Cap & Surrender

An idea for a demand-driven system to decarbonise road transport

Hyperlinks are incorporated in the slides and marked in a different colour (depending on your system).

What is „cap-and-surrender“ (C&S) and what does it want?

- „Cap-and-surrender“ is a system designed to reduce (and possibly eliminate) CO2 emissions from passenger cars and light duty vehicles.
- Under C&S, car holders need to have permission to emit CO2 from a car. The permission to emit *one ton of CO2* by using a car is called a „road transport allowance“ (RTA).
- C&S establishes a cap (absolute limit) on CO2 emissions. The cap is reduced every year and could bring about full decarbonisation over 10, 15, 20 years or more.
- To this end, it provides financial incentives to the holders of cars with internal combustion engines (ICE) that emit CO2 so as to make them driving
  - less (no superfluous rides)
  - more efficient (no unnecessary speeding)
  - Cleaner (modal shift, e.g. walking, bicycles, train, zero-emitting vehicles)
- In addition, it
  - Increases demand for zero-emission vehicles (ZEV), this way contributing to preserving competitiveness of the European car manufacturing industry
  - Raises awareness of people on the need for a transition to a net-zero emissions economy, as it regularly reminds them of their CO2 emissions from cars

How does it work?

- When filling their tank at a filling station, car holders have to give back („surrender“) the amount of CO2 that is contained in the fuel put in the tank of their car by using a card (looks like a credit card).
- The card contains the total amount of CO2 that they are allowed to use or their „individual CO2 budget“.
- If a car holder runs out of CO2 on his card, he/she can purchase more CO2, either from another car holder or from the state.
- If he/she consumes less (more) than the average of car holders per 100 km, he/she has to pay less (more), in order to purchase new CO2.
- Driving less, driving more efficient and driving cleaner would be rewarded, because
  - The car holder can save CO2 and sell it to somebody else
  - The car holder does not need to buy new CO2 and can save money, while emitting less CO2
  - Switching transport modes saves CO2 and allows selling it. Switching to ZEVs could be rewarded by receiving CO2 for sale only. This way polluting car holders promote clean car holders.
- The amount of CO2 available (“cap”) to each car holder is decreasing every year, this way reinforcing the incentives to drive less, more efficient and finally switch to a non-emitting car.

End

Thank you very much for your patience, efforts and feedback!

Questions?

1. Why should we need a system like C&S?
2. What are the costs of introducing C&S?
3. What is the environmental benefit of C&S compared to the existing regulation that is based on emission standards?
4. How does C&S ensure that each car holder is held accountable for the CO2 he emits by driving his car?
5. How is the amount of CO2 each driver is allowed to use determined?
6. How do car holders receive CO2 on a card like a credit card?
7. Could single Member States benefit from C&S?
8. How strong are the incentives to drive, less, more efficient and cleaner under C&S?
9. How does C&S relate to the EU ETS?

Clarifications

1. C&S constrains necessary transport services.
2. C&S punishes people that have to drive more for professional reasons.
3. C&S brings advantages to rich people and constrains poor people.
4. C&S does not live up to the huge range of reality of car holders.
5. C&S bears too high transaction costs for car holders.
6. C&S is prone to fraud.
7. C&S allows for carbon leakage.
8. C&S is too complex.
9. C&S is just a complex tax system.

Additional information

2nd level

Road Transport Allowance

- Under C&S, emitting CO2 from a car/light duty vehicle/motorcycle to the environment is not free, but bears a cost.
- In accordance with the „polluter pays“ principle, car holders (drivers) have to pay, if they want to drive a car with an internal combustion engine that emits CO2 to the environment.
- This means, car holders (drivers) have to possess the permission to emit CO2, similar to what power generators and other big emitters in the EU ETS need to have as well.
- These permissions are called „road transport allowance“ (RTA). Each RTA entails the right to emit 1 ton of CO2 by driving a car with an ICE.
- Car holders can buy and sell RTA in accordance with their needs.

The total Cap

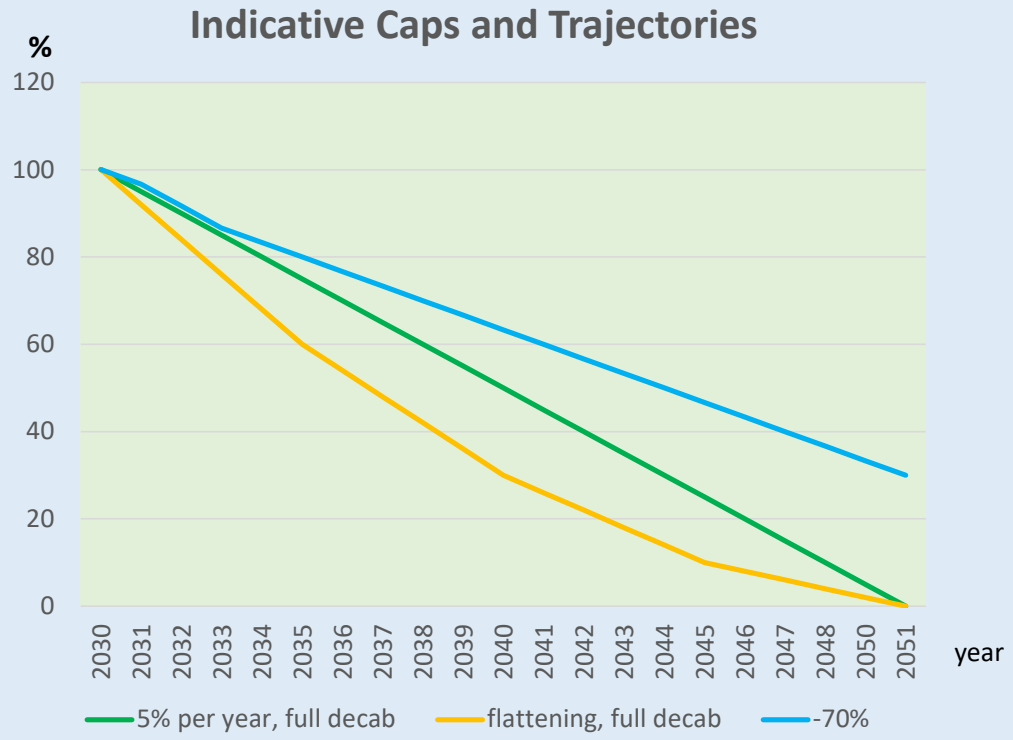
- The total cap is defined by the scope of C&S and determines the overall amount of CO2 emitted by vehicles included in the system and expressed as tons of CO2 (tCO2)
  - Example: in 2017, passenger cars, light duty vehicles and motorcycles emitted 564 million tons of CO2 (MtCO2) in the EU.
  - Under C&S, this is not likely to mean the total cap of the EU, because
    - Cars from third countries would not count
    - Rides from EU cars in third countries w/o C&S are not taken into account
    - The latter would also be the case, if not all EU MS introduced C&S
- It is made up of the accumulated individual carbon budgets of car holders, which are stored/saved on their Electronic Allowance Card (EAC).
- A declining total cap leads to emission reductions induced by incentives embedded in the C&S system
- This way, the environmental benefit in the form of less emissions from road transport is defined by the declining cap:
  - If the cap declines by 5 % in a given year, it means 5% less emissions in this year.

26
28
30
32
35

2 3

Cap and Trajectory

- The cap would be annually reduced by a certain percentage/amount determined at the start of the system
  - This is the trajectory that could result in full decarbonisation after a certain period (20, 25, 30, 40 years).
- The trajectory determines the annual level of reduction of transport services delivered by internal combustion engines (ICE)
- In practice, the annual reduction rate expressed by the trajectory should be based on the potential/ability/willingness to switch transport modes, change behaviour, introduce ZEVs, economic capacities of MS etc.



Financial Incentives

- Strength of incentives determined by individual behaviour and the fuel consumption of the ICE
  - This is reflected by the individual environmental adjustment factor (iEAF)
  - Individual EAF value adds to the price of purchasing new RTA
- Incentives are reinforced by the ability to sell RTA to other car holders:
  - No environmental effect, but rewarding those that save CO2:
    - They could gain extra revenues from selling
- Through the individual environmental adjustment factor (iEAF), C&S provides strong financial incentives to reduce CO2 emissions from road transport, however, there is no sweeping approach in the sense „the more you drive, the more you pay“, but individual driving behaviour is taken into account

Driving less

- After each filling process, the car holder (driver) need to give back („surrender“) that amount of CO2 that corresponds to the amount of fuel put in the tank during the filling process
- This way, the individual carbon budget of the car holder diminishes.
- In order to avoid the need to acquire new RTAs and possibly pay a high price depending on the market price of RTAs and the individual EAF, the car holder holds an incentive to avoid unnecessary rides, thus saving CO2 (and fuel costs).
- This means the car holder (driver) is offered an incentive to drive less in terms of distances, number of rides.
- An additional incentive emerges from the wish to gain extra revenues by selling saved CO2 (RTA)
  - Parts of RTA, i.e. a fraction of a ton of CO2 (100kg, 200 kg) can also be bought or sold

Driving more efficient

- Running out of CO2 (RTA) results in the need to purchase new Road Transport Allowances (RTA) (or fractions of it).
- Purchasing Road Transport Allowances (RTA) bears a cost: the market price of the RTA plus the top-up determined by the individual Environmental Adjustment Factor (iEAF).
- Since the individual EAF is based on the individual fuel consumption of his car per 100 km, the holder (driver) has an incentive to drive more efficiently, i.e. to consume less fuel per 100 km.
- This has three effects:
  - The holder (driver) can cover longer distances with the same amount of fuel
  - In the event that the driver has to buy new RTA, the price effect of the EAF will be weaker and therefore, the costs to pay lower.
  - Finally, the incentive to drive more efficient will push down the reference value that is used to determine the individual EAF, this way amplifying the financial incentives accruing from the EAF

Driving cleaner

- Over time, the reference value will decrease
- A decreasing reference value entails the following effects:
  - Constant fuel consumption of a given car is deteriorating in relative terms to the reference value
  - As a consequence, purchasing RTAs becomes more expensive
  - In combination with a decreasing individual carbon budget of the car holder (driver) and corresponding allocation rules, unchanged driving behaviour becomes more expensive
- The financial incentive to shift to cleaner transport modes (walking, cycling, public transport, car sharing) increases more and more
- In the longer term, the only way to comply with C&S at reasonable costs is replacing an ICE propelled car by a ZEV

Increasing demand for ZEV

- Decreasing cap and decreasing reference value amplify incentives to shift to ever less polluting cars and finally to ZEV
- These in-built incentives can be reinforced by allocation rules according to which RTA are distributed for free (alternatively they could be sold)
  - RTA taken from the individual cap above average polluting car holders could be given to car holders once they replace an ICE car by a ZEV
    - Such a policy could also be linked to social criteria, such as level of income, commuting distances etc
  - Selling the designated RTA brings additional revenues to holder of ZEV
  - Polluter pays to non-polluter
- This way, also poorer people would be encouraged and could afford buying ZEV
- Economies of scale in terms of manufacturing ZEVs
  - Declining costs of ZEV
  - Maintaining/increasing competitiveness of EU car manufacturing industry

Raising awareness

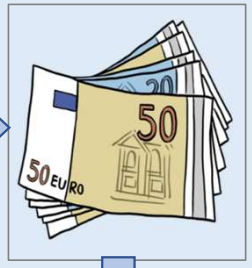
- Net zero target inconceivable without changing behaviour
- Triggering behavioural change may presuppose wide range of different conditions, but awareness of the issue at stake is indispensable
- Therefore, raising awareness across the society is crucial for the transition to net-zero
- C&S very well designed to raise awareness across society:
  - High level of car penetration: every car holder is affected
  - Constant reminder: every filling process requires surrendering of CO2 making people increasingly aware of CO2 emissions caused by own behaviour
  - Need to purchase RTA (CO2) reinforces awareness

Filling the tank and Surrendering

Business as usual!

The car holder (driver) fills the tank when needed

Business as usual!



He pays for the fuel filled in his tank

Like a credit card!

After paying the fuel, he gives back (or „**surrenders**“) the amount of CO2 that he has filled in his tank.
To this end, he uses a card that looks like a credit or bank card. It is called „Electronic Allowance Card“ (EAC), because it holds the individual amount of RTA or CO2 of the car holder (driver).
Each card („EAC“) is assigned to one specific car and cannot be used for another car.

Since the amount of CO2 emissions is defined by the quality and type of the fuel, consumption of fuel represents a reliable indicator of emissions. Therefore, the amount of CO2 contained in the fuel filled in the tank can be precisely determined and “surrendered”.
The corresponding emission factors can be assigned to each fuel.

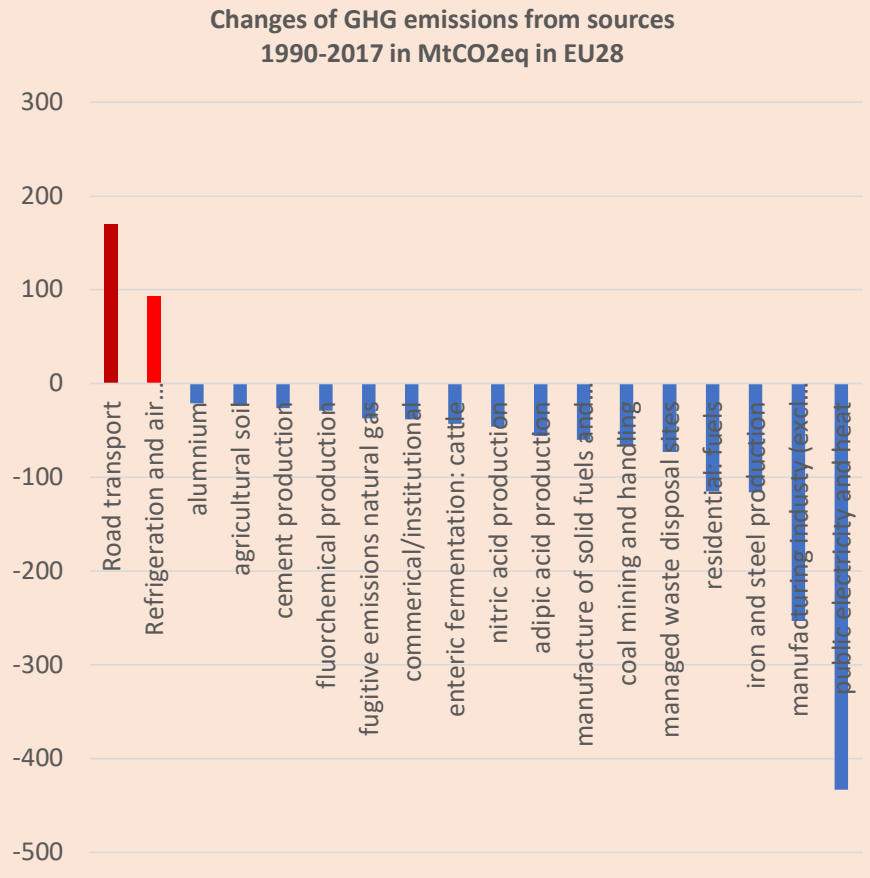
Individual carbon budget

- The total cap is made up of the aggregated amount of the individual carbon budgets of all car holders within the territorial scope of C&S (see indicative example)
- Individual carbon budget or individual cap of each car holder is determined by car holder during transition period
- Subject to allocation rules applying, it declines in the same manner as the overal cap.
- The individual carbon budget of each car holder is saved on the Electronic Allowance Card (EAC)
  - One carbon budget per car
  - A car holder can own several cars. He would then hold several EACs with several budgets

Answers to questions

Qu 1: Why should we need a system like C&S?

- Road transport emissions increased by 170 MtCO2 from 1990 to 2017
  - Offsetting reductions from other sectors
  - Not contributing to overall emission reduction objective
  - Not compatible with net-zero
- Comprehensive regulation in place, however, emissions are not declining
- Abatement potential on consumer side not addressed
- Importance of road transport for awareness raising
- Maintaining competitiveness of EU industry

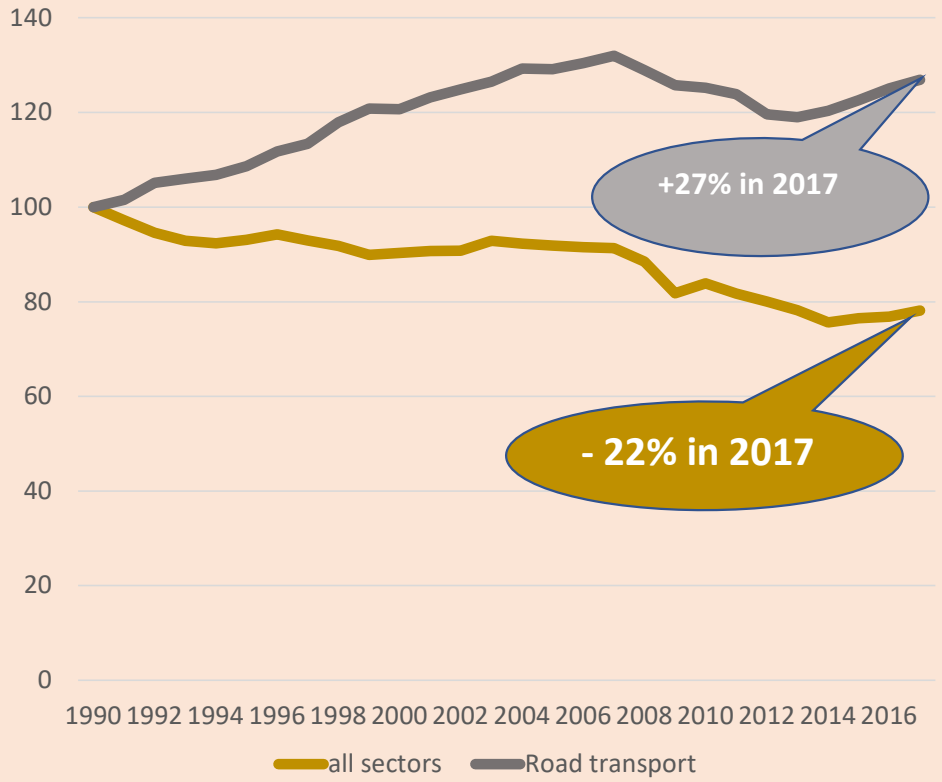


Qu 2: What are the costs of C&S?

- Abatement costs incurred to car holders (drivers) depend on their individual preferences and readiness to change behaviour
- Costs for State/authorities: providing the necessary infrastructure
- Infrastructure costs can be shared or kept cost neutral to
  - State if
    - accounted for tax and/or other fees related to road transport
    - Covered ex-post by revenues from primary market
  - Car holders if
    - Tax rebates etc are granted to car holders
    - Provided by State
- Transaction costs of car holders
  - Costs incurred from Electronic Allowance Card (EAC) and Electronic Identification Device (EID) are one-off costs
  - No further transaction costs identified (Road Transport Allowances for purchase/sale are homogenous)

Qu 3: What is the environmental benefit compared to existing measures?

- Declining cap guarantees emission reductions
  - Reaping reduction potential that is otherwise not available
- Better accuracy in monitoring CO2 emissions from road transport
  - No standard based testing
  - No distortions through testing procedure
  - Individual and accurate monitoring of fuel consumption



Qu 4: How does C&S ensure that each car holder is held accountable for the CO2 he emits by driving his car?

- Electronic allowance card (EAC) that contains the individual CO2 budget of the car holder (driver) is indissolubly linked to a specific car
- It cannot be used for another car
  - Electronic Identification Device (EID) ensures that surrendering after the filling process can only be carried out with the Electronic Allowance Card (EAC) assigned to this car
    - Similar to electronic key cards of cars
    - Optical recognition (see péage system in France) or in-built electronic identification device (EID)
- Car holders owning more than one car would hold one Electronic Allowance Card (EAC) for each car

Qu 5: How is the amount of CO2 each driver is allowed to use determined?

- During transition period, car holders (drivers) deliver the necessary data when filling their tank
  - Consumption per 100 km
  - Distance driven et al
- Data transferred to competent authorities for determination of overall and individual caps
- Data to be taken account for determination of individual carbon budget is left to Member States
  - Different approaches possible
  - National allocation rules to address different cases
- Following introduction of cap, individual budget decreases in line with decrease of overall cap
  - This is notwithstanding specific measures through designated RTA
- In theory, full sale of RTA reduces the need for a transition period
  - In practice, transition period needed to
    - Raise awareness
    - Make people familiar with C&S

Qu 6: How do car holders receive their individual carbon budget on a card like a credit card?

- In order to transfer the individual carbon budget on the Electronic Allowance Card (EAC), the necessary infrastructure needs to be in place
- At the beginning of the transition period, the competent authorities will have to ensure that each car holder receives an EAC for each car he owns
- At each first filling process in a new year, the CO2 in the form of Road Transport Allowances (RTA) will be transferred from the competent authorities to the EAC of the car holder through an Allowance Surrender Terminal (AST) which each filling station needs to host.
- This is an automated process that however will only concern those RTAs that are given for free in accordance with the applicable national allocation rules

Qu 7: Could single Member States benefit from C&S?

- Each MS could decide of its own on introduction of system to meet its road transport emission reduction target and/or comply with the Effort Sharing Regulation
- This is a discrete decision of each MS and irrespetive of what other MS do
  - Establishment of minimum infrastructure in adjacent MS to avoid carbon leakage would be helpful
    - Adjacent MS have incentives to do so to be not held accountable under the Effort Sharing Regulation for tank tourism
- Free choice of cap and trajectory in each MS
- C&S supposed to be most effective at EU level and as a stand-alone system
- MS to design allocation rules in accordance with needs and circumstances in Member States

Qu 8: How strong are the incentives to drive less, more efficient and cleaner under C&S?

- Effectiveness and strength of incentives reinforced or alleviated by national allocation rules
- Strength determined by the individual driving behaviour of the car holder (driver) in combination with the ICE of his car
  - Average consumption per 100 km of car in relation to reference value determines the (positive/negative) top-up on the market price of RTA in the event of RTA purchase, i.e. the individual Environmental Adjustment Factor (iEAF)
  - How often and/or how much a car holder/driver would need to purchase RTA (CO2) also depends on his inclination to carry out/drop unnecessary drives, switch to other transport modes, replace the ICE car by a ZEV (in the mid and longer term) or to gain additional revenues by saving and selling RTAs.
  - The potential top-up (iEAF) to pay for one ton of CO2 (1 RTA) may reach a 4-digit figure
  - As for negative prices and discounts exceeding the market price of RTA, special arrangements would need to be in place

Qu 9: How does C&S relate to the EU ETS?

- Inclusion in EU ETS possible
  - iEAF overcomes problem of too low prices to trigger abatement on road transport emissions, if downstream approach is maintained
- However: no or much reduced environmental benefit
  - No separate cap, buying from other sectors, therefore: environmental objective strongly compromised
  - Infrastructure requirements remain in case of a downstream system
- Therefore, most effective as a stand-alone system
  - Cap determines emission reductions
- EU-level most effective and efficient
  - Best use of infrastructure
  - Largest emission reductions
  - Achieving ESR objectives is very likely
- Effects on EU ETS
  - Increasing electricity demand
- In theory, EUA and RTA exchangeable

Clarification provided

C&S constrains necessary transport services

- Through the cap, C&S determines the level of CO2 emissions. It does not determine the level of transport services.
- The trajectory could be determined in line with the potential to switch transport modes and introduce ZEV
- Therefore, all transport services, whether considered necessary or not, can be delivered either through
  - ICE under the cap
  - Modal switch (cycling, public transport, car sharing etc) or
  - Individual transport service by ZEV
- Current transport policies also favour modal switch and ZEV, but do not introduce incentives on the consumer side.
- Business as usual as during the last decades cannot be an option anymore.

C&S punishes people that have to drive more for professional reasons

- During the transition period, the individual carbon budget of car holders (drivers) is determined
  - All car holders (drivers) should receive an individual carbon budget in line with their needs, i.a. distances to be covered
  - Ineffective consumption of fuel may or may not be taken into account
    - decision left to MS whether or not to address „perverse incentives“ during the transition period
  - Change of situation in the first year of the cap applied could be taken into account by Member States (national allocation rules)
- Fuel consumption of people that have to drive more for justified reasons is therefore fully taken into account
- See „Example EAF: driving more, paying less“

C&S brings advantages to rich people and constrains poor people

- Presumption: rich people can always buy RTA, poor people cannot
- Presumption is not conclusive:
  - Overall amount of RTA (CO2) defined by the cap and cannot be extended by paying more: all participants of C&S subject to the same constraints
  - Purchasing beyond individual carbon budget is only possible, if others save RTA and are ready to sell
    - High demand may push market price up and may make saving and subsequent selling more attractive
    - In this case, rich people may be able to buy where poor people cannot anymore, but would bring higher compensation to those selling
- National allocation rules may be designed to generously reward little consumption or compensate for social hardships (designated RTA)

C&S does not live up to the huge range of reality of car holders

- Member States are free to design national allocation rules in accordance with their specific needs
  - Very few principles to be respected: non-discrimination, objectivity
  - Recommendation: 90:10 rule (at the outset, not more than 90% for sale or free)
- National allocation rules may address general and particular situation of car holders (drivers)
  - Social aspects
  - Professional aspects
  - etc
- However:
  - regulatory measures are unlikely to be perfect
  - Permanent need to adjust to new developments, similar to existing regulatory tools

C&S bears too high transaction costs for car holders

- Transaction costs of car holders
  - Costs incurred from Electronic Allowance Card (EAC) and Electronic Identification Device (EID) are one-off costs
  - No further transaction costs identified (RTAs for purchase/sale are homogenous)
- Complexity of allocation rules may create transaction costs emerging from the need to comprehend and understand
  - Even if allocation rules may be complex to address various situations in the Member State concerned, the consumer (car holder/driver) is always best off, if he strives for driving less, more efficient and cleaner.
  - Possible costs accruing from comprehending allocation rules may be a matter of discretionary decision of each car holder, but are not system-eminent

C&S is prone to fraud

- I am owning two cards: a Hummer and a Fiat. I am using the Electronic Allowance Card of the Fiat to tank the Porsche
  - This is not possible, as the EAC of a specific car can only be used for this specific car.
  - This is ensured by an Electronic Identification Device.
- A black market to buy fuel outside the individual carbon budget is likely to occur
  - This may happen in single cases, but is unlikely to develop into an important size, as MS may have a strong interest to inhibit it
  - Unfortunately, fraud like this may always happen. It is however important to consider whether benefits outweigh costs.

C&S allows for carbon leakage

- In the event that C&S is only applied by single Member States, crossing the border may allow car holders to fill the tank with unaccounted fuel
  - Correct.
  - However, MS not applying C&S may still have a strong interest to provide for a minimum of infrastructure (i.e. Allowance Surrendering Terminal) at the filling stations close to the border or along transit routes,
    - This way, they could avoid being held accountable for the emissions due to car holders evading C&S
    - This is beneficial with respect to Effort Sharing targets of MS.
- This kind of carbon leakage cannot be avoided at borders to third countries, but is unlikely to appear in most other MS.

C&S is too complex

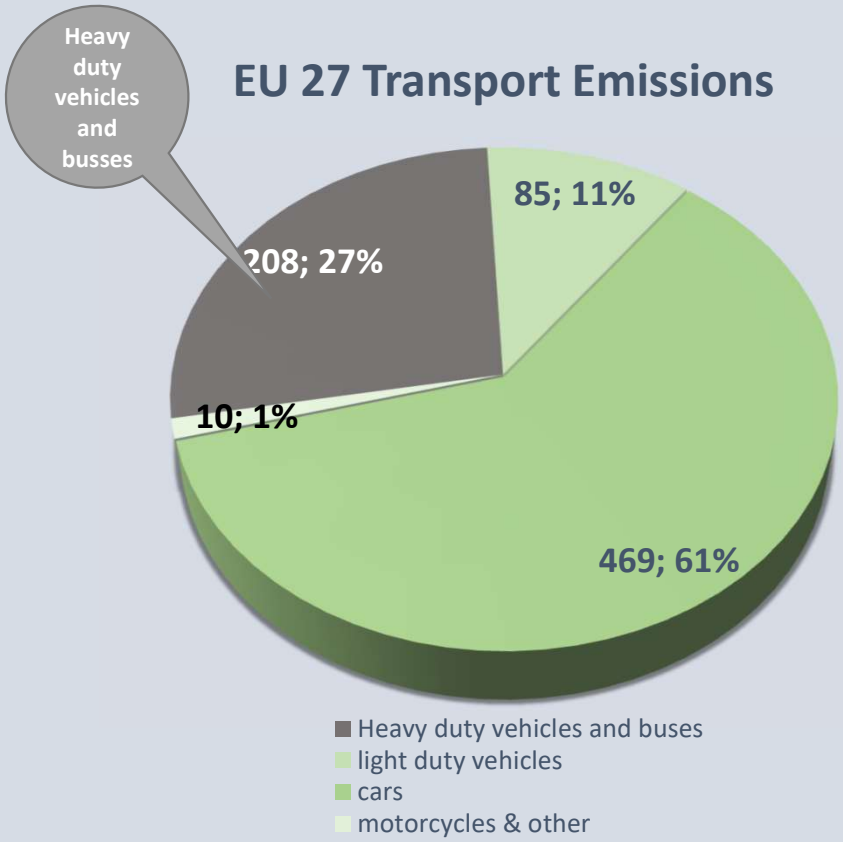
- From a regulatory perspective, C&S is not more complex than current regulation on
  - CO2 standards for cars
  - Fuel Quality Directive
- Main difference is that consumers are directly involved, as they represent the regulatory target (point of regulation)
  - Main challenge for national regulators: design of national allocation rules
- However, what they need to understand is simple
  - Driving less, more efficient and cleaner is benefitting them
  - Surrendering CO2
    - After a while, this will be routine; however the awareness and need to change behaviour remains

C&S is just a complex tax system

- Elements that distinguish C&S from a tax system:
  - C&S does not impose a compulsory contribution to the state budget without getting anything in direct return
  - Car holders acquire permission to emit
  - Permission is tradable
  - Market price is determined by supply and demand
- Without these elements, C&S may be perceived as a tax system
- However, such a tax system would:
  - be less effective as a tax system because:
  - There is no guarantee for the environmental outcome
  - social aspects are ignored

Supplementary information

Scope of C&S



Source: eurostat, EEA, accessed on 5 March 2020

Light vehicles below 3.5 tons registered in EU Member States, i.e. passenger cars and light-commercial vehicles (light duty trucks) including motorcycles

Sector	Emissions in MtCO2 2017	%
Total GHG emissions EU 27	**3606**	**100**
Of which Road transport	**773**	**21**
of which included in C&S:	564	73
- cars	469	61
- light duty trucks	85	11
- motorcycles	10	1,3
Not included in C&S:	208	27
- heavy duty trucks and buses	208	27

Scope of C&S

Individual Carbon Budget

- The individual carbon budget of each car holder (driver) is established during the transition period
- It is based on the annual fuel consumption of an individual car holder (driver), but is not necessarily identical to it
  - If transition period runs over more than one year, it may be based on the average of several years
  - The latest annual fuel consumption could be taken
  - Transport in countries without transition period/C&S need to be taken into account (sweeping approach)
  - Details determined by competent authorities
- The individual carbon budget declines like the trajectory of the overall cap and is subject to national allocation rules

Indicative example: Individual carbon budget

Car holder (driver)	annual mileage in transition period per car	average con-sumption per 100 km in litre	fuel	CO2 emissions per litre in tCO2	total annual emissions in tCO2 = individual carbon budget
1	25795	15	diesel	0,00264	10,215
2	12556	11	diesel	0,00264	3,646
3	41203	10	petrol	0,00233	9,600
4	19564	9	petrol	0,00233	4,103
5	9952	8	petrol	0,00233	1,855
				total	**29,419**

Total cap: sum of individual caps; here: 29,419 tCO2

Environmental Adjustment Factor (EAF) - Principles

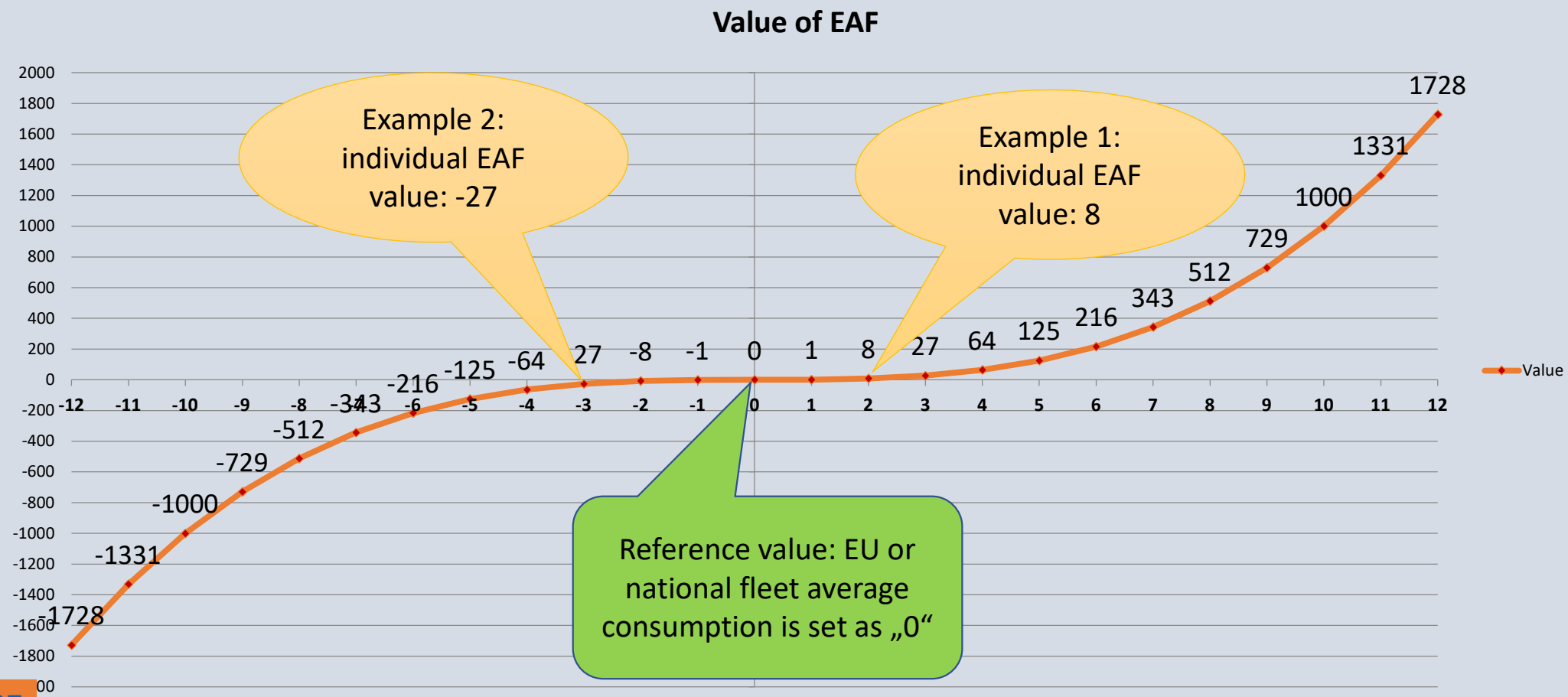
- Based on individual driving behaviour in combination with fuel consumption of internal combustion engine: consuming less than a certain value (reference value) per 100 km makes purchase of RTA cheaper, more consumption more expensive.
- Provides economic incentives to individuals for
  - More efficient driving behaviour (driving less and more efficiently)
  - Modal shift and alternative mobility (public transport, bicycle etc)
  - Increasing demand for ZEVs: no CO2 costs
- EAF is only applied when purchasing new (parts of) RTA

Environmental Adjustment Factor: Determination

- Determination:
  - Reference value: nation-wide (EU-wide) fleet average consumption per 100 km
  - Individual EAF value: deviation of each vehicle from reference value
  - Resulting difference is assigned the corresponding value “y” of the equation f(y) = x^3

Column	Inputs	(1) l/100 km	(2) l/100 km
1	Reference value (average fuel consumption of nation-wide or European fleet)	8	8
2	Individual fuel consumption	10	5
3	Difference reference value (row 1) and individual fuel consumption (row 2)	10 – 8 = 2	5 – 8 = -3
4	Individual EAF value	f(y) = x^3=2^3 = 8	f(y) = -x^3 = -3^3 = -27

Example: individual EAF value



Next page

Effect from EAF on RTA purchasing price

- Different individual fuel consumption results in different deviation from reference value
- Deviation represents basis to determine individual EAF value
- iEAF determines effect from EAF on purchasing price of RTA in form of top-up to RTA market price
- In reality, total RTA price made up of market price and iEAF effect
- Specific provision in case of negative prices needed

Input 1	Input 2	[A] - [B]	[C]^3	[D]
[A]	**[B]**	**[C]**	**[D]**	**[E]**
individual consumpt per 100 km	**Reference value (average consumption of EU or MS)**	**Deviation from reference value**	**individual EAF value**	**effect from EAF on purchasing price of RTA in €**
5	8	-3	-27	-27
6	8	-2	-8	-8
7	8	-1	-1	-1
8	8	0	0	0
9	8	1	1	1
10	8	2	8	8
11	8	3	27	27
12	8	4	64	64
13	8	5	125	125
14	8	6	216	216
15	8	7	343	343
16	8	8	512	512
17	8	9	729	729
18	8	10	1000	1000
19	8	11	1331	1331

Example EAF: driving more, paying less

	Input	Input2	[A]/100*[B]	Input 3	[B]-[D]	[E]^3	[A]/100*[B]* 0,00233	Input 4	[F]+[G]	input 5	input 6	[H]+[M]
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[M]
	mileage per year in km	individual consumpt per 100 km	annual fuel consumption	Reference value	Deviation from reference value	EAF value	CO2 emissions in tCO2 in case of petrol	assumed RTA market price	total RTA market price / difference to today	fuel price/litre	total fuel costs	total fuel costs including CO2 costs
1	10000	10	1000	8	2	8	2,33	10	41,94	1,50	1.500,00	**1541,94**
2	20000	5	1000	8	-3	-27	2,33	10	-39,61	1,50	1.500,00	**1460,39**
3	10000	15	1500	8	7	343	3,495	10	1.233,74	1,50	2.250,00	**3483,74**
4	20000	5	1000	8	-3	-27	2,33	10	-39,61	1,50	1.500,00	**1460,39**
5	40000	5	2000	8	-3	-27	4,66	10	-79,22	1,50	3.000,00	**2920,78**

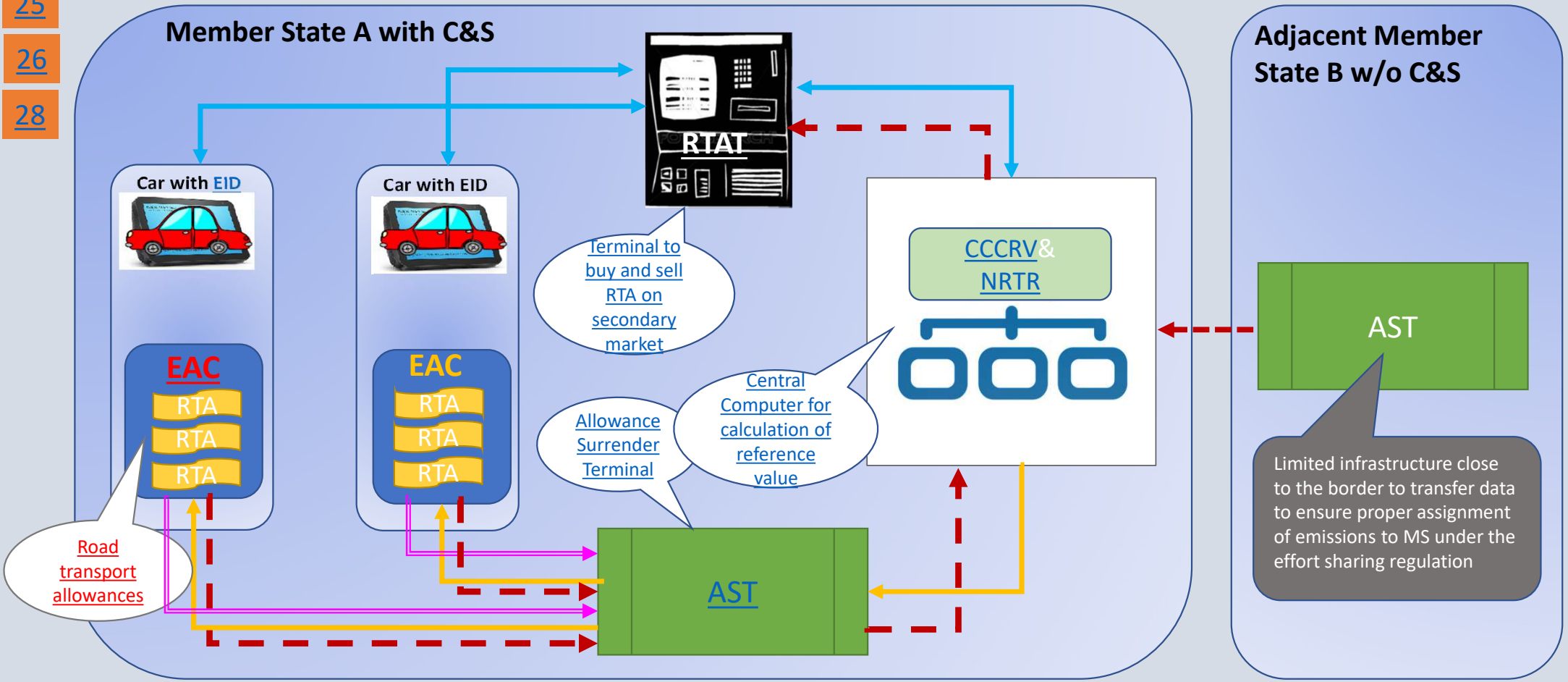
- Individual consumption decisive for EAF effect
- Negative EAF value reduces fuel costs, allows more fuel efficient cars to drive more
  - Compare row 1 and 2, 3 and 4, 3 and 5
  - Example 3 and 5 demonstrate that more fuel efficient car (row 5) can drive four times as much than fuel inefficient car (row 3) and still benefits from EAF (see column M)
- Negative EAF values to be accounted against overall fuel costs

Transition Period

- Definition: 1-3 years before starting cap-and-surrender
- Purpose: collection of essential and necessary data:
  - Fuel consumption of each car
  - Annual basis or sample to extrapolate
  - Reliable data on fuel consumption allows defining allocation rules
  - But *no surrendering*, *no cap*
- Side effect: awareness raising, preparing the public
- Need for infrastructure:
  - Electronic Allowance Card (EAC), Electronic Identification Device (EID) and Allowance Surrendering Terminal (AST)
- All data necessary for reliable cap setting and allocation rules can be established in transition period

21
24
25
26
28

Schematic and indicative outline of infrastructure



Road Transport Allowances (RTA)

NRTR

- One RTA entails the permission to release one tonne CO2
- In reality, RTAs need to be granulated, i.e. slices of 10, 50, 100 or more kg CO2 must be made available
- CO2 account of each car holder indicating the amount (and share) of RTAs in the possession of the car holder is saved on the Electronic Allowance Card (EAC)
- RTAs of one vintage should be valid for 18 months, i.e. could be used or sold 18 months after issuing by the competent authorities.
  - In case of selling on secondary market, this period may be prolonged
- Issuance of RTAs each year on 1st working day of the year
- At first filling process in the year, RTAs allocation for the respective year is automatically transferred from the competent authorities to the EAC of the car holder, when surrendering CO2 after the filling process

Electronic Allowance Card (EAC)

NRTR

- Each vehicle owner must acquire/hold an electronic allowance card (EAC)
- EAC issued by competent authorities of MS
- EAC contains CO2 account of Road Transport Allowance (RTAs) of the car linked to the EAC by means of the EID
- Following the filling process, EAC is used to surrender (give back) the amount of CO2 that is contained in the fuel filled in the tank of the car
  - Surrendering (giving back) is carried by putting the EAC in the slot of the allowance surrender terminal (AST)
- EAC contains the relevant data, notably
  - CO2 account from which the amount of CO2 is deducted after each filling process
  - fuel consumption per 100 km of the respective car for calculation of reference value
- EAC is also used to buy/sell RTAs via the RTAT on the secondary market
- EAC may look like a credit card

Allowance Surrendering Terminal (AST)

NRTR

- Device at each filling station (mandatory equipment) to
  - surrender (give back) CO2 in the form of (granulated) Road Transport Allowances (RTA) saved on the Electronic Allowance Card (EAC)
  - amend the CO2 account on the Electronic Allowance Card (EAC) (free allocation on primary market)
  - Transferring data to the Central Computer for Calculation of Reference Value/National Road Transport Registry CCCRV/NRTR for calculation of reference value
    - Collecting data on fuel consumption per 100 km
- AST and Road Transport Allowance Terminal (RTAT) could be integrated into one device

Electronic Identification Device (EID)

- Each car must be equipped with an electronic device that links the car and the EAC of the car in an indissolubly manner
- This is the decisive instrument to ensure the incentives arrive at the right target (holder or driver of car) and prevent fraud (not to use an EAC linked to a small car for surrendering CO2 from a large car)
  - CO2 account on a specific EAC is assigned to a specific car and its holder
    - This car holder bears responsibility and liability for the fuel consumption of his car, irrespective of who is actually driving the car (other family member, friend etc)
    - In the case of company cars or where the principal car driver is not the holder of the car, specific rules can be defined to made the principal car driver liable for the fuel consumption of the car
- There might be different technologies available to prevent fraud and ensure the right EAC is used for surrendering, e.g. optical car identification
  - Optical car identification (see péage in France) might abandon the need to equip cars with EIDs

CCCRV

Road Transport Allowance Terminal (RTAT)

- RTAT are used to buy (secondary and primary market) and sell (secondary market) RTAs
- Linked to national NRTR to apply the EAF in the event of RTA purchase
- AST and RTAT could be very well integrated into one device

Central Computer for Calculation of Reference Values (CCCRV)

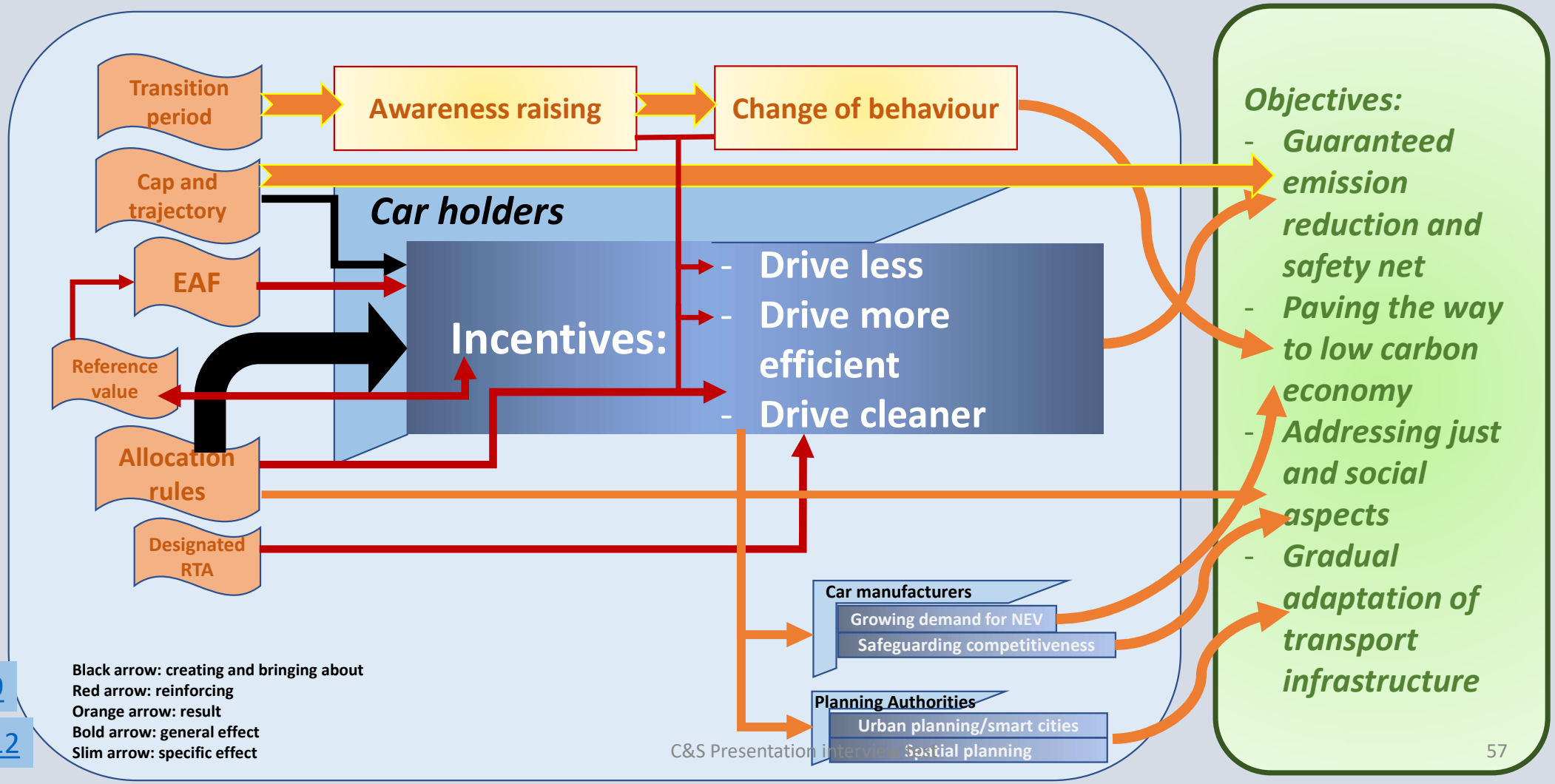
- The iEAF needs to rely on a reference value to be determined.
- The reference value could be the EU or MS wide average fleet consumption (fuel per 100 km) that can be calculated at almost real time by using the actual data of all filling processes carried out within the scope of the reference value.
- The data need to be processed by a computer that
  - collects and processes the relevant data and
  - communicates the appropriate result/reference value to the Road Transport Allowance Terminal (RTAT)
- This is the core task of the CCCRV
- In addition, it could be linked to the National Road Transport Registry (NRTR), where appropriate (not compulsory)

National Road Transport Registries (NRTR)

CCCRV

- Road Transport Allowances under C&S system to be accounted for in the ESR targets of MS
- Allocation from EU registry to NRTR
  - One Road Transport Allowance (RTA) account per Member State applying C&S at EU level (Union Registry) containing the total number of Road Transport Allowance (RTA) allocated to the MS
  - For accounting purposes with Effort Sharing Regulation
- NRTR carries out issuance of Road Transport Allowance (RTA) to Electronic Allowance Card (EAC) of car holders through Allowance Surrendering Terminal (AST)
- Accounting for primary and secondary market implemented by NRTR
- All transactions implemented at MS level; only issuing of Road Transport Allowance (RTA) to MS accounts at EU level
- However, need for EU-wide connection of all NRTR to allow communication and accounting of vehicle owner of MS A filling his tank in MS B (tank tourism).

Cap and Surrender – Overview of effects and incentives



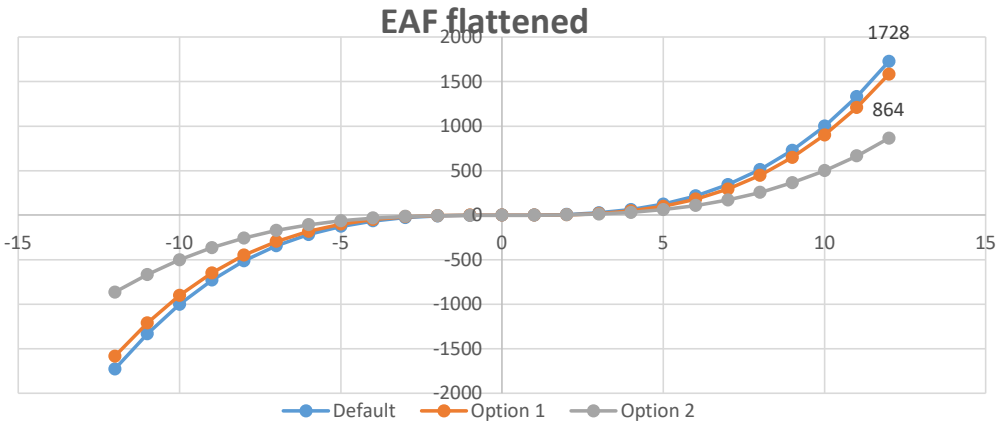
Black arrow: creating and bringing about
Red arrow: reinforcing
Orange arrow: result
Bold arrow: general effect
Slim arrow: specific effect

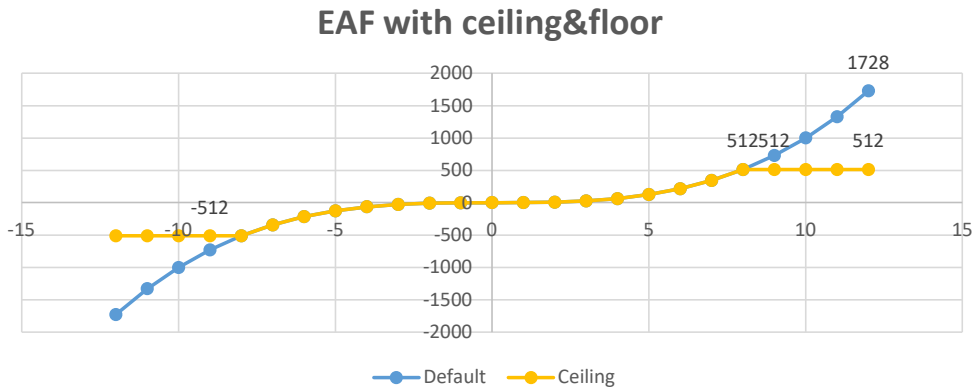
9
12

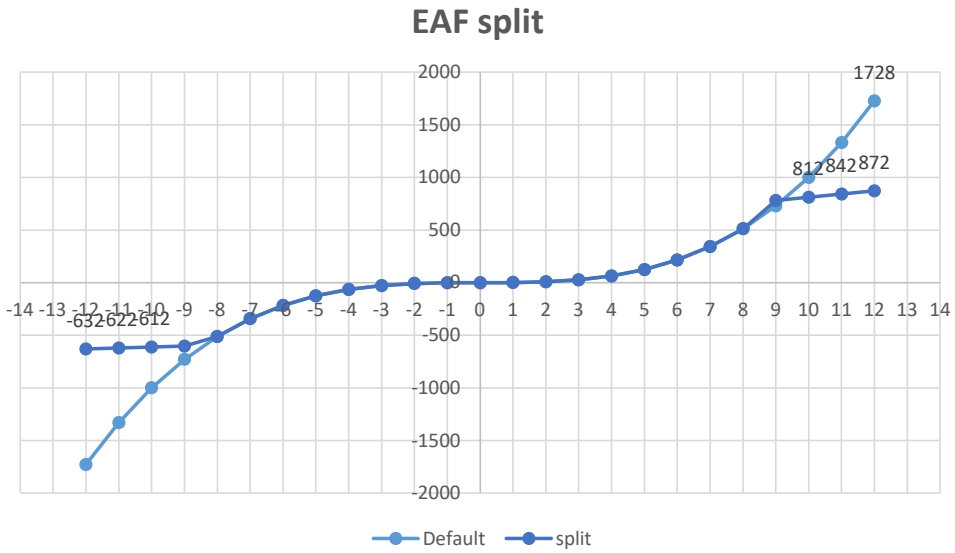
National Allocation Rules

- Not subject to competition rules, therefore no state aid
- However: allocation criteria have to be objective and non-discriminatory
  - Non-discrimination means treating equal things equally, treating unequal things unequally
- Examples refer to first year of implementation period, i.e. after transition period
  - Cap trajectory over several years is not indicated
  - Examples are indicative and can be varied
  - They are for demonstration only

Variations of EAF: flattened, ceiling&floor, EAF split







Cap constraint and declining FA: Cap 1; FA 100%

Input	input	input	input	[A]/100*[B]*[D]	input	[H]*[I]	input	[J]*[K]	
[A]	[B]	[C]	[D]	[H]	[I]	[J]	[K]	[L]	[M]
annual mileage in year 1	average con-sumption per 100 km in litre	fuel	CO2 emissions per litre in tCO2	total annual emissions in tCO2 = individual cap	constraint by cap	available for allocation	free allocation share	free allocation	mileage to compen-sate
20.000	15	diesel	0,00264	7,920	1	7,920	100%	7,920	0
20.000	12	diesel	0,00264	6,336	1	6,336	100%	6,336	0
20.000	9	petrol	0,00233	4,194	1	4,194	100%	4,194	0
20.000	7	petrol	0,00233	3,262	1	3,262	100%	3,262	0
20.000	5	petrol	0,00233	2,330	1	2,330	100%	2,330	0
100.000			**total**	**24,042**		**24,042**		**24,042**	**0**

Cap constraint and declining FA: Cap 0,9; FA 100%

Input	input	input	input	[A]/100*[B]*[D]	input	[H]*[I]	input	[J]*[K]	
[A]	[B]	[C]	[D]	[H]	[I]	[J]	[K]	[L]	[M]
annual mileage in year 1	average con-sumption per 100 km in litre	fuel	CO2 emissions per litre in tCO2	total annual emissions in tCO2 = individual cap	constraint by cap	available for allocation	free allocation share	free allocation	mileage to compen-sate
20.000	15	diesel	0,00264	7,920	0,9	7,128	100%	7,128	2.000
20.000	12	diesel	0,00264	6,336	0,9	5,702	100%	5,702	2.000
20.000	9	petrol	0,00233	4,194	0,9	3,775	100%	3,775	2.000
20.000	7	petrol	0,00233	3,262	0,9	2,936	100%	2,936	2.000
20.000	5	petrol	0,00233	2,330	0,9	2,097	100%	2,097	2.000
100.000			**total**	**24,042**		**21,638**		**21,638**	**10.000**

Cap constraint and declining FA: Cap 0,9; FA 90%

Input	input	input	input	[A]/100*[B]*[D]	input	[H]*[I]	input	[J]*[K]	[J]-[L]
[A]	[B]	[C]	[D]	[H]	[I]	[J]	[K]	[L]	[M]
annual mileage in year 1	average con-sumption per 100 km in litre	fuel	CO2 emissions per litre in tCO2	annual emissions in tCO2 = individual cap = starting point	constraint by cap	available for allocation	free allocation share	free allocation	to buy on primary market
20.000	15	diesel	0,00264	7,920	0,9	7,128	90%	6,415	0,713
20.000	12	diesel	0,00264	6,336	0,9	5,702	90%	5,132	0,570
20.000	9	petrol	0,00233	4,194	0,9	3,775	90%	3,397	0,377
20.000	7	petrol	0,00233	3,262	0,9	2,936	90%	2,642	0,294
20.000	5	petrol	0,00233	2,330	0,9	2,097	90%	1,887	0,210
100.000			**total**	**24,042**		**21,638**		**19,474**	**2,164**

Example: different mileage and consumption
Cap constraint: 1
100% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel con-sump-tion in l	total fuel cost w/o CO2	cap con-strain t	avail-able for allo-cation in tCO2	free allo-cation share	free allo-cation	to buy on primary market	RTA mar-ket price	Assume d deviati on from referen ce value	iEAF value	RTA price (€/tCO 2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	1	2,640	100%	2,64	0,00	15	-3	-27	-12	**0,00**	1500,00	**0,00**
2	20000	7	0,00264	3,696	1,5	1400	2100	1	3,696	100%	3,696	0,00	15	-1	-1	14	**0,00**	2100,00	**0,00**
3	20000	9	0,00264	4,752	1,5	1800	2700	1	4,752	100%	4,752	0,00	15	1	1	16	**0,00**	2700,00	**0,00**
4	20000	12	0,00264	6,336	1,5	2400	3600	1	6,336	100%	6,336	0,00	15	4	64	79	**0,00**	3600,00	**0,00**
5	30000	5	0,00264	3,960	1,5	1500	2250	1	3,960	100%	3,96	0,00	15	-3	-27	-12	**0,00**	2250,00	**0,00**
6	30000	7	0,00264	5,544	1,5	2100	3150	1	5,544	100%	5,544	0,00	15	-1	-1	14	**0,00**	3150,00	**0,00**
7	30000	9	0,00264	7,128	1,5	2700	4050	1	7,128	100%	7,128	0,00	15	1	1	16	**0,00**	4050,00	**0,00**
8	30000	12	0,00264	9,504	1,5	3600	5400	1	9,504	100%	9,504	0,00	15	4	64	79	**0,00**	5400,00	**0,00**
9	40000	7	0,00264	7,392	1,5	2800	4200	1	7,392	100%	7,392	0,00	15	-1	-1	14	**0,00**	4200,00	**0,00**
10	40000	9	0,00264	9,504	1,5	3600	5400	1	9,504	100%	9,504	0,00	15	1	1	16	**0,00**	5400,00	**0,00**
11	40000	12	0,00264	12,672	1,5	4800	7200	1	12,672	100%	12,672	0,00	15	4	64	79	**0,00**	7200,00	**0,00**
12	50000	7	0,00264	9,240	1,5	3500	5250	1	9,240	100%	9,24	0,00	15	-1	-1	14	**0,00**	5250,00	**0,00**
13	50000	9	0,00264	11,880	1,5	4500	6750	1	11,880	100%	11,88	0,00	15	1	1	16	**0,00**	6750,00	**0,00**
14	50000	12	0,00264	15,840	1,5	6000	9000	1	15,840	100%	15,84	0,00	15	4	64	79	**0,00**	9000,00	**0,00**

Example: different mileage and consumption
Cap constraint: 0,9
100% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel con-sump-tion in l	total fuel cost w/o CO2	cap con-strain t	avail-able for allo-cation in tCO2	free allo-cation share	free allo-cation	to buy on primary market	RTA mar-ket price	Assume d deviati on from referen ce value	iEAF value	RTA price (€/tCO 2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	0,9	2,376	100%	2,376	0,00	15	-3	-27	-12	**0,00**	1500,00	**0,26**
2	20000	7	0,00264	3,696	1,5	1400	2100	0,9	3,326	100%	3,3264	0,00	15	-1	-1	14	**0,00**	2100,00	**0,37**
3	20000	9	0,00264	4,752	1,5	1800	2700	0,9	4,277	100%	4,2768	0,00	15	1	1	16	**0,00**	2700,00	**0,48**
4	20000	12	0,00264	6,336	1,5	2400	3600	0,9	5,702	100%	5,7024	0,00	15	4	64	79	**0,00**	3600,00	**0,63**
5	30000	5	0,00264	3,960	1,5	1500	2250	0,9	3,564	100%	3,564	0,00	15	-3	-27	-12	**0,00**	2250,00	**0,40**
6	30000	7	0,00264	5,544	1,5	2100	3150	0,9	4,990	100%	4,9896	0,00	15	-1	-1	14	**0,00**	3150,00	**0,55**
7	30000	9	0,00264	7,128	1,5	2700	4050	0,9	6,415	100%	6,4152	0,00	15	1	1	16	**0,00**	4050,00	**0,71**
8	30000	12	0,00264	9,504	1,5	3600	5400	0,9	8,554	100%	8,5536	0,00	15	4	64	79	**0,00**	5400,00	**0,95**
9	40000	7	0,00264	7,392	1,5	2800	4200	0,9	6,653	100%	6,6528	0,00	15	-1	-1	14	**0,00**	4200,00	**0,74**
10	40000	9	0,00264	9,504	1,5	3600	5400	0,9	8,554	100%	8,5536	0,00	15	1	1	16	**0,00**	5400,00	**0,95**
11	40000	12	0,00264	12,672	1,5	4800	7200	0,9	11,405	100%	11,4048	0,00	15	4	64	79	**0,00**	7200,00	**1,27**
12	50000	7	0,00264	9,240	1,5	3500	5250	0,9	8,316	100%	8,316	0,00	15	-1	-1	14	**0,00**	5250,00	**0,92**
13	50000	9	0,00264	11,880	1,5	4500	6750	0,9	10,692	100%	10,692	0,00	15	1	1	16	**0,00**	6750,00	**1,19**
14	50000	12	0,00264	15,840	1,5	6000	9000	0,9	14,256	100%	14,256	0,00	15	4	64	79	**0,00**	9000,00	**1,58**

Example: different mileage and consumption
Cap constraint: 1
50% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel con-sump-tion in l	total fuel cost w/o CO2	cap con-strain t	avail-able for allo-cation in tCO2	free allo-cation share	free allo-cation	to buy on primary market	RTA mar-ket price	Assume d deviati on from referen ce value	iEAF value	RTA price (€/tCO 2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	1	2,640	50%	1,32	1,32	15	-3	-27	-12	**-15,84**	1484,16	**0,00**
2	20000	7	0,00264	3,696	1,5	1400	2100	1	3,696	50%	1,848	1,85	15	-1	-1	14	**25,87**	2125,87	**0,00**
3	20000	9	0,00264	4,752	1,5	1800	2700	1	4,752	50%	2,376	2,38	15	1	1	16	**38,02**	2738,02	**0,00**
4	20000	12	0,00264	6,336	1,5	2400	3600	1	6,336	50%	3,168	3,17	15	4	64	79	**250,27**	3850,27	**0,00**
5	30000	5	0,00264	3,960	1,5	1500	2250	1	3,960	50%	1,98	1,98	15	-3	-27	-12	**-23,76**	2226,24	**0,00**
6	30000	7	0,00264	5,544	1,5	2100	3150	1	5,544	50%	2,772	2,77	15	-1	-1	14	**38,81**	3188,81	**0,00**
7	30000	9	0,00264	7,128	1,5	2700	4050	1	7,128	50%	3,564	3,56	15	1	1	16	**57,02**	4107,02	**0,00**
8	30000	12	0,00264	9,504	1,5	3600	5400	1	9,504	50%	4,752	4,75	15	4	64	79	**375,41**	5775,41	**0,00**
9	40000	7	0,00264	7,392	1,5	2800	4200	1	7,392	50%	3,696	3,70	15	-1	-1	14	**51,74**	4251,74	**0,00**
10	40000	9	0,00264	9,504	1,5	3600	5400	1	9,504	50%	4,752	4,75	15	1	1	16	**76,03**	5476,03	**0,00**
11	40000	12	0,00264	12,672	1,5	4800	7200	1	12,672	50%	6,336	6,34	15	4	64	79	**500,54**	7700,54	**0,00**
12	50000	7	0,00264	9,240	1,5	3500	5250	1	9,240	50%	4,62	4,62	15	-1	-1	14	**64,68**	5314,68	**0,00**
13	50000	9	0,00264	11,880	1,5	4500	6750	1	11,880	50%	5,94	5,94	15	1	1	16	**95,04**	6845,04	**0,00**
14	50000	12	0,00264	15,840	1,5	6000	9000	1	15,840	50%	7,92	7,92	15	4	64	79	**625,68**	9625,68	**0,00**

Example: different mileage and consumption
Cap constraint: 0,9
50% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel con-sump-tion in l	total fuel cost w/o CO2	cap con-strain t	avail-able for allo-cation in tCO2	free allo-cation share	free allo-cation	to buy on primary market	RTA mar-ket price	Assume d deviati on from referen ce value	iEAF value	RTA price (€/tCO 2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	0,9	2,376	50%	1,188	1,19	15	-3	-27	-12	**-14,26**	1485,74	**0,26**
2	20000	7	0,00264	3,696	1,5	1400	2100	0,9	3,326	50%	1,6632	1,66	15	-1	-1	14	**23,28**	2123,28	**0,37**
3	20000	9	0,00264	4,752	1,5	1800	2700	0,9	4,277	50%	2,1384	2,14	15	1	1	16	**34,21**	2734,21	**0,48**
4	20000	12	0,00264	6,336	1,5	2400	3600	0,9	5,702	50%	2,8512	2,85	15	4	64	79	**225,24**	3825,24	**0,63**
5	30000	5	0,00264	3,960	1,5	1500	2250	0,9	3,564	50%	1,782	1,78	15	-3	-27	-12	**-21,38**	2228,62	**0,40**
6	30000	7	0,00264	5,544	1,5	2100	3150	0,9	4,990	50%	2,4948	2,49	15	-1	-1	14	**34,93**	3184,93	**0,55**
7	30000	9	0,00264	7,128	1,5	2700	4050	0,9	6,415	50%	3,2076	3,21	15	1	1	16	**51,32**	4101,32	**0,71**
8	30000	12	0,00264	9,504	1,5	3600	5400	0,9	8,554	50%	4,2768	4,28	15	4	64	79	**337,87**	5737,87	**0,95**
9	40000	7	0,00264	7,392	1,5	2800	4200	0,9	6,653	50%	3,3264	3,33	15	-1	-1	14	**46,57**	4246,57	**0,74**
10	40000	9	0,00264	9,504	1,5	3600	5400	0,9	8,554	50%	4,2768	4,28	15	1	1	16	**68,43**	5468,43	**0,95**
11	40000	12	0,00264	12,672	1,5	4800	7200	0,9	11,405	50%	5,7024	5,70	15	4	64	79	**450,49**	7650,49	**1,27**
12	50000	7	0,00264	9,240	1,5	3500	5250	0,9	8,316	50%	4,158	4,16	15	-1	-1	14	**58,21**	5308,21	**0,92**
13	50000	9	0,00264	11,880	1,5	4500	6750	0,9	10,692	50%	5,346	5,35	15	1	1	16	**85,54**	6835,54	**1,19**
14	50000	12	0,00264	15,840	1,5	6000	9000	0,9	14,256	50%	7,128	7,13	15	4	64	79	**563,11**	9563,11	**1,58**

Example: different mileage and consumption
Cap constraint: 1
0% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel consumption in l	total fuel cost w/o CO2	cap constraint	available for allocation in tCO2	free allocation share	free allocation	to buy on primary market	RTA market price	Assumed deviation from reference value	iEAF value	RTA price (€/tCO2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	1	2,640	0%	0	2,64	15	-3	-27	-12	**-31,68**	1468,32	**0,00**
2	20000	7	0,00264	3,696	1,5	1400	2100	1	3,696	0%	0	3,70	15	-1	-1	14	**51,74**	2151,74	**0,00**
3	20000	9	0,00264	4,752	1,5	1800	2700	1	4,752	0%	0	4,75	15	1	1	16	**76,03**	2776,03	**0,00**
4	20000	12	0,00264	6,336	1,5	2400	3600	1	6,336	0%	0	6,34	15	4	64	79	**500,54**	4100,54	**0,00**
5	30000	5	0,00264	3,960	1,5	1500	2250	1	3,960	0%	0	3,96	15	-3	-27	-12	**-47,52**	2202,48	**0,00**
6	30000	7	0,00264	5,544	1,5	2100	3150	1	5,544	0%	0	5,54	15	-1	-1	14	**77,62**	3227,62	**0,00**
7	30000	9	0,00264	7,128	1,5	2700	4050	1	7,128	0%	0	7,13	15	1	1	16	**114,05**	4164,05	**0,00**
8	30000	12	0,00264	9,504	1,5	3600	5400	1	9,504	0%	0	9,50	15	4	64	79	**750,82**	6150,82	**0,00**
9	40000	7	0,00264	7,392	1,5	2800	4200	1	7,392	0%	0	7,39	15	-1	-1	14	**103,49**	4303,49	**0,00**
10	40000	9	0,00264	9,504	1,5	3600	5400	1	9,504	0%	0	9,50	15	1	1	16	**152,06**	5552,06	**0,00**
11	40000	12	0,00264	12,672	1,5	4800	7200	1	12,672	0%	0	12,67	15	4	64	79	**1.001,09**	8201,09	**0,00**
12	50000	7	0,00264	9,240	1,5	3500	5250	1	9,240	0%	0	9,24	15	-1	-1	14	**129,36**	5379,36	**0,00**
13	50000	9	0,00264	11,880	1,5	4500	6750	1	11,880	0%	0	11,88	15	1	1	16	**190,08**	6940,08	**0,00**
14	50000	12	0,00264	15,840	1,5	6000	9000	1	15,840	0%	0	15,84	15	4	64	79	**1.251,36**	10251,36	**0,00**

Example: different mileage and consumption
Cap constraint: 0,9
0% free allocation

	mileage per year in km	ICE consumption per 100 km in l	carbon content per litre	transition period emissions in tCO2 = individual cap = starting point	price of fuel per l	total fuel con-sump-tion in l	total fuel cost w/o CO2	cap con-strain t	avail-able for allo-cation in tCO2	free allo-cation share	free allo-cation	to buy on primary market	RTA mar-ket price	Assume d deviati on from referen ce value	iEAF value	RTA price (€/tCO 2)	total CO2 costs	total fuel costs including CO2	emission reduction by cap in tCO2 compared to starting point
1	20000	5	0,00264	2,640	1,5	1000	1500	0,9	2,376	0%	0	2,38	15	-3	-27	-12	**-28,51**	1471,49	**0,26**
2	20000	7	0,00264	3,696	1,5	1400	2100	0,9	3,326	0%	0	3,33	15	-1	-1	14	**46,57**	2146,57	**0,37**
3	20000	9	0,00264	4,752	1,5	1800	2700	0,9	4,277	0%	0	4,28	15	1	1	16	**68,43**	2768,43	**0,48**
4	20000	12	0,00264	6,336	1,5	2400	3600	0,9	5,702	0%	0	5,70	15	4	64	79	**450,49**	4050,49	**0,63**
5	30000	5	0,00264	3,960	1,5	1500	2250	0,9	3,564	0%	0	3,56	15	-3	-27	-12	**-42,77**	2207,23	**0,40**
6	30000	7	0,00264	5,544	1,5	2100	3150	0,9	4,990	0%	0	4,99	15	-1	-1	14	**69,85**	3219,85	**0,55**
7	30000	9	0,00264	7,128	1,5	2700	4050	0,9	6,415	0%	0	6,42	15	1	1	16	**102,64**	4152,64	**0,71**
8	30000	12	0,00264	9,504	1,5	3600	5400	0,9	8,554	0%	0	8,55	15	4	64	79	**675,73**	6075,73	**0,95**
9	40000	7	0,00264	7,392	1,5	2800	4200	0,9	6,653	0%	0	6,65	15	-1	-1	14	**93,14**	4293,14	**0,74**
10	40000	9	0,00264	9,504	1,5	3600	5400	0,9	8,554	0%	0	8,55	15	1	1	16	**136,86**	5536,86	**0,95**
11	40000	12	0,00264	12,672	1,5	4800	7200	0,9	11,405	0%	0	11,40	15	4	64	79	**900,98**	8100,98	**1,27**
12	50000	7	0,00264	9,240	1,5	3500	5250	0,9	8,316	0%	0	8,32	15	-1	-1	14	**116,42**	5366,42	**0,92**
13	50000	9	0,00264	11,880	1,5	4500	6750	0,9	10,692	0%	0	10,69	15	1	1	16	**171,07**	6921,07	**1,19**
14	50000	12	0,00264	15,840	1,5	6000	9000	0,9	14,256	0%	0	14,26	15	4	64	79	**1.126,22**	10126,22	**1,58**