FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

Alternative Jet Fuel Test Database Library
Project 33

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Introduction: Alternative Jet Fuel Test Database

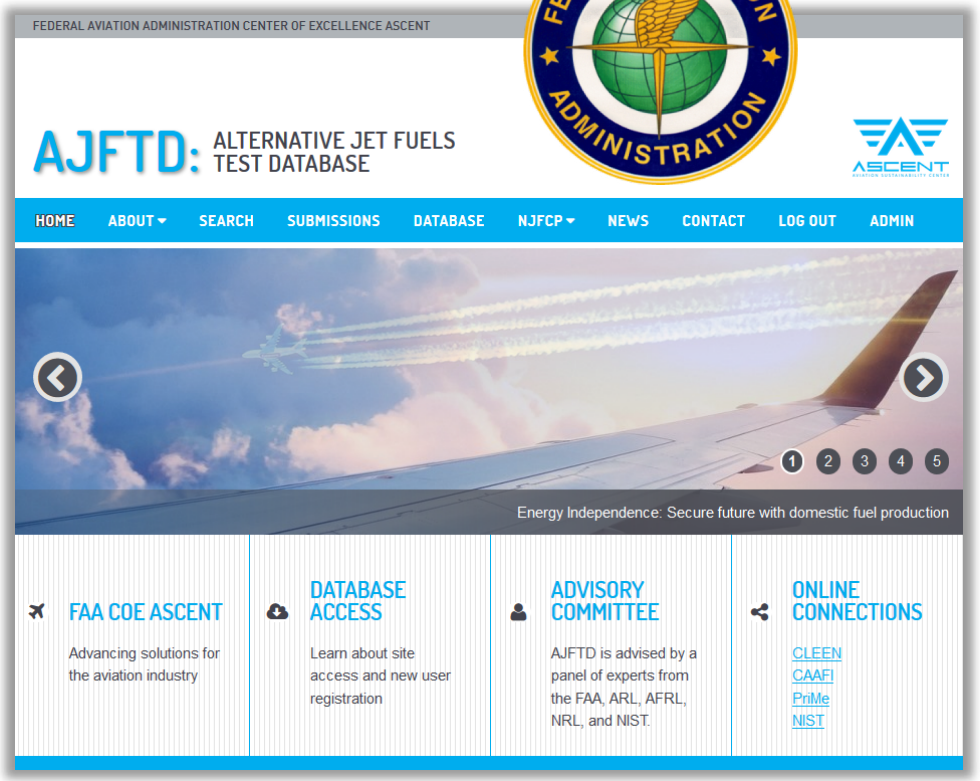
COE Alternative Jet Fuels & Environment

- Program Manager: Cecilia Shaw
- Former Graduate Sudent: Anna Oldani

A foundational database of current & emerging alternative jet fuels

- **Integrate jet fuel data** into comprehensive, common archive
- **Centralize AJF development knowledge** to aid in design and certification of new jet fuels
- **Support alternative fuels research** and certification for national and international policies and multi-stakeholder initiatives
- **Increase accessibility** to fuel testing data and approval reporting to support nascent industry

Over 25,000 fuel records to date



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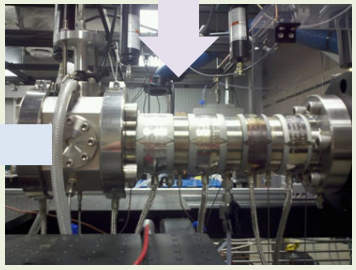
Focus on Critical Fuel Property Data

Feedstock production & logistics

Conversion, scale-up & processing



Fuel property testing & approval

End use production & emission testing

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Phase I: Web Portal & Data Population
Phase II: Database Conversion
Current database addresses critical fuel testing stages of certification process

Easily access, quickly query large dataset

Flexible analytics and web interface (Phase II)

Support across programming languages

Services
AJFTD DynamoDB
JETSCREEN MongoDB

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JETSCREEN – Fuel Database

Authors: Bastian Rauch (DLR), Simon Blakey (USFD / UoB)

Partners involved:

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

The University Of Sheffield.

Objectives

- De chable database fo
  - e properties of pote
  - ain data in addition ram
- Em t:
  - Screening (prior) and streamlining alternative aviation fuel approval process
  - eliable desig
  - ero-engine

ASCENT AVIATION SUSTAINABILITY CENTER

JETSCREEN

Alternative Jet Fuel Test Database
FAA COE Alternative Jet Fuels & Environment

Jet Fuel Screening & Optimization
EU Horizon 2020 Research & Innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723525

Timeline

09.2017

- **NJFCP/JETSCREEN – Rome meeting**

10.2017

- **AJFTD/JETSCREEN – Discussions to Merge Database**
  - JETSCREEN → AJFTD: Fuel data schema
  - AJFTD → JETSCREEN: Access to database

12.2018

- **NJFCP/AJFTD/JETSCREEN – Paris meeting**
  - Decision to join forces and push use of fuel data to a new level
  - Define goals for joint database setup

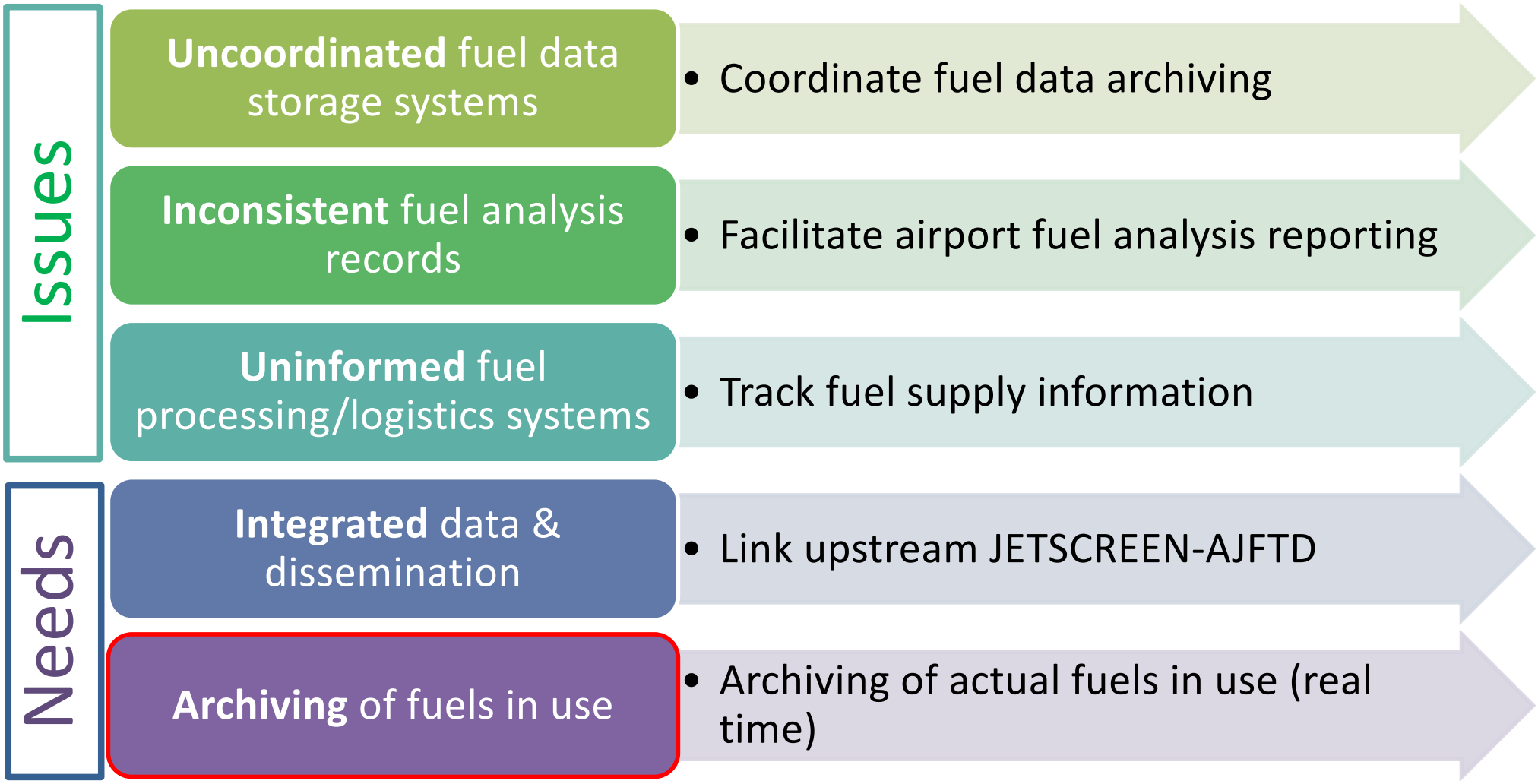
5.2019

- **CRC Aviation Meeting 2019**
  - Introduction of Database Integration Concept

8.2019

- **IASH Meeting 2019**
  - Introduction of Data Integration Scheme and Vision

Existing Issues & Needs



Identified Targets

Common Data Schema – non relational format

- Include Tier 2, 3, and 4 properties, life cycle assessment, and impact on system components
- Need to understand **complexities of extended data sets** beyond standardized Tier 1 testing
- Assess ability to incorporate novel analysis methods (GC x GC)

Integrate Databases

- Identify **currently available databases** housing fuel test method evaluations
- Include measurement uncertainties of applied testing methods
- Detailed **global fuel dataset** under common schema for conventional, alternative, and blends

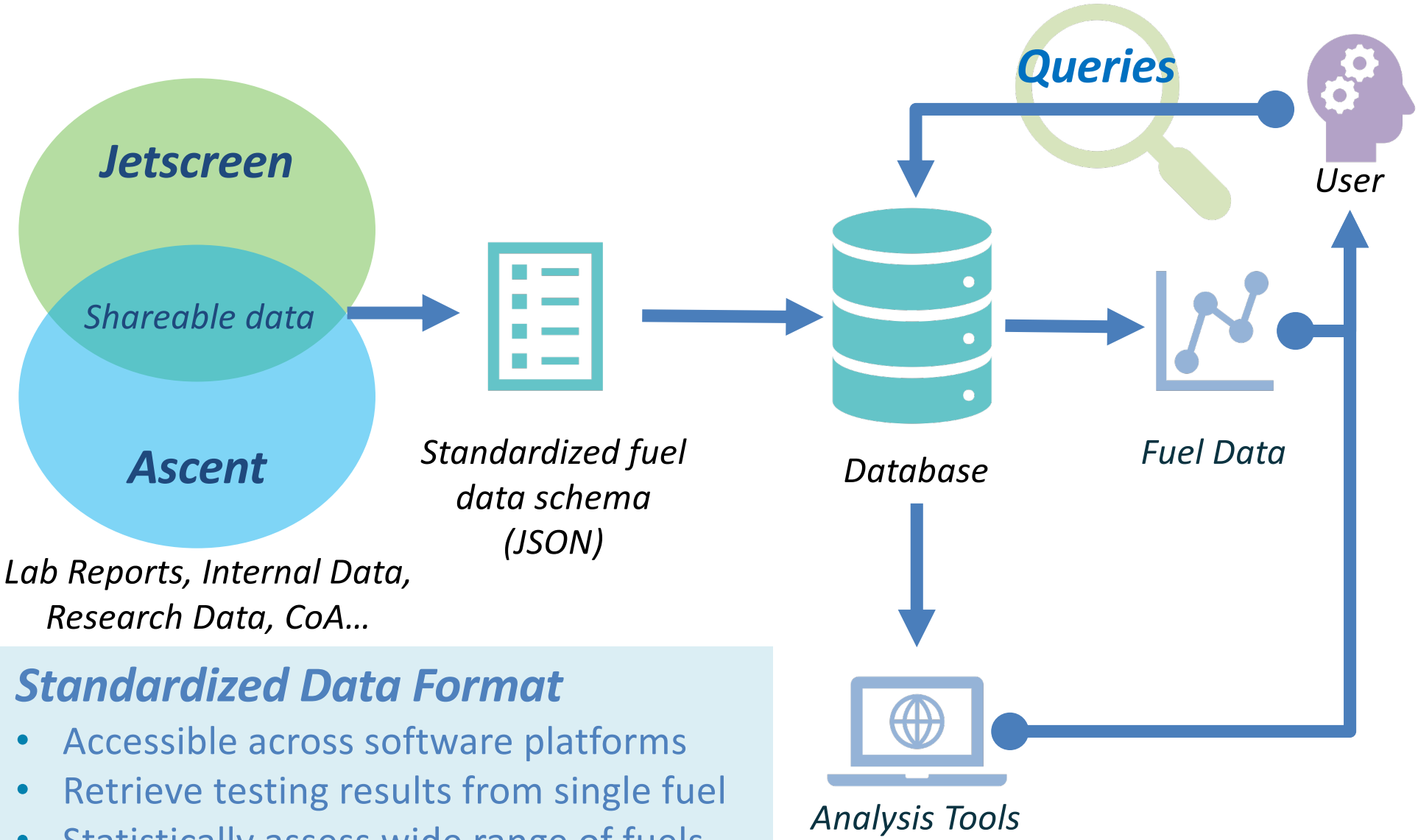
Maintain Proprietary Datasets

- **Common interface**, maintain distinct backends (MongoDB, DynamoDB)
- Different access levels by user group

Develop and Apply Analysis Tools

- **Specialized analysis tools** based on programming platform and user needs
- Employ specification property, performance, and/or end-use/emissions targeted tools

Collaborative DB Architecture

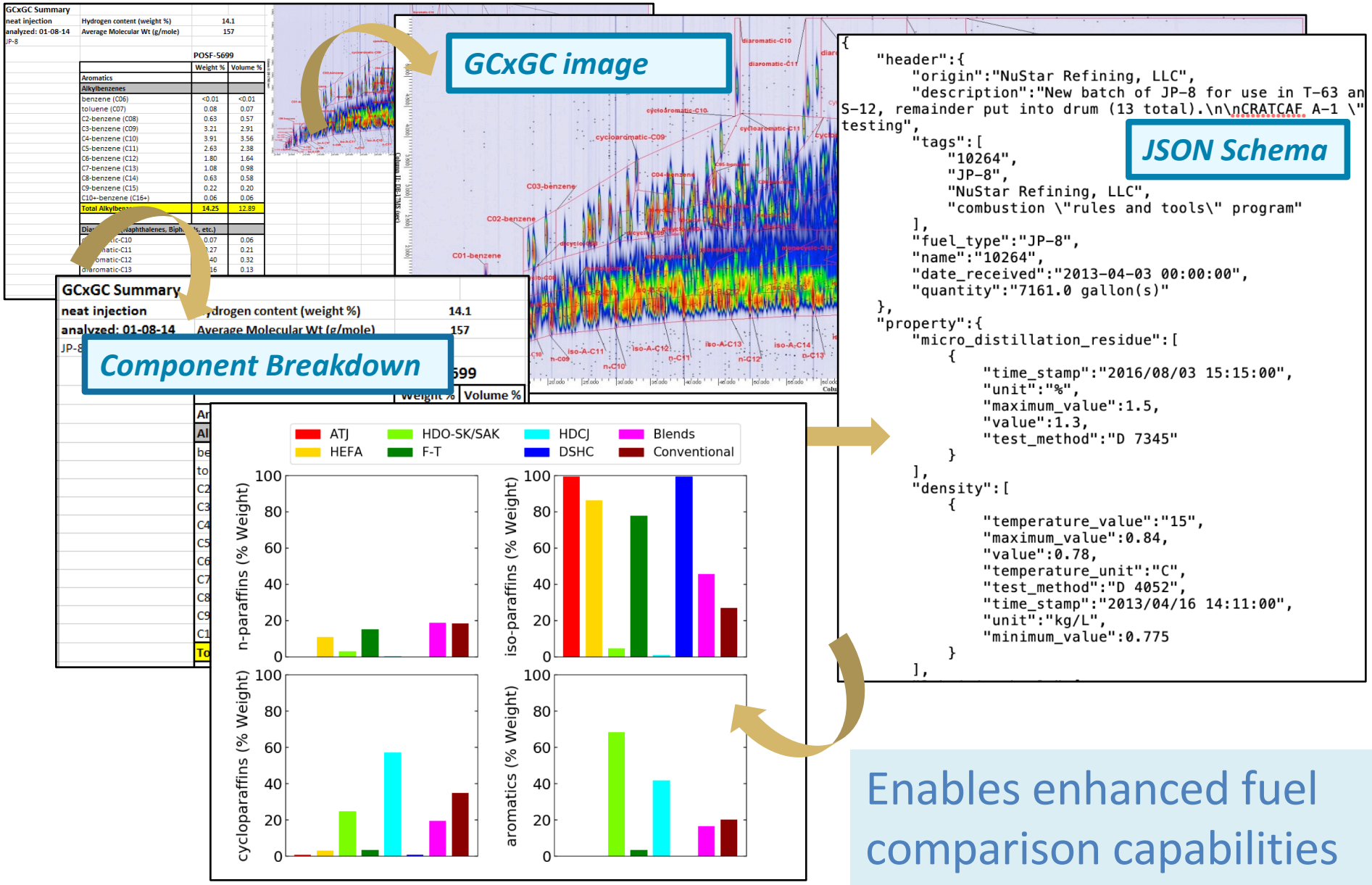


Standardized Data Format

- Accessible across software platforms
- Retrieve testing results from single fuel
- Statistically assess wide range of fuels

https://github.com/JETSCREEN-h2020/devFuelDatabase/wiki/JETSCREEN-Schema-philosophy

Unify Disparate Data

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Enables enhanced fuel comparison capabilities

Impact 1: Screening & Safety

Develop screening guides to assess new fuels

- **Accelerate approval** through early-stage pre-screening
- **Assist fuel producers** with access to AJF property data

Coordinate fuel data with global aviation data

- **Track flight & aircraft system issues** with fuel supply data
- Investigate fuel-related system or component failures

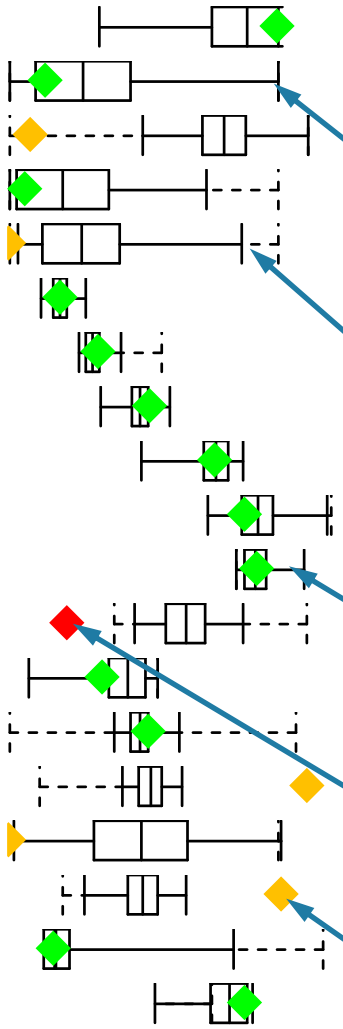
Expand fuel & flight data records

- **Connect AJF blend & flight data** (maintenance, emissions,..)
- **Demonstrate AJF safety & compatibility** in current systems
- **Increase market support** for continued AJF integration

Requires data on actual fuels used

Enhanced Fuel Screening

Fuel specification	Min	Max	Fuel Sample	Whisker Chart
Colour			30	
Acidity (mg KOH/g)	0	0.015	0.002	
Aromatics IP 156 (%vol)	0	25	1.8	
Sulphur (%mass)	0	0.3	0.018	
Mercaptan (%mass)	0	0.003	0	
IBP (degC)			148.8	
10% (degC)		205	169.8	
50% (degC)			198.7	
90% (degC)			235.1	
FBP (degC)		300	251.9	
Flash point (degC)	38		41.5	
Density @15degC (kg/m3)	775	840	759.6	
Freezing point (degC)		-47	-59	
Viscosity @-20degC (cSt)	0	8	3.885	
Smoke point (mm)	5		50	
Naphthalenes (%vol) if SP > 25mm		3	0	
Specific Energy (MJ/kg)	42.8		44.023	
Existent Gum (mg/100 ml)		7	1	
MSEP	85		99	



A new fuel, some properties within spec, but outside experience:

Solid lines represent distribution of the conventional fuels in the database

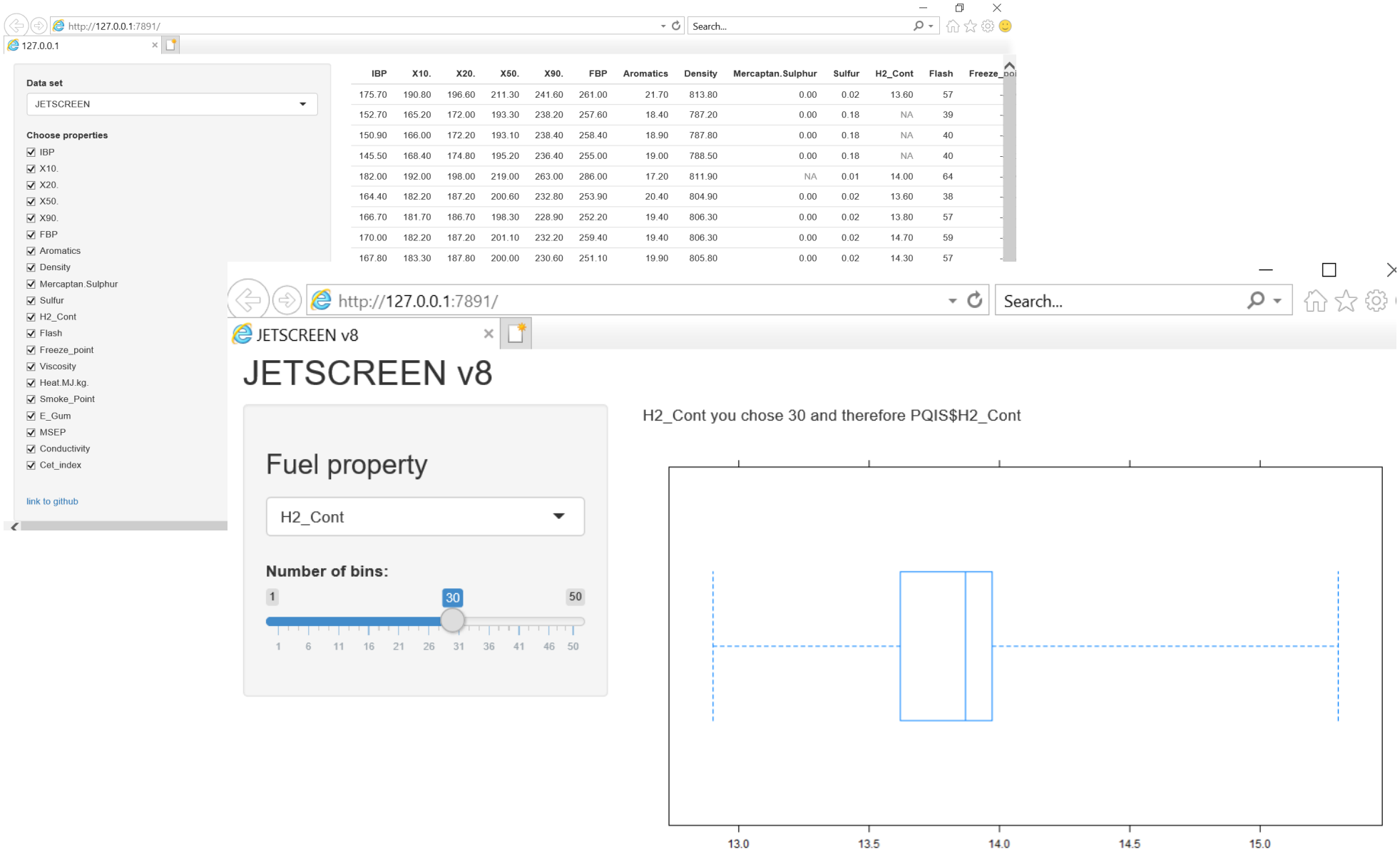
Dashed lines represent the limits of the specification

Properties within specification, and within range of fuels already in use

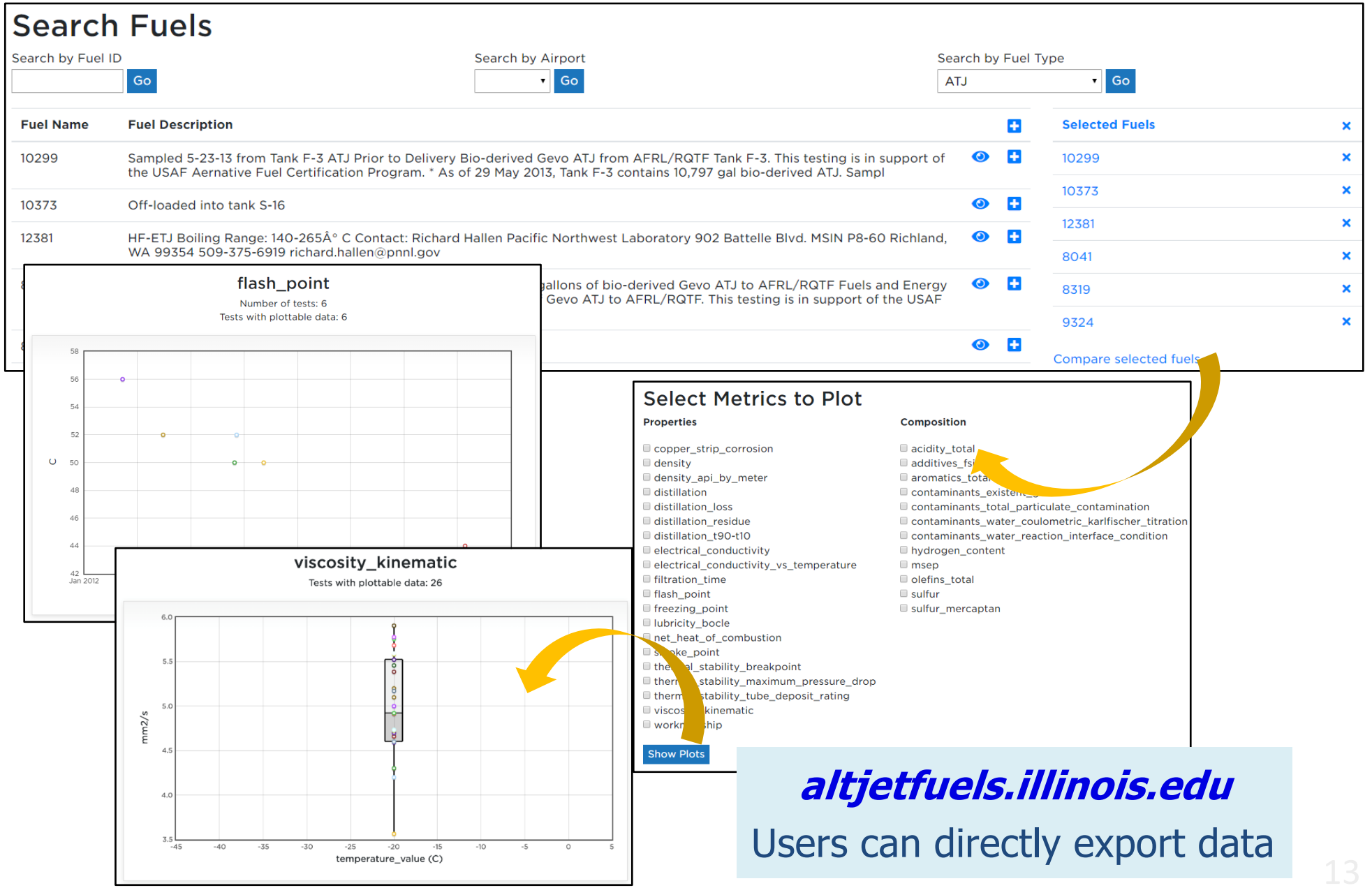
Properties outside of specification

Properties outside of norm, but within specification

Online access to JETSCREEN data



Gen II AJFTD Fuel Tool – Now Live



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Users can directly export data

Impact 2: Engineering & Science

Statistical analysis / feature detection for aircraft-related fuel properties

- Facilitate design of aircraft components impacted by fuel properties

Development & validation of statistical & physical-based models

- Streamline approval, reduce early stage testing
- Enhance development & production of alternative fuels

More widely…


```
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                "unit": "rating",
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            },
            {
            "test_method": "D86",
```
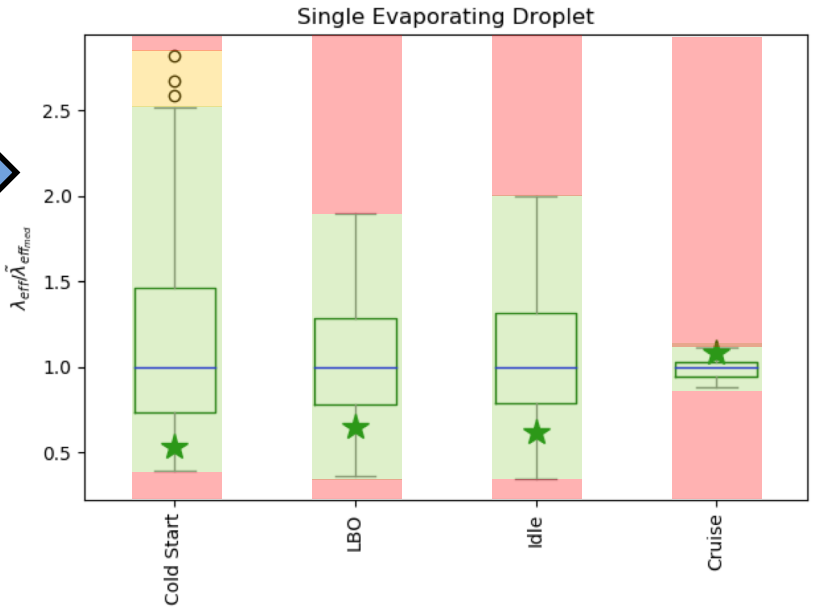


Can be read by multiple software using conversion / interpretation script

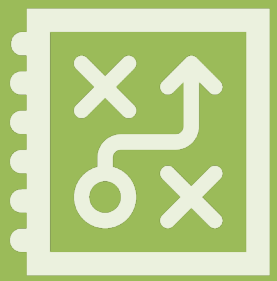
…

Machine learning based analysis tools



Create tailored, reproducible output

Impact 3: System Operations



Track properties of fuels in use: processing, supply chain, end use

- Improve quality control in fuel production & supply

Increase data access for airports & airlines

- Demonstrate safe usage of AJFs with detailed supply info
- Build trust between producers, suppliers, & consumers

Expand operational data compilation & dissemination

- Increase system optimization across industry

Is actual flight fuel data logging possible?

Summary & Future Steps

Integration of other data from CORSEA, CAAFI, etc.

Continue coordination & merging of AJFTD & JETSCREEN databases

Expand Database to address needs **of** producers, airlines, OEMs, & other stakeholders

Extend Database to house real time data across actual flights

Opportunity to increase operational safety, support new fuel integration

Global fuel database & tracking system

Questions

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Other data of interest…

- May include **CORSIA** relevant emissions data
  - Tracking fuels within the system
  - Methods for receiving / storing data need to be developed
- **CAAFI**: Pre-screening relevant data
- Include **fuel production** information (when available), LCA, etc.
- We expect **non-CO_2 impacts** to become increasingly important
  - Storage and information system already in place
- **Fuel data across Europe and around the globe**
  - Vision of extending connection to other databases

Data Conversion Incentives

Accelerate **data retrieval**

Enable **statistical analyses** with robust correlations

Easily identify **unusual data** (misreported, outliers, …)

Facilitate collaboration with related programs and data sharing