EFM

Recycling of Aircraft De- and Anti-icing Fluids
Ecology meets Economy

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Seville, September 24 -27, 2007

Topics

- Munich Airport, Facts and Statistic
- Remote De-icing Concept
- De-icing and Recycling organization
- Recycling and On-site ADF Production
- Fluid Management, Economy
- Fluid Management, Ecology
- Ecology meets Economy, summary

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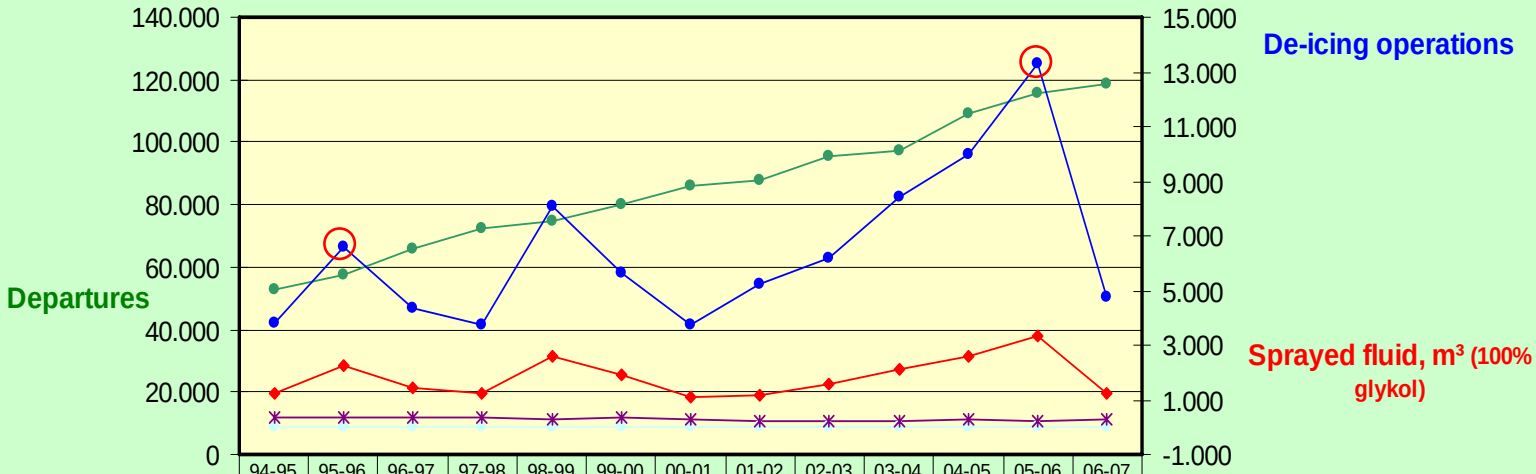
Munich Airport, Traffic year 2006
Passenger: 30,8 million
Movements: 411.335
Cargo : 231.736 t
Air mail : 13.667 t

Munich Airport
Winterseasons (October - April)



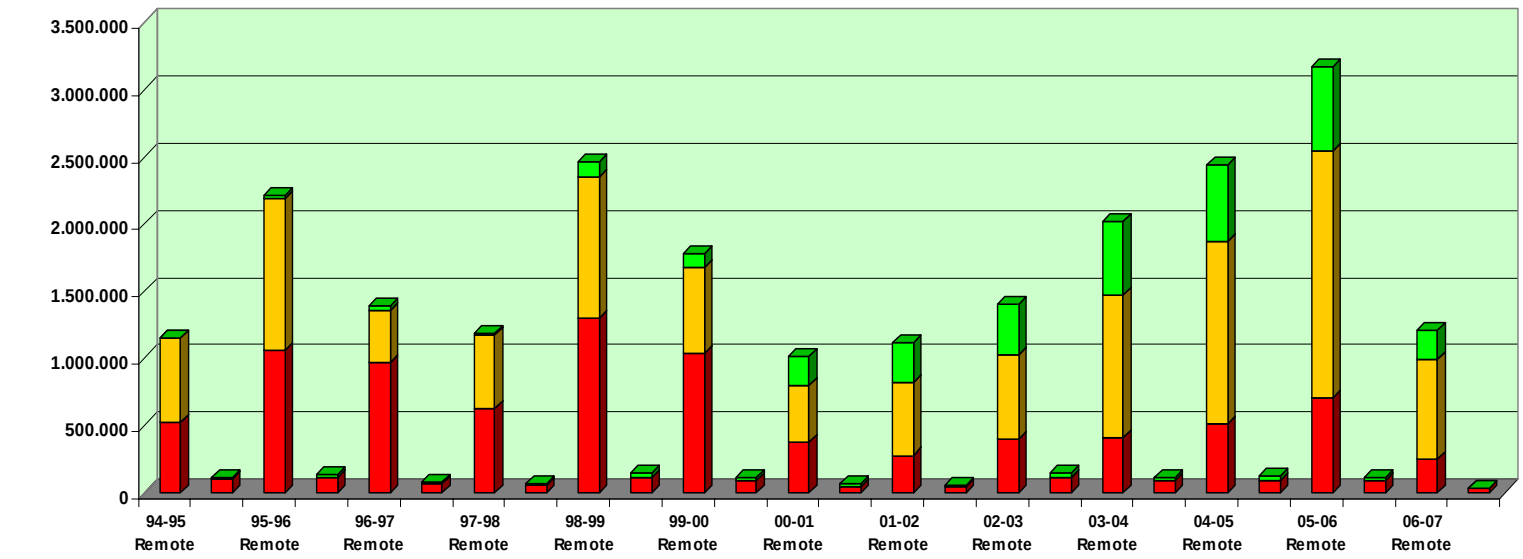
	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
Departures (Oct.-Apr.)	52.882	57.557	65.885	72.182	74.592	79.983	85.972	87.726	95.411	97.372	109.417	115.880	118.680
De-icing operations	3.798	6.595	4.380	3.719	8.066	5.673	3.716	5.232	6.194	8.435	9.955	13.337	4.783
% Aircrafts de-iced	7,2%	11,5%	6,6%	5,2%	10,8%	7,1%	4,3%	6,0%	6,5%	8,7%	9,1%	11,5%	4,0%
Sprayed fluid, m³ (100%)	1.233	2.258	1.418	1.205	2.576	1.893	1.080	1.172	1.546	2.141	2.565	3.331	1.241
ADF per operation, liter (100%)	325	342	324	324	319	334	291	224	250	254	258	250	259

Munich Airport. Winterseasons 94-95 to 06-07

Sprayed fluid at Remote-areas and Gates

(Liters 100 % Glycol)

Total amount sprayed



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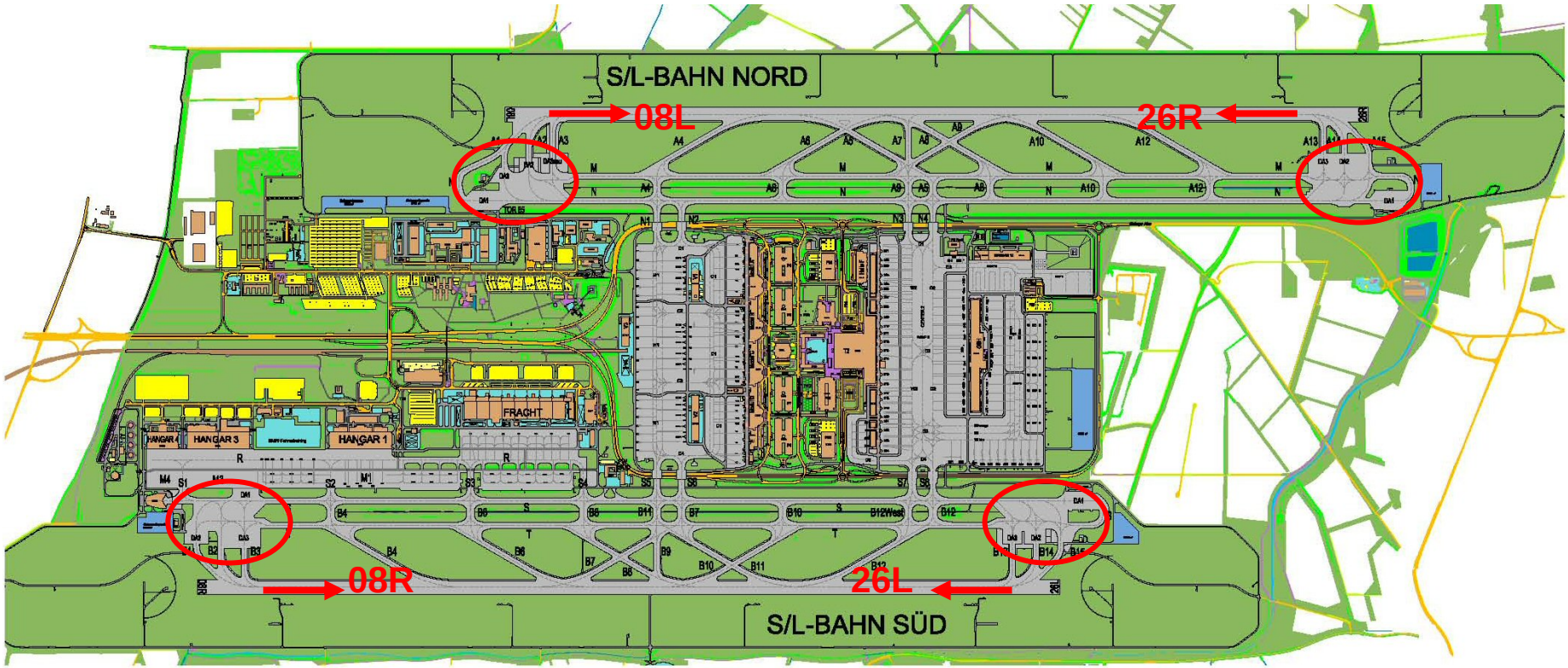
Remote De-icing Concept at Munich Airport

Munich Airport 2007, De-icing pad configuration



- 4 Remote de-icing stations with each 3 pads (bays)
- Total of 12 Remote de-icing pads (bays)

Supply System ADF

Remote service station N/W
75 m³ Type I
50 m³ Type IV

Recycling plant
450 m³ Type I

Remote service station N/E
75 m³ Type I
50m³ Type IV

Remote service station S/W
75 m³ Type I
50 m³ Type IV

Remote service station S/E
75 m³ Type I
50 m³ Type IV

Collecting System

cycling plant
or collected fluid

-BAHN NORD

Stormwater retain
basin 230,000 m³

300 m³ underground basin
for collected fluid

300 m³ underground basin
for collected fluid

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EFM - De-icing operator

- **Shareholders**
  - GlobeGround Deutschland GmbH 51%
  - Flughafen München GmbH 49 %
- **Employees**
  - Operation 108
  - Management, Administration 12
- **Services**
  - Pushback, Towing
  - De-/Anti-icing
  - Air-Conditioning
  - Training, Consulting

EFM - Fluidmanagement

- Facilities — Munich International Airport, FMG
- ADF Supply — Clariant International Ltd.
- Recycling operation — Clariant / Aircraft De-icing Engineering

- Services — ADF Production, Analysis / Certification, Fluidmanagement / Logistic, Engineering, Consulting

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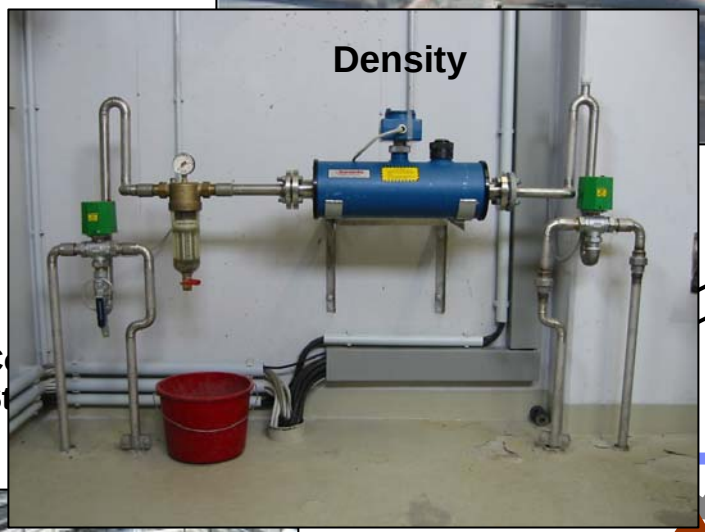
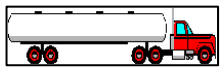
Recycling and On-site ADF production

Collecting system



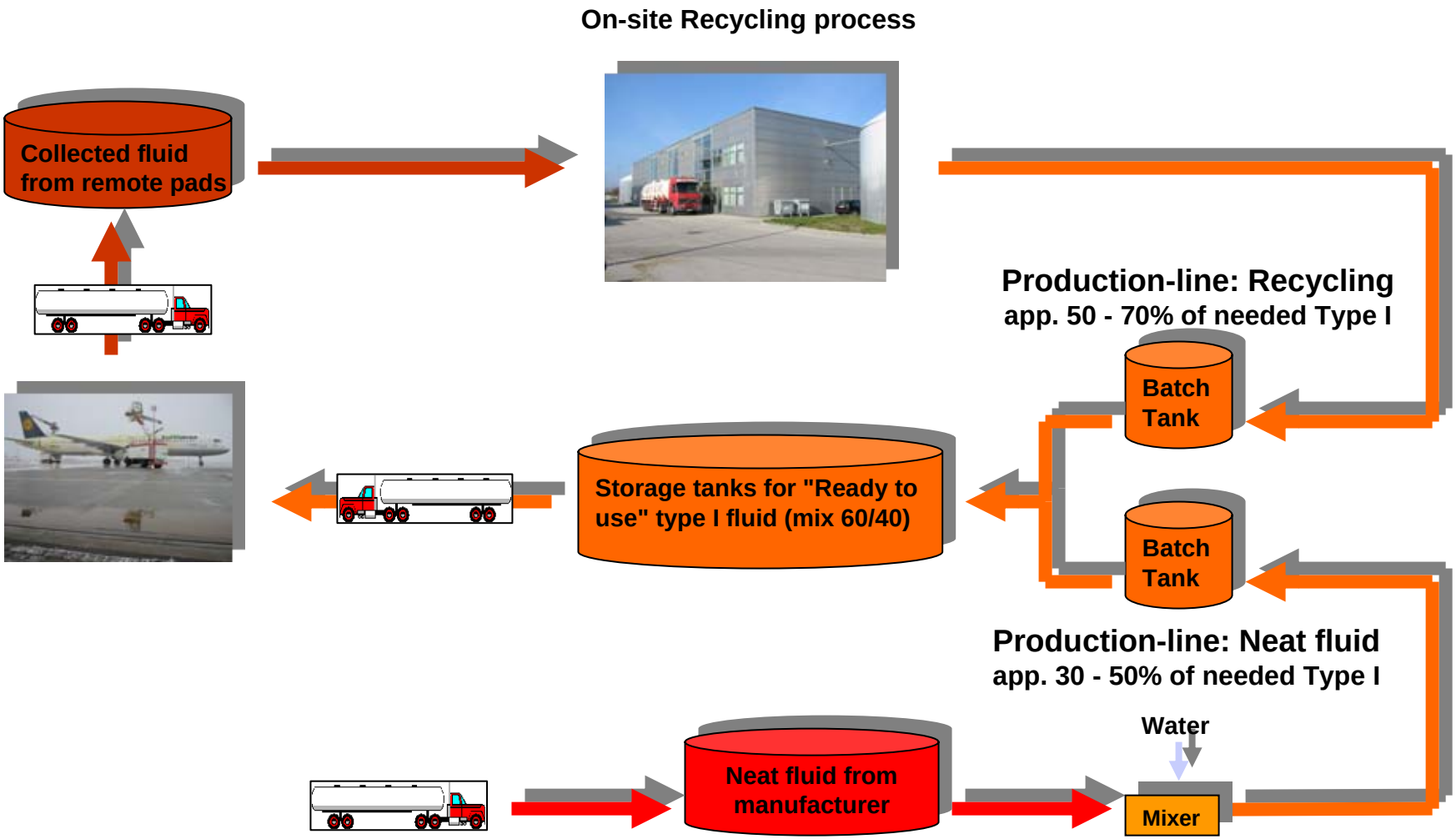
On-line monitoring glycol-concentration

Concentration higher 5



Recycling plant

Recycling plant



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Economy
Alternative Disposal Scenarios

- "Recycling" (Status quo MUC)
  - 60 % Recycling
  - 40 % Local sewage treatment plant

- "Local Sewer"
  - 0 % Recycling
  - 100 % Local sewage treatment plant

- "Hazardous Waste"
  - 0 % Recycling
  - 40 % Local sewage treatment plant
  - 60 % Hazardous waste treatment plant

Economy
Alternative Winter Scenarios

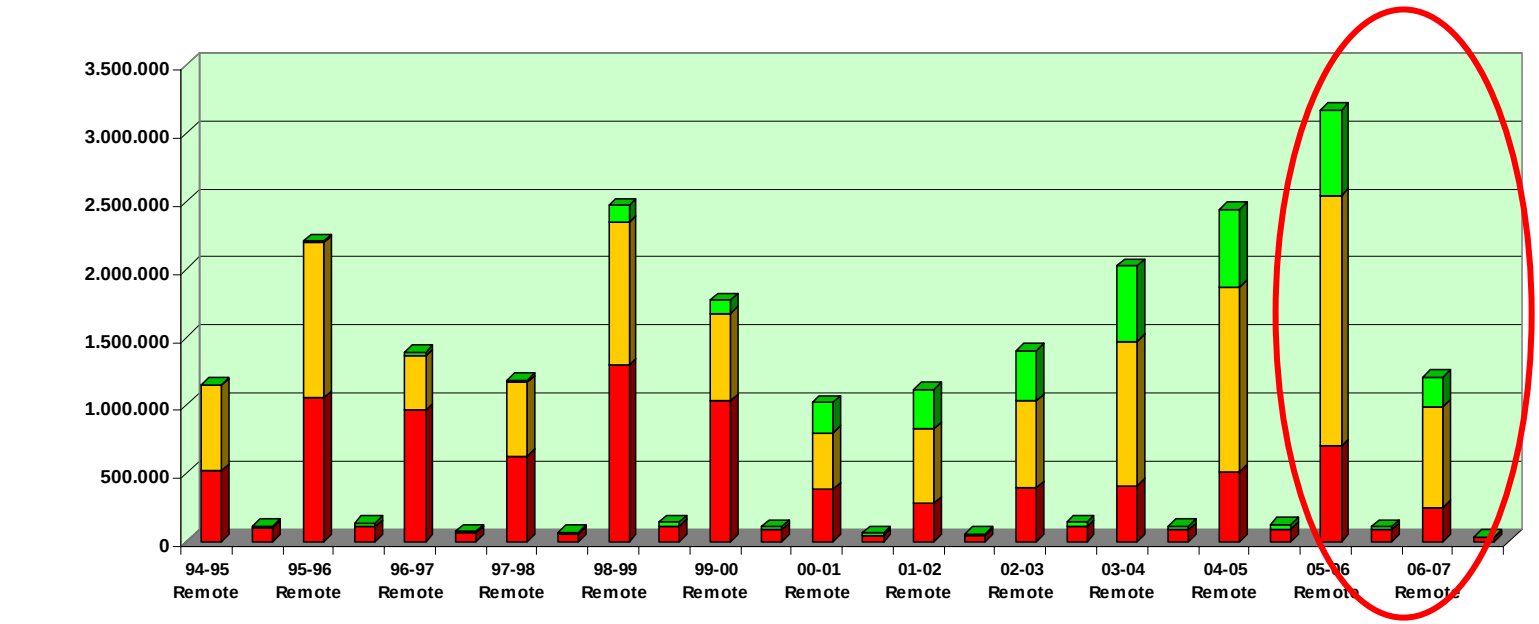
- Fiscal year 10/01/2006 – 09/30/2007 (Budget)
  - de-icing operations 7.300
  - spent glycol (Thsd. liters) 1.753
  - recycled glycol (Thsd. liters) 830
- Fiscal year 10/01/2006 – 09/30/2007 (High)
  - de-icing operations 13.700
  - spent glycol (Thsd. liters) 3.220
  - recycled glycol (Thsd. liters) 1.733
- Fiscal year 10/01/2006 – 09/30/2007 (Low)
  - de-icing operations 4.700
  - spent glycol (Thsd. liters) 1.290
  - recycled glycol (Thsd. liters) 727

Munich Airport. Winterseasons 94-95 to 06-07

Sprayed fluid at Remote-areas and Gates

(Litre 100 % Glycol)

Total amount sprayed



Economy
Cost Factors Aircraft De-/anti-icing

- Staffing

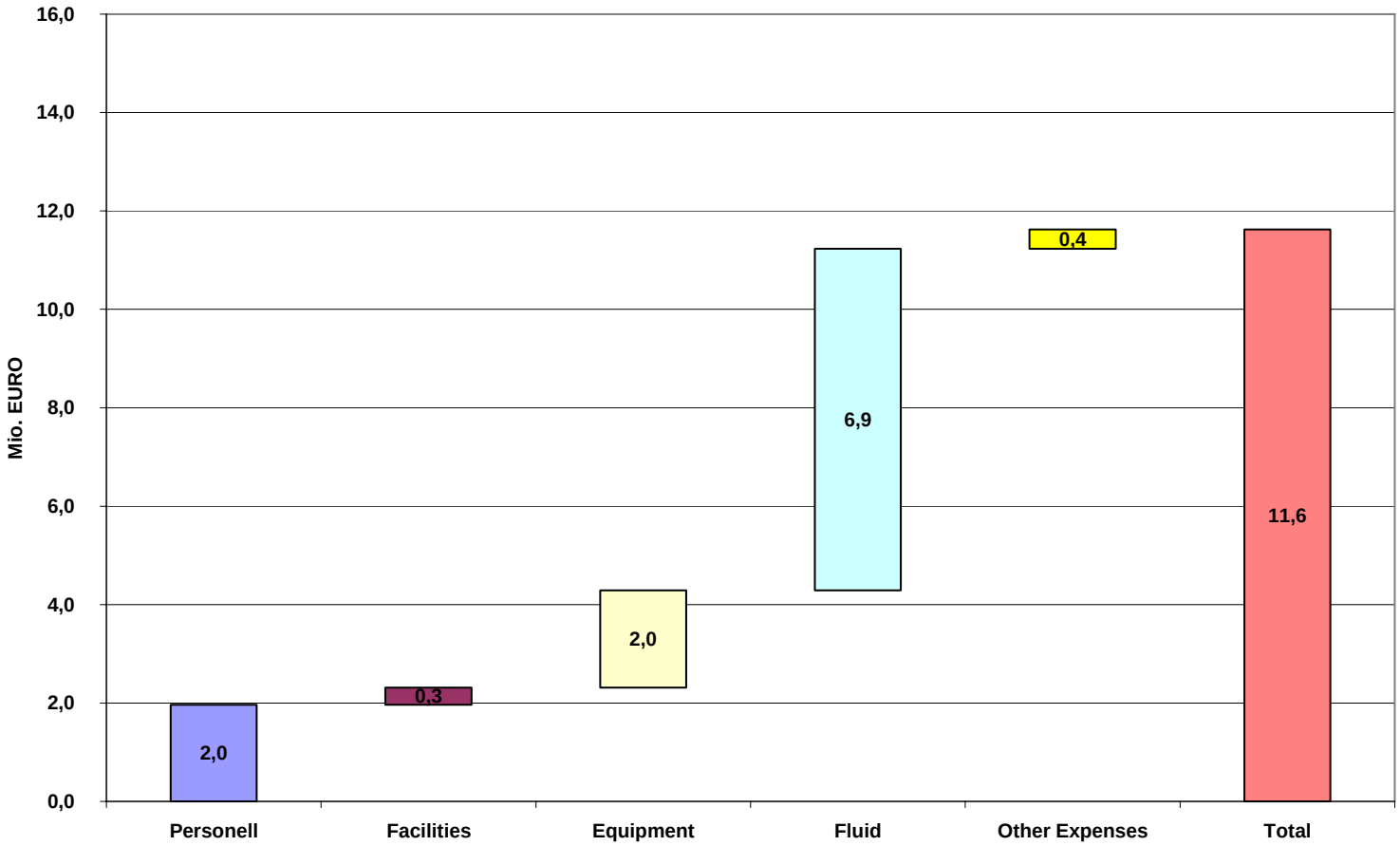
- Facilities
  e.g. - Control room
  - Truck shelter
  - De-icing pads
  - …

- Equipment
  e.g. - Amortization
  - Maintenance
  - Fuel
  - …

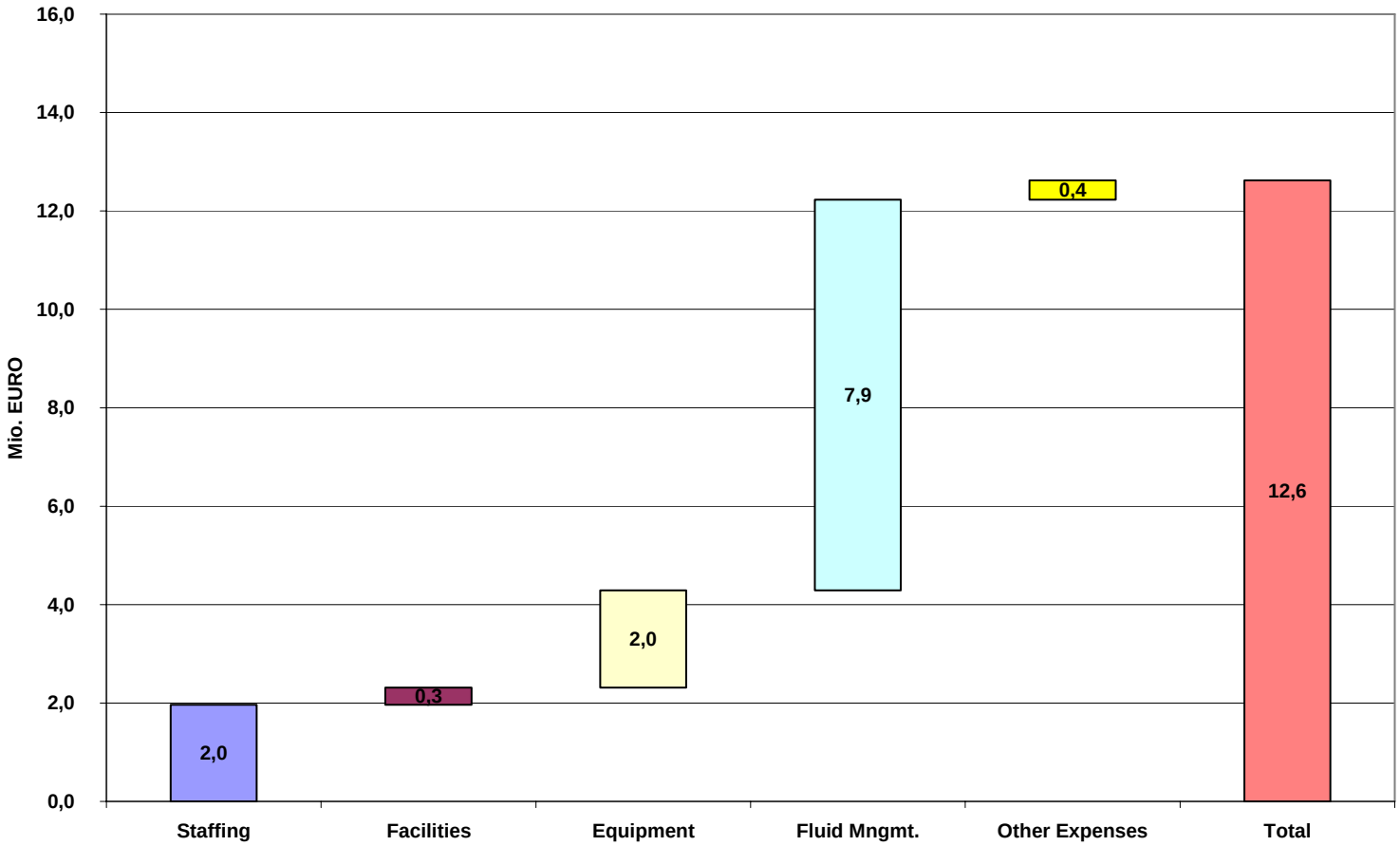
- Fluid Management
  e.g. - Facilities
  - Fluid
  - …

- Other Expenses
  e.g. - Insurance
  - IT
  - …

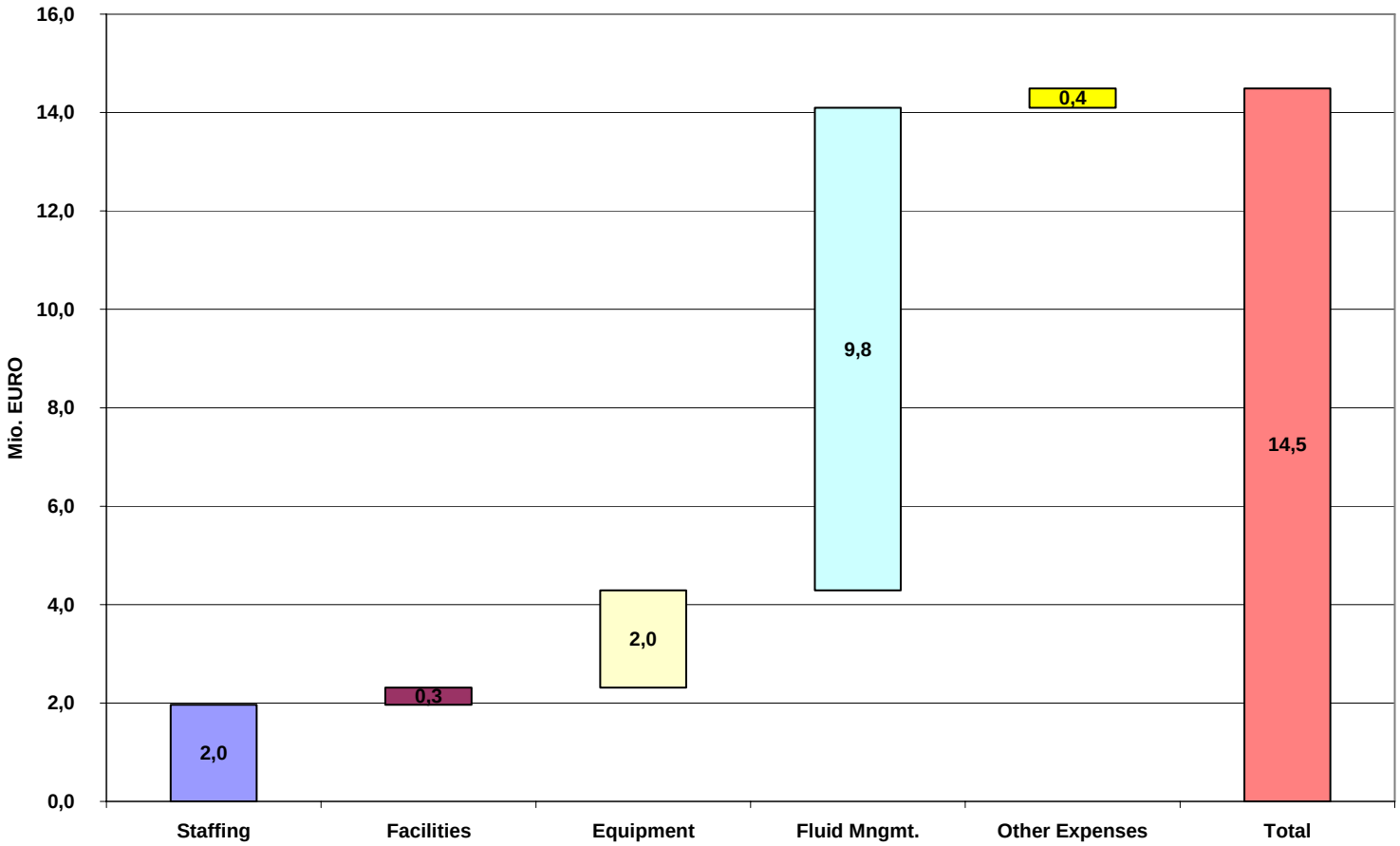
Economy
Expenses Budget FY 2006/2007 (4.700 Ops.) Mio. Euro



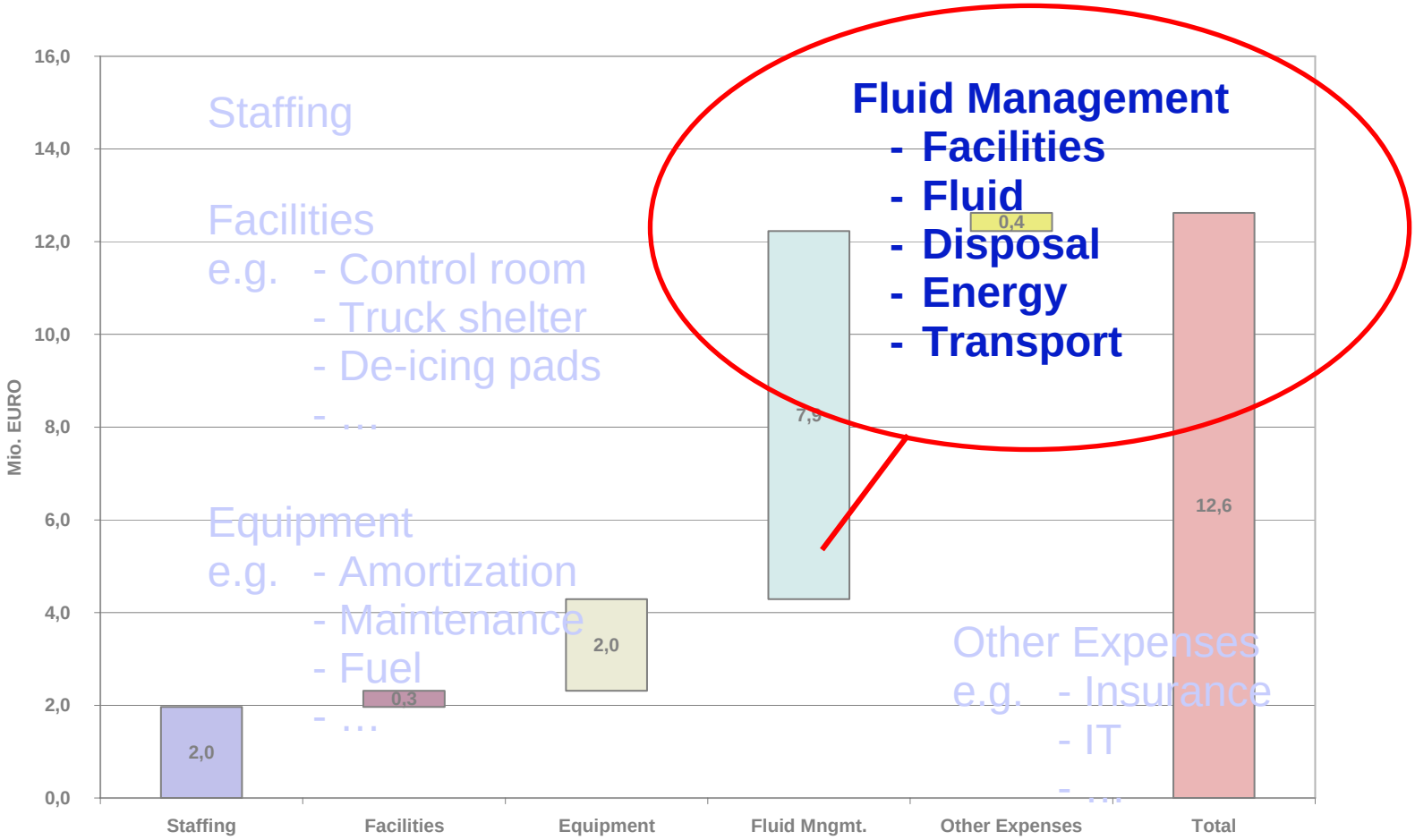
Economy
Expenses Budget FY 2006/2007 (7.300 Ops.) Mio. Euro



Economy
Expenses Budget FY 2006/2007 (13.700 Ops.) Mio. Euro



Economy
Cost Factors Fluid Management



Economy
Cost Factors Fluid Management

- Recycling Facilities
  - Recycling plant and storage tanks
  - Tanks and basins for collected used fluid

- Other Facilities
  - Storage tanks for ready to use fluid
  - De-icing truck supply installations

- Fluid
  - Recycled ready to use fluid
  - Type 1 neat
  - Type 4 neat

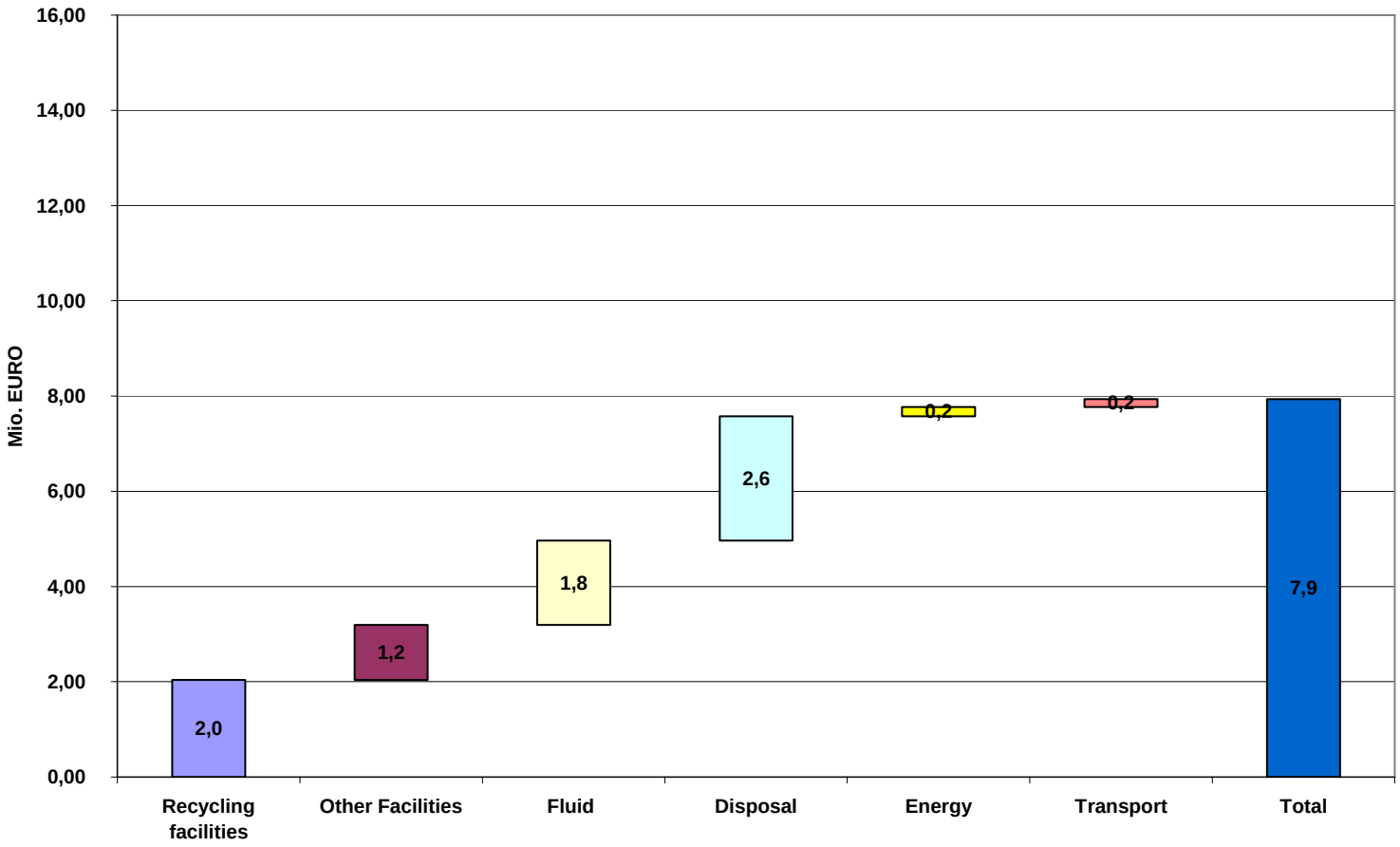
Economy
Cost Factors Fluid Management

- Disposal
  - On-airport collecting and buffering system
  - Off-airport sewage treatment plant
  - Off-airport hazardous waste treatment plant

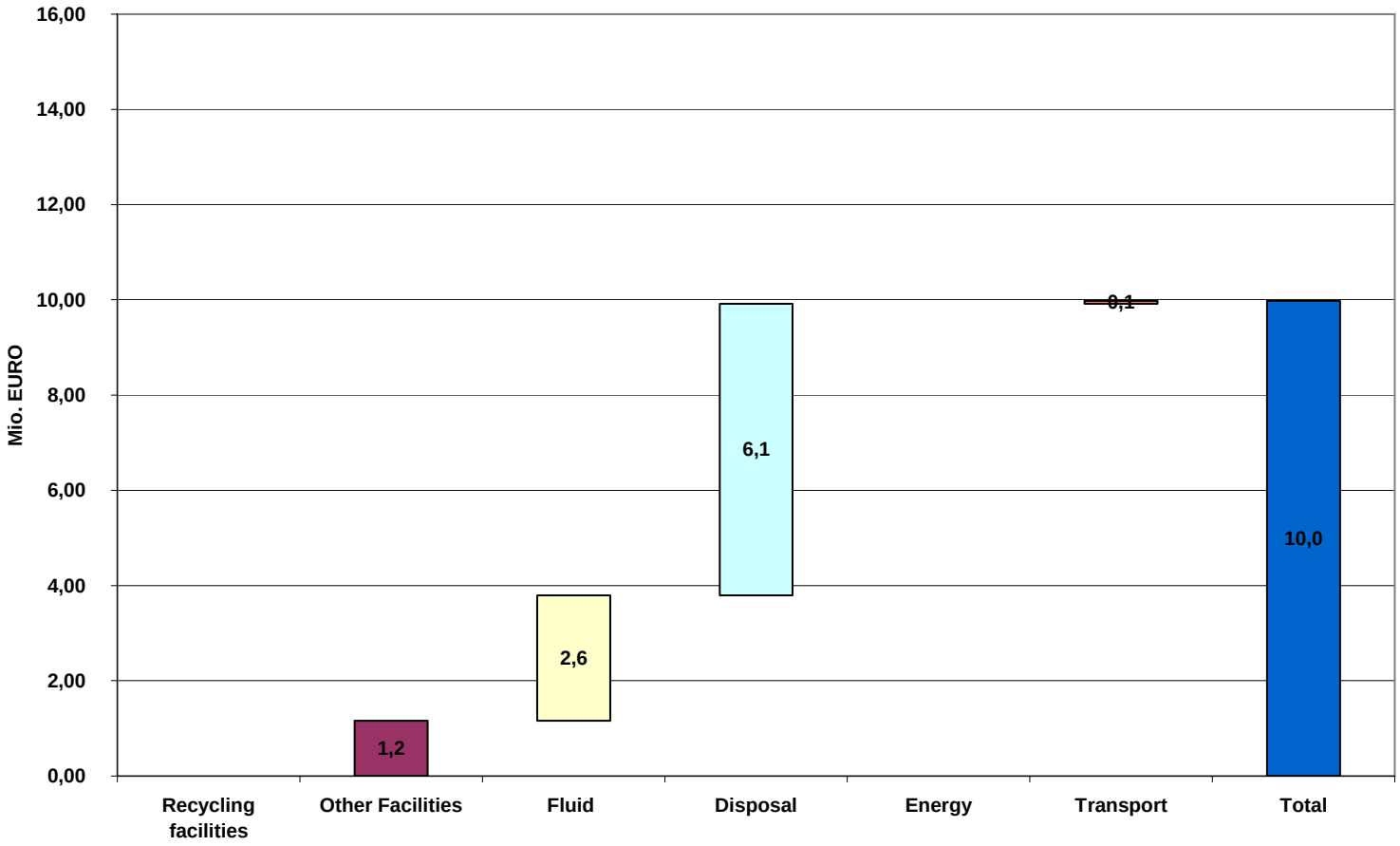
- Energy
  - Natural gas and electricity for the recycling plant

- Transport
  - On-airport transport of used fluid from collecting basins to recycling plant
  - Off-airport transport to hazardous waste treatment plant

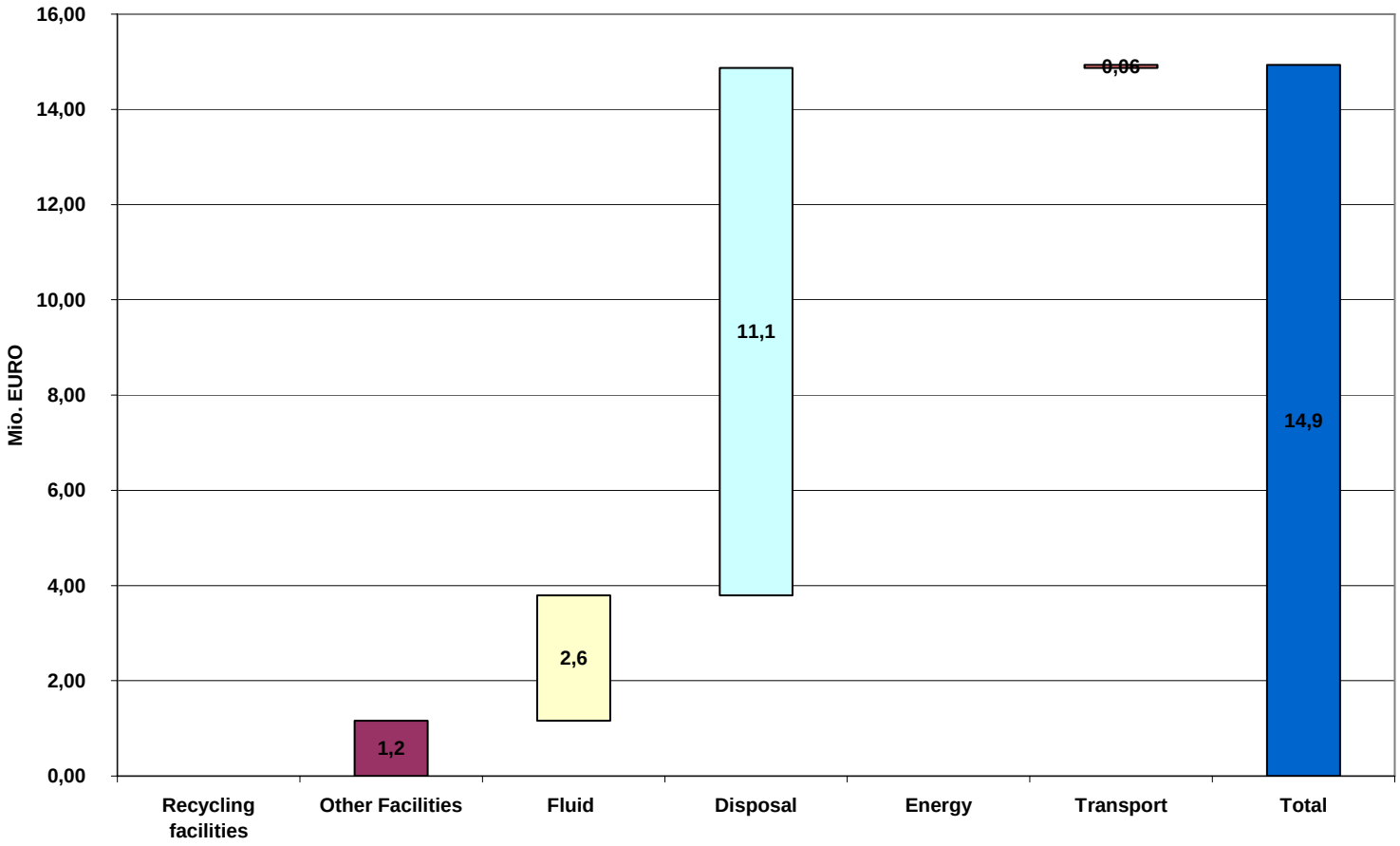
Economy
Expenses Fluid Management “Recycling” (7.300 Ops.)



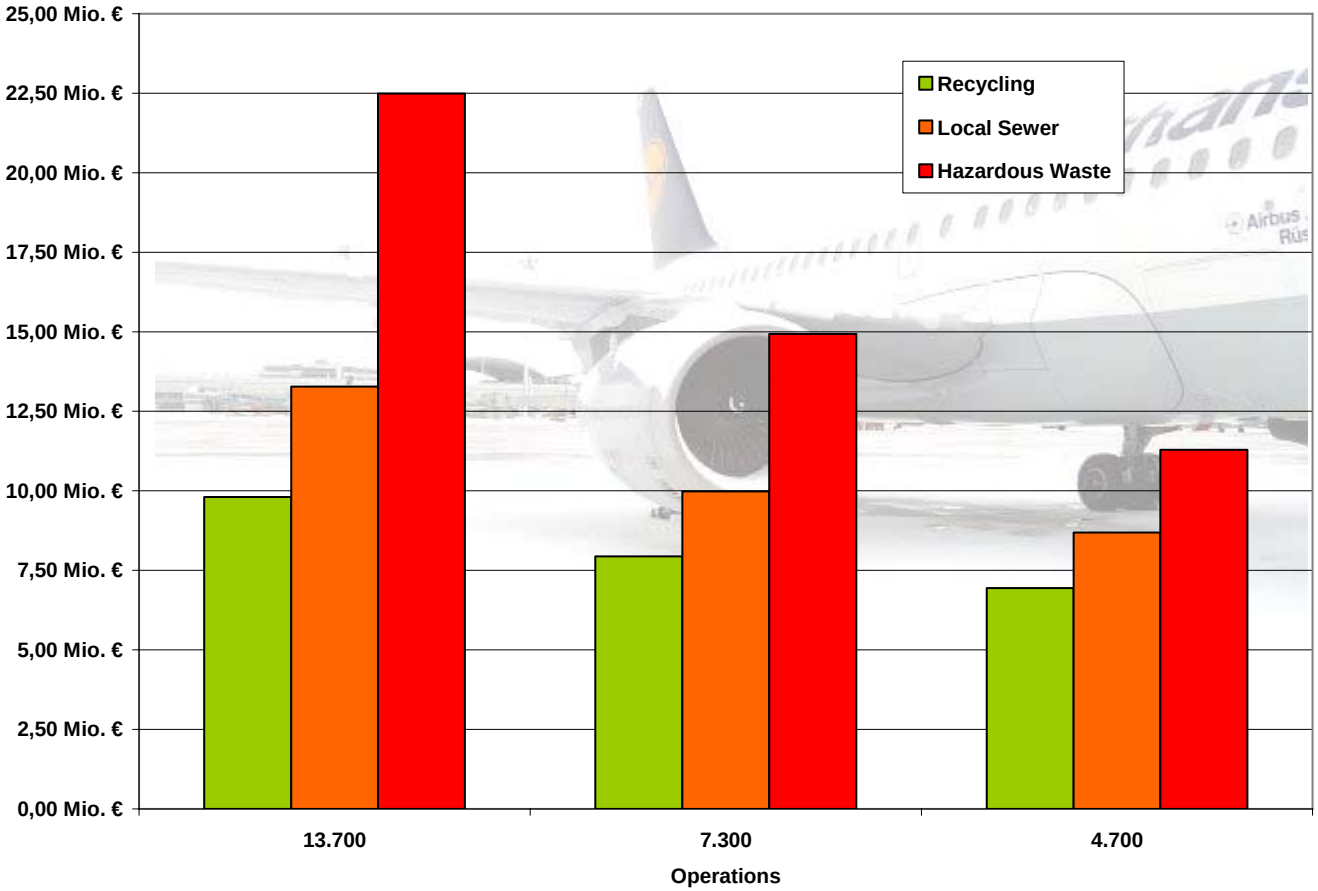
Economy
Expenses Fluid Management “Local Sewer” (7.300 Ops.)



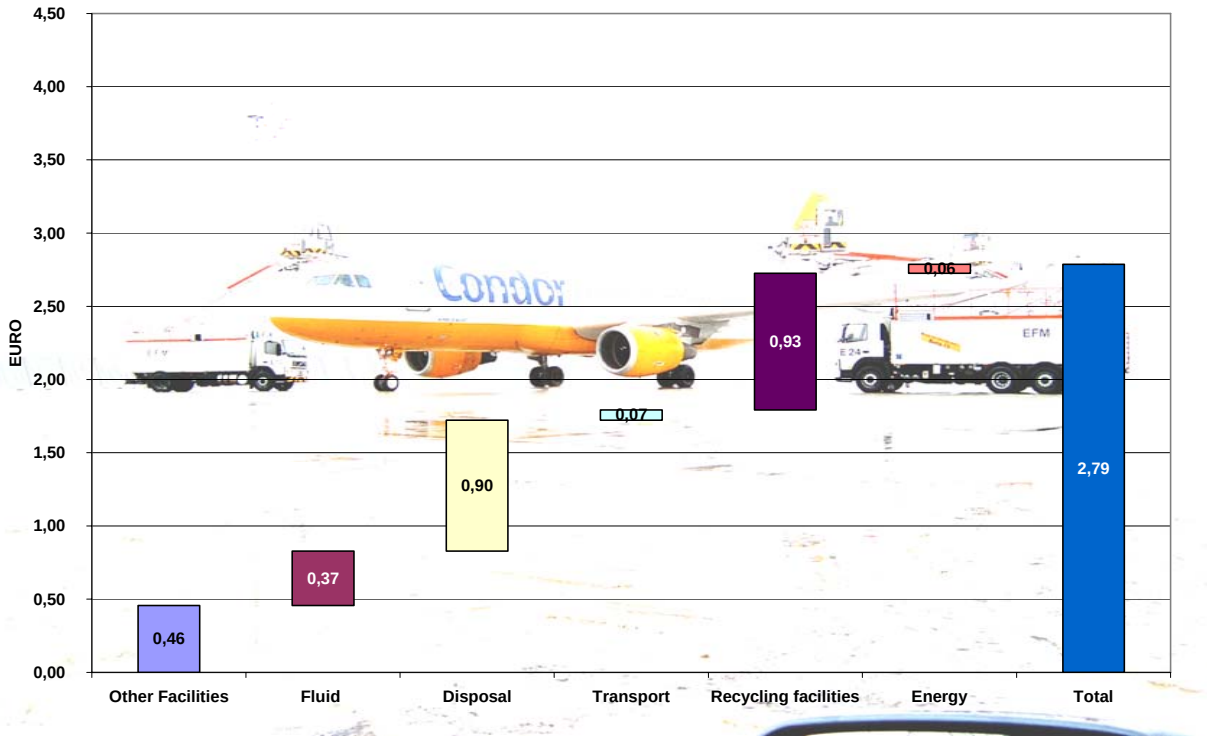
Economy
Expenses Fluid Management "Hazardous Waste" (7.300 Ops.)



Economy
Cost of Fluid Management p.a.



Economy
Cost per Liter ADF Type I 60:40 „Recycling“ (4.700 Ops.)



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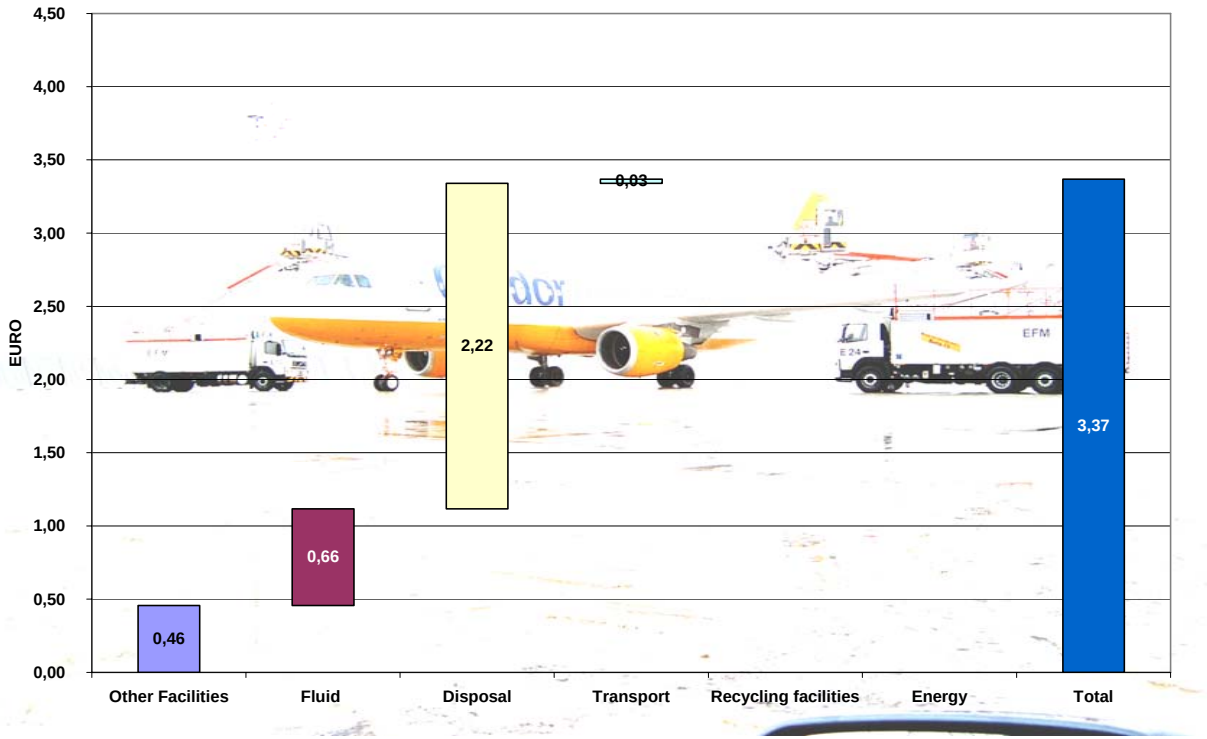

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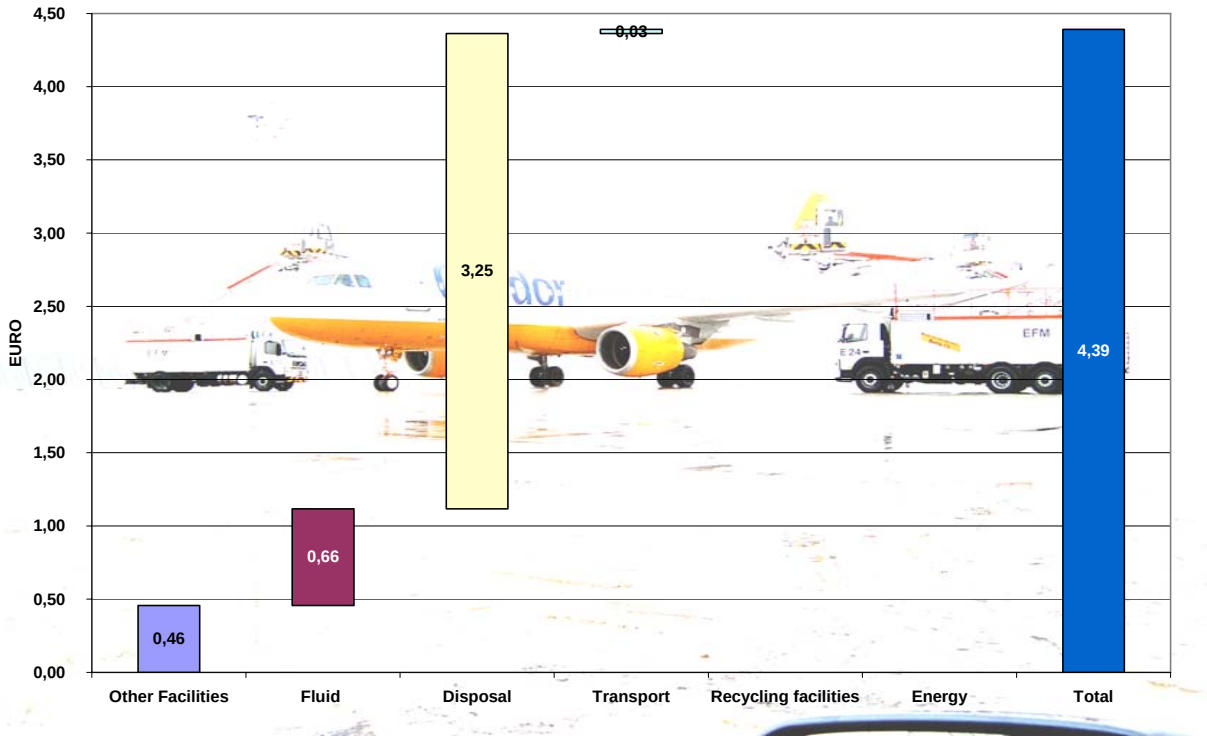

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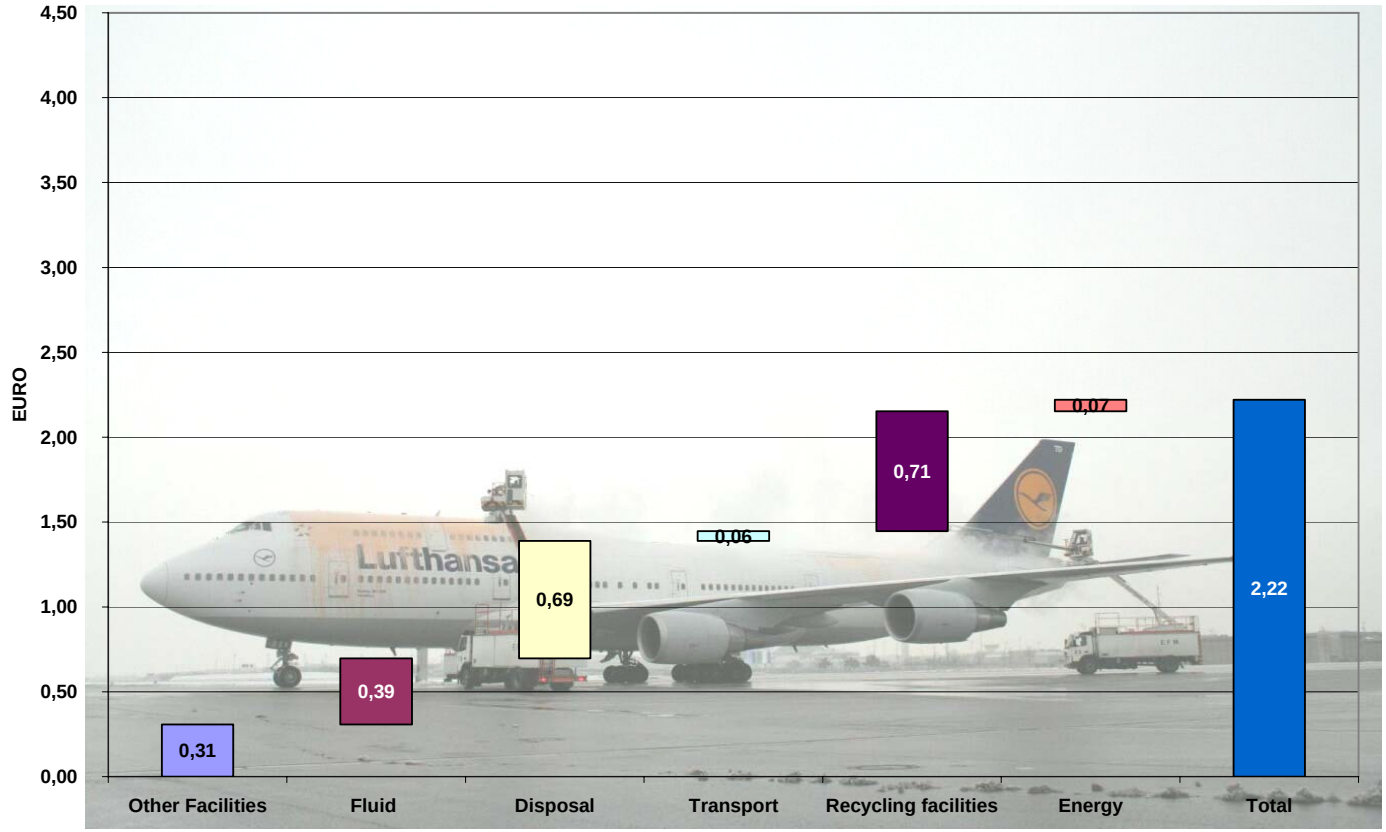

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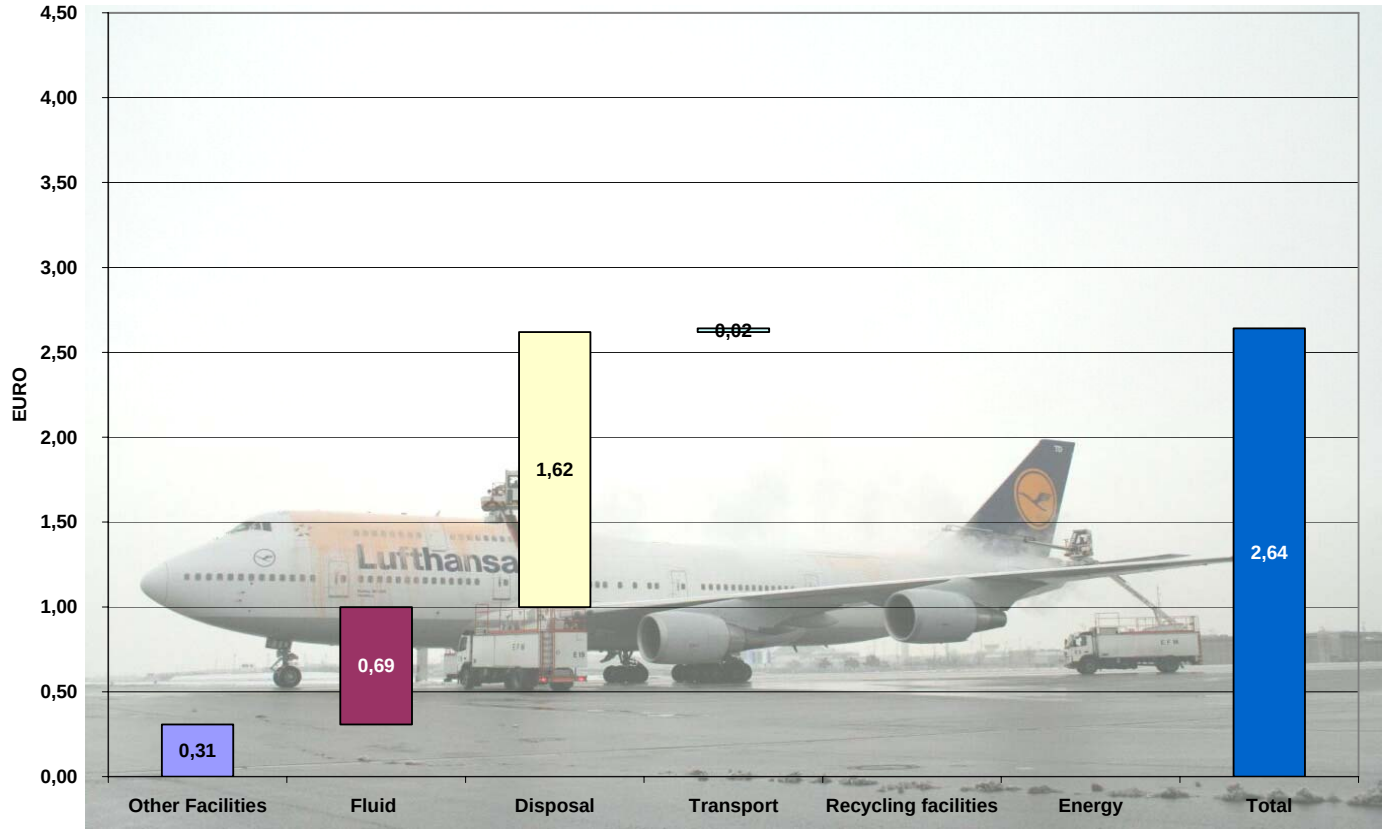

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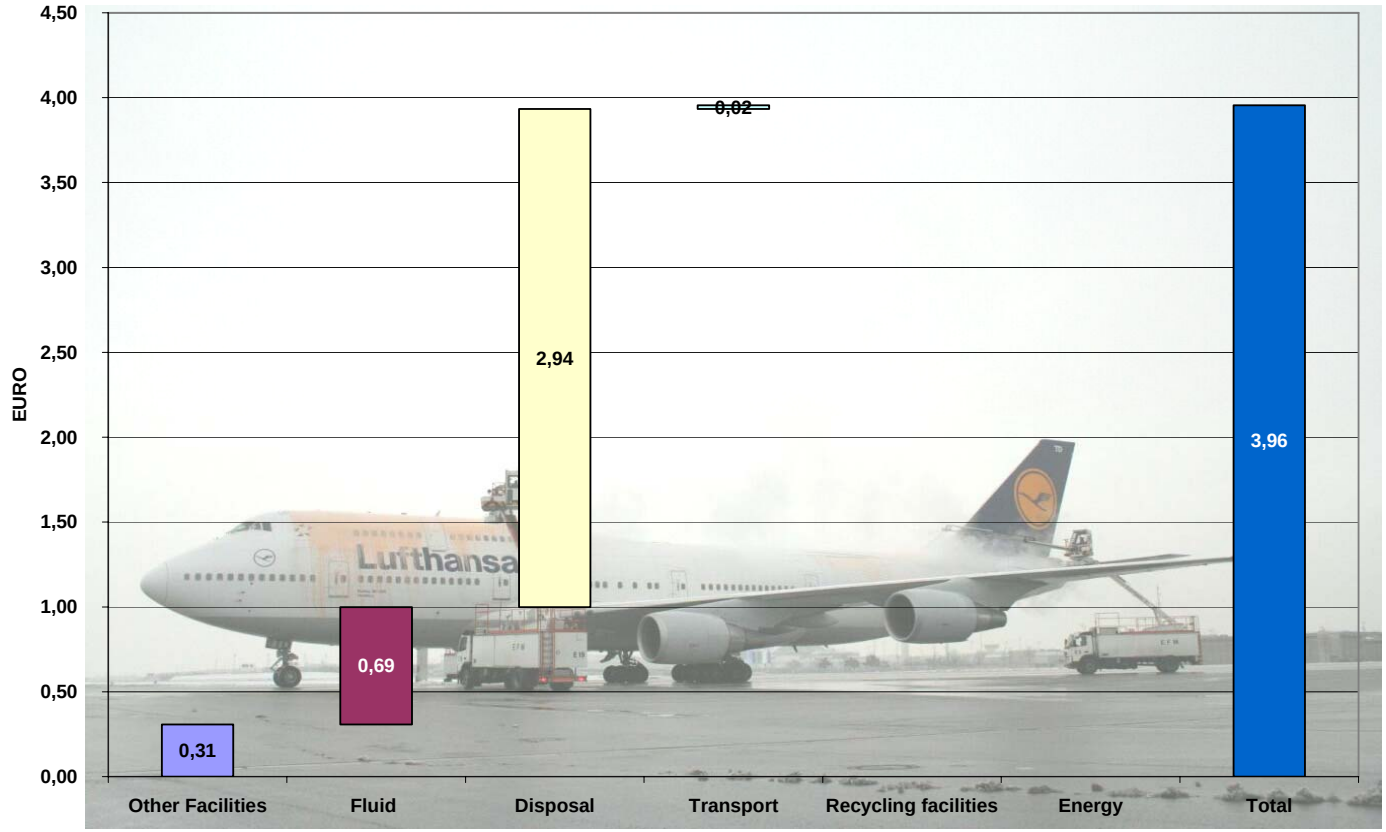

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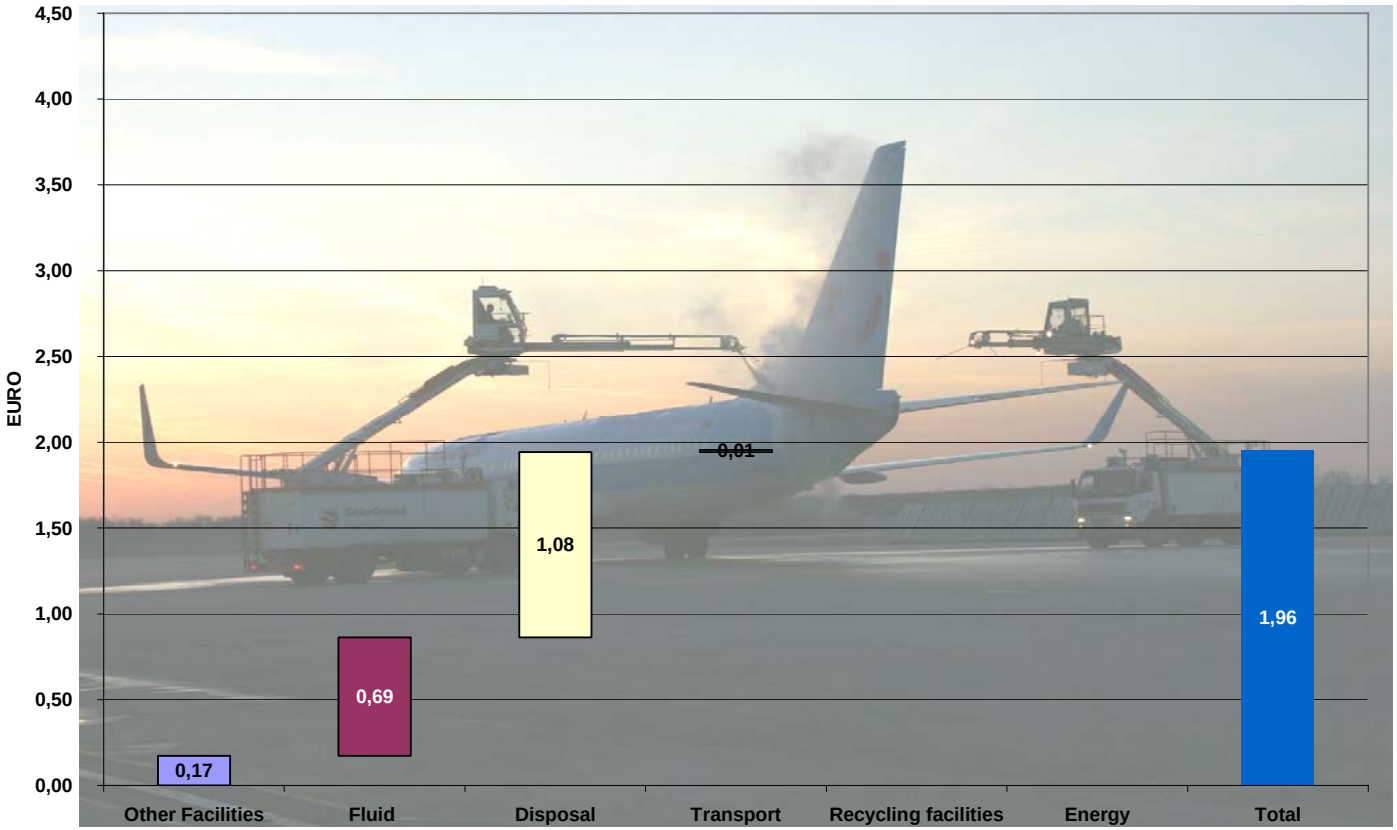
Cost per Liter ADF Type I 60:40 „Recycling“ (13.700 Ops.)

Economy
Cost per Liter ADF Type I 60:40 „Local Sewer“ (13.700 Ops.)



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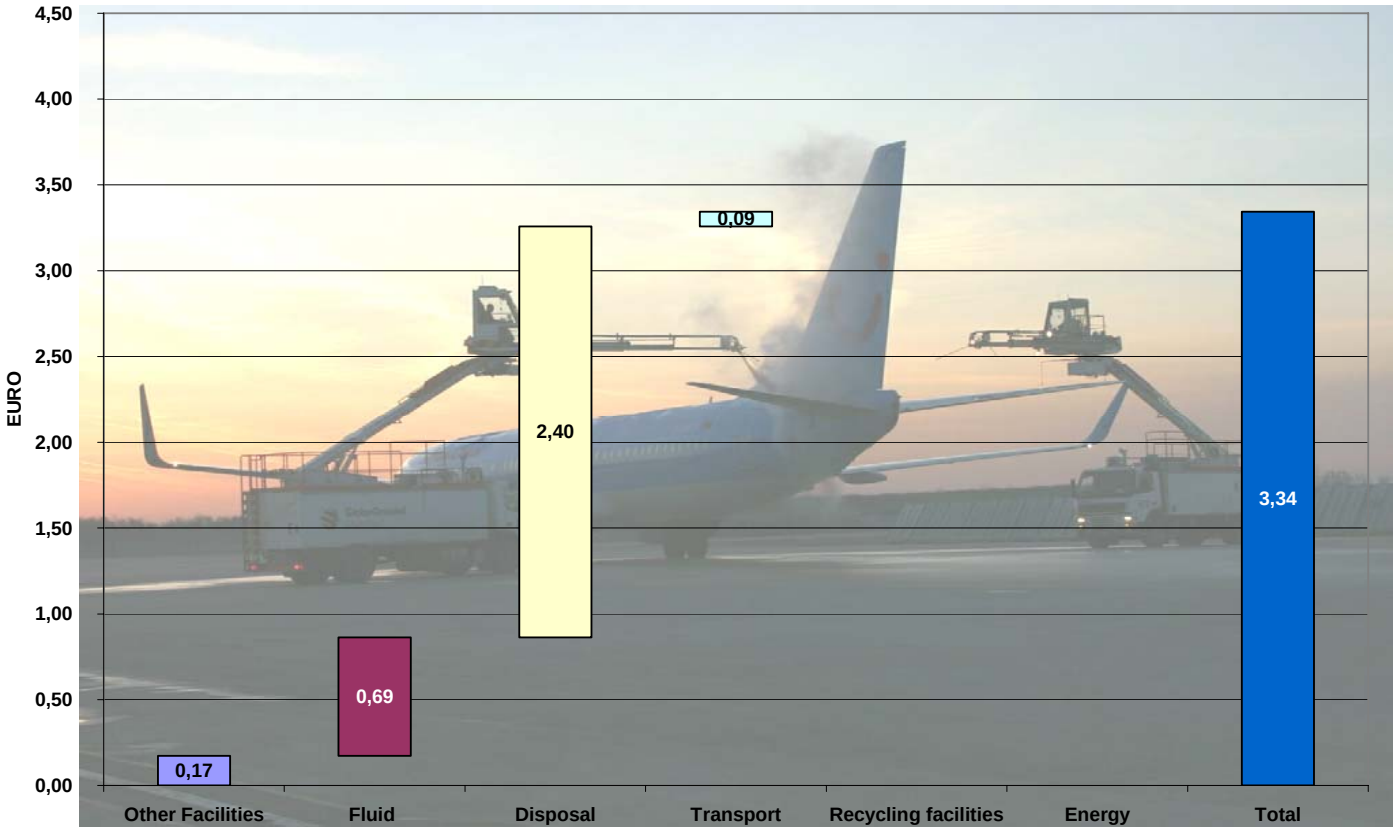
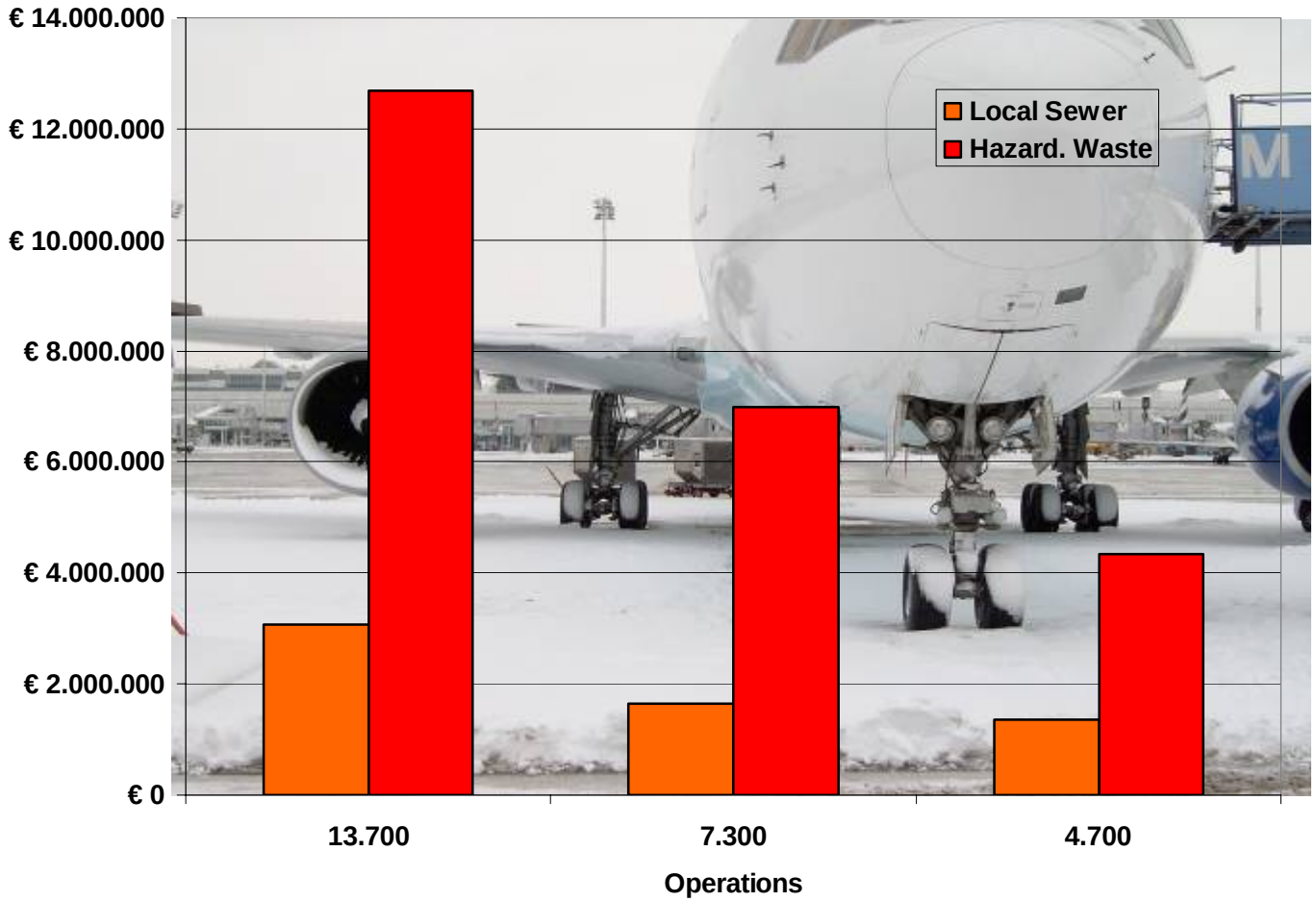


Economy
Savings Recycling vs. Alternatives p.a.



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Fluid Management, Ecology

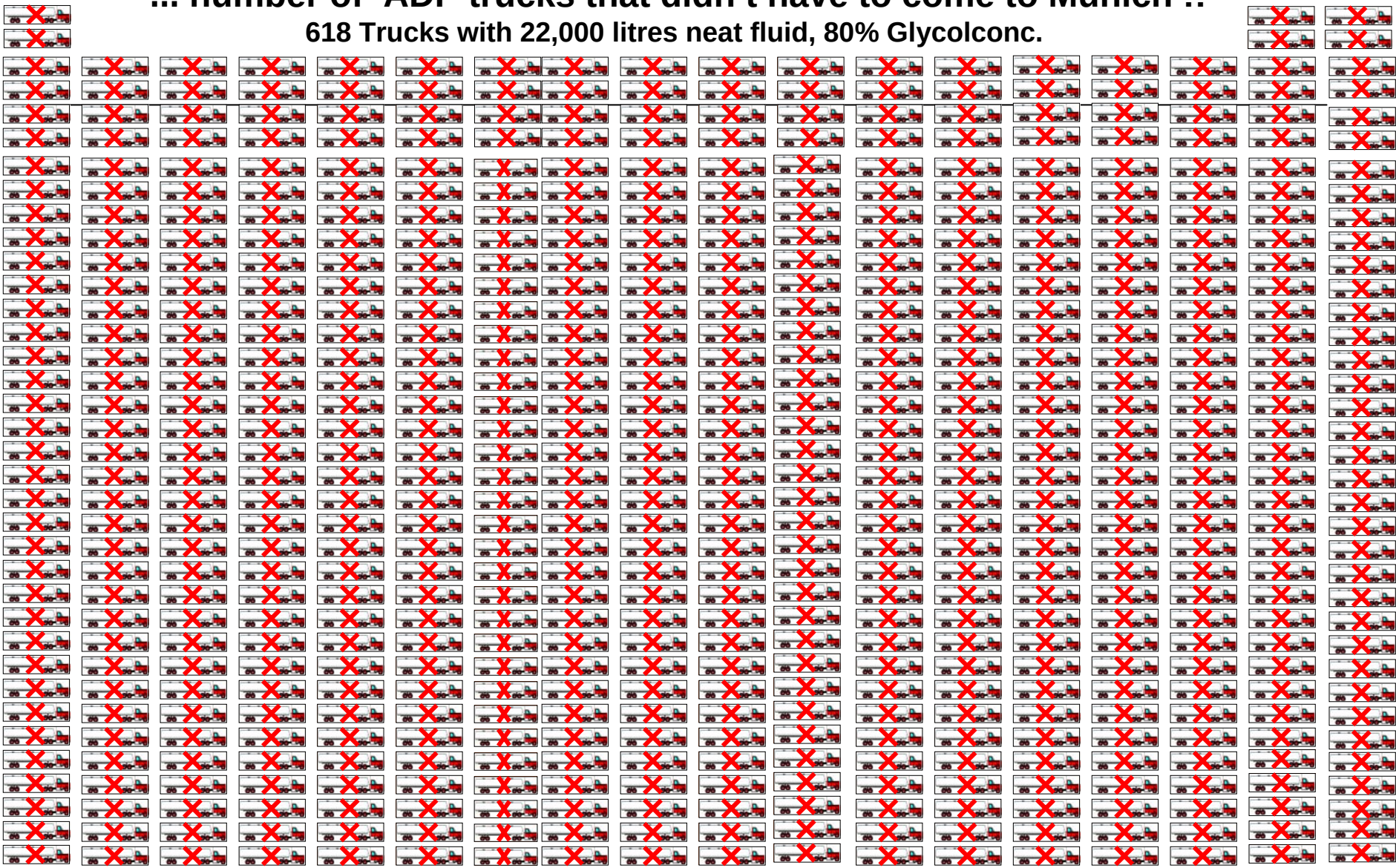
- 15 years of operation, what are the effects on the environment ?

- **Saving of 13.600.000 liters ADF Type I (80% conc.)**

- # 618 trucks of ADF

... number of ADF-trucks that didn't have to come to Munich !!

618 Trucks with 22,000 litres neat fluid, 80% Glycolconc.



Fluid Management, Ecology

- 15 years of operation, what are the positive effects on the environment ?

- **Saving of 13.600.000 liters ADF Type I (80% conc.)**
  - # 618 trucks of ADF

- **Reduction of CO_2 for transports**
  - 83.430 Kg CO_2

- **Reduction of non-renewable* natural resources**
  - 6.070.700 kg of natural gas for PG production
  *- meaning a natural resource that cannot be re-made, re-grown or regenerated in a scale comparative to its consumption

- **Reduction of waste-water for the municipal sewage plant**
  - 80.000.000 liter or 5.190.000 kg TOC

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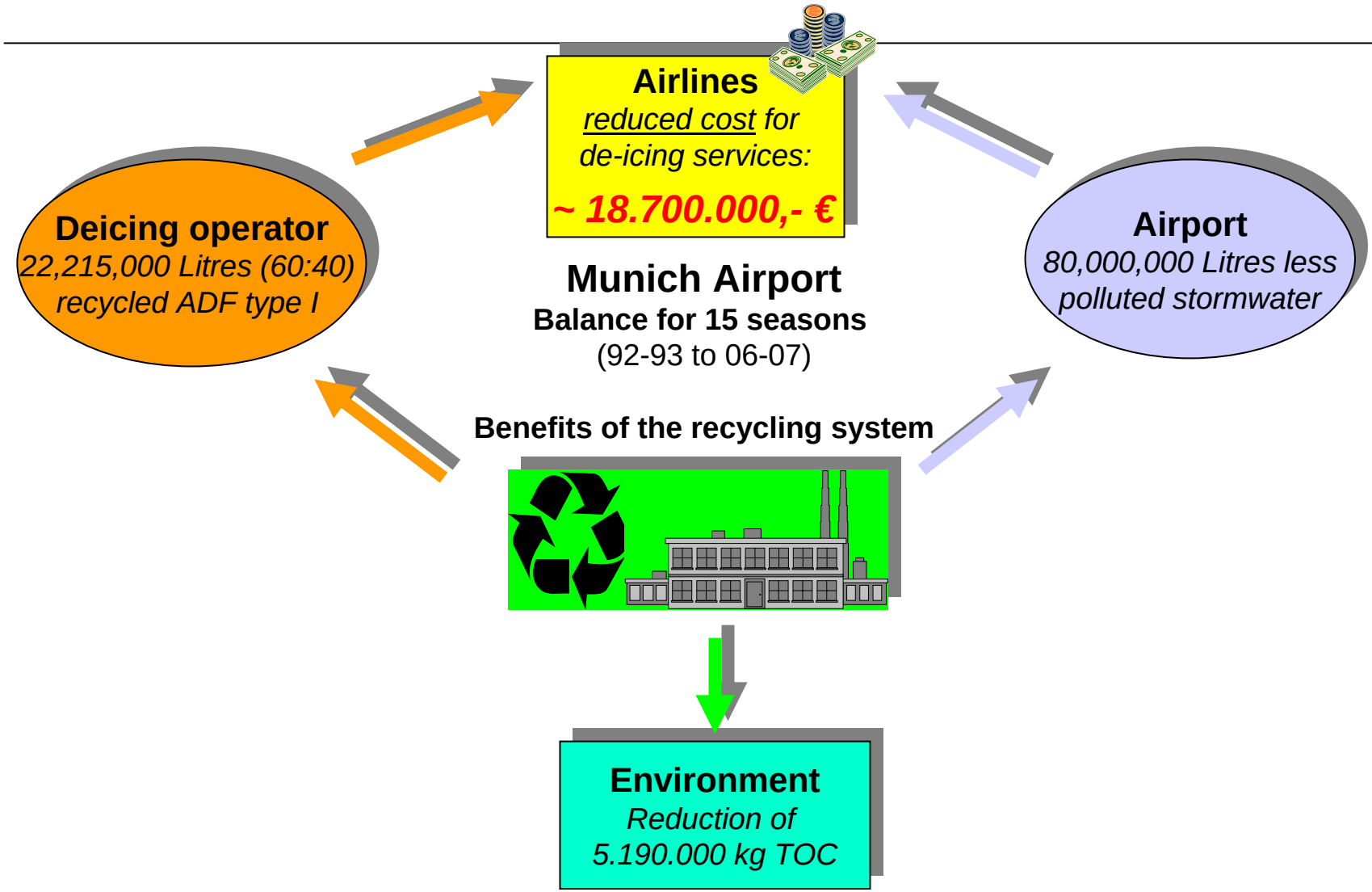
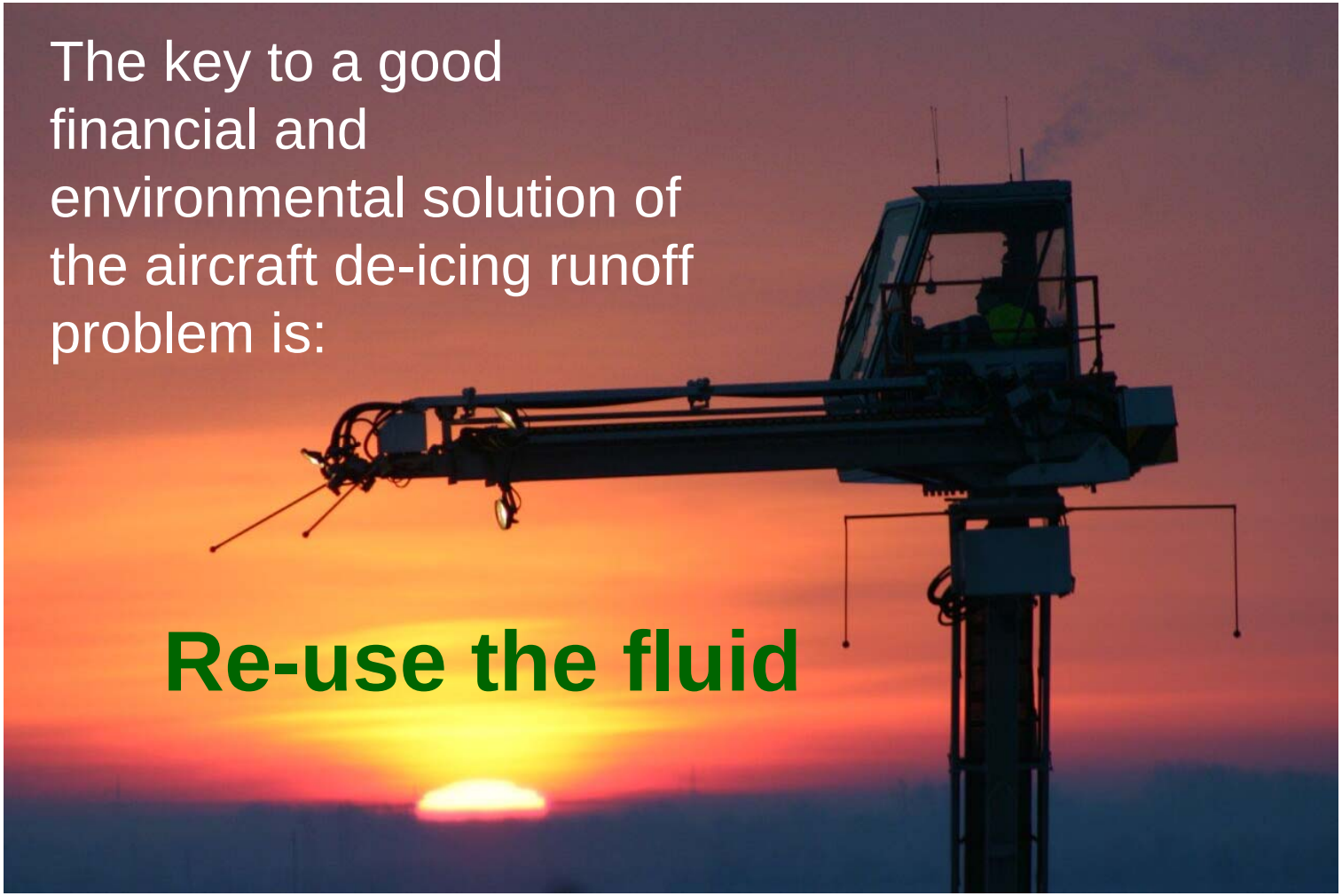

Airlines
reduced cost for
de-icing services:
~ 18.700.000,- €
Deicing operator
22,215,000 Litres (60:40)
recycled ADF type I
Airport
80,000,000 Litres less
polluted stormwater
Munich Airport
Balance for 15 seasons
(92-93 to 06-07)
Benefits of the recycling system
Environment
Reduction of
5.190.000 kg TOC

The End


The key to a good financial and environmental solution of the aircraft de-icing runoff problem is:
Re-use the fluid

Contact


EFM - Aircraft De-Icing and
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