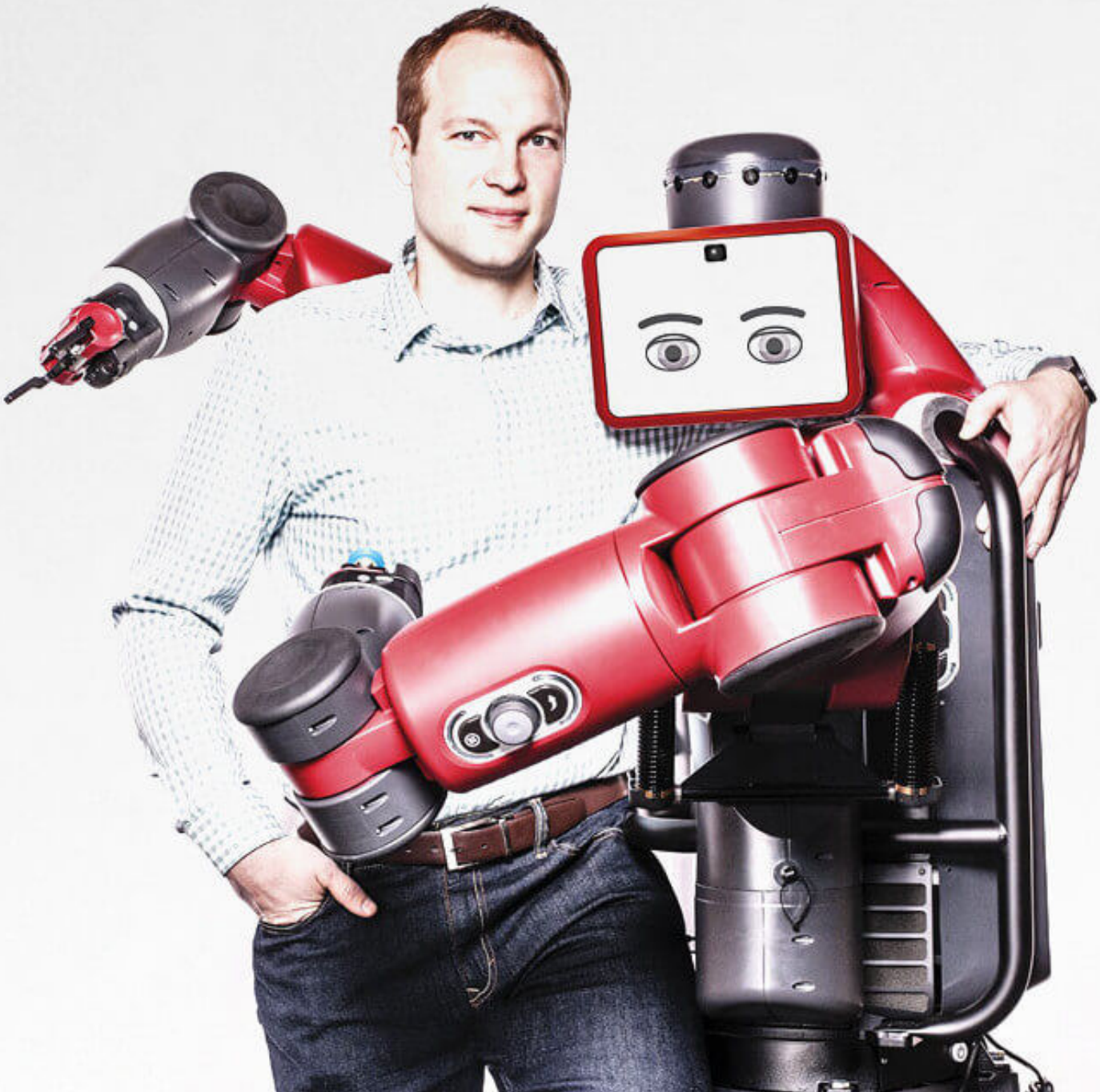
# TRUM

automated autonomous world



**Author:** Tio
**Review:** Ray
**Proofread:** Ray
**Design:** Tio
**Year:** 2013

## Summary:

This book has been a 8-month effort to showcase new and extraordinary technologies that enable us to automate nearly any type of work/process. From production to services, transportation systems to entire cities. This book will look at all such systems, providing real-life examples of applied technologies, plus advanced prototypes, all of which could make any field (research, discovery, construction, education, etc) not only automated, but also autonomous (self sustainable).

You can expect to see supercomputers, smart cities and smart buildings, assembly robots, chef robots, surgeon robots, self-driving cars, a wide variety of 3D printers, materials with amazing properties, and apps that can monitor your health or help you with everyday tasks. This book is also full of additional videos, links to sources to read more deeply about any technology we present, and dozens of documentaries recommended to provide an abundant supply of additional information.

## What is automation ?

*"Automation, or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships or aircraft and other applications with minimal or reduced human intervention.*

*The biggest benefit of automation is that it saves labor, however, it is also used to save energy and materials and to improve quality, accuracy and precision.*

*Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques."" - Wikipedia*

## What is autonomous technology ?

Autonomous technology refers to machines that act independently of humans.They behave in ways that mimic humans and free people from repetitive, unstimulating or dangerous jobs.

Most advanced aircraft are almost entirely autonomous, in the sense that they can take off, fly, obey air traffic control, avoid other aircraft, and land, all without human intervention, except in plotting their destination.

So, for this book, think about automated technology as machines that function with little, if any, human control.

Before we continue, it's very important to understand that today's AA technologies are engulfed within the monetary system and are far from being fully expressed.  For the sake of demonstration, let's say that someone wants to build an automated restaurant.  Although this is quite possible from a technical perspective, its development and deployment would be severely limited by the financial system.  This is why we don't see many AA restaurants already operating today.

It is the impediments of our money-based social system, rather than technological limitations, that hold us back.  The technologies you will find in this special edition, however, are considered not for their financial worth, but rather for their technical worth.  Also, the way these technologies are implement in our current monetary system are not the focus of this edition.

With that in mind, let's begin a 260-page journey full of extraordinary technologies.

construction

transportation

goods and services

the home

cities and the environment

(28 pages)

48 pages)

(48 pages)

(31 pages)

(85 pages)

CONSTRUCTION

Construction techniques are essential to build any structure, be it a home, hospital, or airport. I will show you how automated and autonomous technologies can mechanize the construction process, making it faster, safer, and better able to build complex forms.

## Let’s think about construction in terms of :

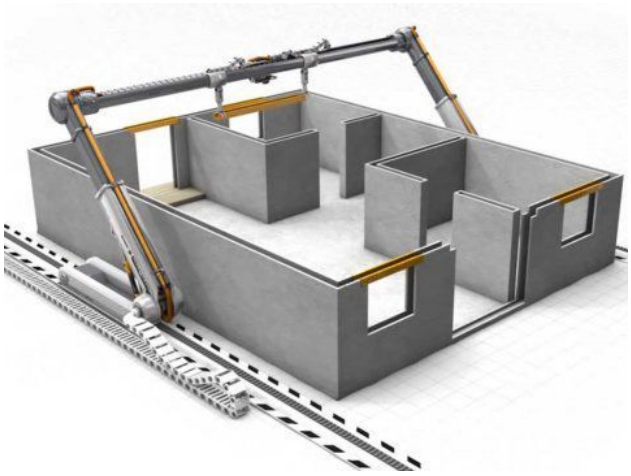
**COMPLEXITY AND AGILITY**

**INTELLIGENCE AND RELIABILITY**

**EFFICIENCY AND DURABILITY**

# Contour Crafting

technology has great potential for automating the construction of whole structures as well as sub-components. Using this process, a single house or an entire colony of houses, each with possibly a different design, may be automatically constructed in a single run. Embedded in each house would be all the conduits for electrical systems, plumbing, and air-conditioning. The potential applications of this technology are far reaching.  (source)




TEDx

# D-Shape

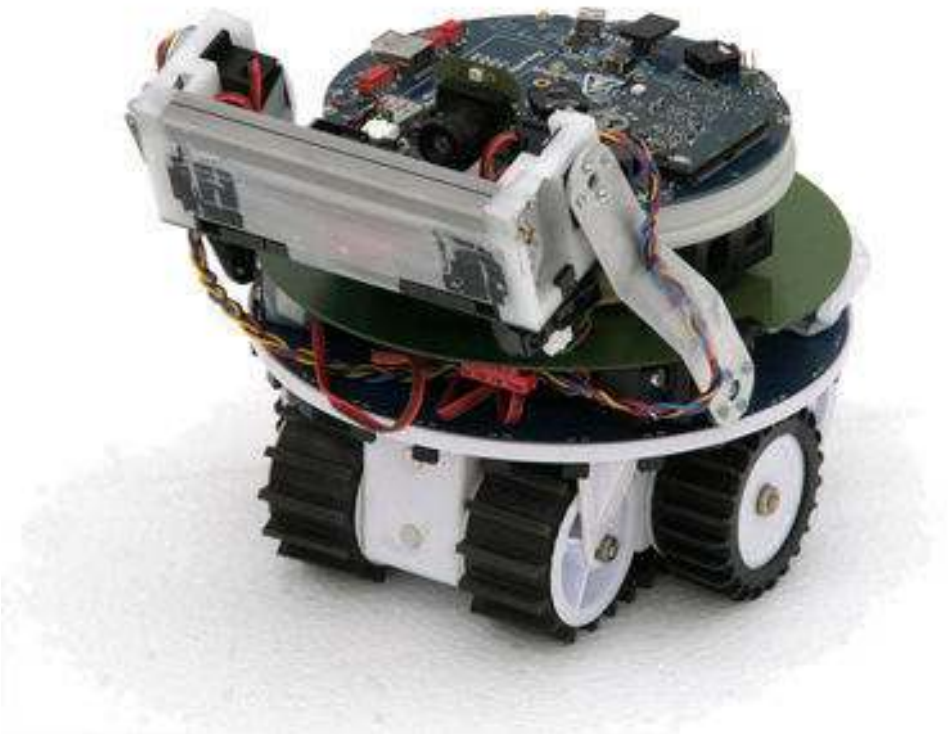
Other similar technologies are using 3D printers like D-Shape to eventually build full houses. The D-Shape building process is similar to the "printing" process because the system operates by straining a binder on a sand layer. This is similar to what an ink-jet printer does on a sheet of paper. This principle allows the architect to design fantastically complex architectural structures.
For instance, the 'Landscape House' is an ambitious plan to build a full house using this technology. (read more)

But where such 3D printing-like technologies cannot be deployed, multiple autonomous robots can build complex structures with little or no help from humans.

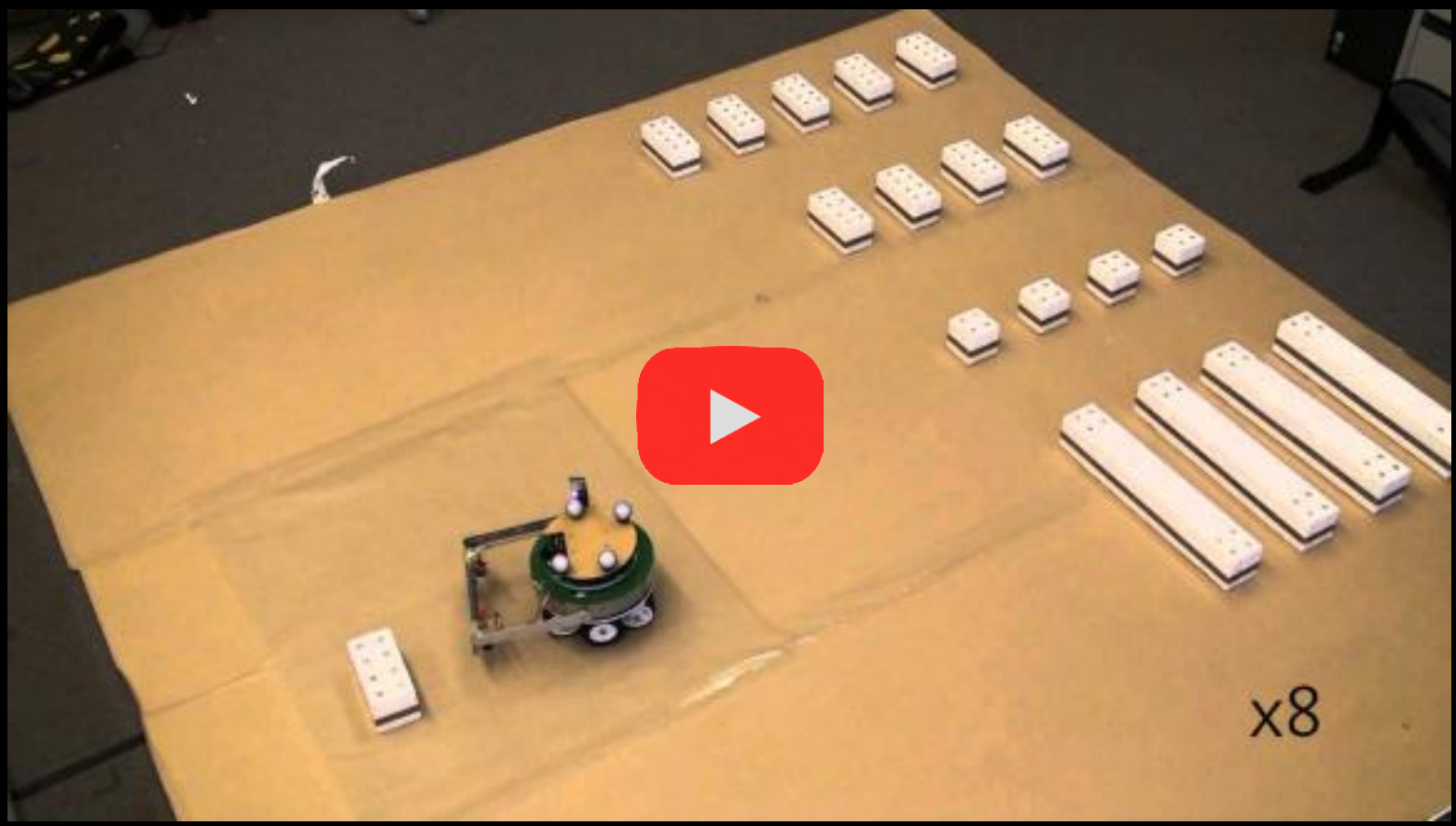
However, we need to consider that autonomous construction is challenging for robotics both at the mechatronic and at the control levels. At the mechatronic level, robots require manipulators with many degrees of freedom. At the control level, autonomous construction mixes complex low-level actions, such as adding new elements to a structure, with a high-level cognitive behaviour, such as reasoning on a course of action to avoid situations that prevent the completion of the structure.

# The marXbot

robot is well-suited tools for autonomous construction. As it is modular, it has many different manipulation capabilities. Moreover, as the robot is small, neither the robot nor the built structures are dangerous. This allows marXbot to efficiently explore different construction modalities. (source)



But robots don't necessarily have to be confined to the ground. Some can also fly, thus helping to make construction faster. ( video 1) ( video 2)
Other autonomous robots can climb tall buildings while carrying heavy parts, mounting them on their route. ( video )


x8

The agility of these robots comes not only from their ability to move and communicate with each other, but also from their specialized arms, which are getting more and more complex. These arms offer robots an expanding range of achievable tasks: from picking up a variety of shapes and materials, to manipulating these objects, or even using tools built for the human hand, and more.

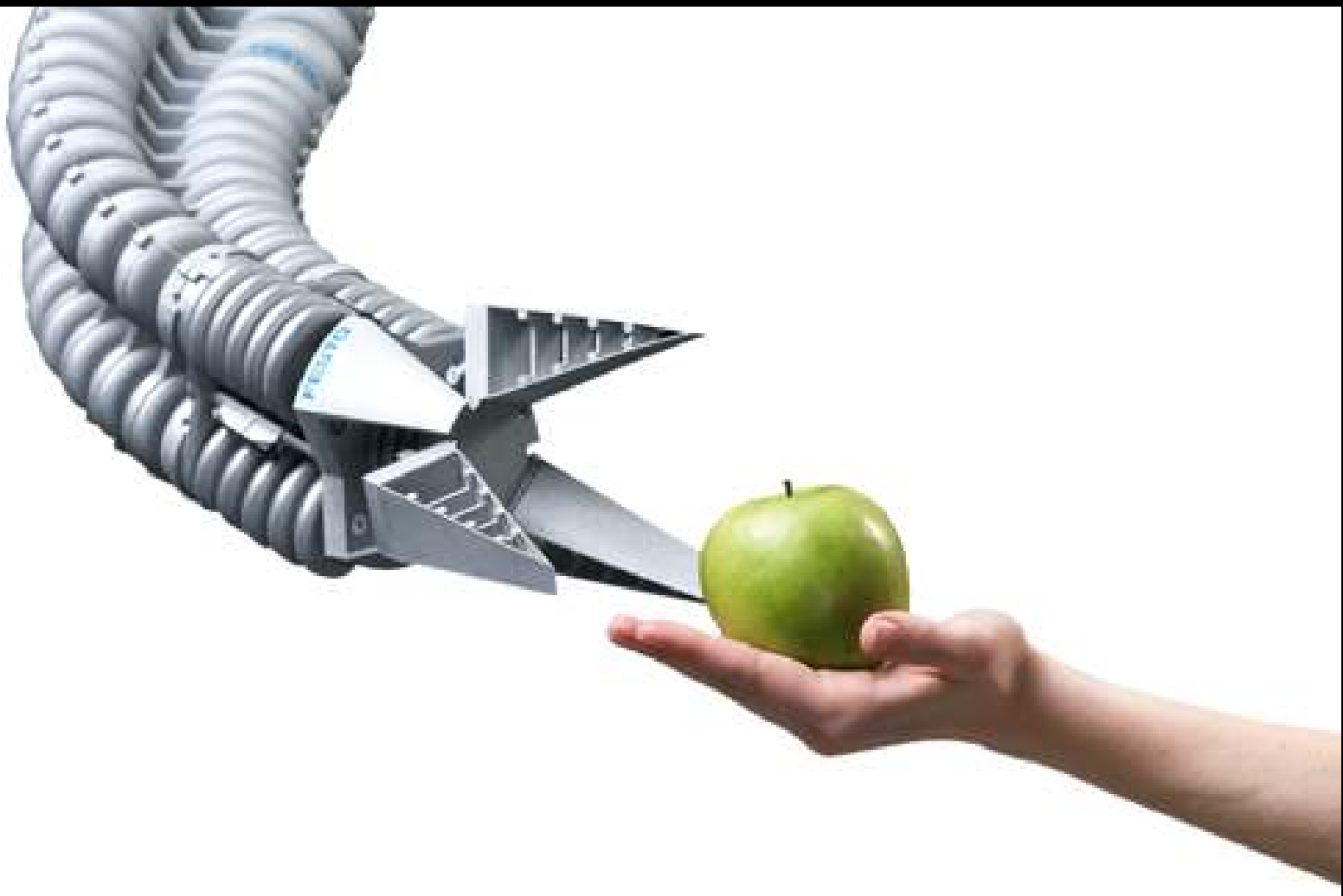
We all know there's a plethora of such complex grippers that manipulate objects from their microscopic size to large construction materials.

Here are 3 examples of such arms:

# 1. 3-Finger Adaptive Robot Gripper

Designed for applications dealing with a wide variety of parts, this 3-Finger Adaptive Robot Gripper represents a solution to improve process flexibility and consistency. This robotic hand gives “hand-like” capabilities to robot arms in advanced robotic applications and industrial automation such as robotic welding, machine loading/ unloading, bin picking and research.

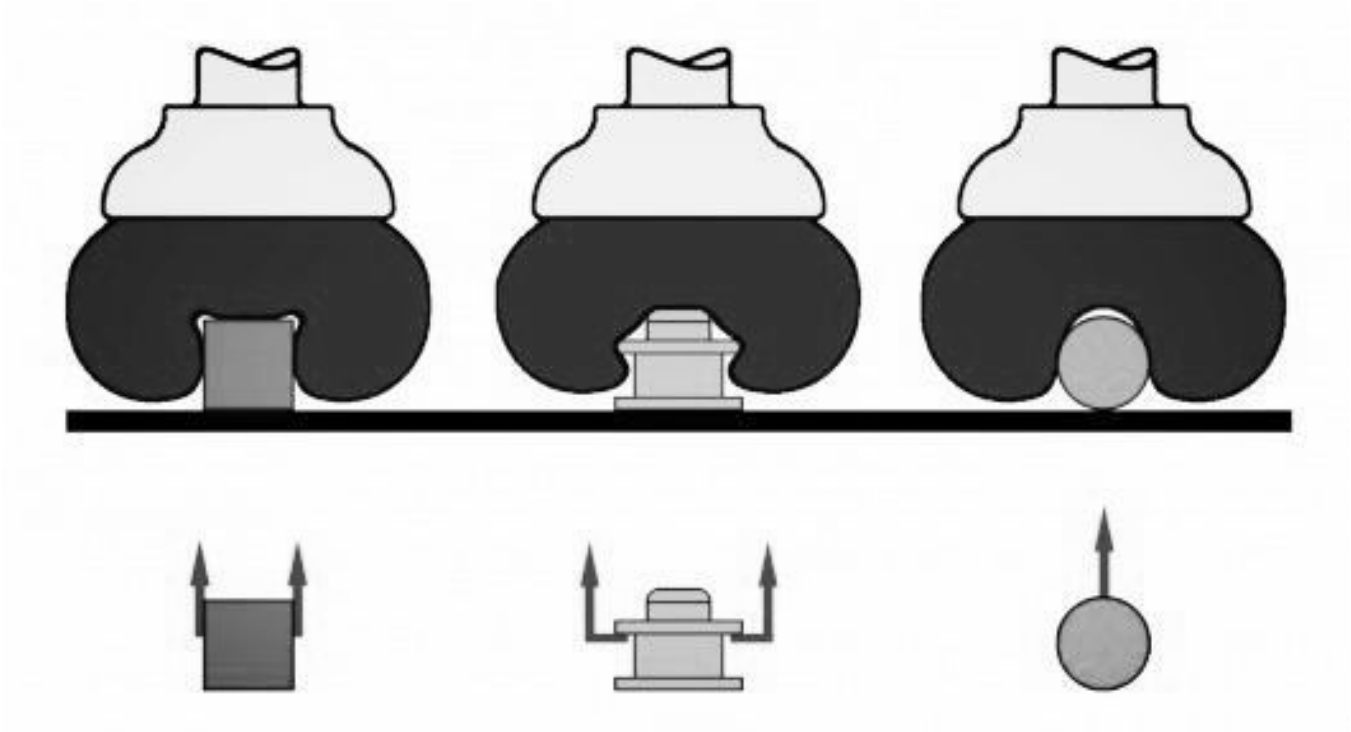
Put a tool designed for the human hand in this gripper and it will definitely know how to use it.



# 2. Festo - Bionic Handling Assistant

Now what about a similar 3-finger design, but inspired by the Elephant trunk? It may seem to be the same technology, but it's not.This arm, designed by a company in Germany, possesses great dexterity, flexibility, and strength; it operates with smooth, yet firm, motions and can pick up and move any kind of object from one place to another.

The arm itself is significantly more flexible than other similar concepts, allowing it to perform tasks that require a great deal of accuracy. (their YouTube channel)

# 3. Jamming Gripper

And lastly, this arm's technology is perhaps the most innovative way of dealing with complexity. The fingers seen in the previous two designs are entirely replaced by a bag of granular material.

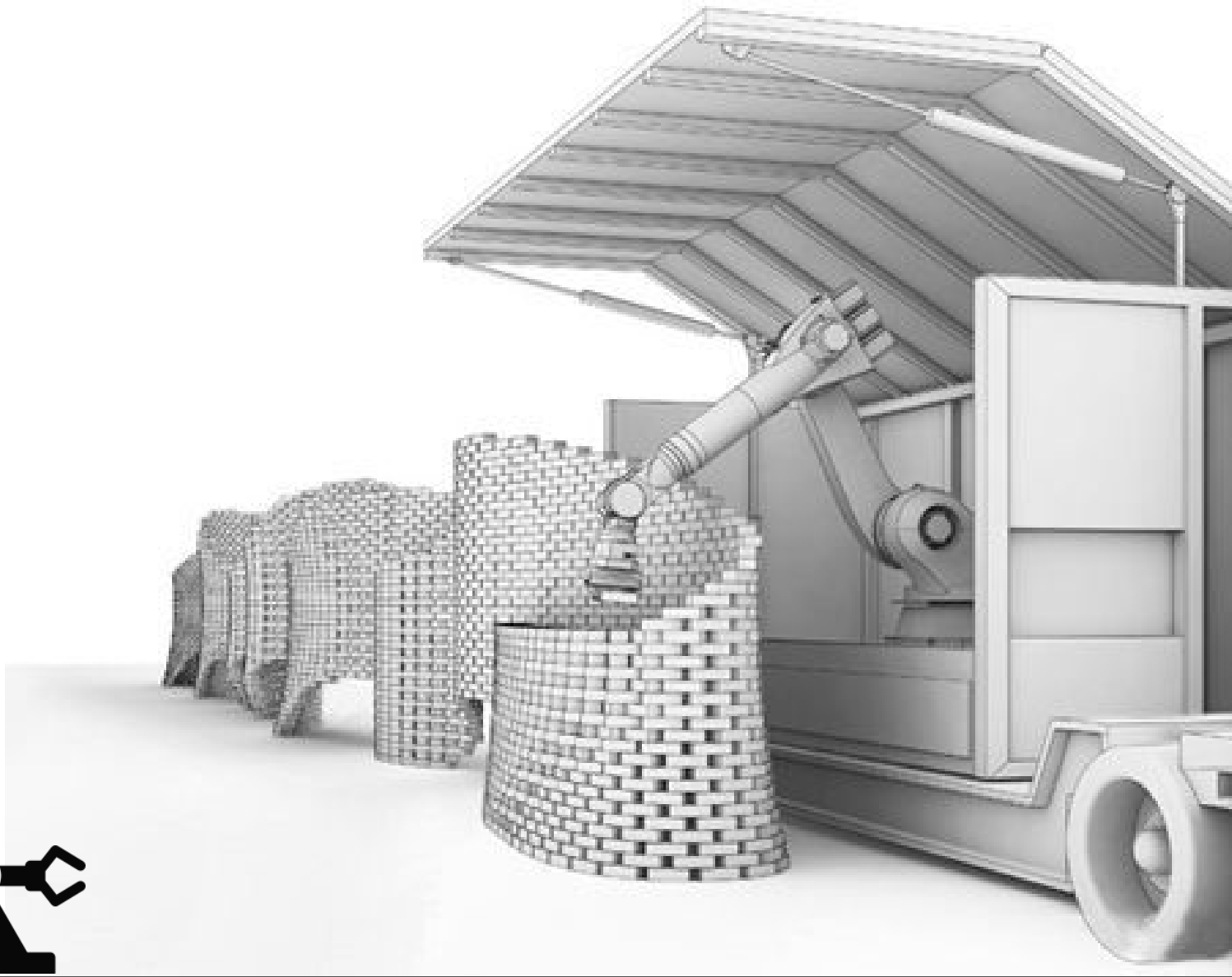
This granular material flows around an object and, when compressed, solidifies to secure the object in place. Such an innovative, simple design makes manufacturing and programming this mechanism very easy. Read more about it here·


x2 playback

These 3 elegant robotic arm technologies are a proof of how complex grippers can be, thus demonstrating how this kind of technology can take on complex and varied construction tasks.

# R-O-B Unit

Some industrial robots with prominent robotic arm technologies are, in fact, being used in present-day construction projects. For example the Gantenbein Winery, in Fläsch, Switzerland, has been the prototype for an entirely new approach to bricklaying: using modified industrial robots. Traditionally, the promise of industrial robots has been that they would replace the human workforce. But these projects, led by the Architecture and Digital Fabrication laboratory at ETH Zürich, demonstrate a different result: architects are free to create designs and patterns of a precision that simply could not be achieved by hand. (source)

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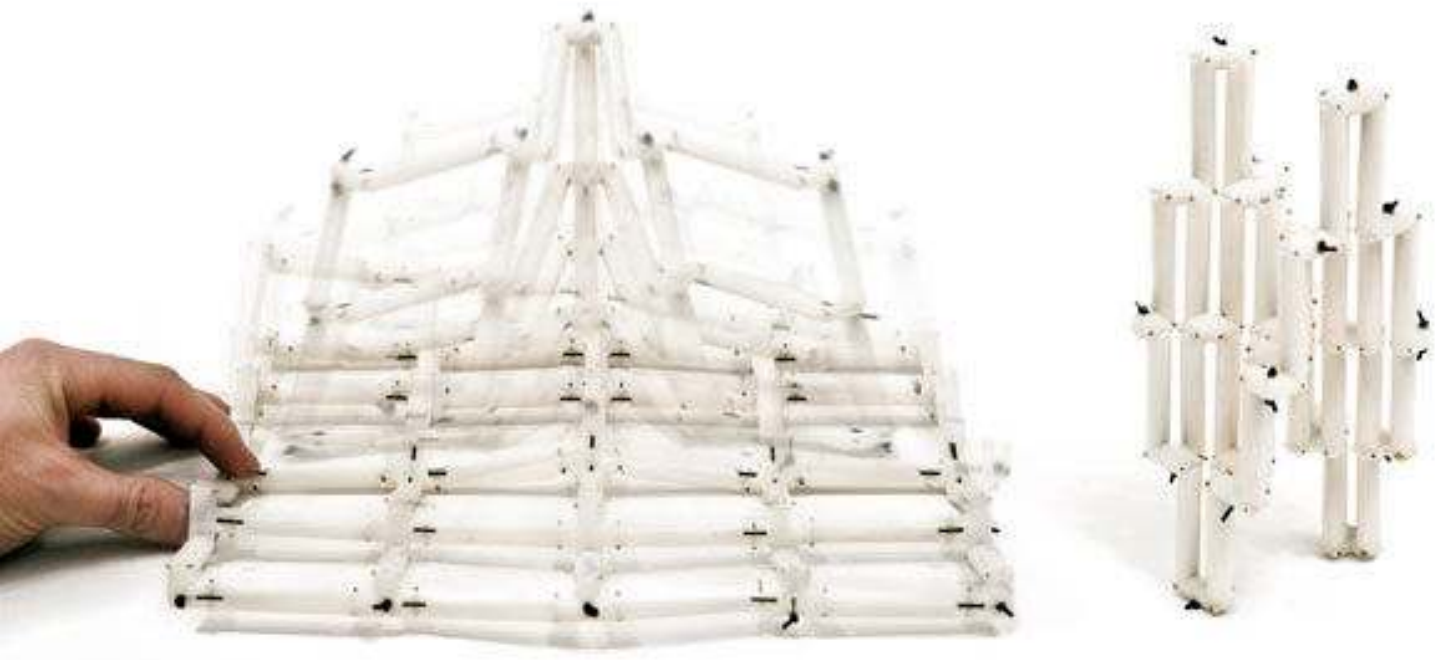
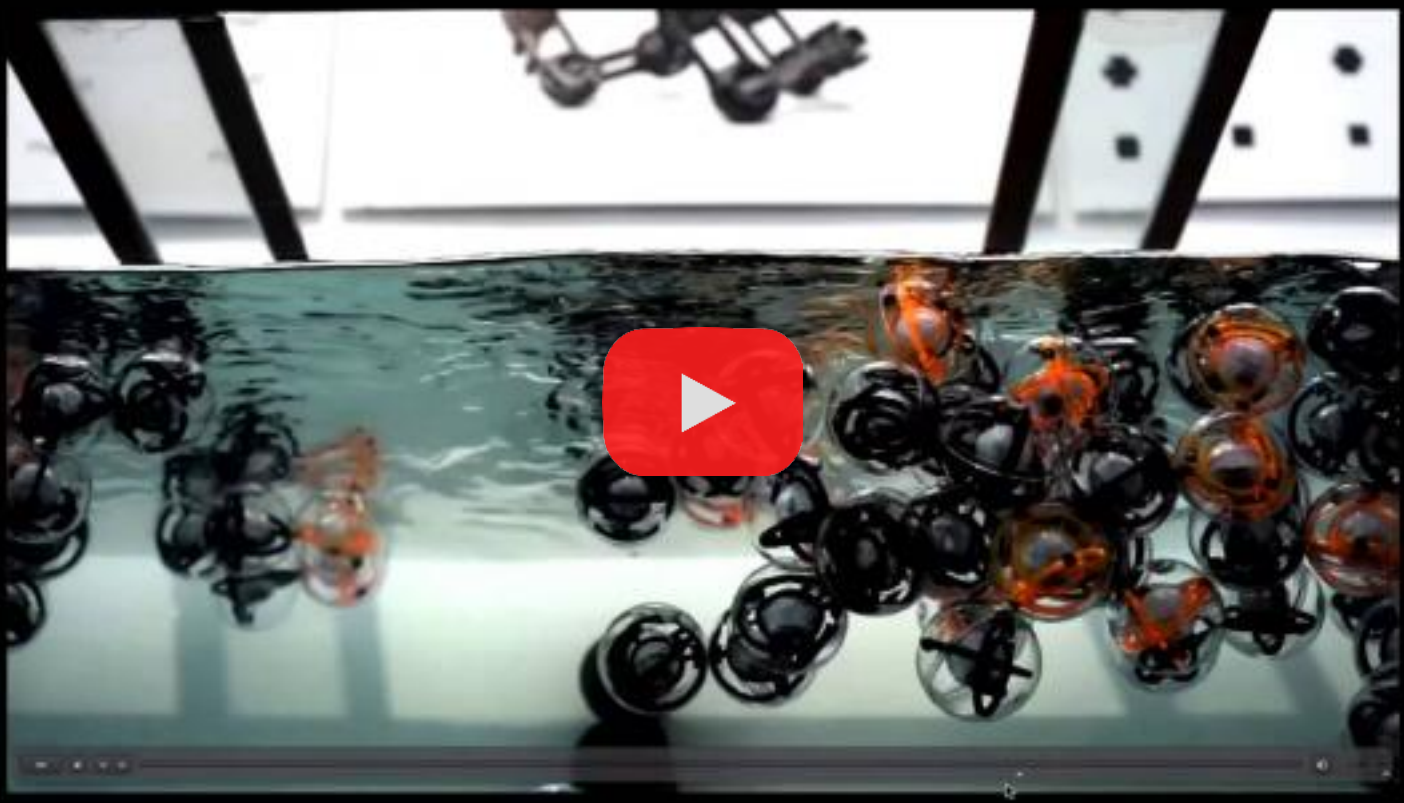
Imagine AI robots using different kinds of materials, prefabricated construction parts, and multiple construction techniques to build infinitely complex structures.
We already showed how multiple robots can work autonomously to construct complex buildings, but construction techniques don't necessarily have to be limited to 3D printing or these intelligent  robots. They can also be embedded directly into prefabricated materials. Imagine a flat piece of material that can self-assemble itself into a house. Seems like science fiction?

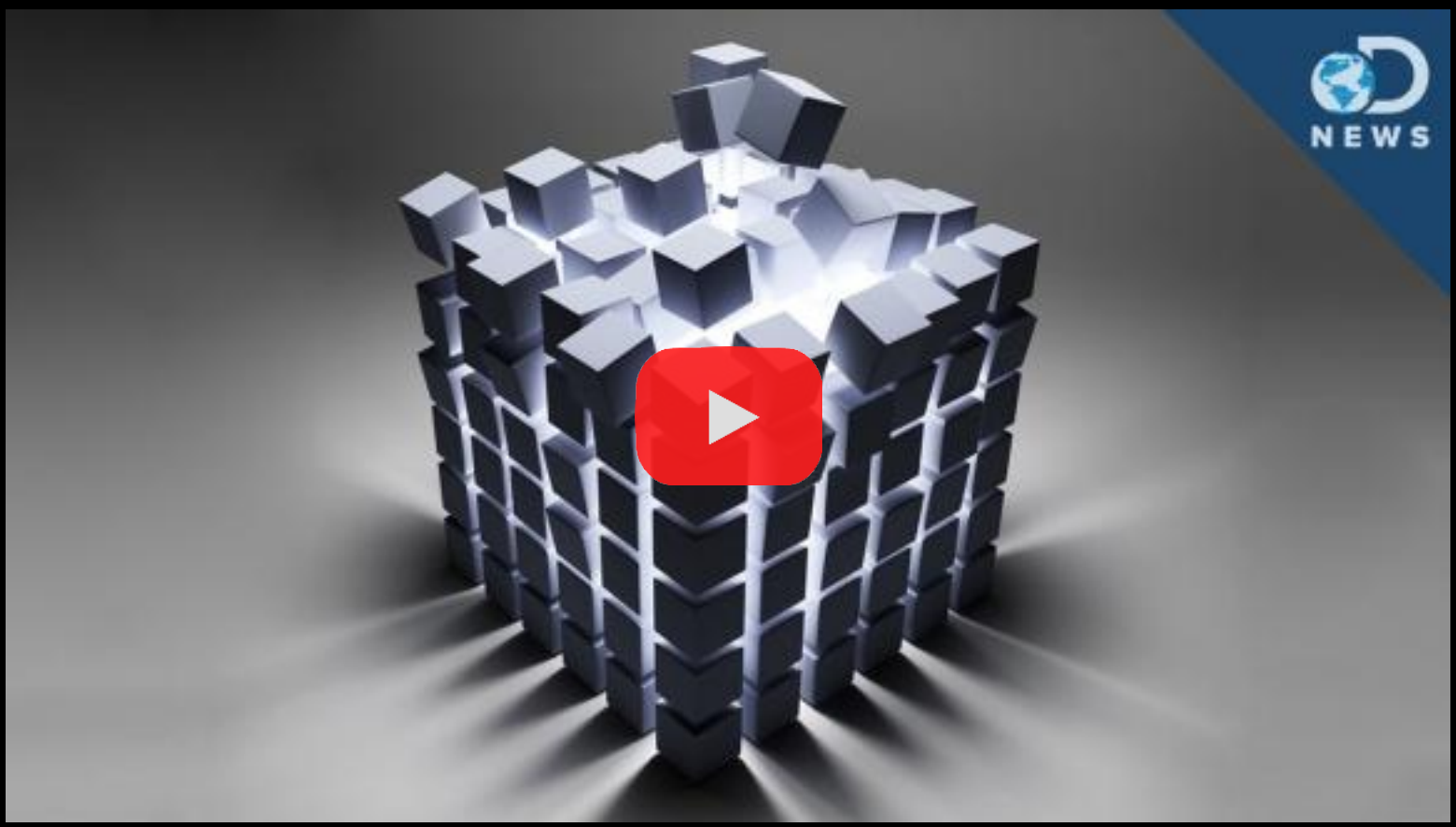
# Sjet

Well look at Sjet, because they are rapidly developing this technology and even have some small scale prototypes. Without external machinery to manipulate them, individually coded building elements can organize and assemble themselves though applied energy sources.

Designer, computer scientist, and lecturer at MIT's Department of Architecture, Skylar Tibbits is a leading innovator on the subject.  His research focuses on developing self-assembly technologies for large-scale structures. Energy sources could be in the form of sound waves, wind, or kinetic sources.  Imagine buildings that could self-correct, adapt, or repair through energy transmitted by seismic energy.  Energy applied from ground shaking provides energy to built-in elements that allows them to adapt and respond and change state, a huge application in western California and other parts of the seismically active world.






NEWS

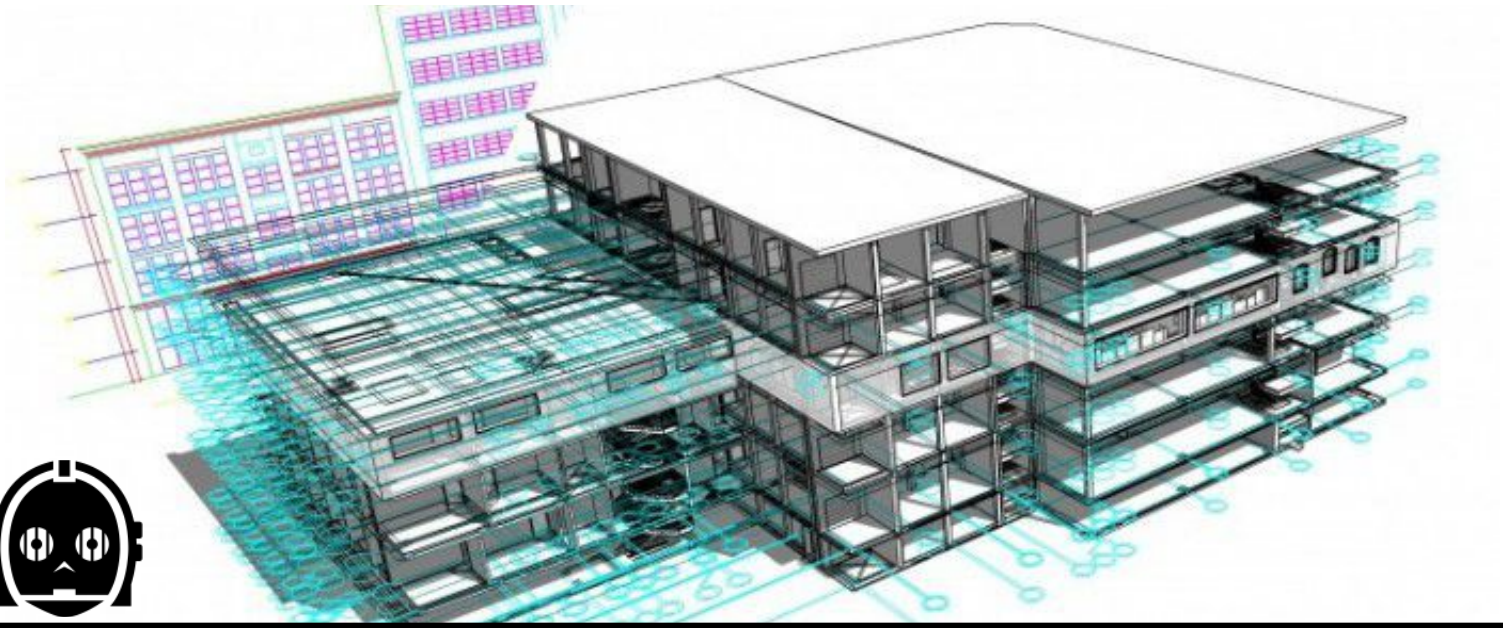
# Real World Simulation

One simple way to think about making construction a smart process, from start to finish, is to first map the real world (from structures to terrain and climate) and then use complex 3D software to generate new building designs. This way you can test a building with high degree of accuracy even before you start building it.

There are plenty of methods today to scan the world and render it in 3D (link2), or to map the weather and simulate real environments and scenarios. And using BIM (Building Information Modeling) can ensure a reliable 3D model that bestfits the environment. Read "The future of construction: Meet BIM (or else)" to understandhow BIM works and why it is so important.

A building can be designed in a 3D software program like Autodesk and then erected in the real world using one of those AA construction technologies.
The way construction can be fully AA is this: the real world would be simulated through powerful computers, 3D models of buildings can be made to accurately match the environment in the simulation, and then these buildings would be simulated and tested under extreme conditions like natural disasters. Once that is done and many tests are simulated to ensure the building is correctly represented in the 3D software, technologies like contour crafting, 3D or 4D printing, or other such autonomous technologies, can be deployed to build the real model

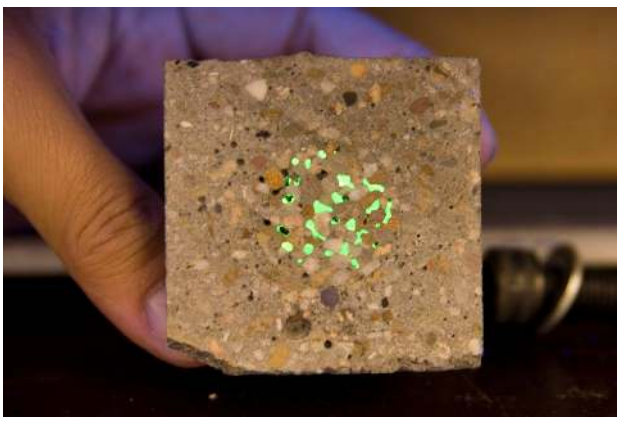
I see a future where you can visit a website and select your desired house from a 3D-models catalogue. These 3D models can be created by experts and shared, updated incrementally, or directly created and updated by AA software itself and edited by you to fit your needs. You would simply order one and it would be built using one of the technologies I mentioned. And this entire process can be fully AA. And if you think about this concept a bit more, you would come to realise that such a virtual environment can be shared and improved by experts, and non experts (if the software is secure enough), from around the world. And with the help of AI's random simulations to test thousands or millions of scenarios and building models, we can truly have a smart construction plan for any kind of project. This is the way I see construction being almost, or even completely, autonomous in all its'stages while continuously being improved and developed.

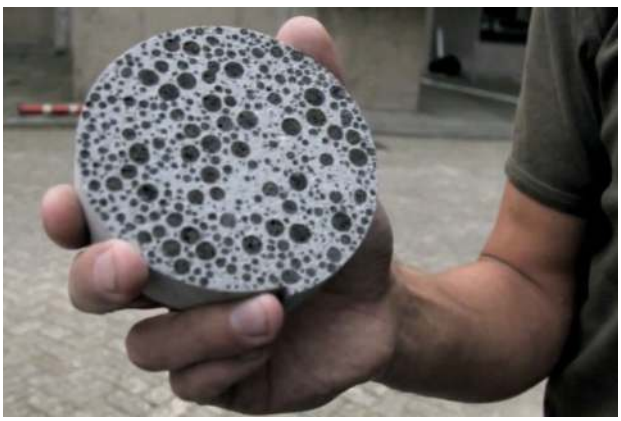


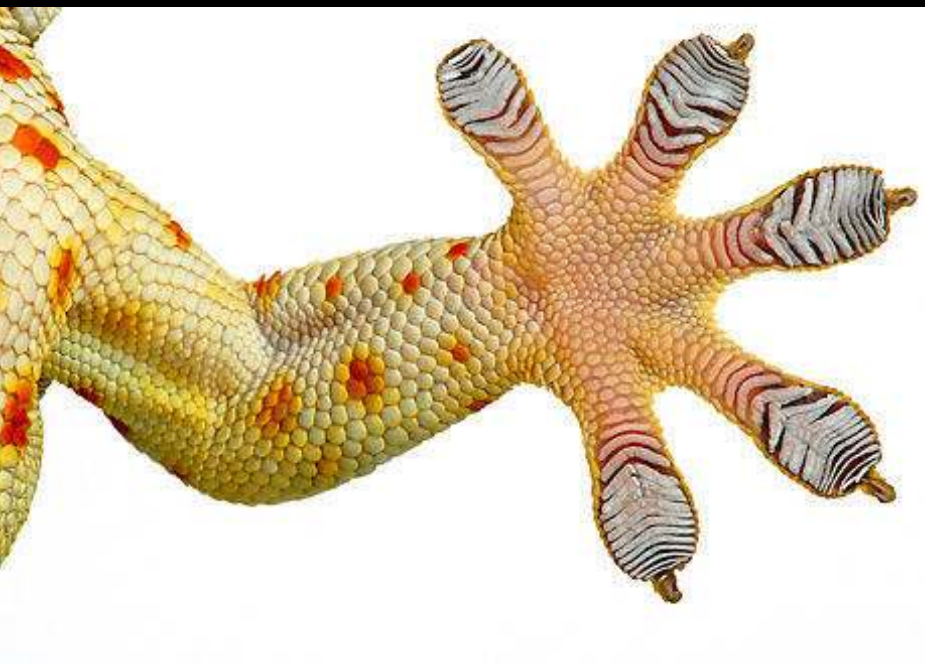
With the use of new materials, buildings can become maintenance free and smart enough to function efficiently through a system of feedback with the environment.
These smart materials are designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields. For a list of such types of materials read this wikipedia article.

# Self-Healing Concrete

For instance self-healing-concrete uses bacteria to fill cracks and prevent decay and corrosion of rebar. (source) Or concrete can use sunlight to fix its own cracks. (source) Moreover, "super concrete", with its high strength and ductility, will make for a much more resilient constructing material which would be able to withstand the power of earthquakes and extreme loading much better than the concrete that is widely used today.

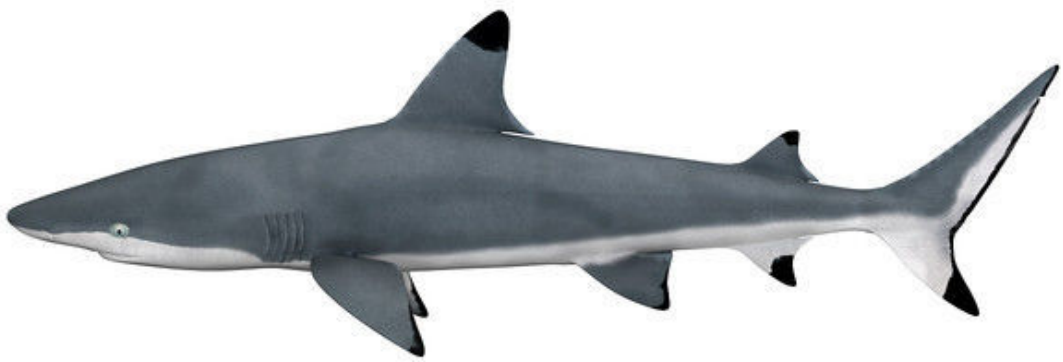






The Gecko foot is known for its super powerful stickiness and now scientists are able to replicate that property for the basis of a new type of super-sticky adhesive material.
The lotus plant has an amazing way to stay clean. Each of its broad, round leaves is coated in a water-repellent wax. But that is not all. The surface of each leaf also has tiny bumps that raise particles and droplets away from the leaf, so that dirt and water barely make contact with the surface. This makes the leaf highly water-repellent. Dirt and water simply roll along the little bumps and off the leaf. The potential uses for this technology are vast and it is already being used in self-cleaning exterior paint.

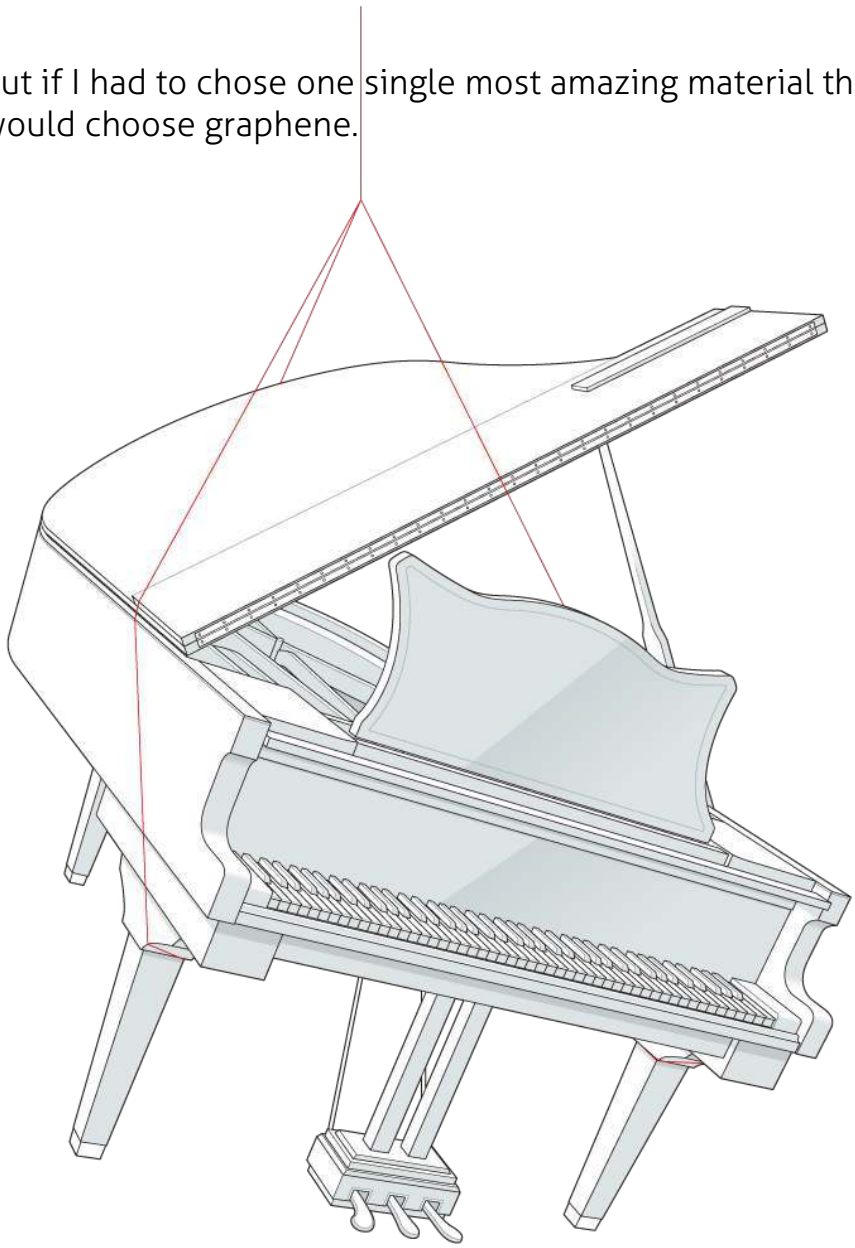
Ancient elasmobranchs (sharks) avoid pesky algae and bacteria by way of an ingenious skin design. Microorganisms prefer flat surfaces, which allow them to form large colonies or biofilms. But unlike most other fish, sharks don't have flat scales. Instead, they have dermal denticles—ridged, tooth-like scales covering their body. These bumpy "teeth" create a rough surface that biofilms can't colonize or thrive on, which contributes to the shark's naturally bacteria-free status. Surfaces mimicking sharkskin are currently available for use in medical and hygienic settings. (source)





You can watch both seasons of Making Stuff at VideoNeat.com >>

But if I had to chose one single most amazing material that seems to be out of this world, I would choose graphene.



# Graphene:

A human hair is almost a million times thicker than a layer of graphene. The material is made of a single layer of carbon atoms arranged in a honeycomb pattern. In theory, a string of graphene with a diameter of just one-tenth of a square millimeter —the size of a very sharp pencil point—could hold up a thousand-pound piano.

High-quality graphene is strong, light, nearly transparent and an excellent conductor of heat and electricity. Its interactions with other materials and with light and its inherently two-dimensional nature produce unique properties, such as the bipolar transistor effect, ballistic transport of charges, and large quantum oscillations. (source)

Other materials made out of similar carbon structures seems to possess super properties, too. Aerographite is a form of carbon with a sponge like structure. It is water-repellent, highly resilient, and extremely light. Actually, it is the lightest material ever created. (source) Also, scientists crushed a naturally occurring kind of carbon called buckminsterfullerene (the molecules look like soccer balls) to create a material strong enough to dent diamonds. (source) Nanotechnology seems to provide a huge range of new materials with super properties. Materials that completely repeal water or dust are no longer science fiction. Amazing insulation and conduction materials are a thing of the present. Nanotechnology, as shown in the case of graphene, will completely redefine the notion of "strong", thus making buildings extremely resistant to natural disasters.

These examples are just a few of the many dynamic and amazing materials that exist today and will continue to be improved in the coming years. They are truly among the most durable and efficient substances in architecture and engineering.

We have shown how, when it comes to construction, 3D-like systems seem to be one of the most reliable, easiest, and fastest ways to build all kinds of buildings. Using wonder materials like self-healing concrete, graphene, or nanotube-like structures, these buildings can be made extremely resilient. Self-sufficient, smart, varied, complex, and reliable are all architectural traits attainable with today's technology.

AI systems, like flocks of robots, that can help with construction or maintain buildings are no longer in the realm of science fiction. And complex grippers can assure even the most delicate task can be achieved.

Such buildings can be built completely with their electrical, plumbing, and communication systems all at once, thus reducing the time of construction and improving the overall functionality of the structure. Plus, reducing waste and using recycled materials can greatly reduce the energy required to build all kinds of buildings. Simulating the real world will also greatly simplify the process of construction and allow incremental improvements, an easy interface for both experienced architects and inexperienced ones. This will ensure that each structure is based on a very high-quality blueprint.

*It is a bit maverik to think we have covered even 1% of the technologies that exist today for automating construction. The realms of science will provide new, almost out of this world materials and methods for construction, while nanotechnology and more complex 3D printers can deliver infinitely complex structures that we cannot even imagine today.*

The AA technologies of construction seems limitless: inspired by nature, imagined by humans, and perfected with AI.

# TRANSPORTATION

Transportation and delivery may be viewed as two distinct types of transportation. Delivery seems like the more complicated one, since it should connect products with individuals; while Transportation's intent appears to simply connect mostly important places together (different regions of planet Earth). Delivery is also dependent on the request and its accuracy must be close to perfect if you intend to have a functional delivery system. If I want an item that is not produced near where I live, the delivery system should be able to get it to my door, and quickly please :)

But the technology is the same for both when provided with autonomous control. A car that drives itself can transport people and also deliver products to your door. Drone technology can also be used for both mass transit on airplanes and as a product delivery system.

It is also important, almost crucial to understand, that both of them depend on the infrastructure. In a well built city model, the delivery and transportation systems should be much simpler to build, much more reliable and much less energy consuming due to the circular structure of the city. What I will try to demonstrate here is the ability of such systems to be both reliable and autonomous with today's technology, no matter the infrastructure. If we show that such systems are extremely capable in our present chaotic infrastructures, they will definitely be able to serve in a trade-free infrastructure.

If you want to go from point A to point B, anywhere in the world, you must find a way to do it without major effort. Even if you have to accept 2, 3 or more 'transfers' to go to that place, it should be relatively easy to do it. But let's be reasonable; it is still unreasonable to think that going from ANY point A to point B on planet Earth can be accomplished completely using machines, at least for today. Some destinations can only be arrived at by foot, while others are simply out of the current reach of humans. Trying to get to the bottom of the deepest parts of the ocean or climbing Mount Everest using only machines to carry you there would be quite a challenge, if not an impossible task.

So let's transform this general term of "transportation" into something that we can all understand: transportation between habitable places.

# THE AUTOPILOT: SENSORS

# AND THE FEEDBACK LOOP

You likely recognize a common scenario from movies where something bad happens to the pilots of a plane and one of the passengers take control to safely land it while only being guided by the control tower? Fortunately, there seems to be no evidence that it has ever happened in the real world. Almost all airplanes today are capable of taking off, flying and landing by themselves - autonomously. No one needs to rely on people with no experience to do that. (source1)(source2)

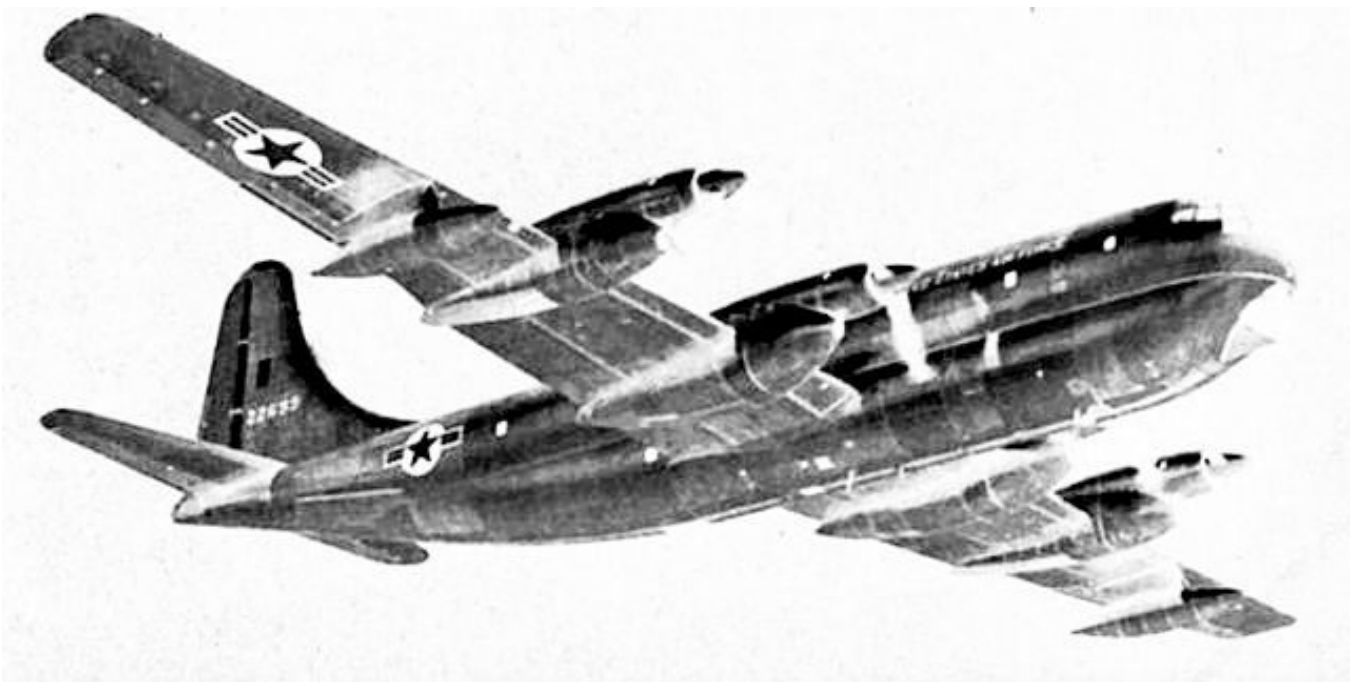
Nearly all commercial aircraft are equipped with instruments called automatic pilots. An autopilot is a system used to control the trajectory of a vehicle without constant 'hands-on' control required from a human operator.

Autopilots are used in aircraft, boats (known as self-steering gear), spacecraft, and others. This technology has evolved significantly over time, from early autopilots that merely held an attitude to modern autopilots capable of performing automated landings under the supervision of a pilot.

The first autopilot was invented in 1912 for an airplane. It permitted the aircraft to fly straight and level on a compass course without the pilot's attention.

In the early 1920s, the Standard Oil tanker J.A. Moffet became the first oceanic ship to use an autopilot.

In 1947, a large US Air Force C-54 plane made a transatlantic flight, including takeoff and landing, completely under the control of an autopilot.



Modern autopilots use computer software to control an aircraft. The software reads the aircraft's current position, and then directly manages a Flight Control System to guide the aircraft. In addition to classic flight controls, many autopilots incorporate thrust control capabilities that can control throttles to optimize the airspeed, and automatically move fuel to different tanks to optimally balance the aircraft's attitude during flight. Although autopilots still tend to handle new or dangerous situations somewhat inflexibly, they generally fly an aircraft with lower fuel consumption than a human pilot.

The software and sensors allow the autopilot to sense the environment and act in accordance to it. Internal sensors - from motor thrust to fuel monitoring, to external sensors including GPS, lasers, sonar, and many others, allow any kind of vehicle to have a relationship with itself and its environment. All of these clusters of data are organized and responded to on a continual basis by complex software systems that maintain the relationships relevant to the input of these feedback loops throughout the entire course.

Since human life, society, and the environment depend on such such systems to operate flawlessly, they must be extremely reliable. In order to ensure that, airplanes, for instance, employ a series of measures to ensure a very high degree of reliability.

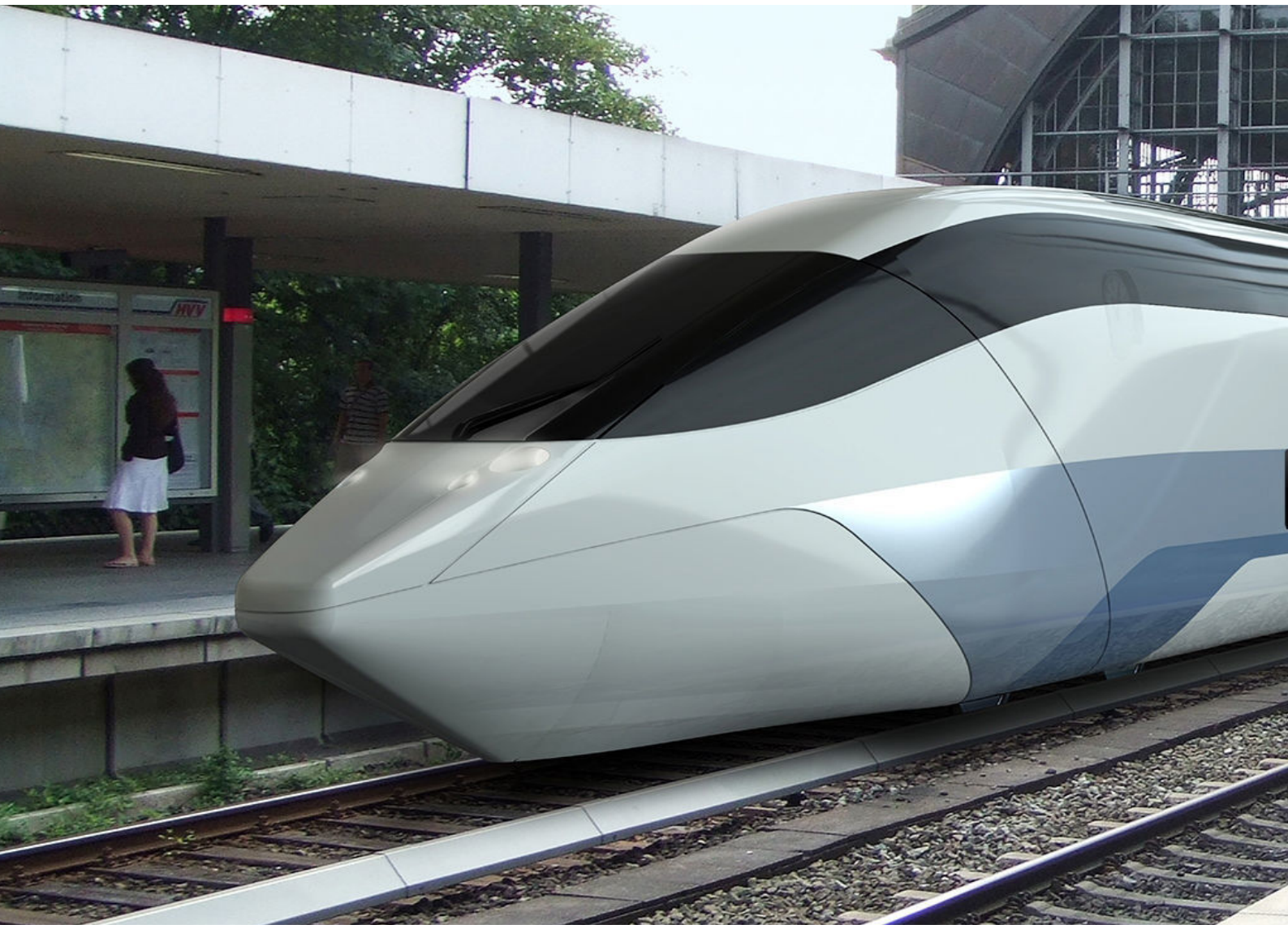
Some autopilots use design diversity. With this redundancy feature, critical software processes are not only run in parallel on separate computers, and possibly even using different architectures, but each computer runs different software created by different engineering teams, often having been programmed in different programming languages. It is considered highly unlikely that different engineering teams would make the same mistakes in their separate code. The flight control computers on the NASA Space Shuttle used this design: there were five computers, four of which redundantly ran identical software, and a fifth backup running software that was developed independently. The software on the fifth system provided only the basic functions needed to fly the Shuttle, further reducing any possible commonality with the software running on the four primary systems.

## Examples of automated rail transportation include

American urban mass-transit systems such as BART (Bay Area Rapid Transit) in San Francisco; MARTA (Metropolitan Atlanta Rapid Transit Authority) in Atlanta, Ga.; and the Metrorail in Washington, D.C. The BART system serves as a useful example, as it consists of more than 75 miles (120 kilometres) of track stretching across roughly 30 stations with around 100 trains in simultaneous operation during peak hours.

The trains can attain speeds of 80 miles per hour with intervals between trains of as little as 90 seconds. In each train, there is one operator whose role is that of an observer and communicator, who can override the automatic system in cases of emergency.  The automatic system protects the trains by assuring a safe distance between them and by controlling their speed and braking.

Another function of the system is to control train routings (track selection) and to make adjustments in the operation of each train to keep the entire system operating on schedule.



As a train enters a station, it automatically transmits its identification, destination, and length, thus lighting up a display board for passenger information and transmitting information to the control centers. Signals are automatically returned to the train to regulate its time in the station and its running time to the next station.

At the beginning of the day, an ideal schedule is determined; as the day progresses, the performance of each train is compared with the schedule, and adjustments are made to each train's operation as required.

The entire system is controlled by two identical computers, so that if one malfunctions, the other assumes complete control.  In the event of a complete failure of both computer control systems, the system reverts to manual control.

These systems are commonly in use today and act not only to ensure a safe course, but also act in dangerous and "unpredictable" situations.

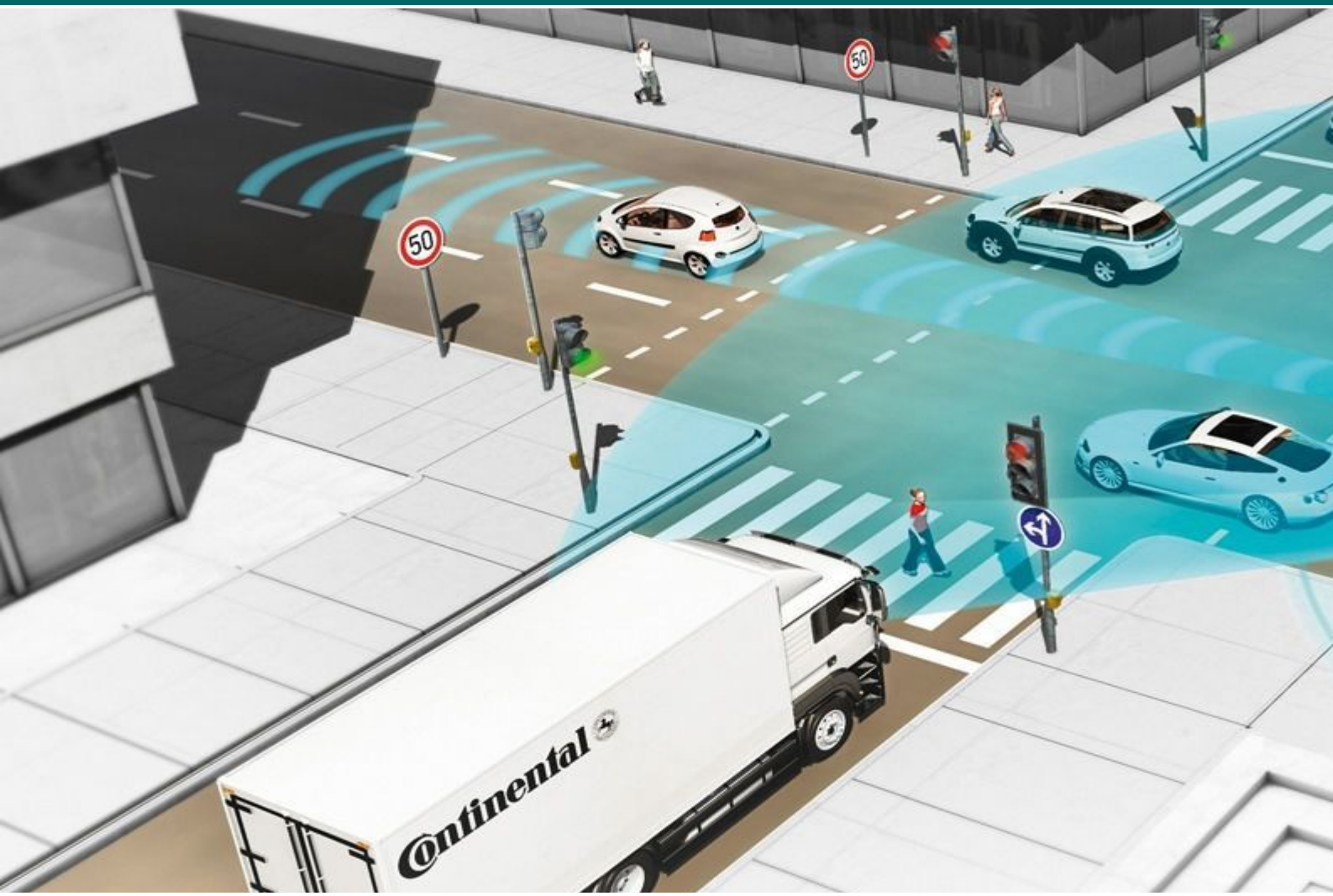
Transporting masses of people may be much easier to accomplish than transporting individual people to more specific locations, because such mass-transit systems usually have fixed stop points.


These stop points must be very strategically positioned to assure all people can reach them easily by foot or other individual transportation systems (cars, bicycles, etc). Again, the underlying infrastructure is essential to this.

Since mass transit systems have fix stopping points and these points are often at significant distances from one another, they can be extremely fast and reliable.  A train mainly depends on its own train mechanics and the rails that it rides on, while individual cars transporting people will have to take into account all other traffic and more (weather & road conditions, human interaction, etc).

Interestingly, as today's self-driving cars and pilotless drones prove, autonomous driving in chaotic conditions, and for a plethora of purposes, is already possible. Transporting people and cargo on land or water, through non-predictable traffic composed of vehicles operated by people, or delivering cargos to remote locations via drones, or using them to track wildlife and much more, is also something that requires a high degree of accuracy, but none of that is science fiction.

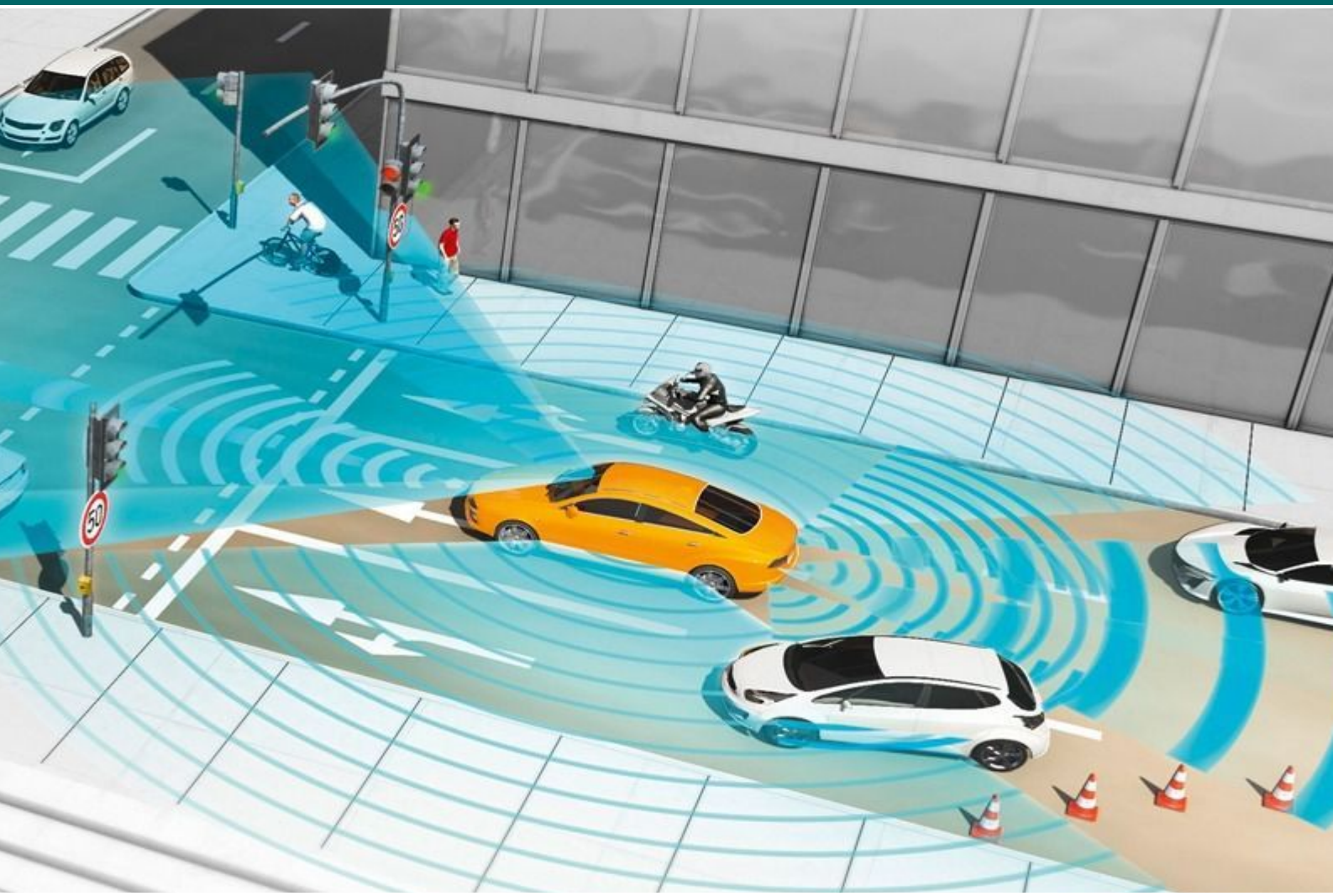
Autonomous vehicles sense their surroundings with techniques such as radar, lidar, GPS, and computer vision.  Advanced control systems interpret this sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage. Some autonomous vehicles update their maps based on sensory input, allowing the vehicles to keep track of their position even when conditions change or when they enter uncharted environments.




There are plenty of examples showing how autonomous car systems are extremely reliable.  Numerous major auto companies and research organizations have developed working autonomous prototype vehicles, including Mercedes-Benz, General Motors, Continental Automotive Systems, Autoliv Inc., Bosch, Nissan, Toyota, Audi, Vislab from University of Parma, Oxford University and Google.

In 2010, four autonomous electric vans successfully drove 8000 miles from Italy to China. The vehicles were developed in a research project, backed by European Union funding, by Vislab of the University of Parma, Italy. In July 2013, Vislab world-premiered BRAiVE, a vehicle that moves autonomously through mixed-traffic routes that are fully open to public traffic. As of 2013, four U.S. states have passed laws permitting autonomous cars: Nevada, Florida, California, and Michigan. In Europe, cities in Belgium, France and Italy are planning to operate transport systems supporting driverless cars.

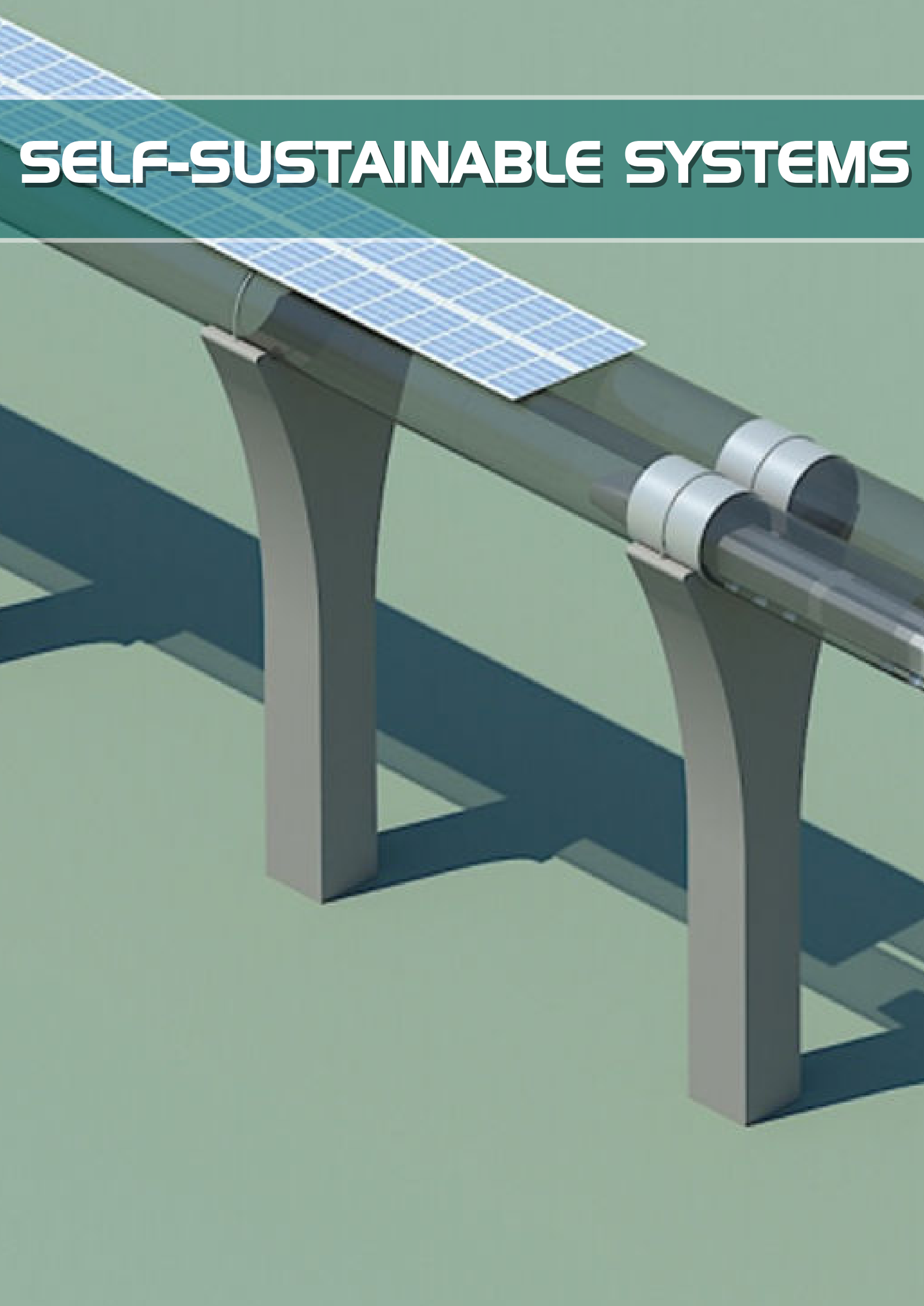
An example of autonomous flight (combined with coordinated tasks) is an UAV (unmanned aerial vehicle), commonly known as drone. It is an aircraft without a human pilot aboard. Its flight can be controlled autonomously by onboard computers. Such "drones" have a wide variety of shapes, sizes, configurations, and characteristics.




**Mass transportation systems, cars, drones, and so on, all seem able to take on autonomous driving with a high degree of accuracy: from air to land, water or underground, and there are systems already in use today. But in order make such systems void of human control, fully AA, we must build them inside smart infrastructures using smart materials.**

SOURCES so far : 1, 2, 3, 4, 5

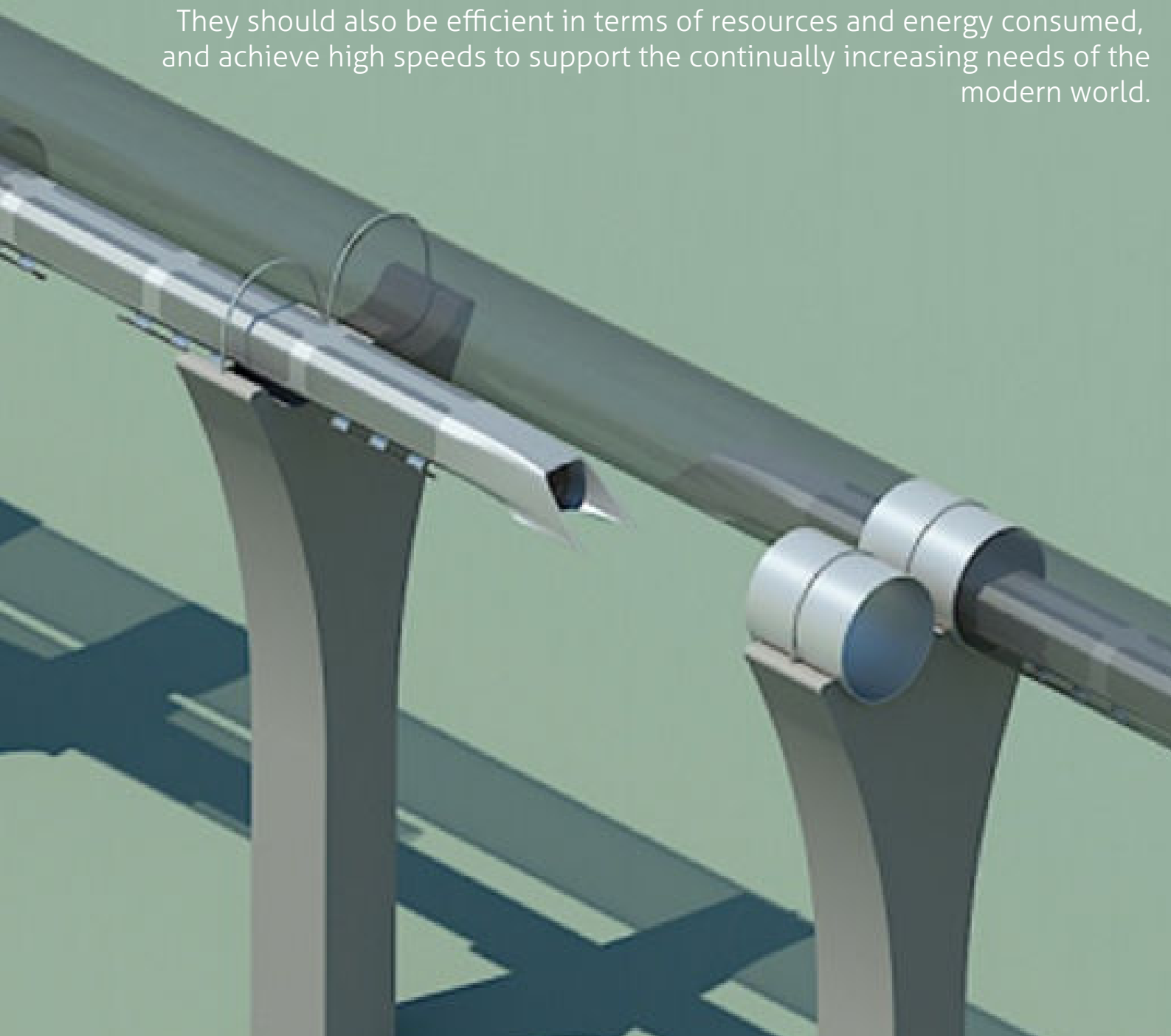
# SELF-SUSTAINABLE SYSTEMS



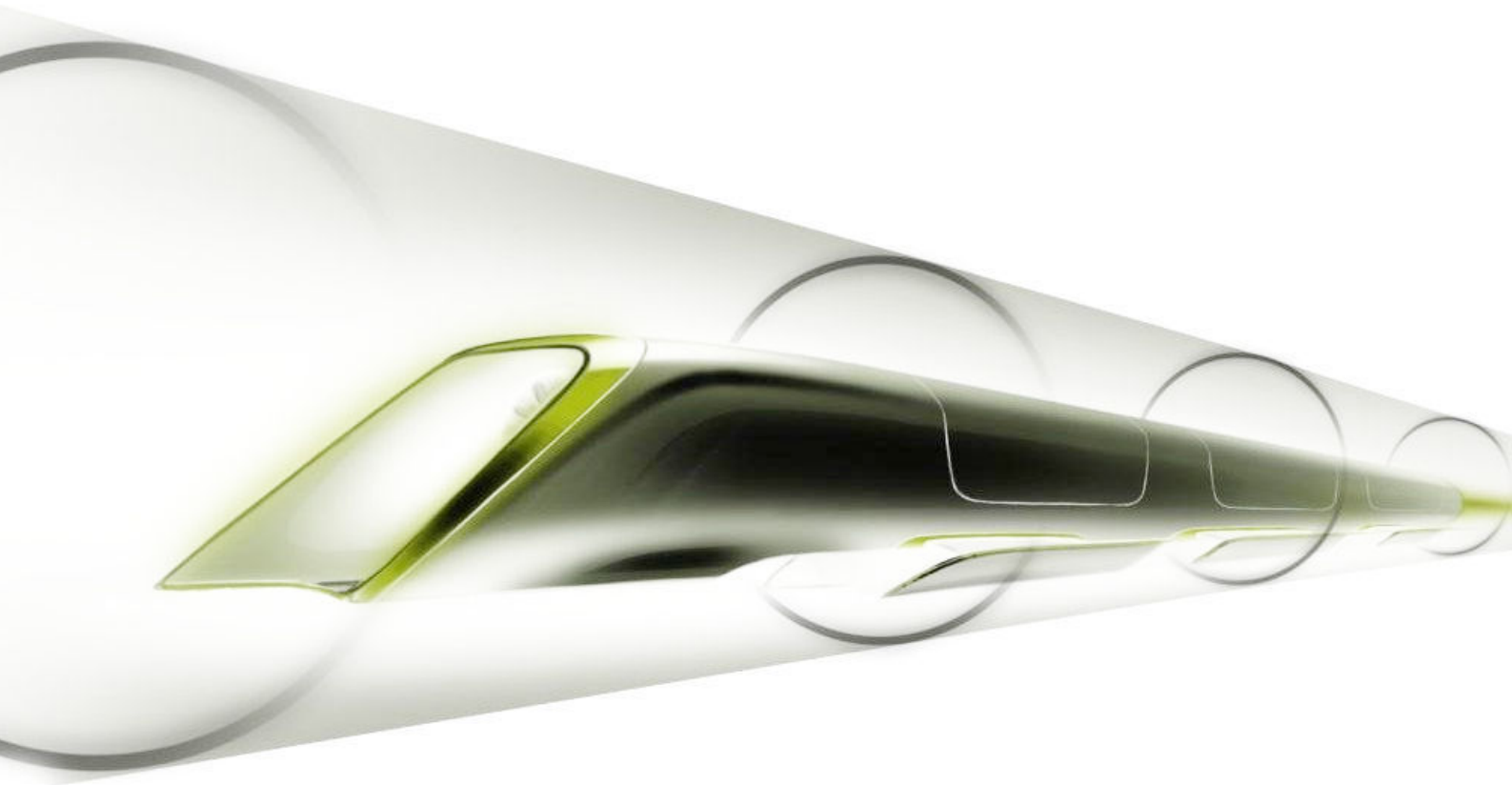
# AND EXPANDING EXAMPLES

There are plenty of autonomous vehicle examples that can drive complex tracks and respond to changes in the environment and the course they are following, but such systems must rely on well-built and maintenance-free infrastructure (vehicles included). While we may have multiple train systems and airplanes that can run themselves autonomously, we're talking about more than that here. In order for these systems to run by themselves, long-term, they must be built so that they require almost no maintenance at all.

They should also be efficient in terms of resources and energy consumed, and achieve high speeds to support the continually increasing needs of the modern world.



# HYPERLOOP



Imagine traveling from California to New York (2,413 miles / 3 884 km) in less than 4 hours.  That is, traveling across the US much faster than you could with a non-stop airplane flight.

Hyperloop's speed is around 598 mph (962 km/h) on average, with a top speed of 760 mph (1,220 km/h).  It can achieve these speeds because it is "incorporating reduced-pressure tubes in which pressurized capsules ride on a cushion of air, driven by a combination of linear induction motors and air compressors."  (Wiki)

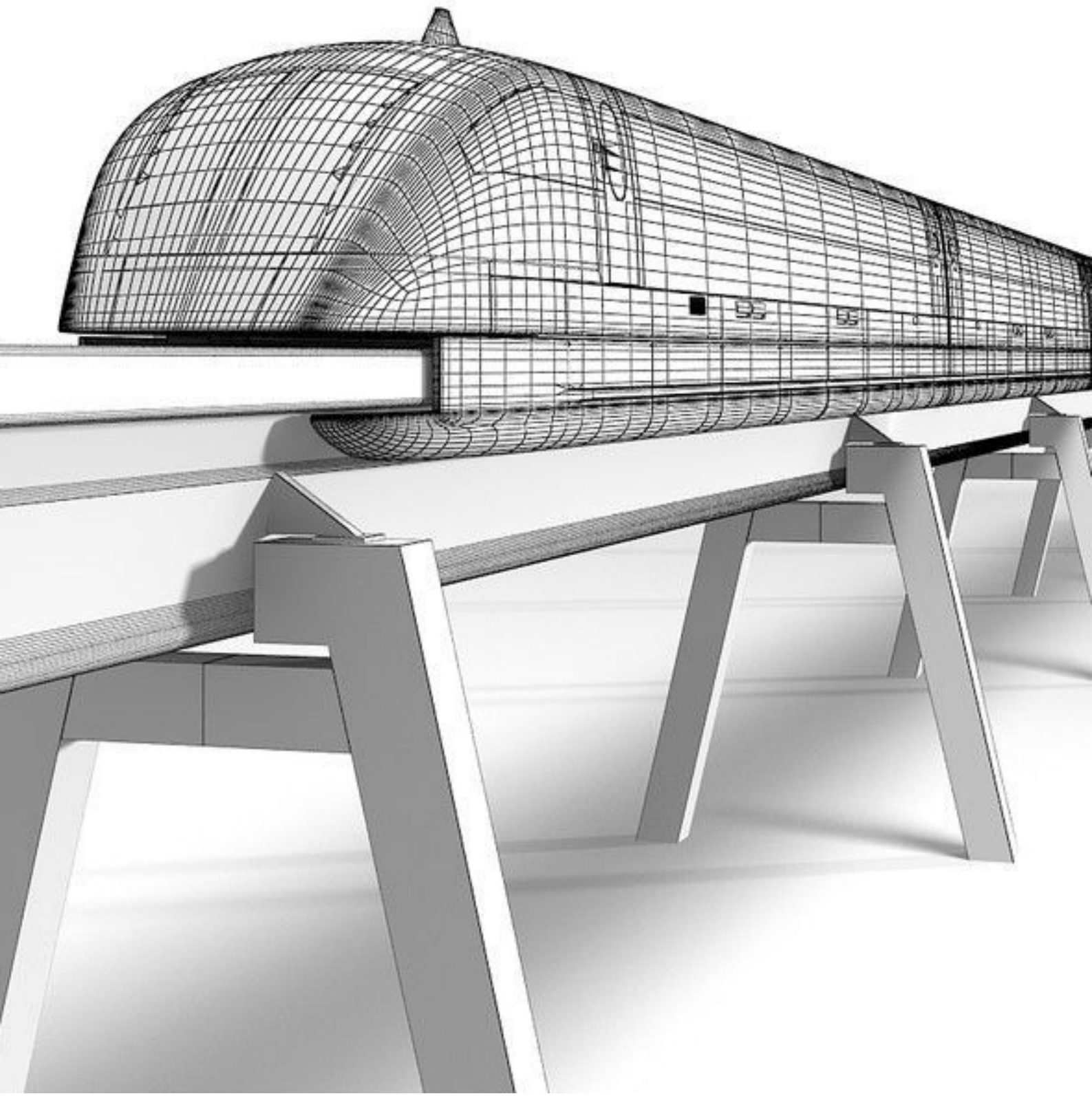
It can also cost much less in terms of resources and energy spent than any other transportation system and is also planned to be powered completely by solar panels that will be placed on top of the track.


***"It will never crash, it is immune to weather, it goes 3 to 4 times faster than the bullet train"***

says Elon Musk in this interview, explaining the technology and the motive behind the transportation system he proposes. Although the concept is still only at this stage of concept, officials from Hyperloop published a detailed PDF underlying the science behind the concept and the plans to build it.

Elon Musk, who has personally demonstrated many other technologies that he developed/financed, seems to be taking this project very seriously and even predicts that it will be a reality in just a few years.

# MAGLEV TRAINS



While Hyperloop's technology needs to be tested in the real world before mass deployment, technologies like Maglev Trains have been around for decades.

Yet, despite decades-long research and development, there are presently only two commercial maglev transport systems in operation, with two others under construction due to the huge monetary costs of building them. They use magnetic levitation instead of wheels, thus requiring far less maintenance than traditional trains.

This is a test of a Japanese maglev train that reaches 500 kmh (310 mph) - and it is scheduled to be fully functional by 2027.


***Maglev trains can also be enclosed in vacuum tubes to increase their speed tenfold, to 5–6 times the speed of sound - extraordinary speeds.***

Instead of traveling from LA to New York in less than 4 hours, as Hyperloop speeds suggests, you would be there in less than a half-hour.

As in the case of Hyperloop, this technology is not currently used in any transportation systems or fully tested, but researchers at Southwest Jiaotong University in China are developing (as of 2010) a vactrain to reach speeds of 1,000 km/h (620 mph). They say the technology can be put into operation in 10 years. (source)

# TUBULAR RAILS

Here are some other mass transportation systems that are not speed-oriented, but less resource-hungry to build and maintain them.

Tubular Rails: In this system, the trains themselves carry the tracks, while the wheels and motors are contained in elevated rings that the train passes through at speeds of up to 240 km/h (150 mph).

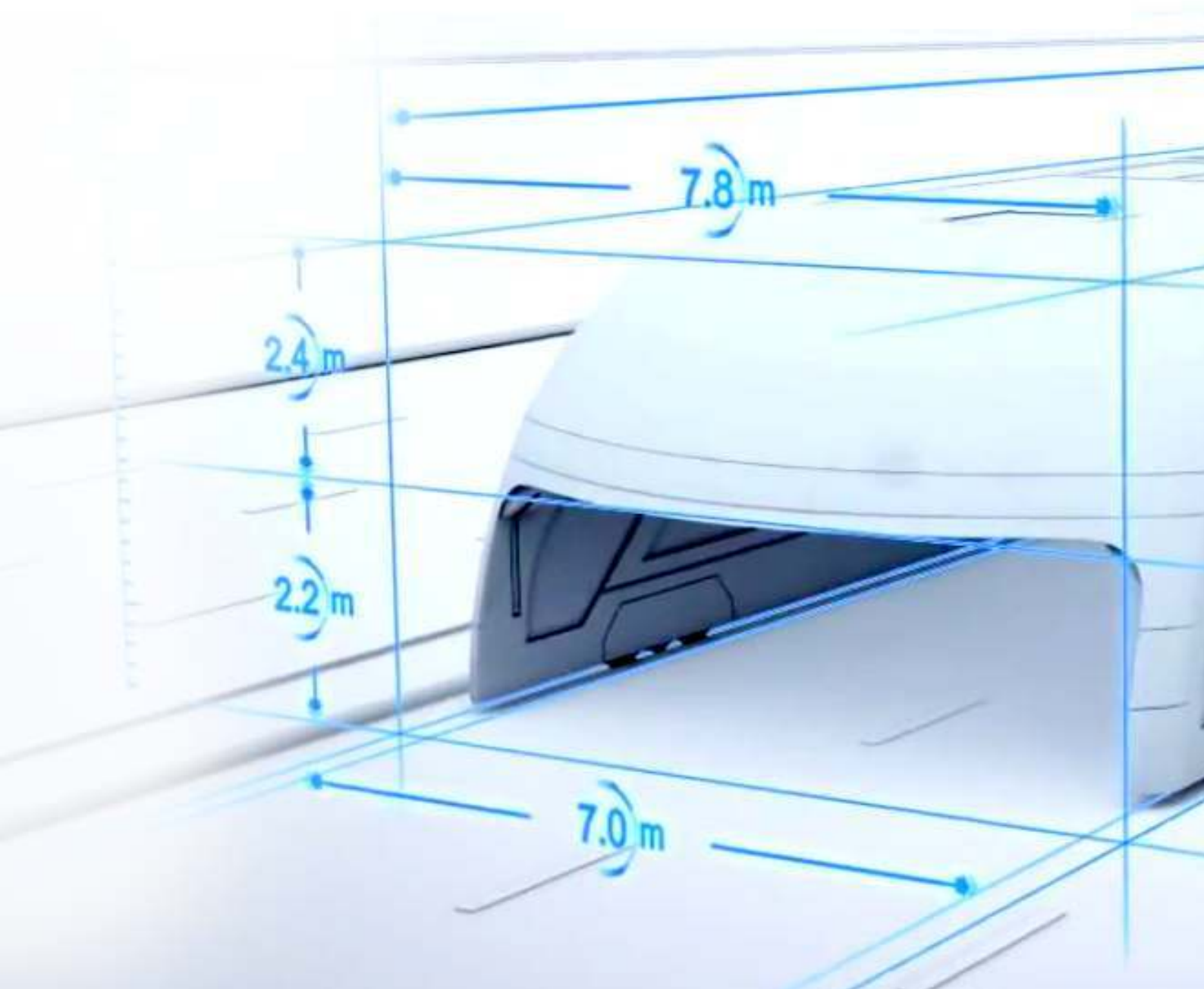
Because the design would cause minimal disruption to existing infrastructure and the technology is readily available, Tubular Rail estimates that construction costs could be 60 percent less than conventional urban train networks. (source)


TUBULAR

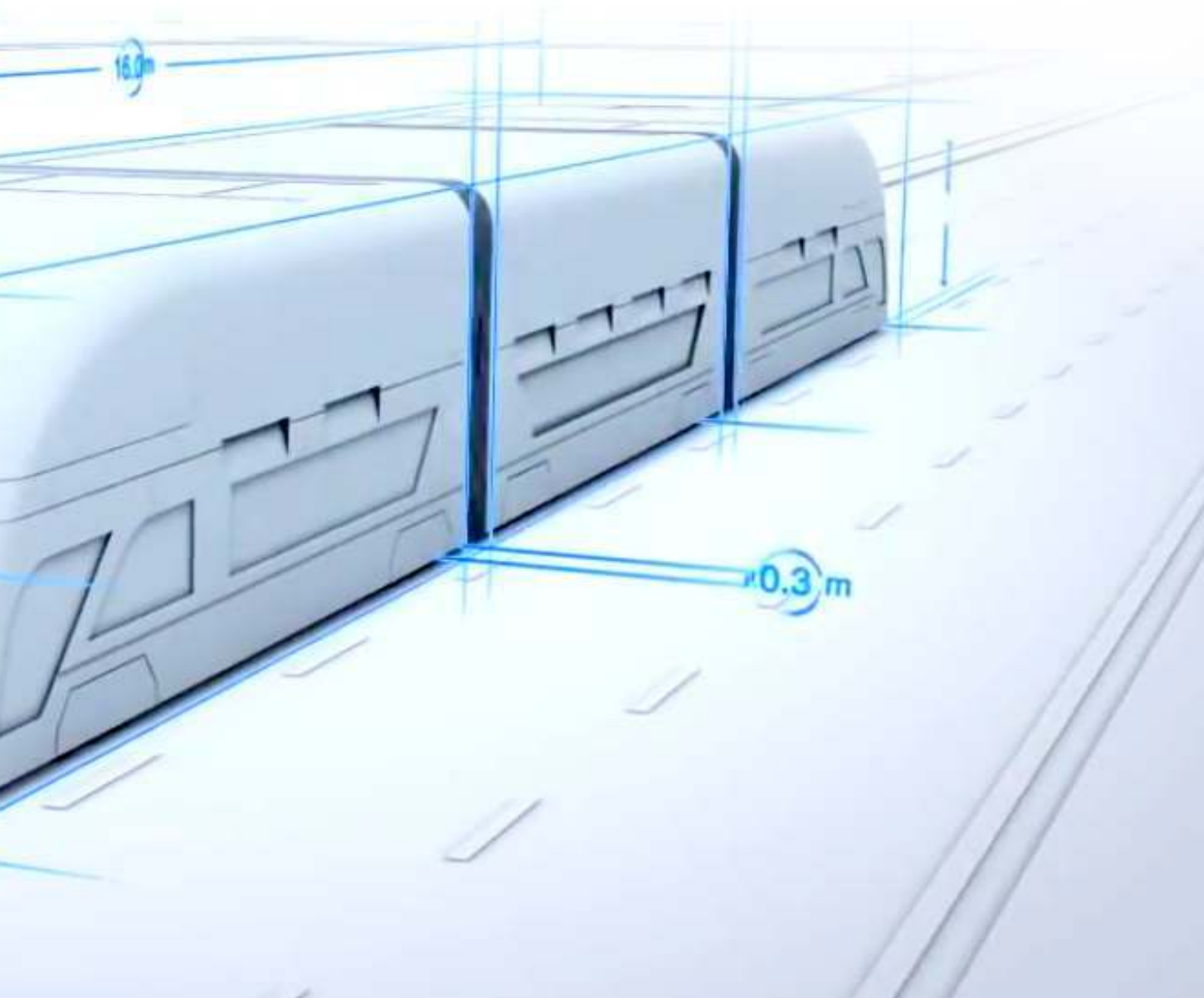
# STRADDLING BUS

The "straddling bus" would roll on stilts above traffic using small tracks positioned between lanes of traffic while passengers get on and off at elevated bus stops.

The result: additional people-carrying capacity for urban roads, no disruption to traffic and no need to build completely independent track systems. (source)




Bridge through solution


16.5m
0.3 m

# PERSONAL RAPID TRANSIT

String Transport System: The concept is based on the use of what look like heavy-duty above ground electrical wires, but instead of carrying power, these high-tension wires become the support for carriages.

These types of carriages, personal rapid transit (PRT), can be widely varied. From "Driverless Pods" that have been programmed so that passengers would never have to wait for more than 12 seconds (zero local emissions, 70% more energy efficient than cars and 50% more than traditional buses), to Human-powered monorail that uses bicycle pods suspended from tracks to create a very efficient option for getting from points A to B.


Just-in-time delivery
06:43
HD


POST

# MOVING PLATFORMS

Another very important factor when it comes to mass-transit are the stops required to pick up passengers at local stations, which consume both energy and time.

What if these transportation systems are no longer required to stop?  These systems transfer passengers from one train to another without the trains stopping along their route.  Physical prototypes of such systems do not yet exist, although there are people that have presented feasible models of the idea. (source)


01:14

Transportation systems can be on the ground, underground, or elevated on top of the infrastructure, thus remaining out of the way of the infrastructure.  We are all used to the subway as a means of underground transportation, as well as underwater transportation, as show in Japan and Uk-France tunnels, while elevated railways have been in use for many decades. (source)

So, we have high speed trains, vacuum tubes that increase the speed and protect the vehicles from external factors, technologies like maglev that require almost no maintenance, buses that can run on top of existing highways and other rapid transit vehicles that reduce the waiting for your next ride to mere seconds; all of these have been proven to be reliable transportation systems.

BUT WHAT ABOUT AUTOMATING

# TRANSPORTATION UNITS

THAT DO NOT HAVE A FIX TRACK ?

# SELF DRIVING CARS

Google's Self-Driving Car is the most well-known autonomous car in the world. In 2005, a team from Stanford Artificial Intelligence Laboratory won the DARPA Grand Challenge, which challenged multiple teams to develop a completely autonomous car that can traverse an unknown off-road course. Watch The Great Robot Race documentary to enjoy that race and see what other technologies were employed besides the one that we are presenting here.

This team is now behind the Google Car which, by August of 2012, had completed over 300,000 accident-free autonomous-driving miles (500 000 km), with about a dozen of these cars on the road at any given time. (source1)(source2)


While the technology used for the Google Car is quite expensive to mass-produce, there are plenty of similar systems that are far cheaper. Ionut Budisteanu, a 19-year-old student from Romania, may have found a way to make autonomous driving technology more affordable. Budisteanu won a $75,000 scholarship from the International Science and Engineering Fair for creating an accurate system that uses a cheaper, lower-resolution three-dimensional radar system, paired with a webcam in place of the pricey high-definition 3D radar Google uses.

As a result, Budisteanu was able to cut costs from $75,000 to $4,000. His system uses artificial intelligence software to identify curbs, lane markings and other small objects on the road with the webcam, while the radar system locates people, cars, houses, and other large objects. In his tests, the system performed as intended 47 out of 50 times (94% accuracy). He believes he can improve the accuracy with a slightly higher-definition radar system while still keeping costs low. (source)

Such technologies will continually grow cheaper and cheaper (not only in terms of money, but also in construction resources). As that happens, more and more companies will invest into this technology, making it more inexpensive & readily available and, perhaps, completely transforming the way people use cars. Indeed, Google is already planning to transform their Google Car into a Robo-Taxi.

**Laser-guided mapping**
A rotating sensor with lasers called a LIDAR on teh roof scans more than 200 feet in all directions to generate a precise 3-dimensional map of the car's surroundings.

**VIdeo Camera**

A camera mounted near the rear-view mirror detects traffic lights and helps the car's onboard computers recognize obstacles such as pedestrians and bicyclists.

**Radar**
Four standa
front and o
positions o

**Position Estimater**
A sensor mounted on the left rear wheel measures small movements made by the car and helps to accurately locate its position on the map,

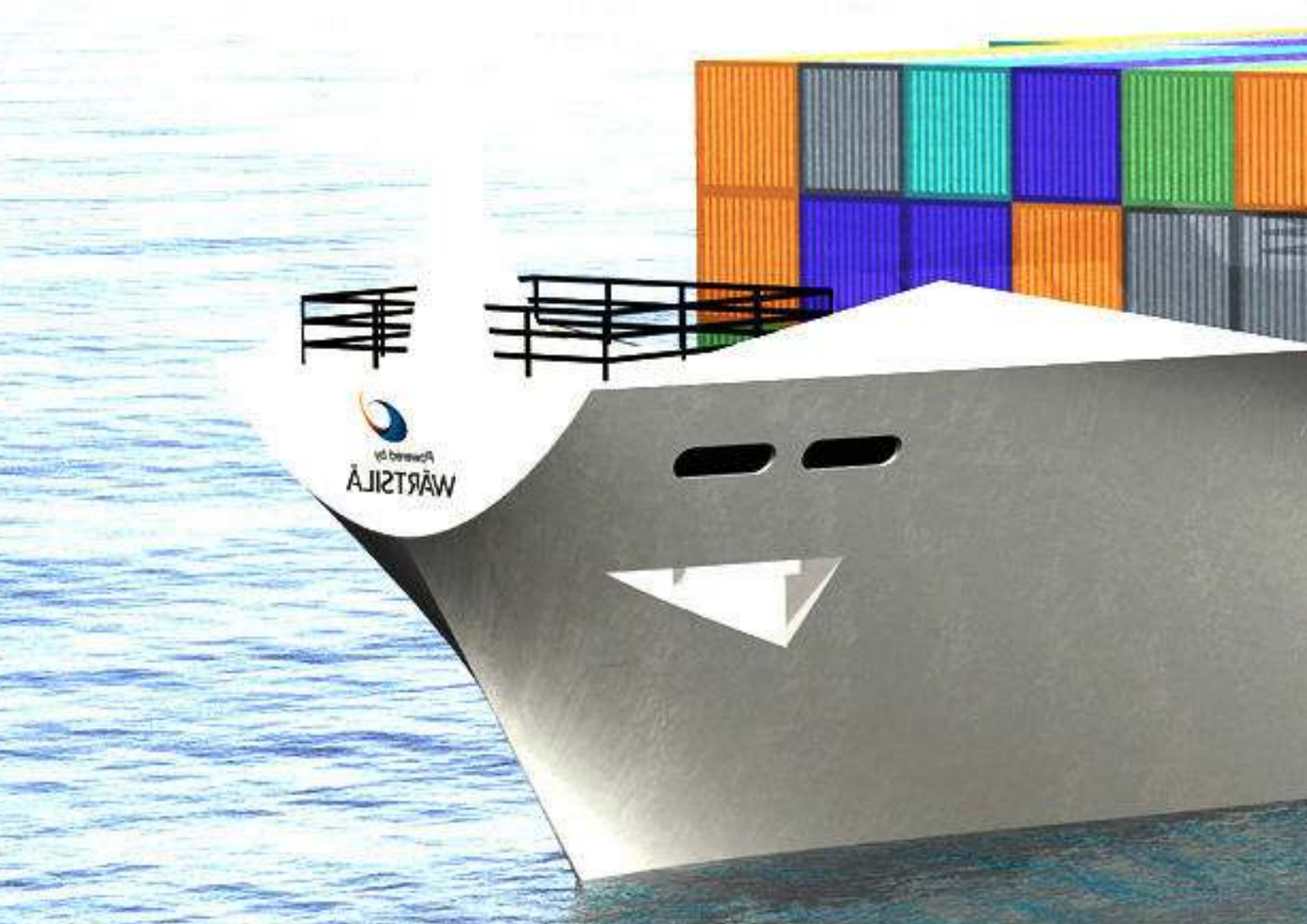

ard automotive radar sensors, three in
ne in the rear, help determine the
f distant objects.

# UNMANNED CARGO SHIPS

Land transportation may turn out to be the most used and the most reliable. So far we have shown that it can be made extremely fast, reliable, very automated and varied. But transportation systems can be achieved on water and air as well, and there are many ways to also make them autonomous.

On water, autopilot systems may be very similar to those used for self-driving cars. The Self-steering gear is one example of equipment being used on ships and boats to maintain a chosen course without constant human action.

Thinking bigger than that, Rolls-Royce is designing unmanned cargo ships. These drone ships would be safer, cheaper and less polluting. They could be deployed within a decade.



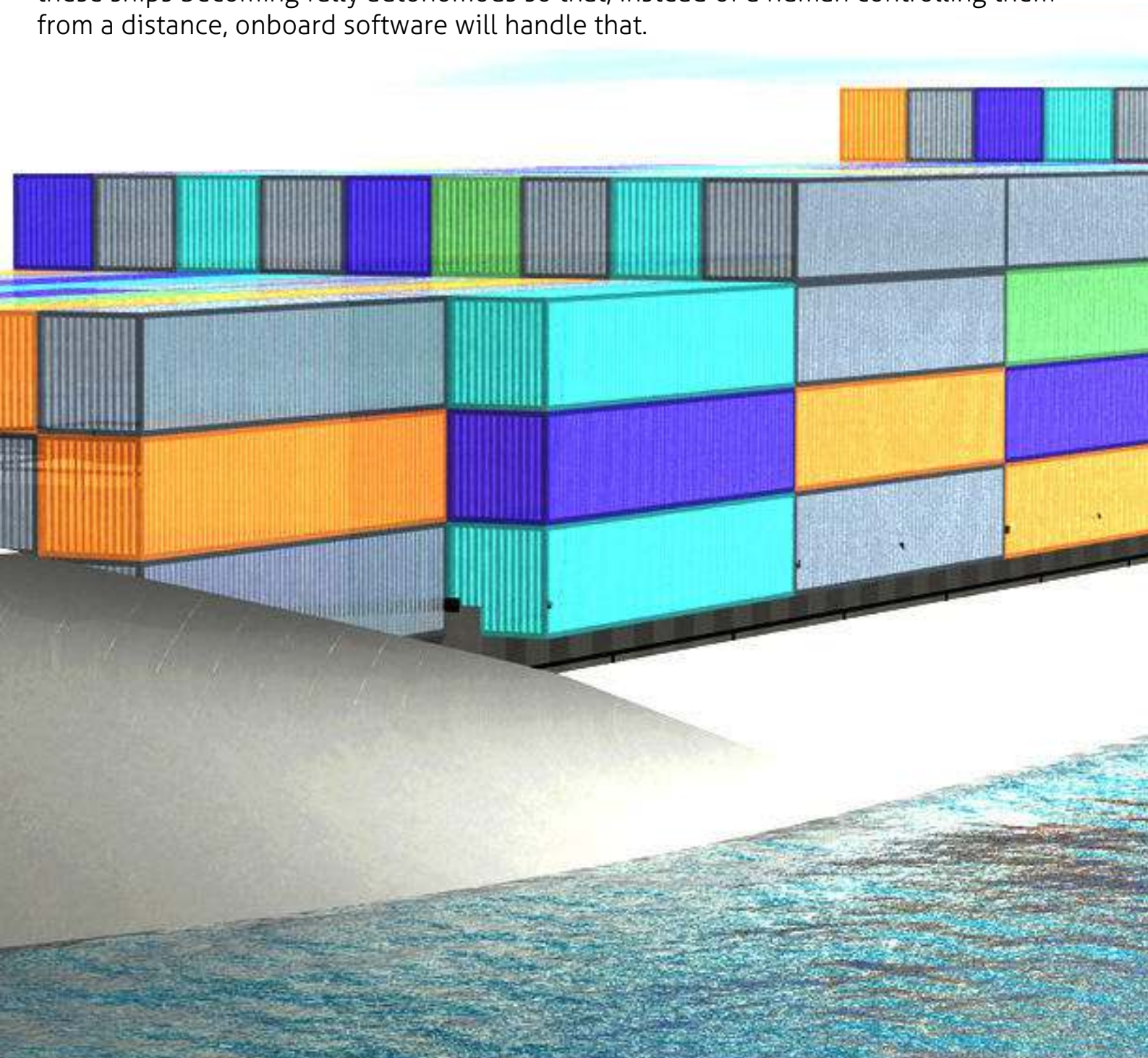
By replacing the bridge -- along with other systems that support a human crew such as electricity, air conditioning, water and sewage -- the ships would be 5 percent lighter before loading cargo and are expected to burn 12 percent to 15 percent less fuel.

“Now the technology is at the level where we can make this happen, and society is moving in this direction”, said Oskar Levander, the company’s vice president of innovation in marine engineering and technology.

"Crews will offer no safety advantage after ships evolve equipment for remote control, preventive maintenance and emergency back-ups.", Levander added.

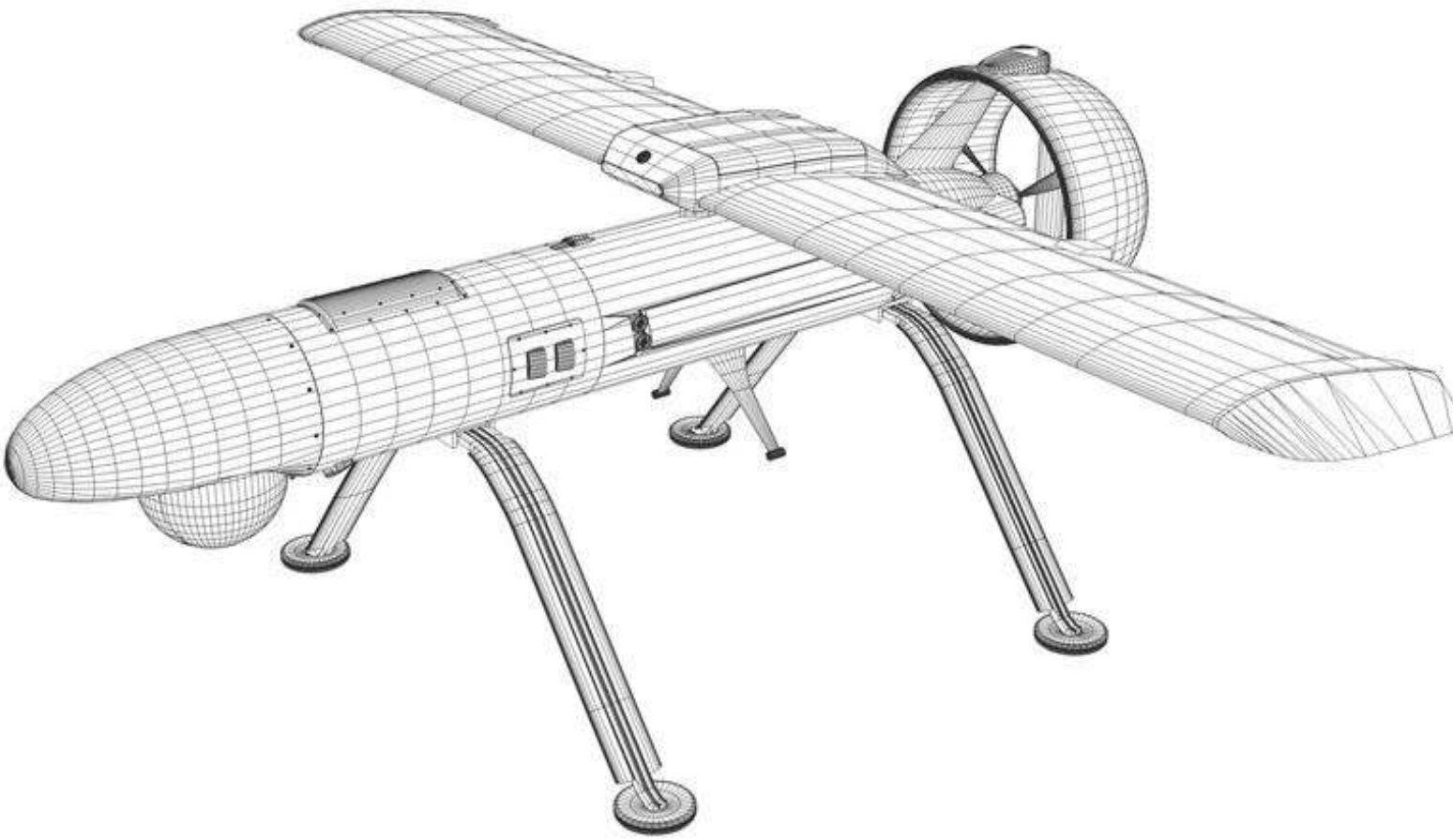
Cameras and other sensors can already detect obstacles in the water better than the human eye.

And although they are still designed for remote control, it isn’t far fetched to imagine these ships becoming fully autonomous so that, instead of a human controlling them from a distance, onboard software will handle that.



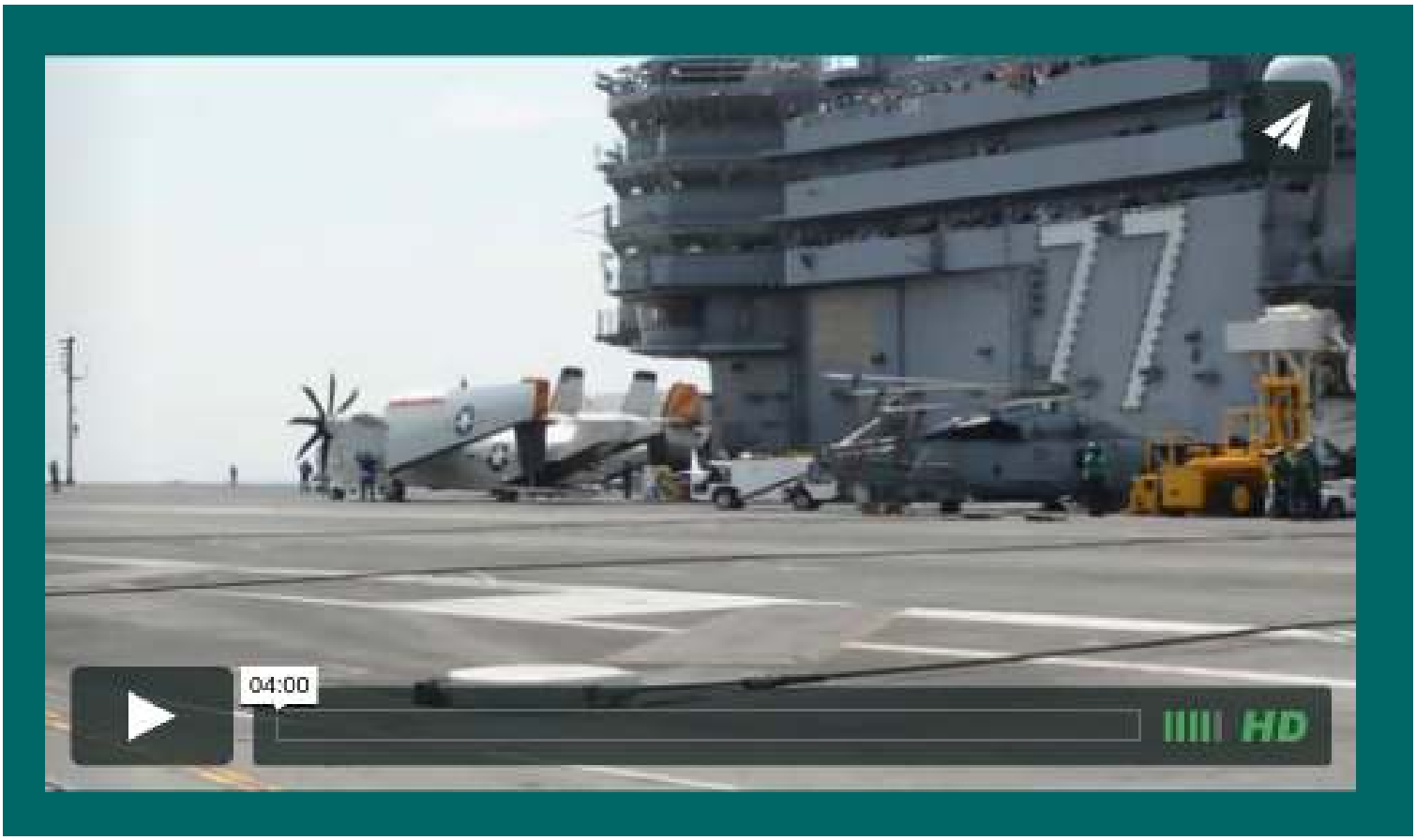
# UNMANNED AERIAL VEHICLES

In the air, UAVs are most often deployed for military and special operation applications, but they are also used in a small but growing number of civil applications including policing and fire fighting, aerial crop surveying, acrobatic aerial footage in filmmaking, search and rescue operations, inspecting power lines and pipelines, counting wildlife, and delivering medical supplies to remote or otherwise inaccessible regions.

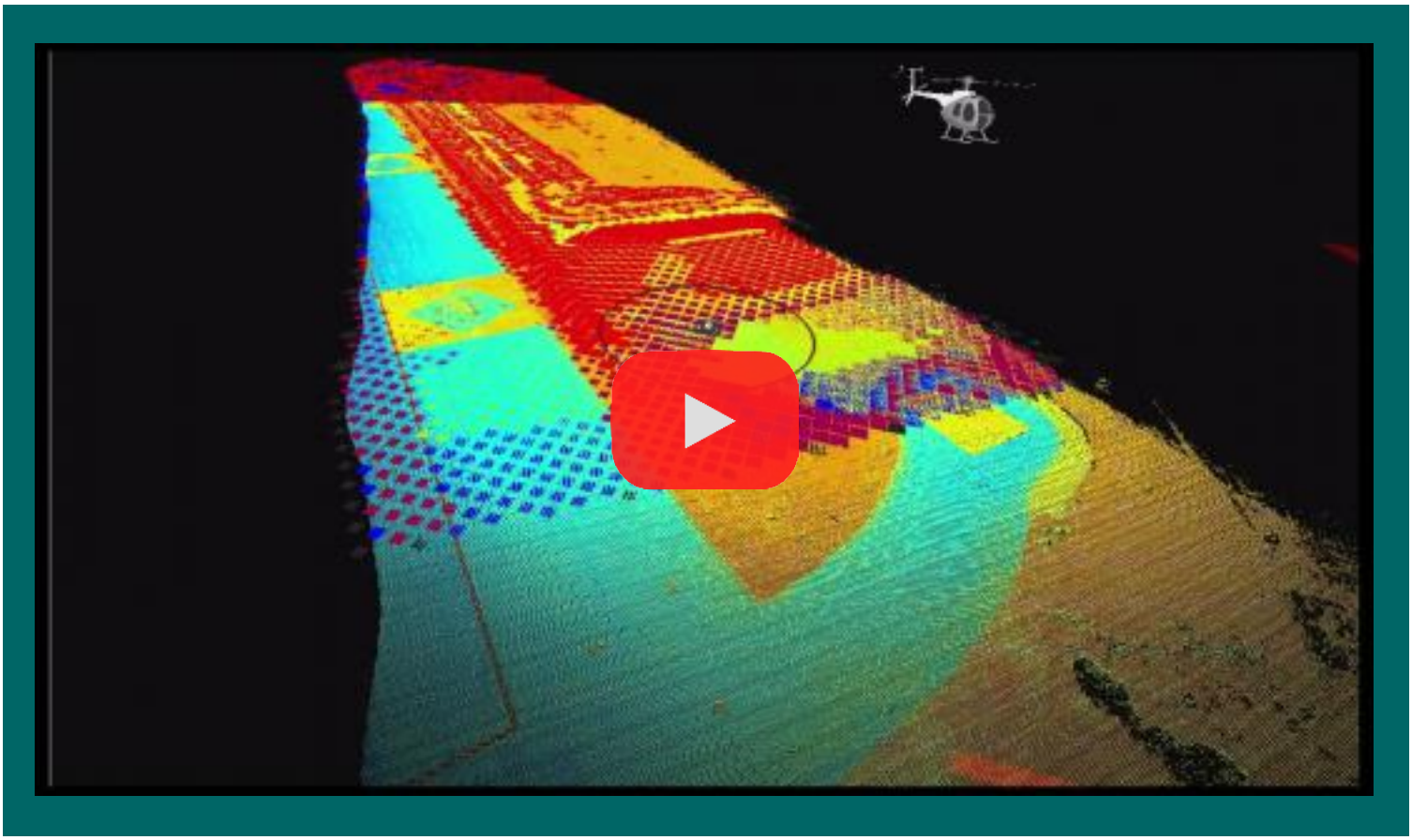


## Some real life examples of "mechanical birds":

Big aircraft landing and taking off of an aircraft carrier, fully autonomously.




A full-size helicopter landing, flying and taking off.  Again, autonomously.



Also, Amazon wants to use autonomous drones for delivery by 2015.  (video)
For an extensive list of the use of UAVs in the present, check out wikipedia.

All of these autonomous vehicles, from drones to self driving cars that seem able to drive without  having a fix track to follow and be very independent, can be made much more efficient if they are built within a fully supporting infrastructure such as magnetic or solar roads.  This change will improve their reliability and allow them to continuously charge their batteries while on route, eliminating any need to stop for charging.

Speaking of batteries, these vehicles must rely on batteries to power them up, right?

While electric vehicles are a thing of the present, able to drive hundreds of kilometers on one charge and fully recharge their battery packs in less than one hour (as Tesla model S shows), this is only one way of allowing cars to "get around". Propulsion of these vehicles can run on air, hydrogen and even water.  Although these technologies are more in prototype stage, they show us that electric cars are not the only option available.

Furthermore, if the roads are made to communicate with the vehicles and the vehicles with themselves, the probability of accidents can effectively become 0%, thus making the costs of building the vehicles much less, using fewer resources and energy.

After all, we do not build airplanes to resist potential impact with other airplanes, because that will likely never happen.

The focus will be on building these vehicles for their functionality, rather than subjective design that may artificially uplift someone's social status, as they do now for cars.

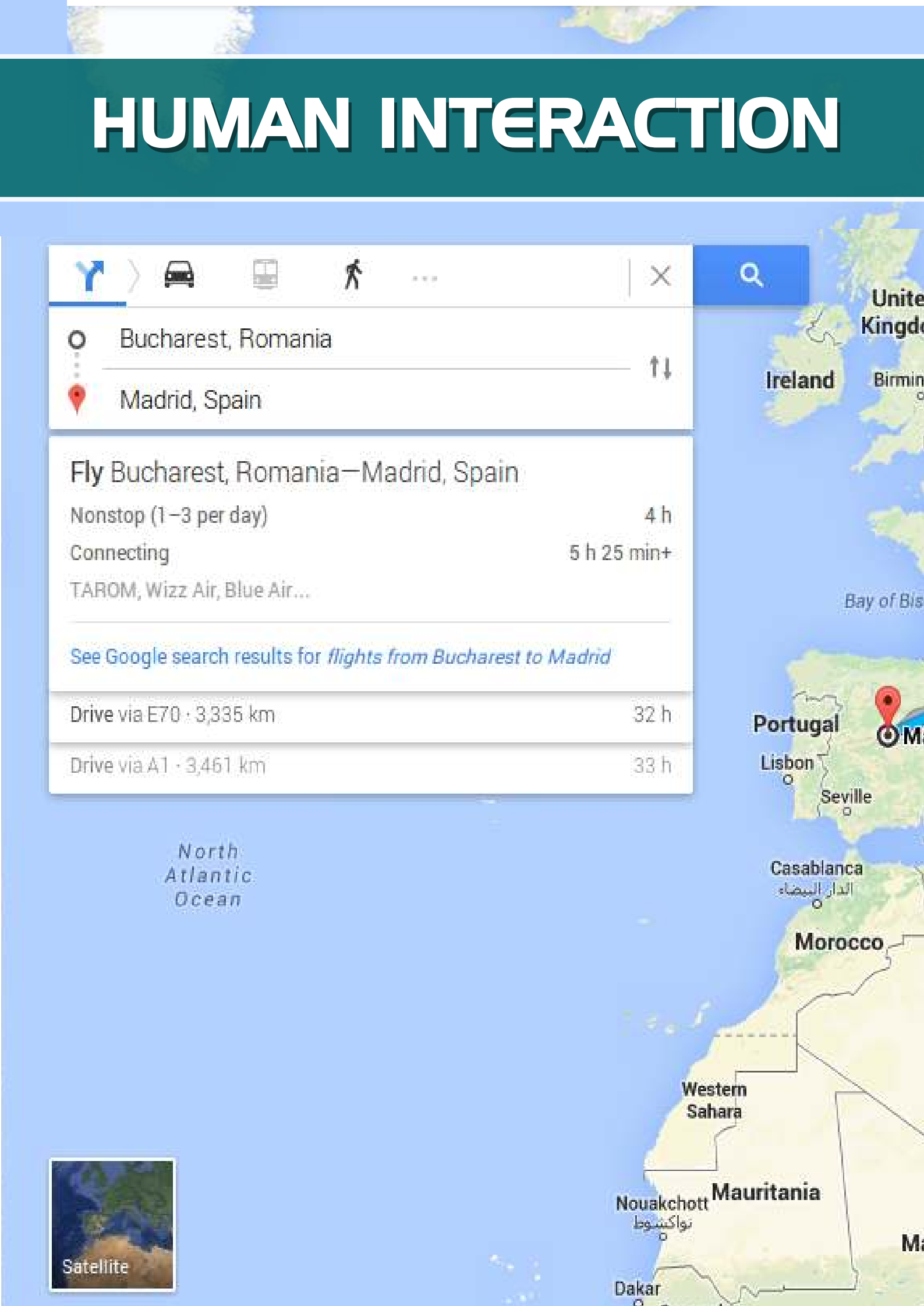
At the same time, with the use of nanotechnology, these vehicles can also become maintenance free.

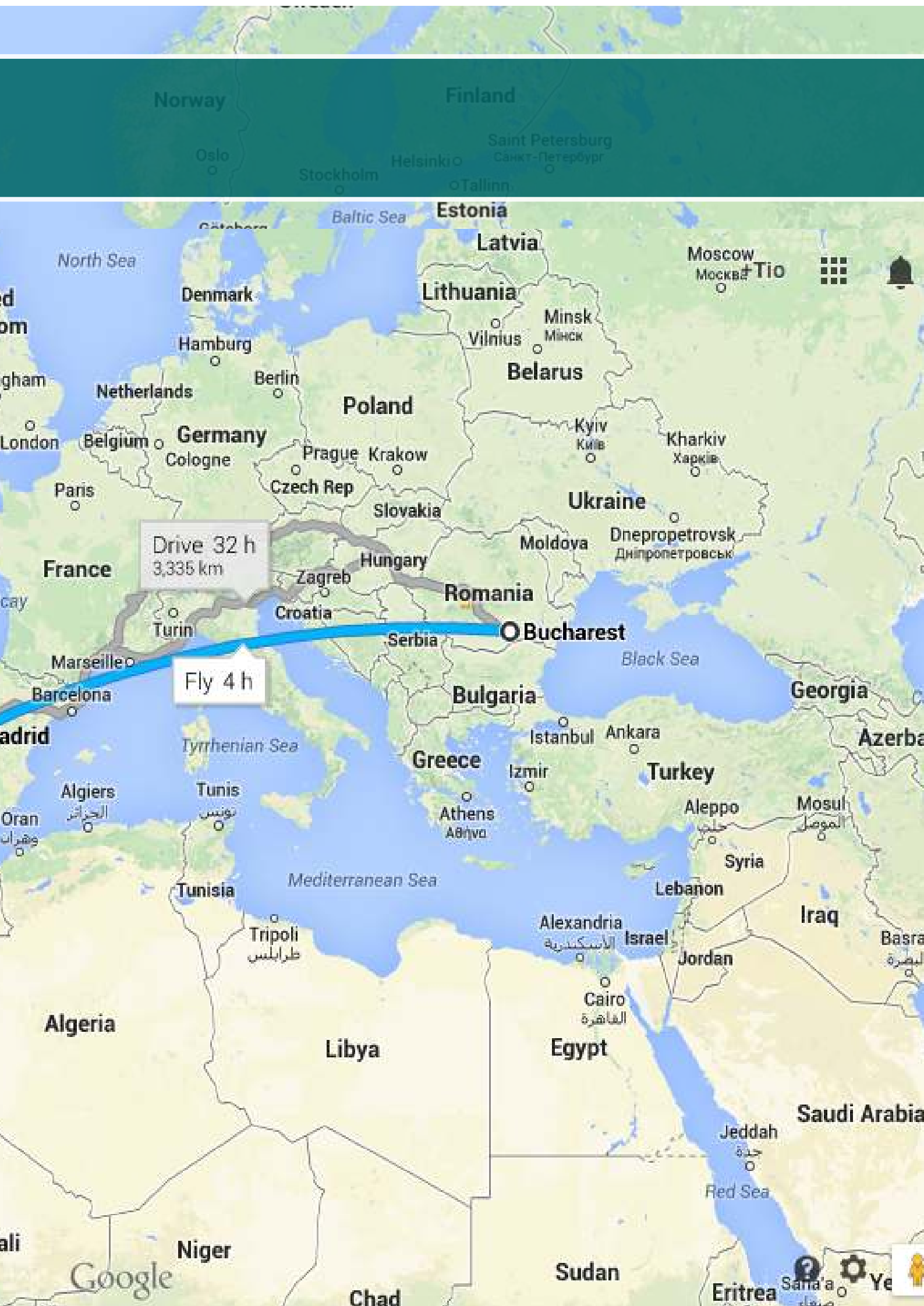
These self-sustainable autonomous transportation systems, whether on air, water or land, will dramatically increase the security, safety, roadway capacity, speeds and overall reliability of travel; anyone will be able to use them (you don’t have to know how to drive them); it will perhaps remove the need for parking, or at least reduce it drastically; it will remove the need for owning such a vehicle which makes such vehicles useless when don’t used; it will eliminate the need for police and driving-related laws; and more...

Contrary to the current thinking that the difference between transportation and delivery is that one delivers humans and the other one packages, these systems can be used for delivery in the same way they are used for transporting people; same sensors, same technology, same approach.

Even today, package delivery systems use computers to arrive at the best route. (source)

# HUMAN INTERACTION



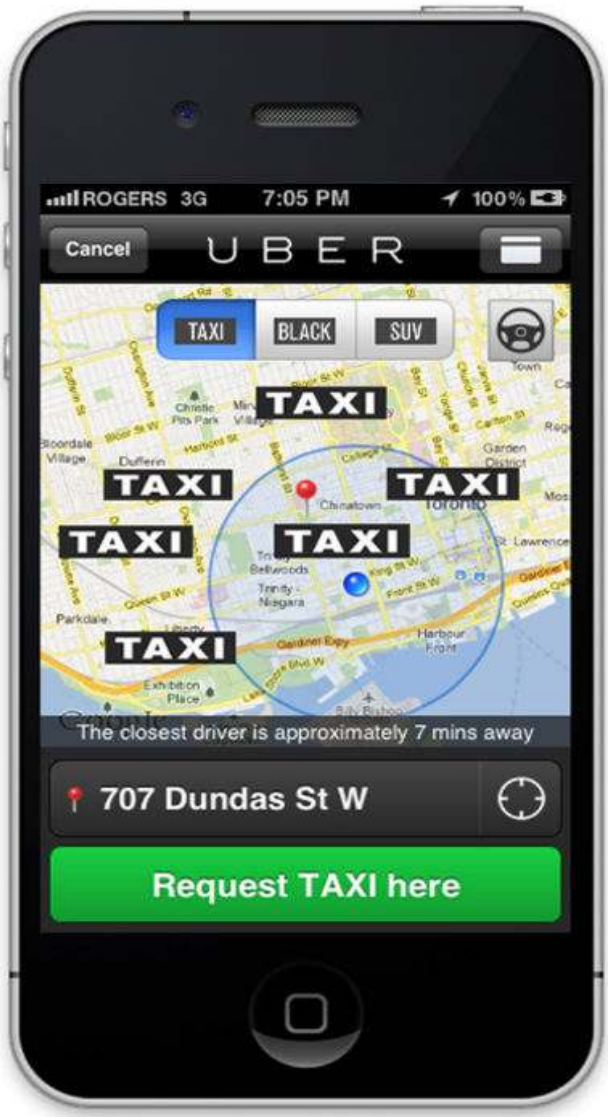

Drive 32 h
3,335 km
Fly 4 h
Bucharest
Turin
Marseille
Barcelona
Norway
Finland
Oslo
Stockholm
Helsinki
Saint Petersburg
Санкт-Петербург
Tallinn
Estonia
Baltic Sea
North Sea
Latvia
Lithuania
Moscow
Москва
Denmark
Minsk
Мінск
Vilnius
Hamburg
Belarus
Berlin
Netherlands
Poland
London
Belgium
Germany
Cologne
Prague
Krakow
Kyiv
Київ
Kharkiv
Харків
Paris
Czech Rep
Slovakia
Ukraine
Moldova
Dnepropetrovsk
Дніпропетровськ
France
Hungary
Zagreb
Romania
Croatia
Serbia
Black Sea
Georgia
Bulgaria
Istanbul
Ankara
Tyrrhenian Sea
Greece
Izmir
Turkey
Algiers
Tunis
Athens
Αθήνα
Aleppo
Mosul
Syria
Mediterranean Sea
Tunisia
Lebanon
Iraq
Alexandria
Israel
Jordan
Tripoli
Cairo
Algeria
Libya
Egypt
Saudi Arabia
Jeddah
Red Sea
Niger
Sudan
Eritrea
Chad
Google

For any technology to be optimized, including all of these transportation approaches, they must be highly efficient and be very easy for everyone to use.  We should not have to wonder when the next train might arrive, feel concerned about road conditions when driving, etc..  Instead, we need them integrated so well that we don't even give them any thought at all; simply use them.

**As an example, let me introduce you to a brand new technology called : the smartphone ! :)**

These devices are now so powerful that you can do pretty much everything with them, while the notion of an "app" is just a thing you install in a few seconds, as if it's barely making use of the smartphone's hardware and software capabilities.

In the near future, these apps will prove essential when it comes to transportation.  Indeed, they are already used by many.




**Uber** is one example of such an app. When you open the app, it recognizes your current location and automatically displays near-by drivers-for-hire. You can choose which one should pick you up or just choose the nearest one, and that's it. The drive comes and pick you up. You can track the car's position in real-time and also see the time it will take to arrive at your destination. The app is also incredibly easy to use.

You do not have to pay the driver, it automatically charges you from the app itself, thus taking away the paying necessity, which is relevant as it shows you can get over that step at least technologically.

And there are plenty of similar apps available today.

Uber focuses on human-driven vehicles instead of autonomous cars, so you may be thinking that human-to-human interaction is necessary for these things. Berlin, however, uses a share-cars rental system. Basically, it consists of electric cars that are parked in many spots across the city. You open an app, detect the location of the nearest appropriate vehicle, and you simply go and pick up the car.

That's it. No middle-man or anything else to cause you frustration or delay. This system's results also prove that people do not act like wild animals, deteriorating the cars as many may project when we imagine such a system of renting cars.


Using apps on smartphone-like devices, tracking and ordering a ride has proven to be a very easy task nowadays and, as shown in the Berlin example, even if the rides are driver-less, like autonomous cars, people can act in a civilized manner in respect to the vehicles, thereby showing the needless of any kind of law system.

Since autonomous cars can park themselves and pick you up, there is no reason to think they cannot also be used for such on-demand systems.

There are also apps for tracking flights, train schedules, and pretty much any transportation systems. Additionally, Google Maps is very easy to use this way. You only have to tell Google "I want to get from here to California" and it will show you the best route for that, including the transportation systems you have available to get there. You can even say to Google Now, the "Siri" of Google and Android, that you want to arrive or leave at a certain hour and it will propose travel plans according to that.


IMAGINATI


ON SALAD

# LET'S SEE WHAT WE HAVE SHOWN SO FAR:

- Autopilots are so sophisticated that they can run entire transportation systems, even in unpredictable conditions.

- From air to land, water to underground, underwater or on top of cities, transportation systems are extremely varied and complex.

- These vehicles and their infrastructure can be made completely reliable, self-sustainable and efficient from every perspective.

- The idea of a completely autonomous transportation and delivery systems is no longer a Sci-Fi idea. This is something that we are experiencing more and more in reality.

- Apps and smartphones convert the interaction between all of these complex sets of systems and you into a simple " walk in the park" . :)

**So now, imagine that you want to go anywhere in the world** (supposedly it is a habitable place). You open your travel app and just say: I want to go there. The app makes the route for you and ask you when you want to arrive or depart. You say the time and a car will come and pick you up. You then enjoy the ride and the landscape, and arrive at the exact same time as the software predicted.

You may need to switch to another type of transportation system along your route, but that's as simple as getting out of a car and walking few meters to get into the other transportation system (maglev train, underground subway, airplane, etc.).

# THE GLOBAL TRANSPORTATION SYSTEM SHOULD BECOME SO EFFICIENT THAT YOU WON'T EVEN THINK ABOUT IT

# IT WILL JUST WORK!

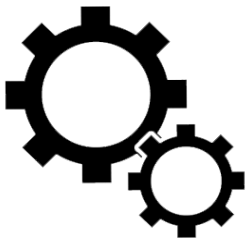
# GOODS AND SERVICES

It is quite a challenge to define either “goods” or “services”. Goods can be anything from 3D printers to furniture, gadgets, clothing and so much more, while services can be anything from medical services to entertainment and different kinds of maintenance services.

Still, I will try to make sense of these concepts and show you how goods can be made in a fully automated way and how services can become completely autonomous.

Before you think about the notion of goods, it is a must for you to understand the notion of 'abundance'. We discuss in length in our "The Money Game and Beyond" book.

But in short, it is quite erroneous to think that the same goods will be produced and people’s wants will be the same in a trade-free society. Also, for hugely complex projects such as the Large Hadron Collider, you may think that if you cannot automate all the processes of its construction, no one will want to get their hands dirty and help with the process. If you think like that, you are missing the “motivation” factor. Consider that if there is something that cannot be built in a fully automated fashion with today’s technology, it does not stop it from being built. People can still get involved here and there, although they will also likely be replaced by machines in the years to come, regardless of sector, thus giving them the opportunity to focus on whatever else they might like to do. So, supposing you have read "The Money Game and Beyond" book, let’s start our journey with this one.



## GOODS:

- COMPLEXITY AND MASS PRODUCTION
- RESOURCES AND THE ZERO MARGINAL COST

## SERVICES:

- FOOD
- HEALTH
- CREATIVITY AND MEDIA

# COMPLEXITY AND MASS PRODUCTION

Have you ever seen the Discovery Channel's "How It's Made" TV series? If not and you are curious about how products are made in automated factories, then you should take a look at it.

I have to warn you, though - it covers 23 seasons, and that's because there are so many products that are produced today.
From toothpaste to umbrellas, cars, shoes, bolts, cookies, cakes, laptops, furniture, and everything else you can imagine, nearly all are created in automated factories already.

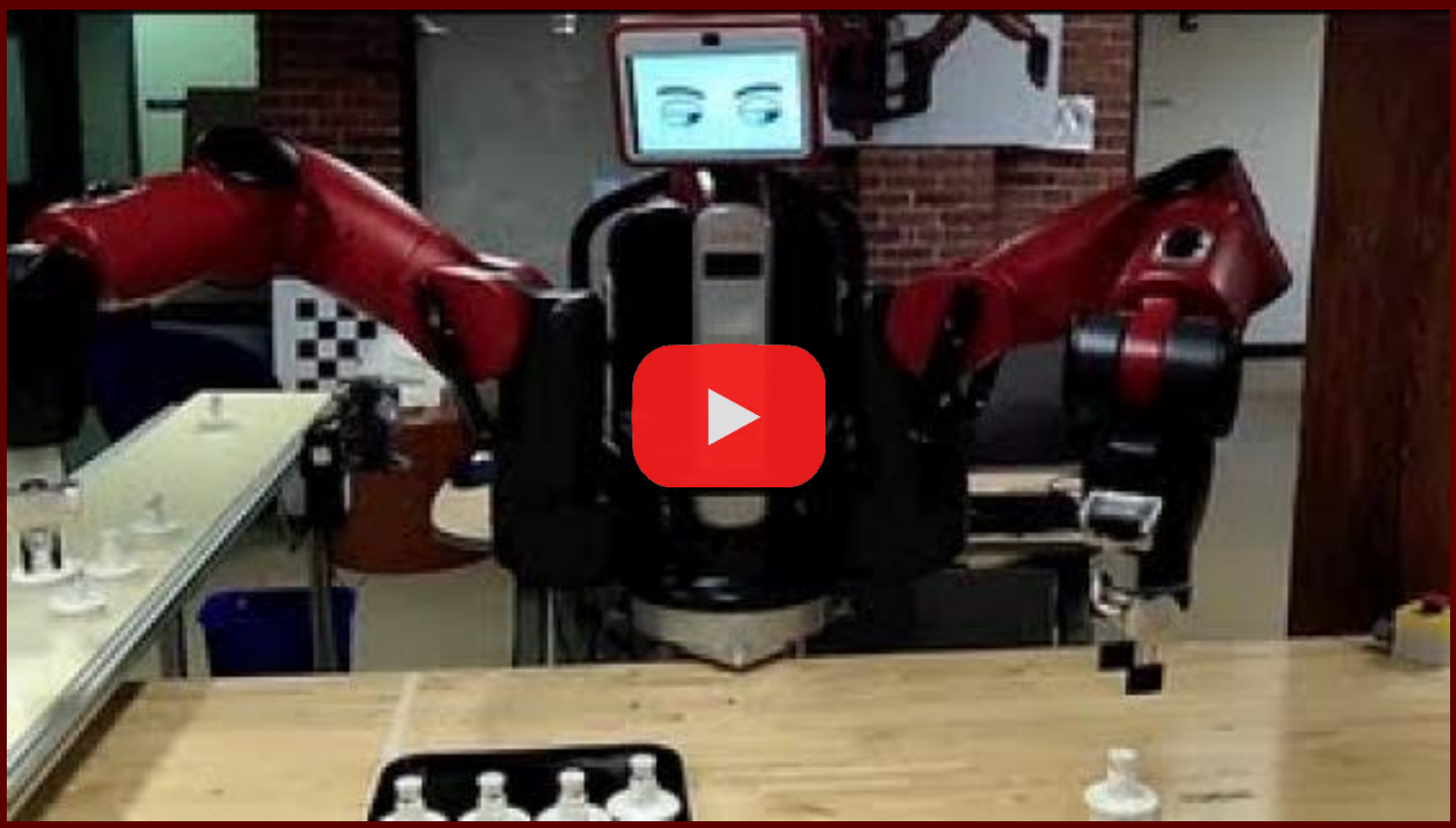
To illustrate just some of the complexity of what can be done today, I'll introduce you to one friendly robot, a car that is built in 3 to 5 days, and 3D printers that may print your next smartphone.


# THE FRIENDLY ROBOT CALLED BAXTER

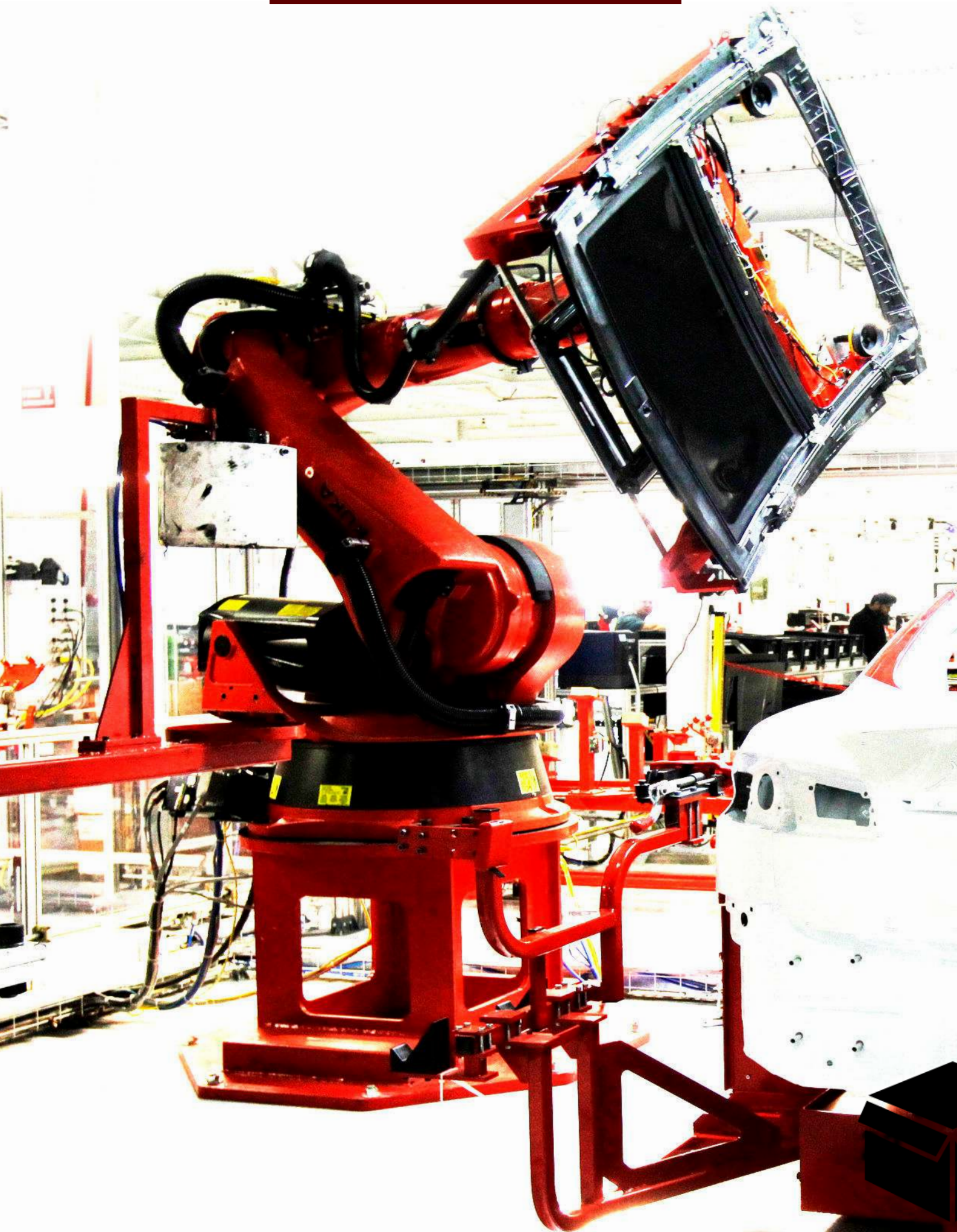
Why is 'he' different from other robots? Well, it's because you program it by simply showing it what to do. That's all it takes! So, if you want it to do complex things, then you can just show 'him' how to do it, step by step, like taking 'his' arm and moving it to the place you want to, then the griper and so on, which is much easier than training a kid to do something. You can take its arm, grab a bottle with it, and then put the bottle in a box, again with its arm. This robot memorizes all of these actions and can repeat it indefinitely, or until you teach it some new tricks. The robot "gets it" and does the work. (read more about it)

You can program this robot to do pretty much anything you can imagine. I suppose the only limitations may be its hardware. But also consider that grippers are getting extremely complex, as we have shown in our previous part about Construction, and with the advent and continual expansion of 3D printing, many products will be produced in a completely new way - not even requiring robots for assembly or other tasks. Baxter's software can be easily updated so that its speed and complex behaviour can evolve. Imagine teaching a Baxter-like robot to prepare many kinds of foods (a robot chef), for instance. There are actually plenty of such robot-chefs, and other kinds of machinery that make the process of creating food an automated one.

# Now is time to actually meet Baxter:



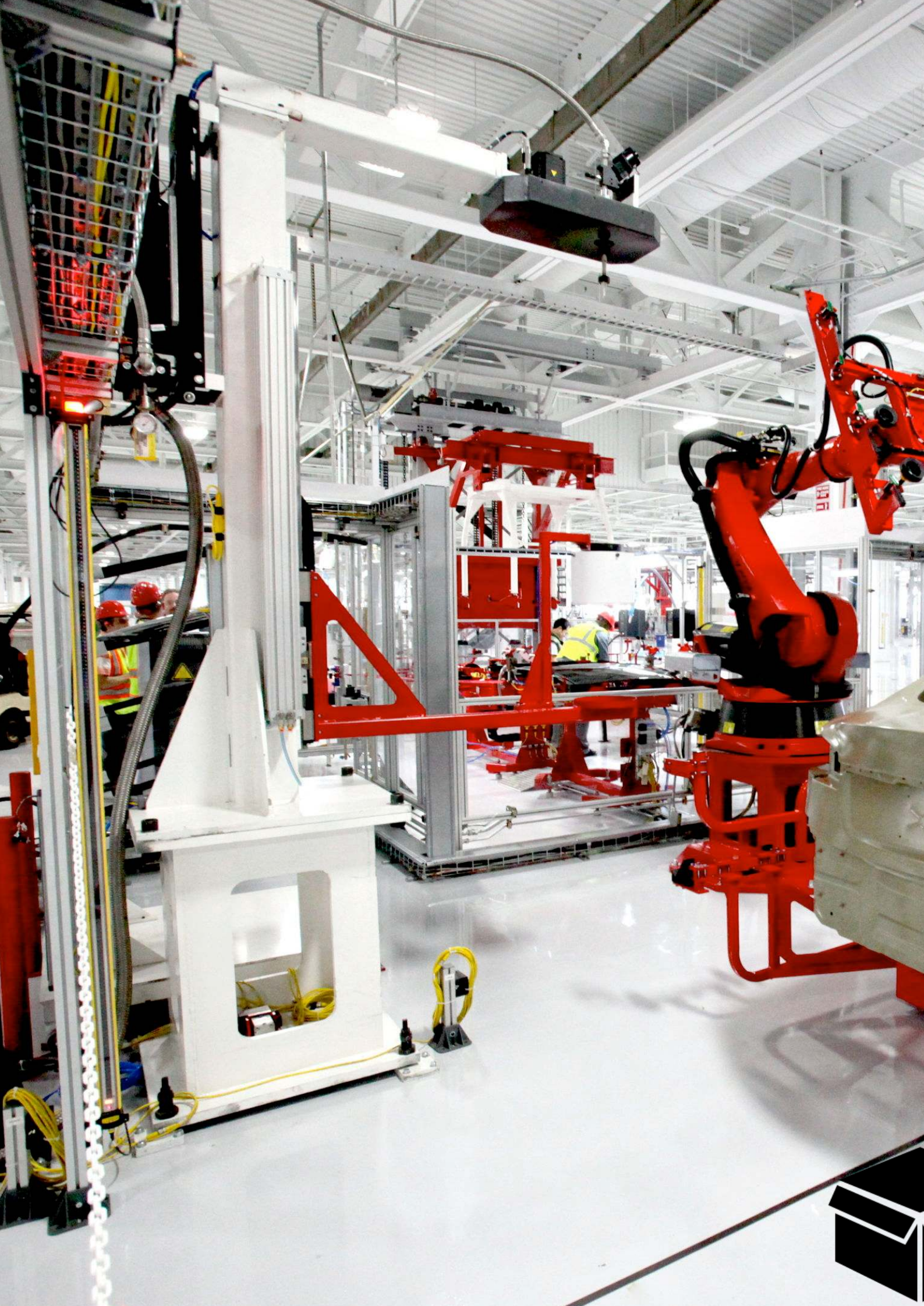
# BUILDING A CAR IN 3-5 DAYS



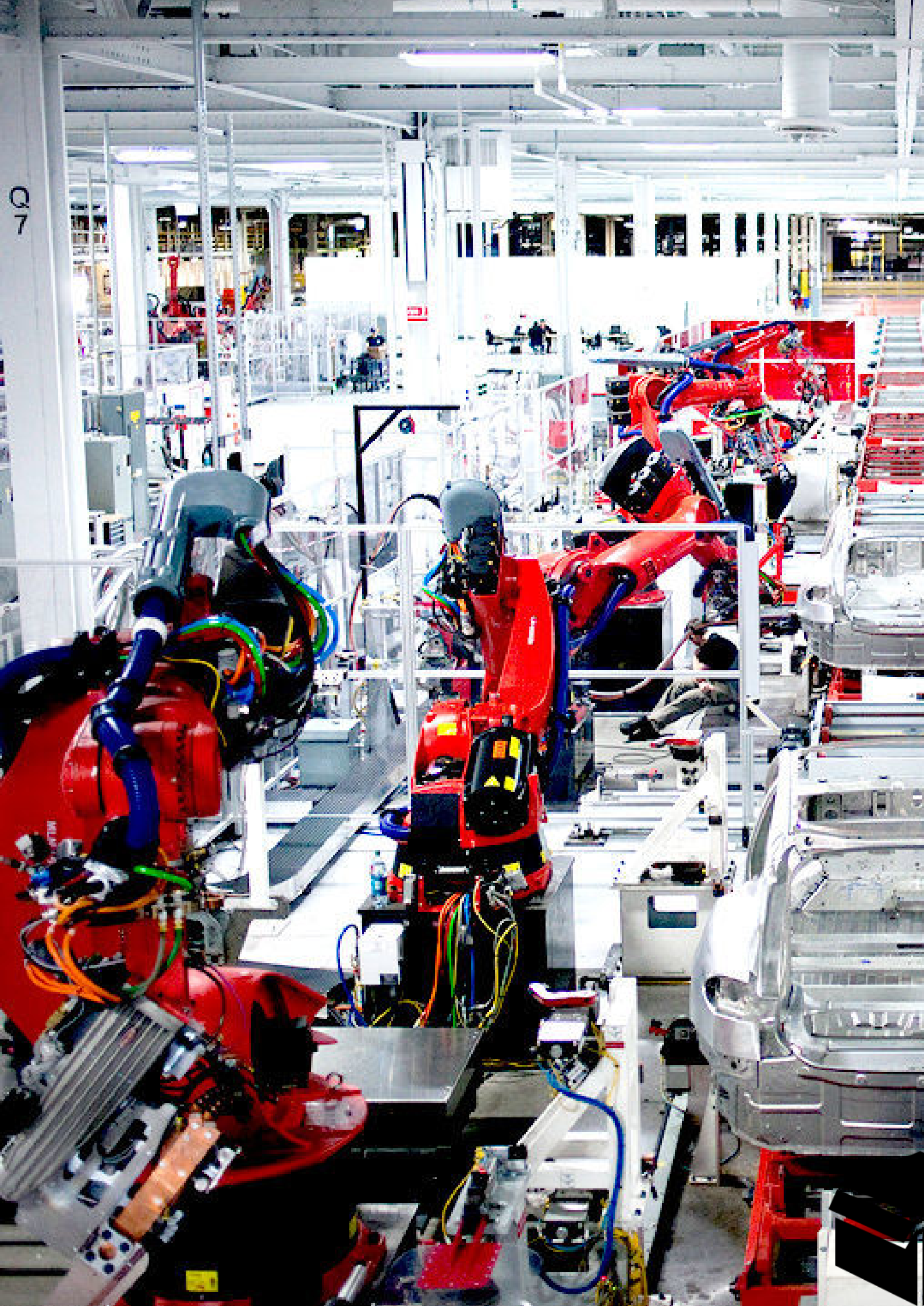
Tesla's Model S car is not only the most efficient electric car, as well as the safest one on the roads today, but the way it is built is almost fully automated.

It only takes 3 to 5 days to get from raw material to a full car. They have 160 robots continuously working on almost all aspects of the car's construction. The same robot can put the seats in the car, change its own tools, and then put some glue around the windshield and fit the windshield onto the car. The same robot then does that for the rear glass of the vehicle - all done by one robot. Think about that!

They also have robots that paint the cars, others that handle welding and yet others that actually transport the vehicles inside the factory in a completely autonomous way.




SMART Cart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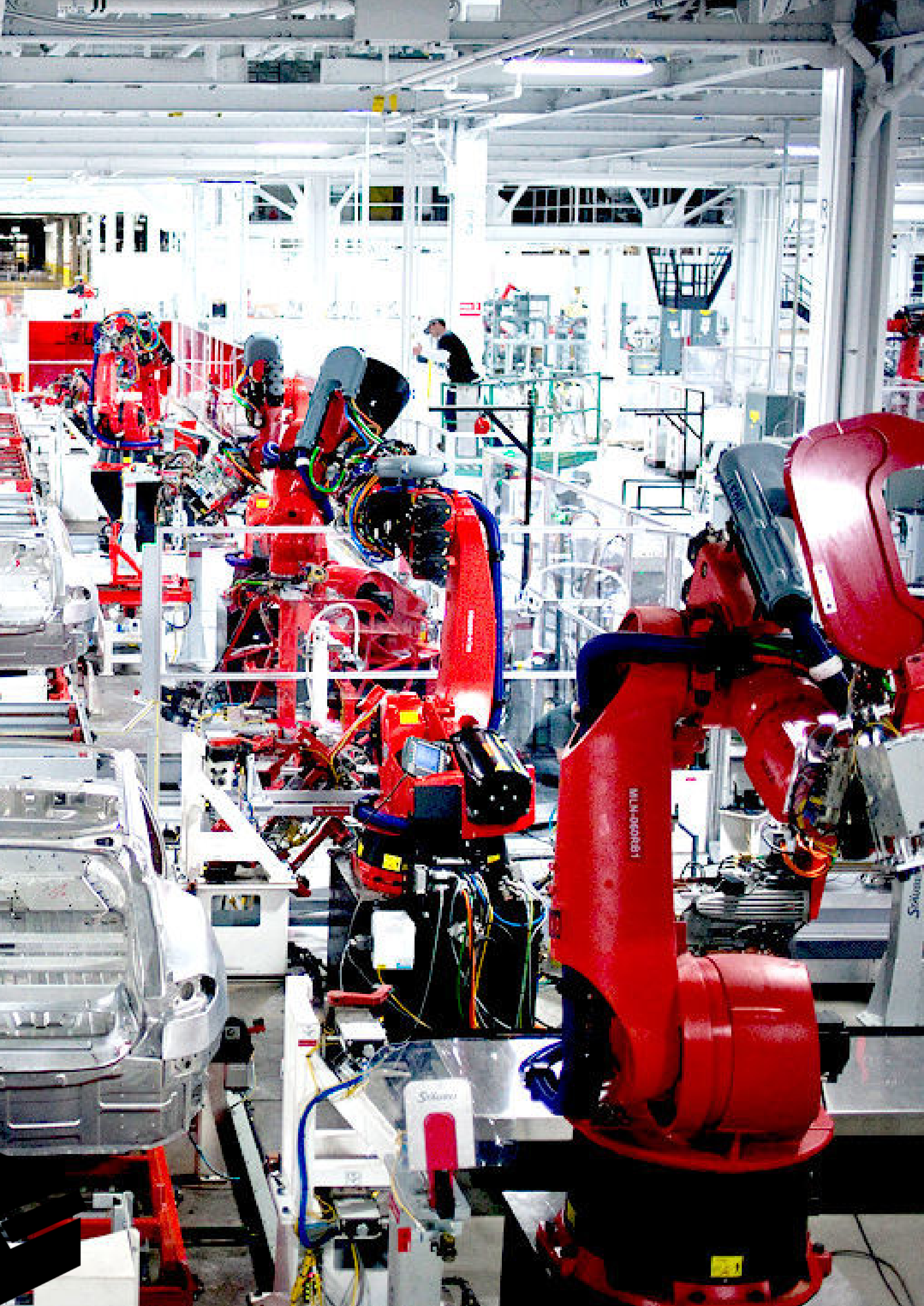


# Here it is!
# Take a look at the factory >

I bet every single human you see there helping the robots build these cars could be replaced with today's technology.


You can also watch the Tesla Model S documentary for more details on this.

# CAN WE PRINT A SMARTPHONE?

3D printers are becoming a common tool among enthusiasts, schools and even manufacturers. The great thing about 3D printers is the layer-by-layer additive process. It means, for instance, that it can make a tool with all its functional parts, all at once. This is an amazing thing, since it means that you do not need multiple techniques and factories to create different parts of the same thing. Because of this process, it can also create extremely complex structures while using even less resources than traditional manufacturing.

You may have already heard of complex 3D printed "stuff" like functional prosthesis, houses with electrical and plumbing systems embedded, edible food, complex and functional tools, clothes and toys and even functional organs. This cluster of products is only limited by the accuracy of the printer, updateable software and the materials used.


Do we dare think that we could print a full-featured smartphone, for instance, with the processor, the screen, and all its parts, together? We may not be there yet, but let's examine some current technologies that allow us to think realistically about this ambition.

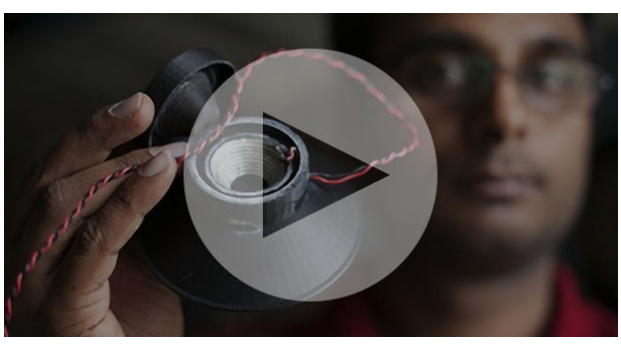
When it comes to such devices, it may still be far easier, smarter, less resource consuming and more efficient overall to build their respective parts separately, and then just put them together. So maybe print the parts, then assemble them.

It is already possible to print electrical circuits. Nearly all common electronic materials, including conductor, dielectric, resistor, and semiconductor inks, can be processed and printed. We can also print conformal sensors, antennas, shielding and other active and passive components, as Aerosol Jet has proven.

**This is an example of putting this idea into use:**

A fully functional game controller printed with one single printer (plastic plus electrical circuit all-in-one)


A fully functional loudspeaker was also created a few months ago using only 3D printers.



Interestingly, Aerosol Jet can also print on non-flat surfaces. This may mean more than you realize. You see, your home PC, smartphone, tablet, and other electronic devices have this thing called a "motherboard" or "mainboard", which may be the biggest thing inside your device.

This core component is a smart circuit board, regulating the flow of energy between nearly all of your device's components: processor, memory, etc.. The ability to print circuits on non-flat surfaces may mean that processors, memory chips, graphic cards, etc. could be connected together in devices of any shape or format. We could even print the motherboard's functionality right on the inside case of the device, getting rid of the "motherboard" as a separated component. (source) This approach reduces the resources consumed and simplifies the method, while potentially increasing the complexity of the motherboard's functionality.

## Aerosol Jet printing on a 3D surface

Although we did not show how to print a cpu or a graphic card, such examples show us that there is already progress when it comes to printing electronic devices.  For instance, not long ago, the same Aerosol Jet system printed a smart-wing for a drone, with its full electronic parts included:

Printing electronics will be a huge change in the way we view 3D printing, because electronics are far more complex in what they can do and thus the wide variety of their uses can explode quite rapidly.

Today's printers can use around 100 materials: from food ingredients to waxes, ceramics, plastics and even metals, and the list is expanding.

Combining those materials with new, more accurate techniques means that 3D printers can become the main technology that produces the goods we need. For a more extensive read about 3D printers, check the Wikipedia article.

The above Tesla Model S factory example and the increasing complexity of 3D printers are proof that very complex goods can already be produced in an automated and autonomous fashion, while the Baxter robot opens the window to the use of a new kind of programmable assembly robot, in a way that is far more varied, complex and easy to maintain.

# RESOURCES AND THE ZERO MARGINAL COST

It is very important that all of these goods and products are produced in the most resource and energy-efficient manner. We live on a finite planet, after all... To make the full case for that, it would take at least two books perhaps going through the latest in nanotechnology.

**But when it comes to resources and producing any kind of product, here's the way I think of them:**

- You make a PRODUCT out of a MATERIAL(s).
- The MATERIAL(s) is created using autonomous technologies and the least energy consumed.
- The MATERIAL is recyclable
- The PRODUCT is recyclable

So, let's say you make a 3D model of a house out of a type of plastic. Once you are finished with it, you should be able to easily, and in an automated fashion, recycle that house model into a different kind of object without much waste, or no waste at all, with very little energy consumption ( renewable energy perhaps ). So, that house model might become a car model, a toy, a tool, or whatever.

**Get it?**

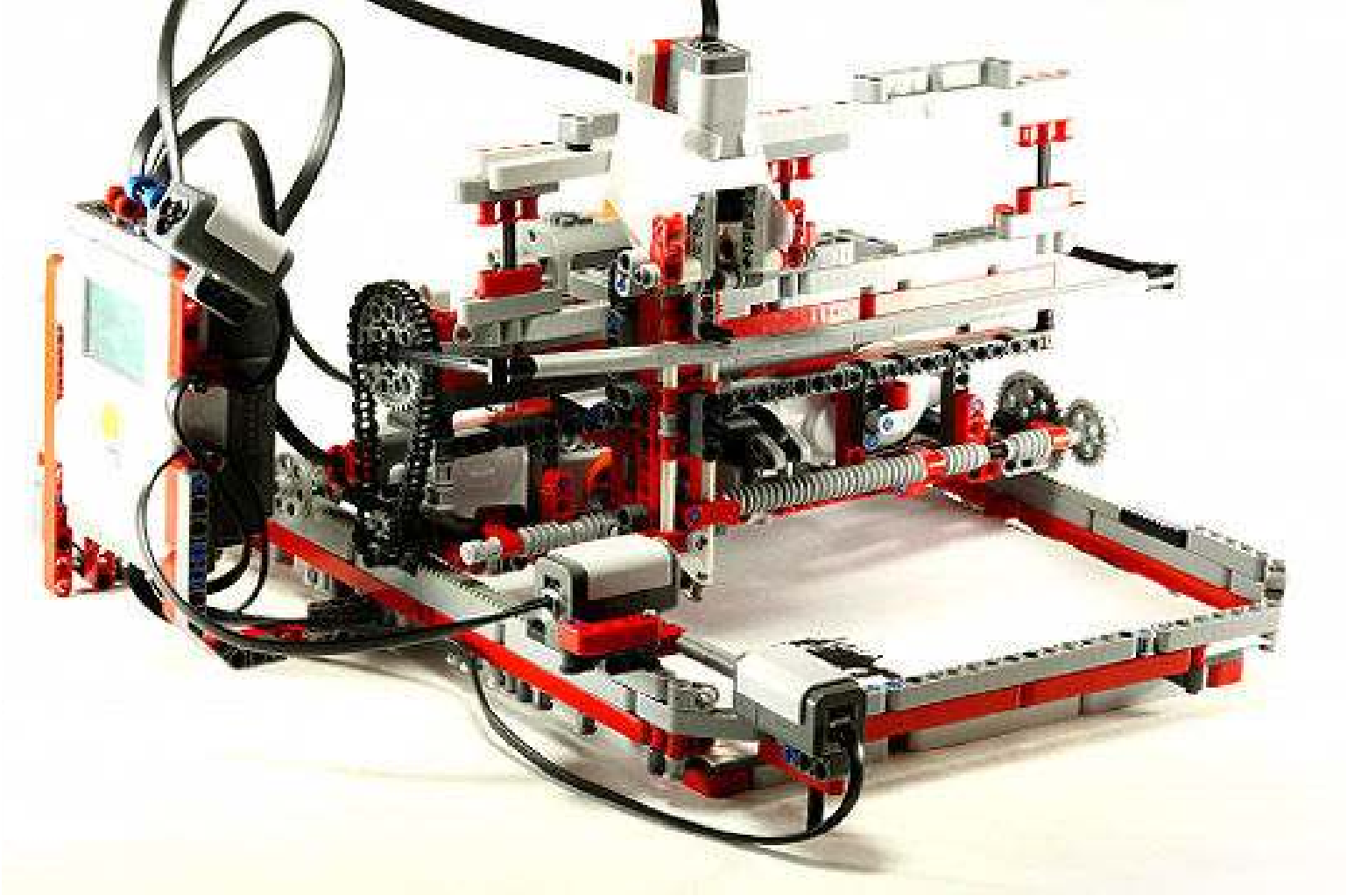
This is what atoms do. When you die, the parts that made up "you" will not disappear. They will become part of some other things: mountains, grass, stars, freezbies, chocolate, and so on. We can already manage these atoms to a certain extend and create stuff with them.

We organize atoms by their properties and divide them into categories: iron, carbon, hydrogen, etc. We then take these categories of clusters of atoms, each with multiple properties, and we model them like we do with plasticine. Of course, it's much more complicated than that, but this is the entire process of making anything. We make things out of selected materials. The more intelligently and efficiently we learn to play with this stuff, the more things we will be able to mold them into: electronics, foods, wheels, houses, bicycles, airplanes, socks, and so on.

We have already shown that we have the methods of building all of this stuff in automated ways, meaning arranging all of these materials that we find in nature and/or isolate, but how much can we efficiently recycle them and reuse them to build other kinds of stuff?
Imagine a bunch of kids playing with Lego pieces. There are a finite amount of lego pieces, but they build many toy-things with them: buildings, cars, houses, food plates, forks, and so on. By arranging the pieces in different ways, they can create a multitude of things. The more they reuse the pieces when they want to build new things, the less resources (pieces) they consume.

If they want to build a Lego car, and no longer need the Lego house, they can disassemble the house and turn it into a car, and maybe even have some spare Lego pieces left out of that to be used later on to build other objects.

If we replace the children's work with some machines that build these Lego parts, and these machines are powered by the Sun, then the cost of building new Lego things is Zero (we don't have to pay the kids to do that anymore :) ). The kids may need food to have the energy to build all of these toys, but the machines can use unlimited power from the Sun, and then recycle the pieces (reuse them). In the end, it won't cost them any resources and energy to build a continually recycleable world of Lego like products.



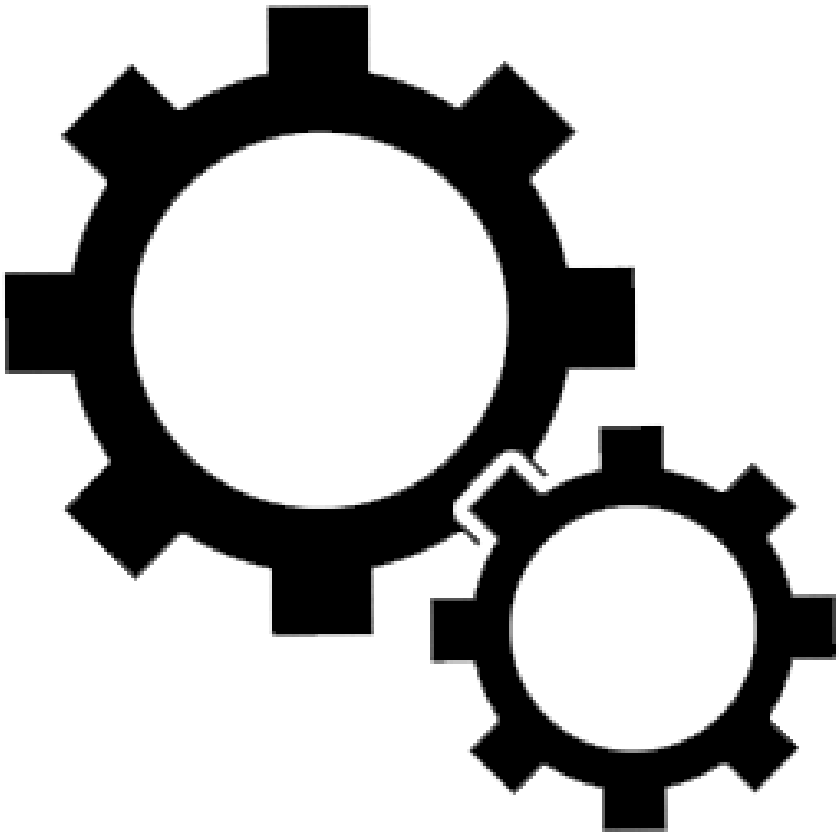
The same goes for the idea of Zero Marginal Cost, which refers to resources rather than money. It means that it may initially cost you to build a thing, but it won't cost you more to build other replicas. For instance, if you buy a 3D printer, the costs are only for building the first one, because this 3D printer can "print" other 3D printers. Sure, you still need the material to build more 3D printers, but nothing more than that. It is essentially a self-replicator and, more and more, people are printing 3D items with types of materials that are easily recyclable (like Lego pieces).

So, it may become like a Lego game, where you have a finite amount of materials (let's say some sort of plastic) that Earth's 'big kids' use to build their 'toys' with their 3D printers and you can build, recycle, and rebuild all sort of 'toys' without using more resources than we already have, simply because you reuse them all the time, very much like the Lego pieces. Making these materials act like Lego pieces may seem difficult to grasp at first, but take a look at the Filabot, for example, which can recycle plastic that you already have in your home and plastic models you had previously created with your printer, directly into your 'ink' supply. So, if you have plastic bottles at your home, or old toys, or whatever is made from plastic, you can let this machine transform it into 'ink' for your 3D printer so that you can create other things with that plastic, exactly like the Lego pieces thought experiment. However, this machine uses just a fraction of the energy to do that.

# Filabot

This way you greatly reduce plastic waste, as well as the energy consumption for recycling plastic or other materials. This is just one example of how we can deal with resources in a Lego-like way, and not only for 3D printers.  This approach may be applied to all other manufacturing processes, as well.

So, automated factories and complex robots (including 3D printer-like machinery), along with reusable materials, will reduce the cost in terms of resources and construction of new products to a zero margin. On the other hand, goods/products are becoming more like information technology - abundant and free.  We can already see them more as "services" than products.  Let me explain.



It's difficult to enclose 'services' into a single concept for discussion, because almost anything can be viewed as a service. However, I will try to showcase some of the complex services we use (or will use in the near future) and thus, I hope to prove that their complexity is a proof that almost everything in terms of so called 'services' can be automatized.

I mentioned earlier that some goods, or more goods, are becoming information-products. If I have a picture file on my computer, it does not cost me anything to copy and send it so that you also have it on your own computer. The "production" of a new digital photo is free. It may move a few electrons here and there, but the energy consumption is so small that it is basically a free process. That is, the information is free.

Now, think about the 3D printing that we have already talked about, and combine that with the digital world. Let's say that the picture file I sent to you was instead a 3D project file. So imagine the scene: I send you a 3D project file which doesn't cost us a thing, you open it with any relevant free 3D printer software out there, and then you "print" it - using recyclable plastic and a printer that was printed with another printer. Then further consider all of that being powered by renewable energy. How does that sound to you? Such typical usage transforms the 3D printing process into an information-technology. There are already tons of websites where anyone can download 3D model files for all kinds of things: toys, tools, shoes, parts to build a new 3D printer, and more. As a sample, Thingiverse is one of the websites where you can go and download tens of thousands of 3D models for free.

On the other hand, there are two services that seem more 'complex and needy' that we all use, regardless of whether we want it or not: health services and food services. We all eat and we all want to be healthy.

# FOOD

Today, many people may prefer to 'eat out' at a restaurant. There's no need to prepare the food or personally clean up afterwards. Plus, you cannot easily make all of these delicacies you tend to find available in restaurants :). However, before we dive into how to get to the food, let's briefly highlight how food is made. In the "How It's Made" series that I mentioned at the beginning of this article, you will see a plethora of automated ways to make any type of food; from cakes to animal products, from salads to fried potatoes.

One recent example of food production is the vertical farm system. Watch this video to better grasp the idea. We will then replace the 'human workers' they describe with the robots I will show you after you watch the video:


*You can also read more about these kinds of farms on wikipedia.* For the farm in the video, we can now replace the people sorting the seeds with this machine, and the ones that pick the grown produce with these.

**There are a variety of ways to get food to people. Here are two methods:**


# 1. VENDING MACHINES

I find vending machines very useful. They are opened 24 hours a day and you simply press one button to get what you want. There shouldn't be much need to go into details about them, since it's already a widely used technology, but you can watch this documentary about vending machines to see how many products are delivered or even made with them. To stir your curiosity, though, pizza or hot food can be made, as well as a wide variety of ice creams, hot dogs and sandwiches.


# ICE CREAM VENDING MACHINE


# HOT-DOG VENDING MACHINE


# FARM PRODUCTS VENDING MACHINE


# PIZZA VENDING MACHINE


## 2. AUTOMATED RESTAURANTS

There are already many restaurants that are automated, at least in the way that you order your food and/or the delivery process. For example, there are robots that can cook up to 80 bowls of ramen/day, and there are restaurants where you order from a touchscreen "menu", either inside the restaurant or from home via an app. There is little need for waitresses or cooks anymore, as this entire concept is already proven to work.

So, as a service, getting and making food is already becoming more and more automated, even for complex types of dishes.

Here’s how you can order food in a fully automated way:

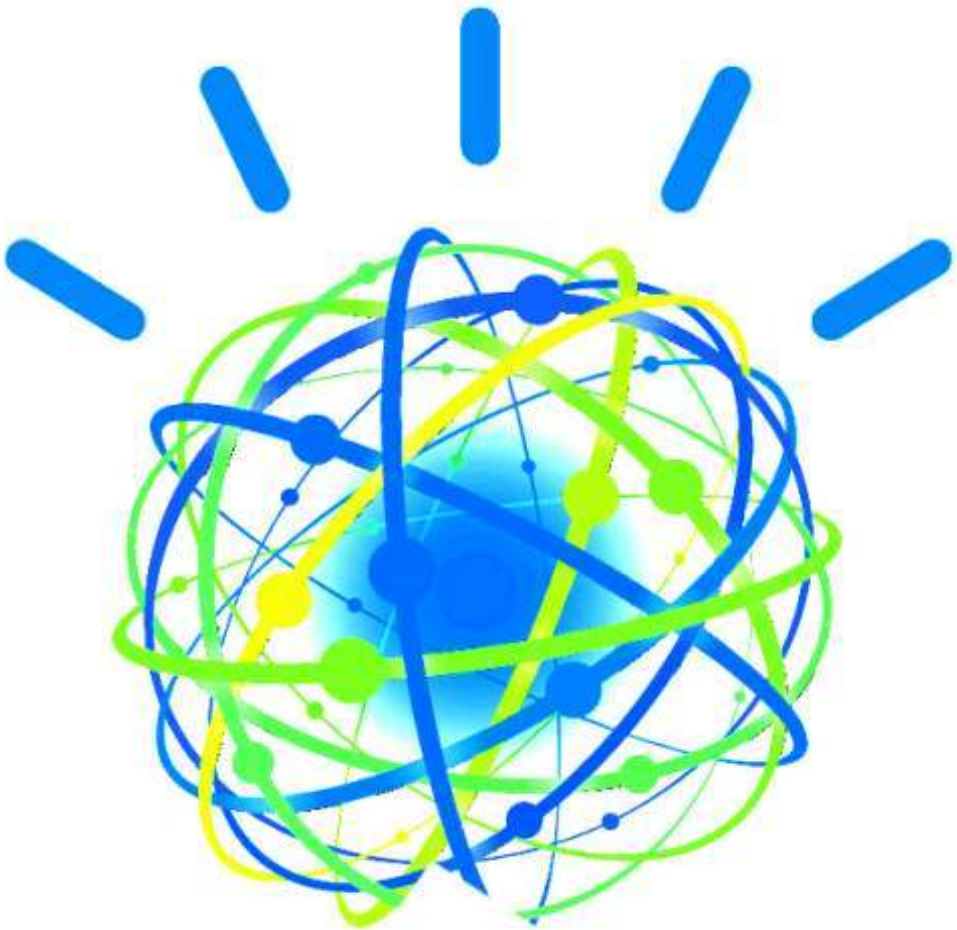

And this is how robots can be chefs:

# HEALTH

But what if you eat something and you feel sick?  What do you do?

Well, it depends, but you should not ask me, you should ask your smartphone.  Artificial Intelligence software like Watson, invented by IBM and capable of reading millions of documents in just few seconds, can help you with your problem.  It understands human language pretty well, helping it win on Jeopardy, a game of 'words and knowledge', against the world's top two 'champions' back in 2011.

Watson is currently working to help with the prescribing of treatments for various symptoms.  It is still in testing, but has already proven itself to be a huge step forward in both speed and accuracy.



## IBM WATSON

It is being used right now to discover new treatments & cures for cancer and the more it learns, the smarter it becomes. (source) Such AI's, combined with cheap, yet powerful smartphones (devices), can analyze your symptoms and arrive at a highly educated conclusion; perhaps the most educated conclusion available in the world. Some sensors can also replace a visit to the doctor. From the smartphone's camera that can track your hearth rhythm and detect skin cancer, to the gps tracking your fitness, or special, small and non-intrusive devices that analyze blood or urine samples, to other more sophisticated sensors, they are already here. There are so many sensors already available and apps for them that I find it impossible to point to specific ones.

Maybe this clip will give you an idea of how advanced they have already become:

These are not toys, however.  They are already very accurate, often more so than a visit to your doctor, and are continually improving.  It may not be long before they completely replace most family doctors.

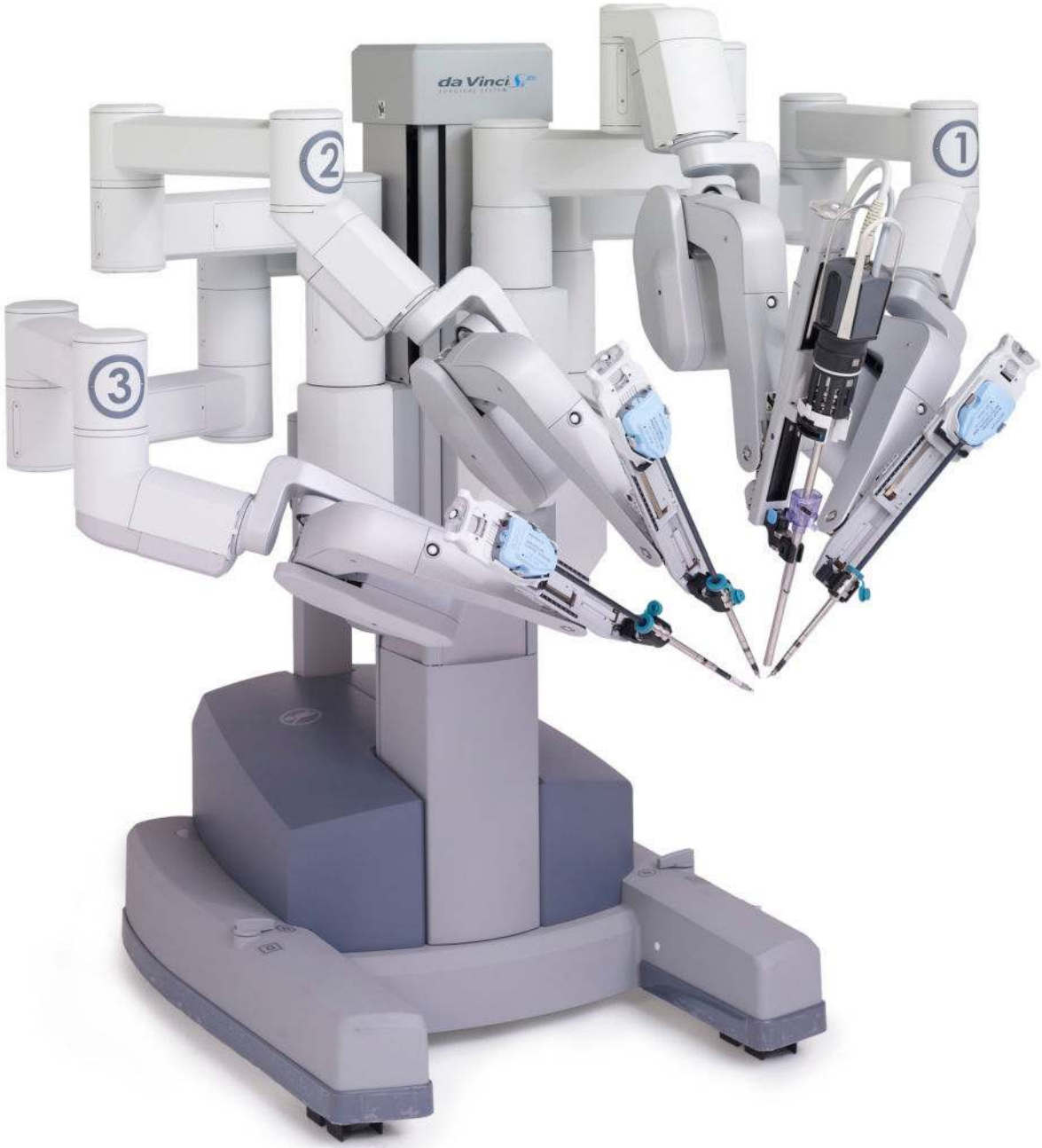
So then, imagine that your health is continuously monitored by such non-intrusive devices and made sense by apps which constantly fee this data to a Watson-like AI.  The AI can then recommend to you what kinds of foods to eat, if and what kinds of physical exercises to make, and much more to help you achieve and retain optimum health.  That sounds great, but what if you need some pills that Watson recommends? Well, let's print it!Really, let's print your medicine with your 3D printer.

## You don't have to blindly believe me - watch this short 3 minutes TED talk

*You can also watch a 13 minute talk by the same person, but more detailed, here.*

This is just an educated idea right now, but we can also envision fully automated pharmacies where you can get your medicine from.  They exist now and are in limited use.

**But what if you need some kind of surgery?**




## DAVINCI ROBOT-SURGEON

DaVinci is a robot that has already been in service for well over a decade (source). Its arms are very precise and it even enables surgeons to operate it from long distances. So, if you need surgery, a surgeon from across the world can do the job. However, the significance of this robot-surgeon is actually far greater than that. What happens when it can learn from these surgeries and then operate without human help?

Some parts of surgeries and full surgeries that are not extremely complicated can already be fully automated, such as certain types of eye procedures that do not require a high degree of complexity, or the field of urology which has integrated robotics into many procedures including radical cystectomies, surgical nerve grafting and pyeloplasty. Robotic surgery has almost entirely taken over radical prostatectomy and the role of surgical robotics is continuously expanding. Robotic surgery helps improve patient outcome by minimizing the surgeon's natural movement tremors, increasing range of motion, decreasing blood loss, decreasing length of hospital stay, and decreasing postoperative pain. Since the field of Urology deals with very difficult and delicate procedures, robotics offers a significant advantage by allowing for far greater accuracy, flexibility, smoother actions, and greater range of motion.

Integrating sensors in the human body can provide an entangled relationship with the robot than what is possible with a human surgeon, allowing the robot greater surgical accuracy. For instance, if it were removing a tumor, the tumor could be injected with a fluorescent fluid that the robot's cameras can identify, thus learning which cells are tumorous in order to remove it with much great precision. If we manage to create a more accurate 3D map (or sensorial map - tissue texture, etc) of the patient's body, then perhaps a robot can interpolate and do the job that a surgeon can. (source1)(source2)(source3)

But we might not need surgery in the future. Tiny nanobots might learn how to 'fix' us from inside-out or keep track of our health, providing the right treatment at the right time and place in a personalized manner that could reduce or remove the need for many of today's surgical procedures.


## RIBA THE ROBOT NURSE

The last one on my list of health services is 'nursing'. Some people, especially old folks, need assistance when it comes to health-related issues. There are already certain kinds of robots used in hospitals to keep an eye on patients, but sure, it may take more to fully replace the human factor.

Similar to surgical procedures, technologies that monitor one's health in non-intrusive ways can reduce the need for nursing. Of course there are many health-related issues that still require human assistance, so this is only intended to showcase how rapidly technology is advancing and how health services are becoming more and more automated, accurate and efficient. It's not science-fiction anymore to monitor your health from home, using small and inexpensive devices, or to be assisted by AI when you get a diagnosis and treatment.

# CREATIVITY AND MEDIA

When I was in school, I thought 'how cool would it be to have my own TV Channel', because I could add so many great movies and documentaries. At another point, I was reading an interesting monthly magazine and thought to myself 'if I had such a magazine, I would write about so many amazing things'.

Well, only a few years have passed and I have already managed to create my own documentary, develop my own documentary/movie/lecture-based website, and manage a magazine for which I also write (this one) - and all of them are far more lovable and enjoyable than I originally imagined. All of that was made possible due to the fact that so many complicated things have become more and more automated and user friendly. With a laptop and an internet connection, I am able to edit photos, videos and music, build websites and manage this magazine (and more).

A few years ago such things could only be handled by huge teams of expensive professionals. I can now, on my own, even remove background noise from audio recordings, stabilize shaky video footage, record with a cheap camera in front of a green screen and then add my own background, improve the image quality, and anything else you might imagine: making 3D animations, radio shows, video shows, slideshows :), websites, programs, etc.

Software plays the most important role when it comes to automating a process: a robot without software is a mechanical corpse.

Often, it's the hardware, the robot itself, limiting the capabilities of the software (although the opposite can also be true). When it comes to the internet and the digital world, software is rarely held back by hardware, which is why we can all create and use so many tools. Want to carry an orchestra in your pocket? You can add a violin, piano, guitar, drums, and all the musical instruments you can imagine from single app, and that's only one category of things you can do with a smartphone.

Your smartphone and computer have become the gateway to a plethora of services: from communication to entertainment, work to health, collaboration and management.

# BUT LET'S THINK BIG. DAMN BIG. HUGE EVEN!

We are all somewhat aware how much information is online. Just consider Wikipedia, which has around 4,536,239 articles in the English Wikipedia alone. But many people may find it hard to taste the great amount of information which was not written for their own personal education level, or presented in a way that they find entertaining and engaging. This is why I am suggesting the following scenario:

**If you want to know more about lions, just say that to your computer and it will teach you about lions in a way that you will find extremely entertaining and educational.**

That sentence probably seems very simplistic and almost devoid of meaning, but it is way, way more interesting and profound than you may realize.

*Before I explain the awesomeness of this idea, I want to make you aware that we have already published an extensive article about such new ways of rethinking education in one of our previous issues (link here) and I recommend that you go back and read that article after you finish this one. I bet you will find it very interesting: it is about games and linux, friends and Watson, Darwin and viruses, and much more.*

Back to our story, let me explain to you the beauty behind this idea. Computers already understand you to some degree, even if it's not perfect. Google displays online searches in a personalized way, depending on where you are from, what have you searched for before, and so on.

Understanding human language is not something new and as we have already seen, IBM's Watson is working on mastering that. Understanding language is only one part of the entire thing,since computers can also examine pictures, videos and audios and make sense of them.

IBM's Watson can already search through millions of videos, audios and photos and display results based on those sources. Let's say you want to search what Jacque Fresco has to say about politics. A Watson-like system could show you a video clip with him talking about politics, or play an audio portion of a lecture, or both combined.

## Let's go even further. Check out this picture:

A bad picture of a cat, isn't it? Not very impressive?

Well, it was BUILT by a computer that knew nothing about cats. It watched 10 million randomly selected YouTube video thumbnails over the course of three days and, after being presented with a list of 20,000 different items, it began to recognise pictures of cats using a "deep learning" algorithm. On its own, it deduced what a cat looks like and 'drew' it.

Google developed this computer that can look at videos and photos, and understand what it sees. That's impressive, and although Facebook face recognition is now as accurate as the human brain, Google's computer can even play games, based only on visual queues, by learning similar to a human.

So basically, this computer watches the game and understand the game's rules based only on that. Google is working hard on creating software that mimics the way human learn and understand. The project is called the Google Brain. Of course, they are not the only ones focusing on cognitive AI abilities.

## Computer learns how to play games by just observing (from min 02:46):

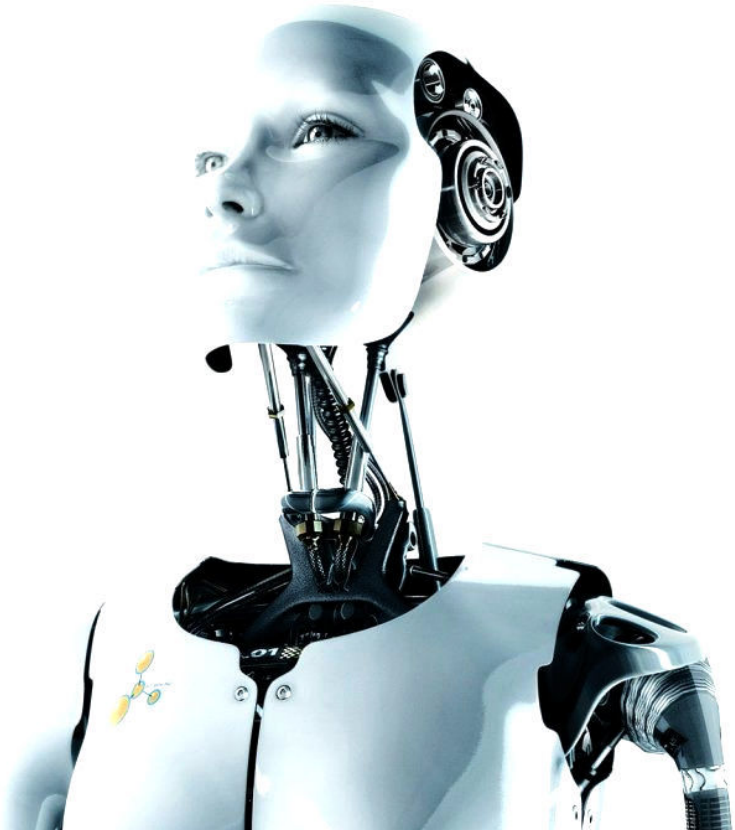
All of these tools can understand you: your level of education, emotions, focus level, what you like and don't like, and more. They can also understand what they are looking at, from videos to photos, audio and text writings.

Now, what if, when you search for something, the search engine already knows your current level of understanding of that topic and only displays the results that you will understand and prefer? Even better, what if the results are not writings that were previously written, but are written by the software in direct answer to your question, using the most up-to-date knowledge on the subject?

Almost all smartphones with iOS, Android, and even Windows 8 can do this to a limited extent. Just over to Google.com, click on the 'mic' icon and say "What is the distance to the moon?" to have Google 'tell' you with a voice, not only in text. More than that, there is software that can actually "create news articles". In March of this year, an earthquake hit California. Three minutes later, a robot created a short post about the earthquake, with all the important information in it. Read the article here and see if you would have been able to tell whether it was written by a robot or a human. This is not an isolated case. Many websites and companies use such software to write their news. These robots can even track events and provide updates. Some research shows that many people could not tell the difference between articles written by robots and human written articles. (source)

So, as you can see, the idea of a computer understanding you quite well, and writing articles specifically for you, is not science fiction at all.

Now, if they can master video games and so many other controls (e.g. you using your smartphone's speech recognition to set up your alarm or send a message), they could also control all kinds of software. So is not farfetched to learn that they can also create videos, like this company is showcasing using a similar software.



**So, you want to know more about lions, you just say that to your computer and it teaches you about lions in a way that you will find extremely entertaining and educational.**

Since it knows you and what you prefer (for instance, short videos, no background music and a male voice), it then searches across millions of articles, creates a relevant 'script' and then transforms that script into a customized documentary (video) using photos, audio and videos from the internet or, even better, drawing the story for you as Google's computer drew that cat (ok, better than that, but you get the point).

So again, the computer searches for what you asked for and understands what it finds. Then writes a script and creates a video. The end result is a very personalized one, custom made for you, since the same computer understands you, your level of existing knowledge of the topic and what you like. How does it sound now? Awesome, isn't it!? You will be able to learn about anything in completelycustomized, original and personal ways.

I think that in the next few years, you will be able to talk to your computer as you do with any other human being. The difference will be that the computer can do many things for you that your friend can't.

Just think of telling it what kind of website you want to build, and it simply creates it for you, as it understands every programming language; or just say what food you want and it cooks it for you; and so much more... Just think of the possibilities.

Couldn't we make any service fully automated and extremely easy to use and interact with?

**I hope I have demonstrated that almost any kind of goods and products can be created in fully automated ways, using far less resources and energy, and that services can be made very smart and complex by using similar processes to learn as humans do.**

**I know I'm unable to talk about all goods and services but, with the examples provide and using your imagination, try to automate in your mind other productions of goods and other deployments of services. See if you can automate everything. ;)**

# THE HOME

Home is the place you stay, sleep, relax, entertain, eat, do exercises, and much more. It is a place where you and your family spend a lot of time, perhaps the most of your time. But is it?

If we imagine the car of the future and project a high-tech steering wheel, translucent windshield displays of speed and fuel gauge, sophisticated digital devices with entertainment features, fancy dashboard gages, or project big, powerful fuel engines, complex shifting gears, and other such features, then we should quickly realize that we are on the wrong track; the car of the future is already shifting towards a more simplistic autonomous car with no steering wheels, an electric engine and overall, very very simple design, as Google has shown in their latest prototype of their Google Car.

The home of the future is likely to follow similar footsteps.

In the same way that we won't need a steering wheel in autonomous cars, perhaps we won't need a kitchen for every home. Or at least, the kitchen will become so simple that it won't be recognizable to what we have today. A dishwasher or a washing machine may be useless if dishes and clothes become treated using nanotechnology to not get dirty or wet. The same goes for many other devices that we currently use for home maintenance, such as vacuum cleaners, carpet shampooers, curtain steamers, rubber gloves and all kinds of caustic solutions for cleaning.

You see, if we are to imagine the kinds of technologies that will be present in the future in such a home concept, we must also recognize that the idea of 'home' may change quite a lot. Many people prefer to eat at restaurants, go to a gym for exercise, or look for entertainment elsewhere than at home.

So, without a complex kitchen, dishwasher, washing machine, vacuum cleaner, and perhaps more, what might the home of the future look like, and what will replace the utility of those machines that we might no longer need?

With that in mind, let's imagine life in such a futuristic house/apartment.

Emma arrives home and the door automatically unlocks through her smart-device (let's say a smartphone). She only has to approach the door for it to open for her. She can even open the door from anywhere in the world using her smartphone.

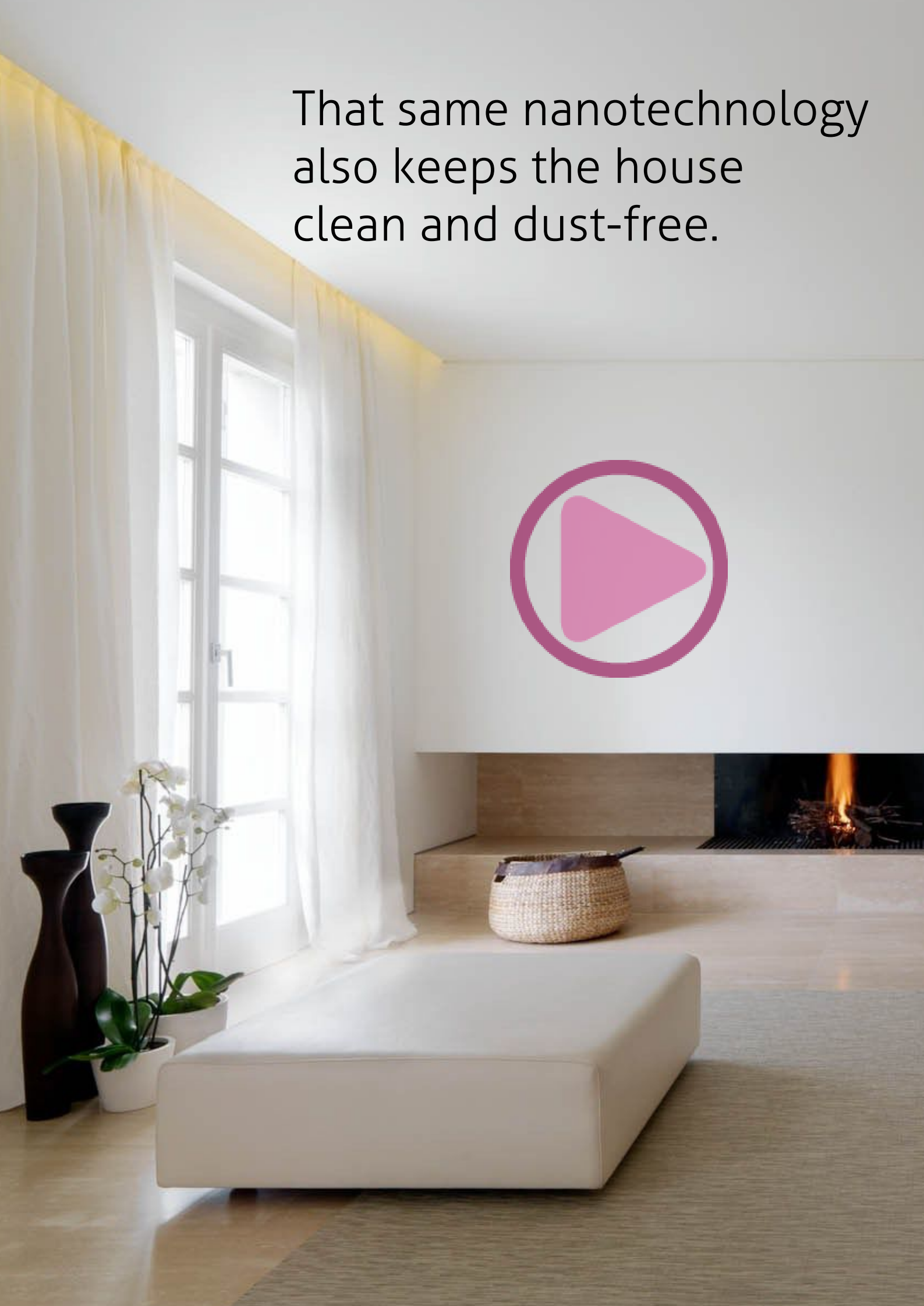
Lockitron is already providing all of these features.

Fingerprint door lock is another concept already in use today, although in saner society no one would have any reason to steal anything from your house; they will have equal access to all of the same things you have.  Still, just in case you were wondering about privacy, there are plenty of automated solutions today.

Emma enters her house. Her clothes are nanotechnology treated so they don't get dirty or wet.

They also repel bacteria, fungi and bad odors, and even prevent sunlight from burning her skin when she is out. Such clothes can even monitor her health.

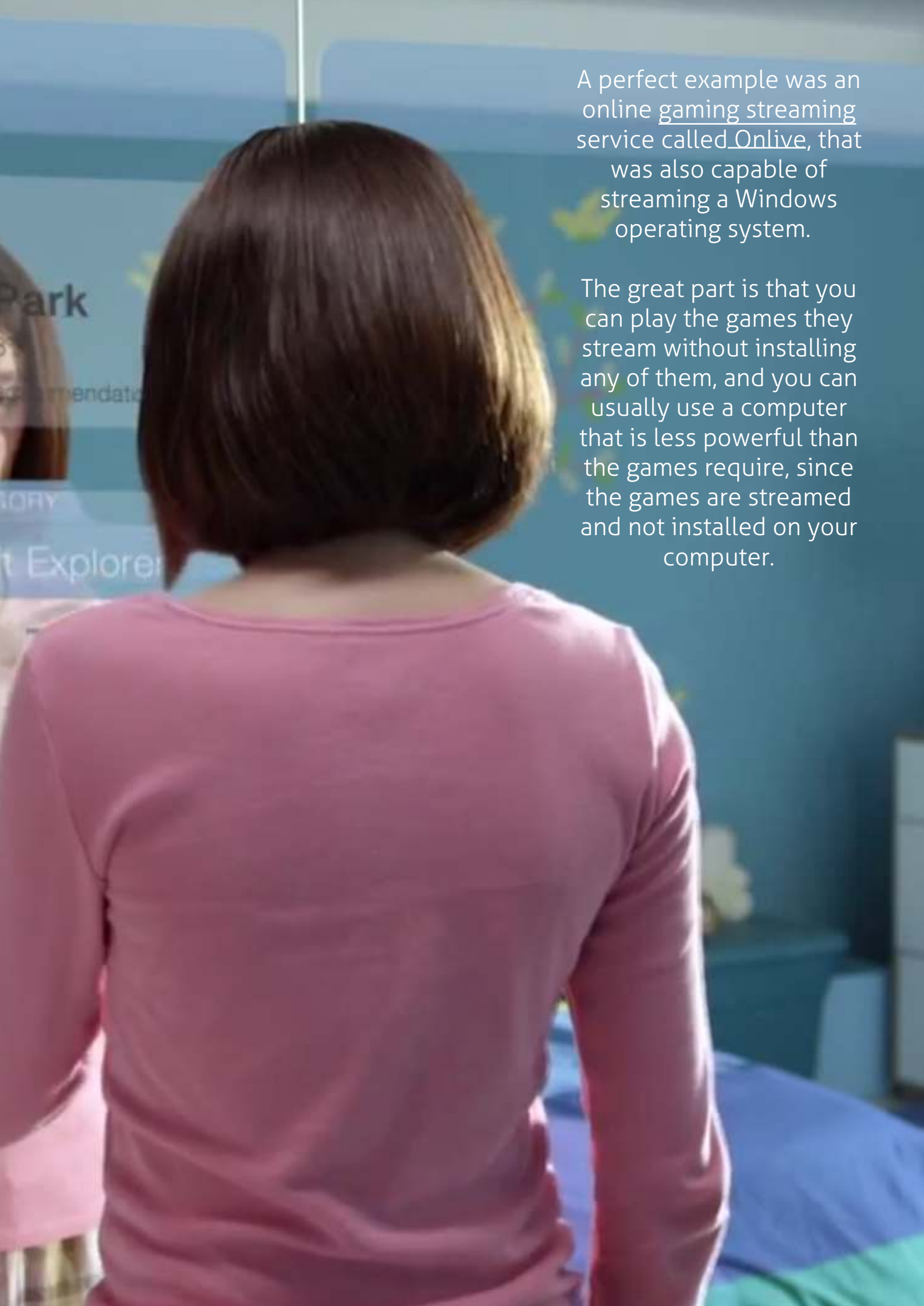

junk


That same nanotechnology
also keeps the house
clean and dust-free.

The walls and mirrors in the house serve as an interface for controlling the house and displaying personalized 'desktops' wherever needed.

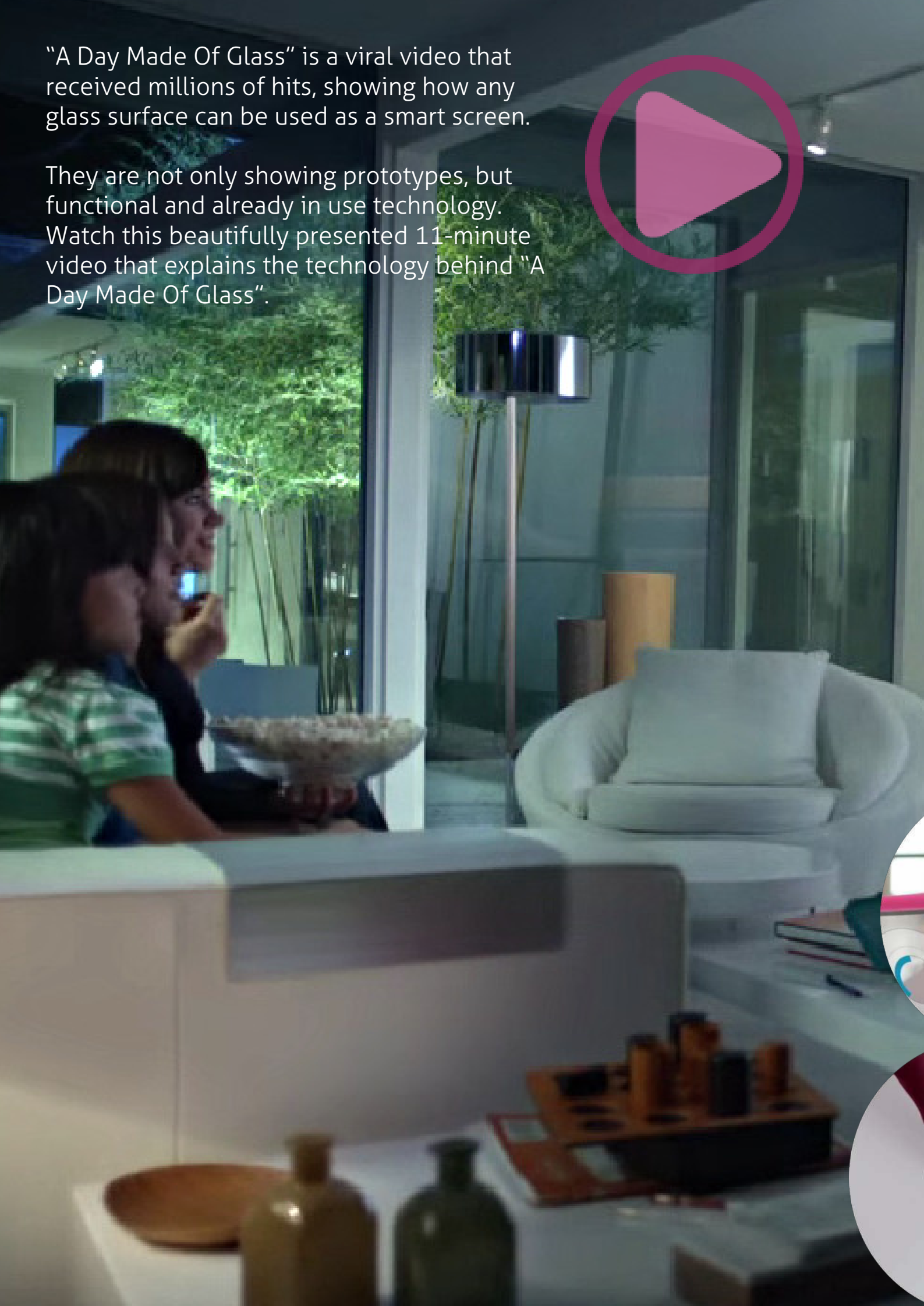
A full-featured Operating System runs 'in the cloud' and can be streamed on any wall or mirror in the house or on any personal device (tablet, smartphone, laptop).

ZeroPC is a current example of such an operating system, where you can access a desktop environment (with apps) from any web browser. Windows, Mac OS, Linux (Ubuntu or other flavors) or Android can already be streamed in a variety of ways.



A perfect example was an online gaming streaming service called Onlive, that was also capable of streaming a Windows operating system.

The great part is that you can play the games they stream without installing any of them, and you can usually use a computer that is less powerful than the games require, since the games are streamed and not installed on your computer.



"A Day Made Of Glass" is a viral video that received millions of hits, showing how any glass surface can be used as a smart screen.

They are not only showing prototypes, but functional and already in use technology. Watch this beautifully presented 11-minute video that explains the technology behind "A Day Made Of Glass".


Click this link to see how that technology looks in reality (pretty close to the concept).

Since transparent glass can be made to display such smart apps, or entire operating systems, then perhaps we can think of embedding glass on any wall in the house, making it a smart wall. More than just displaying a data stream, such glass can be used for monitoring your temperature, assess your blood sugar levels if you're diabetic or even analyze DNA; and even more... (source)

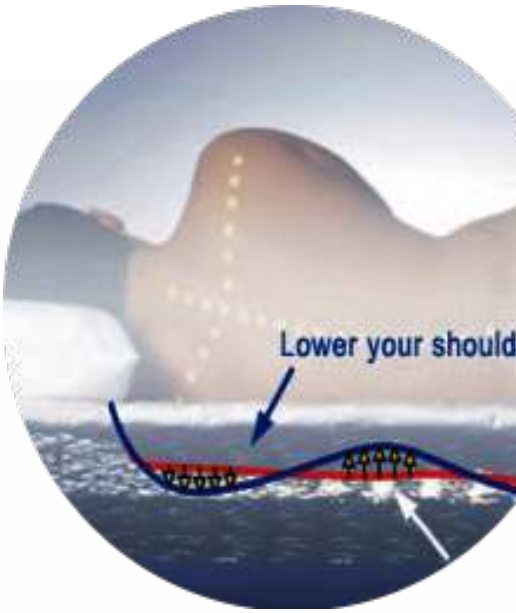
Emma feels at home here, especially with the interior temperature kept exactly as she likes it.

Smart ventilation, together with good insulation, enables each home to provide the perfect temperature that the occupants prefer.

*We are already used to such systems and there are so many ways of cooling, heating or maintaining the temperature in a home that I doubt providing examples is necessary (there are just too many).*

Emma's bedroom is quite simple, yet very smart. The bed monitors her health and also molds itself to Emma's body for a personalized comfort. Indeed, all the furniture in the house is this smart. They are designed by physiotherapists to provide for healthy function, rather than just design.

Health-Beds is just one of the many companies focused on creating beds that automatically adjust to the shape of your body and posture, while other companies are already selling beds that monitor your health through a wide variety of sensors. (source)




For instance, Beddit is a device that you can put under the sheet so it can track your sleeping patterns, heart rate, breathing, snoring, movements and environment. In the morning, Beddit tells you how you slept and suggests how to do it better.

All lights throughout the home can be controlled with Emma's personal device (smartphone, tablet) in the same way Lifx technology is working already. Actually, the same goes for anything in Emma's home: air conditioning, shades, music, water, energy, and so on. All can be controlled with such smart devices.


Emma's mother, Karen, prepares dinner, but in a very different way than we are used to today. From her own personal device, she looks for recipes on the internet. She finds an appealing one, adds her own flavor to it, and then orders the food. An automated food preparer (restaurant, robot) then creates the recipe to her specifications.

The kitchen, as we previously mentioned, might not be much different than any of the other rooms. Perhaps there won't be any need for a room called "the kitchen". As we discussed in our previous "AA World" part about goods and services, anyone may be able to order any kind of food through the push of a button, using their smartphone or any kind of smart device. Automated restaurants, as we described in the same part, already exist and can prepare a wide variety of foods. Then, as we detailed in another part in this book, there are a wide variety of autonomous transportation systems that can deliver food right to your home, including drones, cars, or string transportation systems.

Therefore, it is not far-fetched to think that one can order/create custom recipes and get them delivered to their home in a very short amount of time. This system will greatly reduce the amount of overall resources and energy consumed. Just think of the fact that today, every home has a kitchen with an oven, sink, microwave, fridge and so on.

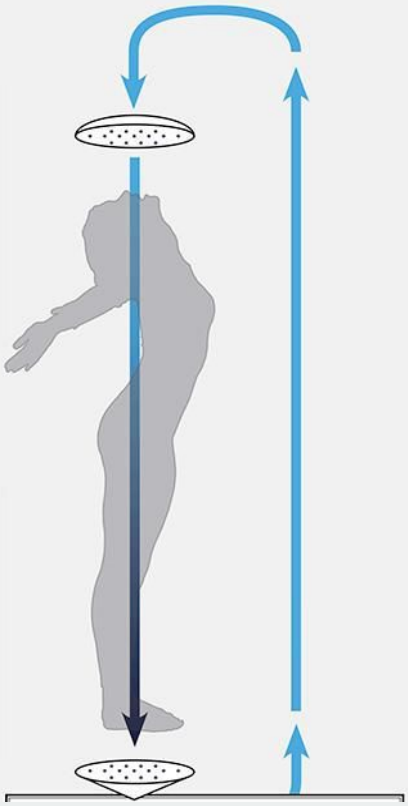
But even if you prefer cooking at home, appliances are becoming more and more 'digitized', and by that I mean they can be controlled via an app on your smart device. They are also smart enough to detect when your food is ready, the freshness of the food, and even transform your cooktop into a computer. (source)

The bathroom: The toilet a utonomously lifts and lowers the lid, heats the seat, and clean itself. It actually cleans you, as well, through retractable spritzing wands and automatic driers ;). This reduces the energy and resources spent on making toilet paper. In addition, it even includes music to mask unpleasant sounds, deodorizer spritzers and other conveniences.

This is actually a common thing in Japan, even more widely adopted there than personal computers. (source)

To reduce water consumption, the sink can be put on top of the toilet so that the water you use to wash your hands will then be used to flush the toilet.

The bathtub or shower, or both, can also be controlled via a wide variety of smart devices. The water pressure and temperature, even the amount of water consumed, can be regulated in a smart way. If Emma wants to take a bath, she can even program that while away from home.

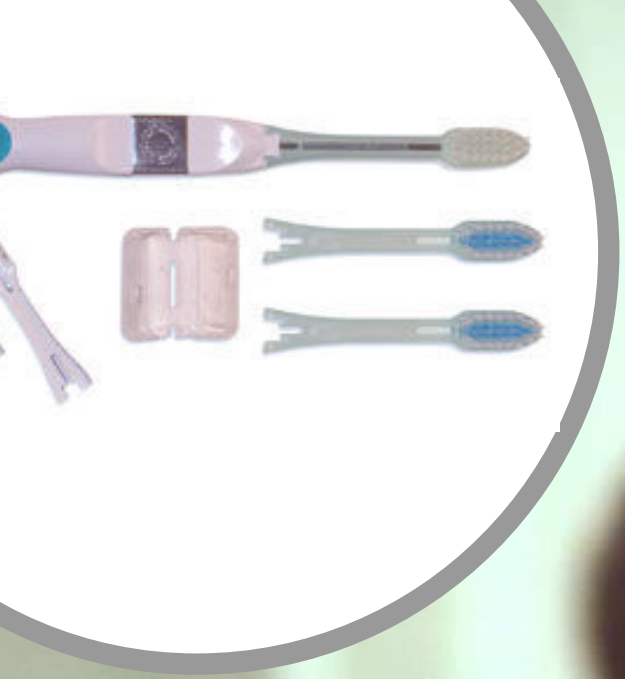


Hydro bathtub is an example of how you can do all that, and even more. And OrbSys Shower is a prototype that can reduce the water consumption by 90%, while it consumes 80% less energy than a normal shower by purifying the water and recycling it.

Body dryers can even eliminate the need of towels, and the bathroom mirror can communicate with the scale which can be part of the body dryer, or can communicate with many other sensors and display data about your health.

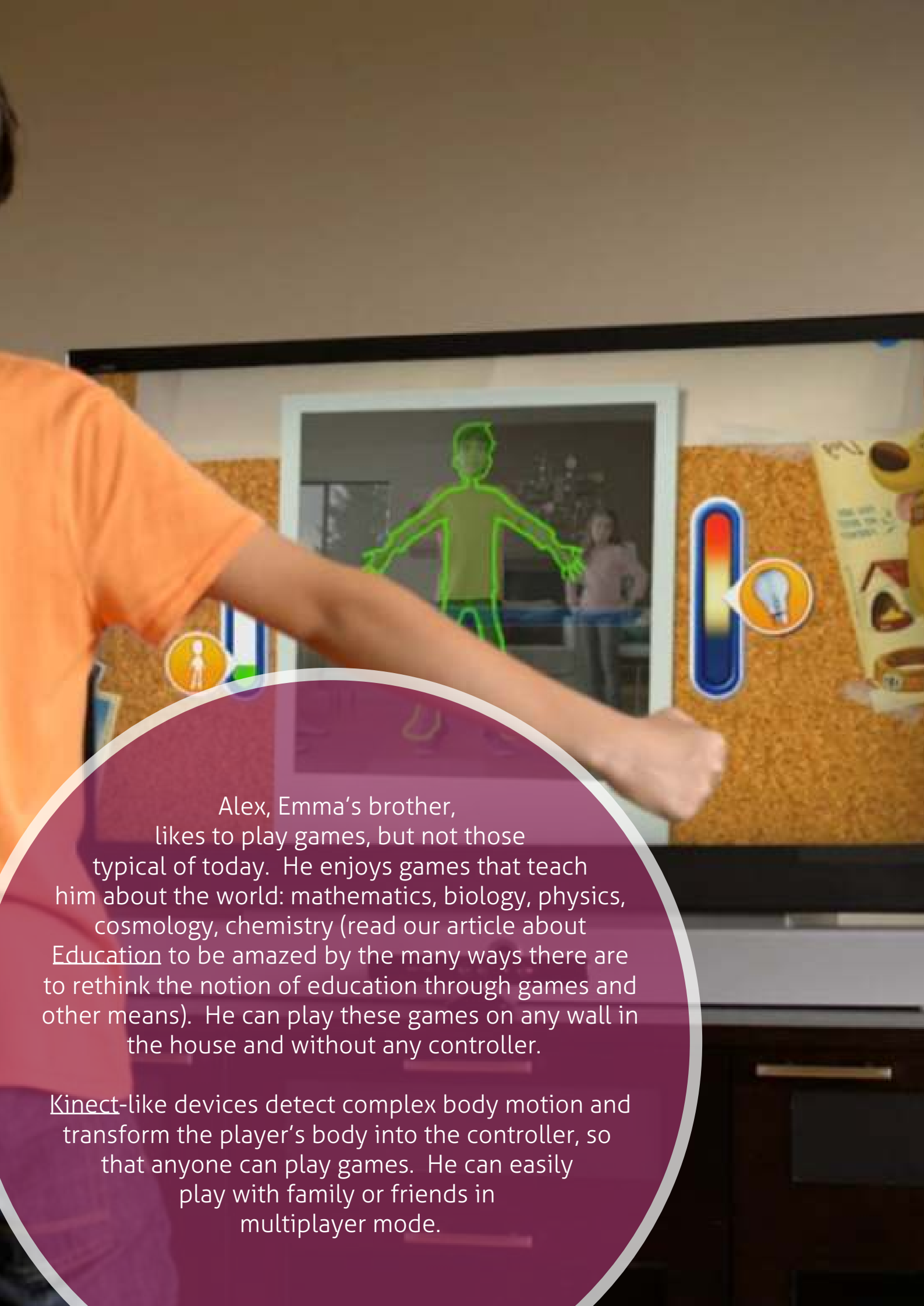
Emma's father, Patrick, wakes up and goes to the bathroom to brush his teeth but there is no toothpaste.

He uses an ionic toothbrush that removes plaque and bacteria from the surfaces of teeth and in places that a regular brush cannot reach without the assistance of toothpaste.



UV light can also be used in places such as door knobs, handles and appliances to keep them bacteria-free. (source)

©Disney/Pixar.



Alex, Emma's brother, likes to play games, but not those typical of today. He enjoys games that teach him about the world: mathematics, biology, physics, cosmology, chemistry (read our article about Education to be amazed by the many ways there are to rethink the notion of education through games and other means). He can play these games on any wall in the house and without any controller.

Kinect-like devices detect complex body motion and transform the player's body into the controller, so that anyone can play games. He can easily play with family or friends in multiplayer mode.


Tacx
CRAFT
Tacx
Tacx
Tacx
Tacx


Some games are designed to keep you in shape. Karen and Patrick play a bicycle racing game that uses real stationary bicycles instead of traditional controllers.

The game simulates tracks and everything else as real as possible: the speed you are pedaling, the bicycle steering mechanism and even your head movement are part of what controls the game. If you were to go uphill, the bicycle reacts to that and forces you to pedal much harder. The best part is that it even produces energy while you are playing.

Their home has no electric plugs, since all electricity is wirelessly transmitted and the house is powered only from renewable sources (solar, geothermal, wind, etc).

A wide variety of sensors and the smart devices that communicate with them make their home very intelligent, able to track water and energy consumption, as well as the occupants health.

The home Emma and her family lives in is completely automated and simple, yet extremely efficient, useful and full of features.

To learn more about home automation technologies, watch the Home of The Future series, a documentary in which a normal house is transformed into a fully automated home using the latest technologies.

A home can look very different than what I am describing here, but the purpose of this part is to show you some examples of present day technologies that can transform any kind of house into an automated smart home.

# CITIES AND THE ENVIRONMENT

Cities are just complex villages - clusters of people with a bunch of 'stuff' around them. In our case, the 'stuff' is mostly technology that allows for comfort, knowledge, research, and more.

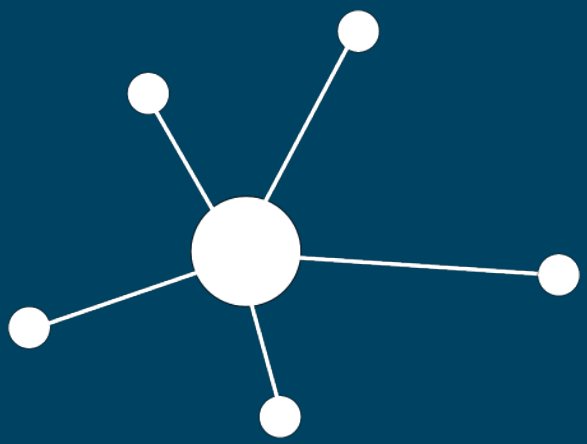
A city may be thought of as a 'total enclosure system' - a self sustainable community, somewhat similar to a cruise ship, that can provide all the needs and wants of the occupants, independent of the other cruise ships or any external reliance.

The clusters of people + technology that we call cities can be very different from one another, from their functionality to their local environment. A city can be round, or perhaps more square, depending of what its functionality will be. For instance, when it comes to access, it is much better to build a circular city with the important facilities in the center, so that access to them is easier. However if you build a city in very hot, dry areas, you may opt for a different shape to better circulate the wind through the city and cool it down. The same goes for locations, as a city in the sea may be very differently built than a city in an area with high hills. The size of cities is also dependent on these factors.

Land, water, and even space are locations where humans can create cities. While space is a recently explored environment and it may take many years of technological development to create cities there, land and water are already environments that humans have the knowledge to control and, thus, the ability to create complex cities in such areas.

However, saying that you want to build a city on land does not say very much, since there are so many factors that can substantially change a city plan: climate, soil, landscape, elevation, etc.. This is why it is impossible to imagine such cities without knowing a great detail about their position on planet Earth. Each city is unique.

SINCE EACH CITY CAN BE VERY DIFFERENT FROM ANOTHER, MAKING IT IRRELEVANT TO CATEGORIZE THEM BY 'TYPES', I WILL TRY TO HIGHLIGHT KEY COMPONENTS OF ANY CITY, SUCH AS:



# DNS

DIGITAL NERVOUS SYSTEM

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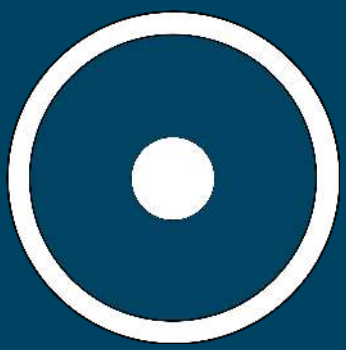

# TES

TOTAL ENCLOSURE SYSTEM

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# CDL

COLONIZING DIFFERENT LANDSCAPES

Until now you may have noticed that from construction to transportation, production to delivery, and even the ‘home’, all can become fully automated and autonomous, while the interface between these technologies and humans can be made very intuitive.  We have also discussed ways of making education decentralized and how schools as we think of them today may not be needed in the future, along with how we will create and deal with abundance.

Since there won’t be nearly as many special places in these future cities like we see today - offices, police stations, banks, petrol/gas stations, so many parking lots, town halls and others - cities of the future might serve many other purposes, as I will try to describe in this last part.

Therefore, when it comes to cities, you have to incorporate the other AA World parts to be able to visualize a more complete picture of how the cities might look in the future.

A smart city needs to sense and react to ever-changing conditions.

In order for this kind of systems approach to work properly, there are 3 key components:

- *Sensors*
- *High Connectivity and Massive Data Storage*
- *Computational Power for Arriving at Decisions*

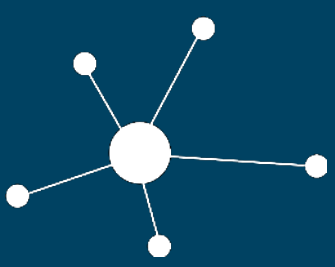
## SENSORS

To sense, the city has to have sensors in key points to record localized temperatures, production flows, air quality, water consumption, analyze bridges and other constructions, and so on.

This mash of sensors, connections and the interpretation of them by software is called 'the internet of things' today, and is something we are experiencing more and more. What this means is that the gadgets, electronics, pipes, walls, full houses and buildings, and almost all of the physical objects around us are gaining digital awareness.

For instance, a system of water pipes with simple flow sensors and pressure valves to control the flow becomes far more intelligent once they are digitized, the data is uploaded into the cloud (the internet) and it is interpreted by smart software that then communicates with and manages the valves and sensors autonomously.

Thus, by monitoring the water consumption of a city, we can program the pipes to adjust the water flow to minimize water waste. This way we can automate a huge network of pipes in a very simple way. This is just one example of why digitizing these objects/things will make a city intelligent and responsive.



Imagine bridges that communicate with the traffic flow, or entire transportation systems that can do that.  Then consider food production lines that are able to 'understand' what it is needed and where it is needed.

In the words of IBM: "***Hospitals can monitor and regulate pacemakers long distance, factories can automatically address production line issues and hotels can adjust temperature and lighting according to a guest's preferences***".

THE POSSIBILITIES SEEM TO BE LIMITED ONLY BY OUR IMAGINATION.

Let's look at some present day examples to highlight more exactly how this technology works, and what it is already possible today.

In Amsterdam, engineers are working to deploy a smart system of public lighting by 2018 by connecting energy efficient LEDs with each other and a smart network that can not only save energy, but be smart enough to light the streets or other public places exactly when needed and as much as needed, and also automatically report failures.

Considering that roughly 19% of all electricity use goes to lighting, an independent, global trial of LED technology in 12 of the world's largest cities found that LEDs can generate energy savings of 50 to 70 percent — with savings reaching 80 percent when LED lighting is coupled with smart controls. (source)

City24/7 created smart screens that they place in key points of a city, such as bus stops, train stations, major entryways, etc., that display relevant information about that particular location.

These smart screens have a dedicated emergency communication networking, battery backup, ruggedized structure (ATM strength), high-speed network access, various sensors such as chemical, bio-hazard, environmental; powerful processing; can direct people in area (what to do, where to go), monitor conditions remotely, and more.

It is basically a highly durable box (screen) that sense the environment and is smart enough to be extremely helpful for the inhabitants of a city.

Cisco, an important name when it comes to the internet of things idea, is collaborating with many cities to make them smarter. One example is Barcelona, where they underlay a plan to transform it by 2020 into a smart city by deploying sensors in various parts of the city and making sense of them through smart computer programs. The sectors of improvements include: transportation, real estate, safety and security, utilities, learning, health, sports and entertainment, and government. (source)

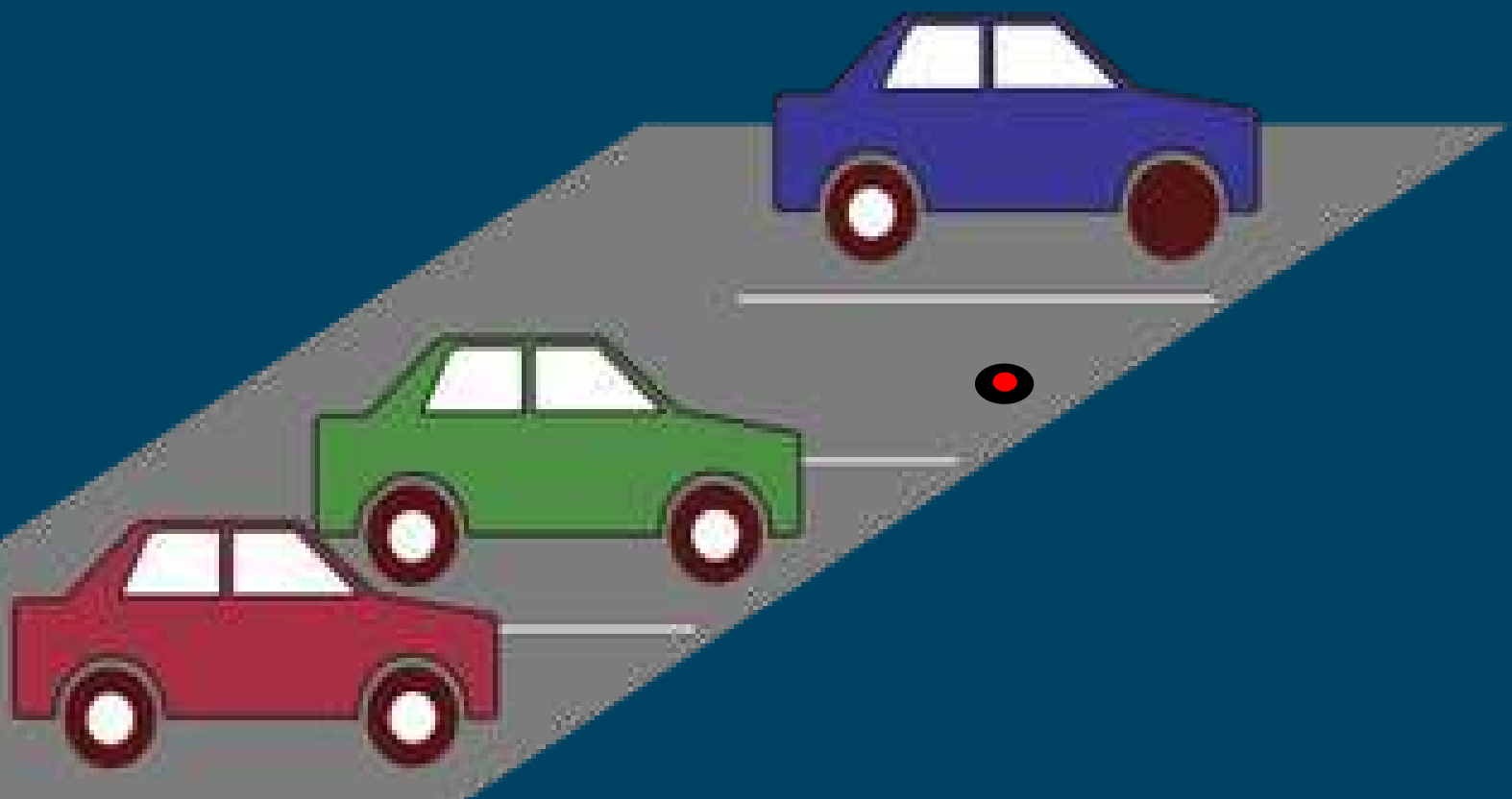
Barcelona has already implemented smart parking, smart bus stations, and they even have smart garbage cans. Sensors inside these garbage cans can detect if the garbage is full and/or is emitting bad odors, and then direct garbage trucks to empty only those that need it. This is much more efficient than picking garbage cans one after another, with some of them empty or hardly used.

The parking lots in Barcelona have light and metal detectors to detect empty parking spots and direct people to those spots via an app. (source)

Also, a city-wide network of sensors provides valuable real-time information on the flow of citizens, noise and other forms of environmental pollution, as well as traffic and weather conditions. (source)

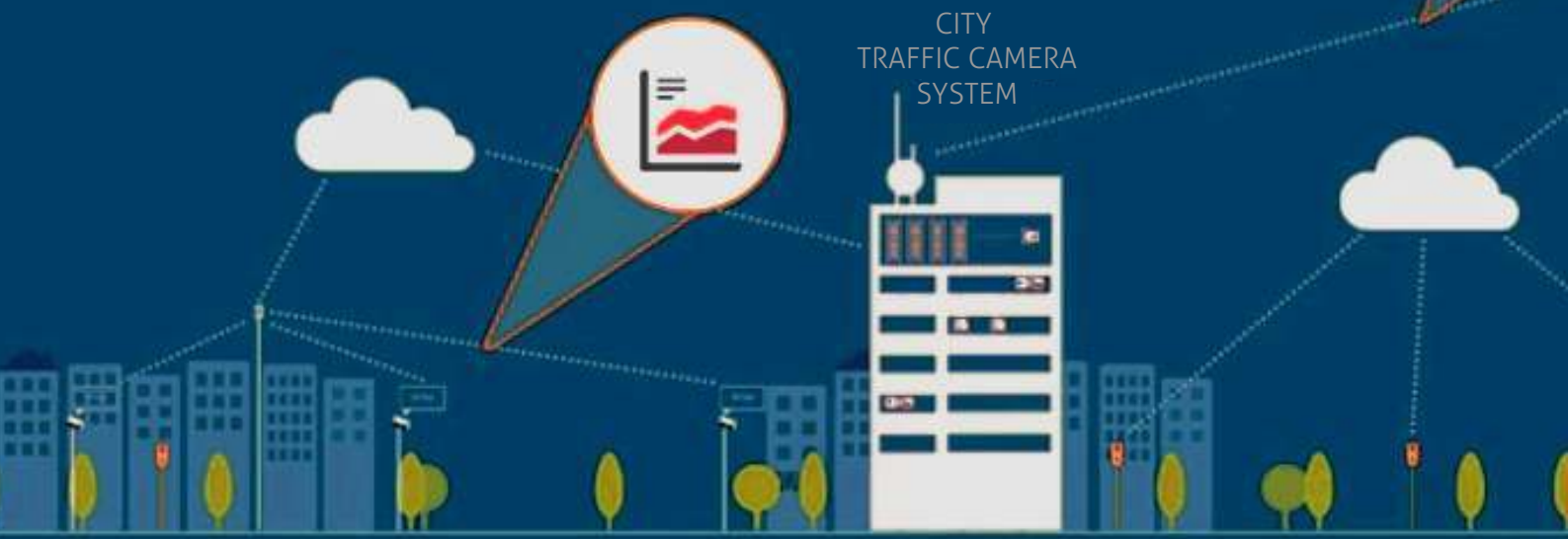
THIS IS A VIDEO SHOWCASING THE BARCELONA SMART CITY PROJECT:

CONTROLLING A CITY SEEMS TO BE AS EASY AS CONTROLLING A GAME, AS THIS CISCO DEMO VIDEO



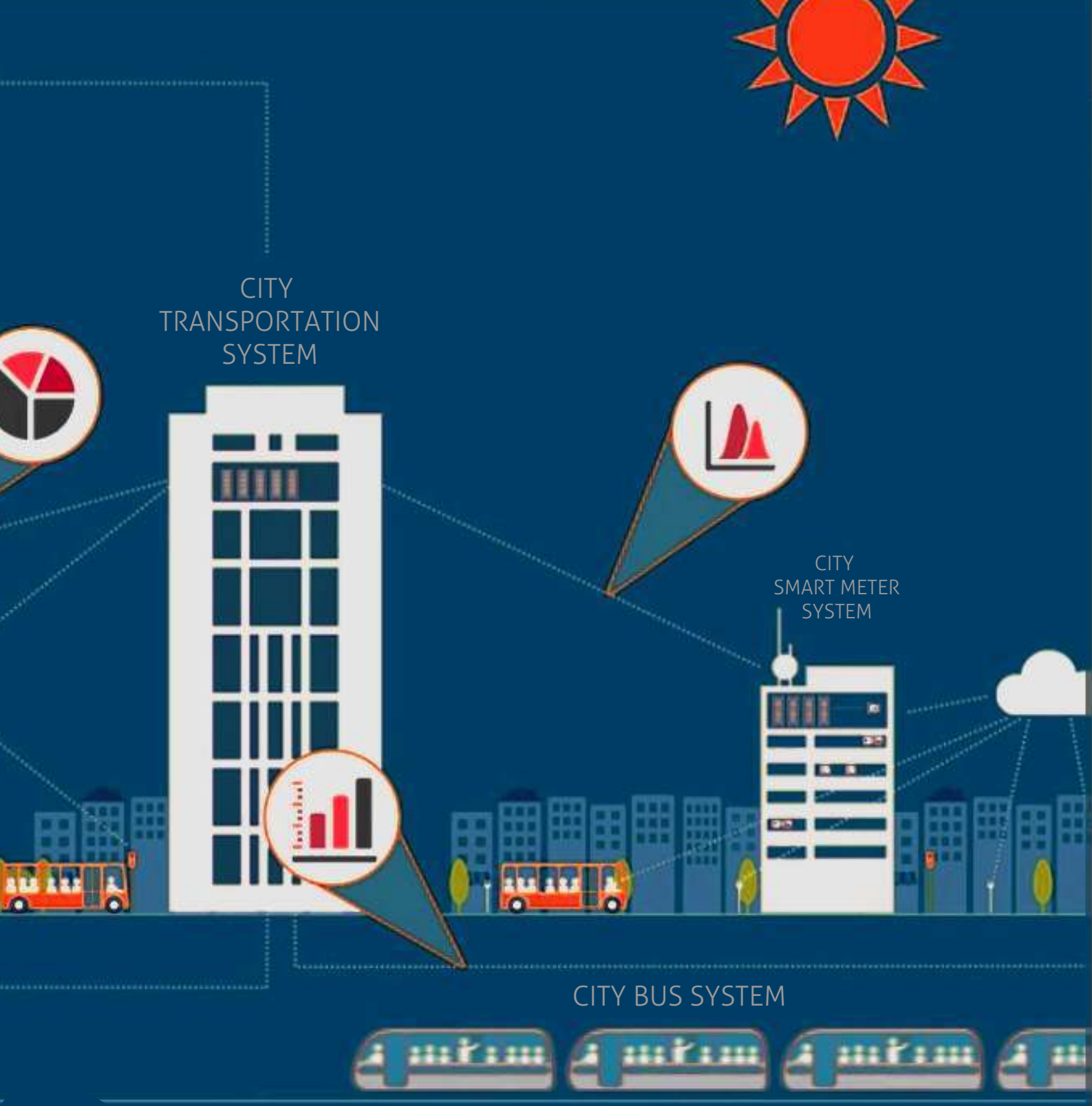
CITY AIRPORT SYSTEM

# BIG POSSIBILITIES COME FROM ANALYZING THE DATA ACROSS THE SYSTEMS




CITY SUBWAY SYSTEM

INTEL: INTERNET OF THINGS

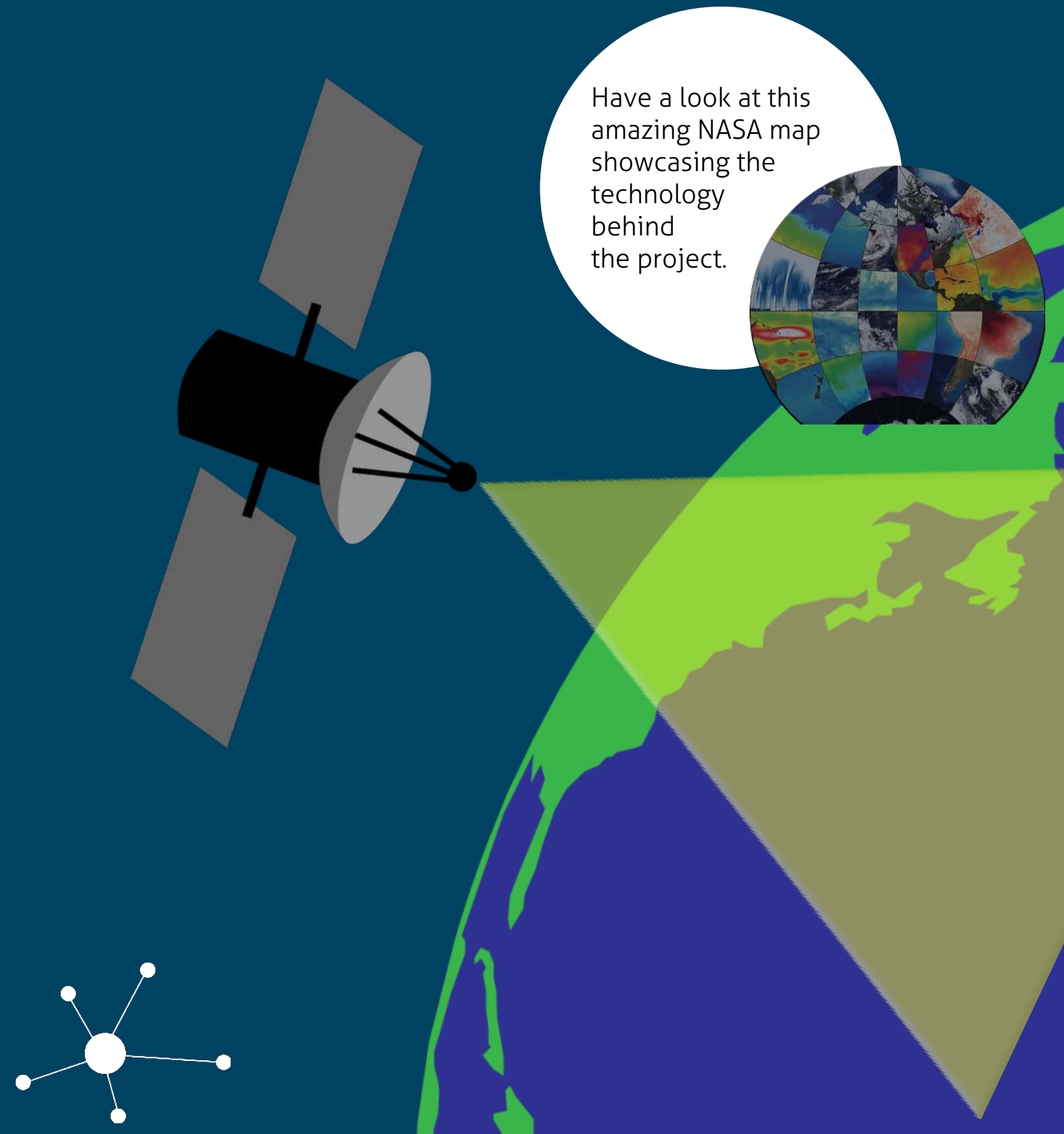



HP CeNSE is another example of this idea of 'sensing' the environment. CeNSE consists of a highly intelligent network of billions of nanoscale sensors designed to feel, taste, smell, see, and hear what is going on in the world.

These sensors can analyze earthquakes, "smell" a gas leak, sense wear and tear on a bridge, track the spread of the next flu virus, and more.

However, it is not only about putting sensors in cars, roads, buildings, and so on; it is also about putting sensors into the soil, atmosphere, space, etc., thus 'sensing' all of nature to better manage the natural resources, predict the weather and more.

NASA has been doing this for quite a while, analyzing global waters, clouds, wind, precipitations, temperatures, land and sea elevations, vegetation and a bunch more.  The system allows for better prediction of hurricanes, tsunamis, floods, etc..



THIS VIDEO HIGHLIGHTS NEAR-FUTURE IMPROVEMENTS OF THE CURRENT SATELLITE SYSTEM

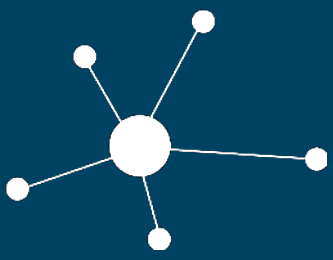
NASA'S FUTURE PLANS INCLUDE THE EXPANSION OF THIS CLUSTER OF SATELLITES, MAKING THEM INCREASINGLY AUTONOMOUS.  THEY ALSO PLAN ON ADDING FLOCKS OF DRONES, SURVEYING THE WEATHER FROM INSIDE THE EARTH'S ATMOSPHERE.

Such complex arrays of sensors can monitor Earth and its resources from inside Earth, on ground level, in the atmosphere and from space. That, combined with sensors in traffic, buildings, and objects will make our environment very sensitive. Yet, there is one more approach that will make Earth extremely sensitive and intelligent: the human network.

You see, putting sensors in key points within cities and around the planet may be quite a challenge and can cover much of our needs, but looking at people as 'sensor carriers' changes this picture a lot. Billions of people are already carrying around a device (smartphone) that has become much more than a phone and, in some situations, even smarter than a computer.

These smartphones can include multiple sensors to detect pollution, location, movement and orientation, atmospheric pressure, temperature, etc.. Many of them already host light sensors, humidity sensors, and a bunch more. (source)

Since humans travel all around the world and inhabit places from Africa's deserts to Alaska, they can become dynamic sensors that help map the world.



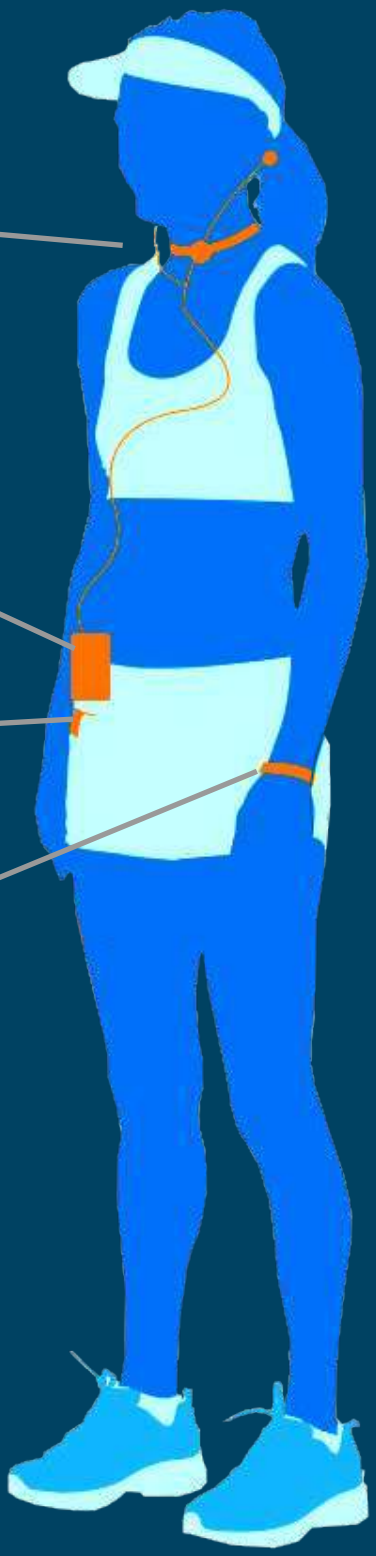
Then consider how all of that, combined with sensors inside the human body that can monitor one's health, would create a highly detailed map of our world that can detect and track virus outbreaks & treatment resistance, better understand disease propensities and much more.

**NECKLACE**
MISFIT SHINE

**CELLPHONE**
MOVES
LOSE IT!
DRINKCONTROL
SLEEP CYCLE

**POCKET CLIP**
FITBIT ONE

**WRIST**
NIKE + FUELBAND
FITBIT FLEX
JAWBONE UP



Sensing the world around and inside us is something that is already happening on a planetary scale.  Billions, perhaps trillions of sensors are already functioning to track almost every aspect of the Earth, including people's health, climate, buildings, and pretty much everything else.

The interesting fact is that, once these objects, buildings, and resources are connected with each other and connected together via smart networks, a huge amount of fine tuning and smart automation can be done.

IBM, Intel and many cities are already adopting this idea of connecting physical objects to the internet, digitizing them, and transforming cities into 'living organisms' that can sense and respond.

This is a proof that the idea of connecting objects with each other through smart networks is not only feasible, but very efficient.

## HIGH CONNECTIVITY AND MASSIVE DATA STORAGE:

To be able to cope with this huge influx of data (information), we need super high-speed connections. The fastest 'wired' broadband connection achieved up to now is 1.4 terabits per second. (source)

**AT THAT SPEED, WE COULD DOWNLOAD 44 HD MOVIES IN ONE SECOND.**

When it comes to wireless connectivity, "The South Korean government announced a new initiative to introduce a next-generation 5G wireless connection within six years." (source)

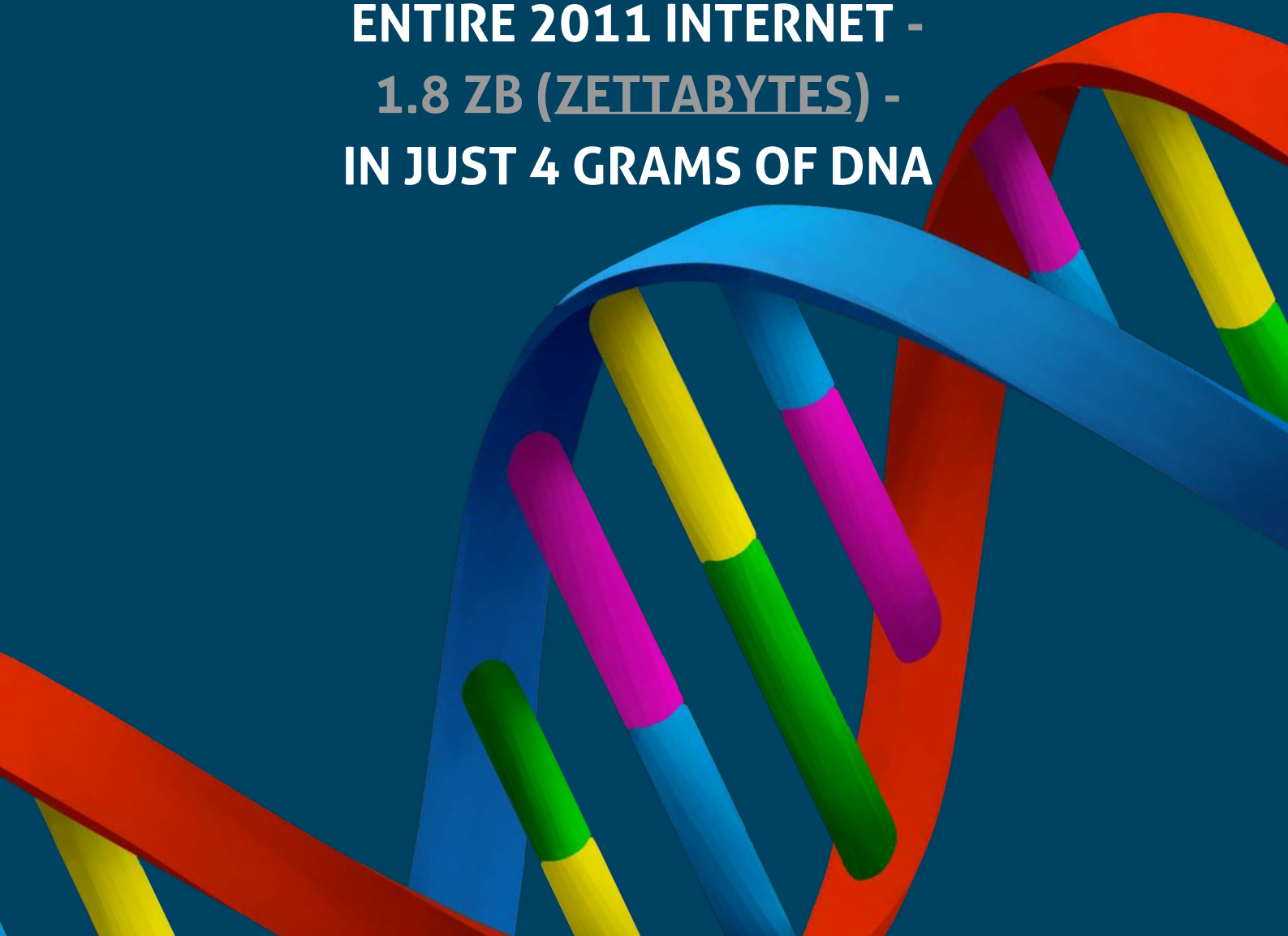
**THE NEW MOBILE STANDARD WOULD OFFER CONNECTIONS AROUND 1,000 TIMES FASTER THAN CURRENT 4G SERVICES**

These speeds are impressive and the amount of data collected will grow bigger and bigger as we connect more devices and sensors to the system. Perhaps a new type of data storage will be required.

The current best hard drive storage capabilities store a 'bit' of data (the smallest unit) using 1 million atoms. IBM has since proved that one bit of data can be stored in just 12 atoms. That increase in storage density is huge. (source)

Now imagine storing digital data within DNA structures. Harvard's Wyss Institute have successfully stored 5.5 petabits of data — around 700 terabytes — in a single gram of DNA, smashing the previous DNA data density record a thousand fold. This new approach to long-term data storage seems to be completely feasible, efficient and extremely durable. (source)

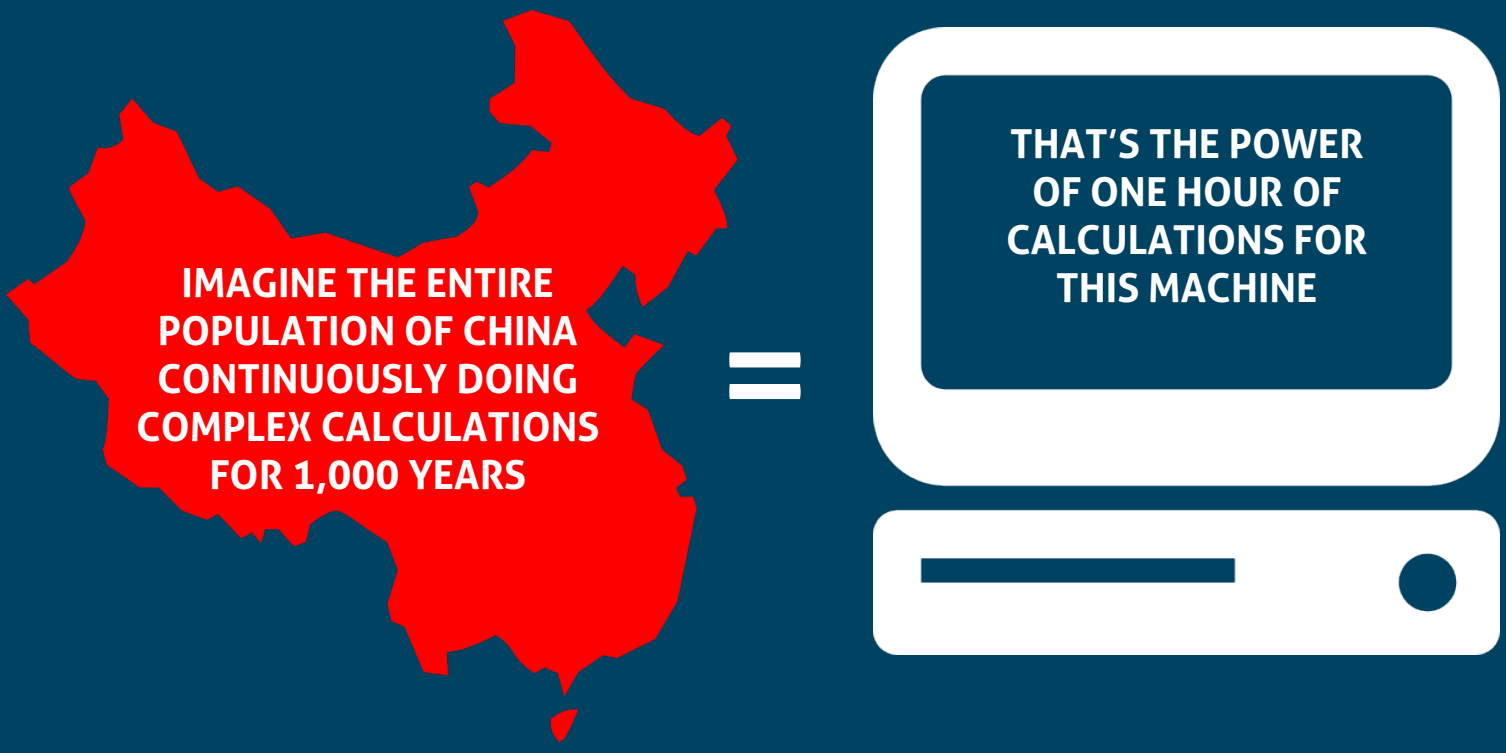
**THEORETICALLY, WE COULD STORE A COPY OF THE ENTIRE 2011 INTERNET - 1.8 ZB (ZETTABYTES) - IN JUST 4 GRAMS OF DNA**



# COMPUTATIONAL POWER FOR ARRIVING AT DECISIONS

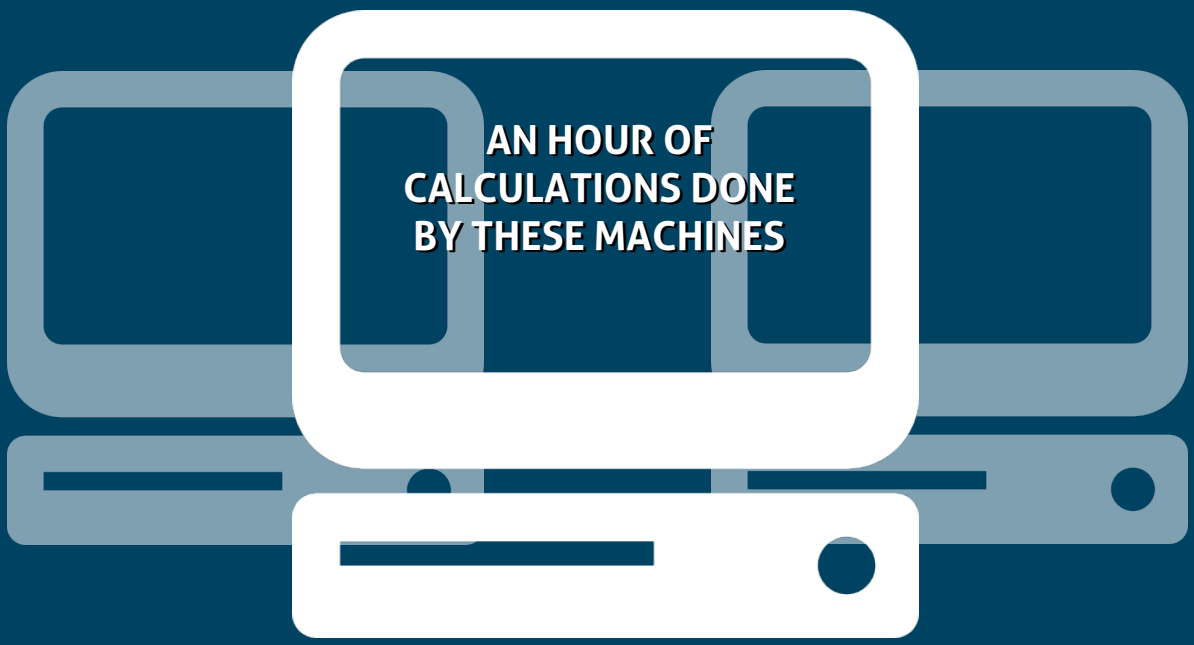
Ok, so let's assume that we now have trillions of sensors in and out of planet Earth, analyzing every aspect of it, along with sensors inside our bodies or carrying them with us, while huge amounts of data are being collected from all these sensors. Even if we also assume that we now have massive storage units for all this data, all of this potential is worthless without powerful computers and smart software.

The power of a computer is scaled by the number of calculations per second it can perform. To date, the most powerful one is *Milky Way 2*, which can do around 33 quadrillion calculations per second. That number is a bit difficult to understand, so consider that one hour of this machine's calculations is roughly equivalent to 1,000 years of difficult sums by 1.3 billion people. (source1, 2)




## IT IS VERY, VERY IMPRESSIVE!

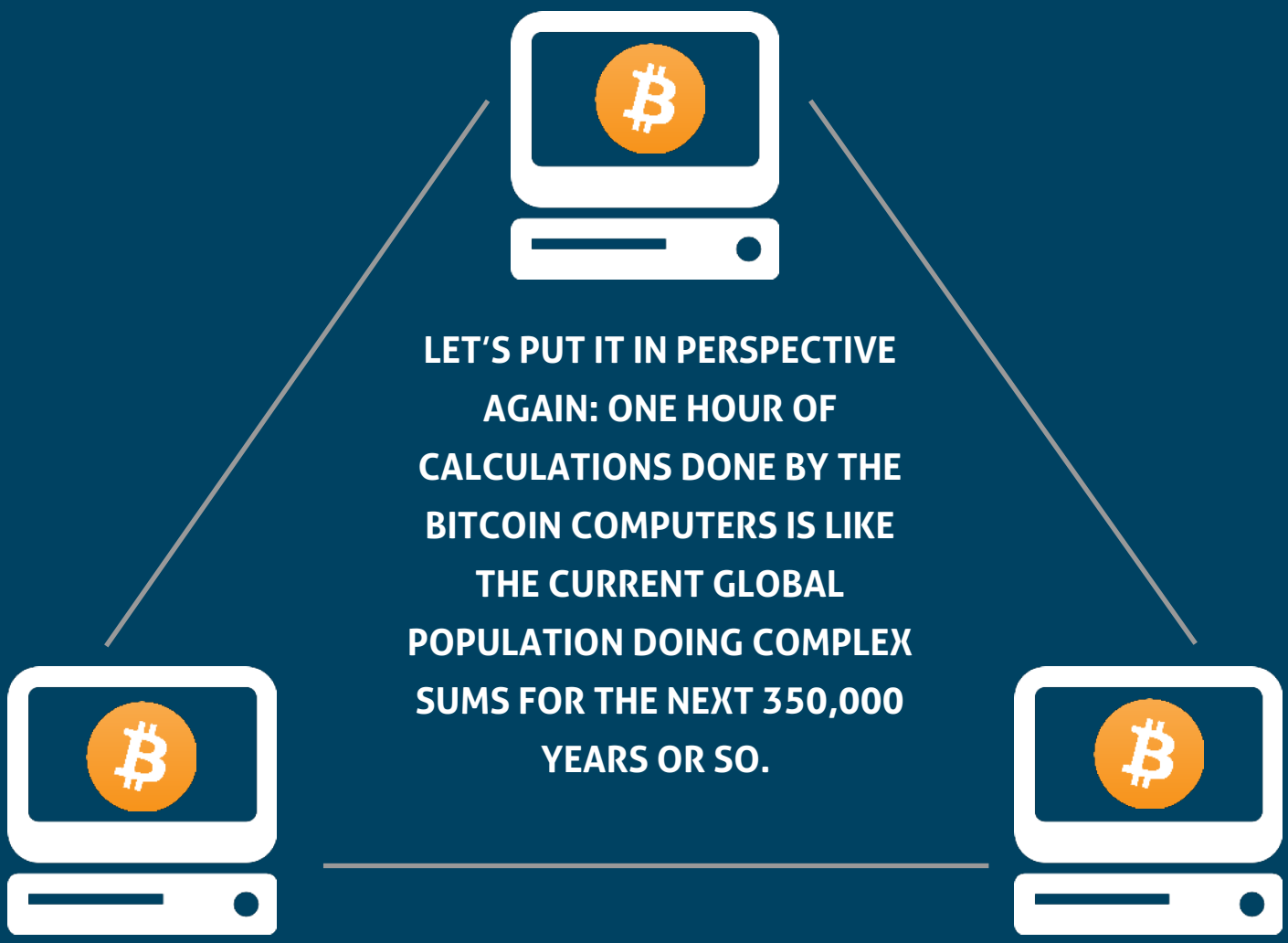
But the Milky Way 2 supercomputer is just one of hundreds, if not thousands, of supercomputers out there. Imagine the combined power of the top 500, which would be around 250 quadrillion calculations per second.



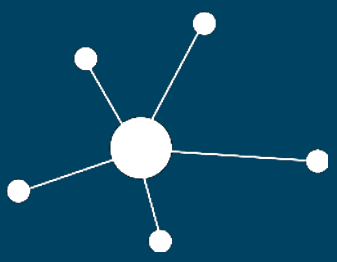

**IS ROUGHLY EQUIVALENT TO 1,400 YEARS OF CONTINUOUS INTENSE SUMS DONE BY 7 BILLION PEOPLE (THE ENTIRE WORLD POPULATION),WITH NO BREAKS FOR SLEEP, BATHROOM, EATING, ETC.. IMAGINE THAT.**

If you are impressed by those numbers, your jaw will likely drop when you will learn the next amazing fact. Bitcoin is a decentralized digital currency (a software-based payment system), with no one in control. To verify and record payments (transactions), users (you, me, everyone with a computer that agrees to help) have put their personal computer's power to work.

Together, people from around the world have created the equivalent of a gigantic supercomputer that is 256 times more powerful than the top 500 supercomputers in the world. What do you think about that? 256 times!



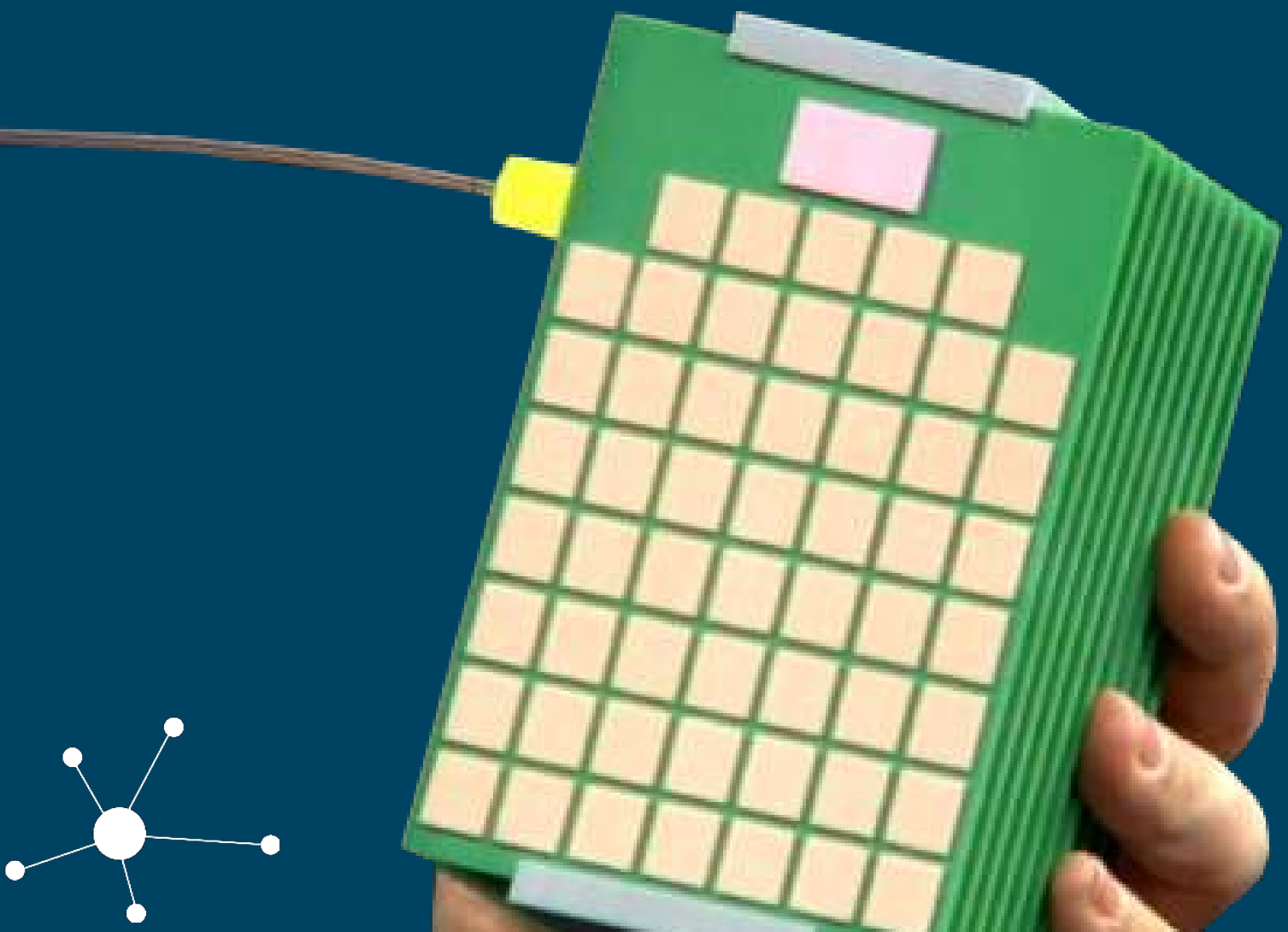
**LET'S PUT IT IN PERSPECTIVE AGAIN: ONE HOUR OF CALCULATIONS DONE BY THE BITCOIN COMPUTERS IS LIKE THE CURRENT GLOBAL POPULATION DOING COMPLEX SUMS FOR THE NEXT 350,000 YEARS OR SO.**



YOU MIGHT ALSO IMAGINE THESE 7+ BILLION PEOPLE STARTING BACK WHEN ARCHAIC HOMO SAPIENS, THE FORERUNNER OF ANATOMICALLY MODERN HUMANS, EVOLVED. ONCE AGAIN, THAT IS JUST TO MATCH ONE HOUR OF THE BITCOIN NETWORK'S COMPUTATIONS.

HP is currently developing a very powerful computer (The Machine) with the 'internet of things' idea in mind.  It uses photons instead of electrons, is six times more powerful than existing servers and requires 80 times less energy.

HP claims The Machine is capable of managing 160 petabytes in 250 nanoseconds.  They also claim that this computer will be a huge shift in computer systems, able to cope with the huge influx of data coming from what it is called as "the internet of things". (source)

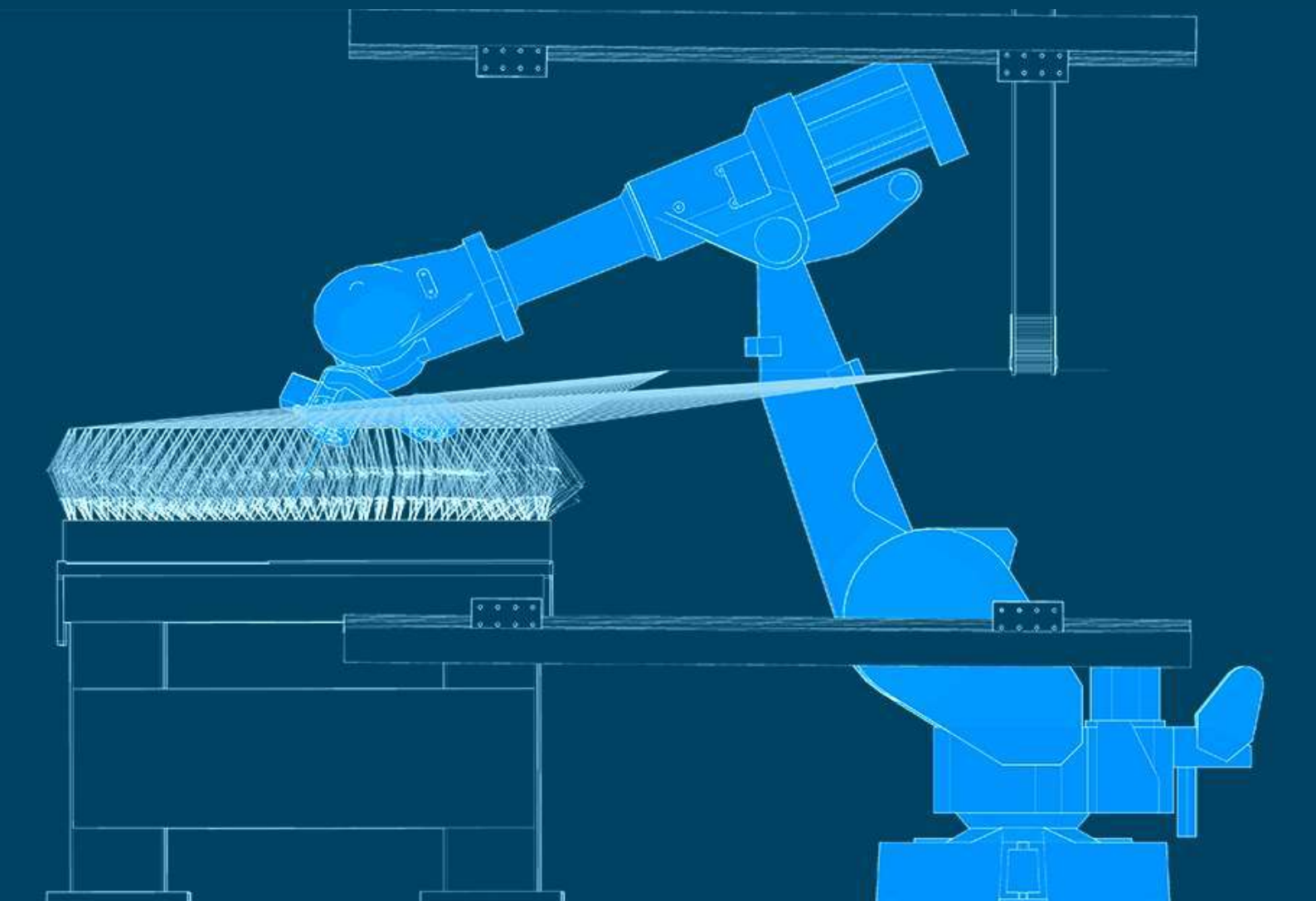


These numbers are impossible to make sense of, but the point is that our present computational power is huge.  Many science researchers are using these supercomputers to do a wide variety of investigation.

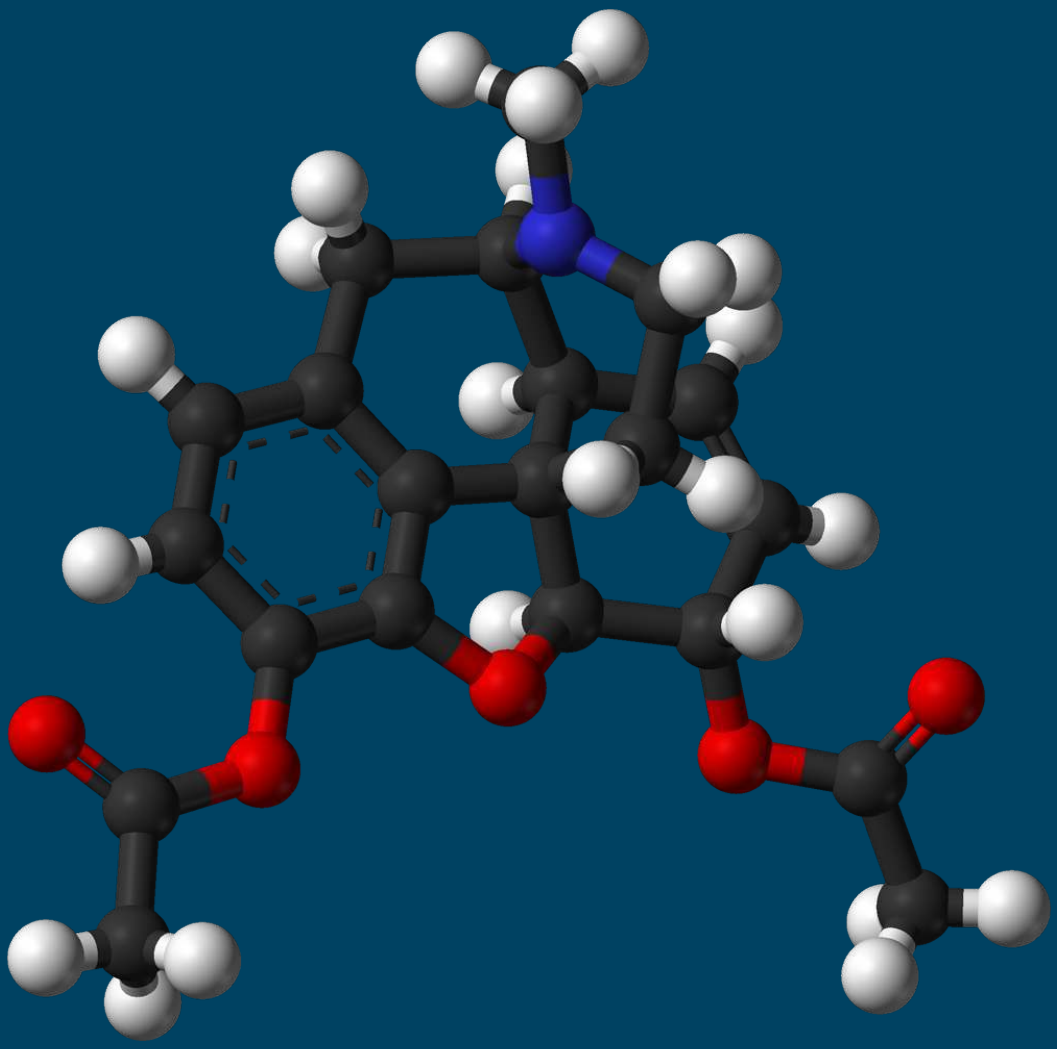
Scientists use supercomputers to explore the chemical properties of materials in physically realistic environments, investigate various processes at the quantum scale, use a combination of experiment and large molecular simulations to understand how, at a molecular level, mutations enable resistance to antibiotics in the causes of, among others, bacterial meningitis; supercomputers are also used for climate modelling research (atmospheric models, ocean models and land models).

Climate researchers are able to run full Earth system models with the additional complexity required in, for example, modelling evaporation from land and the associated plant transpiration.

Supercomputers are also using biomechanical models to understand how dinosaurs moved; simulating the energy production of future fusion reactors; exploring new renewable energy technologies such as dye-sensitised solar cells; and designing quieter, more efficient aeroplanes. (source)

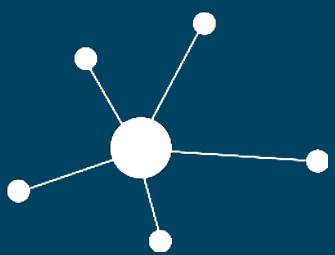


For instance, Tianhe-1A, the second most powerful supercomputer in the world, ran a simulation involving 110 billion atoms through 500,000 time-steps. In every one of these steps, Tianhe-1A has to analyze the relationships between each and every atom. These calculations took three hours to complete and accounted for 0.116 nanoseconds of simulated time — and this is on a computer capable of processing two quadrillion calculations per second. (source)



You can do a google search to see many more uses of supercomputers.

Now think about the various types of research done by distributed computing. As in the case of Bitcoin, this means people donating their personal computer's power to form a network of computers that bring together immense computational power. Here is a list of such projects.



So, with the ability to handle quadrillions of calculations per second, computers are already more than capable to do tremendous work, and we haven't even touched the quantum computer model, which seems to completely revolutionize the computer as we know it today, making a huge leap in computational power.

I HIGHLY RECOMMEND THAT YOU WATCH THIS 3 MINUTE VIDEO ABOUT ONE COMPANY THAT IS ALREADY USING QUANTUM COMPUTING TECHNOLOGY

Perhaps more important than computational power and accumulated data storage is how we can arrive at relevant decisions.  How might we automate the process of arriving at decisions?

Well, this is already happening in almost all aspects of society: construction, food production, management, etc.  When you are dealing with huge amounts of data, you need computers coupled with smart software to search through all of it and arrive at conclusions.  Of course, the software is written by humans, but it serves as proof that such systems are not only useful, but necessary.

If you want to detect supernovas (massive explosions of stars), you need computers to 'watch' the night sky 24/7 to reveal them (source).  If you want to do medical drug research, you need robots (computers connected to external devices) to analyze huge amounts of data and arrive at decisions (source).  Robots now dominate many leading bioscience laboratories, doing in just hours what once took days or weeks.

*Adam* and *Eve* are two robotic computers that form hypotheses, select efficient experiments to discriminate between them, execute the experiments using laboratory automation equipment, and then analyze the results.

Both Adam and Eve have made actual discoveries.

Adam was developed to investigate the functional genomics of yeast and the robot succeeded in autonomously identifying the genes that encode locally "orphan" enzymes in yeast.

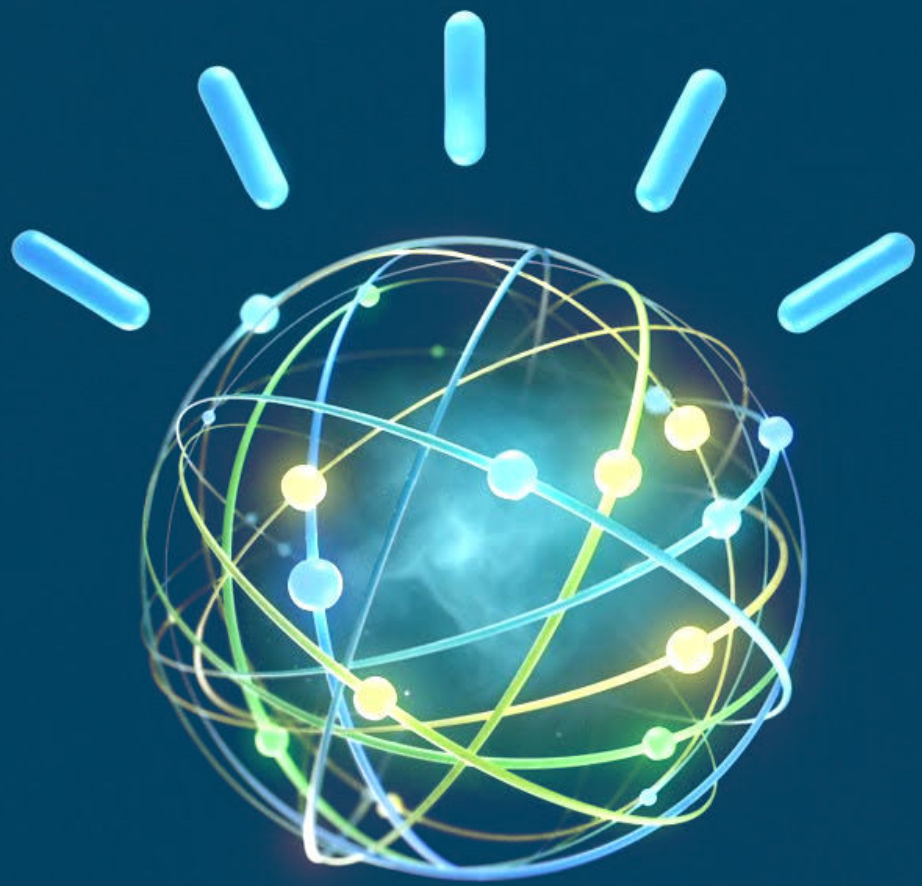
From Eve, scientists have discovered lead compounds for confronting malaria, Chagas, African sleeping sickness and other conditions. (source)


*"ADVANCED LABORATORY ROBOTICS CAN BE USED TO COMPLETELY AUTOMATE THE PROCESS OF SCIENCE."*

**WIKIPEDIA**

When it comes to research, perhaps the most impressive robot discovery and overall ‘arriving at decisions’ is IBM’s Watson.  I have mentioned IBM Watson in the AA WORLD series more than God is mentioned in the bible :), but there is good reason for that.  The way that Watson was built allows for a huge array of uses.

Watson can ‘read’ hundreds of millions of articles in a very short amount of time, look through videos and photos, understand human language and shapes (objects, images), and then arrive at a decision focusing on whatever you are requesting from it.



MEET IBM WATSON

**FROM THE IBM WEBSITE:**

- When asked a question, Watson relies on hypothesis generation and evaluation to rapidly parse relevant evidence and evaluate responses from disparate data.

- Watson can read and understand natural language, important in analyzing unstructured data that make up as much as 80 percent of data today.

- Through repeated use, Watson literally gets smarter by tracking feedback from its users and learning from both successes and failures.

- Watson is a cognitive technology that processes information more like a human than a computer—by understanding natural language, generating hypotheses based on evidence, and learning as it goes.

## What makes Watson so amazing is its capacity to combine 3 extraordinary features:

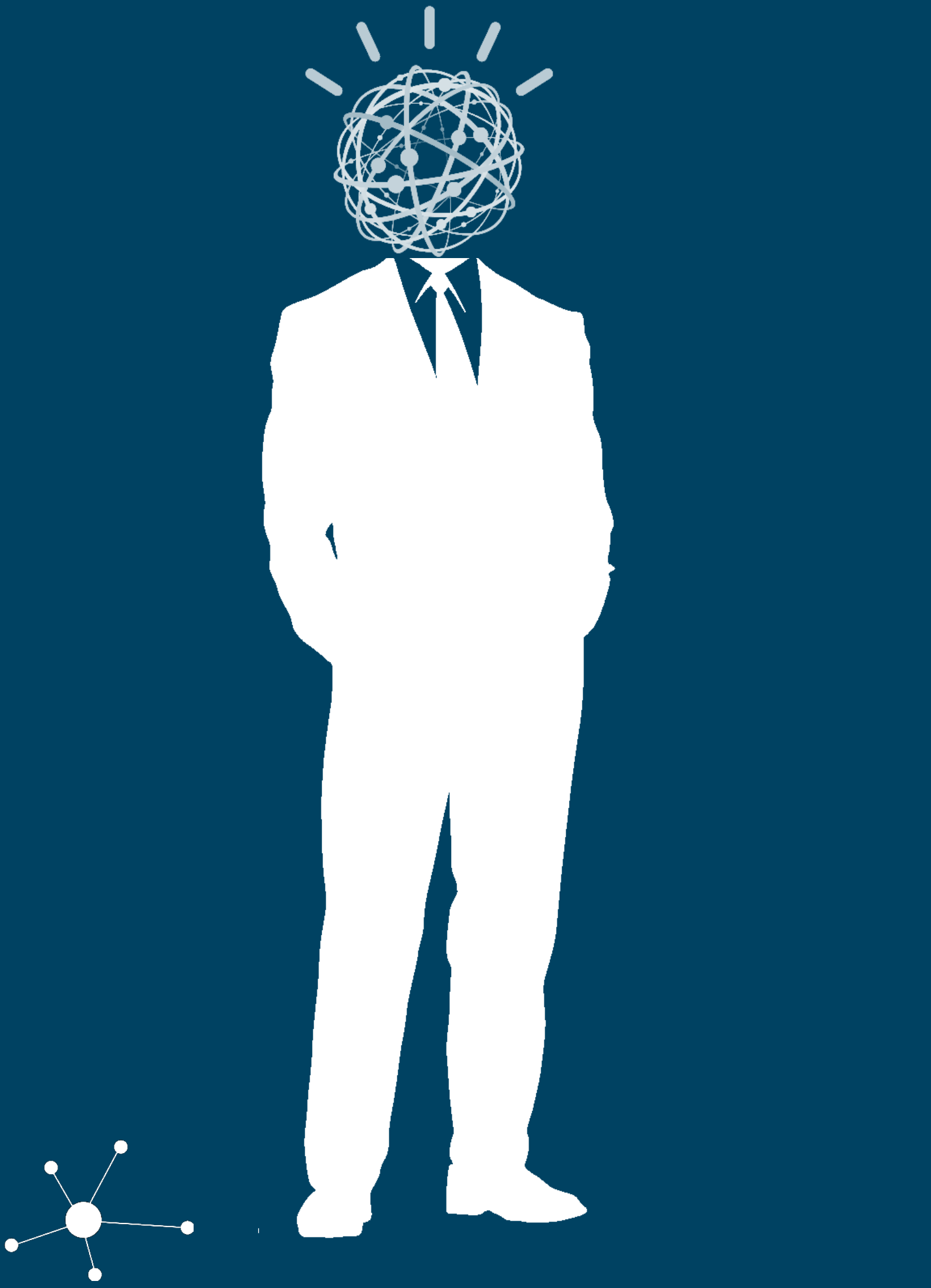
1. **NATURAL LANGUAGE PROCESSING**
2. **HYPOTHESIS GENERATION AND EVALUATION**
3. **DYNAMIC LEARNING**

## HERE'S HOW WATSON CAN WORK IN HEALTHCARE:

"First, the physician might describe symptoms and other related factors to the system.

Watson can then identify the key pieces of information and mine the patient's data to find relevant facts about family history, current medications and other existing conditions.

It combines this information with current findings from tests, and then forms and tests hypotheses by examining a variety of data sources—treatment guidelines, electronic medical record data and doctors' and nurses' notes, as well as peer-reviewed research and clinical studies. From here, Watson can provide potential treatment options and its confidence rating for each suggestion." IBM



**WATSON CAN ALSO REPLACE GOVERNMENT WITH SMARTER SCIENTIFIC DECISIONS:**

"Cognitive computing can help improve the service of the public sector in several ways, improving on slow and manual decision-making processes by employing such capabilities as decision-management, predictive and content analytics, planning, discovery, information integration and data management.

Watson learns like a human. As it refines its own knowledge from its findings in vast sets of data and its interactions with the employees using it, it helps public employees improve process and policy. Watson helps deliver personal service to citizens navigating complex processes. From these interactions, Watson learns the priorities of the public and helps inform policies that serve those interests.

And with threats to security an ongoing problem, Watson can uncover patterns of activity that can help an agency interpret and address abnormal usage that may suggest an emerging problem." IBM

The IBM Watson Discovery Advisor is a research assistant that helps researchers collect information and synthesize insights to stay updated on recent findings and share information with colleagues.

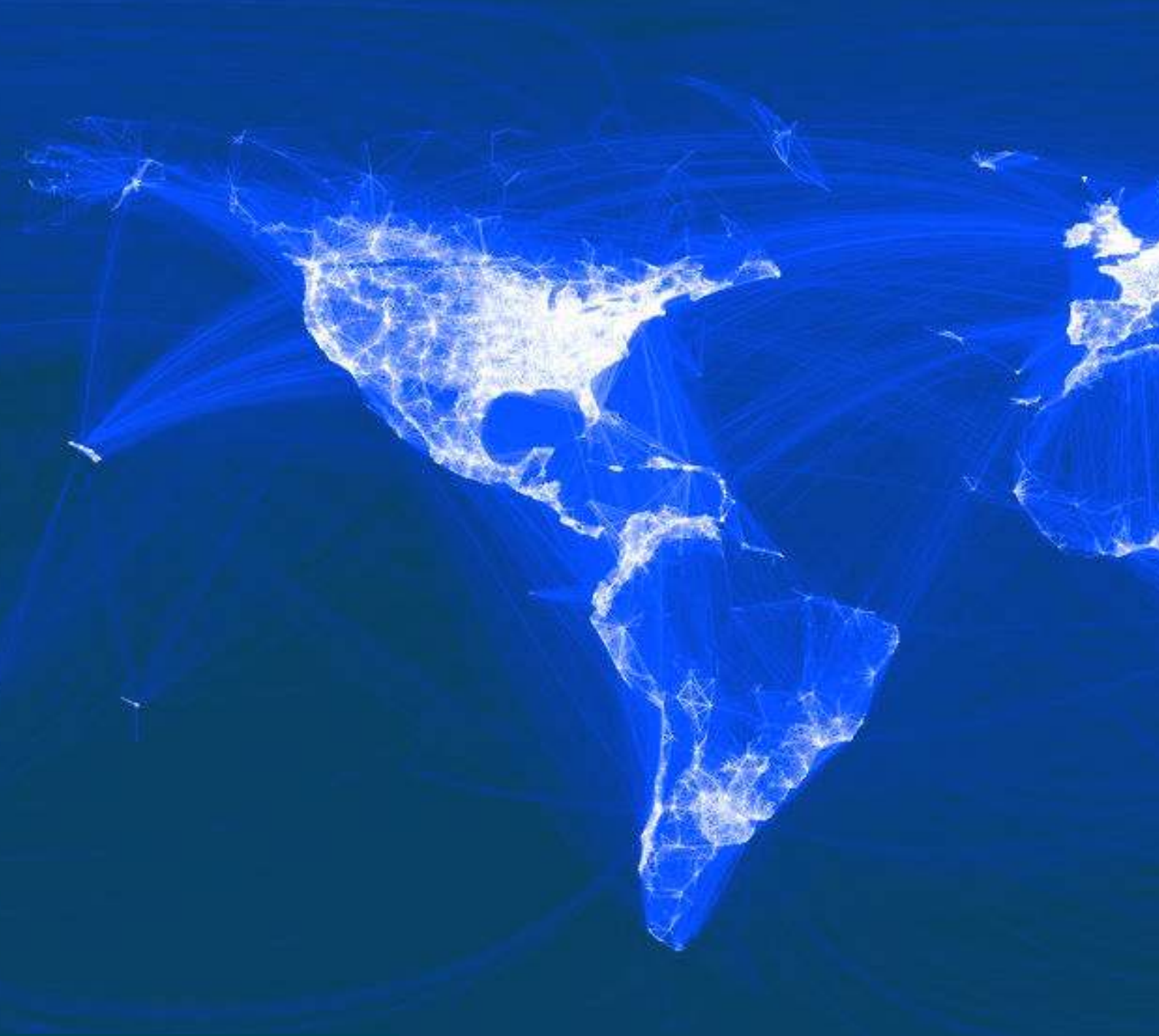
New York's Genome Center plans to use the IBM Watson cognitive computing system to analyze the genomic data of patients diagnosed with a highly aggressive and malignant brain cancer, and to more rapidly deliver personalized, life-saving treatment to patients of this disease.

*Learn more about how Watson can accelerate and help clinicians personalize treatments.*

What is even more 'out of this world' about Watson is its recently presented technology called the Watson Debater, which does just that.

Imagine you ask Watson about anything like, for instance, what is the influence of violent games on human behavior.  Watson will read through millions of scientific papers on the subject and arrive at both PROS and CONS about the subject.

Here's a video showcasing this technology:

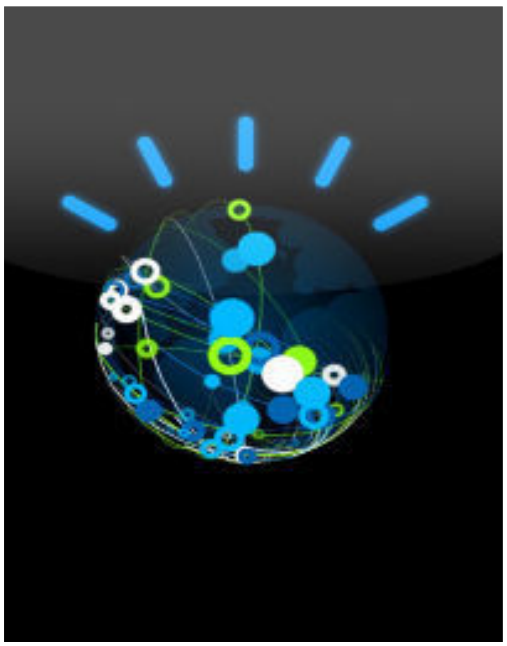


With all that being said about Watson, it is feasible to think that an AI can make scientific decisions of all sorts: city planning, food production, people's health and comfort, environmental decisions, and so on.

The Digital Nervous System (DNS), as I showed you, can be extremely complex; capable of analyzing infinitely varied data from all around the world by making quadrillions of calculations per second and fully capable of complex decision making.

**WITHOUT THIS DNS, A CITY WOULD BE JUST A PILE OF CEMENT & METAL AND, FOR US, THE PLANET WOULD BE AN ENVIRONMENT FULL OF UNPREDICTABLE AND UNCONTROLLABLE SURPRISES.**

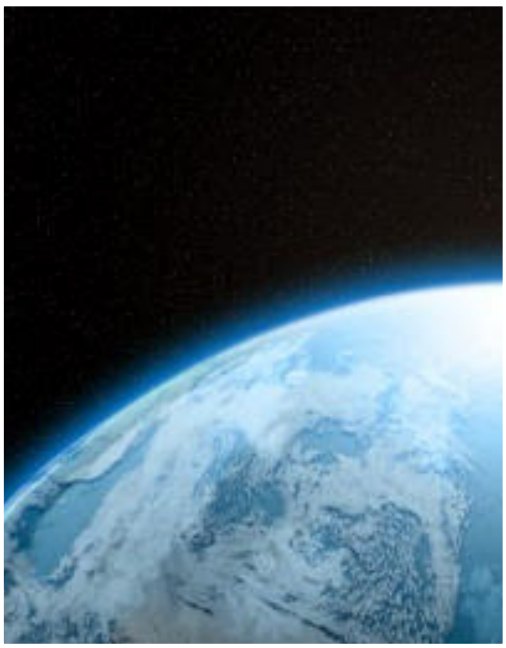
# RECOMMENDED DOCUMENTARIES SO FAR:



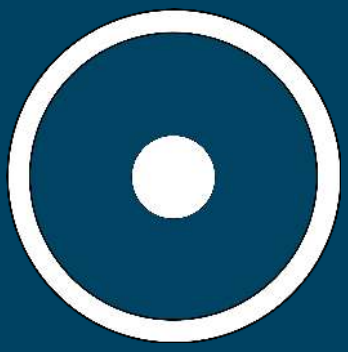
SMARTEST MACHINE ON EARTH

HOW SATELLITES RULE OUR WORLD

THE AGE OF BIG DATA



X-RAY EARTH



# TES

## TOTAL ENCLOSURE SYSTEM

We will explore ways of making these cities autonomous, independent (energy and food production) and also discuss what landscapes could be ‘colonized’ with today’s technology. Since we have already covered the construction, transportation, production & services, and ‘home’ aspect of this automated and autonomous future, we are left with two important topics to cover before we can think of these cities as being fully autonomous: food and energy.

If a city can produce all of the food necessary for its occupants and produce all of the energy consumed within the city, then we can rightly say that it performs as a total-enclosure system.

# FOOD

We have shown in this series how many types of food can be produced in fully automated ways, from robot chefs to vertical farming. We will now focus on the capacity of these technologies to locally produce enough food to feed thousands or more people, per city.

I realize that this particular subject depends on many variables: health and genetics, environment, people's preferences, resources and more. For instance, a city that is situated on water is much more efficient in fish farming, and less efficient in the production of different kinds of crops.

However, by showcasing the efficiency and methods of different kinds of food production techniques, we can paint a more accurate picture of what can be achieved with today's technology.

Farming marine life and plant food, artificial meat, insect farms, and 'crazy food science' - That's what we will talk about.

Farming marine life isn't a new thing. It's been around for many, many decades, but doing it in a sustainable way is a different story. Consuming the water's resources is not sustainable, unless you replace what you consume.

For instance, instead of fishing some types of fish directly from the ocean, it is much more sustainable to farm those fish in closed systems, thereby not impacting the fish population in the sea/ocean. This way, you can preserve a balance.

You can farm marine life on land (special enclosures), on closed systems in water or in the open ocean.

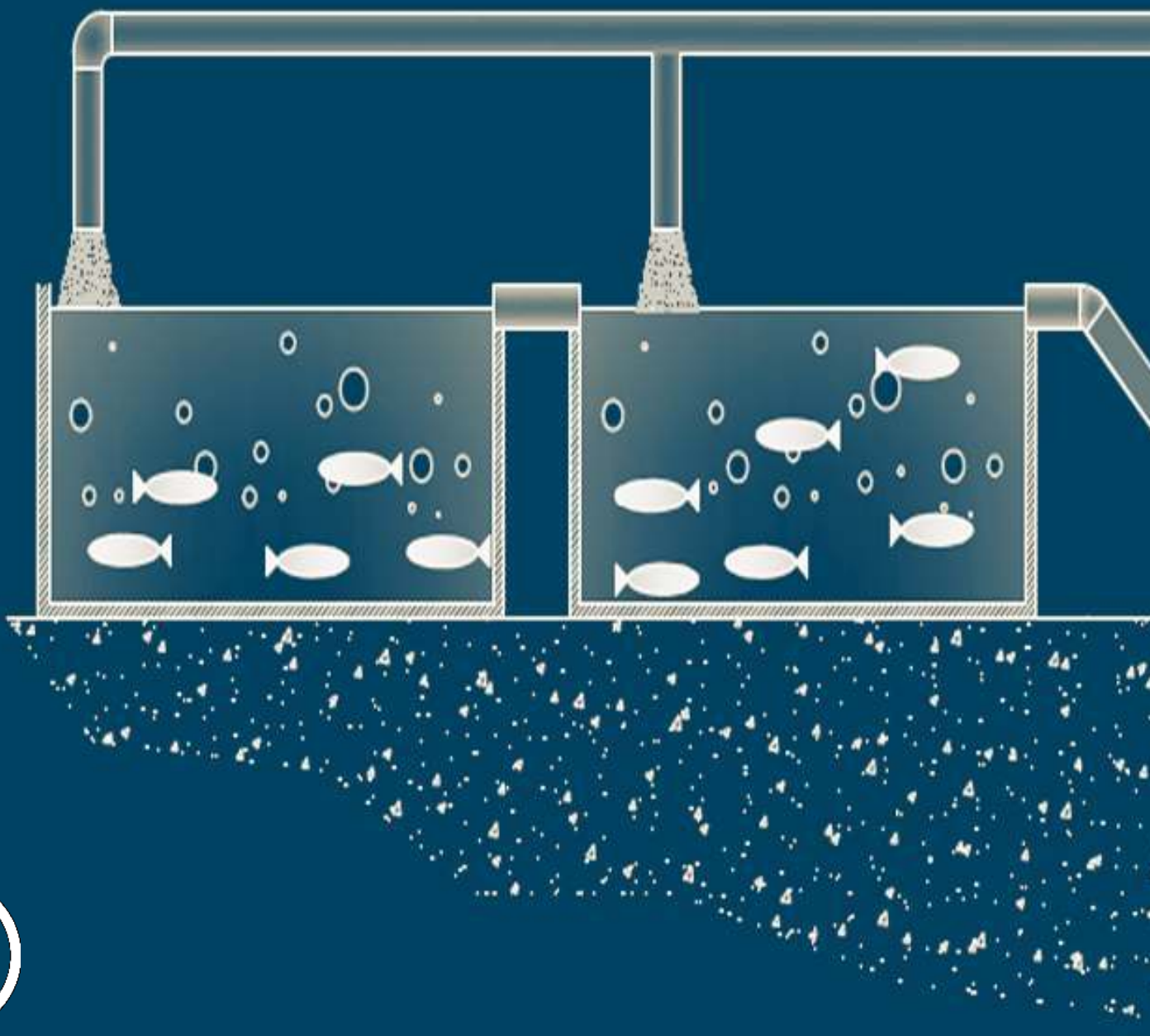
The Velella Mariculture Research Project has developed a 6-7 meter sphere cage that can drift in the ocean containing thousands of fish. Because the pod is drifting in the open ocean, with the current flowing through it, the fish waste is continuously carried off and dispersed. The brass mesh resists biofouling, so anti-algal chemicals aren't needed. Also, much of the fish meal and fish oil in their feed has been replaced with sustainable agricultural proteins, such as soy. (source)

This way of growing marine life can be expanded in many varied ways, and with many types of 'life' (things that provide a nutritional value for us humans - and more): oysters, seaweed, shellfish, and prawns are just a few types of marine life that can be farmed in this way.

These methods that use natural environments such as oceans, rivers, or seas, are subject to potentially serious consequences (introducing a new species to a new environment, wastes, parasite transfer, etc.), which is why they must be undertaken with a highly educated scientific approach. You can read more about mariculture at Wikipedia to understand the risks and the benefits of such systems.

However, Aquaculture is a method of growing marine life in more controlled environments. Aquaculture is based on the same methods as mariculture, but they farm marine life under controlled conditions. Though it seems to limit the variety of marine life that can be farmed in these closed systems, the opposite may be true. Aquatic plants, fish, crustaceans, molluscs and other groups are already farmed using this method.

The best part is that they recycle the waste of one species to become feed (fertilizers, food) for another.



This way, you can grow plants and fish in the same enclosure, for instance. The fish waste becomes fertilizer for the plants, which then cleans and oxygenates the water that goes back to the fish tank.

There are multiple advantages of this farming method, such as a controlled climate, more accurate control of water flow, steady PH & energy usage, etc.. Indoor aquaculture systems can also be deployed in a wide variety of climates and a high degree of automation can be accomplished to make these systems autonomous. There are already projects for large scale deployment, such as Plantagon in Sweden, which began construction early this year. It seems that there is no technological impediment to building such large scale production systems - only financial (fictitious) impediments - which is why there aren't many large scale examples at present.

However, I made a youtube playlist with some of these systems (both large scale and small scale) that grow a wide variety of fish and plants, and some videos even show how the automation behind these technologies works:

If we imagine cities that produce their own food, we might also consider that food habits might change in the future. Currently, many people consume many types of meats as part of their regular diet, but this may decrease or change a lot in the coming years. It is estimated that a third of the land on planet Earth is used for farming animals and growing food for animals. Also, animal waste accounts for a huge 14% of greenhouse gasses in the atmosphere, and thus is contributing heavily to global warming. More than that, many studies show some correlation between eating large quantities of some types of meat and health issues. (source)

With all that in mind, people may opt for a more plant-based diet in the future. Currently, there are many people whose diet consist solely of plant based products and that shows that this idea is not only feasible, but might be healthier and less energy and resource consuming.

Meat production is highly automated in today's world. Considering today's pig farms, cow farms and chicken farms, most of them possess the technology for being completely automated. Yet meat can also be replaced by alternatives that can significantly reduce the energy and resources consumed to produce traditional meat, while also being healthier for us.

In-vitro meat is a cutting-edge technology that is expected to be 45% more energy efficient to produce, uses 82-96% less water, produces 78-95% less greenhouse gasses, and needs 99% less space to be produced than conventional meat production. (source)

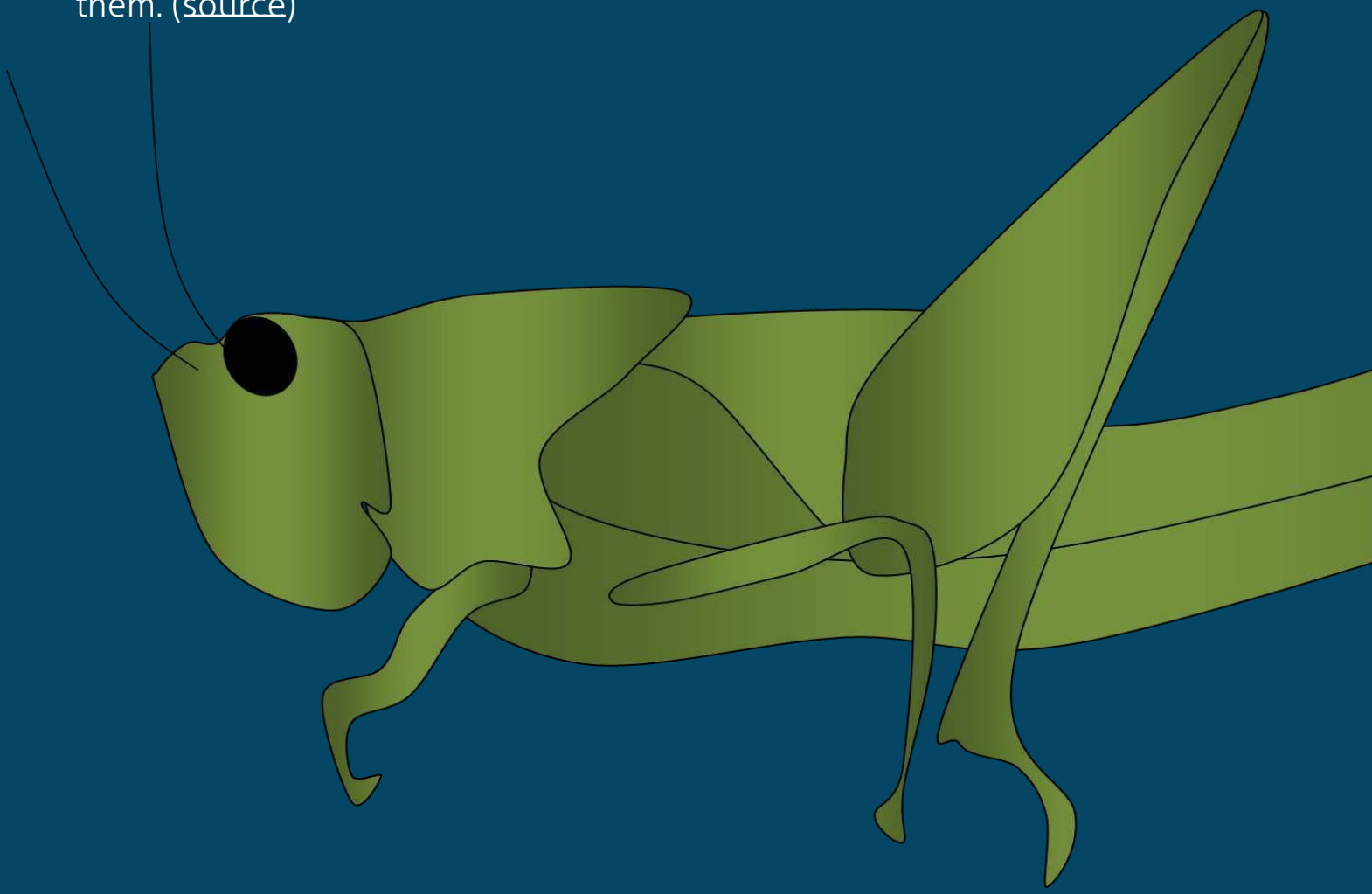
The process of developing in-vitro meat involves taking muscle cells and applying a protein that promotes tissue growth (genetic engineering techniques, such as insertion, deletion, silencing, activation, or mutation of a gene, are not required to produce in-vitro meat). Once this process has been started, it's theoretically possible to continue producing meat indefinitely without introducing new cells from a living organism. It has been claimed that, under ideal conditions, two months of in-vitro meat production could deliver up to 50,000 tons of meat from just ten pork muscle cells. The technology to mass produce in-vitro meat is already here, but again, is held back by economic restraints. As a result, you won't find any in-vitro hamburger on sale today to buy and try. (source)

On the other hand, plant-based meat replacement products are already on the market and BeyondMeat is one of the companies focusing on that. They were able to recreate the full texture and taste of chicken meat and beef. This is one small sample video of people trying to tell the difference between the 'real' meat and the 'fake' one.

Hampton Creek Foods is another company that has successfully created plant-based replacements for animal products, such as eggs.

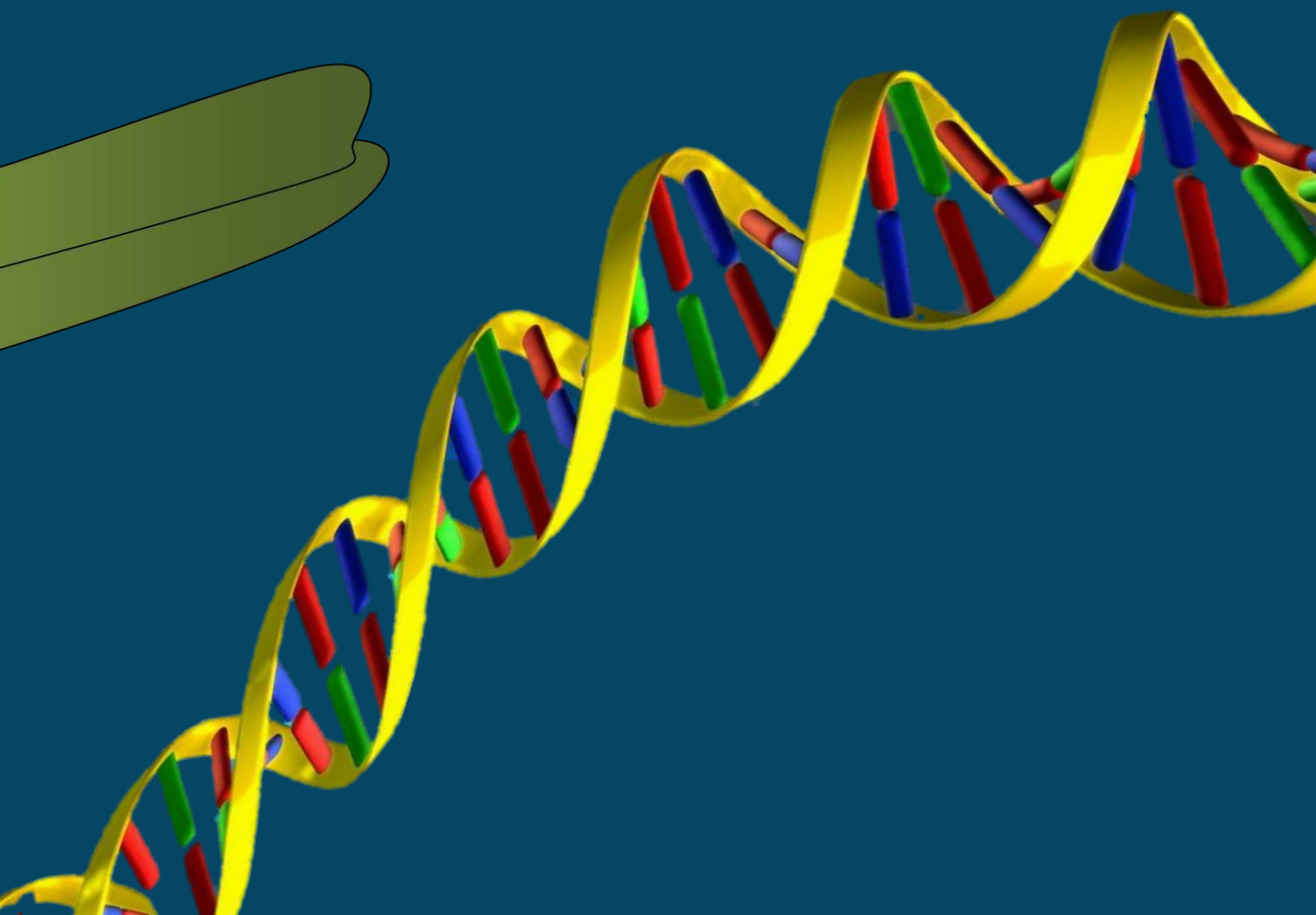
However, plants and meat (or replacements for meat) are not the only source of food out there. The little bug you saw in your house (and perhaps ran away from) is completely harmless, and also tasty. More than that, it is also highly nutritional relative to its size. It might surprize you, but most of the world's population (80% of the world's tribes -- countries) has already adopted insect eating. It's simply a matter of cultural acceptance. I recommend this documentary to learn more about eating insects.

There are many advantages to eating insects. For instance, cattle require roughly 8 pounds of feed to produce a single pound of beef. Insects, on the other hand, require only 2 pounds of feed to produce 1 pound of meat, making them four times as efficient. Much of this efficiency comes about because bugs get their heat from the environment, instead of having to create their own body heat like typical mammals. Insect farming also lower the greenhouse emissions and also greatly reduce the space needed to farm them. (source)



Then we come to what I like to call 'crazy food science', which covers techniques of engineering food that are perhaps not yet mature enough for us to properly understand their long term effects. Genetically Modified (GM) foods are both an awesome idea and quite scary at the same time. The awesome part is that humans can now 'tweak' the DNA of a plant to make it, for instance, resistant to a certain virus, thrive in different climates, be more nutritious, and so on. Livestock is another branch where GM is used to achieve similar goals. Although GM livestock is still more in the experimental stage right now, GM foods have been around for several decades. (source)

There is no doubt that the idea of genetically modifying plants and animals is promising some revolutionary outcomes, and although there has not been any direct correlation between GMO foods and any health issues, as so many scientific papers show, there still could be some long-term effects that are still under debate or not yet well understood, due to their dynamic world-wide effect, such as affecting non-targeted organisms, gene flow, etc. (source), and that's the 'crazy' part, due to the subject's massive complexity.



Still, what do you think of, instead of eating foods, you just take a pill once a day and that's it - it provides all of your bodily nutrition needs?

People have been thinking about this for a long time, and I'm guessing that it would be fantastic to have this option. Imagine how much it would reduce energy and resource consumption if, instead of producing traditional food, there would be some pills that you can take to replace that. Unfortunately, there is no scientific study that I could find to support such a 'diet'. (source)

On the other hand, there are some food replacement 'meals' (drinks), and one of the most well-known is Soylent. Soylent is a drink consisting of most of the things your body needs, including protein, carbohydrates, fats, and fiber, along with vitamins and minerals such as potassium, iron and calcium. It includes all of the elements of a healthy diet, without the 'undesirables' such as sugars, saturated fats, or cholesterol.

It is much cheaper to produce and much more efficient. Just imagine drinking 3 glasses of this 'magic' drink a day and not worrying about food at all, or dishes, or even food shopping. This is not something that may or may not someday become reality; it's something new that thousands of people are already using. Many use it as a complete replacement for food.

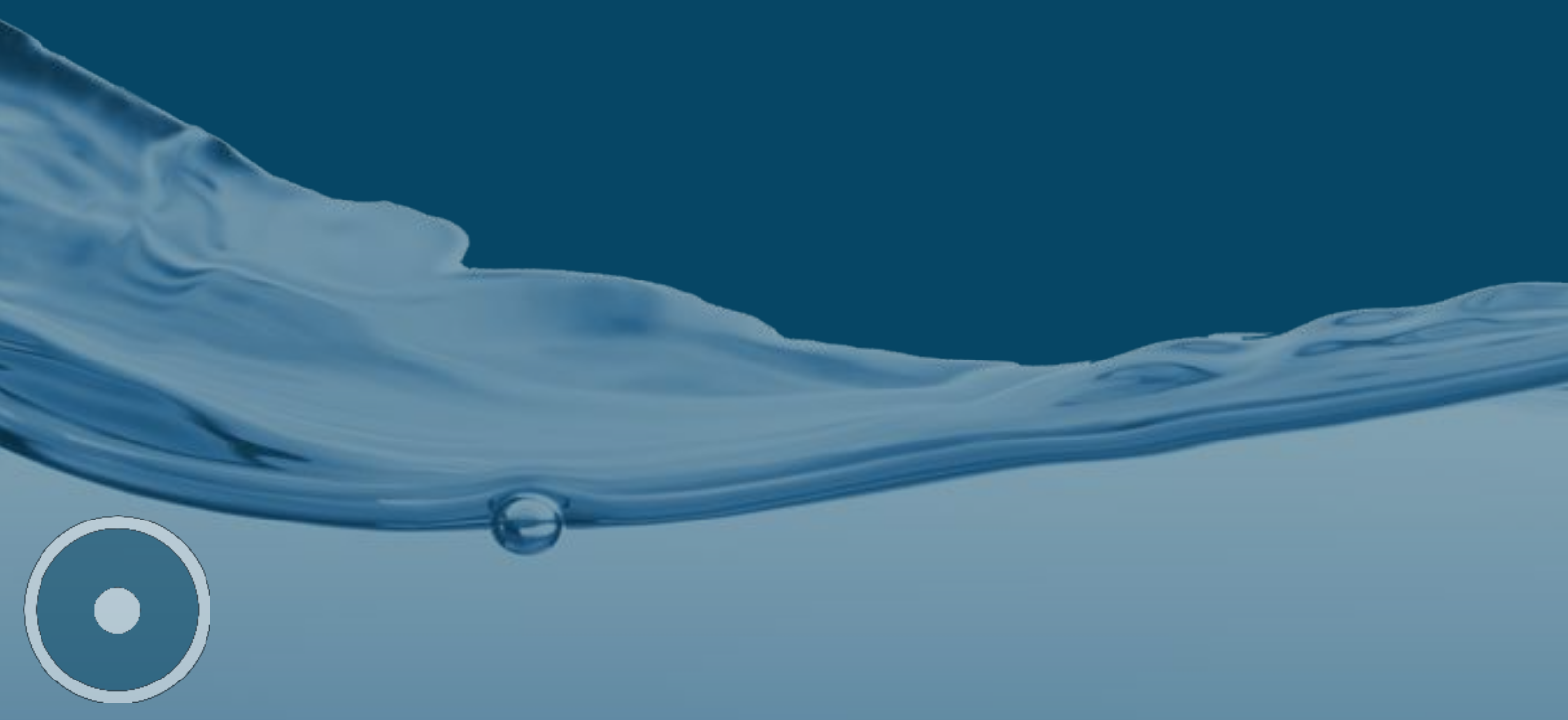
It's an awesome idea, and a 'crazy' one, since it seems almost too good to be true. So far, it seems to be a 'proper' product and I'm very inclined to try it myself.

Ok, so we have seen that there can be smart ways of producing vast quantities of foods by integrated systems that can grow both animal and plant life in a way that recycles the waste and becomes self-sustainable. In-vitro meat looks quite promising and plant based replacements for animal products seems reasonable and healthier. Also, insects could be the new 'meat' in the near future.

Each of the above consumes much less energy and resources than their traditional counterparts and can be managed at a local level; meaning cities can adopt one or more of these methods to provide food for its occupants.

Now, if scientists can learn how to more fully understand any potential long-term effects of GMO foods, perhaps new types of foods that are safe to eat can become 'superfoods' and grow in less-demanding (in terms of resources and energy) environments, produce greater quantities, and be much healthier.

Then, if products like Soylent are further tested and proven to be a complete replacement for the 'normal' meals we all eat today, and our perception about food evolves in a direction that looks more for health and efficiency, then that could bring about a huge shift in producing and consuming 'food'.



Clean water also represents a huge problem.  Although we live on a 'blue' planet, fresh water (water with minimal concentrations of dissolved salt and other solids in it) is only a small percentage of this 'blue planet' and is only accessible in some parts of the world.  Additionally, most of it it is not exactly 'ready-to-drink', first requiring purification to remove contaminants, but that is much less energy consuming than purifying salt water.

Oceans (saltwater) represent 71% of the Earth's surface and more than 96% of all of the water on Earth.  This leaves lakes, ponds, swamps, rivers, and rainfall as the predominant places from where we can extract and purify fresh water for our needs.

First of all, you have to understand that the context matters here.  For instance, if farming methods adjust to use much less water than today, global water consumption will be greatly reduced.  As a result, more water will become available for drinking, bathing, etc. than we have at the moment, alleviating many scientific concerns over the increasing scarcity of drinkable water.

With that in mind, let's check out some new and efficient technologies for purifying fresh and/or salt water for human use.When it comes to water, I think of it in terms of: transform, recycle, collect and store.

**To transform:** Desalination is the process of separating salt from water, and since most of the water on the planet is salty, this process is very important to master.

There are currently two important methods of getting 'rid of' salt from water: boiling it (vacuum distillation) and reverse osmosis which is basically a method of forcing water through membranes to separate salt and other minerals from it. (source)

WaterFX, for instance, uses sunlight to produce heat, with the heat then separating the salt and water through evaporation. The salt solidifies after the separation, allowing it to be removed and used in other industries, such as building materials, metals, or fertilizers.

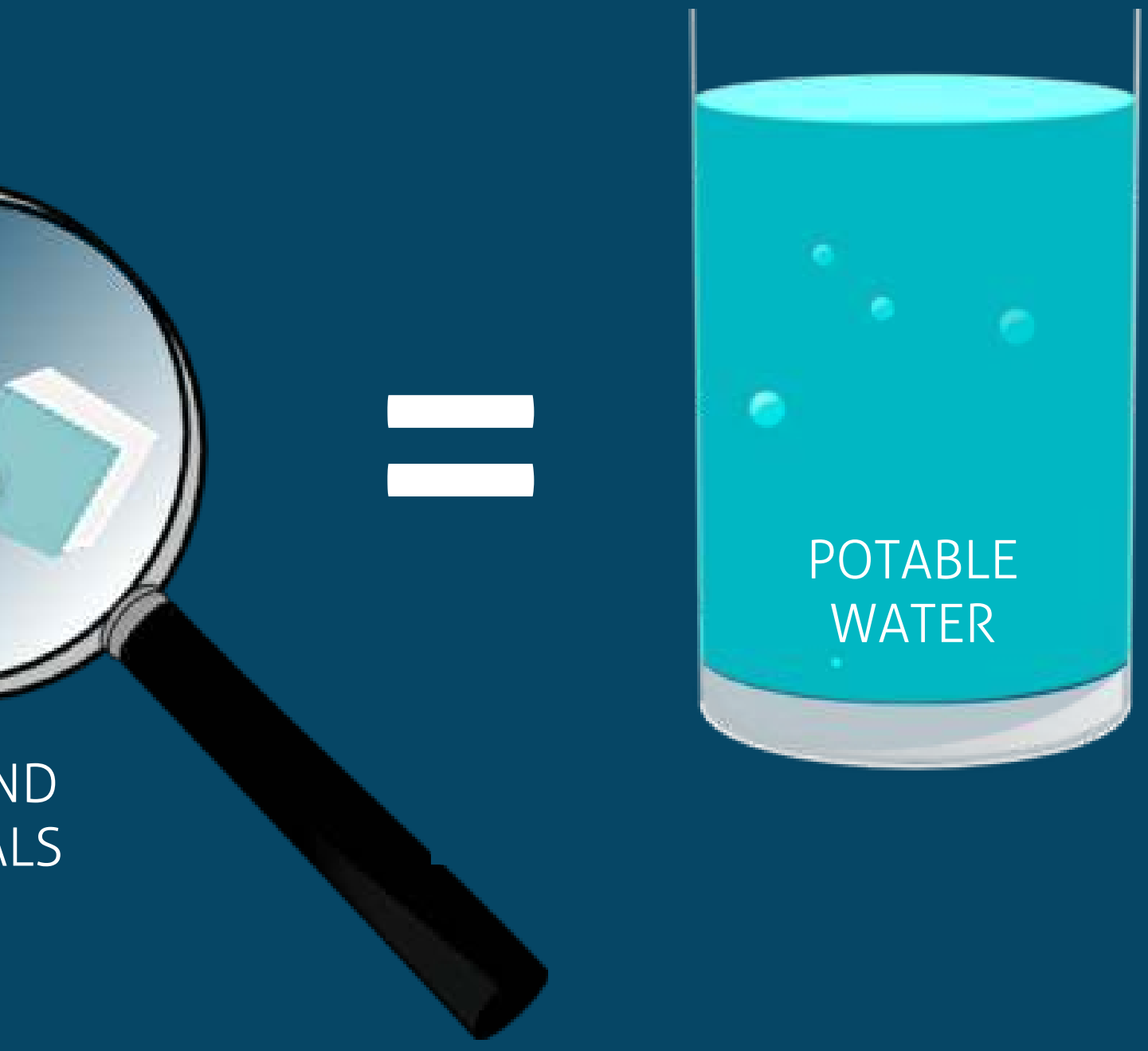
SEAWATER

SALT AN
MINERA

In order to operate continuously, the solar trough is made very large so that it collects extra heat during the day. The process of reverse osmosis is only able to extract around half of the total input saltwater as fresh water, but WaterFX' approach can produce up to 93% fresh water.

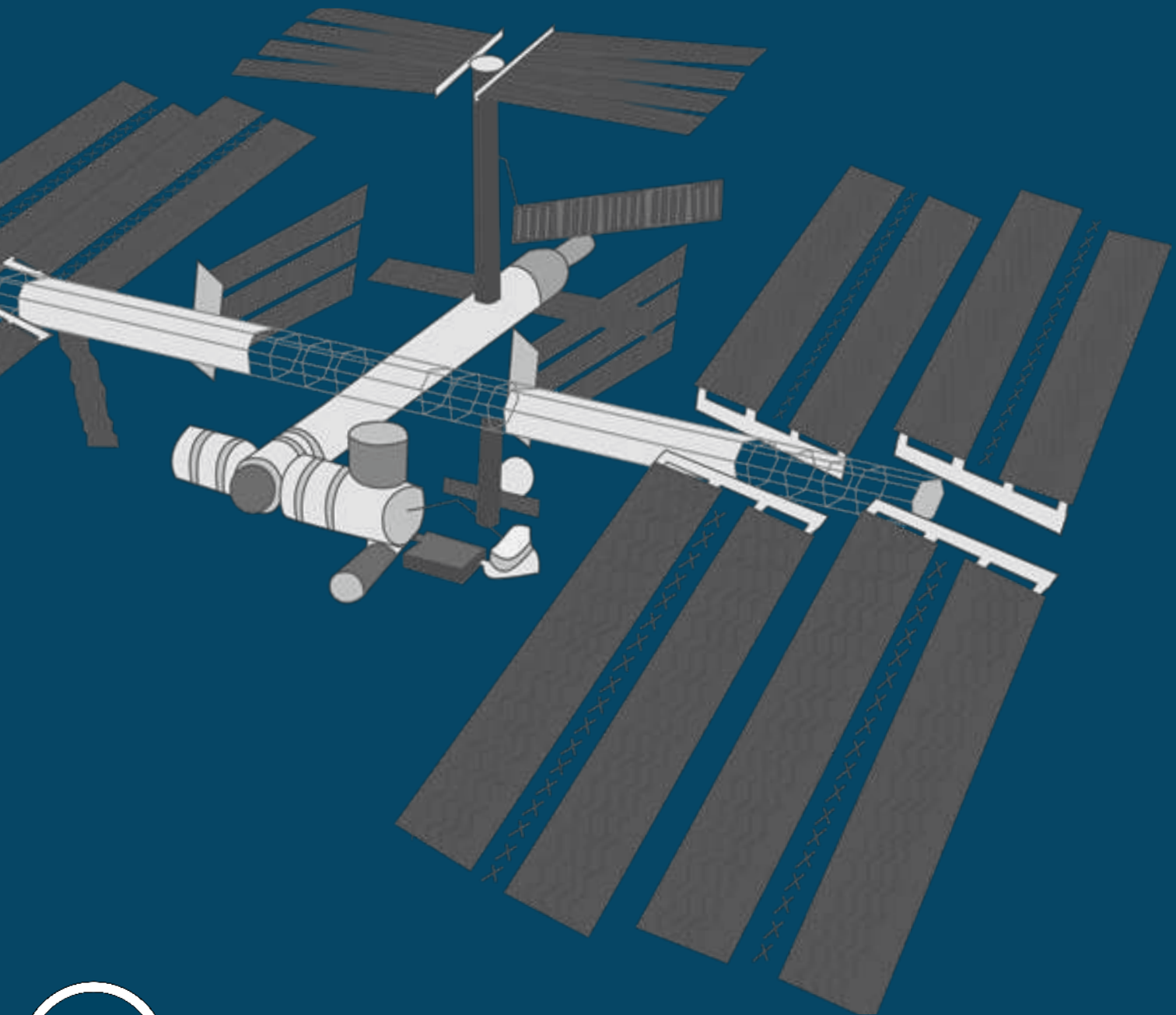
Their first demonstration plant can produce around 100 liters of fresh water per minute. The WaterFX system also has fewer environmental repercussions than traditional methods of desalination that rely on fossil fuels to generate electricity.

WaterFX is not the first company to experiment with solar desalination. The Sahara Forest project in Qatar and an Australian company called Sundrop Farms are using the technology to grow food in greenhouses. (source)



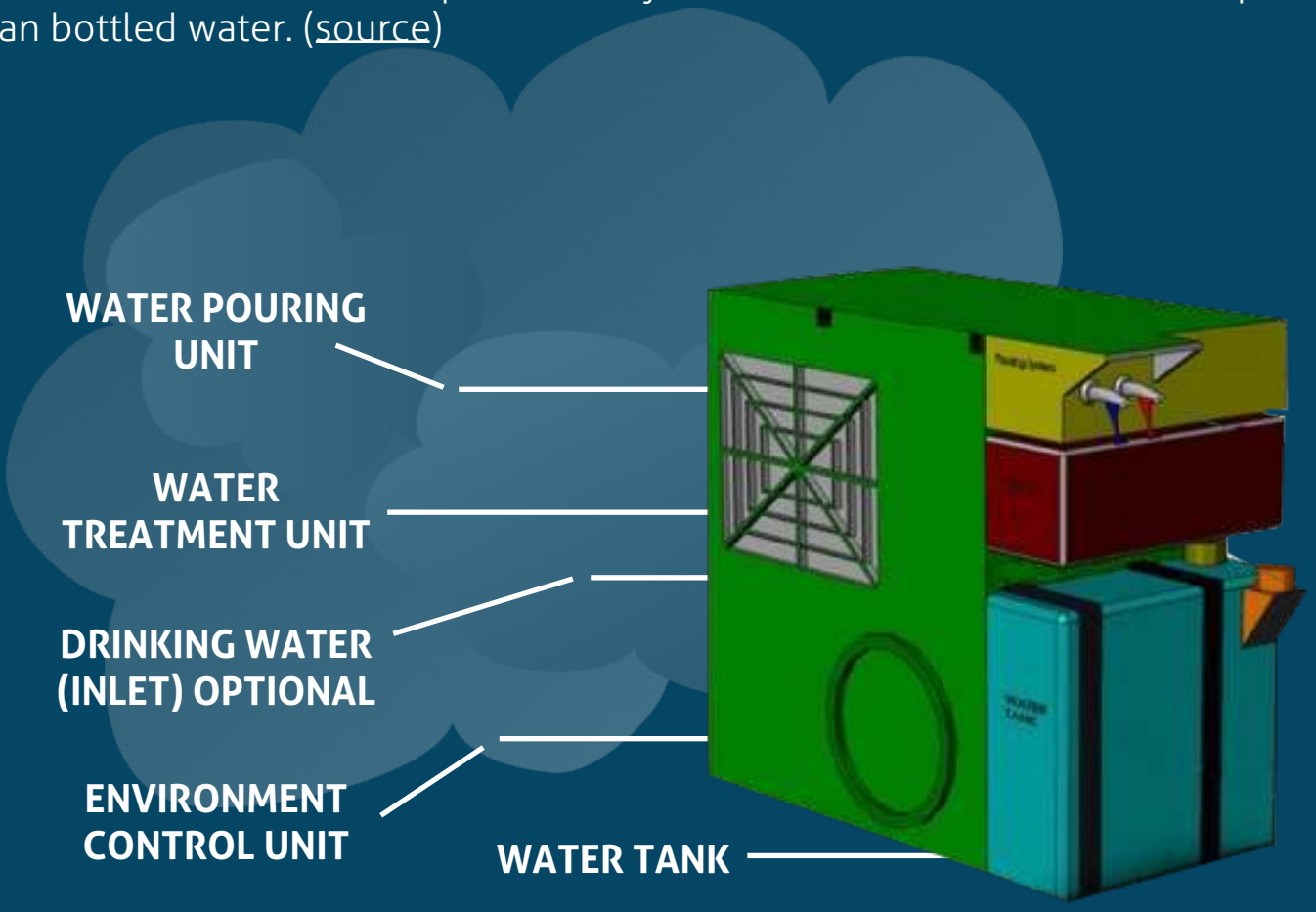
**To recycle**: The recycling of water is likely to bring about huge water consumption efficiency, and since there are so many ways of recycling the many different types of water usage, it's easiest to point towards the International Space Station (ISS) to examine a completely functional multi-purpose system in place. There, water is so scarce that they had to invent new ways of recycling it. Urine, oral hygiene, hand washing, and condensed humidity from the air within the station are all recycled. (source) The ISS can recycle about 93 percent of the liquids it receives. (source)

Now imagine putting human brains to approach the situation on Earth in the same manner.



**Collect and Store**: Huge reservoirs can be used to store water, with multiple systems to collect it. Rainwater can be collected using a wide variety of methods (and there is plenty of rainwater: floods are quite often a result of not applying well-known science and technology to collect rainwater), but while rainwater could be a major fresh water source, water can also be extracted from underground or from the atmosphere.

As an example, GENius is a machine that collects water from the atmosphere and converts it to drinkable water at a cost of two cents worth of energy per liter, and it can produce 250-800 liters per day depending on the climate conditions.  A litre of water produced by these machines is 10 times cheaper than bottled water. (source)




So much technology and knowledge exists for extremely efficiently managing water for our use: from collecting it and storing it, to methods of purifying it. Only the immense short-sightedness of a primitive social system could continue to allow, and worse, support fresh water scarcity on "The Blue Planet" for the 'most intelligent species on the planet'.

I hope we have shown you that food and water can be managed, even with today's technology, in a very smart and efficient way.  However, the key factor to every technology we have presented to you in this series comes down to energy.

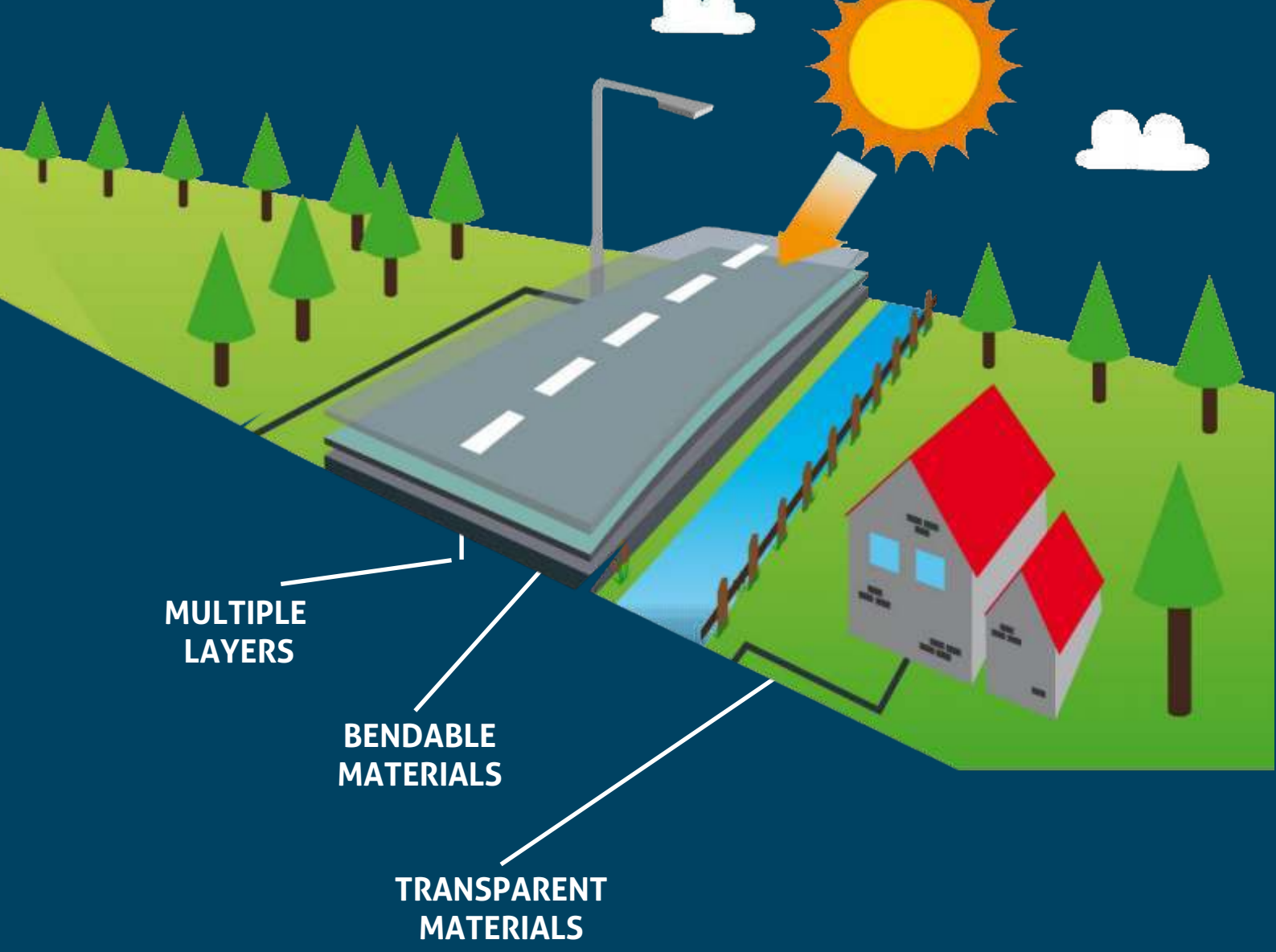
# ENERGY

Sources of energy come in multiple forms; you can 'extract' energy from the Sun, from Earth's underground heat, wind, water movement, chemical reactions, and so on. One key point to keep in mind is that for it to be part of a sustainable society, energy has to be extracted from 'renewable' sources, which means energy that comes from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

Given that there are numerous types of renewable energies and multiple methods for managing each type, I will try to show you some of the latest breakthroughs.

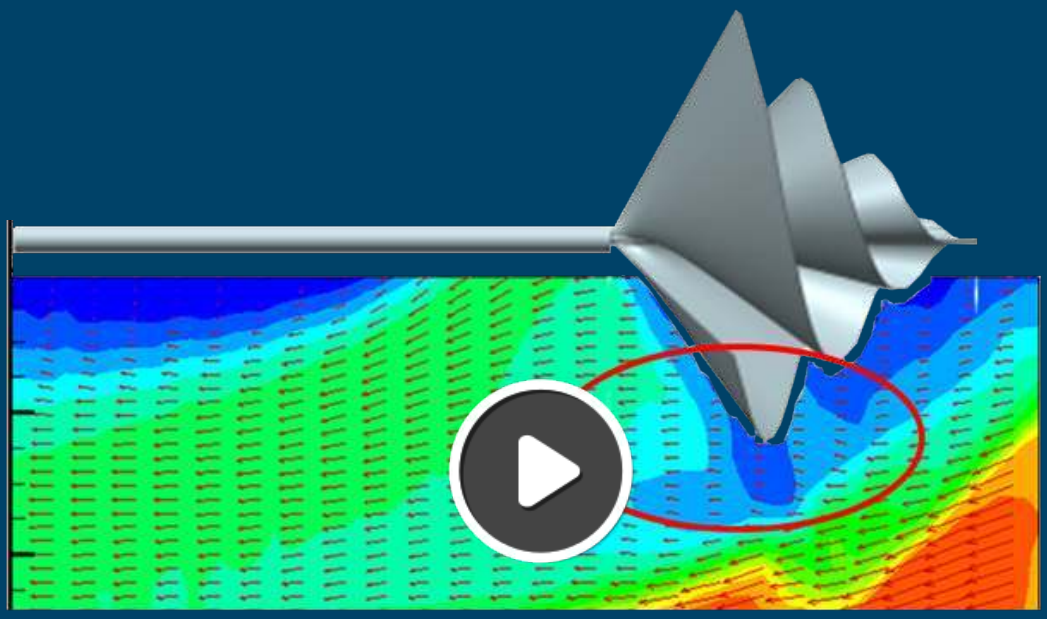
**SOLAR**: A new type of transparent solar panels is being developed. Since they are transparent, they can be used on windows, mobile phone screens, or any other surface that needs to be transparent. They are currently at only 1% efficiency, but researchers say they can be made 5% efficient when fully developed. (source) Solar panels can be installed directly on the ground, as well. Solar Roadways has developed a prototype of this sort which they claim to be 15% efficient. Today's most productive solar cells are 44.7% efficient, which means they can convert 44.7% of the total energy they receive into energy that we can use. (source) However, we can get to 50% efficiency if we stack solar panels in a new innovative way, as one company has recently proven. (source)

Perovskite solar cells is a type of technology that appears quite promising. They currently have an efficiency of only 11%, but they are very cheap to make, in terms of energy and resources consumed, and also seem to be much more durable.



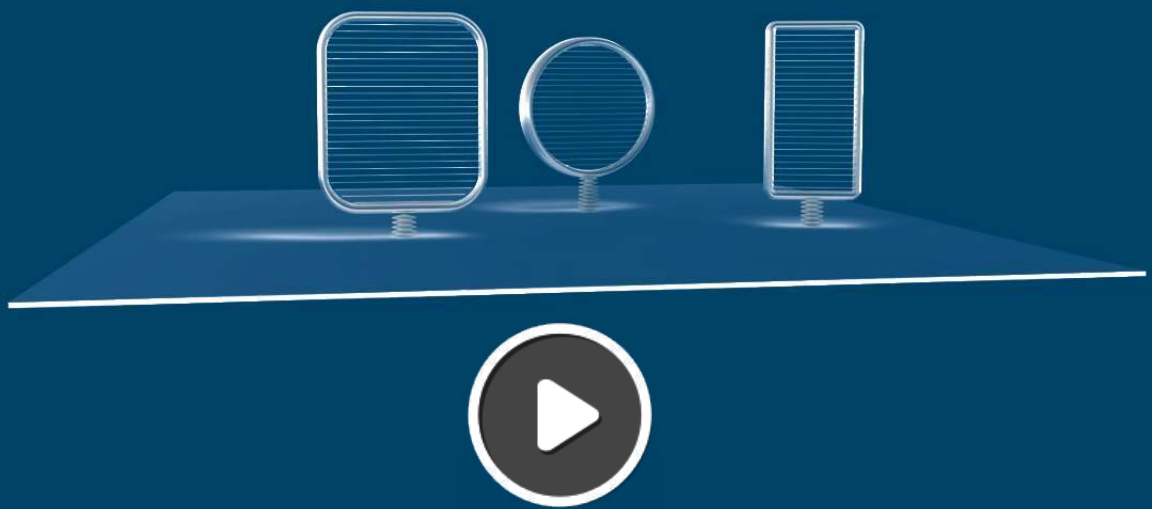

There seems to be a number of ways to 'extract' energy from sunlight: From direct conversion of sunlight to energy, using the sun's rays to heat water or to produce electricity, or using solar energy to directly heat and light buildings, all of these approaches are experiencing rapid rates of technical improvements and overall efficacy, while technologies like transparent materials, bendable surfaces, and solar panel stacking significantly multiply where solar power can be used. (source)

**WIND**: The Archimedes: Weighs 75 kg and can produce 1500kWH/year at winds of 15m/s. With its unique blade design, it is capable of capturing wind from any direction and is quieter than traditional wind turbines. Also, it claims to "turn as much as 80 percent of harness-able energy from wind into electricity, a conversion rate on par with the world's top performing systems." (source)

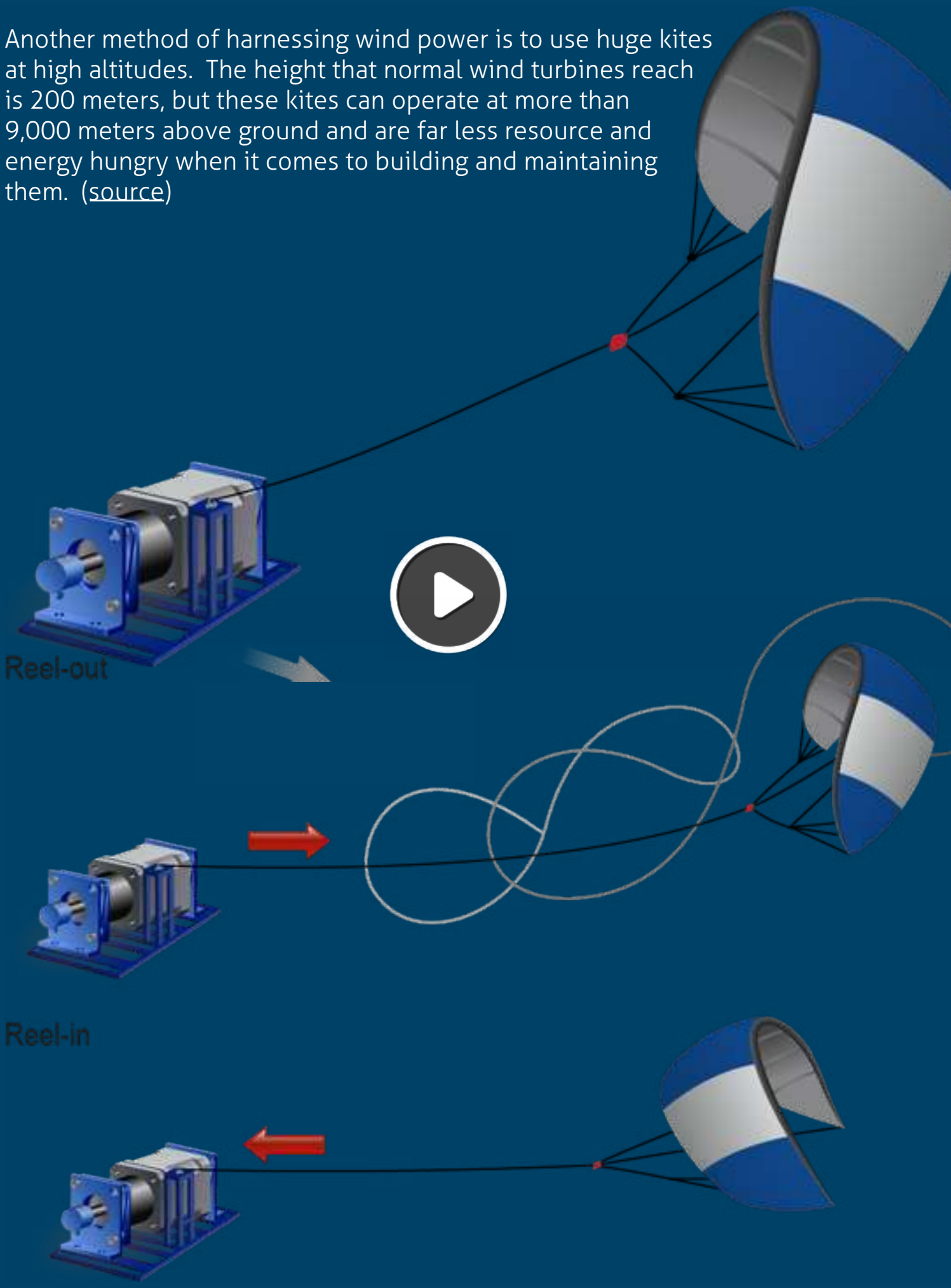


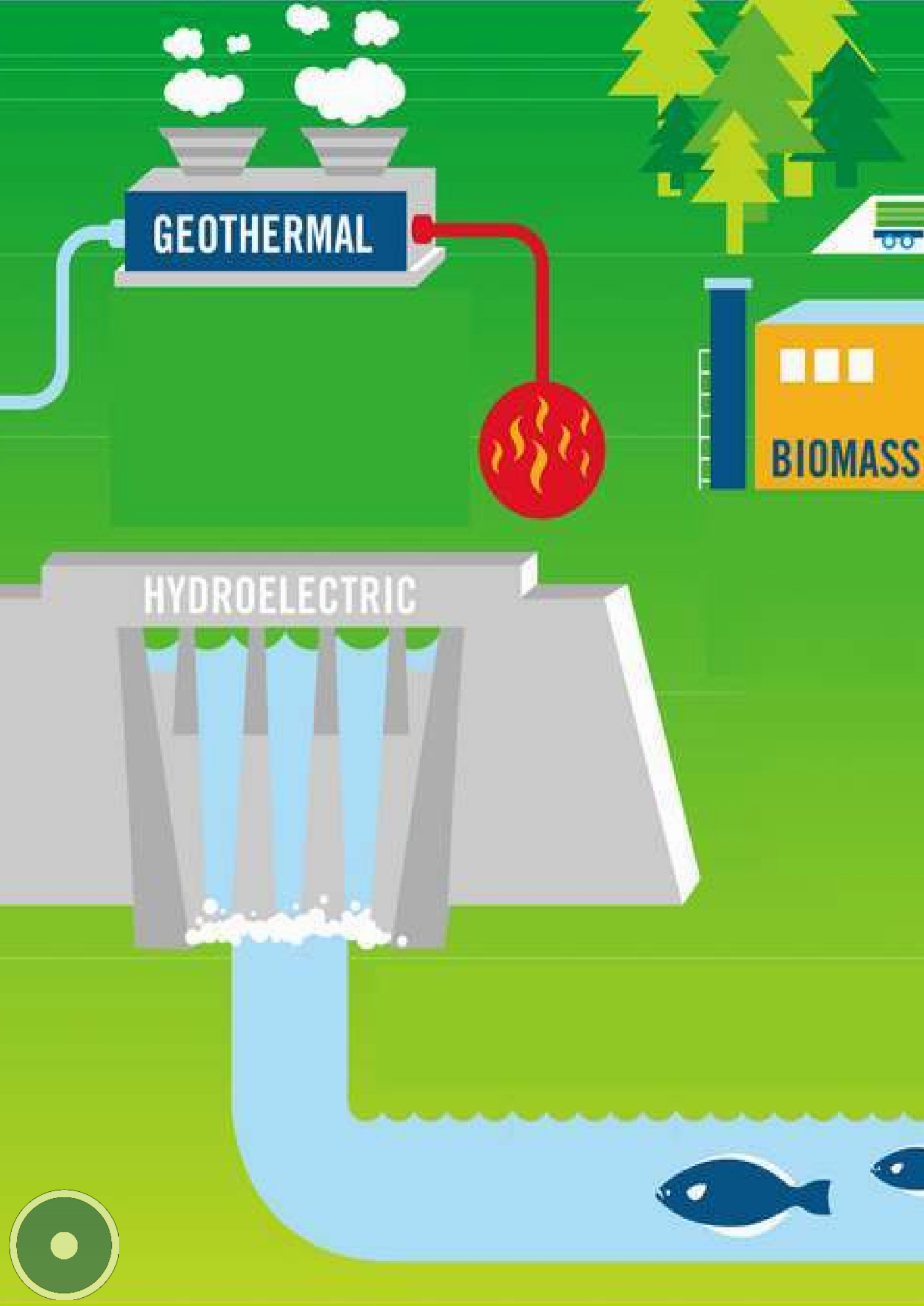
There are many types of wind turbines, with each suited for different environments and wind speeds. Some can even float at high altitudes, where wind is much stronger. Here's a detailed list.

Additionally, wind power can be harnessed even without blades. Dutch researchers have created a bladeless wind turbine with no moving parts that produces electricity using charged water droplets. (source)



Another method of harnessing wind power is to use huge kites at high altitudes. The height that normal wind turbines reach is 200 meters, but these kites can operate at more than 9,000 meters above ground and are far less resource and energy hungry when it comes to building and maintaining them. (source)




GEOTHERMAL
BIOMASS
HYDROELECTRIC

Rivers, tides, and underwater currents can also be harnessed to produce energy. As in the previous section, there are a plethora of technologies and methods to accomplish the task. Geothermal, ocean thermal energy converters, and even extracting energy from the human body are some of the many, many ways to extract energy in a sustainable way. The list is too long to name them all here, but I will show you why there's no need to do that. *You can run your own research on that if you prefer to know more, starting here.*

I watched a talk at NASA Ames Research Center by Mark Z. Jacobson, professor of Civil and Environmental Engineering at Stanford University, director of the Atmosphere/Energy program. His talk focused on how we can power the entire world using only renewable energies. His research was conducted by a team of scientists using highly complex computer simulations and taking into account many variables. They analyzed the impact of these variables on climate and the overall environment, and even the materials that can be used to regionally and globally build a 100% renewable infrastructure. I will outline the highlights of this research for you, but you can also find it all here if you want to learn more about the details.

# THEREFORE, IN ORDER TO MAKE THE HUMAN SPECIES USE 100% RENEWABLE ENERGIES WE WOULD NEED:

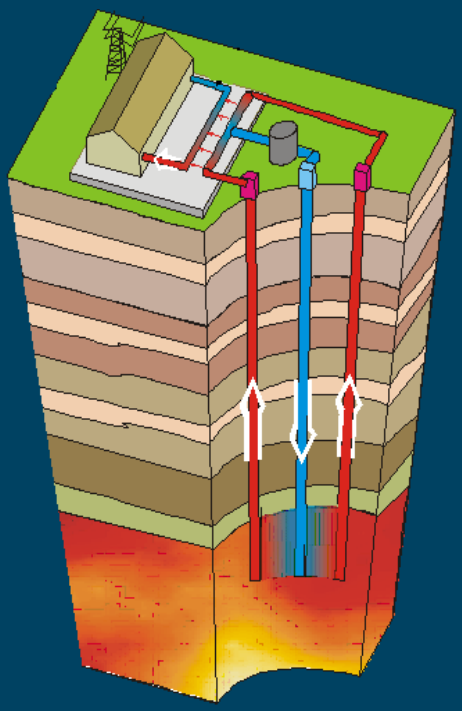
*A SMALL PERCENTAGE OF THESE TECHNOLOGIES ARE ALREADY IN PLACE.*

3.8 MILLION

WIND TURBINES

(5-MW EACH)

50%



5,350

GEOTHERMAL PLANTS

(100-MW EACH)

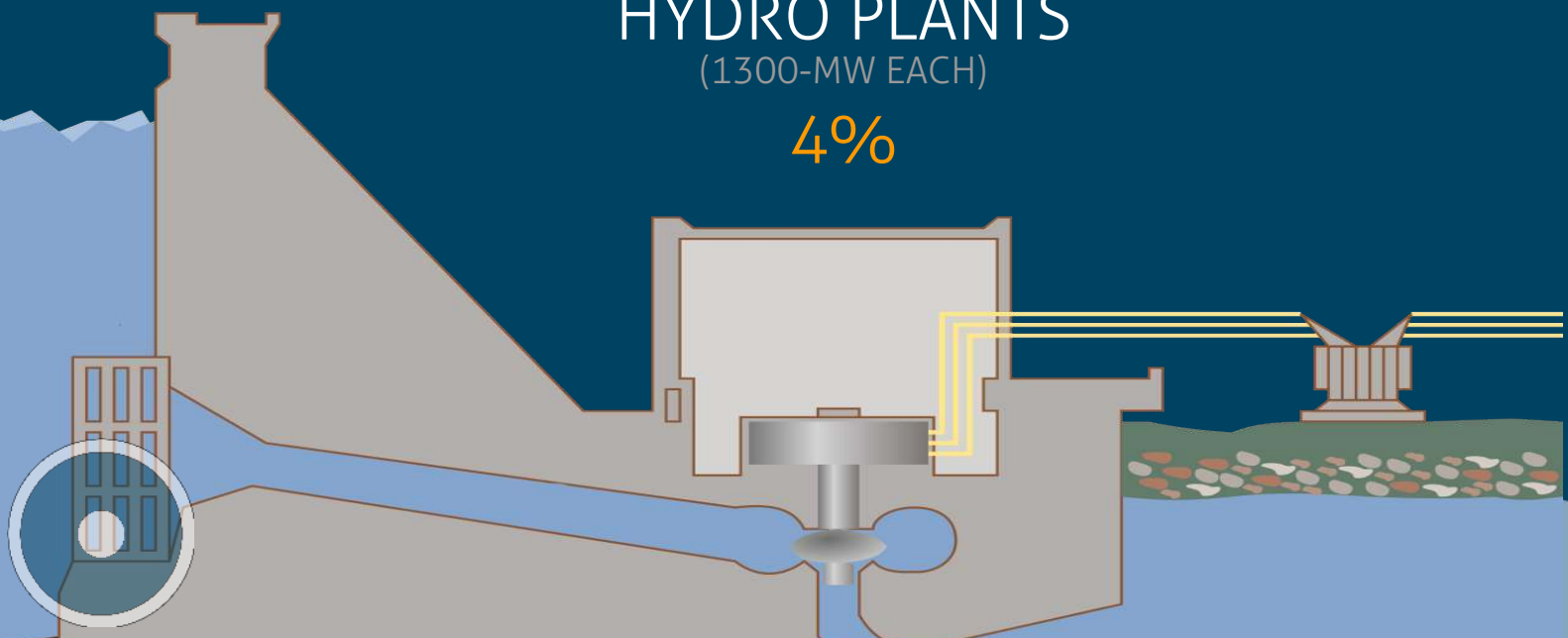
4%

900

HYDRO PLANTS

(1300-MW EACH)

4%

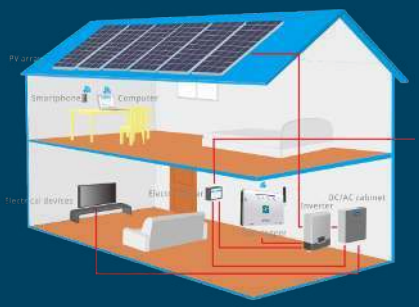


1.7 BILLION

ROOF PHOTOVOLTAIC SYSTEMS

(3-KW EACH)

6%

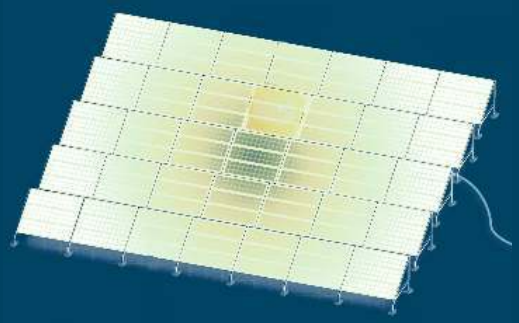


40,000

SOLAR PHOTOVOLTAIC PLANTS

(300-MW EACH)

14%

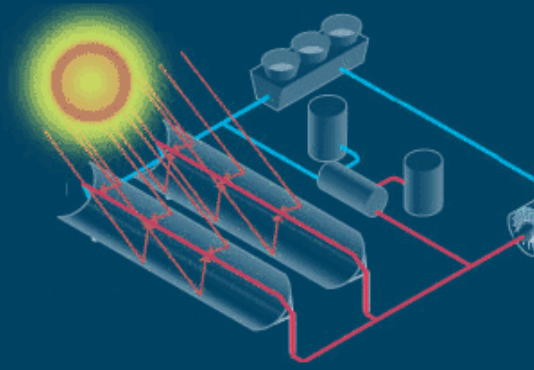


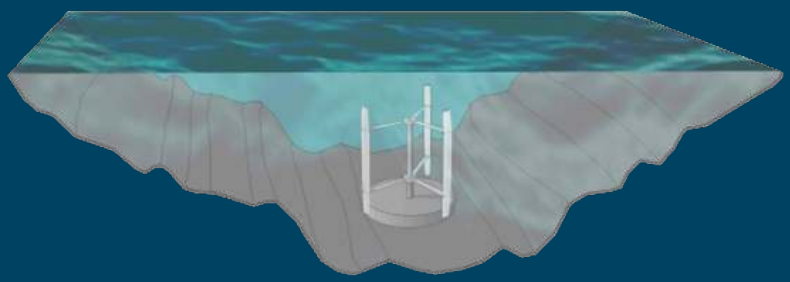
49,000

CONCENTRATED SOLAR POWER PLANTS

(300-MW EACH)

20%





490,000

TIDAL TURBINES

(1-MW EACH)

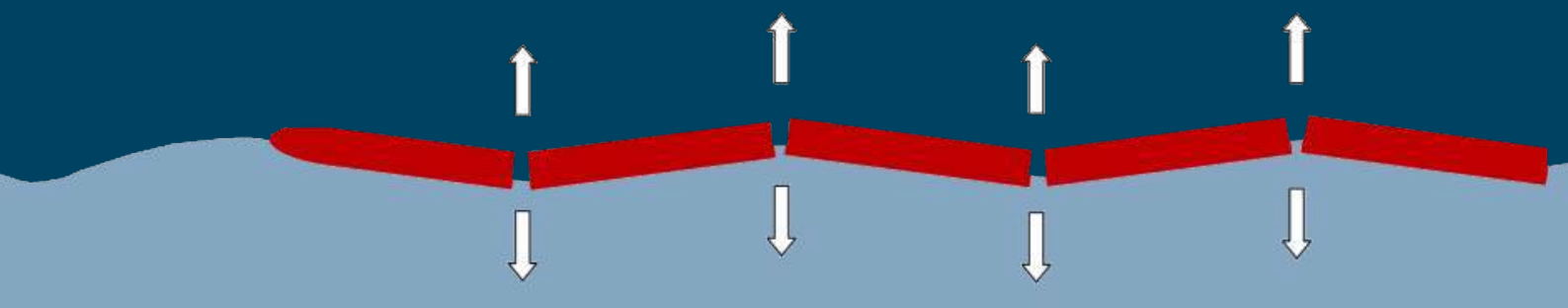
1%

720,000

WAVE DEVICES

(0.7-MW EACH)

1%



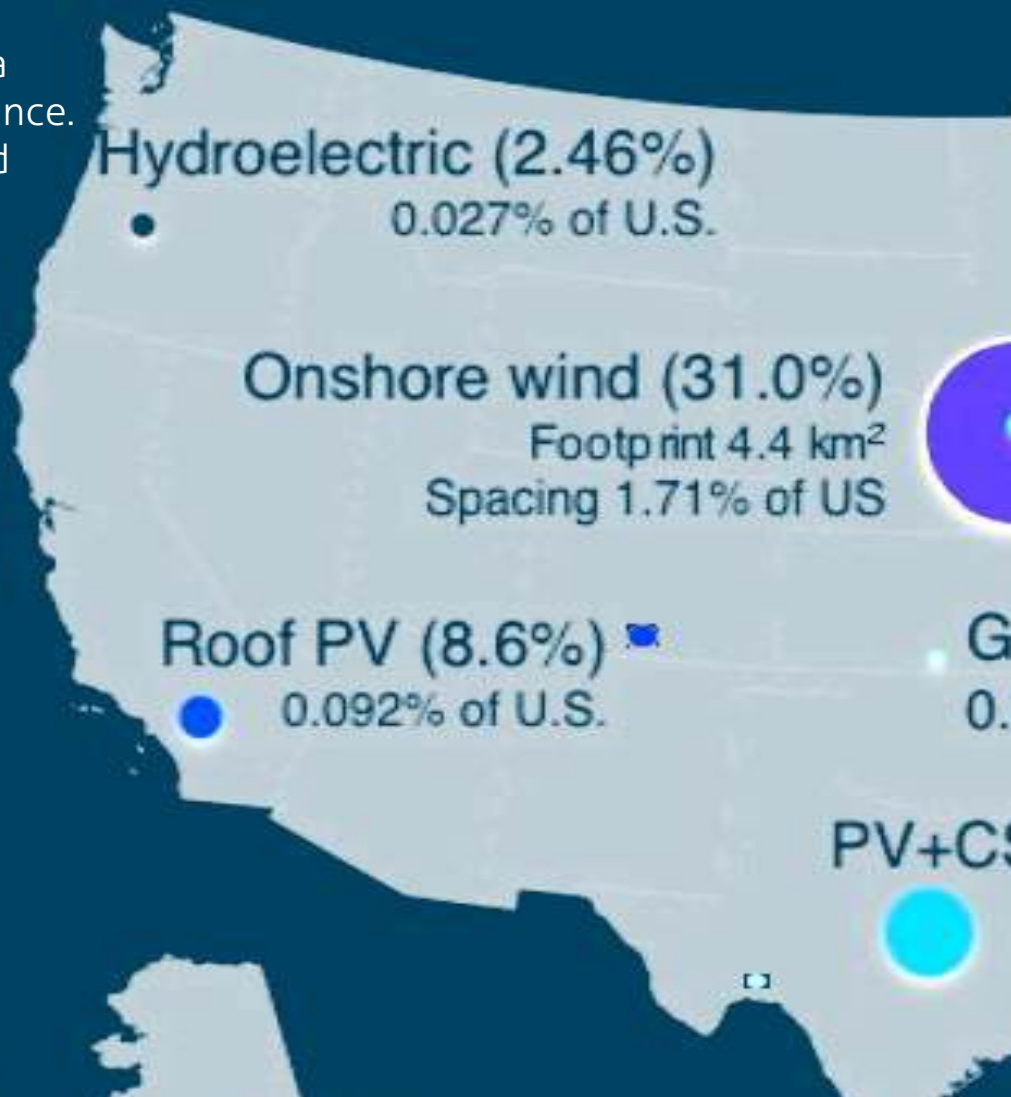
To put it in perspective, 60 million cars are produced each year. Humanity can easily produce 3.8 million turbines to cover half of the world's power needs, especially given that it wouldn't be a repeated yearly need like cars.

It is estimated that it will cost 100 trillion of today's dollars to make the world 100% renewable, keeping in mind that the cost of technology drops while its efficiency increases, both exponentially. To put this number in perspective again, if the world could just stop fighting for 50 years, they would save the money needed to make the world entirely renewable.

However, it isn't about the money at all. Money is a fictional tool that humans invented, therefore the main requirement is that we now have the technology to do all that. Also take into consideration that these numbers reflect today's 'consuming culture'. In an intelligent (trade-free) world, overall energy consumption needs would likely be reduced a lot, so keep that in mind, too.

The team of researchers focused more on the US, showing that it will only take 1.7% of the US landmass to make US rely only on renewable energy. The map shows a relevant distribution of the technologies used to collect energy, taking into account the environment. So, for instance, in areas where there is more wind, there will be more wind turbines than in areas where the sun is more abundant and relying more on solar energy capturing devices.

Their studies also revealed a 'side effect' of great importance. For instance, they simulated hurricane Katrina and what would happen if the 170,000 turbines had been in its path, as their plan proposes.



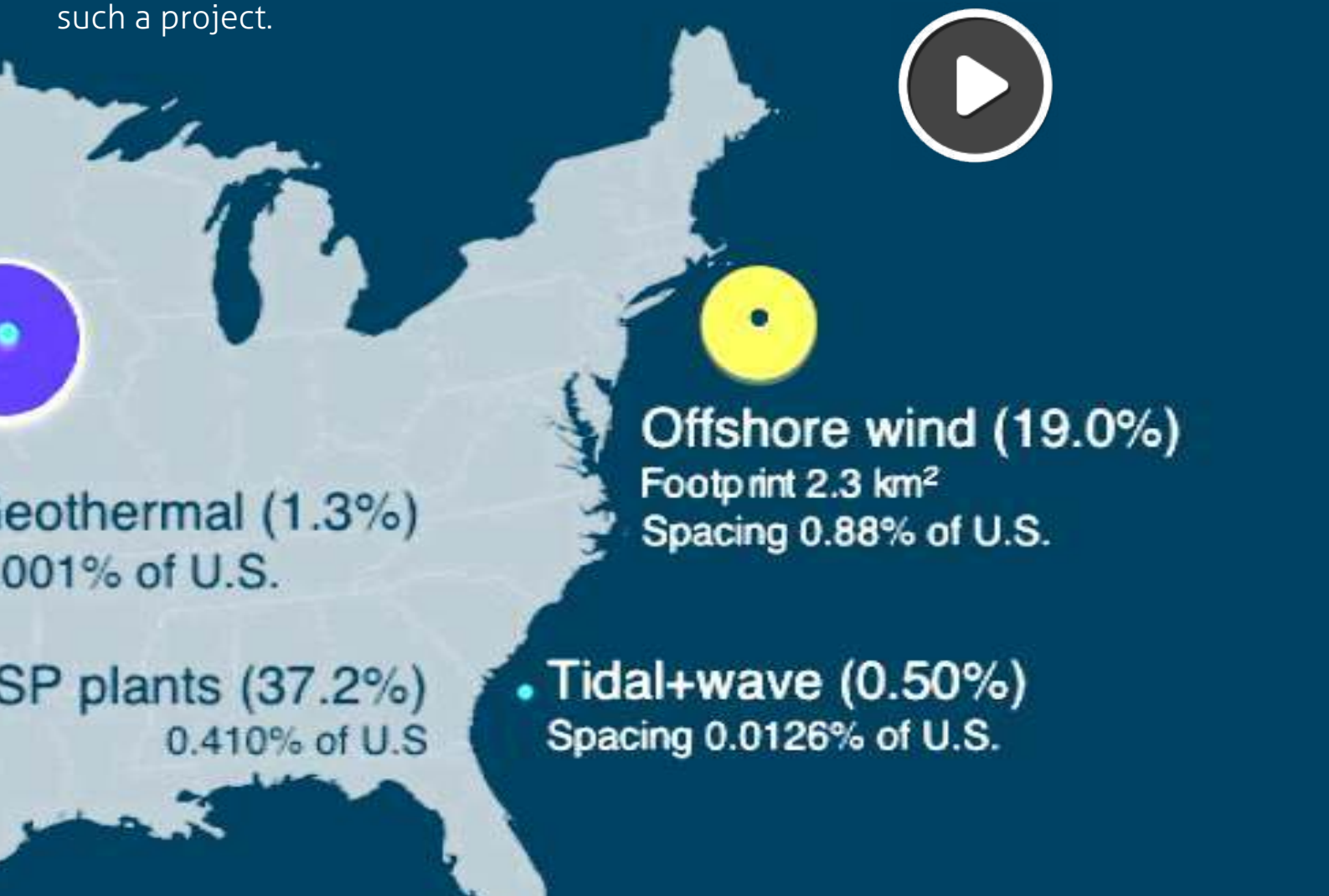
It showed that the turbines significantly slowed down the hurricane, reducing the storm's surge by 80%, while the turbines captured even more energy for the grid. More importantly, they also slowed down the hurricane's winds by 50-60% and no turbine was destroyed. They did this simulation for many other hurricanes and it showed a similar pattern.

They also concluded that the 3.8 million wind turbines would have no significant negative impact on the world's climate. Another graphic shows how they could predict the weather with greater accuracy, so that we would know in advance if a region is going to have enough supply of renewable energy for a period of time.

Jacobson says that there is no technological problem or lack of materials holding this back; it is only a lobbying and political problem.

What is even more remarkable about this study is that the entire project can be accomplished in a way that 98-99% of the energy can be utilized without storage. That is a huge deal! It means that we won't have to rely much on (battery) storage. You can see a detailed map of their project at thesolutionsproject.org.

However, new technologies, like those we have showcased so far, are likely to vastly improve the efficiencies of the approaches that Jacobson and his team are proposing, significantly reducing the energy and resources needed to realize such a project.



I hope that we have proven that there are many solutions to both growing food locally and for relying on renewable energies to power entire cities, all in a sustainable manner.

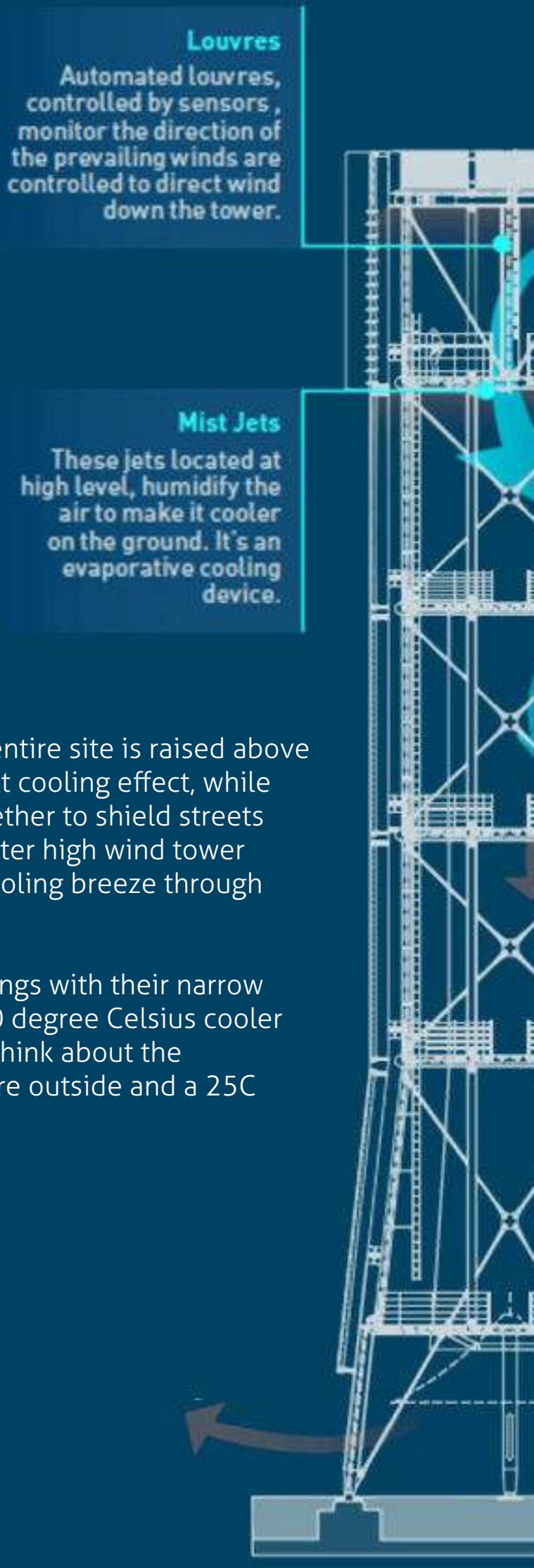
Of course, cities are not only about food and energy, but those are the most essential aspects that have to be properly managed. The rest, such as entertainment places, sport arenas, recreational areas, etc., are an emergent process that depends on the 'sanity' of the world.

## COLONIZING DIFFERENT LANDSCAPES

In this section, we will try to show you some current examples of cities built in different kinds of environments. Since most cities of the world are emergent villages, or they were not build with the idea of a 'total enclosure system' in mind, there won't be many such examples.

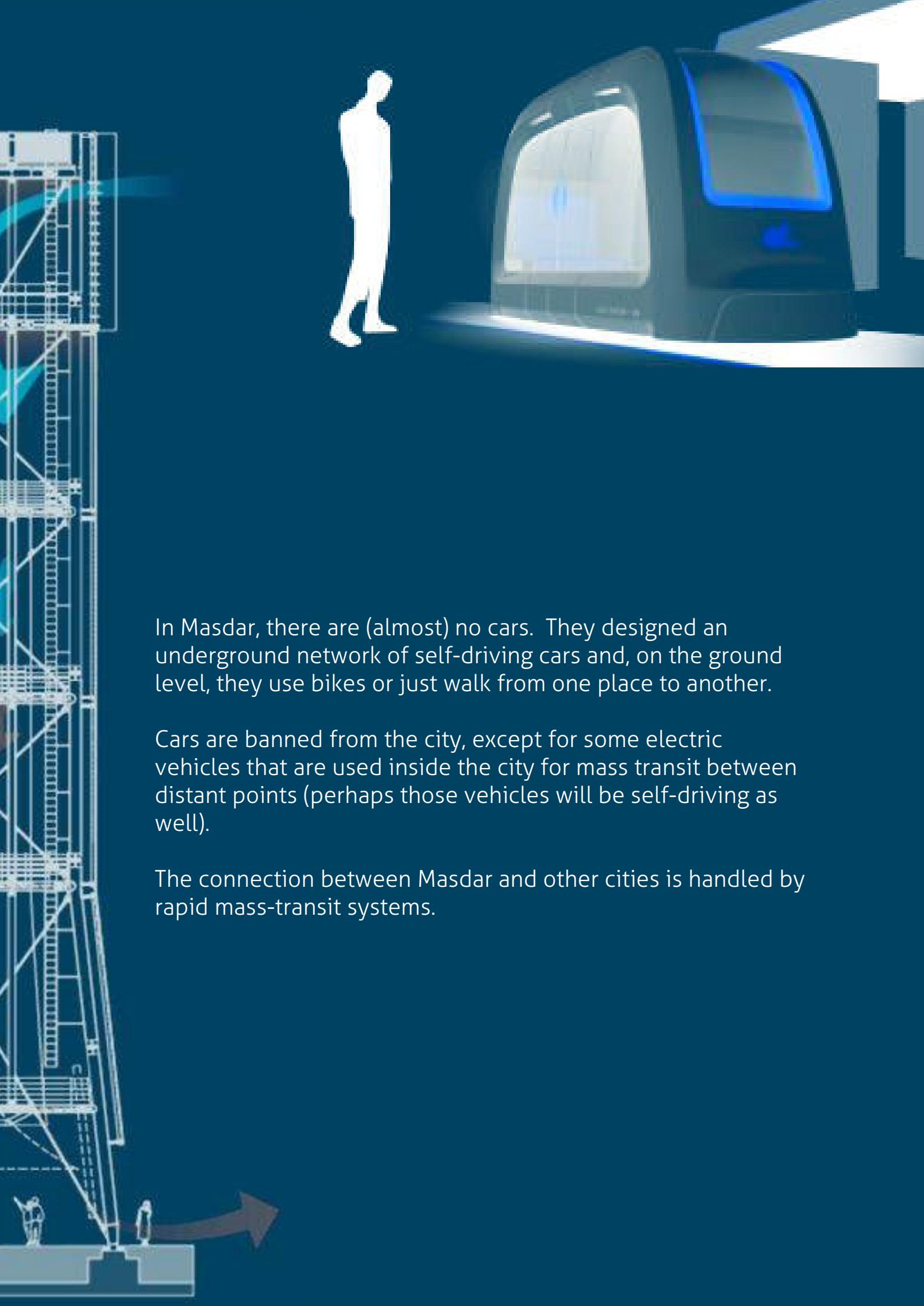
Masdar city is a project to build a self-sustainable city in a desert. The project started in 2006 and final completion is scheduled to occur between 2020 and 2025. The city is envisioned to cover 6 square kilometres and will be home to 45,000 to 50,000 people.

Parts of the city are already completed and Masdar is already inhabited. It is expected that around 4,000 people will be residing there before the end of 2014. Masdar predicts that the city's population will hit 10,000 in three to five years.




**About the city's infrastructure**: The entire site is raised above the surrounding land to create a slight cooling effect, while the buildings are clustered close together to shield streets and walkways from the sun.  A 45-meter high wind tower sucks air from above and pushes a cooling breeze through Masdar's streets.

The position of the city and it's buildings with their narrow streets can keep the entire city 15-20 degree Celsius cooler than the 'outside' temperature.  Just think about the difference between a 45C temperature outside and a 25C inside the city.



In Masdar, there are (almost) no cars.  They designed an underground network of self-driving cars and, on the ground level, they use bikes or just walk from one place to another.

Cars are banned from the city, except for some electric vehicles that are used inside the city for mass transit between distant points (perhaps those vehicles will be self-driving as well).

The connection between Masdar and other cities is handled by rapid mass-transit systems.

Their first occupants were a group of scientists.  The Masdar Institute of Science and Technology (MIST) is a graduate-level research university focusing on alternative energy, environmental sustainability, and clean technology.

MIST is constantly gathering students from around the world to work on plans to focus on renewable energy, smart grids and smart buildings, energy policy and planning, water use, environmental engineering, and electronics.

As an example of efficiency, the MIST research center building uses 70% less electricity and potable water than normal buildings of similar size and is fitted with a metering system that constantly observes power consumption.  There are other buildings inside Masdar that are very energy and water efficient.

The city is powered by nearly 90,000 solar panels and the city produces more energy than it needs. There are no light switches or water taps in the city; movement sensors control all lighting and water, which has reduced electricity and water consumption by 51 and 55 percent, respectively.

Wind-blown sand has been a problem for its solar panels, so Masdar has been working with other companies to engineer surfaces with pores smaller than sand particles to stop them from sticking on the panels. Scientists at the Masdar Institute are also working on coatings that repel sand and bacteria for use on solar panels and in other applications.

Approximately 80 percent of the water used in the city will be recycled and waste water will be reused "as many times as possible", with this greywater then being used for crop irrigation and other purposes. Masdar even plans to grow its own food in the desert. (source)

"All aspects of city life are integrated, so entertainment, recreation and home are all in close proximity, for convenience and to minimise use of transportation." says the official website of Masdar city.

The website goes on to say, "Another unique aspect of the city is that walking – even within buildings -- is encouraged as a way to reduce energy use and promote a healthy lifestyle.  For example, stairs are always prominently featured, while elevators are hidden."

Masdar is still a commercial city; they still have shopping centers, they are still limited by money and laws, and their educational perspective and cultural values are nowhere near what we are proposing with TROM project. So Masdar is just a technological example of a self sustainable city. Nothing more than that.

You can read extensively on Wikipedia about many other sustainable villages or communities to see what methods and tools they used and what their current state of applied technology towards sustainable cities is like.

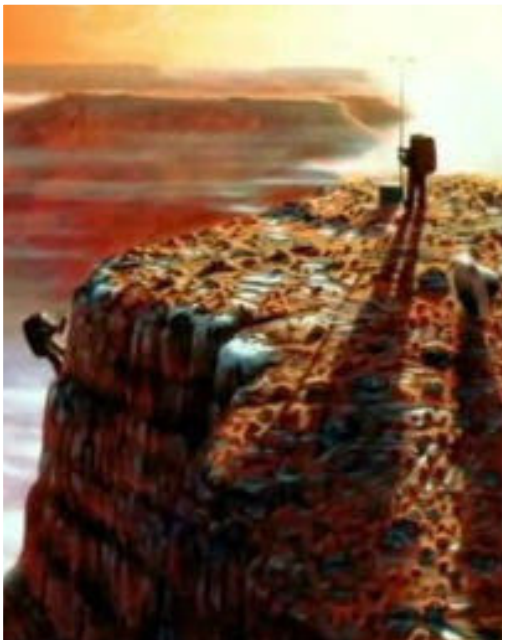
There are also some 'on paper' projects featuring floating cities, underwater cities or even cities on Mars (a very hostile climate).

Since they are only 'on paper', it will not serve the purpose of the AA WORLD series to include them here, since we wanted to show you real examples, or at least working prototypes of technology, to prove the feasibility of the world we are proposing: one of abundance for all, one in which any form of trade is obsolete, where laws and politics make no sense, and so forth, as described in "The Money Game and Beyond" book.

The South pole station, the International Space Station, and even NASA's plans for building colonies on the Moon or Mars (and the prototypes they developed) are a proof that many environments can be 'conquered' by humans. From extracting energy and growing food, to methods of on-site construction and smart automated systems that can maintain such clusters of 'things', anything seems to be possible with today's technology.

THE OVERALL TECHNOLOGIES PRESENTED IN THIS CITIES AND THE ENVIRONMENT PART, ARE, WE BELIEVE, A VERY IMPORTANT SHOWCASE OF TECHNOLOGY AND ITS CAPACITY TO CREATE AND HANDLE THE NEEDS OF COMPLEX CITIES IN DIFFERENT ENVIRONMENTS.

# RECOMMENDED DOCUMENTARIES



**THE MARS UNDERGROUND**

**EARTH UNDERWATER**

**CITY UNDER THE SEA**

**SOUTH POLE STATION**

# WHY TECHNOLOGY ALONE IS NOT ENOUGH

The AA WORLD book is not about promoting Masdar city, Hyperloop, Cisco, or any city, company, or group of people. It is not even about how these technologies are being applied in the current social context. It is, as was stated at the beginning of this book, about highlighting the potential of present day technologies to demonstrate the feasibility of the kind of world we try to describe through TROM project.

There are far more and far better technologies than those that have been presented in this book and we ask you to think deeply about the potential of human brain power when we really want to do something. Just imagine if people put their minds on creating a such a trade-free society as much as they put their minds together 50 years ago on sending people to the moon with technology that is regarded as primitive today. Imagine the potential!

When it comes to this new society, it is imperative that we think about technology as a human 'extension', a tool to help human beings get what they need and want, when they need and want it.

It also must be a tool that is smart enough to maintain an equilibrium between the human society and the environment, to ensure stability for both our human world and the total environment we live in.

Technology will replace repetitive and boring jobs, making processes like construction or fabrication of goods much more complex, efficient and safe; it will allow for much more precise, relevant decision-making through complex AI systems; it will also become a scaffold for the entire planet, sensing and responding to changes.

Overall, technology will make my life, your life and everyone else's life much easier and far more fulfilling.

Interconnecting systems allows for a solid understanding of all available resources, our current technological capabilities and can track all human needs (and wants). These systems can then arrive at the most educated conclusions yet in human history in regards to what, where and when anything is needed.

Keep in mind, however, that this is a future without any kind of monetary game (trade) in place. The result is that the shortcomings that we see today in technological development, such as monetary limitations or misappropriation of technology for the profit of a few, will disappear completely.

**So, let's go through some examples to show you the shortcomings of technology in today's world.**

## FACEBOOK

Facebook is a technology/tool used by more than 1 billion people around the world. People use it to communicate with others, share ideas and photos and post their thoughts.

However, because we live in a money-based world where the main drive is profit, Facebook (like so many other companies) 'extracts' personal information about you: from what you post, what you like, what you share.

They do that so that they can show you targeted advertising in the hope that you will buy those products so that they can make a buck. You may think that such services like Facebook or Google are free, but they make a lot of money from 'milking' your personal information and use your data to sell it to advertisers.

Basically, they let you use their services for free, because you are their unaware customer.

Think about the fact that you are mostly kept unaware of these things, and maybe you don't want Facebook or Google to spy on you like this. Maybe you prefer privacy. What if this collected data is lost (hacked)? What if others use this data to your own detriment?

Obviously, when there is an incentive to do these kinds of things for profit, harmful scenarios can arise. In a trade-free approach, there would be no advertising (at least not in this shape or form), and there would be no basis for anyone to seek profit out of such services, therefore these services, and any people behind them, would have far less or no reason at all to 'spy' on you.

# EBOLA OUTBREAK

Now, let's look at the recent Ebola outbreak in some parts of Africa. Ebola is a virus with a kill rate of 50% to 90% of those infected and, as of this writing, there is still no vaccine or treatment for it. However, we don't see Ebola in more developed tribes like America, Spain, and so on, because the best way to deal with it is to isolate cases of infections so it won't spread more, until the virus eventually disappears. The best approach is prevention in this case.

So, although there is no treatment or vaccine, through technology and scientific understanding, such viruses can be controlled. In those parts of Africa, people are extremely poor and their infrastructure is almost nonexistent. This allowed the virus to spread so much and kill so many.

Technology could have provided a decent standard of living, perhaps the same standard of living as for the other more fully developed tribes, and thus an infrastructure that could have more easily dealt with this outbreak. Unfortunately, due to money limitations, this was not the case, and is still not the case for so many tribes out there.

This is a clear example of how, although there are technological solutions even when the problem is so complex, the technological solution is not implemented due to monetary limitation and thus entire populations of people can be harmed or killed.(source)

This also proves another major issue: if we do not soon recognize ourselves as a single planetary species, then we will continue to suffer until, perhaps, we perish.

Harmful particles, viruses, pollutants, and other threats do not need a passport to migrate from one tribe to another, therefore serious technological solutions must be applied on a planetary scale.

# GLOBAL WARMING

Another example is the overall lack of concern for the environment within a money-based world.

As we have shown in this issue, there are so many technologies to generate energy from so many renewable sources in a way that doesn't negatively affect the environment, contrary to approaches used today that are a huge part of global warming, yet there is little to no incentive built into our world-system to do that because there is little to no profit to be made from it. In this world, if there is no monetary profit to gain from solving a problem, then more than likely that problem won't be solved.

In a trade-free society, there would be no such monetary profit motive drive, therefore all applied technology would reflect need, not profit.

# FAMINE

As we look throughout human history, famines where millions died of starvation are mostly man-made disasters.  Through the technology and science available in their time, most of the famines in human history could have been avoided.

Yet again, because of this monetary game we play, technology could not be deployed to solve those problems or save those people.(source)

# ANOTHER VERY IMPORTANT ASPECT TO KEEP IN MIND IS THAT THIS NEW SOCIETY APPROACH WOULD ALLOW EVERY ONE OF US, WITHOUT EXCEPTION, TO LIVE FAR BETTER THAN THE RICHEST PEOPLE TODAY.

In 1901, the US president died of a 'flu'. He was one of the most powerful people on the planet at that time, but yet a 'flu' killed him. Today, we have a vaccine for that. Until relatively recently, many kings and powerful leaders didn't even have a toilet, or access to internet, or basic medical care. Many of us have those now, but we could have them much more improved and accessible to everyone.

Even today's billionaires are continually stressed to acquire more wealth and to be overly concerned about their businesses versus their so-called competition. One can buy the best car possible today, but if some poor person has a broken-down car and crashes into the rich man's car killing him, then what good was there to having that expensive car?

Global warming, another nasty side-effect of a monetary world, will not affect only the poorest people, and nuclear weapons and eventual war (all conflicts driven by the scarcity of resources or tribal separation) is not going to somehow magically avoid rich people.

It therefore stands to reason that even the most privileged people today are not at all exempt from terrorist attacks, viruses outbreaks, global warming, crowded traffic, poor services due to money limitations, violence, and so on.

In a trade-free (abundant) society it's not only that relevant technology will be created, continually improved and enjoyed by all, without servitude, but also that working together as a global species and unleashing our creative scientific capabilities, without any monetary restrictions, will push our lifestyles to our best human capacity; will elevate problem solving to one of our primary goals; will transform natural enemies such as viruses or asteroids into much more easily controllable events; make scarce or non existent today's problems of crimes and violence; and will free us from unwanted, or dangerous work that will instead be handled by machines, thus allowing our extraordinary brains to be put to much better use: to explore the world and understand it even more, continually improving ourselves and society, and overall making our small flash-like existence, one that any alien creature peeking in on us might envy.  ;)

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