AD NET ZERO
ALL FOR NONE

Channel Emissions Framework and Formulae: Digital Extended Version

Phase	Step & sub-step		Physical processes involved	Formula type	Scaling factors	Expected materiality	Formulae		Accepted Alternative	Expected data hacks	Comments
CREATION	Tech Manipulation (Multivariant creative)	Creative storage	Additional server storage for multiple volumes of assets for the purpose of distribution.	Digital service overhead	• Number and size of assets • Storage duration	Low	$\sum$ Number of assets	(size of asset (kB) ∗ time stored (yr) ∗ carbon impact of storage[1] (kgCO2e/kB/yr) ∗ allocation factor for the campaign[2] (%))	-	Not currently using this formula because part of the storage is expected to be accounted for with the server transmission formula of Ad creative delivery phase (this should help with simplification of the process).	Additional storage impacts will be accounted for, however it is expected to be hard to isolate this type of data, therefore a generic formula was derived from the server formula; it is expected to be covered by a global server emission factor. In the future, this could also account for unused assets and multiple storage.
		Creative transcoding	Server processing for multiple volumes of assets for the purpose of distribution.	Digital service overhead	-	-	-		-	-	No formulas covers this specific topic. However, for now a tweak has been included partially in the Ad Creative Delivery section.
DISTRIBUTION	Ad Space Selection	Creative Selection & Placement	Planning of creative to go on specific inventory within a marketplace	Corporate overhead	-	-	-		-	-	Included within corporate emissions overhead.
		Targeting	Digital services used for all targeting activities	Use phase & Embodied	-	-	-		-	-	Whatever targeting activities not reflected in the allocated corporate overhead emissions, can be addressed in future updates.
		Direct sale	Exchange of campaign booking between ad buyer and media seller / owner	Use phase & Embodied	-	Low	Same formula as real-time bidding. • If a segment of inventory is set aside exclusively for direct sale: only one activated path to be taken into account • If not: accounted as programmatic (total number of activated path).		-	-	Simplified version only accounting for programmatic direct. Corporate emissions accounted for in the global corporate emissions overhead.
		Real-time bidding	Servers processing transmission through automated buying process (SSP/DSP...)	Use Phase	• Number of impressions • Number of paths / number of requests • Calculation time	Low to medium	Impressions ∗ Number of potential active paths per impression[3] ∗ Avails ratio ∗ (1 + Requests ratio) ∗ (1 + Responses ratio)[4] ∗ Time of calculation per bid (h) ∗ Compute ratio allocated to bid processing (compute used by SSP/DSP incl. machine-learning) and reporting/analytics[5] (%) * Total relevant infrastructure power incl. PUE (W) * Carbon intensity of electricity (kgCO2e/kWh) ∗ (1 + overhead of other mutualised server resources ratio[6])		In case of real data of number of avails, bid requests and bid responses per impression, first part of formula could be overridden: Number of potential active paths per impression ∗ Avails ratio ∗ (1 + Requests ratio) ∗ (1 + Responses ratio) Replaced by : (Number of avails + Number of bid requests + Number of bid responses)	• Activated paths per impression : can be determined directly or estimated through global number of potential paths x average of activated paths (%). • Compute ratio allocated to bid processing (compute used by SSP/DSP incl. machine-learning) and analytics: Dedicated vCPUs share of total infrastructure can be a good proxy as most of infrastructure are distributed and highly virtualised. Infrastructure costs breakdown is also a good lead in case physical data is not available. • Time of calculation per bid: Market average likely to be used as this is a highly granular information. • Data transferred by request type : Can be estimated with bid request or response size + overhead payload of additional assets.	On-device advertising is also identified as having an impact on Ad Space Selection processing, but however not modelled for now.
				Embodied		Low to medium	Impressions ∗ Number of potential active paths per impression[3] ∗ Avails ratio ∗ (1 + Requests ratio) ∗ (1 + Responses ratio)[4] ∗ Time of calculation per bid (h) ∗ Compute ratio allocated to bid processing (compute used by SSP/DSP incl. machine-learning) and reporting/analytics[5] (%) ∗ EF manufacturing and EOL of total relevant infrastructure (kgCO2e) / Average lifetime of equipment (s) ∗ (1 + overhead of other mutualised server resources ratio[6])				
		Networks transmission through automated buying process (SSP/DSP...)		Use Phase	• Number of impressions • Number of paths / number of requests • Data transferred by request type	Low to medium	Impressions ∗ Number of potential active paths per impression[3] ∗ Avails ratio ∗ (1 + Requests ratio) ∗ (1 + Responses ratio)[4] ∗ Data transferred by request type[7] (kB) ∗ Server-to-server networks energy efficiency according to network type and country[8] (kWh/kB) ∗ Carbon intensity of electricity (kgCO2e/kWh)				
				Embodied		Low to medium	Impressions ∗ Number of potential active paths per impression[3] ∗ Avails ratio ∗ (1 + Requests ratio) ∗ (1 + Responses ratio)[4] ∗ Data transferred by request type[7](kB) ∗ EF manufacturing & EOL amortisation networks according to network type and country10 (kgCO2e/kB)				
	Ad Creative Delivery	Creative transmission	Ad Servers / CDN edge node processing of ad delivery on display, social, or search	Use phase	• Number of impressions • Output data transmitted (incl. file size) • Share of content delivered locally (CDN)	Medium to high	Impressions ∗ total server output data per impression[9] (kB)	∗ $\sum$ Number of infrastructures: (Breakdown of content delivered by ad servers vs. edge nodes[10] (%) ∗ datacentre or edge nodes energy of efficiency including PUE (kWh/kB output) ∗ carbon intensity of electricity (kgC02e/kWh))[11]	-	• Total server output data per impression / Total data transferred on network per impression: For static format: file size proxy + payload overhead of additional assets For video format: portion of file size loaded (incl. buffer) + payload overhead of additional assets • Breakdown of content delivered by ad servers vs. edge nodes: Cache hit ratio of CDN can be a good lead	Conventional network model for digital networks.
				Embodied		Medium to high	Impressions ∗ total server output data per impression[9] (kB)	∗ $\sum$ Number of infrastructures: (Breakdown of content delivered by ad servers vs. edge nodes[10] (%) ∗ EF manufacturing and EOL) of total relevant infrastructure (kgCO2e) / infrastructure output bandwidth (kB/s) / average lifetime infrastructure equipment(s))[11]	-		
			Networks transmission of ad delivery from ad server / CDN edge node to user network as display, social, or search	Use phase		Medium to high	Impressions ∗ total data transferred on network per impression[9](kB)	∗ $\sum$ Number of network type: (consumption breakdown between types of network (%) ∗ energy efficiency according to network type[12] and country (kWh/kB)) ∗ $\sum$ Number of infrastructures: (consumption breakdown between countries of servers/edges nodes[10] and & users(%) * carbon intensity of electricity (kgCO2e/kWh))	-		
				Embodied		Medium to high	Impressions ∗ total data transferred on network per impression[9] (kB)	∗ $\sum$ Number of network type: (consumption breakdown between types of network (%) ∗ EF manufacturing & EOL amortisation networks according to network type[12] and country (kgCO2e/kB)*)[11])	-		
CONSUMPTION	Device Display	User device load	Download / stream of creative to the user device. Includes embodied emissions of devices.	Use phase	• Data transferred (incl. file size) • Device type	Low	Impressions ∗Data transferred per impression[13](kB) / Broadband speed breakdown by country and by network type (kB/s)	∗ $\sum$ Devices[15]: (Device mix by type and country (%) ∗ Device power consumption to maintain active connection[14] (W) ∗ time conversion ratio (h/s) ∗ carbon intensity of electricity (kgCO2e/kWh))	Load and render power of devices are expected not to be available, therefore the alternative is to account for full device power and lifecycle and not separate those two phases. Replace: Device render power consumption By: Device total power consumption Replace: EF manufacturing & and EOL amortisation of devices, share of render By: EF manufacturing & and EOL total amortisation of devices	Not using this formula yet (see opposite).	Time to load (s) is determined by the first two parameters. Short time is expected therefore materiality is expected to be low. However, it might become more material in time with on-device advertising is also identified as having a growing impact on loading, but not modelised yet, and it also needs to be confirmed.
				Embodied		Low	Impressions ∗Data transferred per impression[13](kB) / Broadband speed breakdown by country and by network type (kB/s)	∗ $\sum$ Devices[15]: (Device mix by type and country (%) ∗ EF manufacturing & and EOL amortisation of devices, share of connectivity[14] (kgCO2e/unit) / total active used time over lifetime by device type (s of active use over full lifetime)))		Not using this formula yet (see opposite).	
		User device render	Render and display of creative on the user device. Includes embodied emissions of devices.	Use phase	• Time displayed • Device type	High	Impressions ∗Time displayed on device per impression(s)	∗ $\sum$ Devices[15]: (Device mix by type and country (%) ∗ Device render power consumption[14] (W) ∗ time conversion ratio (h/s) ∗ carbon intensity of electricity (kgCO2e/kWh))		Use full device power in the formula.	
				Embodied		High	Impressions ∗Time displayed on device per impression(s)	∗ $\sum$ Devices[15]: (Device mix by type and country (%) ∗ EF manufacturing & and EOL amortisation of devices, share of render[14] (kgCO2e/unit) / total active used time over lifetime by device type (s of active use over full lifetime))		-	
										Use full device EF in the formula. Total active used time over lifetime by device type is the result of daily use x lifetime in years.	
ALL	Corporate emissions overhead		Allocated organisational emissions attributed to the specific campaign across ALL entities in the campaign value chain.	Corporate overhead	Campaign revenue	High	$\sum$ Number of entities	Total relevant annual corporate emissions (kgCO2e) ∗ allocation factor for the campaign	-	-	Every organisation in the value chain should be reporting their verified enterprise GHG emissions inventory annually to ensure reasonable data quality at the enterprise level. More guidance will follow on this in the next update of the GMSF.

Key

- = Not yet applicable or to be investigated further

∑ = The mathematical sign for a sum

Footnotes for Digital

Tech Manipulation:

[1]Servers impact (that can be split by lifecycle phase) based on server type, efficiency and location (simplified formula).

[2]Storage of creative is likely to happen across multiple campaigns, therefore an allocation factor for the specific campaign being measured is needed and may be calculated as a percentage (%) either of revenue of the campaign / total revenue of the entity or campaign volume (e.g. impressions) / volume of all campaigns where the assets were used.

Ad Space Selection (Real-time bidding):

[3]A potential path is a server-to-server-to-server link (e.g. exchange of request) between different nodes of the programmatic actors (publisher, SSPs, DSPs...). Not all potential paths are activated at each impression (note: ads.txt only accounts for some potential paths).

[4]Activated paths are a way to estimate number of real requests transmitted, after all optimisation processes, such as SPO and bid throttling, are implemented. These ultimately allow us to account for the impacts of servers and networks. To account for all these filtering and optimisation techniques and avoid overestimating requests, 3 ratios are used to represent the avails, requests, and responses. However, if actual data on requests number is available, previous assumptions can be overridden to work with the absolute number of avails, requests, and responses per impression.

[5]Portion of physical resources dedicated to bid processing, reporting, machine learning, analytics... is a share of total compute power. Dedicated CPUs or costs are a good lead.

[6]Modelising additional mutualised infrastructure resources for other services and development activities. Value of the overhead will have to be determined in the data working group.

[7]Taking into account different sizes for avails, bid requests and bid responses (including all transferred assets).

[8]A substantial share of the requests can be treated within private networks, and all requests are server-to-server links (e.g. fixed networks).

Ad Creative Delivery:

[9] Ideally taking into account both:

- Real size of creative file transferred: file size depending on factors including user device / screen size, network quality, etc.
- Additional assets transmission: scripts...

[10]Popular contents with the local host's user base are temporarily cached on edge nodes, therefore delivered from a local data centre-like infrastructure (impact on carbon intensity of electricity). Country could usually be assumed to be the same as the user.

[11]Sigma to account for different environmental performances of ad servers and edge nodes, as well as location for use phase and computing power for embodied emissions (different server models / configuration end in different emissions).

[12]Accounting for different performances of networks (e.g. fixed vs mobile, global vs local), as well as country. Edge nodes / CDN also allow to win on the network part (local delivery).

Consumption:

[13]Ideally taking into account both:

- Real size of creative file transferred: file size depending on user device / screen size, buffer settings, network quality...
- Additional assets transmission: scripts...

[14]Additional studies are needed to fully model the difference of screen power (render) vs. active connection (load) so it is expected to be modelled globally.

[15]Devices list to be covered: any type of terminal that loads and / or displays digital ad creative content (laptops, tablets, smartphones, TVs...)