Airport Sustainability Assessment

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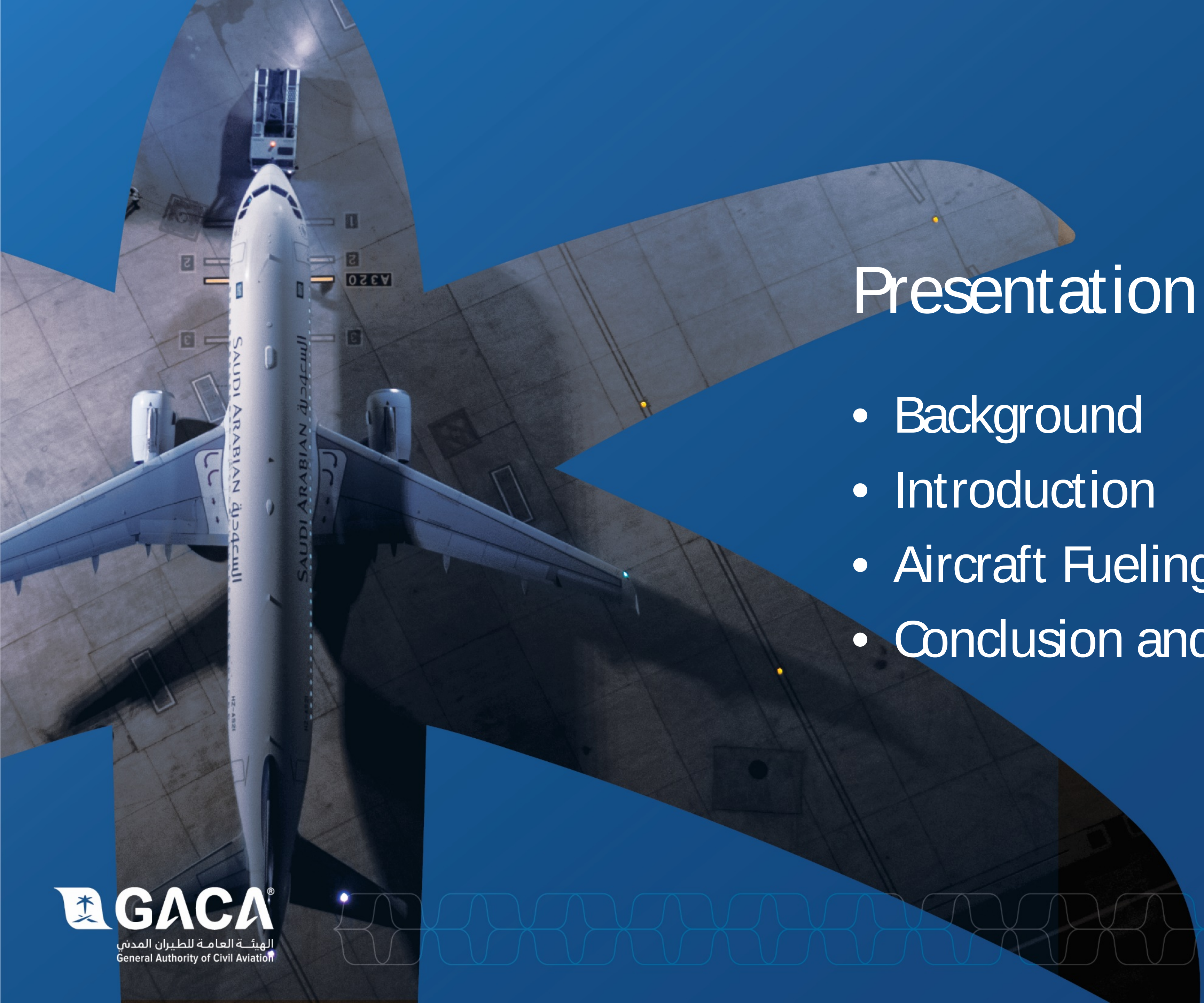
General Authority of Civil Aviation

VISION رؤيـــة
2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA



Presentation Outlines

- Background
- Introduction
- Aircraft Fueling Sustainability Projects
- Conclusion and Recommendations

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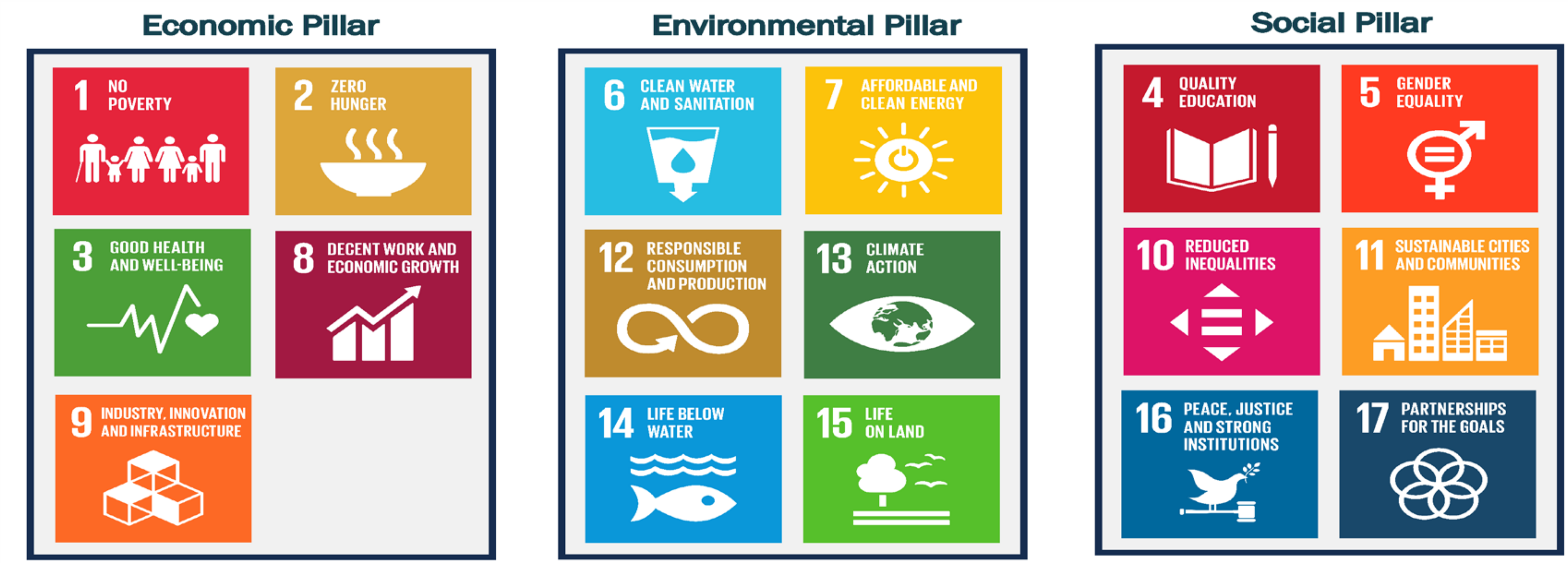
Background

UN Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS

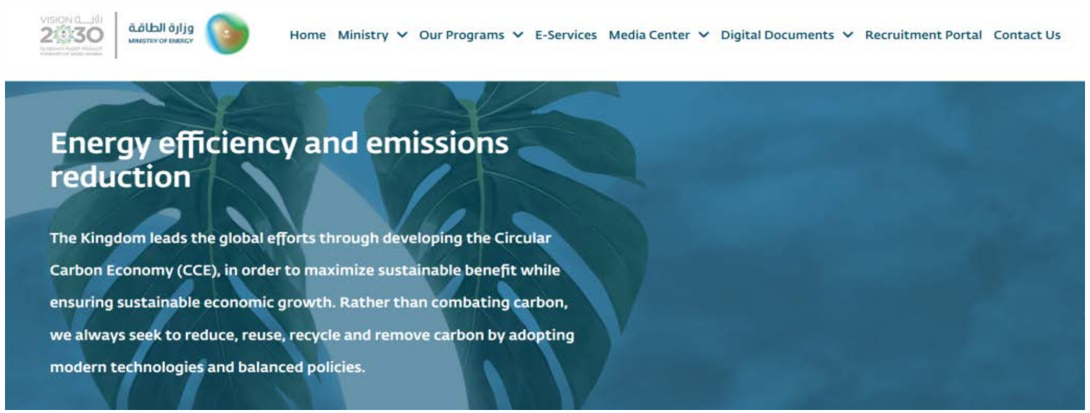


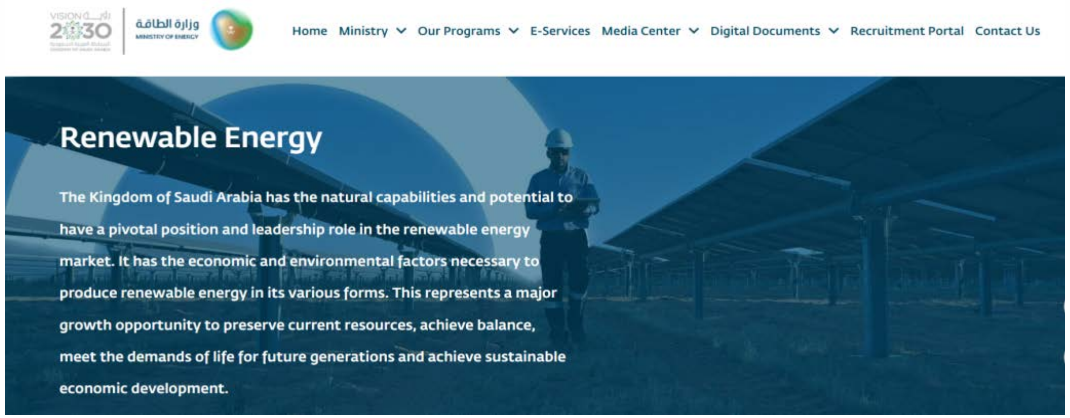
Background

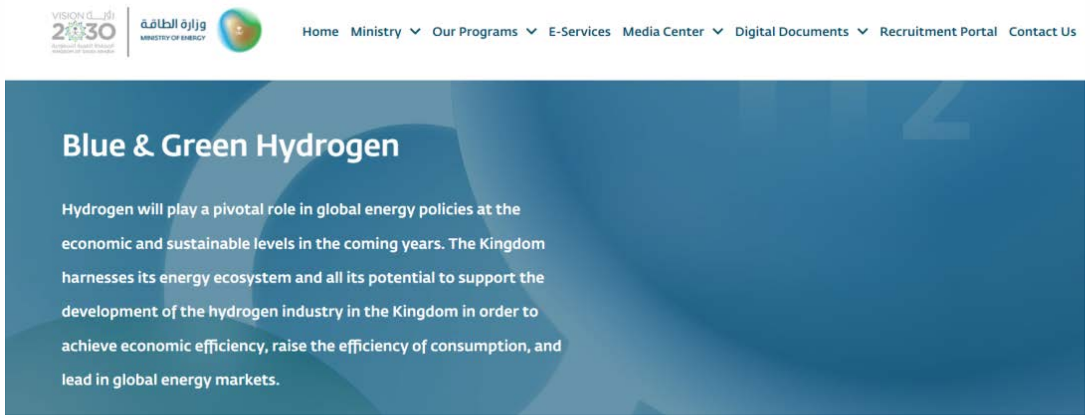
KSA Vision 2030

Background

The Saudi Green Initiative (SGI)



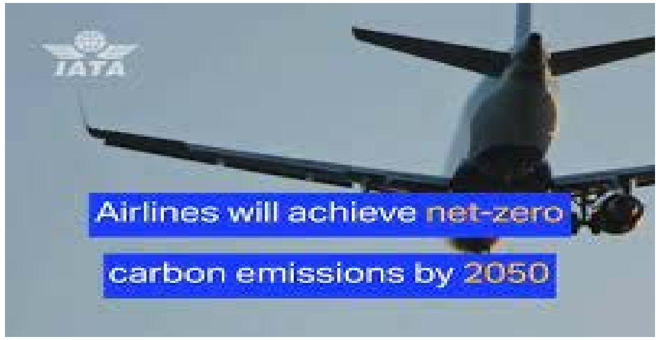




Background

Industry Targets

- At the 77th IATA Annual General Meeting in October 2021, IATA member airlines agreed to commit to net-zero carbon emissions by 2050. The resolution aligns with the Paris agreement to limit global warming to 1.5°C.
- Many of Major oil companies have objective of at least 50% of Net Zero Emission reductions by 2050



Towards the Sustainable Development

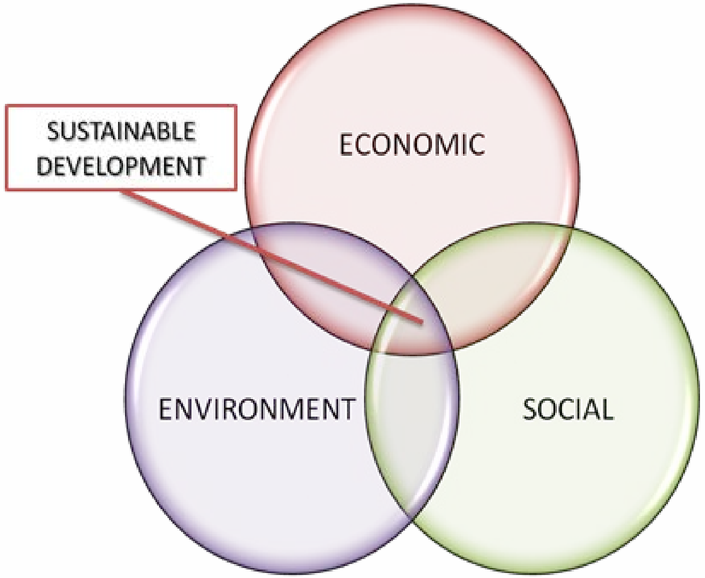
Introduction

Sustainability Development

Definitions and Background

- Scholars have stated that sustainability will be the great challenge of the 21st century
- The United Nations defined Sustainable Development as **"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"**
- Three sustainability dimensions: Economic, Environment and Social

    - Minimize the risk of environmental damage, environmental protection, and ecological sustainability
    - Socio/cultural sustainability recognizing the needs of all
    - Economic sustainability maintaining high and stable levels of economic growth



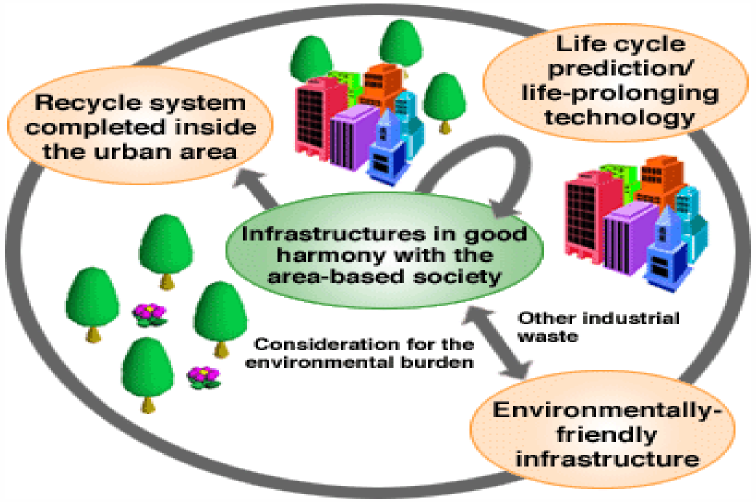
Introduction

Sustainability Development

Definitions and Background

Therefore, the Airport Fueling System, across the overall life cycle (i.e. planning, design, construction, operation, maintenance) should:

- Enhance living and working environments
- Consume minimum energy over their life-cycle
- Generate minimum waste over their life-cycle
- Use renewable resources wherever possible
- Reduce greenhouse gas emissions



(Source: Hokkaido University, 2013)

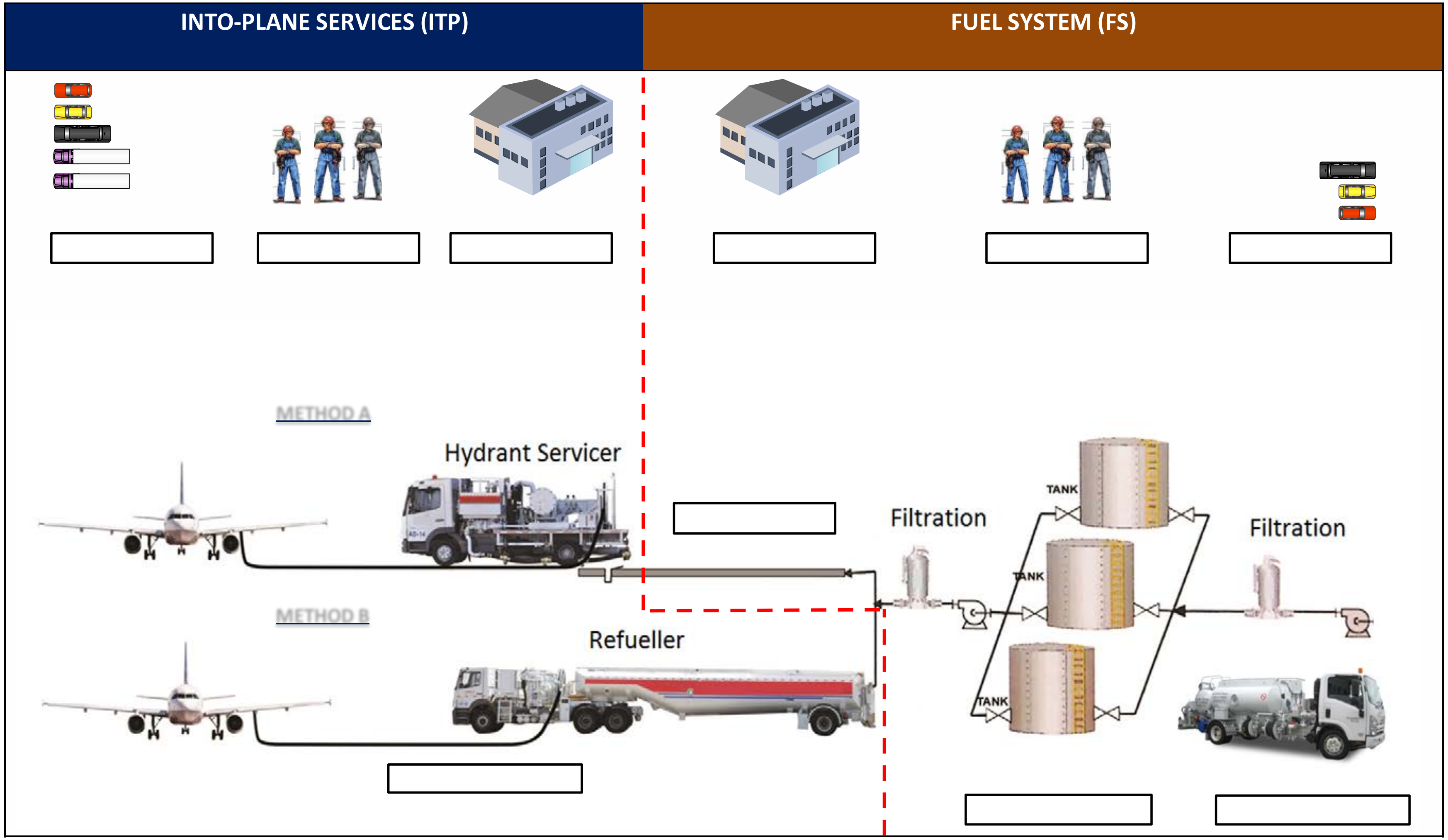
Introduction

Aircraft Fueling Sustainability Project

Economic, environmental and social issues of sustainability should be considered as part of the overall airport fueling project life cycle (i.e. planning, design, construction, operation, maintenance, etc.).

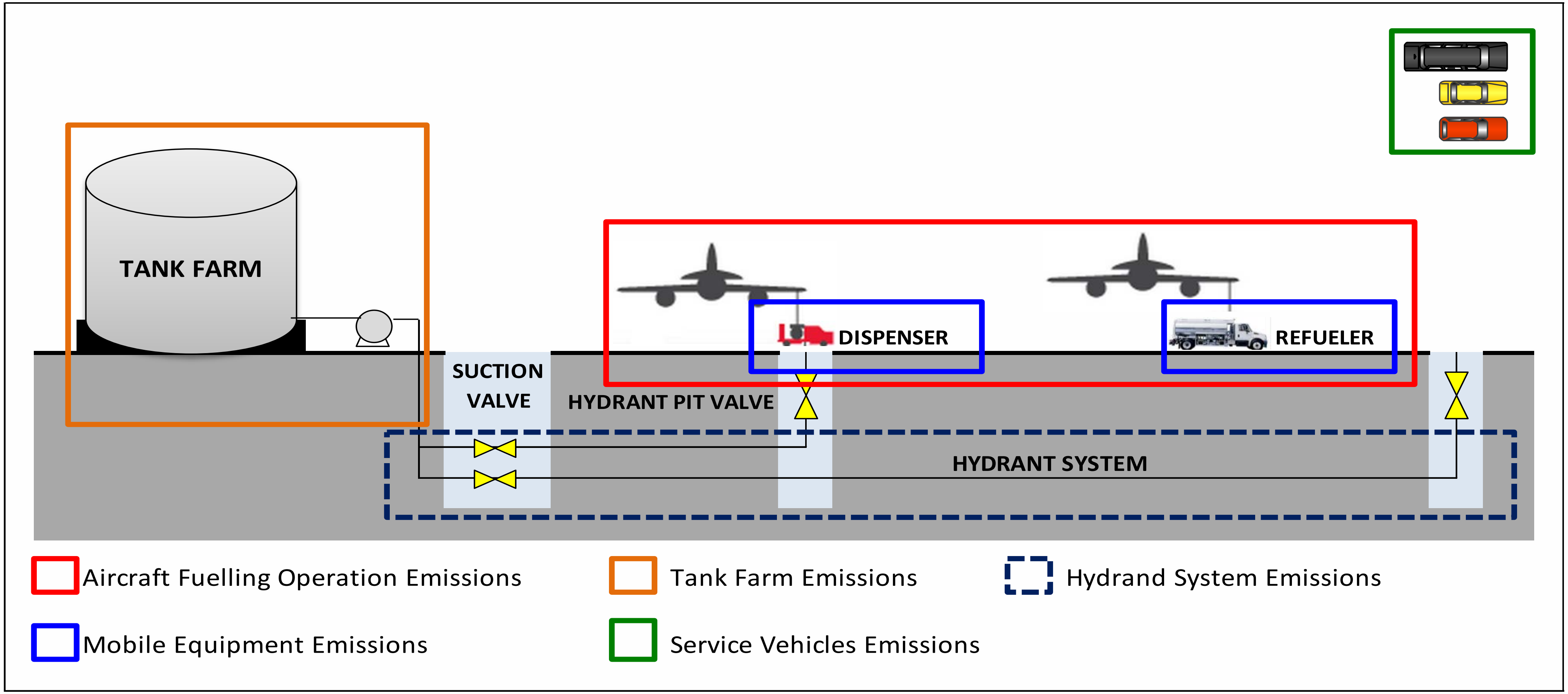
Aircraft Fueling Sustainability Projects

Sustainability Assessment



Aircraft Fueling Sustainability Projects

Analysis



Aircraft Fueling Sustainability Projects

Model Objectives

1. Develop a mathematical sustainability assessment model for airport fueling projects and operations;
2. Develop a mathematical model for analyzing the emissions of airport fueling projects and operations;
3. Develop a mathematical model for analyzing the energy consumption of airport fueling projects and operations; and
4. Validate all three models using case studies

Aircraft Fueling Sustainability Projects

Sustainability Assessment Model

Model Objective #1: Development of a Sustainability Model for Airport Fueling Projects

Input
- Define applicability and importance for all sustainability criteria

Assessment
- Assess project alternatives against the sustainability sub-criteria (environmental, economic, and social)

Output
- Determined sustainability index for each project alternative

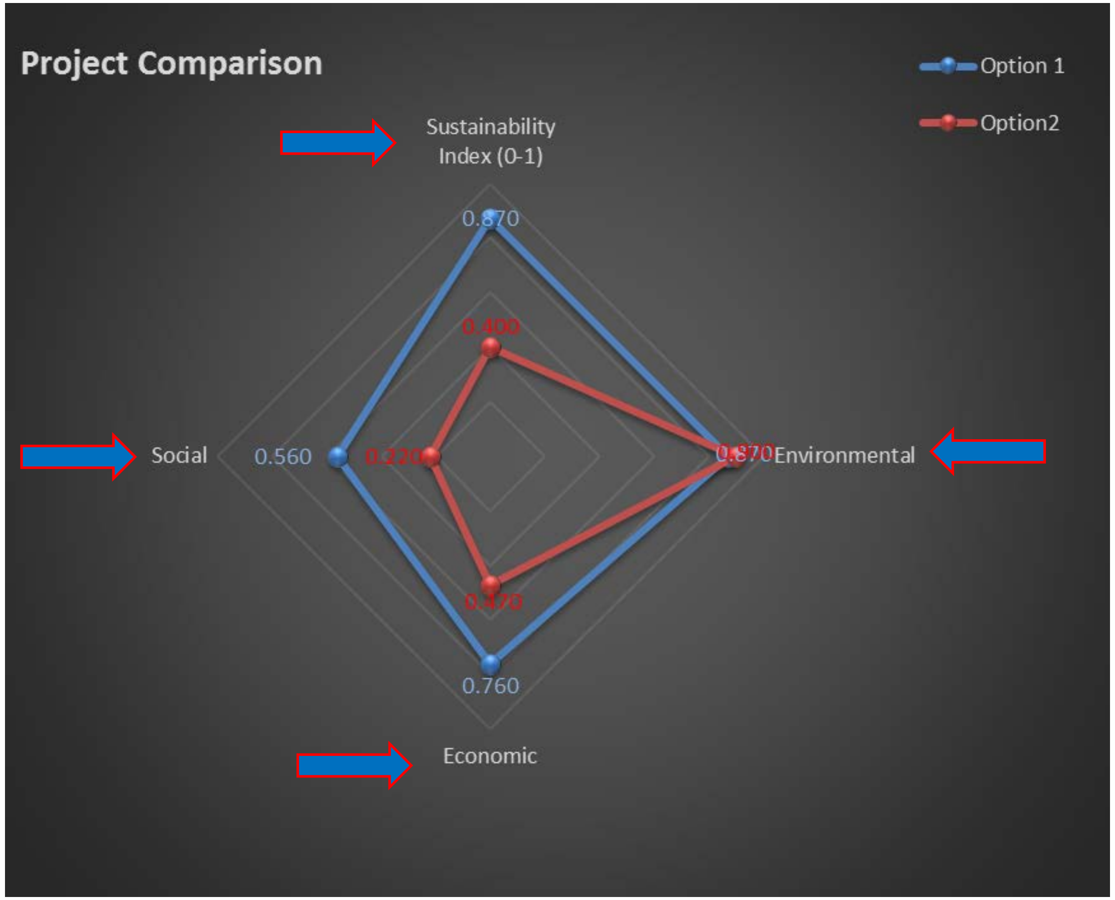
Model Structure

Aircraft Fueling Sustainability Projects

Model Output

Model Objective #1: Development of a Sustainability Model for Airport Fueling Projects

A	Environmental	B	Economic	C	Social
A1	Administrative procedures	B1	Economic performance analysis	C1	Occupational health and safety
A1.1	Cooperative sustainability policy	B1.1	Life cycle cost	C1.1	Representation in Health, Safety, Security and Environment (HSSE) committees



- The model output presents the aggregation and calculations of the sustainability index for each project alternative

Aircraft Fueling Sustainability Projects

Emission Model Structure

Model Objective #2: Development of Aircraft Fueling Emissions Analysis Model for Airport Projects

Input

- Design and operational data

Emissions Calculations

- Aircraft fueling and defueling
- Aviation fuel storage tanks
- Hydrant system operations
- Vehicle traffic

Output

- Environmental impact
- Economic impact
- Social impact

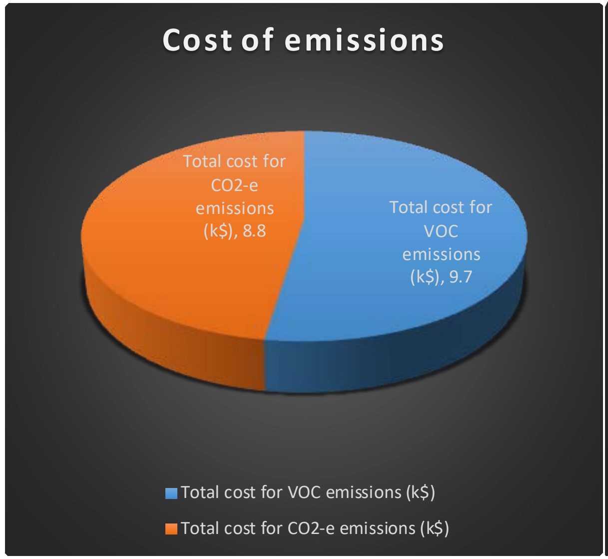
Aircraft Fueling Sustainability Projects

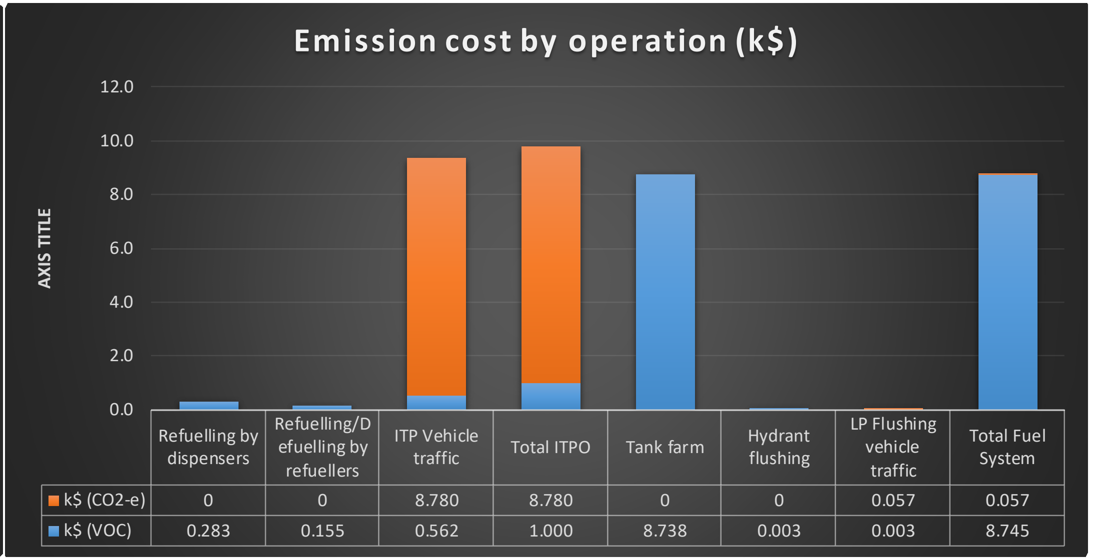
Economic Impact

Model Objective #2: Development of Aircraft Fueling Emissions Analysis Model for Airport Projects

Total Financial calculations

Economic Impact	per year	Units
Unit cost to recover VOC [2]	2,420.0	$/tn VOC reduced
Total cost for VOC emissions (k$)	9.7	k$
Unit cost for to off-set CO2-e [4], [5]	16.2	$/tn CO2 offset
Total cost for CO2-e emissions (k$)	8.8	k$
Total cost	18.6	k$





	ITPO				Fuel System				
	Refuelling by dispensers	Refuelling/Defuelling b	ITP Vehicle traffic	**Total ITPO**	Tank farm	Hydrant flushing	LP Flushing vehicle traf	**Total Fuel System**	
k$ (VOC)	0.283	0.155	0.562	**1.000**	8.738	0.003	0.003	**8.745**	k$
k$ (CO2-e)	0	0	8.780	**8.780**	0	0	0.057	**0.057**	k$
				9.780				**8.801**	k$

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Aircraft Fueling Sustainability Projects

Energy Model Structure

Model Objective #3: Development of Aircraft Fueling Energy Consumption Analysis Model for Airport Projects

Input

- Design and operational data

Energy consumption calculations

- Pumps
- instruments
- Buildings
- Vehicle traffic

Output

- Environmental impact
- Economic impact
- Social impact

Aircraft Fueling Sustainability Projects

Economic Impact of Airport Fueling Energy

Model Objective #3: Development of Aircraft Fueling Energy Consumption Analysis Model for Airport Projects

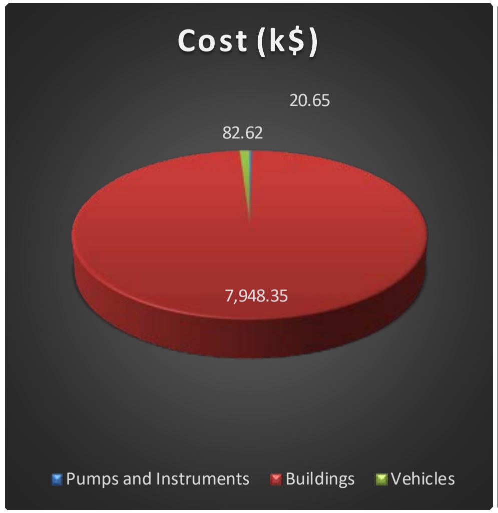
Economic impact calculations

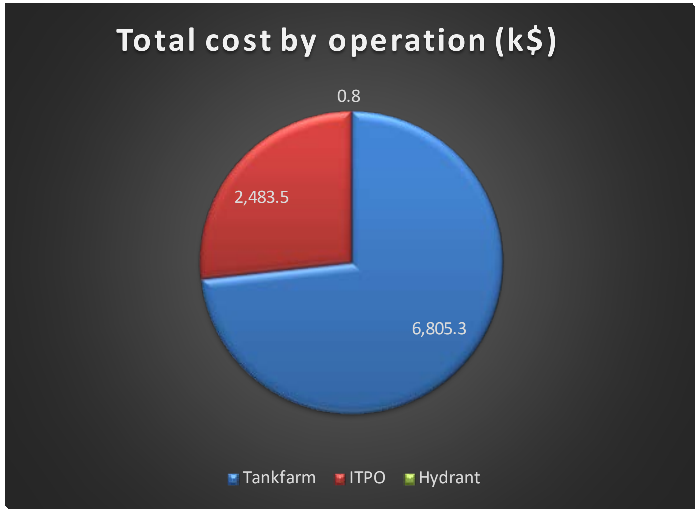
Pumps and Instruments	Energy Consumption	Units	Cost of electricity	Units	Cost of CO_2 offset	Units
Pumps-Tankfarm	**43,209.5**	kWh	**3.69**	k$	**0.56**	k$
Instruments-Tankfarm	**193,070.4**	kWh	**16.48**	k$	**2.50**	k$
Pumps-Hydrant	**0.0**	kWh	**0.00**	k$	**0.00**	k$
Instruments-Hydrant	**5,742.2**	kWh	**0.49**	k$	**0.07**	k$
Total	**242,022.1**	kWh	**20.65**	k$	**3.13**	k$

Buildings	Energy Consumption		Cost of electricity		Cost of CO_2 offset	
Tankfarm	**69,015,660.0**	kWh	**5,889.31**	k$	**892.79**	k$
ITPO	**24,129,420.0**	kWh	**2,059.04**	k$	**312.14**	k$
Hydrant	**0.0**	kWh	**0.00**	k$	**0.00**	k$
Total	**93,145,080.0**	kWh	**7,948.35**	k$	**1,204.92**	k$

Vehicles	Fuel consumption		Cost of fuel		Cost of CO_2 offset	
ITPO vehicles (Diesel engines)	**686,835.0**	lt	**82.42**	k$	**29.96**	k$
Hydrant Vehicles (Diesel engines)	**1,687.6**	lt	**0.20**	k$	**0.07**	k$
ITPO vehicles (Gasoline engines)	**0.0**	lt	**0.00**	k$	**0.00**	k$
Hydrant Vehicles (Gasoline engines)	**0.0**	lt	**0.00**	k$	**0.00**	k$
Total		lt	**82.62**	k$	**30.03**	k$

Total Cost of Electricity	**7,969.00**	k$
Total Fuel cost	**82.62**	k$
Total cost to offset CO2 emissions	**1,238.08**	k$
TOTAL	**9,289.71**	k$





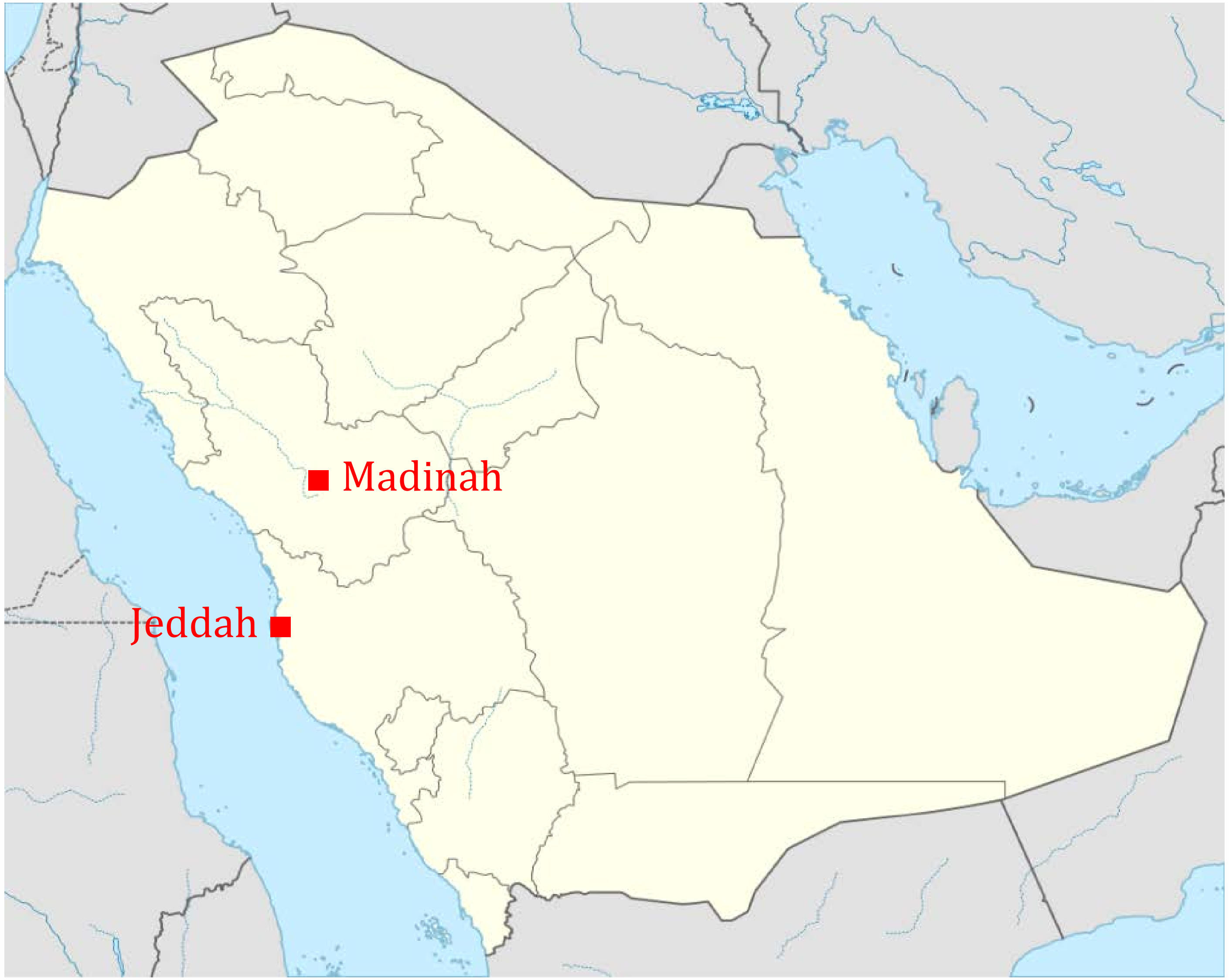
	Energy cost	Fuel cost	CO_2 offset	**Total**
Tankfarm	5,909.5	0.0	895.8	**6,805.3**
ITPO	2,059.0	82.4	342.1	**2,483.5**
Hydrant	0.5	0.2	0.1	**0.8**

Aircraft Fueling Sustainability Projects

Model Objectives Validation

Two case studies for two international airports projects:

- Prince Mohammed bin Abdulaziz International Airport (PMIA) in Madinah
- King Abdulaziz International Airport (KAIA) in Jeddah



Aircraft Fueling Sustainability Projects

Model Objectives Validation

Case Study 1: PMIA Project

- Total cost of approximately US$1.5 billion
- Annual capacity of 16 million passengers
- The passenger terminal became the first gold Leadership in Energy and Environmental Design (LEED) certified building in the Middle East-North Africa (MENA) region
- This case study includes the into-plane fueling facility project and tank farm project

Aircraft Fueling Sustainability Projects

Results of Case Study 1: PMIA Project

Case 1 Project Alternatives

Project Alternatives	Into-plane	Tank Farm
Alternative 1	O1+L1	D1+L3
Alternative 2	O1+L2	D1+L3
Alternative 3	O2+L1	D1+L3
Alternative 4	O2+L2	D1+L3
Alternative 5	O1+L1	D2+L4
Alternative 6	O1+L2	D2+L4
Alternative 7	O2+L1	D2+L4
Alternative 8	O2+L2	D2+L4

O: Operation; **D**: Design; **L**: Location

Aircraft Fueling Sustainability Projects

Results of Case Study 1: PMIA Project

Case Study 1 - Sample

OUTPUT

Instructions

Sustainability Index **Option 1**

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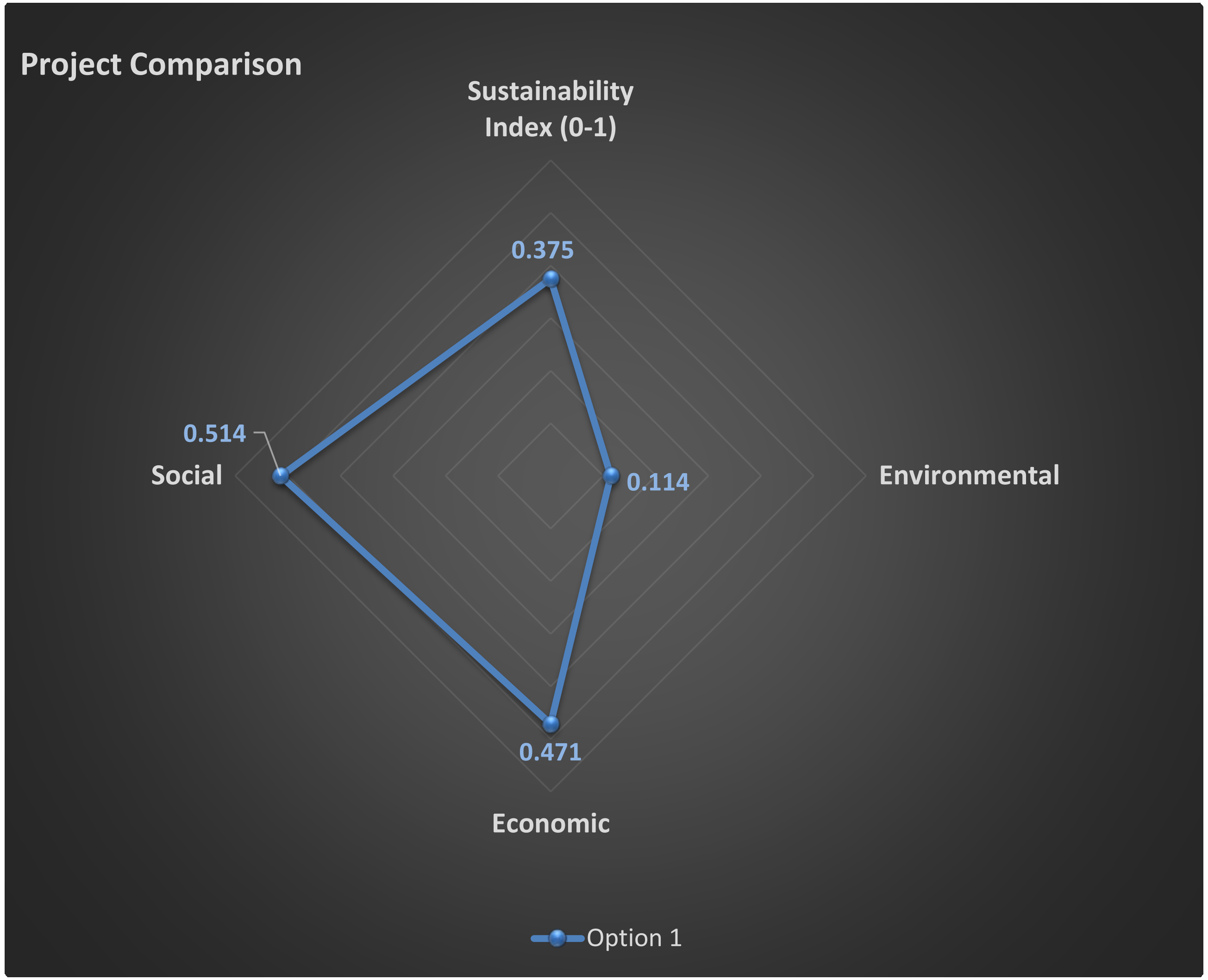
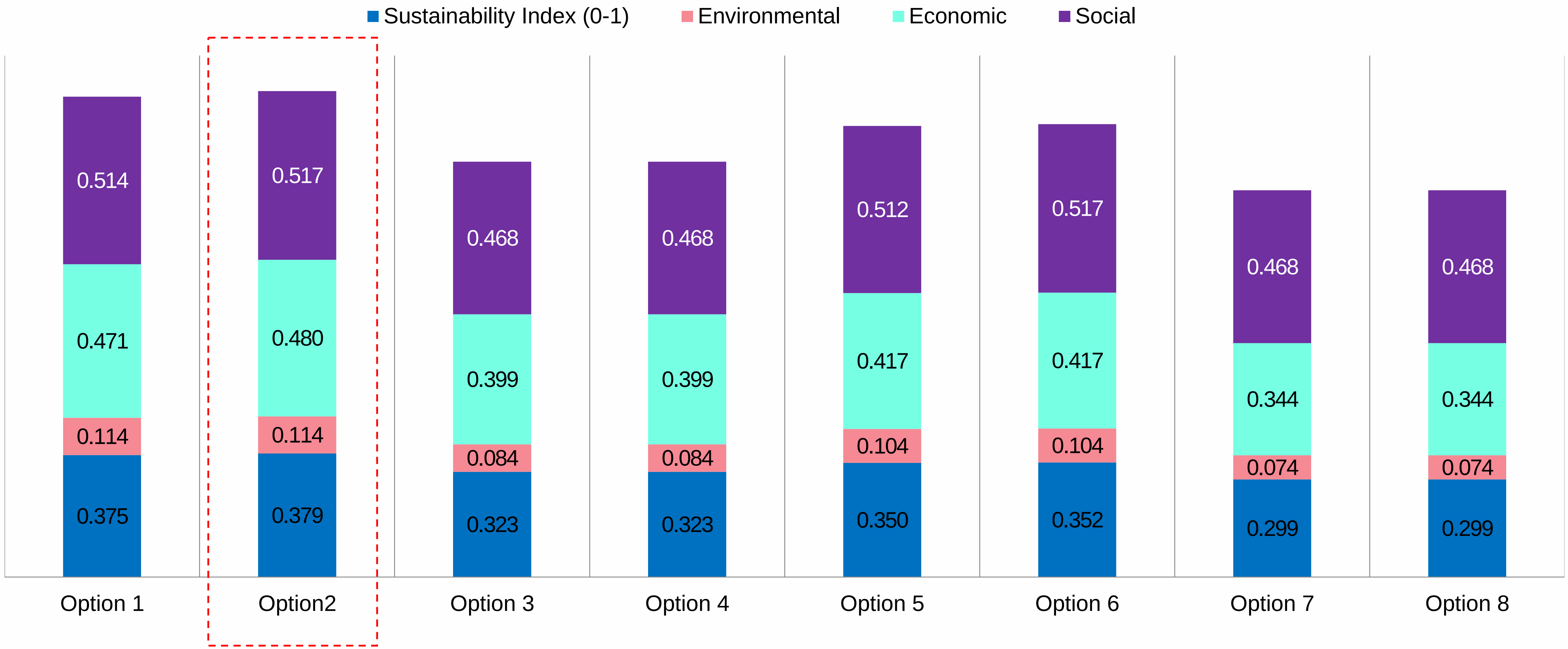
	Sustainability Index (0-1)	0.375
Utility	Environmental	0.114
Utility	Economic	0.471
Utility	Social	0.514



Aircraft Fueling Sustainability Projects

Results of Case Study 1: PMIA Project

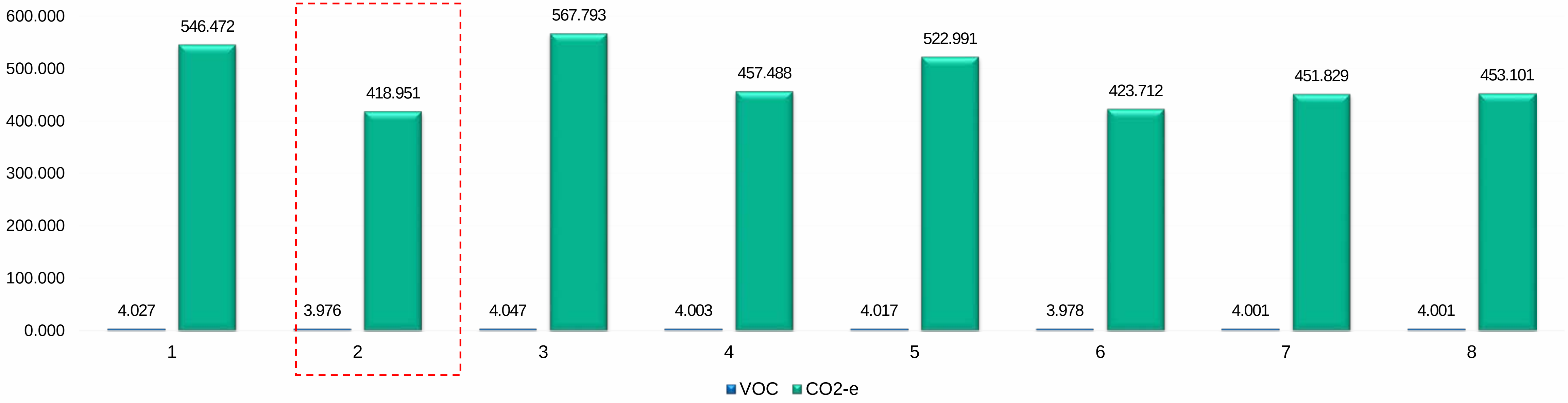
Project Alternative Comparison – SI and Sustainability Factors (Environmental, Economic, Social)



Aircraft Fueling Sustainability Projects

Results of Case Study 1: PMIA Project

Project Alternative Comparison – Emissions' Environmental Impact (Tons of VOC and CO_2)



- The project models assessed all alternatives with respect to the three sustainability criteria and sub-criteria, and determined all energy and emissions sources
- Alternative 2 had the highest SI (0.379) among other project alternatives with the utilities of (0.114) for environmental, (0.480) for economy, and (0.517) for social
- The emission and energy models show that alternative 2 has less environmental, economic, and social impacts

Aircraft Fueling Sustainability Projects

Model Objectives Validation

Case Study 2: KAIA Project

- Total cost of US$7.19 billion
- A domestic and international hub airport
- Annual capacity of 30 million passengers
- This case study includes the into-plane fueling facility project and tank farm project

Aircraft Fueling Sustainability Projects

Model Objectives Validation

Case 2 Project Alternatives

Project Alternatives	Into-plane	Tank Farm
Alternative 1	D1+L1	D3+L3
Alternative 2	D1+L2	D3+L3
Alternative 3	D2+L1	D3+L3
Alternative 4	D2+L2	D3+L3

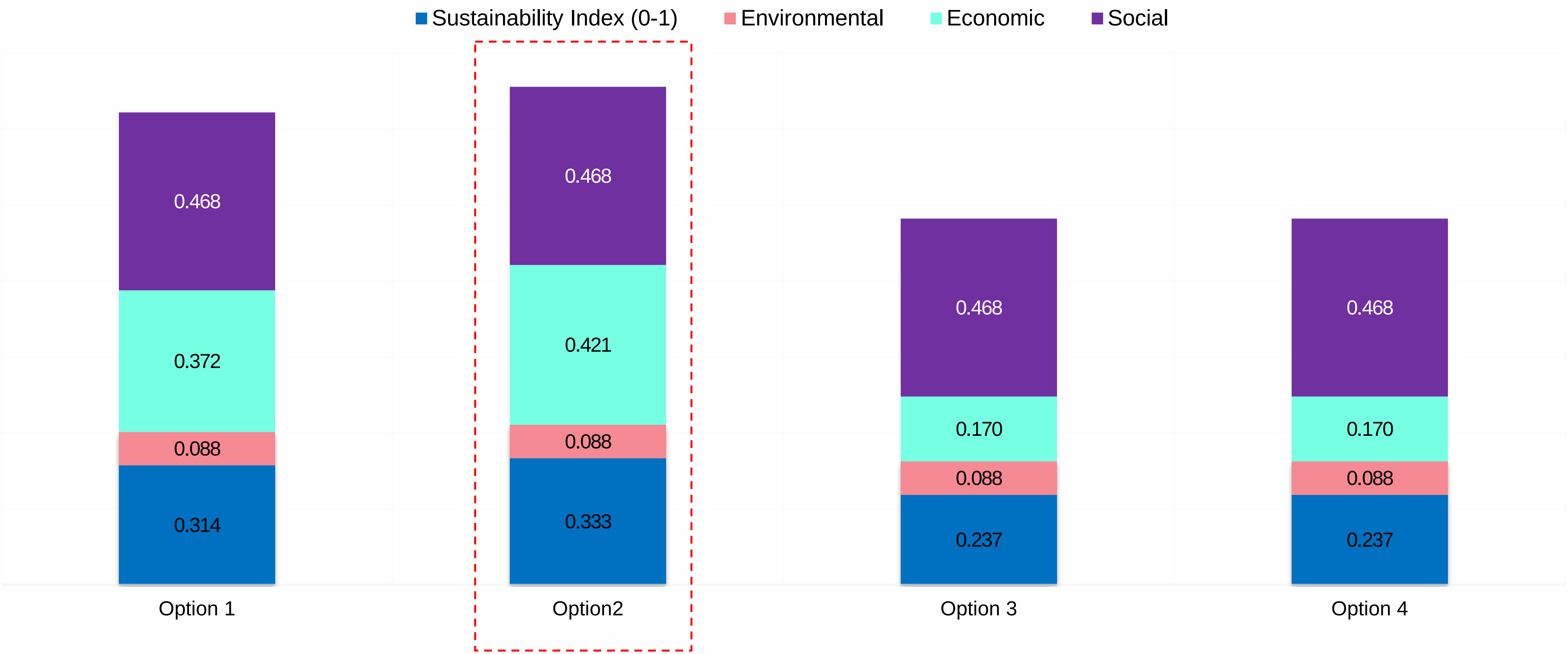
D: Design

L: Location

Aircraft Fueling Sustainability Projects

Results of Case Study 2: KAIA Project

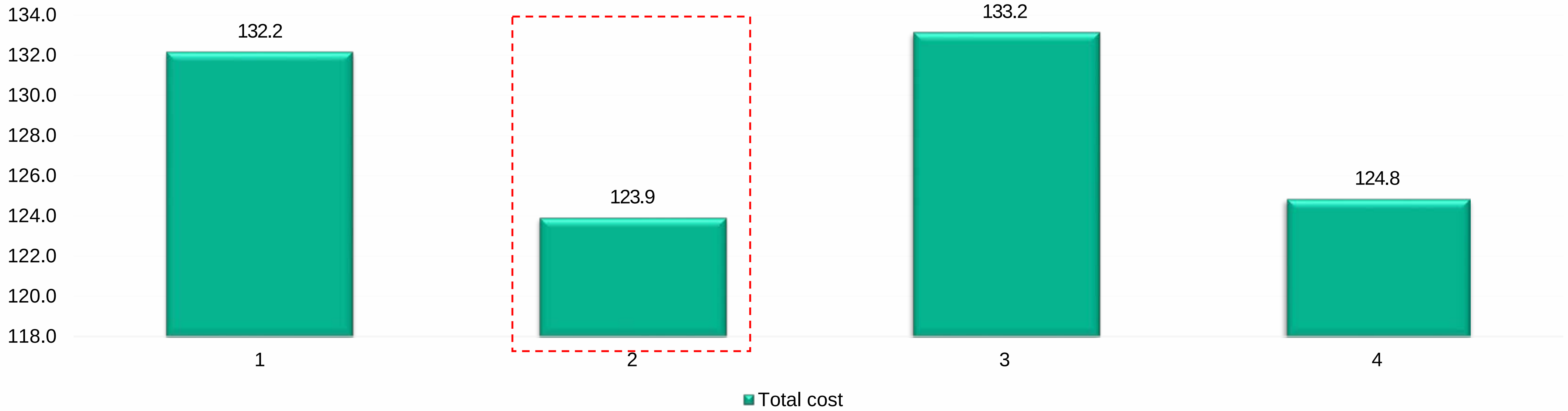
Project Alternatives Comparison – SI and Sustainability Factors (Environments, Economic, and Social)



Aircraft Fueling Sustainability Projects

Results of Case Study 2: KAIA Project

Project Alternatives Comparison – Emissions' Economic Impact (K$)



- The project models assessed all alternatives with respect to the three sustainability criteria and sub-criteria, and determined all energy and emissions sources
- Alternative 2 had the highest SI (0.333) among other project alternatives with the utilities of (0.088) for environmental, (0.421) for economy, and (0.468) for social
- The emission and energy models show that alternative 2 has less environmental, economic, and social impacts.

Conclusion and Recommendations

- The model has provided a detailed investigation for the sustainability of airport fueling projects and operations
- The model developed emissions and energy consumption analyses for airport fueling projects and operations
- The model and its methodology could be implemented for the sustainability assessment and emissions and energy analyses of other airports ground services and projects
- The model could be used as a management tool to improved and monitor sustainability development at airports

- The model could enhance CORSIA methodology for emissions calculation

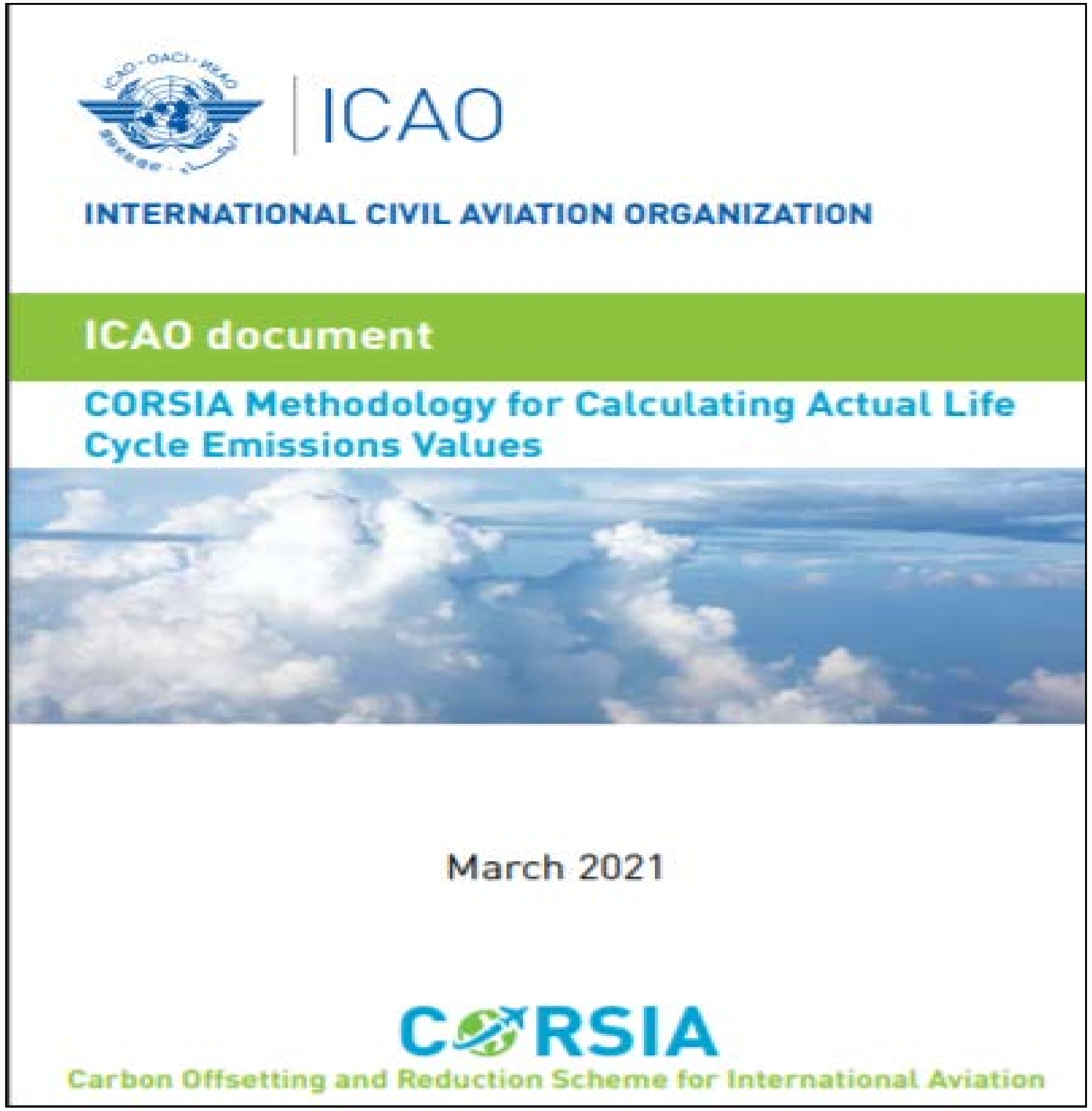
Conclusion and Recommendations

CORSIA Methodology for Emissions Calculation

The system boundary of the core Life Cycle Assessment (LCA) value calculation shall include the full supply chain of CORSIA Eligible Fuel (CEF) production and use.

The following life cycle stages of the CEF supply chain MUST be accounted for:

- production at source (e.g., feedstock cultivation);
- conditioning at source (e.g., feedstock harvesting, collection, and recovery);
- feedstock processing and extraction;
- feedstock transportation to processing and fuel production facilities;
- feedstock-to-fuel conversion processes;
- fuel transportation and distribution to the blend point;
- fuel combustion in an aircraft engine



Thank You

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