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Submission to IPCN re Wallaroo Solar Factory proposal

1. Soil and Water Contamination and the risk to primary production and town & city water

2. Baseline soil and water testing on sites proposed for solar factories

3. Decommissioning and remediation arrangements and responsibilities

4. Public Liability Insurance

5. Tourism and wine growing region

Appendix A: Solar Panels are Toxic

Front page of research conducted by University of Stuttgart, Germany re leaching of photovoltaic modules.

Full submission attached.

energies

MDPI

Article

Leaching via Weak Spots in Photovoltaic Modules

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Abstract: This study identifies unstable and soluble layers in commercial photovoltaic modules during 1.5 year long-term leaching. Our experiments cover modules from all major photovoltaic technologies containing solar cells from crystalline silicon (c-Si), amorphous silicon (a-Si), cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS). These technologies cover more than 99.9% of the world market. We cut out module pieces of 5 × 5 cm^2 in size from these modules and leached them in water-based solutions with pH 4, pH 7, and pH 11, in order to simulate different environmental conditions. Unstable layers open penetration paths for water-based solutions; finally, the leaching results in delamination. In CdTe containing module pieces, the CdTe itself and the back contact are unstable and highly soluble. In CIGS containing module pieces, all of the module layers are more or less soluble. In the case of c-Si module pieces, the cells' aluminum back contact is unstable. Module pieces from a-Si technology also show a soluble back contact. Long-term leaching leads to delamination in all kinds of module pieces; delamination depends strongly on the pH value of the solutions. For low pH-values, the time dependent leaching is well described by an exponential saturation behavior and a leaching time constant. The time constant depends on the pH, as well as on accelerating conditions such as increased temperature and/or agitation. Our long-term experiments clearly demonstrate that it is possible to leach out all, or at least a large amount, of the (toxic) elements from the photovoltaic modules. It is therefore not sufficient to carry out experiments just over 24 h and to conclude on the stability and environmental impact of photovoltaic modules.

Keywords: leaching; long term; photovoltaic modules; delamination; solubility

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1. Introduction

Photovoltaic (PV) modules are not a niche product anymore. The market started with an installed capacity of 20 MW in the early 1990s and increased up to 635 GW of total installed PV modules worldwide at the end of 2019 [1]. By assuming an average lifetime of 30 years, we have to deal with an increasing amount of waste from PV modules of up to 1.7 million tonnes until 2030 [2].

In principle, photovoltaics are a green technology; however, some PV modules contain toxic elements such as lead in the solder ribbons and metalization pastes, or even worse, such as in CdTe technology, the toxic elements Cd and Te in the photoactive layer itself. Many modules using copper indium gallium diselenide (CIGS) also contain cadmium in the so-called CdS buffer layer of the CIGS cells. This situation is mainly possible because PV modules are still excluded from the EU Directive on the restriction of hazardous substances (ROHS 2) in electrical and electronic equipment. This exclusion will remain until the next review of the RoHS 2, which is planned for 2021 [3]. For all other electric and electronic equipment (EEE) on the EU market, the tolerated maximum concentrations by weight in homogeneous materials for lead (Pb) and cadmium (Cd) are 0.1% and 0.01%, respectively. Clearly, in the case of the compounds CdS or CdTe, with 50% of the mass being Cd,

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1. SOIL AND WATER CONTAMINATION AND THE RISK TO PRIMARY PRODUCTION AND TOWN & CITY WATER

Planning has been derelict in their role of ensuring that projects do not pose an unacceptable risk. Planning seems to be taking a position that blindly supports solar developers as they continue to put forward the position that solar panels do not contaminate soil and water.

I do not have the resources that the Planning Department has to do research on this issue however here is some information that Planning should seriously consider. There is a paper titled "Leaching via Weak Spots in Photovoltaic Modules" published in Energies 2021 and based on the study conducted by the Institute for Photovoltaics and Research Centre, University of Stuttgart, Germany. The Abstract states ***"This study identifies unstable and soluble layers in commercial photovoltaic modules during 1.5 year long-term leaching……Our long-term experiments clearly demonstrate that it is possible to leach out all, or at least a large amount, of the (toxic) elements from the photovoltaic modules."*** A copy of the first page of the article is attached for information.

Solar panel leaching is not the only contamination risk that a Solar Factory poses. The additional contamination risks are solar panels broken during installation and maintenance, hail damage to solar panels, panel electrical fires, grass fires under panels, lightening strike on panels and inverters, inverter station fires, battery station fires, BESS fires and Sub-station fires.

The importance of avoiding contamination is critical for the retention of Australia's domestic and international markets for primary produce and the associated food security of the nation. It is also important to avoid contamination of potable drinking water for humans.

2. BASELINE SOIL AND WATER TESTING ON SITES PROPOSED FOR SOLAR FACTORIES.

Baseline soil and water testing of the site for a range of chemicals and elements that are found in solar panels, inverters, batteries and substations should be conducted prior to the commencement of construction and operation of large-scale solar energy generation factories. A baseline test will provide a reference point for assessment of the site following decommissioning and for the requirements of the remediation.

Currently there is no requirement for developers to undertake baseline soil and water testing of the site for solar factory elements and chemicals and therefore no measure for assessment for the purpose of remediating the soil to what it as before the construction of the solar factory. Some say that developers do not do these baseline assessments so they cannot be held accountable for the damage done to the soil and possible contamination.

There is a risk that soil and water could be contaminated from solar panel leaching (leaching has been contested however there are some long-term tests which indicate leaching is likely to occur) and broken panels, especially if there is a severe hailstorm, are highly likely as occurred at BP's Woolooga solar factor in 2023. Contamination will severely impact the potential to farm the land or graze animals again.

The inverters, batteries and sub stations have been known to catch fire and therefore may be a further source of contamination of soils and water.

In order to manage to potential contamination risk, Planning should require developers and operators to:

1. conduct a base level test of soil and water prior to any construction work being undertaken and to lodge the test results with Planning
2. require operators to test the areas following a potential contamination event and report results to Planning
3. test for contamination following decommissioning and instigate remediation measures to deal with any contamination with reference to the base level test results. Both of these test results should be lodged with Planning.

Given the significant risk posed by solar factories, the prudent position would be to adopt the "precautionary principle" and not approve them unless there are stringent commitments to recognise and manage these risks.

3. DECOMMISSIONING AND REMEDIATION ARRANGEMENTS AND RESPONSIBILITIES

Charlatans is an apt description of Renewable Energy developers and they are supported by their financial spivs. My experience so far in dealing with Renewable Energy developers was reflected in the Australian Energy Infrastructure Commissioner's (AIEC) report where he described them as "cowboys" and I find their modus operandi is one of deception, denial and outright lying.

Typically, solar factory developers operate with minimal capital and develop, engineer, construct and then sell their interests in the asset and then "walk away". A large component of the company's profit is thanks to the government (taxpayer) subsidies. Large solar developers are typically ultimately owned by overseas interests however they set up as an Australian Pty Limited company with say A$10 capital.

These companies utilise what is called a "walk away" business model so these developers will have no interest in the long-term operational issues and are unlikely to have to deal with soil and water contamination, grass fires, panel fires, inverter fires, battery station fires, BESS fires and sub-station fires, operating noise, heat island impact and compensation payments where these exist.

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The current planning approval for Large Scale Solar Energy Facilities for developers, owners and landowners has no financial commitment for remediation and allows the use weasel words to avoid a commitment to decommissioning, remediation and rehabilitation of the Solar Facility's site.

> A typical statement in the developer's Scoping Report – *"Decommissioning of the Project will occur at the end of its operational life. A decommissioning plan for the Project and associated infrastructure will be prepared in advance of decommissioning in consultation with the relevant regulatory authorities and landholders. The basis of the plan will be that the Project and associated infrastructure are decommissioned in line with the applicable legislative requirements and best practice guidelines existing at the time."*

Based on the typical solar developer business model, they are unlikely to be around in 30 to 35 years time.

Any arrangement put in place at the time of approval by a start-up company which has never done a remediation and rehabilitation is not worth the paper it is written on.

There is no guarantee that the current developers or owners or land holders will be around at the end of life of the facilities and there is nothing stopping the last company owning a facility going into liquidation, thus leaving no funds for remediation and leaving the clean-up and expense for the local government and taxpayers to conduct decommissioning and remediation.

It is in the developer company's interest to reduce future liabilities as this maximises profit.

One example is the passing-off of the liability for decommissioning and remediation which is usually done by convincing the landowner host to accept this future liability.

Despite Planning saying they are happy with the arrangement that the developer and landowner should agree on who is responsible for decommissioning and remediation there is a lack of transparency about such arrangements. It was mentioned, reluctantly, at the Wallaroo Solar Factory IPCN Hearing on 18 July 2024 by Ben Cranston, Wallaroo Solar Farm Pty Ltd, that the property owners were responsible.

This arrangement raises some serious questions.

There is no material published by an Australian government that we are able to find that relates to industrial solar decommissioning and remediation. We have had to rely on material from the USA and Chat GPT for estimates and our own calculations. Based on that material we find that the costs are mind bogglingly prohibitive.

For instance in a USA publication the costs of decommissioning are largescale solar factory are said to be " on average, about US$368,000/1-MW for a ground-mounted PV System": see https://www.greenclean-solar.com/post/end-of-life-solar-pv-panel-decommissioning-recycling . At 120MWdc the Wallaroo Solar Factory would be facing a decommissioning and remediation cost of US$44,160,000 (A$65 Million).

In another publication a very different figure is estimated around US$100 000 per 2MW, which puts the costs of decommissioning the Wallaroo solar factory at around US$6,000,000. See https://apa.ny.gov/Mailing/2021/05/LocalGov/NYSERDA-Decommissioning-Solar-Systems.pdf

While containing different estimates (in US dollars), these figures are actually entirely consistent with what Chat GPT told us the costs would be, namely between US$5,100,000 and US$51,000,000, depending on a variety of factors.

We have considered the labour cost of decommissioning, given that decommissioning is the reverse of installation. Our estimates are as follows:

Let's say each construction worker costs A$50 per hour.
They work 8 hours a day (= $400/day)
They work 5 days per week (= $2000/week)
They work 39 weeks (9 months) (= $78,000 per 9 months)
200 construction workers for 9 months (= $15,600,000 wages)

That is A$15.6 Million for just the labour cost to decommission and then there is equipment hire, transport, recycling and remediation to deal with sterilisation of the soil and probable cleanup to deal with contamination of the soil and water.

In light of these wildly variant but nonetheless exorbitant estimated costs we are even more concerned about future remediation of the Wallaroo solar factory. We say this bearing in mind that whatever the cost will be, it well exceeds the value of the land which is estimated between $10 and $12 Million. The implication here is that no private landholder could ever bear the costs of decommissioning and remediation. It is likely that the land would simply be abandoned and local governments and taxpayers would be required to fund the clean-up costs if there ever was to be a clean-up.

What the host landowners don't realise is that they will be stuck with the demolition of the solar infrastructure and rehabilitation of the land at end of operational life. The DPIE and the NSW Premier confirmed the ultimate responsibility for the demolition of infrastructure and rehabilitation of land at all these wind, solar and battery projects lies with the host landowner (Lessor). Conditions of approval say the Applicant (Developer/Lessee) is responsible for demolition of infrastructure and rehabilitation of the land. However, here's the catch, the Applicant company has no assets and is beneficially owned through shareholding by another company (a holding company or similar). During the operational life of the project the income earned by the Applicant company is paid as dividends to the holding company which is the beneficial owner of the shares in the Applicant company. At the end of life of the project the Applicant company has no assets and is put into administration by the holding company. Hey presto!, the host landowner has to pick up the tab for demolition of the infrastructure and rehabilitation of the land. Why? Because there is no Rehabilitation Bond or financial guarantee! Caveat Emptor!

It is also high time Council's also wake up to the MORAL HAZARD deliberately being inflicted on them/their Ratepayers - under their POEO Act Responsibilities/Liabilities re-Contamination/Pollution caused by Solar/Wind Electricity Generating Works.

The question is, given the negotiation between Wallaroo Solar Farm Pty Ltd and the property owners and the property owners agreeing to decommission and remediate the property, were the owners informed of the likely cost of decommissioning and remediation?

At the end of the day, developers and subsequent owner operators should be required to lodge a security bond with a government that covers the future decommissioning and remediation expense.

4. PUBLIC LIABILITY INSURANCE

Farm businesses usually hold $10 to $20 Million Public Liability Insurance. The quantum and premium level is assessed based on a farm business having primary production farms as its neighbours.

The Public Liability increases massively when a neighbour hosts a large scale solar energy generation factory. These developments usually range from $300M to $1,000M. By way of example, should a fire inadvertently start on a farm and it was to burn on to the neighbouring large scale solar energy generation factory and burn a significant amount of the infrastructure, the liability could be in the $100s of Millions.

A farm business is currently unable to get Public Liability Insurance to cover such a potential liability and the premium cost would be prohibitive if it was available. This increased cost is caused by having a large scale industrial factory as a neighbour. Farms in the vicinity of these factories are therefore effectively uninsurable.

A possible solution would be for the large-scale solar energy generation factory developer/operator to indemnify neighbours for any Public Liability Insurance claim greater than $10M. Governments and planners should require the developers/operators of large scale solar energy generation projects to indemnify their neighbours and primary producers in the vicinity for any damage to the solar factory caused by an incident on the neighbouring farm or vicinity.

5. TOURISM AND WINE GROWING REGION

At the end of the IPCN hearing on Wallaroo Solar Factory on Thursday 18 July 2024 I was aghast hearing the NSW Planning Department representative say that Planning did not seek and does not intend to seek comment from the Tourism Department or Destination NSW. The Planning representative arrogantly said they made their own assessment regarding the impact on tourism. I have no confidence that Planning understands tourism and the likely adverse impacts. Given the proposed solar factory is going to be dropped in the middle of this tourism and wine growing area, the adverse impacts need to be fully explored, therefore I ask the IPCN to conduct its own assessment and engage with Tourism NSW and the Destination NSW program operatives.

Stan Moore

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APPENDIX A

SOLAR PANELS ARE TOXIC

Solar panels are toxic is the conclusion of a SAVE Gundary Plains Action Group Member (SGPAGM) who has conducted research regarding the toxicity and dangers of elements found in solar panels. This makes for alarming information about the safety of solar panels. Combine this research with contamination of soil and water is addressed below.

The SGPAGM prepared the following paper: All solar panels are declared hazardous e-waste in Victoria, the EU and parts of the US. Clearly they should be declared hazardous waste in all jurisdictions including NSW.

Producing one tonne of polycrystalline silicon used to manufacture panels, generates 'at least 4 tonnes' of highly toxic silicone tetrachloride. (We need 5 tonnes to make 1 megawatt (MW) of conventional solar modules.)

The industry relies on well known toxic chemicals to produce equipment - arsenic, hexafluorethane, hydrofluoric acid, lead, polyvinyl fluoride and many others listed and described below.

Panels can begin to deteriorate from around two years onward to the end of their life! (Up to 20 years, give or take a few 'smashes' here and there)

In 2021 it was estimated to be 4 million panels in Australia which uses cadminium telluride panels. This equates to 48,000 tonnes of waste! (ABC.net.au)

*A lot of the younger generation believe 'green energy' is the only way to head into the future, but sadly they are being lied to, and have no idea of all of the 'dirty' facts! They are the ones who will be left to clean up the toxic waste!

A study of the economics of Solar, published in Harvard Business Review, finds that the waste produced by solar panels will make electricity four times more expensive in the long run!

The economics of solar, write Atalanta Atascadero and Luk N van Wassenhove of one of Europe's leading business schools, and Sean Duranof of the University of Calgary, will 'darken quickly as the industry sinks under the weight of its own trash!'

The JPB Foundation - 'Critical human health and environmental impact data are not well aggregated, organised or easily accessible for the solar industry, industrial communities and regulatory agencies.'

(This foundation in the US aims to enhance quality of life, promote health and enrich and sustain our environment)

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Around the globe, chemicals are linked to asthma, cancer and developmental disorders, among other ailments. The World Health Organisation (WHO) estimates that 23% of deaths globally were caused by air and water pollution and exposure to toxic chemicals.

It's no surprise then that the chemicals needed for solar panels are all linked to these illnesses. When a factory in China dumped a chemical by-product of solar panel manufacturing near farmer's fields, it destroyed crops and made villagers sick! (corebuffalo.org)

According to an article (daily mail.co.uk) grass never grows in the permanent shade of the solar panels.

2021 in UK - Storm Arwen smashed hundreds of glass panels, damaging rows and rows of photovoltaics.

Photovoltaic cells contain toxic materials like lead, cadminium, selenium and tellurium. When panels are damaged like this, or during hail, toxic chemicals leach into the natural environment continuously. During fire events, toxicity is sent into the atmosphere with smoke. (ipa.org.au)

Not a scenario in which you want grazing sheep in the area!

(Mackinac.org) Solar produces 300 times more toxic waste per unit of energy than does nuclear energy.

(nationalgeographic.com) Fabricating the panels requires caustic chemicals such as sodium hydroxide and hydrofluoric acid - silicon particles are released into atmosphere, known to cause silicosis in people who come into contact with the particles.

Information regarding elements used in making of solar panels:

*Cadminium - exerts toxic effects on kidneys, skeletal system, respiratory system, classified as a human carcinogen - body gets rid of extremely slowly.

Cadminium has a half-life and bio-accumulates in plants, invertebrates and vertebrates causing organ system toxicity and growth retardation.

*Copper - too much copper in the body can damage kidneys, liver, heart and brain. If left untreated, copper toxicity has serious health effects, even leading to death.

Extremely toxic to sheep and young calves, where they are often simply found dead if there has been ingestion over a long period. (vet.k.state.edu)

*Telluride Bismuth - chemically related to selenium and sulphur (chalcogens) on the Hazardous Substance list!

Any bodily contact causes nose, eyes skin and throat irritation. There are workplace exposure limits.

? Broken, and damaged panels occupational hazard.

*Cadminium Telluride - considered hazardous if inhaled or any skin contact, oral contact, avoid fumes! Wear protective clothing. It is also carcinogenic.

May release toxic fumes if involved in a fire!

Do not allow to enter drains or to be released into the environment! (espimetals.com)

*Lead, and cadminium leach out of cells getting into ground-water affecting plants and having detrimental effects on human and animal health. Impair brain development in children, and cadminium is a known carcinogen of both neurological and cardiovascular systems (is.sac.org.au)

*Silicon Tetrachloride reacts violently with water and moist air to form heat, and toxic and corrosive Hydrogen Chloride gas. Causes reproductive and lung problems.

*Arsenic - a worldwide toxin to human life.

*Gallium is a corrosive chemical causing skin and eye problems

*Hydrofluoric Acid gas can cause eye, nose, respiratory tract irritation, and breathing it in can cause serious lung/heart issues and possibly death.

*Polyvinyl fluoride - the EU has banned the manufacturing and use of

PFAS, and this includes PVDF - it is Ok for China to use it to manufacture solar panels, but not anywhere in the EU! (These are the dreaded 'forever chemicals')

Hundreds of thousands of birds are killed by solar panels across the globe!

Known as the 'Lake Effect', they think panels are water!

The brightness and intensity of light both day and night in solar fields interfere with animal natural habitat.

(Wildlife.online library.Wiley.com) Measurement of wildlife deaths around solar facilities:

The measurement of Solar energy's impacts to wildlife has been limited and minimised.

A study going from 1982 to 2018 in US at 14 projects by 'carcass detection trials' found that the fatality estimates consistently exceeded those reported eg one annual report said 37,546 birds and 207 bats, whereas a study ' reported 267,732 birds and 11,418 bats.'

(K.Shawn Smallwood US 2022 Jnl wildlifemanagement)

(WION Climate tracker)

The Dark Side of Solar Panels:

Maintainence - sprayed around panels with roundup on a regular basis!

Leached toxicity - Public Health Hazard!

A hail storm in Texas caused damage to solar panels over 10,000 acres of panels - the residents didn't get environmental impact studies, a lot of whom are on 'well' water! Tested water showed high levels of toxicity/pollution.

18/4/22 Sky News (Utube)

Clean Energy's Dirty Secret:

China's mining pollution is gradually reaching the Yellow River.

Vast radio-active pond of waste chemicals leaching into the ground and into the air! The pond is literally full of toxic left-overs.

(weforum.org (World Economic Forum) 2019 'China's pollution is so bad it's blocking sunlight from solar panels!)

2024 - After seeing the detrimental effects of this innovative 'green energy' technology in China, the Indonesian government backed by Chinese business consortium are forcefully claiming the beautiful Rempang island just off the coast of Singapore to become a 'sacrificial zone' for the Xinyi Glass Holding factory, where they will manufacture solar panels!

Farmers, fishermen and villagers who have lived there for generations have until September 28th to move!

2/5/2024 (information Age/ACS) The production of Solar Technology has its environmental downsides, as the mining of materials and manufacturing of panels creates a considerable amount of environmental consequences, greenhouse gas emissions, habitat destruction, soil erosion, and water pollution. The burning of fossil fuels is required to generate heat as well.

(solar-panel-cleaners.com) Cleaning and solar panel maintenance has a very real potential for electrocution and starting of solar panel fires.

Broken panels are hard to see, and if water is sprayed directly onto a broken area, electrocution is a serious risk.

Panels create DC (direct current) electricity, so victims of electrocution are unable to 'pull away' from the source of electricity.

Flicking a switch by the inverter does not turn electricity off - it is still live!

(smh.com.au 2021 authors Angus Thompson, Josh Dye). A Solar Panel device (PVstop) designed to prevent electric shock of firefighters has been behind the alarming increase in solar panel fires. Fire and Rescue attended 139 rooftop fires last year (2020)

SafeWork NSW has recorded two fatalities and 48 serious incidents with roof Solar installation over the last three years. (2020)

(afac.com.au - Fire and emergency Services) - Following a hail storm event in Sydney 2018, which damaged dozens of rooftop panels, surprisingly later sparked fires on damaged areas. Although power had supposedly been isolated, three days later the damaged panels began arcing, causing fires, one which put an entire factory at risk.

Many panels were still damaged a year later (2019) with people apparently oblivious to the fact there is an ongoing fire risk until the panels are disconnected and removed.

(fj.benweilighting.com)

Q. Will you get electrocuted if you touch a solar panel?

A. The short answer is unquestionably 'yes!'

A person can electrocute themselves in a number of different ways when cleaning panels. These warnings shouldn't be disregarded.

Some electrocution events:

Linkedin - (Work Place Safety and Health Council 2024) Workers have been electrocuted even when panels were not plugged in, due to exposed cables.

2017 - San Jose - man survived an electrocution event while cleaning panels- knocked unconscious, clothes set alight causing 50% body burns.

2016 - Enerquest Services Inc. convicted of breaching Occupational Health and Safety laws in 2013, when a 22 year old was fatally electrocuted.

May 2024 Ontario worker fatally electrocuted while cleaning solar panels.

ABC News.

In 2023, 15 new large commercial Solar Farms were completed across Australia, the majority owned by the global renewable energy and financial service companies.

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Workers and Electrical Trades Unions (ETU) officials have told ABC there are major safety issues with the way labour is being managed.

Work which should only be done by a qualified electricians is being done by trade assistants.

Electrician, Dean Ison left the industry after a bad experience, and said 'if they could get backpackers to do everything, they would!'

(linkedin.com) Solar Farms high risk issues:

Panel reflection is a most common safety concern - referred to as 'glint and glare' - cannot be avoided because the panels are designed to absorb as much light as possible - poses a problem for both drivers and aviators!

All electronic equipment has associated electro-magnetic fields, so if electronic devices are in close proximity to each other, interference can occur!

*Gundary has the Goulburn Aerodrome.

(fire trace.com)

How many fires have been caused by solar panels on solar farms?

Studies indicate that these fires are underrepresented! They are often listed as 'other' category in data.

During a solar panel fire, if there is still light in the environment, a solar panel will continue to generate DC current until a system failure! The risk of a live electrical current exists, and fire-fighters must try to control the blaze without increasing their risk of electrocution.

Solar farms do catch on fire! Millions of dollars in equipment can be destroyed in minutes. Combine this fact with the potential for loss of life, raging wildfires and other environmental factors, the dangers become more apparent - especially true for rural areas where response could be many kilometres away.

END.