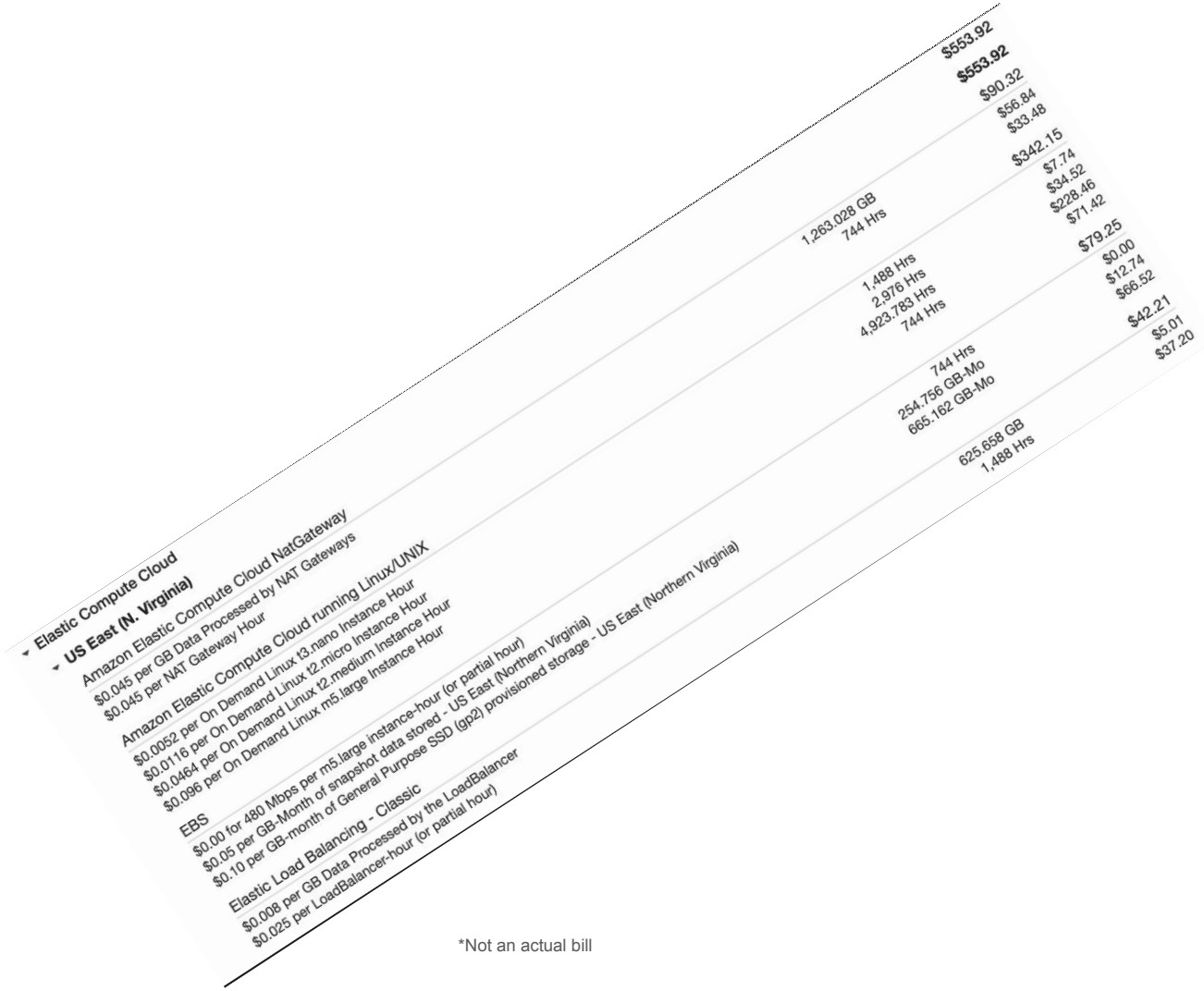
Grafana Labs

Where’s your money going?

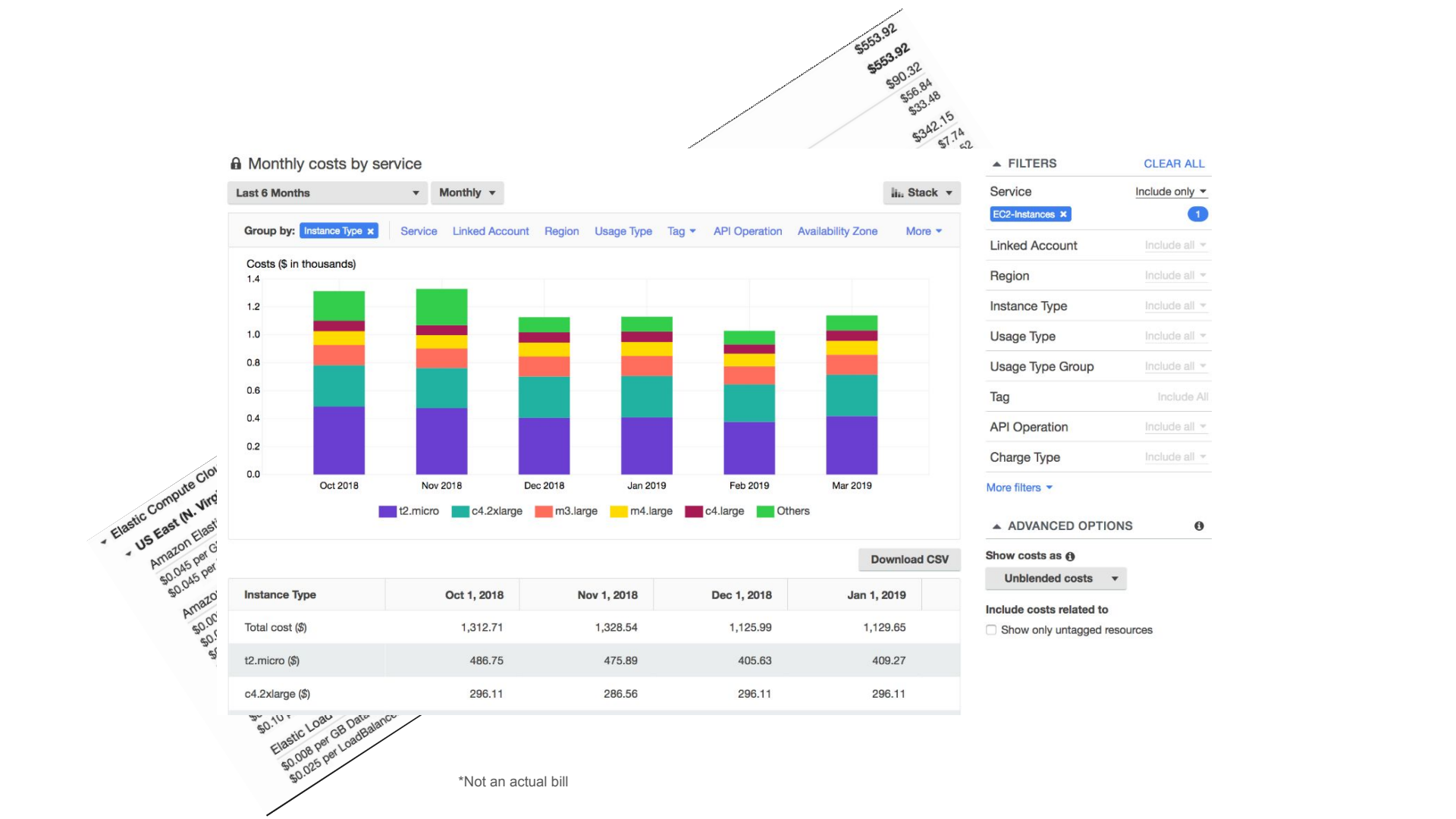
The Beginners Guide To Measuring Kubernetes Costs

Richard “RichiH” Hartmann
Office of the CTO



Elastic Compute Cloud		**$553.92**
US East (N. Virginia)		**$553.92**
Amazon Elastic Compute Cloud NatGateway		$90.32
$0.045 per GB Data Processed by NAT Gateways	1,263.028 GB	$56.84
$0.045 per NAT Gateway Hour	744 Hrs	$33.48
Amazon Elastic Compute Cloud running Linux/UNIX		$342.15
$0.0052 per On Demand Linux t3.nano Instance Hour	1,488 Hrs	$7.74
$0.0116 per On Demand Linux t2.micro Instance Hour	2,976 Hrs	$34.52
$0.0464 per On Demand Linux t2.medium Instance Hour	4,923.783 Hrs	$228.46
$0.096 per On Demand Linux m5.large Instance Hour	744 Hrs	$71.42
EBS		$79.25
$0.00 for 480 Mbps per m5.large instance-hour (or partial hour)	744 Hrs	$0.00
$0.05 per GB-Month of snapshot data stored - US East (Northern Virginia)	254.756 GB-Mo	$12.74
$0.10 per GB-month of General Purpose SSD (gp2) provisioned storage - US East (Northern Virginia)	665.162 GB-Mo	$66.52
Elastic Load Balancing - Classic		$42.21
$0.008 per GB Data Processed by the LoadBalancer	625.658 GB	$5.01
$0.025 per LoadBalancer-hour (or partial hour)	1,488 Hrs	$37.20

*Not an actual bill



*Not an actual bill

Instance Type	Oct 1, 2018	Nov 1, 2018	Dec 1, 2018	
Total cost ($)	1,312.71	1,328.54	1,125.99	1,129.6
t2.micro ($)	486.75	475.89	405.63	409.27
c4.2xlarge ($)	296.11	286.56	296.11	296.11

*Not an actual bill

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What you can expect

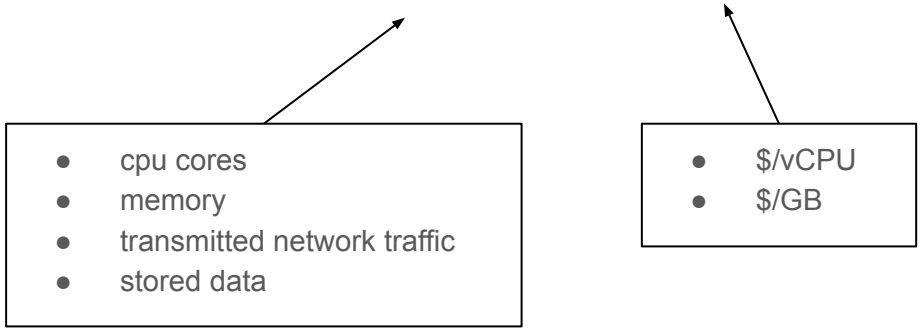
- Disconnect between billing statement and metrics
- How to attribute costs of workloads
- Lessons learned

A simple yet powerful formula …

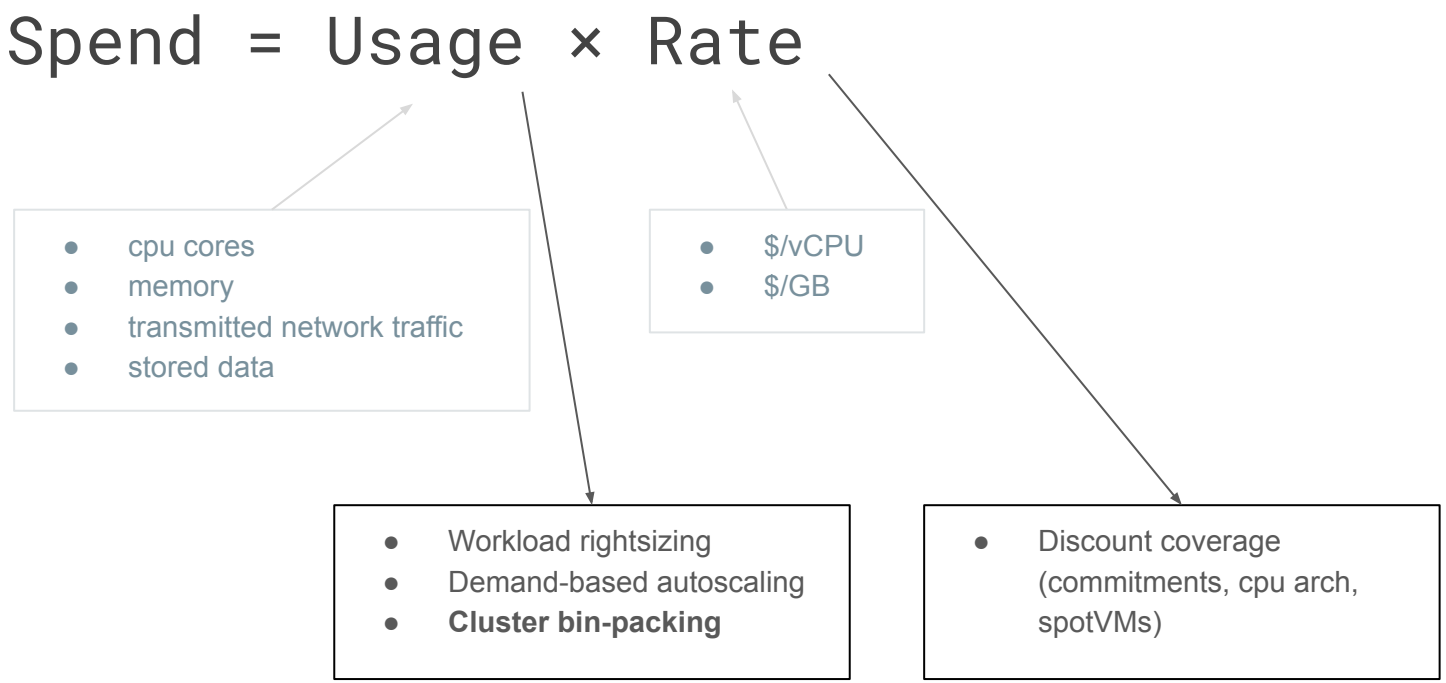
$$\text{Spend} = \text{Usage} \times \text{Rate}$$

A simple yet powerful formula …

Spend = Usage × Rate



A simple yet powerful formula …



A simple yet powerful formula …

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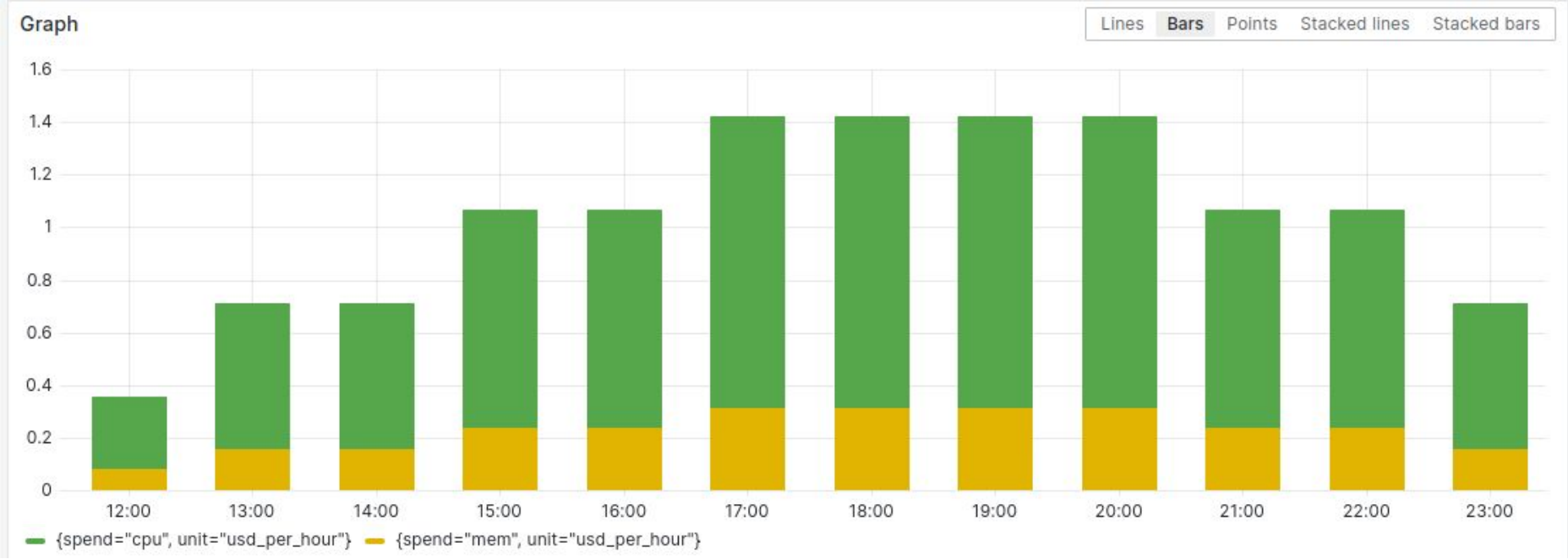
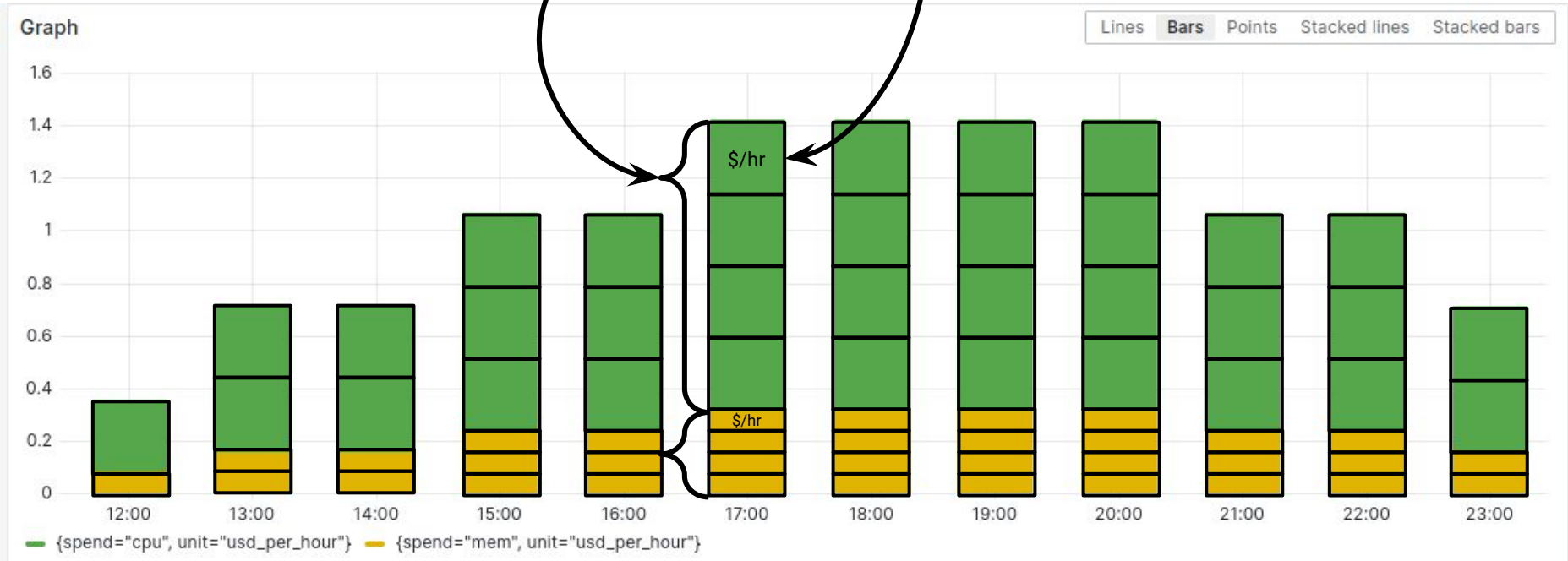


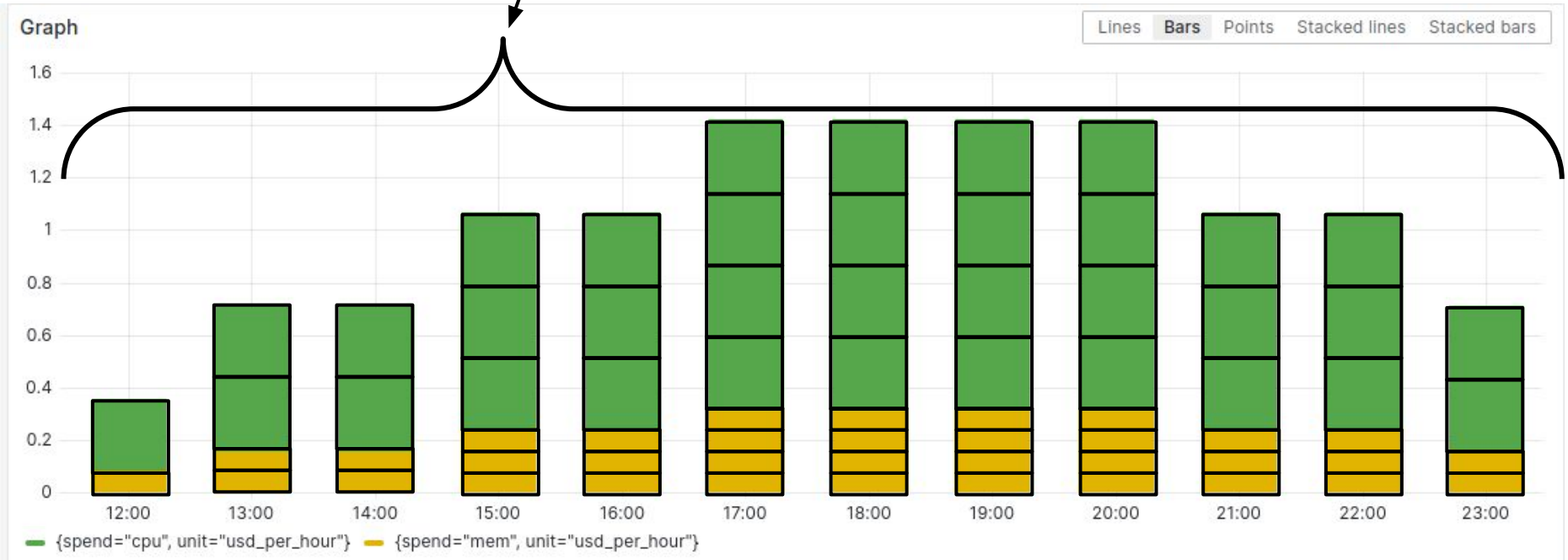
A simple yet powerful formula …

$$\text{Spend} = \text{Usage} \times \text{Rate}$$



A simple yet powerful formula …

$$\text{Spend} = \sum \text{Usage} \times \text{Rate} \; \Delta t$$



What drives k8s costs

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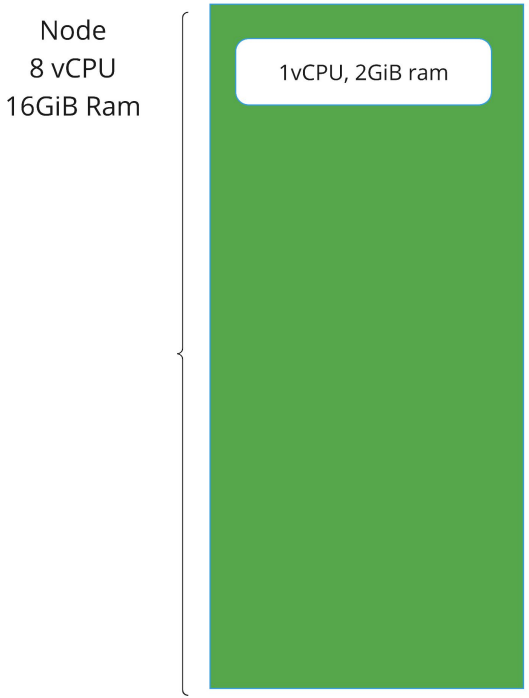
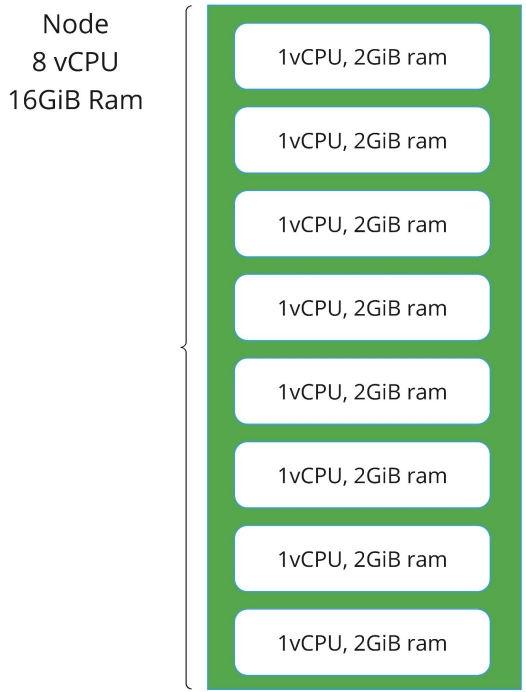
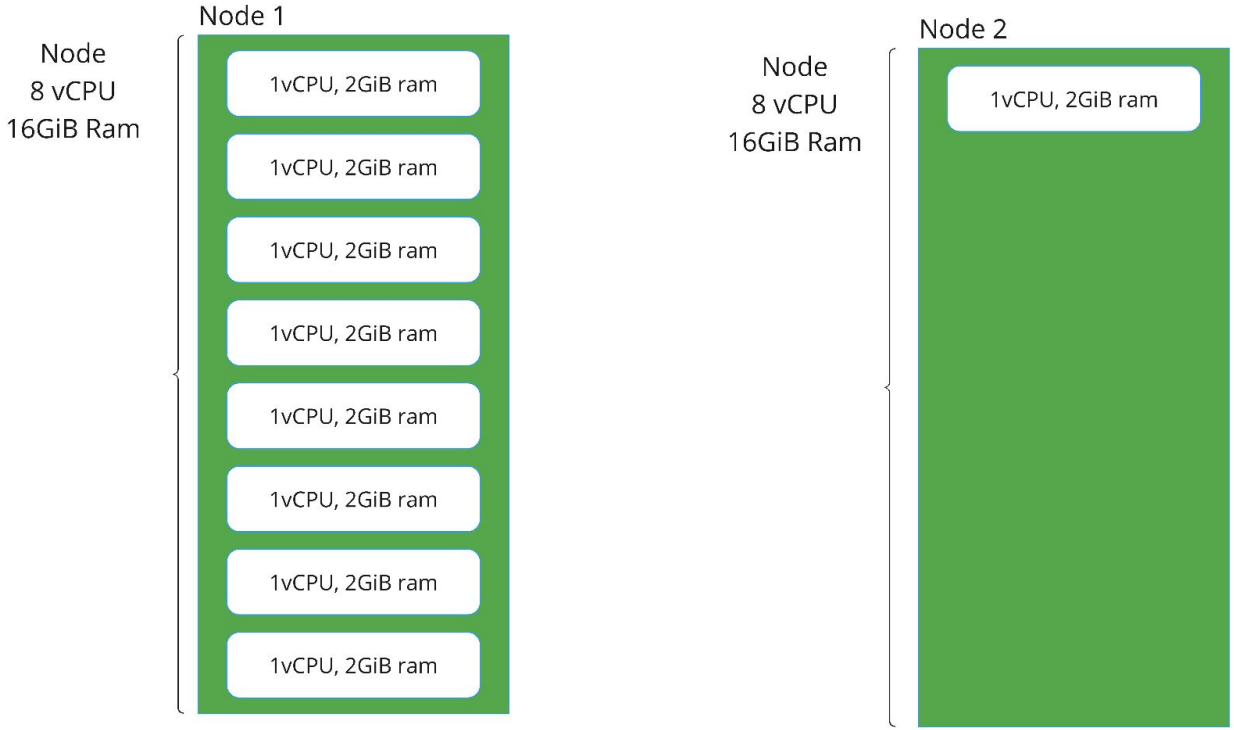


What drives k8s costs



What drives k8s costs



How to measure usage

- cpu|memory of nodes
- cpu|memory requests of workloads

How to measure usage

- cpu|memory of nodes

```
kube_node_status_capacity{cluster, resource, node}
```

- cpu|memory requests of workloads

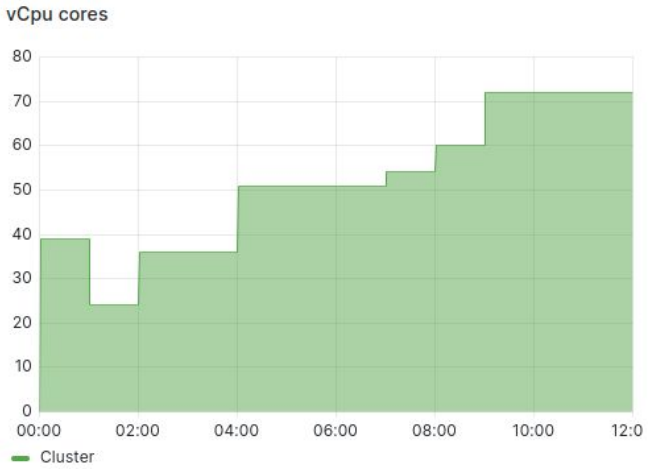
```
kube_pod_container_resource_requests{cluster, resource, node, namespace}
```

How to measure your nodes

```
sum (
  usage
  *
  rate
)
```

How to measure your nodes

```
sum (
  kube_node_status_capacity{resource="cpu"}
  *
  rate
)
```



How to measure your nodes

N2 machine types

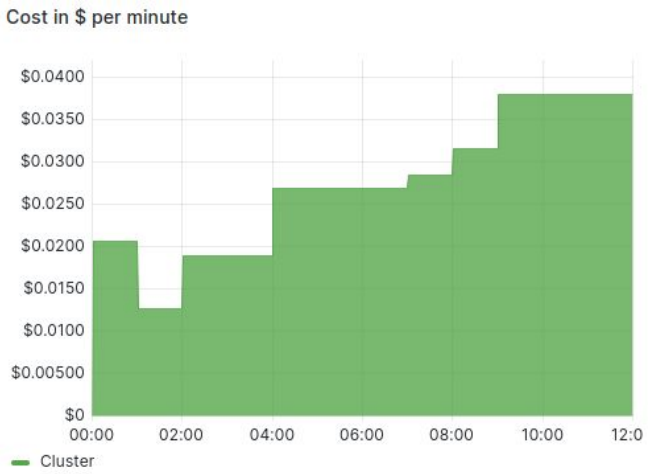
South Carolina (us-east1)

Hourly Monthly

Item	On-demand price (USD)	Spot price* (USD)
Predefined vCPUs	$0.031611 / vCPU hour	$0.00836 / vCPU hour
Predefined Memory	$0.004237 / GB hour	$0.00112 / GB hour

How to measure your nodes

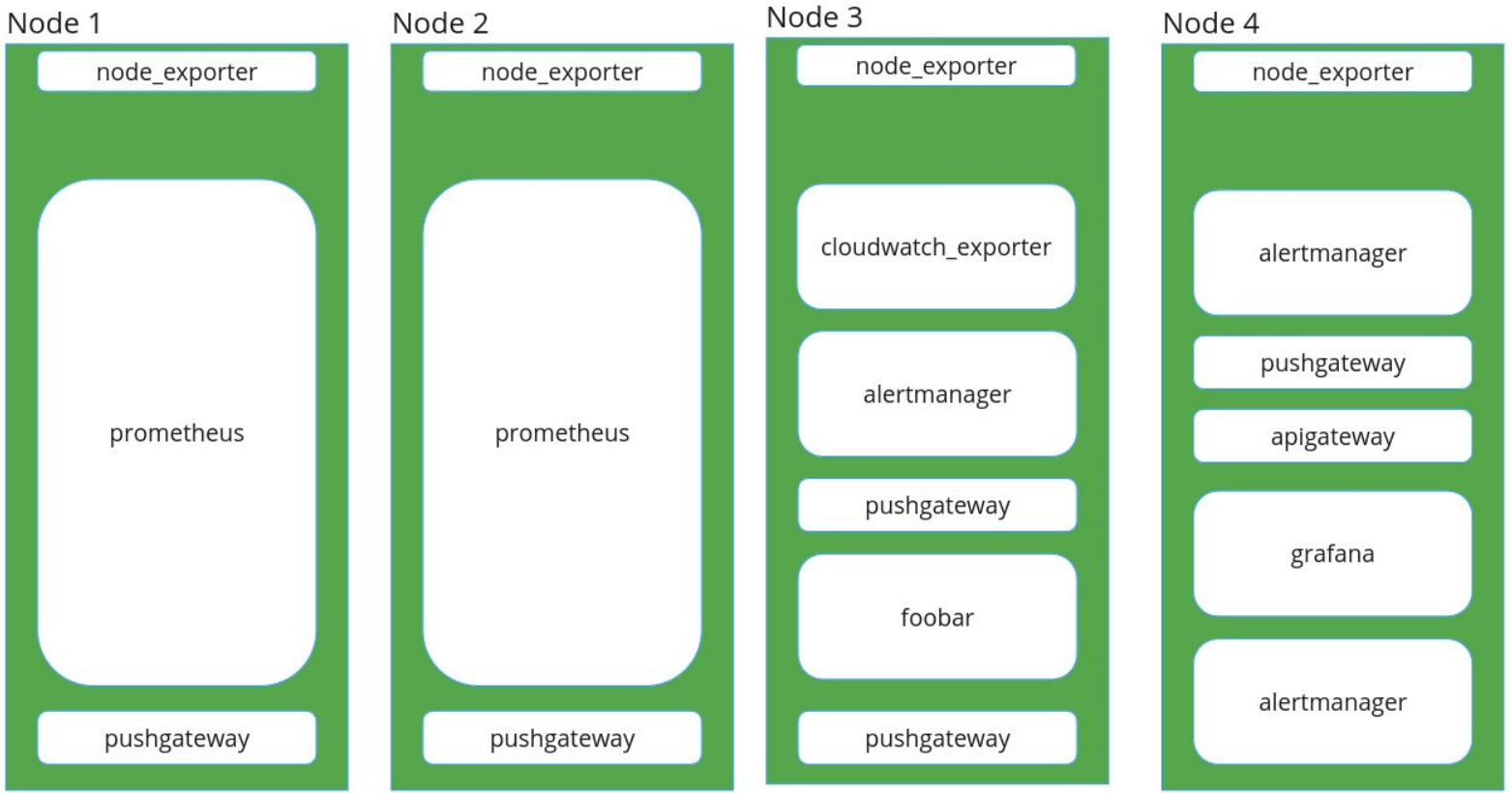
```
sum (
  kube_node_status_capacity{resource="cpu"}
  *
  (0.031611 / 60)
)
```



How to measure your nodes

```
- record: cluster:cost_per_minute:sum
  expr: |
    sum by (cluster) (
      kube_node_status_capacity{resource="cpu"}
      *
      (0.031611 / 60)
    )
  labels:
    resource: "cpu"
```

What drives k8s costs (or who)

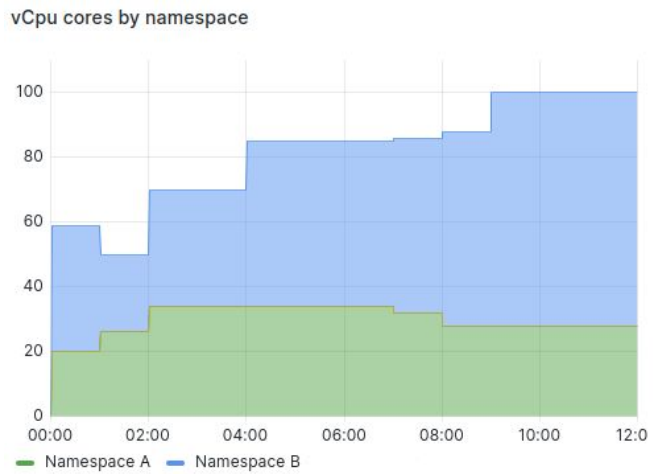


How to measure your workloads impact

```
sum by (namespace) (
  requests
  *
  rate
)
```

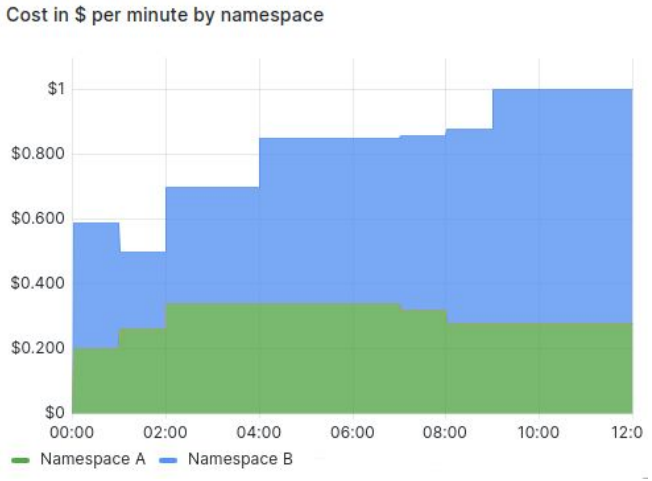
How to measure your workloads impact

```
sum by (namespace) (
  kube_pod_container_resource_requests{resource="cpu"}
  *
  rate
)
```



How to measure your workloads impact

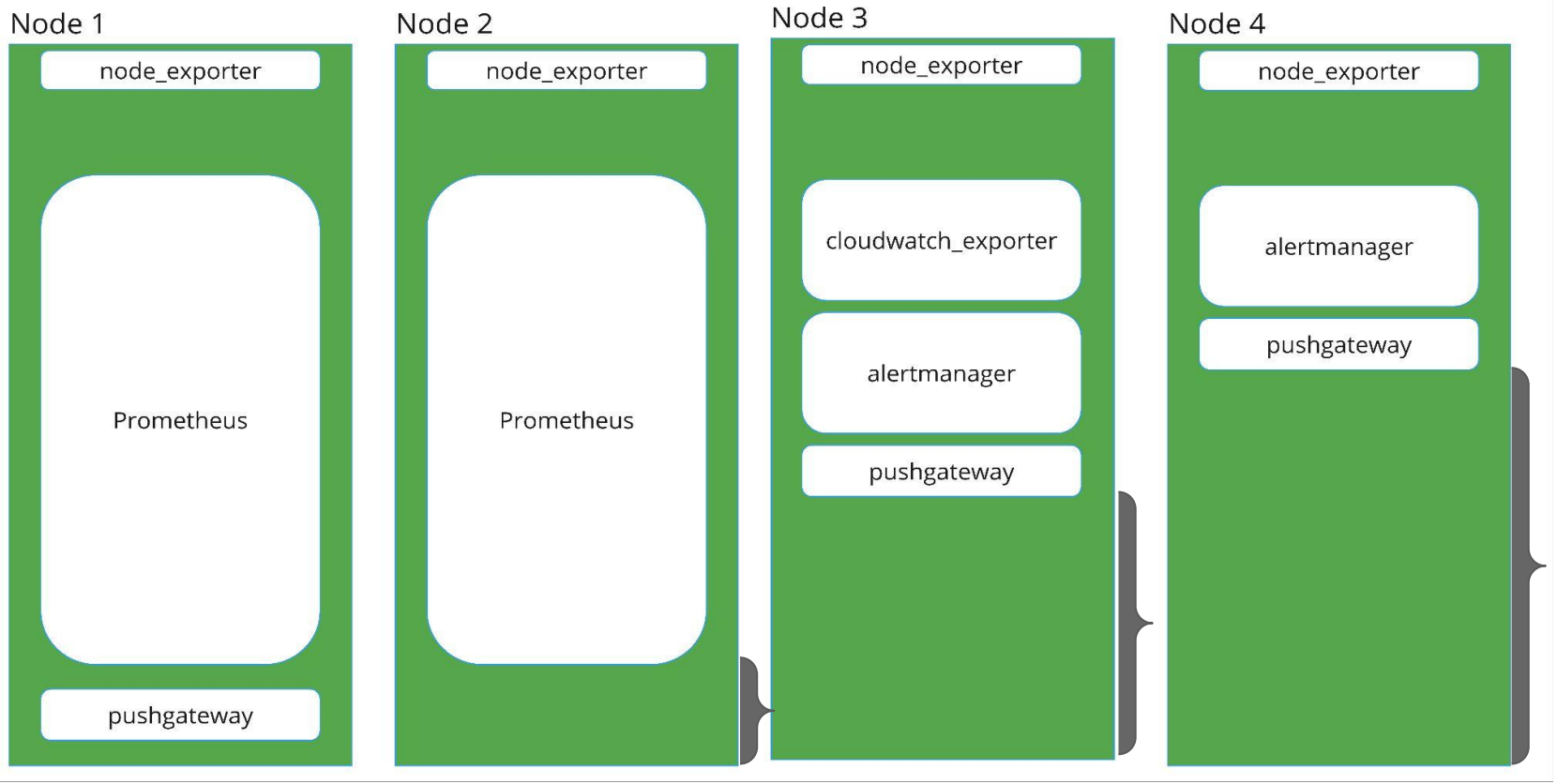
```
sum by (namespace) (
  kube_pod_container_resource_requests{resource="cpu"}
  *
  (0.031611 / 60)
)
```



How to measure your workloads impact

```
- record: cluster_namespace:cost_per_minute:sum
  expr: |
    sum by (cluster, namespace) (
      kube_pod_container_resource_requests{resource="cpu"}
      *
      (0.031611 / 60)
    )
  labels:
    resource: "cpu"
```

What drives k8s costs (realistic)

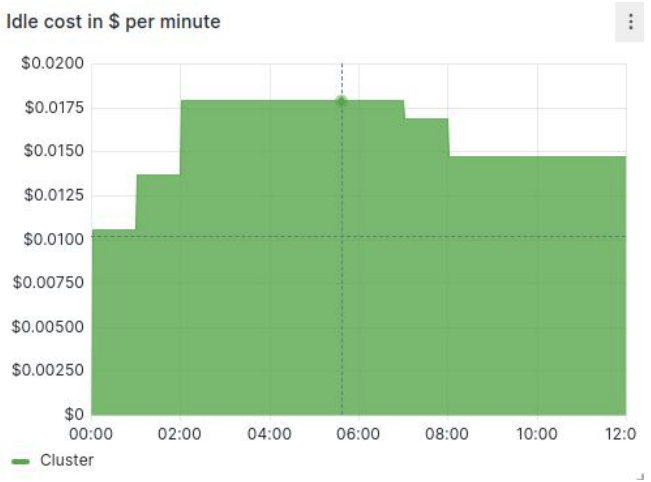


How to measure idle resources

```
sum (
  (
    capacity
    -
    requests
  )
  *
  rate
)
```

How to measure idle resources

```
sum (
  (
    sum by (node) (
      kube_node_status_capacity{resource="cpu"}
    )
    -
    sum by (node) (
      kube_pod_container_resource_requests{resource="cpu"}
    )
  )
  *
  (0.031611 / 60)
)
```



How to measure idle resources

```
- record: cluster_namespace:cost_per_minute:sum
  expr: |
    sum by (cluster) (
      (
        sum by (cluster, node) (
          kube_node_status_capacity{resource="cpu"}
        )
        -
        sum by (cluster, node) (
          kube_pod_container_resource_requests{resource="cpu"}
        )
      )
      *
      (0.031611 / 60)
    )
  labels:
    resource: "cpu"
    namespace: "__idle__"
```

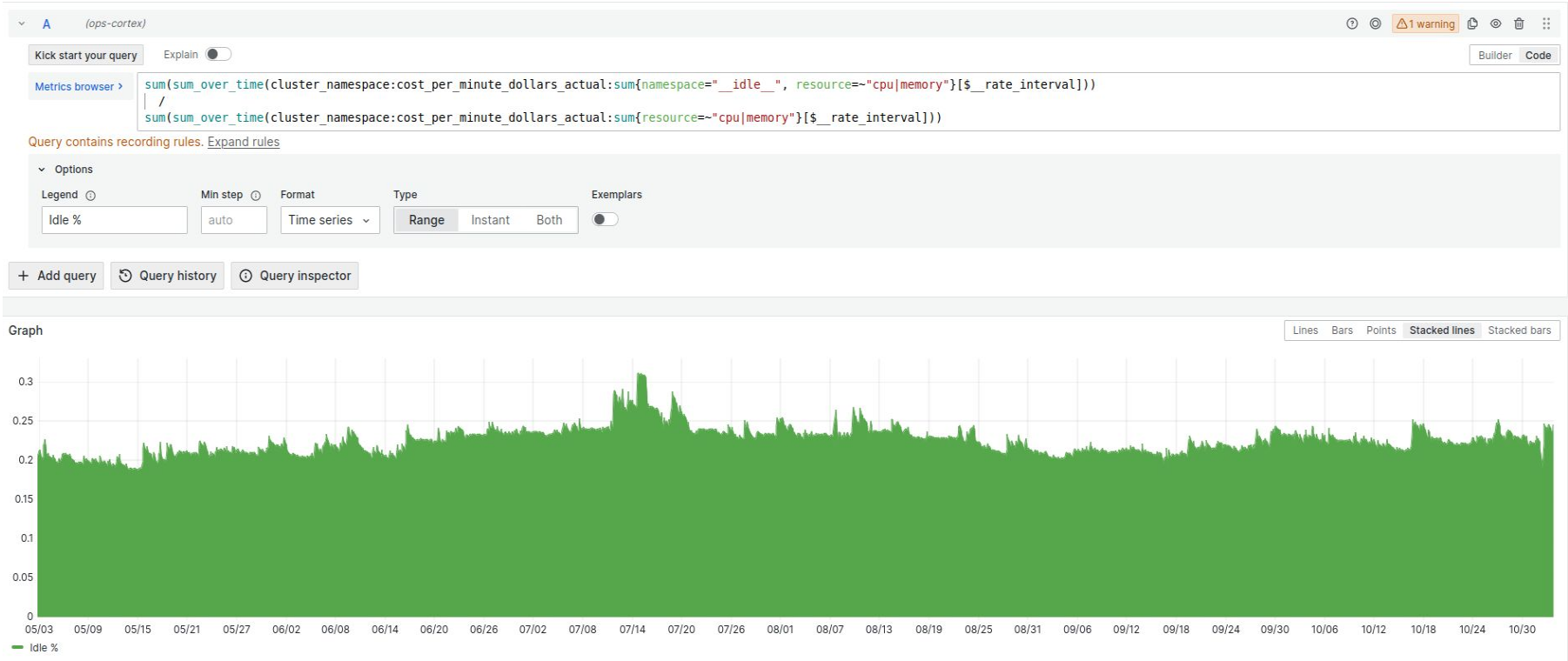
How to draw an Owl.

"A fun and creative guide for beginners"

Fig 1. Draw two circles

Fig 2. Draw the rest of the damn Owl

How to measure idle resources



Lessons learned with Measuring Costs

- This approach only works for homogeneous clusters
- Takes only compute resources into account
- Not all CSPs will give you the breakdown on compute resources costs
- Namespaces is not a 1:1 mapping to teams

Lessons learned: Bin Packing


YOU DO HAVE
CPU AND MEM
REQUESTS, RIGHT?
imgflip.com

Lessons learned: Bin Packing

- In Google, using `OPTIMIZE_UTILIZATION` for `GKE`

Lessons learned: Bin Packing

- In Google, using `OPTIMIZE_UTILIZATION` for `GKE`
- Kubernetes `descheduler` helps improving node utilization

Lessons learned: Bin Packing

- In Google, using `OPTIMIZE_UTILIZATION` for `GKE`
- Kubernetes `descheduler` helps improving node utilization
- In AWS, using `Karpenter` as cluster autoscaler for `EKS`

Lessons learned: Bin Packing

- In Google, using `OPTIMIZE_UTILIZATION` for `GKE`
- Kubernetes `descheduler` helps improving node utilization
- In AWS, using `Karpenter*` as cluster autoscaler for `EKS`
- Google's State of Kubernetes Cost Optimization

`https://bit.ly/grafana-karpenter`

Grafana Labs

Thank you

- Erik Sommer
- JuanJo Ciarlante
- Mark Poko
- Paula Julve

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Join us at
https://slack.grafana.com/
#cost-observability