## Green Measuring tools for Backend Support

KPI	Metric	Tools	Sustainability Dimension				
			Env	Eco	Soc	Ind	Tech
Energy Efficiency	Energy per user/transaction	Google Cloud Monitoring	х	х			х
		DataDog	х				
		CO2.js	х	х		х	х
Carbon Footprint	Carbon per user/transaction	CO2.js	х	х		х	х
		Google Cloud Footprint	Х	х			х
		Code Carbon (only for python)	х	х		х	х
Resource	CPU usage	Containerization	х	х		х	х
Utilization	Memory Usage	DataDog	Х	х		х	х
Green Hosting	% of servers hosted on renewable energy	Google Cloud	x	x	x	x	x

**Google Cloud Monitoring:** A tool used to provide insight regarding how resources are used, as well as well as data related to the performance and status of the application

**Datadog:** A tool that can be used with Google Cloud Monitoring for further insight regarding the cloud infrastructure, service(s), and application(s).

- Comprehensive Monitoring
- Automated Alerts and Responses
- Dashboards

Google Carbon Footprint: Measure, report, and reduce your cloud carbon emissions.

- Dual-reporting of both location-based and market-based emissions
- In-console dashboard
- Exports to BigQuery
- Location-based emission reduction estimates

 Carbon Footprint data is integrated with <u>unattended project recommender</u>, which provides you with estimates of the location-based emission reductions you could achieve by removing idle projects.

**Containerization:** Containerization promotes sustainability by enhancing resource utilization, reducing energy consumption, optimizing infrastructure management, and ensuring efficient application deployment.

## Demonstration

1. CO2.js

CO2.js is a JavaScript library that allows developers to estimate the emissions associated with their apps, websites and software.

Connection to the database has been established successfully. Server listening at http://localhost:3005 Average annual grid intensity for Malaysia 605.83 Data size: 12999999 bytes, Estimated CO2 emissions: 5.12 grams Your request costs 0.0084 kWh

## 2. Why Google Cloud for Green Hosting?

- Google was the first major company to become carbon neutral in 2007  $\frac{1}{2}$
- Google was the first to match their energy use with 100 percent renewable energy in 2017 – including the electricity to power Google Cloud.
- Provide a useful Carbon sense suite of tools to reduce the carbon footprint of cloud-based applications:
  - <u>Google Cloud Region Picker</u>: helps you pick a Google Cloud region considering approximated carbon footprint, price and latency.

2 Lower ca	arbon footprint 🔊	
Not imp	ortant 💶 🚽	Important
S Lower p	ice ⑦	
Not imp	ortant 💶 🚽	Important
n Iowerla	tency ⑦	
Not imp	ortant	Important
Where is	your traffic coming from?	
Your	urrent location	
Afgha	nistan	
Alban	a	
Algen	a can Samoa	•
Product	availability Ø	
Comr	ute Engine	
App E	ngine	
Goog	e Kubernetes Engine	
Cloud	Functions	

 <u>Low carbon regional signals</u>: Helps you pick the greenest region for your Google Cloud resources.



 <u>Active Assist recommendations</u>: a portfolio of tools to generate recommendations and insights to help you optimize your Google Cloud projects. This also includes recommenders that generate recommendations, insights and analysis tools. Those recommendations will help you save up on costs, mitigate security risks, maximize your performance through reducing the management your cloud configuration and this will overall make you more sustainable and reduce your carbon footprint.

0	VM in:	stances	CREATE SCHED	ULE 👕 DEI	LETE 🖞 RESET 📲 SUSPEND	STOP		HELP ASSISTANT	SHOW IN	IFO PAN	IEL 🗢 LEA
	•	7 instances	s could be resized to save	you up to an estir	mated \$60 per month and increase performar	ice. Learn more				C	DISMISS ALL
1	INST	TANCES	INSTANCE SCHEDULE								
r l	VM insta	inces are highl	ly configurable virtual mac	hines for running	workloads on Google						
	infrastru	cture. Learn m	ore								
	ŦF	ilter Enter pr	operty name or value								0 11
	≡ F	ilter Enter pro	operty name or value	Zone	Recommendations 1	In use by	Internal IP	External IP	Connec	:t	0 III
		ilter Enter pro	Name dev-centos-0	Zone us-west1-a	Recommendations 个 💡 Save \$12 / mo 🍷 Save \$24 / mo	In use by	Internal IP 10.138.15.232 (nic0)	External IP 35.185.212.100	Connec	et T	e m :
	₹ F	Status	Name dev-centos-0 staging-debian-0	Zone us-west1-a us-west1-a	Recommendations ↑ ♀ Save \$12 / mo ♀ Save \$24 / mo ♀ Save \$12 / mo	In use by	Internal IP 10.138.15.232 (nic0) 10.138.15.212 (nic0)	External IP 35.185.212.100 35.203.189.68	Connec SSH SSH	.t • •	€ M : :
l.		Status	Name Name dev-centos-0 staging-debian-0 staging-debian-1	Zone us-west1-a us-west1-a	Recommendations         *           •         Save \$12 / mo         •         Save \$24 / mo           •         Save \$12 / mo         •         Save \$12 / mo           •         Save \$12 / mo         •         •	In use by	Internal IP 10.138.15.232 (nic0) 10.138.15.212 (nic0) 10.138.15.218 (nic0)	External IP 35.185.212.100 35.203.189.68 35.185.213.76	Connec SSH SSH SSH	t • •	Image: Control of the second
	₹ F	Status Status	Name           dev-centos-0           staging-debian-0           staging-debian-1           staging-debian-2	Zone us-west1-a us-west1-a us-west1-a us-west1-a	Recommendations         Save \$12 / mo         Save \$24 / mo           *         Save \$12 / mo         *         *           *         Save \$12 / mo         *         *           *         Save \$12 / mo         *         *	In use by	Internal IP 10.138.15.232 (nic0) 10.138.15.212 (nic0) 10.138.15.218 (nic0) 10.138.15.215 (nic0)	External IP 35.185.212.100 35.203.189.68 35.185.213.76 34.83.182.212	Connec SSH SSH SSH SSH		Image: Control         Image: Control           Image: Contro
i i		Itter Enter pro	Name     Name       dev-centos-0     staging-debian-0       staging-debian-1     staging-debian-2       staging-debian-2     staging-debian-3	Zone us-west1-a us-west1-a us-west1-a us-west1-a	Recommendations         ↑                Save \$12 / mo             Save \$24 / mo               Save \$12 / mo             Save \$12 / mo               Save \$12 / mo               Save \$12 / mo	In use by	Internal IP 10.138.15.232 (nic0) 10.138.15.212 (nic0) 10.138.15.218 (nic0) 10.138.15.215 (nic0) 10.138.15.213 (nic0)	External IP 35.185.212.100 35.203.189.68 35.185.213.76 34.83.182.212 35.233.245.97	Connec SSH SSH SSH SSH SSH	t • • •	•         •           •         •           •         •           •         •           •         •           •         •           •         •           •         •
		ilter Enterpro	Name or value dev-centos-0 staging-debian-0 staging-debian-1 staging-debian-2 staging-debian-3 staging-windows-4	Zone us-west1-a us-west1-a us-west1-a us-west1-a us-west1-a	Recommendations         ↑           9         Save \$12 / mo         \$ Save \$24 / mo           9         Save \$12 / mo         \$ save \$12 / mo           9         Save \$12 / mo         \$ save \$12 / mo           9         Save \$12 / mo         \$ save \$12 / mo	In use by	Internal IP 10.138.15.232 (nic0) 10.138.15.212 (nic0) 10.138.15.218 (nic0) 10.138.15.213 (nic0) 10.138.15.213 (nic0) 10.138.15.246 (nic0)	External IP 35.185.212.100 35.203.189.68 35.185.213.76 34.83.182.212 35.233.245.97 35.230.103.248	Connect SSH SSH SSH SSH SSH RDP	t • • • •	Image: Non-State         Image: Non-State<
		ilter Enterpro	Parter value Name dev-centos-0 staging-debian-0 staging-debian-1 staging-debian-2 staging-debian-3 staging-windows-4 dev-windows-4	Zone us-west1-a us-west1-a us-west1-a us-west1-a us-west1-a us-west1-a	Recommendations         ↑           § Save \$12 / mo         § Save \$24 / mo           § Save \$12 / mo         § Save \$12 / mo           § Save \$12 / mo         § save \$12 / mo           § save \$12 / mo         § save \$12 / mo           § Increase perf.         § Increase perf.	In use by	Internal IP           10.138.15.232 (nic0)           10.138.15.212 (nic0)           10.138.15.212 (nic0)           10.138.15.213 (nic0)           10.138.15.213 (nic0)           10.138.15.214 (nic0)	External IP 35.185.212.100 35.203.189.68 35.185.213.76 34.83.182.212 35.233.245.97 35.233.103.248 35.233.190.144	Connect SSH SSH SSH SSH SSH RDP RDP	t • • • •	Image: Constraint of the second sec

 <u>Google Cloud Carbon Footprint</u>: this tool helps you Measure, report, and reduce your cloud carbon emissions. And the key feature here would be the Inclusion of both location-based and market-based carbon emissions data in reports and disclosures which offers more transparency and comprehensive insights for varying use cases.



 <u>Google Workspace Carbon Footprint</u>: mostly for admin use on an organizational level. It can be used to understand the environmental impact of your organization's use of Google Workspace products and know the total and monthly carbon footprint results.



Tutorial: https://www.cloudskillsboost.google/focuses/32138?parent=catalog

All the tools are free of Cost!