

Future Insight Prize—From Dream to Reality

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Merck is the world's oldest pharmaceutical and chemical company and a leading player in science and technology. When the company celebrated its 350th anniversary in 2018 among other activities a comprehensive future-oriented program around science and technology was set up with the overall goal not only to support the further long-term prospering of the company but also to help boost the further advancement of science and technology in general and particularly to help applying it to solve some of humanities biggest problems.

To support that goal a 350th anniversary science and technology program was set up consisting of three consecutive phases. The main goal of phase one, the conceive phase, was to start the thought leadership process and to define the challenges and dreams of today and tomorrow. Together with the journals *Nature*, *Science/AAAS*, *Harvard Business Reviews* and *Technology Forecasting and Social Change*, in total more than 2000 scientists and business leaders were surveyed and more than 10 publications resulted.

Phase number 2, the convene phase, had the goal to assemble the brightest scientific and entrepreneurial minds to shape the future. It involved the flagship science conference *Curious2018—Future Insight* along with the Anniversary Edition of the Merck Innovation Cup. In total, about 1500 people were coming together at the occasion of these meetings. Finally, the goal of phase 3, the realization phase, was to move from curiosity to action and to set in place the infrastructure, processes and resources to implement the best ideas and partnership proposals worked out during the two preceding phases and to initiate activities to lay the foundation for a successful future. For that purpose, the Merck 350th Anniversary Research Grants and the Future Insight Prize and were designed and rolled out. While the main purpose of the 350th Anniversary Research Grants was to perform mid- and long-term research to benefit the Merck product pipeline, the main goal of the Future Insight Prize is to boost scientific and technological progress globally and to help solve some of humanities most pressing issues.

What are these problems? Think tanks all over the world have compiled lists and performed assessments of the greatest threats to humanity as we know it such as the Future of Humanity Institute of Oxford University (<https://www.fhi.ox.ac.uk/>), the BBC (<http://www.bbc.com/future/story/20170815-the-greatest-threats-to-humanity-as-we-know-it>) or the Global Challenges Foundation (<https://globalchallenges.org/>). Main topics are: war (nuclear armageddon, bioterrorism, new

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nano-weapons), global pandemic threat via a newly emerging likely viral pathogen, ecological collapse/climate change/global warming associated with overpopulation and food production issues, a flawed artificial intelligence, emergence of the next ice age (natural climate change), eruption of a super-vulcano or a major asteroid impact. A recent survey conducted with 50 Nobel Laureates by the Lindau Nobel Laureate Meeting and Times Higher Education listed as the three biggest threats: (1) environmental degradation/overpopulation, (2) nuclear war and (3) infectious diseases (<https://www.dailymail.co.uk/sciencetech/article-4838392/50-Nobel-laureates-reveal-greatest-threats-mankind.html>).

A key question in prioritizing the areas where additional stimulation via a special research prize makes most sense and is able to create the highest impact, and it is important to sort out the fields where prospected commercial benefit alone and market forces are not sufficiently stimulating progress and where additional incentives and support structures are required.

In collaboration with Harvard Business Reviews Analytical Services, we conducted a survey with 1000 readers of Harvard Business Reviews which were asked about the anticipated social and business impact of certain technological advances. Interestingly, the top five gap areas in which social impact is greater than business impact were: curing cancer, pandemic preparedness, genetic modification of humans, food for the world and reversing climate change.

To explore the area further, we organized a series of scientific advisory boards to elucidate topics potentially suitable as focus areas for the planned Future Insight Prize. Finally, after thorough evaluation and assessment, it was decided that at the occasion of its 350th anniversary, Merck will sponsor the Future Insight Prize to stimulate innovative solutions to solve some of humanities greatest problems and to realize the dreams for a better tomorrow in the areas of **health, nutrition and energy** (Figs. 3.1 and 3.2).

In the area of health, the key issue on how to achieve a rapid protection from a newly emerging likely viral infectious disease with pandemic



Fig. 3.1 Future insight prize logo



Fig. 3.2 Future insight prize trophy

potential should be addressed. Emergence of a new, potentially lethal infection that is easily transmitted from person to person is among the greatest threats to humanity. The risk is increasing due to global urbanization, ease and speed of travel, climate change and the possibility of bioterrorism. Using current technology, development of medical countermeasures would be too slow to prevent many millions, or even billions, of deaths.

Another field to be tackled in the health area is combating the problem of multi-drug resistant bacteria. Antimicrobial resistance threatens the effective prevention and treatment of an ever-increasing range of infections. CDC estimates that in the USA, more than two million people are sickened every year with antibiotic-resistant infections, with at least 23,000 dying as a result. There are already high proportions of antibiotic resistance in bacteria that cause common infections (e.g. urinary tract infections, pneumonia, bloodstream infections) in all regions of the world. A high percentage of hospital-acquired infections are caused by highly resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) or multi-drug-resistant gram-negative bacteria.

In the area of nutrition, new innovative technologies to feed a growing world population should be the field of focus. The projections show that feeding a world population of >9 billion people in 2050 would require raising overall food production by some 70% between 2005 and 2050. This will only be possible by applying unconventional highly innovative new technology.

Finally, in the area of energy the problem of rising CO₂ levels leading to pronounced climate change should be addressed via production of fuel from atmospheric CO₂. The reduction of CO₂ to useful chemicals has received a lot of attention as an alternative to the depletion of fossil resources without altering the atmospheric CO₂ balance. As the chemical reduction of CO₂ is energetically uphill due to its remarkable thermodynamic stability, this process requires a significant transfer of energy. Achievements in the fields of photocatalysis during the last decade sparked increased interest in the possibility of using sunlight for photocatalytic reduction of CO₂ for the production of solar fuels.

Rather than just providing a general stimulus and research funding in the respective areas, we felt that a vision should be developed for an ideal outcome that would stimulate creativity worldwide on how to make it a reality. For that purpose, the “dream product” concept was developed.

A dream product is a product that cannot be realized with the current state of science and technology, but whose existence would be extremely desirable and which is required to ensure the long-term survival of humanity. Who is finally developing, manufacturing and selling the dream product is not of relevance as long as it is made available in sufficient quantities and to a reasonable price worldwide. The Future Insight Prize will put the vision for ambitious dream products of global importance for humankind into the world and will trigger curiosity and creativity worldwide on how to make this vision a reality. The time-frame given for such a realization was set to 35 years, as a resemblance to the 350th anniversary of the company. The prize should be given to people whose work enabled a significant progress toward making the vision a reality via discovering new groundbreaking science or via development of enabling technologies.

In that sense, the work to be conducted can be termed “**visearch**” visionary research, focusing on areas whose further investigation promises to lead to avenues toward technologies that can then be utilized to make the visionary dream products a reality. It is important to note that this can be basic and applied research! In that sense, it especially has to be kept in mind that breakthroughs very often originated from the so-called Pasteur’s quadrant according to the four-quadrant scheme introduced by Donald Stokes (*Stokes, Donald E. (1997). Pasteur’s Quadrant—Basic Science and Technological Innovation. Brookings Institution Press. p. 196. ISBN 9780815781776*), seeking fundamental understanding of scientific problems, while also having immediate use for society.

Working together with scientific advisory boards, definitions for dream products were compiled covering all four focus areas.

The dream product to achieve a rapid protection from a newly emerging infectious disease with pandemic potential is called “Pandemic Protector” with the following properties: “*The dream product starts with a clinical sample of a person infected with an unknown pathogen and*

produces an agent to cure the infected person or to prevent infection of others within a clinically relevant timeframe.”

The pandemic protector advisory board consisted of Christopher Milne, Daniel Bausch, James Le Duc, Michael Jacobs and Ron Fouchier (Fig. 3.3).

Already at the Curious2018—Future Insight Conference, the topic of pandemic preparedness and the pandemic protector as the first installment of the Future Insight Prize was covered in a panel discussion and received outstandingly positive assessments. The following panelists were participating: Christopher Milne (Tufts Center for the Study of Drug Development), Eileen Farnon (Head Outbreak Investigation Task Force Institute Pasteur), Justin Sanchez (Director Biological Technologies Office DARPA), Lothar Wieler (Director Robert Koch Institute), Nadia T Tornieporth (University of Applied Sciences and Arts Hannover, Coalition for Epidemic Preparedness Innovations), Sir Michael Jacobs (Clinical lead in infectious diseases, Royal Free London NHS Foundation Trust), Stefan Oschmann (CEO Merck), Subhanu Saxena (Bill & Melinda Gates Foundation).

The dream product to combat the problem of multi-drug resistant bacteria is called “multi-drug resistance breaker” with the following properties: *“The dream product is a series of novel narrow-spectrum antibacterial agents that are able to cure any bacterial infection without induction of drug resistance, empowered by a one hour*

diagnostic test to select the appropriate agent from this series for an infected patient.”

The multi-drug resistance breaker advisory board consisted of Deborah O’Neil, Hans-Joachim Zeiler, Harald Seifert and Stewart Cole (Fig. 3.4).

The dream product to help feed a growing world population is called “Food Generator” with the following properties: *“The dream product converts any non-edible biomass into readily edible fully nutritional food within one day without any biohazard.”*

The food generator advisory board consisted of Camille Delebecque, Isha Datar, Kara Bren, Lolke Sijtsma and Martin Jonikas (Fig. 3.5).

Finally, in the area of sustainable energy and stopping further climate change the dream product should have the following properties: *“The dream product generates a high-energy-density fuel from renewable energy, water and atmospheric carbon dioxide with an overall negative carbon dioxide balance.”*

The CO₂-to-fuel converter advisory board consisted of Clifford Kubiak, Daniel Nocera, Ferdi Schüth and Michele Aresta (Fig. 3.6).

The Future Insight Prize will be awarded annually from 2019 onwards to honor and enable outstanding achievements in science and technology toward a groundbreaking innovation, enabling the later realization of a dream product, important for the future of humanity in the areas of health, nutrition and energy. The prize will be given out for the first time in 2019 for work enabling the later realization of the dream

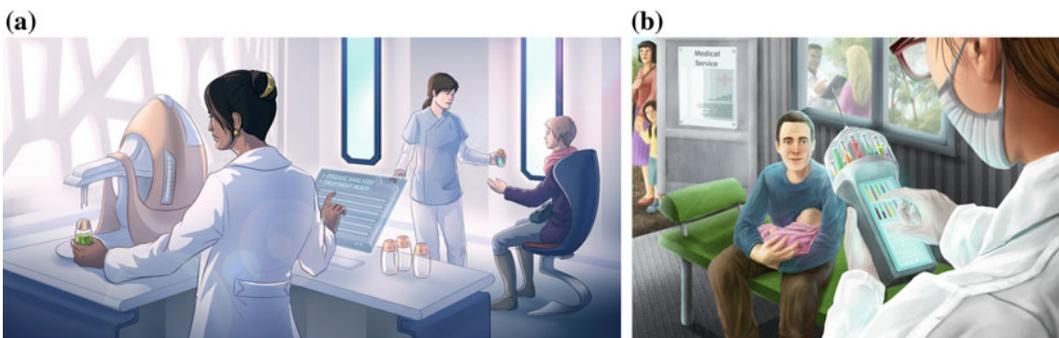


Fig. 3.3 Artist’s view of dream product pandemic protector

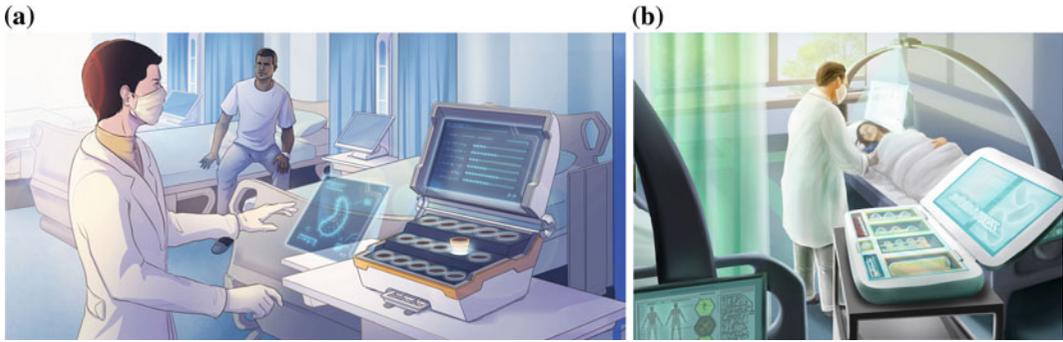


Fig. 3.4 Artist's view of dream product multi-drug resistance breaker

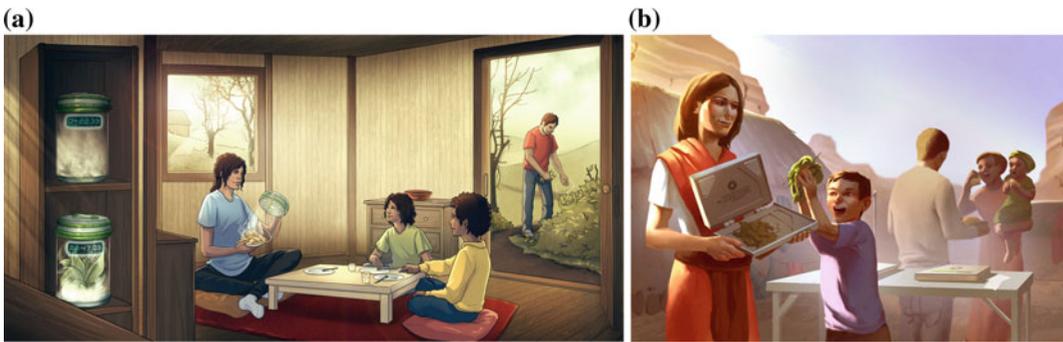


Fig. 3.5 Artist's view of dream product food generator

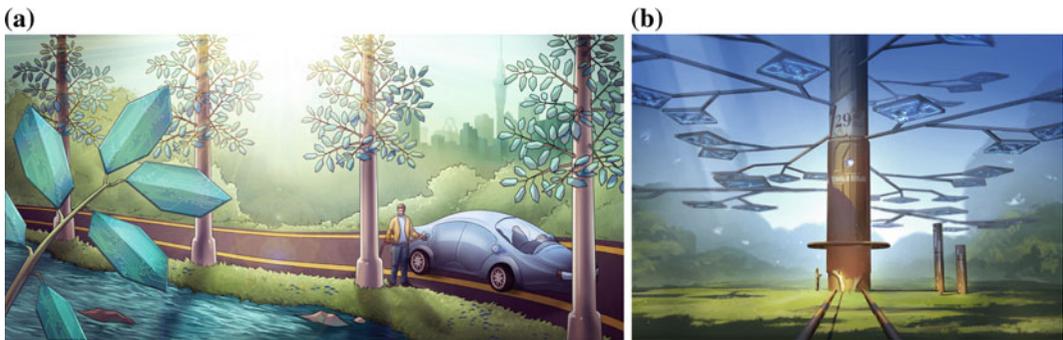


Fig. 3.6 6 Artist's view of dream product CO₂-to-fuel generator

product pandemic protector, to protect humanity from the outbreak of a new viral pandemic. In the following years, Future Insight Prizes will be given out on the topics of multi-drug resistance, food generation and CO₂-to-fuel conversion.

The Future Insight Prizes consists of a research grant of up to 1 million €, the Future Insight Prize trophy, a keynote lecture at the

annual Future Insight Prize Winner Event plus a plenary keynote lecture at the Curious—Future Insight Conference. The research grant can be used by the recipient for research located in an area that will provide important input to making the dream product a reality down the road. Ownership of developed intellectual property is not affected by the research grant.

A jury composed of independent international experts will screen the global landscape and identify potential candidates for the Future Insight Prize. In addition, scientists from all over the world can propose suitable candidates to the jury. The jury will then select the final candidates that will be contacted and encouraged to send in an application. The jury will then screen all received applications and select the winner. The winner will be publicly announced and present their research at the Future Insight Prize Winner event and at the Curious—Future Insight Conference.

The winner will be selected according to the following criteria:

- (1) Has the recipient's work provided important breakthroughs to enable a later realization of the dream product?
- (2) Is the recipient's work of utmost scientific quality recognized by top peer review journals?
- (3) Is there reason to believe that the recipient will be able to make good use of the prize money to advance research in this area further?

The Future Insight Prize Jury is composed of renowned international scientists and managers, and currently (status December 2018), it has the following members:

Angela Belcher, MIT
 Benjamin List, Max-Planck-Institute for Coal Research
 Camille Delebecque, Afineur
 Carolyn Aldige, Prevent Cancer Foundation
 Christina Smolke, Stanford University
 Christopher Milne, Tufts
 Clifford P. Kubiak, UC San Diego
 Daniel Bausch, LSHTM
 Daniel Nocera, Harvard University
 Daniel Zajfman, President Weizmann Institute of Science
 David Solit, Memorial Sloan Kettering
 Dean Radin, California Institute of Integral Studies

Deborah O'Neil, Novabiotics
 Donald Cleveland, UCSD
 Eileen Farnon, Pasteur Institute
 Ernst-Ludwig Winnacker, LMU München
 Ferdi Schütz, Max-Planck-Institute for Coal Research
 Hans-Joachim Zeiler, Creative Therapeutics
 Harald Seifert, University of Cologne
 Isha Datar, New Harvest
 Jake Yeston, Editor AAAS/Science
 James Le Duc, UTMB
 Jef Boeke, NYU Langone Health
 Jean-Marie Lehn, College de France, Strasbourg
 Jeremy Nicholson, Imperial College London
 Joao Monteiro, Editor Nature Medicine
 John Gyapong, University of Health and Allied Sciences, Ghana
 Kara Bren, University of Rochester
 Kenneth Drazan, President GRAIL
 Lolke Sijtsma, University of Wageningen
 Martin Jonikas, Princeton University
 Mary Voytek, NASA
 Matthew Rosseinsky, University Liverpool
 Michael Jacobs, RFL NHS
 Nadia Tornieporth, CEPI
 Nancy Cox, Vanderbilt University
 Nicholas M. Donofrio, IBM Fellow
 Peidong Yang, UC Berkeley
 Peter Hotez, Baylor College of Medicine, Texas
 Peter Piot, LSHTM, London
 Ron Fouchier, Erasmus University
 Ross Maclean, Precision Value & Health
 Rudi Balling, University of Luxembourg
 Rudolf Aebersold, ETH Zürich
 Scott Spangler, IBM
 Shinichi Akaike, NISTEP Japan
 Shyam Sankar, Palantir Technologies
 Stefan Oschmann, CEO Merck
 Stewart Cole, EPFL
 Subhanu Saxena, Bill & Melinda Gates Foundation
 Toby Bloom, New York Genome Center
 Tom Knight, Ginkgo Bioworks
 Ulrich Betz, VP Innovation Merck
 Ulrich Wiesner, Cornell University
 Yang Shao-Horn, MIT

The Future Insight Prize was initiated and designed by Ulrich Betz and officially announced by the CEO of Merck, Stefan Oschmann, at the second day of the Curious2018—Future Insight Conference (<http://curious2018.com>) and in an official press release published July 17th:

Darmstadt, Germany, July 17, 2018 – Merck, the vibrant science and technology company, today announced a new research prize. The company will award the “Future Insight Prize” of up to € 1 million annually for the next 35 years. The prize will be presented to researchers who will make outstanding contributions to enable innovations important for the future of humanity in the categories of health, nutrition and energy.

“As we are discussing the future of science and technology at the ‘Curious2018 – Future Insight’ conference, this is the right place to announce the ‘Future Insight Prize’. With this award we aim to stimulate groundbreaking science and innovative development of key products or technologies, to bring meaningful visions to life for the benefit of humanity.” Stefan Oschmann, Chairman of the Executive Board and CEO of Merck, said when he announced the prize today at the conference. This event in Darmstadt, of which Merck is the main sponsor, is currently being held for the first time and brings together globally renowned scientists, among them five Nobel Prize laureates.

The new award will be issued for the first time at next year’s “Curious2019” conference. It will relate to the health category and a ‘Pandemic Protector’ – a visionary dream product enabling an accelerated protection against newly emerging pathogens. The ‘Pandemic Protector’ should make it possible to swiftly analyze emerging pathogens, to generate an agent for disease treatment or prevention, and in doing so protect humanity against the outbreak of a new, global plague.

A scouting team will monitor scientific activity worldwide with a view to selecting potential candidates for the award. Experts in the relevant fields are likewise free to propose candidates of their own. The chosen scientists will be approached and asked to submit their entry to a jury of distinguished scientists and managers, drawn both from Merck and beyond. The winner of the respective award should use the prize for further research on the specific topic.

The Future Insight Prize for the years thereafter will be awarded for the following three topics:

- 2020: Multi-Drug Resistance Breaker - solving the problem of antibacterial resistance to multiple antibacterials (category health)

- 2021: Food Generator – Technology to help feed the world’s growing population (category nutrition)
- 2022: CO₂-to-Fuel Converter – Generating fuel by photocatalytic conversion of atmospheric CO₂ (category energy)

All future research projects receiving this award should contribute to laying the scientific and technological basis for the later realization of so-called “dream products”, in the first year the ‘Pandemic Protector’. The products envisaged are visionary products which the prize will catalyze to become reality. The same principle applies to the dream products Multi-Drug Resistance Breaker, Food Generator and CO₂-to-Fuel Converter. None of the awarded projects is meant to be in connection to or to directly contribute to any of the three business sectors of Merck. More information and illustrations are available at <http://futureinsightprize.merckgroup.com> or <http://futureinsightprize.emdgroup.com>.

The science conference “Curious2018 – Future Insight” (<http://curious2018.com>), where the award was announced today, brings together some of the world’s most accomplished scientists. The new conference is one highlight of the 350th anniversary year of Merck. More than 35 internationally renowned scientists – including five Nobel Prize laureates – are presenting their work and discussing the future of science and technology from July 16 to July 18, 2018 in Darmstadt, Germany. The speakers are presenting to an audience of around 1000 guests from all over the world topics oriented to the main focal areas of the three Merck business sectors (Healthcare “Healthy Lives – new breakthrough therapies and diagnostics”, Life Science “Life Reimagined – synthetic biology and beyond”, and Performance Materials “Materials & Solutions – chemistry and beyond”). Other conference topics address questions regarding digitalization (“Vibrant Digital – the power of in silico”) and new forms of collaboration (“Bright Future – new ways of working and collaborating”). Merck is fighting cancer, multiple sclerosis and other serious diseases. With our Life Science products we are helping other companies to conduct research even more quickly and efficiently. And we are developing high-tech materials with which autonomous driving or foldable displays are becoming reality. We are doing all this in close partnership with top researchers around the globe. Therefore, we are very much enjoying this huge celebration at ‘Curious2018 – Future Insight’ conference of research with the best of the best,” is how Stefan Oschmann described the concept behind this new conference.

The Future Insight Prize is open for expansion and partners (other corporations, NGOs, academic research institutions, governments, philanthropists etc.) are invited to join the concept and sponsor additional prizes stimulating the realization of dream products of their choice. At a “dream board” positioned at Curious2018—Future Insight conference participants could propose dream products of their choice, also in a survey with readers from Nature, Science and Harvard Business Reviews proposals were collected with some examples given here: Material to grow food in every kind of environment - some kind of intelligent soil, a robotic pill that can target infections and tumor cells, clean up trash and man-made debris from the oceans, stay young and healthy for the entire life, smart drugs, living in our bodies and self-applying according to individual needs, self-cleaning rooms, a dinner plate that can analyse and guide your daily intake of vitamins and nutrients, a tool to collect water from the air, a human knowledge repository to restart civilization after a catastrophe and an in silico predictor to create a drug against each human genome encoded target.

The Future Insight Prize has received considerable echo in the media and also triggered enthusiastic statements, and some are given here as examples:

The Future Insight Prize is great because it sets a grand challenge and seeks a solution to societies greatest future needs.

Merck’s idea to launch the Future Insight Prize is an excellent idea to celebrate the anniversary. In particular for the ‘pandemic threat’ topic. The Future Insight Prize is great because it will allow blue sky research in an area where this type of research rarely happens but major innovations are desperately needed.

The Future Insight Prize in Pandemic Protection is great because it is a clear expression of Merck’s commitment to society and global health.

The Future InSight Prize is great because it shows a 350-year old company is thinking about the next 350 years.

The Future InSight Prize is great because it will foster scientific innovation in areas critical to humanity’s future.

The Future InSight Prize is great because it sets a grand challenge and seeks a solution to societies greatest future needs.

I applaud your Future InSight prize.

The Future InSight Prize is great because it tackles issues that matter to us all.

The Future InSight prize is great because with no/little commercial agenda it is a vehicle to highlight the importance of the best research endeavors in key areas that could greatly impact the future of humankind!

The Future InSight Prize is great because it will inspire researchers to develop solutions to the major challenges that humanity will face over the coming decades.

The Future InSight prize is great because it will stimulate and acknowledge out of the box thinking in an effort to cope with one of the most serious threats i.e. infections caused by multi-drug or more recently even pan-drug resistant bacterial pathogens.

I applaud you and your colleagues at Merck for proposing the Future InSight Prize and specifically for your interests in global pandemic preparedness. The threat of a new pathogen arising from nature, or through genetic mutations or intentional creation, is very real. The Future Insight Prize will stand alone as recognition of technical excellence in a field that historically has not received the attention it so justly deserves.

I am certain that this new Prize will be warmly welcomed by leaders in global health from around the world.

Merck’s idea to launch the Future Insight Prize is an excellent idea to celebrate the anniversary. In particular for the ‘pandemic threat’ topic. The Future Insight Prize is great because it will allow blue sky research in an area where this type of research rarely happens but major innovations are desperately needed.

The Future Insight Prize in Pandemic Protection is great because it offers scientists an incentive to work towards a long-term vision in an area that cannot be stimulated by traditional market forces. It is a clear expression of Merck’s commitment to society and global health.

The Future InSight Prize is great because it shakes the core assumptions behind food sustainability, autonomy and security by rewarding technologies that will empower most humans on the planet to have access to affordable, plentiful and nutritious food.

The Future Insight Prize is great because it shows a 350-year old company is thinking about the next 350 years.

The ambition is not only to get insights into how the future will look like but to actively shape it to be bright and peaceful. You can be a part of it!

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