World Federation of Engineering Organisations (WFEO) Committee on Engineering and the Environment (CEE)

Theme 1: Final Report

Environmental Impacts of Major Engineering Projects for Sporting Events (Olympic Games)

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Cover Image: Portion of Olympic Athletic Centre at 2004 Summer Olympics, Athens, Greece

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Olympic Flame, 2010 Winter Olympics, Vancouver, Canada

1. WFEO-CEE Strategic Plan 2008-2011

The World Federation of Engineering Organisations (WFEO) is the worldwide leader of the engineering profession and cooperates with national and other international professional institutions in developing and applying engineering for the benefit of humanity.

WFEO encourages all of its international and national members to contribute to global efforts to establish a sustainable, equitable and peaceful world by providing an international perspective and enabling mechanisms.

The Committee on Engineering and the Environment (CEE) enables WFEO and the global engineering profession to address the UN Millennium Development Goals through the development, application and enhanced understanding of environmentally sustainable engineering practices, the adaptation of infrastructures to the impacts of a changing climate and the mitigation of the risks of natural disasters.

In partnership with its national members and the WFEO standing committees, the WFEO-CEE has developed and facilitated a four-year thematic, results-oriented programme that:

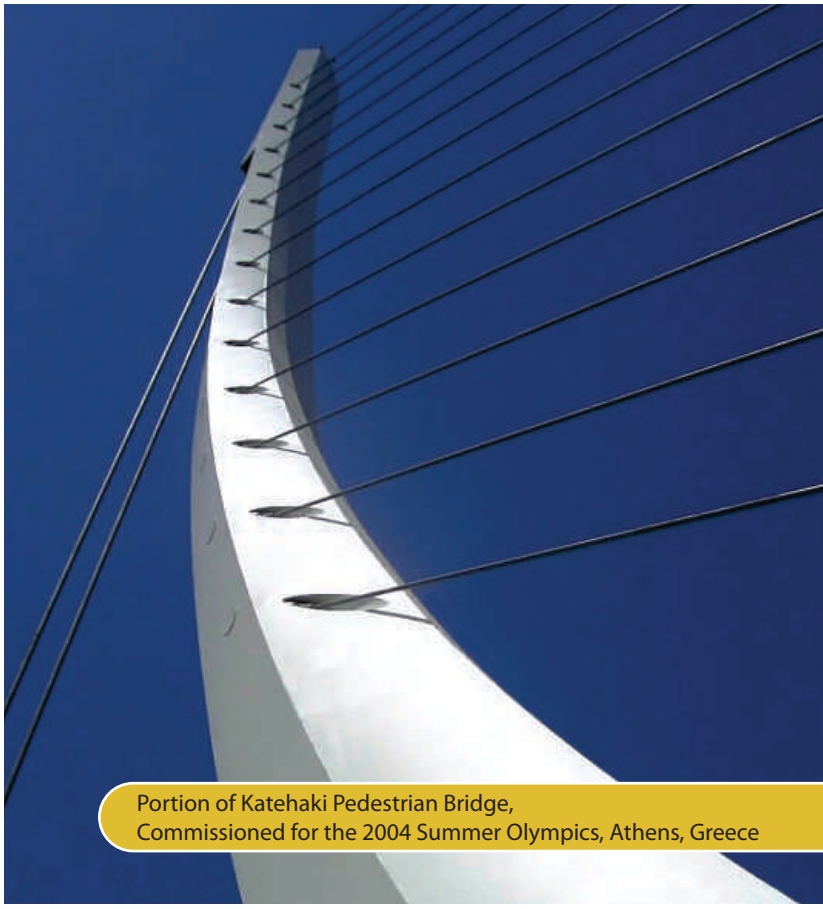
- Increases the understanding of the global engineering profession and society of the global, regional, engineering and policy issues and solutions for the environmentally sustainable development of physical infrastructure and vital services;
- Gathers and disseminates information and provides recommendations on the adaptation of physical infrastructure to climate change and natural disaster risks;
- Develops and promulgates appropriate environmental and sustainable engineering practices in developing and developed countries;
- Increases the profile and participation of the WFEO in the UN Framework Convention for Climate Change (UNFCCC) related to climate change adaptation and infrastructure vulnerability to climate change impacts;
- Achieves recognition of the role and contributions of WFEO and the worldwide engineering profession towards the environment and sustainability elements of the UN Millennium Development Goals;
- Supports and raises WFEO's profile and participation in the work of UNESCO as it relates to engineering and the environment;
- Enables national members to pursue projects and programmes in these areas.

The WFEO has chosen to conduct its work within six broadly based themes, with Theme 1 being "Environmental Impacts of Major Engineering Projects for Sporting Events (Olympic Games)." This report is the final deliverable of Theme 1.

2. Objectives Outcomes

Greece originally proposed the idea of assessing the impact of Olympic Games from an engineering perspective after the 2004 Olympic Games. The intent of the proposal was to develop an engineering strategy in planning and designing infrastructure for the Games to enable the early assessment of the environmental impact. The aim also was to provide the key elements on how the Games can serve as a good opportunity to improve the environment, engineering performance of infrastructure and related matters. The visibility of this work can be very high as it is the focal point of world media during the Games and it also can be considered as a significant part of the Games legacy that enhances the host city or country's profile for years to come.

The objective of this CEE initiative through Theme 1 is to document the environmental impacts and sustainability issues around recent large-scale sporting events, such as the Olympic Games, and to communicate these findings to future organising committees or responsible bodies. The latter could include the International Olympic Committee (IOC), the National Olympic Committees (NOCs), World Sport Federations and Organising Committees of major sport events, etc. The report may apply not only to Olympic Games but also to other national or international games, such as the Pan American Games, the FIFA World Cup or to sport events and activities of a smaller scale that can have a significant environmental impact.



Portion of Katehaki Pedestrian Bridge,
Commissioned for the 2004 Summer Olympics, Athens, Greece

The Task Force programme was first presented at the WFEO/CEE meeting in Brasilia in December 2008. Following that, a work group consisting of senior engineers, who were involved in planning and constructing major engineering projects for Olympic Games, was formed by contacting countries that have hosted Summer and/or Winter Olympic Games. These contacts were identified through WFEO Engineering Organisations in those respective countries.

The process involved international workshops and webinars among the Task Force members to exchange information and experiences, and document them. It also included communication and outreach activities to raise awareness

of opportunities and long-term infrastructure legacies that are intrinsic to large-scale Olympic sporting events. This included focusing on the post-games era and the best utilisation of such infrastructure. WFEO member-country linkages will be used to disseminate the knowledge.

Engineers, among all professionals involved with Games, should aim at sustainability and environmental protection in urban and natural environments. The significant resources made available for large-scale sporting events should be used for the best interest of local populations and take into account existing infrastructure needs.

In a global economic environment hit by the recent recession, the role of major public and private investment in infrastructure and sporting facilities projects can influence improvement of social and economic living standards.

This Report discusses and reviews positive and negative experiences from major past sporting events such as the Olympic Games. It furthermore identifies and discusses key issues, and makes specific proposals on the main subjects that need to be addressed.

Following the discussion of the Interim Report at the WFEO/CEE meeting in Kuwait in November 2009, the Report has been finalised and comprises the WFEO's contribution relative to organising major sporting events. The Final Report conclusions and recommendations will be communicated to the stakeholders.

3. Participants

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- Proceedings of the May 2009 Athens meeting: "Impacts of Olympic Games in Beijing – Athens – Sydney – Barcelona", Technical Chamber of Greece

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4. Task Items

4.1 The Starting Point

The organisation of an event of the scale of the Olympics is a very demanding task, which can play a vital role in the quality of life and the environment of the hosting city.

The Olympic Games or any other sporting event of similar scale (Asian Games, African Games, Commonwealth Games, World Football Championship, etc.) usually mobilises a huge amount of resources for a limited time period at a specific location in order to achieve a set purpose. Major infrastructure projects are planned, designed and constructed. A significant capacity upgrade in power, tele-communications and electronic media is likely to take place. Also the host city's or country's accommodation and entertainment facilities will be transformed to satisfy the extra demands. It is a complex process, which often takes more than five years to complete and involves a significant amount of the host country's public and private resources.

Under the circumstances of extreme pressure that the preparations for the big event creates and, given the wide range of changes taking place, environmental aspects might be underestimated or even ignored. Issues such as energy consumption, water management, recycling of waste, air quality, use of materials friendly to the environment, green areas and biodiversity, innovation technology, etc. run the risk of being set aside by a series of consecutive deadlines for the completion of big, interrelated and intermixed projects.

In this context, it is necessary to strike a fine balance between the urgency and the sheer size of the effort, on one hand, and the need, on the other hand, to follow precautionary environmental-impact procedures.

Finally, post-Games needs and sport requirements must also be carefully examined to achieve improvement of living standards for the host city inhabitants without having to bear high maintenance costs of large "white elephants."

4.2 The Aims

The organisation of big sport events, such as the Olympic Games, gives the host city and country the unique opportunity to combine major city planning changes and new infrastructure with an environmental reform or upgrade within almost all domains.

- The principles of sustainable development should be strictly followed and convincingly show the whole world that a major project, rather happening through quick expansion of a human-created system, can and must occur while respecting the environment.

- The organisation of the Olympic Games or any other major sport event can function as a role model for a similar effort on a global scale to work hard to achieve growth that can eradicate poverty and make peace prevail. At the same time, through the advance of technology, it can minimise the waste of resources, reduce

the effects of pollution and protect the environment.

- Tailoring of sport requirements to everyday city needs should be given a high priority, thereby better justifying and making more acceptable the heavy cost of organising the Games.

- As far as communication is concerned, the power of the message should be utilised for the promotion and sharing of the principles of sustainability and for the advancement of environmental standards aimed at a better quality of life that is in harmony with nature.

Overall Success Story:
The "Barcelona Olympic Impact Model"

In Barcelona, the immediate impact of the Olympic Games was highly notable. However, what was truly surprising was the impact and scale of the permanent Olympic legacy, and the continuation of this impact over the post-Games period.

The key element of the "Barcelona Olympic Impact Model" is investment in infrastructure, both in terms of quantity and quality.

However, this impact model presupposes a certain organisational model for the Games and also involves urban transformation of the city. The model is based on maximising investment, attracting further investment and well-defined timelines. Given the scope of urban transformation sought, continued investment is essential – something that has occurred in the case of Barcelona.

Barcelona has been highly successful in harnessing the Olympic impetus and benefiting from the investment made. This had facilitated change. The resources allocated to urban infrastructure led to temporary employment in the necessary construction work, followed by permanent employment in the operation of this infrastructure. Both led to increased economic activity, although not all of it was concentrated in the city itself. The capital invested and the increased economic activity led to increased wealth, well-being and social cohesion, and made the city more attractive.

More than a decade after the Games, it is acknowledged that the investments made between 1986 and 1992 were the key to the city's urban transformation and its improved strategic positioning.

The investments are the key element within the economic resources mobilised by Barcelona'92, and were crucial in the economic impact of the Games, the city's transformation and the subsequent increase in economic activity, income and well-being. The investments explain a great part of Barcelona'92's exemplary success and were notable both in terms of the quality of the infrastructure and scale of funding (10,660 million Euros). They constitute the Olympic legacy, which underpinned much of Barcelona's economic and social boom in the 1990s.

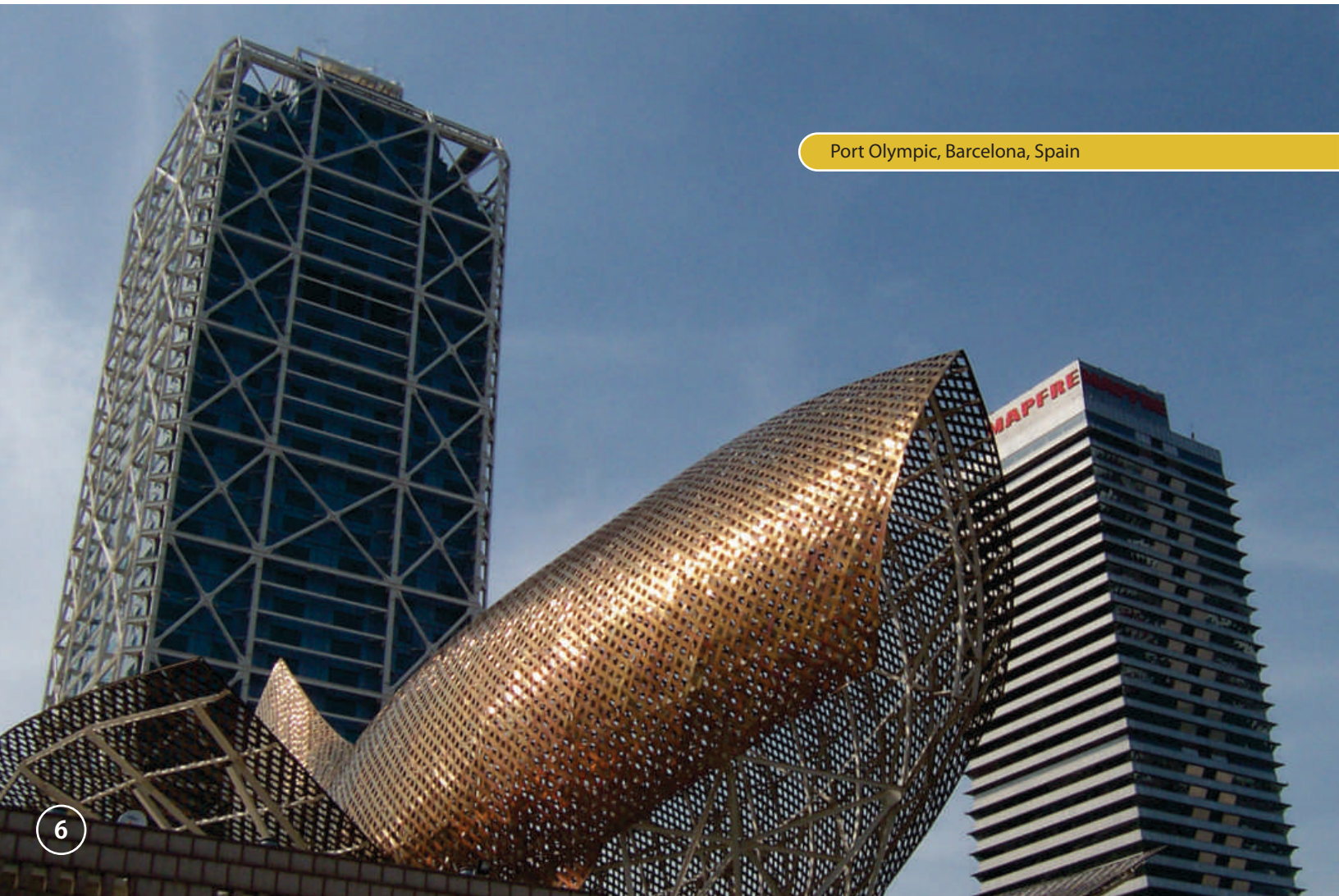
Not only were the investments central to the original Olympic impetus, they were also important in completing the impact and enabling continuation of the urban transformation and strategic strengthening process.

Two central axes served to focus urban transformation in the post-Olympic period.

The first axis involved renewal of Barcelona's eastern section, the Forum 2004 site, thus completing the Olympic Village seafront. Just as occurred with the Games, the Forum serves as a framework for large-scale urban planning projects, several of which would be difficult to undertake and complete under normal, business-as-usual conditions. Funding is largely public.

The second axis comprised far-reaching renovation of the Poblenou district, adjacent to the Forum 2004 site. In this case, the investment was largely private.
To complete Barcelona's urban transformation process up to and beyond 2004, it is necessary to include the inner-city renovation projects (PERI) taking place in various parts of the city: Ciutat Vella, Eixample, Gràcia, Nou Barris, etc.

The new public and private capital, and the permanent employment generated by the Olympic investments constitute the city's Olympic legacy; a legacy that included the city's urban transformation, changed economic structure, increased capitalisation, increased service-sector activity, a heightened international role, attractiveness, centrality, productivity and competitiveness. Barcelona has had outstanding success in strengthening and maintaining the Olympic impetus, thereby increasing the city's level of



Port Olympic, Barcelona, Spain

economic activity and income, improving its quality of life and social cohesion, and advancing it strategically.

Business confidence in Barcelona, as reflected in the willingness of foreign companies to establish there (due to a combination of attractiveness and availability of services, workers, markets and competitiveness) improved notably in the aftermath of the Games. In 1990, Barcelona occupied the 11th position in the relevant scale; by 1993, it had risen to the 10th, and by 2001 it was in 6th position.

The city's capacity to prolong the Olympic impact has enabled it to offset impediments, such as disputes between different public administration bodies, and the delays in providing certain infrastructure, such as the high-speed train (AVE). It has also avoided drowning in a sea of uncertainty with regard to the seafront and urban renewal programmes associated with the Forum 2004. And, although Barcelona does have certain disadvantages (it is neither a state capital nor headquarters for many multinationals, and suffers from shortcomings in public transport, language training, worker mobility and available development land, etc.), the city continues to attract investment and enterprise.

In summary, we can talk of a "Barcelona model" in three respects, namely:

- A model for organisation of the Olympic Games
- A model for economic impact of the Olympic Games, especially in terms of investments not directly linked to the Games
- A model for urban transformation, improved attractiveness and strategic positioning.

Although it is clear from the above that the success of the 1992 Barcelona Olympic Games goes beyond the engineering and environmental aspects of the Games, there is no doubt that, at the core, the whole project rested upon specific choices in terms of sound city planning and environmental design.

The aftermath of the Games has benefited from this inheritance and these choices have been further utilised to build safely upon a solid base. In this context, it is not surprising that architects, town planners and transport engineers involved in the Games have been called, on many occasions, in many parts of the world, to offer their consultancy services.

For more information, see Brunet, Ferran (2005): *The economic impact of the Barcelona Olympic Games, 1986-2004: Barcelona: the legacy of the Games, 1992-2002* [online article]. Barcelona: Centre d'Estudis Olímpics UAB. Available at: http://olympicstudies.uab.es/pdf/wp084_eng.pdf

5. The Areas of Environmental Interest

The main areas of interest regarding the environment are presented below. For each subject, specific basic principles are given. The main thematic parameters are outlined in conjunction to relevant environmental issues and an overview on the role of professional engineers is presented. Where available, specific, brief examples of success or failure stories are presented.

5.1 Energy – Bioclimatic Design

Basic principles:

- Take all measures to minimise energy use in the overall eco-cycle of the development project at all stages of construction, use and maintenance of the development, as well as during re-use, recycling and deconstruction.
- Solar passive design, insulation, natural ventilation and energy-saving materials should be given preference. Heating, cooling, lighting and appliances are key areas where energy conservation or systems requiring no energy should be used.
- Reduce significantly the use of fossil-fuel energy (coal, oil, gas) and replace them with renewable energy sources, such as solar, wind, hydro, wave, geothermal and bio-energy (energy from agricultural products, hot-water systems and waste on site).

Parameters: Clean sources, renewable resources (solar, wind, etc.), energy-saving technologies, innovation, environmental-impact assessment of projects.

Scope – relevant environmental issues: Climate change – greenhouse effect, reduction of fossil-fuel consumption, air pollution, sustainability in resources, preservation of resources for future generations.

In the future, life-cycle analysis of materials and products used, as well as estimation of the carbon footprint of processes can play an important role. The first attempt to incorporate such tools in the organisation of Olympic Games was at Sydney 2000. London 2012 and especially Rio de Janeiro 2016 are working intensively in this regard and, when necessary, to provide for specific compensatory action. Such action can either take the form of production of renewable energy (solar, wind, etc.) and its incorporation into the grid to balance unsatisfactory carbon-footprint results or it can occur through the restoration of brownfield areas, and the design and planting of green areas to balance the areas occupied by large-scale projects.

Role of engineers: Electromechanical engineers, together with architects and town planners, have an important role to play in incorporating low-energy consumption principles into big projects, either sport venues or host villages and buildings. Passive bio-climatic design and low-consumption technology will be at the forefront of expected new standards compatible with world environmental issues, such as global warming and greenhouse effect, climate change, acid rain, etc.

Energy consumption is closely related to transport infrastructure and use.
The main green principles related to transport are:

- Reduce the need for private transportation during the building process as well as during the operation period of the new infrastructure by concentrating developments in existing urban areas, using local resources and using existing facilities to their maximum potential.
- Establish a non-fossil-fuel-based public transport infrastructure and promote individual non-polluting forms of transportation.
- Ensure that public education and incentives to use the system are planned from the beginning.

Success stories in transport fulfilling environmental principles:

Transport has been an environmentally success story in most of the recent Olympic Games, starting from Barcelona and continuing in Sydney, Athens and Beijing. The case of Beijing, summarised below, was selected for its complexity and the large population served.

In 2001, when it successfully bid for the 29th Olympic Games, Beijing was developing rapidly. It was experiencing rapid growth in the number of private cars, the public transport services were relatively weak and the traffic situation was not encouraging. Foreign guests visiting Beijing were left with the impression of many vehicles and crowded roads. In some periods of peak traffic, cars were slower than pedestrians. The whole city was saturated in many ways – including the transport system.

To provide better Olympic transport services and meet the public transport demands of the Olympic officials and participants, and spectators, the Olympic transport services were considered in terms of various aspects, including the public transport service, service-vehicles preparation and transport-personnel training.

Adjusting and Optimising the Public Transportation Network

The public transportation network was adjusted and optimised. Based on the special preparation for Beijing Olympic Games public transportation planning network, 34 Olympic green transport lines were constructed, which exclusively provided services to the Olympic Games and around the Olympic venues. To provide better public transport, as well as transfer and feeder services for passengers, a total of four new transportation hubs were constructed prior to the Games. The south-central axis Bus Rapid Transit (BRT) line, Anli Road line and Chaoyang Road line were also constructed. Those lines and the existing rail transit network constituted a primary network of bus and rapid transit in Beijing. With the public transportation hubs, BRT, subway and bus lines in operation, along with subway-fare-system reform, plus adjustment and optimisation of the bus-lines network, the efficiency of transport service levels were greatly improved.

Green Service Vehicles

An important task in transport preparations was providing different levels of transport services for different groups of Olympic Games spectators. More than 500 Olympic service vehicles were used at the Beijing Olympic Games. In order to implement and embody the concept of "Green Olympics, Hi-tech Olympics," 50 electric buses, 25 hybrid-power buses, three fuel-cell buses and 95 hybrid-power cars were used for Olympic transport services.

The main objective of Olympic traffic management was to provide a safe and orderly traffic environment for the Games and to guarantee a sound, functioning coordination of Olympic and public transport.

Traffic Management Command Centre

A traffic management centre was set up for the overall control of the operation and management of transportation during the Olympic Games. The centre allowed adjustment of transportation management to accommodate the specific circumstances and scheduling of the vehicles. The command centre offered better coordination of the city's traffic operations, improved the efficiency of traffic management, directed and dispatched staff, and provided a better traffic environment for the Olympic Games.

To guarantee the air quality during the Olympics Games and to fulfill the concept of "Green Olympics," Beijing took many measures to stop, renew and modify the yellow-symbol car and to update the transport system. Electric-power buses, hybrid-power buses, fuel-cell buses and hybrid-power cars were used during the Olympics Games. At the same time, the Beijing municipal government constructed several parks and bicycle facilities, and adopted the low-cost policy of facilitating use of public transport and foregoing use o cars. The experience of Olympic Games has proved that citizens' traffic values have changed, and people increasingly and strongly support the policies of bus priority and green traffic.

Olympic Line streetcar, Vancouver, Canada

5.2 Water

Basic principles:

- There should be no pollutant emissions to surface or ground waters during construction or the eco-lifecycle of the building or venue. Specific attention should be given during the construction phase when precautionary measures should be taken to avoid accidental spillages.
- Landscape programmes should minimise impacts on the aquatic environment. Chemical pest controls should be banned.
- Use sustainably managed water-management techniques, practices and products to avoid the exploitation of new water sources.
- Whenever possible, use water conservation, selection of native plants for planting green areas and recycling options.
- Restore natural water cycles in the development area, minimise run-off and stormwater by establishing systems that retain, re-use and recycle water on-site.

Parameters: Water-saving technologies, drinking-water quality, wastewater treatment, industrial-pollution control, reuse of treated water, marine-pollution control, monitoring, environmental impact assessment of projects.

Scope – relevant environmental issues: Surface and groundwater abstraction, surface-water pollution, groundwater quality, conservation of water resources, health risk, preservation of resources for future generations.

Role of engineers: Civil, environmental and mechanical engineers have an important role to play as they are responsible not only for implementing the basic environmental principles in a project but also for convincing, where necessary, the key stakeholders of the need to follow these principles.

Special attention should be given to keeping the relevant costs low so that sustainable methods are proliferated through their implementation on projects at high-profile Olympic or other major sporting events.

5.3 Soil – Waste Management

Basic principles:

- Take advantage of Olympic Games or other major sporting events and plan venues on brownfield areas, for which large-scale remediation and restoration are required. The opportunity of the Games could mobilise the necessary financial resources and prove a cost-effective solution in securing "new" land for venues and other large-scale infrastructure rather than using other land that might be more expensive.
- Planners should have a good knowledge of the past history of the land and the specific hazards should be identified before design and construction begin. When developing new infrastructure on contaminated land, the area must first be

restored to the highest possible environmental standard before building begins.

- Ban the burial of hazardous waste as part of any Olympic development or construction. Any toxic materials should be treated on-site using appropriate non-polluting technologies and methods. This is essential to avoid the unnecessary exposure of communities or future generations to potential environmental and health impacts.
- Avoid products that pollute the environment when they are eliminated as waste in the demolition process.
- Apply an integrated waste-management programme based on waste-avoidance and minimisation.
- Establish a 100-per-cent closed-loop recycling system for packaging, temporary structures and other short-life products, and ban all non-recyclable and non-compostable materials.
- Use systems to minimise waste generation to the fullest extent. All waste systems must be fully integrated and have waste elimination as their main aim.
- Elimination of construction waste must be a primary consideration in the design and building of Olympic and other venues.

Parameters: Minimisation of disposed waste, recycling, packaging, compost production, environmental-impact assessment of projects.

Scope – relevant environmental issues: Soil contamination, water pollution, health risk, preservation of resources for future generations.

Role of engineers: Environmental and chemical engineers have an important role in soil remediation and conservation. Together with planners, they can form a team of experts responsible for the whole restoration project of a brownfield area.

As far as waste management is concerned, again it is the engineers who can lead the way towards the integrated waste-management system that minimises the loads needing to be disposed.

Success stories:
Homebush Bay Remediation Project – Sydney 2000 Olympic Park

Before its transformation, a large part of Sydney's Olympic Park was an industrial wasteland after more than a century of industrial and military ventures on the site. The site was once home to a brickworks, abattoir and an armaments depot, as well as the site for eight of Sydney's rubbish dumps. Both controlled and uncontrolled waste dumping around Homebush Bay transformed the once bountiful wetlands into ugly tips and polluted waterways. Sydney's rapid expansion in the 1950s and 60s and the start of the "throw-away" society meant people and industry needed more space to put their waste. By 1988, it was estimated that 9 million cubic metres of waste and contaminated soils were spread over 400 hectares within the 760-hectare site. The waste was not homogenous and

Showground Hall, Sydney Olympic Park, Sydney, Australia

included petroleum waste, unexploded ordnance, potential acid suphate soils, illegally dumped wastes along the waterways (including persistent organic pollutants, polycyclic aromatic hydrocarbons, etc.), dredged sediments, municipal waste in managed tips, industrial waste (including rubble, power-station fly ash, gasworks waste, asbestos) and contamination from site activities (burning pits, chemical leaks and application).

Part of the suburb of Homebush Bay, the area was redeveloped for the 2000 Olympics. The facilities built continue to be used for sporting and cultural events, including the Sydney Royal Easter Show, Sydney Festival, Big Day Out and a number of world-class sporting fixtures. The suburb also contains commercial development and extensive parklands.

The project represents the most expensive and challenging site clean-up project undertaken in Australia to-date.

Furthermore, it should be mentioned that Sydney 2000 were the first Olympic Games where waste prevention and successful waste management during the Games were accomplished.

5.4 Air Quality

Air quality is closely related to broad issues of atmospheric pollution that are more generic in their origin and concern wider environmental policies. As such, the use of renewable energy resources, the environmentally friendly transport systems, the improvement of fossil-fuel quality and the drastic control of industrial pollution can be mentioned.

The Games themselves can trigger the tackling of air-pollution problems through the adoption and implementation of cleaner technologies and methods.

Taking that into account, no specific Games principles can be denoted except the prevention of dust dispersal, which is usually an acute problem in the period before the Games as a number of big projects usually are in the construction phase and entail extensive earth works.

As for the depletion of ozone layer, a ban should be adopted on building processes, products and servicing systems, insulation, refrigeration and air conditioning that use potent greenhouse gases, such as HFCs and PFCs. Natural systems such as hydrocarbons, ammonia and water- and air-based systems should be used instead.

Sydney Olympic Park Aquatic Centre, Sydney, Australia

For indoor air quality, the following principles are proposed:

- Offer a healthy indoor environment providing comfort, health and well-being. All possible measures should be taken to ensure that materials such as paints, carpets, glues, varnishes and building systems do not emit toxic substances and gases into the interior atmosphere. Only materials that do not contain or emit persistent, bioaccumulative and/or toxic substances should be chosen for indoor fittings and construction materials.

- Provide users of venues and accommodation with natural conditions (natural light, ventilation, views) and ensure users have some control over internal environmental conditions.

Parameters: Transport means, engine technologies, fuel consumption, fuel types, industrial pollution control, central heating, alternative technologies, monitoring, strategic environmental assessment of plans and programmes.

Scope – relevant environmental issues: Climate change – greenhouse effect, air pollution, health risk.

Role of engineers: Chemical, electromechanical, civil and environmental engineers are involved in air-pollution control in transport, industry and project development.

5.5 Physical Planning Post-Games Era

Parameters: Sustainable use of infrastructure by setting "acceptable" limits to international or national sporting federations' requirements, exploitation and expansion of temporary facilities, restoration and/or remediation of degraded or contaminated areas (brownfield areas), expansion and improvement of open spaces and urban green areas, implementation of strategic environmental assessment at an early stage when planning decisions are made.

Scope – relevant environmental issues:
Climate change – greenhouse effect, sustainable design and construction, capital-cost reduction, maintenance-cost reduction, targeted improvement of living conditions on a permanent basis, better social acceptance of projects, increase of green areas in densely populated areas, air quality, thermal pollution in cities, quality of life, health risk.

IOC Guidelines:
The staging of a major event, such as the Olympic Games, and the media coverage it generates can act as catalysts for accelerating the implementation of new urban plans or for re-launching projects brought to a standstill for political or financial reasons. Although the necessary investments may be high, the long-term benefits for the city can be considerable provided that the Games are not viewed as an end in themselves but as a chance to develop the city and take it forward.

In specific terms, the scope of all permanent construction projects should extend beyond the provision of facilities for the Olympic Games and encompass and fit into the short-term and long-term needs of the host city. The permanent facilities should respond to a proven specific city- or country-related demand and their construction should not destabilise the existing housing/hotel/event market.

To fully maximise the opportunity and identify/mitigate risks, several principles should be considered:

- The delivery of positive and sustainable legacy requires long-term vision and early planning. This requires the alignment of Olympic legacies, particularly infrastructure, with a city's long-term planning and management vision, and overall urban planning needs. Involvement and input from city planners is therefore essential, as well as consultation and engagement with the public at large.

- Long-term legacies must be permanently "locked into" existing institutions, such as public authorities and businesses. These organisations will exist after the Games and be able to nurture and oversee legacy planning and fruition.

- Legacy objectives must be realistic as hosting the Olympic Games cannot and will not address all of the challenges that a host city or country faces.

- There must be clear delineation of roles and responsibilities in planning, design and implementation, and on-going management and operations.

- A host city, region or country does not have to wait until after the Games to reap the benefits of Olympic legacy. Early planning and implementation can provide early benefits.

The success of the urban legacy of the Olympic Games can only come about when it is a coherent part of a wider-ranging planning project that responds to long-term urban needs and that is in-line with the city's long-term vision. It is a mistake to believe, for example, that the Olympic venues and the Olympic village can alone form an urban legacy that offers maximum genuine benefits for the host city and its inhabitants. They can, however, form an integral part of a city's revitalisation programme, spatial reorganisation programme, the development of a new hub or the global development of communication infrastructures.

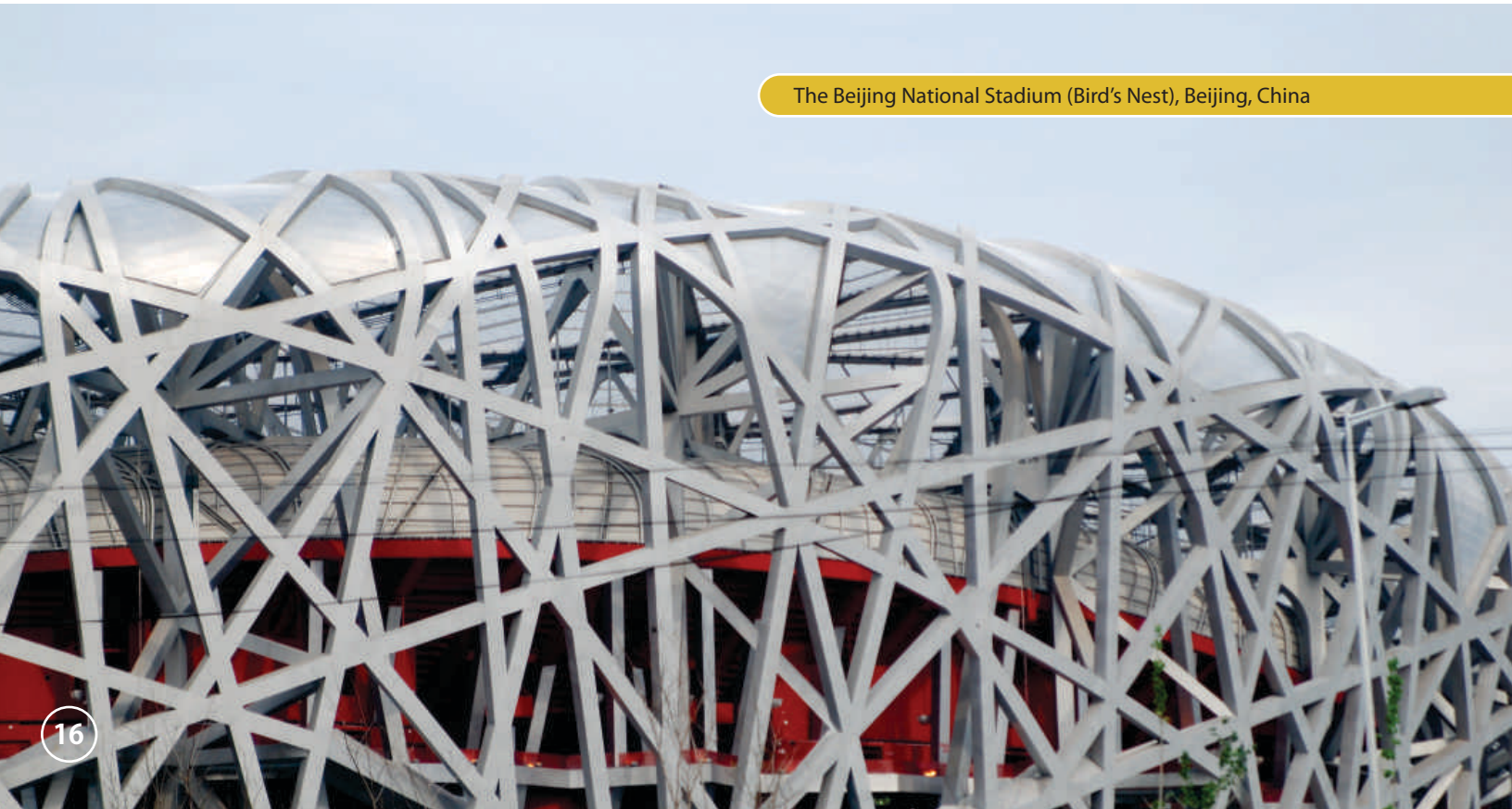
Success stories:
The After-Utilization of Beijing Olympic Stadiums

At the very beginning of planning of the Beijing Olympic stadiums, special attention was paid to the principle of centralization and dispersion. The main part of the plan included four regions consisting of:

- one central district: Beijing Olympic Centre District; and
- three other areas, namely a) University Area, b) the West of Beijing Area and c) North Scenic-Tourist Area.

Beijing Olympic Centre District hosted the following facilities:

- *The National Stadium (Bird's Nest)*
  It became a public centre for citizens, serving as a sports competition venue,



The Beijing National Stadium (Bird's Nest), Beijing, China

conference and exhibition centre, entertainment, a business complex and shopping centre.

- *The National Aquatics Centre (Water Cube)*
  The Water Cube retains the capability of hosting major swimming competition. The future operation projects can be divided into seven parts, including commercial buildings, a tennis court, a warm-up hall, water paradise park, etc. The main project is an artificial surfing beach.

- *The National Gymnasium*
  It is the indoor stadium that possesses the most seats in Beijing and after the Olympics serves as multi-functional activity centre for citizens. Its main role is as a venue to organise national and international professional sports events and large, commercial sports events and performances.

University Area

All the stadiums situated in universities' campuses served as coaching, training and competition spaces.

The West of Beijing Area

The Wukesong Culture & Sports Centre fills the need for large-scale sports facilities, something lacking in the west area of Beijing.

North Scenic-Tourist Area

The Natural aquatic site and rural racetrack provides an attractive zone for tourists.

Failure stories:
The after-utilisation of Athens Olympic sport facilities – opening of the city to the seafront

Athens has been criticized on many occasions for the management of Olympic sport facilities as well as the significant shortcomings in achieving a permanent, long-awaited opening of the city to the seafront of the Saronicos Gulf.

More than six years after the Games, most of the facilities today remain abandoned and waiting for a proper new management scheme involving the private sector. The serious delays are caused by incomplete post-Games planning prior to the Games and underestimating of legal and permitting issues.

The seafront opening deficiency mainly has been caused by lack of necessary investments – principally by the public sector and by shortcomings in the overall design for the post-Games era. Athens, in contrast to Barcelona, failed to secure the necessary financial resources to build upon the Olympic Games success. A more "prudent" fiscal policy was adopted, which viewed the Olympic facilities as "white elephants" that should not further burden the sensitive Greek economy.

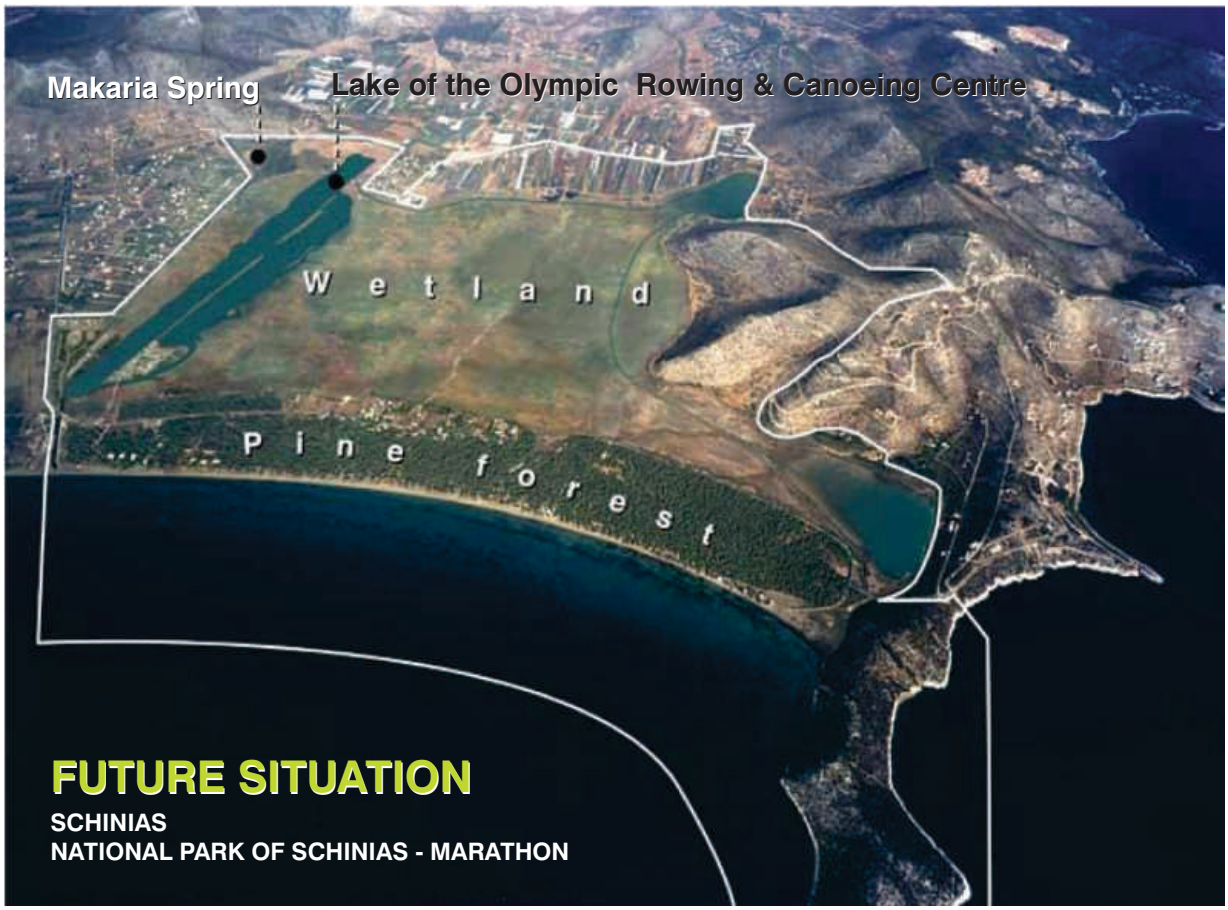
Success stories:
The Schinias Olympic Rowing and Canoeing Centre in Marathon, Athens 2004

The Olympic Rowing and Canoeing Centre lies in the area of Schinias, Marathon, 42 km from the centre of Athens. The new facilities are located in the western part of a previously degraded wetland.

The Olympic Centre covers less than 10 percent of the Schinias Plain, an area burdened in the past by an airport, military facilities, a moto-cross race track, thousands of tons of debris and a plot, ready to be developed, belonging to an active building association.

The basic points of the adopted strategic planning followed by the project's design were:

- The restoration of the area's original hydrology. This mainly refers to the abolishment of the current drainage network and the re-direction of the Makaria Spring's freshwater supply (previously channelled to the sea) to the wetland, through the Olympic Centre's new lake.
- Physical as well as functional location of the Rowing and Canoeing Centre on land previously occupied by the airport and rubble deposits and, to a small extent, by bare ground or reedbeds.
- Removal of uses or settlements incompatible with the landscape or the ecosystem's natural functioning (Marathon airport, abandoned military facilities, motor-bike track, etc.).



- Restoration of landscape and soil (suffering from extensive rubble and trash deposits, chemical pollution by the military facilities, etc.).
- High-protection regime for the area's prominent ecological features and habitats (Makaria Spring, the central and eastern part of the wetland, the coastal pine forest, the Kynossoura Peninsula and the Drakonera Hill). In fact, the whole area was declared a National Park (Natura 2000 site, Directive 92/43/EC).
- Adjustment of land uses, normative and prohibitive regulations for the western part of the wetland, the seacoast and the marine area.
- Establishment of the necessary infrastructure for environmental education and raising of public awareness on the western part of the wetland, construction of footpaths and bird-watching hides.

Role of engineers: It is clear from the examples given above that planning engineers must cooperate very closely with all major stakeholders at a very early stage, when most of the issues discussed above are decided. It is of paramount importance that their continuous involvement in development plans focus not only on the Games period but on the post-Games era as well. Most of the key factors of a long and highly acclaimed Games legacy lie in early and efficient planning.

5.6 Construction Materials

Basic principles:

- Use only environmentally-safe building materials and products that minimise pollution of the environment (air, soil, water, groundwater) throughout their entire lifecycle (production, use and disposal). Ban polyvinyl chloride-based (PVC) and other organochlorine materials and use more environmentally acceptable materials.

- Ban persistent, bioaccumulative and/or toxic substances and materials that incorporate them in Olympic construction or merchandising. Ban persistent organic pollutants (POPs), such as organochlorine-based chemicals. Other examples of persistent, bioaccumulative and/or toxic substances that should be excluded from use include: organotins, phthalates, artificial musks, cadmium, lead, chromium, brominated or chlorinated flame-retardants. Ban any material that exhibits or is suspected of exhibiting endocrine - disrupting properties.

Parameters: Recycling, types of wood, PVC use, ecologically certified paints, environmental impact assessment of projects.

Scope – relevant environmental issues: Tropical forest conservation, green procurement, climate change, land contamination, waste minimisation, preservation of resources for future generations.

Role of engineers: Architects, civil engineers and environmental engineers can play an important role in the selection of environment friendly materials. They usually have to strike a balance between cost-effectiveness and availability of materials, on the one hand, and alternative environmentally friendly solutions, on the other. Life-cycle-analysis methods can be useful tools for the right selection.

5.7 Natural Environment Green Areas

Basic principles:

- Preserve global, regional and local biodiversity. Before design and construction begin, an assessment of habitat and species with special attention to endangered species and ecosystems that are subject to international conservation treaties must be made.

- If the development of a project may reduce or impact on global, regional, or local biodiversity, the project must be stopped and an alternative site found.

- Preserve and protect the integrity of natural ecosystems (including native bushland, forests and waterways) surrounding a development site.

- Protect all wild species and populations in development areas.

- In addition, identify opportunities to preserve or extend pockets of bio-diversity, particularly if these link to or are important for the conservation of ecological corridors.

- Promote the creation of substantial green areas in and around venues by using trees and other flora species suited for the climatic conditions.
- Plan the necessary plantings early enough so that there is time for the trees and shrubs to adapt and reach the level required.
- Avoid the extensive use of hard surfaces and give preference to soft pathways where possible.
- Take adequate measures for the conservation of the planted areas far beyond the Games period by securing the necessary resources required.

Parameters: Protection of natural habitats and species, enlargement of conservation elements, environmental-impact assessment of projects, strategic environmental assessment of plans and programmes.

Scope – relevant environmental issues: Habitats and species conservation, protection of natural areas and biogenetic resources, preservation of resources for future generations.

Role of engineers: In this case, engineers and landscape architects should cooperate closely with natural environment scientists, such as ecologists, botanists, biologists and foresters, to make the right and timely selections.

Failure stories

Green Areas in Athens 2004

A very ambitious plan of planting millions of trees and shrubs had been elaborated before the 2004 Athens Olympics. Unfortunately, significant delays in the development of different Olympic facilities did not allow the plan to materialise. Another important factor was the excess cost of most of the Olympic projects, which did not allow for the funding of the plan. In the end, a few thousand trees and shrubs were planted, some of which died after the Games due to lack of adequate conservation.

A success story within the general failure was the successful transplanting to different parts of the city of many century-old olive trees from their original site in the land taken by the equestrian venue.

5.8 Environmental Awareness and Education

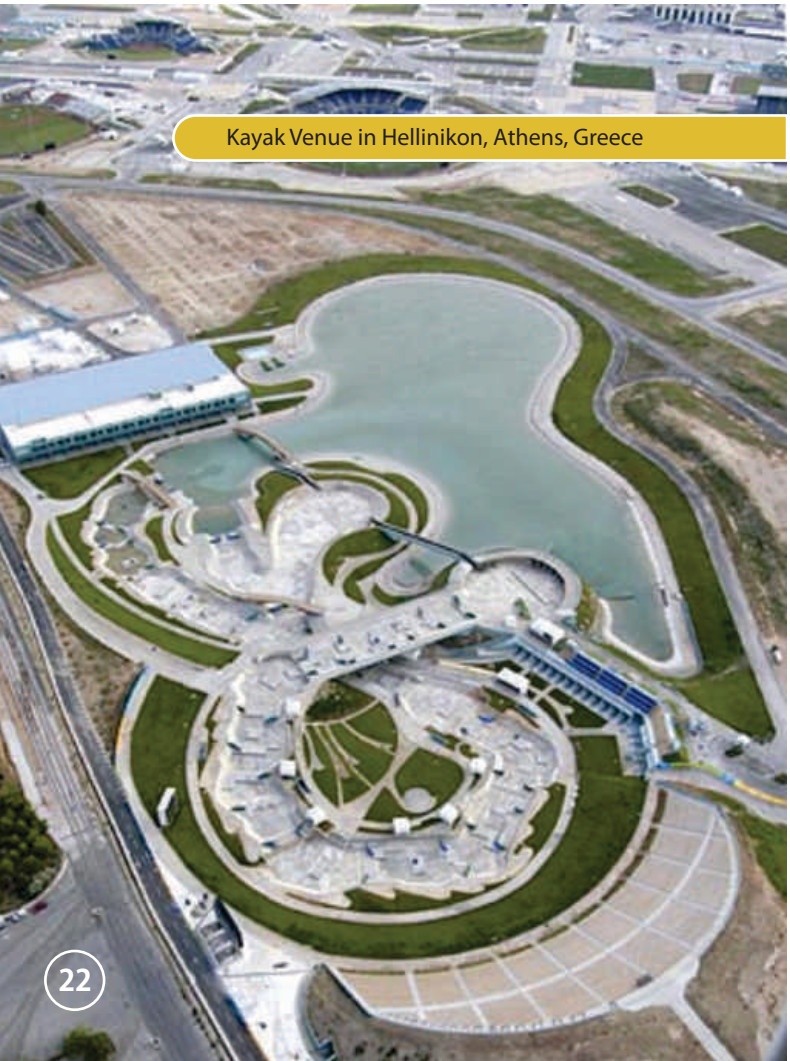
Basic principles:

- Full, comprehensive and publicly accountable, independent auditing of all environmental data for all aspects of the Olympics must be mandatory.
- Set specific environmental goals to fulfill these environmental guidelines at the outset of Olympic or other projects. Ensure that these goals are real, measurable and achievable, and made publicly available.
- Consistent and high-level consultation with community, environmental and social

groups, and the public is essential from the start. Establish a clear process for conflict resolution.

- Independent auditing of environmental information on all aspects of a development project is essential to ensure credibility. Make this information available to the public.

- Plan and budget early to provide public education materials about the environmental aspects of your project. Ensure staff, suppliers, providers, sponsors and media understand the environmental initiatives of the project and why they were undertaken.



Kayak Venue in Hellinikon, Athens, Greece

Parameters: Initiation of programmes for increasing environmental awareness, information packages for different groups, involvement of NGOs and volunteers, media coverage.

Scope – relevant environmental issues: Public participation in the process of planning and permitting general plans and specific projects, easy access to environmental information, access to justice on environmental issues.

Role of engineers: Engineers should adapt to the new public consultation and involvement reality. In many parts of the world, this is now a legal obligation and, in any case, engineers only gain from sharing their knowledge with the general public. Early consultation usually prevents serious delays in projects, so it is worthwhile to spend time not only explaining but also listening. By following this process, engineers can build upon the strong social alliance and achieve better results.

5.9 Adaptation to Climate Change

Basic principles:

- Infrastructure projects, and especially hydraulic and marine works should take into account both extreme weather conditions (as a result of climate-change phenomena) and increasing scale in dimensions and complexity during the anticipated life of the projects.

- Risk analysis should always be carried out at an early design phase of projects by focusing on worst-case scenarios that might be caused by climate-change-induced extreme phenomena.

- General public warning systems and management of possible disaster events should be in place and tested from an early phase.

- Public awareness should be raised through extensive consultation and participation.

Parameters: Incorporation of climate-change effect in the design of large-scale infrastructure, increase of safety margins, planning for extreme conditions.

Scope – relevant environmental issues: Human safety, protection of public and private property, reduction of possible impacts of natural extreme phenomena, increase public awareness.

Fortunately, to this point, there have not been any major failure stories.

5.10 Incorporation of Innovation and High Technology

Basic principles:

- Promote innovation and high-technology applications and make use of major sport events as showcases for the proliferating environmentally friendly concepts.

- Mobilise and incorporate in the main planning for those scientists and researchers from universities and institutes who do not usually have the chance of expressing their views.

- Search for new ideas and build upon innovative methods and techniques adopted in previous Games.

Parameters: Incorporation of academic and research communities, exploitation of new experience gained in previous major sport events, identification of areas where innovation and high-tech applications could be implemented.

Scope – relevant environmental issues: Innovative methods and techniques for pollution prevention and control, recycling of natural resources, waste minimisation, environmental management methods, environmental auditing implementation.

Success Story:
Hi-tech Concept of Beijing Olympics

The Beijing Association for Science and Technology (BAST) is a major science and technology body in the capital city. In the years of preparation for Beijing Olympics, BAST:

- Encouraged and stimulated initiatives by science and technology workers

- Endeavoured to guide science and technology staff in focusing on serving the Olympics

- Actively implemented the concept of hi-tech and innovation Olympics to provide support to the successful hosting of the Olympics.

Provide Intellectual Support to Organisation and Preparatory Work of Olympics

The Hi-tech Olympics needed the support of sophisticated science and technology, encouraged innovation and application of science and technology, and demanded a search for truth and an innovative scientific spirit.

Diverse consultation activities enhanced the scientific rationality of Olympic-related decisions.

The Quarterly Conversazione between science and technology experts, and Beijing Municipality was held in July 2002 to analyse the possible natural disasters and human-made hazards in 2008 through comparison with safety-related accidents and disastrous events at previous Olympics. Through consultation, the International Olympic Committee agreed to postpone the 2008 Bejing Olympics by two weeks. This substantially reduced the risks associated with mid-summer high temperatures, storms, wind and hail, and facilitated gradual establishment of comprehensive safety disaster-reduction and emergency-command system.

Experts made suggestions at the Quarterly Conversazione focused on the theme "Making Full Use of Rainwater and Recycled Water for Creating Favorable Water Environment for Olympics." It led directly to the founding of a Beijing water-affairs coordination and leadership group in 2003 and the formal establishment of Beijing Water Affairs Bureau in 2004. The formation of a unified management system on water affairs provided effective organisational insurance for construction and operation of the water environment for Olympics.

The suggestions on design and construction of a Green Olympics made at the Quarterly Conversazione on the theme "Urban Garden Greening and Livable City Construction" were adopted and directly enhanced the rationality and beauty of the Green Olympics.

Other expert suggestions on air-pollution control and traffic development strategy and Olympics food safety were also highlighted and adopted by municipal leaders.

The Beijing Joint Summit of Natural Science Circle and Social Science Circle adopted proposals made by natural-science and social-science experts, and for two years provided advice to coordinate development of Olympic and urban construction. Starting in 2002, the summits advanced about 40 Olympic-related expert suggestions. They included adopted suggestions on:

- Application and development of emergency-management software related to Olympic safety
- Use of solar energy in 2008 Beijing Olympics
- Strengthening forecast in dealing with storms during the opening ceremony of Olympics
- Cultural implications in medals of Beijing Olympics.

These reflected the openness of Olympic preparatory process and enhanced the scientific nature of preparatory work.

Starting 2002, BAST organised about 40 large-scale academic exchange activities related to Olympics. Science and technology experts from different disciplines gave their professional opinions and worked in close cooperation. It led to emergence of many viewpoints and thinking with extremely practical value, and provided scientific basis and theoretical supports for the successful organisation and technological progress of the Olympics. The spirit of science was fully reflected in preparations for the Olympics, and in the Hi-tech Olympics and related scientific development.

The concept of Hi-tech Olympics advocated innovation scientific exploration. It also emphasised:

- Propagation and application of cutting-edge science and technology achievement
- Popularisation of Olympic science and technology knowledge
- Improvement of public science literacy to benefit society.

The Beijing Municipal Construction Work Program on Scientific Literacy of All Citizens Civilians clearly proposed implementation of Olympic scientific popularisation activities and improved public scientific literacy.

The Beijing Science and Technology Week and Olympics Lecture were large-scale, mass scientific popularisation events focused on the Olympics and popularising Olympic knowledge among different groups. Such events also played active roles in publicising and putting into practice the concepts of Hi-tech Olympics.

The exhibition tours for popularising science under the theme "Sports in Motion - Interactive Show on Scientific Exercises and Health Fitness" were launched in 23 cities in 2005. The main aims were to simulate Olympic projects and explain the scientific and technological contents in Olympic sports facilities and equipment. More than five million people benefited from the tours. The large-scale exhibition tours for scientific popularisation under the theme "Fulfill Your Dream with Technology and Greet Olympics with Harmony" were launched in nine cities in 2007. The tour highlighted the latest achievements of Olympic technology, such as the Olympic torch, the ETFE membrane structure of the Water Cube, the steel structure of the Bird's Nest, the National Indoor Stadium power-generation model, the food-quality traceability system model, the solar-energy thermal-power generation system model, the automatic weather station and the face-recognition system.

The concept of Hi-tech Olympics was very significant in guaranteeing the success of Beijing Olympics. It will play continuing roles in promoting innovation and development of science and technology, the economy and the society.

Role of engineers: Professional engineers have an important role to play in conjunction with the academic sector

(universities, research centres and institutes). They can provide significant input in the following areas:

- Identification of key engineering issues that can take advantage of possible innovative, high-tech solutions
- Feasibility analysis of proposed solutions taking into account their extensive knowledge of their sector
- Successful implementation of innovative, high-tech solutions in "real life" projects
- Dissemination of knowledge gained through innovation to the global engineering community.

5.11 Public Health Standards

Basic principles:

- Incorporate improving public health standards in the basic pillars of the Games planning, especially in developing countries.
- Take advantage of new Games-planned infrastructure to create and expand sewage networks and waste-treatment plants.
- Provide the necessary resources for securing supply of good, quality drinking water to the widest possible part of the population.
- Utilise the large budget of Games' media campaigns to increase general public awareness and improve education on health issues.
- Identify at an early stage major health hazards directly or indirectly related to the Games and take specific measures to eliminate them.

Parameters: Incorporation of sanitary projects in the planning of the Games, initiation of large-scale campaigns for increasing awareness on public health issues, provide adequate information and material packages for different groups on public health issues, involvement of NGOs and volunteers, media coverage.

Scope – relevant environmental issues: Public participation in the process of planning, waste management and treatment, drinking-water supply, easy access to information about public health issues.

Role of engineers: Sanitary and civil engineers have an important role to play in designing and constructing networks, treatment plants and waste-management plans for improving public health standards. Their cooperation with medical doctors, epidemiologists and state or city officials and planners is of great importance. They should also participate in media campaign planning on health issues.

6. The Stakeholders

6.1 The Government (Central, Regional or Local)

The government of the host country needs to collaborate closely with all other parties in order to achieve the best possible results from the economic, social and technical point of view. Government sets the basic principles and policies, it assures the broadest possible participation in the process and safeguards the dispersion of the "goods" to the whole society.

6.2 The International Authority Awarding the Event (International Olympic Committee [IOC] in the case of the Olympic Games)

The awarding authority can influence the final outcome both through prior scrutiny of the proposal submitted on sustainability parameters and in closely following the progress made in the process with regard to environmental aspects.

In the case of IOC, the environment is regarded as the third pillar of Olympism, alongside sport and culture, and specific policies have been adopted in terms of environmental protection and sustainable development.

6.3 The Event's Organising Body

The event's organising body has the main responsibility of implementing the general policies into specific plans, actions and programmes. Its operational and functional characteristics are these of a planner, a doer and an inspector. It epitomises the governments commitments and the international authority's directions.

6.4 Professional and Scientific Associations

Professional scientific associations can play an important role either by instructing and promoting sustainable solutions or by acting as supervisors-advisors on technical matters as well as on code-of-conduct issues.

In the case of professional engineers, the different engineering associations as well as the federation of all engineers can play an important role as a counselling body, a source of inspiration and a watchdog, promoting, monitoring and screening solutions in all areas of interest, as mentioned above.

6.5 NGOs and Society

Non-governmental organisations (NGOs) with environmental or social interests, as well as local societies are the first and ultimate links in the long chain of work and action related to organising a big sport event. They express the public's wishes, queries, priorities and opinions on all issues that could affect the quality of life and the conservation of natural resources. Their consent and active participation is of paramount importance for the successful outcome of the whole effort. The improvement of their quality of life in accordance with sustainable development is the final and most important yardstick of success.

7.1 Setting Clear Environmental Objectives

Experience shows that environmental design and management can only be effective and applicable when they present a clear set of specific objectives on all areas of interest. These objectives should be the result of a rigorous consultation with all stakeholders and should be realistic, specific and accountable. These objectives should be prioritised and well communicated to all stakeholders and the public.

7.2 Collaboration Among Stakeholders

Collaboration among all stakeholders and professionals is necessary to achieve good results regarding sustainability and environmental protection. Due to the complexity and the urgency of the issues, interdisciplinary and multilateral cooperation is required.

7.3 Dissemination of International Experience

International cooperation in the accomplishment of such a complex task facilitates the exchange of knowledge, experience and technology. This is especially so regarding the Games' environmental aspects, where gaps in methods and technologies between different countries can be bridged and thereby contribute toward minimising disparities.

7.4 Compliance with Legislation

Sustainable development and environmental protection can only be achieved if they infiltrate the basic values of the society as expressed by legislation. In this respect, all plans and actions must comply with the existing legal, statutory and administrative framework. Furthermore, any opportunity to advance the existing status in such issues should be taken.

7.5 Strategic Environmental Assessment

The whole construction and operational plan of the Games should be subjected to an ex-ante strategic environmental assessment, included in the relevant bid document seeking the awarding of the event. In this way, possible grey areas from an environmental perspective can be spotted and adequate measures can be proposed.

7.6 Environmental Impact Assessment

Through a comprehensive and explicit assessment study, each project directly or indirectly related to the sporting event should be scrutinised regarding its impact on the human and natural environment. It is important to devote enough time and resources to this process and to allow for minor or major changes in case of significant, irreversible damage.

7.7 Monitoring

All environmental objectives set out in the general plan should be monitored closely, preferably by third parties with relevant expertise and capacity. The results should be evaluated, publicised and taken into account by the planners, designers and contractors.

7.8 Interim Assessment and Reporting

The environmental performance of the big complex project should be assessed and reported at specific intervals before the event and again after the event's completion. This is an important procedure allowing for the broader communication of the results and can assist in the improvement of the process.

7.9 Communication

The great media coverage of the event itself should be utilised to communicate the environmental achievements for the benefit of the whole world. It is a great opportunity to demonstrate sustainable technologies, innovations and environmentally friendly solutions to a global audience.

7.10 Environmental Evaluation Matrix (EEM)

The establishment of an environmental evaluation matrix can be a significant tool for placing emphasis on environmental issues. To succeed in the implementation and proliferation of environmental principles and objectives the EEM should be:

- Elaborated by environmental experts
- Discussed and agreed upon with environmental NGOs
- Approved by the Government and the Organisers
- Widely communicated to the public
- Established early (before detailed planning begins)
- Evaluated at regular, mutually agreed intervals
- Monitored by a third party having the relevant expertise and acceptance
- Adopted by the International Awarding Body (such as the IOC for the Olympic Games) as a measure of success of the Games.

Olympic Village, 2010 Winter Olympics, Vancouver, Canada

8. Actions and Outcomes of Theme 1

The main actions and outcomes of Theme 1 of the WFEO-CEE Strategic Plan 2008-2011 "Environmental Impacts of Major Engineering Projects gor Sporting Events (Olympic Games)" are the following:

A. The Initial Report:

- Set the objectives of Theme 1
- Identified the areas of interest
- Set the work plan

Discussed at the WFEO/CEE meeting in Brasilia in December 2008.

B. Athens Meeting of Representatives of Olympic Cities

Representatives from Barcelona, Sydney, Athens and Beijing participated.

Indicative list of participants:

- Technical Chamber of Greece
- Beijing University of Civil Engineering and Architecture
- Greek Olympic Committee
- International Olympic Committee
- Athens Olympic Games Organising Committee
- University of New South Wales, Sydney
- Beijing University of Technology School of Economics and Management
- Urban Planning Society of Beijing
- Organising Committee of the VOLOS 2013 (GREECE) Mediterranean Games
- Barcelona University
- Athens Local Authority
- Traffic engineers
- Environmental engineers
- Civil engineers
- Urban planners
- NGOs

Subjects presented and discussed:

- The experience from the design and development of infrastructure projects and public works for the Games
- Large-scale urban development planning for the Games
- The "day after" and the use of the Olympic projects and relevant infrastructure (the post-Games period)
- Technological innovation
- Environmental impact (implications and balance)
- The Olympic Games as an opportunity to increase environmental awareness and standards

A round table discussion amongst representatives of the four Olympic cities was organised. The meeting was organised by the Technical Chamber of Greece, May 2009, Athens, Greece.

C. Webinar on the 29th of June 2009

WFEO/CEE Webinar/Teleconference Meeting on Work Plan Review

D. Interim Report

- Discussion and review of positive and negative experience from past Olympic events
- Identification of key issues
- Proposal of main items to be addressed

Discussed in WFEO/CEE meeting in Kuwait in November 2009

E. WFEO-CEE spring 2010 newsletter, focused on the work of Theme 1 – Environmental Impacts of Major Sporting Events – Olympic Games.

Article by Eng. Spyros Papagrigoriou: "Theme 1: Environmental Impacts of Major Engineering Projects for Sporting Events (Olympic Games)"

Article by Eng. Jiming Hao: "Environment and Major Sport Events: Experiences from the 2008 Beijing Olympic Games"

F. Webinar on the 26th of May 2010

WFEO/CEE Technical Webinar "Engineering and Impacts of Civil Infrastructure for Major Sporting Events: The Olympic Games Experience"

G. Webinar on the 22nd of July 2010

WFEO/CEE Mid-Year Webinar/Teleconference Meeting: Discussion of issues for finalising the Theme 1 Report

H. Final Report

The WFEO contribution to organising sustainable major sporting events.

Presented in WFEO/CEE meeting in Buenos Aires in October 2010

I. WFEO Communication

Communication of the Final Report conclusions and recommendations to the stakeholders.

NOTES

NOTES

World Federation of Engineering Organisations (WFEO)
Committee on Engineering and the Environment (CEE)
www.wfeo.net

Theme 1: Final Report
Environmental Impacts of Major Engineering Projects for Sporting Events (Olympic Games)