Jet fuels and the road to future Jet fuels

IATA Operations
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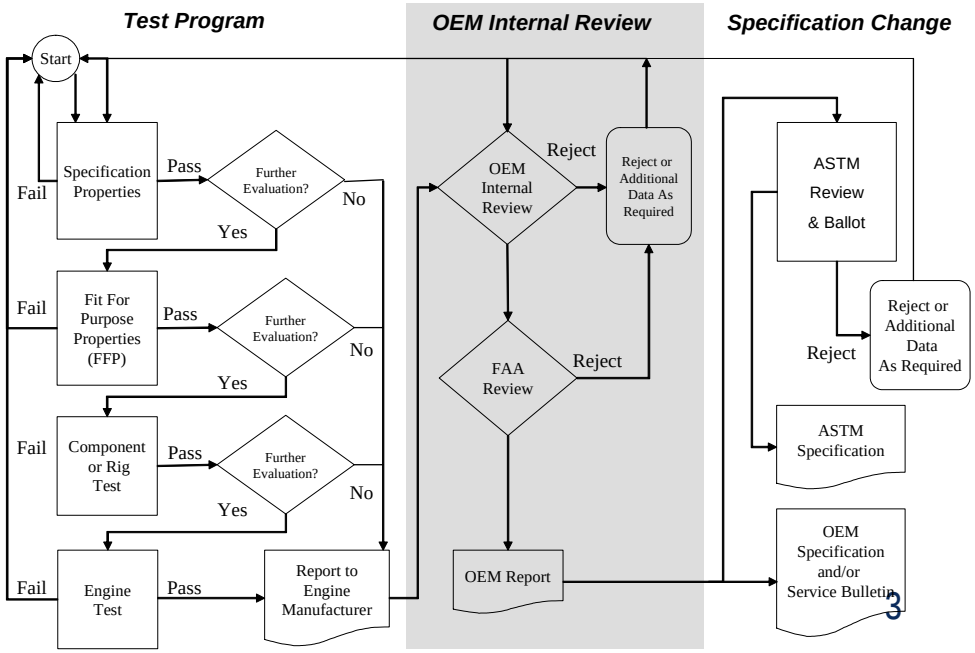
Jet fuels

- Aircraft need energy (MJ/kg)
  - More energy per unit mass means: less fuel to be carried

- But fuel needs to have certain properties:
  - Freezing Point (-40C Jet A / -47C Jet A-1)
  - Flash Point (+38C)
  - Thermal Stability (Improves efficiency)
  - Sulphur (lubricate fuel pump)
  - Viscosity (cold flow properties)
  - etc.

Certification process

- Harmonized process for main specifications Jet A & A-1)
- Approval process takes long testing and $$$



Planes rely on jet fuel from oil

Or alternatives, like:

Fischer Tropsch (FT), synthetic fuel:

- Coal to Liquid
- Gas to Liquid
- Biomass to Liquid

JNB/SASOL (early 90's):

-since 1999 50% approved
-End 2009 100% approved

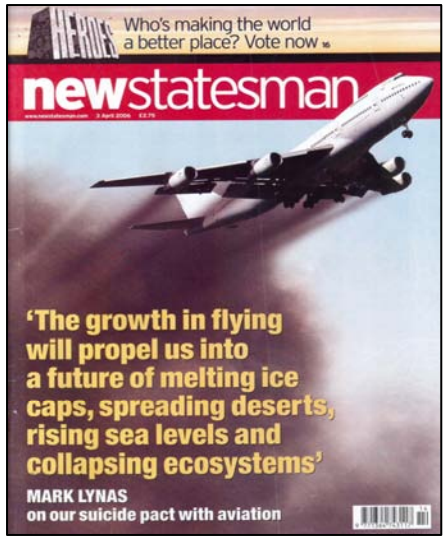
Mr. Fischer & Mr. Tropsch 1920

Four steps:

1. gasify into synthesis gas (CO, H_2, CO_2, H_2O, plus pollutants)
2. clean syngas to CO and H_2 (high energy !!)
3. syngas into FT reactor → wax
4. wax upgrade into end products by hydrotreating

2007: 70.5 billion US Gallons
Similar to 100,000 Olympic swimming pools!

Aviation growth….
Need more volume...
From all possible sources



Emissions trading

+

Our Vision

+ ↗ Is for carbon neutral growth

↗ Leading to a zero carbon emissions future

IATA alternative fuels position

- IATA recognizes that aircraft are long-lived assets and will be using kerosene and/or kerosene type fuels, from other sources then crude, for many years to come.
- IATA supports research, development & deployment of sustainable biofuels which
  - Offer net carbon reductions over their life cycle
  - Do not compete with fresh water requirements and food production (1st generation bio fuels)
  - And do not cause deforestation or other environmental impacts such as biodiversity loss
- While international fuel specifications for biofuels do not yet exist, IATA is working with industry partners towards agreed production standards and test requirements.

Biojet fuels from Sustainable biomass

- Main focus on drop-in fuels, 2nd & 3rd generation biojet fuels / sustainable biojet fuels
- 2nd generation biomass (H-C made from not-widely used sources)
  - Forest residues (e.g. sawdust)
  - Industry residues (e.g. black liquor paper industry)
  - Municipal waste
  - Agricultural residues (e.g. harvest remainings)
  - Sustainable Grown Biomass (e.g. jatropha)
- 3rd generation biomass (H-C made from additionally grown biomass)
  - Algae, switch grass, jatropha, babassu and halophytes

Algae: simple, photosynthetic plants, that can be grown with polluted or salt water and can produce up to 250 times more oil than 1st generation soybeans!!

Jatropha: reclaims wastelands, grows in poor soils

Halophytes**:** grows on salt grounds, where nothing else grows well

Switchgrass: a hardy grass, needs very little water and produces a high output of biomass

Babassu: a native growing Brazillian tree with high oil yield nuts

Alternative fuels in practice

- **Airbus** flew a A380 in early 2008 with one engine powered by FT Gas to Liquid fuel
- **Virgin Atlantic** flew a Boeing 747-400 on 23 February 2008 with one engine operating on a 20% biofuel mix of babassu oil and coconut oil
- **Air New Zealand** flew a Boeing 747-400 with one engine on 50% jatropha derived biofuel and 50% kerosene on 30 December 2008
- **Continental Airlines** flew a Boeing 737-800 with one engine using 50% jet fuel and 50% algae and jatropha mix on 7 January 2009
- **Japan Airlines** trialed a 50% biofuel (camelina, jatropha and algae) and 50% kerosene mix on a Boeing 747-300 with P&W engines on 30 January 2009

Green fuels…not a simple task, but a MUST!!!

IATA ENVIRONMENTAL CAMPAIGN

Paul Steele-Director Environmental System Management

Operations	Infrastructure	Technology	Economics
• Green Teams • Fuel Book • Implementa-tion survey • Regulatory	• Routes &TMA Improvements • ATM Efficiency study.	• ***Alternative Fuel*** • Aircraft/Fleet Upgrade. • Roadmap	• Voluntary Offset Programme • Costing for Carbon Neutral Growth • Mckinsey study.

Communication

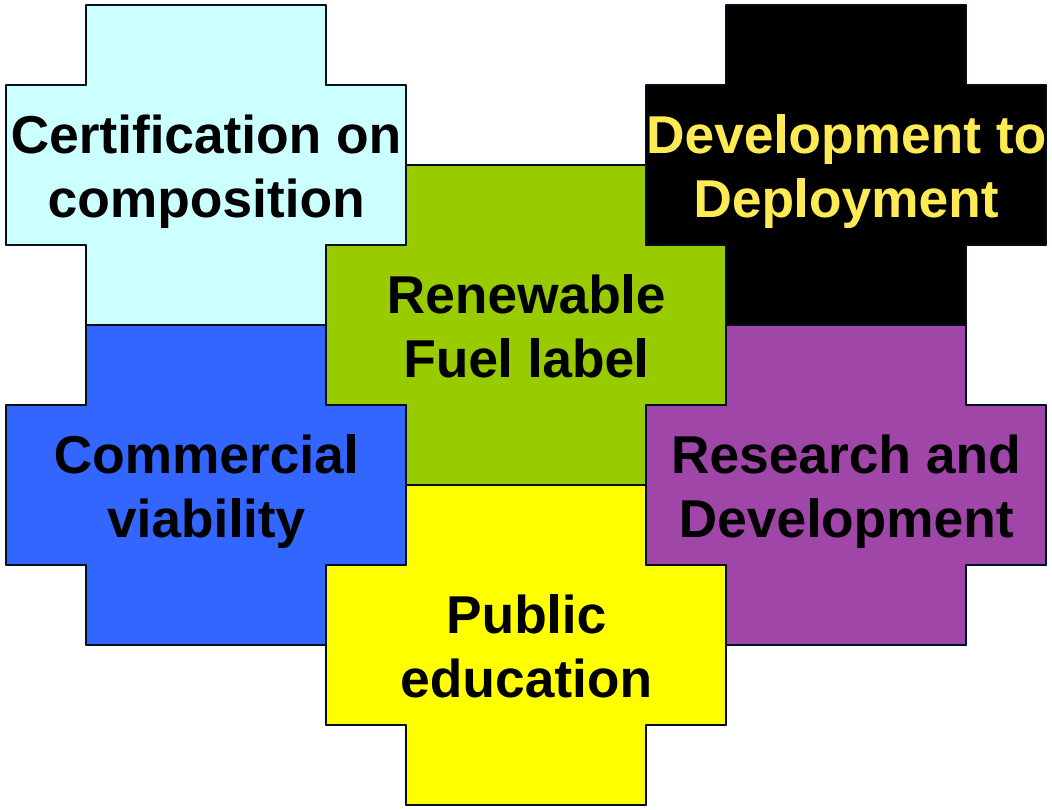
Work plan

- Proposed milestones accepted
- Evaluate milestones on yearly basis
- Evaluate actions each Fuel Forum

What do we want to achieve?

- Certification on fuel composition by 2012, optimistic 2010
- Sustainable renewable fuel label operational, January 2011
- Development to deployment, 2011 plant running
- Commercial viability 2014
- Research and development, 2010 overview of activities, than continuously updated
- Public educated, 2010
- 10% by 2017

6 step strategy / work plan



Actions

Departments:

- Aviation Environment
- Commercial Fuel Services
- Economic Department
- Government Relations
- Operations
- - -

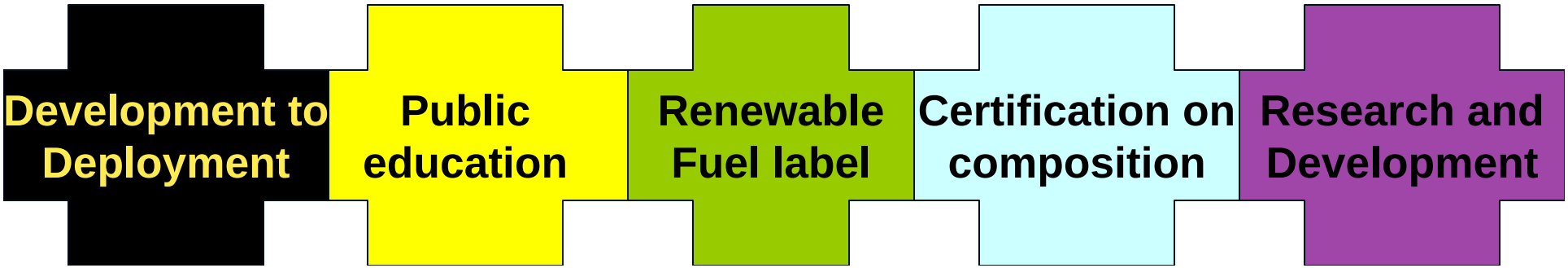
Key Areas – Alternative Fuel

- Technical & Operational
- Specification
- Testing
- Certification
- Production
- Procurement
- Distribution

- Political & Regulatory
- Public and policy maker acceptance
- Industry Acceptance
- Fiscal and legal framework
- Environmental certification

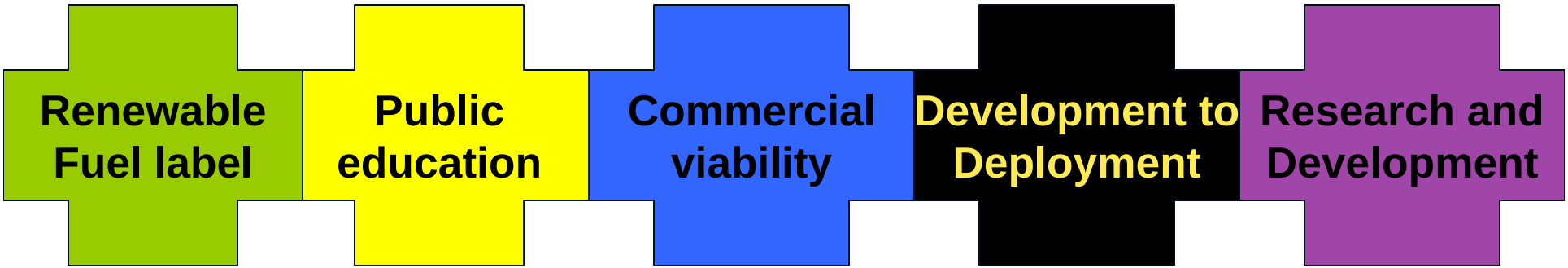
Milestones Operations 2009 (1)

- Ensure IATA is present at key 2009 events to promote ballot issue ASTM Dxxxx in 2009
- Information from OEM's about certification, testing and evaluation process and program
- Stimulate and support airline flight trials with bio fuel blends



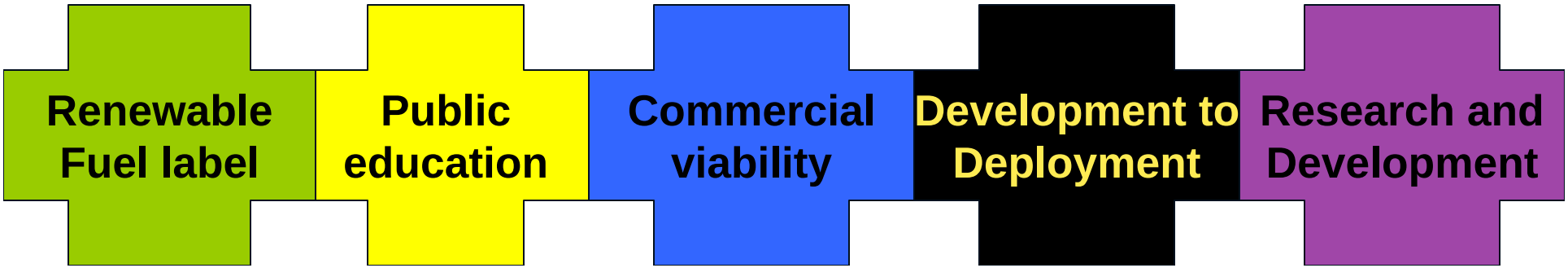
Milestones Operations 2009 (2)

- Follow-up studies required on:
  - Economic viability
  - Preferred production processes
- After those studies:
  - Start creation of database with potential suppliers
  - Workshop with Commercial Fuel Services on evaluation of way forward to establish the use of biojets by group of airlines



Milestones Operations 2009 (3)

- Intensify awareness:
  - Create IATA website events
  - Issue brochures/bulletins
  - Promote at key meetings of aviation industry
  - Issue 2009 Alternative Fuel report to BoG and OPC



Key Conclusions & Outlook

- ↗ Solid organisational fundament established
- ↗ Need industry involvement & participation
- ↗ Communication- & awareness plan