



ACT>>>
GLOBAL

ICAO: UNITING AVIATION ON CLIMATE CHANGE

ICAO Colloquium on Aviation and Climate Change

Using Granular Resource Economics to Manage Aviation Emissions

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Chief Executive,

EQ²

EQ²

Managing the future today

Issue

Aviation industry needs...

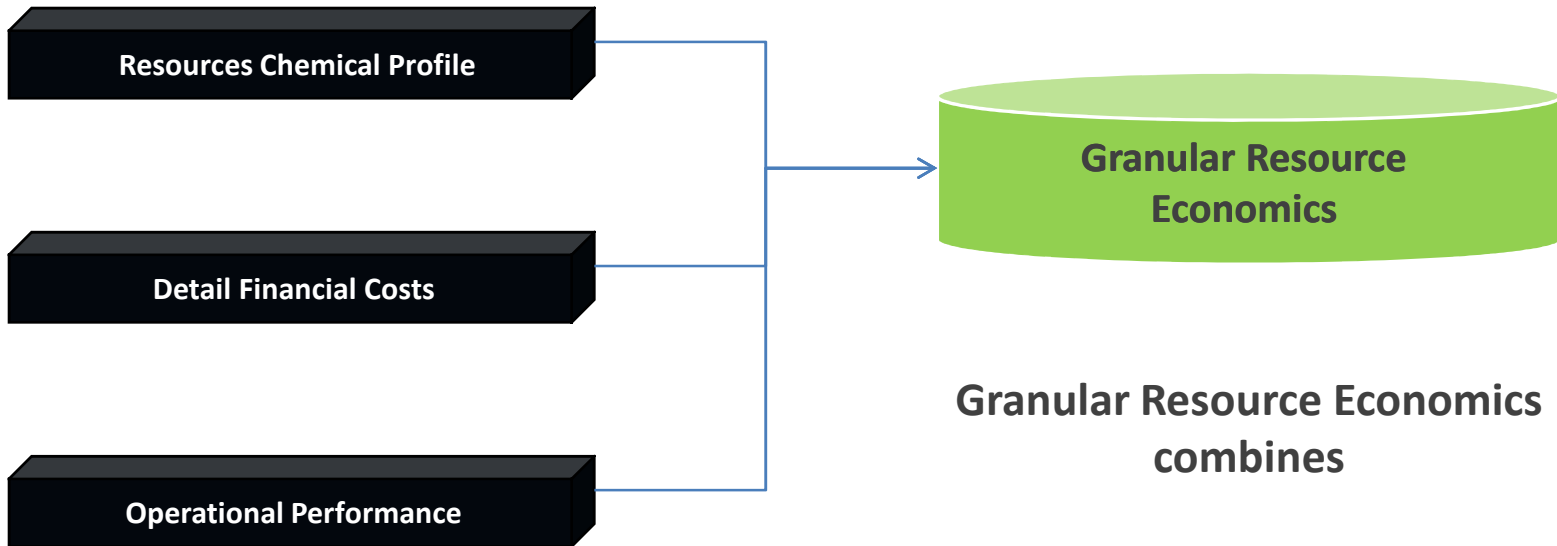
Accurate ... *Measurement*

Actual ... *Measurement*

Absolute ... *Measurement*

Solution

A New Management Method that Optimizes Business and Ecological Performance Requirements



Granular Resource Economics combines

Material Flow Analysis
The Laws of Thermodynamics
Sustainability Economics

Outcome

A Sustainability Management System That Provides ...

Highly Accurate Measurement

Detailed Real World Accounting

Total Impact Balance Sheet

Transparent Reporting

Future Risk Analysis

Aviation Biofuel

EQ² has applied GRE to the issue of biofuel...

Fuel cost impacts and price/supply uncertainty risk reduction

Direct GHG reductions

Direct reduction in emission credit reqs


Supply chain emission impacts



Emission & Cost Accounting

Flight New York to London

Consumes 17,450 gallons Jet-A



Emissions	LTO	Cruise	Total
CO ₂	2,897	161,482	164,379
CH ₄	0.07	0	0.07
N ₂ O	0.10	5.13	5.23
CO	4.82	79.18	84.00
SO _x	0.90	51.26	52.16
NO _x	7.97	427.79	435.76
VOCs	0.58	34.89	35.47
PM10	0.04	10.46	10.50
Metals	<0.01	0.01	0.01

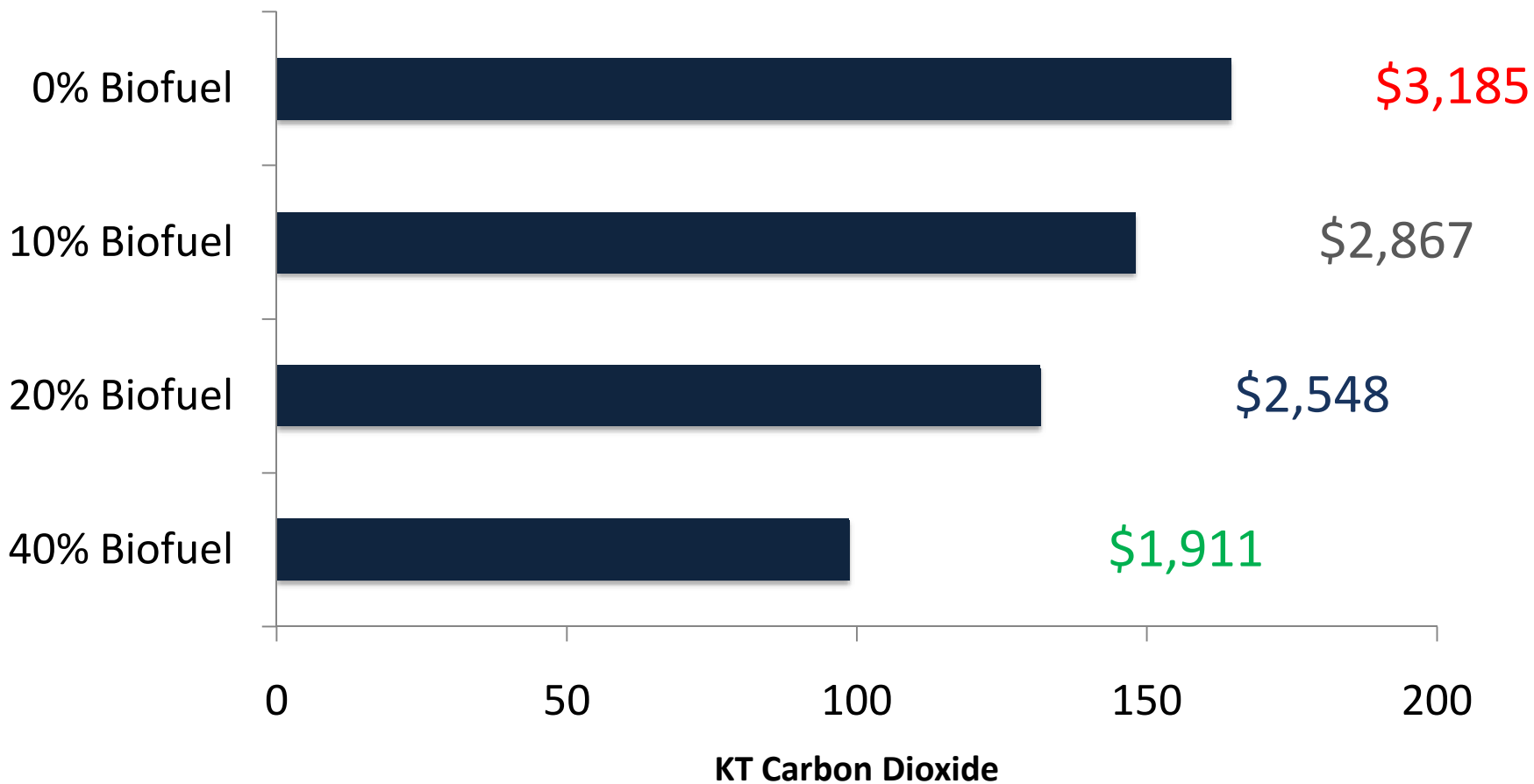


<i>Costs</i>
EU ETS \$3,185
<i>Fuel Cost</i>
<i>Future Costs</i>
?
?



*Efficiency
Reduction
Opportunities*

Biofuel CO₂ Emissions and Cost



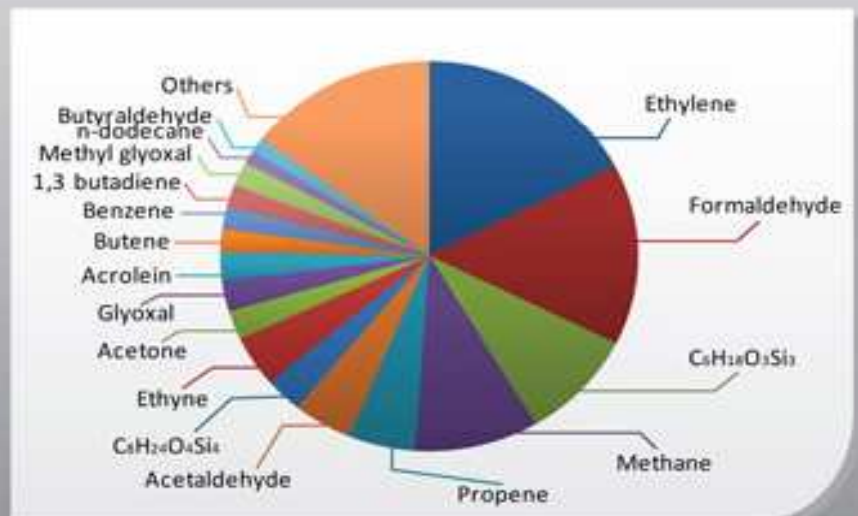
GRE Reporting

Fleet Total VOC Emissions from LTO emissions to local environment

All emissions in kg

Chemical	Emissions from LTO
Ethylene	1,953
Formaldehyde	1,684
$C_5H_{10}O_2Si_3$	1,022
Methane	1,076
Propene	584
Acetaldehyde	516
$C_5H_{24}O_4Si_4$	320
Ethyne	472
Acetone	289
Glyoxal	281
Acrolein	258
Butene	225
Benzene	213
1,3-butadiene	202
Methyl glyoxal	225
n-dodecane	123
Butyraldehyde	135
Others	1,661
Total VOCs from LTO	11,226

VOC Emissions from LTO by Chemical





GRE Reporting

Total Fleet Atmospheric Emissions

All emissions in kg

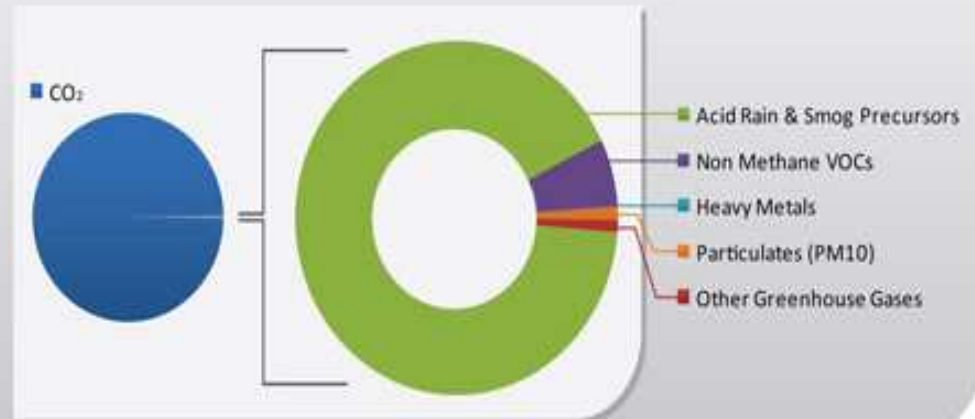
Aircraft Type	Boeing 737	Bombardier CRJ 200	Bombardier Dash 8	SAAB 340	Fleet total
Number of Flights	1,325	917	441	713	3,396
Fuel Use (US gallons)	1,295,246	929,198	200,520	140,788	2,565,753
Greenhouse gases					
CO ₂	73,207,295	52,518,277	11,333,410	7,957,315	145,016,297
CH ₄	375	534	234	132	1,274
N ₂ O	2,354	1,897	660	797	5,708
Acid Rain & Smog Precursors					
CO	48,644	70,124	20,789	11,908	151,466
NO _x	195,059	127,399	47,233	24,213	393,904
SO _x	23,166	16,835	3,598	2,526	46,126
Particulates					
PM10	4.181	2,906	625	444	8,157
VOCs					
VOCs (non methane)	15,634	10,596	7,711	6,310	40,251
Heavy Metals					
Chromium	0.2324	0.1667	0.0360	0.0253	0.4604
Arsenic	0.0012	0.0008	0.0002	0.0001	0.0023
Cadmium	0.2324	0.1667	0.0360	0.0253	0.4604
Copper	0.5229	0.3751	0.0810	0.0568	1.0358
Mercury	0.0023	0.0017	0.0004	0.0003	0.0046
Nickel	0.8134	0.5835	0.1259	0.0884	1.6113
Lead	1.2782	0.9170	0.1979	0.1389	2.5320
Selenium	3.3234	2.3842	0.5145	0.3612	6.5833
Zinc	0.2324	0.1667	0.0360	0.0253	0.4604

GRE Reporting

Emissions Summary

Chemical Group	Total Quantity (kg)
CO ₂	145,016,297
Other Greenhouse Gases	6,982
Acid Rain & Smog Precursors	591,495
Non Methane VOCs	40,251
Heavy Metals	13.15
Particulates (PM10)	8,157

Atmospheric Emissions by Chemical Type



RAA & Real-World Accounting

Industry first to take a group approach...

Measured quantity use and cost

- Fuel and energy
- Carbon dioxide emissions
- Water use
- Waste generation and treatment



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Thank You

EQ²

Managing the future today

London

Washington

www.eq2.us.com

Boston

Seattle