Alternatives Fuels – A commodity or an enabler?

ICAO AF Workshop, 8th Feb 2017

Simon Blakey
The University of Sheffield

Change in focus

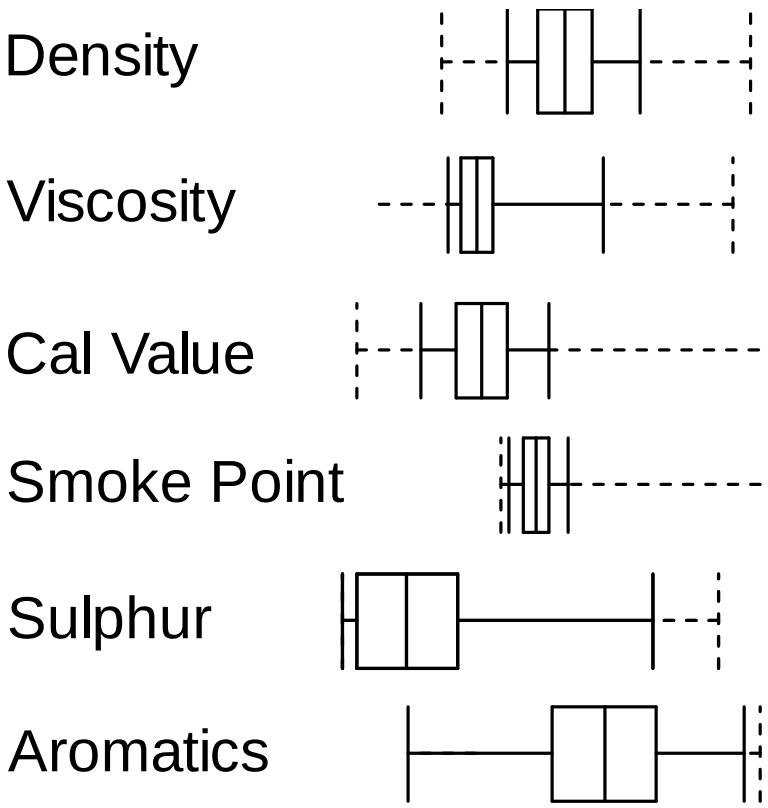
- Last 60 years of development and optimization
  - Given fuel – build engine
  - Long service life of aircraft

- Looking forward
  - Given engine(s) – build fuel
    ∴ Same fuel from a different resource
  - Fuel has harder ride as engine η increases

- Are Alternative Fuels a commodity …or an enabler?

Current situation

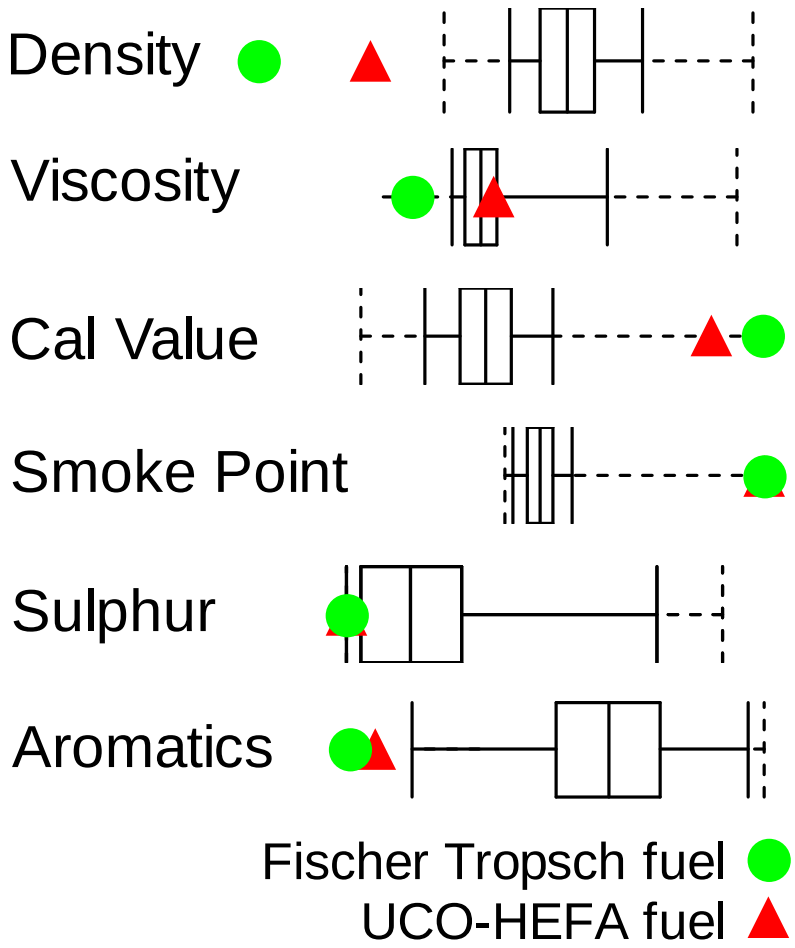
- Safety is paramount: The specification works
- A multi dimensional space for Jet A-1
- The majority of fuels sit in even narrower corner of this space
- Impact of AF fuels…



UK Fuels survey data 2013

Impact of AF

- Currently constrained by requirement for drop-in
- As %age of AF increases, average fuel will shift
- Impact in Long term - Due diligence required (structure in place to do this)
- Including Fit for Purpose understanding

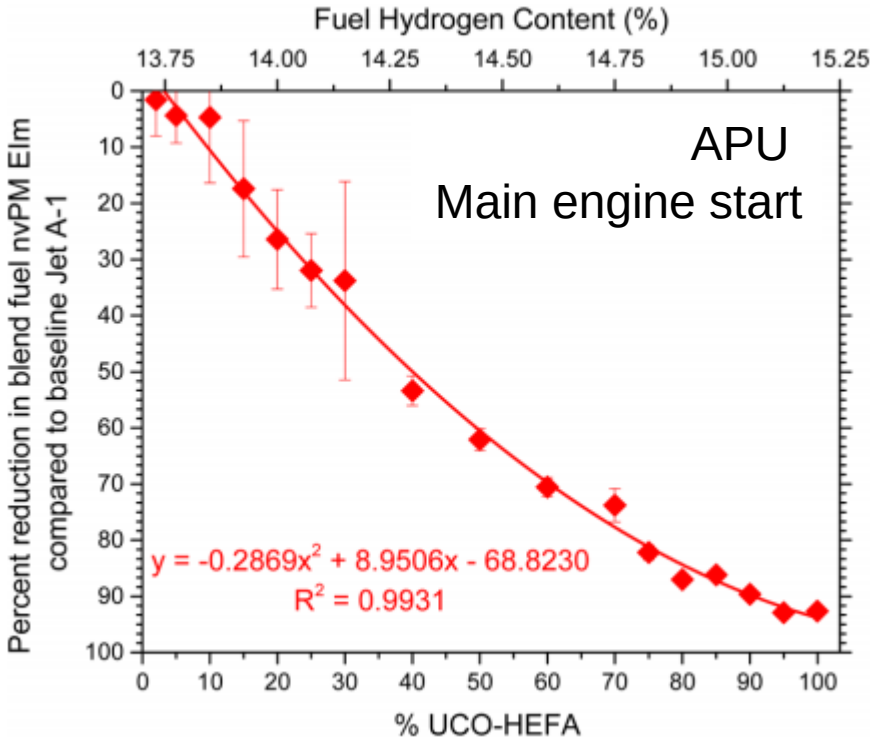


Impact on Air Quality

- A 50:50 blend of Jet A-1 and Alternative fuel:
  60% reduction in air pollution (nvPM mass based)

- Small scale studies help assess impact on Local Air Quality and climate change

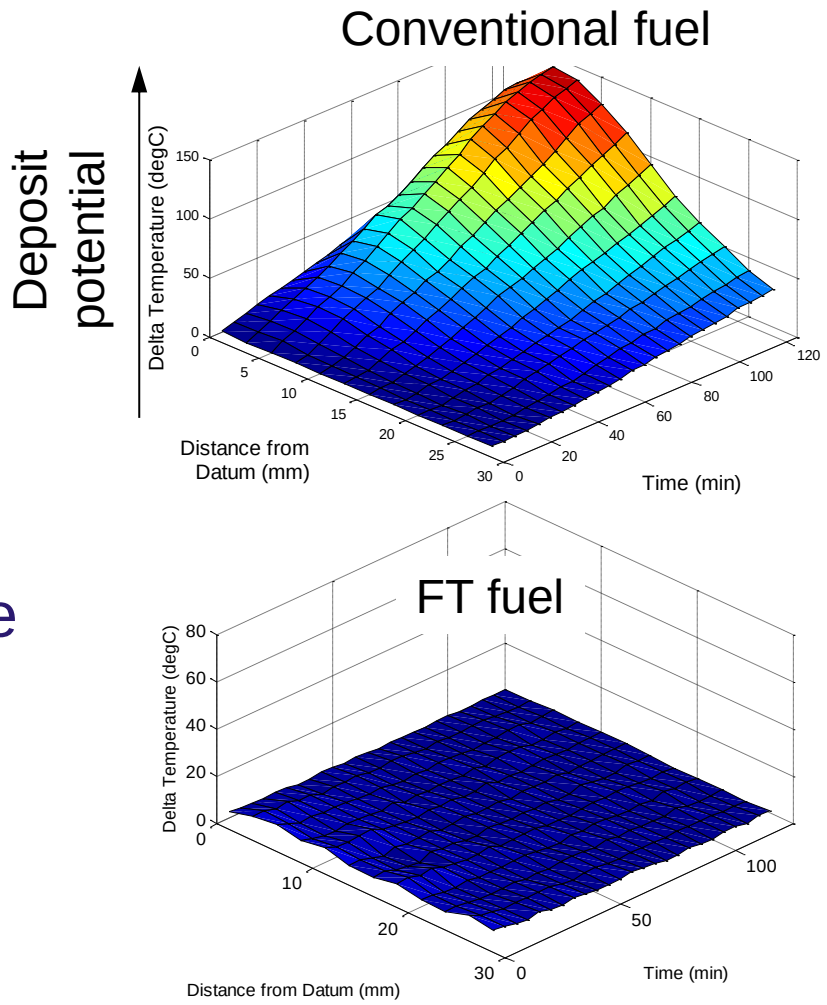
- Low aromatics challenge for seals – system needs to be assessed multidimensionally



Lobo et al. (2015)

Impact on thermal stabilitv

- Fuel operates as heat sink in engine – stability is critical
- Purer fuel greatly improves performance
- Higher specific heat
- Very low Sulphur levels require lubricity additive to pump in current engines



Future fuels

- Assessment needed of non CO_2 impact of synthetic fuels within and beyond the limits of the specification

- Future platforms design *may* exploit change in composition (additional sfc improvements)

Upcoming Questions

- Inside Specification box – how far can we go?
  - Effect of increasing isomerisation
    - Boiling point range, LBO, altitude relight…
  - Effect of lower levels of aromatics or which ones?
    - Fuel gauging, range / payload, emissions, seal performance, thermal stability…
  - New EU H2020 programme - JETSCREEN 2017 - 2020
- Outside Specification box
  - Risk vs benefit needs assessment

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Back up

THE 1ST STUDENT EXPERIENCE SURVEY 2014-15

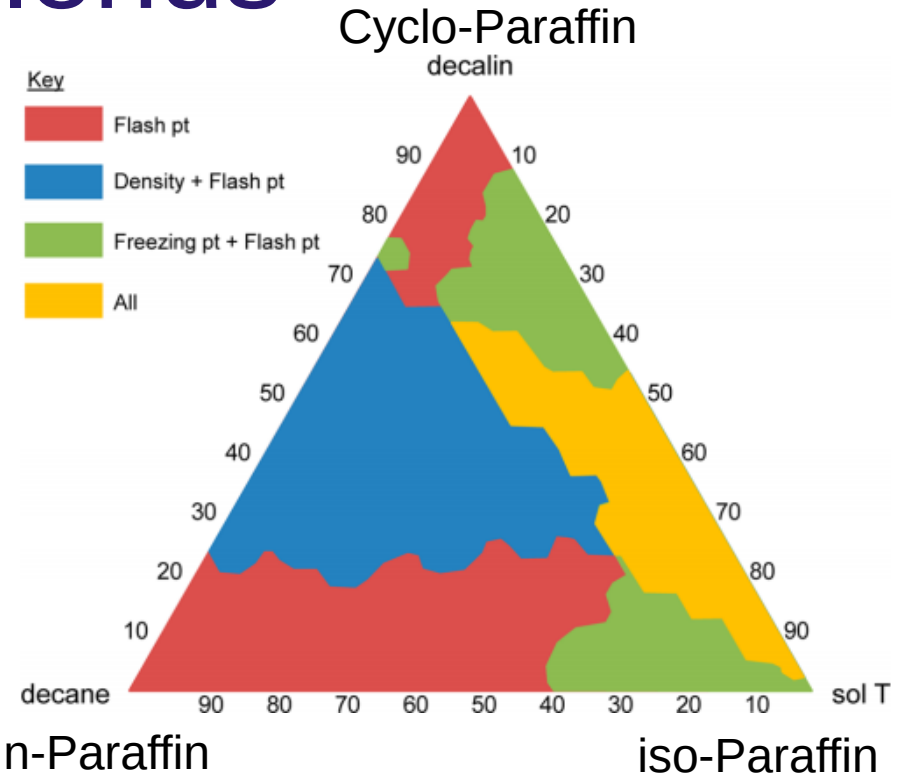
Fuel Composition Change?

- Fuel properties
- Physical mechanisms
  - Atomisation, Chemical kinetics,…
- Combustor performance
  - LBO, Altitude relight, gaseous emissions, PM emissions,…
- Interaction with fuel system
  - Hot end durability, Seal compatibility, thermal stability,…

Aromatic content
Paraffinic groups
Carbon number distribution…

Optimising fuel blends

- Forcing ourselves to meet the specification limits the potential for Alternative Fuels
- Short / medium term: drop-in fuels to boost deployment of SAF
- But Longer term: consider changes to fuel specification & engine design?



Elmalik (2014)