ESG METHODOLOGY & FRAMEWORK WORKING GROUP

PROPOSED METHODOLOGY FOR ESTIMATING DIGITAL AD EMISSIONS

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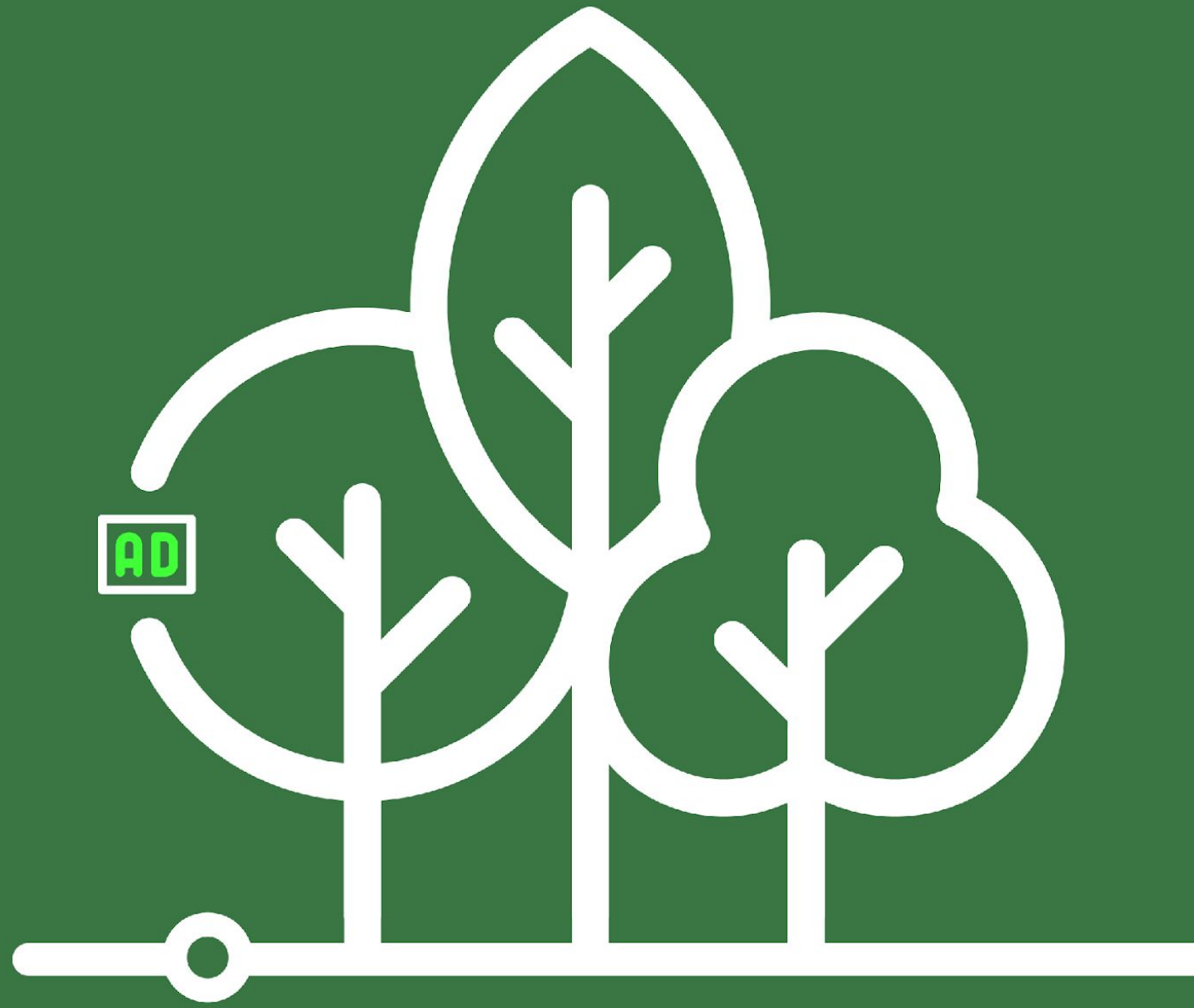
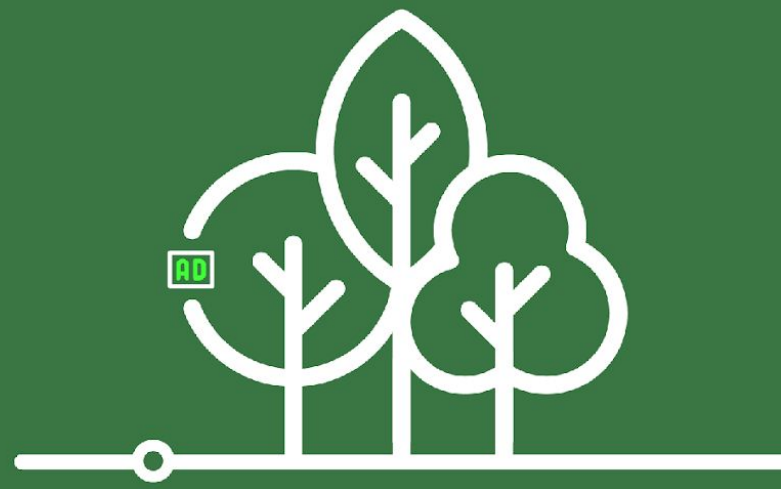


INTRODUCTION: AN ECOSYSTEM UNITED FOR CHANGE



INTRODUCTION: AN ECOSYSTEM UNITED FOR CHANGE

For as long as the environmental impact of media buying has featured as a topic of discussion within the digital advertising ecosystem, there have been calls for standardisation of the way the carbon footprint of digital media products is estimated. Indeed, the lack of standards has consistently ranked as a top challenge preventing progress on sustainability according to IAB Europe's annual State of Readiness report.

In 2024, the Association published the Mapping of GHG Estimation Solutions, a report that confirmed the presence of important methodological differences between frameworks and solutions used by the ecosystem to estimate the environmental impact of campaigns. Since late 2023, IAB Europe's Sustainability Standards Committee has been working closely with other industry bodies to support the formation of robust, practical, and representative standard methodology that enables ecosystem players to understand the carbon footprint associated with digital ad spend.

This document contains the proposal formulated by the Sustainability Standards Committee's ESG Methodology & Framework Working Group for the methodology used to estimate digital ad emissions in Ad Net Zero's Global Media Sustainability Framework.

WHAT ARE THE MAIN OBJECTIVES OF THIS PROPOSAL?

1. **Consistency** across different applications of the methodology.
2. **Clarity** with respect to the methodology and how it should be applied.
3. **Robustness** of the methodology and resulting emissions estimates.
4. **Adaptability** depending on the data that is available to each stakeholder.
5. **Conservativeness** of estimates, especially when based on less granular data.

WHAT PROCESS WAS FOLLOWED TO COMPILE THIS PROPOSAL?

The Methodology & Framework Working Group compiled this proposal over the span of a few months between Q4'23 and Q1'24. The WG began by analyzing the first version of the Global Media Sustainability Framework and identifying areas for improvement - sections where methodological adjustments and additional guidance and/or data were required to meet objectives for the standard.

Ad tech, publisher, agency, and sustainability solution vendors developed the updated methodology with assistance from subject matter experts. IAB Europe worked closely with Ad Net Zero throughout this process and presented a first draft of the WG's proposal to the Ad Net Zero Community. Feedback was collected over a one-month period, during which the M&F WG split into sub-groups to tackle questions relating to data centers, the programmatic supply chain, ad payloads, and view time in more detail. An anonymized version of the Ad Net Zero Community's feedback was reviewed carefully by the M&F WG alongside suggestions for data points required to facilitate application of the methodology.

A NOTE ON UNCERTAINTY

Figures expressing the environmental impact of digital ad products rely heavily on assumptions, proxies, and third-party data. As a result, the Sustainability Standards Committee recommends that these are referred to as **estimates** and that the tools that yield such figures are referred to as **models** rather than calculators. Claims regarding the environmental impact of digital advertising products or campaigns should be communicated as such, making it clear that the quantified impact is characterized by uncertainty. Calculating the statistical uncertainty of the estimates produced by this methodology is impossible due to the lack of relevant data in the sources the WG relied upon.

In its proposal, the M&F WG has sought to account for uncertainty by following the **conservativeness principle** - calculations based on data that is less specific should yield higher figures. Furthermore, this approach should incentivize disclosure of data required to facilitate more accurate applications of the methodology.

Transparency is key when it comes to improving the quantification of digital ad emissions. As more ecosystem stakeholders make data about their operations available, the accuracy and precision of environmental KPIs will improve.

A NOTE ON REDUCTIONS ON PAPER

Emissions estimates calculated using the proposed methodology can vary substantially depending on the input data. One of the guiding principles in designing the methodology was that implementation of best practices and campaign optimization for lower environmental footprint should be **representable** in the results. In other words, when a stakeholder takes an action that likely reduces their carbon footprint, the proposed methodology should yield lower emissions estimates as well. However, organizations applying the methodology should be mindful of the fact that, in some cases, changing the inputs may yield lower results when in reality it is doubtful that greenhouse gas emissions have been reduced

As an example, let's assume the proposed methodology is being used to estimate the impact of targeting mobiles instead of tablets on a campaign's estimated emissions. While the methodology yields lower use-phase emissions for ads served to tablets as a result of the emission factor that is included, there is no direct causal link between opting to advertise to users on tablets and whether users will opt to use their tablets or mobiles. These events are largely independent of each other and the real amount of electricity consumed by the devices that users decide to consume media on will be unchanged.

HOW TO READ THE PROPOSAL

1. Base input tables show the data you need to provide to apply the methodology.

Base Inputs
...

2. Constants tables show the data provided with the methodology. Sometimes calculations based on the base inputs are required.

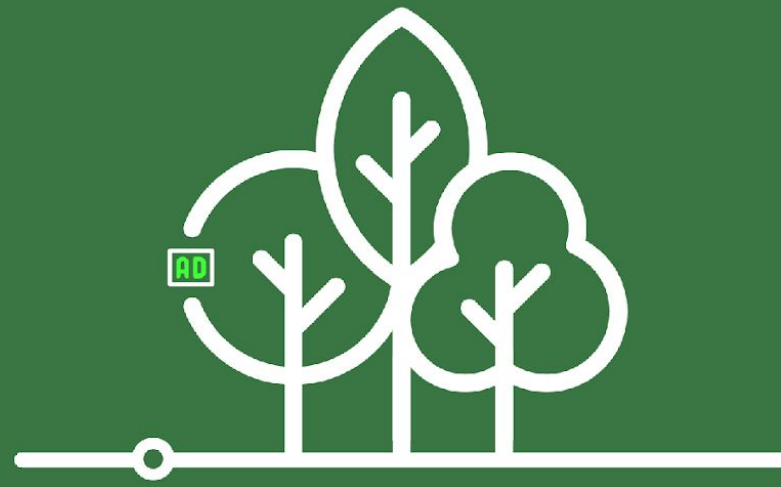
Constants
...

3. In the boxes with the green border you'll find calculations and worked examples.

Post_production_storage_emissions =
= Total_masters_size * ((HDD_copies * HDD_intensity) + (SSD_copies * SSD_intensity) + (LTO_copies * LTO_intensity) + (Cloud_copies * Cloud_intensity))
= 50 * ((1 * 0.02) + (1 * 0.16) + (2 * 0.00114) + (3 * 0.0253))
= **0.25818 kg CO2e**

A condensed version of the calculations in spreadsheet form can be found here.

PROPOSED METHODOLOGY



OUTLINE

The M&F WG's proposal aims to capture the full lifecycle of a digital ad excluding the production of creative assets (accommodation, travel, space etc.), which is out of scope for the Global Media Sustainability Framework across channels. Across the four stages below, it takes account of full lifecycle emissions for the hardware involved (servers, networking infrastructure, user devices).

Post-production storage

The storage of masters bundles after post-production.

Selection

The buying and selling of digital ad space.

Delivery

The transmission of digital ads to the user.

Consumption

The rendering of digital ads on the user device.

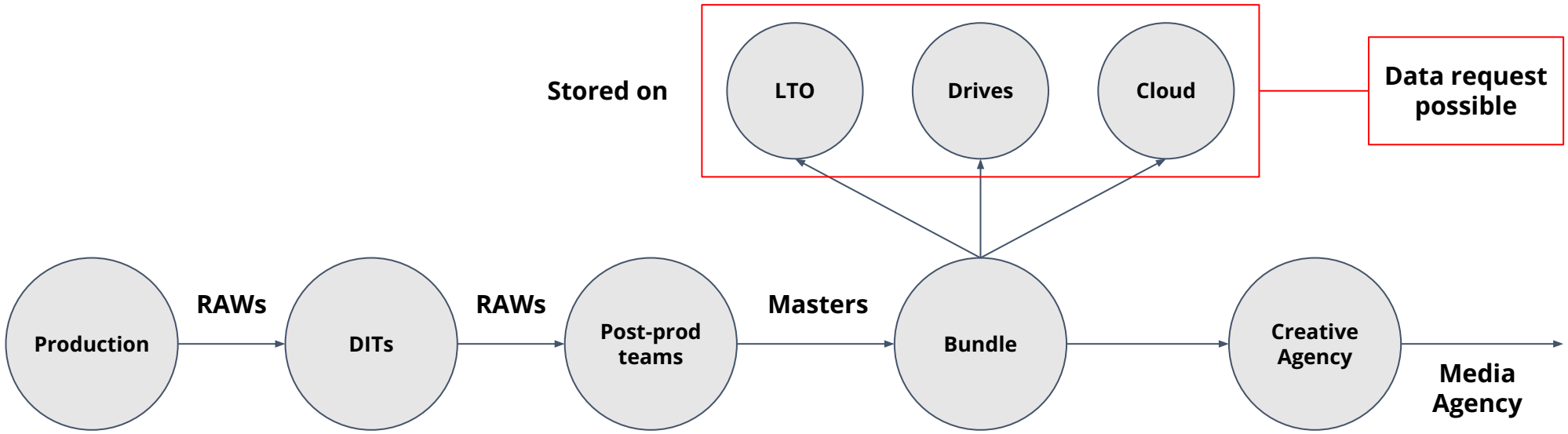
A NOTE ON CORPORATE OVERHEAD

While supportive of including an allocation of enterprise-level emissions in the GMSF, the M&F WG believes that additional guidance is required to ensure consistency between the figures shared by each company and how they are used. As such, it opted to set aside the Corporate Overhead component of the previous version of the GMSF digital methodology as a placeholder and area for future work.

The objective of this proposal is to avoid large inconsistencies in emissions estimates that arise without clear guidance on how to integrate figures from enterprise-level emissions reports, a point which was echoed in the feedback received from the Ad Net Zero community.

POST-PRODUCTION STORAGE

The post-production storage stage accounts for emissions resulting from the storage of masters bundles at the end of the post-production process. The M&F WG consulted with post-production experts in setting this scope based on the difficulty in tracking asset storage in earlier stages of post-production.



All final creatives, incl. versions that are localized, with/without legal language, and other variants.

POST-PRODUCTION STORAGE DATA

Base Inputs		
Variable	Unit	Source
Total masters size	GB	RFI to post-production company
Copies stored on HDD	Integer	
Copies stored on SSD	Integer	
Copies stored on LTO	Integer	
Copies stored on Cloud	Integer	

Constants			
Variable	Unit	Value	Source
LTO intensity	kg CO2e per GB	**1.14E-3**	Fujifilm estimates on LTO-8
HDD intensity	kg CO2e per GB	**1.6E-1**	Tannu, S., & Nair, P. J. (2023).
SSD intensity	kg CO2e per GB	**2E-2**	
Cloud intensity	kg CO2e per GB	**2.53E-02**	ADEME, Base Empreinte (NegaOctet v1.5) 2022 **use-phase based on French grid*

Assets are assumed to be stored for 10 years. Use-phase is excluded for local drives as external drives are assumed to be used with infrequent access.

POST-PRODUCTION STORAGE CALCULATION

Example Inputs		
Variable	Unit	Value
Total masters size	GB	50
Copies stored on HDD	Integer	1
Copies stored on SSD	Integer	1
Copies stored on LTO	Integer	2
Copies stored on Cloud	Integer	3

Constants			
Variable	Unit	Value	Source
LTO intensity	kg CO2e per GB	**1.14E-3**	Fujifilm estimates on LTO-8
HDD intensity	kg CO2e per GB	**1.6E-1**	Tannu, S., & Nair, P. J. (2023).
SSD intensity	kg CO2e per GB	**2E-2**	
Cloud intensity	kg CO2e per GB	**2.53E-02**	ADEME, Base Empreinte (NegaOctet v1.5) 2022 **use-phase based on French grid*

Post_production_storage_emissions =

= Total_masters_size * ((HDD_copies * HDD_intensity) + (SSD_copies * SSD_intensity) + (LTO_copies * LTO_intensity) + (Cloud_copies * Cloud_intensity))

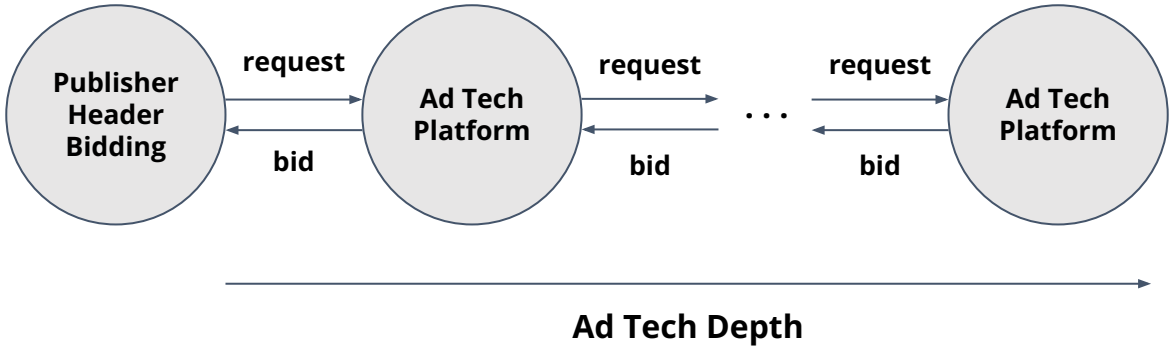
= 50 * ((1 * 0.02) + (1 * 0.16) + (2 * 0.00114) + (3 * 0.0253))

= **12.909 kg CO2e**

SELECTION

The selection stage accounts for the activity required to buy and sell digital ad space, including real-time bidding and direct sale - it is the hardest stage to model in the lifecycle of the digital ad due to limited transparency. The proposed methodology accounts for server processing (compute) and transfer of RTB requests and responses (networking).

Direct sale is modeled as programmatic unless the media owner dedicates a portion of its inventory solely to direct sale and the programmatic supply chain is not activated. Assumptions have been integrated to adapt the methodology for end-to-end platforms (e.g. social) in the absence of information on internal auctioning.



SELECTION DATA LEVELS

There are two things that need to estimated in the selection stage: the volume of programmatic activity and the intensity of server operations. Currently, the calculations rely on ads.txt as a proxy and LCA data layered with assumptions respectively. Following this proposal, the M&F WG will focus on facilitating higher level calculations based on contributed data.

	Programmatic Activity		**Server Operations Intensity**	
Level	Method	Notes	Method	Notes
0	Default value	For cases where no ads.txt is available.	Default value	Based on life cycle assessment of VMs and assumptions.
1	Ads.txt	Based on ads.txt length as a proxy and standard data on supply chain depth.	Allocation from global data	Based on contributed data on the impact of server operations, allocated to the impression level from global, regional, or data center level. Location-based data baselines with optional market-based data and in adherence with GHG Protocol guidance.
2	Contributed data	Based on publishers, SSPs and DSPs sharing aggregate data on volumes of bidding activity for each partner they work with.	Allocation from regional data	
3	Contributed data by geo	Further disaggregated by geo.	Allocation from unit data	
4	Monthly contributed data by geo	Further disaggregated by using monthly data.	**Levels in grey are WIP**	
5	Monthly, placement-level contributed data by geo	Further disaggregated leveraging GPID.		

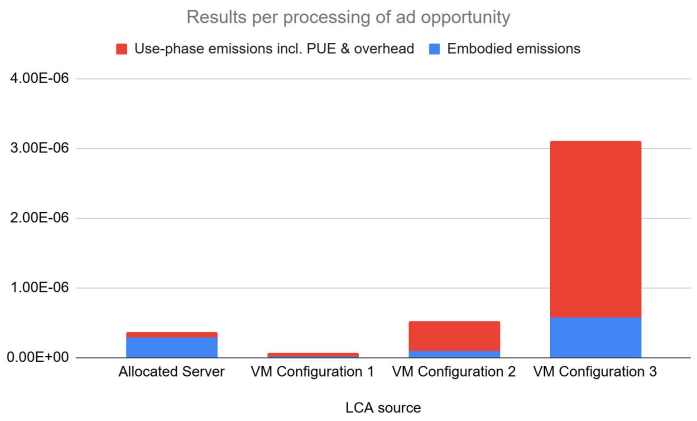
SELECTION DATA OVERVIEW

Constants			
Variable	Unit	Value	Source
Server lifetime emissions	kg CO2e per supply chain node	Calculated using the methodology on the 'Server Model' slide.	
Use-phase network energy consumption	kWh per KB	9.67E-09	Fixed network assumption for RTB calls. Refer to 'Network Emissions Model' slide. Order of magnitude adjusted.
Network embodied emissions	kg CO2e per KB	4.43E-09	
Number of RTB calls per ads.txt line	Integer	Refer to the methodology on the 'Active Paths level 0/1' slide. Different figures for display and video ad slots.	
Number of activated servers per ads.txt line	Integer		
Local intensity	kg CO2e per kWh	Refer to the 'Grid Emission Factors' slide.	
Foreign intensity	kg CO2e per kWh	Refer to the 'Foreign Server Emission Factors' slide.	
Average RTB Payload	KB	3	Chartboost, provided through ANZ feedback.

Base Inputs		
Variable	Unit	Source
Impressions	Integer	Media buy data
Location	Country	
Ads.txt lines	Integer	Media buy data, default available

SERVER MODEL

For the level 0 default on server processing intensity, the relevant M&F sub-group evaluated an approach based on time allocation from LCA data and assumptions around virtualization, drawing from the Digital Carbon Footprint framework. The sub-group elected to use figures from a life cycle assessment of virtual machines for homogeneity (avoiding an additional assumption on VMs per physical machine) and opted for the VM configuration deemed most representative given the set of assumptions and



** comparison uses French and European grid intensities (AIE/EEA)*

Assumptions				
Variable	Unit	Value	Notes	Source
Electricity consumption of VM.	kWh per year	55.2	VM Configuration 1: 1 vCPU, 4 GB dedicated RAM, 5 years lifespan	ADEME, Base Empreinte [French LCA Database] (NegaOctet v1.5)
Embodied emissions of VM.	kg CO2e per year	3.79		
Processing time	ms	100	Used to allocate server emissions to processing of an ad opportunity.	Clearcode, provided through ANZ feedback.
Overhead factor		1.25	Buffer to account for other processing tasks, increase conservativeness.	RTB House, provided through ANZ feedback.
Share of servers in local geo		0.5	Share of servers assumed to be in the same country as the user.	Estimate aligned with Digital Carbon Footprint framework.
Share of servers abroad		0.5	Share of servers assumed to be abroad.	
Average PUE		1.56	Applied as factor to use-phase.	Uptime Institute
Local grid intensity	kg CO2e per kWh	Refer to the 'Grid Emission Factors' slide.		
Foreign grid intensity	kg CO2e per kWh	Refer to the 'Foreign Server Emission Factors' slide.		
Results				
Use-phase server energy incl. PUE & overhead	kWh per ad opportunity	3.41E-07	Based on the assumptions above, to be combined with grid intensities.	
Server embodied emissions	kg CO2e per ad opportunity	1.50E-08	Based on the assumptions above.	

ACTIVE PATHS LEVEL 0/1

For the level 0/1 methodology on active paths, the relevant M&F sub-group utilized aggregate data shared by members to develop a simple and practical approach that improves upon previous models of the programmatic supply chain by using more representative assumptions. For example, the size of the average RTB call was reduced by an order of magnitude (where previously a figure representing the average HTTP request was used) and a bid rate was introduced (where previously all bid requests were assumed to return a bid).

Combining aggregated supply chain data on depth (hops) with aggregated ad tech data (throttling, bid rate) yielded the **server factor** and **call factor**, which can be multiplied with the number of ads.txt lines to estimate the **number of activated servers** and **number of RTB calls** (requests/responses) respectively.

For the level 0 method, to be used **only in instances where no ads.txt file is present**, the sub-group decided to suggest a conservative value of 3000 ads.txt lines. The sub-group noted that in certain regions where ads.txt adoption is less common the level 0/1 methods may be difficult to apply.

The M&F WG acknowledges that the number of ads.txt lines is an imperfect proxy of programmatic supply chain activity and will continue to work on higher-level methods that ingest contributed data.

Results		
Format	Server factor	Call factor
Display	1.412	1.464
Video	1.316	1.334

A NOTE ON END-TO-END PLATFORMS

The M&F WG notes that it is harder to accurately estimate emissions associated with selection on end-to-end platforms (or 'walled gardens') using a bottom-up approach as less information is available. As such, in line with other digital ad emission frameworks and the previous version of the GMSF digital methodology, it proposes a different set of assumptions to adapt the methodology for campaigns run through end-to-end platforms (e.g. social). Specifically:

- The **number of activated servers** is assumed to be **500**.
- The networking emissions are considered to be negligible when operations occur within a single server location.

SELECTION - EXAMPLE

Let's assume we want to estimate the impact of ad selection in a display campaign. Our audience is located in Germany and we are estimating the impact of 100k ads. We will use the reference German grid EF and the European foreign server grid EF.

As we are using the level 1 methodology, the number of activated servers and number of RTB calls are estimated using ads.txt as a proxy. The publisher's ads.txt has 150 lines.

Inputs		
Variable	Unit	Value
Impressions	Integer	100k
Location	Country	Germany
Ads.txt lines	Integer	150

Server_usephase_emissions =
= Servers_per_line * Ads_txt_lines * Server_usephase_intensity * (0.5 * Local_grid_EF + 0.5 * Foreign_grid_EF) * Impressions
= 1.412 * 150 * 0.000000341 * (0.5 * 0.344 + 0.5 * 0.25) * 100000
= **2.145 kg CO2e**

Server_embodied_emissions =
= Servers_per_line * Ads_txt_lines * Server_embodied_intensity * Impressions
= 1.412 * 150 * 0.000000015 * 100000
= **0.318 kg CO2e**

SELECTION - EXAMPLE

Let's assume we want to estimate the impact of ad selection in a display campaign. Our audience is located in Germany and we are estimating the impact of 100k ads. We will use the reference German grid EF and the European foreign server grid EF.

As we are using the level 1 methodology, the number of activated servers and number of RTB calls are estimated using ads.txt as a proxy. The publisher's ads.txt has 150 lines.

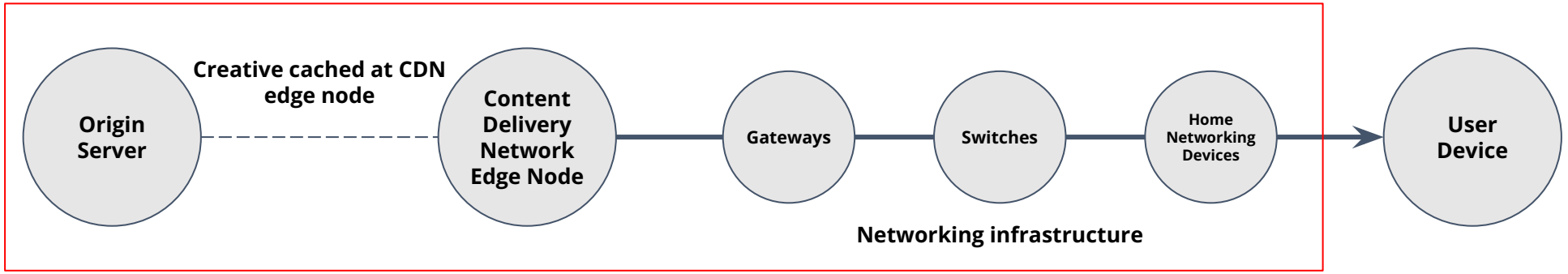
Inputs		
Variable	Unit	Value
Impressions	Integer	100k
Location	Country	Germany
Ads.txt lines	Integer	150

Network_usephase_emissions =
= Calls_per_line * Ads_txt_lines * Network_usephase_intensity * RTB_payload * (0.5 * local_intensity + 0.5 * foreign_intensity) * Impressions
= 1.464 * 150 * 0.00000000967 * 3 * (0.5 * 0.344 + 0.5 * 0.25) * 100000
= **0.189 kg CO2e**

Network_embodied_emissions =
= Calls_per_line * Ads_txt_lines * RTB_payload * Network_embodied_intensity * Impressions
= 1.464 * 150 * 3 * 0.00000000443 * 100000
= **0.292 kg CO2e**

DELIVERY

The delivery section accounts for the emissions resulting from transferring ads to user devices over fixed or mobile connections. The main input is the payload of this transfer. The methodology accounts for content delivery networks and includes an overhead for the origin server. An overhead is applied in certain data levels to account for additional payloads (wrappers, players etc.) - the M&F WG acknowledges that these are often cached on the user device, but no data was found to integrate a representative assumption. The intensity of network transfer is modeled in accordance with the latest ADEME recommendation based on work with ISPs.



DELIVERY DATA OVERVIEW

Constants			
Variable	Unit	Value	Source
Electricity consumption of mobile networks	kWh per MB	1.04E-04	Refer to the 'Network Emission Model' slide. Order of magnitude adjusted.
Electricity consumption of fixed networks	kWh per MB	9.67E-06	
Embodied emissions of mobile networks	kg CO2e per MB	5.80E-06	
Embodied emissions of fixed networks	kg CO2e per MB	2.09E-06	
Use-phase energy intensity of transferring 1 MB from an edge node	kWh per MB	4.3E-07	ADEME study on audiovisual services.
Embodied emissions intensity of transferring 1MB from an edge node	kg CO2e per MB	5.88E-07	
Local intensity	kg CO2e per kWh	Refer to the 'Grid Emission Factors' slide.	

Base Inputs			
Variable	Unit	Notes	Source
Impressions	Integer		Media buy data
Payload	MB	Refer to 'Payload Calculation'.	
Mobile connection ratio	Ratio	Ratio of users being served ads through fixed (ethernet, wi-fi) and mobile (4G, 5G) connections. Defaults available.	
Fixed connection ratio	Ratio		
Location	Country		

PAYLOAD CALCULATION

The table below contains information on how to calculate payload depending on the data that is available. The overhead should be added to the payload if using any of the level 0-2 methods. The payload refers to the weight of the assets that are delivered to the user, not those upload to the ad server - transcoding may be applied. Based on aggregate data submitted by members. If granular data is available showing distribution across different transcodes, delivery should be calculated per transcode.

Payload				
Level	Method	Display default	Video default	Notes
0	Default creative weight	0.25 MB	4 MB, 6 MB instream	Overestimation by design. Instream figure can be used in other environments where heavy ad intervention does not apply (e.g. Safari).
1	100% of creative data assumed to be transferred	**N / A**		Full creative data assumed to be transferred, overestimation due to lack of data.
2	Completion rate used as proxy for data transferred			E.g. 50% video completion rate ~ 50% of video transferred. Option when actuals on completion rate are available.
3	Actual measurement of data transfer			Eliminates need for overhead payload term below. Option when data transfer measurement is available.
Overhead				
Add-on to levels 0-2	Payload beyond creative assets (e.g. players).	0.05 MB	0.35 MB	Overestimation due to caching - actual would require information on network reach, campaign reach, cache lifetimes etc.

FIXED / MOBILE DEFAULTS

These can be used in cases where no data is available on connection type and are based on aggregate data submitted by Teads.

Fixed / Mobile Defaults			
Region	Countries Included in Data Sample	Fixed Ratio	Mobile Ratio
Europe	Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom,Switzerland, Iceland, Liechtenstein, Norway	74.31%	25.69%
APAC	Australia, Bangladesh, Brunei, Cambodia, China, Cook Islands, Fiji, India, Indonesia, Japan, Kiribati, Laos, Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nepal, New Caledonia, New Zealand, Niue, North Korea, Pakistan, Palau, Papua New Guinea, Philippines, Singapore, Solomon Islands, South Korea, Sri Lanka, Thailand, Timor Leste, Tonga, Tuvalu, Vietnam	67.68%	32.32%
NA	United States of America, Canada	86.08%	13.92%
LATAM	Mexico, Guatemala, Honduras, Nicaragua, El Salvador, Costa Rica, Panama, Belize, Haiti, Cuba, Dominican Republic, Jamaica, Trinidad & Tobago, Bahamas, Barbados, St. Lucia, Grenada, St. Vincent & Grenadines, Antigua & Barbuda, Dominica, St. Kitts & Nevis, Brazil, Colombia, Argentina, Peru, Venezuela, Chine, Ecuador, Bolivia, Paraguay, Uruguay, Suriname, Guyana	71.45%	28.55%

NETWORK EMISSIONS MODEL

Assumptions			
Variable	Unit	Value	Source
Fixed network bandwidth	GB per h	2.88	Carbon Trust, 2021
Mobile network bandwidth	GB per h	2.19	Greenspector
Fixed network electricity consumption - component a	Wh per GB	5	Based on ADEME study on the environmental footprint of ISPs. Network electricity consumption model has two components based on payload and time respectively. Time is calculated off payload using the bandwidth assumptions.
Fixed network electricity consumption - component b	kWh per year	117.8	
Mobile network electricity consumption - component a	Wh per GB	103	
Mobile network electricity consumption - component b	kWh per year	21.8	
Embodied emissions of mobile networks - a & b	kg CO2e per GB	5.80E-03	
Embodied emissions of fixed networks - a & b	kg CO2e per GB	2.09E-03	

Resulting Constants		
Variable	Unit	Value
Electricity consumption of mobile networks	kWh per GB	1.04E-01
Electricity consumption of fixed networks	kWh per GB	9.67E-03
Embodied emissions of mobile networks	kg CO2e per GB	5.80E-03
Embodied emissions of fixed networks	kg CO2e per GB	2.09E-03

DELIVERY - EXAMPLE

Let's assume we want to estimate the impact of ad delivery in a video campaign. We will apply the level 1 method as we know our video asset weighs 2.5 MB but have no data on completion rate or actual data transfer. The level 1 method assumes the entire file is delivered and uses the overhead term. We will calculate the impact for the portion of the audience in Italy and on a fixed connection. The reference grid emission factor is used.

Inputs		
Variable	Unit	Value
Impressions	Integer	100k
Location	Country	Italy
Payload	MB	2.5

Delivery_usephase_emissions =

= (Payload + Video_overhead) * (Fixed_network_electricity_consumption + CDN_usephase) * Local_grid_EF * Impressions

= (2.5 + 0.350) * (0.00000967 + 0.00000043) * 0.287 * 100000

= **0.826 kg CO2e**

Delivery_embodied_emissions =

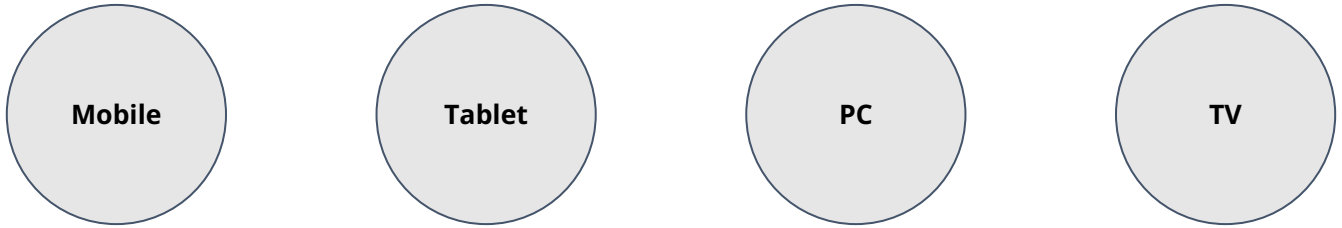
= (Payload + Video_overhead) * (Fixed_network_embodied + CDN_embodied) * Impressions

= (2.5 + 0.350) * (0.00000209 + 0.000000588) * 100000

= **0.763 kg CO2e**

CONSUMPTION

The consumption stage accounts for emissions arising from resource usage on user devices, including both use-phase and embodied emissions across 4 device groups: mobile, tablet, PC, and TV. In the absence of more specific data relating digital ads to hardware usage, two assumptions are included in the proposed methodology. First, the entire device's lifecycle emissions are allocated to each digital ad. Second, view time is used as a proxy to facilitate the time-based allocation.



CONSUMPTION DATA OVERVIEW

Constants			
Variable	Unit	Value	Source
Use-phase energy intensity of mobiles	kWh per second	1.3E-06	ADEME study on audiovisual services. Mobile use-phase value is conservative and based on video playback. TV figure represents a smart TV. PC figure based on laptop.
Use-phase energy intensity of tablets	kWh per second	1.4E-06	
Use-phase energy intensity of TVs	kWh per second	3.8E-05	
Use-phase energy intensity of PCs	kWh per second	2.65E-06	
Embodied emissions intensity of mobiles	kg CO2e per second	6.55E-06	Négaoctet, PEF-GWP, List of data ADEME_220830_v1.4 Daily use time from ADEME study on audiovisual services. Tablet figure higher due to low daily usage.
Embodied emissions intensity of tablets	kg CO2e per second	2.57E-05	
Embodied emissions intensity of TVs	kg CO2e per second	8.65E-06	
Embodied emissions intensity of PCs	kg CO2e per second	6.65E-06	

Base Inputs		
Variable	Unit	Source
Impressions	Integer	Media buy data
Location	Country	
Device type		Media buy data, default available
Average view time	Seconds	Refer to 'View Time calculation'.

Default Device Split		
Type	Ratio	Source
PC	18%	Aggregate global data contributed by Impact Plus.
Mobile	61%	
Tablet	4%	
TV	17%	

VIEW TIME CALCULATION

The table below contains information on how to calculate view time depending on the data that is available. The minimum view time should be used if ads that fail to meet viewability specifications are not included in averages used for the level 1 / 2 methods - this ensures that some device usage is still accounted for. If view time data is available in quartiles rather than as a mean, calculations should overestimate by using the higher bound of the quartile (e.g. if a given portion of users is reported to have watched between 0 and 3 seconds of a video ad, they are assumed to have watched 3 seconds).

View Time				
Level	Method	Display default	Video default	Notes
0	Default view time	3 s	30 s	Overestimation by design. For cases where no view time data is available.
1	Average campaign-level view time.	**N / A**		Average view time for campaign used across device types.
2	Average view time per device type.			Device type-specific view time used in calculations.
Overhead				
Add-on to levels 1-2	Minimum view time	1 s	2 s	Based on MRC standard for viewability - used to account for device usage in cases where view time is not reported for ads that fail to meet viewability specifications.

CONSUMPTION - EXAMPLE

Let's assume we want to estimate the impact of consuming ads on mobiles in Austria. We will apply the level 2 methodology as we know the average view time for mobile users to be 3 seconds. Let's also assume that in this average, ads that failed to meet the MRC viewability standard of 1 second are included, so we do not need to use the relevant add-on. The reference grid emission factor will be used.

Inputs		
Variable	Unit	Value
Impressions	Integer	100k
Location	Country	Austria
Device type		Mobile
Average view time	seconds	3

Mobile_usephase_emissions =

= View_time * Mobile_usephase_energy * Local_grid_EF * Impressions

= 3 * 0.0000013 * 0.102 * 100000

= **0.03978 kg CO2e**

Mobile_embodied_emissions =

= View_time * Mobile_embodied_intensity * Impressions

= 3 * 0.00000655 * 100000

= **1.965 kg CO2e**

GRID EMISSION FACTORS

The M&F WG acknowledges that standard, reference grid emission factors should be provided with the proposed methodology to enable calculations. The Ember dataset is recommended due to its wide coverage and open access.

The levels for grid EFs on the right are provided to categorize the custom emission factors that may be used by organisations with access to third-party databases when applying the methodology. It is noted that when comparing results obtained by applying the proposed methodology, using the reference EF database reduces variance.

Furthermore, organizations applying the proposed methodology should be mindful of the potential error in the consumption stage if using hourly figures as charging of certain devices does not necessarily occur at the same time as ad delivery.

Grid EFs			
Level	Description	Source	Notes
0	Default	Ember	Average figures provided as reference.
1	Annual	Proprietary databases, third-party providers.	Average, location-based figures. Market-based figures can be reported additionally and in compliance with GHG Protocol Scope 2 guidance. Reference figures should be used for post-production storage.
2	Monthly		
3	Daily		
4	Hourly		

EUROPEAN REFERENCE GRID EFs

Country	kg CO2e / kWh
Austria	1.02E-01
Belgium	1.17E-01
Bosnia Herzegovina	6.37E-01
Bulgaria	2.64E-01
Croatia	1.74E-01
Cyprus	5.12E-01
Czechia	4.14E-01
Denmark	1.44E-01
Estonia	3.42E-01
EU	2.13E-01
Finland	7.23E-02
France	4.42E-02
Germany	3.44E-01

Country	kg CO2e / kWh
Greece	3.20E-01
Hungary	1.83E-01
Ireland	2.80E-01
Italy	2.87E-01
Kosovo	9.35E-01
Latvia	1.37E-01
Lithuania	1.39E-01
Luxembourg	1.35E-01
Malta	4.84E-01
Montenegro	4.14E-01
Netherlands	2.53E-01
North Macedonia	5.65E-01

Country	kg CO2e / kWh
Norway	3.07E-02
Poland	6.16E-01
Portugal	1.12E-01
Romania	2.46E-01
Serbia	6.73E-01
Slovakia	9.65E-02
Slovenia	2.28E-01
Spain	1.46E-01
Sweden	3.58E-02
Switzerland	3.41E-02
Türkiye	4.70E-01
Ukraine	1.62E-01

2024 data from Ember

FOREIGN SERVER EMISSION FACTORS

For the portion of servers assumed to sit abroad in relation to the user being served the ad, the relevant sub-group includes in the proposal grid intensities weighted by known data center locations by continent. The sub-group notes that these are weighted by number of data centers rather than traffic, that a small number of locations were omitted due to absence of recent emissions data, and that grid intensity values from 2022 and 2023 were used due to broadest coverage.

Foreign Server EFs	
Continent	kg CO2e per kWh
Africa	4.72E-01
Asia	5.93E-01
Europe	2.50E-01
North America	3.78E-01
Oceania	4.78E-01
South America	1.91E-01
Global	3.76E-01
Sources	
Data center map	Ember EFs

DATA SOURCE LINKS

Data Sources	
Use	Source
Network intensity, device power consumption, device daily usage	ADEME study on audiovisual services (French only) and ADEME study on the environmental footprint of ISP in France
Edge node intensity	ADEME study on audiovisual services (French only)
Cloud storage intensity, virtual machine lifecycle assessment, device embodied emissions over lifetime	ADEME, Base Empreinte [French LCA Database] (NegaOctet v1.5)
Fixed connection bandwidth	Carbon impact of video streaming
PUE	Uptime Institute report
Grid emission factors	Ember
LTO emission factors	Fujifilm estimates on LTO-8
SSD, HDD storage embodied factors	Tannu, S., & Nair, P. J. (2023).

FUTURE WORK

The M&F WG identified the following areas for future work to improve the robustness of emissions estimates based on its proposal:

- Server emissions based on contributed data (levels 1-3).
- Programmatic activity estimation based on contributed data (levels 2-5).
- Guidance on inclusion of enterprise-level emissions.
- Modeling of DMP & other intermediary activity.
- Precise modeling of device resource usage due to ads.
- Precise modeling of network transfer between servers.

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