

Gasoline Explosion QuickStart

This page provides a step-by-step guide for creating a gasoline explosion simulation using Chaos Phoenix for 3ds Max.

Overview

This is an Entry Level tutorial which requires no previous knowledge of Phoenix. A basic understanding of 3ds Max would be helpful but is not a prerequisite for being able to follow along.

This tutorial is created using **Phoenix 4.30 Official Release** and **V-Ray 5, Hotfix 2 Official Release** for 3ds Max 2018. You can download official Phoenix and V-Ray from <http://download.chaos.com>. If you notice a major difference between the results shown here and the behavior of your setup, please reach us using the [Support Form](#).

The instructions on this page guide you through the process of setting up a gasoline explosion simulation in Phoenix for 3ds Max. By the end of the tutorial, you will be able to create your own explosion simulations, understand how the simulation interacts with other objects and will know the basics of editing some of the main settings of the Phoenix Fire/Smoke Simulator.

This tutorial is a companion to go along with the QuickStart video posted on our YouTube channel.

The **Download** button below provides you with an archive containing the start and end scenes.

[Download Project Files](#)

- The video is created using Phoenix 3.0, but the text version of the tutorial is updated and uses Phoenix 4.30 Official. In any case of doubt you may refer to the text.
- Another way to create a Gasoline Explosion is to use the newer and improved version of the Gasoline Explosion Toolbar Quick Setup preset which is included in the Nightly Builds since 16 Sep 2020.

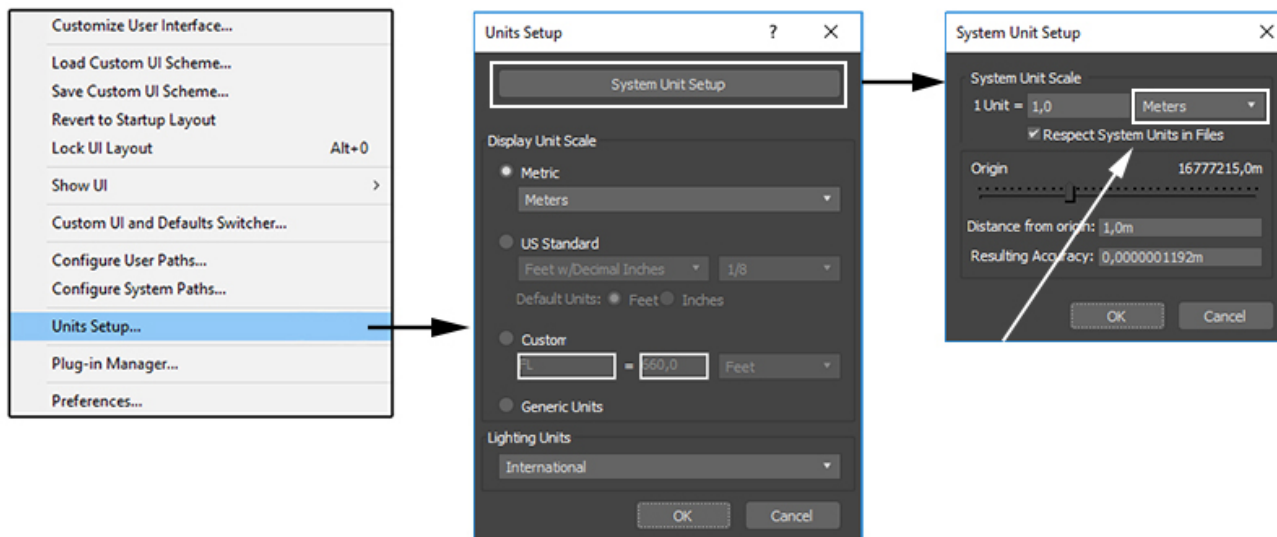
System Units Setup

Scale is crucial for the behavior of any simulation. The real-world **size of the Simulator** in **units** is important for the simulation dynamics. Large-scale simulations appear to move more slowly, while mid-to-small scale simulations have lots of vigorous movement. When you create your Simulator, you must check the **Grid** rollout where the real-world extents of the Simulator are shown. If the size of the Simulator in the scene cannot be changed, you can cheat the solver into working as if the scale is larger or smaller by changing the **Scene Scale** option in the **Grid** rollout.

The Phoenix solver is not affected by how you choose to view the Display Unit Scale - it is just a matter of convenience.

Go to **Customize Units Setup** and set Display Unit Scale to **Metric Meters**.

Also, set the **System Units** such that **1 Unit** equals **1 Meter**.



Scene Setup

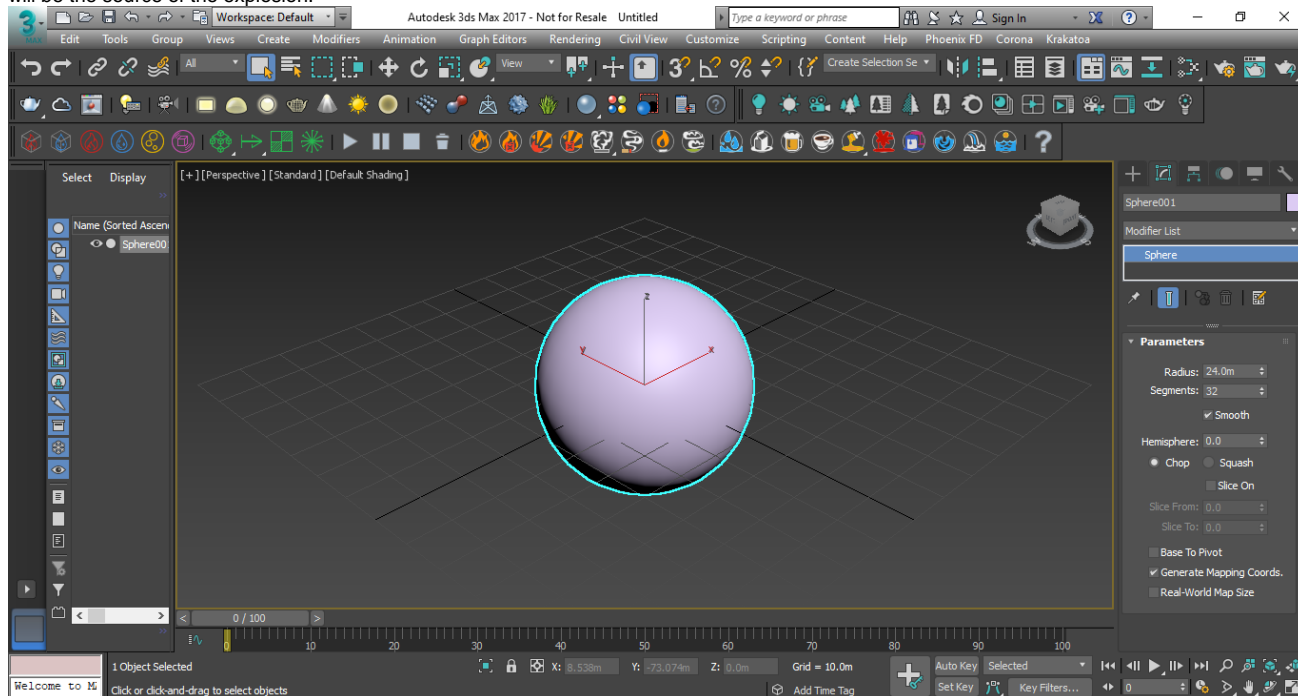
In the following steps we will show how to create a gasoline explosion simulation with the Phoenix Gasoline Explosion Preset.

After that we will explain how to set the simulation manually step-by-step for greater flexibility and control.

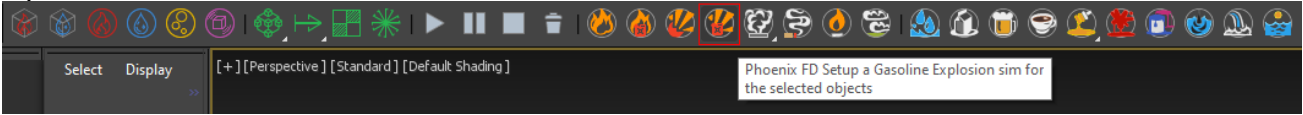
Gasoline Explosion Preset

We will begin by using a quick gasoline explosion preset.

Create a **Sphere** with a **Radius of 24.0** meters. This sphere will be the source of the explosion.



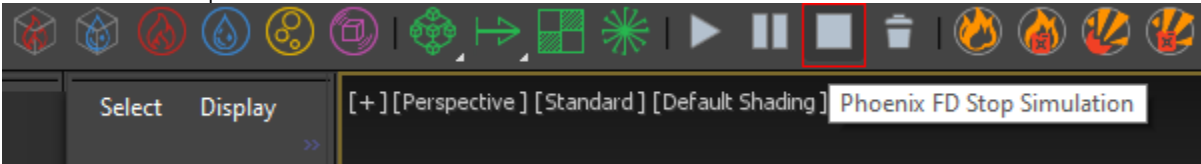
With the sphere selected, click on the **Gasoline Explosion Preset** button from the **Phoenix Toolbar**.



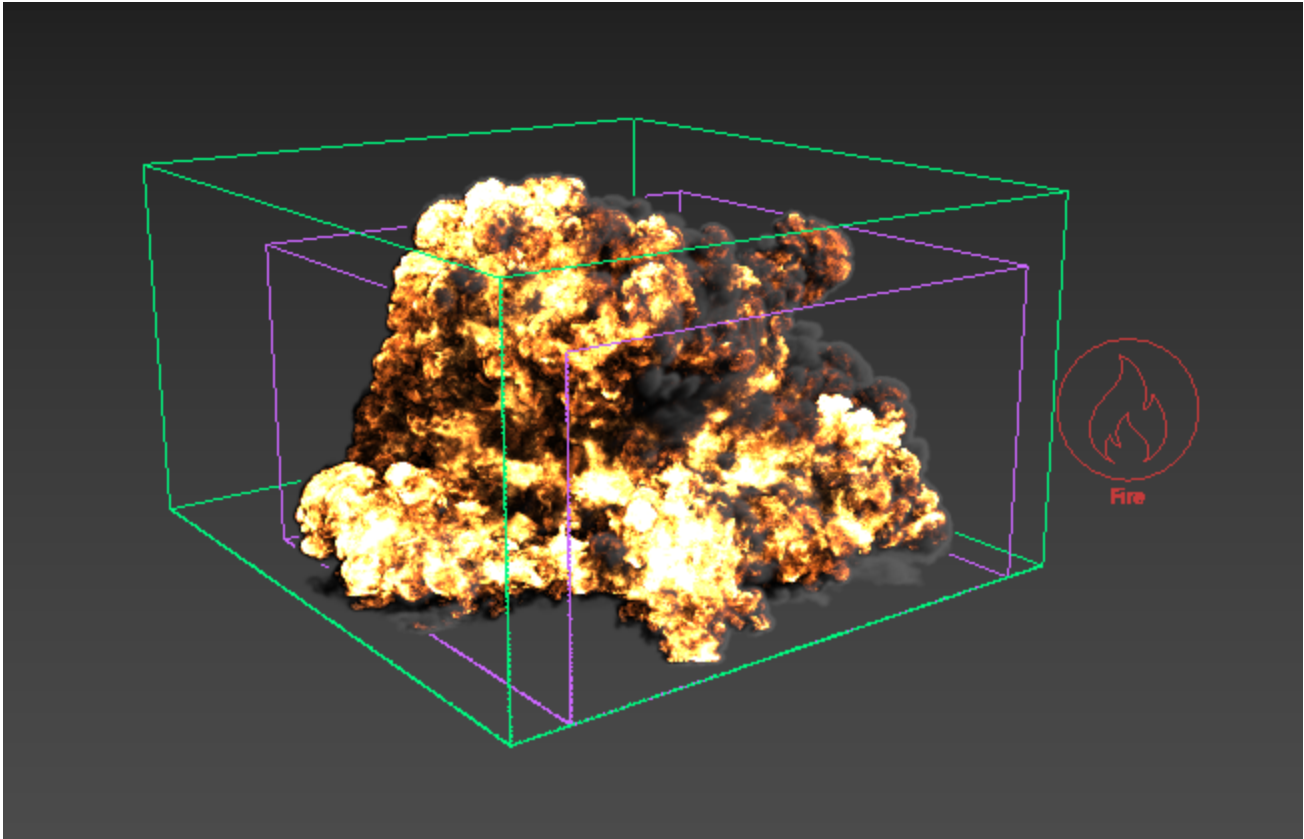
Now press the **Start Simulation** button in the Toolbar.



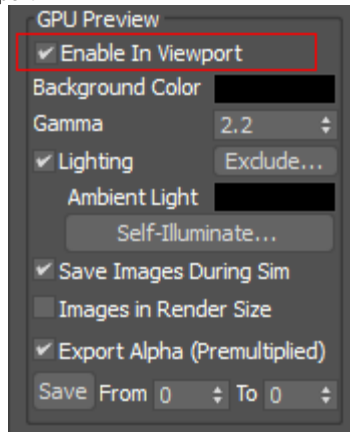
Let the simulation run for a few seconds and you will have a chance to see the results in the viewport, click the **Stop** button to end the simulation process.



Here is a GPU Preview of the simulation.



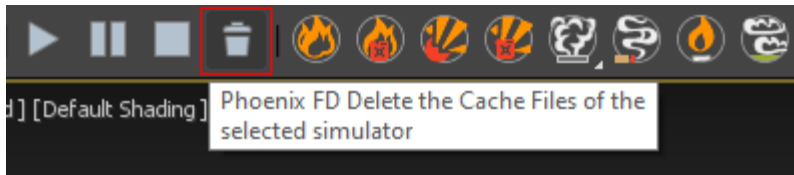
To enable the GPU Preview as seen in the image above, select the **Phoenix Simulator Preview** rollout **GPU Preview** **Enable in Viewport**.



Manual Explosion Setup

Let's take a look at setting up a gasoline explosion simulation manually.

If you are continuing from the preset steps above, select the Simulator and press the **Delete the Cache Files** button from the **Phoenix Toolbar** and then delete the Simulator and the source objects from your scene.



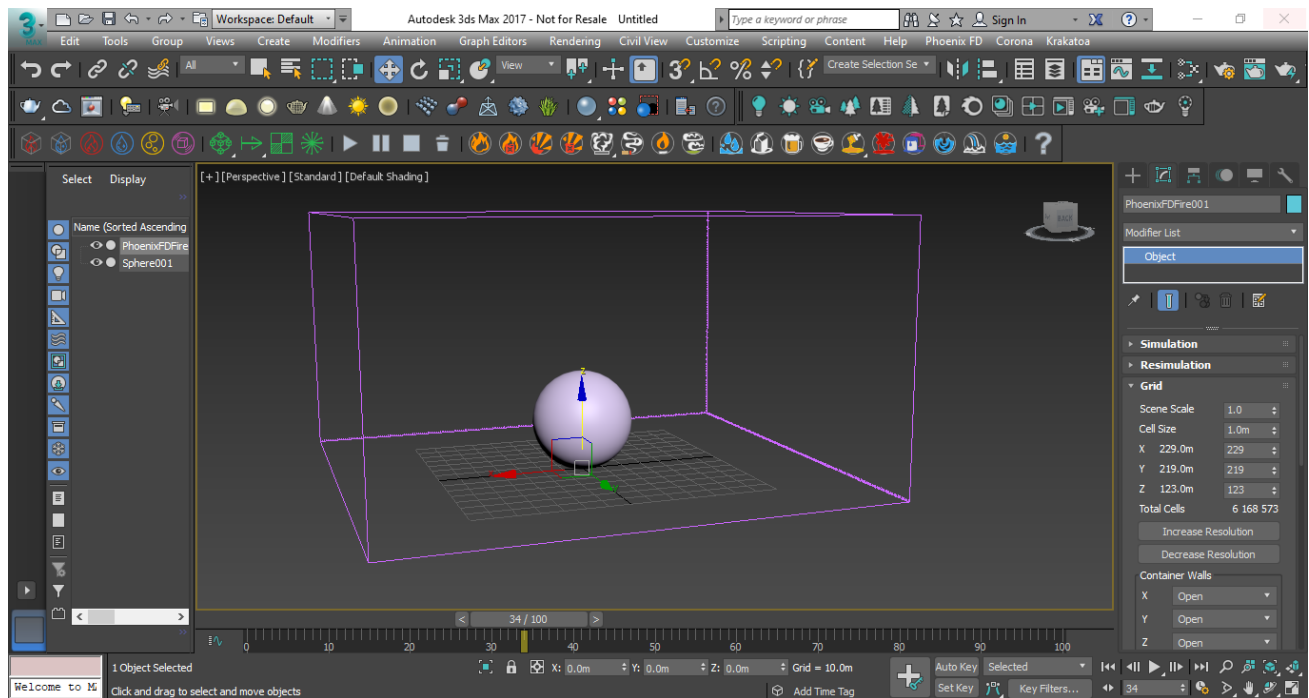
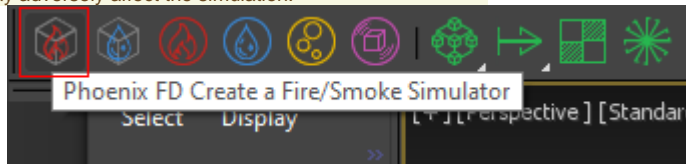
If the sphere has been deleted, create a new **Sphere** with a **Radius** of **24.0** meters.

Click on the **Create a Fire/Smoke Simulator** button in the **Phoenix Toolbar** and click and drag in the viewport to create a volume to encompass the sphere, while leaving some room for the explosion to spread. Move the sphere near the bottom of the Simulator's volume space. Make sure the sphere is still inside the volume.

Open the **Grid** rollout and set the following values:

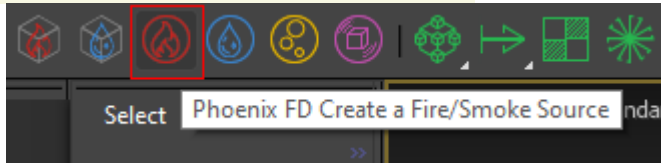
- **Scene Scale: 1.0.**
- **Cell Size: 1.0 m.**
- **Size XYZ: [229, 219, 123].**

Use the **Size** attributes of the Simulator as opposed to simply scaling the Simulator container with 3ds Max's Scale tool, as that may adversely affect the simulation.



Click the **Create a Fire/Smoke Source** button on the **Phoenix Toolbar** and place the source in your scene.

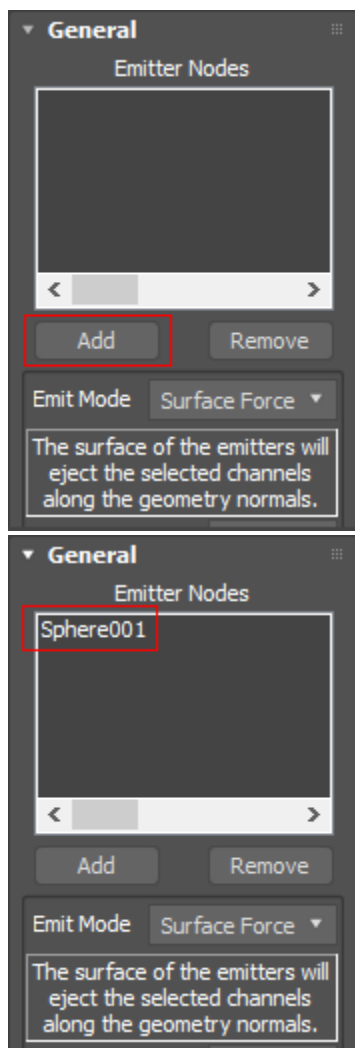
The Source object is a 2D non-renderable icon, so size and placement are only important for being able to select the Source when needed.



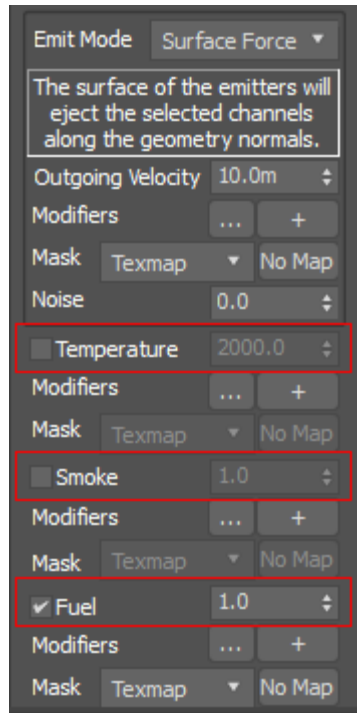
With the **Fire/Smoke Source** object selected, go to the **Modify Panel** and click the **Add** button located under the **Emitter Nodes** list, then select the **Sphere**.

This way the sphere will be selected as an emitter.

The Source node is where we control the Emitter properties, like the Emit Mode and the Outgoing Velocity. The sphere is the actual emitter of the fluid inside the Simulator.

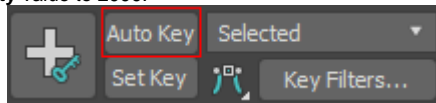


Within the **Fire/Smoke Source** menu, we will disable **Temperature** and **Smoke**, as they will not be needed for this demonstration. Make sure **Fuel** is enabled.

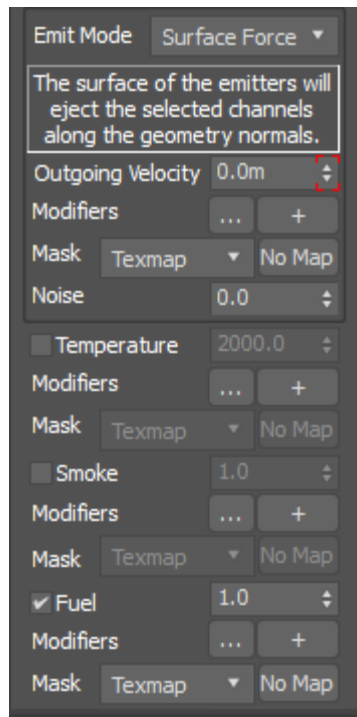


Since we are creating an explosion that will use a large amount of fuel very quickly, we will need to increase the **Outgoing Velocity**. The higher this number, the more fluid will be generated per second. In order to create the short but powerful burst of fluid, we will animate the **Outgoing Velocity** number.

Make sure you're at Frame 0, turn on **Auto Key**, and change the **Outgoing Velocity** value to **2000**.



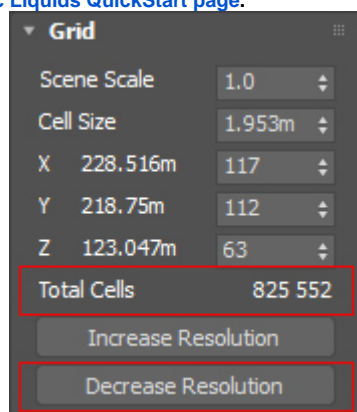
Move to Frame 1 and change the **Outgoing Velocity** to **0.0**, then turn off **Auto Key**.



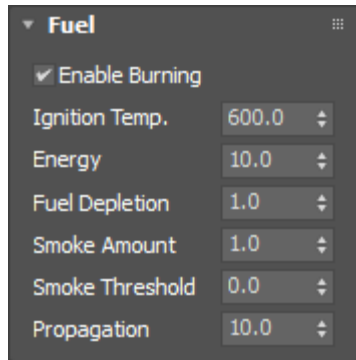
Select the Simulator. In the **Modify Panel** under the **Grid** rollout are located the parameters to control the resolution of the volume grid, which greatly affects the look and performance of the simulation.

Currently, there are about 6 million Total Cells. To save on simulation time during the iteration process, click **Decrease Resolution** several times until the **Total Cells** are around **825,000**.

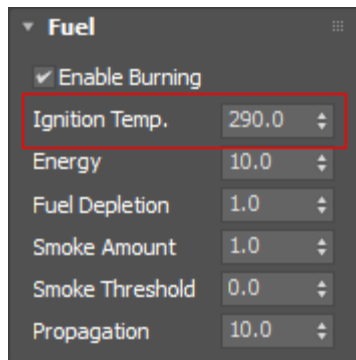
For more information regarding simulation resolution, please refer to the [Basic Liquids QuickStart page](#).



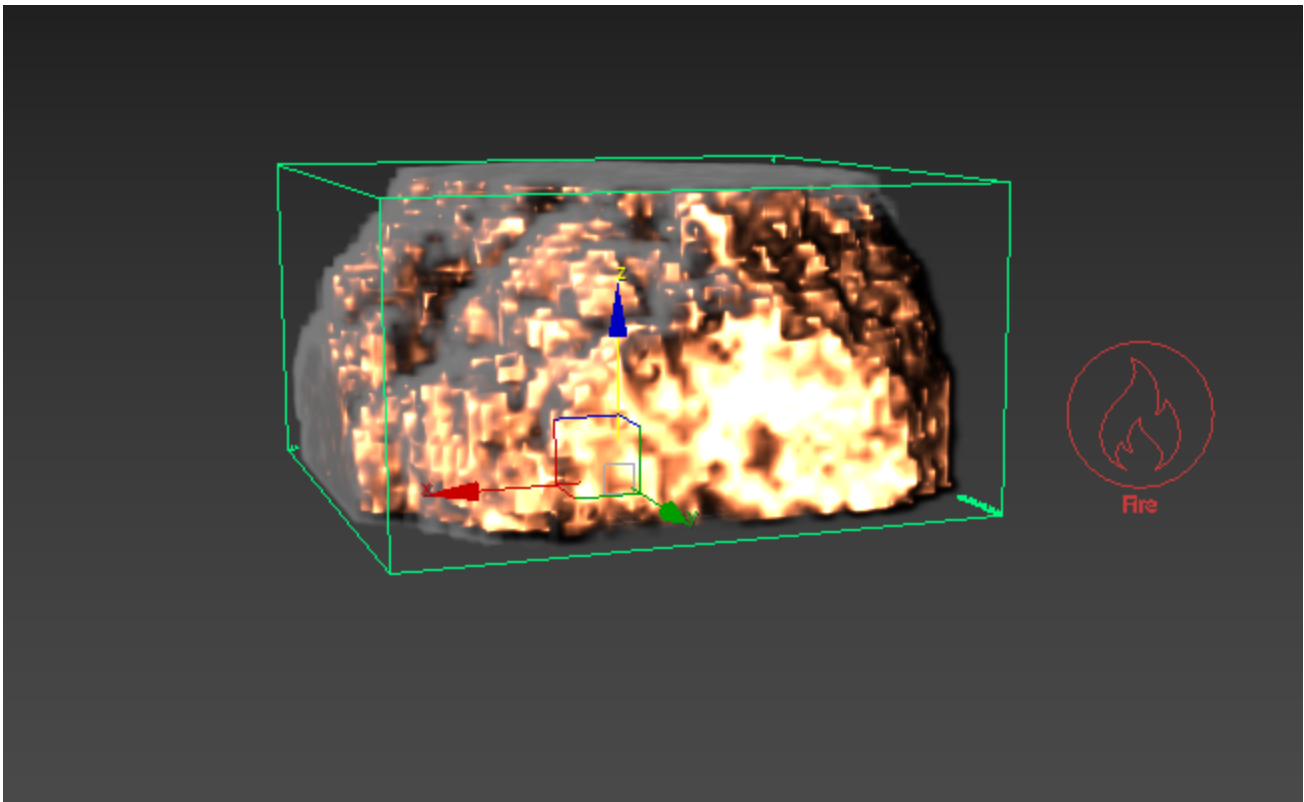
Click the **Start Simulation** icon, and notice that the explosion does not happen. Select the **Fire/Smoke Simulator** and navigate to the **Fuel** rollout. Select **Enable Burning**.



Once again, if you click **Start Simulation**, you will see that the explosion is still absent. This is due to the **Ignition Temperature** being set at **600.0**. This temperature is rather high. By default, Phoenix uses **300.0** as a default ambient temperature. Change the **Ignition Temperature** to a value slightly lower: **290.0**.



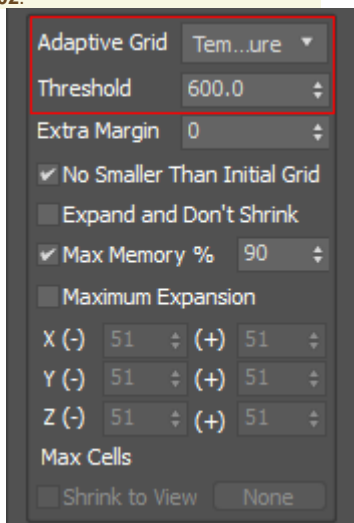
Start the simulation and you will see a puffy preview. To see the explosion more clearly, navigate to the **Preview** rollout and turn on the **GPU Preview** by clicking **Enable in Viewport**.



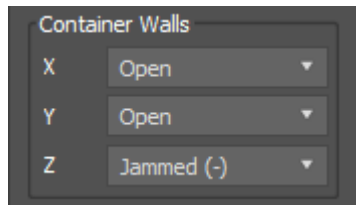
Currently, the explosion is being cut off at the top and sides by the Simulator's Grid.

Adjust this in the **Grid** rollout by turning on **Adaptive Grid** by **Temperature**. Lower the **Threshold** temperature to **600.0** to ensure expansion based on the temperature of the fluid inside when it meets the specified threshold.

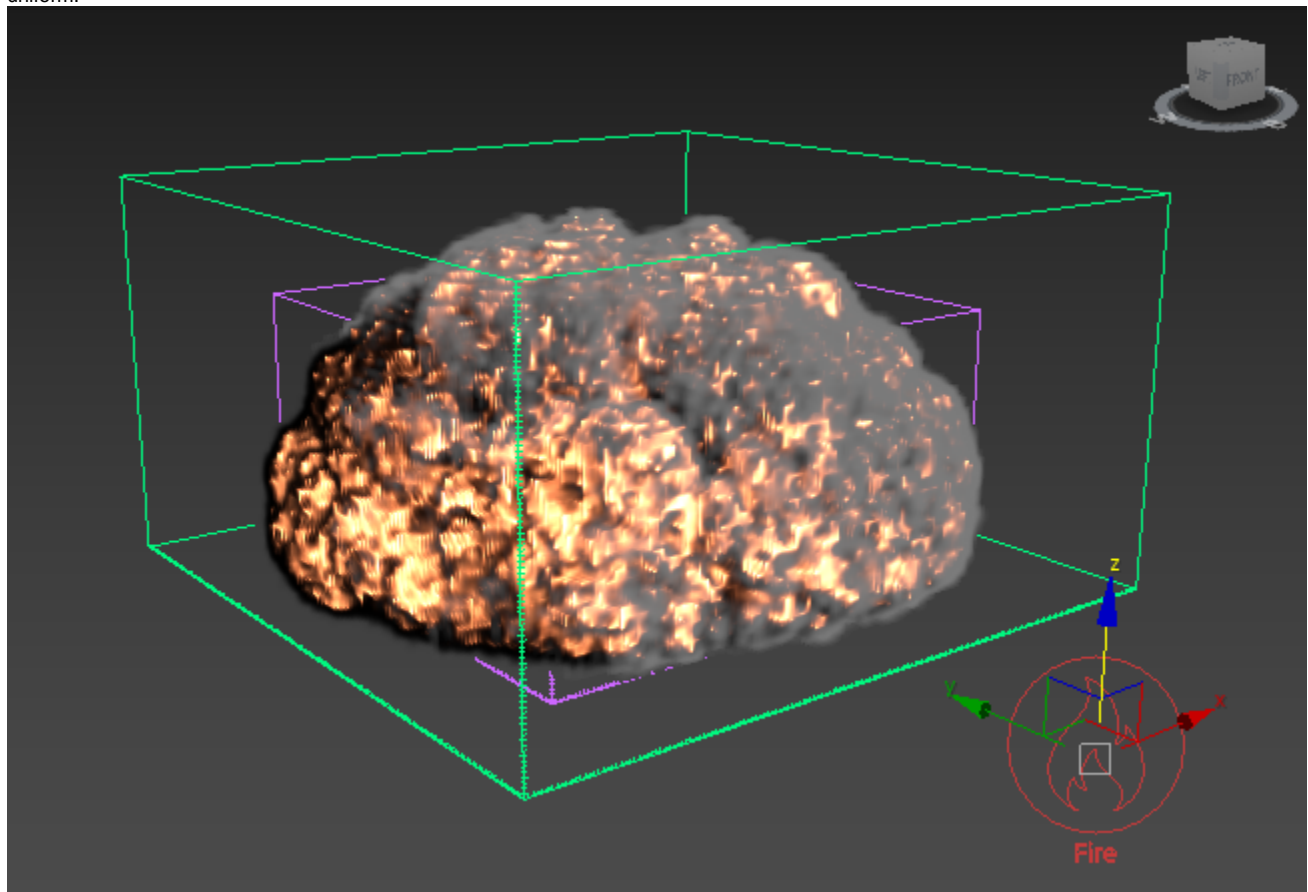
If you experience clipping of your smoke, set adaptive to **Smoke** with a **Threshold** of **0.02**.



To prevent the explosion from expanding the bottom, go to **C ontainer Walls** and select **Jammed (-)** in the **Z axis**. This will act as a floor.

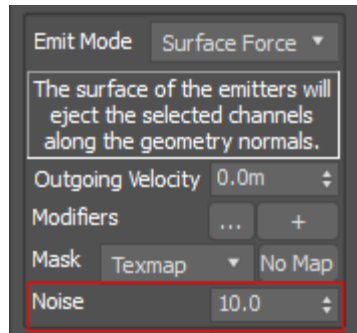


Start the simulation. The resulting explosion looks very uniform.

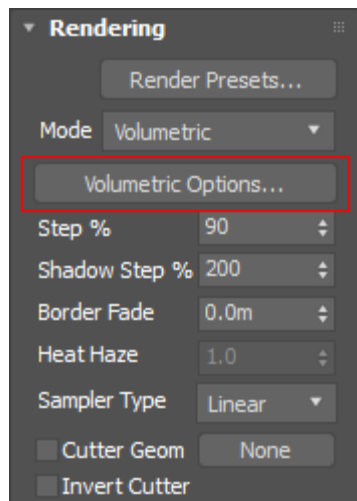


To add variation, select the **Fire/Smoke Source** and increase the **Noise** value to **10**.

Notice the variation that is added to the simulation.



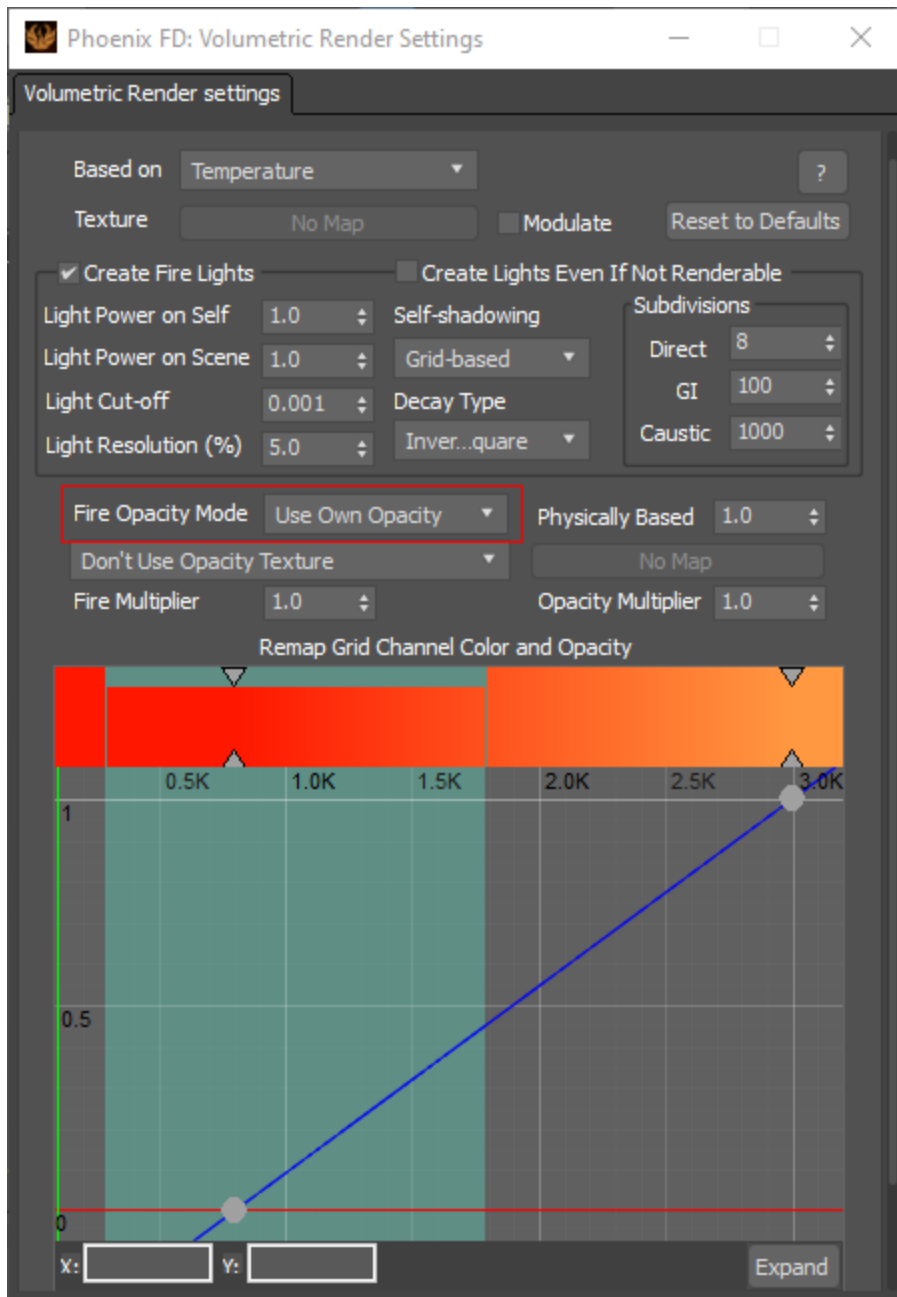
Start the simulation once more. While it is running, select the Simulator and go to the **Rendering** rollout and click on the **Volumetric Options** button.



Under the **Fire** settings, there are a few **Fire Opacity Modes** available: **Use Smoke Opacity**, **Fully Visible**, and **Use Own Opacity**.

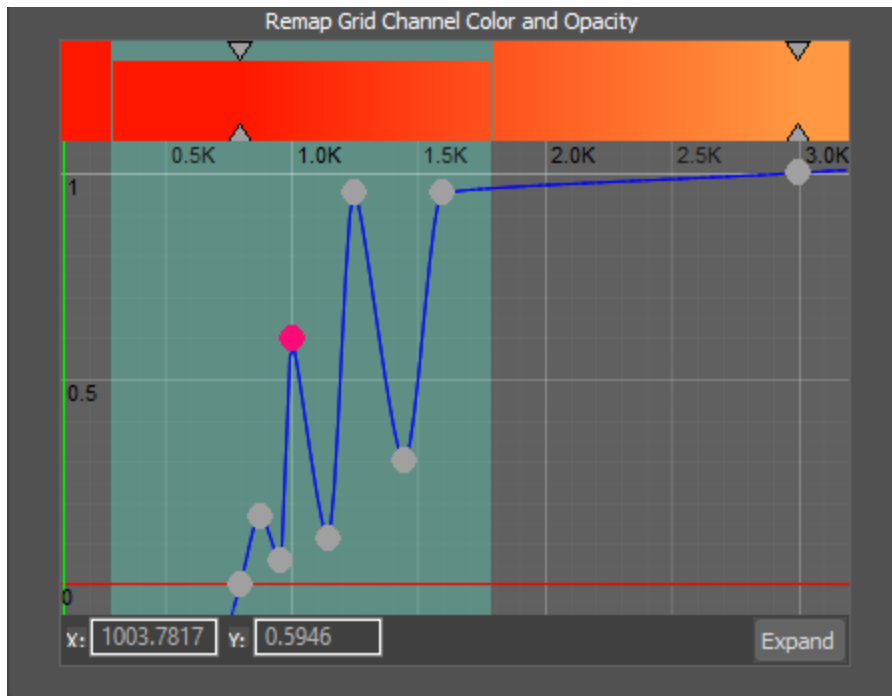
Select **Use Own Opacity**, and stop the simulation.

When you use **Own Opacity mode**, the fire curve will control the opacity of the fire instead of the intensity. The intensity in this mode is controlled by the color gradient and can be boosted or lowered using the **Fire Multiplier**.

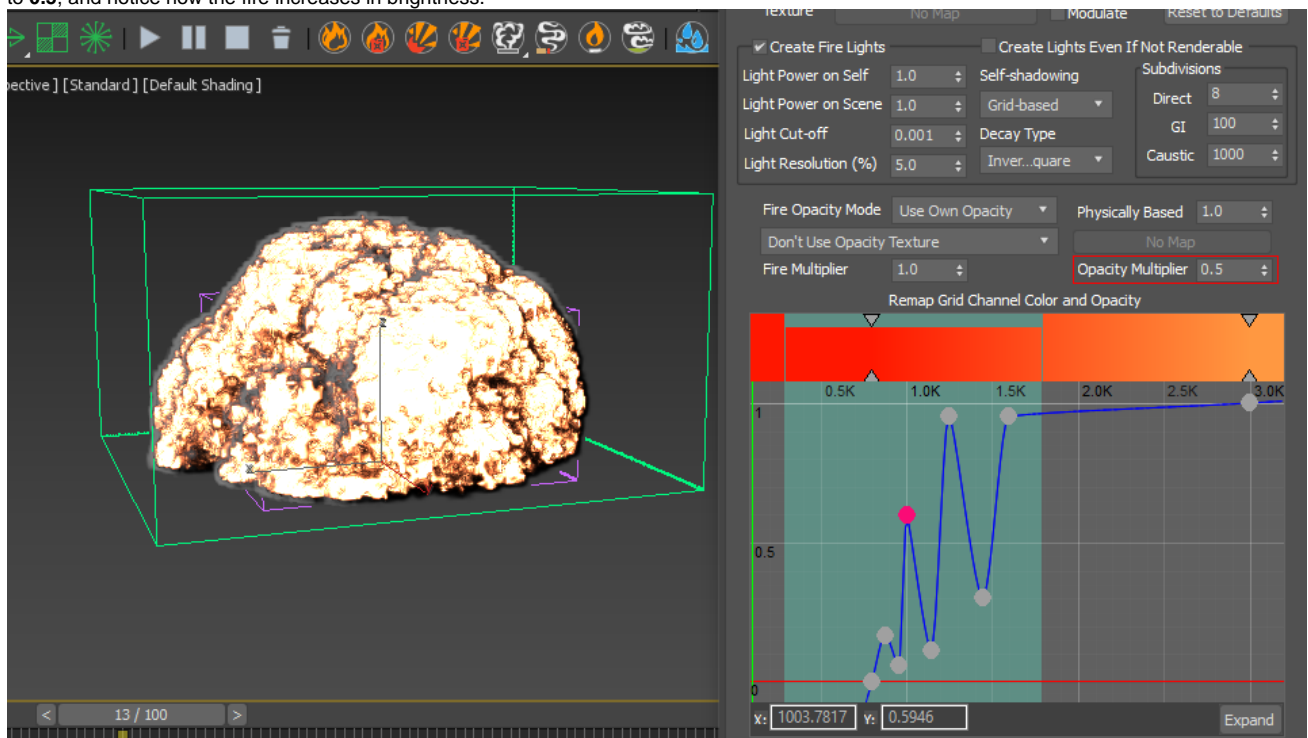


The graph here controls only the opacity of the fire. Double-click to add a new point to the curve and drag it down to reduce the opacity of the fire, revealing more of the internal fire content and making it look brighter. Drag the point up to increase the opacity and hide more of the internal structure. Add points in the middle for a gentle curve.

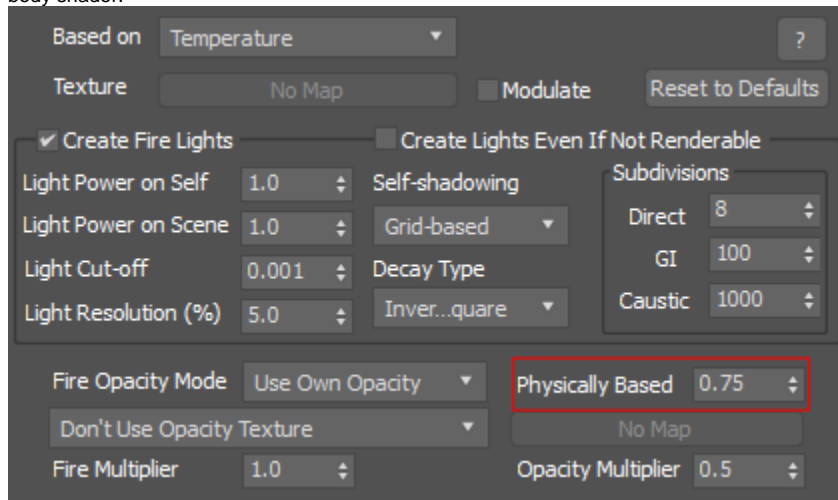
Click the **Expand** button for a larger graph to work with.



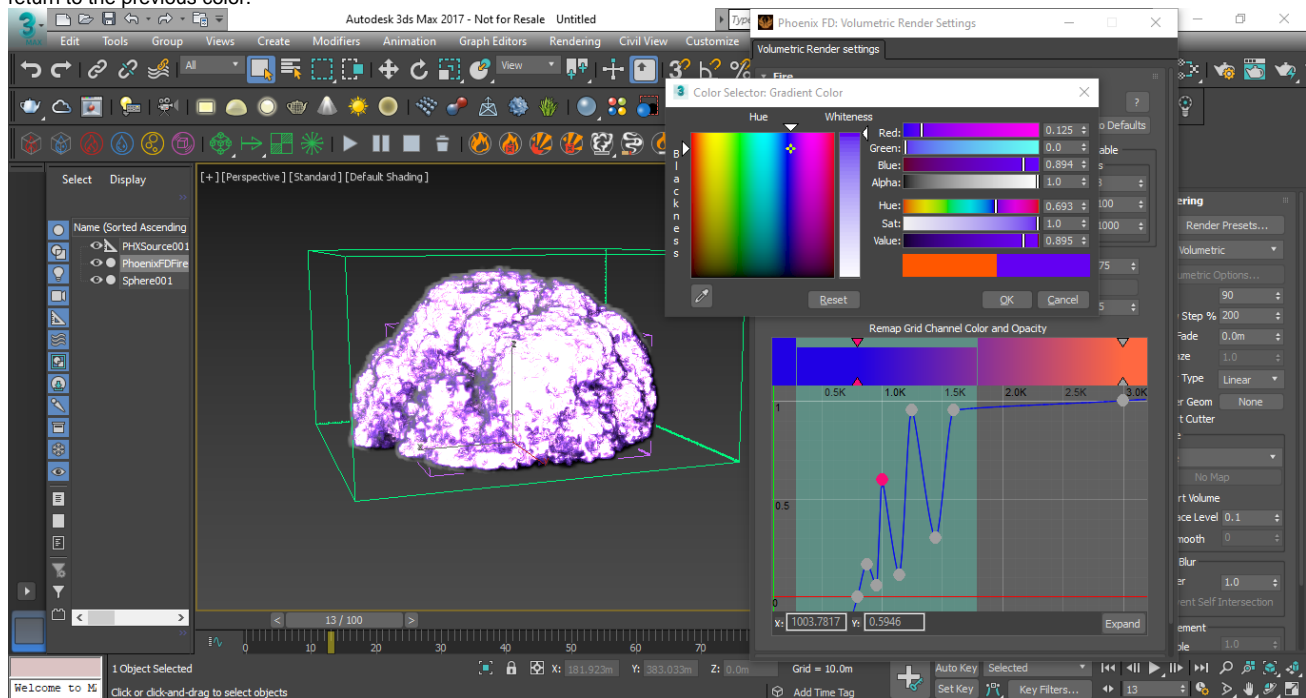
You can further adjust the opacity with the **Opacity Multiplier** above the graph. For this example, we will lower this value to **0.5**, and notice how the fire increases in brightness.



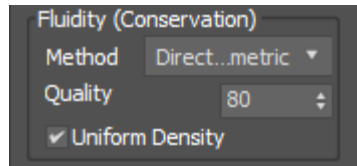
The **Physically Based** setting blends between artistic and physically accurate results. Change **Physically Based** to **0.75** and observe the more "fiery" look in the simulation. This parameter balances between how much of the fire intensity comes from the color gradient plus the fire multiplier versus how much is calculated using the physically-based black body shader.



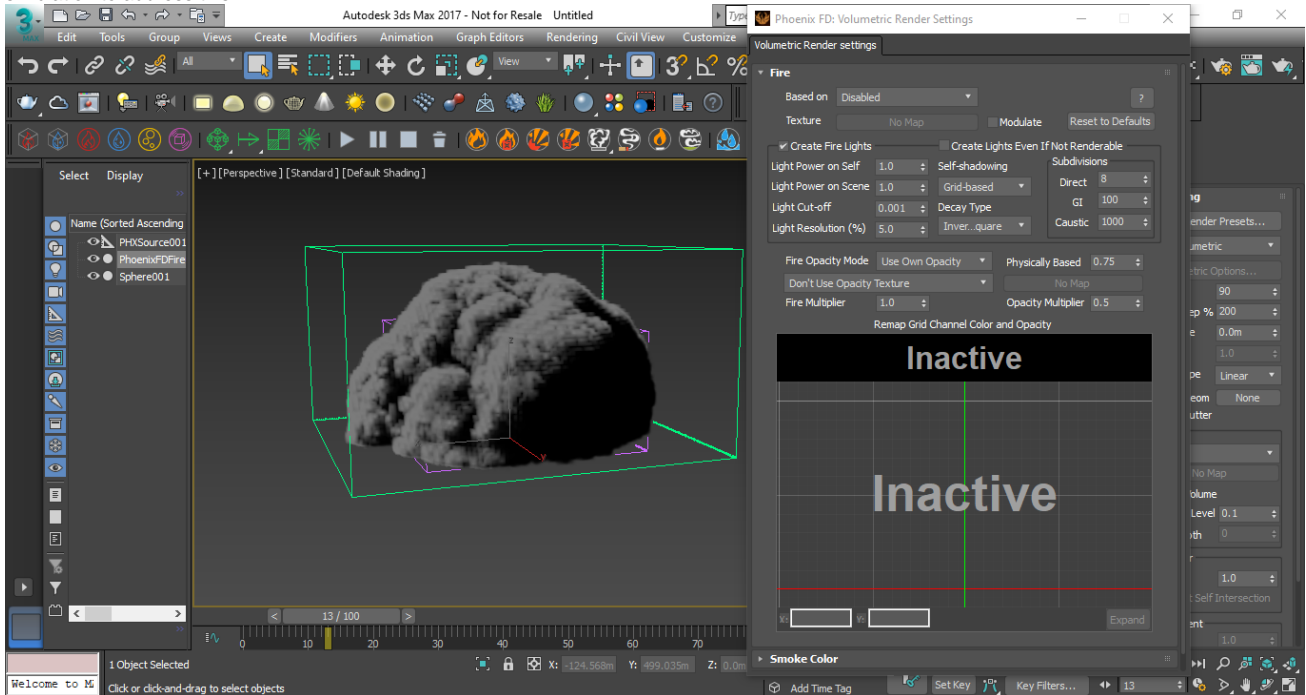
To change the color of the fire, double-click on the carrots above the graph and select a new color. Select **Cancel** to return to the previous color.



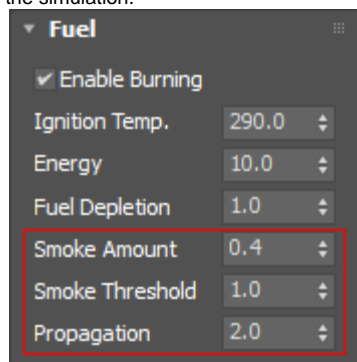
To adjust the explosion to look less contained, navigate to the **Dynamics** rollout and under **Conservation**, adjust the **Quality** setting. This setting allows the simulation to spread more and gives it a swirling motion. Increase **Quality** to **80**. Note that increasing this value will increase simulation time. Start another simulation.



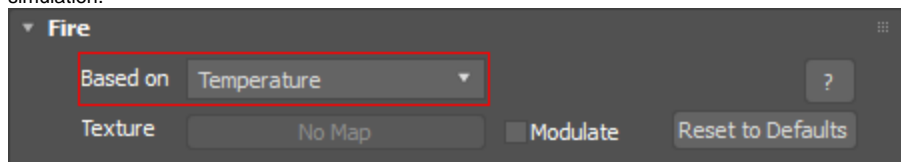
The explosion is breaking up a bit more, but it's not quite there yet. Open the **Volumetric Options** in the **Rendering** rollout again. Disable the **Fire** for now. We can see there is a lot of smoke as a result of the fuel burning so much. Stop the simulation to address this.



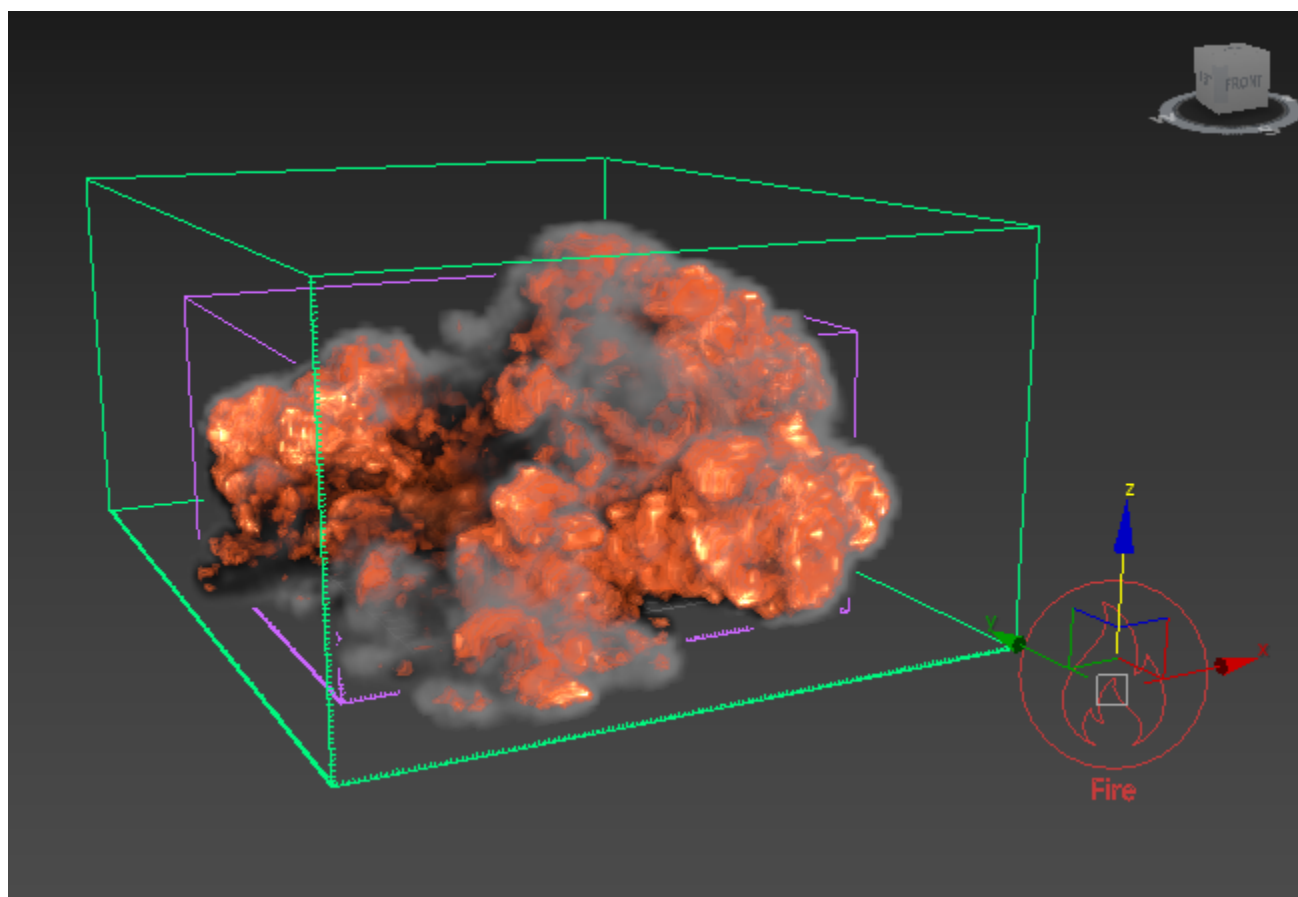
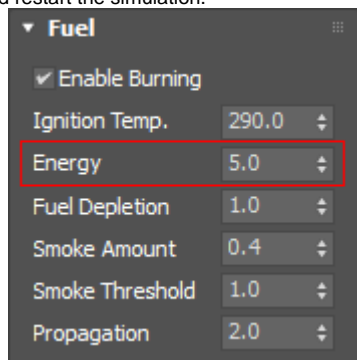
In the **Fuel** settings of the simulation, reduce the **Smoke Amount** to **0.4** to allow for more burning and a brighter fire, and also increase the **Smoke Threshold** to **1.0**. The smoke threshold will lessen how much of the fuel is created as smoke. Reduce **Propagation** of the fuel to **2** to reduce how fast it propagates through the simulation.



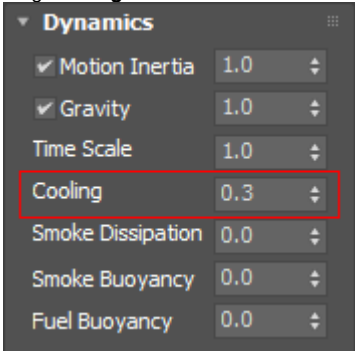
In the **Volumetric Options**, remember to set the Fire's **Based on** parameter back to **Temperature** before restarting the simulation.



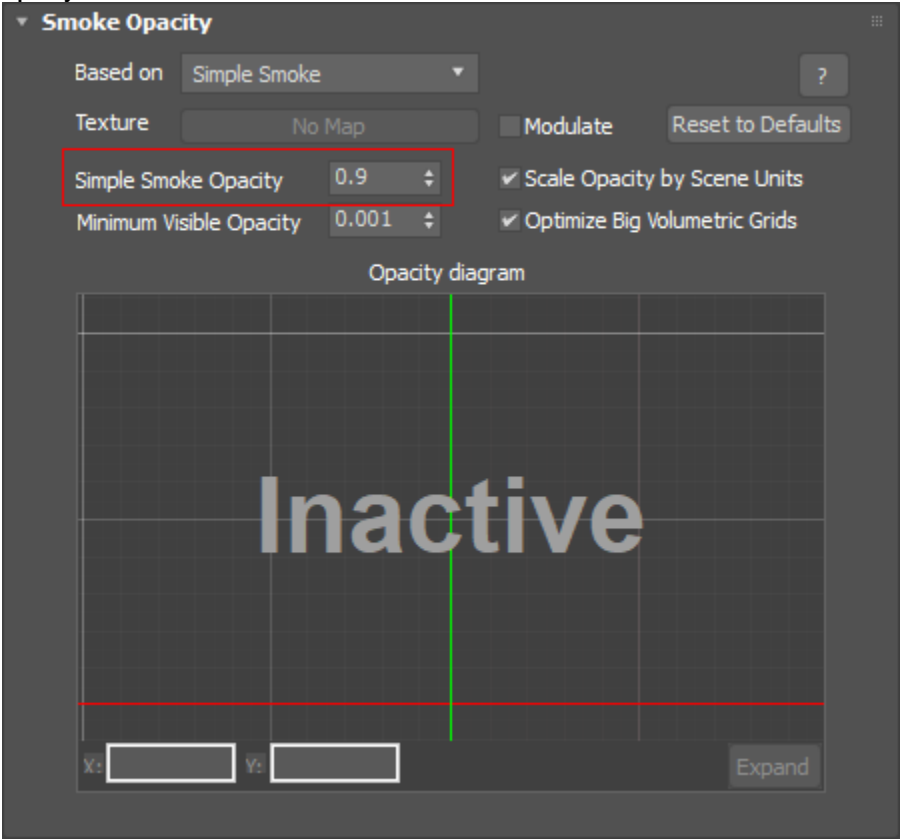
The fire now looks too hot. Go to the **Fuel** rollout and reduce the Fuel's **Energy** to 5 and restart the simulation.

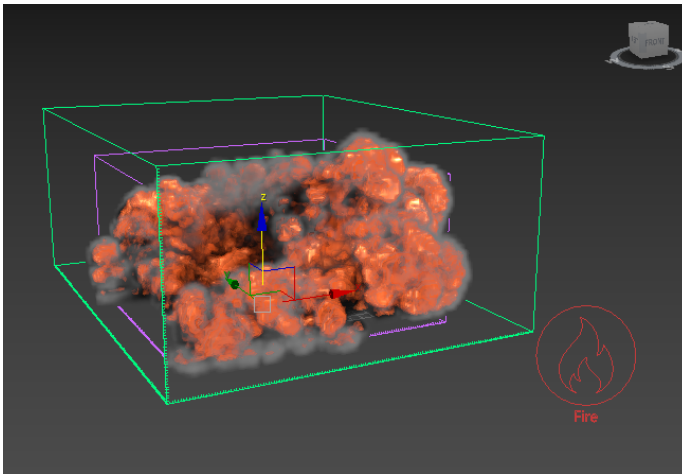


The explosion is starting to look good, but it stays hot for too long. We need to increase the cooling of the fire by going to **Dynamics** rollout and increasing **Cooling** to **0.3**.

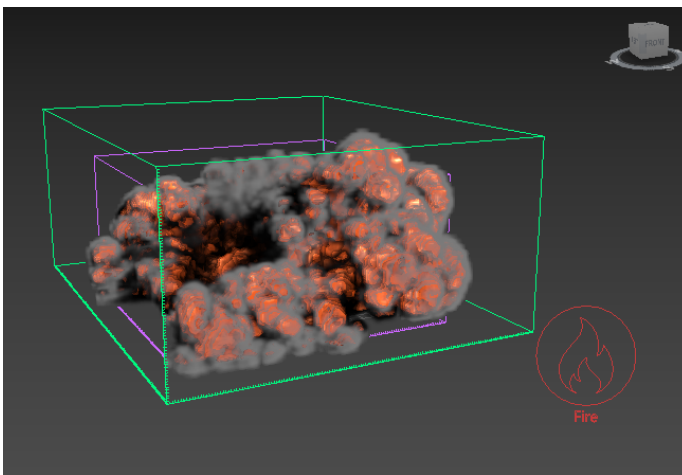


Our smoke looks very thin. In **Volumetric Options**, expand the **Smoke Opacity** rollout and increase **Simple Smoke Opacity** to **0.9**.



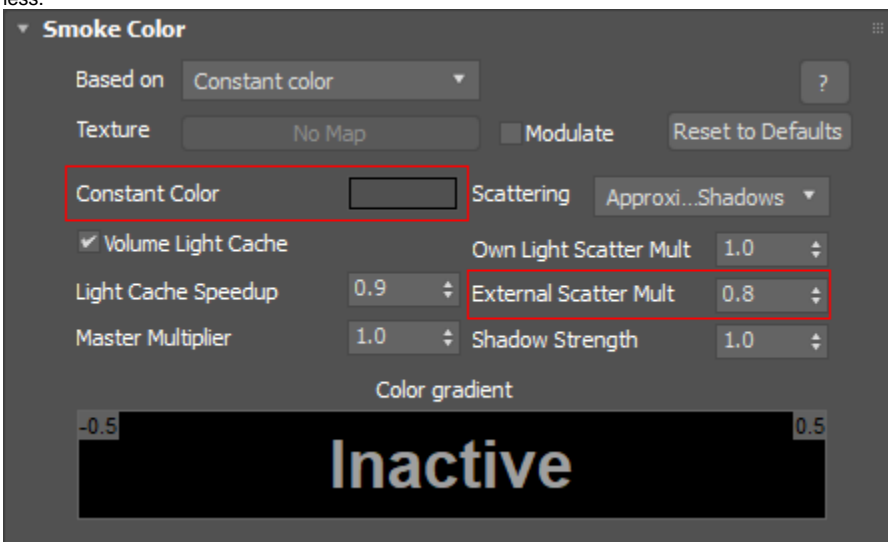


Simple Smoke Opacity: 0.5

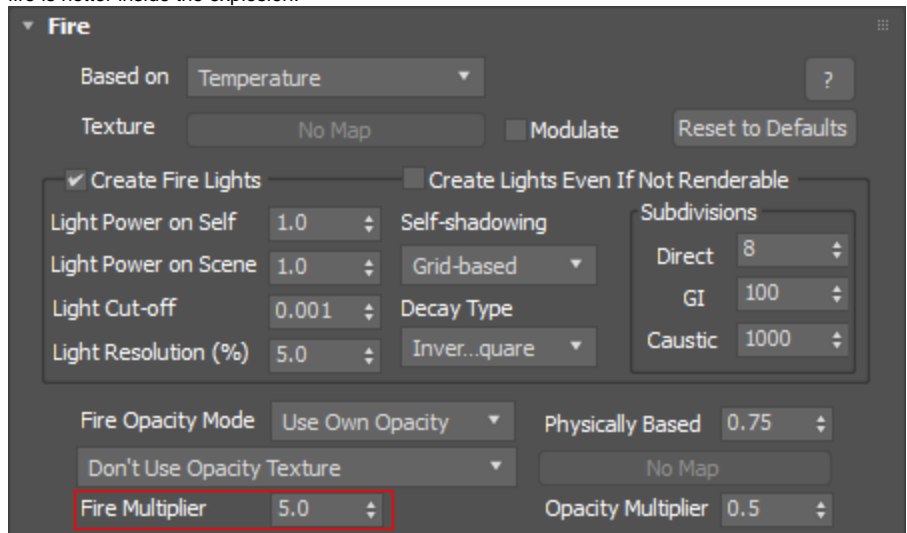


Simple Smoke Opacity: 0.9

Expand the **Smoke Color** rollout and reduce the **Constant color** slightly to make darker smoke. In this example, we used a **Value of 29**. Also, lower the **External Scatter Multiplier** to **0.8** so that the light inside the smoke scatters less.

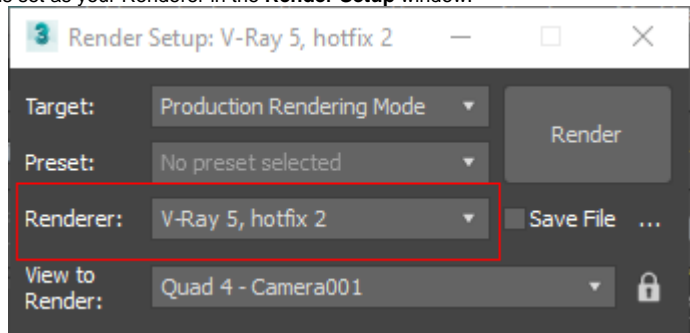


The fire looks a little weaker now. Under the **Fire** rollout in **Volume Options**, increase the **Fire Multiplier** to **5.0** so the fire is hotter inside the explosion.



Rendering

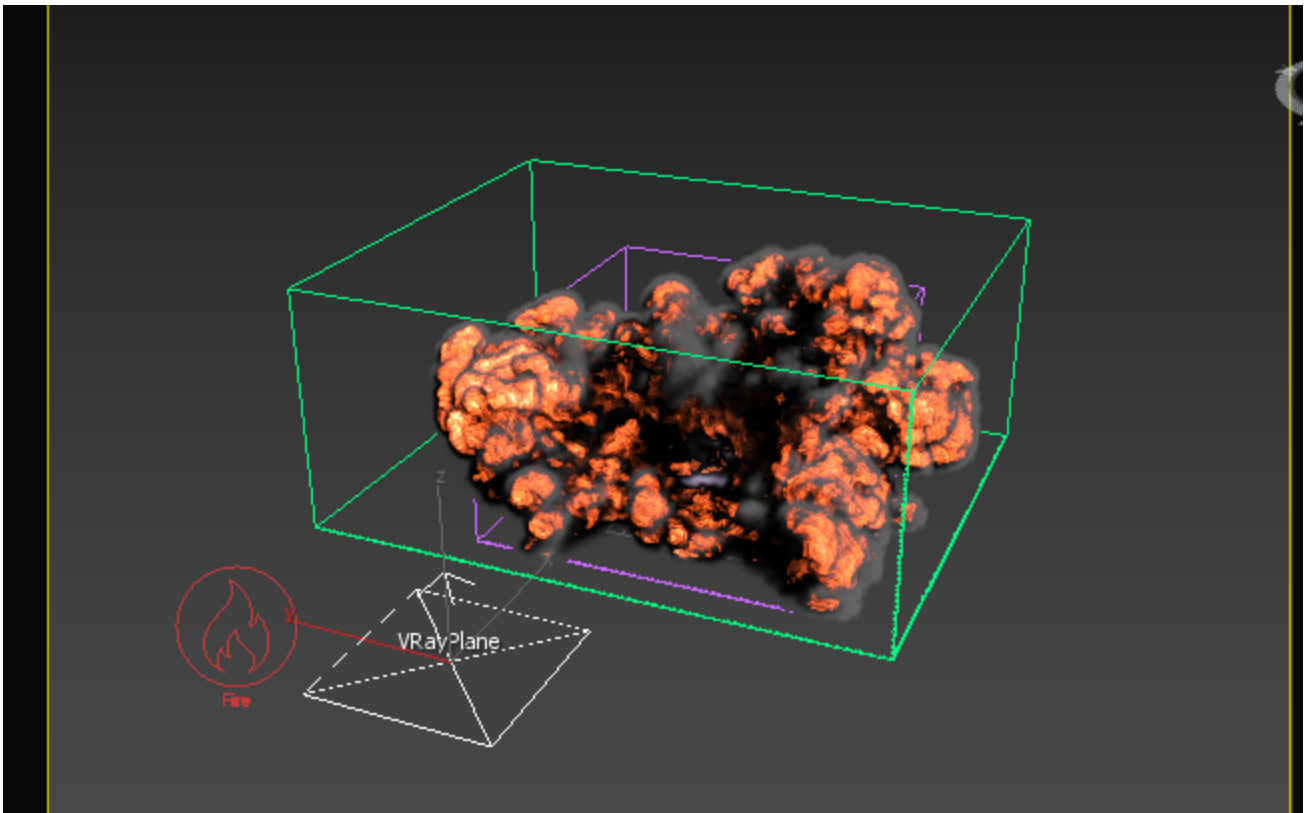
To prepare your scene for rendering a simulation make sure V-Ray is set as your Renderer in the **Render Setup** window.



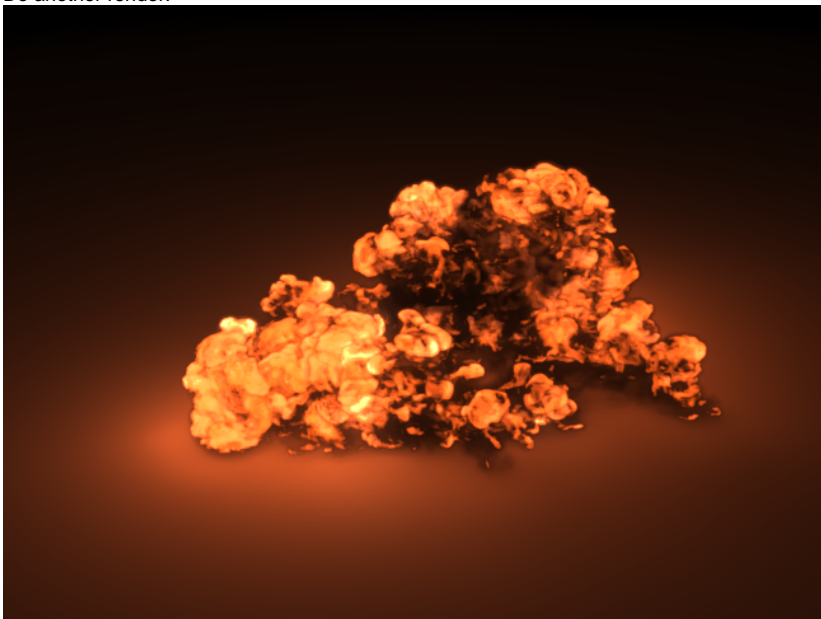
Here is how the render looks so far.



We need a ground plane, so create a floor by navigating to the **Create menu VRay VRay Plane**, and place it in the scene. Set it a little lower than the simulation and give it a gray color.

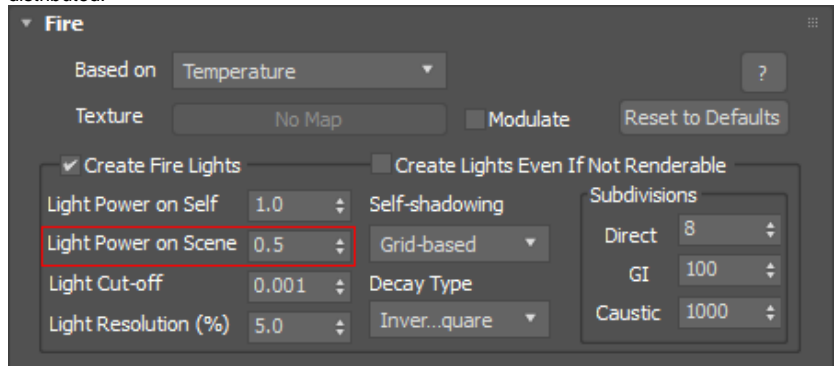


Do another render.



Notice some areas of the floor are too bright. You are able to control this in **Volumetric Render Settings**, under the **Fire** rollout.

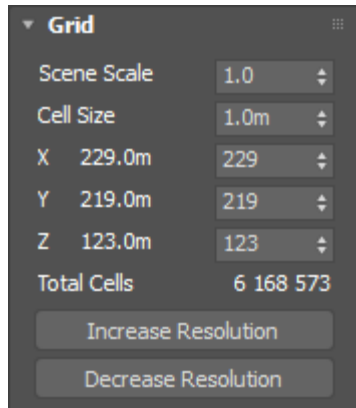
Set the **Light Power on Scene** value to **0.5** and re-render the frame. By reducing this value, the light is more evenly distributed.



Here is the new render.



To get finer detail for a final render, increase the Resolution of the Grid. In the Modify Panel of the Simulator, go to the **Grid** rollout and click **Increase Resolution** a couple of times to have about **6.1 million Total cells** and re-run the simulation.



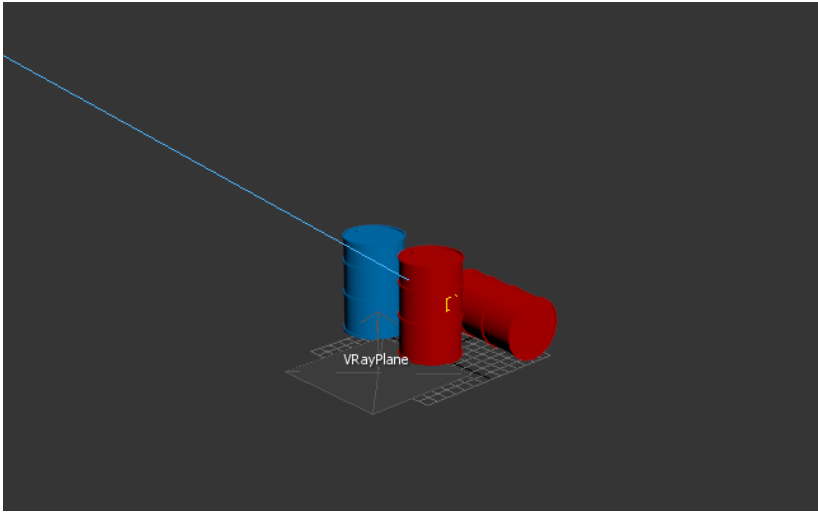
Here is how the final render looks.



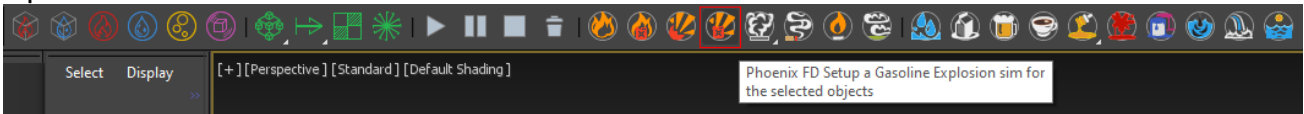
Example Scene

Now let's apply what we've learned to a real-world example and make these barrels explode!

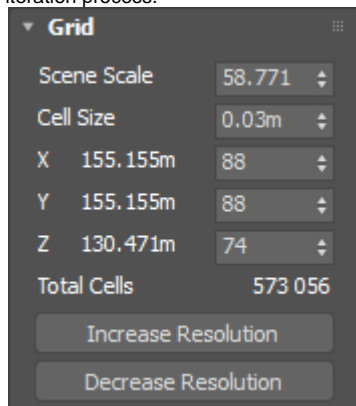
The following scene file can be downloaded from the Overview section above.



Select the blue barrel, *pCylinder3*, and apply the **Gasoline Explosion Preset**.

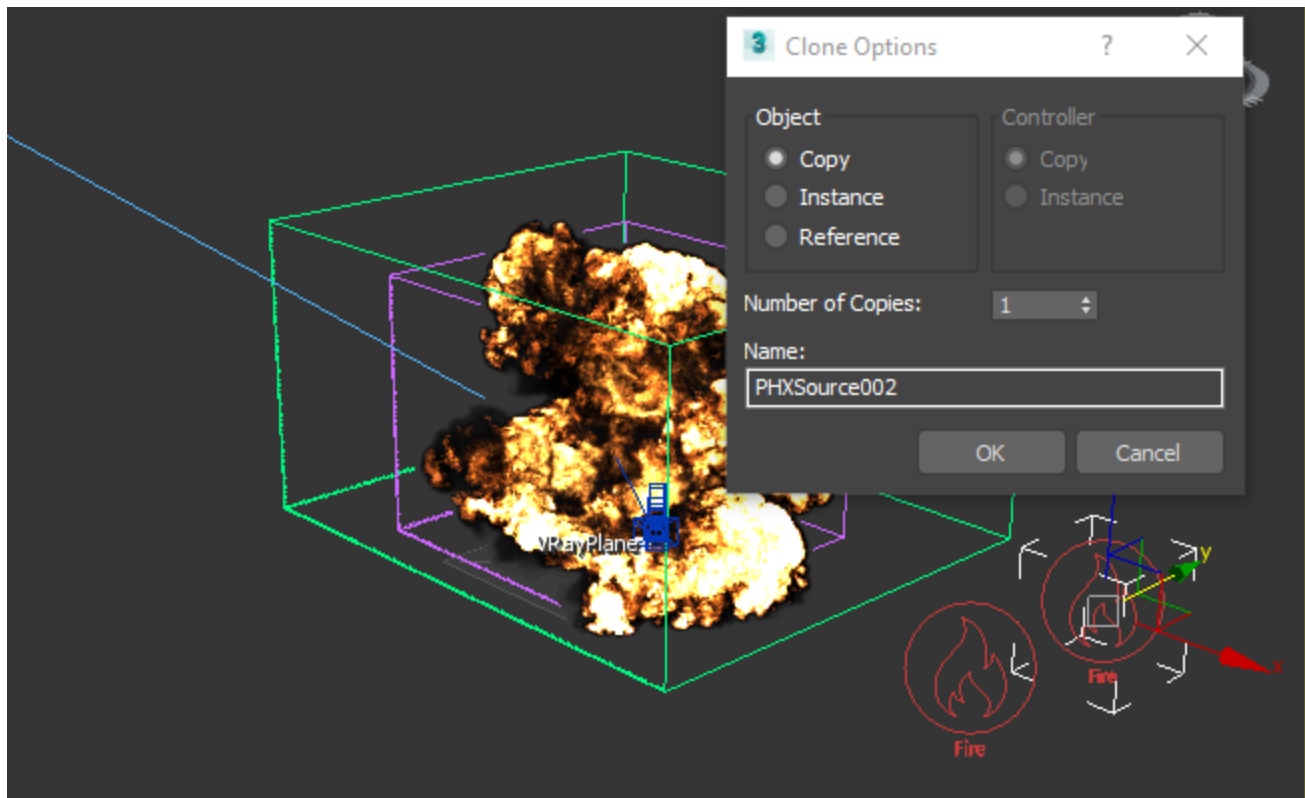


Select the Simulator and change the **Cell Size** to **0.03 meters**. This will decrease the **Total Cells** to around **573,000** and will save you time during the iteration process.



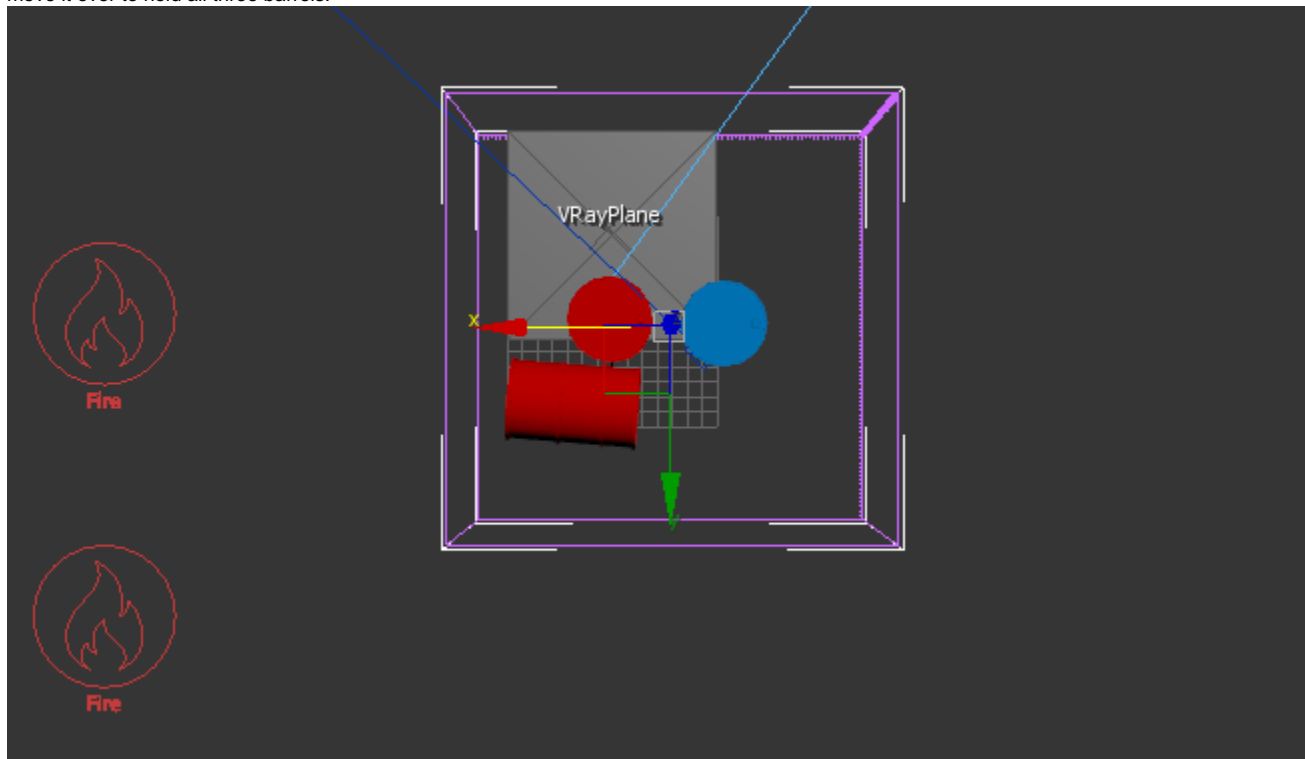
Start a simulation and you'll see that the blue barrel explodes. Now we will focus on the other barrels.

Stop the simulation and select the **Fire/Smoke Source**. Shift-drag to create a copy.



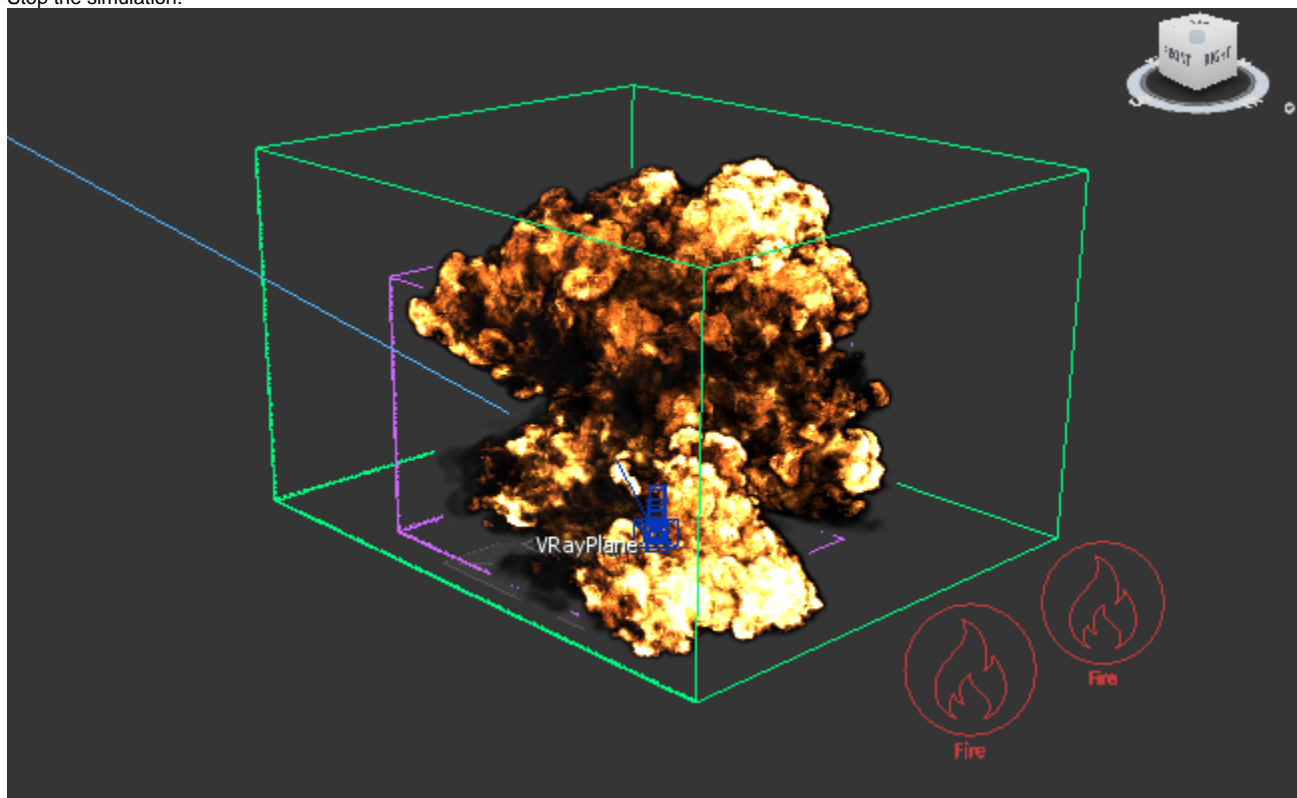
In the **Fire/Smoke Source**, Add the red barrel, *pCylinder2*.

Notice that this barrel laying on its side is slightly outside of the Fire/Smoke Simulator. Select the Simulator box and move it over to hold all three barrels.

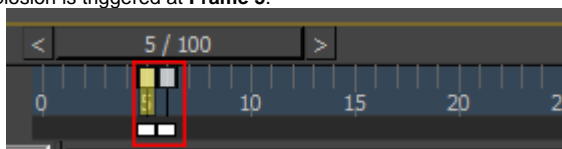


When you start the simulation now, you will see that both barrels explode at the same time.

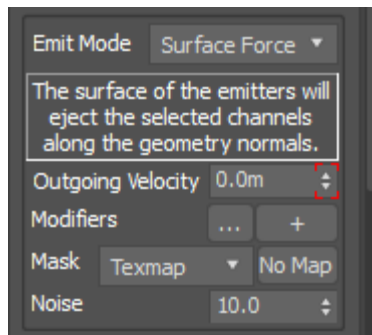
Stop the simulation.



To offset the second explosion so that it looks like a chain reaction, select the second **Fire/Smoke Source** and navigate to its keyframes. Select both keyframes and drag them over so that the explosion is triggered at **Frame 5**.

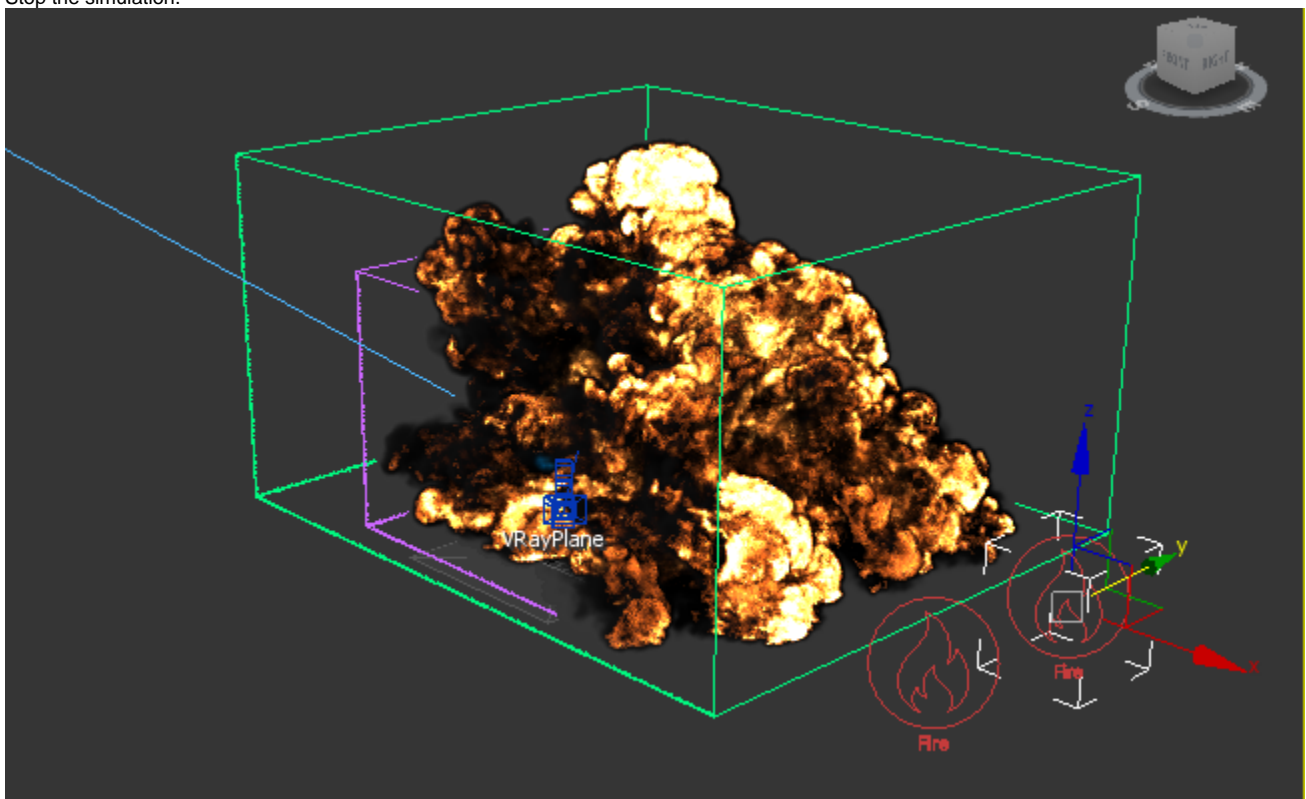


To make sure the explosion is not triggered earlier, step back to **Frame 4**, turn on **Auto Key**, and change the **Outgoing Velocity** of the **Fire Source** to **0**. Then turn off **Auto Key**.

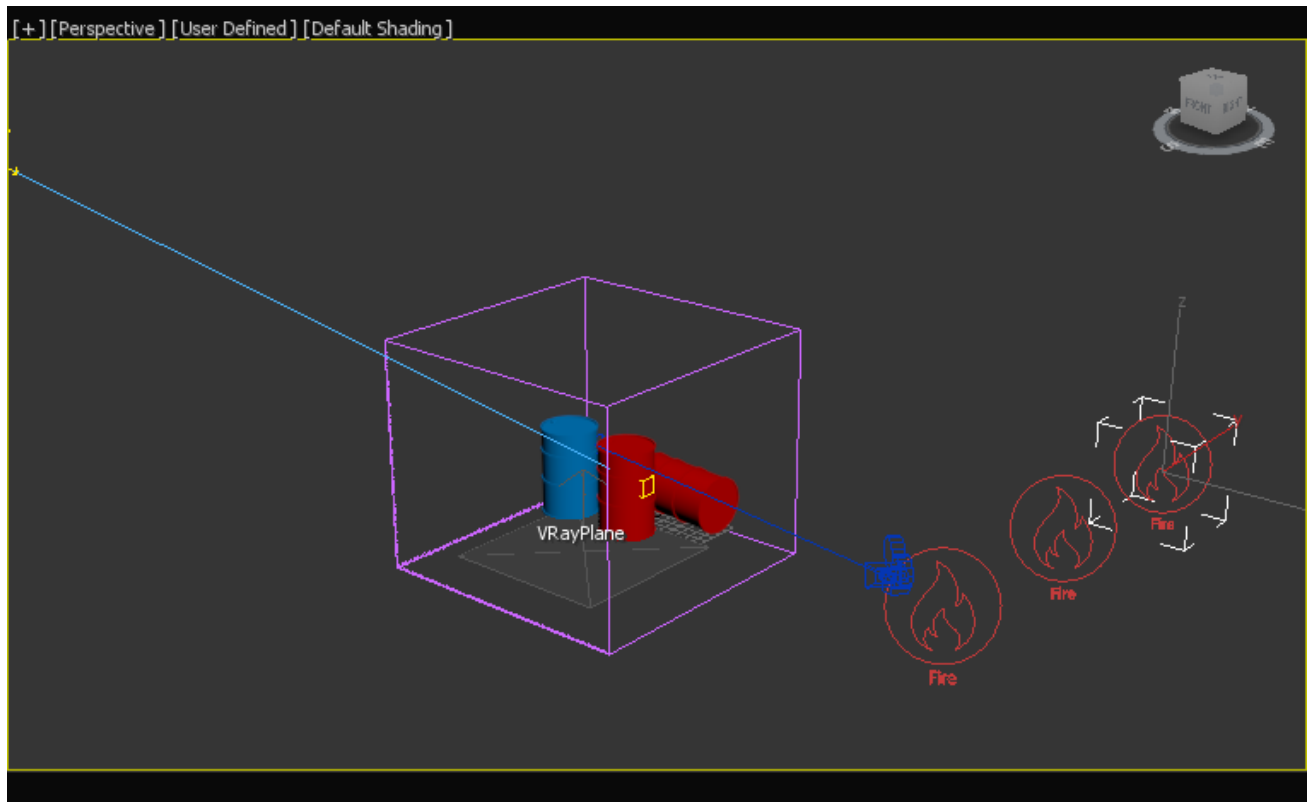


Now when you start the simulation again you will see two explosions, the second being delayed by five frames.

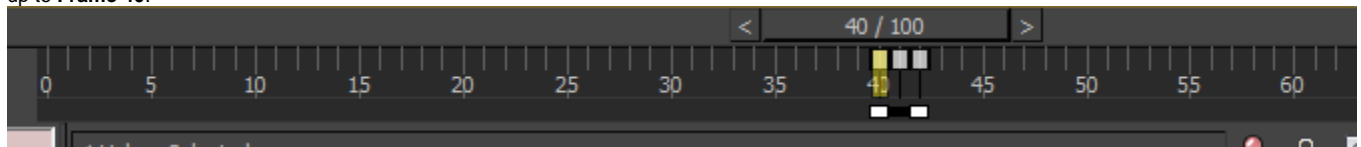
Stop the simulation.



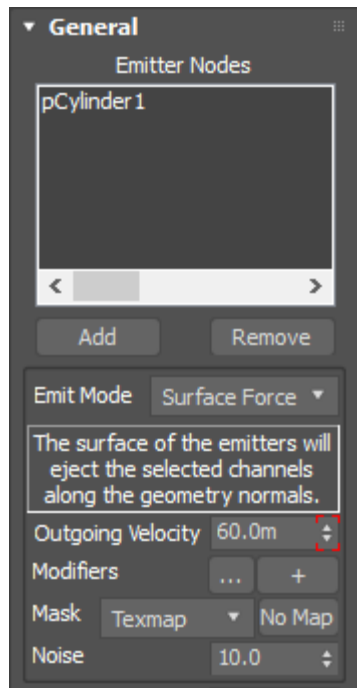
For the third barrel, shift-drag the second **Fire/Smoke Source** to make a third copy and add *pCylinder1* to it.



For this last barrel we are going to let the explosion cool off some before ignition, so with the third **Fire/Smoke Source** selected, move the timeline slider and the source's keyframes up to **Frame 40**.

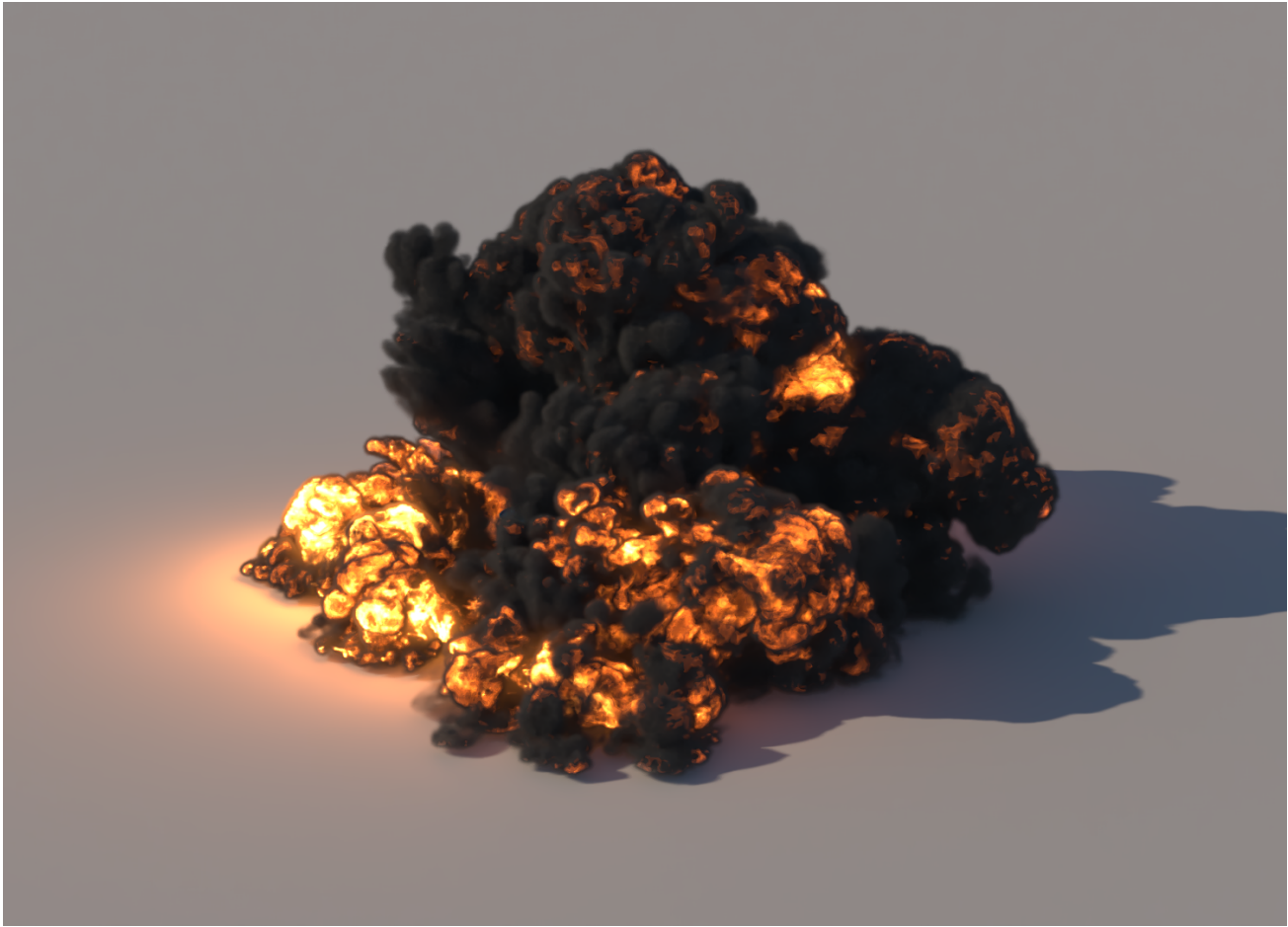


Turn on the Auto Key and navigate the slider to 41st frame. Change the **Outgoing Velocity** to **60.0**.

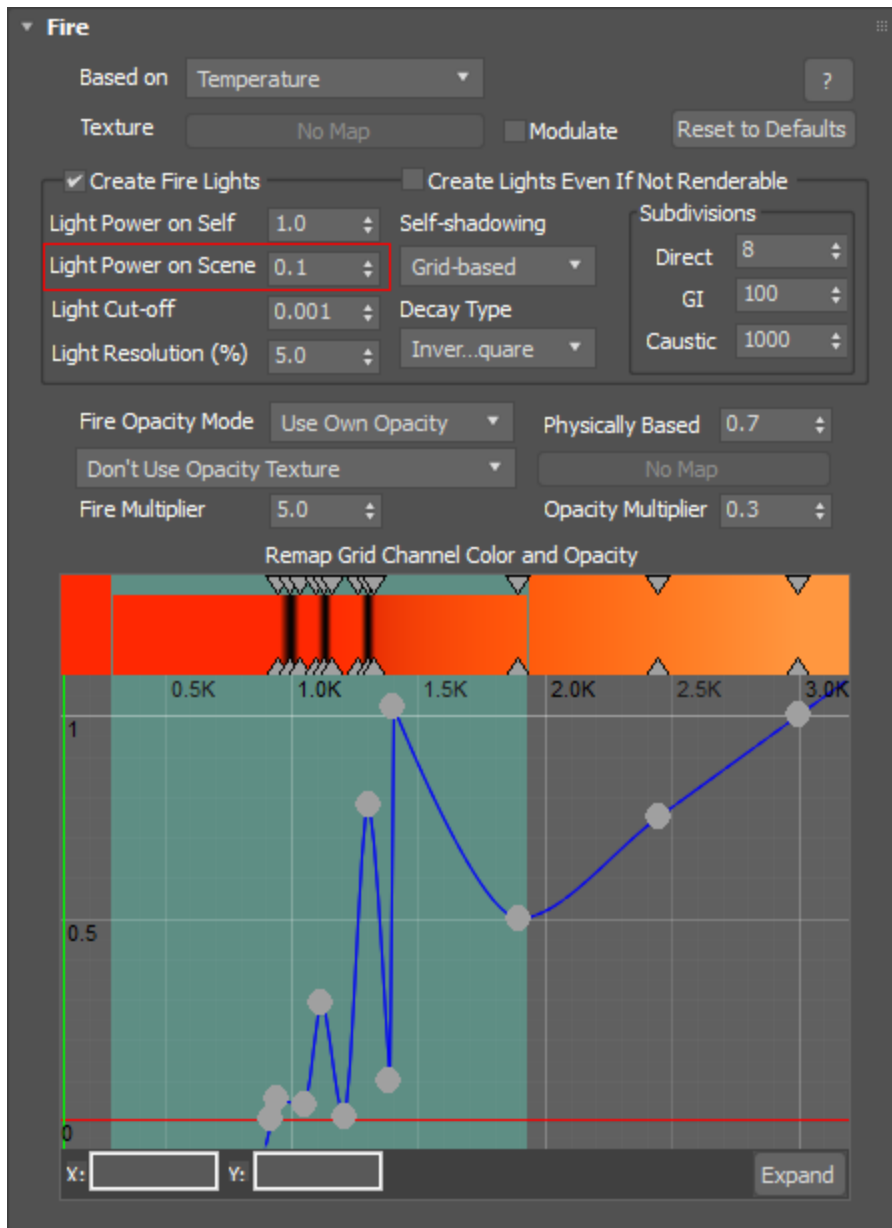


Start the simulation and let it run. The third explosion starts as the first two are cooling off.

Do a test render to see the results. If the fire is too bright, go into the **Volumetric Options** and decrease the **Fire Multiplier** value.



Go to the **Volumetric Options** **Fire** tab and change the **Light Power on Scene** to **0.1**.



To make the final simulation, go into the **Grid** rollout and increase the **Cell Size** to **0.015 meters**. This will increase the **Total Cells** to about **4.5 million**.

Set the **Adaptive Grid** to **Smoke** and the **Threshold** to **0.002**.

Grid

Scene Scale 58.771

Cell Size 0.015m

X 155.155m 176

Y 155.155m 176

Z 130.471m 148

Total Cells 4 584 448

Increase Resolution

Decrease Resolution

Container Walls

X Open

Y Open

Z Jammed (-)

☐ Confine Geom None

Adaptive Grid Smoke

Threshold 0.002

Extra Margin 0

Run the final simulation and make a final render.

