



## Agenda

- Overview of Accomplishments to Date
- Understanding sustainability
- Explore Decision-making tool
- Develop Potential sustainability metrics
- Next Steps
- PAG Questions, Discussion, and Action Item
  - Does the PAG concur with the subcommittee's recommendation on a structured decision making process?

## Accomplishments to Date – Sustainability

- Agreement on sustainability importance and concepts
- Review of aviation and non-aviation sustainability practices
- Identified a process for sustainability implementation into Airport Futures
- Proposed decision making tool for consideration
- Developed a short list of potential metrics
- Began defining sustainability considerations for facility requirements exercise

## Sustainability Overview

*Sustainability implemented throughout the Master Plan and Land Use Plan*

- **Vision and Values provides basic framework of Sustainability**
  - Social
  - Environmental
  - Economic
- **Forecasts**
- **Facility requirements**
- **Alternatives analysis**
- **Recommended final land use plan and master plan**
- **Other agreements & recommendations**

## Strategic vs. Tactical Sustainability

### ▪ Strategic

- Organization-wide strategy to implement sustainability principles and measures
- Vision and Values

### ▪ Tactical

- Actual sustainability measures to be implemented – who, what, when, and how
- Front-line staff implementation responsibility
- Feedback loop on success and future opportunities

## Sustainability Understanding – Aviation Overview

Sustainability Understanding –  
Aviation

- Sustainability has significant broad-based implementation across the industry
- Airports: typically a discrete set of measures
- Airlines: fleet modernization and significant operational implementation
- Aircraft manufacturers: process improvements as well as more sustainable products



## Sustainability Review – Non-Aviation Overview

- **Green building has been a large part of the emergence of sustainability in public discourse**
- **Community planning and infrastructure development**
- **Businesses, organizations and governments have examined their practices**
- **Sustainability is evolving**

## How Do We Implement Sustainability for Airport Futures?

*We need a decision tool...*

- **Need**
  - Sustainability criteria should be used to screen options
  - The criteria form a wide range of measures
  - A transparent analytic process is needed to employ the criteria
- **Options**
  - Various decision-making models exist and have been evaluated
- **Analytic Hierarchy Process (AHP)**
  - Structured technique for dealing with complex decisions
  - Uses hierarchical structure to model complex problems
  - Shows the relationships of the goal, criteria, and alternatives
- **A framework for comparing alternatives using objective and subjective criteria**
- **Enables decision-makers to determine priorities or weights in a methodical, transparent way**
  - Jacobs has used Analytic Hierarchy Process (AHP) successfully on other assignments
  - Unanimous recommendation of Sustainability Subcommittee – AHP

## Steps in the Analytic Hierarchy Process (AHP)

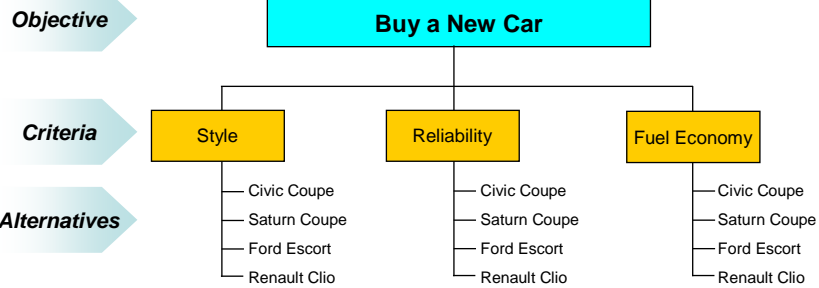
- **State the objective**
  - Evaluate Airport development concepts
- **Define the criteria**
  - Sustainability categories: economic, environmental, social
- **Define the alternatives**
  - Centralized and decentralized concepts, possibly others
- **Determine the importance of each criterion**
  - Use pairwise comparison to determine the relative importance
- **Develop a ranking matrix**
  - AHP software does this using an eigenvector (!)
- **Use the resulting “tree of weights” in a matrix to evaluate the alternatives**
- **Evaluate the results for clarity and consistency, repeat if needed**

## Analytic Hierarchy Process (AHP) Example

### PAG Buys a Car

- **State the Objective**
  - Select a new car
- **Define the criteria**
  - Style, reliability, fuel economy
- **Choose the alternatives**
  - Civic Coupe, Saturn Coupe, Ford Escort, Renault Clio
- **Use AHP**
  - Review results
- **Make a decision**

## A Decision Tree is Used



- The information is then synthesized to determine the relative ranking of the alternatives
- Qualitative and quantitative criteria can be used

## Determine the Criteria Relative Importance (Weighting)

- Use judgments to determine the criteria ranking. For example:
  - Reliability is 2 times more important than style
  - Style is 3 times more important than fuel economy
  - Reliability is 4 times more important than fuel economy
- Pairwise comparisons are used to assess the importance of one criterion over another

	Style	Reliability	Fuel Economy
Style	1/1	1/2	3/1
Reliability	2/1	1/1	4/1
Fuel Economy	1/3	1/4	1/1

## Use AHP Software to Rank the Priorities from the Pairwise Matrix

- AHP uses the Eigenvector computation to determine the relative importance of each criterion

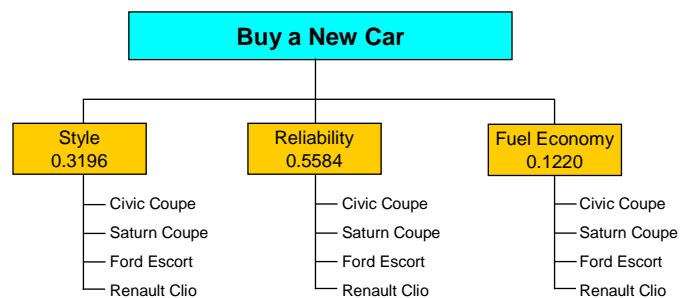
– This involves matrix algebra



	Style	Reliability	Fuel Economy
Style	1/1	1/2	3/1
Reliability	2/1	1/1	4/1
Fuel Economy	1/3	1/4	1/1

	Ranking
Style	0.3196
Reliability	0.5584
Fuel Economy	0.1220

## Decision Tree with Criteria Weights



## For the Alternatives, More Pairwise Comparisons

### In Terms of **Style**

	Civic	Saturn	Escort	Clio
Civic	1/1	1/4	4/1	1/6
Saturn	4/1	1/1	4/1	1/4
Escort	1/4	1/4	1/1	1/5
Clio	6/1	4/1	5/1	1/1

### In Terms of **Reliability**

	Civic	Saturn	Escort	Clio
Civic	1/1	2/1	5/1	1/1
Saturn	1/2	1/1	3/1	2/1
Escort	1/5	1/3	1/1	¼
Clio	1/1	1/2	4/1	1/1

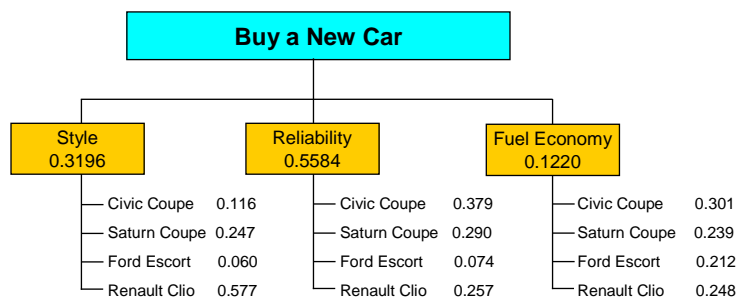
## Relative Subjective Rankings for Style and Reliability

	Style	Reliability
Civic	0.116	0.379
Saturn	0.247	0.290
Escort	0.060	0.740
Clio	0.577	0.257

## Relative Objective Fuel Economy Ranking from Objective Data

	Fuel Economy (Miles/Gallon)		Weight
Civic	34	34/113	0.301
Saturn	27	27/113	0.239
Escort	24	24/113	0.212
Clio	28	28/113	0.248
	113		1.0

## Decision Tree with All Weights



More matrix algebra follows...

## ...And the Winner is...

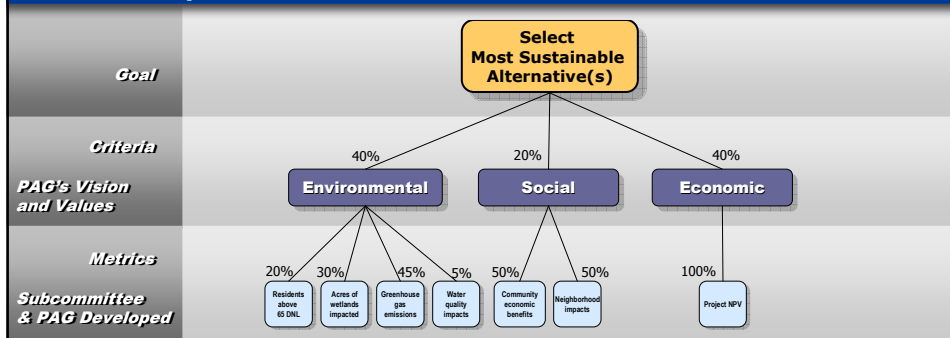
	Style	Reliability	Fuel Economy
Civic	0.116	0.379	0.301
Saturn	0.247	0.290	0.239
Escort	0.060	0.740	0.212
Clio	0.577	0.257	0.248

0.3196	Style
0.5584	Reliability
0.1220	Fuel Economy

\*

	Final Rank
Civic	0.306
Saturn	0.272
Escort	0.940
Clio	0.328

## How Airport Futures Could Use AHP



- Criteria and weights shown above are examples and are being developed by the Sustainability Subcommittee for consideration by the full PAG
- Metrics can be subjective or quantifiable
  - For example, the 65 DNL score could be an objective evaluation:
    - How many residents within the contour
    - Numerical score of X to Y based upon ranking
  - For example, the habitat score could be a subjective evaluation:
    - Categorize as "High", "medium", or "low" where a "high" impact is twice as severe as a "medium" impact
    - Convert to numerical score from 0 to 100 for severity

## Next Steps

- **Master plan alternatives analysis will begin early 2009**
- **AHP must be ready and tested by that time**
- **Proposed development schedule:**
  - Sustainability subcommittee recommend evaluation framework – January - May 2008
  - PAG concurrence on sustainability approach – May 20
  - Sustainability subcommittee to develop recommended criteria, metrics & weighting – March - Oct. 2008
  - PAG approval of criteria, metrics & weighting – October 2008

## PAG Questions, Discussion, and Action Item

- **Questions**
- **Discussion**
- **Action Item:**
  - Does the PAG endorse the subcommittee recommendation to use the Analytic Hierarchy Process (AHP) as a decision making tool?**