

Science AMA Series: I'm Dr. Yogi Goswami, a solar energy scientist and inventor, currently developing the world's first molecular air purifier, AMA!

YogiGoswami¹ and r/ScienceAMAs¹

¹Affiliation not available

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Abstract

Hello, my name is Dr. Yogi Goswami, I am the inventor of Photo-electrocatalytic technology for disinfection and detoxification of air. I am a Distinguished Professor and Director of the Clean Energy Research Center at the University of South Florida and Chief Editor of Solar Energy, the International scientific journal. I'm currently developing the world's first molecular air purifier, capable of neutralizing any organic indoor air pollutants, such as bacteria, viruses, mold and Volatile Organic Chemicals in the air with a level of speed and efficiency never seen before. This is a pretty big and exciting breakthrough, and I'm looking forward to answering your questions! AMA! Proof: <http://imgur.com/Wnqwd9i> Thank you to everyone who participated, I'm signing off now. It was a pleasure conversing with you all! Feel free to message me directly for more information. For information on my solar energy work, check out: <http://cerc.eng.usf.edu/> For the air purification device am working on, check out: <http://molekule.com/> Thank you for being such great participants. You are a great community! Cheers!

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Science AMA Series: I'm Dr. Yogi Goswami, a solar energy scientist and inventor, currently developing the world's first molecular air purifier, AMA!

YOGI_GOSWAMI [R/SCIENCE](#)

Hello, my name is Dr. Yogi Goswami, I am the inventor of Photo-electrocatalytic technology for disinfection and detoxification of air. I am a Distinguished Professor and Director of the Clean Energy Research Center at the University of South Florida and Chief Editor of Solar Energy, the International scientific journal.

I'm currently developing the world's first molecular air purifier, capable of neutralizing any organic indoor air pollutants, such as bacteria, viruses, mold and Volatile Organic Chemicals in the air with a level of speed and efficiency never seen before. This is a pretty big and exciting breakthrough, and I'm looking forward to answering your questions! AMA!

Proof: <http://imgur.com/WnqwD9j>

Thank you to everyone who participated, I'm signing off now. It was a pleasure conversing with you all!

Feel free to message me directly for more information.

For information on my solar energy work, check out: <http://cerc.eng.usf.edu/>

For the air purification device am working on, check out: <http://molekule.com/>

Thank you for being such great participants. You are a great community! Cheers!

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How does it work, and why is it groundbreaking?

What got you interested in Photoelectrocatalysis?

What is the energy cost of this device?

Do you see any reasons why hospitals or the medical community as a whole might be keen to adopt using this purifier?

Finally, what skills are most in-demand for your line of work?

[SmokinGrunts](#)

1. This technology came out of two of my solar technologies (photocatalysis and photovoltaics). The technology includes a special catalytic filter which is activated by the action of light. It oxidizes and destroys microbes (bacteria, viruses and mold) as well as Volatile Organic chemicals in the air which are offgassed from many indoor materials.
2. It started with a personal need. My son is asthmatic and lot of allergy problems. I noticed that there were triggers in the air that made his allergy problems worse. So I started to look around for air cleaners that might help. However, none of the ones on the market helped. I even attended conferences related to Indoor Air Quality, but came back disappointed, because the only solution being presented was filtration, HEPA being the state of the art. Then it occurred to me that a solar photocatalytic technology I had developed and used at the Tyndall Air Force Base in Florida for

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cleaning the contaminated ground water might provide the solution. So a new technology was born. After years of experimentation and further improvements, the latest version, called the Photo-electro catalytic (PECO) technology is now finally ready. I hope it can help many others.

3. There is potential to save energy by cleaning more air in buildings rather than only bringing in air from the outdoors. The energy cost for the technology itself is nominal.
4. Yes indeed, there is a lot of interest from hospitals and medical communities, because of the danger of hospital acquired infections.
5. My line of work is both solar energy and indoor air quality. In the solar energy area, there is a lot of demand for engineers and technicians and scientists. In the Indoor air Quality area there is a lot of demand for people who can measure the IAQ, and those who have expertise in remediation of contaminated buildings. Since the technology I have developed can be integrated with HVAC systems, HVAC technicians will also be in demand.

I'm an HVAC tech, and have a few customers that require high levels of filtration due to things like AIDS, other immunity disorders, and major allergies. What is the future look like in regards incorporating this into residential HVAC systems. And when. I have a particular customer in mind that would pay anything for this now.

Also how does it compare against electrostatic, UV, and high MERV filters?

Edit: is this a pass through device that will act as a filter or some other mechanism, if it is a pass through what is the MERV rating? I'm thinking about the static pressure on a molecular level filter would be basically the same as a installing piece of plywood as a filter.

Edit 2: what is the lifespan, and how do you remove the pollutants from the device.

Edit 3: is this device powered? If yes what does it operate at?

Edit 4: what level of purity does the Air need to be before it can operate efficiently, basically I'm asking, if you have a bunch of Large dust partials will it clog the system to quickly?

Edit 5: does this operate as a CO2 scrubber as well?

[icanthinkofanewname](#)

Yes, I definitely see a product coming to the market that will be integrated with HVAC systems. It will have the level of filtration that is needed and then photoelectrocatalytic technology to really clean the air. Although, the system for HVAC integration is not on the market at this time, I will be willing to help any special cases as pilot projects.

edit: The electrostatic and high MERV filters just filter some of the particles; they cannot filter volatile organic compounds in the air. Moreover, any microbes trapped on the filters continue to multiply.

The PECO technology has a prefilter which filters out dust particles and it has a catalytic filter with a light shining on it which oxidizes any microbes and VOCs passing through it. The basic mechanism is the creation of free radicals confined to a surface which oxidize all of these pollutants.

Edit 2: The device being introduced in the market has a catalytic filter with a MERV rating of 12 to 14; however, it can be a higher MERV rating for applications such as hospitals and medical facilities. In the case of this catalytic filter MERV rating does not have as much significance with regards to performance, because we only require a pollutant to collide with a fiber of the catalytic filter for a reaction to take place, rather than trying to trap pollutants in a full mesh of fibers.

The static pressure of course depends on the MERV rating of the filter and the number of pleats in the filter; so it can be designed with a fan of appropriate power. A portable device we've tested has a pressure drop of about 0.5 inches. A device for central air conditioning systems will have a higher pressure drop but not much more.

Edit 3: The prefilter will need to be replaced every one to three months; the catalytic filter by definition cleans itself, however, because some dust particles settle on the catalytic filter it will have to be replaced every 6 to 12 months.

Edit 4: The large dust particles are filtered out by the prefilter which will have to be replaced every 1-3 months which keeps the catalytic filter clean so that it does not have to be replaced that often.

What benefit does it have over electrostatic + HEPA filters?

[grndzro4645](#)

HEPA filters only work down to a scale of 0.3 microns. The PECO technology deals with pollutants 1000x smaller like viruses and airborne chemicals as well. Mold can grow on filters, and bacteria even when they die on them can release endotoxins. HEPA cannot deal with gaseous chemical pollutants. In contrast PECO chemically breaks down these pollutants into simpler molecular structures. In most cases the resultant is trace amounts of water, carbon dioxide, nitrogen and extremely small amounts of other trace elements.

... capable of neutralizing any organic indoor air pollutants, such as bacteria ...

Most bacteria floating around are pretty much unharmed. What mechanism does the device use to kill bacteria? Does it discriminate against what bacteria are killed?

It looks like this will go on to be very popular. What measures are being taken to make sure that these bacteria will not become resistant to your device?

[rohrsha](#)

This technology creates hydroxyl free radicals that oxidize bacteria into trace amounts of carbon dioxide and water and minerals. It does not discriminate between bacteria, or for that matter, any organic matter. Because we don't just kill bacteria, we disintegrate it completely into trace elements, the bacteria has no chance to become resistant. For some context, oxidation and hydroxyl free radicals exist in nature, and thus far bacteria have not become resistant over the course of their evolution.

Research shows that children exposed to allergens early in their lives tend to have fewer allergies later in their lives. If you could write instructions for your machine that would take this into consideration, what would they be? Thank you for your work!

[ilikepho](#)

The current problem is that the air indoors is often five times worse than the air outdoors. This is because our air handling systems pull in pollutants from the outdoors and allow them to concentrate and mix with additional pollutants generated indoors. Studies have shown that chronic exposure to pollution is a factor in the rise of chronic respiratory disease as well. We want to change the equilibrium so that the air indoors is just as healthy as the air outdoors in natural environments. This technology is a part of that. Because the clean air generated with the device mixes with the air already present, we will not create sterile environments, but a more healthy equilibrium.

Thank you for asking this question however, it is something everyone involved in air purification should take into account. As my technology is commercialized I will work to ensure that we preserve a healthy equilibrium.

What has to happen in order for solar energy to become (more) mainstream, and affordable, than it already is? How long will that take?

Also, what's a 'distinguished' professor compared to a regular professor? Do you just wear a better sports coat to class? :)

Thank you for being part of the science AMA's!

[AthlonRob](#)

Solar energy systems have certainly become much cheaper now than they were some years back. Therefore in many locations and applications they are very cost effective. However, I know based on the research going on, that the efficiencies will continue to go up and the costs will continue to come down. As the demand increases so does the competition, which in turn brings the prices down -- which is what we see happening. One area which is going to be extremely important for solar energy is storage. Right now for photovoltaics we are using the grid as the storage, however, we cannot keep doing that because after a certain level of penetration it can cause fluctuations in the grid. No need to despair though!! There is a lot of research in storage, in fact, we have developed thermal energy storage technology in which we have encapsulated salt in metal and ceramic balls which will be used in large scale solar power plants.

A "distinguished" professor probably means I have more grey hair. :-)

Do you anticipate this being used primarily in hospital settings, industrial uses, or are you anticipating adoption by individuals?

[work2improve](#)

We anticipate widespread use in homes, offices and commercial buildings. And of course, in hospitals and medical facilities also.

I know a couple of very asthmatic folks that would greatly benefit from this (mold). But I was wondering, is there a potential for this to change our own microflora on our skin, mouth, nasal passage etc?

[goatstealotmeal](#)

As the air goes through the device it comes out clean. However, the clean air mixes with the rest of the air in the room so we are not sterilizing the room, only cleaning the air to where people are at much lower risk of allergies and related problems. For some context, the air indoors is up to 5 times more polluted than the air outdoors, because our current air handling systems don't do a good job of dealing with indoor air pollutants. With this technology we can break down those pollutants that build up indoors, and restore the air to more natural levels.

When do you expect this technology to be widely available?

[cheejudo](#)

We are currently working to commercialize this technology, and will hopefully have an announcement soon!

How could China's air pollution problem be solved on a large-scale?

[peterpan_in](#)

Our technology can help people in China while they are indoors. However, to take care of the outdoor air pollution, the long-term solution is to use non-polluting power technologies and non-polluting transportation systems. Right now 80% of china's power comes from burning coal. As long as coal remains their major resource it will be very hard if not impossible to take care of their outdoor air problem. They have to use as much solar energy as they can.

Could something like this be set up on a grand enough scale that it would reduce smog/pollution to more acceptable levels in some of the major cities around the world? And if so, how big would the purifier(s) have to be to make this difference. Thanks ☺

[RoyDraige](#)

This technology will mainly be used for indoor applications. I believe for cleaning the outdoor air we have to look into our power plants, what energy resources we use, as well as our transportation systems. The answer is in making all of these systems more environmentally clean.

We do have some other technologies in development that could someday help purify outdoor air, but the current technology is primarily for the indoors.

I notice you have several gigantic books on the shelf behind you in that photo. What textbooks (if any) would you recommend to someone trying to get into the field?

[Tandemmirror](#)

The books you see behind me are all written or edited by me. So hopefully you will like them! The textbook on Solar Energy is "Principles of Solar Engineering" (3rd edition) published by CRC Press. It is used all over the world by undergraduate and graduate students in science and engineering, however, there are many textbooks available which can be used.

What areas are you most interested in?

Dr. Goswami,

Thanks so much for answering questions. It used to be that integrated circuits would follow Moore's Law, where the density of transistors would roughly double every two years. Now we seem to be hitting a plateau and Moore's Law is breaking down in this sector. Do you know of any standard pace for solar power technology, whether it be in size, price, efficiency or any other known measure, and is the pace changing one way or the other? In a broader sense, where do you see things going in the future?

[Toddler_Fight_Club](#)

I see things going in a different direction in the future. For example, nano-antennas to convert sunlight as well as ambient radiation into electricity. The concept was patented in 1975 and demonstrated back in 1983 at the microwave level. In this case they showed that microwave radiation could be converted

into electricity by using antennas at an efficiency of more than 80%. However, it is not that simple to translate this to solar frequencies because the wavelength of solar radiation is extremely small. This concept uses the wave nature of light instead of the quantum nature of light. Research is ongoing by some groups around the world. It may take a few years, but eventually I believe this concept will replace the present concept of semiconductor based photovoltaic cells.

Do you get to own the patents for this technology or is it all University property? Either way, how does this affect your motivation to work on this technology?

[D_SAC](#)

The motivation for me was personal need, and now the motivation is to see that this technology helps other people. The University owns the patents, but has licensed them to a company to market.

What scale are we talking fit the purifier? Is this industrial size, or can we expect it to become part of the filtration system in vacuum cleaners and air conditioning within a short span of time?

[brabazon](#)

The technology can be designed to fit into any size, based on the application. Although the initial product would be for room air cleaners and HVAC integrated system, in the future this would be integrated in a lot of other places like cars, planes, etc.

As a safety professional and industrial hygienist - I've always been leery of devices which can kill bacteria/viruses/mold in occupied areas. If it kills viruses/bacteria/mold - how will it not affect human cells? Even if it does not produce enough to kill a human cell - can it produce a concentration that will cause upper respiratory issues in sensitive populations (hospitals for example)?

[thefuckingsafetyguy](#)

Our chemical reactions are confined to surfaces, so when the pollutant collides with a fiber of the catalytic filter, the reaction takes place. We do not release any harmful substances or byproducts into the air. This is something you are wise to be leery of, since many devices produce ozone or incomplete byproducts which can be more harmful.

What is its capacity and how much space does it require?

How affordable will it be to the government?

How much time will it take go large scale and what places, positioning it will be most efficient ?

[logicsaysthat](#)

These questions refer to commercialization. Stay tuned :) and there will be more information.

Once you neutralize the bacteria and viruses are they dead? Do you remove them from the air or do they float around as particulates?

[vtjohnhurt](#)

In this technology bacteria is oxidized into trace amounts of CO₂ and water and minerals. The amount of CO₂ and water is so small that it does not really change the composition of the air and there is nothing left floating around.

What are you developing in terms of solar energy? What technologies do you think will solve the energy crisis?

[TheAmazingHanowski](#)

We are focused on research on energy storage because I believe that will be the key to increased use of solar energy. Our energy storage research includes thermal energy storage, supercapacitors, and hydrogen storage.

For someone who has cystic fibrosis i know this technology will be beneficial for someone like me. I have just one question. Will the device/technology ever be distributed throughout the nation-wide public and will the price for the equipment be in reason for a regular person?

[LSmyD](#)

If you can message me on reddit, we can look into the possibility of having you as a beta tester. We are working on getting this technology out to the public as quickly as we can.

As a total layperson who only hears things and gets scared: Does this have any possible overlap with the issue of antibiotic resistant bacteria

[Avenger_of_Justice](#)

In this technology bacteria is oxidized into trace amounts of CO₂ and water and minerals. There is no question of the bacteria becoming antibiotic resistant. However if there was an airborne antibiotic resistant bacteria, the technology would have no problem destroying it as well.

Edited: Thanks for catching my typo!

Could this technology be installed in public transportation such as subways, trains, and buses?

[Angelaw26](#)

Absolutely.

Molecular air purifiers are a fundamental building block of a spaceship life support system.

Do you think that a long term, completely closed system of air recycling is achievable? Right now the big issue is spare parts need and low efficiency.

Thank you for your contribution to human progress, professor.

[Zaartan](#)

We actually did research for NASA for recycling the air in the space station. Complete recycling is achievable, however, that is not what we are doing for the terrestrial system.

Do you have any advice for young inventors?

I have a couple of inventions but I'm having a very difficult time in gaining the attention of investors.

[TheCheeseGod](#)

Fundamental R&D inventions always take time to get attention from investors for commercialization. It took me 20 years to get PECO ready, and to get attention for the technology. My advice to you would be to continue developing the technology, and gathering proof that you are solving key problems. The really important problems always take time, and persistence is the key. Good luck!

Arizona and Nevada have placed fees and costs on going solar that make it not worth it to customers. Solar is clearly a direction we need to expand in, what can we do to get electric utilities like APS, SRP, Nevada Power, etc, to start supporting clean energy? Thanks.

I hope this ama takes off and you're able to answer a lot of questions.

[malaclypz](#)

You have to work through your elected officials. Question the people who are running for election where they stand on solar energy.

This is exciting.

- How does the power efficiency compare to existing filter based technologies?
- Can it operate over large areas such as malls?
- Can this technology be theoretically used to allow smoking on planes? It's a theoretical question and I'm interested in your response - just for the record, I don't smoke or think smoking is any good.

[tryinghardagain](#)

A room air cleaning device based on this technology would use about 60 watts. A unit can be integrated into central air conditioning systems for small and large buildings including malls. Of course large buildings and malls would require multiple systems.

Dr. Goswami, is there any downside to your invention?

[fraands](#)

We have tested in many different ways, but haven't seen any downside yet.

Up to what scale can this be used? Could it be installed as a filter directly on the emission sources? Would it then reduce fluid flow? Thank you!

[luxux3](#)

The device can be designed for many applications. The question of pressure drop and fluid flow can be easily handled in the design.

If this technology was perfected, could I also be used to remove CO₂/other greenhouse gases from the atmosphere?

[Kalbamater](#)

Scrubbing CO₂ from air is a completely different technology; it is not related to the present PECO technology, however we are developing CO₂ scrubbing technology also which can be integrated with this in the future.

How are you sure that the volatile organic compounds are being fully oxidized to CO₂ and water and are not just producing a wide array of oxidized organic compounds? Also, does this method produce oxidants such as ozone or NO_x?

[motoreed](#)

With conventional photocatalysis it is possible to have incomplete oxidation reactions which would produce intermediates. However, in the photoelectrochemical technology the oxidation process is accelerated by way of increasing the free radicals by orders of magnitude so that the reaction is complete. We have made measurements with GC and GCMS (technical instruments capable of measuring down to 1 part per billion) and have found that we are not producing any intermediates.

With our current technology, how efficient do you see consumer grade solar cells getting in the near future?

[cruznr](#)

Fraunhofer Institute in Germany just announced solar cells of 43% efficiency. However, it will take some time before such cells become cost competitive and available.

Hi Dr. Goswami, I'm currently studying electrical engineering in Western Australia and I'm looking forward to getting into the renewable energies industry once I graduate.

Unfortunately the state and federal governments have taken a frustratingly conservative approach to funding solar and wind technologies (mostly due to the large mining industry lobbyists). I'm considering moving overseas instead to somewhere more progressive, but the problem still exists, and I find myself annoyed that I have to even consider leaving my home city because of this.

How do you think engineers and scientists working on green energy technologies should go about cutting through the government lobbying and bureaucracy which pointlessly slows them down?

[theoldcrow5179](#)

Yes my friends in Australia keep me informed about what is happening in solar energy there. My advice is to keep working at it and try to change the system there because Australia has much more to gain from developing and using solar energy. I wish you the best.

What is the specific application for which you are developing your filter?

[buysgirlscoutcookies](#)

We are developing our technology to clean indoor air. The first applications will be in buildings

including residential, commercial, and medical. Eventually this technology will be used in transportation for example, cars, trains and airplanes.

Could the same technology be applied to water filtration, as well?

[spankleberry](#)

The principle can certainly be used for purifying water also. In fact, I first developed the technology to clean contaminated groundwater using sunlight. That technology was demonstrated at Tyndall Air Force Base near Panama City, Florida in 1993.

Is the use of this technology going to be worldwide or used specifically in places such as China with extremely heavy air pollution? Do you think cost will limit where you can deploy it?

[JaydenSheep](#)

Yes, it will be available in places like china sometime in the future. However, it may take a couple of years.

Amazing, and you are amazing.

How fast exactly does this type of purification work?

Also, out of curiosity, how large is the main purifier/filter?

[SpinningMadness](#)

As the air goes through the device it comes out clean. The size of the device will determine how fast a room can be cleaned. With a fan of 200 CFM a room of 400 sq. ft. would be cleaned in less than 20 minutes.

What is the biggest obstacle to efficient and cheap solar panels?

[ecoshia](#)

Research funding. ;-)

Hello Dr. Yogi, could you please explain (in the context of your project) what these phrases mean?

- detoxification
- molecular air purifier
- *pure* air
- neutralizing

Thank you.

[Gingevere](#)

Detoxification means destroying toxic compounds in air Molecular air purifier means purifying air at the molecular level Pure air means air which has been filtered and disinfected and detoxified Neutralizing in strict terms means not allowing the microorganisms to reproduce however, in the

photoelectrochemical technology we are using it for oxidizing and mineralizing the microorganisms.

Do you think the Chinese will overcome US technology in the solar field any time soon? Also tell us more about your molecular air purifier (will it help people like me with allergies?). Thanks!

[LabelingTheory](#)

Research in China is increasing rapidly; however, based on what I see as editor in chief of the technical journal "Solar Energy" there is still more research going on in the USA.

Thanks for the AMA!

I recently received my BS in ChemE, and I would like to dive further into PV technology.

Aside from research, where do you see that engineers are needed in the industry? Where would you recommend focusing my studies?

[gottahobby](#)

The industry needs all kinds of engineers including Chemical Engineers so you are on the right track.

When these get scaled up to larger than billboard size, how long will it take to have the climate pristine, and can you extract the pollutants from the air into usable material?

Also, what exactly IS perfect weather? Do we know the perfect ranges as to prevent a cataclysmic ice age, as I understand this is due to other factors not just pollution?

[thermotronica](#)

We may have a solution for outdoor air in the future, however the current technology is intended for indoor use.

If air purifier filters most of the foreign substances, is there any chance more and more children will develop allergy for them.

If children are not exposed to say pollen even a little bit in their early ages, aren't they more likely to develop an allergy for them?

[SuryaBhushanTripathi](#)

An air purifier in a room can only reduce the level of allergens; it cannot completely remove them. The air that goes through the device comes out clean but it mixes with the air in the room, so that the concentration goes down over time. The idea is that we reduce the harmful concentrations that build up indoors to safe levels of exposure that allow us to build our immunities without being overwhelmed.

Hi! I would like to ask about the rate of reaction behind your invention. How much air would this device be capable of processing within a minute or hour? And what factors would this be dependent on?

How would this product compare to your main competitors, which are activated carbon filters?

Would fouling of any sort be an issue in this device's operation?

Also, on a semi-related subject, would a phenomina similar to the electrical double layer be present in air?

Thank you for taking the time to introduce your research to us.

[Rearranger](#)

A device can be designed based on our technology to process as much air as you need. Of course, if you need to process large amounts of air you will need a large area of catalytic filter and the proportionate amount of light. This is because we improved the reaction rates several orders of magnitude on conventional photocatalysis, so they aren't the limiting factor in practical implementation.

As long as you keep replacing the prefilter fouling should not be a problem, however, because of some dust depositing on the catalytic filter you will need to replace that every 6-12 months depending on the application.

Do you think the solar energy is, or will be, a viable energy souce for large scale energy production in large industrial countries like the US?

[Personfour](#)

Yes indeed!

I often hear about clean technologies that are very innovative. However, most don't make it to a commercial or industrial scale to become a meaningful economic success. I am interested in knowing what specific hurdles do you see in the technology, such as the one being developed by you, in getting to an industrial scale. How can these hurdles be overcome?

[tstMeNot](#)

You are right there are many innovative technologies invented that never become commercially available because of many reasons. The biggest hurdle is the financial investment needed to bring a technology to market. This investment can be huge and has the risk of not being successful. Another potential hurdle is long gestation period for the research. This is where public funding and research grants can help. We have been fortunate on both sides, and are optimistic that in the long run we can make a dent at industrial scale.

Hi Dr. Yogi, I've a huge concern about air pollution. I live in a city where once a month the authorities advise us about the critical conditions of the air. Air pollution as a result of vehicles that run with fossil fuels is bad for our health and in some cases can also be lethal. What are the requirements of breathable air? Just oxigen? If not, what are the principles of air pollutant's filters? Thanks!

[korlandjuben](#)

You are right that burning fossil fuels in cars and power plants is a biggest reason for air pollution. It is worse for cities. The pollutants include gaseous organic chemicals, microbes (viruses, bacteria etc.) and other allergens. These need to be removed from indoor air, to make it breathable. The conventional air cleaning devices are based on filters which cannot take care of all of these pollutants. That is the reason I developed the PECO technology.

In the winter in colder climates because we close our windows and doors for months, what is the benefit to opening the window and letting fresh air in? Why does the air from outside "feel" cleaner?

I asked my chemistry teacher this and he really could not give a definite answer.

[cjrur](#)

A study from the US EPA showed that inside air can be as much as 5 times more polluted than outside air. This is because the pollutants from outside come into the inside space and keep getting concentrated; in addition, there are extra pollutants generated indoors. That is why the outside air feels cleaner when you open the windows.

The answer regarding temperatures is correct, however outdoor concentrations of VOCs are also typically lower because wind and pressure are available to help diffuse pollutants, while the concentrate indoors.

I currently work at a hospital, and a huge part of my job is air quality off our HVAC system. What advantages does this system have over currently used systems like ionizer bars and HEPA filtration? Could this possibly replace these, and what maintenance would be required

[Fil_E](#)

This system has a huge advantage over the ionizers and HEPA filters. The HEPA filters filter out particles larger than 0.3 microns. Many viruses and all of the Volatile Organics pass through the HEPA filter. Even the microbes that are trapped on the filter start to multiply. Our technology takes care of these problems by oxidizing and therefore eliminating the microbes as well as VOCs.

Ionizers actually create more harmful submicron pollution as documented by the Harvard School of Public Health among others, and should not be used.

Is this technology something that will be rapidly adopted within the next few years or is it in preliminary stages?

How long do you think it would be, if it is possible, before this type of filter could be scaled to the size of say a wearable filter mask that surgeons could use?

Is this approach something that could be applied to shielding against radiation or am I fundamentally misunderstanding the technology being used?

[Frankyg170](#)

We believe this technology will be rapidly adopted within the next few years. The first products will be building air cleaning products but eventually it will be integrated in wearable filter masks also. The light used in this technology is safe so you do not need any shielding.

My question isn't so much about solar energy as it is about how you maintain your position as a professor, director of a major research center, and chief editor of a major academic journal (among other things), while still maintaining any semblance of "life" outside academia. How do you balance all of these competing demands? I see that in addition to your commitments stated above, you are also part of these organizations: - ASME - ISES - IASEE - AAAS - ASES

As a young engineer who is thinking about pursuing grad school... how do you keep up with it all?

[k_breeze](#)

I pursue all of these things because this is my life and my passion. My advice to you is to follow your passion wherever it takes you.

1. How could this tech be used for front line fighters combating enemies using chemical warfare methods? Is it resizeable to hand or CO2 tank size?
2. What's the best degree path to take in order to best help the development, spread, and use of solar energy?

[boydo579](#)

This technology can be designed to combat bioterrorism, and can be effective against sarin gas. The US Dept. of Defense is aware of that.

To work in solar energy, a degree in science, engineering and technology would be best, however, a solar energy company needs all kinds of employees including technicians, sales, and others.

Photoelectrocatalytic technology is used in solar panels to store energy. Was this discovery directly spawned from your work in solar panels. If so, how did it come about that you saw it in a new way?

[Hypocritese](#)

This technology came about in combination with a photocatalysis technology I was working on for water purification. When I was searching for a way to purify the air, I realized that I could apply these principles from one field to the other.

Would this work on harmful pollutants like excess CO2 and other gasses that are harmful to the atmosphere? Or just disease causing molecules like bacteria and viruses? If it does then I imagine that would be a massive breakthrough in helping the planet.

[Eraio244](#)

We are developing a technology to absorb and remove CO2 which will eventually be integrated into this technology. Currently it works on harmful gases (VOCs) like methane, benzene, etc.

Hi Dr. Goswami!

I am in R&D for the printing industry and we have some pretty strict regulations for VOC contents of our inks.

Do you see this product allowing for companies to have higher caps on restrictions for VOC content and emissions because of this product?

Could it be scaled up for a large production facility?

[speedy621](#)

This technology should help your industry as well as many other industries to meet the air quality requirements. Yes the technology can be scaled up to meet the industry requirements. If you contact me, I would be happy to discuss in more depth.

What could this mean for us in the next, let's say 20 years?

[HopelessSky7](#)

My hope is that in the future the air indoors is as good as the air outdoors in natural environments.

How could this or similar tech work to purify water?

[HighHighwayman](#)

The principle can certainly be used for purifying water also. In fact, I first developed the technology to clean contaminated groundwater using sunlight. That technology was demonstrated at Tyndall Air Force Base near Panama City, Florida in 1993.

How would someone make a molecular air purifier at home with items bought from a store?

[GoldenDeLorean](#)

I wish I could answer that question. :-)

Does this device differentiate helpful and harmful microorganisms?

Would you elaborate on "neutralize"; are they killed, captured, torn apart on a molecular level, etc.?

Would grants be better spent providing panels and storage systems for individuals, research into the technology, or large solar arrays like CSP systems?

Is the immediate future of 'solar energy' photovoltaic cells, solar thermal systems, or another technology?

Are antidumping and countervailing efforts allowing companies in the solar industry receiving grants and subsidies to pass that money on to shareholders and slow the adoption, rather than lowering prices on the consumer end?

What are more difficult hurdles to applying solar technologies, than the future pollution and waste?

[dynameta](#)

As a researcher I would say that grants for research improve the technology and therefore reduce the cost for individuals. However, for the adoption of technology, some level of subsidy for the consumer actually helps the economy. The feed-in law in Germany is a perfect example of how individuals were subsidized by way of large feed in tariff which increase the market which in turn helped the companies that brought in additional investment, it increased jobs. A study showed that the multiple economic effect was 7 times the investment. A similar concept can work for large scale solar arrays also, such as CSP systems, by guaranteeing certain tariff that will make easier for investors to invest in such systems.

Answer to mix of solar: We need both -- solar photovoltaic and solar thermal. While the cost of photovoltaic are much lower at this time than solar thermal, storage for solar thermal is much cheaper than battery storage.

Hello & thank you for your time! What competing technologies and processes currently exist and how does your technology compete in terms of cost? Also do you foresee this tech used to aide people in high density urban environments either indoors or while commuting?

[JSmo](#)

The competing technologies are the conventional filtration technologies, HEPA filter being the state-of-the-art. However, the filters including HEPA filters cannot remove VOCs, and allow microorganisms to multiply on the filter. This technology takes care of all of those problems. It is certainly useful for the high-density urban environments that you mentioned. Eventually, it will be used in transportation systems also.

Can you make a convincing argument that solar/wind/clean energy are truly capable of meeting our energy needs in a sustainable fashion over a longer time frame of say 2000+ years? 10,000 years? I'm concerned that when you factor in the mining, production, limited amounts of some of the inputs, installation, maintenance etc. it's not a true path to clean/sustainable energy for 7 billion people with no fossil fuels over a long term time frame. Would love to hear otherwise.

[farmerzach](#)

Nature took care of it by providing a source of energy that is virtually inexhaustible -- the Sun. We just have to figure out how to use it for all of our needs. Of course we have to be very efficient so that we can take care of our needs with the least amount of energy used. To address your question regarding mining production, etc., a life cycle analysis of photovoltaic panels showed that their energy payback period was less than 2 years of energy production from the panels, while their lifetime is expected to be more than 25 years.