



Forbes

Vice President Pence recently [spoke](#) at the Kennedy Space Center on renewing our national commitment to space exploration. Despite the amusing [social media distraction](#) over his violating the "Don't Touch" sign on a piece of the Orion Spacecraft, the VP's visit was singularly important. Pence explained the benefits to our national economy and security as he laid out a bold plan for exploration and a re-established National Space Council. Americans are once again getting excited about spaceflight and space science, but many of them still doubt that we can afford to spend \$billions doing this stuff while we have serious problems "right here on Earth." The truth is that we can't afford not to do this and it's great that Pence understands this.

I was recently engaged in a deep dive into the NASA budget myself as a member of the Presidential Transition team and I'm very pleased to note that both our civilian and military space programs have escaped cuts. Working together, the White House, OMB and Congress have wisely increased our investments in space and space fans are excited about the possibilities. Space is incredibly popular with Americans. NASA has [25 million Twitter followers](#), polls show that taxpayers [want to fund it](#) and the agency is consistently voted as the best [place to work](#) in the federal government. We also spend a great deal of money on maintaining our military superiority in space because our leaders understand that investments in space technology are the future of strategic defense as well as maintaining significant battle field advantages for our troops on the ground.

To be fair, a significant number of Americans simply don't get this thinking. They would prefer that we focus our nation's limited resources on solving "problems right here on Earth." They want to see increased spending on the environment, healthcare and other "practical" solutions to the problems real Americans face daily. They want to see Medicare and Social Security stabilized. In this sort of zero-sum thinking money that is spent on space only deprives needy people of the help they require. Seeing NASA and military space programs funded while other agencies suffer drives them mad. Such thinking is understandable, but it is sadly simplistic and terribly misguided. Luckily, it's also easily corrected. Let me arm you for that conversation.

First, we totally undermine the overall argument that money invested space has no return. America spends about [\\$19 billion](#) at NASA and perhaps [\\$23 billion](#) on the military space programs at the Air Force and NRO for a total of about \$42 billion. It's about 1% of our \$4 trillion federal budget. That is not a lot, but it is a level of spending that demands scrutiny. No worries; I assure you that *every dollar that our nation has spent in space, both civilian and military, has been paid back and these investments generate multi-fold returns to our economy every year.* That's a bold statement, but a single space program easily demonstrates this: the Global Position System (GPS) satellite constellation.



GPS is a military run satellite system that includes [NASA support](#). It's also ubiquitous in private and commercial sectors. GPS is built into our phones, cars, drones and many other devices we may not even suspect. It shouldn't be much of a stretch to imagine that GPS returns a lot of value to our economy. We all use it daily to navigate, locate loved ones and even shop. How can you quantify that? A [recent study](#) shows that a limited list of identified GPS commercial benefits returned about \$56 billion to the U.S. in 2013. A Motorola study a few years back showed that with their GPS system a single long haul truck could save \$52,000 a year in fuel, insurance, driver time, wear and tear, etc. Given that we have a million of those in the U.S., savings in trucks alone likely returns more money that we spend on space. On top of that [GPS saves lives and drastically reduces pollution](#) including global carbon emissions by making millions of ships, planes and cars more efficient.

For good measure add in the obvious value of communications satellites, weather satellites and our national security systems. These government space expenditures directly create tens of thousands of high paying jobs in dozens of sectors and support our growing commercial space capabilities and indirect industries that employ hundreds of thousands more.

While important discussions over our national space priorities – like planetary exploration vs. Earth science vs. human exploration – and over specific missions – send astronauts to the space station, Moon or Mars – must continue, our investment in NASA produces a plethora of surprisingly beneficial results few of us recognize. Let's take a look at a typical NASA [spinoff](#): air purification systems.



One of the most pressing requirements for maintaining life in space environments is the purification of air and water. On the International Space Station, the Environmental Control and Life Support System (ECLSS) keeps the air fit for human life. It generates oxygen, removes carbon dioxide and removes human by products like ammonia (from sweat) and methane (well, space farts). However, when scientist decided to grow veggies onboard the station the chemistry became more complex. In particular, it is now necessary to remove excess ethylene from the air. This chemical causes fruit to ripen and eventually to over-ripen and putrefy.

Researchers with the [Wisconsin Center for Space Automation and Robotics](#) came to NASA's rescue with a Photo-Catalytic Oxidization (PCO) scrubber. The PCO device excites an ultra-thin layer of titanium dioxide with ultra-violet light in the presence of oxygen. This drives a chemical process on the metal's surface that breaks apart organic molecules in the air. Works great to remove the ethylene and keep those space veggies fresh – Matt Damon would have need a big one of these in his Mars habitat to keep all those potatoes from rotting.

It also turns out that the anti-organic function of PCO systems can destroy the cell walls of bacteria, take apart viruses and decompose mold spores and other allergens in the air. This effect has many implications for Earthbound applications beyond keeping your bananas from spoiling. That's why PCO has become a standard feature in high-end commercial and domestic air filtering systems.



The primary limitation of PCO is that all the chemical activity happens on the surface of the titanium dioxide, within the air filter. If you can cycle all the air through the device fast enough things work pretty well. That's easy for removing ethylene in a tight environment, but isn't so useful for things like bacteria sitting on your room's surfaces.

The solution is in getting the chemistry from the catalytic action out to where the offending microorganisms and particles are hiding. One leading filtering firm, [Aerus](#), invested over \$10 million in acquiring and developing space technologies to create practical Earth based systems that can do just that. Their Active Pure Technology (a variant of Radiant Catalytic Ionization) system utilizes ambient moisture in the air to release hydroxyls and hydrogen peroxide from the PCO process into the air. Research shows that in addition to taking down airborne organics, these molecules settle on room surfaces where they effectively neutralize germs.

Recognizing Aerus' significant investment in the commercialization of this NASA technology, the Space Foundation recently inducted the firm and its founder into the [Space Technology Hall of Fame](#), a great tool for highlighting the contribution space makes to our economy. It reminds us that Aerus and hundreds of other firms make their money using space tech and they provide a lot U.S. based manufacturing, sales and distribution jobs in the process. Aerus founder Joe Urso remarked, "We are very fortunate to live in a time when space-age technology and innovation have such remarkable implications for us here on Earth." Indeed, we are!

