Multi-criteria Decision Analysis

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Overview

- What is Multi-criteria decision analysis? What is PROMETHEE?
- Assessment criteria and (intermediate) criteria fulfilment
- Decision maker prototypes
- (Intermediate) results and conclusions

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What is Multi-Criteria Analysis?

- Most human decision-making problems are of a multi-criterial nature
- But usually, no solution exists which optimises all the criteria at the same time
- The basic data of such a multi-criteria problem is summarised in the evaluation table:

Alternatives/Policy Pathways	a_1	a_2	a_3	a_4	a_5
Criteria					
Effectiveness : f_1	$f_1(a_1)$	$f_1(a_2)$	$f_1(a_3)$	$f_1(a_4)$	$f_1(a_5)$
Static efficiency: f_2	$f_2(a_1)$	$f_2(a_2)$	$f_2(a_3)$	$f_2(a_4)$	$f_2(a_4)$
Dynamic efficiency: f_3	$f_3(a_1)$	$f_3(a_2)$	$f_3(a_3)$	$f_3(a_4)$	$f_3(a_4)$
Energy security effects: f_4	$f_4(a_1)$	$f_4(a_2)$	$f_4(a_3)$	$f_4(a_4)$	$f_4(a_4)$
Equity: f_5	$f_5(a_1)$	$f_5(a_2)$	$f_5(a_3)$	$f_5(a_4)$	$f_5(a_4)$
Soc.-pol. acceptability: f_6	$f_6(a_1)$	$f_6(a_2)$	$f_6(a_3)$	$f_6(a_4)$	$f_6(a_4)$
Legal feasibility: f_7	$f_7(a_1)$	$f_7(a_2)$	$f_7(a_3)$	$f_7(a_4)$	$f_7(a_4)$

- The analysis will produce a ranking of alternatives, depending on how highly each alternative scores in each criterion
- Obviously, the ranking also depends on the importance attached to each criterion by the decision maker
- For this analysis, we use the MCDA method PROMETHEE

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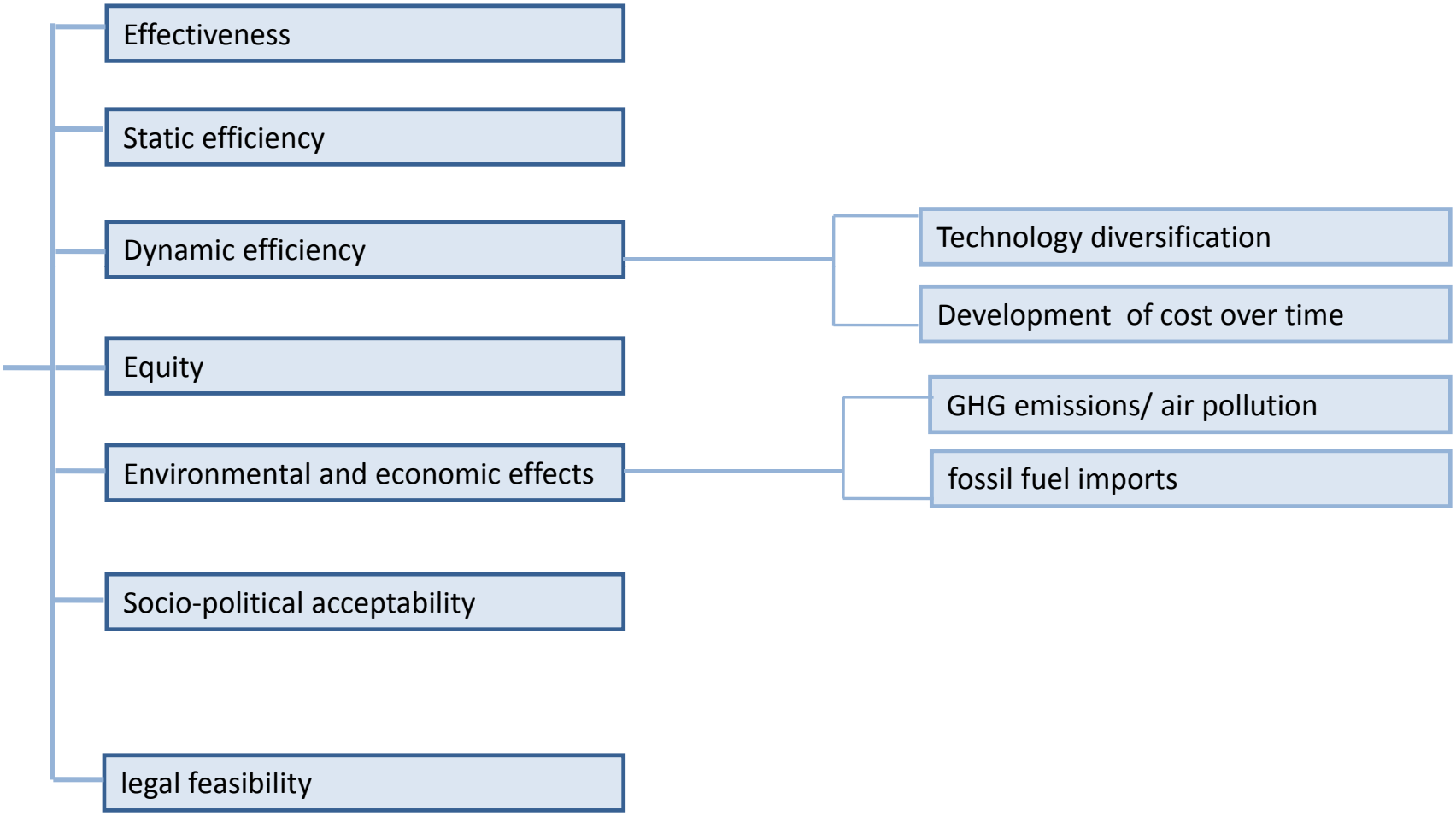
Assessment Criteria



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Effectiveness

- Ability of a policy pathway to trigger deployment. Does this pathway enable EU Member States to achieve the RES(-E) target?

- Relevant data provided by Green-X modelling

Indicator:
Degree of target achievement

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Static efficiency (cost-effectiveness)

- Achievement of a given short-run RES-E target at the lowest possible cost to society
- Equimarginality Principle: Cost-effectiveness is attained when an instrument encourages proportionally greater RES-E deployment by those firms and installations with lower RES-E deployment costs, and lower RES-E deployment by firms with higher deployment costs.

- Relevant data provided by Green-X modelling

Indicator:
Support expenditures [bn €] – average annual expenditures between 2021-2030

Alternative measurement: Generation cost of RES

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Dynamic efficiency

- Ability of an instrument to generate a continuous incentive for technical improvements and costs reductions in renewable energy technologies
- Key in a problem with long-term horizons such as climate change

- Relevant data provided by Green-X modelling

Indicator:
Learning index => RES technologies' reduction in investment cost (€/MW) between 2020-2030, weighted by the energy production from these new installations.

Technology portfolio diversification (Herfindahl-Hirschman-Index as a measure of concentration)

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Equity

- Even if an instrument leads to net benefits for society as a whole, there will be winners and losers
- On Member State level: Does a given instrument lead to a concentration of the costs of RES-E promotion in a limited number of countries?

- Relevant data is provided by Green-X

Indicator:

Variation of policy cost (in % of GDP) across EU-27 (Standard deviation)

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Environmental and economic effects

- Positive effects are possible for the country where the RES-E plants are located, or for the EU as a whole
- Here we focus on benefits for the EU as a whole

- Relevant data provided by Green-X modelling

Indicators:

average annual greenhouse gas emissions avoided due to RES installed between 2021-2030 (expressed in bn €)

average annual fossil fuel imports avoided due to RES installed between 2021-2030.

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Socio-political acceptability

- related to the existence of real or perceived local drawbacks or benefits for specific Member States (MSs) or regions
- Related to support cost and to economic and environmental effects

- Data from interviews with 7 Member State representatives

Indicator:
Preference of national decision makers => scale from 1 („very unlikely to be politically acceptable in my country“) to 5 („very likely to be politically acceptable in my country“)

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Legal feasibility

- legislative competence; and compatibility with other EU primary and secondary law. Does the EU have competence to legislate with regard to each specific pathway? How complex is the adoption procedure?

- Data from legal analysis

Indicator:
Adoption procedure => qualitative legal analysis; scale from „easy“ to „difficult/impossible“ (0-10)

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Evaluation table

Criterion	Desired direction	**Fully harmonised quota** (pathway 3a)	**ETS** (pathway 5)	**Reference with strong coordination** (pathway 7a)	**Reference with moderate cooperation** (pathway 7b)
Effectiveness (share of targeted 2030 RES volumes in %)	maximise	100	57.5	100	100
Static efficiency (support expenditures in bn €)	minimise	46.87	1.12	30.78	30.85
Dynamic efficiency					
Portfolio Diversity (Hirschman-Herfindahl-Index)	minimise	0.143	0.296	0.128	0.127
Decrease in investment cost (%)	maximise	10.7	5.8	11.7	12.2
Equity (standard deviation support expenditures/GDP in each MS)					
assuming no burden sharing (standard deviation)	minimise	0.00396	0.00117	0.00205	0.00211
or assuming perfect burden sharing (standard deviation)	minimise	0	0	0	0
Environmental and economic effects					
Avoided GHG emissions (bn €)	maximise	16.62	8.77	16.91	17.05
Avoided fossil fuel imports (bn €)	maximise	66.42	31.03	57.59	68.92
Socio-political acceptability					
Preference of national DMs					
(mean score of 7 respondents, scale 1-5)	maximise	2.12	2.67	3.46	3.04
(number of respondents who gave a "1")		3	2	1	0
Legal feasibility (rated 0-10)	maximise	0	0	8	10

Decision Makers

Criteria weightings of different stakeholder groups elicited through a questionnaire and detailed interviews.

Other sources, such as the responses to the Commissions Green Paper Consultation "A framework for 2030 climate and energy policies":

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	No 2030 RES target => Policy Pathway "ETS only"	2030 RES target
Member States	**UK** **CZ** **PL** **RO** **CY** – targets should be non-binding **SI**? **EE** – RES target if "EU-level action in these areas provides substantial added value" **FI** – if RES target, then indicative, or moderate binding **ES**? Neither yes nor no	**FR** – complimentary RES target, "partial harmonisation" of support schemes desirable **AT** **DK** –30% RES in 2030 **LT** – yes to RES targets, encourage regional convergence and better use of FlexMex **PT** – willing to have RES targets, if combined with good FlexMex and encouraging interconnection
Other Stakeholders	**IETA** **CEMBUREAU** **Eurelectric; Vattenfall; Statkraft;** and other **utilities** **Eurogas** **FORATOM** **OGP** **EEX** – primary GHG target can be supported by secondary RES target	**European Commission** (proposed in the Green Paper) – 3 targets: GHG 40%; RES 30%; EE not specified **Greenpeace, WWF** – 45% RES in 2030; **BirdlifeEurope** **EREC** – 45% RES in 2030; and other **RES industry players**

Decision Makers

The Environmentalist	
Effectiveness	20%
Static Efficiency	
Dyn.Eff – Portfolio	20%
Dyn.Eff – Learning	20%
Equity	
EnvEco – GHG	30%
EnvEco – Fossil	10%
Socio-Political	
Legal	

Real stakeholders are positioned somewhere between these extremes

The Cost-Concerned	
Effectiveness	
Static Efficiency	80%
Dyn.Eff – Portfolio	10%
Dyn.Eff – Learning	10%
Equity	
EnvEco – GHG	
EnvEco – Fossil	
Socio-Political	
Legal	

The Pragmatic	
Effectiveness	
Static Efficiency	20%
Dyn.Eff – Portfolio	10%
Dyn.Eff – Learning	10%
Equity	
EnvEco – GHG	
EnvEco – Fossil	
Socio-Political	30%
Legal	30%

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Policy pathways / Criteria	a_1	a_2	a_3	a_4	a_5
f_1	$f_1(a_1)$	$f_1(a_2)$	$f_1(a_3)$	$f_1(a_4)$	$f_1(a_5)$
f_2	$f_2(a_1)$	$f_2(a_2)$	$f_2(a_3)$	$f_2(a_4)$	$f_2(a_4)$
f_3	$f_3(a_1)$	$f_3(a_2)$	$f_3(a_3)$	$f_3(a_4)$	$f_3(a_4)$
f_4	$f_4(a_1)$	$f_4(a_2)$	$f_4(a_3)$	$f_4(a_4)$	$f_4(a_4)$

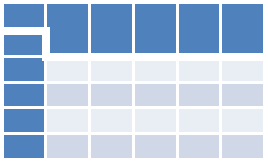
Evaluation table

Criteria weights

PROMETHEE

Generalised criteria

Outranking relations $\pi(a_i,a_j)$



Positive outranking flow $\Phi^+(a_i)$

Negative outranking flow $\Phi^-(a_i)$

Net flow $\Phi^-(a_i)$

PROMETHEE I:
Partial pre-order

PROMETHEE II:
Complete pre-order

Source: own visualisation based on information from Brans et al.(1986) How to select and how to rank projects: The PROMETHEE method.

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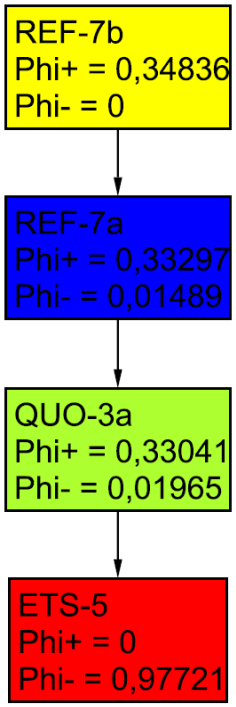
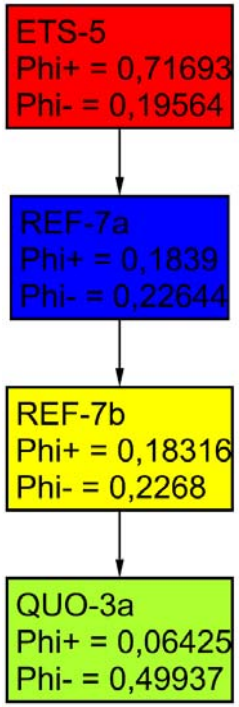
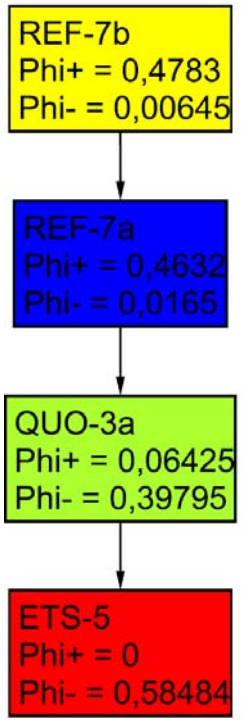
(Intermediate) Results



The Environmentalist

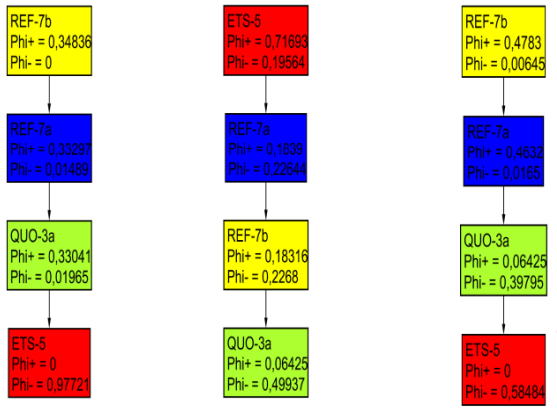


The Cost-Concerned

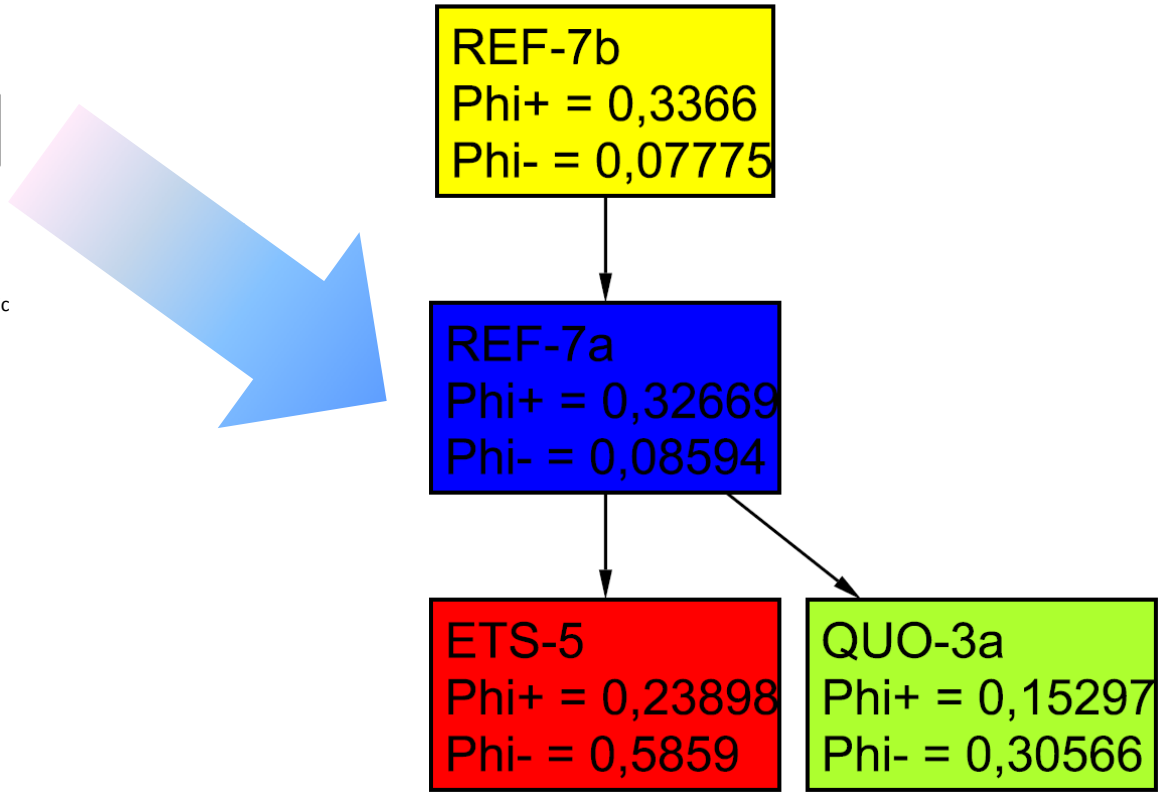


The Pragmatic

(Intermediate) Results



The Environmentalist | The Cost-Concerned | The Pragmatic



Group result

Conclusions

Greatest potential for compromise for a variety of stakeholders: Pathway 7b (moderate cooperation), closely followed by pathway 7a (increased coordination).

They seem to be acceptable to a variety of stakeholders, as well as legally and politically feasible.

A likely policy outcome could be a mixture of EU-prescribed minimum design standards (top-town) and stronger voluntary cooperation and coordination between groups of Member States (bottom-up).

Stakeholders stress that support scheme stability, reliability and transparency are extremely important!

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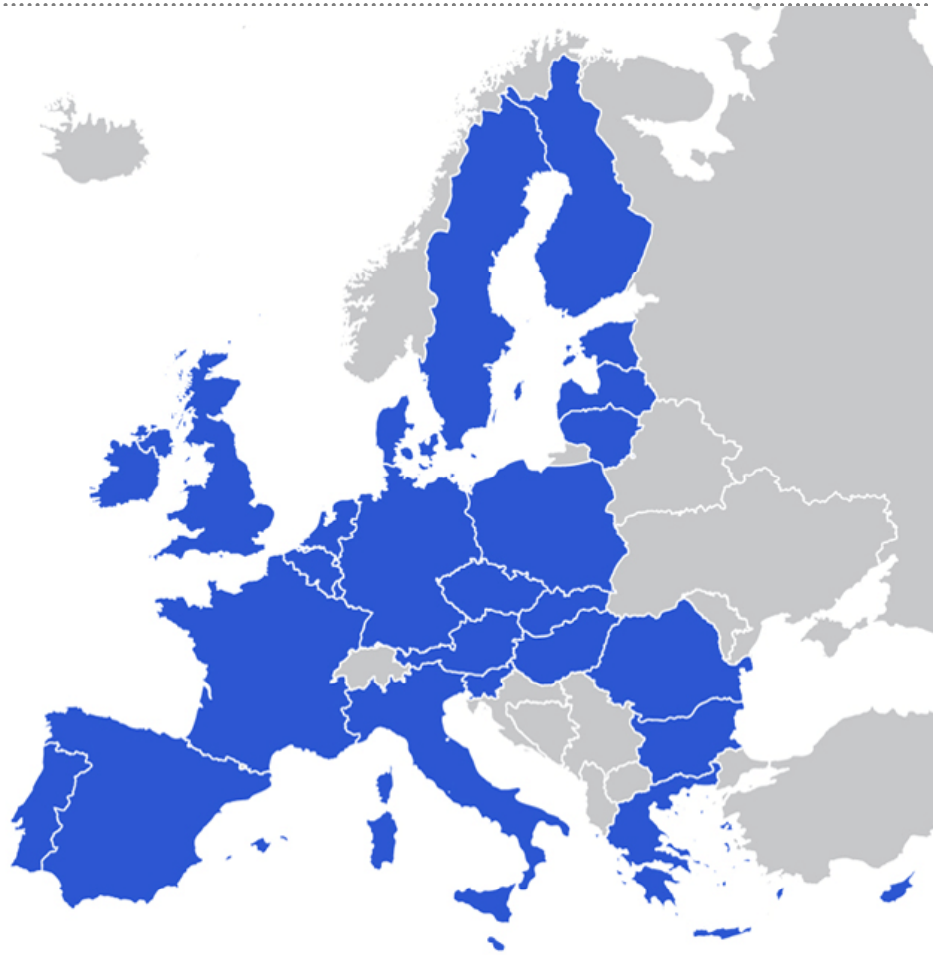
Thank you for your attention!



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