# Data at the Center

How the subsurface data universe will transform subsurface evaluation and derisking

**Tim Roden**
Manager GeoSigns Software

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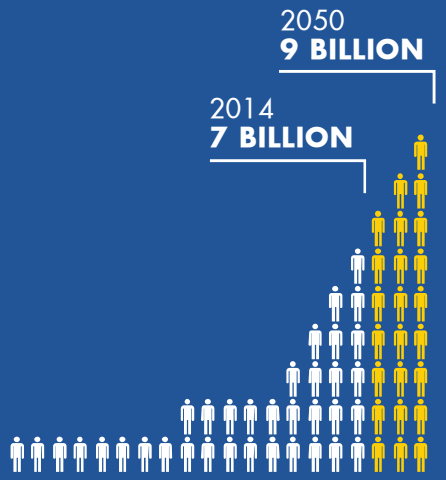
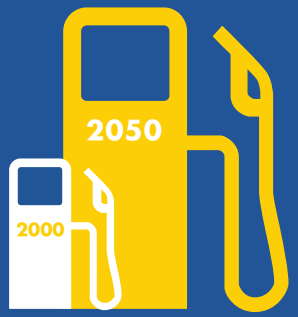
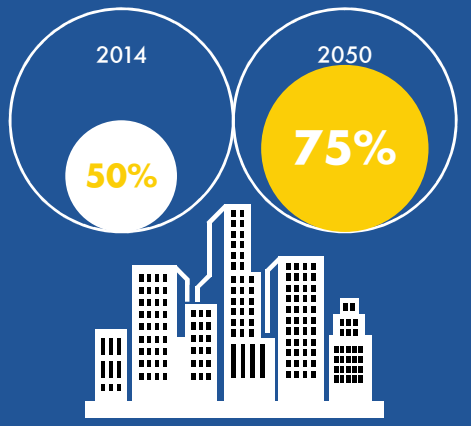
# Energy Challenge - 2050




Global population **9 BILLION**




Energy demand **+100%**




People in cities **75%**

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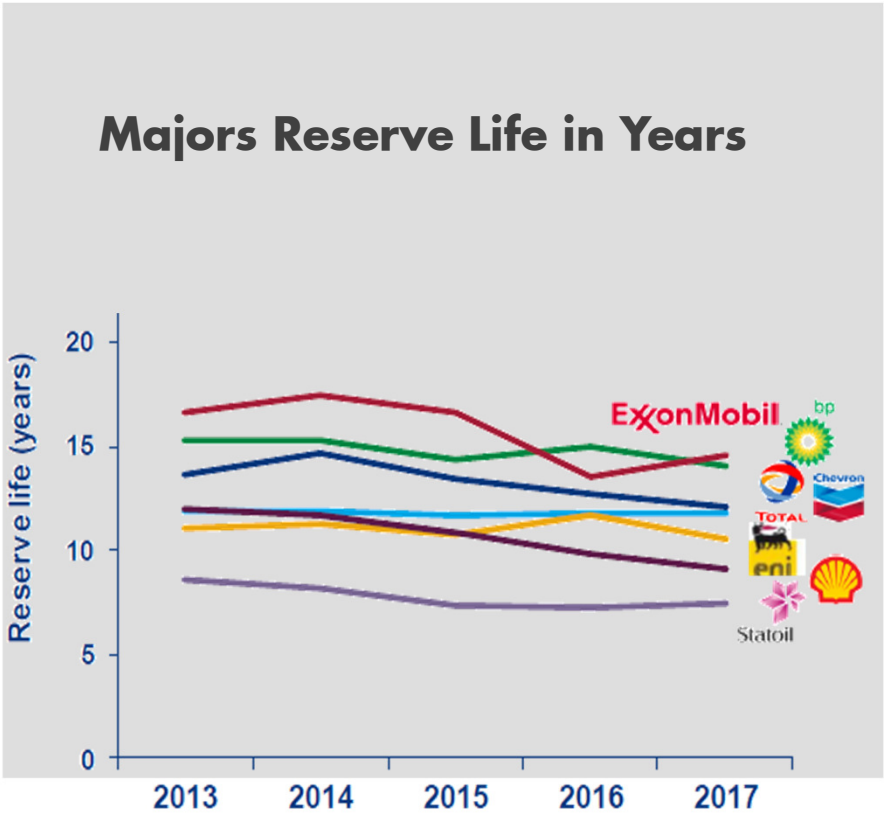
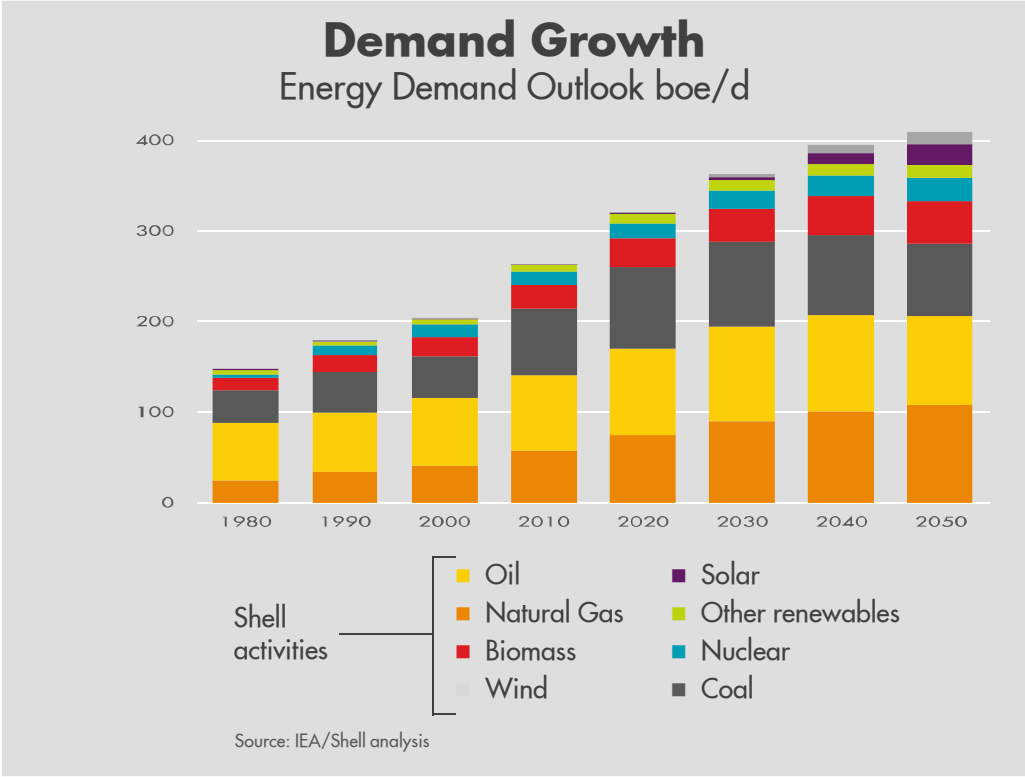
# Resource replenishment – the challenge




Renewable Energy could triple by 2050 – Hydrocarbons dominate the outlook

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# Subsurface workflows are primed for a Digital Transformation

1

## OVERVIEW

- **Digital technologies used** for decades to competitive advantage
- Today, digital technology is **cheaper, faster and more accessible.** Connectivity and **Data** s increasing exponentially
- **Other industries** are using digital technologies in novel ways which Shell can **leverage.**
- Collectively this provides us an opportunity to **make a step change** in our existing workflows

2

## THE LANDSCAPE

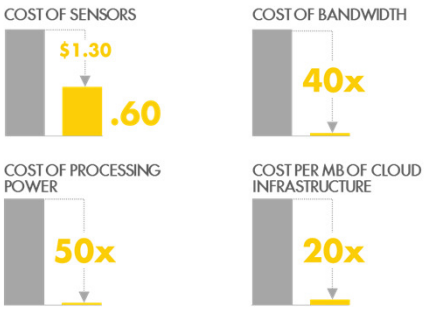
- Cloud
- Data
- Machine Learning
- Artificial Intelligence
- New partnerships

3

## BENEFITS

- Drive cost **efficiency**
- Increase **productivity**
- Provide **new revenue** opportunities
- Optimise our **business models**

Technology is becoming **faster** and **cheaper** over the past ten years

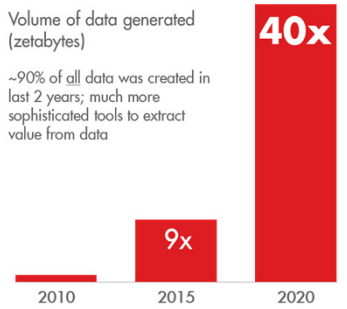



4

## THE JOURNEY

- Maintain **business continuity**
- Starting with targeted projects to **maximize learning**
- Adapt and **scale up**
- Not a large, big bang implementation

Data is **growing exponentially**

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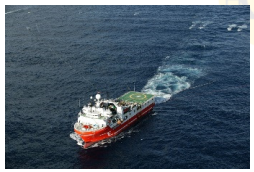
# The Future of Subsurface Work

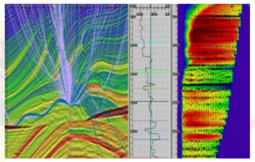
Game-changing data integration compute and networking capabilities to transform our workflows

Potential time reduction from years/months to weeks

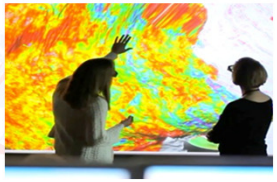
Seismic streams directly into Cloud while still being acquired



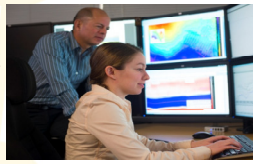
AI Assisted seismic processing delivers fast data to interpreters



AI fully interprets the new data for Explorers to review & Decide



As potential targets are identified, AI-driven well designs are created



AI-derived development scenarios and economics are created by the development group

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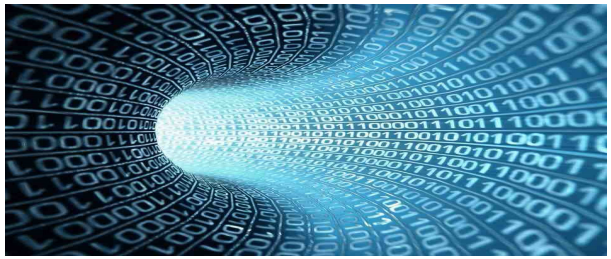
# Data – Subsurface Data Universe

*"We're not smarter than we used to be, even though we have much more information- the real skill now is learning to pick out the useful information from all the noise – Nate Silver- Statistician"*

***What if I had all data at my finger tips?***



## Today

- Data scattered over different locations, technologies, etc.
- Siloed data warehouse solutions
- Lack of data provenance and data relationships
- Varying/unknown data quality

## Future

- Global data discovery, visualisation
- Structured and unstructured data easily accessible
- *"If you like this seismic you will like this velocity and this acquisition report"*
- Known data quality, self-healing, automatic triggers

## Benefits

1. Leverage all data when making decisions
2. Remove manual intervention bottlenecks
3. Improved workflow efficiency – end user, data managers – less rework
4. Automated workflows

## Challenges

- Data ingestion - formats, automated QC workflows,
- Data security, licensing, sovereignty, access rules
- Requires cloud, analytics/ML, different storage mechanisms

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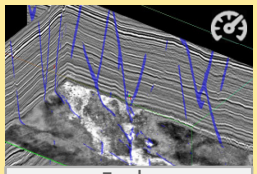
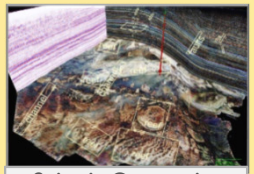
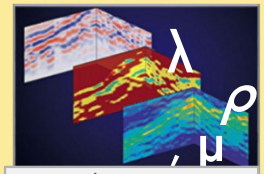
# Next Gen Subsurface Interpretation Roadmap

2018 2019 2020 2021 2022

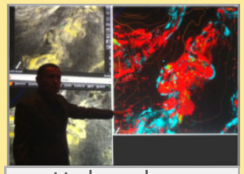
**Deep Machine Learning**


Faults

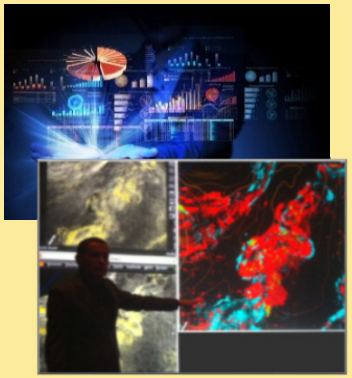

Seismic Geometries



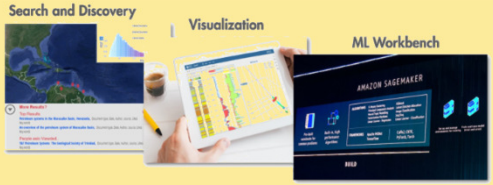
Rock Properties


Hydrocarbons

Cognitive Data Platform



**Cloud Native Subsurface Data Universe**




New Cloud-native Workflows

LoBs Integration

| The "on premise" world | Lift & Shift++ | The cloud world | | |
|---|---|---|---|---|
| GeoSigns | GeoSigns++ | User Interface | User Interface | Access & Info Security; End to end support & Mgt |
| | | Workflow services | Workflow services | |
| | | Application services | Application services | |
| | | Platform services | Platform services | |
| On Premise Infrastructure | Data Ingestion Services; SDU MVP Data Platform Services | | Data Ingestion Services; Data Platform Services | |
| | Infrastructure Platform services (AWS) | | Infrastructure Platform services (AWS) | |

Integrated Data in Subsurface Data Universe (SDU)

Machine Learning

Faster cycle time and better predictions

Reduce exploration finding and unit development costs

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# Data - Subsurface Data Universe | Vision

The Subsurface Data Universe is a cloud-hosted data platform, which provides **game-changing data integration, compute and analytics capabilities** to Shell

SDU is a **fundamental enabler for sustainable digital transformation** of our workflows, enabling fast replication and scaling of valuable digital solutions

SDU is **currently focused on subsurface data** and workflows for Exploration, Wells and Development, but will scale beyond this as required


**Fully Connected Ecosystem**
End-to-end data lineage tracking
All apps read the same data

**Collaboration-Centric Workflows**
User Experience-driven
Workflow orchestration to streamline high-value activities

**Global Data Accessibility**
Supports synchronization and replication of data across regions enabling flexible talent deployment

**On Demand Scalability**
Full storage and compute scalability
Only pay for what you use

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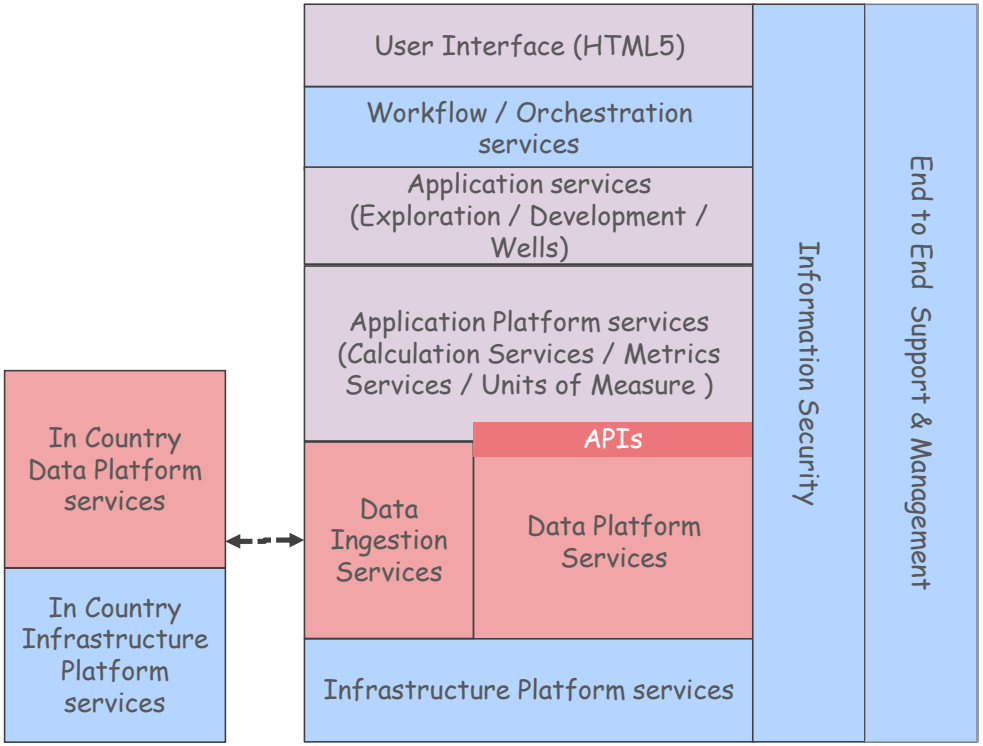
# Open SDU

## Managed by the Open Group (http://www.opengroup.org/)




- Public Cloud based. Leverage Open Source
- Information Security: Covering all elements with focus on Data Security.
- Data Ingestion Services → Extract metadata / data quality / etc. Leverage ML.
- Well defined (RestFUL) APIs defining the access to the Data Platform Services
- Applications: (Micro) Services based, domain specific.
- In Country solution: where not allowed to move data out of the country and there are no cloud services.
- Forum: Open Subsurface Data Universe has been created.
- All Standards, APIs, Reference Implementations available.

The Open Group 2018

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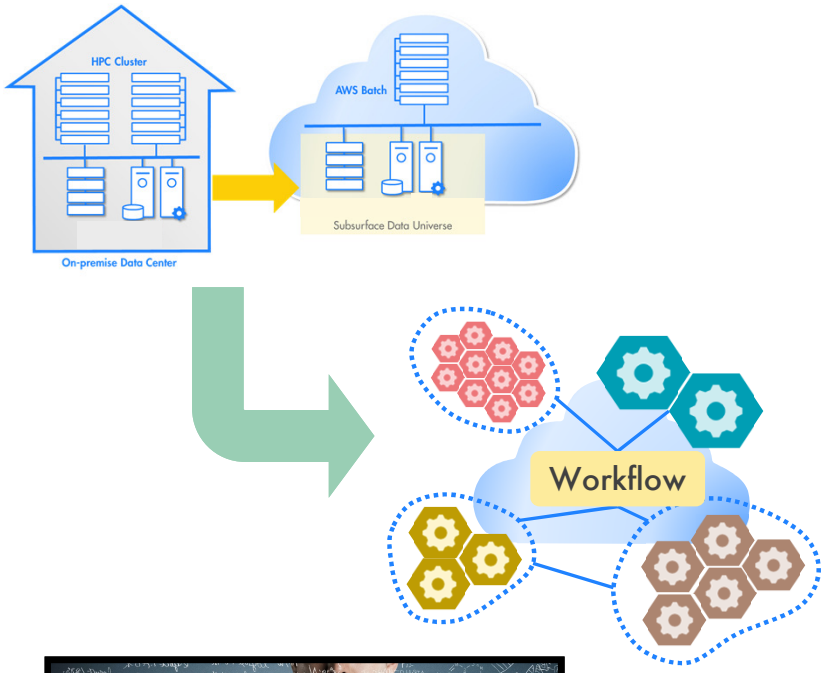
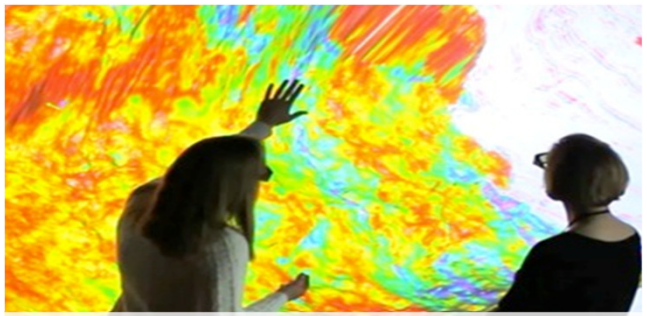
# Challenges in the Digital Transformation

- (Re-)Architect to make scalable cloud affordable
- Technology providers & consumers will continuously evergreen portfolios
- Business continuity vs. speed of transition
- Break both vendor & internal technology lock-in
- Manage costs, maximize pace, minimize disruption
- Skills for the future – data analytics, collaboration driven workflows

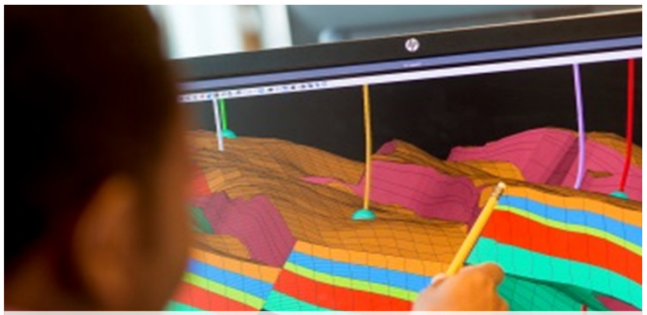



# Digitalisation delivering value in Upstream & Integrated Gas

**Safety & Environment**
Achieving goal zero

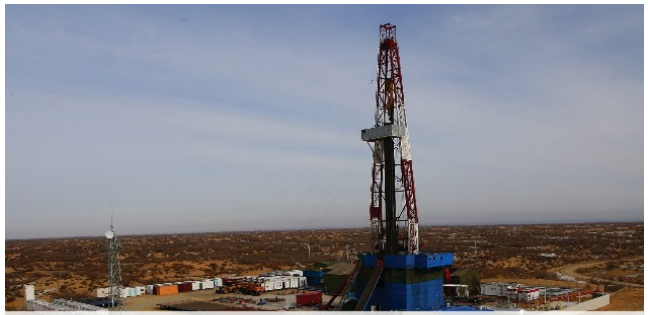


**Exploration**
See what others can't see



**Reservoir Modelling**
Optimise recovery & manage uncertainties

**Engineering & Construction**
Efficient execution of capital projects



**Well Delivery**
Best in class wells

**Production**
Increase reliability & availablity

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# Concluding Remarks

- New workflows – in the cloud, AI enabled, data on any device
- New employee capabilities
- New mindsets & corporate culture
- Data at the center
- Embrace disruptive digital technologies

Integrated Data in Subsurface Data Universe (SDU)

Machine Learning

Faster cycle time and better predictions

Reduce exploration finding and unit development costs