GREENPEACE

How green the Games?

GREENPEACE'S ENVIRONMENTAL ASSESSMENT OF THE SYDNEY 2000 OLYMPICS

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A production of Greenpeace International & Greenpeace Australia Pacific

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Executive summary

The Sydney 2000 Olympics have produced a mix of wins and losses on the environment front. While the wins are impressive, the losses show that Sydney could have done more to give the planet a sporting chance.

Greenpeace is determined to ensure that the pursuit of environmental solutions does not end with the Sydney Olympic Games. We will continue to push for environmental solutions and technologies to be taken off-site and put into use internationally.

The following is a summary of Greenpeace's evaluation of the seven key areas that featured prominently in Sydney's Environmental Guidelines and how Sydney performed against them. Our report also provides the context of what world's best practice for each issue area is and how Sydney's effort stacks up against that.

Finally, and most importantly, there have been many lessons learned by Sydney's Green Games effort that should not be lost. These lessons are not only an important part of the on-going process of moving toward sustainable development, but should be used by future Olympic cities to avoid the pitfalls experienced by Sydney for a better overall environmental performance.

LESSONS LEARNED

Lesson 1:
Make specific environmental commitments as part of your development plans well before design plans are finalised and construction begins. Make these commitments public.

Lesson 2:
Environmental Guidelines must be clear and specific benchmarks that are non-negotiable, measurable and backed up by law. These benchmarks must be included in all of the tenders offered for Olympic development and made public.

Lesson 3:
Olympic organisers and developers must be required to collect and report information on all environmental aspects of their project and make this information publicly available.

Lesson 4:
Independent auditing of all environmental information is essential to ensure credibility.

Lesson 5:
No matter how Olympic construction is managed – with one project manager or as independent projects and contracts – Olympic organisers must ensure that the best and most cost-effective environmental systems and materials are used project-wide.

Lesson 6:
Great enthusiasm for and expertise in environmental building and event management exists at all levels internationally. Seek out and engage those innovative and creative experts and companies interested in the environmental success of your event.

Lesson 7:
High-level and consistent consultation with the community, environmental and social groups is essential and must be part of the project from the beginning. A clear process for conflict should be established as part of the city's Environmental Guidelines.

Lesson 8:
Education about environmental initiatives undertaken and the benefits gained is essential at all levels, from the public to athletes, sponsors, the media and the commercial sector.

GREENPEACE EVALUATION OF SEVEN KEY ISSUE AREAS:

TOXIC CONTAMINATION

Sydney's wider Homebush Bay area was the site of wholesale dumping of domestic, industrial and commercial wastes from the 1930s until the 1980s. Nine million cubic metres of waste were dumped in the area, filling more than 160 hectares of the natural wetlands in the area. Some of this was made up of extremely hazardous industrial waste and has had a significant impact on the wider environment and receiving waters due to its toxicity, persistence and/or bio-accumulative nature.

The New South Wales (NSW) Government's decision to bid for the 2000 Summer Olympic Games meant that the motivation, and more importantly, funding commitments were mobilised to clean-up and manage a site which probably would otherwise have languished as a contaminated legacy of industrial dumping. As a former dumping ground, the redevelopment of the site represented an opportunity to develop Games infrastructure without clearing previously untouched remnant vegetation or contributing further to Sydney's suburban sprawl. It was also close to public transport from the city.

While there are many issues about how effectively the site has been cleaned up, it is highly improbable that the investigation into, separation and landfilling of waste on-site would have occurred to the extent it has without the Olympics to justify the cost and effort. For the short-term at least, the site has been made safer than it was prior to using it for Sydney's Olympic Games.

Just 2.5 kilometres off the site, Homebush Bay and the Rhodes Peninsula is one of the five worst dioxin hotspots in the world due to chemical production by companies such as Union Carbide and Orica for decades. One of the greatest failings of the NSW Government is its failure to live up to a promise to clean up this area – half a million tonnes of dioxin contaminated waste – before the Games.

Selected Achievements
- A new, non-incineration remediation technology, which uses heat to separate waste from soil and chemical treatment to break down the waste, is being trialed to treat 400 tonnes of dioxin-contaminated waste found on the Olympic site. Greenpeace lobbied strongly for this to be used at Sydney's Olympic site because no toxic emissions are released during the treatment process.

Failures and Missed Opportunities
- Despite government promises, there has been no clean-up for Homebush Bay and the Rhodes Peninsula just off-site. Half a million tonnes of untreated dioxin-contaminated waste remain in the muds of Homebush Bay and on land just 2.5 kilometres off the Olympic site.
- The OCA chose to landfill most of the waste on-site rather than to segregate and treat it. Instead, it was collected into a number of large landfill mounds that were capped and installed with drains to allow liquid run-off to go to a treatment plant on-site.
- This system must be managed and maintained indefinitely to ensure leachate does not escape and pollute the environment. Greenpeace has been asking the NSW Government for a long-term, post-Games management plan for the site but this plan has yet to be provided.
- There is still no publicly accessible validation documentation on the bulk of the remediation work.

ENERGY

With climate change fast becoming one of the world's biggest challenges, the need for solutions to our reliance on fossil fuels for energy is dire. At the Sydney Olympics, renewable energy has virtually substituted conventional fossil fuels to meet the huge energy demands of a modern Olympic Games showing that it can be done and that it is cost effective.

With over 90 per cent of Australia's energy generated by coal-fired power stations,[1] the switch to clean, renewable energy at the Olympics is an important success. Remarkably, the grid-connected solar photovoltaics installed at the Olympic Park contribute nearly half of all New South Wales' grid-connected PV power. The use of rooftop solar power for electricity and water heating at the Olympic Athletes' Village is proof that an average home can be directly powered by the sun's energy.

The widespread use of green power at Olympic venues during the Games demonstrates that electricity use for homes, offices and other buildings can be powered by 100 per cent renewable energy

sources. The array of energy efficient design tools and technologies on the site shows that typical energy consumption can be cut by up to 50 per cent.

Collectively, energy efficient design, renewable energy generation from sources such as solar and the use of green power for Sydney's Olympic Games is one of the best environmental legacies achieved.

Selected Achievements

- All competition venues will use 100 per cent Green Power for the duration of the Games.
- Nearly half of all New South Wales grid-connected solar photovoltaics are installed at Olympic Park.
- 665 houses in the Athletes' Village have grid-connected solar (PV) panels and solar hot water systems making it the largest solar-powered suburbs in the world by number of homes at the time of the Games. The Village's energy load is 50 per cent less than conventional dwellings, saving 7000 tonnes of carbon dioxide per year.
- 1,176 solar PV panels on the SuperDome roof provide 10 per cent of its daily energy.
- 19 grid-connected solar-powered lighting towers will provide lighting for Olympic Boulevard.
- Australia's largest centralised solar domestic hot water system will provide hot water for the neighbouring Homebush Bay Novotel/Ibis hotels. The 400 square metre system will provide 60 per cent of the hotels' hot water needs, an energy reduction of 15 per cent.
- 800 solar panels will power water pumps in the Millennium Parkland.
- A natural gas co-generation plant in Stadium Australia will reduce mains electricity demand by 10 per cent when an event is on.
- Waste heat recovered from the Hockey Centre's airconditioning heats domestic hot water for the venue.
- Efficiency measures such as passive natural ventilation save 20 per cent of energy demand in the Showgrounds.

Missed Opportunities

- Plans for an on-site Solar Thermal Electricity plant at Olympic Park were dropped.
- Photovoltaic energy and solar hot water generation were not taken up at all venues.
- A lack of commitment to purchasing Green Power long-term for all Olympic venues.

REFRIGERATION AND AIRCONDITIONING

Australia is the country with the fastest growing rate of skin cancer in the world and is struggling to even begin to reduce its greenhouse gas emissions. It is disappointing that the country lags behind Europe in the move towards environmentally safe refrigeration and airconditioning chemicals. Sydney's failure to meet its own Environmental Guidelines in airconditioning and refrigeration (RAC) in Olympic venues is the biggest and most systematic environmental failure of its Olympic Games.

Greenpeace believes Australia missed an important opportunity to use the Environmental Guidelines to push its airconditioning and refrigeration industry towards clean alternatives such as ammonia and hydrocarbons. Fortunately, our engagement with Olympic sponsor companies such as Coca-Cola, Fosters Brewing and Samsung have proved more successful and will be a major legacy of Sydney's Environmental Guidelines.

Selected Achievements

- After a global Greenpeace protest campaign Coca-Cola announced that it would stop purchasing HFC equipment for all new refrigeration equipment by the Athens 2004 Games. If delivered, this will create significant change in the global refrigeration industry and positively impact on the commercial availability of Greenfreeze equipment internationally.
- After intense lobbying from Greenpeace, Samsung agreed to provide 324 large, environmentally safe Greenfreeze refrigerators for use at the Olympic site.
- Foster's Brewing Group agreed to alter its refrigeration policy to ban the purchase of greenhouse-polluting HFCs and ozone-destroying HCFC refrigeration equipment.
- Greenfreeze refrigerators have been used in half of the Olympic hotel and in small numbers in the SuperDome.

Failures and Missed Opportunities

- Not a single Olympic venue, either permanent or temporary, requiring airconditioning meets Sydney's Environmental Guidelines. Greenhouse gases HFCs and ozone-depleting HCFCs are used throughout.
- The vast majority of refrigeration equipment used by Coca-Cola, McDonald's, Samsung and Foster's Brewing at the Olympic site do not comply with the Environmental Guidelines.
- Car manufacturer, GM Holden, will provide more than 3000 cars that are likely to have airconditioning using the greenhouse gas HFC134A.

PVC

Olympic building construction is proof positive that PVC can at least be minimised or avoided. The manufacture, use and disposal of PVC (polyvinyl chloride) produces hazardous chemicals including dioxin, which has been linked to birth defects, cancer and hormone disruption.

PVC use was reduced at the Sydney Olympics particularly in water and waste pipes used on most Olympic venues. Vinyl flooring was reduced as was a great deal of PVC-sheathed cabling. An Australian-made PVC-free cable was developed especially for use at the Athletes' Village and other

venues and is now available to the Australian market. Unfortunately, many sites chose not to use the local product and chose PVC for power and light cables. Virtually no effort was made to use PVC-free telecommunications cabling.

The widespread use of PVC-free alternatives in Olympic venues clearly shows that with commitment, PVC can be replaced in building construction.

Selected Achievements

- It is estimated that PVC was avoided for infrastructure (sewer, stormwater and water mains).
- The Athletes' Village reduced PVC usage by weight against standard industry practice by approximately 70 per cent. More than one million metres of PVC-free cabling were used there.
- Australian-made PVC-free power and light cable, Envirolex, was developed to meet Sydney's Environmental Guidelines and used extensively in the Athletes' Village and other Olympic venues.
- At least 200,000 metres of Polyethylene (PE) pipe were used as a PVC alternative.
- No PVC was said to have been used for hydraulics at the SuperDome.
- At least 19,000 metres of PVC piping were displaced at the Showgrounds site.
- No in-ground PVC piping was used at the Novotel/Ibis hotels.
- 40,000 metres of PVC-free cabling were supplied to Stadium Australia and 60,000 metres to SOCOG offices.
- Major 132kV power lines were re-routed underground using 8,400 metres of PVC-free cabling.
- Over 5000 square metres of biodegradable linoleum was laid instead of vinyl flooring at the Media Centre and in the Olympic hotels.
- No PVC seating was used in stadium venues with over 390,000 kilograms of Polypropylene seating used instead.
- Over 2000 square metres of polyolefin sail materials were supplied for tensile roofing structures.

Missed Opportunities

- PVC-free power and lighting cabling was not used at many Olympic sites or venues.
- Little effort was made to find PVC-free telecommunications cabling.
- Little effort was made to find PVC-free alternatives for huge numbers of temporary marquees used during the Games.

TIMBER

Regrettably, Sydney's Olympics did not move Australia closer to adopting independent timber certification as a measure of local forestry best practice – an ongoing environmental problem nationally. Greenpeace had hoped Sydney's Environmental Guidelines might help move the market at the beginning of the campaign in 1992/93. Credit goes to Mirvac Lend Lease Village Consortium (MLLVC) for what is believed to be the first commercial use of imported Forest Stewardship Council-certified (FSC) timbers in Australia used in small amounts in the Athletes' Village.

Due to the failure to establish an effective locally certified sustainable timber system in time for the Olympics, emphasis was directed at sourcing native forest timbers with at least a chain-of-custody and recycled and plantation timber. Extensive use was made of recycled and plantation timbers, especially in the application of engineered plantation timbers for joists, bearers and custom trusses.

The native forest timber issue remains contentious. While no evidence was found of timbers sourced from rainforests it does appear that timber from old growth forests and forests nominated for inclusion in World Heritage Areas were used at Sydney's Olympic site. While this is a tragedy, the quantity seems to have been small. On the whole, although information was difficult to obtain in some instances, responsible timber practices seem to have been adopted by most Olympic venue developers.

Selected Achievements

- Australia's first imported FSC-certified timber was used for veneers and handrails at the Athletes' Village.
- 'Feature' grade timber was used in the Athletes' Village using 80 per cent of the log instead of 'Select' grade, which uses only 20 per cent.
- Construction workers union placed a ban on the use of imported rainforest timber.
- 288,000 metres of engineered plantation timber joists and beams were used in the Athletes' Village.
- Chain-of-custody native timber was used at the Equestrian Centre, Shooting Centre and Tennis Centre.
- Plantation timber was used extensively in most Olympic venues.
- 1000 tonnes of plantation timber glue laminates were used in the Showground's Multi-use Arena.
- Recycled timber was used at the Showgrounds Carlton Clydesdale pavilion, Ferry Wharf, Olympic hotels, International Shooting Centre and Archery Centre.

Missed Opportunities

- No timber was sourced from independently certified, sustainably managed forests (eg FSC) within Australia.
- Timber was sourced for veneers from clear-felled, 200-year-old forests in Tasmania.
- Timber was sourced from forests nominated for inclusion in a Tasmanian World Heritage Area.
- No timber was obtained from small-scale 'portable' selective logging operations.

- Recycled timber and engineered plantation timbers were over-specified in some cases over other more environmental options.

WATER CONSERVATION

With environmental threats to clean, drinkable water growing, there is a great need to conserve our water resources. Solid efforts were made to introduce sustainable water management systems at Sydney's Olympic Park. Key features such as the design of the Park to maximise collection of storm water and minimise on-site demand for water were important in creating a more ecologically sensitive site. The collection and recycling of waste water for on-site treatment and the provision of separate potable and non-potable supplies to reduce demand on Sydney's mains water supply were good achievements.

However reliance on traditional technologies for waste water collection and treatment meant that more sustainable options were overlooked. As a minimum, the water management system at Olympic Park could have included separate grey and black water collection systems, an anaerobic digester and a combined heat and power station for better environmental results.

Selected Achievements

- A Water Reclamation and Management Scheme (WRAMS) was implemented across the Olympic site recycling about 50 per cent of water used and 100 per cent of non-potable water (around 850 litres per year).
- A dual water system that separates drinking water and recycled 'waste' water for landscape use and toilet flushing was installed.
- All storm water is collected on site.
- Two megalitres of sewage is treated on-site every day.
- Water saving devices and techniques at the Athletes' Village will cut water use by 30 per cent.
- Dual flush toilets and low flow water-saving devices are installed at most Olympic Park venues.
- Drought-resistant plants are favoured on most sites to reduce the need for watering.
- A central computer controls irrigation for automatic night time use and non-use during rain periods.
- Roof harvested water cuts the Showgrounds' mains water needs by 50 per cent.
- A pool filtration system at the Aquatic Centre reduces the need for top-up water.

Missed Opportunities

- Grey water and black water collection systems were not used. These would have fed an anaerobic digester. This would have produced green electricity from biogas and formed a nutrient rich fertiliser.
- Chlorine disinfection was used for waste water treatment instead of ozone or UV radiation as originally proposed.
- Membrane technologies were not fully explored as alternatives to chemical water treatments.

TRANSPORT

A large contributor to greenhouse gas emissions is our increasing reliance on fossil fuel-burning vehicles. One of the most significant successes of Sydney's Environmental Guidelines was the high degree of public transport used for the movement of people. No provision has been made for spectators to drive their cars to the core site of Olympic Park at Homebush Bay. Strong incentives to use public transport for other sites were developed by building the cost of public transit into event ticketing. The use of electric, particularly solar-powered, vehicles at Olympic Park is also to be commended.

The disappointment is in the inability of the local automotive industry to seize the opportunity to showcase new cleaner technologies in personal transportation, such as low emission fuel or hybrid fuel cars. While spectators are moved around by less polluting modes of transport, Olympic VIPs will be transported by low-efficiency, petrol burning Holden vehicles that produce more greenhouse gases than their original designs did in 1948.[2]

Selected Achievements

- 21 of the 25 Olympic sporting events occur within the Olympic Park or the Sydney Harbour Zone, reducing overall transport demand.
- Virtually all spectators attending events will use public transport.
- The price of Olympic Games tickets includes public transport costs.
- No public car parking will be available at Olympic Park.
- The Olympic rail loop can move 50,000 passengers per hour with trains leaving Olympic Park station every two minutes.
- Both Sydney International and Domestic Airports have new rail stations and links to the city's rail network.
- 3800 buses will carry spectators directly to and from venues as direct services or as rail-bus shuttles.
- Ferry services will move officials and athletes between major venues via Sydney Harbour.
- A network of cycleways feed into Olympic Park venues.
- 500 solar and electrical buggies will transport officials, athletes and staff around the Olympic site.

Missed Opportunities

- None of the 3000+ VIP car fleet provided by Olympic sponsor Holden will be fuelled by alternative fuels such as liquid petroleum gas as originally promised.
- A hybrid fuel/electric concept car developed by Holden is not available for road use in time for the Games.

- Only 24 of the 3800 bus fleet will operate using compressed natural gas (CNG). The rest will use more polluting petrol and diesel.
- Only limited secure bicycle lock-up facilities have been provided at Olympic Park.

ENDNOTES

1. http://www.seda.nsw.gov.au/renewable.asp
2. Geoff Strong, "Blame it on the Australian dream" The Age July 14 2000

Introduction

In 1992, Greenpeace took advantage of Sydney's open and anonymous contest for the best Olympic 2000 Athletes' Village design to show that, with commitment, a city could showcase environmental solutions.

Forward-thinking architects were consulted, ideas and environmental best practices gathered and a Greenpeace design plan submitted. Our plan for an Athletes' Village was car-less, powered by the sun, used land carefully, included only non-toxic and eco-friendly materials, conserved and reused resources, and acted as a platform for cutting-edge green technologies.

Greenpeace focused on a number of key areas: solar energy, energy conservation and design, public transport, best-practice toxic waste remediation, PVC-free building materials, waste reduction and non-toxic disposal, water conservation and re-use, protection of endangered areas and species, and responsible use of timber and building materials.

More than 100 bidders, mostly architectural firms and development companies, entered plans into the Athletes' Village design contest. When the winners were announced, Greenpeace's design was among the five winners. We remained involved in the development of the final plan. Not long after, Olympic bid organisers decided that they liked the concept of a green Village so much that they extended it to the rest of the Olympic site.

At that point, Greenpeace was asked to help Sydney develop a specific set of Environmental Guidelines for the Olympic Games. We worked with alternative power and waste experts, green building designers, academics and our own team of international environmental campaigners to come up with the most progressive standards. We helped draft what became Sydney's official Environmental Guidelines for the Summer Olympic Games.

In September 1993, Greenpeace joined the Sydney Olympic bid committee in Monaco, Monte Carlo to promote the "Green Games" idea as a unique selling point of the city's bid to the International Olympic Committee (IOC) and to other bidding nations as a possible positive legacy of any Olympic Games.

Eyes on the Green Prize

After Sydney won the bid for the 2000 Olympics, Greenpeace began a seven-year campaign to ensure that the city lived up to the environmental promises it made before it won. Greenpeace closely monitored all aspects of the development and construction of the Olympic site, playing an important "green watchdog" role.

Greenpeace successfully lobbied the New South Wales (NSW) Government to have the Environmental Guidelines passed into law as part

of the budget package for the Olympics. We worked with companies tendering to design, build and supply the Olympic site, protesting when the Olympic organisers fell short of their environmental commitments.

While Greenpeace has worked closely with the Sydney Organising Committee for the Olympic Games (SOCOG), the Olympic Co-ordination Authority (OCA) and other Olympic and city officials responsible for the Games, we remain independent. We have praised Sydney's efforts when they have led to some of the most progressive environmental work internationally and protested when efforts have fallen short of promises or possibilities.

For Greenpeace, the Sydney Olympic Games have provided a platform to implement effective, mainstream environmental solutions. Since 1992 when we first came up with the idea for a Green Games, much has been achieved. Yet much more could have been done to see Sydney's original green vision became reality.

Greenpeace's Evaluation Report

With this report, Greenpeace has undertaken a detailed evaluation of how Sydney performed in seven key areas that featured prominently in the Environmental Guidelines: energy, transport, water, toxic remediation, timber, PVC and air conditioning/refrigeration. The report also outlines world's best practise for environmental solutions in these areas in an attempt to put some context to Sydney's performance.

The Greenpeace evaluation primarily covers the Olympic Park where the majority of events, venues, activities and buildings are found. The report also looks at some non-Park venues where there are significant issues or links such as public transport that cannot be separated out.

The Olympic Park covers the Stadium, Archery Centre, SuperDome, Tennis Centre, Aquatic Centre and the Sydney Showground (used for hosting Sydney's annual Royal Easter Show) which includes the Sports Hall, Exhibition Complex and the Multi-use Arena. Other Olympic Park venues covered here are the Athletes' Village, Media Village, multi-storey SuperDome car park, Rail loop and station, Novotel and Ibis hotels,17 technical equipment rooms (portable buildings),15 computer equipment rooms (portable buildings), 33 buildings at the Technical Operations Centre and the Main Press Centre.

The OCA and SOCOG were asked to assist in the collection of data for this report. The information they provided after lengthy negotiation was largely qualitative and fell very short on specific detail. In many cases information on whole areas of interest was unavailable. This is an obvious shortcoming on the part of Olympic organisers charged with ensuring the Environmental Guidelines were adhered to.

In many cases, Greenpeace was forced to search venue by venue for much of the information provided here relying on individual contractors and suppliers. Inevitably there will be data that escaped close scrutiny but every effort has been made to verify the information we obtained. Greenpeace believes a more open environmental reporting process was needed in order to evaluate Sydney's successes and failures, to learn about the obstacles to success and allow for learning for future Olympic Games.

A glossary of terms is included at the end of the report.

The report presents eight important lessons that Greenpeace believes will help other Olympic cities to match and improve upon Sydney's environmental achievements and to avoid some of the mistakes Sydney organisers made.
As we move into the new millennium, it is clear that governments and companies at all levels need to start delivering environmental solutions into the mainstream. Sydney has shown that solutions to environmental problems exist and can, with commitment from government and industry, become part of everyday life.

The challenge now is for the world to assess Sydney's performance and aim to break its environmental records at every turn.

Sydney's Green Games – The lessons learned
Greenpeace became involved in attempting to green Sydney's Olympic Games because we saw an opportunity to forward the environmental agenda and to show the world that environmental solutions are possible.

While we have been critical of Sydney when it fell short of its original environmental goals, an important part of greening the Olympic Games is the need for the lessons learned here to be passed on to future Olympic host cities. We believe the IOC has an important role to play in helping Olympic host cities and bid cities to avoid the pitfalls Sydney faced and to exceed Sydney's environmental standards.

LESSONS LEARNED

The list of lessons learned below is key to ensuring that Sydney's environmental successes are just the beginning of an ongoing international process.

Lesson 1:

Make specific environmental commitments as part of your development plans well before design plans are finalised and construction begins. Make these commitments public.

This was one of the major achievements of the 2000 Olympic Games and it's what has set Sydney apart from other Olympic host cities. In the pursuit of an "edge" over other Olympic bid contenders, the Sydney Bid Company took up Greenpeace's plan for a Green Games early and promised to make Sydney's Games the "greenest ever". Sydney submitted a set of Environmental Guidelines, which Greenpeace and other environmental organisations helped draft, as part of its official bid to the IOC and made these Guidelines public. After winning the bid, the New South Wales Government included these Guidelines in the budget legislation for the Games. While non-binding, this made the Guidelines an official part of Sydney's Olympics effort. Although Sydney fell short on a number of its Environmental Guideline commitments, much of the credit for what has been achieved can be linked to the city's early inclusion of environmental protection in all of its Olympics preparations long before winning the bid for the 2000 Olympic Games.

Lesson 2:
Environmental Guidelines must be clear and specific benchmarks that are non-negotiable, measurable and backed up by law. These benchmarks must be included in all of the tenders offered for Olympic development and made public.

In hindsight, Sydney's Environmental Guidelines were too general to ensure that specific environmental commitments could be achieved and measured. Time- and budget-pressed Olympic organisers, suppliers and developers were able to skirt around the Guidelines when meeting them required time to search for environmentally friendly materials and technologies. Had there been specific and measurable standards in areas such as renewable energy use and soil toxicity levels, such evasion would have been impossible. Equally, without laws to back them up, the Guidelines were just that – guidelines rather than regulations. Companies and developers are notorious for meeting only the minimal environmental standard if they can avoid legal sanction. Greenpeace believes Sydney would have achieved greater environmental success if there had been legal requirements on organisers and developers to meet certain standards.

Lesson 3:
Olympic organisers and developers must be required to collect and report information on all environmental aspects of their project and make this information publicly available.

In carrying out its eight months of research for this report, Greenpeace found that Sydney Olympic organisers had no defined process for gathering, verifying and recording environmental information throughout the development of Olympic venues. Organisers did not require those who won Olympic tenders to show that they were meeting specific environmental criteria. Interestingly, where developers wanted to show off their green credentials, they managed to find their records and make them available. In other instances, we were told that records had been placed in deep storage and were unavailable.

Companies around the world are realising they need back-to-source supply chain information to ensure their environmental credibility. Greenpeace strongly recommends that future Olympic cities establish a clear system for gathering and managing environmental information at all levels of the project as part of their Environmental Guidelines. Without this information, it is impossible to measure the environmental impacts of the project overall and to learn from the experience.

Lesson 4:
Independent auditing of all environmental information is essential to ensure credibility.

As Sydney did not keep detailed records of how it performed against the Environmental Guidelines nor require an accredited, independent auditor to verify this information, it is impossible to properly gauge the city's Olympic environmental achievements and shortcomings.

The OCA employed the Earth Council to undertake a series of 'Environmental Reviews' but these lacked in-depth research and credible data and were more of a PR exercise than an official and independent audit. Likewise, the IOC failed to carry out anything other than a superficial assessment of Sydney's Green Games. An independent audit of environmental information would have given Sydney unequivocal credit for its successes and put real pressure on the city to deliver on its commitments.

Future Olympic cities would benefit greatly from employing credible independent auditors from the start of venue development to ensure successes and failures are accurately monitored throughout the project.

Lesson 5:
No matter how Olympic construction is managed – with one project manager or as independent projects and contracts – Olympic organisers must ensure that the best and most cost-effective environmental systems and materials are used project-wide.

Because Sydney's Olympic venues were built by competing companies, builders were constantly "re-inventing the wheel" in their efforts to source best-practise environmental technologies and materials. The Stadium and SuperDome, for example, both sought PVC alternatives for drain pipes, cabling and flooring but as they were competing companies, they often found separate suppliers with

varying degrees of successful alternatives and at different prices. For the best environmental results, Olympic organisers have a responsibility to ensure the best materials and systems are used throughout the site even if competing companies are involved.

LESSON 6:
Great enthusiasm for and expertise in environmental building and event management exists at all levels internationally. Seek out and engage those innovative and creative experts and companies interested in the environmental success of your event.

During research for this report, architects, project coordinators, suppliers and events managers told us they were thrilled to have been involved in Sydney's green Games effort. Many told us they wanted to discuss the many complex issues involved in their participation with Olympic organisers and others involved but were rarely given the opportunity. Others told us they longed to do more environmental projects but that they came up very rarely.

There is a wealth of expertise and interest in environmentally sustainable projects that need to be tapped. Governments, corporate and residential building clients need to set challenging environmental standards that can keep our experts developing the environmental solutions we need for the future.

LESSON 7:
High-level and consistent consultation with the community, environmental and social groups is essential and must be part of the project from the beginning. A clear process for conflict should be established as part of the city's Environmental Guidelines.

A lot of the public cynicism about Sydney's so-called Green Games stems from the fact that a system was not established early on to maintain regular consultation with the many stakeholders impacted by Olympic construction.

The selection of Bondi Beach for the beach volleyball stadium was a classic case of community outrage going unheard. Residents of the Homebush Bay area were left uninformed for years about the toxic waste found at the Olympic site and were not warned when the waste was moved into landfills on site. The OCA's failure to use any environmentally safe airconditioning in Olympic venues was not made known to Greenpeace until after decisions had been made and equipment purchased.

Confidence in the consultation process would have been greater if it had been more consistent, involved senior Olympic officials and had a conflict resolution process established from the start to ensure failures did not occur without exploring all possible solutions with all stakeholders.

LESSON 8:
Education about environmental initiatives undertaken and the benefits gained is essential at all levels, from the public to athletes, sponsors, the media and the commercial sector.

One of Sydney's most unfortunate failures was its lack of an environmental public education platform for the 2000 Olympic Games. Late in 1999 a plan emerged from SOCOG for an Environmental Pavilion which would have included financial support and participation from Olympic organisers, environmental groups, government agencies and sponsor companies. At the last minute, the project was cancelled and despite seven years of effort, Sydney's Green Games project will be largely unheralded in September 2000. In addition to public education, the commercial successes of Sydney's environmental efforts should also have been analysed and promoted to encourage other developers and companies to take them up.
Olympic host cities should ensure that a commitment to and funding for education at all levels is included from the beginning of the project.

1 | Toxic contamination and the Olympic Games

INTRODUCTION

The production, trade in, use and release of many synthetic chemicals are widely recognised as global threats to human health and the environment. Yet the world's chemical industries continue to produce and release thousands of chemical compounds into the environment every year, in most cases with little or no testing or understanding of the impacts on people and the environment. Of these chemical compounds, Greenpeace has prioritised the elimination of persistent organic pollutants or POPs.

POPs are generally extremely toxic in small amounts and because they travel long distances via air currents, they endanger people and wildlife. POPs are also carried in the atmosphere towards polar environments where they condense and are deposited. This mechanism is believed to account for the surprisingly high concentrations of POPs in arctic environments and in the indigenous peoples who live there.

The other defining and worrying characteristic of POPs is that they cannot be broken down easily by natural processes. In some cases when breakdown does occur, it creates chemicals that are even more hazardous than the original substances. Dioxin, a by-product from combustion processes involving chlorine, is one of the most poisonous POPs known to science.

The United Nations Environment Programme (UNEP) has recognised the need to adopt a worldwide legally binding treaty to eliminate POPs by the year 2001 at the latest. Twelve organochlorine POPs, including dioxins have been prioritised.

The Greenpeace international toxics campaign seeks an end to the manufacture, use and disposal of hazardous, synthetic substances, particularly persistent organic pollutants. Greenpeace activists raise public awareness about the dangers of industrial pollution and encourage governments and industries to convert to clean modes of production.

Greenpeace believes the best way to deal with toxic and hazardous waste is not to produce it in the first place. The problem is that in many parts of the world, including Sydney, toxic legacies have been left by previous generations.

Sydney's controversial decision to use a former waste dump site to locate its Olympic venues raises a serious issue facing many cities around the world – how to treat and make safe toxic waste areas created years ago which pose serious environmental and human health threats.

This chapter outlines the positive and negative aspects and challenges faced during of the clean-up of the Sydney Olympic site and beyond. This

evaluation refers to the area within the site boundaries. However, no comprehensive assessments would be complete without reference to the wider Homebush Bay area, which are included here.

SYDNEY'S ENVIRONMENTAL GUIDELINES STATE:

"Degradation of natural resources by pollution reduces the capacity to protect human health. Toxic waste can pollute ground water, rivers and oceans. Waste gases from factories and cars can create a mixture of toxic chemicals in city air. Uncontrolled power station emissions can cause acid rain and agricultural chemicals can pollute air, soil and water in rural areas."

They continue:
"The protection of human health requires high standards of air, water and soil quality. When implemented, such standards provide protection from excessive exposure to heavy metals, noxious gases, toxic chemicals and bacteria. World Health Organisation guidelines are commonly used by national governments when establishing their own environmental health criteria and may also be used as a yardstick against which to assess performance of governments. Pollution is widespread throughout the world.

"Cities in particular have pollution problems and many are now addressing them. Typical innovations to improve air, water and soil quality include:

- regional air quality strategies such as open burning controls and pollution prevention regulations to minimise industrial emissions;
- improvement of drinking water quality standards to limit people's exposure to toxic chemicals and reduce risk of disease;
- improved management of urban run-off, supported by planning that minimises use of paved surfaces and reduces storm water run-off to waterways;
- effective remediation of former industrial sites.

"Olympic host cities should commit themselves to... comprehensive contamination testing of former industrial sites being redeveloped for the Olympic Games with remediation and risk reduction programs as appropriate."

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

Toxic Remediation Outcomes

Sydney's wider Homebush Bay area was the site of wholesale dumping of domestic, industrial and commercial wastes from the 1930s until the 1980s. Nine million cubic metres of waste were dumped in the area, gradually filling more than 160 hectares of the natural wetlands of Homebush and Wentworth Bays.

Some of this was made up of extremely hazardous industrial waste and has had a significant impact on the wider environment and receiving waters due to its toxicity, persistence and/or bio-accumulative nature.

The New South Wales (NSW) Government's decision to bid for the 2000 Summer Olympic Games meant that the motivation, and more importantly, funding commitments were mobilised to clean-up and manage a site which probably would have otherwise languished as a contaminated legacy of industrial dumping. While there are many issues about how effectively the site has been cleaned up, it is highly improbable that the investigation into, separation and landfilling of waste on-site would have occurred to the extent it has without the Olympics to justify the cost and effort.

Sydney's choice of site was underpinned by the city's Olympic Environmental Guidelines in a number of ways. As a former dumping ground, the redevelopment of the site represented an opportunity to develop Games infrastructure without clearing previously untouched remnant vegetation or contributing further to Sydney's suburban sprawl. The site also has the advantage of being close to the demographic centre of Sydney, facilitating mass transit to and from the site.

The clean-up of the site has been an opportunity to trial mass clean-up strategies on a scale not previously attempted in Australia. Some of the clean-up strategies adopted by Games organisers and the NSW Government have been far from perfect, however they have made the site, at least in the short term, safer than it was.

Early Approaches to the Toxic Clean-up on the Olympic Site

When the Olympic Co-ordination Authority (OCA) started to rehabilitate the site in 1994, extensive analyses of the former dump sites were undertaken. These followed previous studies in the late 1980s when the State Sports Centre precinct was developed. These studies characterised the extent of the contamination and the level of ground water contamination and ground water flow direction and volumes. From these studies, it became apparent that significant environmental impacts were occurring. The NSW Government committed $A137 million to minimising them as part of the site rehabilitation.

Some early plans envisaged relocating all waste to the immense disused brick pit at the former State Brickworks on the Olympic site. The brick pit was considered an attractive option because of the impermeability of its shale/clay structure and the apparent lack of seawater infiltration into the pit. This idea was quickly dropped when ecological surveys discovered a population of the endangered green and golden bell frog (Litoria aurea) in and around the ponds at the bottom of the brick pit.

Cap and Consolidation Strategy

Given the scale of the necessary work, the OCA decided to consolidate the many and diverse waste sites into fewer large landfills to facilitate leachate management. These landfills, with their approximate waste volumes and annual leachate flow rates (where available) are tabled below.

Greenpeace does not endorse landfilling as a waste solution. The reclamation of the site has only contained the material and reduced the impact (at least in the short term) of extensive and inappropriate dumping into the local environment which occurred for decades before the site was chosen for the Olympics.

Greenpeace believes the best possible approach to clean-up would have been to excavate all nine million cubic metres of dumped waste, sort it into various recoverable waste streams and follow this with treatment and destruction of non-recoverable wastes using closed loop non-incineration technology on-site. Such an approach would have been significantly more expensive than the methods chosen by the NSW Government to reclaim the site. But this more comprehensive effort may turn out to be the most cost-effective in the long run. This is especially true when the long-term management and the inevitable environmental and systemic problems that are bound to occur with such a landfill approach are factored into the overall cost.

It is now widely recognised that the most effective and economical approach to toxic waste is not to produce the waste in the first place – that is, eliminate such waste at source. This is only applicable to materials currently being produced. It does not apply to material dumped by previous generations. The retroactive approach to the Olympic site clean-up has dictated a less than perfect clean-up strategy.

As part of its commitment to the Green Olympics, the OCA agreed with Greenpeace not to transport waste off-site as this would unfairly burden a second community with the impacts of waste transport and dumping. In practice, there was probably little alternative to dealing with the waste on-site as other locations were not available to take such an amount of waste. In reality, Greenpeace believes that cost and time constraints were the overriding factors influencing the decisions on the type of remediation chosen for the Olympic site.

Following consolidation of the waste on the Olympic site, the final landfill sites were capped with a metre of clay or sealed under asphalt car parks to minimise rainwater infiltration. They were then landscaped for stability, and monitored for ground water movement.

Olympic Site Landfill Leachate Management

Apart from 400 tonnes of highly contaminated chlorinated material found later on the site,

Table T1 – Waste in Landfill at Sydney's Olympic Site

Landfill name & type of waste	Waste volume (m^3) (estimates including pre-existing landfill volume)	Leachate volume (megalitres per annum) 1600MWh
Haslams Creek South (Kronos Hill) Domestic and industrial waste	550,000	18.25
Haslams Creek North (P5 Carpark) Power station fly ash	600,000	9.125
Archery Park (former Elcom dump) Power station fly ash and some demolition waste	130,000	10.95
Homebush Common (formerly Golf Driving Range) Domestic and industrial waste	780,000	9.125
Clay Pit Landfill Primarily demolition waste	55,000	2.95
North Newington Mix of a variety of waste found on site including industrial waste	1,700,000	Not yet completed (6/00) estimated in NRAP (p175) as 19.13
Auburn/Hardies Domestic and asbestos waste	907,000/70,000	Not yet completed (6/00) estimated in NRAP (p175) as 31.17
Aquatic Centre Car Park Cells Industrial waste	Unavailable	0 (enclosed system)
TOTALS	**4,792,000**	**100.7**

Sources: NSW Waste Services, Newington Remedial Action Plan, Nov 1997
Olympic Co-ordination Authority, Ecology Program, *The Big Clean-up*, 1999
Personal communication with Mike Howe, NSW Waste Services, 2000
Personal communication with OCA Environment Section, June 2000

Olympic organisers missed the opportunity for separation and destruction of waste and the focus moved heavily towards the management of the 'contained waste'.

The consolidate-and-cap approach has attracted strong criticism from many quarters, with most objections based on the fact that the waste has not been significantly separated or treated. All the landfills have leachate recovery drains, sumps and pumps installed. These act at the lowest hydrogeological point in the local ground water systems. This ensures that most of the contaminated ground water flows to these collection points. This is further monitored by an array of water depth-sensing piezometers which verifies the depth profile of the ground water and ensures that flows are towards the interception system.

The collected contaminated leachate from the landfill sites is either reticulated to the Lidcombe Liquid Waste Plant (LWP), a hazardous waste treatment plan located near the SuperDome, or pumped to evaporation ponds for interim storage until rising mains to the LWP can be installed. Volumes are estimated to be at least 100 megalitres per year.

Due to the large volume of water collected from the site the landfill leachate is relatively clean compared with most of the raw industrial liquid wastes they receive from clients throughout the Hunter, Sydney and Illawarra industrial axis.

LWP management uses the leachate as process water in its waste treatment. However, 100 megalitres of liquid waste represents 100,000 cubic metres or around 100,000 tonnes of contaminated water per year. Given that the total capacity of the plant is just 150,000 tonnes per year, the leachate burden represents a significant reduction in plant capacity. It is likely that the interim approach of diversion of waste to evaporation ponds may play an ongoing role as overflow management. Greenpeace believes this could pose environmental risks including volatilisation and release of pollutants into the surrounding environment.

Further, while the NSW Waste Service would like people to think otherwise, the LWP uses incineration technology to dispose of material. Incineration is not only a waste of potential resources, it also significantly contributes to the degradation of human health and the environment. The proliferation of incineration must be prevented to avoid the creation and dispersal of toxic and persistent poisons throughout the environment. Dispersal of persistent, bioaccumulative chemicals from incinerators adds to the chemical contamination of the air, water, land and ultimately our food. For this reason Greenpeace opposes all incineration. Instead, we advocate elimination at source through clean production and where stockpiles or contaminated sites do exist, clean-up and destruction of these sites using non-incineration closed loop technology.

Figures obtained on leachate flows from the currently operational reticulation systems, show that in some cases, the leachate drainage systems are working too well, pulling in uncontaminated regional ground water flows. While not a problem in itself, it does unnecessarily increase the volume of leachate requiring treatment. This has implications for ongoing treatment and management of the leachate.

The obvious weakness inherent in this leachate drainage approach is that it requires active management and maintenance for as long as the leachate continues to flow. This is anticipated to continue indefinitely. Problems of maintenance, monitoring and repairs/improvements, as well as a lack of clarity about which government agency is responsible for ongoing management and costs have not been clearly addressed.

In 1999, the Olympic site leachate pumps were shut off for five days causing ground water levels to rise to a point where leachate reached the surface and flowed into local waterways. This situation apparently arose as a result of a misunderstanding between the OCA and the LWP, which receives the waste leachate. In the end, no one assumed responsibility until the leachate reached the surface[1]. Problems are likely to occur in the coming years which means that the escape of landfill leachate into the environment is likely. This is a major problem with the long-term landfill approach.

Serious questions over the remaining landfill areas on the Olympic site remain. These landfills do not represent a permanent solution to the disposal of toxic waste, although the area is now far less hazardous than it was and will be safer for Games visitors.

For many years Greenpeace has raised concerns over who will be responsible for the on-going maintenance and remediation works after the OCA ceases to exist at the end of the Games. To date, no concrete plans for the post-Games management of the site have been forthcoming from the NSW Government.

(Details of leachate contamination post-capping are included as Appendix A at the end of this chapter.)

Aquatic Centre "Bank Vault" Strategy

The so-called "bank vault" approach taken at the Aquatic Centre carpark, in which the waste was encapsulated in a double flexible liner, pre-dates the controlled leachate strategy. The term "bank vault" is a misnomer as the containment is nowhere near as secure as the name implies. It is a matter of time before the integrity of the liner fails

and ground water is free to percolate through the wastes. Monitoring is conducted on ground water from bores around the cells to ensure that any such breaches are detected. When the liner does fail however, it will be difficult if not impossible to repair and the costs of further remedial action may be substantial.

Complete lining of the North Newington site was also considered but the OCA decided it was too expensive to excavate and store 590,000 cubic metres already on the site while the liners were to be installed.

Incineration Residues

The treatment process at the LWP concentrates heavy metals in the sludgy residues at the end of the de-watering and treatment process. The concentration of leachate contaminants is relatively low in comparison with the usual industrial wastes treated at the LWP. However, the volume of leachate requiring treatment means that a substantial heavy metal load finds its way into the LWP residues. These residues are immobilised in one-tonne blocks and disposed of in landfill areas at Lucas Heights, south of Sydney. There is no guarantee that the "immobilised" wastes will not slowly leak out of the blocks in the future, leading to a significant pollution problem.

Previous proposals to turn the LWP waste sludge into pellets to be burned in NSW power stations were suspended after criticism from Greenpeace and local communities. This approach would have meant that heavy metals and other pollutants would have been released into the environment when burned via smokestack emissions. This is a complete contravention of the ESD principle of "intergenerational equity" or the shifting of toxicity burden from one community to another, inherent in Sydney's Environmental Guidelines. Greenpeace believes this approach should be strongly avoided at all cost.

400 Tonnes of Toxic Dioxin Waste Found on the Olympic Site

In 1997, during the excavation of the corridor wetlands (Newington East), earthworks being driven through old dump sites started to uncover industrial waste drum remnants. Initially, these remnants were treated as isolated occurrences, and unfortunately, the first tonne was buried in the North Newington landfill mound being built at the time.

Further excavation of drum remnants (around 200 tonnes) meant that a more appropriate disposal method had to be found. Analyses of the drums' contents indicated a high organochlorine content (up to 90 per cent), including dioxin and chlorinated benzenes. According to NSW Environment Protection Authority (EPA) regulations, this waste was classified as Scheduled Waste which is not permitted to be landfilled or incinerated. Despite this, the original wastes disposed of in the North Newington landfill were not recovered, and remain buried where they were dumped.

In 1992 Australian State and Federal governments effectively banned hazardous waste incineration and export of these types of substances. This has facilitated the development of safer, more environmentally sound waste treatment options.

The waste found on the Olympics site was removed to a drum remnant holding pad at the northern end of the Newington site. Greenpeace believes storage of this waste was totally inadequate and failed to meet legal standards for the storage of hazardous wastes. In fact, the contaminated soil was covered only by plastic sheeting allowing exposure to the elements and contact with the soil of the holding pad. The subsequent contamination of the holding pad soil doubled the soil requiring treatment to 400 tonnes.

This situation continued until late 1998 when a tender was awarded to Australian Defence Industries (ADI) for an innovative treatment of the contaminants from the soil (using indirect thermal desorption) followed by a base catalysed chemical destruction (BCD/ADOX) of the concentrated contaminants. The second stage of destruction is currently underway.

Greenpeace believes that such treatment methods offer a far more acceptable alternative to incineration of POPs and other hazardous wastes. Internationally, it is recognised that hundreds of thousands of tonnes of POP waste stockpiles continue to pose serious environmental and human health risks. The non-incineration approach used at the Olympic site to destroy this 400 tonnes of waste provides a clear example of effective alternatives to incineration.

Monitoring and Validation of the Olympic Site

Greenpeace is deeply concerned that there is still no publicly accessible validation documentation on the bulk of the remediation work undertaken. While the OCA has been at pains to explain what they have attempted to do at the Olympic site, there is still no public or accountable scrutiny of validation reports. That is, there is no way that members of the public can satisfy themselves that the remediation has actually resulted in an improvement in the environment at the Olympics site.

It is undeniable that the environment is vastly improved visually, and that leachate drains and systems have been installed. However, without seeing independent validation, it is by no means clear or certain that remediation goals have been met, or that they will continue to be met in the future. This is an unacceptable lack of

accountability, and needs to be corrected before any claims of environmental improvement can be made.

Around 40 substances are monitored in leachate every six months, in addition the OCA, through its Ecology Program, is to undertake a series of one-off biological tests called bio-assays. These bio-assays are made up of a range of tests from bacteria to shellfish. This approach assesses the toxicity of the entire cocktail of compounds present and should accurately reflect the overall local biological impact of the leachate. Such an approach has the advantage of detecting hazardous effects that may be due to the combined impact of all the chemicals in the water or soil, which might otherwise not be anticipated or detected.

While a useful tool, a one-off testing regime will not give any long-term indication of environmental impacts. Further, the testing program currently proposed will only address the leachate from landfills, and will not be used to validate the levels of toxic contaminants which may remain in the soils and sediments of the site and surrounding areas. Such tests may also not detect sub-lethal or behavioural effects on animals and other wildlife, which may be exposed to the pollution.

A strict and regular (ie monthly) monitoring regime which includes a wide range of substances as well as bio-assays should be developed. All results should also be publicly available to clearly demonstrate that the environment around the Olympic site is protected.

Validation and transparent monitoring of the Olympic site and surrounds has been an on-going problem for the OCA. For example, in July 1997 the OCA released a review of dioxin contamination at the Sydney 2000 Olympic Site. The report was prepared by consultants CH2M Hill and reviewed much of the available information about the uncontrolled disposal of dioxin contaminated waste at landfills at and around Homebush Bay from the early 1950s to the 1970s, and the clean-up strategy of the 1990s.

The OCA review claimed that the most toxic form of dioxin, 2,3,7,8 TCDD was only detected at low levels at 12 locations from the 5000 soil samples analysed on the site. Greenpeace investigations of the original chemical analyses indicated that TCDD was in fact detected at low levels in almost every sample examined. Several other inconsistencies were also noted and passed on to the OCA.

The excavation of the dioxin contaminated drum wastes (mentioned previously) also quickly highlighted the deficiencies of the review only a few weeks after the report was released. Also, one OCA official made inaccurate public comments that no dioxin had ever been detected on the Olympic site. The OCA later issued a second edition of the report and a public apology for the official's comments.

Community Consultation

During the early stages of Olympic site clean-up and construction, little formal community consultation was undertaken by Olympic organisers. With the formation of a non-governmental watchdog body in 1995 which was strongly supported by Greenpeace, Green Games Watch 2000 (GGW2000) helped establish a more regular mechanism for community input. The GGW2000 management committee was made up of representatives from the NSW Total Environment Centre (TEC), NSW National Parks and Wildlife Association (NPWA) and the Australian National Toxics Network (NTN). The committee employed full and part-time staff.

Given their participation in drafting Sydney's original Environmental Guidelines, these bodies expected their concerns about the management of toxic waste at the Olympic site would be addressed. Unfortunately, this was not the case and the relationship between GGW2000 and the OCA and the Sydney Organising Committee for the Olympic Games (SOCOG) proved difficult and often unproductive. Similarly, Greenpeace's concerns and issues were often ignored.

To some extent these communication problems were channelled through the formation of the Olympic Environment Forum (OEF) in 1997. The OEF is made up of members from the OCA, SOCOG, Greenpeace, GGW2000, TEC and the NSW EPA. Meetings have been held fortnightly for three years allowing a relatively informal atmosphere for information exchange and specific environmental questions and issues to be raised. The success of this process has been mixed, largely depending on the specific issue and the various positions of the participating institutions around those issues. The biggest failure is that the OEF is not a decision making body. Greenpeace believes clearer lines of responsibility and higher level involvement in environmental decision making would have ensured greater environmental success for Sydney's Games.

A further mechanism for more accessible community consultation and participation was established in June 1998 through the Homebush Bay Environment Reference Group (HBERG). HBERG was established as a community consultative forum under the OCA's Ecology Program. This program endeavours to validate and communicate the clean-up processes undertaken at the Olympic site. Membership includes diverse local community and environment group representation, as well as member/observer status for key OCA staff and relevant contractors.

HBERG meeting organisers have had a poor and

sometimes erratic response to the many real and substantive issues raised over site clean-up and this has frustrated local participants and environmental groups. OCA institutional difficulties meant that very little measurable progress was made from HBERG's inception until late 1999, when structural, and apparently attitudinal, changes were made to facilitate the delivery of some of the program's original objectives.

CONTAMINATION & CLEAN-UP ISSUES AROUND THE OLYMPIC SITE

Wilson Park

Wilson Park, just next to the Olympic site, is heavily contaminated from its past use as a "town gas" production site. This resulted in 250,000 tonnes of Polycyclic Aromatic Hydrocarbon (PAH)-contaminated soils on-site. The material has not been cleaned up but contained and the focus put on leachate/volatile control using bioremediation.

The approach to leachate control encourages bacteria in the local microflora that have been naturally selected for their ability to use these contaminants as metabolic energy sources to digest the leachate. By adding additional nutrients, these bacteria have been able to reduce levels of these contaminants in leachate. This area will need to be monitored closely for years to come to ensure no negative environmental or human health impacts occur.

Other ground water controls include ground water cut-off barriers between Kronos Hill and the immediately adjacent Haslams Creek, between the North Newington landfill and the Newington wetlands and between Wilson Park and the Parramatta River.

Toxic Neighbour - the Legacy of Homebush Bay

Just 2.5km from the Olympic site lies Homebush Bay, one of the most polluted waterways in the world. The Bay and the lands adjacent to it (Rhodes Peninsula) contain over half a million tonnes of dioxin-contaminated soils and sediment, which pose human and environmental threats.

After decades of industrial production and dumping, the site is now heavily contaminated with dioxins, organochlorine pesticides, heavy metals and other toxic chemicals. This hazardous waste is inadequately contained and has been allowed to enter the wider environment for years.

High levels of dioxins, DDT, phthalates (plastic softeners) and other chemicals have been found in fish in the Bay – the only waterway in Australia where fishing is illegal due to dioxin contamination. Fish samples from the Bay showed average tissue concentration of 189 ppt (part per trillion) of dioxin in fish – seven times higher than US Environmental Protection Agency safety levels.

The toxic chemicals in Homebush Bay are spread dangerously throughout the environment and cast a dark shadow on Sydney's reputation as host of the first ever "Green" Olympic Games. Interestingly, Homebush Bay was included in the original bid for the Sydney Olympics and was to include a grand gateway to games venue for ferries and other boats. Somewhat expeditiously, Homebush Bay was quickly removed from the proposed Olympic site after Sydney won the bid for the Games.

The multinational chemical companies Union Carbide and ICI (now called Orica) are largely responsible for this toxic mess. From the 1950s to the 1970s Union Carbide manufactured organochlorine pesticides such as DDT and the ingredients of the Vietnam War defoliant Agent Orange at Homebush and disposed of the wastes in the Bay and surrounding lands. ICI was the sole manufacturer of phthalate plasticisers in Australia along with a range of other chemicals.

The NSW Government and the Olympic authorities ignored the extensive contamination for years. It was only after Greenpeace safely secured an abandoned stockpile of 69 drums of dioxin waste adjacent to the former Union Carbide factory site in 1997, that the Government committed A$21 million to clean-up the Bay in time for the 2000 Olympic Games.

The Government committed to remove all the contamination and use innovative Australian non-incineration technology to treat the dioxins – a commitment that was widely praised by community groups, including Greenpeace. However, the clean-up plans ran into serious problems.

The NSW Government was responsible for the Bay's sediments, the company Bankers Trust owned the land adjacent to the former Union Carbide factory site, and a holding company – Lednez Australia Ltd - owned the factory site itself. Union Carbide left Australia in the early 1990s leaving the site in the hands of Lednez, who refused to participate in the clean-up.

This is significant, as any proposal that did not address the Union Carbide site would have left tonnes of dioxin contamination in the middle of any future site development. Negotiations with Lednez took far longer than anticipated and it was only in early 1999 that the NSW Government finally took control of the toxic site. This cleared the way for all of the Union Carbide dioxin legacy to be cleaned up.

Despite Government promises, the Bay and Rhodes Peninsula will not be cleaned up before the Games. The NSW Government is engaged in a tender process to choose a remediation plan for both before the Games but it may or may not

occur. Greenpeace has spoken with the potential remediation companies and the Government throughout the last two years about possible clean-up approaches.

While Greenpeace is concerned about the toxic waste on the Olympics site, we believe that compared with the site, Homebush Bay is a far greater toxic threat and more urgently pressing environmental and human health issue. Greenpeace considers the hazard posed to the community from the Bay to be totally unacceptable and will be holding the NSW Government to its commitment to clean-up the Bay after the Games and to do so to the highest possible safety levels.

At the other end of Homebush Bay the old Orica (formerly ICI Australia) chemical factory has been demolished. The factory was the only producer of phthalates in Australia. Phthalates are chemicals used to soften vinyl plastic and will soon be banned in many European countries because of the risk they pose to children's health. The sediment next to the factory is highly polluted with phthalates and heavy metals, including lead.

Still More Waste Around Sydney

Unfortunately, Union Carbide's toxic legacy is not only confined to Homebush Bay. Reports by the NSW State Pollution Control Commission (the forerunner of the Environment Protection Authority) indicate that between four and 30 kilograms of dioxins mixed with charcoal was dumped in landfills in the Sydney area in the 1970s. Under World Health Organization guidelines four kilograms of dioxins provides maximum lifetime exposure levels for 560 million people.

WORLD'S BEST PRACTICE

In general, Greenpeace believes that elimination at source through the adoption of clean production is the best and most cost-effective way to avoid toxic waste problems. However, where toxic waste has been dumped or stockpiled and needs to be made safe, the best approach is to avoid incineration, ensure that any storage of waste is short term, and that treatment is strictly regulated to ensure it meets safety standards.

Below is what we believe to be the essential ingredients for addressing toxic waste remediation. These are:

- **No dumping or incineration** Organochlorines must not be allowed, under any circumstances, to be dispersed into the environment through direct dumping or the use of dangerous and inadequate disposal technologies like incineration.

- **Secure storage** Secure storage of toxic waste must be considered the first step in a comprehensive program to identify and develop suitable and safe de-toxification for individual waste streams.

  Secure storage is defined as a place where segregated waste streams are stored in purpose built, above ground facilities, which incorporate:

- high security measures;
- the ability to monitor and retrieve chemicals in storage;
- zero emissions to water, soil and atmosphere;
- rigorous and routine inspections;
- emergency response program.

- **Strict regulation** Strict precautionary measures must be taken to prevent environmental and human health damage that could result from an accident, leak, spill, fire, explosion or natural disaster. Storage facilities must be designed with a view to facilitate future methods of detoxification.

- **Closed loop destruction** Systems and technologies for the safe de-toxification of chemicals must be designed to be 'closed-loop' and avoid the release of toxic chemicals into the environment.

- **On-site treatment** Mobile detoxification systems which are taken to a contaminated site must be removed upon completion of de-toxification and not remain in-situ where the system could be used to import and dispose of other waste streams.

- **Responsibility and accountability** Original producers of banned chemicals, where they can be traced, must be liable for the storage, collection and disposal and the full cost of all stages of the de-toxification program.

- **Community right to know** Full access to records and all aspects of the program, including the technologies used, alternatives considered, monitoring data at storage and de-toxification sites, must be made freely and easily available to the public.

Unfortunately, around the world, the most common approach to hazardous waste is incineration, which transfers toxic waste from one form – solid waste – into another – airborne pollution. Incineration of POPs and other hazardous wastes also generates large amounts of contaminated ash, which is often toxic and is usually sent to landfill. Greenpeace believes this is not an answer.

Ironically, Australia is a unique exception to the incineration approach for the treatment of POPs wastes. In 1992, Federal and State Governments of Australia effectively banned hazardous waste incineration making the country an excellent breeding ground for safer, more environmentally sound waste treatment options. This ensured that the dioxin waste found on the Olympic site was not incinerated and that more environmentally responsible options were pursued. Indirect thermal desorption to remove the waste from soil followed

by a base catalysed chemical destruction process (BCD/ADOX) of the concentrated contaminants was used. Other non-incineration treatment technologies have been, and are being developed around Australia and internationally. Hopefully, the use of this technology at the Sydney Olympics site will help demonstrate that alternatives to incineration are capable of successfully treating hazardous wastes and provide the impetus for the further use of such technologies around the world.

CONCLUSIONS

Sydney's controversial decision to use a former waste dump site to locate its Olympic venues highlights a serious issue facing most cities around the world – how to treat and make safe toxic waste dumps and industrial areas created in the past which pose serious current environmental and human health threats. The only effective environmental solution is to stop producing toxic waste. While Greenpeace continues to pressure companies and governments to take up clean production, we still face long-term toxic waste problems. The NSW Government and the OCA chose a short-term landfill approach, which unfortunately, has handed generations to come a waste management issue that is likely to have many unexpected environmental problems.

While the end result at the Olympic site is certainly better than it was before – as an uncontained toxic waste dump – Greenpeace believes that a more active approach to segregating and treating all the wastes on the site would have made the area safe and improved the local environment significantly.

The NSW Government still faces the challenge of cleaning up Homebush Bay. The opportunity exists for this to be a world leading example. Hopefully this time they will get it right.

For more information:

- A full and technical outline of Greenpeace's criteria for toxic waste remediation is available on the Greenpeace Web site: www.greenpeace.org under Toxics. It is also available from the International Forum for Chemical Safety website at: www.who.int/ifcs/isg3/d98-17b.htm.
- Reviews of some appropriate Technologies for Treatment of Scheduled Wastes by the Australia Government are available from: www.environment.gov.au/epg/swm/swtt/swtt.html
- Information on Scheduled Wastes and the regulatory structure in Australia is available at www.environment.gov.au/epg/swm.html
- Information on contaminated sites legislation in Australia, New Zealand, Canada and US: www.environment.gov.au/epg/control/link.html

Endnotes

1. D. Bardwell, personal communication

APPENDIX A

Leachate contamination data post consolidation and capping, as currently pumped to the LWP in the case of Haslams Creek North and South, the Archery Park landfill, Clay Pit, and Golf Driving Range. North Newington and Auburn /Hardies leachate mains are still being constructed and leachate is currently pumped to evaporation ponds as an interim management strategy. The Aquatic Centre carpark cells (1&2) are enclosed and do not require reticulation of leachate at this stage although they will need to be closely monitored for seepage in future.

***BREAKDOWN OF LEACHATE CONTAMINATION, OLYMPIC SITE** (ALL FIGURES ARE IN PARTS PER MILLION UNLESS NOTED)*

	Aquatic Centre Car Park (Cell 1)	Aquatic Centre Car Park (Cell 2)	Haslam's Creek North	Haslam's Creek South	Archery Park	Golf Driving Range	EPA Limit (CWAct, freshwater)
Alkalinity	889	353					
Ammonia (as N)	474	186	7.44	136	1.6	447	0.5
Arsenic (Total)	0.008	0.035	0.003	ND	ND	ND	0.05
Barium	0.141	0.271	0.77	2.26	0.4	2.46	1
BOD5	26	31	0.5	7	3.8	25	20
Boron			2.35	4.28	1.1		1
Cadmium	0.003	0.002	ND	ND	ND	ND	0.01
Calcium	2691	1459					
Carbonate	250	59					
Chloride	13775	8562	4279	2780	741	6700	250
Chromium	0.099	0.003	0.003	ND	ND	0.01	0.05
Copper	0.091	0.014	0.009	ND	0	0.004	1
Cyanide - Total	0.045	3.58	ND	0.3	ND		0.05
Dissolved oxygen*	13.82%	18.08%					
Dissolved Solids	30333	4126					
Electrical Conductivity*	38475µS/cm	24985µS/cm					
Fluoride	0.45	1.25	0.63	1.83	0.4	0.4	1.5
Herbicides			ND	0.07	ND		0.1
Iron (Filterable)			1.52	0.31	0.1	11.65	0.3
Kjedahl Nitrogen	424	159					
Lead	0.033	0.002	ND	ND	ND	ND	0.05
Magnesium	13.81	47.44					
Manganese	0.006	0.191	2.32	1.52	0.2	0.5	0.05
Mercury			ND	ND	ND	ND	0.001
Methyl Blue Active substances			0.18	1.45	0.1		0.5
Nitrate + Nitrite (as N)	1.94	1.25	0.12	0.11	1.8	0.16	10
Oil & Grease			4	ND	ND		
Organic Carbon	96	44.3					
PAH	0.006	0.042	ND	ND	ND	ND	
PCB			ND	ND	ND		
Pesticides - Toxaphene			ND	ND	ND		0.001
Pesticides - OCs			ND	ND	ND	ND	0.01
Pesticides - OPs			ND	ND	ND	ND	0.05
pH*	9.8	8.8	7.6	7.1	8		8.5
Phenolics	0.05	0.11	ND	ND	ND	0.2	0.001
Potassium	2223	851					
Selenium			ND	ND	ND		0.01
Silver			0.006	ND	ND		0.05
Sodium	3791	2249					
Sulfate	1314	1005	490	253	275	116	250
Suspended Solids	685	35606	12	96	13	69	30
TPH	1.07	1.32	ND	ND	ND	3.9	
Uranyl Ion			0.005	ND	0		5
Zinc	0.058	0.0483	0.04	0.11	0.1	0.16	5

*** = measurments other than PPM** **ND** = no data **Source:** OCA Environment Section, data provided to HBERG meeting, June 2000

2 | Energy use at the Olympic Games

INTRODUCTION

Greenpeace has identified global climate change as one of the greatest threats to the planet. Governments and scientists alike have agreed that the problem is real and serious. At the climate summit in Kyoto in late 1997, industrialised countries agreed, at least on paper, to reduce the amount of carbon dioxide and other greenhouse gases they pump into the atmosphere. However, crucial details, upon which the success or failure of the agreement rests, are still under negotiation. At the present time little definite action is being taken to address the problem.

Greenpeace is lobbying governments to face their responsibilities and urgently address the issue of climate change. The longer the delay, the more drastic the action required to avoid dangerous interference with the planet's climate.

Governments should be leading the way with a new energy direction based on clean renewable energy, such as wind and solar power. However, many governments use tax payers' money to support companies that spend billions of dollars on coal, oil or gas - the key climate-damaging fossil fuels.

Scientists estimate that only a limited amount of carbon can be released into the atmosphere before passing the "safe" limit of climate change. It is at this point that climate change will occur so fast that ecosystems will be unable to adapt. Greenpeace believes that a temperature increase of one degree Celsius is the absolute maximum that should be allowed. The amount of carbon that can be released to keep within this limit is in the range of 112.5 to 337.5 billion tonnes over the next 100 years.

However, industry already has around four times this amount of carbon – more than one thousand billion tonnes – in existing reserves of oil, coal and gas. This means that three-quarters of the oil, coal and gas cannot be burned if we hope to avoid dangerous climate change.

If we continue to burn fossil fuels at present levels, the "safe" limit of one degree Celsius will be reached in just 40 years. That is why we have to start reducing carbon dioxide emissions immediately and prepare for an orderly phase-out of fossil fuels. Greenpeace calls this approach the "carbon logic".

Despite having enough oil reserves to alter our global climate, oil companies continue to explore for new sources. Every dollar spent on new oil exploration for fuel which cannot be used due to its negative environmental impact is a dollar not spent on the real solutions to climate change: a conversion to renewable energy sources. Oil companies, such as Exxon, Shell, Mobil and BP Amoco, continue to explore for oil in ever more

remote, "frontier" areas. Despite the climate threat, governments continue to license these efforts and even encourage them with favourable tax rates.

Greenpeace is challenging the oil industry to stop exploring for more oil and to switch investment into renewable energy. Greenpeace believes it is possible to completely change the way the world provides for its future energy needs. We can no longer assume that fossil fuels will provide the bulk of our energy. Instead, changes need to be made now to move towards a future where our energy needs are met by clean, renewable energy sources. We are therefore campaigning for investment in renewable energy; and for removal of the barriers to the development and use of renewable energy.

The focus on saving energy and promoting renewable energy at Sydney's Olympic Games was a key reason Greenpeace became involved in the planning effort back in 1992. It is one of the most important aspects of Sydney's Environmental Guidelines and, ultimately, the city's Olympic site.

SYDNEY'S ENVIRONMENTAL GUIDELINES CALL FOR:[1]

- Passive solar building design wherever appropriate
- Use of insulation and natural ventilation
- The widest possible use of renewable sources of energy
- High efficiency lighting systems with maximised use of natural light
- Use of energy efficient appliances
- Sophisticated building management and control systems to assist management of engineering services at each venue to minimise energy requirements
- Mechanical ventilation zoned to allow ventilation flow to be switched off when spaces are unoccupied

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

On-site Energy Generation

In 1996, the Olympic Co-ordination Authority (OCA) commissioned an Energy Options Study of 14 possible renewable energy sources for the Olympic site. The "strongly recommended" sources were solar photovoltaic (PV) electricity and natural gas co-generation.

Solar PV has been installed on the 665 roofs of Athletes' Village, the roof of the SuperDome, as part of the water pumping system in Millennium Parklands, and in the 19 lighting towers along Olympic Boulevard. Australia's largest single centralised solar domestic hot water system, with 400 square metres of collectors, provides hot water to the neighbouring Homebush Bay Novotel Hotel and Ibis Hotel, and is expected to provide 60 per cent of the hotels' hot water needs. (See tables E1- *Solar Photovoltaic Electricity Generation at Olympic Park*, and E2 - *Solar Hot Water Heating at Olympic Park*.) Details of the quantities of renewable energy sources on site are listed in the chart below. It is expected that thousands of tonnes of carbon dioxide emissions will be reduced at the Olympic site due to these measures.

A natural gas co-generation facility was installed in Stadium Australia, which operates when the Stadium is in use. Although it uses a non-renewable source of energy, gas co-generation results in energy savings of 20 to 40 per cent and reduces greenhouse gas emissions by up to 50 per cent compared with conventional energy sources. The two 500 kilowatt gas fuelled co-generation engines in Stadium Australia produce heat, hot water, and power, and reduce the Stadium's demand on mains electricity by an estimated 10 per cent. The co-generation system will provide

Table E1 - Solar Photovoltaic Electricity Generation at Olympic Park

Olympic venue	Description of system	Peak capacity	Annual electricity generation
Athletes' Village	665 permanent houses are fitted with grid-connected rooftop solar photovoltaic cells (1kW array on each house)	665kW	1,000MWh
SuperDome	1176 solar panels mounted on the roof provide energy comparable to 10% of the arenas normal daily non-event demand	70kW	85MWh This provides power for the Green Power Program
Public Domain	19 grid-connected solar powered lighting towers (6.8kW array on each tower)	130kW	160MWh (6MWh weather-depending during the Games)
Northern Water Feature	Solar powered lights along paths		
Millennium Parklands	800 solar panels power a pump system used to drain/refill freshwater wetlands to control mosquitoes and pump leachate from swales and holding areas. Solar lighting will be used in remote areas		97.7 MWh. (Estimated 39MWh/p.a. surplus will be fed to grid with 7.MKh/p.a. drawn from grid for cloudy days)
Ferry Wharf	Solar powered street lights		

power for lighting and for emergency back-up services. Co-generation at the Stadium saves an estimated 500 tonnes of carbon dioxide emissions annually.

Outside Olympic Park, some Olympic venues also include renewable energy and energy conservation measures. The most notable of these include the grid-connected solar panels located on the roof of the Entertainment Centre in Darling Harbour (14kW) the finishing tower of the Sydney International Regatta Centre in Penrith (1.2kW) and the solar hot water systems at the Sydney International Shooting Centre at Cecil Park.

Green Power

A green power scheme enables electricity customers to buy clean and renewable energy from their electricity provider via existing power lines. The provider commits to supply the equivalent power needs from approved renewable sources, which can be located in other geographical areas and do not need to be installed on the house itself. Participating in a green power program is an easy and effective way for Olympic venues to reduce their greenhouse gas emissions, while contributing to the establishment of clean and renewable energy.

In New South Wales, Energy Australia offers two different green power programs to its commercial market. Pure Energy is the provider's most expensive green power option. Pure Energy is derived from four renewable energy sources: solar, wind, hydro, and landfill gas. Green Power is Energy Australia's less expensive green power scheme, made up of hydro and landfill gas only.

All the Sydney Olympic competition venues will be taking 100 per cent green power during the four-week period encompassing the Games.

On an ongoing basis, the only Olympic venues that have green power commitments are the SuperDome (100 per cent for five years), Stadium Australia (100 per cent for five years), Novotel and Ibis Hotels (100 per cent for 10 years), the OCA offices (25 per cent for five years), and the Sydney Organising Committee for the Olympic Games (SOCOG) offices (100 per cent).

It has not been established if green power will be used for non-competition Olympic Park venues.

Energy Conservation Measures

In 1996, an Olympic Energy Panel was established to develop a strategy to encourage potential venue developers to propose how they intended to reduce energy consumption.[2] This included a set of Energy Guidelines, which were essential reading for all facility constructors and formed a crucial part of the documentation against which venue tenderers were evaluated. With information on "good design practice" for passive solar design and low energy buildings, they were intended not as strict compliance documents but as a guide towards exceptional energy efficiency and environmental outcomes[3]. Energy conservation was an important part of greenhouse gas abatement measures for the life of Olympic Park buildings.[4]

Energy efficient features at Sydney Olympic venues are estimated to save approximately 10,000 tonnes of greenhouse gases per year. A list of energy conservation and energy efficiency practices at Olympic Park is recorded in the table E4.

Total Electricity Consumption at Olympic Park

Energy Australia estimates that approximately 38.5 million kilowatt hoursh of energy will be consumed to deliver the Games.[5] This estimate includes only competition venues and accounts for how long the various venues will be occupied. Peak site load at the time of the Olympics will likely be in the region of 70 megawatts to 80 megawatts.[6]

WORLD'S BEST PRACTICE

Solar Photovoltaics (PV)

Global sales of solar photovoltaic cells increased by more than 40 per cent in 1999 to 200 megawatts, making it one of the world's fastest-growing energy

Table E2 - Solar Hot Water Heating at Olympic Park

Olympic Park venue	On-site renewable energy system	Solar collector area	% of hot water needs met by system
Athletes Village	Solar hot water systems are installed in each single lot dwelling.	1846.8 m2 (665 houses)	65%
Homebush Bay Hotels (Novotel and Ibis)	Australia's largest single centralised solar domestic hot water system on the roof, reducing total electricity consumption by 5%.	400m2 (With a capacity of 312,746kWh/a)	60%
Media Villiage	Solar hot water systems will be provided in each of the permanent residential dwellings being constructed at the Lidcombe Media Village.	65 houses	unknown

industries. One of the main uses of solar cells is for integration onto home rooftops and the roofing or façades of any building.[10]

At the time of the Games, the Athletes' Village for the Sydney Olympics is the world's largest solar suburb (in terms of number of houses). It has 665 solar PV-powered houses with a combined generating capacity of 665 kilowatts.

The world's largest solar community is located in Nieuwland (Amersfoort) in the Netherlands. Solar panels cover the roofs of more than 500 single-family homes, a sports centre, an apartment building, and a school. The housing complex generates a peak output of 1.3 megawatts and an expected total generating capacity of 1000 kilowatt hoursh annually.

Another large solar community has been built in Braedstrup, Denmark, with 300 PV homes giving a combined capacity of 750 kilowatts, or approximately two-thirds of the total electricity used per family per year.

The world's most successful rooftop solar program is in Japan, with the current goal to have 5000 megawatts of solar PV installed by 2010. Some 25,000 solar PV houses have already been constructed, with 9400 installed in the past year. In 1999, Japan produced more solar cells than any other country (84.1 megawatts), and provided US$262 million in government support.[11]

There are already 25,000 solar PV homes in Germany[12] and this year an enormous solar market was unleashed there. A law was passed ensuring that homes generating power are paid about US$0.50 per kilowatt hourh for the energy produced. This is additional to Germany's national 100,000 Roof Program, which has the goal of adding a solar power capacity of 300 megawatts. The quota for the program was reached in six months, rather than the six years originally planned, with demand completely outstripping supply of solar panels.

By 1998, about 500,000 homes worldwide were generating their own solar power, most of these in developing countries.[13] PV systems are well suited to stand-alone applications in remote areas and developing countries, where there is no electricity grid. In South Africa alone an estimated 50,000 PV systems are in place on homes, schools, health

TABLE E3 - GREEN POWER USE AT OLYMPIC PARK VENUES

Olympic venue	Green electricity participation pre/post Games	During Games - Pure Energy	During Games - Green Power
Athletes' Village	Individual home owners have option to purchase green electricity	not known	not known
Hockey Centre	None	10%	90%
Homebush Bay Hotels (Novotel and Ibis)	100% green electricity for 5 yrs -10% Pure, 90% Green Power. Saves an estimated 1,200 tonnes CO2 emissions p.a.	10%	90%
Media Village	None		
Olympic Park Station (rail)	None	not known	
Stadium Australia	100% green electricity for 5 yrs -10% Pure, 90% Green Power. Saves an estimated 5,000 tonnes CO2 emissions p.a.	10%	90%
State Sports Centre	None	10%	90%
Sydney International Athletic Centre	None	not known	
Sydney International Aquatic Centre	None	10%	90%
Sydney International Archery Park	None	10%	90%
Sydney Showground	None	10%	90%
SuperDome	100% green electricity for 5 yrs - 10% Pure Energy, 90% Green Power	10%	90%
NSW Tennis Centre	None	10%	90%
OCA Main Offices	25% Green Energy	not known	not known
SOCOG Main Office	100% Green Power	10%	90%

TABLE E4 - ENERGY CONSERVATION MEASURES AT OLYMPIC PARK

Olympic Park venue	Passive solar design	Photovoltaics	Solar hot water	Photovoltaic lighting	Green power	Energy efficient lighting	Natural lighting	Efficient appliances	Insulation & natural venting	Auto-off vent if unoccupied	Management control system	Comments
Athletes' Village	•	•	•	•		•	•	•	•			– 90% homes oriented for maximum solar access – 50% less energy needed compared to conventional dwellings – PVs & energy efficiency to save 7000 tonnes CO_2 p.a. – Trees/Shrubs selected for passive solar gain or shelter – Ventilating skylights & cross ventilation maximised – Air conditioning optional in permanent houses – All appliances are 5 to 6 efficiency rating – Homes rated 4 stars on NarHERs
Ferry Wharf				•		•	•	•				– Solar features
Hockey Centre						•	•	•				– Waste heat recovered from air conditioning system used in production of domestic hot water via a heat pump system.
Homebush Bay Hotels (Novotel and Ibis)	•		•	•		•	•	•	•		•	– Energy efficiency reduces electricity demand 31.5% or 2,247 MWh/a – Lighting initiatives account for 3.5% of savings – Natural cross flow ventilation equals electricity demand savings of 10.5% (less air conditioning needed) – Building insulation has R2
Media Village	•				•	•			•			– Green Power program estimated to save 5000 tonnes of green gas emissions
Millennium Parklands	•			•		•	•					– Solar features
Olympic Park Station (Rail)						•			•			– Non mechanical ventilation systems can even operate in event of fire within the station
Stadium Australia					•	•	•		•	•	•	– Passive/natural venting has reduced areas needing air conditioning by approx. 40% – Estimated stadium will account for 15% of total power demand during Sydney Olympics – Lighting system reduces energy needs by 20%
Sydney International Aquatic Centre					•	•	•			•		– Spectator seating area cooled by directional air flow – Green electricity during Games only
Sydney International Archery Park					•		•		•			– Green electricity during Games only
Sydney Showground (see glossary)	•				•	•	•		•			– Air conditioning minimised by ground level cool air inlets and roof outlets – 'Chilled beam' in Exhibition Hall 1 cools only first 4.5 metres above floor – Such measures save 20% on energy demand – Equal to saving 1750 tonnes of CO_2 emissions p.a. – Green electricity during Games only
Sydney SuperDome	•	•			•	•	•			•	•	– Grid-connected PV to offset approx. 10% of power used. – 100% green power for 5 years – Energy efficient lighting – Energy efficient heating/cooling system
NSW Tennis Centre	•				•	•	•		•			– Green electricity during Games only
Public Domain				•								– Photovoltaic lighting on Boulevard

Note: Environmental failures of the airconditioning system are detailed in chapter 3.

clinics, and water pumping systems.[14] In Kenya, more than 80,000 PV systems have been installed.

Aside from residential installations, large solar PV roof arrays for trade or recreation use have also been developed (see table E6).

Solar Water Heating

Solar water heating does more to reduce a family's greenhouse gas contributions than any other household appliance. With a solar water heater, energy from the sun can provide 70 to 80 per cent of the average Australian household's hot water needs. Solar water heating systems are used for hospitals, apartment buildings, schools, jails, car washes, nursing homes, health clubs, restaurants, and hotels.

- Up to 30 million square metres of solar collectors worldwide are estimated to deliver as much as 16.7 TWh of energy per year.[18]
- Four per cent of homes in the Australian state of New South Wales use solar water heaters.
- The council of Leichhardt in Sydney's inner west requires solar hot water collectors for all new housing.
- A solar water heater on Australian houses can reduce greenhouse gas emissions by four tonnes per household, per year.
- During the 1990s, the solar water heating market in Europe grew by 18 per cent per annum.
- Europe now has about 10 million square metres of solar collectors or about 5000 megawatts of thermal power.
- All new buildings in Israel must, by law, have a solar hot water system,[19] providing 80 per cent of the country's hot water annually with a three per cent saving in primary energy.
- During the 1996 Olympic Games in Atlanta, the Georgia Tech Aquatic Center not only incorporated solar photovoltaic panels on the roof, but also featured rooftop solar collectors to heat the pool water. (Sydney's Aquatic Centre has neither solar hot water collection for the pool nor a pool cover to retain heat.)

Solar Thermal Electricity Generation

Solar thermal electricity (STE) generation (also called concentrating solar power) is another means of harnessing energy from the sun. STE power plants generate heat by using lenses and reflectors to concentrate the sun's energy. The heat can be used to generate steam and/or electricity. There are a few different types of STE generating technologies. Some STE technologies are best suited to small applications of 25-100 kilowatts and others are better suited for larger applications of 30-80 megawatts

The world's largest solar thermal energy (STE) generating system was built in the 1980s in the US's Mojave Desert. The system provides a total of 354 megawatts to the California grid.[20] STE systems operating in the US today meet the needs of over 350,000 people and displace the equivalent of 2.3 million barrels of oil annually.[21]

Sydney indicated that it was seriously considering the use of solar-thermal electricity generation[22] for the Olympic Games but the plans did not materialise. The plant initially proposed for Olympic Park is now being constructed as an Australian Greenhouse Office Renewable Energy Showcase Project in Queensland, and will be the world's second largest solar thermal project of its kind. The 17,000 square metres array will be the largest array in Australia, producing a peak of 13 megawatts of thermal energy.[23]

Co-generation

Co-generation is where heat produced in the production of electricty, heat and/or mechanical power is used for secondary purposes such as hot water systems. Because "Cogen" plants are on site, transmission and distribution losses are mostly eliminated. "Cogen" is also called Combined Heat

Table E5 - Electricity Consumption at Olympic Park Venues [7 8 9]

Olympic Park venue	Annual electricity consumption (MWh)	Electricity consumption during Games (MWh)
Hockey Centre	~307.7MWh	
Homebush Bay Hotels (Novotel and Ibis)	~5862 MWh	~533 MWh (2 weeks)
Stadium Australia		~2300 MWh
Sydney International Aquatic Centre and Athletic Centre	~67,440 MWh	
Sydney International Archery Park	~10-13MWh	
SuperDome	~8612MWh	
NSW Tennis Centre	~783MWh	
Sydney Showground (see glossary)	~9006 MWh (May 99-April 00)*	Data unavailble
Other Venues	Data not available	Data not available

'~ ' approximately

(* Source: Julie Burns, Asset Management, RAS of NSW, 6 July 2000)

and Power or CHP. Whereas conventional power generation typically wastes about two-thirds of the energy used as heat, co-generation systems can use or recover the majority of this waste heat resulting in energy savings of between 20 and 40 per cent. Co-generation is considered to be an important intermediate technology because it plays a role in reducing greenhouse gas emissions. In comparison to conventional power generation, co-generation results in a reduction of CO_2 emissions by one-half to two-thirds.[24]

The co-generation system at Stadium Australia is fuelled by natural gas – which is the least climate polluting fossil fuel. Co-generation equipment can also run on fuels such as wood, agricultural waste, peat moss, and a wide variety of other fuels, depending on local availability.

Co-generation accounts for around seven per cent of total global power production, and up to 50 per cent of power production in European countries. In the UK, there are 1376 installations totalling 39,286 megawatts (21,104GWh). Some 340 of these are in the leisure sector alone, totalling 46.4 megawatts.[25] Such leisure sector use is often because swimming pools require a large heat load.

Co-generation accounts for well over half of all new power plant capacity built in North America in the past decade.[26] In the United States, there are 52,800 megawatts of installed co-generation.[27]

In Australia, there are 133 co-generation plants with a combined electricity generation capacity of 2084 megawatts, or approximately 5.6 per cent of installed generation capacity. Some 1728 megawatts of these systems are grid-connected.[28] Denmark and The Netherlands are world leaders in co-generation where it provides 50 and 40 per cent respectively of their total electricity requirements.

The largest co-generation plant in Australia is the 180 megawatts Osborne plant in South Australia. The sugar industry is the leading sector for co-generation use in Australia, followed by the health sector, the recreation sector, and the food production sector. The Australian Institute of Sport (AIS) has a 125 kilowatt gas co-generation plant providing water heating and electricity for its pool and campus. Companies using co-generation include Alcoa, AMP, Australian Paper, BHP Steel, Boral Energy, BP Refining, Bridgestone, Cadbury Schweppes, Crown Casino, Esso-BHP, Kodak, San Remo Macaroni, Shell Refining, Visy Paper and Western Mining Corporation. A number of hospitals, educational institutions and office complexes also use co-generation.[29]

Green Power

Green power schemes enable households and businesses to buy clean and renewable energy via the existing power lines without the need to convert to a self-contained renewable energy system. Green power customers typically pay a slightly higher rate to receive non-polluting electricity from their power company. However the international definition of green power is not yet standardised, and there are a variety of schemes in operation worldwide. Green power should stipulate, for example, that renewable energy must come from sources such as geothermal, wind, solar PV, small hydro, and must be 100 per cent nuclear free. Wherever possible,

Table E6 - Size Comparison of Four Solar Photovoltaic Rooftops [15 16 17]

Building	Peak Generation kW	Annual Generation MWh	No. of modules	% of Power Requirements
Sydney Olympic SuperDome, Australia	70	85	1176	Provides power for he green energy program
Georgia Tech Aquatic Centre (1996 Atlanta Olympic Games), USA	340		2856	20-40%
Academy of Further Education (Mont-Cenis), Germany	1000	564	3184	>100%
Munich Trade Fair Centre, Germany	1000	1000	7812	4% during events 50% when no event

Table E7 – Co-generation Installations in Selected Locations

Location	Number of installations	Total capacity
Olympic Park	2 (both at Stadium Australia	1MW
Australia	133	>2084MW
UK	1376	39,285MW
USA	2167	52,800MW

'>' greater than

green power should be sourced from newly constructed facilities.

Green power is available in a number of countries including the US, Canada, the UK, The Netherlands, Australia and Sweden. In Australia, the New South Wales Government's Sustainable Energy Development Authority (SEDA) manages a green power accreditation program nationally. Green power accredited programs are available to 88 per cent of the Australian population, making it one of the largest programs of its type in the world in terms of population access. Over 70,000 Australian homes and 2000 businesses and government agencies have signed up to SEDA accredited green power schemes.

In The Netherlands, 140,000 households or about two per cent of total grid connections use green power.[30] Between September 1999 and January 2000, 44,000 new green energy customers signed up, increasing the total number of customers by 38 per cent. Dutch energy users in 1999 bought more than 350 million kilowatt hoursh of green energy.[31]

In Germany, Greenpeace Germany offers its own green electricity cooperative, Greenpeace Energy. The program was launched in January 2000 and has 5500 customers.

Green power programs are offered in 33 states in the US and there are roughly 300,000 residential customers buying green power.[32] There are more than 80 utilities and 60 small rural electric cooperatives offering green power programs in the US.[33] California has the largest number of green power customers with over 95,000. Pennsylvania follows with 85,000. This corresponds to approximately 1.5-2 per cent of electricity connections.[34] Local government purchases account for about half of all green power being sold competitively in California.[35] The National Renewable Energy Laboratories (NREL) estimates that nearly 115 megawatts of additional, new, renewable capacity has already been installed in the US as a direct result of green pricing programs and green power marketing, with a further 105 megawatts either already under construction or planned.[36]

Ordinarily, green power is sold at a slightly higher price rate than conventional power. However, in Germany and California, some power utilities will continue to supply at the same price as fossil fuel generated power.[37] [38]

As well as households, numerous companies and institutions around the world have committed to 100 per cent green power.[39] For example, the City of Santa Monica, California, is the first in the US to switch all of its facilities to 100 per cent green power.[40] In the UK, the Millennium Dome is taking 100 per cent green power. Media giant Time Warner has converted all of its Los Angeles division accounts to 100 per cent green power.

Energy Efficiency

Building energy efficiency is extremely difficult to benchmark internationally because the potential for energy efficiency is so site specific. The site's

Table E8 - Green Power Participation in Selected Countries

Country	% of Total Population with Access to Green Power	Number of Households Taking Green Power
Australia	88%	~65.0000
Germany	100%	~230,000 (end 99)
Netherlands	>95%	>140,000
United Kingdom	100%	10,800 (Dec 99)
United States	~33%	~300,000

Table E9 - A Small Selection of Companies, Governments & Organisations Taking 100% Green Power [41] [42]

Co-operative Bank (UK)	Ministry of Foreign Affairs (Netherlands)
Corporation of London (UK)	Municipality of Apeldoorn (Netherlands)
Ecological market gardener (Netherlands)	Patagonia Inc (USA)
Episcopal Churches (USA)	SEDA (Australia)
Essent Energie Limburg (Netherlands)	Thames Water (UK)
Fetzer Vineyards (USA)	Toyota Motor Sales (USA)
RABOBANK (NETHERLANDS)	1,000 United States Postal Service Facilities (USA)
75 Kinkos stores (USA)	Wilkens Furniture Ltd & Co (Germany)
Machine & Steel Construct Christian Bhle (Germany)	

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location and climate governs a building's ability to achieve a comfortable internal environment. Even the criterion for comfort varies between cultures and individuals. Moreover, local topography and vegetation can create sun and wind shadows, which limit the energy efficient options available to building designers. The availability of building materials and skill base of local tradespeople can also impinge on the potential for energy efficiency.

Energy efficiency standards and energy efficiency rating programs vary from country to country and even from state to state. With respect to appliance efficiency, there is a variation in electricity supply voltage and frequency in different parts of the world, making a direct comparison increasingly complicated. However, energy efficiency is well established globally, with international research being adapted to local conditions.

World's best practice for energy efficiency in large sporting venues such as those found at Olympic Park is especially difficult to assess. This is primarily due to the fact that sporting venues are far more specialised than housing or office accommodation. No two sporting venues are the same – each varies in design, social environment, climate, and usage patterns. Furthermore, relatively few of these structures are built during any particular decade making comparison difficult.

The Energy Efficiency Best Practice Programme of the Department of the Environment, Transport and the Regions in the UK has developed a series of guides for energy efficiency in sports and recreational buildings. The guide, "Drawing a Winner: Energy Efficient Design of Sports Centres", lists energy efficiency measures to be considered in the design of new sporting facilities.

In Australia, the Nationwide House Energy Rating Scheme (NatHERS) provides a national approach to comparing the energy efficiency of houses across the different climate zones within Australia. A graded five-star rating system is used, with the most energy efficient dwellings receiving the highest number of stars. An average Australian home ranks about one to two stars. The Australian Capital Territory (ACT) has a requirement that all new houses achieve at least a four-star rating.

A four-star house, such as the average Sydney Olympic Athletes' Village home, is considered quite energy efficient but it is not best practice for Australia. Some Australian-built homes have far exceeded the requirements of an excellent five-star rating. However, when combined with other substantial energy initiatives such as solar water heating and solar photovoltaic electricity, the Athletes' Village can be considered Australian best practice for energy. The Energy Efficiency Team of the Australian Greenhouse Office is not aware of any residential development of similar size that equals the energy achievements of the Athletes' Village.

Further Information on Best Practice in Energy:

- www.eren.doe.gov
- www.its-canada.com/reed/reed.htm
- www.weea.org

CONCLUSIONS

At Sydney's Olympic site, renewable energy through a mix of green power, energy conservation and design and on-site renewable energy generators has virtually substituted conventional polluting fossil fuel sources. This renewable energy will successfully satisfy the huge energy demand that a modern Olympics requires.

In Australia, more than 90 per cent of the country's energy is generated from greenhouse gas, intensive, coal-fired power stations.[43] In New South Wales, there is about 2 megawatts of grid -connected solar PV, compared to 15,000 megawatts from other power sources. Nearly half of the state's grid-connected solar PV is installed at the Olympic Park.

The use of solar power on roofs (both PV and water heating) is proof that an average home can be directly powered by the sun's energy.

The widespread use of green power demonstrates that electricity use for homes, offices and other buildings can be powered by 100 per cent renewable energy sources.

A wide array of design tools and energy efficient technologies can cut typical energy consumption by a minimum of 50 per cent.

Worldwide, renewable energy is capable of providing the energy requirements traditionally delivered by fossil fuels, particularly for building electricity use.

It is hoped that the impact of Sydney's Olympic commitment to showcasing renewable energy use will not stop after the Games. Australia and the rest of the world have much to learn about what can be achieved in switching from greenhouse gas, intensive energy sources to clean, renewable energy. The race to prevent climate change is on and Sydney's renewable energy Games show that the race can be won.

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3 | Refrigeration & airconditioning at the Olympic Games

INTRODUCTION

When scientists discovered a hole in the ozone layer in the early 1980s, the world responded by banning the group of chlorinated gases deemed most responsible for the damage – chlorofluorocarbons (CFCs).

The global refrigeration sector, as one of the largest users of CFC gases, needed an alternative. Chemical companies which manufactured CFCs offered more polluting gases as alternatives – hydrochlorofluorocarbons (HCFCs), a less damaging ozone-depleting gas, and hydrofluorocarbons (HFCs), a potent climate change gas. These "alternatives" were promoted despite the fact that a range of commercially and technically proven natural alternatives already existed including hydrocarbons (HC).

In 1997, the United Nations (UN) Kyoto Protocol on Climate Change was extended to include HFCs, identifying them as potent greenhouse gases whose emissions had to be reduced by industrialised countries. HFCs are among the most potent manufactured global warming gases. On average over a 20-year period, one tonne of HFC causes 3300 times more climate change destruction than one tonne of carbon dioxide.

Levels of HFC pollution exploded in the 1990s. An analysis for the European Union noted that there were "rapidly increasing accumulation rates [of HFCs] observed in the atmosphere". Australian and British scientists have been measuring HFC pollution in the atmosphere over Tasmania and Ireland. Between 1992 and 1995 the concentration of HFC 134a – the most common HFC gas – grew exponentially at 200 per cent per year.

HFCs are mainly used by the refrigeration and airconditioning industry. The major growth sector for HFC 134a (the most commonly used HFC, accounting for 80 per cent of all HFC gases used) is the refrigeration and airconditioning industry. In the next 15 years, the UN predicts that consumption of HFC 134a could increase by 250 per cent.

Greenpeace is campaigning for the use of Greenfreeze or environmentally friendly refrigeration technologies that avoid the use of HFCs and HCFCs. This is essential for the long-term protection of the earth's climate and the ozone layer.

SYDNEY'S ENVIRONMENTAL GUIDELINES STATE:

"Olympic host cities should commit themselves to use of CFC-, HFC- and HCFC-free refrigerants and processes."

3 | Refrigeration & airconditioning at the Olympic Games

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

The choice of refrigeration and airconditioning (RAC) systems is one of the biggest and most systematic environmental failures of the Sydney Olympic Games. A significant amount of RAC equipment is used in Olympic venues by corporate sponsors and all over the site as temporary 'overlay' equipment for catering and air conditioning. Unfortunately, no Olympic venue using airconditioning meets the Environmental Guidelines criteria for non-CFC, -HCFC and –HFC coolant chemicals.

The following list (Table R1) demonstrates the extent to which the Olympic Co-ordination Authority (OCA) has failed to comply with the Environmental Guidelines in the use of refrigerants at Olympic Park and off-site Olympic venues. It also provides an overview of environmentally friendlier alternatives that could have been installed in order to comply with the Guidelines.

In 1998, Greenpeace began raising the question of whether the OCA and SOCOG would meet the Environmental Guidelines in airconditioning and refrigeration. In particular, we were concerned that a number of key Olympic venues like the SuperDome, the largest indoor arena, were nearing completion and airconditioning choices were about to be made. Greenpeace campaigners wrote letters to Olympic organisers and raised concerns in our regular bi-weekly meetings on environmental issues, the Olympic Environment Forum (OEF). We specifically requested information about what refrigeration gases and types of equipment were being considered. Clearly Olympic organisers were not considering the natural alternative coolant chemicals that would have met the Guidelines.

In December 1998, Greenpeace filed an injunction in the Federal Court of Australia to stop the OCA from making what we believed were false claims that its choice for the SuperDome airconditioning system was the best environmental option. The OCA and its environmental consultant had stated that "in order to avoid the use of ozone depleting substances and greenhouse gas emissions at the [SuperDome] … 'green friendly' products would be purchased".

As its system of choice uses ozone-depleting HCFCs and the potent greenhouse gas HFC, this was a clear misrepresentation of the facts. After eight months of delaying tactics by the OCA and mounting legal fees, Greenpeace decided not to continue with the case because we believed the issue was never likely to be heard in court on its true merits.

Greenpeace filed a Freedom of Information request in July 1999 that found that not a single Olympic venue met the Guidelines and that all airconditioning systems would use ozone-depleting and/or potent greenhouse gas chemicals.

The use of natural cooling chemicals in one or more of Sydney's Olympic venues would have provided an ideal showcase for this technology nationally. Also, it would have given the building industry a much needed push away from environmentally destructive airconditioning chemicals.

While alternative technology is being used in a growing number of large venues internationally, use in Australia lags well behind. Greenpeace believes Australia has missed an important opportunity to use the Environmental Guidelines for Sydney's Olympic Games to push its airconditioning and refrigeration industry towards clean alternatives such as ammonia and hydrocarbons.

As the country with the highest skin cancer rate in the world, Australia must own its contribution to the ozone hole, expected to become twice the size of Europe in 2000. Unfortunately, the Green Games effort does nothing to help.

SPONSORS' EQUIPMENT

Sponsors have installed a significant amount of refrigeration equipment for the sale and distribution of their chilled products during the Games. Most of it violates Sydney's Environmental Guidelines.

Whereas the OCA is responsible for installing the refrigeration equipment in Olympic- and non-Olympic Park venues, Olympic sponsors have installed their own equipment at Olympic Park. An assessment of sponsor refrigeration installations follows.

Coca-Cola

Coca-Cola is the official soft drink of the Sydney 2000 Olympic Games. Coca-Cola expects to sell more than 11 million drinks during the Olympic and Paralympic Games. Of the 1800 units of Coca-Cola refrigeration equipment at the Games, only 100 will comply with the Guidelines. These are single-door, Greenfreeze Vestfrost fridges that run on hydrocarbons. This means that 94 per cent or 10.34 million of Coca-Cola's drinks at the Sydney Olympics will be cooled by greenhouse gas HFC refrigeration.

After a Greenpeace campaign that began with a series of meetings in Australia and internationally, the launching of a global interactive web site – www.cokespotlight.org – and a series of Greenpeace protests at Coca-Cola facilities, the company made a dramatic policy change.

Coca-Cola International's chairman and CEO Doug Daft announced his company's new global policy on June 28, 2000. It stated that:

1. By the Athens Olympic Games in 2004, Coca-Cola will no longer purchase new cold drink equipment using HFCs where cost efficient alternatives are commercially available. This initiative applies to refrigerant gases and insulation.
2. Between now and 2004, Coca-Cola will expand its research and development program to identify and field-test a variety of promising alternative refrigeration technologies.
3. Coca-Cola suppliers will be required to announce specific time schedules to use only HFC-free foam insulation and refrigeration in all new cold drink equipment by 2004.
4. In concert with the international Kyoto Agreement on Climate Change, Coca-Cola is requiring its suppliers to develop new equipment that is 40 to 50 per cent more energy efficient than today's equipment.

As one of the largest users of refrigeration chemicals and one of the world's best known brands, Coca-Cola's policy shift, if followed through, will have repercussions throughout the refrigeration industry worldwide.

As Coca-Cola is an Olympic sponsor company, its policy shift can be seen as one of the best

TABLE R1: REFRIGERANTS USE AND ALTERNATIVES (BY OLYMPIC VENUE)

Venue	Refrigerant	Environmental alternative
Olympic Stadium	HFC-134a and HCFCs for airconditioning systems	Ammonia chillers and HC air conditioning
Archery Centre	Naturally ventilated	Not Applicable
Sydney Showground	Natural ventilation supported by small HCFC-22 package airconditioning units	Natural ventilation supported by HC package units
Entertainment Centre & Convention Centre	CFC-11 and HCFC-22 in chillers, HCFC-22 in airconditioning & cold rooms	Built in 1993 prior to Environmental Guidelines
Regatta Centre & White Water Stadium	HCFC-22 in the airconditioning in tower, pavilion and boatshed office	Small HC package units
Velodrome	HFC-407c proposed	HC airconditioning units
Equestrian Centre	Naturally ventilated	Not applicable
Bondi Beach Volleyball Stadium	Small package units to be installed in the Pavilion, contract not let, however, contract specifies HFC-407c	Small packaged HC units
SuperDome	HCFC-123 and HFC-134a in airconditioning	Ammonia airconditioning system
Shooting Centre	HCFC-22 unit with the ability to be converted to HFC-407c was installed	Ammonia chillers & HC package units
Tennis Centre	HFC-407c installed	HC package units
Aquatic Centre	HCFC-123 chillers, HCFC-22 chiller, Package units with HCFC-22, coolrooms HCFC-22 & HFC-404a, Ice machines CFC-12, compressor air drier CFC-12	Ammonia chillers, HC package units, HC cold room, ice machine and compressor air drier
Athletes' Village	The homes have been designed not to require airconditioning. HCFC-22 airconditioning in show houses, HFC-407c in food hall. 1000+ bar fridges supplied by Samsung using HFCs	HC package units, Ammonia or HC airconditioning HC domestic fridges
Media Village (Lidcombe Hospital)	No new airconditioning system installed by OCA.	
Multi-storey carpark, Homebush Bay	HCFC-22 package units	HC package units
Rail/Loop Station	HCFC-22 package units	HC package units
Novotel Hotel	Kelvinator M142D 140L fridges in rooms (177) using isobutane, and CFC, HCFC free insulation, 4 star energy rating. HFC-134a in airconditioning systems, however, windows when opened cut off air conditioning to rooms	HC A/C units
Ibis Hotel	Electrolux 56L fridges (150 rooms) using Ammonia/HC.	

environmental legacies of Sydney's Environmental Guidelines of the Summer Olympic Games.

McDonald's

During the Games, McDonald's will operate seven main restaurants located in the Olympic Athletes' Village, the Main Press Centre, the International Broadcast Centre and Sydney Olympic Park. The seven restaurants will employ 1100 staff and the main 5000-seater restaurant is expected to sell up to 25,000 hamburgers a day.

McDonald's said it hopes to break world sales records during the Sydney Games which would be "the biggest single project by the company". Based on previous Olympics, it is estimated that McDonald's will serve close to one million food items at the Games in Sydney.[1] McDonald's says that it has "organised for nine hydrocarbon refrigeration units (which are CFC/HCFC/HFC-free) to be delivered from overseas and will implement trials of these units during the 2000 Sydney Games. The rest of its equipment will use HFCs. This is despite the fact that McDonald's operates two 100 per cent Greenfreeze restaurants in the Millennium Dome in London, UK.

Samsung

Samsung originally planned to supply only HFC refrigerators, even though since the Environmental Guidelines were written, more than 45 million domestic Greenfreeze refrigerators have been built worldwide. Indeed, Samsung was already manufacturing two types of refrigerators using HC for the European market. After constant lobbying from Greenpeace, Samsung agreed to provide 324 large Greenfreeze refrigerators. However, the 1500 bar refrigerators supplied will run on HFCs and not comply with the Environmental Guidelines.

Streets (Unilever)

Streets will install only 50 Greenfreeze ice cream freezers that meet Sydney's Environmental Guidelines. This represents just 14 per cent of their total freezer cabinets. Unilever's cooling units at Olympic Park will be made up of:

- 370 new HFC 134a cabinets with environmentally safe HC foam
- 120 rebranded used Nestlé cabinets with HFC 134a gas and foam
- 276 insulated mobile selling carts with no refrigerant chemicals, and
- 200 vending trays with no refrigerant chemicals and environmentally safe HC foam.

In 1997, Unilever collaborated with Greenpeace to announce a large-scale trial and deployment of Greenfreeze HC refrigerants for the company's ice cream freezer cabinets. These trials involve refrigeration equipment across a range of different countries and operating conditions.

Unilever has made a sufficient policy shift toward developing Greenfreeze technology and away from HFCs, but it has failed to publicly announce this policy shift as Coca-Cola has done.[2]

Foster's Brewing Group

Despite its commitment to using ammonia as its preferred refrigerant for large capacity installations, Foster's will install 200 two-door fridges at the Olympic Park using greenhouse gas HFC-134a.

However, following meetings with Greenpeace the company agreed to alter its refrigeration policy to specifically ban the purchase of greenhouse-polluting and ozone-destroying refrigeration equipment.

The new policy states: "It is Foster's Brewing Group policy to minimise the impact upon stratospheric ozone depletion by complying with all relevant regulations with respect to ozone depleting substances and where practicable, to eliminate their use. In addition, it is Company Policy to minimise the greenhouse impact of its operations to all practicable extent.

In order to fulfil this policy commitment the following shall be adopted:

1. Each site shall create a register of all equipment utilising CFC, HCFC, HFC or halon synthetic gases. The equipment shall be clearly labeled with the name of the substance.

2. No new equipment containing the above gases shall be purchased for use on the company's sites without a full health, safety and environmental risk assessment of alternatives and written approval of Vice President HSE - FBG."

Holden

Car manufacturer, Holden, will provide more than 3000 cars for the Games. Detailed information was not given to Greenpeace, however we believe that all vehicles will have airconditioning that uses HFC134A.

Other Sponsors

No other sponsors provided data on their use of Greenfreeze equipment. It is therefore highly likely that any equipment installed, hired or used in sponsor infrastructure will contain HFCs or HCFCs. (CFC-based equipment is now rare in Australia and likely to be found only in old equipment).

Games-Time Equipment

Since February 2000, the OCA has been responsible for more than 60 different contracts for temporary 'overlay'. This is equipment installed for Games time only and includes temporary airconditioning and a variety of catering equipment. Greenpeace has been advised in Olympic Environment Forum meetings that all of

these contracts will use fluorocarbons, and none will use the more acceptable Greenfreeze equipment.

OCA Refrigeration Policy

The OCA changed its own policy to allow it to contravene the Guidelines. The 1998 OCA Environmental Report stated that "OCA's Homebush Bay Development Guidelines - Volume 1 Environmental Strategy (September 1995) provides a practical interpretation of the Environmental Guidelines and states that CFCs and HCFCs will not be used wherever practicable".

WORLD'S BEST PRACTICE

Technologies

Greenpeace uses the term Greenfreeze to refer to refrigeration and airconditioning technologies that avoid the use of HFCs, HCFCs and CFCs. There are five all-natural refrigerant solutions in commercial use on the market today – water, air, carbon dioxide, ammonia and hydrocarbons. Today there are new applications in the form of sophisticated evaporative airconditioning (EAC) and solutions based on the "air cycle". Of the five alternatives, hydrocarbon and ammonia are the most commonly used refrigerants for commercial and industrial purposes.

Hydrocarbons

HCs provide alternative options to a number of CFC and HCFC refrigerants. As they don't contain chloride or fluoride molecules, they cannot undergo reaction with water and so do not form corresponding strong acids.

Generally, HCs give a superior coefficient of performance (COP) – the measure of refrigeration system efficiency – because of specific characteristics.[3] Noting the thermodynamic and transport properties of various refrigerants, properties like viscosity rate lower for HCs than fluorocarbons and specific heat and thermal conductivity are significantly higher for HCs. These properties are fundamental to the performance of refrigerating systems in terms of heat transfer, pressure loss and compression processes, and as such lead to improved overall performance, particularly when the equipment is optimised to the properties of the refrigerant. Improvements greater than five per cent can be achieved with the use of HCs over fluorocarbon refrigerants. Improvements of up to 20 per cent are not uncommon in this context.

While HCs are flammable, this can be mitigated through adequate safety measures in production and product design, safe deployment of equipment, responsible training and appropriate standards.

HC refrigeration is already safely used in tens of millions of fridges by a wide number of companies like Iceland and Ikea, demonstrating that safety issues can be addressed today. Agreed safety standards for flammable refrigerants are already in place. The global refrigeration standard IEC 60335 -2 - 24 allows the use of up to 150 grams of flammable refrigerant.

In addition to the international standard, Australia, New Zealand and the UK have comprehensive regulatory standards of their own which allow for HCs to be used in different refrigeration systems.[4] The European standard EN378 allows up to 1.5kg of flammable refrigerant to be used in public spaces for airconditioning, commercial cabinets and freezers. This guides national standards. The UK (BS4434) and Australia New Zealand (AS/NZS 1677) are comprehensive standards that cover the use of several kilograms of flammable refrigerants in a wide range of commercial uses.

Ammonia

Ammonia has become the most effective and commonly used refrigerant both in compressor technology and absorption systems (water/ammonia.) Ammonia has been used as a refrigerant for more than 100 years. Currently, it is the most important refrigerant for industrial purposes, with a market share above 80 per cent in some countries. Ammonia has excellent heat transfer properties and, due to its low molecular weight and high critical temperature, also has a very favorable cycle performance. As a result, cold storage and food processing systems with ammonia are known to be more efficient than similar systems with CFCs or HCFC-22.

Carbon Dioxide

Carbon dioxide (CO_2) is a promising long-term environmentally sound refrigerant. The most promising CO_2 heat pump applications are heat pump water heaters and dryers. Heat pump water heaters are expected to enter the market in the course of the next decade.

Several pilot systems have been developed with CO_2 used as heat-transfer fluid. Renewed CO_2 technology for low temperatures, eg food freezing, have reached the stage of practical application. Cascade systems with CO_2 in the lower stage (ammonia in the upper) have proved to be economically viable for medium sized food processing systems (300-400 kilowatts.) For large systems (2 MW cooling effect), 15 per cent saving in investment may be obtained with the cascade system.

End Uses of Greenfreeze Technologies
Greenfreeze is the term used by Greenpeace to refer to refrigeration and airconditioning technologies that don't use HFCs, HCFCs and CFCs. There is a varied range of global suppliers of Greenfreeze equipment.

UK company Earthcare has a catalogue with more than 200 items of HC and other commercially

available green refrigeration systems for commercial use. It includes wall-mounted and ceiling-mounted air conditioners, dehumidifiers, mobile airconditioning, sliding door display coolers, bottle chillers, wine cooler dispensers, glass door merchandisers, mini bars, deli display cabinets, chest chill cabinets, defrost type freezer chillers, multi-deck display cabinets, freezers, ice cream conservators and water coolers.

Throughout the world, supermarkets, department stores, offices, banks, shops, hotels, restaurants and computer rooms have installed these products. The selection of products covers:

- domestic refrigeration
- commercial refrigeration
- cold storage and food processing
- industrial refrigeration
- airconditioning
- heat pumps (air-cooled systems)
- airconditioning (water chillers)
- transport refrigeration
- mobile airconditioning

On average, ammonia is believed to cover 50 to 60 per cent of the European industrial refrigeration market. Ammonia systems are typically 0 to 15 per cent more energy efficient than similar systems with CFCs and HCFCs, depending on system types and temperature levels. In the United States, ammonia has approximately 90 per cent market share for systems of 100 kilowatts cooling capacity and above in custom engineered process. Most of these systems are found within the food industry and cold storage where ammonia is the dominant refrigerant. In Australia and New Zealand, 30 to 40 per cent of new installations are believed to use ammonia.

Evaporative water coolers are among the several alternatives to current models of refrigerators and airconditioners. In the United States, more than 70 companies manufacture evaporative airconditioners for residential, automotive, commercial and industrial markets.

Direct or single-stage, evaporative coolers are used in tens of thousands of homes in the western US, as well as thousands of commercial establishments such as shops, restaurants, dry cleaners, offices, warehouses and factories. Indirect, direct or two-stage evaporative air conditioning systems are also used in schools, office buildings, commercial buildings and homes.

Domestic Refrigeration

In 1992, Greenpeace brought together scientists researching the use of HC as refrigerants and an East German domestic refrigerator manufacturer. It was a meeting that was to create a revolution in refrigeration technology.
Formerly East Germany's leading household appliance manufacturer, DKK Scharfenstein was suffering severe economic problems in the reunified Germany when Greenpeace commissioned the company to produce the world's first ozone and climate benign refrigerators running on HC. The company was within days of being closed down.

These Greenfreeze HC fridges used a mixture of propane and butane for the refrigerant, replacing the ozone-destroying and global warming chemicals otherwise used. At first, major refrigerator manufacturers rejected the idea of Greenfreeze, launching an anti-HC scare campaign. But Greenpeace launched its own Greenfreeze marketing campaign and within a few months had gathered 70,000 pre-orders for Greenfreeze refrigerators. This overwhelming public support for Greenfreeze secured the investment needed to get the new fridges rolling off the production line, salvaging DKK Scharfenstein and the jobs of its workers in the process.

Soon the manufacturers that had claimed Greenfreeze was unsafe, were forced to recognise the market value of a truly environmentally friendly refrigerator and abandoned the use of HFCs. In 1993 the four biggest German fridge producers, Bosch, Siemens, Liebherr and Miele switched to Greenfreeze, producing about four million Greenfreeze fridges a year. By 1996, 90 per cent of the domestic refrigerators produced in Germany were HC. Greenpeace also catalysed the introduction of Greenfreeze production in Latin America, Indonesia, India and China where more than half of the 10 to 12 million domestic fridges sold are now Greenfreeze.

All major European domestic fridge companies, eg Bosch, Siemens, Electrolux, Liebherr, Miele, AEG, Whirlpool, Candy, Thompson, Vestfrost – now manufacture Greenfreeze refrigerators as standard, with a huge variety of sizes and models. Worldwide there are about 20 Greenfreeze manufacturers and since 1992 about 45 million Greenfreeze refrigerators have been manufactured.[5]

Industrial Refrigeration

Industrial refrigeration covers a very wide range of cooling and freezing applications, including the chemical and pharmaceutical industries, the petrochemical and the oil and gas industries, the metallurgical industry, plastic moulding, civil engineering, sports and leisure facilities, industrial ice making and other miscellaneous uses.

Refrigeration capacity ranges from 20 kilowatts to several megawatts, while temperatures may vary from below 100 degrees celsius to well above freezing point. The systems are, to a large extent, custom engineered and erected at site. Unit systems ("chillers") are used for process cooling.

- A number of European manufacturers are now marketing heat pumps using HC refrigerants.

Heat pumps can reduce energy consumption by 50 per cent against electric heating
- A Swedish manufacturer of water chillers has developed a range of units using HCs. These are available across a range of capacities and use different configurations of compressors
- A large refrigeration equipment manufacturer in Derbyshire, UK produces commercial drinks cabinets including wine coolers using HCs. Energy efficiencies increased by between 15 and 20 per cent and the weight of cabinets dropped. Demand for the company's product more than doubled since moving to HCs.

Commercial Refrigeration

The commercial refrigeration category includes a range of equipment. While the refrigeration capacity of centralised systems in supermarkets varies typically from 20 kilowatts to 1000 kilowatts, stand-alone equipment capacities are comparable with domestic equipment.

Commercial HC equipment has been supplied to corporate consumers including: British Airways, McDonald's, Aroma Coffee, Sainsbury's, Tesco, IKEA, TipTop Bread, Esso, AG Favor, The Body Shop and Backhammars Bank. The large UK food retailer, Iceland and Swedish furniture chain IKEA have announced their corporate conversion to HC instead of HFCs.

Coca-Cola is the biggest user of commercial refrigeration equipment in the world and its policy shift to abandon the use of HFCs for all new equipment by 2004 will create significant change in the global refrigeration industry and the commercial availability of Greenfreeze equipment.

Cold Storage and Food Processing

Refrigeration for cold storage and food processing includes equipment for dairy products, meat processing, confectionary, bread and breweries.

Most refrigeration systems for cold storage and food processing are of direct type, with the refrigerant distributed to heat exchangers in the space or apparatus to be refrigerated. Indirect systems with liquid chillers or ice banks are used to a lesser extent, primarily for cooling purposes.

Ammonia has strengthened its position as the leading refrigerant in many European countries, especially in the north. There has been some expansion into less traditional use areas for ammonia such as centralised systems for cooling and/or heating. In Argentina, ammonia covers about 90 per cent of the food industry.

Developments include:

- Earthcare Products was appointed as specialised sub-contractor to Blighline, Holmes Catering and Ice Cool Services to convert integral refrigeration units from HFC134a and HFC404a to CARE30 and CARE50 respectively.[6]
- McDonald's has two 100 per cent HC Greenfreeze stores in the Millennium Dome in London, UK.[7]
- AG Favor, a Swedish supermarket chain, installed a new system working on glycol for medium temperature equipment and with CO2 as the secondary refrigerant for the freezers. The total refrigerant savings are more than 475 kilograms even though the cooling capacity has increased by 30 kilowatts and the freezing capacity by 10 kilowatts.
- A specialist grocery store chain was the first in the UK to use an HC refrigerant (CARE 50) in both its refrigeration and airconditioning systems. This demonstrates the flexibility of HCs in general and especially the blends as the same refrigerant is able to produce air at 50 degrees celsius for heating the shop and at minus 30 degrees celsius for cooling the freezer cabinets.[8]

Airconditioning

In commercial buildings airconditioning is provided by unitary airconditioners or water chillers, coupled with an air handling and distribution system. Unitary airconditioners cool and dehumidify by having air pass directly through a coil containing an evaporating refrigerant. Water chillers cool or heat water, or a water/antifreeze mixture, which is then pumped through a heat exchanger in an air handler or fan-coil unit for cooling and dehumidifying or heating air.

The world market for centrifugal chillers was $US4 billion in 1997 with the US accounting for 43 per cent. The world market for absorption chillers is more concentrated with four countries – Japan, China, Korea, and the US – accounting for 90 per cent.

Water chillers using the vapour-compression cycle are manufactured in capacities from about 7.0 kilowatts to over 35,000 kilowatts. Two types of compressors are used: positive displacement and centrifugal. Water chillers are offered in both air cooled and water cooled versions up through about 1500 kilowatts in single units. Above this range, water-cooled systems are available.

- More than 100,000 De'Longhi portable airconditioning units are in use across Europe using R290 refrigerant. The same manufacturer has extended its use of R290 to dehumidifiers, which it is now marketing in Japan.
- Systems containing HCs have been installed in shops, offices and hospital waiting rooms. One UK manufacturer, IMI Air Conditioning, now has a range of electronic units available.
- Earthcare Products has installed VEF split systems using CARE40 in the UK Department of Trade, Environment, Transport and Regions offices as well as both split systems and computer room chillers.
- Packaged units: These are now available in the

UK for cellar cooling applications.
- HC chillers have been installed across Europe to provide comfort cooling to offices and supermarkets.
- Earthcare Products has installed airconditioning for the whole of a Middlesex University campus. The contract was worth over £400,000 (~A$1 million).[9]
- The UK Chartered Society of Physiotherapy needed comfort airconditioning as a result of an increase in IT equipment. Purchasing requirements included minimum first cost, energy running costs, maintenance costs and risk of premature obsolescence due to environmental refrigerant legislation. Two air-cooled water chillers using an HC (CARE 50) refrigerant were selected.[10]

Car Airconditioning

All new vehicles produced since 1995 have been equipped with HFC-134a airconditioning systems (with the exception of very limited production of CFC-12 systems in China, India, and Korea.) 50 per cent of all HFC-134a production is for automobile airconditioning.

Car manufacturers already have prototypes for HC and CO_2 mobile airconditioners.

- In Australia, more than 300,000 cars have been converted from CFCs and HFCs to HCs.
- TransAdelaide Bus Company has installed HC airconditioning in the drivers' compartment, while passengers are cooled with a desiccant cooling system.
- The Denver Regional Transit Department in the US has equipped buses with roof mounted evaporative airconditioning systems, saving up to 2000 gallons of diesel fuel per bus per year.
- The German company Konvecta uses CO_2 for bus airconditioning.

Further Information on World's Best Practice :

- www.greenchill.org
- www.care-refrigerants.co.uk
- www.teknologisk.dk

CONCLUSION

The use of environmentally destructive CFCs, HCFCs and HFCs in refrigeration and airconditioning is one of the biggest and most systematic environmental failures of the Sydney Games.

In almost a decade since the Environment Guidelines were developed, Greenpeace has campaigned for Greenfreeze alternatives and successfully brought into commercial use more than 45 million Greenfreeze fridges - whereas Sydney was barely able to find a few hundred Greenfreeze systems.

The most significant environmental legacy of the Sydney Games will be Coca-Cola's policy change. After a series of meetings and the launch of a global Greenpeace protest campaign, the company announced that it would ban HFCs in all new refrigeration equipment by the Athens 2004 Games. As one of the world's largest users of refrigeration equipment and one of the best known brand names, Coke's decision, when implemented, will have a global impact on the refrigeration industry. It demonstrates that HFCs, like CFCs, must and can be eliminated by the refrigeration and airconditioning industries.

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4 | Alternatives to PVC at the Olympic Games

INTRODUCTION

Greenpeace believes the plastic poly vinyl chloride (PVC) is an environmental poison which releases dangerous toxic chemicals at every point of its life cycle. These toxins include:

- **Dioxin** A substance considered to be a human carcinogen by the IARC and hormone disrupter that bioaccumlates in the food chain where it can be ingested by humans. Dioxin is a by-product of PVC production and incineration.
- **Phthalates** Linked to cancer and kidney damage and may interfere with the reproductive system and development.
- **Heavy metals** Toxic metals such as mercury, lead and cadmium as used in PVC production, if emitted as pollutants can also bioaccumulate in animals and humans.
- **Vinyl chloride monomer (VCM)** Various cancers, tumours, angiosarcoma and reproductive disturbances have been linked to VCM which is a building block of PVC.
- **Hydrogen chlorine gas** This gas emitted by burning PVC (e.g. cabling) reacts with moisture to form corrosive hydrochloric acid.[1]

Greenpeace has been campaigning for the phase-out of organochlorines, the class of chemicals that includes PVC, since 1987 because of environmental and human health concerns with their production, use and disposal. The manufacture of PVC plastic uses the largest proportion (30 per cent) of chlorine produced within the chlorine industry. Greenpeace has focussed on PVC since the early 1990s and is calling for its material substitution with cleaner alternatives.

Greenpeace believes the building and development industries should be concerned about these issues considering that in Europe alone, building and construction account for 53 per cent of all PVC use (by market share) while wire cable and electrical uses amount to nine per cent. Besides packaging which accounts for 16 per cent of the European PVC market, these are the two largest applications of PVC.[2]

The Royal Australian Institute of Architect's (RAIA) Environmental Design Guide concludes two major papers on the subject by saying: "...PVC products and processes are going to have to get better. Maintaining the pressure on manufacturers by looking to alternative products and additives for example, is essential if this is going to happen."[3]

As PVC is a commonly used toxic building material, the effort to minimise its use was an important part of Sydney's effort to hold an environmental Olympic Games.

4 | Alternatives to PVC at the Olympic Games

SYDNEY'S ENVIRONMENTAL GUIDELINES CALL FOR:

"...minimising and ideally avoiding the use of chlorine-based products (organochlorines) such as PCBs, PVC and chlorine-bleached paper."

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

PVC use is pervasive in the building and construction industry. The low cost and multi-purpose nature of this plastic along with strong lobbying by the chemical industry responsible for producing PVC has encouraged a move from more conventional, less toxic building materials to PVC in a short space of time. The choice to attempt to minimise PVC use for Olympic construction presented many challenges to the architects, designers, builders and suppliers who worked on the project. While alternatives were found for many areas of use, PVC alternatives for others areas were more difficult to find and source.

In attempting to evaluate how Sydney performed in its effort to minimise PVC, the biggest challenge was obtaining information on quantities used in Olympic venues due to the number of contractors involved. With many sites complete at the time of research, many developers' records had been archived and were inaccessible. The lack of a thorough OCA records system on the sourcing of Olympic building materials meant that any research to identify source information had to be done on a venue by venue basis. Where possible, we have identified areas were solid information existed and noted where we were unable to obtain enough information to evaluate success or failure.

Water piping (hydraulics)

The building materials used in the movement of liquids, or hydraulics, is probably the most significant area where PVC-free alternatives are used in Sydney Olympic venues.

In general in Australia, cold 'mains' water is often supplied to buildings via unplasticised PVC pipes (uPVC). When uPVC is not used, high-density polyethylene (HDPE) is often the alternative of choice. Once potable water enters a building, Australian Standard AS3500 stipulates that PVC is not to be used. For in-building cold and hot water, alternatives to PVC include copper, polypropylenes, cross-linked polyethylene (XLPE) and polybutylene (PB).[4]

Similarly, for the removal of drainage wastewater and sewage in general building use, uPVC is most commonly used. It is also used for in-ground sewerage and drainage pipes, which can be replaced by vitreous clay pipes (VCP). A range of materials including concrete pipes and fibre-reinforced concrete pipes (FRC) are used for stormwater drainpipe material but uPVC is most commonly used due to its low cost.

Olympic Site

The main supplier of PE pipe for hydraulics to the Olympic site and venues (up to 95 per cent) estimated that an impressive 200,000 metres of PE pipe were supplied rather than PVC. Another 30,000 metres of nylon pipe for gas services were used. These figures relate to the Sydney Showground, Archery Centre, Regatta Centre, Athletes' Village, Aquilina Reserve, Lidcombe Media Village and the Homebush perimeter (for grey water).[5] Some 1620 metres of PVC-free piping were used for various applications in the cycling Velodrome.[6]

At the Olympic site, ductile iron and cast iron are also used for water and fire mains in some areas. Recycled HDPE was specified for sub-soil drainage and was used in the transfer pipes for reticulated or recycled water.

Athletes' Village

Builders of the Athletes' Village, Mirvac Lend Lease Village Consortium (MLLVC) claim that they saved some 345,000 metres of PVC pipe from being used by specifying VCP for sewers, FRC for stormwater, ductile iron for water, PE for sub-soil drainage and PP for waste lines. MLLVC equate this to the length of piping running from Sydney to Canberra.[7] The PP pipes used for waste lines alone was 35,250 metres.[8] The only place where PVC was not avoided in the Athletes' Village was in the concrete slab foundation of the permanent housing, and sewer and stormwater applications where about 133 kilograms of PVC per standard residence was used.[9]

SuperDome

According to the senior designer of SuperDome's owner/occupiers, no PVC was used for hydraulics. Between 2000 and 3000 metres of aboveground pipe at the SuperDome was made from cast iron or copper pipe. The in-ground stormwater drainpipes were 1000 metres of VCP[10] and an estimated 2000 metres of HDPE were used for the roof drainage and downpipes[11]. The in-ground mains hydraulics were supplied in HDPE. Hot trade waste pipes used for cooking waste at the SuperDome were specified to be cast iron of which about 88,028 kilograms was installed.[12]

Sydney Showground

With over 95 separate projects and a multitude of subcontractors, it was difficult to gather information for the section of the Olympics site used annually for the Royal Easter Show (Media Centre, Multi-Use Arena and a number of other venues) referred to as the Sydney Showground. However, the OCA maintains that about 14,000 metres of PE pipe was used for main trunk services (to and from the site, carrying water) and about 5000 metres of FRC was used for sub-surface bulk water reticulation (water for recycling carried underground).[13] Above ground pipes were made from copper and galvanised steel was used for fire services.

Olympic Hotels

Hydraulic engineers for the Novotel and Ibis hotels said no PVC was used in the ground on-site. Alternatives to PVC were used for moving potable water (copper piping and XLPE), non-potable water (PB), sewage beyond the building's perimeters (VCP) and stormwater beyond the building's perimeters (FRC). For sewerage and stormwater within the building's perimeters, suspended pipe of uPVC was used.[14]

Olympic Stadium

From a Life Cycle Assessment (LCA) prepared for the Stadium Australia developers, it seems that significant quantities of PVC-alternative materials were used (see table PVC1). If PVC was used it would have fallen into the category of 'Various Plastics' group. This group accounts for only three tonnes of materials used for hydraulic works.[15] Within plastics, PE was used for wastewater and potable water. One tonne of PVC is being used within the cooling towers (airconditioning system). From a total of 2767 tonnes of pipe work allocated to hydraulics, cooling towers and stormwater within the Stadium, this is quite small. It seems reasonable therefore to assume that, from a hydraulics standpoint, Stadium Australia is largely PVC-free.

Olympic Rail Station

At Homebush Bay railway station 10,300 metres of recycled HDPE were used for sub-soil and strip drainage.

Other Venues

The Archery Centre used medium density polyethylene (MDPE) and copper for conduits and pipe instead of PVC with HDPE for sewers. Some PVC was used in small lengths for a sewer. Earthenware pipes for in-ground wastewater reticulation displaced PVC at the Hockey Centre with PVC use minimised in plumbing. Likewise ductile iron and 3,000 metres of PE were used at the Media Centre. However at the Showgrounds some PVC was used for temporary water main and fire services. While FPC and PE have been used in some applications at the Tennis Centre, recycled water mains and sewers use PVC. Off-site the White Water Stadium used PVC pipes for stages one and two as did temporary structures at the Sailing Shore Base. Similarly pipes and drains at Aquilina Reserve used PVC.[16]

A 1999 OCA review of PVC use showed that efforts were made at all sites to avoid PVC for hydraulic use. It has been difficult to obtain information on quantities for other major venues due to the number of contractors involved but Greenpeace believes the overall results are a mixed bag of some very good successes as well as some missed opportunities.[17]

Cabling

In the area of electrical cabling, efforts to replace PVC were not as effective as for piping. However, cabling in the permanent housing at the Athletes' Village is largely PVC free. The Australian-made cable Envirolex made by the company Olex Cables was used in all permanent houses and units for power and lighting wiring. It is unclear if Envirolex was also used on all the demountable housing though the developers did specify it. There are 1112 permanent houses and apartments in the Village and[18] Olex believes that 1170 metres of Envirolex were used per fixed house. Greenpeace calculates that an estimated 1.3 million metres (151,454 kilograms) of PVC has been avoided in the Athletes' Village permanent housing.

Co-developers for the Athletes' Village, Lend Lease, also specified Envirolex cabling for the Olympic hotels, Novotel and Ibis.[19] OCA publications give conflicting information about this, stating on one hand that PVC had been eliminated from all electrical services, general communications and computer cabling while in another document claiming it was only "minimised".[20]

The VIP suites in Stadium Australia apparently use PVC-free cabling for lighting and power sub-circuits. Olex note that 40,000 metres of their XLPE sheathed Envirolex was supplied to the Stadium indicating that XLPE sheathing was used for sub-mains cabling.[21] OCA information shows a large percentage of PVC-free cabling in the Stadium (See Table PVC2). While the raw figures

Table PVC1: Hydraulics Materials at Stadium Australia

Pipe type	Tonnes
Concrete pipes, pits and tanks	1590
Cast iron paperwork and fittings	239
Copper and brass pipe and fittings	160
VCP and fittings	149
Ceramics	136
Stainless steel	41
Various plastics	3

seem impressive, no data has been provided on how these figures were determined or why PVC alternatives were not used more widely. A Life Cycle Assessment of the Stadium indicates four tonnes of plastic used for energy cabling but no type is specified. It does specify however that three tonnes of PVC conduit was used.[22] There is an indication that more than 60 per cent of the conduit and cabling has non-PVC content.[23]

When broadcast sponsor NBC noted that the large power pylons on the skyline behind the Stadium would detract from the visual aesthetics of the Games they were removed in 1997. This resulted in about 8400 metres of PVC-free cabling being used for the 132 kilovolts (KV) lines along 9 kilometres of trench. At the crossing of Haslams Creek, 60 metres of continuous PE conduit were used to protect the cabling.[24]

In the SuperDome a system of metal cable trays instead of plastic PVC conduits was mostly used throughout although standard PVC cabling was also installed for other purposes.[25]

The interior fit-out of the SOCOG city headquarters is said to have used 60,000 metres of PVC-free Envirolex cabling.[26]

Unfortunately, PVC-sheathed electrical and telecommunication cable was used at the Archery Centre, Equestrian Centre, Hockey Centre, Shooting Centre, Regatta Centre, Aquilina Reserve and Sailing Shore Base. For these venues PVC telecommunication conduit was used because of a requirement of the national telecommunications supplier Austel/Telstra.[27] Greenpeace protested the use of PVC cabling on site in front of OCA headquarters in 1996 by laying its own PVC-free cabling at the site.

Resilient Flooring

Resilient flooring has a smooth, flat surface that is easy to clean and maintain. PVC-sheet and PVC-composite tiles are the dominant material for this application, known commonly as vinyl flooring.

Where vinyl might normally have been specified for Olympic venues, natural linoleum was the environmentally preferred alternative most often selected. Unfortunately, PVC was used for temporary structures (or 'Overlays') based on cost.[28] About 2000 square metres of studded vinyl flooring was used for the food court area at the Media Centre in Lidcombe.

The largest single installation of natural linoleum seems to have been the Media Village where some 5100 square metres were used.[29] There are only three main suppliers of natural linoleum in Australia including Forbo Floor Coverings and Armstrong World Industries.

Natural linoleum was laid in the Novotel and Ibis Hotels instead of vinyl flooring. This was used mainly for 'back of house' rooms such as tea rooms, phone equipment rooms, first aid office and administration rooms. Vinyl was laid on wet area floors such as bars and bistros.[30]

Ceramic tiles and timber were used for flooring at the Athletes' Village to avoid vinyl. The Stadium also opted for tiled floors instead of vinyl.

Seating

There appears to be no PVC seating at the major Olympic sites. The two key seating suppliers claimed PVC-based stadium seating had not been made for over 10 years in Australia. The company Sebel supplied over 137,000 seats amounting to approximately 244,710 kilograms of PP-based seating to the Showgrounds; Stadium Australia; Aquatic, Athletics, Shooting, Baseball, Softball and Hockey centres and the Velodrome. Seating for the SuperDome was supplied by Camatic who devised eight seating styles in PP with nylon (PA) arms and mountings.[31] The plastic elements of the 21,000 seats are estimated to weigh about 147,000 kilograms.[32]

Tensile Roofing

PVC is commonly used for large canopy, umbrella or tent style structures. There are several of these in place at the Olympic venues. But PVC has been largely avoided in their design and construction.

Situated on the public boulevard areas, the Amenities Buildings have translucent roof

Table PVC2: PVC Cabling at Stadium Australia

Stadium Australia Cabling type	% not using PVC
Mechanical	59.5
Fire	60
EWIS*	60
Electrical	50.5
Lifts/escalators	90

*Emergency Warning and Intercommunication System (EWIS)

structures. The product selected was Flontex, a German teflon sandwich laminate over a glass fibre core material. About 1500 square metres of Flontex was used to make the roof and upper walls. PVC was not suitable because the UV-resistant additives turn the fabric opaque.[33]

Various other tensile structures include the Showgrounds amphitheatre (1500 square metres), Bicentennial Park shade structures (about 40 square metres in total), Hockey Centre canopy (25 square metres) and various large Showgrounds umbrella structures (about 192 square metres in total). These 'sails' are a PVC alternative using polyolefin.[34] The Australian distributor of this material said they had supplied between 2000 and 3000 square metres of polyolefin, an alternative to PVC, for umbrellas, awnings and a sound shell. Polyolefin is the nearest in price to PVC so it is potentially the best PVC replacement.[35]

PVC awnings are being used for temporary structures (eg sponsor and media related shelters) all over the Olympic Site. In one eating area in the Homebush Commons, one such structure will include about 1700 square metres of PVC material.[36] The OCA said the main arch shading membrane at Stadium Australia was teflon-coated glass fibre while another source said the only large tensile application for the site was at the entry to the members area and this was of PVC construction.

WORLD'S BEST PRACTICE

Water Piping (Hydraulics)

In many instances Olympic Park has demonstrated best practice alternatives to PVC. However the bar is always being raised. For example, the water and sewerage system of a new urban development in Leidsche Rijn in the Netherlands with more than 30,000 new houses and 700,000 square metres of office space, will be entirely PVC-free. The UK's Anglian Water specifies polyethylene or ductile iron pipes in their mains renovation program and does not allow developers to use PVC pipe in new sewerage schemes. HDPE is regarded as more flexible and shock resistant.

Cabling

Because the developers of the Athletes' Village, MLLVC, were prepared to commit to PVC-free cabling for lighting and electricity, Olex could justify two years of research and development to create its PVC-free alternative Envirolex, the Australian made XLPE sheathed cable. Envirolex has been specified for eco-villages and national park developments around Australia.

Another Australian-made PVC-free product, Pyrolex, has a higher fire rating as it is halogen-free, creating less smoke when burned. It is also used where PVC cable smoke may damage valuable property, as in museums. The Berlin Museum of Jewish Culture, for example, is PVC-free. Demand in Australia has been steadily increasing over the past five years and now, some buildings contain 50 per cent Pyrolex cable.[37]

In an effort to avoid the use of PVC in high-grade audio cables, European manufacturer, Vandenhul has developed an alternative jacket insulation material, Hulliflex. Compared to PVC, Hulliflex is believed to have greater durability, mechanical strength, lower surface friction and higher thermal endurance.[38]

Resilient Flooring

Linoleum, the natural alternative to vinyl makes up 5 per cent of the resilient flooring market worldwide with the market share growing rapidly.[39] In the past three years natural linoleum sales globally have shown a growth rate of an estimated 71 per cent while vinyl sales are believed to be stable at about three to five per cent. The US market for natural linoleum in 1998 was $US20 million to $US25 million or 1 per cent.[40] The Australian market for natural linoleum is believed to be about 400,000 square metres annually.[41] Natural linoleum is made from linseed oil, natural resins, wood, cork and limestone and usually has jute backing. The product has natural anti-bacterial characteristics, is fire resistant, long-lasting, anti-static and biodegradable. After an incident during the Falklands War in which a number of British Navy personnel died as a result of inhaling smoke from a burning vinyl floor, the Navy has now returned to specifying natural linoleum.[42] It has also been specified for projects as diverse as the Auckland Airport in New Zealand and the Sony Metronome entertainment centre in San Francisco.[43] Being high in 'wood type' content, Natural linoleum is not however suited for use in wet areas, such as bathrooms.[44]

A new US product, Solenium by floor covering company Interface, is a resilient flooring made from polytimethylene terephthalate (PTT) which is bonded to a urethane foam and a PP scrim backing. All the elements were designed to be separated and recycled back into the manufacturing process. A biodegradable corn starch based version of Solenium was launched recently in the USA. Four of the looms at the Interface Solenium production plant are powered by photovoltaic (PV) cells. A US$1.8 billion company, Interface has 40 per cent of the global flooring market and aims to become the world's first sustainable and then first restorative company.[45]

Tensile Roofing

The UK's Millennium Dome is the world's largest single dome structure – larger than the Georgia Dome and the New Denver International Airport. The dome has a diameter of 320 metres, covers 80,000 square metres of floor space and 25,000 square metres of buildings. It is PVC-free using polytetrafluoroethylene(PTFE)-coated woven

fibreglass membrane panels (188,000 square metres of outer and liner fabric) for its roof surface.[46]

Aside from PTFE, the tensile structure market is open to a serious competitor to PVC. Canvas is often suggested as an alternative and may be suitable for short-term projects while industrial hemp could also be a contender. Considered to be the strongest and most readily harvestable of natural fibres, hemp was once the material of choice for sailcloth.[47] The Chinese Academy of Sciences says hemp is also highly UV resistant.[48]

PVC Phase-outs

Since 1986, 274 German communities and six federal States have introduced PVC restriction policies. In the early 1990s, many local authorities in Austria, The Netherlands and the Nordic countries also restricted PVC. In Spain, 52 cities have become PVC-free while the UK, US, Japan, Sweden and Denmark have national restrictions on PVC use. Meanwhile, three European studies released in April 2000 predict that PVC waste volumes will almost double over the next 20 years.[49] Considering the highly toxic content of PVC waste, its continued use for building materials must be called into question.

More information on PVC alternatives and world's best practice can be found on the Greenpeace website: www.greenpeace.org/~toxics/ and in the publication, *Building the Future: A guide to building without PVC*, Greenpeace, 1996.

CONCLUSIONS

This evaluation is limited because much of the detailed information necessary to evaluate Sydney's PVC-free minimisation effort was either not available from the OCA or had been archived by multiple contractors. Many of the larger developers mentioned confidentiality agreements with the OCA that prevented them from releasing data. Much of the information eventually obtained from OCA was useful but did not allow detailed analysis.

Tracing the data through the labyrinth of Olympic contractors and suppliers resulted in some incomplete figures. A more comprehensive and publicly transparent tracking system should have been put in place by the OCA so the construction industry could learn from the use of PVC alternatives through the development of Sydney's Olympic venues and site.

From the data collated, it seems that Sydney's Environmental Guidelines were met in a limited way in that PVC use was "minimised" or "avoided". This happened in varying degrees depending on the venue and the final application of PVC. Piping and flooring were the clear winners although there was room for improvement. Telecommunications cabling was an area of outright failure and very little effort was made to replace PVC in power and lighting cabling, except in those venues noted above.

One of the key successes of the Sydney's Environmental Guidelines was the introduction of a locally manufactured PVC cabling called Envirolex, an Olex product developed for MLLVC.

The Athletes' Village co-developer Lend Lease aimed to reduce PVC use by 40 per cent across the project. On completion they calculated the reduction in PVC by weight, against standard industry practice, to be closer to 70 per cent with a 100 per cent reduction in the 'infrastructure' category (sewer, stormwater and water mains.)[50] Their dedication to achieving this, given the lack of enthusiasm from fellow developers and within the construction industry, is to be highly commended.

Sydney's Olympics have shown that PVC-free alternatives are viable replacements across a range of building materials. Anecdotal information indicates that PVC use would have been much more prevalent in Olympic construction had Greenpeace not kept up its pressure at various building sites and on Olympic organisers. In researching this chapter, developers, contractors and builders were very aware of the Greenpeace PVC campaign.

While the Sydney Olympic Games has shown that PVC can be avoided in many instances, further take up of alternatives off-site in developments around Australia is necessary to reduce cost and ensure experience in the use of alternatives continues to rise. Internationally, regulation has been a key component of the move away from PVC and into environmentally-safer alternatives. Australia would also benefit from regulations that restrict PVC use to hasten the move to these alternatives.

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5 | Timber use at the Olympic Games

INTRODUCTION

Ancient forests are the greatest example of three billion years of evolutionary life on earth. They contain literally millions of different types of flora and fauna. Even more species are yet to be discovered. However, many species will not survive without large intact areas of ancient forests.

Greenpeace campaigns to protect the earth's last remaining tracts of ancient forest from destruction – through a moratorium on industrial developments and logging in ancient forests until appropriately large areas of ancient forest reserves have been established.

Greenpeace also campaigns internationally to ensure governments increase their efforts to stop illegal logging and the funding or approving of projects that expand logging into ancient forests or that convert or degrade ancient forests.
Greenpeace supports forest use by communities and businesses that sustain the natural dynamics and biodiversity of ancient forest ecosystems.

Greenpeace Believes the world's best practice for timber harvesting is:

- timber from rare, old growth, or threatened forests should not be harvested or used and
- use of recycled timber or timber sourced through a sustainable verification system known internationally as Forest Stewardship Council (FSC) certified timber should be given highest priority.

As a new development heavily dependent on timber for construction, forest protection was a key issue to be addressed as part of Sydney's Environmental Guidelines.

SYDNEY'S ENVIRONMENTAL GUIDELINES CALL FOR:

- Preservation and protection of the integrity of natural ecosystems including native bushland, forest and waterways
- Building material selection being subject to consideration of environmental participation in the planning, eg timber should be sourced from sustainably managed sources
- Use of recycled and recyclable building materials

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

Obtaining detailed information on the use of timber presented a major problem in evaluating how Sydney performed in sustainable timber use. There was little practical, formal verification carried out either on the source or end use and the intervening chain-of-custody for timber supplies. Therefore any conclusions about Sydney's success or failure in this area can only be indicative, not comprehensive. A key problem here and across a range of other key issues was the lack of uniform verification of the sourcing of timber products themselves.
From the representative analysis by venue and

volume of wood products used, most timber supplied for the 2000 Olympics was not from verified sustainably managed sources.

The degree to which the wood product sourcing for Olympic venues met Sydney's Environmental Guidelines depends to a large degree on an interpretation on the term "sustainable forestry". There are more than 100 definitions of sustainable forest management worldwide and a similar number for what actually constitutes a forest. By and large, most attempts at defining sustainable forestry are simply a standard on which to evaluate forest management performance rather than something definitive.

The only international forest management performance standards that have widespread stakeholder support and recognition are those of the FSC.

In Australia, where most of the timber for Sydney's Games was to come from, defining sustainable forest harvesting is far from clear. According to the national 1996 State of the Environment Report: "In Australia, forestry is not practised on the basis of even flow sustainable yield. There is no clear answer to whether our current use of the forest is sustainable. Past practices have not been. All forest management agencies have implemented policies designed to meet sustainability criteria."[1]

The amount of timber used on various Olympic projects was immense. Even the Timber Development Association (TDA) of Australia found its use difficult to track. The following does not capture all applications but represents the four different timber types: native forest, plantation, certified and recycled.

Native Forest Timbers

One of the Sydney Olympic's biggest challenges in committing to sustainable timber use was the lack of regulations to verify sustainable timber sources and to access such products in Australia. To complicate matters, there are no agreed criteria for sustainable timber between Australian environmental groups and the forest industry.

Regulation of native or original forests in Australia falls between the Australian Federal Government and State Governments. There is no consistent or effective approach across this regulatory division. The latest attempt to achieve consensus between the various stakeholders is the Regional Forest Agreement (RFA), part of the 1992 Australian National Forest Policy. The RFA was to permit logging only "in an ecologically sustainable manner". However, this has not quelled the debate on use of Australian forestry resources.

Federal government ministers with portfolios for forestry and conservation, environment and heritage co-signed a Statement on Sustainable Forest Management in Tasmania in 1999. It stated that: "Australia's processes for assessing and clarifying that forests are sustainably managed are equivalent to, or better than, any other assurance available for forest products."[2] This illustrates the recalcitrance and defensive stance taken by the Federal Government and industry leaders when faced with overwhelming market demand for independently certified wood products such as those approved by the FSC.

Most project managers and contractors interviewed for this report believed that timber sourced from New South Wales (NSW) State Forest managed regions was automatically "sustainable". The commonly held view was that the NSW State Government had, on entering office, locked up all "old growth" and rainforest areas inside sacrosanct, untouchable reserves. Everybody was confident that their timber did not originate from such forests.

While Greenpeace believes the NSW Government has gone farther than most Australian states to prevent native forests being used for commercial logging, without independent verification, it is impossible to guarantee that this is the case.

The Olympic Co-ordination Authority (OCA) has indicated that a chain-of-custody has been collated for the supply of timber at the Sydney International Equestrian Centre, Sydney International Shooting Centre and the NSW Tennis Centre. Timber supply to other venues occurred before the OCA Environment Branch required a chain-of-custody and is therefore not able to be sourced. The OCA's chain-of-custody process involved asking suppliers to provide a management plan for the forest, forest maps and locations of the timber source, harvesting plans describing the nature of the forest, approvals from relevant authorities for logging, delivery dockets and any inspection certificates.[3]

While information regarding the thoroughness of this process is unavailable, anecdotal evidence from the suppliers of recycled timber (see below) suggests the OCA was as diligent as possible given their inexperience in this new and unresolved field of forest monitoring.

Old Growth Failure and Success

A chain-of-custody does exist for the Tasmanian Oak used as veneer in the dining and entertainment rooms of Stadium Australia. It shows that some of the timber came from re-growth forests while some was sourced from clear-felled old growth trees of about 200 years vintage in coupes near the Huon River, Tasmania.[4] [5]

One logging coupe in particular, PC71, in the Picton Valley, is of particular concern. The Tasmanian Department of Parks, Wildlife and Heritage (DPWH) had endorsed inclusion of coupe PC71A into the Tasmanian Wilderness World Heritage Area because it would contribute

significantly to its value and represent a very significant improvement in its biological integrity.[6] However the specification from the Stadium's developers was that timber be "supplied from sustainably managed forests, from an area covered by a Regional Forest Agreement".[7]

A trial project to supply timber for the Athletes' Village from a low-impact forestry operation did not proceed. Due to time constraints, the hardwood used came from a salvaging operation in Northern NSW. The North East Forest Alliance (NEFA) agreed that this was the next best available option. The resulting timber has been promoted as "feature grade" which is said to utilise up to 80 per cent of the log, resulting in less waste. The standard specification would have been "select grade" where only 20 per cent might be used to obtain a more uniform appearance. Parquetry flooring was the end use. There was a specific stipulation that timber should not be sourced from high conservation value forest, rare and inadequately reserved forest types, old growth forest and habitat for endangered species.[8] A chain-of-custody was established to confirm that timber used met these criteria.

External cladding used on the modular, or temporary homes in the Athletes' Village, is understood to be reconstituted eucalypt hardwood and was sourced from NSW State Forest regions as "silviculture thinnings". These are smaller trees that do not grow into mature trees and are normally left on the forest floor after harvesting. The plant where the timber was produced is an Environment Australia's Cleaner Production demonstration project.[9]

While recycled turpentine wood was originally specified for the International Regatta Centre, milled hardwood turpentine was eventually used for timber decking and structural timbers despite a Greenpeace protest at the site. This timber was sourced from aforementioned "managed forests". The recycled timber was said to have exhibited flaws rendering the timber structurally unsound. While alternatives were apparently sought for a timber that could be submerged in a floodplain, none were found in time. Turpentine was used.[10] The TDA however believes that turpentine's water resistance abilities are best when used with the bark intact as large piers in marine applications. Greenpeace believes that for thin, milled timber in fresh water situations the benefits no longer apply and recycled or other timber species could have been employed in keeping with Sydney's Environmental Guidelines. Informed sources told Greenpeace that recycled timber was available and perfectly suitable for use at the Regatta Centre but the company that supplied timber to the venue persuaded the OCA to accept native forest timber.

While the Carlton Clydesdale Pavilion at the Olympic site was built from recycled timber to much acclaim, the railings at the Sydney International Equestrian Centre are state forest blackbutt hardwood with hardwood plywood partitions. The hardwood used is believed to be blackbutt and flooded gum Armourply from re-growth forests in northern NSW. This and the Regatta Centre were considered opportunities to further expand the profile of recycled timbers and displace wood needed from Australian native hardwood forests.

Other venues using native timbers include the Whitewater Stadium (for underwater stair treads) and the Ryde Water Polo venue,[11] where imported North American native forest timber, western red cedar, was used. In the Showgrounds, the woodchop area has 140 square metres of spotted gum poles for the deck structure and 100 square metres of tasmanian oak and alpine ash for the horse and pony pavilion.[12] The entry halls to the main pavilion have about 1200 square metres of tasmanian oak veneer in the ceilings. This was apparently sourced from regrowth forest for which a chain-of-custody was sought.[13] Reservations about tasmanian oak being sourced from old growth forests as noted for the Stadium apply here.

Certified Wood Products

Forest management certification is a relatively recent market-based mechanism to verify environmental, social and economic performance, and pass on this guarantee to consumers. There are many certification initiatives worldwide but Greenpeace believes the only credible and successful system is the FSC program.

The FSC acts as an umbrella organisation that sets overarching rules and processes for sustainable timber and accredits certifiers such as SmartWood and SGS to offer third party assessment of forest management. This is coupled with a chain-of-custody that tracks the forest product from forest to end consumer. The FSC supports environmentally appropriate, socially beneficial and economically viable management of the world's forests.

A competitive forest management verification system is the Pan European Forest Certification (PEFC) scheme, which was developed because the timber industry in Europe felt the FSC performance rules were too stringent. PEFC however has no environmental non-governmental organisation (NGO) support and little market credibility. The Australian Federal Department for Forestry and Conservation is believed to be considering aligning itself with this group because it could mean fast track certification for Australia's forests. Most astute forest industry players recognise the need for a certification system that has credibility in key markets. For example, most plantation companies in New Zealand are pursuing FSC certification. New Zealand already sells FSC certified timber to the Australian market. Although there are more than 17 million hectares of FSC-certified forests and plantations worldwide,

none are in Australia. As a result, it was impossible for Olympic projects to source Australian certified timber. A very limited amount of imported FSC timber was used at the Olympic site.

It has been noted in other Greenpeace publications that the rail station was to have used FSC timber from Papua New Guinea (PNG). According to The Woodage, the key FSC timber merchant in Australia, that timber did not materialise. However, The Woodage did supply PNG Kwila hardwood for outdoor furniture at the Athletes' Village. While not rated FSC-certified, it was classed as "transitional" (and from an old growth forest). The forestry operation that provided the timber was undergoing assessment for certification. Greenpeace Australia Pacific supplied a letter to say this was acceptable.

Approximately several hundred linear metres of imported FSC-certified rock maple hardwood timber from the US were used for hand railings in the Athletes' Village.[14] FSC-certified rock maple veneer was supplied for timber finishes over particle board on kitchen cabinets in quantities estimated at around 600 square metres.[15] More FSC-certified timber might have been used in the Village but the design-imposed colour restraints disqualified FSC options.

No other venues are believed to have used certified timbers.

Plantation Wood Products

Extensive use of plantation timber (from Australia's nearly one million hectares of softwood plantations)[16] was used throughout Olympic venues. This was predominantly the exotic species radiata pine. Some local softwood can be found in the application of hoop pine, which is considered to be structurally stronger than radiata.[17] Solid radiata was used for framing timbers with most particle board, medium density fibreboard (MDF) and plywood being derived from this species as well. Plantation timber stock was apparently used for all such engineered timber, with no "old growth" or native hardwoods finding their way into such products.

Other "engineered" products include Glulam (glue laminated) structural timbers, and LVL (laminated veneer lumber). The specifying of such engineered structural timbers can reduce demand for large single-piece structural hardwoods that can only otherwise be sourced from mature "old growth" or regrowth forests.

Plantation timber is not without its environmental downsides. Plantations are traditionally monocultures lacking the biodiversity of mature native forests. Binders and adhesives used in engineered timber products are often carcinogens, eg formaldehyde. Plantation softwoods may require protection from termite attack, commonly with a treatment of chromated copper arsenate (CCA). This presents treatment site pollution risks, landfill problems and human health risks associated with physical contact with the treated wood.

Within the Athletes' Village, 288,000 linear metres of Hybeam "I" joists and solid Hyspans were installed in about 960 houses to create the first floor supports.[18] No CCA was used. Light organic solvent preservative (LOSP) was used to treat above-ground timber while alkaline copper quaternary (ACQ) or kopper azole was specified for in-ground applications.[19] Environment statements for each engineered timber product indicated that they were classified low formaldehyde emitting (LFE).[20] For engineered or manufactured wood products, such as MDF and plywood, non-toxic formaldehyde-free adhesives are available (see the 1999 Greenpeace report *Re-Source*). Unfortunately, the New Zealand and Australian industries have been resistant to using them.

With the removal of the overhead powerlines (mentioned in the PVC chapter), nine kilometres of trenches were dug for underground cabling. The trenches were lined with around 3000 to 4000 plywood sheets but the exact type of wood is unknown.

The Sydney Showgrounds Multi-Use Arena (MUA) uses 1000 tonnes of plantation glue laminate (Glulam) for the internal timber structural web. New Zealand suppliers initiated this project but at the eleventh hour, an Australian consortium completed the work. Tasmanian oak, which can be sourced from clear-felled, old growth forests, is believed to have been used in the engineered web trusses. No chain-of-custody exists for sawn timber in Tasmania.[21] Between 1000 and 1500 19 millimetre sheets (2400mm x 1200mm) of marine grade hoop pine line the ceiling. This was considered a gross over-specification of material, which the supplier questioned at the time. It is understood that about 40,000 square metres of plywood were laid in the pavilions over existing asphalt for temporary media facilities for the Games.

In the SuperDome, 3500 sheets of plywood were supplied for use in the acoustic ceiling and wall panelling.[22] It was estimated that more than 200 cubic metres of plywood went into the ceiling.[23]

Off-site, at the cycling Velodrome, plantation hoop pine and radiata were used for panelling, while radiata was used for the 250 metres x 7 metre track supports. For the track itself, imported baltic pine was used. Developers were required to provide a chain-of-custody back to a plantation in Finland, Sweden or Russia. Approximately 3000 square metres of perforated hoop pine plywood were used in the ceiling of the International Shooting Centre for acoustic purposes.

Recycled Timbers

Use of recycled (or reclaimed) timber was considered for several Olympic venues.

The Carlton Clydesdale Pavilion architects designed the building around recycled timber because of its aesthetics. The fully timber-framed Pavilion was constructed using 100 cubic metres of recycled hardwood timber.[24] See Table T1 for applications and species.

The timber for the exterior balcony decking of the SuperDome was recycled from three locations, Kempsey, Oberon and Sydney, which caused a number of logistical problems for developers.[26]

The recycled timber for the more than 1000 bench seats scattered around the Homebush Bay site was obtained mainly from 50 to 60-year-old railway sleepers. Other sources included stockyards and a wharf in Queensland, which amounted to approximately 22,000 linear metres of timber, mostly Ironbark.[27] The bench slats were specified as recycled but could have no cosmetic defects. This created problems as nail and bolt holes had to be cut around. Recycled floorboards could have been sourced but the project specifiers considered timber defects to be cosmetically unacceptable.[28]

Some 330 cubic metres of recycled timber is believed to have been used at the International Shooting Centre, mainly as bullet containment protection baffles over the steel trusses. Some 360 tonnes of recycled mixed hardwoods, much of it from a woolshed in Brisbane, made it into the total site, of which 66,000 linear metres was for the baffles and 18,000 linear metres (or 56 tonnes) for visual ceiling battens.

The OCA visited the mill that provided recycled timber to the Shooting Centre. The chain-of-custody requirement was strict, requiring street numbers for each de-constructed house or building used for sourcing timber. In supplying brushbox, now considered endangered, the mill was required to explain if any arrived without the usual recycled imperfections, such as nail holes.

Recycled timber was used in the shared reception and bistro/bar areas of the Novotel and Ibis hotels. The main timber used was satinay from a demolished pier at Hervey Bay in Queensland. Originally from a unique heritage-listed forest on Fraser Island, satinay will never be cut for timber use again. Recycled timber sources like red stringybark were specified for the beer garden bars and the stair treads at the hotels and some spotted gum and ironbark formed the cladding at the shared bar. Timber suppliers estimate that approximately five to six tonnes of recycled timber were used at the hotels.[29]

Timber for the Archery Centre was recycled from a Sydney warehouse. Final usage of the timber was calculated to be about 12 cubic metres, with 300mm x 300mm girders machined into thin slats for cladding panels. The recycled timber was screw-fixed for easy reuse.[30] Recycled telephone poles became the "virtual forest" art piece on-site.

Haslams Pier within the Olympic site has 600 planks retrieved from tallowood wideboard that were once purloins in a factory building. The supplier was asked to provide defect-free timber where possible but the OCA did allow the suppliers to repair timbers with epoxy adhesives.[31]

Sustainable Timber and Unions

The Construction Forestry Mining Energy Union (CFMEU) placed a blanket ban on the use of plywood coming from countries like Malaysia which exported rainforest timber. This ban covered timber use for all Olympic projects from 1996 to 2000. The union stipulated that only plywood from plantation timber could be used. Invoices and receipts were stringently checked at site union offices during construction. The union believes they controlled the labour on all Olympic construction sites and had 100 per cent membership for the duration of the project. The ban is believed to have resulted in no timber coming from rainforest sources.[32]

Table T1 - Recycled Timber at Carlton Clydesdale Pavilion [25]

Application	Species	Sourced from:
Columns	Ironbark	Birkenhead warehouse
Bearers	Ironbark	Pyrmont Wharf
Joists	Blue gum	Grace Bros. On Broadway
Rafters/trusses	Blue gum & brushbox	Botany Custom Bond Store
Stable siding	Blackbutt, blue gum & brushbox	Musswellbrook coal mine
Flooring	Blackbutt & tallowood	Pyrmont loading dock
Stairs	Blackbutt & blue gum	Pyrmont loading dock
Upstairs servery	Silky oak	n/a
Entrance doors	Blackbutt, blue gum & brushbox	n/a

5 | Timber use at the Olympic Games

WORLD'S BEST PRACTICE

Native Forest Timbers

Greenpeace believes that the earth's last ancient forests[33] should remain intact, allowing them to fulfil their essential biological, environmental, social and non-timber economic functions. Australia has already cleared or degraded more than three-quarters of its ancient native forests and much of the remainder is at risk.[34]

The only Australian native forest timbers that could be considered world's best practice are those sourced outside ancient forest areas that have been independently certified under the FSC. Ending destructive logging practices in ancient forests throughout the world will be an important part of moving toward a sustainable environmental future.

Certified Timbers

The FSC certification system has now certified 17.5 million hectares worldwide in more than 180 forests through 33 countries. More than 20,000 FSC labelled products are now available across the globe.[35] This represents a six-fold increase in four years.[36] The FSC system is the best certification system in the world and is now a mainstream demand in many key markets. FSC-certified timbers are considered world's best practice.

In some western European countries such as the UK, FSC-certified wood is reaching over 20 per cent of the market.[37] An FSC-based trade network in the UK represents 91 companies trading more than 8.5 million cubic metres of 57 certified timber species from 21 countries.[38] [39] B&Q, the number one home improvement retailer in Europe and number three in the world, has committed to purchasing only FSC-certified timber products. Some 22 per cent of B&Q's products are timber products. Although the problems of independent certification and the FSC have been intensely complex with many issues still to be resolved, B&Q believes it is the way forward for retailers and customers alike.[40]

In the US, Home Depot and Lowes, the world's first and second largest home improvement retailers, have joined 240 leading wood product buyers and sellers from the Certified Forest Products Council (CFPC) to choose the FSC system.[41] [42] IKEA, the world's largest furniture retailer, has set itself the goal of ensuring all wood products originate from verified, well managed forests and encourages suppliers to source from FSC-certified forestry operations.[43]

Two of the largest homebuilders in the US (who build over 40,000 new homes each year) recently announced plans to source certified timber. One of these, Centex Homes, which nets $US5 billion in annual sales said they would "by the end of 2002, eliminate from our product mix wood from endangered forests".[44]

The World Wide Fund for Nature (WWF) is the main NGO promoting the FSC in Australia. It reports that an FSC certifier has been in Australia on a scoping evaluation for a large US-owned plantation forest concern in the southern state of Victoria. WWF believes FSC certification in Australia is not proceeding quickly because green groups are focused on contentious native forest logging of high conservation value forests. The Australian timber and forestry industries also remain unconvinced of market interest in FSC-certified timber.[45]

Plantation Wood Products

Plantations are on the increase in Australia and worldwide. They are generally intensive tree-farming operations often involving exotic monocultures. However, many indigenous species are viable for plantations such as hoop pine and many eucalypt species in Australia, and it is possible to manage plantation to include broad ecological and social goals. The FSC has dedicated criteria for plantation management and over 10 per cent of its certified forests are plantations. Therefore an FSC-certified plantation could be considered 'best practice'.

The engineered timber market continues to expand as new technologies allow room for innovation. For example, trusses and panels can save 250 hours on the job site and save more than $US3300 per house while using 26 per cent less wood. Stressed-skin panels can save between 25 per cent and 50 per cent of the framing timber used in a typical house. Efficient practices and materials can typically reduce the wood used in building a home by 15 per cent to 30 per cent. They can therefore help alleviate the growing pressure on natural forests.[46] Recycling of plantation-based MDF and particle board timber is not yet possible in Australia but is practised in Germany where 50,000 tonnes are processed annually.[47]

Recycled/Reclaimed Timbers

Recycling of timber is receiving a great deal of interest throughout the world although directives such as the new European Commission Construction Products state that if reclaimed materials cannot be proven to comply with European standards then they are substandard and therefore illegal. This is difficult for materials up to 75 years old.[48] In Australia however it is possible to visually stress grade recycled timbers using trained people.

The work undertaken on the Carlton Clydesdale Pavilion is considered in line with world's best practice. Other examples include the Monarto Zoological Park, 70 kilometres east of Adelaide, South Australia. Recycled timber was used extensively throughout the new Visitor Centre. More than seven kilometres of recycled jarrah flooring from the wool-store was used at the Visitor Centre for external decking, the Cafe floor and skirting timber trim throughout the project.[49]

Wood recycling is part of an international movement to improve efficiencies in the building construction sector.

Another timber efficient building technique is to avoid the use of timber for applications where suitable alternatives exist. Engineered products like particle board are being made from non-wood sources. These include: hemp, straw, wheat, almond shells, rice husks, blends of soy flour and recycled newspapers and even foil-lined milk or juice cartons. Bamboo, a very fast growing and strong grass, is available in tongue and groove flooring, architraves, benchtops and doors.

Rammed earth, poured earth, adobe, straw bale construction, cob, sandbags, glazed earth and recycled tyres have all been used for creating the shells of buildings while limiting the use of timber (as well as steel and concrete).

CONCLUSIONS

There is no independently verified evidence that current Australian forestry practices are sustainable and therefore sourcing timber from State managed forests cannot be called sustainable. Similarly the existing monocrop system of plantations has no independently verified evidence of its sustainability. Nor will recycled timber always be available in appropriate quantity and specification for growing building needs in Australia or worldwide.

The certification of timber and wood products is less than 10 years old, too early to indicate whether it will prove to be successful in encouraging sustainable timber use. The FSC has, however, shown the greatest success, market and consumer support and has the strongest mix of supporters from both industry and environment organisations.

It is difficult therefore to state with clarity the full impact of Sydney's Environmental Guidelines on timber construction projects for the Olympics and how this might be carried forward. At best it can be said that, by-and-large, strong efforts were made in the initial stages of Olympic site development to comply with the intent of the Guidelines.

Timber from old growth orhigh conservation value forests was generally not sought and was seriously discouraged. Timber from domestic or international rainforests was not considered unless it was FSC-certified and the appropriate alternatives were considered for use. However, from the representative analysis by venue and volume of wood products used, most supplied for the 2000 Olympics were not from verified, sustainably managed sources.

The lack of accessible and transparent reporting from the OCA on compliance with the Guidelines created a need for a great deal of external research. Consequently, this assessment is not complete.

Given the intent of the Guidelines and that a chain-of-custody process did exist, it is a tragic failure that Tasmanian old growth forests and world heritage area-nominated forests appear to have been felled to provide veneer for the dining and entertainment room of the Olympic Stadium.

Also disappointing is that, due to a lack of leadership in industry and government on this issue in Australia, Sydney's Environmental Guidelines did not move the nation closer to joining the global timber market in adopting independent timber certification as a measure of forestry best practice.

Credit must go to Mirvac Lend Lease Village Consortium however for the first commercial use of (imported) FSC timbers in Australia for use in the Athletes' Village. This could be viewed as a direct result of the Environmental Guidelines even if the quantity of timber was insignificant compared with the other sources with no 'best practice' credentials. It has at least exposed the Australian market to its first FSC timber supply.

The importation of FSC-certified timber from PNG to Australia is expected to continue. Greenpeace believes that this relationship is one of the most positive, enduring legacies to come out of the timber use Guidelines.[50]

Australian timber producers lag well behind the rest of the world when it comes to independent verification of the environmental credentials of their products. Influential sectors of the industry and government try to insist that the country's forest industry is already sustainable obviating the need for independent verification from the FSC. The result is that it is impossible to make a judgement about the environmental impact of one piece of Australian hardwood timber and the country is quickly falling out of step with more environmentally responsible markets.

Overall, Greenpeace believes that Sydney Olympic timber sourcing did fairly well within the extremely limited context of the market. With the unfortunate exception of Stadium Australia, steps were taken by Olympic organisers, builders and suppliers to try to minimise the environmental impact of timber use for the Sydney Games.

Further details of alternatives can be found in *Re-Source: Market Alternatives to Ancient Forest Destruction* (Greenpeace International, Nov 1999, ISBN 90-73361-58-3 / www.greenpeace.org).

FOR MORE INFORMATION, VISIT THE FOLLOWING WEBSITES:

- Greenpeace Forest Campaign
  www.greenpeace.org/~forests
- One Stop Timber Shop
  http://timbershop.wilderness.org.au
- Disseminates information on and promotes the use of, environmentally preferable timbers and alternatives.

- Certified Forest Products Council
  www.certifiedwood.org
  Established in 1997 to use market forces to promote best forest management practices.
- Coastal Rainforest Coalition
  www.coastalrainforrest.org/
  Promotes ecologically sound alternatives to forest products sources from old-growth forests.
- Co-op America's Woodwise Consumer Initiative
  www.coopamerica.org/woodwise/index.html
  Practical tips and resources to help individual consumers and businesses to protect forests
- Natural Resources Defense Council Forest Initiative
  www.nrdc.org
  Promotes wood-use efficiency, especially within the home construction industry.
- Rainforest Action Network www.ran.org
  Encouraging companies to reduce use, purchase alternatives, and adopt 'no-old-growth' purchasing policies.
- Forest Stewardship Council
  www.fscus.org – US site
  www.fscoax.org – international site
  International, independent non-profit organisation to support responsible forest management practices.

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6 | Water use at the Olympic Games

INTRODUCTION

More than 70 per cent of the earth's surface is covered with water yet just three per cent is fresh water. Two-thirds of that can't be used because it's frozen in polar ice caps or contaminated with wastes. This means that only one per cent the entire supply of water on Earth is available for human use.

Fresh water is critical for our survival and, as such, is a precious resource we must use carefully. Taking water from rivers for agricultural and personal use is already having an impact on the immediate environment.

Many of our water demands, such as irrigation and toilet use, don't require the same quality of water as that needed for human consumption. In many cases, alternatives to water-intensive processes can greatly reduce our water usage. Sustainable water practices not only conserve water (and, so, energy); they also recognise that establishing different water quality levels for different purposes conserves our limited fresh water resources. Recycling water for domestic use is one of the best ways to begin this process. As a key part of Sydney's environmental commitment to the 2000 Olympics, water conservation and recycling are a focus of the city's Environmental Guidelines.

Greenpeace believes that we must protect our water resources from pollution and substantially reduce our dependence on our precious fresh water supply. This not only ensures enough fresh water for us in the future but for all the biodiversity that depends on water for survival.

SYDNEY'S ENVIRONMENTAL GUIDELINES STATES

The Sydney Olympic Games Environmental Guidelines call for:

- the encouragement of sound, sustainable water resource management through public and industry education programs;
- water conservation and recycling practices;
- the protection of recycled water's useability by minimising the use of pesticides in landscape maintenance;
- recycling of treated storm water and sewage effluent;
- landscape design that decreases water requirements in parks, gardens and other recreational areas, with an emphasis on the selection of plants suited to the climate;
- the use of water conservation devices such as dual flush toilet systems, root-fed water tanks, water-saving shower roses and appropriate irrigation devices;
- the selection of low water-use appliances, including dishwashers and washing machines;
- the introduction of pricing policies that reflect the real cost of supplying water.

6 | Water use at the Olympic Games

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

The long-term water management strategy of the Olympic Co-ordination Authority (OCA) at the Olympic site consists of a Water Reclamation and Management Scheme (WRAMS) and a "water-wise" approach to fittings in buildings and landscaping. The strategy's aim is to minimise the demand for drinking water from Sydney's mains supply and, at the same time, maximise the use of recycled water to conserve Sydney's water resources. For this purpose, stormwater, sewage and swimming pool backwash are collected and treated on-site for reuse.

The OCA has chosen not to use recycling for potable water needs because it anticipated a high level of public resistance to the idea. This is why a completely closed-loop water management system has not been implemented at the Sydney Olympics site.

The maximum volume of recycled water available through the Olympics WRAMS system is estimated at about 50 per cent of the total non-potable water demand. The OCA estimates that, with ongoing use of the site post-Olympics, this corresponds to about 850 million litres of water a year, or between two and 11 million litres a day, depending on changing irrigation needs. The WRAMS is expected to cover this demand entirely with reclaimed water.

The Wrams Components

The WRAMS provides facilities to "mine" and treat sewage, collect and treat stormwater and deliver the treated water from these two sources back to designated areas on site.[1]

Water Reclamation

Sewage is mined from two pumping stations, one collecting sewage solely from the Olympic site, the other collecting from the surrounding region. The mined sewage is then pumped to the Wastewater Reclamation Plant.

Stormwater Collection

All stormwater on-site is collected and drained into one of several water quality control ponds. These ponds have upstream litter traps to remove gross pollutants and are clay lined to reduce infiltration loss. They have been landscaped with plants that naturally remove nutrients from the water and also provide some habitat for water birds. The water in these ponds is pumped to a disused brickpit on the site, referred to as the Brickpit Water Storage Area.

Water Storage Reservoir

Stormwater from the water quality control ponds is stored in the Brickpit Water Storage Area and pumped to the Water Treatment Plant to be treated for reuse on-site. The brickpit has been designed to hold up to 300 megalitres of stormwater and the volume pumped out can vary to meet changing requirements of the Water Treatment Plant.

The brickpit is notable as the location of a population of endangered green and golden bell frogs. In the early days of site construction, Olympic organisers discovered the frog using the site as a breeding ground. It is one of only 12 known breeding colonies of this frog species. To protect the frog's habitat, the OCA altered its design plan to turn the pit into the Olympic tennis centre. The brickpit was instead designated part of the WRAMS and placed under the protection of the new Millennium Park on-site.

Significant areas of new and enhanced frog habitat were created next to the brickpit to allow the pit to be used for stormwater collection. Creation of freshwater ponds, the planting of grasses and reeds and the construction of boulder shelters have encouraged more frogs from the pit to the areas surrounding it. Today, the frog population at Homebush is one of the largest in the country and sightings of the frog elsewhere on the Olympic site indicate the population is flourishing. The frog's habitat will need to be monitored for many years after the brickpit is flooded to ensure its population is not negatively impacted.

SEWAGE AND STORMWATER TREATMENT

Wastewater Reclamation Plant

The Wastewater Reclamation Plant (WRP) is a small-scale sewage treatment plant which can treat up to 2.2 megalitres of sewage per day. On-site and mined sewage is treated through a series of

Table W1: Distribution of Water Use at Olympic Park

Non-potable water (recycled from site)	Drinking water (from Sydney water mains)
Used for:	*Used for:*
Landscape irrigation	Drinking
Wash down	Cooking
Ornamental water features	Showering
Industrial use	Clothes washing
Toilet flushing	Fire fighting

processes. Large objects are screened out and, each day, approximately 140 litres of this waste are disposed of at a sanitary landfill. Microorganisms in the Sequenced Batch Reactor (SBR) break down the organic material biologically and reduce nitrogen and phosphorus concentrations. Excess biomass is removed (with possible reuse options including agricultural fertiliser), followed by the effluent which is decanted and disinfected using ultraviolet light.

As no similar systems have been used during an event such as the Olympics, operators are unsure whether WRP will be able to cope with all sewage generated during the Games. Any sewage in excess of 2.2 megalitres will be delivered to Sydney Water sewers for treatment.

Water Treatment Plant

The Water Treatment Plant (WTP) treats all water collected on-site for non-potable reuse. Methods include screening, microfiltration, reverse osmosis and, finally, chlorine disinfection.

The quality of the recycled water at the Olympic Park exceeds current national and state guidelines for urban/residential reuse and the NSW Recycled Water Committee Guidelines for non-potable water.[2]

The WRAMS is intended as a demonstration project. The Water Treatment Plant has facilities to educate the general public and expert visitors on the treatment process and on the values and benefits of reusing waste water.

WATER-SAVING DEVICES AND TECHNOLOGIES AT OLYMPIC PARK

All facilities at the Olympic Park, including the Athletes' Village at Newington, use water-saving devices and techniques, saving an estimated 30 per cent of total water needs. Half the remaining typical water demand (ie, all non-potable water needs) is met by WRAMS recycled water.

Water-saving devices installed in all venues at the Olympic Park include dual flush toilets and low water-flow devices (such as water-saving shower roses). To minimise irrigation needs, drought-tolerant native plants have been favoured at all Olympic sites. Mulch is used extensively to reduce water loss, improve soil fertility and minimise fertiliser use. Specific soils have been chosen to increase infiltration. A central computer will control irrigation to enable automatic night operation, eliminate overwatering and halt irrigation during rainy periods.

Water Management Concepts at Olympic Park

The main aim of sustainable water management (as with solid waste) are reduce, reuse, recycle.

Reduction in water demand can be achieved through water saving devices such as low-flow

Table W2: Water-saving Practices at Olympic Park Venues[3]

Venue	Water saving practices
Athletes Village	Water flow reduction fittings or valves at major water supply outlets
	Drip type irrigation systems with automatic shut-off during rainy periods
	Drought-resistant plants & water-conserving landscaping
SuperDome	Highly water efficient fittings, appliances & devices
	Flush control on all urinals
	Flow control water systems reducing annual water demand by 30 per cent
Media Centre	Low or dual flush toilets, low flow taps & shower roses
	Low water-use appliances
State Hockey Centre	Low flow taps and dual flush toilets
	Sprinkler layout and directional sprays improve water efficiency
Stadium Australia	Five-litre flush toilets
Sydney Showgrounds	Roof-harvested water irrigation, saving 50 per cent of water needed
	Rainwater collected in subsoil drainage to irrigate arena
	Below-ground automated irrigation for lawns & shrubs
Aquatic Centre	Pool filtration to reduce backwash and lessen need for top-up of pool water

toilets, however it is preferable to consider the water management systems at a macro level, the building, the building complex, the whole community. This enables analysis of water systems and their relationships with the built environment so that measures can be incorporated into all areas of design, not just end-of-pipe solutions.

Many efforts have been made within Olympic Park to reduce water demand. Olympic Park has been specifically designed to reduce the demand for water; many water-saving devices have been installed; separate potable and non-potable water delivery systems are used.

However, there is no separate collection system for black water (from toilets) and grey water (from basins, sink and showers) or use of other water-saving devices, such as vacuum toilets.

Reuse can be achieved by diverting for reuse the water that would otherwise go to the sewer system. Sources of this water include stormwater and waste water. Water with low levels of contaminations can be used, for example, in toilet flushing and irrigation, as it will at the Olympic site.

Stormwater collected from roofs of several Olympic site buildings could be reused directly. However, after analysis of stormwater from other parts of the site, it was concluded that treatment would be required prior to its reuse and it will, therefore, be put through the WRAMS.

Recycling is achieved through collecting and treating water, with the level of treatment dependent on contamination levels and proposed end uses. Hence it is possible to treat water, for example, to non-potable levels and return this water in a separate distribution system for use in toilet flushing and irrigation, as is being done on-site. Stormwater and waste water are separately collected and treated for non-potable use. Further waste water from the surrounding area can be mined to meet on-site water needs.

As mentioned, separate black and grey water collection systems would have enabled more appropriate individual and sustainable water treatment. Also, chlorine disinfection processes are used being used for treatment and, while the chlorine is recycled, chlorine itself is polluting in its production use and disposal. Its use for water treatment is being questioned internationally because of its environmentally damaging impact.

The Failures

With a separate collection system, waste water from basins, sink and showers (grey water) and particularly from toilets (black water) could have been diverted to an anaerobic digester to produce biogas and nutrient-rich fertiliser, as suggested by Greenpeace back in 1993.[4] An on-site combined heat and power plant could have been incorporated into the overall design of the Olympic Park as a showcase of biogas generation.

There are several alternatives to chlorine disinfection that should have been considered. Ozone, successfully used for treating pool water at the Aquatic Centre, is a chemical oxidiser which works in a similar manner to chlorine but produces fewer byproducts. While ozone is able to decompose halogenated compounds (an added benefit over chlorine), the production of this gas consumes a large amount of energy. Disinfection with UV radiation is a better tried-and-tested technology with no byproducts. According to the OCA, UV sterilisation is used for the disinfection of effluent from the Water Reclamation Plant.

Given that, currently, all recycled water is intended for non-potable and the relatively small delivery distances for treated water within the Olympic Park, the use of chlorine disinfection could and should have been avoided. Innovative new technologies include special filtration methods and highly efficient membranes are able to remove microorganisms, pathogenes and viruses from water. These technologies seem to be an excellent alternative to chemical treatment.

The OCA is still investigating uses for the sludge generated from the treatment waste water. Greenpeace advocates approaches that lead to the safe return of the nutrients to the land, helping close the nutrient loop. The OCA has still to confirm what will be done with other wastes generated in the treatment process, such as spent filters.

The issue of potable waste water recycling needs further investigation. However, one of the key water conservation criteria, set out in Sydney's Environmental Guidelines,[5] is the "encouragement of sustainable water resource management through public and industry education programs". Clearly the OCA has an explicit requirement to educate and reassure the public about sustainable technology. The Olympic site would have been an ideal showcase for potable waste water recycling and (as recommended in Green Games Watch 2000's 1996 report[6]) this could have been introduced to the site in a staged fashion to allay public concerns.

WORLD'S BEST PRACTICE

The use of recycled water for potable supply was rejected by Olympic organisers because of health concerns.[7] However, it is technically and economically possible to treat waste water to potable water standards.

A potable reuse plant has been operating successfully in Windhoek, Namibia, for many years. A recent financial analysis of a reuse scheme at Rouse Hill, New South Wales, estimated the difference in cost between a dual non-potable

supply and scheme to provide potable water at less than seven per cent.[8]

Within a few kilometres of the Sydney central business district, a family in a narrow terrace house recycles their own grey and black water for toilet flushing and clothes washing. A book about their home, *Sustainable House*[9] is the publishers' best-seller – an indication that the public is prepared to consider such environmental and money-saving options.

MORE INFORMATION ON BEST PRACTICE CAN BE FOUND AT:

- International Water Association
  www.iawq.org.uk
- USA Environmental Protection Agency Office of Water
  www.epa.gov/owm/genwave.htm
- Water Demand Management Research Network
  www.idrc.ca/waterdemand/index_e.html

CONCLUSIONS

The OCA has taken some major steps towards a more sustainable water management system at the Olympic site. Key features, such as site and venue design to maximise collection of stormwater and minimise on-site demand for water, are important elements in creating a more ecologically sensitive development.

The collection and recycling of waste water for on-site treatment and the provision of a separate potable and non-potable supply to reduce the demand on Sydney's main supply are essential requirements of the Olympic Environmental Guidelines. They are also a significant step forward for water management in Australia.

However, the OCA has consistently missed opportunities to make the water management system a true showcase of sustainable technology. Reliance on traditional technologies for waste water collection and treatment have meant that more sustainable options have been overlooked.

At the least, the Water Management System at the Olympic site should have included a separate grey and black water collection system, an anaerobic digester and a combined heat and power station in addition to the sustainable features that have been incorporated. These technologies were advocated by both Greenpeace and Green Games Watch 2000 throughout the feasibility, design and construction stages of the Olympic site development but, unfortunately, none of them has been incorporated.

The Olympic site has had the potential to influence environmental design well beyond the Olympics. The OCA has failed to use its unique position to fully integrate modern ecological water management technologies into its water and sewage treatment systems. While the OCA and the WRAMS designers are to be commended for the steps they have taken, Greenpeace hopes that other Australian state governments and communities will push beyond the current level of commitment to an even greater ecological approach.

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7 | Transport at the Olympic Games

INTRODUCTION

In 1990, the United Nations Advisory Group on Greenhouse Gases calculated that an average global temperature increase of just one degree Celsius could result in "rapid, unpredictable and non-linear responses that would lead to extensive ecosystem damage". A two degrees Celsius increase would be the "upper limit " the environment could take before risking "grave damage to ecosystems".

Governments and scientists alike agree that the problem is real and serious. At the climate summit in Kyoto in late 1997, industrialised countries agreed, at least on paper, to reduce the amount of carbon dioxide and other greenhouse gases they pump into the atmosphere. However, crucial details, upon which the success or failure of the agreement rests, are still under negotiation. At the present time, little definite action is being taken to address the problem.

Cars are a significant source of polluting greenhouse gases. For this reason, Greenpeace campaigns internationally for better public transport and a reduction in the impact of fossil fuel-burning vehicles on the environment. It is imperative that we reduce the number of cars on the road. One of the best ways to achieve this is to improve public transport and further encourage its use.

Greenpeace is lobbying governments to face their responsibilities and urgently address the issue of transport contributing to the build-up of greenhouse gases. The longer the delay, the more drastic the action required to avoid dangerous interference with the planet's climate.

Transport is a recurring problem with an event the size of the Olympics Games. At the 1996 Atlanta Summer Olympics, traffic congestion and problematic public transport systems were cited as some of the biggest logistical problems by officials, athletes, the media and spectators. Sydney is known to have limited road traffic capacity in normal circumstances and the city realised that, without a comprehensive public transport plan for spectators, its Olympic Games would face similar problems to those of Atlanta. It is this practical challenge that ensured the transport issue was included in Sydney's Environmental Guidelines.

SYDNEY'S ENVIRONMENTAL GUIDELINES STATE:

"The provision of transport is an integral part of sustainable urban planning. The future viability of modern cities requires a shift in the balance from private to public transport and the adoption of transport technologies that maximise energy efficiency, minimise pollution and ensure 'user-friendly' public transport options.

7 | Transport at the Olympic Games

"Sydney as an Olympic host city should commit itself to:
- Location of Games facilities close to public transport systems;
- Provision of satellite car-parking sites to facilitate use of public transport;
- Provision of cycle ways and pedestrian walk ways at Olympic sites."

EVALUATION OF SYDNEY'S GREEN OLYMPIC EFFORT

The Sydney 2000 Olympic and Paralympic Games will create the highest continuous demand for passenger transport ever experienced in Australia. Good transport operations are vital to the smooth running of the Games and to ensure minimal disruption to daily life in Sydney.[1]

- 200,000 daily visitors are expected in Sydney over the 17 days of the Olympic Games.
- At the same time, 3.5 million Sydney residents will continue to travel to and from work and around the city.[2]
- An estimated 500,000 spectators and workers are expected to travel to Sydney Olympic Park on the busiest days of the Olympic Games.
- An additional 100,000 people are expected to travel to Darling Harbour, the second biggest Games venue.[3] More than 1.2 million trips are expected on peak days, excluding travel by athletes, officials and spectators to Olympic venues.
- Sydney residents are being encouraged to work flexible hours and to take holidays during the Games.[4]

Public Transport

Access by public transport was a key factor in the site selection of Sydney Olympic Park and all other Olympic venues.[5] The overwhelming majority of passengers travelling on Olympic Primary Routes will be carried in trains and buses coordinated by the Olympic Roads and Traffic Authority (ORTA), which has been specifically established to organise transport for the Games.[6]

The New South Wales (NSW) Government has developed and built an extensive public transport network which comprises rail, bus and ferry services. Of the three, rail moves the most people quickly and efficiently and is recognised as the main mode of transport for access to the Olympic Park site for major events. Rail and bus systems have been improved to manage the expected 80 per cent increase in passenger numbers.

Public transport is being encouraged through a ticketing system – each Olympic event ticket covers event entry and public transport fare on a nominated transport system. Parking for private cars will not be provided at any competition venues. Spectators who do not catch a taxi, ride a bike or walk will have to use public transport. There is provision for "park and ride", allowing passengers to drive to shuttle bus stops or train stations, park their cars and catch buses or trains to Olympic events.

- Twenty-one of the 25 sports will be staged in two compact zones, Sydney Olympic Park and the Sydney Harbour Zone.
- The two zones are 14 kilometres apart and linked by a network of road, rail and water-based services.
- The rail system provides access to all Olympic sites and will be augmented by buses.
- Ferries will transfer VIPs, athletes and media between Sydney Olympic Park and the Sydney Harbour Zone.
- Satellite parking areas will be established at major bus and rail interchanges.
- All venues and most training venues are within 30 minutes' travel of the Olympic Village.
- Cycleways and pedestrian walkways will be linked to public transport interchanges but only 130 bicycle racks or lockable bicycle storage units are provided for public use at Olympic Park.

Train Line Extensions

The extension of Sydney's rail system to the Olympic site was vital as part of the city's commitment to holding the first "public transport only" Olympic Games in modern times. A$94 million was spent expanding rail lines to the site. In 1998, an additional A$12.5 million was spent on railway infrastructure to boost public transport capacity for Games use. This will allow an

Table M1: Travel Options (by Olympic Venue)

Venue	Primary travel option	Additional travel
Olympic Park (Homebush Bay)	Rail station on-site	Nine regional bus routes
Darling Harbour (City)	City rail & bus network	Monorail & light rail at standard fares
Velodrome (Bankstown)	Rail & shuttle bus	
Softball/baseball (Aqualina Reserve)	Rail & shuttle bus	1.6km walkway from rail
International Regatta Centre (Penrith)	Rail & shuttle bus	
Water polo (Ryde Leisure Centre)	Rail & shuttle bus	
Sydney Football Stadium	Shuttle bus from city	Walk from city
Beach volleyball (Bondi)	Shuttle bus from city & Bondi Junction	

additional 6000 passengers an hour to travel to the site. Greenpeace lobbied strongly for these additions and has supported train access to the Games throughout its seven-year Olympics campaign. It is hoped the NSW Government will continue to support rail service as a key to the city's transport system when the Games are over.

The rail station at Olympic Park can handle 50,000 people per hour. During major events, 30 trains will carry up to 36,000 passengers per hour, with a train departing Olympic Park Station every two minutes.

Airport Rail Link

In May 2000, Sydney launched its first airport rail link in the run-up to hosting the Olympic Games. Australian Transfield and French Bouygues formed a joint venture agreement to contract with the NSW State Rail Authority to build the track and tunnel for a new airport link. The 10-kilometre railway line links the city with Sydney's Kingsford Smith Airport and locations beyond. The line is almost entirely underground and is one of the largest tunnels to be bored in soft ground in the world.

The system is a significant addition to Sydney's transport system, which included no rail access to the airport prior to this project. It provides fast rail links to the airport and expands the capacity of the city's CityRail network. Passengers from the airport are able to reach City Circle stations around central Sydney without changing trains. The four new, privately owned and operated underground stations include the domestic and international airport terminals.

Trains travelling to the south-west of the city arrive at the airport every seven to 15 minutes. Transfer between the two airport stations takes three minutes. The journey between the airport and the city takes around 10 minutes. The new line provides much-needed public transport at Sydney Airport for the Olympics and, afterwards, is an excellent environmental and transport legacy for residents.

Sydney Airport and its partners have invested A$2 billion in a comprehensive upgrade of airport facilities, aimed at providing capacity for forecast growth during the Olympic/Paralympic Games period and into the next decade. Around 680,000 Olympic passengers are expected to pass through the airport between mid-September 2000 and the first week of November 2000.

Bus Transport

Only 24 compressed natural gas buses will operate in the Olympic Village, with 3800 petrol- and diesel-fuelled buses on the roads. Around 1800 buses are being brought to Sydney from country areas to serve specific Olympic transport routes.

At the Olympic site, there are bus stations at both ends of the Olympic Boulevard. Each of these is capable of receiving 18 buses at a time. There is capacity for 500 buses to transport more than 25,000 passengers per hour.

Sydney Olympic Primary Routes

The Olympic Primary Routes, designated by the city, are the main thoroughfares used for all transport associated with the Games. The routes will be used to transport the many groups involved in staging the Games, including athletes, technical officials, accredited media and sponsors. Support vehicles, including emergency services and those carrying Olympic freight, will also use these routes.

Two Olympic Primary Routes – the Sydney Olympic Park Route and the restricted-access Kerb-side Olympic Lane – will facilitate arrivals and departures between the city and the Olympic site. Seven routes will provide travel to competition venues and one will be used to transport technical officials between Sydney Olympic Park and the Technical Officials Village.

The Sydney Olympic Park Route covers 18 kilometres and links the Sydney central business district (CBD) and Sydney Olympic Park at Homebush Bay. It will also service Darling Harbour, the second biggest Olympic competition centre. The route goes through six suburbs from the city via major arterial roads such as the Western Distributor, Anzac Bridge, Victoria Road, Concord Road and Homebush Bay Drive. The Glebe-Homebush Bay Regional Bus Route also runs along most of the route.

The restricted-access Kerb-side Olympic Lane consists of three lanes in each direction. The Olympic Lane will operate during the Games period from 5am to midnight. Only public transport (buses, taxis and cyclists) are entitled to use these lanes.

Road Extensions

In 1993, the NSW Government promised that no major road infrastructure developments would be required for the Olympics. However, in November 1997, it allowed the building of the Eastern Distributor (a major new freeway link and tunnel from the city's north to Sydney Airport), claiming it was necessary for the Games.

Ferry Transport

Ferry travel is a key element of Sydney's city transport and there are five classes of ferry in the NSW State Transit Authority fleet. RiverCat ferries operate on the Parramatta River from the CBD to the Olympic site. Unfortunately, during the Games, only athletes and Olympic officials will be permitted to use ferry transport at the Olympic site ferry terminal.

7 | Transport at the Olympic Games

The New Light Rail

Light rail transport (LRT) is a cross between a tram and a train. It can move through streets, avenues and roads then leave built-up city areas and reach a speed of 80 to 90 kilometres per hour on open track. For this reason, LRT is an ideal urban/interurban public transport mode. LRT track and wheel design reduces noise and vibration.[7] Sydney's LRT consists of seven vehicles (with five cars per vehicle) with a carrying capacity of 217 passengers per vehicle. It operates between Central Rail Station and Darling Harbour.

Car Travel

There will be no private car parking for spectators at Olympic venues during the Games. However, "park and ride" car parks at strategically placed locations will enable people without direct access to the Olympic transport system to drive to relevant bus and train stops. A minimal parking fee may be payable at these "park and ride" sites. Media and VIPs will transported by a selection of cars, solar-powered vehicles and ferries.

Olympic sponsor General Motors Holden will provide more than 3000 cars for transportation of media, VIPs and athletes. Unfortunately, none of these cars will be powered with alternative fuels as originally promised. In a letter to Greenpeace in February 2000, Holden promised that eight per cent of the car fleet would be liquid petroleum gas (LPG) fuelled vehicles. The company subsequently reneged on its promise in favour of more polluting conventional vehicles.

Greenpeace believes that Holden's failure to provide alternative-fuel vehicles and the failure of Olympic VIPs to use public transport is, in turn, a failure to meet Sydney's Environmental Guidelines commitments.

Solar and Electric Vehicles

A fleet of 400 electric and solar-powered buggies will transport athletes, officials, spectators and police between Olympic Games venues within Olympic Park. They range from two-seater through to 19-seater vehicles. With a recharge time of just one hour, the zero-emission carts can run 23 hours a day. Their four-wheel electronic regenerative braking system also replenishes the battery. Running at about 95 per cent efficiency (a standard petrol-powered car is 20 per cent efficient), the buggies travel up to 70 kilometres per hour but will be restricted to 20 kilometres per hour around the Games arenas. Electricity for charging the solar buggies will come from the NSW Green Power or all-renewable energy scheme. While these vehicles are not currently permitted on the open road, their use at the Olympic site is an excellent showcase for this new, non-polluting technology.

Taxi Service

The existing taxi fleet in Sydney is mostly fuelled by LPG, which has lower emissions than petrol.

Cycling and Foot Power

To improve access by foot or bicycle in and around Olympic venues, cycle paths and footpaths have been constructed. Unfortunately, secure bike storage facilities are extremely limited, with only 70 bike racks provided outside Stadium Australia and around 50 lockable storage racks available outside Sydney Showground.

An old rail bridge was successfully turned into a bicycle bridge for access to and from the north. Other cycle links include the Parramatta Valley Cycleway on the north bank of the Parramatta River and a cycle crossing on the Elizabeth Street footbridge. A key cycleway also runs from Botany Bay to Ryde via Homebush Bay, with 80 per cent off suburban roads. There will be a bicycle path on Olympic Boulevard and the main avenues include kerbside bicycle lanes. Other streets within the urban core do not appear to include specific provision for bicycles.

WORLD'S BEST PRACTICE

The Australian transport sector accounts for 71 million tonnes (or 17 per cent) of Australia's total net greenhouse gas emissions. About 87 per cent of these emissions come from road transport. The Bureau of Transport Economics projects that, without reduction measures, emissions will rise by 38 per cent between 1990 and 2010.[8]

In New South Wales, the transport sector is responsible for 28 per cent of all carbon dioxide emissions from human activity. Two-thirds of this comes from passenger and light commercial vehicles. The NSW Government is developing a Metropolitan Strategy and an Integrated Transport Strategy to guide the direction and form of the city's growth and ensure that transport systems best serve the city into the future. Another specific program is the Building Better Cities Strategies adopted under this program, which involves urban renewal and public transport improvements.

The Australian bus and coach industry is a substantial contributor to public transport. Over 3000 bus and coach operators provide route services, school services, and charter and tour services. In 1999, 16,941 vehicles comprising route buses, school buses and coaches travelled 640 million kilometres.[9]

Compressed Natural Gas (CNG)

Infrastructure Program encourages the use of CNG as an alternative transport fuel. Vehicles running on CNG produce far less pollution than gasoline- and diesel-fuelled vehicles, reducing greenhouse emissions by up to 50 per cent. CNG is also a competitively priced alternative to conventional fuels and is ideal for vehicle fleets, particularly light commercial and heavy vehicle fleets. Only four per cent of Australia's bus fleet uses LPG/CNG while six per cent uses petrol and the remaining 90 per cent uses diesel/distillate.

Cycling is by far the most efficient form of transport, both in cost and energy consumption. Linked to rail travel, cycling forms a very effective, clean mode of commuting. A shift to bicycle travel, suggested by the Sydney Bike Plan, has been assessed at providing $5.29 worth of benefit to the community in reduced costs and accidents for every dollar spent. Bicycle travel has other benefits such as improved health and mobility, time savings and a reduction in noise and pollution.

Effective Public Transport in Other Countries

The examples presented below are indications of public transport initiatives that are reducing environmental impact. As each scenario and city is different they cannot be directly compared to the Sydney Olympic transport arrangements.

In 1990, California adopted a law that required two per cent of each car-maker's sales to come from zero-emission vehicles by 1998, and 10 per cent by 2003. Companies with more than 100 employees must act to reduce commuting miles. As a result, carpooling and shortened working weeks have been introduced in such companies as 7-Up, Toshiba, and United Airlines. Government agencies must also support this initiative.

The Brazilian city of Curitiba has made a substantial investment in public transport. This city of 1.6 million people has a unique "surface metro" of fast-running buses, developed over 20 years. Curitiba's public transport system services over 1.3 million passengers per day and 28 per cent of express bus users previously travelled by car. Transport fuel consumption has been cut by 25 per cent city-wide. Many cycle routes have been established. As a result, Curitiba has one of the lowest air pollution levels of any Brazilian city.

Also in Brazil, Sao Paulo's "Project Ciclista", has planned over 300 kilometres of bikeways on a budget of roughly $30 million. More than 10 per cent of the total mileage has been completed and, when it opened in 1995, 4000 cyclists an hour used the bike network on a weekend day.

In Quito, Ecuador, a clean, highly efficient system of electric trolley buses operates on 11.2 kilometres of exclusive right-of-way track. Over 170,000 commuters crowd onto the public transport system daily, which provides the most "express" option for the commuter, greatly reducing travel time. The new system's operating costs are fully covered without any government subsidies and, with passenger tickets costing around $0.20, the system is affordable to most. Construction has also started on 22.4 kilometres of bike paths.

Japan has three million bicycle-train users and two million of these ride an average of 2.3 kilometres per day. Secure parking for bicycles, not cars, is provided at all rail stations. The bus networks supplement rail services accordingly. Buses play a greater role in London, where they improve the cover provided by the underground rail in the greater London area, and in New York, where express lines carry long-distance commuters with poor local railway and metro services into Manhattan.

Further Information on Best Practice in Transport:

- Center of Excellence for Sustainable Development
  www.sustainable.doe.gov/transprt/trintro.htm
- The Institute for Transportation and Development Policy
  www.itdp.org
- The International Association of Public Transport
  www.uitp.com
- International Bicycle Fund
  www.ibike.org
- The International Council for Local Environmental Initiatives (ICLEI)
  www.iclei.org/about.htm
- Sustainable Transport Forum
  www.the-commons.org/access/eehome.htm
- Sustainable Transport Action Network for Asia and the South Pacific
  http://malaysiakini.com/sustran
- Victoria Transport Policy Institute
  www.vtpi.org
- Carfree cities
  www.carfree.com/

Institute for Sustainability and Technology Policy
wwwistp.murdoch.edu.au

- Less Traffic
  www.lesstraffic.com
- Travelsmart
  www.travelsmart.transport.wa.gov.au/
- The Australia Institute
  www.tai.org.au
- Institute for Sustainable Futures (Transport program)
  www.isf.uts.edu.au/transport.html
- Environmental Transport Association
  www.eta.co.uk/index.html
- Sustainable Transport: Australian Greenhouse Office
  www.greenhouse.gov.au/transport
- Sustrans (Sustainable Transport UK)
  www.sustrans.org.uk
- Bicycle NSW
  www.bicyclensw.org.au/
- Pedestrian Council of Australia
  www.walk.com.au/pedcouncil/homepage.html
- Auto Free Ottawa
  www.flora.org/afo/links.html
- UNSW Transport Research Program
  www.emp.unsw.edu.au/Transport/TRPabout.html
- Smogbusters and GreenWays
  http://nccnsw.org.au/transport/

CONCLUSIONS

A major success of the Environmental Guidelines for the Sydney 2000 Olympics has been the high degree of public transport provision for the mass movement of people to Games venues. There is no provision for spectators to drive their cars to

Olympic Park during the Games. Strong incentives to use public transport for other sites have been developed not only through the public transport network but also by building the cost of public transit into the ticketing arrangement. The use of electric and, particularly, solar-powered vehicles at Olympic Park is also to be commended.

Disappointingly, the local automotive industry has not seized the opportunity to showcase new, cleaner technologies for personal transportation, such as low-emission fuel or hybrid fuel cars. Also, while spectators will use less polluting modes of transport, Olympic officials, VIPs and athletes will be transported by vehicles that produce more greenhouse gases than their original designs did in 1948.[10]

While the public transport measures adopted were successfully trialed at major sporting and cultural events running up to the Games, it remains to be seen if the recent spate of mechanical and driver problems on Sydney's rail network can be resolved in time for the Games. If the transport system copes, the Environmental Guidelines will have proven their worth in:

- reducing the greenhouse gas emission load of the Sydney Games;
- providing incentives for Sydney to continue improving its public transport infrastructure, and;
- showing future Olympic host cities a path towards more sustainable transportation options.

ENDNOTES

1. Olympic Roads and Transport Authority, *Sydney 2000 Olympic and Paralympic Games Transport Strategic Plan*, 1998.
2. Greenpeace, Olympic Transport Fact Sheet, Greenpeace Australia Pacific, Sydney, June 1999.
3. ORTA, op cit.
4. Mark Eggleton, Sydney, "Transport will have to go public", *The Australian*, 25 May 2000.
5. Sydney Olympics 2000 Bid Ltd, *Environmental Guidelines For The Summer Olympic Games*, September 1993, p.6
6. Mark Eggleton, op cit
7. Julius Heimen, "How is Sydney going to cope?" p.4 Publication unknown
8. The Australian Greenhouse Office, "Sustainable Transport", company website, www.greenhouse.gov.au/transport/
9. "The Bus Industry Challenge", *Australian Energy News*, March 2000, p.28
10. Geoff Strong, "Blame it on the Australian dream", *The Age* website, www.theage.com.au/news/20000715/A7403-2000Jul14.html, July 15 2000.

Glossary

2,3,7,8 TCDD 2,3,7,8 Tetra Chloro Dibenzo Dioxin
ACQ Alkaline Copper Quaternary
ACT The Australian Capital Territory
ADI Australian Defence Industries
AIS Australian Institute of Sport
Bio-assays Laboratory tests which use simple living organisms to assess the toxicity of complex mixtures
Biogas Gas which results from the (usually) oxygen free breakdown of organic matter (mostly methane)
Bioremediation A clean-up of toxic sites which uses bacteria or other soil organisms to break down toxins
Black water Sewage water containing human waste (as opposed to grey water, which is sewage from domestic washing and bathing)
CARE30 and CARE50 Natural hydrocarbon refrigerant
CCA Copper Chrome Arsenate
CFC Chlorofluorocarbons (ozone-depleting)
CFMEU Construction Forestry Mining and Energy Union
CFPC Certified Forest Products Council
CHP Combined Heat and Power – another term for co-generation
Closed Loop Destruction No release of toxic chemicals into the environment
CNG Compressed Natural Gas
CO_2 Carbon dioxide
Co-generation Where any 'waste heat' that is given off during the production process of electricity and/or mechanical power is used for secondary purposes (such as hot water) instead of being thrown away.
COP Coefficient of performance
DDT Dichloro Diphenyl Trichloroethane - a toxic and persistent organochlorine insecticide
Dioxin A substance which is a human carcinogen and hormone disrupter that bioaccumlates in the food chain where it can be ingested by humans. Dioxin is a by-product of PVC production and incineration.
EPA Environment Protection Authority (NSW)
ESD Environmentally Sustainable Development
EWIS Emergency Warning and Intercommunication System
FRC Fibre-reinforced concrete
FSC Forest Stewardship Council
GGW2000 Green Games Watch 2000
Glulam Glue laminated
Green power Electricity from clean and renewable energy sources
Green Power Energy Australia's less expensive green power scheme, made up of hydro and landfill gas only
Grey water Sewage from domestic washing and bathing
Halogenated compounds Organic (carbon-based) compounds containing halogens (usually fluorine, chlorine, and/or bromine)
HBERG Homebush Bay Environment Reference Group

Glossary

HC Hydrocarbons
HCFCs Hydrochlorofluorocarbons (ozone-depleting refrigerant)
HDPE High-density polyethylene
Heavy metals Toxic metals such as mercury, lead and cadmium as used in PVC production, if emitted as pollutants can also bioaccumulate in animals and humans.
HFCs Hydrofluorocarbons (greenhouse-polluting refrigerant)
Hydrogen Chlorine Gas This gas is given off when PVC in a fire reacts with moisture to form corrosive hydrochloric acid.
IOC International Olympic Committee
KV Kilovolts
LCA Life Cycle Assessment
Leachate Groundwater that flows through contaminated fill dissolves toxic substances and transports them into the wider environment.
LFE Low Formaldehyde Emitting
LOSP Light Organic Solvent Preservative
LPG Liquid Petroleum Gas
LRT Light rail transport
LVL Laminated Veneer Lumber.
LWP Lidcombe Liquid Waste Plant
MDF Medium Density Fibreboard
MDPE Medium density polyethylene
MLLVC Mirvac Lend Lease Village Consortium (builders of the Olympic Athletes' Village at Newington)
MUA Sydney Showgrounds Multi-Use Arena
NatHERS Nationwide House Energy Rating Scheme
NGO Non-governmental organisation
Non-potable Water unsuited for human consumption
NPWA NSW National Parks and Wildlife Association
NRAP Newington Remedial Action Plan (NSW Waste Service, November 1997)
NSW New South Wales
NTN Australian National Toxics Network
OCA Olympic Co-ordination Authority
OEF Olympic Environment Forum
Organochlorines Carbon-based chemicals with added chlorine, often toxic, persistent, bioaccumulative or ozone depleting/greenhouse substances
ORTA Olympic Roads and Transport Authority
PAH Polycyclic Aromatic Hydrocarbons
Pathogens Bacteria or other micro-organisms which may cause disease
PB Polybutylene
PCBs Polychlorinated biphenyls
PE Polyethylene
PEFC Pan European Forest Certification
PET Polyethylene terephthalate
Phthalates Chemicals used to soften vinyl (PVC) plastic. They are linked to cancer and kidney damage and may interfere with the reproductive system and development
PNG Papua New Guinea
POP Persistent Organic Pollutant
PTFE Polytetrafluoroethylene (Teflon)
PTT Polytrimethylene terephthalate
Pure Energy The most expensive green power option. Pure Energy is derived from four renewable energy sources: solar, wind, hydro and landfill gas.
PV Photovoltaic
PVC Poly Vinyl Chloride
RAC Refrigeration and airconditioning
RAIA Royal Australian Institute of Architects
RFA Regional Forest Agreement
SBR Sequenced Batch Reactor
SEDA NSW Sustainable Energy Development Authority
SOCOG Sydney Organising Committee for the Olympic Games
STE Solar thermal electricity
Sydney Olympic Park This covers the Stadium, Archery Centre, SuperDome, Tennis Centre, Aquatic Centre and the Sydney Showground (used for hosting Sydney's annual Royal Easter Show). Other Olympic Park venues are the Athletes' Village, Media Village, multi-storey SuperDome car park, Rail loop and station, Novotel and Ibis hotels, 17 technical equipment rooms (portable buildings), 15 computer equipment rooms (portable buildings), 33 buildings at the Technical Operations Centre and the Main Press Centre.
Sydney Showgrounds Olympic venues used for the Royal Easter Show including Media Centre, MUA and other venues.
TDA Timber Development Association
TEC NSW Total Environment Centre
UN United Nations
UNEP United Nations Environment Programme
uPVC unplasticised PVC
UV Ultraviolet
VCM Vinyl Chloride Monomer (a building block of PVC for which various cancers, tumors, angiosarcoma and reproductive disturbances have been linked)
WRAMS Water Reclamation and Management Scheme
WRP Wastewater Reclamation Plant
WTP Water Treatment Plant
WWF World Wide Fund for Nature
XLPE Cross-linked polyethylene

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