Initiative for Climate Action Transparency (ICAT):

Improving Thailand's MRV System for Climate Change Mitigation

Final Report on MRV for the Industrial Sector - Annexes

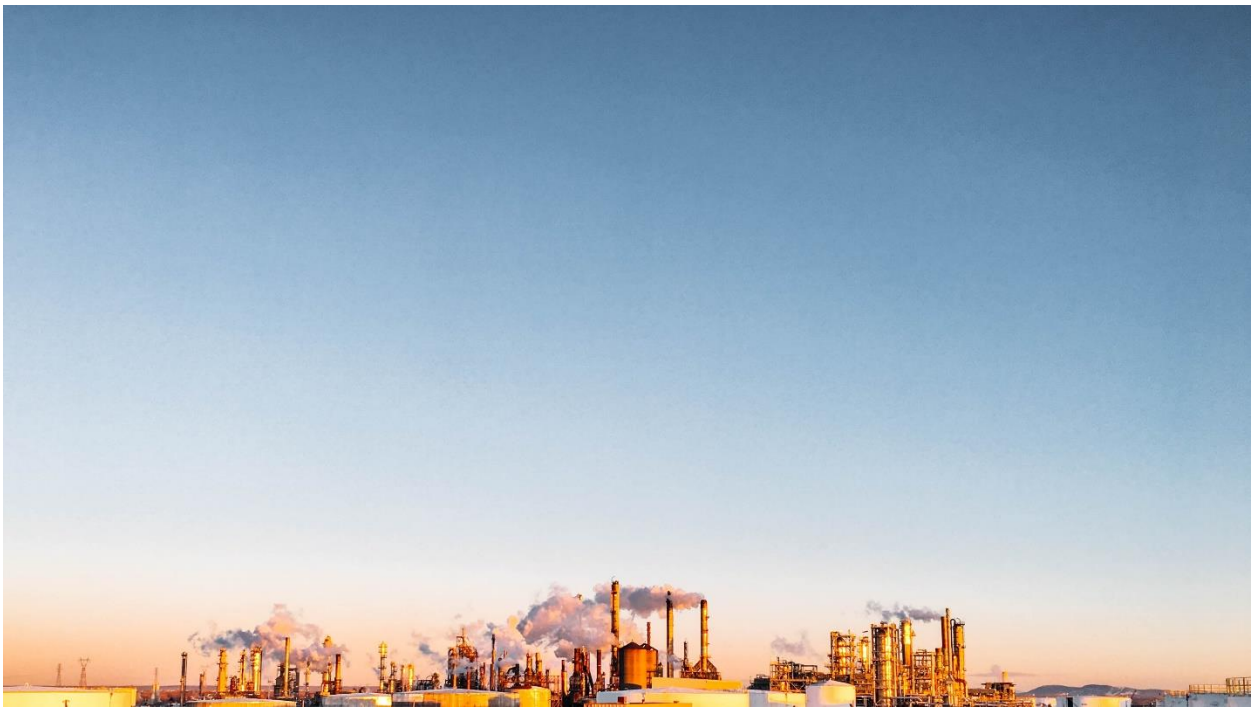

Photo by Chris Liverani on Unsplash

Initiative for Climate Action Transparency - ICAT -

Improving Thailand's MRV System for Climate Change Mitigation

Deliverable #1

AUTHORS

The Global Green Growth Institute

Date of the deliverable 27 September 2019

PUBLISHED BY

Office of Natural Resources and Environmental Policy and Planning (ONEP), Thailand's Ministry of Natural Resources and Environment

PREPARED UNDER

Initiative for Climate Action Transparency (ICAT) project supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Children's Investment Fund Foundation (CIFF), the Italian Ministry of Ecological Transition (IMET) and ClimateWorks.

The ICAT project is managed by the United Nations Office for Project Services (UNOPS)

TABLE OF CONTENTS

Annex 1. Perform, Achieve and Trade (PAT) Scheme, India..... 2
Annex 2. Korean Emissions Trading Scheme (KETS), Republic of South Korea.....17
Annex 3. UK Climate Change Agreement (CCA) for Food Sector 26

Annex 1. Perform, Achieve and Trade (PAT) Scheme, India

1. Introduction

The Perform, Achieve and Trade (PAT) scheme is an innovative, market-based trading program implemented by India under its National Mission on Enhanced Energy Efficiency (NMEEE) within the National Action Plan on Climate Change (NAPCC). It aims to improve energy efficiency in the industrial sectors by capping energy consumption of the energy intensive industries and trading the energy efficiency certificates thus generated. The scheme improves the energy efficiency performance of the identified energy intensive industries by reducing their specific energy consumption (SEC) through carrying out energy efficiency measures (EEMs). The energy savings obtained due to the reduction in SEC over and above a set target can be quantified and traded as the Energy Saving Certificate (ESCerts; 1 ESCerts = 1 ton of oil equivalent (TOE)).

2. Key program features

Scope	Major energy intensive industrial sectors
Mechanism	Cap and trade of energy savings (in terms of ton of oil equivalent)
Participation	Mandatory
Target setting	Energy reduction target for each facility based on the overall sector level energy savings needed
Target period	Three years
Monitoring, Reporting and Verification	Monitoring and reporting are conducted at facility level. Energy reduction claimed is verified by a third-party verifier and re-checked by the administrating agency
Penalties	Any non-compliance of targets leads to the imposition of fixed and variable penalties

3. Legal framework

The Energy Conservation Act (ECA), 2001 put in place the policies, rules and regulations to improve energy efficiency in the energy intensive industries. The 2010 amendment to the ECA 2001 included a legal mandate to the PAT with the provisions for issuance of ESCerts, imposition of penalty for non-compliance and the trading of ESCerts.

The Ministry of Power (MoP) and the Bureau of Energy Efficiency (BEE) were responsible for the PAT implementation. A new institution, Energy Efficiency Services Limited (EESL) was established to administer the trading of ESCerts.

4. Scheme design

Figure A.1.1 represents the schematic process flow of the PAT scheme.

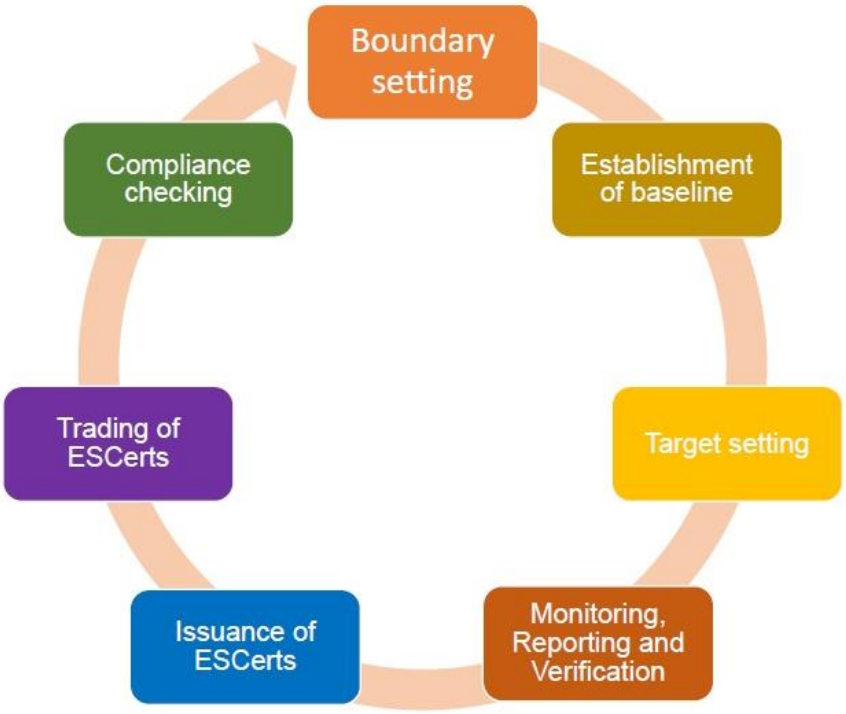

Figure A.1.1 Schematic process flow of the PAT scheme

The PAT scheme is a unique policy instrument and stands out from the pool of several ongoing initiatives across the globe targeted at the GHG emission reduction. The uniqueness of the scheme lies in the overall objective of improving the efficiency of the production process to achieve the ultimate target of energy savings. This approach towards energy saving is a major shift from the emission reduction directives followed in several developed and developing economies which, in general, aim for reduction in absolute number of emission/fuel consumption units. Thus, the reduction in energy consumption, once achieved through the PAT will be far more realistic (pointing towards a more efficient and less energy intensive economy) than those reported through other methodologies where the absolute reduction of emission/energy consumption units may be influenced by the commercial and/or political factors.

The scheme establishes facility-specific targets rather than a sectoral target. The scheme imposes mandatory SEC targets to the energy intensive industrial consumers, identified as “Designated Consumers (DCs)”, with less energy efficient facilities having a greater reduction target than the energy efficient ones. A DCs baseline is determined by its historic SEC. The DCs making greater reduction than their targets receive “ESCerts” which can be traded with the other DCs that are having trouble meeting their targets or banked for future use. The key steps involved are as follows:

- Specification of SEC norm for each DC in the baseline year and in the target year
- Verification of the SEC of each DC in the baseline year and then in the target year by an accredited verification agency
- Checking of compliance and issuance of ESCerts to those who exceed their target SEC at the end of the 3-year period. In case of non-compliance, a financial penalty is due.
- Trading of the ESCerts with the other DCs’ who are unable to meet their target SEC at the end of target period

Table A.1.1 shows the significant phases in overall implementation of the scheme. All the activities are focused toward the DCs. The implementation of each PAT cycle will go through all of these phases.

Table A.1.1. Phases of overall scheme implementation within a target period

Target setting phase	• Establishment of baseline SEC • Review of baseline SEC • Finalization of SEC reduction targets • Consultation with the facilities
Notification phase	• Recommendation by the BEE to the MoP • Notification by the MoP on launch of target period • Formal intimation on individual targets
Implementation phase	• Reporting of action plan by the DCs to the BEE and the State Designated Agencies (SDAs) • Implementation of monitoring at the facilities of the DCs • Engaging the Empanelled Accredited Energy Auditor (EmAEA) by the DCs and conducting energy audit at their facilities
Monitoring , Reporting and Verification (MRV) phase	• Receipt of the monitoring and verification (M&V) report from the EmAEA by the DCs • Submission of the reports to the SDA & BEE and claiming of the ESCerts by the DCs • Issuance of the ESCerts by the BEE • Conduct of check verification by the BEE through an appointed EmAEA

5. Institutional arrangement

The legal frameworks including the ECA 2001, its subsequent amendments and regulations and the PAT Rules, 2012 collectively put in place a robust institutional arrangement for the program. Figure A.1.2 shows the institutional arrangement for the PAT scheme.

The arrangement clearly defined the stakeholder roles, mechanisms to prevent and manage conflict of interest and thus laid a good foundation for a sound institutional mechanism and scheme design.

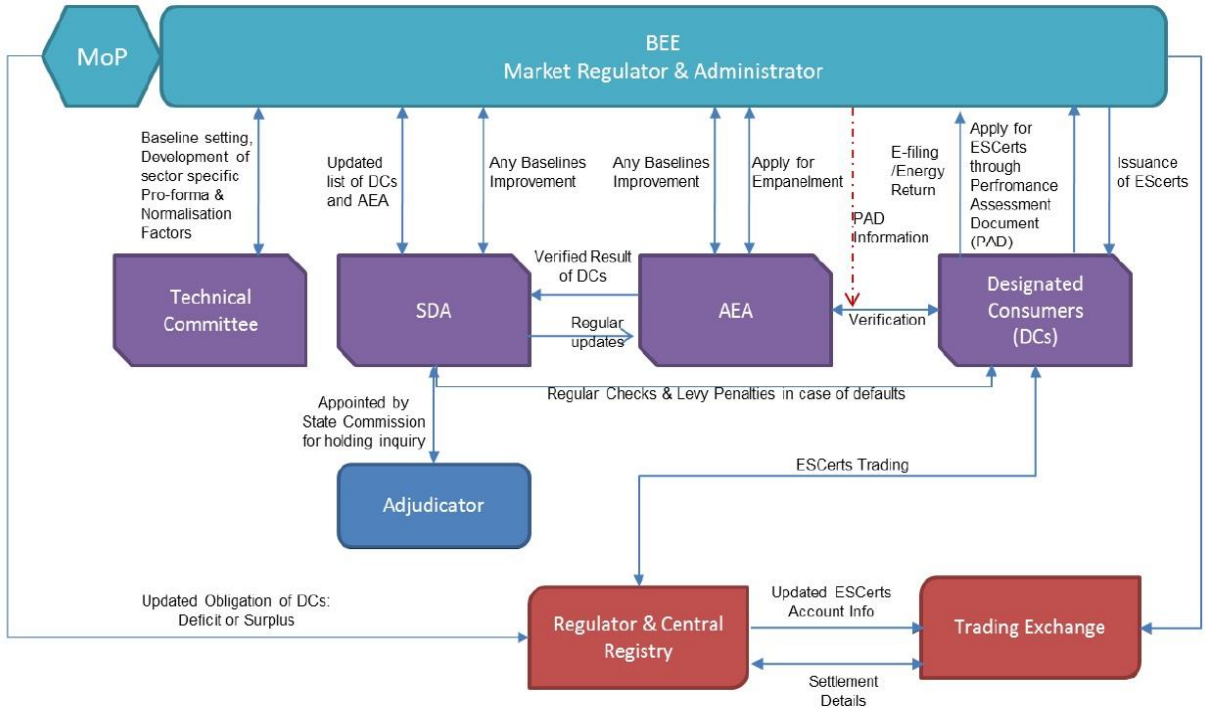

Figure A.1.2. Institutional arrangements for PAT scheme[1]

The MoP provides the overall direction to all the stakeholders involved such as the BEE, SDAs, EmAEAs and DCs. The MOP, after considering the reports submitted by the BEE, specifies the energy consumption norms and standards for every DC's facility. The BEE co-ordinates with the DCs, SDAs, Sectoral technical committee and other agencies to administer and monitor the PAT Scheme. It provides the recommendations to the MoP on the norms and standards required to be notified. It is responsible for empanelment of EmAEA firms as verifiers under the scheme. It is also responsible for the overall capacity building of the SDAs, EmAEAs and DCs.

The SDAs are responsible for the inspection and enforcement of the MRV system. They review and validate all the documents submitted by the DCs within their region before sending it to the BEE. The SDAs appoint the adjudicating officer to hold enquiry on any non-compliance by the DCs and impose penalty.

The EmAEAs are responsible for verification of the DCs compliance with energy consumption norms and target achievement through energy audits. They conduct energy audit in the DC facility and provide a verification report as per the reporting template issued by the BEE.

The DCs in consultation with the EmAEA implement the energy consumption reduction measures in their facilities and put in place a transparent and credible monitoring & verification arrangement in line with the regulations under the PAT scheme. The DCs also facilitate the verification and check-verification works carried out by the EmAEA and the SDAs at their facilities.

6. Methodology

Before the implementation of the PAT scheme, there was an extensive consultation was carried out with all relevant stakeholders. The sector studies were commenced in 2008 to identify the

[1] AEA = Accredited Energy Auditor or Empanelled Accredited Energy Auditor (EmAEA)

DCs by organizing nationwide workshops. The draft document was widely circulated and discussed at the sectoral and regional/state meetings. In addition, frequent letters were sent to the DCs on state and sectoral meetings. The technical committees considered inputs from the DCs before developing the normalization rules.

The nationwide baseline data collection process began in 2009 for the target setting. The target setting methodology and the targets were discussed with various stakeholders for a wide coverage of the program.

6.1. Estimation of energy consumption and production

The total energy consumption in tons of oil equivalent (TOE) of a DC is calculated as follows:

$$\begin{pmatrix} Total\ energy \\ consumption \\ TOE \end{pmatrix} = \left\{ \begin{pmatrix} Electrical\ energy\ from\ the\ grid - \\ (Electricity\ generated \\ by\ the\ captive\ plant + \\ Electricity\ generated\ by\ the \\ RE\ source + \\ Electricity\ export\ to\ others) \end{pmatrix} \times \begin{pmatrix} conversion\ factor \\ for\ MWh\ to\ TOE \end{pmatrix} \right\} + \left\{ \begin{pmatrix} Type\ of\ fuel\ used \times \\ calorific\ value\ of\ that\ fuel \end{pmatrix} \times \begin{pmatrix} Conversion\ factor \\ for\ MJ\ to\ TOE \end{pmatrix} \right\}$$

Each DC in the sector will produce different end products by consuming different energy sources. Hence, the scheme considers all these products to be converted into one single equivalent product. i.e., conversion of minor products to a one major product. The conversion factors of minor products will be same in the baseline year and in the assessment year.

The conversion factor for any minor product to major product is estimated as,

$$\begin{pmatrix} Conversion\ factor\ from \\ minor\ to\ major\ product \end{pmatrix} = \frac{SEC\ of\ the\ minor\ product}{SEC\ of\ the\ major\ product\ in\ the\ sector}$$

For example, let us consider that a DC produces 3 different end products viz., P1, P2 and P3. If the product P1 is identified as the major product in the sector, the product P2 and P3 is converted into equivalent product of P1. Then the total equivalent production by that DC in terms of major product is (P1) is calculated as,

$$\begin{pmatrix} Total\ equivalent \\ production\ in\ tons \end{pmatrix} = \left(P1 + \left(P2 \times \frac{SEC\ of\ product\ P2}{SEC\ of\ product\ P1} \right) + \left(P3 \times \frac{SEC\ of\ product\ P3}{SEC\ of\ product\ P1} \right) \right)$$

6.2. Estimation of baseline SEC

The total energy consumption and production data of the recent three financial years is considered for the baseline SEC setting of a DC. The BEE collects these data from the DCs and calculates the baseline SEC. The calculated baseline SEC will be fixed for the entire period of the respective PAT cycle. Figure A.1.3 gives the conditions in setting the baseline SEC for the DCs.

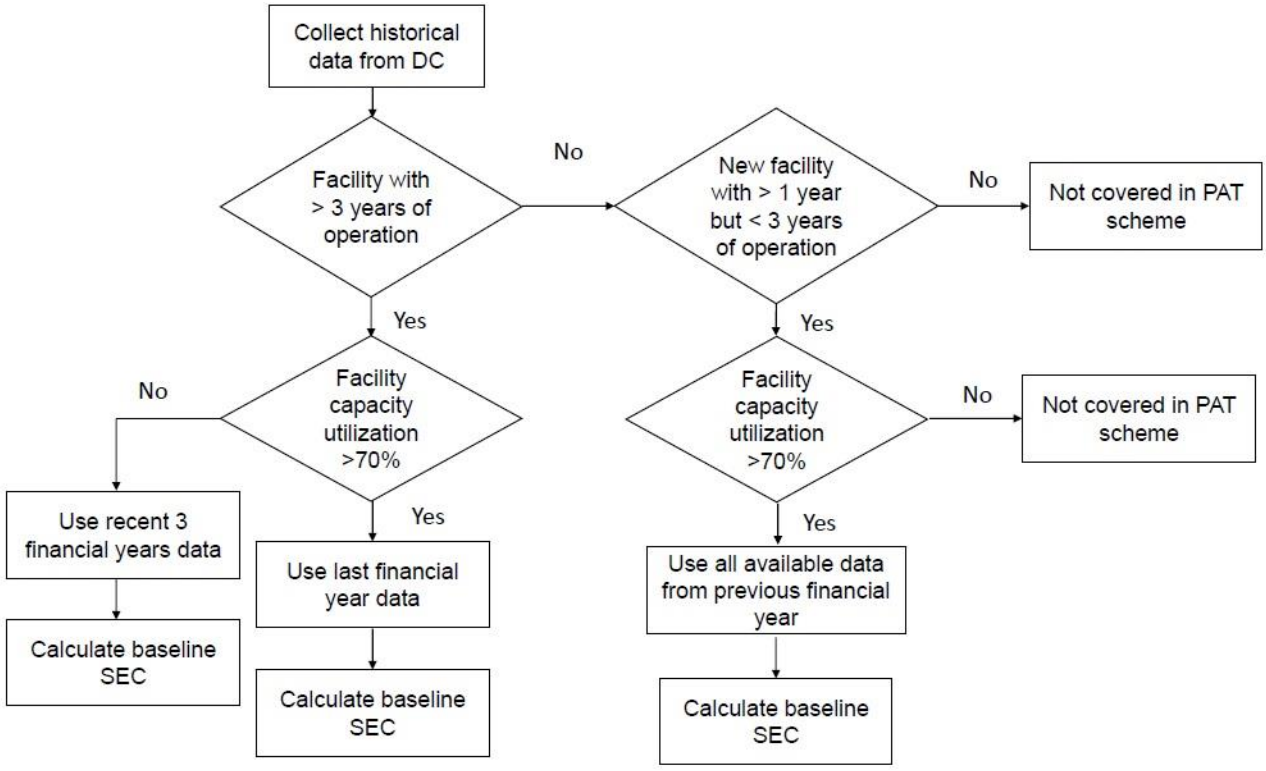

Figure A.1.3. Procedure for the baseline SEC setting

The baseline production of a DC is calculated as,

$$Baseline\ production = (Average\ of\ last\ three\ financial\ year\ production\ in\ tons)$$

The baseline total energy consumption of a DC is calculated as,

$$\begin{pmatrix} Baseline\ total\ energy \\ consumption \end{pmatrix} = \begin{pmatrix} Average\ of\ total\ energy\ consumption\ (TOE) in \\ last\ three\ financial\ year \end{pmatrix}$$

The baseline SEC of a DC is calculated as,

$$Baseline\ SEC = \left(\frac{Baseline\ total\ energy\ consumption\ (TOE)}{Baseline\ production\ (tons)}\right)$$

Where

Baseline total energy consumption	=	Sum of electrical energy and thermal energy consumed by the DC (excluding the energy generated from the renewable energy sources, alternate fuels, etc.) in TOE
Baseline production	=	Sum of all minor product converted into one single major equivalent product (tons)

In case of green field facilities, a minimum of one year data is needed for setting the baseline SEC.

6.3. Setting of target SEC

The target is defined in the 'percentage' form. It is the percentage reduction of SEC for each DC from its baseline value to that of the target year. The methodology for setting target SEC for the DCs is transparent and has no room for any arbitrariness. Figure A.1.4 provides the general steps in target setting for each DC from breaking down the national level target to the sector target and then to the individual level.

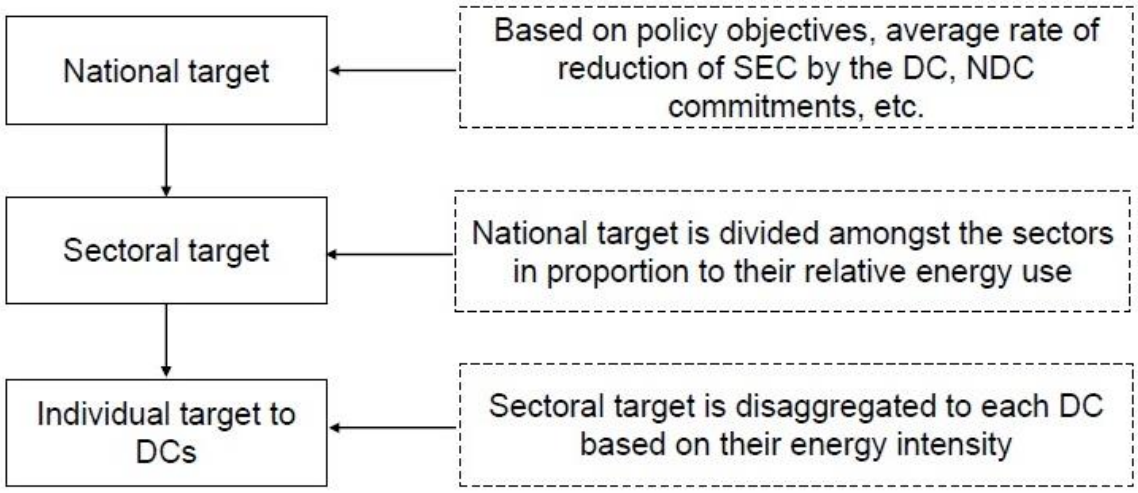

Figure A.1.4. Target setting procedure under PAT scheme

The general steps in the target setting are:

1. The national level target is set based on the average rate of reduction in SEC by the DCs and the policy objectives such as the Nationally Determined Contributions (NDC) and sector target of the country.

2. The national target is divided amongst the sectors in the proportion to their relative energy use to ensure that the sectoral reduction is appropriate. For example, if the national energy savings target is estimated as 10 million TOE and the cement sector shares around 1.5% of total energy consumption, then the energy savings target for the cement sector is 150,000 TOE (= 10,000,000 * 1.5%).

3. The sectoral reduction target would be disaggregated to each DC identified within the sector. Given the diversity of DC configurations within a sector and their vintages, it is being proposed to apply gate-to-gate approach for each DC in defining the target SEC

4. The target will be a certain percentage improvement over a DC's baseline SEC. The target SEC will need to be achieved over a three year period.

5. The methodology is based on the expectation that all DCs will reduce their SEC. The less energy-efficient DCs within a sector will be required to achieve a greater reduction in their SEC than the energy-efficient DCs. The SEC targets will be determined with a statistical analysis followed by the stakeholder consultation in each sector.

The sectoral targets will be disaggregated among the DCs taking into account the historical energy consumption (average of previous 3 financial year energy consumption), potential of energy saving in the DC, sustainability of trading market and other related issues. The lowest % target would be given to the best performing DC whereas the others will be assigned based on the concept of relative SEC.

Therefore, if the best performing DC has X % target, then the targets for the other DCs would be (DC SEC ÷ Best SEC) times of X %. The X can be numerically calculated taking into account the total energy saving goal in that target period. The general equations to set the target for an individual DC under the PAT scheme is given below.

Step 1: Collection of historical data and establishing the baseline SEC of DCs

$$Baseline\ SEC = \left(\frac{Baseline\ total\ energy\ consumption\ (TOE)}{Baseline\ production\ (tons)}\right)$$

Step 2: Calculation of total energy consumption of DCs

$$Total\ energy\ consumption\ (TOE) = (Baseline\ SEC \times Baseline\ production)$$

Step 3: Calculation of relative SEC of DCs

$$Relative\ SEC = \frac{Baseline\ SEC\ of\ the\ DC}{Minimum\ SEC\ of\ the\ DCs\ in\ the\ sector}$$

Step 4: Calculation of % target reduction for the sector

$$\%\ target\ savings = \left(\frac{Sum\ of\ total\ expected\ savings\ from\ individual\ DCs}{Sectoral\ energy\ savings\ needed}\right)$$

Step 5: Target for each DC

$$\underset{(TOE/ton)}{Target\ for\ each\ DC} = (1 - \%target\ savings) \times Baseline\ SEC$$

For example, let us consider that there are 5 DCs in a sector. Table A.1.2 shows the sample target setting for 5 DCs.

Table A.1.2. Sample target setting procedure under the PAT scheme

Parameter	DC 1	DC 2	DC 3	DC 4	DC 5
Baseline production (tons) (A)	369,939	358,967	178,530	79,587	37,635
Baseline SEC (TOE/ton) (B)	1.274	1.364	1.400	1.428	1.780

Parameter	DC 1	DC 2	DC 3	DC 4	DC 5
Total energy consumption (TOE) (C = A * B)	471,302	489,631	249,942	113,650	66,990
Minimum SEC of the DC in the sector (D) (i.e. min. of B)	1.274				
Relative SEC (E = B/D)	1.000	1.071	1.099	1.121	1.397
% target reduction (F)	X				
Expected energy savings (TOE) (G =C*E*F/100)	4,713 X	5,242 X	2,746 X	1,273 X	935 X
Total expected energy savings (H) (sum of all DCs)	= (4,713 + 5,242+ 2,746 + 1,273 + 935) X = 14,912 X				
Sectoral energy savings target (TOE) (I)	104,000				
% target reduction (F=H/I)	X = 104,000/14,912 X = 6.97%				
Target reduction for each DC from baseline (J = F*E)	6.970%	7.467%	7.664%	7.817%	9.744%
Target SEC for the DC (K= J*B)	1.185	1.262	1.293	1.316	1.607

6.4. Estimation of assessment year SEC

The DCs have to monitor the parameters and report their energy consumption in the prescribed format given by the BEE. The assessment year SEC i.e. the final year of PAT cycle will be calculated from the reported data submitted by the DCs at the end of each PAT cycle. However, the DCs also need to submit the annual monitored data to the BEE.

The assessment year SEC is calculated as,

$$Assessment\ year\ SEC = \left(\frac{Total\ energy\ consumption\ (TOE)\ in\ the\ assessment\ year}{Production\ (tons)} \right)$$

6.5. Estimation of energy savings at the end of target period

The absolute energy saving at the end of assessment year will be estimated as:

$$Energy\ savings = \left(SEC_{base\ year} - SEC_{assessment\ year}\right) \times Production_{base\ year}$$

If there is change in the production of a product, then the normalization factor will be applied for the production in the assessment year.

Figure A.1.5 shows the schematic of estimation of energy savings and the issuance of ESCerts based on energy reductions achieved.

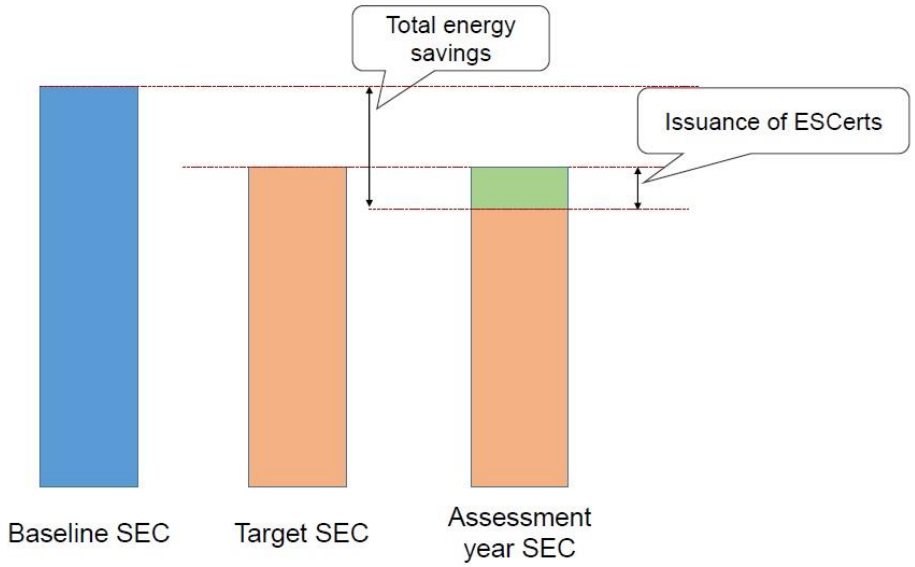

Figure A.1.5. Schematic of estimation of energy savings and issuance of ESCerts

6.6. Application of normalization factors

There are many factors, which can influence the SEC of a DC and the normalization factor is applied to ensure that all the DCs are at the same level. Several aspects are taken into consideration for the normalization of production and energy consumption under the PAT scheme. This is to avoid the undue advantage or disadvantage that could be imposed on a DC. Various aspects for which normalization factors are applied for the DCs are given below.

- Start & stop of the furnace
- Product mix
- Import & export of intermediary product
- Normalization for scrap use
- Power mix (imported & exported from/to the grid and self-generation from the captive power plant)
- Fuel quality in captive power plant and cogeneration
- Others
    - Environmental concern (additional environmental equipment requirement due to major change in government policy on environment)
    - Fuel replacements

- Project activity phase
- Unforeseen circumstances
- Renewable Energy Certificate (REC) normalization

7. Measurement, Reporting and Verification (MRV)

Figure A.1.6 shows the process flow of issuance of ESCerts under the scheme.

The DCs have to monitor the parameters and report their energy consumption in the prescribed format given by the BEE through the PATNET online portal. The portal was established and maintained by the BEE. The energy consumption data are submitted to the BEE through PATNET and in hardcopy within 3 months at the end of every financial year.

The DCs have to monitor the parameters such as raw material usage, final product output, fuel and electricity consumed, energy generation and consumption from captive power plant and waste heat recovery, etc. These parameters are monitored continuously or hourly or daily or weekly or monthly depending upon the monitoring plan. The DCs should also provide the reports, documents and information to the energy auditors during verification. They also have to submit the performance assessment document within 3 months from the end of assessment year (i.e. the final year of PAT cycle) to the SDA and the BEE.

After the target period, the BEE will appoint an EmAEA to conduct Check Verification. The DCs will provide all the information necessary for the verification process, including supporting documents and access to the plant site. The EmAEA will assess and verify that the activities performed by the DCs. The EmAEA in-charge of check-verification will report the results of the assessment in a check-verification report to the BEE.

The DCs who had not achieved the target (under achiever) are entitled to buy the ESCerts from the power exchanges. As per the ECA 2001, a fixed penalty of maximum INR 1 million (≈ 14,300 USD) and variable penalty[2] for the energy reduction that is not achieved by the DCs[3] as specified in EC rules 2012 is applicable. If not paid, it will be recovered as an arrear in land revenue.

[2] Considering average market price of one TOE of fossil fuel for each units of energy savings not met
[3] PAT scheme Normalization document

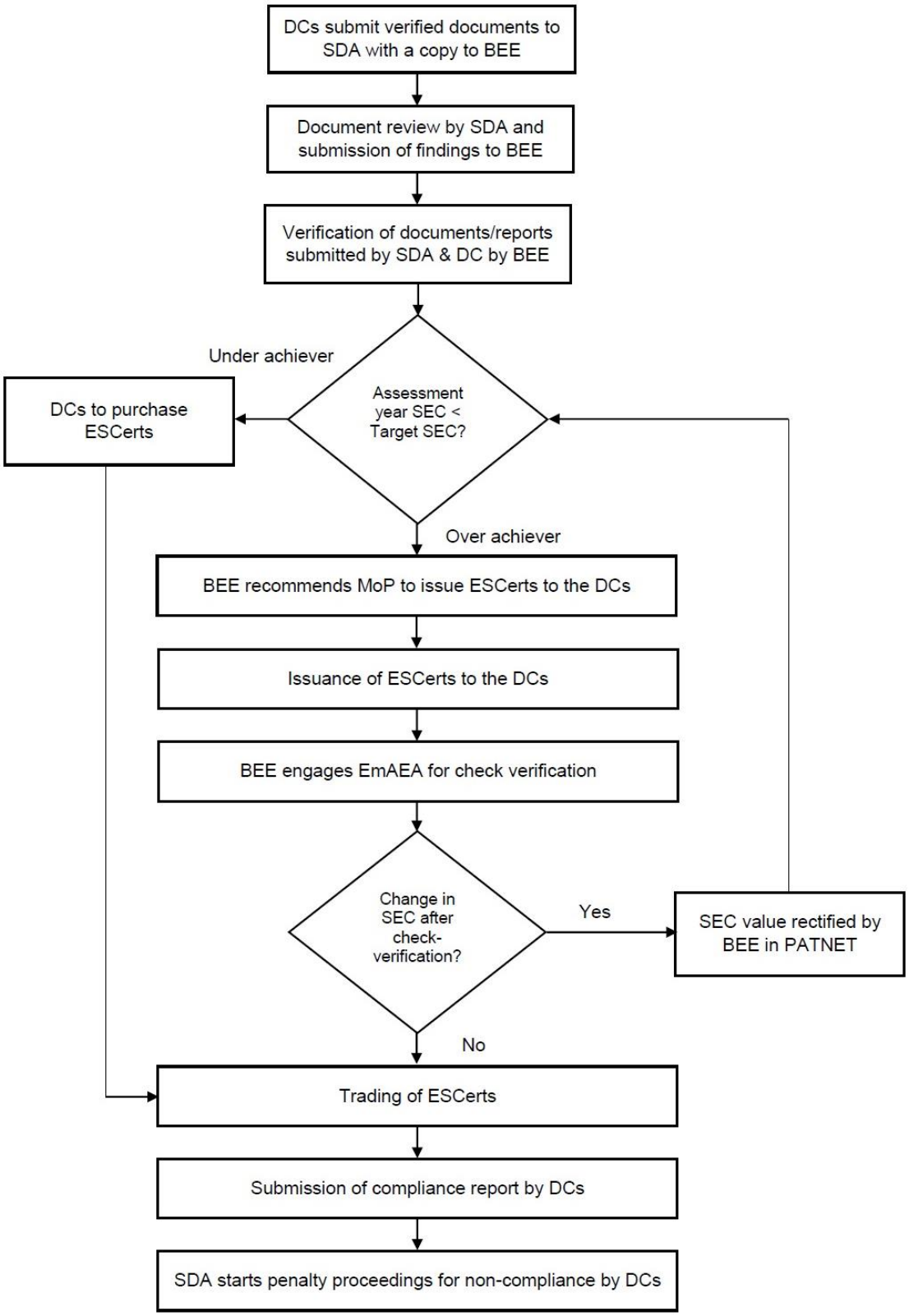

Figure A.1.6. Process flow for issuance of ESCerts

Table A.1.3 gives the list of forms and their submission authorities under the PAT scheme.

Table A.1.3. Different reporting forms under PAT scheme

No.	Name of the form	Submitted by	Time of submission	Submission authority
1	Form 1 – Energy consumption data and sector specific Pro Forma – to calculate notional energy for normalization	DCs	Within 3 months at the end of every year in PATNET portal and in hardcopy	BEE
2	Form A – Performance assessment documents	DCs	Within 3 months from the end of target year	SDA & BEE
3	Form B – Certificate of verification by EmAEA	DCs	Within 3 months from the end of target year	SDA & BEE
4	Form D – Status of compliance	DCs	Within in 5 months from the submission of Form A	SDA & BEE
5	Form C – Check verification report and certificate	EmAEA	Within 6 months after issuance of ESCerts or within 1 year of submission of Form D	BEE

8. Implementation status

The targets for the PAT Cycle I (2012-2015) were notified to 478 DCs under 8 sectors (Aluminium, Cement, Chlor-Alkali, Fertilizer, Iron and steel, Pulp and paper, Thermal power plant and Textiles). The PAT cycle I envisaged energy saving of 6.686 million TOE (4.08% reduction in the total energy consumption).

At the end of PAT cycle I, it had achieved energy savings of 8.67 million TOE which is 27% higher than what was envisaged under the cycle I. This energy savings resulted in a reduction of 31 million tCO_2. The government issued 3.825 million ESCerts to 306 DCs while 110 DCs purchased 1.425 million ESCerts for their compliance under the PAT cycle I[4]. These certificates are tradable at two energy exchanges viz. Indian Energy Exchange and Power Exchange India.

The PAT cycle II was rolled out for the period 2016 – 2019 covering 621 DCs from 11 sectors (which includes eight existing and three new sectors viz. Railways, Refineries and DISCOMS). The PAT cycle II is envisaged to reduce energy consumption in industries by 8.889 million TOE.

The BEE issued notification for PAT cycle III (2017-2020) under which 308 DCs from already notified sectors have been identified for baseline verification and inclusion. Of these, the

[4] https://beeindia.gov.in/content/pat-read-more

verification of 273 DCs has been completed and 116 new ones have been included with a target energy savings of 1.01 million TOE[5].

The targets for the PAT cycle IV (2018-2021) have been notified in March 2018. Total of 109 DCs are covered from the existing and two new sectors (petrochemical and buildings (hotels)) with an overall energy savings target of 0.699 million TOE.

The PAT scheme sets threshold limits based on the sectoral energy consumption pattern. It has strategic advantages for setting benchmarks at sector and even at process level in future. The DCs are notified when they consume energy greater than the threshold limit as mentioned in the regulation. Table A.1.4 gives the threshold limit for the thirteen sectors covered so far under the PAT scheme.

Table A.1.4. Threshold limit for the industrial sectors[6]

No.	Name of the sector	Threshold limit
1	Thermal power plant	>30,000 TOE/y
2	Fertilizer	>30,000 TOE/y
3	Cement	>30,000 TOE/y
4	Iron and steel	>30,000 TOE/y
5	Chlor-Alkali	>12,000 TOE/y
6	Aluminium	>7,500 TOE/y
7	Textile	>3,000 TOE/y
8	Pulp and paper	>30,000 TOE/y
9	Railways	• All zonal railways having traction annual energy consumption of > 70,000 TOE/y and • Workshop/production units having annual energy consumption of >30,000 TOE/y
10	DISCOMS	Aggregate Technical and Commercial loss (AT&C) of 1,000 million units (MU) or >86,000 TOE/y
11	Petroleum refineries	>90,000 TOE/y
12	Petrochemical	>1,00,000 TOE/y
13	Buildings	>1,000 TOE/y

[5] http://www.teriin.org/article/taking-pat-road-leaner-meaner-industries
[6] Deepening and Widening of PAT scheme and provisions of EC Act applicable to DCs

9. Lesson learnt

The lessons learnt from the implementation of the PAT cycles so far are summarized as below.

- Stakeholder inclusion in the scheme design: There was an extensive consultation process in the design and implementation phase, which aided acceptability. The draft document was widely circulated and discussed in 96 sectoral and regional/state meetings. In addition, frequent communications were made with the DCs at the state and sectoral meetings. The technical committees considered inputs from the DCs before developing normalization rules. Inputs were assessed and key changes were made in the design and in enhancing ownership of mechanism.

- Creditability of reported energy savings: Auditing and check auditing by third-party auditors (EmAEA), accredited through an open process by the BEE, built credibility and fairness.

- Strong legal backing: For this, an amended ECA 2001 was passed by the Indian parliament in 2010. While the earlier version already included specification of DCs, energy consumption norms and third-party assessment by accredited auditors, the amendment provided the legal mandate for issuance of certificates for excess savings and their trading.

- Need for stringent targets: Over achievement of the target in first PAT cycle led to reflection that the targets were not stringent enough. A methodology for tightened targets was thus called for. When the results of the second and third PAT cycles come in, they will be able to serve as inputs for future design and implementation of this unique scheme[7].

- Clarity and stability of trading mechanism: When trading began, more than 3 million ESCerts were available against a demand for 1.45 million ESCerts by the companies. At the outset, it was assumed that each ESCert would cost around INR 10,000 (≈ 145 USD) which is the average price of coal, oil, gas and one unit of electricity for the industrial sector (in terms of TOE). However, when trading started in September 2017, the opening price of 1 ESCert was INR 1,200 (≈ 17 USD) almost 10 times lower than expected. As more industries registered on the trading site, the number of ESCerts available for purchase steadily increased. The price of ESCerts gradually declined due to the impact of low demand in the market. By November 2017, the price was as low as INR 200[8] (≈ 3 USD).

- Timeliness in enforcing the penalties: The facilities that did not achieve their targets would be liable to pay an additional penalty of INR 1 million (≈ 14,300 USD) if they failed to purchase ESCerts. In the case of continued failure to meet targets, further penalties would be levied. However, there is no clarity on enforcement or timelines for defaulters to make these applicable[9].

[7] http://www.teriin.org/article/taking-pat-road-leaner-meaner-industries
[8] https://www.thehindubusinessline.com/opinion/pats-path-to-energy-efficiency/article23751019.ece
[9] https://iasbaba.com/2018/05/iasbabas-daily-current-affairs-prelims-mains-focus-3rd-may-2018/

Annex 2. Korean Emissions Trading Scheme (KETS), Republic of South Korea

1. Introduction

South Korea's Emissions Trading Scheme (KETS) is the second largest carbon market after the European Union Emissions Trading Scheme (EU-ETS) and roughly covering two-third of the country's total emissions. It is the first nationwide emission trading scheme in Asia covering all the energy intensive industries and other facilities. The KETS is the government policy measure taken to meet its commitment laid out in the Copenhagen Accord of 2009. Under this Accord, South Korea pledged to reduce its GHG emissions by 30% below its BAU scenario by 2020.

2. Key program features

Scope	Wide sectoral coverage including the industries, buildings, transport, aviation and waste
Mechanism	Cap and trade of emission allowances similar to European Union Emission Trading Scheme (EU ETS)
Participation	Mandatory for the entities with the annual energy consumption above a set threshold limit
Target setting	Each participating entity is provided with a target GHG emission (allowances[10]) based on its historic baseline emissions
Target period	Varies from three to five years for different phases
Monitoring, Reporting and Verification	Monitoring and reporting is done at facility level. Emission reduction must be verified by third party verification agency before issuance of credits
Penalties	Any non-compliance of targets will lead to proportionate imposition of penalties (administrative fine not exceeding three times the average market price per unit of tCO_2e for that year. The maximum penalty is KRW100,000 per tCO_2e)

3. Legal framework

The KETS was implemented through the Act on Allocation and Trading of Greenhouse Gas Emissions Allowances, enacted in November 2012 by the Presidential decree. The details of the KETS were then elaborated in the Master Plan for the Emissions Trading Scheme, prepared by the Ministry of Strategy and Finance (MOSF) and the National Allowances Allocation Plan Phase I), prepared by the Ministry of Environment (MOE), which were introduced in 2014. Together, these legal documents outlined the key elements of the KETS design for the first commitment period (2015–2017) and enabled the launch of scheme in January 2015.

[10] Each allowance represents 1 ton of carbon dioxide equivalent (tCO_2e) that are permitted to be emitted

4. Scheme design

The KETS caps GHG emissions of the covered entities within the scheme and involves the issuance of a corresponding number of emission allowances.
Figure A.2.1 gives the simple process flow of the scheme.

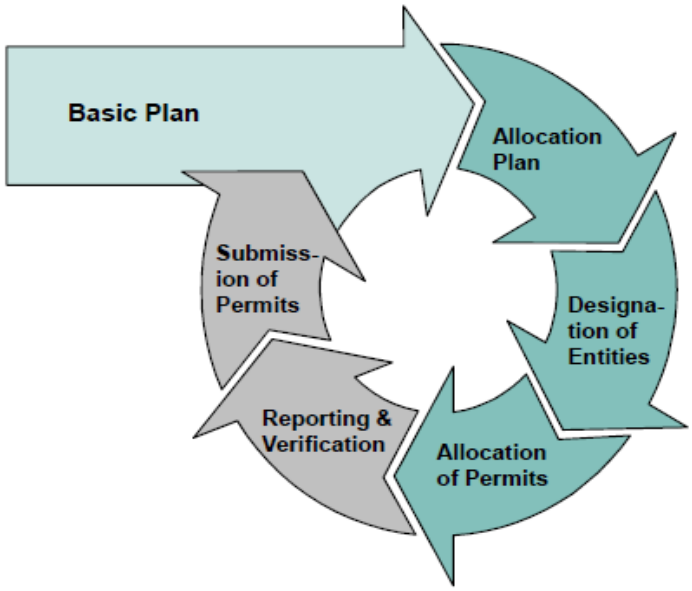

Figure A.2.1. Simple process flow of KETS scheme[11]

At the beginning of each phase, the government establishes an allocation plan, in which it defines how emission allowances are to be allocated. The allowance allocation is detailed by sector and by business category, which creates the basis for each participant's allocation. Allowances can be either allocated for free or auctioned within the KETS.

After the allocation plan, the KETS identifies the sectors/entities that are to be included in the scheme. The KETS covers wide range of sectors such as power generation, industries, buildings, transportation, aviation and waste. Once the participating sectors are selected, participation thresholds (i.e. total emissions in a year) need to be confirmed to identify emitters that have to comply with the system. The participation thresholds are primarily based on each entity's contribution to the national GHG emissions; however, their capacity to measure GHG emissions and participate in the system are also taken into consideration.

The KETS requires mandatory participation from all entities within the covered sectors with the average annual GHG emissions equal to or greater than 125,000 tCO_2e over three consecutive years or business sites with the annual average GHG emissions equal to or greater than 25,000 tCO_2e over three consecutive years. In addition, regardless of its emission levels, any entity may apply for the voluntary participation also. The allowances will be allocated to each entity based on its historical emissions.

[11] Presentation on Korean Emission Trading Scheme, Korea Environment Corporation, Nov 2013.

The emission cap provides an upper limit of the aggregated GHG allowance for the covered entities. The emission cap is established in line with the national emission reduction targets. Table A.2.1 shows the emission reduction target for different sectors covered in the KETS.

The covered entities must measure and report their annual emissions and surrender the allowances to cover their emission responsibility. Entities those who emit less than their allocation can sell their excess allowances through the Korea Stock Exchange (KRX).

Table A.2.1. Emission reduction targets for different sectors

Category	Industry	Transport	Building	Agriculture, Forestry, Fishing	Waste management	Public sector
Sectoral reduction rate compared to 2020 BAU emission	18.5%	34.3%	26.9%	5.2%	12.3%	25%

The entities which do not have enough allowances to cover their annual emissions will need to buy from the KRX. This creates the direct economic incentive for the emission reduction. At the same time, the cap limits the GHG reductions to target levels. The KETS was implemented in phases to allow a progressive evaluation and revision to its design, which was reflected in the updated master plans.

Participants are also allowed to bank allowances for an unlimited period of time. The companies or individuals not subject to emission caps under the KETS, except for a couple of Korean government owned banks, are restricted from trading the allowances in the KETS.

5. Institutional arrangement

Figure A.2.2 shows the institutional arrangement for the KETS scheme.

The MOE is responsible for managing all aspects of the scheme's operation. The MOSF communicates with the line ministries and regulates the volume of allowances in the carbon market. The responsibilities related to allowance allocation, the compliance process and communication with the participants were in turn distributed among four sectoral ministries (Ministry of Trade, Industry and Energy, Ministry of Land and Infrastructure Transport, Ministry of Environment and Ministry of Agriculture, Food and Rural Affairs) with each being responsible for its respective sector emissions.

In 2018, a market maker role was also introduced - an institution that is designed to enhance the stability of the KETS. These include three banks: the Korea Development Bank, the Export–Import Bank of Korea and the Industrial Bank of Korea.

The KETS is supported by the National Greenhouse Gas Inventory System, managed by the Greenhouse Gas Inventory & Research Centre (GIR) for Korea. It tracks GHGs emitted by the entities and provide the data required for measuring, reporting and verifying the same in line with the international standard.

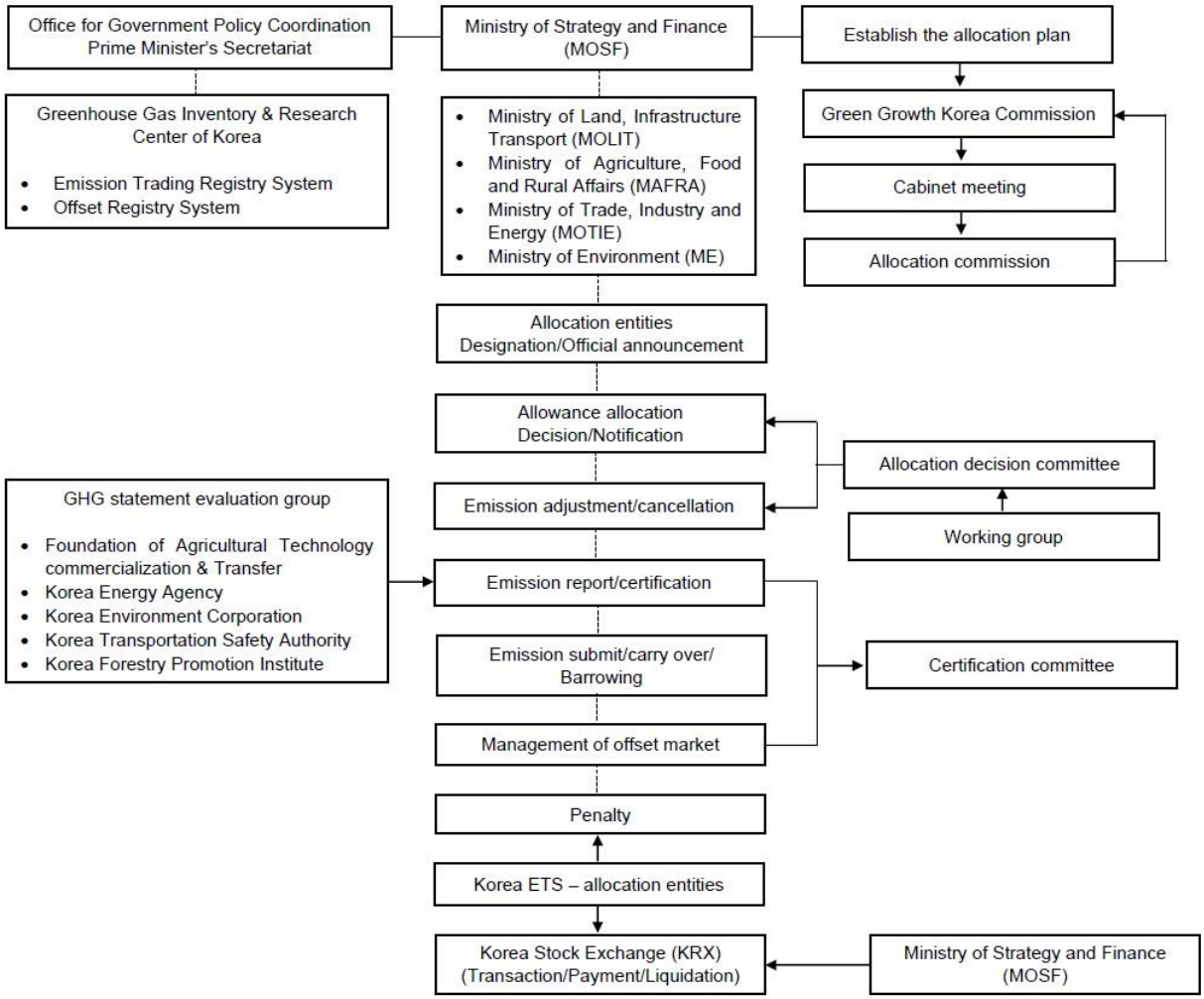

Figure A.2.2. Institutional arrangement for KETS[12]

6. Methodology

Since 2010, South Korea had operated the GHG and energy Target Management System (TMS) to manage industries that are both large GHG emitters as well as large energy consumers. The TMS was a temporary system that was put in place as a tool to build capacities within the industries and local governments and prepare for the KETS. The KETS was built on the approaches set under the TMS. Even now, the data collected under the TMS is used for compilation of the national inventory.

6.1. Target setting

After a rigorous analysis and consultations with various stakeholders, the target for the program was defined against a BAU scenario. The overall commitment of a 4% emission reduction compared to 2005 levels was turned into a 30% emission reduction compared to the 2020 BAU

[12] Republic of Korea: An emission trading case study, Environment Defense Fund (EDF), International Emissions Trading Association (IETA), Climate change research institute of Korea (CRIK)

levels. The KETS cap for different sectors (as given in the table 1) were then established in line with the national emission reduction target.

6.2. Allocation of allowances

The Government of Korea provided 100% free allowances in the KETS Phase I to all the covered entities to ensure a smooth introduction of the system and not to cause excessive economic burden on the industries involved. The overall cap was set at 1,687 million tCO_2e in Phase I. The allowances were allocated based on the historical emissions of individual entities.

Figure A.2.3 gives the allowances allocated for the different industrial sectors under the KETS in Phase I.

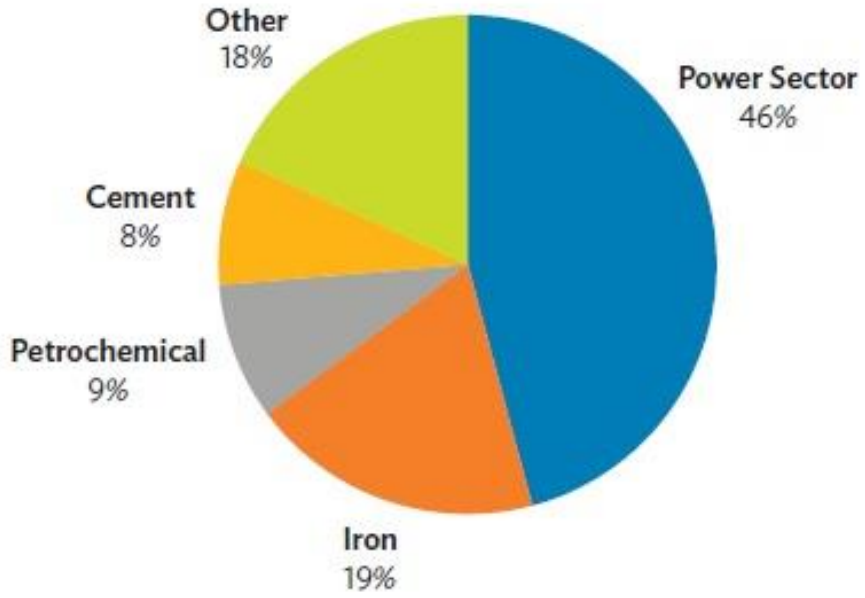

Figure A.2.3. Allocated allowances under the KETS in Phase I

These free allowances are planned to reduce in the subsequent phases i.e., in Phase II 97% allowances will be distributed freely and 3% will be auctioned and in Phase III 90% allowances will be distributed freely and 10% will be auctioned.

The allowance auctions for the Phase II began in 2018 and are open to all KETS covered entities. The MOE prepares and publishes the list of eligible bidders. The auctions are held monthly and a number of conditions are imposed to keep the price within reasonable limits. Particularly, the auctioned allowances are subject to a floor price and no bidder is allowed to purchase more than 30% of the auctioned amount in any auction. The latter provision was added to avoid speculation on the market.

6.3. Emissions reductions and trade of allowances

The total emissions from the each entity is calculated using the formulae

$$\begin{pmatrix} Total\ emissions \\ from\ the\ year\ i \end{pmatrix} = \begin{pmatrix} Electricial\ energy \\ (kWh) \end{pmatrix} \times \begin{matrix} Emission \\ factor \end{matrix} \left(\frac{tCO_2}{kWh}\right) + \left(\begin{pmatrix} Energy\ consumed \\ from\ the \\ fossil\ fuel\ (TJ) \end{pmatrix} \times \begin{pmatrix} Emission\ factor \\ of\ that\ fuel \\ \left(\frac{tCO_2}{TJ}\right) \end{pmatrix} \right)$$

The emission allowances can be sold at the ETS once the entity reduce its emission below the allowances issued by the government. Figure A.2.4 depicts the schematic of the KETS methodology, considering that entities A & B have same amount of emissions in baseline, have same allocated allowance and show different performances at the end of the compliance period.

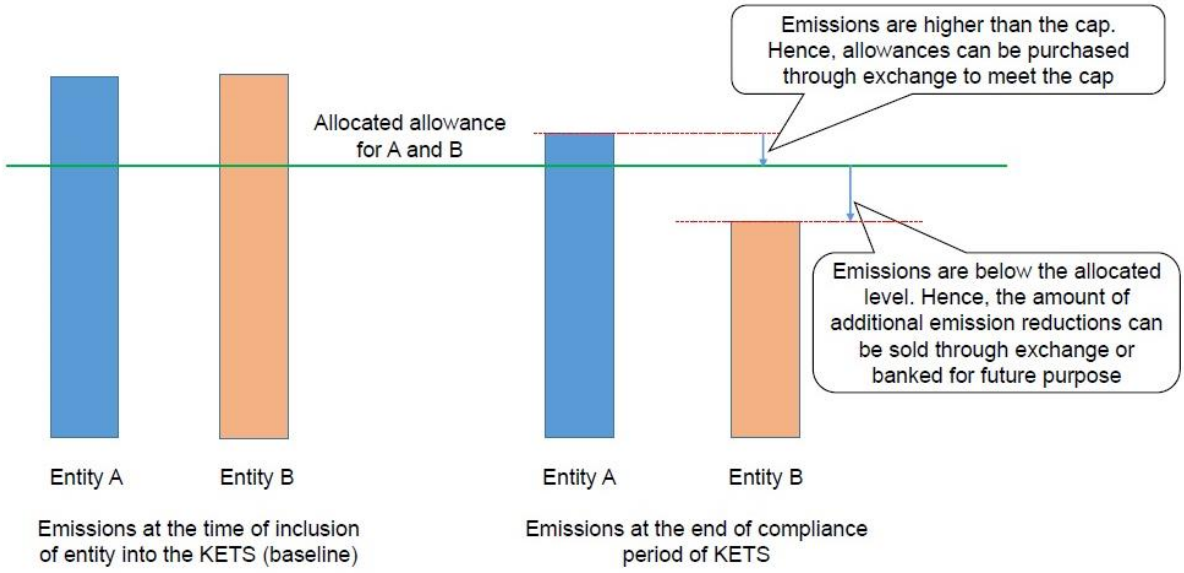

Figure A.2.4. Schematic of KETS methodology

7. Measurement, Reporting and Verification (MRV)

Figure A.2.5 provides the simple schematic of the KETS MRV.

For all activities covered by the KETS, detailed calculation methods, outlining the requirements under all tiers[13] are defined by the regulation. At the star of compliance period, the participating entities have to compile an annual monitoring plan (MP) that includes the following:

- Organizational boundaries
- List of facility emissions, activities and source streams
- Quality assurance (QA) and Quality control (QC) measures
- Monitoring methodologies for each monitored activity
- Explanation of compliance with requested tiers and planned actions in case tiers could not be met.
- Alignment of test result and maintenance report of continuous emissions monitoring system (CEMS), flow meter and other measuring devices related to emission calculation

[13] Tiers' are defined as data accuracy levels of each parameter needed for the determination of emissions

The MP is prepared annually and submitted to the authorities who are responsible for the respective sector. The authorities check and approve the MP. They also keep track of the progress made by the entities in their sector throughout the compliance period.

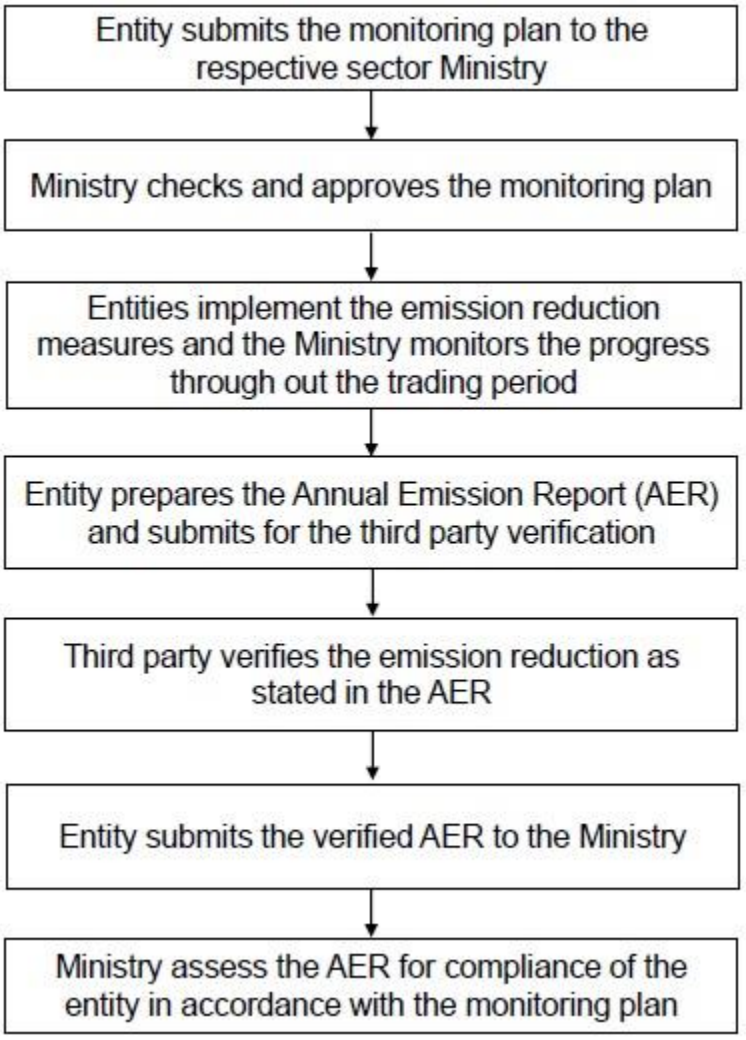

Figure A.2.5. KETS MRV process flowchart

The entities must estimate and report the direct and indirect emissions from their respective facilities. The report must also include a distinction between emissions at the corporation level, business site level, facility level and activity level. A tier system, which is comparable to the system under the EU-ETS, has been established, allowing both, calculation and direct measurement approaches. In parallel, entities are classified into groups based on the type of categories and size of the installation to meet the minimum requirement of uncertainty level (tier) in emission estimation.

The entities conduct quality control (QC) activities on data collection, estimation of GHG emissions, uncertainty management and data management to increase the accuracy of calculation.

At the end of each year (Jan – Dec), each entity must compile an Annual Emission Report (AER) detailing its emissions from all covered emission sources. This report has to be verified by an accredited third-party verifier and submitted to their respective ministry within 3 months from the end of the reporting year. This report is then reviewed by the MOE's Certification Committee. If an entity fails to report its emissions correctly, then the Certification Committee may decide to disqualify the report.

Once the report is approved, the entity may proceed to surrender the allowances to cover its GHG responsibility. This can be done with allowances received through free allocation, purchased on the carbon market, borrowed from the following compliance period or banked from previous compliance years.

The penalty for noncompliance with the KETS is an administrative fine not exceeding three times the average market price per unit of tCO_2e in that year. The maximum penalty is KRW 100,000 per tCO_2e or approximately USD 91 per tCO_2e.

The MOE selected 24 verification bodies, through an accreditation process, to provide third party validation/ verification service under the KETS. By mandating entities to comply with international standard (under the Korean GHG and energy TMS) from the start, they became better prepared to participate in both the KETS and other international carbon markets.

Under the KETS, an information technology (IT) based register, called the GHG Information Registry (GIR) was established and managed by the MOE to record allocation, trading and transfer of emission allowances. In principle, all emission reports are made public.

8. Implementation status

The KETS covers GHGs such as carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per fluorocarbons and sulphur hexafluoride. It also covers the indirect emissions from the electricity consumption. The KETS is implemented in three phases - Phase I: Three years (2015-2017); Phase II: Three years (2018-2020) and Phase III: Five years (2021-2025). For Phase I, 100% of allowances have been freely allocated. In Phase II, 97% of allowances are freely allocated and in Phase III 90% or less allowances will be freely allocated.

For Phase 1, there were 534 entities from 23 business categories across five sectors selected for mandatory participation in the system. The number of entities in 2016 increased to 603, and subsequently reduced to 599 by the end of Phase I (2017).

During the first year of the KETS, approximately 12.9 million tCO_2e credits were traded (representing 2.3% of the 2015 cap) and the sum of the value traded in the Korea Stock Exchange (KRX) and Over-the-Counter exchange market (OTC) was approximately KRW 200 billion.

9. Lessons learnt

The following are the key lessons learnt and takeaway from the KETS scheme.

- Stakeholder inclusion in scheme design: It took the Government of South Korea over 2 years to gain agreement from the industry to launch the KETS. Extensive stakeholder consultation was done to gain support from the private sector. Input was sought when developing the system from more than 100 stakeholder consultations stakeholders from all sectors.

- Developing strong institutional framework: The KETS institutional arrangement went through a number of transformations in an attempt to find the most beneficial way to manage and oversee the system. The responsibilities were variously aggregated and disaggregated and involvement of several government bodies resulted in unclear or even conflicting policy signals.

- Continuous stakeholder engagement: The stakeholder engagement methods are incorporated during introduction of major changes of the system. Public hearings and industry consultations continue to be frequently organized to provide support for KETS participants. The four sectoral ministries organize technical support seminars dedicated for specific industries. In cooperation with the government, a consulting center for small and medium-sized enterprises is operating. In addition to this, the GIR of Korea is conducting annual stakeholder surveys covering approximately half of the KETS participants in each sector to gain their feedback and suggestions related to the system operation. The results are thoroughly reviewed by the government with the intention to implement improvements where it is feasible and reasonable.

- International co-operation and knowledge sharing: As a part of sharing their carbon pricing experience, the People's Republic of China, Japan, and the Government of South Korea held a forum where they explored ways for cooperation and possible options for linkages of the regional markets. In addition to the options for linkages of markets, the Government of South Korea is cooperating with the EU ETS authorities for carbon pricing experience sharing. As a result of this cooperation, in July 2016, the EU–Republic of South Korea (ROK) cooperation project was launched to support the implementation of the KETS. This project aims to share the EU experience and knowledge on ETS operation with key stakeholders in the South Korea.

Annex 3. UK Climate Change Agreement (CCA) for Food Sector

1. Introduction

The Climate Change Agreements (CCAs) implemented by the United Kingdom (UK) are voluntary agreements through which the energy-intensive entities commit themselves to energy savings or emission reduction targets and receive a discount from the Climate Change Levy (CCL) upon fulfilling their commitment. The CCL is a tax on the consumption of electricity (excluding renewable electricity and combined heat and power (CHP), but including nuclear), coal, natural gas and liquefied petroleum gas (LPG).

Although the CCA is a voluntary program, the non-participating entities will have to pay the full tax amount that was imposed for their energy usage. As a tool in a climate-policy-instrument mix, the CCAs mainly correspond to the category of 'energy efficiency and consumption' policy because their focus has been primarily on energy efficiency improvement, rather than the direct carbon emission reductions.

The food and drink processing industry is the fourth biggest industrial energy consumer in the UK. In 2010, it consumed nearly 37 TWh and emitted around 11 million tCO_2 into the atmosphere. Thus, it is one of the key sector under the CCA.

2. Key program features

Scope	Wide sectoral coverage including the industries, buildings, food processing, animal farming, etc.
Mechanism	Carbon pricing (tax) and energy reduction based tax relief
Participation	Voluntary, but non-participation leads to full taxation
Target setting	Two tier in each sector (in terms of energy consumption reduction) – one at sector level and another at facility level
Target period	Two years
Monitoring, Reporting and Verification	Monitoring and reporting is done at facility level. Energy reduction claimed is validated by the sector association and re-checked by the administrating agency
Penalties	Any non-compliance of targets leads to the cancellation of tax relief

3. Legal framework

The legal basis for the CCA is provided by the Finance Act 2000 (as amended), which introduced the CCL and prescribed changes to the excise duties, value added tax, income tax, corporate tax, stamp duty and capital gains tax, etc. Besides introducing the CCL, the Act also outlined the legal foundation for the CCA. In addition, a series of ministerial regulations such as Climate Change

Agreements (administration) Regulations 2012 (as amended), the Environmental Permitting Regulations 2010 (as amended) and the Climate Change Agreements (eligible facilities) Regulations 2012 (as amended) provide detailed guidance and rules for the implementation of the CCA. Table A.3.1 provides the CCL rate for different fuels (as of April 2019).

Table A.3.1. Climate Change Levy rates for different fuels

No.	Fuel type	CCL rate
1	Electricity	0.00847 (£/kWh)
2	Natural gas	0.00339 (£/kWh)
3	Liquefied Petroleum Gas (LPG)	0.02175 (£/kg)
4	Other commodities	0.02653 (£/kg)

The agreements made by the entities under the CCAs have the force of a public law agreement and there are concrete monitoring and enforcement provisions. Once the entities have opted for it, the CCA is considered legally binding for them.

4. Scheme design

Figure A.3.1 gives the simple schematic of CCA.

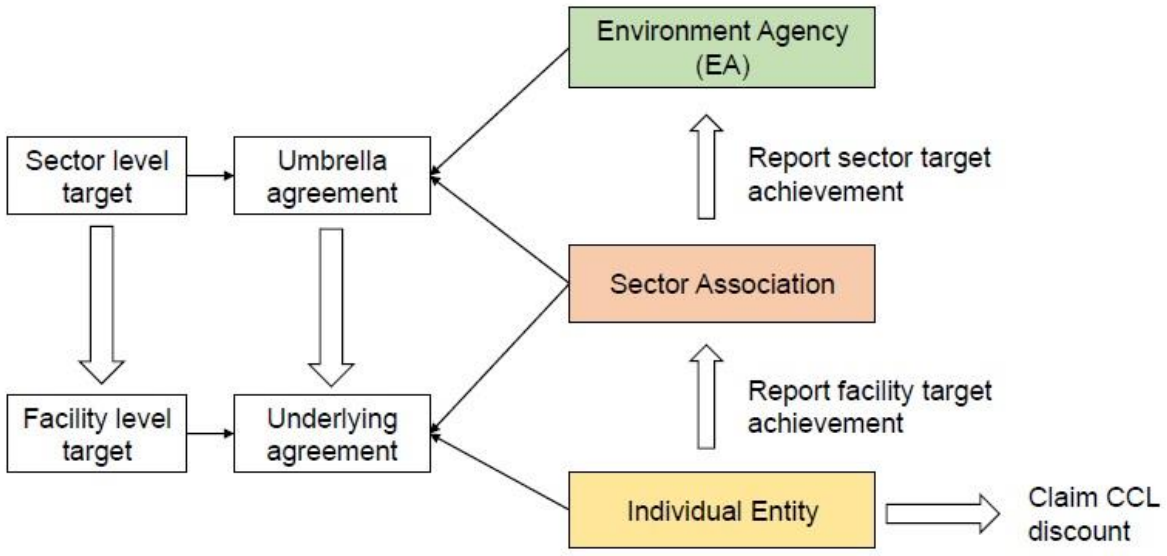

Figure A.3.1. Schematic of CCA scheme

Under this program, voluntary agreements are made between the industrial sector association and the Environment Agency (EA) to the reduce energy use and carbon dioxide (CO_2) emissions in that respective sector. In return, the entities (operators) in that sector will receive a discount on the CCL on fulfilment of the commitment. For operators who hold a CCA, the CCL will be reduced by:

- 90% on electricity bills
- 65% on other fuels

The CCAs are available for a wide range of industry sectors from the major energy-intensive processes such as chemicals, paper and supermarkets to agricultural businesses such as intensive pig and poultry farming. The CCAs are a combination of two types of agreements, following a two-tier structure:

- Umbrella agreements set commitments for eligible industrial sectors ('sector commitments').
- Underlying agreements allow individual operators to set targets for their target units comprising one or more specific facilities (industrial commitments).

The EA and the industrial sector association negotiate and sign the umbrella agreements. Together they agree on the energy efficiency targets for a sector – the sector commitment. The Umbrella agreements also list the processes within the sector that are eligible for a CCA.

The sector associations manage the underlying agreements for operators in their sector. An operator who wants to enter into a CCA must apply to its sector association. An underlying agreement is signed covering a site or group of sites owned by an operator within a particular sector. The agreement contains the energy savings or carbon reduction targets appropriate for their type of operation.

The CCA targets are set and tracked through two-year periods called Target Periods. The Certification Period is the time during which an operator is certified to receive the CCL discount. The discount is given prospectively upon entering into an agreement. If the targets for a given target period are not met by the end of it, the discount is not renewed for the next two-year period (i.e., in the consecutive certification period).

The CCA scheme has four target periods and five certification periods. Each target period is for two calendar years. A target is set for each of these target periods with reference to the operators' base year performance.

The certification period is the two financial years that an operator is certified to receive the CCL discount. The first certification period is based on an operator holding an agreement, even though the operator has yet to meet a target. At the end of a target period, if a target unit meets its target or uses the buy-out mechanism to make good any underperformance against its target, it will remain certified within the CCA scheme for the next certification period. Therefore, the next certification period starts once reporting is complete for the previous target period. If the target is met for the last target period (ending 31 December 2020), the target unit remains certified for the final certification period and eligible to receive the appropriate CCL discount until the end of the scheme in March 2023. Target units that pay the buy-out will also remain certified for the final certification period.

Figure A.3.2 gives the target and certification period for the Phase 2 CCA scheme.

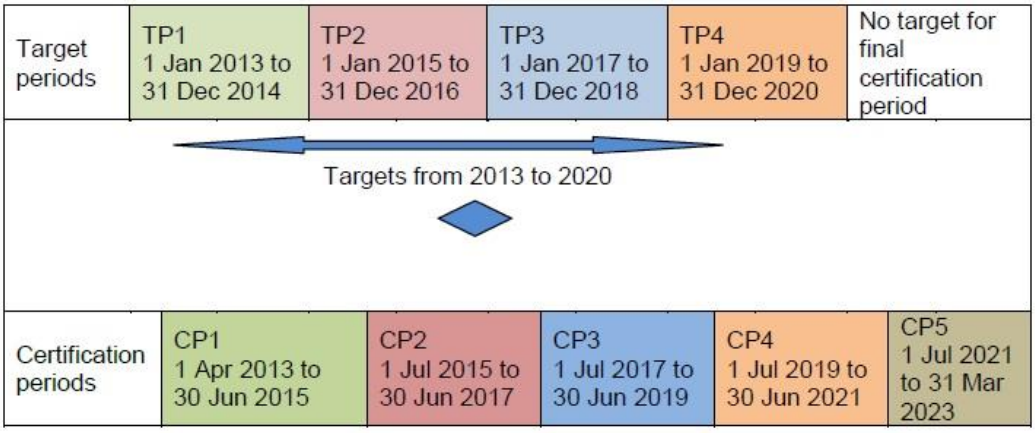

Figure A.3.2. Target and certification period for the CCA scheme (Phase 2)

5. Institutional arrangement

Figure A.3.3 provides the institutional arrangement for the CCA scheme.

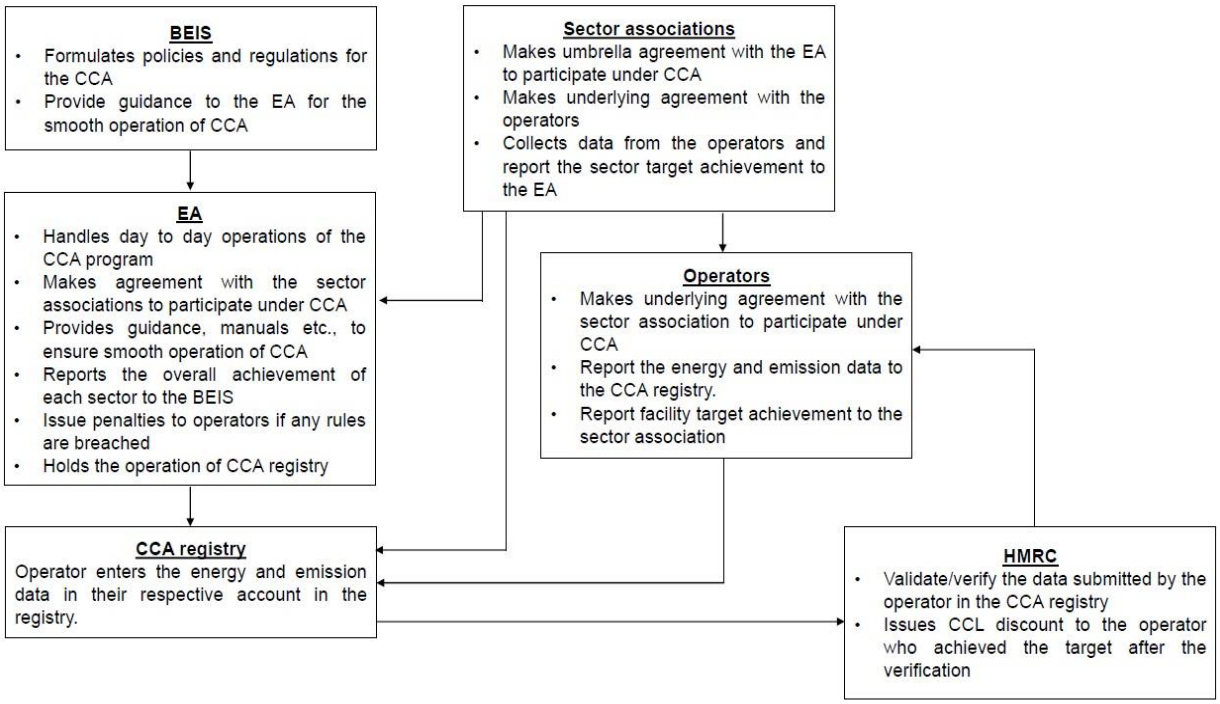

Figure A.3.3. CCA institutional arrangement

A number of different organizations play important roles in the operation of CCA. The key players are as follows:

Department for Business, Energy and Industrial Strategy (BEIS) is the government department responsible for the CCAs. They have the responsibility for policy development and decisions regarding the CCAs and for target negotiations.

Environment Agency (EA) administers the CCAs on behalf of the BEIS. It is responsible for the day to day operation of CCAs, using the policy set by the BEIS. It is responsible for registering every CCA and ensuring that every operator complies with the requirements of the CCAs. It is also responsible for issuing penalties to any operator who have breached the rules set in the CCAs.

Her Majesty's Revenue and Customs (HMRC) are responsible for checking proper claiming of the CCL discount.

The BEIS and the EA are supported by a Technical Consultant to validate/verify the eligibility information in application forms and the energy data submitted by the operators under the CCA.

The Government has set up the CCAs based on the "industry sector groups". There are separate CCAs for each main industrial sector. This approach allows the CCA targets to be customized to the circumstances of each industrial sector. A "lead body" in each sector, usually the relevant sector association, is responsible for operating their sector's CCA. The sector associations play the following role:

- Negotiate the sector targets and sign umbrella agreements with the EA
- Facilitate the negotiation of underlying agreements for operators in their sector
- Collect and report required data bi-annually, including checking the quality of the data submitted by the operators in their sector

There are currently 51 separate sector covering around 10,000 individual sites under the CCA[14].

The **Food and Drink Federation (FDF)** manages the CCA for the food and drink sector and acts as the key point of contact for negotiations between the sector, the BEIS and the EA. They play a crucial strategic role to ensure that the CCA rules are fair and reasonable for operators in the food and drink sector and that the targets are set in a fair and appropriate way.

The role of entities in the sector (operators) are:

- Work with their sector association to develop appropriate targets
- Measure and report its energy use and carbon emissions against agreed targets
- Collect and report data bi-annually
- Take measures to meet its own targets

In order to carry out the detailed administration of the umbrella targets under the sector associations, a technical consultant is engaged. The consultant is responsible for all the "day to day" activities such as processing applications, dealing with variations, gathering annual energy and production data from each operator and ensuring operators who fail to meet a target are given appropriate information so that they can take the actions to retain the CCL discount. The consultant also provides on-going technical and administrative support to the operators via a telephone help desk and a dedicated CCA website page.

6. Methodology

Figure A.3.4 depicts the flowchart for the methodology followed in the CCA.

6.1. Defining the site boundary

[14] A list of sectors under the CCA is given in the below link.
https://www.gov.uk/climate-change-agreements--2#sector-associations-with-ccas

In CCA, a site managed by the operator is defined as an area of land falling within a continuous boundary which encloses the land used in connection with a production process. For this purpose, however, an area of land can still be regarded as a single site even if it is dissected by a road, railway line or river. Other non-contiguous parcels of land would not, however, constitute a single site.

6.2. Calculation of energy consumption

Activities on the site are divided into three categories in terms of their energy consumption viz. Stationary Technical Unit (STU), Directly Associated Activities (DAA) and other activities. Figure A.3.5 shows the three key activities on the site in terms of their energy consumption.

The energy consumption is calculated and divided based on the site's primary energy consumption. The STU and DAAs together form the eligible installation or process. Activities that are directly associated with the eligible process (STU) and on the same site as the STU must be included in the installation and the energy consumed by all such activities must, therefore, be reported. It is to be noted that energy consumption by any processes that are already covered under any other GHG reduction program such as EU ETS, must not be included under the energy consumption of the site.

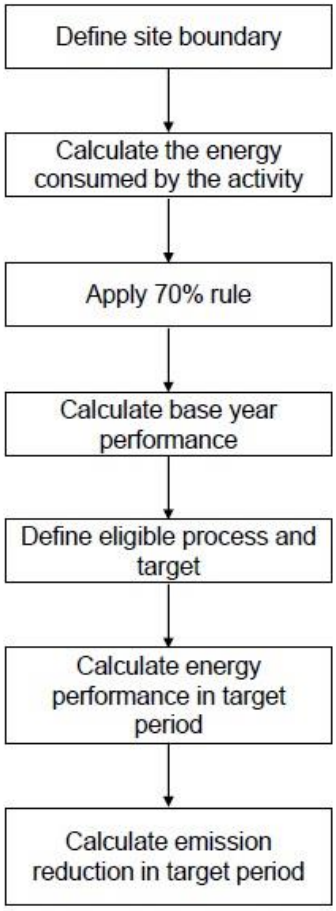

Figure A.3.4. Methodology followed in the CCA scheme

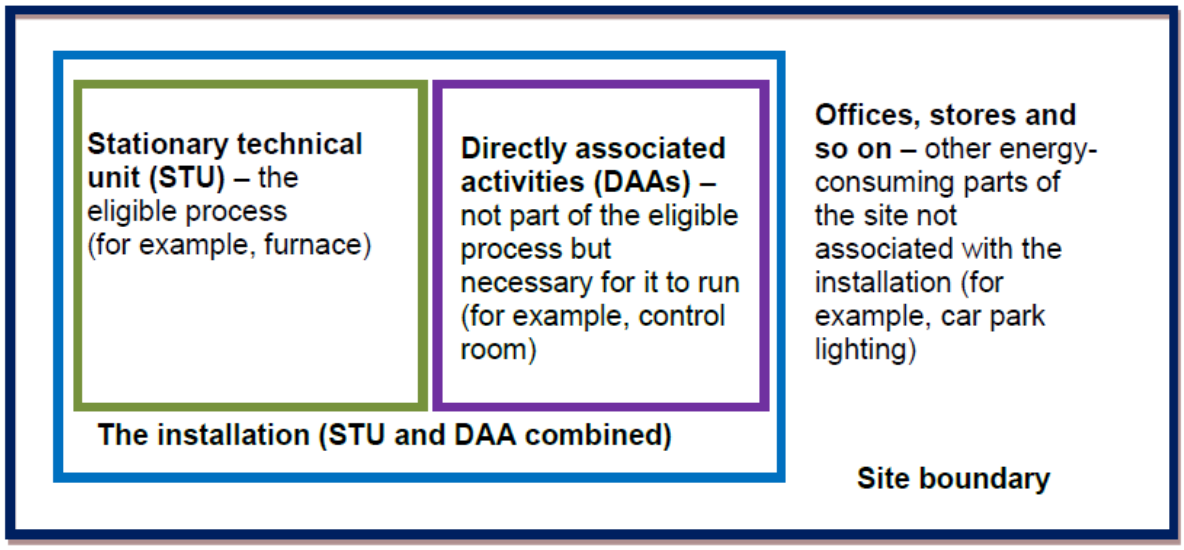

Figure A.3.5. Activities at site for energy consumption monitoring

The energy consumption at the site is calculated using the formulae below:

a) Fossil fuel consumption

The energy consumed from different fossil fuel use is calculated as,

$$\begin{pmatrix} Fossil\ fuel \\ consumption \\ (kWh\ of\ fuel) \end{pmatrix} = \begin{pmatrix} Quantity\ of\ fuel\ type\ 1\ \times \\ Gross\ calorific\ value\ of \\ type\ 1\ fuel \end{pmatrix} + \begin{pmatrix} Quantity\ of\ fuel\ type\ 2\ \times \\ Gross\ calorific\ value\ of \\ type\ 2\ fuel \end{pmatrix} + \cdots n$$

b) Electricity import

For the electricity import, the primary energy (fossil fuel) consumed in generating that electricity is considered as stated below.

$$\begin{pmatrix} Fossil\ fuel \\ consumption \\ (kWh\ of\ fuel) \end{pmatrix} = \frac{\begin{pmatrix} Quantity\ of\ electricity\ consumed\ through\ grid, \\ RE\ and\ captive\ power\ plant\ (kWh\ of\ fuel) \end{pmatrix}}{\begin{pmatrix} Efficiency\ of\ power\ generation\ \ and \\ from\ each\ of\ the\ source\ distribution \end{pmatrix}}$$

c) Heat generation from the renewable energy (RE) and waste fuel sources

The thermal energy consumed from different RE and waste fuels is calculated as,

$$\begin{pmatrix} Heat\ generation\ by \\ RE\ and\ waste\ fuels \\ (kWh\ of\ fuel) \end{pmatrix} = \begin{pmatrix} Quantity\ of\ fuel\ consumed \\ (kg) \end{pmatrix} \times \begin{pmatrix} GCV\ of\ the\ fuel \\ (kWh/kg) \end{pmatrix}$$

In case of mixed fuel use i.e., RE sources mixed with the fossil fuel sources,

$$\begin{pmatrix} Heat\ generation \\ by\ mixed\ fuels \\ (kWh\ of\ fuel) \end{pmatrix} = \left(\frac{\begin{matrix} Quantity\ of\ energy \\ consumed\ in\ a\ facility \end{matrix}}{\begin{matrix} Total\ energy \\ generated \end{matrix}} \right) \times \begin{pmatrix} total\ quantity\ of \\ fuel\ consumed \end{pmatrix} \times \%\ of\ fuel\ mix$$

d) Combined heat and power (CHP)

Three scenarios were considered if the site utilizes energy from CHP.

- CHP – where all fuel input is non-renewable
- CHP – where all fuel input is renewable
- CHP – where fuel input is a mix of renewable and non-renewable

When all fuel input is non-renewable:

- Where all the electricity or heat outputs from a CHP plant (located within the site or outside) are consumed within the target site, the energy to be reported must be calculated on the basis of total energy input to the CHP plant.

- Where a target site is served by a CHP plant that serve a number of consumers, the energy input to the CHP must be allocated to each consumer of the heat or the electricity and the energy input for the target site must be taken in to account.

When all the fuel input is renewable:

If the fuel input to the CHP is 100% renewable, all of the electricity and heat outputs of the CHP must be considered as RE. This means that consumption of all of this electricity will be treated as grid electricity. Consumption of CHP heat will lead to the reporting of primary energy consumption (in the form of some of the input fuels), but this energy consumption will be zero rated for carbon.

For a CHP where the fuel inputs are 100% renewable, the primary energy for CHP heat is calculated as follows:

$$\begin{pmatrix} Primary\ energy\ for \\ CHP\ heat \\ (kWh\ of\ fuel) \end{pmatrix} = \begin{pmatrix} Total\ fuel\ input \\ to\ CHP \\ (kWh\ of\ fuel) \end{pmatrix} - \begin{pmatrix} Total\ power\ output \\ from\ CHP \\ (kWh) \end{pmatrix} \times 2.6$$

When fuel input is a mix of renewable and non-renewable energy sources:

If the fuel input to the CHP is not 100% renewable, then a proportion of the electricity/heat output must be treated as renewable and the balance as non-renewable. The proportion of the electricity/heat output that is treated as renewable must be the same as the proportion of the fuel input that is deemed renewable, on an energy content basis.

e) Energy from steam

As energy is accounted for on a primary energy basis in the CCA scheme, it is the fuel used to generate the steam consumed in the eligible process that is accounted for, rather than the energy content (enthalpy) of the steam itself.

f) Accounting for Oxygen

The energy equivalent (provided by the CCA guidelines) is used for the Oxygen, when it is generated within a site for consumption in the eligible process. When Oxygen is imported for consumption in a site, then its energy content is considered as zero.

g) Accounting for Liquid nitrogen or solid CO_2 used for cooling

When liquid nitrogen or solid carbon dioxide (CO_2) is imported to perform a cooling function in a site, an energy equivalent (provided by the CCA guidelines) is used for the imported liquid nitrogen or solid carbon dioxide. The energy will be considered as zero when the imported liquid nitrogen or solid carbon dioxide is used for other than the cooling function.

h) Accounting for transport fuel

It is optional to include the transport fuel in total energy consumption of the site. When choosing to include fuel used by vehicles in the eligible process, the operators should take into account the following.

- Once the choice has been made to include fuel consumed by vehicles in the base year data, this fuel must be reported at future target periods and vice versa.
- Only fuel consumed by vehicles operating on site can be included.
- Operators must therefore be able to distinguish between fuels consumed by vehicles when they operate on site from that consumed if they operate off site.
- If the operator feels unable to meet any of these requirements, fuels consumed by vehicles should be left out of the eligible process energy consumption.

The energy content from the following scenarios are not accounted under the CCA:

- Fuel used as a chemical feedstock
- Heat recovered from exothermic reactions
- Electricity generated from recovered heat

6.3. Applying the 70% rule

Figure A.3.6 depicts the procedure for applying 70% rule in CCA.

The basic principles of the 70% rule is as follows:

- If the eligible process consumes 70% or more of the site's total primary energy, an operator is allowed to include 100% of site's energy consumption under the CCA.

- If the eligible process consumes less than 70% of the site's total primary energy, an operator is allowed to claim the eligible process energy consumption, plus energy consumed by other processes on site up to a value equal to an additional $3/7^{th}$ of the eligible process energy consumption under the CCA. However, both the eligible process and any additional energy claimed under the $3/7^{th}$ provision must be separately sub-metered.

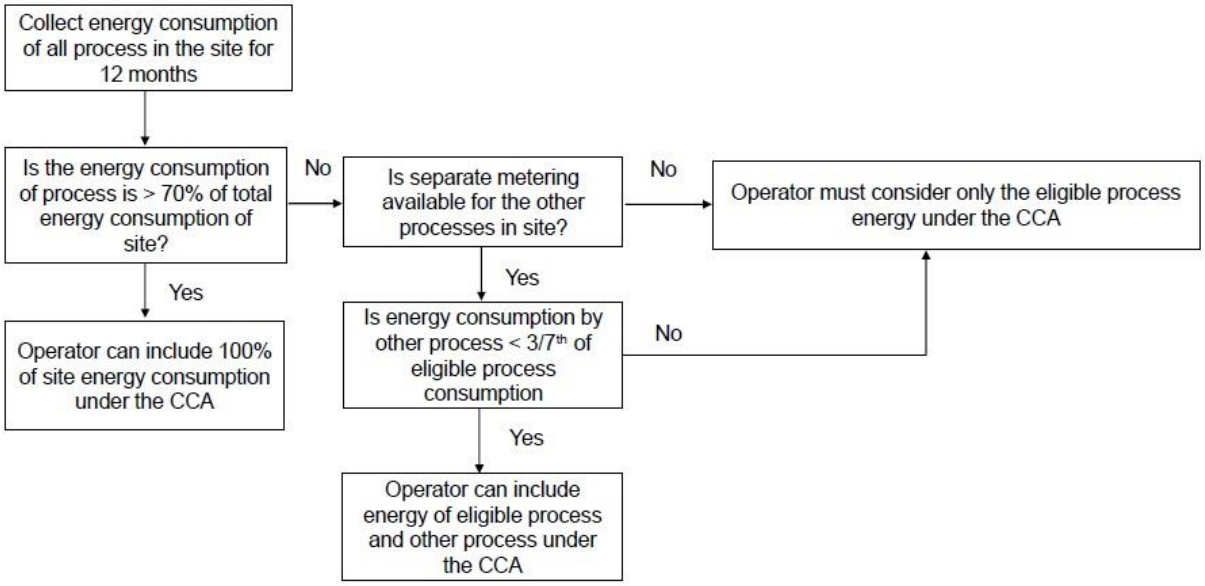

Figure A.3.6. Procedure for 70% rule in CCA

Before applying to the CCA scheme, an operator should estimate the energy consumed by the installation over the previous 12 months using any existing sub-meters, spot metering or calculation based on the equipment rating and the operating hours. The methodology for any estimation must be site-specific and set out clearly when the site eligibility application in the CCA register is completed.

6.4. CCA target setting for a site

Under the CCA scheme, two level of targets are fixed i.e., at the sector level (sector commitment) and at the operator level (target unit target). The sector commitments are agreed between the BEIS and the sector associations in 2012 and form the overall energy consumption or emission reduction percentage improvement until 2020. The commitment for each sector is stated in the sector's umbrella agreement. All operators who hold an underlying agreement have a target for their sites.

The CCA scheme may express the target in terms of energy or emission units. Therefore, four types of targets are possible in the CCA scheme and are as follows:

1. relative energy (for example, kWh/m^2)
2. absolute energy (for example, MWh)
3. relative carbon (for example, kgC/ton)
4. absolute carbon (for example, tons of Carbon)

For the energy targets, kWh is the most commonly used unit because it is the unit most frequently used in metering the main types of energy (electricity and gas). Target for the operators must be the same type (carbon or energy) as the sector commitment (or sub-sector commitment where a sector has sub-sectors). For example, where a sector commitment is in relative energy terms (kWh/m^2), an operator must choose either a relative energy or an absolute energy (MWh) target but can't choose a carbon target.

The operators should work with their sector association in selecting a suitable target for their operation. Once the underlying agreement is signed, it is not possible to request a change to the type of target.

The sector commitment (or sub-sector commitment if applicable) is used to set the percentage improvement target for a site when,

- A site or group of sites is entirely new to the scheme and becomes a target unit.
- A site formerly covered by the umbrella agreement of a different sector is moved into a new sector and becomes a target unit in that new sector.

The new site that comes under CCA with 2008 as the base year are expected to adopt the target profile agreed for the sector as a whole. The target profile is based on reporting performance at the end of each 24-month target period to 2020. For example, the sector target profile could be 3% by 2014, 7% by 2016, 11% by 2018 and 15% by 2020. When a facility is joining the CCA scheme in 2017 with 2008 as a base year, then the site will have a target of 11% by 2018 and 15% by 2020.

The target profile for new sites that don't have 2008 as their base year is calculated differently. For example, if base year was 2015 for a site, it will be assumed that the site has already reached the required savings for the sector from 2008. Using the example sector target profile from above, 2015 is midway between the 2014 (3%) and 2016 (7%) targets, that is, 5% savings from 2008 is set as a target for that facility. The remaining targets are calculated by linear interpolation for the sites.

New entrants cannot join the scheme during the last two months of a target period. This means that all new entrant applications have to be processed by the administrator on or before the 31st October of every target period. Any new entrant applications which cannot be processed by this date will have to wait until start of next target period to be able to join the scheme.

The CCA scheme has 'Target calculator' workbook tool to calculate the target for the any site. The operators can use Novem methodology to calculate the target when a mix of products are produced in a site. In Novem method the energy used for the actual production in the target period is compared with the energy that would have been used if the same level of production and mix of products had been produced in the base year, but with the base year's level of energy efficiency. The procedure for the target calculation in Novem methodology is given below.

The baseline energy consumption of the site is calculated as,

$$\begin{pmatrix} Baseline\ energy \\ consumption \end{pmatrix} = \begin{pmatrix} Individual\ energy \\ consumption\ for\ product\ 1 \end{pmatrix} + \begin{pmatrix} Individual\ energy \\ consumption\ for\ product\ 2 \end{pmatrix} + \cdots n$$

The target year energy consumption of the site is calculated as,

$$\begin{pmatrix} Target\ year\ energy \\ consumption \end{pmatrix} = \begin{pmatrix} Individual\ energy \\ consumption\ for\ product\ 1 \end{pmatrix} \times \begin{pmatrix} percentage\ target\ of \\ product\ 1 \end{pmatrix} +$$

$$\begin{pmatrix} Individual\ energy \\ consumption\ for\ product\ 2 \end{pmatrix} \times \begin{pmatrix} percentage\ target\ of \\ product\ 2 \end{pmatrix} + \cdots n$$

The target energy reduction of the site is estimated as,

$$\begin{pmatrix} Target\ energy\ reduction \\ \% \end{pmatrix} = 1 - \left(\frac{Target\ year\ energy\ consumption}{Baseline\ year\ energy\ consumption}\right)$$

The actual energy reduction target for the site by Novem method is calculated as,

$$\begin{pmatrix} Actual\ energy\ reduction \\ in\ a\ facility, \% \end{pmatrix} = 1 - \left(\frac{Actual\ energy\ consumption\ in\ target\ year}{Baseline\ year\ energy\ consumption}\right)$$

The CCL discount will be given to the site if the actual energy reduction is greater than the target energy reduction in the target year.

6.5. Calculation of base year performance

Ideally the base year should be the continuous 12-month period from January to December 2008. If not, it should be the next available 12-month period starting during or after 2008. If the operator of a site isn't able to use 2008 as its base year, the operator will need to provide justification. If a structural change has occurred, then the 2008 base year should be reconstructed where possible.

A greenfield site is a special case. A site can apply to join the CCA scheme as a greenfield within 12 months of starting to undertake the eligible process. It will be given an agreement as soon as it is able to commence the collection of data necessary to establish a representative base year performance. This base year data must be complete and made available 12 months after the date of its agreement.

The baseline of the site is calculated in terms of absolute energy as given below:

$$\begin{pmatrix} Baseline\ energy \\ consumption \\ (kWh\ of\ fuel) \end{pmatrix} = \begin{pmatrix} Sum\ of\ primary\ energy\ from \\ fossil\ fuels\ used, electricity \\ and\ any\ other\ primary\ energy \\ associated\ with\ the\ activities \\ within\ the\ site \\ (kWh\ of\ fuel) \end{pmatrix} - \begin{pmatrix} Energy\ consumed\ by\ the \\ processes\ to\ carry\ out \\ activites\ for\ the \\ GHG\ reductions\ in \\ EU\ ETS\ scheme \\ (kWh\ of\ fuel) \end{pmatrix}$$

6.6. Emission calculation

The total number of units of carbon emitted from a target facility during a target period must be calculated by multiplying the units of energy consumed in each fuel used in the target facility during the relevant target period, by the relevant carbon emission factor set out for that fuel.

The total carbon emissions is calculated as,

$$Carbon\ emissions\ (kgC) = Total\ energy\ (kWh) \times carbon\ emission\ factor\ \left(\frac{kgC}{kWh}\right)$$

Figure A.3.7 depicts the procedure for giving CCL discount for achieving the energy reduction by an operator under the CCA scheme.

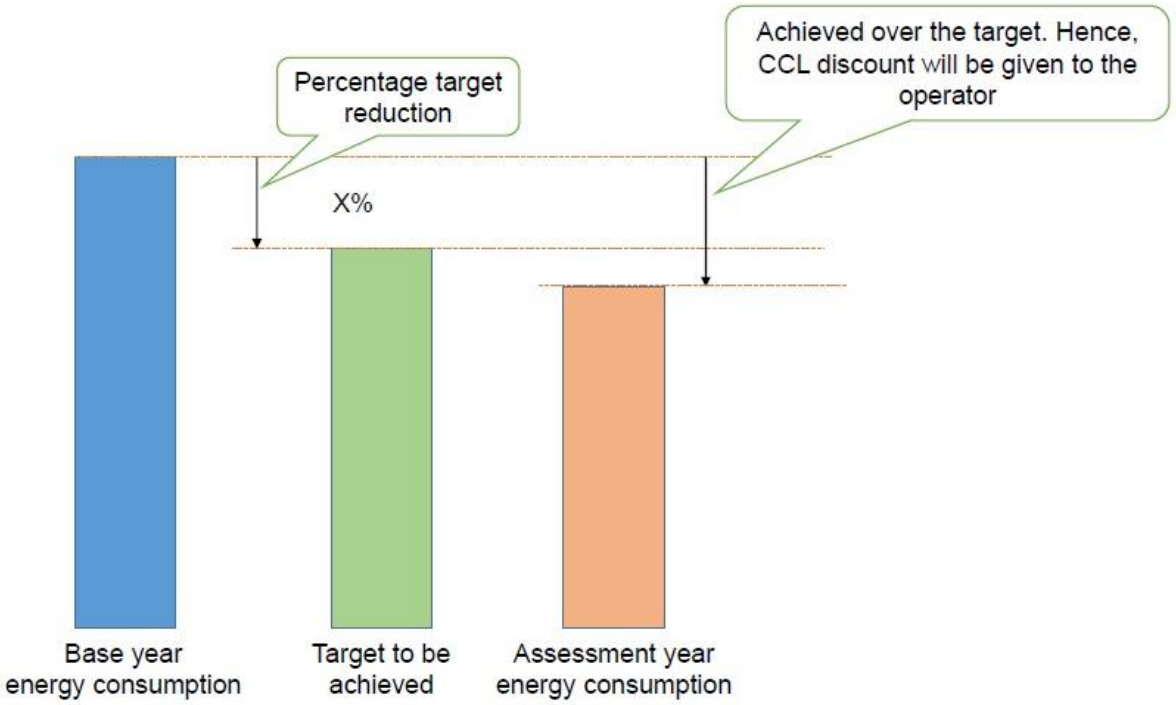

Figure A.3.7. Methodology for CCL discount for an operator

To enhance fairness and accountability, the compliance standards have been set at individual liability, meaning that the operator are required to meet their own targets in order to qualify for compliance, regardless of whether the sector as a whole has met its target or not.

7. Measurement, Reporting and Verification (MRV)

The CCA has set up rules and processes for monitoring and enforcement. At the end of each target period, energy consumption, production and other related data for every site of an operator must be reported through the online register. Audits on selected sites and sector associations are carried out to verify eligibility and performance. This selection of site is made by either a risk-based approach or random selection. The assessment may be desktop-based or a full-site audit.

A set of workbooks is available to assist the operators with the calculations needed for reporting and to present performance data in a standardized format. The reporting of all data for the target period is made through on-line registry and the individual site performance data are disclosed publicly.

The operators who meet or overachieve their target are automatically re-certified for the next certification period. Overachievement is converted into a carbon dioxide equivalent (CO_2e) which is banked on the register for that operator. This banked CO_2e can be used by the operator in the subsequent target periods to offset any underperformance.

An operator that does not achieve its target and cannot fill the gap between actual performance and target performance with previously banked CO_2e, will need to pay for re-certification.

There are also financial penalties for minor infringements, e.g., missed reporting deadlines or inaccuracies in data. For instance, if an operator fails to provide the request information by the

given deadline or fail to inform the government any changes as required by the underlying agreement, a penalty which is the amount of the greater of GBP 250 (EUR 278) or 10% of the annual value of its CCL discount would apply. Furthermore, if an operator provides inaccurate baseline data or target period data, the penalty is based on the extent of inaccuracy i.e., the greater of GBP 250 (EUR 278) or GBP 12 (EUR 14) per ton of CO_2 of the difference would apply.

8. Implementation status

The phase 1 of the scheme was for the period from 2001 till March 2013. The phase 2 of the scheme is being administered from 1 April 2013 until 31 March 2023.

When launched in 2001, the CCA scheme initially covered 44 sectors, around 12,000 sites (5,500 operators) and nearly 44% of total UK industry emissions. In the latest target period reported, 49 industrial sectors encompassing 7,814 sites were covered by the CCA, emitting approximately 25 million tCO_2e in the base year 2008.

The phase 2 of scheme applies to 51 sectors with around 4,300 operators covering some 9,900 sites. This phase 2 of CCA will lead to an energy efficiency improvement of 11% in the UK's major energy intensive industries by 2020. Targets widely vary across the industrial sectors ranging from 2% to 25%. Table A.3.2 shows the emission reductions from the baseline year in phase 1 and phase 2 of the program.

Table A.3.2. Reported emission reductions against baseline emissions

Target period	Emission reduction achieved (million tCO_2/y)
TP1, Phase 1	10.4
TP2, Phase 1	8.9
TP3, Phase 1	7.3
TP4, Phase 1	9.2
TP5, Phase 1	10.5
TP1, Phase 2	3.1
TP2, Phase 2	4.9

The Food and Drink (FDF) Federation's "Ambition 2025", initially launched in 2007, brought together businesses across the food and drink manufacturing sector to work together in reducing their environmental impact by promoting more efficient use of water, reducing packaging, embedding environmental standards in transport practices and eliminating food waste to landfill. Having met its 2020 target over five years early and reporting a 46% reduction in 2015 from a 1990 baseline, a new target of a reduction in emissions by 55% by 2025 against 1990 baseline

levels has now been set[15]. The Ambition 2025 seeks to continue its work and further improve resource efficiencies and address the wider sustainability agenda for the sector i.e., to de-carbonizing the whole food and drink value chain, from farms to manufacturers to consumers.

9. Lessons learnt

Following are the lessons learnt on implementation and operation of UK CCA for food sector:

- A stick and carrot approach: A unique feature that distinguishes the CCA from other voluntary climate policy instruments is its stick-and-carrot approach. Despite its participation being fully voluntary, the CCA is embedded in a broad policy package (i.e. with CCL), where the cost of not participating (i.e. paying full rate under CCL) is a clear, and provides a strong incentive to participate.

- Target structure and setting: Another creative feature of the CCA is its two-tier structure: the combination of sector targets and individual targets. Rather than relying on direct government-company interactions, the sector associations' involvement streamlines communication processes, enhance administrative efficiency and offer sector-specific expertise. Despite these positive effects, cautious attitude must be taken, especially regarding their role in the target negotiations and target setting because they could also play a lobbying role in protecting the companies under them (who wish to avoid 'environmental policy burdens').

- Clear MRV rules and timelines: The CCA has set up a system to monitor and assess target achievements and sanctions for non-compliance, including both disqualification of the levy discount for the following compliance period and financial penalties in case of minor infringements. Besides defining a clear timeline, rules and processes for monitoring and reporting, the government also makes the target assessment results transparent, which increases credibility and accountability. The technical support and service provided by a qualified third-party has proven as key for validating and verifying submitted data and information. In addition, the use of an electronic register further enhances administrative efficiency; reduces costs (for both administrator and participants) and improves the data quality checking process, i.e. automating some data consistency cross checks and identifying missing data.

- Simplification, streamlining and reducing policy overlap: As a policy that works with relatively broad base sectors and a large number of participants, it is important for the CCA to be continuously improved by simplifying, streamlining and addressing policy overlap. Some key examples are as follows:
  - Removing overlaps with the EU Emission Trading System (ETS) and the Carbon Reduction Commitment (CRC)[16];
  - Streamlining the content of agreements, baseline years (i.e., from different baseline year to a single baseline year) and administration (i.e. moving from BEIS to the EA, which already administrates EU ETS and the CRC);

- Effective enabling environment: Besides the 'stick-and-carrot' approach itself, mandatory carbon budgets provide a strong enabling environment for voluntary agreements to perform

[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/ 651970/food-and-drink-decarbonisation-action-plan.pdf

[16] The Carbon Reduction Commitment (CRC) scheme of UK is applicable to the organizations that have a half-hourly metered electricity consumption greater than 6,000 MWh per year.

more effectively. The Climate Change Act provides both a statutory long-term target (for 2050) and a set of statutory medium-term targets (over a period five years). It also assigns the Committee on Climate Change (CCC) to produce independent annual progress reports with details on whether or not the government is on track to stay under its carbon budgets. The reports are debated in Parliament and the government has a statutory obligation to respond. This creates a binding process to hold government to account not just to Parliament but to third parties and, potentially, to the courts (i.e. a judicial review).