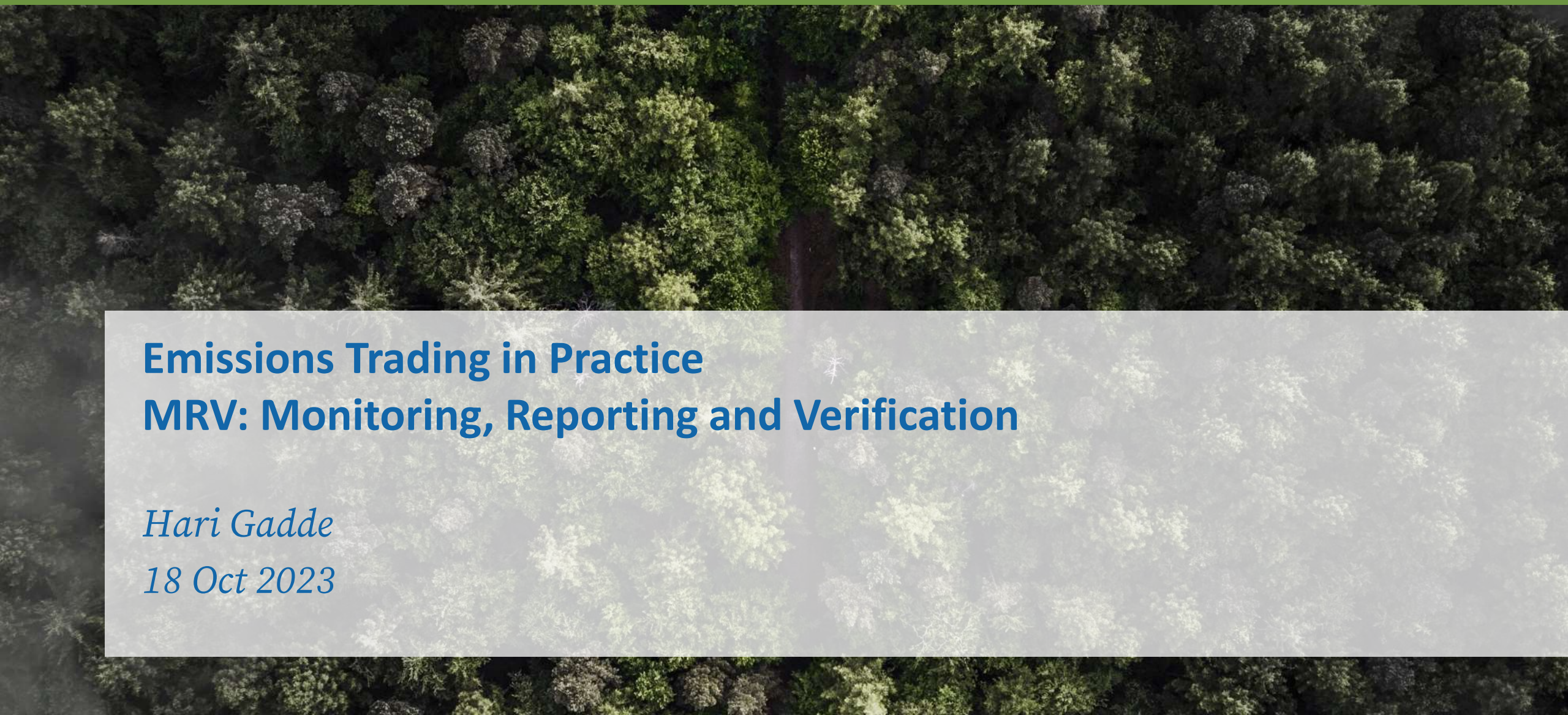

Emissions Trading in Practice
MRV: Monitoring, Reporting and Verification

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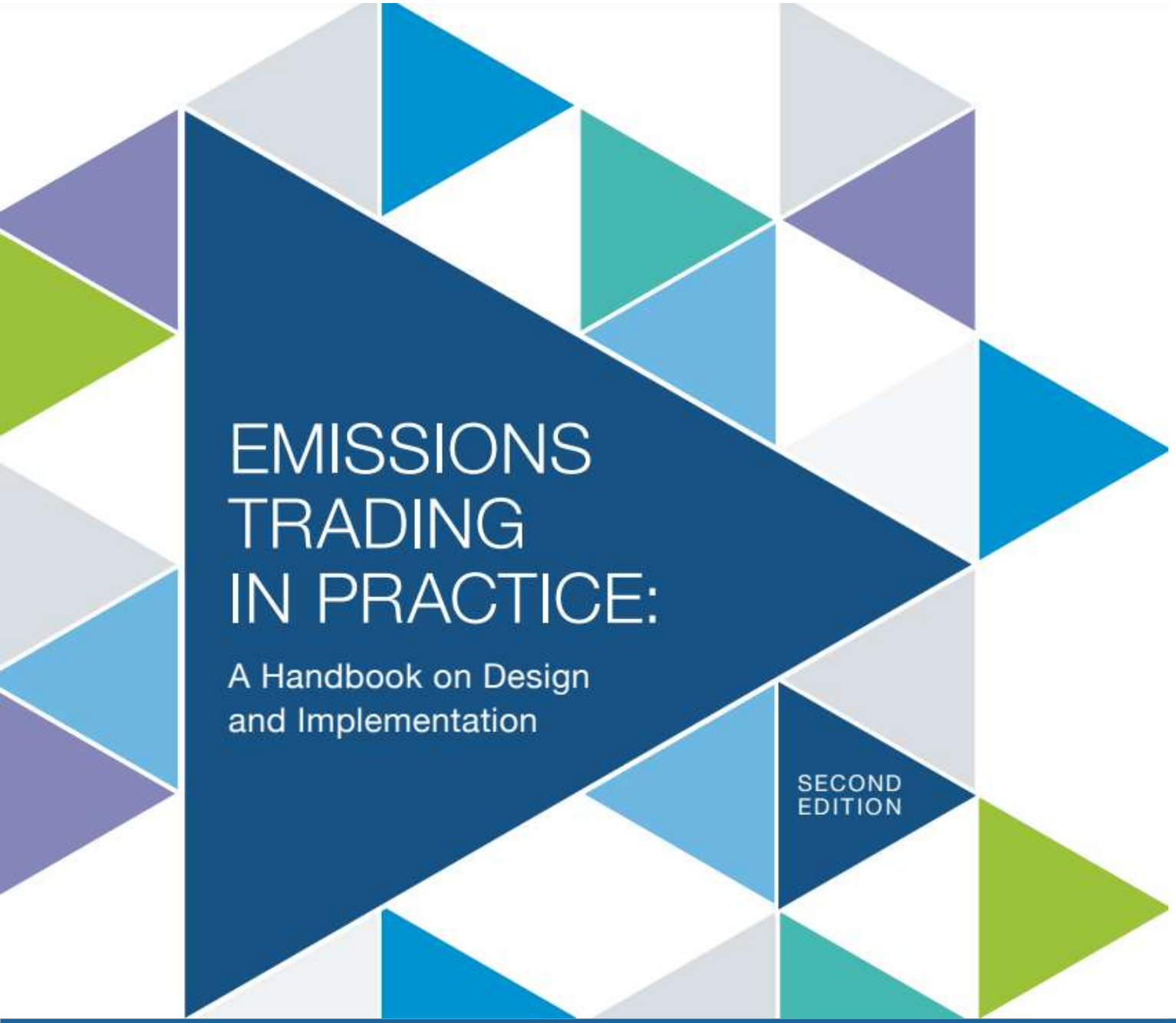
18 Oct 2023



ICAP-PMR ETS Handbook

Learning objectives

- Be able to identify the regulated entities
- Understand how to manage emissions reporting by regulated entities
- Understand how to approve and manage the performance of verifiers
- Know how to establish and oversee an ETS registry
- Understand the design and implementation of the penalty and enforcement approach

Agenda

1. Developing a legal framework
2. Managing the reporting cycle
3. Managing the performance of verifiers
4. Designing an enforcement approach
5. Developing an ETS registry

We are not starting from scratch...

- Every country has some experience with MRV, not necessarily with tCO2
- Environmental legislation and regulation by a competent authority (regulator)
- The need for permits to operate (approved by the competent authority)
- Operator ‘self-monitoring’ (as well as any ‘check-monitoring’ arranged by the competent authority)
- Operation and maintenance of emissions monitoring systems
- QC/QA (Quality Control and Quality Assurance)
- Reporting

How do we transition from a system based on emission limit values to a system based on financial incentive??

A robust, reliable and transparent MRV is key for the successful operation of an ETS

Any MRV should ensure...

- **Completeness**: all emission sources and activities within the scope shall be reported.
- **Consistency**: Consistent methodologies shall be used over time
- **Comparability**: Methodologies have to be internally comparable between the covered participants
- **Transparency**: Methodologies and assumptions are clearly explained, unambiguous and are documented transparently
- **Accuracy**: Uncertainties must be reduced as far as practicable

Complete monitoring and reporting with respect to the scope of the ETS and to emission sources and source streams on installation or entity level are a prerequisite to guarantee for example that reduction targets are not weakened e.g., by loopholes.

- **Enforcing the regulation** to that end is essential to create a robust ETS

Role of law in ETS design and implementation

An ETS imposes constraints on the economic freedom of regulated entities, which is why its introduction generally requires a formal mandate. In most jurisdictions, a firm basis in statutory law is vital for the exercise of public authority.

A robust legal framework includes:

- **Initial mandate** authorizing the establishment of the ETS
- Legal **operationalization** of key design parameters
- **Enforcement** of compliance obligations

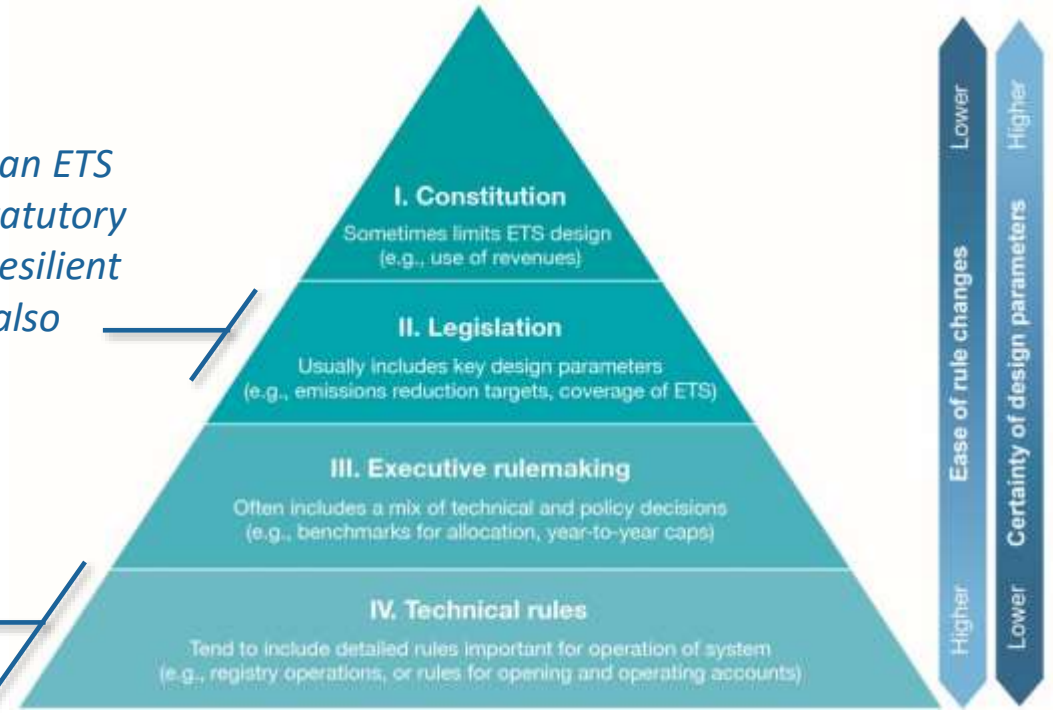
Overarching compliance and monitoring structure

Role of law in ETS design and implementation

Each jurisdiction's constitutional and broader legal framework will determine how the ETS is legislated, who must be involved, and the timeline for implementation

- *Design features of an ETS set out in formal statutory law may be more resilient to change but are also harder to amend.*

- *Technical guidance that require frequent updating (i.e., benchmarks or MRV rules) are commonly adopted in flexible regulations*



Legal framework in California

California's legislation AB 32

- Specifies the overall emissions reduction target from the ETS and a **high-level overview** of the features of the ETS — for example, the start date and duration, the existence of an auction system, and the development of offsets
- **Provides authority** to the California Air Resources Board (CARB) to establish the technical guidance and operational rules for the ETS

CARB Regulation

- Inclusion thresholds for covered entities
- Allowance allocation and auctions
- Compliance and market monitoring
- Cost containment
- Use of offset credits

Identifying and managing legal entities

Identifying the regulated legal entities

- Legal entities in an ETS are those that are responsible for emissions and ensuring compliance with ETS legislation
  - Usually corporations, individuals or government entities responsible for the installations and/or operations covered by the ETS
- Two main approaches to identifying the regulated entities:
  1. **Self-nomination** by the entities that fall under the conditions of coverage established in the regulation
  2. **Regulator's own research**
- Once identified, regulated entities are included on a **public list** for transparency and clarity

Identifying and managing legal entities

Leveraging existing reporting frameworks with regulated entities

- Policy makers may benefit from building on **existing regulatory relationships** with entities and with other government departments and industry associations

Managing regulated entities over time

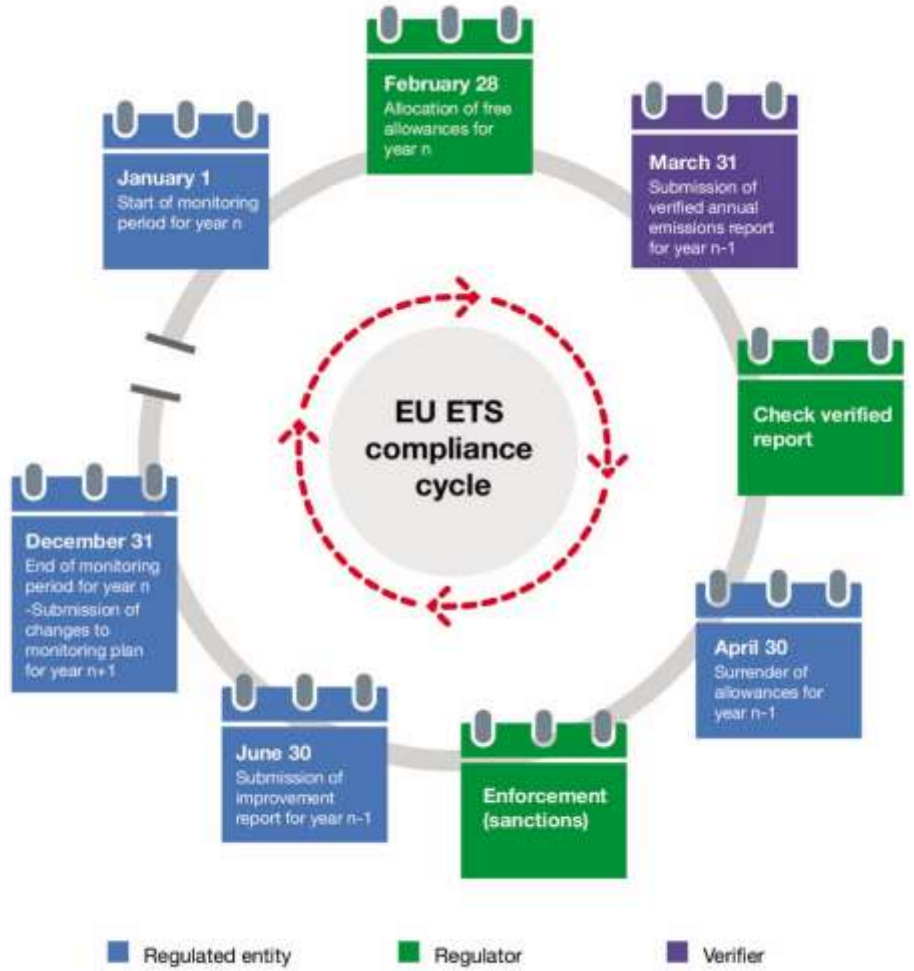
- Businesses may open, close, or merge their operations, with implications on the compliance requirements under an ETS
- The regulator needs to establish rules and processes for managing **part-year emissions liabilities** and compliance requirements
- Most ETS regulators have a **regular cycle for updating the list of regulated entities** and oblige entities to **report material changes** in their operation

Managing the reporting cycle

An ETS requires effective Monitoring Reporting and Verification (MRV)

- **Monitoring** involves emissions quantification through calculation or direct measurement
- This must then be consolidated in an emissions **report**
- Typically, these reports are then **verified** by independent service providers (verifiers) or through similar audit processes

MRV in the EU ETS



Source: ECRAN, 2014.

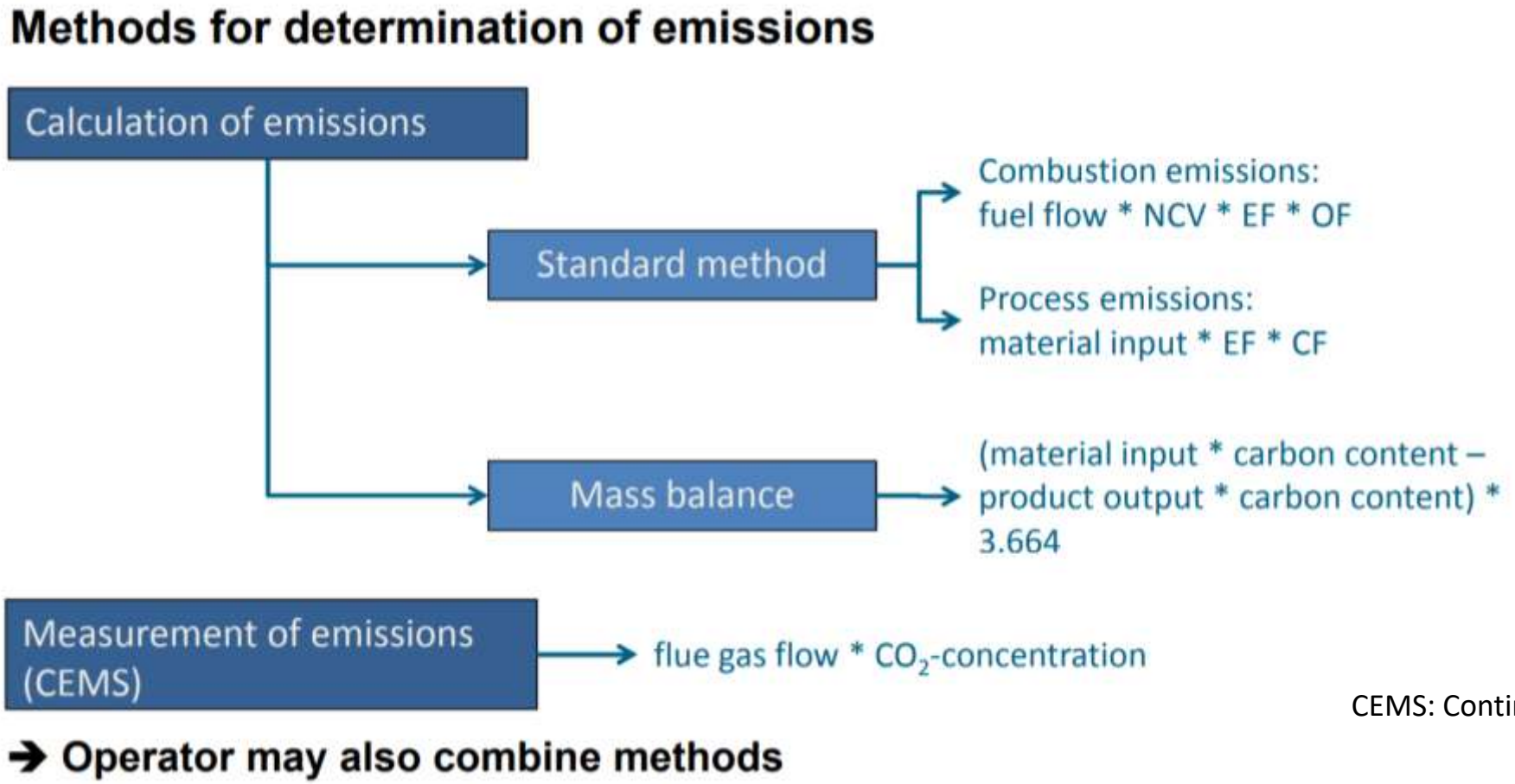
Establishing monitoring requirements

- Monitoring guidelines must be available **for each sector covered by the ETS**. These can draw upon a wide library of **detailed methodologies**, **product and activity descriptions**, **emissions factors, calculation models, and relevant assumptions**
- **Different monitoring requirements will work best for different sectors and different GHGs**. Easy-to apply default calculation methods for small emitters, along with complex monitoring requirements for larger emitters
- Balance need for **accurate data against the risk of gaming**
- Possible **stepwise phase-in** of more precise monitoring and reporting approaches, starting with default factors followed by a carefully **supervised transition** to site-specific sampling and emission factor calculation

Coverage of gases

Scheme	Method
EU ETS	• CO2 emissions; N2O and PFC only for selected industries • Pure Downstream approach • Covers largest share of Energy and Industrial emissions (about 45 % of emissions)
California	• CO2, CH4 and N2O emissions • Combined Upstream / Downstream approach (upstream: suppliers of natural gas and refinery products) • Mechanism to avoid double counting: Natural gas delivered to covered entities is subtracted from the emissions reported by gas suppliers
South Korea	• CO2, CH4, PCF, SF6, HFC and N2O emissions • Downstream approach

Methods for determination of emissions



CEMS: Continuous Emissions Measurement System
NCV: Net Calorific Value
EF: Emission Factor
OF: Oxidation Factor
CF: Conversion Factor

Common terminology used in the MRV

- **Calorific Value:** the amount of thermal energy released by a tonne, litre or cubic meter of a material during complete combustion expressed in kJ/unit
- **Emission Factor:** average rate of a specific GHG produced in relation relative to the activity data utilised expressed in tCO2e/kJ or tCO2e/t
- **Oxidation Factor:** fraction of carbon which is oxidized during combustion
- **Carbon content:** fraction of carbon in a unit of a material expressed in tC/t
- **Conversion Factor:** the numerical factor to convert Carbon to CO2 according to the respective stoichiometry
- **Global Warming Potential Values:** factor of how much heat a GHG traps in the atmosphere compared to CO2

Requirements for calculation factors

Scheme	Method

EU ETS	• Material specific analysis of relevant source streams to derive calculation factors is required for installations > 50,000t/a
	• Minimum frequencies for sampling and analysis are defined for different types of source streams
	• Strict quality requirements on laboratories (EN ISO / IEC 17025 or comparable standard)
	• Establishment of an installation specific sampling plan is mandatory (to foster representativeness of the samples taken)
	• Standard factors only for installations <=50,000t/a or minor /de-minimis source streams and commercial standard fuels:
	  • Based on IPCC 2006 (Tier 1)
	  • Country specific values (Tier 2a)
	• Oxidation Factor: Application of 1 for all categories required

California	• Monthly material specific analysis of relevant source streams to derive calculation factors is required for process emissions (non-combustion) • Fuel specific default values for combustion processes (TIER 1/partly TIER 2) allowed • Minimum frequencies for sampling and analysis are defined for higher TIERs • No requirements on laboratories but plausibility of factors used is checked during verification

Methods for determination of emissions

Scheme	Method

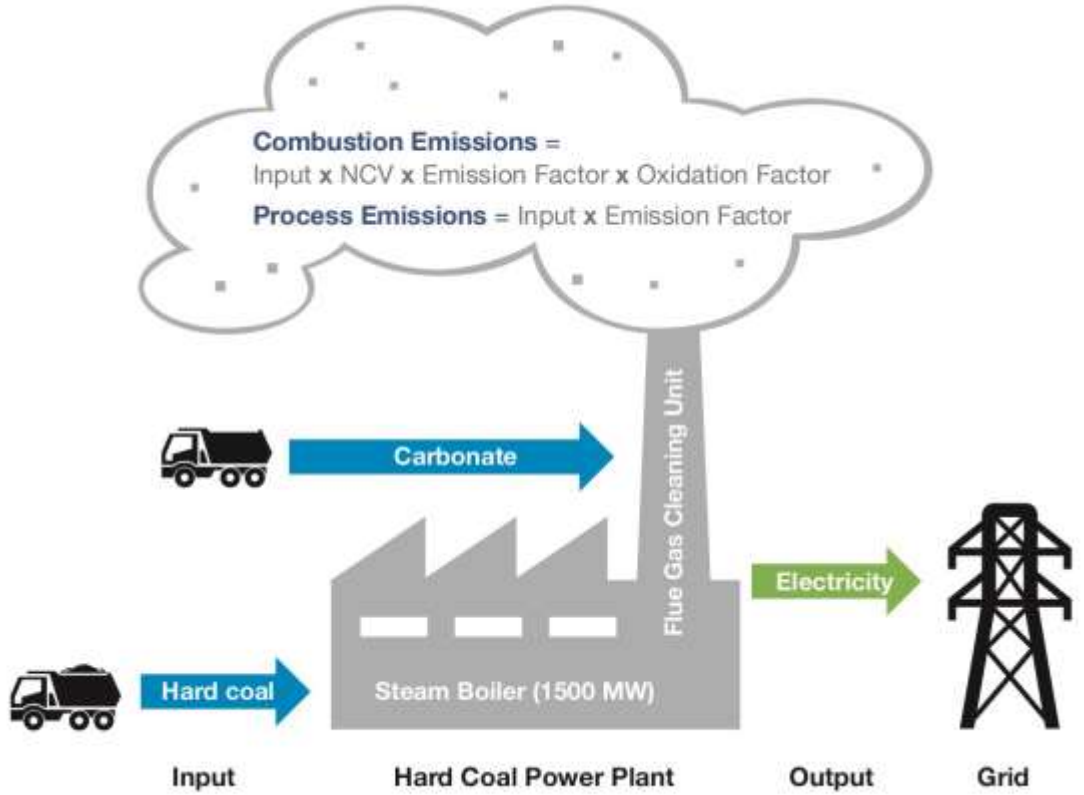
EU ETS	• Calculation is the dominating method
	• CEMS mandatory for N2O-emissions and catalytic crackers in refineries
	• Estimation only under the following conditions:
	  • de-minimis source streams
	  • Source streams with biomass fraction =>97%
	  • Conservative estimation required

California	CEMS in some cases under state regulation (e.g. Acid Rain Program) mandatory

Example of annual emissions monitoring in a hard coal power plant

	Inputs	Heating Value (NCV)	Emissions Factor	Oxidation Factor	Emissions
	tons	Energy GJ/t	tCO_2/GJ		tCO_2
Hard Coal	1,087,387 (truck scale)	25.5 (sample analysis)	0.095 (sample analysis)	1	2,634,195
Carbonate	10,321 (truck scale)	–	0.44 (standard factor)	1	4,541
Total					**2,638,736**

Source: German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB/Futurecamp)



Addressing uncertainty

Scheme	Method

EU ETS	• Uncertainty requirements linked to TIER approach
	• Highest Tier requirement: maximum uncertainty 1.5%
	• Uncertainty calculation simplified under the following conditions:
	  • Devices under national metrological control
	  • Calibrated devices
	• Calibration standards and guidelines to calculate uncertainty of devices
	• CEMS quality assurance according to ISO 14181

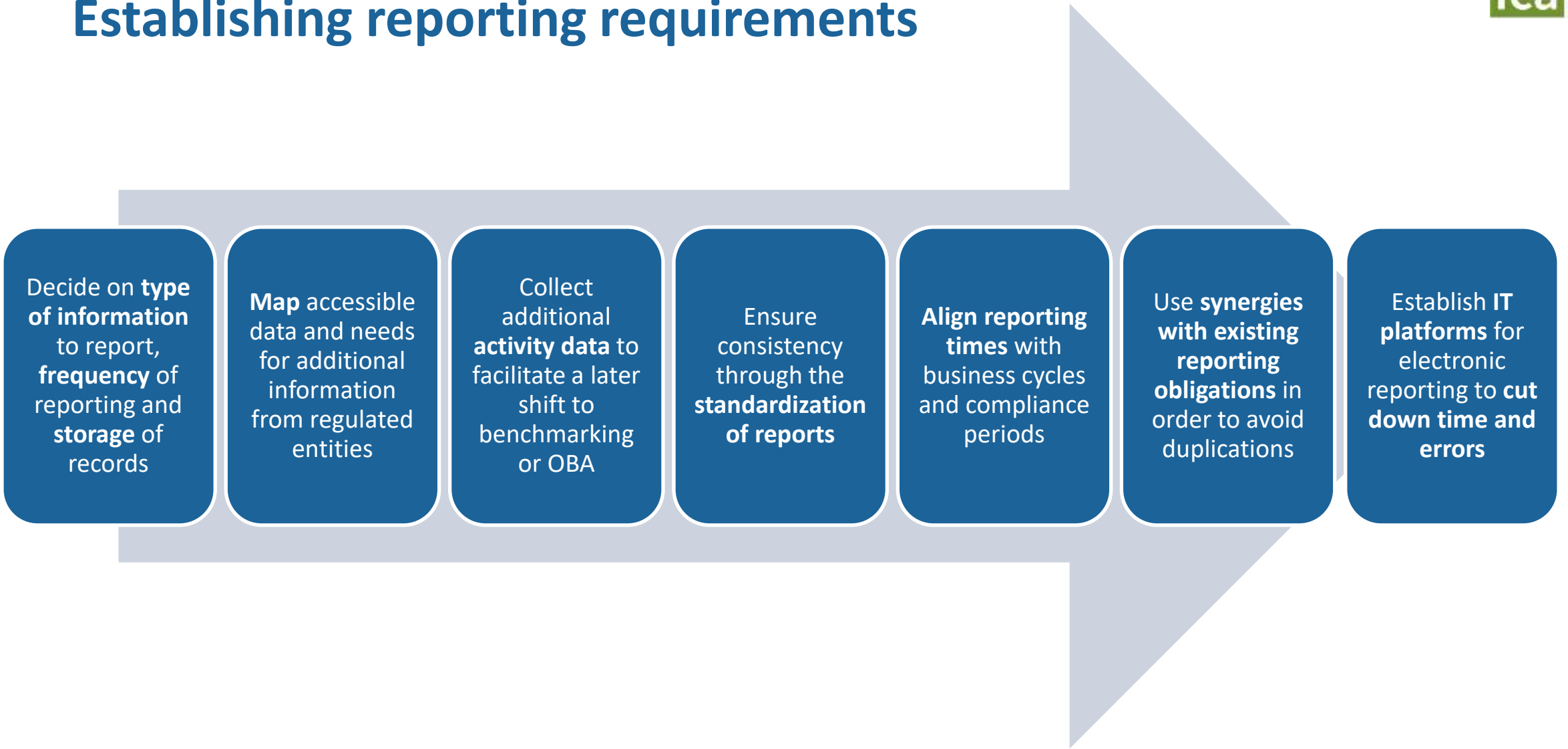
California	• For combustion processes, type of data source linked to TIER approach (no uncertainty values):
	  • Tier 1 + 2: company records
	  • Tier 3: calibrated flow meters, fuel billing meters or tank drops (gaseous and liquid fuels)
	  • Tier 4: CEMS

To summarize..

Levels of Data Quality: EU ETS Tier Approach

Uncertainty for Calculation (source stream amount)	Calculation factors		Uncertainty for CEMS (GHG mass stream)
Tier 4 = ± 1.5 %	Tier 3 = Individually determined by sampling and analysis	High data quality	Tier 4 = ± 2.5 % (n.a. for N_2O)
Tier 3 = ± 2.5 %	Tier 2 = National standard Factors (e.g. from national inventories or values separately published by CA)		Tier 3 = ± 5 %
Tier 2 = ± 5 %	Tier 1 = International Standard Factors (IPCC based values included in the regulation)	Low data quality	Tier 2 = ± 7.5 %
Tier 1 = ± 7.5 %			Tier 1 = ± 10 %

Establishing reporting requirements



Examples of deadlines for preparation of ER and verification statements

	month available for preparation	
	ER	Verification statement
California	CY - until 10 April	CY - until 1 September
EU-ETS	CY - until 31 March	
Australia	FY - until 15 June (prelim.)	FY - 31 October
South Korea	CY - until 31 March	
Shanghai	CY - 30 April	
Kazakhstan	CY - until 1 April	
RGGI	CY - until 1 March	n. r.
Quebec	CY - until 1 June	

(CY=reporting based on calendar year; FY=reporting based on fiscal year)

Source: FutureCamp

Source: Report on Essential elements of robust MRV Systems and Analysis of their Relevance for Linking Emissions Trading Schemes, German Environment Agency

Examples of use of IT within reporting process

Scheme	Issue	IT-Solution
EU-ETS (in general)	ER	Excel Template[46]
	MP	Excel Template[47]
EU-ETS (Germany)	ER, MP	Formular Management System (FMS), "Anlagendatenbank" (installation data base)[48]
	Communication	Via Virtual Post Office and FMS
California	ER	Californian electronic Greenhouse Gas Reporting Tool (Cal e-GGRT)[49]
Australia	ER	Emissions and Energy Reporting Tool (EERS)[50]
South Korea	ER	National Greenhouse Gas Management System (NGMS)

Source: FutureCamp

Source: Report on Essential elements of robust MRV Systems and Analysis of their Relevance for Linking Emissions Trading Schemes, German Environment Agency

Procedural considerations

Phased implementation

- Jurisdictions could establish **mandatory reporting before an ETS**, to allow entities to adapt to the MRV framework
- Regulators can adopt a **learning-by-doing approach**, e.g., by first implementing MRV on large emission sources or simpler methodologies

Case-by-case technical decisions

- A technical panel or advisory committee can support the regulator in the interpretation and **technical decision-making on a case-by-case basis**

Managing disclosure of sensitive data

- The benefits of public disclosure of emissions and broader (market) transparency in the ETS need to be **balanced** with the objective to protect commercially sensitive information

Establishing verification requirements

Verification occurs when an independent party reviews an emissions report and assesses that the reported information is an appropriate estimate of emissions, based on the available data

Quality assurance used by regulators comes in three forms:

1. **Self-certification**, where the reporting entity makes a formal assertion of the accuracy of its emissions report, often combined with auditing requirements
2. **External review by program administrators**, review by the government's program administrators
3. **External review by third-party verification,** in this case the review is done by a qualified/accredited third party

In practice, many jurisdictions use more than one / all these approaches.

Accreditation procedures in different schemes

EU-ETS[31]:

- Accreditation body and competent authority are different entities (in each member state)
- Accreditation standard: International standard ISO 14065 + AVR
- Accreditation of verification bodies
- Witnessing activities by accreditation body in order to keep up accreditation for verifiers

California[32]:

- Accreditation body and competent authority are the same entity (ARB)
- Accreditation standard: individual standard similar to ISO 14065
- Accreditation of natural persons and verification bodies (each auditor needs individual appointment by ARB)
- Annual mandatory training of auditors and witnessing activities by CA/accreditor

Australia[33]:

- Accreditation body and competent authority are the same entity (Clean Energy Regulator)
- Accreditation standard: individual standard
- Accreditations for natural persons only
- Mandatory review of verifiers every 3 years (more frequently in case of suspicion of irregularities)

South Korea[34]

- Ministry of Environment acts as AB and central authority responsible for general ETS issues
- VB have to apply at the National Institute of Environmental Research (NIER) to perform verification services. After approval of NIER, the verification agency is designated and examined by the Minister of Environment
- A provisional verifier needs to have attended a course (>80h) set by the Ministry of Environment (MOE). To become a verifier one has to participate in three or five verification processes within two years, depending on the sector. The verifiers have to complete a refresher course (>24h) every two years

Managing the performance of verifiers

Accrediting third-party verifiers

- Possible to involve local and international **accreditation bodies** for training and accreditation of verifiers
- **Draw from standards**, e.g., by the CDM Executive Board and the International Organization of Standardization (ISO)

Balancing risks and costs in the verification process

- Provide verifiers with **guidelines and checklists**
- **Self-certification** for all reports, with legal liability assigned for false reporting
- **Randomized samples** for third-party verification
- **Stricter reviews** for sectors prone to non-compliance
- **Reducing the frequency** of reviews or verification

Establishing verification requirements

	Verification part of ETS	Verification threshold (only above x tCO2e/a)	Verification of the Monitoring Plan	Verification of the Emission Report
California	x		x	x
EU-ETS (GER)	x			x
Australia	x	x		(x)
South Korea	x			
Shanghai	x			x
Kazakhstan	x		x	x

Source: Report on Essential elements of robust MRV Systems and Analysis of their Relevance for Linking Emissions Trading Schemes, German Environment Agency

Challenges with MRV

1. Ambiguity in the legal status of relevant policies and regulations;
2. Unclear requirements on the content of monitoring plans;
3. Lack of consistency and harmonization in the monitoring and reporting guidelines; and
4. Lack of information technology (IT).

Example of MRV approaches

	Applicability requirements	Monitoring methodologies	Verification required for	Reporting software/ platform
EU ETS	Threshold: capacity threshold for combustion activities: rated thermal input > 20MW. Emissions threshold for aviation, excluding air transport operators that operate flights with annual emissions below 10,000 tCO2. Source categories: Specific source categories irrespective of emissions levels (e.g., production of aluminum, ammonia, and coke, refining and mineral oil). Production capacity threshold: By industry, e.g., manufacture of glass: melting capacity that exceeds 20 t/day.	For CO_2: calculation (standard methodology, mass balance), direct measurement, fallback approaches, or combinations of approaches can be used. For N_2O, direct measurement is required. A tier system sets requirements for data quality and accuracy.	Emissions Report	Excel templates (European Commission); others by member states, e.g., FMS (Germany)
California	Emissions threshold: All facilities with annual emissions ≥ 25,000 t CO_2e. Source categories: Some source categories irrespective of emissions levels (e.g., cement production, lime manufacturing, petroleum refineries). Embedded emissions: Suppliers of petroleum products, natural gas and natural gas liquids, and CO_2, if annual emissions that would result from consumption of products produced and sold are ≥ 10,000 t CO_2e.	Both calculation and measurement may be used with specific tier requirements. Continuous Emissions Monitoring (CEM) is required for certain activities.	Monitoring Plan and Emissions Report	"Cal e-GGRT"
Québec	Emissions threshold: All facilities with annual emissions > 10,000 t of CO_2e per year.	Entities can choose their calculation methods among those provided by the Ministry for each sector. If entities have measurement instruments, they must use the method associated with the instrument.	Monitoring Plan and Emissions Report (but only for installations with emissions > 25,000 metric tons of CO_2e per year)	
South Korea	Emissions threshold: On installation level > 25,000 t CO_2e per year. On entity level > 125,000 t CO_2e per year. Installations with 15,000–25,000 tCO_2e per year remain under Target Management Scheme.	Calculation with different uncertainty and data requirements. For some installations, CEM is required.	Monitoring Plan (annual) and Emissions Report	National Greenhouse Gas Management System (NGMS)
New Zealand	Energy threshold: Liquid fossil fuels: Owning more than 50,000 liters per year of obligation fuel, to be removed for home consumption or refinery. Stationary energy: Includes importing and mining coal in excess of 2,000 t/year, natural gas in excess of 10,000 liters per year, combusting oil, crude oil, waste oil, and refining petroleum. Source categories: Industrial processes, forestry, and others.	Methodologies for each sector are provided. Generally the accounting uses activity data on inputs. Emissions factors are specified by the Ministry but entities can apply for unique emissions factor. Majority of activities have to use calculation as standard methodology. However, use of CEM is an explicit possibility in the context of "combustion of used oil, waste oil, used tires, or municipal waste."	Emissions Report, but only if participants use a unique emissions factor	

Designing an enforcement approach

A credible enforcement regime with appropriate penalties is needed to ensure full compliance across the ETS

- Penalties should incur a substantial additional cost compared to the cost of complying with the ETS

Noncompliance that carry penalties

- Emitting in excess of the number of allowances surrendered
- Misreporting or not reporting emissions or other data before the deadline
- Failing to provide accurate or providing false information

Penalties

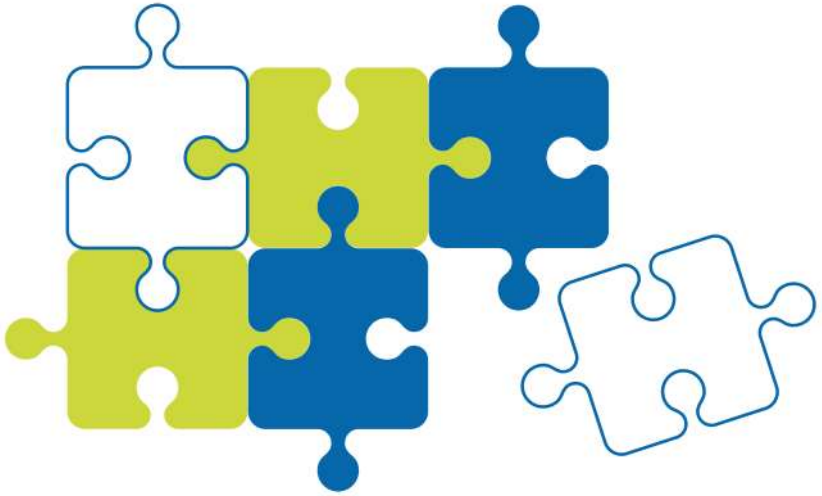
- "**Naming and shaming**" publishing names of noncompliant entities
- **Fines** (fixed or set pro-rata)
- "**Make-good requirements**": Buying allowances from the market or borrowing them from their future allocation
- **Further measures,** e.g., restrict approvals of new construction project, performance evaluation for state-owned companies, and credit records

Examples of penalties for non-compliance

ETS System	Jurisdiction
European Union	A fine per unit of 100 EUR. The name of the non-compliant entity is also published. For the pilot phase from 2005 to 2007, a reduced fine of 40 EUR is applied.
New Zealand	A fine per unit of 30 NZD (19 EUR) and a make-good requirement (surrender or cancel allowances to make up for shortfall). The fee may be reduced by up to 100 percent if participant states voluntarily that it failed to surrender the required allowances or made a mistake in its emissions return before the administering agency sends a penalty notice or the participant is visited by an enforcement officer.
Switzerland	A fine per unit of 125 CHF (115 EUR) and a make-good requirement (surrender missing allowances and/or international credits in the following year).
RGGI	Penalties for noncompliance are set by each state.
Tokyo	The following measures may be taken in two stages: *First stage*: The Governor orders the facility to reduce emissions by the amount of the reduction shortage multiplied by 1.3. *Second stage*: Any facility that fails to carry out the order will be publicly named and subject to penalties (up to 500,000 JPY [3,828 EUR and surcharges (1.3 times the shortfall)]
California	Under the Cap-and-Trade Regulation, if an entity fails to surrender sufficient instruments to meet its obligation, California imposes a non-enforcement incentive requirement that the entity submit four compliance instruments (only one quarter of which can be offsets) for each instrument the entity failed to surrender. Of these four instruments, one is permanently retired, effectively reducing the cap, and three allowances are recirculated through the auction mechanism. If an entity fails to meet this untimely surrender obligation (i.e., 4 times per metric ton missed), California may institute formal enforcement actions, including seeking penalties as defined by statute. This includes statutory penalty provisions setting forth penalty amounts of 1,000-10,000 USD (921-9,204 EUR) per day per violation (i.e., per metric ton that remained unsurrendered) for strict liability, and increasing amounts depending on the level of intent.
Kazakhstan	A fine per unit of 11,156 KZT (30 EUR). In the first year of the system, 2013, penalties for noncompliance with unit surrender requirements were waived.
Québec	Companies failing to surrender enough allowances to match their emissions have to surrender the *shortfall plus* a 3 for 1 penalty. Furthermore, depending on the infraction, they can face additional charges varying from 3,000–500,000 CAD (1,988-331,250 EUR) and up to 18 months in jail in the case of a natural person, and 10,000–3,000,000 CAD (6,625-1,987,500 EUR) in the case of a legal person.

Developing an ETS registry

- Units are **recorded and monitored i**n an ETS registry
- **Keeps track of the allowance transactions** in the market
- At the end of each compliance cycle, regulated entities **surrender allowances via the registry** to the ETS regulator



Setting up an ETS registry

Create a legal framework

- Address **interdependencies** with tax, accounting, property and financial legislation
- Identify the **legal nature** of the allowances and designate legal duties

Create an institutional framework

- Determine the **scope of responsibility** for the registry administrator
- **Terms of use** for registry users

Functional and technical requirements

- Work with suitable **IT systems**
- Address **system risks and options**
- Establish **traceability** procedures

Preventing fraud

Technical measures and regulatory instruments are needed to ensure the integrity of the ETS registry and to minimize the risk of unauthorized use for criminal purposes such as fraud and theft of allowances.

Regulatory instruments

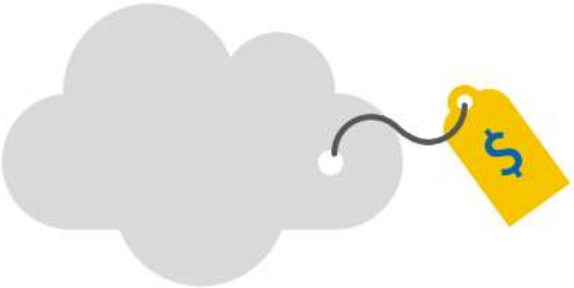
- Authority of the registry administrator to refuse operations
- Continuous supervision of daily transactions by the market monitoring authority
- Cooperation between registry administrator and authorities that carry out criminal investigations

Technical security measures

- Two-factor authentications and session time-outs
- Limitation of the registry's opening hours to working hours to facilitate intervention in case of misuse
- Password or other protection of sensitive operations (for example, transfers)
- Emergency stop functions, block accounts, and reverse operations
- Independent security audits of registry providers.

Examples of fraud

- Incidents of **fraud and cyber-attacks** led to the introduction of a system-wide registry in the EU ETS
  - **Phishing**: Account holders in Germany and Romania had their allowances stolen after replying to a fraudulent mail
  - **Hacking**: EU Allowances were stolen from national registries in 5 member countries and trading needed to be halted
- Enhanced security measures for account opening, transacti and registry oversight help minimize risks



Summary

- Crucial to create general framework legislation that is legally binding and of a sufficiently high legal status to facilitate legal enforcement of the MRV
- Clear rules on the content of the monitoring plan and development of templates
- Implement regulations that include specific requirements on monitoring and reporting
- Evolve gradually towards an integrated IT system

Calculation Factors: Tier 3 provisions for Individually Determined Data

- **Individually determined:** Sampling, analysis, calibration and validation must be based on one of these hierarchically sorted standards:
  - EN standards,
  - ISO standards,
  - national standards,
  - industry best practice (applied as hierarchy)
- plus **Sampling Plans** must be provided by CA together with the MP
- **ISO 17025 accredited laboratory**
- **Frequency of analyses:** table available in the MRR

ANNEX VII

Minimum frequency of analyses (Article 35)

Fuel/material	Minimum frequency of analyses
Natural gas	At least weekly
Other gases, in particular synthesis gas and process gases such as refinery mixed gas, coke oven gas, blast-furnace gas, convertor gas, oilfield and gasfield gas	At least daily — using appropriate procedures at different parts of the day
Fuel oils (for example light, medium, heavy fuel oil, bitumen)	Every 20 000 tonnes of fuel and at least six times a year
Coal, coking coal, coke, petroleum coke, peat	Every 20 000 tonnes of fuel/material and at least six times a year
Other fuels	Every 10 000 tonnes of fuel and at least four times a year
Untreated solid waste (pure fossil or mixed biomass/fossil)	Every 5 000 tonnes of waste and at least four times a year
Liquid waste, pre-treated solid waste	Every 10 000 tonnes of waste and at least four times a year
Carbonate minerals (including limestone and dolomite)	Every 50 000 tonnes of material and at least four times a year
Clays and shales	Amounts of material corresponding to 50 000 tonnes of CO_2 and at least four times a year
Other materials (primary, intermediate and final product)	Depending on the type of material and the variation, amounts of material corresponding to 50 000 tonnes of CO_2 and at least four times a year

Why Third Party Verification in EU ETS?

Pros, Cons, and Challenges