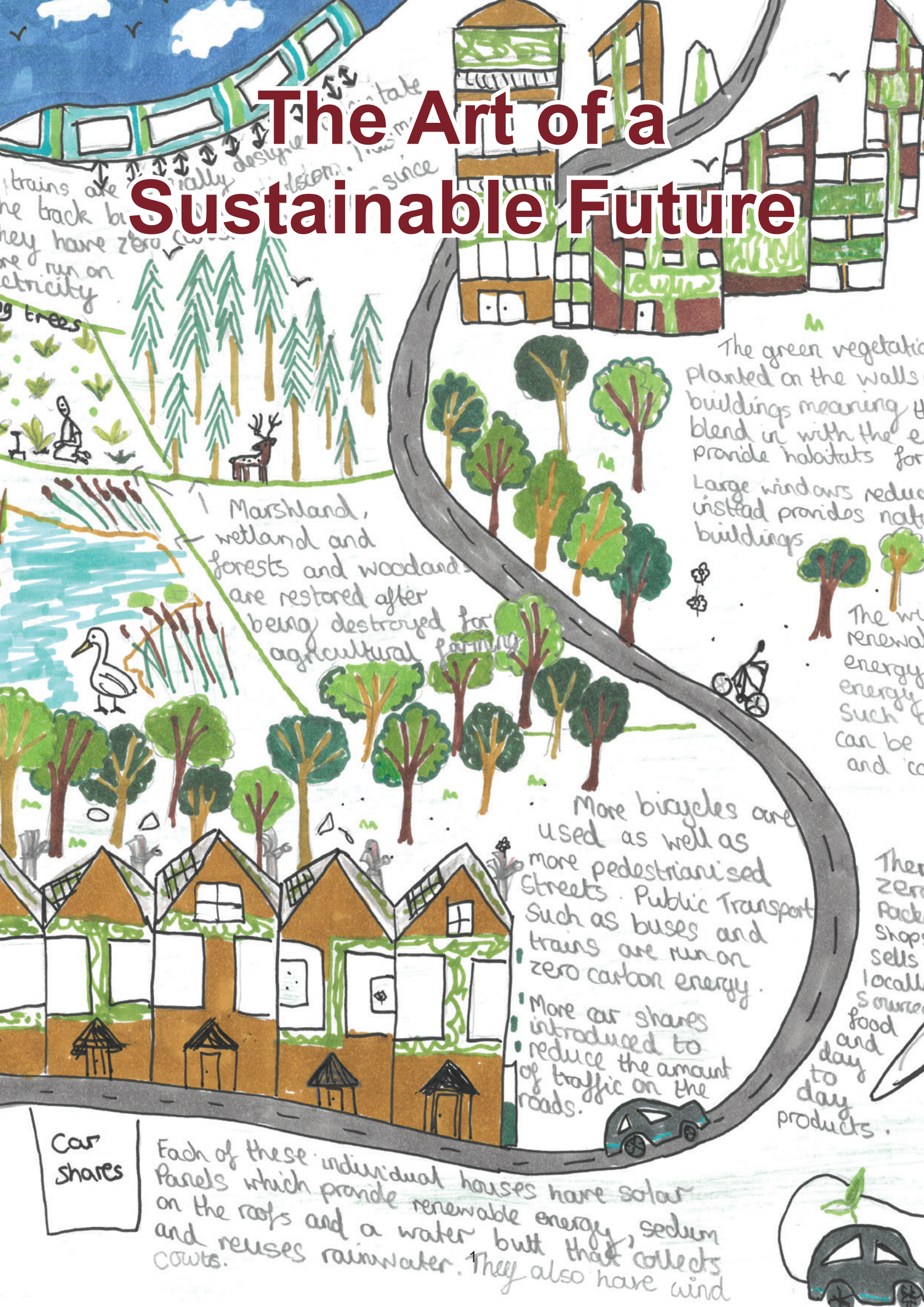


The Art of a Sustainable Future



trains are
the back b
they have zero
run on
electricity
g trees

Marshland,
wetland and
forests and woodlands
are restored after
being destroyed for
agricultural farming

The green vegetation
planted on the walls
buildings meaning y
blend in with the e
provide habitats for
Large windows reduce
instead provides nat
buildings

The w
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Such
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More bicycles are
used as well as
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streets. Public Transport
Such as buses and
trains are run on
zero carbon energy.

More car shares
introduced to
reduce the amount
of traffic on the
roads.

There
zero
Pack
Shop
Sells
locall
Source
food
and
day
to day
products.

Car
shares

Each of these individual houses have solar
panels which provide renewable energy, sediment
on the roofs and a water butt that collects
and reuses rainwater. They also have wind
towers.





The Art of a Sustainable Future

An INGENIOUS Project



Edited by James McKay and Benjamin Dickson

Introduction

Climate change is the greatest challenge humanity has ever faced.

It may seem terrifying and depressing, especially for the young people who will have to live with the consequences, and who until now have had little power to do anything about it.

Young people all across the world are now marching in protest to demand change, as they see little evidence that any solutions are working.

It will be their future, and during their lifetimes they will need to adapt not only to changes already occurring, but also transform society to prevent further climate change.

Understandably, many fear for the future.

However, it is not all doom and gloom. In fact, humanity is at a crossroads—there are still reasons to be hopeful (see below), and it may be possible to avert catastrophe if we act wisely.



This is the subject of this booklet.

The following pages showcase artwork created by school children and adult artists, as part of a project called 'The Art of a Sustainable Future' supported by the Royal Academy of Engineering INGENIOUS scheme for engineering engagement.

School children and adults, including scientists, artists and community groups, came together to imagine life in a zero carbon, positive, optimistic, sustainable future. They created art to visualise this future.

If we don't have a vision of a good future it makes it very hard to take action. Creating positive visions will hopefully inspire people to focus on what is possible and achievable.

Some Good News Stories

Nearly all the governments in the world came together in 2015 to create a treaty to address climate change - the largest such agreement in human history.

At least some governments have set targets of being 'Net Zero Carbon' by 2050 - this would have been unthinkable only a few years ago.

The cost of producing solar and wind energy has fallen dramatically, so it will be easier to make the transition to using renewable energy.

Amounts of pollution have reduced in many countries, even as people have become better off. The wealthier countries have cleaner environments, and as poorer countries escape from poverty, they are more able to protect their environment, and to protect themselves from climate change extremes.

Many organisations have stopped investing their money in fossil fuels.

Governments have come together to stop pollution from CFCs (which was causing the hole in the ozone layer). They have also created laws to stop emissions of sulphur dioxide from power stations, and reduced the numbers of nuclear weapons.

People are becoming more efficient, being able to produce more while reducing greenhouse gas emissions.

As people move into cities (which is increasingly happening), it becomes easier to reduce greenhouse gas emissions by organising cities more efficiently - for example by improving public transport.

As farming practices improve and people move into cities, land is freed up to be 're-wilded' and re-forested. Protected areas (nature reserves) have grown in number and area.

The Project

What can we learn from young people's visions of a zero carbon future?

First, a 'vision of a zero carbon future' was worked out, through lots of discussions. If you would like to do similar discussions in your class or community group, please see the guide on Page 22.

Following the development of the 'vision' an art competition was launched, open to anyone including school children. The selected artwork from the project shown in the following pages is intended to prompt some thoughts about the transition to a zero carbon future, and the text will address common themes that arose during the course of the project.

Thus, we hope the booklet will be inspiring and useful for any groups of children and members of the public who are worried about climate change and want to take action.

Imagining a positive future is *really hard*. Rather than saying 'we're all doomed' and switching off, anyone thinking positively about trying to solve the challenge created by climate change has to get to grips with new technologies, understand human behaviour, how society works, and how problems are solved. In short—



engineering the future. Research shows that people who find information about climate change scary do not want to do anything about it. Engaging people with practical solutions and problem solving is much more effective.

The Royal Academy of Engineering supports this project as a way to inspire children to consider engineering as a career. There is no bigger challenge than climate change, and skilled people are desperately needed to help humanity find solutions. We hope that some of the participants in the project, and some of the readers, will be inspired to become the Engineers of the Future!

Disclaimer:

The ideas in this booklet are those of the children and members of the public who took part. They don't represent any of the organisations involved, including the Royal Academy of Engineering. If you don't agree with these ideas, why not try to come up with your own?

Further information about climate change solutions can be found at the links included at the end of the booklet.



A Global Warning

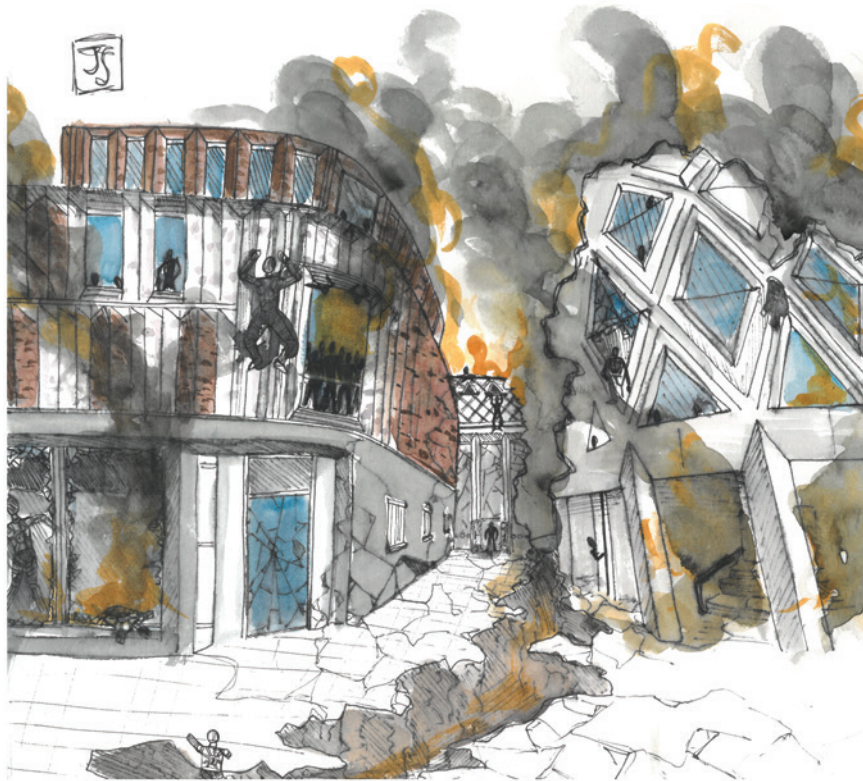


We're killing the Earth
And that's 'really fun'
But no one will listen
Because we are young.

Our forests are turning
To ash in a second
Ask California [and others like Finland]
They'll tell you how they've
Lost all their homes
While the president turns away
To tweet on his phone
"Global warming is a hoax"
Our future is stolen and
We are the thieves
Don't cry to me because
Your fur coat isn't clean,
Endangered animals total
Forty-one thousand, four hundred and
sixteen

Global Warming isn't a hoax,
It's a Global Warning.

Rhiannon C, Adam C



Human activities release greenhouse gases (including carbon dioxide, methane, nitrous oxide and CFCs) into the atmosphere. This warms the planet.

Although young people engaged in the project are aware of factories and cars producing 'smoke' and pollution, what is less clear are the links between greenhouse gases and providing heat for homes, power for the internet and electricity, and greenhouse gas emissions from agriculture, particularly meat production. All of these areas must go 'zero carbon' to avert dangerous climate change.

If they don't...

All the children involved in the project agreed about what a bad version of the future will look like—something like the pictures on this page.

Many science fiction books and Hollywood movies show a similar negative future.

It's pretty easy to imagine this NEGATIVE future. One could argue it's also a bit lazy. It's much more difficult, but vital, to imagine a POSITIVE future.

Climate Change Solutions

What will a POSITIVE future look like? In the following pages you can see artwork that shows some of the changes below:

Environment and Land Use

We re-wild the world, including planting billions of trees and re-introducing plant and animal species to restore ecosystems. Vast areas of the oceans are protected as marine reserves, allowing fish stocks to recover. Restored forests, mangroves and peatlands act to store carbon.

Energy

Renewable energy replaces fossil fuels. These are mainly solar and wind backed up by energy storage (e.g. batteries); but also including large-scale Bioenergy with Carbon Capture & Storage, which removes carbon dioxide from the atmosphere (this is controversial, as it may conflict with using land for growing food). There is generally a move from national energy grids to local communities generating their own power.

Food

We move to a mostly meat-free diet. Some aspects of agriculture become more intensive. New varieties of very productive and disease-resistant crops are developed, however it will be a challenge providing enough for everyone to eat while climate change destroys areas of farmland through drought, soil erosion and sea level rise.

Waste

A 'circular economy' is developed based on imitating living systems, where waste from one process feeds another. Wastes of all kind are minimised through better design, maintenance, repair, re-use, repurposing and recycling.

Transport

Sustainable transport is developed, with great emphasis on walking and cycling in cities, along with better public transport.

Buildings

New buildings are made so they are zero-carbon, and older buildings are fitted with insulation to enable people to stay warm (or cool) while using less energy. Wooden buildings lock up carbon.

Working together

We use advanced communications technology to enable global cooperation to tackle climate change problems.

Changing Values

New ways to measure improvements in society are developed, for example 'Gross National Wellbeing' rather than 'Gross National Product' (which just measures the value of goods and services). We transform society to focus on improving wellbeing. Improving wellbeing is thought to include* enabling people to:

1. Connect to others;
2. Be active;
3. Take notice of their surroundings;
4. Keep learning;
5. Give to others.

**according to research by the New Economics Foundation*

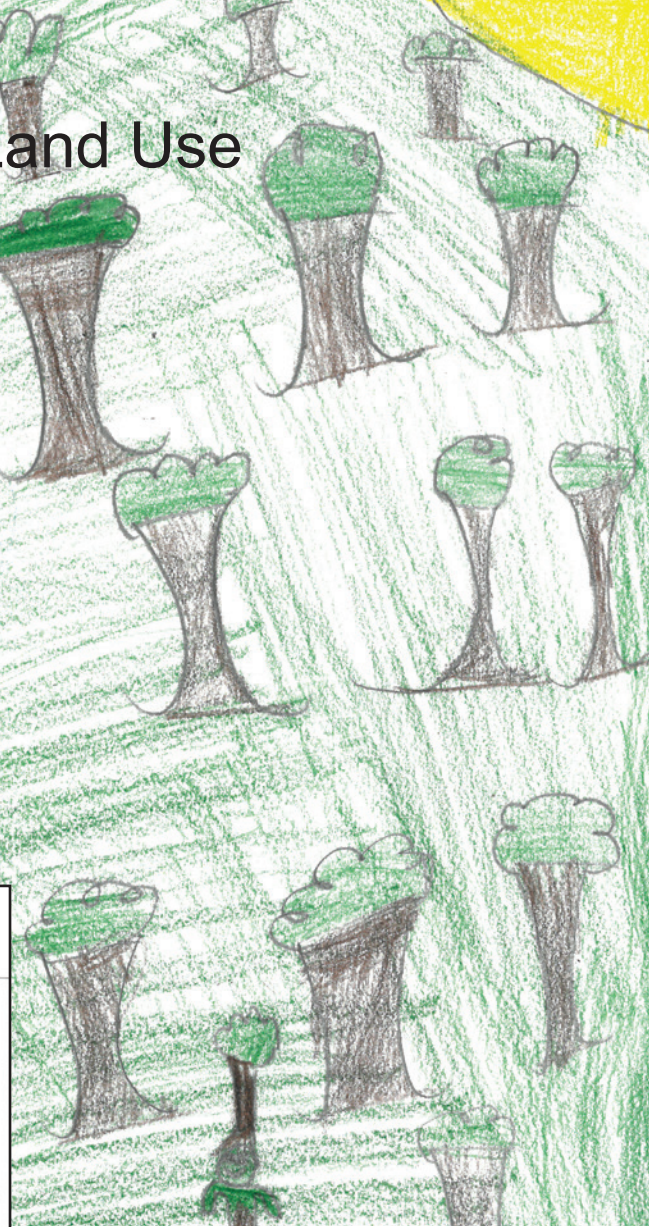
Population

As widely predicted by scientists, global population growth slows and then declines in the middle of the 21st Century, thus making it easier to solve our environmental problems.

The changes above make it possible to reduce the chance of catastrophic climate change. However, we also have to *adapt* to climate change impacts that are already occurring such as droughts, flooding, and extreme weather events. Some adaptations like planting trees will help to both tackle climate change and reduce extreme temperatures and flooding at the same time.

Remember that achieving a zero carbon future will involve changing our *existing* way of life in the places where we live, not inventing a new society from nothing. For example, some roads, bridges and historic buildings in the UK are hundreds of years old, and are likely to be around for many years to come. Anyone trying to imagine life in a positive future needs to consider how we will fit the changes onto our existing way of life. For example, insulating existing homes will be very important to reduce demand for energy, although it is less dramatic than designing stylish new 'green' buildings.

Environment and Land Use



The way we use land for farming and other activities has a huge impact on the planet. An important way to prevent further climate change is to use natural processes, because restored forests and soils act to lock up carbon, preventing it from entering the atmosphere. We can do the following:

- Tree planting on a huge scale
- Restoring peatlands
- Restoring mangroves
- Restoring soils
- Farming efficiently (also reduces water use)

Above: Tree Planting Drone: made from an old Army tank. My hope is that there will be some government organizations which will divert military spending to combatting climate change. An automated tree planter would be an ideal use of technology for large rural spaces that need re-forestation.

All of the above provide many other benefits in addition to helping avoid climate change.

Amazing initiatives worldwide are being undertaken to plant more trees, including in the UK, which is one of the most nature-depleted countries in the world. If some of the commitments to planting trees really happen, this will have a huge positive impact.

Tanks are ideal for travelling over all terrains and if they're not being used to kill people then they could be easily retrofitted at low cost to do the job of planting a tree.

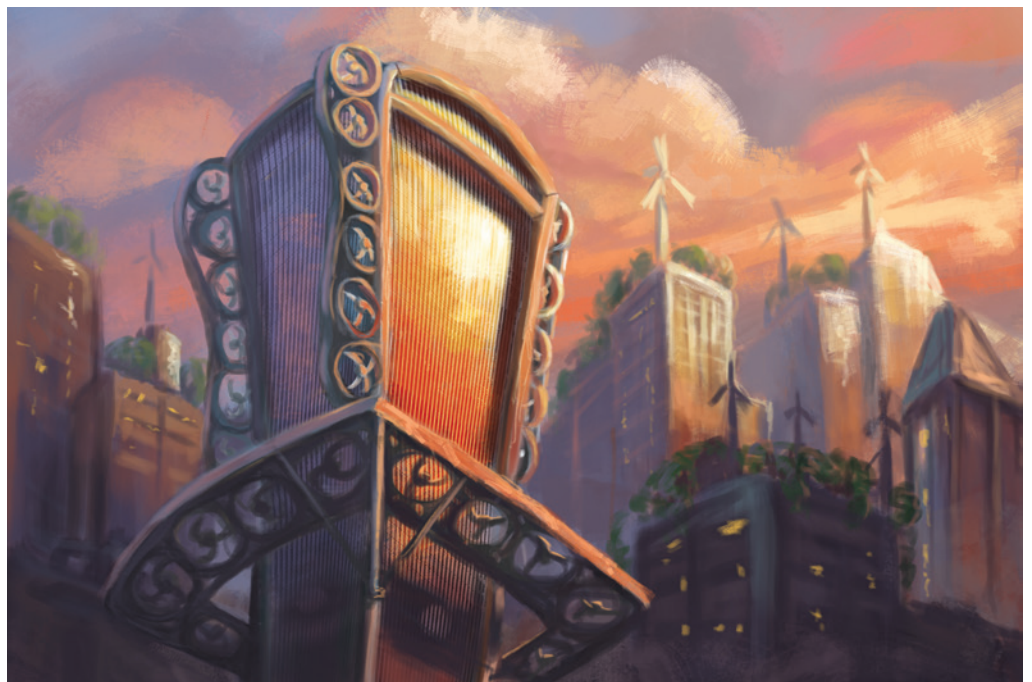
Keegan B



All of the young people involved in the project liked illustrating Wind and Solar power. There are many other less familiar sources of energy that are renewable or emit fewer greenhouse gases, including Tidal, Geothermal, Bioenergy and Nuclear power.

Putting solar panels and wind turbines everywhere will not be enough. We also have to think about how to provide *additional* electricity if we are going to have lots of electric cars driving around.

Batteries and hydrogen can be used to store energy produced by renewable sources. These can address the problem that solar only works when the sun shines, and it is difficult to predict the wind.



Above: My idea is to give these buildings 'Wind Skirts' that can produce power. Future sky scrapers should be oriented to the prevailing winds.

Keegan B

Food, Water and Waste



All the young people involved in the project were very concerned about waste, especially plastic waste. Plastic waste is a huge issue, but any waste, including leftover food that breaks down, for example in a landfill site, produces greenhouse gas emissions.

Ideally we need to avoid waste through better design, maintenance, repair, re-use, repurposing and recycling. We should only need to recycle once the other options have not worked out, because recycling itself uses energy and produces greenhouse gas emissions.

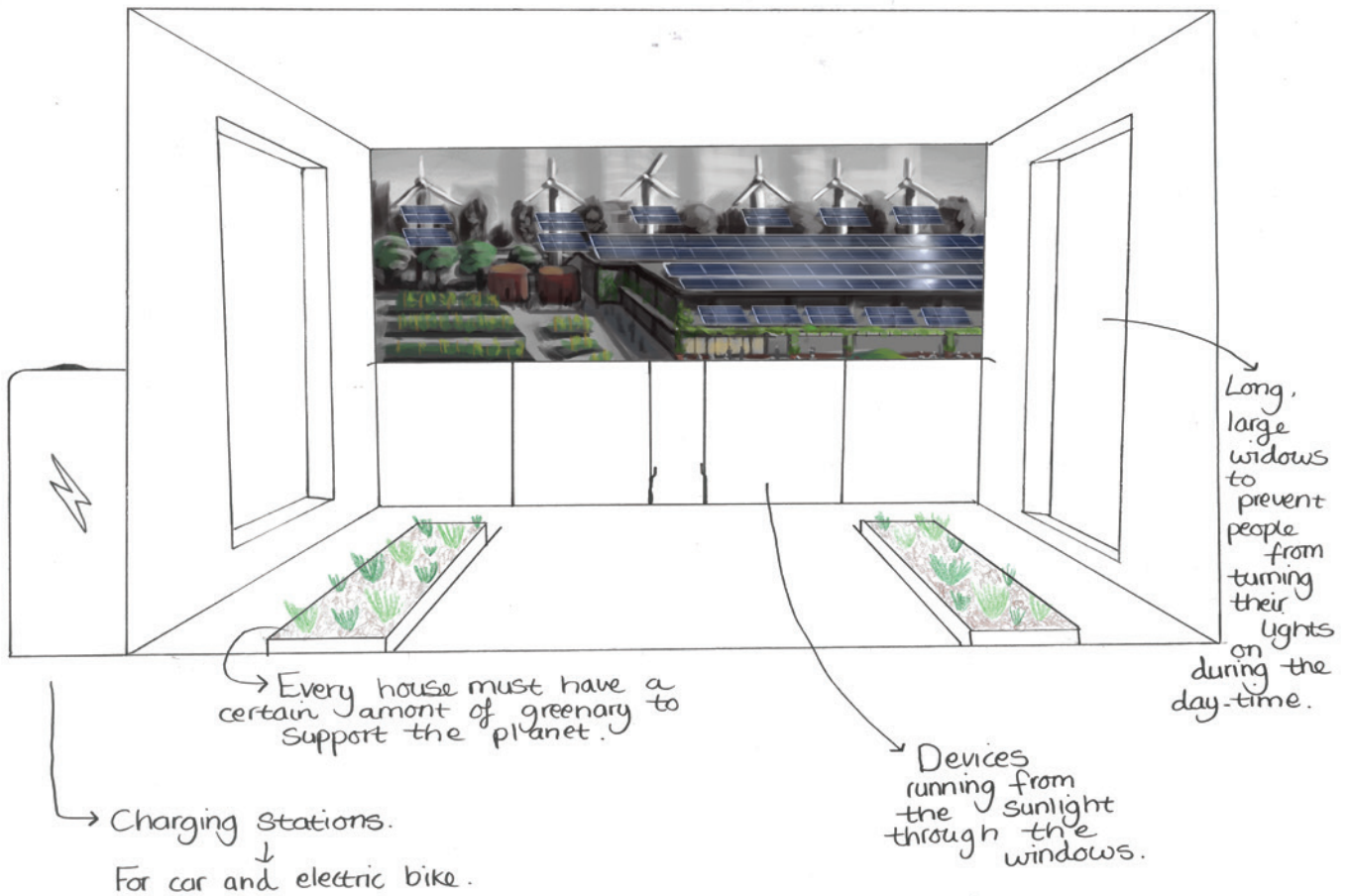
The way we produce food has a big impact on the climate, particularly because we waste so much of it. In particular, meat production produces more greenhouse gas emissions than crops. Also, meat production requires land areas to be cleared to grow crops to feed to animals, and consumes huge amounts of water thus it is much less efficient as a way of growing food.

The pictures children produced show lots of food being produced locally, which means less transport, less waste, and opportunity for communities to work together. However, urban farms and local produce are unlikely to provide enough food for everyone, so intensive agriculture using new techniques and productive crops is needed.





Buildings and Industry



All the pictures produced for the project showed buildings with solar panels on the roofs, along with green roofs. In the future, many more buildings are likely to have these, however less obvious changes might occur.

Insulation of existing homes will be very important - reducing energy use is the cheapest way to prevent greenhouse gas emissions.

Buildings may be made of wood, which will lock up carbon.

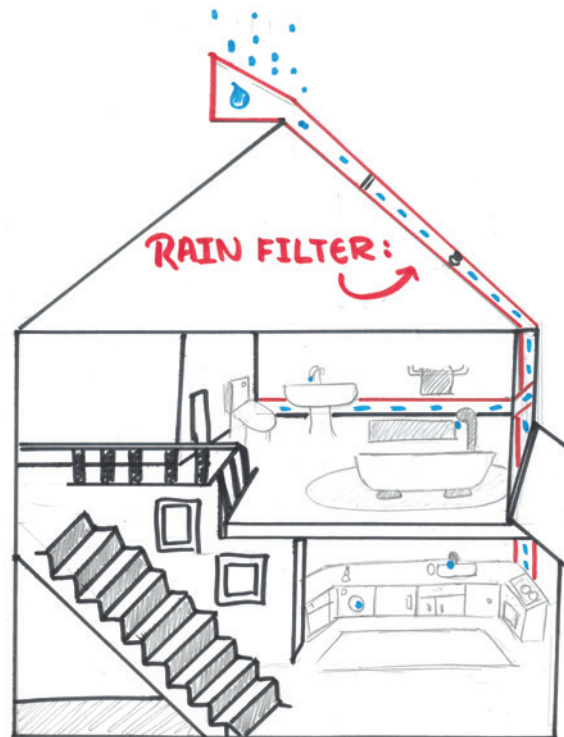
Housing:

Building things out of wood is a very effective way of locking up carbon, keeping it out of the atmosphere.
↳ like, paper, card, furniture, fencing etc.

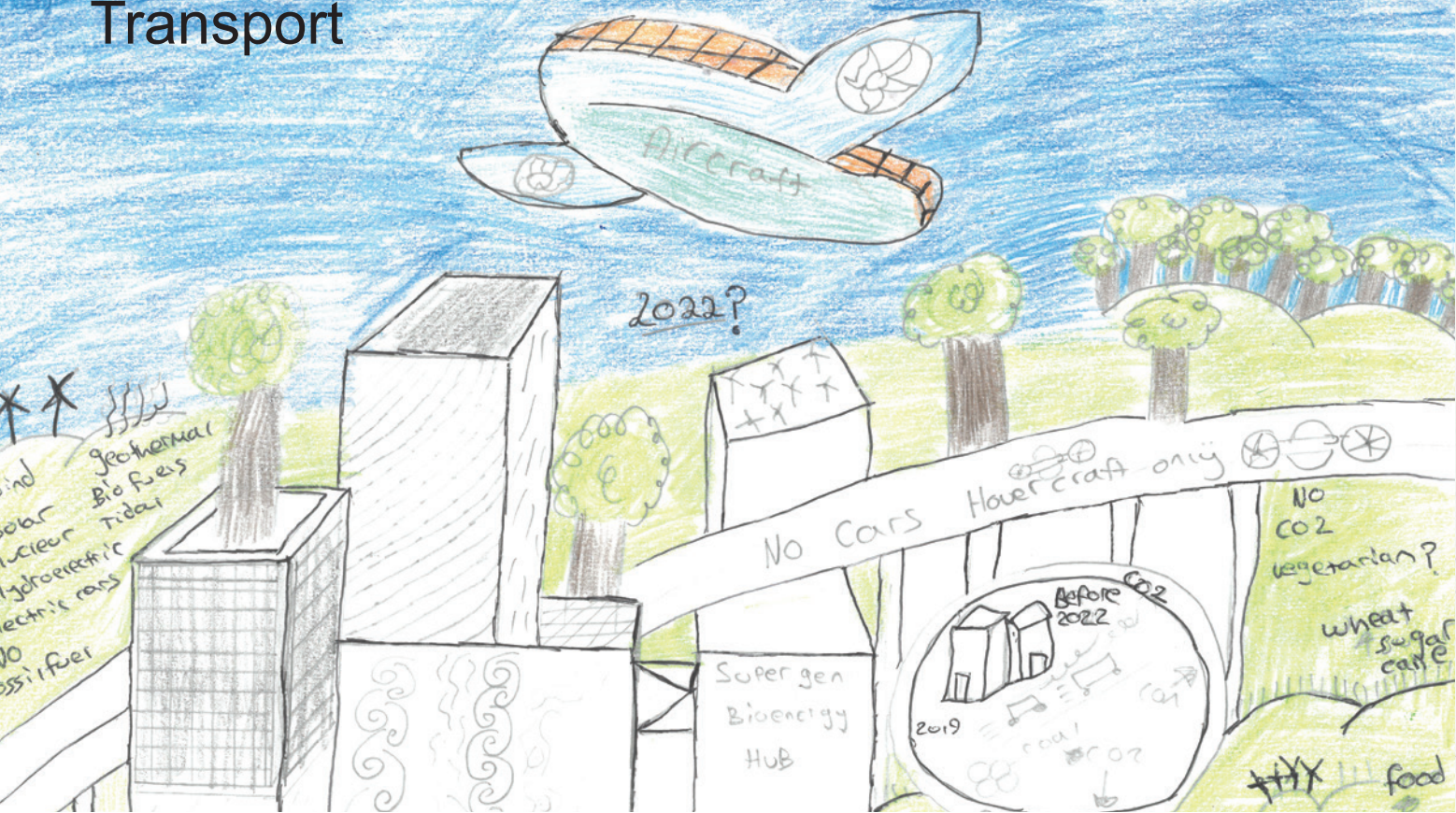


Heavy industry will still be needed to produce concrete and steel, among many other goods. Both of these materials generate large amounts of greenhouse gas emissions during production. Some of it may be impossible to avoid, so it is likely that we will have to remove greenhouse gas emissions from the atmosphere to compensate - for example, by planting trees.

Trees and crops take in carbon dioxide as they grow. If they are then used to produce bioenergy (by burning in power stations) and the carbon dioxide is pumped underground, this will actually remove carbon dioxide from the atmosphere. This is called Bioenergy with Carbon Capture and Storage, and is controversial because some people don't think there is enough land area to grow the trees and plants needed to make it work.



Transport



In a sustainable future, walking and cycling will be the commonest means of transport, enabled by city planning that makes it easier to get around.

Next will come improved public transport such as electric trams, buses and trains, all linked together to provide seamless journeys.

Electric cars are likely to make a breakthrough in the next few years, however most private cars are not used for 90% of the time (they just sit on the street or in car parks) so

they are a very inefficient means of transport. In addition, the manufacture of cars accounts for a large fraction of the lifetime greenhouse gas emissions produced, even before a car has even been driven. Car share schemes may become common, reducing the numbers needed.

Greenhouse gas emissions from aviation are difficult to reduce, even though electric planes are being tested. As with heavy industry, we may have to compensate by removing greenhouse gas emissions from the atmosphere. Or just fly less often.

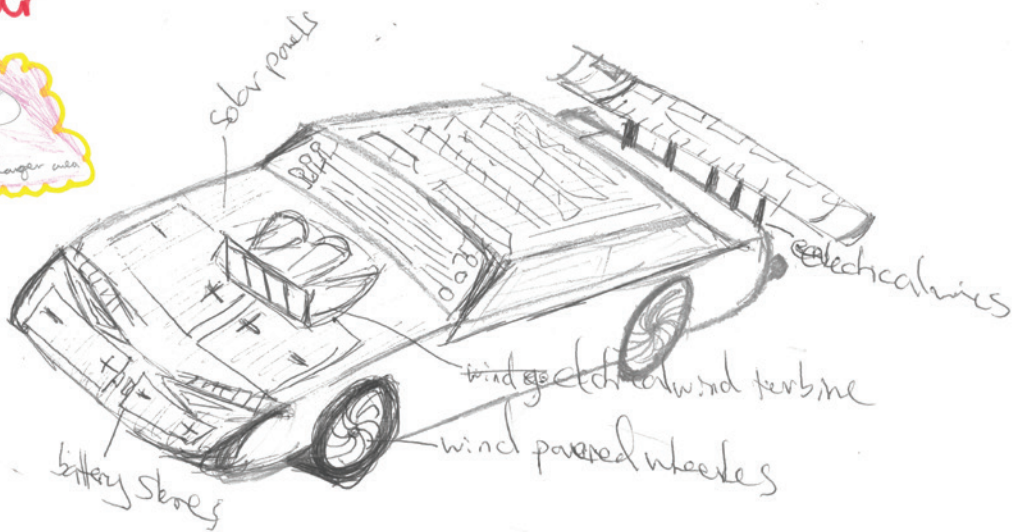




Electric car

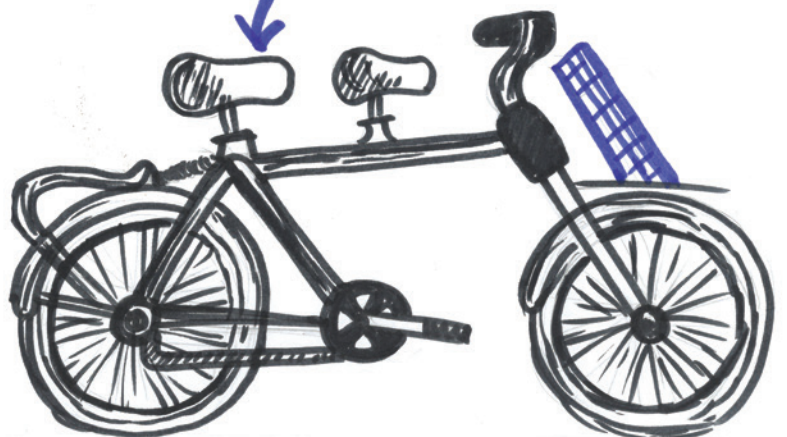


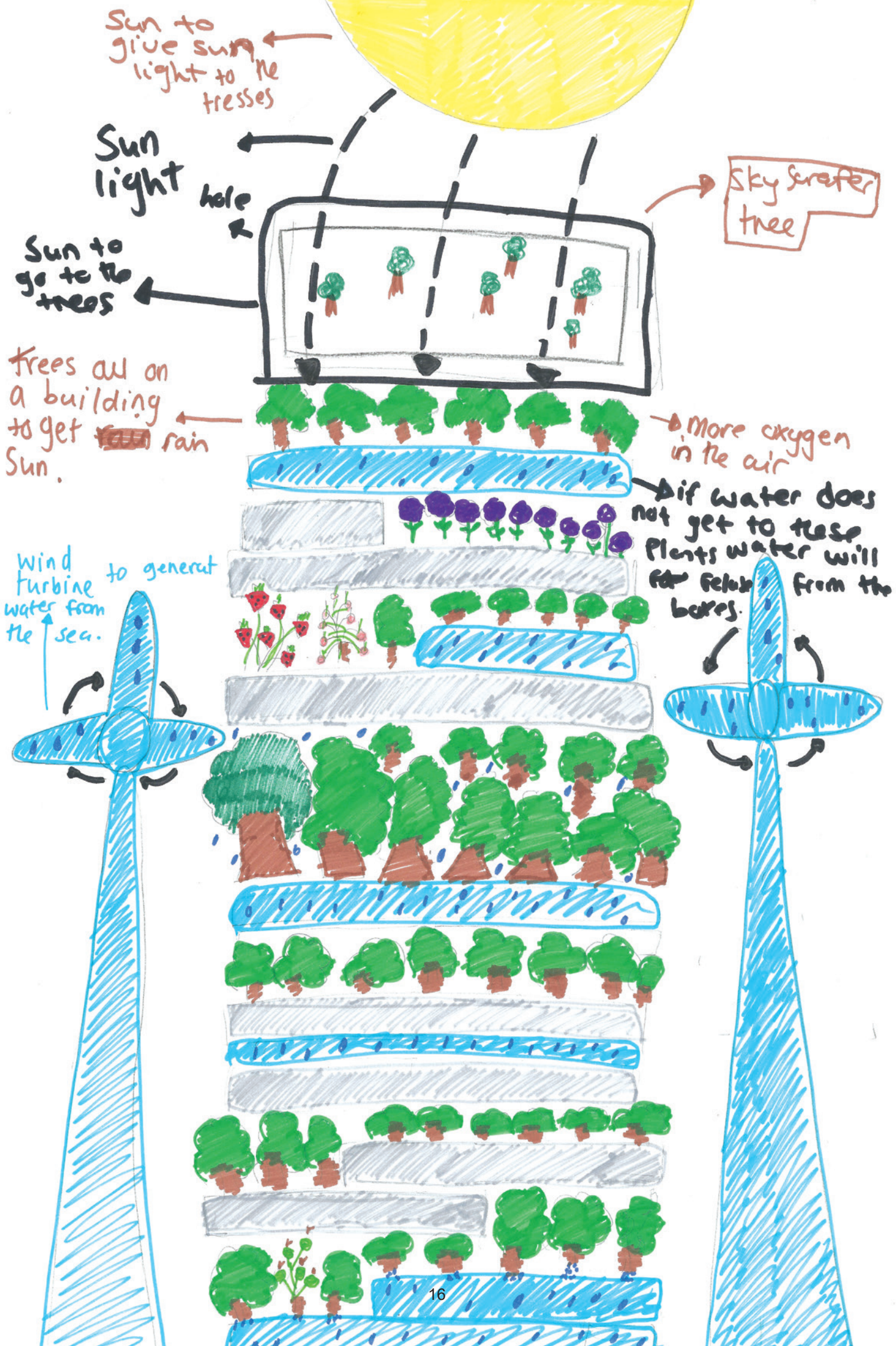
Public
reminders of the ban
etc!



This car is powered by natural power sources like sun the sun wind basically when the car is ~~stop~~ not used it charges by the sun and the outside part of the car is made of solar panels and it has wind wheels so when the car is moving its the wheels are generating energy constantly which means no more money waste and oil waste and pollution because it is powered by natural

SOLAR BIKE:







The Complete Zero Carbon Landscape

Above: I chose Fort William, Scotland as a potential site for the permaculture principle landscape. A combination of natural and manmade structures utilise gravity and water to generate energy. Salt farms purify water, sea beds grow algae and sea weed for nutrition. There are 'fit-pods' for people to recharge batteries both outside and indoor, these can be linked with domestic energy needs.

Biospheres, similar to Eden project designs house protected cultivation spaces, due to unpredictable weather. Architecture includes living walls wherever possible.

Shareena H

Following pages:

Putting everything together—a view of a complete 'zero carbon' landscape

Pages 18 and 19: A Low Impact Living Affordable Community of the future

Features:

- Allotments for growing food locally
- Algal biorefinery for fuels and green products
- Solar panels and roof tiles
- Green roofs
- Wood stack—energy storage
- Bee hives
- Reed bed water treatment
- Insect farms
- Net zero carbon homes
- Cooperative community facilities
- Shared tools, bikes
- Forest gardens
- Wooden buildings
- Lots of biodiversity and green space



maglev trains are specially designed to levitate
above the track by magnetic repulsion. This means
that they have zero carbon emissions since
they are run on electricity

planting trees

Marshland, wetland and forests and woodlands are restored after being destroyed for agricultural farming

The green vegetation planted on the buildings means they blend in with the environment and provide habitat. Large windows instead provides buildings

More bicycles are used as well as more pedestrianised streets. Public Transport such as buses and trains are run on zero carbon energy.

More car shares introduced to reduce the amount of traffic on the roads.

Car shares

Each of these individual houses have solar panels which provide renewable energy, sediment on the roofs and a water butt that collects rainwater. They also have wind

the
orange

car
day
to
day
product

Vegetation is
walls of the city
ing that it can
the environment and
s for insects.

reduce the use of lights
s natural lights for the

he wind turbines provide
renewable energy (wind
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uch as cars - electric cars
n be plugged into the turbine
nd can be charged.

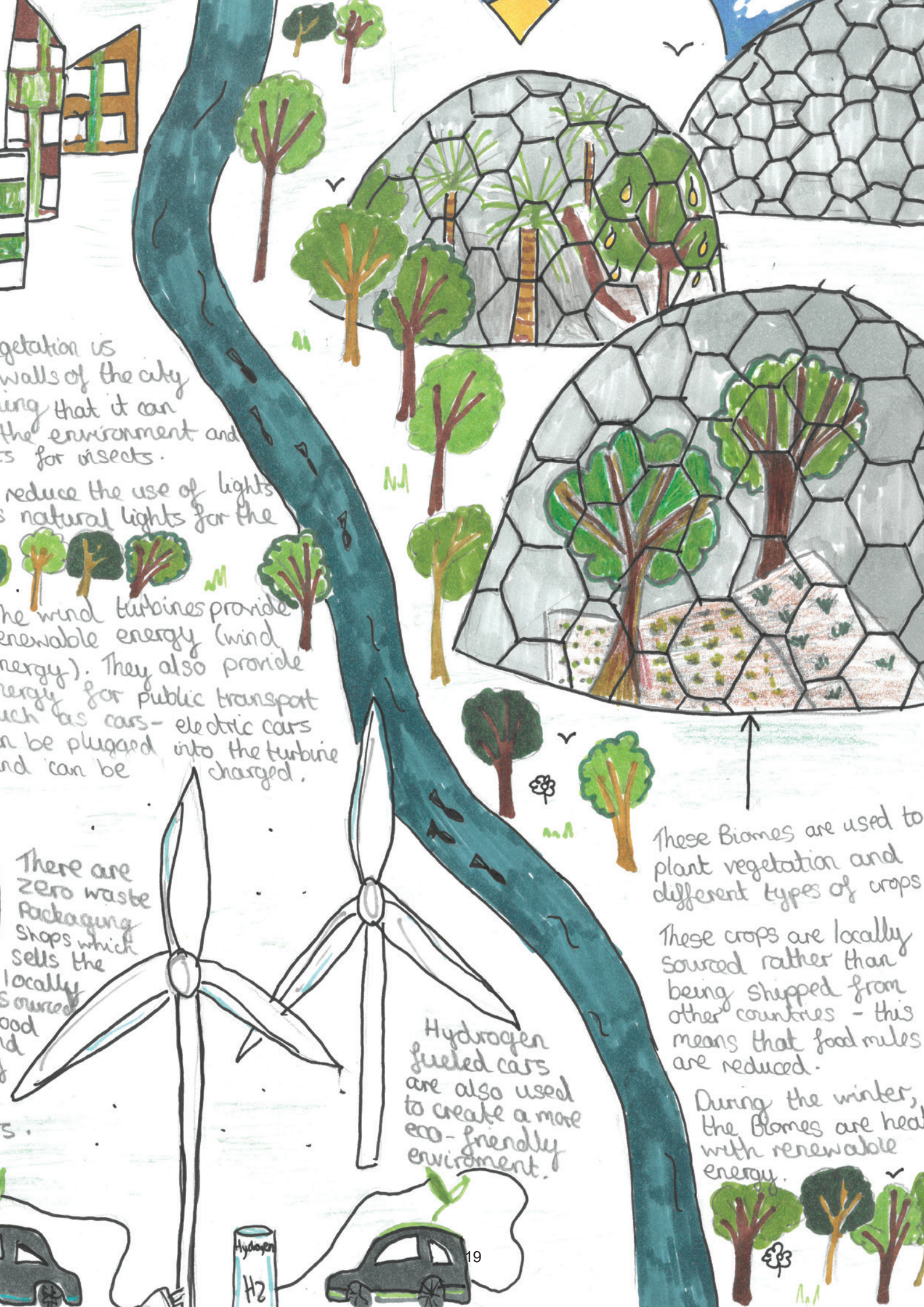
There are
Zero waste
Packaging
Shops which
sells the
locally
sourced
ood
nd

Hydrogen
fueled cars
are also used
to create a more
eco-friendly
environment.

These Biomes are used to
plant vegetation and
different types of crops

These crops are locally
sourced rather than
being shipped from
other countries - this
means that food miles
are reduced.

During the winter,
the Biomes are heat
with renewable
energy.



A Low-Impact Living Affordable Community of the Future







A Zero-Carbon Future City: Leeds

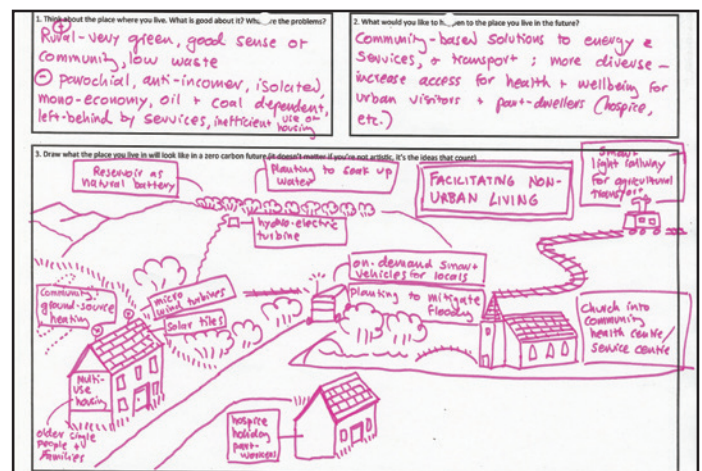
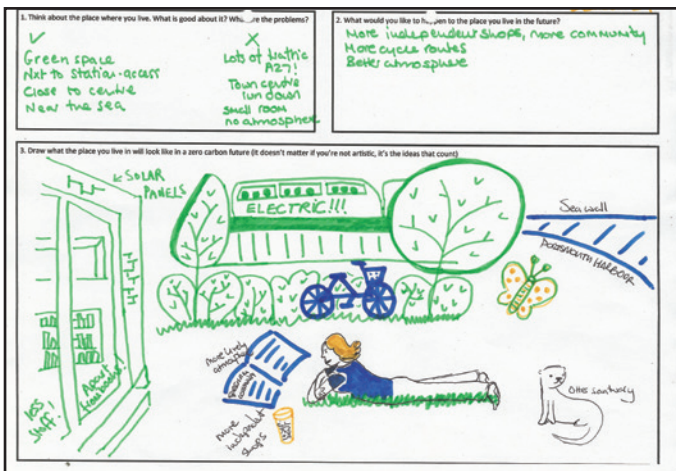
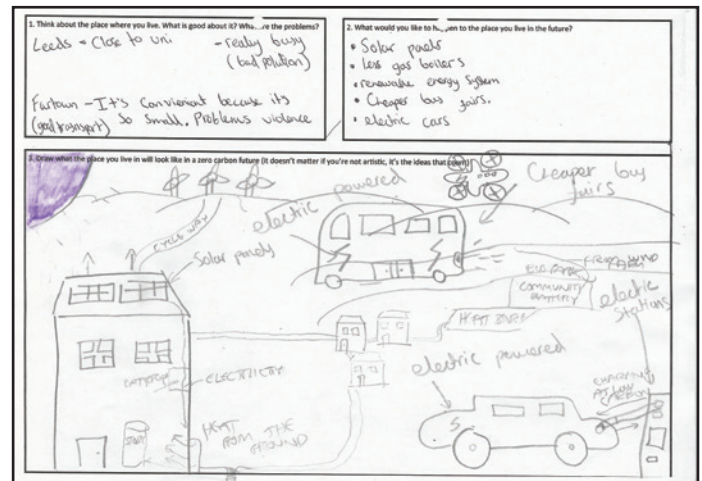
Above: A composite photograph to show a vision of a Zero Carbon Future Leeds, by artist Jonathan Turner. This picture was inspired by the workshops and discussions during the project, and involved photographing some of the project participants along with many other residents of Leeds. Locations in Leeds were used for backdrops.

The picture shows how trees, green roofs and walls on apartment blocks can add to biodiversity, reduce pollution, store carbon, improve people's wellbeing and help keep the city streets cool. Renewable energy technologies such

as wind turbines appear in the background and some roofs have solar tiles to generate energy, incorporated into building designs so they are almost invisible. The artist was most interested in the idea of community and local production, reducing the need to import foods and other goods, and lots of recreation space, taking over from current city designs that are based around giving most of the street space to cars. Most citizens get around via walking and cycling, with some futuristic renewable-powered monorails in the background and light aircraft powered by wind and sun.



Draw the Future - Run your own Future Vision Workshop



Sketches: Anonymous; Photo: Anna Woolman

Above: These are typical sheets used during the project to prompt people to think about how climate change will affect their area, and how they think their area will look in a positive future. You can easily make a sheet for your own session:

Box 1: Think about the place you live. What is good about it? What is not so good? List as many points as you can.

Box 2: Think about how the place you live will change in a positive, zero carbon future. List all your ideas.

Box 3: Now draw a picture! This could be a view of one street or a whole city. It could be a series of sketches and notes. It doesn't matter if you're not an artist - it's the ideas that count. The effort of trying to turn your thoughts into drawings might trigger new ideas.

Future Vision Workshop Plan (1 hour long)

5 minutes - Everyone introduces themselves and explains what they are most interested in (keep this short as this could take a whole hour itself!)

5 minutes - Get people moving with an 'Energy User Quiz'. Everyone lines up against a wall, and moves forward if they answer 'yes' to any of the following questions: 1. Do you turn out the lights at home when you're not using a

room? 2. Do you turn off the water when brushing your teeth? 3. Do you recycle? 4. Do you walk or cycle to work/school? 5. Do you take local holidays (without flying)? 6. Are you a vegetarian? The participants have to explain why they think each answer is important for reducing emissions. The exercise helps people understand how all activities can have an impact on the climate, although individual actions will only be part of the answer.

10 minutes - a 'Climate Change Solutions' discussion. This could be a question and answer session if you have an expert present, or a discussion among all the participants. Someone should note down the solutions that everyone thinks are the most important.

30 minutes - Now draw the future based on your ideas! Remember this is not about creating a fantasy world, but trying to imagine real places where people live. The 'Draw the Future' template above could help with this, but is not essential.

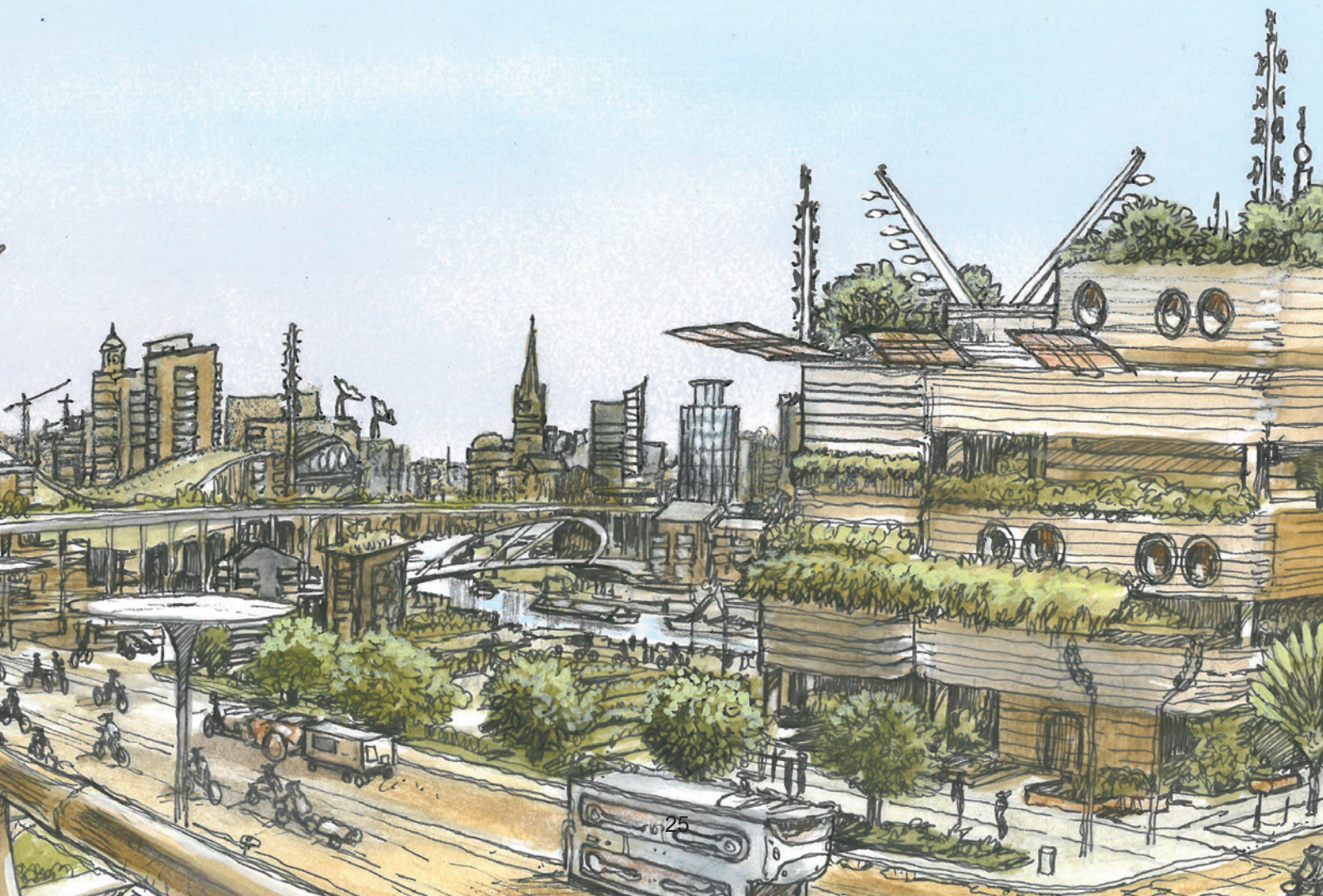
10 minutes - finish up by presenting some of the drawings and discussing them. You could take this further by working the ideas up into finished pictures which could be turned into posters, or used for social media campaigns, and the group could use these ideas to inspire action in their community.

A Change in Perspective

Our planet was not put first
Nobody could say that
Creating a zero carbon future was of the utmost importance
And we decided to believe that
Installation of infrastructure for renewable energy was too challenging
We chose to ignore that
Reducing greenhouse gas emissions is essential to our future
Now we know that
Climate change is still affecting us
You'll never hear us say that
Air pollution is no longer a problem for our health
We all know that
We continue to burn fossil fuels without capturing emissions
And that
Sea levels continue to rise and ice caps continue to melt
It would be wrong to say that
We chose to put our planet first

Now read it backwards

Katherine G



Glossary

Bioenergy - Obtaining energy from material made from plants and animals (biomass), containing stored energy from the sun. Biomass is a renewable energy source because we can keep growing more trees and crops. Examples are wood, manure and seaweed.

Circular Economy - waste from one process feeds another. Wastes of all kind are minimised through better design, maintenance, repair, re-use, repurposing and recycling.

Climate Change - Also called 'global warming' or 'global heating', this is a change to the Earth's climate caused by increased greenhouse gas emissions. Currently, these greenhouse gas emissions are mainly caused by human activity. Although the planet warms overall, changes are very complex so many people prefer the term climate change to global warming.

Geothermal Energy - Energy can be obtained from the ground. This doesn't have to be in an area with volcanic activity, even a small difference in temperature is enough to drive a ground source heat pump.

Green Roof - A green roof is a roof of a building which is partially or completely covered with plants. This acts to regulate the building's temperature, air quality, and also provide a habitat for some plants and animals.

Hydrogen Energy - Hydrogen can be used as an alternative fuel to power vehicles, or devices like mobile phones. Hydrogen fuel cells (batteries) make electricity. They are very efficient, but expensive to build. When hydrogen is used for fuel in a car, water comes out of the exhaust pipe instead of harmful chemicals.

Net-Zero Carbon - Achieving zero carbon emissions will be difficult because it is almost impossible to avoid producing carbon emissions through steel and concrete-making, and aviation. So to get to a net-zero carbon future,

we need to remove some carbon from the atmosphere.

Nuclear Energy - Some atoms are unstable and split apart - termed nuclear fission. The energy released in most nuclear reactions is much larger than that for chemical reactions.

Permaculture - a way of growing food in harmony with the environment.

Smart City - A smart city is where systems are very efficient because everything is connected through behaviour changes and advanced computing.

Solar Energy - Solar energy is the sun's rays (solar radiation) that reach the Earth. This energy can be converted into other forms of energy, such as heat and electricity.

Sustainability - Usually meant in a positive way - to act in a way that doesn't regard the planet as a resource to be used up: "Meeting the needs of the present, without compromising the ability of future generations to meet their needs".

Tidal Energy - The moon's pull on the Earth results in tides; i.e. rises and falls in water level. These fluctuations mean water is moving, and moving water means kinetic energy. There are several ways to turn this tidal energy into electricity, including tidal fences, tidal barrages (like dams) and tidal turbines. Each uses the movement of the tides to spin turbines, or electromechanical generators.

Wind Energy - Like old fashioned windmills, today's wind turbines use blades to collect the wind's energy. The wind flows over the blades creating lift, just like aeroplane wings, which causes them to turn. The blades are connected to a drive shaft that turns an electric generator to produce electricity.

Further Reading

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Steven Pinker (2018) *Enlightenment Now*. Penguin Books Ltd.

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Links

Committee on Climate Change: <https://www.theccc.org.uk/>

Centre for Alternative Technology – Zero Carbon Britain: <https://www.cat.org.uk/info-resources/zero-carbon-britain/>

IPCC Report on 1.5°C of global warming: <https://www.ipcc.ch/sr15/download/>

Priestley International Centre for Climate: <https://climate.leeds.ac.uk/>

Credits and acknowledgements

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Page 1—John Swogger
Page 2—James Mckay
Page 3—James Mckay, Freya S
Page 4—James Mckay, Jasmine S
Page 6—Keegan Blazey, Mariam S, Anne-Marie B, Isabel
B, Stayeie P
Page 7—Samuel K, Keegan Blazey
Page 8—Alana C, Isabel S
Page 9—Lily, Oriel O
Page 10—Keegan Blazey, John Swogger, Isabel B, Nuha C
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Page 12—Muhammad A, Junior T
Page 13—Lucy C, Faysal H, Mariam S, Anne-Marie B,
Isabel B, Asma M, Joudy A
Page 14—Anonymous
Page 15—Shareena H
Page 16,17—Sophie K, Nabah H
Page 18,19—James Mckay
Page 20, 21—Jonathan Turner & Tony O'Keefe
Page 22—Anonymous
Page 23—James Mckay
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Imagine what a positive, optimistic, zero-carbon, sustainable future would look like. Then draw a picture of it!

This was the challenge set to hundreds of school children, students, engineers, scientists and artists, as part of a Royal Academy of Engineering INGENIOUS project called 'The Art of a Sustainable Future'.

This booklet showcases some of the art produced for the project and explains how children, community groups, engineers and scientists think we can address the problem of climate change by creating a better world.

Also included is a guide for schools and community action groups to help them run similar 'visioning' projects in their local area.