AVIATION CO_2 REDUCTIONS

STOCKTAKING SEMINAR

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS

STOCKTAKING 2020 | ICAO

Novel aircraft technological concepts

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Representative Benefits from NASA N+3 (Far Term) Concept Studies

note: subsequent NASA studies have predicted varying benefits – assessments continue

Boeing SUGAR High (737–800 like baseline, 900 nm)

- ~56% fuel burn/energy/CO_2 reduction with conventional fuel

Boeing SUGAR Volt (737–800 like baseline, 900 nm)

- ~60% fuel burn reduction, ~54% energy use reduction, Life-cycle CO_2 reduction dependent on electricity source

Boeing N+4 SUGAR Freeze Hybrid UDF (737–800 like baseline, 900 nm)

- ~64% fuel weight (LNG vs. baseline with Jet-A), ~60% energy use reduction, ~68% CO_2 reduction

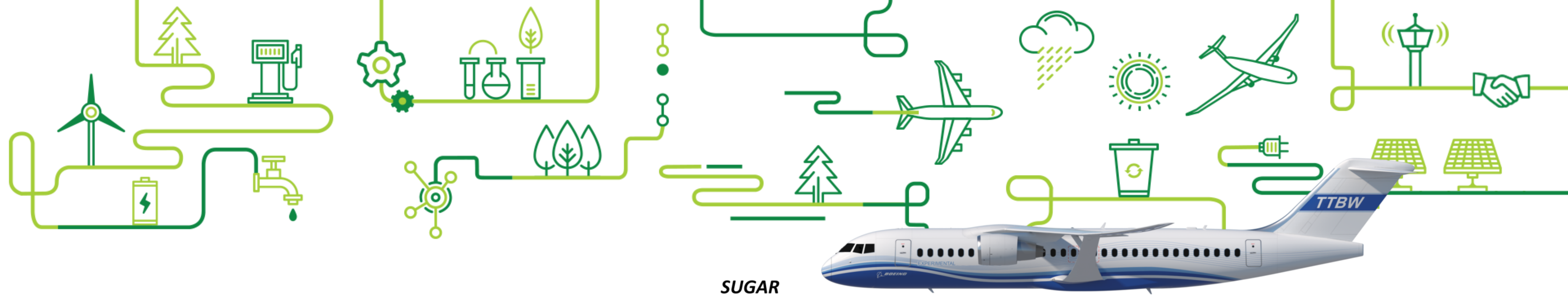
MIT D8.6 (737–800 like baseline)

- ~66% fuel burn/energy/CO_2 reduction with conventional fuel

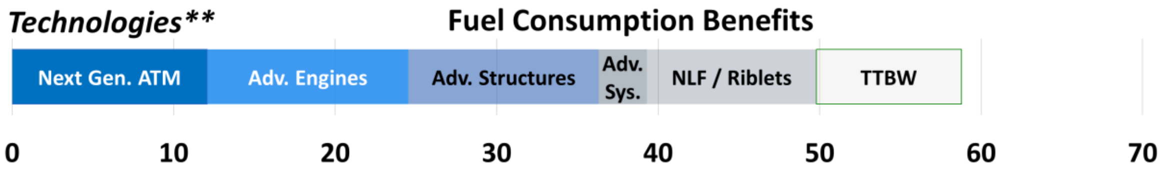
N3–X (Boeing 777–200 like baseline)

- ~70% fuel burn/energy/CO_2 use reduction with conventional fuel

Advanced concept studies for commercial subsonic transport aircraft for 2030-35 EIS



SUGAR Single Aisle Evaluated Against NASA Goals @ 3,500 nm



Technology Benefits	Technology Generations Compared to TTBW		
	Mid Term 2025 - 2035	TTBW	SUGAR
Noise (cum below Stage 4)	32 to 42 dB	-	32 dB
LTO NOx Emissions (below CAEP 6)	80%	11%*	75%*
Cruise NOx Emissions (rel. to 2005 best in class)	80%	12%*	76%*
Aircraft Fuel/Energy Consumption (rel. to 2005 best in class)	50 to 60%	9%	59%

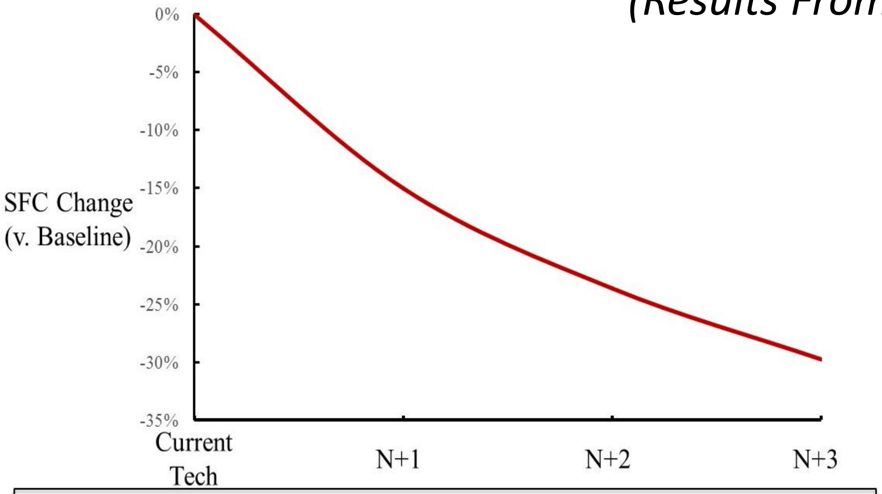
* Emissions Deltas Scaled by Fuel Burn

** SUGAR Technologies – A suite of integrated technologies including TTBW

Does not include potential benefits of hybrid-electric

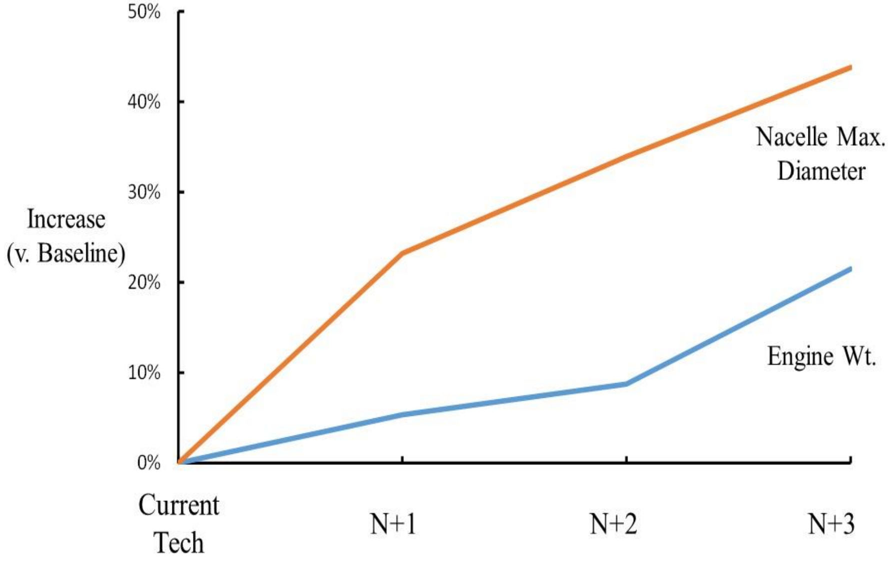
Propulsion System Trends for Single-Aisle Thrust Class

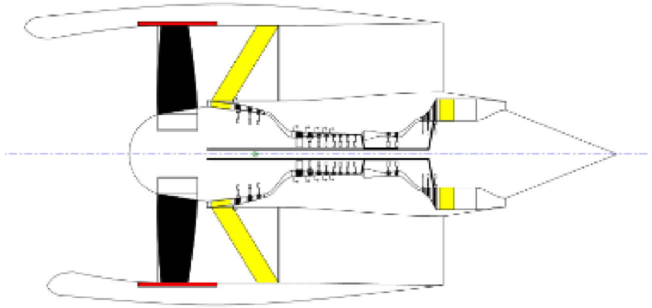
(Results From NASA In-house Benefit Assessments)



	Current Tech	N+1	N+2	N+3
BPR_{DES}	5	14	19	24
HPC Wc_{exit}	~7	5.4	3.7	~3

(Engines Sized for Approximately Same Thrust)





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- SFC reductions possible through higher OPRs, turbomachinery eff. gains, advanced cooling schemes and increased propulsive efficiency (i.e., lower FPR)
- Challenge to maintain high component efficiencies at smaller engine core size
- Engine weight/diameter increases will limit the fuel burn reductions that are achievable in practice

Next Generation Single-Aisle Transport

Technology

Transonic truss-braced wing concept with high efficiency small core engines and potential electrification of propulsion system, supported by high rate composite manufacturing

CO_2 reductions per flight — **60%**
Relative to 2005 best-in-class

Level of finance required — **TBD**

Timeframe — **2032**

Main challenges:

- Unique airframe / propulsion system certification
- Cost of advanced technology
- High rate manufacturing

Thank You

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