LIFE COASE

EU Carbon market indicators - Technical note

Context

Following a Technical workshop on EU ETS Carbon Market Indicators held on 2 January 2025, we propose six indicators to track the evolution of the EU ETS permit transfers. Focusing on the publicly available Union Registry data, the aim of the indicators is to detect structural changes within the EU ETS. Structural change can either refer to architectural changes in the system due to administrative/regulatory changes (eg, most of the power sector stopped receiving free allocation in 2013). It can also refer to changes in firm behaviour (eg, the reduction of OTC trading and the increase in intermediated exchanges, which we observed starting 2013). The objective of the indicators is also to provide insights into the entities regulated and/or actively trading in the EU ETS. [1] The R code used to estimate the indicators is available upon request.

1. *Net Entries (NE)*

This indicator reveals the net number of installations entering the system every year. The purpose of this indicator is to track changes in regulation coverage.

Data source: EU Emissions Trading System installations entries and exits (https://cadmus.eui.eu/handle/1814/77336;jsessionid=C9C0D1AC456C6965CAF88445C412790C)

Definition: The indicator is estimated yearly as follows:

$$NE_t = \text{Total entries}_t - \text{Total exits}_t$$

With NE_t, net entries for year t;
Total entries_t, the total count of installations entering in year t;
Total exits_t, the total count of installations exiting in year t.

Data manipulation: we reshape the data to estimate the total count of installation entries and exits per year.

[1] We thank Julien Mazzacurati, Simon Quemin, and Estelle Cantillion for presenting their work. We are also grateful for their and the workshop participants' input in orienting our work. More information on the workshop can be found here. We also thank Jan Abrell for his helpful discussion and comments on an early version of this document.

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2. Net free allowances (NFA)

NFA indicates the excess free allowances installations received every year. The aim is to show how much free allowances meet each installation's compliance needs.

Data source: European Union Transaction Log data parsed by Jan Abrell (https://www.euets.info/), which corresponds to EUTL Version: Version: 15.1.3EUTLP03-10-2024 15:42. Specifically, the Excel sheet "compliance.csv".

Definition: The indicator is estimated yearly as follows:

$$NFA_{i,t} = \text{Total free allowances}_{i,t} - \text{Total verified}_{i,t}$$

With $NFA_{i,t}$, net free allowances for installation i in year t;
$\text{Total free allowances}_{i,t}$, the total volume of free allowances an installation i receives in year t;
$\text{Total verified}_{i,t}$, the total volume of verified allowances by an installation i in year t.

Data manipulation: the estimation of the indicator is straightforward. For all installations in the compliance table, we take the difference between the "allocated Total" and "verified".[2]

3. Financial actors (FA)

FA is the number of account holders in the system who don't have a compliance obligation.[3] This means they are not required to participate in the system but choose to trade permits in EU Carbon Markets.

Data source: *EUTL*: European Union Transaction Log data parsed by Jan Abrell (https://www.euets.info/), which corresponds to EUTL Version: Version: 15.1.3EUTLP03-10-2024 15:42. Specifically, the Excel sheets "account.csv", "account_holder.csv", and "transactions.csv".

Definition: The indicator is defined yearly as follows:

$$FA_t = \text{Total count of active financial account holders}_t$$

Data manipulation:

1. Flag financial accounts and account holders.

From the list of accounts in "account.csv", we flag the accounts that don't have a compliance obligation. To flag them, we create an account type variable, which is a categorical variable of levels "OHA", "PHA" and "AA", following Abrell's methodology. We are only interested in the "PHA", Person Holding Accounts, as they correspond to the financial accounts (account_type == "100-8" |

[2] We notice that allocatedTotal is the sum of "allocatedFree", "allocatedNewEntrance" and "allocated10c", except for 224 cases of installations reported as esd in the system.
[3] Actors in the EU ETS can be broadly grouped into compliance entities and financial actors (Cludius et al., 2022). The financial actors could also be referred to as non-compliance actors.

account_type == “100-12” | account_type == “121-0”).[4] We flag 10 444 financial accounts (23% of all the accounts).

Grouping the accounts at the account holder level brings us closer to the firm level. Account Holders are the primary contacts of an account. Multiple accounts can have the same Account Holders, indicating that the accounts are part of the same entity.
To create a holder type variable, we merge “account.csv” and “account_holder.csv” using the id of the account holder as the key variable.[5] We then group the data at the account holder level (grouping by accountholder_id and keeping account_type).
For each account holder, we define the holder type as follows:

- If all its accounts are the same account_type, then holder_type = account_type;
- Otherwise:
    - If one account_type is “AA”, then holder_type = “AA”;
    - If one account_type is “OHA”, then holder_type = “OHA”.

We flag 6 191 financial account holders (30% of all the account holders).

2. Create list of active account holder per year

From financial account holders, we only want to consider those active in a given year. Activity is observed by looking at transactions. Transactions in the EUTL are recorded at the account level. We assume an account holder is active for a given year if one of its accounts records at least one transaction during that year.

For this step, we rely on the data in “transaction.csv”. The relevant variables for us are the acquiring account (acquiringAccount_id), the transferring account (transferringAccount_id), and the date (date). We group the data at the year level and create a list of accounts that record a transfer in and/or a transfer out. We then group the list at the account holder level to make a list of unique account holders active yearly.

3. Flag active financial accounts

Based on the list of active account holders created in step 2, we only keep the financial account holders. We flag them searching for a match with the financial account holder list created in step 1. We are left with a panel of 15 289 rows (12% of all the rows in the original panel, which also contains compliance and administrative account holders).

[4] Table C.2 in the Abrell documentation provides a full list of account types and their description. For 811 accounts, we cannot assign an account type as the information on accountType_id is missing.
[5] The account holder id is missing for 788 accounts.

Note: this indicator only reveals the number of financial account holders and cannot be directly interpreted as the number of financial firms active in the system. Indeed, the same firm may have more than one account holder.[6]

4. Compliance transfer ratio (CTR)

This indicator aims to inform on the share of allowances the holders trade due to compliance activity, free allowance allocation, or allowance surrendering. CTR is estimated yearly at the holder level. This indicator can be interpreted as such:

- CTR = 1, all the transfers recorded are for compliance purposes;
- CTR=0, none of the transfers recorded are for compliance purposes.

Data source: *EUTL*: European Union Transaction Log data parsed by Jan Abrell (https://www.euets.info/), which corresponds to EUTL Version: Version: 15.1.3EUTLP03-10-2024 15:42. Specifically, the Excel sheets "account.csv", "account_holder.csv", and "transactions.csv".

Definition: The indicator is defined as:

$$CTR_{i,t} = \frac{Regulatory\ transfers_{i,t}}{Total\ transfers_{i,t}}$$

With $CTR_{i,t}$, compliance transfer ratio for holder i in year t;
$Regulatory\ transfers_{i,t}$, the total volume of allowance transfers related to compliance for holder i in year t;
$Total\ transfers_{i,t}$, the total volume of transfers recorded for holder i in year t.

Data manipulation:

1. Flag financial accounts and holders.

This is the same as step 1 described above for FA.

2. Flag regulatory transfers

For this step we rely on the "transaction.csv", which tracks all physical transfers of allowances registered in the EU ETS. We group the transactions by "year", "acquiringAccount_id", and "transferringAccount_id". For each seller and buyer, we consolidate with information on the accountholder_id and the holder_type to create a transaction_type categorical variable such as:

- Transaction_type = "Regulatory", if the holder type of the seller or the buyer is "AA".
- Transaction_type = "Other", otherwise.

In total we flag 244 411 rows of transactions that correspond to regulatory transfers (61% of all the rows in the panel of the yearly transactions between holders.[7])

[6] Consolidating the account holders at the firm level by relying on LEI, company registration number, or a match with orbis would provide an overview of the financial firms active in the system.
[7] 5923 rows of transactions are missing a type.

3. Estimate CTR for every holder per year

We group "transaction.csv" at the year level and only keep variables of interest: year, accountholder_id of the buyer and the seller and transaction_type. We create a list of the yearly sellers, with the total volume of permits transferred, distinguishing according to the transaction type. We do the same with buyers. We bind the list of sellers and buyers. We create a list of holders and aggregate the total volume of permits transferred, distinguishing transaction types.[8] We also create a total variable, summing both the volume of regulatory transactions and other transactions. CTR is then estimated for each holder every year. The panel of yearly active holders has 124 517 rows.

Note: We also observe some unexpected values of CTR. Some compliance holders have a CTR of 0, meaning that they do not receive nor transfer any allowances for compliance purposes. The CTR indicator could thus also be used to determine to what extent a holder can be considered as a regulated entity.

5. Total compliance transfer ratio (TCTR)

This indicator aims to inform on the share of permits traded related to compliance activity at the system level. Similarly to the CTR, the TCTR can be interpreted as such:

- TCTR = 1, all the transfers recorded in the system are for compliance purposes.
- TCTR=0, none of the transfers recorded in the system are for compliance purposes.

Data source: *EUTL*: European Union Transaction Log data parsed by Jan Abrell (https://www.euets.info/), which corresponds to EUTL Version: Version: 15.1.3EUTLP03-10-2024 15:42. Specifically, the Excel sheets "account.csv", "account_holder.csv", and "transactions.csv".

Data definition: The indicator is defined as:

$$TCTR_t = \frac{Regulatory\ transfers_t}{Total\ transfers_t}$$

With $TCTR_t$, the total compliance trading ratio in year t;
$Regulatory\ transfers_t$, the total volume of allowances transfers related to compliance in year t;
$Total\ transfers_t$, the total volume of transfers recorded in year t.

Data manipulation: We follow step 1 and 2 described for the CTR indicator. We carry out step 3 as such:

We group "transaction.csv" at the year level and only keep variables of interest: year and transaction_type. We aggregate the total volume of permits transferred, distinguishing transaction

[8] We don't distinguish the direction of the transfer (in vs out).

types for ever year.[9] We also create a total variable, summing both the volume of regulatory transactions and other transactions. TCTR is then estimated for every year.

Appendix

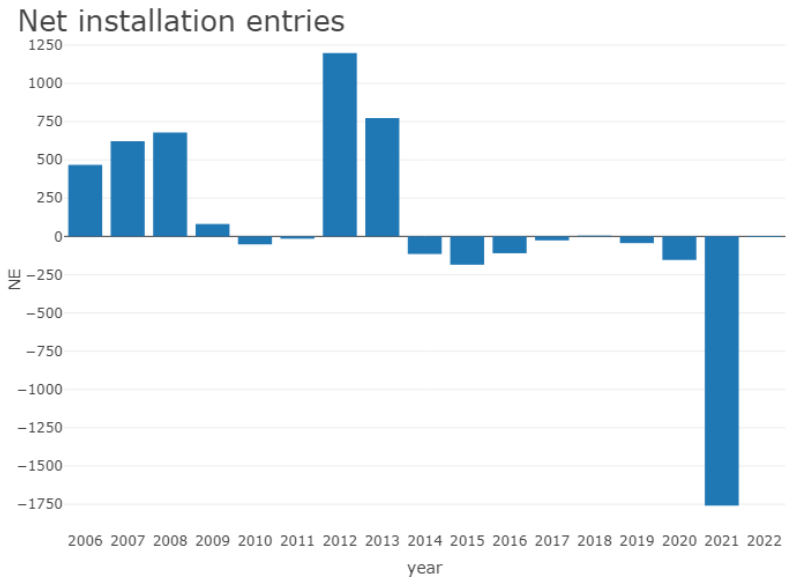
1. Dataset overview

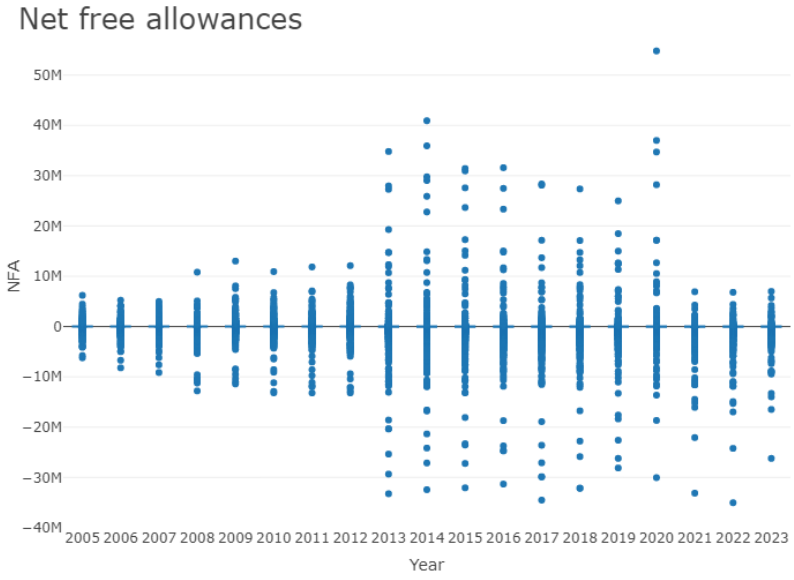
Variable Name	Definition	Database source	Notes
year	Year	-	-
installation_id	Unique installation identifier.	EUETS.INFO	The unique installation identifier as created by Abrell of type "XX_1234" (combination of the registry code and the installation ID defined by the registry ID).
holder_id	Unique account holder identifier.	EUETS.INFO	The unique account holder identifier.
NE	Net entries	*Own Elaboration*	Estimated as described in section 1.
NFA	Net free allowances	*Own Elaboration*	Estimated as described in section 2.
FA	Financial actors	*Own Elaboration*	Estimated as described in section 3.
CTR	Compliance transfer ratio	*Own Elaboration*	Estimated as described in section 4.
TCTR	Total compliance transfer ratio	*Own Elaboration*	Estimated as described in section 5.

Table 1: List and definition of the variables, data sources and notes

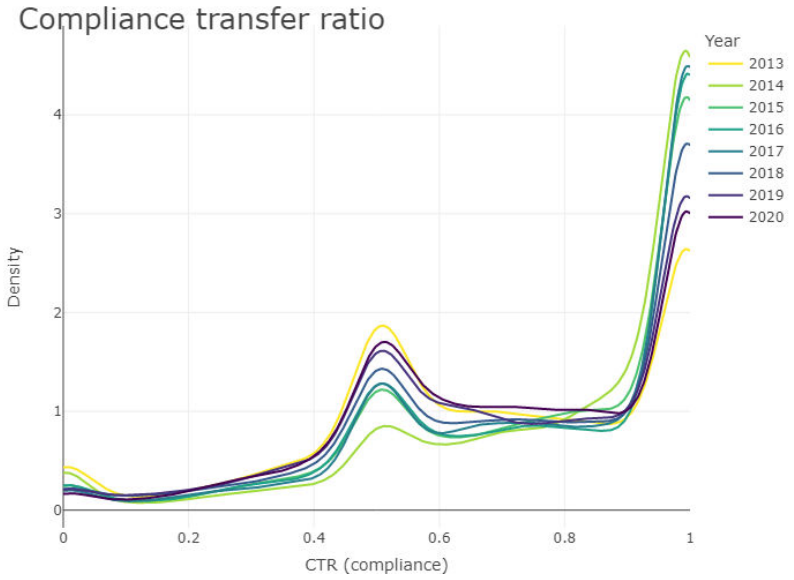
[9] We don't distinguish the direction of the transfer (in vs out).

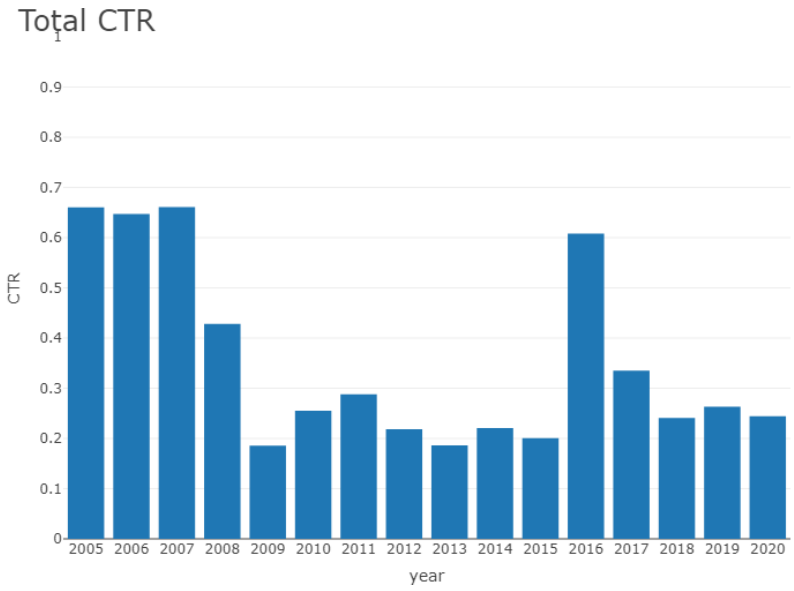
1. Visualisation of the estimated indicators






Financial account holders
FA
year
1400
1200
1000
800
600
400
200
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020


Compliance transfer ratio
Density
CTR (compliance)
Year
2013
2014
2015
2016
2017
2018
2019
2020
0
1
2
3
4
0
0.2
0.4
0.6
0.8
1


Total CTR
CTR
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
year