EnergyTag

EnergyTag Whitepaper:

Accelerating the transition to 24/7 clean power

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Executive summary

EnergyTag, the independent industry-led initiative to accelerate the shift to 24/7 clean energy, is coordinating ten projects worldwide to demonstrate a radical new approach to track the source of electricity in near-real time. This report sets out how the world's biggest energy consumers and producers can use hourly energy certificates to ensure they are getting clean energy 24/7.

Demand for clean energy from consumers is at an all-time high; there was a three-fold increase in the number of companies pursuing net zero targets in 2020. As more renewable power plants are built and the availability of carbon-free energy becomes more volatile, organisations including Google, Microsoft and the US Federal Government have announced projects or commitments to source 24/7 clean energy. However, there is currently no recognised system of verifying renewable electricity supply on an hourly basis. EnergyTag is leading a coalition of more than 100 supporting organisations including the world's largest utilities, corporate consumers, grid operators, government agencies, NGOs, and start-ups to develop a mechanism to 'tag' electricity with the time and source of production so consumers can match their consumption with clean energy hour by hour. Specifically, the EnergyTag Initiative is seeking to define a framework for adding a timestamp to energy attribute certificates (EACs) which will make them more reflective of the physical availability of clean energy. Participants believe this may improve public perceptions of clean energy claims, and could incentivise energy storage and support new carbon accounting methodologies.

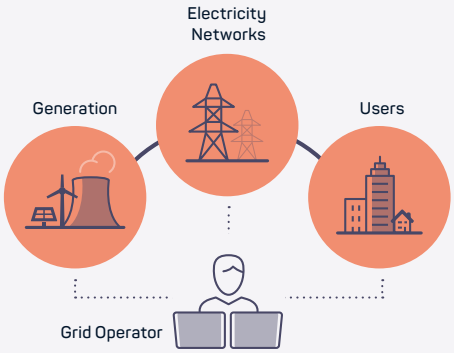
Some of the world's largest technology, energy and corporate firms, including Google, Microsoft, PwC, Enel, Engie, Statkraft and Ovo, and grid operators such as Energinet of Denmark, Statnett of Norway and TenneT/CertiQ of the Netherlands, are part of the initiative. The report calls on the world's big energy consumers and producers to join EnergyTag and accelerate the development of hourly electricity certificates.

The EnergyTag Initiative is an industry-led, non-profit, global initiative to define and build a framework for hourly energy certificates. This contrasts from current energy attribute certificate (EAC) reporting frameworks which are typically based on annual matching of consumption and production and are widely used internationally.

The EnergyTag Initiative is initially supporting the development of a market for hourly energy certificates through: i) the provision of a set of guidelines for market participants and service providers to increase the time granularity of existing EACs and ii) the co-ordination of a series of demonstrator projects around the world which, it is hoped, will lead to the emergence of a voluntary market for hourly certificates from late 2021 onwards.

How renewable energy certificates work

The background

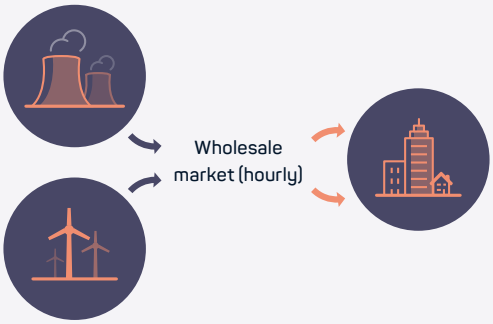


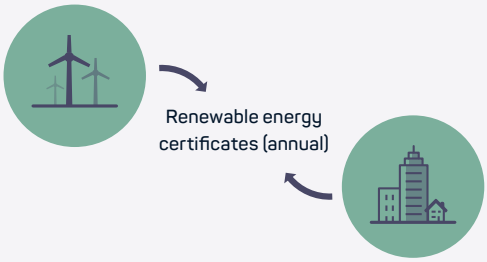
The power grid

- All electricity uses the same network
- Supply and demand have to be kept perfectly in balance at all times

Physical power market

- Used by grid operators to coordinate producers and consumers
- Market participants must match supply and demand in 30 minute windows
- Power markets don't provide a mechanism for consumers to trace the source of their electricity





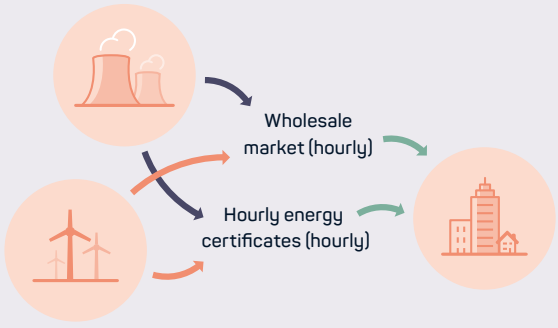
Certificate market

- Established 25 years ago to enable consumers to 'choose' renewable electricity
- Robust system that prevents double counting
- Today, energy users match their annual demand with energy produced in the same year

The EnergyTag initiative

Granular energy certificates

- Improved certificate market that keeps track of the time of energy production with hourly granularity
- Brings closer correlation between certificates and real-world availability of renewable energy
- Drives investments in physical infrastructure needed to switch to clean energy 24/7, such as battery storage



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Introduction

At the heart of EnergyTag is a belief that consumer choice, combined with the right incentives, can be a powerful driver of the technological changes necessary to stop climate change. The electricity system is probably the single most important tool we have to decarbonise our world, not only because we now have cheap, abundant, and carbon-free power sources, but also because so many other parts of our lives (e.g. transportation, industry, heating) can be electrified to take advantage of them.

But when it comes to choosing where your electricity comes from, the situation is not as straightforward as sourcing physical products such as fruit and vegetables, simply because all power sources are connected to the same electricity network where electrical energy from different sources cannot be distinguished.

For this reason, around 20 years ago, various systems of Energy Attribute Certificates (EAC) were developed around the world so that consumers could 'choose' one form of electricity over another. Certificates work by tracking the environmental attributes of electricity generation separately from physical power delivery, enabling the owner of the certificate to claim the use of that unit of energy generation. They are now well established and used in many liberalised energy markets globally. They have also been adopted for use in greenhouse gas reporting standards and are used by governments for a variety of mandates. As more organisations have become interested in sustainability, the use of certificates has increased dramatically.

In the time since they were introduced, we have witnessed a massive expansion in renewable energy deployment. Once the share of renewables increases above a certain point, grid integration issues start to emerge, such as needing to curtail renewable energy at times of overproduction. These markets also face renewables price cannibalisation, a phenomenon whereby the price of electricity crashes when the wind is blowing or the sun is shining, which reduces revenues available for new renewable energy projects producing electricity at the same time. The question is not simply 'how do we install more renewables?', it is 'how can we consume more when renewables are abundant, and less when they are not?'.

Luckily, a range of solutions have recently been developed to address this challenge. Smart grids, demand response and energy storage technologies are now needed on a massive scale to enable us to reach 100% clean energy.

Moreover, the need to move to more granular procurement of green energy is becoming increasingly recognized by consumers. As an example, some companies have set specific targets for procurement of '24/7 carbon-free energy', meaning that electricity consumed is matched by clean generation every hour of the year. More recently, the US government announced that it will "use the federal government's incredible purchasing power to drive clean energy deployment across the market by purchasing 24/7 clean power for federal buildings." [1]

This report is the first in a series of publications by the EnergyTag Initiative and describes the history of existing EACs and accounting frameworks, the potential benefits of moving towards increased temporal granularity, the structure and activities of the EnergyTag organisation itself, the starting principles behind the Initiative, and the first EnergyTag demonstrator projects.

[1] *Fact Sheet released by the White House on 31/03/2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/*

Background to Energy Attribute Certificates

In order to explain the EnergyTag Initiative and the benefits of hourly energy certificates, it is helpful to understand the origins of EACs in general, their purpose and function. It is hoped that a better understanding of the history of certificates, energy procurement methods and carbon accounting will help to address some of the confusion and distrust that has started to emerge in relation to green energy procurement, due to the ability to associate EACs with energy produced from fossil fuels, to use EACs issued for energy produced earlier in the year, or to use EACs from other countries[2].

Wholesale electricity markets were introduced in order to coordinate supply and demand and keep the grid in balance. Because power markets are designed to match supply and demand and let a price emerge that reflects the value of electrical energy, while ensuring a stable electricity grid for all types of generation, they did not initially offer a means of traceability. As a result, policymakers and market parties needed to have a way of identifying the source of electricity. This would enable policy instruments to be designed for allocating support to producers of electricity from specific sources of energy and permit electricity producers and suppliers to differentiate their supply.

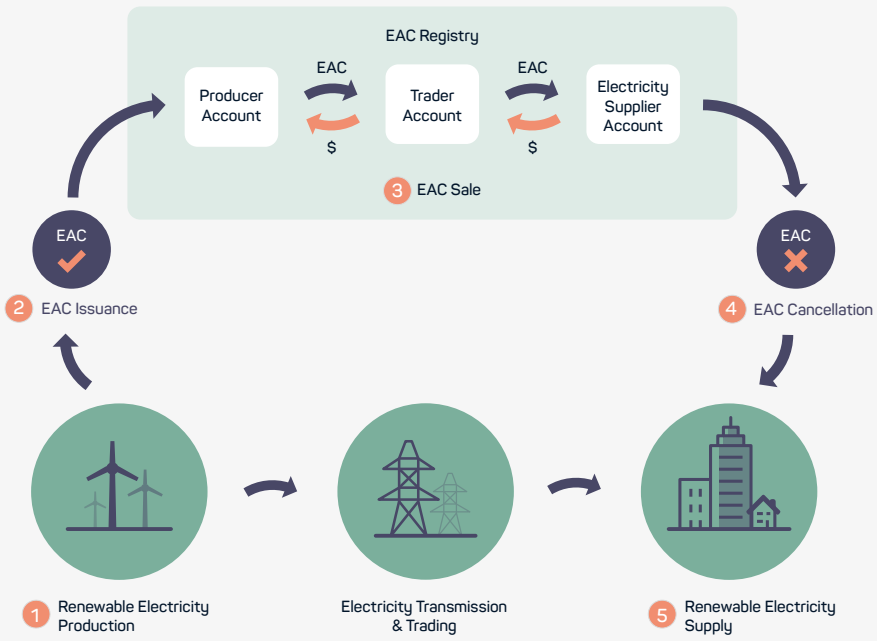
Electricity can be tracked from producer to consumer in several ways. Allocating disclosure attributes based on the contracts concluded by market participants seems the simplest solution, but can lead to double-counting and double-use due to the difficulty of differentiating the source of energy traded via power exchanges and aggregators, and due to swap contracts disguising the source of the energy. Shares of energy sources and environmental indicators of un-tracked consumption can be determined by the statistical mix of available attributes, such an implicit tracking mechanism being known as a 'residual mix'. However, reliance upon such a mechanism prevents suppliers from competing on the energy source, forcing them to supply a homogenous product. Neither contract-based tracking nor the supply mix met market demand for reliable tracking of energy sources. Hence, starting in the late 1990s, separate markets were proposed for physical energy and the associated characteristics of the supplied energy – the current generic term for this being "Energy Attribute Certificates" (EACs).[3] The core principle behind EACs is that the environmental attributes of electricity can be separated from the physical power delivery through a robust 'book and claim' mechanism, providing a reliable means of attributing the electricity produced from a specific source to a specific end-user.

[2]https://www.theguardian.com/business/2021/apr/02/green-energy-tariff-renewable-deals

[3]EACs include guarantees of origin (GOs) in Europe; and elsewhere as renewable energy certificates/credits (RECs), energy attribute certificates (EACs), green certificates/tickets/tags, and tradable renewable energy certificates (TRECs).

Components of EAC systems

How does the EAC mechanism work? *(Figure 1)*



The operation of a well-run EAC system conforms to the following principles.

Account holding: To protect the market from financial impropriety and minimise risk to the market and the market operator, account holders must provide information about themselves and their commercial activities in order to be registered and comply with EAC system rules. EACs may only be held in the account of a registered account holder, and this provides proof of ownership.

Avoidance of double counting (of the same attributes of renewable energy): EACs may only be created, used, and cancelled once, and the renewable attributes of energy production for which an EAC is issued may not be claimed as having been consumed, other than by cancellation of that EAC.

Cancellation/retirement and expiry: Ultimately, a consumer (or a supplier on its behalf) cancels (referred to as "retires" in the US), the EAC and removes it from circulation as evidence of the source of the energy. Those which are not cancelled expire after a period of time or by a deadline, and may be used to adjust the residual mix.

Disclosure: It is important that consumers know that the attributes of the energy they have purchased cannot be claimed by another consumer.

Issuance: EACs are only issued to registered facilities. The EAC system supervisor measures and validates energy created and used, and assigns the electronic EACs to the producer.

Quality control: Production facilities are inspected to identify any changes to their configuration and metering arrangements and ensure the energy they consume is as they have declared. Also, to assure the integrity of the system, the EAC system supervisor's operations are audited by a supervising authority to guarantee their probity and compliance with system rules.

Registration: EAC system supervisors only issue EACs to registered production facilities. Registering requires the producer to provide information about itself and the facility, including the technology and energy sources, commissioning date, location, energy measurement arrangements, etc.

Transfer: EACs may be transferred from a producer's account to that of a trader, supplier or consumer. Trade agreements are often made separately, followed by the transfer of the associated EACs.

Supervision: EAC systems supervisors are known as issuing bodies in Europe, and registry operators, tracking system operators etc. elsewhere. They maintain details of production facilities and account holders, which are recorded in an electronic registry to avoid duplication of the EAC.

Withdrawal: The EAC system supervisor may withdraw any EAC issued in error.

The development of EACs across the world

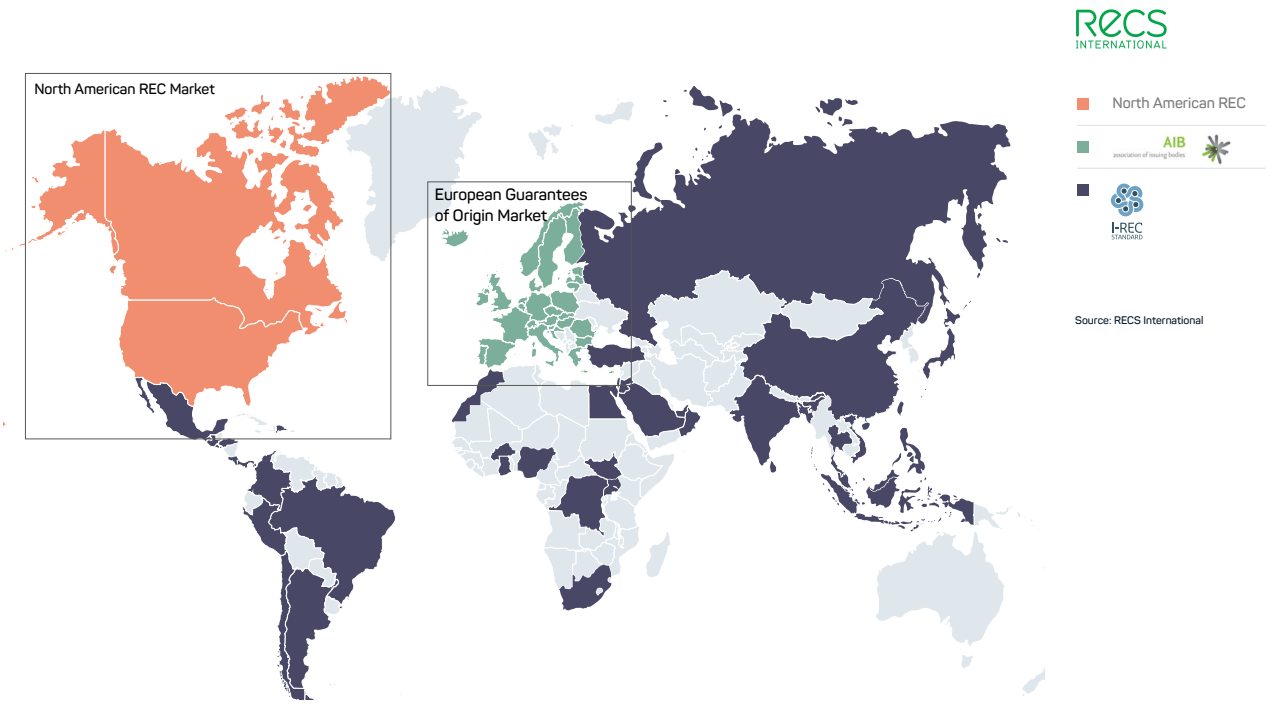


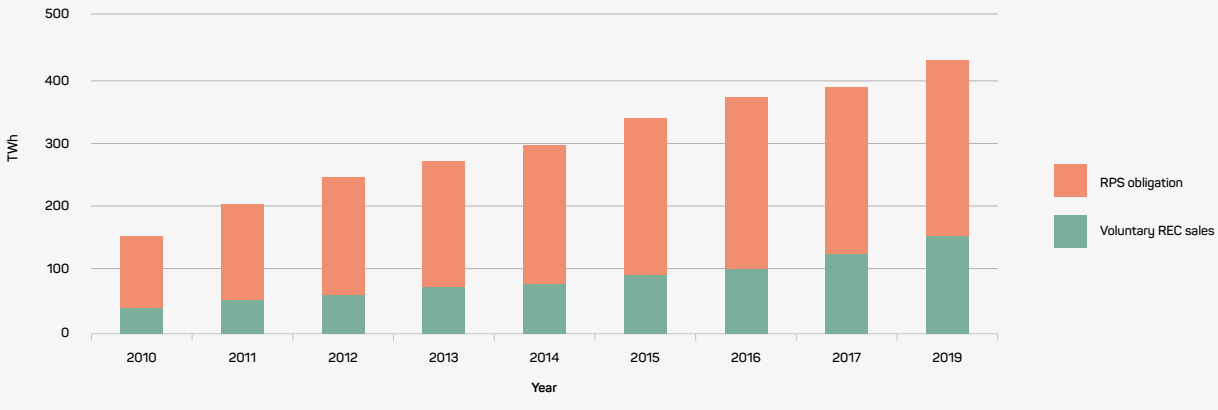
Figure 2: map of the three main EAC schemes: I-REC, Guarantees of Origin and REC

1. United States of America

Although EACs, generally referred to as renewable energy certificates (RECs) in the US, had been considered by several bodies, the first public mention was in the mid-1990s during the design of a Renewable Portfolio Standard (RPS) - a regulatory mandate to increase production of energy from renewable sources - for the California Public Utilities Commission. The idea resurfaced in 1997, when Enron proposed to audit power purchase agreements to document the chain of custody and, as it would be impractical for electricity purchased from the spot market, to trade the fuel and environmental attributes separately from the commodity, thus creating new markets and trading opportunities. Also at that time, ISO New England wished to enable stakeholders to verify electricity supplier claims concerning fuel mix and emissions. In 1998, retail electricity markets opened in Massachusetts, Rhode Island and California, where the renewable electricity market recognised the benefits of separating environmental attributes from the underlying energy. In 1999, a market was introduced for "green tickets" sold separately to physical energy before being re-bundled with the energy and supplied as green power. Also, Texas adopted an RPS which used renewable energy certificates as a tracking mechanism.

In May 1998, AllEnergy Marketing Company of Massachusetts launched Regen - the first such product sold separately to the electricity. This was followed in 2000 by Bonneville Environmental Foundation's Green Tags, and in 2001 Sterling Planet's national REC product and NativeEnergy's RECs supporting new renewable generation. The lack of a common standard led the nonprofit Center for Resource Solutions (CRS) to mitigate consumer confusion and misleading advertising by establishing the Green-e® standard for renewable energy products which was adopted nationally in 2002.

Major developments in US renewable energy markets since around 2002 include establishing regional electronic EAC systems. ERCOT and NEPOOL-GIS were among the first in 2001-02, while PJM-GATS, M-RETS, and WREGIS arrived in 2005-07. Also, voluntary renewable energy supply options expanded to reflect unbundled RECs[4] as the main supply option in terms of volume, stimulating the national voluntary market and voluntary sales while RPS programs rapidly expanded to 18 states during 2002-2009. Compliance markets[5] surpassed the voluntary market in terms of transacted volume from new renewables in 2010. Since then, traded volumes have continued to grow rapidly.



*Source: Reproduction from RECS international, data source NREL and Lawrence Berkely National Lab

Figure 3: Growth of US REC sales

Key US initiatives which have added credibility to voluntary renewable energy include the Guide to Purchasing Green Power by a group of government agencies and NGOs and the Federal Trade Commission's Guides for the Use of Environmental Marketing Claims. In 2015, the GHG Protocol released its Scope 2 Guidance, reinforcing the role of EACs in market-based scope 2 GHG accounting for renewable energy purchases and allowing scope 2 reductions to drive demand for voluntary renewable energy. This is discussed further in the section on "Carbon Accounting and Energy Attribute Certificates"

Since 2015, there has been a rapid decline in the cost of renewable energy and rapid growth in corporate procurement which have enabled the emergence of new corporate procurement activities like physical and virtual Power Purchase Agreements (PPAs). RECs remain however the recognised and necessary instrument to determine the origin of renewable energy consumption across purchasing options in the US and the markets for renewable energy continue to grow rapidly.

2. Europe

Europe is unquestionably the largest standardised and legally enforceable market for EACs in the world, with its Guarantee of Origin scheme enshrined in EU law.

In 1997, the Dutch electric utilities developed an EAC trading program to enable energy suppliers to share voluntary renewable energy targets, supported by an electronic tracking system. This ran from 1998 to 2000, stimulating the creation of the voluntary EU-wide Renewable Energy Certificate System (RECS) initiative in 1998, which was operational from 2001 to 2015.

The European Union Renewable Electricity Directive of 2001 introduced guarantees of origin (GOs) to measure EU member states' compliance with targets, but instead, stakeholders used them to prove to consumers the source of their electricity. Further Renewable Energy Directives confirmed this usage, strengthened GO system rules, and included gas, hydrogen, and heating/cooling.

In 2002, the RECS initiative reorganised itself into two bodies: RECS International, representing market parties; and the Association of Issuing Bodies (AIB), representing the EAC system administrators. The AIB became custodian of the RECS standard, which evolved into the European Energy Certificate System (EECS) and supported GOs as well as RECS certificates (which were phased out in 2015).

The EECS Rules became the basis of the CEN/CENELEC (the European standardisation body for electrical engineering) standard EN16325 for guarantees of origin, which in a revised form will become legally binding on all EU member states from summer 2021. The members of the AIB have each been appointed by an EU member state or a state bound to the EU by treaty (including Norway and Iceland under the EEA Treaty, and the former Yugoslavia, Moldova, Georgia, Ukraine and Albania as contracting parties to the Energy Community treaty) to exclusively supervise national GO systems - membership is voluntary, and most EU member states are now members or applying to be. The AIB also developed rules for registry-to-registry intercommunication via a central communication Hub, which also provides connected parties with a database of account holders, tools for market monitoring, and supports calculation of the European residual mix. AIB members are audited every three years against the EECS rules to protect trust in other's EACs.

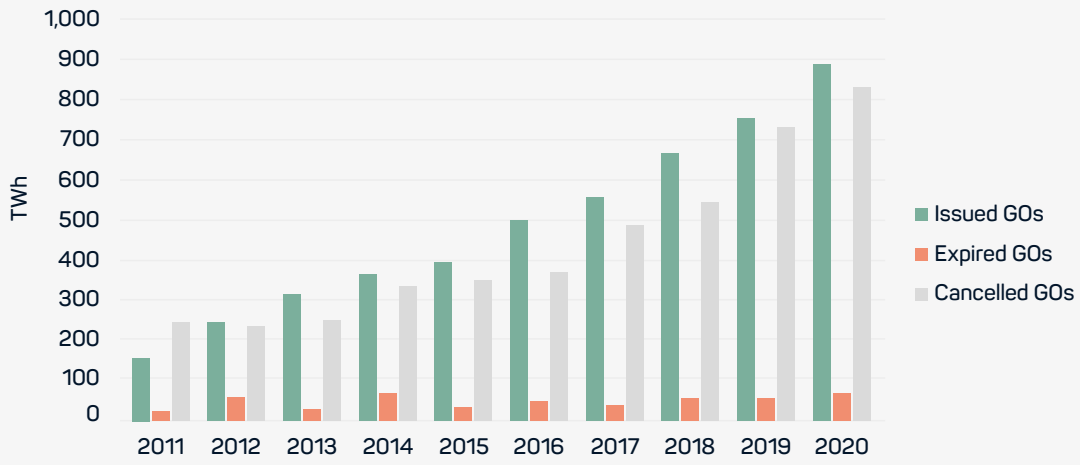
[4]"Unbundled" RECs are purchased in a separate transaction from the associated electricity.

[5]Compliance markets are created by a regulatory act imposing an obligation to produce, supply or consume; while voluntary markets exist to satisfy consumer demand

Parallel to GO systems, some EU member states employ feed-in tariff systems, while others created EAC systems to measure compliance with national systems to stimulate renewable energy investment. The UK for instance, has implemented its REGO scheme partly in compliance with the EECS rules, however to date it has not yet become a member of the AIB.

As a result of this standardisation and adoption into EU law, the traded volumes of GOs have increased steadily and in 2020, 736 million renewable electricity GOs were cancelled. With a steadily increasing demand for renewable energy, volumes are expected to grow steadily for the foreseeable future.

The following graph shows market development among the members of the AIB, which include most European countries.



*Source: Association of Issuing Bodies February 2021

Figure 4: EECS GO market activity

3. Australia

The Australian Renewable Energy (Electricity) Act 2000 created an EAC system administered by the electricity regulator, ORER, and designed to improve greenhouse gas performance by stimulating the uptake of renewable energy. It included a mandatory target for renewable energy - the Mandatory Renewable Energy Target.

4. China

China has ambitious plans for energy from non-fossil sources due to global companies operating in China requiring proof that their energy consumption is environmentally friendly; and rising levels of air pollution, leading to demand for local renewable energy and willingness to pay for cleaner air in order to avoid coal-fired electricity. This has led to the recent emergence of a voluntary market for EACs. The EAC market began in 2017, and restricts issuance of GOs to unsupported renewable production. This has led to market prices for EACs which are similar to the level of the feed-in tariff and are 10-50 times higher than the values of EACs in Europe and the US. The extent to which this market grows will depend on the environmental awareness of Chinese consumers and governmental support for the scheme.[6]

[6]*https://resource-solutions.org/wp-content/uploads/2019/11/Accelerating-Corporate-RE-Engagement-in-China.pdf*

5. EAC systems in other markets

EAC schemes have now emerged in a wide range of countries around the world, often driven by the growing trend of market liberalisation over the past 10 years. Oftentimes, EAC schemes begin as voluntary, supported by standards bodies and service providers such as the International REC Foundation (I-REC) (See Demonstrators section) and APX Group's Tradable Instrument for Renewable Energy (TIGR). Later these schemes may be adopted into mandates by governments.

Carbon accounting and Energy Attribute Certificates

Current carbon accounting for electricity consumption

As EAC systems developed, they came to be seen as a way to account for the impact of a consumer's carbon emissions. The Greenhouse Gas Protocol (the Corporate Standard) was created to provide[7] the international framework for accounting for the emissions associated with purchased electricity (or scope 2 emissions). It has been adopted by reporting programs like CDP[8], GRI[9] and The Climate Registry[10], and defines the role of EACs in electricity customer carbon targets, classifying as "scope 2" the emissions associated with purchased energy generated by another entity and supplied to the reporting customer (most commonly, grid-delivered electricity).

The original Corporate Standard dated 2001 provided examples of different types of data that customers could use to calculate their scope 2 emissions, ranging from the annual emissions average within a region to utility/supplier-specific emissions based upon contracted generation sources, and made limited reference to the ability of customers to cancel EACs in order to calculate emissions. To address the latter, in 2015 the Greenhouse Gas Protocol issued the Scope 2 Guidance, proposing that customers calculate and report their emissions from electricity in two ways:

Location-based: electricity usage data is multiplied by a factor representing the average emissions from electricity generated in that region or country; and

Market-based: this reflects the emissions associated with contractual information relating to the source and attributes of electricity supply, whether through EACs or where they are not available/used, a bilateral contract or supplier-specific that meets quality criteria for exclusively conveying generation attribute information.

In the market-based method, EACs must convey an emissions rate attribute (for most renewables this is "zero" emissions per MWh). Additionally, renewable facilities can have significantly different emissions impacts on the rest of the grid, so the Guidance encourages companies to report avoided emissions impact separately from the two scope 2 totals and use it to drive decision-making that supports decarbonisation.

[7] *https://ghgprotocol.org/corporate-standard*

[8] *https://www.cdp.net/en*

[9] *https://www.globalreporting.org/*

[10] *https://www.theclimateregistry.org/*

Other carbon instruments in the power sector

The attributional emissions rate associated with a kWh can intersect with other carbon-related policies and instruments in the power sector. For a good summary of the various carbon accounting schemes and terminology, CRS has recently produced a useful glossary[11]. In particular:

- The emission allowances that emitting power generators would need to acquire and retire to cover their applicable emissions and demonstrate compliance with a reduction target (cap and trade).
- Carbon offsets generated by renewable energy projects, based on fossil fuel generators whose production was reduced/never built due to a new generation facility.

European consumers of renewable electricity have derived their indirect, secondary emissions impacts by reference to IPCC emission figures for the relevant fuel, but it is unclear whether plant efficiency is taken into account; or whether the claimed emissions reconcile with the EU ETS.

Evolution of Energy Attribute Certificate systems

In the US, RECs generally represent "all environmental attributes" associated with the generation of renewable energy, including both the direct and avoided GHG emissions associated with generation[12]. Different states may have different eligibility and compliance requirements and timeframes, which may yet be different from those in voluntary market standards and programs. RECs are typically issued in monthly vintage batches.

In Europe, carbon emissions and avoided emissions are only (optionally) recorded on GOs for high-efficiency cogeneration. Further, the purpose of a GO was only clarified by the Renewable Energy Directive in 2009, which provided that GOs were exclusively for proving to consumers the source of their electricity. Over time, EAC systems matured: processing and quality assurance were strengthened, data definitions and validation rules were clarified, supervision was enhanced, and the lifetime of a GO has been standardised to one year after the production of the electricity.

It is worth noting, that both in Europe and the US, EACs are generally produced only for renewable sources. A number of organisations, including EnergyTag, have recently suggested that EAC tracking systems and carbon accounting methodologies should be extended to include non-renewable power sources.

However, while electricity markets increasingly operate on a timeframe of one hour or less, until now this has not been the case in EAC markets.

[11] *https://resource-solutions.org/document/031921/*

[12] *See Jones, T. et al. (2015). The Legal Basis of Renewable Energy Certificates. Center for Resource Solutions. https://resource-solutions.org/wp-content/uploads/2015/07/The-Legal-Basis-for-RECs.pdf. Weinstein, J. (Jan 2021). What are Renewable Energy Certificates? Futures and Derivatives Law Report, Volume 41, Issue 1. Thomson Reuters.*

Potential benefits of increasing the time granularity of certificates

Over the last 20 years, EAC schemes have significantly grown, but the matching between the Energy Attribute Certificates and energy consumption is still done on a yearly (or more rarely monthly) basis. There are, however, significant benefits that could be unlocked by increasing the time granularity of certificates.

A better reflection of the physics and economics of the grid

The electrical system must be kept in balance by matching electricity generation and consumption at all times. The Transmission System Operator usually manages this real-time balancing, and electricity market participants are required to match demand and supply in each "settlement period" (typically ranging between 5 and 60 minutes, depending on the market) and in each market area. In contrast, EAC schemes currently allow the matching of generation with consumption on a yearly or monthly basis. This allows consumers to claim, for example, the use of solar energy that was produced at noon in summer for consumption that happened overnight in winter.

The current EAC schemes play an essential role in enabling consumers to choose renewable energy and have helped kick-start the renewables industry, accelerating the energy transition, and increasing consumer awareness of "green" electricity. However, increasing the time granularity of the matching system can be beneficial when higher penetration of renewables in the system is reached, by stimulating the synchronisation of demand with times of greater renewable energy production. The EnergyTag Initiative believes that increasing the time granularity of EACs will create more incentive to ease the integration of renewable generation on the grid.

An electricity supplier which is capable of delivering EACs with a sub-hourly timestamp at all times not only supports investment in renewable energy, but also addresses the intermittency challenge of the future.

Increased transparency and trust

EAC schemes track the attributes of a given unit of renewable energy from the producer to the consumer - providing information and transparency about the energy which the producer is selling and the consumer is buying. It is, therefore, important to educate consumers about the nature of electricity systems and markets, so that they understand how their 100% clean electricity is sourced and delivered.

The lack of understanding of the "book and claim" principle underlying EAC schemes has sometimes generated distrust from consumers, who are fully aware that renewable generation is not always available when their electricity consumption occurs.

Consumer trust is vital in any voluntary market, and some governments are acting to proactively address this potential issue. As an example, France is now introducing a label for "premium" green electricity that will, among other things, require the supplier to disclose the percentage of renewable penetration in their offer, calculated on a half-hourly basis.

Increasing the granularity of information is a way of increasing transparency and addressing consumer confidence. The EnergyTag Initiative is creating the framework for Energy Attribute Certificates with a sub-hourly timestamp, which would enable consumers to track the source of their consumed electricity on an hourly basis. We anticipate that some energy consumers and suppliers will wish to set targets for the proportion of renewable or carbon-free hours in their consumption. This shift would increase competition among suppliers, who could then offer the highest hourly carbon-free or renewable penetration percentage.

Allowing any form of electricity generation, including generation not currently covered by EAC schemes, to participate in the EnergyTag scheme would also increase transparency and empower customers to buy the electricity mix they desire, as well as improve the transparency of all electricity generation sources. Google, for instance, has set a target of reaching 24/7 carbon-free energy, which includes non-renewable generation such as nuclear, by 2030[13].

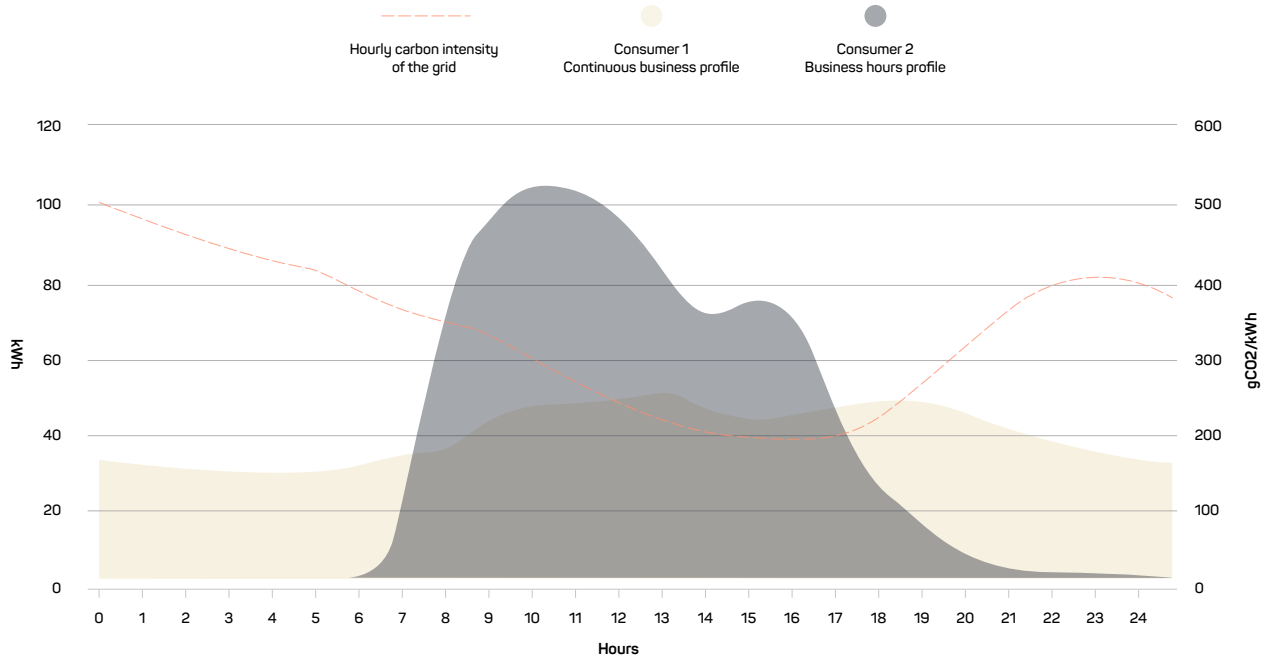
Potential improvements to carbon emissions calculations

Under the GHG Protocol, emissions from purchased and consumed energy are classified as "Scope 2" emissions. To provide clarity and consistency in these calculation methods, the GHG Protocol published the Scope 2 Guidance in 2015. Here, emissions must be calculated and reported in two ways, a location-based method, and a market-based method. Both begin with the volume of energy consumed over the course of the reporting period, in kWh, multiplied by an emissions coefficient or emissions factor. The location-based methodology seeks to represent the physical nature of the grid's local mix of generation resources used to meet collective demand, independent of a particular customer's contractual arrangements. It requires an emissions factor reflecting the emissions from the generating resources in a defined grid distribution region—typically a transmission organization, region, or country—reported in pounds or tons of CO2/kWh. The Guidance encourages the use of the highest accuracy factors representing both the temporal and geographic boundaries of the grid's generation. To date, most grid-average emission factors are compiled and updated annually and applied to a company's annual compiled electricity usage for facilities in that region. However, the Guidance notes that *"Companies may have access to detailed studies or software solutions linking their facility's time-of-day energy use patterns to the GHG emissions from local generation dispatching during those times. This emission data could be compiled over the course of a year for a consumer to record, match against temporal usage by location, and calculate scope 2 emissions"* (Box 6.1, p. 53).

However, to date, most customers have compiled their electricity usage data based on monthly utility bills and meter readings and use grid-average emissions factors representing the average emissions associated with generation throughout the year. This typical usage data means that customers do not have visibility into the timing of consumption—both when it occurs during the day, and throughout a given month. Even where customers might have advanced metering infrastructure that would provide temporally detailed usage data over the course of a day or month, grid emissions data has not been available to represent time-differentiated grid emissions—particularly when these hourly emissions are not fixed to particular hours or can vary over time. This means that the actions a customer may take to shift the time of its consumption would not result in reported changes to its location-based scope 2 emissions in an annual GHG inventory or sustainability report. For instance, a customer that tends to consume more at times where the generation is predominantly from fossil fuel would consequently underestimate its emissions—and conversely, other customers using grid average emissions factors may overestimate their emissions.

[13] *https://blog.google/outreach-initiatives/sustainability/our-third-decade-climate-action-realizing-carbon-free-future/*

Figure 1 below represents the hourly carbon intensity of the grid in Germany over a day in summer 2020, with a decrease around noon due to solar PV generation, and the consumption of two different fictitious consumers: Consumer 1 has a rather flat consumption profile across the day, whereas the Consumer 2 consumes mainly during business hours. Both consumers in this example have the same total electricity use over the day, equal to 1MWh.



*Source: Agora Energiewende for the carbon intensity of the grid and BDEW for the consumer profiles

Figure 1: hourly carbon intensity of German grid on 10/07/2020 and hourly consumption of two example consumers.

Using average values for the day for carbon accounting calculation, both consumers would end up with the same carbon emissions. However, using more granular emissions data, the second consumer would report lower emissions than the first one. Doing the calculations on an hourly basis would lead to carbon emissions of 330kgCO2 for Consumer 1 versus 282kgCO2 for Consumer 2, a difference of 17% on this day.

In countries with relatively high renewable penetration, the difference between yearly and hourly accounting is already non-negligible and will become increasingly significant as more renewable generation is added into the system and the carbon intensity variations become more important.

[14]*The two consumption profiles used in this example are actually used in Germany for electricity settlement of non half-hourly metered consumers for specific categories of consumers. Consumer 1 is using the G3 profile from BDEW "Gewerbe durchlaufend" which is used for settlement of businesses running 24/7 e.g. sewage treatment plant. Consumer 2 is using the G1 profile from BDEW "Gewerbe werktags 8–18 Uhr" (working days 8 am–6pm businesses). Source: https://www.bdew.de/energie/standardlastprofile-strom/*

The GHG Protocol also requires reporting a second scope 2 total using a market-based method that reflects the contractual purchases or electricity supplier-specific information which a customer may have. Under this method, emissions are attributed to customers on the basis of qualifying contractual instruments, including Energy Attribute Certificates, and emissions rate information conveyed by an EAC. As certificates are usually issued and procured for renewable generation, the carbon content is typically 0gCO2/kWh. As EACs are issued on a monthly or yearly basis, the scope 2 market-based method can only be applied on a monthly or yearly basis. Increasing the time granularity of the certificates would allow consumers to calculate their market-based scope 2 emissions on an hourly basis.

Moving to more granular EACs would empower consumers and pave the way for more temporally precise emissions accounting.

Market signals to drive investment in the right generation technology

One of the aims of current Energy Attribute Certificate schemes is to drive investment in renewable generation. However, the relative benefits to the energy system of one type of generation technology are not taken into account. As an example, the incremental value of solar PV generation to the system decreases when more generation from the same technology is added as solar PV generation tends to always generate at the same time in a given region.

Hourly procurement of Energy Attribute Certificates could incentivise consumers and energy suppliers to assess which clean energy resources are best suited to match their demand and could lead to geographical and technology diversity of generation. If there is excess solar on the system, but a lack of certificates for renewable generation compared to night-time demand, it could lead to certificate prices being significantly higher at night, sending a market signal for more investment in technologies that can generate on these hours, e.g. wind farms.

Hourly procurement could also lead to a higher price of certificates overall if consumers are willing to target a high (or 100%) share of hourly matching in the medium term and the price of certificates is ultimately driven by the cost of additional generation in hours where certificates are scarce.

Incentivisation of flexibility on the power system

There is currently no incentive in the various renewable certificate schemes to shift consumption or generation as the price for current EACs applies to the whole period (year or month). Moving to shorter time periods could unlock additional revenues from flexibility such as Demand Side Response (DSR) or storage. In an hourly mechanism, a flexible consumer can increase their consumption in the hours where clean energy generation is high and decrease their load in low clean energy generation hours, in order to better match clean energy generation and demand.

This is something that some companies are already implementing: as explained in a blog post in 2020[15] Google is now forecasting the carbon intensity of the grid, and optimizing the consumption of its data centres - e.g. by shifting tasks from one time to another - in order to decrease their electrical carbon footprint. Figure 2 below illustrates how Google's system shifts consumption from the baseline (dashed line) to better align with less carbon-intensive times of the day (solid line).

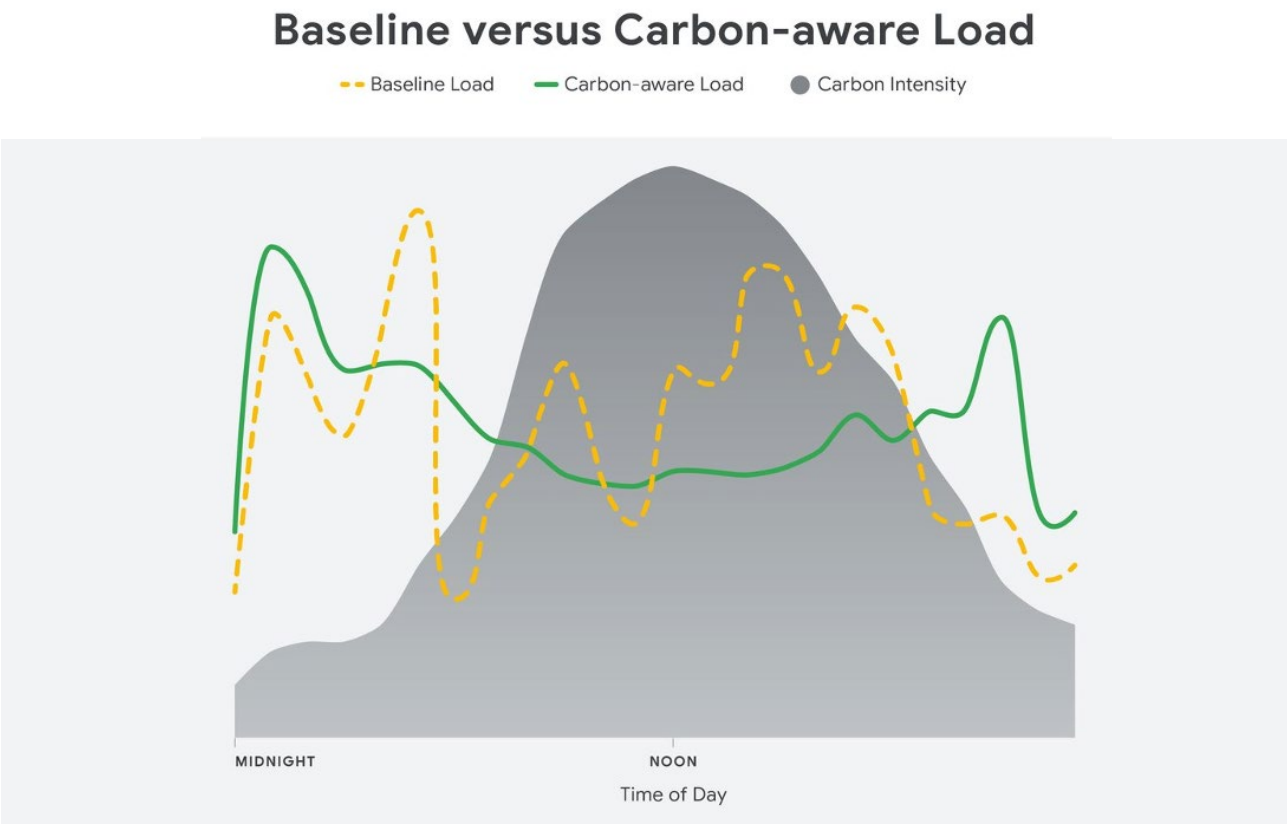


Figure 2: Illustration of Google's implementation of "carbon aware load" [15]

[15] *https://blog.google/inside-google/infrastructure/data-centers-work-harder-sun-shines-wind-blows/*

Some companies are doing this to decrease their carbon emissions without getting any direct economic benefit from it, but not all companies can afford to do that. An hourly certificate scheme would lead to a price for certificates on each time period that will reflect the volume of the desired, usually renewable or carbon-free, generation available on the grid on this hour, leading to low prices when there is high renewable generation, and higher prices on low renewable generation hours. This would create an additional economic incentive for consumers to also shift their load to decrease the cost of renewable certificate procurement.

Similarly, energy storage could capture the spread between high certificate price hours and low-price hours, hence bringing additional revenue on top of the spread that they are already capturing in the energy markets. Through some of the demonstrators presented in the Demonstrator section, the EnergyTag Initiative will endeavour to prove that there is indeed an incentive for additional flexibility.

Increased time granularity is a requirement for some cross-commodity uses such as low-carbon hydrogen

Hydrogen is enjoying renewed and rapidly growing attention in Europe and around the world. Hydrogen can be used as a feedstock, fuel or an energy carrier and storage, and has many possible applications across industry, transport, power and buildings sectors. Most importantly, it emits no CO2 if it is produced by electrolysis from carbon-free power and almost no air pollution when used. It thus offers a solution to decarbonise industrial processes and economic sectors where reducing carbon emissions is both urgent and hard to achieve.

The potential and versatility of hydrogen also increases the need to track primary energy sources all the way to applications, taking into account energy transformations along the way (power to hydrogen, hydrogen to methanol, etc.) for market actors to be able to make educated choices about the energy they purchase and consume.

Finally, the carbon footprint of hydrogen production must be carefully allocated and tracked along the value chain in order to have an important impact on all applications. For instance, hydrogen and its derivatives can be used for the purposes of measuring compliance with renewable fuels targets provided they show 70% of GHG emissions reduction[16] , and that there is temporal correlation between the energy generation and the electrolyser consumption.

France recently released a new law on hydrogen, announcing the implementation of CO2 emissions thresholds for hydrogen to be qualified as renewable or low carbon. Under the European Renewable Energy Directive, a Delegated Act is under development where there is consideration of the temporal correlation and sustainability of the electricity with which hydrogen is produced, in order to take the hydrogen into account for the European renewable transport fuel targets. As a result, we now need to answer the question: how to reliably track the CO2 emissions and production time period of electricity for hydrogen production?

Given the fact that CO2 emissions from the power grid can vary from hour to hour, hourly certification of electricity (including CO2 emission factor) is therefore crucial to allocate CO2 emissions of renewable and low-carbon hydrogen production in a meaningful way. Such hourly certificates will facilitate the development of future hydrogen certificates which are crucial to the development of an efficient hydrogen market.

In general, as the integration of electricity, transport and heating and cooling sectors progresses, the question of when grid-supplied electricity can count as fully renewable becomes increasingly relevant. Beyond the production of hydrogen and other electricity-based fuels, hourly certificates could potentially facilitate the tracking of renewable energy characteristics at other cross-sectoral intersections such as Power to Heat and electromobility.

[16] *Under the Renewable Energy Directive (RED) II*

The EnergyTag Initiative

The Initiative

EnergyTag is a voluntary initiative led by a group of industry participants and NGOs with a common vision of accelerating the transition to carbon-free energy. The Initiative's participants recognise the core principles, importance, and success of the EAC systems in their current form, yet also recognise that as the energy system changes, there is an opportunity for them to evolve, in particular by adding a more granular timestamp. As such, the EnergyTag Initiative's mission is to define and build a framework for hourly or sub-hourly energy certificates.

Because making changes to an existing certificate system is understandably a long process (especially where changes in legislation are needed), the EnergyTag Initiative was established in 2020 to define and build a framework for hourly certificates, working within the existing EAC schemes. Rather than define a new independent standard, the EnergyTag guidelines will seek to define the minimum adjustments necessary to the prevailing local EAC system (such as GOs in Europe, RECs in the US or I-RECs elsewhere) in order to enable a voluntary market. The initial defining principles behind the EnergyTag guidelines are discussed in the next section.

It is hoped that once this voluntary market has been established, local certificate schemes may be readily updated using lessons learned from the initiative.

As Phil Moody, EnergyTag's Chairman and the founder and former Secretary General of the AIB (Association of Issuing Bodies) can testify, the beginnings of Guarantees of Origin in Europe were similarly industry-led; and it was several years before the European Energy Certificate System was adjusted to support GOs and adopted in principle under EU-wide legislation.

The Initiative and the guidelines themselves are strongly 'technology-agnostic' - they are not developing or advocating any one specific technology for use in EAC systems. This is important because in recent years a range of different enabling technologies for tracking renewable energy have been developed. Developments in ledger technology, data processing and data availability now make a system of hourly energy certificates possible where it was not just a few years ago. What has been lacking until now is a common standard or framework to define hourly certificates as a trusted, robust, tradable instrument.

EnergyTag provides a forum for industry experts to come together and agree on a common approach to hourly certificates through its working groups, and through a series of demonstrator projects. EnergyTag is governed by an Advisory Board composed of the membership, and an independent council will be appointed to rule on any decisions where consensus is unable to be reached.

Throughout 2021, the EnergyTag Initiative has two main activities. Firstly, development of the EnergyTag guidelines and secondly, the coordination of a series of demonstrator projects in order to accelerate market development.

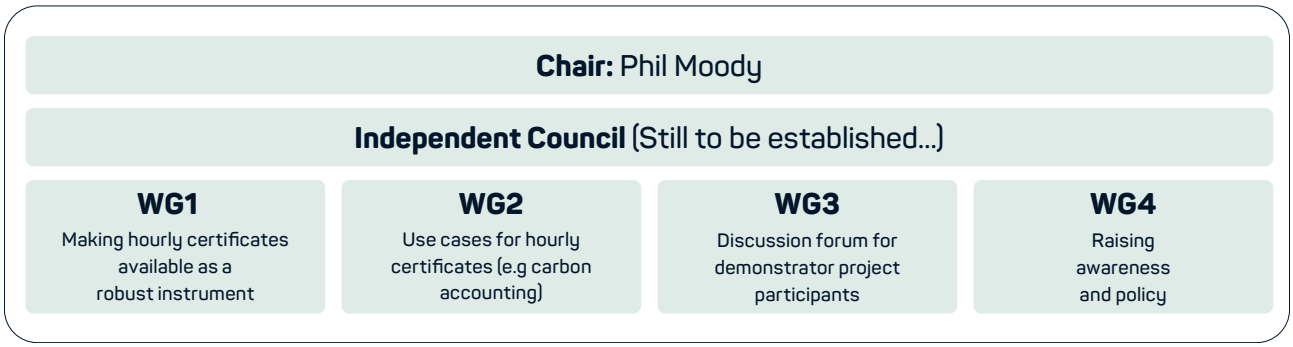
The work of the participants is currently structured into four separate working groups:

Working Group 1: Making hourly certificates available and robust (e.g. defining the certificates attributes, technical questions regarding issuance)

Working Group 2: Use cases for hourly energy certificates (e.g. potential usage in carbon reporting)

Working Group 3: Demonstrator projects (forum for coordinating markets for hourly certificates)

Working Group 4: Raising awareness (e.g. public education and suggestions for policy makers)



Our members

The Initiative was originally founded in October 2020 by Dr Toby Ferenczi, following a period of research into green energy procurement methods. Despite its recent establishment, the Initiative has grown very rapidly, and already comprises over 100 organisations. These include the world's largest utilities, energy consumers, grid operators, government agencies, NGOs, existing certificate schemes and leading start-ups. The membership has been extremely active with most participating in either our working groups, or demonstrator projects, or both.

The number of participants continues to grow and, in particular, the Initiative is focussed on attracting large numbers of energy consumers, big and small, who recognise the importance of verifying the source of their energy consumption on an hourly basis.

Some examples of comments from our members are:

M-RETS, Ben Gerber, CEO: "24/7 renewables—and the benefits that come from hourly data coupled with grid data that provides more insight into carbon intensity—are essential to building out a global energy system focused on decarbonization. EnergyTag's approach which includes data standards and a focus on creating a globally scalable and replicable framework is critical to achieving a data driven approach to carbon reductions. EnergyTag's work will allow both mature and developing renewable energy markets to achieve their decarbonization goals while reducing the costs to participate in local, regional, national, and international renewable energy markets."

"Google intends to run on carbon-free energy everywhere, at all times by 2030," says Michael Terrell, Director of Energy at Google and head of its 24/7 carbon-free energy programme. "EnergyTag will be an important tool for helping Google and many others source carbon-free energy for their operations, at an hourly level. We are excited to be part of the EnergyTag initiative and look forward to supporting the development of this important standard."

Martin Lervad Lundø, Vice President & CEO Energinet DataHub: "By showcasing our real-life open-source prototype for granulated Guarantees of Origin (Project Origin) Energinet wants to spur on the discussion of how to document the "green value" of energy and scale the concept internationally. EnergyTag is a relevant umbrella for global initiatives which can bring a future blueprint of a European standard for granulated GOs to life and gather relevant stakeholders."

Max Andrews, Head of Nordic Environmental Products Statkraft: "We see demand from customers to understand in greater detail where their energy comes from, and increasingly when it is renewable. By making hourly energy certificates available, EnergyTag provides an important and innovative tool to enable end-users to verify the source of their energy throughout the day"

Vattenfall, Marcus Melin, Strategic Energy Advisor: "Vattenfall wants to enable fossil-free living within one generation, and support customers in their climate goals. We have developed a 24/7 matching solution together with Microsoft. We welcome EnergyTag as a joint standard for providing 100 percent fossil-free electricity every hour."

The EnergyTag guidelines

This section outlines a first version of the definitions and principles of the EnergyTag guidelines.

The EnergyTag guidelines will be developed through an open process in dialogue with the stakeholders and managed by a non-profit organisation, the EnergyTag Initiative. The purpose of the EnergyTag guidelines is to define the issuing criteria, attributes, and other elements in order to facilitate the development of a voluntary market for hourly energy certificates. The guidelines are designed to act as an extension to the rules governing existing, established EAC schemes in different geographies. The EnergyTag guidelines will allow for different ways of implementation but will also ensure interoperability through a certain degree of standardization. This will enable participants to integrate the EnergyTag guidelines easily across borders and energy types.

The EnergyTag guidelines do not seek to replace or act as an alternative to existing EAC systems; rather, they offer an agreed common means of extending such systems to support hourly matching of supply and demand. Where no such EAC system exists, then they offer guidelines for developing such a system.

The operation of an hourly matching system will be under the overall control and direction of the relevant EAC Issuing Body, which will be wholly responsible for the quality of its system. This body is liable for the activities of any agents to which specific responsibilities have been delegated.

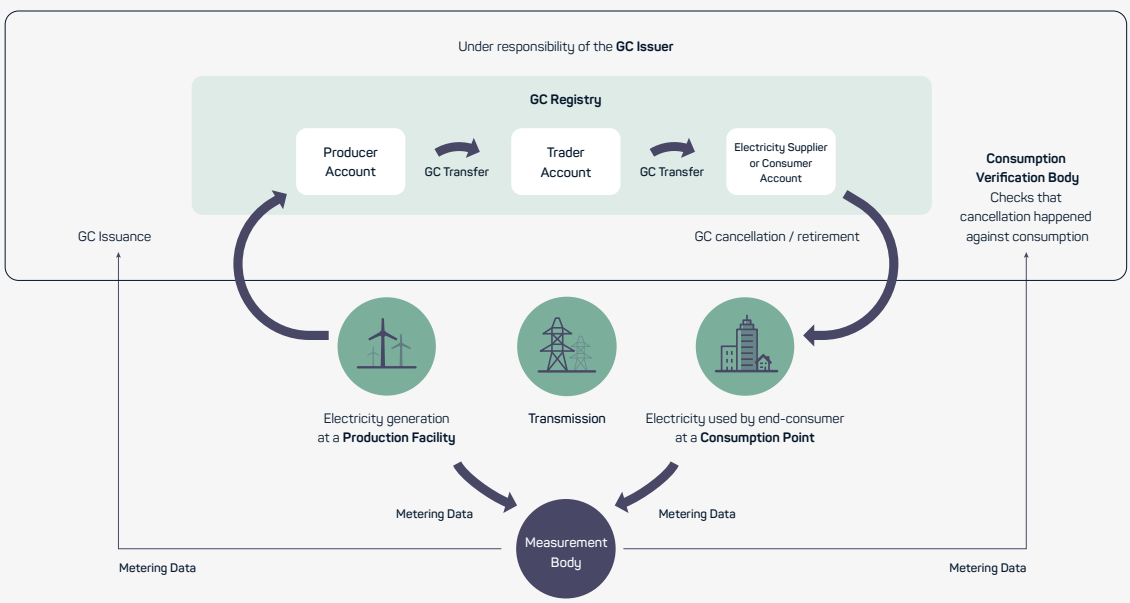
The EnergyTag Initiative encourages existing EAC systems to be amended in such a way as to support hourly matching. Where this is for some reason not feasible in the short term, then a complementary system may be considered, provided it excludes double counting of attributes in relation with existing accounting methods for energy attribute declaration in that country or region, and is integrated with the existing EAC system in compliance with these Principles.

Because existing EAC systems vary depending on the region, these guidelines will eventually incorporate specific components for each regional EAC system. EnergyTag's working groups will appoint stakeholders for specific EAC systems such as GOs, RECs and I-RECs to support this.

As existing EAC systems are expected to evolve over time to incorporate new features including more granular timestamping, the role of the EnergyTag Initiative is also likely to evolve over time. It is expected that EnergyTag will play an ongoing role in hourly matching systems once developed, however this is still to be defined and will be discussed among the working groups.

Note that the content of this section is intended to be seen as a first proposition to be debated in the EnergyTag working groups over the coming months.

EnergyTag Market Diagram *(Figure 1)*



Initially, the EnergyTag guidelines will only cover electricity, although the ambition is to later expand to include other Energy Carriers (see definition below).

Definitions and roles

Account: A record of the Certificates held on a Registry by a company or individual.

Attribute: Data item specifying the characteristics of an energy unit produced by a Production Facility in terms of the input(s) used and/or the details of that Production Facility and production process.

Cancel/Retire: To use a Certificate as proof of the Attributes (source, production time, etc) of supplied energy and to prevent it being used again for this purpose or transferred to another Account.

Consumption Point: Location of energy consumption. For the electricity Energy Carrier, the Consumption Point is a separately measured grid access point at which electricity is consumed.

Consumption Verification Area: The geographic area or market sector containing the Consumption Points for which a Consumption Verification Body has responsibility for verifying that Granular Certificates (GCs) have been cancelled against consumption.

Consumption Verification Body: An organisation responsible over a Consumption Verification Area of checking that Granular Certificates (GCs) are cancelled against the energy consumption measured at one or a group of multiple Consumption Points. This organisation can be a GC Issuer, or a different organisation.

Domain: The geographic area or market sector containing the production facilities for which an EAC Issuing Body and/or an GC Issuer has exclusive responsibility for a certificate system.

EAC Issuing Body: An EAC Issuing Body is an organisation responsible for the administration of the existing EAC system within a Domain for an Energy Carrier, that operates regardless of any interrelation with EnergyTag.

EAC System: A system for the management of EACs in one or more domains according to an agreed set of regulations.

Energy Attribute Certificate (EAC, or Certificate): A generic term for a unique transferable electronic record or guarantee created to provide to a consumer evidence of the characteristics of a specific unit of energy conveyed by an Energy Carrier and/or the method and quality of its production. Examples include a Guarantee of Origin (GO) or a Renewable Energy Certificate (REC).

Energy Carrier: Means of conveying energy – can be electricity, gas, hydrogen, or heating/cooling.

EnergyTag Initiative: The non-profit organisation that oversees the creation of the EnergyTag guidelines and promotes the use of certificate schemes with a time granularity of a maximum of one hour.

Expire: To make a Certificate ineligible for Transfer or Cancellation as a consequence of the passage of a given period of time since the production of the associated energy.

Granular Certificate compliant with EnergyTag (Granular Certificate or GC): A Granular Certificate compliant with EnergyTag is an Energy Attribute Certificate relating to the characteristics of energy produced during a period of one hour or less, issued in accordance with the principles and rules of operation of the EnergyTag guidelines.

Granular Certificate Issuer (GC Issuer): A Granular Certificate Issuer is an organisation responsible for the administration of the Granular Certificates within a Domain for an Energy Carrier, ensuring avoidance of double counting of the Attributes represented by the Granular Certificates it administers throughout their lifetime. The GC Issuer may or may not be the same body as the EAC Issuing Body. Where it is a different party, the EAC Issuing Body remains wholly responsible for ensuring that the GC Issuer correctly discharges its responsibilities, including preventing double counting.

Measurement Body: An organisation responsible for measuring the energy produced by or input to a Production Facility, and/or the energy consumed at a Consumption Point.

Production Facility: Separately measured facility for transferring energy from a primary energy source into an Energy Carrier or from one Energy Carrier to another – for instance, a power station or a gasifier.

Registry: A database administered by an EAC Issuing Body or GC Issuer and recording the characteristics of the Production Facilities for which that Issuing Body or GC Issuer is responsible, and the Accounts and the Certificates held in them.

Transfer: The handover of a Certificate from one Account to another, whether on the same or on another Registry.

Principles

Avoidance of double counting: A GC shall circulate in an environment that guarantees the avoidance of double counting. Measures shall be in place to prevent double issuance, duplication during its lifetime and double cancellation or usage of that GC.

A GC shall at all times be under the supervision of a GC Issuer. For the avoidance of doubt, this means that it shall at all times be recorded in a system managed by a GC Issuer, thus ensuring its uniqueness, and avoiding its duplication.

Cancellation/Retirement: A GC must be cancelled against energy consumption at one or multiple Consumption Points that took place during the same timeframe (start and end time) as the production period for which that GC was issued and for the same Energy Carrier to which that GC relates (e.g. electricity). However there may be other carbon accounting methodologies for which another process occurs, and this would need to be clearly labelled.

Once a GC has been cancelled, it may not be transferred or cancelled again.

GCs shall be cancelled in a Registry and shall be cancelled only against measured energy consumption at a Consumption Point.

Corrections: When, following a measurement correction, the quantity of GCs issued is found to be less than the measured energy, then additional GCs may be issued.

When, following a measurement correction, the quantity of GCs that has been issued exceeds the metered energy then the GC Issuer may withdraw them from the account to which they were issued, unless they have been transferred to another Account or cancelled, in which case: (1) where they remain on the Registry operated by this GC Issuer, then the GC Issuer and the original and current owners of the relevant GCs shall cooperate to resolve the issue; and (2) where they have been transferred to a Registry operated by another GC Issuer, then the originating GC Issuer and original account holder shall cooperate with the current GC Issuer and account holder to resolve this issue.

Data Quality: A verification protocol shall be put in place that guarantees the correctness of the quantity of GCs issued, their energy source, production technology and any other data recorded on them as Attributes.

A Measurement Body is responsible for measuring the energy produced and consumed. Data used for the issuance of GCs shall be derived from the registered details of the production facility and the meters that are used for the purposes of energy settlements when determining the quantity of the corresponding physically traded energy.

GCs cannot be issued for production periods for which there is no measurement data available.

Emissions: GCs may be used to enable consumers to calculate the greenhouse gas (GHG) emissions related to their energy consumption on an hourly or sub-hourly basis. This may pave the way in the future for "market-based" hourly accounting for direct GHG emissions. It shall be ensured that where carbon accounting mechanisms exist, then emission reductions calculated by reference to GCs do not double count these.

Methodologies need to be developed to calculate greenhouse gas emissions associated with each GC, e.g. how to take into account the efficiency of a power station. While methodologies might not yet be harmonised around the globe, the GC can indicate the methodology used to determine the GHG emissions it represents.

Energy storage device: An energy storage device should be treated both as a Consumption Point and as a Production Facility. GCs shall be cancelled/retired to reflect the energy fed into the energy storage device, and new GCs will be issued to reflect the release of the stored energy.

GC systems shall support the linkage of GCs issued for stored energy with the cancelled GCs from which the energy originates.

Immutability: A GC may not be modified after its creation other than by cancellation and reissuance in multiple parts, unless it remains on the account to which it was originally issued.

Issuance: All GCs must be issued by a GC Issuer in a Registry, based on data provided by a Measurement Body.

Measurement Bodies shall either be independent of the beneficiary of GC Issuance, or their measurements shall be verified by an independent third party.

All sources of energy should be eligible for GC issuance (both renewable and non-renewable energy sources).

Linking GCs with certificates under an existing EAC: If the existing EAC scheme is not compliant with the EnergyTag guidelines, GCs may be issued under the condition that a link between the GC and the existing EAC is established in cooperation with the EAC Issuing Body and in such a way that neither GCs nor EACs can be double counted in any way that relates to declaring consumption of the same Attributes of energy.

Period of validity: GCs shall have a limited time during which they can be transferred and cancelled for usage claims.

Production Facilities not covered by an existing EAC scheme: The EnergyTag guidelines allow the Issuance of GCs to any type of production technology and energy source, including energy generation not covered by the scope of some of the current EAC schemes.

With the approval of relevant authorities, energy produced in Production Facilities that cannot qualify under the current EAC scheme may still be issued GC by a GC Issuer. The GC Issuer shall guarantee, based on adequate verification mechanisms, that these GCs are not also issued as part of any existing EAC scheme in order to avoid double counting of the Attributes of the same energy production quantity. They shall integrate their activities with the applicable disclosure rules in place in that Domain, while ensuring that any legally imposed methods for declaring the origin of energy towards consumers, including the calculated residual mix, are observed.

Purpose: GCs have the purpose of informing energy consumers of the Attributes of the energy supplied to them.

Quantity resolution for the unit of energy: The resolution of the energy unit for expressing the quantity of energy to which a GC relates, shall enable GCs and the energy represented by them to be represented in whole numbers, even for installations such as residential rooftop solar and energy storage. This avoids decimal and rounding issues.

Reference to another GC: Where appropriate, GC systems should support the identification of previous GCs of the same or different energy carrier, for full traceability and transparency of the history of energy tracking. This could be used for instance for energy storage or conversion from one Energy Carrier to another.

Standardization of information format: The EnergyTag Initiative aims to explore standardizing the exchange of information related to transfer of GCs. The EnergyTag Initiative will for example explore the feasibility of harmonising the data format for GCs transfer across Registries and providing guidance for Registry APIs.

Time resolution: The energy production period for which individual GCs are issued, shall never be greater than 1 hour.

This limit is imposed to reflect the most commonly adopted market time unit for wholesale electricity market products, dispatch periods and forecasting algorithms. Therefore, hourly granularity is the longest time period allowed to ensure that GCs accurately account for the commercial and physical flows of electricity markets. For now, the time period shall however not be shorter than the settlement period used by the local System Operator for settlement. GCs are defined by a "start" & "end" time and date of the corresponding energy production.

Time zones: All GCs should use a single common time zone for expressing time (production period, timestamp of issuance, etc.) which will be UTC (Coordinated Universal Time).

Transferability: GCs are transferable to other Accounts within the same and other Registries.

Verifiability of claims: Each Registry shall enable mandated third parties to verify the GCs cancelled as proof of the Attributes of energy consumed. The Consumption Verification Body shall ensure that cancelled GCs are linked with measured energy consumption.

Verifiability of GCs: Issued GCs should follow a harmonized identification scheme across Registries.

The Registries shall enable the relevant users, such as Account holders, to validate that historic data has not and cannot be changed, without the change being visible. Data shall never be deleted and can only be changed for corrections.

The Consumption Verification Body shall display transparently on its website which geographical restrictions are applied in relation to the cancellation of the corresponding GCs.

Next steps

The principles covered in this document are only high-level, and there is still significant work to do. Over the coming months, the EnergyTag team and EnergyTag members will keep working on

- Clarifying the principles and covering any gaps
- Providing guidelines for implementation
- Providing recommendations for IT standardization

This work will be covered by working groups 1 and 2 of the EnergyTag Initiative. The upcoming EnergyTag demonstrators will also provide valuable feedback to the working groups.

The EnergyTag Initiative aims to publish an additional report by the end of 2021 that will update these principles and outline a first version of the implementation guidelines based on working group work over the year, and demonstrator learnings.

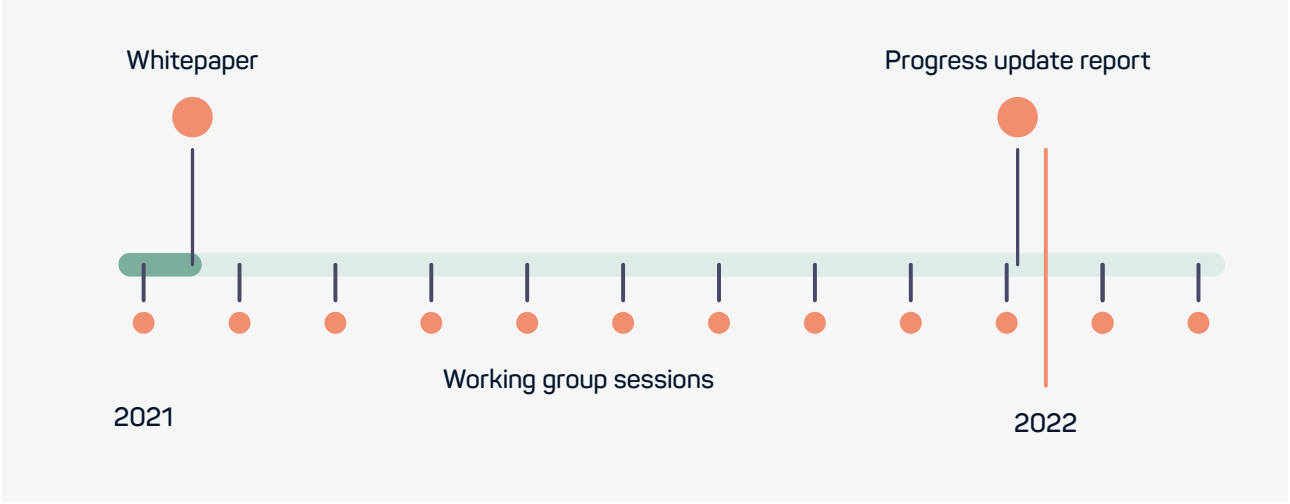


Figure 2: Next steps

It is still possible to join the Initiative and take part in the working groups by contacting the EnergyTag team through the website: http://www.energytag.org.

Among the many topics that need to be addressed by the working groups, the following have been identified as a priority:

- Architecture of role allocation:
  - *Uniqueness guaranteeing while allowing multiple Issuers in a Domain?*
  - *Roles and entitlements of a Consumption Verification Body*
- Defining the Attributes on a GC
- Developing a methodology for determining GHG emissions or composing a list of existing methodologies.
- Implementation of the link with an existing EAC: most demonstrators will operate in a market where an EAC scheme is already in place, there are hence already discussions about how to increase the granularity of these certificates.

- Metering: agreeing where measures should be taken for EACs. Not all smart meters are capable of hourly granularity. Results may also differ depending on whether renewable generation or consumption is measured at the connection to the grid for each asset. For example, how should self-consumed rooftop solar PV be accounted for by an MID meter on the inverter, or only the data from the DSO smart meter at connection to the grid?
- Prevention of double counting: is there a need for a central registry of assets in the scheme, independent of the GC Issuer? And if so who shall manage it?
- Storage: energy storage will be key in the coming years to deal with intermittent generation, and EnergyTag could unlock additional revenue for this flexibility. It is therefore important to enable storage participation into the mechanism. There are still numerous issues to address to integrate storage efficiently in the mechanism: storage efficiency and reservoir capacity, link between the certificates cancelled and reissued, time correlation of cancellation and issuance; etc.
- Validity period of a GC: there must be a predefined lifetime end. Must this be harmonised?

The EnergyTag demonstrators

The EnergyTag Initiative is supporting demonstrators all over the world to trial hourly certificates and test different implementations. The lessons learned from these demonstrators will be fed back to the working group for the definition of the standard guidelines. The demonstrator guidelines and first projects are described in this section.

Guidelines for demonstrator projects

All EnergyTag demonstrator projects have been provided a set of guidelines and have completed application forms. The guidelines communicate the main objectives and scope summarised below.

Objectives: The main objectives of the demonstrator projects are to:

- Test and learn different methodologies to inform the EnergyTag guidelines and guidance setting process;
- Showcase existing technologies for hourly energy tracking for industry and policy stakeholders; and
- Seed new markets for hourly energy certificates that have the potential to grow organically.

The overall goal is to create markets for granular certificates, where the ultimate proof of success is a market that is functioning enough to continue to grow organically.

Timing: Projects are expected to commence in H1 2021 and run into 2022. Following the publication of this report, lead participants for each project are expected to develop detailed timelines and begin regular reporting to EnergyTag working group 3.

Participants: There are a wide range of organisations that may be interested in participating in demonstrator projects, however the minimum necessary are the following:

- an energy buyer;
- a clean energy asset owner; and
- an issuing technology company.

Scope: There is some flexibility in scope for the participants to decide; however the core scope should include:

- Demonstrate the issuance and cancellation of an hourly energy certificate in accordance with the EnergyTag guidelines; and
- Demonstrate an exchange of Granular Certificates between a producer and consumer.

Confirmed Projects

M-RETs supporting 24/7 energy in North America

To support 24/7 carbon-free energy initiatives, M-RETS, a renewable energy tracking platform, facilitated the first-ever hourly Renewable Energy Certificate ("REC") claim when Google finalized an hourly REC retirement[17] in January 2021. This is an exciting first step in building out the data available in existing environmental commodity markets like RECs to help facilitate and quantify efforts toward economy-wide decarbonization in both voluntary and compliance markets.

M-RETS believes existing REC markets are uniquely situated to begin and sustain this process in a way that does not disrupt – and hopefully supports – existing markets. Certain consumers are demanding more granular data integrations on RECs such as hourly data to support evolving sustainability goals. These evolving goals place the highest value on quantifying the benefits of their decisions toward decarbonizing their environmental footprint.

[17] *https://cloud.google.com/blog/topics/sustainability/t-eacs-offer-new-approach-to-certifying-clean-energy*

As part of Phase 1, M-RETS accomplished the following:

1. Developed technical tools to collect hourly data beginning in January 2019. At publication, M-RETS has more than 60 million megawatts of hourly generation data - and this is growing.

2. Created an accessible user interface ("UI") to both view hourly generation data in the system and download that data or access it via an application programming interface ("API").

3. Built advanced hourly reporting tools that allow users to aggregate hourly generation from multiple generators over time.

4. Built a retirement process that integrates hourly generation data into the process when a user retires a complete batch of RECs (i.e., not subdivided after issuance)[18]

Hourly generation data access is an important first step in a multi-faceted process to establish data-driven renewable energy markets. In recognition of this, M-RETS suggests a four-phase process to work through the important market implications of the decisions necessary to achieve the growth of globally scalable data-driven renewable energy markets.

Phase two involves providing access to more granular energy market data and emissions data.

M-RETS hopes to begin working on this in Q1 and Q2 2021. Deciding what market data is important to integrate will depend not only on the availability, but also the accuracy and source of the data. There are important decisions to make within this phase, including whether to include estimated or modeled data.

Phase three involves working with voluntary and compliance market stakeholders to obtain consensus on how to manage the full lifecycle of hourly certificates to support more specific hourly accounting claims. M-RETS hopes to begin work on this in Q3 and Q4 2021. This phase will determine whether REC batches should be broken up and transacted in hourly or smaller increments.

Phase four involves providing a mechanism for more specific hourly claims to also include verified or estimated carbon data, and how to quantify decarbonization efforts on behalf of customers. M-RETS hopes to begin working on this phase in Q1 and Q2 of 2022. This may be a more controversial phase because it requires that stakeholders make important decisions on integrating hourly and other data into existing markets, and how both real and estimated emissions data is reported at the individual and grid level. More information can be found at www.mrets.org/hourlydata/

Power Ledger was founded in 2016 to develop software for environmental commodity and energy trading but also tracking and tracing for EACs, RECS and GOs. More recently we have been providing certification for green hydrogen. We use blockchain technology to guarantee the integrity of every record made, to allow precise time and place attribution and prevent double counting. We help companies stay on top of many of the issues highlighted in this report.

Power Ledger and TDED are creating the first REC marketplace of its kind in Asia called TraceX, bridging the gap between buyers and sellers. It provides an end-to-end solution that tracks REC generation, trading and retirement through one integrated online system without the need for a broker.

TraceX is a fully automated exchange, designed to work hand in glove with M-RETS or any other certificate registry. TraceX has a real time user interface that allows sellers to view their REC balances on the registry. TraceX utilizes blockchain technology that will bring faultless, immutable, and reliable records to these complicated processes.

TraceX was designed specifically to facilitate hourly and spatial RECs on an automatic basis, therefore, in the future this platform may play an important role in the evolving granular REC and TEAC markets. More information can be found at https://www.powerledger.io/platform-features/tracex

Contact details: sales@powerledger.io

[18] *A batch of RECs with hourly data subject to a transfer or transaction that removes even one REC will not qualify for an hourly retirement at this time. However, transfers of a full batch, even if it is between different organizations, does not render a batch ineligible for an hourly retirement.*

24-hour clean heat from power - a Dutch demonstrator project

Participants:

CertiQ – The designated Dutch issuing body of guarantees of origin (www.certiq.nl)

Eneco – Integrated and independent Dutch energy company (www.eneco.com)

FlexiDAO – Energy sector software provider (www.flexidao.com)

Project description:

Power will be produced by the Eneco offshore windfarm 'Prinses Amaliawindpark'. The farm has a capacity of 120MW and is located 23km from IJmuiden, off the Dutch coast. The generation will be consumed by an 11MW Eneco electric-boiler located in Ypenburg, just east of The Hague. This e-boiler is part of a domestic heating district that is otherwise mainly gas fired. The average annual consumption of the e-boiler, in MWh, is still to be determined. FlexiDAO will provide the technology to enable 24/7 tracking of this production and consumption – supported by Ealyze, a Dutch regulated metering company who will provide the necessary metering data. The underlying certificate scheme for this project will be the European guarantee of origin scheme as implemented in Dutch law. The project will be governed by a memorandum of understanding between the participants.

The project will deliver a dry-run test of hourly renewable energy certification in a real-world power to heat system with the aim of providing carbon-free electricity to displace fossil-based heating. The demonstrator project is focused solely on the certification of renewable electricity generation from the Amalia windfarm and its consumption by the Ypenburg e-electric boiler, but optionally other renewable producers and/or consumers can be included in the test. Under the EnergyTag Initiative, the conversion of an "Electricity Guarantee of Origin" into a "Heat Guarantee of Origin" is not included in the scope of this demonstration project.

Contacts:

For more information on this project please contact Simone Accornero at FlexiDAO (s.accornero@flexidao.com), Remco Faas at Eneco (remco.faas@eneco.com) or Remco van Stein Callenfels at CertiQ (remco.van.steincallenfels@certiq.nl).

Greater granularity in guarantees of origin - A Danish demonstrator project

Participants:

Energinet – Danish TSO and issuing body for guarantees of origin (GOs), developing and operating the Danish electricity and natural gas transmission systems (https://en.energinet.dk)

Centrica Energy Trading – Asset manager and trader of power, gas, and green certificates in Europe (https://www.centrica.com/)

Air Liquide – manufacturer of industrial and medical gases (www.airliquide.com)

Dansk Vindenergi ApS – Developer of wind power generation projects (www.dansk-vindenergi.dk)

Project description:

Green power is being generated from two wind turbines (1.5MW capacity) for the hydrogen production of a 1.2MW electrolyzer (both connected to the national grid). Energinet's 'Project origin' has been used to demonstrate that there is currently a 26% (based on Oct-Dec 2020 test period) hourly matching of this production and consumption, as proven through the issuance and cancellation of prototype Granulated Guarantees of Origin (GGOs). The concept of GGOs does not require any fundamental changes to the existing European Guarantee of Origin scheme, as it is implemented throughout Europe today.

This demonstration project is in its initial phase, in which it aims to demonstrate the transparent, time-based documentation of renewable energy, in which production and consumption are matched on an hourly basis.

The project uses the DataHub market settlement data where all production and consumption data in Denmark are compiled and saved. These are the most reliable measurements available, to ensure accurate accounting of the matching of energy production and consumption. The time resolution of the data in this project is flexible and can be adapted to the prevailing market framework, be that 1 hour or 15-minute intervals.

There are two primary purposes of this demonstration project. Firstly, the goal is to prove the share of temporally matching green hydrogen production without optimisation. Secondly, the project aims to demonstrate how forecasts from renewable energy production can optimise and enhance the proportion of renewables used in green hydrogen production by increasing hourly matching, possibly also lowering production cost.

Looking forward, the project strives to implement GGOs to support peer-to-peer trading between smaller producers and consumers, which do not currently use GOs as these are specified as certifying 1MWh of energy. In the project this is enabled by the assets manager as mediator. This project can also support an hourly based emission calculation module that enables the consumers to track emissions related to their energy consumption and for companies to check for compliance with internal company targets. Overall, the project participants anticipate that this system of more granular certificates will enable and inspire end-users to shift their demand to make the best use of the available supply of renewable electricity - encouraging flexibility and demand for energy storage.

Contacts:

For more information on this project please contact Jakob Fauerskov at Energinet (JFU@energinet.dk), Killian Daly at Air Liquide (killian.daly@airliquide.com), René Treumer Andersen at Centrica (rene.andersen@centrica.com).

A new way for Norway – A Nordic demonstrator project

Participants:

Unicorn – Software development company with experience in energy attribute tracking as the developer of the AIB hub (https://www.unicorn.com/en/)

Statkraft AS – Europe's largest renewable energy producer and a global company in energy market operations (www.statkraft.com)

Statnett – Owner and operator of the Norwegian transmission grid, responsible for maintaining power grid balance, and Norwegian issuing body (www.statnett.no/en/)

Tibber – The first digital energy company for consumers in the Nordics. Tibber has operations in Norway, Sweden, the Netherlands and Germany.

Project description:

Unicorn currently offers the energy attribute certificate (EAC) registry solution called Certigy (www.certigy.net). This registry solution was first implemented for and by the Norwegian guarantee of origin issuing body – Statnett. As a result, the Norwegian issuing body is able to issue GOs that specify the day of production, as compared with the month of production that is typical in other European single market countries. The Certigy software could also facilitate issuance with finer granularity, such as specification of the hour of production. While this system has been implemented in Norway, it is based on the European Energy Certificate System (EECS) rules for GOs, and could be implemented in all Association of Issuing Body (the organisation that maintains the EECS rules) member countries.

Through this demonstration project, Unicorn, together with Statkraft, Tibber and Statnett, aims to demonstrate the feasibility of issuing GOs with hourly granularity and matching them to the consumption profile of a chosen consumer. The project should prove the following:

- Hourly issuance and matching can be achieved within the EECS GO scheme;
- Hourly GOs could be deployed independently in each AIB member states without limitation in international imports/exports;
- Hourly GOs can work within the existing IT systems used by issuing bodies and the AIB hub.

As a result, the project aims to contribute to the objective comparison of different approaches to the development and adoption of hourly certification of energy production and consumption.

Contacts:

For more information on this project please contact Filip Kral at Unicorn (filip.kral@unicorn.com), Ivar Clausen at Statnett (ivar.clausen@statnett.no) or Max Andrews at Statkraft (max.andrews@statkraft.com).

Shaking up energy markets down under - An Australian demonstrator project

Participants:

Enosi Australia Pty Ltd

Others, in negotiation

Project description:

Enosi Australia runs the Powertracer technology platform that uses smart meter data to support large and small customers to source their electricity directly from solar and wind farms. Enosi has deployed Powertracer through four electricity retailers and is making 24/7 matching of generation and consumption a reality in Australia. Enosi is also working with several academic institutions and research bodies to ensure the success of the project. Support is also being sought from the I-REC Standard Foundation as the developer of the I-REC scheme and the Australian Clean Energy Regulator has been invited to provide oversight of this demonstrator project. The project has been fully scoped and planned, and Enosi is seeking Australian Federal Grant funding to finance the project. This Enosi project aims to provide 24/7 tracing of generation and consumption in 5 to 30 minutes intervals between wholesale renewable generators and commercial customers.

Contacts:

For more information on this project please contact Steve Hoy at Enosi (steve@enosi.energy).

Software solution for 24/7 matching - A Swedish demonstrator project

Participants:

Microsoft enables digital transformation for the era of an intelligent cloud and an intelligent edge. Its mission is to empower every person and every organization on the planet to achieve more. (www.microsoft.com).

Vattenfall – European energy company engaged in power production, electricity distribution, energy sales, district heating, energy services, and decentralised generation (group.vattenfall.com).

Project description

Vattenfall and Microsoft in Sweden have already successfully piloted a 24/7 renewable energy matching programme, and are now extending this partnership to cover the three new Microsoft datacenters in Sweden.

For this pilot project, Vattenfall used Microsoft Azure to build and deliver a solution that allows hourly matching of renewable energy generation with demand for Microsoft and other Vattenfall customers. Renewable generation and energy consumption are measured hourly with smart meters and other devices and matched hourly on the Azure solution, which enables transparency by providing increased information about the hourly source of energy for each MWh of consumption. Vattenfall uses this real-time information feed to cancel hourly matched guarantees of origin on Microsoft's behalf. In the future, this project will not only track renewable energy production on an hourly basis, but it will also include the marginal carbon emissions abated by the hourly matched GOs. This project is another contribution towards Microsoft's commitment to be carbon negative by 2030.

This project aligns with Vattenfall's goal of enabling fossil-free living in one generation.

Contacts

For more information on this project please contact Taylor Leyden or Vanessa Miler-Fels at Microsoft (taylor.leyden@microsoft.com, vamiler@microsoft.com).

The I-REC Standard and hourly matching around the world

As a standard setting organization, the International REC Standard (I-REC Standard) Foundation is actively working with market facilitators to ensure that certificates with increased temporal granularity can be a reality in any renewables market. Fair and robust implementation of any new development is a core principle of the Foundation and as such, the I-REC Standard governance documents now allow for the reliable implementation of more granular certificates. This update includes the creation of new roles to be undertaken by third-party stakeholders who will have to prove their adherence to the I-REC Standard through a process called accreditation. In this way, the I-REC Standard Foundation is supporting broader market innovation while ensuring that the robust standardization of the underlying asset, the renewable attributes or I-REC, remains unquestioned. The I-REC Standard Foundation separates the work of "hourly matching" into two distinct categories: the first is the issuance of a REC with increased temporal information to a producer - allowing for the creation of a granular certificate as defined in the EnergyTag Guidelines - and the second is the matching of that REC to the consumption profiles of an end-user. This service would be further supported by the EnergyTag Consumption Verification Body.

Regarding the issuance of I-RECS with increased temporal information, the I-REC Standard Foundation has found that the availability of the necessary data varies significantly between markets and systems. The variety of local situations in which I-REC Standard adherent markets are facilitated required the Foundation to ensure that I-RECs could be issued on the basis of different data streams, as long as those streams could be proven to be robust.

In some cases, the Issuer of I-RECs will be the grid operator, regulated entity, or private enterprise with access to temporally granular data streams from the individual generation sites across the country or region. In these cases, the Issuer can overlay this information at the time of I-REC issuance and allow this to be traded or matched by individual market parties or through third-party platforms. However, at other times the local operators will not have this granular data and will require a 'verification authority' to be used to overlay additional data with the goal of providing secondary data streams for increased temporal granularity.

These verification authorities are often private companies who provide I-REC Standard accredited hardware, often installed on-site, or calculation methodologies to ensure reliable data streams on top of what is already used by the Issuer. With this increased data, issuance of I-RECs can be facilitated with the necessary temporal granularity to allow for "hourly matching".

The second workstream for any hourly matching pilot is the matching of temporally granular I-RECs or generation data with the associated end-user. This can be done through an accredited registry or a proprietary platforms or visualization tool. A platform is an electronic interface, visualization tool, marketplace, or other such digital tool that is connected to the underlying registry through API and accredited as being compliant with the I-REC Standard. Through a platform, any organization can use an accredited tool for matching or visualizing their procurement of temporarily granular certificates for the purposes of "hourly matching."

These two work streams come together in the first I-REC Standard hourly matching demonstrator project. These projects are coordinated by various market facilitators with various accredited roles under the I-REC Standard governance documents, including among others:

- Evident/I-REC Services coordination of hourly matching in Chile with a large IT Company
- Instituto Totum as Issuer in Brazil with data delivery from the grid operator
- Becour, FlexiDAO, and others as a Platform Operator
- Various organizations as I-REC Standard defined "Verification Authorities" for data retrieval from distributed generation sources.

More information on the rules for the I-REC Standard and associated market facilitators can be found on our website www.irecstandard.org.

Projects in-development

Spain 1:

Acciona and FlexiDAO are furthering their long-standing relationship by running a demonstrator project to match renewable generation with electric vehicle charging to offer customers 24/7 matched zero-carbon energy. The power will be generated by over 90MW of mixed renewable energy (wind, solar and hydro) and will be consumed from EV chargers installed in Moraleja Green Mall, located in Madrid Spain. For more information contact Simone Accornero at FlexiDAO (s.accornero@flexidao.com) or Pedro Benítez at Acciona (pebenitez@acciona.com).

Spain 2:

Entra Agregacion y Flexibilidad in Spain is the industry association that promotes innovative demand side flexibility solutions for an efficient energy transition. The association is developing a demonstration project that seeks to use battery storage to support 24/7 matching of renewable energy consumption and production. The project is defining the user case for storage to support hourly matching before putting the theory into practice with a range of potential consumers. For more information contact Alicia Carrasco at Entra Agregación y Flexibilidad (alicia@entra-coalicion.com).

EWF:

Global nonprofit Energy Web Foundation (EWF) is developing functionalities to track and match renewable electricity generation and consumption on a 24/7 level. These features are being developed and tested as part of proof of concepts (PoCs). They will be open-sourced in Q3 2021. These PoCs will involve, interalia, the collection of generation and consumption data via a standardized API protocol, the automated issuance of energy attribute certificates on kWh level, the matching of generation and consumption and automated transfers of EACs and the retirement of certificates and intuitive reporting. Currently, these proof of concepts have no official integration with the existing EAC schemes and are therefore not in the first phase of the EnergyTag demonstrator projects. If and when integration with existing EAC schemes is achieved, EWF will look to become an EnergyTag demonstrator. For more information contact Meerim Ruslanova at Energy Web Foundation (meerim.ruslanova@energyweb.org)

Germany:

Lumenaza GmbH is an energy as a service provider which aggregates renewable generation and empowers green utilities to deliver clear origin electricity to consumers. Lumenaza is developing a demonstration project that seeks to optimize the aggregated renewable portfolio mix to support 24/7 matching of production and consumption. As part of the concept, advanced production and consumption forecasts. For more information contact Tereza Borges (tereza.borges@lumenaza.de).

Conclusion

This report has outlined how granular energy certificates could be used to harness rising consumer demand for carbon-free energy, to drive investments in the technologies needed, such as energy storage, and to eliminate our dependence on fossil fuels.

We have described how granular energy certificates can be seen as a natural evolution of EAC systems worldwide to make them more reflective of the physical reality of the energy system. We have provided a brief history of energy certification schemes for context, and have summarised the main activities of the EnergyTag Initiative, namely developing a set of guidelines for granular energy certificates and co-ordinating a series of demonstrator projects.

It is hoped that these demonstrator projects will serve a number of purposes including:

- Demonstrating the potential benefits of granular energy certificates;
  - *Improving the perception of energy certificates schemes in general*
  - *Providing an incentive for energy storage*
  - *Informing the development of the EnergyTag guidelines for granular energy certificates*
- Enabling new carbon accounting methodologies
- Seeding the first voluntary markets for granular energy certificates by continuing to grow organically Towards the end of 2021, EnergyTag aims to publish a second report featuring the initial results from these demonstrator projects, alongside a more detailed set of guidelines developed in the working groups.

The EnergyTag Initiative will continue to work towards its mission of building a framework for granular energy certificates and promoting the potential benefits of increased time granularity of certificates. The aim of the EnergyTag Initiative is to facilitate this movement and seeks to work collaboratively with all organisations playing a role in existing certificate schemes and in the power market. Only strong collaboration within the energy industry and with regulators can push this new development forward.

This report is only the first step on a long journey for granular energy attribute certificates to become widespread, however we are delighted by the level of support the initiative has received so far (see Acknowledgements).

Acknowledgements

This report was produced as a result of the hard work of a wide range of contributors and reviewers. The EnergyTag Initiative thanks everyone involved for their time and hard work. A list of 19 contributors who provided content is provided at the end of the report, however there are likely others who have been missed. We received written comments and feedback from over 30 organisations which have been incorporated to the best of our ability.

Finally, we are grateful for the many participants in the EnergyTag Initiative, over 100 of which have given permission to be listed publicly as a supporter and are listed at the end of the report.

We would also like to thank EIT InnoEnergy for a grant award which contributed to the production of this report.

Glossary

EAC	Energy Attribute Certificate
GO	Guarantee of Origin
REC	Renewable Energy Certificate
I-REC	The International REC Standard
GHG	Greenhouse Gas
EU ETS	European Union Emissions Trading System
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standard
PPA	Power Purchase Agreement
RECS	Renewable Energy Certificate System
EECS	European Energy Certificate System

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Bruno Menu	EnergyTag
Emilien Simonot	EIT InnoEnergy
Jared Braslawsky	I-REC
Toby Ferenczi	EnergyTag

Supporting Organisations

3Degrees	Countryside Renewables	Energy Unlocked	Hamburg Institut	Onoma Commv	Statnett
Accenture	Dansk Vindenergi	Energy Web Foundation	HDF	Ørsted	Stem
Acciona	DAPEEP	ENGIE	Hinicio	OVO Energy	Sumitomo Electric
AES	Directional	ENI Gas e Luce	Iberdrola	Power Ledger	Sunamp
Air Liquide	DNV	Enosi	I-REC	PowerRegistry	Traken
Alpiq	E2i	Entrnce	Iron Mountain	Pure Energi	Unicorn Systems
Altenex	ECOHZ	ESG	Itron	PwC	Vattenfall
Altergrids	econscia	Eurelectric	LO3 Energy	RECs International	Vest Energy
American PowerNet	EDF Energy UK	European Federation of Energy Traders	Lumenaza	Redshaw Advisors	VITO/EnergyVille
Argus Media	EIT InnoEnergy	EWF	Megawatt-X	Reneum	WattTime
AXPO	Elblox	FlexiDAO	Microsoft	Renewable Energy Hub	WBCSD
Baringa	Electron	Future Earth	Mitsubishi Corporation	Re-Source	WePower
Belltown Power	ElectroRoute	Google	Montel	Ripple	Wind Europe
Blockchain Lugano	Elering	Greenfact	M-RETS	Scene	zaRECs
Carbon Cap	Elia Group	Greenhouse PR	National Grid ESO	Sindicatum	Zeigo
Centrica Energy Trading	Eneco	Grexel	Nord Pool	Soladvent	Zytech Group
CertiQ/Tennet	Enel	Guidehouse	NZECS	Squire Patton Boggs	
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