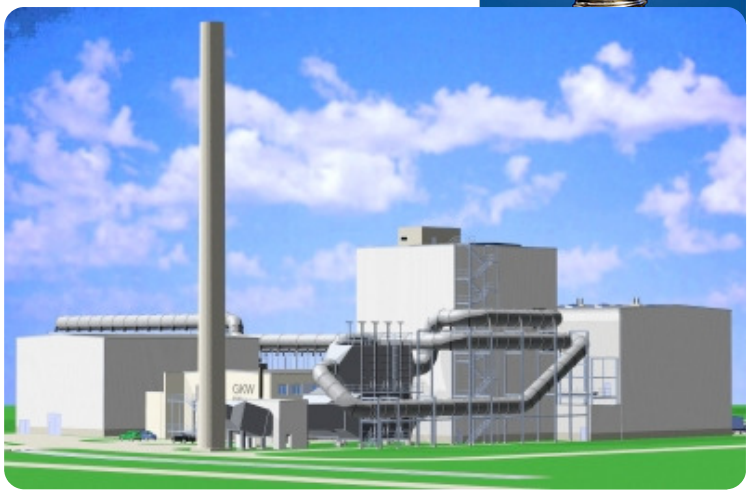
A Multi-Criteria Analysis Approach to Comparing of GHG-Emission Mitigating Policy Instruments

Case Study: Power Generation Sector of Trinidad & Tobago



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Problem

GHG-emission mitigation one of the major challenges for **policy makers**

➔ How to find the **most appropriate policy instrument** for this challenge?

➔ How to **support** the **decision process** and the **decision**?

A **Multi-Criteria Analysis Approach**

to Comparing of GHG-Emission Mitigating **Policy Instruments**

in the Power Generation Sector of Trinidad & Tobago

Structure Presentation

- Intro-duction
- Methods
- Case Study T&T
- Evaluation Criteria
- Policy Instruments
- Conclusion

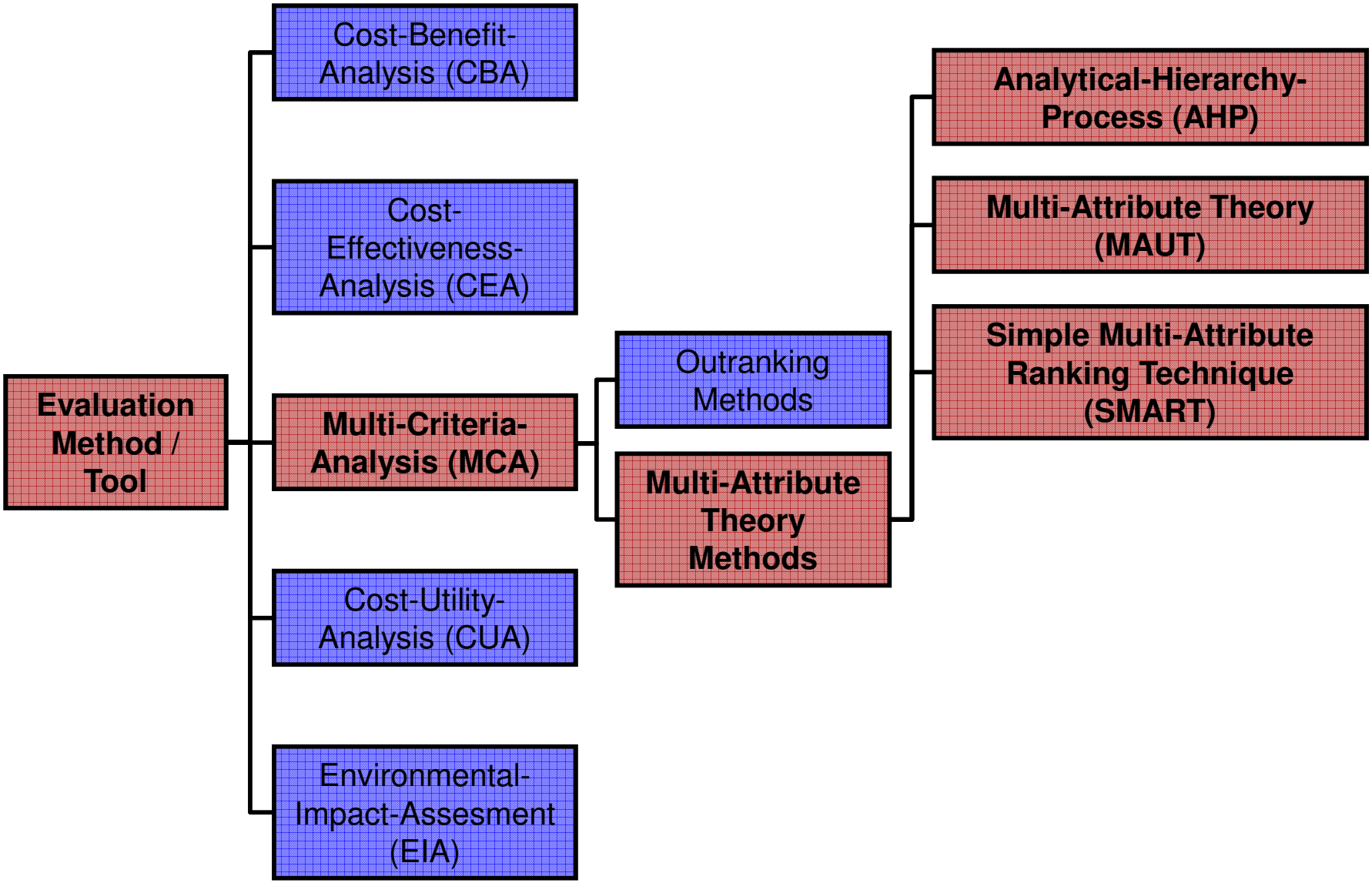
- ✓ Introduction: Problem
- ✓ Methods
  - Basic conditions
  - Selection
- ✓ Case Study Trinidad & Tobago
- ✓ Evaluation criteria
  - Selection criteria
  - Calculation and results for T&T
- ✓ Policy instruments
  - Selection policy instruments
  - Calculation and results for T&T
- ✓ Conclusion

Basic conditions

- Broad spectrum of criteria and policy instruments
- Specific weighting of the criteria
- User-friendly and transparent in the calculation process
- Usable without knowing in detail its methodological background
- Quantitative evaluation
- Results show strength and weaknesses of the policy instruments
- Clear and comparable results in a ranking

SelectionTree – Policy Evaluation Methods

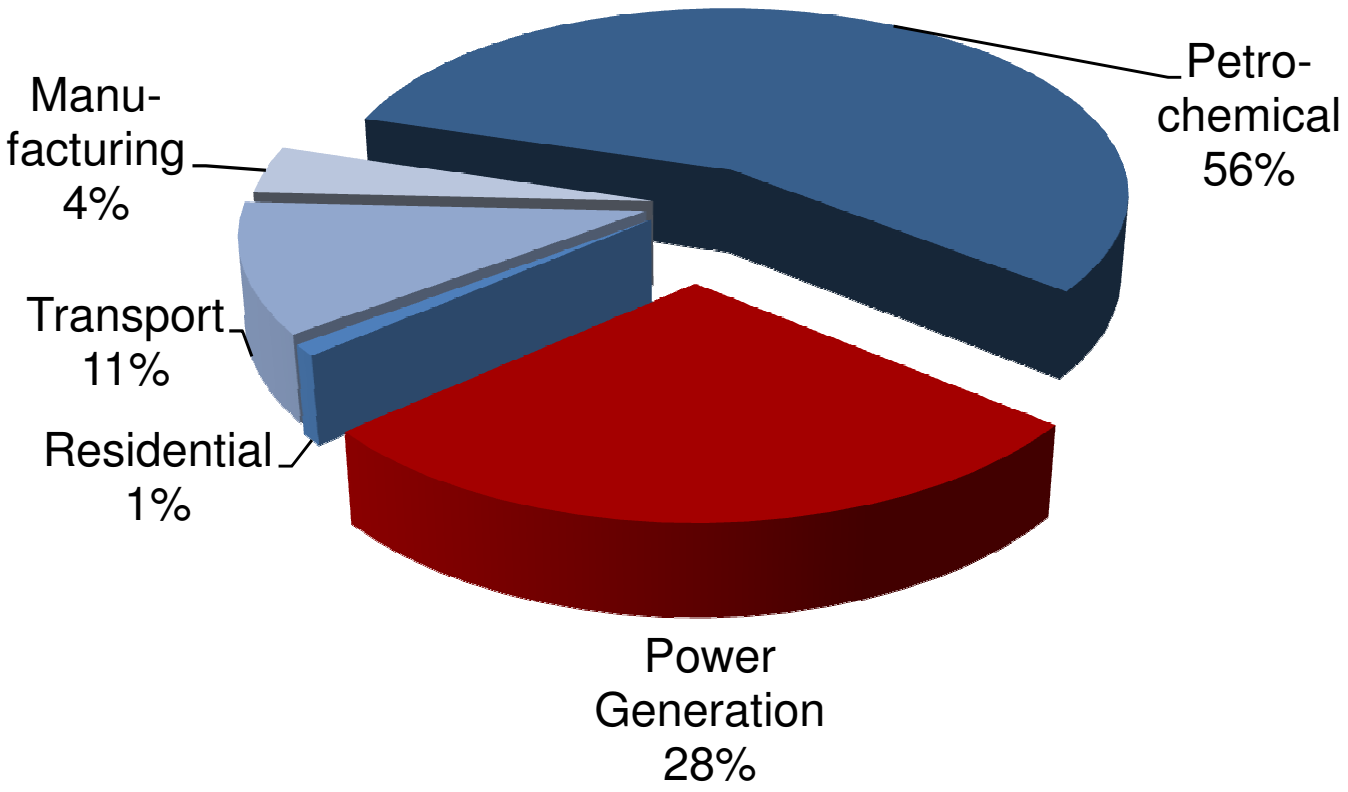
- Intro-duction
- **Methods**
- Case Study T&T
- Evaluation Criteria
- Policy Instruments
- Conclusion



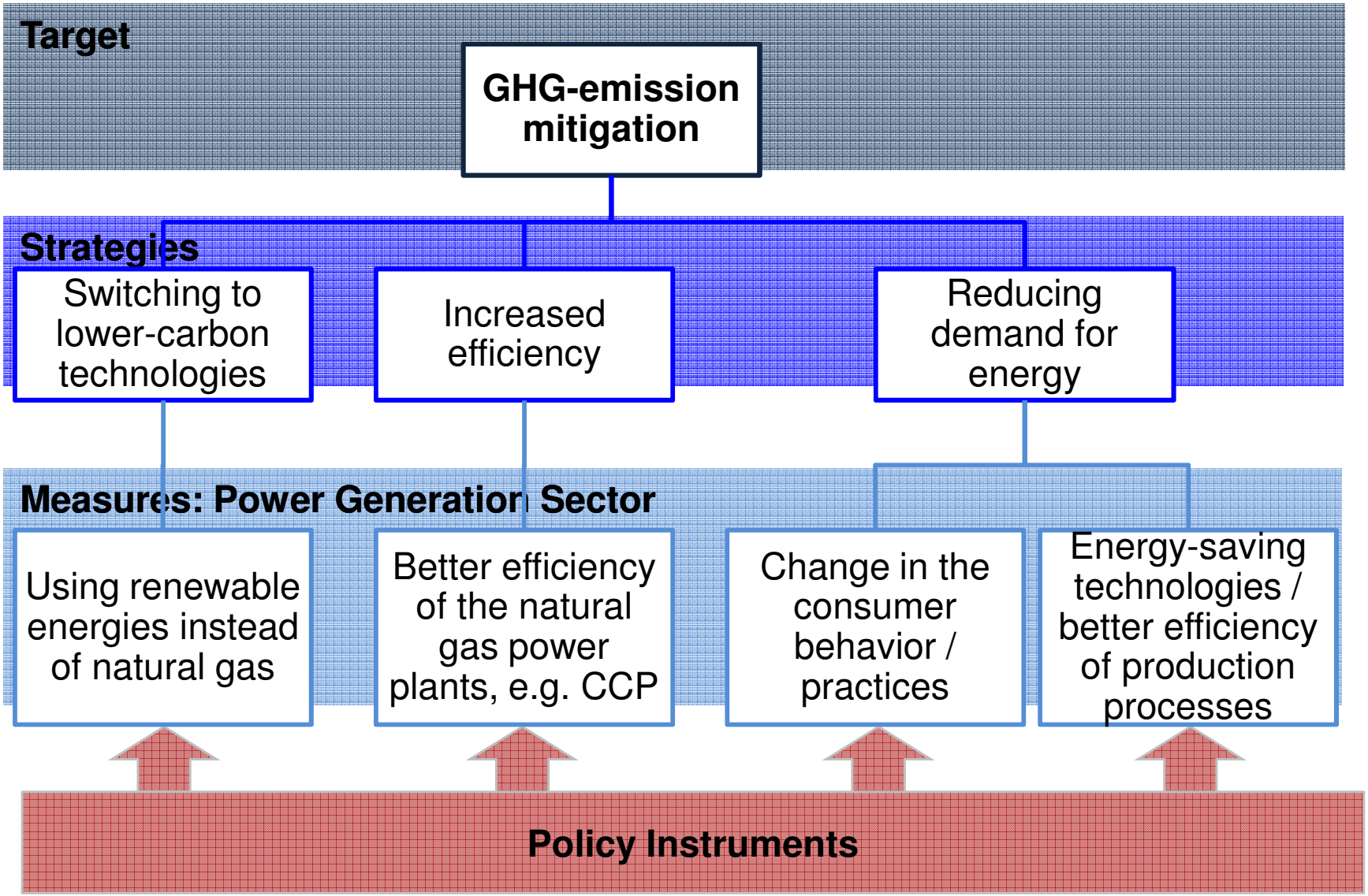
Power Generation Sector of Trinidad & Tobago

GHG-emissions in the year 2007 in T&T:

- 23.4 million metric tons
- 18 $tons_{GHG\text{-}emissions}$/capita

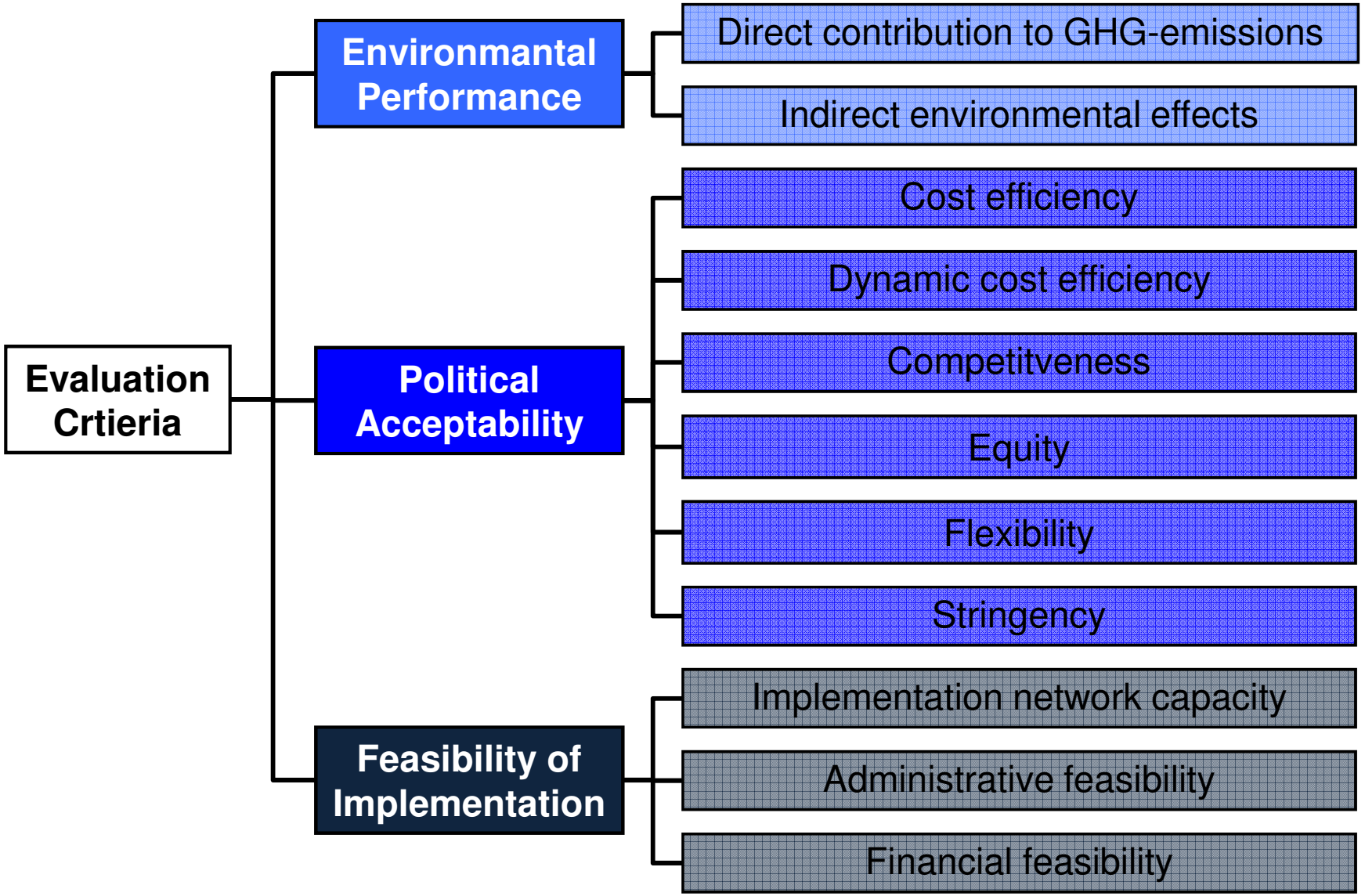


Hierarchy of GHG-emission mitigation



Tree of main and sub-criteria

- Intro-duction
- Methods
- Case Study T&T
- Evaluation Criteria
- Policy Instruments
- Conclusion



Weighting – Analytical Hierarchy Process – Input

- Literature research
- Expert Interviews
- Empirical approach

➔ Survey to different experts of the stakeholder of the power generation sector:

- ➔ Environmentalists
- ➔ Policy maker
- ➔ Researcher
- ➔ Companies

➔ Scale of importance of the single criteria

5	4 3	2	1	0	
extremly high important	high important	moderate important	low important	extremly low important	absolute not important

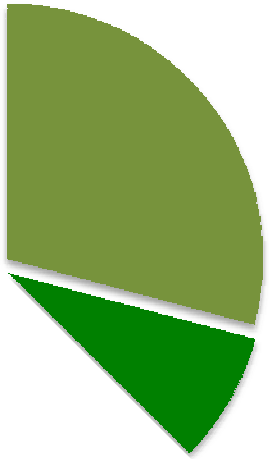
Weighting – AHP– Calculation

AHP: Analytical Hierarchy Process

- Pairwise Comparison
- Setting Intensity
- Test of Consistency
- Calculation Weight Coefficients

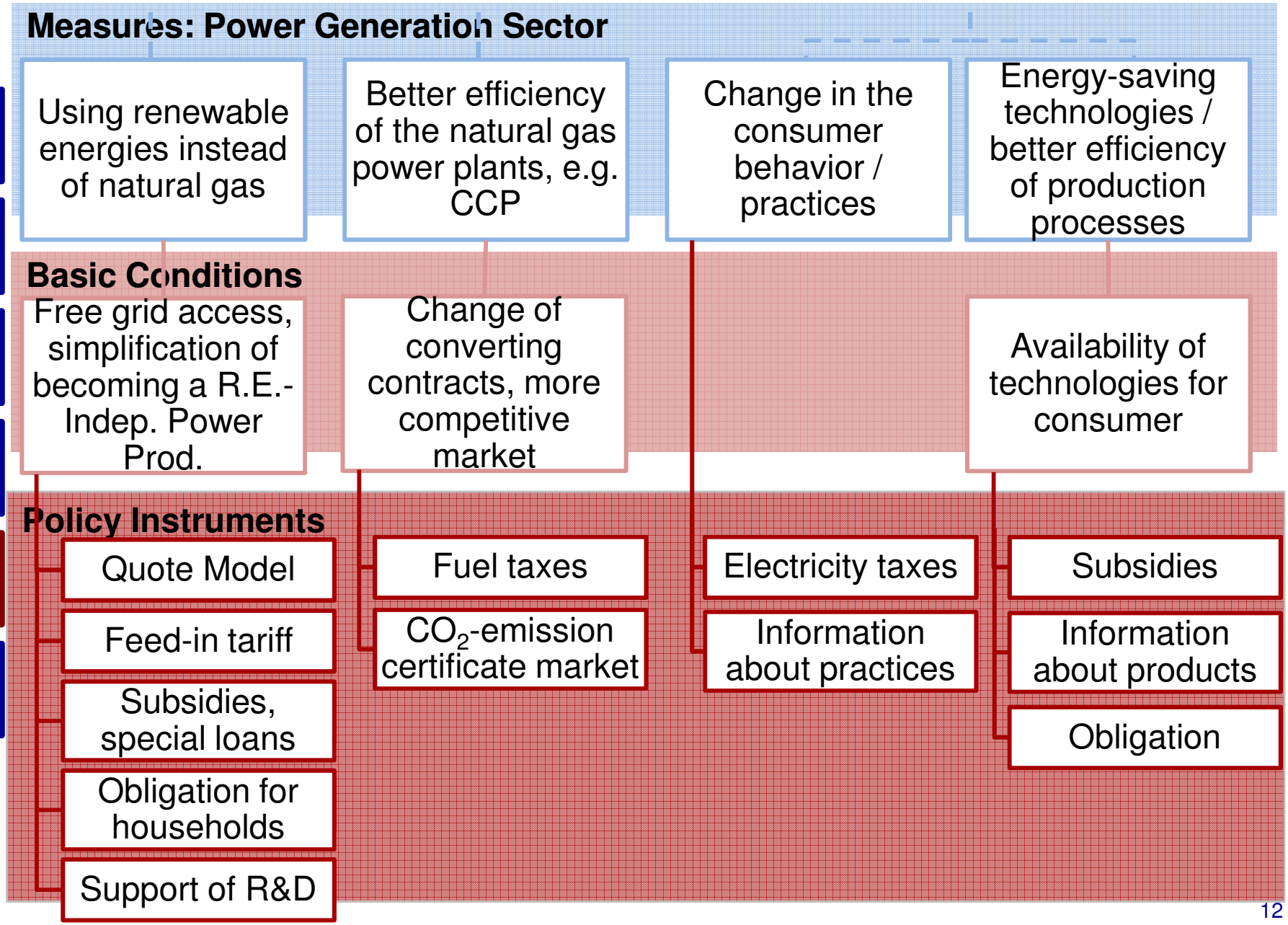
Intensity of Importance	Definition
1	Equal Importance
3	Moderate importance
5	Strong importance
7	Very strong or demonstrated importance
9	Extreme importance
2, 4, 6, 8	Intermediate values
1.1 - 1.9	When activities are very close a decimal is added to 1 to show their difference as appropriate

Weighting – AHP – Results



	Direct contr. to GHG em. mitigation	0.29	Environmental performance (0.375)
	Indirect environ-mental effects	0.08	

Clustering Policy Instruments



Policy Instruments Evaluation - Input

Intro-duction
Methods
Case Study T&T
Evaluation Criteria
Policy Instruments
Conclusion

- Calculated data
- Empirical approach

➔ Survey to different experts of the stakeholder of the power generation sector again
➔ Scale of performance of the policy instrument regarding to every criterion

10	9	8	7	6	5	4	3	2	1	0
Ex-cel-lent	Very good	Less than very good	Good	Less than good	Mo-der-ate	Less than mo-der-ate	Bad	Very bad	Less than very bad	Null

Policy Instruments Evaluation - Calculation

Multi-Attribute Theory (MAUT):

- Calculated data (e.g. prices, tons of GHG)
- Scale from 0 to 100
- Transformation via Utility-function: $u(x) = a*x + b$

Simple-Multi-Attribute Ranking Technique (SMART)

- „Soft"-Values
- Empirical approach
- Scale from 0 to 10

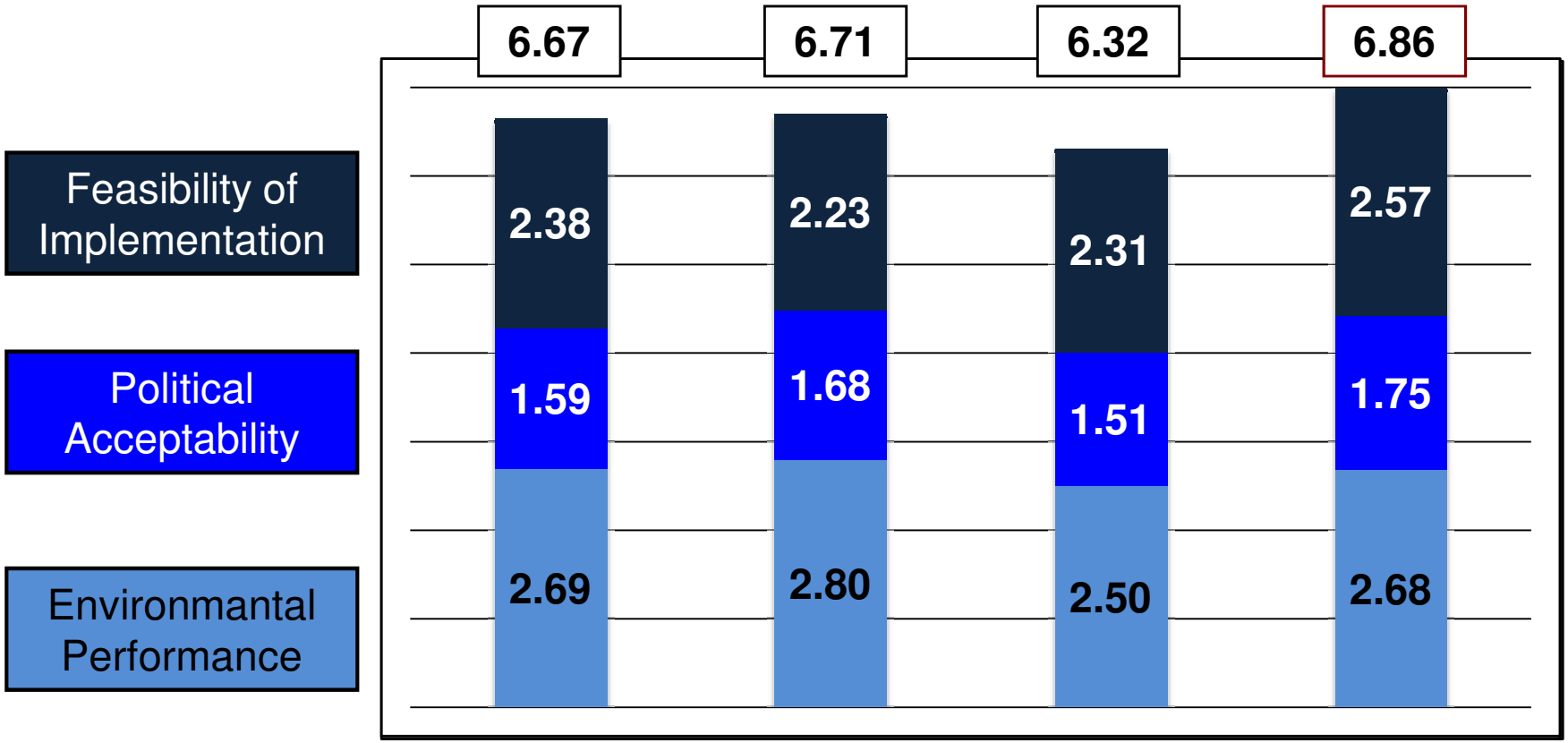
Mixture of both

- Transformation of SMART Scale to MAUT Scales

Final calculation:
Average result for each sub-criteria multiplied by the weigh

Policy Instruments Evaluation - Ranking

- Intro-duction
- Methods
- Case Study T&T
- Evaluation Criteria
- **Policy Instruments**
- Conclusion



Measures	Renewable Energies	Increased Effiecency	Consumer Behavior	Energy-Saving Technologies
Best Policy Instrument	**Feed-in Tariff**	**CO_2 Certificates**	**Information Practices**	**Subsidies Prod. / Proc.**

Policy Instruments Evaluation - Results

- → For every measure the best instrument can be shown
- → Results between “less than good” and “good” according to the evaluation scale
- → Subsidies for energy-saving technologies and processes have best overall performance
- → Results quite close => comparison with expert knowledge, literature necessary
- → Sensitivity Analysis

Challenges – Empirical Approach

Not enough **experts** to respond ?

→ PEEST-Analysis of the interrogated sector

→ Conferences !

Not **enough valuable** responses / outliers ?

→ Personal contact

→ Proper guidance, short survey !

Responses not **in time** ?

→ Deadline

→ Reminding calls !

Does the MCA meet the conditions?

- ✓ Broad spectrum of criteria and policy instruments
- ✓ Specific weighting of the criteria
- ✓ User-friendly and transparent in the calculation process
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Final Conclusion

The combined **Multi-Criteria Analysis Approach**

is an appropriate method for the evaluation and selection of environmental policy instruments for GHG-emission mitigation for Caribbean countries

- Supports structured thinking
- Decision process is transparent
- Results are based on clear analyses

→**Empirical approach** for weighting evaluation criteria

→**Calculated input data** for evaluation of policy instruments

Thank you for your attention!

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BACKUP

Weighting – AHP– Calculation (1/4)

AHP: Analytical Hierarchy Process

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- Setting Intensity
- Test of Consistency
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Weighting – AHP– Calculation (2/4)

Example: Sub-criteria for the **Feasibility of Implementation**:

3.1 Implementation network capacity
3.2 Administrative feasibility
3.3 Financial feasibility

	3.1 to 3.2		3.1 to 3.3		3.2 to 3.3	
Environmentalists						
Policy Maker						
Researchers						
Target Groups						
Sum						
Intensity						

Moderate Importance

Almost equal Importance

Little less Moderate Imp.

Weighting – AHP– Calculation (3/4)

Matrix – pairwise comparison between sub-criteria

Sub-criteria	3.1	3.2	3.3
3.1	1.00		
3.2		1.00	
3.3			1.00
Sum of colum			

1/x

Cell / Sum of column

Cell / Sum of Cells

Normalized matrix with weight coefficients

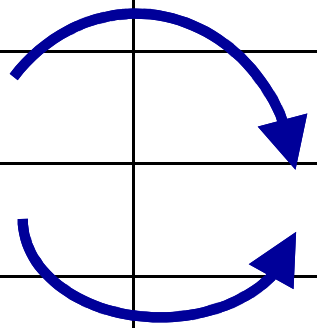
Sub-criteria	3.1	3.2	3.2	Sum of row	Weight coefficient
3.1					
3.2					
3.3					

Σ

Weighting – AHP– Calculation (4/4)

Transformation weight coefficient sub-criteria

Criterion / Subcriterion	**Weight coefficient**	**Sub-coefficient**
Feasibility of implementation		
Implementation network capacity		
Administrative feasibility		
Financial feasibility		



Coefficient main criterion x Coefficient sub-criterion