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High Performance

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HPC

MAY 12 – 16, 2024 | HAMBURG, GERMANY

# Compute Energy & Emissions Monitoring Stack (CEEMS)

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# Jean Zay - HPE/ATOS

## 123.6 PFLOPS



### CPU Partition

Intel 6248  
720 nodes  
28 800 cores  
192 GiB/node  
2.3 PFLOPS

### V100 Partition

Intel 6248  
265 nodes with 4 Nvidia V100 32 GiB  
131 nodes with 4 Nvidia V100 16 GiB  
31 nodes with 8 Nvidia V100 32 GiB  
1832 GPUs  
15.6 PFLOPS

### A100 Partition

AMD Milan  
52 nodes with 8 Nvidia A100 80 GiB  
416 GPUs.  
8.1 PFLOPS

### H100 Partition

Intel Sapphire Rapids  
364 nodes with 4 Nvidia H100 80 GiB  
1452 GPUs  
87.6 PFLOPS

Currently being commissioned

# Estimating Power: Top-Down



Building

Data Center

Compute Server

job

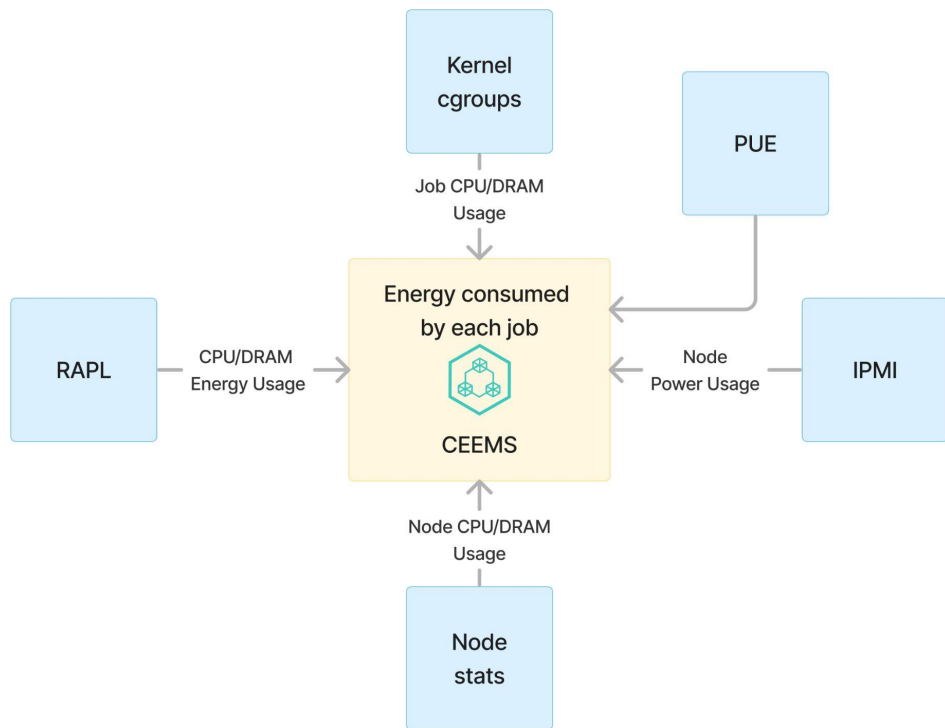
job

Compute Server

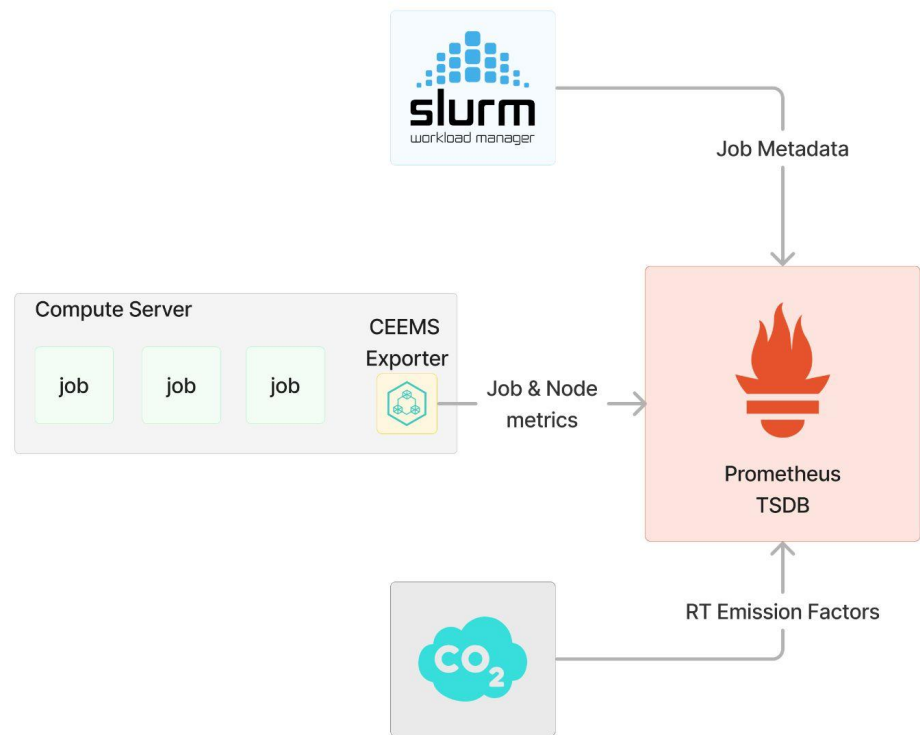
VM

VM

# Estimating Power: Bottom-Up



# Core Architecture

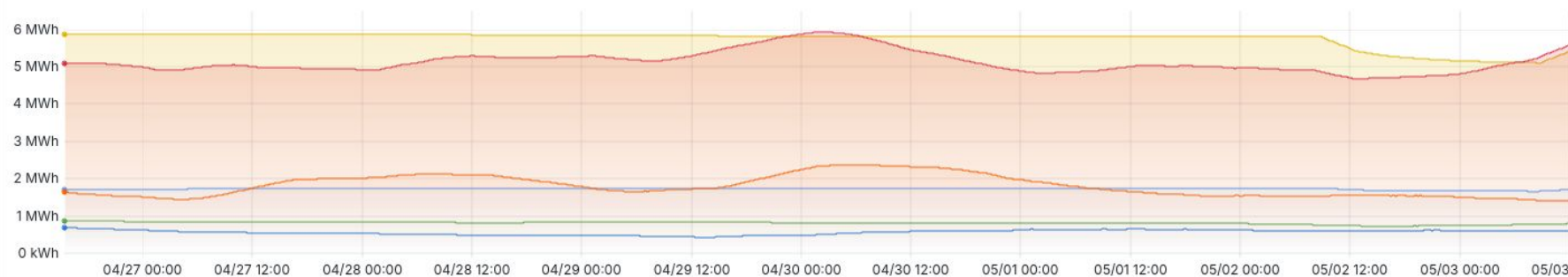


# Real time Emission Factors

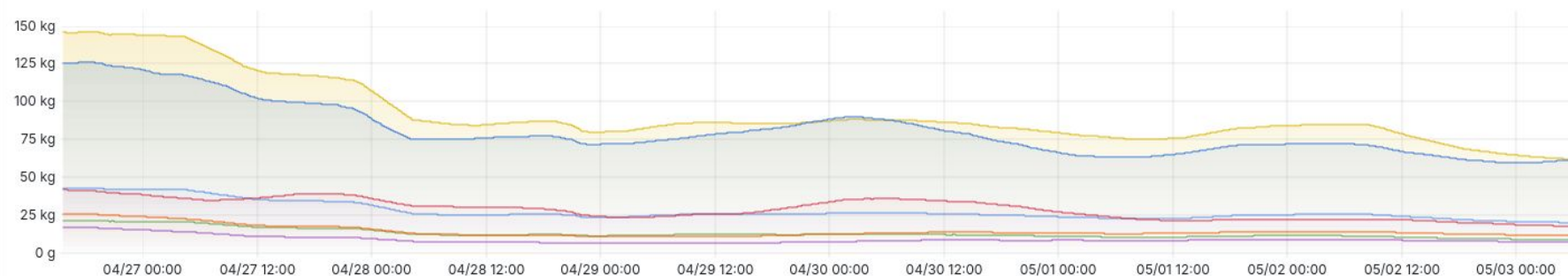


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Node Level CPU and GPU Energy Usage ⓘ



Node Level CPU and GPU Emissions ⓘ





# Real time Emission Factors



ELECTRICITY MAPS

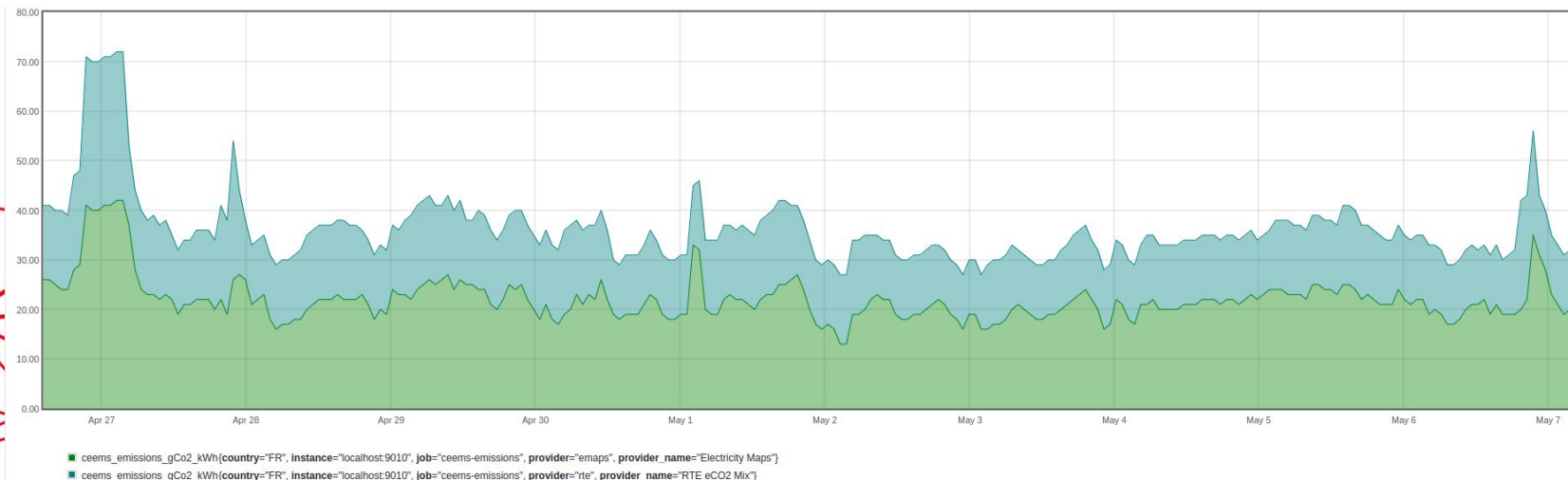


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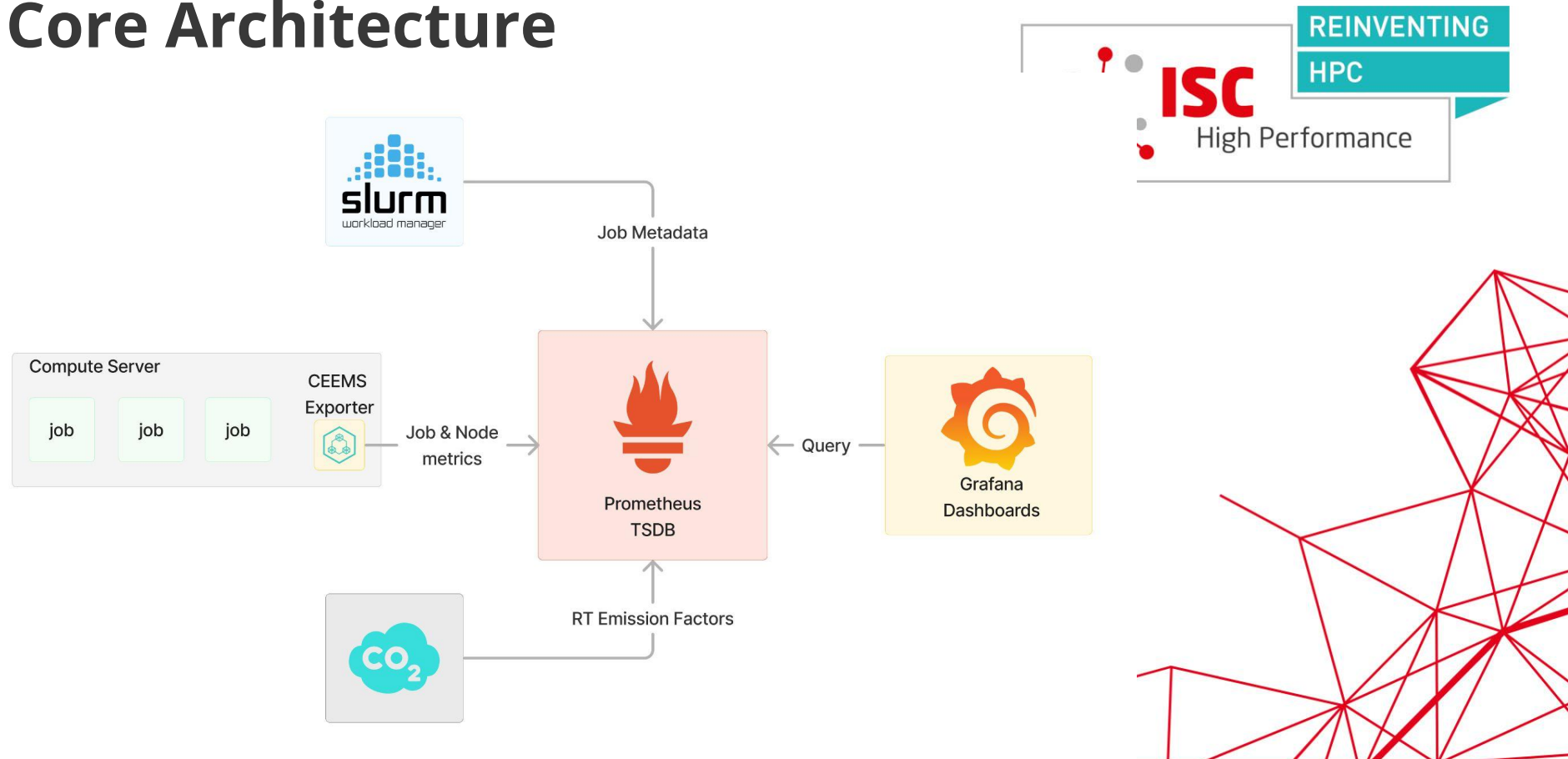
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# Core Architecture





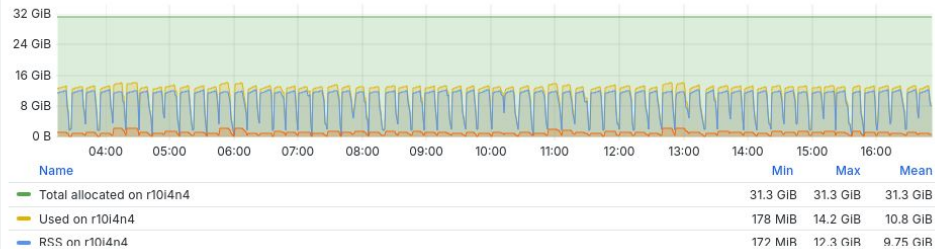
# User dashboards



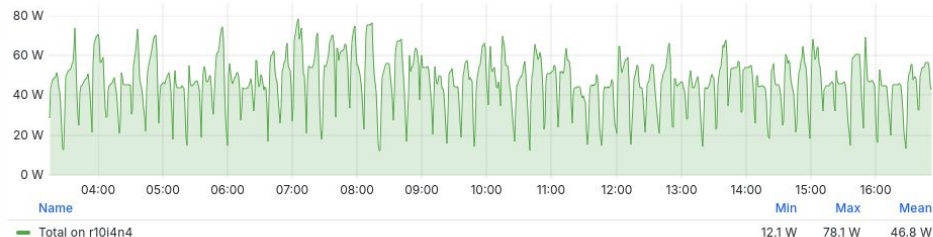
Job CPU Utilization ⓘ



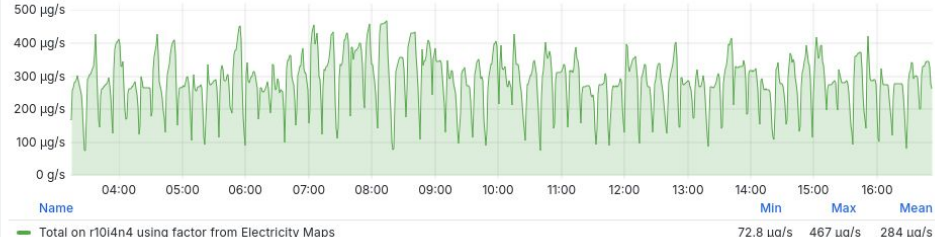
Job CPU Memory Utilization ⓘ



Job CPU Power Usage ⓘ



Job CPU eCO2 emissions rate ⓘ

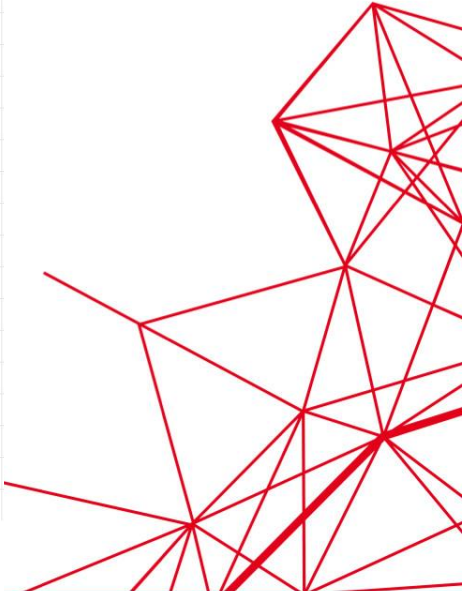


# User dashboards

JobID ⌵	Start Time ⌵	End Time ⌵	Elapsed ⌵	State ⌵	CPU Usage (%) ⌵	CPU Energy (kWh) ⌵	CPU Emissions (g) ⌵	GPU Usage (%) ⌵	GPU Energy (kWh) ⌵	GPU Emissions (g) ⌵
1735381	2024-05-01T16:...	2024-05-01T17:...	00:20:04	TIMEOUT	12.4	0.228	3.88	84.3	0.803	13.7
1735377	2024-05-01T16:...	2024-05-01T16:...	00:20:12	TIMEOUT	11.2	0.209	3.55	72.3	0.762	13.0
1735217	2024-05-01T16:...	2024-05-01T16:...	00:20:06	TIMEOUT	11.7	0.0762	1.29	79.3	0.745	12.7
1735216	2024-05-01T16:...	2024-05-01T16:...	00:20:37	TIMEOUT	12.1	0.204	3.46	82.8	0.769	13.1
1735210	2024-05-01T16:...	2024-05-01T16:...	00:20:06	TIMEOUT	10.0	0.221	3.76	64.6	0.759	12.9
1735194	2024-05-01T16:...	2024-05-01T16:...	00:20:09	TIMEOUT	8.35	0.223	3.80	57.5	0.775	13.2
1735177	2024-05-01T16:...	2024-05-01T16:...	00:05:18	CANCELLED by ...	9.07	0.0529	0.899	56.7	0.144	2.45
1735176	2024-05-01T15:...	2024-05-01T16:...	00:10:26	FAILED	8.82	0.107	1.82	53.8	0.313	5.32
1733909	2024-05-01T13:...	2024-05-01T13:...	00:20:19	TIMEOUT	11.7	0.237	3.80	80.3	0.780	12.5
1705935	2024-04-30T01:...	2024-04-30T01:...	00:04:22	COMPLETED	9.56	0.00569	0.0853	56	0.0118	0.178
1705934	2024-04-30T01:...	2024-04-30T01:...	00:06:03	COMPLETED	9.78	0.00728	0.109	100	0.0330	0.495
1705840	2024-04-30T0:...	2024-04-30T01:...	00:04:16	COMPLETED	10.3	0.00549	0.0824	87.5	0.0218	0.327
1705834	2024-04-30T0:...	2024-04-30T01:...	00:06:09	COMPLETED	4.91	0.00926	0.139	28.5	0.0244	0.366
1705810	2024-04-30T0:...	2024-04-30T0:...	00:05:30	COMPLETED	10.8	0.00826	0.124	100	0.0353	0.530
1705809	2024-04-30T0:...	2024-04-30T0:...	00:05:42	COMPLETED	10.6	0.00891	0.134	95	0.0278	0.418
1705808	2024-04-30T0:...	2024-04-30T0:...	00:04:16	COMPLETED	9.60	0.00600	0.0899	55.8	0.0146	0.219
1705807	2024-04-30T0:...	2024-04-30T01:...	00:19:41	COMPLETED	10.3	0.0300	0.450	70.0	0.0898	1.35
1705806	2024-04-30T0:...	2024-04-30T01:...	00:40:20	TIMEOUT	10.4	0.0639	0.959	95.0	0.213	3.20
1705805	2024-04-30T0:...	2024-04-30T01:...	00:26:08	COMPLETED	11.2	0.0497	0.746	97.0	0.150	2.25
1704678	2024-04-30T0:...	2024-04-30T0:...	00:40:07	TIMEOUT	11.1	0.0635	0.952	50.9	0.131	1.97
1704677	2024-04-30T0:...	2024-04-30T0:...	00:09:46	COMPLETED	11.2	0.0129	0.193	100.0	0.0620	0.930
1694324	2024-04-30T01:...	2024-04-30T01:...	00:05:36	COMPLETED	8.26	0.00281	0.0422	62.1	0.0130	0.195
1694323	2024-04-30T0:...	2024-04-30T01:...	00:05:40	COMPLETED	5.43	0.00685	0.103	28.0	0.0159	0.238

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# Operator dashboards

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Usage Stats ⓘ										
Project ⓘ	Users (uniqueValues) ⓘ	Num Jobs (sum) ⓘ	Avg. CPU Usage (m%) ⓘ	Avg. GPU Usage (m%) ⓘ	Avg. CPU Mem Usage ⓘ	Avg. GPU Mem Usage ⓘ	Total CPU Energy Us ⓘ	Total GPU Energy Us ⓘ	Total CPU Emissions ⓘ	Total GPU Emissions ⓘ
[	...	49033	6.40	40.3	5.59	25.8	1253	3670	18527	55828
[	...	18142	22.7	2.71	2.63	1.01	188	279	3152	4635
[	...	16060	47.7	59.7	28.7	15.7	7459	19141	119818	306113
[	...	13774	8.10	68.3	3.30	23.4	551	1642	7816	22799
[	...	13323	73.9	0	24.2	0	140	0	2023	0
[	...	12742	44.3	34.3	0.413	2.55	69.6	67.7	1036	992
[	...	12634	35.0	50.5	4.56	15.5	857	1661	12657	25726
[	...	10799	34.1	62.1	22.1	20.9	4195	15063	67972	244384
[	...	8666	22.9	42.1	14.2	9.90	191	591	3150	10351
[	...	7783	5.57	44.6	2.89	14.0	21.5	147	386	2631
[	...	6956	86.9	0	5.42	0	682	0	10845	0
[	...	6466	90.1	0	26.0	0	301	0	5481	0
[	...	5775	14.9	31.2	22.0	24.2	8421	11672	134542	185421
[	...	5723	48.3	0	7.50	0	2970	0	49344	0
[	...	5531	11.3	78.5	34.5	26.8	58.9	287	1352	6499
[	...	5278	115	0	23.4	0	117	0	2274	0
[	...	4782	27.9	0	5.41	0	714	0	11617	0
[	...	4606	20.4	29.7	5.94	12.6	120	310	1763	4579
[	...	4605	12.4	78.5	18.7	41.5	356	1158	5139	16799
[	...	4550	13.0	75.5	15.6	35.1	235	1740	3731	27345
[	...	4526	113	0.787	7.10	0.199	127	120	1596	1514
[	...	4474	28.7	63.1	9.00	26.7	2265	4634	35039	72749

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1 - 22 of 1063 rows

# What more can we do?

## ■ Explore eBPF to get IO and network stats

eBPF proved to be a powerful framework in observability

## ■ Support Openstack

CEEMS has been designed to be modular and resource manager agnostic







# Thank you

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**CEEMS Resources:**  
[GitHub Repository](#)  
[Docs](#)