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Near-Earth Objects – Threats and Treasures
(National Space Society)

Slide 1

Madame Chair, distinguished delegates,

My name is Paul Wunderl, and I'm a member of the International Committee of the National Space Society. The National Space Society, colloquially known as NSS, is an independent, educational, grassroots, non-profit organization dedicated to the creation of a spacefaring civilization. NSS is an American-based, but globally active, organization with a history of 50 years.

Today, it is my pleasure to present to you "Near-Earth Objects – Threats and Treasures". In the first part, I will discuss why Near-Earth Objects pose a threat to us, and in the second part, I will explain how we can make use of them.

Slide 2

First, let me give you some basic facts about Near-Earth Objects.

Per definition, NEOs are asteroids or comets that come within 1.3 astronomical units of the Sun, which is about 195 million kilometers or 120 million miles. This implies that NEOs can come at least within 0.3 astronomical units of Earth's orbit. This is about 45 million kilometers or 28 million miles. Most NEOs originate from the inner part of the Main Asteroid Belt which is located between Mars and Jupiter.

To date, 34,218 NEOs have been discovered. There are 860 NEOs with a diameter larger than 1 kilometer. The largest is about 37 kilometers in diameter. The bigger NEOs pose little threat to us. It is actually the smaller ones that we need to be more concerned about, because they are more likely to sneak past our detection mechanisms. For example, just two weeks ago, on January 24, a very small and unknown NEO of around 1.5 meters in diameter missed Earth only by 774 kilometers. The great majority of NEOs still approach Earth with either no warning or a warning of less than 24 hours.

Slide 3

Out of the approximately 35,000 NEOs that we know today 2,324 NEOs are classified as Potentially Hazardous Objects, or PHOs. This is about 7.5 percent.

Per definition, PHOs have a minimum orbital intersection distance of less than 0.05 astronomical units from Earth's orbit (which is about 7.5 million kilometers or 4.6 million miles) and measure more than 140 meters across.

Apophis is the PHO with the historically highest rating on the Torino Scale. It reached level 4 in 2004, with a probability of 2.7 percent of hitting Earth. Luckily, the threat was lowered to level 0 in 2006. It will pass safely between the geostationary orbit and Earth on April 13, 2029 and it will be visible in the Eastern Hemisphere to anyone under a dark sky. This is an extremely rare event that occurs on average only once every 1,000 years.

Slide 4

As you can see here on this chart, most of the almost 35,000 NEOs have only been discovered in the last few years. In 2017, we knew only half of the NEOs that we know today. Even more surprisingly, we knew only around 1,000 NEOs in the year 2000, but already half of the NEOs bigger than 1 kilometer that we know today. The discovery rate averages about 40 NEOs per week and is still increasing exponentially. This means that during this STSC session around 80 NEOs are discovered.

Slide 5

This chart shows the annual discoveries by the various surveys. There are about 3,000 discoveries now, most by Catalina Sky in Arizona (which is shown here in green) and by Pan-STARRS in Hawaii (shown in magenta). Here, I also must mention NASA's NEO Surveyor, whose launch is planned for September 2027. This is an infrared space telescope that is designed to find more than 90 percent of all NEOs larger than 140 meters in diameter.

Slide 6

As you can see on this slide, the big strikes are extremely rare. The impact of an asteroid with a diameter of 100 meters, which on average occurs every 10,000 years, could destroy a large city. The impact of an asteroid with a diameter of 1 kilometer, which on average occurs every 100,000 years, would devastate most nations. And the impact of an asteroid with a diameter of 10 kilometers would cause a global-scale destruction. Luckily, we are able to deflect NEOs, which NASA's Double-Asteroid Redirection Test has shown, the world's first-ever test for planetary defense that marked humanity's first-ever purposeful movement of a celestial object's motion in space.

Slide 7

But, of course, it is not only NASA that established a Planetary Defense Coordination Office in 2016 and released a Planetary Defense Strategy and Action Plan just last year that I want to mention. Also, the other space agencies make great efforts. We all know, planetary defense is an international effort. The United Nations play a crucial role here. In the event of a credible impact threat prediction, warnings will be issued by the International Asteroid Warning Network. If the object is larger than about 50 meters and the impact probability is larger than one per cent within the next 50 years, the Space Mission Planning Advisory Group will start to assess mitigation options and implementation plans for consideration by the Member States.

Slide 8

NEOs are Janus-faced. Janus is the god of duality in ancient Roman mythology. On the one side, NEOs are a threat, but on the other side, they are also a treasure. But Janus is not only the God of duality. He is also the God of beginnings and the God of endings. This also applies to the current situation. We are working on ending the threat of NEOs, well, at least mitigating it, and we are approaching the beginning of a new era – an era, in which we can turn asteroids into resources.

Slide 9

Basically, there are three main types of chemical compositions of asteroids.

The C-type asteroids are in the outer asteroid belt. They consist of clay, minerals and silicate rocks. It is estimated that some of these asteroids contain more than 20 percent water.

The S-type asteroids are found in the inner asteroid belt. They are made up of stony materials and nickel-iron metals. Many NEOs belong to this type.

In the middle region of the asteroid belt, we find the M-type asteroids. They contain the highest concentration of metals - about 80 percent iron and 20 percent a mixture of a variety of other metals including nickel, iridium, palladium, platinum, gold, magnesium, osmium, ruthenium and rhodium.
All these materials are used in a wide variety of industries. On the next slide you will see the various benefits that asteroid mining will bring.

Slide 10

Asteroid mining will provide abundant resources. The extracted metals can be used for manufacturing purposes, including construction, electronics, and advanced materials. Many precious metals such as gold, silver, and platinum, just to mention a few, are also highly sought after for various industrial and technological applications, as well as for investment purposes and jewelry.

Asteroid mining will also help us become less dependent on Earth‘s limited resources. Eventually, this will help us protect our planet. For example, some asteroids contain Helium-3, an isotope that could potentially be used in advanced nuclear fusion as a clean and efficient energy source.

Furthermore, asteroid mining will bring many economic opportunities with new jobs and businesses. I mentioned NASA’s DART before. So, let’s take Didymos, with a diameter of about 800 meters, as an example. Didymos’ estimated value is 84 billion USD, and the estimated profit is 22 billion USD. Given such numbers, the overall economic opportunities that come with a new trillion-dollar industry will be tremendous.

And last, but not least, asteroid mining will support the exploration of space. Extracted resources could be used to support further space exploration, including building spacecraft, space habitats, and fueling rockets for deep-space missions. Therefore, asteroid mining will enable large-scale operations in the Solar System and be another important step towards becoming a multi-planetary species.

Slide 11

Now, let me finish with two quotes about NEOs by the famous American astrophysicist Neil deGrasse Tyson. One is about the threats and one about the treasures of NEOs. Together they illustrate the Janus-faced nature of NEOs.

"Asteroids have us in our sight. The dinosaurs didn't have a space program, so they're not here to talk about this problem. We are, and we have the power to do something about it. I don't want to be the embarrassment of the galaxy, to have had the power to deflect an asteroid, and then not, and end up going extinct. We'd be the laughing stock of the aliens of the cosmos if that were the case.“

And:

“The first trillionaire in the world will be the person who mines asteroids.”
Let’s hope that the scenario in the first quote will not happen and that the scenario in the second quote will happen in the not-too-distant future for the benefit of mankind.

Slide 12

Madame Chair, distinguished delegates, thank you for your time and attention.