



Digitalisation and Advanced Analytics @ Shell

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Advanced Analytics CoE



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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.

Shales: Our use of the term ‘shales’ refers to tight, shale and coal bed methane oil and gas acreage.

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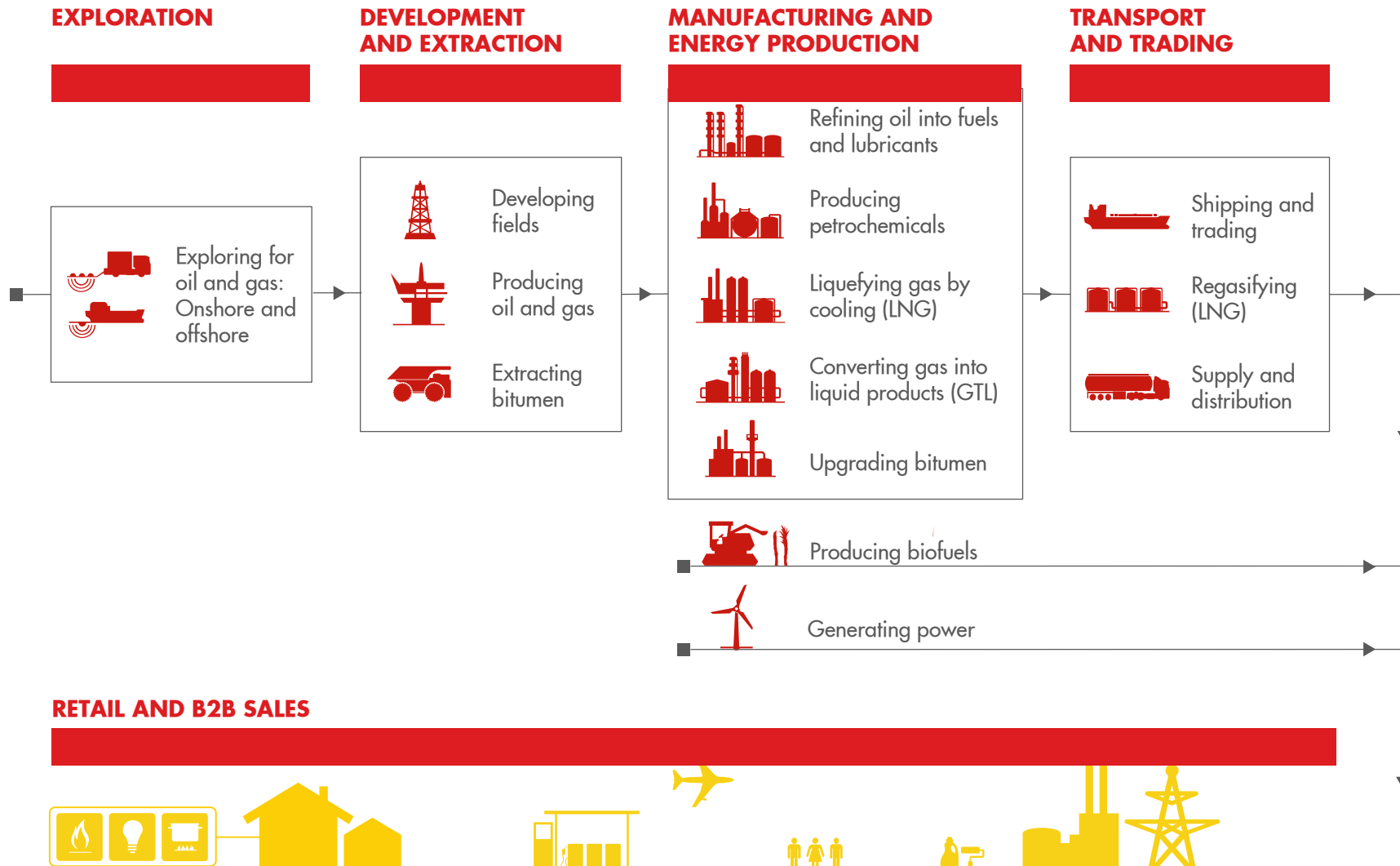
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Agenda

- About Shell
- The Energy Challenge
- TaCIT & Our Digitalisation Strategy
- Our Innovation Process & the Advanced Analytics CoE
- Use of MatLab in Shell
- An example use case: Quest CCS
- Planned Next Steps

Business Overview



New Energy Future by 2050

Rising energy demand, supply pressure, climate change



Population

9 billion people,
75% living in cities
(2 billion more than today)



Vehicles

2 billion vehicles
(currently 800 million)



Rising standards

Many millions of people will rise
out of energy poverty; with higher
living standards energy use rises



Demand

Energy demand could double
from its level in 2000...but CO₂
emissions must be half today's to
avoid serious climate change



Efficiency

Twice as efficient, using
half the energy to produce
each dollar of wealth



Renewables

4 times more energy
from renewable sources

Technical & Competitive IT



- Partnering with the business and functions to drive innovation
- Product development through Research & Development to deliver differentiating solutions
- Maintain and enhance technology solutions across Upstream and Downstream
- Enable Projects & Technology division within Shell

What is digitalisation

Shell context

Focus

- How Digital technologies can help address current business challenges
- Technologies that can have a substantial impact on our industry

Is not

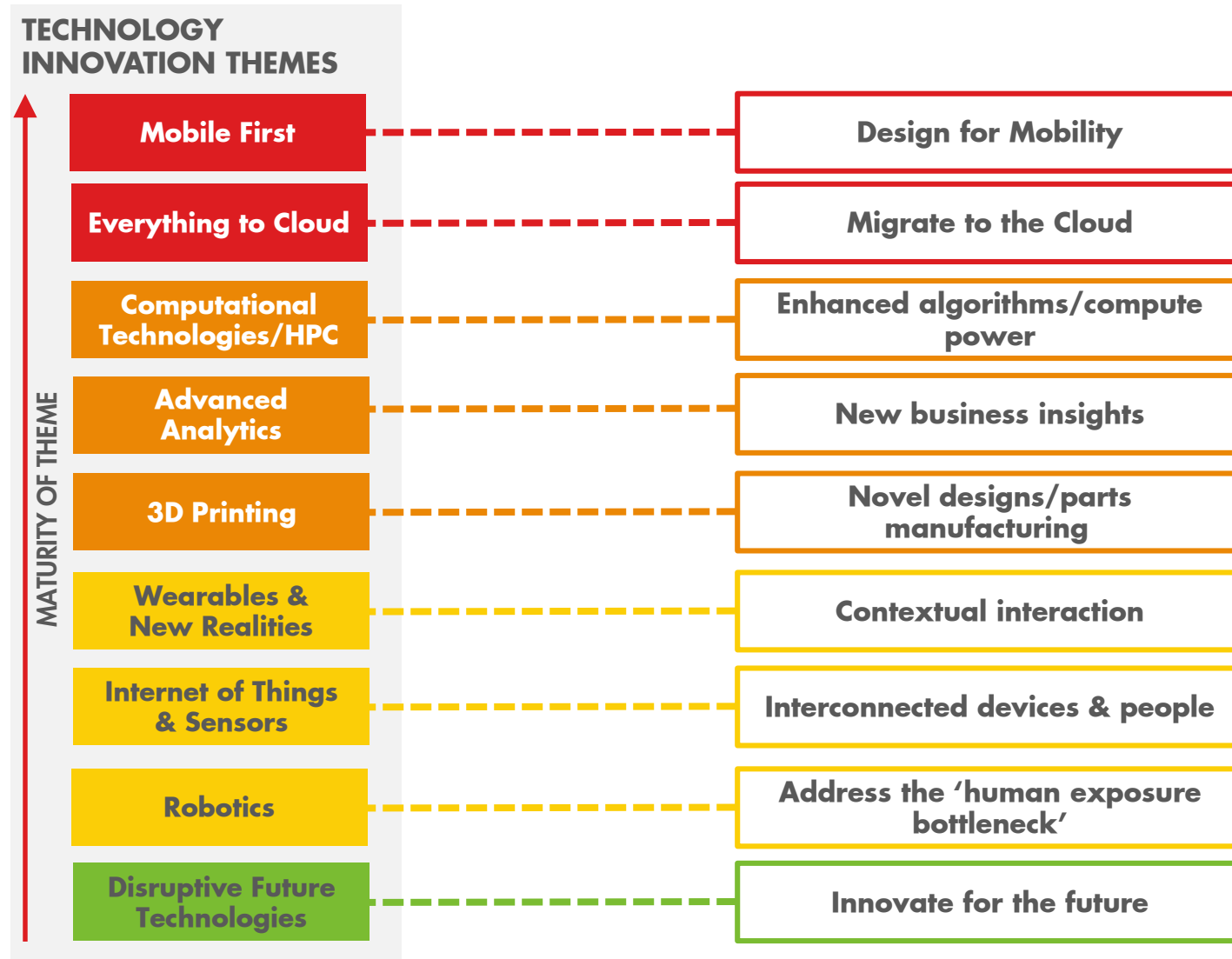
- New
- An outcome
- One off thing
- Only in the future

Industry definition*

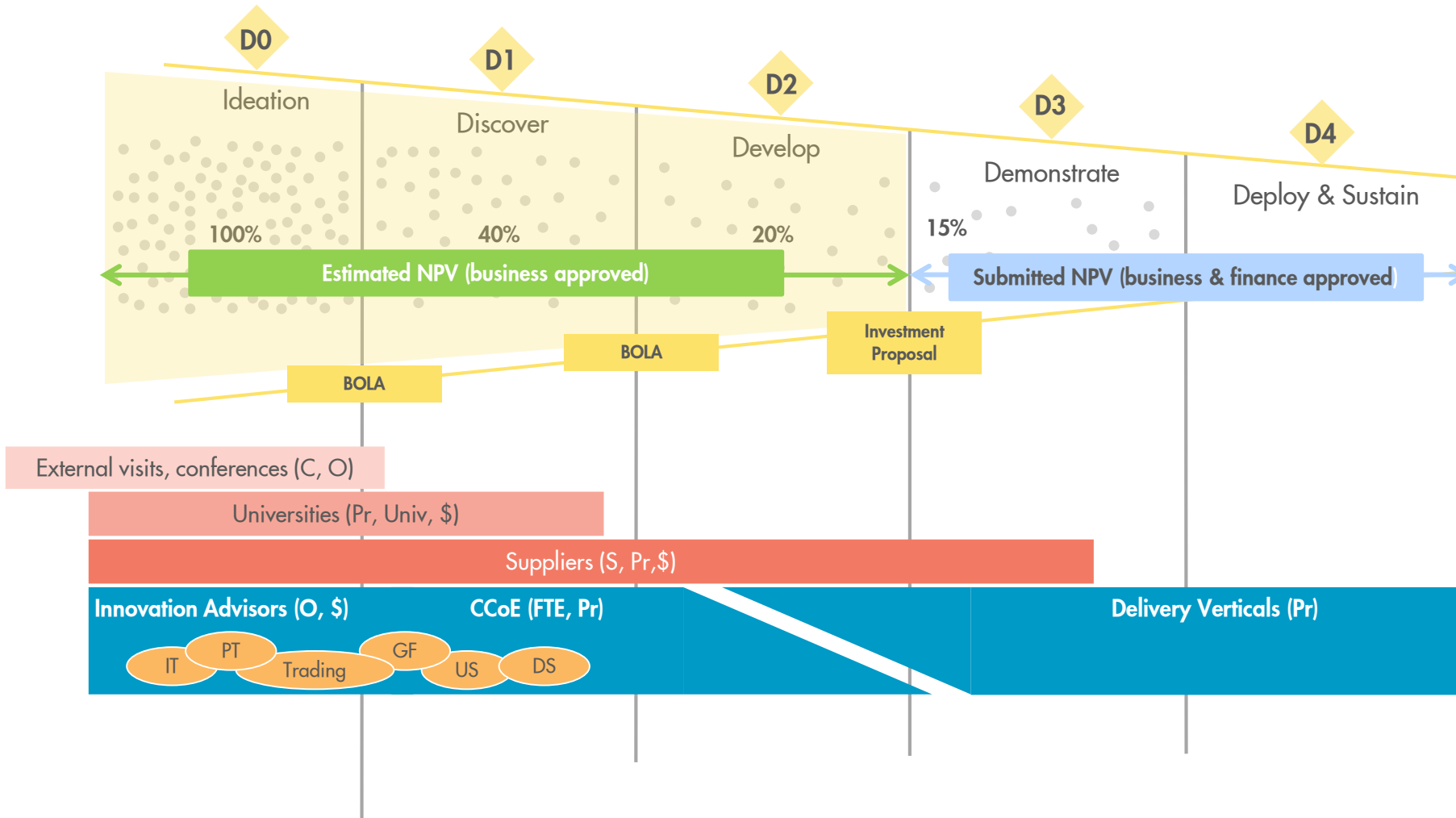
“The use of Digital technologies to change a business model and provide new revenue and value-producing opportunities”

*Industry definition has been sourced from Gartner

Disruptive Digital Themes



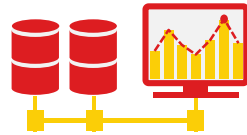
Shell Innovation Process



What does the Advanced Analytics Centre of Excellence do?

Strategic Objective

1 Platform Development



Methodology

- Scale & grow Production Platform to meet needs of Advanced Analytics community in Shell
- License Analytics Lab to user communities for Proof of Concepts
- Develop enterprise licensing agreements for Analytics software and drive convergence
- Translate Proof of Concepts into supported Business Services leveraging standard Production Platform
- Analytics Lab a test-bed for cutting-edge tools & techniques

2 Value Identification & Delivery



- Validated pipeline of opportunities constantly updated & iterated
- Robust valuation methodology
- Execution of ★ Proof of Concepts
- *Inventory Optimisation*
- *HSSE Incident Prevention*
- *Market Basket*
- Processes to assess business impact & coordinate investment proposals
- Assure & extend business cases by progressing ★ Proof of Concepts to production

3 Network Co-ordination



- Raise profile of AA within Shell and develop greater sense of community with the support of senior leaders
- Generate best practice benchmarks and materials for analytics delivery in Shell
- Technical, Commercial, Data Science & Tooling streams
- Single point of contact, advice & best practices relating to Advanced Analytics
- Identify & attract relevant skills & capabilities, and coordinate interventions where appropriate



Innovation Remit



Core Team with Technical & Commercial skillset



Analytics Education & Communication of best practise



Analytics Network & External Partners



Analytics Lab to trial & test technology in supported environment

MatLab Usage in Shell

UPSTREAM	INTEGRATED GAS	DOWNSTREAM	PROJECTS & TECHNOLOGY
<ul style="list-style-type: none"> ■ Operated ■ Joint ventures ■ Deepwater ■ Safety & environment ■ Production excellence ■ Exploration 	<ul style="list-style-type: none"> ■ Venture development ■ Production excellence ■ Qatar ■ Australia & New Zealand ■ Russia ■ Safety & environment ■ Ventures ■ Commercial/NBD 	<ul style="list-style-type: none"> ■ Refining ■ Pipelines ■ Chemicals ■ Trading and Supply ■ Retail ■ Lubricants ■ Business to business ■ Biofuels 	<ul style="list-style-type: none"> ■ Innovation, R&D ■ Technical IT ■ Project execution ■ Global technical expertise ■ CO₂ management ■ Safety and environment ■ Contracting and procurement
FINANCE	HR & CORPORATE	LEGAL	<div data-bbox="1814 965 2132 1008" style="border: 1px solid green; border-radius: 10px; padding: 5px; display: inline-block;">Matlab Applied</div>
<ul style="list-style-type: none"> ■ Finance ■ IT ■ Investor relations ■ Tax ■ Strategy ■ Planning and appraisal ■ Internal audit 	<ul style="list-style-type: none"> ■ HR ■ Real Estate ■ External Relations ■ Shell Aircraft ■ Health ■ Security 	<ul style="list-style-type: none"> ■ Legal ■ Compliance ■ Intellectual property 	

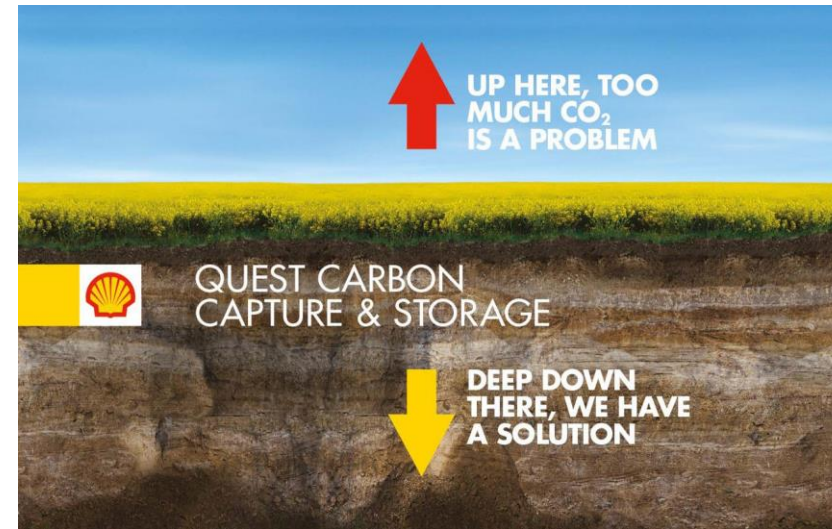
Quest Background

- The Albian oil sands in Canada produce 255k barrels per day of heavy bitumen products which are upgraded at Scotford.
- Dense phase CO₂ captured and compressed from the Scotford Steam Methane Reformer Units (around 1.2 Mt/yr).
- The CO₂ is transported by pipeline to three injection wells near the Scotford Complex and stored approximately 2,300 meters underground in a deep geological formation.
- As part of Shell's license to operate they need to monitor the site to check the CO₂ is not leaking back into the atmosphere



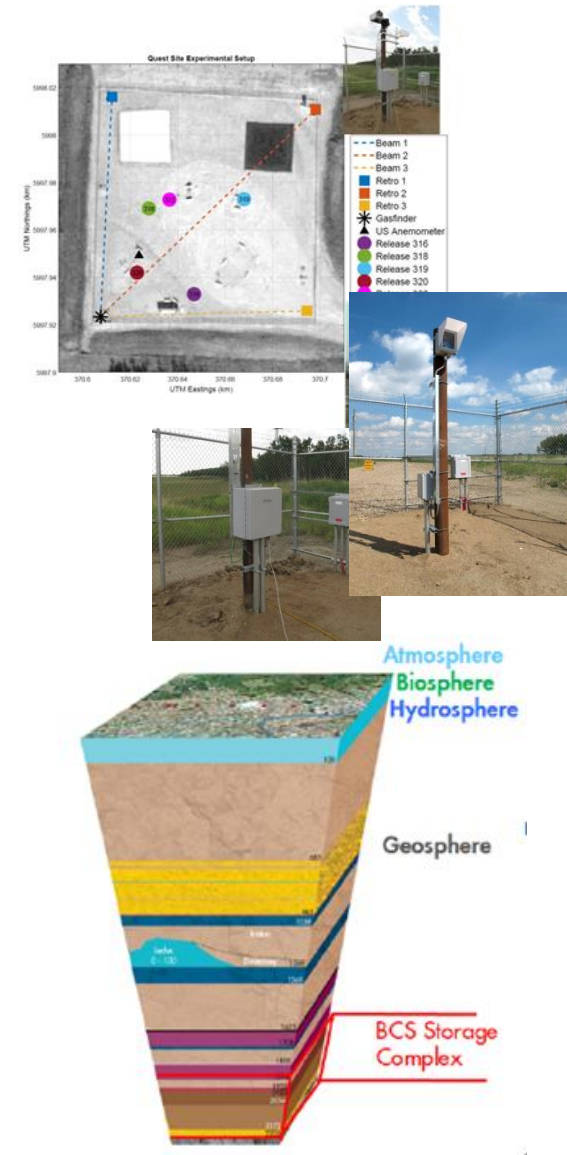
The Challenge

- Quest CCS is a critical innovation for Shell.
- CO₂ is captured and stored underground and government funding is contingent on Shell proving the CO₂ stays in the ground.
- Innovative sensors (based on lasers) have been installed at the plant to monitor the atmosphere for CO₂ emissions.
- Algorithmic approaches are required to distinguish actual CO₂ events from “background noise”



Technical Solution

- Over the past 8 years Shell's remote sensing' group have been developing surface monitoring algorithms for measurement the Quest monitoring verification (MMV) program:
- Primary objectives are to:
 - Ensure containment
 - Verify absence of environmental effects.
 - Detect early warning signs of loss of containment.
 - Trigger additional safeguards
 - Safety critical - ALARP
 - Ensure conformance - LightSource technologies to address 'containment' objective.

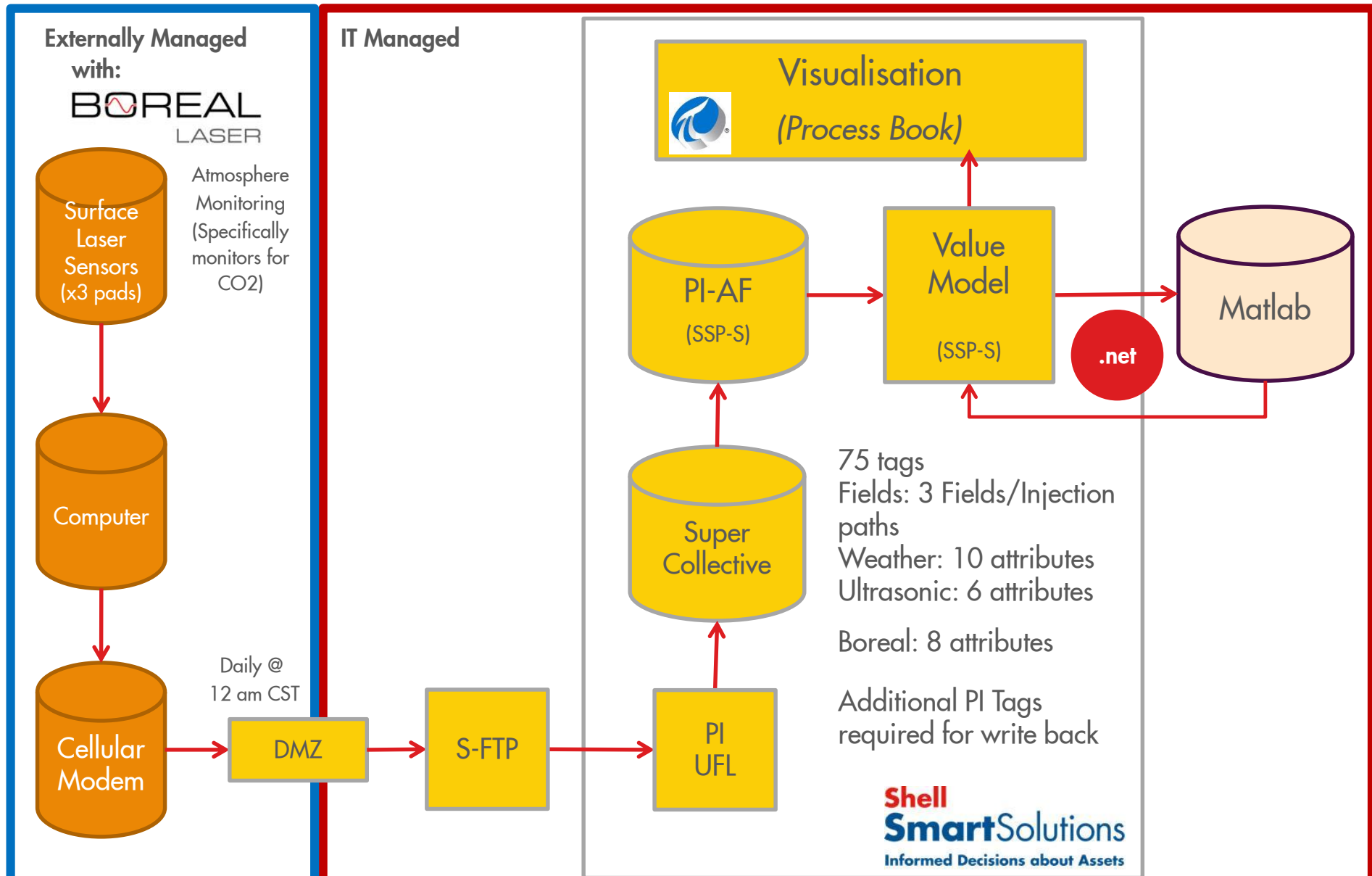


Solution – Advanced Analytics Lab

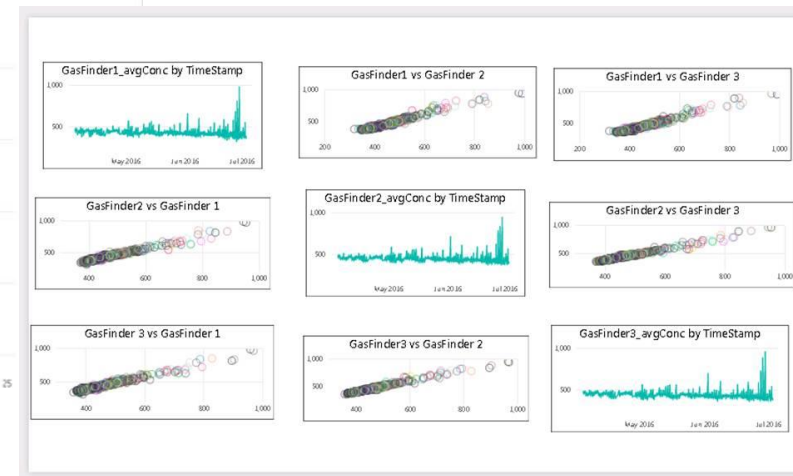
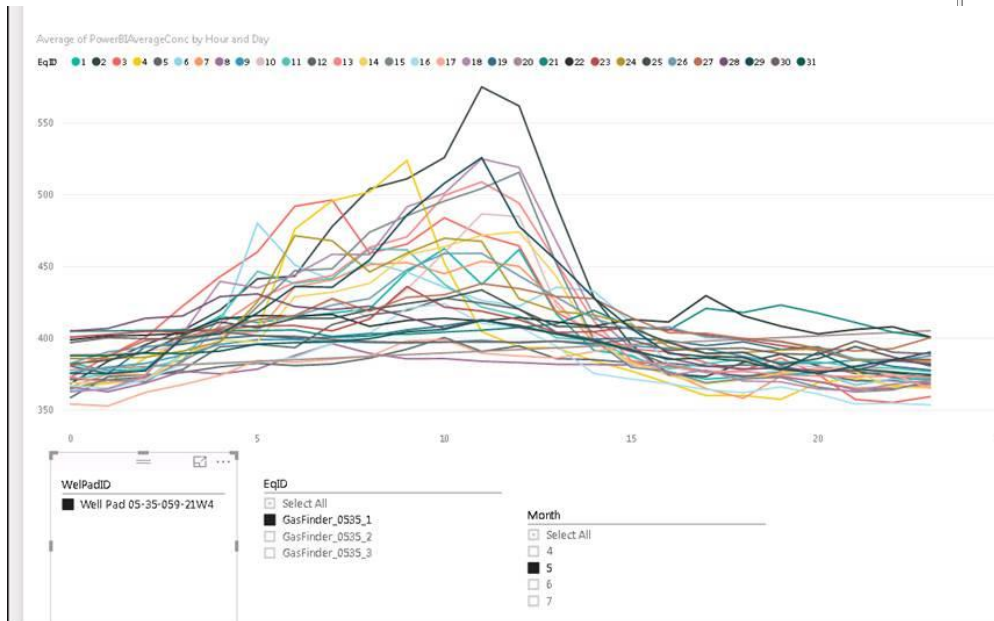
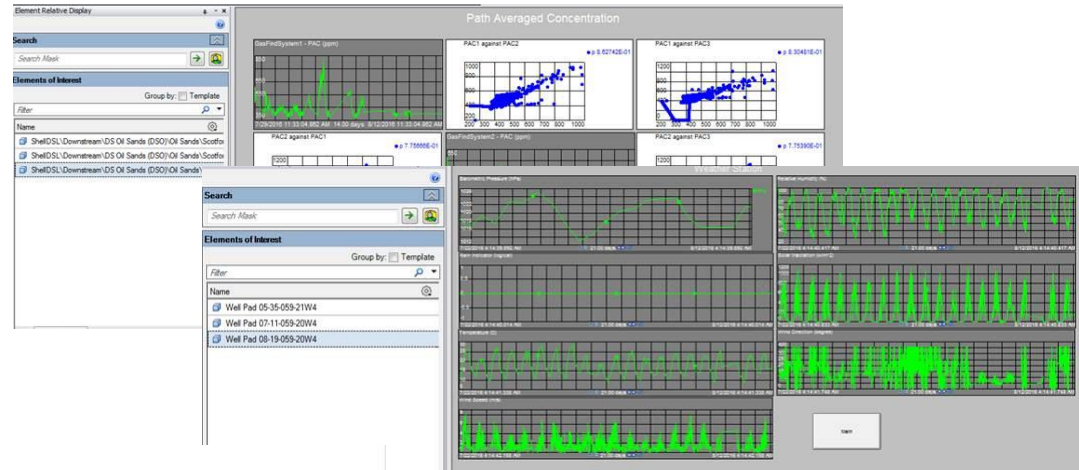
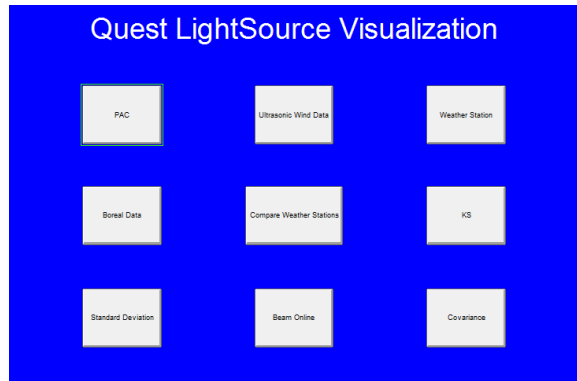
- Deploy the monitoring algorithm using the **Matlab Production Server** in the Advanced Analytics Lab (PoC).
 - Provide daily monitoring and alerts depending on algorithm results.
 - Improved visibility of algorithm results.
 - Eliminate manual effort involved in running the analysis.
 - Productionise Quest by embedding solution in a fully supported IT landscape (October 2016).
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- Value:
 - Compliance with regulation assures access to government funding /reduced exposure to fines & penalties/license to operate.



Solution – Target Architecture



Quest Visualisation (Process Book & Power BI)



Shell & Matlab, the Future?

More explicit linkage to other Digital Themes:

- **Internet of Things** - Edge computing
- **High Performance Computing** - Distributive/Spark computation
- **Mobility** - Smart apps development/management

■ Immediate Priorities for 2017

- Enterprise licenses
- Continued deployment through MPS
- Prove the business value of current Matlab projects in innovation pipeline:
 - Bitumen image analysis
 - Excel trading
 - MADA
 - Acoustic sensing

