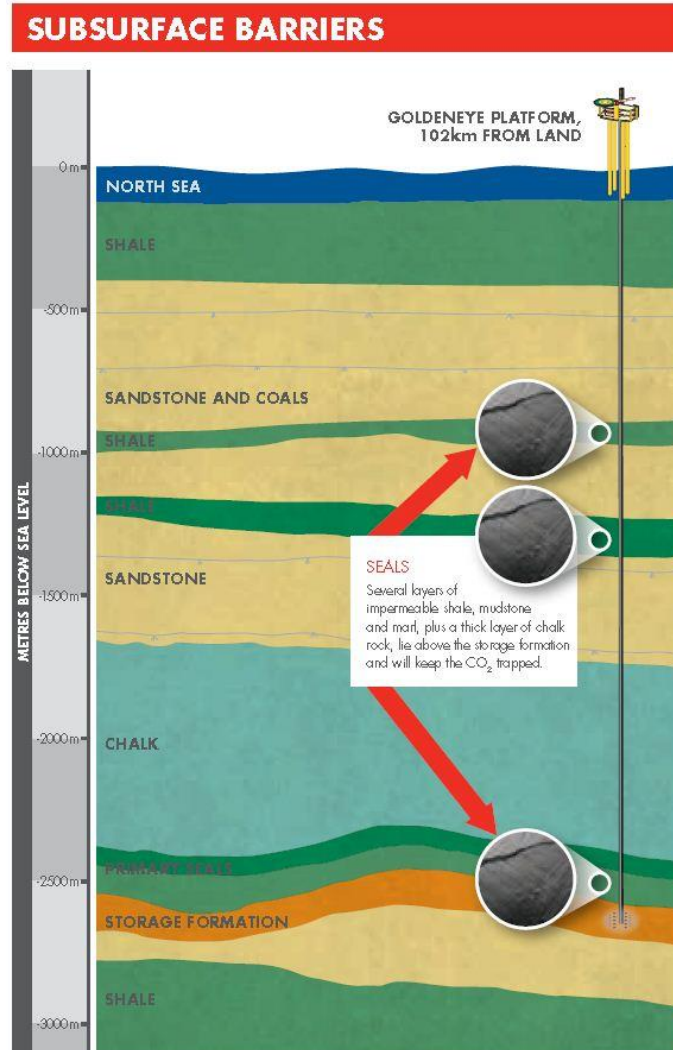
WHAT THE PROJECT REQUIRES

New pieces of equipment and modifications to existing equipment at the Peterhead power station will be required to enable the carbon capture process to be integrated into the site. These will include:

1. A CO₂ absorber tower
2. A compression and conditioning plant
3. The heat-recovery steam generator
4. A selective catalytic reduction system
5. A new steam turbine
6. Replacement auxiliary boilers
7. The seawater cooling system
8. Amine tanks
9. A waste-water treatment plant
10. A control room and office block
11. Power supply and substations
12. An export pipeline.

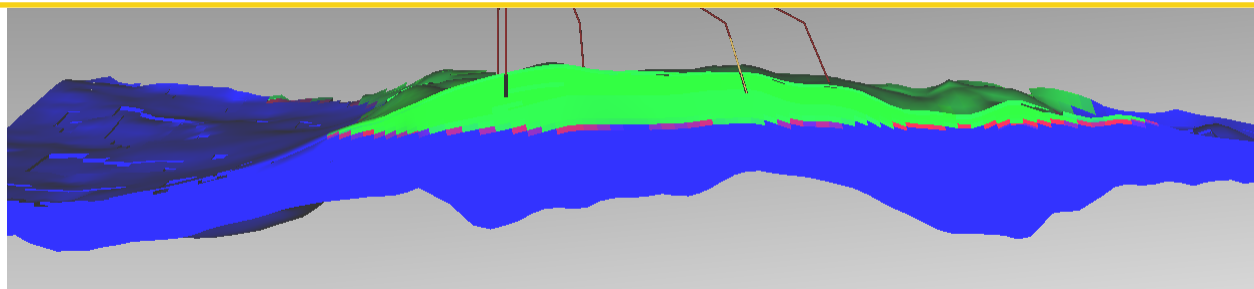


STORING CO₂ SAFELY BENEATH THE NORTH SEA

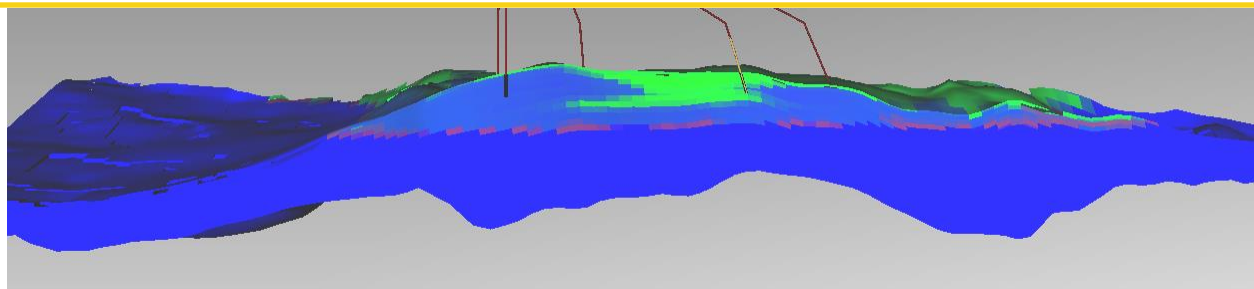


PRODUCTION BEHAVIOUR HISTORY MATCHED AND FORWARD MODELLED

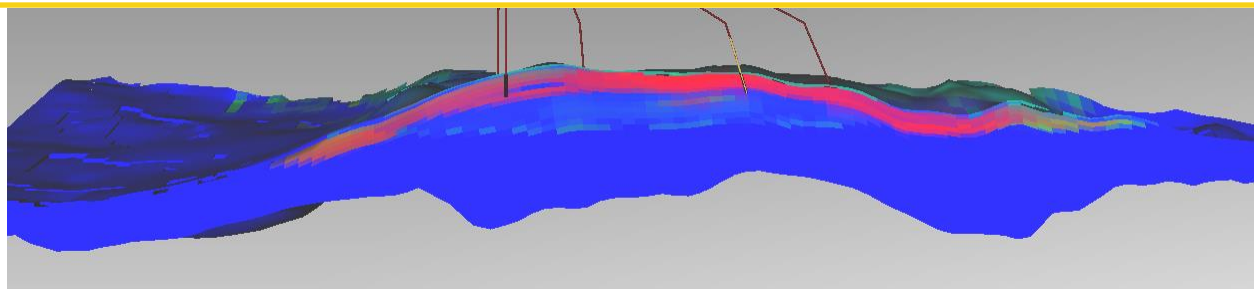
Pre-production



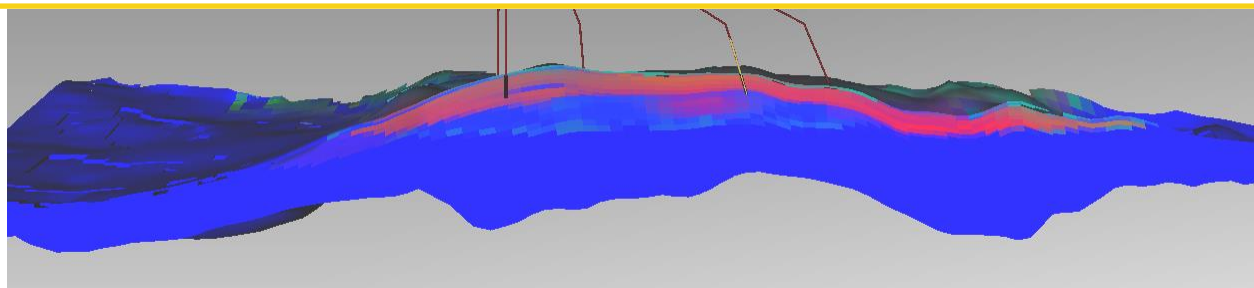
■ At COP



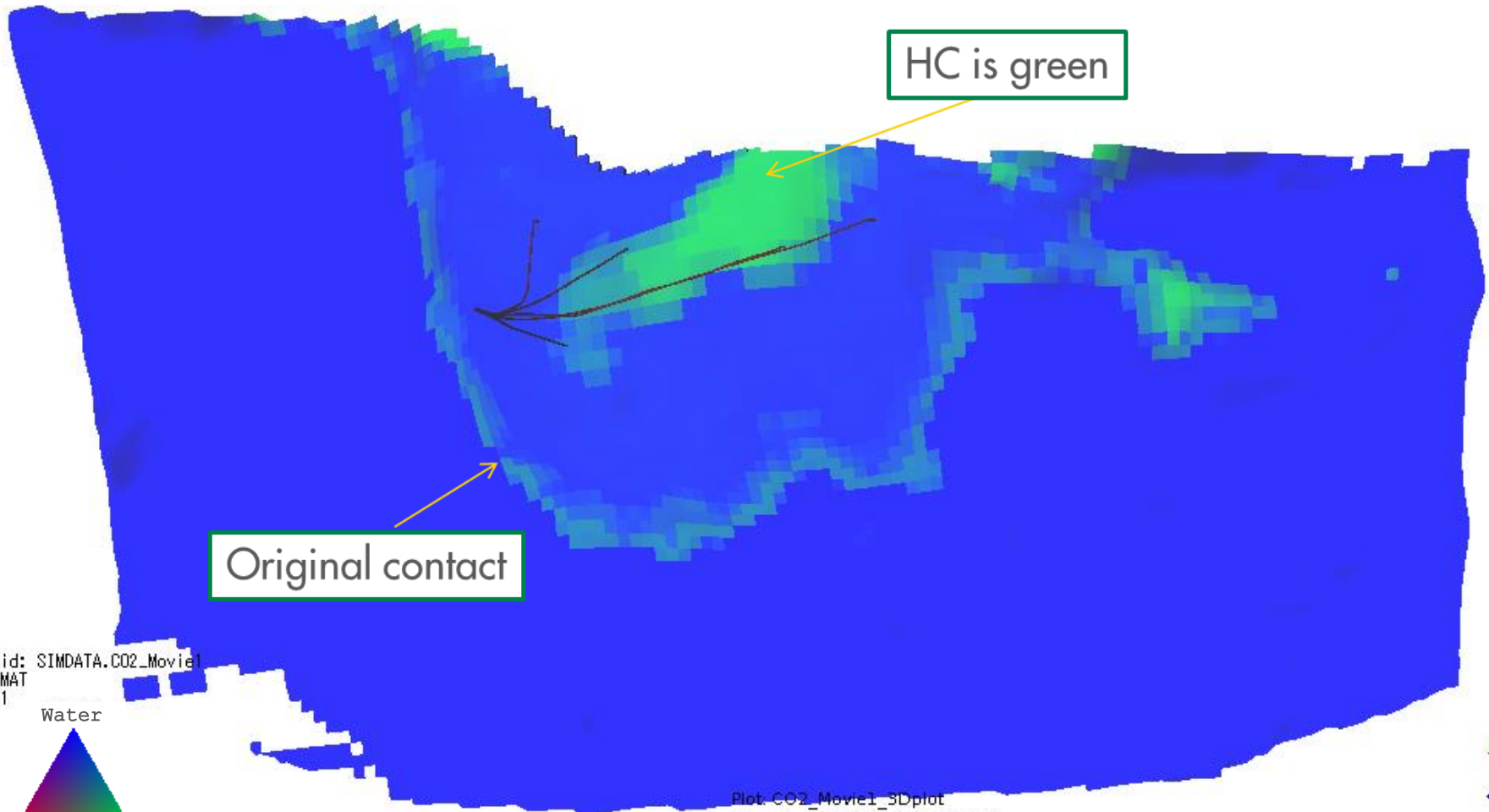
■ At end of injection



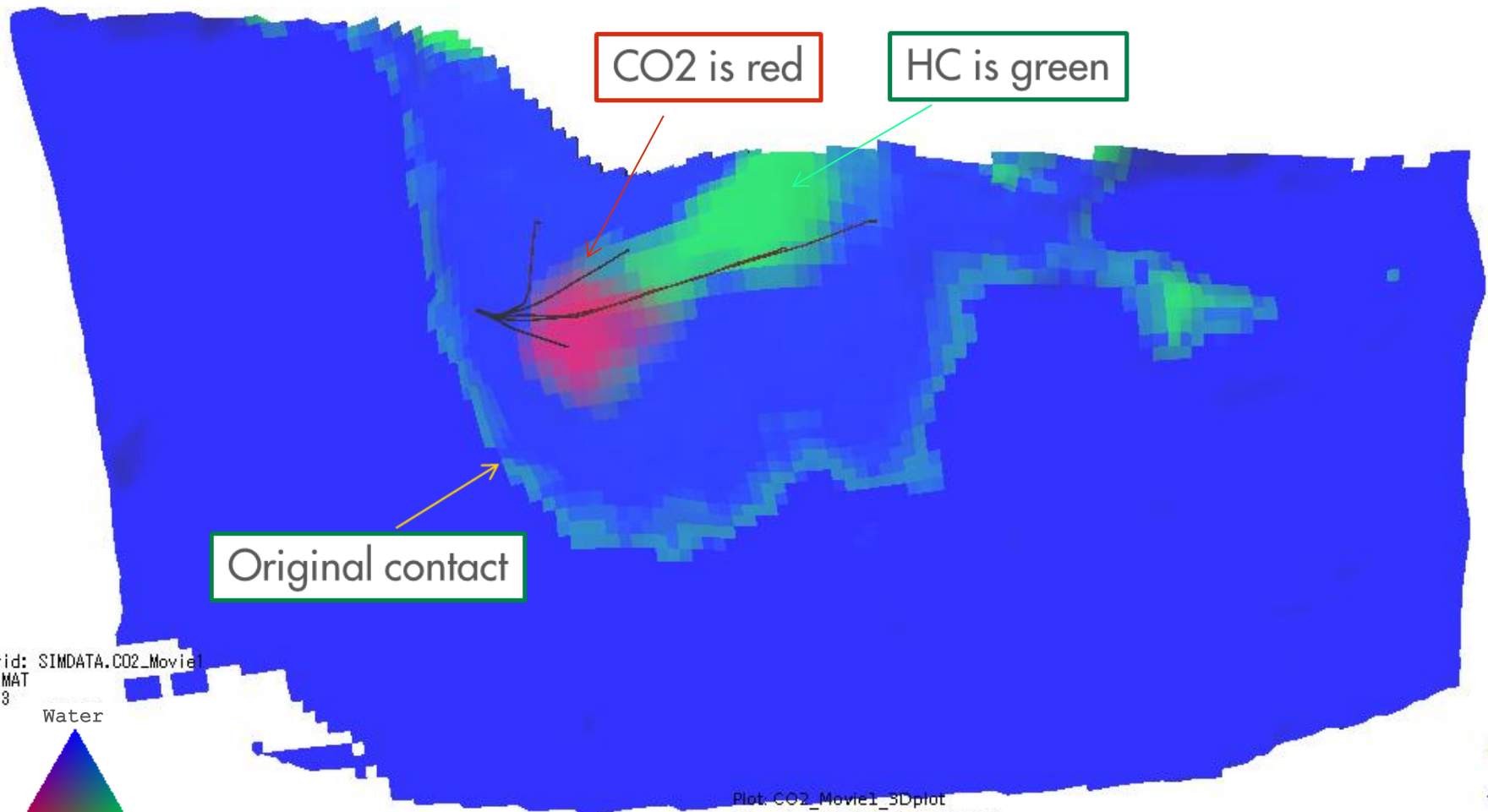
■ After 100 years



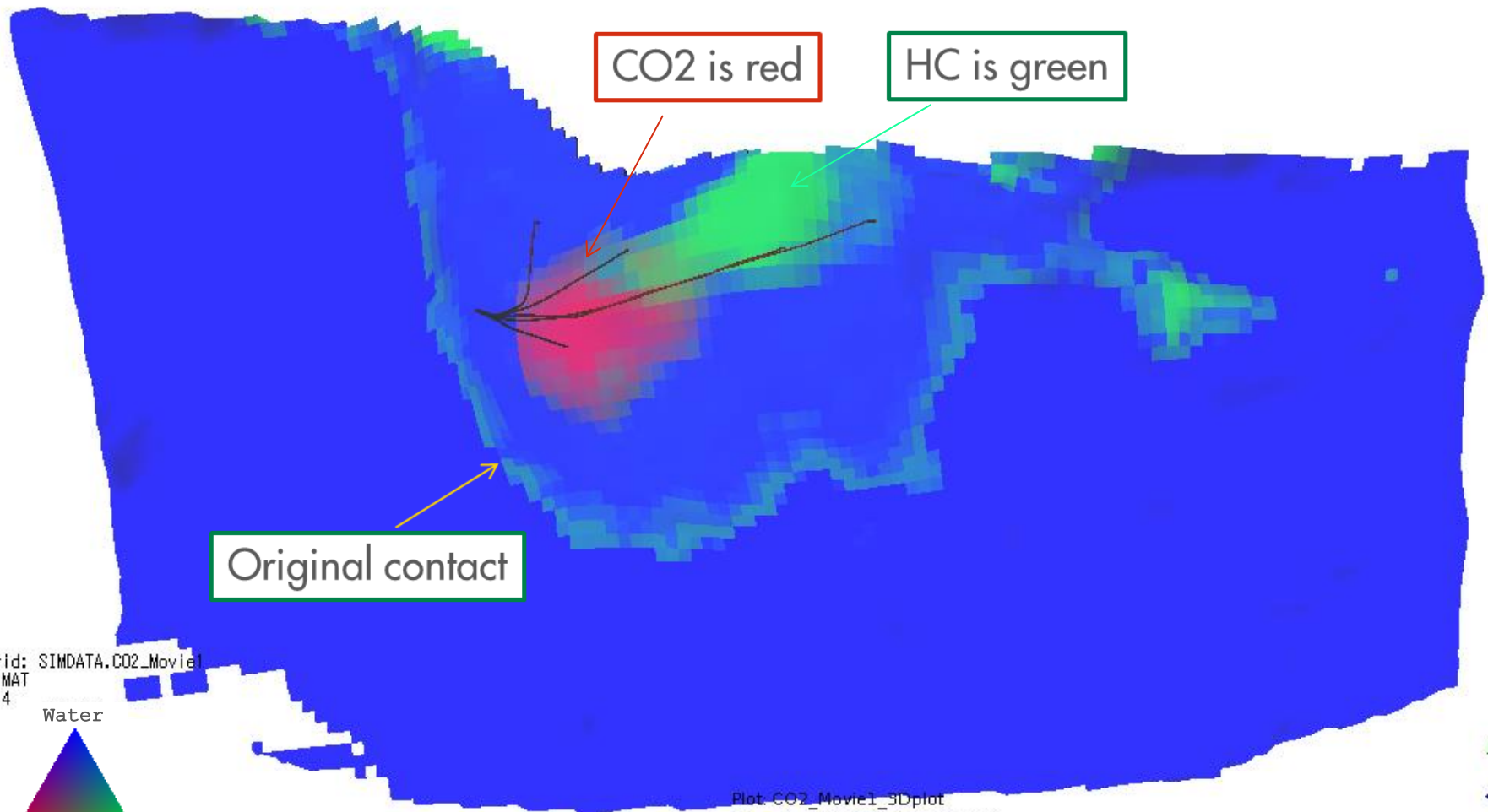
SIMULATION EXAMPLE: BEFORE INJECTION



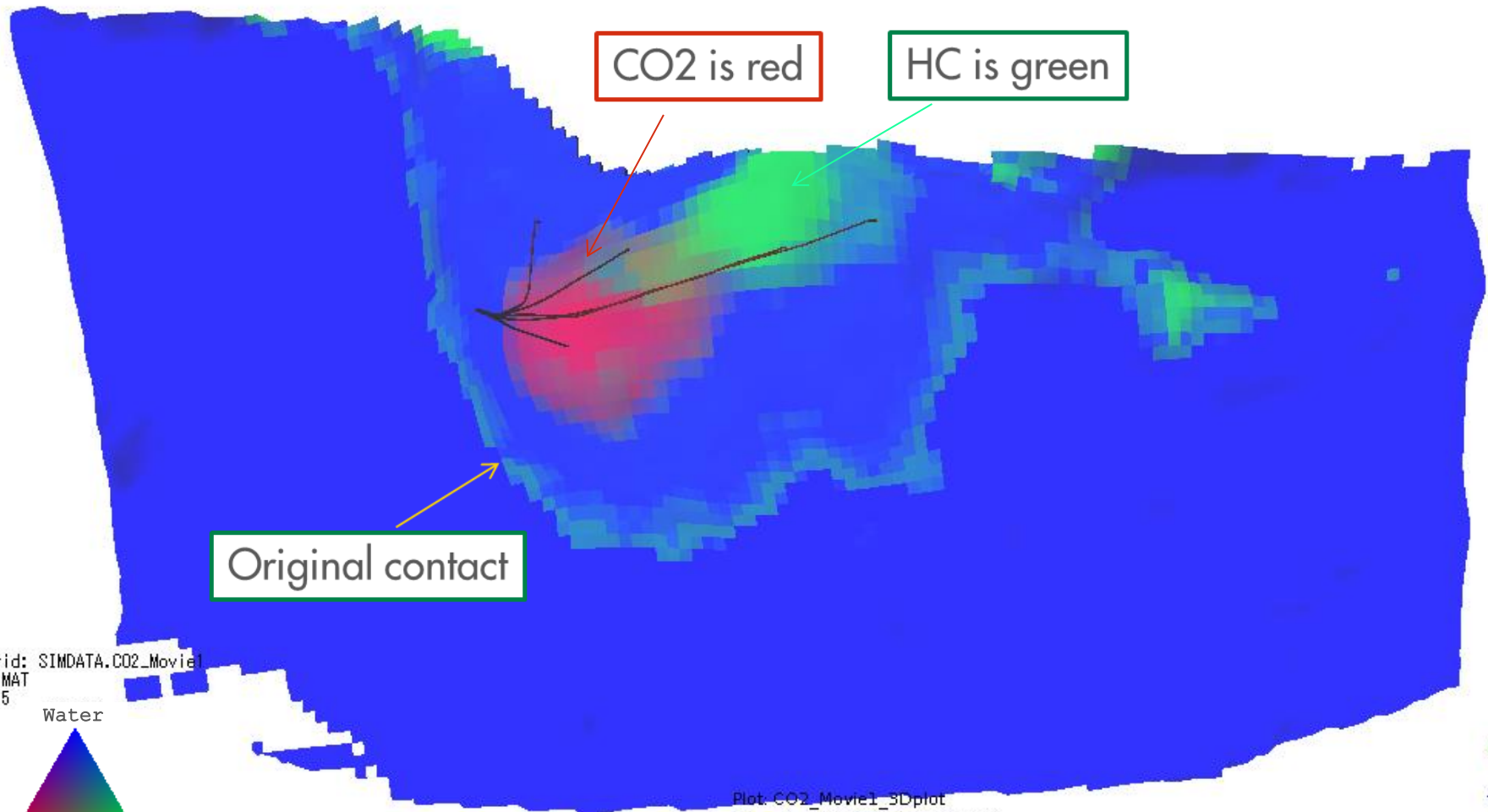
1 YEAR OF INJECTION



2 YEARS OF INJECTION



3 YEARS OF INJECTION

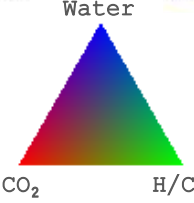


Original contact

CO2 is red

HC is green

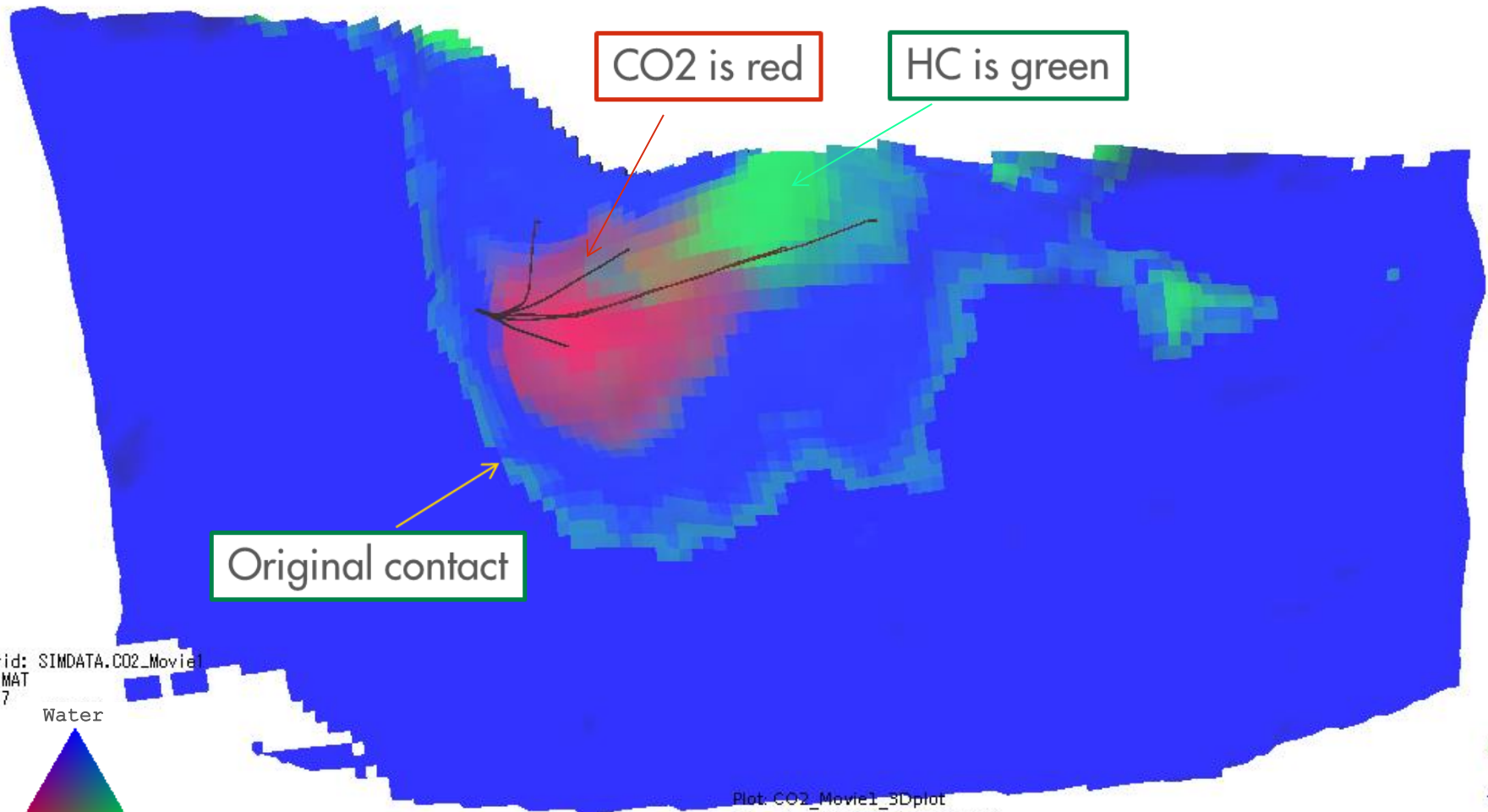
Grid: SIMDATA.CO2_Movie1
F:MAT
T:5



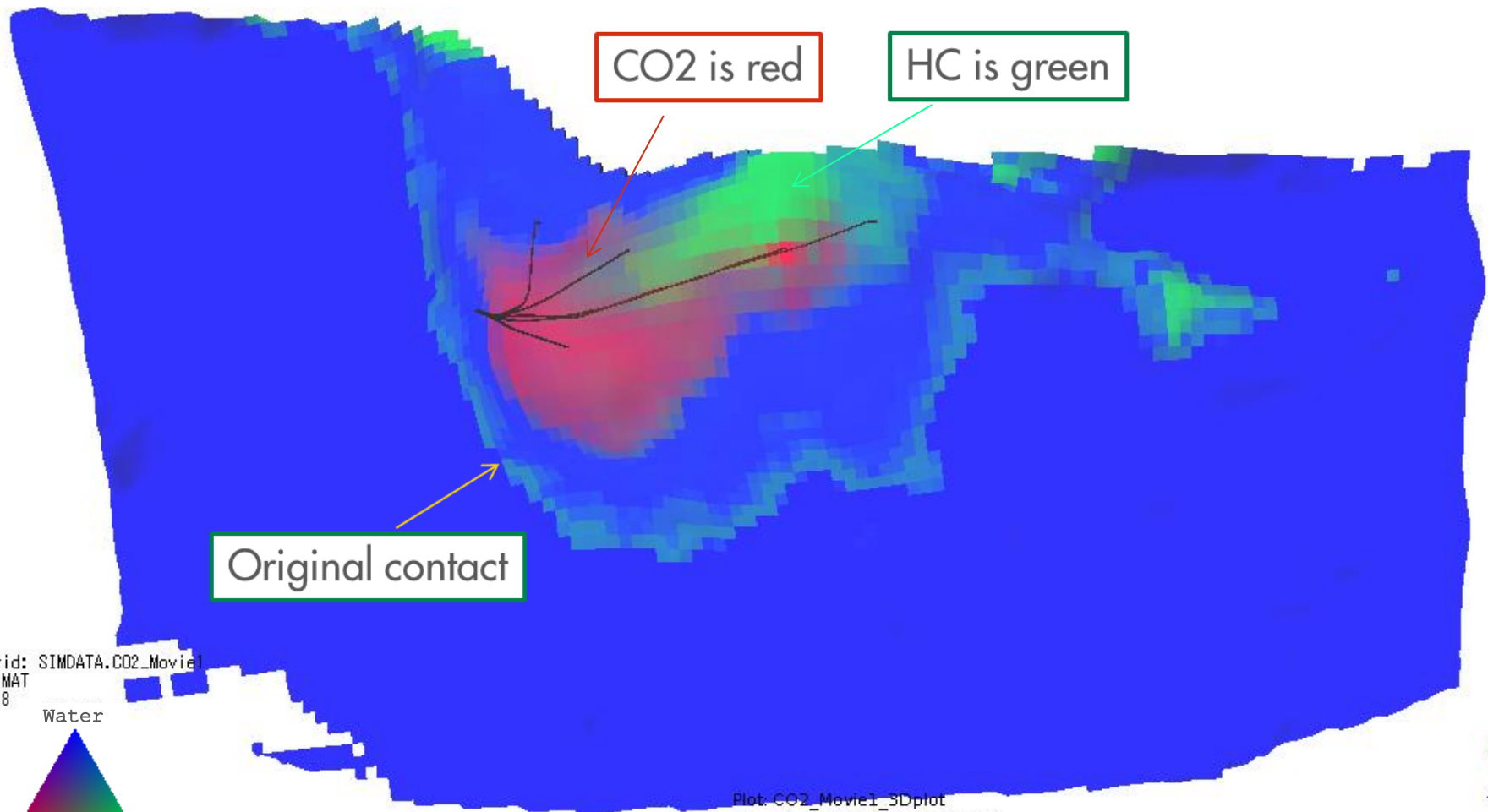
Plot: CO2_Movie1_3Dplot
Timestep: 6616 (3000.0 * YEAR)
Creation date: Mon Jun 9 12:16:05 2014
Run file: gesrm31fc0263_finaqi10aa_1only_staged_rate10_10mte_incl_relax_v2012_2.run



5 YEARS OF INJECTION



6 YEARS OF INJECTION

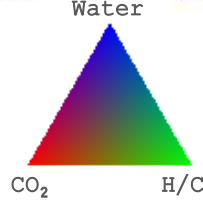


Original contact

CO2 is red

HC is green

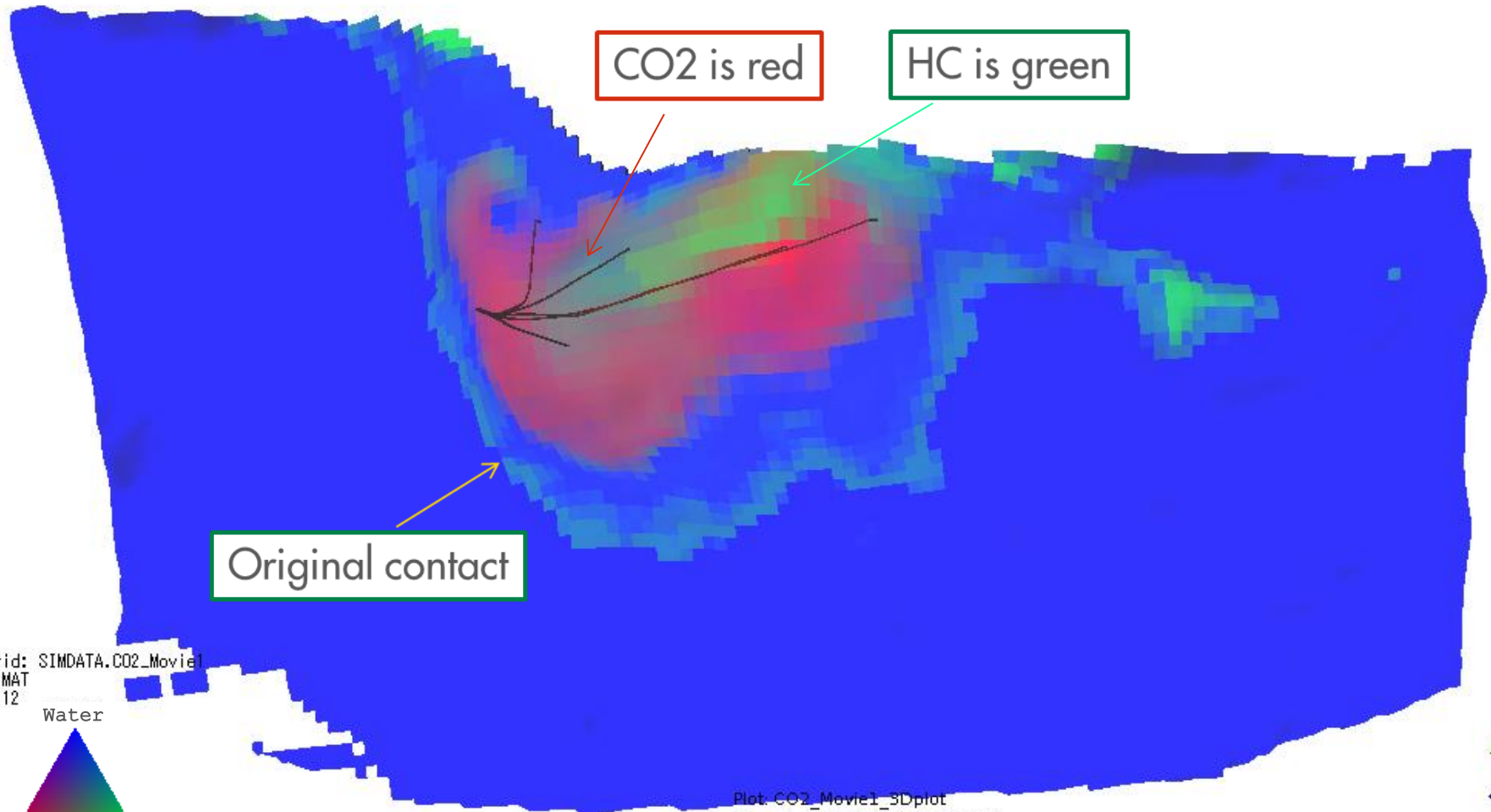
Grid: SIMDATA.CO2_Movie1
F:MAT
T:8



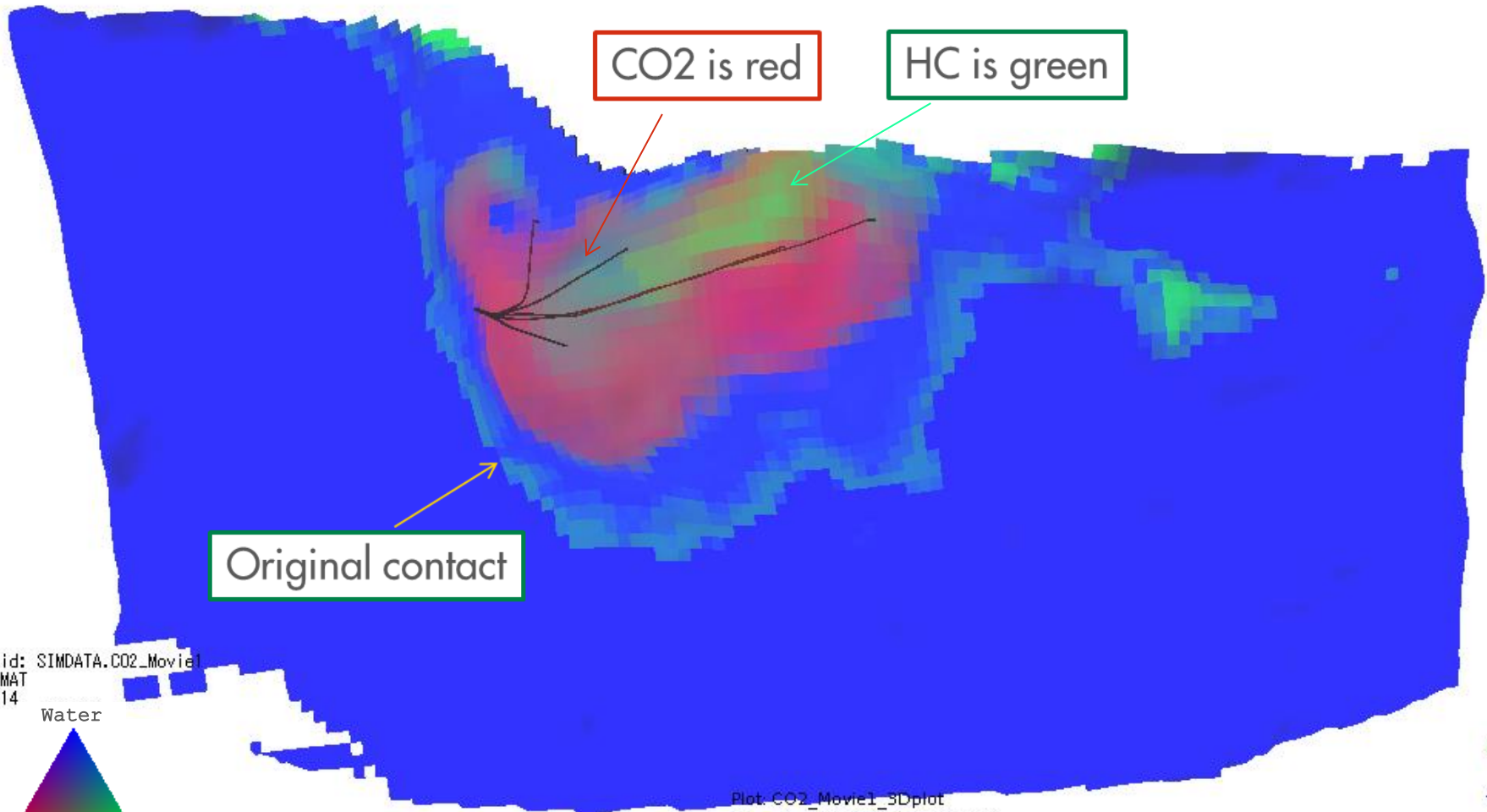
Plot: CO2_Movie1_3Dplot
Timestep: 6616 (3000.0 * YEAR)
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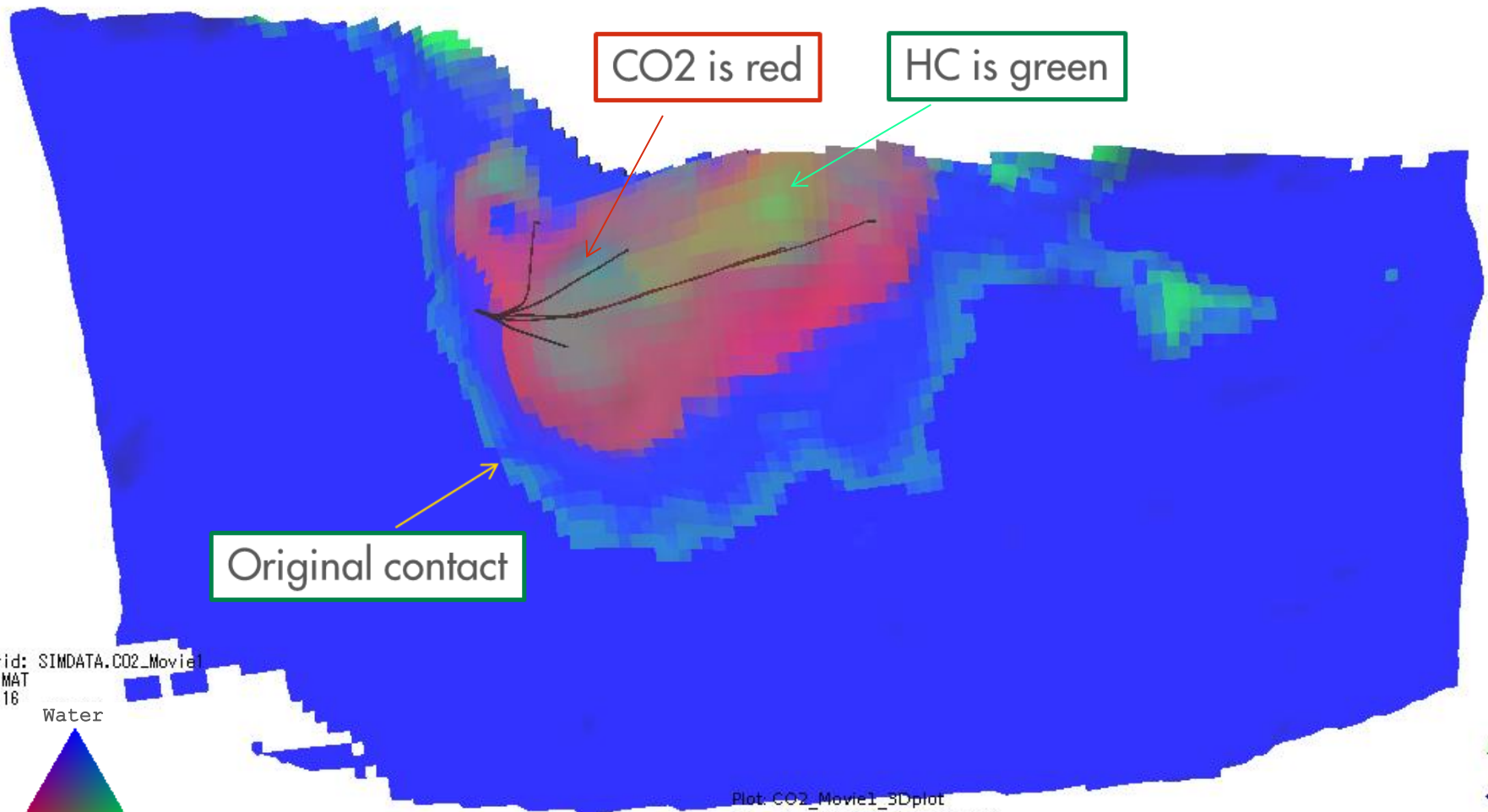
10 YEARS OF INJECTION, 10MT CO₂



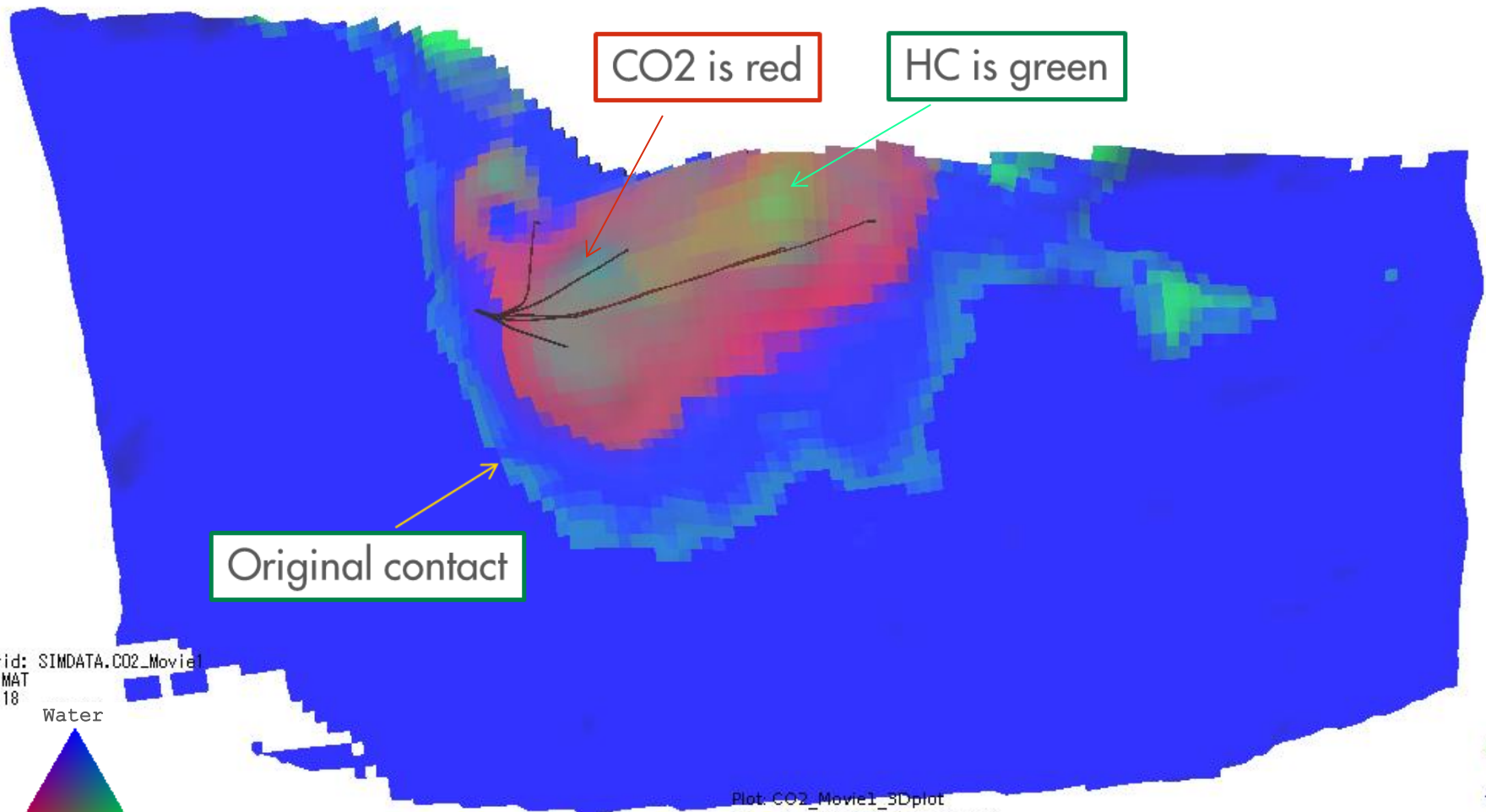
1 YEAR AFTER INJECTION STOPPED, 10MT CO₂



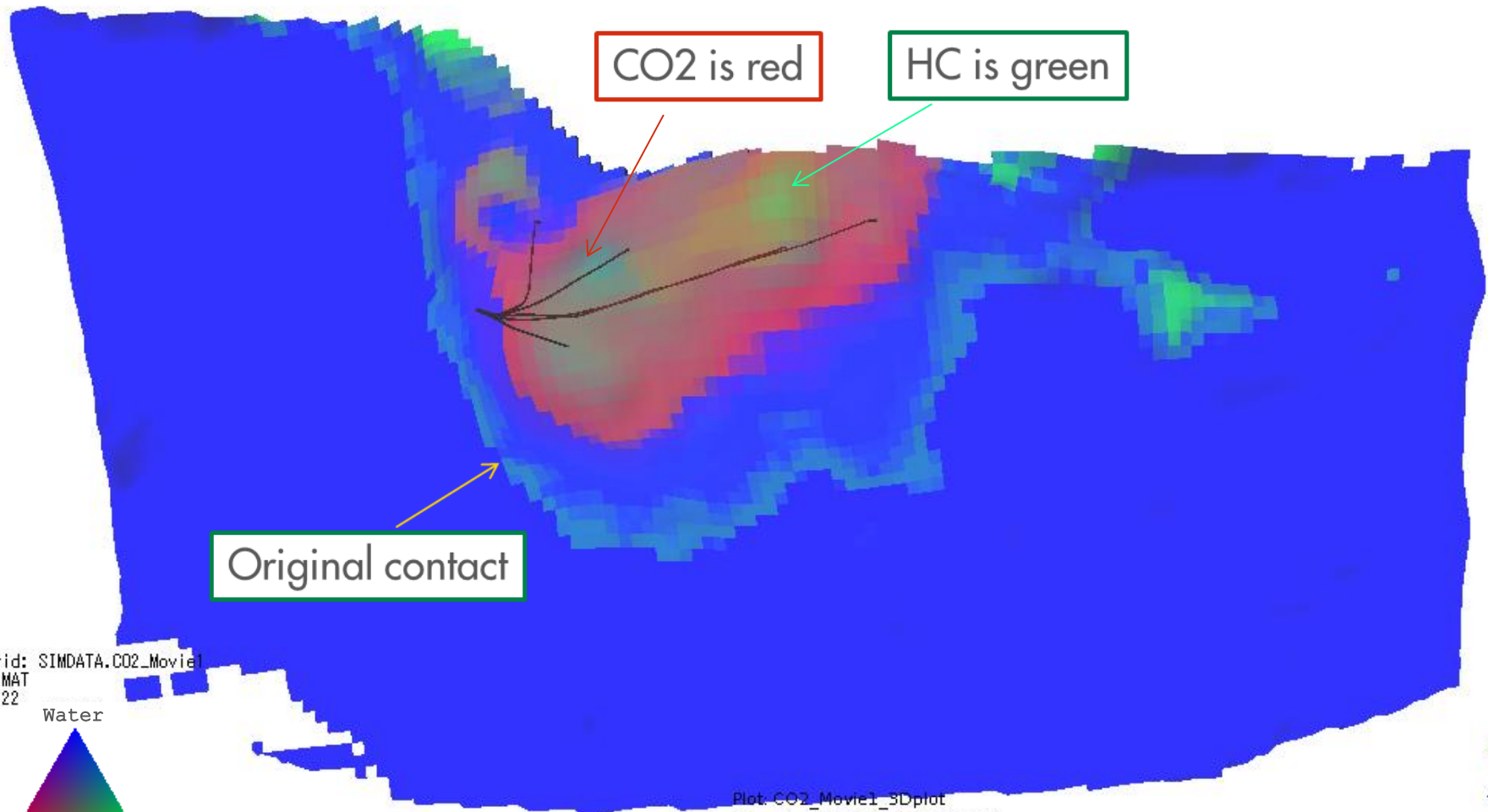
11 YEARS AFTER INJECTION STOPPED, 10MT CO₂



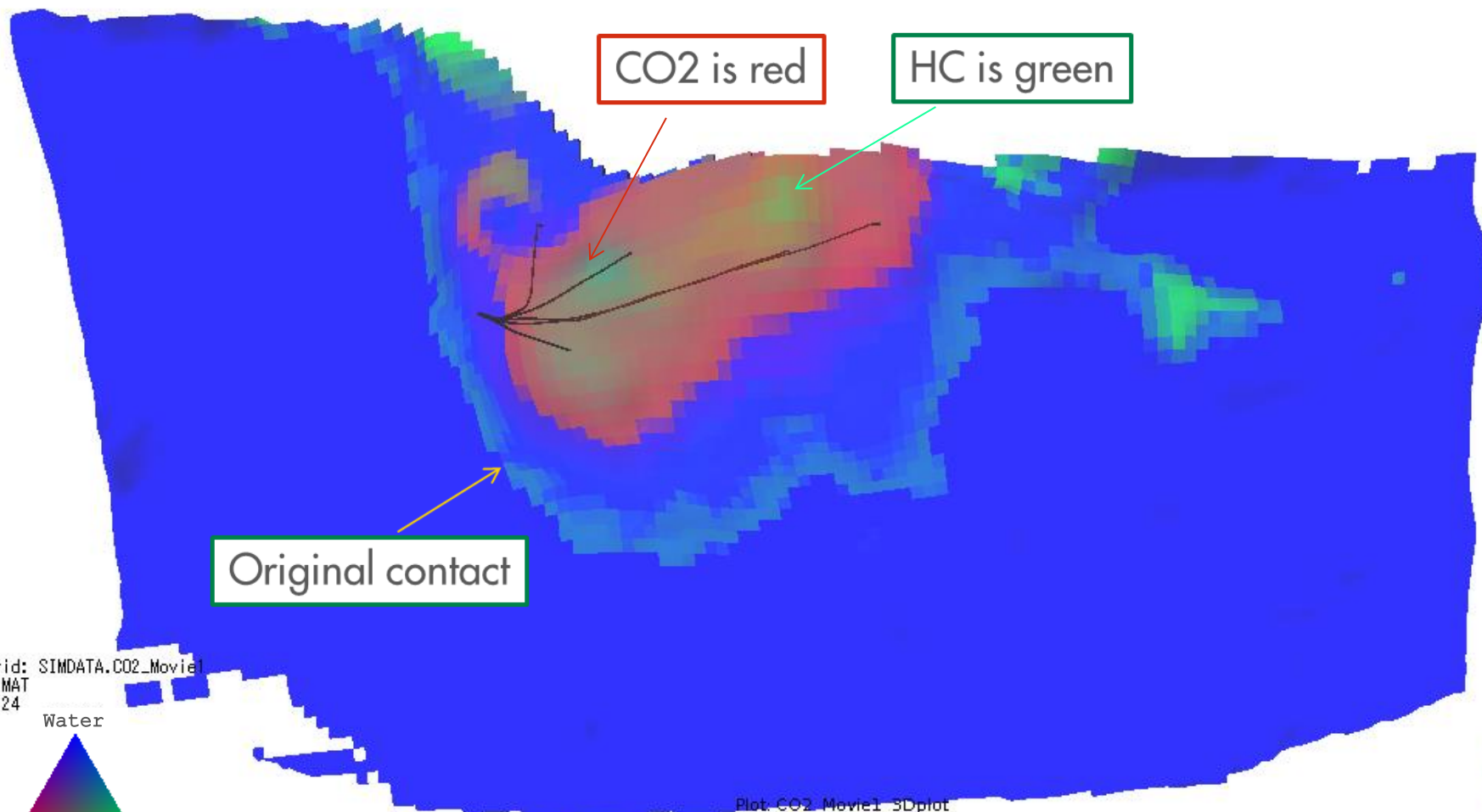
20 YEARS AFTER INJECTION STOPPED, 10MT CO₂



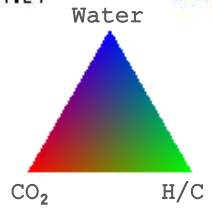
50 YEARS AFTER INJECTION STOPPED, 10MT CO₂



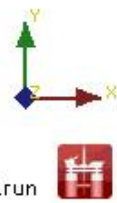
180 YEARS AFTER INJECTION STOPPED, 10MT CO₂



Grid: SIMDATA.CO2_Movie1
F:MAT
T:24

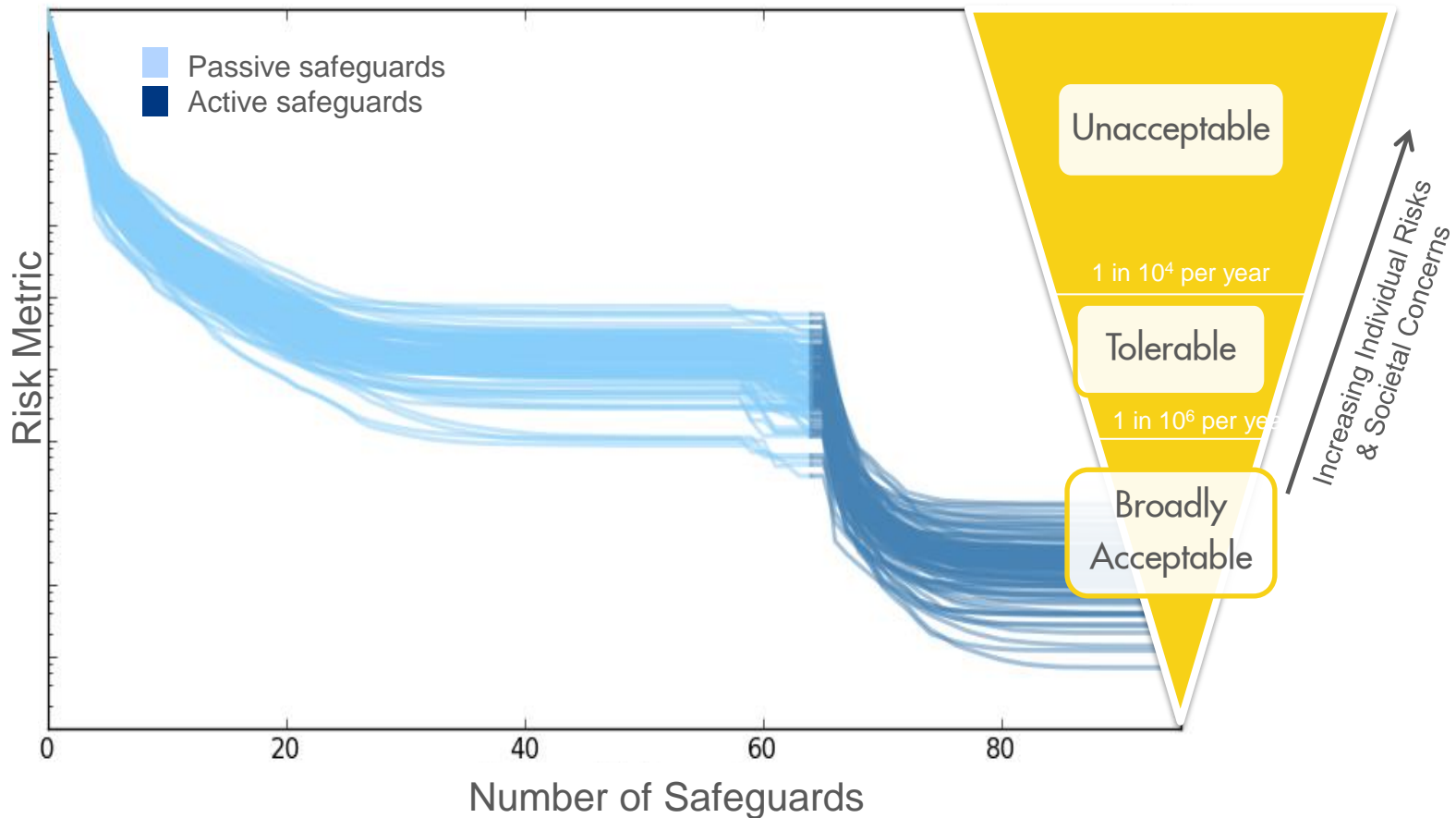


Plot: CO2_Movie1_3Dplot
Timestep: 6616 (3000.0 * YEAR)
Creation date: Mon Jun 9 12:16:05 2014
Run file: gesrm31fc0263_finaqi10aa_1only_staged_rate10_10mte_incl_relax_v2012_2.run



CCS RISK MITIGATION WHEN HAVE YOU DONE ENOUGH

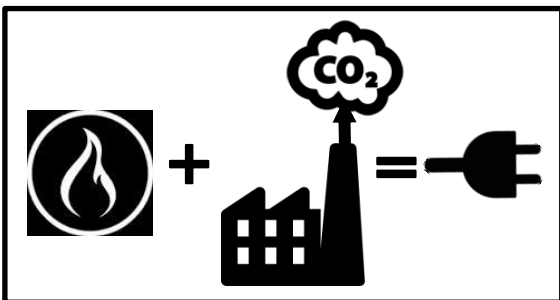
- Based on collective expert judgement
- Informed by appraisal data and feasibility studies



CLEAN ELECTRICITY TO 500,000 HOMES

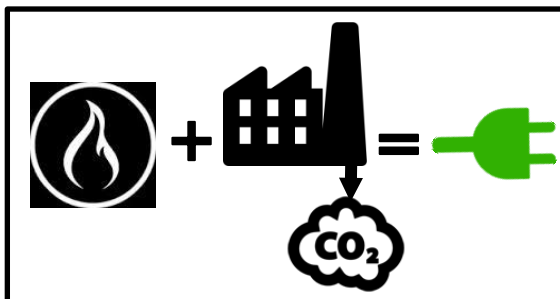


IT IS GOOD FOR SHELL



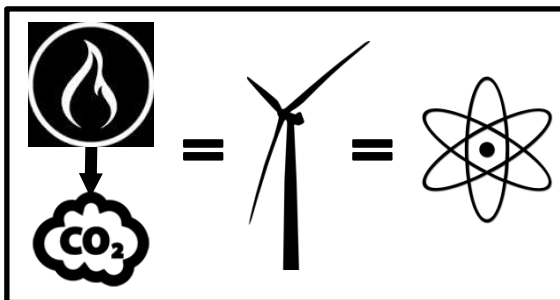
Natural Gas is supplied to the Peterhead Power Station in NE Scotland where it is burned in a combined cycle gas turbine (CCGT) to deliver 'grey' electricity to the grid.

Current
Status



Shell removes the CO₂ from the power station flue gas, compresses it and pipelines it offshore into the depleted Goldeneye gas reservoir for permanent storage. The resulting electricity is rewarded with a 'green premium'

Peterhead
CCS Project



Under the UK's Electricity Market Reform, all low carbon energies are eligible for a green premium putting Gas+CCS on par with nuclear and renewables. Gas is recognised as a destination Fuel.

Opportunity

THE LOCAL COMMUNITIES



THE LOCAL COMMUNITIES – IMPACTS & BENEFITS



Power Station
Life



Construction
Jobs



Operations
Jobs



Future Industry
Hub



Noise



Traffic



Visual Impact



Waste

PETERHEAD COMMUNITY



PETERHEAD – A TRUE FIRST OF A KIND

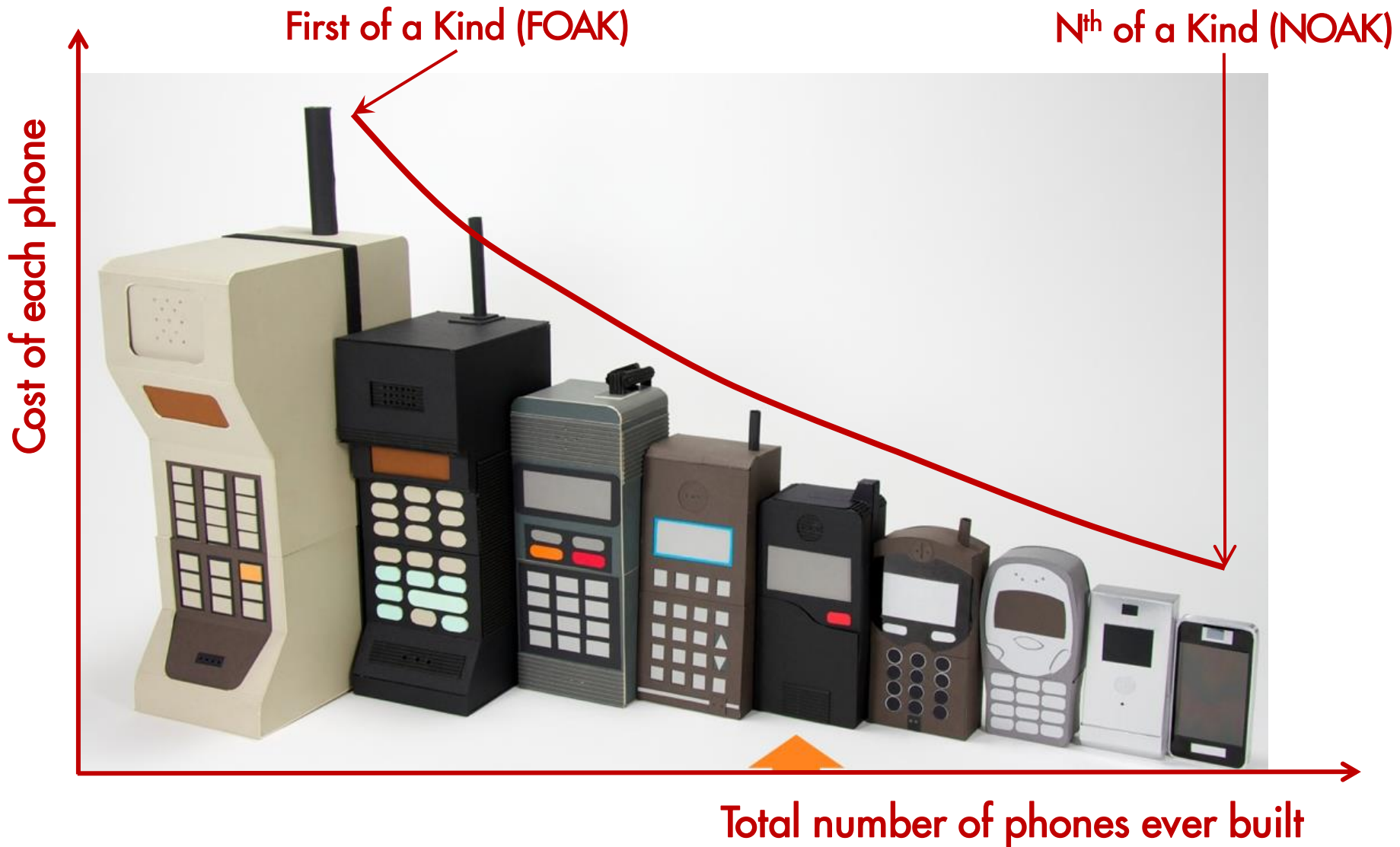
1 of a Kind



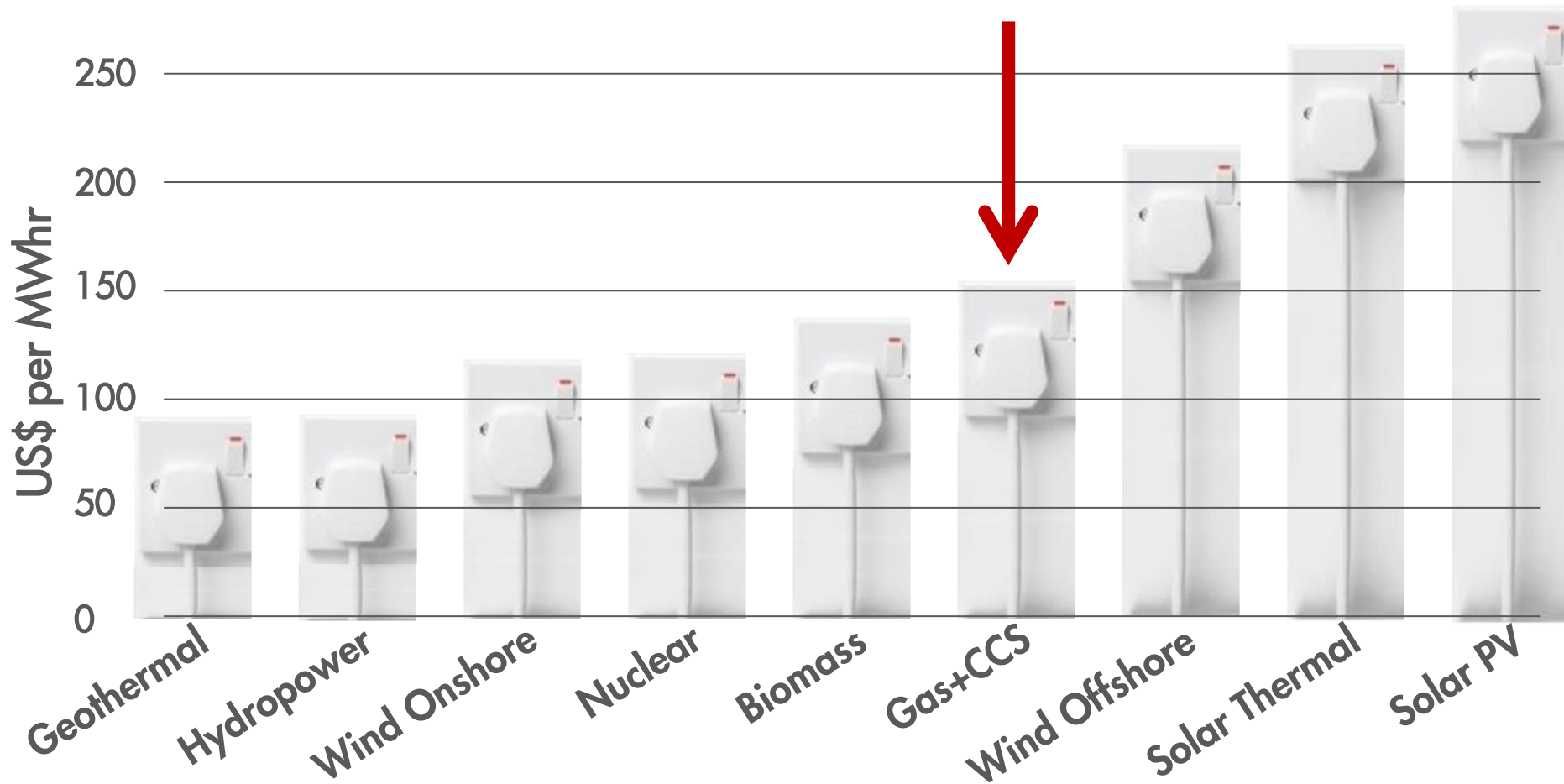
1st of a kind



DEMONSTRATION PROJECTS – LEARNING CURVES



GAS + CCS – COMPETITIVE LOW CARBON ENERGY



*Levelised cost of electricity of low-carbon technologies and conventional power generation – as presented in 'The costs of CCS and other low-carbon technologies' Global CCS Institute.

PETERHEAD KNOWLEDGE SHARING

Knowledge Transfer Obligations

- Committed to providing 45 Key Knowledge Deliverables for public dissemination.
- These deliverables cover key project aspects such as Engineering, Subsurface, Commercial, and HSE.
- The deliverable content has been agreed in FEED negotiations between Shell and DECC.
- A specification sheet is provided for each deliverable describing the agreed content.
- Shell have a dedicated resource and process to manage the dissemination of these Key Knowledge Deliverables

KEY KNOWLEDGE DELIVERABLE	KEY KNOWLEDGE DELIVERABLE	KEY KNOWLEDGE DELIVERABLE
<p>FEED Commercial Report</p> <p>Document ID: 11.218</p> <p>Document Type: Commercial Report</p> <p>Document Status: Final</p> <p>Document Date: 2011</p> <p>Document Size: 14</p> <p>Document Description: This document provides a comprehensive overview of the commercial aspects of the project, including market analysis, financial projections, and risk assessment.</p>	<p>FEED Engineering Report</p> <p>Document ID: 11.219</p> <p>Document Type: Engineering Report</p> <p>Document Status: Final</p> <p>Document Date: 2011</p> <p>Document Size: 14</p> <p>Document Description: This document details the engineering design and construction of the project, covering process flow, equipment specifications, and safety systems.</p>	<p>FEED Subsurface Report</p> <p>Document ID: 11.220</p> <p>Document Type: Subsurface Report</p> <p>Document Status: Final</p> <p>Document Date: 2011</p> <p>Document Size: 14</p> <p>Document Description: This document focuses on the subsurface geology and reservoir characteristics, providing data for production forecasting and well placement optimization.</p>

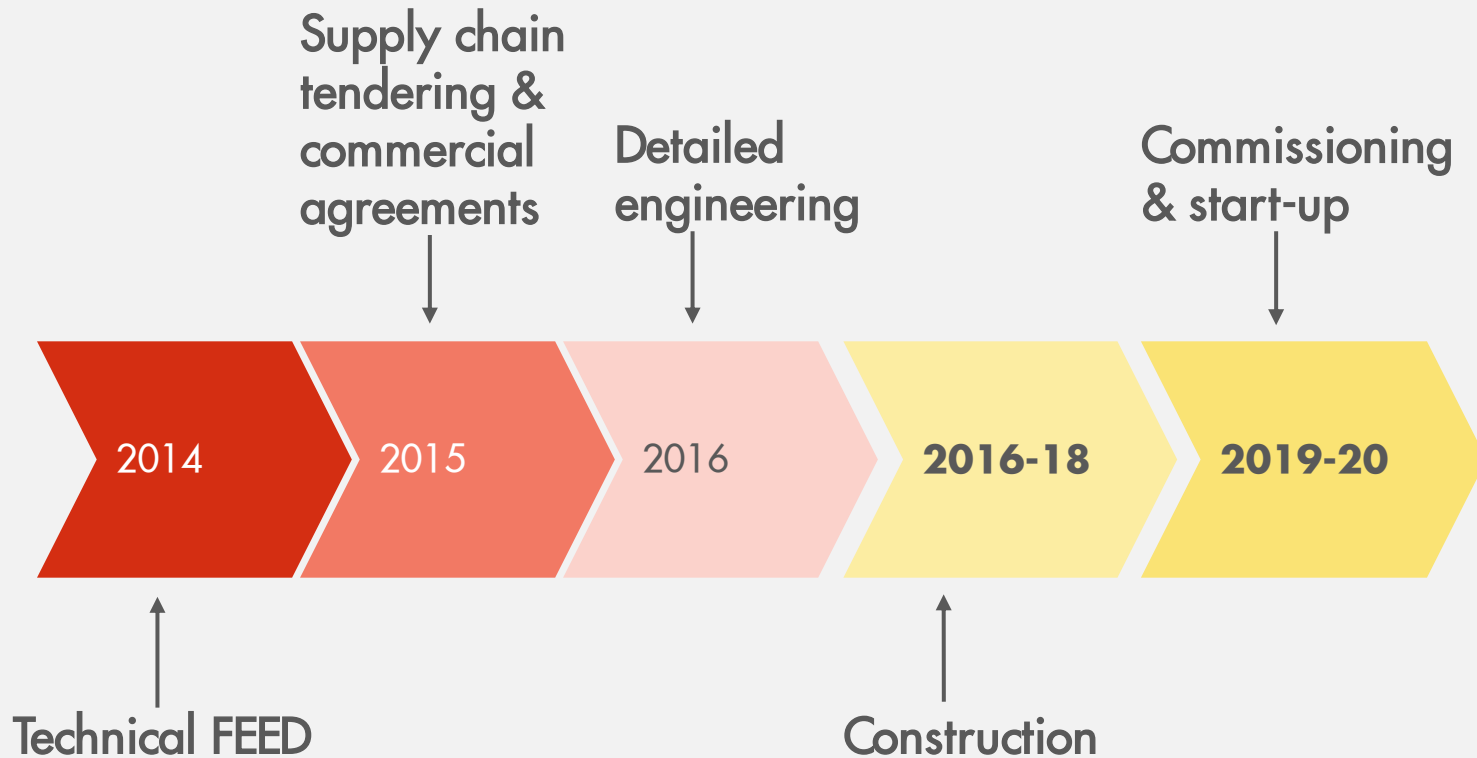
DECC Knowledge Sharing Site



Public access to (non commercially sensitive) knowledge & information derived from the projects

- CCS Cost Reduction Task Force**
- The task force was set up in spring 2012 to advise the government and industry on the steps needed to reduce the cost of CCS, so it can compete with other low carbon technologies in the 2020s.
- [Read more about the CCS Cost Reduction Task Force](#)
- CCS knowledge sharing**
- The government is committed to sharing the knowledge from UK CCS projects and to learning from other projects around the world to help accelerate CCS cost reduction, as well as sharing information from the reports it commissions.
- The government has already made available substantial amounts of information from the detailed engineering and design studies completed as part of the first UK CCS Competition. This information goes beyond anything previously made available.
- Commissioned CCS Reports**
- [CCS Storage Liabilities in the North Sea - An Assessment of Risks and Financial Consequences](#)
- Kingsnorth FEED**
- [Front End Engineering and Design Material](#)
 - [Executive Summary](#)
 - [Project Design](#)
 - [Technical Design - Carbon Capture and Compression Plant](#)
 - [Technical Design - Pipeline and Platform](#)
 - [Technical Design - Vessels and Storage](#)
 - [Health and Safety](#)
 - [Environment and Consents](#)
 - [Project Management Reports](#)
- Longannet FEED**
- [Programme Abstract](#)
 - [FEED Cost Abstract](#)
 - [Design Abstract](#)
 - [End to End CCS Chain Operations Abstract](#)
 - [FEED Decisions Abstract](#)
 - [Health, Safety and Environment Abstract](#)
 - [Risk Management Abstract](#)
 - [Consents and Permitting Abstract](#)
 - [Stakeholder Profiling Abstract](#)
 - [CCS Project Costs Abstract](#)
 - [Lessons Learned Abstract](#)

ANTICIPATED PROJECT TIMELINE



DR ROGER BANNISTER



Illustration is an estimate based on the current Peterhead technical design that aims to capture 1 million tonnes of CO₂ per year

**IMAGINE CAPTURING THIS
MUCH CO₂ EVERY DAY**

Find out how Shell plans to capture CO₂ at shell.co.uk/peterheadccs

LET'S GO



Questions?