A Technical Program for Improved Supplier Engagement for the Procurement of Bulk Explosives

Richard Sullivan, Specialist D&B Engineer, Sedna D&B
Preferred partner of Blast It Global

Intro: Are we Still looking for a standard?

1990

- "reach agreement on fundamental criteria used by detonation codes for determining strength…These measures would assist explosives customers in **assessing the true strengths of explosives**." (*Cunningham, C. V. B., SARRACIN0, R. S. Fragblast 90)*

2001

- "a comparison of the products from different manufacturers based on their proprietary rating systems **may be misleading**."*(Djordjevic, N, 2001*)

2012

- "An **effective selection of bulk explosives** cannot be made based on price and the claims made on specific Technical Data Sheets (TDS)." (Martin, D. *AusIMM 2012)*

Why are we here?

1. Choosing the right bulk explosive is fundamental;
   - Each site is different. There is no ‘One size Fits All’
   - Optimisation of powder factor, stemming, timing, etc depend on the bulk explosive chosen
   - Impact on downstream users (dig rates, fines-lumps, dilution, wall control, processing costs, safety & Environment)

Why are we here?

2. Choosing the right bulk explosives is not easy;
   - Many different products/ pricing structures/ options.
   - Difficult to compare ‘Apples with Apples’
   - Intellectual Property issues
   - Field trials of Supplier’s products is time-consuming, can be difficult to enact (Contractual) and not an option for a green fields site

Why are we here?

3. The market place in Australia has changed a great deal over the past decade;
   - New Suppliers/ sources of raw materials/ plants in proximity to mining regions
   - Traditional methods of Supplier engagement have been challenged, and broken!

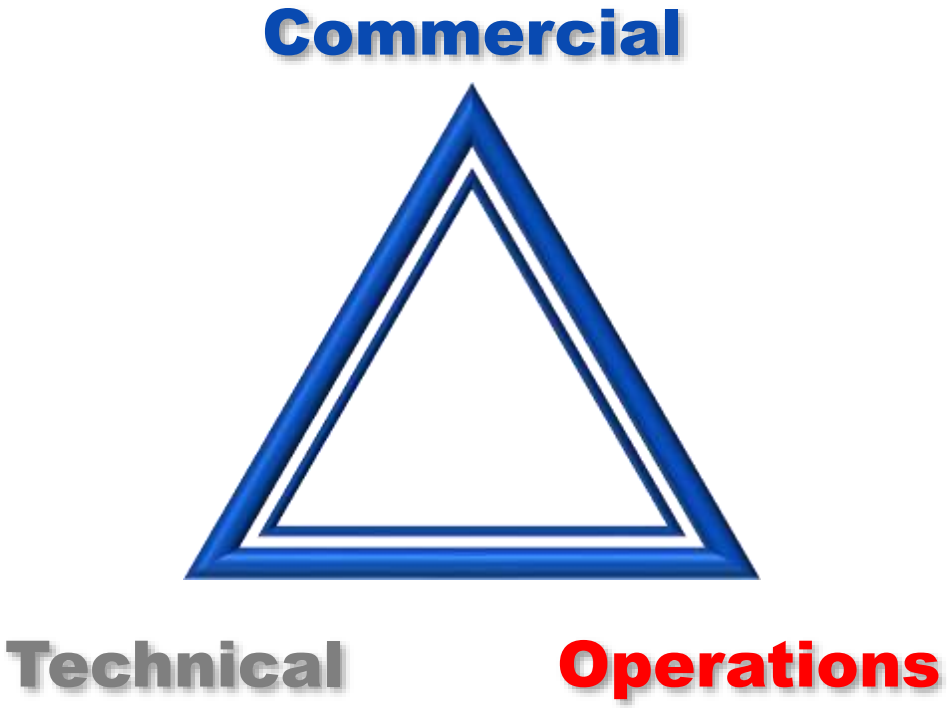
Establish a Multi-Disciplinary Team

Goal: a Defence-Against-the-Dark-Arts strategy employing Cross-Functional Collaboration:

- Bring together Head and Regional offices and on-site departments
- Commercial, Technical and Operational specialists to work together

The desired outcome of the procurement process is a final decision that will ultimately be Corporate approved, Regional led and site-owned.

Establish a Multi-Disciplinary Team



- Map Subject Matter Experts (SME) and their areas of experience to enable critical assessment/ verification of claims and statements:
  - ✓Commercial pitches and market evaluations,
  - ✓Technical Engineering case studies
  - ✓Operational needs assessments and practicalities.

Find key players with a passion to effect change

As few as just 3 people can set a business on a new path

Akin to pushing a big wheel out of its current rut, and setting it on a new course.

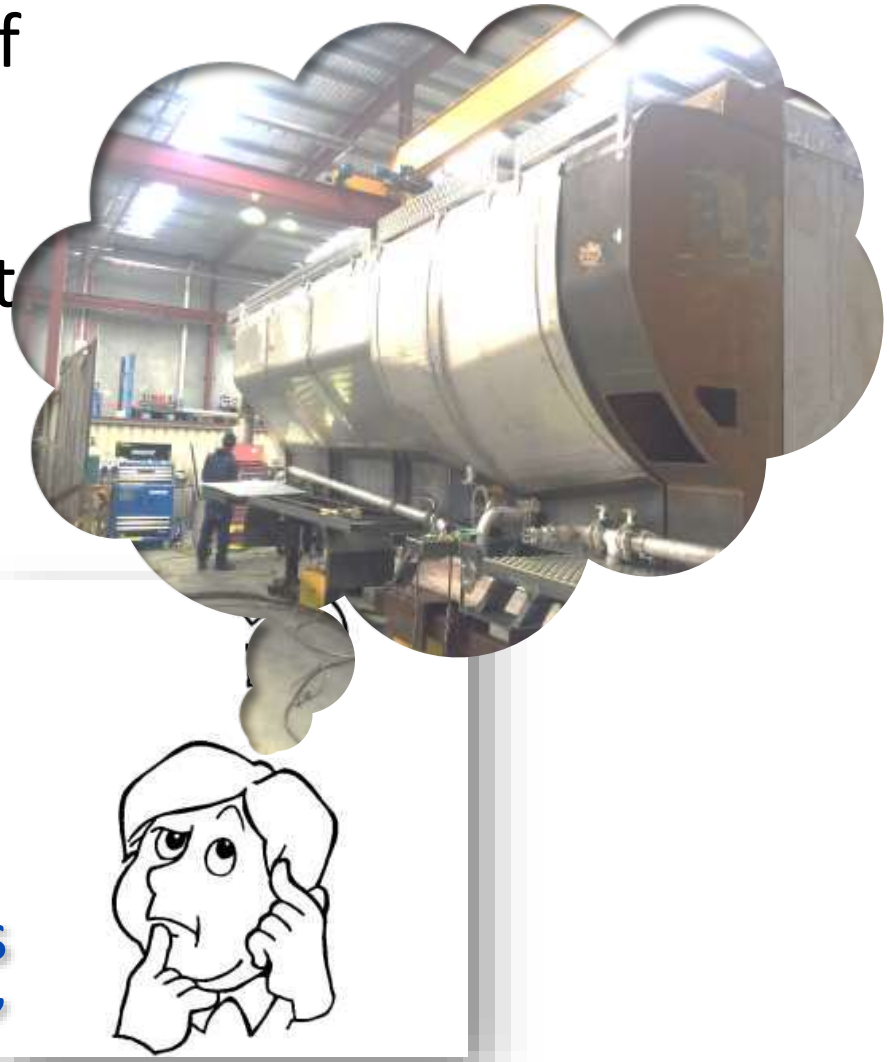
Once on the new path it will tend to stay there (Momentum)

Prepare: Gather ideas, develop concepts

Think outside the box. Start with a blank sheet of paper.

What worked before might no longer be the best opportunity for your company.

- Hold pre-tender meetings to learn about what has recently changed in the industry.
- Offer site visits, listen to sales pitches.



"Why not build the trucks to suit the bulk products you want to use?"

Own the Process

Keep control of the tender process. Be on the lookout for;

- Suppliers trying to circumvent and going straight to the top: Board of Directors, or Executive Level
- Blasting Case studies presented by the Supplier's top Technical specialists to your commercial group, without any of your own Technical SME's present
- Attempts to bypass the tender altogether by offering early discounts for a contract rollover

Own the Process

- Bundling products and services together,
- Overly complex tender proposals, for example intricate Rise and Fall formulas with non-standard indices, scrubbing equations from proposals

EVERYTHING tender related must go through ONE point of contact (Commercial Lead) who can then coordinate/ delegate as appropriate.

Manage Intellectual Property Issues

How do we find a compromise between;

1. Customers having sufficient product knowledge, so that meaningful assessments and comparisons can be made
2. Suppliers safeguarding their Intellectual Property

"Would you buy a car without being able to look under the hood?"

Manage Intellectual Property Issues

Consider:

- Not Intellectual Property if information already in the public domain.
- Suppliers may make claims on Intellectual Property they don’t necessarily own;
- Not automatically one party’s IP just because the other party doesn’t know the information.

Patent Review: Bulk ANE based Explosives

Key Patents/ applications:

Patents - google.com
https://www.google.com/patents

- 1961 “Ammonium nitrate-containing emulsion sensitizers”, IMC Chemical Group.
- 1967 “Water-in oil-emulsion type explosives”, Atlas Chemical Industries.
- 1984 “Gas bubble-sensitized explosive compositions”, ICI Australia
- 1988 “PIBSA Emulsifiers”, Imperial Chemical Industries.
- 1995 “Modular Controller for MMU”, ICI Australia.

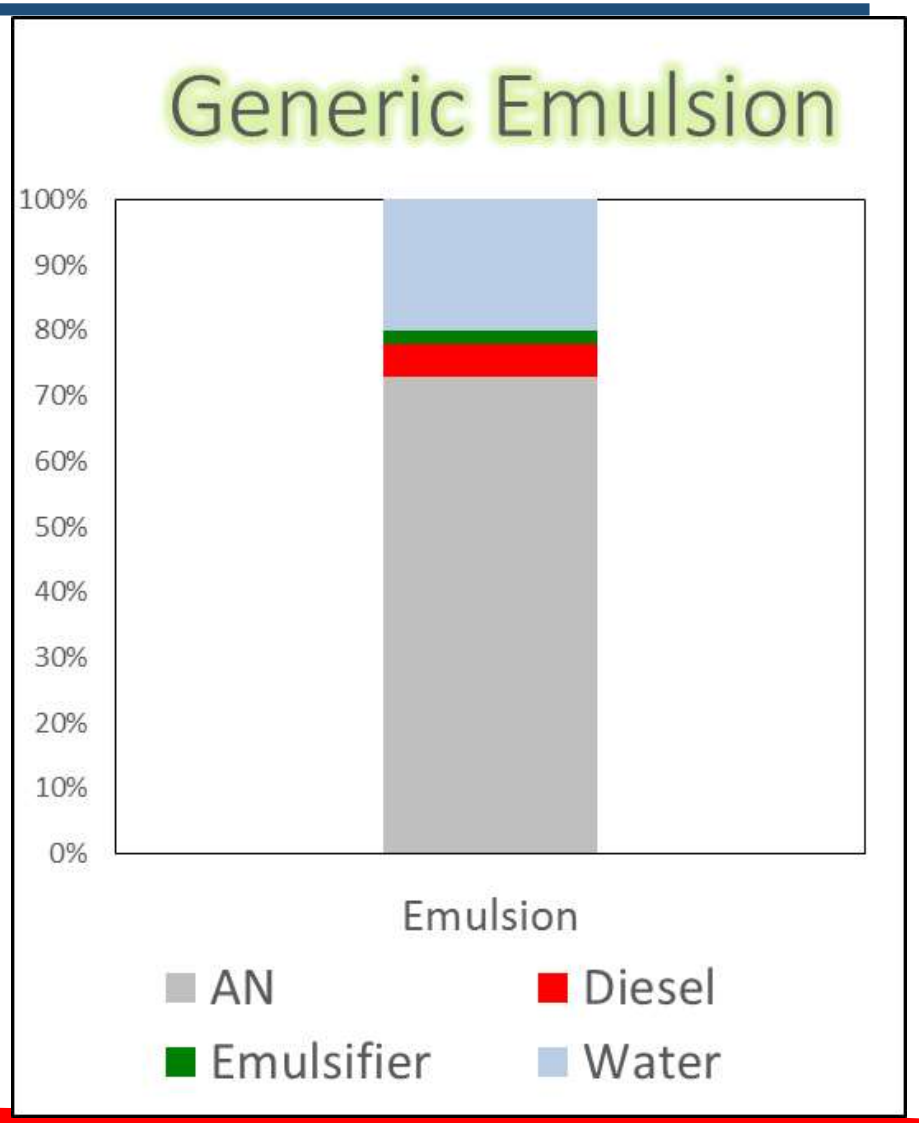
20 Years

Basics of Ammonium Nitrate Emulsions

Generic emulsion containing 20% water (minor ingredients not shown).

All emulsions require some water;

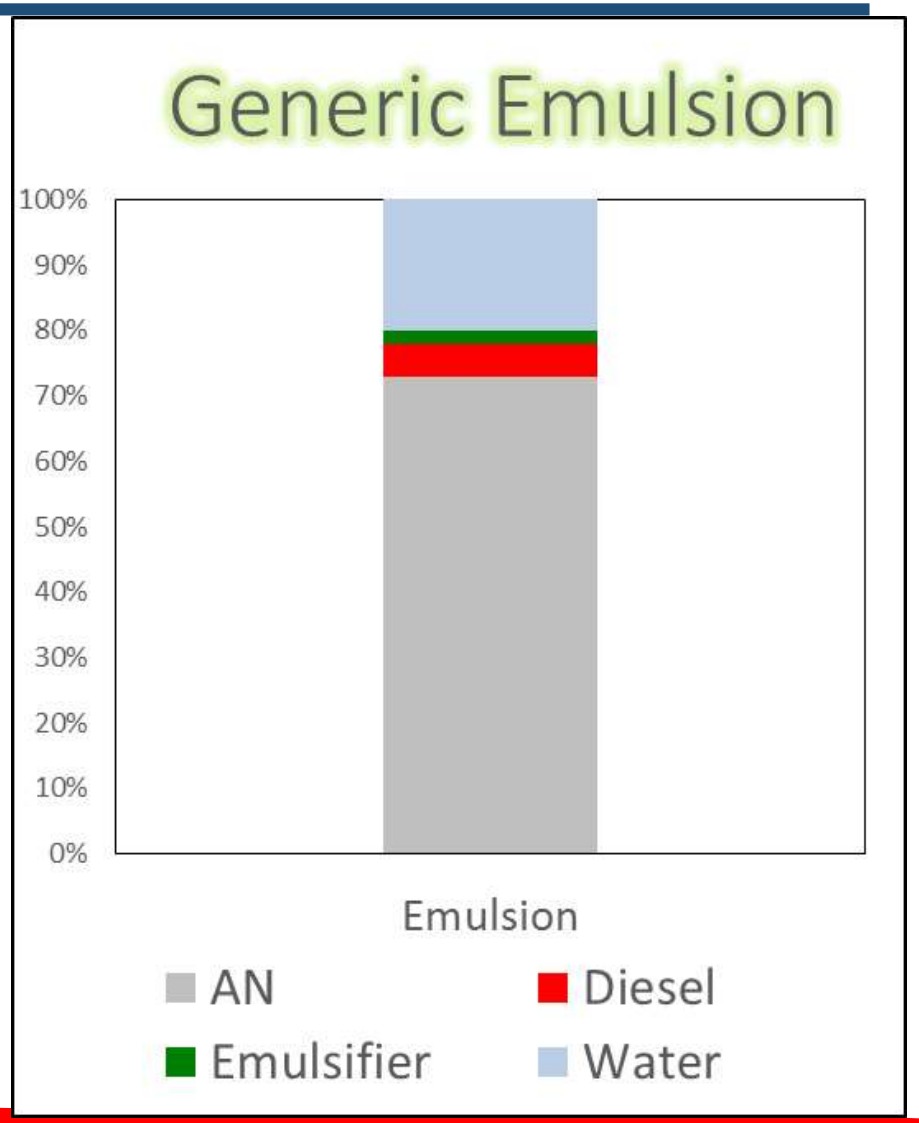
- ✓ Keep AN in solution (otherwise product crystallises)
- ✓ Storage and Handling (Pumpability during transport/ storage/ loading)
- ✓ To meet UN classifications (for example safe to transport on the road or by rail)



Basics of Ammonium Nitrate Emulsions

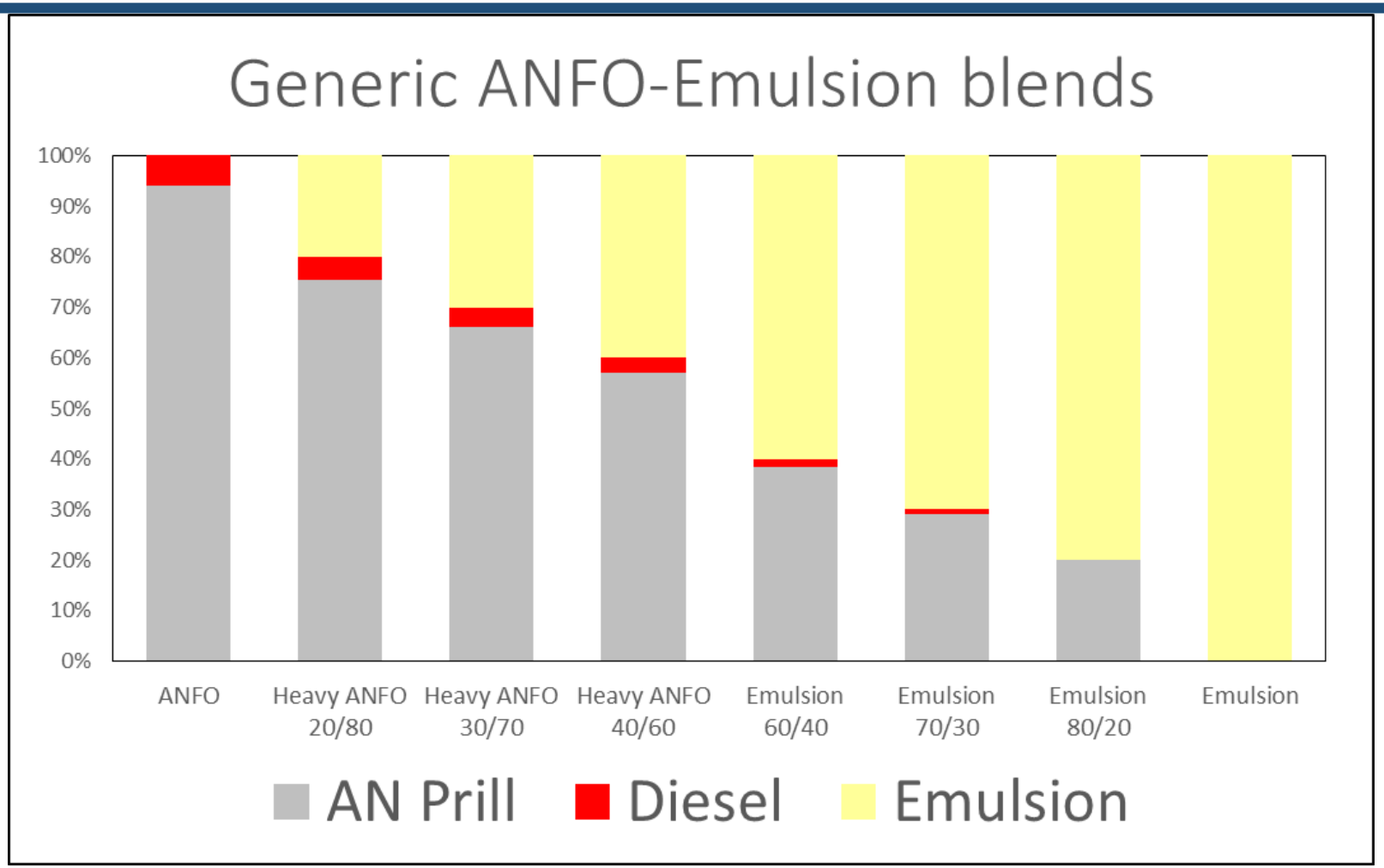
However too much water is not desired;

- Lowers product energy (so need to buy more product)
- Lowers sensitivity (less likely to fire in small diameter holes)
- Lowers resistance to dynamic desensitisation (for example when firing high Powder Factors in saturated ground)
- Increases potential for adverse fume



Basics of Bulk ANE based Explosives

ANFO on the left



Rising to 100% emulsion on the right

(minor ingredients not shown)

Minimum product information

Ingredients	
A list of all ingredients present >0.5% concentrations	Trace ingredients often Supplier dependent, might be IP
0.5% accuracy	Sufficient to understand product
Total ingredients add up to 100%	Always check

A MSDS is *not* an acceptable substitute

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
AMMONIUM NITRATE	6484-52-2	229-347-8	>90%
FUEL OIL, NO. 2	68476-30-2	270-671-4	<10%
DYE(S)	-	-	<0.99%

Minimum product information

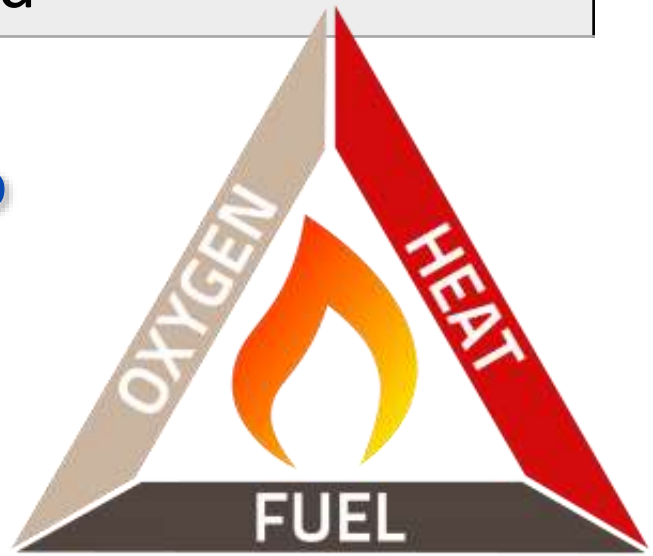
Properties	
Total water content	Used as a check that information between sheets is consistent:
Product densities	For gassed products it is recommend that cup density is stated, and also an allowable maximum in-hole density/ or maximum hole depth.

Minimum product information

Properties	
Minimum recommended diameter	Some products are not suitable for small diameter holes
Water Resistance	Qualitative scale 1-5
Sleep time: Dry & Wet holes	Number of days recommended

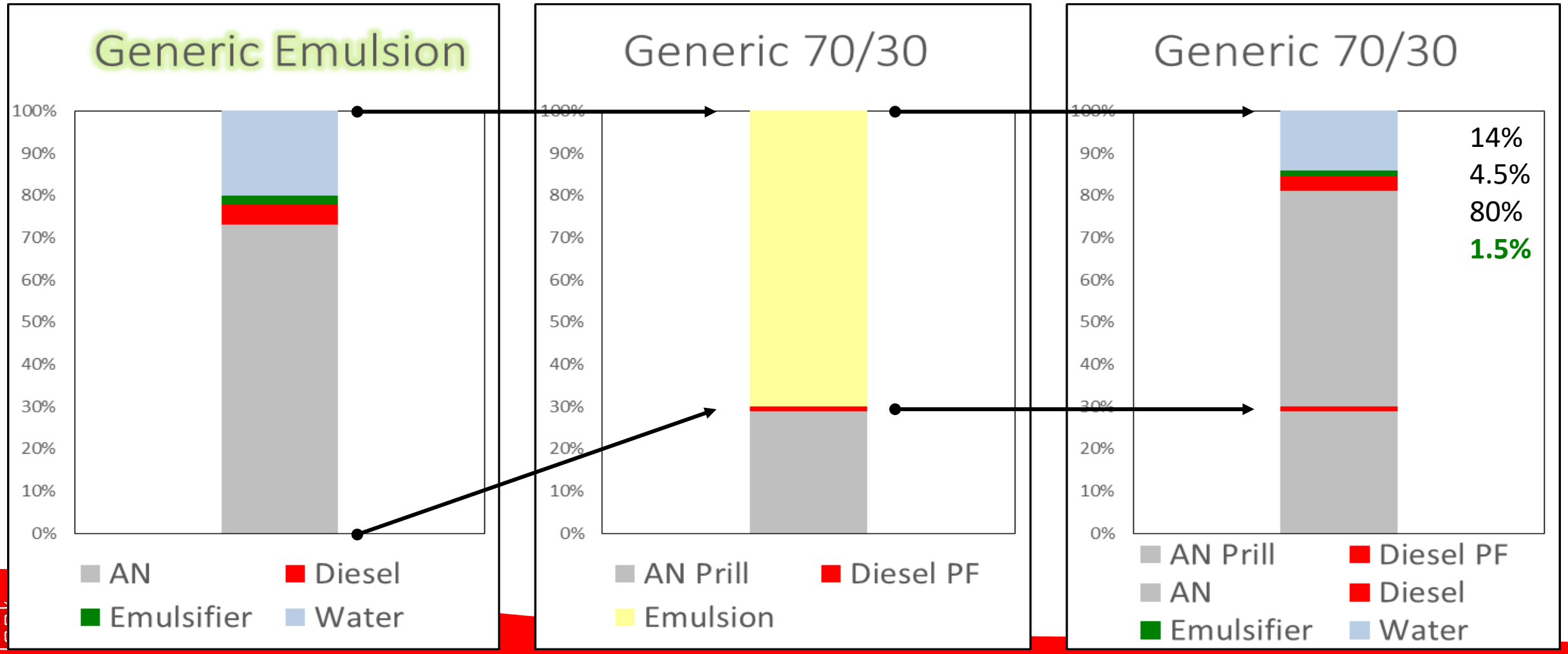
Only a few years ago, it was rare for Customers to request this information from Suppliers.

Water content was a closely-held ‘secret’



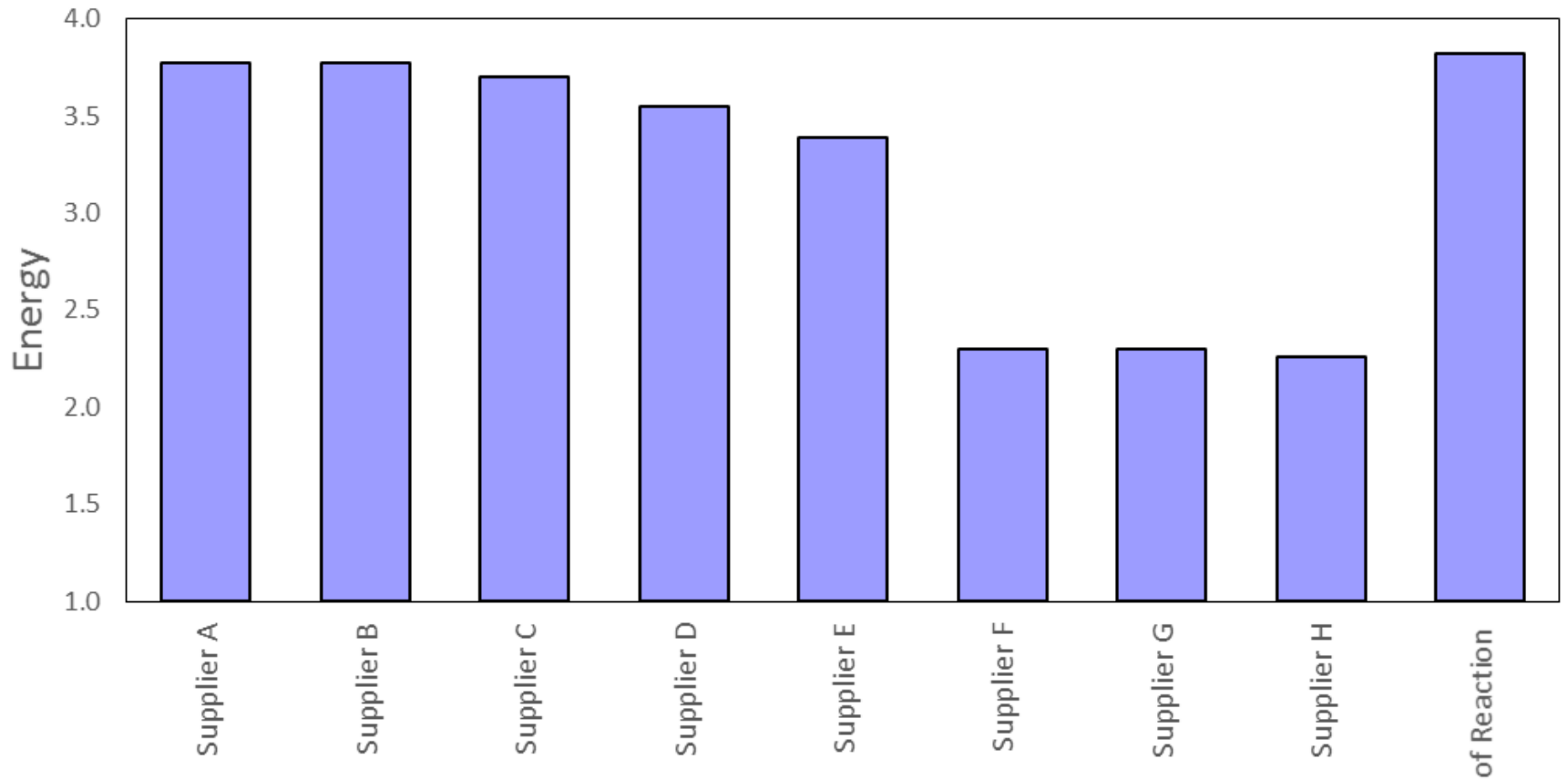
Understand product differentiation

What ingredients are the same or very similar between Suppliers?



Calculating Energy

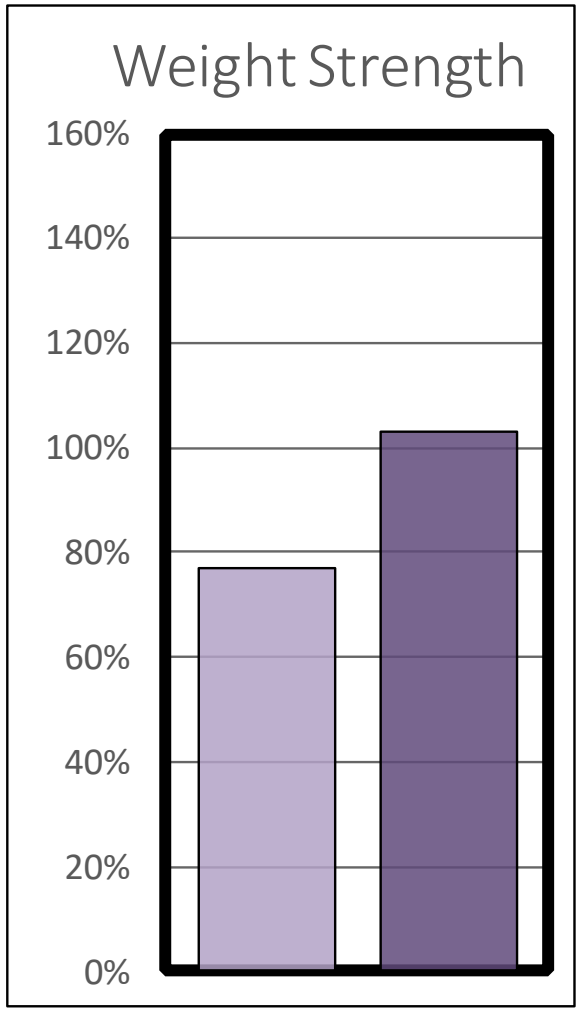
If we accept that ANFO, is a ‘standard product’ then; Shouldn’t it have a similar energy rating across various Suppliers?

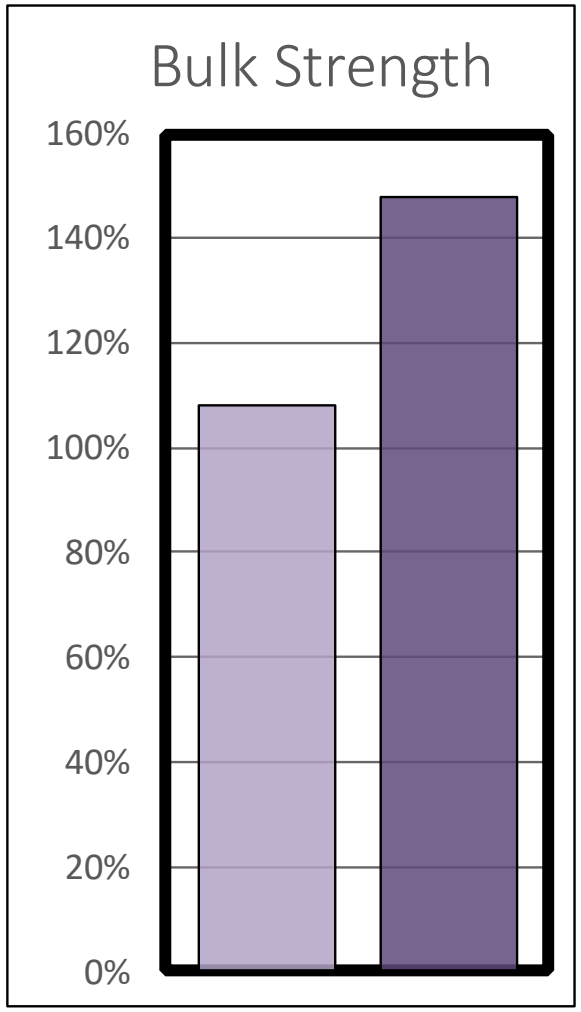


59%

- Due to the BIG difference in **Cut-off pressures**.

Beware Different Cut-off Pressures



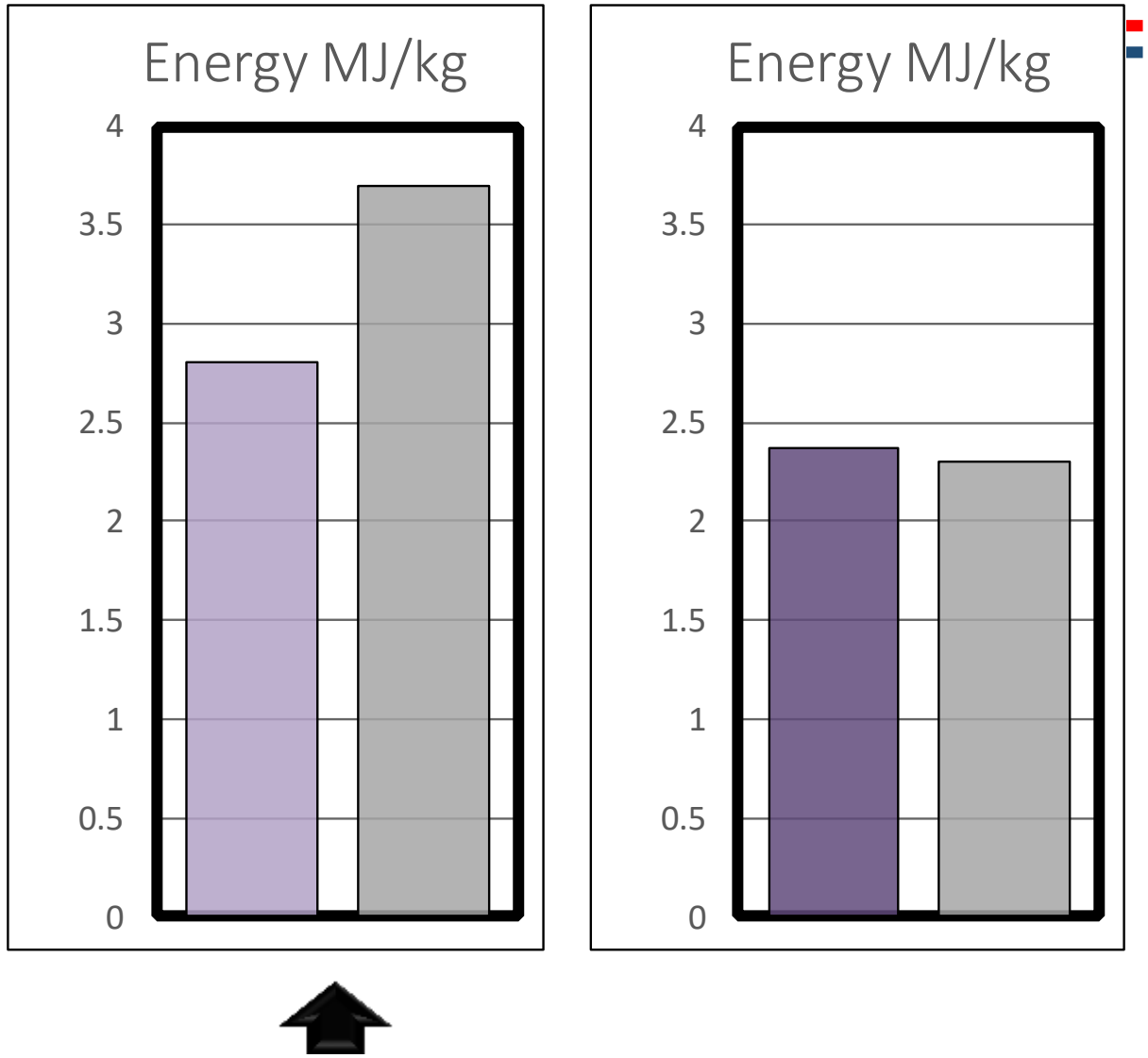


- Two products; properties sourced from downloaded Technical Data Sheets (TDS):
- Light Purple is a 70/30 blend at 1.15 density from Supplier I
- Dark Purple is a 70/30 blend at 1.15 density from Supplier J

Is it possible to work out which product has the highest energy?

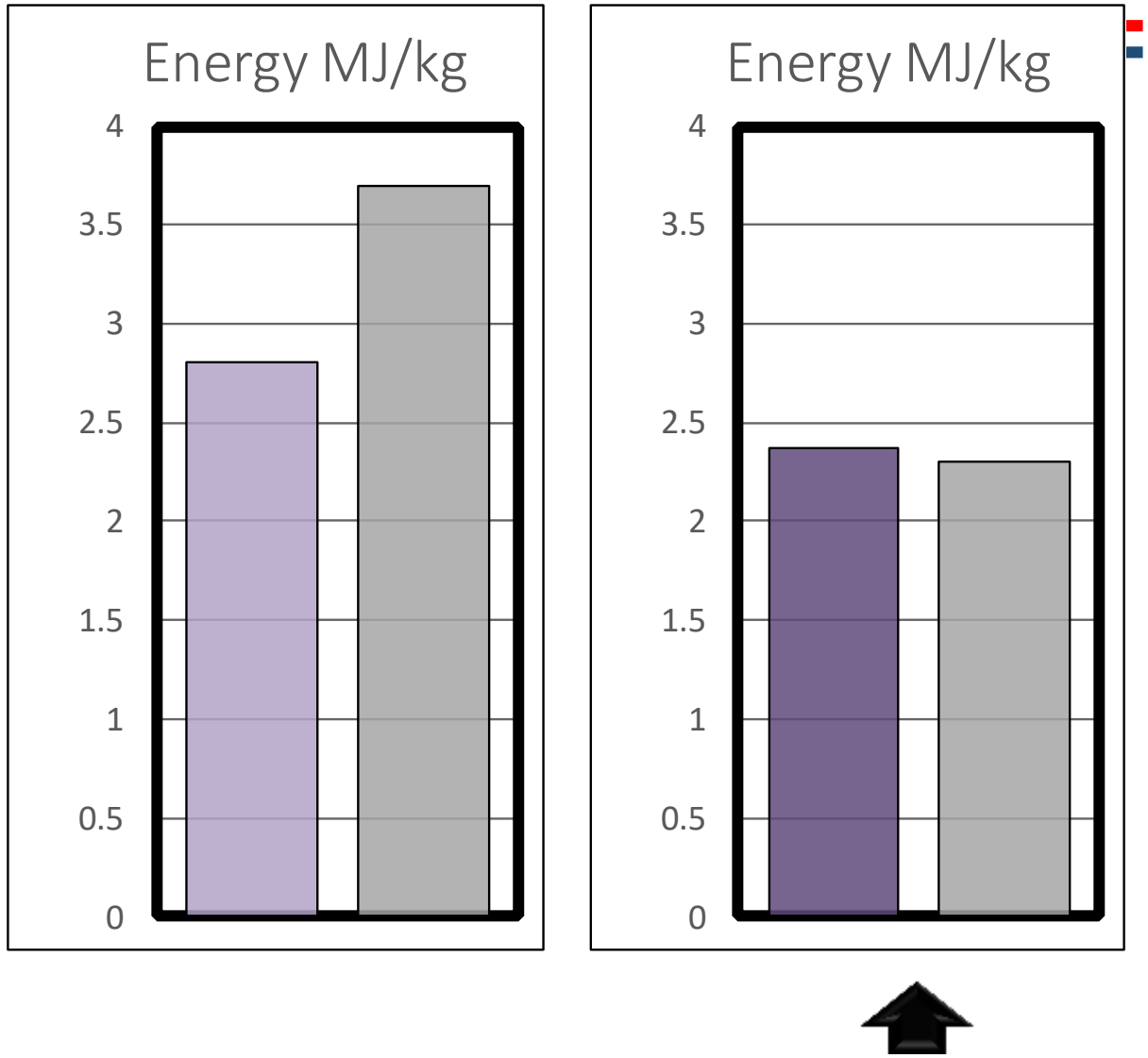
Beware Different Cut-off Pressures

- Light Purple's Supplier uses a low Cut-off Pressure; this method rates ANFO (in grey) at 3.7 MJ/kg
- The use of low Cut-off pressures retains much of the so-called 'heave' energy



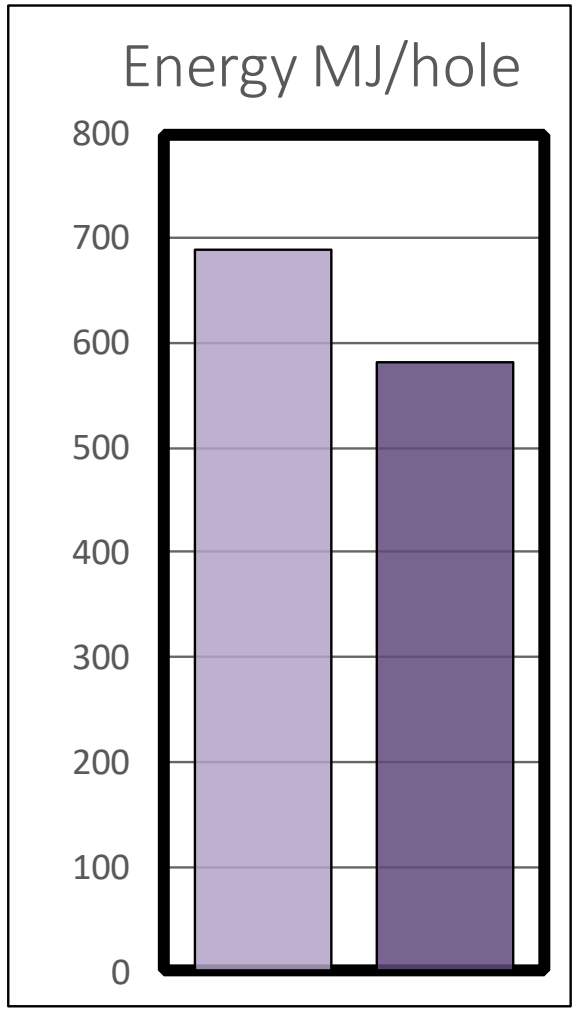
Beware Different Cut-off Pressures

- Dark Purple's Supplier uses a **Very High** Cut-off Pressure; this method rates ANFO (in grey) at only 2.3 MJ/kg
- Reduces the reported energy and makes so-called '**Shock**' energy more prominent.



Beware Different Cut-off Pressures

- (With assumptions) we can estimate the total energy in a given hole, from the Suppliers' TDS information
- So is Light now better than Dark then?
- We cannot say. The energies (and possibly densities) have been calculated differently; they are not comparable.



We cannot rely on the TDS information to pick the 'highest energy' or 'best' explosive

Specifying an Energy basis

Without a common approach to specifying energy, the various manufacturers' methods will be incomparable.

Since there is (currently) no standardised rating, it is best that the Customer specifies the basis to be used.

Recommended Energy Basis	
Energy Basis	Heat of Reaction
Reference Point	STP (0 °C, 100 kPa)
Assumptions of ideality	Ideal Detonation
Cut-off pressure	100 kPa

This energy basis will result in ***Highest*** energy values.

Minimum product information (3)

To the Customer's Standard:	Emulsion	Bulk Explosives
Formulation	✓	✓
Properties		✓
Energy		✓

Multiple TDS

Tender specifies the Standard that *must* be used

One consistent Specification Sheet

Desired product information

Data req'd to calculate the explosive's energy using a computer program:

Required Inputs			
Heat of Formation		- 4.594 MJ/kg	
Atomic Abundances	Moles/kg	C	4.274020
		H	53.782340
		N	23.540580
		O	35.306160
		(other)	-
Density		0.80 g/cm3	

Example data kindly supplied by Martin Braithwaite, Cavendish Laboratory, University of Cambridge, UK

Using Cloud Energy

A vision for the near future;

STANDARIZED input data. ONE computer code. CLOUD based.

Pay per use

Energy Values

Customer collects Specifications Sheet from each Supplier

Cloud based detonation code administered by independent organisation

Suppliers have confidence:

- IP is protected
- Known and consistent evaluation method
- Will reveal high quality formulations

Build Total product costs

Bulk Product Costs

Emulsion ($/tonne)

Diesel ($/tonne)

AN Prill ($/tonne)

Service Costs

MPU ($charge)

Labour ($charge)

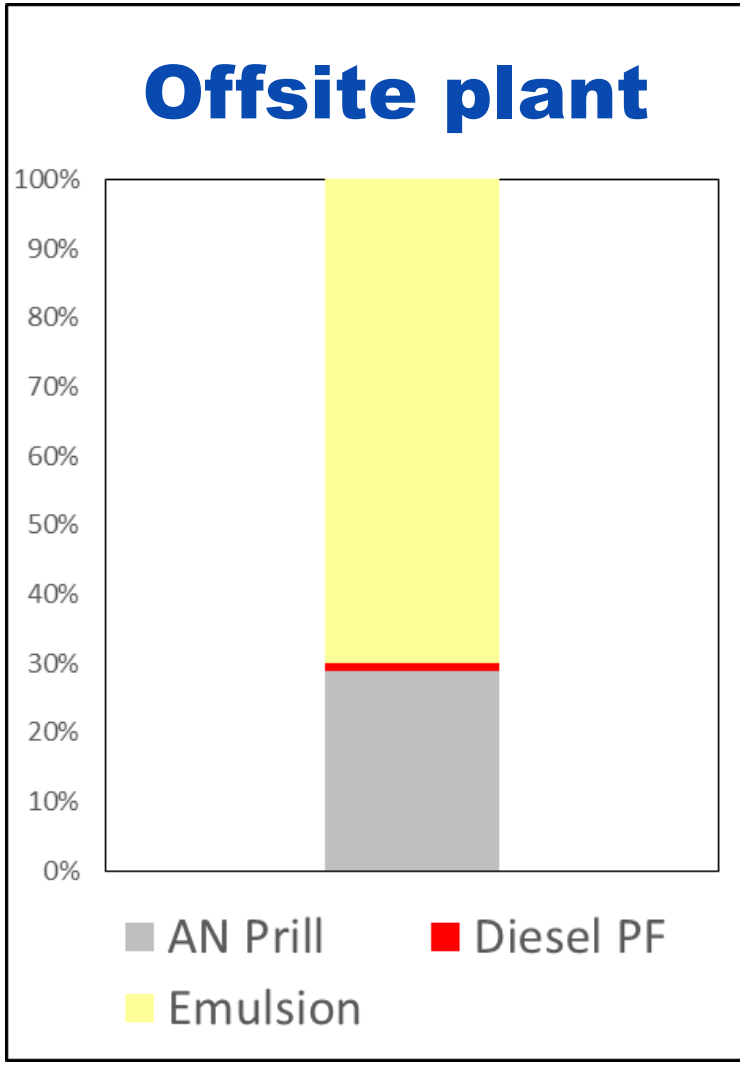
Loading Fee

Information

Capacity of truck (tonnes)

No. of operators

Site provided



Build Total product costs

Bulk Product Costs

Emulsifier ($/tonne)

Diesel ($/tonne)

AN Prill ($/tonne)

ANSOL ($/tonne)

Service Costs

Emulsion Manufacturing ($/tonne)

MPU ($charge)

Labour ($charge)

Loading ($charge)

Maintenance ($charge)

Information

Capacity of plant

No. of operators MPU

No. of operators plant

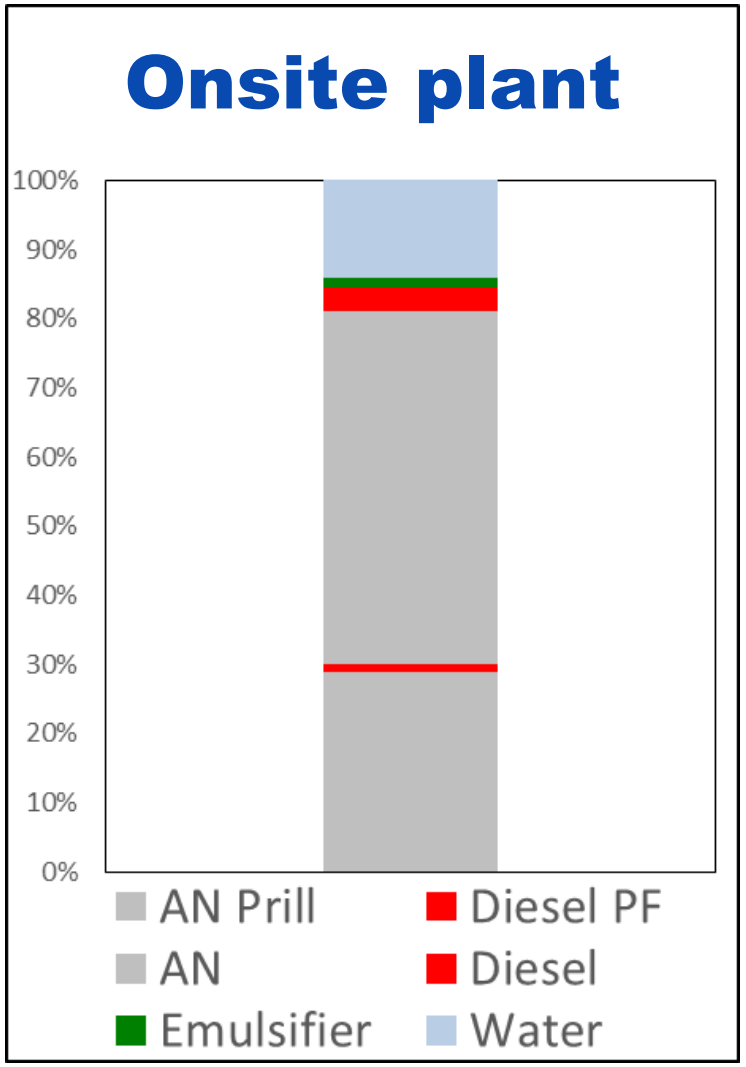
Org Chart: Supervision/ Safety/ Training

Site provided

Diesel Process ($/tonne)

Diesel Road ($/tonne)

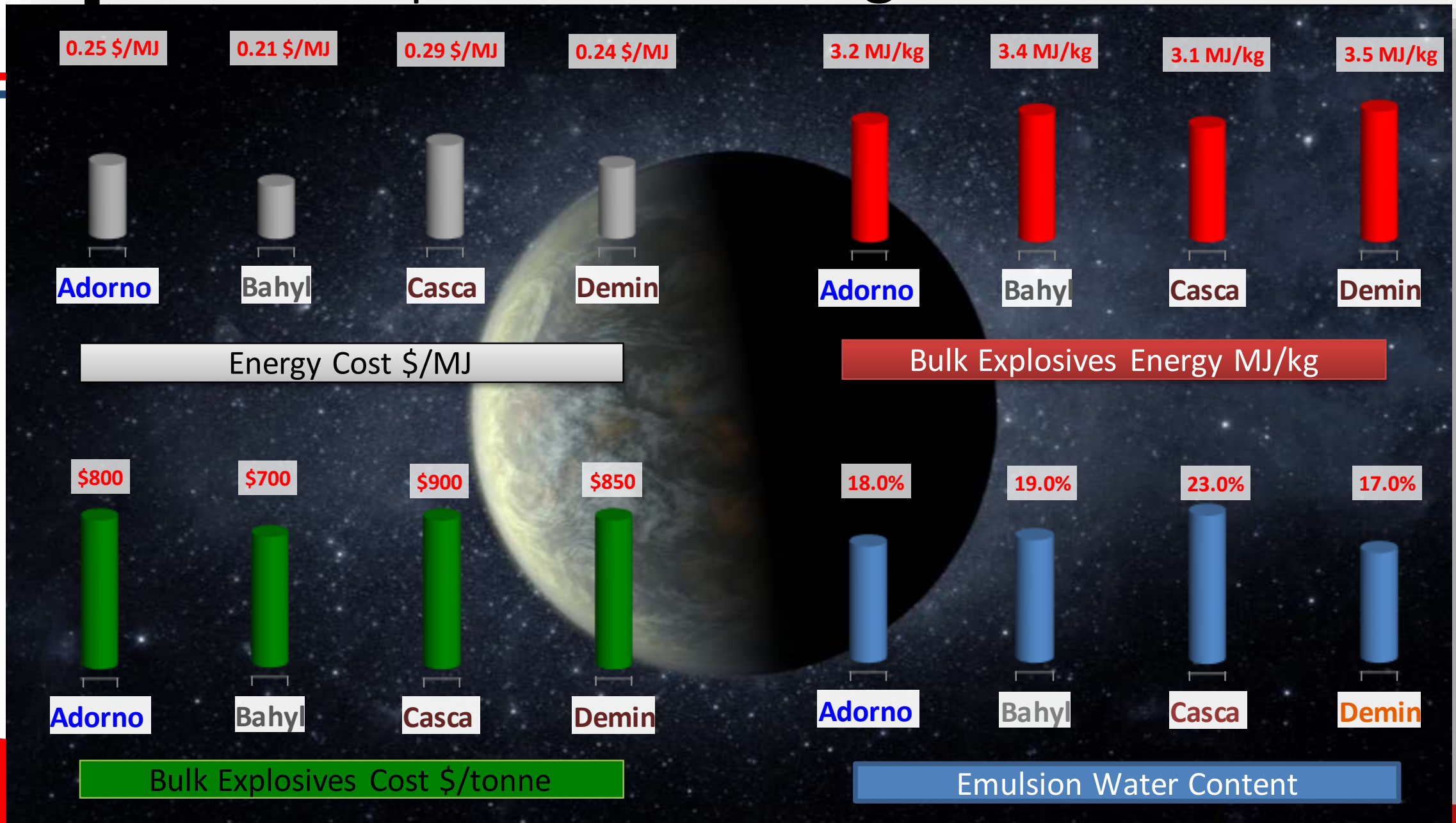
Electricity ($/unit)



Calculating The cost of buying energy

Information	Units	Source
Ingredients	$/tonne	Tender Submission
Rates	$/tonne	Tender Submission
Energy	MJ/kg	Tender Submission
Cost of Energy	$/MJ	**Ready to calculate**

Compare the product offerings



Verify Suppliers by field trialling

Conduct field trials for the Suppliers on the preferred shortlist;

- Validate that products & services perform as claimed: No surprises or ‘undocumented features’
- Verify suitability for site conditions.

Field trials are very important for the Operations team to be able to scrutinize service levels;

- Observe Supplier personnel, training levels, SOP’s
- Ensure safety systems meet site requirements
- Review equipment presentation and maintenance standards.

Verify products by field trialling

"A better understanding of the detonation performance of an explosive charge can be gained by directly measuring pressure, temperature and velocity of detonation (VOD).

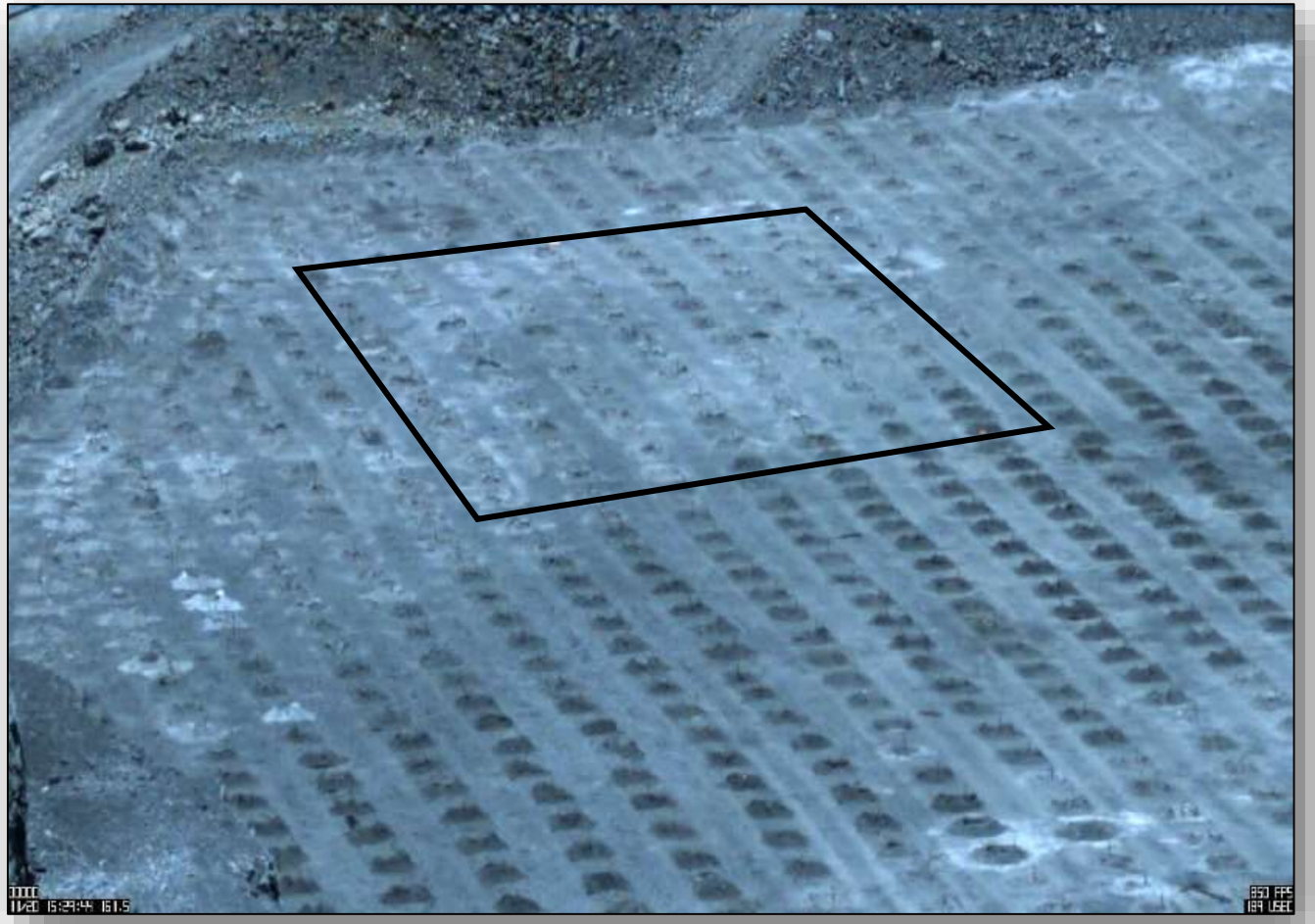
Onederra, Cavanough and Torrance, 2011

Verify results by field trialling

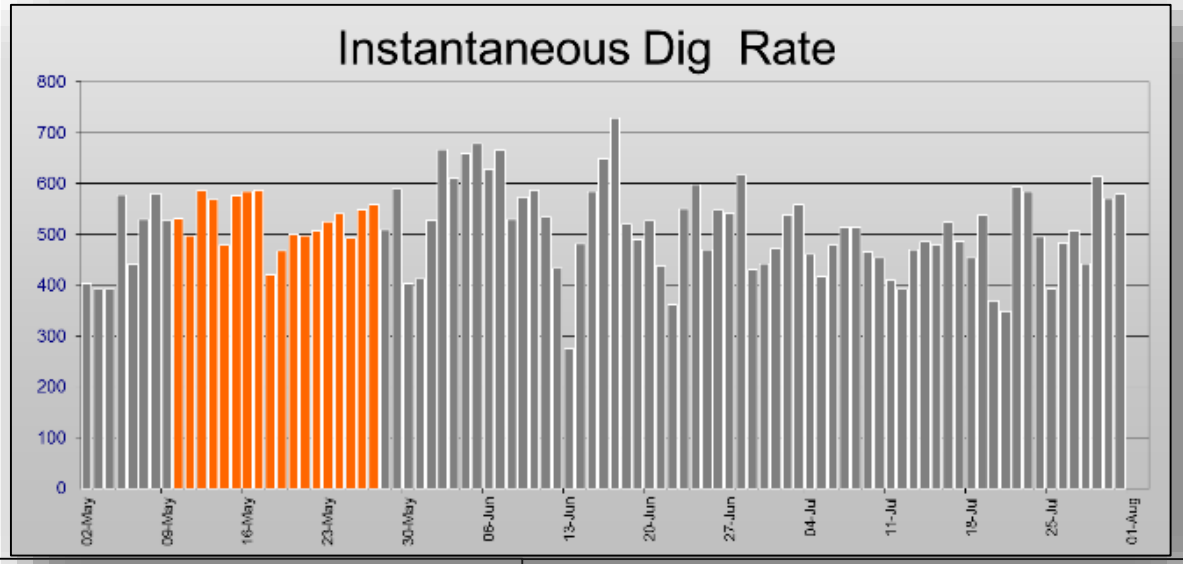
Load a section of trial bulk product in a good representative area inside a standard blast.

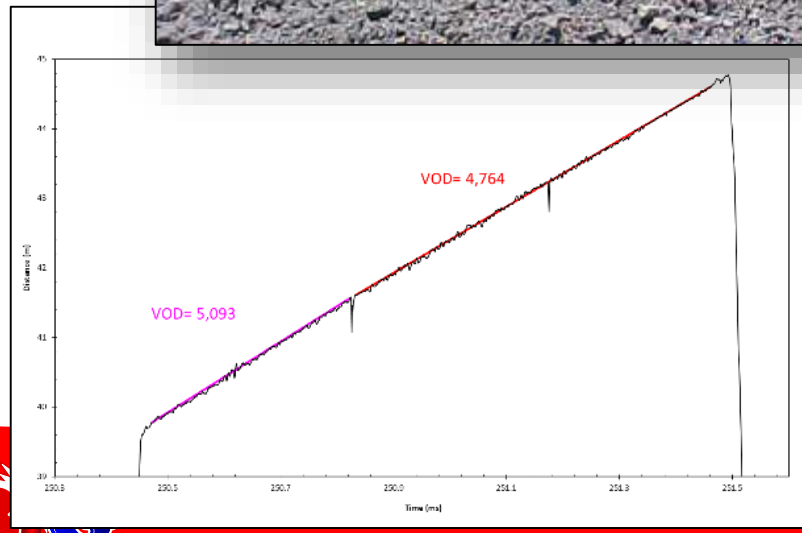
Observe and measure;

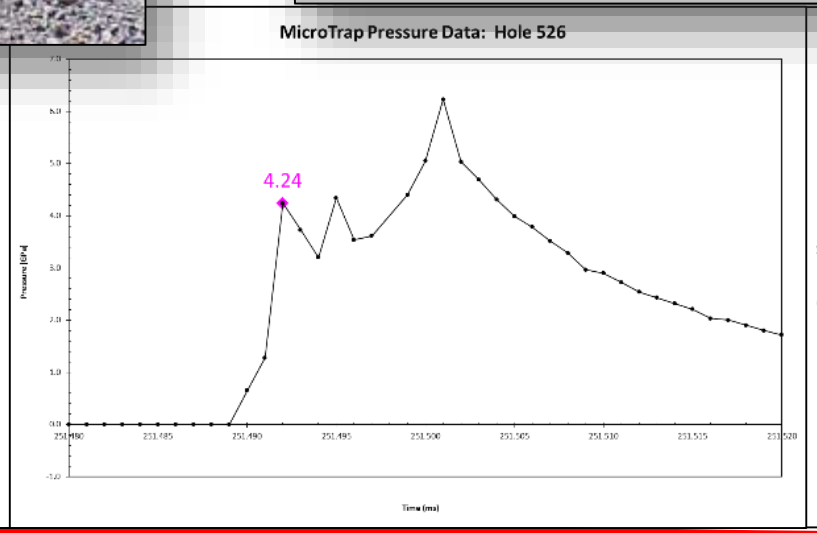
Fume, flyrock, heave, movement, muckpile presentation, oversize, dig rates, floor control, toe, vibration, misfires…

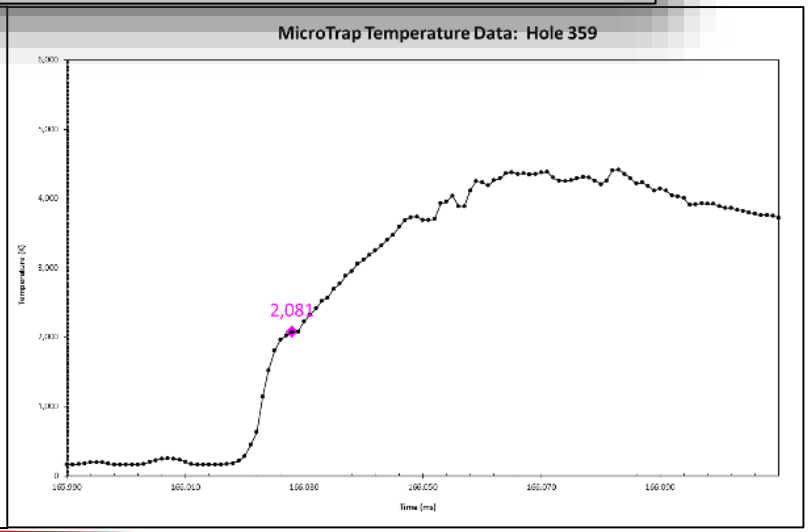


Verify results by field trialling









Improved Supplier Engagement strategy

Offering

Specifications

Independent Assessment

Valuation

Test Drive

Thank you