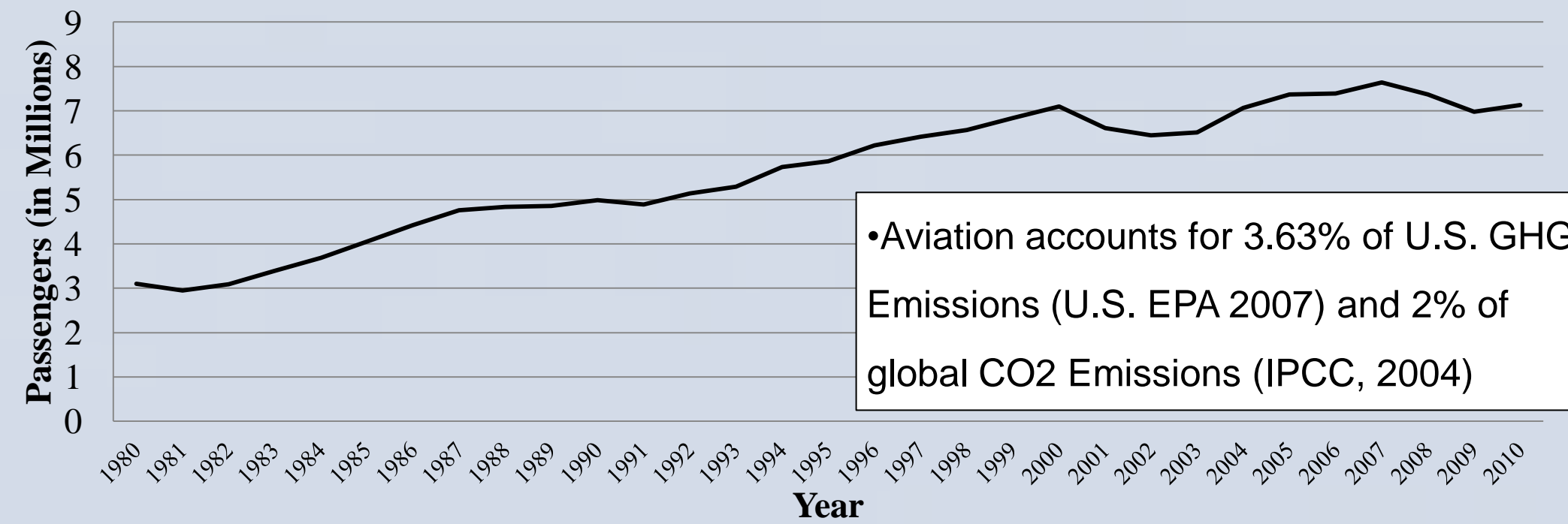
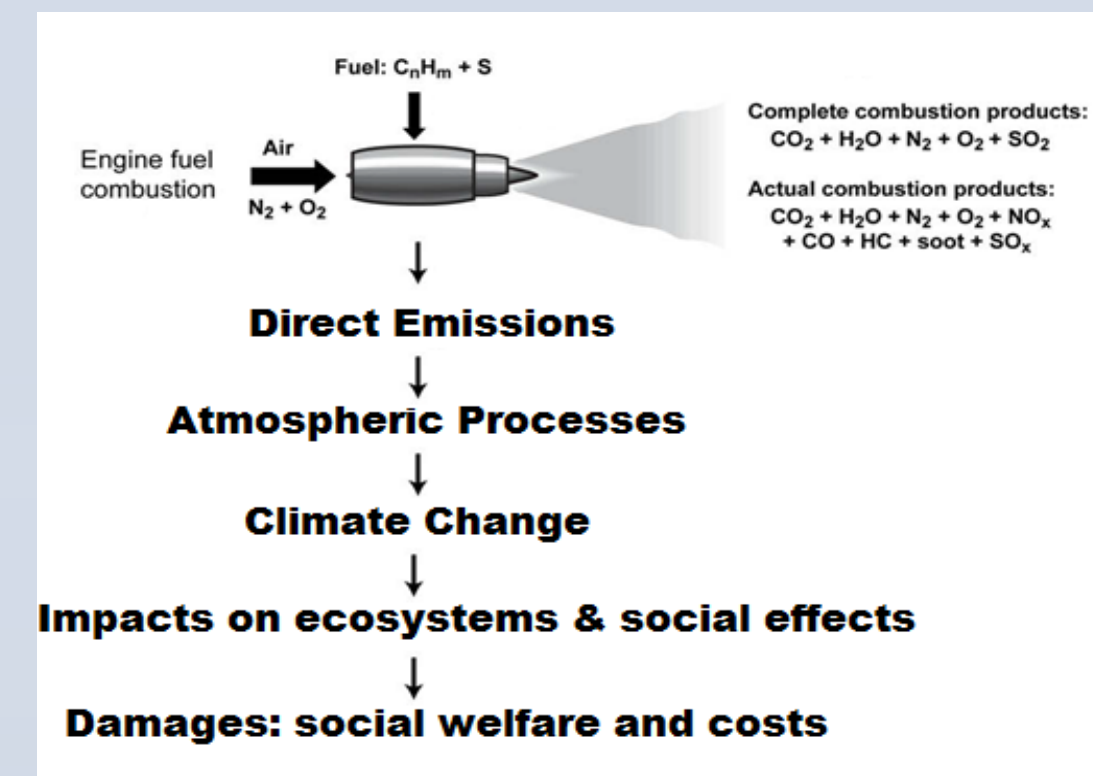


Context

Enplanements at U.S. Airports



•Aviation accounts for 3.63% of U.S. GHG Emissions (U.S. EPA 2007) and 2% of global CO2 Emissions (IPCC, 2004)



CO2 from emissions impacts atmospheric processes, climate change.

People care about social effects and costs of emissions impacts

Problem and Design Alternatives

Problem Statement:

Airports need to achieve carbon neutral growth operating an enterprise with limited control

- Carbon neutral growth by 2020
- Baseline of 2005
- Zero net growth of emissions by 2050

Design Alternatives:

Alternative	How will this impact emissions	Goal	Utility Value	CO2 Reduced (kg) Annually
Minimize the Use of Auxiliary Power Units (APUs)	Decrease emissions through APU, supplement APU with electric ground power	50% reduction in emissions from APU	0.63	6,129,651
Install Sustainable, Long-term Vegetation	Offset CO2 Emissions through trees (CO2 removed based on tree diameter)	4 acres of mature trees (planted 10 feet apart, each absorbing 10 kg CO2 annually)	0.63	17,400
Alternatively Fueled Taxis	Convert Taxi Fleet to Hybrid (Control through MWA Contract)	100% Taxi Fleet to Hybrid	0.63	2,545,749
Push Back Tugs	Minimize taxi time, implementing push back tugs reduces taxi time	Reduce Taxi Time 50%	0.62	37,016,242
Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles	Convert Rental Cars from Gas to Hybrid	50% Rental Fleet to Hybrid	0.62	24,111,294
Fuel Efficiency Targets for Aircraft	Higher efficiency, less fuel burned, lower emissions/LTO	50% inc in efficiency per aircraft	0.60	125,591,052
Implement Emission-based Incentives and Landing Fees	Incentivize landing more efficient aircraft, lower emissions/LTO	Shift total annual LTO per aircraft class to most efficient aircraft in that class	0.52	63,968,930
Provide Transit Fare Discounts and/or Alternative Mode Subsidies	Promote using low emission vehicles for airport transport	10% GAV to Hybrid	0.52	17,093,539
Provide Priority Vehicle Parking for Emissions Friendly Vehicles	Priority Parking encourages driving Emissions Friendly Vehicles	2% GAV to Hybrid	0.50	1,084,202
Alternatively Fueled Ground Service Equipment (GSE)	Convert GSE from Gas/Diesel to Electric Power	50% GSE to Electric Power	0.48	10,386,825
Development of Alternative Fuels for Aircraft	Alternative fuels have lower Emission Index compared to Jet A Fuel	50% fuel mix in all engines	0.32	67,920,449

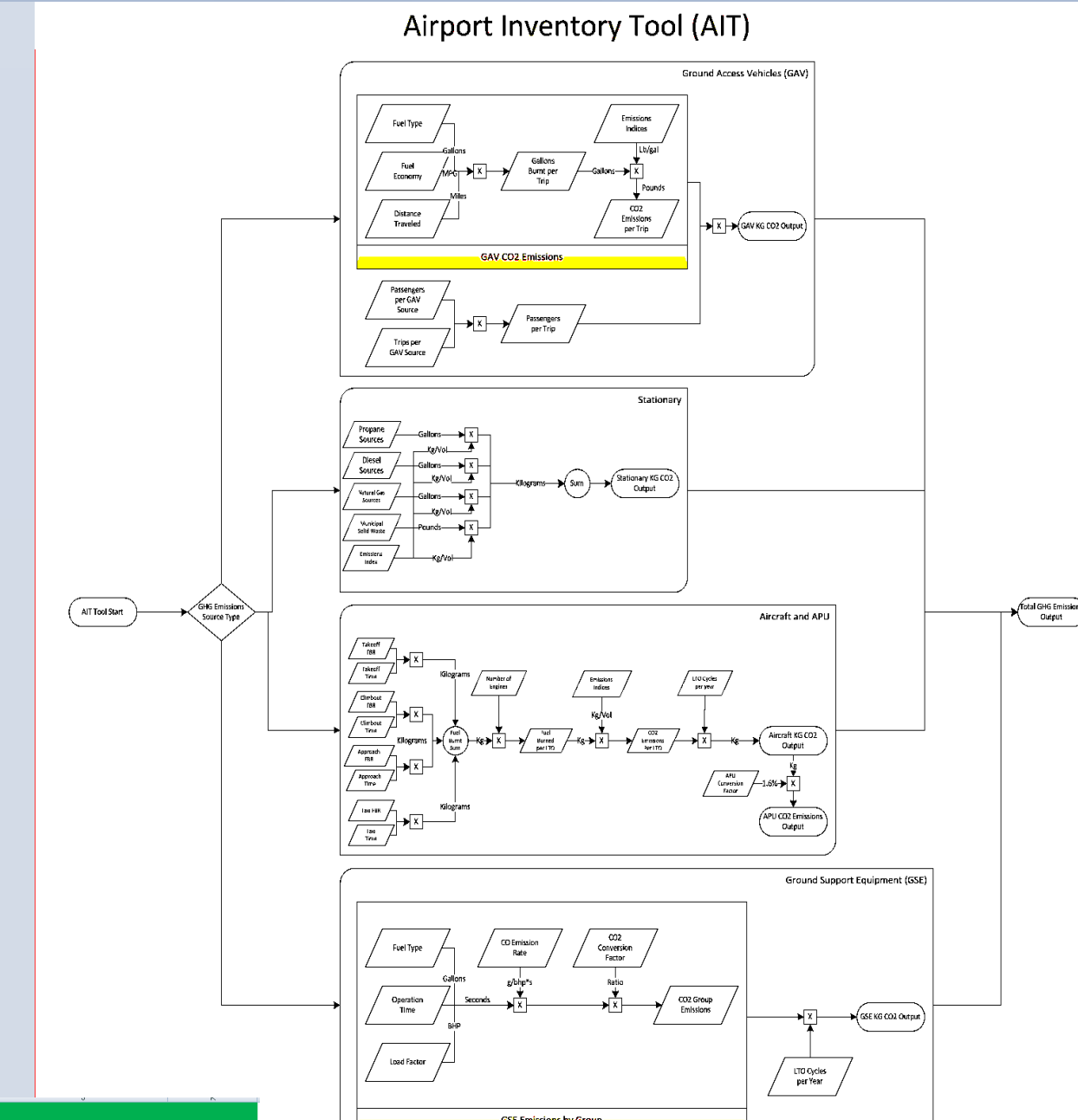
$$\text{Utility} = 0.15(\text{Implementation Time Score}) + 0.15(\text{Maturity of Reduction Strategy Score}) + 0.30(\text{Airport Control Score}) + 0.40(\text{Emissions Reduction Score})$$

Method of Analysis

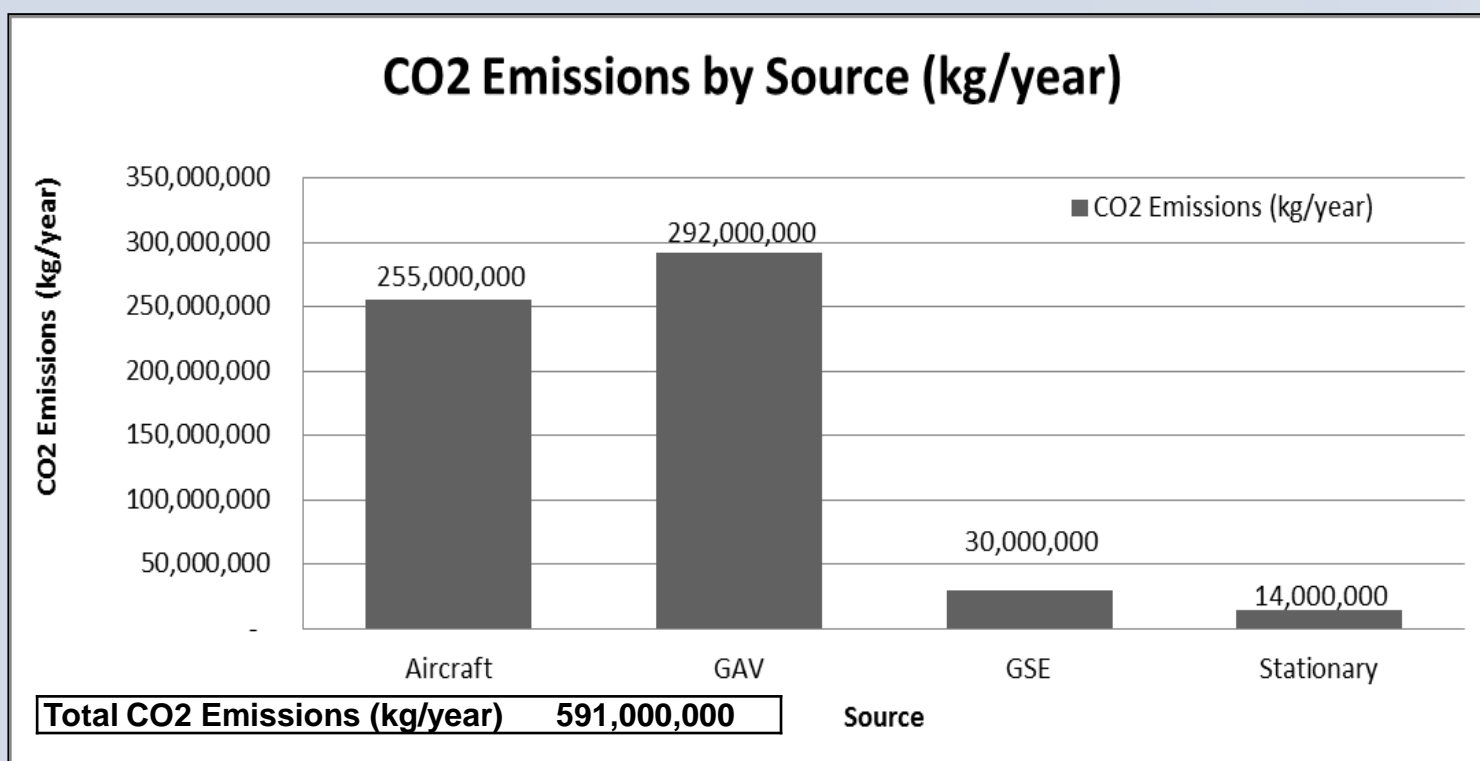
Airport Inventory Tool (AIT)

- User: airport manager
- Purpose: tradeoff analysis

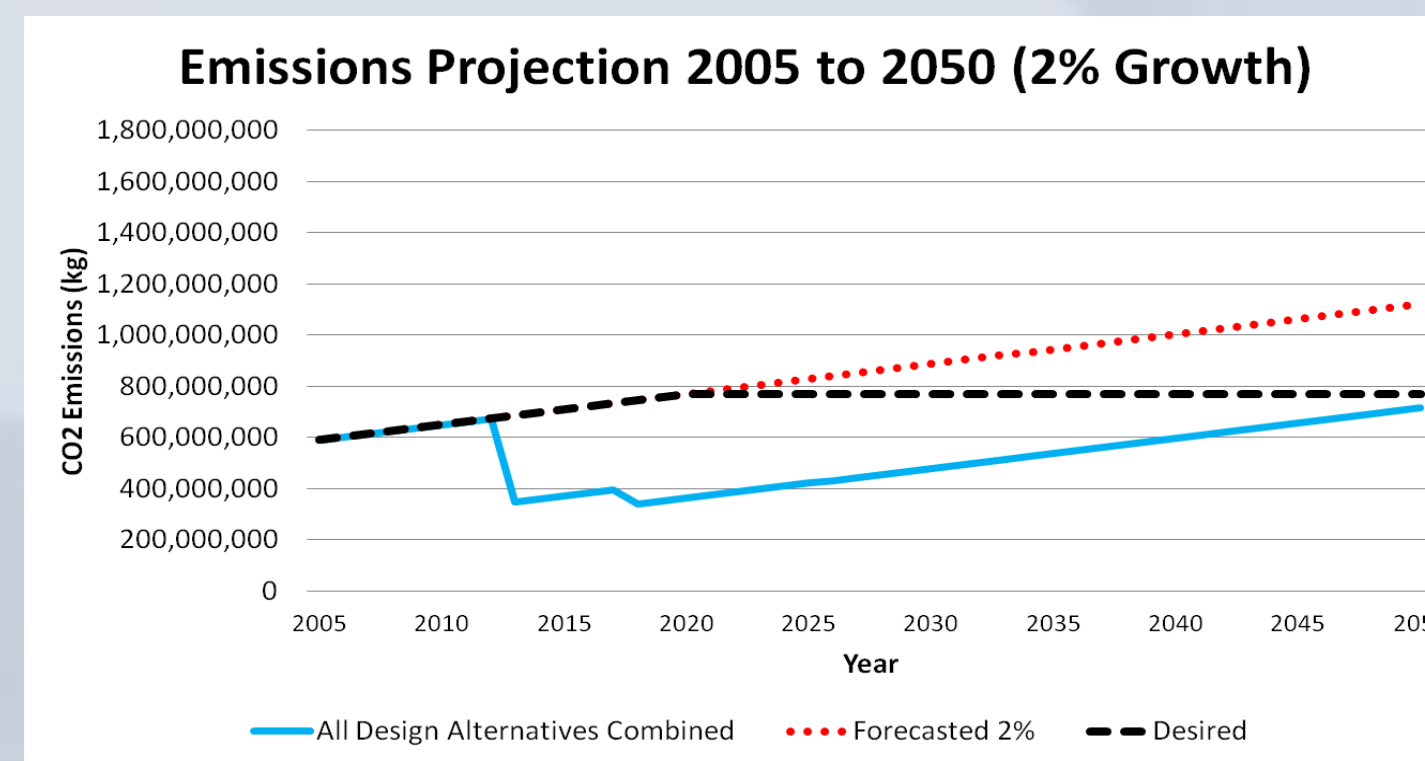
of design alternatives vs. baseline emissions calculation for carbon neutral growth



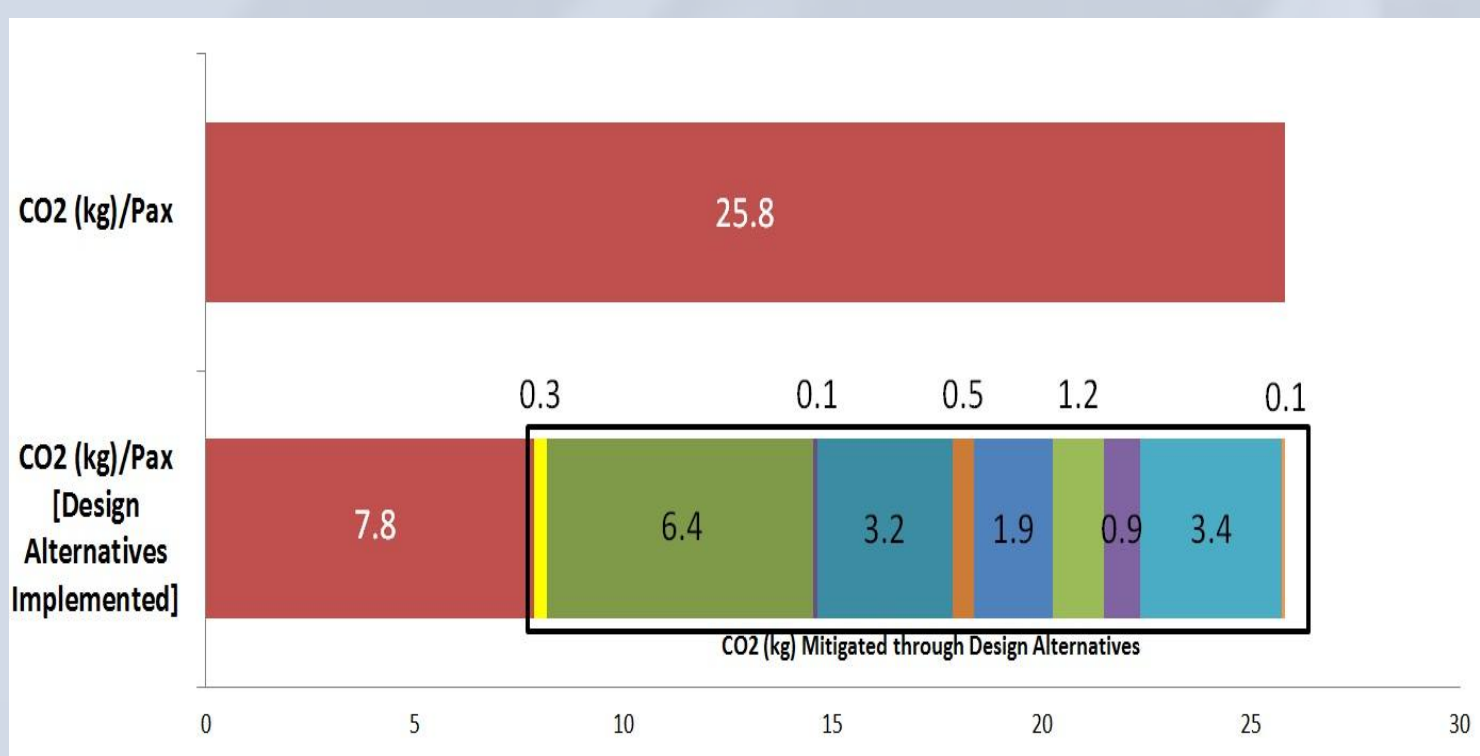
Results



Output from AIT shows GAV and Aircraft are two largest contributors of emissions



2% forecasted growth rate*:
•carbon neutral growth can be achieved with margin of 51 million kg CO2 in 2050

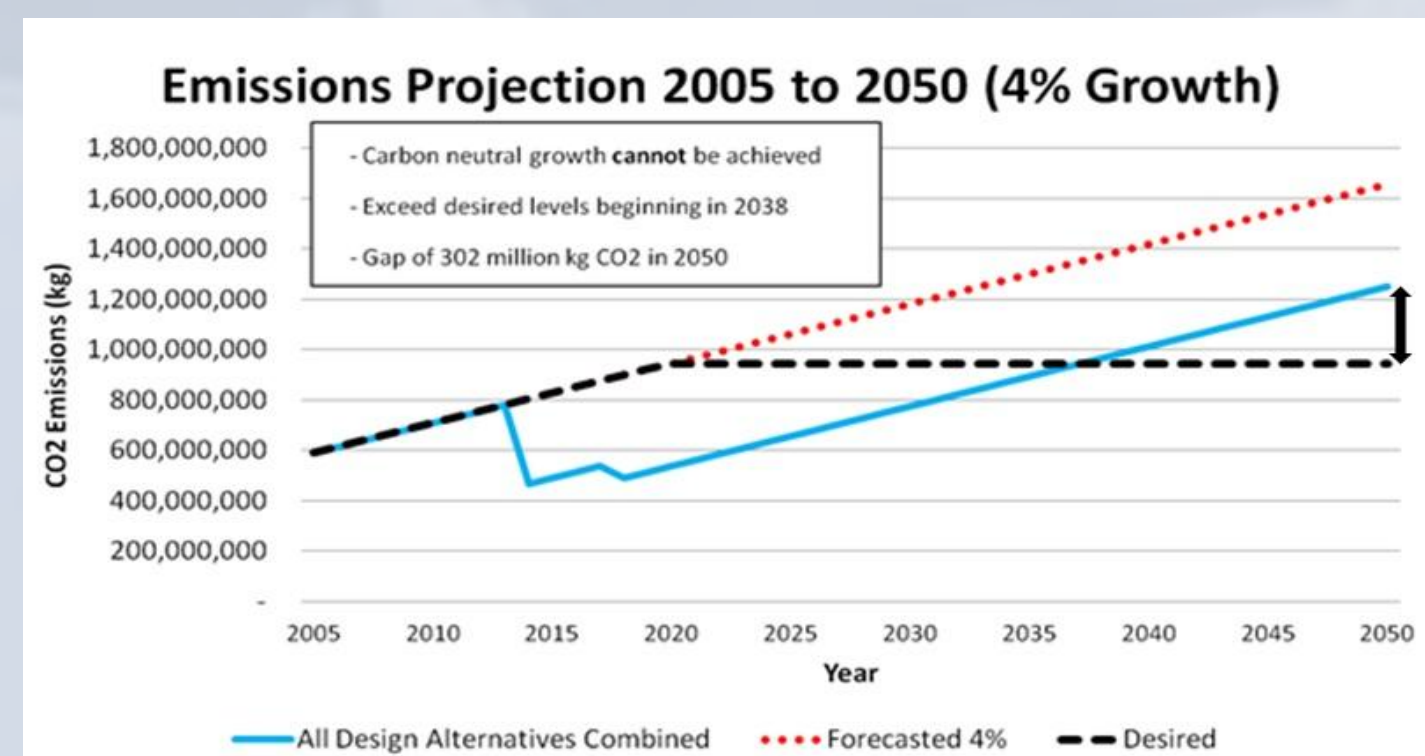


CO2 (kg)/Pax [without mitigation] **25.8 kg**

CO2(kg)/Pax [with design alternatives] **7.8 kg**

7.8 kg

18.0 kg mitigated



4% forecasted growth rate*:
•carbon neutral growth cannot be achieved
•mitigated emissions exceed desired levels beginning in 2038
•result in a gap of 302 million kg CO2 in 2050

* Assuming uninhibited implementation of all design alternatives in 2013

Conclusions & Future Work

Design Alternative Recommendations:

1. Minimize use of APUs by using ground power
2. Implement Push Back Tugs to Reduce Taxi Time CO2 emissions
3. Alternatively Fueled Airport Access Taxis (e.g. Hybrids or Electric vehicles)

Inhibiting Factors to Carbon Neutrality:

- Technology (Aircraft)
- Cost of changes and limitations on available capital for CO2 mitigation
- Stakeholder Disagreement: Disagreement between people and policy; Required cooperation between multiple regulatory agencies

Future Work:

- Evaluate how advances in technology impact ability to attain carbon neutral growth
- Evaluate the use of 'green' ticket fee to cover carbon offsets and invest in new technology