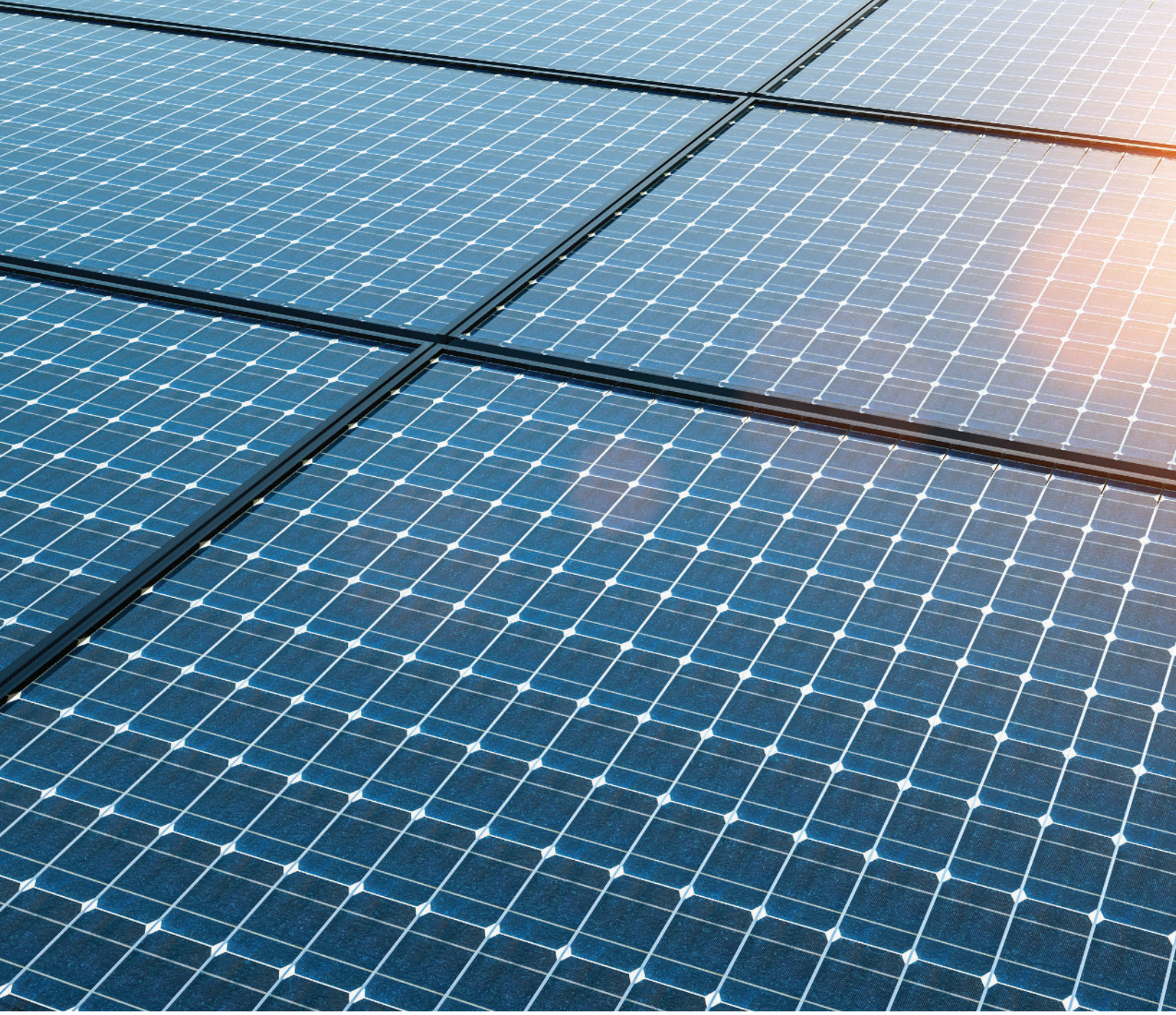

# Residual Mix Applications and Existing Data

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CEAP | CLEAN ENERGY ACCOUNTING PROJECT

CRS™

# Table of Contents

In general, "residual mixes" represent "untracked or unclaimed energy and emissions."[1] Residual mixes, and associated emissions factors (EFs), are needed for many applications. Today they are often used for greenhouse gas (GHG) emissions calculations and reporting by either electricity providers or customers. Residual mix information is currently produced by both governmental and non-governmental organizations (NGOs). Even when residual mixes are developed for the same application, they can vary in terms of data sources, treatment of clean generation resources used for compliance and voluntary purposes, and geographic and temporal boundaries. This lack of consistency begs the question: how should residual mixes be defined and calculated in the U.S. for different uses?

This document includes a representative summary of residual mix applications, and publicly available residual mix EFs.[2] It also identifies general considerations for residual mix calculation methodologies.[3] As this backgrounder is intended to provide a baseline of available information and to facilitate discussion, it is not a comprehensive list of all applications, residual mix EFs or considerations.

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1 Sotos, M. Jan 2015. *GHG Protocol Scope 2 Guidance: An Amendment to the GHG Protocol Corporate Standard.* World Resources Institute. Pg. 8, 9, 56, 101.

2 Center for Resource Solutions (CRS) researched publicly available information and conducted interviews with organizations that produce or use residual mixes and others.

3 Though for the purposes of this backgrounder residual mix refers to electricity, the term is not only relevant to electricity, e.g., residual mix has also been used to address chemical and other material chain of custody systems.

# 1. Residual Mix Applications

For the purposes of this backgrounder, residual mix applications are used to highlight situations which need residual mixes.

## 1.1 MARKET-BASED SCOPE 2 DEFAULT EMISSIONS FACTOR

Organizations reporting a GHG emissions footprint in accordance with the GHG Protocol Corporate Standard are required to quantify emissions from the generation of acquired and consumed electricity based on contractual ownership of generation attributes consistent with the choices a consumer makes regarding its electricity supplier or product. Where consumers do not make choices about the electricity they acquire, they are instructed to use a market-specific residual mix EFs. This prevents consumers across a market from double counting attributes of specified generation. Where this is not available today, consumers often use a grid average EFs instead, which does lead to double counting.

## 1.2 UTILITY-SPECIFIC FACTORS

A utility-specific factor describes the portfolio of resources that are used (owned or procured) for retail customers or sales. Standard offer utility-specific factors exclude specified power products and represent the resource mix the utility is delivering to customers enrolled in a standard offer product. Clean energy included in the standard offer may be considered clean energy that is delivered by default, including clean or renewable energy a utility may be using to comply with a state renewable portfolio standard or clean electricity standard. These specific default emissions factors are often called "residual mixes" and "residual mix emission factors" because they've removed voluntary and other specified product sales, but are not residual mixes for a region, state, or other area.[4] Utility-specific factors will need residual mix factors for any null power or unspecified wholesale procurement provided to customers.

## 1.3 ELECTRICITY PRODUCT DISCLOSURE LABELS

Many states require utilities and other load-serving entities (LSEs) to produce electric product disclosure labels which convey the provider's resource mix and/or emissions factor to customers. There is a great deal of variety in terms of what information is included (e.g., clean and renewable energy definitions vary by state), whether the information represents electricity generated or delivered, whether a standardized reporting and accounting methodology is required, whether verification is required, etc. States may define the calculation methodology utilities use to comply with product disclosure rules, and often provide methodologies to assign emissions to null power and unspecified power when residual mix information is not available. For example, in California, the state's Power Source Disclosure (PSD) program assigns a default GHG emissions intensity to both null power and unspecified power that is similar to that of a natural gas generator.[5]

4 For more information see our Data Sources: *Data Sources: Accounting for Standard Delivery Renewable Energy*, pp. 2–3 **resource-solutions.org/wp-content/uploads/2021/03/Data-Sources-Standard-Delivery.pdf**

5 See PSD Frequently Asked Questions: **www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/psd-frequently-asked-questions**.

### 1.4 RENEWABLE OR CLEAN ENERGY USE TARGETS (NON-VOLUNTARY PROCUREMENT)

In some cases, renewable or clean energy use targets may include qualifying default delivered energy resources present in a residual mix.[6] A residual mix may be necessary under several circumstances including where utility-specific data is not available, where null power is procured, or where RECs are sold from owned generation.

### 1.5 CLEAN FUELS PROGRAMS

Clean Fuels Programs that rely on electricity as a fuel source can greatly benefit from incorporating residual mix EFs instead of grid averages. These programs aim to promote the adoption of cleaner and more sustainable energy sources in transportation or other sectors that utilize electricity as a fuel. By using residual mix EFs, Programs can provide a more accurate assessment of the emissions reductions achieved. This approach ensures that the programs accurately reflect the environmental impact of using electricity as a fuel and facilitates more informed decision-making regarding the adoption of cleaner energy sources.

### 1.6 LIFECYCLE ANALYSIS (LCA)

The use of residual mixes EFs in the lifecycle analysis (LCA) of a product's carbon footprint could offer significant advantages compared to relying solely on grid mixes. LCA aims to assess the environmental impact of a product throughout its entire lifecycle, including the emissions generated during its production, use, and disposal. By incorporating residual mixes emission factors, the LCA can provide a more accurate representation of the product's carbon footprint. This approach allows for a more comprehensive evaluation of the environmental impact, enabling better-informed decisions and promoting the adoption of cleaner energy sources within the product's lifecycle.[7]

### 1.7 BUILDING EFFICIENCY STANDARDS

Utilizing residual mix instead of grid mixes can offer significant benefits in the context of Building Efficiency Standards. These standards aim to improve energy efficiency in buildings by establishing requirements for factors such as insulation, lighting, and heating/cooling systems. When determining the energy savings and emissions reductions achieved through these standards, relying on residual mix data can provide a more accurate representation of the actual environmental impact.

## 2. Existing Residual Mix Examples

Existing residual mixes are distinct methodologies and calculations relevant to various applications.

6 This is not accepted under RE100 (except in certain markets with very high RE generation).

7 Estimating future emissions or impacts poses significant challenges due to the complex and interconnected nature of various factors involved, such as technological advancements, economic growth, and policy changes, making it difficult to precisely predict their long-term effects.

## 2.1 ALL-GENERATION CERTIFICATE TRACKING SYSTEM RESIDUAL MIXES (NYGATS, PJM-GATS, AND NEPOOL-GIS)[8]

Regional transmission organizations (RTOs) operate wholesale markets for electricity in which generators sell power and load-serving entities purchase it and sell it to consumers. Some RTOs use all-generation certificate tracking systems to facilitate the tracking and transaction of renewable and other specified power for compliance with renewable/clean energy standards and power source disclosure programs as well as voluntary sales. All-generation certificate tracking systems—including the New England Power Pool Generation Information System (NEPOOL-GIS), the PJM Generation Attribute Tracking System (PJM-GATS), and the New York Generation Attribute Tracking System (NYGATS)—issue certificates for generation from all resource types and all electricity generation in their footprints. These systems automatically calculate and publish their own System Mixes and Residual Mixes for use in power source disclosure programs. The residual mix is calculated as the weighted average of resource types and emission factors for all unclaimed certificates. This rate is applied to load-serving entity (LSE) load that has not been matched to certificates (i.e., "unfulfilled load") as Residual Mix Certificates, without being actively sourced by the account holder to meet their load.

### What is Included?

This data includes $CO^2$ emissions factors (lbs $CO^2$/MWh) of the generation included in unsold certificates tracked in all-generation tracking systems. It does not disclose the resource mix (%). By excluding all retired certificates (i.e., all specified transactions) from the calculation, these emissions factors do not include renewables used for state compliance programs or voluntary products.

### Treatment of Imports / Exports

Specified imports of energy will only result in unit-specific certificate creation if the energy being imported is coming from an area with a Compatible Certificate Tracking System (other all-generation tracking system and NAR [certificate only]). Specified Imports from areas without a Compatible Certificate Tracking System will result in the Certificate Attributes reflecting the residual mix (if available) or the System Mix of the exporting Control Area. Unspecified imports receive either the residual mix (if available) or system mix. Specified and unspecified energy exports are withheld from the residual mix and power source disclosure processes. Unbundled certificate Imports and exports that are not accompanied by energy are excluded from the residual mix.

### Scope of Data

For NYGATS and PJM-GATS this data is annual and represents the previous year (PJM-GATS is moving to monthly reporting). For NEPOOL-GIS the residual mix is calculated quarterly. The data is all specific to the respective wholesale market for each tracking system.

8 See operating rules for all-generation tracking systems: **NEPOOL GIS Operating Rules**, **NYGATS Operating Rules**, **PJM-GATS Operating Rules**.

## 2.2 GREEN-E® RESIDUAL MIX EMISSION FACTORS[9]

CRS publishes annual residual mix EFs that "can be used to calculate the GHG emissions associated with untracked and unclaimed U.S.-based sources of electricity, based on location of consumption." The Green-e® residual mix emissions factor is "an emissions factor that is adjusted to remove all Green-e® Energy certified [voluntary] sales for each Emissions & Generation Resource Integrated Database (eGRID) subregion." Since regional residual mix EFs that factor out all voluntary or specified electricity purchases are not yet available for all regions of the U.S. or published by a national data source, the Green-e® residual mix EF are published to provide a more accurate depiction of emissions from sources not used in specified purchases. This residual mix EF does not remove all voluntary or claimed generation from eGRID, only the generation certified by Green-e® Energy program. The Green-e® residual mix EFs are intended to be used for Scope 2 emissions calculations by electricity customers for unspecified purchased electricity where resource mix and emissions information is not available from the electricity supplier and based on the eGRID subregion in which the electricity is consumed.

### What is Included?

This program discloses residual mix emissions factors (lbs $CO^2$/MWh), but not the resource mix (%). The residual mix emissions factor is calculated by first subtracting all unique Green-e® Energy certified sales (in megawatt-hours [MWh]) from the total generation within each subregion. The total $CO^2$ emissions for each region are then divided by this new generation number for each subregion, resulting in an adjusted emissions factor that accounts for use of renewable energy from a Green-e® Energy certified product. These emissions factors include renewables that are delivered to customers in default products.

### Scope of Mix

Green-e® residual mix emissions factors are published every spring using Green-e® voluntary renewable energy market sales data collected during the annual Green-e® Energy verification audit from two calendar years prior and the most recent U.S. generation and emissions factor at the time of publication. This lag raises questions around when this EF should be applied to electricity relative to the time of consumption.

### Treatment of Imports / Exports

The Green-e® residual mix EFs do not account for imports or exports from eGRID subregions, since the underlying eGRID data does not. The generation that is used in Green-e® Energy certified sales is subtracted from the eGRID subregion in which the generator is located.

## 2.3 A RESIDUAL MIX OUTSIDE THE U.S.

One salient example of a residual mix outside of the U.S. is the European Union (EU) Residual Mix, which uses the Guarantee of Origin (GO) system to track the origin and environmental attributes of sold electricity (IEM Directive (EU) 2019/944, Annex 1 (5)).[10] This residual mix shows a method for developing a residual mix in the absence of an all generation tracking system.[11]

9 See **Green-e® Residual Mix**

10 **www.aib-net.org/sites/default/files/assets/facts/residual-mix/2021/AIB_2021_Residual_Mix_Results_1_1.pdf**

11 The calculation is carried out by Grexel Systems, Ltd. on behalf of the Association of Issuing Bodies (AIB).

This residual mix represents the part of electricity supply in Europe that is not issued guarantees of origin. Although GOs are primarily employed to verify the use of renewable electricity, their usage is expanding to encompass various forms of energy, such as fossil fuels and renewable natural gas.

### What is Included?

This residual mix represents all untracked generation in participating EU countries. However, at the country level, the generation counted towards the domestic residual mix is still inconsistent, e.g., in some countries some generation receiving support through government programs such as feed-in tariffs may not be issued GOs or factored into the residual mix.

### Treatment of Imports / Exports

The EU residual mix is based on the European Attribute Mix (EAM), a common attribute pool which interconnects participating countries' domestic residual mixes. Net electricity imports per country are added to the production data of the importing country according to the shares of different energy sources in the production mix (or if available, residual mix) of the exporting external country. Net electricity exports are deducted from the available attributes of the exporting country according to the shares of different energy sources in the domestic residual mix of the exporting country. Under this scheme, countries with a surplus of attributes (importers) compared to their consumption, feed attributes to the EAM, those attributes are then distributed to countries with deficits (exporters) on a country-by-country basis.[12] Countries calculate their domestic residual mix by subtracting GOs that are issued in their country that year and GOs that have expired and can no longer be claimed for electricity disclosure from their production data.[13] The domestic residual mix is then compared to the volume of untracked consumption in the country. Surpluses reflect the domestic residual mix of each country and are added to the EAM, which is used to fill in deficits in deficit countries.

### Scope of Mix

AIB publishes annual mixes and residual mix emissions factors that represent all unclaimed generation in participating EU countries.

# 3. General Considerations for Residual Mixes

## 3.1 TERMINOLOGY

The "residual mixes" available in the U.S. today differ greatly in terms of intended use and methodology. Given that residual mix data will be developed for different purposes using different methodologies, there may better ways to label these different data sets. Examples could include more specified residual mix types such as "Unspecific Wholesale Mix," or "Import Mix." Further, there is also uncertainty around the differences between a residual mix, an LSE specific emissions factor, and standard offer products. Guidance is needed to enable buyers, utilities, and policy makers to know what to ask for and when.

12 Meaning it is possible for a country to have both physical electricity net imports from country A and physical electricity net export to country B.

13 For more information see Grexel. Issuance Based Residual Mix Calculation Methodology (p.16). Available at: **https://www.aib-net.org/sites/default/files/assets/facts/residual-mix/2022/RM%20EAM%20IB%20Calculation%20Methodology%20V1_2.pdf**

### 3.2 GEOGRAPHY

Questions remain about what geography should define a market boundary for a particular application. For example, organizations reporting Scope 2 emissions today, may use a variety of grid averages to represent unspecified purchases, e.g., utility specific, state-level, ISO/RTO, and national. Alternately, for a California utility reporting its power content label to customers, should the market boundary used to calculate residual mix factored into that total be the California Independent System Operator (CAISO), the Western Interconnection? How should parts of California that are not in in CAISO be treated? A further complication is that market boundaries for electricity are not the same as for attribute boundaries.

Some feel that in the U.S. the balancing authority level is the appropriate geographic boundary as it enables harmonization across all regions and best represent what is happening on the grid. EAC generation data could be overlaid with generation totals reported on Form EIA-923. Because the EAC generation data does not specify the retirement reason, this would provide a residual mix that does not include renewables generation used in standard offers and would not remove voluntary clean energy products with precision.

### 3.3 DATA AVAILABILITY

Residual mix calculations can require generation data, load data, voluntary market data, compliance market data, and energy transaction data as well as attribute transaction data. Depending on the geography of the residual mix, these data needs become increasingly complex. A residual mix that accurately excludes voluntary purchases requires data from utilities, tracking systems, and markets actors that interact with that respective geography. Concerns exist around the availability of this data and the risk of the abuse of this data to create a market advantage. It's also possible, depending on the data source, that some generation (e.g., small renewable generators) would not be captured in the calculation. Tracking systems may be able to facilitate residual mix calculations by tagging RECs that are used in different residual mix calculations.

### 3.4 TIMING

Currently most residual mixes are produced annually or quarterly, for a previous period. This is due to needing both generation data and attribute data. Residual Mixes that cover larger territories may take more time due to the variation of when attributes are retired for various state, regional, and voluntary programs. One outstanding question is how residual mixes should treat temporal differences, such as banking that is eligible under a RPS, in attribute generation and retirement.

### 3.5 RPS INCLUSION

One of the primary differences in residual mixes is how they treat renewables used in RPS and CES programs. All generation tracking systems currently do not include RPS generation in the residual mix, as the certificates are sold to specific entities (regulated suppliers) and applying that generation to unfulfilled load would result in double counting. But RPS generation would potentially go into a residual mix used by a customer for Scope 2 reporting or other applications if what's being calculated is what is publicly shared by customers in an area for load covered by RPS obligations, or what can be claimed by customers at a regional level if they're not buying specified power.

# 4. Conclusion

This backgrounder has described the importance of residual mixes in a variety of applications, including market-based Scope 2 default EF, utility-specific factors, electricity product disclosure labels, renewable energy targets, clean fuels programs, lifecycle analysis, and building efficiency standards. These applications clearly demonstrate the necessity for new residual mix calculation methods as well as the availability of publicly accessible residual mix emission factors, such as those provided by all-generation certificate tracking systems and Green-e®. By understanding and utilizing residual mixes, stakeholders can effectively address the unique requirements of different applications and make informed decisions based on accurate and standardized methodologies. Moving forward, it is crucial to continue refining and expanding the understanding of residual mixes to ensure transparency, consistency, and sustainability in energy-related practices.


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