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Submission details

I am making this submission as	A resident in a bushfire-affected area
Submission type	I am making a personal submission
Consent to make submission public	I give my consent for this submission to be made public

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Your story

This 4172 word article presents interesting facts and figures relating to the recent fires and to forest and fire management generally. It puts forward an alternative to large scale controlled burning of forest as a means of reducing fire risk and intensity. The author has lived in the Eurobodalla region for nearly forty years and is quite familiar with local forests and their tendency to burn. In the recent fires, his own house was saved at the last minute by a timely wind change although half his land was severely impacted.

THE REAL COST OF THE BUSH FIRES.

The sheer scale of Australia's recent bush fires might have shocked the whole nation but comes as little surprise to those who reside adjacent to forest and have witnessed the climatic

and geographic abnormalities that contributed to what is undoubtedly this country's greatest natural disaster. As well as affecting many communities directly, the broader financial implications and the immensity of the recovery task have left many people floundering.

When the fires were officially extinguished the estimated cost was in the vicinity of five billion dollars and is still rising. That figure was based on the values of buildings destroyed, loss of stock and trade, damage to machinery and fencing, emergency services, diminished tourism, insurance payouts, health effects, food distributions, cancellations, government assistance packages and direct expenses involved in fighting the fires. The loss of power and customers has left many small businesses struggling. Some may never recover.

However the monetary cost pales to insignificance when compared with another hidden loss that nobody even considers. It concerns energy, natures own economic yardstick, the significance and distribution of which have been dramatically altered in a few short weeks.

When an area of bush is burned, organic material is converted into carbon dioxide along with large amounts of steam, smoke and heat. A calculation of those amounts reveals a few surprises. Dry wood and leaves are known to have about the same calorific value as the average coal, around 21 mega-joules per kilogram (or, in more familiar terms, about 6 kilowatt hours (kwh) per kgm). A bucket full of crushed gum leaves, weighing about two kilograms, contain 25% more chemical energy than a litre of petrol, worth $1.40 (temporarily much less). A green bin full would drive a steam car from Sydney to Canberra. Pure Eucalyptus oil is comparable with diesel, generating around 9.5 kwh/litre, and has been blended with the latter to improve performance. Its vaporization and ignition in a bush fire is largely responsible for the fast moving and very high temperature sheets of flame that incinerate everything in their paths.

The amount of litter that builds up in a typical east coast forest ranges from about twenty to fifty tonnes per hectare. Because of the extreme conditions, the recent fires became sufficiently hot to annihilate everything at ground level plus most of vegetation in the under storey and canopy. A conservative estimate of the average dry mass consumed in this case would be sixty tonnes per hectare although the true figure could easily be more that double that in some places. At that rate, the combustion of the estimated 5.4 million hectares burned in NSW alone would have annihilated 324 million tonnes of organic material and generated a staggering 1.95 TRILLION kwh of heat energy, worth some 390 billion dollars retail and more than three times Australia's combined annual electricity and vehicle fuel energy bill...and this is a low estimate.

Overall, it is likely that energy valued at nearly Australia's annual GDP has just literally just gone up in smoke, maybe $30000 for every man woman an child,. Also produced was about 1.2 billion tonnes of CO_2 as well as plenty of steam and a variety of other substances, some toxic.

These are not just figures plucked out of the air to impress. They are simple scientific facts that any year twelve science student could calculate. If the reader cannot comprehend such magnitudes and their significance, then have them checked and explained. (Approximate figures and calculations are given below)

That is not the end of the story. The heat generated does not simply go away. It warms the air and has nowhere else to go. Air doesn't cool down like a cup of coffee will. Some of the heat blows over to New Zealand and mixes with cooler air but a lot hangs around like the smoke and carbon dioxide and inhibits the formation of rain clouds. The smoke itself absorbs sunlight which puts even more heat into the upper atmosphere. A calculation shows that the amount of heat produced by the recent fires was enough to warm the air over the whole of NSW by at least one

degree possibly two, seriously reducing the likelihood of rain.
In the analysis of this massive fire event, much discussion and controversy will inevitably ensue. Fire fighters will be commended for saving many properties during extreme weather conditions even though their best attempts to contain the main fires were continually hampered by the strong winds and abnormally dry state of the vegetation. There will be much enquiry along with many questions and suggestions as to how such calamities might be avoided in the future. Unfortunately, the age old recommendation for more controlled burning will inevitably reappear.
That is certainly not the answer as the figures show. Whilst its simplicity might appeal to the pyromaniacs of this world and reduce firefighter boredom during quiet months, it is totally destructive of the local biosphere and pours many millions of tonnes of unwanted substances into the atmosphere for no return. The controlled burning of just one hectare of mature eucalyptus forest will consume about thirty tonnes of dry litter and generate one hundred and eighty thousand (180000) kilowatt hours of heat energy, worth $36000 retail, (assuming 20c per kwh). That is equivalent to scattering 360 one hundred dollar bills over the ground and setting fire to them. Nobody in their right minds would do that yet there are calls for around one million of those hectares to be deliberately burned every year for fire mitigation purposes...even though, as one fire chief recently put it, “no amount of controlled burning would have prevented these fires”. Australia cannot afford to throw away thirty-six billion potential dollars each year in such a thoughtless manner.
Controlled burning programs allow bewildered governments to appear to be doing something useful when in fact they are only exacerbating the overall problem. It is a self defeating and environmentally disastrous practice, rather like deliberately setting fire to a huge oil storage complex just to prevent it from catching fire later and then refilling it. The whole principle of ‘fighting fire with fire’ might have worked reasonably well five thousand years ago but the adversary has recently acquired a powerful new ally, climate change, which will increase the frequency of severe drought and the likelihood of uncontrollable bushfire, whether natural or deliberately lit. There is a high possibility that the persistent small scale burning of the world’s forests has been a major contributor to greenhouse gas emissions. It is an incredibly naive and wasteful tradition that should be kept to an absolute minimum if not eliminated altogether. A complete rethink of the whole approach to forest security and fire management is required.
In Australia right now, there is a drive to reduce greenhouse gas emissions and increase renewable energy production. The government has set up a 'Renewable Energy Agency' and 'Bio energy Australia' whilst a recent Select Senate Committee emphasized renewable energy schemes when considering 'Jobs for the Future in Regional Areas'. Nowhere has the intelligent usage of non-essential forest material been seriously considered, even though typical annual 'hazard reduction' burns, including indigenous practices, produce nearly as much CO2 as our whole motor vehicle fleet and waste as much valuable energy. The recent hot fires more than quadrupled Australia’s total annual CO2 emissions from all causes...so much for attempts to set future goals.
It is obvious that a lucrative new industry is urgently needed. The fallen forest litter commonly referred to as 'fire hazard' is actually a valuable renewable resource, worth about as much as coal by weight and far easier to harvest, particularly in State Forests and on private land. Most of the material earmarked for controlled burning should instead be selectively collected, dried, stored and utilized constructively. It is completely free, just sitting neatly on the ground, inviting someone to pick it up and cook their lamb chops with it or heat their pools. Australians in their ignorance simply set fire to it because that’s easier and is something that

tough men have always regarded as a natural right. The practice is somewhat justifiable on the grounds that it is currently the only effective way to safeguard property and also that it has been used for millennia by the original inhabitants. Some might add, however, that the element of pyromania which naturally afflicts many people originating from cold climates could also have something to do with this. Watching fire can be comforting, fascinating and maybe even addictive.

It is a principal aim of this article to explain in precise scientific terms why controlled burning is so damaging to the environment and wasteful of money and job opportunities. In many parts of the world, bio-fuels are routinely used for the co-generation of both electricity and hot water. Australia is in a perfect position to similarly exploit much of its forest surplus and in a way that will reduce fire risk without seriously affecting natural ecosystems. It is suggested here that substantial and strategically selected strips of forest be kept reasonably free of fallen litter and unimportant vegetation using mechanical means, whilst leaving enough debris on the ground to protect the environment. In complete contrast to burning, mechanical harvesting would do what is required without months of carcinogenic, tourist repelling smoke pollution and at the same time preserve valuable topsoil, ground habitat and the wide range of organisms that make up what is essentially the 'engine room of the forest'. The preservation of remaining wildlife would be top priority. In that way, State Forests could be relieved of much flammable regrowth and the perimeters of National Parks and residential areas would be quite well protected from fire without losing their functionality or amenity.

Naturally, the whole process would be somewhat labour intensive and would require considerable planning but would normally take place in regional localities where unemployment is a traditional problem. Teams of workers made up of volunteers, the unemployed, anyone short of a dollar and even low risk prisoners could be transported into State Forests each day, armed with rakes, chainsaws, bobcats, trucks and snake bite kits and paid accordingly for a good day's work. Maybe petty fines could be swapped for a few days' service cleaning up the bush. Portable campsites could be set up. Contributing to society in healthy, natural surroundings would give participants a sense of self worth and assist with their rehabilitation. The use of contractors would also be an option. Some R&D would be necessary but surely Australia's innovators would welcome the challenge of devising appropriate machinery or finding ways to feed atomized leaf powder into gas fired turbines without clogging them up. Since plant material is already used to produce paper, cardboard and denser materials like pine board, turning it into a convenient and safe fuel should not be too difficult.

It is high time one of our financially fixated governments showed some technical initiative and established this much needed multi-billion dollar industry, particularly with unemployment now running at such a high level and manufacturing almost non-existent. Overall control could be placed in the hands of an appropriate government department with groundwork managed jointly by the Rural Fire Service and indigenous advisers, along with considerable technical and scientific input from research institutions like CSIRO. Many jobs would be created. If the Federal Government can afford 52+ billion dollars to pay for ten totally useless submarine death traps that appear increasingly unlikely to ever become a reality and even more unlikely to ever fire a torpedo in anger if they do, then surely it can afford to hand out a few million to set up this national necessity.

Opponents to such a scheme might base their arguments on its commercial viability, its effectiveness as a fire inhibitor or the fact that building power stations near any of Australia's National Parks would amount to environmental vandalism. They might also question whether the damage caused during collecting would be any less than that from burning. They should be duly

reminded that the material will likely be burned anyway so better to remove it in a clean way that replaces coal. It should also be pointed out that the original inhabitants were hunter gatherers who lit only small fires to clear areas for hunting purposes. Even when and if the pro-fire lobby does get its way, as it usually does, it would be blatantly senseless to deliberately set fire to significant areas without first collecting as much valuable litter as possible. Dry eucalyptus leaves and the like produce a great deal of heat, minimal smoke and constitute an ideal, renewable and environmentally friendly fuel. There is a great deal of money at stake...as well as CO2 and jobs.

Southern Australia experiences quite cold winters and those who live there would welcome any scheme that provides cheap electricity and space heating derived entirely from renewable local material. For instance, a 50000 litre tanker filled with directly heated water would warm a whole supermarket for a fortnight at about one twentieth the current cost, using less than a tonne of leaves. A standard 1.2 megawatt electric generator with an efficiency of 0.33 would consume about fourteen tonnes of dry forest litter per day and produce about the same electrical power as three large and ugly wind turbines, enough for 25000 people. The direct heating of water and air is a particularly efficient way to use the heat from fire and future town planners should consider that fact when designing new building complexes. Whole townships could have cheap central heating and their own heated pools (even ancient Rome had those), fuelled entirely by some of the thirty-six billion dollars worth of material that is currently turned into smoke and CO2 each year. Energy-wise, Australia has been very poorly planned right from the start. It is time for a change.

Collecting the material would no doubt be difficult in some areas but the overall benefits would well justify considerable government subsidizing of the harvesting process if necessary. An inspection of the now fire ravaged forests provides a few clues as to how it might be done. Most noticeable, even in National Parks, is the unnatural uniformity of the existing vegetation and the almost complete absence of old growth. After two hundred years of indiscriminate logging, just about every original tree has been replaced by a sickly array of maybe twenty or thirty spindly saplings, all of similar height and all competing strongly for moisture and sunlight. The dense regrowth of Acacia and Eucalyptus that shoots up after clear felling is particularly flammable. The recent drought resulted in an abnormally dry canopy which was prime target for lightning strikes and consequent crown fire. No amount of controlled burning would have prevented the disaster that followed.

Wood is a very convenient renewable resource and there is nothing wrong with cutting down trees in a sustainable way. Sadly however, the seemingly incurable avarice of Australia's timber industries has completely altered the character of our forests and created a monster. One can drive all day through the now blackened forests of Eurobodalla Shire without seeing one tree that was alive in 1788 (although several do apparently exist). Even before the fires, State Forests had become bleak, sterile and unfriendly places, their once colourful array of flora and fauna having already given way to unnatural vegetation that reeked of past over-exploitation and destruction. After the fires, there is nothing left but bare ground and blackened trunks, many of which are too closely packed to ever reach maturity. There are plenty of areas where nine out of ten saplings could and should be harvested, not only to provide good fuel and reduce potential fire intensities but also to increase the growth rates of remaining trees. There are also far too many trees lining the sides of roads in Eurobodalla right now. These are mainly on council land and have little or no ecological value. They are a serious fire hazard and should be removed and used to heat local town CBDs.

Even worse is the fact that in the whole S.E. region, habitat trees (those with hollows) were already very rare and most that did

exist will have now falling victim to the latest fires. This is particularly concerning since in previous times, those trees were home to the wide variety of birds and mammals whose regular actions converted otherwise flammable ground litter into nutritious and moist topsoil. Australia's most efficient leaf composter, the Lyrebird is now a delicacy of foxes, domestic dogs and feral cats. Most of our native animals will never reappear since the old and dead trees that once brought life and shelter to the forest have gone forever. Controlled burning and subsequent 'mopping up' have undoubtedly resulted in much of the species extinction that has occurred in Australia.
Many National Parks in the S.E. were also previously logged and are currently revealing an inability to adjust to rapid climate change. About eighty percent of park area has just been decimated, together with most of the wildlife that lived there. All such forest reserves contribute to the habitability of this planet and it is clear that considerable human intervention of the right type is now needed if they...and we...are to survive. They are valuable assets that deserve the security of a bank vault but currently have virtually none. Even though our National Parks are large, it might be possible to tighten security and limit access in order to reduce the risk of arson. Even the use of security cameras might be worth considering. Pine plantations, the backbone of Australia's immigration driven home building industry, are another matter altogether. They look green enough but these fire vulnerable mono-cultures have probably done more harm to Australia's native forests than anything else. Many people would rate the introduction of the Radiata pine alongside that of rabbits, cane toads, Kikuyu grass and White Man's money.
The energy tied up in the world's forests does not lie idle. It is being continuously used to not only maintain the forests themselves but also to cleanse the atmosphere and restore oxygen levels. Every tree has a considerable value as an oxygen factory. It costs about two dollars to manufacture one kilogram of oxygen using electrolysis yet a single large tree will continually produce enough for maybe ten humans, completely free of charge. The figures below reveal that the return from a single hectare of forest as an oxygen producer could easily be in excess of ten thousand dollars per year. The recent loss of Australia's vegetation, on top of widespread burning of the Amazon and the drought in South Africa will have profound implications for the climate of the whole Southern Hemisphere, including its oceans. It remains to be seen what the future holds.
Australia's native flora and fauna have no official monetary value and will not be included in assessments of fire damage even though every species plays an important part in the overall forest ecology. Healthy forests are vital for a healthy planet yet to an economist, a hectare of natural bush is completely worthless. If cleared, however it might generate a million dollars for its owner and the nation. To a hunter-gatherer, the opposite is true and cleared land has little or no intrinsic value. No wonder 'conservation' has become a dirty word in some circles. It is a direct barrier to the creation of wealth.
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Some approximate figures, see for instance https://www.engineeringtoolbox.com/co2-emission-fuels-d_1085.html:

Heat of combustion of dry leaves (with some oil), etc. = 21.6 mega-joules/kgm. = 6 kwh/kgm = 6000 kwh/tonne.
Eucalyptus oil : around 11000 kwh/tonne.

For recent fires:
Assume that 60 tonnes dry litter per hectare was burned.
For each 1 million hectares:
Amount of dry organic material consumed = 60 million tonnes.

Heat liberated by fire = 360 billion kwh.
At 20c per kwh, its value = $72 billion.
CO2 production = about 120 million tonnes.(assuming 2:1)

(NSW is estimated to have lost about 5.4 million hectares in the fire)
For 5.4 million ha., 324 million tonnes were burned,
Energy lost is about 1.95 trillion kwh
value of lost energy = $390 billion @ 20C per kwh.
CO2 produced = 650 million tonnes.

(Australia-wide, the burned area is estimated at >10 million Ha.)
Energy lost = 3.6 trillion kwh, worth $720 billion.
CO2 produced = 1.2 billion tonnes.

Those are conservative figures.

For Control burning of 1 million Hectares, assume 30 tonnes is burned per hectare (or 30000 kgs):
Burning 1 hectare produces 30x6000 = 180000 kwh of heat energy
That has a retail value of 36000 dollars
For 1 million Ha, Heat liberated = 180 billion kwh.
Retail value = $36 billion. (Totally wasted)
CO2 production = 60 million tonnes.

Australia's motor vehicle fuel consumption = 35 billion litres per year (about 28 million tonnes per year or 4 litres per person per day).
Its energy content @ 9 kwh/litre = about 320 billion kwh

Australia's annual electricity consumption = 280 billion kwh (about 1.15 kwh per person per day.)
(The fuel needed to produce that is far more than that figure, say 900 billion kwh.)
Total mass of coal and gas consumed => 140 million tonnes , (a fair estimate).
Total consumption (vehicle and electric) = about 600 billion kwh per year.
CO2 production from vehicle fleet => 80 million tonnes.
CO2 production from coal and gas: => 400 million tonnes.

Heating of the atmosphere:
For Air:
Specific heat, Cp = 1 Kj/kg/Cdeg = 10^6 j/tonne/CDeg or ¬ 2.8 kwh/tonne/Cdeg
Density at sea level = 1.25kg/m3 = 1.25e9 kg/km3 = 1.25e6 tonnes/km3

Mass of Earth's atmosphere = 5.1e15 tonnes.
Area of Earth's surface = 5.1e8 km2
Area of NSW = 8e5 km2.
Mass of air over NSW = 7e12 tonnes
Energy needed to raise that amount by 1 degC = 2e12 kwh.
Burning six million hectares @ 60 T/ha = 360 million tonnes and produces 2.16e12 kwh.
That is enough to heat the air over whole of NSW by more than 1 degC.

A 3.6 megawatt generator produces 1 kwh every second.
That is: 86400 kwh/day. ..enough for 75000 people.
If efficiency = 1/3, 3 kwh worth of fuel must be burned every second. That is, 0.5 kilo of leaves every second...or 43.2 tonnes every day.
A 1.2 megawatt generator would consume about 14 tonnes of fuel per day. It would produce about the same power as 3 large wind turbines, enough for 25000 people.

Production of oxygen, (density = 1kg/m3):
Using electrolysis of water, 1 kg O2 requires about 6.3 kwh of electricity.
Average human consumes about 0.4 to 0.9 kg of oxygen per day. (say 150-320 kg per year)
At a kwh value of $0.2 per kwh that amounts to about $200-$450 per year per person.

The following quotes vary widely and are inconsistent. True figures are hard to come by:

(One hectare of trees, (1000 trees) will produce enough oxygen for upwards of 40 humans. Return = $8000-$18000 per year.
(A single mature tree can absorb carbon dioxide at a rate of 20 or more kgs per year and release enough oxygen back into the atmosphere to support between two and ten human beings.'
(The mean net annual oxygen production (after accounting for decomposition) per hectare of trees (100% tree canopy) offsets oxygen consumption of about 4 to 18 people per year, depending on amount of sunlight. High sunlight, considerably higher.'
(One hectare of trees annually consumes the amount of carbon dioxide equivalent to that produced by driving an average car for 65,000 miles. That same hectare of trees also produces enough oxygen for 45 people to breathe for a year.'

Direct water heating.
Specific heat of water is 4200 joules/kgm/Cdeg.

50000 litres of water at 96C loses 294000 x 50000 joules cooling to 26C
= 14.7e9 joules = 4083 kwh.
Value @ 25c per kwh = $1021

That would supply 20 kw of heat for 204 hours.
Heating the water would require less than one tonne of leaves.

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Terms of Reference (optional)

The Inquiry welcomes submissions that address the particular matters identified in its Terms of Reference.

1.4 Any other matters

My article is also available here:
www.scisite.info/articles/firefacts.docx

Supporting documents or images