



AWS  
re:Invent

ENT307

# Saving at Scale with Reserved Instances

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As your Reserved Instance portfolio grows, tracking your ROI becomes more critical. You'll need the right tools, metrics, and strategies in place to make sure you're maximizing RI savings and minimizing unused RI hours. In this session, you'll learn how scaled organizations like yours track, report and optimize their Reserved Instance savings. Attendees walk away with new strategies and tools for choosing Reserved Instances and properly account for your RI's after they've been purchased. Topics will include: - Accounting for Reserved Instances and their upfront costs - Centralizing and streamlining the RI buying process - Choosing the right RIs to buy and modify

How many of you have purchased Reserved  
Instances?

We are going to talk about how to manage Reserved Instances RI at the 1000, 5000, 10000 level scale.

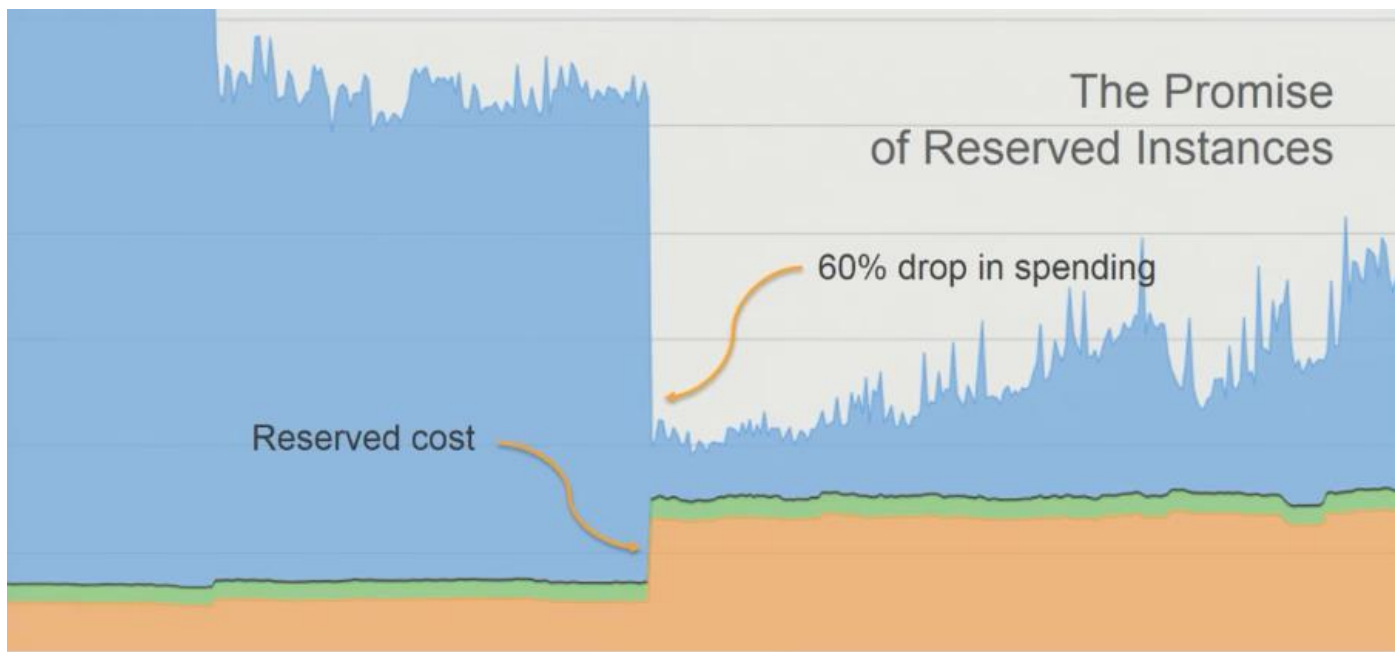


# Story:

## The (Reserved Instance) hangover

Let us see a story of an RI buy gone bad by a company.

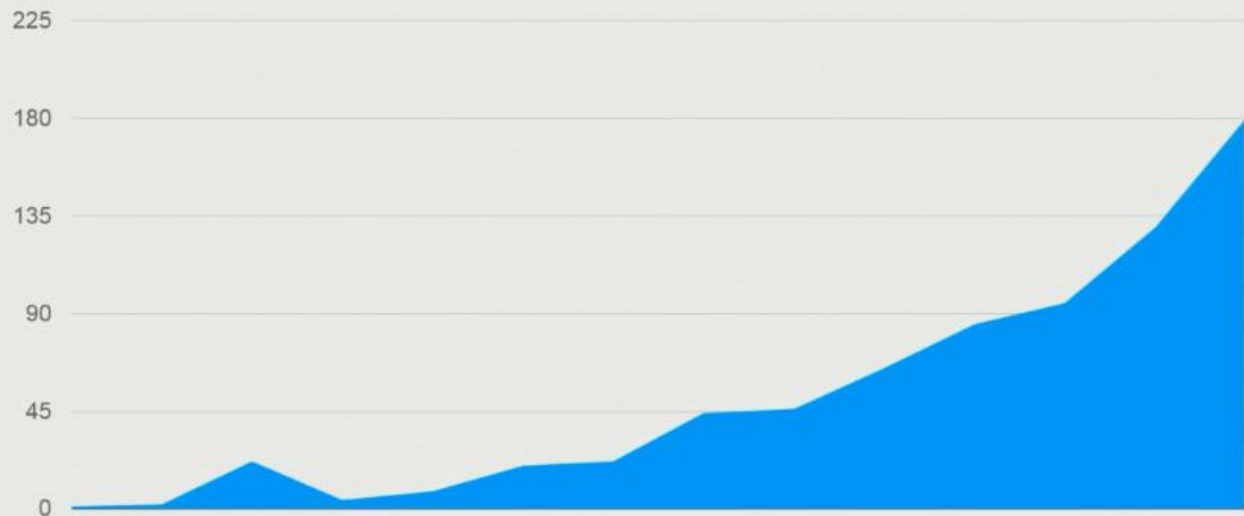
### How one company came to buy **\$2m+** of Reserved Instances



The company purchased some RI for their EC2 instances

Just bought  
a bunch of ...

Reserved Instances



The next month, the bill went up anyway...

The bill continued to go up



### What went wrong

- Very few of the Reserved Instances were applied because of...
    - Wrong OS data** – used incomplete CloudWatch data, not billing data so they bought wrong types
    - Wrong time frame** – bought on future plans that changed, not actual usage
    - Wrong people** – Only involved Tech team, didn't consult Finance teams in how to deploy cash (upfront or partial)
- Increase in costs by \$120k/mo while usage stayed flat**

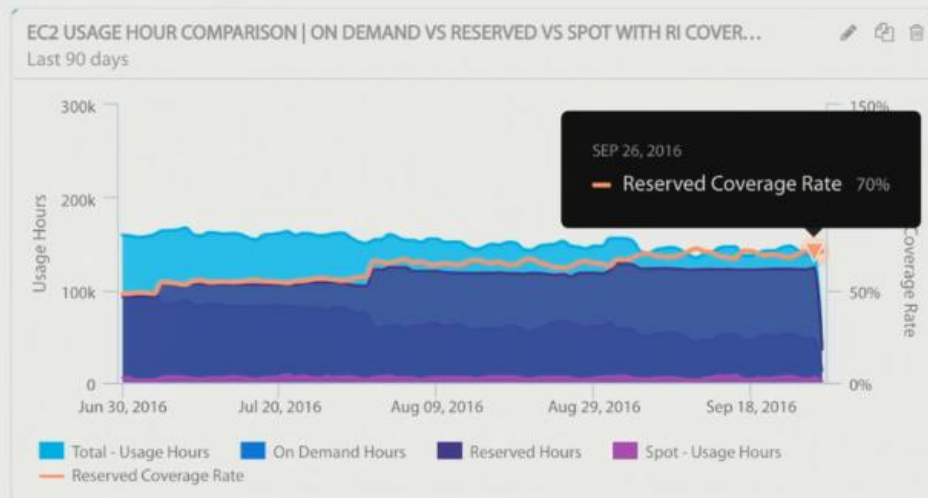


@cloudability

They then have to create a better process to manage their RI

### A year later...

Went from 11% to 70% Reserved Instance coverage with <5% unused hours



*On seven figure monthly EC2 bill*

## Acme Corp

Saved \$5.6m over 12 months -  
Initially wasting \$120k/mo to  
saving \$500k/mo

12 Month Trend: Average monthly  
savings of ~\$500,000  
( including upfront fees )



They are now saving over 500,000/mth over on-demand using RI they buy. We are going to see how they made this change work over time for their company

# But first, let's go back to the basics...

## Reservations have two parts



Cost Savings



NO VACANCY

Capacity Reservation

Reserved Instances RIs have 2 components, you get a **Cost Savings component** where you pay some amount upfront for a reduced rate over time and the Capacity Reservation component that is not guaranteed but says if AWS is short of a particular instance type you want in a certain AZ, you will get the first opportunity to use it. Most companies are focused on the cost savings component.



Reservations give you 744 hourly ***coupons*** that can be applied each hour of the month



### Reserved Instance Mechanics

#### What Makes Up a Reserved Instance?

Instance				Term	Type
Instance Family	Size	OS	Location (AZ)		
m4	large	Linux	us-east-1a	1 year	No upfront
r3	8xlarge	RHEL	us-west-2b	3 years	Partial upfront
t2	medium	Windows	ap-northeast-1b	1 year	All upfront

1. You are committing to pay for every hour of the period, regardless of the type
2. Don't confuse term with breakeven point, which is often less than half of the term

# (New!) Reserved Instance Types

## • Convertible Reserved Instances and Regional Scope

### What did AWS change in 2016?

**No changes to Standard Reserved Instances:** 1 or 3 year commitment, ability to “modify” instance size (only if Linux) and AZ

**Added Regional Scope:** applies Reserved Instance in entire region, not just AZ.

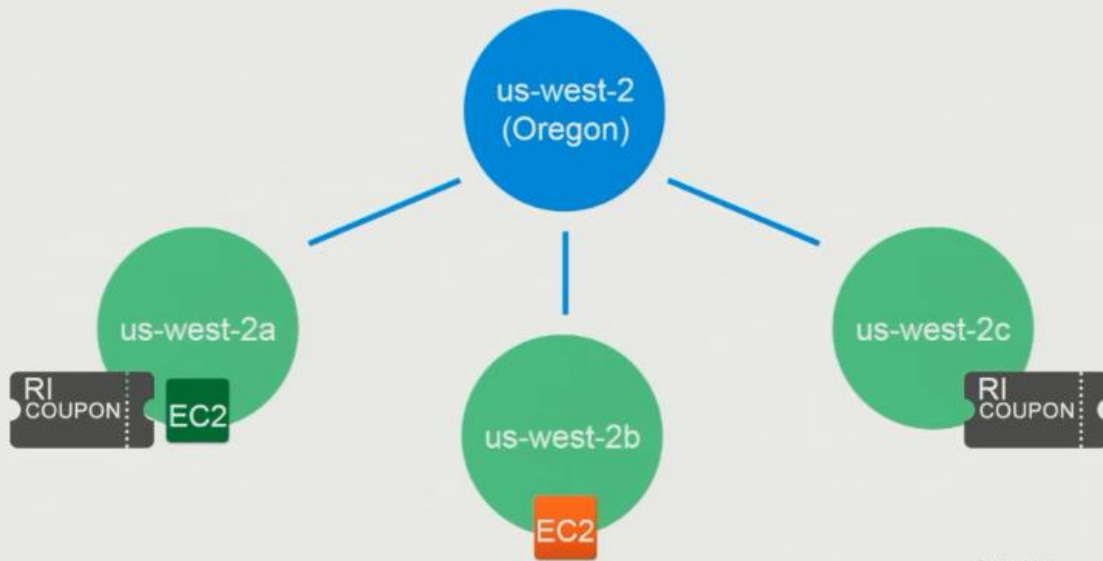
**Added Convertible Reserved Instances:** 3-year commitment, ability to “exchange” for other sizes, families, or OS.

**Regional scope option** lets the RI be applied in any AZ within the chosen region regardless of where the instance comes up. The **Convertible Reserved instances option** are 3-year commitments that you can exchange with new instances in different sizes, families or OS.

## New in 2016: Regional Scope

## Understanding reservations

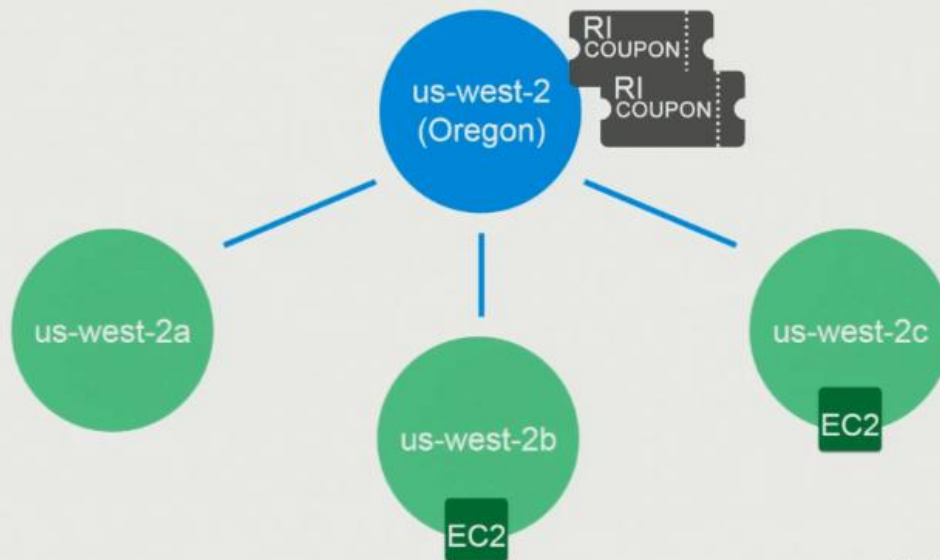
### Reservations in linked accounts



You will need to buy the RIs in any one of the AZs in a region you want to use the EC2 instances. But if you spin up the EC2 instance in the AZ with the RI coupon it is going to be covered, the EC2 instances you spin up in the AZ with no RI coupon will spin up as an on-demand instance.

## Understanding reservations

### Reservations in linked accounts



The Regional Scope option takes the RI coupons and moves them up to the regional level.



## Regional Benefit

# What's the Regional Scope for Reserved Instances?

Using Regional Scope allows Reserved instances to be applied in any Availability Zone within a region.

Remember:

This is **not a new type** of Reserved Instance — it's an optional **attribute** of any Reserved Instances (Standard or Convertible, 1 or 3 year, etc)

Regional Scope Reserved Instances have no capacity guarantees

Highly recommended addition to your RI strategy



# New in 2016: Convertible Reserved Instances

## Convertible RIs

Convertible Reserved provide more flexibility but require a 3 year term

You need to feel confident that you will be using at least the same or more EC2 over time.



## Convertible Reserved Instances

...they are exchangeable for other Reserved Instance types at any point

Convertible RIs grant you the flexibility to change which instance type the Reserved Instance can cover.



Imagine the first two years of this Reserved Instance reducing the hourly rate of an **m4.2xlarge** instance.

...and then being converted into a **c4.2xlarge** for its remaining term.

## Which type should I choose?

Class	Commitment to EC2	Flexibility	Upfront Fee	Savings
Standard 1 yr	Low	Low*: Not expecting to change families	All/Partial/No	Least ~40%
Convertible 3 yr	High	Medium**: Expecting families to change	All/Partial/No	Medium ~45%
Standard 3 yr	High	Low*: Not expecting to change families	All/Partial	Highest ~60%

\* Standard RIs that are Linux can be modified to a different size within the same family (e.g., from m4.4xlarge to m4.2xlarge)

\*\* Convertible RI exchanges require a move to an equal or greater value RI which can limit options without additional cost

## What do these changes mean for Reserved Instance planning?

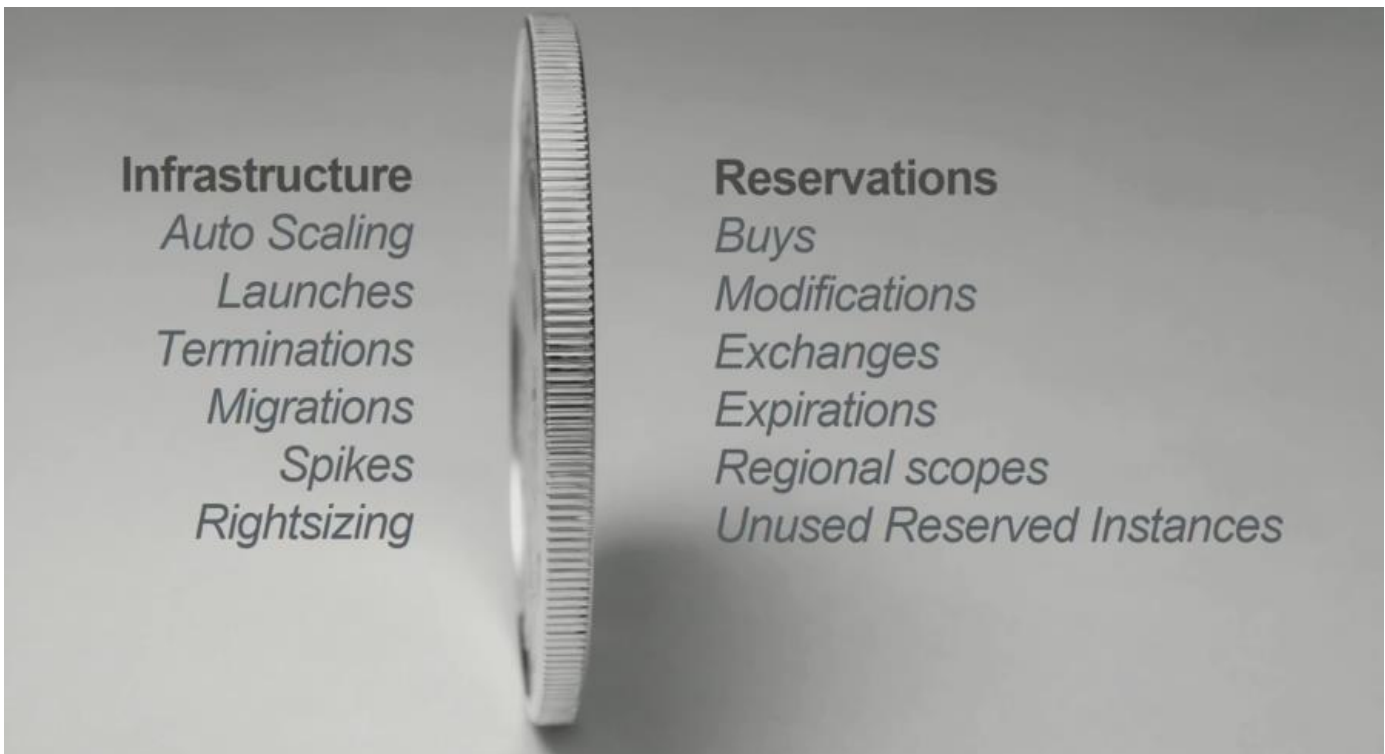
1. Many more choices to consider
2. You may need a mix of both types
3. Management is more complex with both convertibles and standards
4. Be aware of the often increasing commitment that convertibles require when exchanging

1 Year / Standard		3 Year / Convertible (Annualized)		3 Year / Standard (Annualized)	
<b>No Upfront</b> 31%		<b>No Upfront</b> 38%		Not Available	
Savings	\$1,281,923	Savings	\$3,845,769 (\$1,281,923)		
Upfront	\$0	Upfront	\$0		
Total	\$1,234,567	Total	\$9,345,678 (\$3,115,226)		
<b>Partial Upfront</b> 42%		<b>Partial Upfront</b> 48%		<b>Partial upfront</b> 60%	
Savings	\$1,758,115	Savings	\$6,775,826 (\$2,258,608)	Savings	\$8,649,990 (\$2,883,330)
Upfront	\$1,711,481	Upfront	\$4,045,718 (\$1,348,572)	Upfront	\$3,236,574 (\$1,078,858)
Total	\$1,234,567	Total	\$12,345,678 (\$4,115,226)	Total	\$12,345,678 (\$4,115,226)
<b>All Upfront</b> 43%		<b>All Upfront</b> 48%		<b>All upfront</b> 63%	
Savings	\$1,820,890	Savings	\$6,917,547 (\$2,305,849)	Savings	\$9,079,280 (\$3,026,426)
Upfront	\$2,930,945	Upfront	\$8,298,162 (\$2,766,054)	Upfront	\$6,533,986 (\$2,177,995)
Total	\$6,789,012	Total	\$23,456,789 (\$7,818,929)	Total	\$23,456,789 (\$7,818,929)
				<input type="button" value="Cancel"/> <input type="button" value="Apply"/>	

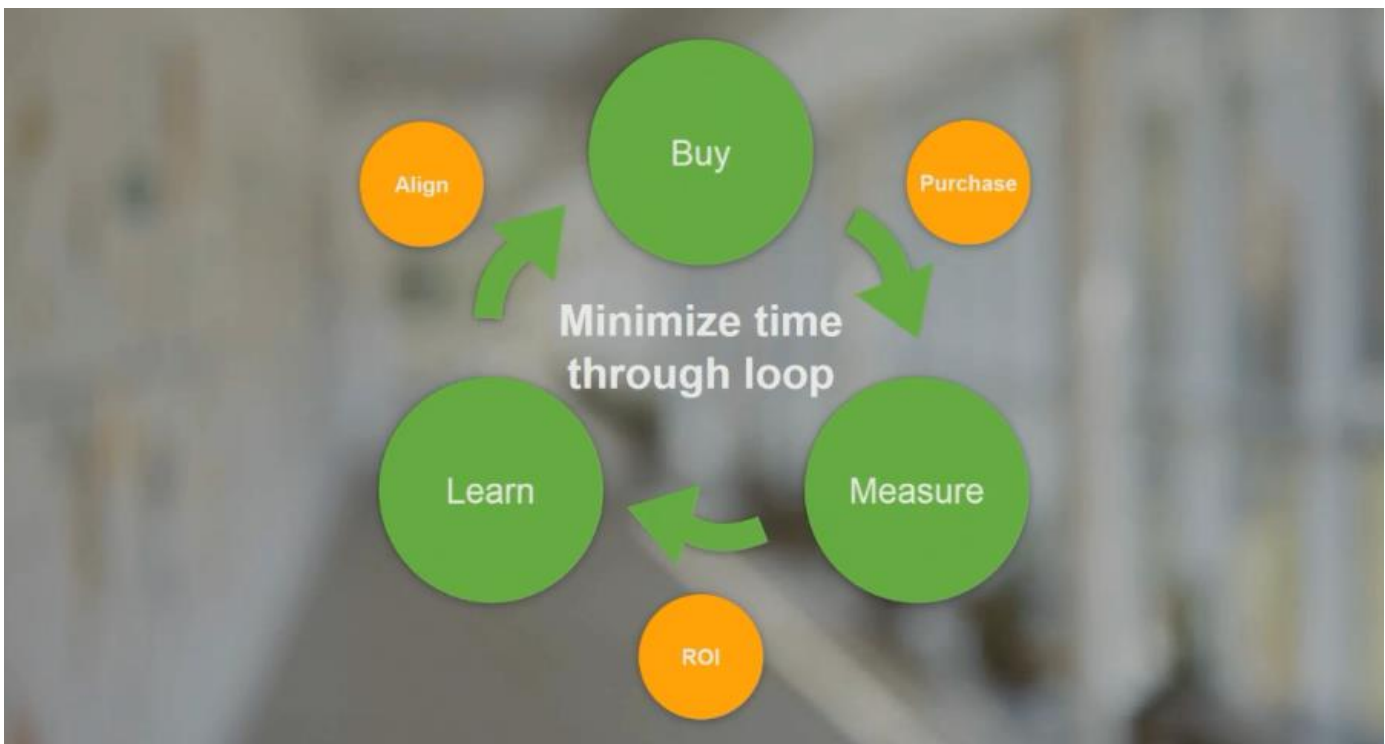
Back to these guys...



# How did Acme Corp fix their Reserved Instance process?



Reserved Instances are 2 sides of the same coin with regards to your infrastructure. Reservations are really just in time purchasing, very quick to purchase and use.



What they put in was a more agile process for measuring their RIs, they continuously learn how their RIs are aligned with their infrastructure by tracking metrics closely



## Primary Reserved Instance metrics

### 1. Reserved Coverage Rate

Percentage of hours that are covered by reservations, excluding Spot hours

### 2. Unused Reserved Hours

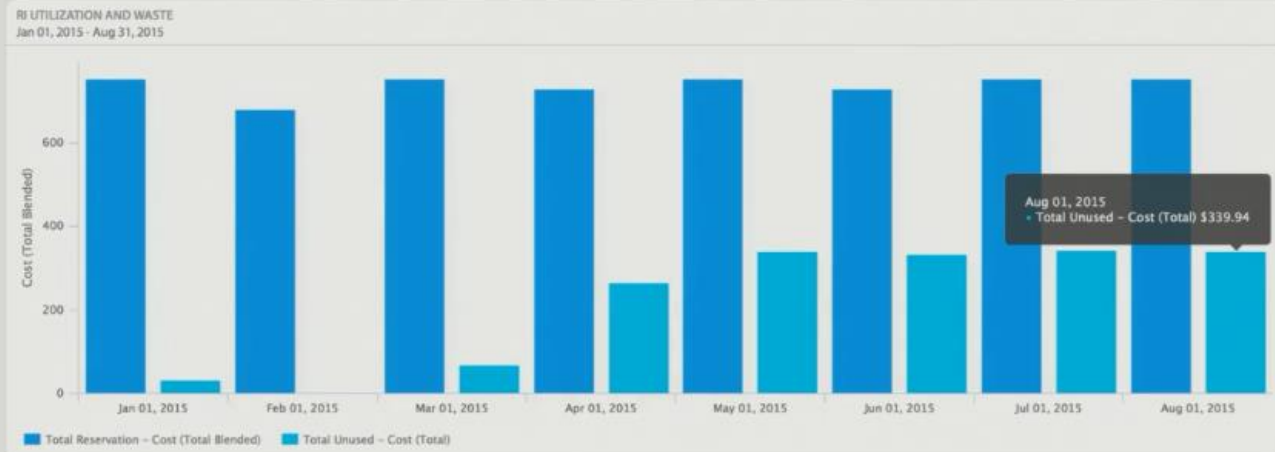
Amount of unused (but paid for) Reserved Instance hours – in dollars or a percentage

Start with the Reserved Coverage Rate





## Keep tabs on unused reserved hours



Month over month total spending on Reserved Instances vs.  
Unused Reserved Instance hours



# Acme's Reserved Instance Team



RI Czar is a person or team focused on looking at the AWS billing data each month to identify opportunities to increase Reserved Instance coverage.

Why appoint one?

- Proper purchasing of Reserved Instances can save 30%+ on your EC2 bill
- Potential savings of \$300k+ year on a \$1M/yr EC2 spend
- Usually a technically minded business analyst tied to the finance team

#### Reserved Instance Strategy

### ● Acme's Reserved Instance Schedule

**Daily:**

Modifications executed

**4 days before end of month:**

Reserved Instance Recommendations generated from Cloudability

**2 days before end of month:**

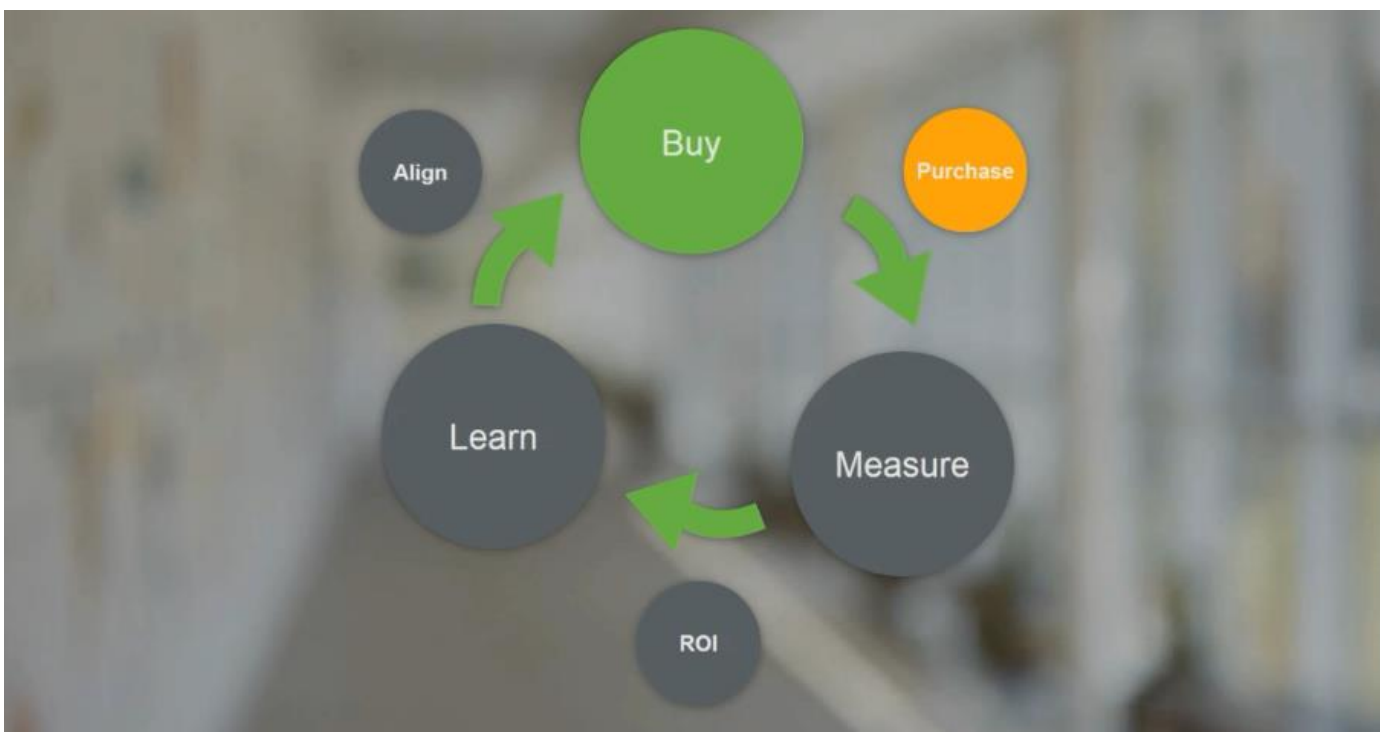
Proposed purchase is reviewed with stakeholders

**1st of every month:**

Purchase is made on the same day each month to align expirations

Purchase is made in an RI holding account to simplify management

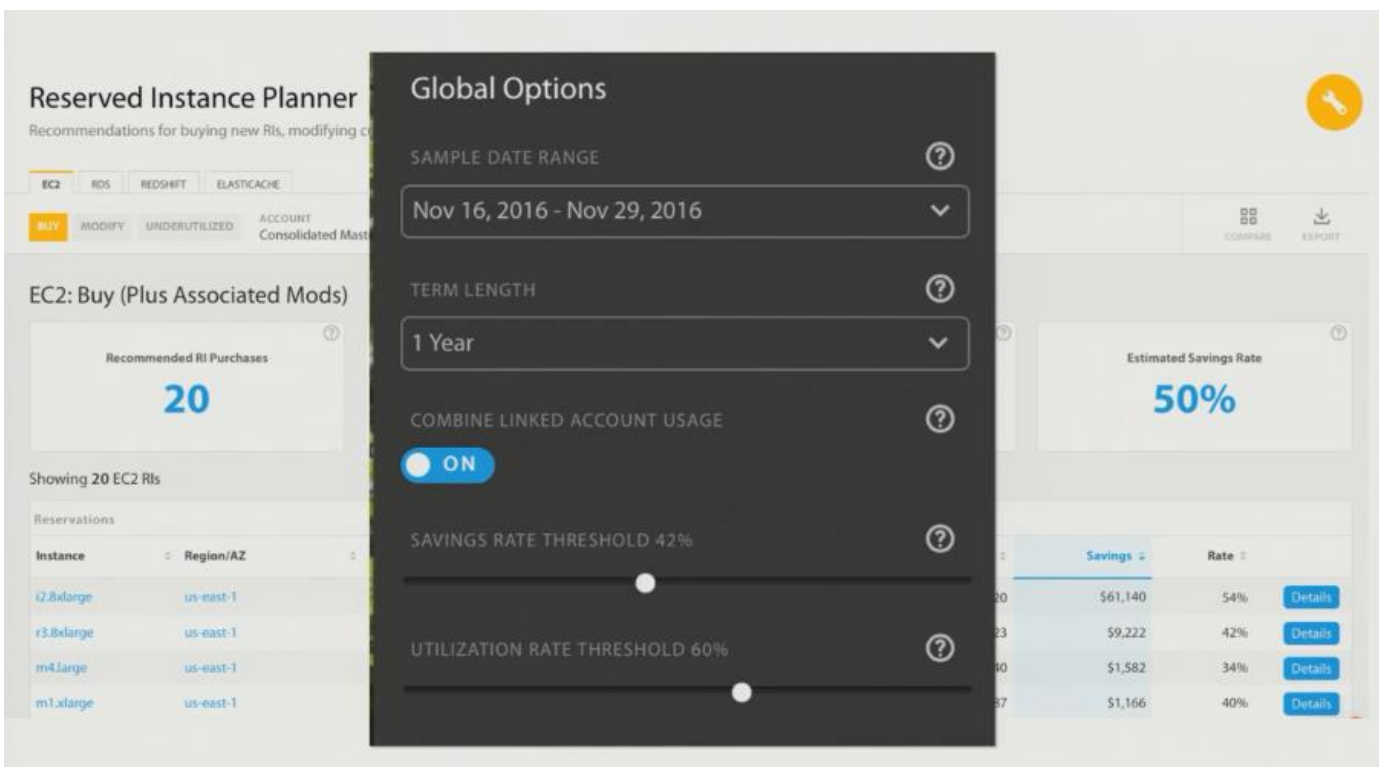
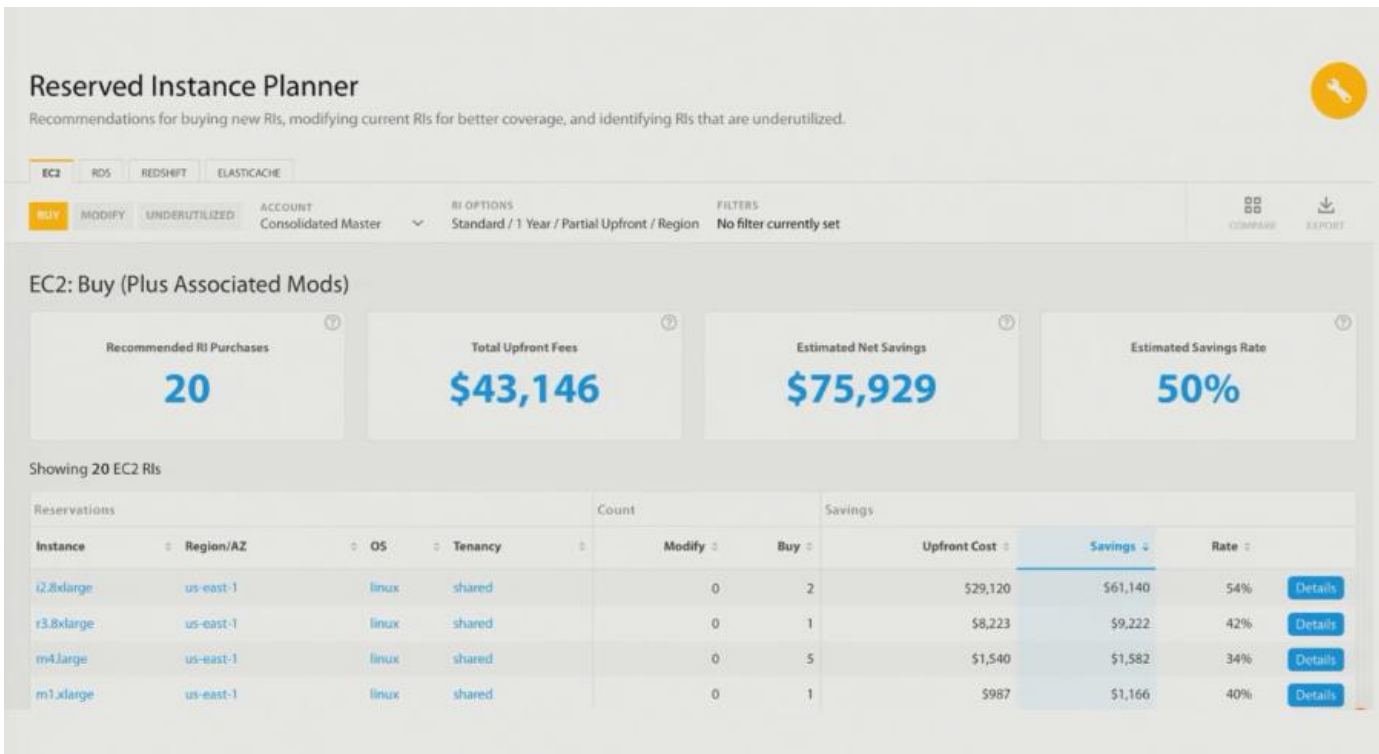
# Acme's new Reserved Instance Process



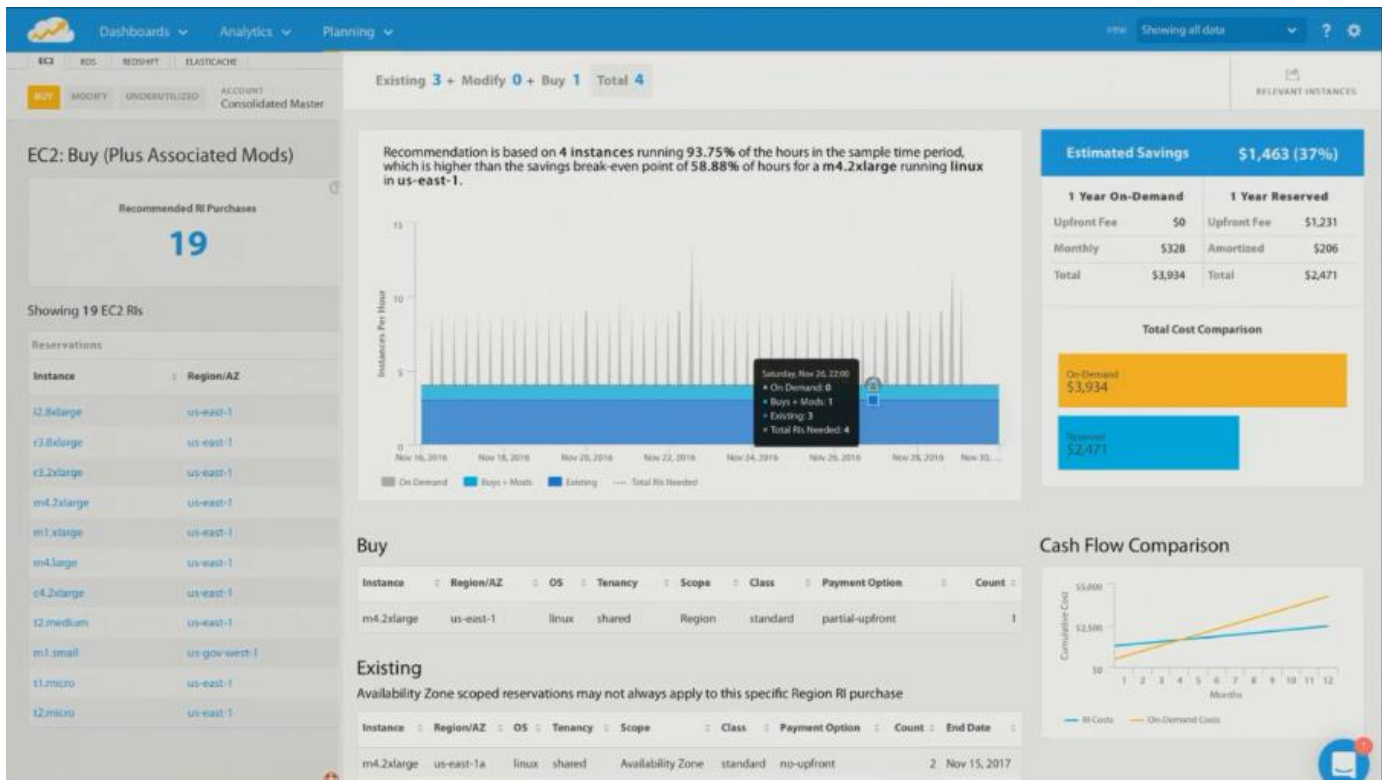
## RI management

### Buying Reserved Instances

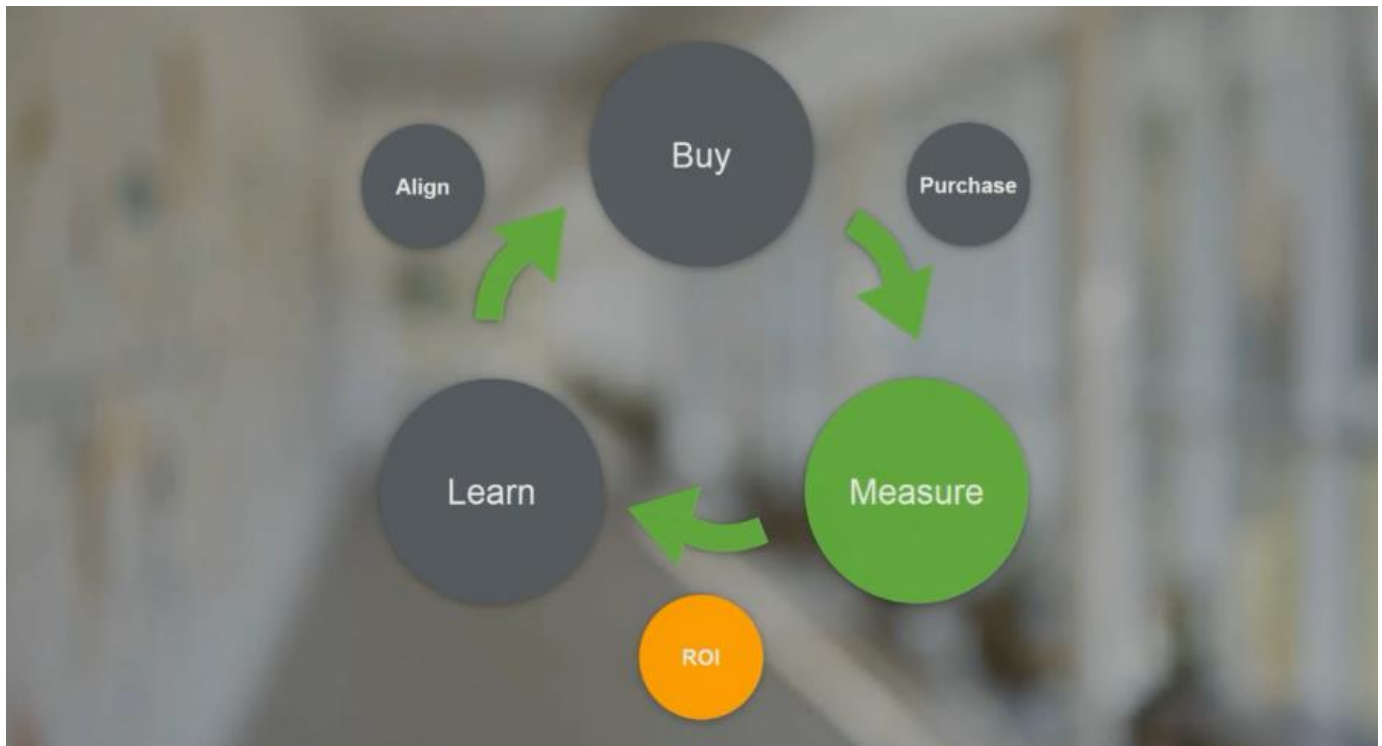
1. Walk before you run:  
First buy should be small and uncontroversial
2. Focus your budget on high confidence & savings purchases first
3. Use the right date ranges



Pick the most recent time frame that you want to purchase RIs for

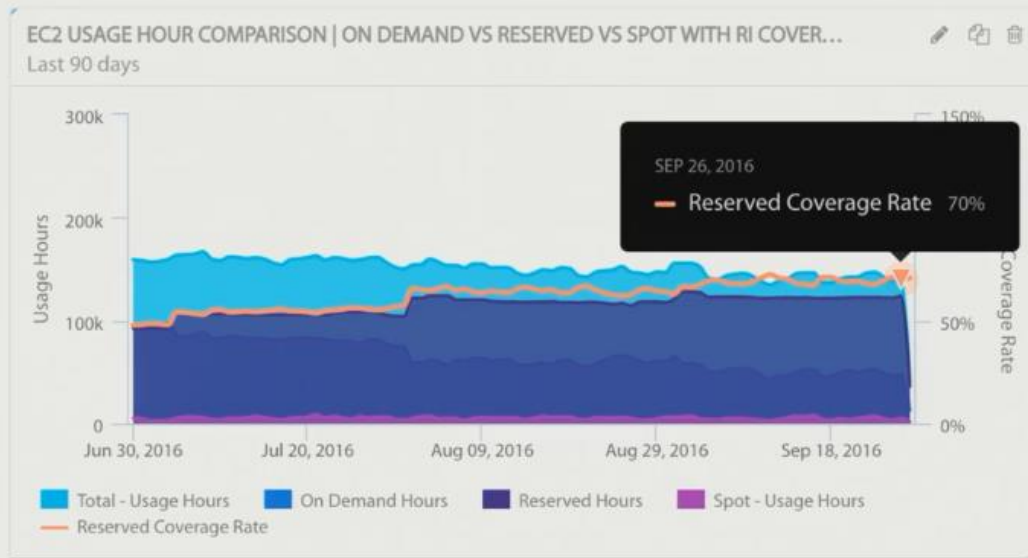


You can also do actual cash flow comparison to see where the breakeven point is as they continue to make RI purchases



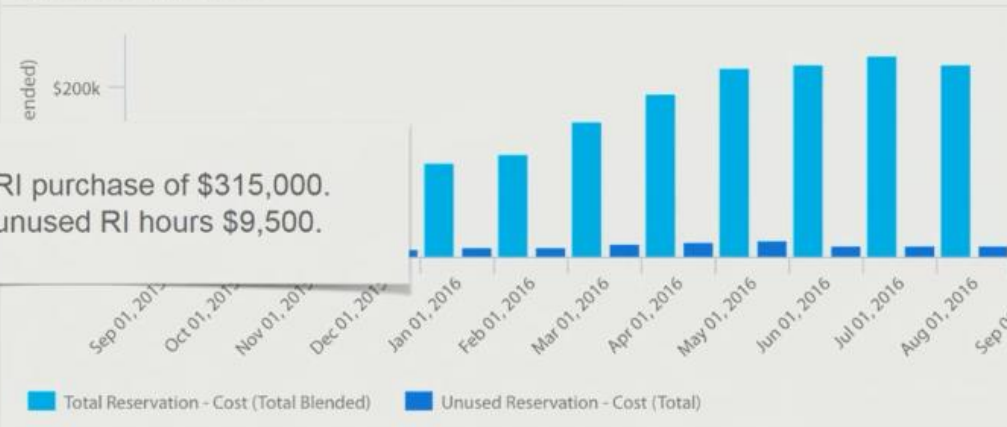


## Reserved Coverage should increase with each buy



## Keep Tabs on Unused Reserved Instance Hours

RI UTILIZATION | TREND OF TOTAL RI AND UNUSED RI COSTS (LAST 12 MONTHS)  
Sep 01, 2015 - Sep 30, 2016



### 12 Month Trend:

Average monthly RI purchase of \$315,000.

Average monthly unused RI hours \$9,500.

Mods automated

Month over month total spending on Reserved Instances vs.  
Unused Reserved Instance hours

## Unused hours are caused by underutilized Reserved Instances

### EC2: Underutilized

Showing 7 EC2 RIs

Reservations											Underutilized
Reservation ID	Account ID	Account Name	Instance	Region/AZ	OS	Class	Scope	Payment Option	Tenancy		Count
c58c1ec6-b69b-4bea-806c-	3382-734-	Production	m3.medium	us-east-1b	linux	standard	Availability Zone	no-upfront	shared		2
4cada7ad-0ba1-4f78-9dce-	3382-734-	Production	c3.8xlarge	us-east-1e	linux	standard	Availability Zone	no-upfront	shared		1
3d752646-97f9-42b2-92cc-	3382-734-	Production	r3.xlarge	us-east-1	linux	standard	Region	no-upfront	shared		1
21e69d01-2489-4590-86e7	3382-734-	Production	r3.large	us-east-1d	linux	standard	Availability Zone	no-upfront	shared		1
f127bd27-b2f1-43bb-a805-	3382-734-	Production	t2.micro	us-east-1a	linux	standard	Availability Zone	no-upfront	shared		1



Decrease unused Standard Reserved Instance hours by making ***“Modifications”***

Rightsizing with Standard Reserved Instances: in Linux, you can modify within a family...

## Understanding Reservations

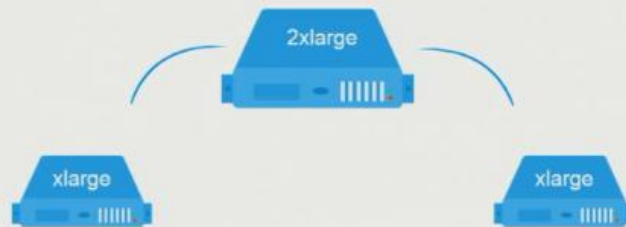
### Modifying Instance Type



A 2xlarge instance is worth 16points RI coupon, you can modify this into 2 different instances as below

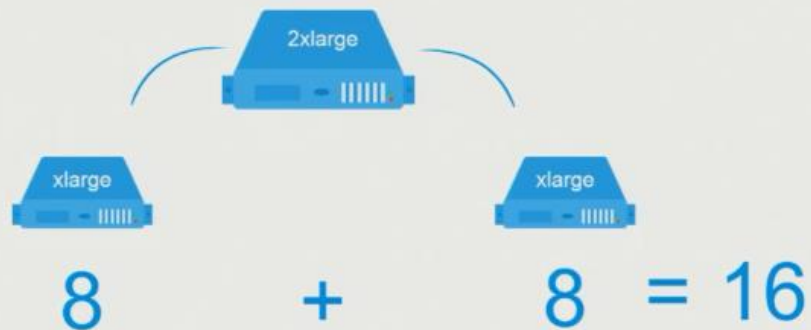
## Understanding Reservations

### Modifying Instance Type



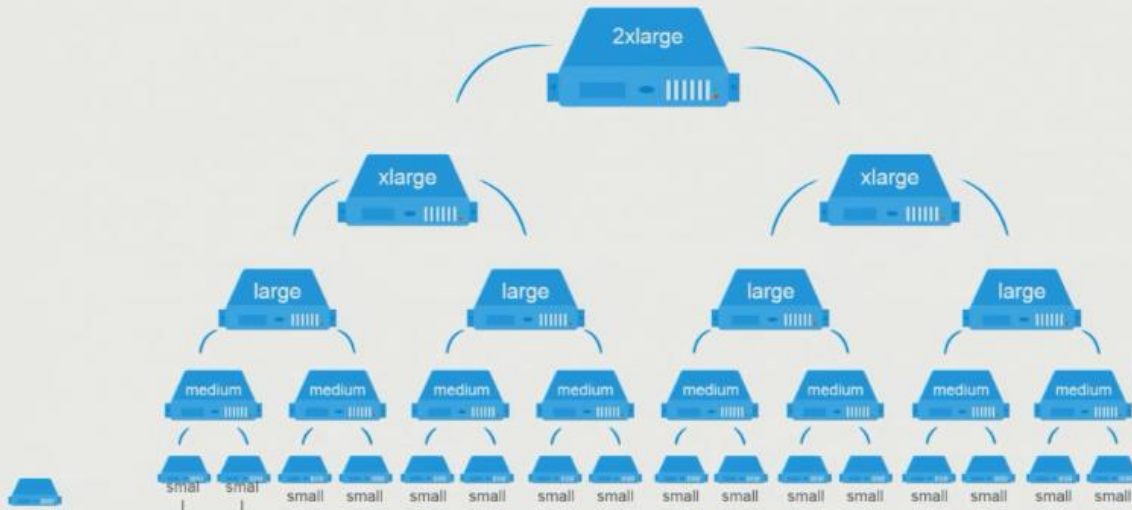
## Understanding Reservations

### Modifying Instance Type



## Understanding Reservations

### Modifying Instance Type



You can keep doing RI coupon modifications like this to change to their types on instances you will actually be needing, you can also automate this modifications request process to make it really easy to do.

## Modifications utilize underused reservations

Reservation Id: af111206-102f-4d2b-99bf-d5054a5da0d5

Account Name: AWS Standby (4090-2981-8598)  
Scope: Availability Zone

Underused  
Reserved Instances

Currently On-Demand

#### Original Reservation

Instance	Region/AZ	OS	Tenancy	Count	Units
t2.small	us-west-2a	linux	shared	2	2

#### 2 New Reservations

Instance	Region/AZ	OS	Tenancy	Count	Units
t2.small	us-west-2c	linux	shared	1	1
t2.small	us-west-2a	linux	shared	1	1

Reservation Id: ad8489be-dac8-4ae4-84a8-38c0416f6697

Account Name: Production (3382-7344-4847)  
Scope: Availability Zone

#### Original Reservation

Instance	Region/AZ	OS	Tenancy	Count	Units
r3.8xlarge	us-east-1b	linux	shared	1	64

#### 3 New Reservations

Instance	Region/AZ	OS	Tenancy	Count	Units
r3.2xlarge	us-east-1e	linux	shared	1	16
r3.4xlarge	us-east-1b	linux	shared	1	32
r3.2xlarge	us-east-1b	linux	shared	1	16

You can use modifications to cover things that you are presently running on-demand but you can use your unused RI coupons to cover for and save money.

## Automation

### Automating Reserved Instance Modifications - Set it and forget it



Cloudability API  
provides modification  
recommendations



Lambda function  
or Ruby gem



AWS APIs execute  
Reserved Instance  
Mods or Exchanges

Cloudability provides the Lambda function (or script), you keep the keys

The Cloudability APIs will give recommendations for what modifications you can make, then you can initiate the process using lambda functions that talk to the API. You get to keep the keys for your lambda functions for locking down access to your infrastructure and make things secure. You can set a frequency for automating the lambda function for requesting modifications on your behalf to daily, weekly, or monthly.

Decrease unused Convertible Reserved Instance hours by making "**Exchanges**"

The Convertible RIs use a different endpoint from the modifications RIs, you have a Quotes API where you can find out what coupons you can exchange a current RI coupon you own for, and an Exchanges API where you can do the actual exchanges.



## Think value involved, and not compute family

For example, if your Reserved Instance costs \$1000, at any time, you can convert it to another Reserved Instance that costs exactly or at least \$1000. If the cost is higher, then you “true up” the costs at the time of exchange.

3-Year Conv. RI	Year 1	Year 2	Year 3
	\$1000 for one RI #1		\$600 for RI #2 \$400 for RI #3

The catch:

- New Reserved Instance has to be of equal or greater value.
- You can exchange as many times as you want but you may end up increasing your commit over time.

Fast forward:  
Reserved coverage is...at 70+%!

They have now achieved the target 70% RI coverage

The bill still  
doesn't  
look right?!



- # It's accrual world.

**Accrual basis =**  
expense when *incurred*

## Reserved Instance on a Cash Basis

[illegible]

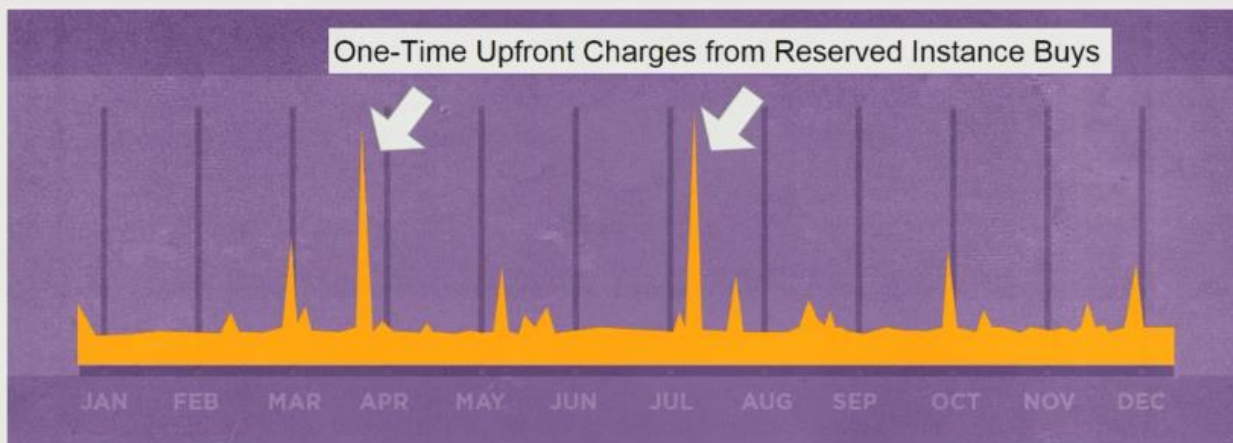
## Amortization

### Reserved Instance on an Accrual Basis



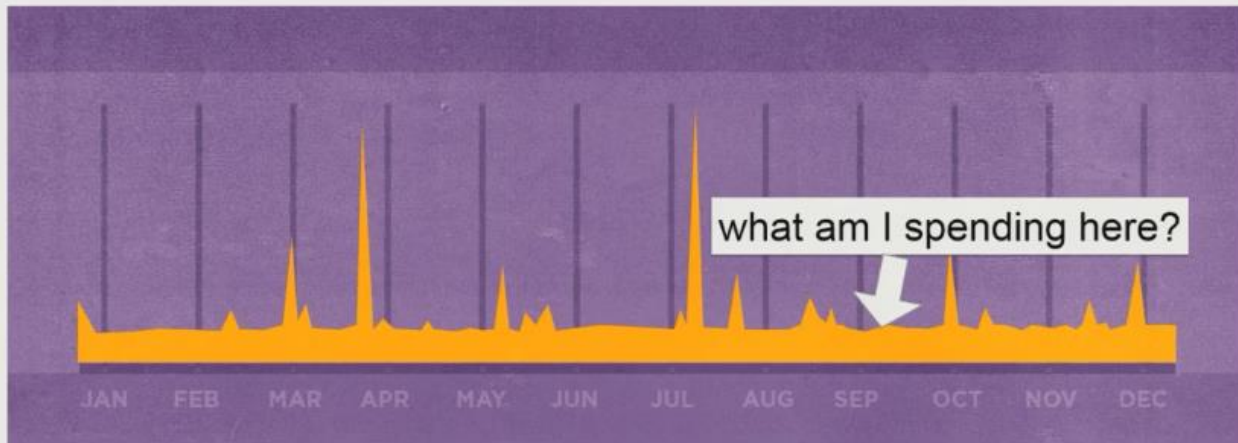
## Amortization

### Cash view of your spending from AWS



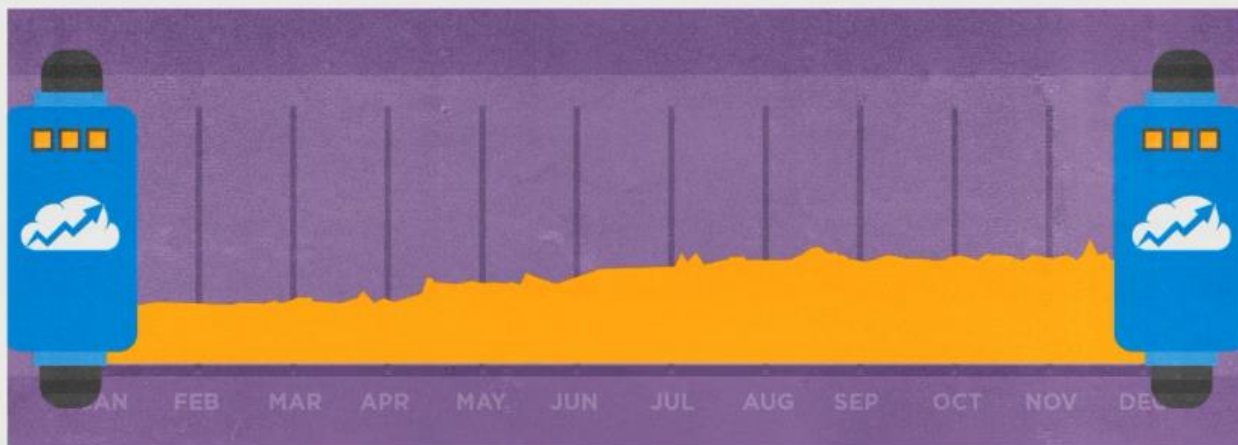
## Amortization

Wouldn't it be nice to know...



## Amortization

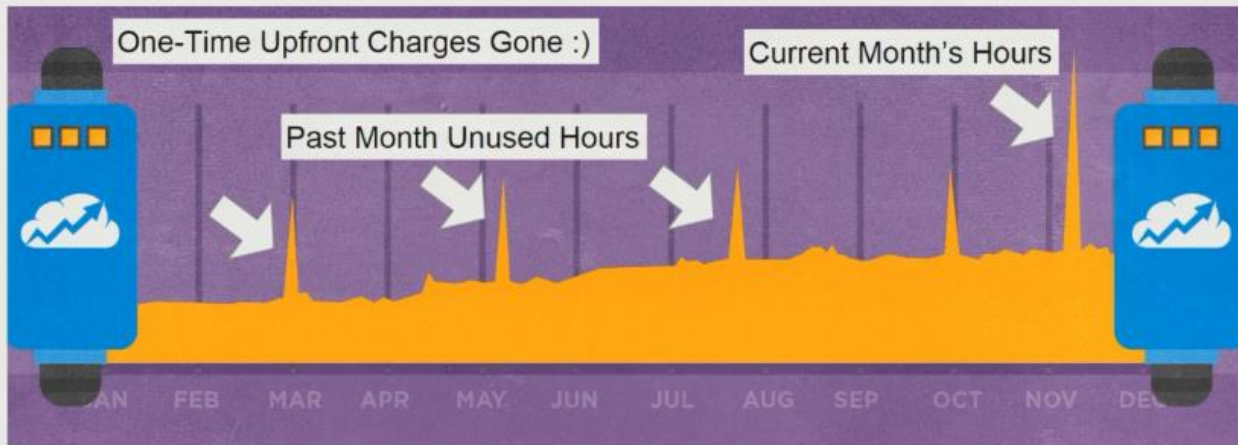
Your dream bill (but not necessarily accurate)





## Amortization

In reality, your daily amortized costs will look like this...



An amortized daily view of spending will show unused Reserved Instance hours from each month on the 1st. The current month will start high then burn down throughout the month as they are used.

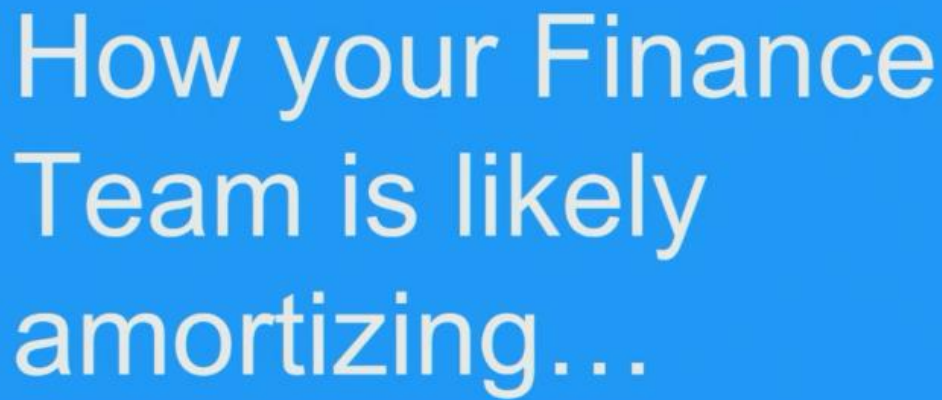
## Amortization

Why does amortization matter to tech folks?

1. Non-amortized reporting shows only a portion of what you spent
2. Your Finance team may amortize manually and will chargeback a higher amount than you expected
3. Amortized hourly rates shows how effective your Reserved Instance buys are and how much you are really paying per hour
4. Your VP may get amortized monthlies from Finance







An amortization 'waterfall': the numbers are 10% off

Simple—and **inaccurate**—amortization schedule spread evenly over 12 months

This is typically what a finance guy would do as they amortize the cost out over the days and month, but this is inaccurate due to modifications

## Amortization

### Challenge: The family tree of modifications

Reservation ID ca901a6d-bba1-44fb-8336

Modification requires a reallocation of 352 units based on the table below. This will result in 7 new reservations that will replace the original/current.

INSTANCE	AVAILABILITY_ZONE	BI TYPE	COUNT	UNITS
c3.4xlarge	us-east-1a	linux	11	352

INSTANCE	AVAILABILITY_ZONE	BI TYPE	COUNT	UNITS
c3.4xlarge	us-east-1a	linux	6	192
c3.4xlarge	us-east-1b	linux	2	64
c3.4xlarge	us-east-1d	linux	1	32
c3.2xlarge	us-east-1e	linux	1	16
c3.2xlarge	us-east-1d	linux	1	16
c3.2xlarge	us-east-1c	linux	1	16
c3.2xlarge	us-east-1a	linux	1	16

Modified Reserved Instances need to be re-amortized to be properly divided among the new target Reserved Instances

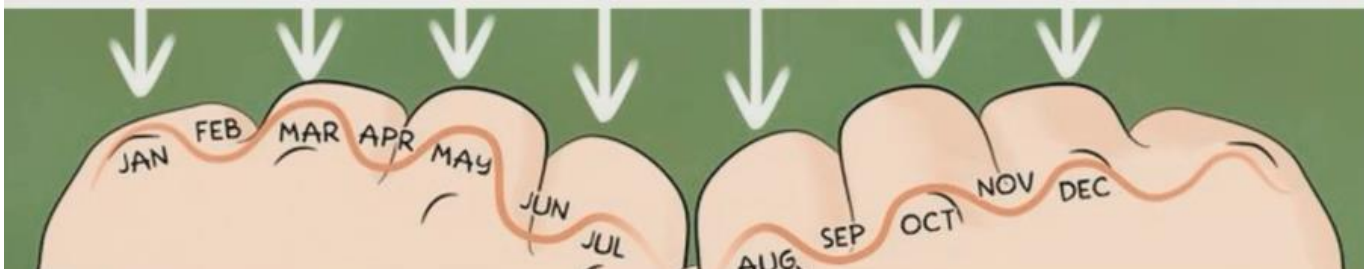
## Amortization

### Hourly amortization is critical

Amortization needs to be calculated at an hourly-level. A 1-year Reserved Instance is actually a purchase of 8760 reserved hours. So the math works out like this:

$$(\$ \text{ original upfront cost} / 8760 \text{ hours}) * N \text{ days in given month} * 24 \text{ hours}$$

31-day months will have different totals than 30-day months, as costs are spread evenly across the terms of each reservation.



## Amortization

# Reserved Instances stop/start on different days

Reserved Instances often start on different days of the month. You need to amortize just for the days the instance was active, not the entire month. See the increase on the 5th and the decreases on the 21st due to expirations:



## Amortization

# Some months have different number of hours

COST (AMORTIZED) \$  
**\$9,297.47**

Customize this report to add up to 10 dimensions and 10 metrics

[Customize Report](#)

RESERVATION ID	MONTH	INSTANCE TYPE	OPERATING SYSTEM	AVAILABILITY ZONE	COST (AMORTIZED)
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	1	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	2	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$740.22
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	3	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	4	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$765.75
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	5	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	6	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$765.75
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	7	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	8	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	9	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$765.75
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	10	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	11	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$721.08
<input type="checkbox"/> 88395821-54c6-4d53-af01-1	12	c3.8xlarge	Red Hat Enterprise Linux	us-west-2b	\$791.27

What you ultimately want to end up with is a view like this, this is drilled down to just individual reservations in each month and their costs

## Reserved Instance Review

Stay on top of your purchases

Reservation Portfolio

ACCOUNT	RESERVATION ID	RESERVATION TYPE	INSTANCE TYPE	AVAILABILITY ZONE	OS	TERM	INSTANCE COUNT	START DATE	END DATE
2-8521-	c382afdd-9478-8f3468b92b8	All Upfront	r3.2xlarge	us-west-2a	Windows	1Y	1		
2-8521-	7f33ee1f-b337-06ac1504c327	All Upfront	r3.4xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
2-8521-	e78b3e35-5a41-7e0272f2f0e8	All Upfront	i2.2xlarge	us-west-2a	Linux/UNIX	1Y	1		
1-1522-	bc9455aa-cad0-d8d5bdc5e4b	All Upfront	c3.2xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
1-1522-	b97d5794-7cc7-934bd9b3c440	All Upfront	c3.4xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
1-12-	2666f10-bd49-786213d315fd	All Upfront	i2.4xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
1-	7d2f5f85-d03b-a604da4315fd	All Upfront	r3.8xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
1-3522-	8a60b862-7971-e7db8133213b	All Upfront	d2.8xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
1-3522-	ab597590-4097-4039-ada2-8eacc88062fe	All Upfront	d2.8xlarge	us-west-2a	Red Hat Enterprise Linux	1Y	1		
2-8521-									

Reserved Instances Subscription

EXPIRES WITHIN: 7 Days

SEND: Monthly

30 am

SEND EVEN IF THERE IS NO CONTENT

Filter Reservations

End Date

equals

Feb 20, 2016

Cancel Submit

Stay on top of the RI expirations and plan ahead for more buys to replace the RIs you will need in future

## Things to remember (and do) after re:Invent

Drink lots of water.

- 1) **Reserved Instances are frequently misunderstood:** Train everyone on the fundamentals.
- 2) **Reserved Instance coverage changes constantly:** Start tracking your Reserved Coverage Rate and Unused Reserved Instance Hours closely.
- 3) **Don't forget standard RI Modifications:** Make modifications to maximize use of Standard Reserved Instances (easy) when your infrastructure changes. Be careful with Convertible "exchanges", you may need to up your commit.
- 4) **It's easy to get distracted:** Appoint an Reserved Instance Czar then schedule ongoing Reserved Instance management tasks to ensure they happen.
- 5) **Start and manage iteratively:** Make small, uncontroversial purchases with future modification in mind to keep up with infrastructure changes.

My contact: [jr@cloudability.com](mailto:jr@cloudability.com), Meet us in booth #1821!

@cloudability