IUBH
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An Efficiency Analyses of Airlines' Investments in Sustainable Alternative Jet Fuel

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MA International Aviation Management

IASA's Message to U.N. Climate Change Conference:
Greener Skies Ahead 2017

26th October 2017

Overview

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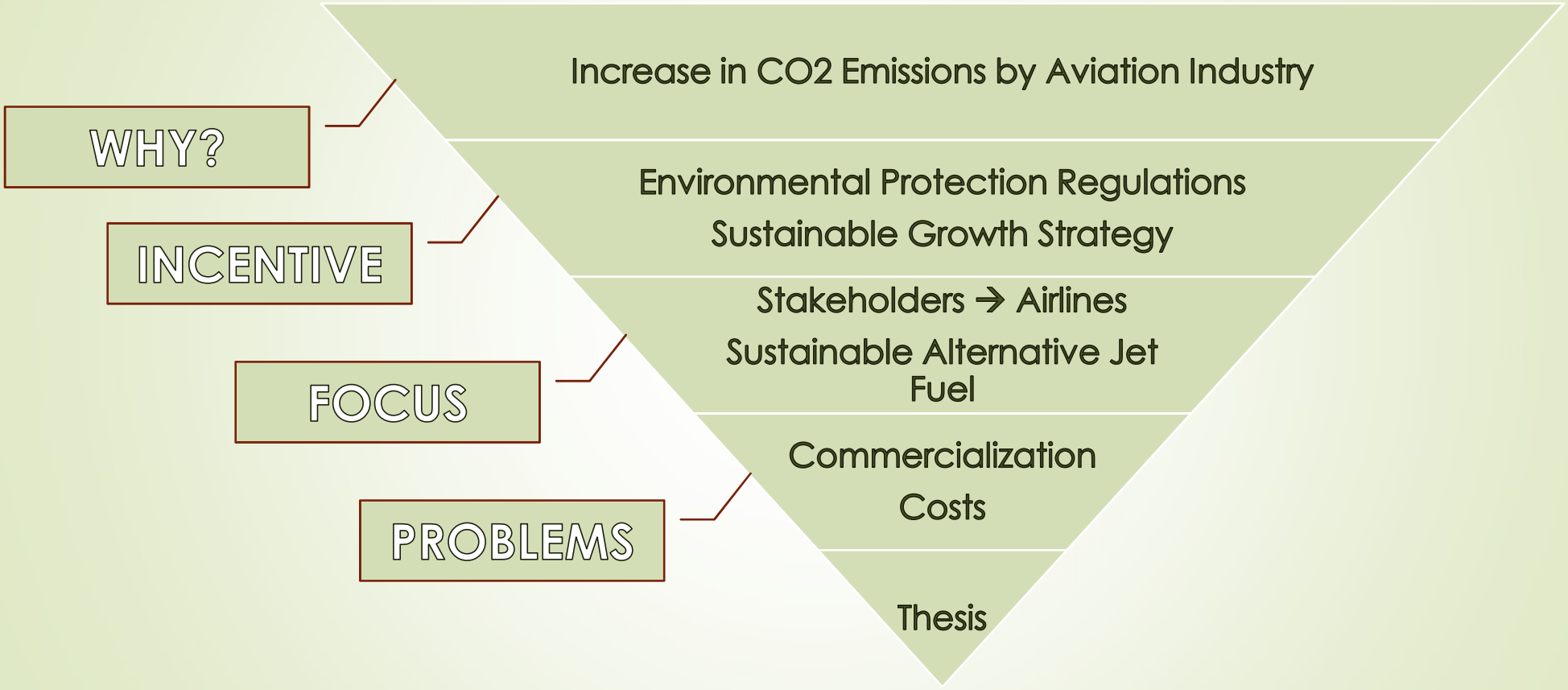
Why This Research Topic ?



Efficiency Analyses of Airlines' Investments in SAJF

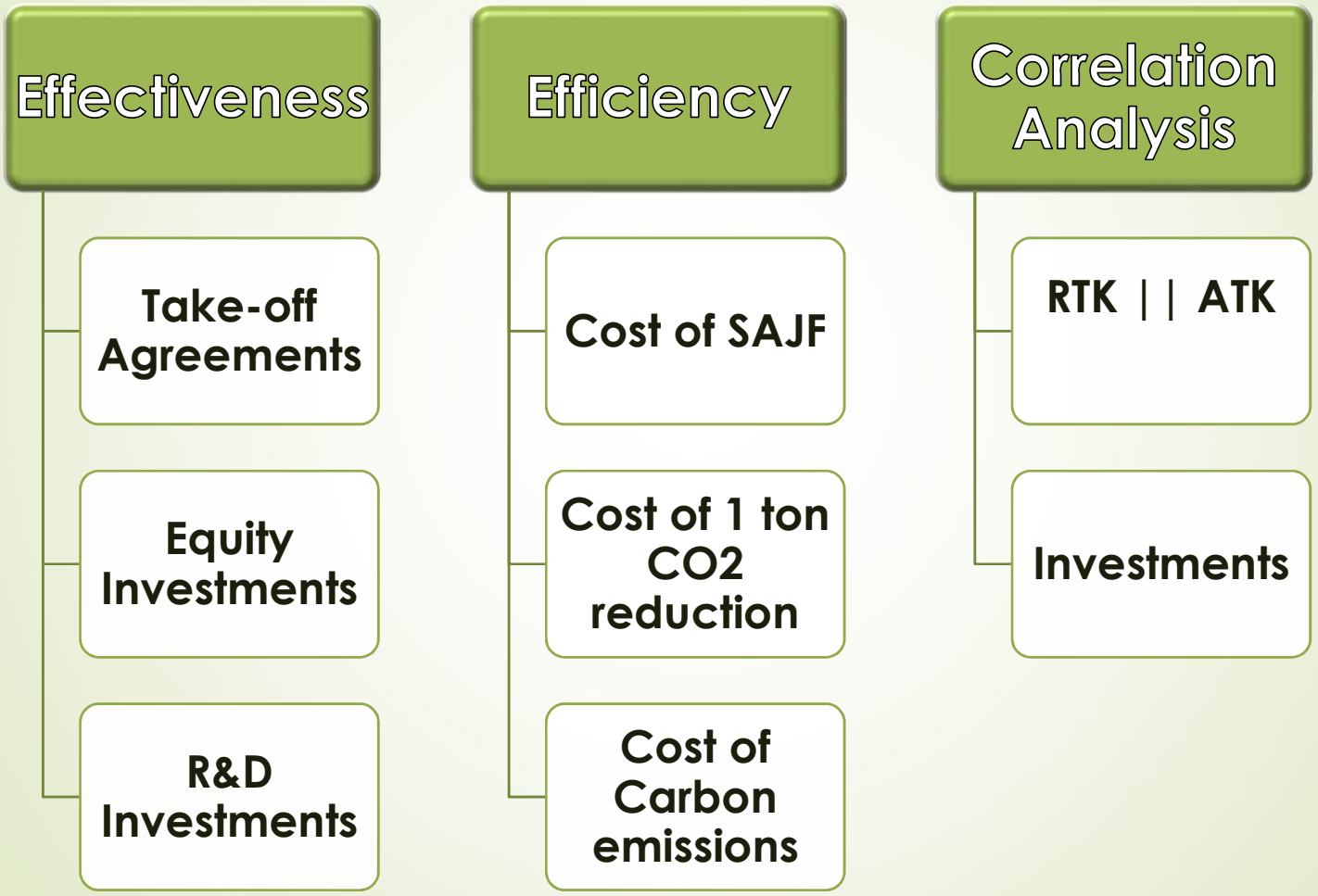
Where did I get my data from?

Literature Review

Expert Interviews

Market Survey

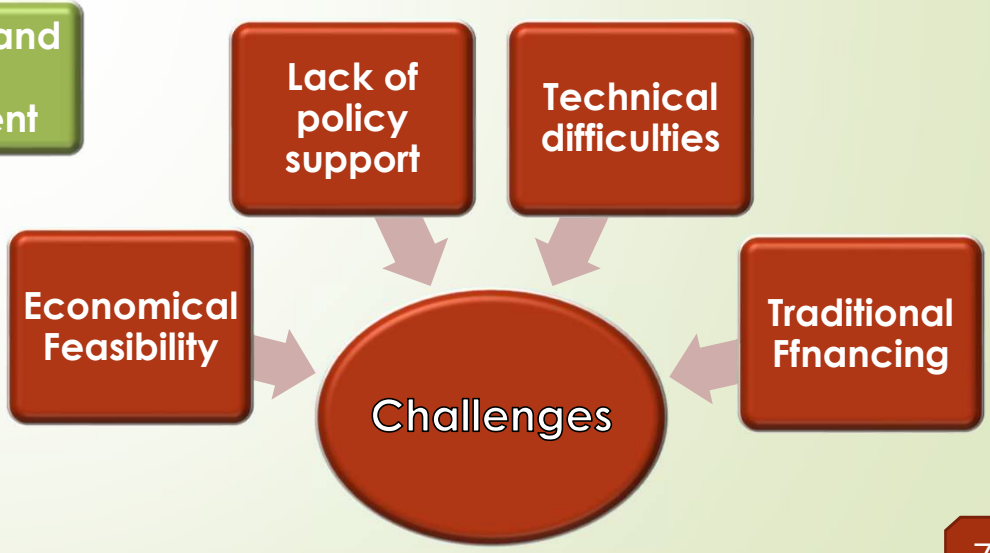
Defining Measures



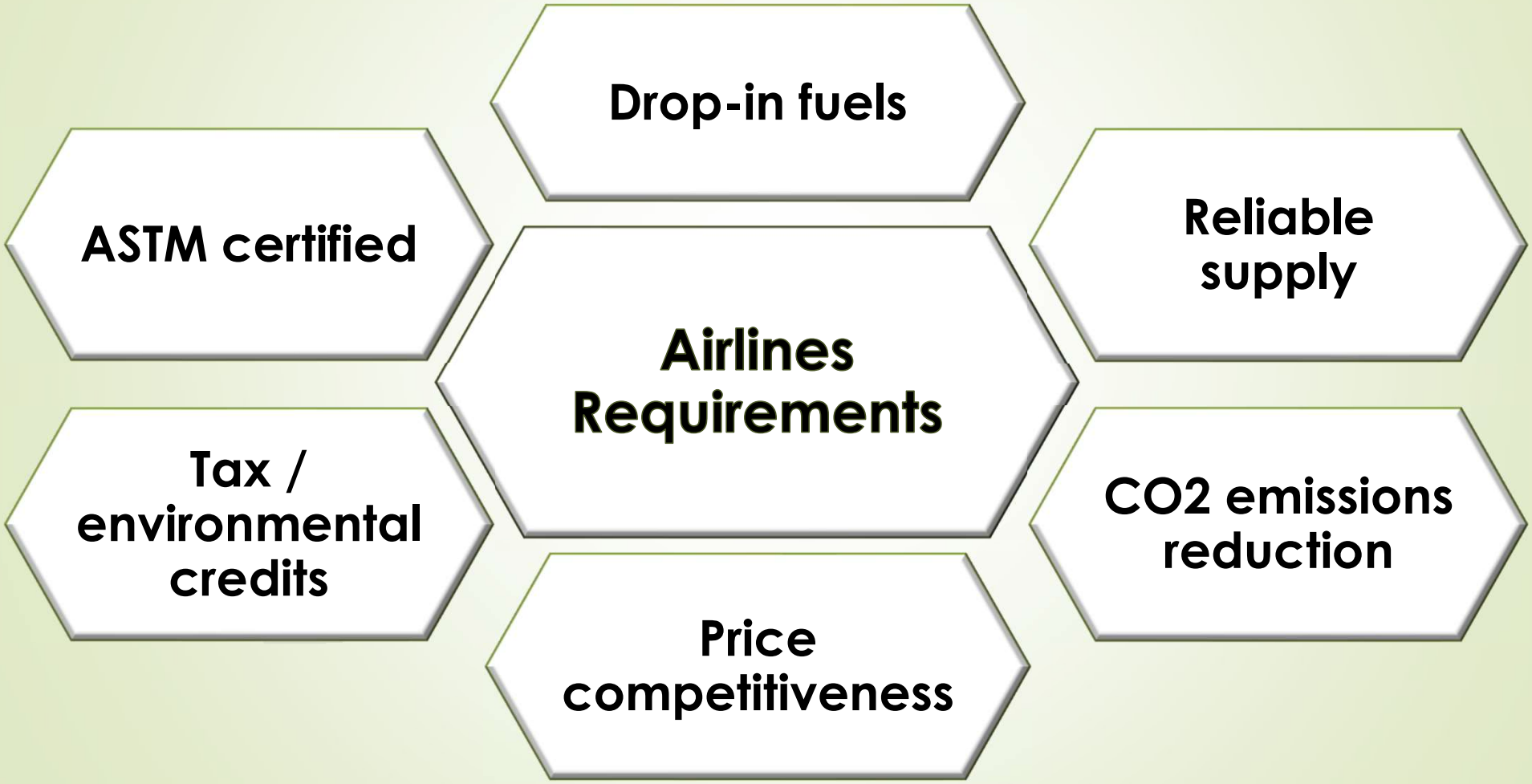
Approved ATSM Conversion Pathways

Pathway	Description	Qualification Date
FT-SPK	Fischer-Tropsch conversion of syngas to synthetic paraffinic kerosene	September 2009
HEFA-SPK	Hydroprocessed ester and fatty acids lipid feedstock (vegetable oils or waste oils and fats) to synthetic paraffinic kerosene	July 2011
HFS-SIP	Hydroprocessed fermented sugars to synthesized isoparaffins	June 2014
FT-SPK/A	*Fischer-Tropsch conversion of syngas to synthetic paraffinic Kerosene with Aromatics*	November 2015
ATJ-SPK	Thermochemical conversion of alcohols (isobutanol) to paraffinic kerosene	April 2016

Incentives & Challenges to Investments



What are the requirements of the airlines?



SAJF Market Fundamentals - Supply

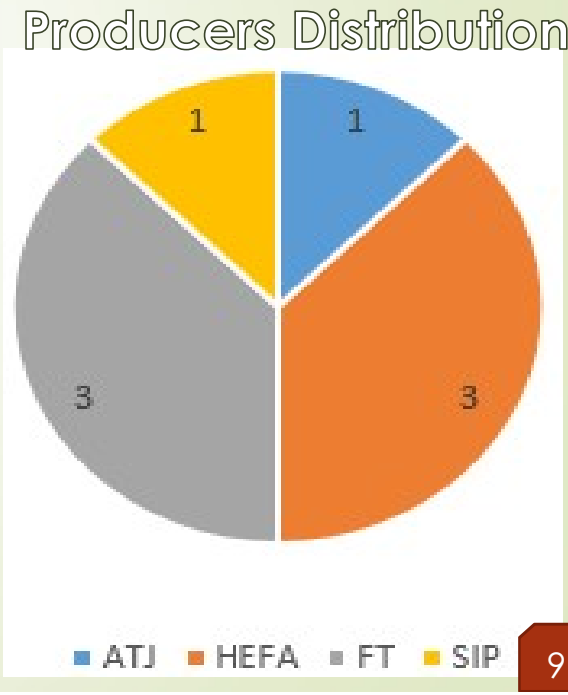
Suppliers

- Established for profit business
- Signed a take-off agreement
- Member of stakeholder group

Capacity: 354 MM. L

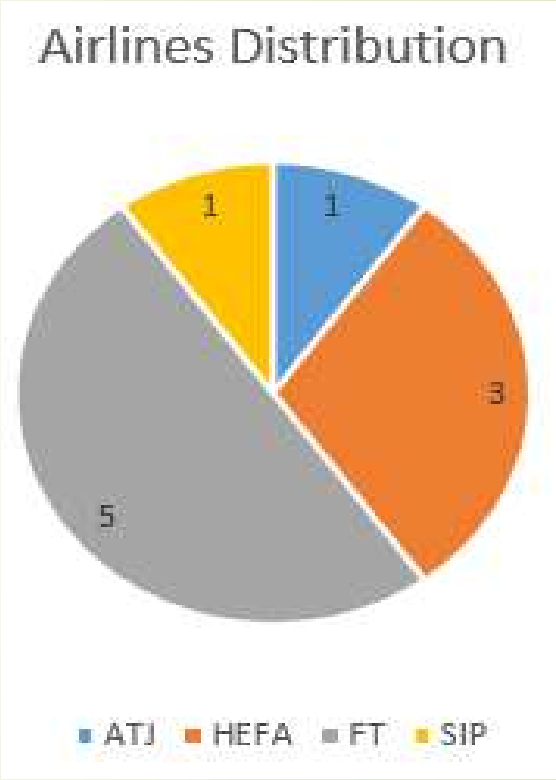
Grants: 150 MM. USD

Supplier	Pathway	Feedstock
Fulcrum BioEnergy Inc.	*FT*	*Municipality Solid Waste (MSW)*
AltAir LLC.	*HEFA*	*Non-edible oil, agricultural waste*
Red Rock LLC.	*FT*	*Forrest wood biomass*
Solena Fuels Co.	*FT*	*MSW*
Amyris Fuels LLC.	*SIP*	*Sugar Cane, fairness based*
Neste Oyj.	*HEFA*	*Camelina oil*
Gevo Inc.	*AJT*	*Cellulosic Isobutanol/Hydrocarbons*



SAJF Market Fundamentals - Demand

Producers	Airlines	CO2 reduction	Maximum blend	Blended Reduction	MFSP
Neste, AltAir, SG Preston	*Lufthansa, KLM, JetBlue, SIA*	*47%*	*50/50*	*25%*	*$1.16*
Red Rock	*Southwest, Fedex*	*50%*	*50/50*	*25%*	*$1.64*
Fulcrum, Solena	*United Airlines, Cathay Pacific, IAG*	*80%*	*50/50*	*40%*	*$0.98*
Gevo	*Lufthansa*	*50%*	*30/70*	*15%*	*$1.35*
Amyris	*Cathay Pacific*	*90%*	*10/90*	*9%*	*$1.05-$1.89*



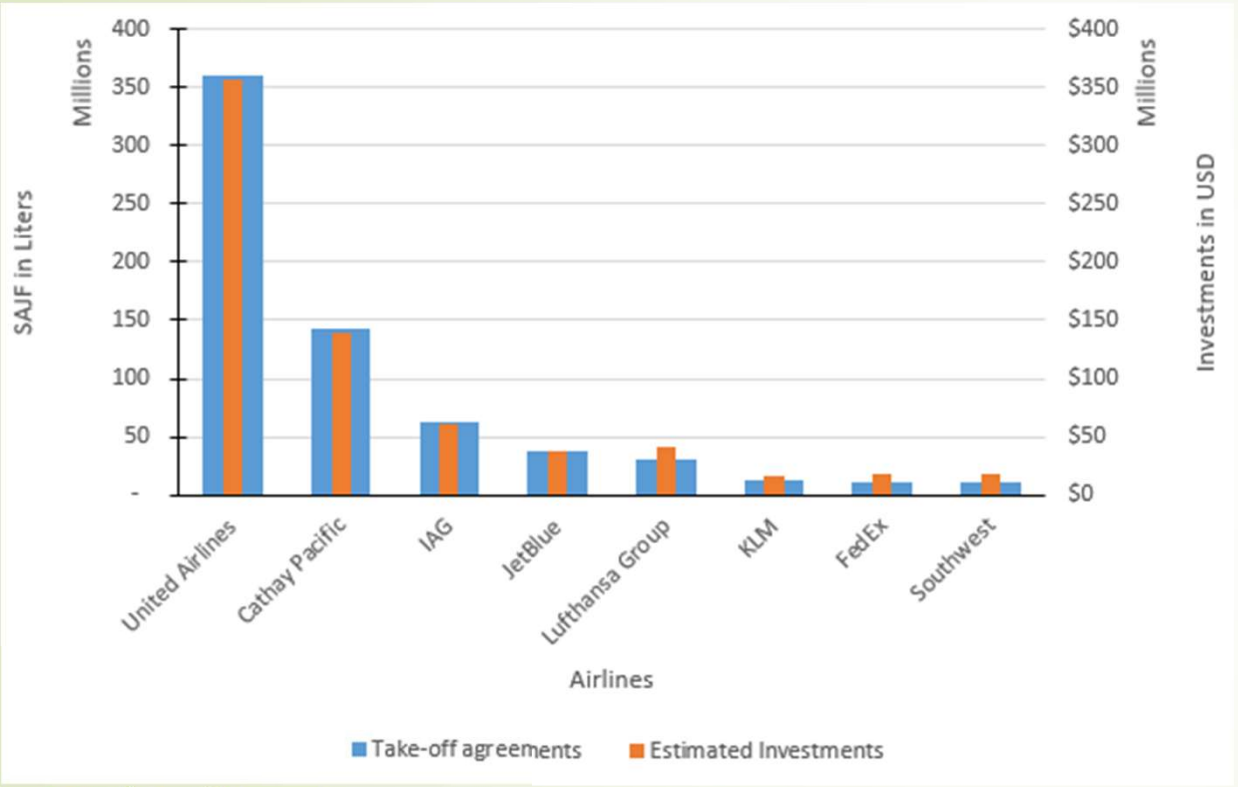
Airlines

- **R&D or Equity investments**
- **Signed a take-off agreement**
- **Member of stakeholder group**

9 Airlines

$0.98-$1.64

Investments – Takeoff Agreements & Equity

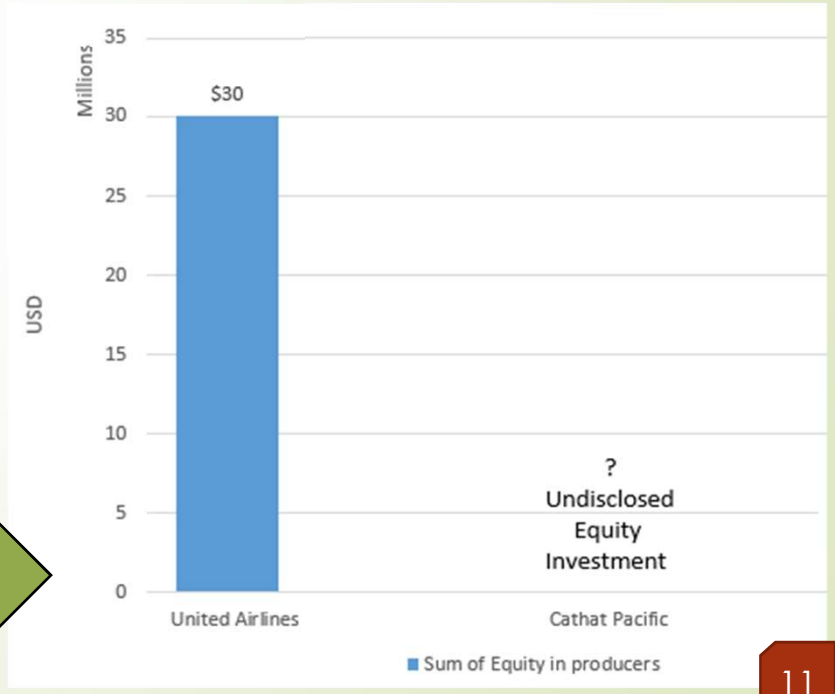


jetBlue AIRWAYS

1 Binding agreement

United Airlines + CATHAY PACIFIC

+$30 MM Equity

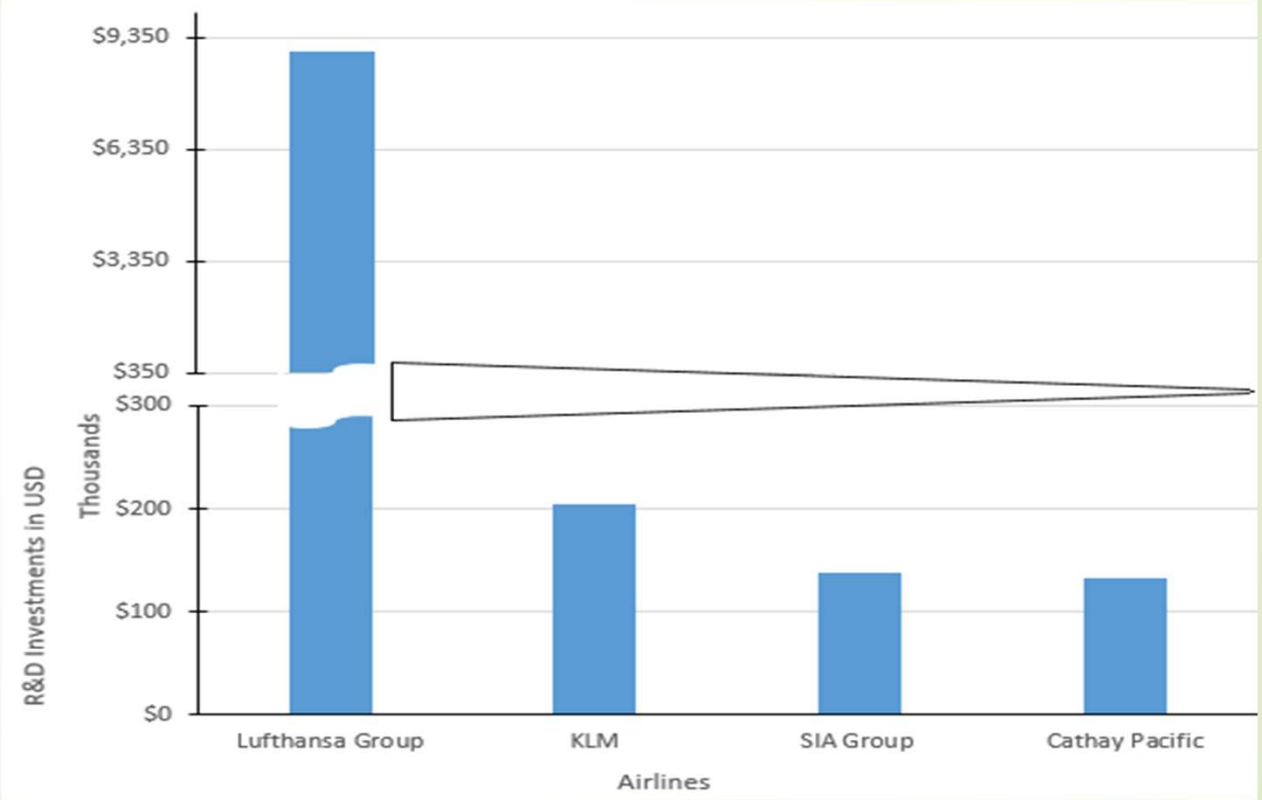


Investments – R&D

Effective

Most needed

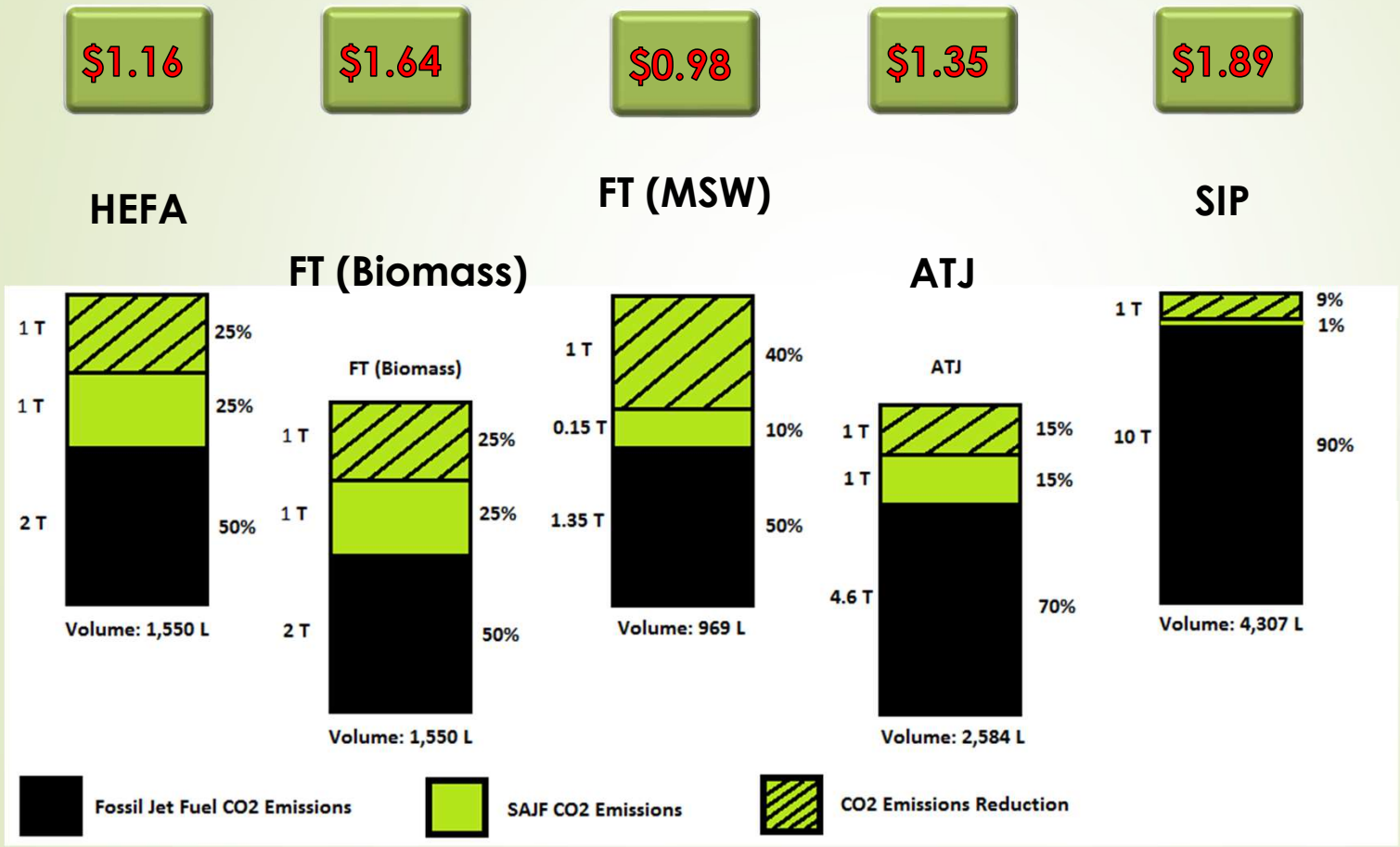
-$10 MM



Direct

Long-term test flights

Efficiency & Environmental Benefit

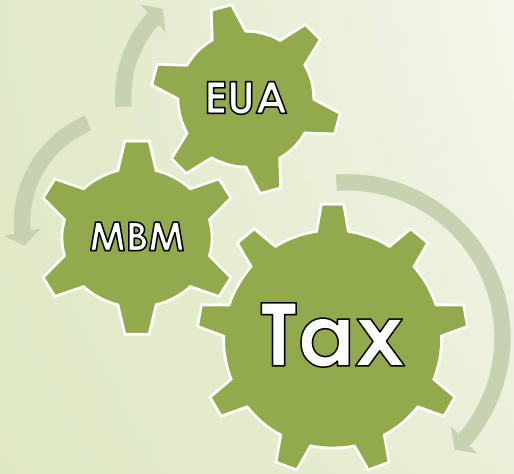


Jet Fuel Price
$0.37 L ($57 bbl)

Efficiency -Cost of CO2 Reduction

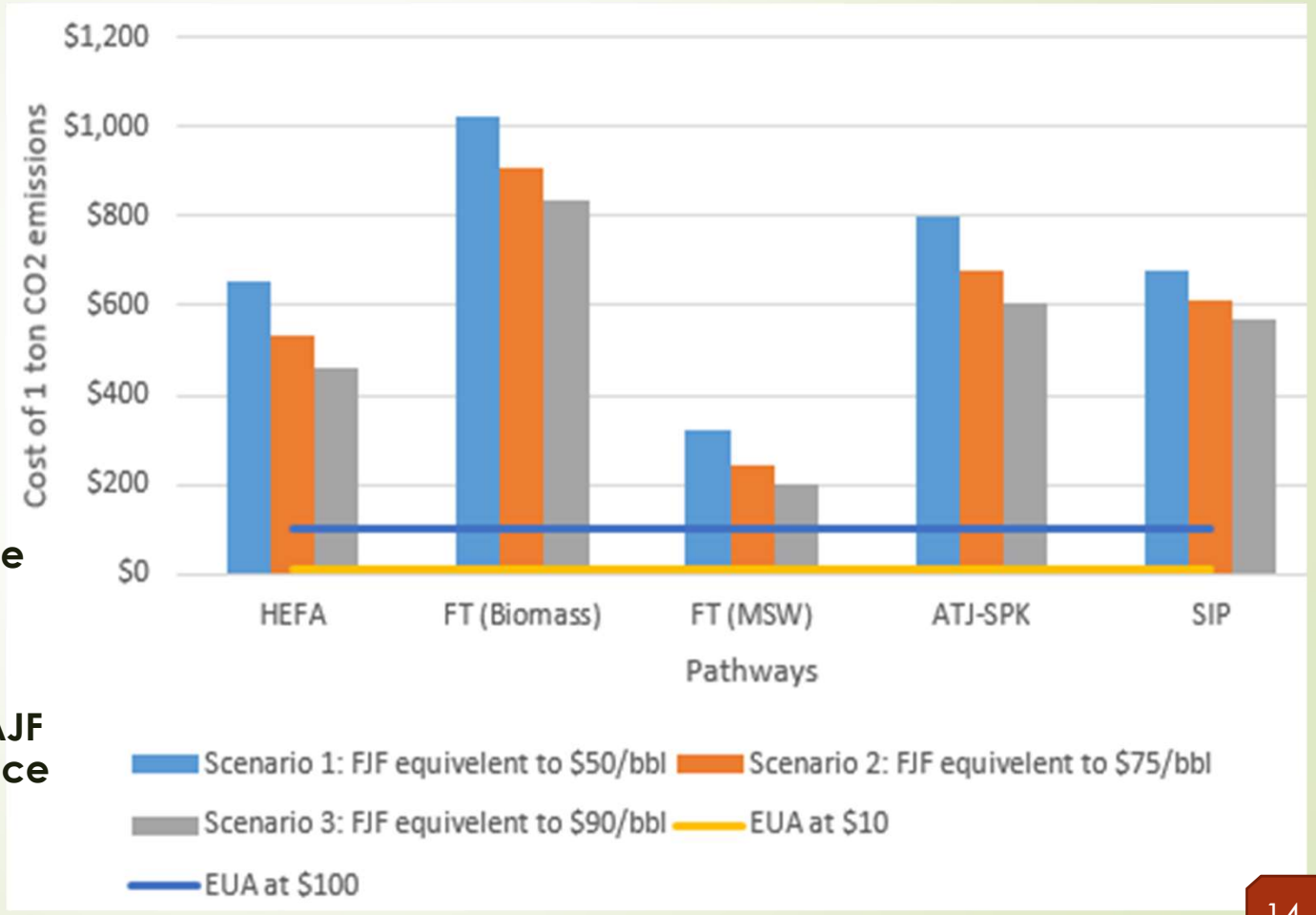
1st FT (MSW)

2nd HEFA

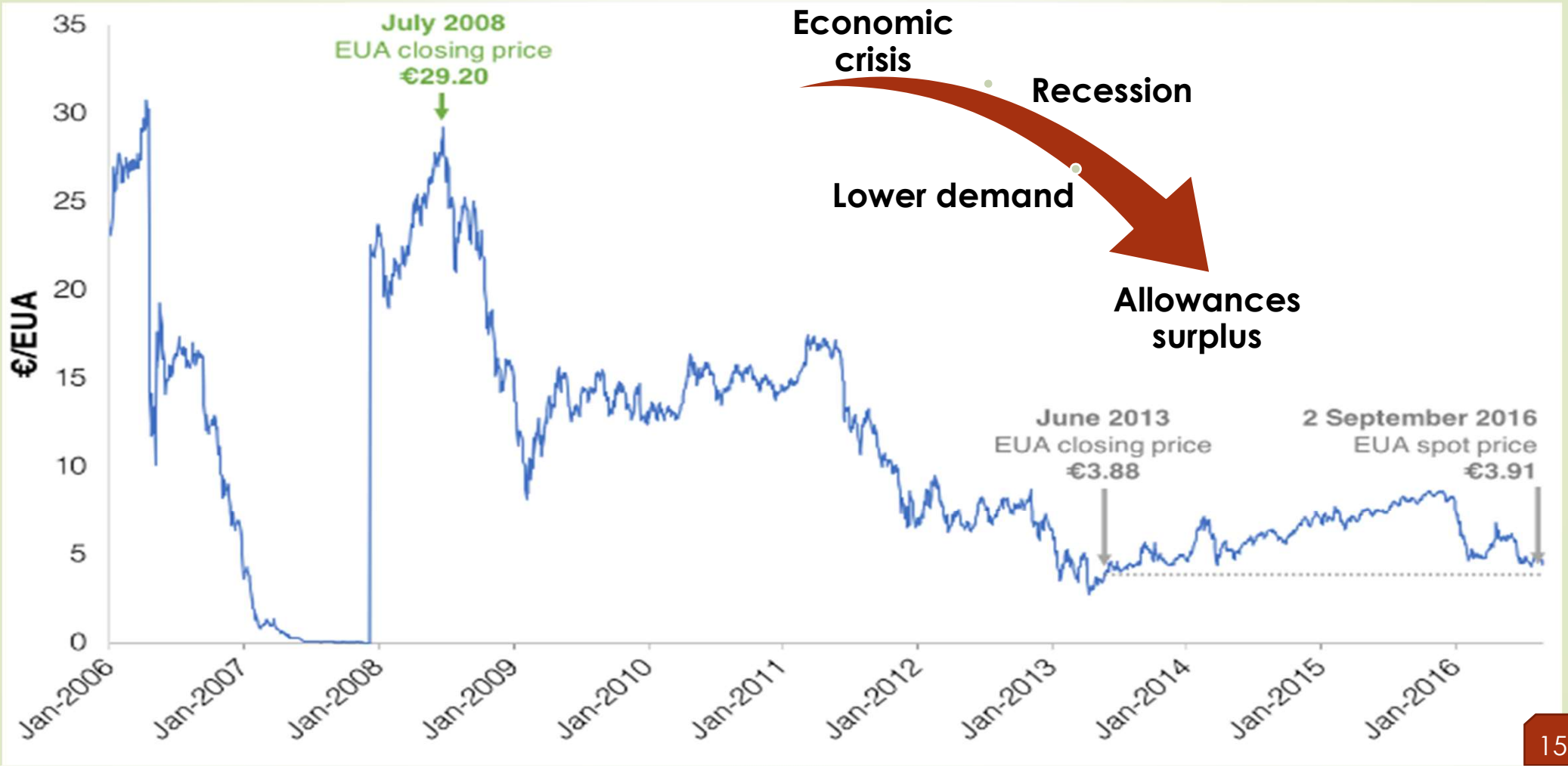


Oil Price

SAJF Price



What can we learn from EU ETS / EUA ?



A Return of (Alt) Fuel Surcharges-What's the Impact?

- Higher ticket prices
- No real environmental benefit
- Low interest of voluntary carbon offset

(Ulrich et.el. 2009)

Short-run

Inelastic Demand

Price Elasticity of Demand= -2.4

Long-run

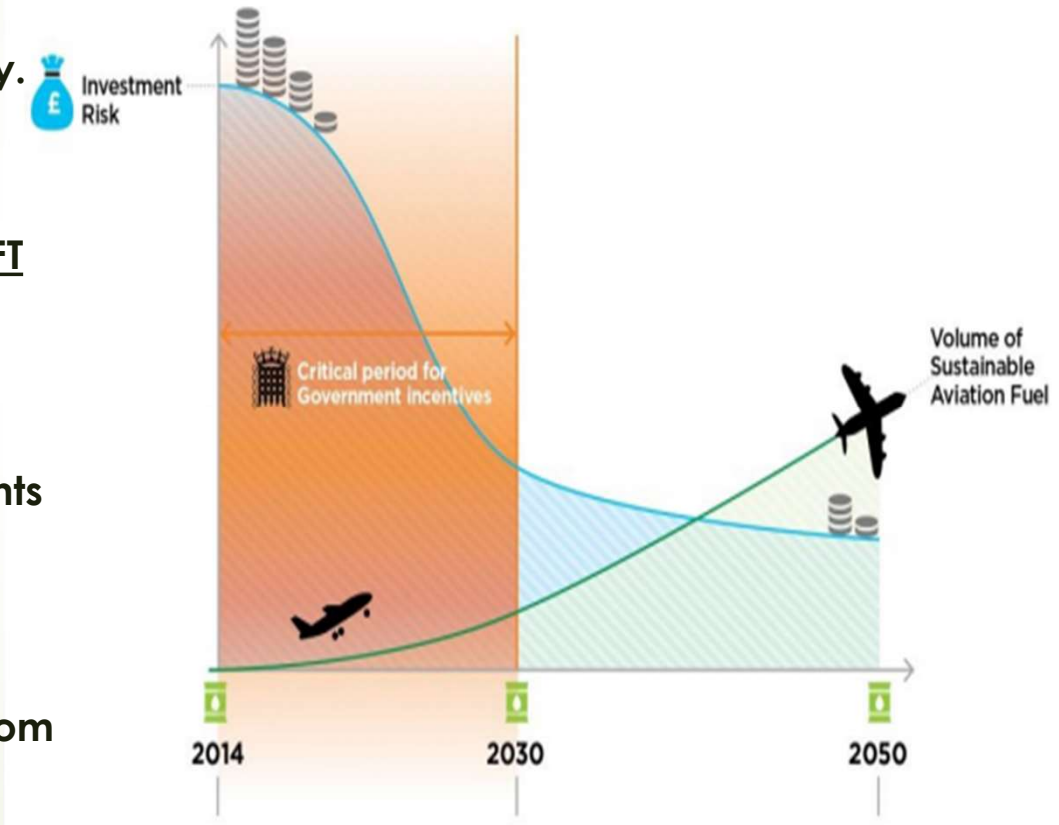
Elastic Demand

Price Elasticity of Demand= -0.1

(Mclellan et.el, 1997)

Conclusion

- **Discrepancies between SAJF demand & supply.**
- **Need for policy support.**
- **Short-term (2017-2025), investing in HEFA and FT pathways in R&D, or equity segments are most efficient.**
- **Intermediately (2025-2035), take-off agreements with SAJF producer utilizing proved & competitive pathways.**
- **Long-term (2035 onwards), Direct purchases from energy suppliers.**



(Sustainable Aviation, 2014, p. 45)

Recommendations for Future Studies

- Finding optimal O&D for short and medium term development phases
- Further analysis on efficiency of future pathways to be approved.
- Further analysis on effectiveness of take-off agreements with producers after production starts, or binding agreements are confirmed.
- Finding actual selling pricing of SAJF as per delivered fuels status.
- Re-visit efficiency of SAJF when global MBM is effective or EU ETS is reformed and incorporate new carbon prices.


Thank you for your attention!
Any Questions ?