

What is carbon farming?

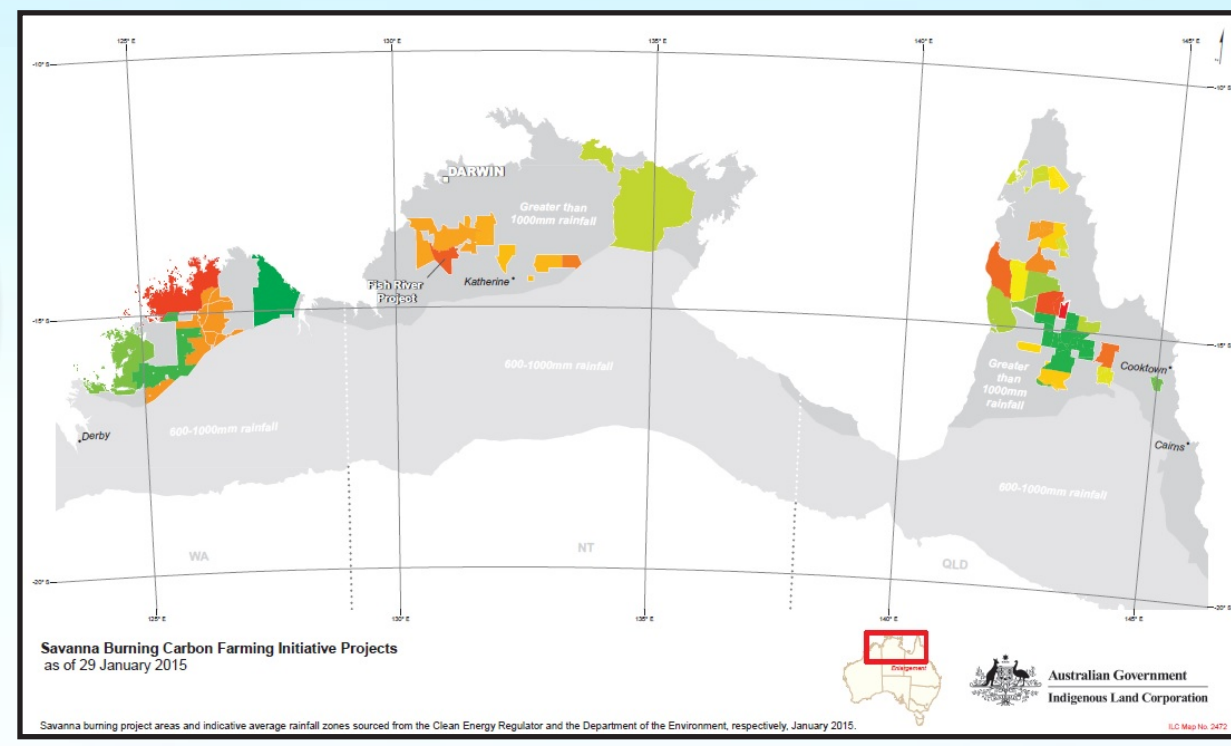


Carbon farming can help us deal with the big changes that have happened

Many Indigenous people have left country or were forced to leave. Country suffers without people to care for it and people and culture suffer without country.

Unmanaged land is vulnerable to big, late season wildfires, and wildfires release greenhouse gases into the air which causes climate change. Government and other organisations are trying to find ways to deal with climate change by reducing **greenhouse gas emissions**.

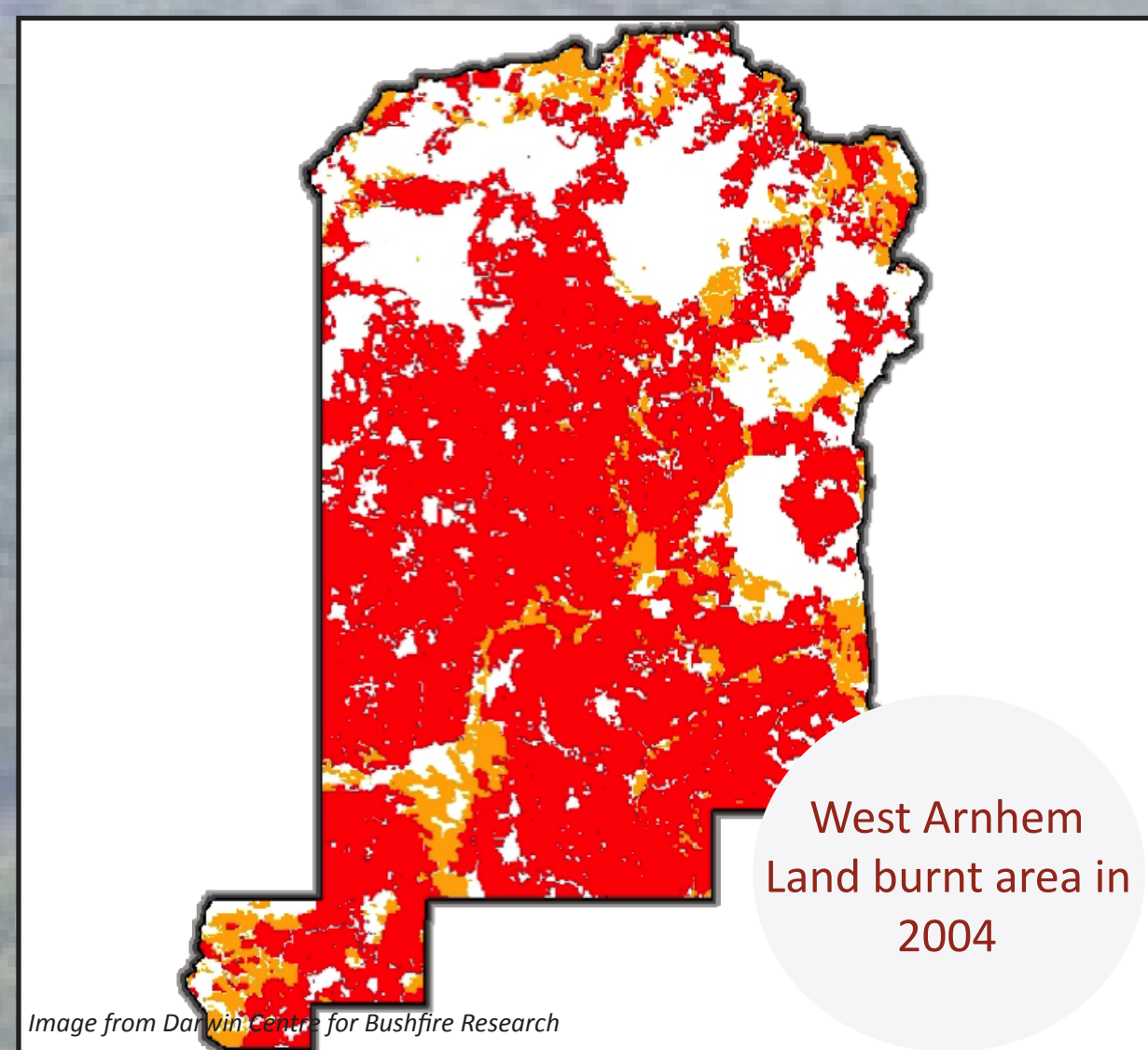
One way is to pay people to start **carbon farming projects** that reduce the amount of greenhouse gases that go into the air. There are many different types of projects but one type allows Indigenous land managers to use traditional-style fire management techniques to reduce the frequency of big wildfires. These are called savanna fire management projects, and they combine traditional knowledge with modern, western science.



The colour spots on the map show that there are over 33 carbon farming projects using traditional-style fire management in north Australia. The first project was the WALFA project in West Arnhem Land.



ConocoPhillips own a liquefied natural gas plant in Darwin. They create a lot of greenhouse gas emissions so they agreed to pay the people of Arnhem Land to develop and run their project to **offset** their emissions.



Before the project started satellite images showed that 40% of the project area was burnt every year, mostly by uncontrolled, late season wildfires (red fire scars).

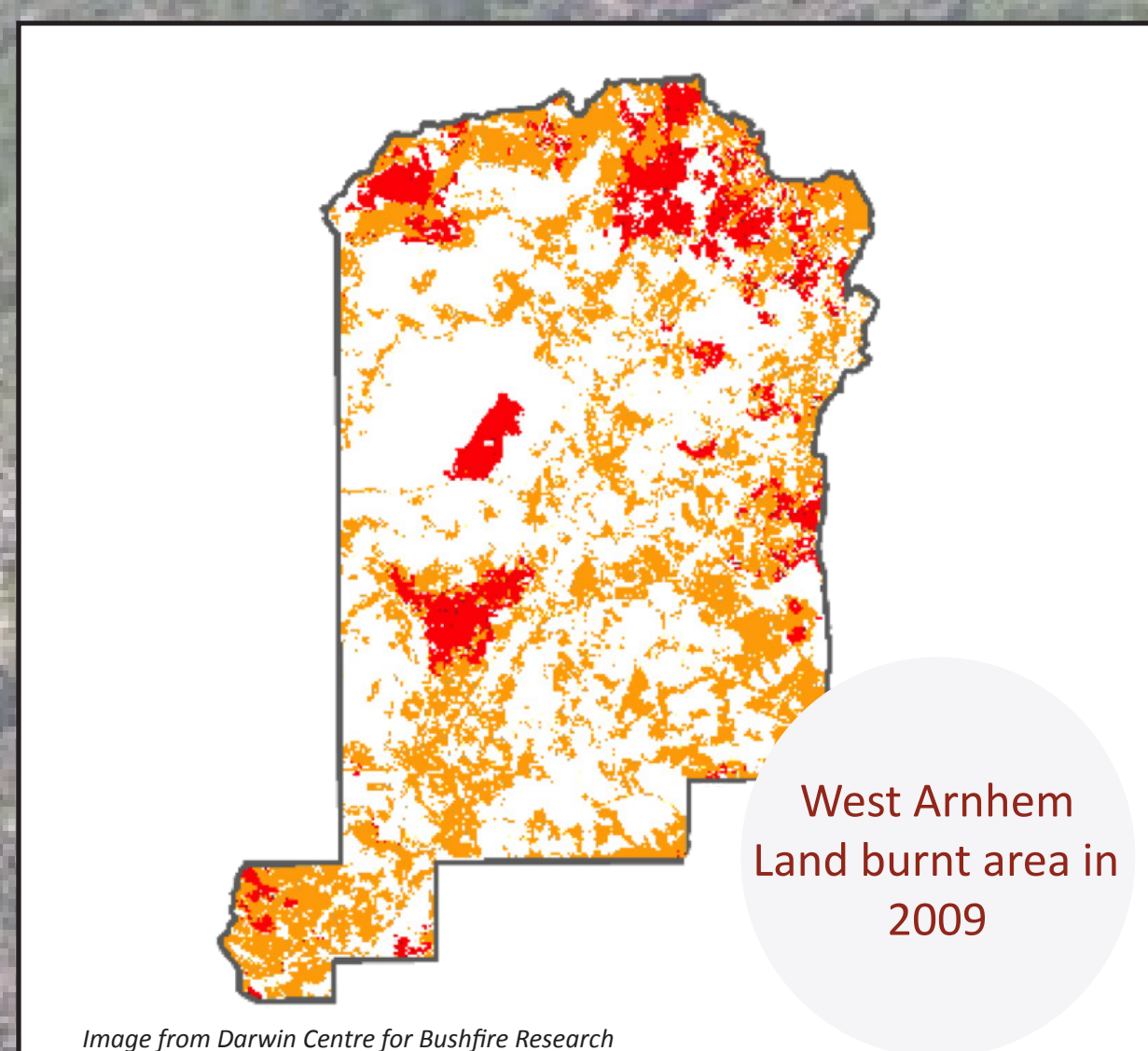


Then early in the dry season rangers and partners used modern technology like helicopters and drip torches to do traditional-style, early-season, patch burning.

The WALFA project example

The first savanna fire management project in Australia started in 2006 and was called the The West Arnhem Land Fire Abatement (WALFA) project. The people of west Arnhem Land made a deal with the Northern Territory government and a big gas company to fund a fire management project.

Over 9 years, approximately 1,500,000 tonnes of greenhouse gases have been saved. In turn the WALFA project has earned approximately \$1million dollars a year. This money helps run the project, give people jobs and support the community.



This created a strategic mosaic of smaller burn patches (orange fire scars) that stopped the big late dry season wildfires (notice how much less red there is).



The project has been a very important example to show how traditional-style burning can **abate** (reduce) greenhouse gas emissions and protect valuable country.

Greenhouse gases keep the Earth warm

Greenhouse gases keep us warm but humans are making it too warm.

The air is full of gases but you cannot see them with your eyes. If you look at them under a powerful microscope you can see that they are made up of tiny atoms joined together. **Greenhouse gases** keep our planet warm with a process known as **the greenhouse effect**.

The three main greenhouse gases are called:



Carbon dioxide (CO₂)

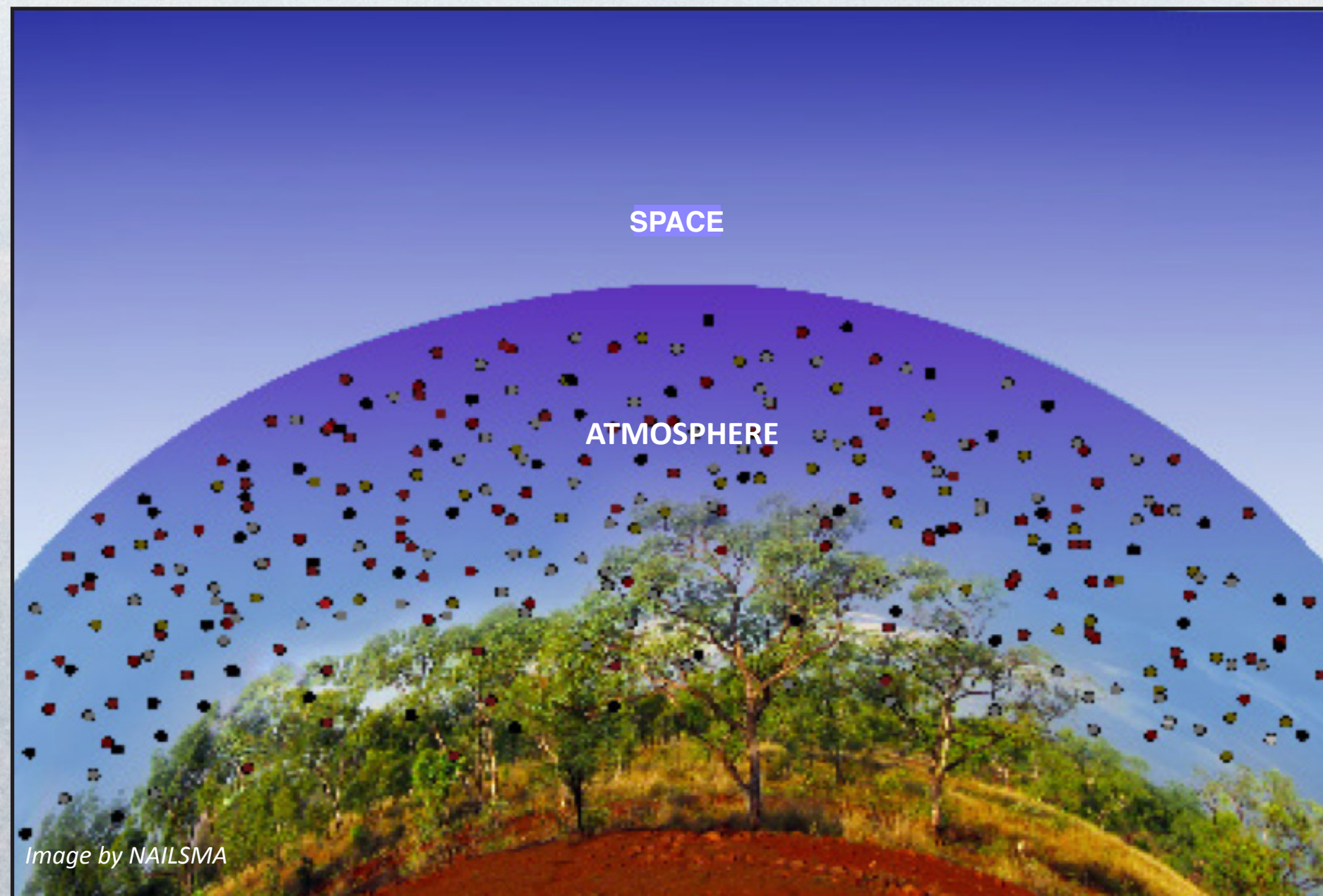


Methane (CH₄)

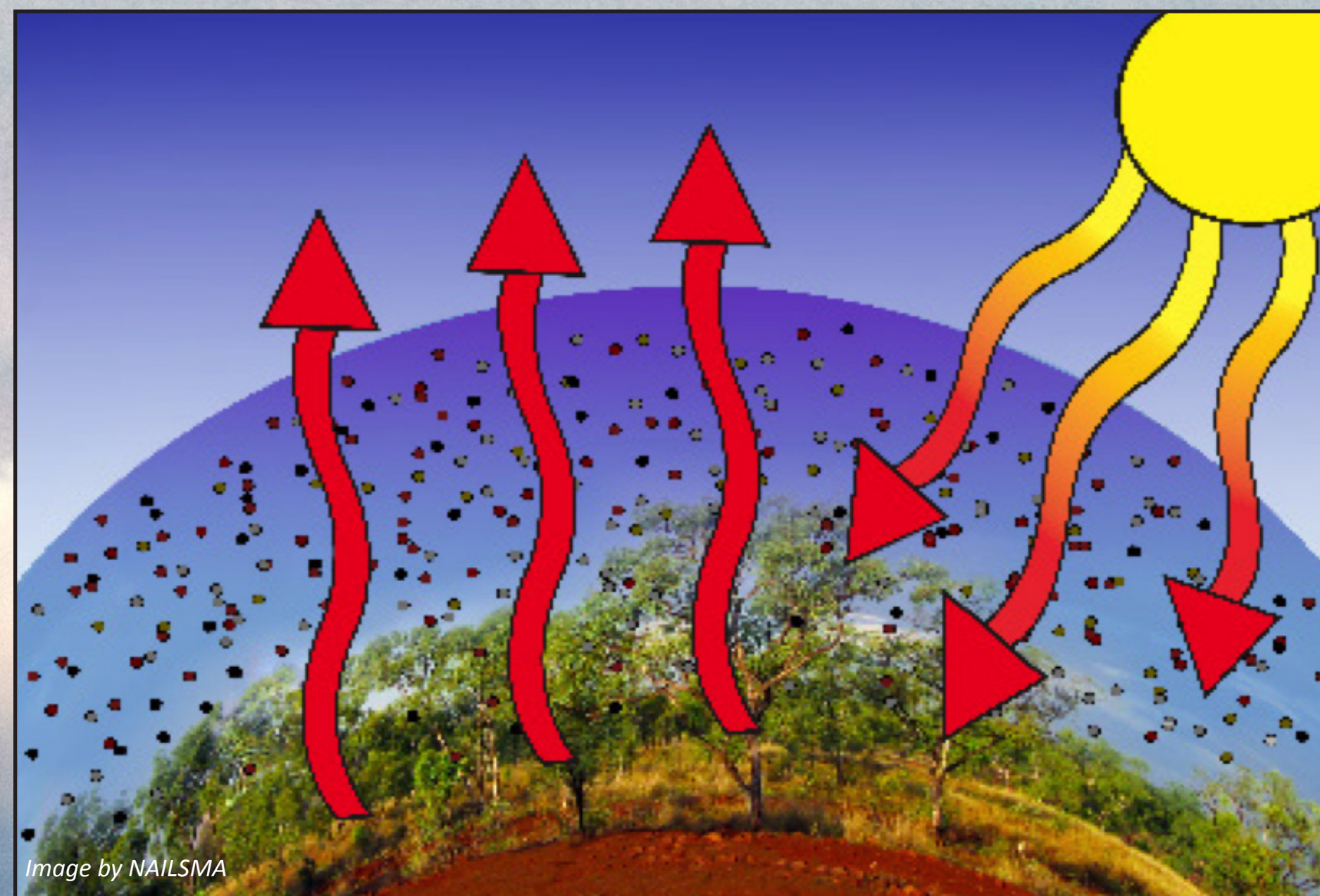


Nitrous Oxide (N₂O)

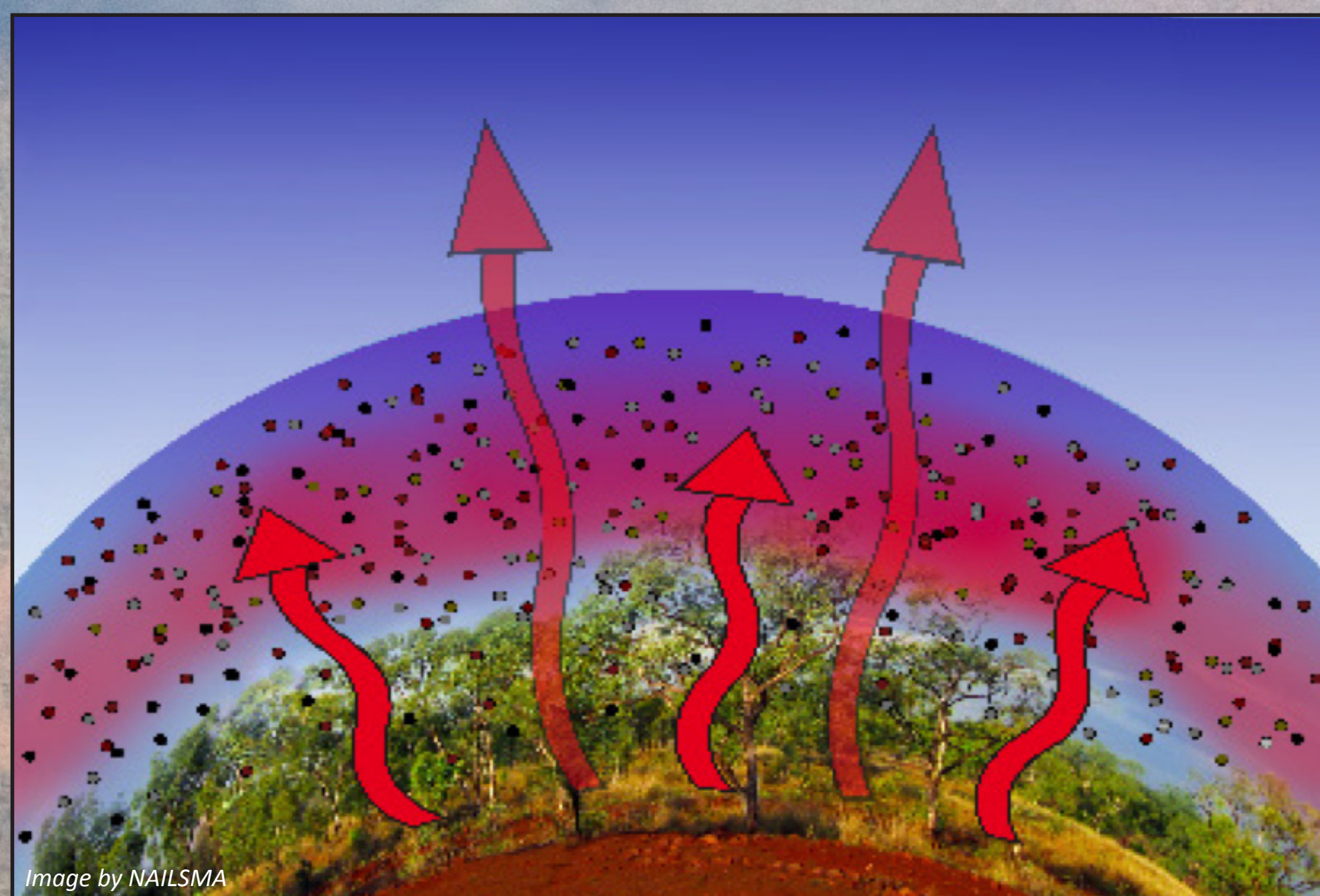
Carbon dioxide is the most common and important of these gases, and will be talked about in this book.



The Earth is surrounded by the atmosphere (air) which is made up of lots of different gases, like oxygen which we need to breathe.



The heat from the sun passes through the gases and warms up the land, sea and atmosphere. Some of the heat bounces back off Earth and into space.



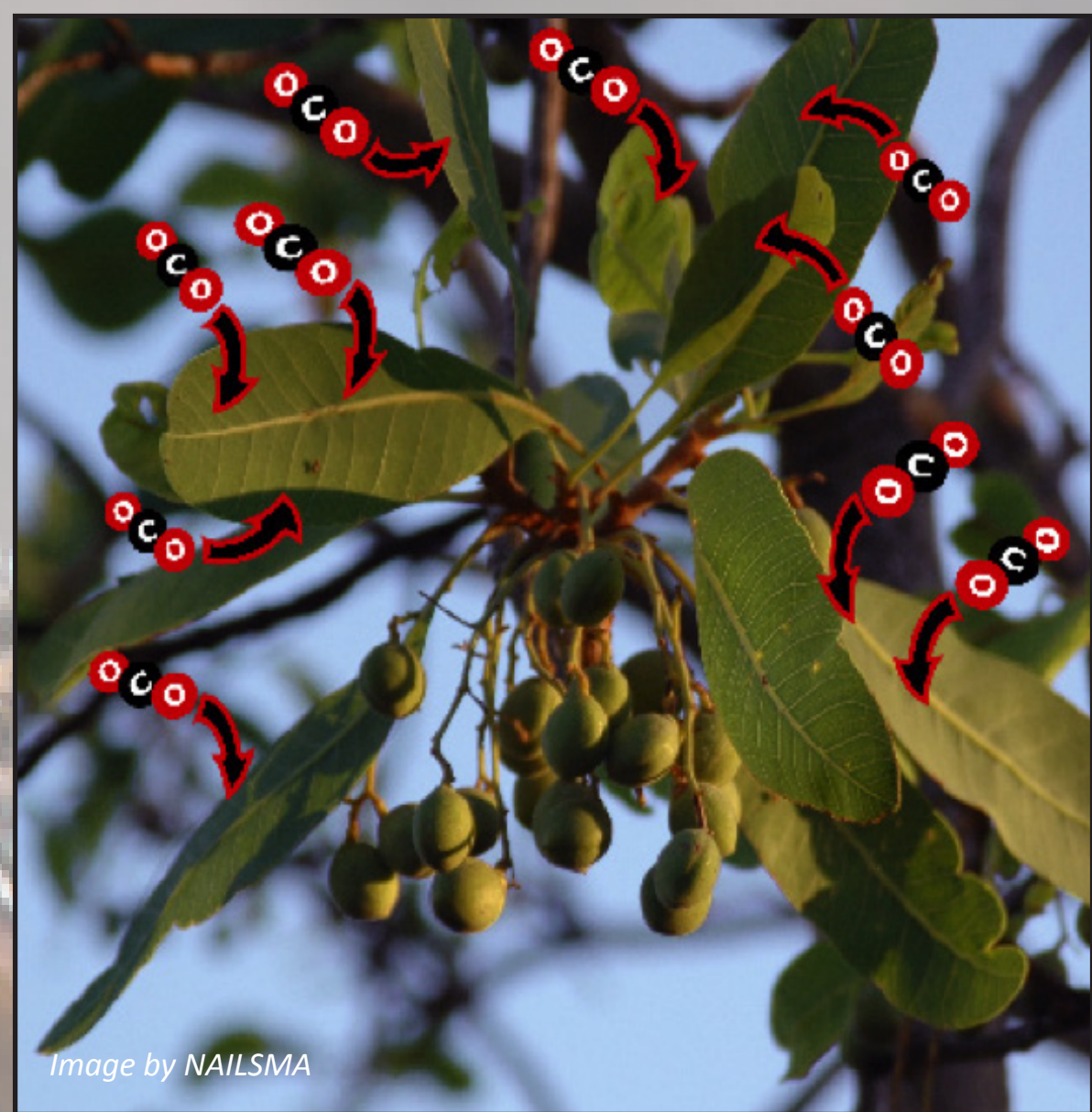
Some of the gases absorb and trap the heat holding it close to Earth like a blanket. This keeps the Earth at a good temperature for us to live on. These gases are called greenhouse gases.



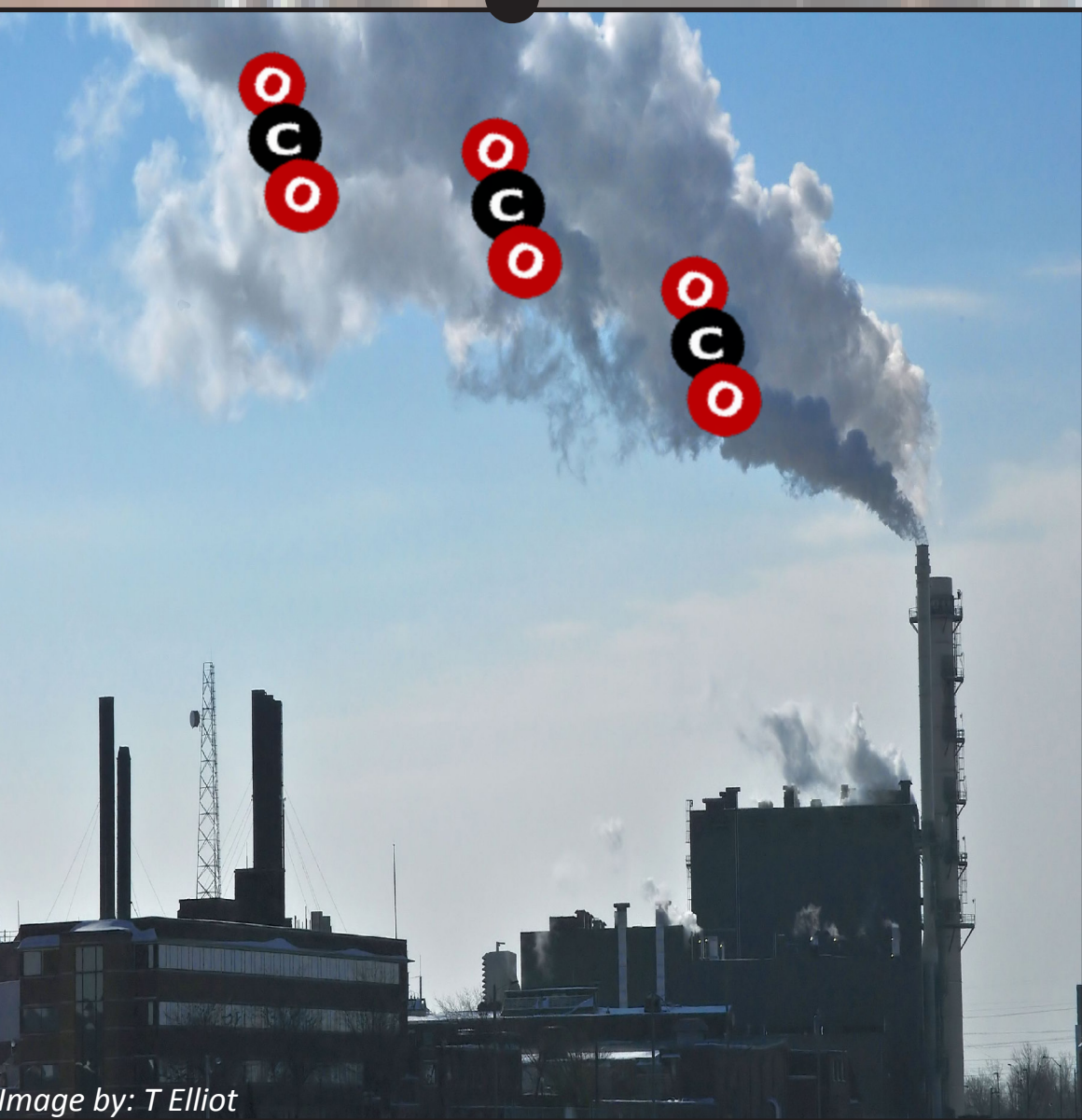
But over the last 200 years humans have been putting lots of extra gases into the air from things like unmanaged wildfire, cities, factories and cars. This makes it harder for the heat to escape, so our climate is getting warmer. This is called **global warming**.

How do humans cause global warming?

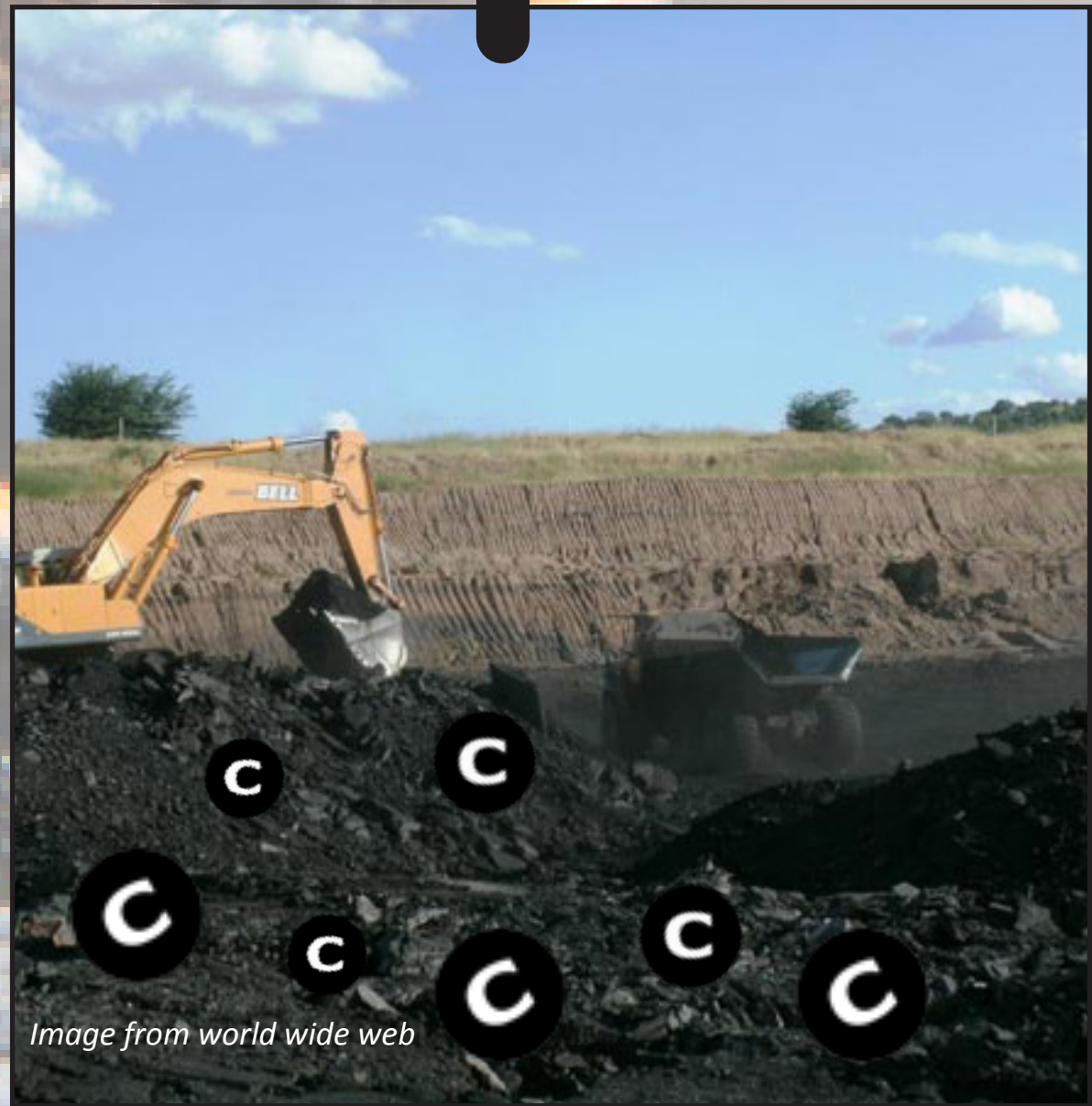
Start here



Plants take in carbon dioxide gas from the air through their leaves.



When we burn coal or trees the carbon and other gases go back into the air. This increase in greenhouse gases is trapping more of the sun's heat and making the Earth warmer.




Some plants and their carbon have been locked up for millions of years deep down in the Earth and transformed into coal and oil. They are called **fossil fuels**. We burn them to make electricity and to run cars.

Humans cause global warming by creating pollution.

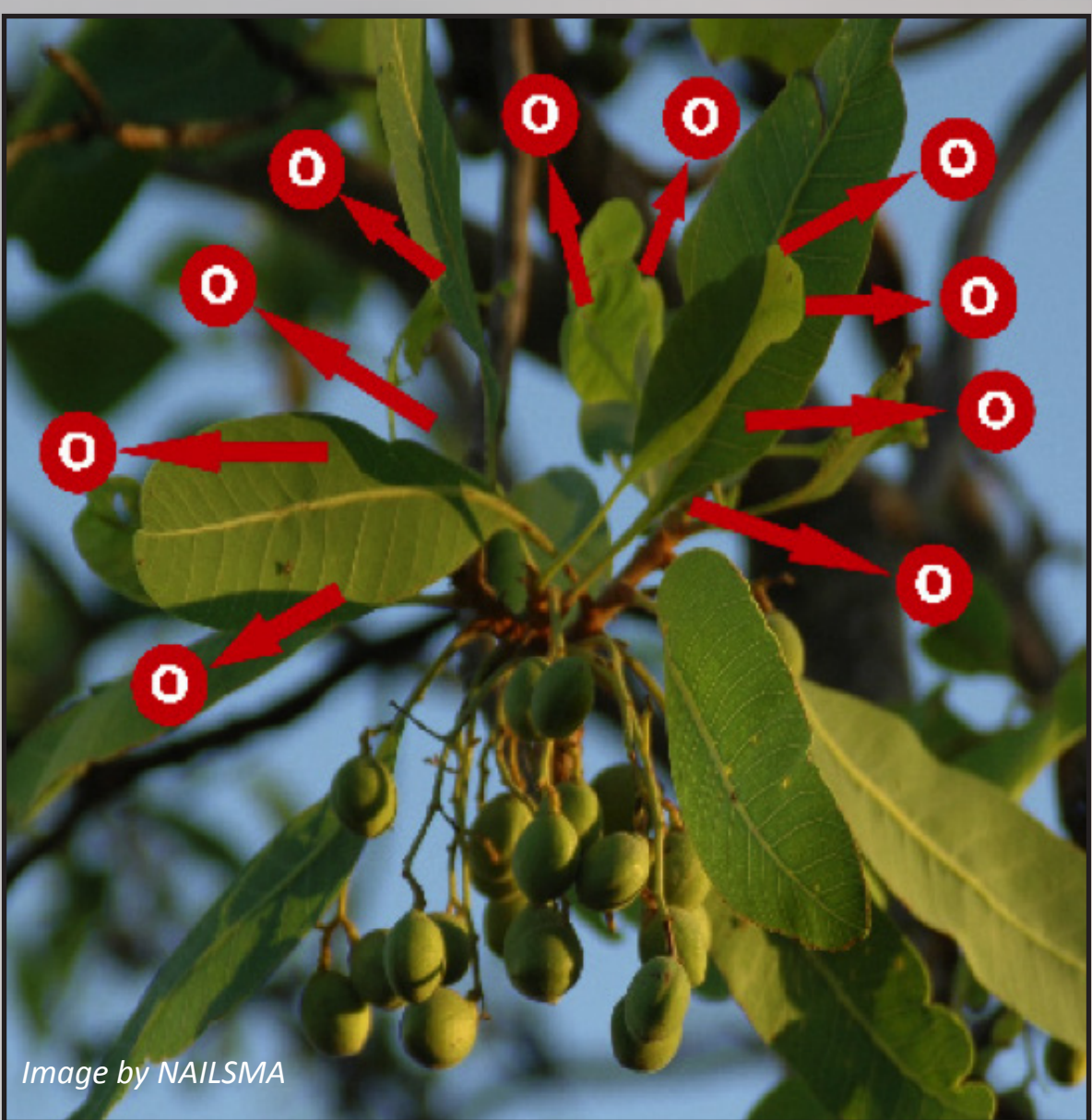
Humans cause pollution when they release extra greenhouse gases into the air. For example, a gas called methane is released from the stomachs of cattle, and humans breed huge numbers of cattle for food. A gas called nitrous oxide is released from pesticides that we spray on crops. However the most common gas that causes global warming is called carbon dioxide.

Carbon dioxide (CO₂) is made up of 3 atoms

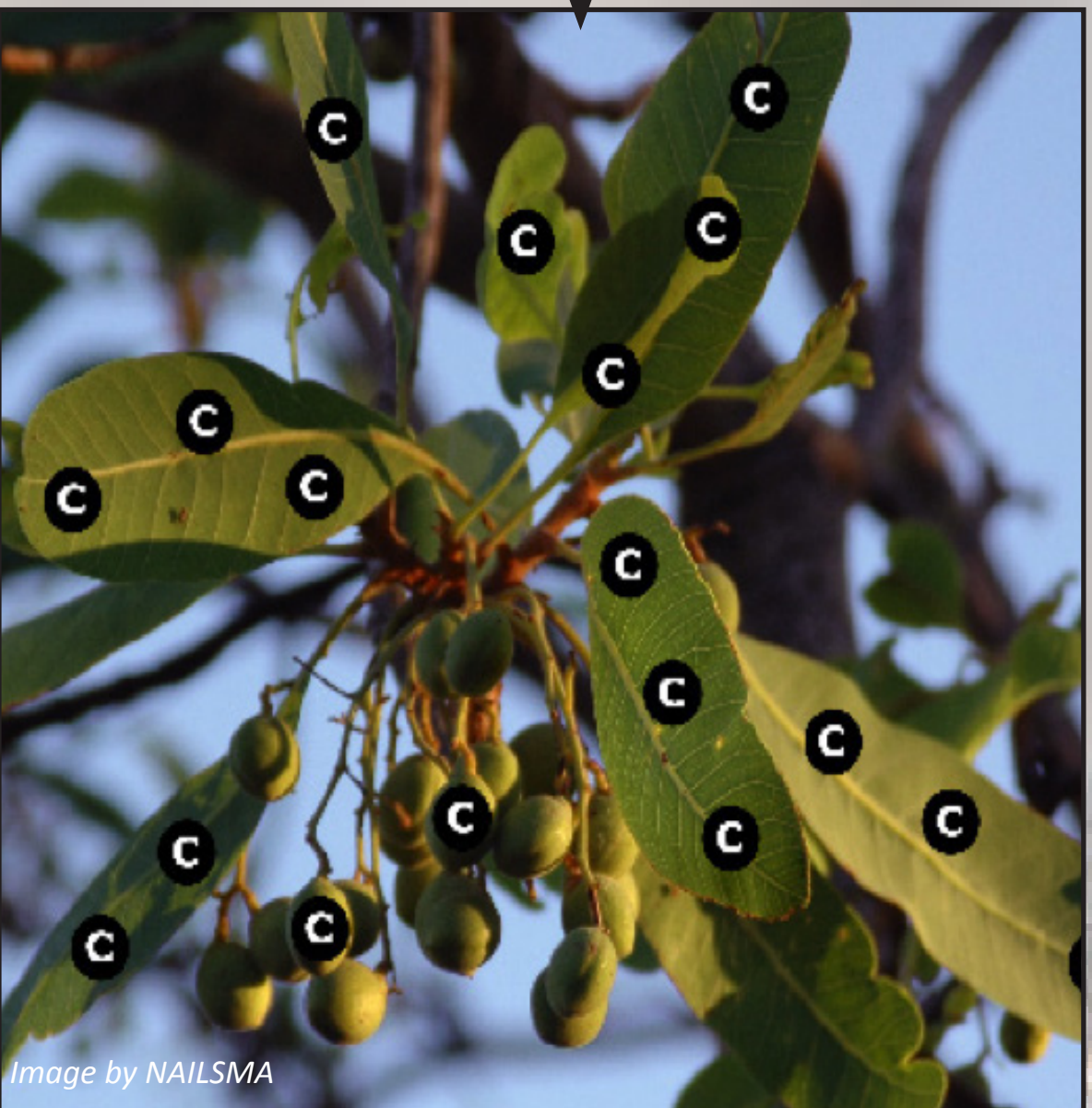
1 carbon + 2 oxygen



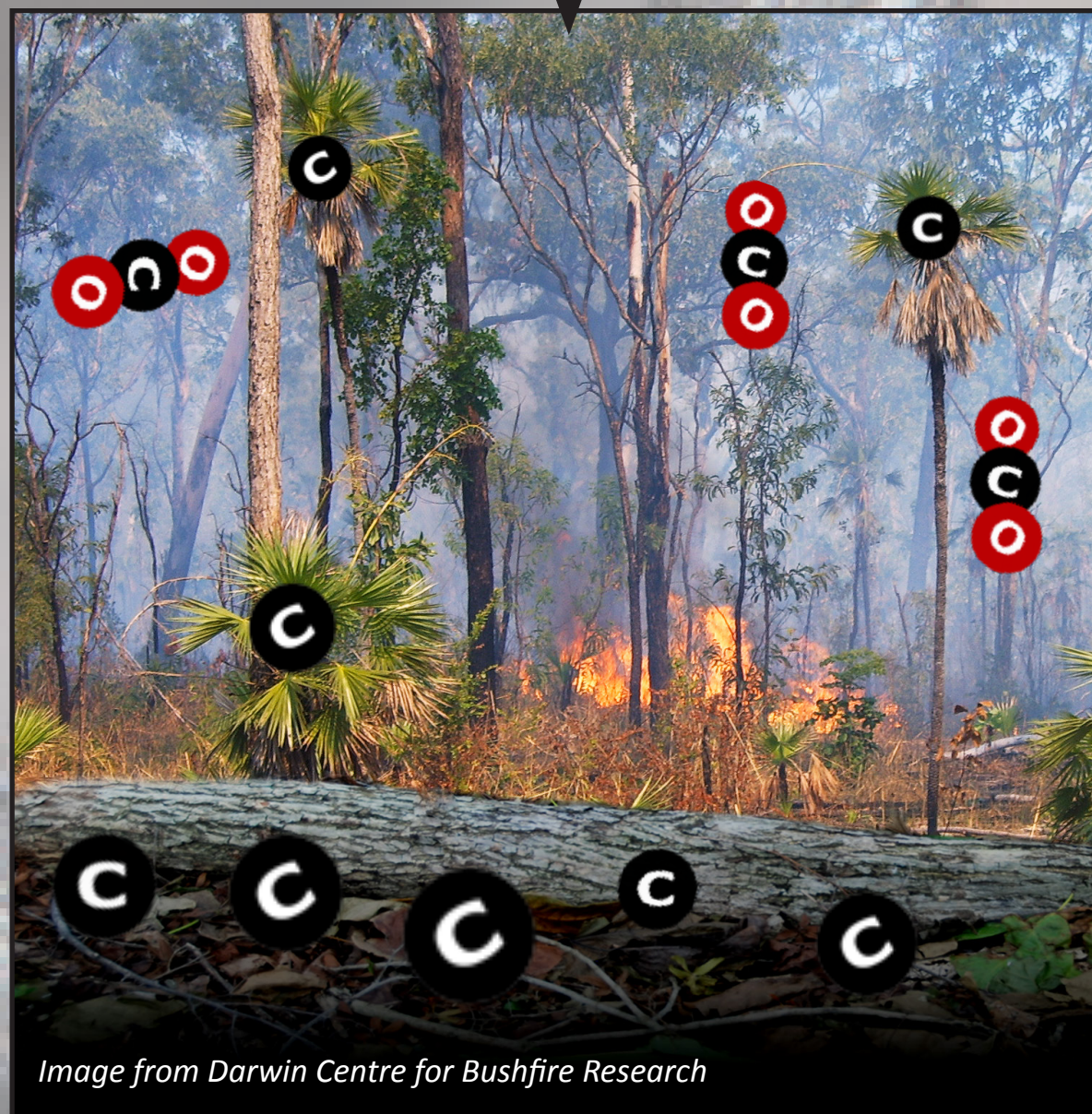
Carbon is natural and moves around in a cycle, becoming a part of different things - plants, animals, air and rocks. Humans create carbon dioxide when we transform solid carbon into a gas form as it bonds with oxygen. For example, when we dig up and burn coal or allow uncontrolled savanna fires. This is called **carbon pollution** but it is sometimes used to describe all types of greenhouse gas pollution.



They release oxygen into the air. People and animals need oxygen to breathe.



The carbon stays in the plants to make solid parts like wood, leaves and fruit.



When plants die or burn most of the carbon goes back into the air and merges with the oxygen in the air. It becomes carbon dioxide (CO₂) which is one of the greenhouse gases.

The problem with making the Earth too warm

For a long time carbon pollution did not change much.

Now climate scientists agree that it is having a big impact and we are experiencing **climate change** like never before. People are starting to see the problems occurring around the world and here in Australia.

There are four main types of change;

1. More intense extreme weather events like cyclones, heat waves and floods.
2. Rising sea levels caused by melting ice in the polar regions. This happens slowly but the problem is very noticeable during storms (storm surge).
3. The oceans are becoming warmer and more acidic which can impact the health of coral reefs and therefore the fisheries.
4. Regional changes in temperature and rain. Some places are becoming hotter and dryer, and some places are becoming colder and wetter. Seasons are occurring later and later and are not as predictable. This changes how and where plants and animals grow, reproduce and live.



Image from: Kowanyama Aboriginal Land & Natural Resources Management

The sea level is getting higher, and especially in big storms this can damage sand dunes, drown trees, destroy sacred sites and cause fresh water sites to become salty.



Image by: D Green

Rising sea level and big storms are causing more damage to homes and property because the winds are stronger and the water levels are higher.



Image from Darwin Centre for Bushfire Research

In north Australia more hot days (longer heat waves) are predicted. This means there is a higher risk of big wildfires in country that is not managed.



Image via: D Newry

'Knockem Down Rain' (rain that flattens spear grass), the last rain of the wet season that indicates the start of the dry season has been getting later and later.



Image via: D Newry

In Miriwoong country (east Kimberley) people have noticed that traditional seasonal indicators are changing. Sparrows (Jirinyngaleng – Fairy Martin) used to fly around during the wet season but not any more.



Image via: D Newry

When the water quality and temperature changes animals and people can get sick. Fish from Paruku (Lake Gregory) now have red worm.

Healthy country - healthy people

Looking after country helps solve problems.

Getting back to looking after country with fire can help tackle climate change, and many local problems that arise when country is not cared for properly.

It provides jobs and is healthy work. It helps with diet and exercise. It brings people together and gets them out of town. It makes opportunities for older people to pass on language and knowledge to young ones.



Burning in a traditional-style can help slow down global warming by stopping big wildfires so less greenhouse gases go into the air.



The traditional-style patchwork and careful burning also helps protect important places, plants and animals.



Indigenous land managers are adapting land management to changes in their seasons as well as fixing problems from years when Traditional Owners may not have been on their country to care for it.



Today, people following traditional ways to look after country also learn about western science and can get many new skills.



Looking after country and fire properly means people are back on their land improving their livelihood and well being - it's good for people and good for country.

Measuring smoke and greenhouse gas

We have shown the government how traditional-style burning makes less greenhouse gas.

Indigenous land managers and their science partners weighed grasses and other fuels before and after burning, in both wildfire and managed situations. They also tested smoke to find out what gases were in it.

Using this information they have shown that traditional-style fire management produces less smoke and **greenhouse gas** emissions than wildfires. Indigenous land managers have developed strong partnerships to do this work.



Teams of people go out and measure the grass cover, leaf litter, logs and small plants along a 100 metre line. They identify the different plants and record the canopy cover overhead, the grass cover on the ground and the height and width of trees and logs.



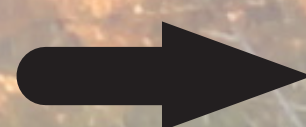
They select a number of 1m x 1m square areas along the 100m line and weigh the amount of grass and litter within them. They then take the grass and litter back to the lab to dry and weigh it again, to compare.



Then they do all the measuring again in the burnt areas. The difference between the 'before burning' and 'after burning' measurements is the amount of fuel that has burnt and become smoke. The smoke contains the greenhouse gases.

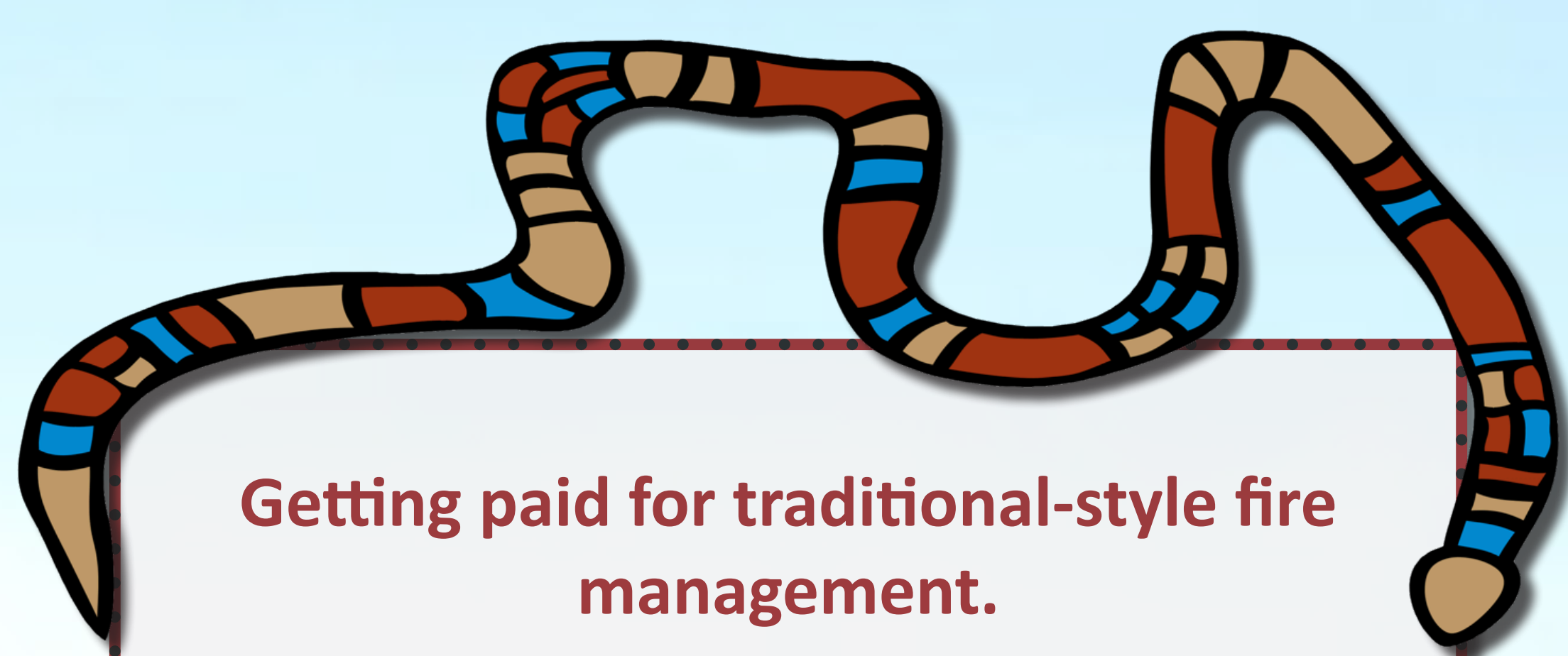


When measuring is finished, it is time to burn. This is done at different times through the year to compare how much fuel burns in different seasons.



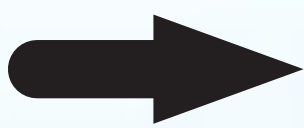
By testing the smoke we know how much of the different types of gases are given off when a certain amount of fuel is burnt. We then work out how much smoke and gas are given off by fires in this type of bush at different times of the year.

Managing country with fire can be good business



Getting paid for traditional-style fire management.

When land managers re-introduce traditional style fire management to the country, they tend to do more burning in the early dry season and stop a lot of the late dry season wildfires. This cuts a lot of smoke and carbon pollution from fires. Doing this is called carbon farming. This is good for country and means less greenhouse gases go up in the air. It is also an opportunity for land managers to look after each other and strengthen culture.



We know that traditional-style patchwork burning early in the year reduces wildfires late in the year.



Traditional Owners, ranger groups, Land Councils and scientists have been working together across northern Australia for a number of years now to make these projects work.



They have shown government that traditional-style fire management can prevent about half of the wildfires and reduce smoke and greenhouse gas emissions each year.



Fire managers can earn a **carbon credit** for each tonne of greenhouse gas they stop from going into the air. These carbon credits can be sold in the **carbon market** to the government or to private organisations.



Land managers can earn money to support them looking after their country. The price that the carbon credit is sold for will be different depending on when it is sold and who it is sold to.

Earning money from carbon farming



Money can be made from traditional-style fire management from private companies or from the government.

A carbon farming business can make money by selling **carbon credits**. How much money the business can make will depend on when it sells the credits, who they are sold to and what price is negotiated. There are two places you can sell to. One is to private companies, for example, the WALFA project entered an agreement to sell credits to ConocoPhillips.

The other place you can sell to is the Australian Government. The government has set up a big pool of tax payer's money called the **Emissions Reduction Fund (ERF)**. With this money the government will buy as many carbon credits as possible from different kinds of carbon projects across Australia (not just fire projects). But before a carbon farming business can sell credits to the government it must meet all the **eligibility criteria** such as using an approved **methodology**, and registering with the government's 'Clean Energy Regulator'.



$$E_{\text{net}} = M_{\text{net}} \sum_k \left(A_{\text{p}} P_k \sum_l \left(E_{\text{p}} E_{\text{net}} C_l \sum_m (S_m BEF_{\text{net}}) \right) \right)$$
$$E_{\text{net}} = M_{\text{net}} \sum_k \left(A_{\text{p}} P_k \sum_l \left(E_{\text{p}} E_{\text{net}} C_l \sum_m (S_m BEF_{\text{net}}) \right) \right)$$

Indigenous land managers, NAILSMA, Land Councils, scientists and government have worked together to measure how much less smoke and greenhouse gases are going into the air when using traditional-style burning. It looks like a complicated maths equation. Scientists and government call this the methodology for savanna fire management.



The methodology includes steps and rules for running the project and for measuring and reporting on greenhouse gases saved. The Clean Energy Regulator has approved the savanna fire management methodology, making it into law so any group can sell their carbon credits to the government.



But first the savanna fire management project must register with the Clean Energy Regulator and then follow the methodology exactly. The government purchases the carbon credits in an auction made on the internet, however it will only buy the cheapest carbon credits. Therefore carbon project owners will be competing against each other to sell their carbon credits. The project owners must try to sell their carbon credits for a fair price.



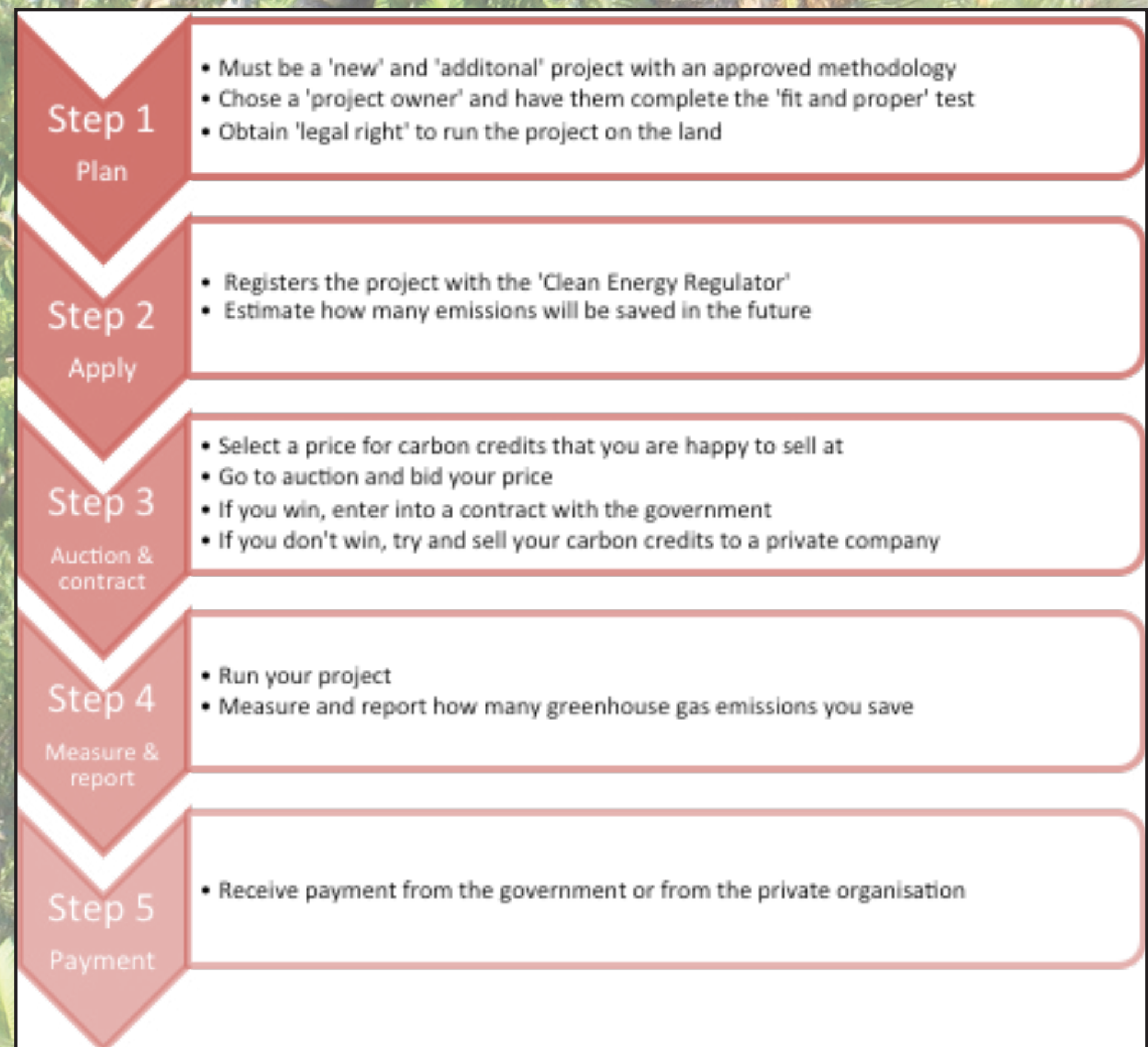
Most project owners will offer a price that is big enough to cover the cost of running the project (e.g. the cost of paying staff, fuel, insurance etc). Project owners will want to get the highest price they can for their carbon credits, but they must make sure the price isn't too high otherwise the government won't buy them. Instead, the government will buy them from a carbon project selling cheaper credits.

Taking the next step

There are lots of steps involved in starting a carbon farming project, but there are many resources to help!

NAILSMA is working with Indigenous land managers, Land Councils, governments, non-government organisations and scientists to support Indigenous land owners who want to set up their own savanna fire management project.

The basic steps to sign up and earn money from the ERF are listed to the right. There is actually a lot more to it than this, but there is some good help around to work through it with you. For more information and help, contact your Land Council, the Department of the Environment, NAILSMA and see the resource links below..



'Climate Change in North Australia' - animation:

'Savanna Burning' – animation:

Climate change and carbon farming: Education manual:

'Climate change animation; everyone's business':

Good Work – 'Ashton Nandoo, Wungurr Ranger':

Kimberley Fire Management Project:

'Fighting Carbon with Fire' - Video:

Aboriginal Carbon Fund website:

Emissions Reduction Fund website:

Savanna Fire Management Methodology:

SavBAT (Savanna Burning Abatement Tool):

<http://www.nailsma.org.au/hub/resources>

<http://www.nailsma.org.au/hub/resources>

<http://www.nailsma.org.au/hub/resources>

<http://www.livelearn.org/live-learn-multimedia>

<http://www.nailsma.org.au/hub/resources/video/good-work-ashton-nandoo>

<http://www.klc.org.au/news-media/video-gallery>

<http://ourworld.unu.edu/en/fighting-carbon-with-fire>

www.aboriginalcarbonfund.com.au

<http://www.environment.gov.au/climate-change/emissions-reduction-fund>

<http://www.environment.gov.au/climate-change/emissions-reduction-fund/cfi/methodologies/determinations/savanna-burning>

<http://savbat2.net.au/#/welcome>



A special thanks to the ranger groups across north Australia for their contributions, photographs and feedback and to government and non-government organisations for their ongoing support for carbon farming projects.

What people are talking about when they say...

Abate/ Abatement

The word abatement means to reduce or make something less. One category of carbon farming project is an abatement project because it reduces greenhouse gas sources (the things that release gas such as wildfire). Savanna fire management projects are called abatement projects because they reduce the size of wildfires which are a source of greenhouse gases. By using traditional-style fire management to create ‘cool burns’ in the early dry season, less smoke and greenhouse gases go into the air compared to an unmanaged wildfire.

Carbon Market

One way to reduce greenhouse gas (GHG) emissions is to make it worth money for polluters and land managers to prevent or reduce greenhouse gas emissions. Greenhouse gas emissions (and carbon storage) can be measured and a price calculated for each tonne (= to one credit) counted. The carbon market is about buying and selling these credits. In Australia carbon credits can be made by carbon farming projects and sold to the government or private organisations. The government buys carbon credits because it must ensure Australia’s total greenhouse gas emissions are reduced by the agreed amount made under the Kyoto Protocol (an international agreement). At the moment private companies may choose to buy carbon credits (to help their business image for example) but in future polluters may be forced to either reduce their GHG emissions or buy credits from someone who is doing that.

Emissions Reduction Fund (ERF)

The Emissions Reduction Fund (ERF) was introduced by the Australian Government in 2014 as a way to reduce Australia’s total greenhouse gas emissions. It is a big pool of money that the government uses to buy as many carbon credits as possible from carbon projects all over Australia. The government buys carbon credits in a reverse auction, where a carbon project owner must try and sell their carbon credits for the lowest price possible. If the price is too high, another project might win. If the price is too low, the project owner won’t make any money. The government will decide how much it is willing to spend on credits and the maximum amount it will pay.

Carbon

When you look at a solid, liquid or gas very closely under a powerful microscope you can see that it is made up of tiny little atoms. Different kinds of atoms joined together make molecules and groups of the same molecule form elements—like carbon, iron, magnesium, helium and many more. Carbon is one of the most common elements. It’s in almost all living things and many other natural things; plants and animals, humans, rocks and soil, the air around us. Carbon exists in solid, liquid and gas forms and can move from one form to another. For example carbon in trees is in solid form. When a tree dies and decays, some of its carbon joins with oxygen and goes into the air as a gas (carbon dioxide). This gas can be breathed in by living trees and converted back into solid form (timber, leaves). Solid form carbon in ancient algae may turn into oil (carbon in liquid form) as it decays over millions of years. When we use oil in engines, the carbon is released into the air as gas.

Carbon offsets/ Offsets

Carbon offsets or offsetting is about reducing carbon pollution in one place to cancel out the same amount of pollution created in another place. When a private organisation buys carbon credits from a carbon farming project, they are in effect paying other people to reduce emissions for them. The organisation is still putting out the same amount of greenhouse gases but they can say they have reduced greenhouse gases because they have paid someone else to cut greenhouse gas somewhere else.

Fossil Fuels

Fossil fuels come from the decaying remains of plants and animals such as trees and algae living millions of years ago. We extract these from deep in the ground and use them as fuel. For example, gas and coal are mined from the ground and burned at power stations to create electricity. When we burn fossil fuels carbon and other pollutants are released into the atmosphere (for example in exhaust from cars) and add to the blanket of greenhouse gases warming the Earth and changing its climate.

Carbon Credits

In a carbon market, for every tonne of greenhouse gases that a project reduces or avoids emitting, a carbon credit is issued. Under the Australian Government’s Carbon Farming Initiative (CFI) and the Emissions Reduction Fund (ERF) carbon credits are called ‘Australian Certified Carbon Units’ (ACCU). Carbon credits can be sold to the Australian Government who buys them using money from the Emissions Reduction Fund (ERF). Alternatively, carbon credits can be sold to the voluntary market, which includes private organisations who wish to offset their own emissions because it is a good thing to do for our environment, or because it is good for their business image.

Carbon Pollution

The Earth has always had phases of cooling and warming - think of ice ages for example. Around 250 years ago humans started moving into cities from villages and small scale agriculture. They built factories to mass produce goods for trade and created huge cities that needed fuel, iron and electricity. This was the start of the Industrial Revolution. From this time huge amounts of pollution containing carbon and other GHGs is released into the air. This is mostly from oil, coal and gas that had been underground for millions of years. The development of modern industrial cities also meant that human populations exploded and vast areas of land were cleared of forest to grow food crops, stock and to build more cities. These areas can no longer absorb and store the same amount of carbon. This unsustainable cycle has continued and has resulted in extreme carbon pollution that is warming the Earth faster than what happens naturally.

Global Warming

The Earth is naturally kept warm by greenhouse gases trapped in the Earth’s atmosphere in a process known as the greenhouse effect. However, the Earth is getting warmer than usual because of extra greenhouse gas emissions that humans are putting into the air (emitting). These extra gas emissions are forming a blanket around the Earth and making it harder for extra heat to escape back into space. So gradually the air, seas and land are getting warmer and warmer. As the Earth gets warmer it alters our climate and creates problems that affect people, plants and animals.

Carbon Dioxide (CO₂)

Carbon dioxide is a gas in the air around us. It is made up of molecules where one carbon atom is joined with two oxygen atoms (CO₂). It is a greenhouse gas, which means it is a gas that stays in our atmosphere and keeps the Earth warm. It can build up in the atmosphere and absorb reflected heat from the Earth, making the Earth warmer.

Climate Change

Whilst the climate changes naturally over time it is happening faster than normal. The Earth is getting warmer because humans have put lots of extra greenhouse gases in the air, forming a blanket around the atmosphere and making it harder for heat to escape. This changes how the atmosphere and oceans interact and as a result causes the following changes to the Earth: (1) more intense extreme weather events (floods, heatwaves, cyclones). (2) Shifts in temperature and rain so seasons will change at unusual times and it will be hotter and wetter in some places and colder and drier in others. (3) Rising sea levels, caused by melting ice sheets in the north and south pole. (4) More acidic oceans, making it harder for ocean species, like coral to survive.

Greenhouse Gas/ Effect

The sun warms the Earth and the Earth reflects some of the heat back into the atmosphere and out into space. Greenhouse gases in the atmosphere, such as carbon dioxide methane and nitrous oxide, absorb and trap some of this heat. This process is called the greenhouse effect. Greenhouse gases are always in the air and help keep the Earth warm and our climate stable. But they need to be in the air in the right amounts. Too many greenhouse gases trap extra heat and cause global warming. The main greenhouse gases are: carbon dioxide, methane and nitrous oxide.

Sequest/ Sequestration

Sequestration means to store or remove something. There are some kinds of carbon farming known as sequestration projects because in one way or another they take greenhouse gases out of the atmosphere and store them or prevent them from being emitted. For example, trees remove carbon dioxide from the air and store the carbon as wood, leaves and fruit. Savanna fire management projects (as well as an abatement project) may soon also be treated as sequestration projects because good fire management can avoid vegetation being completely burnt and increases the amount of carbon stored in the extra growth of tree trunks and canopies that results. A methodology for savanna burning sequestration is likely to be approved by the Clean Energy Regulator early 2016

Carbon Farming Projects

The Carbon Farming Initiative (CFI) was created in 2012 by the federal government to support carbon farming projects but in 2014 it was streamlined into the Emissions Reduction Fund (ERF). Its purpose is to encourage land managers to reduce greenhouse gases and by earning money for it. There are many types of carbon farming projects, but the one discussed in this book is about savanna fire management. It involves managing fire so that most of the burns occur in the early dry season and create a pattern of burnt and unburnt country that prevents as much end of dry season wildfire as possible. There are many rules and guidelines surrounding how to start, run, report and receive carbon credits from carbon farming projects and these must be followed.

Eligibility Criteria

For a carbon farming project to sell its carbon credits to the Emissions Reduction Fund it must meet all of the following eligibility criteria: (1) Use an approved methodology. (2) Be new - the project must not already be operating. (3) Be additional - it can’t be required to be carried out by or under another law or program. (4) A project owner must also open an account with the Australian National Registry of Emissions Units (ANREU) - a secure electronic system into which carbon credits are issued. (5) The project owner must complete a ‘fit and proper’ test to prove that they have no prior convictions or history of non-compliance under a range of laws.

Methodology

A methodology is a step by step approach for doing something, like a cooking recipe. Under the government’s Carbon Farming Initiative (CFI) and Emissions Reduction Fund (ERF) an approved methodology is a set of rules to measure and account for abated emissions or stored carbon in a specific kind of activity—for example in savanna fire management. The research to develop a methodology can be done privately or by government but must be scientifically robust and has to be approved by the Clean Energy Regulator. These rules and the science behind them get packaged up into legislation under the CFI so that any prospective carbon project owners can access and follow them to guide their carbon farming activities and make them ‘eligible’. A savanna fire management methodology for tropical savanna country that gets more than 600 mm annual rainfall was approved in 2015.



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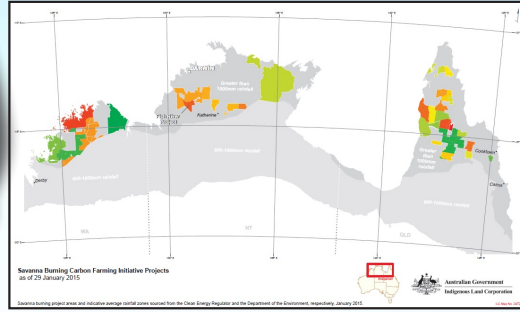


Carbon farming can help us deal with the big changes that have happened

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One way is to pay people to start **carbon farming projects** that reduce the amount of greenhouse gases that go into the air. There are many different types of projects but one type allows Indigenous land managers to use traditional-style fire management techniques to reduce the frequency of big wildfires. These are called savanna fire management projects, and they combine traditional knowledge with modern, western science.



The colour spots on the map show that there are over 33 carbon farming projects using traditional-style fire management in north Australia. The first project was the WALFA project in West Arnhem Land.



Image from world wide web

ConocoPhillips own a liquefied natural gas plant in Darwin. They create a lot of greenhouse gas emissions so they agreed to pay the people of Arnhem Land to develop and run their project to **offset** their emissions.

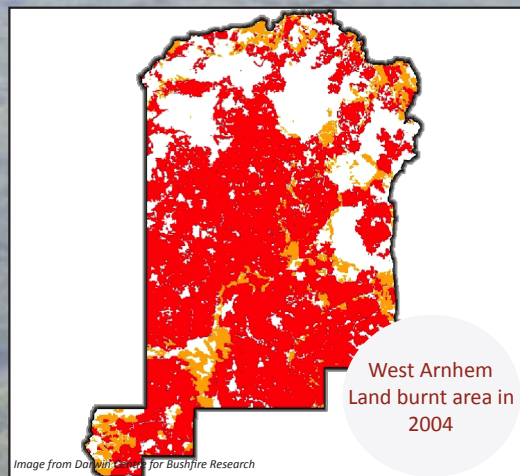


Image from Darwin Centre for Bushfire Research

Before the project started satellite images showed that 40% of the project area was burnt every year, mostly by uncontrolled, late season wildfires (red fire scars).



Image by J Holmes

Then early in the dry season rangers and partners used modern technology like helicopters and drip torches to do traditional-style, early-season, patch burning.

The WALFA project example

The first savanna fire management project in Australia started in 2006 and was called the The West Arnhem Land Fire Abatement (WALFA) project. The people of west Arnhem Land made a deal with the Northern Territory government and a big gas company to fund a fire management project.

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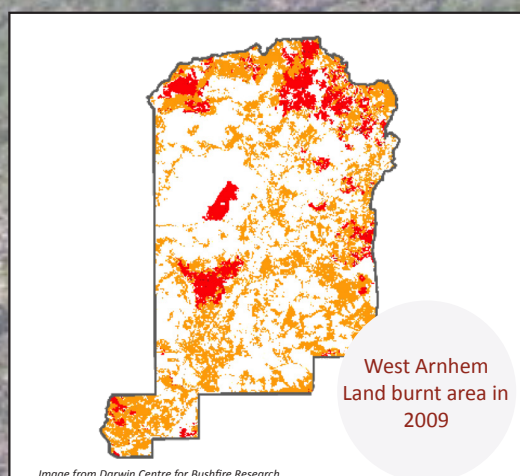


Image from Darwin Centre for Bushfire Research

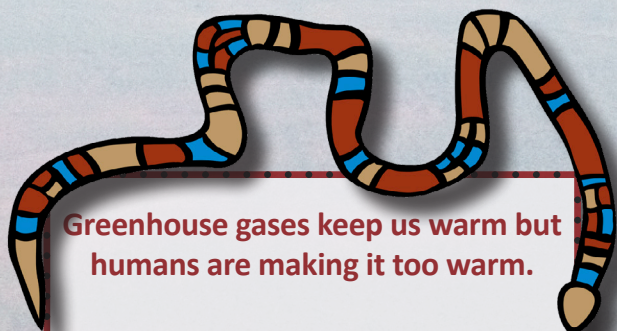
This created a strategic mosaic of smaller burn patches (orange fire scars) that stopped the big late dry season wildfires (notice how much less red there is).



Image by D Hancock

The project has been a very important example to show how traditional-style burning can **abate** (reduce) greenhouse gas emissions and protect valuable country.




Greenhouse gases keep the Earth warm



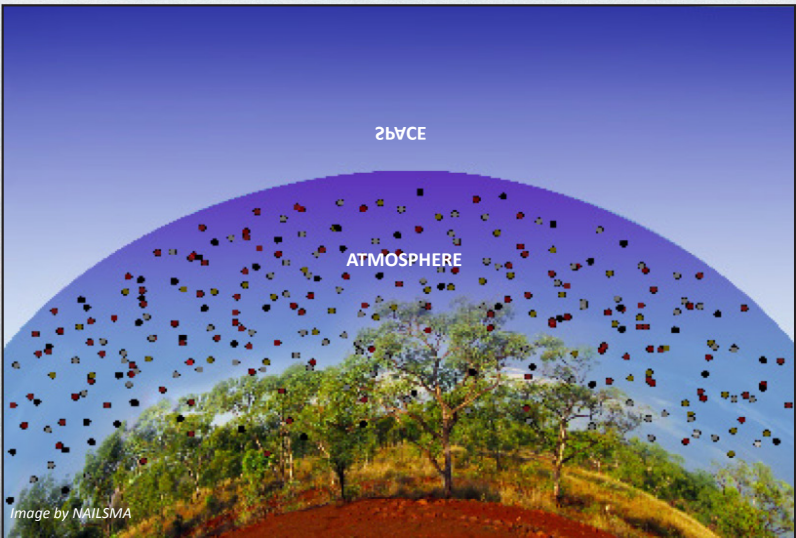
Greenhouse gases keep us warm but humans are making it too warm.

The air is full of gases but you cannot see them with your eyes. If you look at them under a powerful microscope you can see that they are made up of tiny atoms joined together. **Greenhouse gases** keep our planet warm with a process known as **the greenhouse effect**.

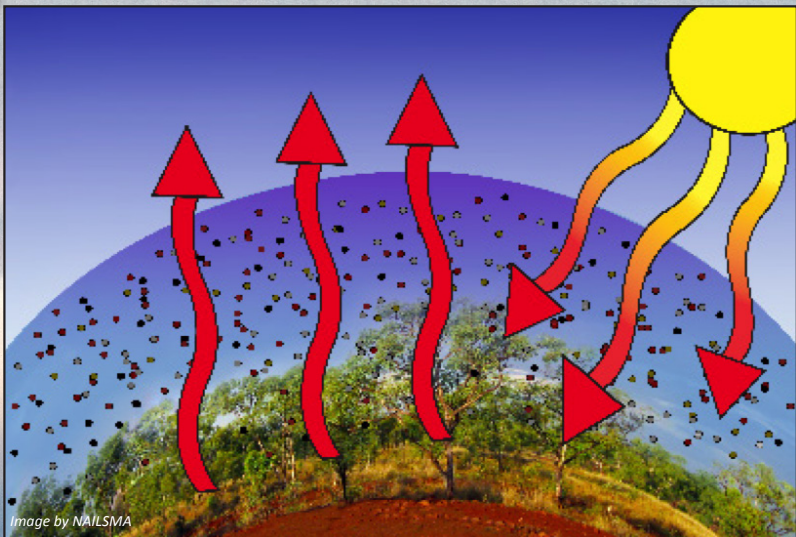
The three main greenhouse gases are called:

-  Carbon dioxide (CO₂)
-  Methane (CH₄)
-  Nitrous Oxide (N₂O)

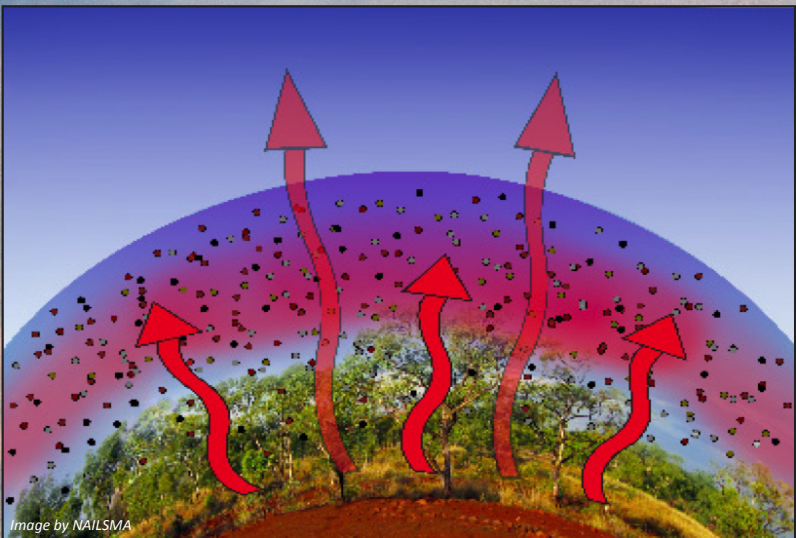
Carbon dioxide is the most common and important of these gases, and will be talked about in this book.



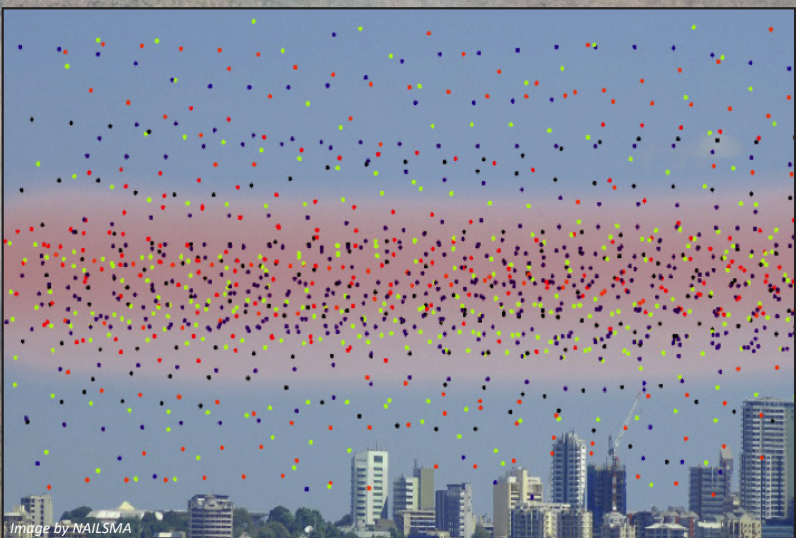
The Earth is surrounded by the atmosphere (air) which is made up of lots of different gases, like oxygen which we need to breathe.



The heat from the sun passes through the gases and warms up the land, sea and atmosphere. Some of the heat bounces back off Earth and into space.



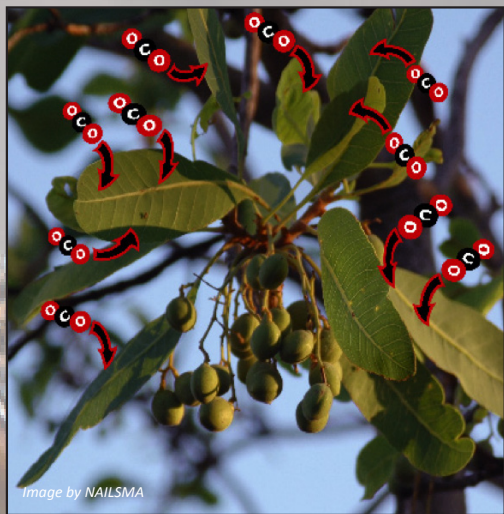
Some of the gases absorb and trap the heat holding it close to Earth like a blanket. This keeps the Earth at a good temperature for us to live on. These gases are called greenhouse gases.



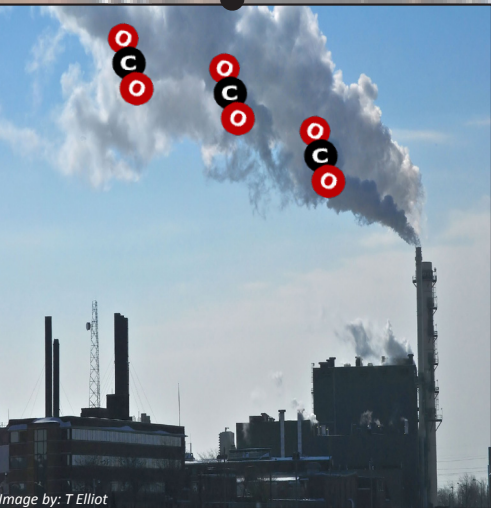
But over the last 200 years humans have been putting lots of extra gases into the air from things like unmanaged wildfire, cities, factories and cars. This makes it harder for the heat to escape, so our climate is getting warmer. This is called **global warming**.

How do humans cause global warming?

Start here



Plants take in carbon dioxide gas from the air through their leaves.



When we burn coal or trees the carbon and other gases go back into the air. This increase in greenhouse gases is trapping more of the sun's heat and making the Earth warmer.



Some plants and their carbon have been locked up for millions of years deep down in the Earth and transformed into coal and oil. They are called **fossil fuels**. We burn them to make electricity and to run cars.

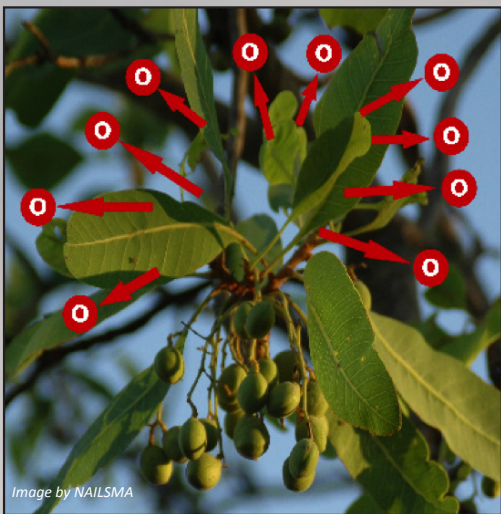
Humans cause global warming by creating pollution.

Humans cause pollution when they release **extra** greenhouse gases into the air. For example, a gas called methane is released from the stomachs of cattle, and humans breed huge numbers of cattle for food. A gas called nitrous oxide is released from pesticides that we spray on crops. However the most common gas that causes global warming is called carbon dioxide.

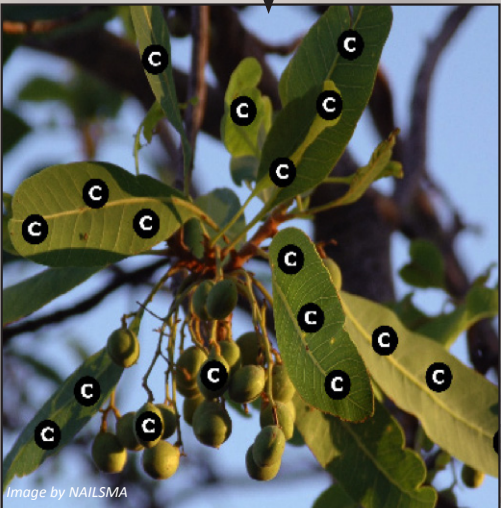
Carbon dioxide (CO₂) is made up of 3 atoms

1 carbon + 2 oxygen

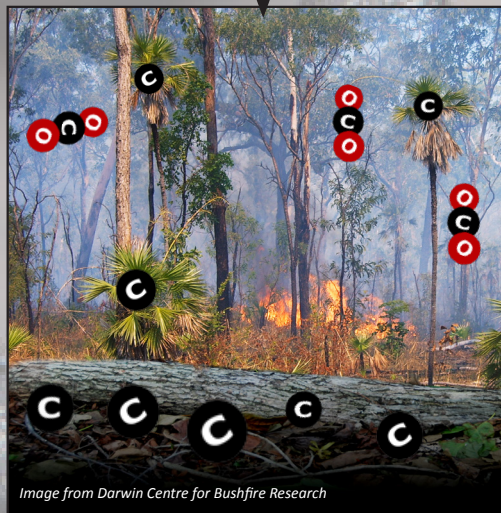
Carbon is natural and moves around in a cycle, becoming a part of different things - plants, animals, air and rocks. Humans create carbon dioxide when we transform solid carbon into a gas form as it bonds with oxygen. For example, when we dig up and burn coal or allow uncontrolled savanna fires. This is called **carbon pollution** but it is sometimes used to describe all types of greenhouse gas pollution.



They release oxygen into the air. People and animals need oxygen to breathe.



The carbon stays in the plants to make solid parts like wood, leaves and fruit.



When plants die or burn most of the carbon goes back into the air and merges with the oxygen in the air. It becomes carbon dioxide (CO₂) which is one of the greenhouse gases.

The problem with making the Earth too warm

For a long time carbon pollution did not change much.

Now climate scientists agree that it is having a big impact and we are experiencing **climate change** like never before. People are starting to see the problems occurring around the world and here in Australia.

There are four main types of change;

1. More intense extreme weather events like cyclones, heat waves and floods.
2. Rising sea levels caused by melting ice in the polar regions. This happens slowly but the problem is very noticeable during storms (storm surge).
3. The oceans are becoming warmer and more acidic which can impact the health of coral reefs and therefore the fisheries.
4. Regional changes in temperature and rain. Some places are becoming hotter and dryer, and some places are becoming colder and wetter. Seasons are occurring later and later and are not as predictable. This changes how and where plants and animals grow, reproduce and live.



Image from: Kowanyama Aboriginal Land & Natural Resources Management

The sea level is getting higher, and especially in big storms this can damage sand dunes, drown trees, destroy sacred sites and cause fresh water sites to become salty.



Image by: D Green

Rising sea level and big storms are causing more damage to homes and property because the winds are stronger and the water levels are higher.



Image from Darwin Centre for Bushfire Research

In north Australia more hot days (longer heat waves) are predicted. This means there is a higher risk of big wildfires in country that is not managed.



Image via: D Newry

'Knockem Down Rain' (rain that flattens spear grass), the last rain of the wet season that indicates the start of the dry season has been getting later and later.



Image via: D Newry

In Miriwoong country (east Kimberley) people have noticed that traditional seasonal indicators are changing. Sparrows (Jirrinylgaleng – Fairy Martin) used to fly around during the wet season but not any more.



Image via: D Newry

When the water quality and temperature changes animals and people can get sick. Fish from Paruku (Lake Gregory) now have red worm.

Healthy country - healthy people



Looking after country helps solve problems.

Getting back to looking after country with fire can help tackle climate change, and many local problems that arise when country is not cared for properly.

It provides jobs and is healthy work. It helps with diet and exercise. It brings people together and gets them out of town. It makes opportunities for older people to pass on language and knowledge to young ones.



Image by: D Hancock

Burning in a traditional-style can help slow down global warming by stopping big wildfires so less greenhouse gases go into the air.



Image by: D Hancock

The traditional-style patchwork and careful burning also helps protect important places, plants and animals.



Image by NAILSMA

Indigenous land managers are adapting land management to changes in their seasons as well as fixing problems from years when Traditional Owners may not have been on their country to care for it.



Image by NAILSMA

Today, people following traditional ways to look after country also learn about western science and can get many new skills.



Image by: Bush Troaders

Looking after country and fire properly means people are back on their land improving their livelihood and well being - it's good for people and good for country.

Measuring smoke and greenhouse gas

We have shown the government how traditional-style burning makes less greenhouse gas.

Indigenous land managers and their science partners weighed grasses and other fuels before and after burning, in both wildfire and managed situations. They also tested smoke to find out what gases were in it.

Using this information they have shown that traditional-style fire management produces less smoke and **greenhouse gas** emissions than wildfires. Indigenous land managers have developed strong partnerships to do this work.



Teams of people go out and measure the grass cover, leaf litter, logs and small plants along a 100 metre line. They identify the different plants and record the canopy cover overhead, the grass cover on the ground and the height and width of trees and logs.



They select a number of 1m x 1m square areas along the 100m line and weigh the amount of grass and litter within them. They then take the grass and litter back to the lab to dry and weigh it again, to compare.



Then they do all the measuring again in the burnt areas. The difference between the 'before burning' and 'after burning' measurements is the amount of fuel that has burnt and become smoke. The smoke contains the greenhouse gases.

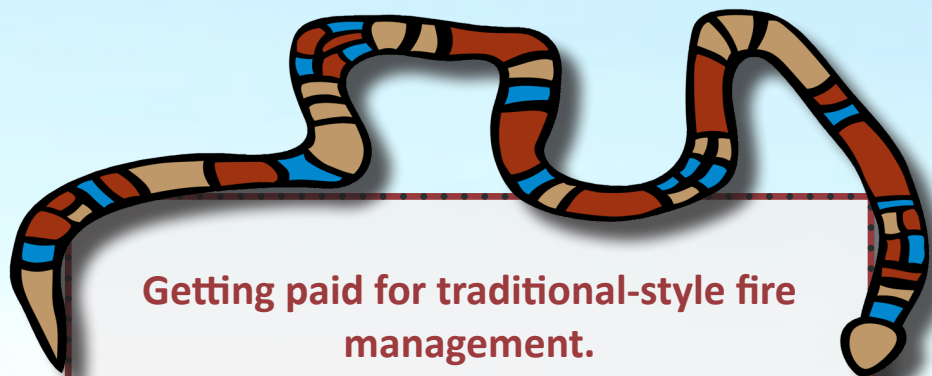


When measuring is finished, it is time to burn. This is done at different times through the year to compare how much fuel burns in different seasons.



By testing the smoke we know how much of the different types of gases are given off when a certain amount of fuel is burnt. We then work out how much smoke and gas are given off by fires in this type of bush at different times of the year.

Managing country with fire can be good business



Getting paid for traditional-style fire management.

When land managers re-introduce traditional style fire management to the country, they tend to do more burning in the early dry season and stop a lot of the late dry season wildfires. This cuts a lot of smoke and carbon pollution from fires. Doing this is called carbon farming. This is good for country and means less greenhouse gases go up in the air. It is also an opportunity for land managers to look after each other and strengthen culture.



Image source unknown

We know that traditional-style patchwork burning early in the year reduces wildfires late in the year.



Image by: D Hancock

Traditional Owners, ranger groups, Land Councils and scientists have been working together across northern Australia for a number of years now to make these projects work.

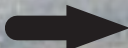


Image by: Ed Hatherley

They have shown government that traditional-style fire management can prevent about half of the wildfires and reduce smoke and greenhouse gas emissions each year.



Image from Darwin Centre for Bushfire Research

Fire managers can earn a **carbon credit** for each tonne of greenhouse gas they stop from going into the air. These carbon credits can be sold in the **carbon market** to the government or to private organisations.



Image by: J Holmes

Land managers can earn money to support them looking after their country. The price that the carbon credit is sold for will be different depending on when it is sold and who it is sold to.

Earning money from carbon farming



Money can be made from traditional-style fire management from private companies or from the government.

A carbon farming business can make money by selling **carbon credits**. How much money the business can make will depend on when it sells the credits, who they are sold to and what price is negotiated. There are two places you can sell to. One is to private companies, for example, the WALFA project entered an agreement to sell credits to ConocoPhillips.

The other place you can sell to is the Australian Government. The government has set up a big pool of tax payer's money called the **Emissions Reduction Fund (ERF)**. With this money the government will buy as many carbon credits as possible from different kinds of carbon projects across Australia (not just fire projects). But before a carbon farming business can sell credits to the government it must meet all the **eligibility criteria** such as using an approved **methodology**, and registering with the government's 'Clean Energy Regulator'.



$$E_{\text{total}} = M_{\text{total}} \sum_k \left(A_{\text{p}} P_k \sum_l \left(E_{\text{p}} E_{\text{npd}} C_l \sum_m (S_m BEF_{k\text{lot}}) \right) \right)$$
$$E_{\text{total}} = M_{\text{total}} \sum_k \left(A_{\text{p}} P_k \sum_l \left(E_{\text{p}} E_{\text{npd}} C_l \sum_m (S_m BEF_{k\text{lot}}) \right) \right)$$

Indigenous land managers, NAILSMA, Land Councils, scientists and government have worked together to measure how much less smoke and greenhouse gases are going into the air when using traditional-style burning. It looks like a complicated maths equation. Scientists and government call this the methodology for savanna fire management.



The methodology includes steps and rules for running the project and for measuring and reporting on greenhouse gases saved. The Clean Energy Regulator has approved the savanna fire management methodology, making it into law so any group can sell their carbon credits to the government.



But first the savanna fire management project must register with the Clean Energy Regulator and then follow the methodology exactly. The government purchases the carbon credits in an auction made on the internet, however it will only buy the cheapest carbon credits. Therefore carbon project owners will be competing against each other to sell their carbon credits. The project owners must try to sell their carbon credits for a fair price.



Most project owners will offer a price that is big enough to cover the cost of running the project (e.g. the cost of paying staff, fuel, insurance etc). Project owners will want to get the highest price they can for their carbon credits, but they must make sure the price isn't too high otherwise the government won't buy them. Instead, the government will buy them from a carbon project selling cheaper credits.

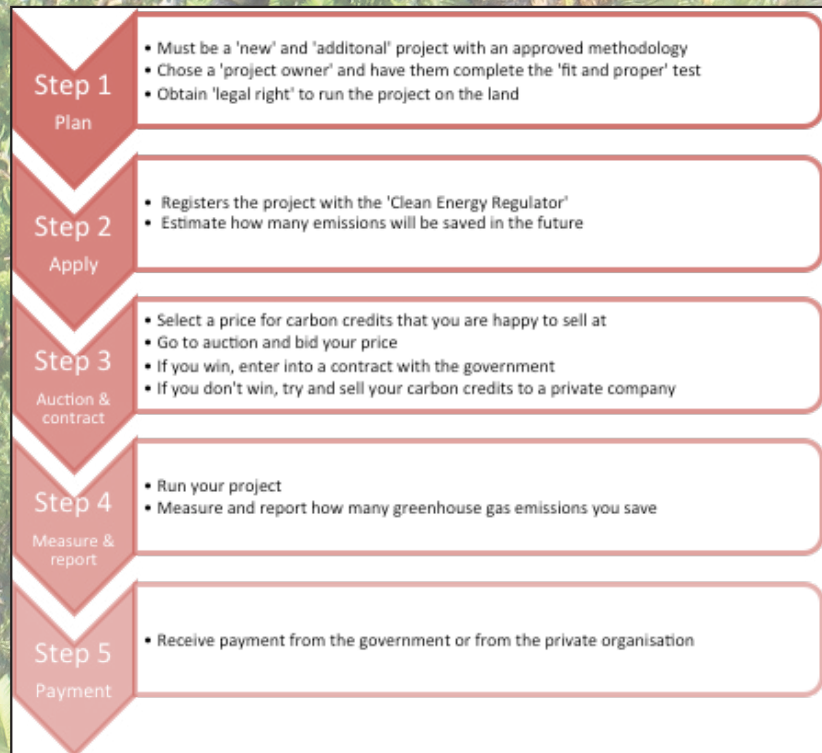
Taking the next step



There are lots of steps involved in starting a carbon farming project, but there are many resources to help!

NAILSMA is working with Indigenous land managers, Land Councils, governments, non-government organisations and scientists to support Indigenous land owners who want to set up their own savanna fire management project.

The basic steps to sign up and earn money from the ERF are listed to the right. There is actually a lot more to it than this, but there is some good help around to work through it with you. For more information and help, contact your Land Council, the Department of the Environment, NAILSMA and see the resource links below..



'Climate Change in North Australia' - animation:

'Savanna Burning' – animation:

Climate change and carbon farming: Education manual:

'Climate change animation; everyone's business':

Good Work – 'Ashton Nandoo, Wungurr Ranger':

Kimberley Fire Management Project:

'Fighting Carbon with Fire' - Video:

Aboriginal Carbon Fund website:

Emissions Reduction Fund website:

Savanna Fire Management Methodology:

SavBAT (Savanna Burning Abatement Tool):

<http://www.nailsma.org.au/hub/resources>

<http://www.nailsma.org.au/hub/resources>

<http://www.nailsma.org.au/hub/resources>

<http://www.livelearn.org/live-learn-multimedia>

<http://www.nailsma.org.au/hub/resources/video/good-work-ashton-nandoo>

<http://www.klc.org.au/news-media/video-gallery>

<http://ourworld.unu.edu/en/fighting-carbon-with-fire>

www.aboriginalcarbonfund.com.au

<http://www.environment.gov.au/climate-change/emissions-reduction-fund>

<http://www.environment.gov.au/climate-change/emissions-reduction-fund/cfi/methodologies/determinations/savanna-burning>

<http://savbat2.net.au/#/welcome>



A special thanks to the ranger groups across north Australia for their contributions, photographs and feedback and to government and non-government organisations for their ongoing support for carbon farming projects.

What people are talking about when they say...

Abate/ Abatement

The word abatement means to reduce or make something less. One category of carbon farming project is an abatement project because it reduces greenhouse gas sources (the things that release gas such as wildfire). Savanna fire management projects are called abatement projects because they reduce the size of wildfires which are a source of greenhouse gases. By using traditional-style fire management to create 'cool burns' in the early dry season, less smoke and greenhouse gases go into the air compared to an unmanaged wildfire.

Carbon Market

One way to reduce greenhouse gas (GHG) emissions is to make it worth money for polluters and land managers to prevent or reduce greenhouse gas emissions. Greenhouse gas emissions (and carbon storage) can be measured and a price calculated for each tonne (= to one credit) counted. The carbon market is about buying and selling these credits. In Australia carbon credits can be made by carbon farming projects and sold to the government or private organisations. The government buys carbon credits because it must ensure Australia's total greenhouse gas emissions are reduced by the agreed amount made under the Kyoto Protocol (an international agreement). At the moment private companies may choose to buy carbon credits (to help their business image for example) but in future polluters may be forced to either reduce their GHG emissions or buy credits from someone who is doing that.

Carbon

When you look at a solid, liquid or gas very closely under a powerful microscope you can see that it is made up of tiny little atoms. Different kinds of atoms joined together make molecules and groups of the same molecule form elements—like carbon, iron, magnesium, helium and many more. Carbon is one of the most common elements. It's in almost all living things and many other natural things; plants and animals, humans, rocks and soil, the air around us. Carbon exists in solid, liquid and gas forms and can move from one form to another. For example carbon in trees is in solid form. When a tree dies and decays, some of its carbon joins with oxygen and goes into the air as a gas (carbon dioxide). This gas can be breathed in by living trees and converted back into solid form (timber, leaves). Solid form carbon in ancient algae may turn into oil (carbon in liquid form) as it decays over millions of years. When we use oil in engines, the carbon is released into the air as gas.

Carbon offsets/ Offsets

Carbon offsets or offsetting is about reducing carbon pollution in one place to cancel out the same amount of pollution created in another place. When a private organisation buys carbon credits from a carbon farming project, they are in effect paying other people to reduce emissions for them. The organisation is still putting out the same amount of greenhouse gases but they can say they have reduced greenhouse gases because they have paid someone else to cut greenhouse gas somewhere else.

Carbon Credits

In a carbon market, for every tonne of greenhouse gases that a project reduces or avoids emitting, a carbon credit is issued. Under the Australian Government's Carbon Farming Initiative (CFI) and the Emissions Reduction Fund (ERF) carbon credits are called 'Australian Certified Carbon Units' (ACCUs). Carbon credits can be sold to the Australian Government who buys them using money from the Emissions Reduction Fund (ERF). Alternatively, carbon credits can be sold to the voluntary market, which includes private organisations who wish to offset their own emissions because it is a good thing to do for our environment, or because it is good for their business image.

Carbon Pollution

The Earth has always had phases of cooling and warming - think of ice ages for example. Around 250 years ago humans started moving into cities from villages and small scale agriculture. They built factories to mass produce goods for trade and created huge cities that needed fuel, iron and electricity. This was the start of the Industrial Revolution. From this time huge amounts of pollution containing carbon and other GHGs is released into the air. This is mostly from oil, coal and gas that had been underground for millions of years. The development of modern industrial cities also meant that human populations exploded and vast areas of land were cleared of forest to grow food crops, stock and to build more cities. These areas can no longer absorb and store the same amount of carbon. This unsustainable cycle has continued and has resulted in extreme carbon pollution that is warming the Earth faster than what happens naturally.

Carbon Dioxide (CO₂)

Carbon dioxide is a gas in the air around us. It is made up of molecules where one carbon atom is joined with two oxygen atoms (CO₂). It is a greenhouse gas, which means it is a gas that stays in our atmosphere and keeps the Earth warm. It can build up in the atmosphere and absorb reflected heat from the Earth, making the Earth warmer.

Climate Change

Whilst the climate changes naturally over time it is happening faster than normal. The Earth is getting warmer because humans have put lots of extra greenhouse gases in the air, forming a blanket around the atmosphere and making it harder for heat to escape. This changes how the atmosphere and oceans interact and as a result causes the following changes to the Earth: (1) more intense extreme weather events (floods, heatwaves, cyclones). (2) Shifts in temperature and rain so seasons will change at unusual times and it will be hotter and wetter in some places and colder and drier in others. (3) Rising sea levels, caused by melting ice sheets in the north and south pole. (4) More acidic oceans, making it harder for ocean species, like coral to survive.

Greenhouse Gas/ Effect

The sun warms the Earth and the Earth reflects some of the heat back into the atmosphere and out into space. Greenhouse gases in the atmosphere, such as carbon dioxide methane and nitrous oxide, absorb and trap some of this heat. This process is called the greenhouse effect. Greenhouse gases are always in the air and help keep the Earth warm and our climate stable. But they need to be in the air in the right amounts. Too many greenhouse gases trap extra heat and cause global warming. The main greenhouse gases are: carbon dioxide, methane and nitrous oxide.

Sequest/ Sequestration

Sequestration means to store or remove something. There are some kinds of carbon farming known as sequestration projects because in one way or another they take greenhouse gases out of the atmosphere and store them or prevent them from being emitted. For example, trees remove carbon dioxide from the air and store the carbon as wood, leaves and fruit. Savanna fire management projects (as well as an abatement project) may soon also be treated as sequestration projects because good fire management can avoid vegetation being completely burnt and increases the amount of carbon stored in the extra growth of tree trunks and canopies that results. A methodology for savanna burning sequestration is likely to be approved by the Clean Energy Regulator early 2016

Carbon Farming Projects

The Carbon Farming Initiative (CFI) was created in 2012 by the federal government to support carbon farming projects but in 2014 it was streamlined into the Emissions Reduction Fund (ERF). Its purpose is to encourage land managers to reduce greenhouse gases and by earning money for it. There are many types of carbon farming projects, but the one discussed in this book is about savanna fire management. It involves managing fire so that most of the burns occur in the early dry season and create a pattern of burnt and unburnt country that prevents as much end of dry season wildfire as possible. There are many rules and guidelines surrounding how to start, run, report and receive carbon credits from carbon farming projects and these must be followed.

Eligibility Criteria

For a carbon farming project to sell its carbon credits to the Emissions Reduction Fund it must meet all of the following eligibility criteria: (1) Use an approved methodology. (2) Be new - the project must not already be operating. (3) Be additional - it can't be required to be carried out by or under another law or program. (4) A project owner must also open an account with the Australian National Registry of Emissions Units (ANREU) - a secure electronic system into which carbon credits are issued. (5) The project owner must complete a 'fit and proper' test to prove that they have no prior convictions or history of non-compliance under a range of laws.

Methodology

A methodology is a step by step approach for doing something, like a cooking recipe. Under the government's Carbon Farming Initiative (CFI) and Emissions Reduction Fund (ERF) an approved methodology is a set of rules to measure and account for abated emissions or stored carbon in a specific kind of activity—for example in savanna fire management. The research to develop a methodology can be done privately or by government but must be scientifically robust and has to be approved by the Clean Energy Regulator. These rules and the science behind them get packaged up into legislation under the CFI so that any prospective carbon project owners can access and follow them to guide their carbon farming activities and make them 'eligible'. A savanna fire management methodology for tropical savanna country that gets more than 600 mm annual rainfall was approved in 2015.

Emissions Reduction Fund (ERF)

The Emissions Reduction Fund (ERF) was introduced by the Australian Government in 2014 as a way to reduce Australia's total greenhouse gas emissions. It is a big pool of money that the government uses to buy as many carbon credits as possible from carbon projects all over Australia. The government buys carbon credits in a reverse auction, where a carbon project owner must try and sell their carbon credits for the lowest price possible. If the price is too high, another project might win. If the price is too low, the project owner won't make any money. The government will decide how much it is willing to spend on credits and the maximum amount it will pay.

Fossil Fuels

Fossil fuels come from the decaying remains of plants and animals such as trees and algae living millions of years ago. We extract these from deep in the ground and use them as fuel. For example, gas and coal are mined from the ground and burned at power stations to create electricity. When we burn fossil fuels carbon and other pollutants are released into the atmosphere (for example in exhaust from cars) and add to the blanket of greenhouse gases warming the Earth and changing its climate.

Global Warming

The Earth is naturally kept warm by greenhouse gases trapped in the Earth's atmosphere in a process known as the greenhouse effect. However, the Earth is getting warmer than usual because of extra greenhouse gas emissions that humans are putting into the air (emitting). These extra gas emissions are forming a blanket around the Earth and making it harder for extra heat to escape back into space. So gradually the air, seas and land are getting warmer and warmer. As the Earth gets warmer it alters our climate and creates problems that affect people, plants and animals.

