Meteorology, Environment and Aviation - METENVIA

Zurich University of Applied Sciences

School of Engineering

ZAV Centre for Aviation

Swiss research of particle emissions reduction with sustainable aviation fuels

Dr. Lukas Durdina

Zurich Universities of Applied Sciences and Arts

26th ETH-Nanoparticles Conference (NPC-23)

Numerous experts and organizations have made this work possible

2023 at Payerne


2017 at SR Technics


SMARTEMIS

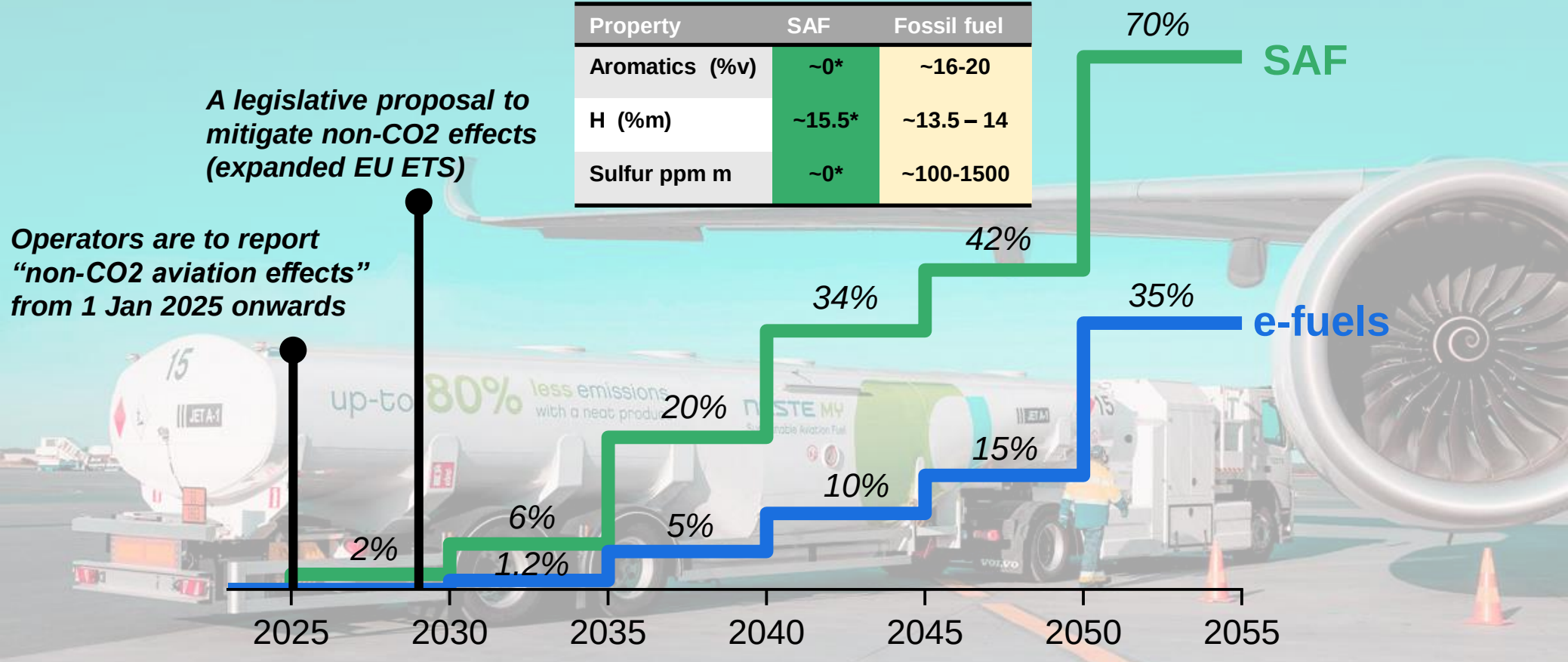
ZHAW: *J. Edebeli, C. Spirig, T. Frischknecht, J. Anet*
Empa / PSI: *B. Brem, M. Elser, D. Schönenberger, Ch. Bach, M. Oertig, D. Rentsch, R. Haag*
SR Technics: *F. Siegerist, M.Weiner*
FOCA: *T. Rindlisbacher, A. Suri*
Swiss Air Force
Funding by Swiss FOCA

Aircraft fuel suppliers at EU airports to gradually increase the share of SAF and notably synthetic fuels

Property	SAF	Fossil fuel
Aromatics (%v)	~0*	~16-20
H (%m)	~15.5*	~13.5 – 14
Sulfur ppm m	~0*	~100-1500

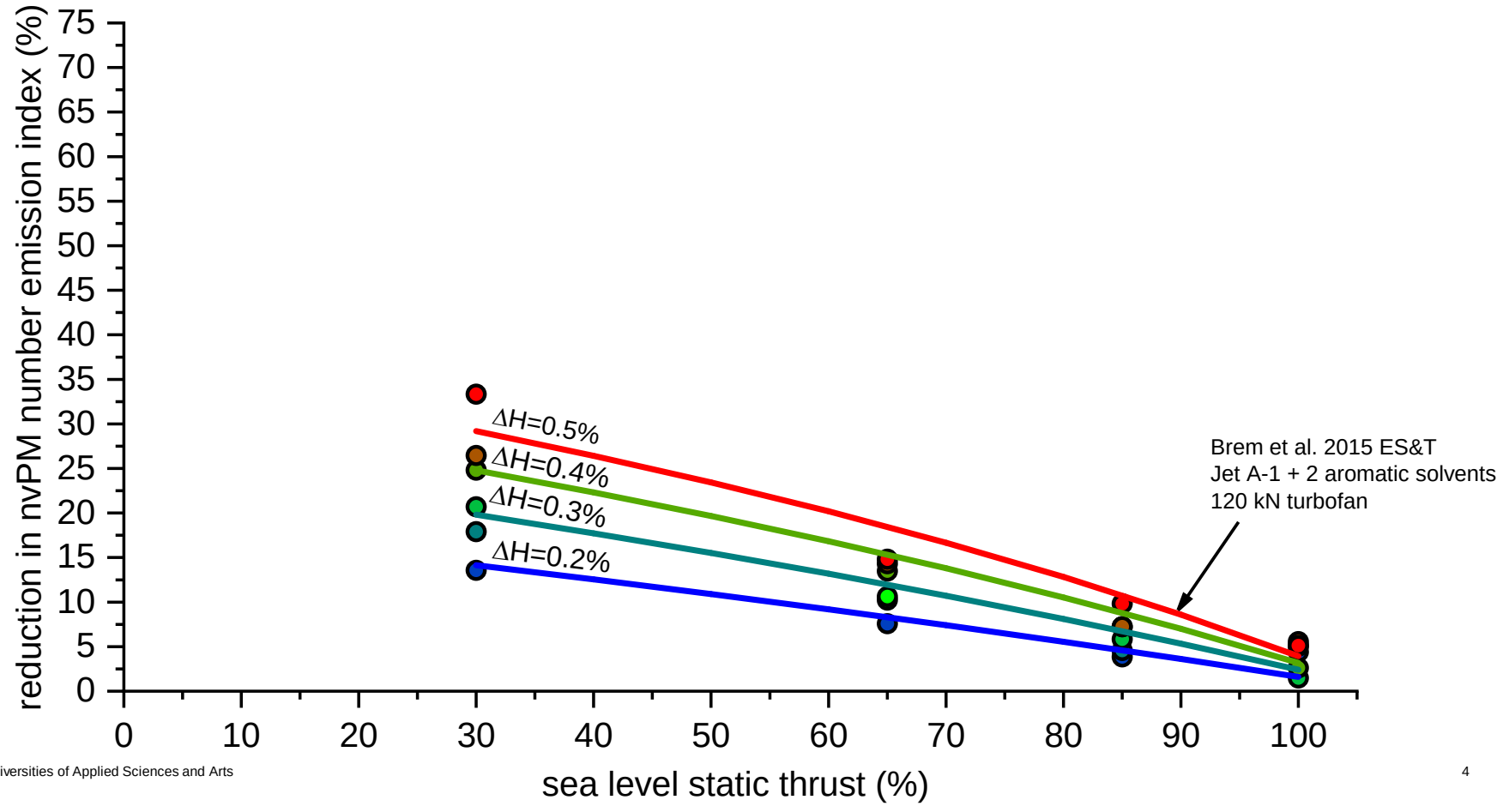
A legislative proposal to mitigate non-CO2 effects (expanded EU ETS)

Operators are to report "non-CO2 aviation effects" from 1 Jan 2025 onwards



background image: https://energyindustryreview.com/environment/europe-closer-to-a-green-flight-sustainable-fuels/

nvPM emission reductions are a function of fuel H content and thrust



nvPM emission reductions are a function of fuel H content and thrust

Durdina et al. 2021 ES&T
32% HEFA SAF blend
120 kN turbofan

ΔH=0.48%

Durdina et al. 2023*
5% and 10% HEFA SAF blends
120 kN turbofan

ΔH=0.16%

ΔH=0.08%

ΔH=0.5%

ΔH=0.4%

ΔH=0.3%

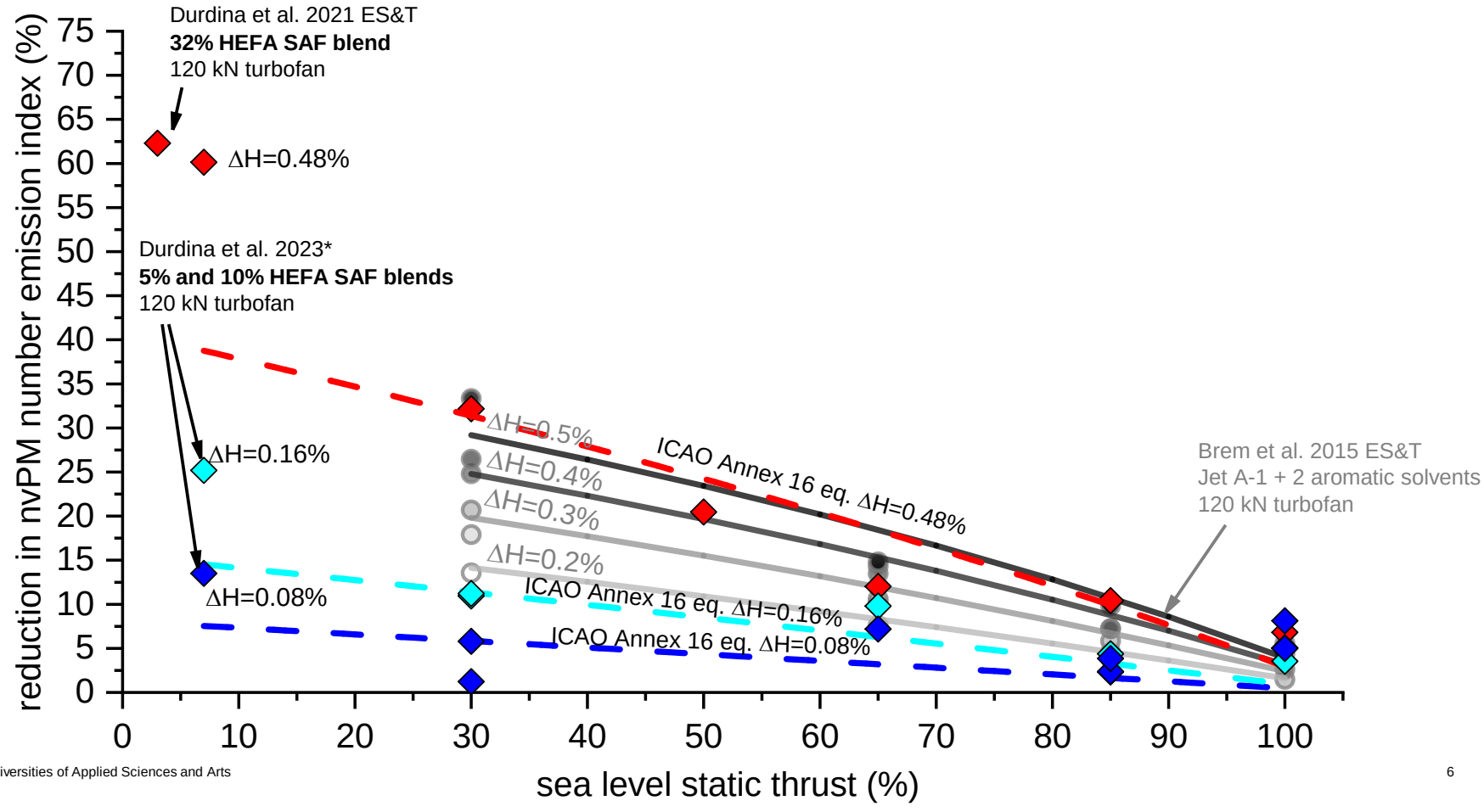
ΔH=0.2%

Brem et al. 2015 ES&T
Jet A-1 + 2 aromatic solvents
120 kN turbofan

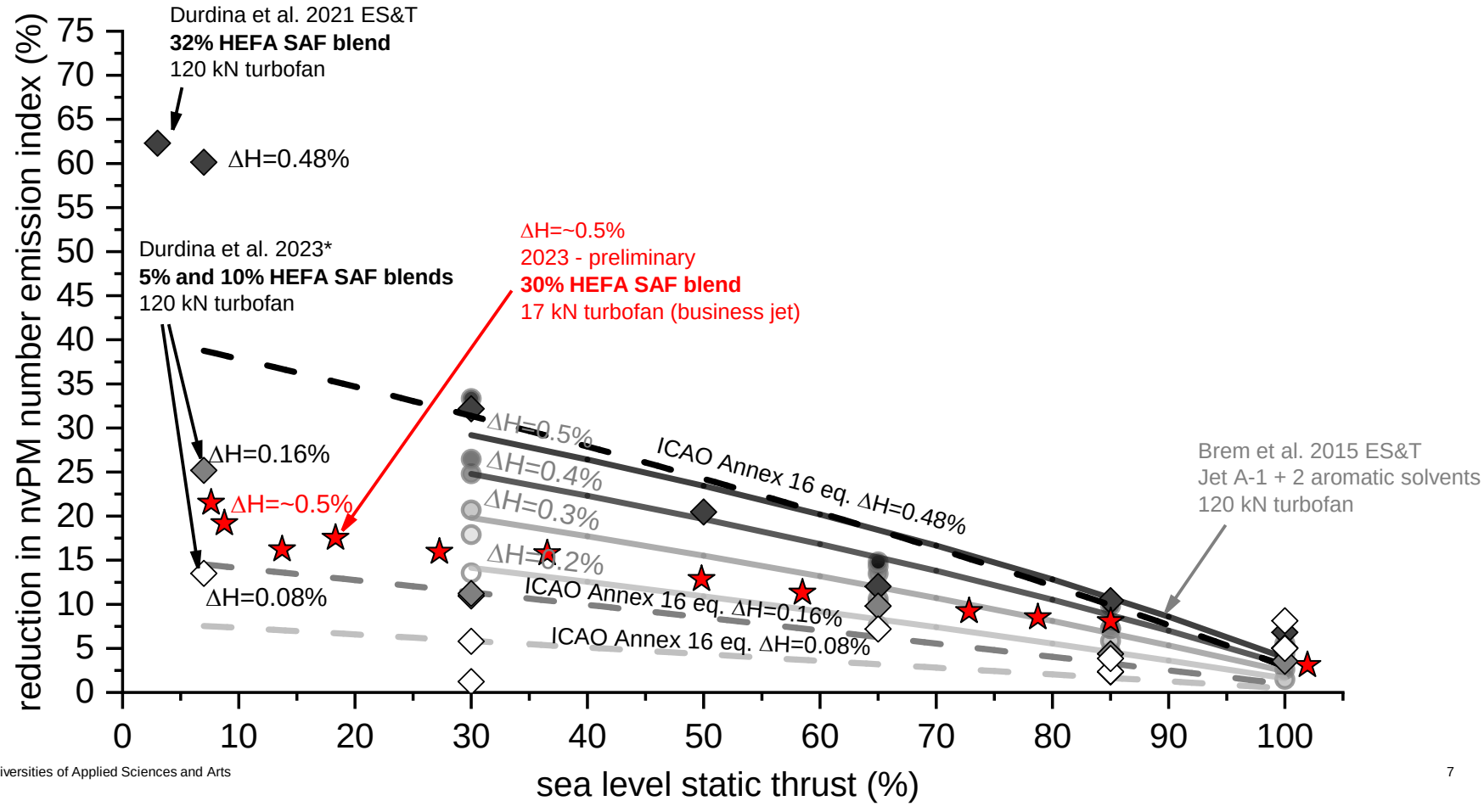
reduction in nvPM number emission index (%)

sea level static thrust (%)

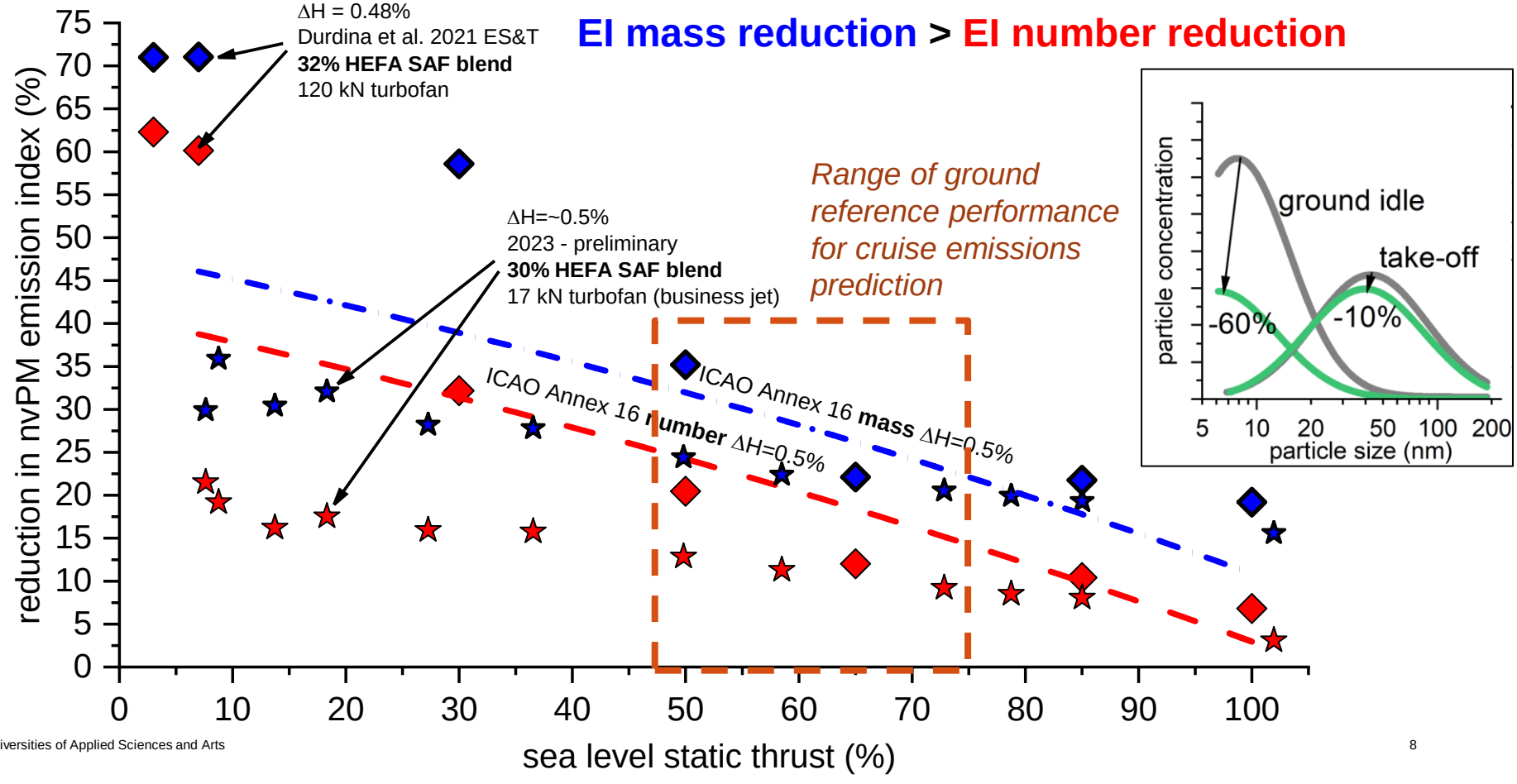
nvPM emission reductions are a function of fuel H content and thrust



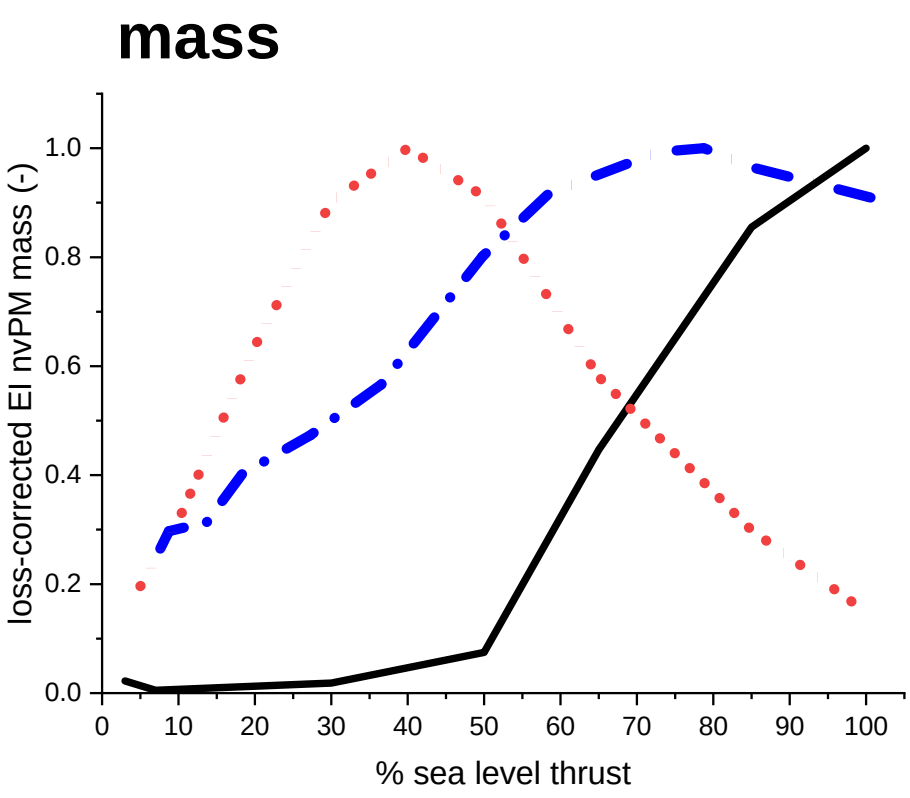
nvPM emission reductions are a function of fuel H content and thrust

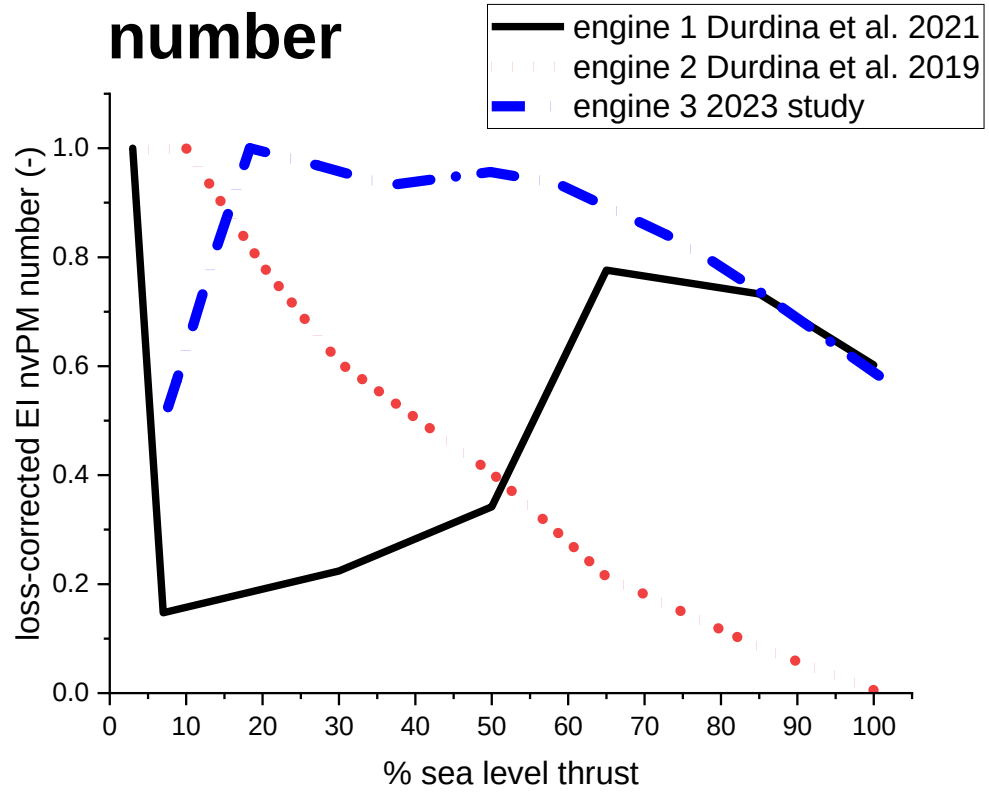


Mass reductions > number reductions due to smaller GMD and GSD

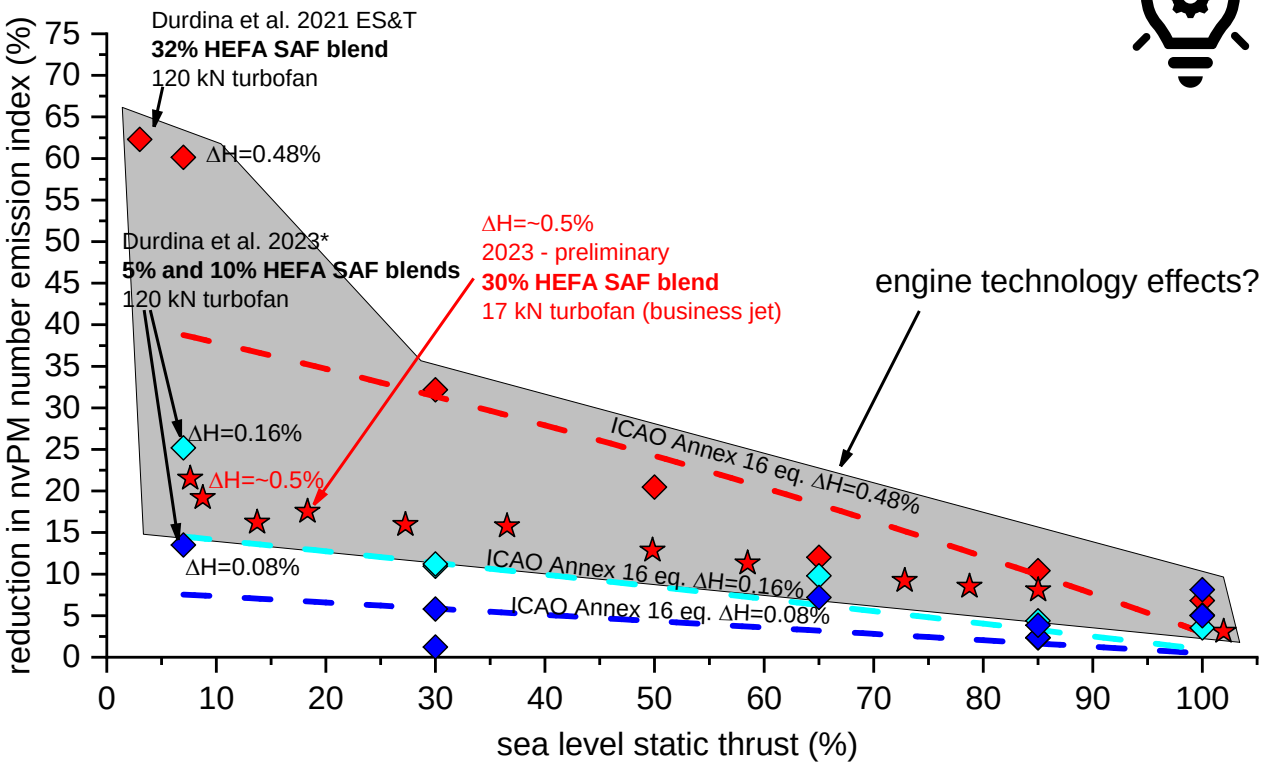


Absolute reductions strongly depend on nvPM emission characteristics of a given engine type





Summary



- Large differences in SAF effects between a large turbofan engine and a smaller business jet
- **More (standardized) data needed (different engine types and SAF types) to develop more robust fuel composition correction models for nvPM**
- Cruise emissions reduction significant only with high blending ratios
- LAQ benefits at low power (idle) already with a 10% blend