Nature has the solution

new insights in sustainability

by Rob de Vrind

Explanation of the figures on the cover

The earth gets warmer
An IT revolution is happening
Green solutions are emerging
We can work and think together all over the world for a better future.

Nature has the solution

new insights in sustainability heading to a new social eco-economy

by Rob de Vrind

This booklet is inspired on the insights, speeches and illustrations of among others Michael Braungart, Sonja Eser, Ken Webster, Janine Benyus and Rob de Vrind.

It is about Cradle to cradle, Circular economy, Biobased economy, Bionica, Biomimicri, Industrial ecology, Agricultural ecology, 3D printing, Society 3.0. and other things we can learn from nature.

This booklet creates one logical concept out of it of which the writer suggests to call it a social eco-ecomomy. A social economy created on the rules of ecology and made sustainable like ecosystems do (after succession).

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Looking at sustainability one strives for enough for all for ever. The world population is growing and growing and heads for 9-10 billion people in 2050. When I was attending primary school in 1970 I learned the earth contained 3 billion people. In one life time it will grow three times.

As a consequence we need three times more agricultural area's and space for industry, harbours, airports, roads ect. No wonder biodiversity is under pressure.

One can point out many more consequences due to the increase of the world population as problems with drinking water, the enormous usage of coal, gas and gasoline (producing the greenhouse effect), bio industries, the overfishing of the world seas, islands of plastic floating in the oceans and the depletion of soils.

So we have to think how we can create enough for all for ever. To solve that most of the time people preached not to spill energy and materials and to make bad things less bad.

But then the car only drives less fast in a direction of a wall but the collision will follow inevitably.


205

No, we have to turn the steering wheel. We have to start to think different.

Not doing things less bad, but do the right things first.

Not leaving death behind but life.

We have to change waste in nutrients. We have to close the loops.

We have to work with renewable energy.

We have to increase biodiversity.

We must not leave a negative footprint but a positive.

We have to start working like nature does (and already does for billions of years).

In other words, we have to learn from nature.

Nature has the solutions.

- Absorbs CO_2
- Produces oxygen
- Produces biomass
- Supports biodiversity
- Delivers a habitat for many species
- Filters the air
- Creates soils

  etc.

What can we learn from nature.

Look at a cherry tree.

It absorbs CO_2 and produces oxygen.

In supports biodiversity and creates an environment for many species.
(all kinds of animals use the tree like ants, birds, squirrels).

It filters the air.

It creates soil and makes the environment suitable for more nature.

It delivers cherries.

It produces no waste.

Etc.

- Zero (fossil) energy
- Zero material (usage)
- Zero land (usage)
- Zero water (pollution)
- Zero air (pollution)

What if you could build in that way.

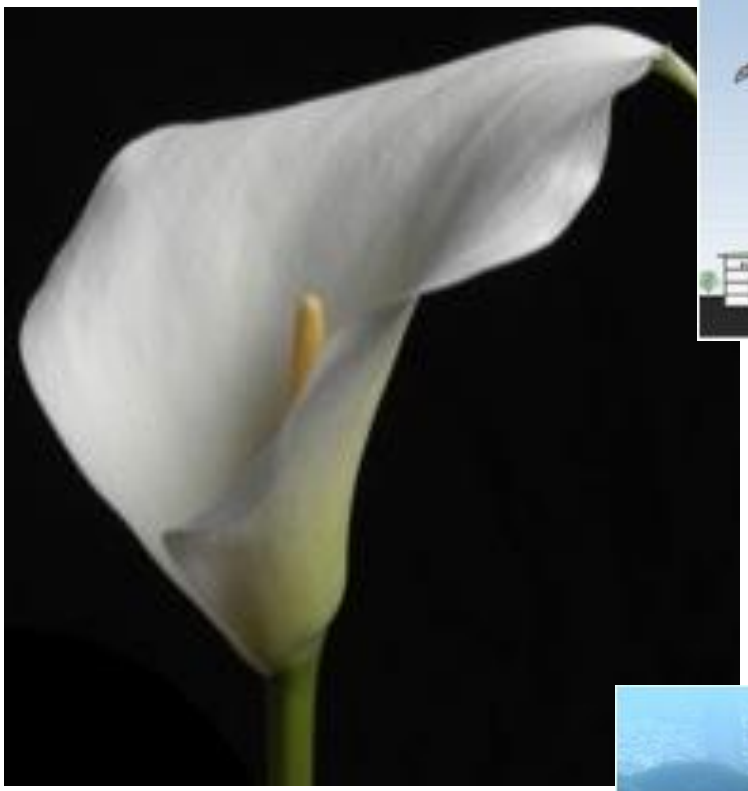
Can you build without using fossil fuels
Without spilling materials
Without using land
Without polluting water
Without polluting air.

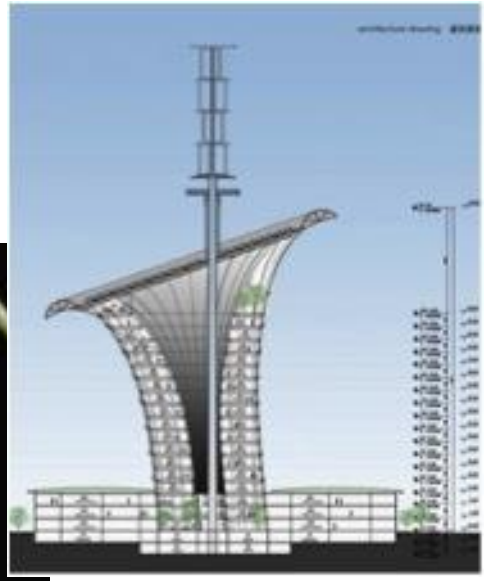
That is possible ? Yes…..

Build with renewable energy (sun, wind, tide, water power ect).
Build with materials that can be renewed, reused or can be grown again like bamboo or wood.
Let nature continue on the roofs (green roofs).
See for it water goes out of the building more clean than it comes in.
See for it that the air goes out of the building more clean than in.

Then people would say the more of those buildings the better.

Then such a building delivers a positive footprint in staid of a negative one.





Wuhan Energy Flower

Soeters Van Eldonk

In that way you also can build factories on solar energy, with renewable materials purifying water and air and on top of which nature can continue.

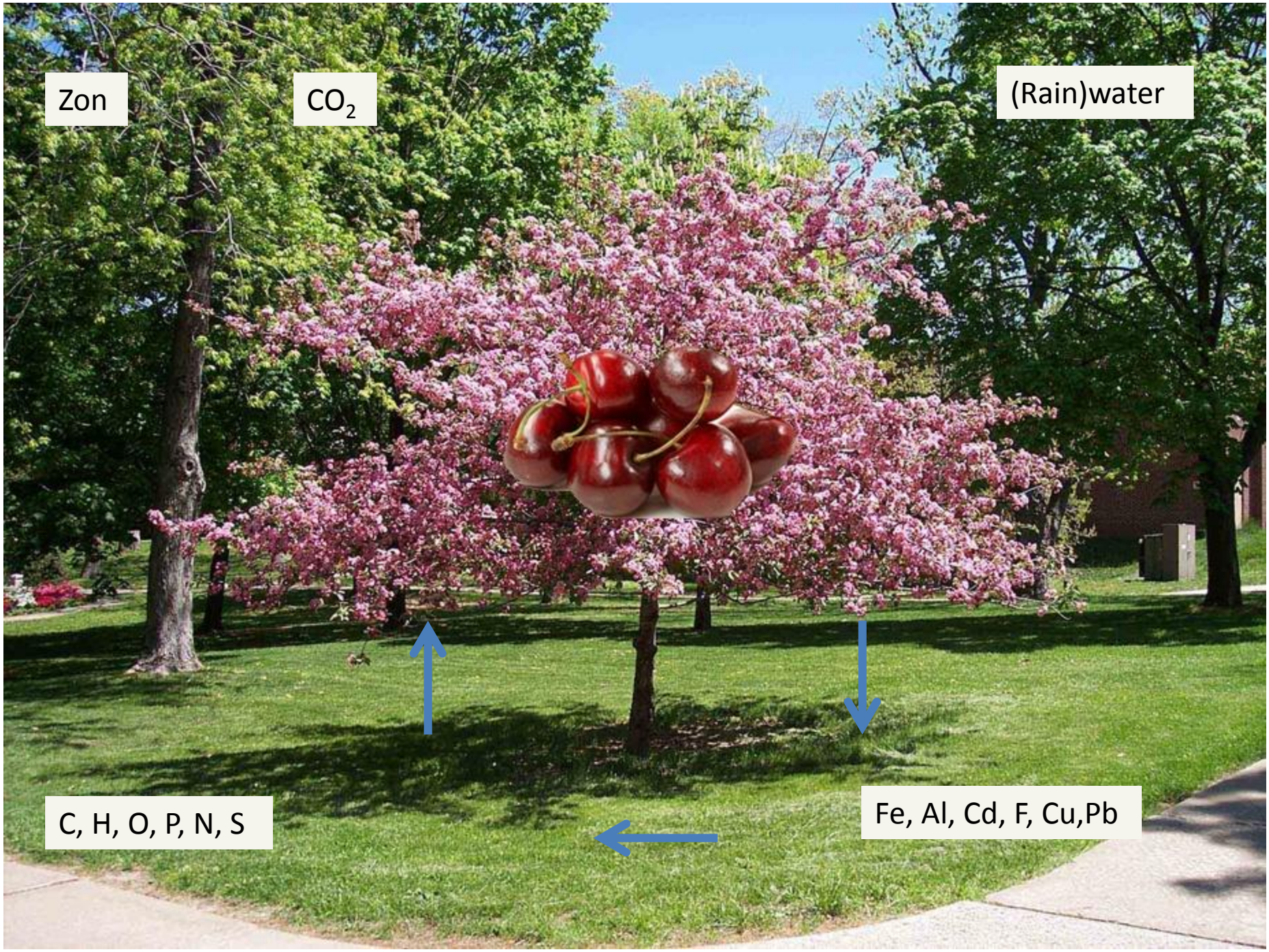
Desso, Ford and dozens of other producers are busy with it.

You try not only to meet environmental laws but you try to create a factory with a positive footprint, leaving life behind in staid of death.

In the building here next to the architect looked at a arum. The big upper side puts the building into the shade (so you need less cooling) and it creates a big surface for solar panels. Also the big roof collects a lot of rain water for flushing the toilets. The roofs of the leaves are green and are positive for nature.

The building is constructed in China but is designed by a Dutch architect Soeters van Eldonk.

Wuhan energy flower is 140 meters high.


Zon
CO_2
(Rain)water
C, H, O, P, N, S
Fe, Al, Cd, F, Cu,Pb

How a cherry tree can produce cherries over and over ?

It creates them out of the sun that shines for free. CO_2 out of the air and (rain) water as also always there.

Next to that it needs nutrients out of the soil (mainly N, P and S)

The leaves that fall are degraded into the nutrients again so the circle is round.
In other words the tree doesn't produce waste.

The tree doesn't use (toxic) elements as cupper, cadmium, iron, aluminum.

When we also are able to produce without toxic elements and know how to produce out of C,H,O,N,P,S then everything is decomposable. Then everything can be a nutrient again.

old

Take → Make → Waste

Linear

In the old economy we extracted everything our of the earth, made stuff out of it and threw that away creating large landfills.

That is linear thinking (thinking in a straight line).

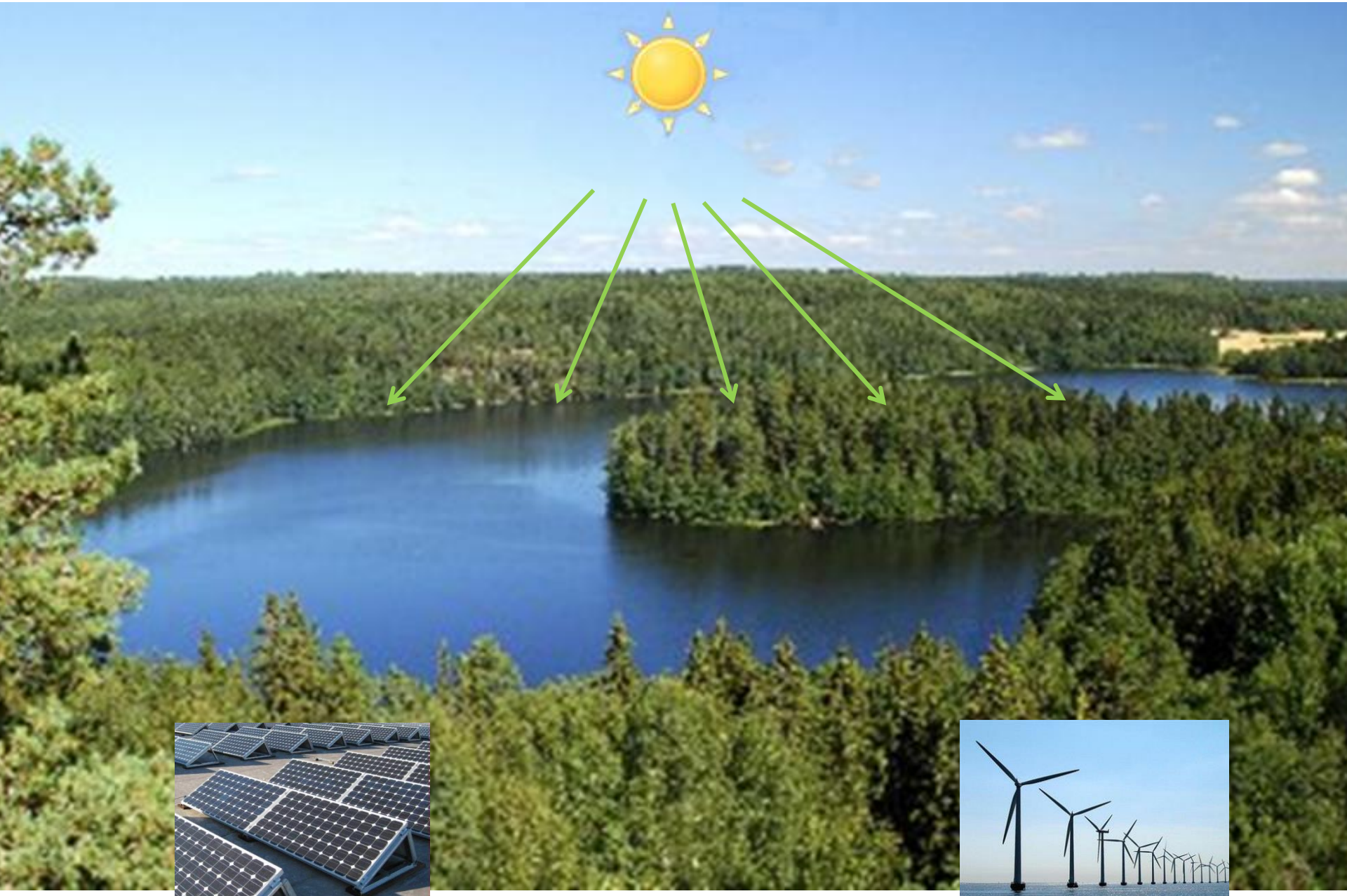
We have to develop to circular thinking in which we close the loops and produce toxin free with decomposable materials that can be used over and over.

Materials that consist out of C,H,O,N,P en S .

The materials must be capable to enrich the soils again so new crops can grow on it.

Or materials that can be decomposed and given to algae.

Just like a tree you have to give back N, P and S. C, H and O not because that came out of the air (CO_2) or out of (rain) water. In the phase of decomposing you may ferment it to methane (CH_4) to be used for heating or producing electricity.



What can we learn from nature ?

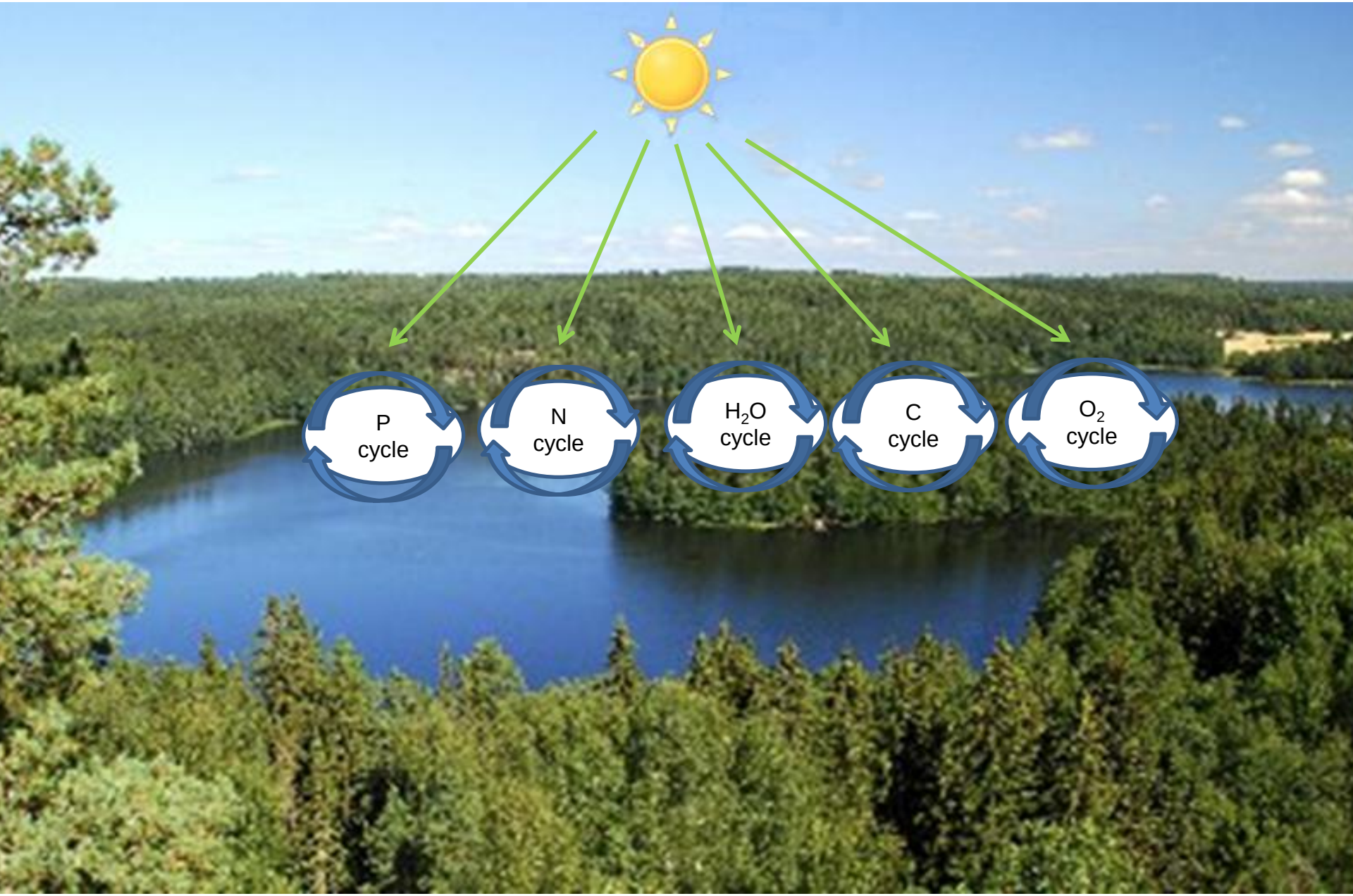
The more the world looks like and functions as the natural world the more likely we can survive on our planet that is not ours only.

Nature completely runs on the sun.

We can do the same as we change the fossil energy production into a renewable one as

wind energy,
solar panels, solar water heaters,
concentrated solar power,
tide energy,
water power,
warmth and cold storage in the soils

or
geo thermal energy
or reverse osmosis ect.


P cycle
N cycle
H_2O cycle
C cycle
O_2 cycle

Nature works with all kinds of cycles

For instance the water, nitrogen, phosphorus, carbon or oxygen cycles.
The substances (nutrients) are used , processed, decomposed and used again over and over. We call that a metabolism.

In this way we should compose our industry and economy.

We have to create products, use them and decompose them in a way the nutrients can be used again. This makes you independent from raw materials that become more and more expensive or scares or fluctuate in price a lot.

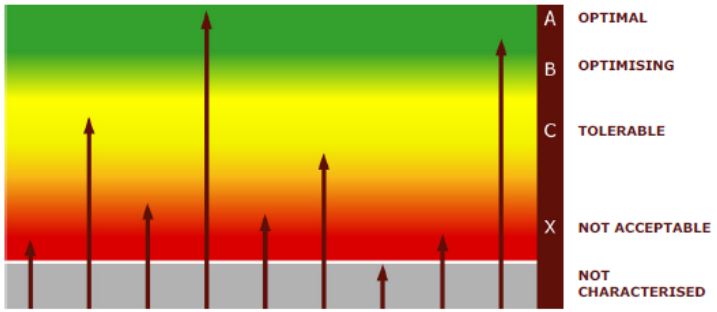
You can discriminate substances that are compostable and those who can’t be decomposed but can be recycled.

The first group can be used in the bio cycle over and over and the other group can do the same in the techno cycle.

compost

biogas

collection



All substances known
Everything free of toxins

The bio cycle

The sun shines on the fields. Potatoes grow. They have a very high yield and so they are made very effectively. The substances like stork, proteins and fats can be changed through bio refinery in all kinds of substances like bio plastics. They consist out of C, H, O, N and P en S.

They can be used in products and in the end they can be collected. Then the C and H can be transferred though fermentation into biogas (methane). What remains (the effluent with N, P and S) must be given back to the soils so the potatoes can grow again.

One condition is that no toxic substances are in it, otherwise you pollute the soils on which you want to grow crops again.

Then you have constructed a bio cycle that produces and turns on solar energy for ever and ever.


MANUFACTURE
BIODEGRADE
RECOLLECTION
COMPOST
COTTON


PREVIOUS
NEXT IMAGE ▶
PUMA
PUMA


6 WEEKS


6 MONTHS

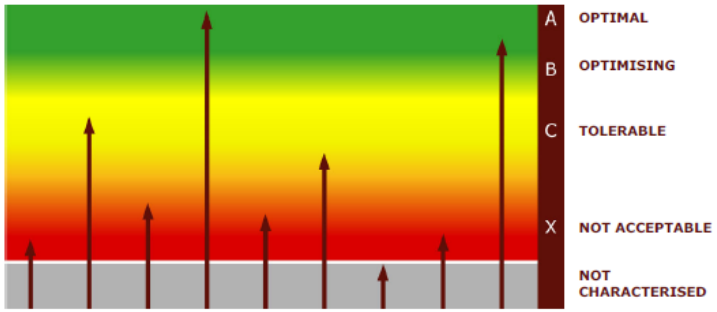
An example of this are the clothes of Trigema. The cotton plants are grown free from toxins. From the cotton for instance shirts are made which also are made free from toxins. After usage the clothing can be fermented (delivering methane gas) or thrown on the compost belt where it is decomposed.

The compost or the effluent (= what remains out of the fermentation) enriches the soils again so cotton plants can grow again.

They grow on renewable energy and if factories that produce the cotton and the clothing also run on renewable energy the process can go on and on.

When the factories also clean water and air, the factories are build with renewable or recycled materials and nature continues over the roofs, they deliver a positive contribution to life on earth.

Also Puma already created sport shoes which are free from toxins and can be decomposed.



All substances known
All free of toxins

In the techno cycle you for instance produce a washing machine which will be collected after usage. So out of the materials industry can create new washing machines again. In this way the producer regains the materials which are needed.

But this means you in fact don’t buy the washing machine any more. As you are going to fly you don’t buy the airplane as well. What if you for instance buy 10.000 washes and afterwards the manufacturer collects the machine again to regain the materials.

As the machine is broken down you tell the manufacturer you bought 10.000 washes so he has to repair it. They don’t like this, so they provide you the finest washing machine with the smallest chance they have to repair it.

The price of the machine also can be less because the manufacturer regains the materials where you don’t have to pay for.

Already some companies are busy with this concept and in Holland there exists a school and an office in which the tapestry, the furniture and the light is leased.

compost

collection

collection

Design

When products contain substances as well out of the bio cycle and the techno cycle then one has to design in such a way that you can separate them easily.

In this way it must be possible to save a lot of raw materials.

As everything happens without toxic substances, the circles can continue like the circles on which nature works.

This means we have to think about which materials we use and if they are decomposable and can be fermented (without toxins). Or if the materials can be used again and again.

Together with this the design must be in a way products are created out of as less different materials as possible and can be disassembled as easy as possible. This as well has the advantage things can be repaired easily.

Already a lot of companies are busy with it.

Cradle to cradle products

Carpet

Wall paper

Lamps

Couch

Office furniture

Laptops

TV’s

Glass

Cleaning substances

Shoes

Clothing

They call these products cradle to cradle products. These are products not made from the cradle to the grave but from cradle to cradle.

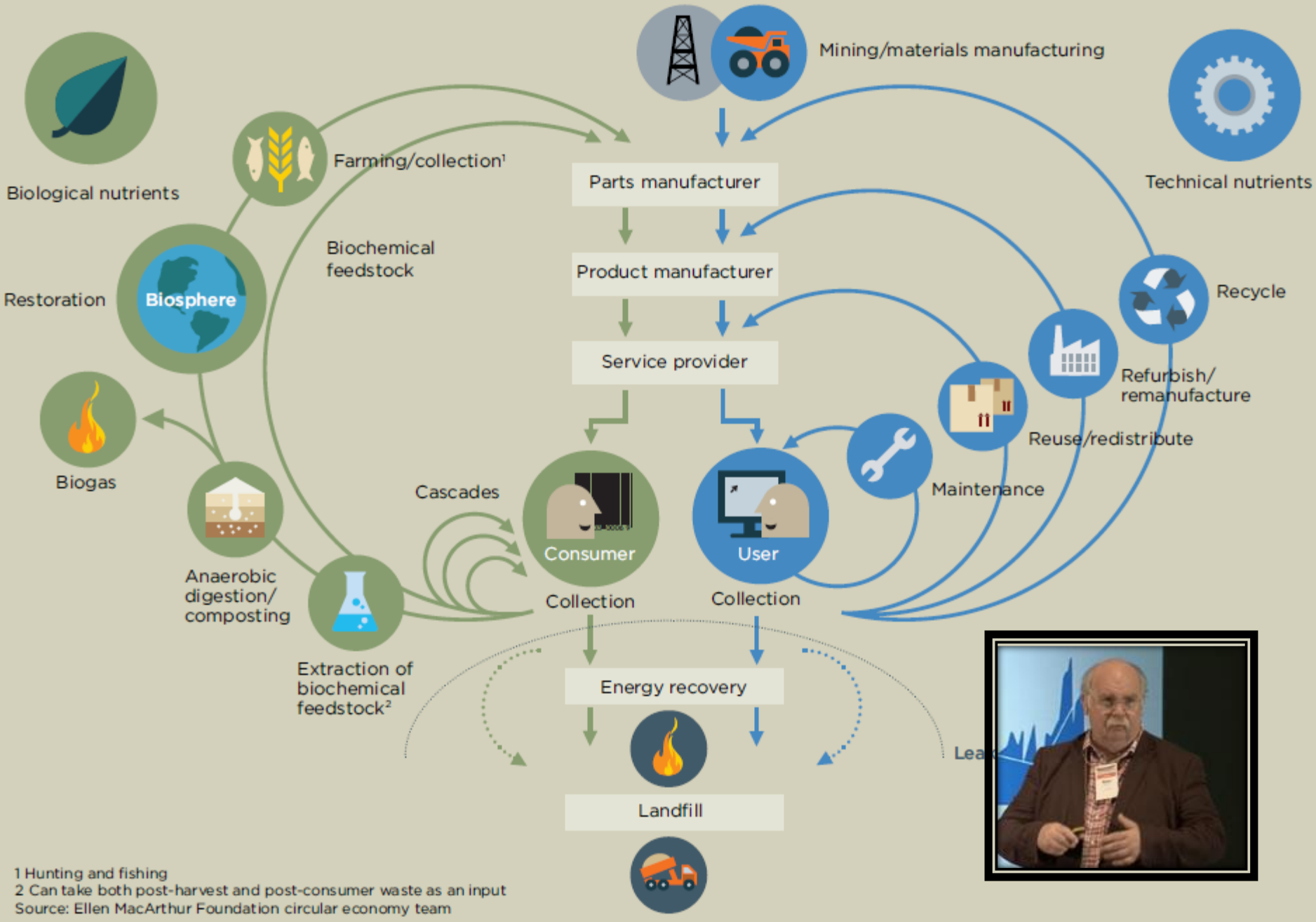
Already there exists tapestry, wall paper, lamps, couches, office furniture, laptops, TV's, glasses, cleaning materials, shoes and clothing produced in this way.

Also one is busy producing cars in this way. To create a car of 1300 kg you need 22.000 kg of raw materials. This must and has to be done better says Ford. They are searching for cars on renewable electricity or hydrogen with seats filled with soya foam and tires made of mays plastic. Cars completely consisting out of biodegradable products or technical nutrients that can be raw materials again.

You can see if a product is made like this at the cradle to cradle label.

Already dozens of factories are busy with the concept and have cradle to cradle certified products.

The circular economy—an industrial system that is restorative by design



1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input
Source: Ellen MacArthur Foundation circular economy team

When you look at whole industrial systems, they also could try to get the materials into cycles. Then you talk about circular economy. The person under is one of the big inspirers: Ken Webster.

Also in this concept one discriminates the bio and techno cycle.

In the bio cycle biological nutrients are used in all kinds of products that not end after usage on the landfill. But they are first reused in all kinds of ways in cascades (see further).

As the products can't be used at all any more, first we have to pick valuable materials our of it to ferment what is left. Then you get gas to produce electricity or warmth. The effluent (what is left) you spread on the soils to fertilize the fields. Then you grow crops on it again so you can harvest again.

In the techno cycle at first it is important to maintain well, then repair what is possible or reuse and then refurbish or reproduce the products. If that can't be done any more, you start recycling and the nutrients can be used again for new materials and products.

P → C1 → C2 → C3

R

Energy cascades

Material cascades

Nature deals very efficient with solar energy and with substances.

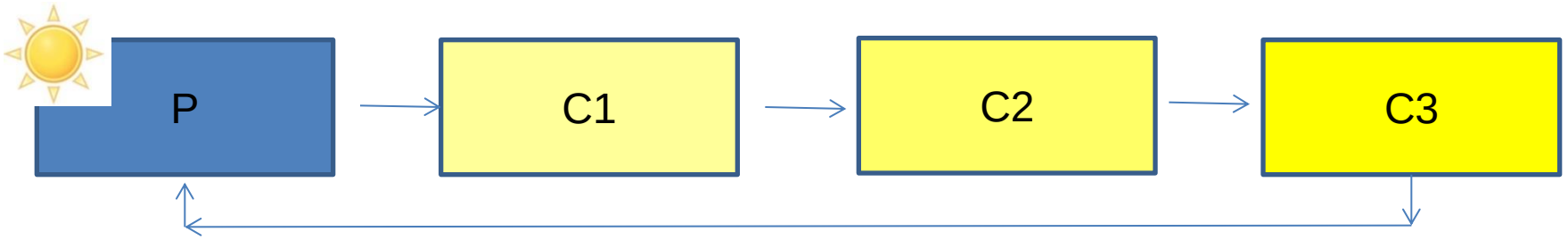
On solar energy grass creates fuel and building blocks. They are called producers. The grass is eaten by rabbits (consumer of the first order) In fact the rabbit lives on the fuel and building blocks created by the grass.

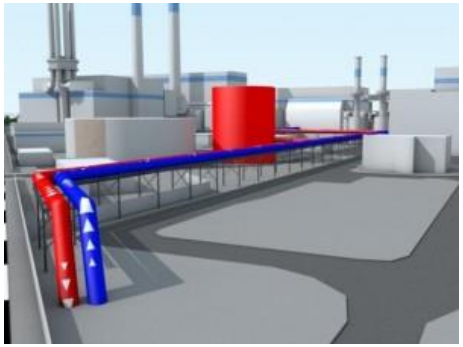
Then the rabbit is eaten by the fox (consumer of the second order) and he again by a eagle. The eagle lives in fact on the fuel and building blocks that via the fox and the rabbit are captured and created by the grass.

Then bait eaters or worms, beetles etc. eat the dead animals and what resumes is decomposed by bacteria and fungi (reducers) to become nutrients again for the grass.

Without the grass (or the producers) the whole chain behind it can't live. The solar energy is transmitted and transmitted and transmitted and in that way used very efficient.

We call it energy cascades. A cascade in fact is a water fall behind a waterfall behind a waterfall. This resembles it.





Energy cascades

In this way we should deal with energy as well .

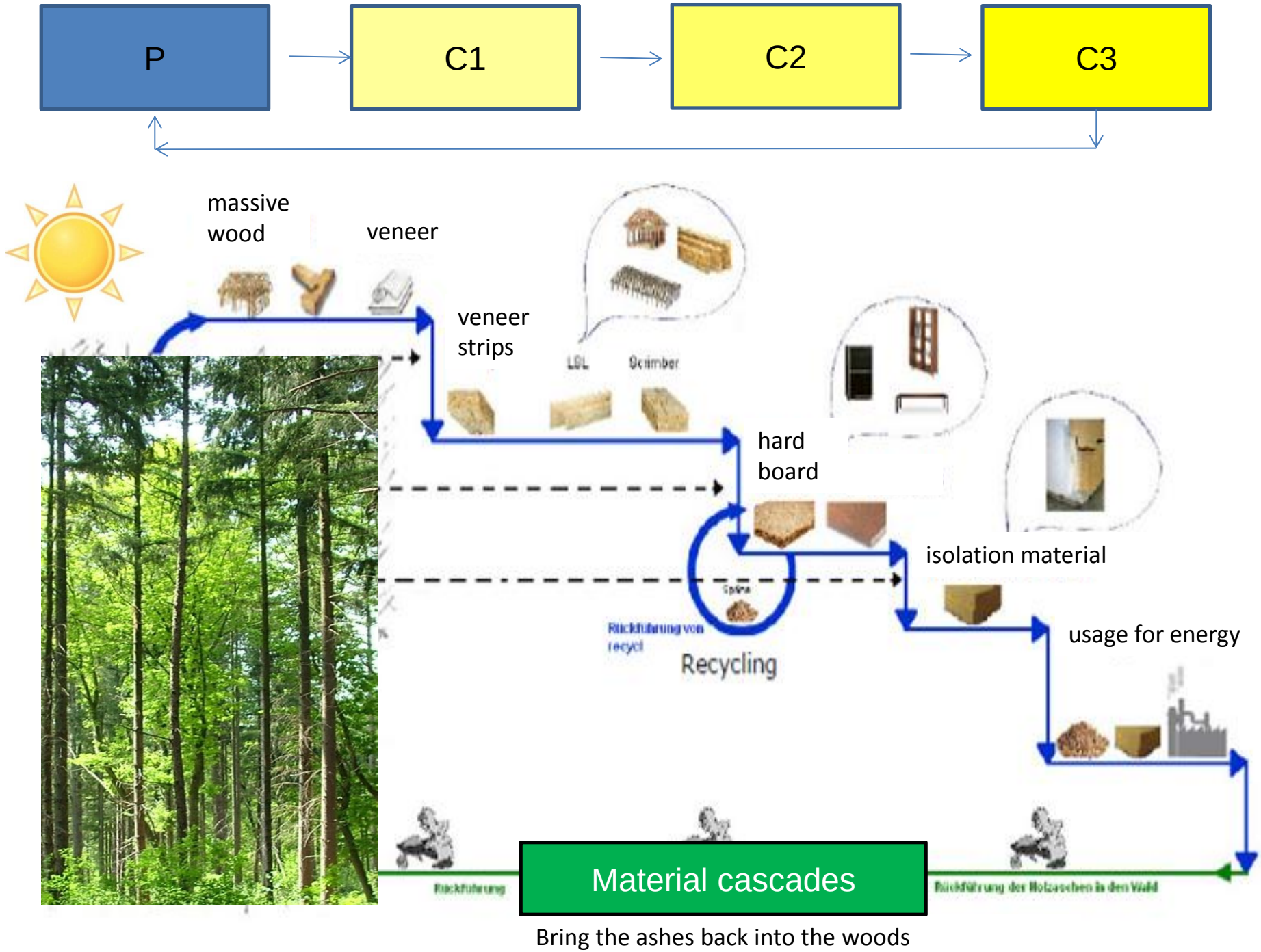
Energy plants burn coal (= thousands of years compressed solar energy in old plants). With that we make electricity with which we can do a lot of things. But also heat is produced. And in fact heat is energy. The warmer, the more energy.

We should not let go this energy immediately into the air. The high valuable warmth can be used in industrial processes. The warmth remaining can be transported to greenhouses or houses in residential areas.

The warmth the houses loose by ventilating can be used to heat up the incoming air or can be compressed by a heat pump to heat up the house again or to produce warm water.

In this way it goes from high valuable warmth to low valuable warmth. This we call a energy cascade. The same as in nature with P-C1-C2-C3 etc. Only then energy is used in an optimal way.

But coal plants are not sustainable. This can be the fact when for instance geothermal warmth is used. At 3000 meter the temperature is 130 ^{o}C.


P
C1
C2
C3
massive wood
veneer
veneer strips
LSL
Oriimber
hard board
isolation material
usage for energy
Recycling
Material cascades
Bring the ashes back into the woods

Concerning materials the same principle is important.

Wood from trees can be transformed first into furniture or houses. As they have had their time, the wood can be transformed into hard board. After a period the hard board can be created again or can be transformed into isolation material. The very last thing you do is ferment it or burn it as now a days is usual. This is a material cascade .

What is left (the P, N, S) must be brought back to the forest again otherwise the soils will deplete.

At this moment we don't throw the wood on the landfill any more but we are capable to burn it immediately. Because we use a lot of toxic substances the ashes cannot be thrown into the forests that easily. The ashes go to other places so the cycles are not round and the soils deplete.

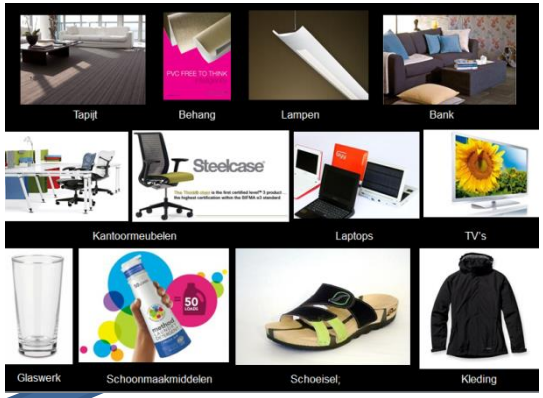
So it is better to use the wood into material cascades in which we reuse materials time over time to bring it back as nutrients on the soils finally.

Biobased economy

P → C1 → C2 → C3

Sun
Water
CO_2
phosphate
nitrate
sulphate
ect.

Fuels
Building blocks



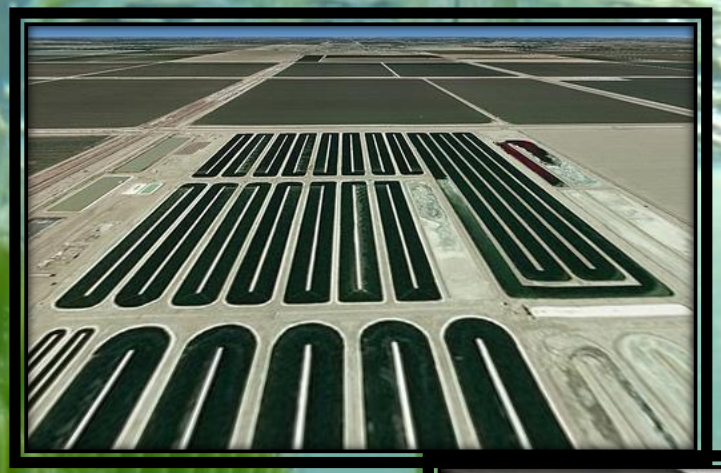
In the biobased economy this is also the principle. We grow crops or wood which we can bio refine into building blocks which we can use for all kinds of toxin free products. As these go through the material cascades and cannot be used any more, they can be fermented and the methane can be sold or used for the production of electricity or warmth.

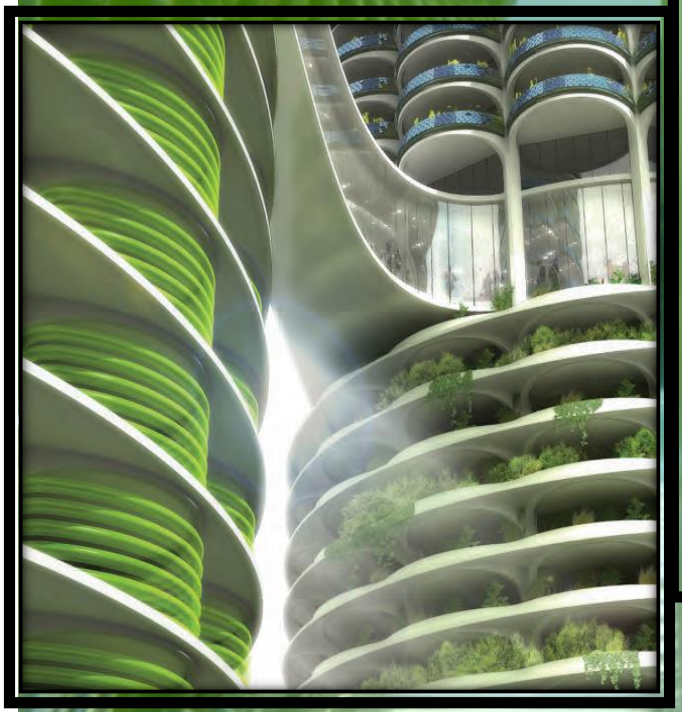
What is left (the effluent) can be put on the soils. In it P, N and S is present so crops can grow again (and you don't need artificial manure).

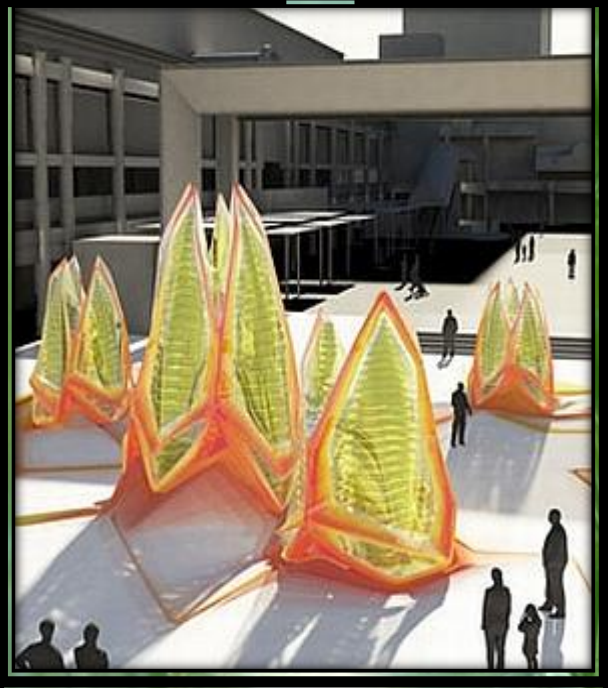
One disadvantage is we need the crops to feed ourselves and our cattle. That is to look towards reed out of ditches or elephant grass (which can be planted on all kinds of areas which are not used).

But also algae can be a solution. They grow fast and have a high yield.

A forest produces 500 kg / ha, cereals 750 kg / ha but potatoes 40.000 kg / ha. This production algae are also capable to.







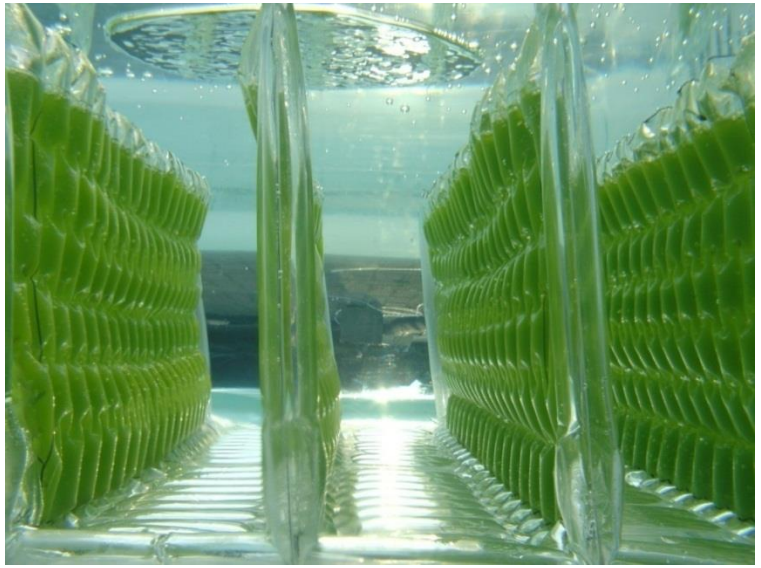
40.000 kg / ha

We could breed algae on very large scales. They are plants out of one cell who don't have to put energy in making flowers, roots or leaves. They grow fast if you provide them N, P and S with CO_2 and light.

Scientist are even capable to transform them so they produce alcohol, or butanediol (fuel for airplanes), lactic acid (for bioplastics) , acetoine (the smell substance for butter) or terpenes (against cancer).

Also the can be manipulated to contain 80 % of oil. Out of that gasoline can be created or all kinds of substances for the creation industry.

We heat, beat and treat



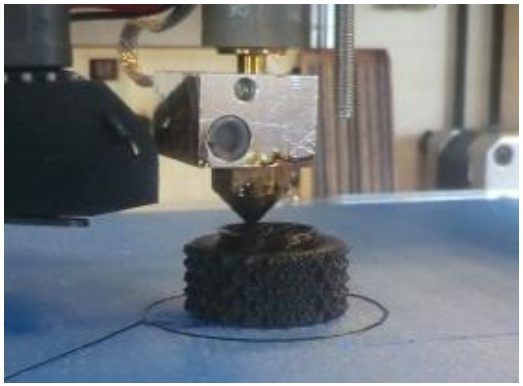
In water, at normal temperatures and pressure

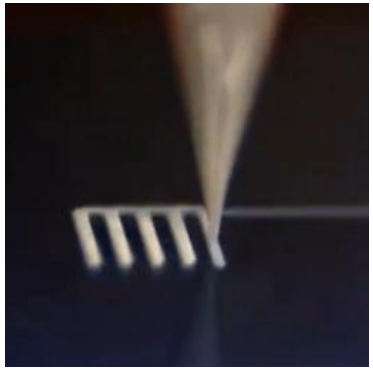
Also we can learn out of nature to produce without heat, beat and treat. We use high temperatures (which costs a lot of energy) in which we create the shapes we want to have.

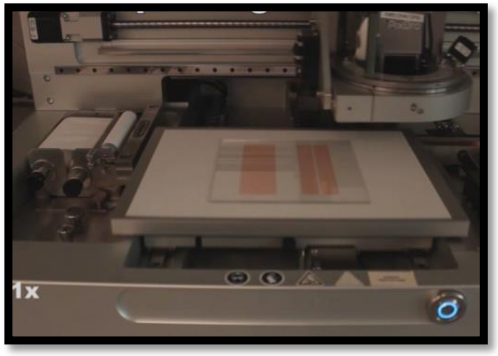
In nature it works at room temperature (or 37 ^{o}C) at normal pressure in an environment with water.

The first washing product now works already at normal temperatures. You don't have to wash at 80 – 90 ^{o}C any more.
This saves a lot of energy.

We could use algae to produce all kinds of substances at room temperature, in an environment with water and at normal pressure.



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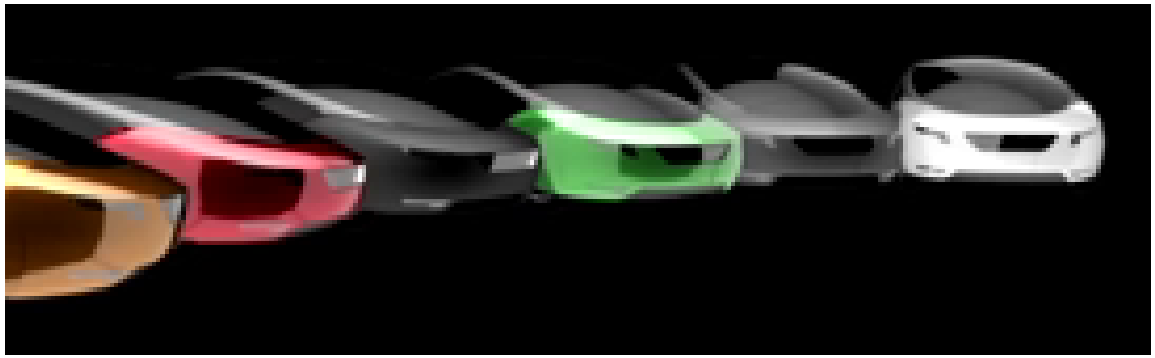


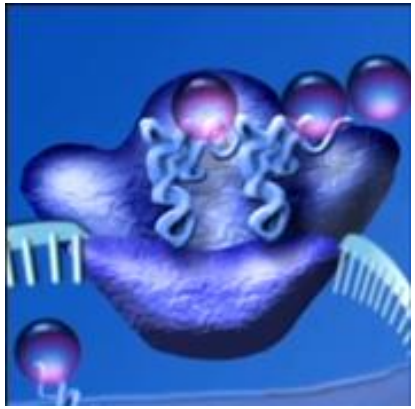
A pearl is two times as strong as porcelain. How is it possible an oyster can create such a thing. Well it filters the water and layer by layer the pearl is created.

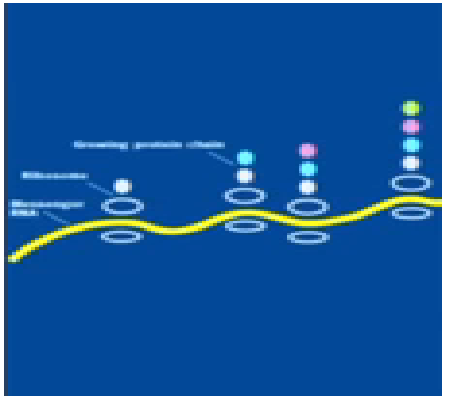
Only recently we do this more and more with 3D printing. Products are created layer by layer. You can print super small or super big. The first houses are printed with 3D printers or entire art objects. Also they are able to print the bodywork of cars. Even now they are able to print bio plastics that make electricity our of sunlight (middle left). Perhaps they will become the new cheap solar panels which can be printed on almost everything.

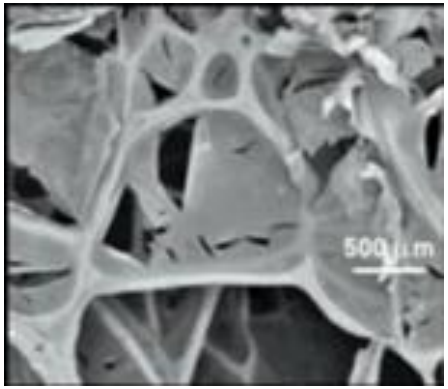
Also now food printers exist that can print food in all kinds of shapes with the right composition of nutrients with for instance a lot of sugar for sportsman, a lot of calcium for elderly people etc.

The materials of cups from bio plastics can be transformed into printing materials for 3D printers.

The nice aspect from 3D printing is the software is open source and people from all over the world help to improve it.






500 µm

We use 350 polymers and nature only five. The structure determines if the the material is strong or smooth or should have a certain color.
A peacock has its nice colors though thin layer interference.

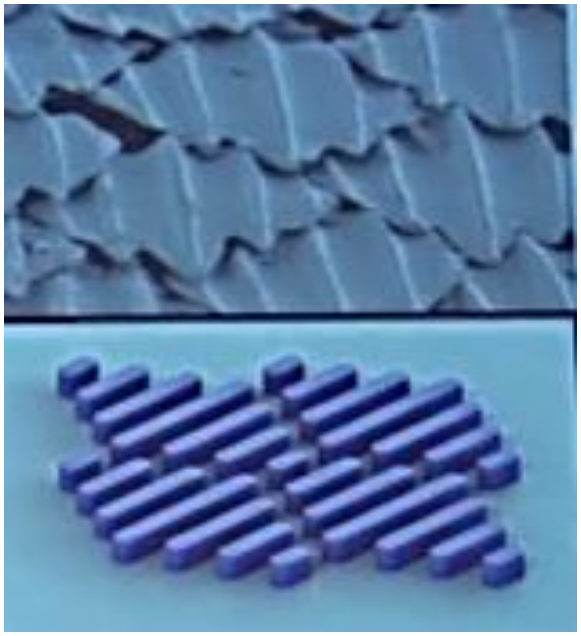
When we can create this in the same way with 3D printers we could make colors, strength, or smoothness out of a 3D printer.

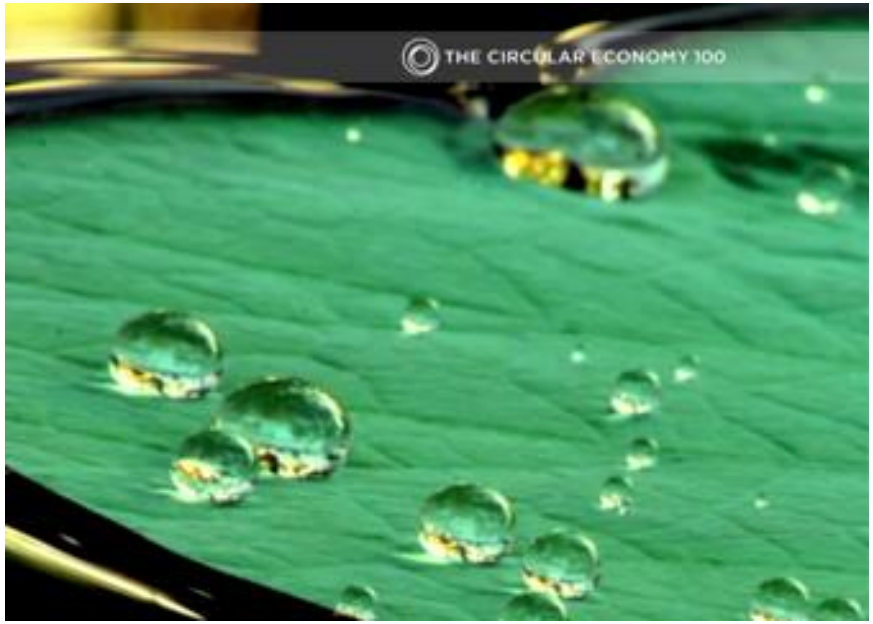
The arranging of molecules can be done along miniscule templates. In nature these are ribosomes. That's why people are now looking at Ribosome Inspired Surface Chemistry.

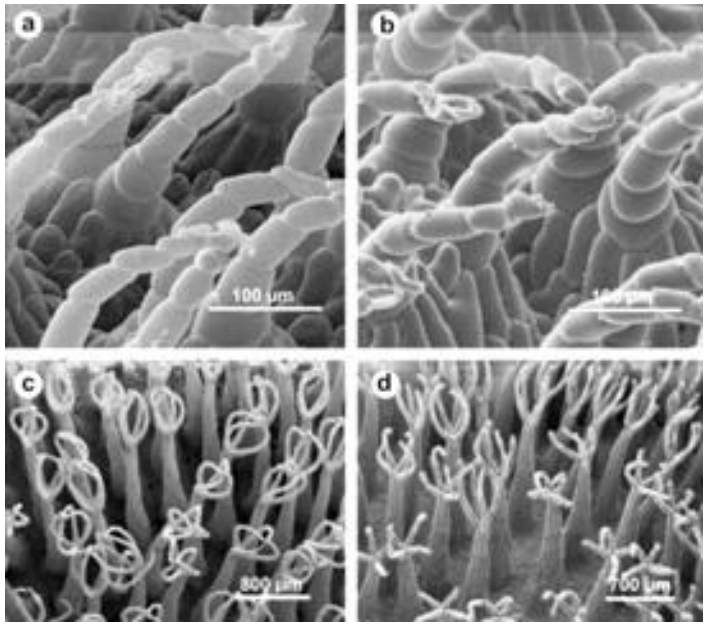
3D printers can print layer by layer but they also can mill away layer by layer. In nature this happens for instance when bones are created. First the rough structure is formed after which on every piece where pressure is on stays and is made stronger as where the other parts can vanish (to make the structure not too heavy)

In this way they already created a very strong but light structure for a car.

The beak of a toucan is very light but very strong. What if we could make foils out of it.




THE CIRCULAR ECONOMY 100


a
100 µm
b
c
800 µm
d
100 µm

The structures at a shark skin seem to be resistant against bacteria. People are busy to make foils against decay on this concept.

Some leaves have structures which can clean themselves. This self cleaning surface can be very useful for all kinds of applications.

In this way we also can learn from the fur against the cold or the beak of a kingfisher to provide high speed trains less air resistance.

The shape of a trunkfish inspired people to create a car with a lot of space but a very low air resistance.

A spider thread is five times stronger than a similar steel wire and also much lighter. Ideal for bulletproof vests.

Bacteria could help to mine minerals.

Out of nature you can learn what can bounce, isolate or sticks. We call that biology inspired design or biomimicri.

When something in nature doesn’t function well any more it is broken down and used again in the cycles. In autumn this happens a lot.

Lucky the nutrients can be used again in springtime to create new leaves on the trees.

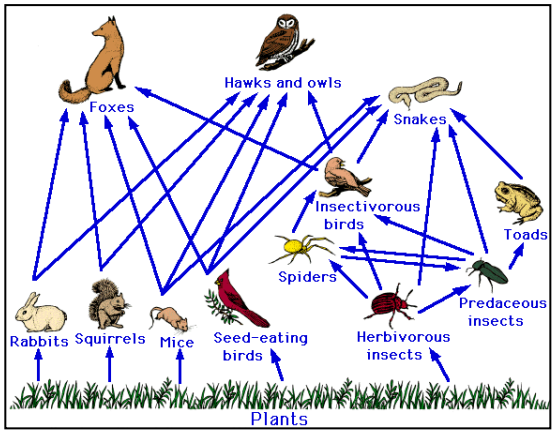
This can only been done when the soils stay fertile. At the moment we loose a lot of fertile soils. They are depleted by over cropping. To rebuild one cm of fertile soil can take 300 years.

So we have to take care for our soils and we have to seek for it to keep them fertile so you are able to harvest.

Nature also can repair itself. We imitate it a bit by self repairing lacquers that repair scratches when heated.

Also self repairing asphalt is invented. It contains needles of steel of 1 cm. With an induction coil the road warms up till 60 - 70 °C so it becomes fluid and the cracks vanish.

Meat



manure

Cattle

Different crops

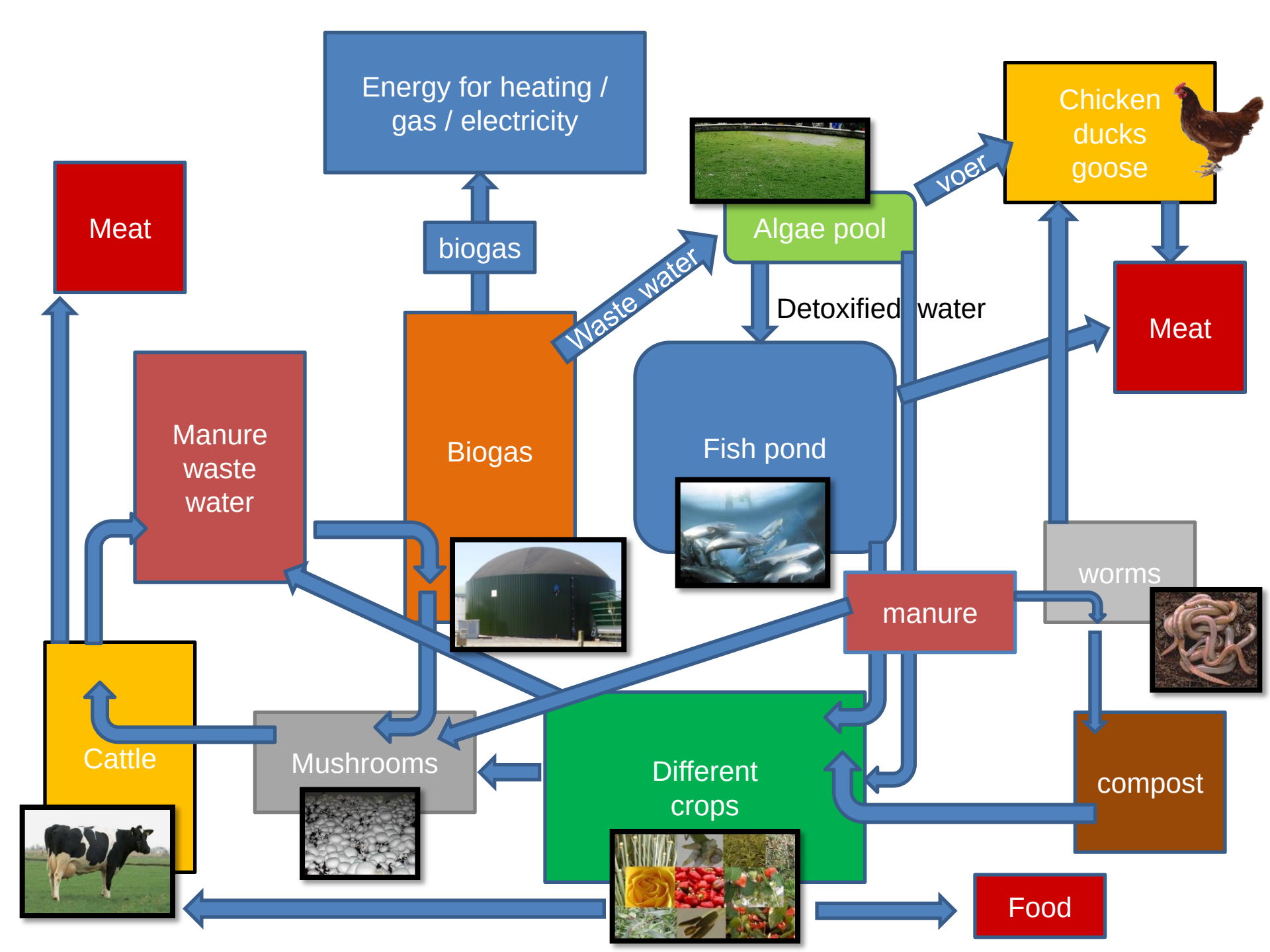
Food

What we also can learn is that biodiversity makes systems more resistant. The more diverse the better. So companies should not bet on one product. That makes you venerable. Also when in society more cultures work together it evokes more creativity and resilience.

In nature you can see food webs. The one organism lives on the other on the other and everything is in balance with each other. These food webs are mostly very complex.

In agriculture we can learn from it. We used to know mixed agriculture. You produced crops and what was left you feed to the cattle. In this way you produce food and meat.

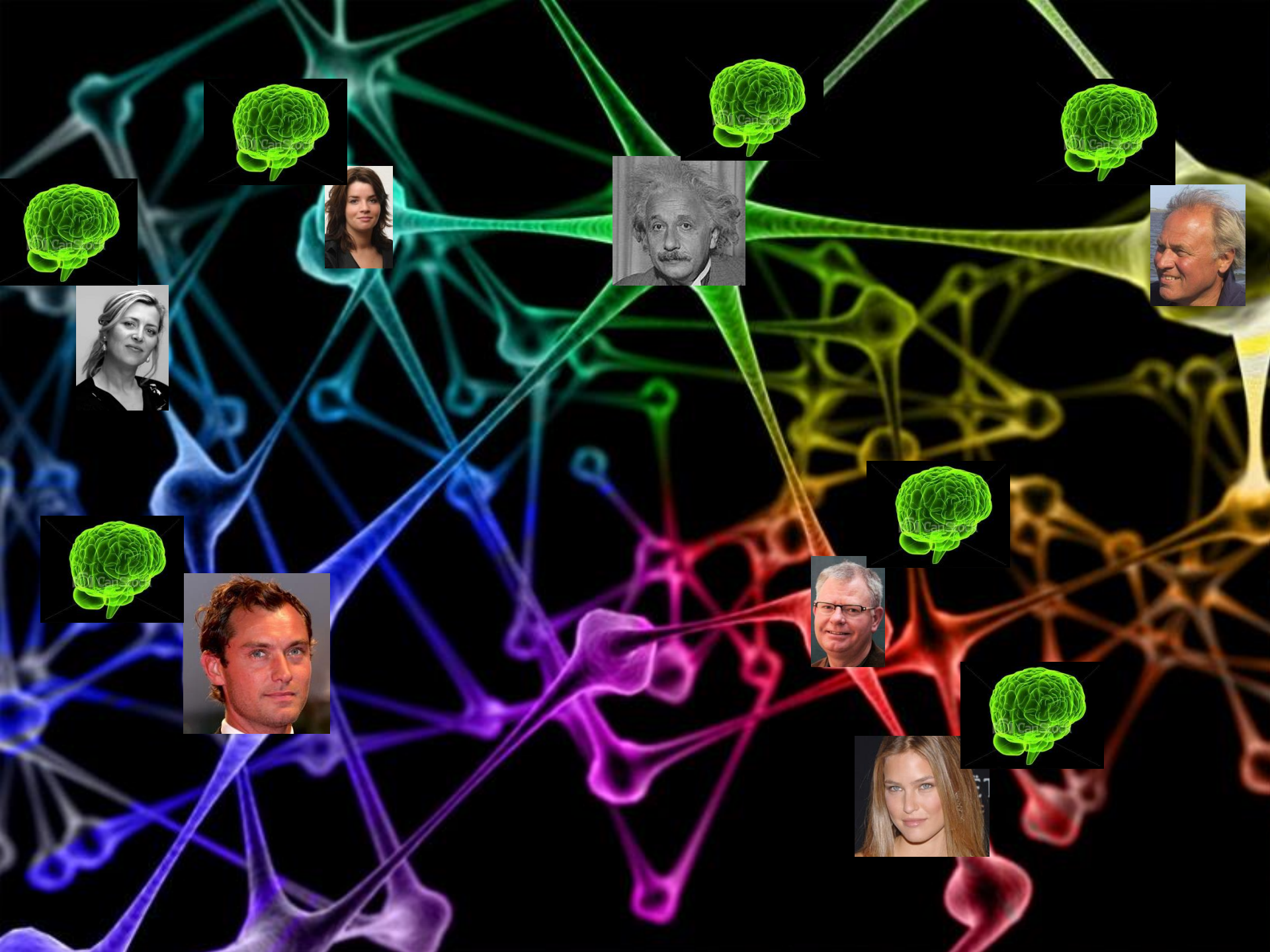
In nature things are very much more complex. Is this possible in agriculture as well ? Or in the organization of industries together.


Energy for heating / gas / electricity
Meat
biogas
Algae pool
voer
Chicken ducks goose
Waste water
Detoxified water
Meat
Manure waste water
Biogas
Fish pond
worms
manure
Cattle
Mushrooms
Different crops
compost
Food

Of coarse this is possible. The manure of the cattle you can ferment. The biogas which comes out of it you can use for heat or electricity. Or sell. The effluent you give to algae that purify the water and which goes into the fish pond. The algae can be fed to the chickens ducks or goose so they can provide meat as well as the fish does. The manure of the fish can be used to breed worms that can be used to create compost.

The compost can be spread on the soils so crop can grow and mushrooms can be breaded. What is left can be fed to the cattle. In this way production can be much higher. Agricultural ecology.

When you situate industries in the right way in the neighborhood of each other the waste of one can be used as a material for others. The heat from one can be used to heat up the factory of an other. We call this industrial ecology and it resembles a food web.



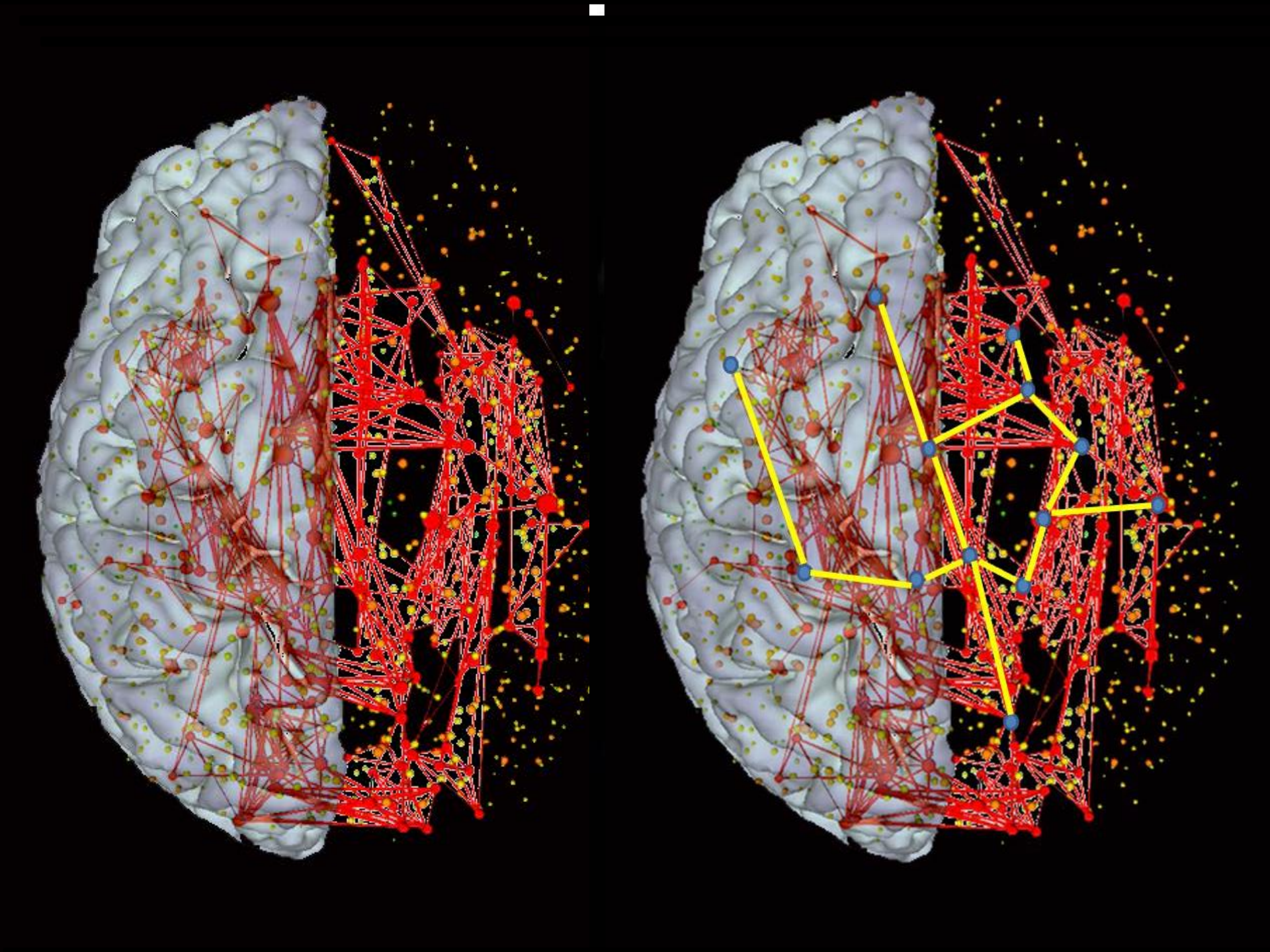
Like in our brain nerve cells (neurons) are linked to each other now a days it seems through glass fiber and internet our brains are connected together. Together we can be creative, we can produce or think for solutions needed in the future. Distances don't count any more.

When we connect green brains (people who have knowledge about sustainability) they together can help companies better so they can make big steps forward. In the Netherlands they started with it, connecting 46 top scientists in the field of sustainability together in the so called 'Green Brain'.

Alas Einstein said that mostly the people who created the problem will not find the solution. We need fresh thinking (young) people to find completely new solutions.

If you invent something that makes a product more sustainable the whole world is waiting for you and it can make you rich. You don't have to be Einstein or invent something big. A little improvement is also fine and many little ones make one big.

Someone invented glue but it didn't stick well. Till someone else thought it is ideal for post-its. He became rich. What if you can stick posters in the same way ?



In our brain we have nerve cells which have a lot of connections when we are born. Only the routes which are used more often are facilitated and strengthened. The rest vanishes. It is not good to have too many connections because it consumes too much energy.

By strengthening what is used a lot, we learn and in that way our brain adapts to the circumstances we live in or to the sport you exercise a lot. After your 25 th birthday you can loose a lot of neurons a day which are not needed any more. Fortunately it has no effect on your capacities,

In the same way you can better connect to a few good contacts rather then too many. What if you have Facebook for your friends but for instance Linked in for your professional network.

How beautiful it would be if those contacts would think with you and provides you tips. What if those contacts are creative and tell you what is smart, new, more sustainable or what creates a positive footprint ?

Investigate in different countries

Improve

Broaden

Market

Even nicer it would be if you had contacts with persons in different continents and countries like South Korea, Japan, South Africa, America, Canada ect. Contacts which keeps you informed about new ideas and products in your profession.

Then you could anticipate fast and look if those ideas and products even can be improved or broadened . This means a smart idea or product can be smart in a completely different field of which nobody had thought about yet.

And then, when you have a good idea or product, you start to market it for instance in your own web shop or you are going to spread good ideas with your friends on the internet. Then you get more status and perhaps you are offered a better job.

As sustainable solutions and ideas contribute to a better world and better social circumstances it is profitable in three fields namely in the field of people, profit and planet or in other words it can make you rich but it is also good for the earth and for social aspects. The whole world is waiting for that.

But as in nature the first vegetation (the pioneer vegetation) experiences hard times and it is uncertain if every plant survives. In economy the same happens. Not everything is successful. But if it succeeds the pioneer plant can create a forest or a very successful company. Just start and sometimes you have to try several times.

Producers

Prosumers

1.0

2.0

3.0

Consumers

Source: Marco Derksen, Marketingfacts

We are heading for the 3.0. society in which question and demand can be brought together through internet and IT.

There used to be a time companies created products and we had to buy them (1.0.)
Now though internet the consumer can tell what his or her opinion is.
Hotels are judged in that way. You can see what the opinion was of others about the hotel. So we can compare prices and quality much better now. The hotels and the companies react on that as well (2.0.)

But in 3.0. you as a prosumer (a producer and consumer) decide what you want and what companies and industry have to provide.

You see a beautiful T-shirt, you put it on the internet and you ask who is going to provide you this T-shirt. Out of the most attractive offers you choose. You want to go to Thailand on a holiday and you ask on the internet who provides me a nice holiday in Thailand. You get several offers and you choose to most attractive one.

The world is changing and though the fabulous possibilities of IT we now can work and think together all over the world for a better future. We can be co-creative, we can co-create and co-produce. We can share ideas and market good products. Hopefully it helps us to create a more sustainable world.

Written and illustrated by Rob de Vrind

As a result of the Leonardo da Vinci project:
“ Working and learning in the world of Cradle to Cradle”

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