How scientists accidentally caused climate change

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Article summary

The world is experiencing a totally unnecessary climate crisis, thanks to a series of mistakes made by scientists during the 1850s.

This article identifies the mistakes and explains how, by correcting them, we can achieve net zero carbon emissions well before 2050, while enjoying a more prosperous future than we currently anticipate.

We know that the Earth's climate is changing because:

1 **It's getting warmer**
The Earth's atmosphere is warming up, causing health problems for humans and many other forms of life.

2 **The weather is getting wilder**
The atmosphere acts as a giant heat engine that converts atmospheric thermal energy into other forms of energy that powers our weather systems.
Unfortunately, global warming is increasing the frequency and intensity of extreme weather events like heat waves, heavy rainfall, droughts, and more powerful storms

Scientists could have solved these problems more than a century ago, by replacing fossil fuel burning engines with cheaper and clean engines that imitate nature by running on atmospheric thermal energy.

But, instead of working together, scientists have split into two camps with contradicting beliefs. This has reduced the science of climate change to Orwellian doublethink.

Here is the contradiction
The meteorologists are warning us that our present method of powering the world by burning fossil fuels is unsustainable because carbon dioxide pollution is making the atmospheric heat engine too active.
But the engineers decline to try and solve the problem by imitating nature and building a new type of electricity generator that runs on atmospheric thermal energy. They explain that they would be wasting time and money trying to build such a generator because the laws of thermodynamics would not allow it to work.

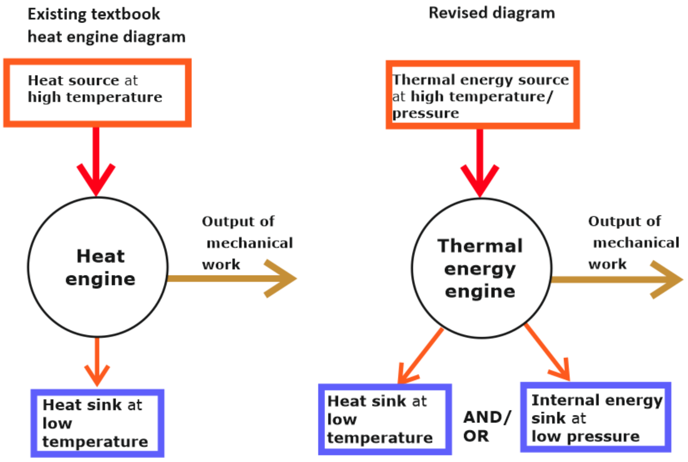
> So, this is doublethink thermodynamics for you:
> Scientists are telling us that the atmosphere is a giant heat engine powered by atmospheric thermal energy (heat). But they are also telling us that you can't build a heat engine powered by atmospheric thermal energy, because this would violate the laws of thermodynamics.

This article explains how the science of climate change went so badly wrong.
But it also offers us our best hope of solving the problem. If we can break down the doublethink barriers between meteorology and engineering, we will discover new and cheaper ways of fighting climate change.
One such way is suggested in Section 14, but there is plenty of scope for alternatives, once the taboo on talking about doublethink thermodynamics has been broken.

I have been campaigning to break this taboo for many years, but scientific self interest has been working against me. Our present strategy for fighting climate change has created many thousands of jobs for scientists and we also enjoy a high public status as the defenders of the climate.
So, nobody in the scientific community wants to step out of line by being the first to admit that bad science may have accidentally caused climate change.
However, I am hoping that the addition of Artificial Intelligence (AI) to Google's search engine will allow scientists to discretely shift their position, without having to publicly step out of line.
This is how it could work.
Readers of this article can check my claims swiftly and in private by asking Google (or any equivalent search engine) for an AI opinion on them.
I will suggest some fact checking questions for readers, but they are encouraged to probe deeper, by asking the AI awkward alternative questions of their own.

In a nutshell, the 'new' thermodynamics required to fight climate change can be summarised by making changes to a standard diagram taught to thermodynamics students for more than a century.

In the new diagram, the name **heat engine** is changed to **thermal energy engine** and an **Internal energy sink** is added.



Thermal energy entering an internal energy sink can be recycled, but thermal energy entering a heat sink cannot.
So, once the engineers start using the new diagram, they will discover new ways of generating cheap and clean electricity.

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1 Evidence that we can tap into atmospheric thermal energy

Heat pumps have been tapping into atmospheric thermal energy since 1856.
We use them to keep our homes warm in winter by extracting thermal energy from cold winter air and pumping its temperature up by around 40-50°C.
According to a *correct* interpretation of the laws of thermodynamics, we could do far better than this, by converting the thermal energy in cold air into electricity.

Please don't be put off by the term 'thermodynamics'.
The mistakes made by the past generations of scientists were surprisingly simple. So, even if you wriggled out of studying science at the earliest possible school age, you should still be able to grasp the new knowledge required to fight climate change.

Fact check
You could ask the Google search engine,
'Does the existence of heat pumps provide evidence that the atmosphere contains large quantities of accessible thermal energy?'

2 So why don't we generate electricity in this cheap and clean way?

In the middle of the nineteenth century there was a revolution in our understanding of heat, with the old *Caloric Theory of Heat* being replaced by a new theory called *Thermodynamics*.

During the revolution, the pioneers of thermodynamics made several mistakes that have never been corrected.
These mistakes do not adversely affect our understanding of hot running, fossil fuel burning engines. But they have led to the creation of two myths that distort our understanding of cool running heat engines.

> *First myth:* 'The laws of nature make it practically impossible to convert atmospheric thermal energy into electricity.'
> *Second myth:* 'The laws of nature prevent us from building heat engines that can recycle their rejected thermal energy.'

These myths are bad news for people alive today, but the very long term outlook is even gloomier.
Thus, starting off with a hot universe, the temperature of the universe will fall as thermal energy flows through successive natural heat engines. Ultimately, this will result in the 'heat death of the universe', with all the matter in the universe ending up in a deep frozen state, just above the above absolute zero of temperature.
The heat death hypothesis was put forward in 1852 by Lord Kelvin, one of the pioneers of thermodynamics. It has no direct bearing on our fight against climate change but it has been instrumental in creating a fatalistic mindset among scientists, that all heat engines are inherently inefficient.

However, the evidence presented in Section 10 suggests that the long term universal weather may be warmer than most scientists are predicting.

Fact check
Ask Google about what we currently believe,
1. ‘Does the second law of thermodynamics prevent us from building heat engines that can recycle their rejected thermal energy?’

2. ‘Does the second law of thermodynamics predict the heat death of the universe?’

3. ‘Did the scientist Lord Kelvin who proposed the heat death of the universe theory science find it attractive because it conformed to his religious beliefs?’

In my opinion, there are two main reasons why today’s secular scientists have failed to correct the mistakes behind these myths.
The first is that the scientific community has been living with these mistakes for so many generations that they have become completely oblivious to them.

The second reason is scientific hubris.
I discovered these mistakes in 1965, when I was an undergraduate physics student. In the sixty years since then, I have made numerous presentations to scientists and engineers. However, rather than engaging in debate, my evidence has been dismissed on the grounds that scientists could not have made such foolish mistakes.

Fortunately, once these mistakes have been corrected, new ways of generating clean energy will emerge. Essentially, the new technology will be able to mimic heat pumps by harvesting thermal energy from the atmosphere, even on cold winter days.
However, the new generators will be a vast improvement on heat pumps because, in addition to providing indoor heating, they will be able to supply sufficient electricity to meet all of our domestic and industrial needs.
So, apart from purchasing the required equipment, paying their government energy taxes and for regular service checks, the whole of humanity will be able to enjoy a prosperous future based on clean free electricity.

[As a very crude first estimate, the domestic versions of the new types of power generators, as outlined on the Cheshire Innovation website www.cheshire-innovation.com should be approximately the same as the cost of purchasing and installing three domestic washing machines.]

3 The disagreement between scientists fighting climate change

The big clue that something is wrong with climate change science is that meteorologists and engineers disagree about the properties of the heat engines that convert thermal energy into other forms of energy.
As far as meteorologists are concerned, the Earth’s atmosphere acts like a giant heat engine that converts atmospheric thermal energy into other forms of energy, such as the kinetic energy of winds.

> If you are confused by the difference between ‘heat’ and ‘thermal energy’, that’s because it is part of the doublethink problem. This issue will be discussed in Section 7 ‘The doublethink use of the term ‘heat’.

The fresh water cycle powered by the atmospheric thermal energy engine has been delivering water to dry land since before the first creatures crawled ashore, 3.2 billion years ago. However, during the last three centuries of industrialisation, fossil fuel powered heat engines have been pumping carbon dioxide into the atmosphere and altering the climate faster than life can evolve.

The ‘obvious’ solution to this problem should be for humans to learn from nature and power our civilisation using heat engines that convert atmospheric heat (thermal energy) into electricity and other useful forms of energy.

But, this is where the science starts to contradict itself.
Meteorologists recognise that heat engines can be invisible engines, with the only matter involved being water vapour and atmospheric gases.
However, engineers are trained to think of heat engines as hot running engines that are made from steel and other solid materials. Examples of manufactured heat engines include old time steam engines, internal combustion engines in road vehicles, jet engines and even the humble rocket firework.

In my experience, many engineers see manufactured heat engines as being an entirely different species to natural heat engines, with different rules applying to them. This seems to be one of the factors that reinforces doublethink.

But this does not justify the meteorologists and engineers contradicting each other, with the meteorologist telling us that heat engines can run on atmospheric heat, while the engineers reassure us that this is thermodynamically impossible.

Fact check
You can confirm this contradiction for yourself by inputting the following questions into Google or any other internet search engine.
1. *This question taps into meteorological knowledge.*
‘Is it true that the Earth’s atmosphere acts as a giant heat engine that converts atmospheric thermal energy into the kinetic energy of moving air?’

2. *This question taps into engineering knowledge.*
‘Do the laws of thermodynamics prevent us from building engines that convert atmospheric thermal energy into other forms of energy?’

This disagreement between scientists is probably doing more harm to our planet than the big oil companies, populist politicians or climate change deniers.

So please double-check my evidence of a disagreement, by asking the Google AI probing questions of your own.

If the meteorologists have got their thermodynamics right, we should be able to fight climate change by building heat engines that convert atmospheric heat into other forms of energy. Such engines could provide the whole of humanity, with all of the electrical and other forms of energy that it needs, until the sun expands and destroys all life on Earth. [Scientists predict this will happen in about 5 billion years time.]

But, if the engineers have got their thermodynamics right, Mother Nature is mistaken, and it is thermodynamically impossible for her atmospheric heat engine to function.

My experiences extending over sixty (60) years suggest that scientists are quite happy to tolerate this Orwellian doublethink.

For example, in 2006 I teamed up with a chartered engineer, Dick West, to form Latent Power Turbines Ltd. Our aim was to develop a proof of concept power generator that ran on atmospheric heat.
Since then, I have made numerous presentations to 'experts' on thermodynamics in which I draw attention to the contradiction between the beliefs of meteorologists and engineers.
My audience agrees that the meteorologists are right when discussing natural heat engines.
But they also agree that the engineers are right, when discussing manufactured heat engines.
They usually try to dodge this contradiction by suggesting that some unknown person with a deep enough knowledge of thermodynamics will be able to spot the flaw in my doublethink claim. Then, if I refuse to accept this defence of doublethink, my audience tends to get annoyed.
[If you want to discover why Latent Power Turbines failed, put the terms **Cheshire Innovation, Black Swans** into a search engine and go to the Black Swans webpage.]

Here is a standard thermodynamics textbook diagram plus a list of the key facts that students of thermodynamics are taught. [I speak from experience, as a further education teacher who taught basic thermodynamics for twenty years.]

Textbook teaching

A Carnot's theoretical heat engine is the ideal heat engine.

B All heat engines mimic the Carnot engine by having a warm and cold thermal energy reservoir.

C Heat flows from the warm thermal energy reservoir to the cool thermal energy reservoir, in accordance with the second law of thermodynamics.

D Atmospheric heat engines are not a practical proposition because, on the limited occasions when a cold reservoir below ambient temperature can be found, the temperature drop between the two reservoirs is so small that the output of mechanical energy (also referred to as mechanical work) is negligable.

E When heat enters a cool reservoir it is diluted and cannot be recycled. (Technically, this dilution is referred to as an increase in entropy.)

Standard textbook diagram

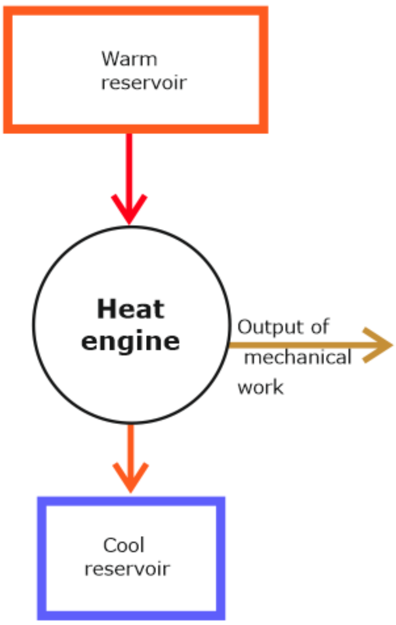


Figure 1. In order for my students to pass their exams, I was morally obliged to teach them these 'facts', even though I knew that they were only half truths, or even false. So, I have played my part in promoting doublethink thermodynamics.

Fact check
By converting the statements **A** to **E** into questions for Google, you can verify that they are currently accepted as being true.

*For example Statement **A** becomes,*
'Is it true that Carnot's engine is the ideal heat engine?'

To get to the root of these mistakes, we need to go back to 1824, to a time when scientists still believed in the caloric theory of heat.
According to this theory, heat is a substance that takes the form of an invisible weightless fluid called caloric.
According to caloric theory, temperature is explained by the density or amount of caloric within an object. Thus, a hot body has a lot of caloric inside it, while a colder body is currently storing very little caloric.
Temperature differences drive the flow of caloric from hotter to colder objects, and an object's temperature is assumed to rise as it absorbs caloric.

The key point for you to grasp is that in 1824, scientists assumed that caloric flowed on a manner analogous to water.

4 Carnot's 1824 ideal heat engine

By 1824 the industrial revolution was well underway, with entrepreneurs using engines to do their heavy mechanical work instead of humans or animals.
Water wheels and steam engines were the commonest engines that they used.
Steam engines could continue running during draughts, but buying the coal cost money.

There was another important difference that intrigued Carnot: Water wheels where about 80% efficient at converting the potential energy stored in the reservoir water into useful work inside the factory. In contrast, steam engines were only 3-5% efficient in delivering useful work.
Carnot was in an ideal position to understand why water wheels were so efficient because his father was an eminent scientist who specialised in the theory of water wheels.

An obvious problem with steam engines was the large amount of heat that had to be used for converting water into steam, so Carnot chose to use dry air as his working fluid. This was also safer because, in the event of a high pressure explosion, dry air burns were preferable to being scalded by steam.

Given his family background, it is no surprise that Carnot's alternative to steam engines was a water wheel analogue that replaced water with caloric (heat).

In ideal water wheel theory, water runs from an upper reservoir to a lower reservoir via a water wheel.
In Carnot's heat engine equivalent, the water reservoirs are replaced by heat reservoirs and a heat engine replaces the water wheel.

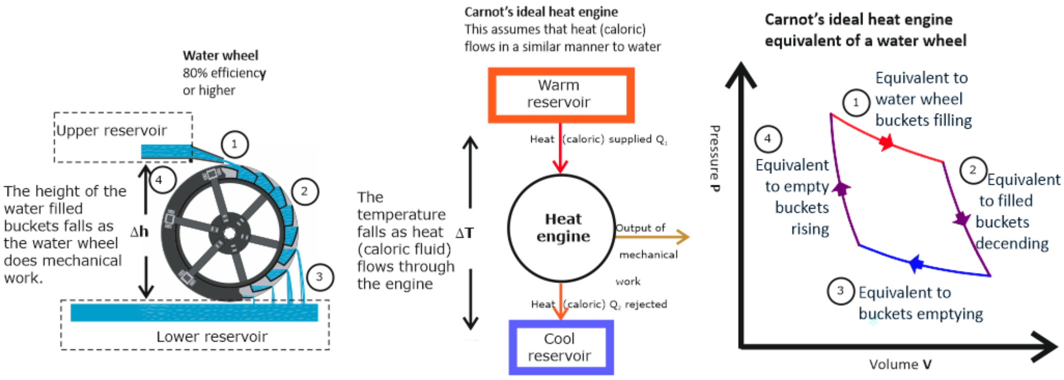


Figure 2. In Carnot's day, heat was believed to be a fluid that flowed in a similar manner to water. This suggested that an ideal heat engine would be an analogue version of the four stages in a water wheel cycle.

Carnot followed standard practice for developing basic theoretical models by assuming that friction and other impediments were negligible. Then, to meet his caloric flow needs, he also assumed that an infinite amount of time was available for each cycle.

Carnot never built any engines that approximated to his design, but he published his theoretical ideas in an 1824, in an 118 page long scientific paper titled 'Reflections on the motive power of fire'. This included the first reference to the term **heat engine** and influences our thinking on heat engines to this day.
By caloric era standards, Carnot's paper was a useful contribution to our understanding of heat engines. But in the years after his death in 1832, the caloric theory gradually fell out of favour as scientists started to understand the consequences of matter being made up of atoms and molecules.
By the early 1850s, the leading scientists had abandoned the idea of heat being a fluid, in favour of heat being the kinetic energy of vibrating atoms in solids and the kinetic energy of molecules whizzing around in liquids and gases.
Scientists also realised that assemblies of these atoms and molecules possessed potential energy, due to the chemical bonds linking the atoms or molecules together. So they created the concept of ***internal energy*** that covered the sum of the kinetic and potential energy stored inside a body.

> A basic understanding of the role of internal energy will help us to bridge the gap between meteorologists and engineers, so I will add a few notes about it.

The concept of internal energy helped scientists to explain the phenomenon of latent heat that had puzzled them since 1761. In that year Joseph Black found that as he added heat to a vessel filled with cold water, its temperature gradually increased until it reached its boiling point. Then, if he added more heat, its temperature remained constant, but the water changed into steam. He referred to the extra heat required to convert water into steam at the same temperature as **latent heat**.
A century later, the link between latent heat and internal energy became clear. All of the heat supplied to water at its boiling point is consumed in providing the steam with the extra internal energy it possesses compared with water at the same temperature.

In the years between the discovery of latent heat and internal energy, Carnot was aware that one of the reasons for the poor efficiency of steam engines was the heat lost in converting the water to steam.
So, in order to overcome the latent heat problem, he replaced steam with a sealed piston chamber filled with dry air and replaced the flow of steam through the engine with a flow of caloric.
Carnot's primary goal was to explore the fundamental principles governing all heat engines and their efficiency.
He came up with the best solution to the latent heat problem that was available in 1824. But following the invention of a range of internal combustion engines in the second half of the nineteenth century, his sealed piston chamber solution became outdated.
This new class of internal combustion engines quite literally solved the latent heat problem in a flash, thanks to the explosive combustion of a fuel plus air mixture inside the combustion chamber.

The new scientific theory of heat that emerged around 1850 was given the name **thermodynamics** because it combined the ideas of bodies having both thermal and dynamic properties at the atomic and molecular levels.
Carnot is often referred to as 'the father of thermodynamics' because his work was so influential. But, based on my investigations over the last 60 years, the importance of his work has been oversold.

Fact check
Ask Google,
1 'Was Carnot's heat engine design inspired by the high efficiency of water wheels?'
2. Why is Sadi Carnot often referred to as the father of thermodynamics?

5 Overselling the importance of Carnot's engine

5.1 The outdated claim that Carnot's engine represents the 'gold standard' for heat engines

One of the great attractions of Carnot's water wheel analogy is that water flows are easier to image than flows of invisible weightless fluids. However, once the caloric theory had been replaced by thermodynamics, the water wheel analogy lost its validity and the Carnot engine should have lost its claim to be *the* ideal heat engine.
The argument in favour of Carnot's heat engine being 'the gold standard' for heat engine design became even weaker once internal combustion engines started to dominate the heat engine markets.

Fact check
Ask Google,
'Is Carnot's heat engine recognised as being the gold standard for heat engine design?'

Developing detailed models that precisely explains the working of any engine in the real word is almost impossible because of the problems caused by friction, heat losses and other nuisances that cannot be avoided. So it is quite legitimate for scientists to start off by creating an ideal model which assumes that all of the nuisance factors are negligibly small.

Consequently, theoretical ideal models are 'Too good to be true', but they perform a useful role by acting as benchmarks for rating the performance of real world designs.

But in thermodynamics we benchmark the other way round, by comparing our new heat engines with a water wheel analogue that was discredited after the collapse of the caloric theory.

It is almost inevitable that a bad benchmarking model will lead to bad 'improvements'.

An alternative candidate for consideration as the ideal heat engine is the Converging Flow Heat Engine to be described in Section 10.

5.2 Exaggerating the significance of temperature drops across heat engines

There is a temperature drop across all heat engines, but its significance varies.
In the case of Carnot and Stirling engines, it plays a causal role because, the greater the drop in temperature across the engine, the greater the output of mechanical work.

However, in the case of steam and internal combustion engines, it is the pressure drop across the engine that plays the causal role, with the temperature falling as a consequence.

The following diagram illustrates this difference by comparing a steam engine with a Carnot engine.

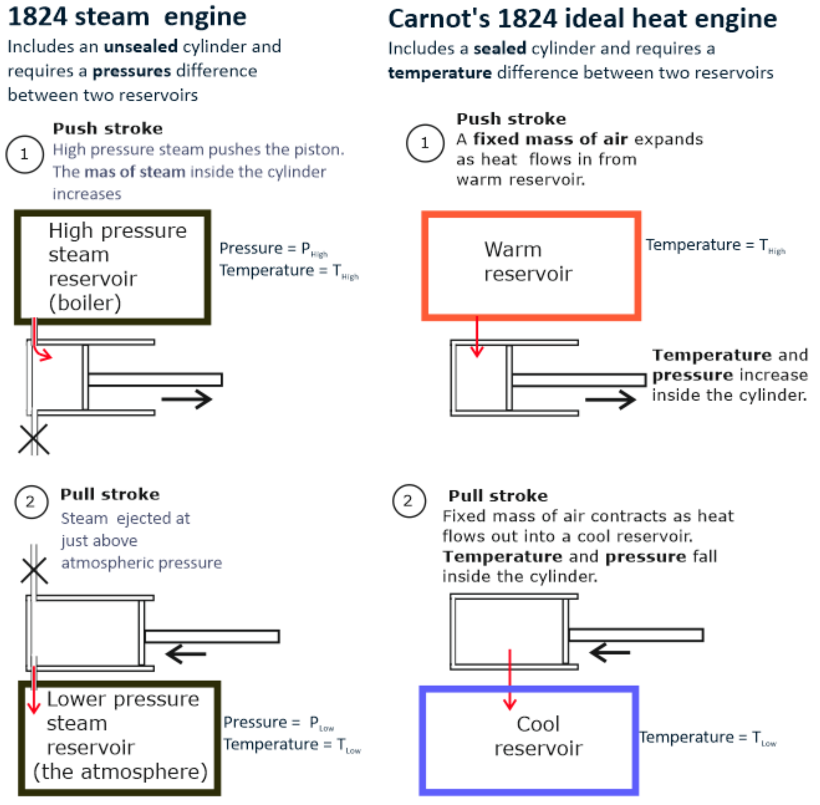


Figure 3. In a steam engine, matter which possesses internal energy flows from the High Pressure reservoir to the and Lower Pressure reservoir. But there is no flow of matter between the Carnot engine reservoirs.

Here are some other differences between Carnot and other heat engines.

- A Carnot engines requires a temperature drop from T_{High} to T_{LOW} for it to function.
- A steam engines requires a pressure drop from P_{High} to P_{Low} for it to function, but the temperature also drop from T_{High} to T_{LOW}.
- For both engines, the maximum mechanical work production efficiency is given by the same formula, Efficiency = $1 - (T_{Low}/T_{High})$.
- However, in reality, steam engines have a far lower efficiency than a Carnot engines because of the large amount of thermal energy needed to convert water into steam before it enters the engine.
- Internal combustion engines overcome the water boiling losses by replacing steam with high pressure combustion gases generated inside the engine.

Stirling engines are the only common heat engines that comply with the Carnot model by having a temperature drop as their independent variable.
They were invented in 1816 and there is speculation that Carnot was aware of them.
There are several different configurations of Stirling engine, all of which differ from a Carnot engine, either by having two pistons or two pistons each in its own cylinder.
They are typically 10% to 40% efficient, depending on operating circumstances. They have several disadvantages compared with heat engines where a pressure drop is the independent variable. These include high cost, low power to weight ratio and being slow to start. On the other hand, they are quiet and can tap into relatively cool thermal energy sources.

Here is the key mistake identified in this section
The textbooks tell us that all heat engines require a warm and cool heat reservoir/sink, but this is only true for a very limited number of heat engines, including Carnot and Stirling engines.
Other engines, including steam and internal combustion engines require high and low pressure reservoirs/sinks where thermal energy takes the form of the internal energy of matter.

6 Mistakes involving the second law of thermodynamics

In its simplest form, the second law of thermodynamics tells us that thermal energy can only flow from warm to cold, unless it is carried by a vector. [The term *vector* will be explained below.]
In its more advanced form, the second law tells us that, in any isolated system, the total entropy will increase over time, unless it is operating under ideal conditions.

In this section, heat engine mistakes relating to the simple version will be discussed. Then in Section 10, the more subtle mistakes relating to entropy will be examined.

Before discussing heat engines, we will examine the relationship between the second law of thermodynamics and a mug of tea.

Here is an example of where the second law applies
If you wrap your cold hands round a hot mug of tea, then thermal energy will flow out of the warm mug and into your cold hands. However, the second law prevents this happening the opposite way round, with thermal energy flowing out of your cold hands and into the warmer tea.

An example of where the second law does not apply
If you wrap your hands round a jug of cold milk, it will feel cold, but it still contains a lot of thermal energy, due to the molecules whizzing around inside the milk.
So, if you pour cold milk into hot tea, then some of the thermal energy stored in the cold milk will flow 'the wrong way' into the hot tea.

In this example, we say that the milk is acting as a **vector** for carrying thermal energy from one place to another. In such circumstances, the second law does not apply.
The experimental evidence behind the vector transfer of thermal energy was discovered by Joseph Black in 1760. But it was only after the concept of internal energy had been defined, that scientists understood what was happening at a molecular level.

This is where the developers of heat engine theory made a surprising mistake.
They failed to recognise that the second law of thermodynamics does not apply to steam engines or any heat engine that emits an exhaust because, in both cases, the thermal energy is carried through the engine by a vector.

We now have two mistaken beliefs based on the overzealous interpretation of Carnot's work.

These are:
(i) All heat engines require a warm and cool heat reservoir.
[This is not true for any heat engine that emits exhaust matter.]
(ii) All heat engines must obey the second law of thermodynamics.
[Also, not true for any heat engine that emits exhaust matter.]

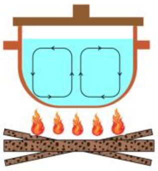
Engineering thermodynamics got off to an unlucky start, because the Carnot engine played a misleading role as the ideal heat engine.
In contrast, the meteorologists got off to a very lucky start because Mother Nature did not make either of these mistakes, when giving us natural heat engines.

The heat engine schism separating meteorology from engineering is at the heart of our climate crisis. So the doctrines behind the schism will be repeated.

The meteorologists inform us that the Earth's atmosphere acts as a giant heat engine that converts atmospheric thermal energy into other forms of energy. It is also characterised by its ability to recycle thermal energy using convection loops.

However, based on their false beliefs, engineers come to opposite conclusions:
(i) A heat engine cannot recycle its rejected thermal energy because this would violate the second law of thermodynamics.
(ii) A heat engine that runs on atmospheric thermal energy is not a practical proposition for power generation because the second law of thermodynamics would require the engine to have a heat sink below atmospheric temperature.

Here is some evidence that engineers need to have a complete rethink about their idea of heat engine



1. We have been using thermal energy recycling engines in the form of cooking pots since they were invented in China, approximately 20,000 years ago.

2. The air impacts wrenches used for loosening and tighten wheel nuts are heat engine that are powered by ambient temperature thermal energy.
This tool is used by engineering technicians, but it contradicts engineering heat engine beliefs.

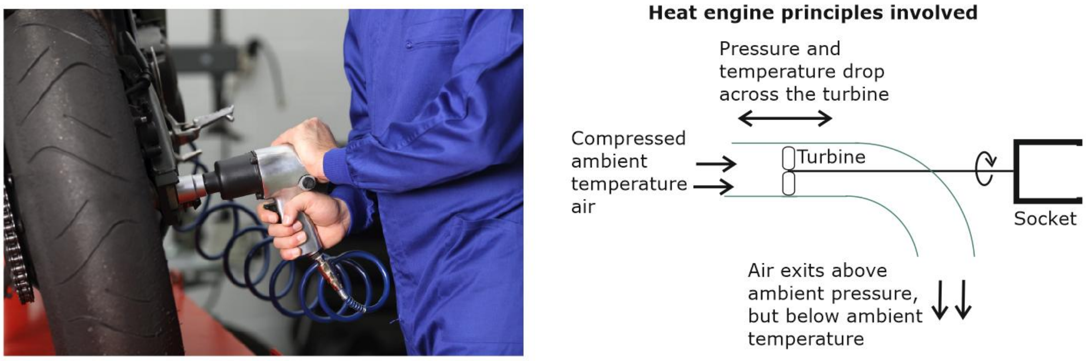


Figure 4. This tool is the ambient temperature equivalent of a steam turbine heat engine. The air ejected by the tool acts as a vector, carrying thermal energy away at a temperature below ambient.

Compressed air tools have been on the market since the 1870s, but scientists and engineers failed to spot that they had invented a heat engine powered by ambient temperature thermal energy.

Here is the key mistake identified in this section

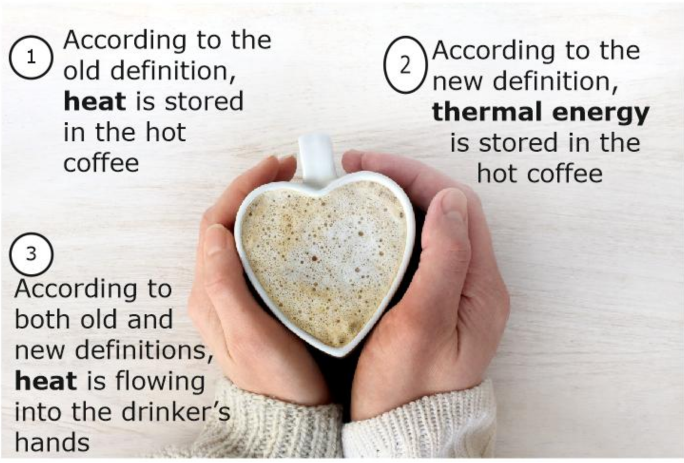
Scientists have correctly recognised that during a single transit of a heat engine, only a fraction of the thermal energy that enters is converted into mechanical work.
But they have failed to recognise that, if the residual thermal energy is carried away by a vector, the second law of thermodynamics does not apply.
Consequently they have failed to recognise that, with an appropriate design of heat engine, it is possible to recycle rejected thermal energy and to power a heat engine using ambient temperature thermal energy.

7 The doublethink use of the term 'heat'

In a poorly thought out attempt to make thermodynamics clearer and more precise, the pioneers of thermodynamics decided to change the meaning of the term 'heat'.

Fact check
Ask Google,
'Did the pioneers of thermodynamics change the meaning of the word heat, with the intention of making thermodynamics clearer?'

In reality, this attempt to improve clarity had the opposite effect, with scientists causing confusion by using the term 'heat' in two different ways.
For over a thousand years, English speaking people have used the term 'heat' to mean 'warmth'. Thus, it is quite acceptable for a scientist to refer to 'the amount of heat in the oceans'.
However, after James Prescott Joule established that heat is a form of energy in1843, scientists started to use the term 'thermal energy' instead of heat. Then, after the second law of thermodynamics was established in the 1850s, the term 'heat' started to be used in the special case where thermal energy was flowing from warm to cold, in accordance with the second law of thermodynamics.



This leads to some bizarre contradictions.

If you are using the term 'heat' in the new and 'clearer' way, Carnot's engine is a heat engine because its thermal energy flows according to the second law of thermodynamics.
However, a steam engine is not a heat engine, because the vector transfer of thermal energy by steam does not obey the second law of thermodynamics.
Likewise, internal combustion engines are not heat engines because the second law does not apply to them.

Nevertheless, the thermodynamics textbooks refer to steam and internal combustion engines as heat engines.

Fact check
To discover what we teach our students, ask Google,
'Are steam and internal combustion engines heat engines?'

8 Doublethink thermodynamics for beginners

Tragically for our planet, doublethink conditioning begins during the school years.

School age students living in countries with cool climates are taught about central heating systems as part of the science curriculum. They learn that the traditional central heating system includes a central boiler that supplies warm water to radiators throughout the building.
Honest science teachers then go on to introduce the doublethink. First they inform their pupils that a boiler is not actually a boiler, because, if the water was heated to boiling point, this would create vapour locks inside the pipe work.
They then explain that a radiator is not strictly a radiator because it mainly warms the adjacent air by conduction.

In contrast with this doublethink, pupils are actually taught some good science that will be knocked out of them later. Thus, they learn that it is possible for ambient temperature heat engines to recycle thermal energy, because this is what central heating convection current loops do.
However, if they go on to study more advanced thermodynamics; they will learn that the opposite is true, because heat engines cannot recycle their rejected thermal energy.

Fact check
Check the 'advanced' thermodynamics by asking Google,
'Can a heat engine recycle all of its rejected thermal energy inside the engine?'

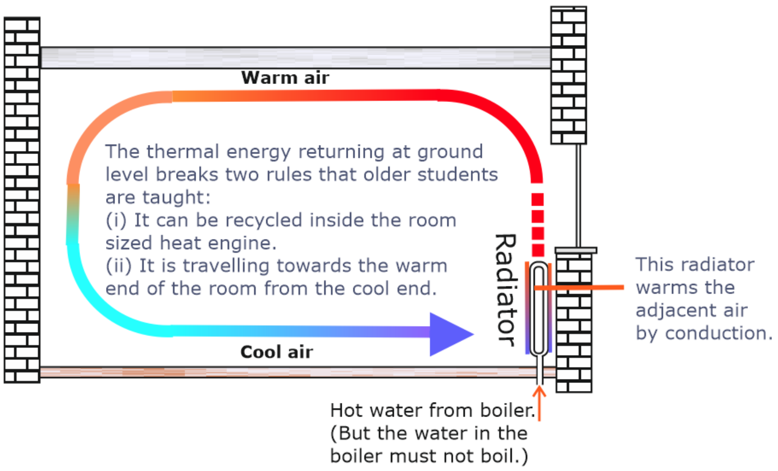


Figure 5. We condition the next generation of scientists and engineers into tolerating doublethink thermodynamics by teaching them that boilers and radiators are not boilers and radiators.

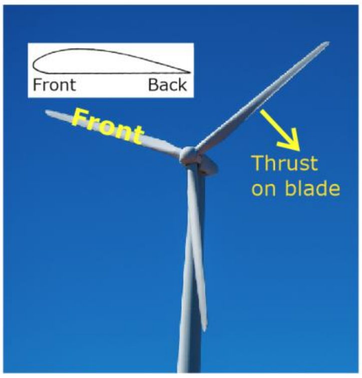
9 Wind turbine doublethink

The establish wisdom among scientists is that wind turbines extract kinetic energy from the wind and convert it into electricity. And, when this happens, the wind must slow down.

Fact check
Ask Google,
1 'What do wind turbines do?'
2 'Do wind turbines slow the wind down when they generate electricity?'

However, the wind slowing theory is full of loopholes.

- How do these thin turbine blades slow the wind down?



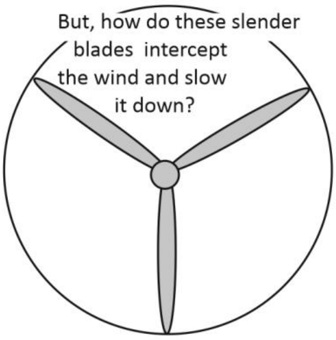


Figure 6.

- The basic school science is wrong. Anyone who has pushed a car knows that you have to push it from behind. If you try pushing the car sideways, it will not move forward.
  The same science applies to wind turbines. The wind cannot push the turbine blades so that they spin at right angles to the wind.

- If the wind did slow down, it would cause a 'molecular traffic jam', with air molecules approaching the wind turbine zone at a faster rate than they are leaving it.
- The molecular traffic jam argument is essentially a modern understanding of Leibniz's 1701 continuity principle that, 'what flows in, must flow out'.

Wind tunnel tests also tell us that the standard explanation is wrong.

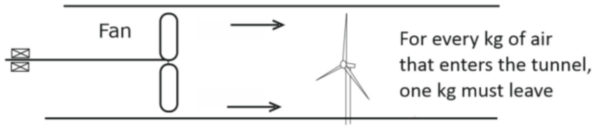


Figure 7. Engineering students commonly learn about wind turbines by doing tests on miniature wind turbines mounted inside wind tunnels. But, the 'what flows in, must flow out' rule must apply, otherwise the tunnel would soon become clogged up with stationary air.

The correct explanation is that the air does not slow down, it cools down.

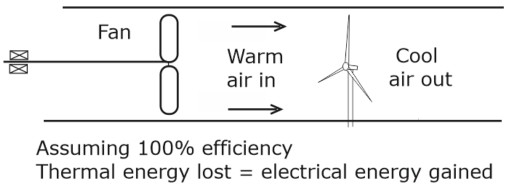


Figure 8. The cool air is denser than the warm air. So the air does slow down slightly, but that is a secondary effect, with the primary effect being cooling.

So, every time you see a wind turbine in action, you are looking at an engineering marvel, with the turbine acting as a cool running heat engine that imitates nature by converting atmospheric thermal energy into electricity.

But, during their student days, the engineers who built the wind turbine were probably taught that what they have done is thermodynamically impossible, because the second law of thermodynamics prevents us from building heat engines that run on atmospheric thermal energy. [Statement **D** in Figure 1.]

Here is an explanation of how a wind turbine blade can act as a heat engine.

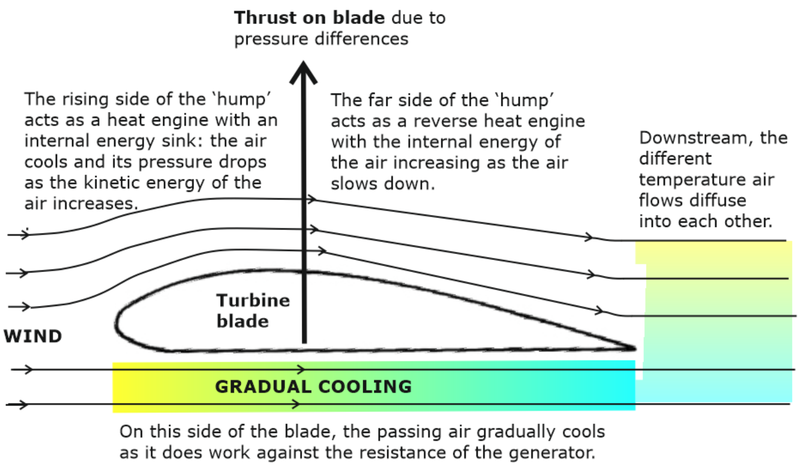


Figure 9. The temperature of the transiting air falls, but measuring the temperature drop is challenging because the effect is swamped by the rotating blades churning different layers of air at different temperatures behind the turbine. [If you are looking for a short research project that will overturn conventional thinking on wind turbines, then a wind tunnel simulation would probably give you publishable results. A calorimeter based method is worth considering.]

<u>The key message in this section</u>
The textbook explanation of how wind turbines work is clearly wrong and is an embarrassing failure of science. But at least it avoids an even greater source of embarrassment about power generation.
The correct explanation undermines the textbook teaching that it is thermodynamically impossible to build a heat engine that convert atmospheric thermal energy into electricity.

Fact check
You can verify that the scientific establishment disagrees with me by asking Google,

'Are wind turbines heat engines that convert atmospheric thermal energy into electricity?'

10 An alternative to Carnot's ideal heat engine

The textbook teaching since the late 1850s has been that any heat engine that converts thermal energy into some other form of energy must also produce an increase in the amount of disorder or entropy of the universe.
However, there are several examples of heat engines in our everyday lives that produce a reduction in entropy, but nobody seems to have noticed.

In this section, the class of squirting heat engines will be discussed. This class includes water pistols, hosepipes with nozzles and soft fruits that squirt juice if you tread on them.

I will refer to the class of squirting heat engines as '*Converging flow heat engines*'. [The term 'heat engine' will be retained to emphasise that these engines are part of the traditional heat engine family.]

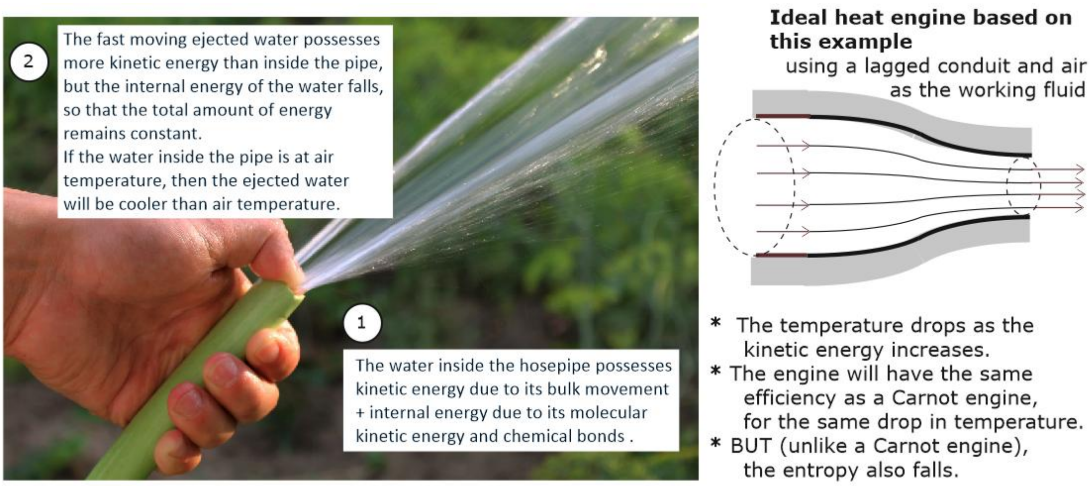


Figure 10. If the relatively slow moving water inside the hosepipe is at ambient temperature, then the temperature of the ejected water will drop to below ambient, to offset the increase in kinetic energy.
The water molecules whizzing around inside the ejected water are less energetic than they were in the warmer water inside the hosepipe.
Consequently, this hosepipe system can be treated as a heat engine in which the entropy of the working fluid falls as it generates an increase in kinetic energy.

Positive messages highlighted by this example
(i) It is possible to construct a heat engine powered by ambient thermal energy.
(ii) It is also possible to construct a heat engine that reduces the entropy (disorder) of the universe.

Once scientists have acknowledged these textbook mistakes, they can turn their minds to the possibility of building heat engine that convert atmospheric thermal energy into other forms of energy.

Fact check
You can verify the established teaching by asking Google,
1. 'When a body cools, does its entropy fall?'
2. 'Do heat engines always produce an increase in entropy?'

Ambient temperature converging flow engines offer us another useful asset, because in their unlagged form, they can draw in additional thermal energy.

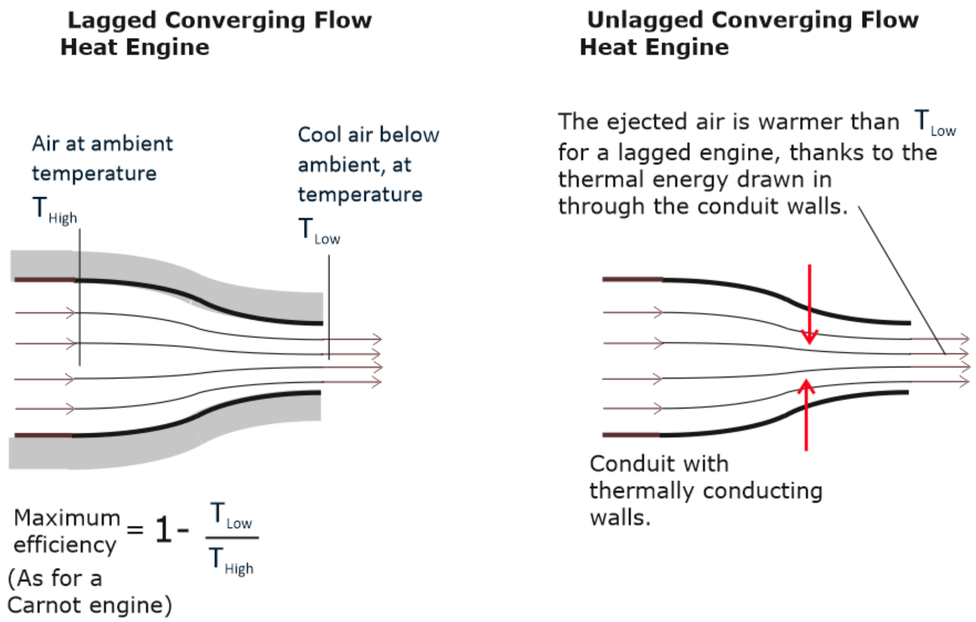


Figure 11. If the working fluid is an ideal gas, then the converging flow engine has the same efficiency as a Carnot engine. However, an unlagged engine can outperform a Carnot engine by drawing in thermal energy through the conduit walls.

The converging flow engine can also work in reverse, with the internal energy of the working air rising as its kinetic energy falls.
To create ideal reversible conditions, the enclosing conduit needs to be lagged. If it is unlagged, then the exiting air will be warmer than the incoming air.

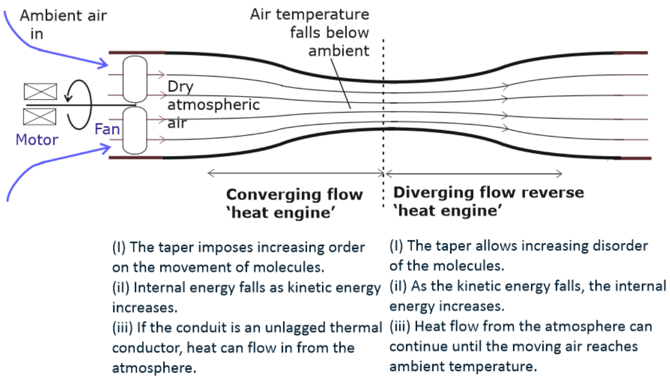


Figure 12. In Section 14 below, this converging-diverging arrangement will be combined with a miniature wind turbine to create 'a canned wind turbine'.

Providing hope for long term universal weather watchers

On a cosmological scale, gravitational attraction could result in streams of matter converging.

When Kelvin predicted the eventual heat death of the universe, he assumed that the natural heat engines involved in cosmological processes would all create an increase in entropy. However, converging flow heat engine produce the opposite effect, a reduction in entropy. So, the long term weather outlook may not be so chilly after all.

As a bonus, we have a relatively simple hypothesis that explains the accelerating expansion of the universe, without having to employ dark energy.

11 A list of the thermodynamics mistakes that need correcting

A The Carnot engine is invalid for benchmarking heat engines because the water wheel analogy on which is based is invalid.

B Most heat engines do not require warm and cool heat reservoirs.

C The second law of thermodynamics does not apply to all heat engines.

D The second law of thermodynamics does not prevent us from building thermal energy recycling heat engines.

E The second law of thermodynamics does not prevent us from building heat engines powered by ambient temperature thermal energy.

F The term 'Heat engine' is misleading. So we should either replace it with 'Thermal energy engine', or abandon our modern definition of heat that links it to the second law of thermodynamics.

12 A new 'heat engine' diagram to remove the doublethink

One of the standard digrams that we use to teach our thermodynamics has been misleading students since the 1850s.

The standard diagram is misleading because,
(i) It confuses heat with thermal energy,
(ii) It fails to recognise that most 'heat engines' require a low pressure internal energy sink, not a low temperature heat sink.

Fact check
Ask Google,
'What standard digrams are used to sum up the properties of a heat engine?'

Here is a proposed alternative for the next generation of students.

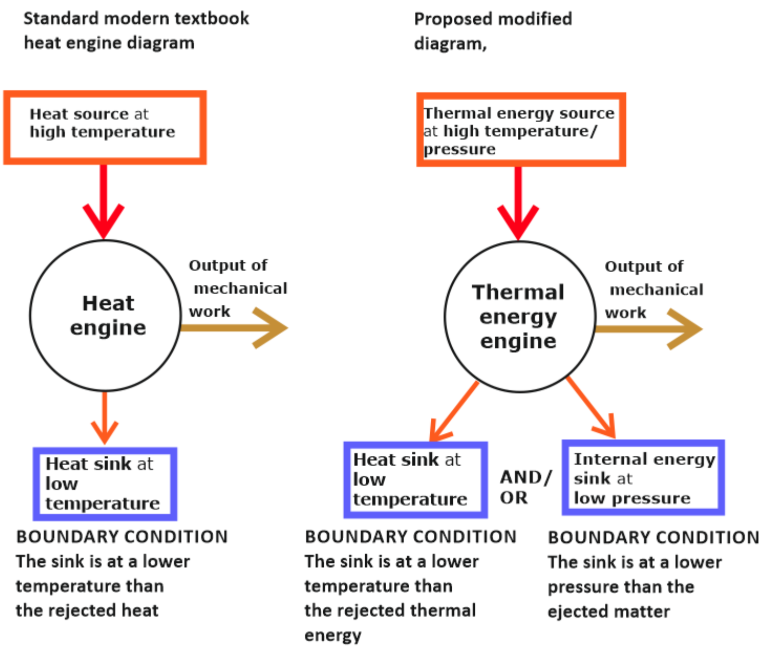


Figure 13. The term *internal energy* was first used by Kelvin in1851. So we can tentatively give this as the earliest possible date at which an *internal energy sink* might have been added to heat engine diagrams. It is possible that this did happen, but has become lost to history.

Road vehicles powered by petrol or diesel engines provide an example of a 'heat engine' that requires both types of sink.

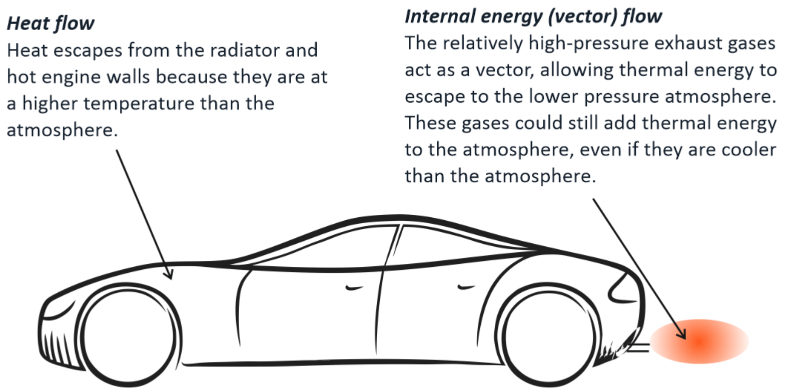


Figure 14. Internal combustion engines require heat sinks to prevent the engine overheating, but they are not required for thermodynamic reasons.
Because the exhaust gases are warm, they create the illusion of entering a heat sink.

13 Atmospheric convection current loops

Natural heat engines in the form of convection currents incorporate both heat and internal energy sinks. They rely on different parts of the Earth's surface simultaneously being at different temperatures.

Here is a coastal atmospheric convection loop at night.

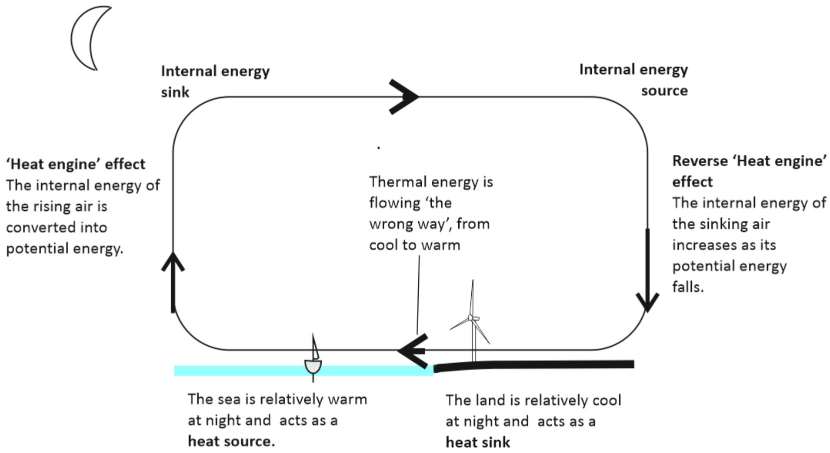


Figure15. George Hadley proposed the existence of atmospheric convection current loops in 1735.

It would be wrong to claim that the meteorologists are smarter than the engineers because they have made fewer mistakes about heat engines. It's just that from Hadley's day onwards, atmospheric convection loops have dominated meteorological thinking.
To create a mathematical model of a convection loop, it is more convenient to use the gas laws, rather than treat the atmosphere as a mechanical heat engine.
The gas laws have concepts such as the vector transfer of thermal energy and internal energy sinks embedded into them. So meteorologists can take these factors into account, while being blissfully indifferent to their engineering significance.

14 A 'Canned wind turbine' replacement for heat pumps

This 'canned wind turbine' extracts thermal energy from its surroundings in a similar manner to a heat pump, but delivers a net output of electricity. It incorporates three design features that only become thermodynamically acceptable, after the contradictions of doublethink thermodynamics have been overthrown.

These paradigm changing features are:

(i) A wind turbine that convert atmospheric thermal energy into electricity.

(ii) A converging-diverging reversible heat engine.

(iii) A compact equivalent of an atmospheric convection loop that replaces potential energy changes with kinetic energy changes.

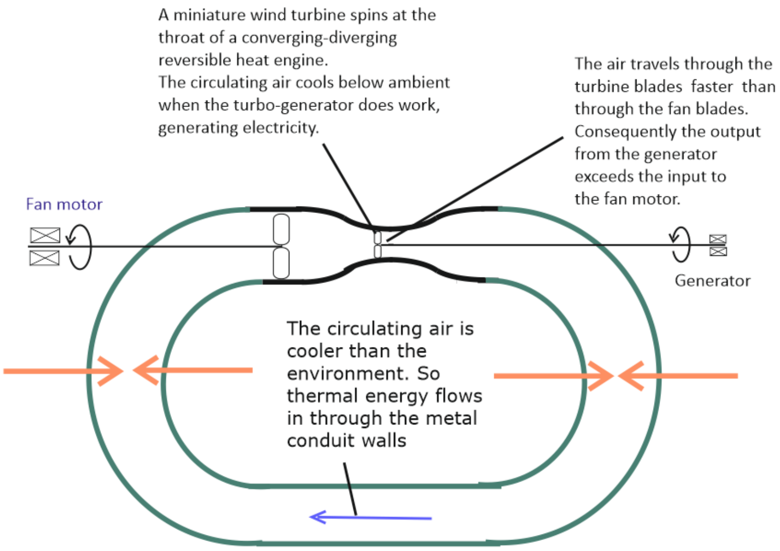


Figure16. This paradigm changing design uses the atmosphere as a warm heat source, but the rotating turbine heat engine rejects its unused thermal energy into a low temperature internal energy sink.

This is a theoretical design that need several modifications before it is commercially produced. The most important modification required will be to use differently shaped turbine blades, to cope with the cramped conditions inside the conduit throat.

This new class of power generators are referred to as Latent Power Turbines. A range of royalty free designs are suggested on the Cheshire Innovation website www.cheshire-innovation.com,

Notes on power output and cost
One of the reasons for placing the turbine at the throat of a taper is to ensure that the power output exceeds the power input to the fan.

Under ideal conditions, the ratio of power output to power input varies with the square of the air speed.

For example, if the air travels through the turbine blades three times as fast as it travels through the fan, then then the output from the generator will be nine times the input to the fan motor. To offset the difference between the input and output of electricity, thermal energy is drawn in from the environment.

In the steady state, the working air is always cooler than the environment, allowing the design to run anywhere on the planet, hot or cold. However in cool damp climates, a defrosting mechanism will have to be added to prevent the conduit icing up.

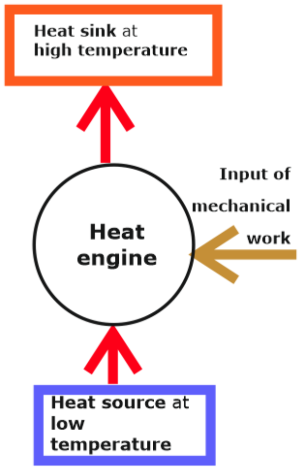
Latent Power (LP) Turbines cool the atmosphere locally, but on a global scale, they cannot be used to help us cool the planet. This is because, most of the ways we will use the electricity generated by LP Turbines will end up leaking back into the atmosphere as low grade heat.

15 Doublethink refrigerators

Refrigerators cool objects down and keep them cool, by drawing thermal energy out of them. Air conditioning units perform a similar role, but on a larger scale, cooling the air in living spaces.
The design of most of the refrigerators we use today can be traced back to 1824, when Carnot published his ideal heat engine proposals. Carnot pointed out that if his ideal heat engine was run in reverse and forced to do work, then it could be used as a heat pump for pumping heat out of a cool heat source and into a higher temperature heat sink.
Today, we credit a Carnot engine working in reverse as being an ideal refrigerator.

Here is a standard textbook diagram of an ideal refrigerator.

The Reverse Carnot engine which scientists credit with being **the'Ideal refrigerator'**



The universal acceptance of the reverse Carnot engine being the ideal refrigerator has resulted in refrigeration being done the hard way for the last two centuries.

To do refrigeration the easy way, we need to start with a new ideal model that replaces the **heat source** and **sink** with an **internal energy source** and **sink.**

Figure17. A Carnot engine working in reverse can pump thermal energy from a cool heat source to a warmer sink. Perkins built his first refrigerator according to Carnot's theory in 1834. And two centuries later, refrigerators, air conditioning units and heat pumps are still running on the same thermodynamic principles.
The climate problem with refrigerators built according to the Carnot-Perkins design is that they contribute to global warming by consuming energy that is largely produced by burning fossil fuels.

Fact check
Ask Google,
'Does the operation of fridges and air conditioning units contribute to climate change?'

This is one of the terrible ironies of doublethink thermodynamics, because as our planet gets warmer, the demand for refrigeration and air conditioning increases. And this in turn results in the release of more greenhouse gases.

In order to break out of this positive feedback loop of planetary destruction, scientists need to stop fighting against Mother Nature and learn from her instead.
As Hadley realised in 1735, nature keeps the tropics cool enough for humans to thrive by using atmospheric convection loops for shifting thermal energy away from the tropics.

Here is a small scale atmospheric equivalent of a Hadley atmospheric cell.

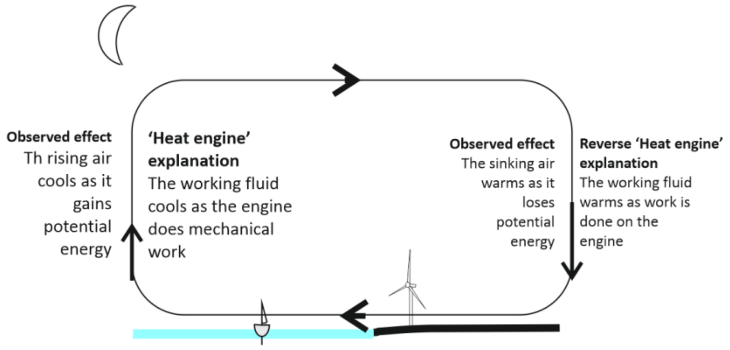


Figure18. When atmospheric air cooling is compared with the ideal refrigerator, we discover that science has fallen into another doublethink trap.
Thus, according to nature, we can build an engine that generates cooling fluid and an *output* of mechanical work at the same time.
However, according to current science, even an ideal refrigerator requires an *input of work* in order to produce cooling.

The reason why manufactured refrigerators require an input of work is that they employ heat sources and heat sinks, instead of internal energy sources and sinks.

In contrast, Latent Power Turbines emulate nature by employing both heat and internal energy sinks.This enables them to deliver an output of cooling fluid, as in a Hadley cell plus an output of mechanical work.

The following diagram shows how an insulated Latent Power Turbine can be used to cool a refrigeration box.

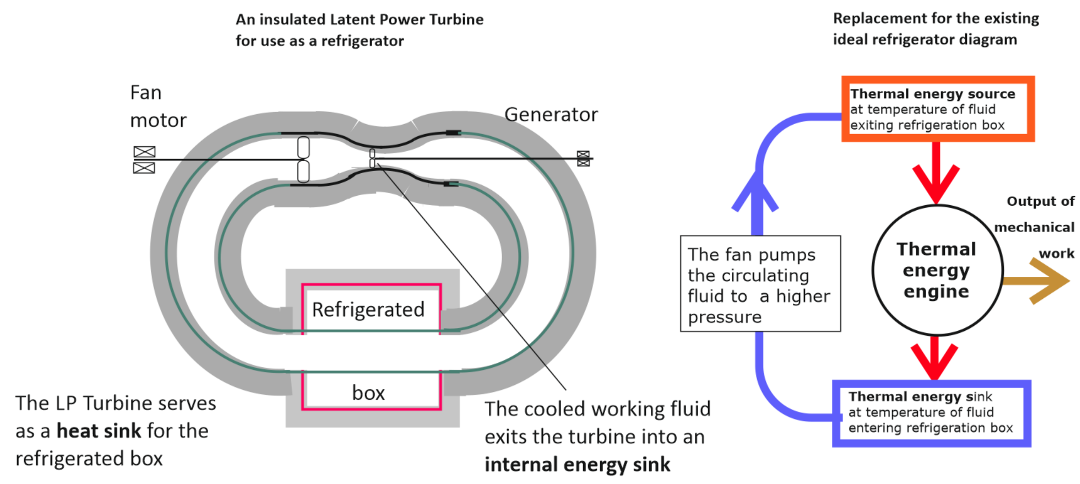


Figure19. If the system is extremely well lagged, then the refrigerated box could keep on cooling until either the working fluid starts to liquify or one of the components suffers low temperature damage.

A compact power generating refrigerator for domestic use is suggested on the Cheshire Innovation website.
Clean, low running cost refrigerators - Cheshire Innovation

Implications for the second law of thermodynamics
In its simplest form, the law still stands, but its definition in terms of entropy could be misleading for practical purposes.
Thus, the following statement remains valid:
'The second law of thermodynamics tells us that thermal energy can only flow from warm to cold, unless it is carried by a vector'.

However, the following statement may require qualification to make it more useful:
'The second law of thermodynamics tells us that in any isolated system, the total entropy will increase over time, unless it is operating under ideal conditions'.

For example, a lagged Latent Power Turbine arrangement can be described as an isolated system, provided that it is encased in ideal thermal insulation.

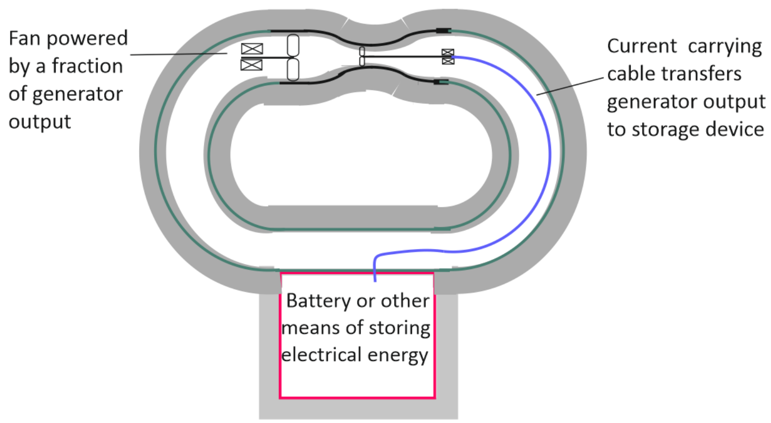


Figure 20. Under ideal insulation conditions, the entropy of this isolated system will decrease with time until low temperature damage brings electricity production to a halt.

This experimental arrangement has too many flaws to provide proof that the increased entropy version of the second law has fallen.

Nevertheless, it reduces our level of confidence in this version of the second law.

16 A lesson from fiction

I have been struggling to persuade my fellow scientists to abandon doublethink thermodynamics for the last sixty years and obviously, my time is running out. Yet I am still hopeful.

Just as in Hans Christian Anderson's story of the King's invisible clothes, it will only require one respected influencer to question the hubris of climate change scientists, for the whole rotten edifice of doublethink thermodynamics to come tumbling down.

17 Some speculative historical consequences of doublethink thermodynamics

By the 1860s, the first heat pumps that run on atmospheric thermal energy were in use.
It had also become technically possible to build 'canned wind turbines' or similar power generators for converting atmospheric thermal energy into clean electricity.

But, thanks to doublethink thermodynamics, fossil fuels are still dominating the energy markets today.

Clean energy alternatives have been around for a long time, starting with the first hydroelectric scheme in 1878, the first wind turbine in 1887 and the first commercial solar panel in1956. Unfortunately, none of these technologies offer the 24/7 reliability of fossil fuels.

But it didn't need to be this way.
If scientists had not fallen into the doublethink thermodynamics trap, we could have been generating cheap clean electricity since the 1860s, with the human desire for cheap energy incidentally driving us to net zero carbon emissions by the 1890s or earlier.

In addition to escaping climate change, several other great tragedies of the modern world could have been avoided.
The nineteenth century colonial system developed in tandem with industrialisation because Europe and North America had the massive coal reserves required by industry. But the tropical countries had the bulk of the raw materials that industry required.
However, if 'canned wind turbine' electricity had been available from the 1860s onwards, it would have been far cheaper to shift manufacturing to the tropical regions. And, as a bonus, extracting thermal energy from the air would create cool dehumidified air as a by-product. This would allow tropical factories to offer the productivity benefits of cooler climate working conditions.

Industrial investment would have shifted to the tropics and the high costs of colonial administration avoided.

Thus, by 1914, the jingoistic nationalism of the imperial European powers would have been in retreat, and there would have been no incentive for the clash of the imperial powers in the First World War.

And, without the First World War, there would have been no Second World War, no holocaust and little incentive to invent the atom bomb.
The colonial system could have ended at least half a century earlier, with cheap energy based prosperity replacing poverty and economic migration from the tropics.

If we want to prevent doublethink thermodynamics causing yet another catastrophe for humanity, then the way forward is simple. Scientists need to confront their hubris and add an internal energy sink to their ‘heat engine’ diagram.

Bill Courtney (Scientist)