



**WELCOME**

# **Evolving Interchange Guidelines and Tests**

ICIS Base Oils and Lubricants Conference  
London, 22 February 2019

[www.atiel.org](http://www.atiel.org)

## Today's session - what we will cover

**01**

Insights into API and European approaches to interchange guidelines and tests

What are the options for running European interchange projects?

**02**

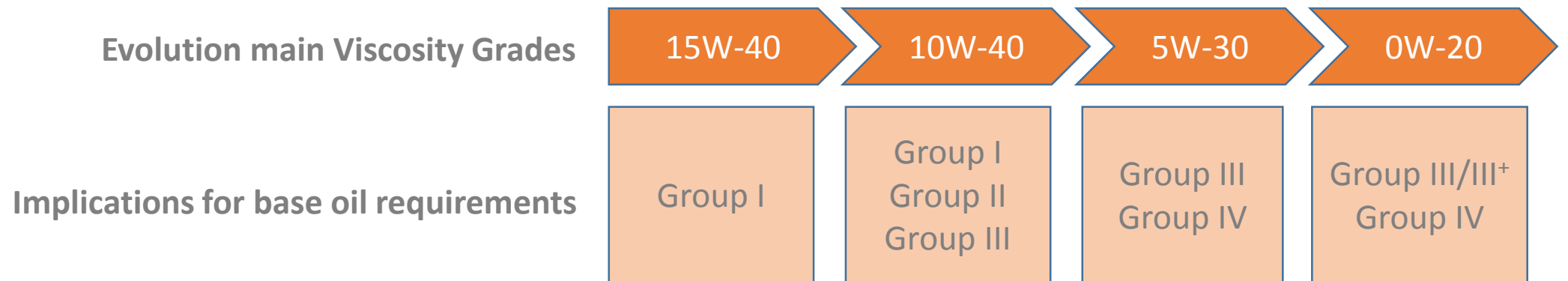
**03**

Hear a case study as well as views on industry hurdles and future initiatives

A white plastic container is tilted on the left side of the frame, pouring a thick, golden-brown liquid, likely motor oil, into a clear glass. The liquid is captured in mid-pour, creating a dynamic splash and a curved stream. The background is a light, neutral color, making the pouring action the central focus.

# Evolution of European (ACEA) Specification

# Engine Oil Specifications driven by Emission Legislation

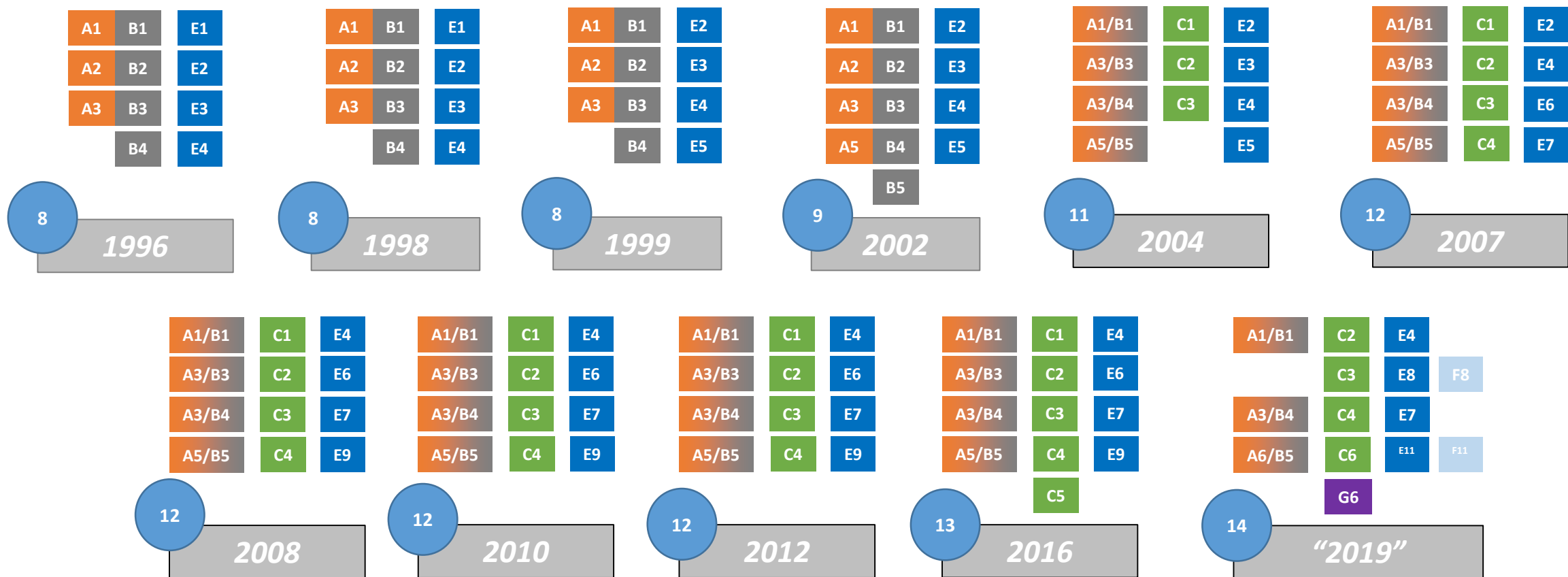


- Increased use of Group II and III base oils in Light and Heavy Duty
- Very limited BOI interchange guidelines for Grp II and III
  - Current guidelines focused around group 1 base stocks

*Interchange Guidelines did not hold pace with specification evolution*

# The Complexity Challenge

*From 8 to 14 Categories*



*Interchange Guidelines help to manage increasing complexity*







# New Engine Tests Add Complexity



*Proposed new engine tests in “ACEA 2019 Sequences”*

## Heavy Duty

- CEC OM471LS 
- Mack T-13 

## Light Duty

- M271 EVO Sludge 
- Toyota Turbocharger 
- Seq IVB Wear 
- Seq. VH Sludge 
- Seq. IX LSPI 
- Seq. X Chain Wear 

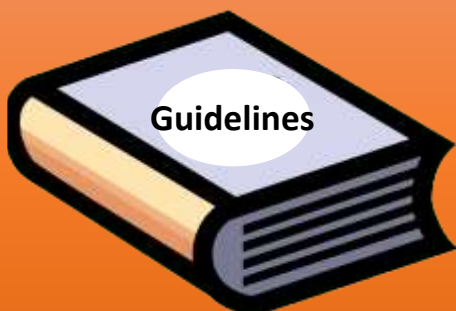
- For new  Tests no VGRA/BOI interchange guidelines available
- For  tests the North American (API) Interchange guidelines are applied

# The Industry Response



## Complexity Increase

- Number of ACEA categories increased from 8 to 14
- New and more engine tests in ACEA Sequence for which there are no interchange guidelines
- Changing viscosity grades
- New and more base oils appearing on the market



## Interchange Guidelines

- Viscosity Grade Read Across and base oil interchange can contribute to managing the increased complexity and reduce engine oil development costs, while continuing to assure final product performance.
- ATIEL and ATC joined forces to move the development of read across guidelines for (new) CEC tests forward.

A close-up photograph of a clear plastic bottle being poured, with a stream of clear water falling and splashing. The background is a soft, out-of-focus white and light grey.

# **NA vs European Approach**



# Differences between API and ACEA systems



## Engine Oil Licensing & Certification System (EOLCS)

- One organisation (API) representing OEMs, Oil and Additives industries
- API develops and owns lubricant classifications
- Enabled development of licensing system
- Logo and policing system
- Fee-based licensing
- Licensing ('Donut') still voluntary



## Voluntary code

- Different organisations representing OEMs, Oil and Additives industries
- ACEA owns Oil Sequences, but chooses not to license
- Not legally possible for ATIEL to license/police against the Oil Sequences
- Voluntary code, with signatory system (Letter of Conformance) - required by ACEA to make performance claims

## Differences between API and ACEA systems (Cont'd)



Read Across Guideline development embedded in test development

- Viscosity Grade Read Across and Base Oil Interchange Guidelines are developed as integral part of new test development.
- Read across guidelines available at start of new category.
- Funding:
  - Light Duty OEMs, ILSAC members
  - Heavy Duty OEMs, EMA members
  - Additive companies, ACC members
  - Oil marketers, API members.



Read Across Guideline Development separated from test development

- Viscosity Grade read Across and Base Oil Interchange Guidelines are responsibility of ATIEL
- No read across guidelines available at start of new tests.
- Funding:
  - Oil Marketers, ATIEL members
  - Additive companies, ATC Members

A white plastic bottle is tilted on the left side of the slide, pouring a clear liquid into a glass. The liquid is captured in mid-pour, creating a dynamic splash and ripples. The background is a light, neutral color, making the water and the bottle stand out.

# **The EP6 VGRA Programme**

## **First European Industry Read Across Test Programme**

# Interchange Guideline development in Europe

## First ACEA Sequences

Interchange Guidelines based on agreed technical principles and combined engine test data of ATIEL members

After  
1996

## ATC/ATIEL

ATIEL and ATC workgroup to progress development of interchange guidelines.

2015



## EP6 VGRA

ATC/ATIEL established funding mechanism to run a statistically designed full E6 engine VGRA test programme.

2018



## Grandfathering

Interchange guidelines since then primarily based on "grandfathering" as most tests were evolution of existing tests.

2012



## TU5 VGRA + BOI

ATIEL and ATC cooperation resulted in VGRA and BOI interchange rule based on collective data from ATC/ATIEL members and a full statistical evaluation.

2016



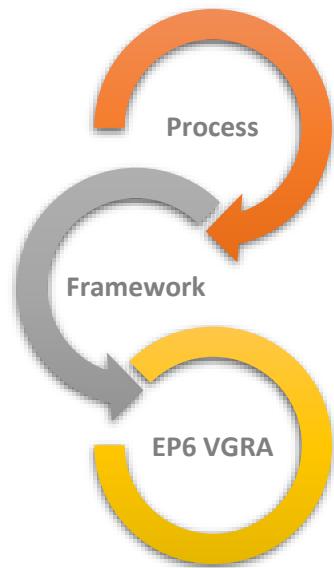
## EP6 completed

50/50 funded ATIEL and ATC sponsored test programme was completed resulting in a new VGRA guideline for the EP6 test engine to be published in ATIEL CoP in 2019

1996



# EP6 Engine Test Development - joint ATIEL/ATC Initiative



Prior to 2016, there was **no process in place** to develop read-across guidelines for new engine tests

ATIEL/ATC developed a **framework for read-across guideline development**, with plans to apply this framework to the new ACEA 2016 engine tests

Agreement was reached to proceed with **EP6 VGRA** as the first read-across guideline development programme

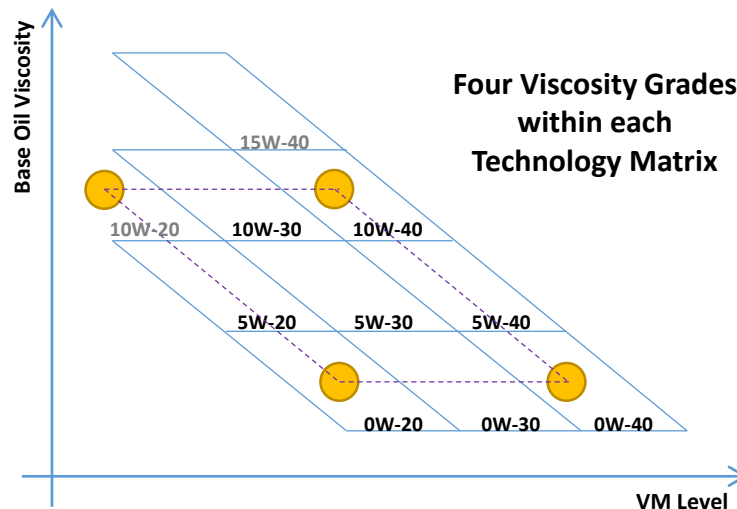
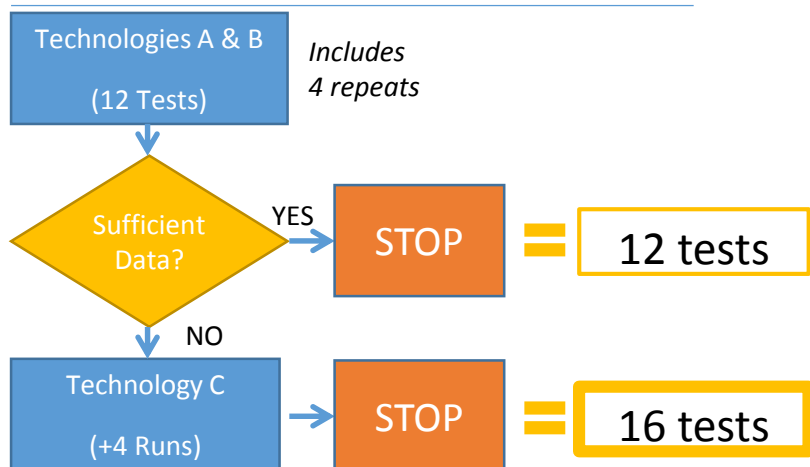
## EP6 VGRA Working Group Objectives

- **Develop & validate EP6 VGRA guidelines for the ATIEL Code of Practice.**
  - Plan and run a statistically designed experiment in the EP6, exploring the effect of base oil viscosity and viscosity modifier treat-rate on test performance.
  - Interpret results and recommend VGRA guidelines for incorporation into the ATIEL Code of Practice.

# Test Matrix Design

- Viscosity Grade coverage from **0W-20** to **10W-40**
  - Maximises change in base oil viscosity and VM Level to achieve high statically power to identify effects above the noise of the test
- **Three technologies**, across three suppliers
  - Maximises opportunity to identify unexpected effects and interactions,.
- BOI is **not** being considered – base stock slate will be consistent within each Technology

## EP6 Test Order



## Technology C will only be required if:

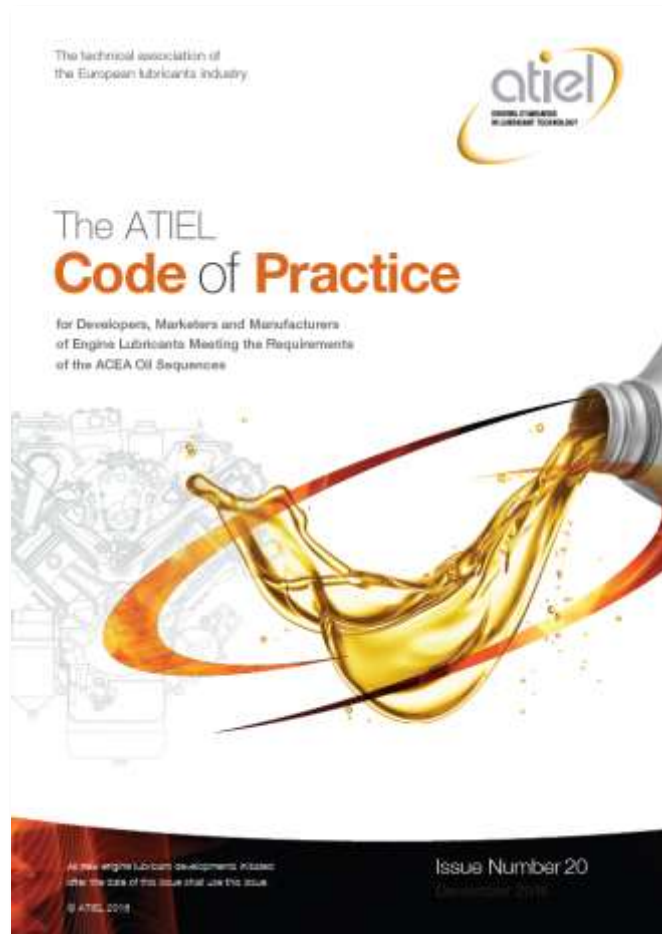
- Analysis of the first two technologies gives neutral results
- Initial conclusions conflict with technical judgement and experience
- Results demonstrate strong interactions and read-across cannot be permitted

**Program costs ~ € 1 million for 16 tests**



# Format of the Current EP6 VGRA Guideline

Issue 20, Appendix A, December 2016



**Table VGRA.5 VGRA guidelines for the VW TDI or OM646LA Bio or EP6CDT engine test**  
*(Applicable only to engine lubricant with non-dispersant type of viscosity modifier)*

Test run on	Can be read-across to														
	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20		no	no	yes if (*)	yes if (*)	no	no	yes if (*)	yes if (*)	no	no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
0W-30	yes if (*)		no	yes if (*)	yes if (*)	yes if (*)	no	yes if (*)	yes if (*)	yes if (*)	no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
0W-40	yes if (*)	yes if (*)		yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)
5W-20	no	no	no		no	no	no	yes if (*)	no	no	no	yes if (*)	no	yes if (*)	yes if (*)
5W-30	yes if (*)	no	no	yes if (*)		no	no	yes if (*)	yes if (*)	no	no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
5W-40	yes if (*)	yes if (*)	no	yes if (*)	yes if (*)		no	yes if (*)	yes if (*)	yes if (*)	no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
5W-50	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)		yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)
10W-30	no	no	no	yes if (*)	no	no	no		no	no	no	yes if (*)	no	yes if (*)	yes if (*)
10W-40	yes if (*)	no	no	yes if (*)	yes if (*)	no	no	yes if (*)		no	no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
10W-50	yes if (*)	no	no	yes if (*)	yes if (*)	yes if (*)	no	yes if (*)	yes if (*)		no	yes if (*)	yes if (*)	yes if (*)	yes if (*)
10W-60	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)	yes if (*)		yes if (*)	yes if (*)	yes if (*)	yes if (*)
15W-40	no	no	no	yes if (*)	no	no	no	yes if (*)	no	no	no		no	yes if (*)	yes if (*)
15W-50	no	no	no	yes if (*)	yes if (*)	no	no	yes if (*)	yes if (*)	no	no	yes if (*)		yes if (*)	yes if (*)
20W-40	no	no	no	no	no	no	no	no	no	no	no	no	no		no
20W-50	no	no	no	yes if (*)	no	no	no	yes if (*)	no	no	no	yes if (*)	no	yes if (*)	

(\*) Yes, VGRA is permitted if the **viscosity modifier concentration increase** in the read-across viscosity grade vs the tested viscosity grade **is less than 15% mass fraction relative**.

If the viscosity modifier concentration increase is larger than 15% mass fraction relative, VGRA can be permitted if **technical support data** as defined in Section h.15 of the ATC Code of Practice<sup>1</sup> is available to justify read-across.

# The new VGRA Guideline for the EP6CDT test provides more flexibility



VGRA is permitted if the viscosity modifier concentration is decreased, or if the increase in the read-across viscosity grade vs the tested viscosity grade is less than 15% mass fraction relative.



This VGRA guideline is the result of a statistically designed matrix of EP6 test oils run by ATIEL and ATC in a diverse range of technologies.



If the viscosity modifier concentration increase is larger than 15% mass fraction relative, VGRA can be permitted if technical support data as defined in Section h.15 of the ATC Code of Practice is available to justify read-across.



A background image showing a clear plastic bottle being poured with water. The water is captured in a dynamic, flowing state, creating a sense of movement and freshness. The bottle is on the left, and the water stream extends towards the right, with some splashing and droplets visible.

# **Future Programmes**

## **Viscosity Grade Read Across**

# Next VGRA Programme Selection Criteria

Industry currently in the process of selecting the next VGRA programme:

- Consensus now forming to develop interchange guidelines for the Toyota Turbocharger test as no interchange guidelines for this new test are available

Are VGRA Guidelines available today ?

Expected in ACEA Heavy Duty Categories ?

Expected Lifetime of tests ?

Expected in ACEA Light Duty Categories ?

Test Costs per run ?

Duration of test?

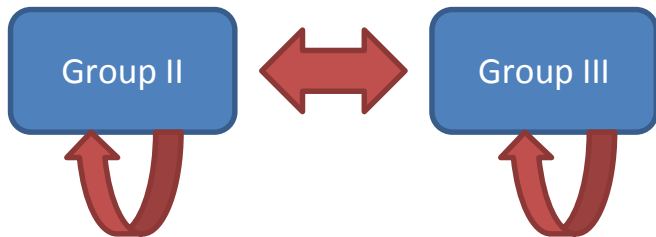
The background of the slide is a light, semi-transparent image showing a stream of golden-brown oil being poured from a white plastic container on the left side. The oil is captured in motion, creating a dynamic, flowing effect. The top of the slide has a decorative border with overlapping orange and yellow circular shapes, resembling light flares or oil droplets.

# **Future Programmes**

## **Base Oil Interchange Options**

## Base Oil Interchange Matrix Design

- Design example for e.g. the EP 6 Engine test (cost per test ~ € 67,300)
- Assumption that two base oil groups, including intra-group read-across is a minimum requirement for BOI to be worthwhile.



- Group II to Group II
- Group III to Group III
- Group II to Group III
- Group III to Group II

# Possible Base Oil Interchange Matrix

1	Technology A	10W-30	<b>Group II</b> Slate 1	<b>Group III</b> Slate 1	Technology A	10W-30	10
2	Technology B	5W-40			Technology B	5W-40	11
3	Technology C	5W-30			Technology C	5W-30	12
4	Technology A	10W-30	<b>Group II</b> Slate 2	<b>Group III</b> Slate 2	Technology A	10W-30	13
5	Technology B	5W-40			Technology B	5W-40	14
6	Technology C	5W-30			Technology C	5W-30	15
7	Technology A	10W-30	<b>Group II</b> Slate 3	<b>Group III</b> Slate 3	Technology A	10W-30	16
8	Technology B	5W-40			Technology B	5W-40	17
9	Technology C	5W-30			Technology C	5W-30	18

3 BO slates
×
2 base oil groups
×
3 VG's

=
18 tests
+
4 duplicates
=
22 tests

## Base Oil Interchange Matrix

- Assumption that two base oil groups, including intra-group read-across is a minimum requirement for BOI to be worthwhile.
- Testing may become prohibitively expensive very quickly when additional base oil groups are added (see example with EP6 below).

### EP6 Test Cost

67 300 EUR

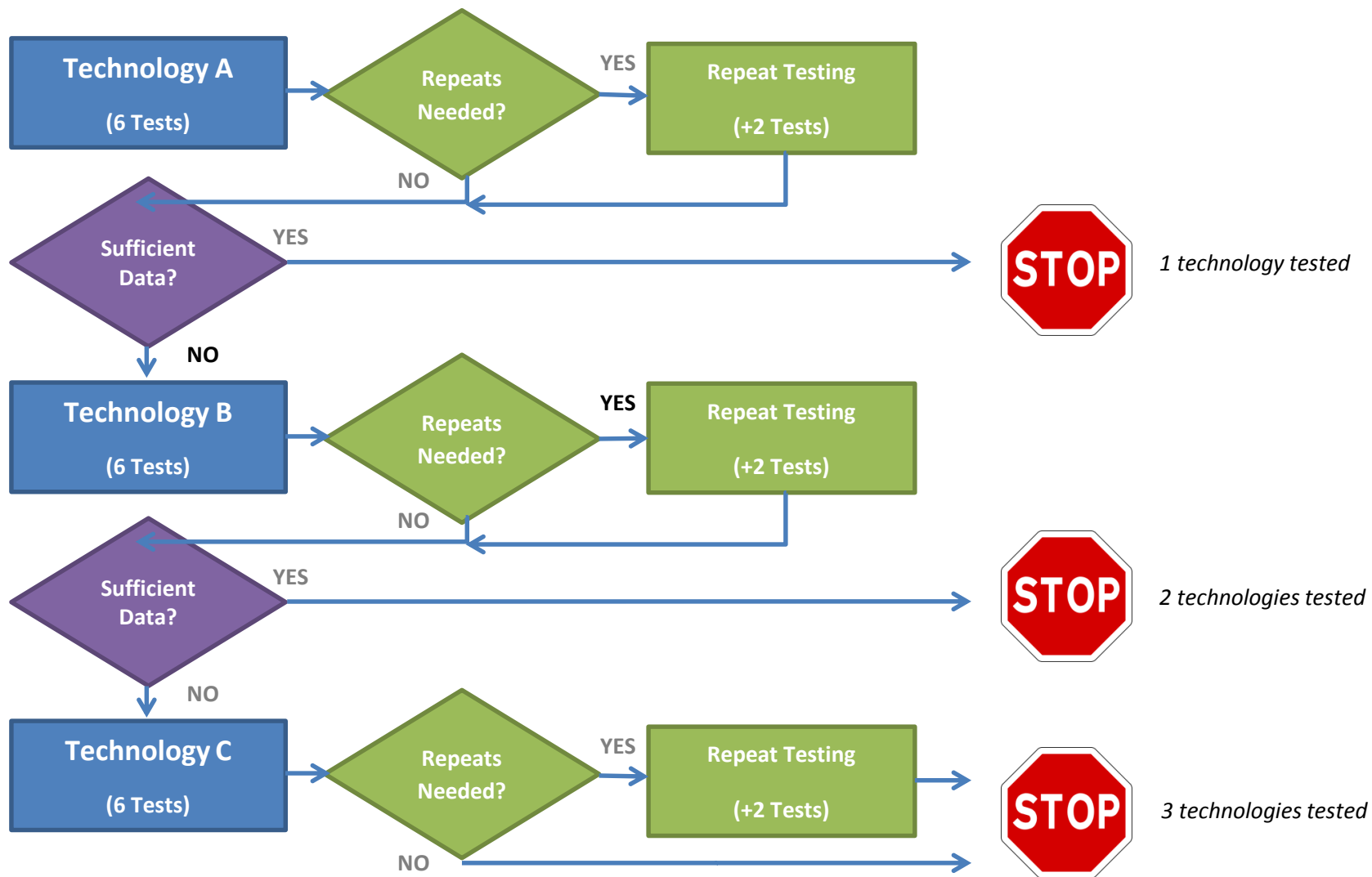
Condition	Number of Tests	Total
<b>Two base oil groups</b> (including intra-group interchange)	<b>22</b>	<b><u>1 480 000 EUR</u></b>
<b>Three base groups</b> (including intra-group interchange)	+ 9 <b>= 31</b>	+ 606 000 EUR <b><u>2 086 000 EUR</u></b>

# Base Oil Interchange Matrix Simplification

- BOI Experimental Matrix is much more expensive than the VGRA Matrix
  - Approximately at least twice as expensive
  
- How can we reduce the costs ?
  - Take a more practical approach
    - Is it necessary to include Group II <-> Group III interchange ?
    - Is interchange in same group not sufficient ?
  - Step by step including stopping rules



# BOI Matrix/Stopping rules - Stepwise Approach





# Base Oil Interchange Matrix/Stopping rules

Application to EP6

	No Repeats	All Repeats
Technology A	403 800 EUR	538 400 EUR
Technology A+B	807 600 EUR	1 076 800 EUR
Technology A+B+C	1 211 400 EUR	1 615 200 EUR

- Opportunity to stop testing after Technology A if:
  - Confidence is sufficiently high in read-across
  - No read-across is possible

A close-up photograph of a clear plastic bottle being tilted to the left, pouring clear water. The water is captured in mid-pour, creating a dynamic splash and several small droplets in the air. The background is a plain, light grey color.

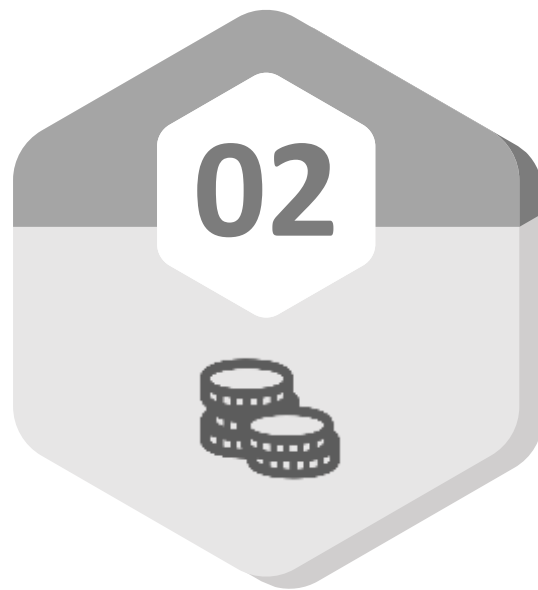
# Industry Challenges

# Main Industry Challenges



## Alignment

Industry alignment within and across organisations (ATC and ATIEL)



## Cost

- Especially Base Oil Interchange Programs require significant level of funding
- Currently only PCMO
- HDDO will be even more expensive



## Funding

- Funding mechanism
- How to distribute costs amongst beneficiaries ?



## Test Engines

Availability of test engines

## Main Industry Challenges

- It is ATIEL's position that ultimately the best option is to include VGRA and/or BOI in the CEC test development phase (similar to API approach)
  - Most cost effective overall solution
  - Possibly delays engine test development
- This will require further industry alignment and funding



ATIEL is committed to progress the development of interchange guidelines for the benefit of its members and the industry

**Thank you!**

For more information visit:

**[www.atiel.org](http://www.atiel.org)**  
**[www.eelqms.eu](http://www.eelqms.eu)**

Contact us at: **[info@atiel.eu](mailto:info@atiel.eu)**