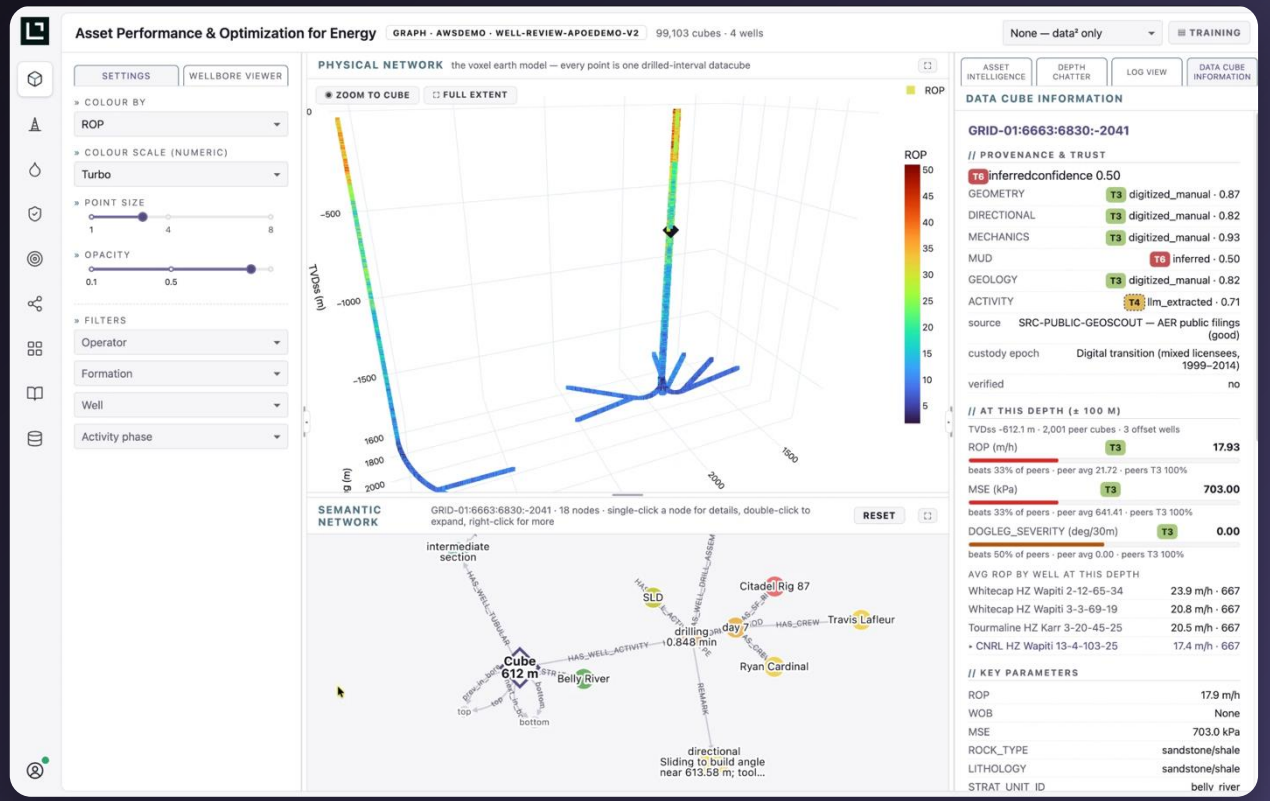
data²®

Asset Performance & Optimization for Energy

A provenance-first knowledge graph for wells, so every answer, from an engineer or an AI, arrives with the evidence behind it.



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THE QUESTION EVERY ASSET TEAM ASKS

Given a place in the earth, what do we know about it, and how much should we trust each fact?

Most data platforms can answer the first half. Very few can answer the second, and an AI working on top of them can’t either.

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THE PROBLEM

Where today’s well data breaks down

01

The record is split

- Business data (DDRs, time logs, AFEs, service tickets, production history)
- Drilling physics (ROP, MSE, vibration, lithology) sit in separate systems.
- Geological data and well logs

Someone joins them by hand for every study.

02

Trust doesn’t travel

A re-keyed paper-era survey and a corroborated wireline value end up in the same column. Once they’re aggregated, nobody can tell which one drove the number.

03

AI makes it worse

An LLM over that data answers fluently either way. Without provenance it can’t tell you what it doesn’t know, or what you should go and measure.

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HOW WE SOLVE IT

One graph, two layers, one industry standard

BUSINESS LAYER

Well Information Network on PPDM 3.9

- Wells, surveys, DDRs, time-log activities, rigs, crews, BHAs, completions, frac, production, AFEs, invoices
- PPDM table and column names, composite keys, audit columns, _**OUOM** unit pairs
- About 47 of PPDM's 2,688 tables, generated from the data dictionary

PHYSICS LAYER

DataCube lattice along every wellbore

- The drilled earth as 0.30 m voxels, each with about 90 attributes: mechanics, directional, mud, vibration, geology, NPT/ILT, apportioned cost
- A PPDM-sanctioned **X_*** extension, where every cube keys back to UWI, activity, strat unit and AFE

Both layers live in **reView**, data²'s graph platform, queried over Cypher/REST.

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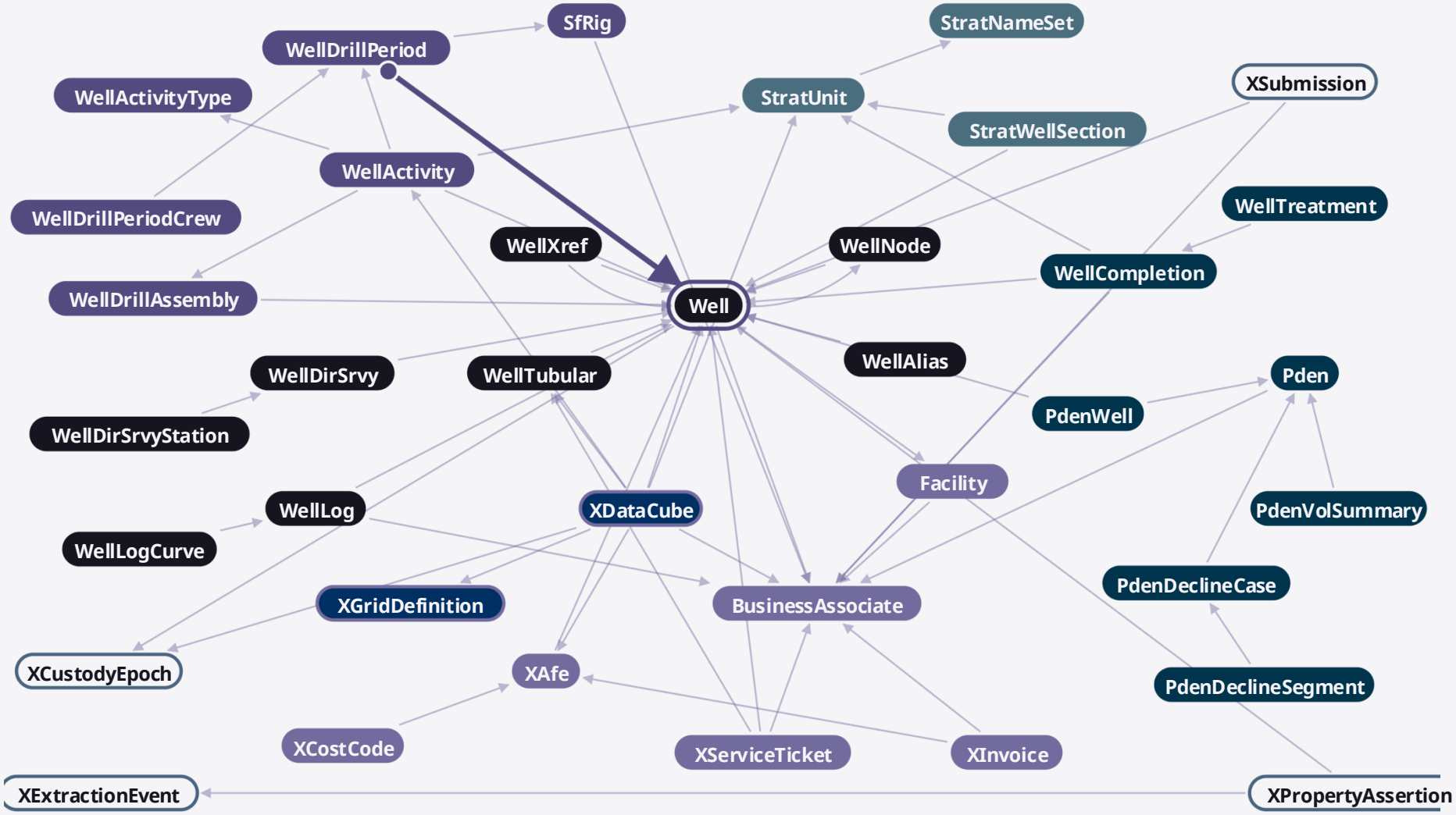
THE DATA MODEL

The map: PPDM as a graph

Arrows run from the row holding the foreign key to the row it references. Reference lookups are left out.



FROM A WELL TO A CUBE

1. **Well**: start from the well
2. **WellDrillPeriod**: its daily drilling reports
3. **WellActivity**: what the crew logged that day
4. **XDataCube**: the metres drilled during it
5. **StratUnit**: the formation each one is in

The first three hops run **against** the arrows. A graph walks either way.

- Well, surveys and logs
- Drilling operations
- Geology
- Completions and production
- Business
- DataCube
- Provenance (outlined)

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HOW THE GRAPH ANSWERS

A question is a walk through the model

Which rig drilled this metre, and who owns it?

XDataCube
↓ HAS_WELL_ACTIVITY
WellActivity
↓ HAS_WELL_DRILL_PERIOD
WellDrillPeriod
↓ HAS_SF_RIG
SfRig
↓ HAS_BUSINESS_ASSOCIATE
BusinessAssociate

How is this well tracking its type curve?

Well
↑ HAS_WELL (inbound)
PdenWell
↓ HAS_PDEN
Pden
↑ HAS_PDEN (inbound)
PdenDeclineCase
↑ HAS_PDEN_DECLINE_CASE
PdenDeclineSegment

Which vendors billed the budget behind this metre?

XDataCube
↓ HAS_X_AFE
XAfe
↑ HAS_X_AFE (inbound)
XInvoice
↓ HAS_BUSINESS_ASSOCIATE
BusinessAssociate

Ask reView works the same way: it reads this model through the domain pack, plans the walk and runs it as Cypher

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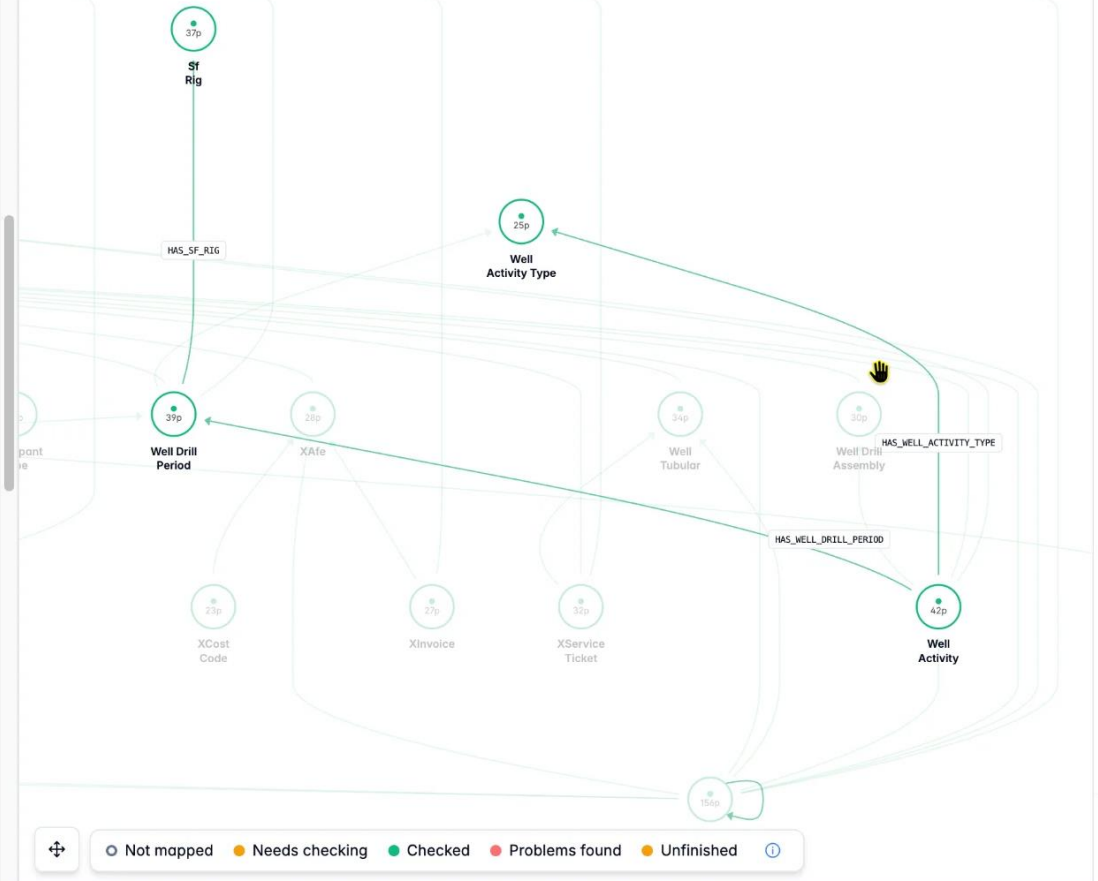
well-review-APOEDemo-v2

Sources 140 · Entities 48 checked · 48/48 · Relationships 91 checked · 91/91 · Analyses 34/34

Add · Asset Performance & Optimiza... · Load into graph

Sourc... 140 | Sche... 139 | Analys... 34

- Which wells were drilled from each pad?
- **Daily Footage and Cost by Rig** 11/11 — How many metres a day does each rig drill, and at what average day cost?
- **Vendor Billing by Service Category** 9/9 — What does each vendor bill per ticket in each service category?
- **Operator Versus Competitors by Formation, Named** 17/17 — Per formation, by name, how does the operator's mean drilling ROP compare...
- **Completion Summary by Well** 19/19 — How was each well completed: frac vendor, stages, proppant and lateral...
- **Monthly Production by Well** 21/21 — What did each well produce each month: oil, gas, water and BOE?
- **Vendor Billing Totals** 9/9 — How much has each service vendor billed in total, over how many tickets?
- **Lost Time by Rig** 19/19 — How many hours did each rig spend in non-productive time (NPT) and invisibl...
- **Proppant Intensity Against Performance** 23/23 — How does each well's proppant intensity relate to its performance against type...
- **Water Cut Jumps by Well** 19/19 — Which wells had the most months in which water cut rose by more than 5...



ANALYSIS · requirements met

Lost Time by Rig

How many hours did each rig spend in non-productive time (NPT) and invisible lost time (ILT), and what share of its time is that?

`table` `grain: SfRig` `1 parameter`

19/19

The project reports this question as dirty.

PARAMETERS

`rigCode` · string · optional
Limit to one rig, e.g. RIG-02.

OUTPUTS (5)

- `rigCode` · key · string · non-null · `SfRig.RIG_ID`
- `totalHours` · metric · numeric · nullable · `WellActivity.ACTIVITY_DURATION`
  aggregation: sum · units: time · extensive
- `nptHours` · metric · numeric · nullable
  aggregation: sum · units: time · extensive
- `iltHours` · metric · numeric · nullable
  aggregation: sum · units: time · extensive
- `lostShare` · metric · numeric · nullable

Requirements met means the mappings this question depends on passed their data checks. It does not run the analysis, and it does not establish identity uniqueness or join fan-out.

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PROVENANCE ON EVERY VALUE

Six trust tiers, enforced by the application

Tier	Meaning	Example	Highest permitted use
1	Measured, verified	Survey cross-checked against wireline	Reserves booking
2	Measured, unverified	EDR channel, no independent check	Engineering design
3	Digitised, verified	Tower-sheet value re-keyed and checked	Benchmarking
4	Machine-extracted	LLM-parsed TD from a scanned report	Screening, always flagged
5	Interpolated, modelled	Porosity from the nearest logged well	Context, never the sole driver
6	Inferred, assumed	Regional mud-weight assumption	Excluded from every ranking

Flattened onto PPDM's ROW_QUALITY, so the standard carries the tier

Too little evidence? The app won't rank it, and it says what to go and measure

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ADIPEC 2026 ABU DHABI EXHIBITION & CONFERENCE · 2–5 NOVEMBER

GRAPH · AWSDEMO · WELL-REVIEW-APOEDEMO-V2

ADIPEC 2026 | TRAINING

99,103 cubes · 4 wells

▾ The six evidence tiers

T1 measured verified
— Direct measurement; source record sighted and independently corroborated. e.g. Directional survey cross-checked against wireline log

T2 measured unverified
— Direct measurement from a single uncorroborated source in good condition. e.g. EDR channel data, no independent check

T3 digitized verified
— Transcribed, calculated, or extracted from a legible record; human-verified where extraction was automated. e.g. Tower-sheet value re-keyed and checked against the scan

T4 machine extracted unverified
— OCR/LLM extraction from a source document with no human verification; must be visibly flagged. e.g. LLM-parsed TD from a scanned completion report

T5 interpolated modelled
— Computed from neighbouring or analogous data; never a sole decision driver. e.g. Porosity decayed from the nearest logged wellbore

T6 inferred assumed
— Engineering judgement, field analogue, or default; excluded from ranking inputs. e.g. Regional mud-weight assumption for an unrecorded well

» WELLS

All wells

☐ Include interpolated shell

Every value in this dataset carries an evidence tier on a 6-step scale: 1 measured & verified … 6 inferred/assumed. The estate grade weights every data-type value by its

D	39,012	6,446	6%	25%	0%	0.56
ESTATE GRADE	DRILLED CUBES	ESTATE RECORDS	MEASURED (T1–2)	INTERPOLATED+ (T5–6)	CUBES VERIFIED	MEAN CONFIDENCE

60,091 SHELL CUBES (EXCLUDED)

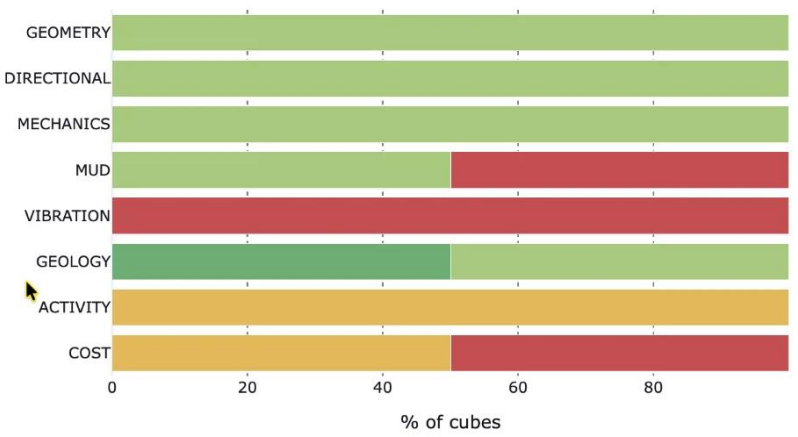
4 wells · 39,012 cubes · tier gates: T6 excluded from aggregates, T5 never a sole driver, T4 flagged until verified

Where to spend data-quality effort — weakest evidence first

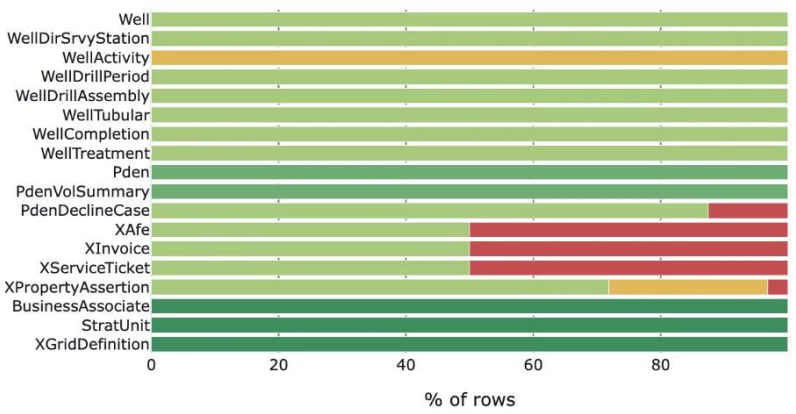
1.	**Whitecap HZ Wapiti 2-12-65-34 · Vibration**	100% tier ≥5	9,997 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
2.	**CNRL HZ Wapiti 13-4-103-25 · Cost**	100% tier ≥5	9,898 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
3.	**CNRL HZ Wapiti 13-4-103-25 · Mud**	100% tier ≥5	9,898 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
4.	**CNRL HZ Wapiti 13-4-103-25 · Vibration**	100% tier ≥5	9,898 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
5.	**Tourmaline HZ Karr 3-20-45-25 · Cost**	100% tier ≥5	9,589 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
6.	**Tourmaline HZ Karr 3-20-45-25 · Mud**	100% tier ≥5	9,589 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
7.	**Tourmaline HZ Karr 3-20-45-25 · Vibration**	100% tier ≥5	9,589 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
8.	**Whitecap HZ Wapiti 3-3-69-19 · Vibration**	100% tier ≥5	9,528 cubes	→ *re-source — tier-6 evidence is structurally excluded from every aggregate*
9.	**Whitecap HZ Wapiti 2-12-65-34 · Activity**	100% tier 4	9,997 cubes	→ *verify the extraction — machine-extracted values stay flagged until someone checks them*
10.	**Whitecap HZ Wapiti 2-12-65-34 · Cost**	100% tier 4	9,997 cubes	→ *verify the extraction — machine-extracted values stay flagged until someone checks them*
11.	**CNRL HZ Wapiti 13-4-103-25 · Activity**	100% tier 4	9,898 cubes	→ *verify the extraction — machine-extracted values stay flagged until someone checks them*
12.	**Tourmaline HZ Karr 3-20-45-25 · Activity**	100% tier 4	9,589 cubes	→ *verify the extraction — machine-extracted values stay flagged until someone checks them*

… and 2 more cells with some weak evidence

Evidence tier mix by data type



Evidence tier mix by record type



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WHAT IT GIVES THE TEAM

Four ways in, one graph underneath

See the earth

A 3-D view of every cube. Click one to walk the graph to its formation, activity, daily report, rig, crew, remark and invoice.

Benchmark drilling

Compare operators, rigs or pads on ROP, MSE, DLS, cost per metre and NPT inside a box drawn on the map. Evidence floors decide what can be ranked.

Benchmark production

Actuals against Arps type curves, EUR against proppant intensity, frac-vendor league tables, and a ranked list of wells that need attention.

Ask reView

Send anything you’re looking at, with its context, to the reView Reasoner. You see the prompt before it goes.

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GRAPH · AWSDEMO · WELL-REVIEW-APOEDEMO-V2

ADIPEC 2026 | TRAINING

99,103 cubes · 4 wells

SETTINGS | WELLBORE VIEWER

» COLOUR BY
ROP

» COLOUR SCALE (NUMERIC)
Turbo

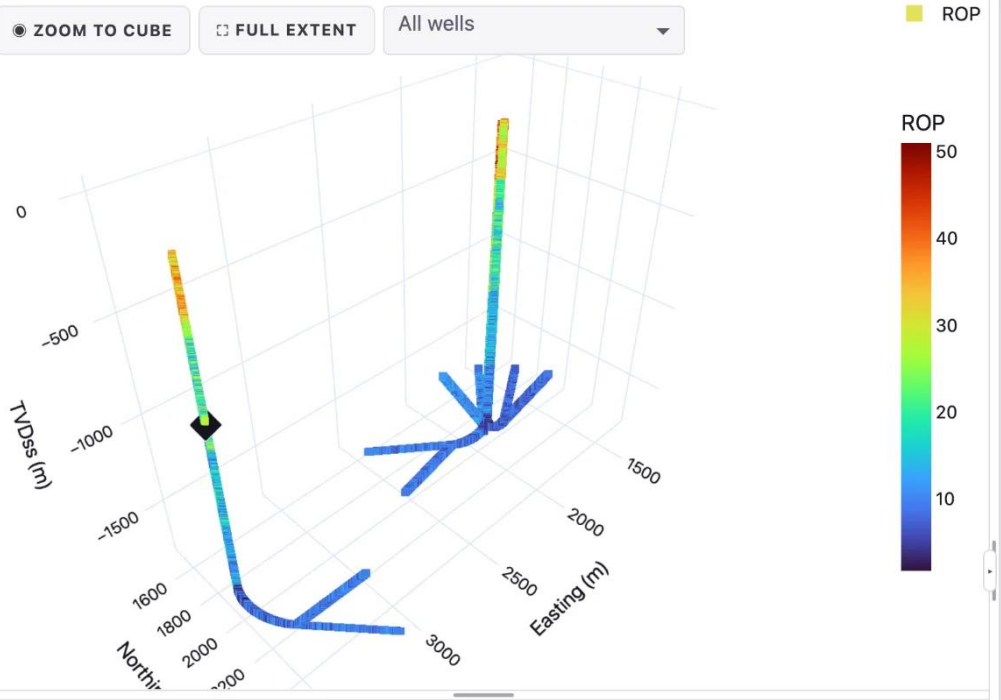
» POINT SIZE
1 4 8

» OPACITY
0.1 0.5

» FILTERS
Operator
Formation
Well
Activity phase

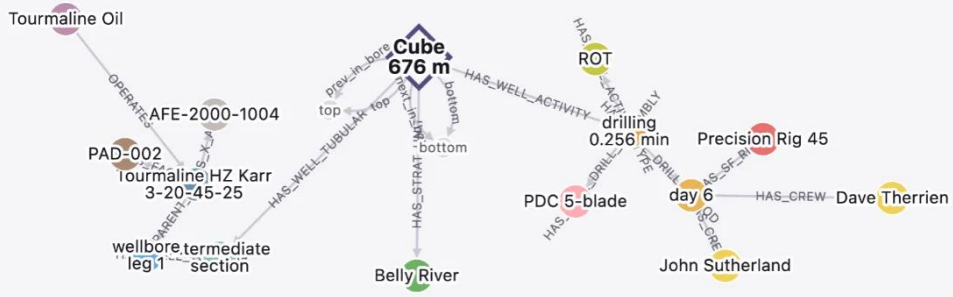
PHYSICAL NETWORK
the voxel earth model — every point is one drilled-interval datacube

ZOOM TO CUBE | FULL EXTENT | All wells



SEMANTIC NETWORK
GRID-01:11747:6810:-2253 · 17 nodes · single-click a node for details, double-click to expand, right-click for more

RESET



ASSET INTELLIGENCE | DEPTH CHATTER | LOG VIEW | DATA CUBE INFORMATION

2. DRILLING PERFORMANCE — WHERE THIS VOXEL STANDS

All values below are TIER-3 (digitized/verified from regulator filings) unless otherwise noted.

Metric	This voxel	Fleet avg (Belly River, 7,464 cubes)	Formation nominal (TIER-1 ref)	Assessment
ROP	28.6 m/h	21.46 m/h	27.0 m/h	✅ +33% vs fleet avg, +6% vs nominal
MSE	441 kPa	651 kPa	—	✅ 32% below avg (more efficient)
Dogleg Severity	0 deg/30m	0.0 deg/30m	—	✅ Vertical, no deviation stress
Rock Signal	0.323	—	0.36 (TIER-1)	⚠️ 10% below expected — see below
EST_UCS	36 MPa	—	36 MPa (TIER-1)	✅ Matches formation reference

Performance read: At this voxel, Precision Rig 45 with BHA-00013 is drilling the Belly River efficiently — the MSE/ROP combination is the best of the three visible consecutive cubes. However, **the down-bore trend is notable:**

Cube	MD (m)	ROP (m/h)	MS (kP
prev: -2208 (id 01M5H4YAQBWV84KWA7YV05HTC0)	662.239	27.98	45
this: -2209 (id 01M5H4YAQ3MA30RGK7T4AE9RD2)	**662.537**	**28.6**	**44**
next: -2210 (id 01M5H4YAFJX1XFPNXKXNANEJH1)	662.836	22.14	56

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99,103 cubes · 4 wells

SUMMARY

CNRL HZ Wapiti 13-4-103-25 (UWI: 103/13-04-103-25W5/00) is the worst-performing well, averaging **12.44 m/h** across 9,898 drilled cubes — 25% below the field-best of 16.64 m/h. The deficit is not a rock problem (all four wells drill the exact same formations with identical UCS values); it is a **rig-efficiency problem**, locked in by RIG-02 "Citadel Rig 87" (skill factor 0.78 — the lowest of the three rigs on the pad) and amplified by an unusually high mechanical specific energy consumption in every formation it drilled.

CONFIRMED FINDINGS

1. WELL-LEVEL ROP RANKING (ALL FORMATIONS, DRILLED CUBES ONLY, M/H)

Well	UWI	Avg ROP	Avg MSE	Total ILT	Cubes
CNRL HZ Wapiti 13-4-103-25	103/13-04-103-25W5/00	**12.44**	**2,925.2**	337 h	9,898
Tourmaline HZ Karr 3-20-45-25	102/03-20-045-25W4/00	14.72	2,467.5	322 h	9,589
Whitecap HZ Wapiti 3-3-69-19	103/03-03-069-19W4/00	14.85	2,455.5	330 h	9,528
Whitecap HZ Wapiti 2-12-65-34	103/02-12-065-34W4/00	16.64	2,221.0	314 h	9,997

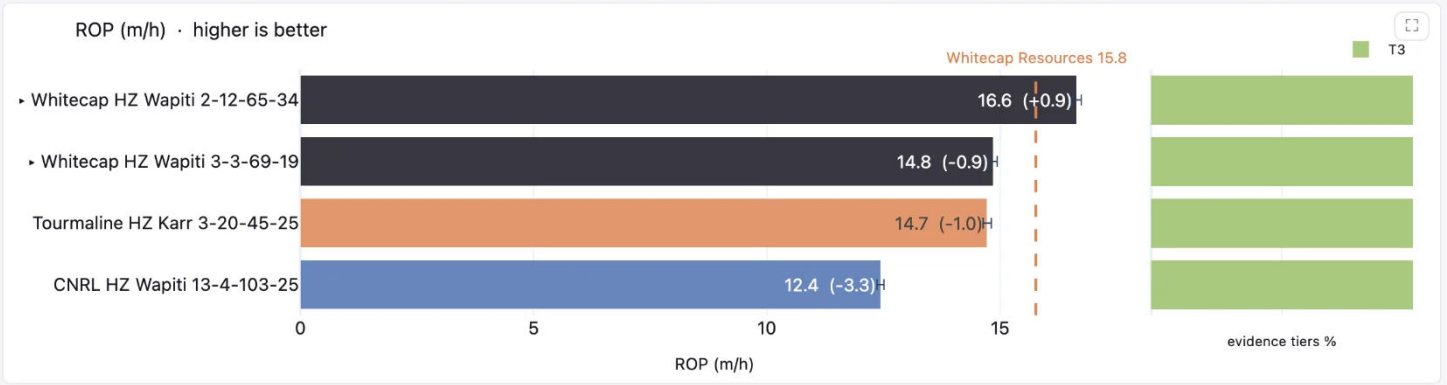
ROP in m/h (all cubes tagged ROP_OUOM = "m/h"). ILT in ILT_DURATION_OUOM = "min" converted to hours.

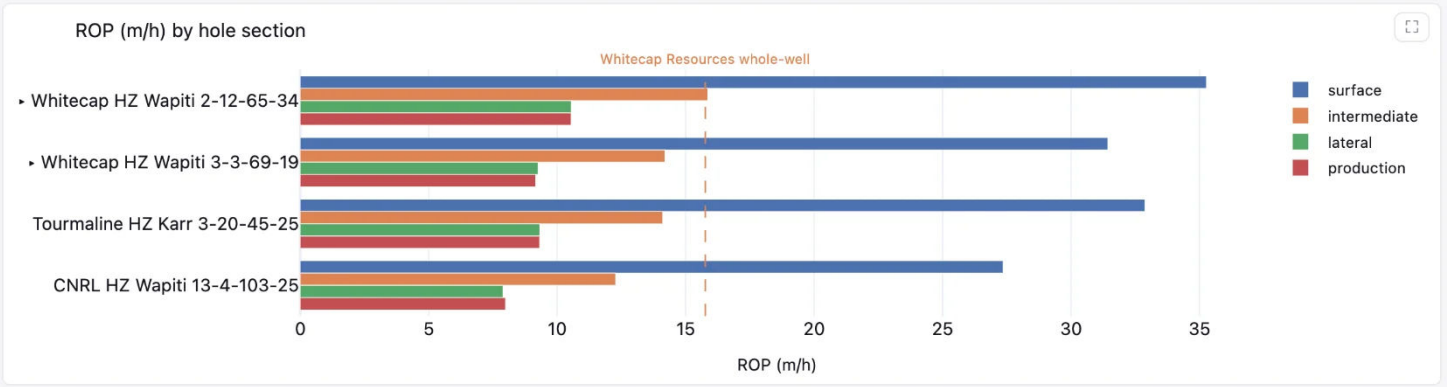
2. IT IS NOT THE ROCK — ALL WELLS DRILL IDENTICAL FORMATIONS

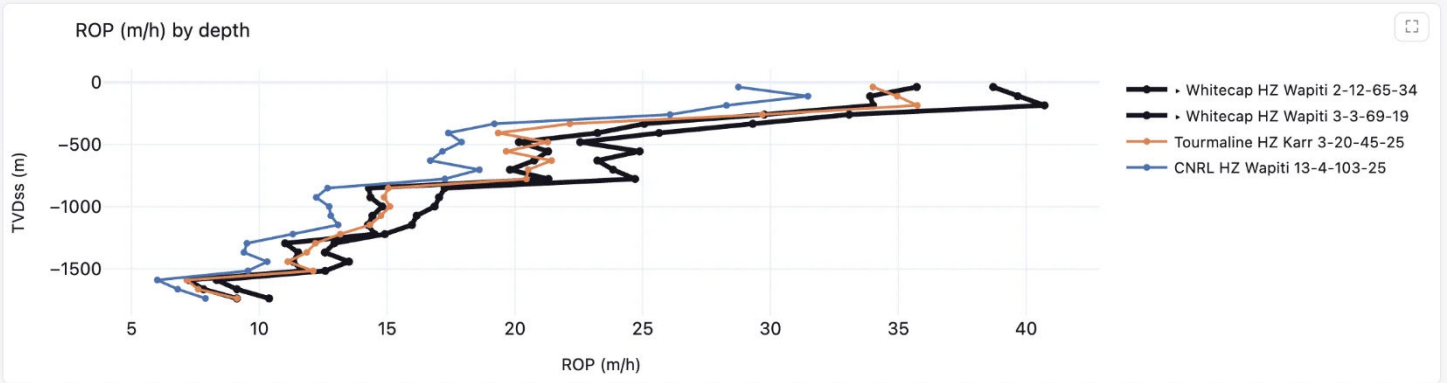
Every well drills the same six formations in the same cube counts. The UCS is a fixed property of the rock, not the well:

Formation	UCS (M	Lithology	Nominal	CNR	Tourmalin	WC 3-	WC 2-

39,012 drilled cubes across the field · 4 wells compared · reference: Whitecap Resources @ 15.8 · evidence floor: ≥82 cubes, ≥100% tiers≤4, ≥35% tiers≤3







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4. **Well-level detail:**

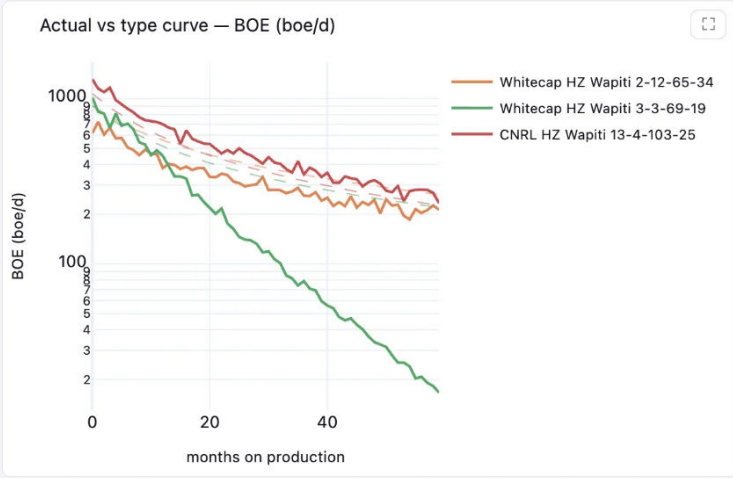
Well	UWI	Frac Vendor	Actual EUR (Mcf)	Type-Curve EUR (Mcf)	Ratio
Whitecap HZ Wapiti 3-3-69-19	103/03-03-069-19W4/00	TitanFrac	426,818	1,520,852	**0.281** 🔴
Whitecap HZ Wapiti 2-12-65-34	103/02-12-065-34W4/00	North Peak	1,381,084	1,787,098	**0.773** 🟡
Tourmaline HZ Karr 3-20-45-25	102/03-20-045-25W4/00	TitanFrac	1,603,502	1,413,396	**1.135** 🟢
CNRL HZ Wapiti 13-4-103-25	103/13-04-103-25W5/00	Cascade	1,827,708	1,590,628	**1.149** 🟢

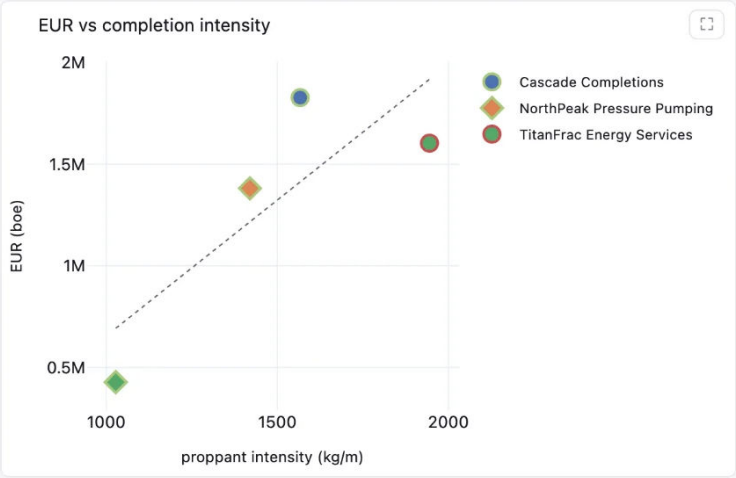
5. **The single worst-performing well is Whitecap HZ Wapiti 3-3-69-19** (TitanFrac, id: 01M5H4WFKAK6MB4PB01A54A3KF) — it achieved only **28.1%** of its *Montney LRG Tier-1* type-curve EUR, an 1,094,034 Mcf shortfall. This one well is almost entirely responsible for pulling TitanFrac to the bottom of the ranking.
6. **TitanFrac's other well (Tourmaline HZ Karr 3-20-45-25**, id: 01M5H4WFKAK6MB4PB01A54A3KJ) **outperforms** the type curve by 13.5% — indicating the vendor's results are highly variable rather than uniformly poor.

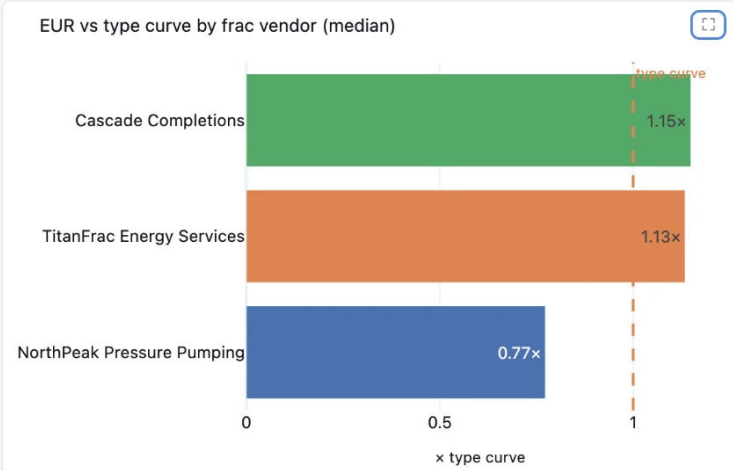
DATA GAPS

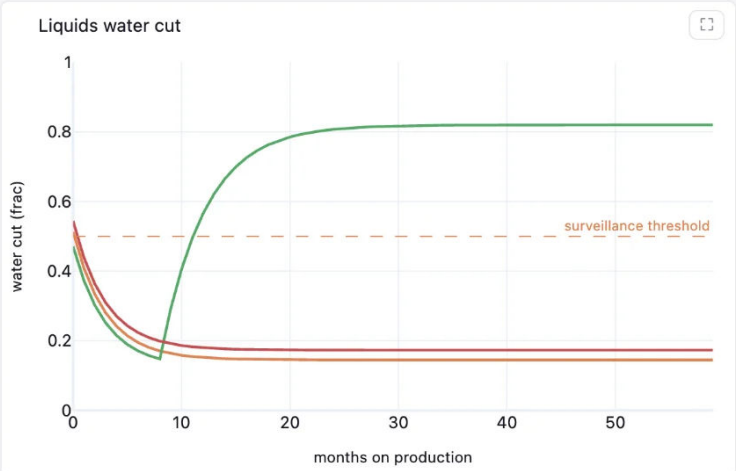
- **Well count is small (4 wells, 3 vendors).** With only 1 well behind NorthPeak and Cascade, their ratios carry high uncertainty — a single completion design or reservoir

4 wells · group benchmark uses the median vs type curve, wells with recent water cut > 50% excluded · 1 well below the evidence floor (not ranked)









Production targets — ranked vs type curve, worst first

1.	Whitecap HZ Wapiti 3-3-69-19	0.28× curve	T3	weakest: curve fit T3 water breakthrough · low proppant intensity
2.	Whitecap HZ Wapiti 2-12-65-34	0.77× curve	T3	weakest: curve fit T3 frac vendor (NorthPeak Pressure Pumping)
3.	CNRL HZ Wapiti 13-4-103-25	1.15× curve	T3	weakest: curve fit T3 on type curve

Insufficient evidence — not ranked

—	Tourmaline HZ Karr 3-20-45-25	1.13× curve (context only)	→ *re-source the production months — tier-6 evidence is structurally excluded from every aggregate*

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HOW WE PROVE IT

We don’t trust the AI’s answers. We test them.

1 · Set the exam

Questions with known answers

Twenty questions for each of six roles, from executive to well engineer. The right answer is worked out and confirmed by engineers.

2 · Sit it three ways

Same questions, same data

- **reView**: the graph plus the domain pack
- A strong AI model on the raw graph
- The same AI on the data as database tables

3 · Mark it the same way

One independent judge

Every answer is checked against the known one. Each score breaks down into checks you can open.

The gap between the scores is what the graph and the domain pack add.
You’ll see real runs in the demo.

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ADIPEC 2026 | TRAINING

99,103 cubes · 4 wells

1 Questions | 2 Answer traceability

Questions

Pick a question to replay how it was answered.

well-review-APOEDemo-v2 (AWS demo) · executive · 2026-11-01 01:56 · 15 of 16 right

16 questions

✓	N01	How many wells are there? Executive · Asset manager	Natural
✓	N02	What's the average rate of penetration across the wells? Executive · Drilling lead · Production engineer	Natural
✓	N05	How much non-productive time has there been? Executive · Drilling lead	Natural
✓	N06	How much invisible lost time is there? Executive · Drilling lead	Natural
✓	N08	Which vendor is paid the most? Finance · Executive	Natural
✗	N10	How far over budget are the wells, in total? Finance · Executive	Natural
✓	N11	Which well ran furthest over its planned drilling days? Asset manager · Executive	Natural
✓	N13	How much gas have the wells produced? Executive · Asset manager	Natural
✓	N14	Which rig causes the most non-productive time? Drilling lead · Executive	Natural
✓	N15	Does Whitecap drill faster than the other operators? Executive · Drilling lead	Natural
✓	C01	Which well has produced the most gas? Executive · Asset manager · Production engineer	Natural

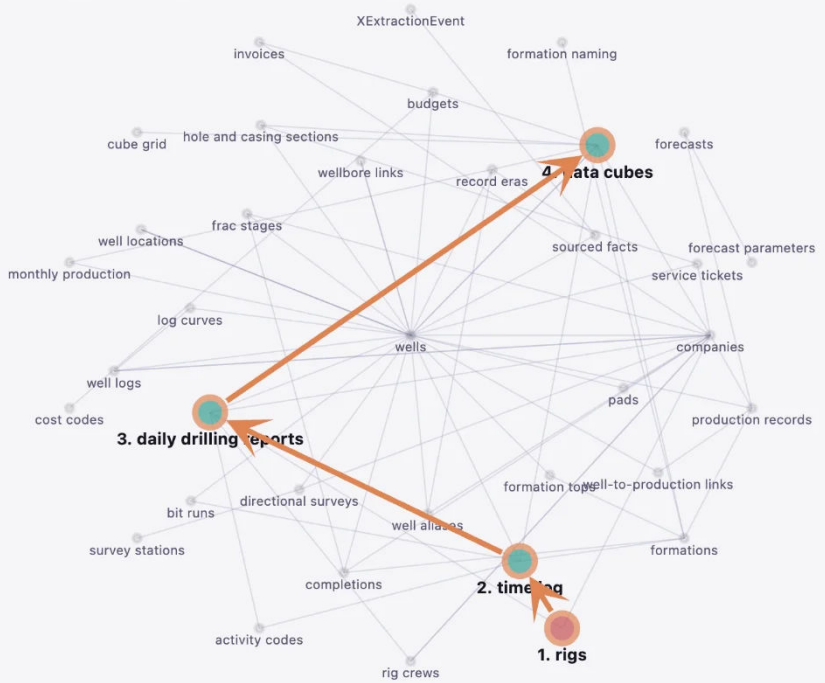
N02 What's the average rate of penetration across the wells?

REVIEW (Open in Reasoner ↗)	RAW FILES	RIGHT ANSWER
14.67 m/h grand average across 4 wells (range per well: 12.44–16.64 m/h)	12.48 m/h	14.67

? How to read this picture

⏮ ‹ ▶ Play › ⏭ 1 / 4

Route it took: 1. rigs → 2. time log → 3. daily drilling reports → 4. data cubes
Expected path for this question: time log, daily drilling reports, data cubes
Small grey dots: the graph's other 44 record types, not used



Step 1 of 4: **Run the pack analysis "rig rate of penetration"**

Looked at rigs, time log, daily drilling reports, data cubes · followed has sf rig, has well activity, has well drill period

▾ the exact query

> Run the pack analysis "rig rate of penetration"

▾ Cypher (translated from the pipeline)

```
// pack analysis
gov_rig_rate_of_penetration:
its Cypher is shown on its
own step
```

▾ Pipeline as sent to reView

```
[
 {
  "op":
"gov_rig_rate_of_penetration"
 }
]
```

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What you'll see in the demo

1 **Project**: pick the environment and the graph

2 **Data Viewer**: click a cube and walk to the daily report and the invoice

3 **Drilling**: benchmark operators in a box, and watch a rank get refused

4 **Ask reView**: a question with its full context, prompt shown first

5 **Benchmark**: run one role's questions, then read the results and the trace

Decisions you can defend.

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