Sustainable and Resilient Cities: Leveraging Urban Surfaces

Iceland Liechtenstein Norway grants

Norway grants

PARP
PFR Group

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Background

Methodology

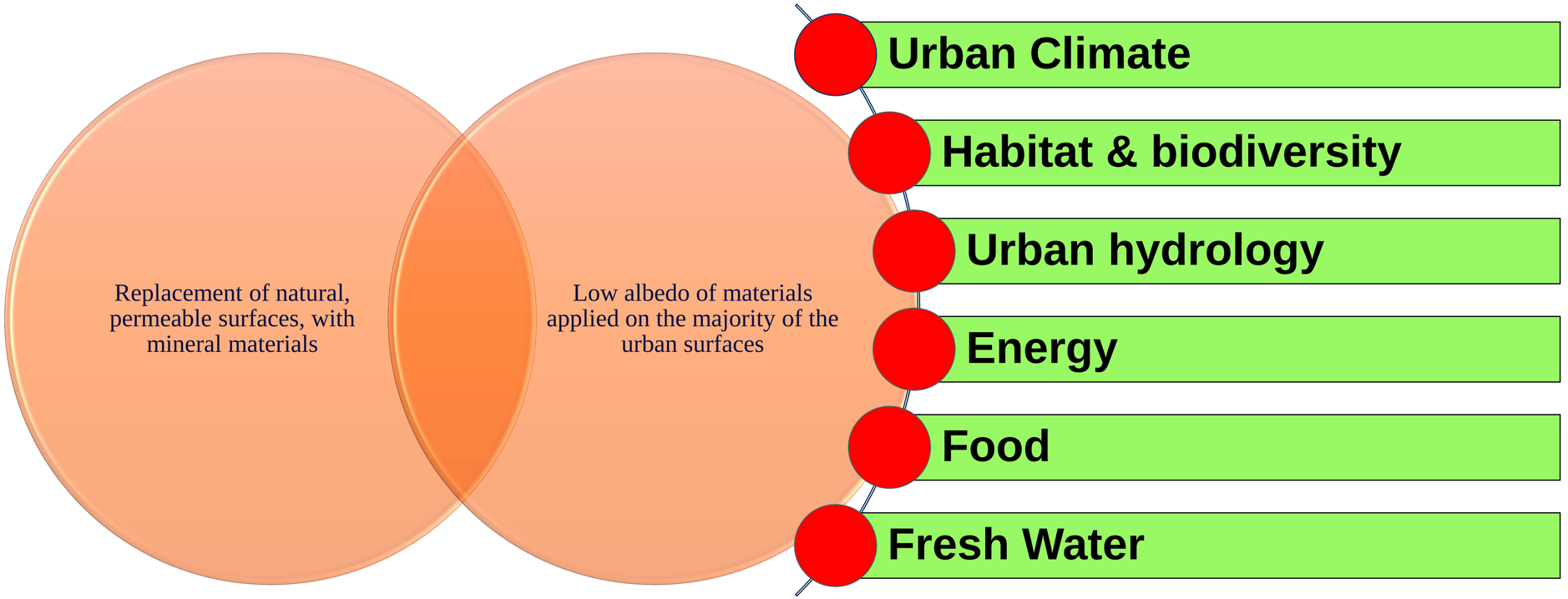
Assessment

Summary

Background

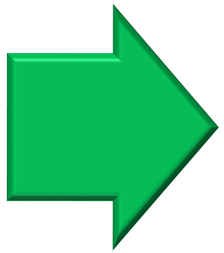
Background

- The urban surfaces significantly influence the quality of life in urban areas and environmental conditions.



Urban climate

- Increased concentration of GHG emissions
- Replacement of natural surfaces with mineral materials
- Extensive use of materials with low albedo
- Loss of green spaces
- High urban densities



- Raise of temperatures
- Urban heat island effect
- Reduction of outdoor comfort
- Reduction of evapotranspiration
- Entrapment of radiation inside the urban area
- Lower wind velocities (reduced convective heat removal)

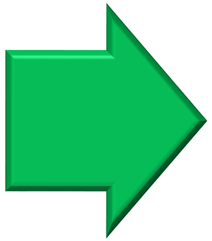
Habitat & biodiversity

- Habitat loss and fragmentation
- Import of species for gardening and urban landscaping

- Species richness decrement
- Spread of exotic and invasive species, with consequent decrement of native plants diversity
- Decreased biodiversity and environmental degradation

Urban hydrology

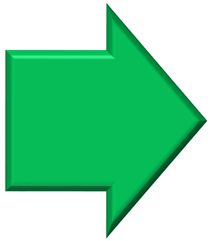
- Urban land sealing and increase in impermeable areas
- Extreme rainfall events



- Loss of soil natural retention capacity
- Reduced surface storage capacity
- Decreased evapotranspiration
- Higher volumes of urban runoff flows
- Increased discharge rates and flood peaks
- Storm-water management issues

Energy

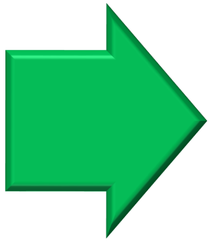
- Summer heatwaves
- High temperatures in urban areas



- Increment of energy consumption for cooling
- Peak electricity demand

Food

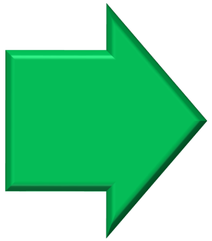
- Pressure on cities' food system (because of boost in urbanization)



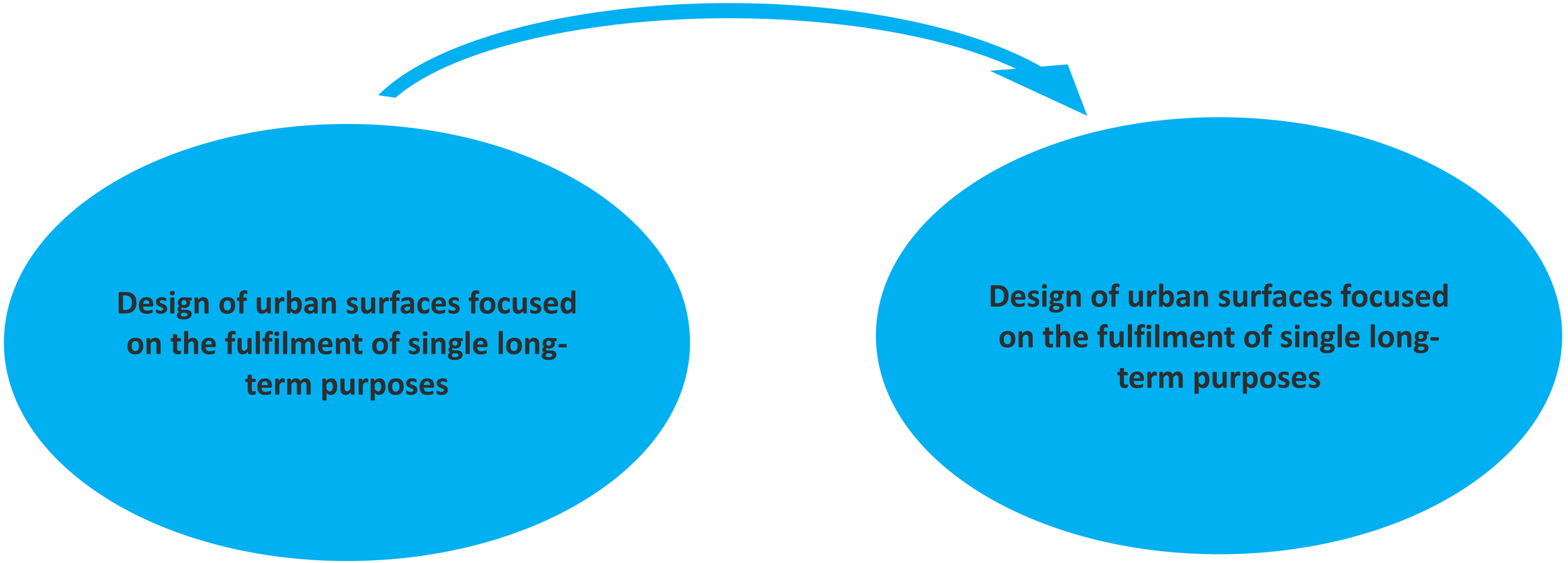
- Intensification of urban inhabitants' vulnerability to food insecurity
- Shocks in the agricultural market

Fresh water

- Increase of water consumption in urban areas
- Modified global hydrologic cycle and precipitation patterns



- Challenges in freshwater provision
- Changes in freshwater availability and water shortages
- Water pollution issues


Design of urban surfaces focused on the fulfilment of single long-term purposes
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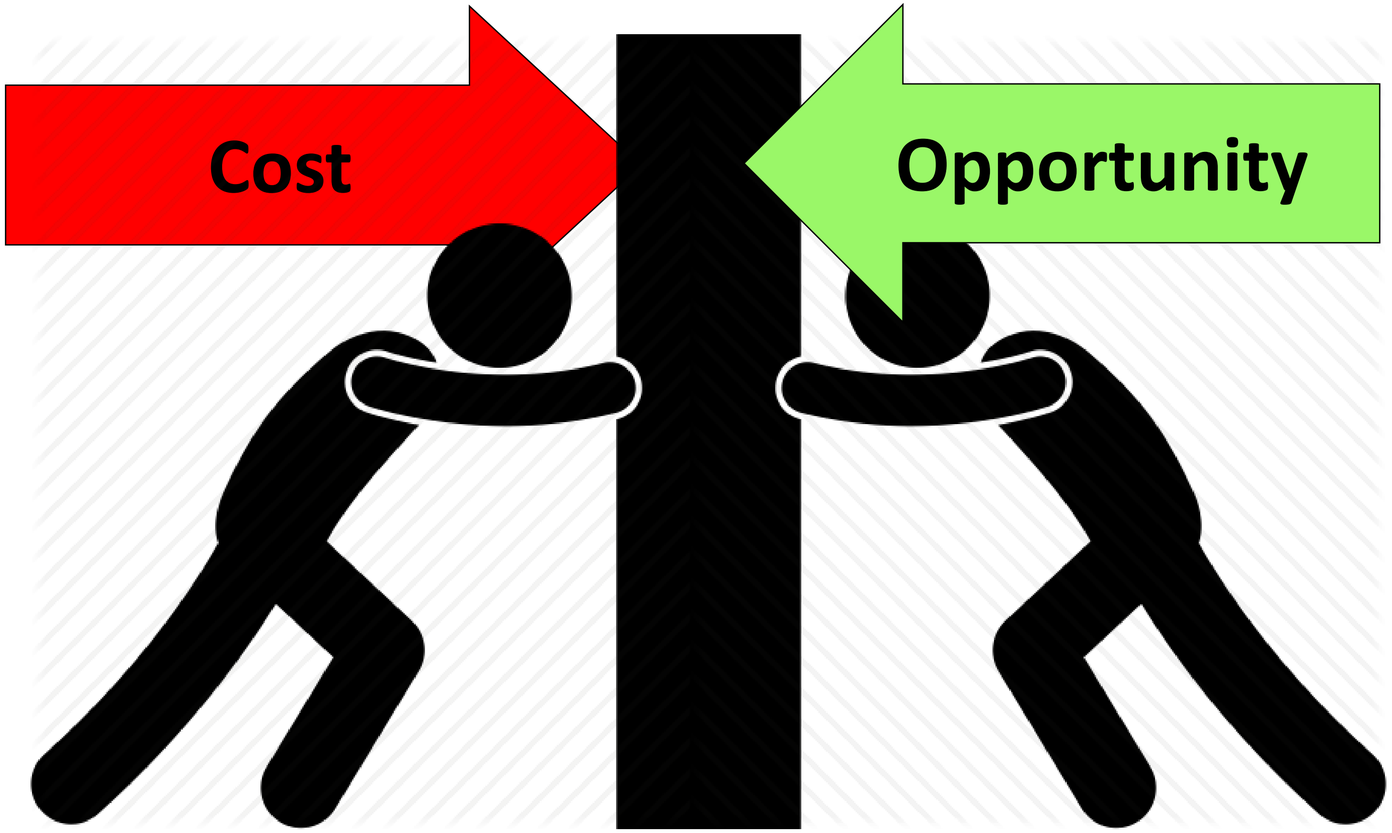
Cost
Opportunity

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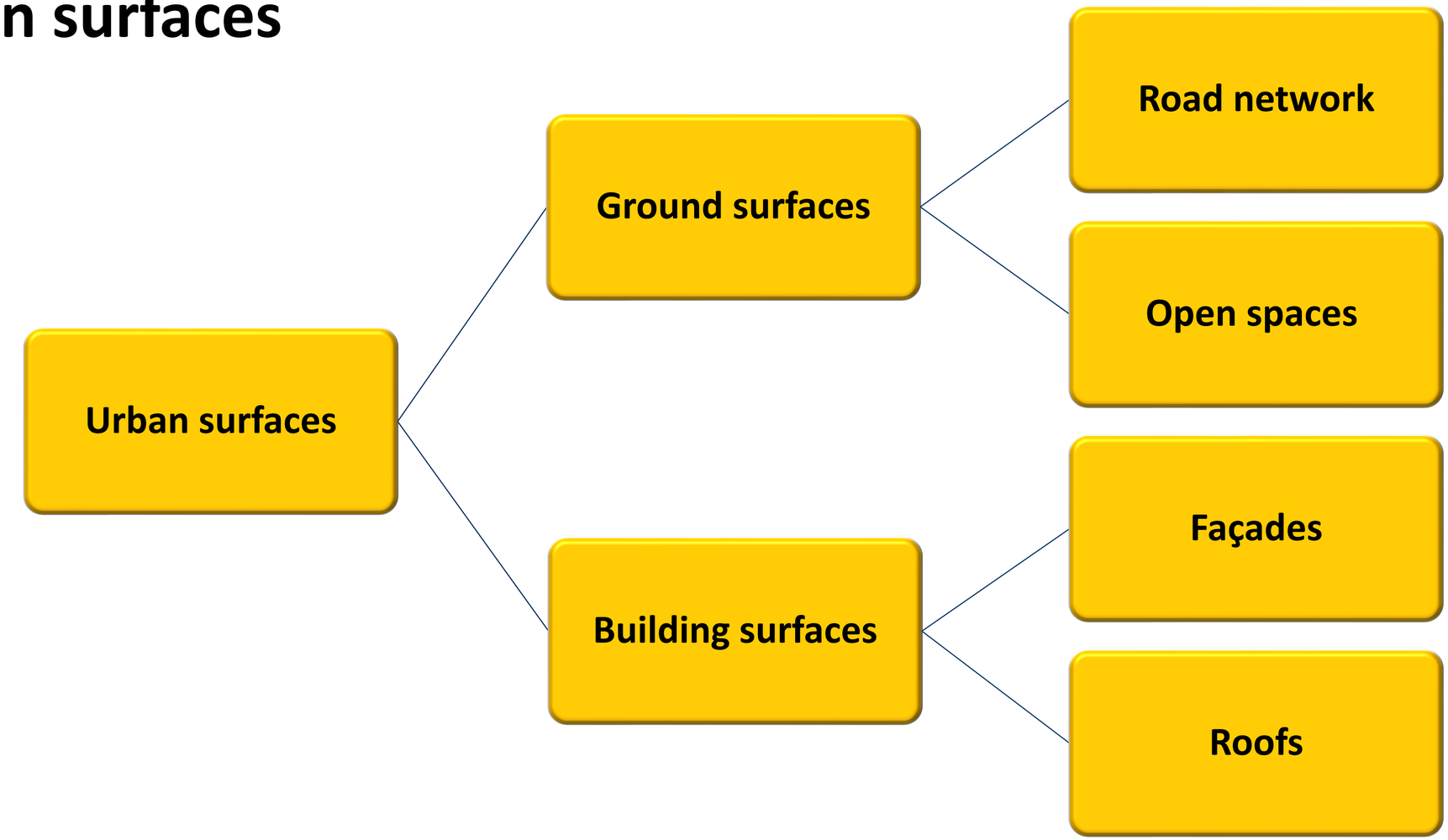
Cost

Opportunity

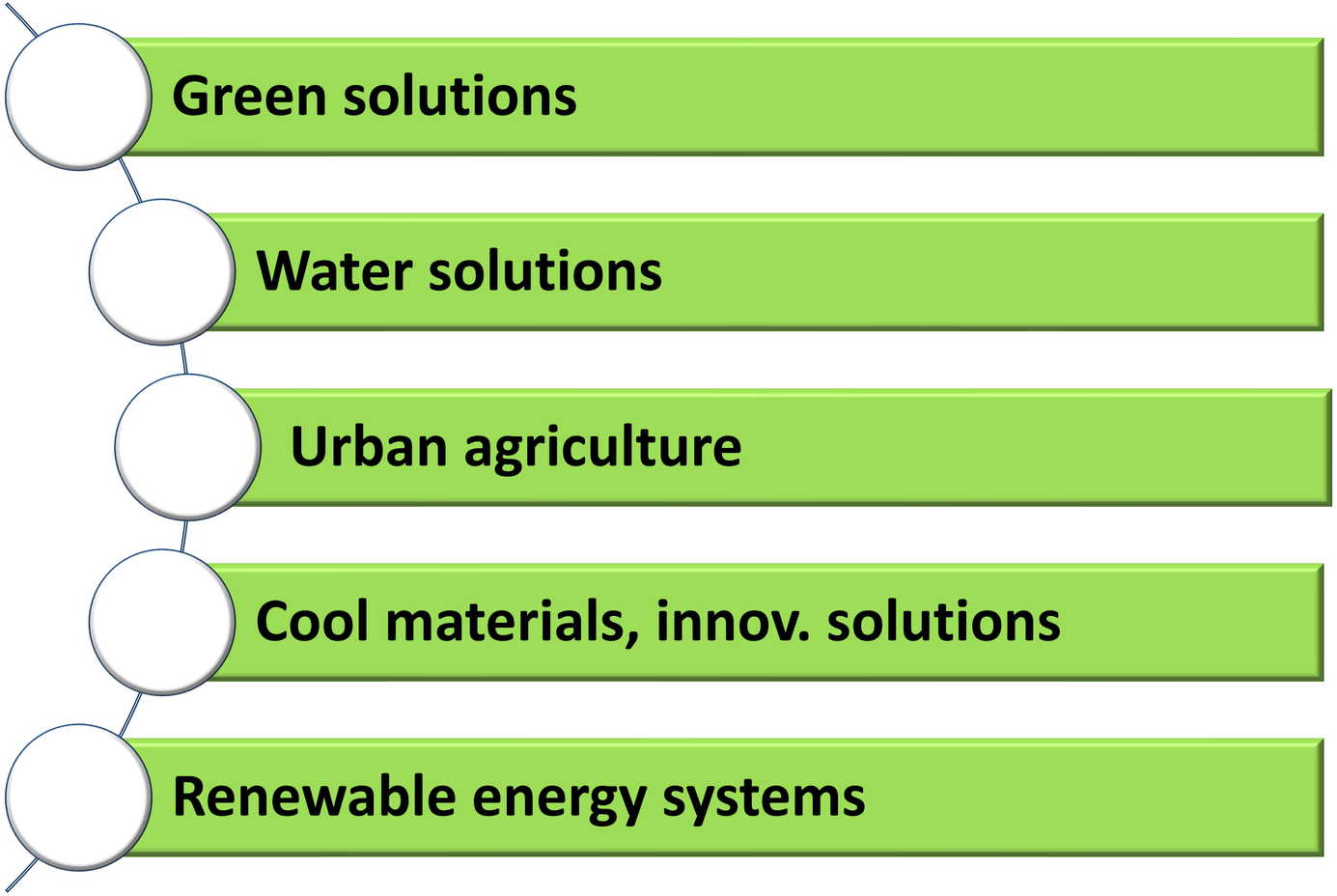
Urban surfaces



Urban surfaces

Roads	Cycle paths	Sidewalks	Parking areas	Railways
Tramways	Public areas	Green public spaces	Spaces in between buildings	Water bodies
Opaque facades	Transparent facades	Balconies	Flat roofs	Tilted- roof
		Curve roofs/ Other form		

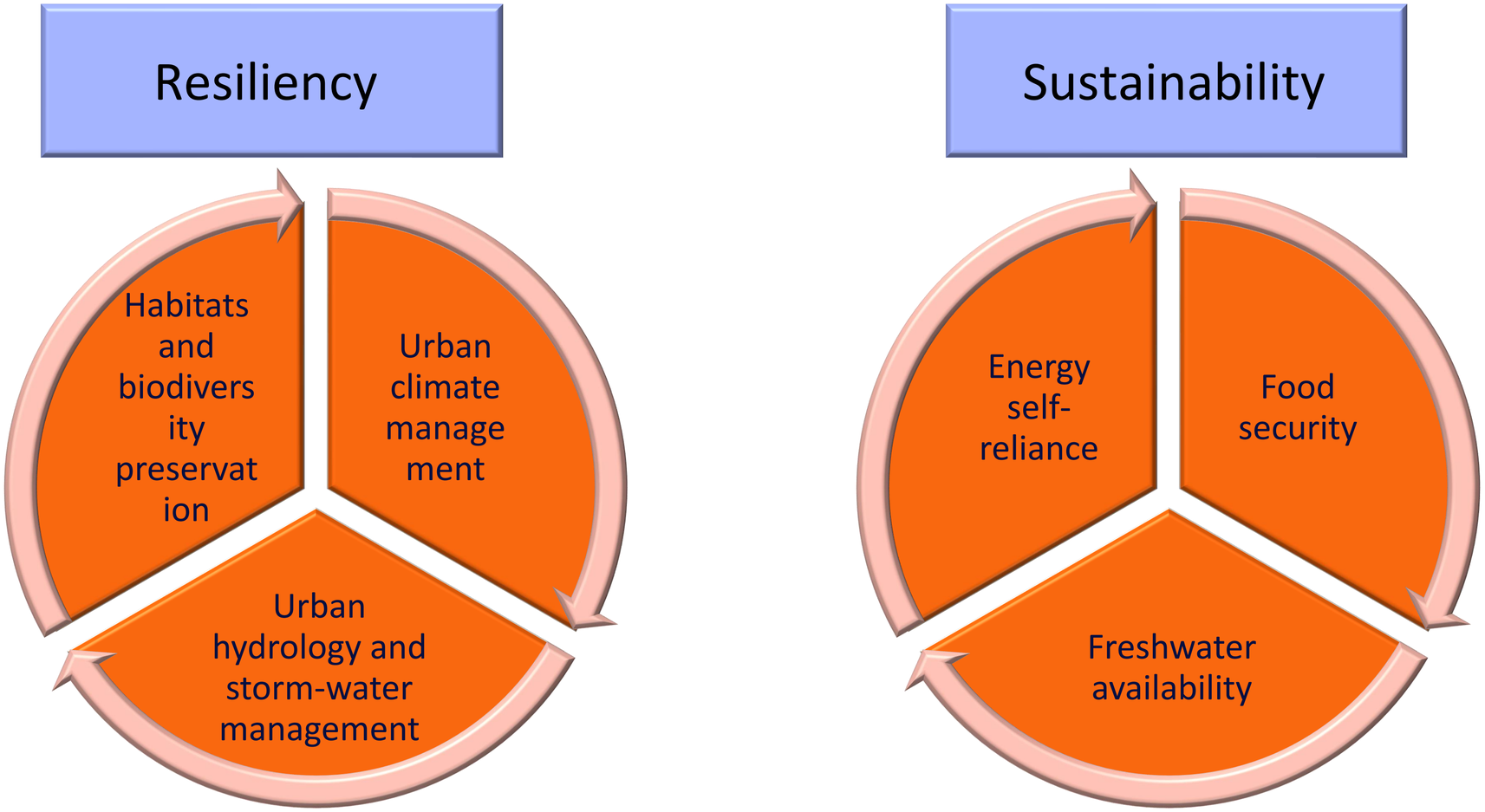
Urban Surface uses



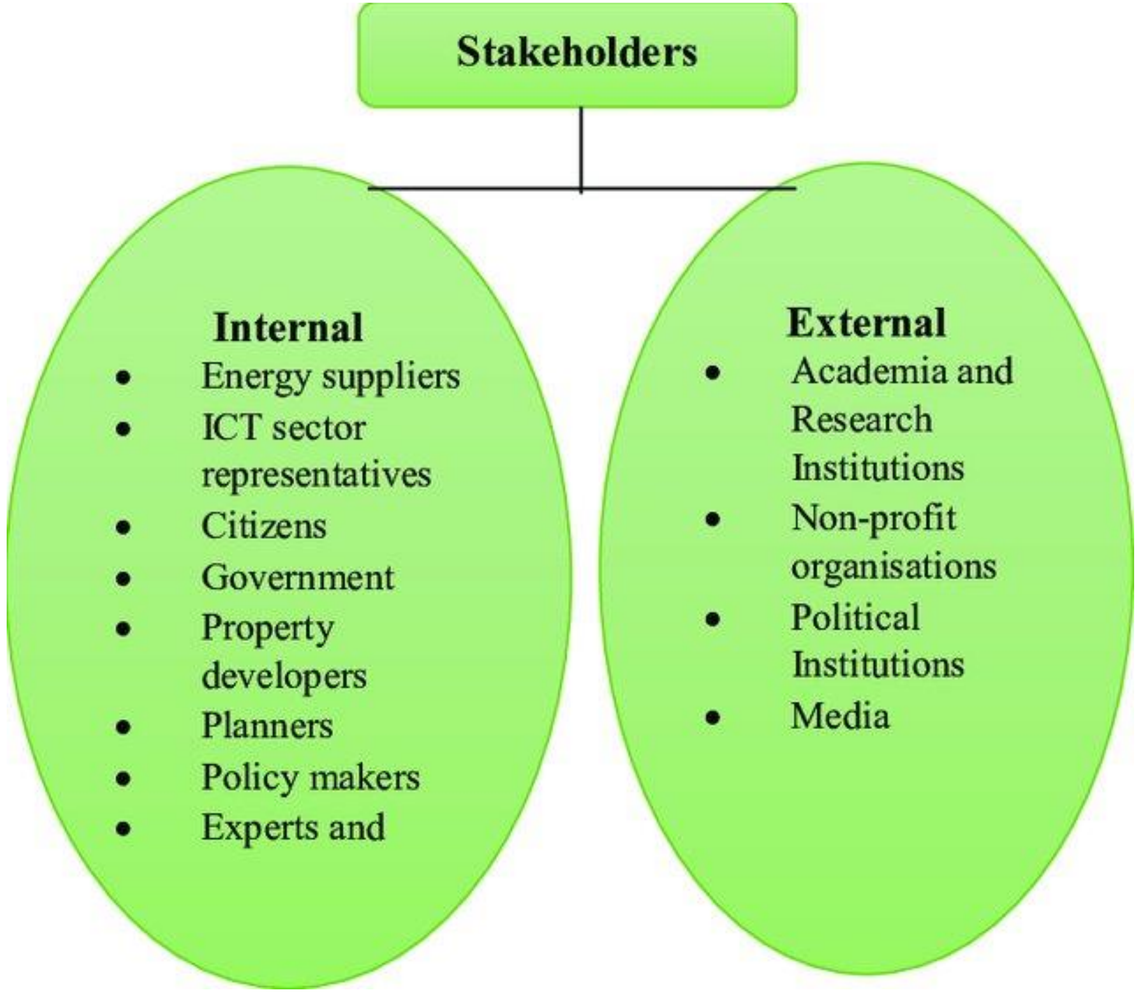
Methedology

Methedology

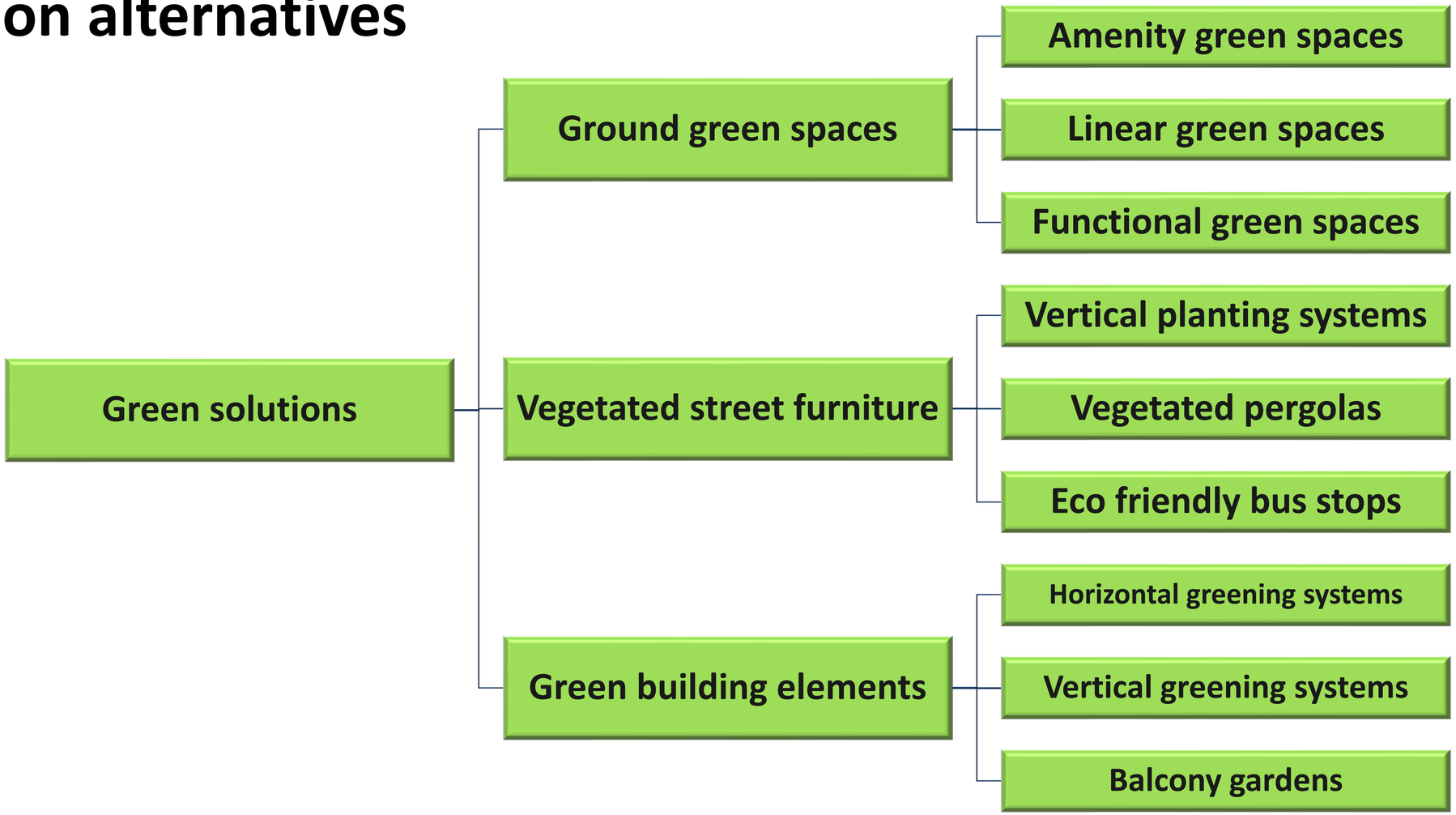
Goal


Resiliency
Habitats and biodiversity preservation
Urban climate management
Urban hydrology and storm-water management
Sustainability
Energy self-reliance
Food security
Freshwater availability

Decision makers/stakeholders/players



Decision alternatives



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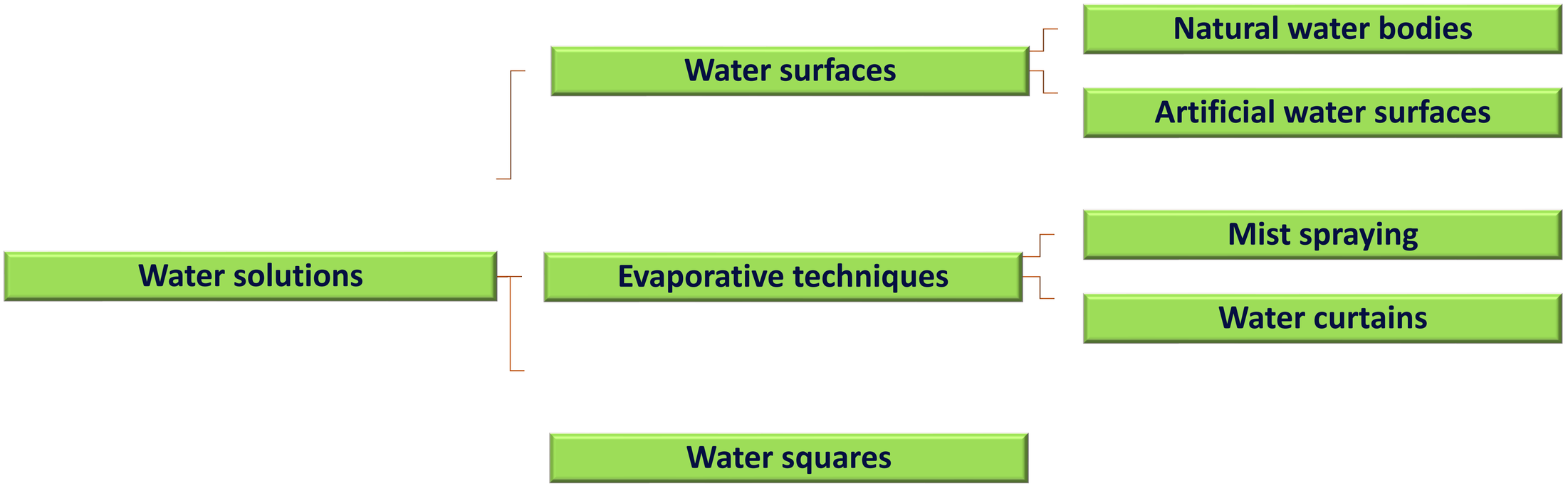

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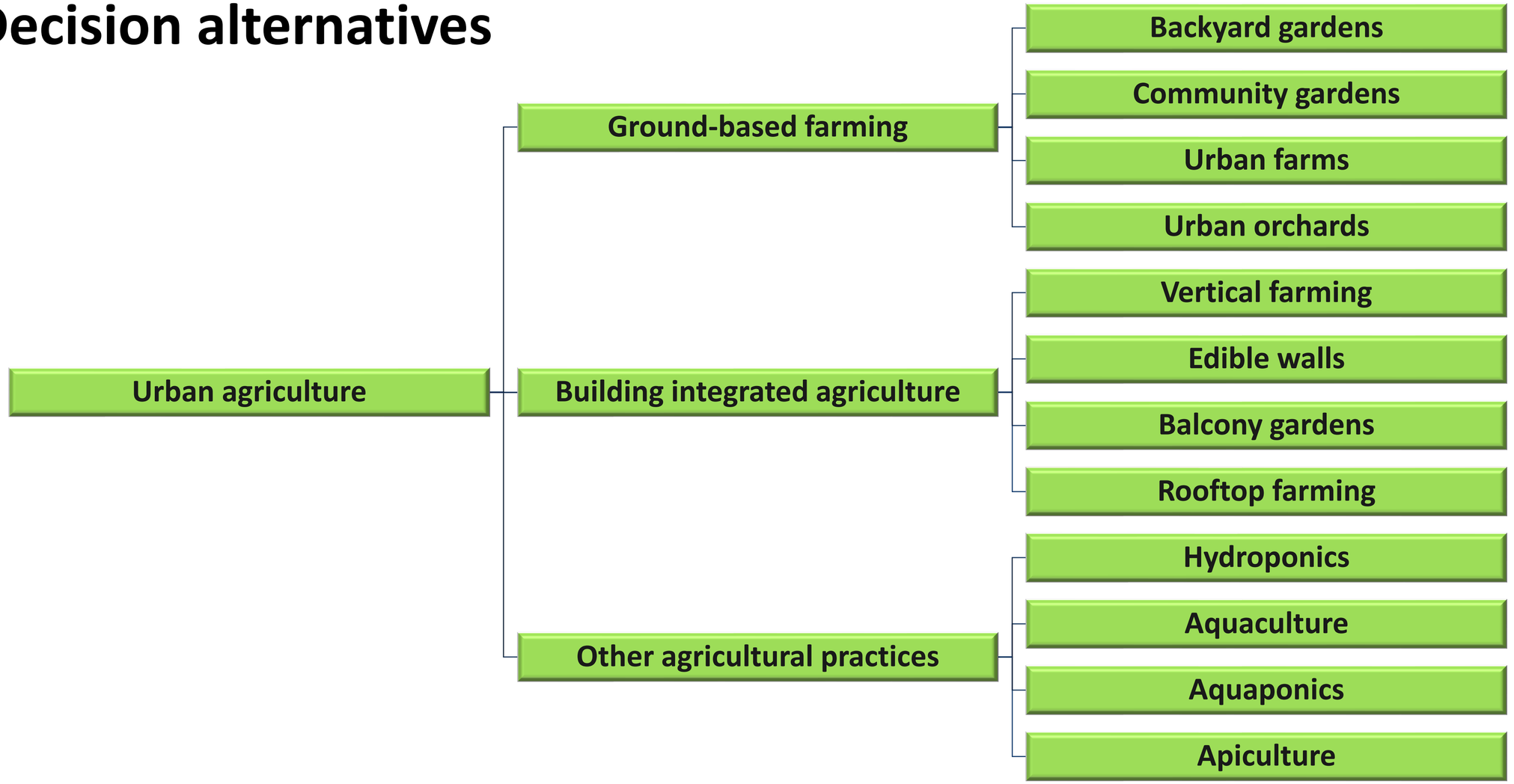

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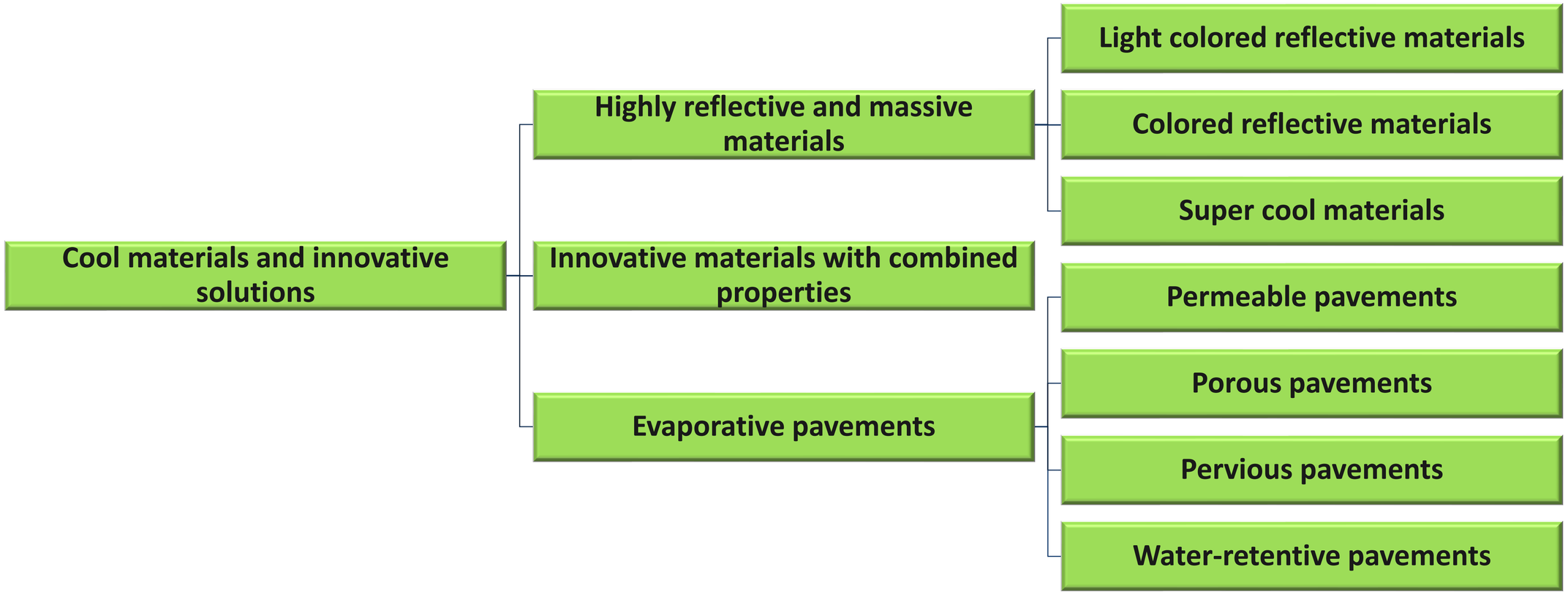

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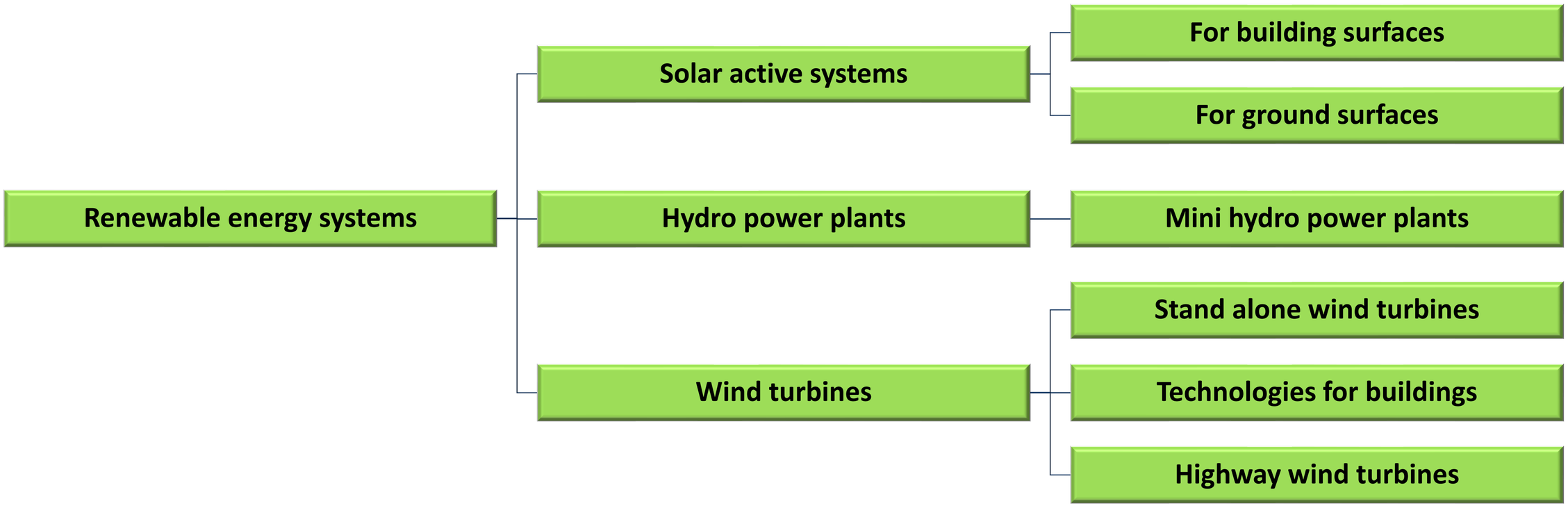
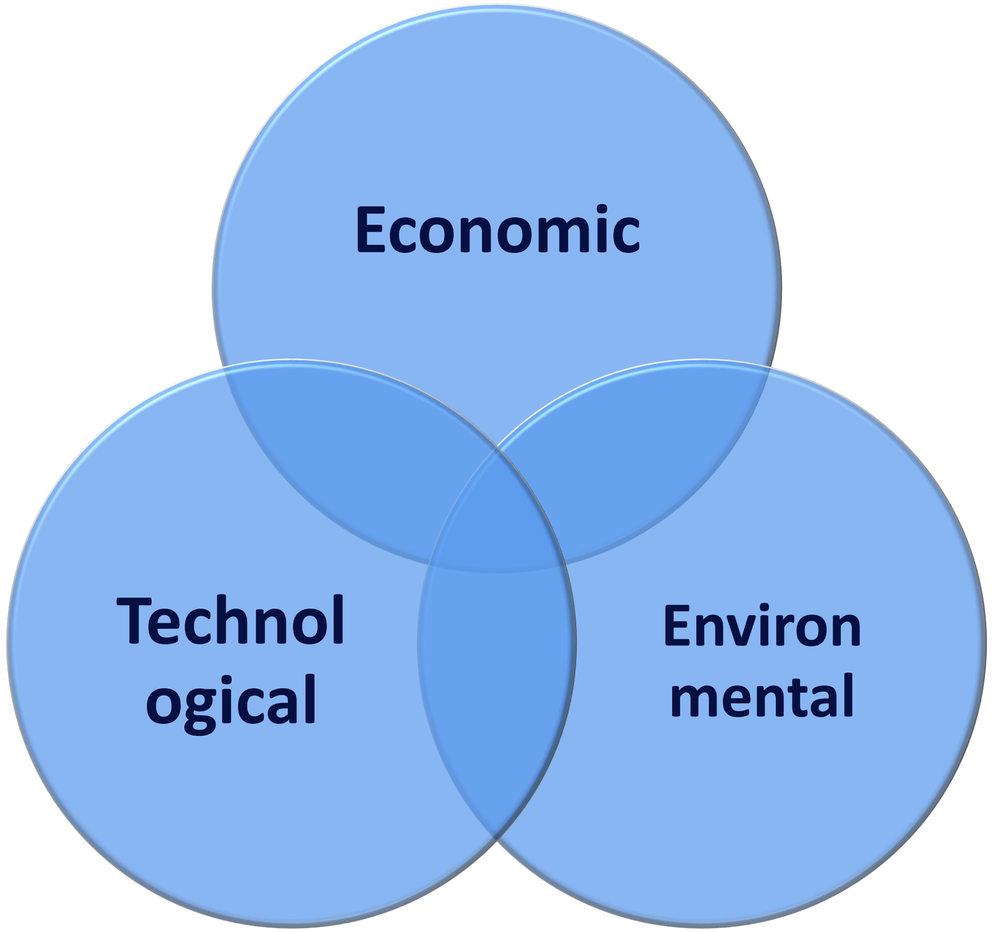


Evaluation criteria



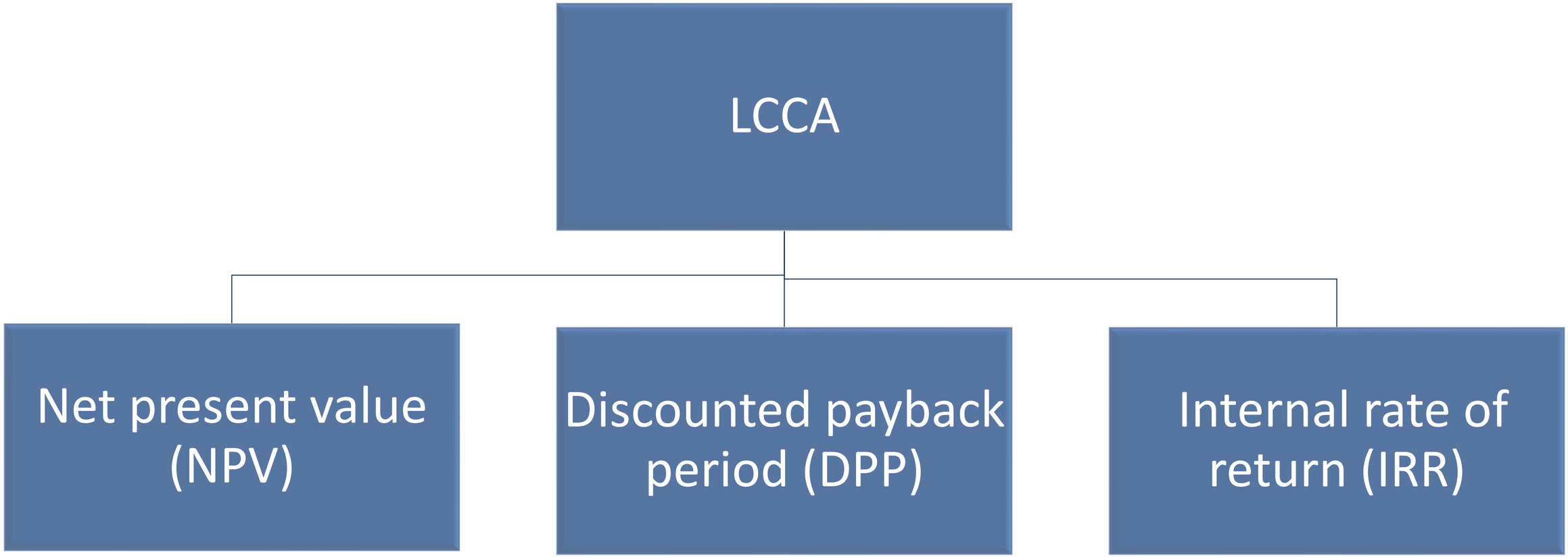
Evaluation criteria

Economic

Lifecycle cost analysis (LCCA): LCCA is a method for assessing the total cost and profit of facility ownership. It takes into account all costs and profits of acquiring, owning, maintaining and disposing steps.

Evaluation criteria

Economic



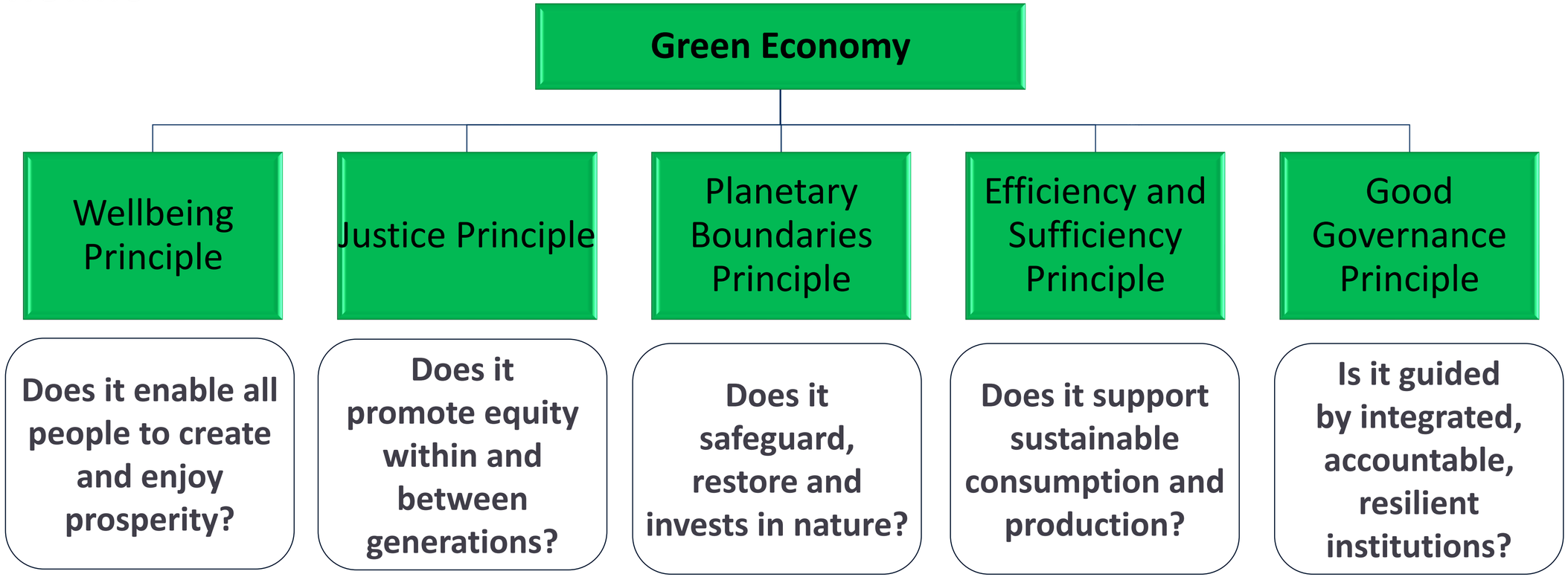
Evaluation criteria

Economic

Green Economy: An economy that results in improved human well-being and social equity, while significantly reducing environmental risks.

Evaluation criteria

Economic



Evaluation criteria

Environmental

Carbon footprint assessment: A carbon footprint assessment measures the total set of GHG that are emitted at different stages of a product's life cycle.

Evaluation criteria

Environmental

Carbon footprint assessment

Evaluation criteria

Environmental: (In) direct effect

	Urban Climate	Habitat and biodiversity preservation	Hydrology and storm water management	Energy self reliance	Food security	Freshwater availability
Green sol.	Direct sun shading Evapotranspiration	Preservation and enhancement of biodiversity	Increment of permeability and water retention	Management of heat exchange	Possibility for urban agrcul. activities	Contribution to the restoration of natural water cycle
Water sol.	Heat removal (evapotranspiration)	Promotion of local biodiversity	On-site stormwater management (infiltration)		Possibility for aquaculture	Restoration of natural water cycle
Urban agric.	Heat removal (evapotranspiration)	Preservation and enhancement of biodiversity	Mitigation of stormwater impact	Decrement of energy in food trans.	Food production as main objective	Contribution to the restoration of natural water cycle
Cool mat.	Decrement of surface temp.			Reduction of building cooling load		
Renewable en.				On-site RE Production		

Evaluation criteria

Technological Feasibility

Suitability matrix

Suitability matrix: Overview of the urban surfaces' suitability for the application of each usage cluster. ✓: suitable.

Surfaces			Green solutions	Water solutions	Urban Agric.	Cool & Innovat.	Ren. En. Systems
Ground	Road network	Roads	✓	✓	-	✓	✓
		Cycle paths	✓	✓	-	✓	✓
		Sidewalks	✓	✓	-	✓	✓
		Parking areas	✓	✓	-	✓	✓
		Railways	✓	-	-	-	-
		Tramways	✓	-	-	-	-
	Open spaces	Public areas	✓	✓	-	✓	✓
		Green public spaces	✓	✓	✓	-	✓
		Spaces in between buildings	✓	✓	✓	✓	✓
		Water bodies	✓	✓	✓	-	✓
Building	Façades	Opaque surfaces	✓	✓	✓	✓	✓
		Transparent surfaces	✓	✓	✓	-	✓
		Balconies	✓	-	✓	-	✓
	Roofs	Flat	✓	✓	✓	✓	✓
		Tilted	✓	-	-	✓	✓
		Curves / Other forms	✓	-	-	✓	✓

Evaluation criteria

Technological Feasibility

Conflicts and synergies matrix

Uses	Conflicts	Integrated solutions
Green solutions		Green roofs Edible walls Open-air rooftop farms Bio-solar roofs Multifunctional solar-green roofs/façades
Water solutions		Green roofs Rooftop acquaculture Rooftop acquaponics
Urban agriculture		Edible walls Open-air rooftop farms Rooftop acquaculture Rooftop acquaponics Productive façades Rooftop solar greenhouses
Cool materials & innovative solutions		Cool + PV roof
Renewable energy systems		Bio-solar roofs Multifunctional solar-green roofs/façades Productive façades Rooftop solar greenhouses Cool + PV roof

Assessment

Economic

Criteria	Weight	Score	Point (Weight X Score)
Is the solution economically feasible?			
Does the solution advance green economy?			
Does the solution enhance entrepreneurship opportunities in the urban area?			
Does the solution advance local food/energy/water production?			
Does the solution improve the vibrancy of the urban area?			
Is the investment signifacantly higher than the other alternatives?			
Is the plan and implement time long?			
…			
SUM			

Environmental

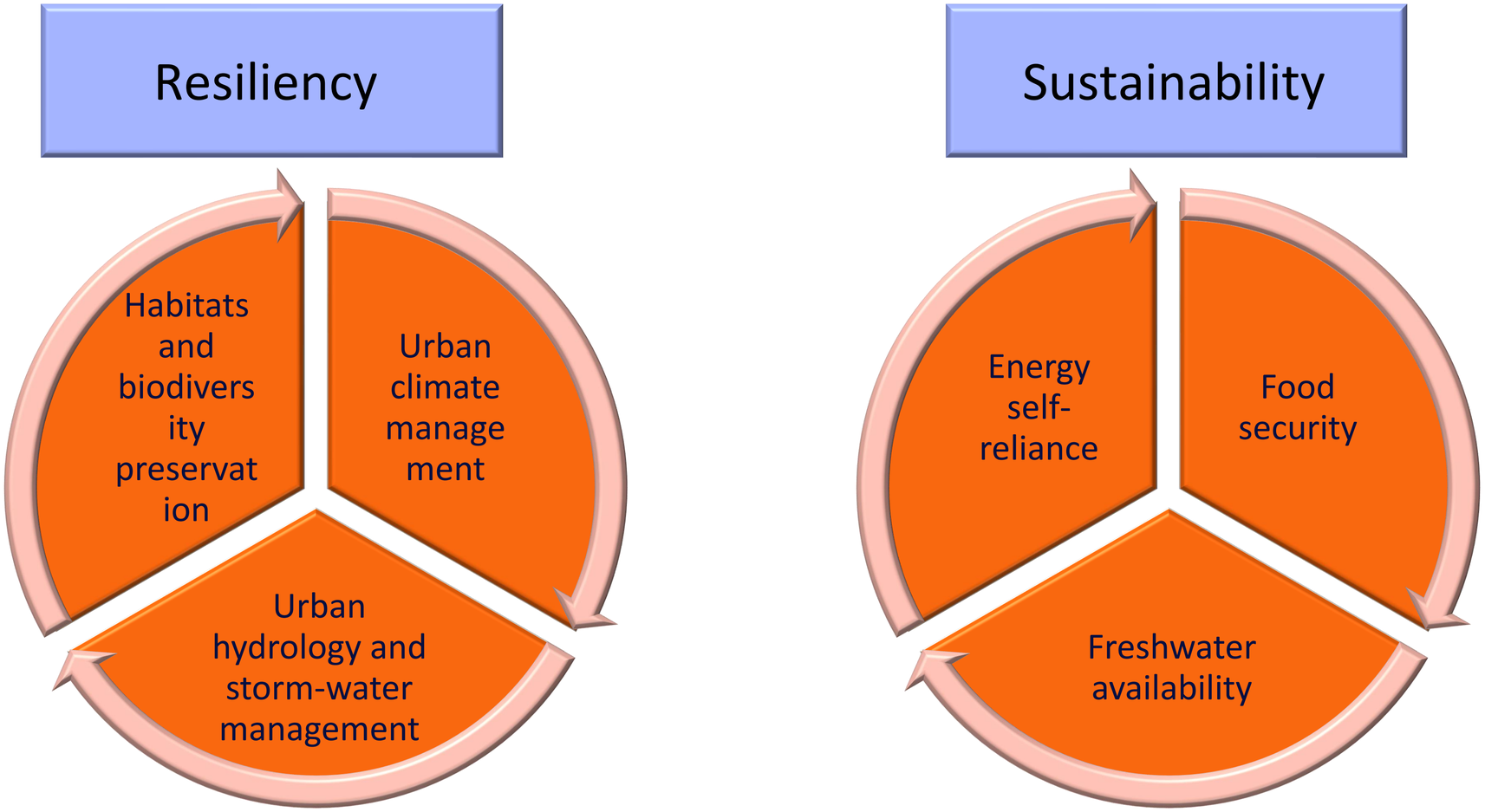
Criteria	Weight	Score	Point (Weight X Score)
Does the solution reduce fossil fuel consumption?			
Does the solution reduce solid waste disposal demand?			
Will the solution protect local food/energy/water?			
Does the soluiton contribute to the heat removal of the urban area?			
Does the soluiton improve biodiversity?			
Does the solution contribute to evapotranspiration?			
Does the solution improve urban hydrology and storm-water management?			
…			
SUM			

Technical

Criteria	Weight	Score	Point (Weight X Score)
Does the soluiton has a proper lifetime?			
Is the solution integrable with other solutions?			
Is the solution already commercialized?			
Is there sufficient area available for the solution?			
Does the solution meet standards and regulations (safety, aesthetic, etc.)?			
Does the business model of the solution involves several stakeholders?			
Is the solution customizable?			
…			
SUM			

Summary

Summary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Summary

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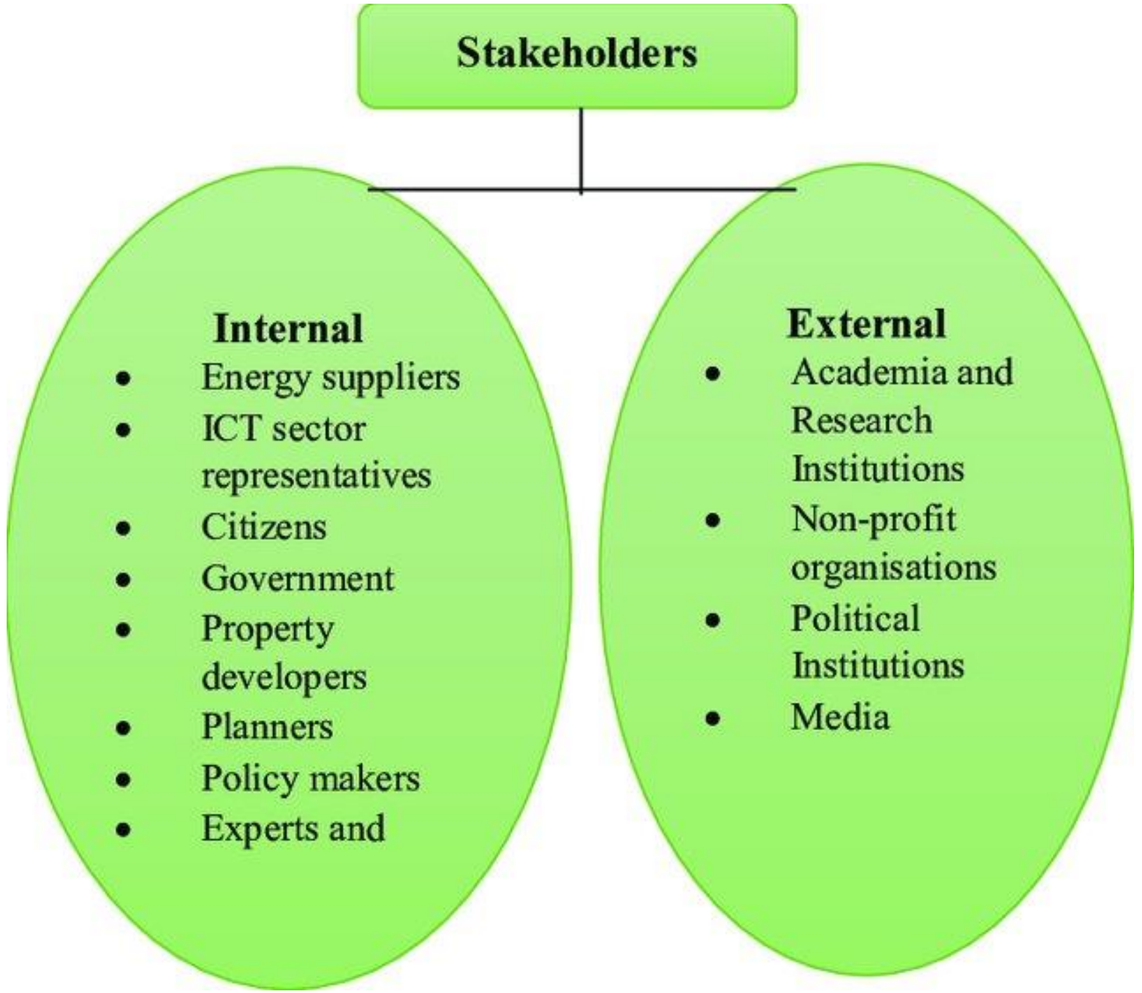
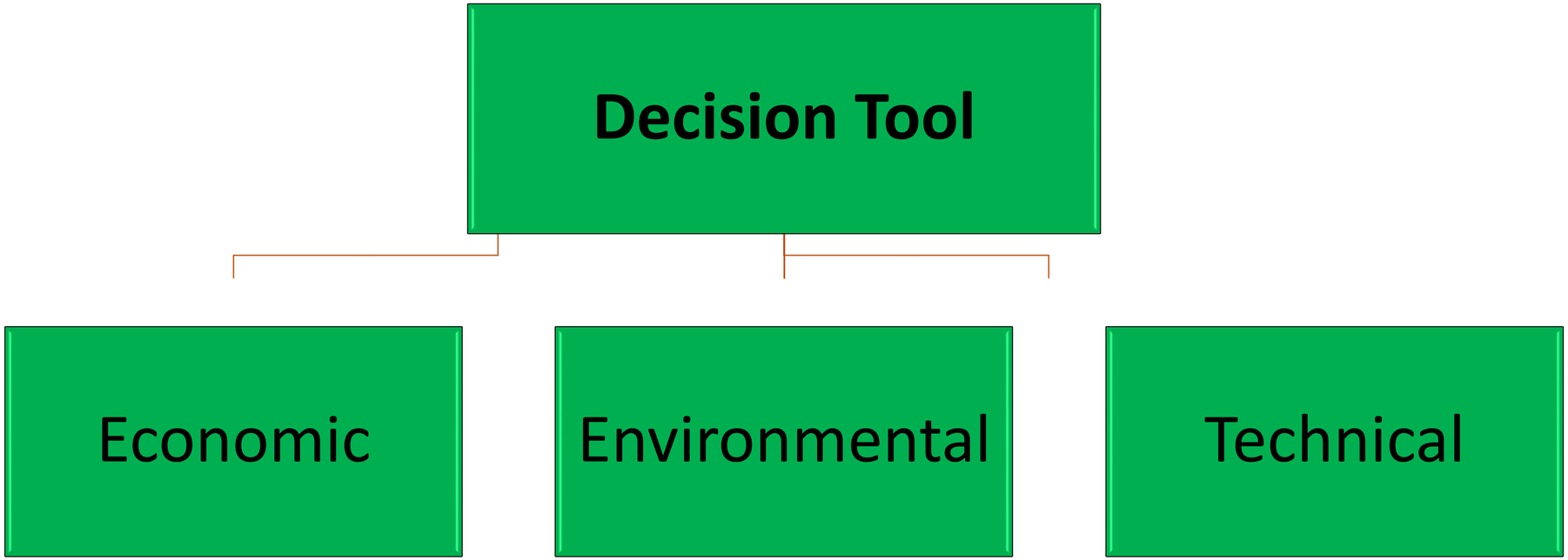
Summary

GREEN SOLUTIONS	WATER SOLUTIONS	URBAN AGRICULTURE	COOL MATERIALS INNOV. SOLUTIONS	RENEWABLE ENERGY SYSTEMS
Ground green spaces	Water surfaces	Ground-based farming	Highly reflective and emissive materials	Active solar energy systems
Vegetated street furniture	Evaporative techniques	Building-integrated agriculture	Innovative materials with combined properties	Hydropower plants
Green building elements	Water squares	Other forms of urban agriculture	Evaporative pavements	Wind turbines
				Other systems

Summary


Stakeholders
Internal
Energy suppliers
ICT sector representatives
Citizens
Government
Property developers
Planners
Policy makers
Experts and
External
Academia and Research Institutions
Non-profit organisations
Political Institutions
Media

Summary



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Thank you for your attention!