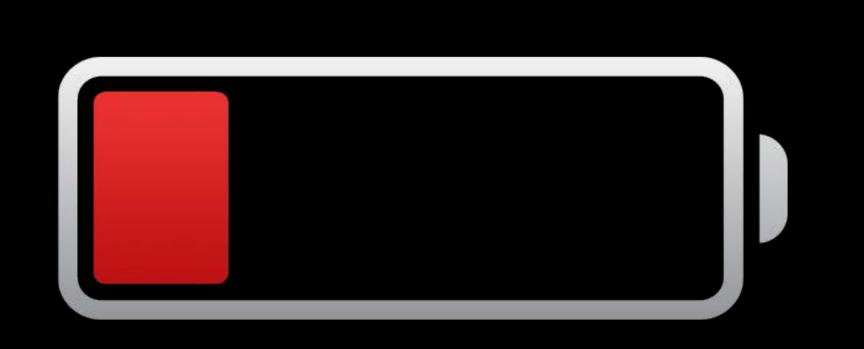
Debugging Energy Issues

Session 708

Abhinav Pathak iOS Power Team Pai-Han Huang iOS Power Team



Survey finds battery life is most important for iPhone owners

Luke Dormehl (4:10 am PDT, May 13th 2014)



GIZMODO

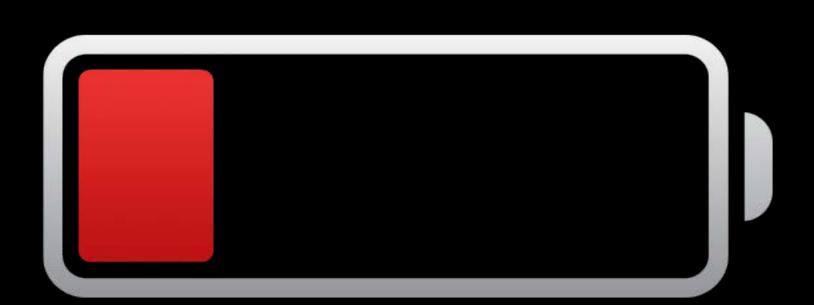
Battery Life Is the Only Spec That Matters





J.D. POWER: CONSUMERS MOST DISSATISFIED WITH SMARTPHONE BATTERY LIFE

By Jeff Saginor — March 15, 2012







		Activity	Monitor (Application	s in last 8	3 hours)		
8	⊕ * ~	CPU	Memory Energy	Disk	Network	Q Searc	h
App N	ame	Energy Impact	Avg Energy Impact ~	App Nap	Requires High Perf	Preventing Sleep	User
9	iTunes	9.9	2.40	No	No	Yes	John
4	Activity Monitor	4.0	2.24	No	No	No	John
0	Spotlight	0.0	1.86	8.	¥		John
	Photo Booth	0.0	0.64	Yes	No	No	John
▶ 🙆	App Store	0.0	0.54	Yes	No	No	John
-	Numbers	0.0	0.54	Yes	No	No	John
▶ 76	iPhoto	0.2	0.34	No	Yes	No	John
	Mail	0.0	0.23	Yes	No	No	John
	Messages	0.0	0.21	No	No	No	John
▶ 🕢	Safari	0.0	0.19	No	No	No	John
2	Maps	0.0	0.18	Yes	No	No	John
	Contacts	0.0	0.16	Yes	No	No	John
100	Disk Utility	-	0.14	-	9	- 2	John
	FaceTime	0.0	0.13	No	No	No	John
17	Calendar	0.0	0.12	Yes	No	No	John
	iCloud Photos	0.0	0.12	-	<u> </u>	1.5	John
■	iBooks	0.0	0.11	No	No	No	John

E	NERGY IMPACT	Graphics Card:	High Perf.	BATTERY (Last 12 hours)
		Remaining charge:	13%	
	A.	Time remaining:	0:38	
1	1 m /	Time on battery:	0:15	

•••••	∻	9:41 AM	100%			
< Set	tings	Battery				
BATTERY USAGE						
La	ast 24 Hours	Last 7 Days				
	Safari		21%			
f	Facebook		17%			
	Phone		14%			
	Mail Background Activi	ty	13%			
280	Maps Location		11%			
P	Pandora _{Audio}		9%			
	Messages		6%			
	Photos AirPlay		4%			
A	App Store		2%			
	Weather Background Activi	ty	2%			
	Calendar		1%			
	proportion of bat iPhone was not ch	tery used by each apparent	р			



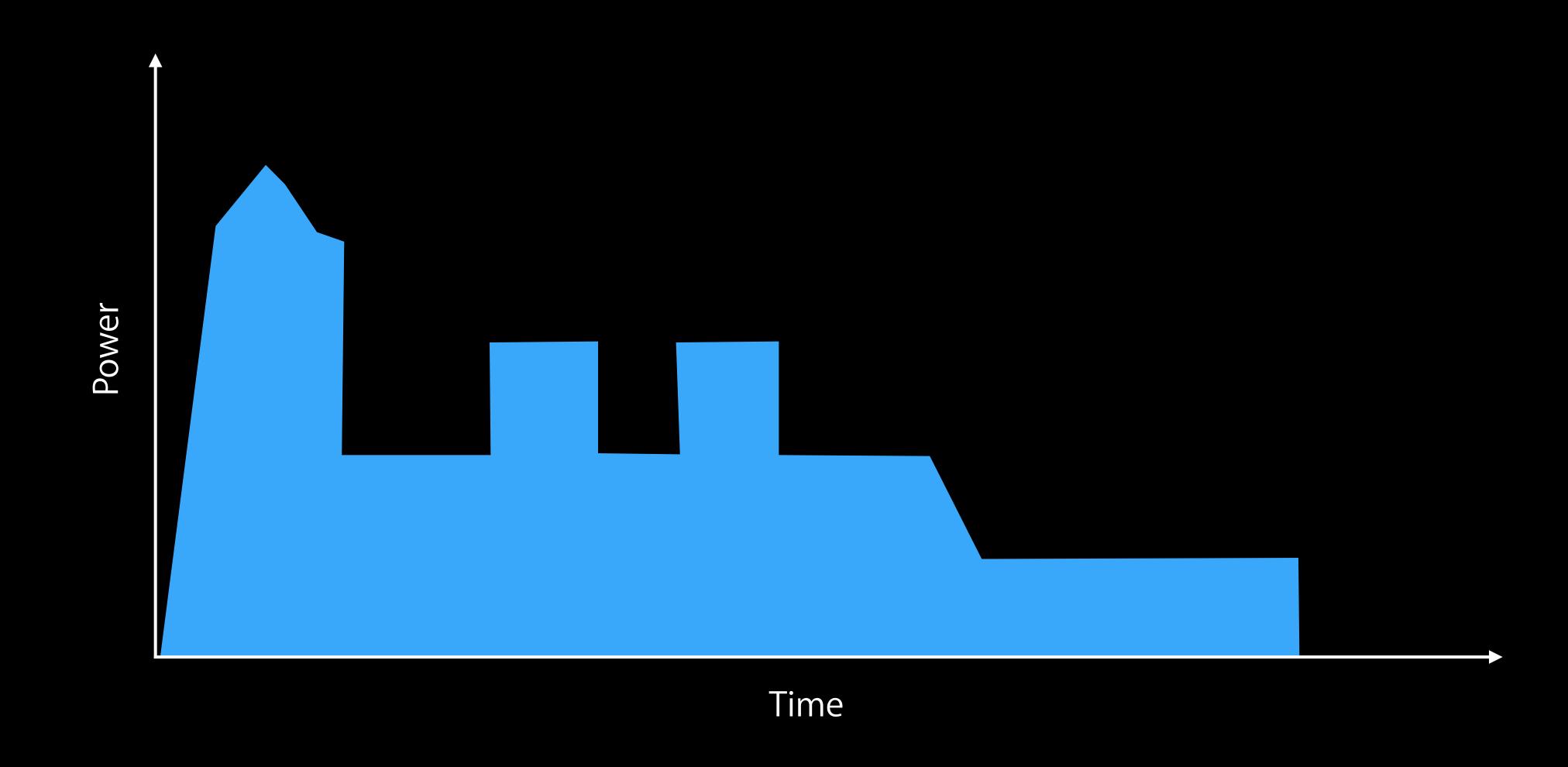




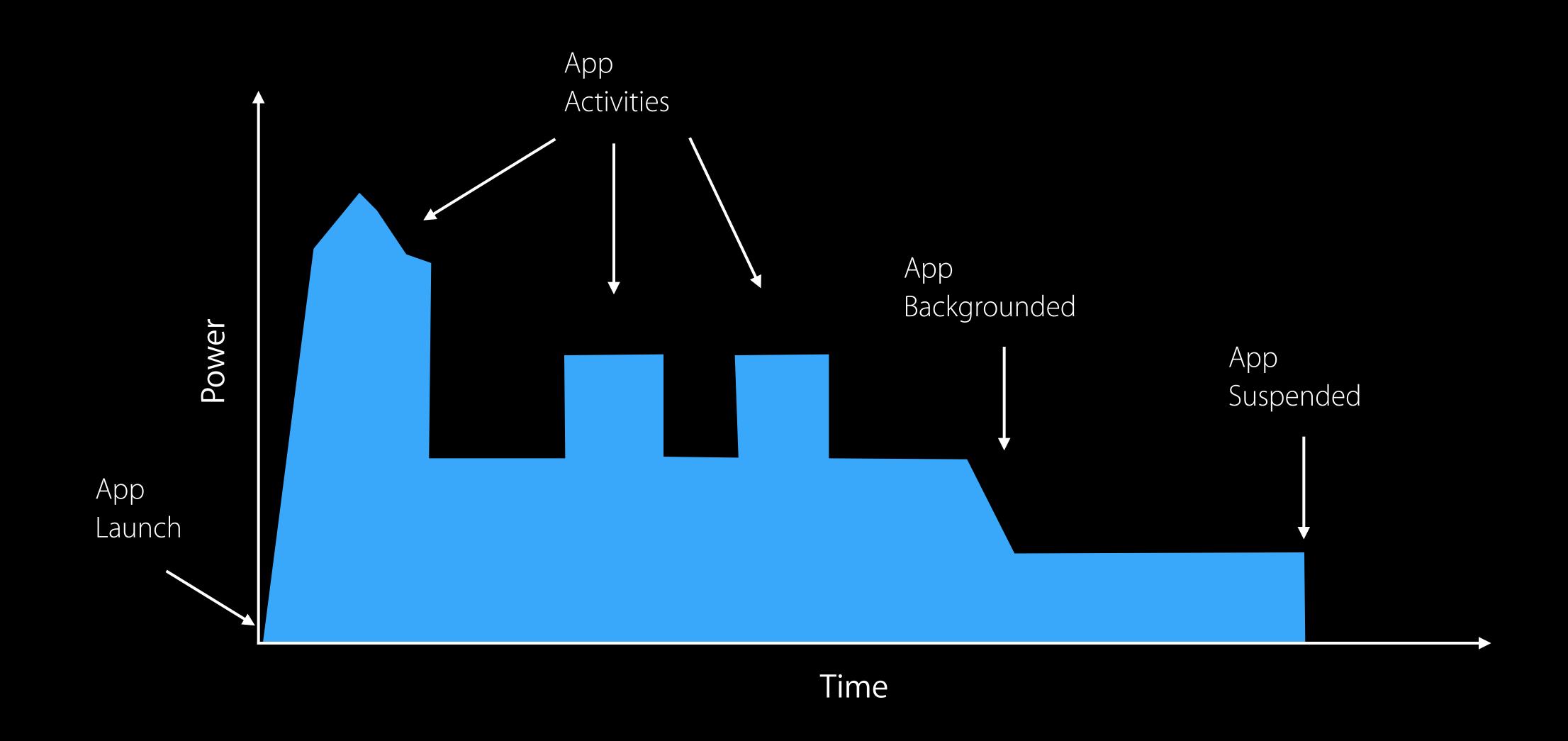
•••••	9:41 AM	100%
Set	ttings Battery	
BATTI	ERY USAGE	
L	ast 24 Hours Last 7 Days	
	Safari 52 min on screen — 1 min background	21%
f	Facebook 38 min on screen — 3 min background	17%
	Phone 20 min on screen	14%
	Mail 31 min on screen — 12 min background	13%
280	Maps 12 min on screen	11%
P	Pandora 2 min on screen — 51 min background	9%
	Messages 18 min on screen — 1 min background	6%
	Photos 10 min on screen	4%
A	App Store 5 min on screen — 1 min background	2%
	Weather 3 min on screen — 5 min background	2%
	Calendar 2 min on screen	1%
	s proportion of battery used by each a iPhone was not charging.	рр

- (1) Energy Fundamentals and Best Practices
- (2) Energy Debugging Workflow and Tools
- (3) Demo: Fixing Energy Issues on iOS
- (4) Final Thoughts

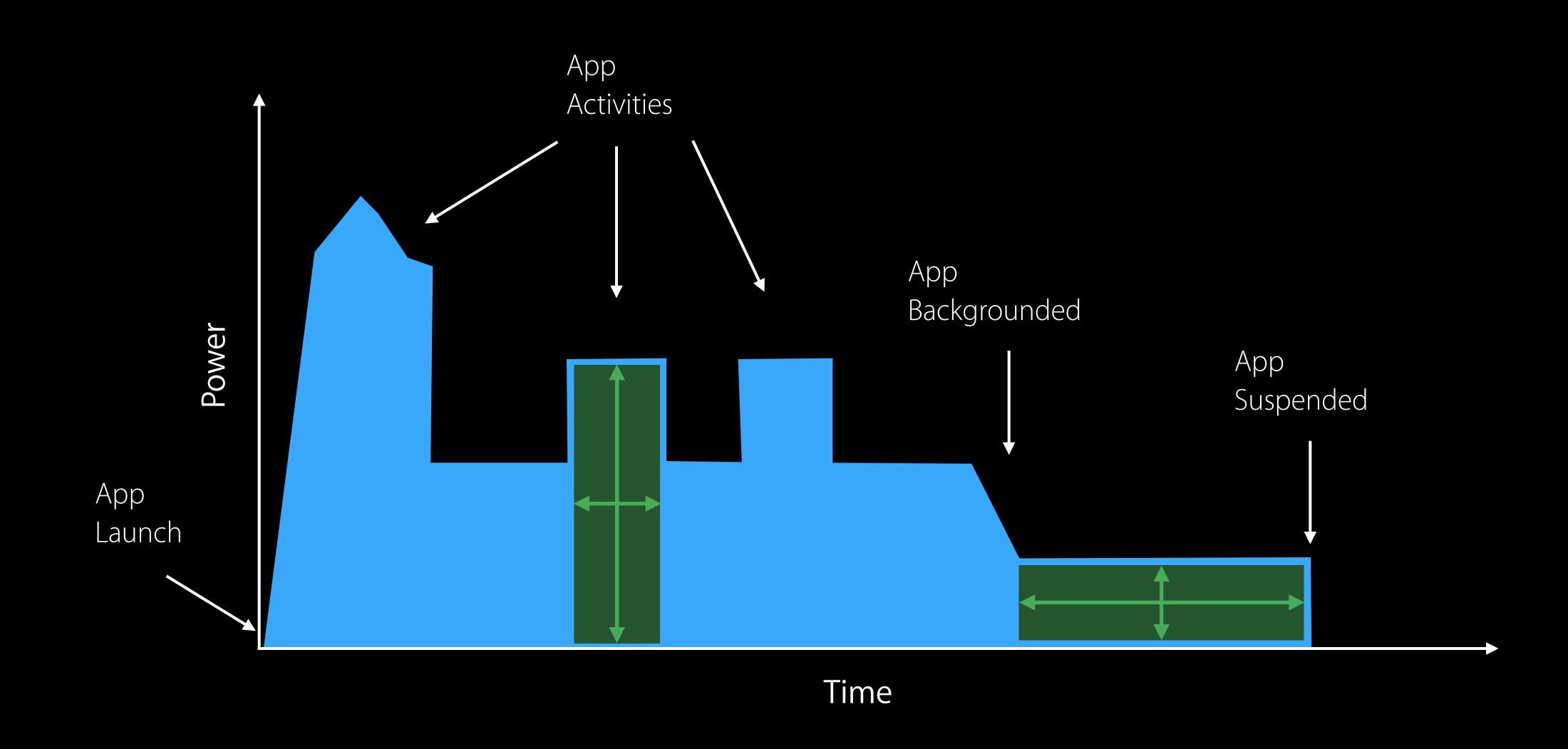
Energy = power * time



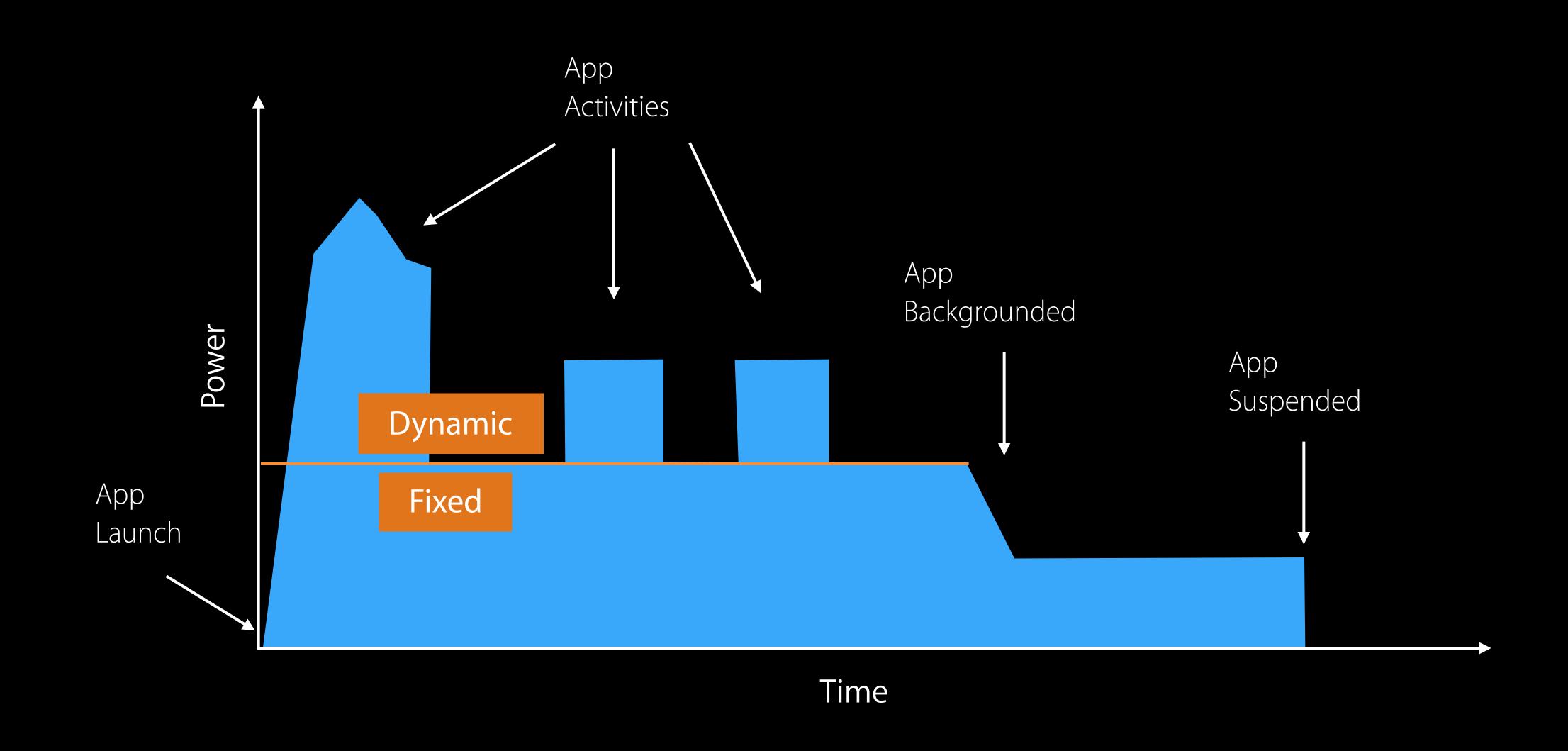
Energy = power * time



Energy = power * time



Minimizing overhead cost



Reducing Energy Use

What it comes down to...

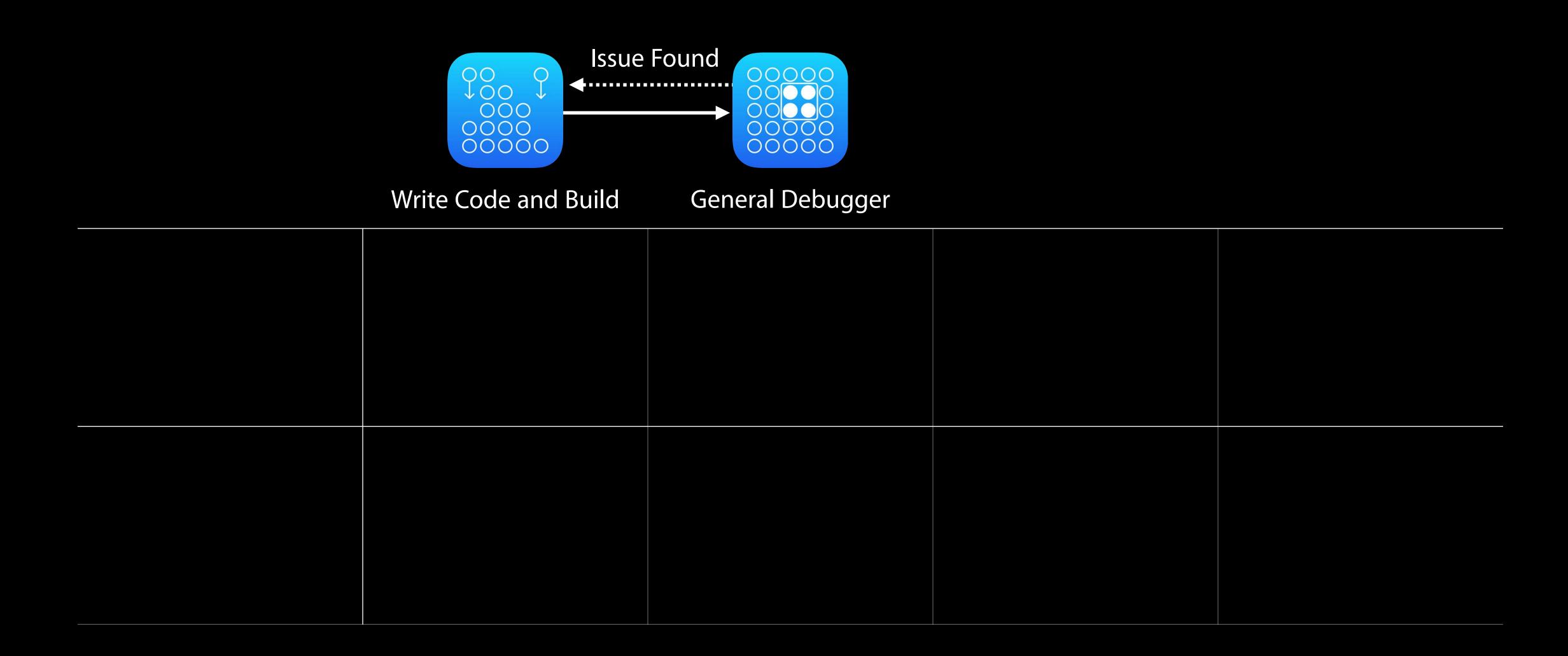
Do it never/do it less

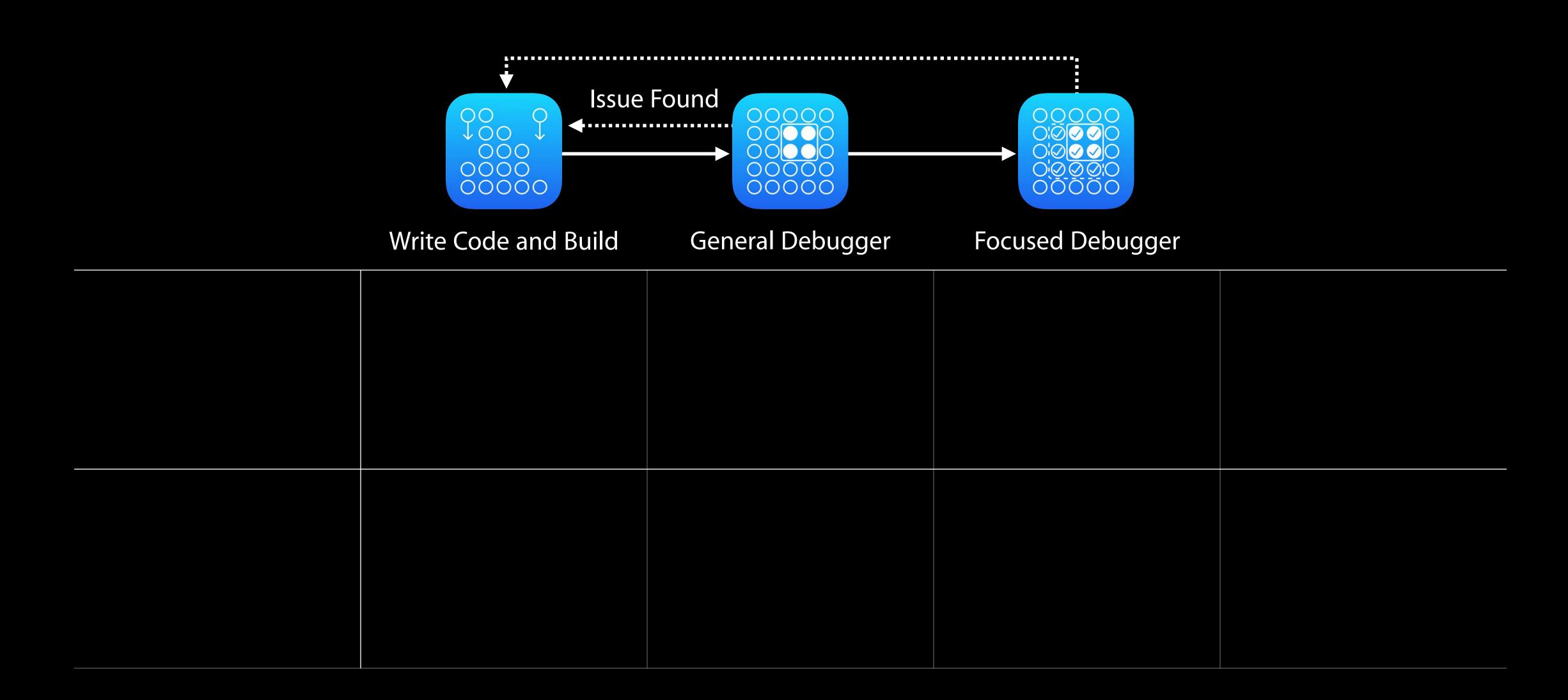
Do it at a better time

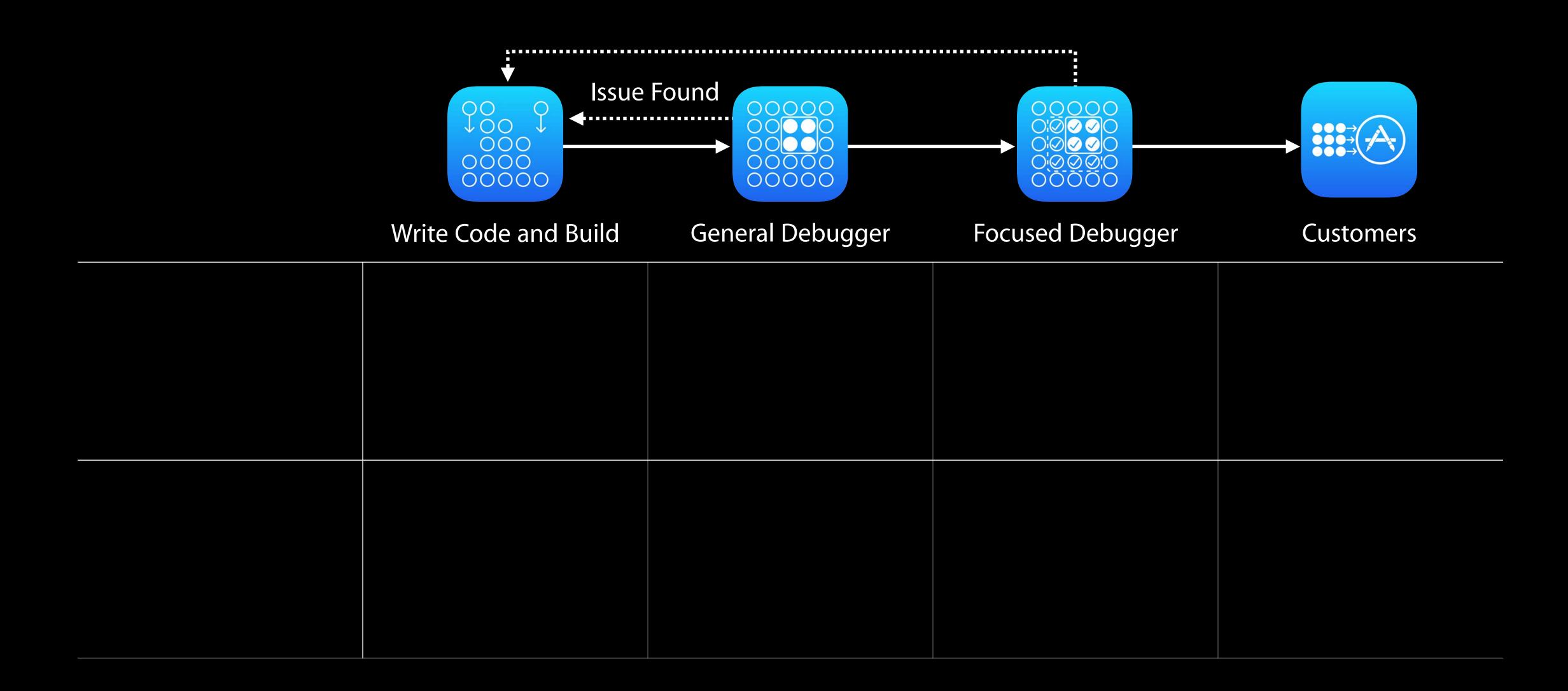
Do it efficiently

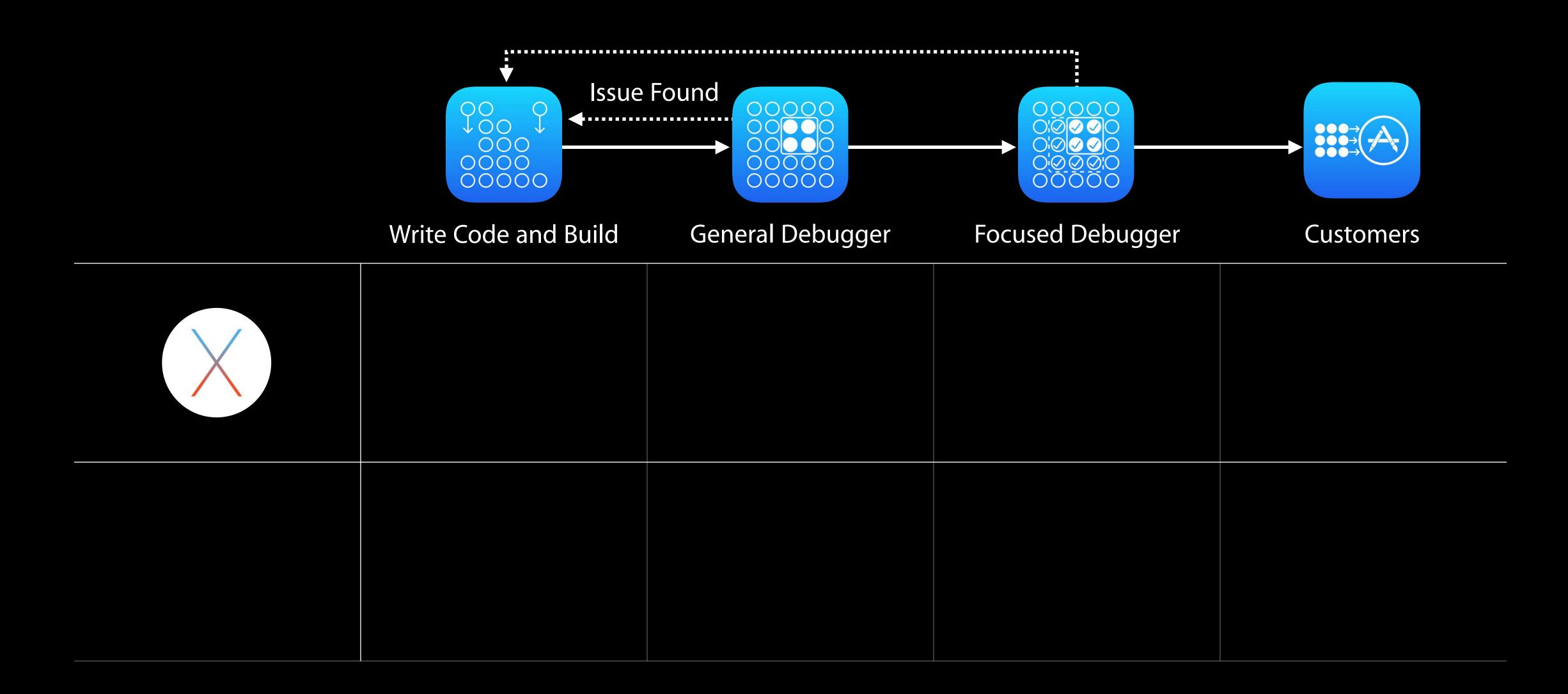
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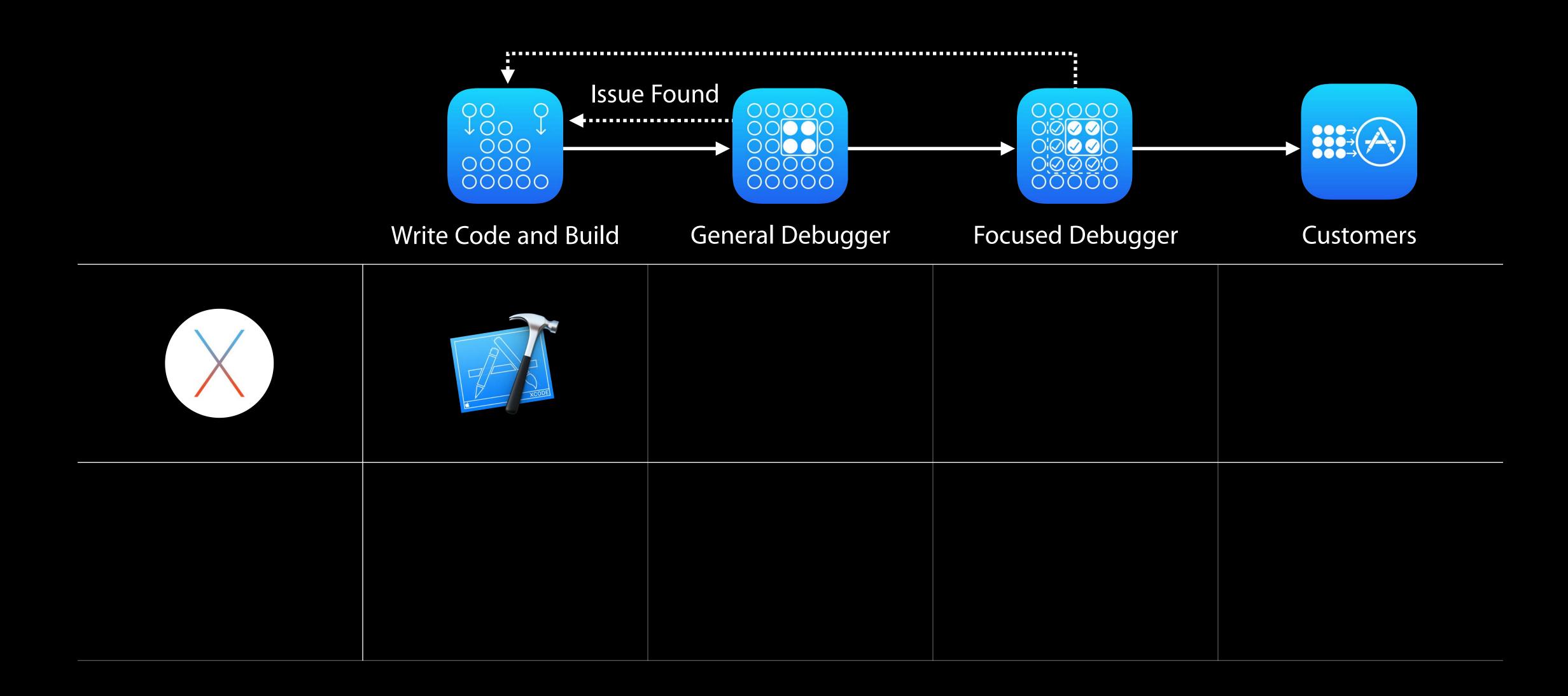


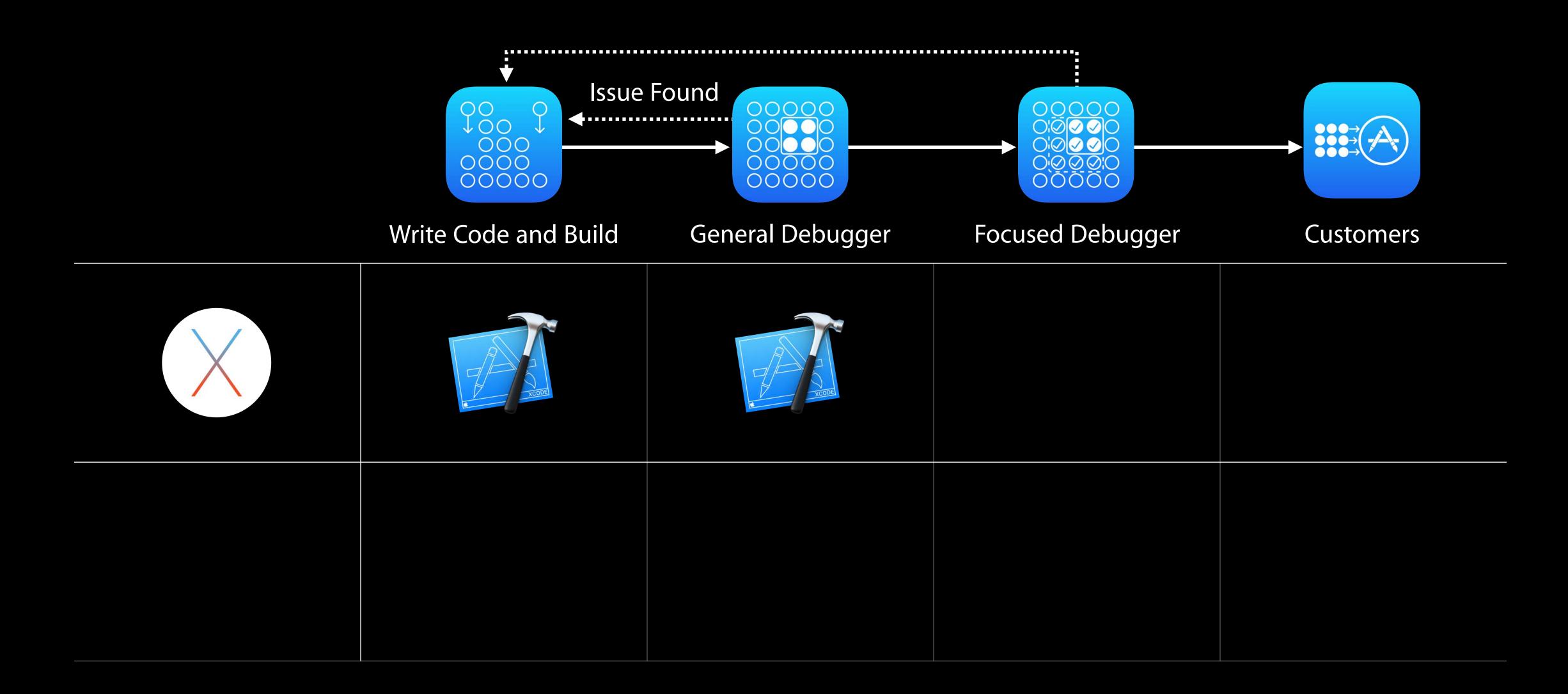


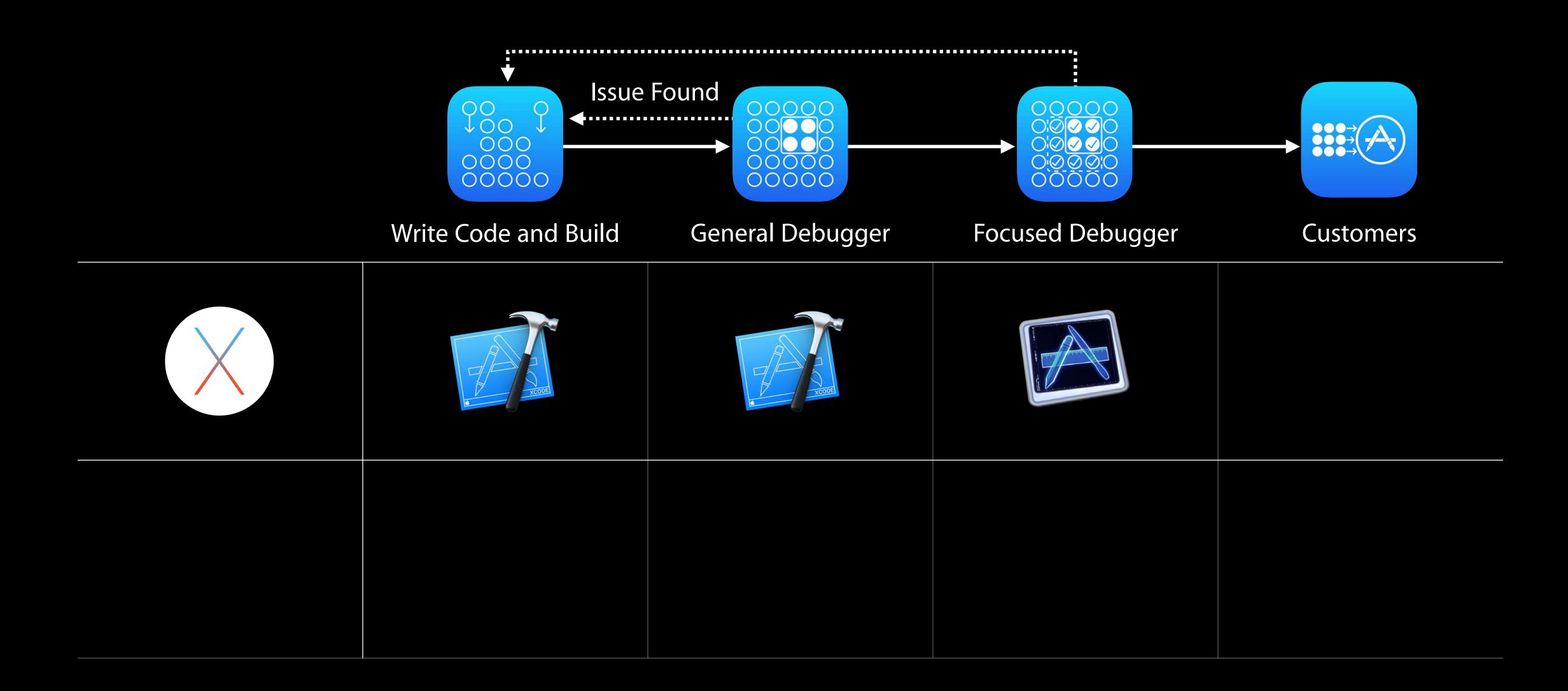


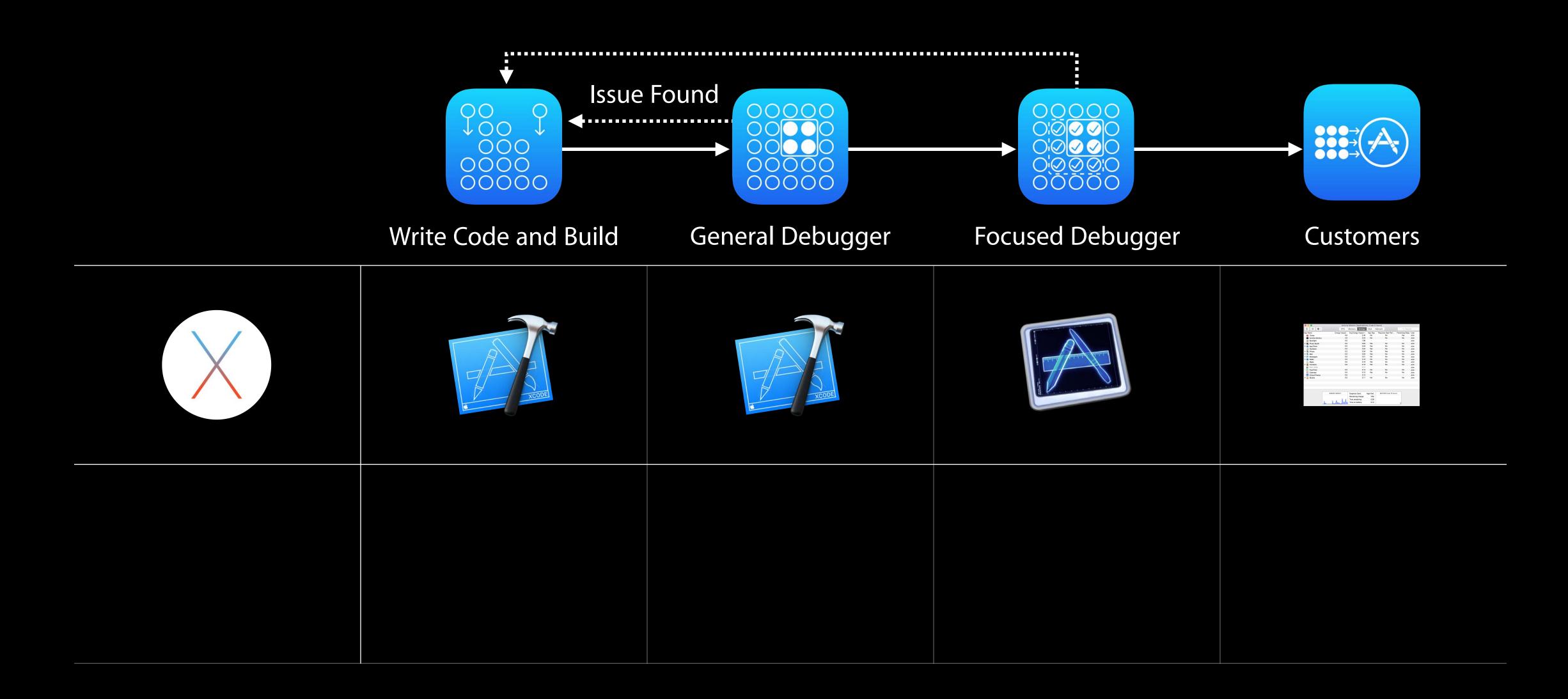








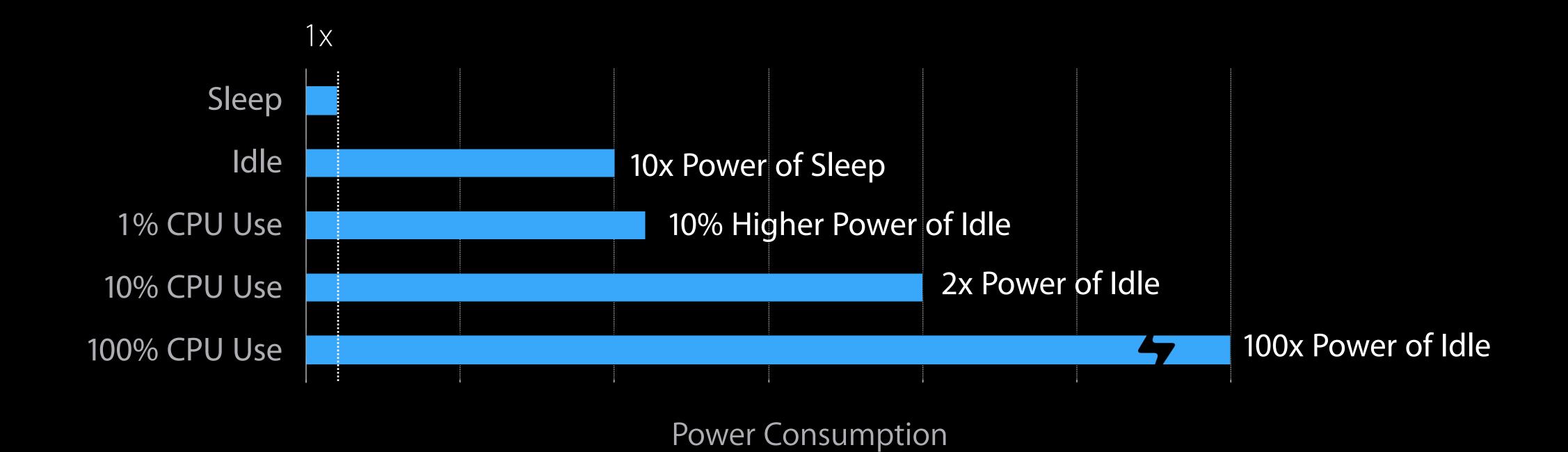




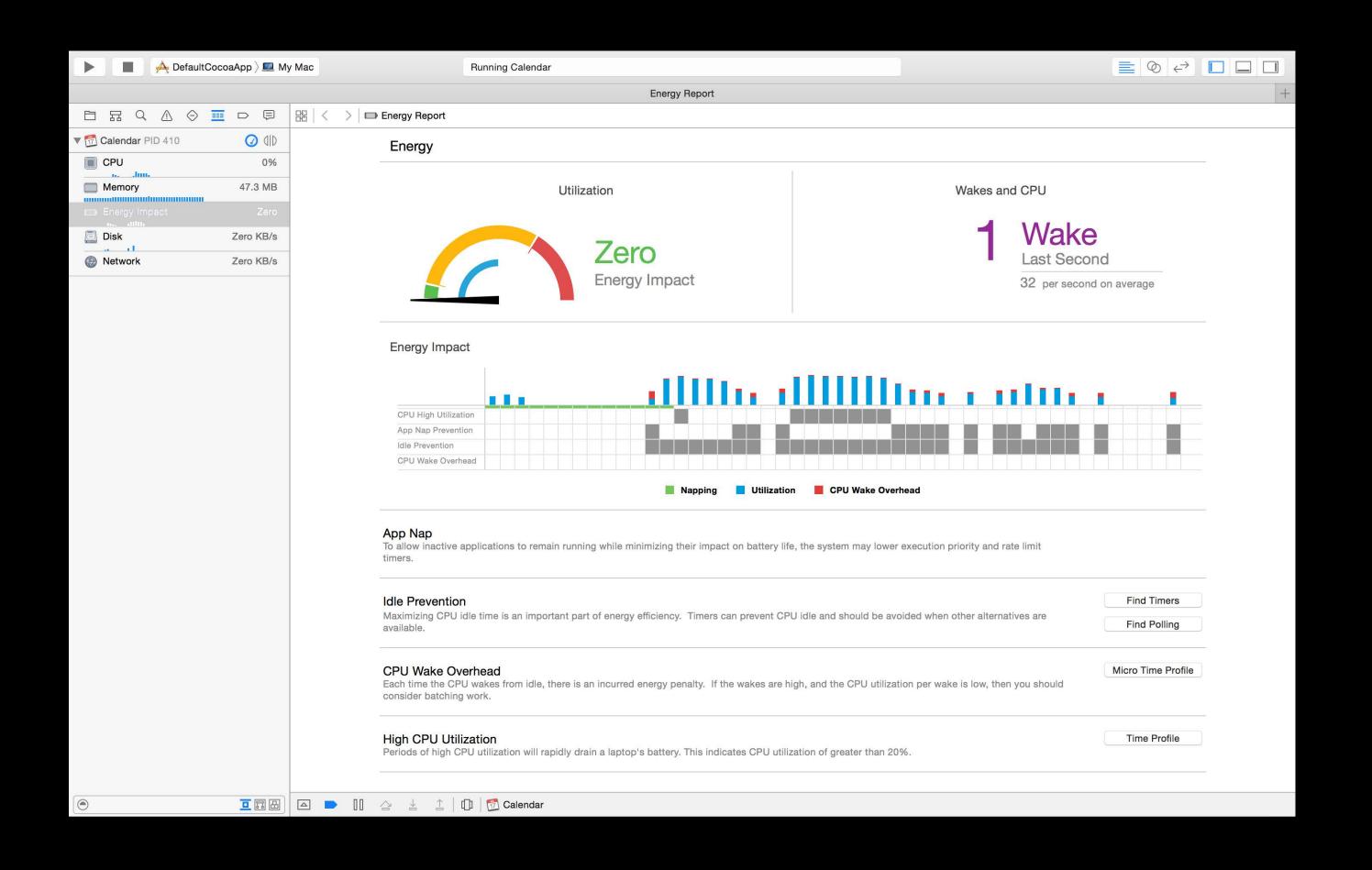
Energy Debugging Priorities on OS X

Priorities on OS X are CPU and GPU

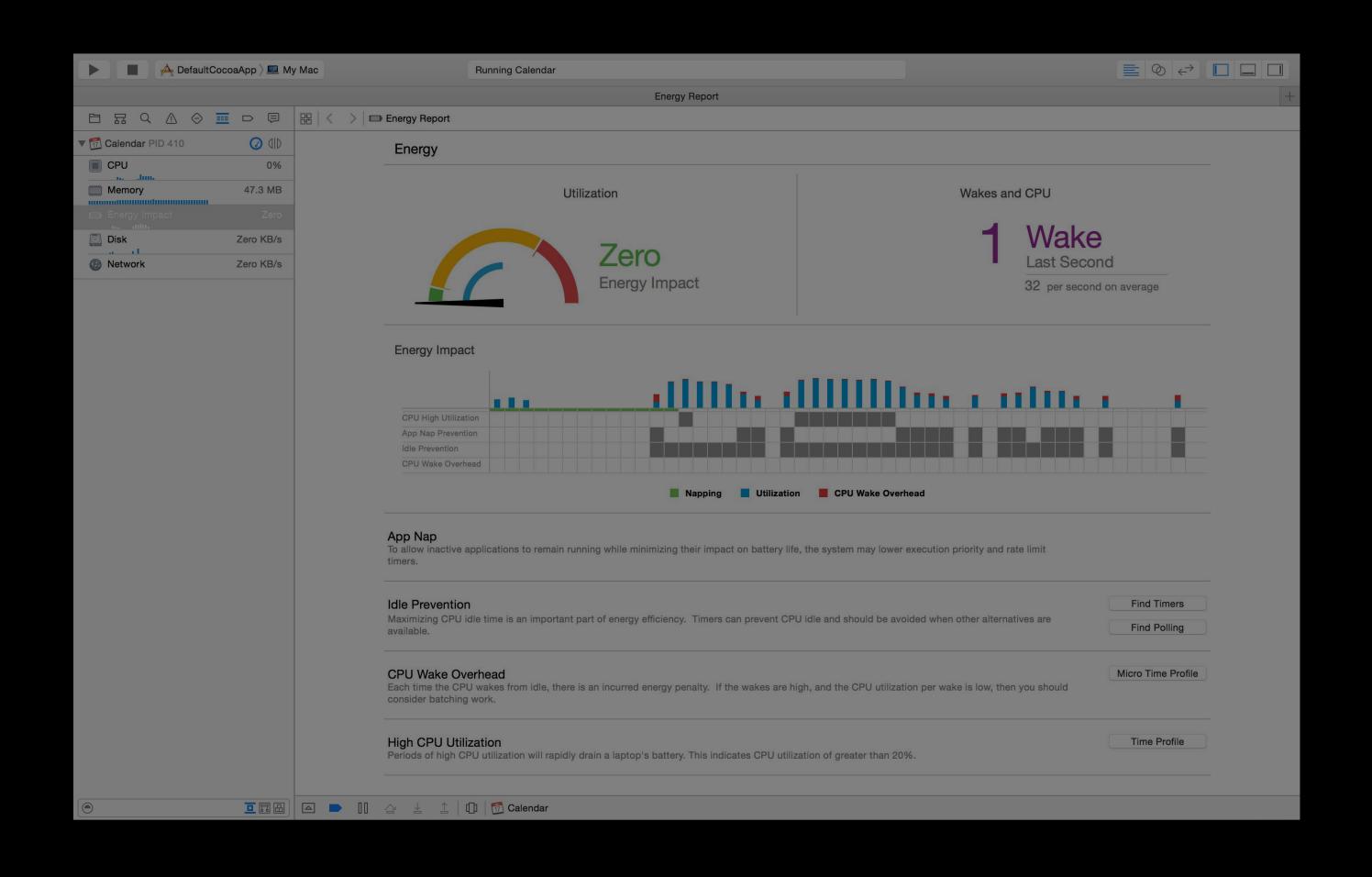
High fixed cost: let giant compute units rest! (sleep)



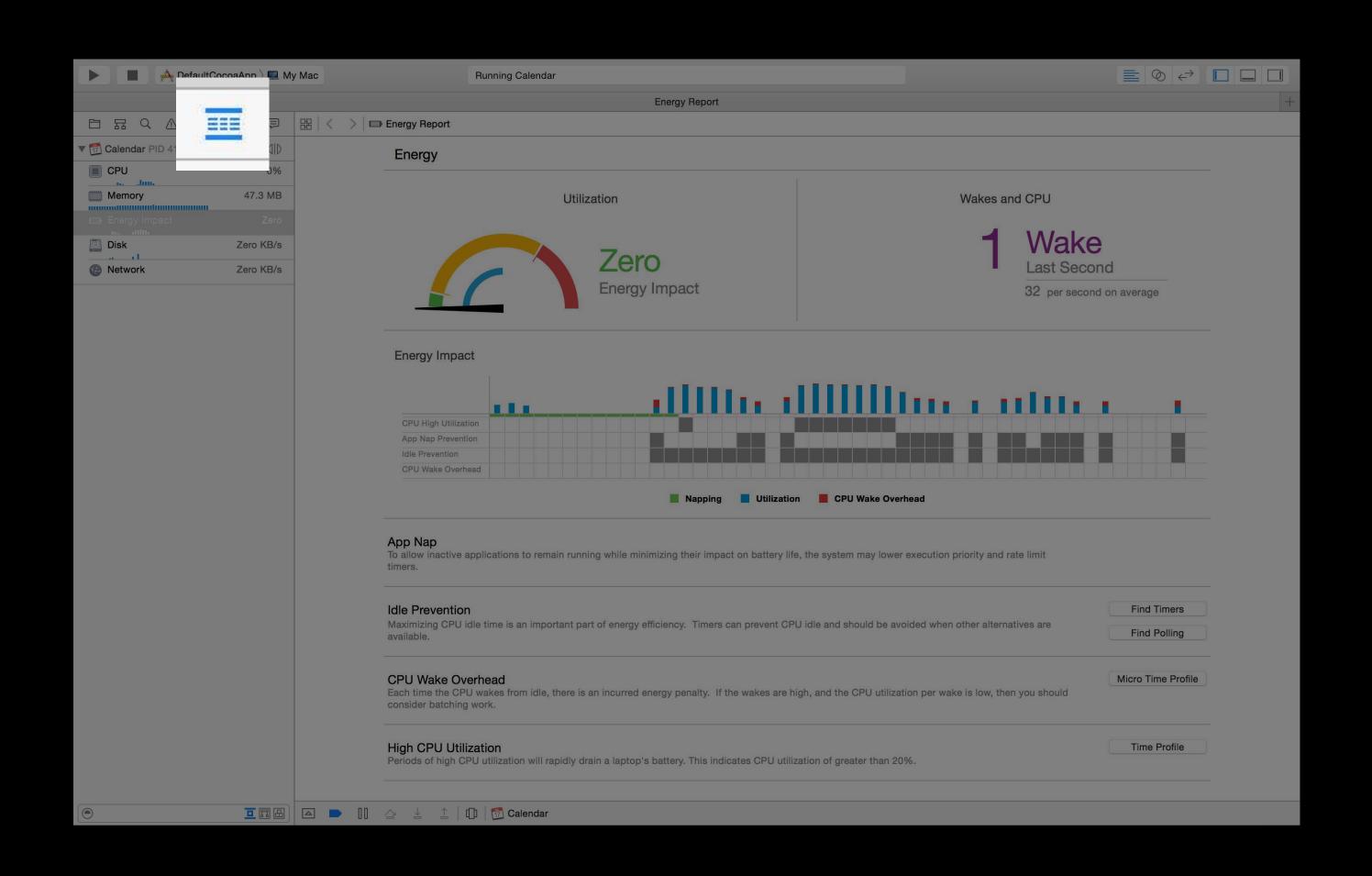




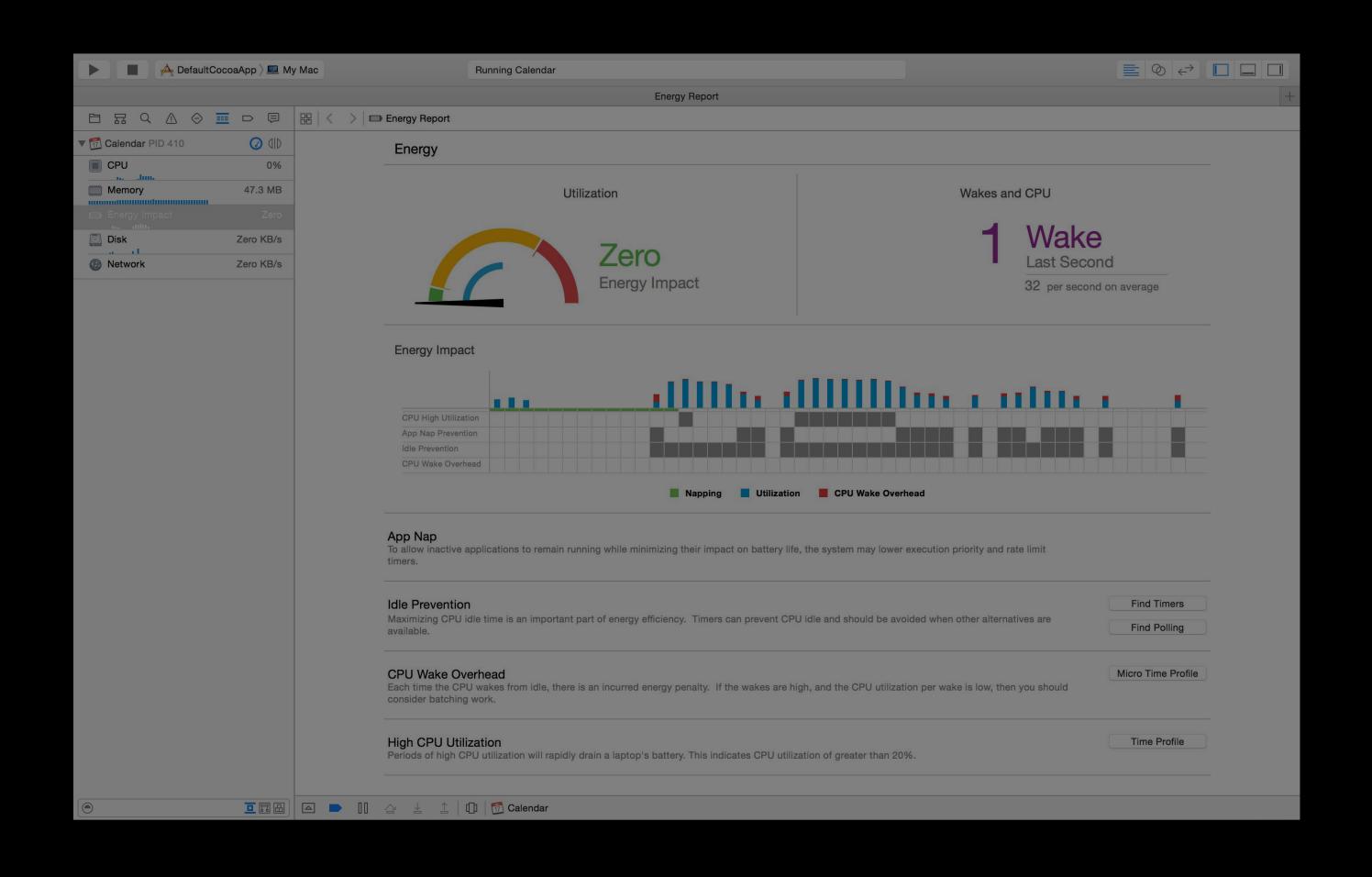




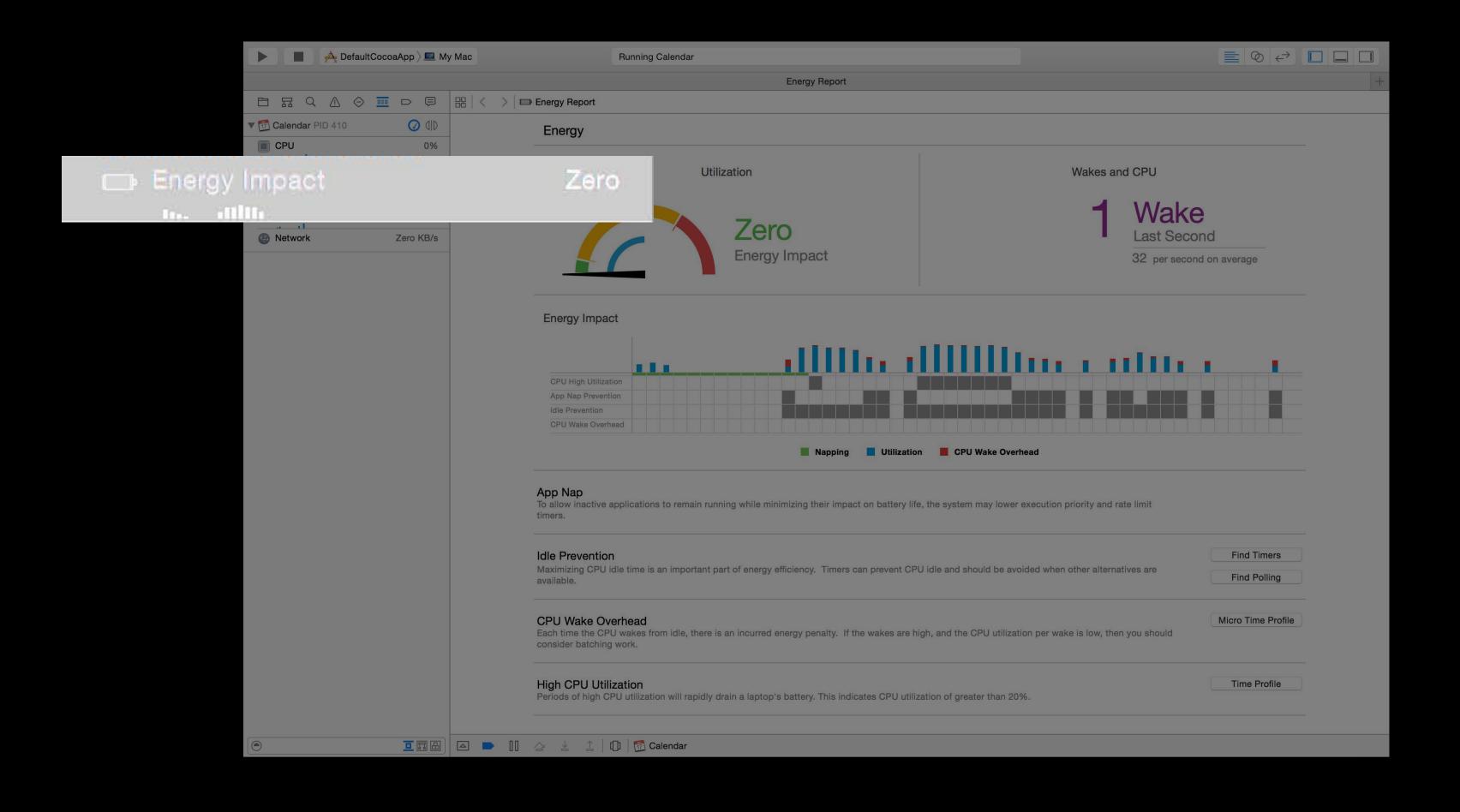




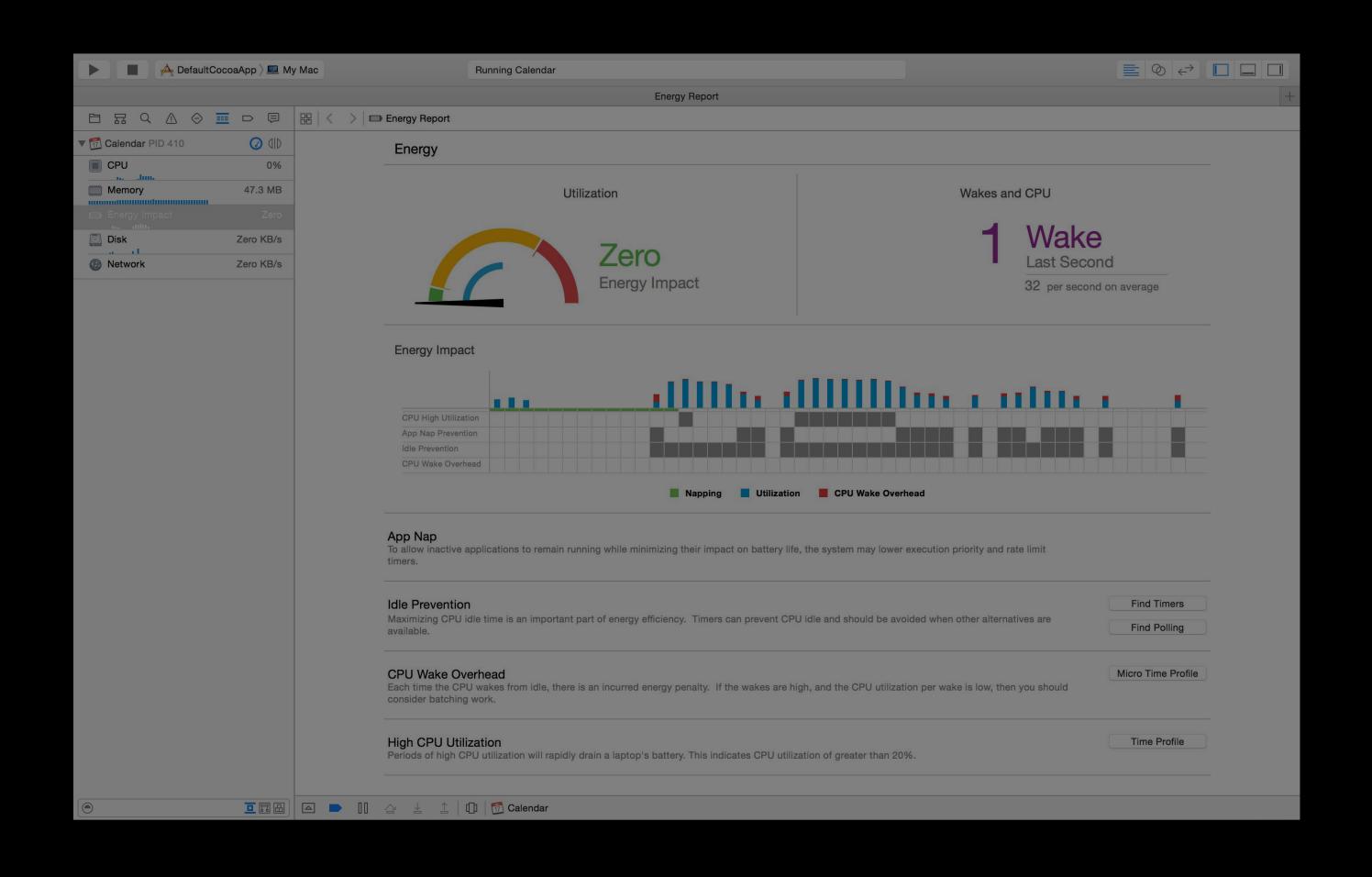




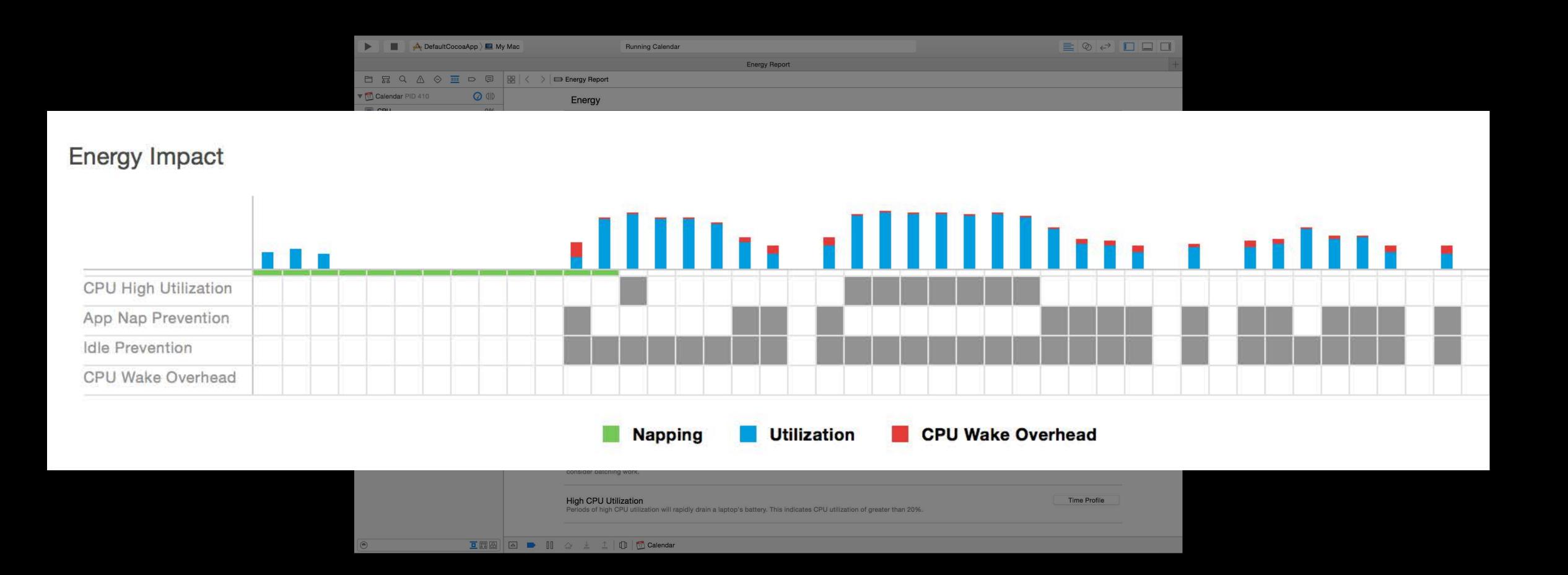




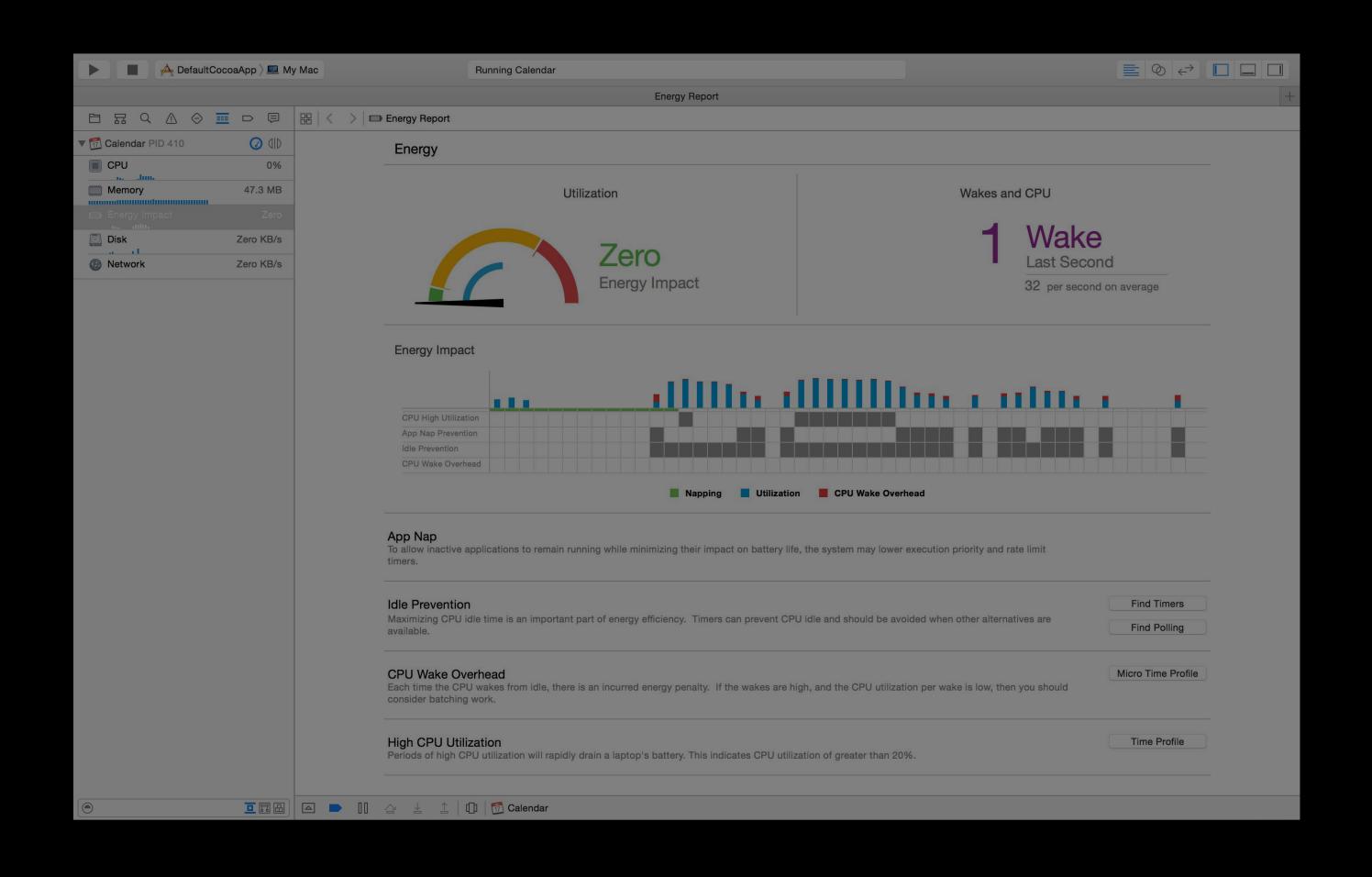
















App Nap

To allow inactive applications to remain running while minimizing their impact on battery life, the system may lower execution priority and rate limit timers.

Idle Prevention

Maximizing CPU idle time is an important part of energy efficiency. Timers can prevent CPU idle and should be avoided when other alternatives are available.

CPU Wake Overhead

Each time the CPU wakes from idle, there is an incurred energy penalty. If the wakes are high, and the CPU utilization per wake is low, then you should consider batching work.

High CPU Utilization

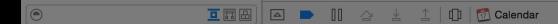
Periods of high CPU utilization will rapidly drain a laptop's battery. This indicates CPU utilization of greater than 20%.

Micro Time Profile

Find Timers

Find Polling

Time Profile



Reducing Energy on OS X

Do it never/do it less

- Coalesce timers => let CPU idle
- Minimize CPU wakes

Do it at a better time

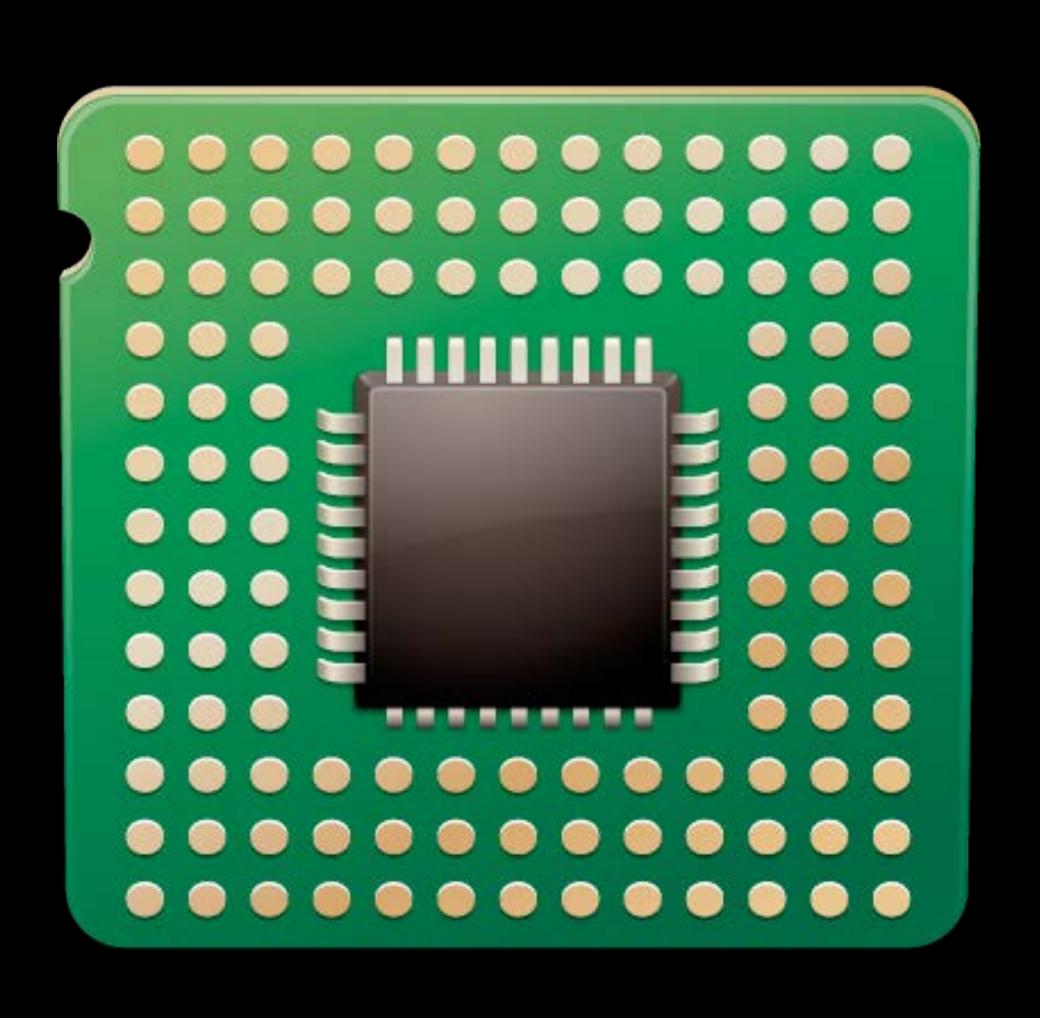
Scheduling with NSBackgroundActivityScheduler

Do it efficiently

Set appropriate QoS work priorities

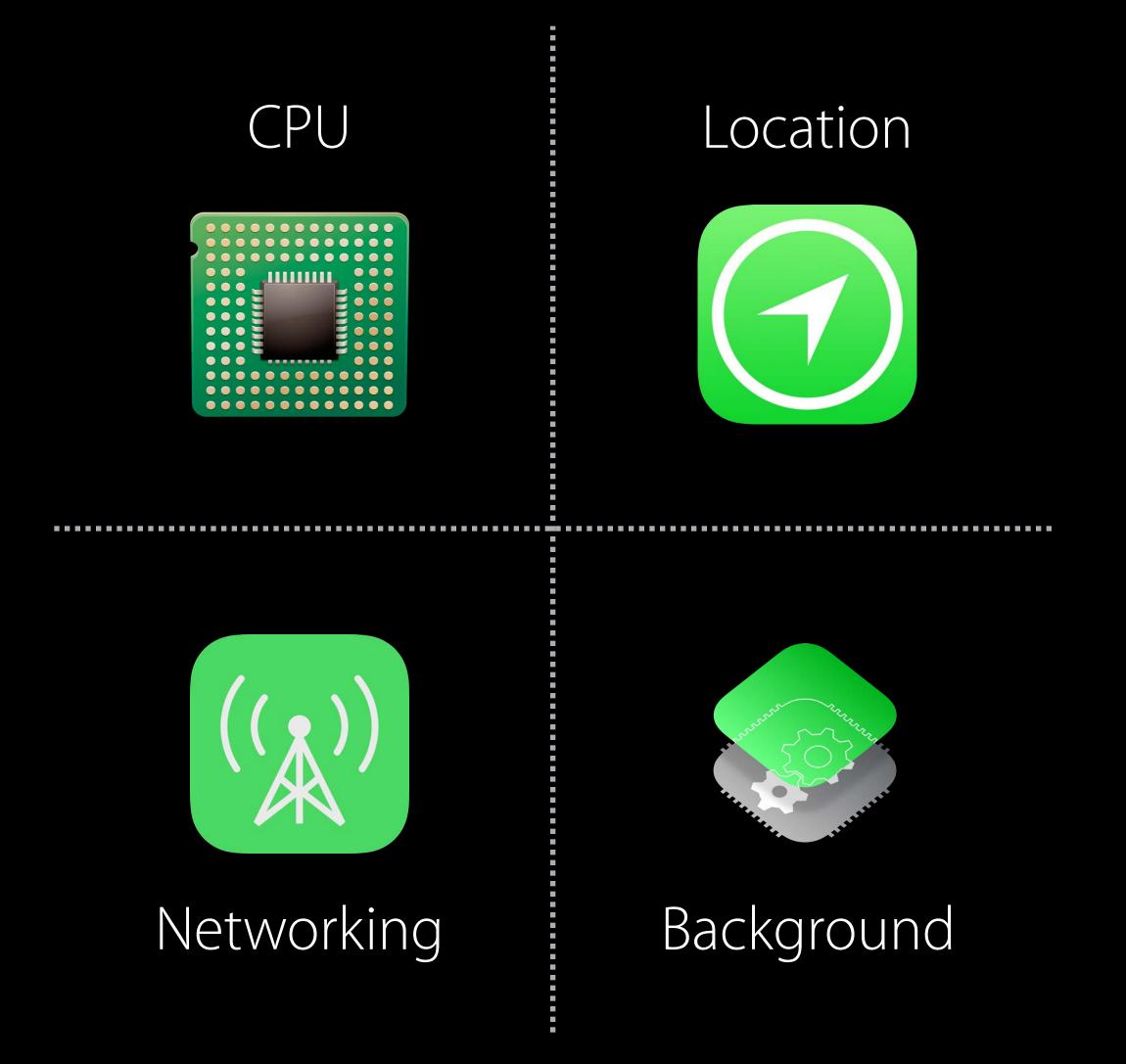
Energy Debugging Priorities in iOS





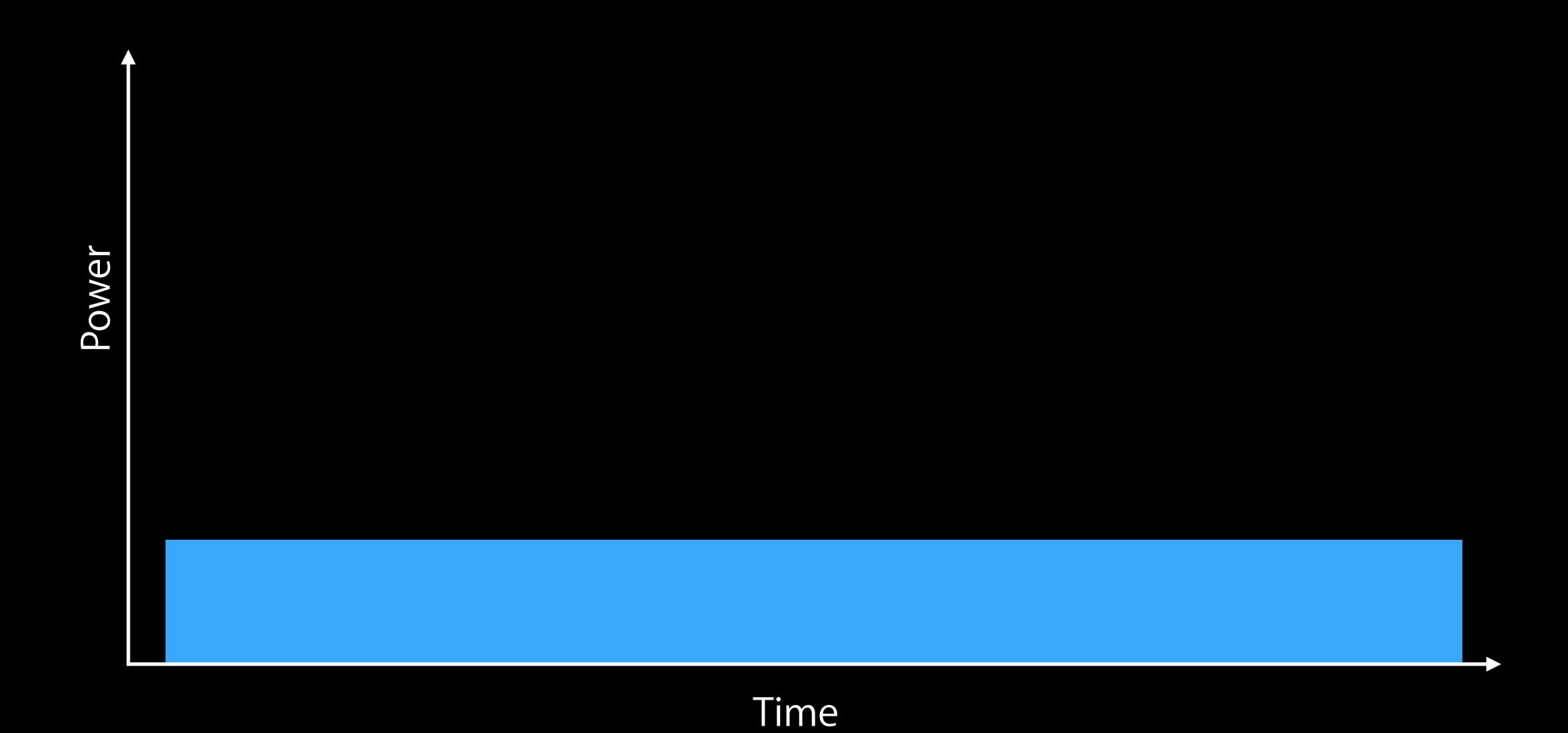
Energy Debugging Priorities in iOS





Location Energy





Energy Efficient Location

Concepts to remember



Do it never/do it less

- Continuous location only if absolutely needed
- Stop location when you're done with it

Energy Efficient Location

Concepts to remember

Do it never/do it less

- Continuous location only if absolutely needed
- Stop location when you're done with it

Do it efficiently

- What accuracy is actually required for app?
- Which location API to use?
 - Deferred location updates, significant location change, region monitoring
 - iBeacons, AutoPause, significant locations visited

Energy Efficient Networking



Concepts to remember

Do it never/do it less

• Cut down transfers: caching, compression, media quality, etc.

Energy Efficient Networking

Concepts to remember

Do it never/do it less

• Cut down transfers: caching, compression, media quality, etc.

Do it at a better time

• Consider tolerance: when is it needed, is it discretionary, etc.

Energy Efficient Networking

Concepts to remember

Do it never/do it less

• Cut down transfers: caching, compression, media quality, etc.

Do it at a better time

• Consider tolerance: when is it needed, is it discretionary, etc.

Do it more efficiently

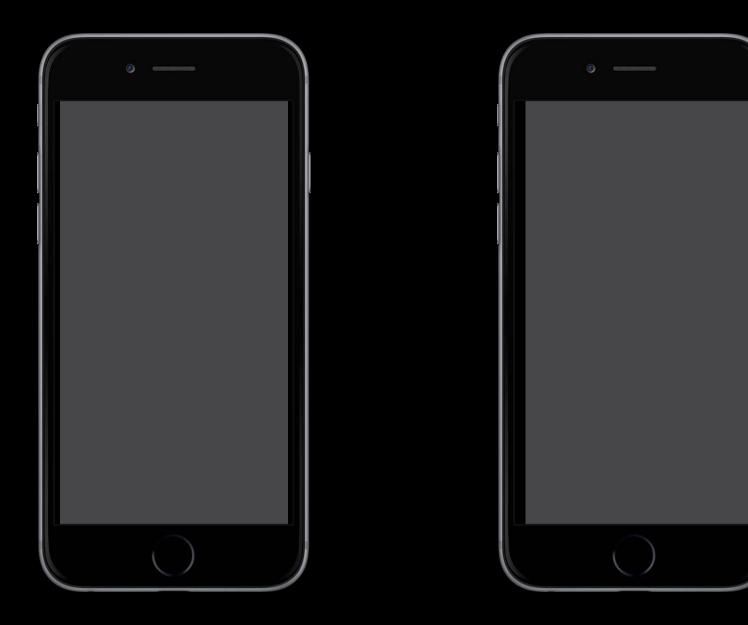
Coalesce transfers



Requirements

Sync data to server







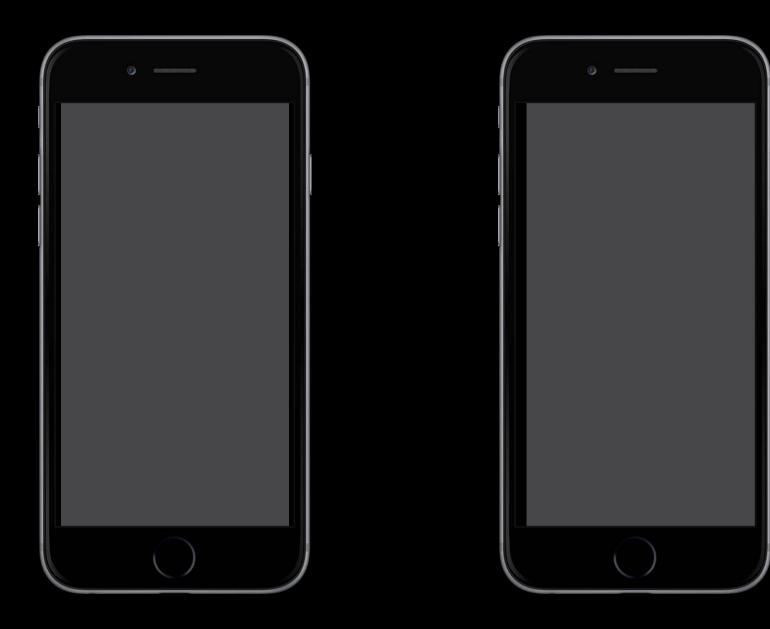
Requirements

Sync data to server

Simple solution

Sync data as it comes







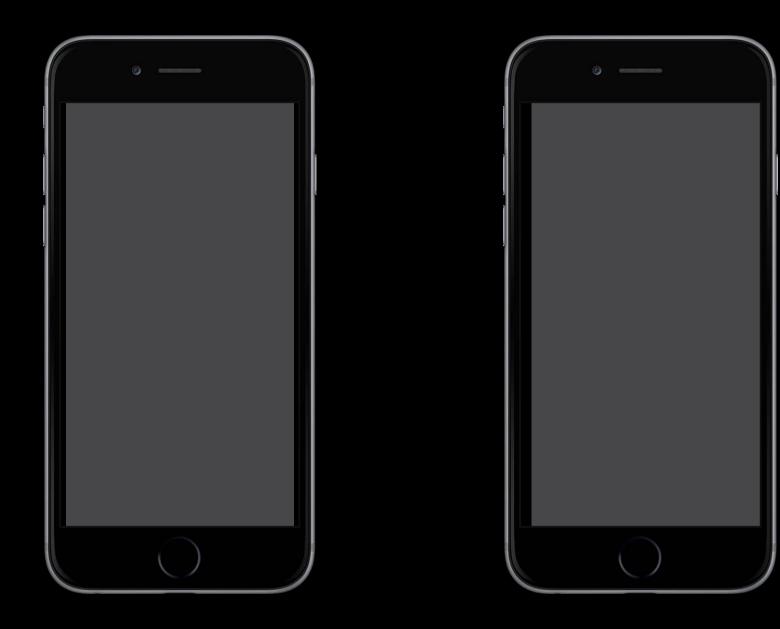
Requirements

Sync data to server

Simple solution

Sync data as it comes







Requirements

Sync data to server

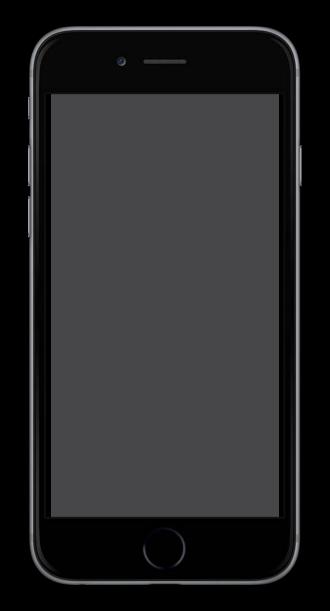
Simple solution

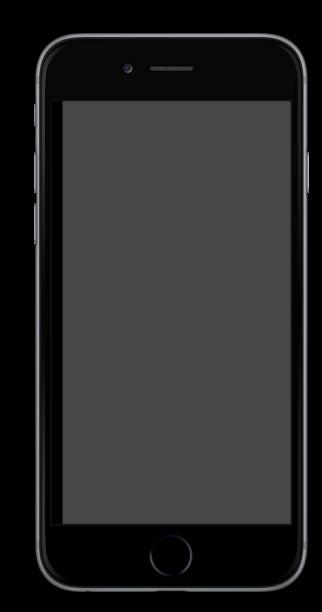
Sync data as it comes

Energy efficient solution

Buffer data before syncing









Requirements

Sync data to server

Simple solution

Sync data as it comes

Energy efficient solution

Buffer data before syncing









Energy Efficient Background Activity



Concepts to remember

Do it never/do it less

- Do not run in background
- Call Background Task Completion Handler as soon as work is completed

Energy Efficient Background Activity



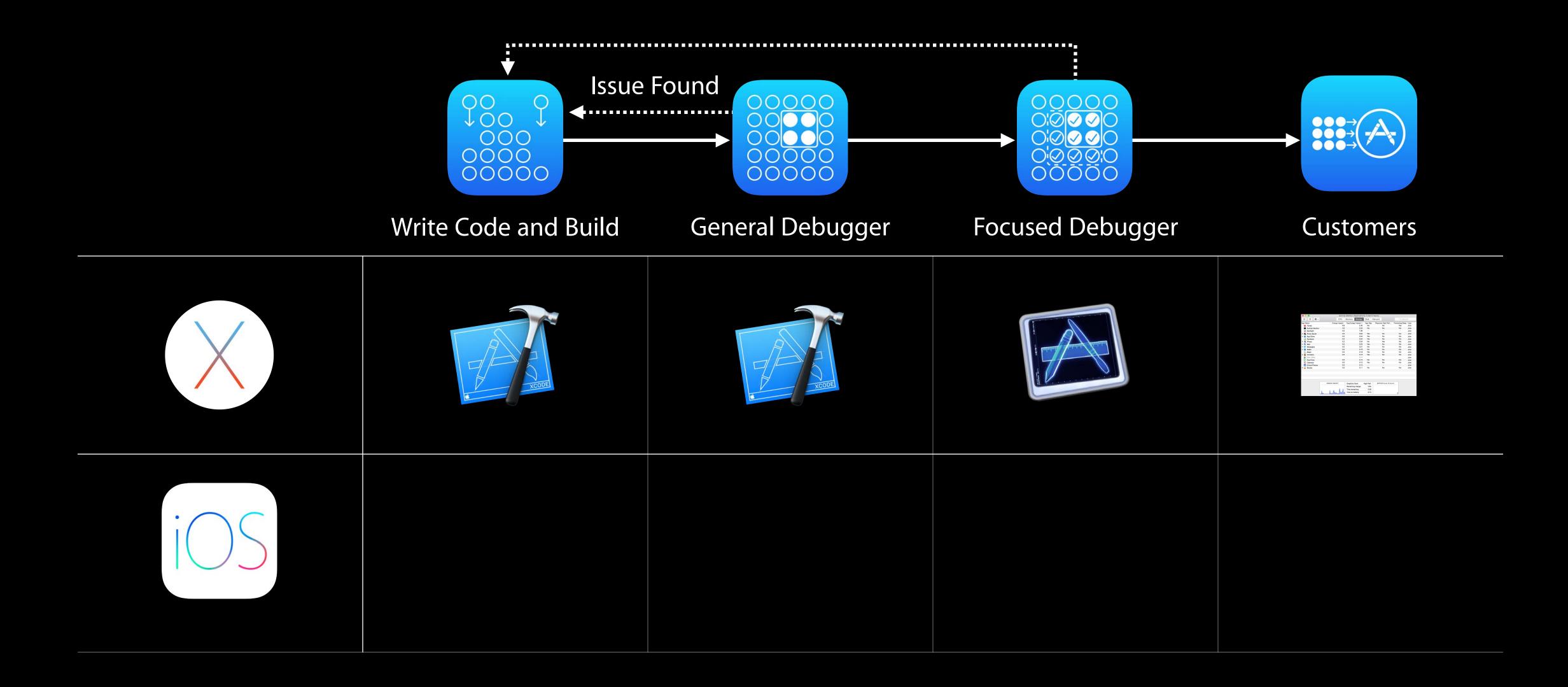
Concepts to remember

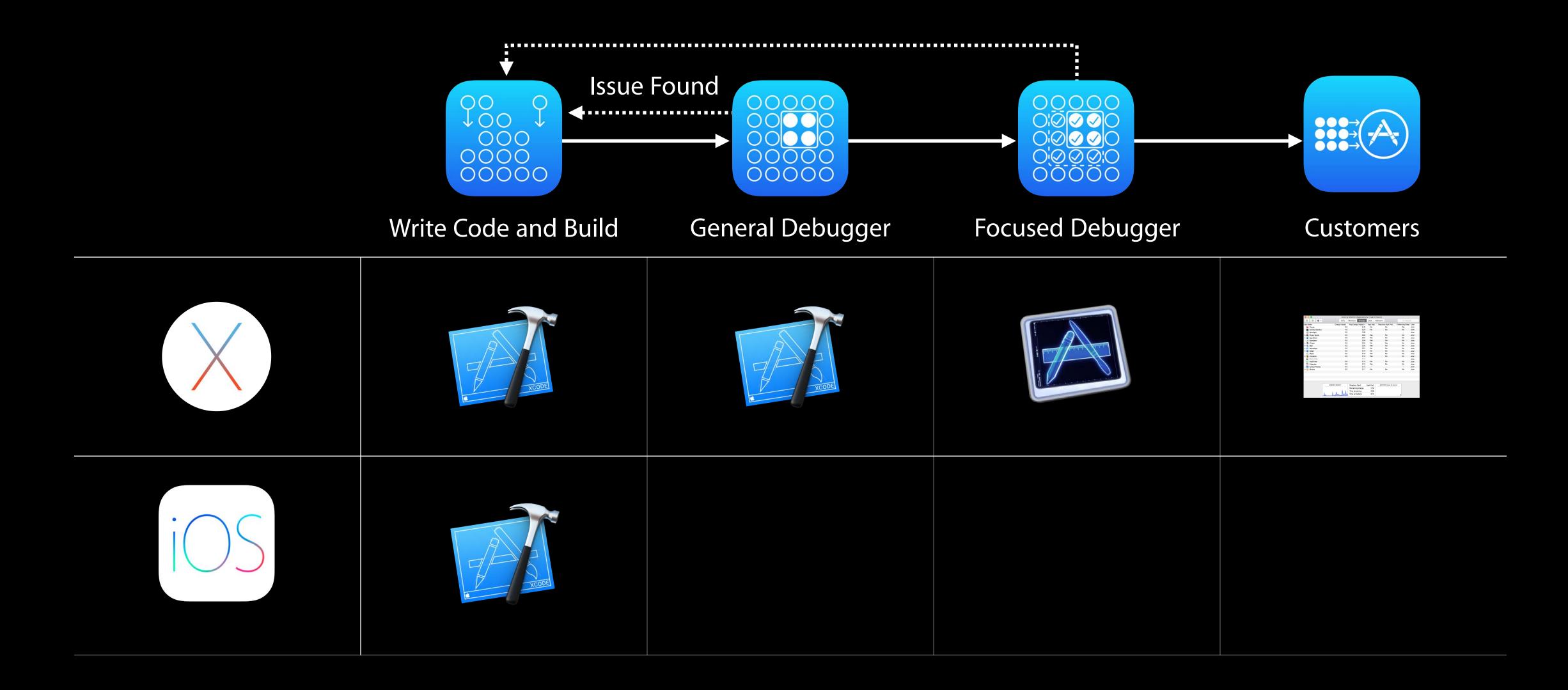
Do it never/do it less

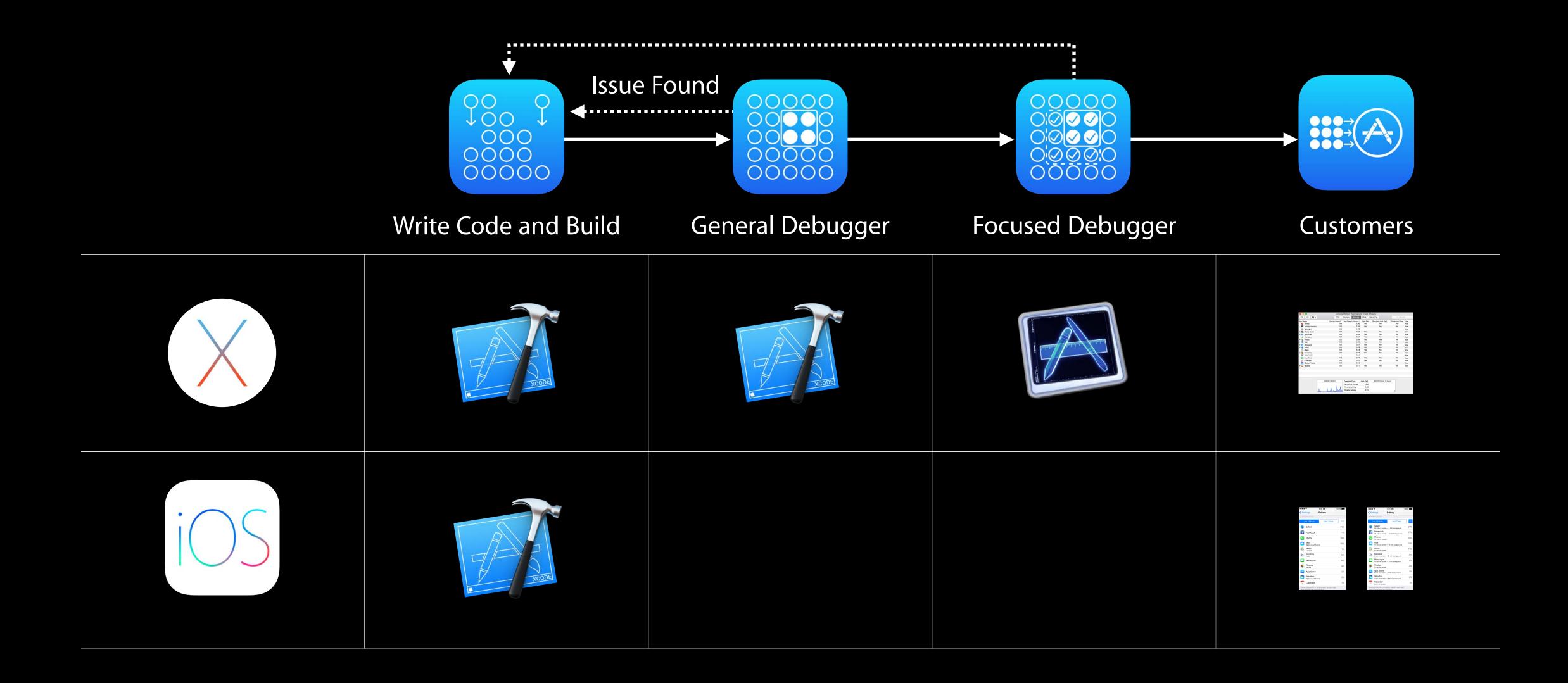
- Do not run in background
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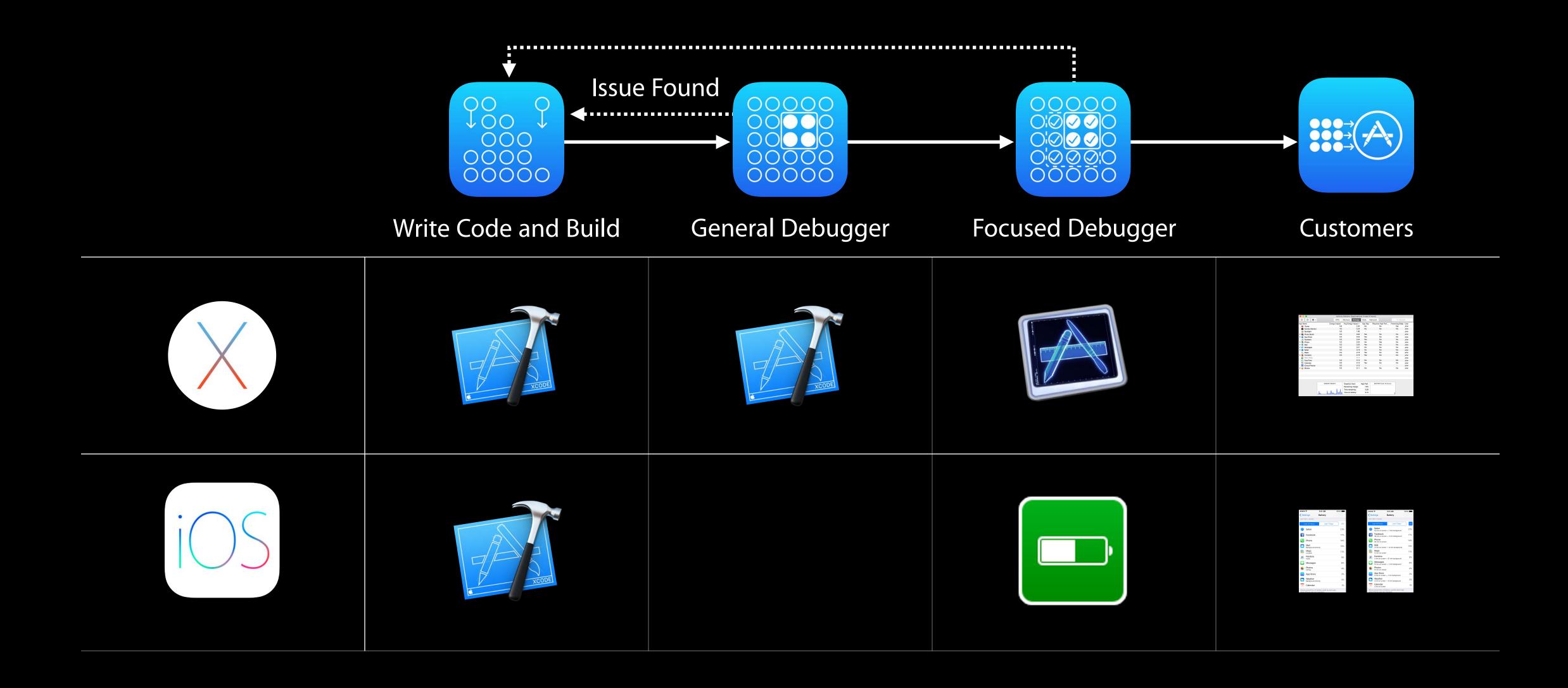
Do it efficiently

- Call energy-efficient background APIs
- Ex: application:performFetchWithCompletionHandler:





















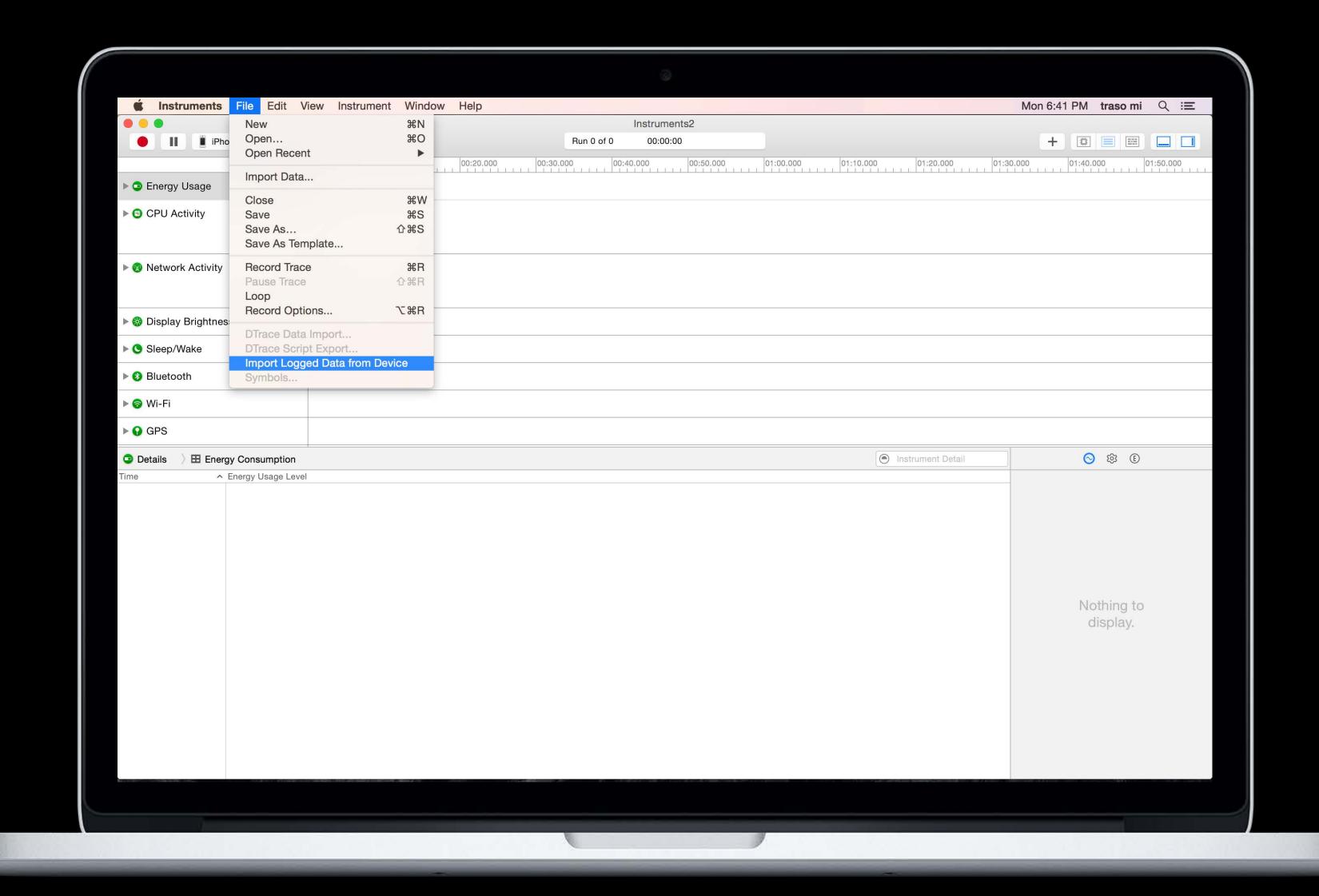




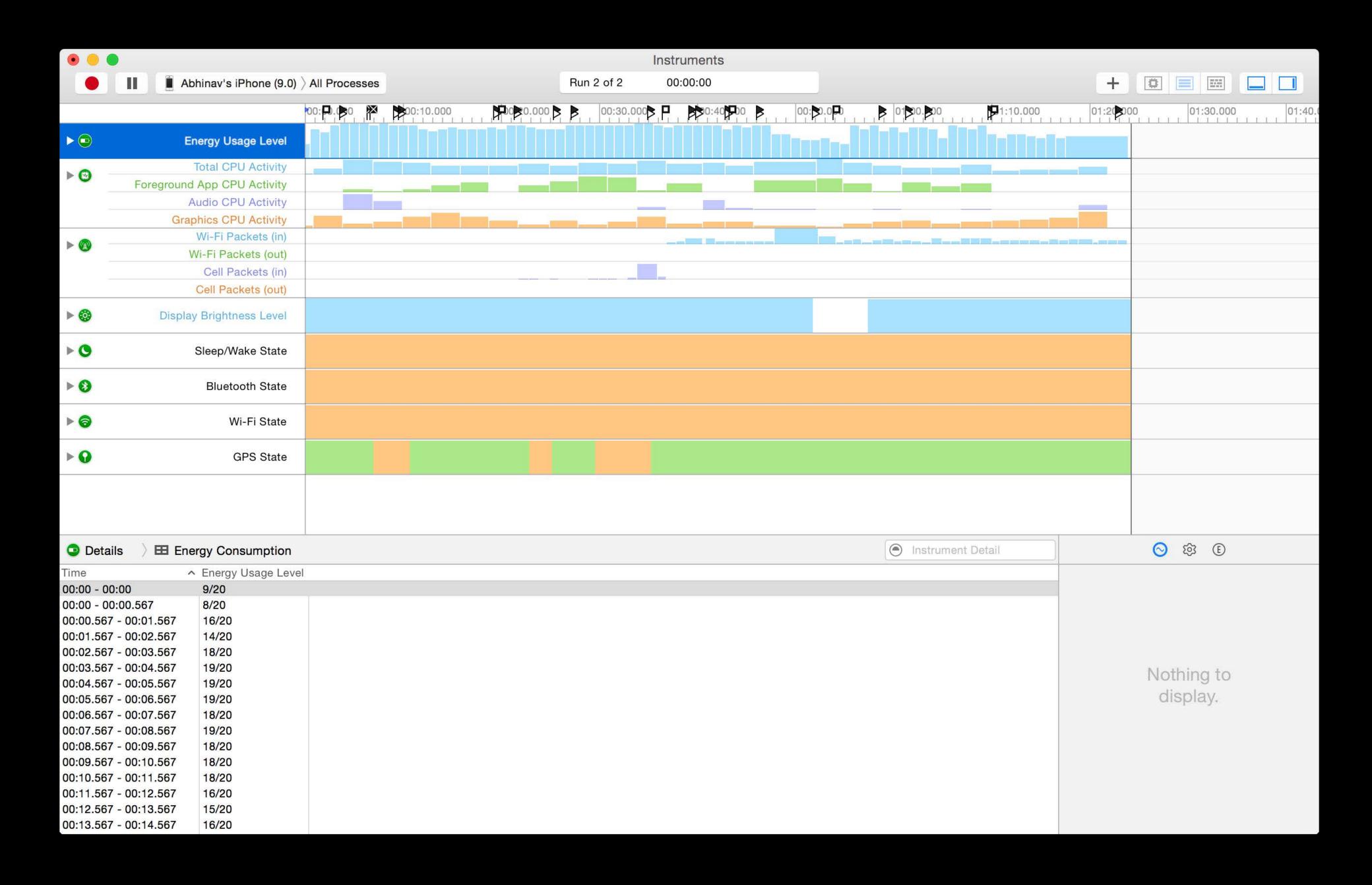


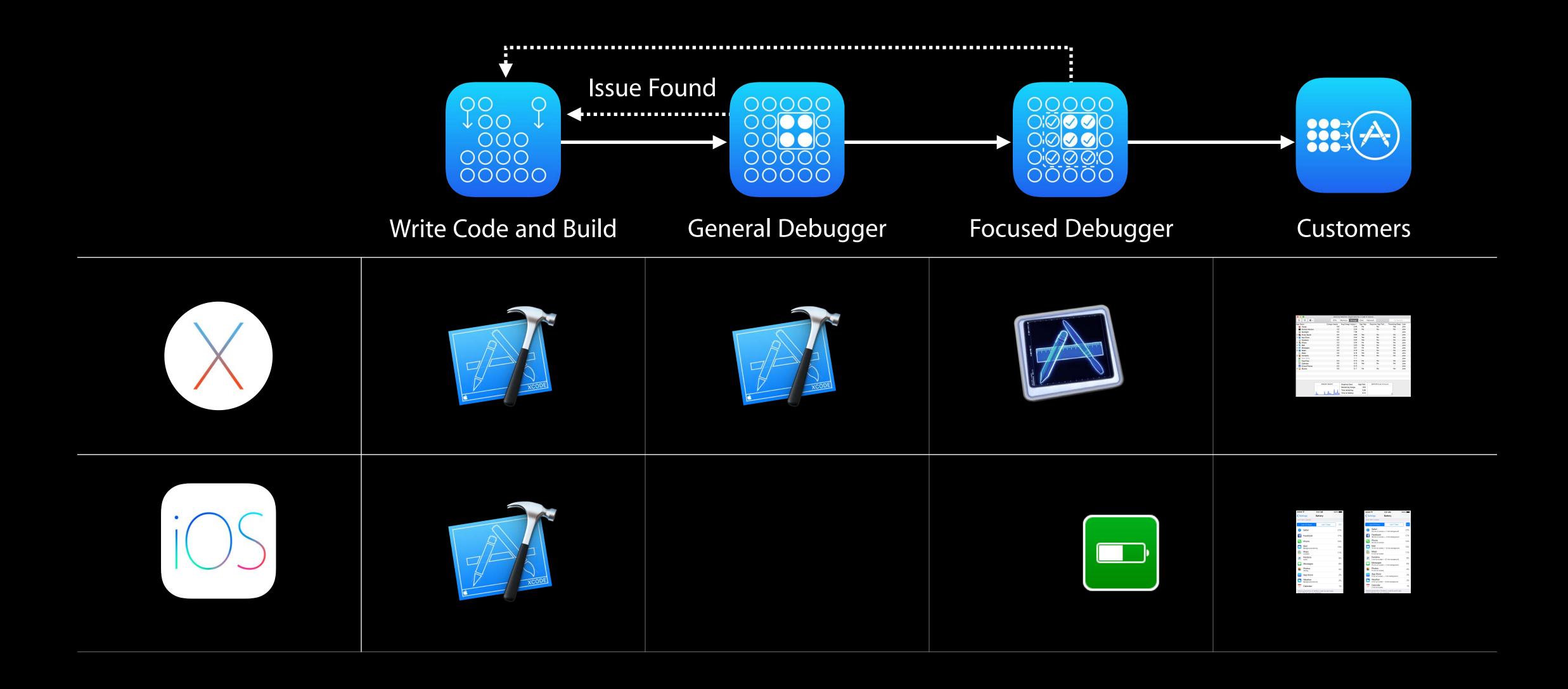


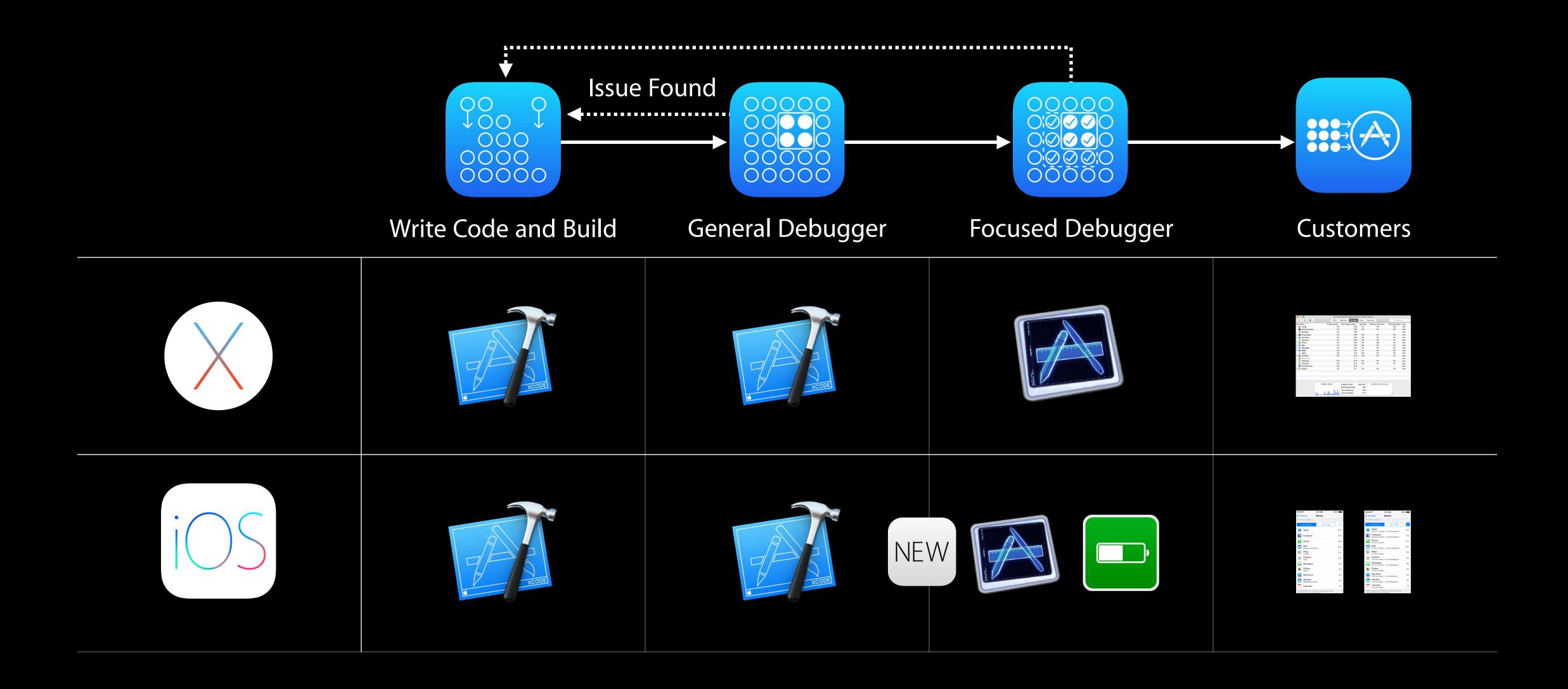










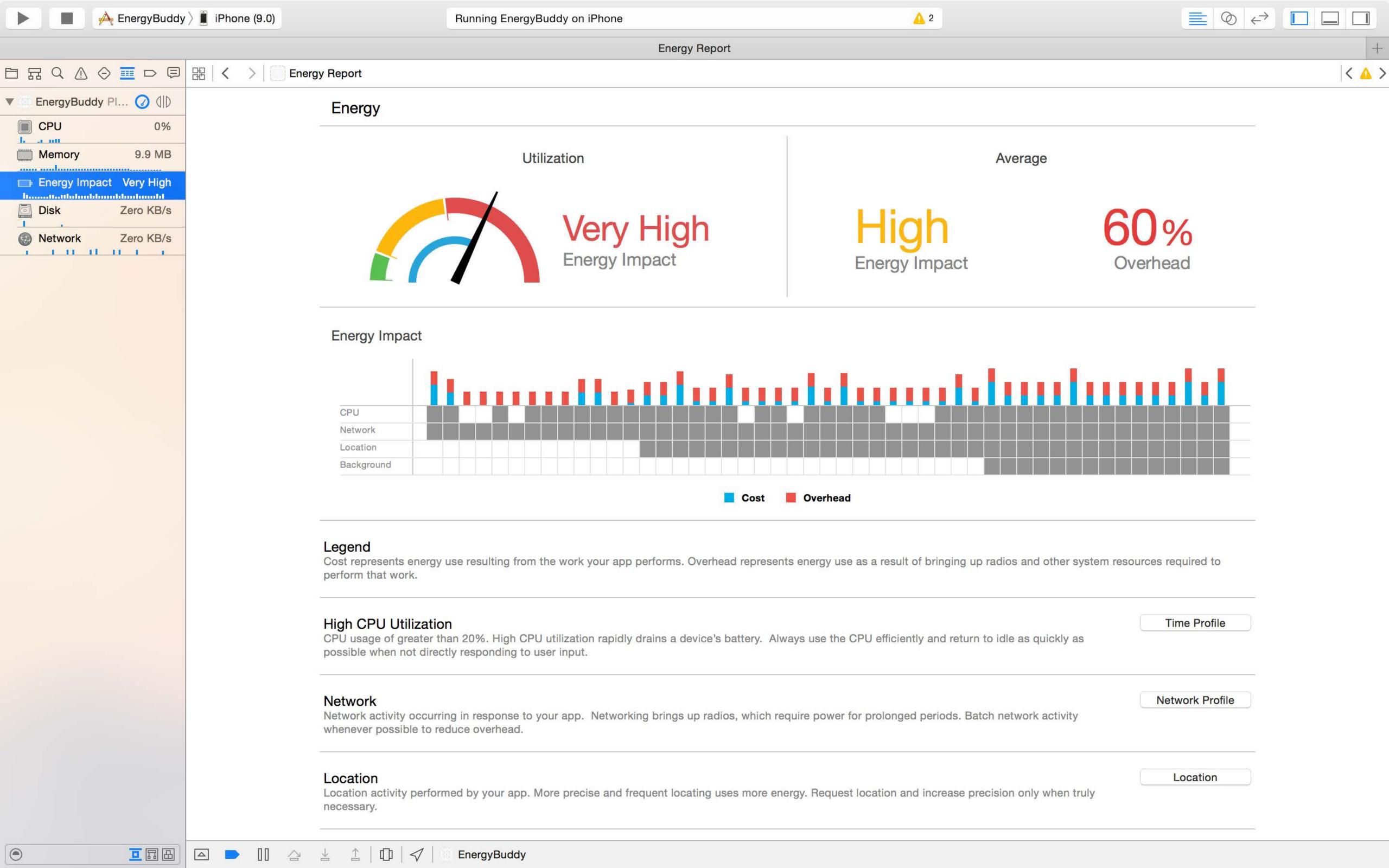


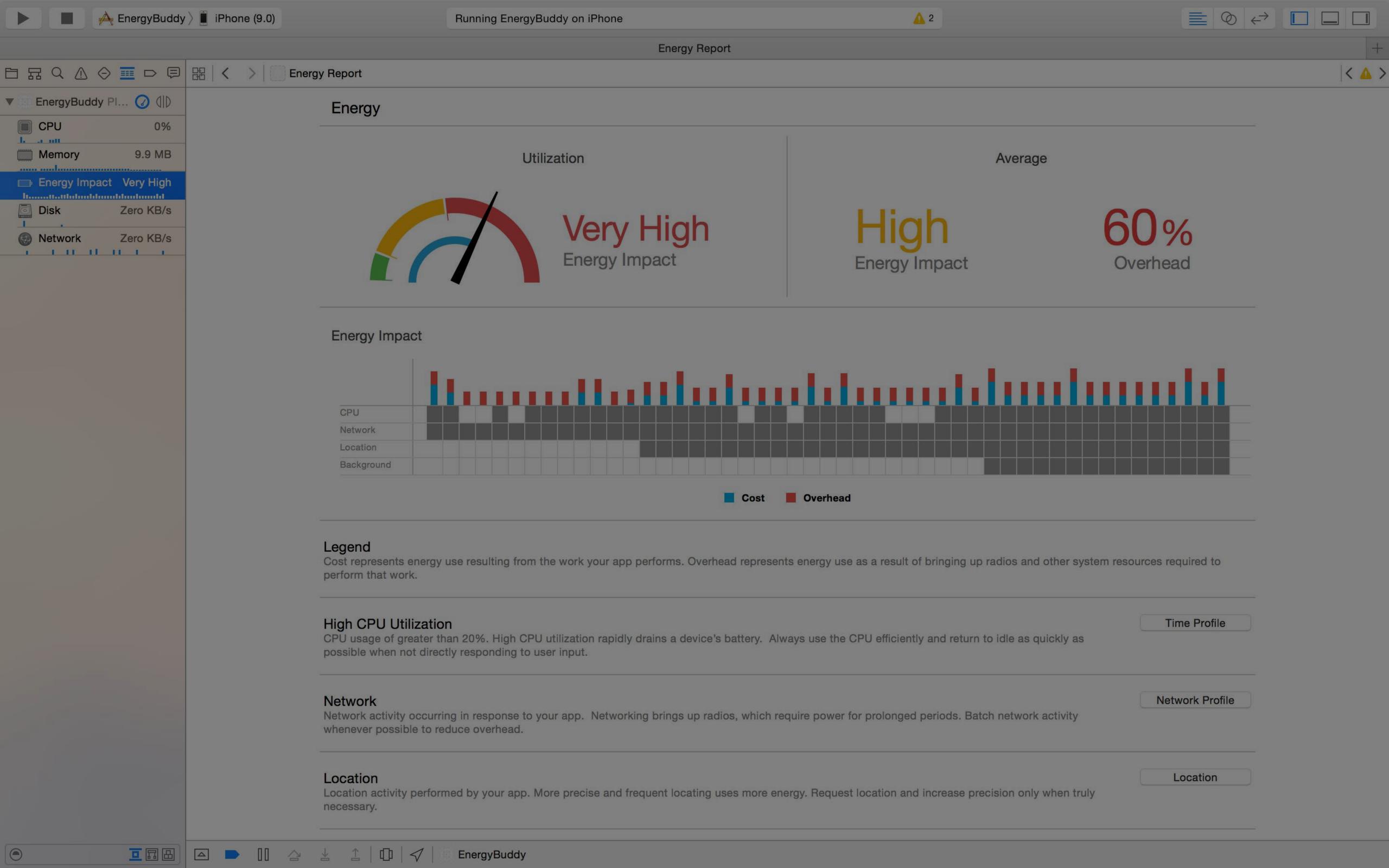
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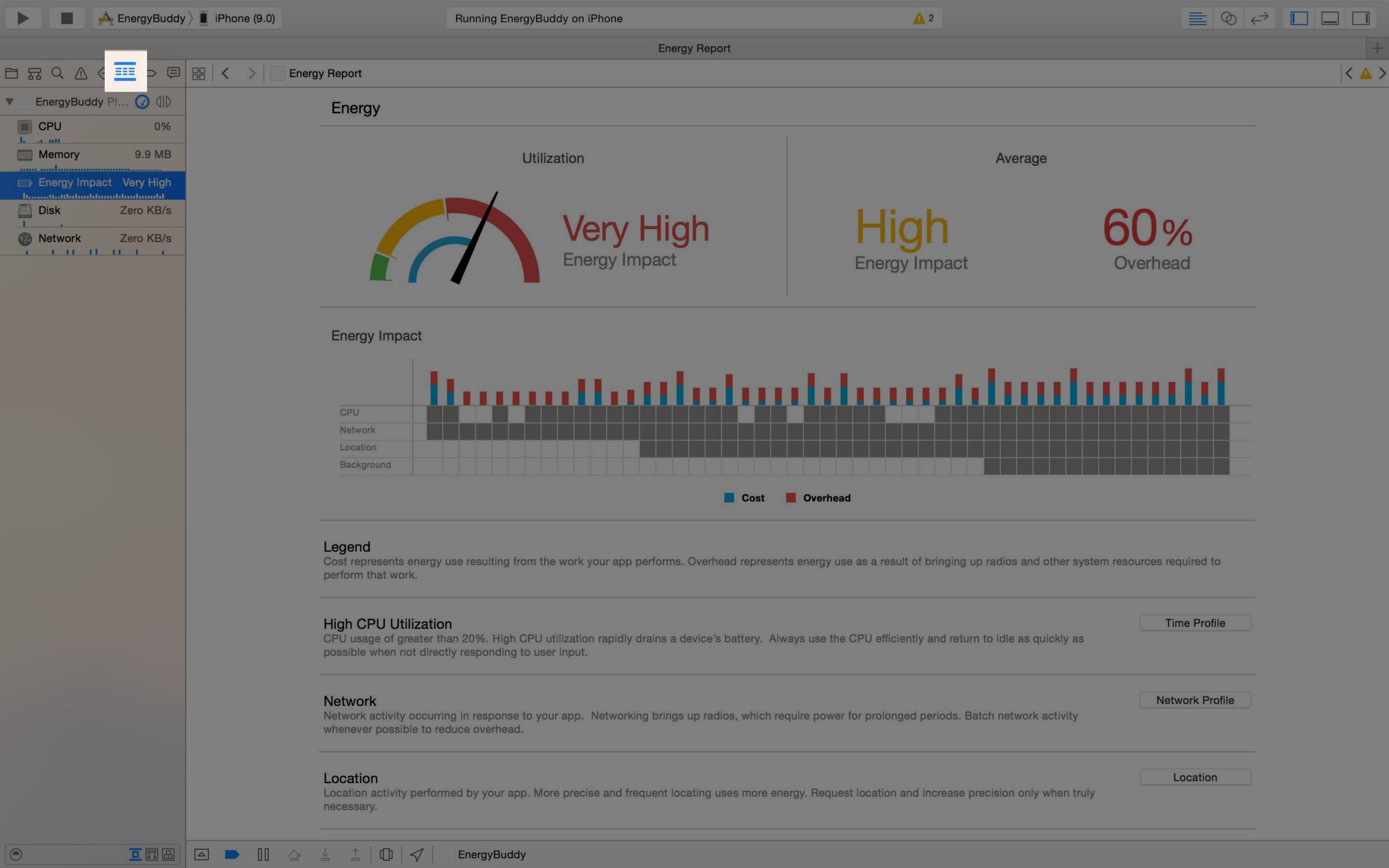


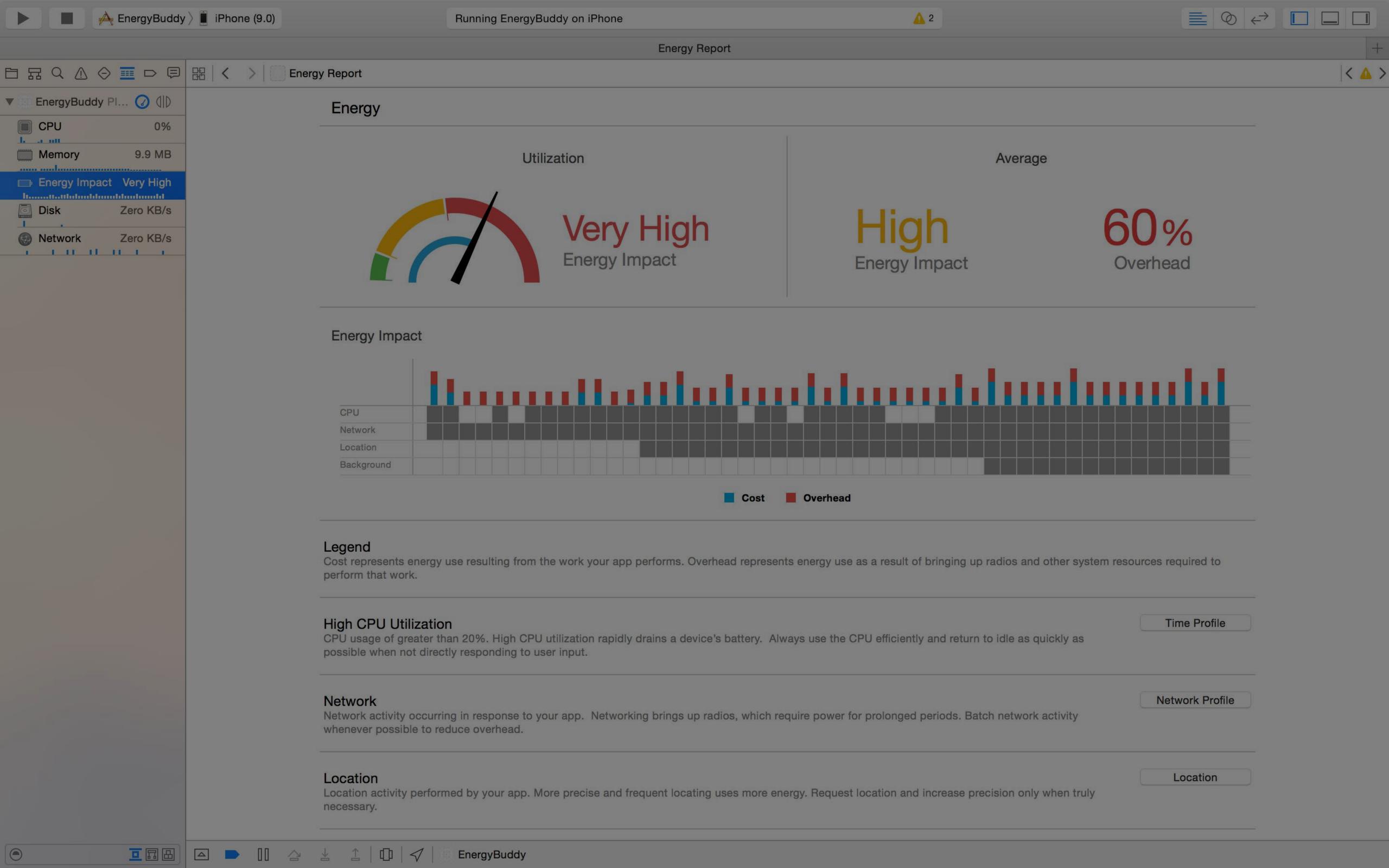
Demo

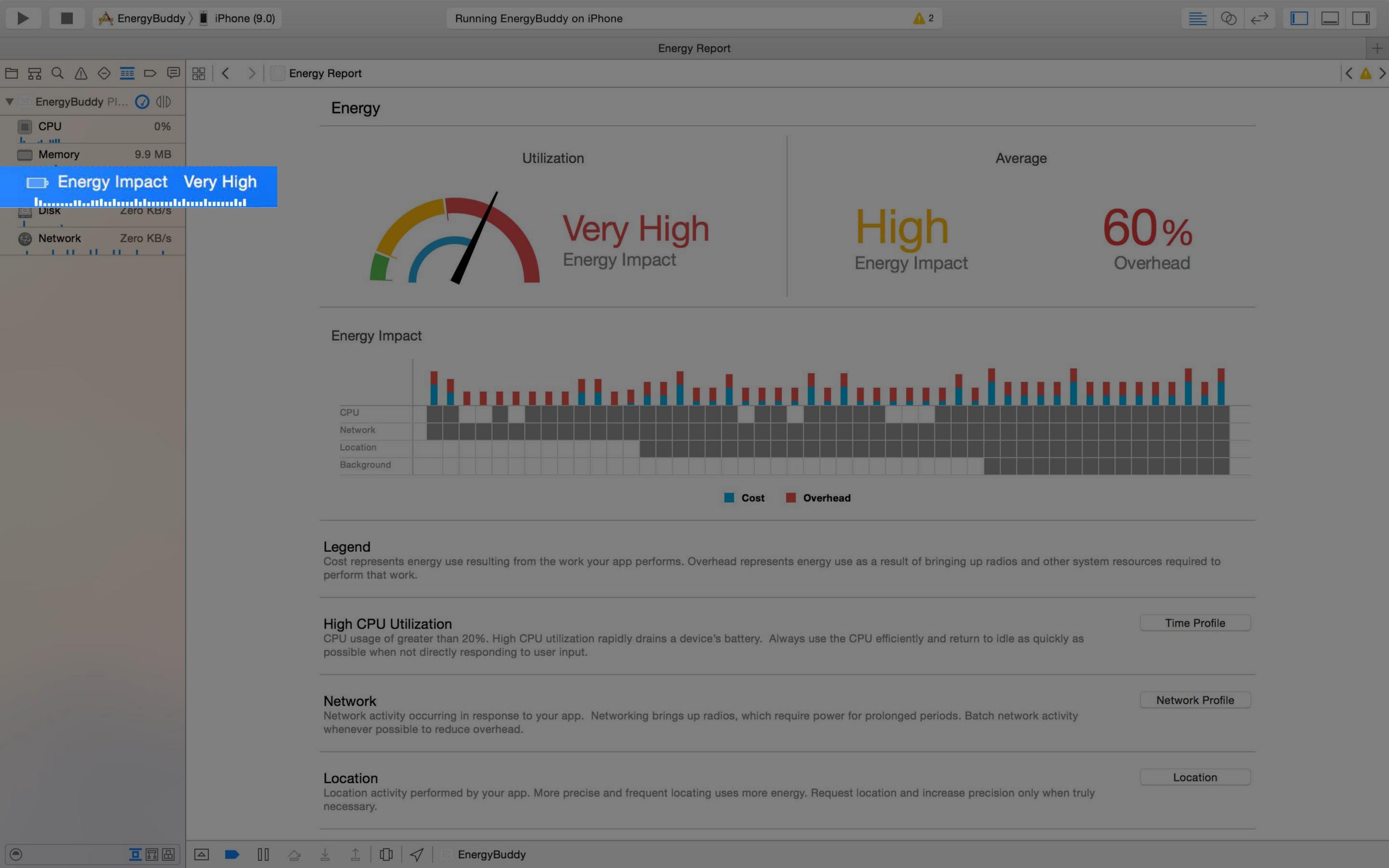
Pai-Han Huang iOS Power Team

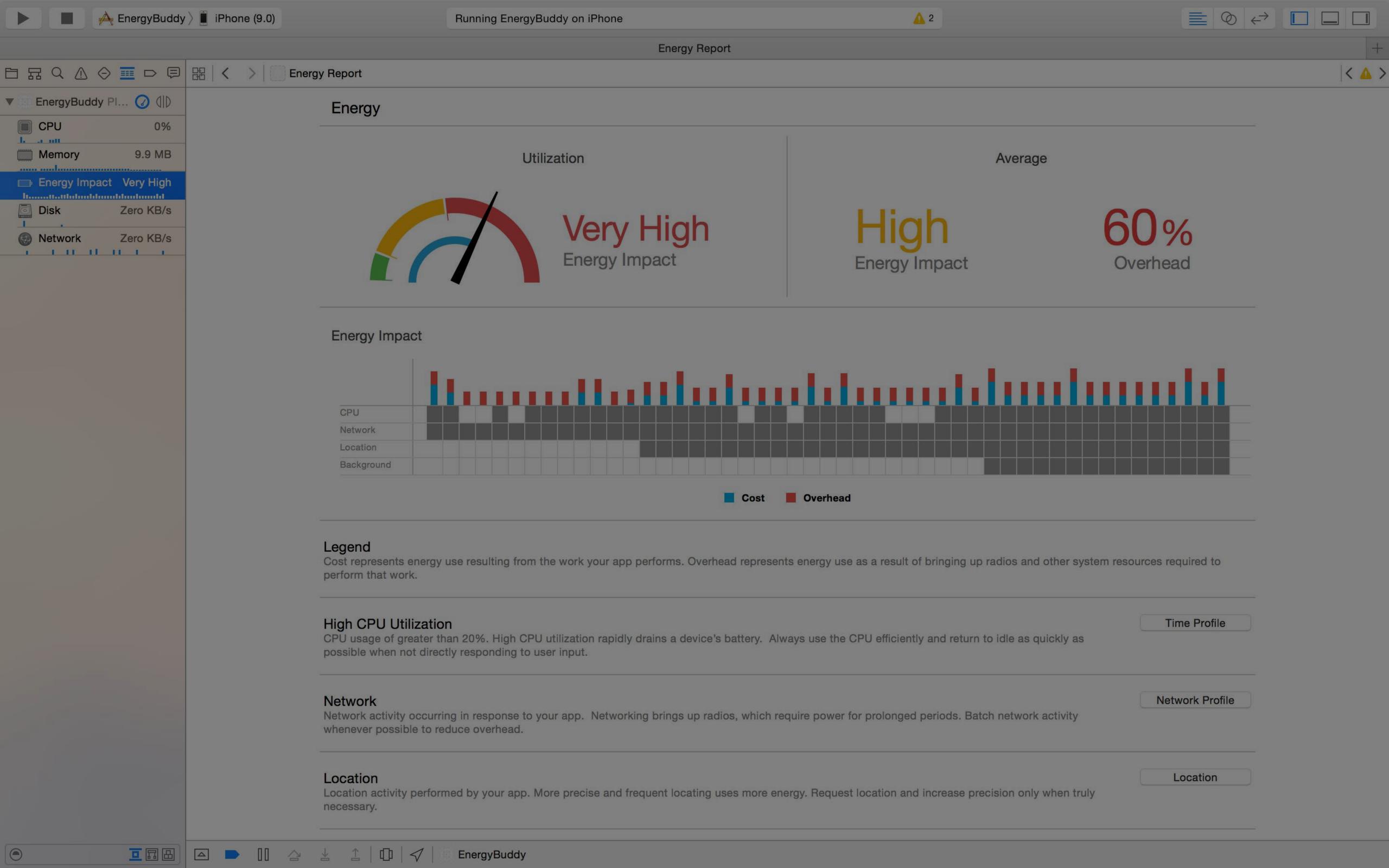


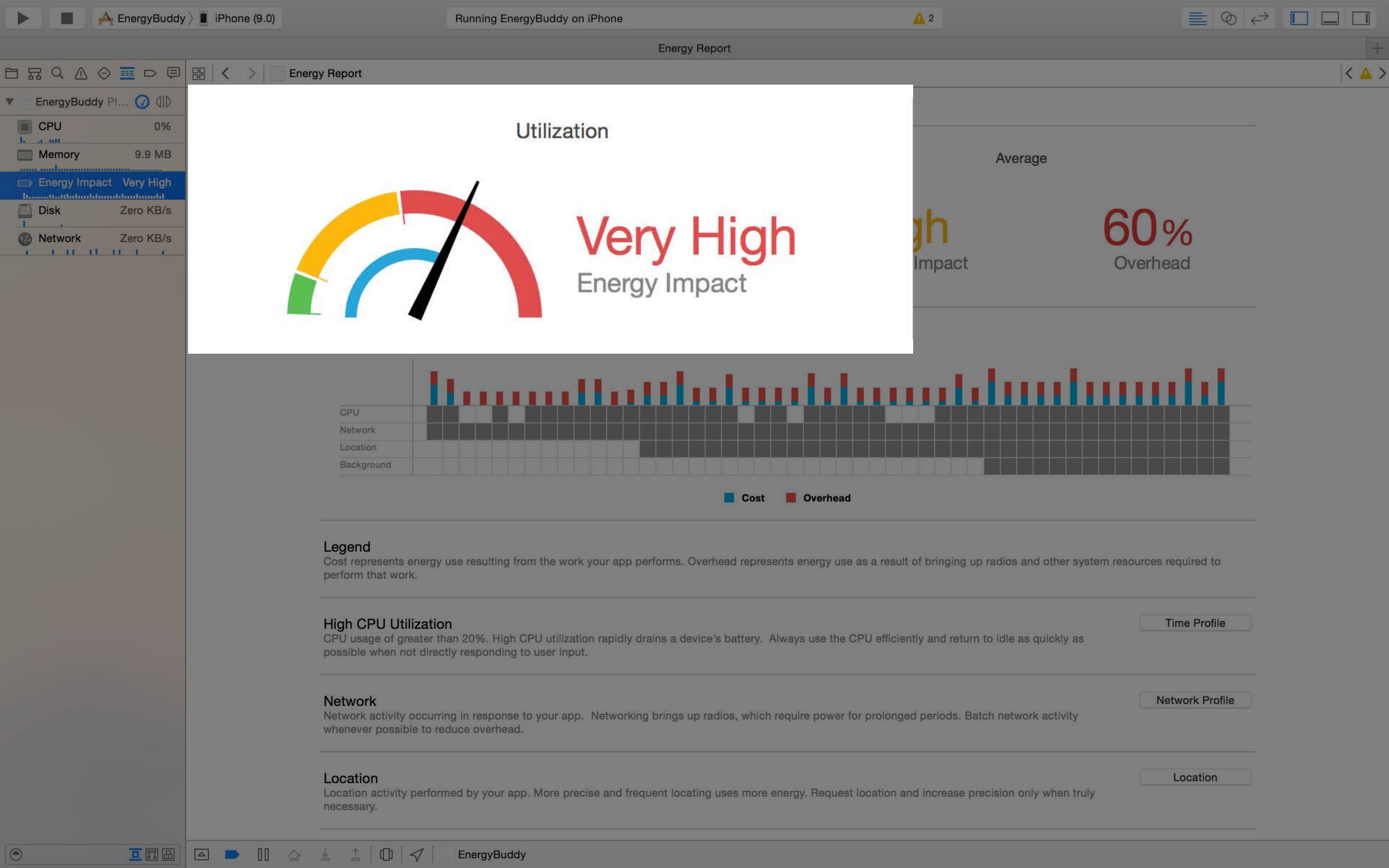


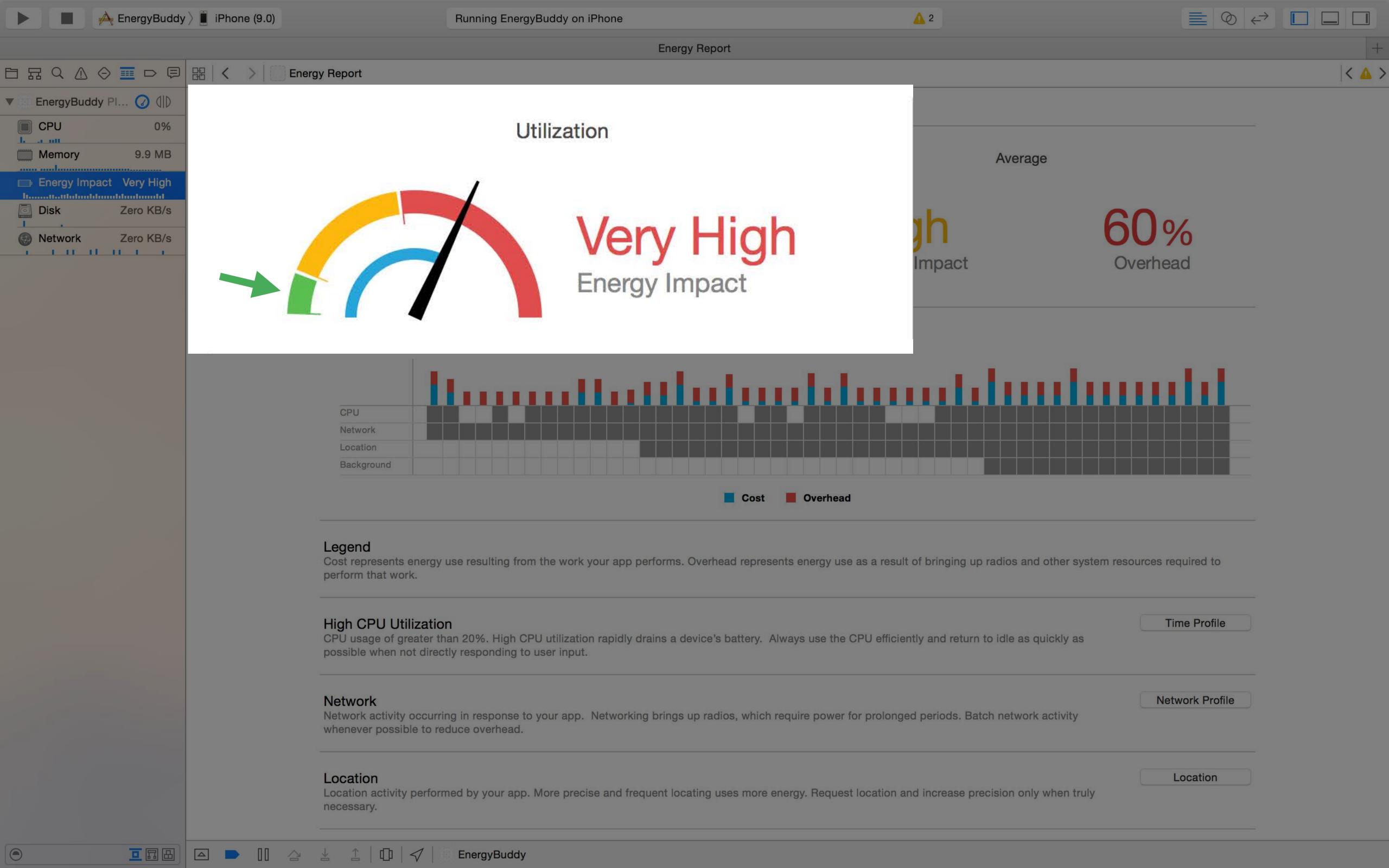


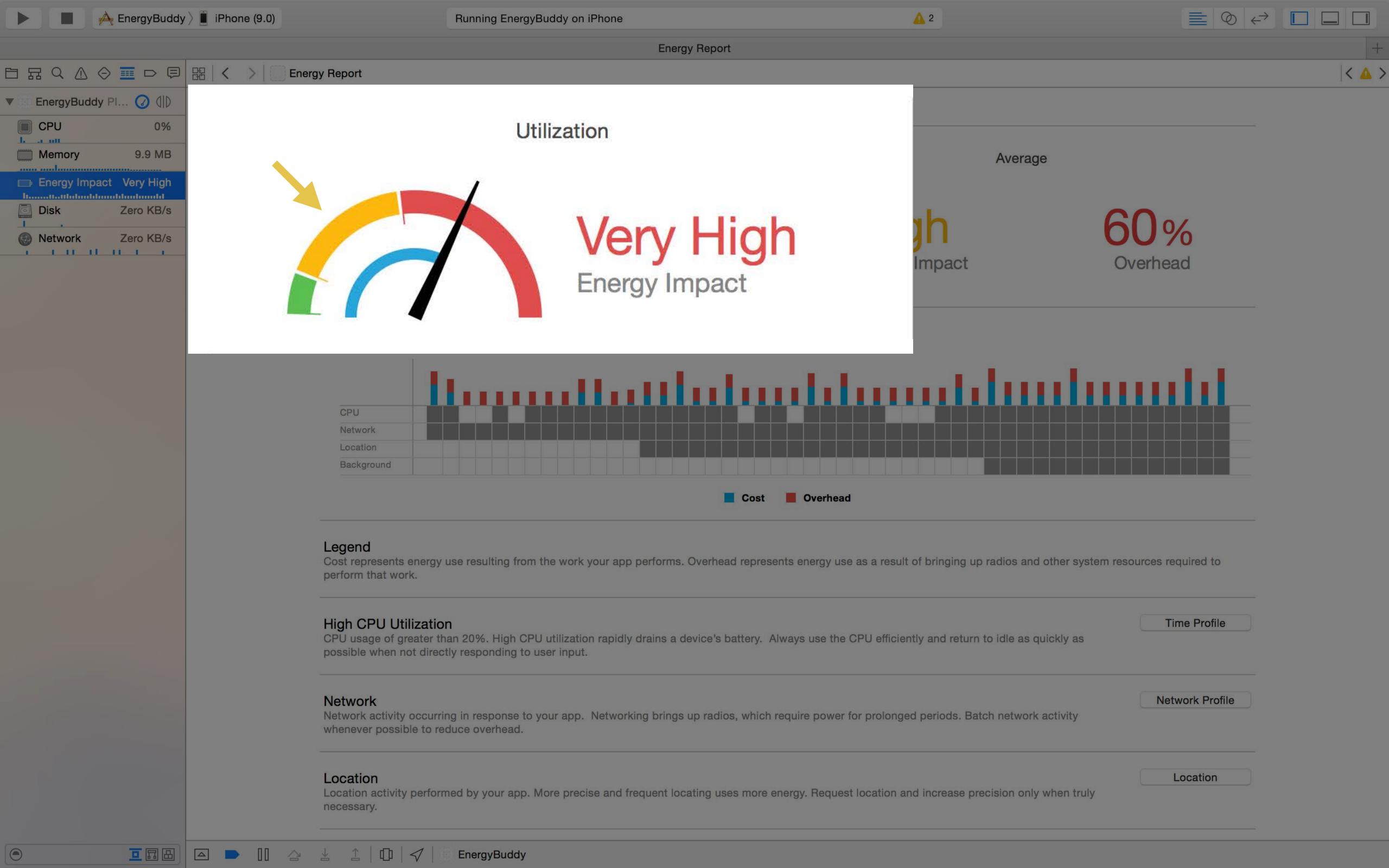


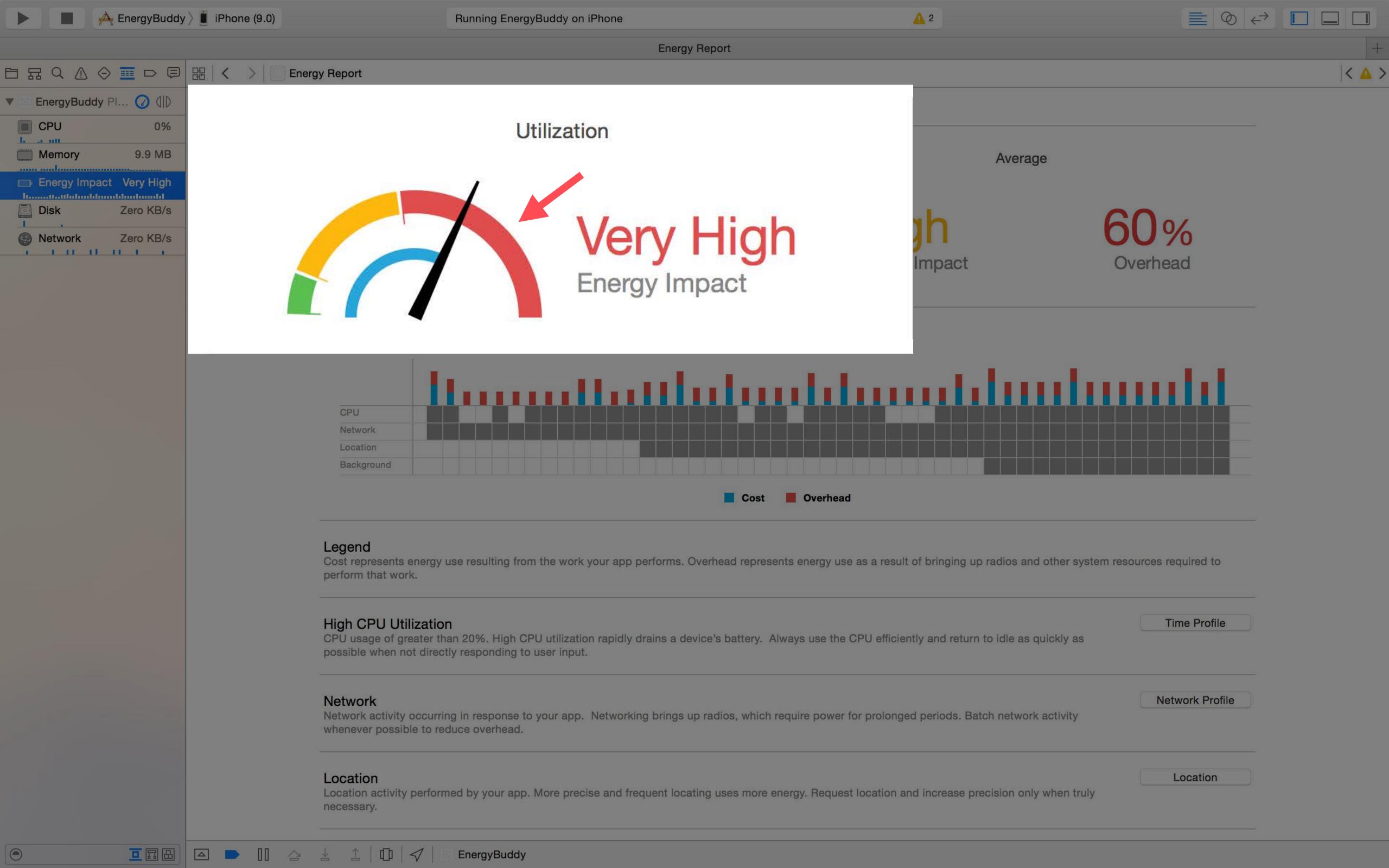


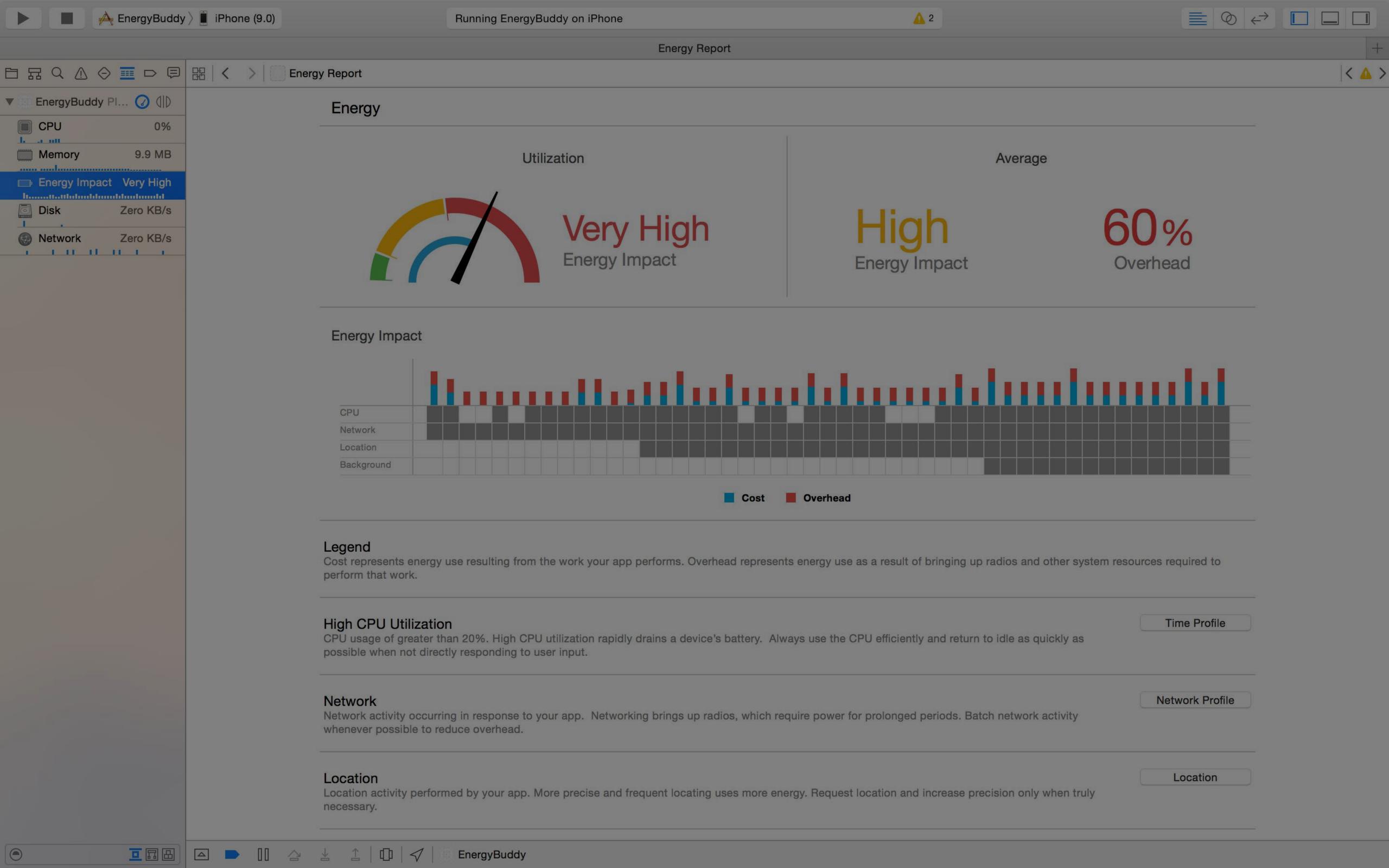


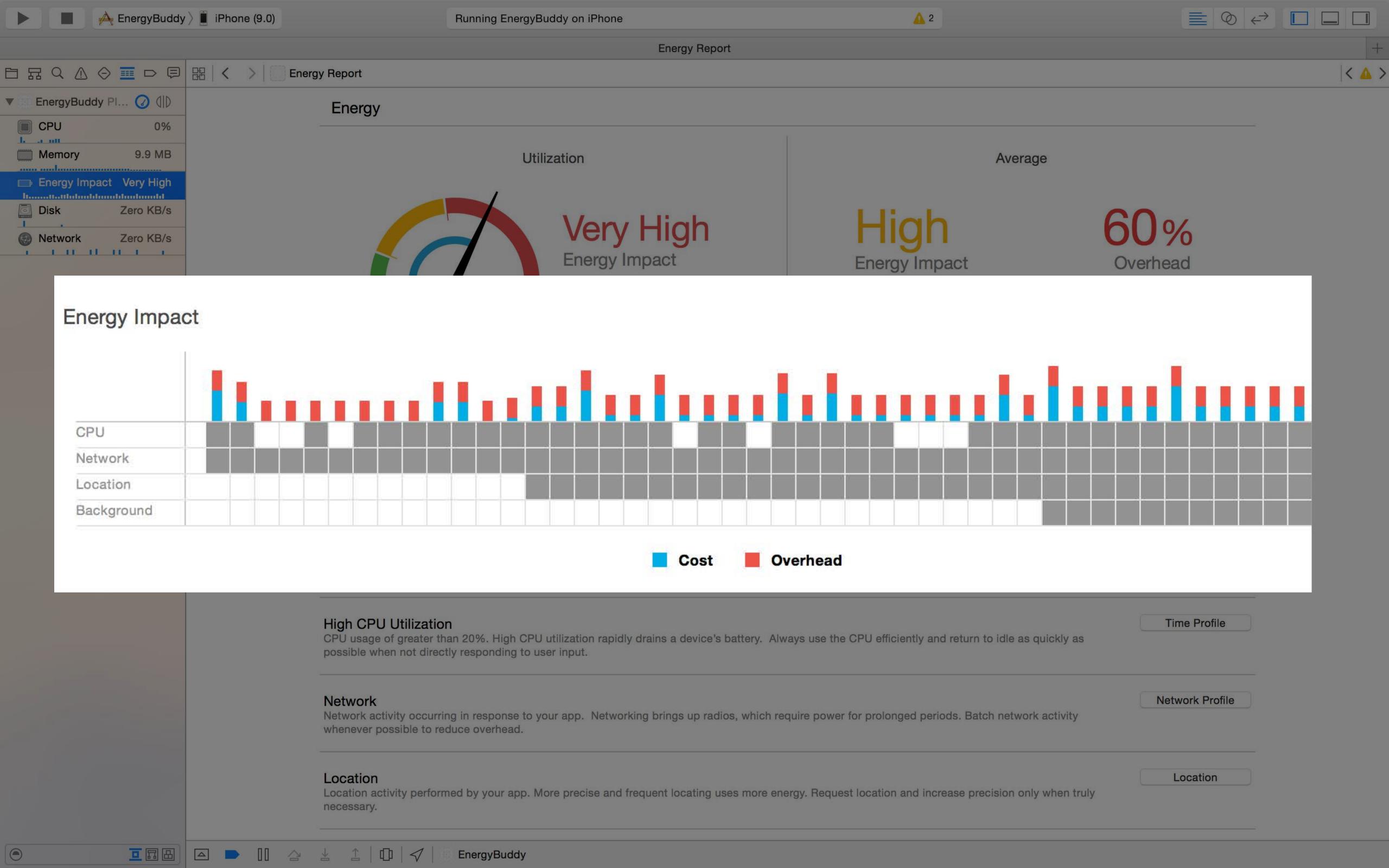


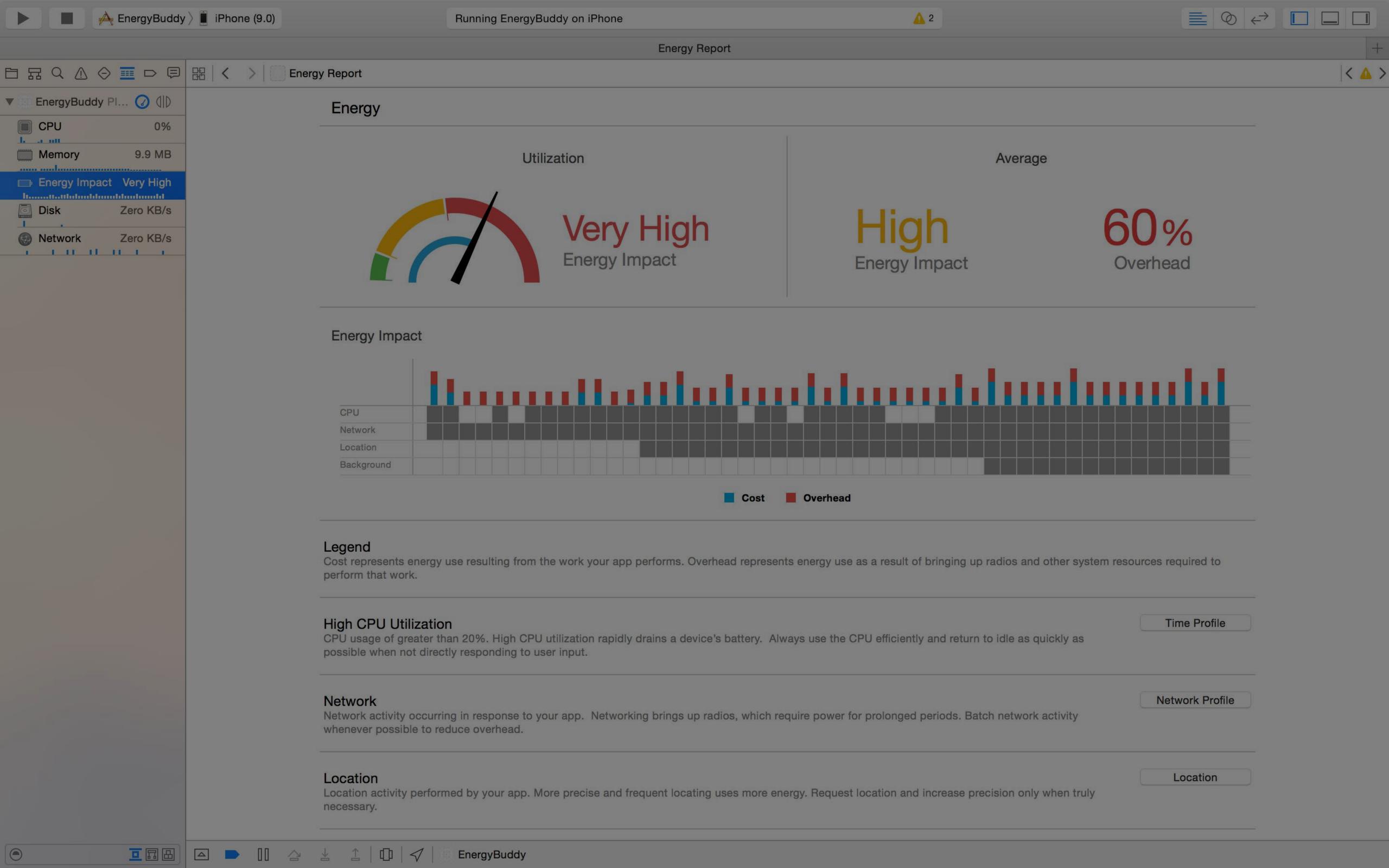


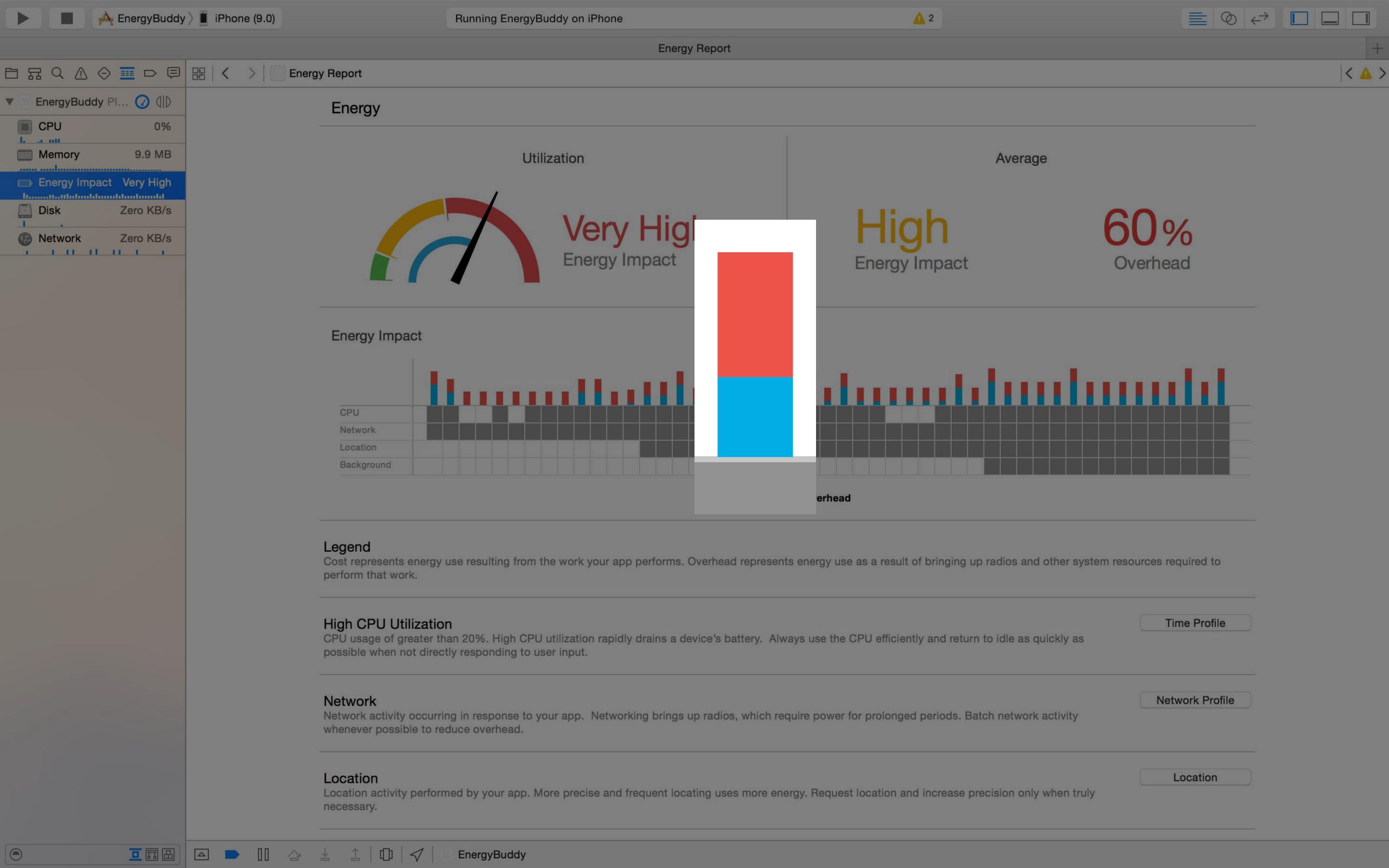


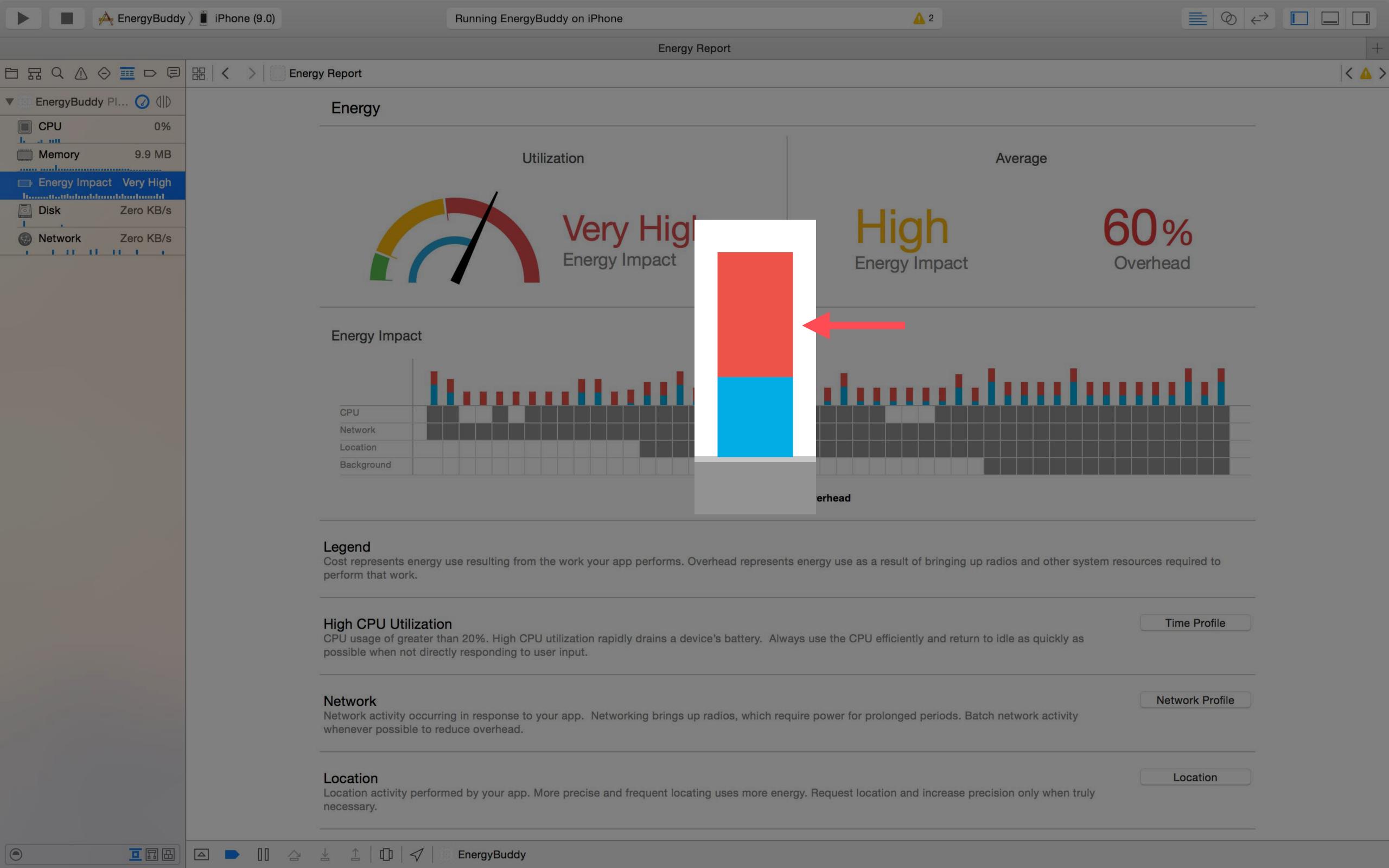


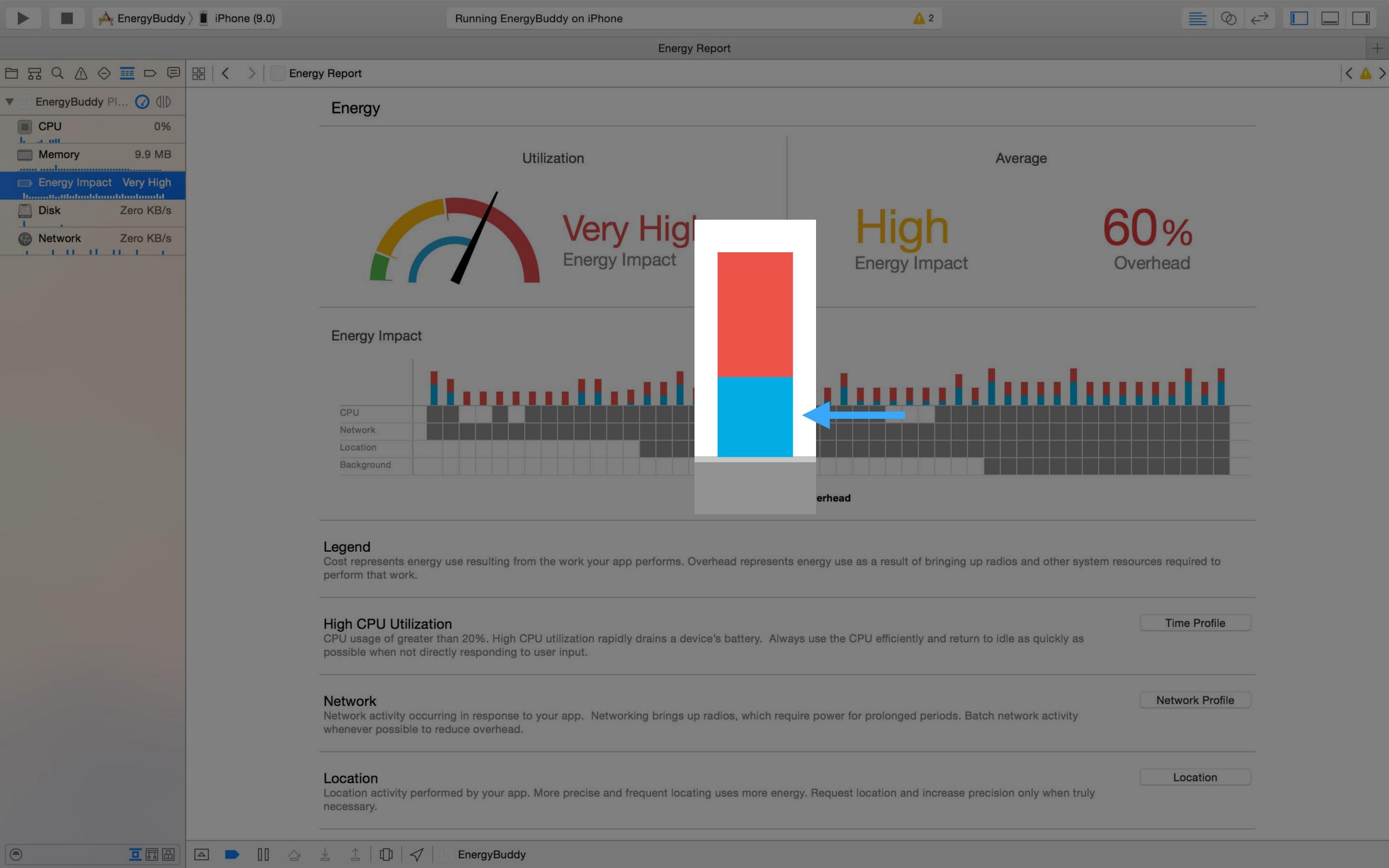


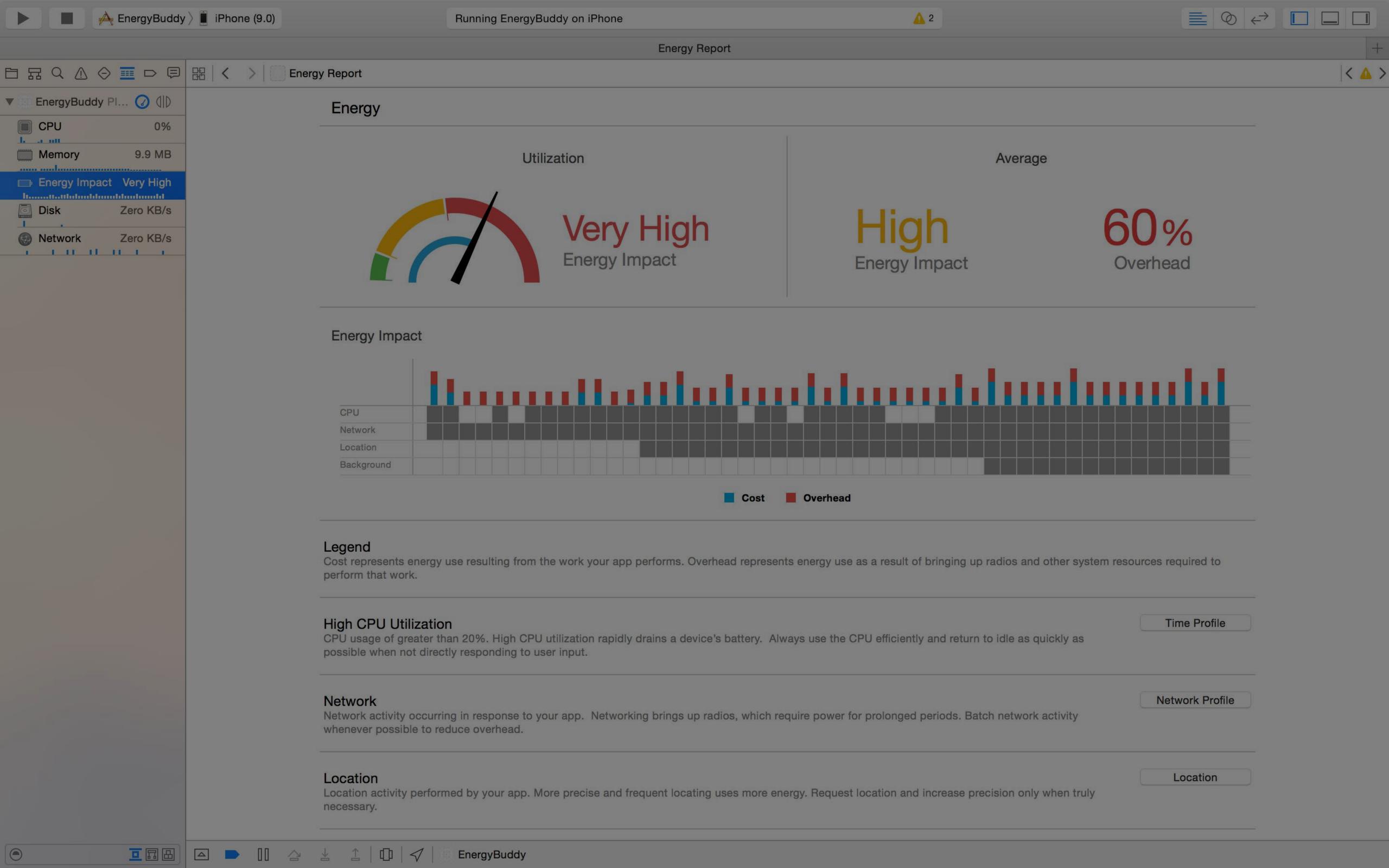


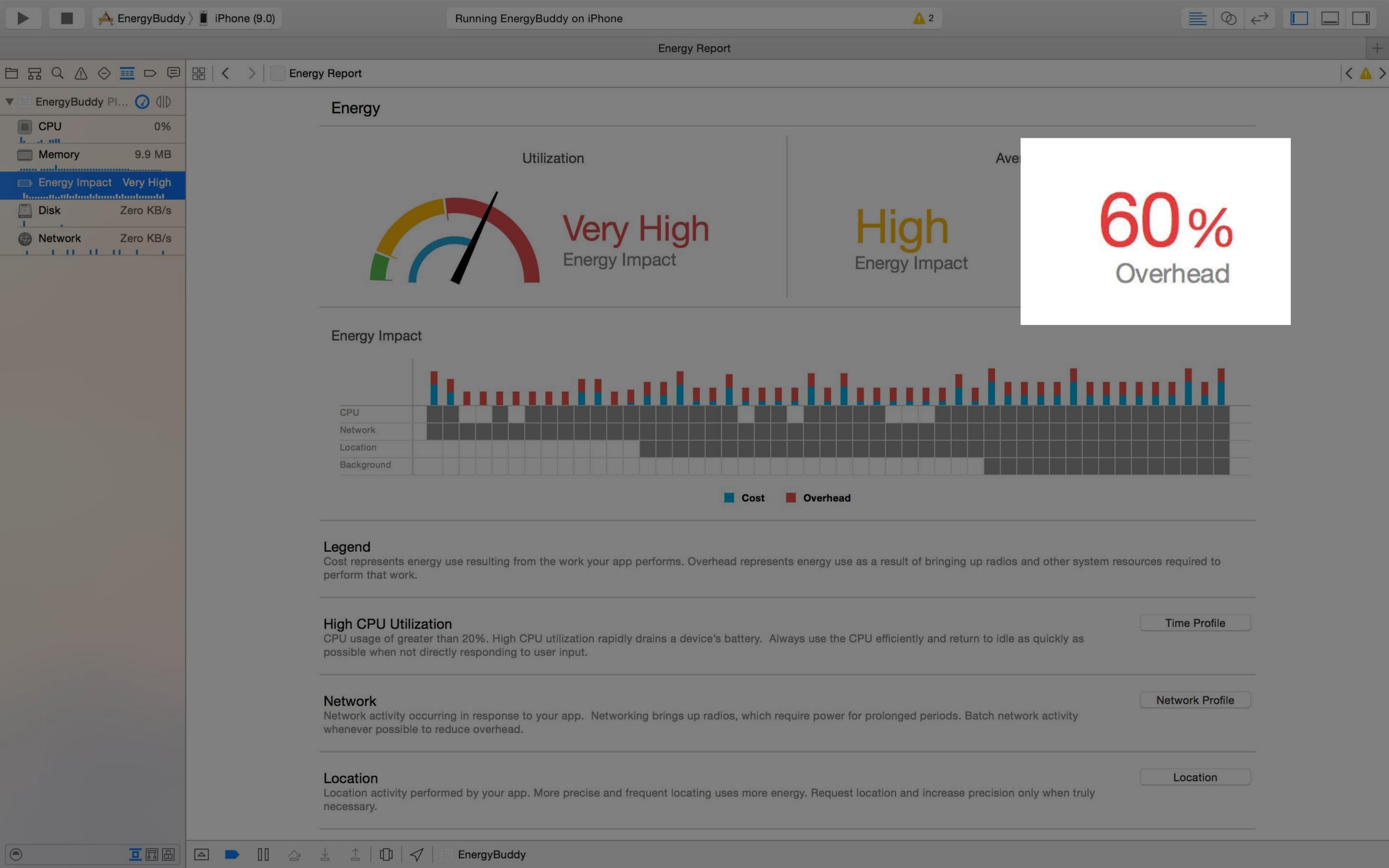


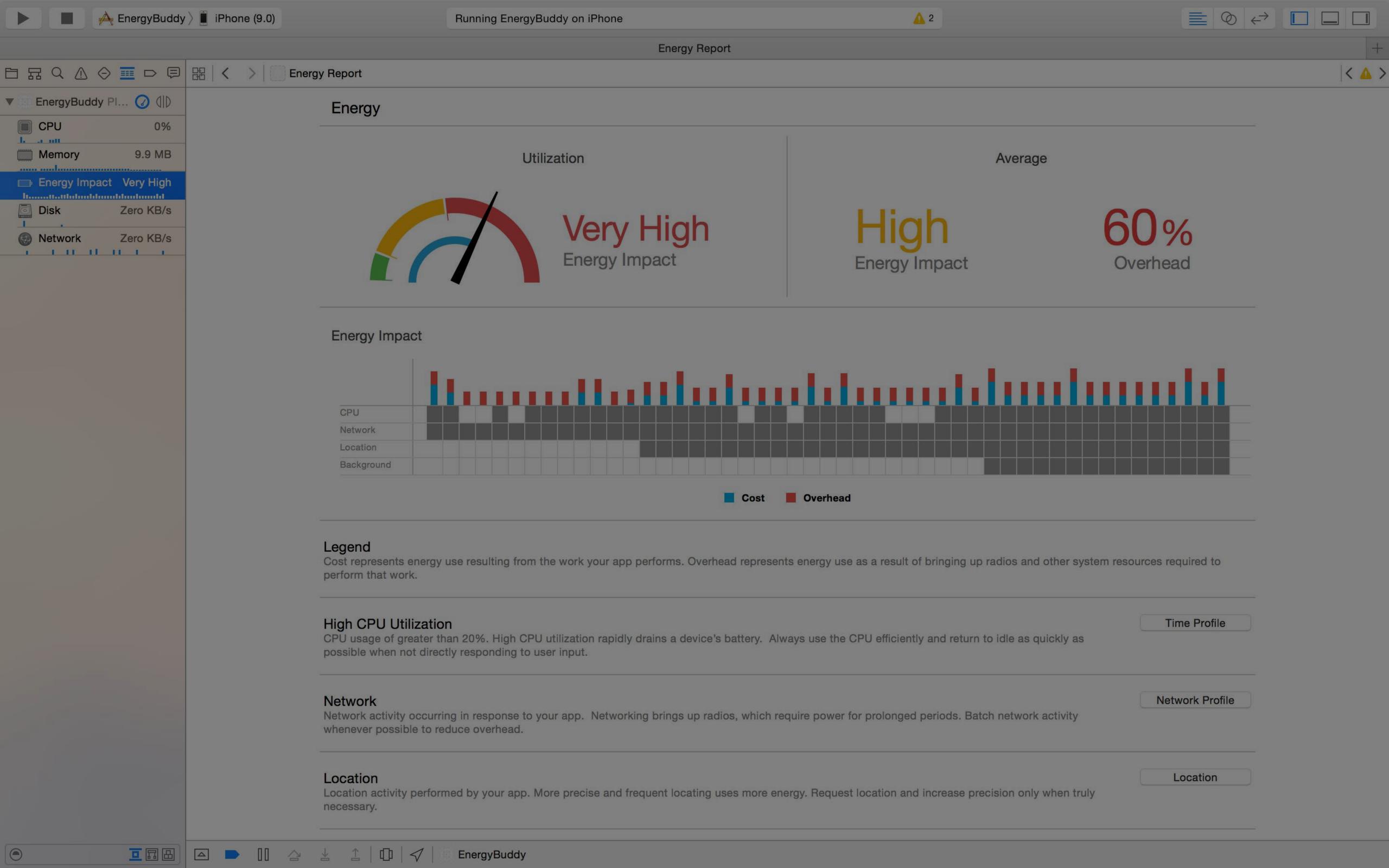


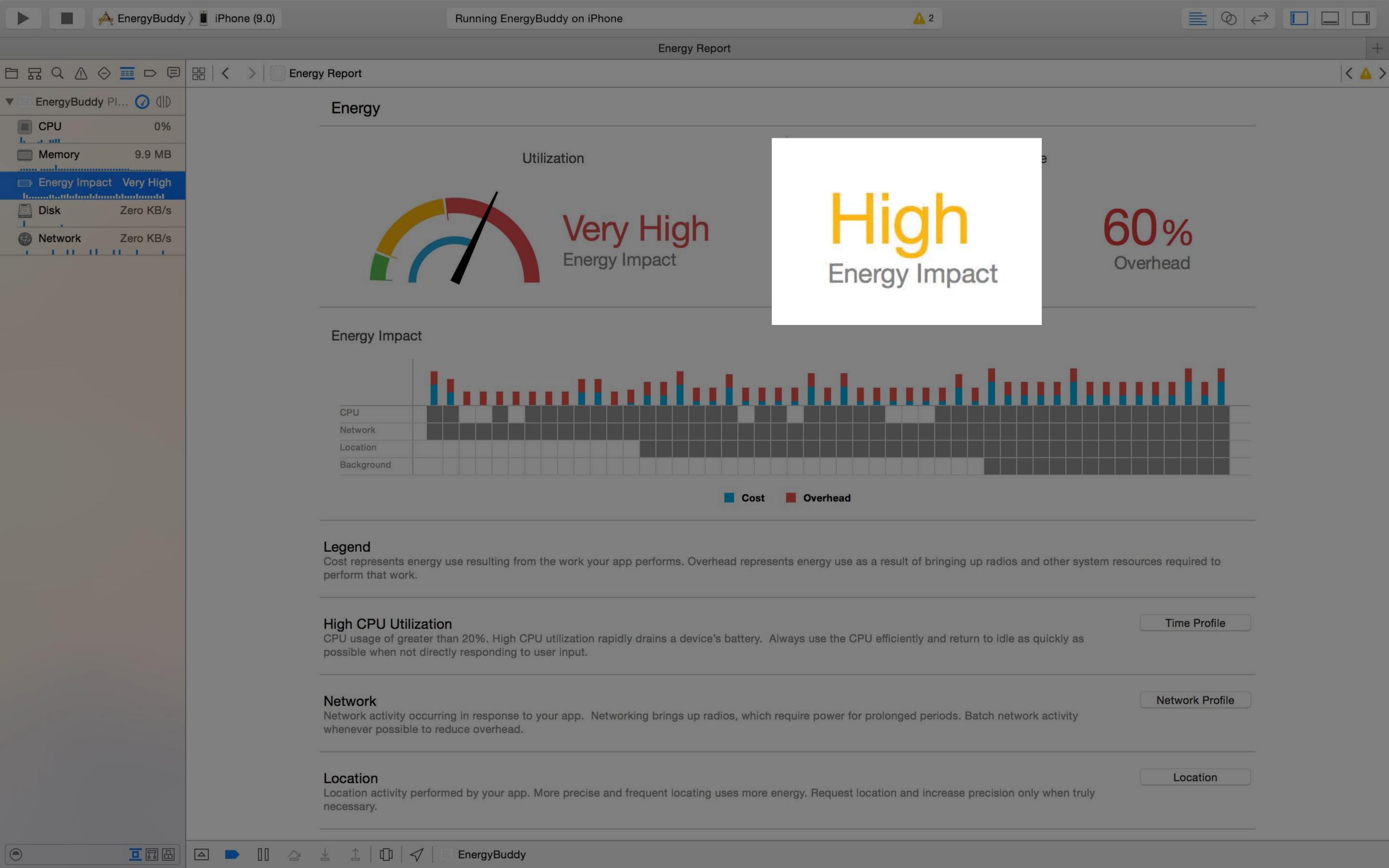


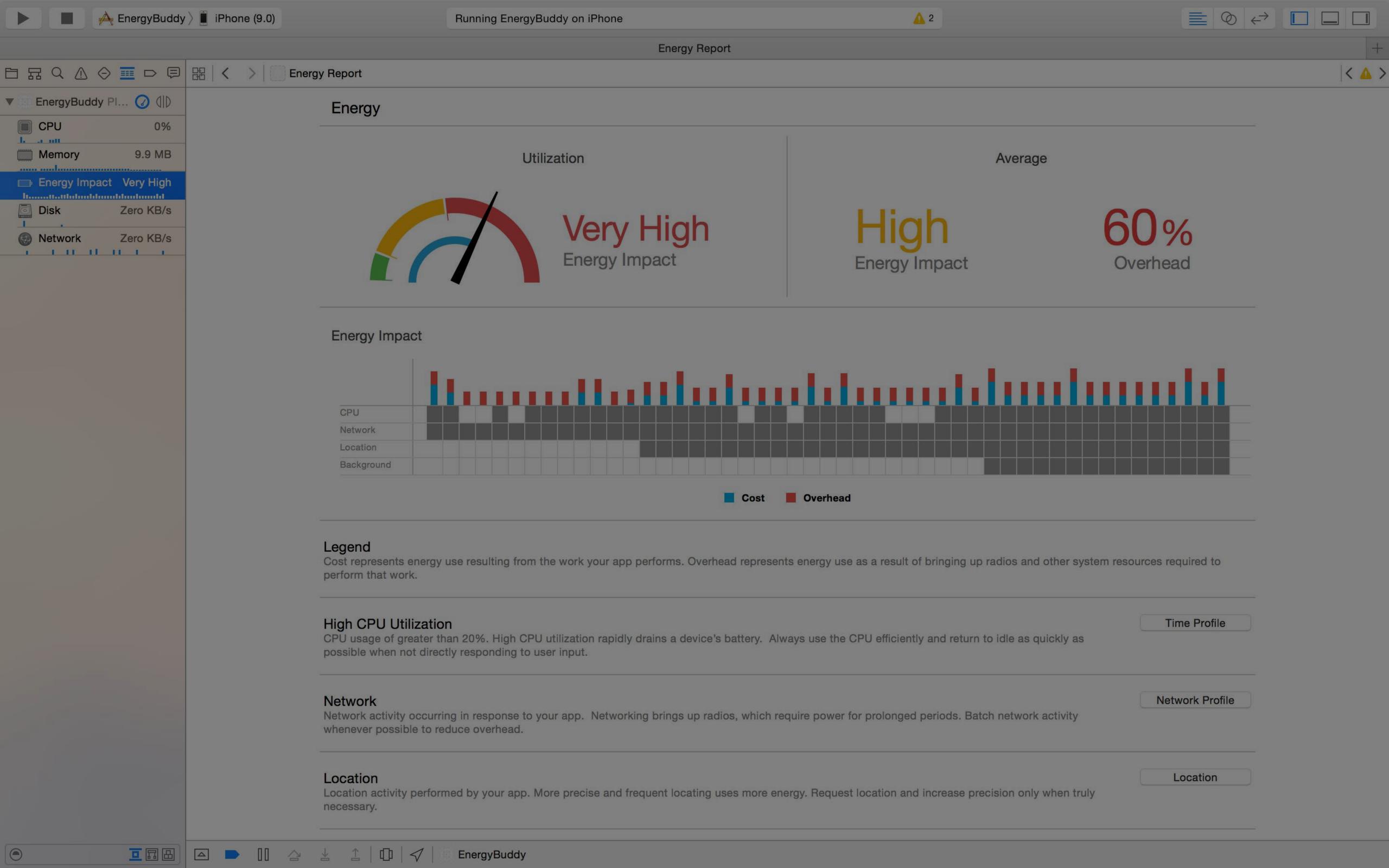


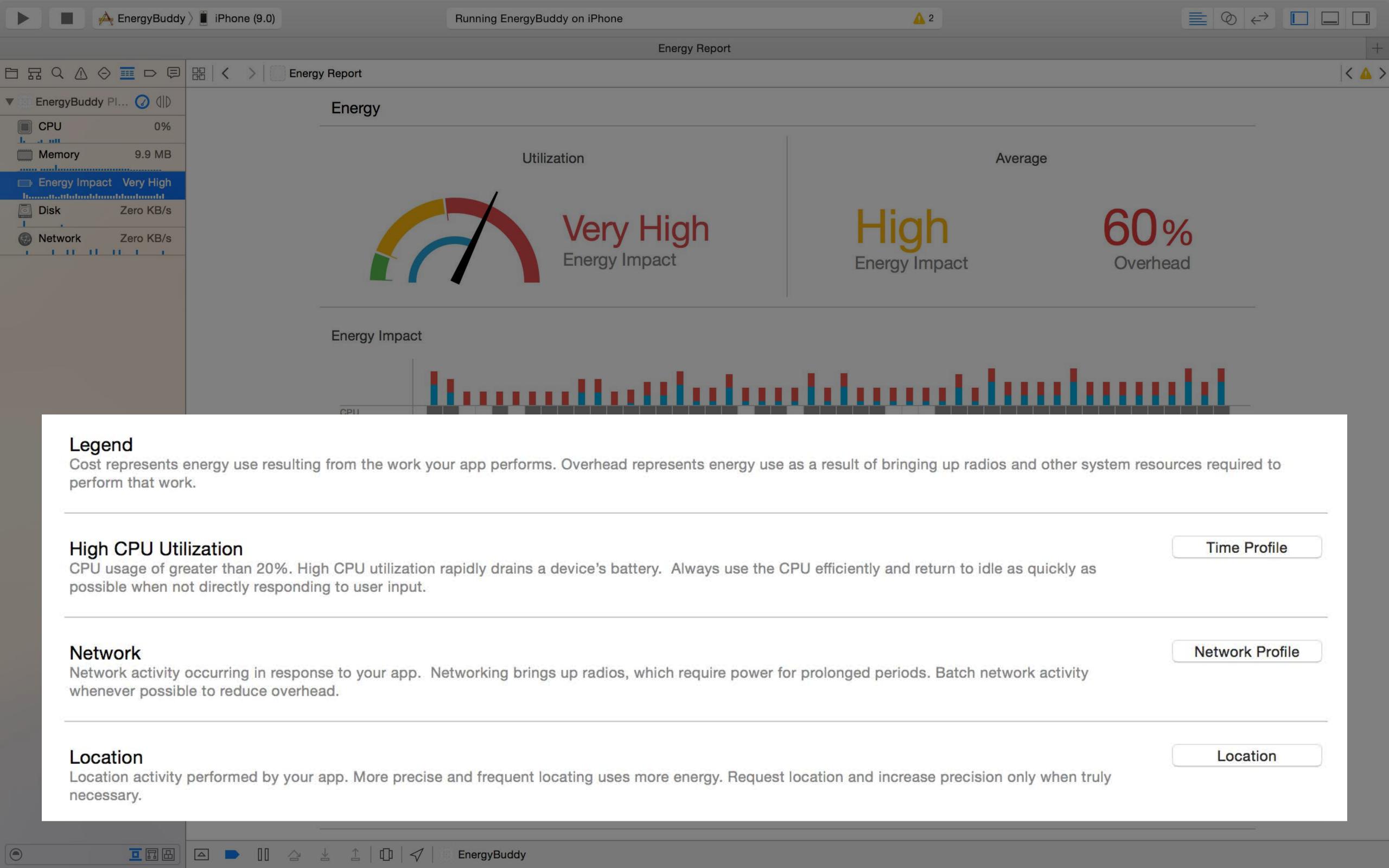


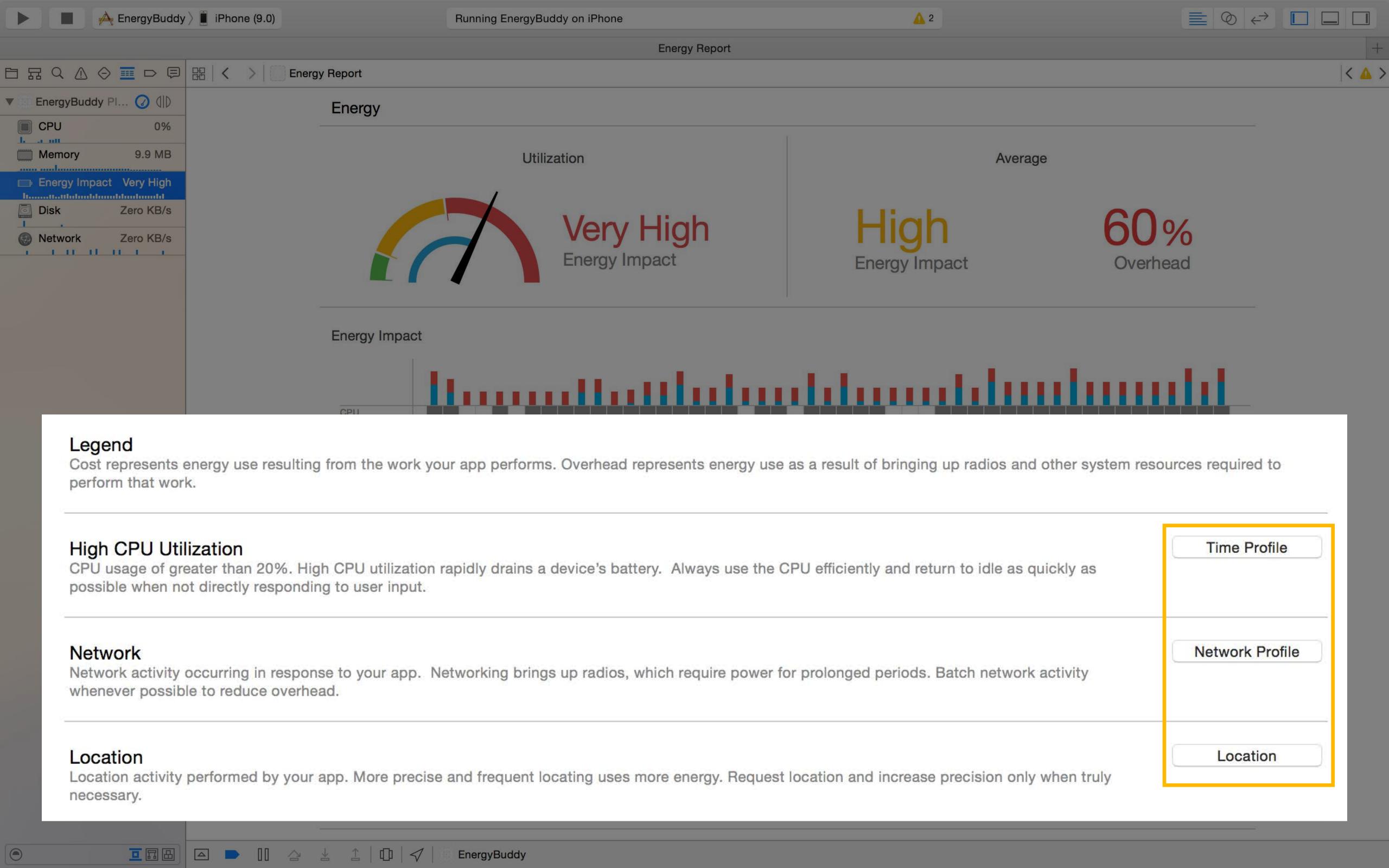


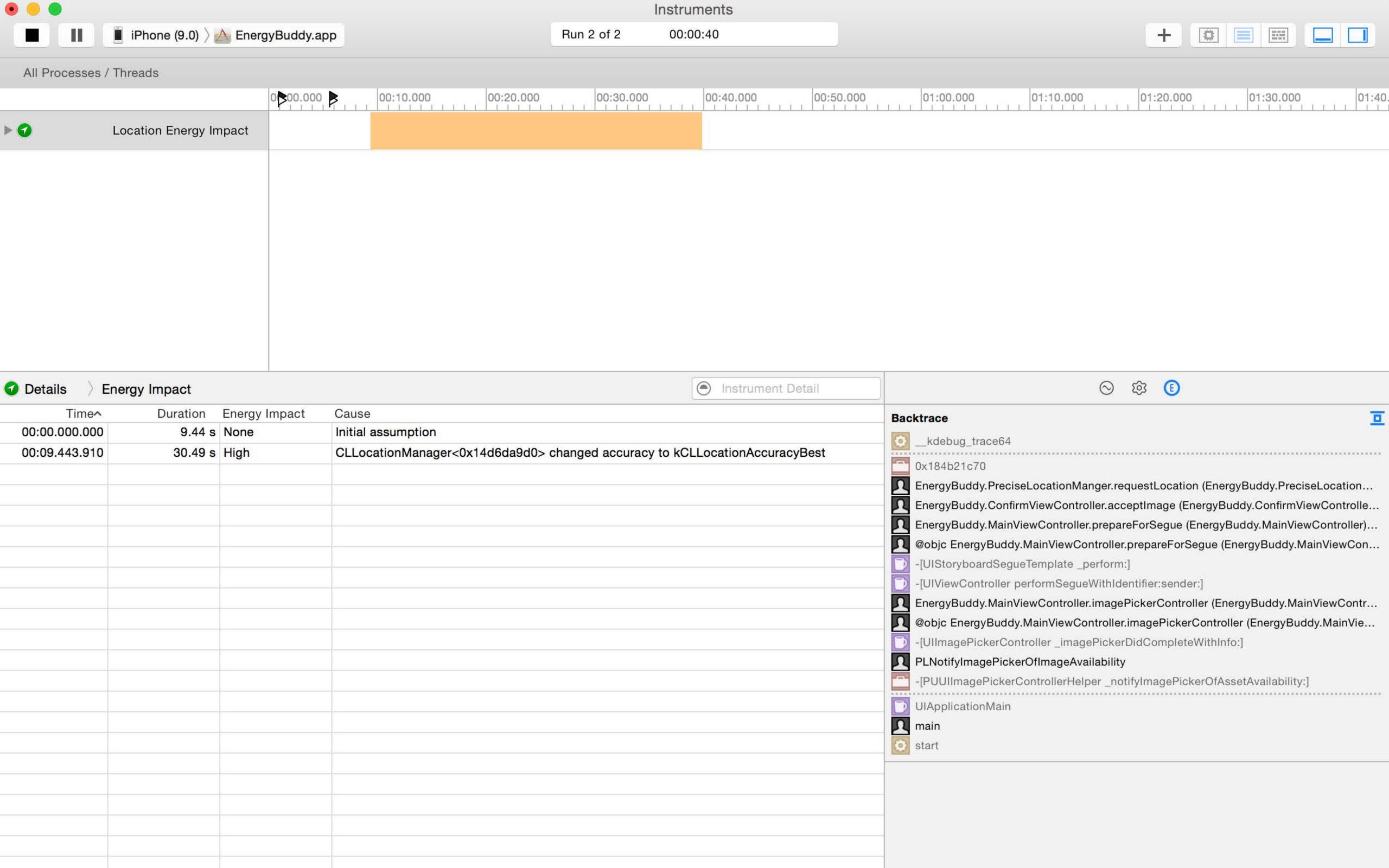


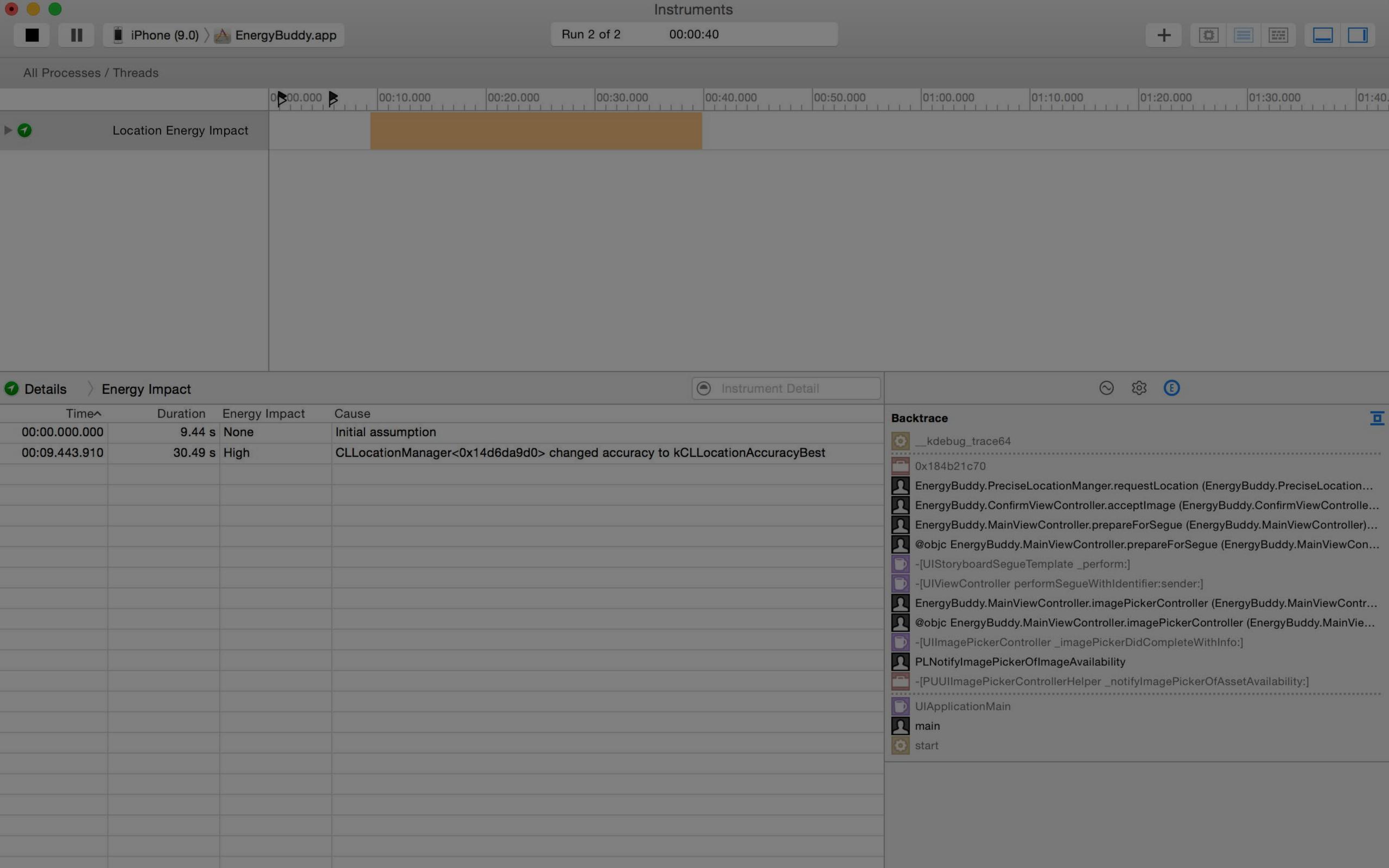


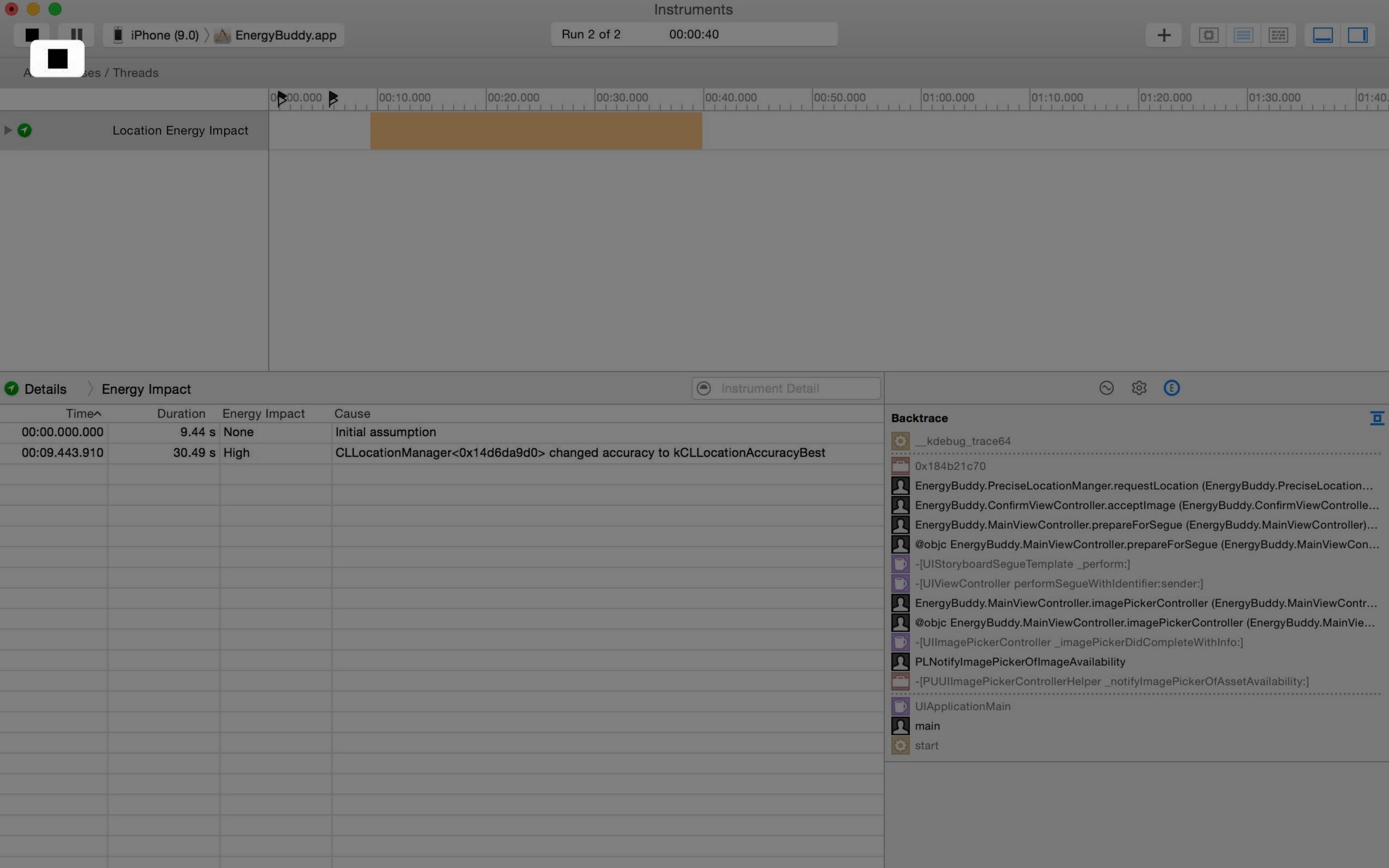


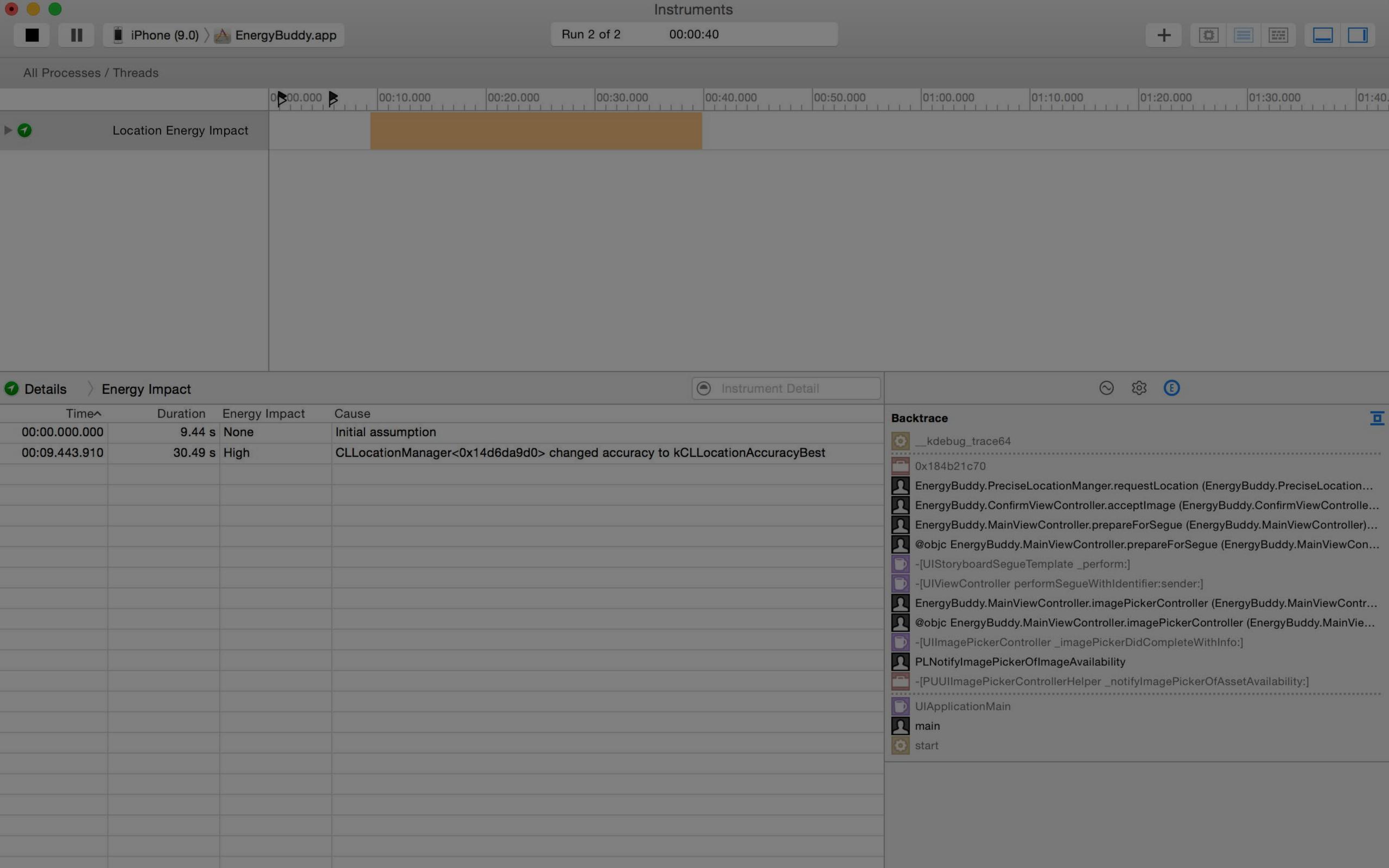


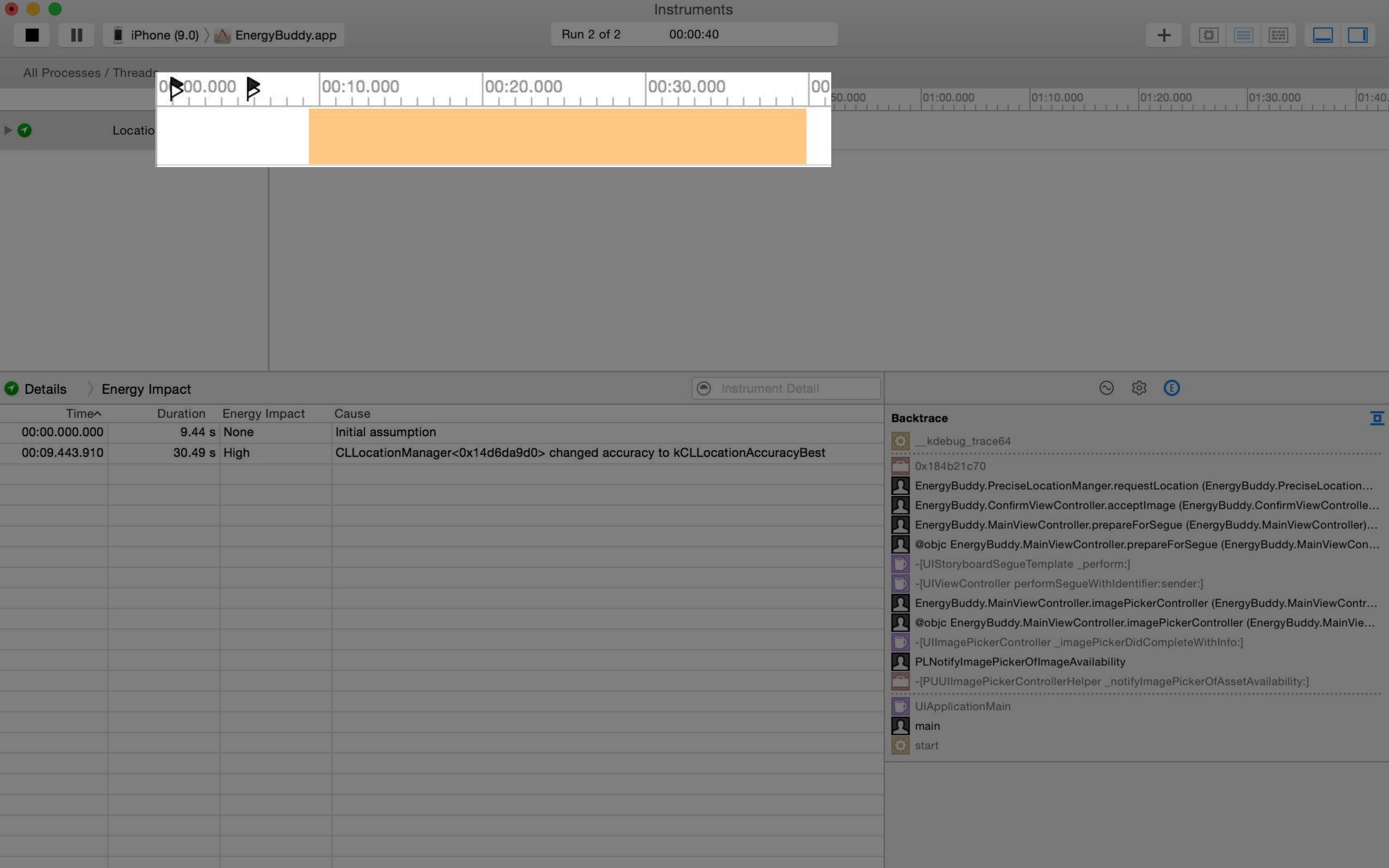


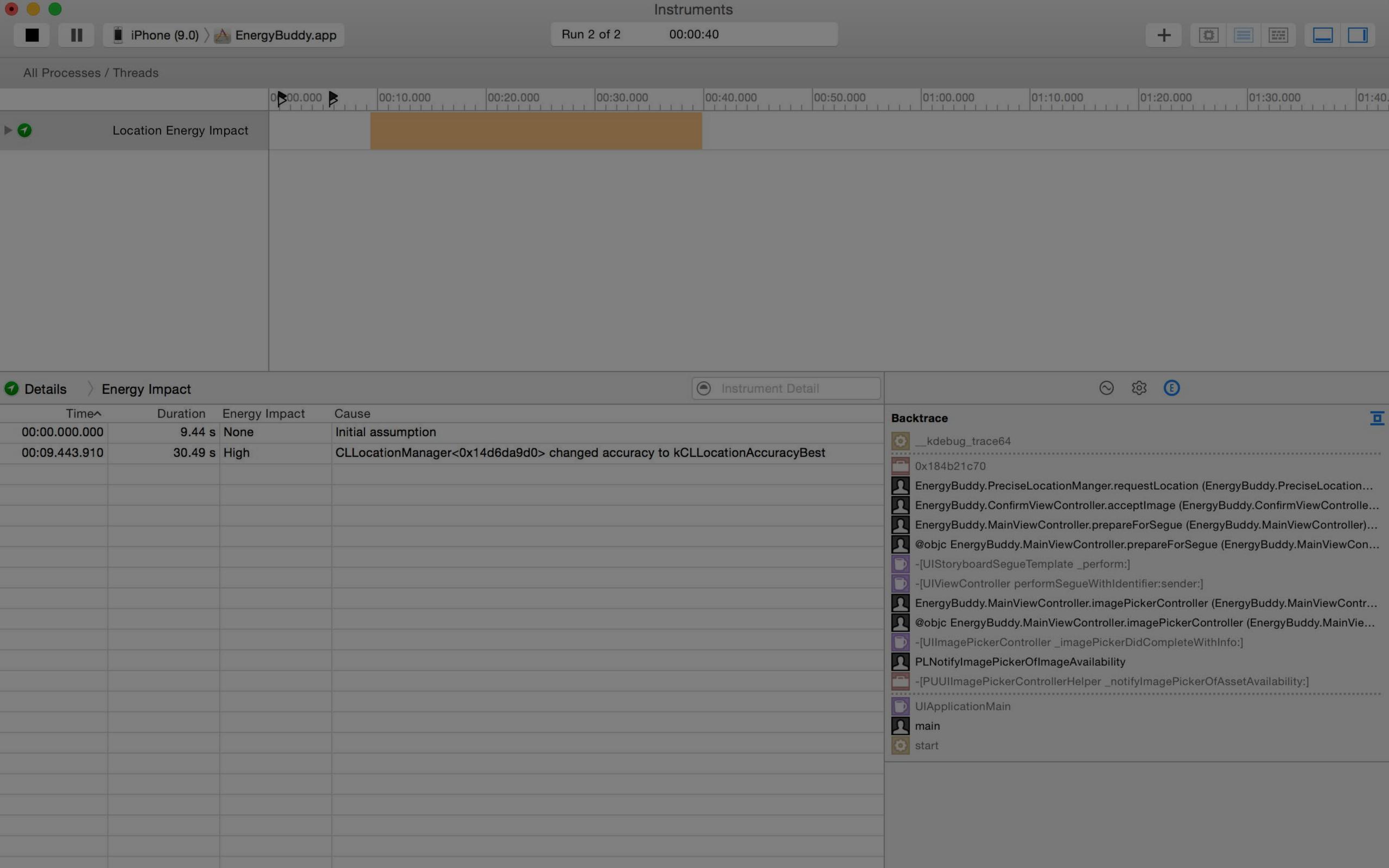


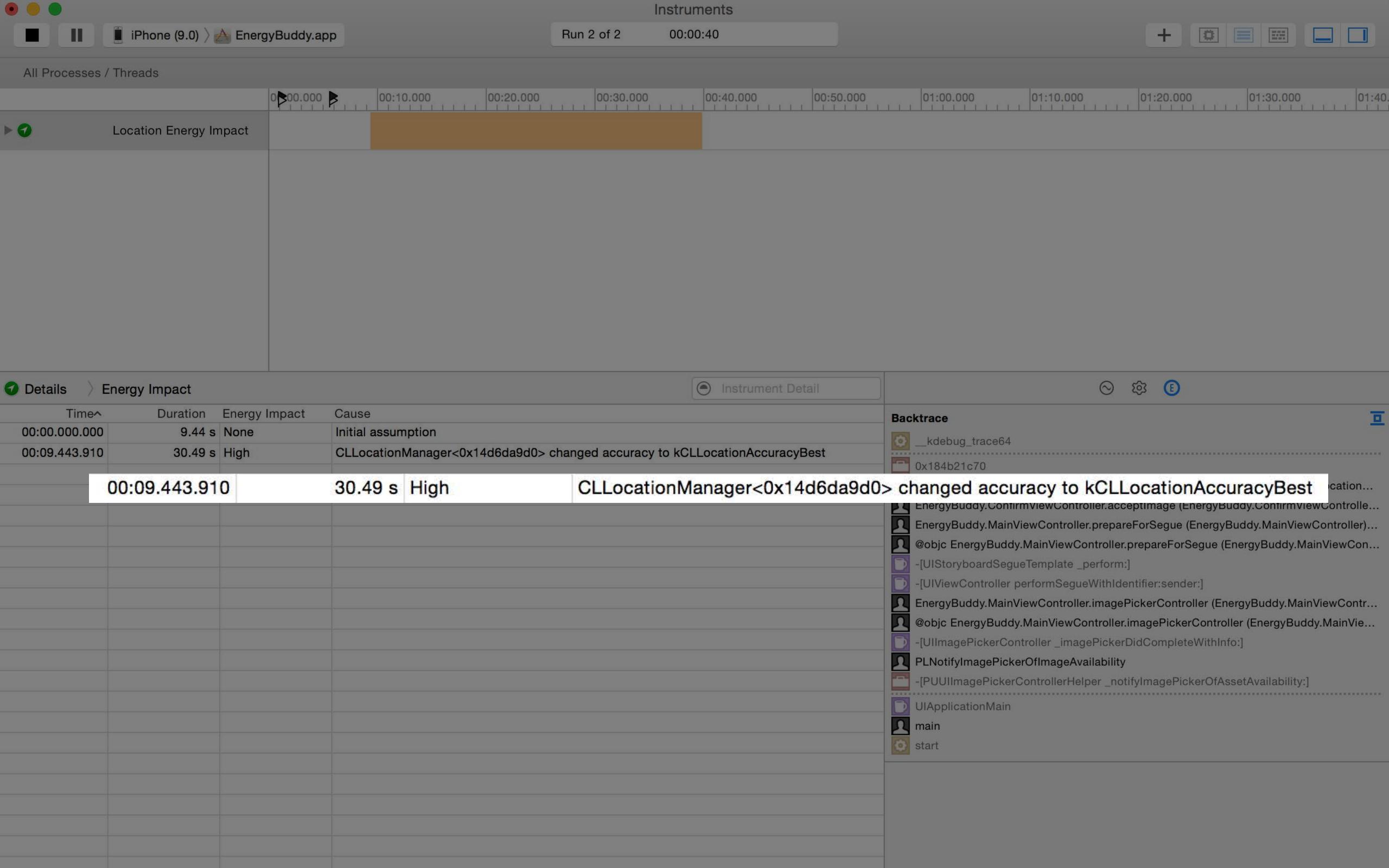


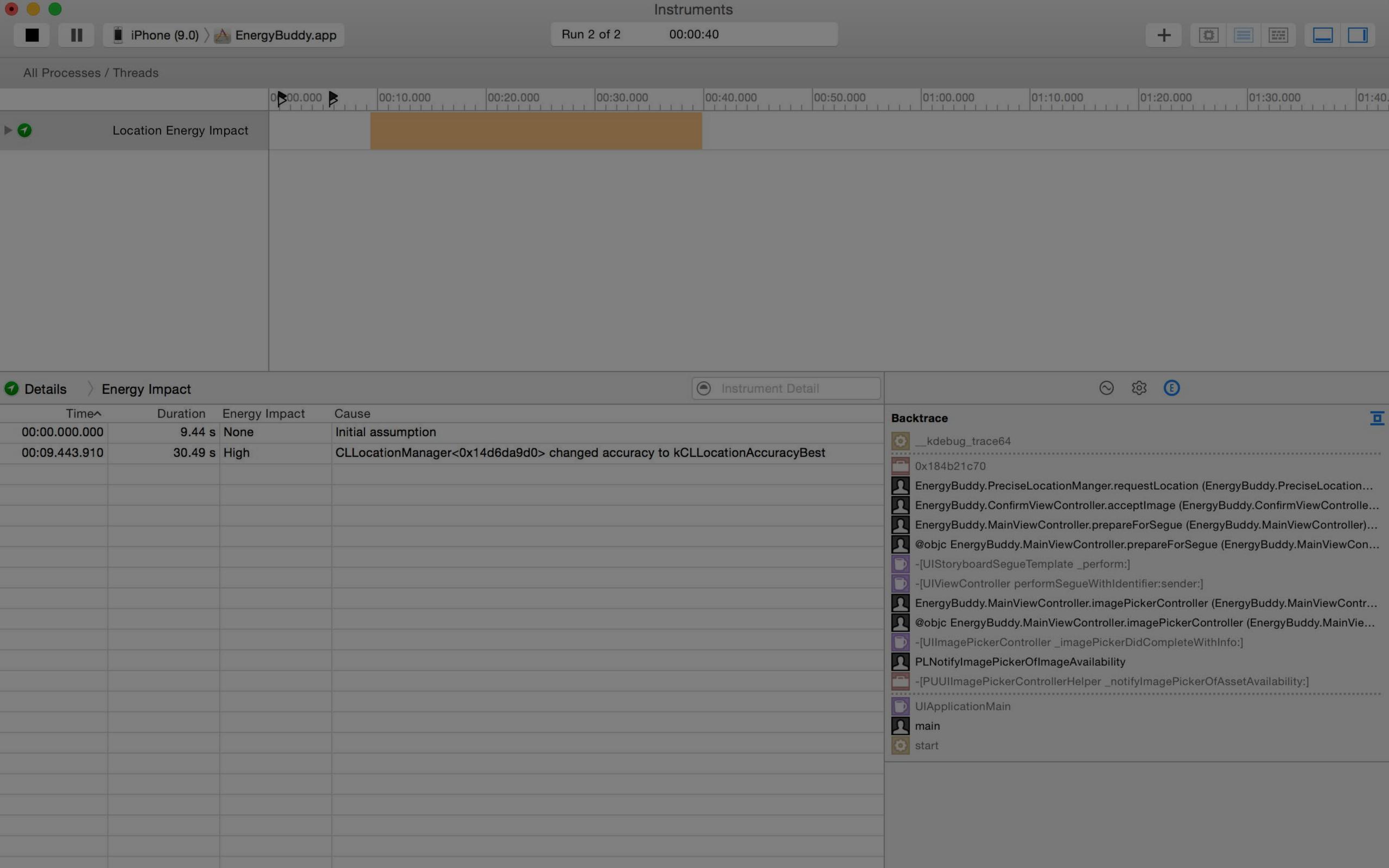


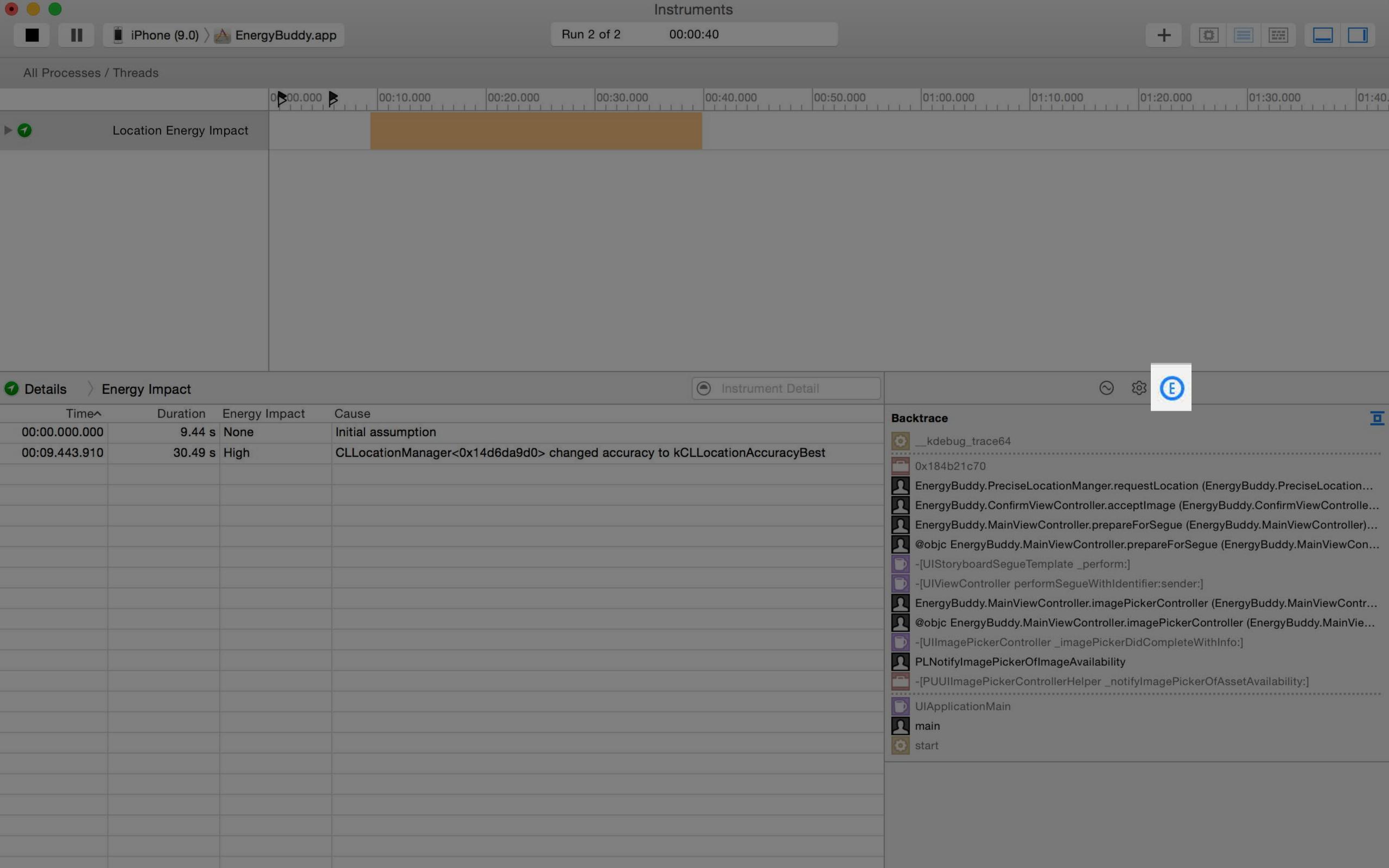


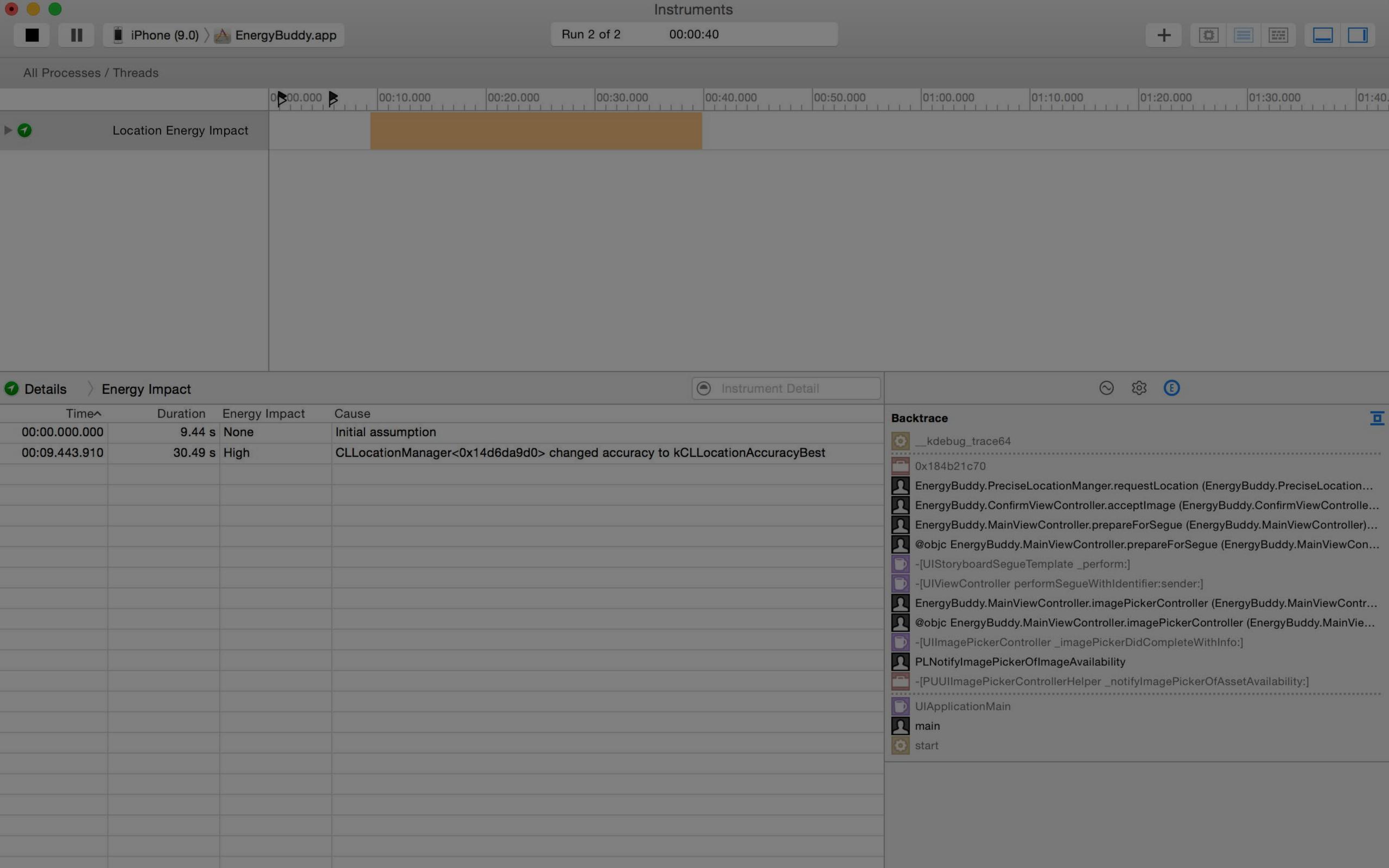


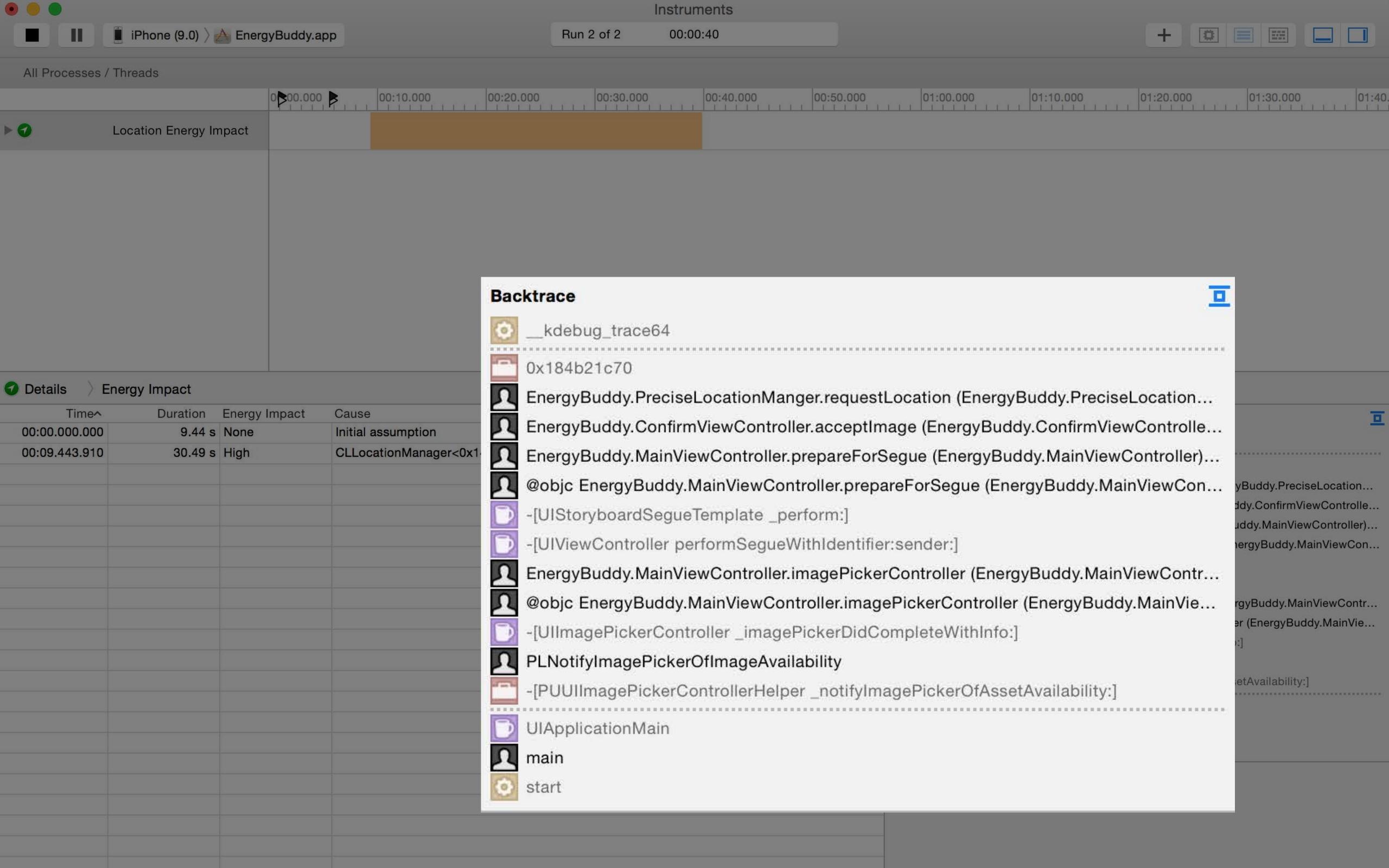


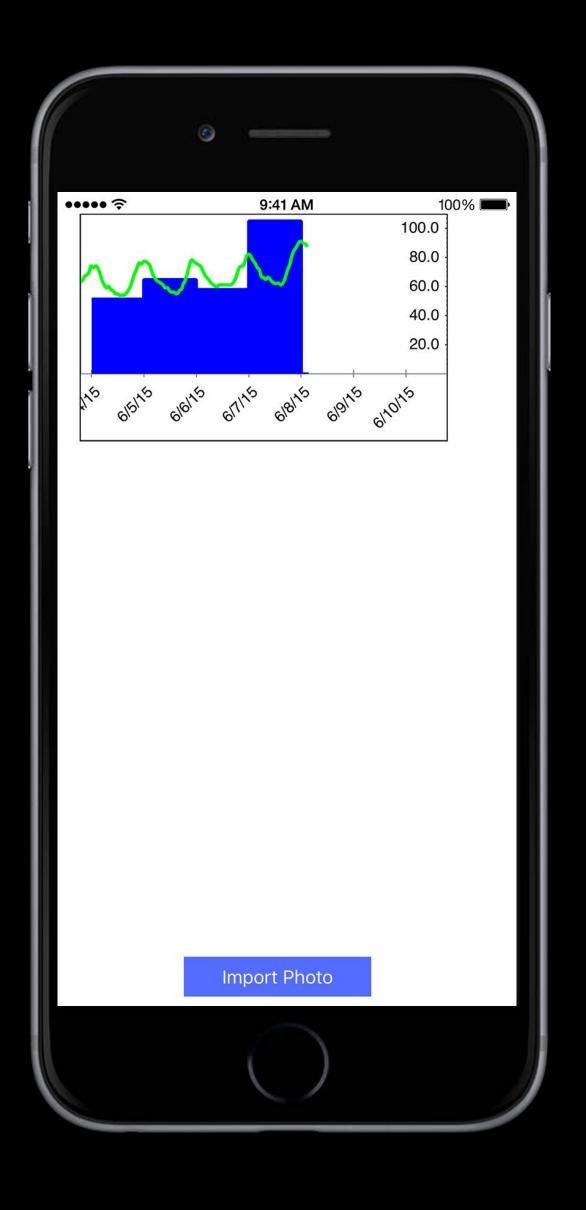




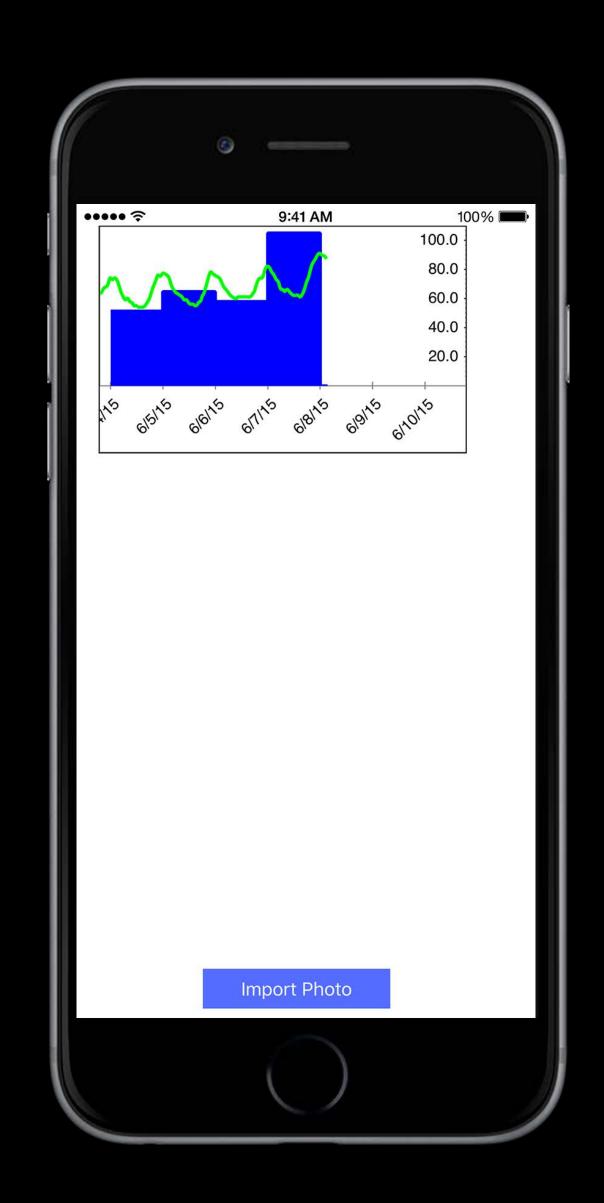


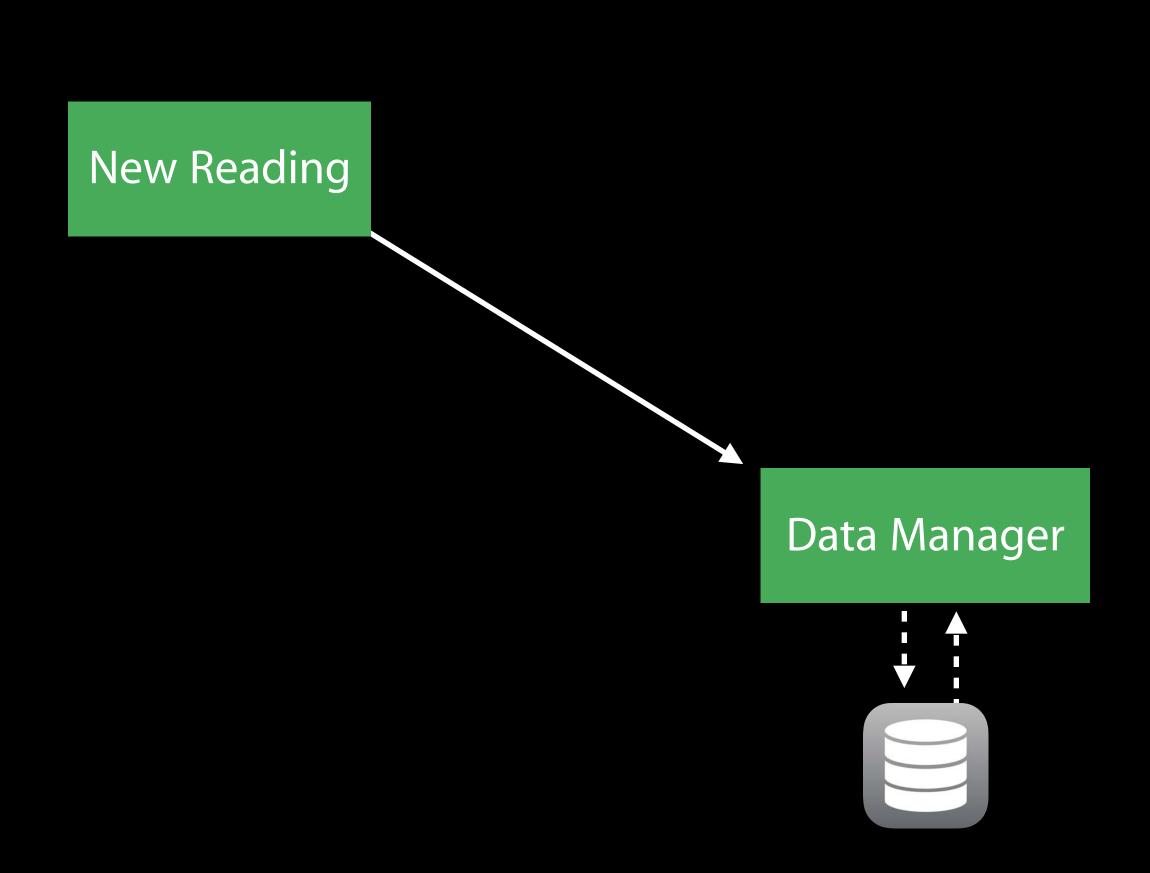


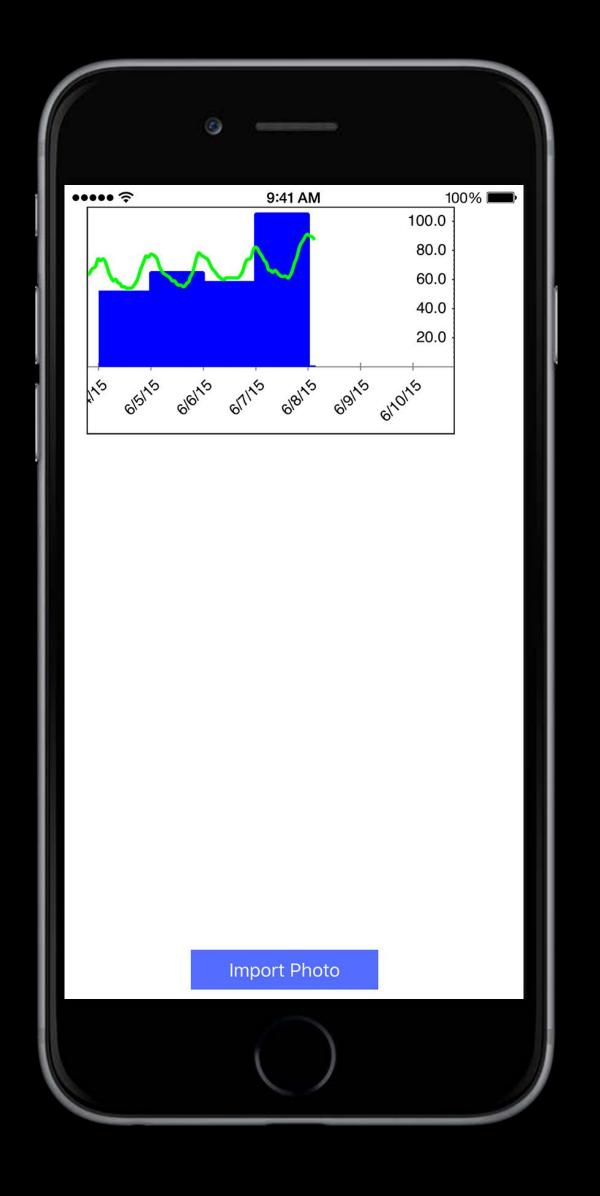


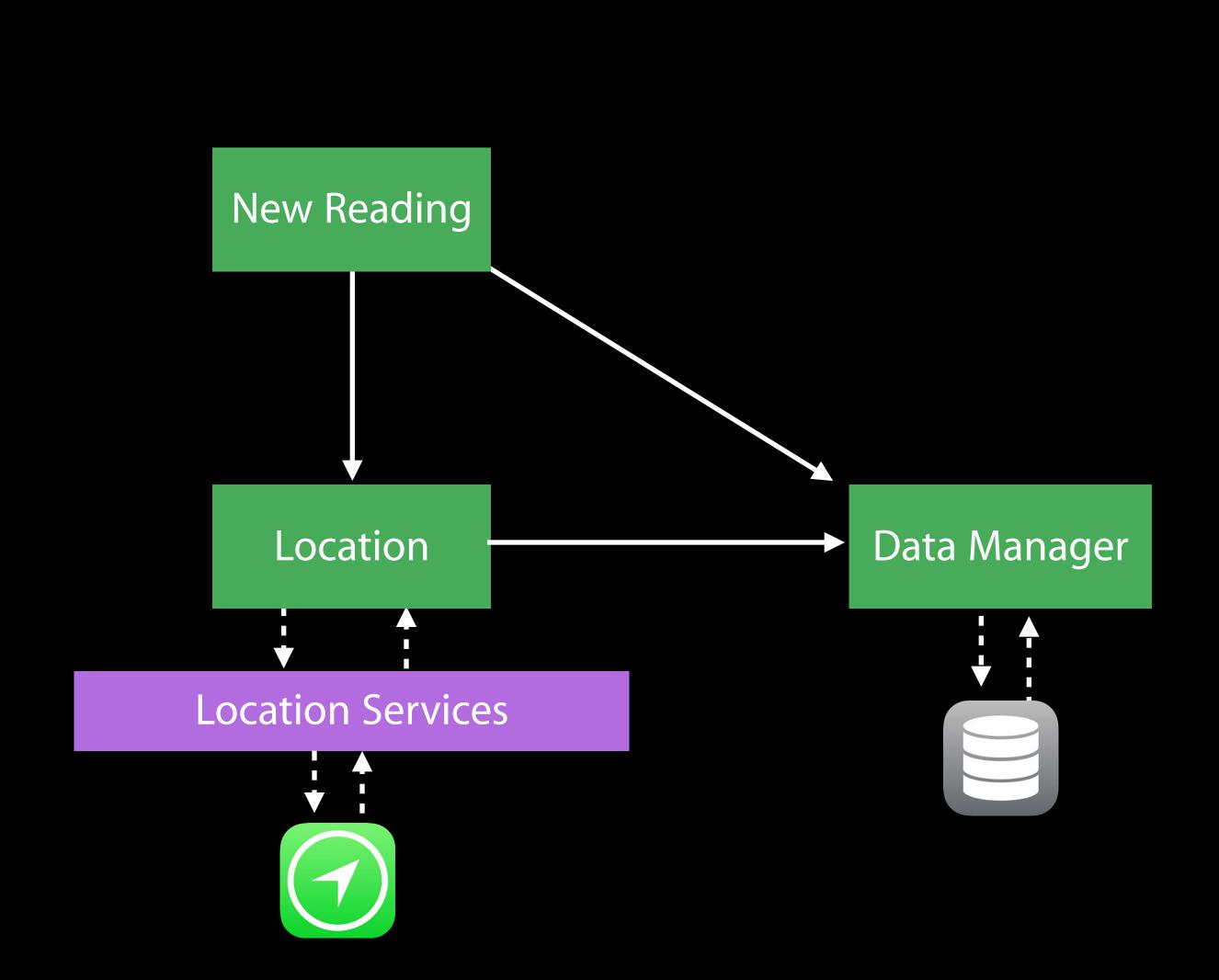


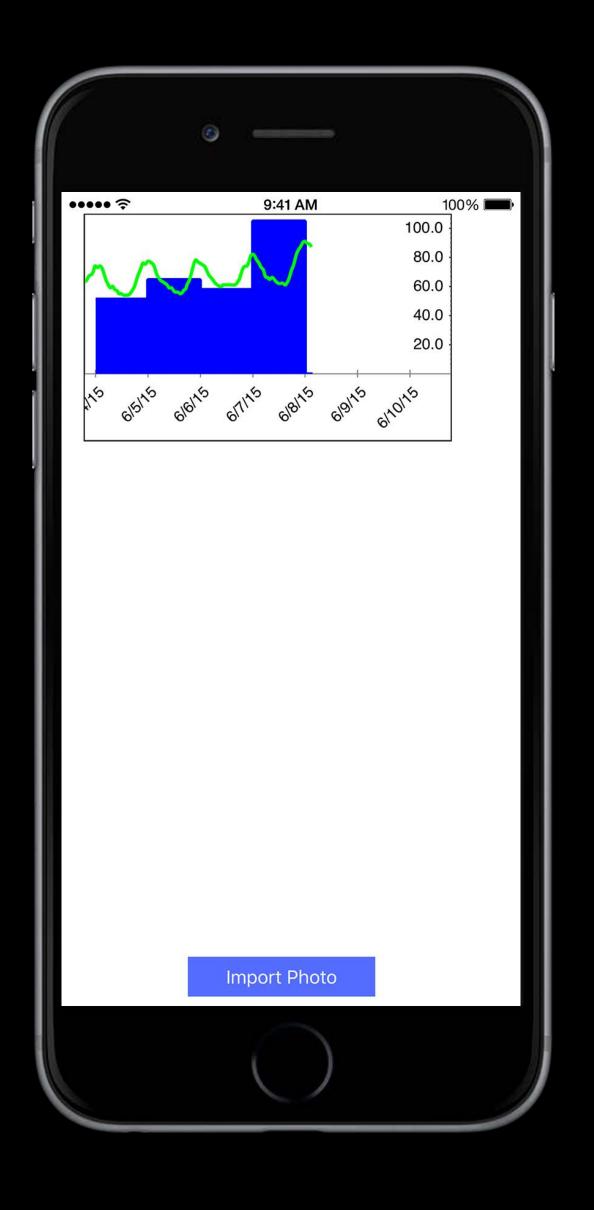


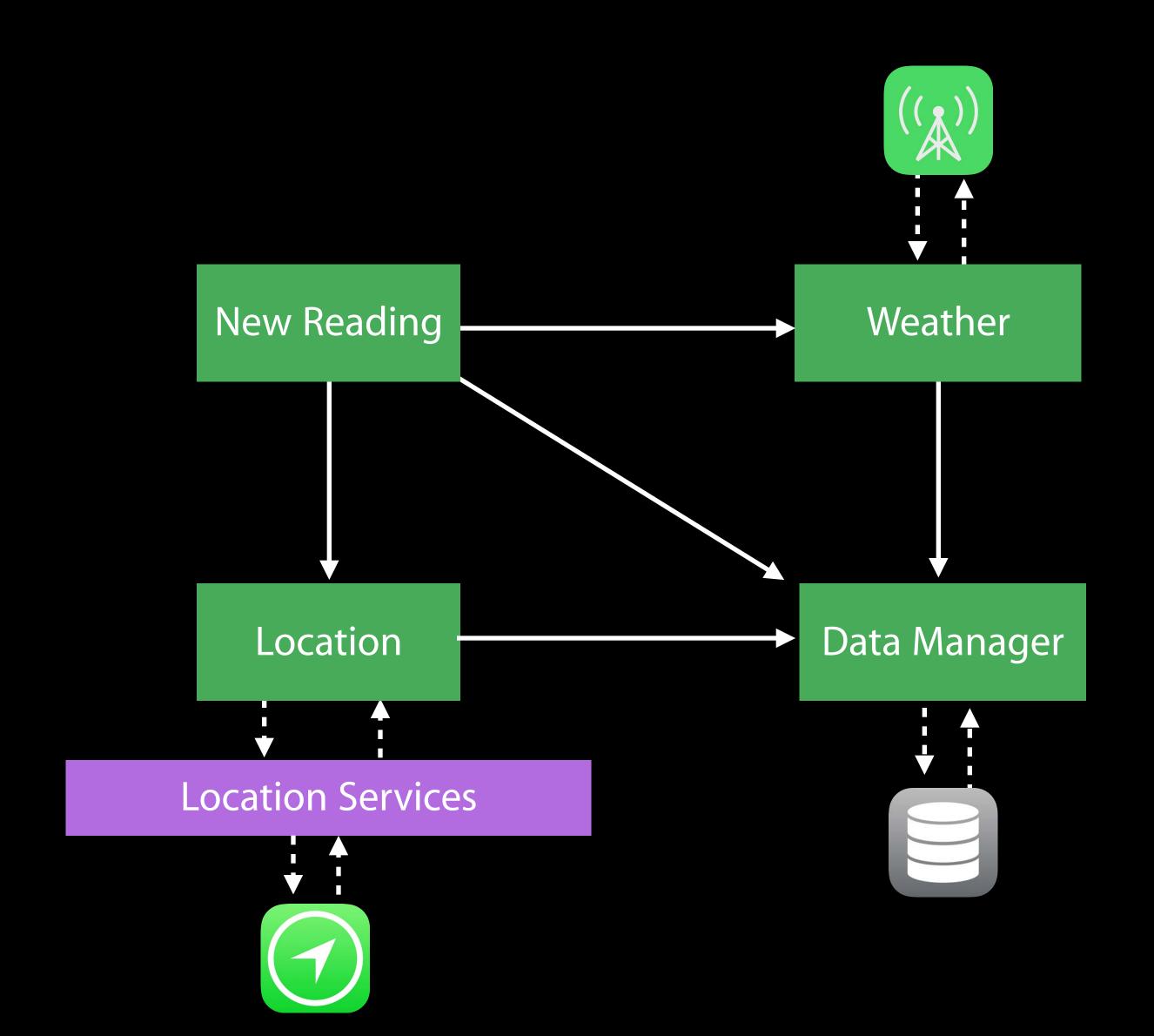


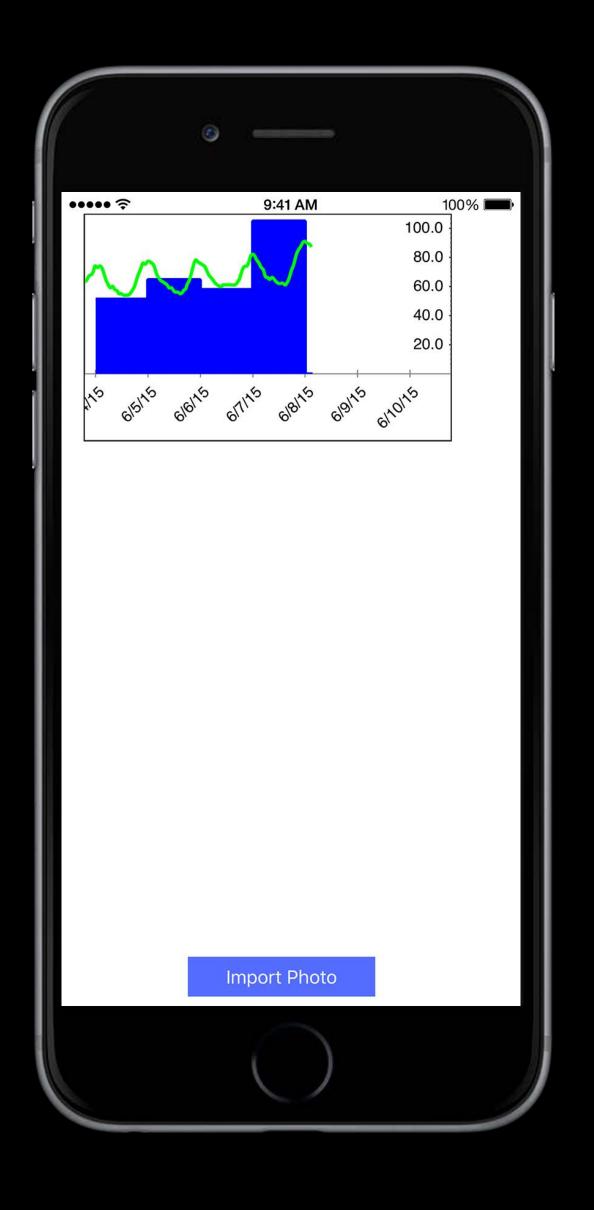


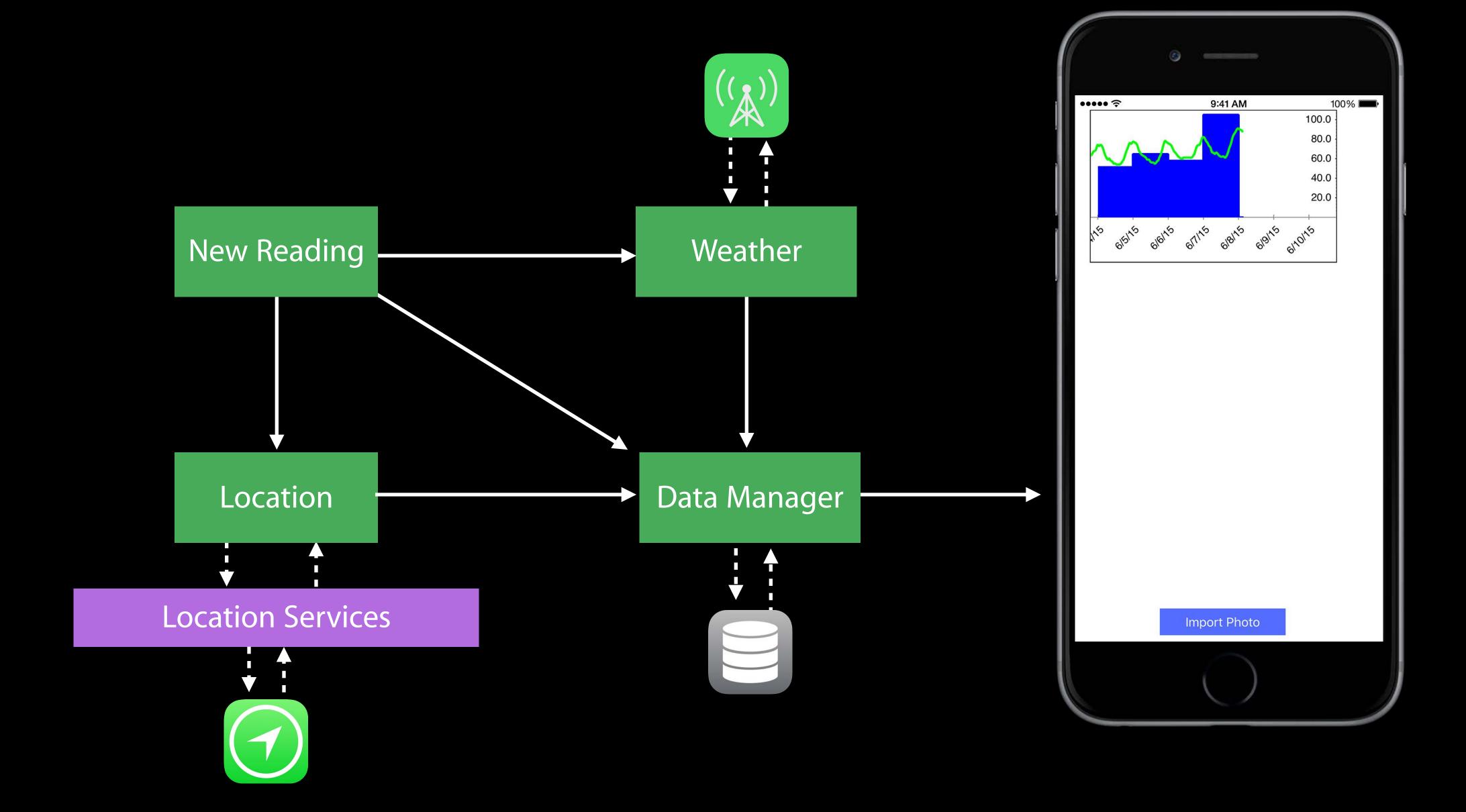












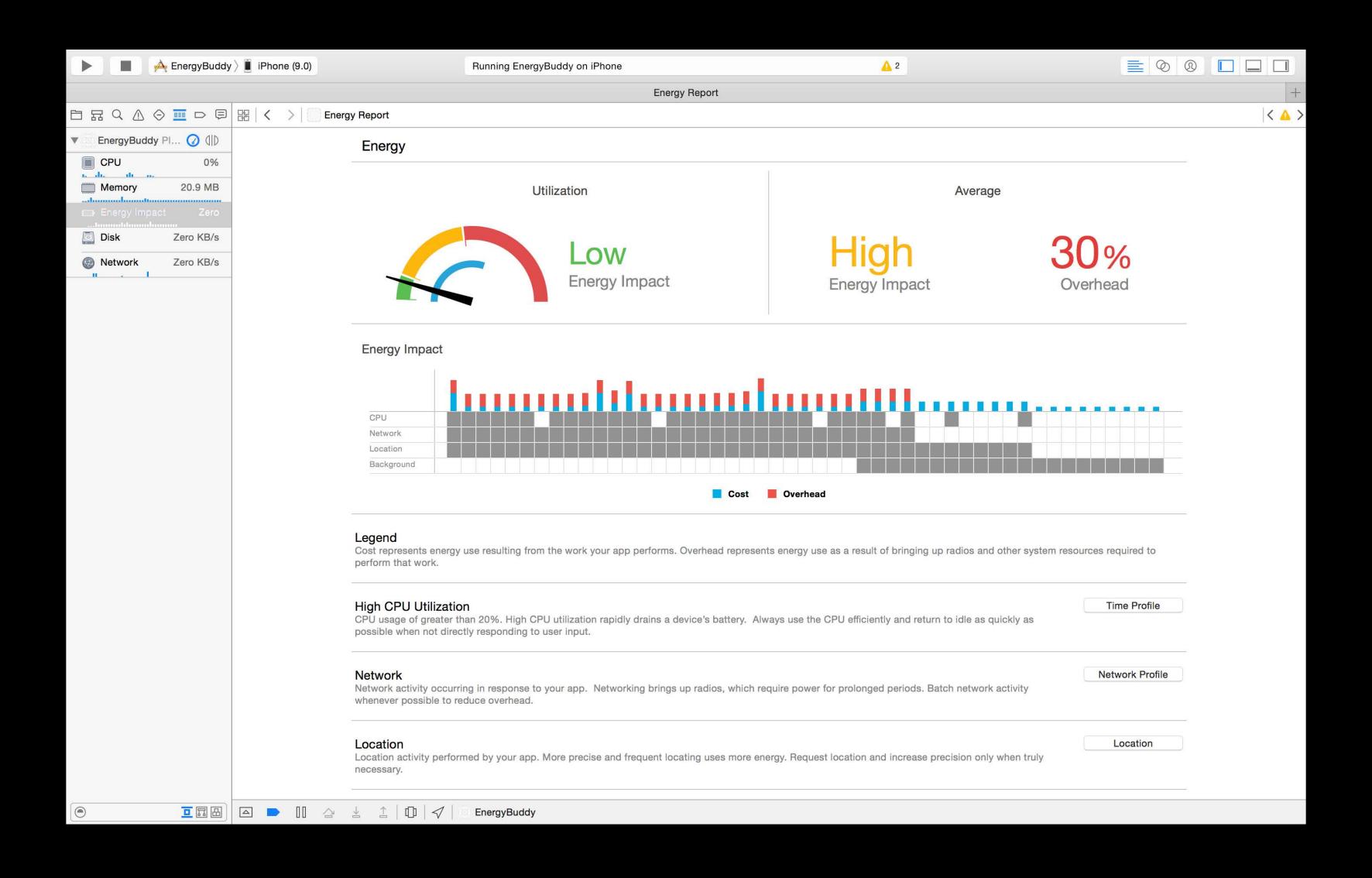


Demo

Pai-Han Huang iOS Power Team

- (1) Energy Fundamentals and Best Practices
- (2) Energy Debugging Workflow and Tools
- (3) Demo: Fixing Energy Issues on iOS
- (4) Final Thoughts

Energy inefficient code



Energy inefficient code

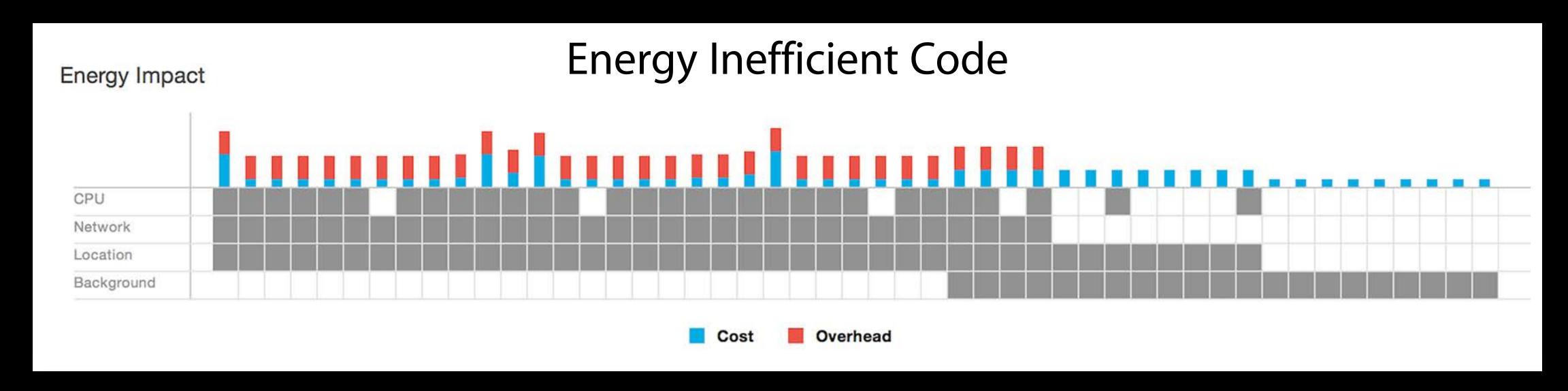
```
func locationManager(manager: CLLocationManager, .....) {
    let location = locations[locations.count-1] as! CLLocation
    if let confirmViewController? = self.confirmViewController {
        confirmViewController.handleLocation(location)
    }
}
```

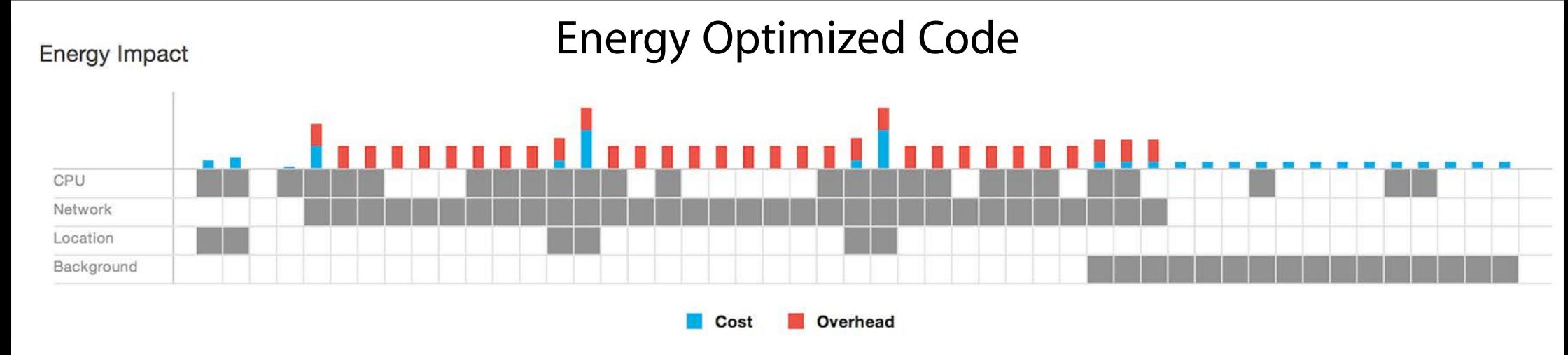


Energy optimized code

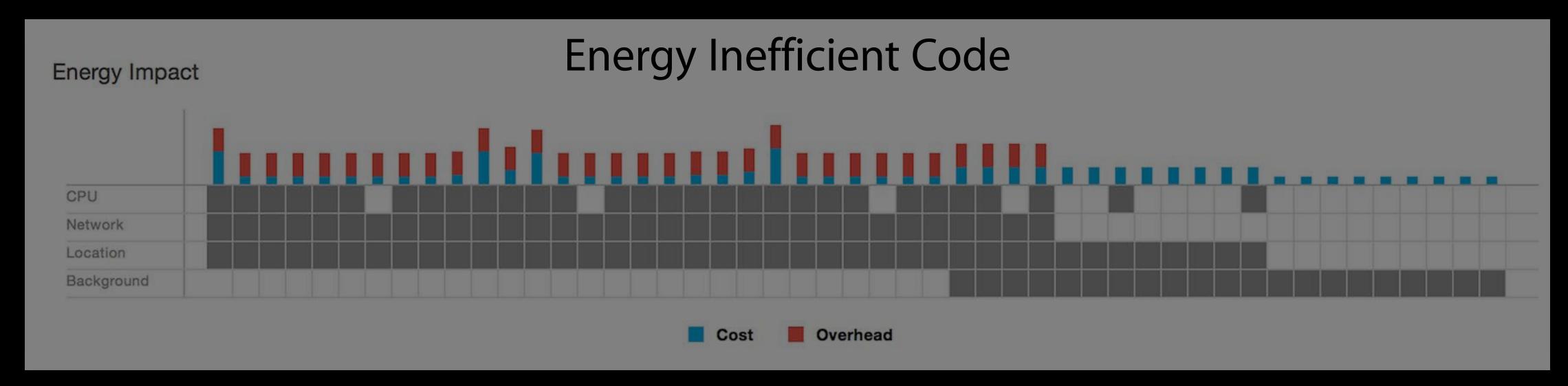
```
func locationManager(manager: CLLocationManager, .....) {
    let location = locations[locations.count-1] as! CLLocation
    if let confirmViewController? = self.confirmViewController {
        confirmViewController.handleLocation(location)
    }
    self.locationManager.stopUpdatingLocation()
}
```

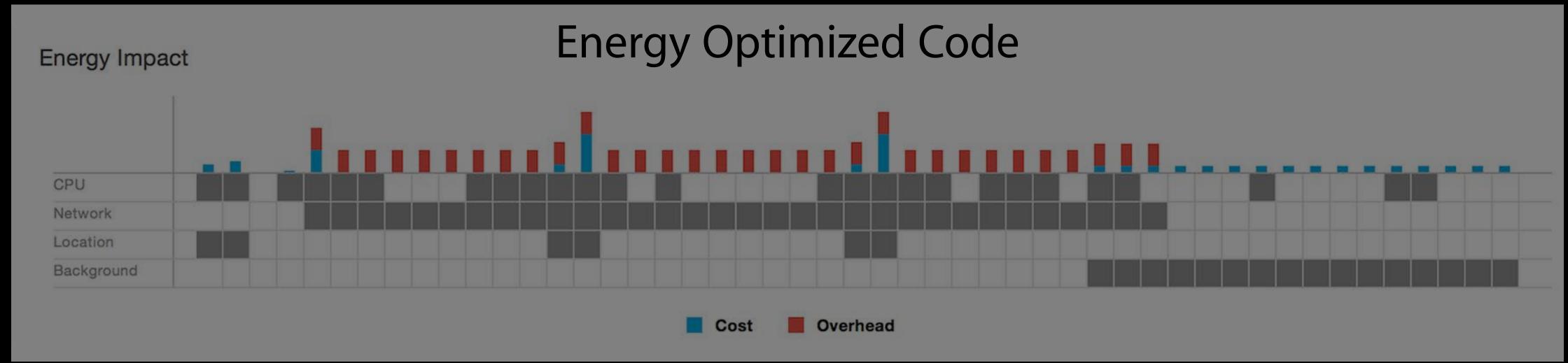




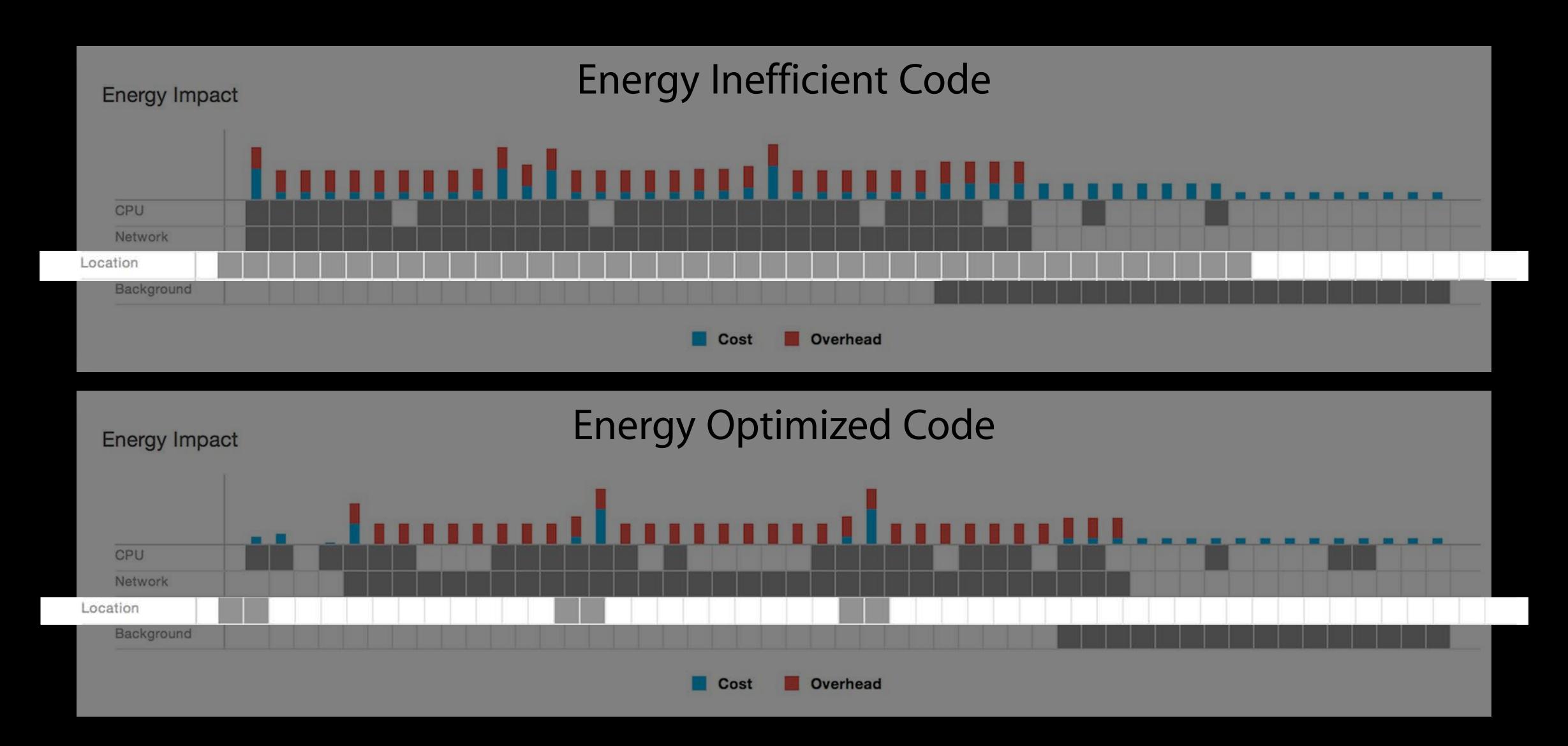












Energy inefficient code

```
......
app.dataManager.storeEnergyData(location: location, values: values)

var weather = getWeather()
app.dataManager.storeWeatherData(weather)
```



Energy optimized code

```
app.dataManager.storeEnergyData(location: location, values: values)

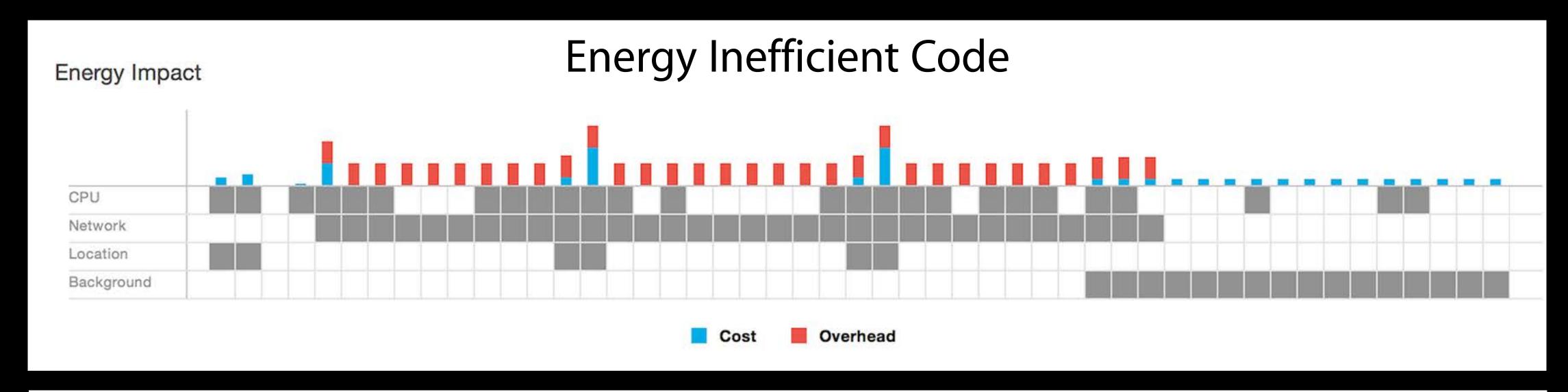
if(!recentlyCalled()) {
    var weather = getWeather()
    app.dataManager.storeWeatherData(weather)
}
```

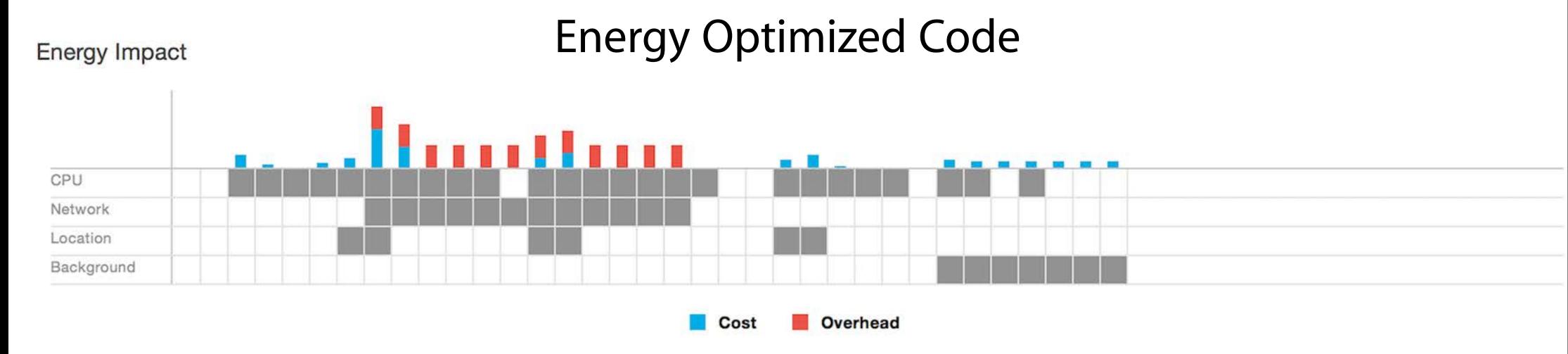
Energy optimized code

```
app.dataManager.storeEnergyData(location: location, values: values)

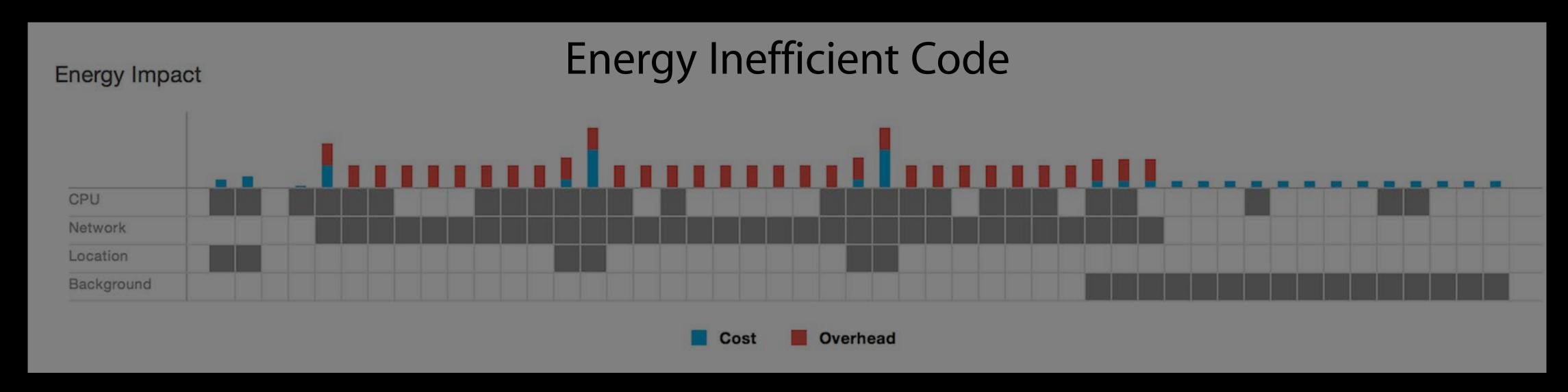
if(!recentlyCalled()) {
   var weather = getWeather()
   app.dataManager.storeWeatherData(weather)
}
```

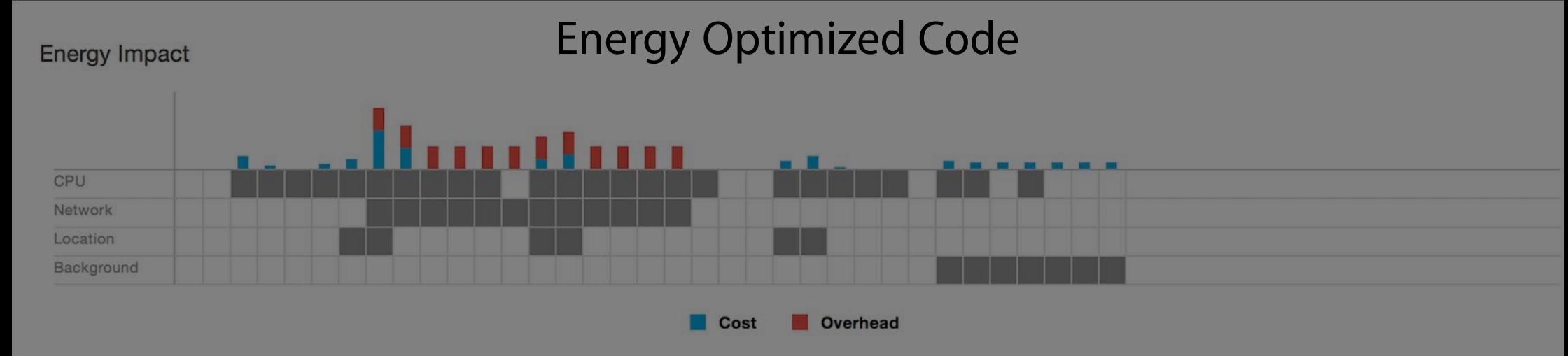




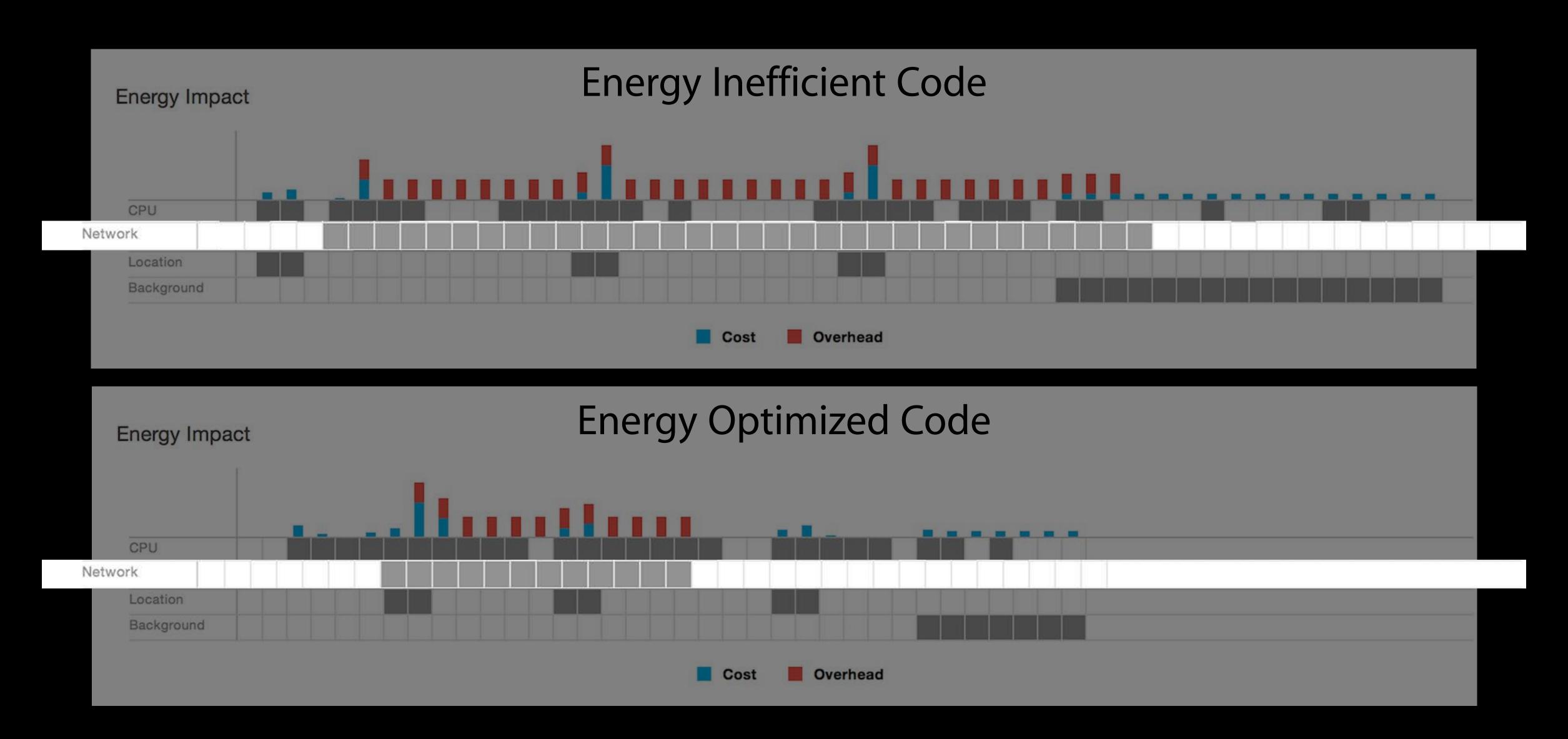














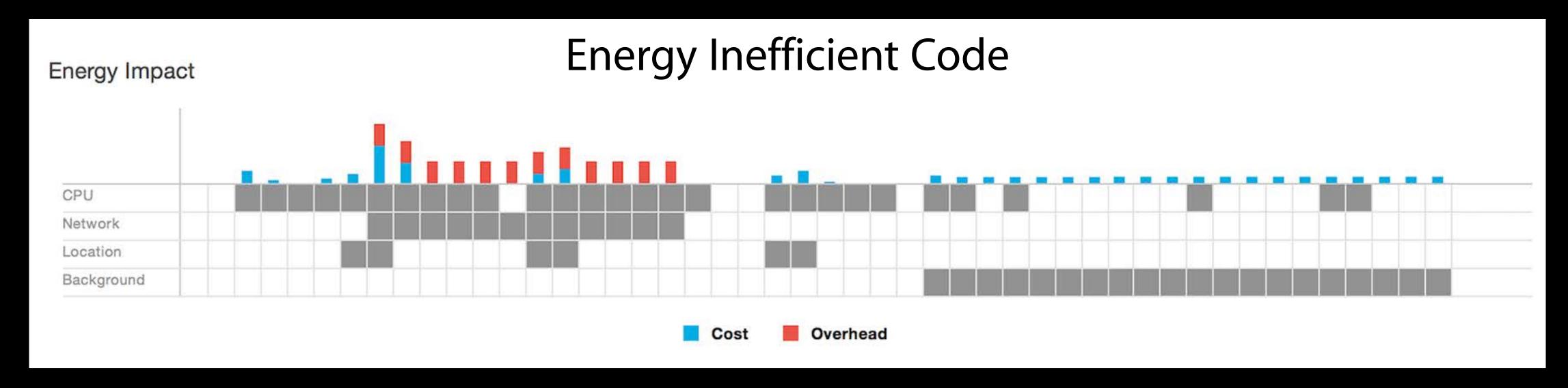
Energy inefficient code

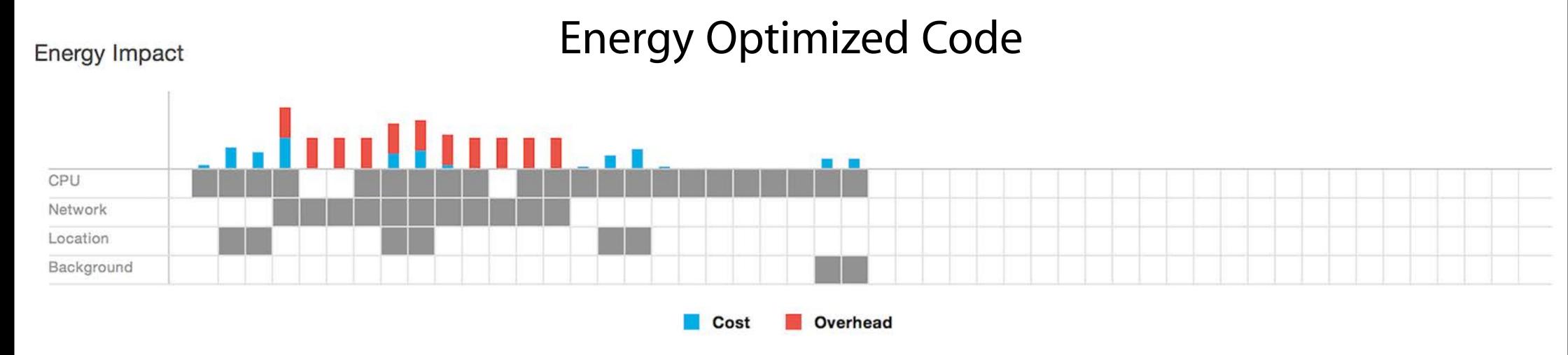
```
func applicationDidEnterBackground(application: UIApplication) {
    ......
    self.archiveToDataManager()
    self.waitForInput()
}
```

Restrict Annaham

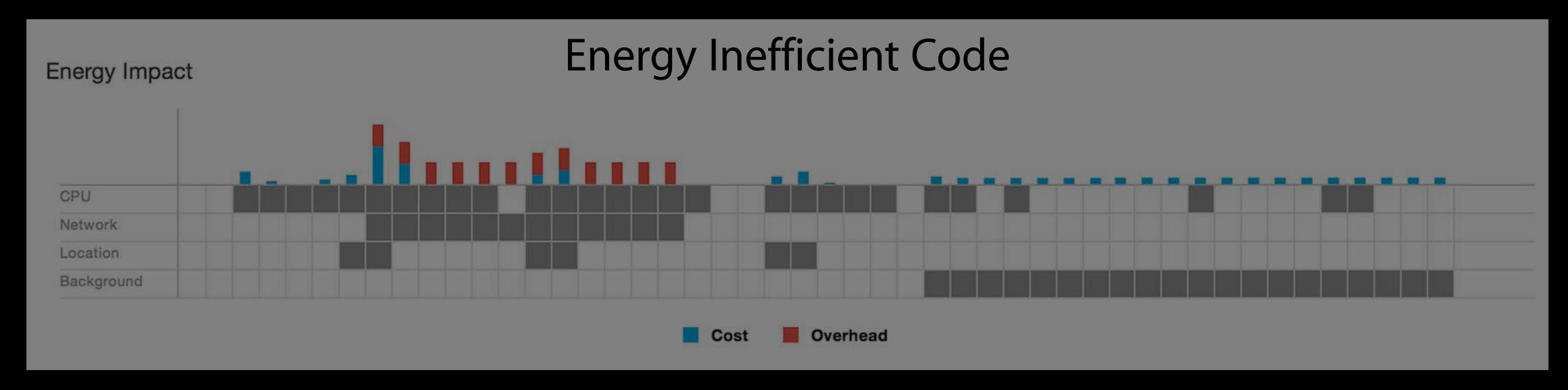
Energy optimized code

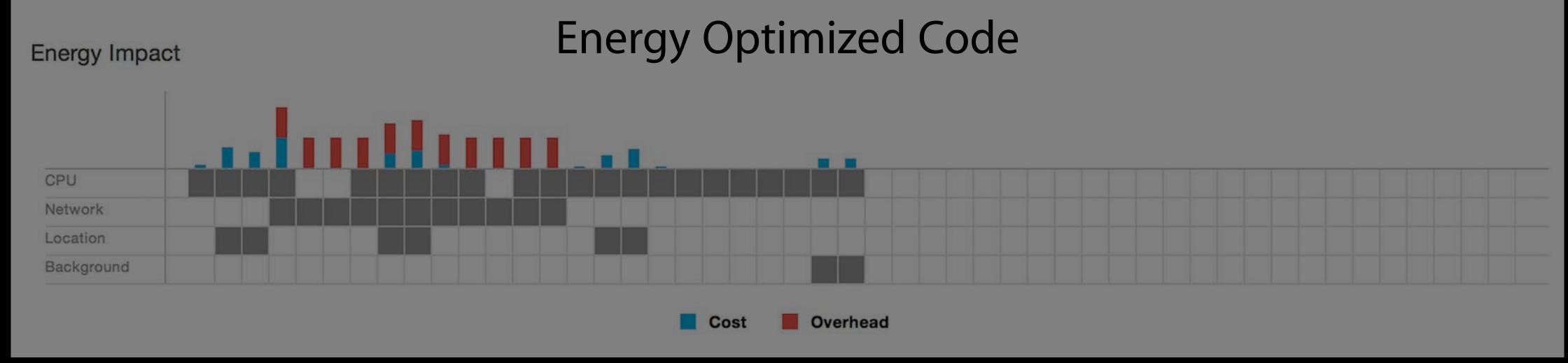




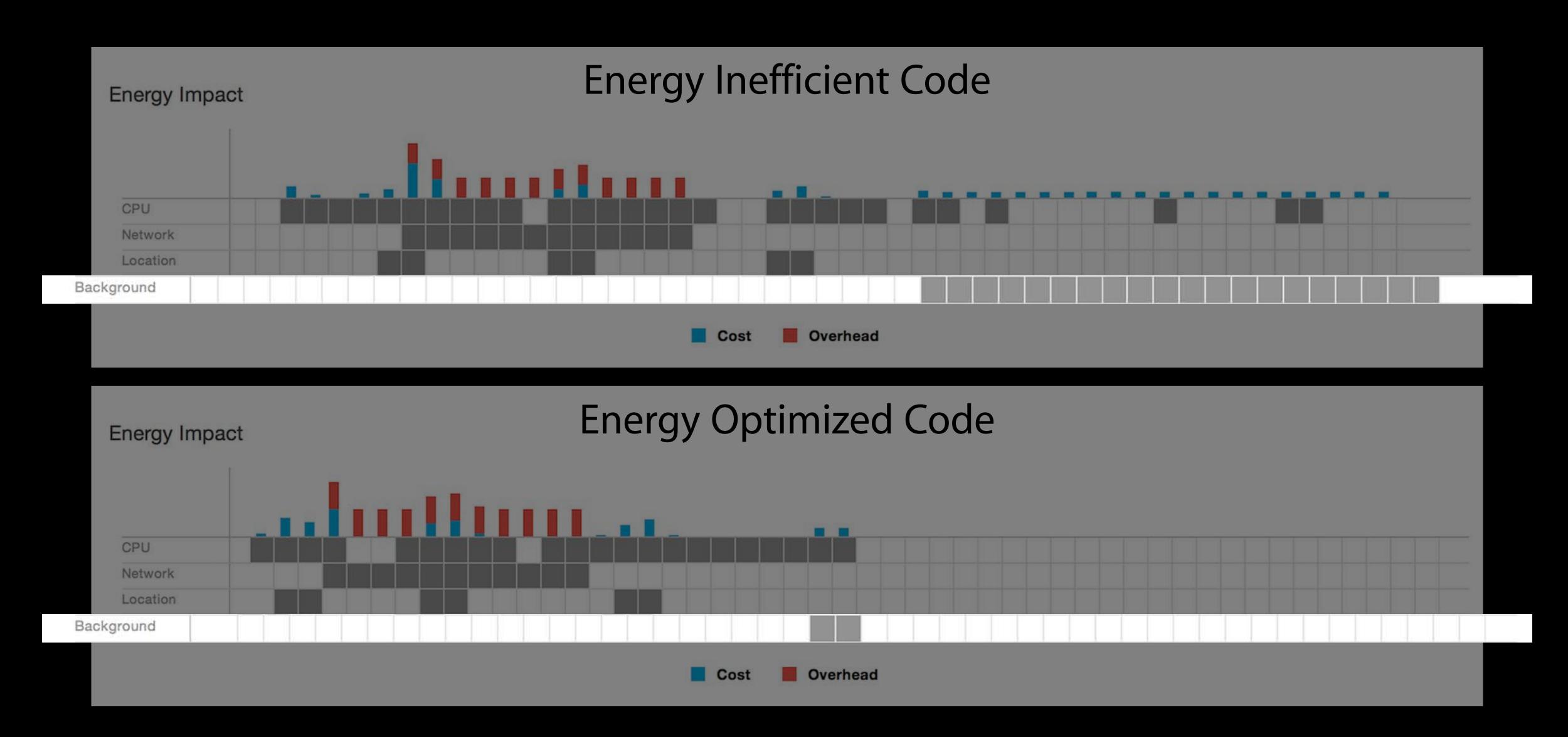












Energy Inefficient Code

Energy
Optimized Code





Energy Buddy: Demo App

Statistics before/after fixing energy issues

Living on app

- 50% energy reduction
- Battery UI shows app is lower in list

Energy Inefficient Code



Energy Optimized Code



Summary

Your turn

Battery life impacts user experience

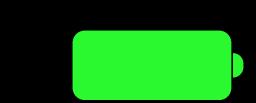
Design your apps with the following in mind

Do it never/less

Do it more efficiently

Do it at a better time

Be a considerate background app



Summary

- Try out new energy debugging tools
- Check out energy documentation
- Bring your apps to power lab

More Information

Documentation and Videos

iOS Energy Guide

https://developer.apple.com/go/?id=ios-energy-efficiency-guide

OS X Energy Guide

https://developer.apple.com/library/mac/documentation/Performance/Conceptual/power_efficiency_guidelines_osx/

Writing Energy Efficient Code, Parts 1 and 2 (2014) http://developer.apple.com/videos

More Information

Technical Support

Apple Developer Forums http://developer.apple.com/forums

Developer Technical Support http://developer.apple.com/support/technical

General Inquiries

Paul Danbold, Core OS Evangelist danbold@apple.com

Related Labs

Power and Performance Lab	Frameworks Lab B	Wednesday 1:30PM
Networking Lab	Frameworks Lab E	Thursday 10:00AM
Core Location Lab	Frameworks Lab A	Thursday 2:30PM
Power and Performance Lab	Frameworks Lab C	Friday 12:00PM
Networking Lab	Frameworks Lab B	Friday 1:30PM

Related Sessions

Achieving All-Day Battery Life	Nob Hill	Wednesday 9:00AM
Networking with NSURLSession	Pacific Heights	Thursday 9:00AM
What's New in Core Location	Pacific Heights	Thursday 1:30PM
Advanced NSOperations	Presidio	Friday 9:00AM
Building Responsive and Efficient Apps with GCD	Nob Hill	Friday 10:00AM
Performance on iOS and watchOS	Presidio	Friday 11:00AM

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