FLASHPOINT

NZ INSTITUTE OF HAZARDOUS SUBSTANCES MANAGEMENT

Winter 2018

Plastics: Disaster or opportunity?

USEFUL ORGANISATIONAL CONTACTS

NZ Institute of Hazardous Substances Management
(formerly the Dangerous Goods Inspectors Institute)
www.nzihsm.org.nz
The official home of professionals committed to the safe management of hazardous substances and dangerous goods. The NZIHSM is a 'not for profit' industry association whose goal is to protect people, communities, and the environment against the adverse effect of hazardous substances, while maintaining the benefit of these.

Responsible Care NZ
Box 5557 Wellington 6145
Responsible Care NZ works with industry partners to implement the Hazardous Substances legislation.

Worksafe (MBIE)
www.worksafe.govt.nz
Government agency formed to povide compliance advice and enforcement of hazardous substances. Responsible for hazardous substances certificates.

EPA
www.epa.govt.nz
The EPA administers the HSNO Act and supplies extensive information on working with hazardous substances.

Ministry for the Environment
www.mfe
The Ministry provides policy, publications, technical reports and consultation documents on HSNO legislation.

Department of Building and Housing
www.dbh.govt.nz
The Government agency that maintains the Building Act and the Building Code.

Local Government NZ
www.lgnz.co.nz/lg-sector/maps/
Local Authorities have responsibility for policing building controls. Some local authorities are contracted to Department of Labour to provide enforcement of hazardous substances legislation. Often a first response point with valuable local knowledge.

Government legislation
www.legislation.govt.nz

If you know of other agencies which could be useful to members, please let us know at office@nzihsm.org.nz.

President's column

All in this together!

It is interesting times at present, with our government taking due recognition of our Paris commitments along with most of the rest of humanity.

However, we humans have changed the world generally to our advantage amazingly in the past 500 years, by mastering chemicals, although with a few 'side-effects' that we are now also addressing.

In this edition of Flashpoint there is an interesting summary of the recent NZ Productivity Commission's report, which shows a significant change in government thinking to try and rectify some of the changes that we have made. Along with this are a number of interesting and sometimes competing articles on the different views of current concerning issues under:

(i) Plastic recycling issues and how it degrades once disposed?
(ii) Alternate view under "like coal"?
(iii) Future sustainable Energy options including needs for more electricity.
(iv) Report on successful NZIHSM seminar and current certifier issues.

There are also the usual ramblings from our Editor and Archie's lot and some new compounds to help us all that are being discovered in the NZ bush.

Overall an interesting read, and if any of our readers wish to have an opinion, by all means send an article to our Editor at editor@nzihsm.org.nz so that ALL of us can positively contribute to a great future.

Best regards

John Hickey
Chemical engineer/
Certifier
NZIHSM president

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Plastics:

Brave decisions pending for law makers

Despite the Government's best intentions and supermarkets mounting campaigns to rid us of the ubiquitous plastic bag, it and its drink bottle and other cousins will be with us for a while yet.

The agricultural sector is getting better at doing its bit through a couple of nation-wide recycling endeavours that turn triple-washed chemical containers and other farm-used plastics into useful 'afterlives' such as underground electrical wire covering, which hints at the fact it doesn't break down easily when buried.

Apparently the average supermarket bag gets 12 minutes of use before being discarded, but they actually hang around for over a century.

Plastics can be divided into two distinct categories on the basis of their chemical composition. One category is made up of polymers having only aliphatic (linear) carbon atoms in their backbone chains. They are represented chiefly by polyethylene, polypropylene, polyvinyl chloride, and polystyrene.

As a result the decomposition products for most plastics are carbon and hydrogen – the 'building blocks of life', to be expected where they are derived from oil, which in turn comes from breakdown of oganic matter. Left alone, these would naturally decompose, but the engineering of the chemical chain to produce the various types of plastic is what slows up the whole process, and in some cases, produces toxic components.

The other category of plastics is made up of heterochain polymers. These compounds contain atoms such as oxygen, nitrogen, or sulfur in their backbone chains, in addition to carbon. These can be a bit trickier in that added chemicals (eg: halides) can lead to some toxicity.

Victoria University's Joanne Harvey (pictured below) explained that most bags picked up in New Zealand shops will eventually break down,. The right combination of microbes, sunlight and composting are required, but most of the conventional bag we use in New Zealand will take a century to vanish, because they don't experience the optimum conditions for breakdown.

This compares to 1-2 years for a compostible plastic bag to break down in soil and 1-2 months for a paper bag to breakdown in soil. A little sting in the tail here, though, is what chemicals have been used in the paper bag construction that can be released during breakdown.

The breakdown has its own problems as smaller pieces of plastic will more easily find their way and thence to acquatic life where their devastation is dramatic.

What to do?

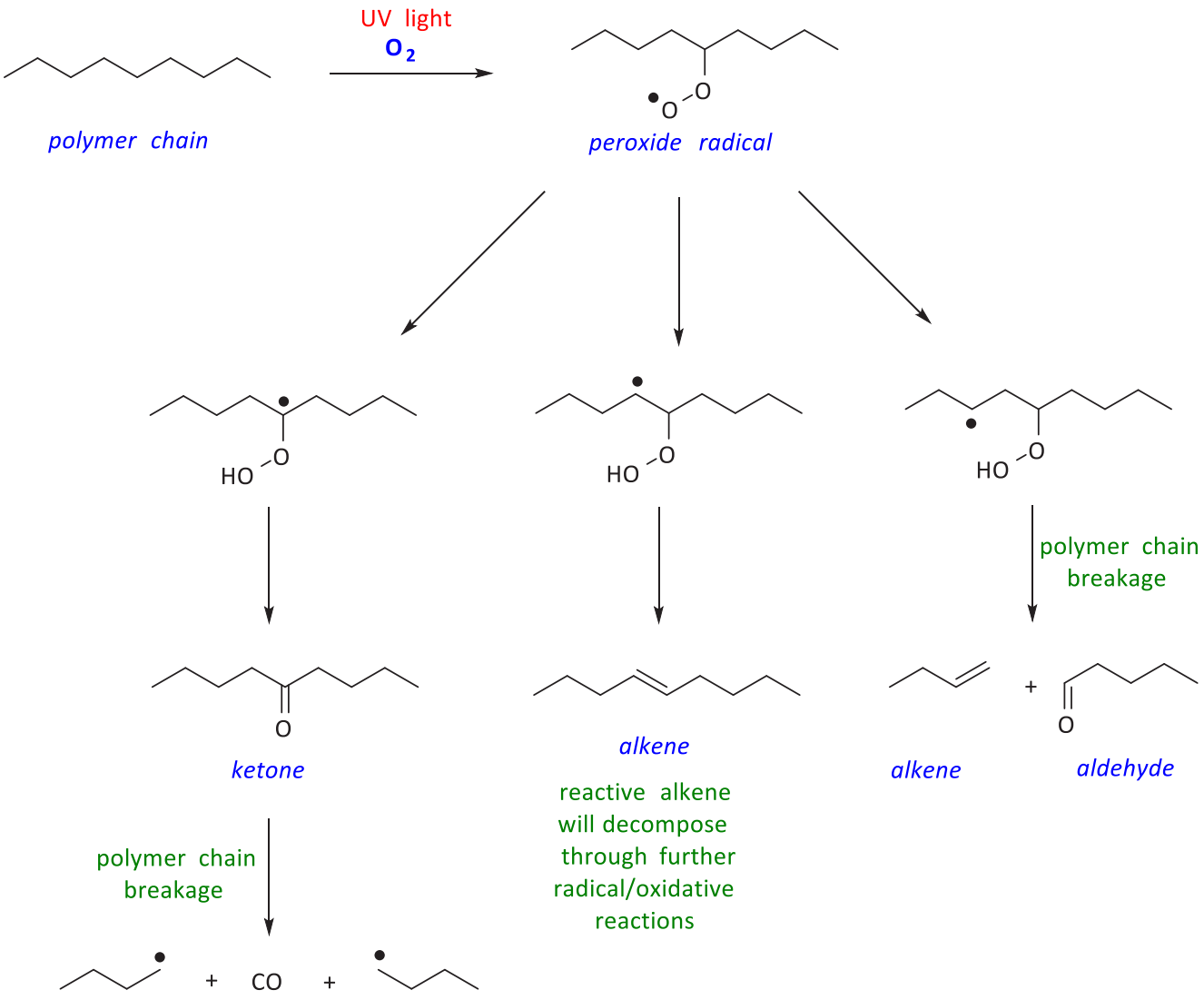
So having created this monster, what do we do with it? Burning

Plastics breakdown requires specific conditions, says Dr Joanne Harvey of Victoria University's School of Chemical and Physical Sciences. See following page for Joanne's stylised degradation mechanism of LPDE plastic.

Polyethylene degradation

Mechanism of polyethylene chemical degradation:

- Sunlight and oxygen produce peroxide free radicals on the polymer chain
- The radicals break down to form ketones and alkenes, which are reactive groups
- Ketones fragment into CO and radicals; alkenes will ultimately fragment similarly
- The diagram below shows some of these photo-oxidative processes that lead to photo-degradation of polyethylene plastics (note that the real situation is much more complex than this)
- The diagram describes on the molecular level (chain breakage) what manifests itself on the macroscale (plastic tearing and fragmenting)



Evidence of the photo-degradation process and mechanism shown:

- Ketone/aldehyde and alkene functional groups have been observed by infrared spectroscopy to form upon prolonged exposure to sunlight (significant quantities visible by 6000 h exposure)
- Tearing occurs in plastic in regions of high carbonyl density after 10,000 h; if we assume 6 hours of sunlight per day, that is equal to 4.5 years

Prepared by Joanne Harvey, September 2018.

it only creates poisonous polymers for us to breathe in, so some smarties and lateral thinkers turn the plastics' indestructible qualities into benefit and create melded plastic structural building blocks.

A Costa Rican design centre takes mixed dirty plastic, turns it into clean pellets and uses that as aggregate for high quality building blocks and other construction materials. Others have developed technology to extrude construction beams from used plastic.

New Zealand-based inventor and engineer, Peter Lewis has produced the Byblock which turns compressed plastic bottles, bags, whatever, into the equivalent of the standard concrete block used in a lot of commercial construction, slotted around reinforcing rods and filled with sloppy concrete.

His company says the product is stonger and lighter than brick, has huge sound and temperature insulation properties, requires no glue or adhesives and has 95% lower greenhouse gas emissions than concrete blocks and dos not crumble unde pressure.

The blocks are created by super-heating shredded plastics and compressing them into the desired shape. They are then covered in whatever the houseowner desires in way of a skim coat. One assumes fire retardant is used in addition to the plaster.

The blocks have been used to construct low-cost housing in Hawaii, but it might take a while for the New Zealand regulation regime to get its head around it.

Peter Lewis' Byblock fusion invention turns bags of plastic waste into the equivalent of the standard concrete building block.
Photo: *Otago Daily Times*

Whatever the future for the humble plastic bag becomes, it will take some brave legislation by governments to achieve.

The point is that if the plastic is here to stay, we may as well use those very durable properties in a constructive way (no pun intended!) instead of just filling rubbish dumps, or feeding the fish with it.

So will we let plastics be the new environmental disaster, or push our imaginations and grab this opportunity with both hands, creating something new from a load of old rubbish?

Editor's snippets

An interesting fact

Approaching 100,000 chemicals are used in workplaces worldwide. Barely one in a 100 has been thoroughly tested for health risks. Over 50 substances are rated by the United Nations' International Agency for Research on Cancer as a definite or probable cancer risk at work. Over 100 more are IARC-rated as a possible cancer risk.

Exercise can be bad for your health!!

Stirling University research suggests that sports stars, amateur players and ground staff could be at risk as a result of a 'remarkable' lack of occupational health checks on the effects of rubber crumb pitches, a study has found.

Britain: Furniture firm exposed workers to carcinogenic wood dust

A Hertfordshire furniture manufacturer was fined after exposing its employees to significant quantities of hardwood dust, a hazardous substance known to cause occupational asthma, nasal cancer and which has been linked to lung cancer. The Court heard how employees in the company's workshop were exposed to hardwood dust on a daily basis.

USA: Solvent defended

Seventeen workers dying in the US between 2000 and 2015 isn't enough to convince the methylene chloride industry that more is needed than just labels on a can to prevent the needless deaths of worker stripping bathtubs.

Instead legal representatives of a solvents industry lobby group say the Environmental Protection Agency's proposed ban on methylene chloride – also known as dichloromethane - as a paint stripper is a "blatant and raw power grab" of the authority that Congress gave the Consumer Product Safety Commission. Defending the indefensible?

Global: Deadly jeans fade out of fashion

Two major multinationals have agreed to end sandblasting denim jeans, a practice that has led to deadly lung disease in garment workers. ITGLWF, the global union federation for the sector, welcomed the announcement by Levi Strauss and H&M. Ever wondered how they got that stone-washed look?

China: Apple supplier hit by poisonings protest

Workers at a Chinese factory that supplies Apple touchscreens smashed vehicles and factory facilities last week in a protest over safety and pay. The *China Daily* reported that the more than 2000 workers were involved in the protest at the United Win (China) Technology Ltd factory where they say there have been deaths from over-exposure to n-hexane, a toxic solvent used to clean the screens. Reminiscent of the reaction to job losses, with the introduction of machinery into factories at the start of the industrial age in Europe.

Why house work is to be avoided!

A university in Norway has found that regular exposure to cleaning products significantly effects lung function. Cleaners who fell ill at a Torquay hospital after being exposed to a hazardous disinfectant were awarded £70,000 in damages. The 22 cleaning staff, began using the disinfectant seven years ago, and experienced runny eyes, nose sores, and wheezing coughs.

Are you nuts on nuts?

The following is an interesting food fact might just change your mind. The sale of raw apricot kernels is prohibited in many countries. Apparently there have been reports of cyanide poisoning from eating raw apricot kernels in Australia, New Zealand, and elsewhere. The kernels contain cyanogenic glycosides that can convert to a type of cyanide when eaten.

An unusual cause of fire

A chemistry laboratory in a university suffered significant fire damage when roof tar leaked through the roof on a hot day igniting flammable materials within the laboratory.

Beware of Greeks

Draco, an Athenian lawmaker, was reportedly smothered to death by gifts of cloaks and hats showered upon him by appreciative citizens at a theatre.

Dung dash did for Prince

Crown Prince Philip of France died in 1131 while riding through Paris, when his horse tripped over a black pig running out of a dung heap.

Turning emmisions thinking on its head!

Low-emissions economy

New Zealand is well positioned to respond

- New Zealand has a low-emissions electricity system…
- …and there is large scope to increase the supply of clean electricity, enabling electrification in transport and other parts of the economy.
- Expansion in forest planting can give New Zealand valuable adjustment time.
- New Zealand already has the architecture for an emissions pricing system in place.
- New Zealand can provide leadership in developing an effective approach to tackling biogenic methane.

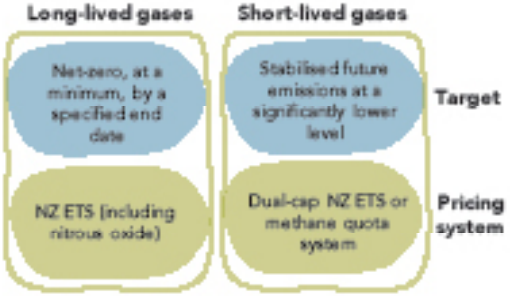
The challenge

- Climate change is a prime example of the tragedy of the commons, where short-term private incentives swamp the long-term public interest.
- New Zealand is committed to reducing its emissions to help achieve the Paris goal of limiting warming to well below 2°C.
- Meeting this commitment is achievable, but there will be tough challenges.

"Shifting to a low-emissions trajectory will critically depend on political leadership and fortitude. Inertia and resistance to change can be expected…meeting this challenge will likely be futile without broad agreement across the political spectrum on both the need and means to make the transition. (p. 507)"

NEW ZEALAND PRODUCTIVITY COMMISSION

A new approach that treats long- and short-lived gases differently



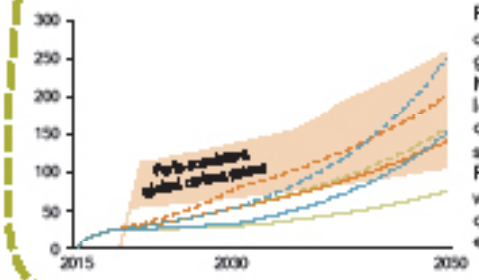
Three shifts to achieve a low-emissions economy

Transition from fossil fuels to electricity and other low-emission fuels

Substantial afforestation

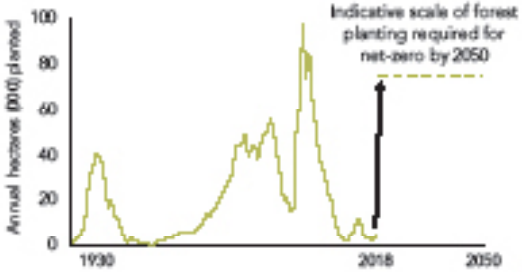
Changes to the structure and methods of agricultural production

Emissions prices are a critical motivator of change



Prices need to rise considerably to generate action. Modelling suggests at least $75 per tonne and over $200 for some scenarios by 2050. Prices are comparable with what's required in other developed economies.

Sustained afforestation will need to exceed past rates



Immediate priorities for Government

1. Reform the NZ ETS (introduce multi-year quantity caps, establish a new market agency) and address biogenic methane in a pricing system.
2. Set in place laws and institutions, including legislated targets, a system of emissions budgets and an independent Climate Change Commission.
3. Devote significantly more resources to low-emissions innovation to lower the future costs of reducing emissions.
4. Prioritise policies to avoid high emissions lock-in (eg, feebate scheme for light vehicles and limits on installing fossil-fuel powered heating systems)
5. Amend electricity system regulation to facilitate the expansion of low-emissions electricity and reduce barriers to innovation and new services
6. Take an active approach to accelerating forest planting (including native species)

Important insights for the transition ahead

- The transition will be long and involve change and uncertainty. Stable and credible policy (with a broad political consensus) is critical to overcome short-term thinking.
- Strong early action is justified. Delaying action limits options in the future and could make the transition much more abrupt and costly.
- Relying heavily on forestry creates challenges in the long term. Forestry buys valuable time. But ongoing progress in reducing gross emissions is necessary up to and beyond 2050.
- Innovation is core to the transition (and can lead to wider productivity benefits).
- In addition to the benefit and tax credit system, other policies may be needed to support households disadvantaged by the transition. Transport costs for low-income households may be a particular pinch point.
- Successful and productive economies handle change well – improving wider productivity performance will make the transition more beneficial and less disruptive for New Zealanders.

Uncle Archie

Kia ora HS PRACTITIONERS!

HSAW (Hazardous Substances) regulations
The HSWA Hazardous Substance Regulations 2017 have now been in service for over six months and the 'lift and shift' approach from the HSNO regulations appears to be understood by many in industry.

The environment?
The new HSAW HS regulations 17 include for Flammables (Class 1-5) and Toxics (6,8), but have left Class 9s (environmental toxins) only in for information only?

Fortunately a new EPA HS (Hazardous Property Controls) Notice 2017 Cl 41 allows to treat Class 9 storage in a similar manner to Class 6 & 8 substances under HSWA. Although this is interesting in that under the HS reg Cl 13.32 2(b), secondary containment for non Cls1-5 for greater than 20,000l storage is only 5%, but Cl 13.31 2(a) is 25% for 15,000 litres – does this encourage greater storage of these toxic class substances?

Atmospheric controls vs oil and gas
With increased New Zealand commitments for the environment arising from the 2° Paris climate change target, the Government has banned the exploration for new oil and gas reserves in NZ. Recent powerful world storms in the Philippines and USA floodings may help explain this need, but while it will be hard to replace fossil fuels without suitable replacements over the immediate term, it is good for people to consider all of the effects of our actions on our environment.

Ease of replacing oil and gas?
A recent report has stated that many dairy companies often need the equivalent energy of a small town to run their plant. This energy is usually not available from the local grid so dairy plants often need oil and coal to meet their energy needs to process our major export products.

Plastic recycling!
The subject of plastic recycling has become a major issue over recent months and a soft plastic recycling campaign run around NZ is now collecting 360 tpa and is predicted to rise significantly. Perhaps unfortunately at the same time as our collections are rising, the Chinese and Australian recycling companies that these products have been sent to are now no longer able to take these. Perhaps the NZ recycling product industry needs to get additional assistance?

Plastic problem
There is much discussion of the problems when plastics enter the oceans and chemical leaching. The main problem with plastics, of course, is that once the hydro-carbon chain is plasticised, it can remain solid for up to 100 years, and because it is solid, does not aid the digestion once ingested.

The price of power!
A recent government report (RNZ "Power poverty 12/09/18") said electrical power now costs 80% more than 10 years ago. As well as this it is believed that –100,000 dwellings can no longer afford their electrical costs and are needing to turn off heating, etc during winter. Conversely, as electrical replaces oil and gas through electric vehicles, etc even more costs will be required for the electrical networks. How will this be managed?

10 years since GFC
Yes, it has been over 10 years since the GFC caused the world markets and mortgage derivatives, and finance companies to fall. The fixes, including historically low interest rates and quantitative easing (money printing?), required to recharge the world markets have meant major world markets have had record runs for the longest periods since the 1929 world depreciation. Hopefully any correction won't coincide with increased costs of energy management.

Compliance issues aired at seminar

The recent NZIHSM seminar and AGM at the Mecure Hotel in Wellington found our Institute in good heart and finances as we continue in our mission to "Protect people, communities and the environment against the adverse effects of hazardous substances while maintaining the benefits of these".

Our committee members all stood again and were duly elected un-opposed.

Then as part of our seminar we had a few well-delivered presentations from Peter Keller – Management of Solid Wastes within the Environment, John Hickey – Chemicals, Fuels and Hazardous Substance Management, Kate Studd (pictured below) and Simon Buckland from Worksafe) –

Update on issues affecting the Hazardous substance regime

All of these were well received by the attendees and a good number of questions and a tasty lunch were enjoyed by all.

Issues affecting certifiers:
Earlier in the morning at the conclusion of the AGM, we had some time, so over a cup of tea the attendees held a discussion on the current issues that appear to be impacting all compliance certifiers, as raised by those attending and sent in by some certifiers who could not make it, as we adapt to the implementation of the new Hazardous Substance Regulations since December 2017.

Worksafe also asked that we send them a review of items that the meeting discussed so that we can all assist on addressing issues that may be arising within the actual implementation of the new regulations, and as requested we also share these with our *Flashpoint* readers.

Issues Raised

Control Zones:
There appears to be some documentation published under Worksafe (New Rules for Hazardous Substances Nov 2017, p30) informing businesses that they now do not need Control Zones for Class 2 and 3 (flammable substances). This appears contrary to Hazsub Reg Schedule 12 requirements that have been previously been required to be checked by certifiers. Can Worksafe please clarify?

Training
It has, however, been noted by many certifiers that less persons are requesting training courses from certifiers than under the Approved handler regime, although a few certifiers have not noted significant changes. Certifiers are now to check training requirements for all persons handling hazardous substances onsite and it is often not clear as to the suitability of any training that may be claimed.

Perhaps NZIHSM may verify members courses as to their suitability (if the NZIHSM exec have time for this) and would this be acceptable to Worksafe?
Public vs Protected Areas
Onsite offices at Industrial sites, where suitable HS training has taken place, should be acceptable under office exemption.

Separation distances (Class 6 & 8)
It is believed by some that enforcement of the currently defined separation distances for Class 6 & 8 substances, when they come in, may make many existing retail stores and Industrial workplaces unworkable?

There were general thoughts on this and possibly the increased use of Class 6 DG cabinets should be encouraged?
Secondary Containment Bunding to 110% largest container vs for containers >60L Class 3 Cl 10.32 becomes 50% plus half total volume leads to significantly different size requirements for bunding.

However, certifiers have been

Peter Keller presenting at he AGM/seminar.

told that they can issue location certificates without site meeting the bunding requirements (which for Class 9 is for information only under new HS Regs) but what would be the certifiers liability if the site does have a leak?

Environmental
Class 9 not being included under new certification requirements can allow businesses to avoid bunding requirements in areas outside tank storage. (It has since been noted that the EPA HS (Hazardous Property Controls) Notice 2017 has partly addressed this issue through treating Class 9 storage containment in a similar manner to the HSWA HS Reg Class 6 & 8 requirements.)

Type D stores
In practice it is very hard to get a 240 min rated (typically concrete roof) for any large store. Is the neighbours letter (clause 9) acceptable for a potential infringement into a neighbours 'protected' premises without requiring an exemption from Worksafe. This is because some members seem to be finding that Worksafe seem to be busy and are taking a long time to process any exemption requests?

There were also a few specific items discussed which have been discussed directly with the parties concerned.

New compounds lurk in NZ bush

Looking back seems the antithesis of modern medical research, but a new types of analysis has found almost 400 New Zealand native plants contain promising medicinal compounds.

These new potential natural chemical compounds have arisen from revisiting plants already known to have medicinal properties based on earlier studies and Maori traditions, said research fellow Lisa Pilkington of the School of Chemical Sciences at the University of Auckland.

The known medicinal compounds were categorised using a fairly new system. About 10 percent of the compounds were considered 'lead-like' – the most promising category. Over half were considered to be in the 'drug-like space – the second most promising category. And about 75 percent were in the 'known drug space' – the broadest category.

New Zealand flora presents an untapped and rich source of potential drug leads and future therapeutics. The researchers said oral availability is one of the most sought-after attributes of the compounds, meaning they could be packaged into pills, which patients prefer over injections.

Many of the preferred compounds are similar to existing commercial drugs –not duplicates, but similar enough that existing drugs can be used as reference points.

There are about 2000 different species of plants in Aotearoa, with at least 80 percent endemic.

The new look is in its infancy and has been conducted on computer, with new analysis of existing data. Their analysis was largely done on computers. In the future the research team hopes consultation with Maori will be at the forefront of an expanded investigation into New Zealand plants.

I love coal!

Why are so many people opposed to the coal industry? Everyone seems to hate coal. Coal has become the pariah fuel. It was not always like this.

The historical appeal of coal lies in the fact that coal is sunlight in a form locked up from the carboniferous age about 300 million years ago. Early mankind learned how to unlock this trapped sunlight and used it as a source of heat.

During the industrial revolution mankind found that through burning huge amounts of coal, it could develop the types of products that have created the lifestyle and the world as we know it today. Coal was the energy that drove the industrial revolution – economic growth based on coal lifted millions out of poverty and developed many of the life-saving medicines that we take for granted today.

For generations and still today, coal and its fuel-based derivatives have powered the mass movement of people and products around the world as societies grow and develop. The use of coal remains unabated – China accounts for half of the worldwide use of coal, and unapologetically plans to increase its use two-fold by 2025. India has doubled its coal use over the past 10 years, and ASEAN nations' use of coal will reportedly triple by 2035.

Commentators paint China as some sort of coal addict, and liken their suppliers to a global drug dealer. What they ignore is the huge growth in China's economic prosperity over the past 20 years, derived from the use of coal.

Today it is as if delving in the earth for fuels is some sort of crime, which scars the landscape and pollutes the air with black clouds of smog. The pleas to stop using coal are endless, as if it is some sort of pervasive cancer.

If this sort of thinking had successfully halted the industrial revolution, the vast majority of us would still be in poverty, enslaved; and without the coal-based medical advances arising out of the industrial revolution, be dying of now commonly curable diseases before we were 30.

Try selling climate change to those in the world for whom low economic growth and poverty are the norm. Coal still has its place in the need to raise world living standards.

Strip coal mining in the Upper Yangtze and coal-driven air pollution in Teinjin

More electricity needed to meet Paris Accord

Transpower believes that we'll need to electrify more and more of our economy to meet New Zealand's Paris Accord commitments.

Which means the country has to figur out how to deliver asecure, sustainable energy supply ove the next 30 years.

Its research suggests use of gas and coal for electricity generation and industrial heat processes will be replaced with renewable solar, wind, hydro and geothermal energy.

Transport fleets will have converted around 85% of their vehicles to electricity to realise lower operating and maintenance costs.

Private vehicles will follow a similar trend as electric vehicles become cheaper to buy, run and maintain than their internal combustion equivalents.

By 2050, the electrification of transport and key industrial processes will double the amount of electricity generation required in New Zealand. It is likely that new large-scale renewable-power stations connected into local lines companies may help to manage peaks in daily demand. In addition, robotics and artificial intelligence may well effect how humans live and work and to protect all of our society, so we may need to rearrange how human can earn or receive living resources to 'pay for the energy' as machines replace human labour.

So, society is again in interesting times and energy technologies, especially in the small scale personal or solar energy generation systems are likely to replace carbon or oil based energy technologies, over time. In the meantime we should try and manage with what we have already got or grow cold together!

The global warming argument flows back and forth between beieves and nay-sayers, however, you really only have to step outside to see the changes in temperature,changes in seasons, high tides, etc.

Even in less-than-tropical Wellington, over the past couple Wellington, over the past couple of years, pohtutukawa and kowhai have begun blooming in early to mid-winter. And ask any lawn bowler what happened to the nice settled weather of February?

For some generations now we have been able to get much of our energy from hydro-carbon fossil fuels which have has good calorific or energy output but also has the downside in that it is not renewable and contributes carbon to an overheating atmosphere.

The recent pounding of the USA and Phillipines and Japan by tropical storms is a percursor to the future, say the climatologists. Expect more of the same.

Our current energy sources are:

The Sun

The Sun is our largest energy source as it burns its hydrogen providing most of the energy in our neighbourhood. This great furnace in the sky allows our plants to grow and in many ways contributes most of the energy on our planet.

The trick is however, how can we harness and store this energy so we can use it when we want it.

More of this?

Photo-voltaic panels have been developed over the past decade to convert sunlight to 12V DC power which can be stored in batteries to provide future energy for our appliances. This is renewable and can be local on individual dwellings, however due to the limitation of batteries at present is only adequate for lighting and general low power appliances but is limited for high energy heating.

The flammables

Plants and life forms grow in the sun and as they grow they absorb and trap energy. Some energy can be obtained by burning wood and vegetation and in the past 300 years even more energy has been obtained from past life forms as we burn and re-energise the remains in carbon- based fire of coal and oil through the typical carbon fuel combustion reaction:
$CH_4 + 2 O_2 \rightarrow CO_2 + 2H_2O$.

We have benefitted greatly from the use of these fuels over recent periods. However, because of the pollution side effects and global concern on climate change their usage is going to become more limited over the few years. Other energy technologies will need to replace these.

Nuclear

Einstein formulated of the equivalence of mass and energy through the nuclear reaction $E=MC^2$

This suggests that mass is made or a vast quantity of energy and nuclear energy has proved to be large indeed.

The issues are however that it is hard to control, causes long-term radiation and there is a shortage of the usual uranium fuel.

Wind, water and solar generation

These are generally considered renewable in that they use natural process and do not use up a fuel or create waste products.

Wind and solar are good in that they can be used at house or grid level, but only work during daylight or when the wind is blowing. They are at present limited by battery storage but this technology is improving rapidly.

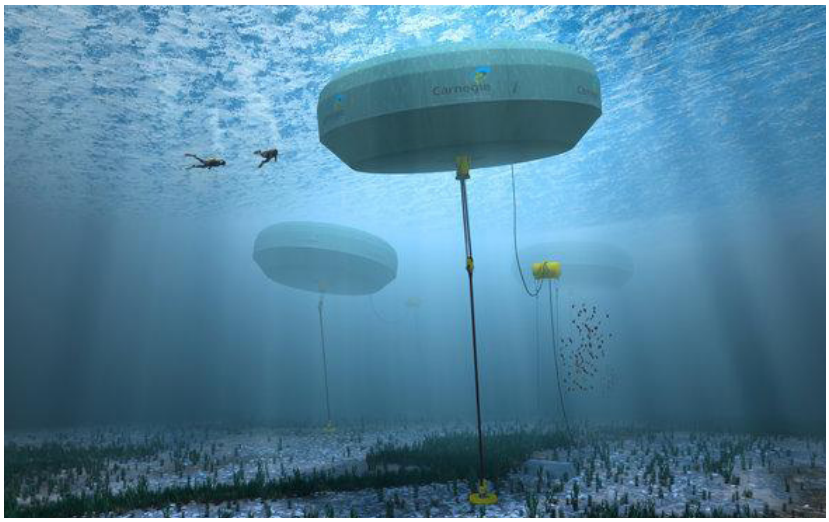
At present battery storage is mainly used for short-term peak demand.

Water (or hydro power) is useful but requires significant water storage dams and a significant power distribution network. While renewable, the capital costs are expensive and there is a limitation to how many rivers can be dammed or wave stations assembled.

Wind power in Wellington.

Chemical & nano technology

(eg: water to ethanol)
Some energy can be created from exo-thermic chemical or bio-chemical reactions however for this a supply of reactant chemicals is required.



One of the several forms of capturing wave energy.

NZ Institute of Hazardous Substances Management (Inc)

MEMBERSHIP APPLICATION FORM

1. Name: ……..

First Name *Surname*

2. **Employment**

Business/Employer's Name: ……

***Position and Contact Details**:*

Position Held: ……..

Qualifications: ……

Experience in HS:

……

……

……

……

3. Preferred mailing address:

……

……

……

Telephone Contacts (Bus.) (0) ……

(Res.) (0) ……

(Mob.) (02) ……..

(Facsimile) (0) ……

E-Mail: ……..

Website: ……..

4. I have previously been a member of the Institute ❒Yes ❒No

If NO: I am applying to be a ❒Member ❒Associate member

5. **Return to**: P O Box 10-385, The Terrace, Wellington
Email: office@nzihsm.org.nz

How did you find out about us?

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