ASTM Qualification of Synthetic Aviation Turbine Fuels (SATF)

DLA Energy Worldwide Energy Conference

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Chair, Aviation Fuel Subcommittee D02.J

ASTM International

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Director, Regulatory Affairs & Quality

Air Company

About ASTM International

A Leading Independent Partner for Agile, Global Standards and Testing Programs that Help Solve Complex Challenges and Improve Lives by Making Products and the Environment Better for All

Established in 1898

150 Committees & 13,000+ Standards (Covering 90 industry sectors from aviation to construction to advanced manufacturing)

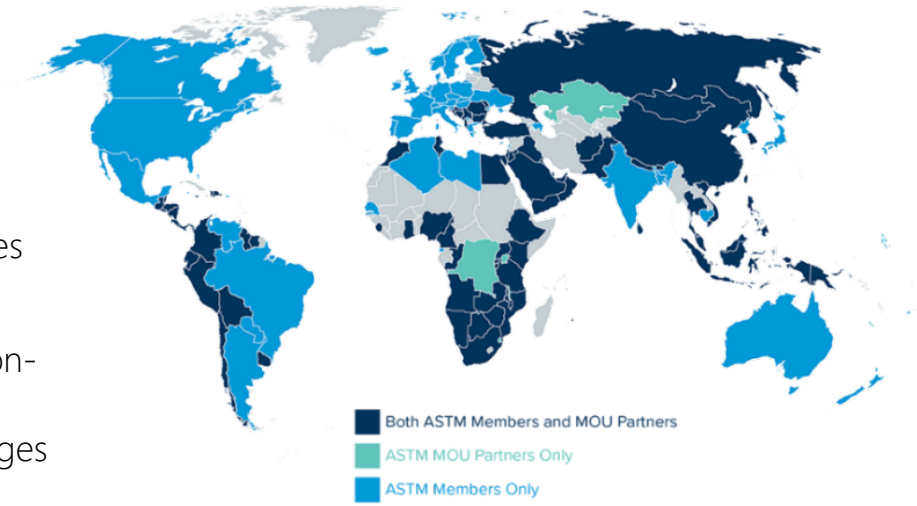
A leading global standards organization with more than 34,000+ members:

- 8,000+ International Members from 135 countries
- 8,400+ ASTM standards used in 83 countries

A highly agile, independent, non-governmental, non-profit, member-led standards body

- uniquely positioned to help society solve challenges and seize opportunities

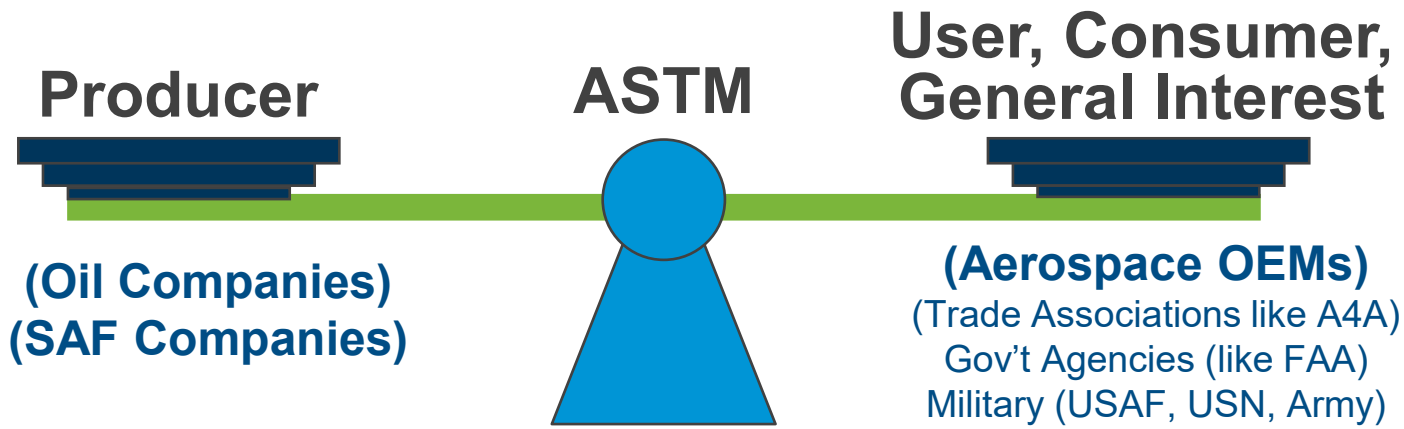
Globally recognized for quality and relevance



ASTM Process

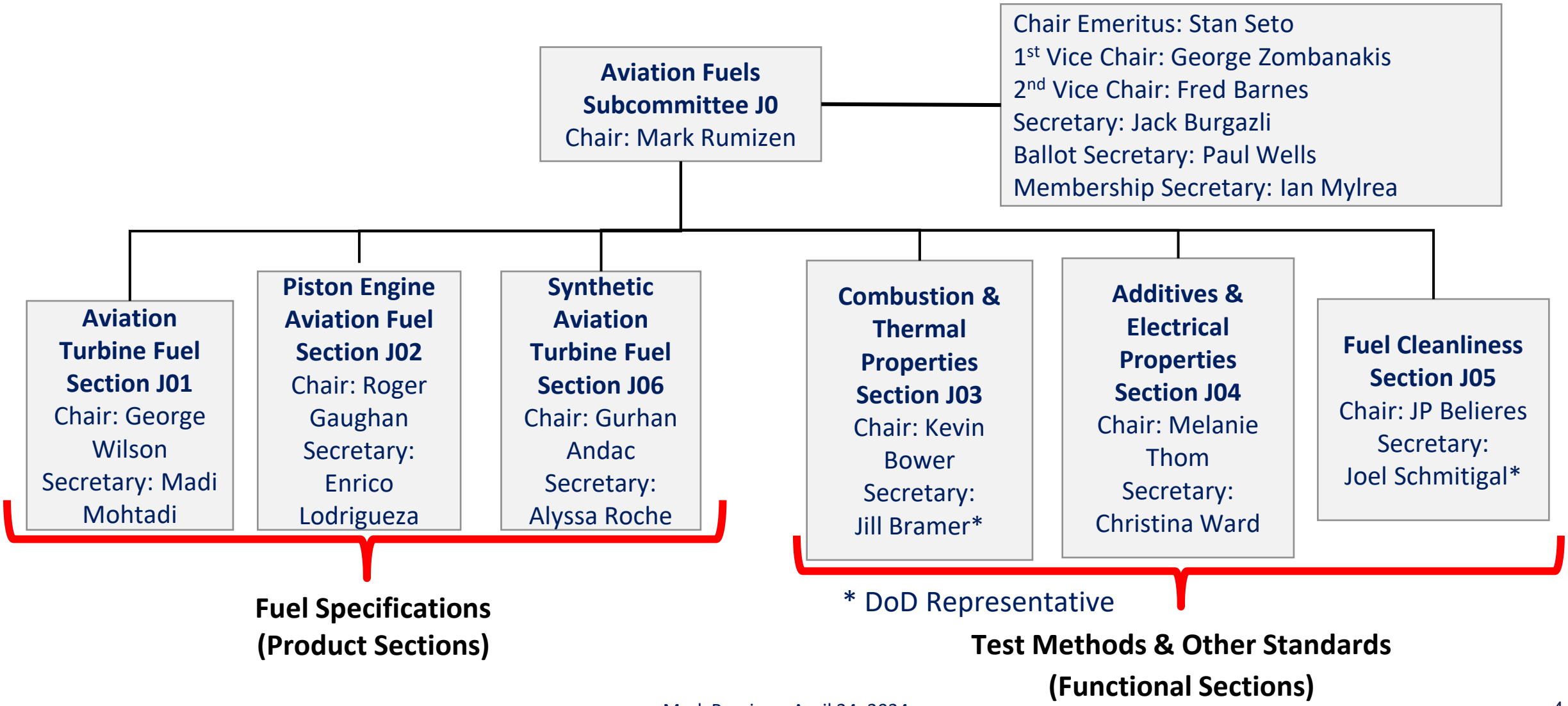
Equal Voice, Equal Vote

- Openness
- Consensus based
- Balance between Producers and Users/General Interest
- One official vote per “voting Interest”
- But **all** members can vote
- **All** negatives and comments are addressed

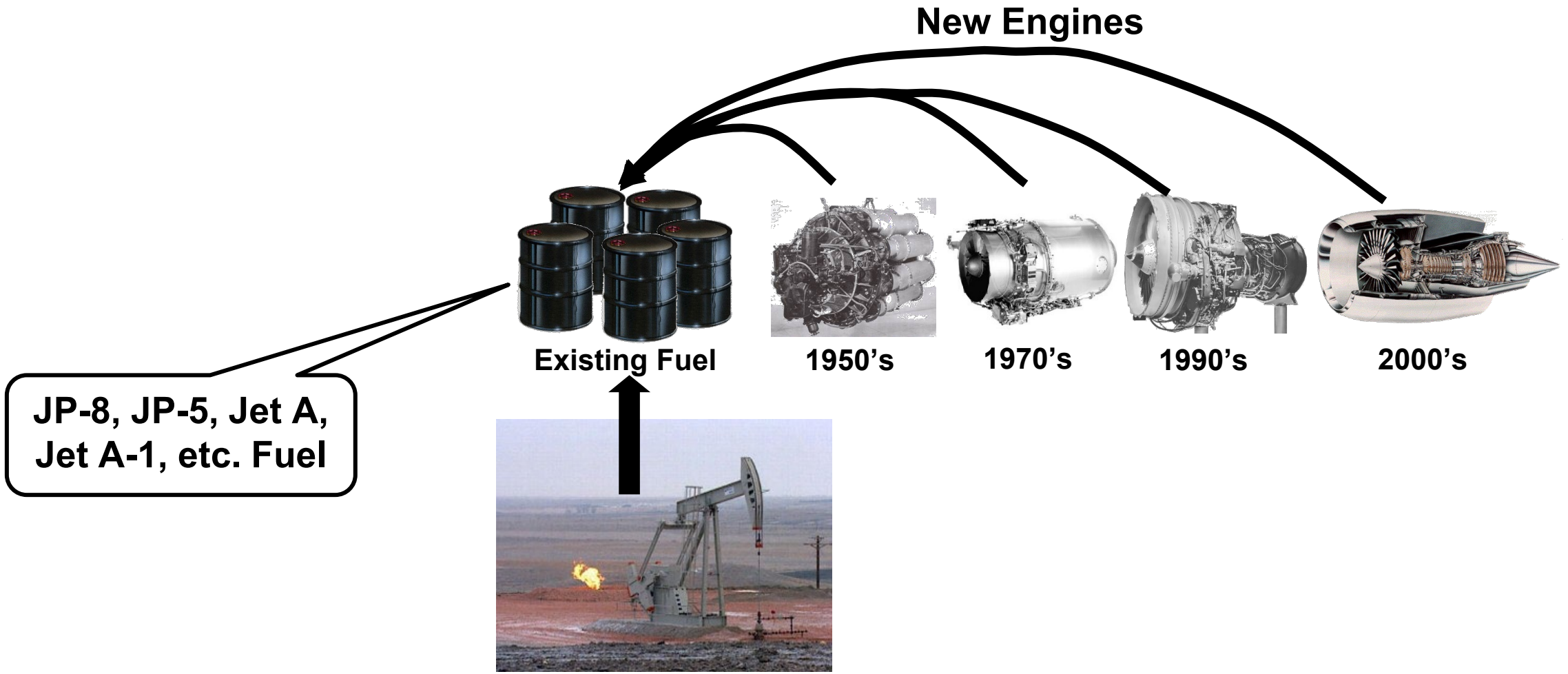


Technical Committees are balanced.

ASTM Aviation Fuel Subcommittee Overview

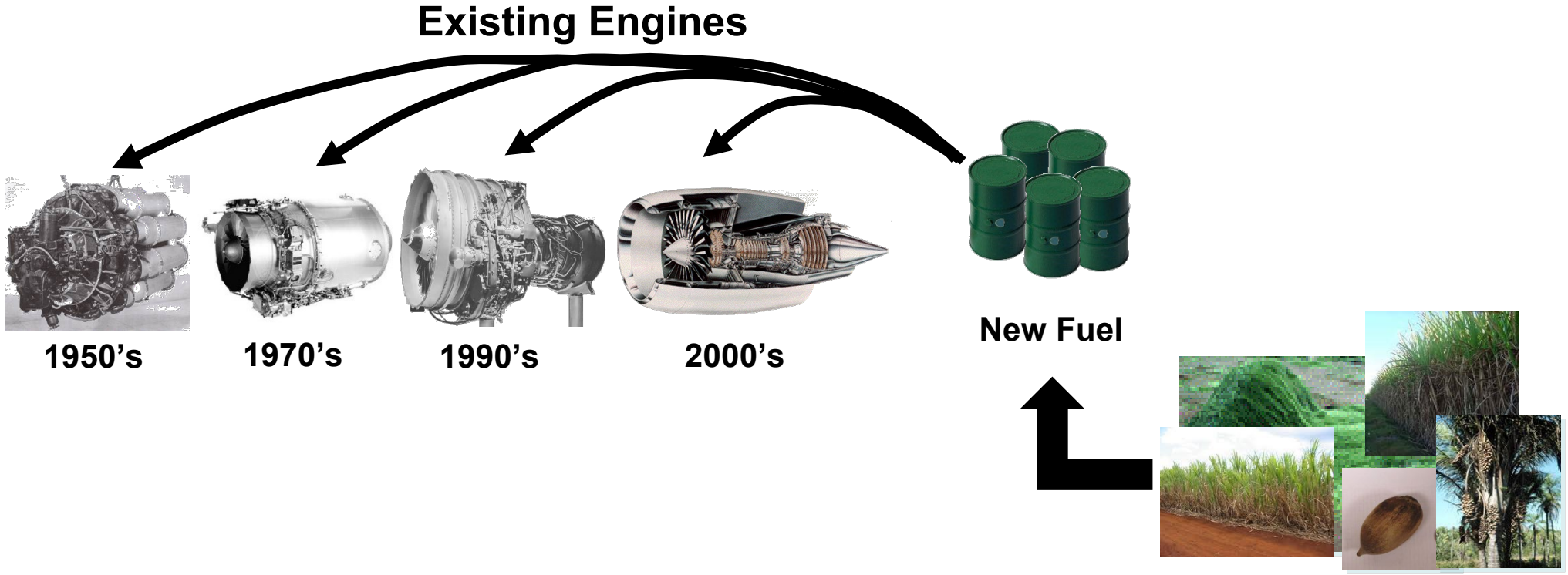


Engines & Aircraft Have Historically Been Designed To Operate with Jet A Fuel Produced from Petroleum



SATF (or SAF) Must be Backwards Compatible
(or ‘Drop-in’)

How do we prove this?



Leverage ASTM Framework for SATF Qualification

(SBC = Synthetic Blending Component)

New SATF Meets Existing Operating Limitations, Therefore Approved to Use on Virtually All Existing Aircraft

ASTM Specification = Approval to Fly

4 **D1655** = **D7566**
Conventional Jet Fuel Spec | Drop-In Jet Fuel Spec

1

Aircraft Approved Operating Limitations Based on Industry Fuel Specifications

Jet A and Jet A-1 Fuel

2 **ASTM D4054**
SATF Evaluation Process
If New SATF Meets Conventional Jet Fuel Spec & Properties

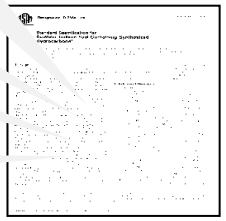
3 **ASTM D7566**
Drop-In Jet Fuel Spec
Then New SBC Annex Added to Drop-In Fuel Spec

Airworthiness Authority (FAA) Certification Includes Fuel Specification

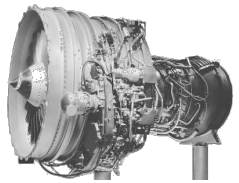
The Airworthiness Authorities do not certify fuel, they certify airplanes and engines to operate on specified fuel

Jet A/A-1

- DEF STAN 91-091
- ASTM D1655
- OEM Specifications
- MIL-DTL 83133



Fuel Specification



Engine Ratings and Operating Limitations

Powerplant Limitations

- Fuel Specification

Operating Limitations

- Powerplant limitations in Airplane Flight Manual

Aircraft Flight Manual

- no person may operate a civil aircraft without complying with the operating limitations specified in the approved AFM

Airlines May Only Use the Fuel Specified by the OEM

This Must Control the Fuel Composition and Properties to Ensure a Consistent Product

Aircraft/Engine Operation with the Fuel is Evaluated During Aircraft and Engine Certification

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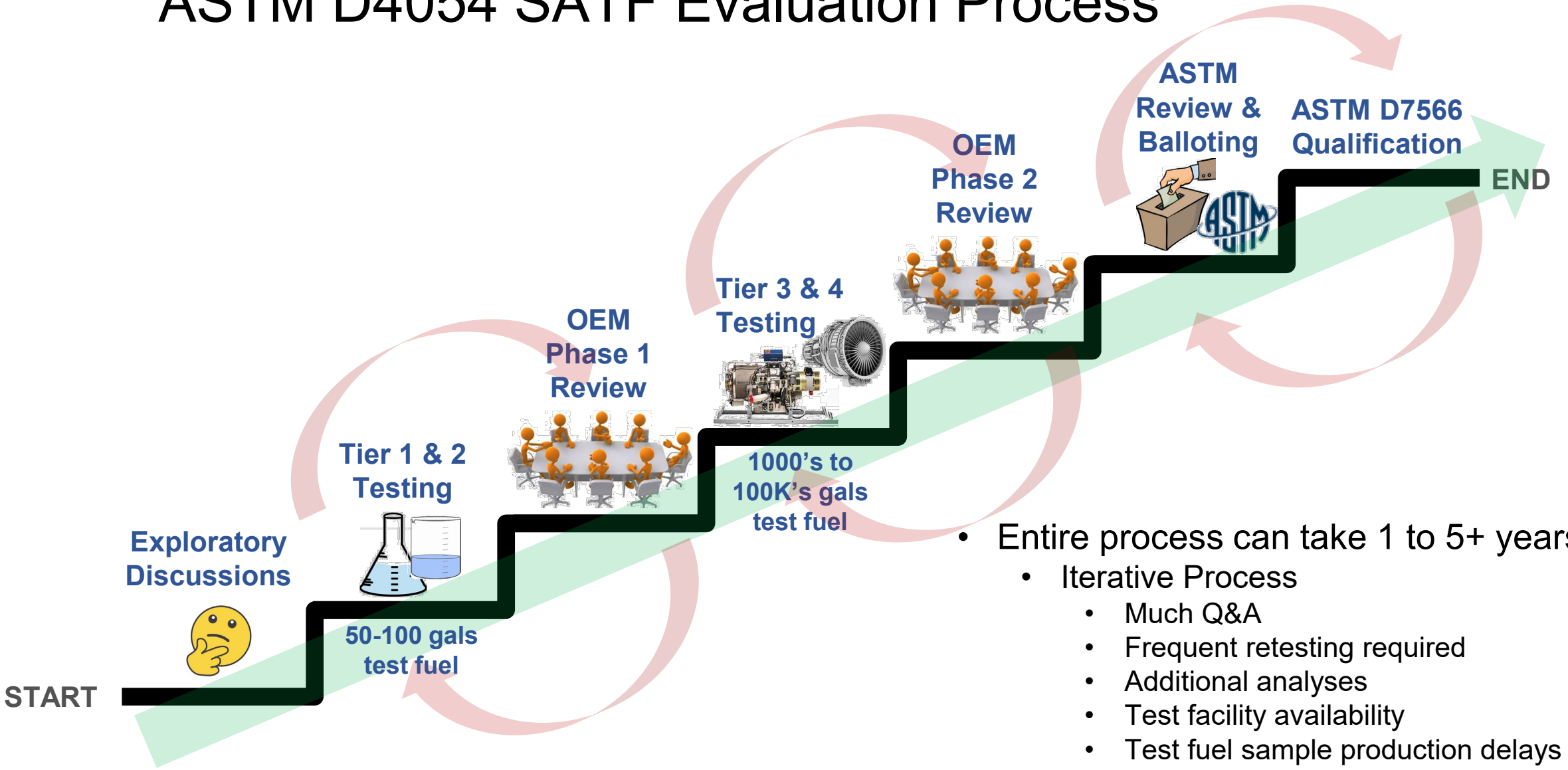
ASTM D4054 SATF Evaluation Process



- Entire process can take 1 to 5+ years
  - Iterative Process
    - Much Q&A
    - Frequent retesting required
    - Additional analyses
    - Test facility availability
    - Test fuel sample production delays
  - ASTM balloting may take several rounds

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ASTM D7566 Foundational Concept

Production

Semi-Synthetic Fuel

Tighter Control of Fuel Properties

Distribution

Re-Identified

Conventional Jet Fuel

Separate Tracking NOT Required

Operations

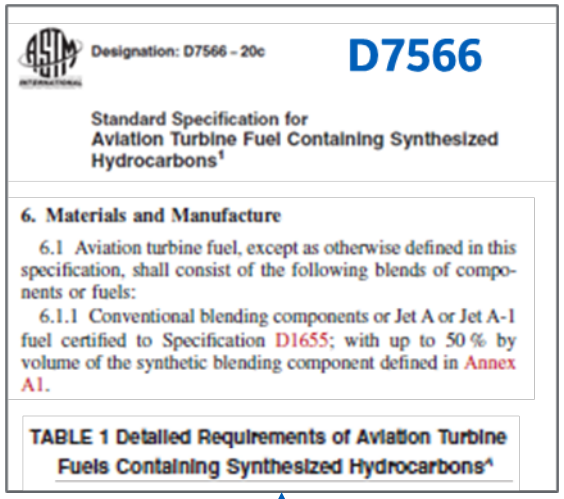
Conventional Jet Fuel

Re-Certification NOT Required

ASTM D7566 Structure

Blending limit for each blend component

Provision to allow reidentification to D1655 Conventional Jet A



Designation: D7566 – 20c

D7566

Standard Specification for
Aviation Turbine Fuel Containing Synthesized Hydrocarbons[1]

6. Materials and Manufacture

6.1 Aviation turbine fuel, except as otherwise defined in this specification, shall consist of the following blends of components or fuels:

6.1.1 Conventional blending components or Jet A or Jet A-1 fuel certified to Specification D1655; with up to 50 % by volume of the synthetic blending component defined in Annex A1.

TABLE 1 Detailed Requirements of Aviation Turbine Fuels Containing Synthesized Hydrocarbons[A]

Additional property requirements for blended jet fuel

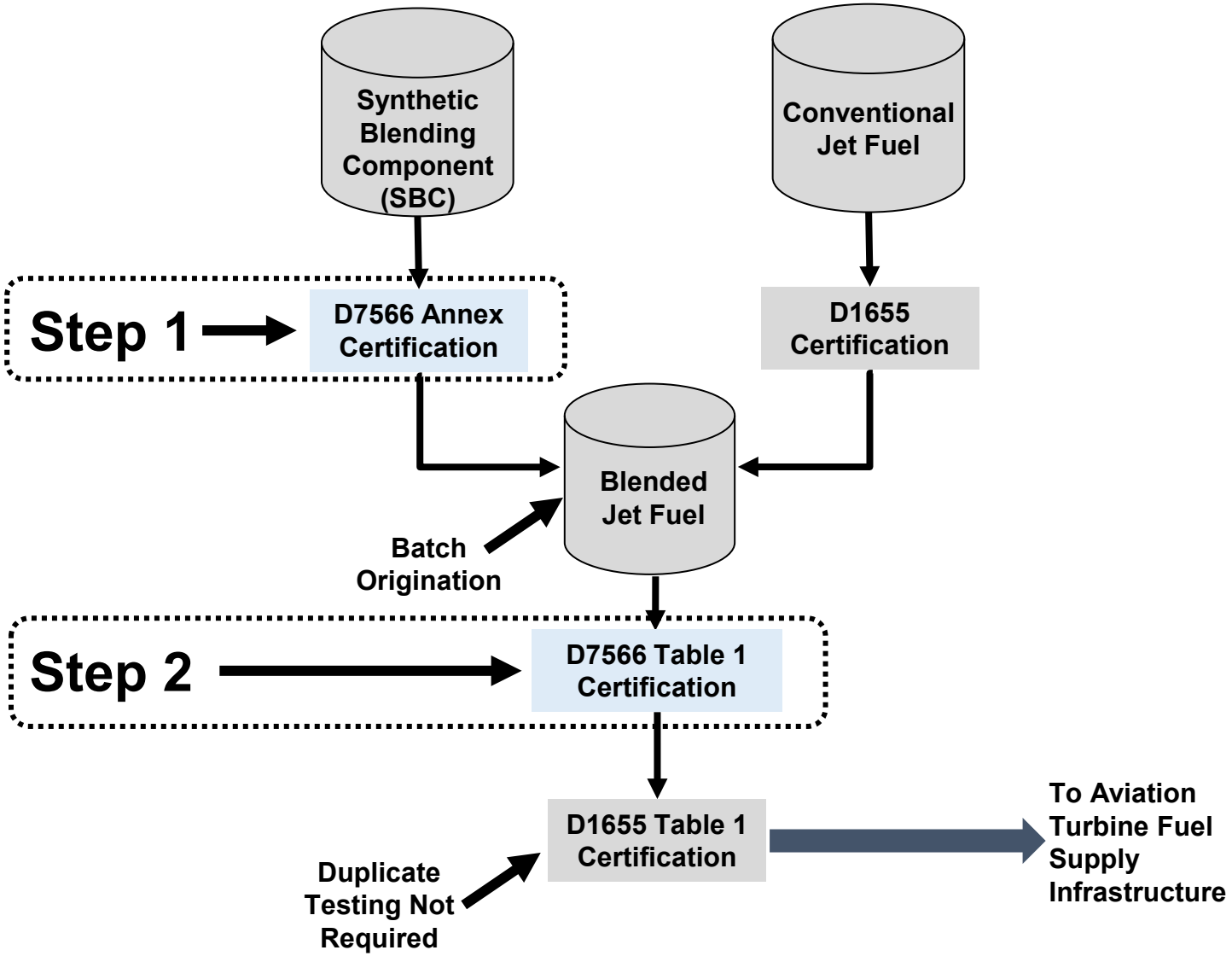
Annexes Added for each new blend component after successful D4054 process and ASTM balloting

Annex A1 FT-SPK (50%)	**Annex A2** HEFA-SPK (50%)	**Annex A3** SIP (10%)	**Annex A4** FT-SPK/A (50%)
Annex A5 ATJ-SPK (50%)	**Annex A6** CHJ (50%)	**Annex A7** HC-HEFA (10%)	**Annex A8** ATJ-SKA (50%)

Annex Ax TBD (xx%)

Unique criteria in each Annex to control blend component

ASTM D7566 Two-Step Certification



Key Controlling Elements of a D7566 Annex

Feedstocks

Qualitative


Plant/Animal Oils


Coal


Biomass

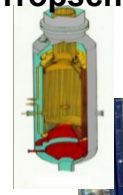

Natural Gas

Lignocellulose

Sugar

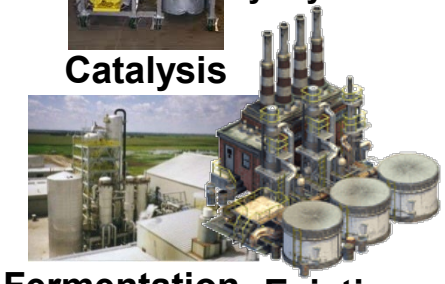
Conversion Process

Qualitative


Fisher-Tropsch

Pyrolysis

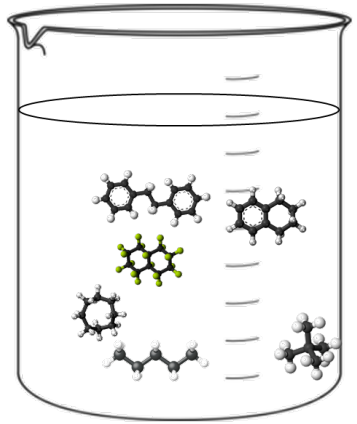
Catalysis


Fermentation

Existing Refinery Processes

Composition

Qualitative



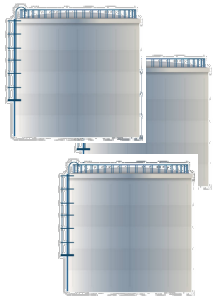
Properties

Quantitative

Property		HEFA–SPK
COMPOSITION		
Acidity, total mg KOH/g	Max	0.015
VOLATILITY		
Distillation—both of the following requirements shall be met:		
1. Physical Distillation		
Distillation temperature, °C:		
10 % recovered, temperature (T10)	Max	205
50 % recovered, temperature (T50)		report
90 % recovered, temperature (T90)		report
Final boiling point, temperature	Max	300
T90-T10, °C	Min	22
Distillation residue, percent	Max	1.5
Distillation loss, percent	Max	1.5
2. Simulated Distillation		
Distillation temperature, °C:		
10 % recovered, temperature (T10)		report
20 % recovered, temperature (T20)		report
50 % recovered, temperature (T50)		report
80 % recovered, temperature (T80)		report
90 % recovered, temperature (T90)		report
Final boiling point, temperature		report
Flash point, °C	Min	38[D]
Density at 15 °C, kg/m³		730 to 772[F]
Freezing point, °C	Max	–40

Not in Annex, in Main Body of D7566

Blend % with Conventional Jet



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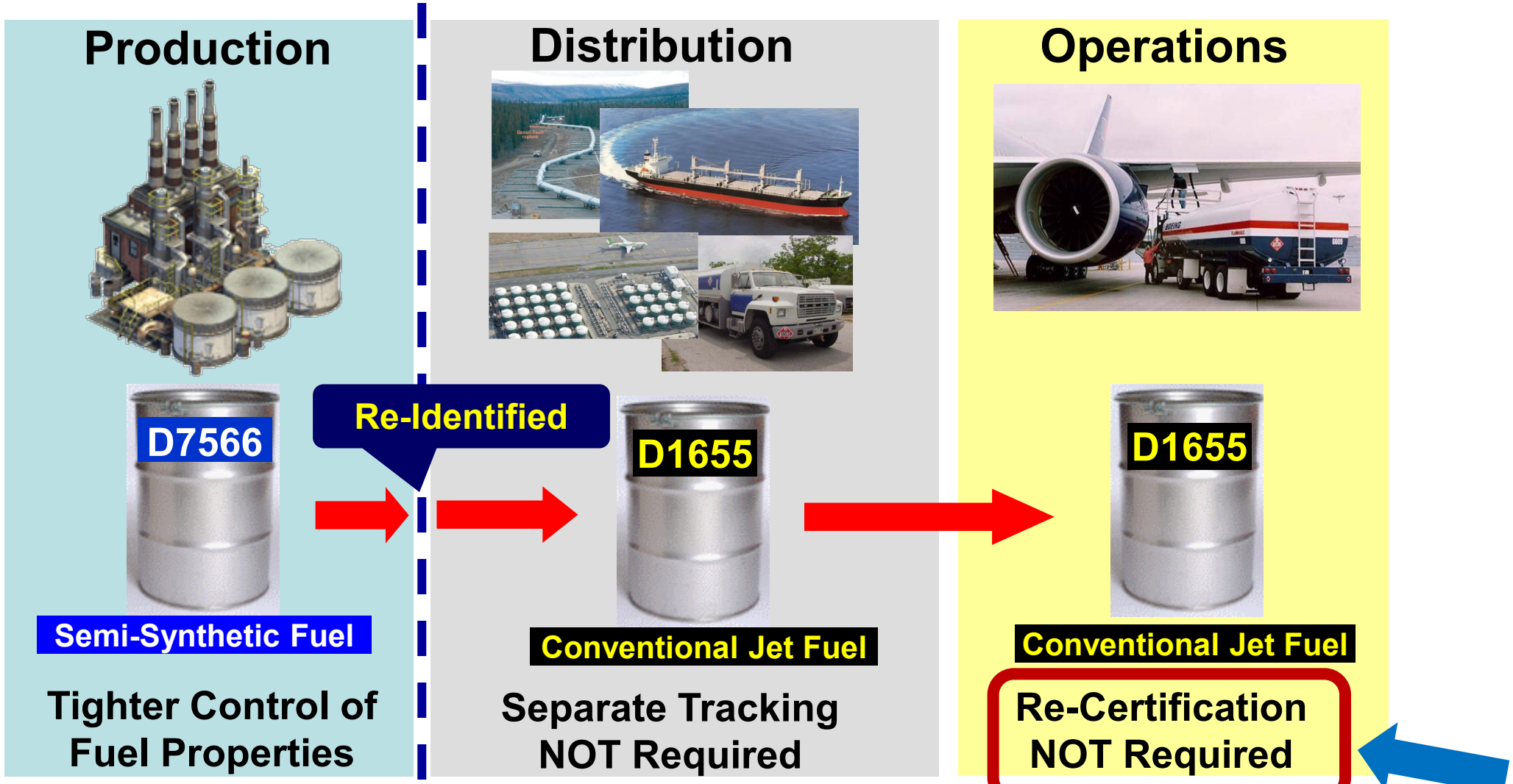
ASTM D7566 Foundational Concept



Thank You

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Questions?

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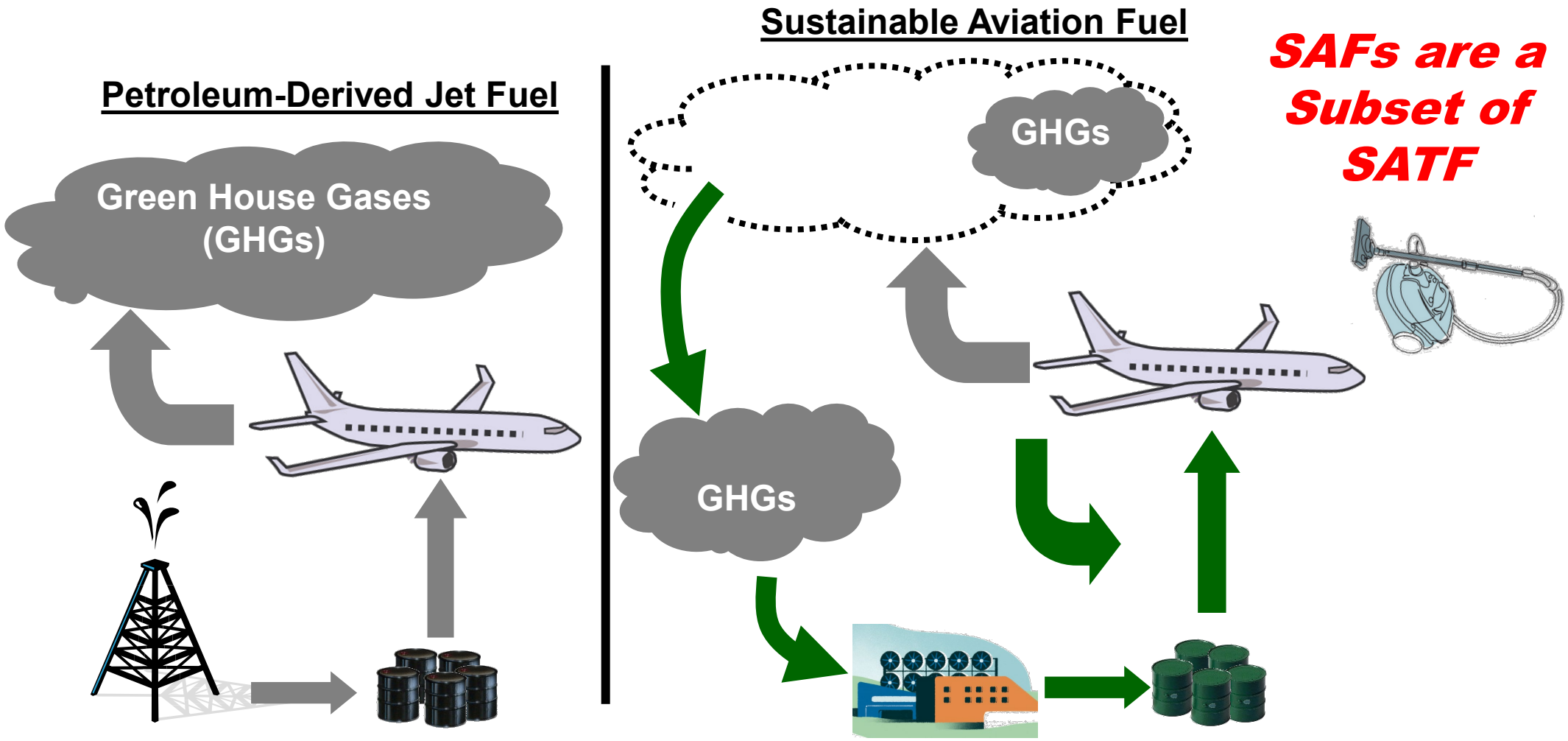
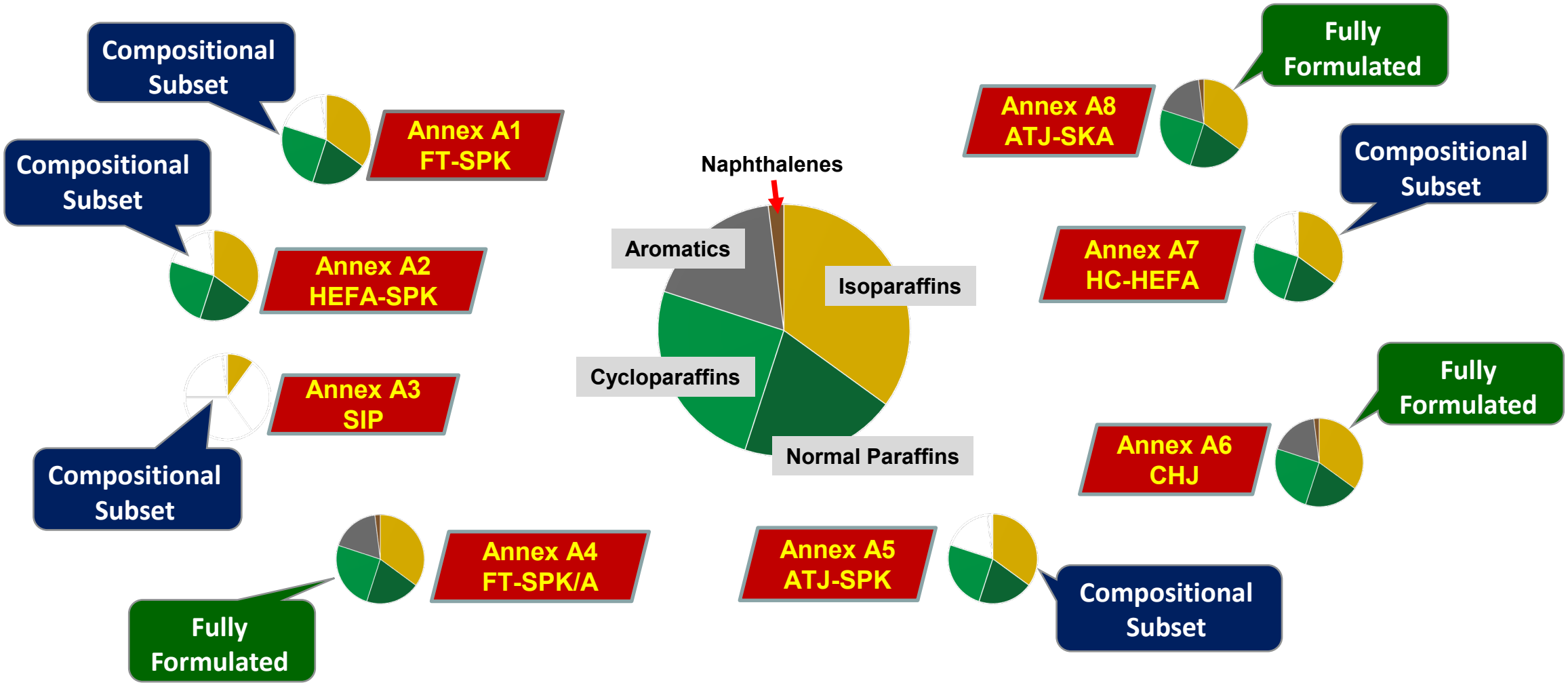
Back-Up Slides

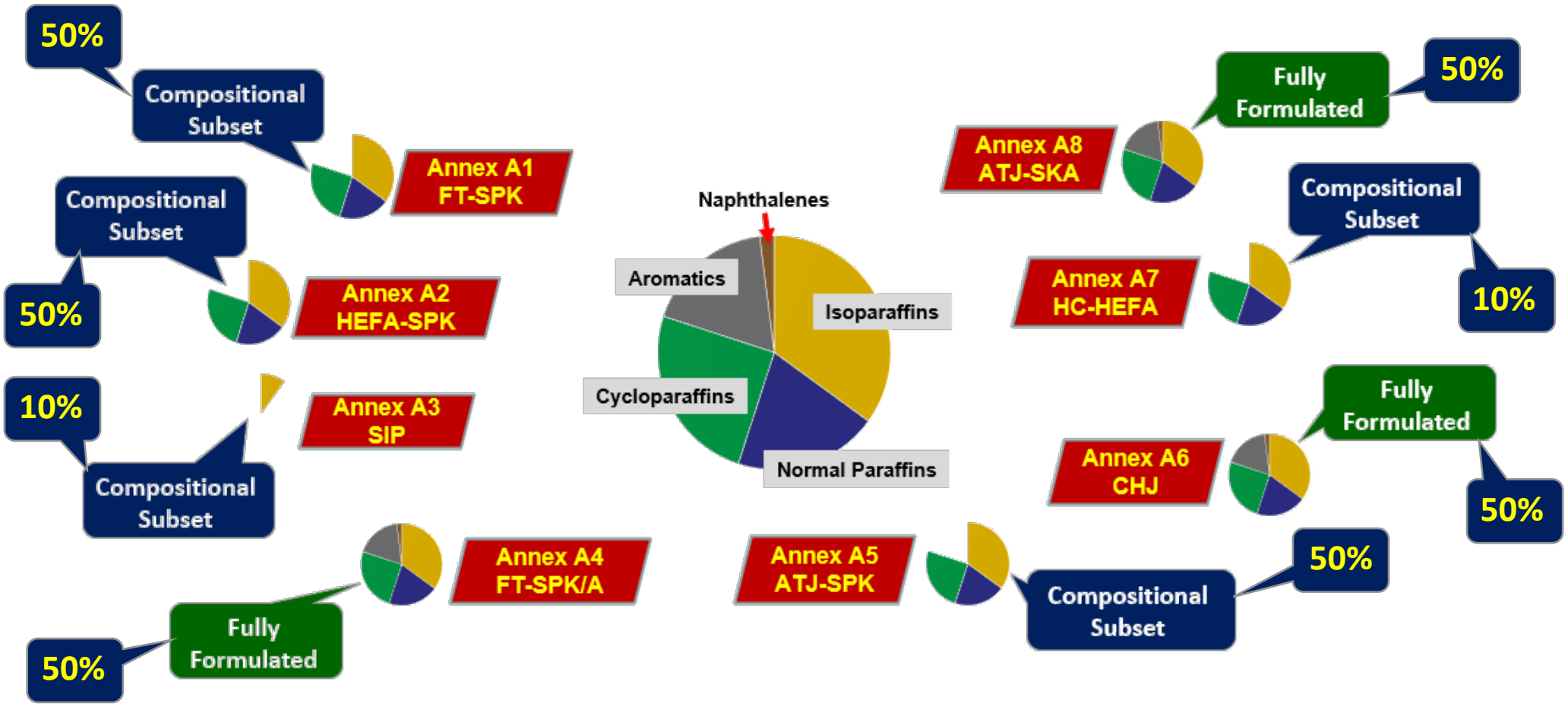
Sustainable Aviation Fuels (SAF) Reduce **Net** Carbon Footprint



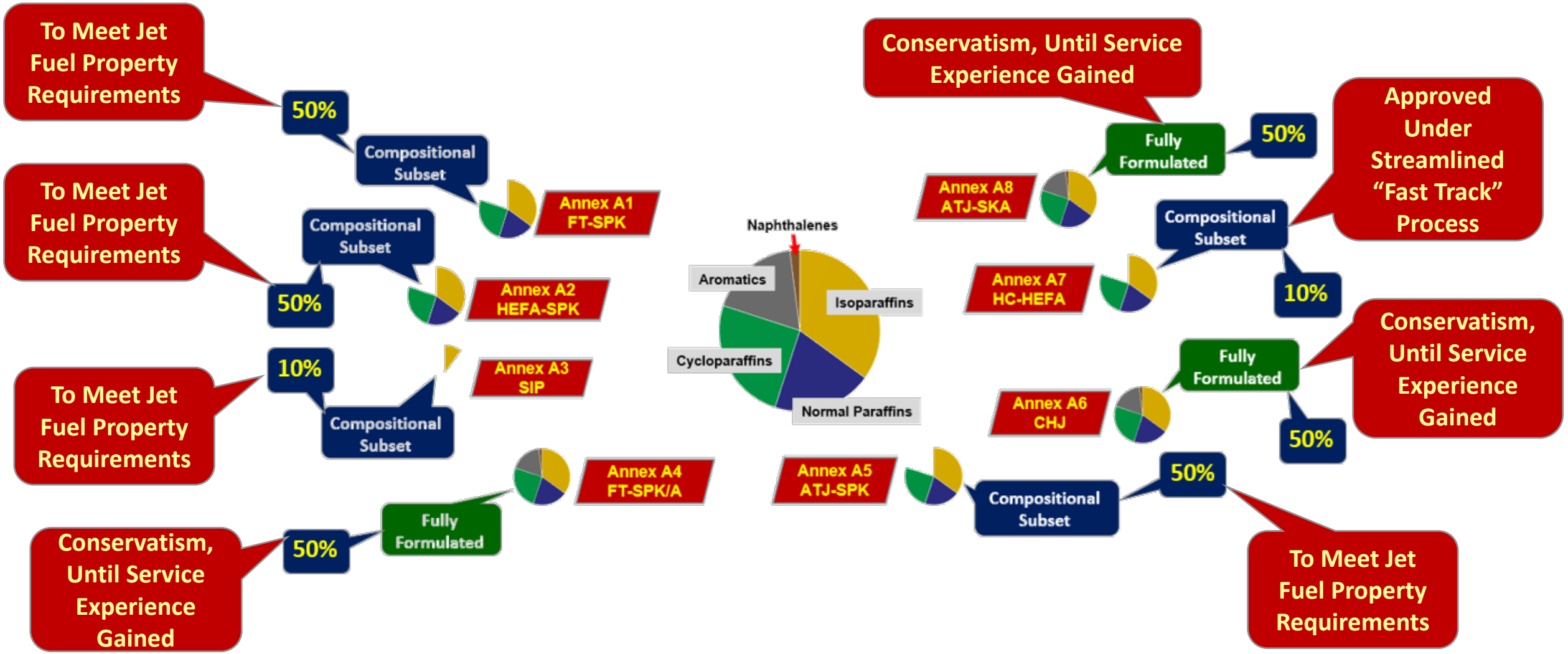
SBC Compositions Compared to Jet A Fuel



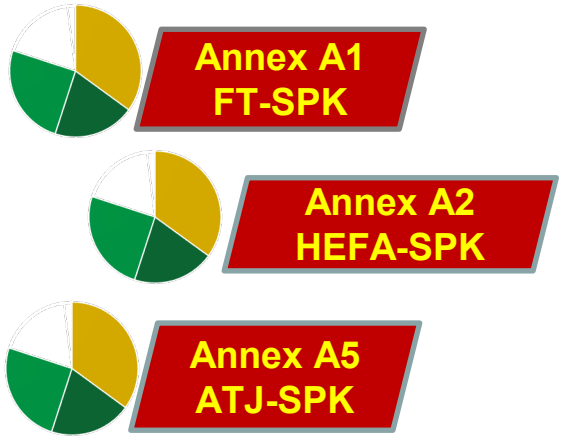
Maximum Allowable Blend % with Conventional Jet Fuel



What Determines the Maximum Allowable Blend %

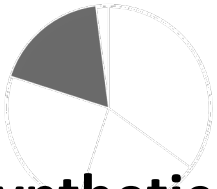


100% SAF: Blending of Paraffinic Streams with Renewable Aromatics



Synthetic Paraffinic Kerosene

+



Synthetic Aromatic Kerosene (SAK)

SAK Developed by Virent Currently Under Evaluation at ASTM

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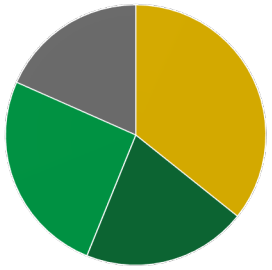
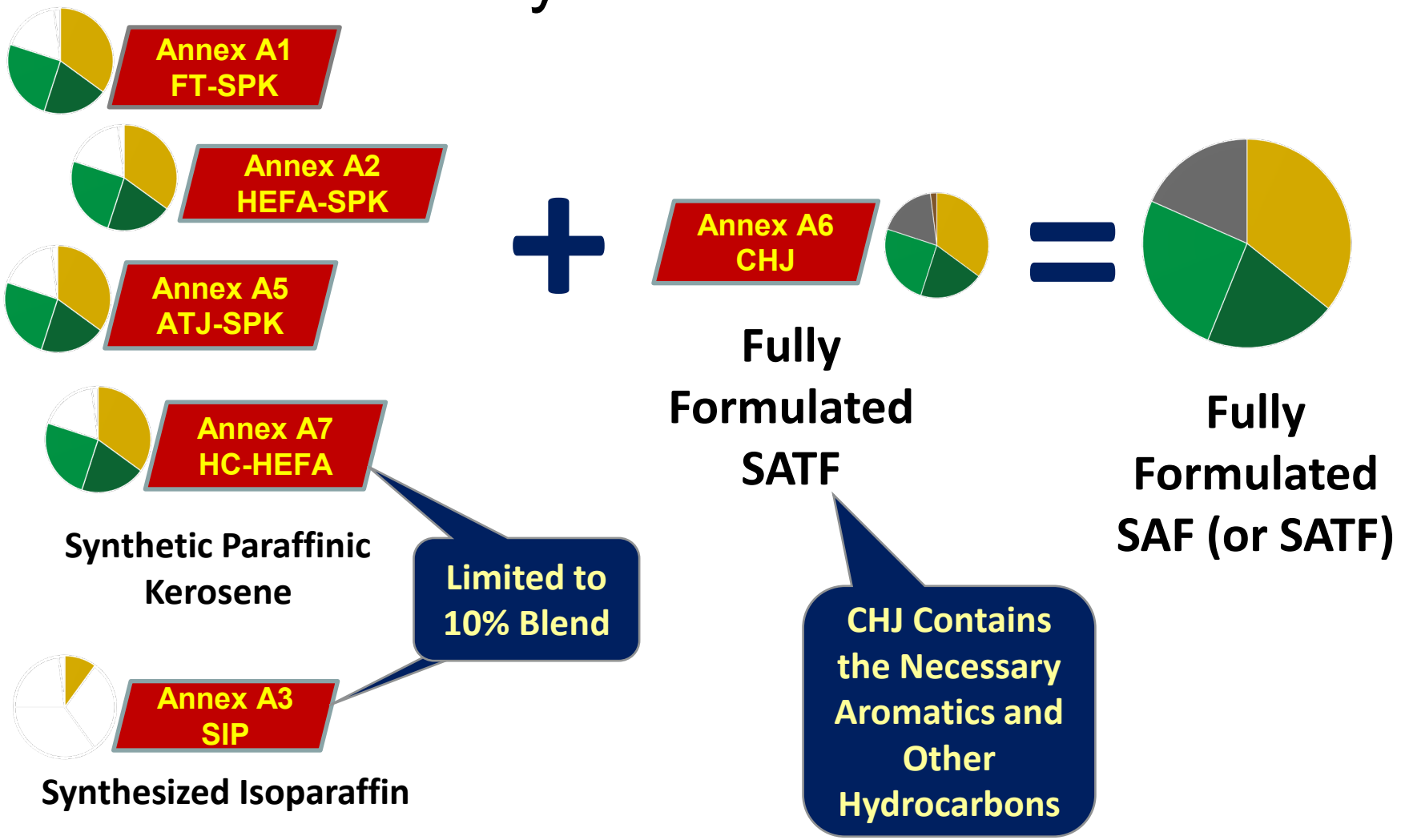


Fully Formulated SAF (or SATF)

<u>Necessary Standards Actions</u>:

- **Issuance of D7566 Annex for Virent SAK**
- **Revision of D7566 to Accommodate 100% SATF via Blending of SPK with SAK**

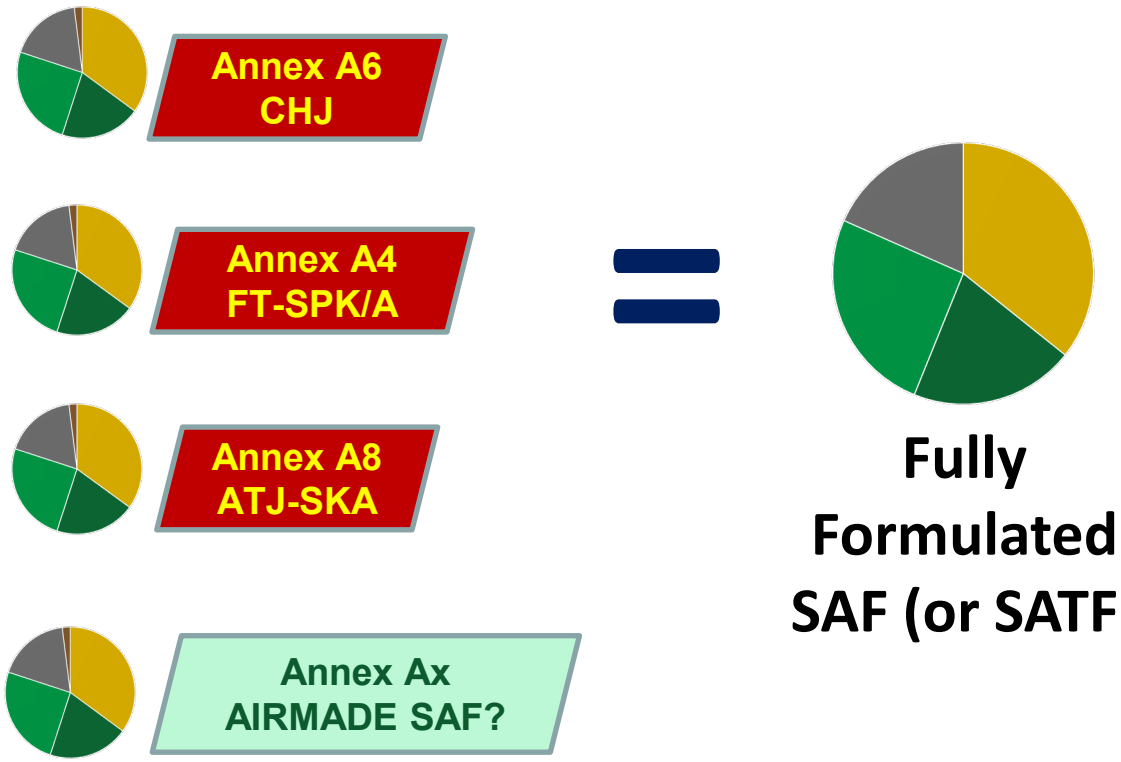
100% SAF: Blending of Paraffinic Streams with Fully Formulated SAF



Necessary Standards Actions:

- **Revision of D7566 to Accommodate 100% SATF via Blending of SPK with CHJ**

100% SAF: Use of Unblended Fully Formulated SATF



Necessary Standards Actions:

- **Revision of D7566 to Accommodate Use of Unblended CHJ or FT-SPK/A**