

flexess



Assessing the environmental impact of electricity from renewable energy sources (RES)

Agenda

- 1 | Goal setting
- 2 | Choosing a method
- 3 | Applying the chosen method
- 4 | Real world insights & summary

Agenda

1

Goal setting

Today's goals: choose method, apply method & provide recommendations

1. **Choose method** that is best suited for assessing a company's electricity-related emissions
2. **Apply method** to different contractual setups of company electricity procurement
3. **Provide recommendations** for companies on:
 - a. Reporting and
 - b. Mitigation of electricity-related emissions

2

Choosing a method

Market-based and locational method are alternatives for calculating emission factors

Approach A:

For companies procuring electricity exclusively from renewable energy sources (RES), electricity related emissions should be calculated using the emission factor for these RES (*market-based method*).



Consumer's emissions are determined by their contractual setup.

Approach B:

For companies procuring electricity exclusively from renewable energy sources (RES), electricity related emissions should be calculated using the grid average emission factor (*location-based method*).



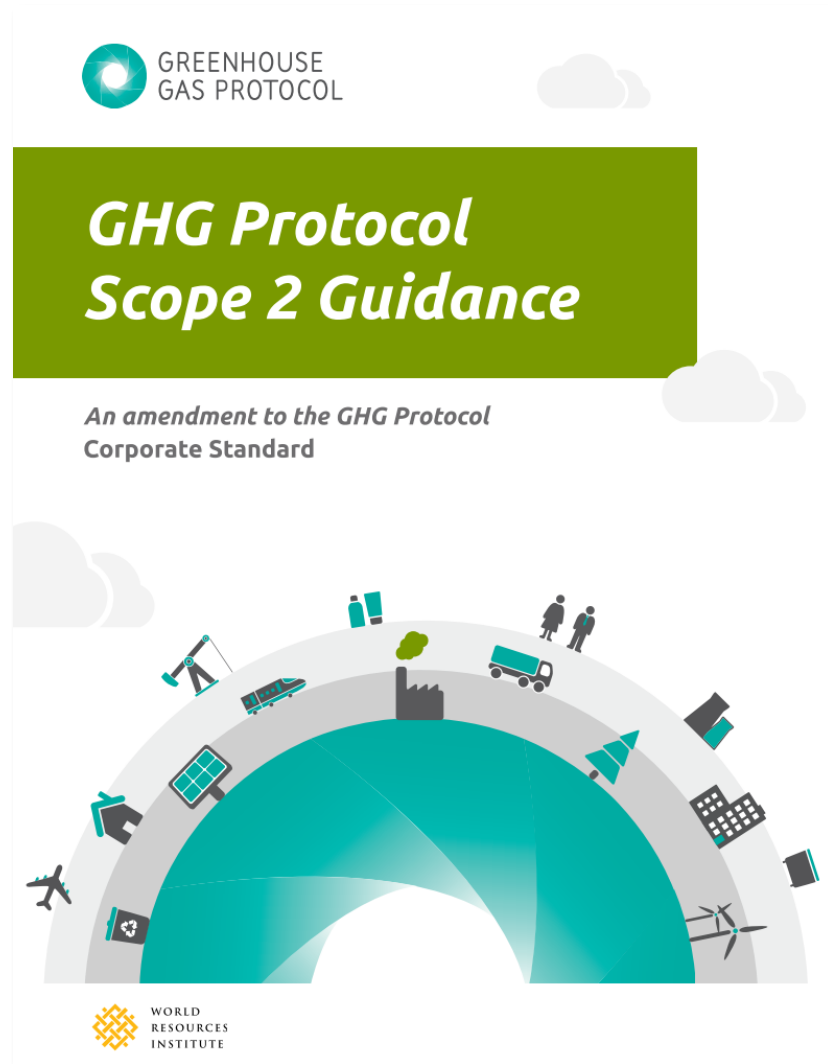
Consumer's emissions are determined by their location.



Which method is more **appropriate**?

RES = renewable energy supply

GHG Protocol states that companies should employ both methods



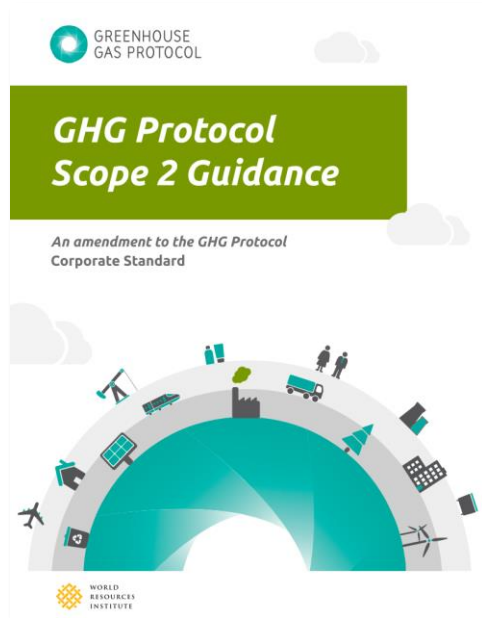
- Standard protocol for assessing corporate greenhouse gas emissions.
- Scope 2 emissions:
“Emissions from the generation of acquired and consumed electricity, steam, heat, or cooling.”
- Reporting requirement:
“Companies [...] shall report scope 2 emissions in two ways [...]: one based on the location-based method, and one based on the market-based method.”

No preference for either method



GHG = greenhouse gases, RES = renewable energy supply

Research studies challenge the assumptions of the **market-based method**



Underlying assumption

of the **market-based-method**:



"[...] If demand for low-carbon energy [...] begins to approach existing supply, the pressure or incentive to build additional supply grows, with certificates also serving as an additional revenue stream to help signal that demand."


Challenge assumptions

*"Financial contributions to existing renewable capacity are **unlikely to result in the supply of additional public goods.**" [1]*

*"[The market for RECs] has currently very low, or **no, impact on investor decisions.**" [2]*

*"[...] Explicit choice for [RES] does, for the time being, **cause no pressure** for building new [RES] in order to mitigate climate change." [3]*

*"[The market-based method] [...] is likely to **lead to a misallocation** of climate change mitigation efforts." [4]*

*"[RECs] currently provide **little or no incentive** to increase the production of green electricity." [5]*

REC = renewable energy certificate, RES = renewable energy supply

Own assessment necessary to judge methods' appropriateness



Consumer's emissions are determined by their contractual setup.



Consumer's emissions are determined by their location.

Which method is more **appropriate**?

Define criteria to assess "appropriateness".

Assess appropriateness of each method.

Apply appropriate method to different cases.

First step: define assessment criteria



Consumer's emissions are determined by their contractual setup.



Consumer's emissions are determined by their location.

Which method is more **appropriate**?

Define criteria to assess "appropriateness".






These criteria describe aspects a method should consider to ensure a correct assessment of electricity-related emissions.

Assess appropriateness of each method.

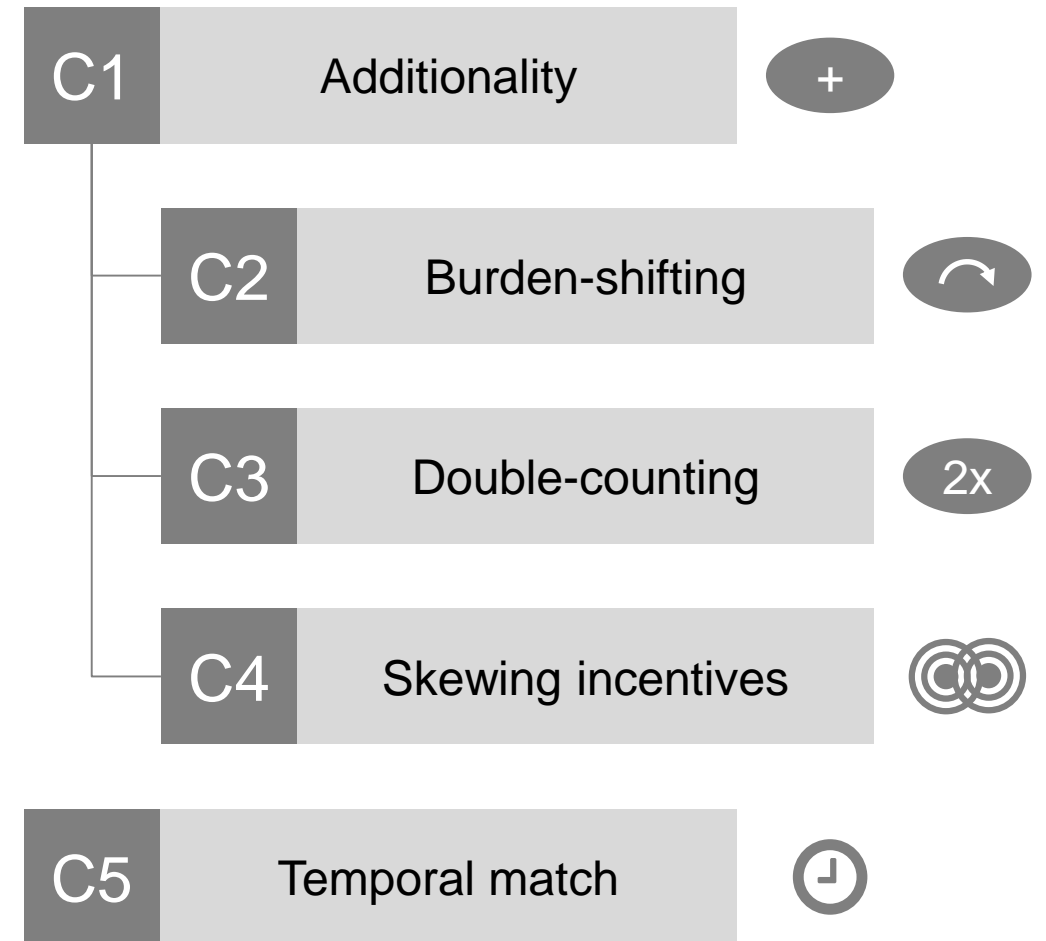
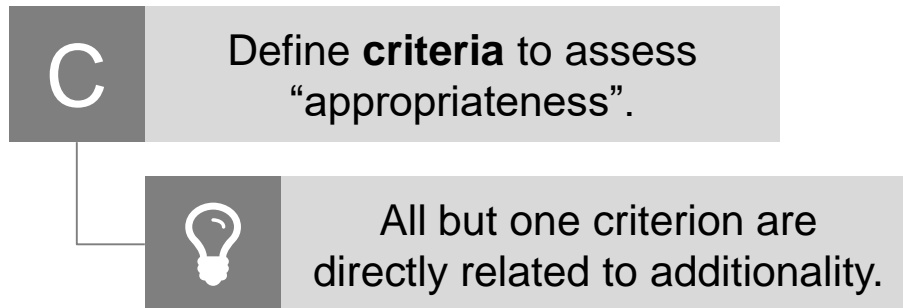
Apply appropriate method to different cases.

An appropriate method should consider these five criteria

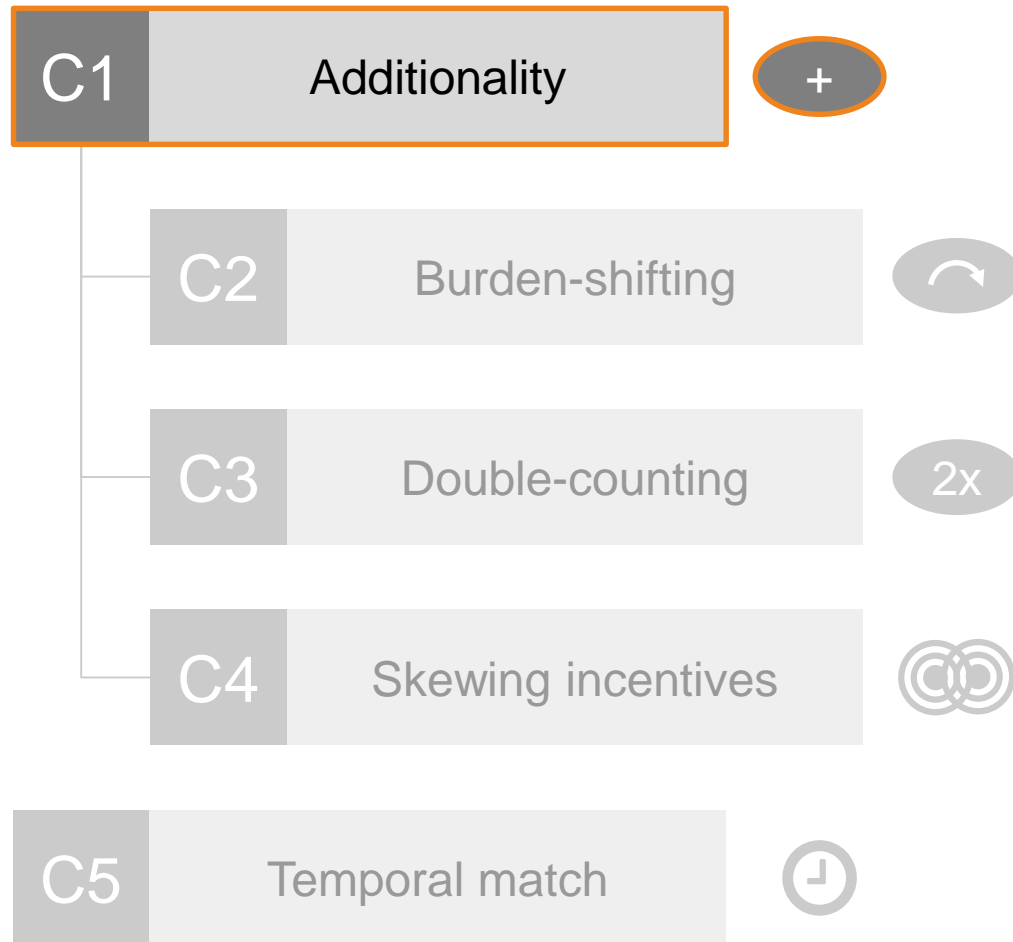
C Define **criteria** to assess “appropriateness”.

- C1 Additionality 
- C2 Burden-shifting 
- C3 Double-counting 
- C4 Skewing incentives 
- C5 Temporal match 

All but one criterion directly relate to additionality



Additionality describes additional supply caused by additional demand

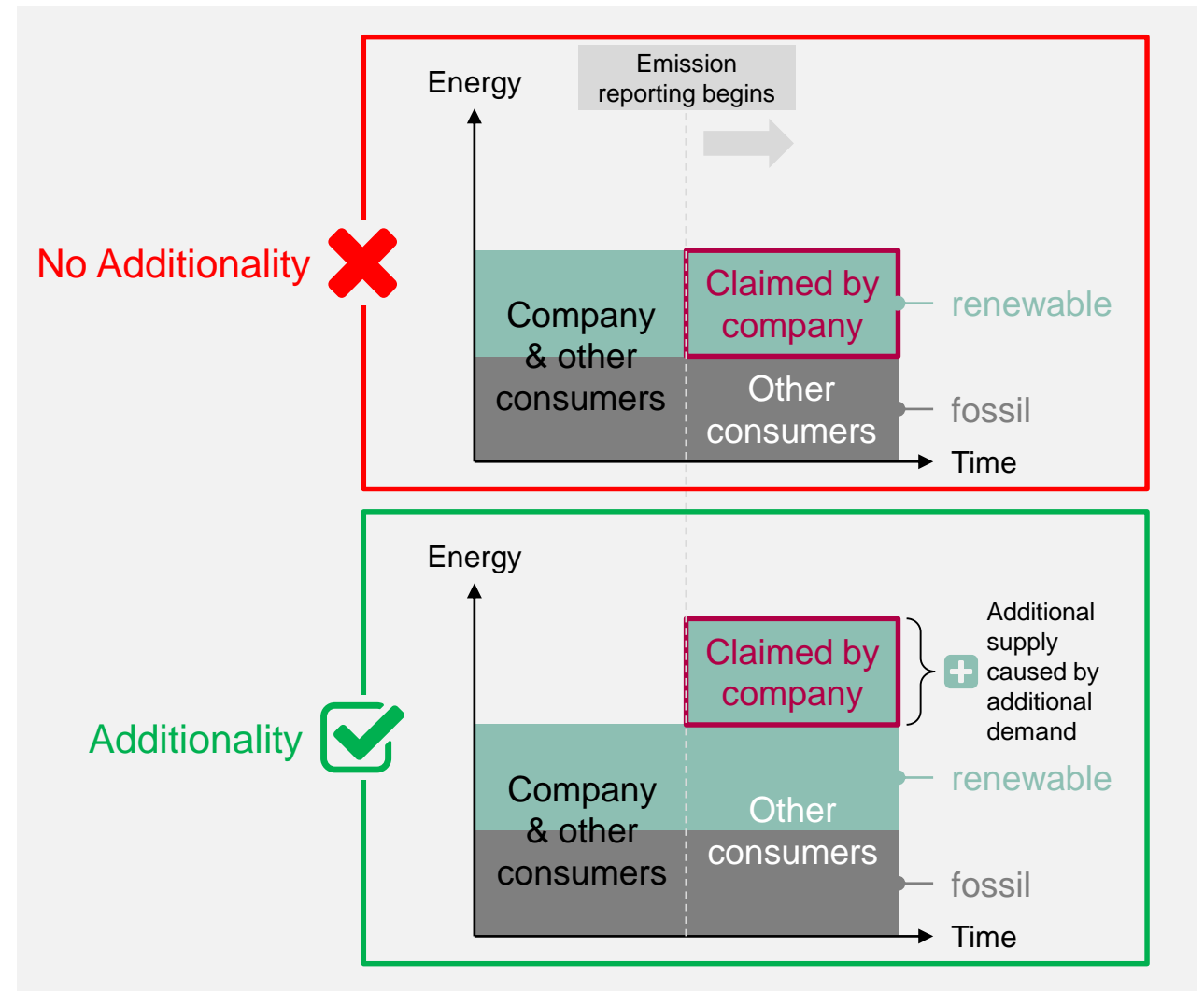
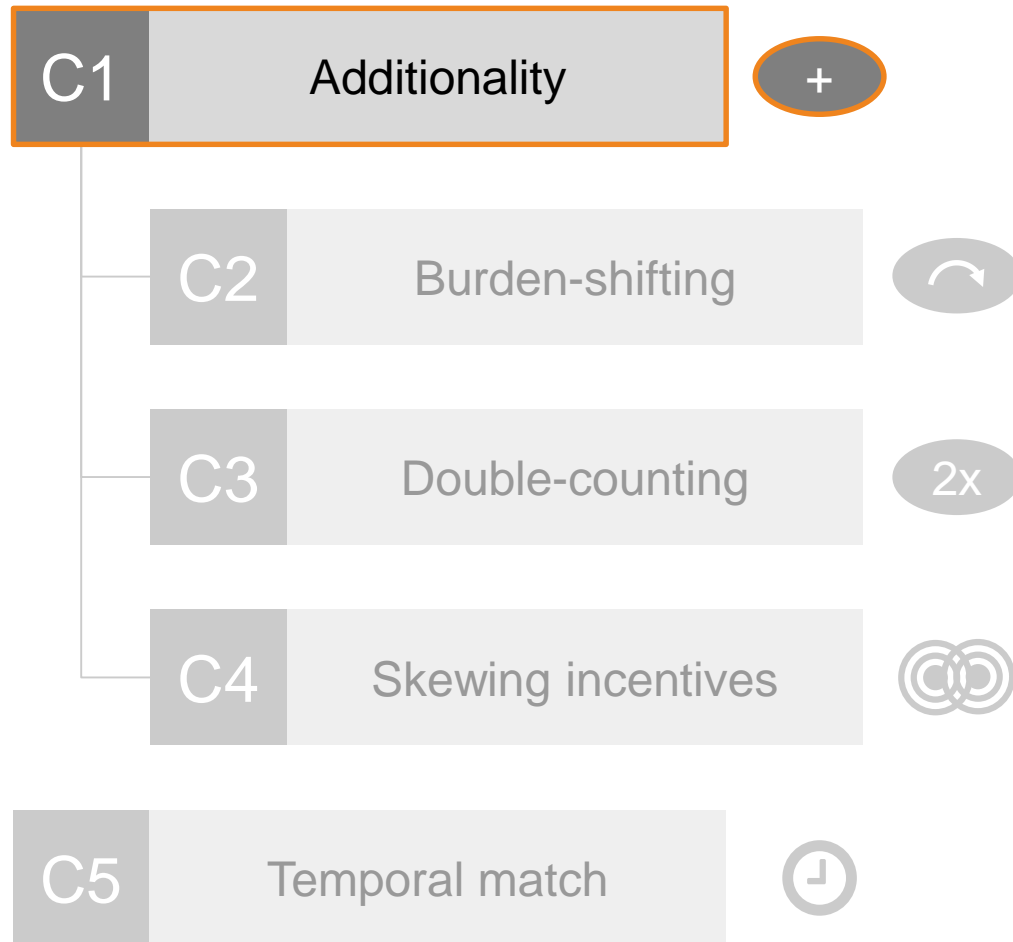


A company's *demand* for electricity from RES causing additional *supply* of electricity from RES.

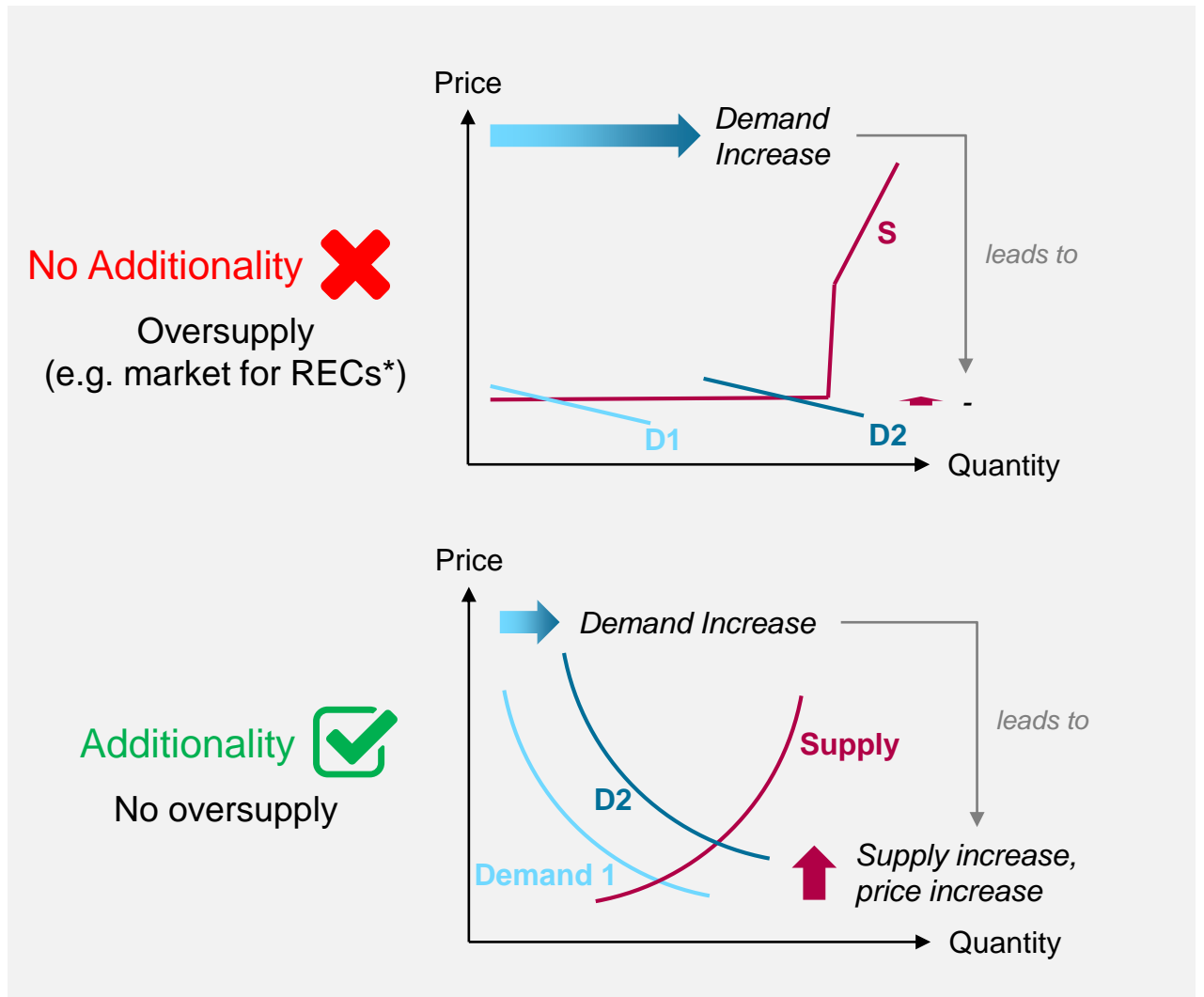
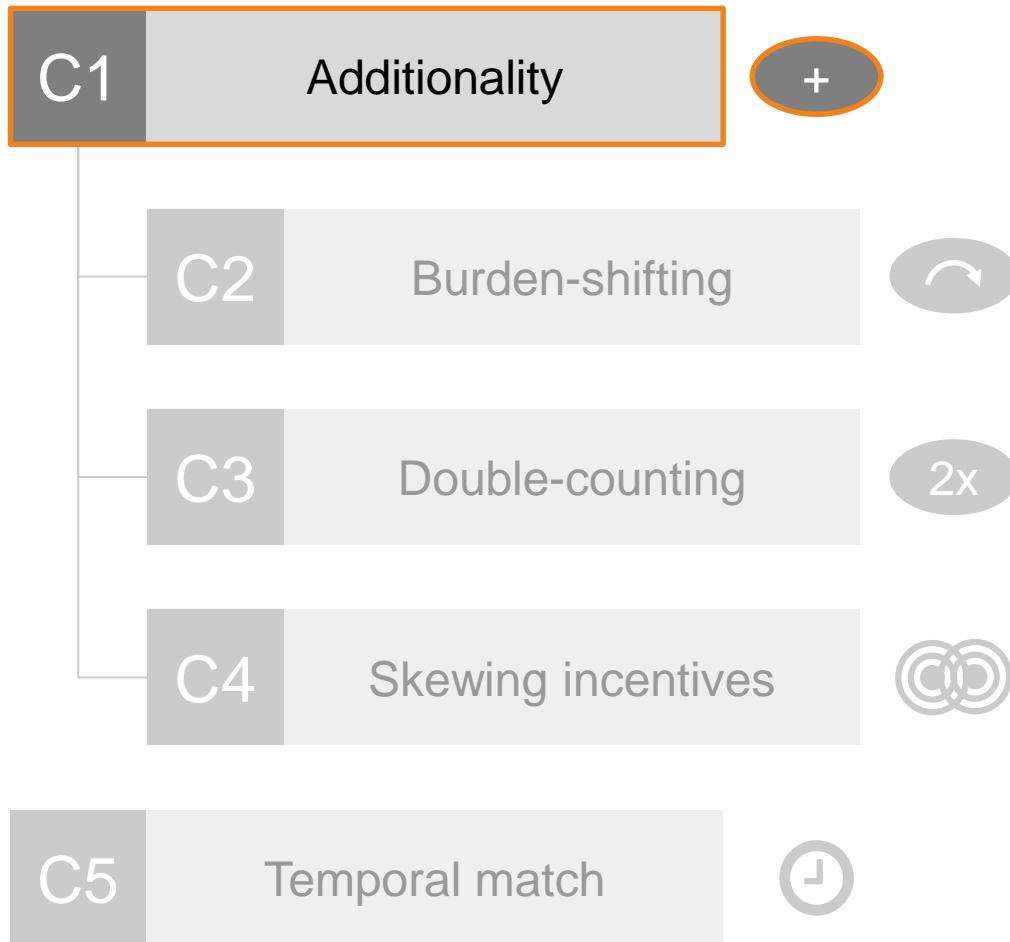


RES = renewable energy supply

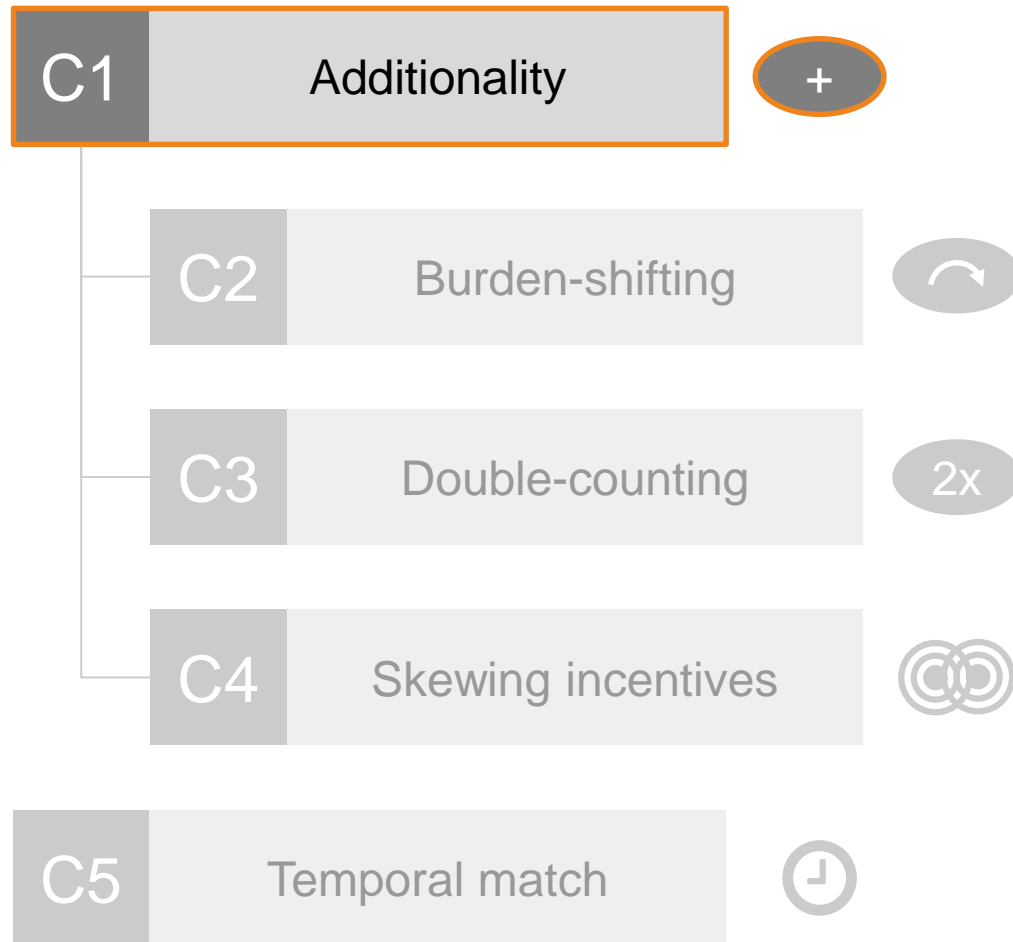
Without additionality, RES supply remains unaffected by demand





Oversupply of RECs causes lack of additionality

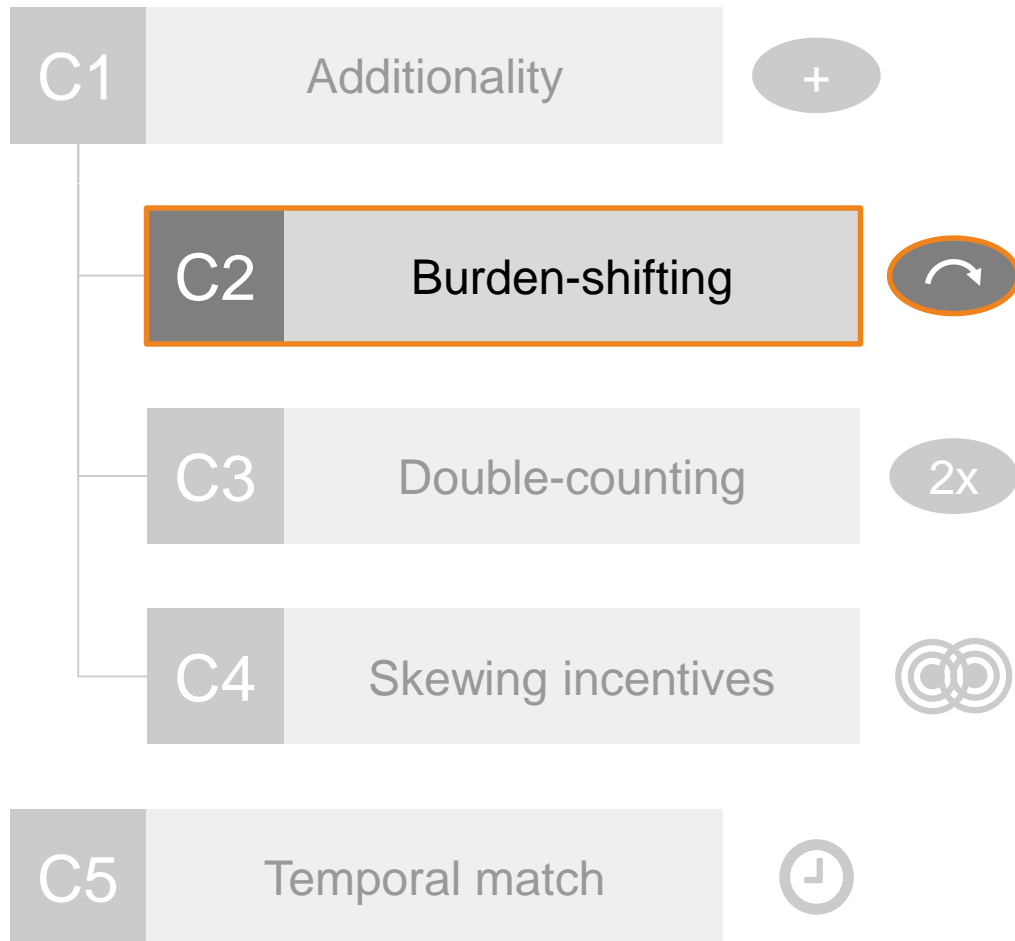


Only **location-based method** considers additionality

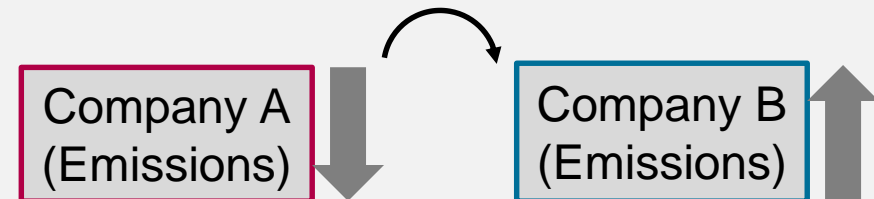


Market-based method	Location-based method
 Additionality ❌	 Additionality ✅
Does the method consider this aspect?	

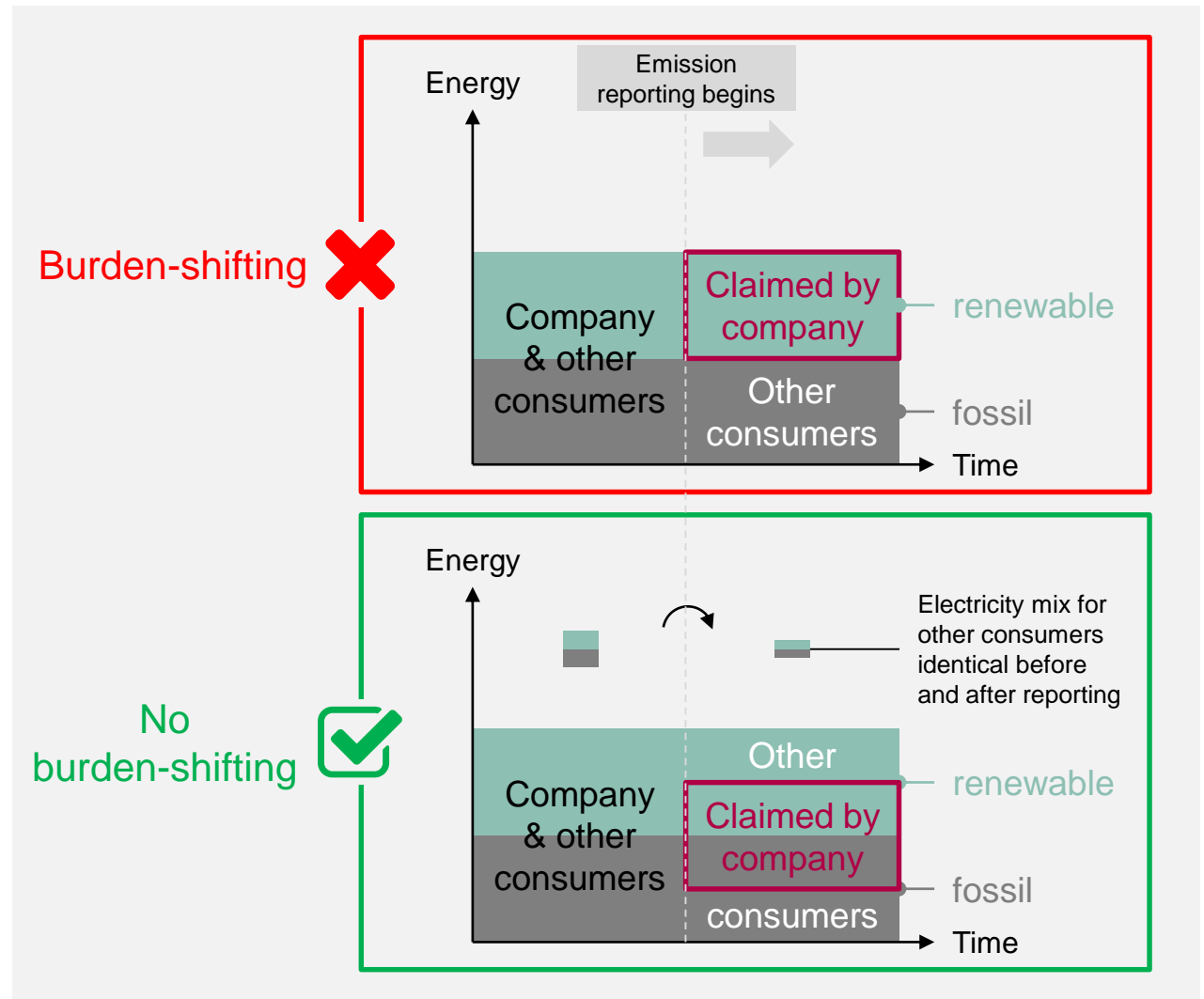
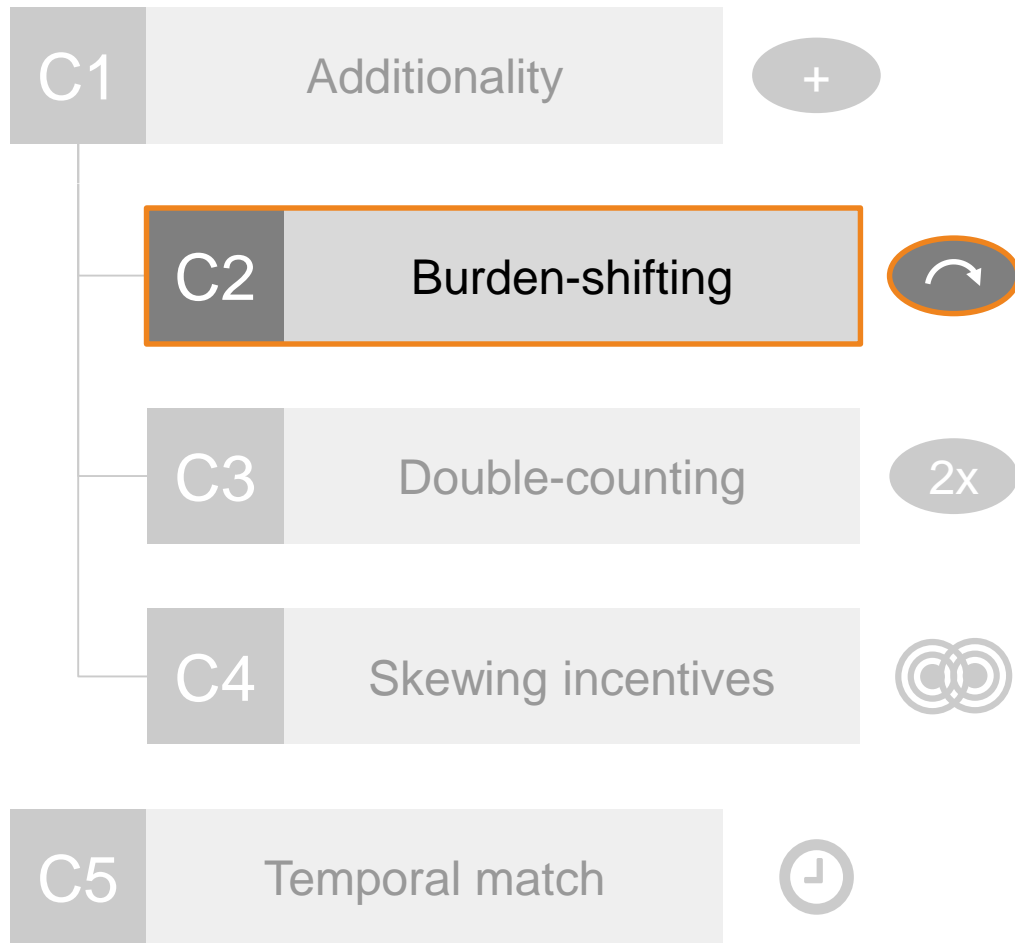
Burden-shifting describes emission offloading onto others



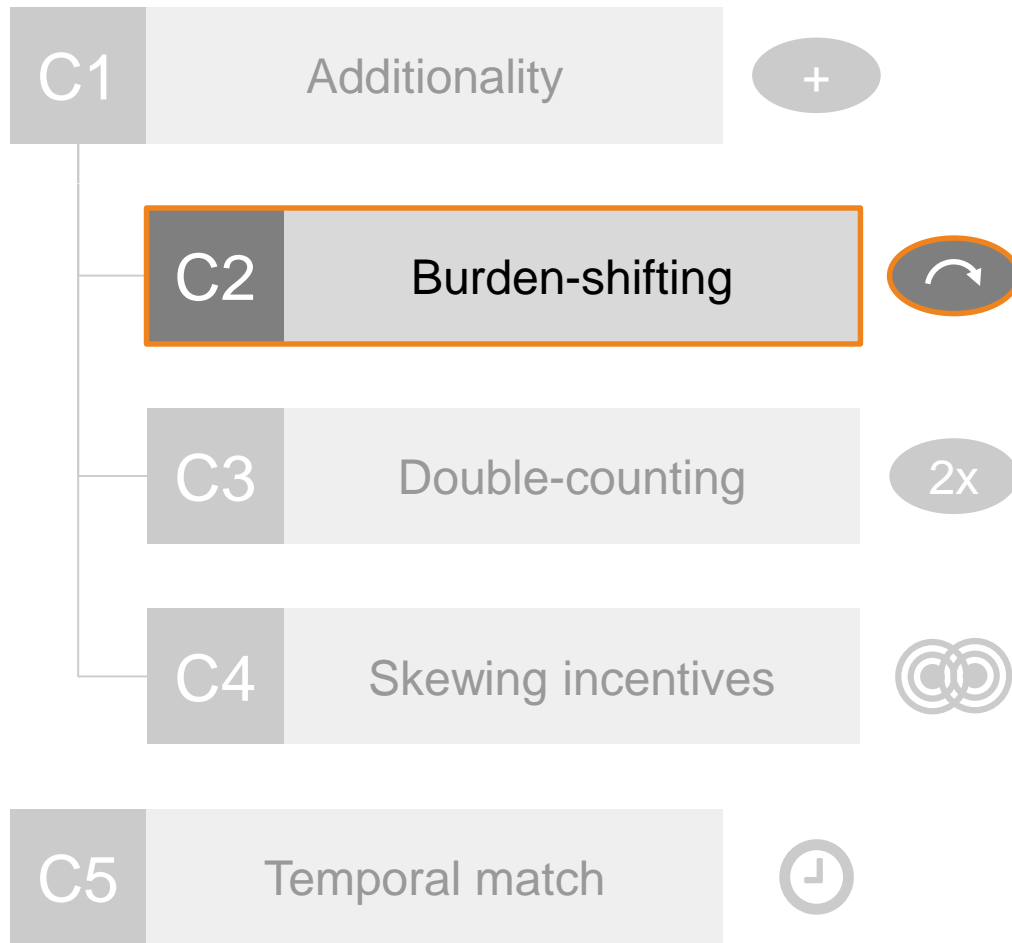
One company's emission claim leading to *higher emissions for other companies*, without any underlying real-world changes.



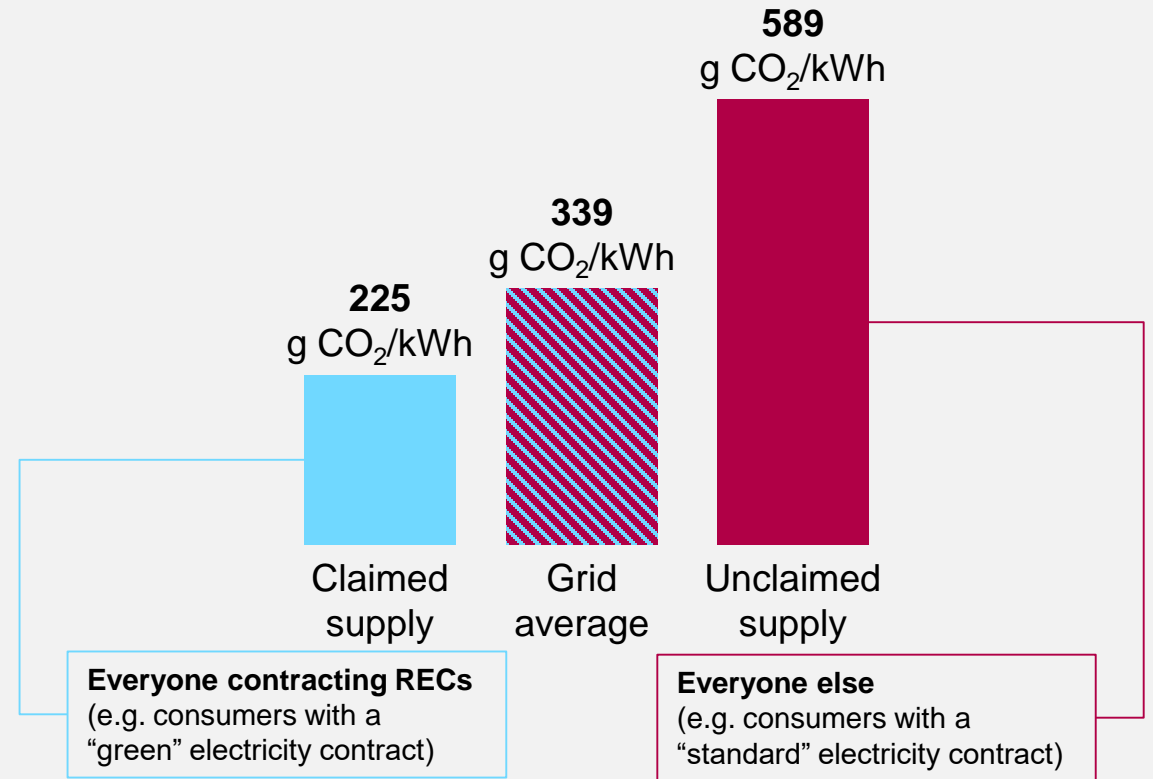
By avoiding burden-shifting, other consumers' emissions remain unaffected



Purchase of RECs causes burden shifting to non-purchasers



For all electricity consumers not claiming RECs, electricity related emissions increase **above the grid average** [1,2].



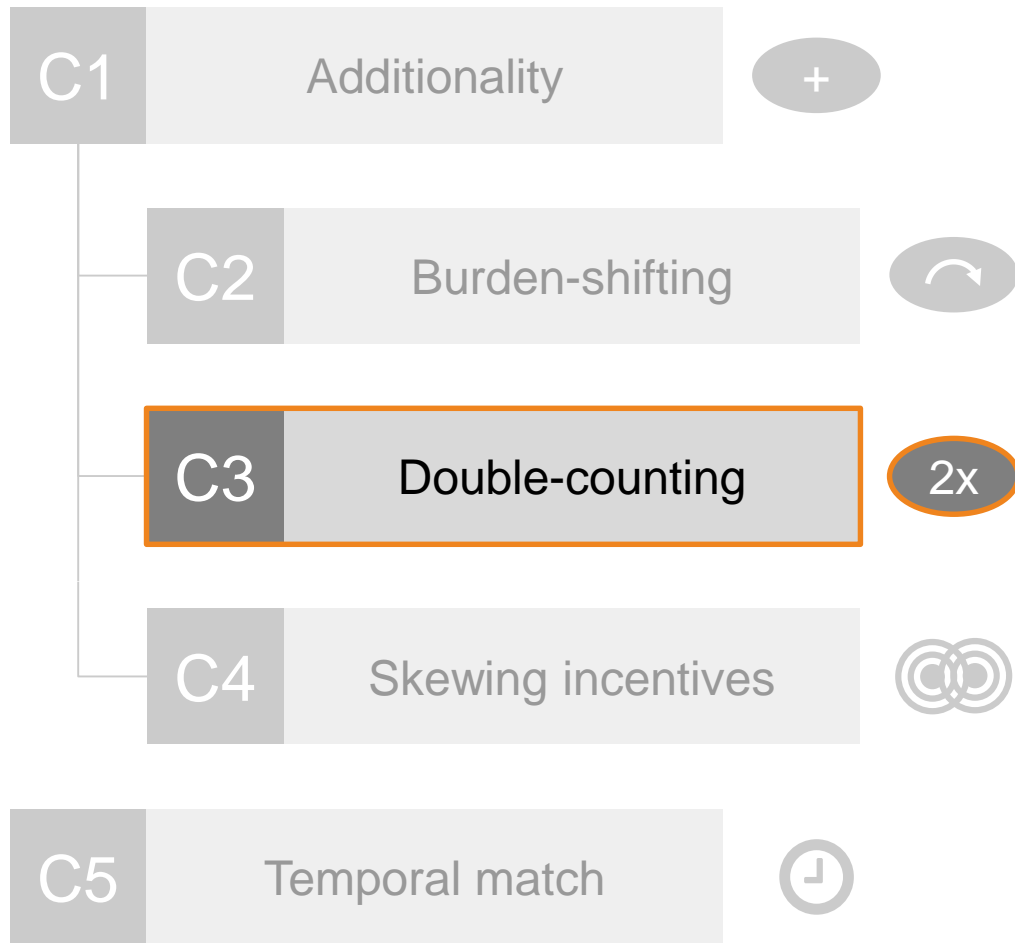
REC = renewable energy certificate

Emissions from tracked supply are not lower because "claimed supply" here also includes some fossil sources. For example, it includes Deutsche Bahn contracting electricity from the coal plant "Datteln".

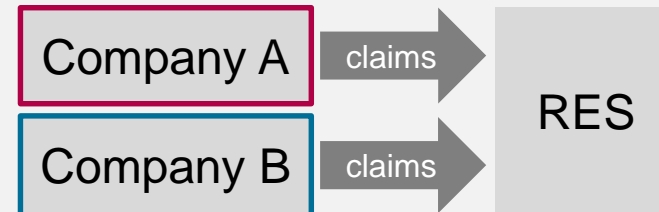
Only **location-based method** considers burden-shifting



Double-counting describes a unique good claimed twice

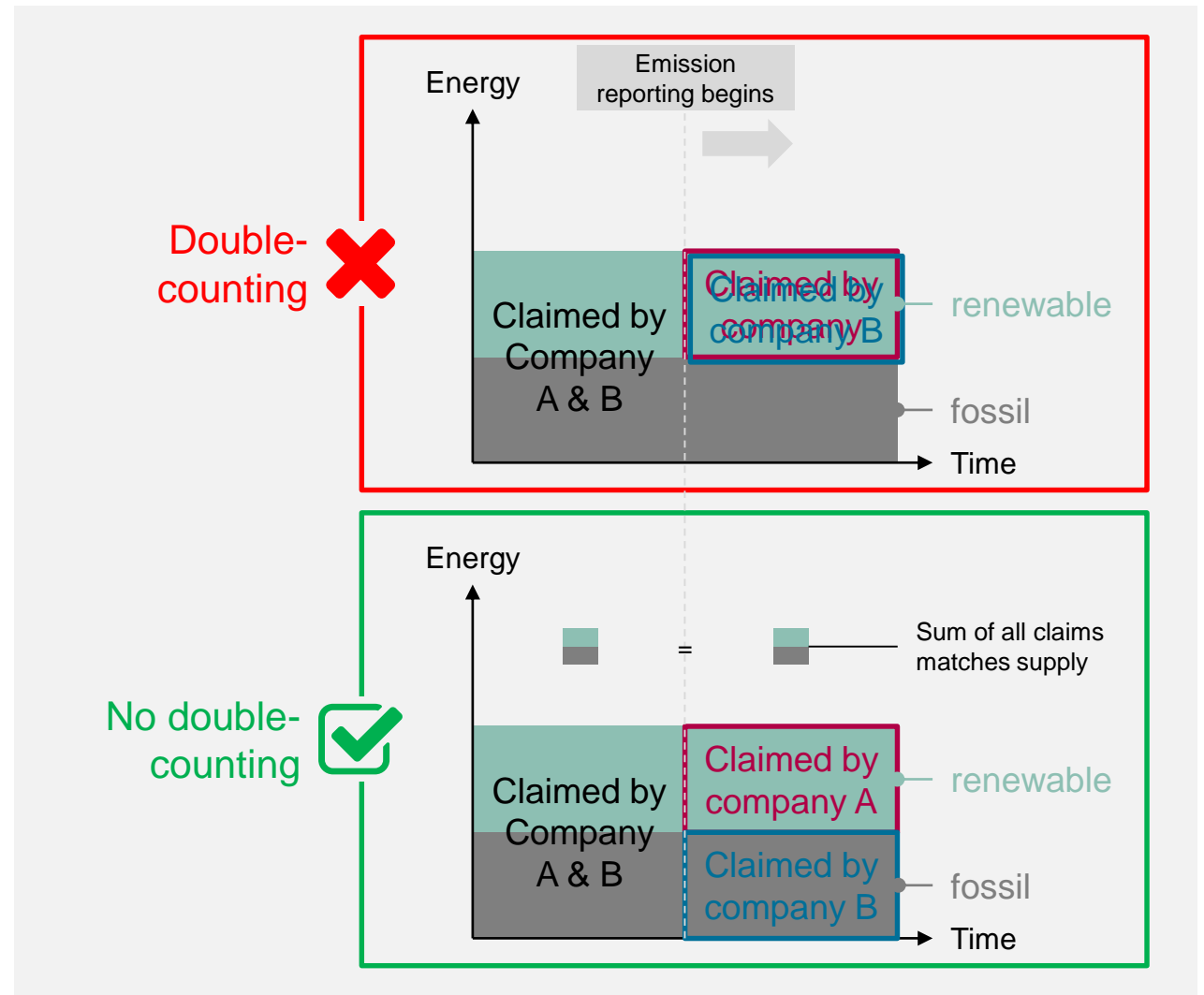
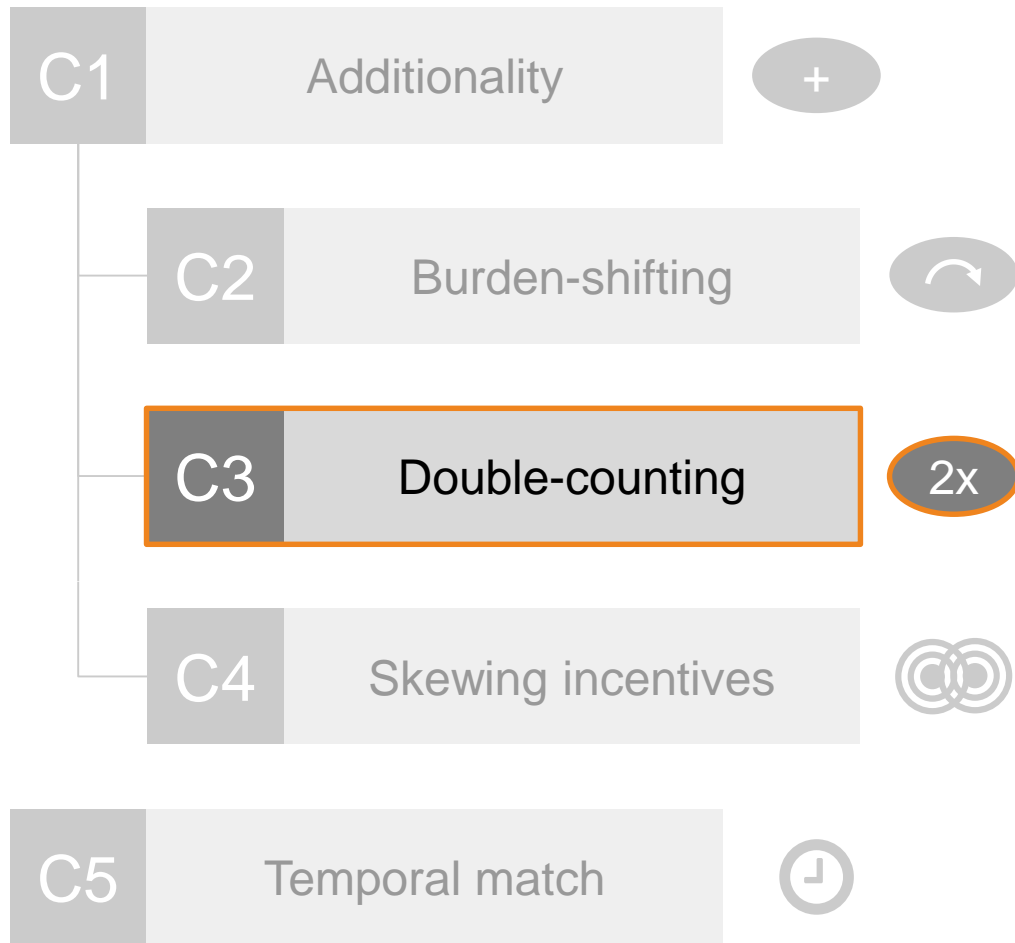


Two or more companies *claiming the same RES* for themselves.

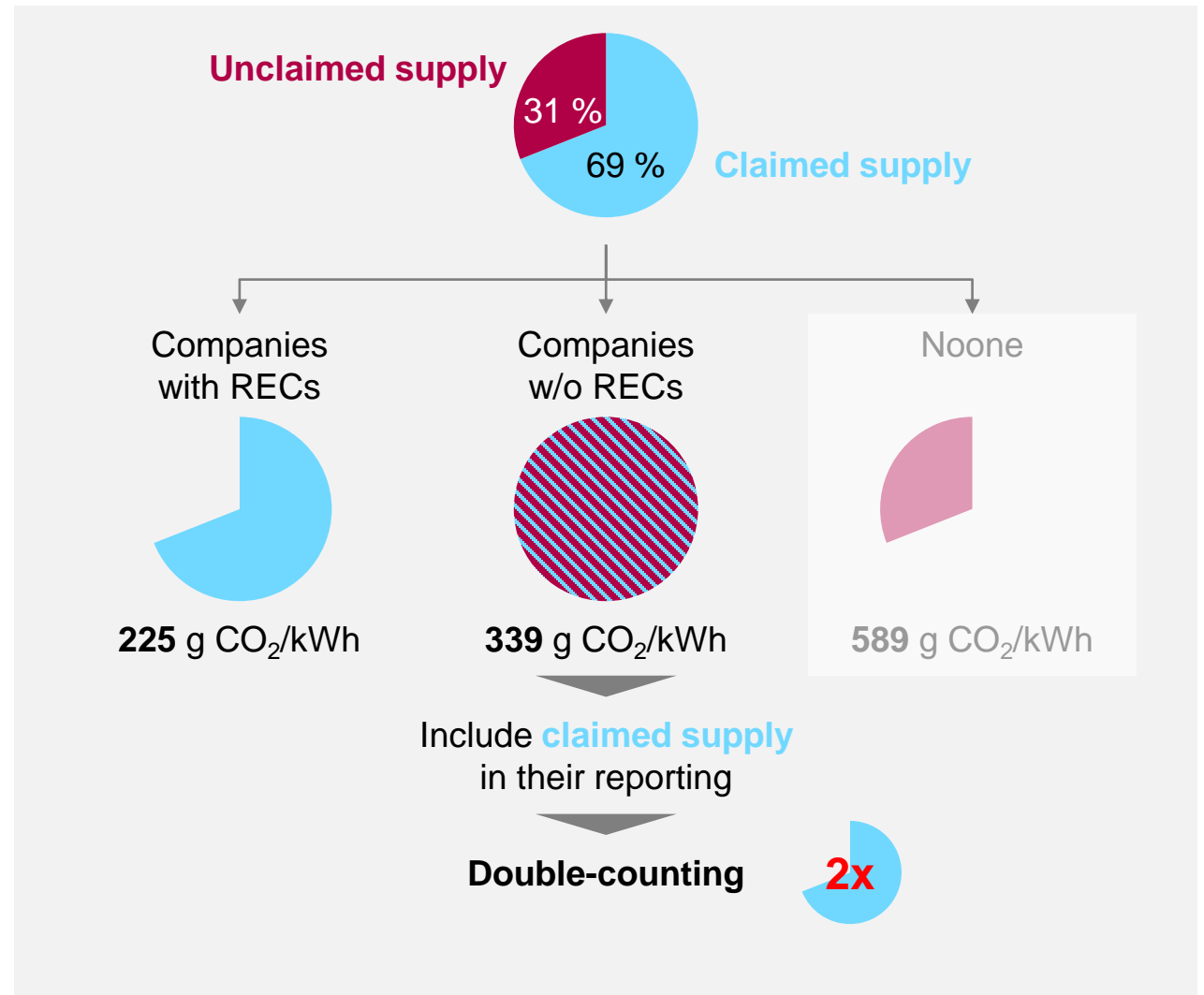
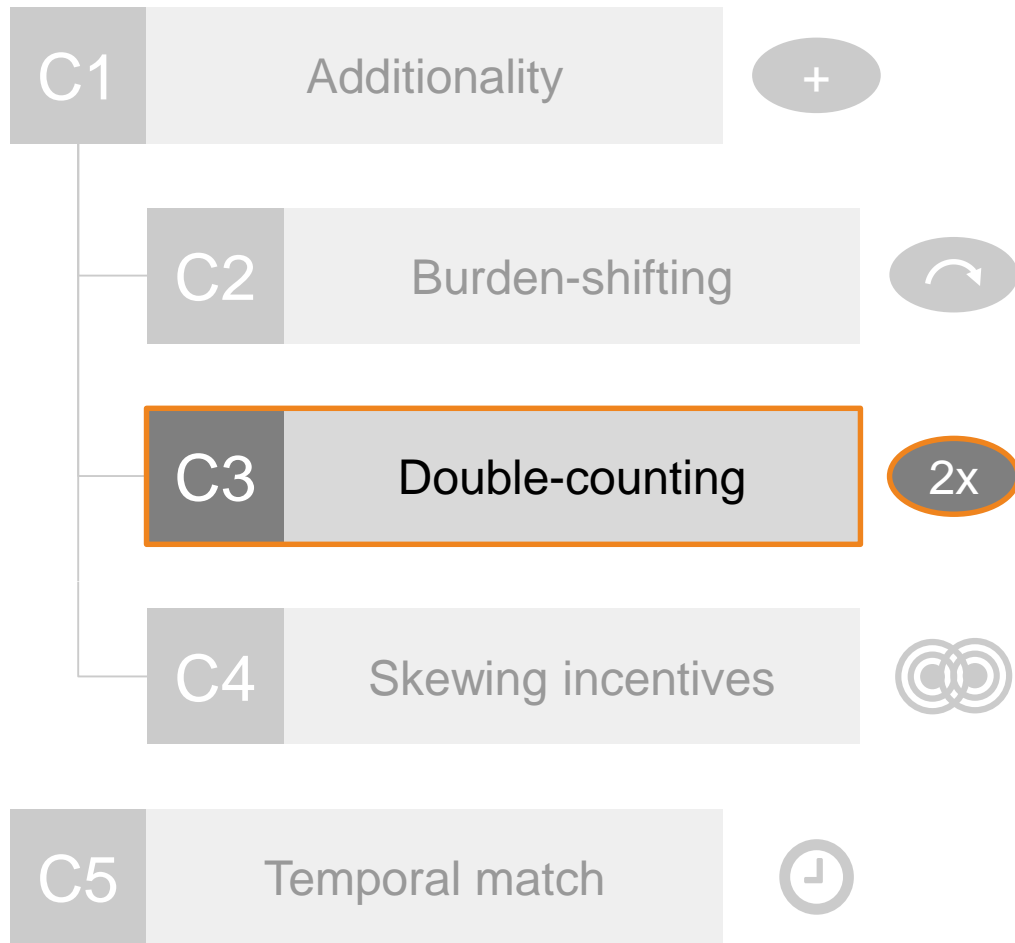


RES = renewable energy supply

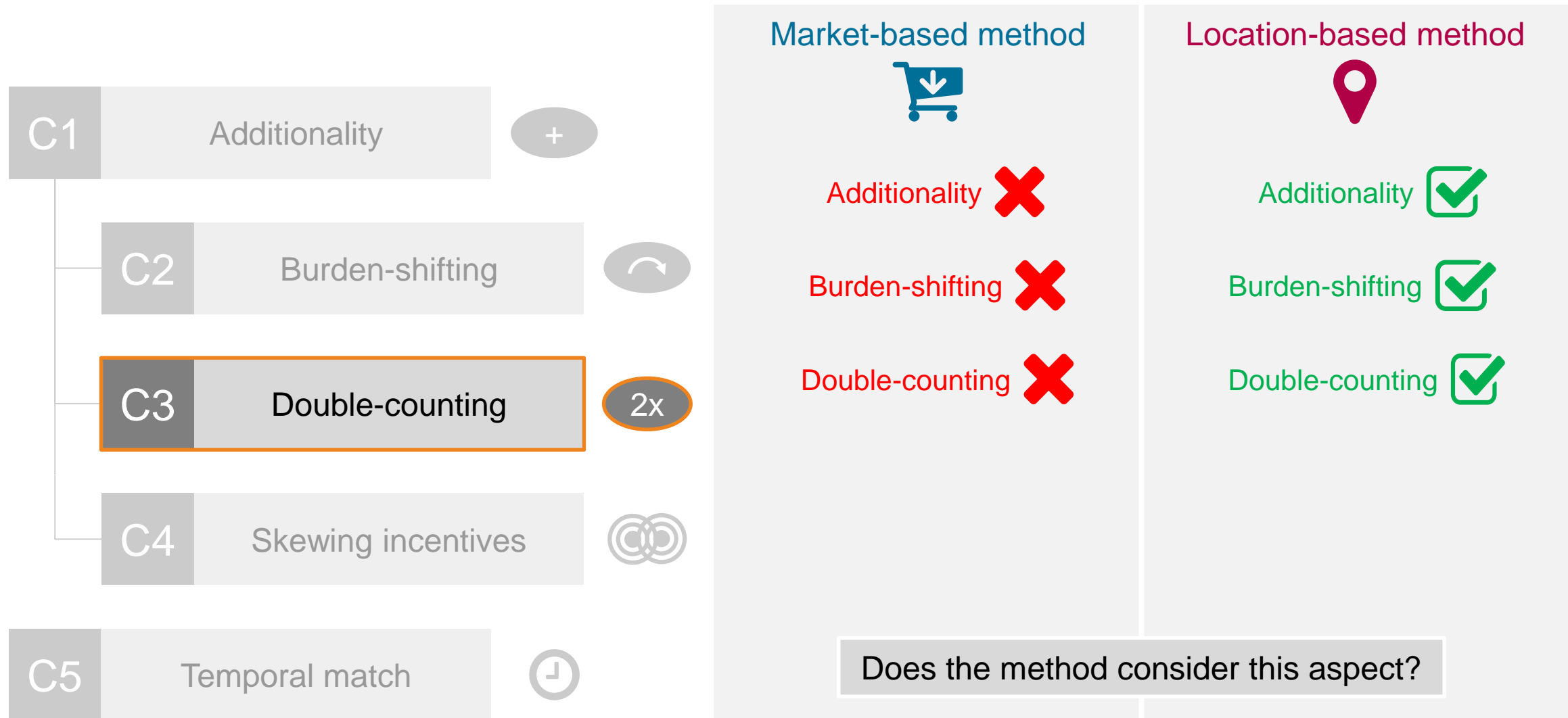
Only without double-counting, the sum of all claims matches the supply



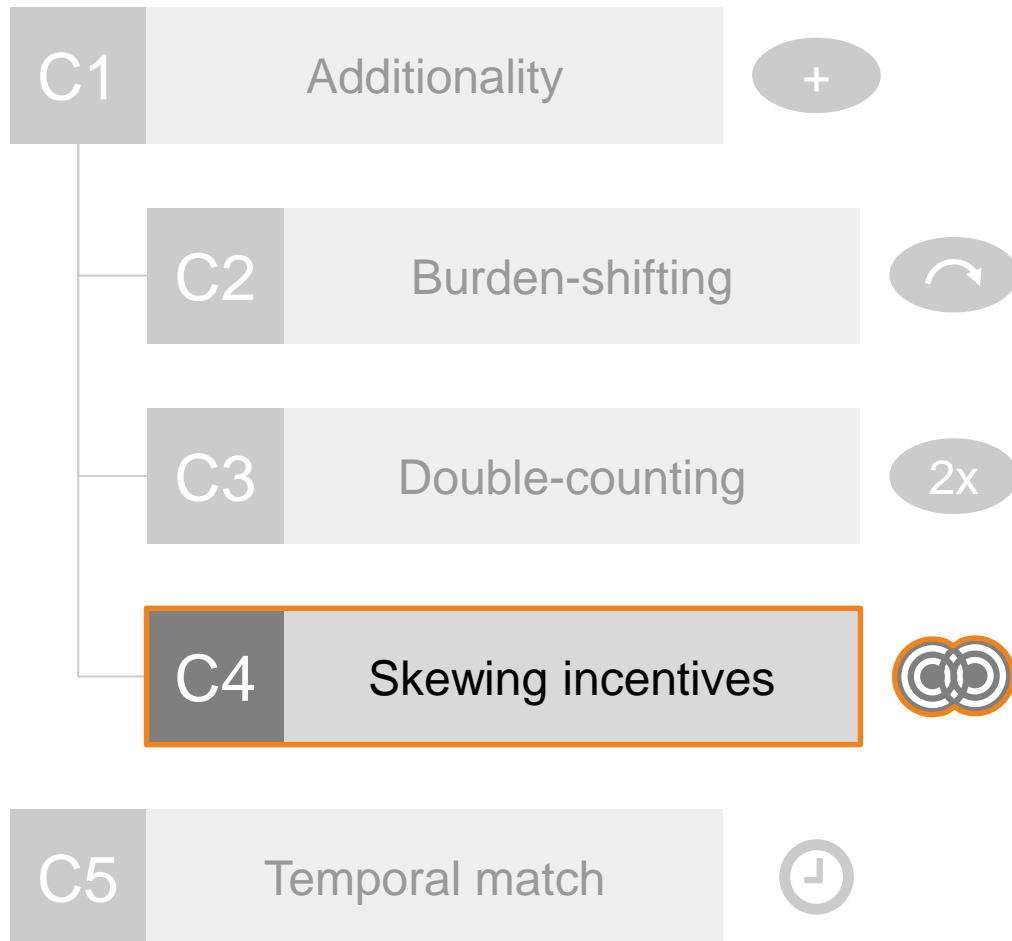
Purchase of RECs leads to double-counting of RES



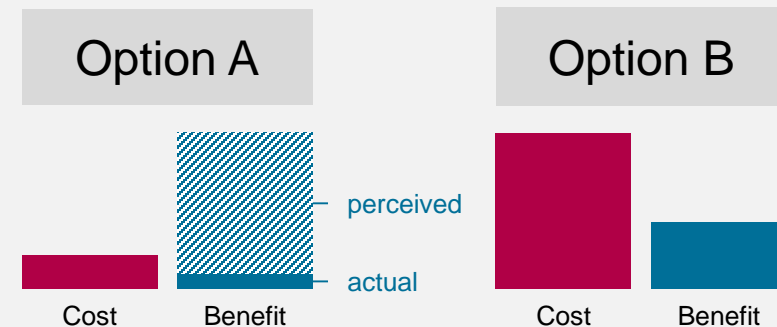
Only **location-based method** addresses double-counting



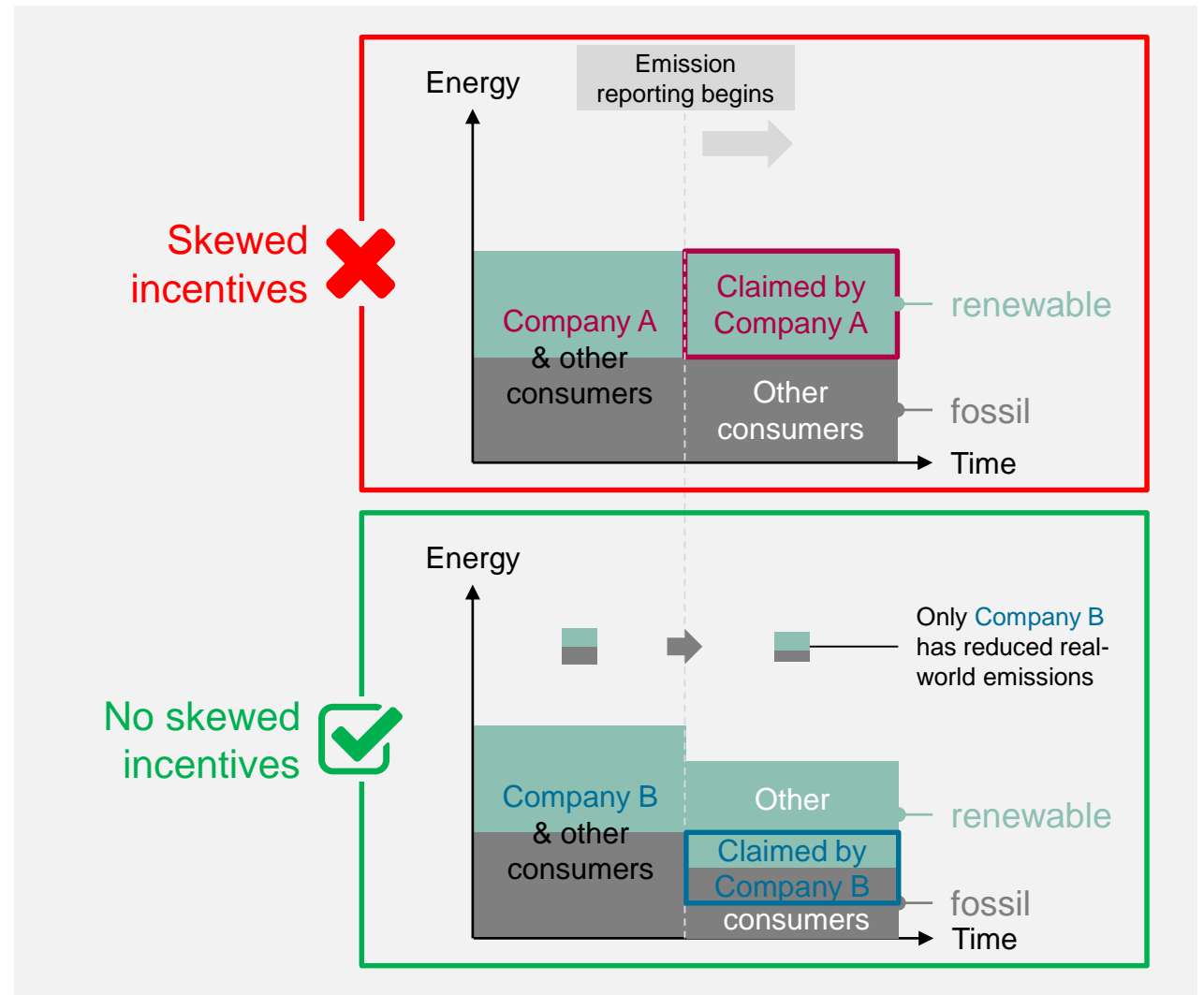
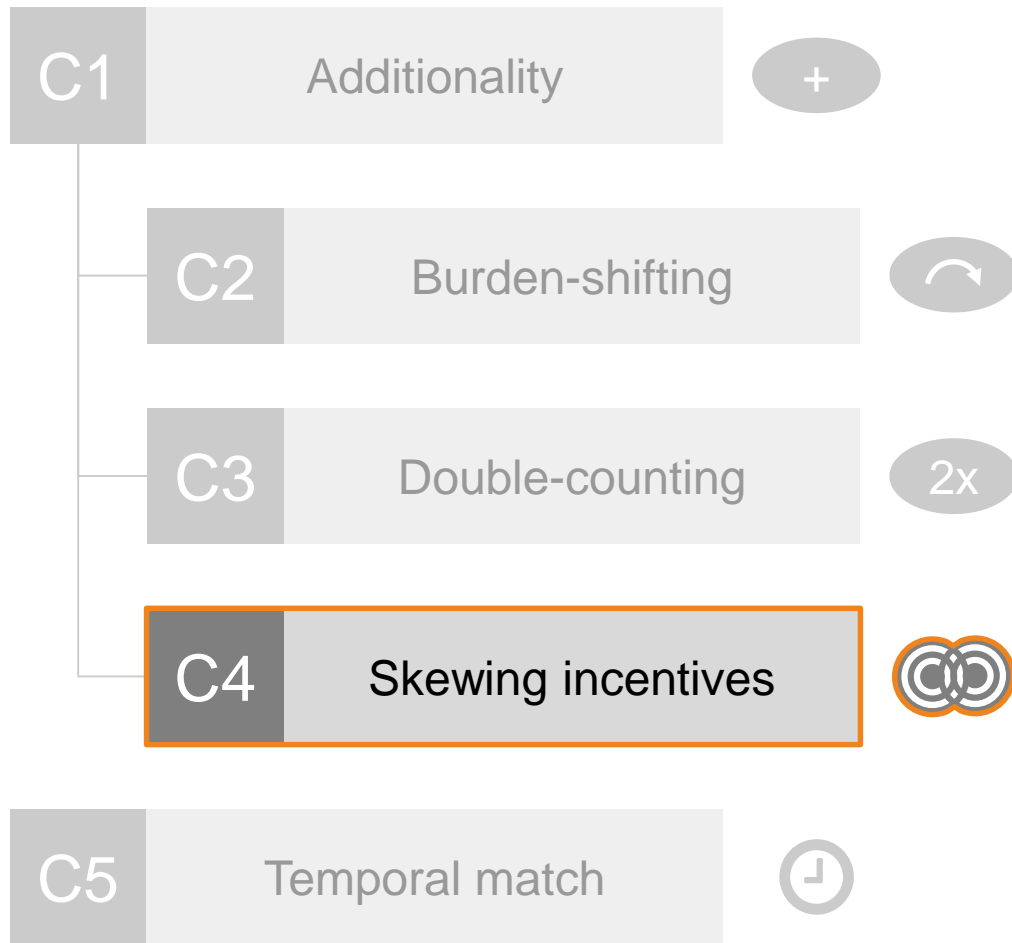
Skewing incentives describes a misalignment of effectiveness and attractiveness



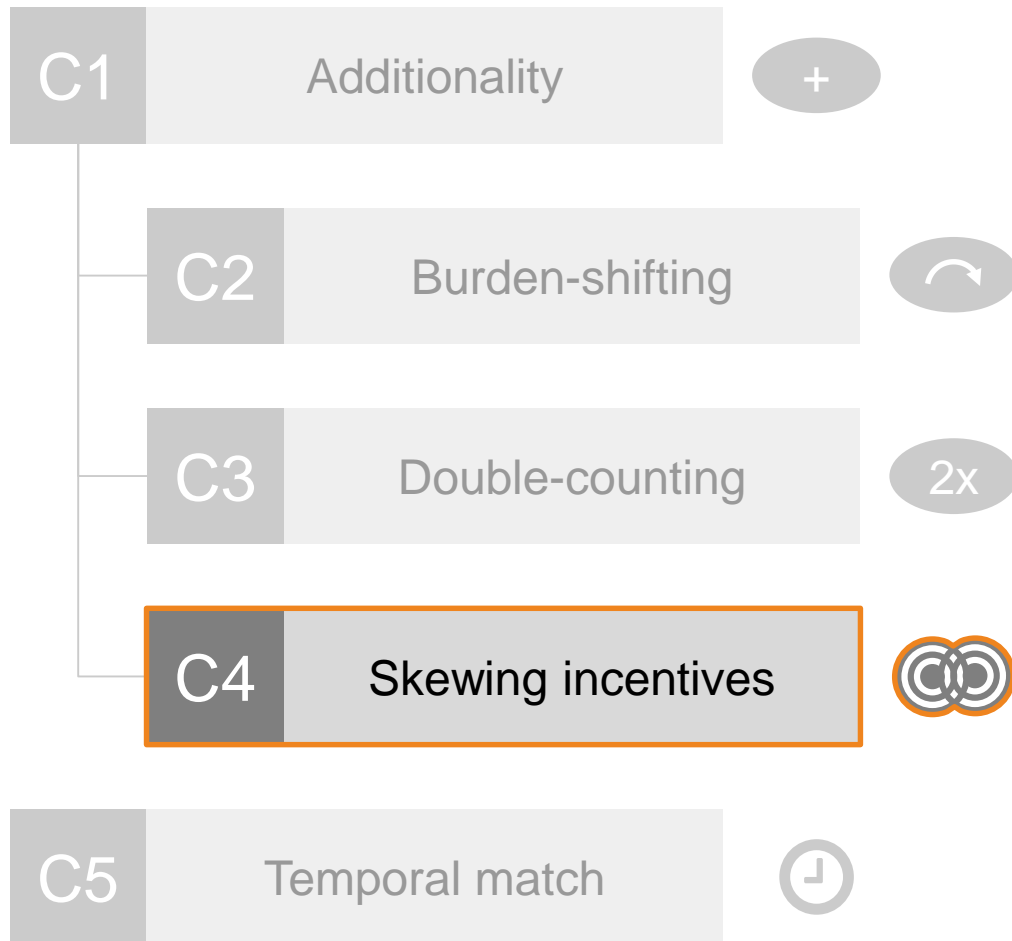
An *ineffective* emission mitigation option being more *cost-effective*, and thus more attractive, than an effective one.



Skewing incentives hinders emission reductions



With skewed incentives, (effective) energy efficiency appears cost-ineffective



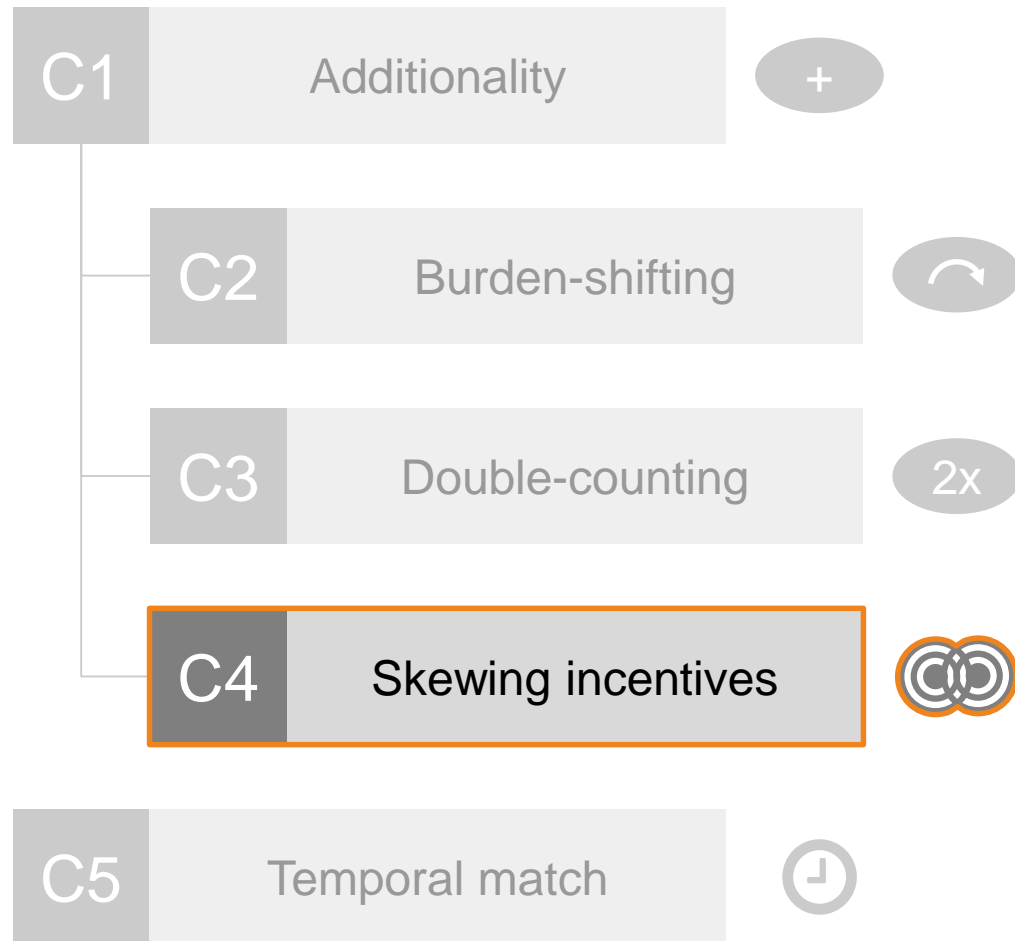
For companies, it is **much more cost-effective** to purchase RECs than to invest in energy efficiency – yet only the latter affects real world emissions.



Company A	Company B
Invests 100.000 € in RECs	Invests 100.000 € in energy efficiency
Cost per REC: 2 € / MWh*	Electricity demand: -5 %
<u>Emissions</u>	<u>Emissions</u>
Before: 16.950 t CO ₂	Before: 16.950 t CO ₂
After: 2.500 t CO ₂	After: 16.100 t CO ₂
Reduction: -14.450 t (-85.3 %)	Reduction: -850 t (-5 %)
7 € / t CO₂ avoided	118 € / t CO₂ avoided

REC = renewable energy certificate

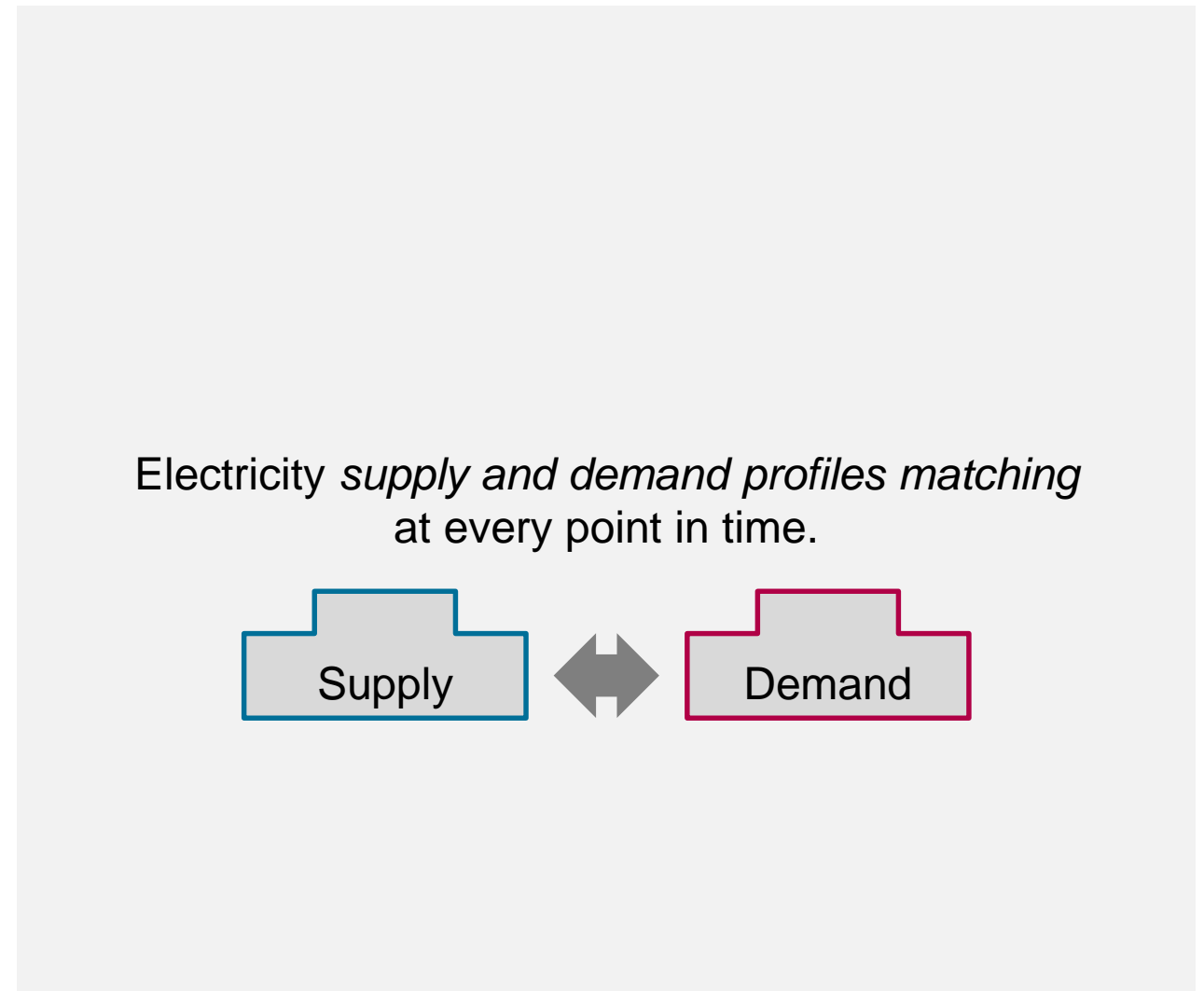
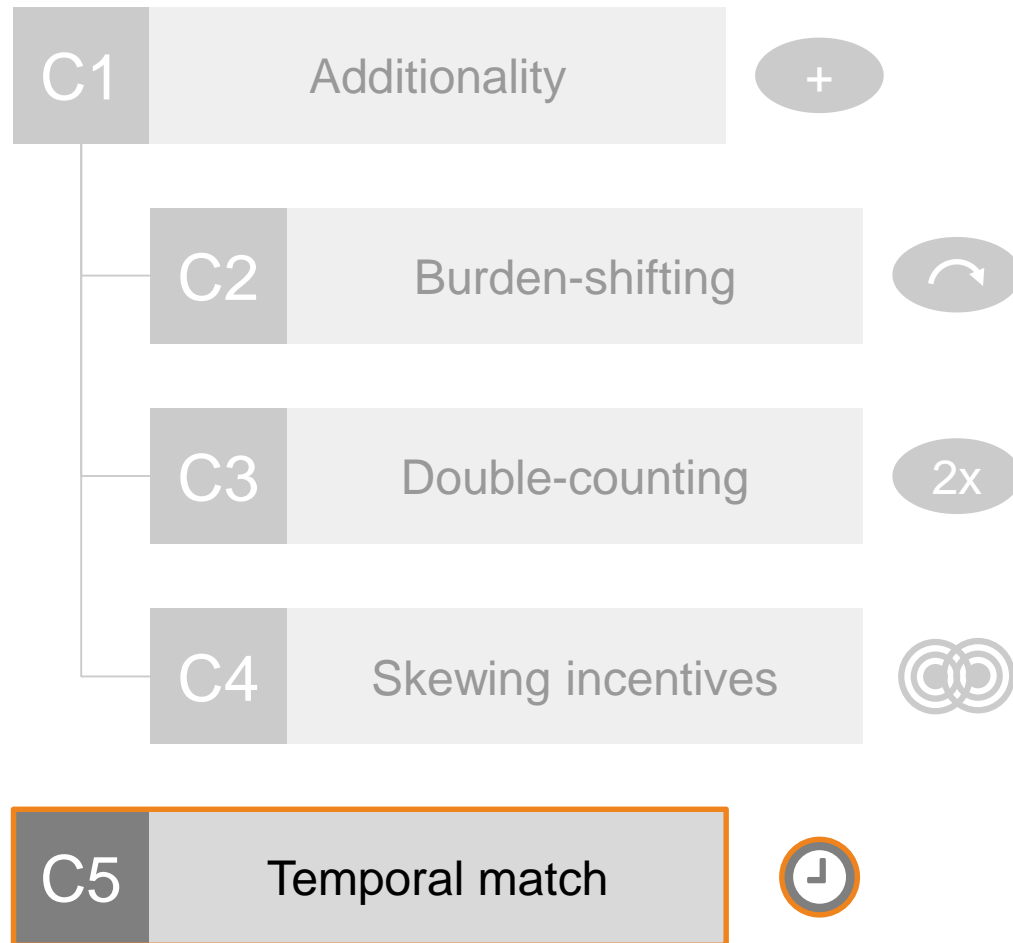
Electricity demand (each company): 50.000 MWh/a
 Grid average emissions: 339 g CO₂/kWh,
 Emissions with RECs: 50 g CO₂/kWh

Only **location-based method** avoids skewing incentives

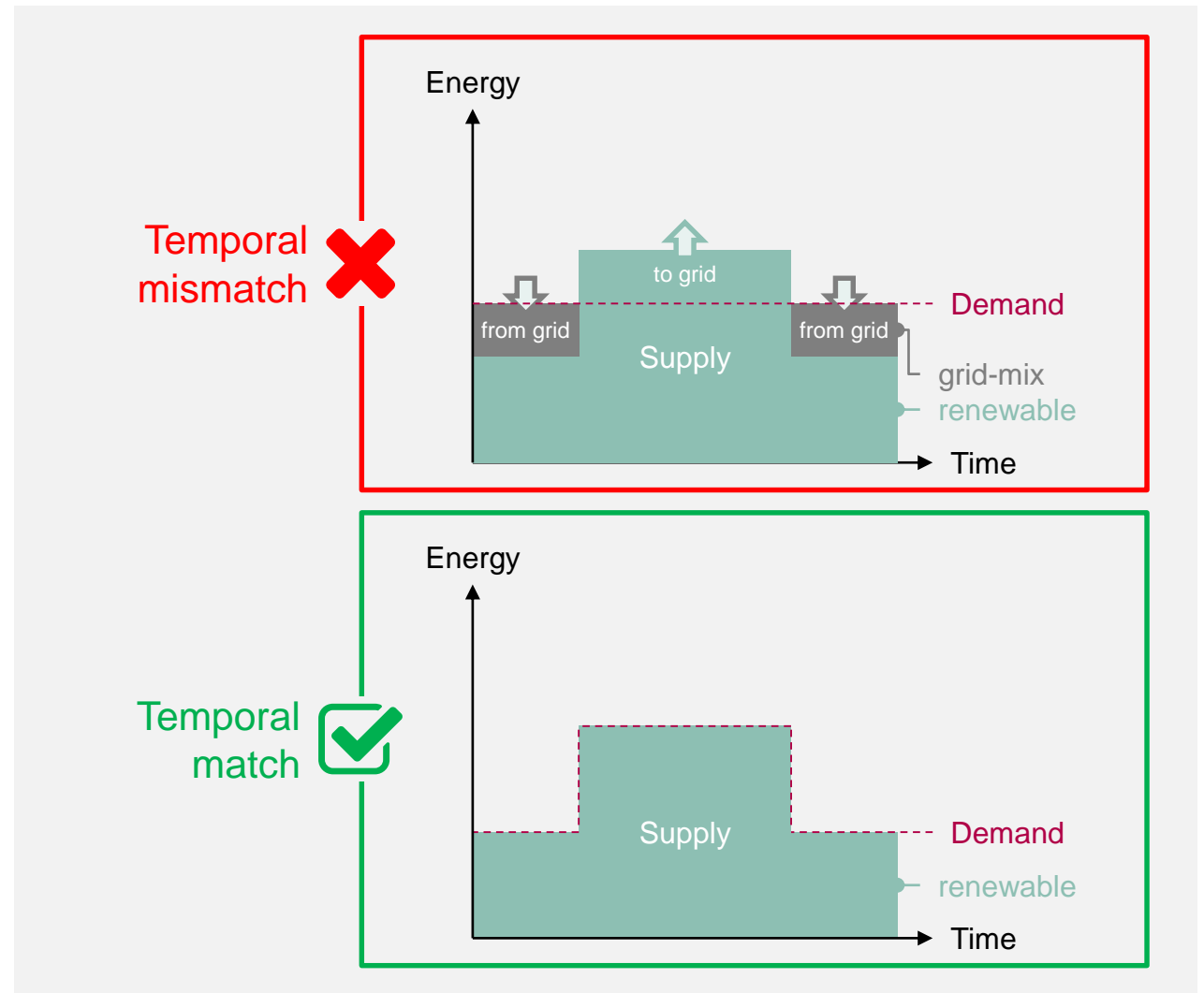
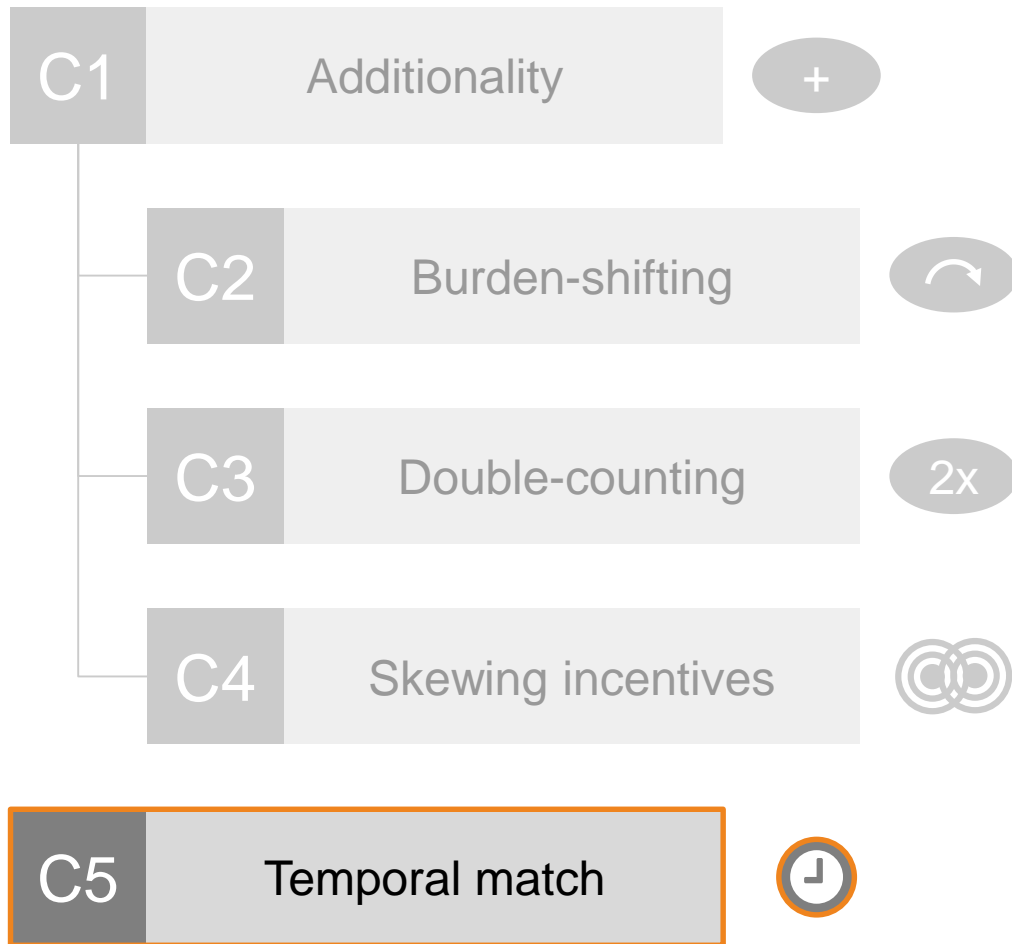


Market-based method	Location-based method
	
Additionality ❌	Additionality ✅
Burden-shifting ❌	Burden-shifting ✅
Double-counting ❌	Double-counting ✅
Skewed incentives ❌	Skewed incentives ✅
Does the method consider this aspect?	

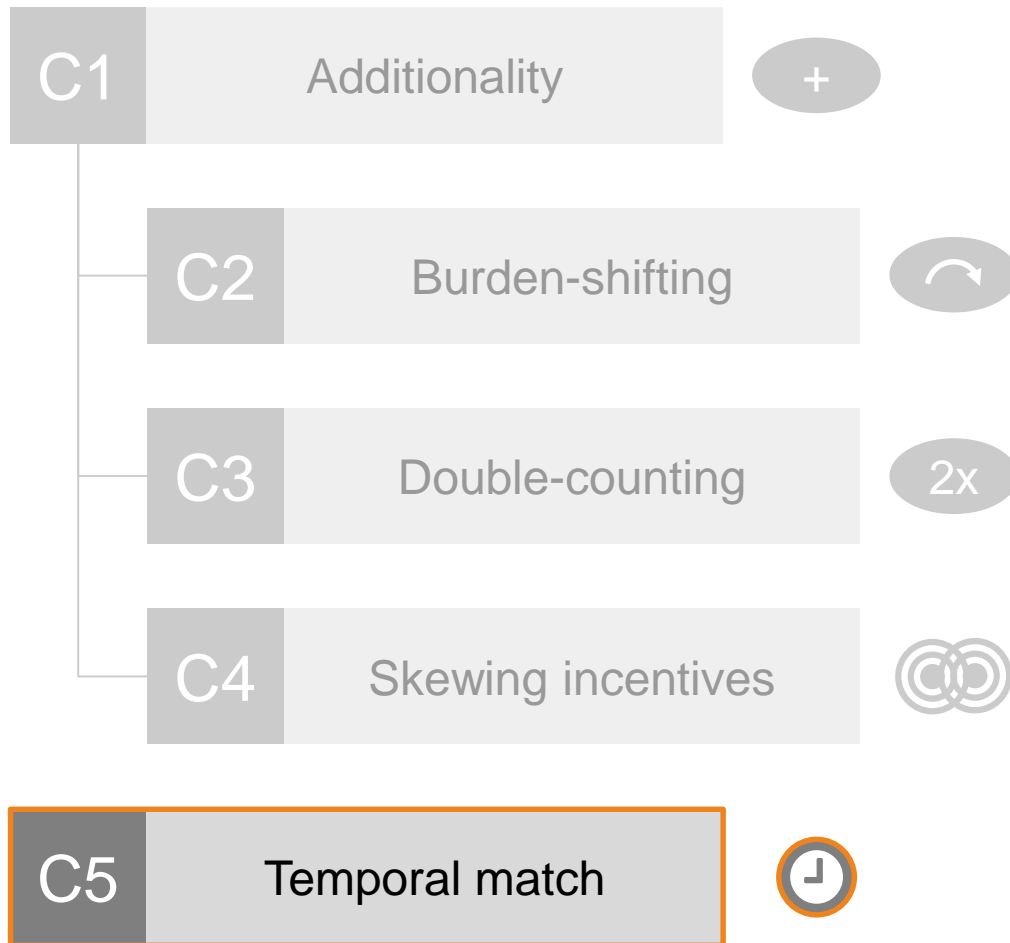
Temporal match describes the alignment of supply and demand profiles



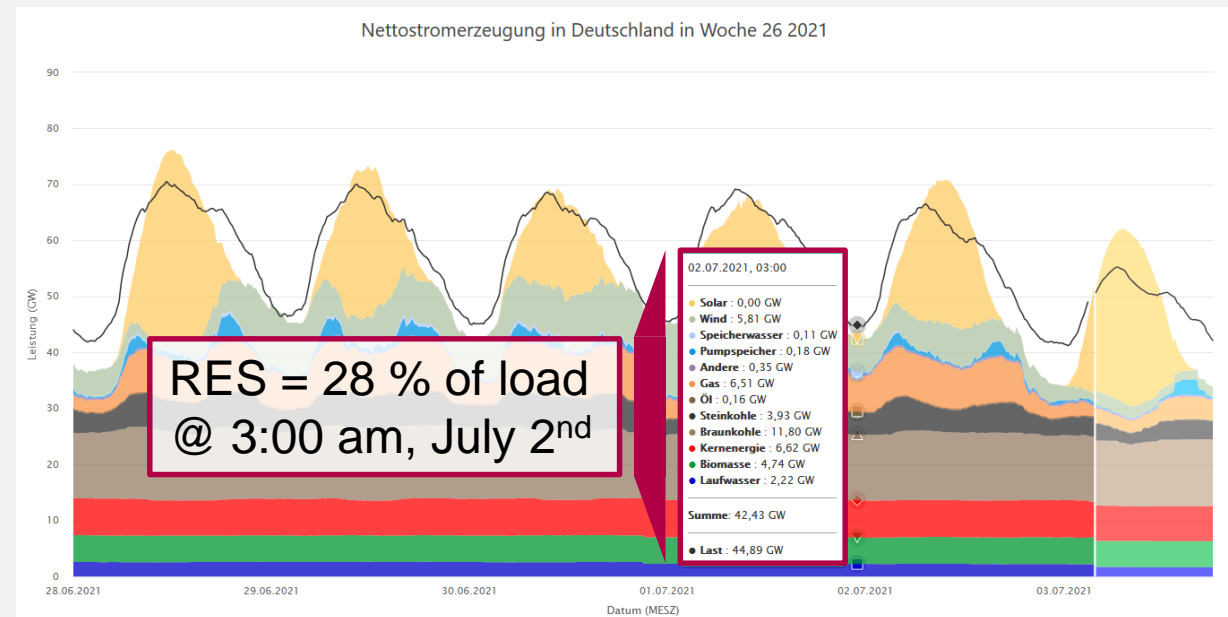
Only with 100 % temporal match can a consumer claim 100 % RES



Temporal mismatch means that REC holders rely on electricity from conventional sources



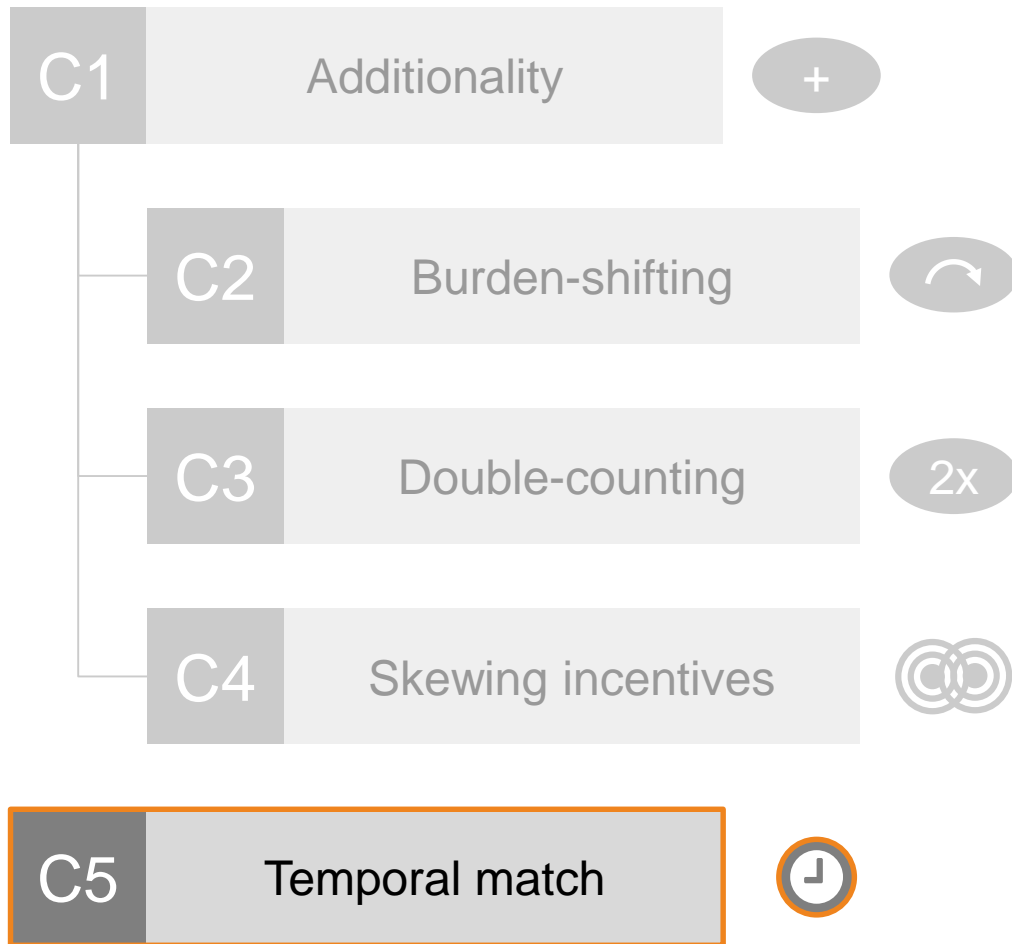
Even though RECs ensure full RES supply coverage on average, *RES supply is insufficient* during many time periods. The missing amount is supplied from *conventional sources*.





Possible objection from consumers with their own RES (e.g. rooftop-PV): Of course, on-site RES may also feed electricity into the grid. Yet, due to grid- and storage losses, 1 kWh supplied to the grid does “not cancel” out 1 kWh drawn from the grid.

PV = photovoltaics, REC = renewable energy certificate, RES = renewable energy supply

Only **location-based method** allows an assessment of the temporal match



Market-based method	Location-based method
 Additionality ❌	 Additionality ✅
Burden-shifting ❌	Burden-shifting ✅
Double-counting ❌	Double-counting ✅
Skewed incentives ❌	Skewed incentives ✅
Temporal match ❌	Temporal match ✅
Does the method consider this aspect?	

Second step: assess appropriateness of each method



Consumer's emissions are determined by their contractual setup.



Consumer's emissions are determined by their location.

Which method is more **appropriate**?

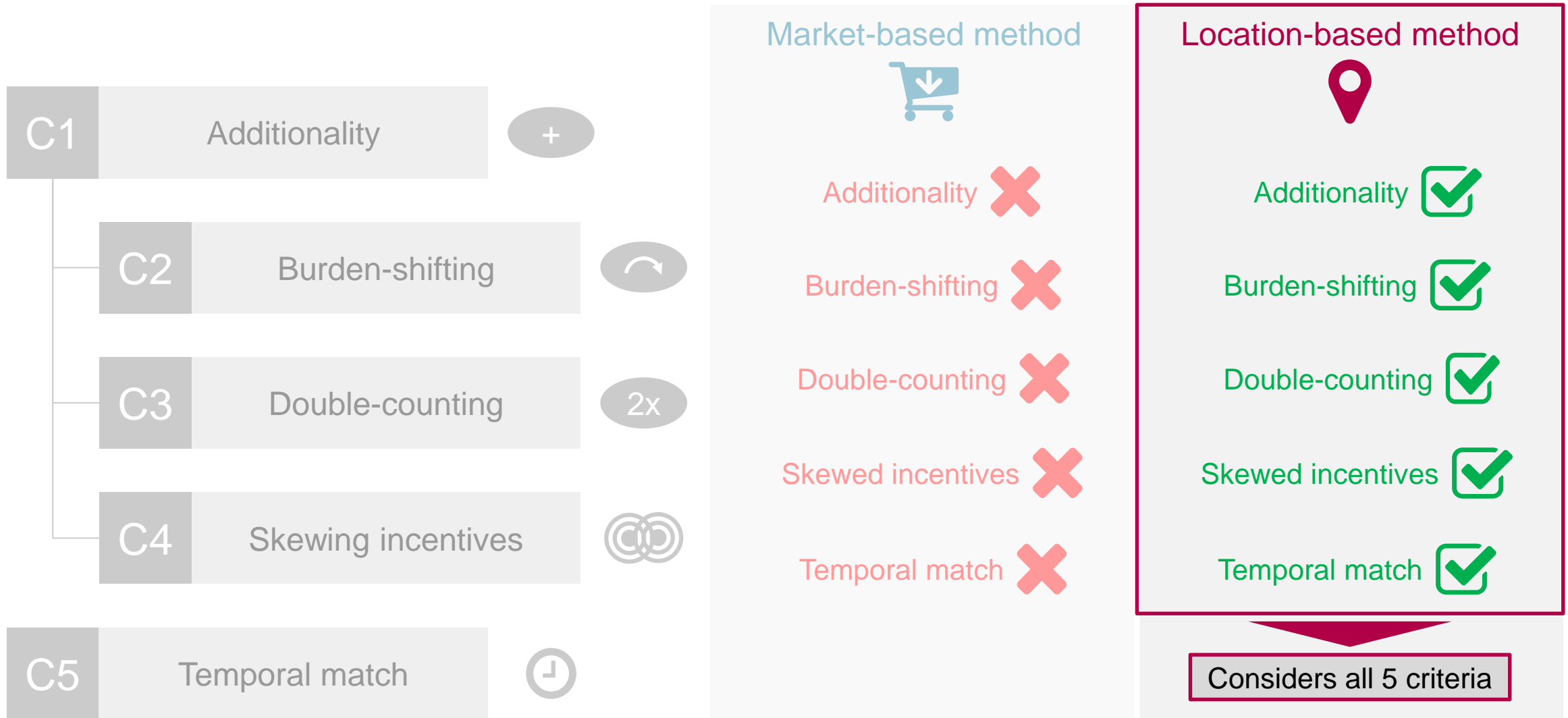
Define criteria to assess "appropriateness".



Assess appropriateness of each method.


Apply appropriate method to different cases.

Location-based method considers all five criteria

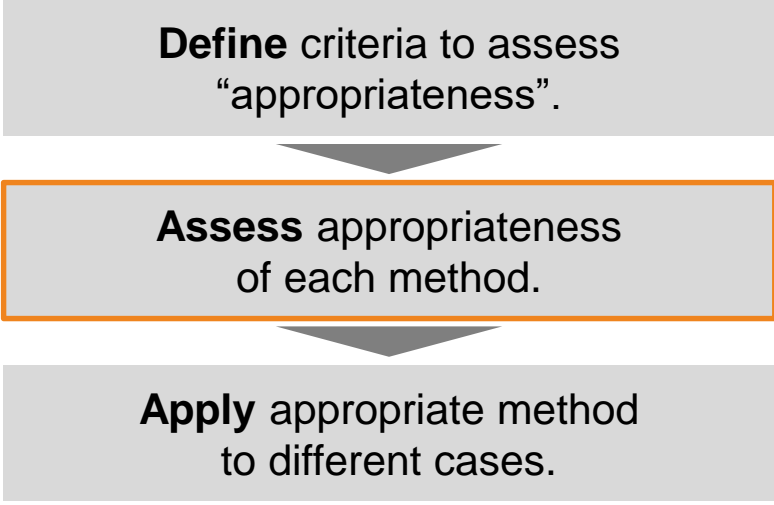


Location-based method is the more appropriate method


Consumer's emissions are determined by their contractual setup.


Consumer's emissions are determined by their location.

Which method is more **appropriate**?



Agenda

3

Applying the chosen method

Third step: apply **location-based method** to different cases



Consumer's emissions are determined by their contractual setup.



Consumer's emissions are determined by their location.

Which method is more **appropriate**?

Define criteria to assess "appropriateness".

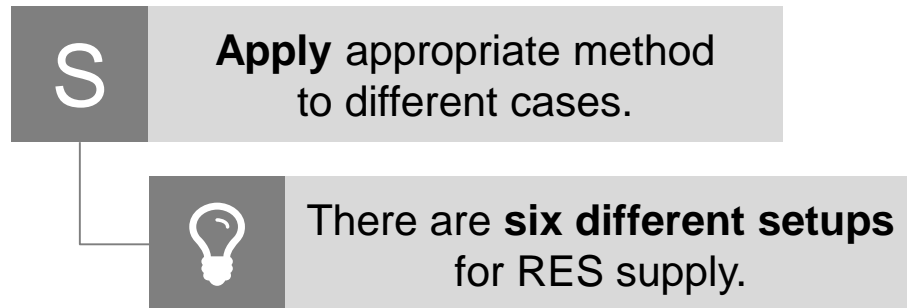


Assess appropriateness of each method.



Apply appropriate method to different cases.

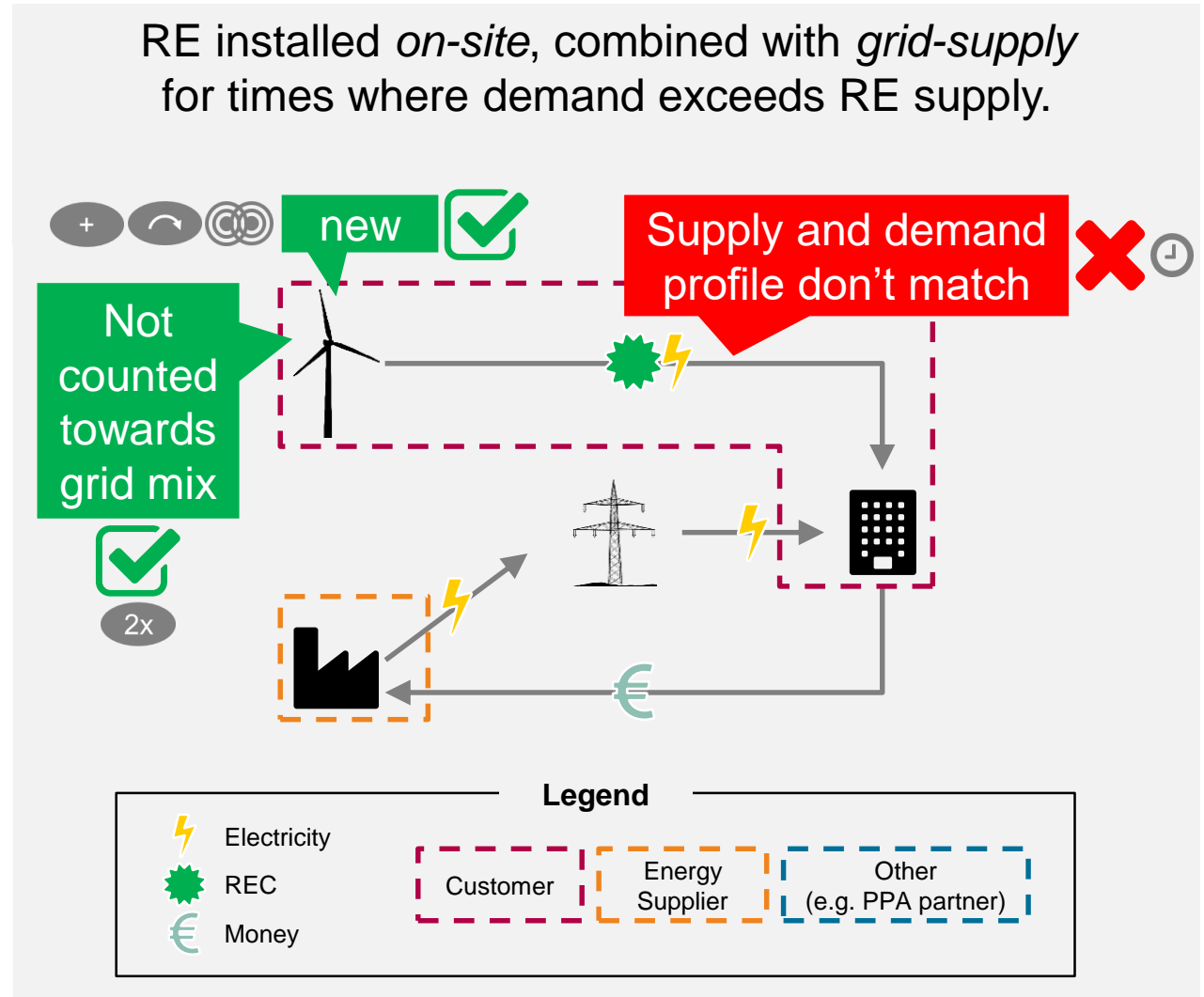
There are six different setups for RES supply









S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	











Own RE installation: on-site RE combined with grid-supply

S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



Own RE installation: meets all but one criterion

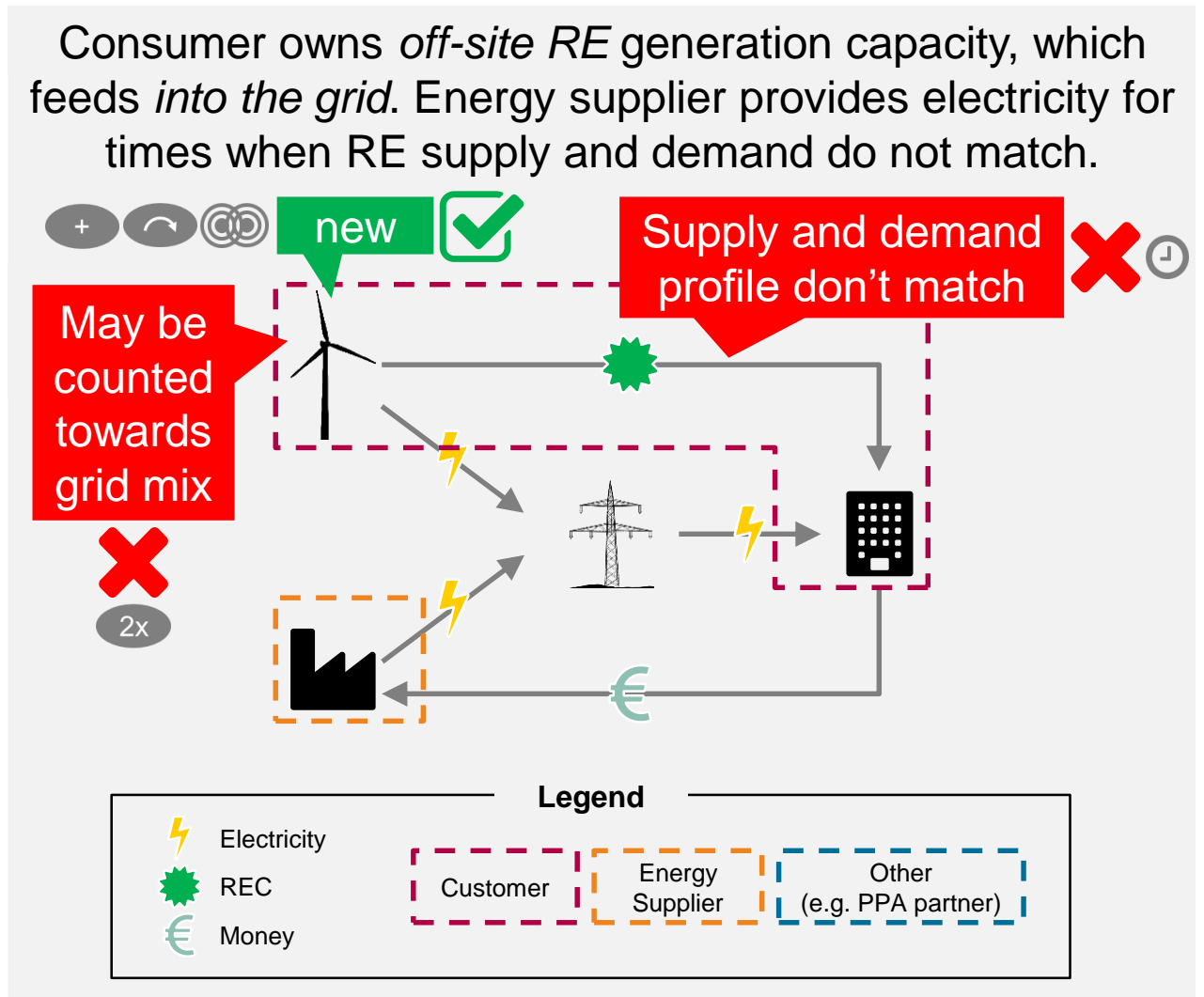
S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

Evaluation		
Additionality		Yes 
Burden-shifting		No 
Double-counting		No 
Skewing incentives		No 
Temporal match		No 







New RES ensure additionality, avoid burden-shifting (when RES expansion matches the consumer's demand), and reflect the real cost of RES capacity expansion, thus avoiding skewed incentives.

Equity in RE installations: off-site RE, owned by consumer











S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



Equity in RE installations: may lead to double-counting







S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

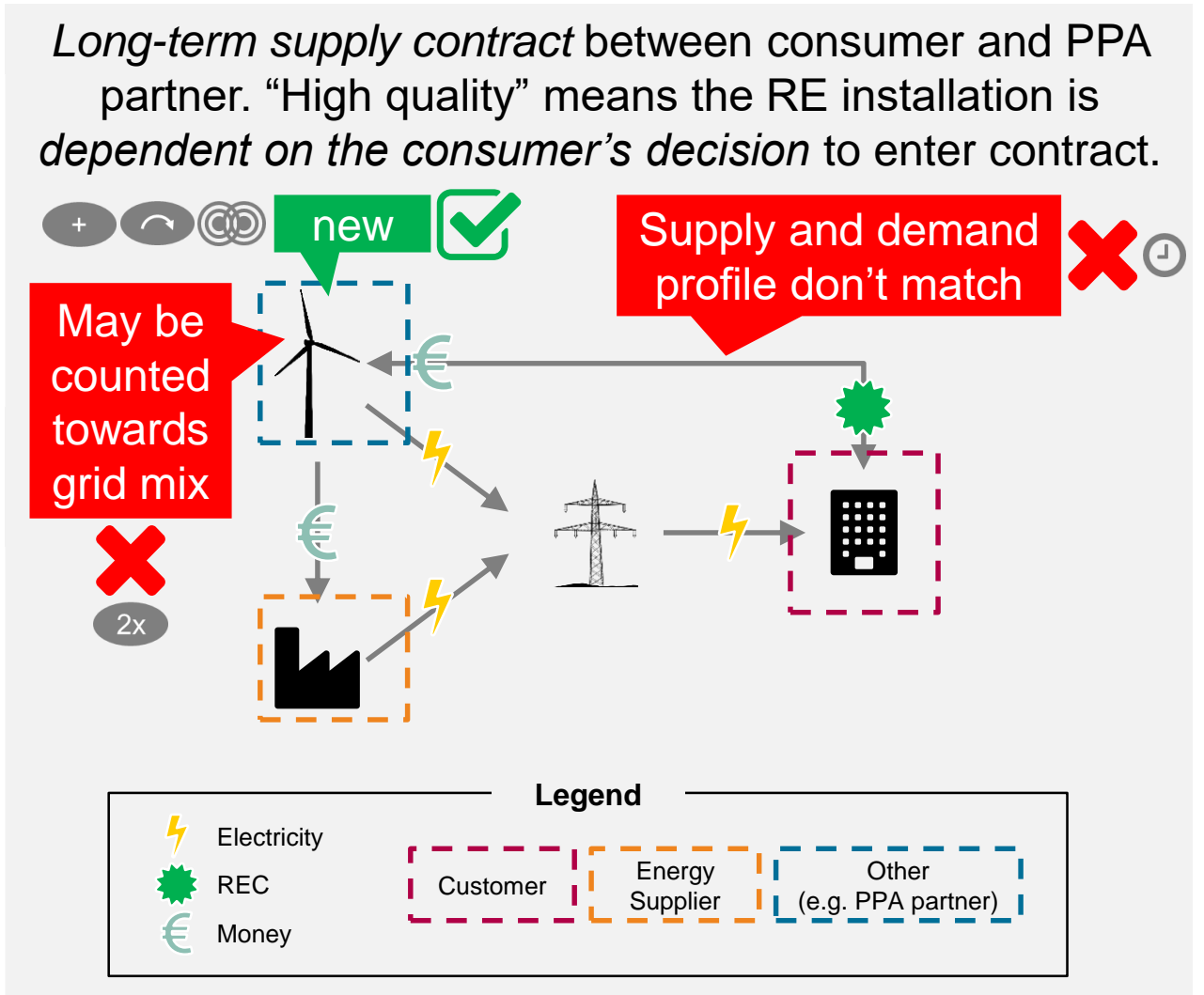
Evaluation

Additionality		Yes 
Burden-shifting		No 
Double-counting		Yes 
Skewing incentives		No 
Temporal match		No 







New RES ensure additionality, avoid burden-shifting (when RES expansion matches the consumer's demand), and reflect the real cost of RES capacity expansion, thus avoiding skewed incentives. Grid-connected RE may be counted towards electricity statistics, reducing electricity-related emissions for all other electricity consumers as well (double-counting).

High quality PPAs: long-term supply contract stimulating new RE generation capacity











S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



High quality PPAs: may lead to double-counting

S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

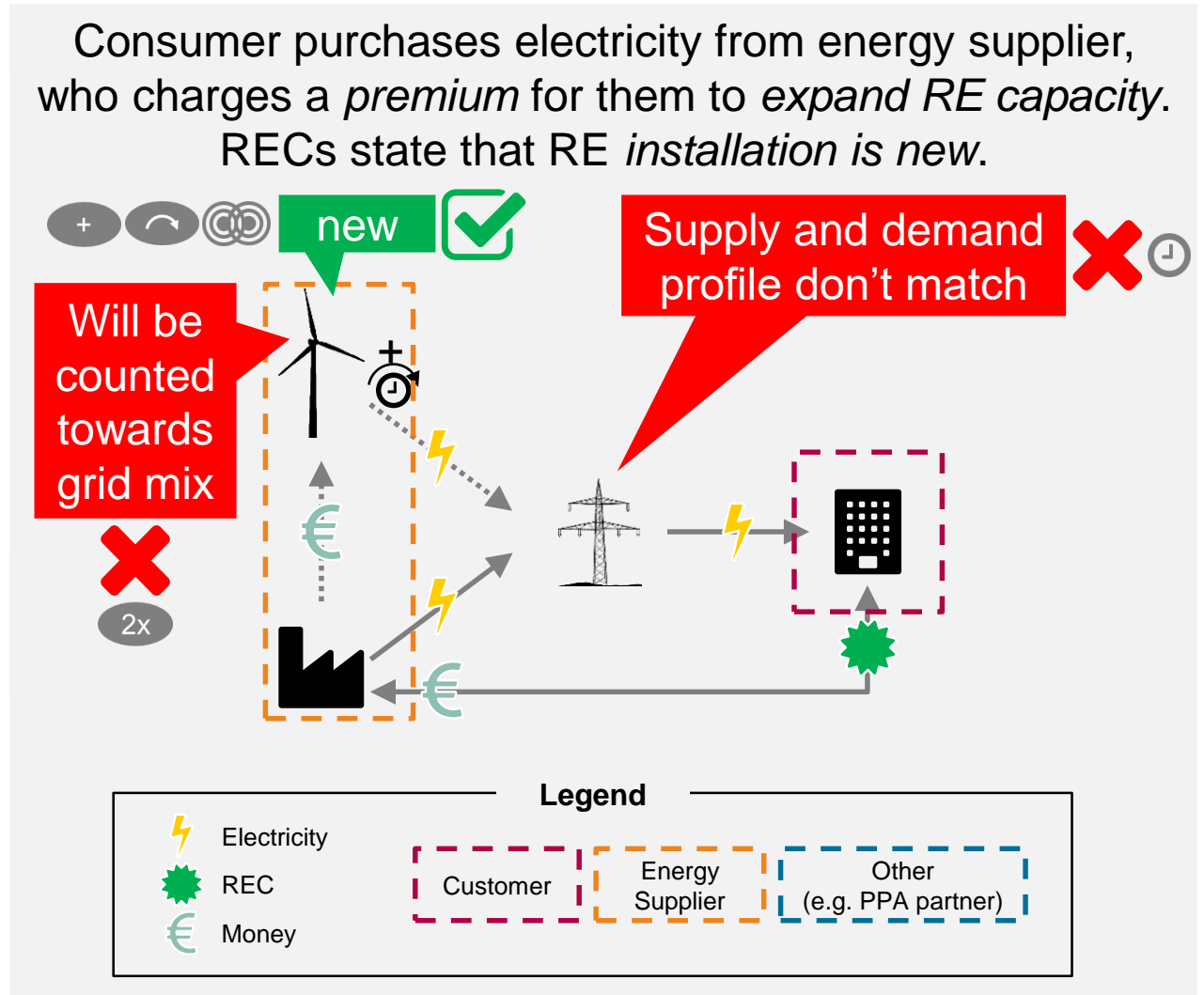
Evaluation

Additionality		Yes 
Burden-shifting		No 
Double-counting		Yes 
Skewing incentives		No 
Temporal match		No 







New RES ensure additionality, avoid burden-shifting (when RES expansion matches the consumer's demand), and reflect the real cost of RES capacity expansion, thus avoiding skewed incentives. Grid-connected RE may be counted towards electricity statistics, reducing electricity-related emissions for all other electricity consumers as well (double-counting).

Premium for new RE capacity: consumer pays supplier to expand RE capacity











S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



Premium for new RE capacity: may lead to double counting

S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

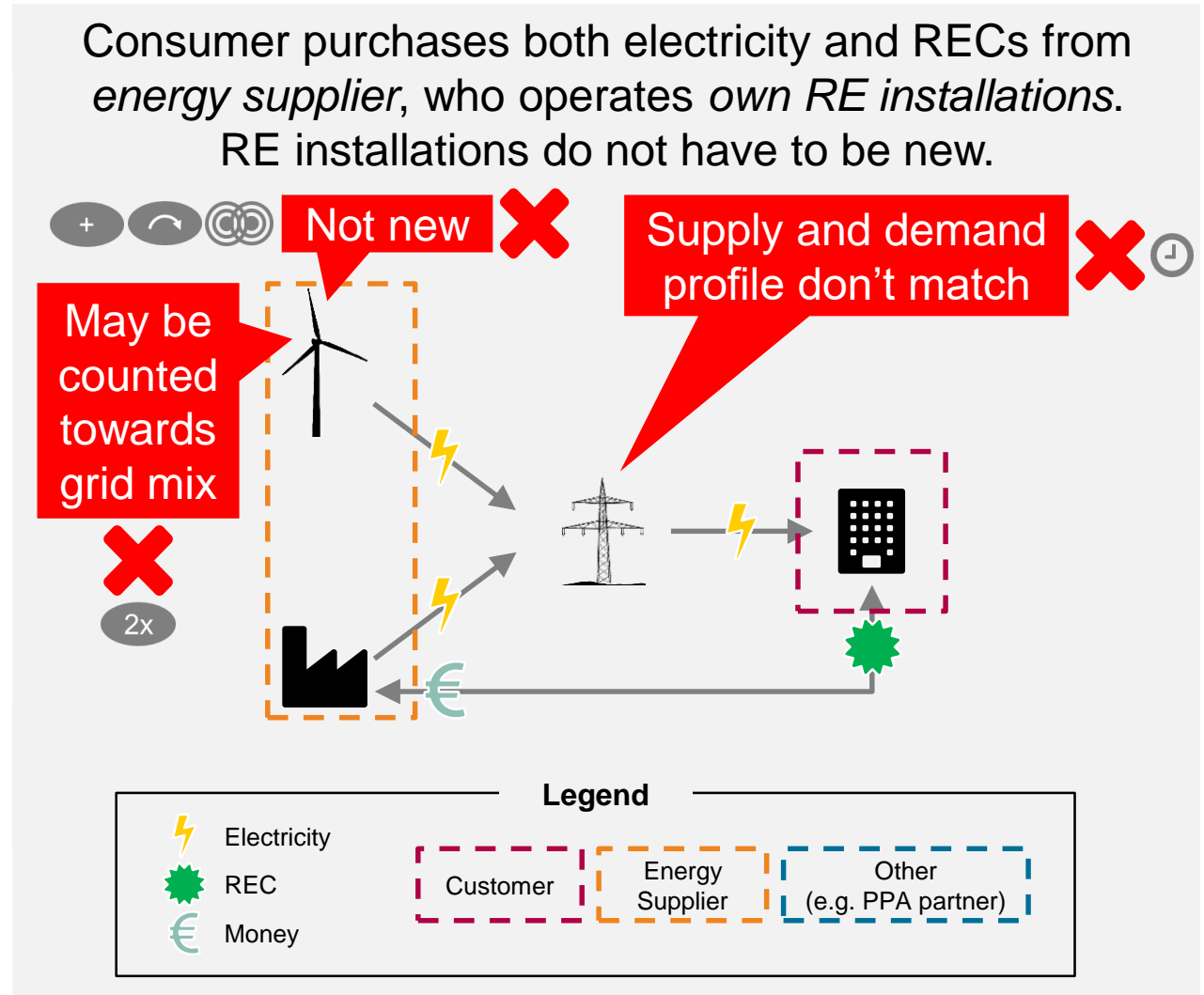
Evaluation

Additionality		Yes	
Burden-shifting		No	
Double-counting		Yes	
Skewing incentives		No	
Temporal match		No	







New RES ensure additionality, avoid burden-shifting (when RES expansion matches the consumer's demand), and reflect the real cost of RES capacity expansion, thus avoiding skewed incentives. Grid-connected RE may be counted towards electricity statistics, reducing electricity-related emissions for all other electricity consumers as well (double-counting).

Supplier-generated RECs: consumer pays supplier with own RE generation capacity











S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



Supplier-generated RECs: meet none of the criteria

S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

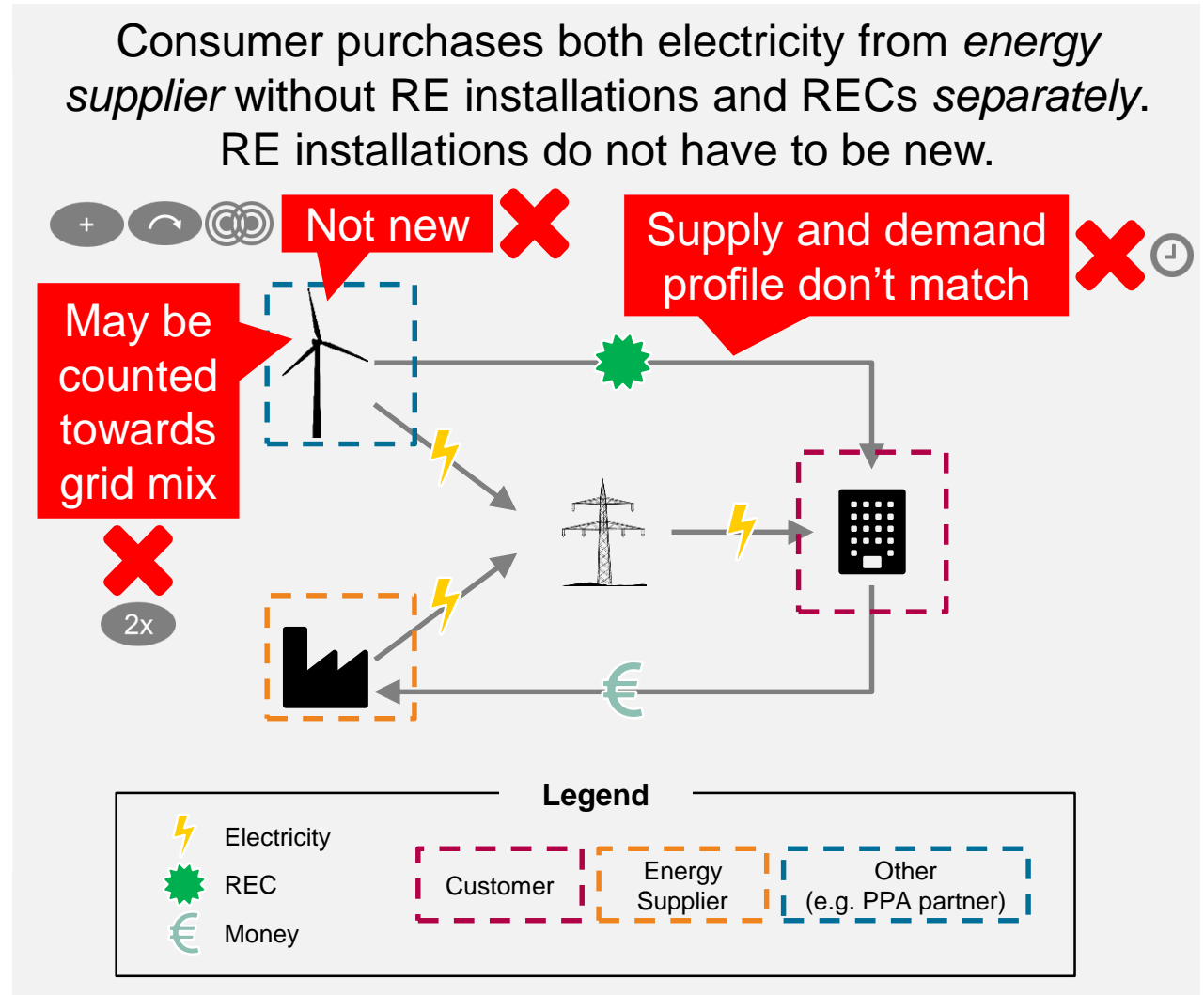
Evaluation

Additionality		No	
Burden-shifting		Yes	
Double-counting		Yes	
Skewing incentives		Yes	
Temporal match		No	






Since no new RE generation capacity is added, RECs lack additionality. Grid-connected RE may be counted towards electricity statistics, reducing electricity-related emissions for all other electricity consumers as well (double-counting). Since no new RE generation capacity is added, RECs lack additionality. Static RE generation capacity combined with REC purchases lead to a burden-shifting from REC holders to non-holders. Low prices of RECs compared to the cost of RE capacity expansion lead to skewed incentives.

Other RECs & low-quality PPAs: consumer purchases electricity and RECs separately











S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	



Other RECs & low-quality PPAs: meet none of the criteria




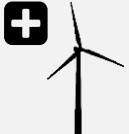





































S1	Own RE installation	
S2	Equity in RE installations	
S3	High quality PPAs	
S4	Premium for new RE capacity	
S5	RECs: supplier-generated	
S6	Other RECs & low-quality PPAs	

Evaluation

Additionality		No	
Burden-shifting		Yes	
Double-counting		Yes	
Skewing incentives		Yes	
Temporal match		No	

Since no new RE generation capacity is added, RECs lack additionality. Grid-connected RE may be counted towards electricity statistics, reducing electricity-related emissions for all other electricity consumers as well (double-counting). Since no new RE generation capacity is added, RECs lack additionality. Static RE generation capacity combined with REC purchases lead to a burden-shifting from REC holders to non-holders. Low prices of RECs compared to the cost of RE capacity expansion lead to skewed incentives.

Summary of all cases

		 Own RE installation	 Equity in RE installations	 High quality PPAs	 Premium for new RE capacity	 RECs: supplier-generated	 Other RECs and low-quality PPAs	
Additionality		Yes 	Yes 	Yes 	Yes 	No 	No 	
Burden-shifting		No 	No 	No 	No 	Yes 	Yes 	
Double-counting		No 	Yes 	Yes 	Yes 	Yes 	Yes 	
Skewing incentives		No 	No 	No 	No 	Yes 	Yes 	
Temporal match		No 	No 	No 	No 	No 	No 	
Verdict		Recommended				Not recommended		

Third step: apply **location-based method** to different cases



Consumer's emissions are determined by their contractual setup.



Consumer's emissions are determined by their location.

Which method is more **appropriate**?

Define criteria to assess "appropriateness".



Assess appropriateness of each method.



Apply appropriate method to different cases.



Agenda

4

Real world insights &
summary

How corporations report their electricity-related (= scope 2) emissions



Carbon neutral by:



% of electricity from RES (scope 2):



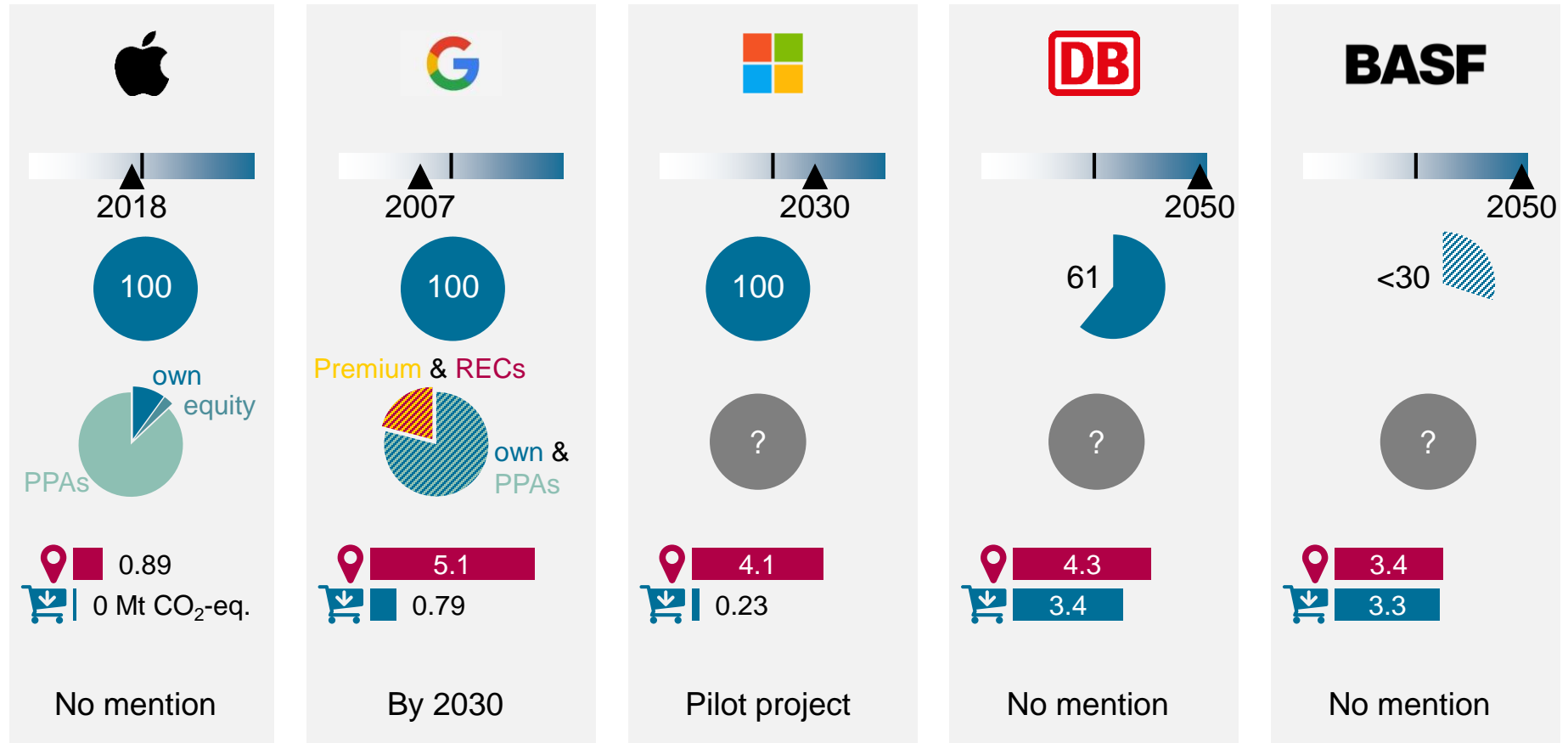
RES contractual setup:



Total scope 2 GHG emissions:



Temporal match of RE supply & demand:



GHG = greenhouse gases, PPA = power purchase agreement, REC = renewable energy certificate, RE(S) = renewable energy (supply)

Companies **vary widely** in their efforts to report and reduce scope 2 emissions. All of them report using **both the market-based and the location-based** method.

Summary: location-based method for reporting, RES with additionality for mitigation

1. Choose method that is best suited for assessing a company's electricity-related emissions

→ Location-based method



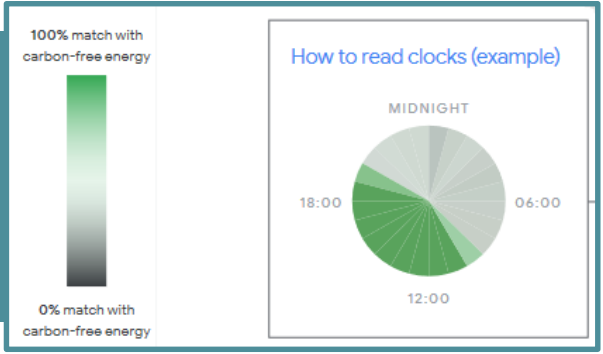
Consumer's emissions are determined by their location.

2. Apply method to different contractual setups of company electricity procurement

	Own RE installation	Equity in RE installations	High quality PPAs	Premium for new RE capacity	RECs: supplier-generated	Other RECs and low-quality PPAs
Additionality	Yes	Yes	Yes	Yes	No	No
Burden-shifting	No	No	No	No	Yes	Yes
Double-counting	No	Yes	Yes	Yes	Yes	Yes
Skewing incentives	No	No	No	No	Yes	Yes
Temporal match	No	No	No	No	No	No
Verdict	Recommended			Not recommended		

Always report location-based emissions (market-based optional), list avoided emissions from RES use separately*

For temporal match, study Google's approach (load shifting with real-time emission factors)**



3. Provide recommendations for companies on:

- a. Reporting and _____
- b. Mitigation of electricity-related emissions _____

GHG = greenhouse gases,
 PPA = power purchase agreement,
 REC = renewable energy certificate,
 RE(S) = renewable energy (supply)

Question & comments?

Appendix

Some counter-arguments

Consumers are not responsible for expanding RES.

→ True, but then they do not get to claim low emissions from RES which they did not finance.

It is the responsibility of policy-makers to make sure incentives are aligned.

→ True, but even within the current regulatory framework it is already possible for consumers to reduce the environmental impact of electricity supply (e.g. on-site RE, PPAs).

RECs certainly won't hurt either, so why shouldn't companies purchase them?

→ Because it only generates revenue for REC traders, but does not contribute to RES expansion. Also, it wastes money on ineffective measures, which may be better spent on effective ones (e.g. energy efficiency).

REC purchasers are not to blame for burden-shifting and double-counting. Consumers without RECs are responsible to sort his out.

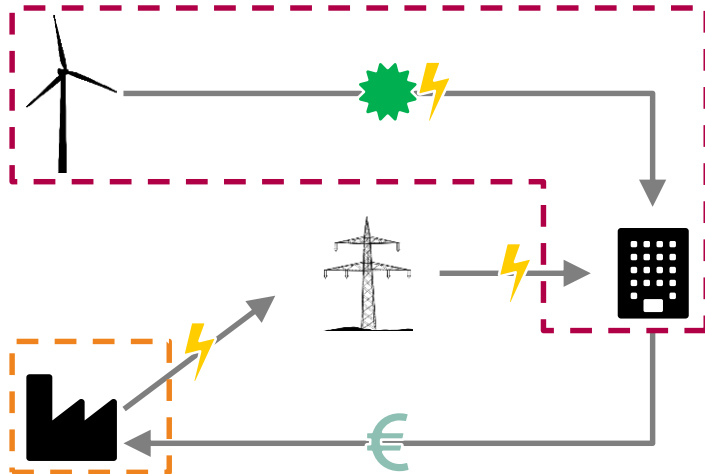
→ True, but REC purchasers can help to avoid burden-shifting and double-counting, by pursuing options with additionality instead (e.g. on-site RE, PPAs).

Temporal match is a criterion impossible to achieve.

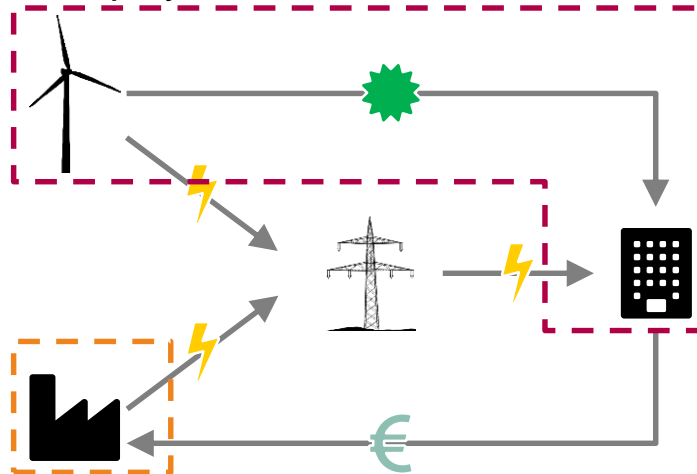
→ (Mostly) True, so it is good to be transparent about the fact that virtually every consumer relies on electricity from the grid, at least some of the time.

Differentiate between different RE supply typologies

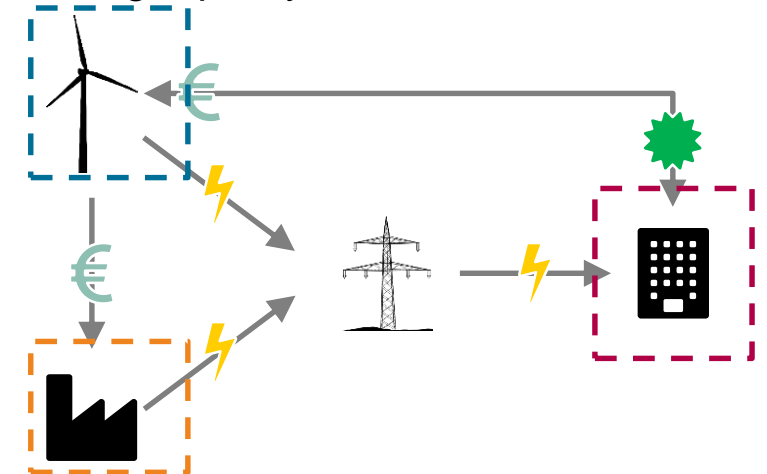
Own RE installation



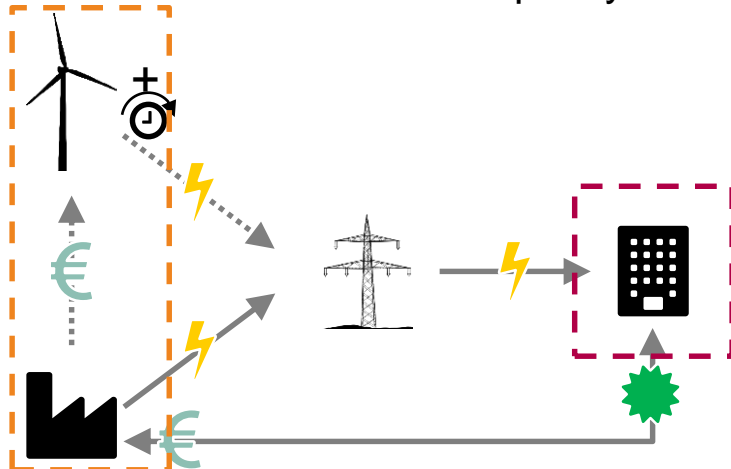
Equity in RE installations



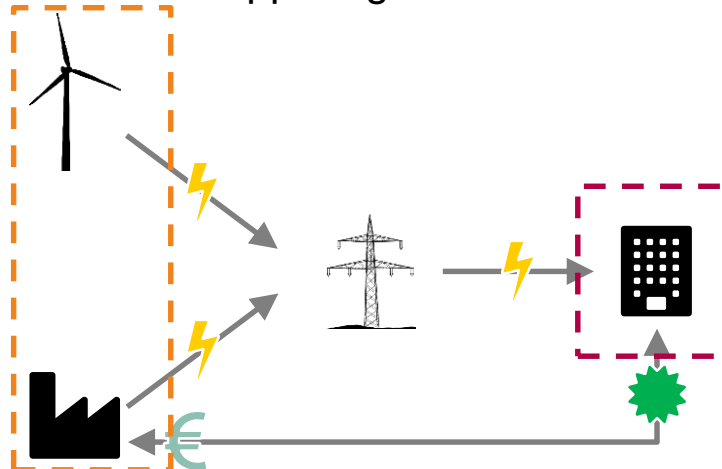
High quality PPAs



Premium for new RE capacity



RECs: supplier-generated



Other RECs & low quality PPAs

