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PARTNERSHIP FOR MARKET READINESS

FOREST CARBON PARTNERSHIP FACILITY

EMISSIONS TRADING REGISTRIES

Guidance on Regulation, Development, and Administration

WORLD BANK GROUP

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* For more information on the workshop, see https://www.thepmr.org/events/eventlist/workshop/technical-workshop-12-building-registries-support-next-generation-carbon.

BUILDING EMISSIONS TRADING REGISTRIES: A Guiding Framework for Policy Makers

The issues around the environmental integrity of international market mechanisms have gained a great deal of attention in the wake of the Paris Agreement. In addition, with the agreement on market-based measures for international aviation being reached, these issues are likely to gain even more prominence in countries' efforts to prepare for the implementation of international market mechanisms. In a context where inaccurate accounting is one of the environmental integrity risks associated with market mechanisms, an emissions trading registry is critical for avoiding "double counting"—the situation where a single GHG emission reduction (ER) or removal is used more than once to demonstrate compliance with mitigation targets.

An emissions trading registry is an online database that issues, records, and tracks the carbon units that are exchanged within market mechanisms or financed through Results-Based Climate Finance (RBCF) programs. Given the length of time and capacity needed for the development of a registry, it is essential for countries that are in the process of designing market mechanisms to factor in specific regulatory, administrative, functional, and technical aspects of registry development. Bearing in mind these factors, three guiding questions can facilitate the process of reconciling multiple policy objectives and choosing between various design options.

What type of registry system would be the most suitable?

A number of different registry options are available to meet a wide range of country needs. The more complex the mechanism itself, the more complex the accompanying registry will be and, hence, the more administrative and financial resources will be necessary for the registry's implementation. For example, developing countries aiming to access RBCF through bilateral or multilateral channels probably do not need more than a registry system in its simplest form—one that supports basic accounting and data management—to track carbon units and provide transparent information about underlying ERs. By contrast, countries considering market mechanisms that involve a large number of sectors and participants, with the possibility of progressively scaling up their efforts and linking up with different market mechanisms in other regions or countries, will require registries sufficiently elaborate and secure to capture, manage, and record transactions. Prior to developing or procuring the registry system, a needs assessment must be conducted to find the right functional balance, including an analysis of risks and scalability requirements.

What legal and administrative arrangements need to be put in place?

The legal and administrative arrangements necessary for the establishment and future operationalization of registries will largely depend on the type of registry that a country opts for. The more elaborate the registry's structure, the larger the number of building blocks required to create its legal and administrative framework. The legal framework may address issues such as data protection, confidentiality, and disclosure; the legal nature of the carbon unit; the tax implications of carbon unit transfers; and the rules to be applied in the event of insolvency of account holders. Where the market is highly liquid and the number of transactions requires automation of processes, the national legal framework will need to be adjusted to accommodate such an electronic environment. Similarly, policy makers will probably have to consider different alternatives when it comes to who should be made responsible for the administration of the registry, as well as for its management, operational, and supporting processes. The responsibility for administering a registry can be assigned internally—that is, to a public authority—or externally (contracted out to a third party) and should be subject to appropriate oversight.

What resources are required for implementation?

The selection of a specific type of registry that takes into account relevant national circumstances will also have cost implications, and thus likewise for the resources needed, for the registry's development and administration. In principle, where these costs are not (fully) covered by domestic or international public funding sources, one option is to charge a fee for a range of registry operations and services. If a fee is charged, it is important to duly consider several issues, including how to determine the ideal fee structure, differentiated rates for various market participants, and the use of revenues derived from fee payments, to name just a few.

EXECUTIVE SUMMARY

Inaccurate accounting is one of the environmental integrity risks associated with market and Results-Based Climate Finance (RBCF) mechanisms and programs.[1] The most significant accounting risk is that of "double counting"—where a single greenhouse gas (GHG) emission reduction (ER) or removal is used more than once to demonstrate compliance with mitigation targets. The issues related to accounting have received considerable attention as a number of countries prepare the infrastructure necessary to engage in the international market mechanisms enabled by the Paris Agreement.

An important building block for ensuring accurate accounting and safeguarding the environmental integrity of these mechanisms is an emissions trading registry, which is an online database that issues, records, and tracks the carbon units that are exchanged within market mechanisms or financed through RBCF programs. Since registries typically require significant technical and financial capacity for their design and implementation, it is essential for countries in the process of designing market mechanisms and RBCF programs to plan their specific regulatory, administrative, functional, and technical aspects adequately and with sufficient lead time.

Against this backdrop, and to further facilitate future registry design and implementation, **this report provides policy makers and other stakeholders with technical insights and step-by-step guidance on how to support country-specific decision making and activities related to registry development.**

Defining Key Terms and Concepts

All markets require a trading place for buyers and sellers to hold and exchange assets. A carbon market is no different, and a registry is an important element of that marketplace. It is a platform that performs two basic functions: (i) to determine the quantity of carbon units held by account holders and (ii) to enable the exchange of carbon units between account holders.[2]

Beyond the need for commercial and legal certainty, **accurate accounting in carbon markets is imperative to safeguard the environmental integrity of the system**, which is to say, that emissions levels accounted for through a market mechanism reflect real world GHG emissions and removals from the atmosphere. Only a registry that gives policy makers an accurate and transparent picture of the real world emissions impact of a policy is environmentally robust. Inaccurate accounting is one of the environmental integrity risks associated with carbon markets and has received considerable attention as a number of countries prepare the infrastructure necessary to engage in the international market mechanisms enabled by the Paris Agreement.

Accurate accounting is important to avoid the risk of "double counting"—where a single GHG ER or removal is used more than once to demonstrate compliance with mitigation targets. This is acknowledged in the Paris Agreement which, with its accompanying decision, refers to the risk of double counting on multiple occasions. Double counting can be understood to consist of two main processes: double *claiming*, where two or more Parties claim the same ER to comply with their mitigation target, and double *issuance*, where more than one carbon unit is registered for the same mitigation benefit under different mitigation mechanisms.

There is understandable confusion over the term "registry," largely because of the many ways in which the term is used. In common parlance, a registry is simply a place for storing data. In the climate change policy context, however, the term registry is used to refer to a whole range of things—including a GHG emissions inventory, a list of project and program information, and carbon unit databases with varying levels of functionality. To help dispel the

1 Although RBCF programs are, in some cases, being introduced as a stepping stone to potential market-based mechanisms, they do not necessarily lead to the generation of a transferable carbon unit, and thus do not require an emissions trading registry. All RBCF programs which generate transferable carbon units, however, need to take measures to avoid instances of double counting including developing a registry to issue, transfer, and retire carbon units.

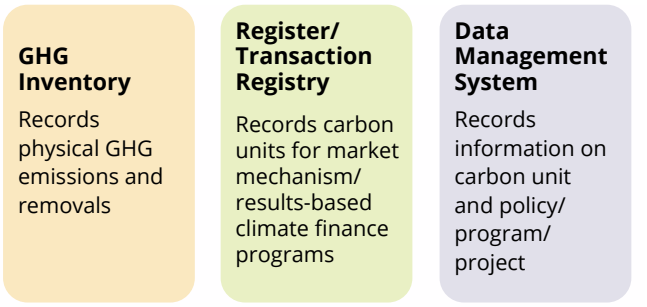
2 A marketplace may also involve a trading platform or exchange for market participants to "clear" transactions—that is, to ensure that both delivery and payment commitments are honored. Thus, a trading platform and a registry may be linked to the extent that allows the trading platform to send settlement instructions to the registry.

confusion, this guide makes a clear distinction between four types of emissions accounting systems (box 1).

With that in mind, this guidance report covers the issues around the development of registers and transaction registries—accounting systems that record and track carbon units exchanged within market mechanisms or carbon units financed through RBCF programs (Figure 1). The term *register* is used to describe lower-end functionality accounting systems, where the exchange of carbon units is restricted to a limited number of actors. The term *transaction registry* is used to describe higher-end accounting systems that have all of the features of a register, as well as the capability to transfer carbon units between account holders in the transaction registry (internal transfer), and/or the capability to transfer carbon units to another transaction registry (external transfer). The term registry is used as an umbrella term to refer to both registers and transaction registries when it is not necessary to distinguish between the two.

This report also uses "carbon units" as an umbrella term for different carbon accounting instruments. It refers to the following four categories: (i) *allowances* (which give a regulated entity the right to emit); (ii) *carbon credits* (which are earned for undertaking an emissions reducing activity and sold to regulated entities for use instead of an allowance); (iii) *voluntary credits* (which are not primarily issued under mandatory schemes, even if they may be further used for compliance purposes); and (iv) *compensated results* (ERs paid for under RBCF programs).

FIGURE 1: **Different Types of Emissions Accounting Systems Compared**



Outlining Policy Foundations for Registry Development

International climate policy

The Paris Agreement provides a platform for present and future carbon market mechanisms. It establishes the basis for the potential transfer of the rights to emission reductions (ERs) without defining specific market mechanisms or carbon units, nor mentioning markets. This stands in contrast to the Kyoto Protocol, which assigned multiyear

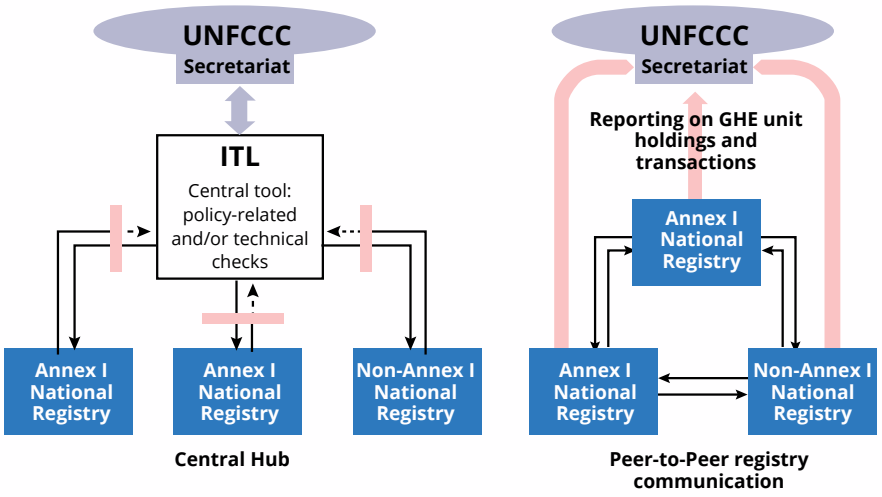
BOX 1. **Types of Emissions Accounting Systems**

1. **GHG inventory:** An inventory that records physical GHG emissions and removals. Accounting of GHG emissions must be distinguished from accounting of carbon units.
2. **Register:** A database that records serialized carbon units and any other information specific to the carbon unit required by policy. This could include the vintage of the carbon unit, the identity and location of the project for which the carbon unit was issued, the project funder, or verification details. A register may be used by a country that receives results-based climate finance for generating carbon units backed by emission reductions, to provide assurance that the same emission reduction is not paid for twice (double payment). A register could also be used for a simple emissions trading system (ETS) without multiple accounts, whereby a country "transfers" carbon units to a purchasing country through simple double-entry bookkeeping (a subtraction of a carbon unit in one register mirrored by an addition in another one).
3. **Transaction registry:** A database that has all of the features of a register, plus the capability to transfer carbon units between multiple account holders on the transaction registry (internal transfer), and/or the capability to transfer carbon units to another transaction registry (external transfer). The more complex the ETS, the more features the transaction registry will require.
4. **Data Management System (DMS):** A database that records and archives specific information about a carbon unit that is not stored in the transaction registry or register, but that for policy reasons is required to transparently demonstrate environmental integrity, and compliance with safeguards and other conditions. For example, to facilitate compatibility between registries, it may be desirable to limit the information that travels with a carbon unit when it is externally transferred. At the same time, it may be desirable to archive information about that carbon unit (for example, baseline information according to which a carbon unit was issued, or geographical information relating to a project boundary), and this can be recorded in a DMS. The serial number of a carbon unit should link it to the information in the DMS, so the latter can be retrieved if necessary.

BOX 2. An Expert View: Tracking Internationally Transferred Carbon Units

By Christina Hood, International Energy Agency

One key question for negotiators will be whether to make available (or even require the use of) a central UN architecture for the linking of national registries. The Kyoto Protocol's International Transaction Log (ITL) could be adapted to provide a central hub to link both UN-led and domestic carbon pricing mechanisms, though this would require domestic systems to be designed to the UN specification. The central hub could also collect the relevant information on unit transfers needed to account for NDCs. Alternatively, registries of linked systems could link bilaterally in a peer-to-peer arrangement; in this case, the information needed for (UNFCCC) accounting would need to be submitted from the individual registries. This would potentially include information on issuances, retirements, international transfers, banking, and holdings (including vintages). The figure below compares the two systems.



Source: Prag. A., C. Hood A. Asruned and G. Briner, "Tracking and Trading: Expanding on Options for International Greenhouse Gas Unit Accounting after 2012"

Note: UNFCCC = United Nations Framework Convention on Climate Change; GHG = greenhouse gases; ITL = International Transaction Log.

Although a peer-to-peer system may be simpler, there may be concerns about varying security standards and a lack of transparency: it would be difficult for outside observers to know that units and transactions are unique. This could potentially give rise to a separate UNFCCC process of reporting and review of the carbon pricing systems themselves, to demonstrate they are maintaining high environmental integrity.

Under the Paris Agreement, the use of international transfers toward NDCs is voluntary and must be "authorized by participating Parties." This does not preclude subnational systems from linking without approval from national authorities, but means that any unapproved flows of carbon units could not be counted toward NDCs. For example, if a plant covered by a linked subnational scheme chooses to buy carbon units from a plant covered by a linked scheme in another country, rather than reduce its own emissions, then the transaction would be "invisible" in term of progress toward the NDC. Subnational systems may therefore need to change (including changing registry arrangements to meet international standards, or aligning metrics and methodologies with the UNFCCC) if these systems want their units to be counted toward national NDCs.

GHG emission budgets to developed countries. In addition to capping the emissions of developed countries, the Kyoto Protocol defined carbon units and enabled the transfer of such carbon units between countries. Finally, the Clean Development Mechanism (CDM), as stipulated in the Kyoto Protocol, allowed ERs originating in uncapped regions to be imported into the Kyoto-covered system.

Under the Paris Agreement, this landscape differs significantly. First, **Parties have submitted—and will continue to do so in the future—their GHG mitigation goals as formulated in their Nationally Determined Contributions (NDCs)**. The implication is that the host countries of crediting mechanisms will need to account for the export of units against their own targets. Second, there is an inconsis-

tency between the ways targets are formulated in countries' NDCs, with some using business-as-usual emissions projections as the reference point (of zero mitigation), and others using the emissions targets from a baseline year or emissions intensity per unit of economic output as the point of reference. As a consequence, accounting issues become more complex. Third, it is expected that the different market mechanisms will generate a great variety of carbon units and unit flows, making it difficult to make them fungible. Finally, the Paris Agreement does not define accounting standards for NDCs, which raises a question about fungibility, and creates the risk of oversupply and variable integrity of carbon units.

Under the Paris Agreement, **Parties are expected to develop implementation rules to enable accurate accounting of NDCs**. The Paris Agreement allows for the cooperation of countries in meeting their NDCs and introduces the concept of "Internationally Transferred Mitigation Outcomes" (ITMOs), which Parties can use toward achieving their NDC targets (Art. 6.2). Though the Paris Agreement does not define ITMOs—which could potentially take some form of carbon units—it does establish that as a condition of their use, Parties musts "apply robust accounting to ensure, inter alia, the avoidance which could potentially take some form of carbon units of double counting." The decision that accompanies the Paris Agreement notes that this should be done on the basis of a "corresponding adjustment" by Parties (Para. 35), but what form this should take to ensure that it accounts for the diverse range of NDCs is an open question.

Domestic climate policy

In case of any market mechanism implementation at the domestic level, registries are required for regulated entities to demonstrate compliance by reconciling allowances held (what covered entities are allowed to emit) with verified emissions (what covered entities actually emit). That said, it is important to distinguish between domestic ETSs, whereby regulated entities trade carbon units to meet an emissions cap set by national legislation, from the international transfer of carbon units under the Kyoto Protocol or Paris Agreement for the purpose of compliance with international law.[3] In fact, a domestic ETS could operate as a purely domestic mitigation measure without any linking to international mechanisms.

In practice however, domestic ETSs may pursue "one-way" linking[4] with international carbon markets—such as in the case of the EU ETS, which allowed limited import of credits from the CDM and Joint Implementation (JI) defined under the Kyoto Protocol. At the same time, domestic ETSs may pursue "two-way" linking[5] with domestic ETSs of other regions and jurisdictions—such as the linking sought between the EU ETS and Swiss ETS. Commonly heard arguments in support of linking are that it bolsters market liquidity, efficiency, and price stability. However, a hybrid system of domestic and international regulation, involving both one-way and two-way links between multiple ETSs, will require highly developed and interconnected registries to ensure accurate accounting.

Putting Theory into Practice: Developing Legal, Technical and Institutional Frameworks for Registries

Legal framework

All market mechanisms are created through legislation or regulation. The GHG monitoring and reporting obligations of regulated entities (countries at the international level, companies at the national/jurisdictional level) must be set out in guidance, regulation, or legislation. Ideally, the guidance and modalities are binding, and the legal instruments also establish and vest powers in bodies authorized to verify, audit, and administer emissions data.

3 In recent years, a number of developed countries/regions have introduced jurisdiction-wide emissions trading systems as a means to regulate GHG pollution from major emitters, such as power stations and industrial plants. As of 2016, ETSs in force include the European Union Emissions Trading System (EU ETS), the Swiss Emissions Trading System, the California Cap-and-Trade Program, the U.S. Regional Greenhouse Gas Initiative (covering Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont), the Quebec Cap-and-Trade System, the Kazakhstan Emissions Trading Scheme, the New Zealand Emissions Trading Scheme, the Korean Emissions Trading Scheme, Japan's Saitama Target Setting Emissions Trading System, and Tokyo Cap-and-Trade Program. In addition, Alberta's Specified Gas Emitters Regulation (SGER) sets a facility-level emissions intensity target (as opposed to an absolute cap). A range of regional, pilot ETSs are in force in China, with a view to absorbing these in an overall Chinese cap-and-trade system by 2017. Another 15 jurisdictions are currently considering implementing ETSs (see PMR, ICAP (2016), Emissions Trading in Practice: A Handbook on Design and Implementation, available at https://openknowledge.worldbank.org/handle/10986/23874).

4 Where entities in one ETS can buy units issued from one or more other systems, but not vice versa.

5 Where both systems recognize each other's units.

At the *international* level, overarching principles are often expressed in treaties, while concrete modalities are developed on the basis of decisions of the treaty's governing body. For example, the Paris Agreement obliges all Parties to account for their NDCs in a way that promotes environmental integrity, transparency, accuracy, completeness, comparability and consistency, but does not formulate concrete accounting guidelines.

At the *national* level, obligations should be expressed in primary and secondary legislation. One example are the regulations under the United Kingdom's Companies Act (2006), which require companies quoted in the United Kingdom to report their GHG emissions. Moreover, the Act establishes a body that is responsible for monitoring compliance of company reports and accounts (The Conduct Committee of the Financial Reporting Council).

Where some form of emissions trading is undertaken, a legal basis is required for the establishment of a registry as well as for the creation, issuance, transfer, and retirement of carbon units. Administrative rules or terms and conditions will be needed for account opening, closing, and access. Specific rules may be required for the handling of sensitive data. If dealing with carbon credits, it may be necessary to distinguish between allowances and compliance accounts on the one hand, and carbon credits and automation accounts on the other. Where the market is highly liquid and the number of transactions requires automation of processes to ensure transfer settlement is manageable, the legal framework of traditional national laws will need to be adjusted to accommodate such an electronic environment.

To ensure the smooth functioning of carbon transactions, it is important that national policy makers define the legal nature of a carbon unit (e.g., whether it is an administrative grant, license, financial instrument, a good, or a service, and whether the holder of the unit has a full and defendable property title). If a carbon unit is treated as property, its owner can derive specific rights that potentially allow use of that carbon unit in a broader range of transactions (e.g., as collateral to raise financing), not merely in selling/purchasing or surrendering for compliance. The broader the use of the carbon unit, the wider its appeal will be to market participants and other investors, but the more limited the ability of regulators to adjust the market (e.g., canceling carbon units in the event of oversupply) without incurring obligations to market participants. If a carbon unit is not considered property, it is likely to have a more limited application beyond the market mechanism's primary goal. The legal status of the carbon unit will affect the tax implications on transfer. If it is deemed a transfer of property or an asset, it may attract a tax such as a stamp duty, whereas if deemed a service provision, it may be subject to a sales or service tax such as value added tax (VAT). The tax liability will also require valuation of carbon units, which may be challenging, particularly if they were initially allocated for free. In the event of insolvency of an account holder, it will be necessary to determine the treatment of transacted carbon units. Issues that may arise in this context include the question of who has legal claims to the carbon units, and whether compliance and offset accounts are managed differently.

In highly sophisticated carbon markets with multiple participation levels and thousands of daily trades, a carbon unit may become subject to the same regulatory treatment as other financial products. The creation of an expansive regulatory legal framework will increase consumer protection and legal certainty. On the other hand, if this is established before the market is sufficiently mature, it may stifle its potential for growth by making participation too costly. Examples of additional regulatory safeguards include the introduction of a licensing requirement for brokers, and extending existing laws on market abuse, insider trading, and other financial crimes, to carbon unit trading.

Institutional framework

All market mechanisms involve the designation of a public authority, commonly within an environment or energy department, to be responsible for the registry's actual implementation. A registry can be administered internally, by a public authority, or outsourced to a third party. Countries should conduct a cost-benefit analysis before contracting a third-party service, and duly consider the specific expertise and level of service required, the risks and costs associated with outsourcing and the extent to which capacity already exists (or would have to be developed) in-house. Registry administration comprises both management and operational processes.

Management processes include staff and system management; risk, budget, and resource management; and cooperation with regulatory authorities. *Operational* processes represent the bulk of the administrative tasks, and include monitoring the relationship with users (e.g., entering and terminating a relationship with registry users), and managing registry operations (such as the issuance of carbon units).

Registry administrators are exposed to a number of risks, which require careful consideration and management. Residual risks may be covered by an insurance policy.

Risks include the accidental non-execution or late execution of operations, entering into relations with an account holder

or user who subsequently engages in fraudulent behavior, failure to block violating accounts, and failure to report suspicious activities/incidents to the relevant authorities.

A key risk mitigation measure available to registry administrators is to set "know your customer" requirements, such as requiring that specific information and a number of supporting documents be provided about the prospective account holder and each of the physical persons legally entitled to act on their behalf, before an entity may open a registry account.

Registry administration requires financial resources and, where these costs are not covered with public funding, one option is to charge a fee for a range of registry operations and services. Where a fee is charged, the fee structure should be as kept as simple as possible, and all participants should be treated equally and pay "acceptable" prices, with smaller market participants possibly being charged lower fees. In addition, the amount and timing of revenue derived from fee payments to cover registry costs should be predictable.

Alternatively, several options could be considered to cut administrative costs. Formalizing operational procedures (e.g., the process by which new customers have to be screened) can improve effectiveness and ensure equal treatment of all users, while also reducing the risk of operational errors. Setting control and monitoring standards for participants in accordance with their size and level of market involvement can reduce costs, without exposing the system to significant risks. Automating informational exchanges with registry users (such as requesting missing documents) can significantly shorten the time needed for administrative processing and reduce the risk of human error. Similarly, automating the monitoring of account activity can help detect suspicious forms of behavior. Finally, providing training materials and developing communication support tools (e.g., video tutorials) can reduce the number of incoming calls on a Registry User Hotline.

Technical framework

When procuring a registry, countries basically have to consider four major options:

- **Sharing**, by using a single common registry across jurisdictions;
- **Developing**, by drafting functional and technical specifications for an information technology (IT) services provider to develop a registry system from scratch;
- **Adapting**, by contracting an IT services provider to adapt and implement an existing, open source or licensed registry;
- **Outsourcing**, by using the software as the basis for a service model—the software vendor hosts and maintains the servers, databases, and code that constitute the registry application.

Any approach that involves the services of an IT company has specific pros and cons, and the final decision should duly take into account factors such as the cost of maintenance, complexity, and flexibility of the system, and data ownership.

A registry is unlikely to operate in isolation and, depending on the type of market mechanism, is likely to interface with several IT systems and databases. Other systems and databases include the national GHG inventory, a data management system that records offset projects and other crediting mechanisms, and other registries where there is linking between jurisdictions. In the case of linking distinct registries between jurisdictions, basically two interfacing options are available: (i) the use of a central communication hub (such as the ITL under the Kyoto Protocol) or (ii) the development of peer-to-peer network connections; both options have pros and cons.

A registry will be exposed to various security risks, which can be mitigated by adopting the following technical security measures:

- Enhancing the strength of authentication and time-out requirements can reduce the risk of identity usurpation.
- Limiting administrator access to normal working hours, automatic system checks during data entry, and multiple validation requirements can reduce the risk of fraudulent or accidental transfer.
- Limiting administrator access to the registry by client IP address (i.e., administrator users may only log on to the registry from networks known to be controlled by the responsible organization).
- Restricting both physical and electronic access to registry hosting infrastructure/servers.
- Ensuring strong encryption of data transfer and data storage.
- Conducting regular penetration testing and operating system and software patching.
- Adding detection and alert functions—which can be customized for individual account holders—to detect

suspicious administrative events, such as an unusually high number of transactions.

To enable identification and discrete tracking, each carbon unit will be issued with a unique serial number. Serial numbers are made up of consecutive number blocks that record information such as carbon unit type, vintage, project identification, and project type. A serial number should create a permanent link between each unit created and the initiating project, and reflect any other relevant market information (such as environmental or social quality labels associated with the unit) stored in a data management system.

A registry is likely to require different account types for different functions. Accounts can be split into *technical* accounts (those managed by the registry administrator) and *holding* accounts for market participants. *Technical* accounts may include those for the issuance, surrender, and cancellation of carbon units, as well as buffer accounts for risk management. *Holding* accounts may include *operator* holding accounts (for capped entities under the market mechanism), *project proponent* holding accounts (for carbon project developers), and *trading* accounts (for brokers and other intermediaries); each account is linked to a different set of functions and, in some cases, restrictions.

A web-based registry will require a service to host registry data, and rules for determining whether to allow online access. Security measures will be required to restrict access to authorized users. The registry's hours of operation—in other words, when will the registry be available to users—will have to be determined. It will also be necessary to determine some technical standards related to the registry's performance—for instance, the bandwidth, CPU power, system memory, and capacity required for handling the volume and frequency of transactions anticipated and for storing all the relevant data.

Registry Requirements for Sectoral Crediting: A Case Study of REDD+

A number of emerging market mechanisms premised on the provision of international financial support for domestic mitigation measures in developing countries are currently under development. One modality of such mechanisms relies on the issuance of carbon units based on the ERs achieved by an entire sector. Such sectoral crediting allows for the fast-tracking of ERs in sectors that have been prioritized for mitigation action, while country-wide accounting systems are still being built. Carbon units may be used as carbon credits under national ETSs (i.e., offsetting) or used in the context of international transfers of carbon units.

Sectoral crediting raises a number of accounting questions that have implications for registry design when used alongside NDC accounting and flexibility mechanisms established by the Paris Agreement.

- Do certain sectors present particular challenges, such as permanence risk, or a degree of uncertainty in monitoring, reporting, and verification that require the use of distinct carbon units with different accounting requirements?
- Can a credited sector contribute toward a country's NDC target, but be accounted for separately? For example, if the credited sector in question generates ERs, but a country fails to meet its NDC, are ITMOs still available for transfer?
- Can a credited sector be excluded from an NDC, so that ITMOs can be transferred that contribute to a purchaser's NDC without detracting from the host country's NDC accounting?

The international incentive framework for reduced emissions from deforestation and forest degradation (REDD+) enables countries and subnational entities to generate quantified ERs. Through sectoral crediting, these ERs can be linked to market-based transactions. As such, it is instructive to review the registry arrangements developed to date for the handling of forest carbon units. REDD+ countries wishing to transfer forest carbon units are likely to use the registry infrastructure already developed for other sectors, to a large extent. However, in some respects, ERs from forest and land-use interventions differ from those in other sectors, and registries dealing with the exchange of forest carbon units will have to be designed accordingly.

One key consideration is the role of markets in the implementation of REDD+. Forest carbon units can in principle be exchanged in the following markets:

- Voluntary carbon markets;
- International, government-to-government carbon markets;
- Domestic carbon markets; and
- Linked domestic and international carbon markets.

Another important category of REDD+ transactions refers to RBCF Programs that reward REDD+ countries for reducing emissions from deforestation and forest degradation. Although RBCF programs are, in some cases, being intro-

duced as a stepping stone to potential market-based mechanisms, they do not necessarily lead to the generation of a transferable carbon unit, and thus do not require an emissions trading registry. All RBCF programs which generate transferable carbon units, however, need to take measures to avoid instances of double counting including developing a registry to issue, transfer, and retire carbon units.

A second consideration is the scale of implementation. REDD+ can be implemented at the national, subnational, or project level, and in any combination of these approaches. The complexity of a registry depends on the number of accounting levels that are part of the national implementation, which of these levels are linked to carbon markets, and whether such a link is direct (e.g., whether credits can be issued to and traded by any level or if credits can only be issued to/traded by national governments, with subnational benefit sharing/crediting arrangements).

Implementation on multiple scales will require the nesting of lower-level accounts within the higher-level accounts, and/or the creation of separate levels of forest carbon units for trading at different scales.

A third consideration is that registries will need a number of special features to hold and manage carbon units related to land-use activities. REDD+ market systems need to manage the risk of reversal of emission reductions—by the release of carbon stored in biomass into the atmosphere (permanence risks)—which is a risk specific to land-use transactions. REDD+ is also exposed to the potentially higher risk of emissions displacement (leakage) and uncertainties in measuring and reporting emissions.

Leakage risk can be managed by large-scale accounting and emissions monitoring. Uncertainties in the measuring of emissions should be managed by adopting conservative accounting approaches. Many additional risk management strategies exist, three of which (buffer accounts, discounting, and temporary credits) have implications for registry design. In the case of buffer accounts, a portion of the ERs generated is set aside rather than being sold. In the event of reversal, leakage, or underestimation, emission reductions in the buffer can be used to compensate for this loss. Buffer accounts may also be pooled to ensure that there are sufficient buffer credits to account for any reversal that any one project or program may experience. This also contributes to diversifying the risk profile of the pool. Discounting permanently sets aside a portion of the emission reductions generated and allows only the remainder to actually be used. Temporary credits are units that expire at a set time after issuance and at that time need to be replaced by the holder, either with another temporary unit or a permanent unit.

The legal, technical, and institutional frameworks for REDD+ will be similar to those outlined above, be it that some additional factors will have to be taken into account. In land-use transactions, legal issues may arise from uncertainty around legal and beneficial ownership of transferred carbon units. However, a registry may not be the place to resolve legal risks related to carbon unit ownership. The starting point for a registry should be the assumption that the entities holding forest carbon units are uncontested owners, and thus legally entitled to transfer and to benefit from the sale of their forest carbon unit.

The technical requirements for handling forest carbon units will only differ from those of standard carbon unit trading systems to the extent that a regulatory system defines forest carbon units as distinct from other carbon units. Forest carbon unit serial numbers may be required to convey information on quality markers, limitations, or ER activity associated with the forest carbon unit in question, and may affect the type and number of accounts that the registry administrator must establish in the registry. Where buffer accounts are used, the IT system will need to develop a distinct buffer accounting model.

The development of an institutional framework for handling forest carbon units will also have to duly consider a number of factors. For instance, low-capacity entities may require support with account registration, and there might as well be a need for agents acting on behalf of groups that do not have access to information technology or for other reasons lack the capacity to access a digital registry. The sensitivity to information barriers faced by potential REDD+ participants may also be recognized when designing user guides and communicating registry functions. The fee structure should be established taking into account the needs of participants with limited financial resources.

Looking Ahead: the Role of Registries in the Post-Paris Regime

The Paris Agreement is the first-ever universal climate treaty that requires both developed and developing countries to contribute to the efforts in limiting global warming to 2°C above pre-industrial levels. Unlike the Kyoto Protocol, the Paris Agreement reinforces the principles of voluntary cooperation and bottom-up approaches, thereby presenting a largely self-implementing framework for climate change mitigation and adaptation. To this end, and in the wake of the INDCs submitted ahead of the COP, Parties will have to continue demonstrating political will and even increase their ambition by developing and

communicating voluntary, domestically defined, increasingly ambitious mitigation contributions every five years. These national mitigation strategies will likely cover a wide array of policies, including the intention to use carbon pricing and market-based instruments as a way to achieve countries' mitigation targets.

Besides the fact that all countries have assumed a responsibility for reducing GHG emissions, the Paris Agreement has more distinct features than the Kyoto Protocol. **While the Kyoto Protocol with its internationally governed market-based approaches and related institutions has provided a common framework for GHG accounting, the Paris Agreement is not calling for the establishment of one centrally coordinated or interlinked emissions trading architecture.** The practical implications of these differences is the evolution from the Kyoto-regime registry infrastructure that allowed the transfer of largely fungible carbon assets among Parties, both private and public entities, to the fragmented, Paris-regime approach whose distinctive feature will be diverse and country-driven systems.

Despite the bottom-up and fragmented nature of these country systems, it will be critical to ensure that the mitigation outcomes generated and potentially transferred internationally are environmentally robust, real, and measurable. International accounting standards will surely be key to achieving that, as will be the country-driven infrastructure of registries. Therefore, **emissions trading registries are likely to become even more important in the framework of the Paris Agreement.** While these registries will need to reflect the diversity of instruments and market transactions, as well as differences in country capacities, a certain degree of standardization is likely to be required if the countries intend to use international market mechanisms or cooperate by connecting their national registries to those of other jurisdictions.

Striking the right balance between these two purposes—that is, creating a registry that is both nationally appropriate and internationally compatible—will be one of the registry's biggest design challenges. That said, future developments in regard to registry design in the Paris framework will benefit greatly from already existing registry infrastructure, as well as knowledge and experience that have been gained over the years.

Against this backdrop and to further facilitate future registry design and implementation, this report provides detailed guidance for policy makers and other stakeholders on a number of issues related to regulatory, administrative, and technical aspects of registries that will need to be in place before emissions trading is implemented.

LIST OF ACRONYMS

AAU	Assigned Amount Unit
ACR	American Carbon Registry
AFOLU	Agriculture, Forestry, and Other Land Use
ANREU	Australian National Registry of Emissions Units
ARB	California Air Resources Board
ARBOC	Air Resources Board Offset Credit (California)
CCER	Chinese Certified Emission Reduction
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CITSS	Compliance Instrument Tracking System Service
CMP	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CPM	Carbon Pricing Mechanism
CRM	Customer Relationship Management
DES	Data Exchange Standards
EPA	Environmental Protection Agency (United States)
ER	Emission Reduction
ERF	Emissions Reduction Fund (Australia)
ER-PIN	Emission Reductions Program Idea Note (Forest Carbon Partnership Facility)
ERU	Emission Reduction Unit
ETS	Emissions Trading System/Scheme
EU	European Union
EU ETS	European Union Emissions Trading System
EUTL	European Union Transaction Log
FCPF	Forest Carbon Partnership Facility
GHG	Greenhouse gas
INDC	Intended Nationally Determined Contribution
IT	Information Technology
ITL	International Transaction Log
ITMO	Internationally Transferred Mitigation Outcome
JCM	Joint Crediting Mechanism
JI	Joint Implementation
JNR	Jurisdictional and Nested REDD+
MRV	Monitoring, Reporting and Verification
Mt	Megaton
$MtCO_2e$	Megaton of Carbon Dioxide Equivalent
NAMA	Nationally Appropriate Mitigation Action
NERP	National Emission Reduction Plan (United Kingdom)
NZ ETS	New Zealand Emissions Trading Scheme
NZEUR	New Zealand Emissions Unit Register
NZU	New Zealand Units
OPR	Offset Project Registries
OS	Operating System
PES	Payment for Ecosystem Services
PFSI	Permanent Forest Sink Initiative (New Zealand)
PIU	Pending Issuance Unit (United Kingdom)
PMR	Partnership for Market Readiness
RBCF	Results-Based Climate Finance
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	REDD plus Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks
REM	REDD Early Movers
RFI	Request for Interest
RFP	Request for Proposal
RGGI	Regional Greenhouse Gas Initiative
RMU	Removal Unit (Kyoto Protocol)
ROC	Renewable Obligation Certificate (United Kingdom) or Registry Offset Credit (California Cap-and-Trade Program)
ROE	Recognised Offsets Entity (Australia)

t	Ton (ton in this report refers to a metric ton = 1,000 kg)
tCO_2e	Ton of carbon dioxide equivalent
UK	United Kingdom
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
VCS	Verified Carbon Standard
VCSA	Verified Carbon Standard Association
VPN	Virtual Private Network
VVB	Validation/Verification Body (VCS)
WB	World Bank
WCC	Woodland Carbon Code (United Kingdom)
WCI	Western Climate Initiative
WCU	Woodland Carbon Unit (United Kingdom)

PART I. Registries: Introduction and Design Options

All markets require a trading place for buyers and sellers to hold and exchange assets. A carbon market is no different, and an emissions or "carbon" registry is typically required to perform two basic functions: (i) determine the quantity of carbon units held by account holders and (ii) enable the exchange of carbon units between account holders.

However, not all carbon markets are the same and, the more complicated the rules of the market, the greater the number of features a registry will need to have to accommodate these rules. Furthermore, jurisdictions that intend to engage in carbon markets but presently lack the capacity or experience to do so, may wish to develop some form of accounting of carbon units as a stepping stone to registry development.

This guidance report is intended to provide countries with technical insights and step-by-step guidance to support country-specific decision making and activities on registry development. It is targeted at countries in the process of designing domestic, market-based policies to reduce greenhouse gas (GHG) emissions. Part I is primarily meant for policy makers, while parts II, III, and IV are directed at both policy makers and specialists likely to play a technical role in registry design and implementation, ranging from IT specialists to legal experts.

Part I is structured as an introductory primer, aimed at demystifying the terminology on registries, and giving policy makers a clear, practical explanation of what registries are and how they cater to different market mechanisms. It gives some background on the development of registries to support environmental market mechanisms, from the domestic Emission Trading Systems (ETSs) of the 1990s to the Kyoto Protocol and the post-2020 climate regime outlined in the Paris Agreement, illustrated by a handful of case studies of registry arrangements in key jurisdictions. The aim is to show how registry design relates to the specific market mechanism adopted by a jurisdiction, and to highlight not only the legal and institutional frameworks, but also the technical infrastructure required for registry implementation. Part I concludes with guidance in a nutshell on three key questions for policy makers: (i) the type of accounting system their countries require; (ii) the optimum framework for its implementation; and (iii) the resources available for implementation.

1. Basic Terminology

There is understandable confusion over the term "registry," largely because of the many ways in which it has been used. In common parlance, a registry is simply a place for storing data. In the climate change policy context, the term has been used to refer to a whole range of things—including a GHG emissions accounting system, a list of project and program information, and carbon unit databases with varying levels of functionality.

To help dispel the confusion, this guidance report makes a distinction between four types of emissions accounting systems, briefly described below:

1. **GHG inventory:** An inventory that records physical GHG emissions and removals. Accounting of GHG emissions must be distinguished from accounting of carbon units.

   An example is the United States National Greenhouse Gas Inventory, which tracks total annual U.S. emissions and removals by source, economic sector, and GHG. The inventory is prepared by the Environmental Protection Agency (EPA) and submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat and other Parties in Annex I to the Convention.

2. **Register:** A database that records serialized carbon units and any other information specific to the carbon unit required by policy. This could include the vintage of the carbon unit, the identity and location of the project for which the carbon unit was issued, the project funder, and verification details. A register may be used by a country that receives RBCF for generating emission reductions (ERs), to ensure that one and the same ER is not paid for twice (double payment).

   Participants in the REDD Early Movers (REM) program led by Germany must develop an accounting platform to track, retire, and cancel, but not transfer, ERs. This is an example

of what is referred to as a register in this guide. Forest Carbon Partnership Facility (FCPF) Carbon Fund participants must develop an accounting platform to transfer carbon units to the World Bank (WB). This is also referred to as a register, even while the transfer is not sophisticated because it only requires one account holder (the national authority) in the register.

3. **Transaction registry:** A database that has all the features of a register, plus the capability to transfer carbon units between account holders in the transaction registry (internal transfer), and/or the capability to transfer carbon units to another transaction registry (external transfer). Any emissions trading system (ETS) will require a transaction registry in some form. The more complex the trading system, the larger the number of features the transaction registry will require.

   An example is the Union Registry, a single E.U. registry operated by the European Commission to enable participation in the European Union Emissions Trading System (EU ETS), which has more than 20,000 account holders and thousands of daily trades. Security measures include preventive measures to avoid fraud (e.g., two-factor authentication and out-of-band confirmation of transactions), measures to quickly respond to fraud (e.g., the ability of seller to cancel transactions within 24 hours of a sales transaction), and measures to avoid market disruption if fraud does occur (e.g., buyers who acted in good faith will acquire full entitlement to purchased allowances).

4. **Data Management System (DMS):** A database that records and archives information about a carbon unit that is not stored in the transaction registry or register, but that for policy reasons is required to transparently demonstrate environmental integrity, compliance with safeguards, and other conditions. For example, to facilitate compatibility between registries, it may be desirable to limit the information that travels with a carbon unit when it is externally transferred. At the same time, it may be desirable to archive information about that carbon unit (e.g., baseline information according to which a carbon unit was issued, or geographical information relating to a project boundary), and this can be recorded in a data management system. The serial number of a carbon unit should link it to the information stored in the data management system, so this can be retrieved if necessary.

   An example is the database of registered Clean Development Mechanism (CDM) project activities, which for each project records, inter alia, project design document, information on methodologies used, and validation reports.

This guidance report concerns the development of registers and transaction registries—accounting systems that record and track carbon units exchanged through market mechanisms or carbon units financed through RBCF programs (Figure 2). The term registry is used as an umbrella term to refer to both registers and transaction registries whenever it is unnecessary to distinguish between those two terms.

This guidance report also distinguishes between different types of "carbon units," an umbrella term used to refer to the following three categories:

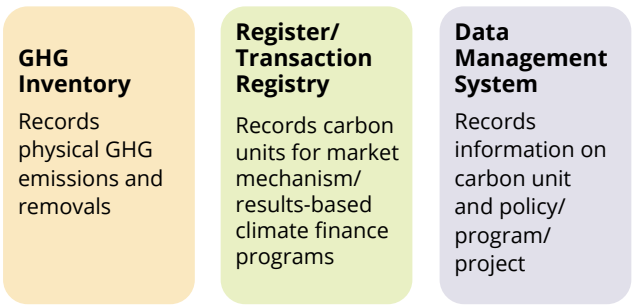
1. **Allowance:** Similar to a permit, an allowance is issued by a central authority and gives a regulated entity the right to emit, up to the maximum of the allowance, without being subject to a penalty.

   An example is the European Emission Allowance (EUA), which is issued to fixed installations and gives the holder the right to emit one ton of carbon dioxide (or equivalent) under the EU ETS.

2. **Carbon credit:** A credit that is earned for undertaking an activity that reduces emissions against a baseline, according to a regulated standard. Credits are issued to authorized project developers upon verification. Credits are sold as offsets to be used by regulated entities instead of an allowance.

   An example is the Certified Emission Reduction (CER), issued by the CDM Executive Board for a CDM project activity. CERs can be purchased, to a limited extent, by Kyoto Protocol Annex B countries to comply with their targets under the Protocol, and by regulated entities under the EU ETS.

FIGURE 2: **Different Types of Emissions Accounting Systems Compared**



3. **Voluntary credit:** As with a carbon credit, voluntary credits are earned for undertaking an activity that reduces emissions against a baseline. However, voluntary credits are issued according to a "private" (i.e., voluntary) standard. They may be recognized by regulated trading systems for compliance purposes.

   An example are the Verified Carbon Units (VCUs), which are issued, tracked, and retired on the "VCS registry system," which consists of the two transaction registries (APX and Markit) and a central project database.

Other basic terms used in this guide are briefly defined in Table 1; more elaborate definitions are presented in appendix A.

TABLE 1: **Basic Relevant Terminology**

Types of Emission Accounting System	
GHG inventory	An inventory that records physical GHG emissions and removals
Register	A database that records serialized carbon units and any other information specific to the carbon unit , as required by policy
Transaction registry	A database that has all of the features of a register, plus the capability to transfer carbon units between multiple account holders
Data Management System (DMS)	A database that records information about emission reductions (e.g., the type of carbon unit, relevant methodologies, the policies, and programs) and, more generally, any information that is not stored in the transaction registry or register, but that for transparency purposes should be recorded and archived
Types of Emissions Trading Systems	
Cap-and-trade	Creates a fixed ceiling on total emissions for a compliance period, and then distributes allowances (usually through free allocation or auctioning) to regulated entities that are subject to the cap
Baseline-and-credit	Entities that are not subject to an emissions cap are issued credits for voluntarily undertaken projects that reduce emissions compared to a baseline or counterfactual projection. Credits are sold as offsets to entities subject to an emissions cap
Purely voluntary	Entities that are not subject to an emissions cap generate and sell offset credits to other entities that are likewise not subject to an emissions cap
Types of Carbon Units	
Carbon unit	An umbrella term to refer to the three types of carbon units distinguished by this report
Allowance	Similar to a permit, this gives a regulated entity the right to emit without being subject to a penalty
Carbon credit	A credit that is earned for undertaking an activity that reduces emissions against a baseline, according to a regulated standard
Voluntary credit	Similar to a carbon credit, except that it is issued according to a voluntary standard
Registry Functions	
Issuance	The creation of a carbon unit by a registry administrator and its allocation to an account holder
External transfer	The transfer of a carbon unit from an account in one registry to an account in another registry
Internal transfer	The transfer of a carbon unit from one account to another one within a registry
Retirement	The disposal of a carbon unit for compliance with an emissions target ; in some contexts, retirement is referred to as "surrender"
Cancellation	The disposal of a carbon unit where the unit is not used for compliance with an emissions target, and cannot be used by others for compliance either
Conversion	The transformation of one carbon unit type to another
Banking	The carrying over of unused carbon units from one compliance period to the next
Borrowing	The use of carbon units from future compliance periods to meet obligations in the current compliance period

(CONTINUED)

TABLE 1: **Basic Relevant Terminology** (CONTINUED)

Market Participants	
Regulator	A public authority appointed by law to oversee and enforce the market mechanism
Registry administrator	A body responsible for the day-to-day operations of the registry; this can be a public or private body
Regulated entity	A body that is legally subject to an emissions limit or other obligation; this could be a country under international law or a company under domestic law
Project developer	An organization that voluntarily engages in a project to reduce emissions in order to sell carbon units
Verifier	Responsible for ensuring, among others, that the emission reductions reported by project developers are real and additional
Broker	Engages in carbon unit transactions on behalf of a client
Intermediary	Purchases a carbon unit on its own behalf for a purpose other than compliance (e.g., resale)
Trading Levels	
Primary market	Where allowances or carbon credits enter the market and are acquired by regulated entities for compliance purposes
Secondary market	Where allowances or carbon credits are resold and purchased, either for resale or compliance
International market	Where countries/jurisdictions acquire carbon units to comply with caps or targets expressed in international legislation
Domestic market	Where entities, such as power stations and industrial facilities, acquire carbon units to comply with caps established through domestic legislation

2. Registries: Experiences to Date and Future Needs

2.1. Registries and domestic market-based policies pre-Kyoto

The most prominent example of emissions trading in the era preceding the Kyoto Protocol emerged through amendments to the United States Clean Air Act to control sulfur dioxide emissions (known as the Acid Rain Program). The Acid Rain Program being a cap-and-trade program, allowances are allocated (and later auctioned) by the United States EPA to power plants, in line with a predetermined formula, and plants that emit less sulfur dioxide than their allowances permit, can sell excess allowances to other, higher emitting plants that are short of allowances.

The registry ("Allowance Tracking System") developed by the U.S. Environmental Protection Agency (EPA) to account for allowances creates two types of account: (i) *unit accounts*, opened by utilities regulated by the Acid Rain Program to determine compliance, and used for the issuance, holding and deduction of allowances to cover emissions; and (ii) *general accounts*, which can be opened by any individual or group, and used for holding and transferring allowances, but not for compliance purposes. General accounts can be used by covered utilities to pool their allowances, by intermediaries wishing to purchase allowances for resale, or by public interest groups wishing to remove a portion of available allowances from the market. Each allowance is identifiable through a unique serial number that, among other things, reflects the first year in which the allowance can be used for compliance.

Originally, the Allowance Tracking System did not automatically record allowances transferred between accounts. Rather, transfers were reported to the EPA by the "authorized account representatives" of the buyer and seller in question, using an allowance transfer form. More recently, an electronic trading platform has been developed (the CAMD Business System), which records the horizontal transfer of allowances between account holders.

2.2. International registries established in accordance with the Kyoto Protocol

In 1997, the Kyoto Protocol introduced the concept of emissions trading into the climate regime. By capping the emissions of developed countries, it created the conditions

for a harmonized GHG accounting that, in turn, allowed the transfer of units between Parties with an emission cap. The Kyoto Protocol features a cap-and-trade aspect, as trading of allowances (Assigned Amount Units or AAUs) is permitted between developed Parties subject to emissions targets. It also features a baseline-and-credit aspect, project developers being allowed to generate and sell carbon credits through ER projects in developed countries (through "Joint Implementation" (JI) and the trading of Emission Reduction Units or ERUs) and developing countries not subject to emissions targets (through the "Clean Development Mechanism" (CDM) and the trading of "CERs").

The involvement of multiple participants and types of carbon units necessitated the development of multiple registries, all linked to one another, and able to issue, hold, transfer, convert, replace, carry over, and retire/cancel/surrender various types of carbon units. Developed country Parties had to establish national registries to track their holdings of and transactions (additions/subtractions) of Kyoto units (including AAUs). AAUs can be transferred between national registries, thereby giving flexibility to developed countries in meeting their Kyoto commitments. In addition, national registries can convert AAUs into ERUs for issuance to ER project developers in developed countries under JI. Project developers can sell ERUs to other developed countries.

Developing countries are not subject to emissions targets under Kyoto and have not established national registries. Hence a CDM registry was established to issue CERs to qualifying emissions reduction projects in developing countries. Authorized project developers can instruct the CDM registry administrator to transfer these CERs to accounts in Annex I registries.

To ensure that transactions are consistent with the rules of the Kyoto Protocol and that one and the same unit is not used in multiple accounts simultaneously (which would lead to "double counting"), an International Transaction Log (ITL) was developed to connect registries and oversee transactions. The ITL is administered by the UNFCCC secretariat.[6] To ensure that communication between registries is secure and processed in real time, the UNFCCC maintains a special communication protocol (the Data Exchange Standards or DES) with specific technical specifications (e.g., web services using a Simple Object Access Protocol (SOAP) and a hardware-based Virtual Private Network (VPN)).[7]

2.3. National registries established in accordance with the Kyoto Protocol

To help meet their Kyoto commitments, a number of developed countries have introduced market mechanisms as a means to regulate pollution from major emitters, such as power stations and industrial plants. These mechanisms include New Zealand's Emissions Trading Scheme and Australia's Carbon Farming Initiative, though the largest and longest lived of these ETSs is the EU ETS. Currently covering the 28 member states plus Iceland, Lichtenstein, and Norway, the EU ETS began life as a largely decentralized system of mostly independent but interlinked trading systems of the EU member states, member states being responsible for issuing carbon units, setting emission caps, and operating their respective registries. This led to significant coordination problems and consequently, in 2012, the various Member State registries were replaced with a single EU registry operated by the EU Commission. The EU registry records national implementation measures, company or physical person accounts, transfers of allowances, verified GHG emissions from installations, and annual reconciliation of allowances and verified emissions.[8]

The EU ETS is a cap-and-trade system in which allowances ("EUAs") are traded between market participants. Moreover, the EU ETS Linking Directive allows the limited import of Kyoto credits (e.g., CERs) for compliance purposes. Originally, EUAs were linked to Kyoto AAUs—each EUA issued by a Member State registry through the conversion of an equal quantity of AAUs. In fact, the transfers of EUAs between Member State registries under the EU ETS were shadowed by the transfers of AAUs under the Kyoto Protocol. In the current phase of the EU ETS, however, EUAs issued by the Commission are no longer linked to AAUs, and the EU registry and Kyoto registries are only linked to the extent that CERs and ERUs can be traded between the two platforms. The European Union Transaction Log (EUTL) automatically checks, records, and authorizes all transactions that take place between accounts in the Union registry.

6 For more information on systems and processes that support registry integration under the Kyoto Protocol, see the presentation given by Jean-Francois Halleux of UNFCCC at the PMR Workshop held in Sacramento, September 23–25, 2015, available at https://www.thepmr.org/sites/wbpmr/files/2.%20UNFCCC_PMR_IntegratingReg%20v0.9.pdf

7 For more information, see UNFCCC, Data Exchange Standards for Registry Systems under the Kyoto Protocol, Technical Specifications (version 1.1.10), available at https://unfccc.int/files/kyoto_protocol/registry_systems/application/pdf/des_full_v1.1.10.pdf.

8 For more information, see World Bank. 2012. State and Trends of the Carbon Market 2012, available at http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_2012_Web_Optimized_19035_Cvr&Txt_LR.pdf#page=29.

Box 3 reviews milestones in the use of Emissions Trading Registries in the United Kingdom.[9]

BOX 3. Emissions Trading Registries in the UK—from UK ETS to EU ETS

In 2002, the United Kingdom launched a voluntary Emissions Trading Scheme (UK ETS). It pioneered the reverse auction format, whereby companies "bid" for public money (an "incentive payment") with emission reduction commitments. Successful companies were then issued with allowances, which they could trade among themselves to meet their commitments. The Department for Environment and Rural Affairs (DEFRA) established and administered the U.K. Emissions Trading Registry (UK ETR) to serve the UK ETS. Given the small number of participants involved (32) and the limited number of trades, DEFRA undertook registry transactions on behalf of participants and facilitated any transfers of allowances between participants.

The UK ETS was designed to be compatible with the EU ETS, and the U.K. government-designed software (Greenhouse Gases Registry for Emissions Trading Arrangements) was shared with 16 other EU member states for participation in the EU ETS.

For phases I and II of the EU ETS, the "U.K. national registry" was administered by the U.K. Environment Agency. The national registry enabled account holders to hold, transfer, cancel, or acquire EU Allowances (EUAs) as well as Kyoto units that could be used for compliance with the EU ETS. The U.K. national registry was reconciled on a periodic basis with the Community Independent Transaction Log (CITL) of the EU and the UNFCCC International Transaction Log (ITL), to ensure consistency of records across the EU and Kyoto systems.

In June 2012, the EU member states' registry systems were brought together into a single registry system, operated and managed by the European Commission. As the member states remained severally responsible for their Kyoto targets in the event that the EU does not meet its collective target, each member state has a national registry section within the single Union Registry. The United Kingdom's Environment Agency remains responsible for the administration and maintenance of the U.K. national registry section. The accounts in the U.K. national registry section are governed by U.K. laws and fall under the jurisdiction of the United Kingdom, and the units held in these accounts are considered to be situated in the United Kingdom.

2.4. Jurisdictional registries established outside of the Kyoto Protocol

Following the United States' decision not to ratify the Kyoto Protocol and in the absence of a national carbon pricing policy and emissions targets, a number of U.S. states have developed regulations to limit GHG emissions internally. The most prominent of these regulations is California's Global Warming Solutions Act, also known as AB32, which laid the basis for the development of California's Cap-and-Trade Program, operational since 2012.

In 2007, California entered into the Western Climate Initiative (WCI), together with four other subnational jurisdictions in the United States and Canada (British Columbia, Manitoba, Ontario, and Quebec). The WCI is a non-binding commitment to certain ER goals, and includes an agreement to develop a linked set of multisectoral ETSs. The WCI has gained the support of seven US states and four Canadian provinces, though to date, only California and Quebec have linked their ETSs.

Beyond the WCI, a group of northeastern U.S. states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont) have formed the Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade program to reduce emissions from the power sector. Participating states have developed the RGGI CO_2 Allowance Tracking System (RGGI COATS), a registry that records and tracks data for each state's CO_2 Budget Trading Program. Both allowances and carbon credits can be traded as part of the RGGI.

Alberta, which has introduced emissions regulation requiring existing facilities to immediately reduce their GHG output, has also developed a registry to enable regulated entities to engage in compliance flexibility mechanisms, including the use of "emission performance credits" and Alberta-based carbon credits.[10]

Box 4 outlines what arrangements California and Quebec had to make to be able to formally link their programs in January 2014.[11]

9 See the Department for Environmental and Rural Affairs (DEFRA), Appraisal of Years 1–4 of the U.K. Emissions Trading Scheme, available at http://webarchive.nationalarchives.gov.uk/20090908171815/http://www.defra.gov.uk/environment/climatechange/trading/uk/pdf/ukets1-4yr-appraisal.pdf.

10 For more information, see presentation given by John Storey-Bishoff of Alberta Environment and Parks at the PMR Workshop held in Sacramento, September 23–25, 2015 (available at https://www.thepmr.org/sites/wbpmr/files/3.WB%20PMR%20-%20Alberta%20Registry%20-%202015-09-23.pdf).

11 Based on the presentation given by Jason Gray of the California Air Resources Board (ARB) at the PMR Workshop held in Sacramento, September 23–25, 2015 (available at https://www.thepmr.org/sites/wbpmr/files/4.%20Sept%2025%202015%20ARB%20PMR%20Presentation.pdf).

BOX 4. Registry Arrangements for Linking of California and Quebec Cap-and-Trade Programs

Following considerable joint planning, the California and Quebec cap-and-trade programs were formally linked in January 2014, with the first joint auction held in November 2014. A number of differences exist between the two programs, not least the fact that California's emissions target is for 2020 levels to equal 1990 levels, whereas Quebec's target is for emissions by 2020 to be 20 percent below 1990 levels. The ambition of Quebec's target suggest that it will be a net importer of carbon units.

High-level rules for linking are set out in an agreement between the California Air Resources Board (ARB) and the government of Quebec on the harmonization and integration of cap-and-trade programs. This agreement contains, inter alia, a commitment of the parties to work together to develop and use common electronic platforms in order to ensure program compatibility, integrity, and integration.

The registry supporting the California-Quebec linked program is the Compliance Instrument Tracking System Service (CITSS), which functions as a single, linked registry. Covered entities, project operators generating offsets, and any other bodies holding or trading compliance instruments on the secondary market, must register an account with the CITSS. CITSS is used to issue, trade, and retire compliance instruments with unique serial numbers.

California and Quebec had begun using CITSS separately, prior to formal linking, and thus a number of technical, administrative, and legal hurdles had to be overcome for linking to function (e.g., for data security and monitoring purposes, both parties' regulations had to be aligned, and new processes and procedures jointly developed).

The use of a single registry by multiple jurisdictions reduces the threat of security breaches, simplifies accounting of cross-border transfers, and creates clear requirements for new participants (a consideration in the case of CITSS, Ontario having signaled its intent to join). On the other hand, a challenge of this approach is that it requires policy alignment from participating jurisdictions, which in turn requires coordination to resolve differences arising from variant legal structures, regulatory timetables, and processes.

2.5. Registries in voluntary carbon markets

Voluntary carbon markets emerged in the late 1990s, largely driven by demand from private companies to "offset" their emissions, often as part of corporate social responsibility (CSR) programs or to gain experience in carbon trading, in anticipation of the introduction of regulated markets. Voluntary carbon units are created through private contracts, with ERs commonly verified to an offset standard by an independent accredited entity (validation/verification body) to provide quality assurance. Certification to a voluntary standard allows the issuance of verified emission reductions (VERs) into emission registries established by independent third parties. Major voluntary standards include, among others, the Verified Carbon Standard (VCS), the Gold Standard, and the American Carbon Registry (ACR). Voluntary standard bodies determine the methodologies for quantifying the GHG ERs of specific project activities. Project proponents must open an account with a registry operator. In the case of the VCS, registry operators are the private companies APX and Markit, both of which are directly linked to the VCS Project Database. Voluntary credits are issued into registries upon verification, which is conducted by an approved project validation/verification body.

Entities involved in voluntary standards have also played a role in regulated carbon markets. For example, the VCS, ACR, and CAR operate "Offset Project Registries" within the California Cap-and-Trade Program, which permits regulated entities to use offset credits to meet a portion of their compliance obligation. Offset credits issued by Offset Project Registries must be converted into Compliance Offset Credits before they can be used for compliance with the Cap-and-Trade Program.

2.6. Registries as part of Results-Based Climate Finance Programs and REDD+

RBCF programs are a financing tool that condition payment on the achievement of particular results, and typically describe donor country aid programs that pay for *outcomes* rather than *inputs* such as capacity building and action plan development. In recent years, a number of donors have developed bilateral and multilateral RBCF programs. While using ERs as a performance metric, most of these programs do not issue and transfer carbon units and therefore do not require an emissions trading registry. Those RBCF programs that generate transferable carbon units, however, need to take measures to avoid instances of double counting including developing a registry to issue, transfer, and retire carbon units.

The Carbon Fund of the WB's Forest Carbon Partnership Facility (FCPF) makes payments for REDD+ results measured against a national baseline or "reference level." The fund requires host countries to either maintain a national transaction registry, or use a transaction registry managed by a third party on its behalf. This reflects the fact that Carbon Fund payments are made in exchange for the transfer of

carbon units from the host country to the Carbon Fund, and a transaction registry is required for the appropriate issuance, serialization, transfer, retirement, and/or cancellation of carbon units.

By contrast, Norway's bilateral results-based agreements, such as those with Brazil, Guyana, and Indonesia, do not involve the transfer of carbon units but rather the financing of compensated results, and thus the development of a transaction registry has not been necessary. For example, Norway's contributions to Brazil's Amazon Fund are defined as grants for which personal, nontransferable and nonnegotiable diplomas that do not grant ownership rights or any kind of credit are issued. ERs corresponding to these diplomas will not be sold on carbon markets, and an inventory of payments received and corresponding ERs is published online.

The REDD Early Movers Program (REM) led by Germany, meanwhile, requires participating countries and jurisdictions to permanently retire ERs (to avoid double counting), and cancel additional ones in order to, inter alia, mitigate permanence and leakage risks. This requires that participating countries and jurisdictions develop an accounting system to track, retire, and cancel ERs. However, the development of a transaction registry is not necessary, as REM does not involve the transfer of carbon units. For example, the Brazilian jurisdiction of Acre selected the Markit Environmental Registry platform, a private financial information services company, to develop a platform to account for ERs compensated under the REM Program, though this does not involve the transfer of carbon units to Germany.

2.7. Registries to be established for emerging market mechanisms in developing countries

In recent years, a number of developing countries have begun to develop market mechanisms to tackle domestic emissions, and these require varying levels of registry sophistication.

Cap-and-trade schemes are under development in a number of developing countries. Seven regional pilots have been introduced in China since 2013, aimed at creating a national ETS by 2017. Transaction registries have been developed for each pilot region to issue, hold, transfer, and retire allowances. In addition to allowances, domestically produced offset credits are accepted across all seven pilots. China is already exploring the possibility to link these regional pilots (and eventually a national ETS) with other ETSs. In total, six developing countries are currently considering implementation of a domestic ETS, and an ETS has been operational in South Korea since 2015.[12]

Although **carbon taxes** do not themselves require the development of transaction registries, taxes introduced in Mexico and planned for South Africa include an offsetting component, according to which taxed entities can reduce their tax liability by purchasing project-level offset credits. These offsetting programs have yet to be operationalized, and accounting rules and infrastructure have not yet been developed. Nonetheless, some form of registry system will likely be required, through which entities are able to acquire, hold, and surrender offsets credits instead of paying taxes.[13]

Sectoral crediting refers to the process by which carbon units (for domestic or international use) are issued to a sector as a whole, rather than to individual projects or programs, for reducing emissions against a baseline. Jurisdictional-level, market-based REDD+, with carbon units sold by a jurisdiction for forest ERs across that jurisdiction or biome, would be an example of sectoral crediting. Sectoral crediting would require some form of registry development, either for holding and retiring carbon units at the national level (e.g., for compliance with an emissions cap) or for the sale of carbon units at the international level. However, sectoral crediting is yet to be implemented and no international or domestic framework exists so far.

Nationally Appropriate Mitigation Actions or **NAMAs** are a policy tool for developed countries to define the mitigation actions for which they seek financial, technical, and capacity-building support from developed countries. Through the NAMA process, a number of countries, including Mexico and Colombia, have begun to explore the possibility of developing "credited NAMAs", that is, NAMAs for

12 The developing countries that are considering an ETS are Thailand, China, Turkey, Ukraine, Mexico, and Chile (see World Bank Group. 2015. Carbon Pricing Watch, available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/26/090224b08309a09a/4_0/Rendered/PDF/Carbon0pricing0e0released0late02015.pdf). Information on registry infrastructure developed to support market mechanisms in Kazakhstan and Thailand has been presented at the PMR Workshop held in Sacramento, September 23–25, 2015, available at https://www.thepmr.org/system/files/documents/4.Kazakhstan%E2%80%99s%20Carbon%20Units%20Registry.pdf and https://www.thepmr.org/system/files/documents/3.TGO_Registry_23Sep15.pdf respectively.

13 For more information on the use of international offsets in domestic programs, see PMR (2015), Technical Note 10, Options to Use Existing International Offset Programs in a Domestic Context, available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/27/090224b08309d7dd/1_0/Rendered/PDF/Options0to0use0n0a0domestic0context.pdf.

which carbon units are issued in exchange for investment.[14] Credited NAMAs would require the development of transaction registries for the issuance and international transfer of carbon units. Unlike sectoral crediting, credited NAMAs would generate carbon units for ERs from specific projects, rather than measured across a sector as a whole.

Box 5 gives an overview of the development of China's national registry system.[15]

2.8. Registries to be established after the Paris Agreement

Negotiated in December 2015, the Paris Agreement creates a framework for international climate policy post-2020. Unlike the Kyoto Protocol, which was built around binding emissions targets for developed countries only, the Paris Agreement is structured around volunteered Nationally Determined Contributions (NDCs), which express the bottom-up feature of the climate goals of developed and developing countries.

The Paris Agreement sets the groundwork for a number of market mechanisms. First, the Paris Agreement allows Parties to exchange "internationally transferred mitigation outcomes" (ITMOs), which can be used to account toward NDC implementation.

The sum total of NDCs does not represent a "cap" in the traditional sense, as NDCs are self-determined and the Paris Agreement does not oblige countries to meet their NDCs. Hence, the trading mechanism, if leading to the generation of transferable carbon units, would more closely resemble a baseline-and-credit system—with ITMOs taking some form of carbon credits for reductions against a baseline—than a system based on allowances. One major challenge, however, is that NDCs are not formulated consistently across countries, with the targets in some NDCs expressed as absolute emission cuts compared with baseline years, and other NDCs expressing targets relative to projected business-as-usual scenarios. As such, *it is not clear, at the time of writing, how the equivalence (and fungibility) of ITMOS will be established, and Parties to the Paris Agreement will need to*

BOX 5. China's national registry system

In 2012, the government of China began developing a national registry system to support both a national voluntary carbon market, launched in 2015, and a national, allowance-based carbon market. Although the allowance-based market is still in the design phase, it is expected to use the same registry infrastructure as the voluntary carbon market. The registry IT system has been developed by the Chinese government from scratch.

The Chinese national ETS is envisioned as an allowance-based system in which allowances will be either allocated or auctioned. Moreover, the use of offsets, termed Chinese Certified Emission Reductions (CCERs), will be permitted for compliance purposes. Governance is split between the central government and provincial governments, and it is expected that participants will include regulated entities, project developers generating offsets, brokers, and other intermediaries. As such, the national registry system will comprise multiple types of accounts and holders:

National management accounts: accounts held and managed by national authorities, including a total quantity account, national allocation account, national auction account, and national cancellation account.

Provincial management accounts: accounts held and managed by provincial authorities. In addition to national types of management accounts, provincial management accounts include an offset (CCER) compliance account.

Holding accounts: accounts for regulated entities and project developers. These include compliance holding accounts, general holding accounts, and trading accounts.

Others: Includes an auction platform delivery account and an exchange delivery account. Auction agencies certified by the authorities will manage the auction delivery accounts. Exchange delivery accounts are to be used for the indirect transfer of carbon units between account holders.

Account management within the national registry system will be conducted by administrators appointed by the national authorities, and to be responsible for opening, blocking, and closing of accounts, and information editing.

It is conceived that the Chinese ETS may be linked to other compliance regimes under the UNFCCC in the future. For this reason, the national registry system will implement a connection interface with ITL under the UNFCCC Data Exchange Standards (DES).

14 For more information, see PMR (2015), Crediting-Related Activities under the PMR, available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/12/090224b08306caff/1_0/Rendered/PDF/Crediting0rela0t0for0implementation.pdf.

15 Information taken from presentations given at the PMR Workshop held in Sacramento, September 23–25, 2015, available at https://www.thepmr.org/sites/wbpmr/files/2.%20WB_Sacramento_Sino_Day1_Session4.pdf, https://www.thepmr.org/system/files/documents/2.%20WB_Sacramento_Sino_Day1_Session3.pdf and https://www.thepmr.org/sites/wbpmr/files/2.201509%20China%27s%20ETS%20registry%20-NCSC.pdf.

develop further rules to clarify the nature of ITMOs and how the trade in ITMOs is to be structured.

At the same time, the Paris Agreement seems to have established a further baseline-and-credit system, modeled after the CDM, in the form of a "mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development." Modalities that guide these mechanisms have still to be established. The reference to authorized public and private entities that may participate in mitigation activities in the host country, and the creation of ERs that can be counted by another country to meet its NDC but must be subtracted by the host country in its own NDC accounting (to avoid double counting) suggest similarities with existing baseline-and-credit mechanisms.

Under the Paris Agreement, countries must account for their NDCs. This will require each country to develop an emissions accounting system to monitor and report on its emissions and removals. Further, NDCs will be recorded in a "public registry," maintained by the UNFCCC Secretariat and serving as a compendium of published NDCs). Countries wishing to exchange ITMOs would need to ensure the same "mitigation outcome" is not reported by more than one country, which may require transaction registries with an interface to their emissions accounting systems, or, alternatively, a simple double-entry bookkeeping and tracking tool built into the national inventories of countries. Countries wishing to host activities under the "mitigation and sustainable development mechanism" will need to develop transaction registries that, in addition, link project-level "emission reductions" to national emissions accounting systems, so that "emission reductions" transferred abroad can be subtracted from national accounts.

3. Key Questions for Policy Makers

A key theme of this report is that registry requirements will vary according to the market mechanism they support. The more complex the market mechanism, the more complex the accompanying registry, and hence the greater resources, both administrative and financial, that will be necessary for its implementation. It is thus important that decision makers have a clear picture at the outset of resource requirements, so that design choices are informed by resource availability and constraints.

As the chapter above indicates, registry design is not straightforward, and for policy makers faced with multiple policy objectives and design choices, knowing where to begin can be difficult. A good starting point is addressing the three questions posed below, for which we provide some initial guidance. Policy makers should keep these questions in mind while working through the more detailed guidance presented in parts II, III, IV, and V of this report.

Question 1: What type of registry does my country require?

To comply with the Paris Agreement, all Parties will have to account for anthropogenic emissions and removals corresponding to their NDCs, which will require the development of a GHG inventory.

Developing countries intending to access RBCF through bilateral or multilateral channels will likely have to develop a register to track compensated results, and a data management system if the tracking of detailed, project-level information is required. For RBCF that require the transfer of carbon units (such as envisaged under the FCPF Carbon Fund or credited NAMAs), a register with the capacity to issue and transfer units will be required.

▶ **See Part II, Section 2, for a discussion of factors influencing the choice of platform; see part III, Section 1.1, on the scale and scope of market mechanisms.**

Countries intending to implement ETSs will require a transaction registry.

Parties to the Paris Agreement that intend to exchange "international transferred mitigation outcomes" (Art.6.2) will have to apply robust accounting to ensure, among other things, the avoidance of double counting. This will require the development of transaction registries to issue, hold, and externally transfer ITMOs.

▶ **See Part V, Section 2, for a discussion of emerging market mechanisms under the Paris Agreement.**

Parties to the Paris Agreement intending to engage in the "mitigation and sustainable development mechanism" (Art.6.4) will need to develop transaction registries that feature subaccounts for the issuance of carbon units to mitigation activity proponents. Carbon units from mitigation activities that are externally transferred to entities in other countries must be excluded from the national accounts of the host country (for the purpose of NDC reporting) and credited to the national accounts of the purchasing country.

▶ **See Part V, Section 2, for a discussion of emerging market mechanisms under the Paris Agreement.**

Parties to the Paris Agreement that intend to implement the flexibility mechanisms described above and implement a domestic ETS that is linked to another or multiple ETSs, will

require a highly developed transaction registry that ensures reconciliation between different accounting levels.

- **See Part V, Section 2, for a discussion of emerging market mechanisms under the Paris Agreement.**

Question 2: What are the legal, institutional, and technical frameworks for the required registry?

As noted throughout the accompanying guidance materials, the degree of sophistication of the registry, and hence the required legal, technical, and institutional arrangements, will depend on the choice of market instrument(s). There is a sliding scale of registry functionality, from basic accounting and data management all the way up to sophisticated international crime detection and prevention.

- **See Part II, Section 1.1, for a discussion of the sliding scale of functionality between a register and a transaction registry.**

The legal framework should address, among other things, the monitoring and reporting obligations of regulated entities; the creation, issuance, transfer, and retirement of carbon units; the administrative rules or terms and conditions relating to account opening, closing, and access; the legal nature of the carbon unit; the tax implications of carbon unit transfer; relevant financial instrument regulations; and rules in the event of insolvency of account holders.

- **See Part II, Section 3.2.2 and 3.2.3, for a discussion of carbon unit creation, issuance transfer, and retirement.**
- **See Part II, Section 3.3.2, and Part V, section 3.4.3, for a discussion of the legal nature of carbon units.**
- **See Part II, Sections 3.3.3, 3.3.4, and 3.3.5, for a discussion of tax, financial regulation, and insolvency rules.**

In building a registry, countries have four major options: (i) to share a registry with other jurisdictions; (ii) to develop an IT system from scratch; (iii) to adapt existing systems; or (iv) to commission a software vendor to host and maintain the registry. Transaction registries may need to be interfaced with other databases (e.g., a GHG inventory) and potentially be linked to other transaction registries through a central hub or peer-to-peer network connections. A registry is exposed to a number of security risks, and technical security options will need to be developed to address these.

- **See Part IV, Section 2.1, for an introductory discussion on whether to develop, adapt, share, or outsource a registry; see part IV, Section 5, for detailed guidance on registry development from scratch.**
- **See Part IV, Section 2.2.2, for an introductory discussion on potential it systems and databases interfacing with a registry; see Part IV, Section 2.2.4, on the technical infrastructure for establishing connections.**
- **See Part IV, Section 1.1, for an overview of security risk assessment measures; see Part IV, Section 4.2, for a detailed discussion of security requirements.**

Although a public authority will ultimately be responsible for the implementation of an ETS, a registry may be administered internally, by a public authority, or externally, by a third party contracted. Registry administration involves management processes, operational processes, and supporting processes. The responsibilities for these various processes may be divided among different institutions/entities.

- **See Part III, Section 2, on criteria for selecting a registry administrator.**
- **See part III, Section 3.1, for an overview of registry administrative tasks.**

Question 3: What resources are available for the development of registries?

As part of the Paris Agreement, developed country Parties have committed to provide financial resources to developing countries. Beyond general climate finance commitments (set out in Article 9), the Paris Agreement also determines that support shall be provided to developing countries for the purpose of anthropogenic emissions reporting (Article 13), NDC implementation reporting (as part of Article 4 and Article 13), and for the "timely and accurate communication of information" (Article 11) as part of the transparency framework. Taken together, these commitments can be interpreted to form the basis of financial and capacity-building support for the development of GHG accounting systems, registers, and transaction registries.

Outside the Paris Agreement, a number of multilateral and bilateral funds are already providing support to developing countries for registry development. The WB's Partnership for Market Readiness (PMR) provides grant funding for building market readiness components, including registry development. Other potential WB sources include the Carbon Asset Development Fund of the Carbon Partnership Facility (CPF) and the Readiness Fund of the Carbon Initiative for Development (Ci-Dev). More specifically, the Forest Car-

bon Partnership Facility's Readiness Fund provides support for the development of REDD+ registries. Bilateral sources of support for registry development include Germany's REM Program and Norway's International Climate and Forest Initiative.

▶ **See Part V, Section 3.1, for a discussion of international multilateral and bilateral REDD+ initiatives.**

Where public financial resources, international or domestic, are not available for the development of registries for domestic market instruments, authorities may wish to impose a fee on market participants that covers the cost of registry development and administration. However, the fee structure should take into account the resources available to market participants.

▶ **See Part III, Section 3.2.1, for a discussion of registry fee structures.**

▶ **See Part III, Section 4, for ways in which the registry administration costs can be reduced.**

PART II. The Legal Framework

1. Overview: Register versus Transaction Registry

1.1. A sliding scale of platform functionality

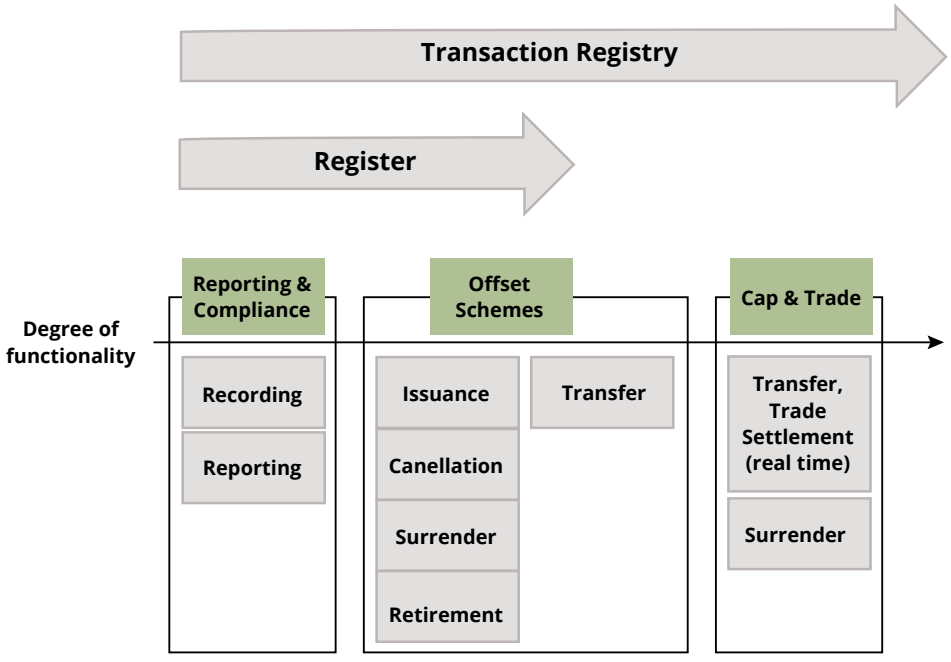
In the context of environmental market mechanisms, the terms database, reporting platform, and register have often been used interchangeably, as have the terms register and registry. The purpose of this chapter is to clarify the differences between a "transaction registry," which refers to a type of transaction platform, and a "register," which refers to a data and reporting management tool. The key difference between these two terms derives from a sliding scale of legal and functional considerations. At the lower end of the scale is an electronic database that records carbon or other environmental units (referred to in this report as a "register") and, at the other end, a multifunctional settlement platform (referred to in this report as a "transaction registry") that may at some point be connected to a trading platform.

While largely the same requirements apply to the legal framework of a transaction registry and a register, the former has some additional, more complex requirements deriving from legal and fiscal considerations. The main reason for this is the recognition that at the top end of our sliding scale, the carbon asset held in the transaction registry will be treated as a financial asset. As with all financial assets, its holder will want to make sure the asset maintains its value and can be used like any other financial asset—for instance, be sold freely, pledged, or used as collateral.

1.2. Proposed modular approach

Whether under the framework of a new international climate change agreement or as part of the "solution" inde-

FIGURE 3: **Sliding Scale of Platform Functionality**



pendently chosen by each PMR/FCPF participant country, it is impossible to prescribe a "one size fits all" approach in this report. Where exactly a country's preferred domestic market-based policy for GHG mitigation sits on the sliding scale, will determine the functional, technical, and legal layers of sophistication needed for its framework to support that choice. For example, a country that commits to adopt a self-reporting regime for its GHG emissions will not need much more than a register, whereas a country that adopts an offset mechanism may require something closer to a transaction registry. This chapter presents the options through a modular approach so it is easier for the reader to establish the degree of sophistication most suitable for their country's legal framework in this context.

2. Factors Influencing the Choice of Platform

2.1. Purpose of policy-based market mechanism

The purpose of the underlying market-based mechanism adopted by a given PMR/FCPF participant country (hereafter referred to as the "market mechanism") is an important consideration in determining the most suitable platform. The more elaborate the market mechanism envisioned, the greater the number of building blocks that will be necessary to create the supportive legal framework. For example, a "cap-and-trade" mechanism, where the ability to cap emissions and establish a successful trading market will be the key to success, is likely to require greater sophistication than an offset scheme that simply aims to register offsets and record their purchases and retirements.

2.2. Scope of market mechanism

The scope of the market mechanism is also important. A market mechanism that covers a relatively large number of sectors—energy generation, forestry, transportation (including road, aviation, and shipping), manufacturing, medium and large industrial operations, etc.—will attract a larger number of participants, potentially more transactions and therefore, by necessity, require more automation. The wider the scope of participants in the market mechanism, the harder it will be to find the right functional balance for the platform, as the varying levels of experience, knowledge, and familiarity of those actors will affect the platform's design.[16]

16 Understandably, a lack of sophisticated participants will result in a less sophisticated and less functional platform, until the market has matured enough.

2.3. Scale of market mechanism

The larger the proposed trading market, the more likely it is that *automated* processes will be required to capture, manage, and record transactions. Such automation will be accompanied by an increased level of risk commensurate with the functionality of the platform, and specific rules or laws will be needed to ensure the legal rights and liabilities of the underlying asset subject to electronic dealings are duly protected.[17] E-commerce laws, cyber security laws, and other property rights legislation will need to be recognized, slightly modified, and applied in the context of an intangible asset. Moreover, as carbon units held in registries may have financial value, they may be a target for theft. Establishing security arrangements through legislation helps lower that risk.

2.4. Potential for international or domestic growth

If a market mechanism intends to progressively scale up by linking with market mechanisms in other *regions* (e.g., with Chinese pilot markets) or *countries*, this process can be facilitated by using platforms that operate under compatible legal frameworks. It would be difficult to link mechanisms, for example, if a carbon unit is recognized as property under the laws of one mechanism but not in the other mechanism, and might require a country to adopt a law similar to the one adopted by the other mechanism as a condition for linkage. Just as the use of minimum internationally accepted standards for verification, reporting, and compliance will facilitate such functional linkage, so will the use of platforms that have similar supporting legal frameworks. In the more fragmented, "bottom-up" approach as suggested by the Paris Agreement, which discusses whether such scaling up or linkage is possible, it is important to ensure that legal rights are treated similarly among linked registers/transaction registries to avoid a patchwork of legally incompatible platforms.[18]

17 Higher technology requirements will also increase the cost of implementation and maintenance of the market mechanism.

18 For more information, see Zaman, P (2016), The Regulatory Framework to Support Carbon Market, available at. http://pubdocs.worldbank.org/en/680061461687518813/The-Regulatory-Framework-to-support-the-NCM-Linking-Model.pdf

3. Building Blocks of the Legal Framework

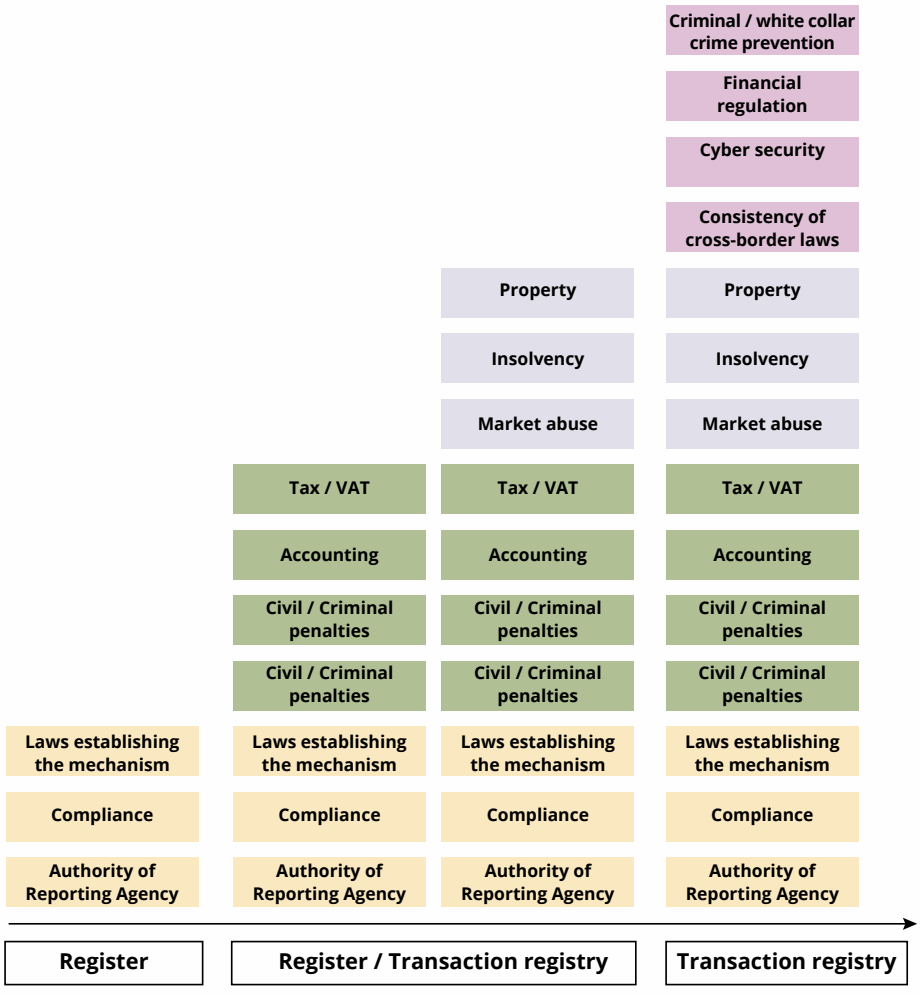
3.1. Different levels within a legal framework

This section discusses the legal framework necessary to support the functions of the register/transaction registry. Keeping in mind that the nature of a register or transaction registry is *functional* or *transactional*, a legal framework must be designed so that it supports the functions and transactions of the register/transaction registry. This means broad areas of legislation must be addressed to ensure the functional and transactional outcome of the register/transaction registry are supported.

The legal framework may draw on several sources of legislation; not all outcomes require *primary* legislation. In many instances, primary legislation will only provide the broad framework to be supplemented by secondary or enabling legislation that authorizes bodies to set the rules, regulations, or terms and conditions that allow the primary legislation to be implemented. As such, references to a legal framework in this context should be interpreted as the publication of that which is necessary to make that legal framework effective in a given PMR/FCPF participant country.

At the end of the analysis, it should be possible to determine whether an appropriate framework is in place for protecting the integrity of the market mechanism. The assessment should consider the overall market regulation and oversight rules that apply, the country's definition and legal status of the carbon unit, and the register/transaction registry system for recording and disclosing data.

FIGURE 4: **Building Blocks of the Legal Framework**



3.2. Registers

Starting at the lower end of the sliding scale, the functions that the legal framework will need to support are likely to include the following:

- To serve as a reporting database;
- To be able to record the creation (registration) or issuance (serialization) of a carbon unit;
- To facilitate the unit's surrender, cancellation, and retirement; and
- To facilitate transfers of the underlying unit (including tracking).

3.2.1. Reporting database functionality

The register must be able to function as a reporting database for the market mechanism to be transparent. Ideally, there should be national or state-level[19] laws that detail the necessary monitoring and reporting obligations (such as the obligation to report all CO_2 emissions) and enabling legislation to authorize a specific body to develop the necessary rules and tools, including a database, to support the reporting requirements. Where this is the case, the legislation may also need to ensure that the data is subject to a specific level of audit or quality control,[20] for example, through a requirement for verification of data prior to reporting by third parties that are qualified, independent, pre-approved, or accredited.

The use of that data would similarly be dictated by the primary legislation, for example, to whom the compiled reported data must be sent and whether its disclosure should be public or private. However, questions on specific data formatting, such as is required by international reporting standards or international treaties, could be determined by the appointed authorities.

The sensitivity of data collection and management will also be driven by the nature of the market mechanism and the data in question. For example, data on whether an entity has met its compliance obligation are sensitive for the compliance entity concerned but perhaps less significant for other market participants. By contrast, information on whether a covered sector's overall emissions levels have decreased because fewer units had to be surrendered will be highly sensitive in the context of a full cap-and-trade mechanism. The collected data may or may not be released or distributed by the Register/Transaction Registry operator but there will need to be a clear recognition of the sensitivity and value of that data based on the type of market mechanism.

The legal status of the register/transaction registry administrator should be clearly enshrined in law. In order to operate and maintain the registry, the administrator will need to take actions and ad hoc decisions. It will be necessary to empower the administrator with discretion, for example to refuse or block an account or to suspend the operations of the register/transaction registry as necessary. The successful operation of the register/transaction registry requires sound governance structures, with appropriate segregation of IT and business duties in the internal organization of the administrator, as well as adequate resources.

3.2.2. Carbon unit recording functionality

A database where a unit is issued to reflect the underlying environmental benefit achieved (e.g., a reduction of GHG emissions against a baseline) reduces the risk of double counting, particularly if the information about the units is transparent, and provides accountability to registry users. Such a database may also serve as a repository for information about offsets issued from activities recognized by a market organization (e.g., Verified Carbon Standard and the Pennsylvania Emission Reduction Credit ("ERC") system[21]). As this information is public, interested parties can make sure that the offset that they are being sold has environmental integrity and has not already been used for compliance. However, how to ensure transparency should not be left to the discretion of the platform administrator; details on when, how, and to whom the data will be reported could be reflected in secondary legislation, while the transparency requirements themselves could be established in primary legislation.

3.2.3. Carbon unit end-of-life functionality

A register may have several types of accounts; for example, if dealing with offsets, the register could distinguish between the accounts for project operators (from which offsets are traded) and the accounts that can be used for the surrender or cancellation of offsets. Thus, administrative rules or terms and conditions of the register will have to be established for opening, closing, and accessing an account. These could include "Know Your Client" (KYC) requirements for

19 Depending on the scope of the mechanism.

20 To be compliant for use in the California Cap-and-Trade Program, American Carbon Registry offset projects need to be approved and offsets generated by the project need to be verified by an approved party before they are issued in the California Registry.

21 The Federal Clean Air Act creates an offset requirement but there are no U.S. federal rules on ERC generation. Each state has its own rules. The ERC rules require the Pennsylvania Department of Environmental Protection (DEP) to maintain a statewide registry of ERCs and deduct ERCs from the registry when ERCs are consumed in issuance of a construction permit.

account opening, fees to be paid for account maintenance, and limiting the register administrator's liability.

The account opening process may involve the platform operator collecting a large amount of data—including personal data—about individuals. Account holders will want assurance that their confidential information is not publicly disclosed. To that end, it should be clear what rules govern the protection of personal and confidential information, and how the register's legal framework is linked to data protection laws already in force.

3.2.4. Carbon unit transfer functionality

The specific purpose of a carbon unit transfer may affect the degree of sophistication of the supporting legal framework required for the register/transaction registry. If the market mechanism contemplates unit trading, the purpose of a transfer is different than in the case of a transfer for surrender or compliance purposes. For example, if a unit is used to trade, it obtains the character of an asset that has an associated value. Such transfers may therefore carry urgency, and have a need for additional security and settlement finality. By contrast, if the purpose of a transfer is merely compliance, the unit's value derives from the avoidance of a penalty for non-compliance. While the former entails the need to provide greater transactional certainty, the latter only requires receipt by the regulating authority before a particular cut-off point, for example, to avoid a penalty. In the United Kingdom, the power and gas market regulator Ofgem (Office of Gas and Electricity Markets) maintains an electronic, web-based system called the Renewables and CHP Register ("R&CHP Register"), which enables the issuance and trading of Renewable Obligation Certificates ("ROCs"), among other similar certificates. This is presently a relatively illiquid product with few transactions occurring, unless the ROCs' compliance deadline is very close. ROCs can be transferred directly between two parties using the online R&CHP Register, provided the parties have accounts at the register. At the time of compliance, the administrator will automatically redeem the required ROCs from the compliance entity's account and cancel them.

Where the market is highly liquid and the number of transactions requires automation of processes to ensure transfer settlement is manageable, the traditional legal framework of national laws will need to evolve to accommodate an electronic environment. Even where such laws currently exist, they may have been designed to support electronic share trading and not necessarily be fit for the trading of carbon units.

3.3. Transaction registries

At the lower end of the scale, the American Carbon Registry (ACR) is a voluntary offset scheme whose credits may be sold between account holders. The sale and transfer of offset credits are not driven by any compliance deadline. Sales occur outside the platform and are settled via direct confirmation of a change in each of the relevant account holders' records. As this registry is voluntary, the registry operates outside any legislative framework and is entirely contractual. The legal certainty associated with the value of an offset credit issued by the ACR will be very different from the same offset reissued in the California Air Resources Board registry (CITSS)[22] as an ARB Offset Credit (ARBOC),[23] where it is recognized as a compliance unit under state legislation. The legislation confirms that the compliance entity holding an ARBOC is entitled to a limited authorization to emit up to one metric ton of CO_2e. However, it also confirms that an ARBOC does not constitute a property right.[24] That kind of certainty cannot be accorded to an ACR offset. The difference between a legislatively supported and a contract-based CO_2 reduction will be reflected in different market prices and in different degrees of certainty regarding the nature and value of that offset for its investor or holder.

3.3.1. Laws and rules to be modified

The legal framework for a registry may sometimes require that a PMR/FCPF participant country extend or revise some of its general laws (e.g., its property, insolvency, tax, accounting, and regulatory laws) so they are able to recognize and handle the transaction registry activities, while in other instances entirely new legislation will have to be created.

Market participants will look to laws and rules that are clear, internally coherent, and unambiguous. While PMR and FCPF participants should aspire to such clarity in all legislation, it is especially important for the development of a market mechanism because market participants often have no prior experience with carbon markets in their country.

The following sections illustrate how several types of existing laws and rules could be modified to address key questions associated with a carbon market.

3.3.2. Property law

The specific *legal nature* of a carbon unit—more specifically, whether it is an administrative grant, a license, or property

22 The Compliance Instrument Tracking System Service (CITSS).

23 Air Resources Board Offset Credit.

24 As this differs from the legal treatment of a carbon unit within the EU ETS, the different legal frameworks would need to be resolved should the EU ETS ever wish to link with AB32.

—is a major determinant of the degree of certainty it provides market participants.

If a carbon unit is legally considered *property*, specific rights become associated with it, potentially allowing its owner to use it in transactions other than selling/purchasing or surrendering for compliance (e.g., as a collateral for a loan). On the other hand, if the carbon unit is *not* deemed property, it is likely to have a more limited application beyond the market mechanism's primary purpose. Where the legislative framework does not address this issue, the result could be speculative and opportunistic speculation, which could have an adverse effect on the market mechanism in the longer term.

Treating a carbon unit as property raises additional questions, for example, whether security can be granted over the property right. The larger the number of uses a carbon unit has, the wider its appeal will be to market participants, other investors, financiers (e.g., banks and hedge funds), insurers, intermediaries, and brokers. A wider appeal increases potential participation in the carbon market.

3.3.3. Tax and accounting

Several questions regarding tax and accounting have to be addressed. For example, should the transfer of a carbon unit between two account holders be treated as a service provision? If so, should it be charged with a sales or service tax (such as a VAT)? If so, who should pay the VAT: the buyer or the seller? Alternatively, does the transfer involve a property or an asset that attracts a tax such as a stamp duty? Do all entities have to pay those duties or should compliance entities be exempted, given that they have not voluntarily chosen to engage in the activity but do so on account of a regulatory requirement?

Moreover, what rules should the holder of a carbon unit apply for accounting purposes? If the unit currently has a certain market value but had been allocated under the market mechanism for free, how should that unit be valued—at nil or market value? In case of the latter, do daily movements in the market value of the carbon unit adversely affect the overall financial accounting of the entity in question?

3.3.4. Insolvency

Insolvency legislation also raises issues. National insolvency laws often provide for transactions carried out before an insolvency to be set aside in certain circumstances. Under those circumstances, would a transaction between party A and party B involving the sale of carbon units be voided if it took place 24 hours prior to party A's insolvency?

Upon the insolvency of the transaction registry account holder, who has rights to the carbon units held in the account? If the account holder is a company and has creditors, can the creditors demand that the carbon units be sold to them to cover their claims against the account holder? Is the answer to this question any different if the registry account holder is a compliance entity? If security has been granted over that account in favor of a particular creditor, can that secured creditor's claim outrank the claims of the general creditors? Although this may be as much a question of company law as of insolvency law, where the account holder is an individual, the question is equally applicable but with additional considerations. For example, will inheritance laws allow parents to bequeath carbon credits to a beneficiary in the same way they may bequeath their shares? Will a registry administrator recognize carbon units that are held on trust as distinct from those held in another capacity?

3.3.5. Financial regulation and licensing

Potentially, at the upper end of the scale, a carbon unit may be considered subject to the same regulatory treatment as other financial products.[25] Therefore, would a participant who transacts in carbon units require a license the way a broker who transacts in stocks and shares would be? There are both positive and negative aspects to such a classification. On the one hand, treating a carbon unit in the same way as other financial products will envelop the carbon unit within a heavier regulatory framework, thereby increasing consumer protection and legal certainty.[26] However, if this is introduced before the market is sufficiently mature, it will stifle the market's growth potential by excluding some investors, making it more costly for participants and deterring smaller businesses from participating in the carbon markets.

Treating participation in the market mechanism the same as participation in financial markets risks failing to recognize the underlying environmental purpose associated with the establishment of the scheme. In most financial markets, those who participate do so voluntarily. On the other hand, in the context of a compliance-driven cap-and-trade market, the key actors—that is, the compliance entities—are not participating by choice. A mix of compliance and non-compliance participants is necessary for a healthy, liquid mechanism, but mixing the financial regulatory legal framework with the environmental compliance framework is very likely to lead to significant issues. These include specific

25 As will be the case of the EU allowance in the EU member states under the MiFID II (Markets in Financial Instruments Directive II) from 2017 onward.

26 In many countries, financial products benefit from increased protection against creditor adverse but debtor friendly insolvency laws (e.g. by having a carver out for netting).

exemptions from licensing requirements, capital controls, reporting regimes, and the extension of laws on market abuse, insider trading, and other financial crimes to carbon unit trading.

Where the transaction registry includes trade settlement functions, such as real-time transfers of carbon units, additional questions regarding transaction settlement finality must be addressed. For example, at what point in time does the risk associated with a carbon unit transfer from party A to party B? Similarly, if, under a transaction with party B, party A has initiated a transfer that was not completed by the registry administrator before party A's insolvency, should the transaction registry administrator nonetheless continue with the transfer to party B? If the news of party A's insolvency arrives only after the transfer has been completed, can the transfer be unwound and the carbon unit clawed back? What happens if the transaction registry administrator or account holder transfers or cancels carbon units in error? What remedy should be provided to an account holder for these mistakes?

4. Lessons Learned from Existing Mechanisms

The EU ETS illustrates some of the problems arising from the creation of a market mechanism with an incomplete legal framework. As the pioneer in the establishment of a cap-and-trade market, the EU ETS has borne the brunt of the consequences of "learning by doing." Although many more valuable lessons could be cited, the following sections provide some of the more significant ones.[27]

4.1. VAT fraud

Until 2010, the EU ETS tax regime treated the transfer of a carbon unit as a service for which a VAT is charged, which is collected by the seller and paid to the local tax authorities. Trading of carbon units was also possible on exchanges offering carbon unit spot products,[28] which, along with the "real-time" (i.e., instant) transfer and settlement capability of EU Registries, allowed multiple transactions involving the one and the same carbon unit changing hands to be carried out within a short time span. These elements, along with lax registry account opening procedures, including KYC requirements, combined to make the EU ETS an attractive space for VAT fraudsters perpetuating carousel fraud.[29] Europol estimated that the loss to carbon credit fraud (through VAT carousel fraud) between June 2008 and December 2009 amounted to approximately EUR 5 billion.

4.2. Phishing, cyber theft, and hacking

Although the EU ETS is a creature of EU law, the establishment of an ambitious multicountry, single trading market would have to fit within the legal frameworks of existing national laws. Given sensitivities on national sovereignty and the jurisdictional limitations of the European Commission's mandate, it was not possible for the EU ETS to prescribe for many of the legal issues that have been discussed in this chapter. This resulted in each member state having the freedom to establish its own registries using different software platforms, with different degrees of functional and security arrangements. This, in turn, led to a patchwork of linked but not harmonized registries with a common asset being traded that had a single market value across all member states. As a consequence, in order to recover the value of valuable carbon units acquired through phishing or hacking, cyber attackers merely had to identify and use the weakest point of entry (i.e., account establishment) to transfer and transact the carbon allowances. The lack of prescribed KYC requirements and equally strong registry account access requirements led to EU carbon credits being hacked and then traded on a cross-border basis. Ultimately, this forced the EU to shut down the registries of all 27[30] member states for up to 3 months to raise the security standards to a common level across all registries. In addition, the lack of certainty under the laws of most member states regarding the type of property a carbon unit represented and whether established laws relating to stolen goods applied to carbon units led to such uncertainty that trading in the top exchange traded spot EU carbon contract was suspended for more than a year.

4.3. Management of market data

During the first phase of the EU ETS, although there was a fixed date in which the annual emissions compliance data were meant to be released, the ministries of certain member states, without notice, disclosed these data on their website in advance of that fixed date. These data were very significant as it was the first time market participants would be able to compare the actual emissions of compli-

27 Cap-and-trade regimes introduced later, for instance, California's AB32, made a conscious effort to apply the painful lessons learnt by the EU ETS in the design of their schemes.

28 These are exchange traded products with physical settlement by way of delivery of a carbon unit within 1–3 days of the transaction date.

29 Fraudsters legally acquired carbon units without paying VAT (because of the cross-border nature of the transactions), then sold the carbon units in the same country at a price that included VAT, and then "disappeared" before the tax had been handed over to the tax authorities.

30 At the time the member state registries had to be temporarily shut down, the EU had 27 members.

ance entities against the estimated data on which carbon credit allocations were based. As a result, the market positions (i.e., whether to go "long" or "short") of many active traders would turn on this information. The leakage of this sensitive information in a haphazard manner meant that some trading entities with prior access to this information were able to take better trading positions than those who were unaware of this information. Ultimately, by the fixed date on which the information was published, the market had already anticipated the outcome and taken positions accordingly.[31]

5. Recommendations and Guidance on Development of a Legal Framework for Registries

- Build the register/transaction registry in a manner commensurate with the nature, scope, and scale of the proposed market mechanism.
- Identify what is required to establish the immediate legal framework necessary to support the role of the register/transaction registry in the context of the market mechanism and the time frame required to achieve that.
- Identify the other areas of legislation likely to be affected by the intended market mechanism and identify the necessary responsible entity to address those laws (Ministry of Environment, Ministry of Finance, Ministry of Trade, etc.).
- Establish a plan to coordinate and consult on issues, obstacles to achieving the necessary changes (e.g., delays, lack of expertise, budget authority). The changes determined need to be consistent and not conflict with each other, with a view to implementing the policy objectives of the market mechanism.[32]
- Recognize limitations—seek expertise and support where required (including from other government agencies) and do so in a timely manner.
- Do not ignore the hard issues (e.g., what is the legal nature of the carbon credit) because, sooner or later, the issue is bound to arise via a market incident and the fallout then will be far more difficult to manage.
- Ensure the allocation of responsibility, and specify the roles of regulators and administrators in clear and unambiguous terms. It is important that along with the allocation of roles and responsibilities, sufficient budgets are provided to enable their discharge.[33]
- If the purpose (scope) of the market mechanism is to create a tradable carbon asset, recognize the success of a market product depends on the market participants' confidence in it and provide what is necessary to achieve that confidence.

31 Incidentally, the information showed that the EU ETS had been overallocated in Phase 1, causing the carbon unit price to drop from above EUR 25 to EUR 0.05 in a relatively short period of time.

32 A recent special report produced by the European Court of Auditors (the "EU Audit Report"), titled "The integrity and implementation of the EU ETS," concluded that "At the Commission, the development and operation of the Registry has been a complex project which was hindered by internal coordination issues and resource constraints."

33 The same EU Audit Report concluded that "that the organizational structure and available resources in the Commission services did not sufficiently facilitate the management and development of the Registry."

PART III. The Institutional Framework and Registry Administration

The registry administrator is the body responsible for the day-to-day operations of the registry system, which includes managing users and accounts and the issuance and cancellation of carbon units in accordance with the regulations of the market mechanism. Registry administrators also monitor transfers and, where appropriate, report issues and irregularities to relevant authorities and take follow-up action. While these operations must be performed with a concern for effectiveness and equitable treatment of all participants, clear and robust procedures—such as KYC requirements—are nonetheless necessary to ensure smooth registry operations and compliance with related regulation. Building on existing experience, this section provides an overview of the key aspects of registry administration, including the responsibilities, risks, processes, resources and costs involved.

1. Before You Begin: Assessing Registry Administration Needs

1.1. Scale and scope of the market mechanism

As is the case for the legal framework (Part II), the scale and scope of the market mechanism considered will significantly affect the complexity of institutional arrangements for its registry. The number of necessary arrangements is generally proportionate to the number of participants in the market mechanism, and thus to the number of accounts to manage, the value of the units held in these accounts, and the number of transactions these units are subject to. At the upper end of the scale, the registry administrator may have to operate an electronic IT system with fully automated functions, manage fraudulent activity risks, and cooperate with a range of authorities (e.g., the Ministries of Environment, Finance, and Justice).

For ease of guidance, and based on real-life observations, roughly three levels of registry administration can be distinguished by degree of sophistication (in increasing order):

- **Level 1:** Few users and transactions; no interaction with any other IT system (e.g., MRV database); only the administrator can access the registry system (i.e., users have no online access to their accounts). The registry can be paper-based, or supported by an Excel spreadsheet or other basic accounting tools; reports (e.g., on account holdings and transactions) are issued, published, and audited periodically. The financial value of the units and related market and/or fraud risks are low.

LEVEL 1 EXAMPLE: **The National Emission Reduction Plan (United Kingdom)**[a]

Main characteristics:

- The "Register holder" is the U.K. Environment Agency (public authority). Administration is performed by one person on a part-time basis
- No IT system: quarterly reports made available online via Excel spreadsheets
- The registry only includes compliance participant account (i.e., 79 large combustion plants)
- A total of 42 transactions in 2014. Transfers are initiated by compliance participants filling out a dedicated form sent by e-mail to the administrator

a See https://www.gov.uk/government/publications/national-emission-reduction-plan-nerp-quarterly-registry.

- **Level 2:** Communication with other systems is possible but exchanges are limited; the registry is computerized with little automation; user interfaces are provided and accessible through the Internet (e.g., check on account balances and related reporting). The execution of operations requires the involvement of the administrator, at least to validate the operations. The value of account holdings and their related risks are moderate.

LEVEL 2 EXAMPLE: **National Register[a] of White Certificates (France)**

Main characteristics:

- A register administered by a private company, selected via a call for tender
- The register holds named accounts by users, available online
- The vendor and the purchaser both sign a transfer order that is then mailed (by snail mail) to the register administrator. Upon receipt, the administrator validates the transfer, notifies the transaction counterparts, and updates the balances of the accounts
- An average of 40 transactions per month is registered

a See https://www.emmy.fr/front/accueil.jsf.

- **Level 3:** The registry is automated and exchanges a large volume of information with a number of other systems, databases, and potentially other registries. It supports a large market with frequent and numerous transactions; users perform operations directly online, with no intervention by the registry administrator. A range of intermediaries hold accounts, which makes registry administration procedures more complex.

LEVEL 3 EXAMPLE: **Consolidated System of European Union Registries (CSEUR)[a]**

Main characteristics:

- Each EU member state appoints a national administrator for its national registry
- A single IT system manages both each member state's independent registry under the Kyoto Protocol and a unique Union registry supporting the EU ETS operations
- Transfers are directly made online by the users, without any intervention by the registry administrator
- Up to thousands of transactions daily, mostly driven by the EU ETS (very few transactions are sovereign transactions under the Kyoto Protocol)

a Public link: https://ets-registry.webgate.ec.europa.eu/euregistry/FR/index.xhtml

Figure 5 represents a decision diagram that features three concentric circles, corresponding to three different levels of cost and complexity for a registry—going from the simplest kind of registry (i.e., register), at the very center, to the most complex one (i.e., transaction registry) on the edges of the outer circle .

Over time, market-based mechanisms can evolve, a simple registry becoming increasingly costly and complex (hence moving from the center to the outer edges of the decision diagram). To identify the most appropriate level of complexity that the registry should initially have, this decision diagram offers two sets of criteria:

- In blue (upper part of the diagram), criteria linked to operational management issues:
  - Volume of transactions;
  - Number of connections with registries from other jurisdictions/systems (in case of linking);
  - Communication with other IT systems, such as GHG reporting platforms, project/program databases, and so on.
- In orange (lower part of the diagram), criteria associated with risks:
  - Type of transactions (i.e., compliance or pure trading) ;
  - Risk of unit theft;
  - Need for market supervision and regulation.

Depending on the features of each market-based policy (e.g., use of offset projects and degree of openness to international market participants) and national circumstances, additional criteria can be added to this decision diagram, as long as they are associated with all three levels of cost and complexity.

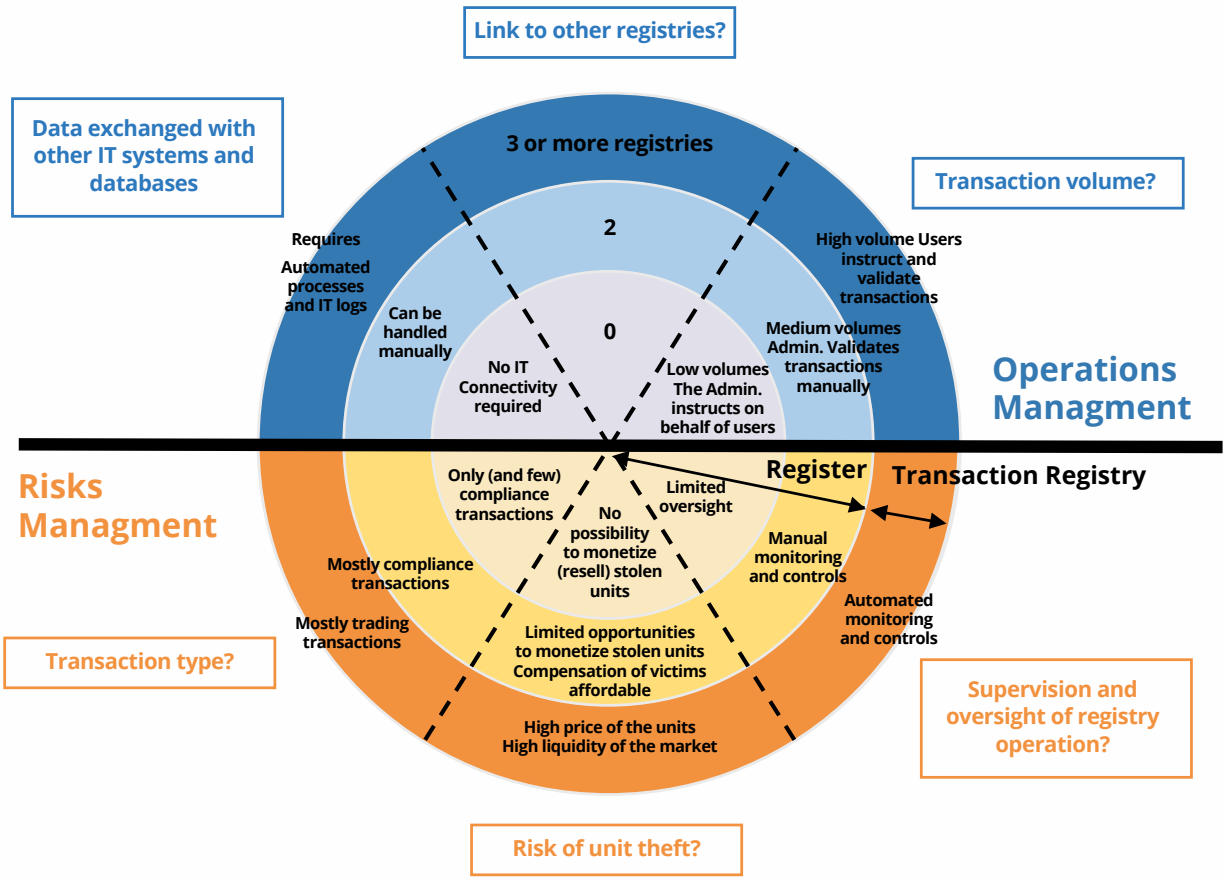
This report covers institutional and administrative approaches under level 3 registries (i.e., transaction registries) and, hence, level 1 and level 2 (i.e., registers) are de facto also covered.

1.2. Responsibilities and risks in registry administration

1.2.1. Responsibilities

The effective administration of a registry requires a decision on the allocation of responsibilities among the following registry stakeholders: the regulator, the registry administrator, and the account holders—as illustrated in Table 2. Such responsibilities can be allocated through legislation and possibly supplemented by contractual agreements involving the registry administrator and each registry user.

FIGURE 5: **Deciding on Level of Complexity for the Registry**



1.2.2. **Risks**

Registry administrators are subject to a number of risks, with risks proportional to the size and financial value of the market. The most significant risks include:

- Non-execution of operations, late execution of an operation, or other operational errors as part of the execution of an operation, leading to:
  - An opportunity cost for the account holder (e.g., a delay in issuing or allocating a unit)
  - A noncompliant status for the account holder
  - Reputation damage (e.g., featuring the holder in a public noncompliance report, either mistakenly or because the operation for achieving compliance was made impossible due to an action by the registry administrator or the system);
- Entering into relations with an account holder or with a user who subsequently engages in fraudulent behavior;
- Mistakenly maintaining the account in an active state, or maintaining a user's authorization while the account should have been blocked or the user's authorizations revoked;
- Failure to report suspicious activities/incidents to the relevant authorities.

Measures can be taken at all levels to mitigate these risks and reduce the impact and cost of potential incidents. At the legislative level, regulation must ensure that regulators have the resources and powers necessary to investigate and intervene where appropriate. In terms of registry management and administration, the following actions can help mitigate risks:

- Raising the awareness of the registry administrator's staff regarding the stakes and risks;
- Training staff regarding control procedures and compliance with requirements related to updating documents, monitoring transactions, and reporting suspicions;

TABLE 2: **Indicative Matrix of Responsibilities for Registry Administration**

Responsibilities	Examples	Regulator	Registry administrator	Account holders	Owner of the system	Central hub
Registry architecture	Ensuring the registry complies with regulation.	✓				
Registry IT system	Ensuring the registry system (hardware and software) is fit for purpose.		✓			
Accounts administration	Account opening, freezing, closing; suspending access.		✓			
Customer relation management	Hotline, help desk, etc.		✓			
GHG-related data entry	Entering verified GHG emissions reports, allocation tables, etc.		✓			
Legal obligations	Carrying out periodic activities such as performing calculations to check compliance with regulatory obligations.		✓			
Monitoring of registry activity	Detecting errors and anomalies, resolving incidents, including security-related ones.		✓			
Issuance of carbon units	Issuance of carbon units to a customer account or to an account dedicated to provisions for risks.		✓			
Allocation of carbon units	Allocation of quotas in ETS.	✓				
Transfers	Transfer of carbon units between a vendor and a purchaser.			✓		
Regulatory operations	Conversion of units, release of units in a buffer account		✓			
Cancellation of units	Ensuring any form of elimination (end of life) of a unit.		*	✓		
Cancellation of transactions	Explicit decision to cancel an operation in accordance with the arrangements for the workflow.		*	✓		
IT/technical aspects	Availability; security; execution of the computerized processes; management of data confidentiality; management of authorizations for processing operations and data, etc.		✓		✓	
Control checks	Formatting of data, exchange protocol, compliance with the accounting plans, etc.				✓	✓

** Under the circumstances created by the applicable regulations.*

- Formalizing operational procedures and checkpoints; envisaging validation by a second agent for sensitive operations;
- Rigorously managing user authorizations for the registry's data and processing operations;
- Allowing for peer review: key public accounting reports should be reviewed by competent third parties before publication;
- Implementing procedures for managing incidents and continually improving the service;

In terms of registry IT system, the following features can help mitigate risks:

- Automatic alerts triggered upon detection of or to prevent events in breach of regulatory requirements;
- Strong (two-factor) authentication measures and, more generally speaking, IT security features (session timeout, periodic mandatory renewal of passwords, etc.);
- Measures allowing for emergency shutdown of the registry;
- Periodic checks to ensure the robustness of the system's protection, such as intrusion tests and external audits.
- Good faith buyer protection measures to ensure clarity over ownership of units, such as control and validation stages before accounting for a transaction.

In terms of contract agreements, measures that can mitigate risks include:

- Account agreements that specify:
  - Scope and limits of the registry administrator's responsibilities;
  - Clear ownership rules for any units in case of a dispute arising from an insolvency or other special circumstances;
  - In case of an incident, rules for calculating and capping compensatory payments for the aggrieved parties;
  - Operational provisions for the beneficiary of units received mistakenly to return them;
  - Exhaustive inventory of the information to be made public, the publication calendar also being made available;
  - Definition of what information is considered confidential, and when and under what circumstances it may be made public (e.g., to law/tax authorities, legal courts, government institutions, and insolvency administrators and regulators);
- An insurance policy that the registry administrator may purchase to cover various risks. Alternatively, the regulator—or the registry administrator, when distinct from the regulator—may assume financial responsibility as the bank of last resort.
- KYC requirements:
  - Requiring information and supporting documents about the account holder and each of the physical persons who may act on their behalf helps to secure the "entry door" to the registry system. The registry administrator checks the information received ("Know Your Customer checks") on initial contact, and may request regular updates. Depending on the number of users, using an automated IT system to collect and manage data may be helpful.

Table 3 includes an indicative and non-exhaustive list of the potential information to be requested from applicants. Applicable regulation may require that such information be made public or remain confidential, and be updated on a regular basis.

2. Mandating a Registry Administrator

2.1. Key criteria for choosing a registry administrator

The regulator of the market mechanism acts as the competent authority on registry issues, and can mandate a third party to administrate the registry. Registries in existing systems are administered by various types of entities. While some regulators have assigned the registry to a government agency—generally in charge of environmental issues (e.g., the United Kingdom, Germany, and New Zealand)—others have mandated a range of independent third parties on which to rely.

A cost-benefit analysis should be conducted to weigh the appointment of third parties against delivering registry services publicly. If appointing a third party to administer the registry, regulators will require such third party to demonstrate specific expertise in markets and related infrastructure, experience delivering similar levels of service, a track

TABLE 3: **Indicative List of KYC Documents for Account Opening**

Document or information	• Checks to perform
Identity documents	• Minimum validity period • Nationality and associated country risk • Document number • Person with or without a political profile, public figure or not • Public notoriety of the user (e.g., web and social networks)
Proof of address	• Reliability of the document as a "proof of address" • Country of residence and associated country risk
Copy of cell phone bill	• Invoice is effectively in the name of the user • Telephone number should be identical to the one recorded in the registry for sending SMS notifications
Bank account identification number (IBAN)	• The document refers by name to the user • The bank should be subject to financial regulation in the country where the bank account is held
E-mail address	• Confirmation of the e-mail address through a confirmation request • Eligibility of the e-mail address (e.g., no Gmail)
Company registration number, VAT number (or equivalent)	• Via public database and/or request to competent authorities • Documents are recent and/or still valid
Activity of the company	• Discretionary interpretation of the statuses and activity of the company by the registry administrator • Questionnaire on motivations and experience
Company financials	• Income statement, balance sheet, cash flow statement, financial ratio, etc.
Proof of authorization	• Certificate of incorporation, corporate organigram, power of attorney declaration
Criminal record	• Criminal records—especially regarding terrorism, money laundering, or other fraudulent activities in financial markets
Authenticating documents	• Certification requirements applicable to the country are observed • Certificating authority is legitimate • Date of certification is sufficiently recent
Acceptance of registry terms and conditions	• Documents duly completed and sent/approved electronically

record of risk management, and sufficient resources to dedicate to the required tasks.

2.2. Possible approaches to mandating a registry administrator

The following examples illustrate how countries consider the above criteria in practice, depending on local priorities and resources.

Specific expertise in market finance—and particularly for environment-related commodities —as well as experience in market infrastructure management and development have been the primary driver of the French government's decision to mandate *Caisse des Dépôts et Consignations*—a public institutional long-term investor—to act as the National GHG Registry Administrator under Kyoto's International Emissions Trading and the EU ETS. The same goes for Spain, where the company Iberclear was appointed by the Spanish Office of Climate Change,[34] based on its experience building and managing the clearing and settlement systems for the Spanish Stock Exchange Market.

The Verified Carbon Standard Association (VCSA), which manages the Verified Carbon Standard (VCS) Program, appointed two private entities (APX United States and Markit

34 The Spanish Office of Climate Change is a General Directorate of the Ministry of Agriculture, Food and the Environment.

United Kingdom) through a competitive tender, based on the experience, reliability, and sustainability of their services and related IT infrastructure. The decision to appoint multiple and competing registry providers was particularly motivated, in part, by the need to keep costs down. Both entities must ensure continued compliance with the registry procedures[35] published by the VCSA, which include collecting fees on behalf of the VCSA in addition to their own.

In the Czech Republic, the government appointed OTE, a joint-stock company (fully owned by the state), which operates the country's electricity and gas market. Such an approach was mandated under the Czech Emissions Trading Act and overseen by the Ministry of the Environment as the regulator. By doing so, the regulator caps registry costs in the EU context, where registry regulation and IT have experienced turbulences and undergone significant changes in the last 10 years.

Denmark has transferred responsibility for the EU ETS Registry to the Danish Business Authority,[36] which enables the Danish registry administrator to have access to all companies registered in the country. Because registry access is only granted to Danish resident entities, data collection is done systematically, through an electronic system, which brings down costs while also ensuring the information collected is reliable and up-to-date.

3. Administering a Registry: Operations and Resources

3.1. Operational tasks

This chapter provides an overview of the tasks that are involved in registry administration. In the design and implementation phase of a market mechanism, mapping these processes helps to delineate the overall organization of the registry administrator, and to mobilize the appropriate resources and skills to execute such processes. In the operational phase, more precise mapping may be needed to improve the efficiency of execution, especially if certain tasks are computerized.

Figure 6 identifies three types of processes:

- **Management processes**, those that result in decisions from the registry administrator on operational strategy and business directions;
- **Operational processes**, those representing the core registry administration activities such as monitoring the relationship with users and managing registry operations;
- **Supporting processes**, those representing the activities that support the operational processes with the resources required for their proper execution.

3.2. Resources and costs

Depending on the contribution level from the public budget, financial arrangements for registry administration may vary. Proceeds from potential sales and/or auctions of emissions allowances by the regulator (e.g., ETS) may also provide resources to cover costs incurred. The structure of the registry fee scheme, which represents the costs borne by registry users or account holders, can also take different forms, such as flat rate, transaction-based, or differentiation by user categories.

3.2.1. Registry fees

Charging for a range of registry operations and services can generate resources for administration and maintenance. However, charging for registry services will also generate a specific workload to produce and mail invoices, monitor payments received, and in some cases, handle contentious situations. Table 4 provides an overview of operations and services for which registry users can be charged, and includes examples from existing registries. It should be noted that the fees listed in Table 4 are not necessarily related to the *operation* of registries, but rather to the overall management of the standard and program.

Moreover, it should be noted that administrators of other IT systems connected to transaction registries, such as project databases or repositories of agreed verifiers, may also charge registration or listing fees that are not included in the table 4. Lastly, regulators may also charge compliance participants for services related to the reporting of GHG emissions. For example, the UK regulator charges a fee for collecting monitoring plans (e.g., aircraft operators). A part of those fees is meant to cover registry costs. Some regulators (in Scotland, Northern Ireland, etc.) collect such fees and use the resulting proceeds to pay the Environment Agency for its registry services.

A review of the fee structures used by a number of existing registries shows that:

- Not all registry fee schedules are publicly available (e.g., the VCS Registries supported by APX and Markit);
- Some registries provide their services for free (e.g., New Zealand) while other registries charge a fee; in Belgium,

35 See: http://www.v-c-s.org/sites/v-c-s.org/files/Registration%20and%20Issuance%20Process,%20v3.6%280%29.pdf

36 See: http://danishbusinessauthority.dk/the_eu_ets_registry

FIGURE 6: **Indicative Mapping of Registry Administration Processes**

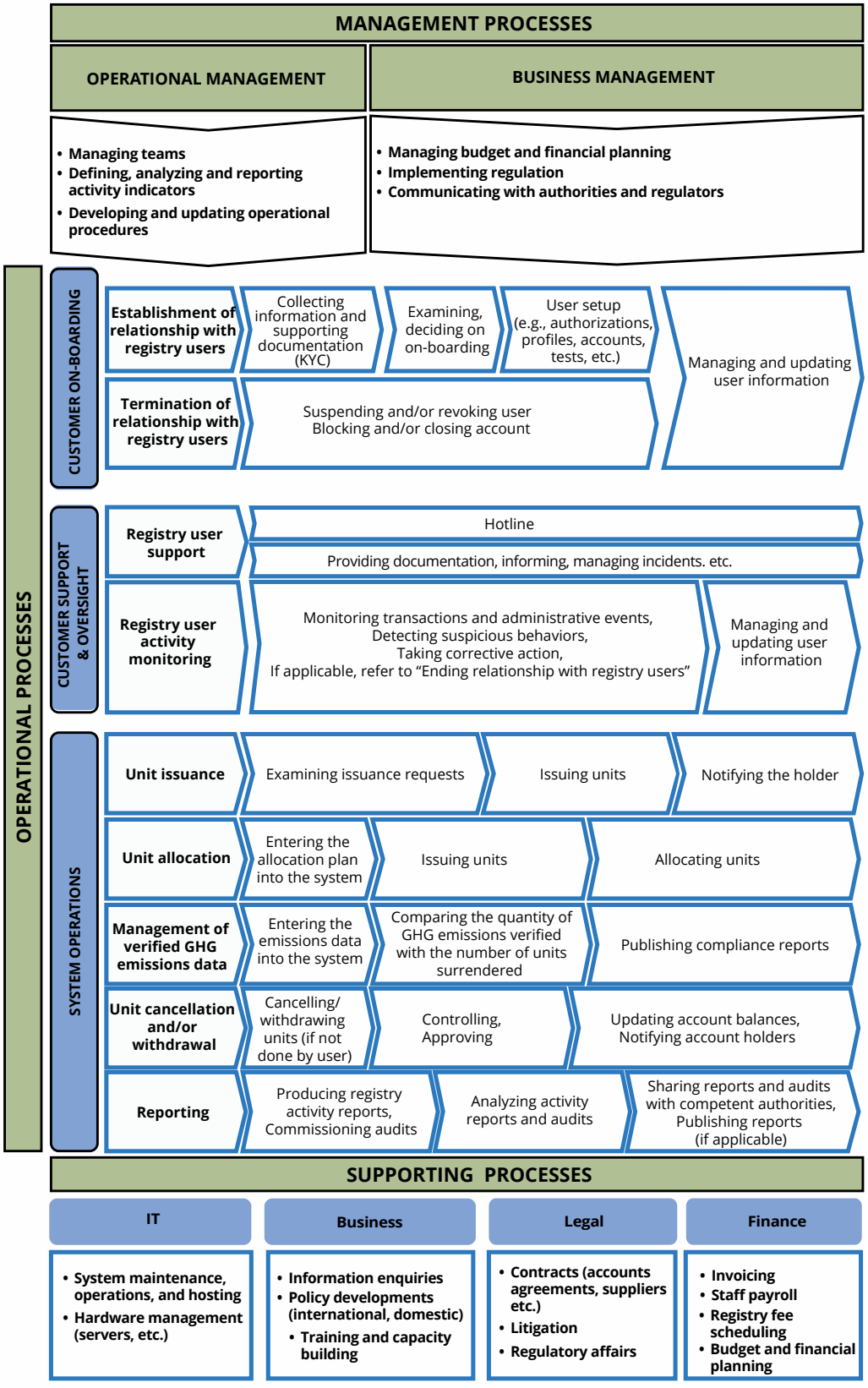


TABLE 4: **Overview of Fees Charged in Existing Registries**[a]

Service and cost range	Registries and fees charged illustrated
Opening an account (one-time fee) • Max./min. ratio: 18 • Min.—max. values:[b] USD 110–2,000	• Climate Action Reserve: USD 500 • France: EUR 600 (USD 666) to EUR 1,800 (USD 2,000) • Ireland: EUR 350 (USD 388.9) • Croatia: KN 750 (USD 110.5)[c] • UK: GBP 190 (USD 297.2), none for compliance entities[d] • No fee in Belgium
Account management (annual fee) • Max./Min ratio: 54 • Values: USD 55–3,000	• Climate Action Reserve: USD 500 per account and per year[e] • France: between EUR 360 (USD 400) and EUR 3,000 (USD 3,333)[f] • Austria: fixed fee (USD 278 to USD 1,666, depending on the type of account holder) plus a variable fee proportional to verified emissions[g] • Germany: EUR 400 (USD 444) per account for the 2013–20 commitment period (except for operators account), that is, USD 55.6 per account and per year[h] • Norway: NOK 1,200 (USD 146.2) per account and per year (except for operators account, for which no fee is paid)[i] • Belgium: EUR 548.99 (USD 610) per account and per year, without any exemption[j] • United Kingdom: annual fee of GBP 380 (USD 594.5) except for compliance entities[k] • Some other EU countries such as Ireland have no annual fee[l] • Gold Standard Foundation: USD 500 per account per year
Issuance/Labelling of unit(s) • Max./Min ratio: 11 • Values: USD 0.06–0.65	• Climate Action Reserve charges USD 0.22 per unit • Gold Standard Foundation: USD 0.65 per credit issued (including registration fee)[m] • VCSA (collected by registry administrators, who may also apply their own, additional fees): USD 0.05 per unit converted from another GHG program into VCUs • USD 0.05 per VCU for a CCB label (in addition to issuance fee)[n] • USD 0.10 per VCU for the first 1 million VCUs • USD 0.09 per VCU for an additional 1 million VCUs • USD 0.08 per VCU for the subsequent 2 million VCUs • USD 0.06 per each VCU issued over 4 million
Holding • Max./Min ratio: NA • Values: NA	• Slovakia: EUR 0.015 (USD 0.023) per unit held on each account
Transfer • Max./Min ratio: 4 • Values: USD 0.01–0.04 per unit	• Climate Action Reserve: USD 0.03 per unit paid by the transferor (i.e., seller) • Alberta Emission Performance Credit Registry: CAD 0.02 (USD 0.02) per unit transferred. No fee for intra-company transfers. Export: CAD 0.05 (USD 0.04) per unit. There is a minimum of CAD 50 (USD 38) per transaction • Gold Standard Foundation: USD 0.01 per credit, paid by the transferor
Retirement • Max./Min. ratio: NA • Values: NA	• Alberta Emission Performance Credit Registry: CAD 0.05 per unit retired for compliance purpose; no fee for voluntary retirements • Climate Action Reserve: no fee for retirement
Verified Emissions • Max./Min ratio: NA • Values: NA	• France: EUR 0.0104 (USD 0.0116) to EUR 0.056 (USD 0.562) per tCO_2e emitted • Austria: variable account maintenance fees (USD 0.00001 to USD 1.991 per ton) based on verified emissions

(CONTINUED)

TABLE 4: **Overview of Fees Charged in Existing Registries**[a] (CONTINUED)

Service and cost range	Registries and fees charged illustrated
Change in authorized representatives[o] • Max./Min ratio: 1.3 • Values: USD 86–111	• Ireland: EUR 100 (USD 111.1) per application to change account details and/or authorized representatives further to account opening[p] • United Kingdom: GBP 55 (USD 86), except for compliance entities • Most other EU member states (e.g., France): no fee
Periodical Review of Documentation (KYC) • Max./Min ratio: NA • Values: NA	• France: 1,250 EUR (USD 1,389) to EUR 3,792 (USD 4,213) per account holder and EUR 300 (USD 333) per user for each documentation review

Note: CCB = Climate, Community & Biodiversity; KYC = Know Your Customer; NA = Not available; VCSA = Verified Carbon Standard Association; VCU = Verified Carbon Unit.

a. Source for currency exchange rates: http://www.xe.com/fr/currency/hrk-croatian-kuna?c=EUR; average rate as of year 2015 calculated on 15th August, 2015.
b. Minimum value will be considered as the lowest but different from zero applicable fee.
c. Source: http://www.azo.hr/HowMuchIs
d. Operators and aircraft operators.
e. Source: http://www.climateactionreserve.org/how/program/program-fees/
f. Source: http://www.seringas.caissedesdepots.fr/sites/www.seringas.caissedesdepots.fr/IMG/pdf/5.fr_tarif2014.pdf
g. Source: http://www.emissionshandelsregister.at/ms/emissionshandelsregister/en/en_ehr_unionregistry/ehren_fees/
h. Source: http://www.dehst.de/SharedDocs/Downloads/EN/Registry/Account-person-holding-trading.pdf?__blob=publicationFile
i. Source: http://www.kvoteregister.no/docs/Terms%20and%20conditions.pdf
j. Source: http://www.climateregistry.be/EN/BE/accounts.htm
k. Source: https://www.gov.uk/guidance/eu-ets-charges
l. Source: http://www.epa.ie/climate/emissionstrading/union%20registry/access/#.VctPNPnDHhE
m. Source: http://www.goldstandard.org/wp-content/uploads/2013/01/v2.2_ANNEX-L.pdf
n. CCB Standard fee schedule as of 1 July, 2015.
o. Some Registries may provide functions enabling account holders to manage users' authorizations and privileges on their own and at their own risk.
p. Applicable to aircraft operators only, see: http://www.epa.ie/climate/emissionstrading/union%20registry/access/#.VctPNPnDHhE

for instance, the registry's total costs are divided by the total number of accounts to derive an annual fee, which is revised each year;

- Registries supporting the same market mechanism and using the same IT tools (e.g., the EU ETS national registries[37]) may apply fee schedules that differ significantly: the same service may be provided for free in one registry, while other registries charge different fees for this service and sometimes also apply different exemption rules.

When deciding on the fee structure, the following parameters could be considered:

- **[E&A] Equitable treatment and acceptable prices:** a balance may have to be found, so that entities participating in the market mechanism in a less active way pay less than the major market players. However, if this approach leads to disproportionate prices, acceptability issues may arise.
- **[P&T] Predictability and timing of revenue to recover registry costs:** the first fees to be charged during the life cycle of a carbon unit are the registration fees, possibly proportional to the expected issuance volumes (e.g., in the CDM registry[38]). Up to several years later, issuance fees and/or transfer fees will be charged to either the transferor or the transferee. Lastly, retirement fees may be charged to the transferor. For the registry administrator, it may be very challenging to predict the respective volumes (of units issued, transferred, and retired) and when these transactions will occur, especially compared with the predictability of incomes deriving from account maintenance fees.
- **[C] Complexity:** the more complex the fee structure, the more difficult it is to manage invoicing and, thus, the more likely it is operational mistakes will be made. Some registries decided to keep it simple by introducing one unique fee to recover their costs.
- **[Et] Declination of ethical choices:** the right balance between having "each citizen pay" to tackle climate

37 See: http://ec.europa.eu/clima/policies/ets/registry/documentation_en.htm

38 https://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid07.pdf

change (e.g., New Zealand[39] does not charge any registry service), which includes covering registry costs (e.g., through tax and hence the national budget), and "the polluters pay principle" has to be considered. An alternative approach involves charging for participation in the market mechanism as a whole, but not for any additional, registry-specific fee (e.g., Shenzhen, China).

Table 5 outlines the pros and cons of different fee structures (as listed in Table 4) with reference to these parameters. It also highlights the complexity in establishing a fee structure that provides certainty on timing and revenue, avoids complicating registry administration, and ensures that transaction costs paid by users remain appropriate. In most cases, fee schedules are reviewed periodically and subject to change, allowing for progressive improvement of the balance between those criteria.

3.2.2. Operating cost

Staff costs are a substantial cost component of a registry administration (see Table 6 for a tentative estimate of the workload involved).

Below 500 users, it is estimated that at least two or three persons are necessary to ensure ongoing availability during the hotline operating hours. Above and beyond 500 users, additional staff may be required to provide hotline services.

3.2.3. Staffing

When discussing the tasks and skills required for registry administration, it is important to distinguish between management and operational staff.

Management

Managing the registry administration team may involve the following tasks:

- Daily supervision of management operations for the registry processed by the team of managers, carrying out arbitrages and determining the management orientations, ensuring compliance with the administrative deadlines for dealing with requests and, more generally, dealing with the quality of the registry administrator's provision of service;
- Being the direct contact person for the regulatory authorities to whom the activity is reported, and for the other ministerial entities that have relations with the registry;
- Representing the registry outside the department—in national and international bodies—at the request of the regulatory authorities;
- Producing activity statistics for the registry every month;
- Managing execution of the KYC processes: entering into and monitoring relations, particularly updating supporting documentation and monitoring compliance operations;
- Periodically doing a statistical check of the accounts based on their historic profiling (e.g., detection of a typical activity levels);
- Supervising tests of new tools and exchanges with the supplier of the registry, in the context of the development of the IT system;
- Supervising management of customer relations, and monitoring any incidents and disputes;
- Proposing improvements (e.g., rules of the mechanism and functioning of the registry);
- Identifying and managing major malfunctions;
- Identifying and managing suspicious activities such as tax avoidance, evasion, or fraud; money laundering; sanctions avoidance; and theft.

To be able to perform these tasks successfully, the following skills are essential:

- Legal skills;
- Rigorousness in maintaining the confidential nature of the information;
- Very good interpersonal relationship skills, organizational skills, and document drafting skills;
- Managerial capacity, ability to make decisions;
- Passion for team work;
- Ability to adapt to peak periods of activity;
- Knowledge of the stakes linked to sustainable development;
- Knowledge of how a registry or something similar operates (e.g., accountancy and maintaining/keeping an account);
- Ability to use IT systems and mastery of standard office software tools;
- Knowledge of back-office management methods;

39 www.eur.govt.nz/how-to/guides-hmtl/guide-to-registering-as-a-user see Q&A: "Will registering cost me anything? No."

TABLE 5: **Comparing Registry Fee Schedules**

Registry Service	Pros	Cons
Opening an account (one-time fee)	• [E&A] Incomes are correlated with the costs of account opening (KYC checks)	• [P&T] Low predictability of incomes • [P&T] No contribution to ongoing operational costs
Account management (annual fee)	• [E&A] Can be based on expected use of the account • [P&T] Predictable incomes	• [E&A]Acceptability: Not always correlated with the use of registry services by account holders
Issuance of unit(s)	• [E&A] If fee is proportional to the amount issued, it contributes to a proportionate share of registry costs among market participants	• [E&A] This fee is charged while market participants may not yet have found a buyer for the units issued, as opposed to retirement fees • [E&A] Likely to affect obligated more than market participants • [P&T] Low predictability of incomes
Conversion of unit	• [E&A] Incomes correlated with the intervention of the registry administrator	• [E&A] Likely to affect compliance participants more than market participants • [P&T] Low predictability of incomes
Holding	• [E&A] If fee is proportional to the amount held, it contributes to an equitable share of registry costs among market participants • [P&T] High predictability of incomes	• [P&T] If registries are connected, it may incentivize users to pool the units they hold within the cheaper registry
Transfer	• [E&A] If fee is proportional to the amount transferred, it contributes to a proportionate share of registry costs among market participants	• [E&A] Likely to affect market participants more than compliant participants • [P&T] Low predictability of incomes
Retirement	• [E&A] Acceptability: the value of the retirement (either regulatory compliance, possibly avoiding a penalty, or voluntary offset) is presumably significantly higher than applicable registry fees • [P&T] High predictability of incomes in the case of an ETS	• [E&A] Likely to affect compliance participants more than market participants • [P&T] Timing: incomes occur at the end of the units' life cycle, whereas registry costs occur mainly at the beginning of units' life cycle
Verified Emissions	• [Et] Complies with the "polluters pay principle" • [P&T] Predictable incomes • [E&A] Contributes to a proportionate share of registry costs among market participants	• [E&A] Acceptability: not directly linked to the use of registry services • [E&A] Likely to affect compliance participants more than market participants • [P&T] While aiming to reduce GHG emissions, this source of income is intended to diminish over time
Change authorized representatives	• [E&A] Incomes are correlated with the intervention of the registry administrator	• [C] Accounting for such interventions may be complex • [P&T] Low predictability of incomes
Periodic Review of Documentation (KYC)	• [P&T] Incomes are predictable and correlated with the intervention of the registry administrator and contribute to the system's security	• [C] Accounting for such interventions may be complex

- Understanding of quality assurance mechanisms;
- Independence and rigorousness.

Operational staff

Operating registry administration under the management authority requires both multitasking of everyday tasks and specialization for certain tasks—such as the checks performed prior to account opening or unit issuance.

TABLE 6: **Breakdown of Workload Linked to Registry Administration (for an ETS)**

Administration category	Managing staff (%)	Operational staff (%)	Example of key tasks
Users application management	10	30	Documentation collection, control, and updating, etc.
Users hotline	0	50	System upgrades, orgotten passwords, guidance, etc.
Day-to-day registry operations	10	20	Manual system operations, reporting, etc.
Management	80	0	Managing teams, regulatory monitoring, relations with the authorities, etc.

The operational staff may perform the following tasks:

- Managing the operations set out in regulations:
  - Handling administrative tasks: setting account parameters, and opening, closing, and updating accounts,
  - Informing customers of changes in regulations,
  - Managing relations with the regulatory authorities and inspection bodies,
  - Where applicable, producing specific reports (e.g., for monitoring sensitive operations and handling disputes);
- Updating documentation (requested from customers) and making updated documents available;
- Ensuring compliance checks on customer files by implementing the KYC criteria:
  - Checking the comprehensiveness of each of the customer files concerned (pre-existing customers or requests for opening new accounts),
  - Making individualized requests for additional documents required, where applicable,
  - Monitoring the use of procedures and following up as appropriate,
  - Checking the compliance of documents received,
  - Reporting inconsistencies and instances of non-compliance;
- Keeping accounts: updating, activating, or deactivating an open account and the accounts to be opened in the registry:
  - Periodically checking movements in the context of risk prevention (e.g., fraud, money laundering, and theft) and normal surveillance of operations,
  - Updating, improving, and drawing up the procedures applicable to the activity,
  - Managing authorizations to use the registry,
  - Applying the procedures (e.g., for opening accounts),
  - Advising management when procedures need updating,
  - Providing feedback on anomalies in the software in relation to the supplier of the registry,
  - Providing support and technical advice to users of the registry;
- Managing assistance provided to customers:
  - Drawing up and updating Frequently Asked Questions (FAQ) to be put together, in particular with a view to starting up the registry system,
  - Ensuring telephone hotline services and e-mail services during opening hours: answering customers and enhancing the FAQs where necessary,
  - Quickly reporting incidents and keeping up-to-date a summary report of past incidents;
- Ensuring regular reporting to the manager of the registry (and possibly the assistant), and referring matters to them if an issue arises;
- Taking part in team meetings (e.g., to discuss regulatory or IT changes);
- Suggesting ways to improve the quality and performance of the service.

These tasks require continuous communication with multiple external contacts and with support services. In order to perform these tasks successfully, the following skills are essential:

- Demonstrate great rigorousness and keep the information confidential;
- Follow the confidentiality rules and, where applicable, the professional ethics measures specific to the activity;

- Be on duty within the department as agreed;
- Demonstrate an interest in issues relating to environmental goals;
- Show proven experience in terms of middle-office and/or back-office control procedures;
- Demonstrate good personal relations and organizational qualities;
- Demonstrate a feel for good customer relations;
- Demonstrate an ability to adapt to cyclic activity and to a market environment exposed to specific risks;
- Demonstrate an ability to use, and a passion for, IT systems and mastery of standard office software tools;
- Demonstrate independence, rigorousness, and the capacity to take the initiative and work in a team.

4. Ways to Reduce Registry Administration Costs

This chapter provides a number of technical options that can help reduce the administrative burden and associated costs of registry administration. It should be noted, however, that none are substitutes for the diligence and involvement of the registry administrator's management and staff.

4.1. Formalizing operational procedures

Each of the activities making up registry management may be subject to a formalized procedure. Applying formal quality assurance systems demands resources, but can help structure the internal processes, procedures, and operating instructions. The presence of an externally audited quality assurance system is also useful as a source of good practices and helps maintain standards without investing in any formal certification.

For example, the UNFCCC Secretariat is developing a quality management scheme based on ISO 27000[40] for information security management. ISO 9001[41] is another quality management standard used by a number of registry administrators (e.g., France's CDC and the United Kingdom's Environment Agency). It is important to note, however, that currently none of these registries are required by law to comply with quality management standards such as ISO 9001 or ISO 27000.

4.2. Applying proportional control and monitoring

As part of the application process, the prospective account holder may be asked to provide an estimate of its activity in the registry, such as number of transactions and amount of units held. Such information will allow the administrator to perform KYC checks and transactions monitoring in a way that is proportional to the risk related to the estimated user's activity. This may in turn reduce costs for the registry administrator, but also for applicants, which is important for small and medium-sized entities. This option may require that the registry IT record these estimated figures and block the account when limits are reached.

40 Source: http://www.iso.org/iso/home/standards/management-standards/iso27001.htm?=

41 Source: http://www.iso.org/iso/iso_9000

4.3. Computerizing operational tasks

4.3.1. Exchanges of information with registry users

Part of the workload when setting up new users or periodically updating files consists of follow-ups to obtain missing, incomplete, or noncompliant documents. Such administrative workflow generates a significant workload, which is proportionate to the number of users and to the variety of their profiles (e.g., compliance entities vs. banks) and jurisdictions of origin.

Computerizing these tasks enables some of this workload to be transferred to the user, and enables automation of exhaustive controls (e.g., missing documents) and follow-up notification (e.g., out-of-date documents). Another advantage of workflow automation is that it facilitates monitoring of progress, such as the identification of the files requiring high processing time, or the allocation of files to staff for processing. Finally, connecting supporting IT systems to the registry further increases the efficiency of business processes and data consistency.

REMA (Registry Management) is one example of a Customer Relationship Management (CRM) tool, developed by the Belgian Registry Management team (part of the Belgian Ministry of Food and the Environment). It is licensed free of charge to several EU member states.

4.3.2. Monitoring of account activity

If the volumes of transactions and administrative events—such as changes in users or opening/closing of accounts—are substantial, monitoring them to detect suspicious behavior may be complex and time-consuming, particularly in the case of linked registries. Using tools to monitor transactions, as some countries are doing, may address both issues. Germany has created a German Transaction Analysis Module (GYM) used to monitor transactions and identify fraudulent ones. Denmark has automated its risk analysis procedure for new accounts and users. This module cross-checks the information received by the registry with that held in the Danish Business Authority, and person and tax registers, to ensure the reliability and accuracy of the information held. The United Kingdom is developing an online application process that will check the integrity of requests to open accounts, appoint users, or alter registered data. The system will use a mix of public, commercial, and government sources to confirm the accuracy of more than 80 percent of the submitted data. The objective is to reduce the administrative burden of having to manually check the supplied documentation. The process will be similar to that used by the U.S. government's visa waiver system[42] and the U.K. Financial Conduct Authority.[43] Final decisions will still be made by the registry administrator.

4.4. Training material and communication supports

Providing registry users with guidance documents and other training material reduces the number of calls to the registry user hotline. Initial activity and feedback from the hotline can help estimate the need for such material. Several options exist for the development of training and communication support material, which may include step-by-step operating procedures, screenshots, and video tutorials or live training sessions that allow for real-time interactions between users and the registry administrator.

Some interesting examples in this context include the user guides and user reference documents provided by the ARB, which are available online, with additional training webinars,[44] or the first time registry user video[45] produced by the European Commission, which is likewise available online.

42 https://esta.cbp.dhs.gov/esta/

43 https://www.gov.uk/registration-with-the-financial-conduct-authority

44 Source: http://www.arb.ca.gov/cc/capandtrade/markettrackingsystem/markettrackingsystem.htm

45 http://ec.europa.eu/clima/sites/registry/media/1-FirstTimeUser.mp4

5. Recommendations and Guidance on Development of an Institutional Framework for Registry Administration

- Assess risks facing registry management and identify potential mitigation measures
- List the tasks and operations to be performed by the registry administrator
- Mandate an appropriate entity to administer the registry (possibly third party)
- Empower the registry administrator to perform operations (e.g., refuse to open an account, block an account, or revoke a user's right)
- Facilitate cooperation between the registry administrator and relevant authorities (financial regulator, energy regulator, etc.)
- Formalize exchanges and reporting (regular meetings, expert groups, etc.)
- Consider user criteria and processes related to registry access in order to benefit from the protection of existing applicable regulations
- Consider specific features related to registry use and activity (e.g., limit on the transfers for certain user categories)
- Estimate the resources and costs associated with registry administration, and identify relevant measures and options to reduce them, if necessary
- Consider options for ensuring the financial viability of registry administration (budget, fee schedule, etc.)
- Set up robust monitoring and oversight of registry activities

PART IV. IT System Procurement and Development

This section provides guidance for the specification and procurement of a registry. It gives: (i) an overview of the steps involved in registry procurement; (ii) preliminary consideration of the steps required prior to delineation of the services requested; (iii) a detailed description of the *functional* specifications of a registry; and (iv) a detailed description of the *technical* specifications of a registry.

1. Overview of Four-Step Approach to Registry Procurement

This guide proposes a stepwise approach to registry procurement. A volumes and risks assessment is first required to analyze security issues and options related to the registry. A Request for Interest (RFI) document can then be issued to potential suppliers, including estimated volumes and clarifications on security-related requirements.

Based on answers to the RFI, the participant country should take into consideration the delivery model, registry connectivity, and accounting options for imported/exported units. At that stage, both functional and technical specifications can be drafted, to be subsequently attached to a proposal request for registry development.

The proposed process is illustrated in Figure 7.

1.1. Conducting a risk assessment

This section is dedicated to security in the design and functionality of the registry and is broken down into three parts. The risk assessment should first outline the general security issues and options, next review risk mitigation measures, and finally focus on how the DES deal with more technical IT security issues.

1.1.1. Registry security—issues and options

In assessing risk, the following key questions arise: What is the probability of a security breach and what are its likely consequences? Who underwrites the risks of a security breach? As a consequence, what is the acceptable cost that can be borne by the host to ensure the security of the system?

The following types of risk should be assessed:

- **Financial risk:** run by account holders in the case of fraud, theft of units, or operational error. This risk may be proportional to the number of units held and to their market price.
- **Market risk and/or reputational risk:** including registry transactions instructed for other purposes than those authorized, and the failure to respect the rules of communication of information that should have remained confidential or not been made public before a certain date. This can result from unintended or fraudulent modification, or disclosure of confidential data. This risk is proportional to the number of transactions.
- **Reputational risk:** run by all participants in the carbon market, by the authority in charge of the carbon market, and by the registry administrator in case of a security failure, fraud, or theft, or general improper use of the market mechanism, as well as in the case of operational error, noncompliance with rules, or simple data entry error.

These risks may result in liabilities for the entity in charge of the registry's administration, as well as, in some cases, the personal liability of management staff or other personnel.

FIGURE 7: **Proposed Steps for Procurement of a Registry**

A quantitative evaluation[46] of the cost of these risks enables scoping of the security measures that should be implemented to mitigate these risks, reduce their impacts if they do materialize, and limit financial compensation to the aggrieved parties, as needed.

Note that the reputational risk in certain cases may lead to higher costs than the cost of the units involved. This could be the case, for example, of a company that meets its corporate social responsibility commitments by purchasing carbon credits. If credits are issued improperly because of a lack of control by the issuing registry administrator, the company may seek compensation not just for the amount of units involved, but also for the reputational damage it may have incurred.

The indicative list below shows key volume estimates that may be considered in the risk analysis and that will also be useful at a later stage, when determining registry IT performance requirements:

- Number of units held and their estimated monetary equivalent;
- Number of transactions each year;
- Number of users expected;
- Number of accounts to open each year;
- Expected peaks of activity (e.g., transactions by type and account opening) during the year.

1.1.2. Possible risk mitigation measures

Table 7 proposes security measures to address the various risks identified above. It demonstrates that the security measures adopted have implications for all aspects of registry IT and administration. Some of these measures will affect the way functional and technical specifications are drafted.

46 For example, based on a Business Impact Assessment (BIA).

TABLE 7: **Security Measures for Different Types of Risks**

Risk	Effect of measures	Security options
Financial risk following fraud or theft of units	Mitigation	**Terms of Use of registry services:** Require users to adhere to Terms of Use, including security guidelines involving users' participation (e.g., regularly change password and the use an up-to-date antivirus program). Registry functions: Two-factor authentication, session time-out, out-of-band notification of users; limit the registry's opening hours to open days' working hours to facilitate a quick intervention in case of a security breach; require that the password be entered again and/or an SMS code (or security token) be used to confirm sensitive operations; allow for limited time frame between the last stage of validation of an operation by the transferor and completing the transfer, during which time an operation can be canceled through an emergency procedure; enable the registry with emergency stop functions, revoke users, block accounts, and reverse operations. IT/Technical: Require the registry provider to accept independent security audits performed upon request; dedicated URL and dedicated IP to access registry administrator functions.
	Impact reduction	**Registry functions:** Automatic alerts following detection of suspect movements and based on registry emergency service stoppages, security protection for bona fide members.
	Rectification	**Account convention:** Measures forcing the unintended receiver of units to return them. IT/Functional: The registry may require transferee's explicit acceptance of units received, prior to completing any transfer.
	Compensation	**Account convention:** Calculation rules setting a maximum value on compensation for victims, thereby limiting the responsibility of the registry administrator.

(CONTINUED)

TABLE 7: **Security Measures for Different Types of Risks** (CONTINUED)

Risk	Effect of measures	Security options
Financial and Reputational risks following operational errors by the *registry administrator*	Mitigation	**Contract between the registry administrator and each user:**[a] explicitly specify the information made public. Awareness and training for registry administrator staff. **Operational procedures:** Instructions and validations to be performed by various users. **Registry functions:** Rigorous management of users' authorizations (privileges). Dedicated machine, without Internet access, except for a dedicated URL required for administration of the registry; dedicated machine with fixed IP that is recognized by the registry system; dedicated machine with no peripherals; impossibility to connect as registry administrator via the URL used by other users; strong authentication: login, password, and security token; physical access security: office badge access required, security-guarded premises outside working hours. **Peer-review procedures:** The main public (accounting) reports issued by the registry may be peer-reviewed by administrators of connected registries (if any) prior to publication.
	Impact reduction	**Subscribe to an insurance policy:** Associated with the operational risks of a registry administrator. Continuous improvement procedures: Incorporates lessons from experience into the operational registry administration procedures and into requirements applicable to the IT.
	Rectification	As above
	Compensation	As above
Financial risk following user operational errors	Mitigation	**Awareness of users:** Via the registry web page (tutorials, video, FAQ). Contract between the registry administrator and the user:[a] limit the responsibility of users (in relation to registry functions). Registry functions: "Push-push-pull" principle: two distinct users instruct and validate an operation, and an explicit approval is required from the acquiring account holder; checks during data entry; alerts in the case of an operation where quantities entered are greater than a certain limit or in the case of a compliance operation, entering quantities different from the regulatory obligation (e.g., return credits greater or smaller than verified emissions).
	Impact Reduction	As above
	Rectification	As above
	Compensation	As above
Market risk following unauthorized use of the system	Mitigation	**Regulation:** Registry operations and related banking operations to be placed under surveillance of a market monitoring authority; facilitate the cooperation between registry administrator and any authorities carrying out police investigations; ensure that personal data protection rules do not hinder legal investigations. **Registry functions (transactions oversight):** Develop detection and alert functions to detect suspicious administrative events (e.g., frequency of change of authorized registry users) or suspicious transactions (e.g., where the same unit serial numbers are exchanged in high numbers, at unusual frequency or volume); repeated transfers between counterparts ruled by different fiscal buy/sell regulations (e.g., buying without VAT—offshore or reverse-charge—and selling with VAT).
	Compensation	As above

(CONTINUED)

TABLE 7: **Security Measures for Different Types of Risks** (CONTINUED)

Risk	Effect of measures	Security options
Correlated subcontractor/ supplier transactions	Mitigation	**Demands on the entity that administers the registry:** Solvency, capitalization, risk scoring, submission of audited accounts each year to the relevant authority. **Prevention of conflicts of interest:** The registry administrator (all staff included) will not hedge a position on the purchase or sale of units (outside own obligations or commitments[b]), nor bring buyers and sellers into contact with each other, nor develop projects that generate credits. **Obligations of the registry administrator:** ensure that staff and contractors respect the rules of confidentiality. **Contractual clause** by which the registry administrator accepts unscheduled audits by the competent authority and conducts independent audits on a regular basis.
	Rectification	**Registry Administration Mandate:** Build in the possibility to terminate or bring to an end the mandate of the entity responsible for registry administration.
	Compensation	**Registry Administration Mandate:** Building an exit clause (e.g., timescale, data transfer, and knowledge transfer).
Obligations of account owners or authorized representatives (users of the registry)	Mitigation	**Contact:** Required documentation, document monitoring (KYC), and an escalation procedure for suspicious activities. More stringent requirements for market intermediaries and other voluntary participants. Regulatory instruments allowing the registry administrator to refuse the opening of an account and limiting the possibility of appeal. Computerize the administrative workflow of initial contact and CRM.
	Impact reduction	**Supervision of the relationship:** Supervision of daily transactions, detection of suspect behavior; reporting to the relevant authorities able to investigate or intervene. Develop CRM functions with alerts in the case of obsolete documents or checks not done; computerize the risk-profiling of users; subscription to external databases of company information, companies' owners and managers.
	Rectification	**Terminate the relationship:** Legal instruments allowing the registry administrator to refuse to open an account, block or close an account, and freeze or revoke a user's access to the registry.

a. A contract or other document detailing the mutual obligations of the parties.

b. For example, buying and canceling units for the purpose of offsetting one's own GHG emission

1.1.3. Addressing IT security

The "Data Exchange Standards" (DES published by UNFCCC describes a set of security measures for registry information systems. Certain measures are generic while others specifically address the connection between a registry and a central hub. Table 8 lists the main information systems security requirements for registries, independent of their connection to a central hub such as ITL, according to DES version of December 2013.

TABLE 8: **List of the Main Information Systems Security Requirements for Registries**

Paragraph	Security measures
3.1.1	Registry systems have fixed public IP addresses
3.1.3	The use of SSL will protect any communications that may pass over the networks at the registry site
3.1.4	Use of a trusted certificate authority
9.	Documentation to show that the registry will be operated in a manner consistent with excellent operating practices. These requirements ensure the registry has an adequate plan for addressing the operational and security requirements of the application
9.1.1	Database and Application Backup
9.1.2	Disaster Recovery Plan
9.1.3	Security Plan
9.1.4	Application Logging Documentation
9.1.5	Time Validation Plan
9.1.6	Version Change Management
9.1.7	Test Plan and Test Report
9.1.8	Operational Plan

1.2. Identifying potential registry vendors and their offer

A RFI—based on clear functional specifications—can be issued and shared with several preselected IT/registry providers. The RFI could include:

- A regulation applicable to the registry;
- An estimate of volumes and a list of security measures (see building block 1 below);
- A description of the registry and services sought (see building block 2 below).

The feedback received from interested providers may bring valuable first-hand information and insight, in particular related to:

- Offering and prices;
- Experience and level of expertise;
- Quality of their project management; and
- Capacity to cooperate closely and deliver expected results in a common working language.

The RFI also allows a first assessment to be made of the suitability of different types of delivery models for registry product and services, including Software as a Service (SaaS, see section 2.1), the application or adaptation of existing software, or development from scratch.

Following the RFI, a Request for Proposal (RFP) can be drafted. An RFP is a comprehensive document providing all the information needed to make an informed purchasing decision.

RFI/RFP building block 1	**Specify volumes expected and security measures required**

This first building block is intended to synthesize the volumes of data to be managed by the registry (to be further detailed in technical specifications), and the security measures required. Providers will use this information to estimate the need for IT scale and security performances.

Expected volumes could especially specify:

- Number of units held and their estimated monetary equivalent;
- Number of transactions each year;
- Number of users expected, including simultaneous accesses to the registry system;
- Number of accounts to open each year;
- Expected peaks of activity (seasonality).

The list of security measures recommended, to be listed here, is the result of decisions made on the basis of due consideration of Table 8.

Outcome	**The scope and objectives of the services sought are defined.**

RFI/RFP building block 2	Delineate the nature of expected services

This building block lists the services sought from the supplier and associated volumes and security measures expected. A range of services and delegation of responsibilities can be recommended over and above the provision of the registry system. The list of services expected could be taken from the indicative list suggested below.

Regarding the IT system (i.e., the registry):

- The procurement of the registry, in accordance with the functional and technical specifications;
- The reversible hosting of data and processing services, and the registry site;
- A secure and confidential infrastructure;
- Maintenance in operational condition of the IT system: concerns corrective and upgrade maintenance for both the registry and the underlying software component versions;
- A service level agreement, which details the level of commitment to quality and security management, including reactivity to change.

Regarding auxiliary services:

- First-level hotline and support for users;
- Training material, user guides, operating manuals, and training courses;
- The drawing up of "Terms of Use" of the registry, including security measures and any limitations (web browsers);
- Management of requests for opening accounts: formal checks, due diligence, account opening upon confirmation by the registry administrator, and assigning user authorization;
- Regular update and review of users' related documentation;
- Invoicing users.

Outcome	The scope and objectives of the services sought are defined.

1.3. Developing the functional and technical specifications

Functional specifications are an inventory of business requirements, including users' interfaces, expected functions, and data to be managed by the registry. These requirements are derived from the regulation in place. Security requirements have an impact on functional specifications (e.g., users' authorization profiles and transactions workflows).

Technical specifications are related to the IT aspects of the registry, and thus give particular attention to the description of the technical environments, and performance and security requirements.

1.3.1. Functional specifications—a bird's eye view

Comprehensive functional requirements should be based on the functional requirements suitable for a core generic registry. Key components of functional specifications are illustrated below, in the third building block of the final RFP.

RFP building block 3	Specify registry functional requirements

This includes the need to:

- Translate the regulation into business rules that must be respected by the registry;
- Describe, as necessary, automatic or planned events (issuing reports or notifications, calculating compliance figures);
- Establish a list of user authorization profiles, and the corresponding table with associated list of functions;
- List the types of units required, and specify the need for additional labels and the format of serial numbers;
- Formalize accounting models for each transaction;
- Describe the workflow applicable to each transaction;
- List all reports and notifications to be issued by the registry;
- Detail the registry website structure, and requirements for animation and design.

Outcome	Business requirements are specified and reflect functional needs. The functional specifications of the registry are completed.

1.3.2. Technical specifications—a bird's eye view

The key components of technical specifications are illustrated below, in RFP building blocks 4 and 5. Detailed guidance is provided on how to draft comprehensive technical requirements, based on the technical requirements suitable for a core generic registry.

RFP building block 4	**Specify registry technical requirements (1/2): "scale" of the registry**

This building block is intended to "size" the processing capacity required for the registry.

Putting the registry IT in context:

- Based on the map of information systems to connect to the registry (e.g., central hub and MRV), draw up an inventory of IT interfaces between the registry and those other systems;
- Exchanges between registries: detail the technical architecture to be implemented for the transfer of units between registries (via a central hub, peer-to-peer, or both);
- Stipulate whether the registry needs to use a particular communications protocol for certain interfaces, and don't fail to specify if the registry must conform to the DES for handling exchanges between registries.
- Consistency between the organization and administration of the registry and data processing services:
- Determine working hours and holidays, hotline opening hours, and the times the registry will be available online (distinguishing as necessary, the hours available for users and those available for administration); determine the number of staff required for the hotline and for registry administration.
- Provide detailed estimates of the following elements (most of them have been used earlier to assess risks, see building block 1):
- Number of users expected;
- Number of simultaneous user accesses to the registry;
- Number of transactions and number of accounts to open each year;
- Expected peaks of activity (e.g., due to compliance transactions) during the year;
- For each connection, volume and frequency of data exchanged with the registry;
- Number of units held and their estimated monetary equivalent;
- Minimum number of technical environments required (e.g., production, preproduction, testing);
- List of data to archive (logging, audit trail, history available online) and the duration for which the archive must be kept (taking into consideration regulatory constraints).

Outcome	**The "scale" of the registry is specified: registry/IT providers are able to "size" the performance and service level of the solution they can offer.**

RFP building block 5	**Specify registry technical requirements (2/2): "IT environment" of the registry**

This stage details the technical requirements for IT architecture, security, and confidentiality.

The following requirements need to be described:

- Data hosting, taking account of appropriate personal data protection and data confidentiality legislation;
- Encryption in data exchange processes via the web interface and systems that make files available for download;
- Information systems environments to implement;
- Data archiving;
- Performance expected from the information system;
- Management of data confidentiality;
- Authentication factors required;
- Transaction traceability (audit trail).

Based on specific IT circumstances such as the registry administrator's existing IT security strategy and IT environments, the following requirements may also need to be specified:

- Systems solutions favored and solutions excluded;
- Quality service level and monitoring of quality service level.

Outcome	**The technical specifications are completed and can be attached to a RFP.**

1.4. Preparing the Request For Proposal (RFP)

The last step consists of soliciting potential registry providers through a competing or bidding process, such as an RFP. In all cases, there is a need to delineate the services sought and specify the functional and technical requirements for the registry and its associated services.

The RFP can be structured using the above building blocks to:

- Specify the volumes of data expected and to be managed by the registry, and the security measures required (see RFP building block 1)
- Delineate the nature of the services expected to be delivered by vendors, based on basic registry needs (see RFP building block 2);
- Specify the registry's functional requirements (RFP building block 3);
- Specify the registry's technical requirements (RFP building blocks 4 and 5).

Note: If the registry is developed from scratch, the functional specifications will have to provide additional details such as prototypes of user interfaces, web page cinematics, and a detailed workflow for each registry function.

1.5. Implementation timeline

The selection of a registry provider may take several months to a year. One to two additional years may be required to start operating the registry, depending on the complexity of the solution and on the level of specificity of the IT components required (as compared to the re-use or integration of existing software modules.)

1.6. Indicative list of providers of registry IT and services

Table 9 provides an indicative (non-exhaustive) list of suppliers of registry transaction solutions.

TABLE 9: **Indicative List of Registry Services Providers**

Country	Supplier	Service offering	Registry Experience	References for IT systems connected to registries
Belgium	Trasys	• Integration • Development	• ETS	• Transaction logs
Canada	CSA Group	• Development	• ETS • Voluntary offset	• Project database
China	ZBX	• Developer	• ETS	• Reporting platform • Trading platform
China	Sinocarbon	• Specifications • Development	• ETS • Voluntary offset	• Project database • Communication protocol • Reporting platform
France	Powernext	• SaaS	• Power[a]	• Hotline and administration
France	Andal Conseil	• Specifications • Procurement approach	• ETS • Voluntary offset • Power	• Registry administration • Project databases
Germany	LiWa GmBH	• Integration	• ETS	• Registry suspicious patterns detection • Workflow automation
Japan	NTT Data	• Development	• ETS	• —
United Kingdom	SFW	• Integration • Development	• ETS • Voluntary offset	• Administrative workflow automation
United Kingdom	Markit	• SaaS	• Voluntary offset	• Project databases • Auction platform • Platform for initial buyer seller contact
United Kingdom	Noumenal	• None	• Voluntary offset	• Project databases • Communication protocol
United States	CSRA	• Development	• ETS	• Transaction logs • Project databases • Auction • CRM
United States	APX	• SaaS	• Voluntary offset	• Project databases

Note: ETS = Emissions Trading System; SaaS = Software as a Service; VCSA = Verified Carbon Standard Association; — = not available.

a. Examples: registries for capacity regulation and for guarantees of origin.

2. Preliminary Considerations

2.1. Different registry procurement options: develop, adapt, share, or outsource

The main procurement options for registries are the following:

- **Share:** involves using a single, common registry. One example is the Western Climate Initiative, which has developed a single registry IT shared by its members (California and Quebec). Another example is the Consolidated System of European Union Registries (CSEUR)—a shared registry IT that replaced all national EU ETS registries formerly hosted in each EU Member State and the EEA EFTA states (i.e., Norway, Iceland, and Liechtenstein), as well as the Kyoto Protocol national registries of these countries, which have their distinct obligations and connections to the UNFCCC system.[47]
- **Software as a Service (SaaS):** is based on a software licensing and delivery model in which the software vendor—based on a subscription/fee—hosts and maintains the servers, databases, and code that constitute the registry application. Registry management services may also be offered (e.g., operating the hotline and user operation management). In addition to the subscription/fee, other potential costs to consider under this option include:
  - Initial specific personalization and configuration;
  - Secure hosting (e.g., annual subscription);
  - Upgrade maintenance (based on specific estimates) and upgrades imposed by [suppliers of] underlying technologies (databases, etc.).
- **Adapt:** involves having an IT services provider adapt and implement an existing open-source registry (e.g., Open Registry) or a registry solution under license (e.g., "Greta" or "Seringas," which are under SFW license).
- **Develop:** requires the drafting of very detailed functional and technical specifications for an IT services provider to develop a registry system from scratch.

Deciding on one of the above options involves assessing them against their cost of maintenance [C], timescale [T], required know-how [S], complexity [X], performance, security, and continuity plan [PS], flexible functionality and scalability [F], data ownership and linking [SV], and documentation and training material [D]. Table 10 compares each of the above registry procurement options on the basis of these eight criteria.

Notes:

- When comparing costs, it is useful to bear in mind that any IT system generally has a limited lifespan, and that costs have to be compared over a time period that is at least equal to the lifetime of each option;
- The cost of adapting existing software is sometimes higher than the cost of developing from scratch; particularly adapting the presentation layers (user interfaces) to a specific language can be very costly;
- Open-source code can be vulnerable to hackers. In addition, long-term support and maintenance for open-source IT technologies may be an issue, especially if the community of contributing developers is small.

Some general conclusions can be drawn from the above:

- If the priority lies on data ownership and sovereignty in decision making, the registry's capacity to respond to specific requirements, and the ability to respond quickly to requests, then the development and integration options seem preferable;
- If the priority lies on lower costs, rapid delivery, a low workload and a low level of internal expertise, then the use of a third-party registry ("share" option) or paying for registry as a service (SaaS) seem preferable.

2.2. Registry connections

Depending on the scale of the market mechanism and the sophistication of the registry, a number of IT systems and databases can interface with the registry—including other registries.

2.2.1. Registry connectivity requirements

The connectivity requirements of the registry system will be determined at the policy level and reflect the level of data and extent of market linking that policy makers deem appropriate. Connections can be established to:

- Transfer units from/to another registry;
- Settle trades, upon request from a trading platform;
- Access external databases related to users or documents;
- Update MRV data, e.g., periodic verified GHG emissions, thereby enabling the registry to calculate compliance figures and status;

47 See the EU ETS Handbook, available at: http://ec.europa.eu/clima/publications/docs/ets_handbook_en.pdf.

TABLE 10: **Comparing Registry Procurement Options**

	Advantages	Disadvantages
Share	[C] Cost is probably low [X] Lower level of registry complexity (implementation and maintenance) [PS] Level of reliability and security inherited from the host system [S] No specific requirement for technical registry expertise [T] Operational immediately (if the registry used already exists) [D] Existing documentation and training material	[F] No possibility to implement specific functionality [SV] To some degree, lower control of data (ownership), no influence on decisions to link market mechanisms and subsequently connect registries [X] Legal issue linked to the physical location of units held [D] Potentially a problem of interface language
SaaS	[C] Cost is spread over time and predictable (contractual) [S] No specific requirement for technical registry expertise (the basic functions exist already) [T] Operational once the personalization and configuration project is complete [X] Less of a need for registry expertise and information systems project management [D] Existing documentation and training material can be adapted	[SV] Lower data ownership, unless databases are hosted in the same country [F] Little scope to respond to specific requirements, lower responsiveness to requirements for change
Adapt	[F] Flexibility: possibility to implement specific requirements (lower than for a development from scratch) [SV] Ownership of data and linking [D] Existing documentation and training material can be adapted	[S] Expertise required in registries and information systems project management [T] Takes time to implement (be it less than for a development) [PS] Risk of non-quality in a new development, including for security
Develop	[F] Flexibility: possibility to implement specific requirements [SV] Ownership of data and sovereignty regarding linking decisions	[C] Development costs potentially higher than for other options [PS] Risk of non-quality in a new development, including for security [S] Expertise required in registries and Information Systems project management [T] Takes time to implement [D] Documentation and training material to be designed and produced

In listing systems to be connected, there is a need to:

- Identify the relevant system(s) to connect. The information available in various systems should be obtained from the "originating" system, owned by the entity responsible for this information;
- Specify for each connection, rules, timing, checks, and applicable IT protocols—file transfer protocols, encryption requirements, technical specifications for exchanging information, data exchange standard, and other web services-based protocols.

2.2.2. IT systems and databases potentially interfacing with a registry

Figure 8 shows a generic functional architecture of the different IT systems and databases that can share connections and exchange information with a registry:

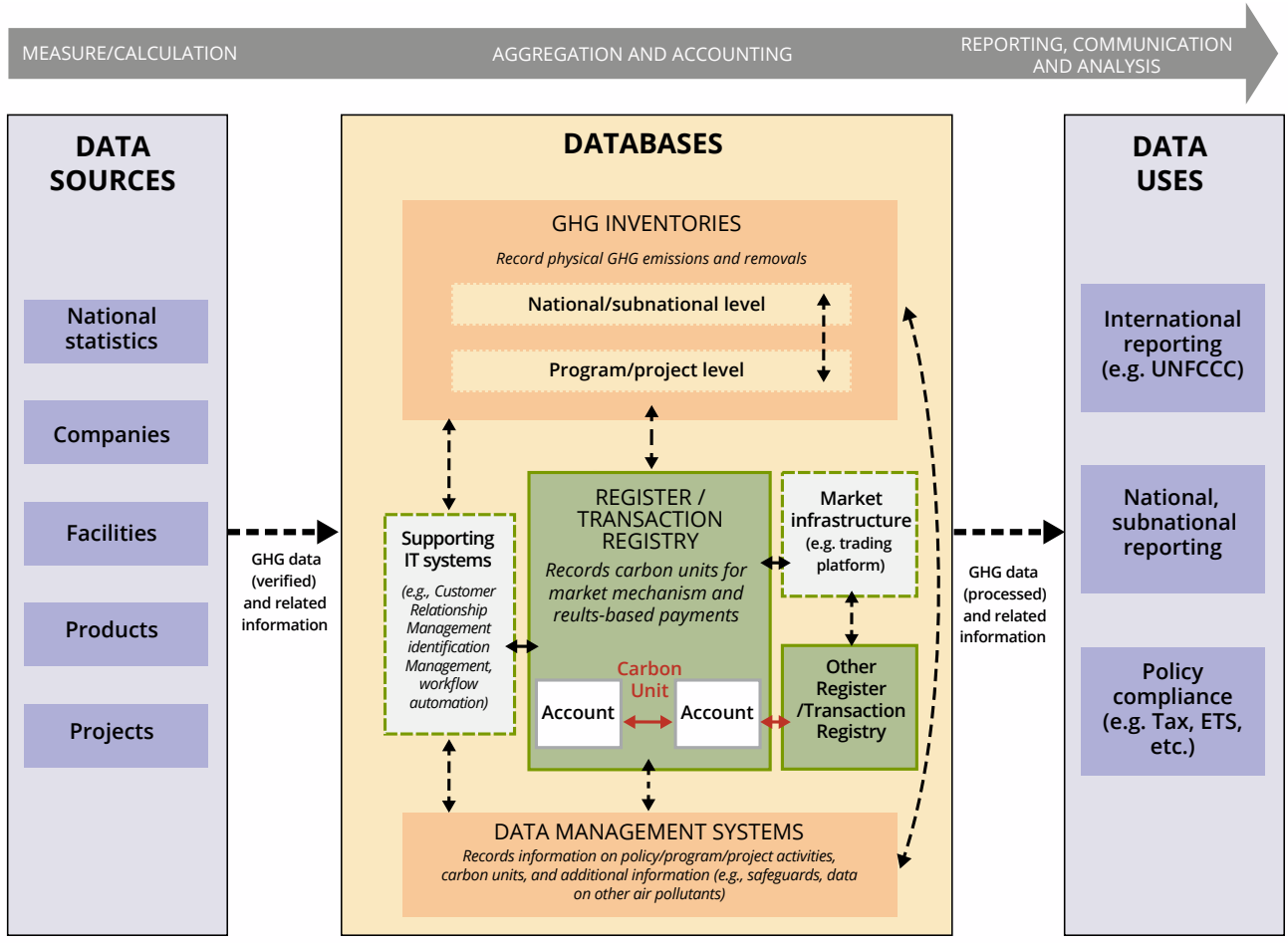
The upper middle box "GHG Inventories" refers to the systems that record physical GHG data (e.g., emissions and removals) at the national, program, or project levels.

The bottom middle box "Data Management Systems" refers to the systems that records specific information on GHG (and also potentially non-GHG) policies, programs, and/or projects.

The central part of the diagram shows the actual registry, and other (domestic or international) registries it may be connected to—through a central hub or a peer-to-peer connection. The diagram also shows other systems that provide a range of auxiliary registry services, which may include:

- Information database on market participants, including CRM tools
- Market infrastructure such as trading and auctioning platforms that match supply orders with demand orders and send settlement instructions to the registry;

FIGURE 8: **The Registry in its Environment: Potential Connections and Interfaces**



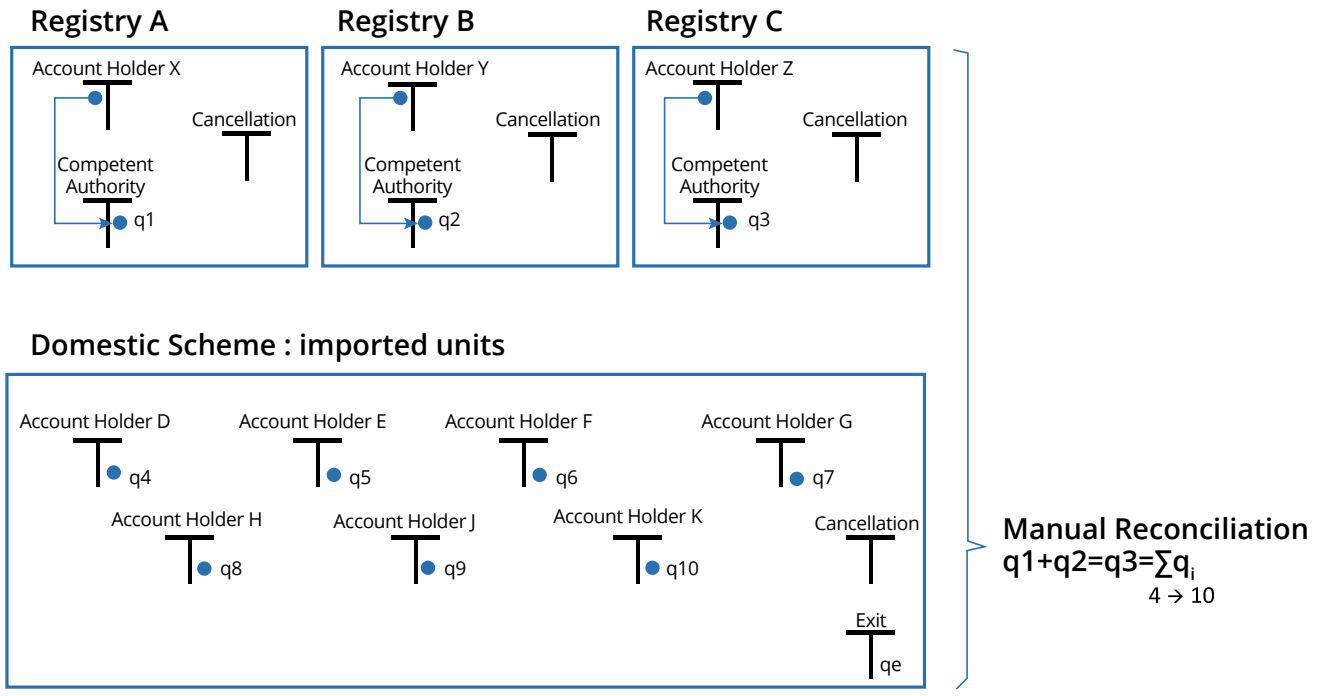
- Data analysis tools for detection of suspicious behavior and fraud;
- Reporting, logging, and archiving services;
- Automation of administrative workflow between registry administrator and account holders (e.g., account opening procedure and the subsequent periodic documentation update) ; and
- Identify and access management) (IDAM) system such as Single Sign On (SSO) capabilities for administrator users wishing to use the same access credentials as for other systems within the organization.

2.2.3. Accounting issues and options when importing or exporting units

The following two options exist for registries to ensure robust accounting when units are imported (exported) from (to) another registry:

- **Definitive transfer:** consists of canceling the units in the exporting registry to re-issue them in the importing registry. Such re-issuance may be done against a "proof of cancellation" generated by the exporting registry (administrator), to avoid double counting issues.
- **"Mirror" accounting:** under this option, there is no cancellation/re-issuance of the exported unit. It is instead stored in a *special account* of the exporting registry and is *virtually* reflected in the importing registry, where it can subsequently be transferred from and/or canceled, as long as these operations are reflected in the special account of the exporting registry. In fact, this is how accounting is managed for the VCS program when transfers take place between the two VCS registries: units never actually leave the registry in which they were initially issued.

FIGURE 9: **Domestic Chart of Accounts For "Mirror Accounting"**



2.2.4. Technical infrastructure for connection: central hub vs. peer-to-peer

The technical infrastructure connecting distinct registries can be centralized around a communication hub (e.g., the ITL for Kyoto registries) or consist of peer-to-peer network connections.

Other types of infrastructure are also possible to connect registries but may require stronger institutional and regulatory coordination:

- A single IT platform that consolidates distinct registries (e.g., the consolidated system of EU registries);
- A single registry where each jurisdiction administers its own chart of accounts (e.g., issuance account, scheme participants holding accounts, and cancellation accounts).

Table 11 lists the main advantages and disadvantages of central hub and peer-to-peer connections.

From a technical, financial, and security perspective, the central hub solution may be favored, especially if more than two registries are to be connected. However, from a technical control and sovereignty perspective, a peer-to-peer architecture may be preferable.

Under the Kyoto system, the ITL currently connects registries administered by different countries, developed using a range of different technologies, and connected at different points in time. Since implementation, it has overseen the transfer of billions of units through hundreds of accounts.

The ITL presents the following characteristics:[48]

- An architecture built around a centralized hub as opposed to peer-to-peer connections between registries;
- A standardized and secured data exchange protocol (i.e., the Data Exchange Standard);
- Real-time monitoring of transactions;
- Ex post checks: reconciliation and peer-review process.

These characteristics have allowed the ITL to offer security, reliability and credibility, operational and cost efficiency, and impartiality of treatment across the entire Kyoto registry network.

TABLE 11: **Comparing Central Hubs with Peer-to-Peer Architecture**

	ADVANTAGES	DISADVANTAGES
Central hub	• Centralizes costs and complexity related to communication management and transaction controls • No impact when adding a new registry to the registries already connected • Integrity of accounting is ensured (i.e., automatic detection of errors) • Identical treatment for all transactions • Imposes the same level of security on all registries • Each registry has only one connection: with the central hub • Single communication protocol (e.g., UNFCCC's Data Exchange Standards)	• Potential sovereignty issues deriving from registry data being made available to the administrative entity (i.e., central hub) • Costs may be high if few registries are connected • Any failure of the hub paralyzes the whole registry network • Maintenance operations on the central hub may require network-wide coordination
Peer-to-peer	• If few registries are connected, costs may be lower	• Complexity and costs increase with the number of registries connected • Responsiveness to change will become challenging as the number of registries connected rises • A security flaw in the connection between two registries poses a risk to the whole network • Transaction checks may differ from one registry to the other • Network-wide reconciliation (i.e., checking for accounting consistency in all registries) is complex

48 For more information, see UNFCCC: http://unfccc.int/kyoto_protocol/registry_systems/itl/items/4065.php.

The EU has implemented its own central hub—the EUTL (European Union Transaction Log). EU ETS units are transferred between EU member states' registries through the EUTL and not through the ITL. Only transactions involving Kyoto units are checked by both the ITL and the EUTL. Therefore, the EU benefits from a central hub while also ensuring that no other entity has access to EU ETS transactions and data.

2.2.5. Language for connection: communication protocols

Regardless of the technical options chosen for connection, a communication protocol is needed for registries to be able to exchange information (e.g., UNFCCC DES). Although the need for a "common language" may only emerge in the future, it may be anticipated in the early phases of registry development. A communication protocol imposes a specific data nomenclature, value, and format for account, unit, transactions, and the design of workflows. Using the DES from the start may make it easier for registries to connect in the future, but without any kind of commitment to ever actually connect to the ITL.

3. Functional Specifications

Determining the functional specifications of a registry system is a key first step, driven by regulation and the business processes associated with registry administration. It consists of a description of the system operations that could be applied to registry administration, with or without an IT system.

Business requirements are determined on the basis of a few key tasks involving both the authority in charge of the market-based mechanism and business analysts or IT consultants. The tasks proposed in this context are presented in Table 12.

TABLE 12: **Breakdown of Tasks to Determine Business Requirements**

Task	Market mechanism authority responsibilities	IT consultant responsibilities
Transpose the policy and market mechanism's design into business rules	Determine the regulation and rules the registry shall comply with. Review IT consultants' specifications regarding users and their privileges.	Provide suggestions on issues relevant to IT.
List eligibility criteria for users participating in the market mechanism		List types of users and profiles/level of privilege of parties using the registry.
Determine connectivity requirements	Review IT consultants' specifications regarding users and their privileges.	Determine registry connectivity requirements.
Determine account arrangements and transfer rules	Further clarify mechanism's accounting specificities. Review IT consultants' specifications regarding users and their privileges.	List account types, chart of accounts, and transactions with their respective accounting models.
Finalize functional specifications	Review IT consultants' specifications regarding users and their privileges. Officially approve/validate final functional specifications, prior to ordering any IT development.	Produce functional specifications, aligned with the regulation, with registry administration processes, and with business requirements.

3.1. Generic business rules

Business rules indicate the behavior expected of the registry system. The ones listed below are generic, and may therefore have to be adjusted somewhat.

- The registry must comply with the legal regulations in force;
- An *account holder number* (identifier) is unique and never changes (consider whether this needs to align with identifiers used in other systems);
- The registry applies user authorization before any consultation, edit, or modification is made possible;
- With the exception of the registry administrator, a user cannot enter a predated transaction;
- With the exception of the registry administrator, a user cannot modify the date of a transaction;
- A *user number* (identifier) is unique and never changes (consider whether this needs to align with identifiers used in other systems);
- A *transaction number* (identifier) is unique and never changes;
- A transaction must simultaneously debit one account and credit another;
- An *account number* (identifier) is unique and never changes. An account with a "closed" status retains its account number;
- An *account* that holds serial numbers may never have a negative balance;

  - The technical account debited on issuance does not hold serial numbers; its balance is structurally "debit;"
- A closed account cannot be reopened;
- The serial number of a unit cannot change;
- At any given time a unit may be credited only to one account;
- The registry does not allow the use of out-of-date units, nor does it allow for the use (i.e., the surrender for compliance purposes) of credits issued by ineligible projects;
- An ETS registry may limit the maximum number of credits authorized for the conformity of each market participant;
- The registry enables parameterization of restrictions on the use of certain types of units:
  - For certain types of transaction;
  - On certain types of accounts;
  - Depending on criteria related to projects (e.g., host country, sectoral scope, and registration year).

3.2. Generic configurable alerts

To make sure that business requirements are fulfilled, automatic alerts can be specified to detect the occurrence of situations that should not have occurred. Alerts are brought to the attention of the registry administrator or registry users. Some examples of events that may generate alerts are the following:

- Regulatory transactions expected but not yet completed;
- Accounts with a debit balance (other than the technical issuance account "-Q"). This situation should never occur and, if it does, represents a technical system error;
- Pending transactions: transactions for which the last status in the workflow was not attained within "x" days of being entered or imported into the registry (configurable time lapse) or for units that will expire in less than "y" working days (configurable time lapse);
- Transactions for which the accounting date differs from the date entered (later or earlier);
- Discrepancies in compliance figures;
- Number of administrative operations on hold for more than "x" days (configurable time lapse);
- Anomalies: differences (total amount and/or sign) between:
  - The sum of all account balances and the sum of all issued quantities;
  - The sum of all credits and the sum of all debits.

3.3. Taking stock of the data to be managed by the registry

The business analyst/IT consultant inventories the data and specifies the relations between those data. If it is decided that the registry should be developed from scratch, this inventory should be much more detailed. In the following sections, the focus lies on data that do not (yet) exist in all registries or require clarification.

3.3.1. Data related to registry users

The registry administrator establishes a relation (eventually a contract) with the account holder, preferably[49] a company rather than a natural person. The account holder is the responsible entity and the owner of the units held in the account. The account holder designates natural persons as "authorized representatives," that is, the users of the registry system.

Each account belongs to one and only one account holder. At least two persons may be authorized to enter and validate transactions on this account (i.e., the "authorized representatives").

In order to properly monitor risks and carry out the checks required by regulations, including those related to money laundering and terrorism financing, it is necessary to identify the "beneficial owners,"[50] that is, natural persons who effectively benefit from the transaction, such as the majority shareholder of a company.

3.3.2. Categorization of registry users

The users of the registry system are determined by the business analysts/IT consultants in accordance with the relevant market mechanism's regulation, especially considering the

49 Checks can be performed on a company, to control its liability, through mandatory and public documents.

50 FATF (Financial Action Task Force) definition: "Beneficial owner refers to the natural person(s) who ultimately owns or controls a customer and/or the natural person on whose behalf a transaction is being conducted. It also includes those persons who exercise ultimate effective control over a legal person or arrangement. (...)"

eligibility criteria for participation in the mechanism and the responsibilities assumed by the execution of processes.

Registry administrators' users can be categorized by administration process and by management structure of the competent authorities.

It is suggested that other registry users be grouped in the following way:

- Divide the market participants (account holders) into two categories: voluntary participants and compliance participants;
- Categorize account holders by type of units they are allowed to hold and transfer, and by type of transactions they are granted access to;
- Create different categories depending on the kind of relationship between account holders and users, and various levels of users' privilege;
- Create different categories based on distinct user profiles.

If the registry is shared by different jurisdictions, it may be necessary for the registry system to manage several, distinct registry administrators, ensuring that each account is associated with one and only one registry administrator, and that the data for each registry administrator area are kept confidential.

3.3.3. "Beneficial" owners

The "beneficial owner" is defined by the FATF[51] recommendations R24 and R25 (and their respective explanatory notes, available on the FATF official website). The measure proposed here to protect the carbon market from being used for criminal activity (e.g., money laundering or to finance terrorism) depends upon transparency of the identity of the person benefitting from units held and from transactions involving a given account. The expected outcome is to detect fraudulent use/users likely to be hiding behind one or more front organizations. To this end, the registry administrator should request that the natural persons who are the beneficial owners of companies holding accounts in the registry be identified.

Similarly, the registry administrator may request that beneficial owners of transactions carried out on behalf of third parties be identified. Therefore, over and above the information requested on initial account opening and documentation renewal, it is also recommended that the accounts used for the account holder be distinguished from accounts opened for third parties. This can be achieved by also using subtypes of accounts ("proprietary" accounts vs. "third-party" accounts), as per recommendation no. 9 of the Prada Report on CO_2 Markets regulations.[52]

3.3.4. User authorization profiles

Not all data on a registry will be public or accessible to all authenticated users, and all functions are not available to authenticated users. Registry functional specifications should be in place to clarify users' authorization profiles. Regulation, registry administration processes and transaction workflows provide the grounds enabling the business analyst/IT consultant to:

- List users' authorization profiles;
- Propose a corresponding table, associating user authorization profiles with data and with functions.

A list of suggested user authorization profiles is presented in Table 13. However, to configure the registry, it is necessary to detail whether a user profile has access to a function or not. To that end, a comprehensive list of core registry functions and related authorized user profiles is presented in appendix B. In practice, it is beneficial for a registry to be designed with the ability to configure the permissions of a given user role (the access needs for various user roles may evolve over time and sometimes, new roles are needed).

3.3.5. Account arrangements and transaction rules

Accounts can be classified by "type of management" account (allocation, retirement, cancellation, and buffer accounts) and by "type of participant" (operator, trading, and third-party accounts). Accounts arrangements are summarized in Table 14.

The rules for transferring units are derived from the arrangements of accounts described above. Carbon unit transfers include: allocation, buffering/release, transfers between account holders within the registry or involving another registry, settlements of trades, and all kind of end-of-life cycle transactions (cancellation, deletion).

For each type of transaction, except for end-of-life cycle transactions, a dedicated "reversal transaction" should be created. For each type of transaction, the functional specifications should mention restrictions regarding which account may or may not be debited/credited.

51 Financial Action Task Force, an organization created in 1989 with the objective of developing and promoting policies against money laundering and the financing of terrorism.

52 *Source:* Prada Report, 2010: http://www.ladocumentationfrancaise.fr/var/storage/rapports-publics/104000201.pdf

TABLE 13: **Proposed List of User Authorization Profiles**

User authorization profile	Data access	Access to functions
Information system administrator	All	All
Registry administrator	All	All
Registry operator	All	All except validation
Authorized representative	Designated holder accounts and transactions on these accounts	Entering transfers and cancellations
Additional authorized representative		Validation of transfers and cancellations
Account auditor		Read only
Sole representative[a]		Entering and validation of transfers and cancellations
Any user	Public reports	Read only

a. An account holder who may not designate more than one person to manage his registry account.

3.3.6. Different types of accounts for accounting purposes

Figure 10 shows a generic chart of accounts. The different account types proposed are described below.

Technical accounts managed by the authority in charge of the market mechanism (or the Regulator) include:

- The *issuance account* (and its counterpart, the "-Q" account) will receive units issued, before transferring them to a client's holding account;
- The *surrendering account* is used, in the case of an ETS, to receive units surrendered by liable parties in the same quantity as their verified emissions;
- A *deletion account* and a *cancellation account*. This distinction enables the following: if an operational error is made, for example an overissuance, units will be transferred to the deletion account, whereas units canceled to comply with the market mechanism regulation will be transferred to the cancellation account;
- The *risk buffer account* is dedicated to managing risk through buffered units;

TABLE 14: **Procedures for Identifying Account Arrangements**

Account type	Purpose	Account identification procedure
Management account	Manage the issuance, allocation, import, and export of carbon units	• List events and describe processes triggering any kind of unit issuance (e.g., project verification and administrative decision to issue or buffer units) • List events and describe processes triggering imports/ exports of units • List events and describe processes triggering the "end-of-life cycle" of any type of units (e.g., deletion and cancellation) • List specific account types needed to account for these events. Where needed, specific account types can be used for specific units (e.g., an account dedicated to the conversion of international credits into domestic credits)
Holding accounts	Transfer of carbon units	• List events and describe processes triggering a transfer of credits debiting or crediting a market participant's account • List characteristics that can prompt the application of different market rules or different checks to participants' accounts or transactions (e.g., account held for proprietary trading or account held for third-party trading)
Accounts dedicated to third-party platform	Security and balance reliability regarding accounts associated with third-party trading platform	• Define a specific type of account for each type of third-party platform

- The *exit account* is a technical account that is credited for any unit leaving the registry. This allows the registry to apply double-entry bookkeeping (the debit of an account transferring units to another registry is balanced by the credit to this technical account).

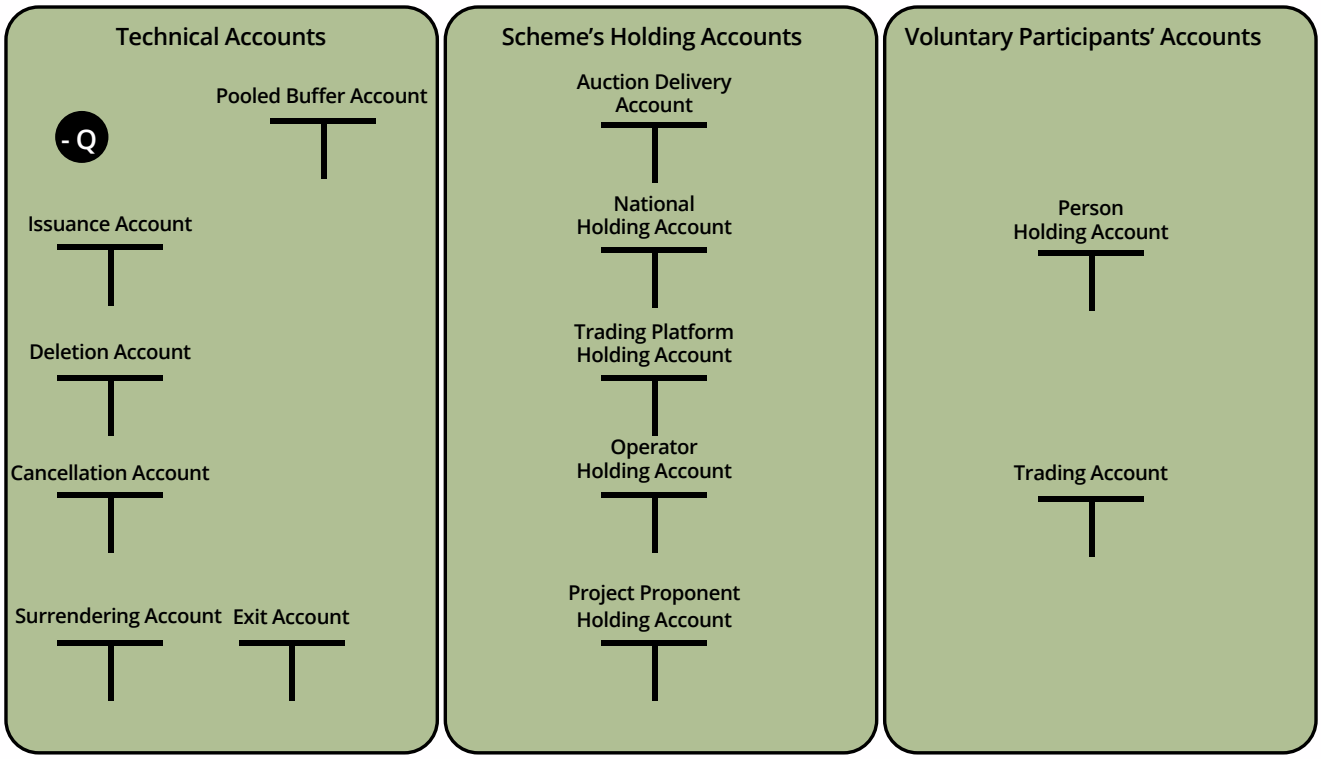
Holding accounts required for compliance scheme participants include:

- The *auction delivery account* is needed if the authority in charge of the market mechanism sells units;
- The *national/jurisdictional holding account* is needed if the market mechanism is established at the national/jurisdictional level and requires national/jurisdictional holding of units;
- Whether a *trading platform account* is required depends on whether a trading platform is in place, and how trades are to be settled within the registry (directly on the market participant accounts or on the trading platform account, ensuring opaque counterparts, and to be followed by an end-of-day net clearing among the participants' registry accounts);
- The *compliance account* (e.g., US EPA systems, as well as RGGI) is held by the account holder (with a compliance obligation). By transferring units to their "compliance account," account holders still hold these units but send the signal that these units are available for surrender/compliance. The administrator can then run a "batch compliance" process and the required units are deducted/debited from the compliance account to the central surrender account (this is done across the entire set of compliance entities for the period). The administrator can also run a "draft batch compliance" to give an early indication of the state of compliance across the scheme;
- The *operator holding account* is required for persons required or encouraged to adhere to the market mechanism;
- The *project proponent holding account* is needed for project developers receiving credits issued based on project verification reports.

Holding accounts for those who participate voluntarily in the system (e.g., intermediaries) include:

- The *natural person holding account* is for natural persons, as required;

FIGURE 10: **Generic Chart of Accounts for a Registry**



Note: The black circle marked "-Q" represents the structurally in-debit technical account that is debited in quantity (without serial number) on each issuance.

- The *trading account* is specifically for brokers and other market intermediaries.

Notes:

- Holders of "operator accounts" may also wish to open a trading account;
- It may be necessary to determine whether it is appropriate to allow accounts to be opened for natural persons. In a relatively complex and financially risky mechanism, it may be difficult to make sure that natural persons are fully aware of the rules and risks related to trading. It may also be difficult for the registry administrator to assess the reliability of a natural person (as compared to the ways and means available to assess the reliability of a legal entity with public records).
- The black circle marked "-Q" represents the structurally in-debit technical account that is debited in quantity (without serial number) on each issuance. Indeed, a registry uses double-entry bookkeeping because it is a generally accepted accounting principle: any unit credited to an account (including at issuance) must have a counterpart debit in another account.

3.3.7. Accounting models

For the chart of accounts presented in Figure 10, the corresponding accounting models for the main types of transactions that a domestic registry must manage (excluding transfers between registries) are illustrated in Figure 11.

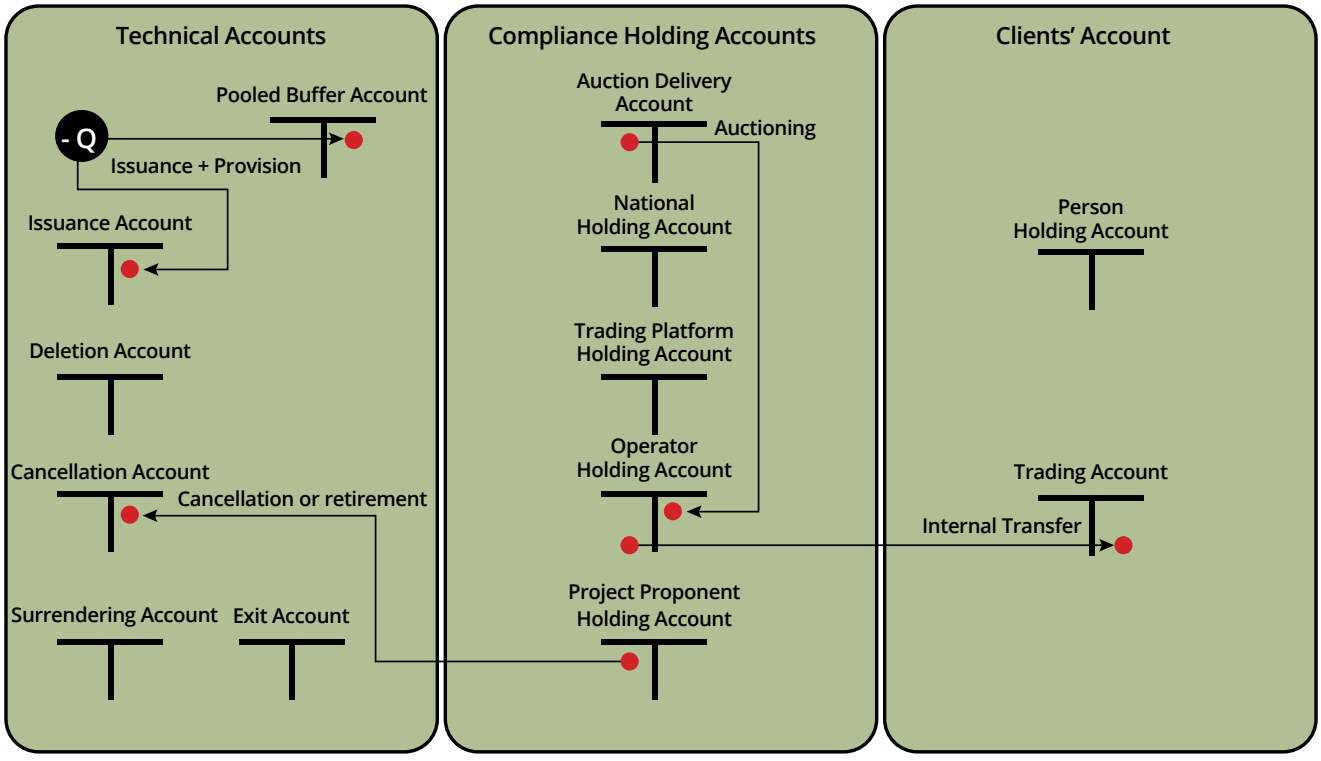
Each transaction within the registry debits an account and credits another account. It is recommended that restrictions be implemented regarding account type debited or credited. Appendix C details the accounts eligible for debit and credit for each type of transaction.

3.3.8. Data related to accounts and units

Type of holding

The type of holding characterizes each account, and can take two forms: holding for own use (proprietary trading) or holding for a third party. In the case of units held for own use, the account holder declares himself the beneficial owner of any transaction on the account. Where an account

FIGURE 11: **Accounting Models for Key Transactions**



Note: The black circle marked "-Q" represents the structurally in-debit technical account that is debited in quantity (without serial number) on each issuance.

is held for a third party, the account holder declares that all transactions are carried out on behalf of a third-party "beneficial owner."

Serial numbers

Serial numbers are managed by blocks of consecutive numbers (e.g., the block 501–1,500 is a block made up of 1,000 similar units, of the same type label, vintage, and project). However, a transaction can break up this block, for instance, if a block of 500 units is to be debited from the account that holds the block 501 to 1,500 (T [a] able 15).

The registry archives the history of breakup of blocks of serial numbers. This allows an audit or, in the case of a reconciliation error, a serial number to be traced back to its original block.

Label

The label represents a quality certificate that could be associated with a serial number. The CCBA (Climate, Community & Biodiversity Alliance) and Social Carbon are examples of labels that can be borne by carbon credits.

FIFO, LIFO, or "undetermined"

When a transaction debits an account within a range of serial numbers, the registry must select serial numbers to be taken from the block of available serial numbers.

Several options are possible:

- **LIFO: Last in First Out.** The serial numbers to be debited first are the latest, by date, to have been added to the account. To choose between serial numbers credited on the same date, a second criterion is required (for example, serial number);
- **FIFO: First In First Out.** The serial numbers to be debited first are those that were first added to the account, by date. To choose between serial numbers credited on the same date, a second criterion is required (for example, serial number);
- **User's choice:** the user chooses the serial numbers for the transaction. The user can select a rule (FIFO or LIFO) for the selection process or choose individual serial numbers.

Notes:

- The registry allows the user entering a transaction to select a given project, a given label, or a specific vintage or year of issuance associated with the units involved in the transaction (e.g., transfer or cancellation). The FIFO/LIFO rule then applies.
- Over time, large unit blocks can be broken down to progressively smaller and smaller blocks, creating a higher and higher total number of blocks. This has the potential to lead to performance issues if a given transaction includes large amounts of blocks (e.g., thousands of blocks). In order to mitigate this performance risk, transactions can be designed in a way that they automatically select blocks that minimize the number of block splits required.

3.4. Standardized nomenclatures and values

As described earlier, there is a need to list data and organize those data based on the relationship between them. In addition, for some data it may be necessary to specify eligible values (e.g., by limiting "transaction type" to a few eligible values such as "issuance" and "allocation").

Bearing in mind the aim of connecting together registries in the future, it is recommended that the DES and their nomenclatures and lists of values, in accordance with annexes F and G in the November 2013 version of the DES,[53] be adhered to from the start.

53 Available at http://unfccc.int/files/kyoto_protocol/registry_systems/itl/application/pdf/data_exchange_standards_for_registry_systems_under_the_kyoto_protocol.pdf.

TABLE 15: Management of Blocks of Serial Numbers

	Transferor Account		Beneficiary Account	
	Debit	**Credit**	**Debit**	**Credit**
Block of serial numbers before transfer		501–1,500		
Accounting model of a transfer of 500 units	500			500
Account balance after transfer		501–1,000		1001–1,500

Note: Underlying assumption is LIFO (= Last In First Out).

Note: Where the DES does not provide a value for a given type of transaction, it is recommended to "subtype" an already existing (i.e., listed) type of transaction.

Table 16 lists the main nomenclature and codes that have been standardized by the DES.

3.5. Potential requirements to update DES reference nomenclatures based on registry developments

Whether connecting to the ITL in the future or not, market mechanisms may choose to use the DES, an existing standardized communication protocol to exchange information between registries (see page 30, particularly footnote 6, for more information).

Procedures could be implemented at the UNFCCC level, enabling authorities in charge of market mechanisms to reserve and share supplemental reference values for codes and nomenclatures laid out by the DES (even to create new reference nomenclatures, e.g., for labels). This would be particularly useful where subtyping of existing nomenclature is not enough to address a mechanism's connectivity needs. Table 17 gives several examples.

3.6. Transactions to be managed by a Registry

The life cycle of a unit is often determined by three main stages:

- Its initial creation (issuance);
- Transfer of ownership (allocation, auction, transfer) or even intermediate transformation (such as adding a label, conversion from one unit type to another, or change of expiry date in the case of temporary units such as tCERs and lCERs[54]);
- Irrevocable unit's "end of life" (e.g., cancellation, surrender, deletion, restitution, or retirement).

The registry offers different transactions for accounting and recordkeeping at each of these stages, serial number by serial number. For each transaction described below, a workflow is suggested as well as an accounting model, and a summary diagram of status changes presented.

54 tCER (temporary CER), a CER issued for an afforestation or reforestation project activity under the CDM, which expires at the end of the commitment period following the one during which it was issued; lCER (long-term CER), a CER issued for an afforestation or reforestation project activity which expires at the end of its crediting period.

TABLE 16: **List of Nomenclatures and Codes Reserved by the DES**

Reference to the DES	Code	DES Reserved values
Annex G, fig. 1	Type of account	Discrete values between 100 and 423
Annex G, fig. 3	Guarantee period	0 to 4
Annex G, fig. 4	LULUCF activity	1 to 7
Annex G, fig. 5	Notification status	1 to 3
Annex G, fig. 6	Type of notification	1 to 11
Annex G, fig. 7	Participant status	1; 2
Annex G, fig. 8	Reconciliation status	0 to 11; 98; 99
Annex G, fig. 9	Transaction status	1 to 16
Annex G, fig.10	Transaction type	1 to 10
Annex G, fig.11	Type of unit	1 to 7

Note: DES = Data Exchange Standards; LULUCF = Land Use, Land-Use Change and Forestry.

Specific requirements of a given market mechanism may make it necessary to specify other types of transactions and/or alternate workflows, which can be specified by the cloning and adaptation of those suggested below.

3.7. Issuance without provision for risk

Units are issued in accordance with applicable rules and under the responsibility of the registry administrator. Some examples are the issuance of quotas in accordance with a commitment to cap GHG emissions; and the issuance of credits in accordance with the procedure in force and consistent with the project's verification reports.

3.7.1. Accounting for unit issuance

Issuances may be initiated by a manual instruction (e.g., receiving a verification report for a project) or by an imported file handled automatically (e.g., for an ETS, the validation of an "allocation table" that determines the amount of quota each compliance participant will receive).

The registry will credit the units on the beneficiary account, unless the account's status precludes the registry from doing so (e.g., if the account status is "blocked" or "closed").

- At issuance, the units are created in the registry with a unique serial number; in the case of Kyoto units, uniqueness is defined by the combination of the originating Party and the serial number (in the case of CERs,

TABLE 17: **DES Reference Nomenclature Updates**

Where in the DES	Code	Reserved values	Example of new values that may be required
Annex G, fig. 1	Type of account	100... 423	• Risk buffer account • Project proponent account • Surrendering account (by liable parties) • Nostro account • Vostro account
Annex G, fig. 4	LULUCF activity	1 to 7	• Types used by REDD+, by voluntary standards, and by market mechanisms
Annex G, fig. 5	Notification status	1 to 3	• No requirements identified
Annex G, fig. 6	Type of notification	1 to 11	• Question not asked
Annex G, fig. 7	Participant status	1; 2	• Source registry (for the case of a transfer between Nostro/Vostro non-emitting [accounting] registries)
Annex G, fig. 8	Reconciliation status	0 to 11; 98; 99	• Question not asked
Annex G, fig. 9	Transaction status	1 to 16	• Question not asked
Annex G, fig.10	Transaction type	1 to 10	• No requirement identified if the risk buffer account has its own type. Otherwise, requirement for a dedicated type of transaction for buffer provision and buffer release
Annex G, fig.11	Type of unit	1 to 7	• Types of units of voluntary standards and of each new market mechanism

Note: DES = Data Exchange Standards; LULUCF = Land Use, Land-Use Change and Forestry; REDD+ = REDD plus Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks.

the originating Party is the project host Party); in the case of credit issuance:

  - A permanent link associates each unit created with the initiating project. This link is created by combining the project identifier and the respective units' serial numbers;
  - A quality label (e.g., CCBA, Social Carbon) may be associated with the units issued;

- The units may be associated with one or more specific periods: vintage of emission reductions (as is the case under the VCS), year of credits' issuance (as is the case for credits issued under the CDM), commitment period at the time of issuance, applicable commitment period limiting the eligibility of units used for compliance purposes;
- The registry automatically notifies the users associated with the beneficiary account.

Table 18 represents the accounting model for an issuance. For the workflow involved in an issuance, see appendix D.

3.7.2. Issuance statuses and status changes

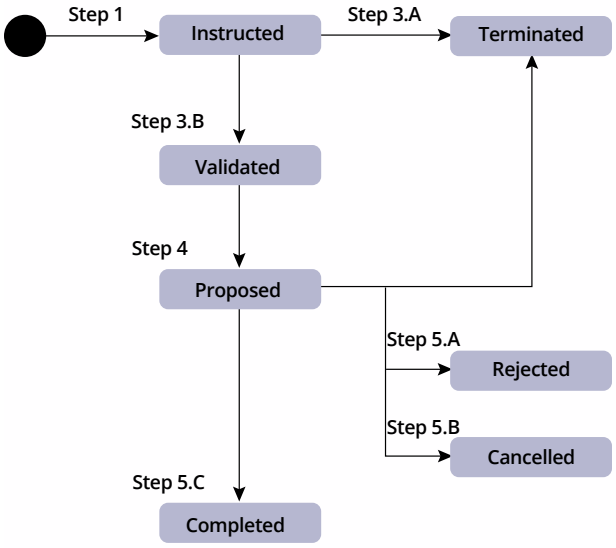
The registry keeps an audit trail of statuses and status changes of all issuances. The diagram presented in Figure 13 shows the changes in status for an issuance according to the workflow proposed above.

3.7.3. Options and variants

Possible security measures related to the instruction of an issuance:

- The issuance is the responsibility of the registry administrator. Therefore, the above workflow assumes that it is not necessary to provide the same level of security and cancellation period as for transfers, but other choices are possible. Notably, the same workflow and timescale may apply to all transactions, issuances included.
- Similarly, it is deemed unnecessary to require that registry administration staff confirm their passwords and data entry (by SMS), for security purposes.
- An alternative to these security measures would be to assign a third user over and above the first two to check the issuance.

FIGURE 12: **Issuance—Transaction Status and Status Changes**



Measures to ensure the responsibility of the beneficiary:

- The registry can automatically notify the beneficiaries of an issuance. This notification can be delivered by e-mail or "out of band," via SMS, for additional security.
- Explicit validation may be required by the beneficiary. After a certain time lapse, an issuance not explicitly validated by the beneficiary can be automatically validated (or rejected, but the risk is that the registry administrator may have to reenter issuances).
- These nonexclusive measures ensure that the beneficiary takes responsibility for the reception of units issued in his favor and reduces the adverse consequences of operational error.

3.8. Issuance with risk buffer

Certain standards manage the risk of non-permanent ERs in agricultural and forestry sectors by withholding credits on a dedicated account.

At each issuance, up to four operations may need to be accounted for:

- The units issued to the project proponent;
- The units issued to a risk buffer account. The buffer account may be common to all projects or one managed specifically for a set of projects, for a sector, or for a country/jurisdiction;
- Under certain conditions, a release of buffer units (buffered at former issuances), to be accounted for as credits to the project proponent's account;
- Another option is to issue all project units to the buffer account to make sure that the required buffer is in place before issuing units to beneficiary accounts.

The verification report provides the quantities concerned for each operation:

- "q" is the quantity to credit to the beneficiary account;
- "b" is the quantity to buffer; and
- "r" is the quantity to release from the buffer account and to credit to the beneficiary account (r can be zero).
- The GHG emissions avoided/sequestered during the verification period triggering the issuance amount to "q + b" tCO_2eq.

TABLE 18: **Issuance Accounting Model**

	"-Q" Account		Beneficiary account	
	Debit	**Credit**	**Debit**	**Credit**
Account balance before transfer				Quantity Q2 T/P/L/t
Accounting model for issuance of "q" units of type "T"	Quantity: q	→		Quantity: q
Account balance after transfer				Quantity: Q2+q T/P/L/t

Note: T/P/L/t represent characteristics of the unit; T = type; P = Project; L =Label; and t = validity period or vintage.

TABLE 19: **Accounting for Unit Buffers**

	"-Q" Account		Buffer account	
	Debit	**Credit**	**Debit**	**Credit**
Account balance before transfer				Quantity Q2 of T/P/L/t
Accounting model for issuance of "q" units of type "T"	Quantity: q →			Quantity: q
Account balance after transfer				Quantity: Q2 + q of T/P/L/t

Note: T/P/L/t represent characteristics of the unit; T = type; P = Project; L =Label; and t = validity period or vintage.

The registry creates a link between these operations. All of these operations link to the same project and to the same verification report, and all credits and debits to the buffer account are linked to the issuance.

3.8.1. Issuance of "q" units credited to the project proponent account

The accounting model and workflow for issuance of credits are identical to those described above for issuance transactions without a risk buffer.

3.8.2. Issuance of "b" buffer credits to a risk buffer account

Table 19 represents the accounting model for "crediting" a risk buffer account. The transaction is very similar to an issuance, but credits a "technical" (risk buffer) account.

Appendix E presents the workflow involved in crediting a risk buffer account.

3.8.3. Transaction statuses and status changes

The registry keeps the history of the statuses and status changes of each transaction in the audit trail. Figure 13 shows these status changes in the case of issuance of buffer credit based on the workflow presented in appendix E.

3.8.4. Release of "r" buffer credits

The risk buffer release transaction is an internal transfer, initiated by the registry administrator debiting the buffer account and crediting the project proponent account. The workflow is that of an internal transfer. The corresponding accounting model is presented in Figure 14.

It should be noted that another approach is to issue units first to a buffer account and then to the beneficiary account, with additional checks to ensure that the project has sufficient units in the buffer account to cover the units that have been proposed be issued to the beneficiary account. Such an alternate approach is similar to how the DES 2.0 proposes managing the 2 percent share of the proceeds requirement.

3.8.5. Allocation

Allocation is specific to ETSs: this operation transfers entitlements to emit GHGs (i.e., GHG allowances to a list of compliance participants committed to comply with the ETS regulation adopted. Therefore, allocation will occur after issuance and consist of a "batch" of internal transfers debiting the account of the authority in charge of the market mechanism (or the regulator) and crediting installations.

FIGURE 13: **Issuance of Buffer Credits—Transaction Statuses and Status Changes**

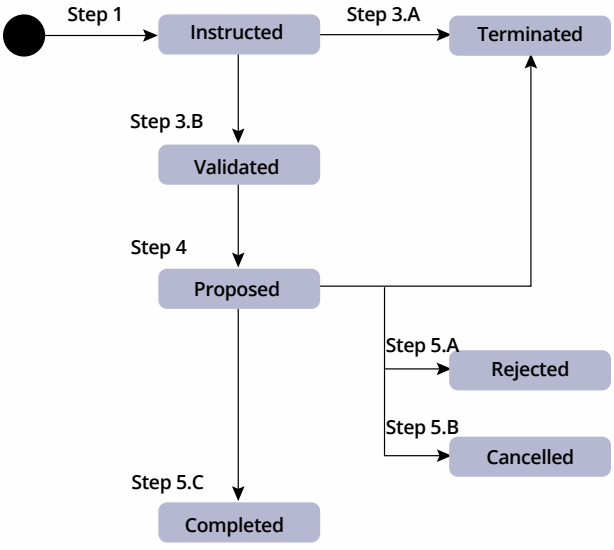


FIGURE 14: **Accounting for Risk Buffer Release**

	Buffer account		Beneficiary account	
	Debit	**Credit**	**Debit**	**Credit**
Account balance before transfer		Quantity: Q1 T/P/L/t		Quantity Q2 T/P/L/t
Accounting model: release of risk buffer of "r" units	Quantity r →			→ Quantity r
Account balance after transfer		Quantity: Q1-r T/P/L/t		Quantity: Q2+r (unchanged) T/P/L/t

Note: T/P/L/t = characteristics of the unit; T = type; P = Project; L = Label; t = validity period or vintage.

Handling allocation manually may be an issue if a lot of installations have to be credited in a limited time frame. To deal with such a situation, two options are available:

- The registry can propose a dedicated function, allocating units based on an imported "allocation table;"
- Allocation can be accounted immediately, without requesting beneficiaries to explicitly accept allocated units first, thus reducing the risk of automatic rejection because of late approval.

3.9. Internal transfers

3.9.1. Accounting for internal transfers

Internal transfers involve two account holders: the transferor and the transferee. Upon request of the transferor, the registry transfers a certain quantity of units from its account to that of the transferee, unless the account status of the transferor or the account status of the transferee is incompatible with such transfer (blocked or closed accounts).

In accounting terms, an internal transfer subtracts a certain quantity of units from the inventory of the transferor's account to add the same quantity to the inventory of the transferee's account. The transferred units retain their unique serial number, and the registry automatically notifies the authorized users linked to both accounts. Table 20 shows the accounting model for an internal transfer.

Appendix F proposes a workflow for internal transfers. The optional security measures proposed and their variants are subsequently discussed.

3.9.2. Transaction statuses and status changes

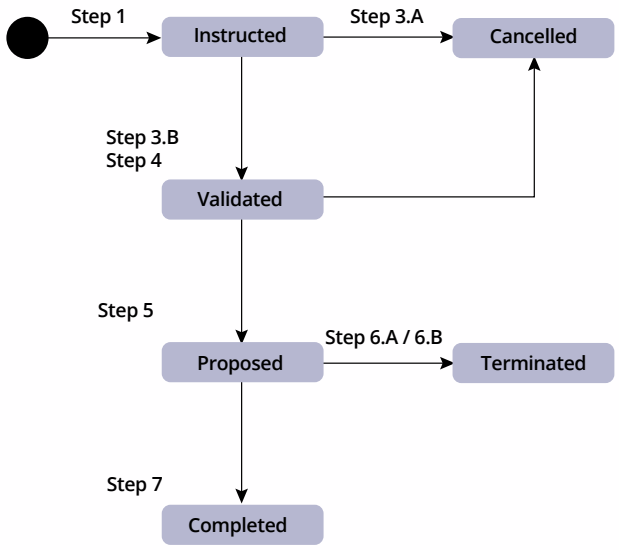
The registry stores the history of the statuses and status changes of each transaction in the audit trail. Figure 15 shows these status changes for an internal transfer based on the workflow proposed in appendix F.

TABLE 20: **Accounting for Internal Transfers**

	Transferor's account		Transferee's account	
	Debit	**Credit**	**Debit**	**Credit**
Inventory of the account before the transfer		Quantity: Q1 Unit type: T		Quantity: Q2 Unit type: T
Accounting scheme for the transfer of "q" units of "T" type	Quantity: q Unit type: T Serial numbers: from x to y	→		Quantity: q Unit type: T Serial numbers: from x to y
Inventory of the account after the transfer		Quantity: Q1-q Unit type: T		Quantity: Q2+q Unit type: T

Note: T/P/L/t = characteristics of the unit; T = type; P = Project; L = Label; t = validity period or vintage.

FIGURE 15: **Internal Transfer—Transaction Statuses and Status Changes**



3.9.3. Options and variants

A transferor's security and accountability measures can include:

- Prior to debiting the transferor's account, various security measures may be considered to limit the risk of mistaken or fraudulent transfers.
- These can range from an "out of band" notification (by sending an SMS) to the requirement of an explicit confirmation. The latter may involve reentering the user's password, approval by an authorized representative—other than the one who instructed the internal transfer (the four-eye principle)—or entry of a confirmation code from a security token or sent automatically by the registry by SMS to one of the authorized representatives associated with the transferor's account.

Other options, prior to notifying the transferee, include:

- Automatic cancellation of any internal transfer entered but not approved, after a defined time lapse;
- A cancellation period offered to the transferor's authorized representatives;

Transferee accountability measures include:

- The registry may automatically notify the transferee of any internal transfer credited to one of its accounts. These notifications can be issued by email, or "out of band" via SMS for enhanced security;
- An explicit approval by the transferee may also be required for any transfer. After a certain time lapse, a transfer received but not expressly approved by the transferee may be automatically approved or rejected, depending on the design chosen by the designers of the registry's computer system.

These measures, which are not mutually exclusive, not only serve to enhance system security, but also explicitly engage the responsibility of the transferor and the beneficiary in recognition of an internal transfer. By doing so, the outcomes expected are to protect "good faith buyers" against the risk of claims being made against them for units they hold, and to reinforce the reliability of the registry as a proof of ownership of units.

3.10. External transfers

An external transfer is an operation initiated by the transferor, to transfer units to a third party (the transferee), whose account is held in another registry. In the simplest case, both accounts are open and the transfer is accounted for. However, at the time the transfer is initiated, the transferring registry has no knowledge of the existence, or the status, of the transferee's account in the receiving registry. Therefore, a dialogue is required between registries for the completion of the transfer in both registries.

An external transfer deducts units from the balance of the transferor's account in order to add the same quantity to the balance of the transferee's account held in the receiving registry. The units transferred retain their unique serial number. Each registry automatically notifies the authorized users linked to the account it manages.

Two different IT architectures may be used to link registries: (i) each registry is linked to every other registry (peer-to-peer, as was initially the case of the VCS registry system) and (ii) each registry is linked to a central communication hub (as is the case via the ITL for Kyoto Protocol national registries, and via the European Union Transaction Log for EU ETS registries). More details are presented in Table 11.

Only the central hub approach will be referred to in the next section.

3.10.1. Accounting for external transfers made through a central hub

When a central hub is in place, each registry communicates with the hub and no registries are in direct communication with another registry. Table 21 represents the accounting model for such an external transfer.

TABLE 21: **Accounting for External Transfers**

	Transferring registry		Receiving registry	
	Transferor account		*Account of the transferee*	
	Debit	**Credit**	**Debit**	**Credit**
Account balance before transfer		Quantity Q1 T/P/L/t		Quantity Q2 T/P/L/t
Accounting model of a transfer of "q" units of type "T"	Quantity: q T/P/L/t Serial numbers: from x to y	→		Quantity: q T/P/L/t Serial numbers: from x to y
Account balance after transfer		Quantity: Q1-q T/P/L/t		Quantity: Q2+q T/P/L/t

Note: T/P/L/t = characteristics of the unit; T = type; P = Project; L = Label; t = validity period or vintage.

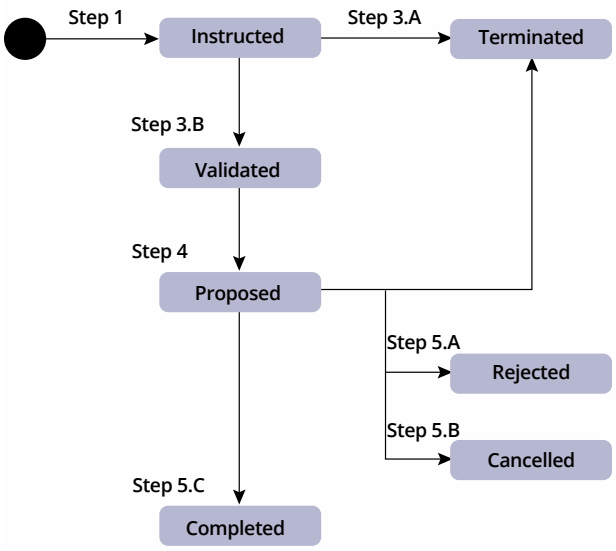
Once the transfer is completed, the units associated with the serial numbers transferred are no longer held in the transferring registry, but in the receiving registry.

The diagram shown in appendix G proposes a workflow for external transfers.

3.10.2. Statuses and status changes in case of an external transfer

The registry keeps an audit trail of the statuses and status changes of all transactions. Figure 16 shows the status changes for an external transfer according to the workflow proposed in appendix G.

FIGURE 16: **External Transfer—Transaction Status and Status Changes**



3.10.3. Options and variants

- Possible security measures and responsibilities of the transferor:
  - Before debiting the transferor's account, various security measures can be implemented to limit the risk of operational error or fraud. These measures can vary from a simple "out of band" notification (sending an SMS) to an explicit confirmation. The latter may involve reentering the password, validation by an authorized representative distinct from the initiator of the internal transfer (four-eyes), or entering a confirmation code received by SMS or a security token by one of the authorized representatives.
- Other options can be implemented before the transfer is proposed to the receiving registry:
  - Automatic cancellation of any internal transfer entered but not validated before a certain configurable time lapse;
  - Retraction period offered to the authorized representatives of the transferor's account prior to proposing the transfer to the receiving registry.
- Measures to ensure accountability of the beneficiary:
  - The registry can automatically notify the transferee of any transfer credited to one of his accounts. These notifications can be effected by e-mail or "out of band" via SMS, for increased security.
  - Moreover, an explicit validation by the transferee can be requested for any transfer. Or, after a cer-

tain time lapse, a transfer received but not explicitly validated by the transferee can be automatically rejected.

- A pre-approved remote account list can also be implemented at the account level (by transferring account) or at the registry level.

As above, these measures are not only designed to reinforce the security of the system, but also to reinforce and make explicit the responsibility of both the transferor and the transferee in the completion of transfers.

3.11. Cancellation

Cancellation, in the wider sense, represents the last stage in the life cycle of a unit. The triggering event may be a manual instruction to cancel (or delete, withdraw, retire, surrender, restitute…) units, initiated by an authorized representative to comply with the regulation (surrender units against verified emissions) or for voluntary offset, or a request from an authority (e.g., following the detection of overissuance). The triggering event may also be a planned event, such as the automatic cancellation of temporary or out-of-date units.

3.11.1. Accounting for unit cancellation

The cancellation will involve only one account holder: the transferor, the owner of the units to cancel. The registry allows the user to choose the units to cancel, by selecting the type of unit, the project, the label, and the period. The registry debits a quantity of units from the transferor's account, unless the status of the account prohibits this (e.g., account blocked or closed), and credits these units to the cancellation account, specific to various types of cancellation.

Opening different types of cancellation accounts allows for clearer accounting of different cancellation motives (voluntary cancellation, cancellation in accordance with regulation, cancellation following operational errors).

Once completed, a cancellation is definitive and irreversible: canceled units and their serial numbers can no longer change accounts. Canceled units retain their unique serial number. The registry automatically notifies authorized users linked to the transferor's account. Table 22 presents the accounting model for a cancellation.

FIGURE 17: **Cancellation—Transaction Status and Status Changes**

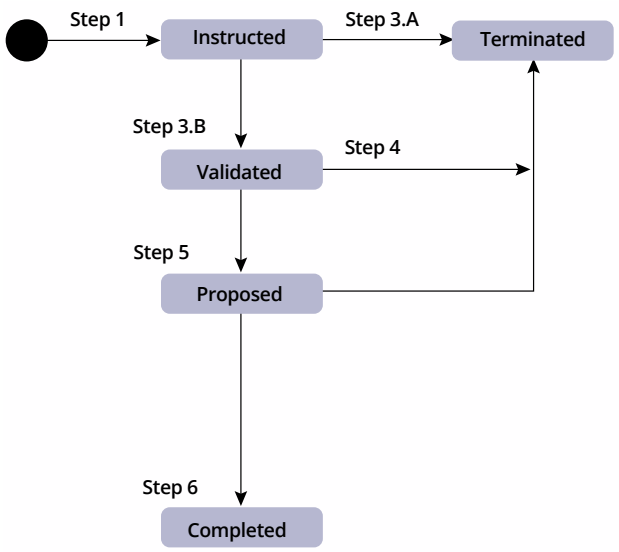


TABLE 22: **Accounting Model for a Cancellation**

	Transferor account		Cancellation account	
	Debit	**Credit**	**Debit**	**Credit**
Account balance before transfer		Quantity Q1 Type of unit: T		Quantity Q2 T/P/L/t
Accounting model for cancellation of "q" units of type "T"	Quantity: q Unit type: T Serial numbers: from x to y	→		Quantity: q Unit type: T Serial numbers: from x to y
Account balance after transfer		Quantity: Q1-q Unit type: T		Quantity: Q2+q T/P/L/t

Note: T/P/L/t = characteristics of the unit; T = type; P = Project; L = Label; t = validity period or vintage.

The diagram shown in appendix H proposes a workflow for a cancellation, including optional security measures. These options and their variants are subsequently discussed.

3.11.2. Statuses and status changes in case of a cancellation

The registry keeps an audit trail of statuses and status changes of all transactions. Figure 17 shows the status changes for a cancellation according to the workflow proposed in appendix H.

3.11.3. Options and variants

Possible security measures and responsibilities of the transferor:

- Security measures can vary from a simple notification by e-mail or "out of band" (by sending an SMS) to the requirement of an explicit additional confirmation such as reentering a password, validation by an authorized representative distinct from the initiator of the cancellation (four-eye principle), or entering a confirmation code received by SMS or a security token by one of the authorized representatives.

Automatic termination of any transaction entered but not validated after a certain configurable time lapse can also be implemented.

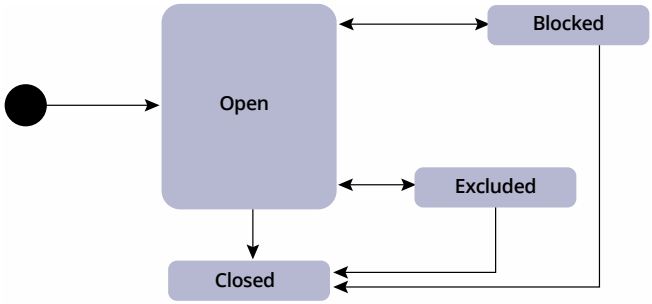
3.12. Administrative events

The registry offers several non-accounting functions to manage administrative events. These functions are made available only to users in charge of registry administration. The following sections propose functional specifications for generic administrative events required in any registry to be adapted to any specific circumstances.

3.12.1. Managing accounts

The registry administrator can open (or refuse to open) an account, modify the status of an account, authorize or revoke user account authorization, and close an account.

FIGURE 18: **Account Statuses and Change of Status**



Closure is permanent (no account may be opened in the future using the same account identifier as a formerly closed account).

An account may show the following statuses: open, blocked, or closed (Figure 18). In the case of an ETS, the status "excluded" can also be used, which embodies an account initially—but no longer—committed to regulatory compliance obligations. By way of example, a market compliance participant suffering from a significant economic downturn shows GHG emission levels dropping below the regulatory threshold for being obliged to participate in the market mechanism. The account would remain open, but is no longer subject to compliance calculations.

A blocked account can no longer carry out operations, except when depending on regulation in force, to comply with regulatory obligations. A closed account can no longer be debited or credited, shows a zero balance, and cannot be reopened.

3.12.2. User management

Registry users are natural persons who represent the account holder and are authorized to carry out transactions on the account. These "authorized representatives" have authorization profiles that give them more extensive or fewer rights on a given account such as:

- Read only;
- Consultation and entering transactions; or
- Consultation, entering, and validating transactions.

The registry administrator, subsequent to document control ("KYC checks"), may attribute an authorization profile to a user. Within the scope of the periodical review of user documentation, the registry administrator will update information relative to authorized representatives, including their profile and the list of accounts to which they are attached.

It should be noted that certain users may be mandated to manage the accounts of several account holders and may have different privileges for each account. The registry will therefore manage multiple authorizations for a single authenticated user.

3.12.3. Management of GHG verified emissions

In the case of an ETS, the registry administrator receives and enters manually (or imports by file) the verified emissions of each compliance market participant. The registry is therefore able to compare the verified emissions of a compliance market participant with the amount of units surrendered for the same year, and thus can:

- Produce a conformity report for each compliance participant ("compliance figures");
- Produce a report of compliant and noncompliant participants with the compliance shortfall (for the latter); and
- Alert the relevant authorized representatives (users) of the compliance participant during surrender transaction entry, in the case of either a shortfall or an excess in surrendered units.

3.12.4. Management of allocation tables

In the case of an ETS, the registry administrator can enter or import a file, listing the quotas to be allocated to each installation (to be credited to each installation's account). The registry offers a function that enables entry or import of this "allocation table." The registry may also, upon instruction received from the regulator, execute an allocation process that consists of a set of internal transfers debiting the issuance account and crediting installations' accounts.

3.13. Traceability: audit logs, notifications, and messages

The registry must retain, with no time limit,[55] all transactions and administrative events executed, with all their characteristics, at each stage of the workflow. In particular, records will be kept for the following data: who entered them and at what time, who validated them, values, notifications issued, and whom these notifications were sent to and through which media. Some particularly sensitive data require the archival of value change history, the date of each value change, the identity of each user who made a change, and the previous value.

This applies in particular to the following:

- Verified emissions of an installation and, more generally, the level of obligation of a compliance participant or a liable party (in the case of an ETS);
- Account status and account balances;
- The status of transactions;
- The type of account;
- The user authorization profile associated with each account to which the user is authorized.

More in general, the registry update logs, which record all processes executed and all data changes.

55 Unless otherwise specified by regulations in force.

3.14. Main reports produced by the registry

The registry should generate a set of reports for users, and provide the registry administrator with a catalogue of ad hoc, predefined, and/or configurable queries.

If the registry is to be developed from scratch, the reports have to be specified in a very detailed manner. An example of such a specification for registry reports can be found in UNFCCC Conference of the Parties (COP) decision 13/CMP.1[56]

3.14.1. Reports to account holders (nonmodifiable)

The following reports can be generated:

- **Transaction notification:** made available to users authorized on both accounts affected by the transaction. It shows the characteristics of the transaction reported (date, amount, accounts, unit types, and serial numbers);
- **Account balance on date:** shows the balance of an account, split by unit type;
- **History of "end of month" account balances between two dates:** shows a table listing balances by unit type, on a given account;
- **History of transactions between two dates:** shows a table listing all transactions completed on a given account;
- **Transaction status change history:** shows a table listing all status changes for a given transaction.

3.14.2. Library of predefined queries

The registry administrator may filter the database using queries. These queries should be developed in such a way that the registry administrator does not require the intervention of IT personnel. Queries can be run on a copy of the database, so that the registry IT performances will not be altered. To that end, a library of queries could be developed, each with its title, delivery dates, and a comment that describes the result. The result of the query is generally downloadable in CSV format.

Some of the common queries that should be developed are the following:

56 See UNFCCC website: http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=23.

- **List of users** and all their attributes: identifier, title, name, first name, address, login, cell phone number, e-mail, fax number, identifier and title of authorization profile, and identifier and business name of employer.
- **List of accounts** and all their attributes: identifier, designation, type of account, status of accounts, identifier and business name of account holder, identifier and business name of lead manager, identifier and business name of the authorized representative, identifier, name and first name of each user, user rights on the account (RAA, RA, Auditor), and account balance on query date for each delivery year.
- **List of account holders** and all their attributes: identifier, identifier of contract with registry administrator, contract date of effect, contract end date, login, and account holder business name.
- **List of blocks of serial numbers held** by year of issuance, site, credit account on which the blocks are held on the query date, label, vintage or year of issuance, and type of unit.
- **Unit block history query**. For an input unit serial number (or range), show the full history of the unit block from issuance through current time.
- **List of transactions** with all attributes, notably those reported on the transaction notification.
- **Configuration tables:** table of correspondence between functions and profiles; and list of accounting schemes by type of operation and all other exports of IT tables.

4. Technical Specifications

This chapter refers to the contract holder and the competent authority. The "contract holder" is defined as the supplier appointed to provide registry services. The "competent authority" is defined as the entity contracting with the "contract holder" (e.g., the regulator or the registry administrator).

The chapter may be used as a technical guide—it gives instructions for specifying security, performance, and other technical IT requirements. However, it is assumed that each competent authority will adapt the following proposals to fit their specific regulation, IT security strategy requirements, and other specificities.

The security measures applied to production data similarly apply to archived data.

4.1. Technical requirements

4.1.1. Location of registry data hosting

The contact person responsible for service and data hosting and for the designation of the domain name (the contract holder, the competent authority, or another entity) should be specified. Restrictions on the location of data centers and the conditions required to change the data center during the life of the contract should be detailed.

4.1.2. Online access to registry services

All users must be able to securely access the registry by Internet. To ensure access to the registry is duly protected and reserved to authorized users, specific requirements may be implemented such as the requirement to secure https protocol on port 443 (with robust encryption algorithms: SSLv3/TLSv1 mandatory) and mandatory strong authentication for all users.

Other measures may be required, such as limiting access to the registry to access via a standard Internet browser (i.e., a "thin client"). In this case, clarifying which versions of the main internet navigators must be fully supported by the registry may prove useful in limiting the scope of maintenance and testing.

To ensure compatibility of the registry provided by the contract holder, the computing environment for access to the registry by the registry administrator should be described, including the following details:

- Type of workstation and operating system (OS);
- Browser(s) used
- Notification period required by the contract holder before any change is made to this environment;
- Mode of access to the Internet: network and security equipment, mandatory servers (proxies);
- Requirements for functional tests of user technologies in the registry environment.

Depending on the competent authority's specific requirements, including requirements derived from the regulation or from the IT security strategy, certain technologies may be banned; these should be listed explicitly. For example, registries requiring or using the following technologies might not be accepted:

- Installation and configuration of software on the workstation;
- Specific user rights on a workstation (e.g., administrator rights);

- Runtime execution environment such as Java (JRE: Java Runtime Environment), applets, ActiveX, "plug-ins" (Flash/Flex), with the exception of plug-ins for formatting and printing documents (such as Acrobat Reader);
- Personal Homepage Tools (PHP tools).

Finally, whether access from mobile devices is required or accepted should be specified.

4.1.3. Documentation

Obligations should be imposed on the contract holder regarding the frequency with which documentation is updated with the competent authority. Key documentation includes architecture documentation and production documentation, which cover all hosting solutions.

The *architecture documentation* describes the computing hardware, the software used and its versions, data flows and volumes, implemented redundancy, and the environment and hosting infrastructure that achieve the levels of service expected. It should also describe the mechanisms implemented to guarantee AICT (Availability, Integrity, Confidentiality, Traceability) service levels and all security requirements, including compliance with an industry security standard (e.g., ISO 2700x).

The *production documentation* describes backup plans, data purging and archiving processes, monitoring and internal escalation of incidents, and escalation procedures to the competent authority in case of crisis.

4.1.4. Environment and production implementation process

The following procedures are recommended at this stage:

- Detail expectations regarding accesses to the various computing environments required: training environment, test environment, preproduction environment, and production environment.
- Stipulate that any IT release must pass through the test environment and requires prior, explicit approval from the application owner, to move into production.
- Stipulate whether "volume tests" (i.e., benchmark) are required with real-life data. Where real-life data are required, it is advisable to clarify whether those data should be encrypted.
- Indicate whether a distinct backup site is required and, if so, clarify whether the following requirements should be met:
  - Synchronization of data in real-time and the guarantee that no information will be lost in the case of failure of the main hosted site;
  - A test of the registry backup, before commissioning the registry, with a test report submitted to the competent authority.

4.1.5. Registry launch phase

The tests required for commissioning the registry should be specified in detail, as well as the timescale required to correct any defects detected, against the general functional specifications.

The warranty period after commissioning (launching) of the registry, during which defects will be corrected, should also be specified.

4.1.6. Registry availability

The following aspects regarding the registry's availability should be clarified:

- The working hours during which the registry will be available to users; distinguish access by the registry administrator from that of other users, as necessary. Determine if releases of functionalities will occur during or outside these working hours;
- The notification period for any requests for availability outside these working hours;
- The conditions that the registry must adhere to, to be considered effectively available;
- The effective availability rate required for the registry, detailing the formula used to calculate this service level indicator;
- The Maximum Tolerable Period of Disruption (MTPOD) during working hours, in number of consecutive hours.

The reliability of the registry requires that the Recovery Point Objective (Maximum Acceptable Data Loss rate) be equal to zero.

4.1.7. Data archiving

Detailed rules should be specified for online accessing of archive data by the registry administrator.

4.1.8. Performance

Performance requirements refer to data storage volume requirements, system access volume requirements, system operation time frame requirements, and system reliability requirements:

- **Data storage volume** requirements refer to the required data storage capacity of the system;
- **System operation time frame** requirements refer to the required system response speed;
- **System access volume** requirements refer to the access volume requirement of the system;
- **System reliability** requirements refer to the reliability of the system.

Table 23 sets out in detail how to define the performance requirements.

In addition to those set out in Table 24, the following performance indicators should be defined:

- Measured availability rate of registry functions;
- CPU usage rate;
- Number of inputs/outputs;
- Bandwidth used;
- Memory capacity used;
- Volumes and frequency of transactions, in a day and over the course of a year;
- Measure of average, minimum, and maximum response time over the period of the report.

4.1.9. Data exchange between the registry and other information systems

Information systems with which the registry will exchange data should be listed in the "preliminary considerations" section. Beyond preliminary considerations, the technical specifications should further specify the format and communication protocol applicable to these data exchanges.

If the registry exchanges files via the Internet, a file server should be used. Detailed requirements should be provided on data encryption of any data exchange, for example, the use of SFTP secure protocol (SSH File Transfer Protocol) and encryption and authentication for interconnected systems. The security and confidentiality requirements applicable to the registry must also apply to the data exchange folders. Finally, the list of files exchanged with the registry must be included in monitoring reports produced by the contract holder.

If the registry is expected to support application programming interfaces (APIs) for consumption by other systems (i.e., for either pushing data to the registry or querying data from the registry), these APIs should be explicitly defined. APIs may be used for:

- Transaction message data exchange;
- Reconciliation with transaction hub;
- Receiving auction results or allocation plans;
- Synchronizing with IdAM (Identify and Access Management system)/SSO (Single Sign-On) for authentication;
- Receive issuance instructions;

TABLE 23: **Procedures for Determining Performance Requirements**

Performance requirement type	Performance requirement determination procedure

Data storage volume requirement	• Estimate the annual volume of data expected regarding:
	  • Compliance and voluntary participants information;
	  • Users information;
	  • Unit management (number of transactions, including all transaction types and number of units, including all unit types);
	  • Number of other operations to be managed each year such as compliance management by the registry administrator.
	• Estimate the data volume of audit logs required to store the volumes mentioned above in the registry system.
	• Specify the amount of peaks in volume of data expected within a year (e.g., peak in transaction volumes expected close to regulatory issuance or retirement milestones).

System access volume requirements	• Determine the peak user load or the maximum concurrent user load, which is directly related to the consumption of system resources: period of concern, total number of user sessions, and average length of user session.
System operation response time requirements	• Determine the response time required and the longest response time accepted, under average system access volume for transactions, administrative events, and parameterization and configuration functions.
System reliability requirements	• Determine when the system must be operating for the users' access, and when the system can be upgraded.

TABLE 24: **Examples of Stakeholders' Concerns**

Stakeholders	Examples of concerns
Competent authorities	Actions taken by registry administrator • Fraudulent activities, including theft of units; • Conflict of interests; • Operational errors. Usurpation of administrators' identity: • Fraudulent issuance or transfers (theft of units); • User information theft; • Account information theft; • Compliance information theft; • Confidential information theft or disclosure; • Key system information modified. Others: • Mismatch of accounting information between local registry and external registries; • Mismatch of accounting information between local registry and third-party platforms; • System data losses.
Market participants	• Account representative operational errors. • Account representative authentication information theft; • Ditto competent authorities.

TABLE 25: **Examples of Threats**

Threat type	Threats
Application-level threats	• Social attack (denial-of-service attack); • Deliberate fraud activities; • Operational errors; • Disasters.
Technical-level aspects	• Buffer overflow; • Malicious software; • Brute force password cracking; • Network monitoring; • SQL injection; • Cross Site Scripting (XSS); • Cross Site Request Forgery (CSRF); • Back doors; • System code theft attack; • Data file theft attack.

- Receive/query project data;
- Receive/query emissions data;
- Any other defined query.

4.2. Security requirements

The security requirements for a registry system can be defined in three steps: (i) a risk analysis, (ii) the identification of security goals, and (iii) the formulation of security measures. Risk analysis involves the identification of stakeholder concerns and the business, functional, and technical threats faced by each stakeholder. Security goal identification involves evaluating threat severity and determining which threats can be handled within the registry system. Security measures can be divided into application-level security measures and technical-level security measures.

A few typical stakeholder concerns are shown in Table 24 and possible threats are listed in Table 25. In addition, it is highly recommended to consult and address the OWASP (Open Web Application Security Project) list of 10 Most Critical Web Application Security Risks.[57] Examples of possible security measures to address those threats are presented in Table 26. Figure 19 illustrates the possible configuration of a secured network.

4.2.1. Integrity and confidentiality of data

The contract holder should be required to describe the computing and organizational facilities implemented to guarantee the integrity and confidentiality of data, the protection against disclosure, and the unauthorized modification of data, notably between users and between applications hosted on the same server. The contract holder should also be prohibited from using client or user data for any purpose other than those stipulated in the contract. In particular, data must not be transmitted to a third party for commercial ends.

4.2.2. Availability

The contract holder must adopt elaborate measures to protect against all types of denial-of-service (DOS) attacks.

4.2.3. Traceability

In addition to the traceability requirements described above, the contract holder should be required to ensure the traceability of all technical events such as:

- The connection and disconnection of technical accounts (e.g., system accounts, application accounts, and administrative accounts);

57 See https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project.

TABLE 26: **Examples of Security Measures**

Level at which security measures are applied	Security measures
Application security measures	• Two-factor authentication; • Four eyes principles; • E-mail notifications; • SMS/out-of-band notifications; • Trusted list of accounts; • Transfer time frame; • Reverse operations; • Allowance allocation time frame; • Credit issuance time frame; • Verification code; • Session time-out and password management measures.
Technical security measures	• Https protocol; • Encrypted data transmissions between system layers; • Multiple database access authorities; • Encrypted database authentication information; • Stored procedure-based database access; • Parameterized SQL; • Encrypted database; • Divide the network into multiple zones; • Use VPN to control network access; • Deploy modules of the system in servers of different zones in accordance with user authorities; • Close unnecessary ports through hardware firewall and software firewall; • IP access control through hardware firewall and software firewall; • Use IDS and IPS; • Use other network security hardware; • Use antivirus software; • Port access control on switches; • Point-to-point network service; • Hot backups; • Disaster recovery system.

- Actions carried out through technical accounts;
- All individual accesses to databases;
- Password changes on technical accounts;
- Creation, deletion, and modification of access rights to technical accounts.

The length of time that these elements will be held in archive by the contract holder should also be specified.

4.2.4. Authentication

Two authentication factors should be required: one related to something that the user ***knows*** (password, secret question) and one related to something that the user ***possesses*** (e.g., SMS, token, PKI certificate). Use of a password update service should also be required. This service should allow users to request the reinitialization of their personal password and immediately receive a request confirmation e-mail. The e-mail will contain an unblocking code (or one-time password) that allows the user to choose a new password once he connects again. A password policy must also be established, requiring that the password chosen should not be easy to guess and should be changed frequently.

4.2.5. Management of security incidents

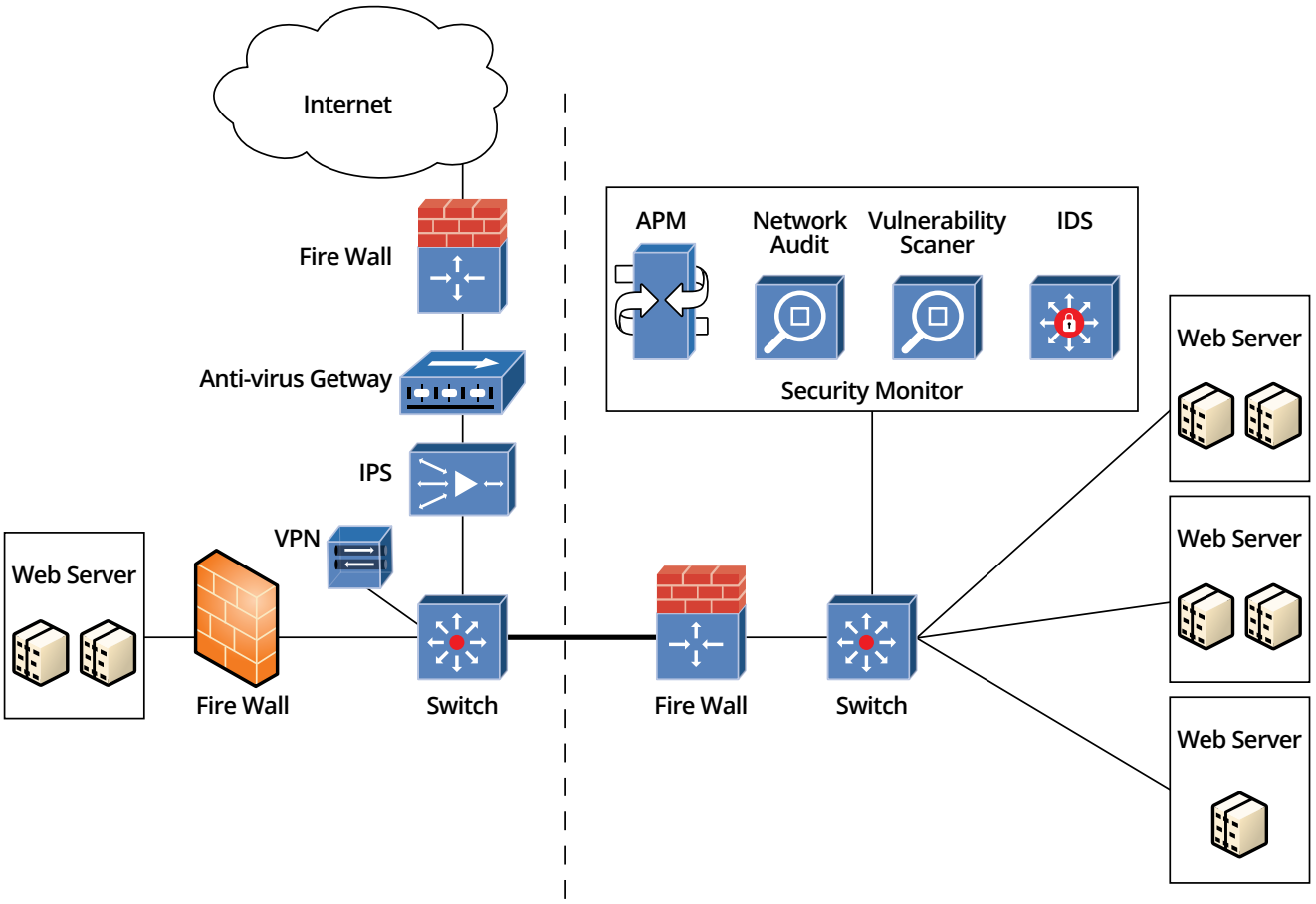
The contract holder should be required to implement security system and incident management procedures, including:

- Detection of security alerts;
- Keeping track of each incident until its effective closure;
- Implementing the recommendations made following a security incident;
- Informing immediately and coordinating with the competent authority, in the event of any major incident;
- Supplying a monthly dashboard reporting security incidents to the competent authority;
- Managing platform vulnerabilities and security patches made available by the software's editors.

4.2.6. Security audits

The contract holder should be required to describe the information system security strategy, such as the choice of standards adhered to, performance monitoring indicators, system availability, quality of service, and security architecture (e.g., firewalls, DMZ, application and data layer reporting, VPN, WAN/LAN, and redundancy of critical services).

FIGURE 19: **Example of Secured Network Deployment**



Note: IPS = Intrusion Prevention System; VPS = Virtual Private Server; APM = Application Performance Management; IDS = Intrusion Detection System.

The contract holder should authorize the competent authority to proceed with, or contract a third party to carry out, regular audits of the registry in order to:

- Ensure that practices adhere to the contract specifications and requirements of the general functional specifications;
- Ensure that the registry is not vulnerable to events that could affect the availability, integrity, confidentiality, and traceability of data;
- Ensure that recommendations from previous audits have been correctly implemented.

Audits may include configuration audits, intrusion tests, organizational audits, and physical audits on the service provider's site. They should be carried out before the commissioning of the registry to implement monitoring and control processes. Security and penetration tests should be performed before each production release of registry software. If releases are infrequent, security and penetration tests should be performed on at least an annual basis in recognition of the fact that security threats are constantly evolving.

5. Detailed Guidance on Registry Development from Scratch

Developing a registry from scratch requires more knowledge and experience with IT project management than other delivery models. This chapter provides further guidance for competent authorities opting for development from scratch.

Close cooperation between the regulator, the registry administrator, and the developers is critical. Business analysts/IT consultants are also key stakeholders in the process, and required to clarify and stabilize requirements. Developers meanwhile are responsible for producing detailed specifications and prototypes of the registry, and for ultimate registry delivery and maintenance.

The software should be designed in accordance with well-defined functional and technical specifications. The software design can be based on a six-step approach, involving participation of the registry owners, IT consultants, and developers. The suggested approach—consisting of six steps—is summarized in Table 27 and elaborated in the main text.

TABLE 27: **Steps Involved in the Design of Registry Software**

	Role		
Step	**Registry owner**	**Business analysts/IT consultants**	**Developers**
1. Visualize function requirements	• Express requirements • Validate the results produced by IT consultants and developers.	• Complement functional specifications with visualization requirements; • Manage the implementation project; • Test the result.	Implement visualized function design.
2. Design software architecture	• Test the registry IT delivered.	• Validate design, choices, and detailed technical specifications proposed by the developers. • Test the IT and manage the process for correcting bugs, prior to requesting registry owner testing.	Design overall software architecture in accordance with the software requirements.
3. Customize data exchange protocols			Design customized data exchange protocol in accordance with the relevant connectivity requirements.
4. Design the Database			Design database in accordance with the visualized system design and required data exchange protocols.
5. Choose software implementation technology			Choose software implementation according to the software requirements.
6. Produce the software design detailed specification			Produce software design specification in accordance with the software design.

Step 1: Visualize function requirements. The requirements of the system's functions should be visualized by implementing a demo of the system. The demo should show all user interfaces of the system and their transitions triggered by operations. Procedures for implementing a system demo are illustrated in Table 28.

TABLE 28: **Procedures for Implementing System Demo**

Task	Demo implementation procedure
Implement user interfaces of the system demo	• Design the style of the system user interfaces; • Assign user interfaces to each function; • Design tables associated with each user interface in accordance with function requirements; • Design objects triggered by each function of each user interface, in accordance with function requirements; • Design each notification that can be triggered on each user interface; • Implement the user interfaces.
Implement the transitions of user interfaces triggered by operations	• Design all transitions between user interfaces (triggering function and triggered user interface); • Implement the transition between user interfaces.
Consistent and reciprocal upgrade of system demo and functional specifications	• Modify the functional specifications of the software based on feedback received using the system demo; • Further modify the system demo in accordance with the modified functional specifications.

Step 2: Design the software architecture. The software architecture of an IT system includes the access mode, the layer arrangement, the modules in each layer and communication requirements between layers, the inner operational mechanism requirements of each layer, and the deployment requirements of the modules of each layer. The steps involved in designing the overall software architecture are illustrated in Table 29.

TABLE 29: **Procedure to Design Overall Software Architecture**

Task	Overall software architecture design procedure
System access mode	• Estimate the number of users of the system; • Choose between browser-based access mode (B/S) and dedicated client access mode (C/S) depending on the estimated number of users; • If external connections are required, choose access mode for data exchange interfaces.
Layer arrangements	• Arrange user interface layers in accordance with system access mode; • Arrange an application service layer to process requests received from user interface layers; • Arrange a database layer for the system to provide data storage and data operations.
Modules in each layer	• Arrange modules of user interface layers in accordance with the functions of the system; • Arrange modules of application service layer in accordance with the functions of the system; • Arrange modules of database layer in accordance with the functions of the system (stored procedures and functions).
Deployment requirements of the modules of each layer	• Determine the deployment requirements of the modules of each layer and each module in accordance with security requirements and performance requirements.
Inner operational mechanism requirements of each layer	• Determine the inner operational mechanism requirements of each layer in accordance with the performance requirements of the system.
Communication requirements between layers	• Determine requirements applicable to communications between the user interface layers and the application service layer, in accordance with system performance requirements, system security requirements, and modules deployment requirements; • Determine requirements applicable to communications between the application service layer and the database layer, in accordance with the security and performance requirements.

Step 3: Customize data exchange protocols. It may be necessary to customize a data exchange protocol, especially if the registry IT needs to connect to registries or other systems, without an existing data exchange protocol. Designing a customized data exchange protocol requires determining data exchange operations, designing data package format, and determining security measures for connectivity, as shown in Table 30.

TABLE 30: **Procedure for Designing a Customized Data Exchange Protocol**

Task	Data exchange protocol design procedure
Determine data exchange operations/ messages	• List operations and messages to be exchanged through the connection, including reversal of errors; • For each operation/message, describe the communication workflow; • Determine the constraints and requirements for each operation/message: frequency, timing, consistency checks, and criteria for rejection or repair.
Design data package format	• For each operation/message, list and describe format and values of associated data.
Determine security measures	• Determine connectivity architecture (central hub or peer- to-peer); • Determine reconciliation methods (check for inconsistencies, process to repair); • Determine application-level security measures (data encryption strategy); • Determine requirements related to hardware connectivity security (VPN, separate connection server, determined IP, determined port).

Step 4: Design the IT Database. The IT database must be designed on the basis of the software requirements and data exchange standards. Designing the IT database requires identifying the system's entities and the relations between them, and producing an entity-relationship chart.58 A possible procedure for designing the IT database is presented in Table 31.

58 Several methods and tools exist to establish entity-relationship models (e.g., Merise, Chen, Bachman, and UML).

TABLE 31: **Procedure for Designing Database**

Task	IT Database design procedure
Identify entities	• List and define the associated data (entities and their characteristics) for each of the following elements: • Accounts, account representatives, users, roles, and privileges; • Unit types; • Transaction types and transaction states; • Transaction logs and audit logs; • Registry reports, notifications, and compliance figures; • Registry connections; • Data required to parameterize and configure the registry; • Metadata.
Identify relations between entities	• Describe the relations between entities and the primary/foreign key used for each relation.
Represent entity-relations chart	• Establish a comprehensive entity-relationship chart of the IT database.

Step 5: Choose software technology. Software technology should be chosen based on a range of criteria—including reliability, maintenance, performance, development cost, technology constraints, security, and the ability to realize the software architecture needed. Table 33 suggests key points to consider in relation to those criteria.

TABLE 32: **Considerations for Choosing Software Technology**

Criteria	Key aspects to take into account
Reliability	• Operational reliability requirements • Serviceability requirements
Performance	• Performance requirements
Development cost	• Budget
Technology constraints	• Compatibility of the chosen technology with registry IT environment, OSs, and other systems to be linked with the registry
Security	• Ability to address the security threats identified
Potential to realize software architecture	• Compatibility with the registry system access mode • Compatibility with the inner operational mechanism requirements of the registry system

The main technologies for implementing a registry system are C/C++, Java EE (Java Enterprise Edition), and Dot Net. PHP is another server-side scripting language designed for web development. Hence, in principle it is also a technology suitable for implementing a registry system.

However, as PHP is an interpreted language, it may raise additional concerns if used for a registry system. The source code of PHP interpreters can be downloaded from the Internet and, as a result, the security of the system implemented through PHP may be compromised relatively easily. In addition, as most of the popular PHP solutions execute PHP script directly, without first compiling the scripts, an attacker can easily access and read the source code of the system implemented by PHP directly. By doing so, an attacker might be able to breach the system's security measures. Moreover, attackers can leverage the direct interpretation of script source code to inject malicious code into the system server to breach the system's security; attackers often use this method. In addition to these security considerations, some limitations in the implementation of PHP interpreters result in PHP's performance being inferior to that of other technologies, such as Java EE or Dot Net.

In view of these security and performance considerations, PHP is not recommended for the implementation of a registry system. The registry technical specifications can make sure that PHP will not be part of any offer received. The advantages and disadvantages of three suitable technologies are listed in Table 33.

In terms of performance, C/C++ is more advanced than Java EE technology and Dot Net technology. Conceptually, the performance (computational speed) of a software system implemented using C/C++ will be twice the performance of the same software system implemented using a technology based on a virtual machine. However, the cost of implementing a registry system using the C/C++ technology is much higher, due to both its lengthier development process (higher number of workdays required) and higher personnel cost (C/C++ programmers). In addition, particularly complex IT development procedures are required to ensure the robustness of a registry system implemented using C/C++ technology. The maintenance and upgrade of a registry system implemented through C/C++ technology is also difficult, in particular for a browser/server (B/S)-based registry system. More specifically, the cost of implementing a registry system using Java EE technology will be no more than half the cost of implementing the same registry system using C/C++ technology. Lastly, implementing a registry system using C/C++ requires that the OS be determined before any development can start.

Although the performance of a software system implemented using Java EE is inferior to the performance of the same software system implemented with C/C++, the added advantage of supporting the development of a B/S-based

TABLE 33: **Comparison of Three Technologies**

Criteria	C/C++	Java EE	Dot Net
Reliability	• Difficult to ensure the reliability of the system • Difficult to ensure the serviceability of the system	• Easy to ensure the reliability of the system • Easy to ensure the serviceability of the system	• Easy to ensure the reliability of the system • Easy to ensure the serviceability of the system
Performance	• High system operation performance	• Relatively low system operation performance	• Relatively low system operation performance
Development cost and timeline	• High development cost, high development timeline	• Relatively low development cost and timeline	• Relatively low development cost and timeline
Technology constraints	• OS-dependent	• OS-independent	• OS-dependent
Security	• Capable of implementing security mechanisms • Deployed code is difficult to analyze	• Capable of implementing security mechanisms • Deployed code is relatively easy to analyze	• Capable of implementing security mechanisms • Deployed code is relatively easy to analyze
Potential to realize software architecture	• Difficult to implement browser-/server-based system • Capable of implementing any inner operational mechanism	• Capable of implementing browser-/server-based system • Advanced inner operational mechanism provided by a virtual machine	• Capable of implementing browser-/server-based system • Advanced inner operational mechanism provided by a virtual machine

registry system by leveraging an application server for Java EE technology more than make up for its inferior performance: Java EE is thus preferable to C/CC++.

Leveraging a high-performance application server, a high-performance OS, and high-performance hardware can, to a certain degree, mitigate the drawbacks inherent in (relatively) poor performance. In fact, a properly equipped and configured registry system implemented using Java EE can duly support 300 to 400 concurrent system accesses, which is suitable for the operation of a market mechanism with the scale of the EU ETS.

Therefore, Java EE technology is preferable for implementing a registry system to C/C++ technology in many respects: costs, timeline, and responsiveness to changes.

As it is based on a virtual machine, Dot Net compared with C/C++ shows the same advantages and disadvantages as the Java EE technology in terms of performance, development complexity, development costs, and timeline. In a registry system implemented using Dot Net technology, these factors are similar to those of the same registry system implemented with Java EE technology. However, since the ASP.net technology of Dot Net technology for implementing B/S- based systems is only practically available on the ISS application server for the Windows OS, the use of Dot Net to implement a registry system is constrained.

The selection of a specific technology for implementing a registry system should be based on the software requirements of the registry system and the scale of the market mechanism. If the registry system has to be able to support a market mechanism comparable to a large-scale stock market, such as the Chinese stock market (20–30 million transactions per day), the C/C++ technology should be employed. On the other hand, for a market mechanism with a scale similar to the EU ETS (maximum of 5,000 transactions per day), the Java EE and Dot Net technologies are the appropriate choices.

Before opting for Java EE or Dot Net technology, the OS used for the registry system's deployment should be considered. If the Windows Server cannot be used for this purpose, it is not practical to select Dot Net technology. If the Windows OS is to be used for deploying the registry system, it is preferable to select Dot Net technology because of the high compatibility of the IIS application server with the Windows OS.

The costs and delays associated with C/C++ technologies are twice as high as those associated with Java EE or Dot Net. Moreover, experience shows that, for most registries, the relative disadvantage of Java EE or Dot Net in terms of performance is not significant and can be mitigated through technical optimizations. Between Java EE and Dot Net, the latter shows higher compatibility with Windows Server OSs. However, if Dot Net is chosen, requirements will have to be imposed to ensure that the registry is also fully operational for users of non-Microsoft browsers.

Step 6: Formulate the detailed specifications for the software's design. Table 34 shows how the detailed software specifications of a registry system can be structured. The information should reflect all previous decisions in this trajectory and be included in the reference documents specifying the IT registry requirements.

TABLE 34: **Content of Software Design Specification**

Aspect	Content
Visualized function design	• Inventory of all the user interfaces; • Description of the objects contained in the user interfaces; • Description of transitions between the user interfaces; • A demo of the system.
Overall software architecture	• Description of system access mode; • A list of layers of the system; • A list of modules in each layer; • Requirements applicable to the deployment of modules; • Description of inner operational mechanism of the system; • Requirements applicable to communications between layers; • A graph showing the sketch of overall software architecture.
Data exchange protocol	• Specifications related to existing data exchange protocols; • Detailed specifications of each customized data exchange protocol and any required APIs.
Database design	• Inventory of entities of the system; • Detailed description of relations between entities; • Detailed description of tables associated with each entity; • A comprehensive entity-relationship chart.
Software implementation technology	• Description of software implementation technology.

6. Recommendations and Guidance on the Design and Procurement of a Registry IT System

- Assess risks and volume, and determine security measures and performance requirements.
- An RFI to improve knowledge of existing offers and potential providers, but also to assess which solutions are available in practice in a given context.
- Decide on:
  - The scope and nature of the service sought;
  - Procurement options (i.e., shared IT platform, SaaS, adaptation of an existing solution, or development from scratch);
  - Accounting model for imported/exported units, considering reversibility and the need for credibility regarding the double-counting issue;
  - Registry connectivity;
  - Organization of the IT project, considering the option of hiring an independent business analyst/IT consultant.
- Draft functional specifications:
  - Translate the regulation into business rules;
  - Inventory the data related to users, accounts, transactions, and units;
  - Describe the workflow related to each type of transaction;
  - List any other function required and define user authorization profiles;
  - Describe reports and notifications;
  - Describe the web pages of the registry's website.
- Draft technical specifications, including:
  - Technical architecture, including hosting and archiving;
  - IT security requirements, including authentication, confidentiality, traceability, and security audits;
  - IT performance requirements and a description of IT environment and deployment OS in use;
  - IT technologies preferred/banned.
- Issue an RFP.

If the registry is developed from scratch, additional time and effort will be required to develop the functional and technical specifications, and the final IT reference documents will accordingly be more comprehensive and detailed.

PART V. Registry Requirements for Emerging Market Mechanisms and Results-Based Climate Finance Programs: The Example of REDD+

1. Introduction

This part considers how emerging market mechanisms and the market-based concept of Results-Based Climate Finance (RBCF) Programs (i.e., those that generate transferable carbon units) could fit in the context of the flexibility mechanisms outlined in the Paris Agreement, and discusses potential registry requirements associated with these arrangements. As REDD+ is a relatively advanced example of an emerging market mechanism (in theory, if not in practice) and vehicle for RBCF, this part focuses on the registry requirements specific to REDD+.

Market-based instruments for environmental protection have been in place in a small number of developing countries for some years, the Payment for Ecosystem Services (PES) programs in Costa Rica and Vietnam being two notable examples. Some developing countries are currently in the process of designing carbon taxes and/or domestic ETSs as market instruments to tackle domestic emissions.

At the same time, a number of market mechanisms premised on the provision of international financial support for domestic mitigation measures are under development. Two examples of this are sectoral crediting and compensated Nationally Appropriate Mitigation Actions (NAMAs). *Sectoral crediting* refers to the process by which carbon units are issued to a sector as a whole, rather than to individual projects or programs, for reducing emissions against a baseline. The market-based concept of REDD+, according to which a jurisdiction can generate carbon units for reducing forest-based emissions across that particular jurisdiction, is an example of sectoral crediting.

NAMAs are a policy tool that emerged from the United Nations Framework Convention on Climate Change (UNFCCC) process, through which developing countries define the mitigation actions for which they seek financial, technical, and capacity-building support from developed countries. Through the NAMA process, a number of countries, including Mexico and Colombia, have begun to explore the possibility of developing "credited NAMAs," that is, NAMAs for which carbon units are issued in exchange for investment. Unlike sectoral crediting, credited NAMAs would generate carbon units for emission reductions from specific projects, rather than measured across an entire sector.

At the international level, the recently negotiated text of the Paris Agreement leaves the door open to market mechanisms, outlining three flexibility mechanisms according to which Parties can meet their national targets (expressed in Nationally Determined Contributions or NDCs). These mechanisms are: (i) the formulation of joint NDCs; (ii) the exchange between Parties of "internationally transferred mitigation outcomes" (ITMOs); and (iii) the generation of emission reductions by authorized public and private entities resulting from activities that contribute to both mitigation and sustainable development.

As the rules, modalities of and procedures for these flexibility mechanisms are currently being developed by the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) for consideration and adoption by the UNFCCC's Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement, it remains to be seen to which extent these flexibility mechanisms will include elements or allow for the use of not fully developed market-based mechanisms, and much of the detail remains to be determined, in particular regarding REDD+. However, assuming that the use of marked-based and RBCF approaches will be allowed—given the work already underway with emerging market instruments in developing countries as well as results-based approaches to climate finance under these flexibility mechanisms—it is useful to consider how the flexibility mechanisms of the Paris Agreement could accommodate these different approaches, and what the registry implications would be under the various scenarios. It is also worth considering the registry requirements associated with specific emerging market mechanisms.

Alongside the development of market-based approaches, a number of developed countries have set up or are funding *results*-based payment approaches to climate finance. RBCF programs are financing tools that condition payments on the achievement of particular results, and typically describe donor country aid programs that pay for outcomes rather than inputs such as capacity building and action plan development. Numerous bilateral and multilateral RBCF

programs have emerged over the last decade, largely in the REDD+ context, from Norway's International Climate Forest Initiative (NICFI) to the Forest Carbon Partnership Facility's Carbon Fund. Recently, the Green Climate Fund has adopted a logic model for results-based REDD+. Article 5 of the Paris Agreement acknowledges RBCF as an approach to supporting the implementation of REDD+.

Although RBCF programs are, in some cases, being introduced as a stepping stone to potential market-based mechanisms, they do not necessarily lead to the generation of a transferable carbon unit, and thus do not require an emissions trading registry. All RBCF programs which generate transferable carbon units, however, need to take measures to avoid instances of double counting including developing a registry to issue, transfer, and retire carbon units.

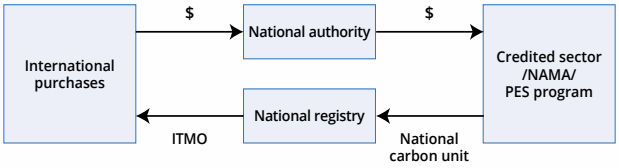
2. Registry Implications of Emerging Market Mechanisms and Results-Based Climate Finance Programs under The Paris Agreement

At first glance, it seems relatively straightforward how sectoral crediting and credited NAMAs could align with the transfer of ITMOs under the Paris Agreement (as illustrated in Figure 20); crediting by the host country could take the form of ITMOs, deducted from the host country's NDC accounting and added to the donor/purchaser's NDC accounting; for subnational crediting (e.g., jurisdictional REDD+ programs), any carbon unit transfers would need the consent of the country in order to qualify as ITMOs. This scenario is illustrated in Figure 20, and could equally apply to international contributions toward domestic PES programs. If an RBCF program requires the exchange of a carbon unit from host country to donor country, the same setup would be sufficient. In the case of an RBCF program where the donor country "cancels" the carbon unit,[59] the registry of the donor country/institution would need an account in which to cancel carbon units not counted toward an NDC.

However, a number of questions would need to be resolved. For one, in the case that the credited sector (e.g., forestry) generates emission reductions, but the country does not meet its NDC or fails to reduce emissions beneath its baseline because of high emissions elsewhere (e.g., in the transport sector), would the host country still generate ITMOs

59 The rationale of this approach would be to increase the ambition of the collective NDC "cap" by reducing the availability of emission reductions for use as ITMOs.

FIGURE 20: **Potential Transfer of Units under the Paris Agreement (Scenario 1)**

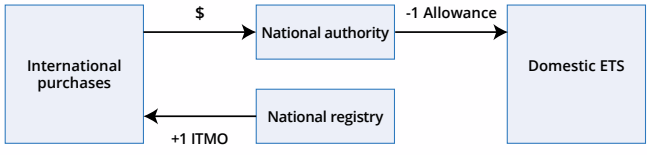


to transfer? If all sectors are accounted for as inseparable components of an NDC, then ITMOs would not be available under this scenario. An alternative option is that sectoral accounting, though a component part of NDC accounting, could be separable from NDC accounting. For instance, each sector has a target emissions level with performance measured on a sectoral basis, so that ITMOs would be available in high-performing (i.e., low-emitting) sectors, irrespective of performance in other sectors and aggregate NDC performance. *This would require national registries to develop sectoral subaccounts that could externally transfer carbon units.* This approach could prove controversial, however, as it would allow for the cherry picking of high-performing sectors to generate ITMOs.

Of course, a country may opt to include only a limited number of sectors within its NDC. In this case, there would not be an accounting overlap between emissions from covered sectors and emissions from noncovered sectors, in which case ITMOs would be available for emission reductions from covered sectors despite emissions outside of the NDC coverage. *This would require a separate registry (or separate account types) in the host country for noncovered and covered sectors, and an ITMO that would contribute to the donor/purchaser country NDC without detracting from the host country NDC.* However, it remains to be seen whether the Parties to the Paris Agreement would sanction such an arrangement and, in any case, such partial NDC coverage is unlikely to be acceptable beyond Least Developed Countries.

The linking of domestic ETSs to international transfers under the Paris Agreement will be more complex, but two potential scenarios can be envisaged. In the first, an allowance under a domestic ETS is converted into the equivalent number of ITMOs and, instead of being available to regulated entities under the domestic ETS, it is transferred to an international purchaser (Figure 21). This will increase the level of ambition of the domestic ETS by restricting allowance availability (in much the same way as voluntary purchases of allowances by citizens groups), though national authorities may wish to limit the number

FIGURE 21: **Potential Transfer of Units under the Paris Agreement (Scenario 2a)**



of allowances available for conversion to ITMOs, in order to limit exposure to international competition.

The second scenario in this context (Figure 22) is similar to the first, except the international purchaser pays a regulated entity directly for an allowance, which is converted to an ITMO for international transfer.

In the third scenario (Figure 23), carbon credits generated by project developers for use by regulated entities under a domestic ETS will also be available for transfer to international purchasers. This exchange could occur through the conversion of domestic carbon credits to ITMOs by the national registry, but also potentially through the mitigation and sustainable development mechanism of the Paris Agreement. In either case, national registries would need to deduct externally exported carbon units to ensure against double counting[60] by host and purchaser country.

In linking a domestic ETS with the international transfer of ITMOs or credits from the "mitigation and sustainable development mechanism," as described in the above scenarios, measures would need to be taken to avoid the risk of double counting. One option would be for a registry to be

60 In this context, when the same ER is used as a domestic carbon unit for compliance with a domestic ETS, at the same time that it is used as an ITMO or "mitigation and sustainable development mechanism" credit for NDC accounting at the international level.

FIGURE 22: **Potential Transfer of Units under the Paris Agreement (Scenario 2b)**

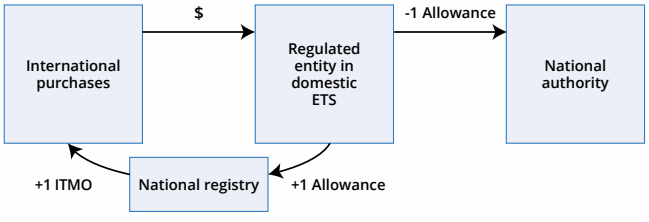
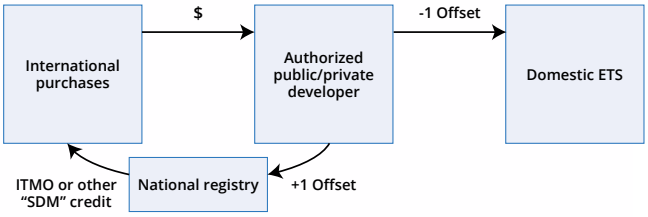


FIGURE 23: **Potential Transfer of Units under the Paris Agreement (Scenario 3)**

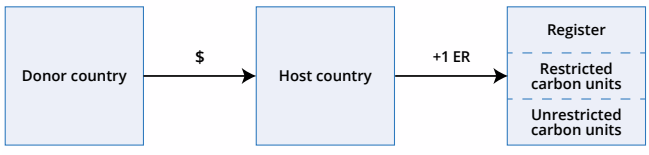


able to convert domestic carbon units into ITMOs according to double-entry bookkeeping methods, with ITMOs held in a specific account type separate from that for carbon units used for domestic compliance (e.g., a "national" account).

RBCF under the Paris Agreement may have registry requirements even where RBCF programs do not require a transfer of a carbon unit from host country to donor country. For example, restrictions may be attached to payments, such that emission reductions (ERs) for which a country has received financial support in the past cannot be compensated, or that compensated ERs should not be paid for again in the future or sold on carbon markets. In this scenario (Figure 24), the host country would require a register to ensure that compensated results are assigned a unique identity that distinguishes between restricted and unrestricted carbon units, and conveys the nature of any restrictions. Restrictions on the sale of carbon units could restrict access to the flexibility mechanisms of the Paris Agreement.

What form registries take post-Paris will ultimately depend on how the Paris Agreement flexibility mechanisms are implemented, and on the landscape of RBCF programs put in place by donor countries, in particular whether or not RBCF programs lead to the generation of carbon units. However, the example of REDD+ (and more broadly the use of forest carbon units to contribute to governments' mitigation targets), which has been implemented through

FIGURE 24: **Potential Transfer of Units under the Paris Agreement (Scenario 4)**



both RBCF programs and (to a more limited extent) market mechanisms, provides an illustrative example of what these flexibility mechanisms and accompanying registry requirements could look like in practice. The following chapter works through multiple REDD+ implementation scenarios to shed light on the registry arrangements that could become relevant for emerging market mechanisms and market-based RBCF post-Paris.

The implementation of REDD+ presents a number of challenges, from both the technical perspective (e.g., reference-level formation, the accuracy of monitoring of forest emissions, and the permanence of forest carbon) and the policy perspective (e.g., establishing forest tenure and the right to forest resources). However, these challenges should not be confused with the narrower accounting challenge of recording and tracking forest carbon units. As the discussion below illustrates, a number of straightforward registry options are readily available to address the particular accounting challenges presented by REDD+, should policy makers wish to integrate forest carbon units into broader market mechanisms.

3. REDD+ Registries

Countries that engage in REDD+ are in the process of developing greenhouse gas (GHG) accounting and tracking systems to approve and report on REDD+ programs and ensure consistency between national, jurisdictional, and project-level processes and results. These systems consist, at a minimum, of data management systems that systematically record and monitor information to ensure transparency and consistency and to avoid double counting of ERs. If countries seek to engage in market-based transactions that include REDD+ or other forest carbon units, they will also need a registry to allow for the unique identification and tracking of carbon units. Such tracking is important for transactions between different accounts of one registry as well as between different national or international registries.

The decision on the need for a registry and the level of required complexity depends on three key implementation choices:

- The role of carbon markets in REDD+ implementation;
- The scale of implementation of REDD+ (national, subnational, projects);
- Measures adopted for mitigating forest-specific risks.

The following sections discuss these implementation choices and their impact on the design of REDD+ registries.

3.1. The role of carbon markets in REDD+

REDD+ was originally conceived as a market-based system.[61] Today, however, REDD+ as established within the UNFCCC allows for market- and nonmarket-based transactions.[62] Multilateral and bilateral programs pioneering REDD+ rely on a mix of grant financing, loans, and RBCF. Private sector entities invest in REDD+ projects that certify ERs according to voluntary standard rules. Initiatives are financed by multiple sources through a variety of financial modalities and mechanisms.

All national REDD+ systems require a Data Management System (DMS), but only market-based systems require the establishment of a registry. DMSs ensure that the same ER is not claimed, issued, or sold more than once. Ensuring that no form of double counting occurs is essential for the environmental credibility of any ER program. Countries that do not wish to issue carbon units can manage this risk through an information system combined with a legal approval requirement for all subnational and national, project- and program-based carbon transactions. This includes situations where governments decide to retire ERs without further use, or where they use and report them only to meet their mitigation commitments.

Where countries wish to engage in market-based transactions, they will need a registry with the ability to uniquely identify and track carbon units. This includes situations where the country does not wish to implement a national carbon market involving forest carbon units, but allows the selling of carbon units from its domestic ER programs to international buyers. Countries may, however, implement national incentives for REDD+ that are market-based and include the issuance and transfer of carbon units. A number of developed countries have established mechanisms for trading forest carbon units as part of domestic mitigation strategies. For example, the New Zealand Emissions Trading Scheme (NZ ETS) links forest carbon units to both a domestic regulated market and an international regulated market (see appendix K). The Kyoto mechanisms (e.g., CDM Afforestation and Reforestation) and voluntary markets also provide some precedent. There is currently no framework for trading carbon units

61 See Papua New Guinea and Costa Rica submission to United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) 11, held in 2005, on Reducing Emissions from Deforestation in Developing Countries: Approaches to Stimulate Action, U.N. Doc FCCC/CP/2005/Misc.1, at 8.

62 See Warsaw Framework on REDD+, UNFCCC COP 19, Decisions 9/CP.19-15/CP.19, U.N. Doc FCCC/CP/2013/10/Add.1.

related to REDD+ at a global scale,[63] and very few countries contemplate linking REDD+ to carbon markets in the short term. Table 35 summarizes different market approaches of REDD+ implementation and provides examples.

For REDD+ RBCF that does not rely on the issuance of a carbon unit, there may be no need for a registry. In cases where the acquiring entity does not purchase a carbon unit but only pays for the right to use the ER as part of its mitigating or financing pledges, management of the transaction by the REDD+ DMS would be sufficient. The DMS would be required to assign an identity to ERs, for example, tracking location (ER program) and vintage (year of generation), to avoid the risk of double payment. This also applies where payment conditions require an "own contribution" of the REDD+ country, that is, the retirement of more than one ER for every ER paid for.

If REDD+ units are exchanged between nations, a registry will be required. In its simplest form, such a registry—referred to as "register" in Part I of the report—will not have to accommodate multiple accounts, and a simple REDD+ subaccount in an existing GHG registry where carbon units from other sectors are managed would be sufficient. The REDD+ country may, however, choose to open accounts for authorized private or public sector entities that assist with the marketing and sale of sovereign REDD+ carbon units. The registry would continue to serve the public sector only. Transfers undertaken would be limited to those among government subaccounts (if they exist) and between sovereign accounts of participating countries. Such a simple version of a registry must:

- Be able to issue forest carbon units with unique serial numbers to prevent the multiple sale of the same unit.
- Have the capacity to add forest carbon units to the registry on verification, and remove from the registry on international transfer.
- Record information on liabilities, in particular relating to the nonpermanence risk (see section 3.3). In most cases, the purchasing country will need to be assured that the selling country has in place a strategy (e.g., through buffers) that addresses risks specific to forest-based ERs.
- Receive periodic information from the national forest monitoring system. The flow of information between the national MRV system and the registry is needed to

63 The International Civil Aviation Organization is, however, discussing a potential link between mitigation requirements for the aviation industry and REDD+.

TABLE 35: **Role of Carbon Markets in Different REDD+ Implementation Strategies**

Approach	Description	Forest-relevant examples
RBCF not related to carbon markets (public sector)	International public RBCF for ERs in which no carbon unit is issued or transferred. ERs are used as a performance metric to increase the effective use of public finance.	• Results-based REDD+ initiatives such as the bilateral REDD+ agreements of Norway and Germany, and the REDD Early Movers Program in Acre (Brazil), Colombia, and Ecuador.
Regulated international markets (public and private sector)	Countries in an international, treaty-based ETS, are allowed to purchase forest carbon units (from private or public sellers) to meet national targets. REDD+ countries use their registry to identify ERs and avoid double selling. ERs may be used for reporting purposes by the host country (or jurisdiction) to the UNFCCC.	• The Paris Agreement allows for the cooperation of countries in meeting their NDCs and for the transfer of mitigation outcomes. It also foresees a mechanism to contribute to GHG mitigation and sustainable development that appears similar to the CDM, which may include forestry as eligible activity. • Afforestation and reforestation credits under the CDM of the Kyoto Protocol. • FCPF Carbon Fund, Tranche A, which allows the use of carbon units to meet mitigation targets.
Regulated national markets (private sector)	Regulated forest owners can buy and sell forest carbon units to meet their obligations. Regulated entities in a national ETS can offset their obligations by purchasing forest carbon units.	• National trading schemes that allow for the trading of forest carbon units, for instance, South Africa or New Zealand (New Zealand Emissions Trading Scheme or NZ ETS). • Jurisdictional systems such as California's Cap-and-Trade Program.
Voluntary markets (private sector)	Private entities voluntarily purchase forest carbon units that are issued across voluntary standards.	• Major voluntary standards include: • Verified Carbon Standard • The Gold Standard • American Carbon Registry • Climate Action Reserve.

ensure that forest carbon units issued into the registry are based on reconciled emission data reporting.

To allow the transfer of carbon units between registries, there needs to be either (i) peer-to-peer linking of registries or (ii) a link to a central hub or International Transaction Log (ITL) to ensure secure, cross-registry transfer of forest carbon units. The linking between registries needs to ensure the smooth transfer of units between registries and allow a number of compliance checks to be conducted that ensure regulatory legitimacy of the transfer. Forest carbon units will need to meet the specifications of the market into which the forest carbon units are transferred, and a peer-to-peer link or central hub must be able to ensure that the unit is accepted in the market into which it is sold.

Registries become significantly more complex where REDD+ is linked to regulated subnational or national ETSs. The involvement of private entities in REDD+ means that such a registry—referred to as "transaction registry" in Part I of the report—will have to be able to hold many accounts and transfer units internally to provide the necessary security and legal protection, and manage risks specific to REDD+ (e.g., permanence, see section 3.3), within or with a link to the registry.

In addition to the features described above, a full private sector-enabled REDD+ transaction registry must:

- Allow for a high number of connected accounts;
- Check and approve private account holders (automated and nonautomated checks of eligibility and security);
- Allow the transfer of carbon units between account holders according to double-entry bookkeeping method, and possibly the retirement or surrender of forest carbon credits for compliance purposes;
- Check that all traded forest carbon units held in the registry meet the legal specifications that they are either defined or recognized by national law. Those defined by law are generated according to the same methodology (e.g., harmonized rules for reference-level formation, harmonized safeguards standards) in order to create standardized, fungible units. In addition, the registry may accept units from accredited and accepted standards.

Where forest carbon units are created as offset units, two potential options exist for linking the offsets to the regulated ETS: (i) the creation/accreditation of a parallel offset registry from which forest carbon units can be transferred to account holders in the main registry (e.g., California); or (ii) the creation of offset accounts (held by offset project developers and possibly intermediaries) within the main registry, from which forest carbon units can be transferred.

Depending on national laws, there may be quantitative and qualitative limitations on the use of forest carbon units. Where there is a percentage limit to the use of offset credits permitted in a cap-and-trade system, either across the system as a whole or for individual regulated entities, forest carbon units must be identifiable as such from their serial numbers, and the registry must be able to automatically (or through manual operations) calculate the percentage of forest carbon units held collectively or individually, and may automatically prevent transactions that would exceed the permitted percentage limit.

Where forest carbon units are not transferred between market participants, but from participants to the government or vice versa, registries can be much simpler. An example of this type of transfer is Australia's Carbon Farming initiative, in which credits are sold to the government through reverse auctions (see appendix K). Where forest carbon units are used as a performance metric in programs that financially incentivize landowners to maintain or increase tree cover (e.g., a payment for ecosystem services subsidy), a registry is not required and a DMS will be sufficient to ensure environmental integrity.

The most complex implementation scenario is where national or subnational trading systems are implemented with links to international markets, in particular where private account holders are authorized to make international transfers of forest carbon units. This requires a harmonization of publicly available program rules not only at the national but also at the international level, including comparable risk management strategies and harmonized standards that govern the creation of REDD+ carbon units, to ensure comparability and environmental integrity.

In addition to the features described above, in the context of international carbon markets it is recommended that the registry:

- Have the facility to either recognize units issued in linked registries as accepted for compliance or convert forest carbon units traded internationally into forest units traded in domestic markets. For every national forest carbon unit converted to an international unit for international sale, the relevant number of carbon units must be deducted from national emissions reporting to avoid double counting (though in the case of fully integrated domestic and international markets using

the same communication protocol, conversion would not be necessary).

- Data and information exchange between linked registries allows mutual compliance checks.
- Be linked to a transaction log to enable international transfers, or be able to transfer units into other registries through peer-to-peer linking.
- Be enabled to undertake the relevant compliance checks. Depending on national laws, there may be quantitative and qualitative limitations on the import and export of forest carbon units. To enforce limits (whether applied to individual account holders or across the system as a whole), the registry should track the amount or percentage of international sales/purchases, and could automatically prevent transactions that exceed permitted limits.

Voluntary efforts to reduce deforestation track forest carbon units through private registries. Standards of the voluntary carbon market, such as the Verified Carbon Standard (VCS) or the American Carbon Registry, often operate their own tracking systems or cooperate with approved GHG registry operators. ERs generated and verified according to the program rules of these standards are issued as carbon units in these private registries. To avoid double counting of these ERs, the host country of the voluntary carbon project will have to deduct the same number of units that are issued to voluntary registries from its national accounts. This consolidation of national and project-level ER accounts can happen in the DMS or a registry where one exists. For more details on the consolidation of national and subnational accounts, see section 3.2.

When establishing national REDD+ systems, governments can also decide to grandfather voluntary forest carbon units into REDD+ registries. To do so, governments will need to define the conditions under which forest carbon units tracked through the voluntary carbon market registries are acceptable and will be recognized by the national system.

The recognition of carbon units issued under the rules of *voluntary* standards can follow different operational approaches:

- The private entity opens an account under the national registry, cancels carbon units corresponding to REDD+ units generated in the country in the private registry where they are held and receives an equivalent number of units in the registry. Note that this option may only be favored by private entities if the registry is linked to other registries and enables international transfers.
- The national regulator records the serial numbers of the privately held carbon units, confirms their validity, and cancels an equivalent number from its accounts. Note that the voluntary standard may require a confirmation of cancellation to ensure that the carbon units are not subject to double counting.
- The registry could also formally be linked to the private carbon registry and allow the transfer of units between the registries. Note, however, that such linking would require significant resources and administrative capacities, would present additional risks, and would thus require a careful cost-benefit analysis.

Finally, a registry must also make sure that there is no double claiming and consequent issuance for REDD+ ER programs that overlap with mitigation programs of the agriculture or wood fuel sectors. REDD+ differs from other sectors in that land-use emissions can be avoided (or sequestered) through other projects that are typically not considered REDD+. Projects that generate ERs through sparing biomass (e.g., biogas, clean cook stoves, and water purification) implicitly have an overlap with REDD+ emissions. These ERs have been captured to date using a factor known as the fraction of nonrenewable biomass but, under a national system, these ERs should be aligned with REDD+ accounting systems to avoid double counting of emissions. Thus, even REDD+ countries that do not have project-level REDD+ may need to take into account non-REDD+ project-level activities that have implications for forest emissions.

Box 6 provides a summary of the FCPF-submitted proposals on REDD+ implementation choices.

BOX 6. Carbon Markets and FCPF Emission Reduction Programs

Of the 18 Emission Reductions Program Idea Note (ER-PINs) accepted into the FCPF Carbon Fund pipeline, none indicate a plan to integrate forest carbon units into a national regulated carbon market. Chile's ER-PIN proposes a platform for trading of forest carbon credits, though this is with a view to selling into international voluntary markets. Costa Rica's ER-PIN notes that REDD+ finance will be used to build on their existing PES scheme, but this is not part of a regulated carbon market. A number of ER-PINS propose the domestic private sector as a source of finance for ERs, though private sector incentives to invest are unclear. Of the 18 ER-PINS, 14 indicate an intention to sell forest carbon units on international markets, but no concrete details have been provided. Only one ER-PIN (Nicaragua) expressly rules this out. To date, there are no examples of REDD+ units being sold into compliance markets.

3.2. Scale of implementation of REDD+

REDD+ under the UNFCCC is designed as a national system, which means that ERs will be accounted under a national reference level (RL). Considering that it can take years to gather all the data needed to establish a national reference level, UNFCCC Decision 12/CP.17 recognized that subnational reference levels can be used "as an interim measure."[64] In many countries, subnational and project- level REDD+ activities are being established to fulfill different aims, such as building capacity and experience in REDD+ implementation or generation of early ERs and removals in defined geographical or administrative areas. These subnational and project-level activities may prove to be pilot or demonstration activities that are eventually subsumed into a national REDD+ approach. However, countries may choose to pursue REDD+ in the long term as a series of subnational and project-level interventions, which retain independence but in sum constitute the national approach. Cases could exist where multiple layers of integration are required; for example, a project operating in a jurisdiction that is itself integrated into a national accounting scheme.

The process of consolidating different levels of accounting systems and integrating projects and subnational efforts into the national system is commonly referred to as "nesting" or following a "nested approach."[65] The strategic importance of the nested approach lies in its ability to coherently integrate various levels of GHG accounting and incentive allocation into the national system while maintaining accounting and environmental integrity. Nested REDD+ has several potential advantages to a purely national approach. Integration of REDD+ activities at multiple scales can provide for flexible approaches based on local circumstances, promote private sector investment, facilitate benefit sharing, and support phased implementation of a national REDD+ scheme led by REDD+ projects and subnational programs. While national systems and capacities are being developed and consolidated, subnational activities can continue to support forest investments while providing valuable lessons learned. Finally, nested approaches to REDD+ provide a potentially smooth transition from the current patchwork of voluntary REDD+ projects to national-level accounting.

If a country chooses to have nesting of subnational accounting systems within the national system, it is necessary to ensure that:[66]

- There is consistency in how GHG emissions, ERs, and removals are measured within projects and programs in a given country.
- Double counting of ERs can be avoided, to preserve environmental integrity where there is overlap with the scope of the national carbon accounting system.
- Payments based on performance can be fairly allocated to those who have achieved them.

Countries that consider nesting for forest carbon projects or carbon projects more in general will have to adopt rules that define the modalities under which nesting is possible and allowable. Such rules include the adoption of harmonized definitions, rules for baseline setting, MRV standards, and approval requirements. While not forming part of registries, such rules are a prerequisite to ensure that nesting creates incentives for private investments while protecting the environmental integrity of the national REDD+ system. These rules will also form part of the DMS.

Models for nested REDD+ systems, including in the land sector, already exist. The Kyoto Protocol allows the nesting of Joint Implementation (JI) systems in national

64 *"[S]ubnational forest reference emission levels and/or forest reference levels may be elaborated as an interim measure."* UNFCCC (2012): FCCC/CP/2011/9/Add.2. Decision 12/CP.17: Guidance on systems for providing information on how safeguards are addressed and respected and modalities relating to forest reference emission levels and forest reference levels as referred to in decision 1/CP.16, available at: http://unfccc.int/meetings/durban_nov_2011/session/6294/php/view/decisions.php.

65 Creating Incentives for Avoiding Further Deforestation: The Nested Approach. 2009. Lucio Pedroni, Michael Dutschke, Charlotte Streck, Manuel Estrada Porrua, in Climate Policy, 9: 207–220.

66 Adam Gibbon, Timothy Pearson, Sarah Walker, Ken Andrasko. 2014. Planning Guide: Integrating REDD+ Accounting within a Nested Approach. USAID LEAF.

accounting frameworks of developed countries operating under an emissions cap. Voluntary carbon market standards, such as the VCS and the American Carbon Registry, have also developed nested accounting systems and can provide some guidance on what is expected from participating governments and third parties under these systems.[67] By contrast, ETSs that cover whole sectors and allocate allowances to private entities often ban additional project-level activity and prohibit the generation of credits at the project level.

The complexity of a registry depends on how many accounting levels form part of the national implementation of REDD+ and which of these levels are linked to carbon markets. Carbon accounting and incentive allocation frameworks are a central component of REDD+ mitigation programs and, in structuring these frameworks, decisions need to be made on how to reach REDD+ objectives in a timely, economically efficient, and socially and environmentally sustainable manner. Establishing accounting frameworks at the project and program level may form part of the public system of benefit sharing or facilitate direct private sector investments into voluntary carbon market projects.

A registry that tracks REDD+ activities and outcomes is essential to a well-functioning system that involves crediting at the subnational, program, or project level. The registry must, at a minimum, track credits for ERs or removals or any similar instrument to reduce the risk of double counting. The registry complements the DMS, which fulfills a number of project-level tracking functions, such as collecting overlaying basic information about project-level activities or subnational programs, recording applicable safeguards and technical requirements, land use rights, or other information. Based on the DMS, the registry may evolve over time alongside REDD+ development and implementation. Registries may be created at subnational levels instead of, or in addition to, at the national level.

Nested REDD+ requires the consolidation of data from projects and programs at the subnational and national levels and the checking of compliance with nesting rules. Most of these checks will be done at the level of the DMS, which may serve to fulfill a number of tracking functions, overlay basic information about project-level activities or subnational programs, verify applicable safeguards and technical requirements, land use rights, or other information. Nesting will also have to consolidate MRV information and apply fair and transparent program rules that handle overlapping programs or projects that maintain the environmental integrity of the ERs claimed. Such approaches could deduct ERs earned by lower-level programs from a national total, cap the ERs that lower-level programs can claim, exclude areas covered by subnational programs or projects from national accounting, or incorporate lower-level data temporarily.

The DMS will apply the program rules and communicate the number of units to be issued and canceled to the registry. The DMS ensures that the total aggregated amount of ER units issued out of all REDD+ ER programs or projects, irrespective of the issuing scheme and registry, remains below the total amount of REDD+ performances claimed by the country. The registry then consolidates the accounts, by either issuing units to project/subnational accounts and deducting the equivalent number from higher-level accounts, or converting higher-level units into lower-level units. The latter approach finds its precedent in the Kyoto Protocol program rules for JI and the conversion of Assigned Amount Units (AAUs) or Removal Units (RMUs) into Emission Reduction Units (ERUs).

Where private sector entities implement REDD+ but are *not* issued with forest carbon units, the registry will not feature accounts for private sector project proponents. Information about ERs achieved by specific entities can be stored on the DMS and used to calculate the level of payment through, for instance, a benefit-sharing system.

Where private sector entities implement REDD+ and *are* issued with forest carbon units, private sector accounts will need to be integrated (nested) into the national or subnational REDD+ framework. This requires significant administrative capacity and resources and should be done only after a careful cost-benefit analysis, and the extent to which the benefits of private sector involvement outweigh the added transaction costs.

The integration of private accounts into national registries calls for enhanced security and data protection. Private accounts require:

- Enhanced confidentiality of account holder information to protect commercially confidential holdings of private entities. This may require the registry to restrict the amount of publicly accessible information on, for instance, the number of forest carbon units held by a specific entity, and the volume and value of transactions.
- Enhanced security options to mitigate the risk of fraud or theft of units, which increases with the number of

67 VCS Nested Program documents and the new 2016 VCS nesting rules: http://www.v-c-s.org/just-released-new-guidance-for-nesting-redd-projects/.

TABLE 36: **Levels of REDD+ Implementation and REDD Registry Implications**

Approach	Description	Forest-relevant examples	Registry implications
National REDD+ implementation: Implementation at the national level with a national RL and without any lower accounting levels.	The government records ERs at the national level and may decide to issue carbon credits and transfer them to international accounts. The government is the sole owner of REDD+ benefits and reserves the right to market and transfer ERs/carbon units.	REDD+ implementation in Ecuador, where forest carbon units are only issued at the national level.	• A simple, single account system, where the national government is the sole owner and beneficiary of forest carbon units. • Where forest carbon units are transferred to international sovereign buyers, a link to the registries of buyer countries.
National and subnational REDD+ implementation: Implementation with subnational RL/MRV in advance of or parallel to national RL/MRV.	Subnational RLs and MRV systems are implemented in most REDD+ countries in parallel with or in advance of national REDD+ systems. In some countries, they represent interim strategies that will be replaced by national systems. In others, subnational approaches will also be important as a permanent measure to enable REDD+ to be implemented through existing governance frameworks. It matches the legal framework in many countries that have delegated land-use decision making to subnational states or municipalities.	Subnational systems may cover jurisdictional units, such as departments or states, such as Madre de Dios in Peru or Acre in Brazil. They may also cover biomes, such as the Amazon Region in Colombia.	• Possibly subaccounts for public or private intermediaries that hold and manage forest carbon units on behalf of the government. • Where forest carbon units are transferred to international sovereign buyers, a link to the registries of buyer countries.
National/subnational implementation with REDD+ Projects: Project-level accounting in addition to the above.	REDD+ projects as part of the implementation strategy, nesting of projects into the national RL or the subnational RL. REDD+ projects can be registered under a voluntary standard or a regulated standard such as CDM. In the future, this may include project-level activities under the mechanism to contribute to GHG emissions mitigation and support sustainable development (i.e., under Art. 6.4 of the Paris Agreement).	Most REDD+ countries recognize private sector REDD+ initiatives. Countries that allow the nesting of private projects include Peru, Kenya, the Democratic Republic of Congo, and Colombia.	• Facility for private entities to open accounts in a national or subnational registry. • Projects must be "nested" within both national and subnational accounts. • As an interim step, a country may allow REDD+ projects to be registered under voluntary carbon market standards and credits to be issued to accredited registries of these standards. Once a national (or subnational) registry is in place, the regional registries could either be linked or integrated into the national registry.[a]

a. The registries of voluntary standards could continue to exist.

account holders on a registry. Risks include fraudulent transfer of credits and identity usurpation on the registry. Risk mitigation measures could include enhanced authentication requirements for registry access (e.g., increasing strength of password protection) or the facility to automatically detect suspicious account activity and suspend account functionality.

- IT links to potential trading platforms to facilitate market transactions.

Table 37 gives an overview of registry features in the context of different scales of REDD+ implementation. Box 7 provides a summary of the FCPF-submitted proposals on the scale of implementation of participating REDD+ countries.

TABLE 37: **Summary of Registry Features and Scale of Implementation**

Registry features	National REDD+ implementation	National and subnational REDD+ implementation	National, subnational, and project REDD+ implementation
A national accounting system	✓	✓	✓
Subaccounts for entities marketing units on behalf of government	✓	✓	✓
Link to registry of acquiring country	✓	✓	✓
National and multiple subnational accounts		✓	✓
Possible creation of regional registries as transitional step to national registry		✓	✓
Private sector accounts in subnational or national registries			✓
Nesting of project accounts in national or subnational accounts			✓
Optional creation of separate levels of forest carbon units (e.g., national units and subnational units)			✓

BOX 7. **Status of REDD+ Countries: Scale of Implementation**

Of the 18 ER-PINS accepted into the FCPF Carbon Fund pipeline, four propose exclusively using national reference levels, with one of these proposing a process for eventual consolidation of subnational reference levels within the national reference level. Eight ER-PINS propose exclusively subnational reference levels, though seven of these propose transitioning toward a national reference level, and consolidation of subnational reference levels within this. Five ER-PINs propose a combination of national and subnational reference levels from the outset of the ER-Program, with subnational reference levels aggregating into a national reference level.

A total of 13 of the 18 ER-PINS propose that project-level activities form part of the ER Program. Of these, seven ER-PINS expressly indicate that projects will be nested within either national or jurisdictional programs.

3.3. REDD+ and land use-related risks

Forest-related activities differ in a number of ways from activities in other sectors. The risks related to the release of sequestered carbon through deforestation, the displacement of emissions, and uncertainties in the estimation of ERs all constitute challenges specific to the forest sector. These risks, in particular the risk of reversal of ERs, have to be managed by REDD+ programs and, depending on the management strategies, will have a bearing on REDD+ registries.

3.3.1. Risks specific to forest ERs

A number of risks that are associated with the environmental integrity of forest-based ERs are either not relevant or far less pronounced for other sectors. These risks are briefly described below.

The estimation of all ERs is subject to uncertainty due to a lack of data and natural disturbances. While data on forests have become a lot more accurate and granular in recent years, forest inventories still have many uncertainties attached. Hence, uncertainty is particularly significant in the REDD+ context, given the scale of implementation and the fact that many REDD+ countries have very poor data informing their MRV systems. Where systems are still being established, there is a significant risk that with improved methods and data, estimates from previous years will appear to be too high. Statistical uncertainty can be addressed by adopting conservative assumptions regarding forest reference levels or forest emission factors. These assumptions will need to be recorded in the DMS, but do not require specific registry features. An uncertainty assessment may, however,

inform the size of the REDD+ buffer (see section 3.3.2) and the number of carbon units issued and available for sale.

Further, land-based ER projects involve the risks of leakage, that is, the risk that emitting activities are simply shifted outside of the credited project, jurisdiction, or country. While this risk is not unique to the land sector, the dispersed nature of emission sources in REDD+ often make the displacement of emissions often more difficult to manage and monitor than for energy or industry. Leakage can occur indirectly—through the displacement of activities that previously led to deforestation in the project area. For example, where REDD+ projects lead to a decline in the local supply of wood products, this can lead to increased deforestation elsewhere to meet wood demand. Leakage can be addressed through the implementation of REDD+ at large scales, or by simply canceling a quantity of ERs achieved according to the displacement risk (as proposed, for example, by Mozambique, as part of its ER PIN[68]). The leakage risk should always be managed through the design of ER programs. The residual leakage needs to be accounted for and recorded in the DMS. With few exceptions, leakage management and monitoring do not require specific registry features.

The third and final differentiation between REDD+ and other carbon accounting systems is that carbon removals can be reversed and the climate benefits can be lost. There is a risk that carbon may be released due to human or natural causes (known as a "reversal event"), before it is often considered permanent—after approximately 100 years of storage, although atmospheric reality is more complex.[69] Carbon sequestered in biomass may be released because of non-anthropogenic hazards (e.g., fire, wind, and floods) or anthropogenic causes (e.g., the conversion of land to agriculture). A number of measures can be taken to address the non-permanence risk, some of which require specific registry features, and these are discussed in the next section. This risk of reversal or "non-permanence" is often considered one of the main differences between biological sequestration projects on the one hand and projects that reduce emissions on the other.[70] If forest carbon has been surrendered for compliance within an ETS, then a reversal event will undermine the environmental integrity of the system unless insurance measures are in place.

3.3.2. Mitigating risks

Two basic strategies exist to manage the risks of insecurity, leakage, and non-permanence: countries can decide to either issue less carbon units for REDD+ than measured or retire a certain number of REDD+ carbon units that would no longer be available for sale. A number of variations of these options—mainly in the context of permanence—have been proposed to address these risks (Table 38).[71]

The strategies adopted to address risks depends on a number of factors; some strategies are harder to implement than others, with discounting simpler and easier to administer than maintaining buffer accounts, and thus probably preferable for REDD+ countries with lower administrative capacity. Strategies also depend on whether the private sector is authorized to generate and hold carbon units and on whether permanence management occurs on more than one accounting level. Some measures transfer the risk to the buyer (e.g., the use of temporary credits), reducing the market value of a forest carbon unit, whereas other measures (e.g., buffer accounts or discounting) transfer the risk to the REDD+ project or program developer, increasing the cost of generating forest carbon units.

Buffer accounts provide a robust system of addressing risks that can be tailored to individual program and project needs. In the context of projects, the most common mechanism adopted to address reversals is the creation of a buffer account, to which project developers must assign a number of forest credits that can be canceled in the event of a reversal. Other systems such as discounting and mandatory cancellations also provide a means to ensure against risk. If discounts are to be used to account for reversals, it is important to set a sufficiently high discount rate to ensure that any unforeseen reversals are covered. The compulsory cancellation of ERs by the project, for example, in the case of a reversal (as used, for instance, in New Zealand) or leakage (e.g., as required by the ACR[72]) places the burden on individual project owners.

Buffers will likely emerge as an important risk mitigation strategy for sovereign REDD+ transactions, addressing risks related to non-permanence, uncertainty, and reversal. The FPCF, for example, proposes

68 See ER-PIN Zambézia Integrated Landscapes Management Program, available at: https://www.forestcarbonpartnership.org/sites/fcp/files/2015/September/Mozambique%20ER%20PIN_Zamb_18Sep2015_FINAL.pdf

69 This is how long it takes for CO2 to leave the atmosphere. The natural carbon fluxes in mature forests make standing forests under natural conditions carbon neutral.

70 Chomitz, K., 2002. Baseline, Leakage, and Measurement Issues: How Do Forestry and Energy Projects Compare? *Climate Policy* 2: 35–50.

71 See, for instance, http://unfccc.int/resource/docs/2013/sbsta/eng/misc18.pdf, http://unfccc.int/resource/docs/2013/sbsta/eng/misc18a01.pdf.

72 See http://americancarbonregistry.org/carbon-accounting/standards-methodologies/american-carbon-registry-nested-redd-standard/acr-nested-redd-standard_v1-0.pdf.

TABLE 38: **Risk Management Strategies**

Risk Management	Description	Example
Buffer accounts	A portion of ERs generated can be set aside in a "buffer account" instead of being sold. In case of reversal, leakage, or underestimation, ERs within the buffer can be used to compensate for this loss. Buffer accounts may additionally be pooled to ensure that there are sufficient buffer credits to account for any reversal that any one project or program may experience.	Buffers are common features of voluntary and private carbon programs (VCS, ACR). FCPF MF developed a buffer guideline to address both uncertainty and reversal, and the FCPF draft guidelines for buffers also foresee the establishment of a "pooled reversal buffer" at the fund level; the ACR has approved a Nested REDD+ Standard's "leakage buffer account" and "performance reserve account," in which the jurisdiction deposits and/or requires nested projects to deposit a portion of their credits at each issuance; the VCS uses a buffer that allows the release of units from the buffer based on effective management of risks creating additional performance incentives.
Discounting	Permanently sets aside a portion of generated ERs and only the remainder are actually used. For example, if a project generates 100 ERs, only 80 will be entered as forest carbon units on a registry. ERs are not held in a buffer in this case; they are simply retired or remain unaccounted.	The German REM program requires 1:1 matching and subsequent cancellation of ERs compensated by RBCF to mitigate the various risks associated with ERs.
Conservative approaches	REDD+ agreements or financing modalities require conservative definitions of REL, MRV systems, or other elements.	Conservative approaches are used to manage the risk in regulated ETSs, both on the national level (New Zealand) and international level (LULUCF accounting under the Kyoto Protocol).
Temporary units	Temporary carbon units can be issued for forest ERs. These are units that expire at a set time after issuance and need to be replaced by the holder, with either another temporary or permanent unit. Temporary units will typically be usable for one crediting period, but expire in the subsequent crediting period.	Temporary credits were introduced for CDM afforestation/reforestation projects to take account of the fact that sequestered carbon can eventually be released through harvest or decay.
Legal replacement obligation	Those selling REDD+ carbon units can be asked to replace them in the case of reversal.	Strategy to address non-permanence under the New Zealand Emissions Trading Scheme.
Adjustments on future issuance of units	ERs lost in a reversal event are subtracted in equal quantity from any future issuance of forest carbon units to the project developer.	In the Norway-Brazil REDD+ agreement, future payments will be reduced where emissions exceed RLs.

Note: ACR = American Carbon Registry; ERs = Emission Reductions; ETS = Emissions Trading System; FCPF MF = Forest Carbon Partnership Facility Methodological Framework; LULUCF = Land Use, Land-Use Change, and Forestry; RBCF = Results-Based Climate Finance; REL = Reference Emission Level; RLs = Reference Levels; REM = REDD Early Movers; REL VCS = Verified Carbon Standard.

to cover both uncertainty and non-permanence risks with a buffer. Buffers will be established at the level of an ER program and to mitigate risks that go beyond those buffers, an additional buffer will be established at the level of the Carbon Fund, pooled across all ER Programs for which an Emission Reductions Payment Agreement (ERPA) has been signed.[73] The purpose of the uncertainty buffer is to manage the risk of overestimation and to create incentives for addressing the uncertainty associated with MRV systems. The reversal buffer seeks to insure against potential reversals of ERs. The ACR proposes a "Leakage Buffer Account" to account for the time difference between the jurisdictional assessment of leakage and the crediting of nested projects. Under this account, nested projects calculate leakage based on project methodology and create "leakage tons," which will be retired in case a subsequent jurisdictional assessment detects and attributes leakage to specific projects. If

73 See draft Buffer Guideline: https://www.forestcarbonpartnership.org/sites/fcp/files/2015/October/DRAFT%20FCPF%20ER%20Program%20Buffer%20Guidelines%20final.pdf.

the buffer is exceeded, the project is required to deposit additional ERs in the buffer.

Where it includes a buffer, the registry must:

- Issue buffer carbon units into a buffer account, something that often occurs simultaneously with the issuance of forest carbon units.[74]
- Establish buffer accounts at the entity or project level, or pooled across all registered projects and programs. A pooled buffer account reduces the risk that the amount of emissions released or reductions offset is greater than the corresponding number of carbon units set aside by the responsible account holder. A pooled buffer implies an additional insurance that risks at the project or program level can be managed.
- Account for buffer carbon units in a way that links them to the project and account holder to which related forest carbon units are issued. To ensure transparency, it should be possible to determine the number of buffer credits deposited in a pooled account by any one account holder. The buffer account need only be accessible by the registry administrator.
- Be able to cancel buffer carbon credits following a reversal event and have in place a process for the responsible account holder to adjust the number of carbon units that need to be put into the account to replenish the buffer account.
- Have a process for the automatic release of buffer carbon credits after a number of years without a reversal event occurring, if the rules of the system so determine.

In a nested system with national accounting, there may be need for a separate sovereign buffer that insures the country against risks at the national level (i.e., not covered by project- or program-level buffers).

For the discounting of forest carbon units, the registry must:

- Automatically cancel a proportion of ERs for which forest carbon units are issued.
- Link forest carbon units to identifiable canceled ERs (i.e., ERs that are location- and date- specific) to prevent the resubmission of canceled ERs for verification. Information about canceled ERs should ideally be stored on a DMS.
- For the issuance of temporary forest carbon units, the registry must:
- Assign serial numbers that distinguish temporary forest carbon units.
- Establish and maintain either (i) a temporary carbon unit account that is separate from but linked to a standard holding account from which units are canceled or retired or (ii) a holding account that automatically debits the same number of carbon units that were credited under the previous accounting period using temporary credits.
- Put in place a system that notifies holders of temporary units of the requirement to replace units a set time prior to their expiration.
- Program the automatic expiration of units at a predetermined time, combined with a note to the issuance or user of the unit to replace it.

Table 39 provides an overview of registry specifications for different risk management strategies. Box 8 summarizes the risk management choices expressed by FCPF participants.

BOX 8. **Status of REDD+ Countries: Managing Non-Permanence Risk**

Of the 18 ER-PINS accepted into the FCPF Carbon Fund pipeline, 14 propose the use of buffer accounts. Of these, two ER-PINS expressly indicate that buffer accounts will be pooled.

74 The VCS, for example, says in its guidelines: "At first VCU issuance, buffer credits shall be deposited into the jurisdictional pooled buffer account."

TABLE 39: **Summary of Registry Features and Permanence Measures**

Registry features	Buffer accounts	Discounting	Temporary credits
Issuance of buffer credits to buffer account	✓		
Possible pooling of buffer reserves	✓		
Possible sovereign buffer reserve	✓		
Cancellation of buffer credits on reversal event and for account holder to replenish	✓		
Release of buffer credits (where policy in place)	✓		
Automatic cancellation of ERs		✓	
Preventing resubmission of canceled ER for verification		✓	
Serial numbers to distinguish temporary forest carbon units			✓
Creation of separate temporary accounts or debiting facility			✓
Automated expiration of units, with advanced notification of account holders			✓

3.4. Governance, administration, and legal issues

3.4.1. Governance issues

Voluntary market mechanisms are typically created by voluntary standards and administered by a non-governmental body. National or jurisdictional ETSs meanwhile are created by legislation or regulation, with a public authority, commonly within an environment or energy department, ultimately responsible for their implementation and accountable for the manner of their implementation. While the responsible line ministry is in charge of designing mitigation programs, the integrity of registries depends on the neutrality of the administrator as well as its ability to manage complex IT systems and uphold standards of confidentiality.

A REDD+ registry may be integrated within an existing registry or established separately. If a registry already exists for other emissions trading in other sectors, the managing entity may also take responsibility for REDD+ registries management.

Before the government decides to establish a separate REDD+ registry, it should conduct a careful cost-benefit assessment. If it concludes that a separate REDD+ registry is needed, it can decide to either delegate the task of administrating the registry to a public authority or contract a private service provider. Where registry services are contracted out, retaining public, regulatory oversight will be important for accountability reasons.

The following are relevant governance considerations specific to the development of registries that handle forest carbon units:

- For countries implementing REDD+ programs with limited scope and limited capacities, for example, a nonmarket-based system or an international market-based system with only one or a small number of purchasers (e.g., the FCPF Carbon Fund), REDD+ countries may wish to establish simple registries or use existing registries developed and operated by third parties. A number of independent carbon registries already exist, with established IT systems and administrative capacities, and contracting these services, rather than seeking to develop this capacity in-house, may reduce costs with the added benefit of increasing standardization across ETSs. For example, FCPF ER Program countries will have the option to use the FCPF registry.
- For countries implementing, or planning to implement REDD+ programs linked to international or domestic ETSs, the development of a dedicated national REDD+ registry, or the development of a national emissions

registry within which forest carbon units are housed (i.e., among other types of units) will be necessary. The development and operations of such a dedicated registry could be outsourced to a private operator or managed by the public sector, depending on the national capacities to manage complex and confidential IT systems.

- For highly complex ETSs, outsourcing of subregistry services can be a way to reduce the administrative burden on the government. An example of a complex ETS is a cap-and-trade system with the use of offsets generated according to a baseline-and-credit methodology, where offsets are held in subregistries that must be converted in order to be traded on a parent registry (see appendix D, the California Cap-and-Trade system and the use of "offset registries").

Whether operations are outsourced or not, in both cases standard operational procedures must be formulated to guide the administration and use of the registry.

3.4.2. Administrative issues

The administration of REDD+ registries may require a number of additional skills and competences that go beyond general registry administration. The administrative processes and required competencies for operating a REDD+ registry resemble those for registries in general. Registry administrators may, however, need to support the registration and management of forest carbon units, in particular where individual landowners, communities, or other actors that lack the sophistication of commercial market participants, are authorized to engage in transactions. Actors participating in REDD+ and other forest mitigation acvitities (e.g., through benefit-sharing programs) often lack the legal knowledge and financial standing that is common among actors in industrial or energy sectors. Without some aggregation, they may not have the standing that would allow them to participate in transactions involving carbon units, and without training they may not be able to manage their account to their benefit.

REDD+ programs that authorize "non-sophisticated" market participants to hold carbon units will need additional assistance programs. Non-sophisticated market participants are those that lack the ability to weigh the risks and benefits of a carbon transaction and are finacially exposed to the risk of market and transaction failures. In REDD+ such participants are individual owners, rural or indigenous communities, or small and local NGOs. In these cases, a number of considerations specific to REDD+ should be taken into account:

- To open new accounts, registry administrators generally require information and a number of supporting documents from prospective account holders, including details on company financials, authenticating documents, and criminal record background checks.[75] However, some entities that wish to participate in REDD+ programs may be unable to provide all supporting documentation, and provisions will have to be in place (e.g., simplified procedures or additional third-party support) to facilitate account registration.

- The implementing regulation may also require communities to be represented by a single entity with proven sophistication to be able to interact with the registry. Groups that do not have access to IT or for other reasons lack the capacity to engage in a digital registry may require agents to act on their behalf, and registries should be designed to authorize such agents.

- In providing information about registry features and participation, registry administrators will need to consider the additional information barriers faced by potential REDD+ participants. This may require producing informational brochures in a wide number of languages and engaging in outreach, for example, through community workshops. Alternatively, participants could be required to act through a legal representative.

- In desiging registry fee structures, registry administrators will need to consider financial barriers faced by potential REDD+ participants, particularly of those operating at smaller scales. This may require the development of varied fee structures, or the use of ex post administrative fees as an alternative to up-front payment.

3.4.3. Legal Issues

It is important to consider and regulate the ownership of carbon units held in a registry.

Depending on the legal system, **the account holder may always be the owner (whether legitimately or not) and the holding of units in an account is constitutive for ownership**. Such treatment of ownership is typical for financial markets and, in some jurisdictions (e.g., England, Germany, Switzerland), also for land ownership. Registration of carbon units in an account would then be equated with the possession of bearer documents. This means that the holding of units on an account confers similar legal effects as the holding of a bearer's document. The owner of an account then has the right to dispose of the carbon units registered on his or her account. Assigning constitutive

75 Id p. 12.

effect to the registration of carbon units in a registry facilitates transactions and may help to build a market place.

Alternatively, **the registration of carbon units may be merely declaratory**. In that case, the account holder is not autmatically the owner of the carbon units and a transaction of carbon units may not be protected by bona fide (good faith) if the owner turns out to be illegitimate. Examples of such declaratory effects of land and real estate registration exist in Portugal, Spain (with bona fide protection), and Belgium and France (without bona fide protection). Where the registration of carbon units is declaratory, the transfer of carbon units could require the accompanying transfer of a physical certification, and it is that bearer certificate that serves as evidence of ownership. Similarly to the transfer of registered shares in a company, the transfer requires an endorsement or a written assignment in addition to the delivery of carbon units.

The decision on the legal effect of registration of carbon units in a registry is independent from the way a carbon unit has been acquired. Acquistion can come via allocation (allowances), certification against baseline emissions (credits), or puchase (of an allowance or credit). The government putting in place a registry would also have to decide whether account holdings could be used as security for other transactions.

In land use transactions, the right to benefit from emission reductions may be contested. In many countries land and resource tenure rights as well as rights to emission reductions are not well defined and, therefore, subject of conflict. Where ownership is unclear, more than one entity participating in an environmental service may expect to benefit from it (or claim ownership of resulting emission reductions/carbon units). In these cases, the question of who can engage and benefit from an activity related to a piece of forest land is often complicated and controversial.

A registry is not the place to resolve legal risks related to tenure. A registry must start from the assumption that entities holding forest carbon units are uncontested owners with the right to transfer and benefit from the sale of the forest carbon unit. Verification of a project developer's legal right to undertake an ER project should occur before a forest carbon unit is issued onto a registry, and relevant documentation establishing this right should be available in a DMS.

3.5. Decision guide for creation of a REDD+ registry

Two key considerations should guide decision makers in the complex process of REDD+ registry design: (i) the policy objectives sought from REDD+ and (ii) the level of capacity to implement and administer REDD+ projects and programs.

The design considerations required for the creation of a REDD+ registry are summarized in Figure 25 (at the end of this chapter). In addition, we present three hypothetical scenarios to illustrate how REDD+ policy objectives and REDD+ implementation capacity can influence registry design choices.

Scenario 1 applies to a small, least developed country, with limited administrative capacity; *scenario 2* applies to a lower-middle-income country with a relatively developed administrative capacity; and *scenario 3* applies to an upper-middle-income country with high administrative capacity.

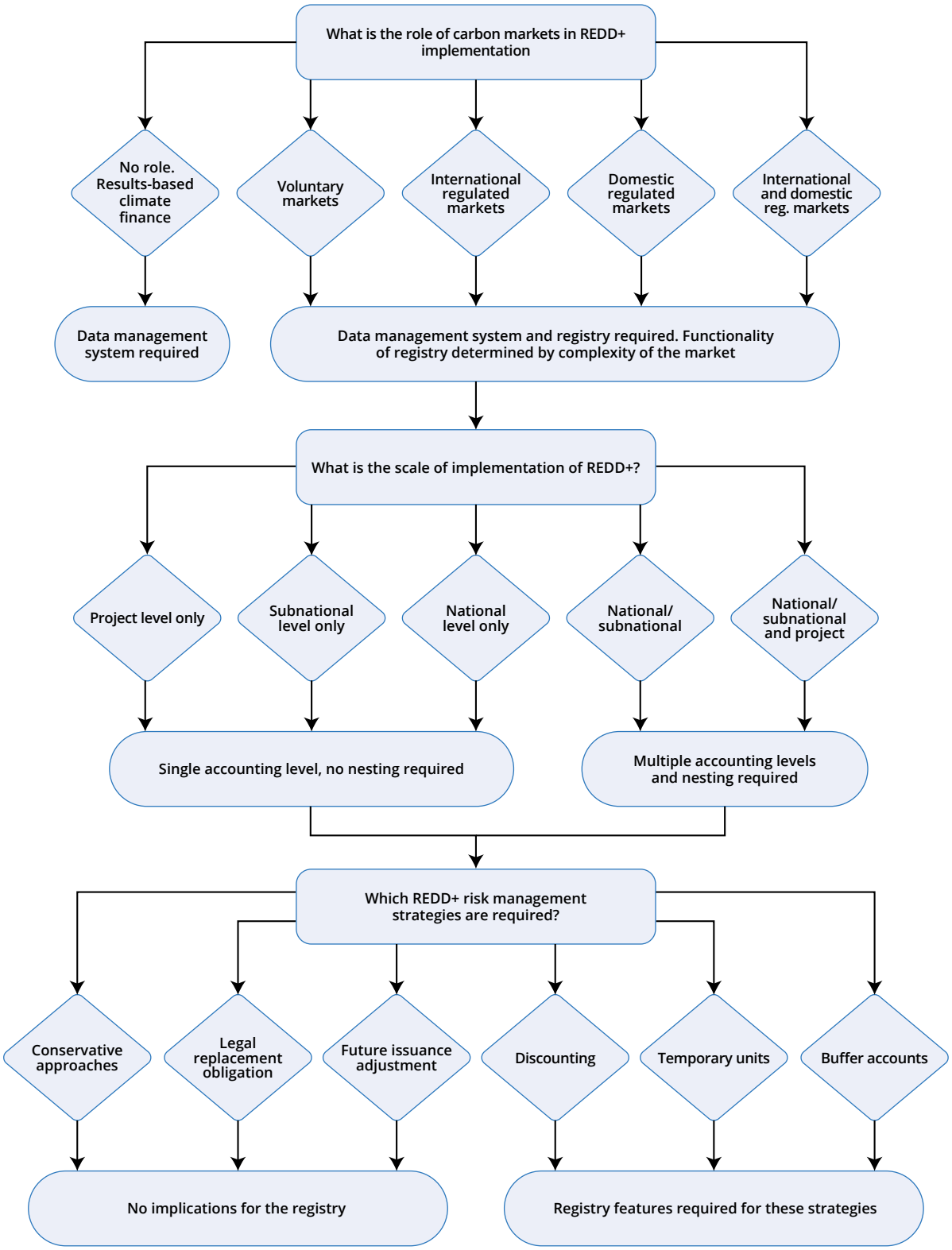
Scenario 1: a small least developed country with limited administrative capacity, is currently receiving REDD+ readiness finance and expects to access RBCF for reducing emissions from forest loss against a national reference level, with no transfer of carbon units. Country 1 is interested, however, in eventually transferring forest carbon units internationally under the flexibility mechanisms of the Paris Agreement. There is no project-level REDD+.	
Role of carbon markets in REDD+	Country 1 will need to develop a DMS to be able to track ERs for which RBCF are sought. Once a DMS is in place, a simple registry (i.e., a register) can be developed to issue forest carbon units for international transfer.
Scale of implementation	Country 1 has no project-level REDD+ and, as a small country, does not have subnational jurisdictional REDD+ programs. A simple, single account system will be sufficient, where the national government is the sole owner and beneficiary of forest carbon units.
Risk management strategies	Country 1 should aim to develop the simplest risk management strategy that is compatible with the rules for the international transfer of forest carbon units.
Governance	The registry will be created by national law in accordance with international standards. The REDD+ registry will be stand-alone as carbon units will not be transferred from other sectors. Where complex risk management functions are required, country 1 should consider using a private sector contractor with existing capacity.
Administration	With only a single account holder, limited administrative capacity is required to manage the registry.
Legal issues	It will probably be assumed that the government is the uncontested owner of carbon units with the right to transfer and benefit from their sale at the international level.
Technology and IT specification	A single national holding account may be sufficient.

Scenario 2: a lower-middle-income country with a relatively developed administrative capacity, intends to establish a domestic cap-and-trade system in which forest emissions are not covered, but in which project-level forest carbon units can be used as offset credits by covered entities. Indigenous and community groups are expected to benefit from the sale of forest carbon units. Country 2 is currently receiving international RBCF for reducing forest emissions with no transfer of carbon units and does not intend to engage in the international transfer of forest carbon units, as it wishes to count all domestic ERs toward its NDC under the Paris Agreement.	
Role of carbon markets in REDD+	Country 2 will need to develop a DMS and transaction registry for a domestic regulated market in forest carbon units, but no international linking to other registries is required. There is no double counting risk with RBCF, as there is no transfer of carbon units internationally, though ERs for which RBCF are received will need to be tracked in a DMS.
Scale of implementation	Project-level implementation only of REDD+, and no nesting requirements.
Risk management strategies	The use of buffer accounts for forest carbon units traded as offsets is a likely option.
Governance	The registry will be created by national law, and could operate as a stand-alone offset registry, managed by a public or private body. Alternatively, limited offset accounts (without a surrendering function) could be created within the registry used for the cap-and-trade system.
Administration	Possible support required for individual landowners, communities, or other actors that lack the sophistication of commercial market participants and the ability to assess the risk of engaging in carbon transactions.
Legal issues	Verification of a project developer's legal right to undertake an ER project should occur before a forest carbon unit is issued onto a transaction registry.
Technology and IT specification	Possible requirement for issuance, holding, cancellation, buffer, trading, and/or natural person accounts. Forest carbon units will need to be distinguished from allowances issued under the cap-and-trade system. Where forest carbon units are issued onto a stand-alone offset registry, there will have to be a facility to convert offset credits into units that can be surrendered for compliance with the cap-and-trade system.

Scenario 3: an upper-middle-income country with high administrative capacity, intends to establish a domestic ETS in which some forest emissions are capped and project-level activities in noncapped forest areas can generate offsets to be used by capped entities. At the same time, it is expected that carbon units (including forest carbon units) can be transferred internationally by both the government and project-level participants (e.g., through the sustainable development mechanism of the Paris Agreement).

Role of carbon markets in REDD+	Country 3 has chosen the most complex implementation scenario in which forest carbon units can be traded as allowances within a domestic cap-and-trade system, and offset credits can be traded within a domestic cap-and-trade system, and transferred internationally at both the government-to-government level, and by domestic non-governmental entities.
Scale of implementation	Project-level implementation for domestic cap-and-trade system. At the international level, it is likely that the government will wish to transfer carbon units on the basis of national accounting, as any internationally transferred carbon units will need to be deducted from national accounting toward country 3's NDC. This may require multiple levels of forest carbon unit, with carbon units for the domestic ETS distinguished from internationally transferrable forest carbon units.
Risk management strategies	As with scenario 2, the use of buffer accounts is a likely option. Buffer accounts may be required for forest carbon units traded at the domestic ETS level and for forest carbon units traded at the international level.
Governance	The registry will be created by national law. Although contracting out of registry services to the private sector is an option, the government may wish to retain day- to-day control because of the need to reconcile trades within the domestic ETS with international transfers.
Administration	As with scenario 2, possible support required for low-capacity participants.
Legal issues	As with scenario 2, verification of a project developer's legal right to undertake an ER project. In addition, the multiple types of carbon unit and the rights associated with each, should be defined in law.
Technology and IT specification	In addition to the accounts listed under scenario 2, deletion, exit, and auction delivery accounts may also be required. There are multiple scenarios in which double counting could arise (e.g., a non-governmental entity in country 3 transfers a carbon unit internationally without the transfer being registered by the government of country 3, in which case the unit may be counted in two countries). Double-entry bookkeeping will be required to avoid this. The conversion of domestic offset credits into domestic allowances and the conversion of both types of domestic forest carbon units into internationally transferrable forest carbon units may be necessary to avoid double counting.

FIGURE 25: **Registry Design Decision Steps**



Note: For RBCF programs generating carbon units, the data management system could assume the function of a simple register, thereby avoiding double counting. Where a transaction registry exists, ERs and payments could be recorded in such a registry.

APPENDIX A: Glossary

Types of Accounting Systems

Data Management System (DMS): A database that records information about a carbon unit that is not stored in the transaction registry or register, but that should remain archived for policy reasons. For example, to facilitate compatibility between different registries, it may be desirable to limit the information that travels with a carbon unit when it is externally transferred. It may also be desirable to archive information about that carbon unit (e.g., baseline information according to which a carbon unit was issued or geographical information related to a project boundary) and this can be recorded in a DMS. The serial number of a carbon unit should link it to the information stored in the DMS, so the information can be retrieved if needed.

GHG inventory: An inventory that records physical greenhouse gas (GHG) emissions and removals. It is important to distinguish between accounting of *emissions* and removals, and accounting of *carbon units*.

Register: A database that records serialized carbon units and any other information specific to the carbon unit that is required by policy. This can include the vintage of the carbon unit, the identity and location of the project for which the carbon unit was issued, the project funder, and verification details. A register may be used by a country that receives Results-Based Climate Finance (RBCF) for generating emission reductions (ERs), to provide assurance that one and the same ER is not paid for twice (double payment). A register may also be used as part of a simple Emissions Trading System (ETS) without multiple accounts, so a country can "transfer" carbon units to a donor country through simple double-entry bookkeeping (the subtraction of one carbon unit in one register being mirrored by the addition of one carbon unit in another registry).

Transaction registry: A database that has all the features of a register, plus the capability to transfer carbon units between account holders in the transaction registry (internal transfer), and/or the capability to transfer carbon units from one transaction registry to another one (external transfer). Every ETS requires a transaction registry in some form. The more complex the trading system, the more features the transaction registry will require.

Types of Emission Trading Systems

Baseline-and-credit: Under a baseline-and-credit system, entities that are not subject to an emissions cap are issued credits for voluntarily undertaking projects that reduce emissions. These emission reductions are commonly measured against a counterfactual scenario in which the project would not have taken place (the "business as usual" scenario or baseline). Thus, emission reduction projects do not have to be carbon negative, but simply emit less than would otherwise have been the case. Project developers can then sell credits as offsets to entities subject to an emissions cap, which use those offset credits to meet their emissions cap. Project developers may also be able to transfer or retire credits with a government body in exchange for a rebate or some other form of subsidy.

Cap-and-trade: A cap-and-trade system creates a fixed ceiling on total emissions for a given compliance period, and then distributes allowances (usually through free allocation or auctioning) to regulated entities that are subject to the cap. Entities subject to the cap can then trade allowances among themselves. At the end of the compliance period, the number of allowances held by a capped entity must cover their actual emissions over that period. Entities with actual emissions in excess of their respective allowances are subject to a penalty.

Purely voluntary: In a purely voluntary system, entities that are not subject to an emissions cap generate and sell offset credits to other entities that are likewise not subject to an emissions cap.

Types of Carbon Unit

Carbon unit: An umbrella term for allowances, carbon credits, and voluntary credits.

Allowance: Analogous to a permit, an allowance is issued by a central authority and gives a regulated entity the right to emit, to the extent of the allowance, without being subject to a penalty.

Carbon credit: A credit is earned for undertaking an activity that reduces emissions against a baseline according to a regulated standard. Carbon credits are issued to authorized

project developers upon verification, under voluntary or regulated systems.

Voluntary credit: As with a carbon credit, voluntary credits are earned for undertaking an activity that reduces emissions against a baseline. However, voluntary credits are issued according to a *voluntary* standard.

Registry Functions

Banking: the carrying over of unused carbon units from one compliance period to the next compliance period.

Borrowing: the use of carbon units from future compliance periods to meet obligations in the current compliance period.

Cancellation: the disposal of a carbon unit through, for example, its transfer to a cancellation account, where the unit is not used for compliance with an emissions target and cannot be used by others for compliance either.

Conversion: the transformation of one type of carbon unit to another type.

External transfer: the transfer of a carbon unit from an account in one registry to an account in another registry, using either an independent transaction log or peer-to-peer linking of registries.

Internal transfer: the transfer of a carbon unit from one account to another.

Issuance: the creation of a carbon unit by a registry administrator and its allocation to an account holder.

Retirement: the disposal of a carbon unit through, for example, its transfer to a retirement account for compliance with an emissions target. In some contexts, retirement can be referred to as "surrender."

Market Participants

Broker: an entity that engages in carbon unit transactions on behalf of a client (where the client is the beneficial owner of the carbon unit).

Intermediary: an entity that purchases a carbon unit on its own behalf for a purpose other than compliance. This could include entities that speculatively purchase carbon units for resale, or entities that purchase carbon units for cancellation to reduce the number of carbon units available on the market.

Project developer: an organization that voluntarily engages in a project to reduce emissions, in order to be issued with carbon units for sale to either regulated entities or voluntary purchasers.

Registry administrator: a body responsible for the day-to-day operations of the registry; it may be a public or a private body.

Regulated entity: an organization that is legally subject to an emissions cap.

Regulator: a public authority appointed by law to oversee and enforce the market mechanism.

Verifier: a body tasked with verifying, among others, that the emission reductions reported by project developers are real and additional.

Trading Levels

Domestic market: the home (national) market, as opposed to the international market. Some entities, such as power stations and industrial facilities, have emissions caps expressed in domestic legislation. These entities can acquire carbon units to comply with these caps, in accordance with the domestic legal framework.

International market: Countries (or jurisdictions such as the EU) have international emission reduction limitations or goals; countries can acquire carbon units to comply with these caps or targets in accordance with treaty rules.

Primary market: refers to the market that allowances (distributed by regulators) or carbon credits (created from ER projects) enter first. For example, the sale of a carbon credit generated by a project developer to a regulated entity for compliance with an emissions cap would take place on the primary market.

Secondary market: refers to the market on which carbon units are resold, either for further resale or for compliance purposes. The secondary market can include various options for future sales of carbon credits or other derivatives.

APPENDIX B: Indicative List of Functions to Develop User Profiles that Have Access

Type of process	Process	Specific process (as necessary)	A	B	C	D	E	F	G	H
Administration	Registry administration dashboard		✓	✓	✓					
Administration	Configure the system	Functional	✓	✓						
Administration	Configure the system	Technical	✓							
Administration	Manage an alert (function provided to the registry administrator)	The whole registry	✓	✓	✓					
Administration	Manage an alert (function provided to the users)		✓	✓	✓	✓	✓		✓	
Administration	Open an account			✓	✓					
Administration	Modify the status of account			✓	✓					
Administration	Create a new authentication profile			✓	✓					
Administration	Change an authentication profile			✓	✓					
Administration	Consult an authentication profile		✓	✓	✓					
Administration	Export authentication profiles		✓	✓	✓					
Users	Change a password		✓	✓	✓	✓	✓	✓	✓	
Administration	Revoke a password		✓	✓	✓					
Account	Modify an account		✓	✓	✓					
Account	Consult the list of accounts (for which the user is authorized)		✓	✓	✓	✓	✓	✓	✓	
Account	Consult the detail of account		✓	✓	✓	✓	✓	✓	✓	
Account	Consult the history of account balances		✓	✓	✓	✓	✓	✓	✓	
Administration	Create a user		✓	✓	✓					
Administration	Modify a user		✓	✓	✓					
Administration	Authorize a user		✓	✓	✓					
Administration	Modify user authorization		✓	✓	✓					
Administration	Authorize an administrator or registry operator		✓	✓						
Administration	Modify the authorization of an administrator or registry operator			✓	✓					
Account	Authorize an account user			✓	✓					

Type of process	Process	Specific process (as necessary)	A	B	C	D	E	F	G	H
Users	Revoke a user		✓	✓	✓					
Transactions	Enter an operation	Issuance		✓	✓					
Transactions	Enter an operation	Allocation		✓	✓					
Transactions	Enter an operation	Cancellation		✓	✓					
Transactions	Enter an operation	Internal transfer		✓	✓	✓	✓		✓	
Transactions	Enter an operation	External transfer		✓	✓	✓	✓		✓	
Transactions	Enter an operation	Unit surrendering (ETS)		✓	✓	✓	✓		✓	
Transactions	Enter the verified emissions of an installation			✓	✓					✓
Transactions	Import a file of verified emissions		✓	✓	✓					
Transactions	Import an “allocation table”		✓	✓	✓					
Transactions	Validate verified emissions			✓						✓
Transactions	Validate a transaction			✓	✓		✓		✓	
Transactions	Cancel a validated transaction			✓	✓	✓	✓		✓	
Transactions	Cancel a transaction			✓	✓	✓	✓		✓	
Transactions	Approved a transaction			✓	✓		✓		✓	
Transactions	Refuse a transaction			✓	✓		✓		✓	
Transactions	Consult the list of transactions awaiting further action		✓	✓	✓	✓	✓	✓	✓	
Transactions	Consult the list of posted transactions		✓	✓	✓	✓	✓	✓	✓	
Transactions	Consult the detail of a transaction		✓	✓	✓	✓	✓	✓	✓	
Administration	Consult alerts and notifications		✓	✓	✓	✓	✓	✓	✓	
Administration	Cancel an alert/notification			✓						
Transactions	Consult the history of operations between two dates		✓	✓	✓	✓	✓	✓	✓	
Administration	Emergency stop: registry unavailable for customers		✓	✓	✓					
Administration	Emergency stop: registry unavailable for all users and the public		✓	✓						
Administration	System restart		✓	✓						
Transactions	Consult/Download a transaction receipt/account balance		✓	✓	✓	✓	✓	✓	✓	
Administration	Enter information to publish on the public registry welcome page		✓	✓	✓					
Administration	Enter information to publish on the welcome page for authenticated users		✓	✓	✓					

Type of process	Process	Specific process (as necessary)	A	B	C	D	E	F	G	H
Administration	Export the list of natural persons and companies (e.g., name, first name, title, company name, address, e-mail, landline/mobile/fax number, formatted postal address)		✓	✓	✓					
Administration	Upload documents to make available on the public website		✓	✓	✓					

Note: A = System administrator profile; B = Registry administrator profile; C = Registry operator profile; D = Authorized representative profile; E = Additional authorized representative profile; F = Account auditor profile; G = Unique representative profile; and H = MRV report verifier profile.

APPENDIX C: Accounting Models: Type of Accounts Debited or Credited by Type of Transaction

Type of account	Type of holding	Account holder	Type of transaction													
			Provi-sioning		Buffer release		Issuance		Transfer		Surren-der		Technical deletion		With-drawal	
			DB	CR	DB	CR	DB	CR	DB	CR	DB	CR	DB	CR	DB	CR
"-Q"	Proprietary	CE/S[a]	Yes				Yes									
Issuance	Proprietary	CE/S						Yes					Yes			
User	Proprietary	Customer						Yes	Yes	Yes	Yes		Yes			
Project proponent	Proprietary	Customer				Yes		Yes	Yes	Yes			Yes			
Buffer	Third-party	CE/S		Yes	Yes			Yes								
Other holding[b]	All	Customer							Yes	Yes			Yes			
Return	Third-party	CE/S										Yes			Yes	
Withdrawal	Proprietary	CE/S														Yes
Cancellation	Third-party	CE/S	XX[c]		XX	Yes	XX		XX		XX		XX			
Deletion	Proprietary	CE/S	XX		XX		XX		XX		XX		XX	Yes		

Note: DB = Debit; CR = Credit. "-Q" represents the structurally in-debit technical account that is debited in quantity (without serial number) on each issuance.

a. CE/S: Competent authority or State.

b. Trading account, personal holding account.

c. Debit is not permitted on this account for any transaction.

APPENDIX D: Proposed Workflow Diagram for an Issuance

1 – The administrator of the registry is responsible for the issuance: he authorizes it as necessary by approving an integrated file. The date of the transaction is automatically set to current date. Serial numbers are created.

2 – Four-eye principle (optional): the issuance is monitored by a user different from the one who authorized it.

3. A – The issuance is cancelled.

3. B – The issuance is approved. Depending on optional security options, approval may require a password or code sent by SMS to be entered. Approval of the issuance is notified to authorized representatives of the transferee account.

4 – If applicable, the issuance is proposed to the central hub which carries out checks. The registry receives a response from the platform. If there is no discrepancy, the transfer may be finalized, otherwise it is cancelled.

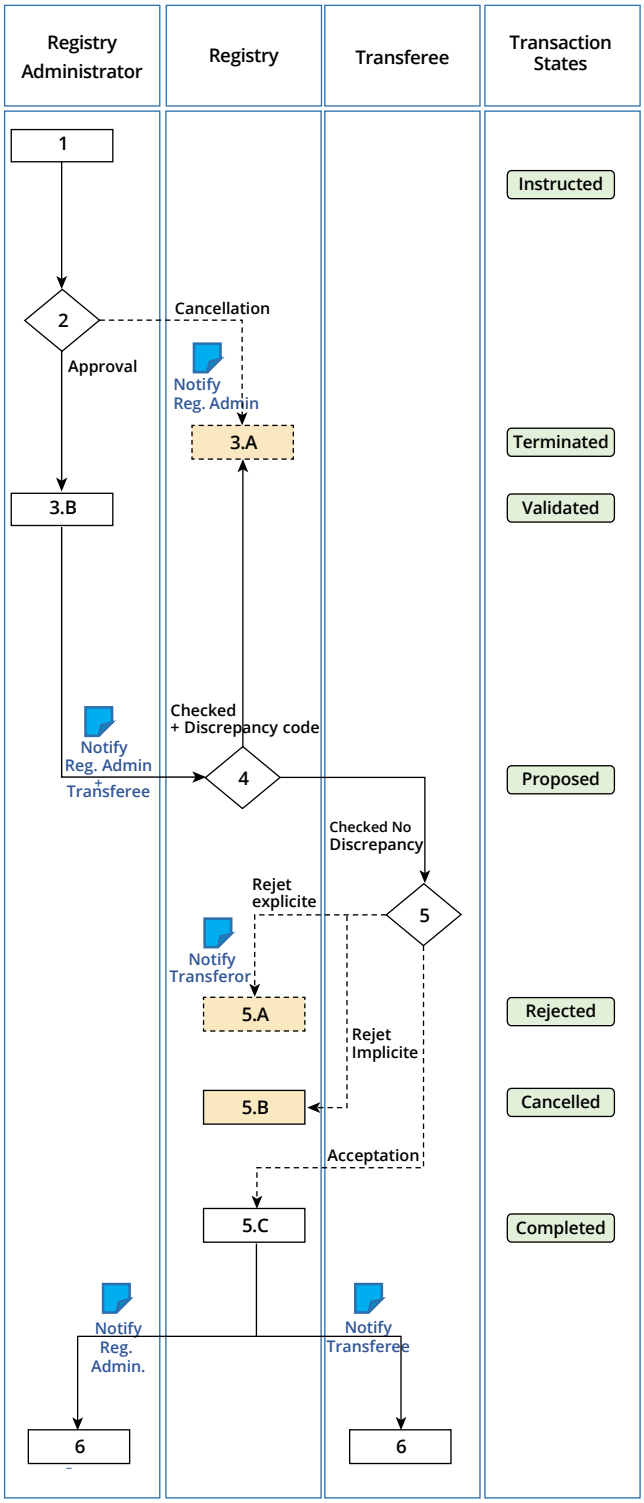
5 – Option: explicit approval may be required for the issuance from one of the authorized representative of the transferee account.

5. A – In the case of an explicit rejection, the system cancels the issuance.

5. B – Option: an issuance may be cancelled automatically after a specific time lapse without explicit approval.

5. C – The issuance is accepted (explicitly or implicitly according to the design of the system). The transferee account inventory is updated.

6 – The registry produces notifications of issuance which can be downloaded online. The administrator of the registry and authorized representatives of the transferee account are notified.



APPENDIX E: Proposed Workflow Diagram for an Issuance with Buffer Credits

1 – The administrator authorizes the issuance. The date of the transaction is automatically set to the current date.

2 – Four-eye principle (optional): the issuance is monitored by a user different from the one who authorized it.

3. A – The issuance is cancelled.

3. B – The issuance is approved. Depending on optional security options, approval may require a password or code sent by SMS to be entered. Serial numbers are created. Optional: The transaction can be cancelled (delay before completion, or request to enter a SMS code or password following incorrect entry)

4 – If applicable, the issuance is proposed to the central hub which carries out checks. If there is no discrepancy, the transfer may be finalized, otherwise it is cancelled.

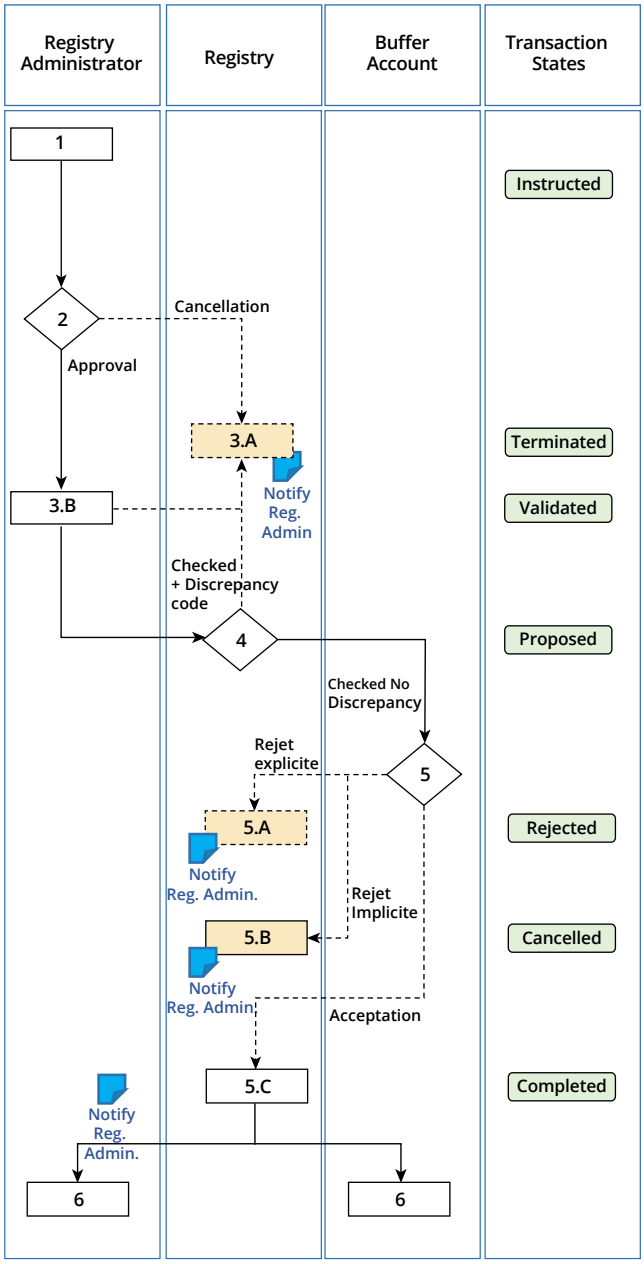
5 – Option: explicit approval may be required for the issuance from one of the authorized representative of the transferee account.

5. A – In the case of an explicit rejection, the system cancels the issuance.

5. B – Option: an issuance may be cancelled automatically after a specific time lapse without explicit approval.

5. C – The issuance is accepted (explicitly or implicitly according to the design of the system). The transferee account inventory is updated.

6 – The registry produces notifications of issuance which can be downloaded online. The administrator of the registry is notified.



APPENDIX F: Proposed Workflow Diagram for an Internal Transfer

1 – An authorized representative instructs the transfer to debit the transferor's account. The date of the transaction is automatically set to the current date.

2* – *Four-eye principle (optional): the transfer is reviewed by an authorized representative different from the one who instructed the transfer.

3. A – The transfer is cancelled.

3. B – The transfer is approved. (Based on optional security measures, such approval may require entering a password or an SMS code.) The serial number affected by this transaction are no longer available for any transaction.

4 – Option: after a certain time, an automatic decision may cancel or confirm the transfer.

5 – If applicable, transfer to the central hub for a check (e.g. internal transfer between accounts bearing distinct account types).

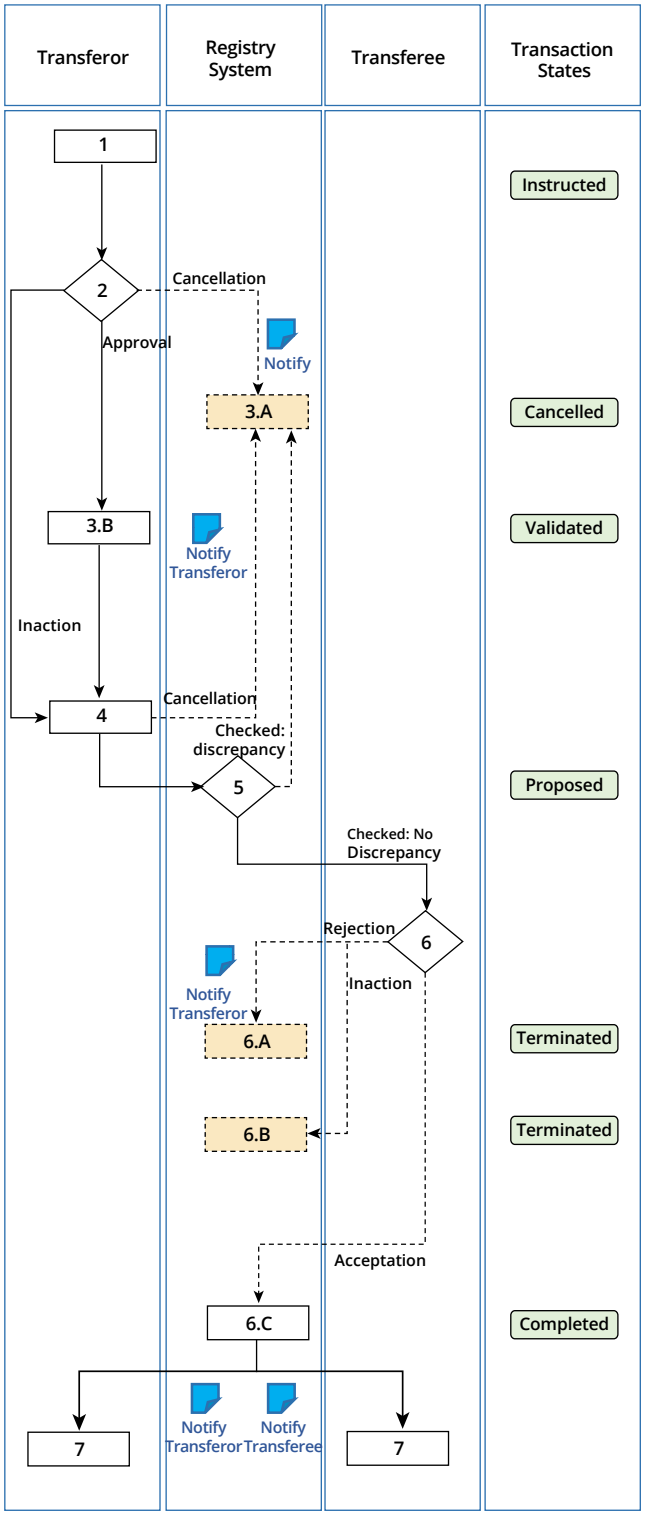
6 – Option: explicit approval of the transfer may be required by one of the authorized representatives of the transferee's account.

6. A – In case of rejection of the transfer by the transferee, the system cancels the transaction and restores the inventory of the transferor's account to its position prior to the transfer.

6. B – Option: the rejection of the transfer can be performed automatically after a certain period without explicit approval by an authorized representative of the transferee's account.

6. C – The transfer is approved (either explicitly or automatically depending on the system design). The inventories of the accounts involved in the transfer are updated.

7 – The registry produces transfer notifications that are downloadable online. The authorized representatives of the transferor's account and the transferee's account are both notified.



APPENDIX G: Proposed Workflow Diagram for an External Transfer

1 – An authorized representative instructs the transfer to debit the transferor's account. The date of the transaction is automatically set to the current date.

2 – Four-eye principle (optional): the transfer is reviewed by an authorized representative different from the one who authorized the transfer.

3. A – The transfer is cancelled.

3. B – The transfer is approved. (Based on optional security measures, such approval may require entering a password or an SMS code). The serial numbers affected by this transaction are no longer available for any transaction.

4 – Option: after a certain time, an automatic decision may cancel or confirm the transfer.

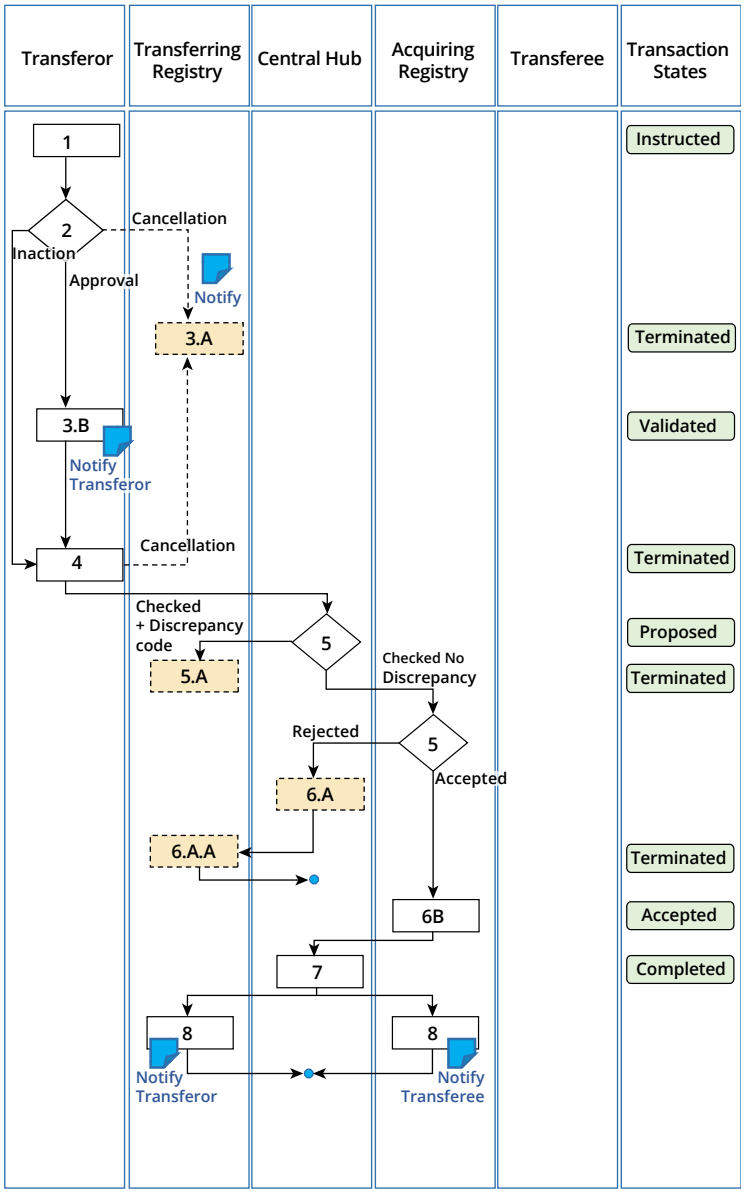
5. A – The central hub rejects the transfer.

6 – The central platform proposes the transfer to the rejection of the transfer proposal which notifies the payer ***(6A.A)*** who confirms receipt.

6. B – The destination registry accepts the proposal for transfer and notifies the platform.

7 – The central platform notifies both registries.

8 – Both registries post the transfer and produce notifications of successful transfer. The authorized representatives of the payer account and transferee account are notified by their respective registries. The central platform is notified of the successful completion of the transaction by each registry.



APPENDIX H: Proposed Workflow Diagram for a Cancellation

1 – An authorized representative authorizes the cancellation of the withdrawal from the payer account. The date of the transaction is automatically set to the current date.

2* – *Four-eye principle (optional): the transfer is reviewed by an authorized representative different from the one who instructed the transfer.

3. A – The transaction is cancelled.

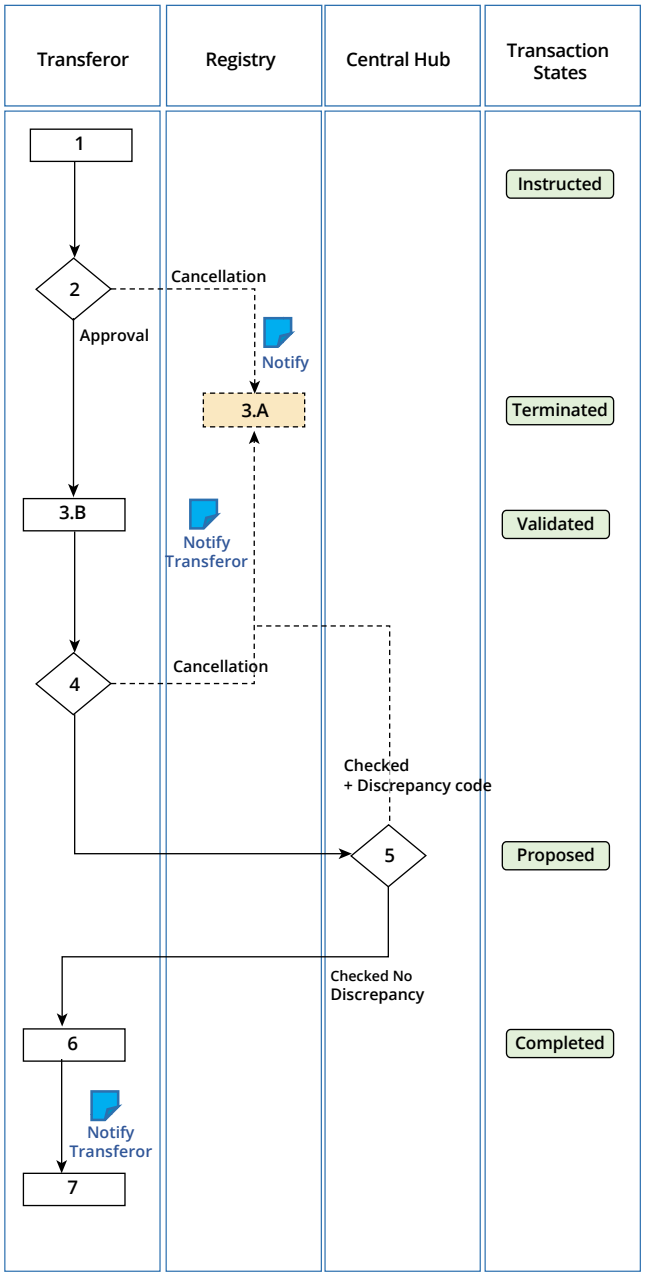
3. B – The transaction is approved. (Based on optional security measures, such approval may require entering a password or an SMS code.) The serial number affected by this transaction are no longer available for any transaction.

4 – Option: after a certain time limit without approval or explicit cancellation, the transaction can be automatically cancelled or non approval automatically recorded.

5 – Option: the cancellation may be under the control of the central platform which may block or finalize it.

6 – Once posted, the debited and credited account journals are updated.

7 – The registry produces notifications of issuance which can be downloaded online. The authorized representatives of the payer account are notified.



APPENDIX I: Origins and Specifications of Kyoto Registries

National registries have been established under the Kyoto Protocol by the Parties listed in Annex 1 of the UNFCCC, in accordance with the Kyoto Protocol, article 7.4: "The Conference of the Parties serving as the meeting of the Parties to this Protocol shall also, prior to the first commitment period, decide upon modalities for the accounting of assigned amounts," and article 17: "The Conference of the Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading."

National registries have been developed and upgraded over time, in accordance with COP and CMP decisions. Compliance with the Data Exchange Standard (DES) is required for any national registry to be able to connect to any other Kyoto registries through the International Transaction Log (ITL). It should be noted that Annex H to the DES provides a comprehensive and detailed test plan for registries: each registry transaction must pass these tests prior to connecting to the ITL.

Table 41below provides a list of the main Conference of the Parties (COP) and Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP) decisions that are relevant to the design of Kyoto registry systems.

TABLE 40: **Main COP and CMP Decisions with Relevance for the Design of Registry Systems**

Decision	Year	Purpose
24/CP.8	2005	a. Technical standards for data exchange between registries.
16/CP.10	2004	a. Define content and standard electronic format of reports issued by registries; b. Consistency between national registries, CDM registry, ITL; c. Specific operations (replacement of expired units) and calculation of the commitment period reserve; d. Disclosure of information.
13/CMP.1	2005	a. Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol; b. Registry requirements.
14/CMP.1	2005	a. Specify standard electronic format requirements applicable to reports issued by registries.

Note: COP = Conference of the Parties; CMP = Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol ; CDM = Clean Development Mechanism; ITL = International Transaction Log.

APPENDIX J: Analytical Framework to Compare Registries

The table below provides a generic list of key characteristics that can be used to compare registries.

Id.	CHARACTERISTIC
ADMINISTRATION	
1.	Is the administrator of the registry a public or private entity?
2.	Is the registry administered at different jurisdictional levels (i.e., national, provincial, regional)?
3.	How many users does the registry have?
4.	How many accounts are open in the registry?
5.	How many full-time staff (or equivalent) administer the registry?
6.	How many accounts are held by compliance entities (as opposed to intermediary and financial sector accounts)?
7.	What are the operational hours and days of the registry?
8.	What are the main security measures adopted for the registry?
CONNECTIVITY	
9.	What other systems is the registry connected to (e.g., GHG reporting platform, trading platform)?
10.	Is the registry connected to other registries? How many?
11.	In case of connection to one or more registries: how are external transfers accounted for?
12.	In case of connection to one or more registries: is the connection based on peer-to-peer or a central hub?
13.	In case of connection to one or more registries: is the communication protocol used tailor- made or standard (e.g., Swift, DES)?

Id.	CHARACTERISTIC
FUNCTIONS AND DATA	
14.	Does the registry manage types of transactions other than issuance, allocation, transfer, and cancellation (e.g., buffer provisions, buffer release, or surrendering)?
15.	Does the registry manage accounts other than holding accounts? For example, accounts for specific participants (e.g., subnational government or financial players) or accounts for specific purposes (e.g., cancellation or auctions)?
16.	What types of units does the registry account for?
17.	What are the add-on labels managed by the registry (e.g., co-benefits)?
18.	What are the authentication profiles available to registry users (e.g., data entry, entry and validation, read only)?
DELIVERY MODEL	
19.	Was the registry IT system developed from scratch, adapted from existing solutions, or "rented" on use (SaaS)?
20.	What kind of external support has been sought to implement an operational registry: Synthetize business requirements and prepare functional specifications? Prepare IT technical specifications? Provide development, hosting, and maintenance services? Provide hotline services? Provide all or part of the registry administration services (initial contact, following up on and updating of documents pertaining to account holders)?

APPENDIX K: Forest Carbon Units and Existing Market Mechanisms

Given the limited experience with the implementation of REDD+ programs in developing countries, it is helpful to review the market mechanisms established in developed countries and voluntary markets to reduce forest emissions, and the transaction registries put in place to handle forest carbon units. This appendix reviews five systems: Australia's Carbon Farming Initiative (CFI), the New Zealand Emissions Trading Scheme (NZ ETS), the United Kingdom Woodland Carbon Code, California's Cap-and-Trade Program, and the Verified Carbon Standard (VCS).

These systems are reviewed according to five criteria: (i) the role of carbon markets; (ii) the scale of implementation; (iii) the role of the private sector; (iv) permanence measures; and (v) governance. The main design features of each system according to these five criteria are outlined in five tables, and followed by a detailed description of each system and its relevant registry arrangements.

1. Role of Carbon Markets

Australia Carbon Farming Initiative	The CFI originally created a regulated national market in forest carbon units, where forest carbon units can be purchased as offset credits. The CFI has been reformed into a quasi-market, where the government purchases forest carbon units from landowners through a reverse auction.
New Zealand Emissions Trading Scheme	The NZ ETS links forest carbon units to both a domestic regulated market and an international regulated market.
U.K. Woodland Carbon Code	The WCC created a regulated national market in forest carbon units, where forest carbon units can be purchased to offset GHG reporting obligation.
California Cap-and-Trade Program	Created a regulated subnational market in forest carbon units, where forest carbon units are used as offset credits in a cap-and-trade system.
Verified Carbon Standard	The VCS is a program through which forest carbon units are marketed as voluntary offsets.

Australia's Carbon Farming Initiative (CFI) is a mechanism to generate carbon credits through land- use activities.[76] The CFI was originally designed as an offset mechanism within Australia's Carbon Pricing Mechanism (CPM), which enabled covered entities to avoid fixed charges on carbon by purchasing credits generated by voluntary projects, priced according to supply and demand. Forestry projects are a major part of the CFI, farmers and landowners being allowed to earn carbon credits through revegetation and reforestation of their land. It had been anticipated that up to 5 percent of an entity's liability under the CPM could be met with offsets for an initial period (2012–15), rising to all of an entity's liability under the CPM in a subsequent period.

Following the repeal of the Carbon Pricing Mechanism in 2014, and its replacement with an Emissions Reduction Fund (ERF) to finance voluntary emission reductions (ERs), the CFI was amended to function more like a compensation scheme, where credits generated through projects are "sold" to the government through reverse auctions.[77]

New Zealand's Emissions Trading Scheme (NZ ETS) was introduced in 2008 to help New Zealand meet its ER targets under the Kyoto Protocol. Participants with obligations under the NZ ETS must acquire and surrender New Zealand Units (NZUs) or other eligible units in an amount proportional to GHG emissions released.[78] The NZ ETS covers emitters in the forestry, liquid fossil fuels, electricity production, industrial processes, synthetic gases, and waste sectors, with biological emissions from, and agriculture subject to reporting obligations. To prevent loss of international

76 See http://www.environment.gov.au/climate-change/emissions-reduction-fund/cfi/about.

77 See Carbon Farming Initiative Amendment Act 2014.

78 The following units can also be purchased by participants in the NZ ETS and canceled or surrendered to meet their obligations: Emission Reduction Units (ERUs), generated by Joint Implementation (JI) projects that reduce emissions or create forest sinks in so-called Annex B countries; Removal Units (RMUs), awarded to Annex B countries on the basis of net removals by carbon sinks in the land use, land-use change, and forestry sector; and Certified Emission Reductions (CERs), generated by the Clean Development Mechanism (CDM). However, since June 1, 2015, Kyoto Protocol units have no longer been eligible for use to meet obligations under the ETS.

competitiveness from the NZ ETS and ease the financial cost of compliance, NZUs were initially freely allocated to participants in the fishing and forestry sectors, as well as to firms whose activities are emissions-intensive and who are exposed to international trade. Allocation rates of NZUs are based on the size and emissions intensity of operations, and the amount of free NZUs provided each year is indexed to production.[79] Participants can also purchase NZUs directly from the government at a fixed price or from other entities with surplus NZUs, or that have generated NZUs voluntarily.

Under the NZ ETS, landowners of "post-1989 forest land"[80] do not face legal obligations, but may voluntarily participate in the NZ ETS, receiving NZUs for increases in the carbon stock of their forest, which can then be sold to other participants. However, they are also treated as an emitter so if they harvest or deforest their land, they must repay units to the government. Landowners of post-1989 forest land may also earn NZUs by participating in the government's Permanent Forest Sink Initiative (PFSI), which is similar to the NZ ETS, except for some minor differences, described below. Landowners of pre-1990 forests face legal obligations under the NZ ETS for deforesting land. Moreover, they cannot earn NZUs for increases in forest carbon stocks, do not have surrender obligations for loss of carbon stocks provided the land remains forest, and cannot participate in the PFSI.

The Climate Change Response Act (2002)—the legislation that established the NZ ETS—also allows account holders to exchange NZUs for NZ-originated Assigned Amount Units (AAUs), a unit that can be traded internationally under the Kyoto Protocol. Conversion takes place via the New Zealand Emissions Unit Register (NZEUR) platform. The legislation committed the government to convert units, and is contingent on the availability of AAUs and the Commitment Period Reserve.[81] Where an AAU is transferred to an overseas registry, the transaction is made via the International Transaction Log (ITL). The overseas registry must be linked to the ITL for the transaction to be completed.[82] Since 2009, only NZUs transferred for forestry removal activities have been eligible for conversion to AAUs so they can subsequently be transferred to an overseas registry. Since 2015, conversion has not been possible in practice because trading in Kyoto Protocol first commitment period units has been closed off. New Zealand took its emission reduction target for 2013–20 under the UNFCCC rather than adopt a Kyoto Protocol target for the second commitment period. Therefore, New Zealand will not issue any second commitment period AAUs and none will become available.

United Kingdom's Woodland Carbon Code (WCC) was launched in 2011, as a voluntary standard for forest projects that generate and sell credits (known as Woodland Carbon Units or WCUs) for carbon sequestration. Although project developers and purchasers cannot use WCUs in any compliance scheme and WCUs are not internationally tradable, U.K. companies can use WCUs when reporting on their GHG emissions (since 2013, all United Kingdom-based quoted companies have had to report on their GHG emissions as part of their annual Director's Report[83]) and in claims of carbon neutrality of an organization's activities, products, services, buildings, projects, or events.[84] WCUs will also be accounted for at the national level toward the United Kingdom's national targets for reducing GHG emissions under the Kyoto Protocol and the U.K. Climate Change Act 2008.

California's Global Warming Solutions Act of 2006 (AB32) requires the state to reduce GHG emissions to 1990 levels by 2020. As one tool to achieve this, AB32 authorized the Air Resources Board (ARB) to develop a state-wide cap-and-trade program, which went into effect in January 2013. Forestry emissions are not directly regulated under **California's Cap-and-Trade Program**. However, covered entities (those organizations with GHG compliance obligations under the Cap-and-Trade Program) may use offset credits for up to 8 percent of their total compliance obligation, and the ARB has approved U.S. forestry projects as a source of compliance offset credits.

The **Verified Carbon Standard (VCS)**, established in 2006, is a *global* program that offers standardized methodologies for *voluntary* ER projects and programs, and provides a platform through which to track the ERs generated (called Verified Carbon Units or VCUs). The purpose of the VCS program is to provide quality assurance to companies, governments, and other entities looking to voluntarily offset their GHG emissions. The VCS was one of the first global standards to develop crediting for agriculture, forestry, and other land-use (AFOLU) projects, and has developed the world's first framework for Jurisdictional and Nested REDD+ (JNR).

79 http://www.climatechange.govt.nz/emissions-trading-scheme/participating/industry/allocation/how-it-works/.

80 Areas that were not forest land on December 31, 1989, or were forest land on December 31, 1989, but were deforested between January 1, 1990, and December 31, 2007. Landowners of pre-1990 forest have a legal obligation under the NZ ETS to surrender units.

81 Account holders will not be able to transfer Kyoto units internationally if their transfer would cause the minimum number of Kyoto units held within the NZEUR to fall below the Commitment Period Reserve (CPR), currently set at 90 percent of New Zealand's initial assigned amount.

82 http://www.eur.govt.nz/about-us/transfer-units.

83 Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013.

84 PAS2060: 2014 http://shop.bsigroup.com/ProductDetail/?pid=000000000030286698.

2. Scale of Implementation

Australia Carbon Farming Initiative	Project-level crediting only
New Zealand Emissions Trading Scheme	Project-level crediting only
U.K. Woodland Carbon Code	Project-level crediting only
California Cap-and-Trade	Currently project-level crediting only. However, nesting options would be considered in the event that ARB would decide to allow international REDD+ credits.
Verified Carbon Standard	Three accounting and crediting scenarios: (i) crediting to projects only; (ii) crediting to jurisdictions only; and (iii) crediting to both projects and jurisdictions with nesting of projects.

Australia's CFI, the **NZ ETS**, and the **United Kingdom WCC** are implemented at the project level only. There is no jurisdictional issuance or accounting and, hence, no nesting arrangements are in place.

Under **California's Cap-and-Trade Program**, U.S. forestry projects are only credited at the project level, so no nesting arrangements are in place either. However, the Cap-and-Trade regulation does consider nesting arrangements in the case that international REDD+ credits would be permitted for use in the Cap-and-Trade Program (though to date ARB has yet to authorize the use of such credits). The staff's report accompanying the Cap-and-Trade regulation considers two crediting pathways for crediting programs: (i) an ARB-approved program achieves sector-wide ERs from mitigation policies undertaken by or in coordination with the jurisdiction; or (ii) an ARB-approved program issues credits to project developers for project-level activities that are "nested" within a jurisdiction-wide sectoral program.85 If following a nested approach, projects must follow a methodology that ensures the inventorying, quantification, monitoring, verification, enforcement, and accounting for all project-level activities, and also includes a system for reconciling offset project-based GHG reductions in sector-level accounting from the host jurisdiction. Hence, the host state's REDD+ program would need to define how credits will be allocated between projects and the jurisdictions.[86]

VCS's approach to scale is set out in its JNR Requirements, which offers three different accounting and crediting scenarios. Under the first scenario, individual projects within the same jurisdiction (i.e., in the same region or country) are credited relative to reductions against a jurisdiction-wide baseline. This scenario is appropriate where there is no jurisdictional REDD+ program, but only stand-alone projects. Under the second scenario, individual projects are "nested" within jurisdictional programs, with the option for VCUs to be credited directly to individual projects, or to the jurisdiction itself, if removals take place outside the boundaries of any individual projects. This scenario is appropriate where nested projects exist within jurisdictional REDD+ programs. Under the third scenario, VCUs cannot be credited to individual projects, but only to the jurisdictional proponent for removals across the entire jurisdiction. This scenario is appropriate where there are no well-developed, independent REDD+ projects, or where REDD+ interventions are planned at the jurisdictional level and implemented by representatives of jurisdictional authorities. Under scenarios two and three, the jurisdictional proponent is responsible for monitoring, and leakage and risk assessments. Jurisdictions are able to transition—for instance, from scenario 1 to scenario 2, or from scenario 2 to scenario 3, depending on evolving preference and the level of development of their REDD+ programs.

Scenario 2 potentially involves the registration of three levels of implementing body with a VCS registry: (i) national authorities (the highest level); (ii) lower jurisdictional-level authorities; and (iii) project-level operators. Lower-level programs or projects must be reviewed and approved or receive no-objection by the higher-level jurisdictional proponents in order to be registered. Scenario 2 will thus require a more sophisticated registry arrangement to track and account for ERs at different scales. There must also be a clear allocation of rights between the various levels, to request issuance of VCUs from a VCR registry.

The assessment of double counting of ERs is performed at project validation and verification. When the Validation/Verification Body (VVB) is actually verifying, they must ensure that the jurisdiction or project is attempting to verify only those ERs that they are able to verify. The JNR Registration and Issuance Process document sets out all the registry procedures relevant to JNR REDD+.[87] Once VCUs are issued at either the jurisdictional or project level, they are treated in much the same way within the registry. The exception is the buffer account; VCS keeps a separate buffer for jurisdictional ERs, given the potentially overwhelming effect that a

85 See http://www.arb.ca.gov/regact/2010/capandtrade10/capisor.pdf.

86 For discussion, see http://greentechleadership.org/documents/2013/07/row-final-recommendations-2.pdf.

87 http://www.v-c-s.org/sites/v-c-s.org/files/JNR%20Registration%20and%20Issuance%20Process,%20v3.0.pdf.

reversal at the jurisdictional level could have on the project AFOLU buffer.

3. Role of Private Sector

Australia Carbon Farming Initiative	Originally forest carbon units issued to private landowners and developers, and purchased by private sector entities. Currently, forest carbon units issued to private landowners or private project developers and sold to the government.
New Zealand Emissions Trading Scheme	Forest carbon units are purchased by private sector entities and issued to private landowners and project developers, and can also be traded on secondary markets.
U.K. Woodland Carbon Code	Forest carbon units purchased by private sector entities and generated by private landowners and project developers.
California Cap-and-Trade Program	Forest carbon units purchased by private sector entities and issued to private landowners and project developers. Offset credits can also be traded on secondary markets.
Verified Carbon Standard	Forest carbon units on voluntary markets are generated by private developers and can be purchased by public or private entities, though the bulk of purchasers are from a small pool of private companies.

In all five systems reviewed, ERs are generated by private landowners or project developers with the permission of private landowners, and forest carbon units are issued to accounts held by private landowners/project developers for marketing. This approach is possible thanks to the clarity and security of land tenure regimes in the implementing countries, and may be harder to replicate in REDD+ countries where tenure is contested. Interestingly, data in the New Zealand registry, including unit holdings and transactions, are publicly available and can be searched online.

In three of the four national systems reviewed, the domestic private sector is the main purchaser of forest carbon units. Private sector entities are incentivized to purchase forest carbon units to either meet an emissions cap (as in the California Program) or improve public reporting of GHG emissions (as in the U.K. WCC). REDD+ countries that expect the domestic private sector to invest in forest carbon units must also be willing to create the necessary incentive structures, for instance, an emissions cap (or some other liability such as an emissions tax) to create private demand for such units.

4. Permanence measures

Australia Carbon Farming Initiative	Automatic deduction of 5% of credits. No separate buffer account. Relinquishment of credits in the event of significant reversal.
New Zealand Emissions Trading Scheme	Requirement to surrender credits in event of reversal. No separate buffer account.
U.K. Woodland Carbon Code	Contribution to pooled buffer account based on risk assessment. No process for release of credits in buffer account.
California Cap-and-Trade Program	Contribution to a pooled buffer account based on risk assessment. No process for release of credits in buffer account.
Verified Carbon Standard	Contribution to pooled buffer account based on risk assessment. Buffer credits become eligible for release where projects meet VCSA risks-related requirements and show a reduced risk over time.

For forest offset projects in the **Australia CFI**, a risk of reversal buffer applies, in which five percent of the credits sequestered by a project are deducted from the net number of tons reduced.[88] This buffer is automatically deducted and does not do into a separate buffer account.

In the event of a significant reversal due to a natural disturbance or conduct beyond the control of the project proponent, and where the project proponent has not taken reasonable steps to mitigate the effect of that natural disturbance or conduct, the project proponent may be required to relinquish a certain number of carbon credits.[89] The relinquishment requirement also applies in the event of an intentional reversal.[90] The project proponent remains liable for reversals throughout the permanence period (the maximum permanence period being 100 years)[91] and must notify the Clean Energy Regulator (Regulator) in the event of a reversal. The registered holder of an Australian Carbon Credit Unit (ACCU) can relinquish units by electronic notice transmitted to the Regulator, specifying the number of units relinquished and the reason for it.[92] If the project proponent does not relinquish sufficient ACCUs to comply with the requirement, it becomes liable to pay the government for every unit not relinquished.[93]

88 CFI 2011, arts. 16–17.

89 Ibid., art. 91.

90 Ibid., art. 90.

91 Ibid., art. 87.

92 Ibid., art. 175.

93 Ibid., art. 179

New Zealand's PFSI and ETS do not require forest landowners to contribute units to a buffer account. Under the PFSI, landowners earn units for every additional ton of carbon dioxide stored in forest. If carbon stocks subsequently fall below a previously reported level, whether due to planned or unplanned deforestation, landowners become liable to surrender a corresponding number of units to make up the shortfall. The landowner is not liable to surrender more units than the number of units transferred to the landowner's account for a given area of forest.[94] Similarly, under the ETS, participants become liable to surrender units when harvest or deforestation occurs in forest for which units have already been issued, or where forest land participants choose to deregister an area of post-1989 forest from the ETS. In the ETS, all deforestation in both pre-1990 and post-1989 forests (with a few minor exemptions) incurs surrender obligations.[95]

For the **United Kingdom WCC**, landowners must calculate the level of risk of a reversal according to the guidance on WCC Risk Assessment, taking into account legal, project management, and financial risks in addition to natural disturbance risks.[96] Based on the risk assessment score (which will lie between 15 and 40 percent of net carbon sequestered), project developers contribute a proportion of the project's net carbon sequestration to the WCC Buffer, a single account held in the Markit Registry and managed by the Forestry Commission. There should be sufficient units in the "pooled" buffer to cover any losses from individual project reversal events.

At the validation stage, Pending Issuance Units (PIUs) are transferred to the WCC PIU buffer account. Upon verification, these PIUs will be canceled, and the same number of WCUs transferred to the WCC buffer account.

In the event of a "loss" (defined as "the woodland losing some of its trees and standing volume because of avoidable or unavoidable circumstances"), the project must submit a Loss Event Report and the relevant number of WCC buffer units to cover the loss will be put on hold. In the event of a "reversal" (i.e., when the net GHG benefit of the project is negative in a given monitoring period), WCC buffer units already put on hold (and additional buffer units if required) will be canceled and the Project Design Document reviewed with the aim of taking Corrective Actions to compensate the losses in a reasonable time frame. Where the reversal is *avoidable,* the project must reimburse the WCC Buffer for all credits canceled before additional WCUs can be issued. Where the reversal is ***unavoidable*** (e.g., due to extreme weather events), the project must only reimburse the WCC Buffer for carbon units canceled in excess of the contribution the project had previously made.[97]

At the end of a project's duration, all remaining buffer units contributed by a project are canceled (the project duration can be up to 100 years from the project's start date). There is no process for the release of credits held in buffer accounts.

As noted in the paragraphs above on tenure requirements, additional permanence safeguards include the Forestry Commission's ability to withhold a felling license where planned felling has not been part of the WCC project's management plan, and the requirement to conduct an Environmental Impact Assessment for all deforestation covering more than one hectare.

In the **California Cap-and-Trade Program**, to ensure against the risk of forest reversals, a portion of the ARB credits issued to forest project operators are transferred to a Forest Buffer Account.[98] When Offset Project Registries (OPRs) issue Registry Offset Credits (ROCs), they also issue buffer account credits. When a project seeks ARB credit issuance, all credits (including buffer account credits) are retired by the OPR, and the ARB issues an equal number to the operator and the ARB Buffer Account. The portion of credits transferred to the Buffer Account is based on a project-specific risk rating of reversals, which is conducted by project operators.[99]

In the event of an *unintentional* reversal,[100] ARB will retire ARB offset credits from the Forest Buffer Account equivalent to the amount of carbon lost in the reversal. In the event of an *intentional* reversal,[101] the forest owner must, within six months, replace the ARB offset credits by submitting additional compliance instruments equivalent to the amount of carbon lost in the reversal, for placement in a Retirement Account. Failure to do so renders the forest owner subject to enforcement action; retiring offset credits from the Buffer

94 http://www.mpi.govt.nz/document-vault/6940.

95 https://www.climatechange.govt.nz/emissions-trading-scheme/participating/forestry/obligations/.

96 http://www.forestry.gov.uk/forestry/INFD-8J5B82#legal.

97 http://www.forestry.gov.uk/forestry/infd-8vxmlf.

98 http://www.arb.ca.gov/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf.

99 http://www.arb.ca.gov/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf.

100 Any reversal, including wildfires or disease, that is not the result of the forest owner's negligence, gross negligence, or willful intent.

101 Any reversal caused by a forest owner's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the area within the offset project boundary.

Account to make up for the difference also constitutes a violation.[102]

Under the **VCS**, the non-permanence risk associated with land-use projects is addressed through an AFOLU pooled buffer account that holds buffer credits, which are different from VCUs in that they cannot be traded.[103] The number of buffer credits placed in a buffer account is based on a non-permanence risk report prepared by the project proponent and assessed by a (VVB) at both project validation and ER verification. Given that risk ratings may change over time, a risk analysis must be conducted every time ERs are verified. Where the non-permanence risk rating is verified to be equal to or less than the previously verified non-permanence risk rating,[104] the project becomes eligible for the release of buffer credits from the AFOLU pooled buffer account.[105] Released buffer credits become VCUs that can be traded like any other VCU.

On the occurrence of a "loss event" (any event that results in a loss of more than five percent of carbon stocks in pools included in the project boundary but not planned for in the project description[106]), the VCS registry administrator must put a number of buffer credits (equivalent to the amount lost as stated in a "loss event report") on hold.[107] If, at the next verification event, the net GHG profile of the project is negative (i.e., more GHGs have been released than sequestered), a reversal has occurred. If, on the other hand, the net GHG emission reductions or removals are positive at the time of verification, a reversal is deemed ***not*** to have occurred and buffer credits are released from their hold status. Where the total reversal is less than the number of credits put on hold, the VCS registry administrator cancels buffer credits equivalent to those released in the reversal event and removes the remaining buffer credits from their hold status. Where the total reversal is greater than the number of credits put on hold, all buffer credits put on hold are canceled and additional buffer credits from the AFOLU pooled buffer account are canceled to the extent of the GHGs released in the reversal event.

Where the reversal is a *catastrophic* reversal ("caused by disasters such as hurricanes, earthquakes, flooding, drought, fires, tornados or winter storms, or man-made events over which the project proponent has no control"[108]), the baseline may be reassessed, though no VCUs will be issued for any increased rate of sequestration from natural regeneration and any shortfall in buffer credits must be deposited in the buffer account. Where the reversal is the result of poor management or overharvesting (non-catastrophic), no further VCUs can be issued until the deficit is remedied.

5. Governance

Australia Carbon Farming Initiative	CFI is governed by Australia's Clean Energy Regulator (a public body), which is responsible for issuing credits and maintaining a register of projects. The Regulator also administers the Australian National Registry of Emissions Units (ANREU), that is, the registry.
New Zealand Emissions Trading Scheme	The New Zealand Emissions Unit Register (NZEUR) is administered by the New Zealand government.
U.K. Woodland Carbon Code	WCC is governed by the Forestry Commission, a quasi-autonomous non-governmental organization, or "quango." Registry services have been contracted out to Markit, a private company.
California Cap-and-Trade Program	The California Air Resources Board (ARB), a public body, is the governing authority. Offset Project Registries (OPRs) are run by third parties (e.g., VCS), which verify, issue, and track credits on a separate registry before OPR credits can be converted for use within the ARB registry.
Verified Carbon Standard	VCS is a private, non-profit group. The VCS project database is managed by the VCS Association. Information is fed into the database from "VCS registries." Markit and APX, private operators, are contracted by the VCS Association (VCSA) to provide registry services.

Under **Australia's CFI**, the Clean Energy Regulator (the Regulator) issues ACCUs to projects generating ERs according to approved methodologies. To run a project, the project

102 http://www.arb.ca.gov/cc/capandtrade/guidance/chapter6.pdf

103 VCS Agriculture, Forestry and Other Land Use (AFOLU) Requirements, version 3, 3.7, available at http://www.v-c-s.org/sites/v-c-s.org/files/AFOLU%20Requirements%2C%20v3.4.pdf.

104 That is, their "longevity, sustainability and ability to mitigate risks."

105 VCS Jurisdictional and Nested REDD+ (JNR) Registration and Issuance Process, Version 3, 5.2, available at http://www.v-c-s.org/sites/v-c-s.org/files/JNR%20Registration%20and%20Issuance%20Process%2C%20v3.0.pdf.

106 Defined by VCS as "any event that results in a loss of more than five percent of carbon stocks in pools included in the project boundary but is not planned for in the project description," see http://www.v-c-s.org/sites/v-c-s.org/files/Program%20Definitions%2C%20v3.5.pdf.

107 VCS Agriculture, Forestry and Other Land Use (AFOLU) Requirements, Version 3, 3.7.7.

108 http://www.v-c-s.org/sites/v-c-s.org/files/Program%20Definitions%2C%20v3.5.pdf.

participant must become a Recognized Offsets Entity (ROE). Once this is done, the Regulator can approve Eligible Offsets Projects (EOPs) submitted by the ROE, which may then generate ACCUs. There are two types of ACCUs: Kyoto ACCUs, generated from projects within Australia's Kyoto Protocol emissions reporting inventory (e.g., reforestation projects), which can be sold for compliance with the CPM; and non-Kyoto ACCUs, for use in voluntary markets. The Regulator can only issue ACCUs to entities holding an account with the ANREU (Registry). ACCUs can subsequently be traded between entities within the Registry.

The Regulator must maintain an up-to-date electronic Register of Offsets Projects (the Register).[109] For each eligible offset project, the Register must set out, among other things, the name, location, and description of the project, the project proponent, the applicable methodology for the project, and the number of Kyoto ACCUs and non-Kyoto ACCUs (with further details including vintage, transfers, etc.) issued for the project.[110]

An ACCU is personal property under Australian law and can be transferred between Registry account holders by assignment. On transfer, entries should be removed from the transferor's account at the same time they are credited to the transferee's account, with all transfers recorded in the Registry. The 2011 legislation contained provisions for the international transfer of units in and out of the Australian Registry, provided such units met required specifications,[111] but the CPM was repealed before Australia's program was linked to other trading systems. According to the Clean Energy Act 2011, Kyoto ACCUs (and certain non-Kyoto ACCUs[112]) can be surrendered by an entity holding the ACCUs to meet any liabilities under the CPM.

Established by the Climate Change Response Act (2002), the **New Zealand Emissions Unit Register** (NZEUR) is responsible for accounting, reporting, and reconciliation of emissions and unit holdings and transactions under the NZ ETS, which is done by way of an online registry.[113] The New Zealand government is responsible for issuing NZUs. Entities with obligations under the NZ ETS must open a holding account with the NZEUR through which to surrender units to the government. Entities wishing to voluntarily participate in the NZ ETS as post-1989 forest landowners to receive units must also open a holding account with NZEUR, as must entities wishing to hold and trade units to take advantage of market opportunities. Forest landowners wishing to receive NZUs under the PFSI must also set up a NZEUR holding account.[114] NZEUR records the title of units held in a holding account and allows for the transfer of units between NZEUR holding accounts. Data in the registry are publicly available and can be searched online.[115]

The **U.K. Woodland Carbon Registry (WCR)** is responsible for project registration and the issuance, tracking, and retirement of WCUs.[116] The Markit Registry has been contracted to provide these services, though the Forestry Commission (a quasi-autonomous non-governmental organization) retains overall responsibility. In addition to project registration and WCU management, the registry provides a "request for information" platform on which projects or brokers can offer any unretired units for sale. The WCR is publicly available and provides information on account holders, projects, unit issuances, holdings, and retirements. The information listed includes a project's name, type, status, validator, developer, and location, as well as a link to the Project Design Document (PDD) and validation/verification statements.

The Compliance Instrument Tracking System Service (CITSS) is the main registry system of the **California Cap-and-Trade Program**, used to hold, transfer, and retire compliance instruments. Covered entities, project operators generating offsets, and any other bodies holding or trading compliance instruments on the secondary market, must register an account with the CITSS. However, it is important to note that offset credits are initially tracked in separate authorized Offset Project Registries (OPRs), and must be converted to "ARB credits" before they can be used for compliance with the Cap-and-Trade Program.

OPRs are independent bodies, approved and overseen by ARB, that monitor offset projects and issue Registry Offset Credits (ROCs) to operators. To date, ARB has approved three OPRs: Verified Carbon Standard, American Carbon Registry, and Climate Action Reserve. Project operators must list their projects with one of these OPRs. Following third-party project verification performed pursuant to ARB regulatory requirements, the OPR must determine whether an operator has satisfied the regulatory criteria for ROC issuance. On issuance, OPRs will create a unique serial number for each ROC.

109 CFI 2011, art. 167.

110 Ibid., art. 168.

111 CEA 2011, art. 108 & 109

112 That is, those that would have been issued as Kyoto ACCUs if the reporting period for the project had ended before the Kyoto abatement deadline.

113 See http://www.eur.govt.nz/about-us.

114 See http://www.mpi.govt.nz/document-vault/6940.

115 See https://app.eur.govt.nz/eats/nz/index.cfm?fuseaction=search.home&clearfuseattribs=true.

116 http://www.forestry.gov.uk/forestry/infd-8vxmlf.

Information submitted by project operators to OPRs (company information, project type and description, project status, location, and so on) are uploaded to OPR registries, which maintain front- facing websites that track all project data.[117] Once verification is complete, verification bodies upload verification statements and reports to the OPR platform, which are reviewed by the OPR and, if successful, ROCs are issued to the account of the project operator. The number of serialized ROCs issued by the OPR per project is then displayed on the OPR website. ROCs can also be traded between account holders using the OPR platform; a small fee is charged for each ROC transferred.

Leveraging the administrative expertise of independent OPRs for conducting registry services for offset projects reduces the public cost and administrative burden on ARB. Only once credits have been verified and registered in the OPR system are they eligible for conversion into ARB credits (once ROCs have been issued, the project can seek ARB offset credit issuance, which requires ARB and the operators to be acting within CITSS). This means that ARB does not expend resources monitoring and overseeing projects in the earlier stages, which may not lead to the generation of verified credits.

The Cap-and-Trade Regulation Order[118] (the Regulation) determines that ARB offset credits must be "real, additional, quantifiable, permanent, verifiable, and enforceable." The Regulation further specifies measures to deal with the risk of forestry offset reversals. These rules are elaborated at length in the Compliance Offset Protocol developed by ARB for U.S. forest projects. The Protocol must be followed by project operators[119] when quantifying and reporting GHG reductions and GHG removal enhancements.[120]

To convert ROCs to ARB credits, ARB must determine that ROCs submitted by operators meet all relevant requirements as set out in the Regulation. If approved, ARB will issue ARB offset credits in CITSS to project operators and inform the OPR to retire or cancel the corresponding ROCs from its system. At that point, the ARB credits can be purchased by covered entities for compliance purposes.

117 See, for instance, https://acr2.apx.com/myModule/rpt/myrpt.asp?r=111 and https://thereserve2.apx.com/myModule/rpt/myrpt.asp?r=211.

118 http://www.arb.ca.gov/cc/capandtrade/capandtrade/unofficial_c&t_012015.pdf

119 The official term for entities with legal authority to implement a project is Offset Project Operator (OPO). OPOs may also designate an entity as an Authorized Project Designee (APD).

120 http://www.arb.ca.gov/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf.