DecisionTogether©: Evaluating Priorities for Future Solid Waste Management Planning

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Outline

- Motivation
- Methodology
  - Life Cycle Assessment (LCA)
    - Streamlined LCA
  - Multicriteria Decision Analysis (MCDA)
    - Analytic Hierarchy Process (AHP)
  - DecisionTogether© Development
  - DecisionTogether© Elicitation
- Preliminary Results
- Future Work and Concluding Remarks

Motivation

Environmental decision making is challenging!

Motivation [2]

- Diverse stakeholders
  - Environmental decision making involves stakeholders with diverse backgrounds – experts to citizens
  - Stakeholders approach decisions with diverse perspectives and frames of reference
  - The outcomes of environmental decisions affect stakeholders in different ways
  - Achieving consensus among decision makers is critical and challenging to select a choice, or at least narrow the choices

Motivation [3]

- Multiple criteria
  - Several factors influence and impact the outcome of environmental decision making (e.g., environmental, social, and economic, among others)
    - One criteria cannot be used to make multifaceted decision
    - Multiple criteria must be considered at one time to provide a thorough evaluation
  - The challenge is to integrate all criteria into one evaluation to allow for equal consideration

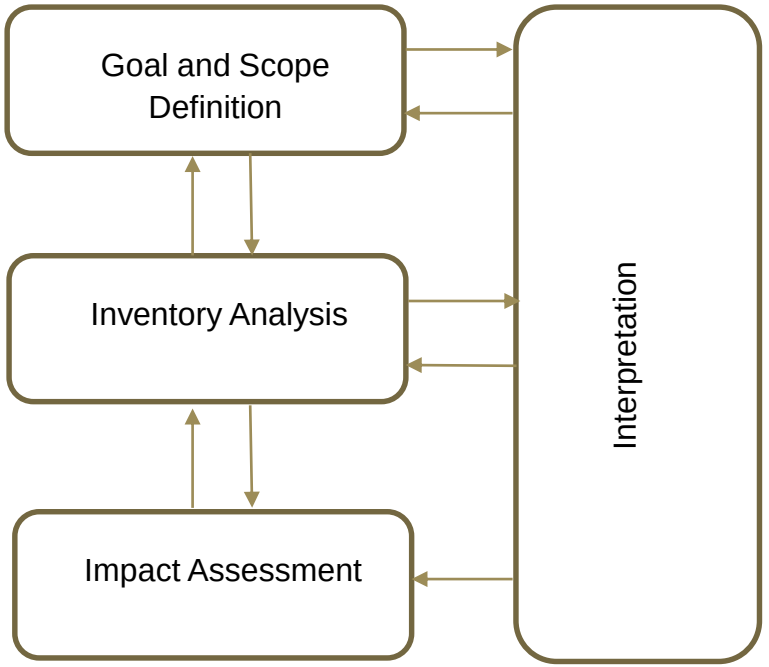
DecisionTogether©

- DecisionTogether© integrates Streamlined Life Cycle Assessment (SLCA) and Multicriteria Decision Analysis (MCDA) to provide a means for diverse stakeholder engagement to evaluate environmental problems
  - Allows an equal contribution from all stakeholders
  - Allows for a consistent understanding and a means to evaluate criteria and alternatives
  - Tested to evaluate end of life municipal solid waste systems

Life Cycle Assessment

Full Life Cycle Assessment (LCA)

- LCA is used to evaluate impacts of a given system
  - ISO 14040:2006 presents the principles and framework for LCA
  - LCA is a means to assess environmental impacts associated with all stages of a product's life
    - Cradle to Grave
    - Considers all material inputs and outputs, as well as energy use/production to determine environmental impacts



Reference: Guinée, 2001

Full LCA - Limitations

- No consideration of time and spatial aspects of evaluated system
- Difficult to utilize in the early stages of planning due to the amount of unknowns and data gaps
- Requires expensive software/databases
- Systems are often complex and almost impossible to model completely

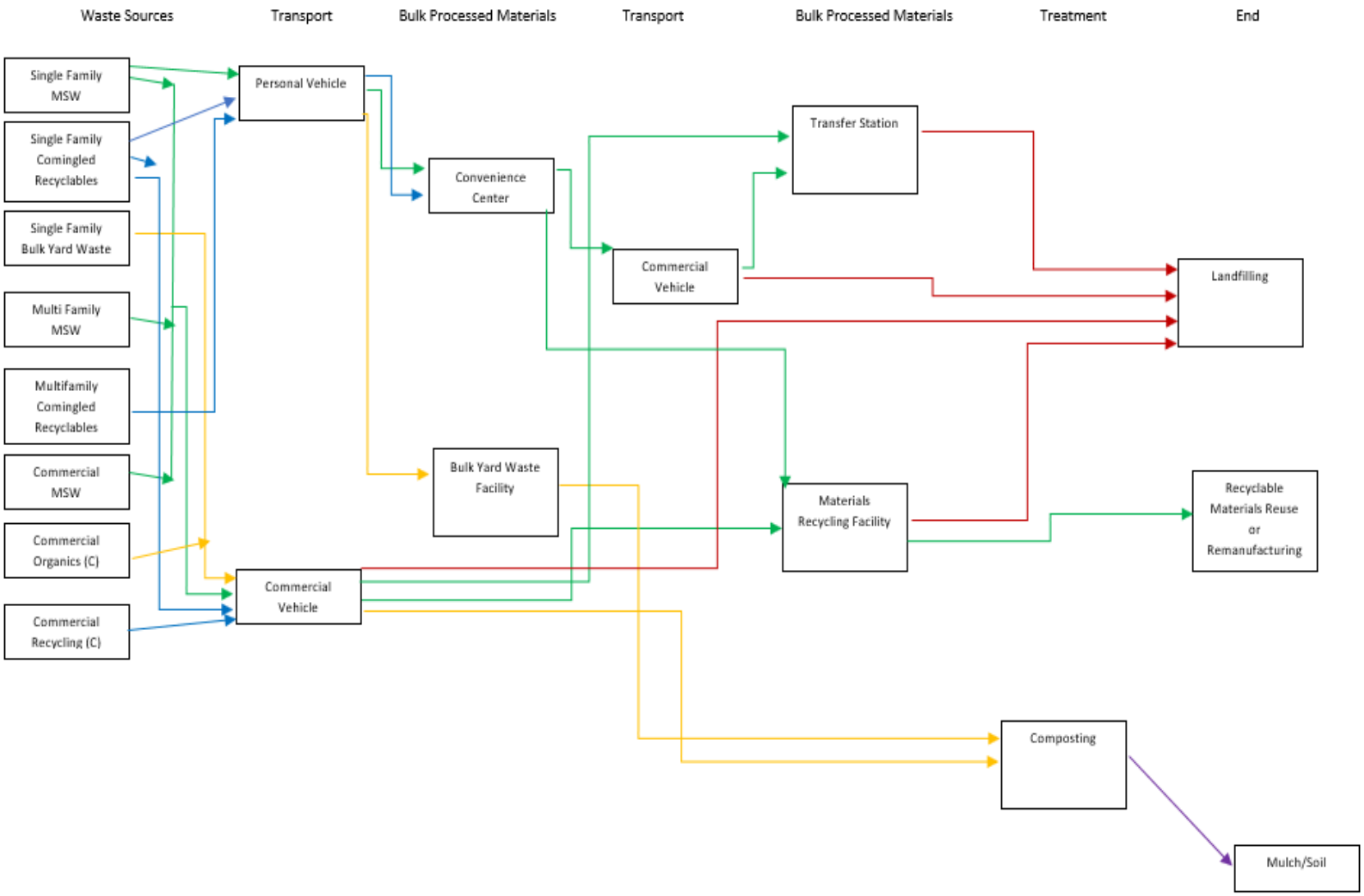
Reference: International Organization for Standards, 2006

Streamlined LCA (SLCA)

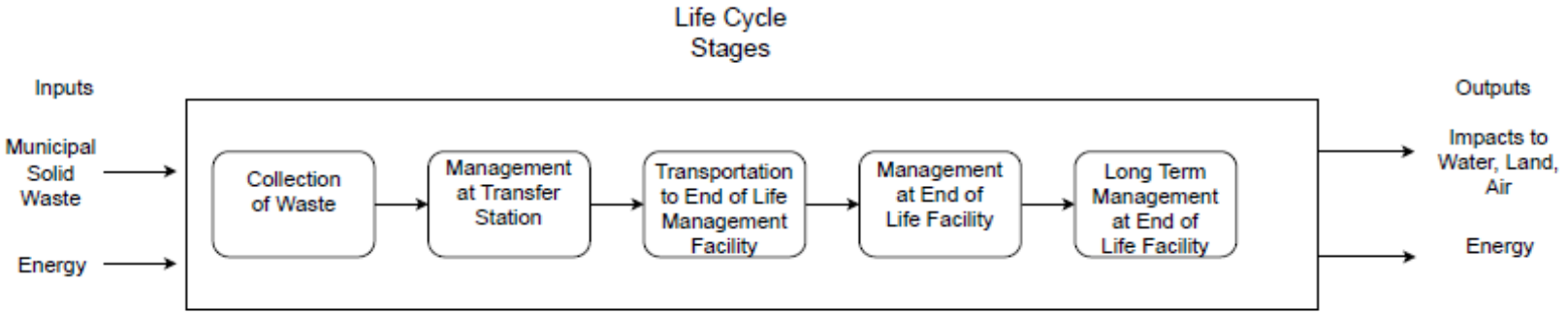
- SLCA can be used to allow for early system evaluations and model simplification
  - Identifies environmental hot spots and highlights opportunities for improvement
  - Requires limited data collection and analysis
  - Limits or eliminates LCA stages
  - Includes only selected environmental impacts and inventory parameters
  - Uses simplified assessment methods

Reference: Graedel, 1998

Full LCA


Waste Sources
Transport
Bulk Processed Materials
Transport
Bulk Processed Materials
Treatment
End
Single Family MSW
Single Family Comingled Recyclables
Single Family Bulk Yard Waste
Multi Family MSW
Multifamily Comingled Recyclables
Commercial MSW
Commercial Organics (C)
Commercial Recycling (C)
Personal Vehicle
Commercial Vehicle
Convenience Center
Bulk Yard Waste Facility
Transfer Station
Commercial Vehicle
Materials Recycling Facility
Landfilling
Recyclable Materials Reuse or Remanufacturing
Composting
Mulch/Soil

Streamlined LCA System



Life Cycle Stages	**Environmental Impact**				
	Solid Waste Managed	Energy	Air Emissions	Water Emissions	Land Impacts
Collection of Waste					
Processing at Transfer Station					
Transportation to End of Life Management Facility					
Processing at End of Life Facility					
Long Term Management at End of Life Facility					

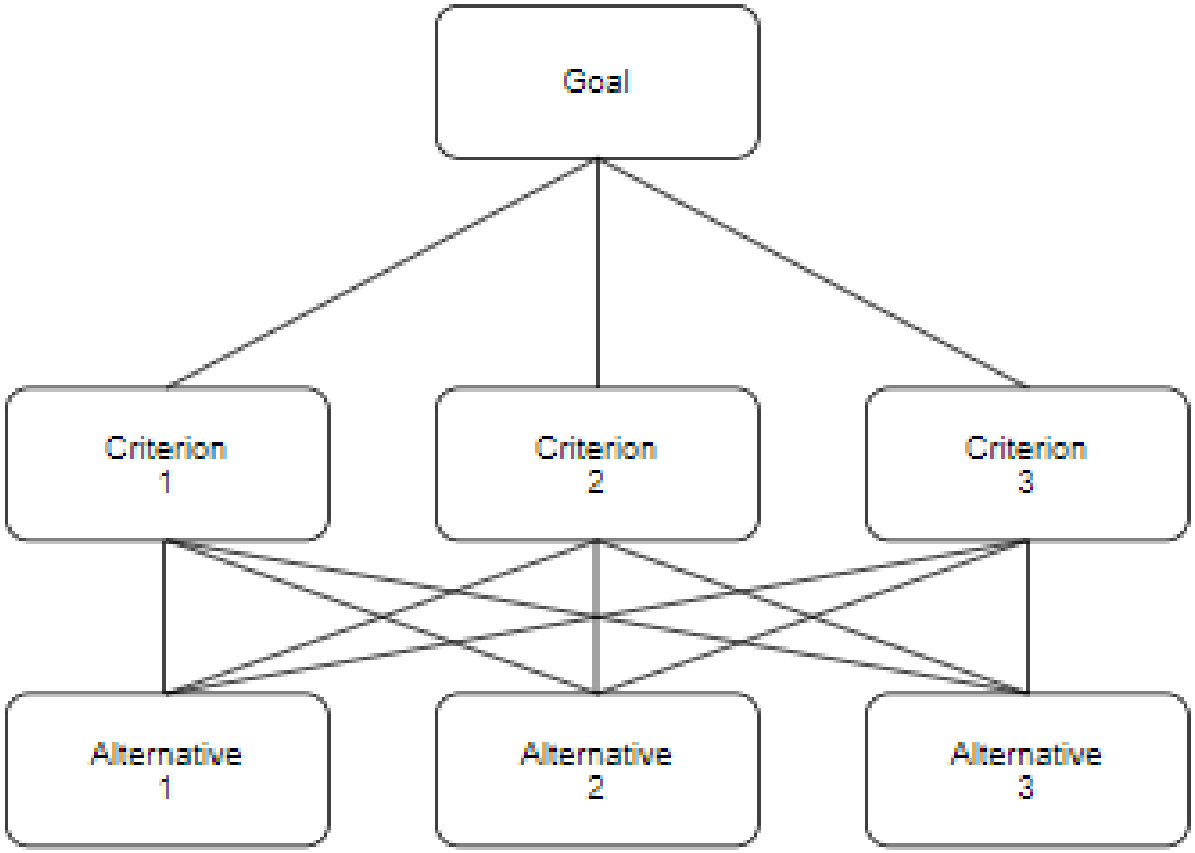
Multicriteria Decision Analysis (MCDA)

Introduction to MCDA

- Multicriteria Decision Analysis (MCDA)
  - Rational decision making model with the following steps:
    - Define decision problem
    - Generate alternatives and criteria
    - Evaluate and identify optimal decision
- Analytical Hierarchy Process (AHP) is one example of MCDA
  - Developed by Thomas Saaty
  - Commonly used in environmental decision making
  - Utilizes pairwise comparison and verbal importance scale
  - Allows for the development of consensus

Reference: Saaty, 1980

Analytical Hierarchy Process

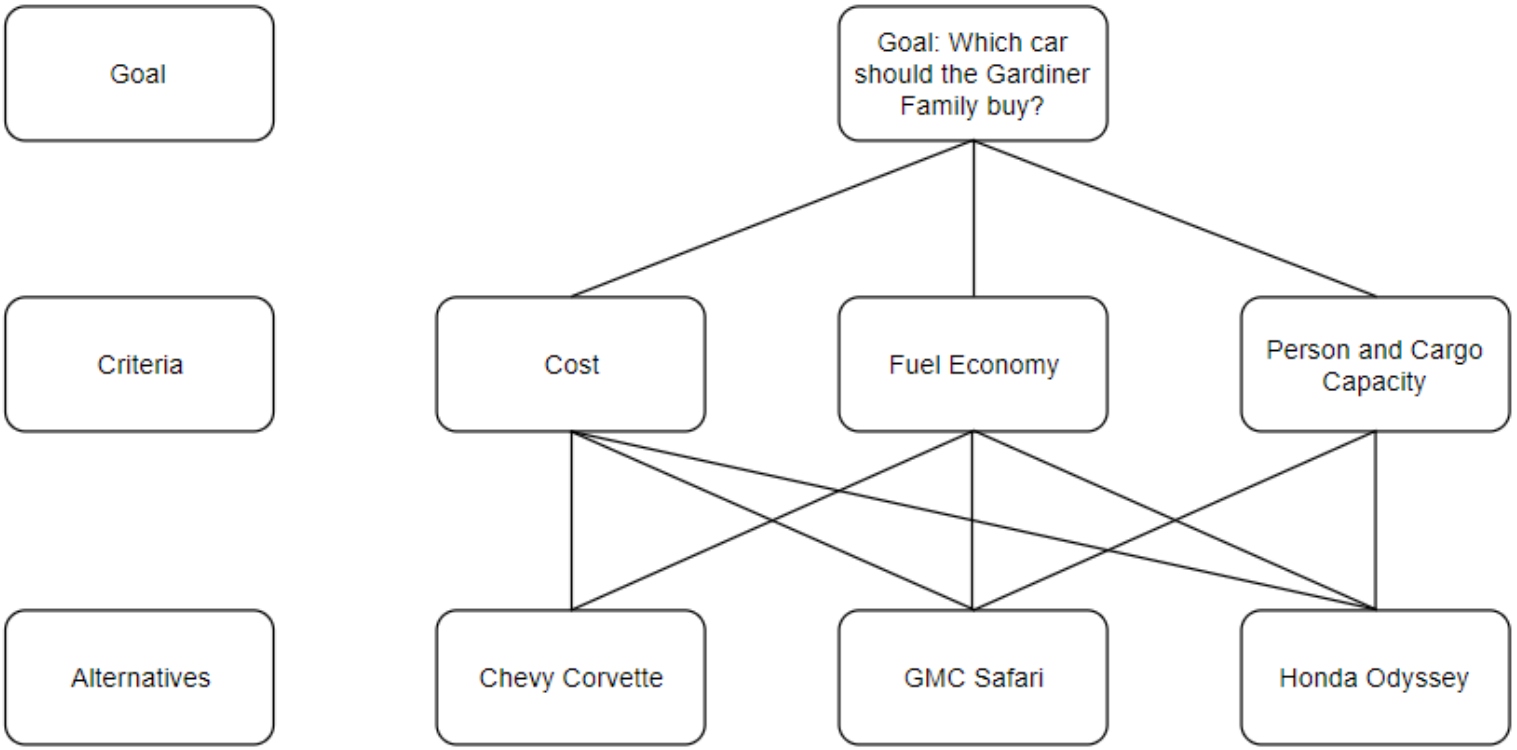


Pairwise Comparison

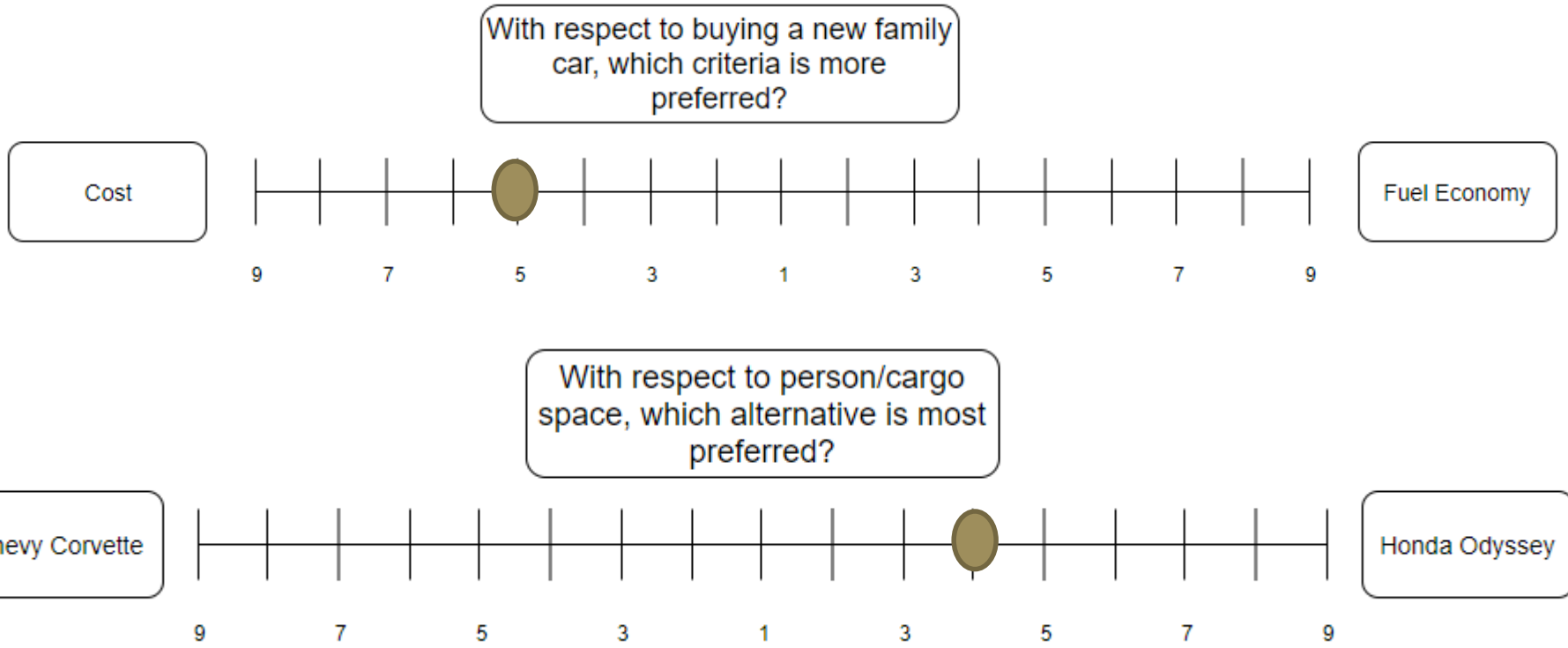
- Evaluates preference by comparing multiple items in pairs to determine their relative significance
- Combines numerical and verbal assessments

Importance Level	Verbal Assessment
9	Extreme Importance
8	Very, very strong
7	Very strong or demonstrated importance
6	Strong plus
5	Strong importance
4	Moderate plus
3	Moderate importance
2	Weak or slight
1	Equal importance (indifference)

AHP Example – New Family Car



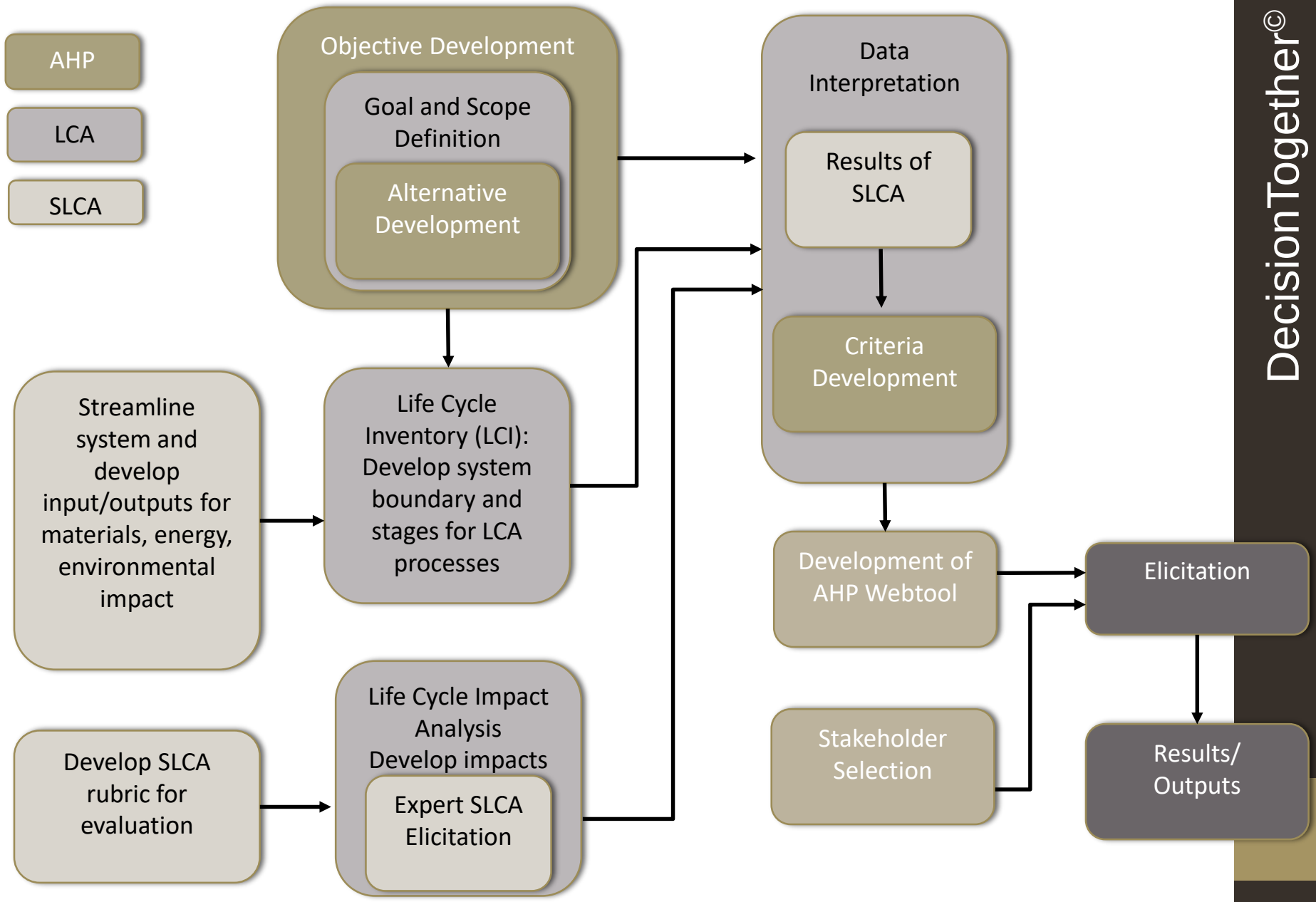
AHP Example – New Family Car



DecisionTogether© Development

Need for Integrated LCA-MCDA

- Though LCA/SLCA can assess the environmental impacts of a system, they do not provide a means to evaluate or rank alternatives
- AHP guides stakeholders through criteria and alternative evaluation to allow for prioritization of preference
- In preliminary planning, definitive answers are not needed initially:
  - Instead, consensus is needed to further develop understanding of agreement and disagreement and to aid in future planning
  - Allows for way to evaluate multiple, diverse criteria



DecisionTogether©

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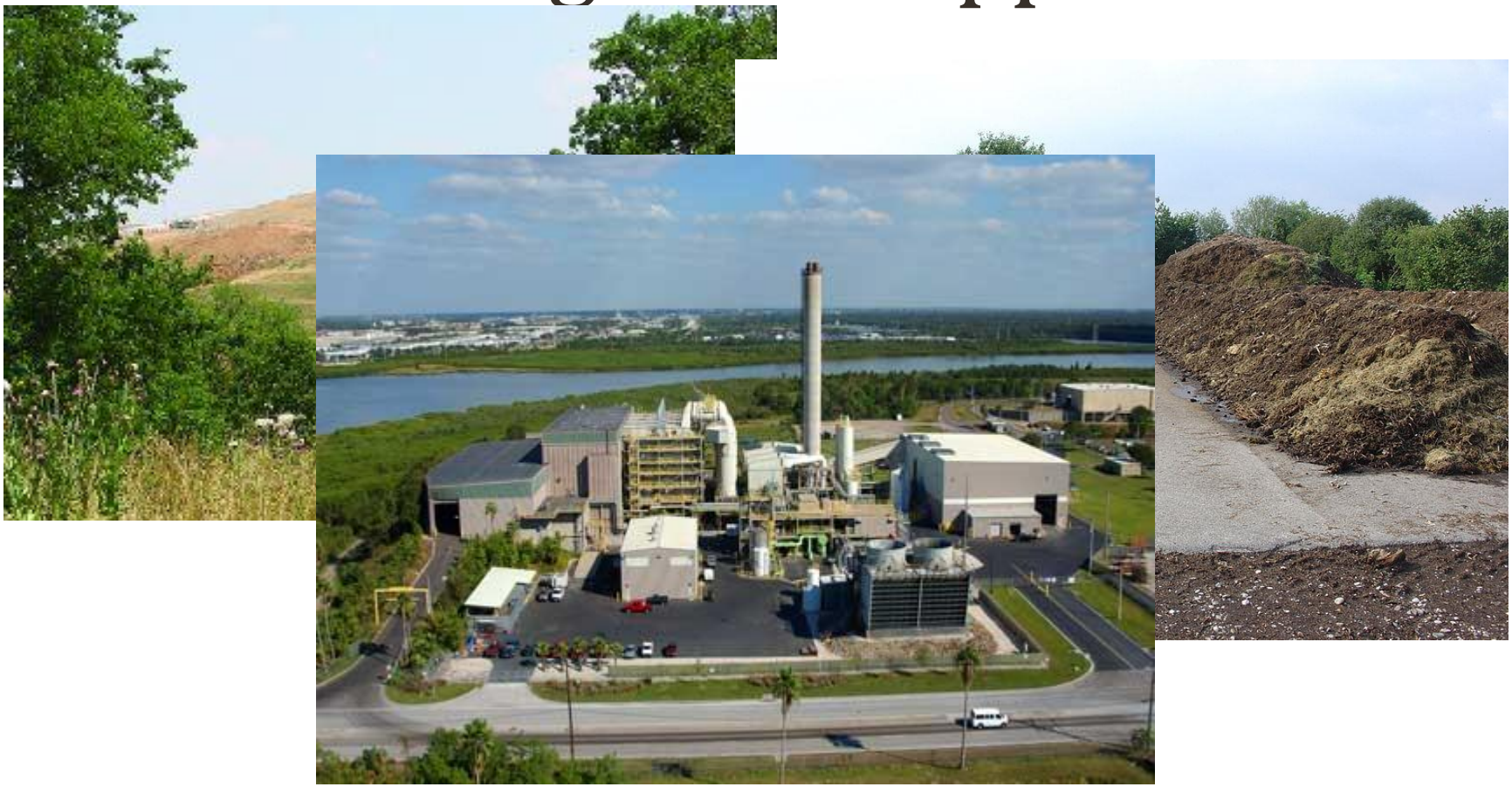
DecisionTogether© Elicitation

DecisionTogether© Application



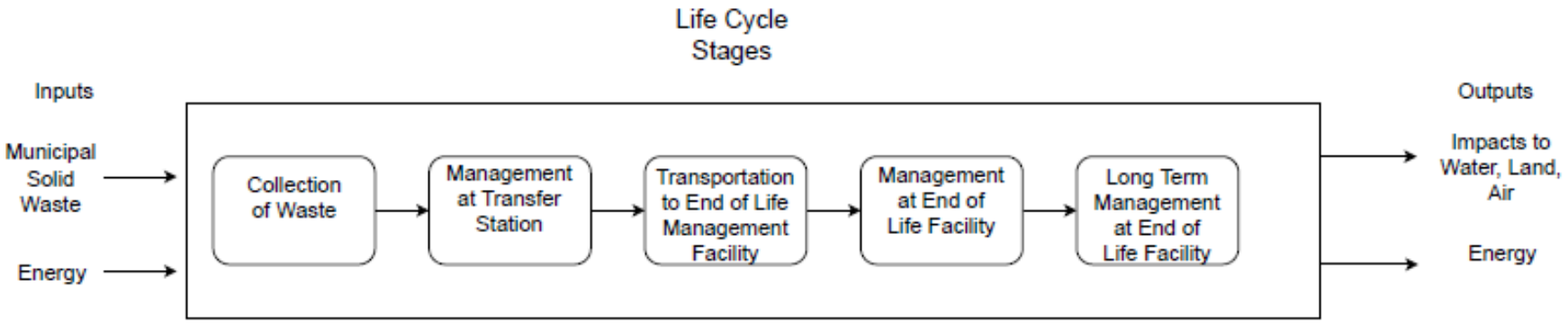
How can we engage stakeholders to evaluate MSW system alternatives?

Source: Murfeesboro Post, Crystalclear~commonswiki, , City of Tamp Bay

DecisionTogether© Elicitation

- Objective/Goal : Determine which end of life residential (MSW) management system should be implemented for Middle Tennessee communities.
- Alternatives:
  - Scenario 1: Class I Landfill Facility
  - Scenario 2: Waste to energy facility with associated landfill
  - Scenario 3: MSW composting facility with associated landfill
- Streamlined LCA used to define the system boundary and evaluate environmental impacts

SLCA System Boundary



Criteria and Attributes

- Environmental
  - Impacts to Water
  - Impacts to Air
  - Impacts to Land
- Economic
  - Capital Investment Costs
  - Operational and Maintenance Costs
  - Economic Incentives on Communities Surrounding Facility
  - Property Values Around Facility

Criteria and Attributes

Social

- Employment
- Location with respect to community
- Nosie/Odor
- Ease of removal and management of MSW

Technical Feasibility

- Availability of Land/Land Use
- Energy Efficiency
- Distance form Community/Transfer Station
- Beneficial Reuse/Resource Conservation
- Available Infrastructure

Criteria and Attributes

- Regulatory Acceptance:
  - Applicable Regulations in Place
  - Presence of Permitting System
  - Zoning Limitations

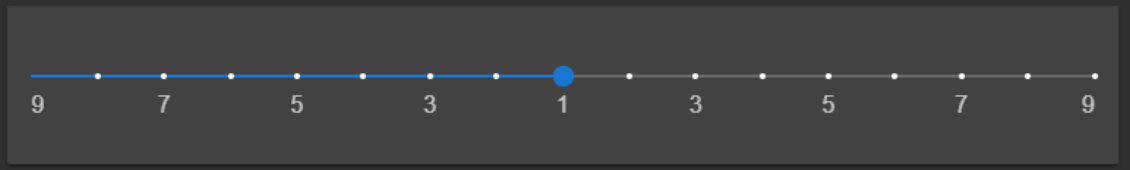
Decision Together

VIEW DOCUMENT

Of the two criteria being evaluated, which is considered more important when evaluating end of life residential MSW systems for Middle Tennessee?

Environmental

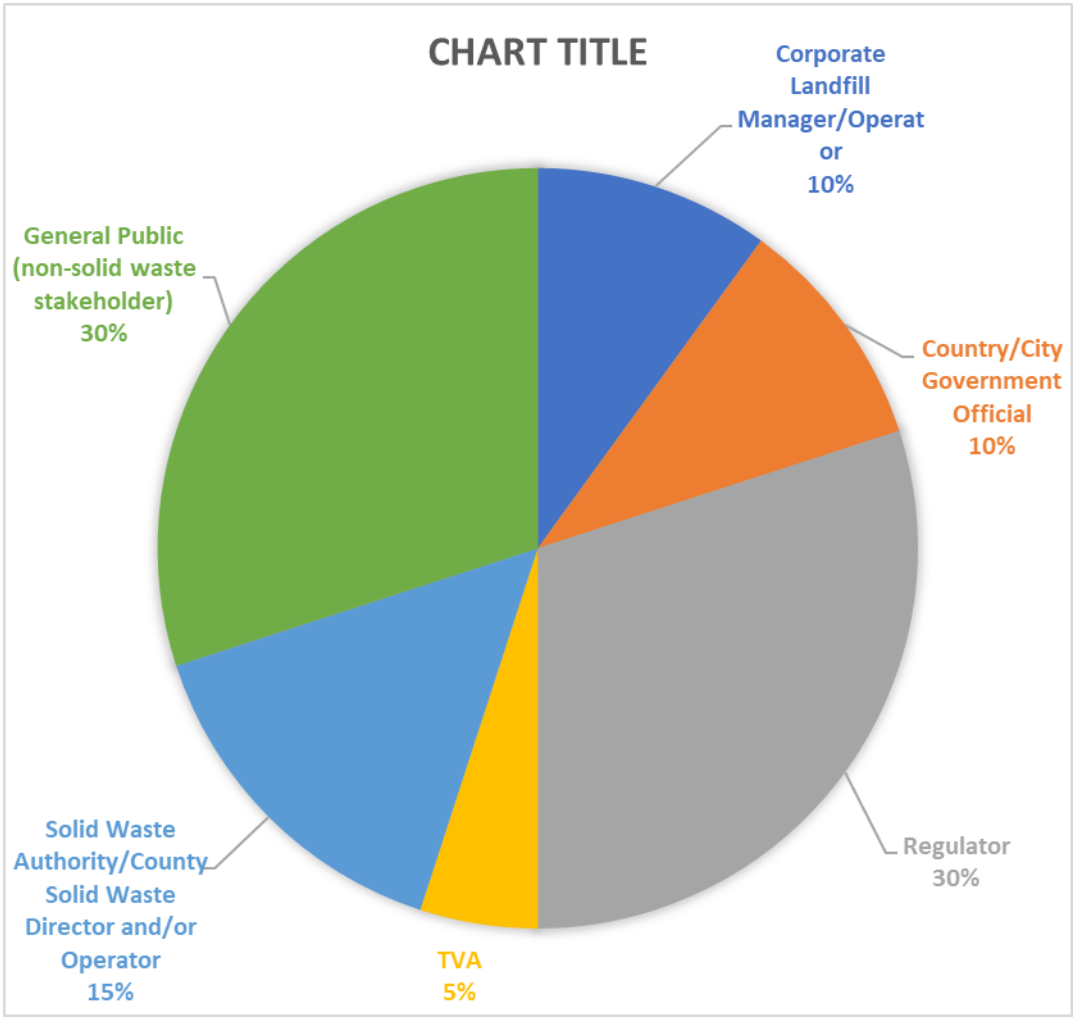
Economics



Comments

NEXT

DecisionTogether© Stakeholders

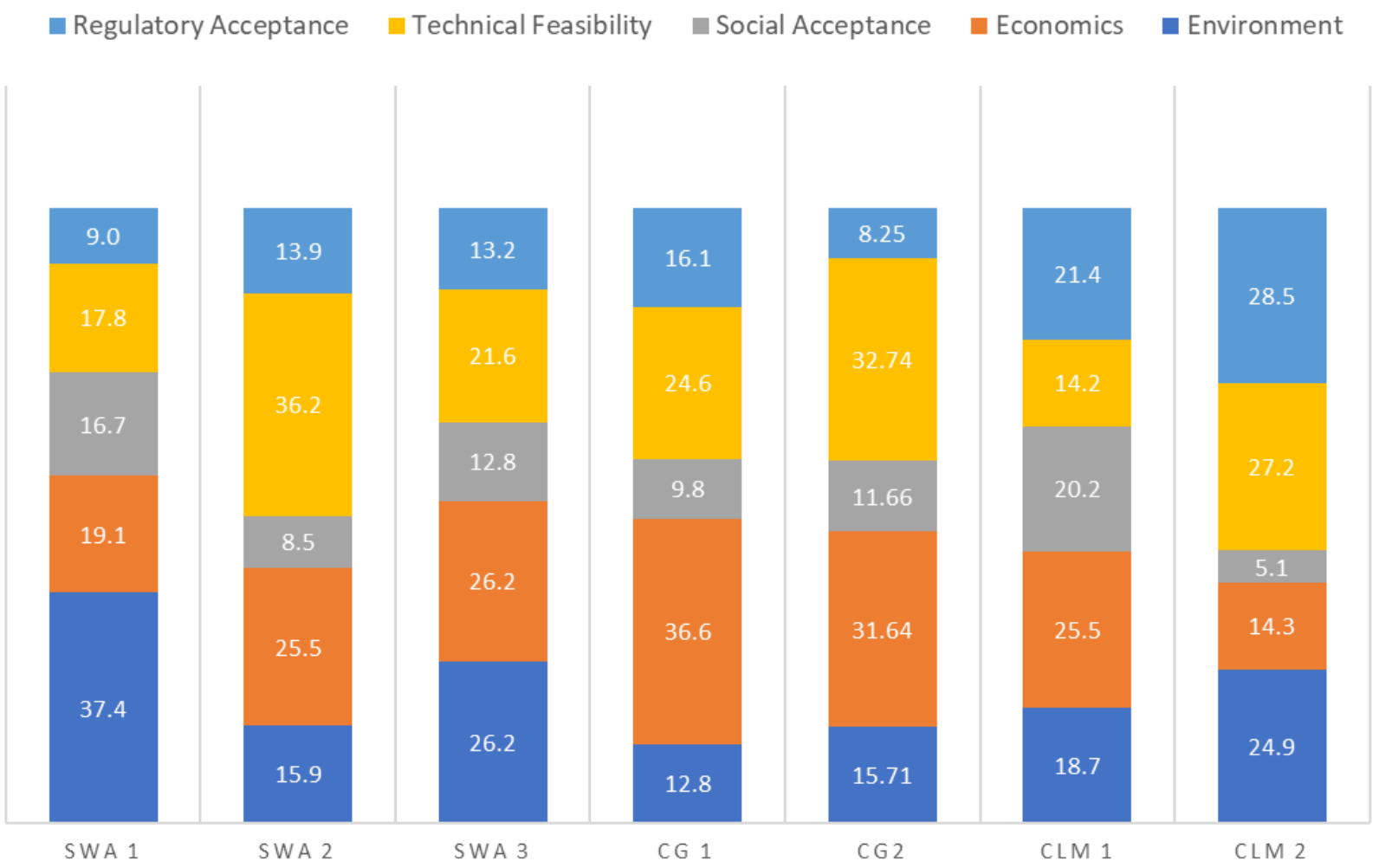


Preliminary Results

Part 1: Criteria Evaluation

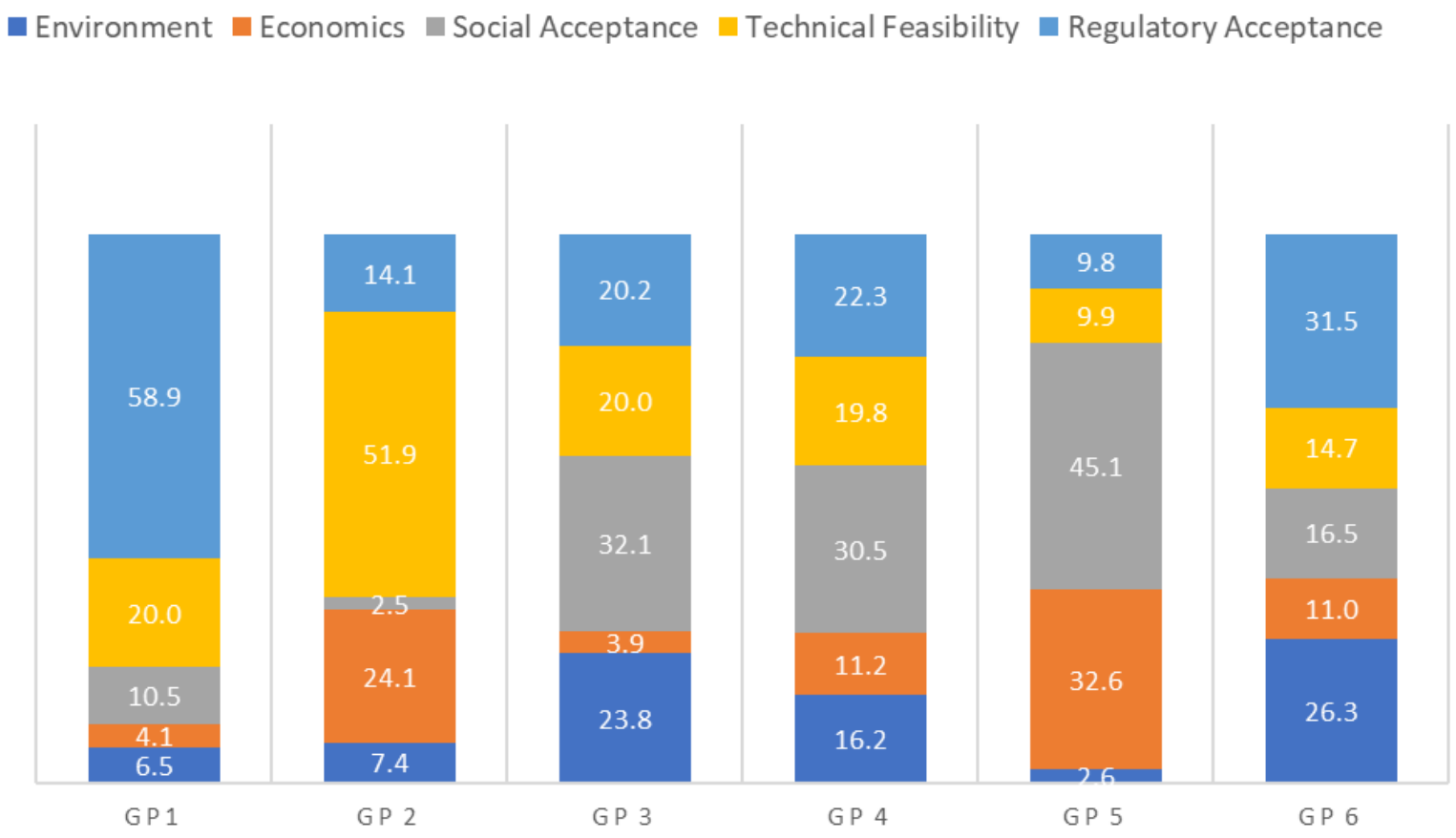
PART 1: CRITERIA PRIORITIZATION-

COUNTY GOVERNMENT/SOLID WASTE AUTHORITY



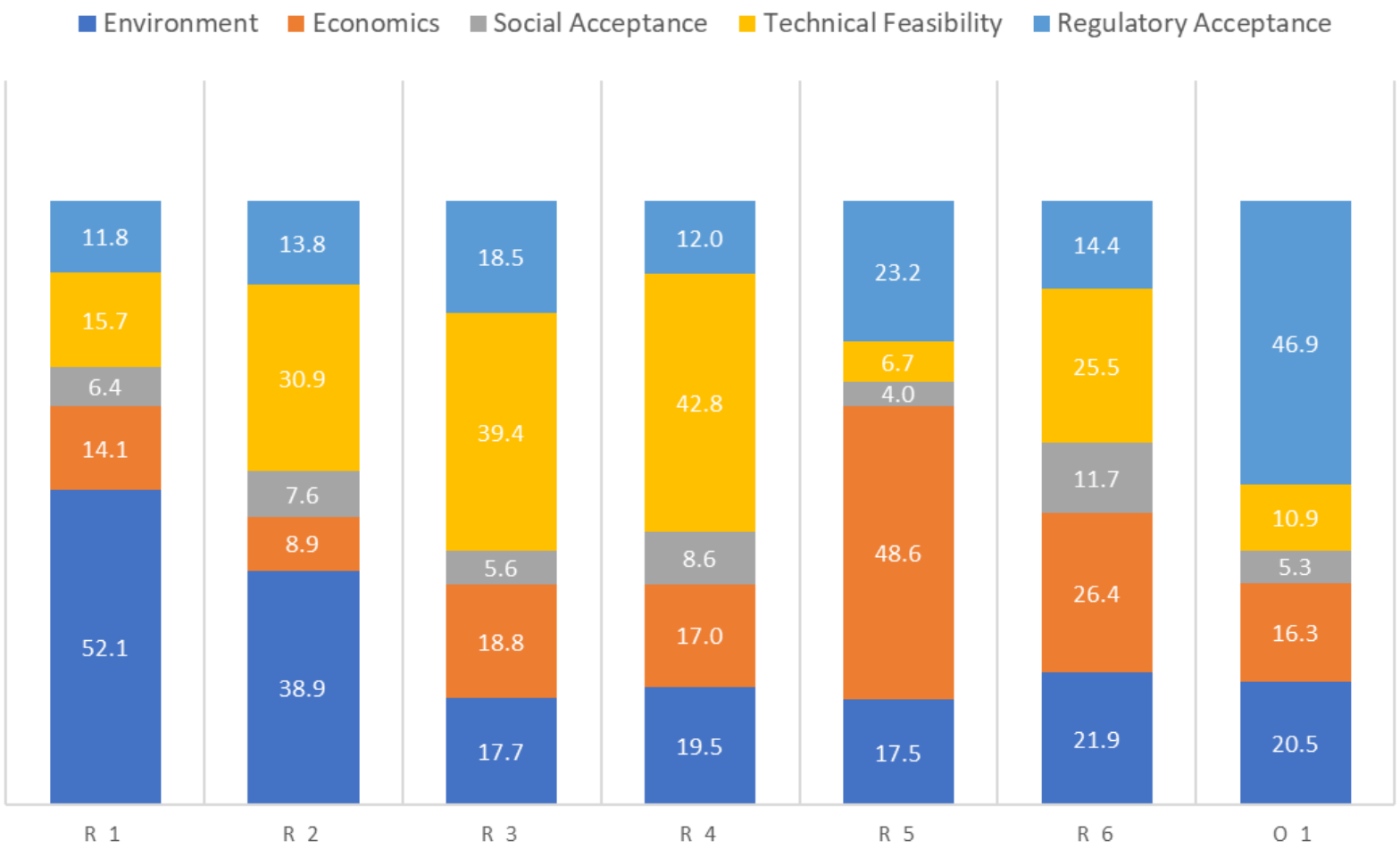
PART 1: CRITERIA PRIORITIZATION

GENERAL PUBLIC



PART 1: CRITERIA PRIORITIZATION

REGULATORS/TVA

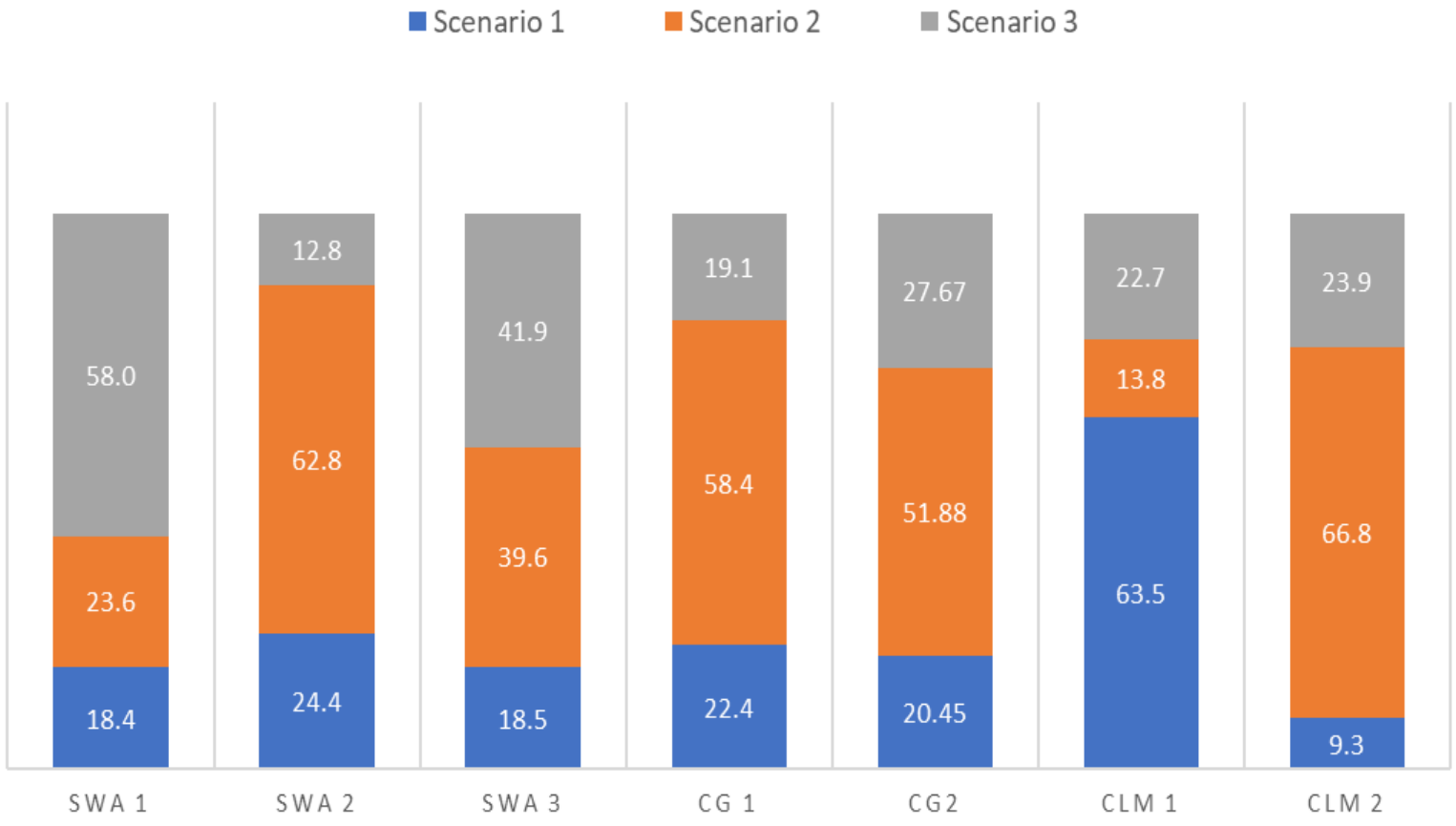


Preliminary Results

Part 3: Alternative Evaluations

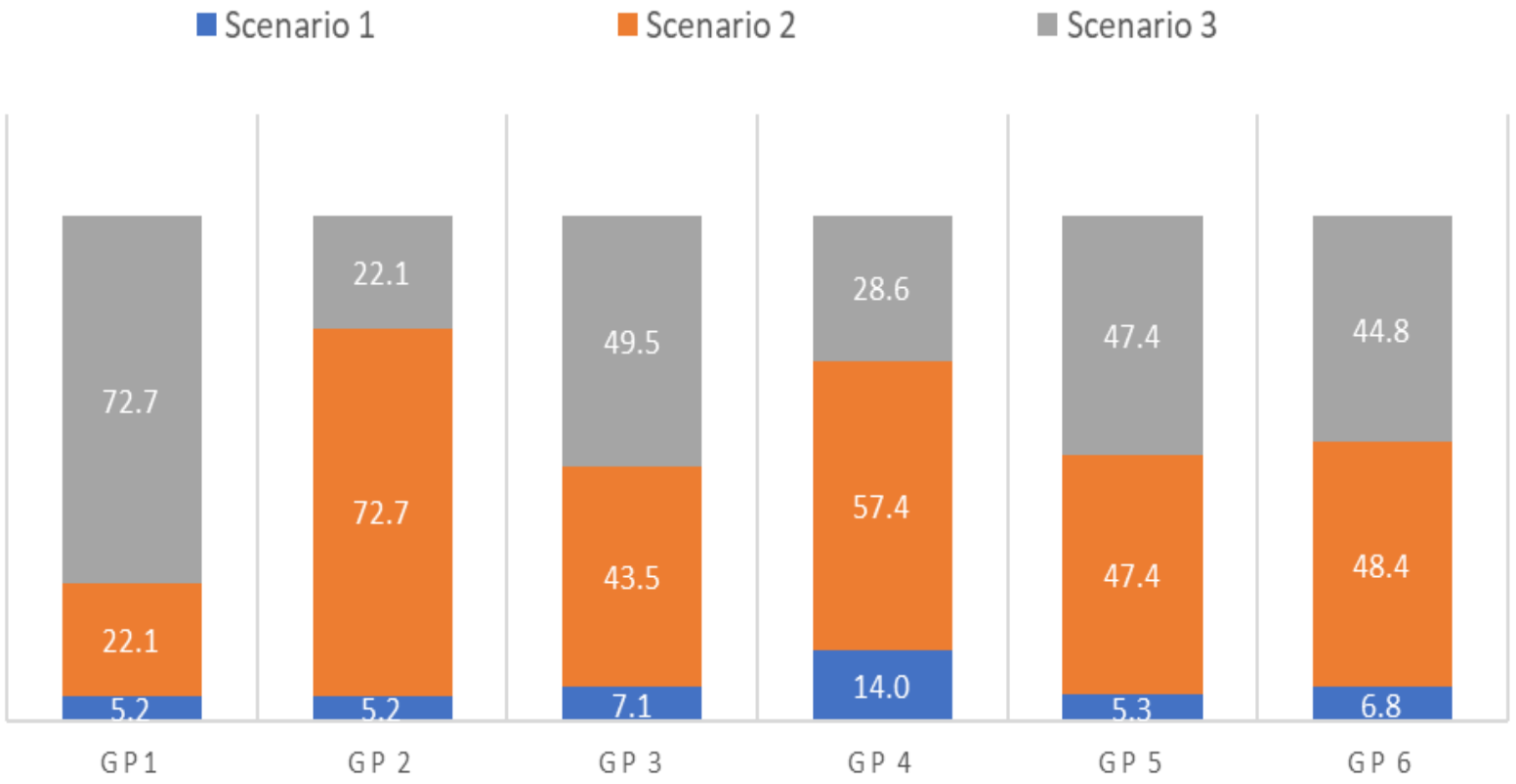
PART 3: ALTERNATIVE PRIORITIZATION

COUNTY GOVERNMENT/SOLID WASTE AUTHORITY



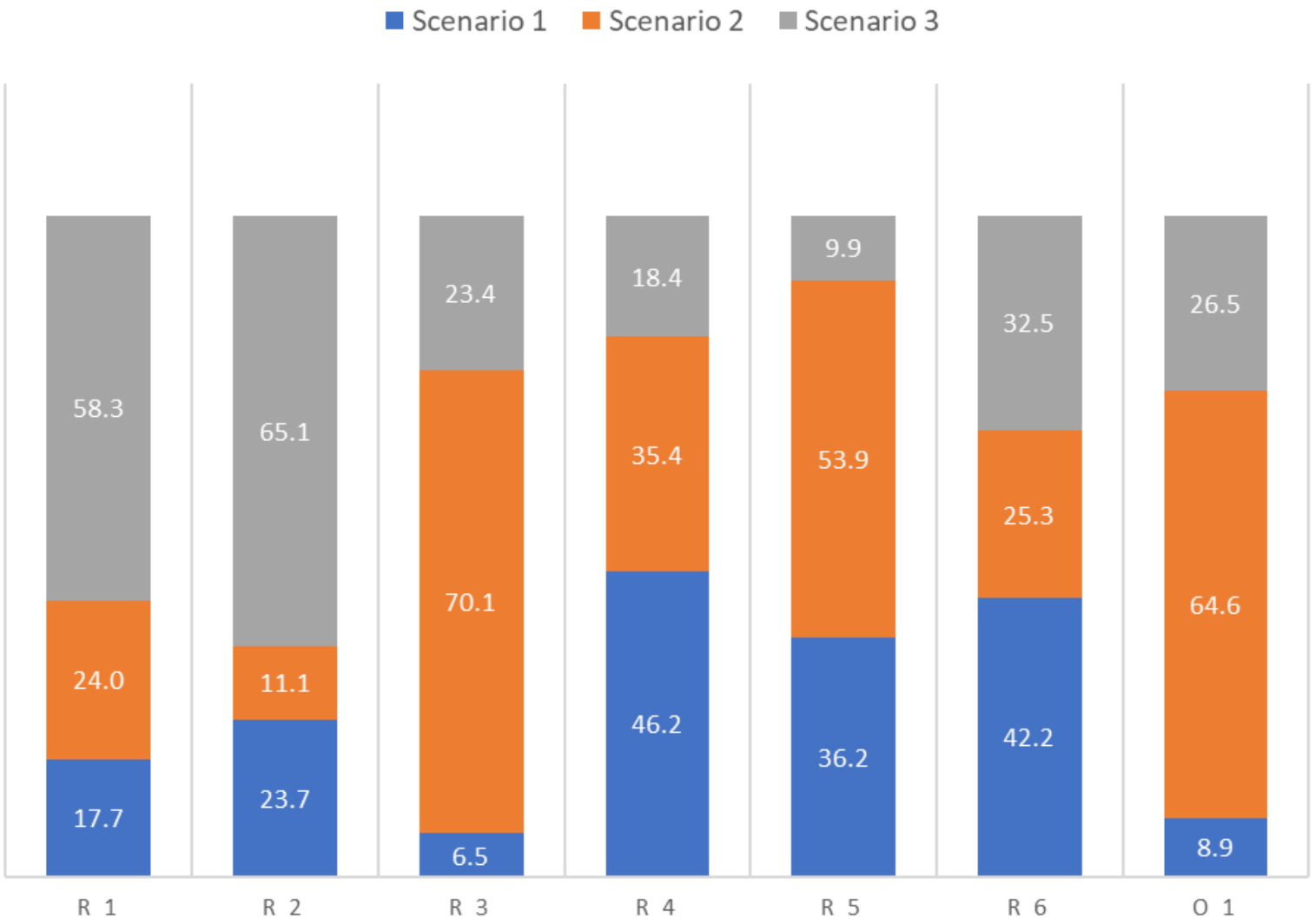
PART 3: ALTERNATIVE PRIORITIZATION

GENERAL PUBLIC



PART 3: ALTERNATIVE PRIORITIZATION

REGULATORS/TVA



Conclusions

- SLCA use helps in simplifying boundaries for decision making purposes
- The DecisionTogether© web application is useful in collecting input from geographically distant stakeholders
  - It can be tailored for a variety of decision-making problems with diverse stakeholders
  - Shows that many different perceptive exist
- Consistency values were high for many participants and require further evaluation on how to improve elicitation experience

Future Work

- Need to evaluate what causes the inconsistency the data
  - Determine which data can be kept in an evaluation and which needs to be removed
- Follow up participants to determine if provided answers are consistent with their perspectives and opinions
- Evaluate the elicitation process to determine ways to improve the process for stakeholders and improve consistency
  - Provide additional training for pairwise process
  - Provide additional guidance documents
  - Consider completing the process together in one meeting

Thank you

For addition information please contact Andrea Resch Gardiner at: andrea.r.gardiner@vanderbilt.edu