

Channel Emissions Framework and Formula: Digital V.1.0

Phase	Step & sub-step	Physical processes involved	Formula type	Scaling factors	Expected materiality	Formulae V1	Accepted Alternative	Expected data hacks for V1	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 <i>(size of asset (kB)*time stored (yr) * carbon impact of storage³ (kgCO2e/kB/yr) * allocation factor for the campaign⁴ (%))</i>	/	Not using this formula yet, as part of the storage is expected to be accounted with the server transmission formula of Ad creative delivery phase (simplification).	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 V1 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.				
	Ad Space Selection	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	<i>Impressions * Number of potential active paths per impression⁵ * Avails ratio * (1 + Requests ratio) * (1 + Responses ratio)⁶ * Time of calculation per bid (h) * Compute ratio allocated to bid processing (compute used by SSP/DSP incl. machine-learning) and reporting/analytics⁷ (%) * Total relevant infrastructure power incl. PUE (W) * Carbon intensity of electricity (kgCO2e/kWh) * (1 + overhead of other mutualized server resources ratio⁸)</i>	In case of real data of number of avails, bid requests and bid responses per impression, first part of formula could be overridden: <i>Number of potential active paths per impression * Avails ratio * (1 + Requests ratio) * (1 + Responses ratio)</i> Replaced by : <i>(Number of avails + Number of bid requests + Number of bid responses)</i>	• 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 are distributed and highly virtualized. 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 modeled in V1.			
				Embodied		Low to medium	<i>Impressions * Number of potential active paths per impression⁵ * Avails ratio * (1 + Requests ratio) * (1 + Responses ratio)⁶ * Time of calculation per bid (h) * Compute ratio allocated to bid processing (compute used by SSP/DSP incl. machine-learning) and reporting/analytics⁷ (%) * EF manufacturing and EOL of total relevant infrastructure (kgCO2e) / Average lifetime of equipment (s) * (1 + overhead of other mutualized server resources ratio⁸)</i>						
		Use Phase	• Number of impressions • Number of paths / number of requests • Data transferred by request type	Low to medium	<i>Impressions * Number of potential active paths per impression⁵ * Avails ratio * (1 + Requests ratio) * (1 + Responses ratio)⁶ * Data transferred by request type⁹ (kB) * Server-to-server networks energy efficiency according to network type and country¹⁰ (kWh/kB) * Carbon intensity of electricity (kgCO2e/kWh)</i>								
		Embodied		Low to medium	<i>Impressions * Number of potential active paths per impression⁵ * Avails ratio * (1 + Requests ratio) * (1 + Responses ratio)⁶ * Data transferred by request type⁹ (kB) * EF manufacturing & EOL amortization networks according to network type and country¹⁰ (kgCO2e/kB)</i>								
	Ad Creative Delivery	Creative transmission	Ad Servers / CDN edge node processing of ad delivery on display, social, or search	Use phase		Medium to high	<i>Impressions * total server output data per impression¹¹ (kB) * \sum Number of infrastructures</i> <i>(Breakdown of content delivered by ad servers vs. edge nodes¹² (%) * datacenter or edge nodes energy of efficiency including PUE (kWh/kB output) * carbon intensity of electricity (kgCO2e/kWh))¹³</i>	• 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	<i>Impressions * total server output data per impression¹¹ (kB) * \sum Number of infrastructures</i> <i>(Breakdown of content delivered by ad servers vs. edge nodes¹² (%) * EF manufacturing and EOL of total relevant infrastructure (kgCO2e) / infrastructure output bandwidth (kB/s) / average lifetime infrastructure equipment(s))¹³</i>						
			Networks transmission of ad delivery from ad server / CDN edge node to user network as display, social, or search	Use phase		Medium to high	<i>Impressions * total data transferred on network per impression¹¹ (kB) * \sum Number of network type</i> <i>(consumption breakdown between types of network (%) * energy efficiency according to network type¹⁴ and country (kWh/kB))</i>						
Embodied					Medium to high	<i>Impressions * total data transferred on network per impression¹¹ (kB) * \sum Number of network type</i> <i>(consumption breakdown between types of network (%) * EF manufacturing & EOL amortization networks according to network type¹⁴ and country (kgCO2e/kB)¹⁵)¹³</i>							
CONSUMPTION			Device Display	User device load	Use phase	• Data transferred (incl. file size) • Device type	Low			<i>Data transferred¹⁶ (kB) / Broadband speed breakdown by country and by network type (kB/s) * \sum Devices¹⁷</i> <i>(Device mix by type and country (%) * Device power consumption to maintain active connection¹⁶ (W) * time conversion ratio (h/s) * carbon intensity of electricity (kgCO2e/kWh))</i>	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.	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 modeled in V1, and it also needs to be confirmed.
					Embodied		Low			<i>Data transferred¹⁶ (kB) / Broadband speed breakdown by country and by network type (kB/s) * \sum Devices¹⁷</i> <i>(Device mix by type and country (%) * EF manufacturing & and EOL amortization of devices, share of connectivity¹⁶ (kgCO2e/unit) / total active used time over lifetime by device type (s of active use over full lifetime))</i>	Replace: Device render power consumption By: Device total power consumption	Not using this formula yet (see opposite).	
	User device render	Use phase		• Time displayed • Device type	High	<i>\sum Devices¹⁷</i> <i>(Device mix by type and country (%) * Time displayed on device (s) * Device render power consumption¹⁶ (W) * time conversion ratio (h/s) * carbon intensity of electricity (kgCO2e/kWh))</i>	Replace: EF manufacturing & and EOL amortization of devices, share of render By: EF manufacturing & and EOL total amortization of devices	Use full device power in the formula.					
		Embodied			High	<i>\sum Devices¹⁷</i> <i>(Device mix by type and country (%) * Time displayed on device (s) * EF manufacturing & and EOL amortization of devices, share of render¹⁶ (kgCO2e/unit) / total active used time over lifetime by device type (s of active use over full lifetime))</i>		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 organizational emissions attributed to the specific campaign across ALL entities in the campaign value chain.	Corporate overhead	Campaign revenue	High	\sum Number of entities <i>Total relevant annual corporate emissions¹⁸(kgCO2e)*allocation factor for the campaign²¹</i>	/	Every organization in the value chain should be reporting their verified enterprise GHG emissions inventory annually to ensure reasonable data quality at the enterprise level. These enterprise emissions should then be allocated to specific ad campaigns based on either a kg CO2e/\$ or kg CO2e/person hour emissions factor.					