



Beijing 2008



**The Environmental Impacts of the Olympic Games—
Looking Forward to the Olympic Games 2008 in Beijing, China**

"The only environmentally sound Olympics would be no Olympics at all." ---- Olav Myrholt, the Olympic project leader for the Norwegian Society for Conservation of Nature.

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Abstract

The Olympic Games have developed from small scale Games in the early 20th century to being the largest sports event in the world today. The Games have evolved to have considerable impacts on the host city. Before 1994, not much attention was paid to the environment. In 1994 the IOC together with UNEP adopted the sustainable development concept. The Games in Lillehammer the same year became the first Green Games. As a result, the environment become the third pillar of the Olympic charter together with sport and culture. The Olympic Games has an environmental impact on the host city of the Olympic Games before, during and after the Games. Some of the areas that put pressure on the environment is venue and building construction, transport, and waste. Beijing was chosen to be the host city for the Olympic Games in 2008 and is facing many of the environmental challenges their predecessors faced. In preparing for the Olympic Games in 2008 the organisers have developed an Olympic Action Plan which if implemented limits the negative environmental effects and incorporates sustainable development into the Games. However the organisers need to put extra consideration into some important areas.

Keywords: Olympic Games, Mega Event, Environmental Impact, Sustainable Development, Beijing 2008

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Abbreviations

BOCOG	Beijing Organising Committee for the Olympic Games
CCICED	China Council for International Co-operation on Environment and Development
CLD	Cause Loop Diagram
DPSIR	Drivers- Pressure- State- Impact- Responses
EEA	European Environmental Agency
IOC	International Olympic Committee
LAOOC	Los Angeles Olympic Organising Committee
NOC	National Olympic Committee
NSCN	Norwegian Society for the Conservation of Nature
OCA	(Sydney) Olympic Co-ordination Authority
OCOG	Organising Committee for the Olympic Games
OG	Olympic Games
UNCED	United Nations Conference on Environment and Development
UNEP	United Nation Environmental Program
UNSD	United Nations Division for Sustainable Development
NGO	Non Government Organisation
WHO	World Health Organisation

Chapter 1

Introduction

The Olympic Games is the biggest sports event in the world and have major impact on the host cities. The modern Olympic Games started 1896 in Athens, Greece and has developed over the years from being a small scale event, with about 300 participating athletes, to be the biggest sports event in the world. The Olympic Games in Sydney 2000 had 10,651 athletes from 199 countries competing in 300 events. 6,7 million tickets to the games were sold and about 20,000 members of accredited media were reporting (IOC, 2003). From being side-shows to other events such as World Fairs, the Olympic Games today have become major showcases for the host cities and countries. The Games have evolved to have considerable impacts on the host cities. From a political perspective, the Games function as an opportunity to improve the host city's and country's international image. One example was the Berlin Games 1936, used as a political statement of Hitler's nationalism. From an economic perspective, the Games have a catalyst effect for the economic development. From a social perspective, the Games bring people together and give citizens a sense of unification, but also give rise to protests, like in Mexico City 1968. From an urban development and environmental perspective, the Games have changed the infrastructure and environment of the host city. For example, the Rome Games of 1960 improved the public transportation and built a new water supply system for the city. The Tokyo Games of 1964, built 22 new highways and improved the city's water and sewage system.

However, the Games arrangements may also lead to increased environmental pressure, risks and damages. The preparation of the Games involve infrastructure building, for example freeways, airports and venues etc. The construction leads to air, land and water pollution. The large amount of people gathering during the Games put pressure on the host city's infrastructure and environment as demand increases on transport, water, energy, waste, accommodation etc. After the Games the storage, collection, transportation and landfilling of the waste accumulated during the Games cause environmental pressure. From a long term perspective, it is still too early to see if the large investments and decisions of changing the city design for the Games will have a positive or negative environmental effect.

The bigger the Games becomes, the greater the pressure. This impact puts the Olympic Games into questioning. After the Rome 1960 and Tokyo 1964 Games, the investment in the Olympic Games became too big to afford for the host city and the number of cities bidding for the Games decreased for a period of time until Los Angeles 1984. The Games in Los Angeles made a difference by changing

the financing structure of the Games, using more private funding. The Games made a surplus of about \$ 215 million. Because of the private sector funding, there was less infrastructure development and more use of existing facilities. The major surplus of the event changed the motive for the bidding. The motive moved towards more commercialism and the number of cities bidding increased dramatically after 1984. The increase in investments have made the Olympic Games a mega event. How has this influenced the environment e.g. resources and land use of the host cities? In the short-term and long-term? Are the investments made into an Olympic Games event in line with the goal of sustainable development?

Aim and Questions

The purpose of the thesis is to contribute to the understanding of the environmental impacts of the Olympic Games and strategic opportunities to make the Games contribute to sustainable development. The study assesses the environmental impacts of the Olympic Games by reviewing previous Olympic Games. The action plan for the Olympic Games in Beijing 2008 is analysed based on the findings of the previous Games. Recommendations for Beijing are given. The environment in China and city of Beijing are described, from a cultural, economical, geographical, political and legal perspective and the current problems and concerns in the region and their relation to the Olympic Games are discussed. The multidisciplinary approach of the master program lets this thesis cover several aspects. The central research questions are:

- What are the environmental impacts of the Olympic Games?
- How much consideration have been paid to environmental aspects?
- What has been done to limit the negative environmental impacts of the Olympic Games towards more sustainable development?
- In the case of Beijing 2008, how to incorporate sustainable development into the Olympic Games arrangements?
- What suggestions and recommendations can be given for Beijing 2008?

Study Approach and Limitations

The thesis builds mainly on reviewing past Olympic Games, the urban development and environmental impact on the host cities of those Games. The information data has been collected from various sources. During the 20 weeks thesis course, the IOC Olympic Games study centre was contacted, advise and materials were received, a number of the previous Olympic Games official reports, scientific journeys and Olympic Games action plans were reviewed. Course literature was used as references. In August, a visit to Beijing China was made and interviews with Olympic Committee Officials were conducted in Beijing. Since I was the first individual to collect information about the Games from the Olympic Committee in Beijing, due to schedule and security reasons, I was not able to review materials. However, questions were answered and useful web site information was

collected from interviewing the officials. And so far, as personal experiences, visits to the following Olympic host cities or Olympic stadiums have been done: Amsterdam, Netherlands; Antwerp, Belgium; Innsbruck, Austria; London, England; Los Angeles, USA; Munich, Germany; Paris, France; Tokyo, Japan; Beijing, China.

DPSIR models and Cause Loop Diagrams (CLD) are used to demonstrate the environmental impacts of the Olympic Games. DPSIR represent Drivers- Pressure- State- Impact- Responses.

The DPSIR model is an assessment framework especially for policy-makers to use for “analysing the inter-related factors that impact on the environment” (European Environmental Agency (EEA), 2003).

The CLD shows interrelations causes and their effects from a systematic point of view. Both DPSIR models and CLD's are used for cause –effect analysis of the Olympic Games and its environmental impacts.

Sustainability is the key word. Sustainable Development is defined by the United Nations as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”(United Nations, 2003). To incorporate Olympic Games with sustainable development involve many areas such as: land use, urban development, transport, water, energy and waste control in all phases of the games: before, during and after the games. The paper focuses on Summer Olympic Games with the addition of the Winter Games in Lillehammer 1994 (see Appendix).

Structure of the Thesis

Chapter 1 Introduction:

Chapter 1 contains an introduction part where the Olympic Games are introduced from an urban development and environmental perspective. The introduction part is followed by aims and questions. In the end of the chapter, the study approach and limitations are presented.

Chapter 2 Background:

This chapter starts with a short presentation of the history of the ancient and modern Olympic Games. The presentation is followed by a description of the organisation of the Olympic Movement. The last part of the chapter is a longer discussion of the Olympic Games impact on the host city, with a special focus on the Games in Lillehammer and Sydney.

Chapter 3 The Environmental Impact of the Past Games:

This chapter summarises the environmental impacts of the past Olympic Games according before Games, during Games and after Games phases. The DPSIR model is used to summarise the impacts in different areas.

Chapter 4 Case Study of Beijing Olympic Games 2008:

China in general is described as background. Beijing information is provided in terms of its geographic location, metropolitan areas, climate and environmental problems. The Beijing Olympic Games 2008 action plan is analysed. A summary is presented and recommendations are given based on the action plan and previous findings.

Chapter 5 Conclusion and Ideas for Future Research:

The last chapter concludes the thesis and comes up with ideas for future research.

Chapter 2

Background

The History of the Olympic Movement

Ancient Olympic Games

In ancient Greece four major national festivals were held, the Olympic Games (ancient), the Isthmian Games, the Pythian Games, and the Nemean Games. The Olympic Games being the most famous one. The events the athletes competed in were: boxing, foot racing, wrestling, horse racing, pancratium (a combination of boxing and wrestling) and the Penthalon, where the athletes competed in discus throwing, javelin hurling, long jumping wrestling, sprinting, and wrestling. The competitions were held in the *stadion*, which was “an oblong area enclosed by sloping banks of earth”. The history of the games is dated all the way back to 776 BC. In the 5th and 4th centuries BC the games were at their top of popularity. The games were suppressed in about AD 393 by the Roman emperor Theodosius. (Microsoft Encarta, 2003)

Modern Olympic Games

The modern Olympic Games started in Athens, 1896. There are two types of modern Olympic Games, the Summer Olympics and the Winter Olympics. The Games in 1896 only consisted of Summer Olympics and included cycling, fencing, gymnastics, target shooting, swimming, tennis, track and field, weightlifting, and wrestling (Microsoft, 2003). The Games had 300 athletes from less than 15 countries competing. The Olympic Games in Sydney 2000 had 10,651 athletes from 199 countries competing in 300 events. 6,7 million tickets to the Games were sold and about 20,000 members of accredited media were reporting (IOC, 2003). The winter Olympics started in Chamonix 1924.

Pierre de Coubertin was the father of the modern Olympic Games. “According to the Olympic Charter, established by Pierre de Coubertin, the goal of the Olympic Movement is to contribute to building a peaceful and better world by educating youth through sport practised without discrimination of any kind and in the Olympic spirit, which requires mutual understanding with a spirit of friendship, solidarity and fair play.” The Olympic Rings symbolise the five continents; Africa, Americas, Asia, Europe and Oceania (IOC, 2003).

All through the years, De Coubertin’s original objectives and principles have remained central to the operational purposes of the Games, which are:

1. to foster the goals of the competitive sport;
2. to provide a legacy of facilities that will stimulate athletic development which would not have been possible with inferior facilities; and
3. to heighten the profile of the sports involved by providing better opportunities for training as well as sites for national and international competition.

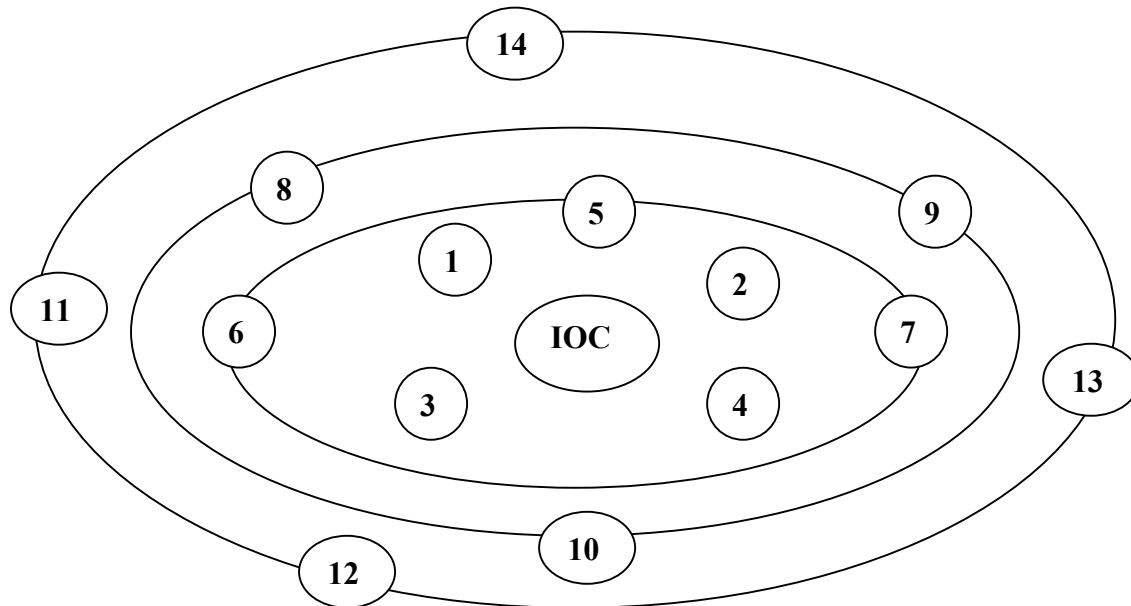
(Chalkley and Essex, 1999)

Organisation of the Olympic Movement

The International Olympic Committee (IOC) is the supreme authority of the Olympic movement (see figure 1). The IOC, based in Lausanne Switzerland, is non-governmental and non-commercial. The IOC was started in 1894 by Baron Pierre de Coubertin and currently has 130 members. National Olympic Committees (NOC) are organisations within each country that leads the Olympic movement in the country. Further there are different International Federations responsible for one or more sports (AAFLA, 2003).

Since the foundation of the IOC, the members have not been representatives of their countries, but preventatives of the organisation in their countries. The first ones to have members on this new international body were Argentina, Belgium, Bohemia, France, Germany, Great Britain, Greece, Hungary, Italy, New Zealand, Russia, Sweden and the United States (Barcelona Olympic Organising Committee, 1992).

The Olympic Games event is organised by three actors, the International Olympic Committee (IOC), the National Olympic Committee (NOC) and the host city. The Organising Committee for the Olympic Games (OCOG), which is formed by the NOC, communicates directly and receives instructions from IOC (IOC, 2003). At the date of writing this thesis the Beijing OCOG includes 15 departments that employ a couple of thousand of people. The OCOG also has a sailing sub-committee in Qingdao consisting of another 15 departments. In 2008 the planning phase is followed by the organising phase and culminates in the implementation or operational phase (BOCOG, 2003).



- | | |
|--|---|
| 1. President | 2. Administration |
| 3. Executive Board | 4. Members |
| 5. Commissions and working groups | 6. Olympic Solidarity |
| 7. Olympic Museum Lausanne | 8. National Olympic Committee |
| 9. International Sports Federations | 10. Organising Committees for the Games |
| 11. National Sports Associations and Clubs | 12. Media |
| 13. Top Partners, Local Sponsors and Supplies | |
| 14. Athletes, Judges/ Referees, Coaches and Other Sports Technicians | |

Figure 1 , Organisation of the Olympic Movement, IOC, 2003

The Sport and Environment Commission

Through the years, the Olympic Games have become bigger and the impact on the host city especially on the environment is greater. IOC has recognised the problem and has put more attention on the environmental issues. In 1994, IOC and UNEP signed a co-operative agreement and the concept of sustainable development was adopted. As a result, the environment became the third pillar of the Olympic charter together with sport and culture. Environmental guidelines for the summer Olympics

were provided for host city in terms of organising the Games. The Sydney Olympic Games in 2000 were the first Olympic Games that followed the guidelines.

In 1999 the Sport and Environment Commission implemented its own Agenda 21 according to the 1992 Rio Agenda 21. The Olympic Movement's Agenda 21 focuses on three main points:

1. Improving socio-economic condition;
2. Conservation and management of resources for sustainable development;
3. Strengthening the role of the main groups.

(IOC Sport and Environment Commission, 2003)

The Agenda speaks for improving socio-economic conditions. Examples are combating exclusions, health protection and human habitats and settlements. The conservation and management of resources for sustainable development includes for example the management of facilities, energy, water, hazardous products, waste and pollution. Some of the key areas that the Olympic Movement's Agenda 21 focuses on are that host cities should make an extra effort to use existing buildings, and to keep them in good condition and environmental friendly. New facilities should only be constructed if there is more demand than the existing facilities can handle. A possibility for the cities is to use the new sport facilities (or renovating existing) and other infrastructure to remediate "sites contaminated by hazardous or toxic products, pollutants or waste" A good example of this is the Homebush Bay in Sydney. Before the Olympic Games in Sydney 2000, the Homebush Bay was an industrial area with uncontrolled dumping. The Homebush Bay project will be discussed in detail later in the paper. In general the host city must not use products that are hazardous or toxic.

In the transport area the Agenda recommends the use of public transportation and if the distance is short, bicycling and walking. The host city should minimise all pollution. Unnecessary contamination of air, soil and water should be avoided. Plant and animal species shall be protected and deforestation and practices prejudicial to land conservation should be avoided (IOC, 2003).

The Olympic Games Impact on the Host City

There are different perspectives that can be used to discuss the Olympic Games' impact on the host city. One is from an urban development perspective, the Olympic Games have gone through several phases. Chalkley and Essex (1999) divides the Games into four separate phases: 1896-1904, 1908-1932, 1936-1956 and 1960-1996. The developments have been: moving from small scale, poor organised, no development Games to large scale, good organised Games with significant impacts on the host city.

Although the motivations to host the Olympic Games have shifted over time, before 1984 the motivations of bidding for the Olympic Games had mainly been for sport reasons. Some Games also have been motivated by political reasons, such in Berlin 1936 which was Hitler's showcase for nationalism. 1980 Jimmy Carter made USA withdraw from the Games in Moscow. After 1984, when Los Angeles made a surplus of \$215 million the motivations changed towards commercialism. This has led to an sharp increase in the number of cities bidding (see figure 2).

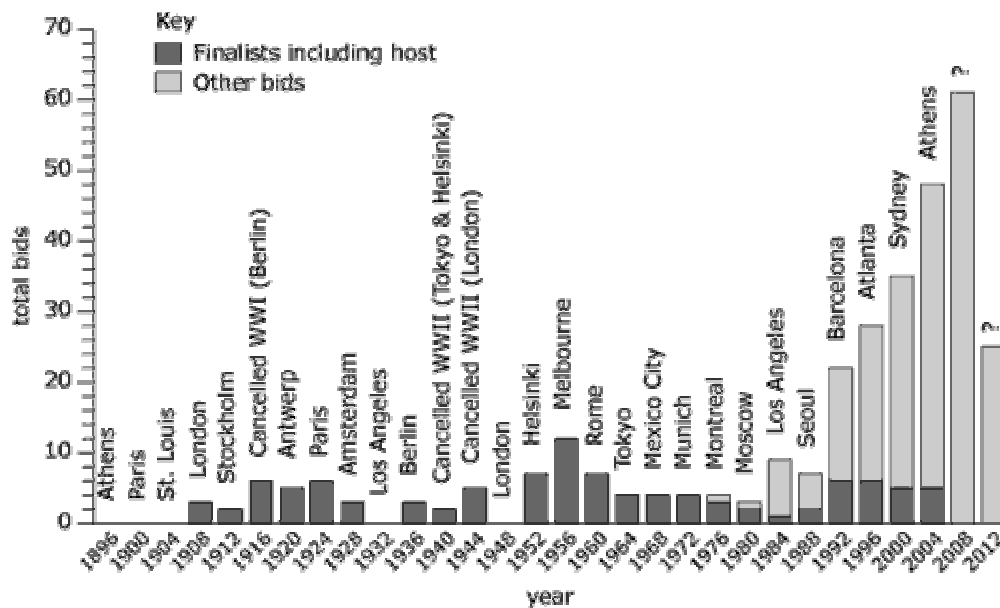


Figure 2 Cities bidding on the Olympic Games, Source: Chalkley and Essex, 2001

Chalkley and Essex describe the increased number of candidates bidding as a “clear reflection of the international inter-urban competition for investment, business and image which characterises modern urban policy” (Chalkley & Essex, p. 374, 1999).

Olympic Games In the Past

In this section the Olympic Games in the past from 1896 to 2000 will be discussed, with the exceptions of the post-war (First and Second World War) Games, that saw little development in the urban infrastructure due mainly to recessions. The Games excluded are: after first World War; the Games in Antwerp 1920, Paris 1924, Amsterdam 1928 and after second World War; the Games in London 1948, Helsinki 1952, and Melbourne 1956.

The early Games were small in scale and did not have much of organisation. The Games of 1900 in Paris, France and 1904 in St Louis, USA were side shows to the World Exhibition and the World Fair. The impact on the urban development was very small. No new facilities had been provided in Paris and the swimming competitions simply took place in the Seine river. In the early 20th century there

were doubts regarding IOC's idea of moving the games to different countries (Chalkley & Essex, 1999).

The Games of London 1908 was the first Games to build a new venue. However, the new White City Stadium was not a success due to the accommodation of too many sports (Chalkley & Essex, 1999).

The Games of Stockholm, Sweden 1912 built a new stadium (see figure 3) that is still used today for sports events and concerts. The stadium was changed from a temporary to a permanent project after the Swedish Government allowed the stadium to be financed by lottery draws. The stadium was officially opened on June 1, 1912 and could seat 20000 spectators. Also a smaller tivoli(amusement park) was built adjacent to the Arena to please the younger spectators (Swedish Sports, 2003). It was later claimed that the stadium “ expressed the individuality and artistic taste of the Swedish people” (Chalkley & Essex, p. 376, 1999). The stadium in Stockholm started the architectural movement where more grandiose olympic facilities started to symbolise the host society's culture.

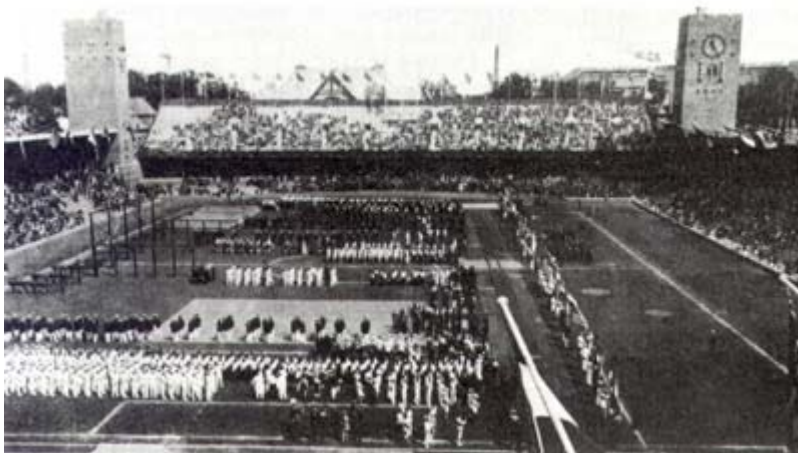


Figure 3 Stockholm Olympic Stadium 1912, Source: Olympic Stadiums by Munsey and Suppes

The Games in Los Angeles 1932 were the first Olympic Games providing an Olympic Village. When planning the Olympic Village, one of the major factors were the climate conditions. The organisers took into consideration that most of the athletes competing were used to lower temperatures than in Los Angeles in summer. They decided that to make the conditions more fair a location that was cooler than downtown Los Angeles should be chosen as the location for the Village. Seven locations were chosen as possible sites for the Village and the temperature was measured 24 hours a day for the months of July and August in 1931. Baldwin Hills was the coolest location(it averaged 10 degree cooler than any other location), and was chosen as the place where the Village should be built. The location, which is on sloping hills, chosen for the village had private owners and when buildings and roads were built the organisers had to make sure that no unnecessary grading had to be done. Further

an underground water system, using welded steel pipes, had to be installed (The Los Angeles Olympic Organising Committee, 1932).

Berlin 1936, which is most famous for Adolf Hitler's propaganda for nationalism: " If Germany is to stand host to the entire world her preparations must be complete and magnificent"(Chalkley & Essex, p.377, 1999) had the greatest impact on the host city's infrastructure so far of the Olympic Games. The major project was to redevelop the racecourse(Grunewald) into a sporting and cultural centre. A package of a major stadium, an open air theatre, a sportsforum and a large administrative building for the house of German Sport together were developed together with an assembly field for mass demonstrations. The Olympic Village was located in the west of the Berlin on 136 acres of land with 90% of it to remain naturally. The choice of the location was because "the predominating west wind guaranteed pure, fresh air," while the industrial area of Berlin was located mainly in the north and east of Berlin. Further the location was close to the Berlin-Hamburg highway for easy commute to the centre of the city (The Berlin Olympic Organising Committee, 1936).

Rome in 1960 began the last phase of urban development in which larger scale Olympic Games have had significant impacts on the infrastructure. New municipal water systems, better public transport and new airport facilities were developed. Tokyo 1964 was different than the earlier games in that Tokyo was directing the development towards projects not meant to be used for sporting events and athletes. As an example 22 main highways were constructed and the water supply system was improved. Tokyo's waste management system was improved by the construction of three sewage disposal systems. Moreover, the standards of public health were improved. Regular refuse and garbage collections, maintenance of public toilets and cleaning of streets were some of the areas improved. The next Olympic Games in Mexico 1968 saw less developments than the Games before. Mexico had financial problems and much less investments into new facilities were made. The city used already existing facilities all over the city, which caused enormous pressure on the public transport system (Chalkley & Essex, 1999).

The 1972 Games in Munich fast tracked a City Development plan from 1963 for the development of a 280 ha abandoned airstrip. Instead of the planned 15-20 years it was completed in five years(Chalkley & Essex, 1999). The next Olympics in Montreal 1976 also fast tracked development plans. The development plans included a new airport, new roads, an 20 km extension of the subway, new hotels and the building of an Olympic Park with a main stadium and a few new stadiums outside the park. The city also used existing facilities that were improved and renovated. The financial result of the Games in Montreal was a debt of CAN\$ 1.5 billion. In the 1980 Moscow Games, the city of Moscow built 12 new sports facilities and renovated 13 existing facilities. A new air terminal, new hotels, an Olympic Village, a Radio and TV centre and other buildings were added to the city. The Olympic Village in Moscow now functions as a residential area (Chalkley & Essex, 1999).

The Games in Los Angeles 1984 used many existing facilities including the Olympic Stadium from the Games in 1932. Because it was the first privately funded Olympic Games (the taxpayers had refused to fund the Games), little infrastructure was built. LAOOC spent \$1.8 million on permanent renovation of the 1932 Exposition Park, including a new 20-bus transit station (Los Angeles Olympic Organising Committee, 1984). The Games reached a surplus of \$ 215 million, much because of television income and business sponsorships (Chalkley & Essex, 1999).

The Games in Seoul 1988 spent US \$ 14 billion to improve the transport and the environment of the city. The city added new subway and bus routes and 389 new parks. Another major project was to depollute the Han river. The local community participated in different projects to improve environmental awareness. Further public transportation during the Games was promoted (Chalkley & Essex, 1999).

In Barcelona 1992, 15 new venues were built and 10 existing facilities were renovated. 43 other facilities that needed little improvement were used. The area used for the main events was the largest park in the city and had previously been used for the Barcelona International Exposition in 1929. The Games led to a redevelopment and refurbishing of the park. The athletes were transported by coaches, saloon-cars and minibuses. The residents of Barcelona choose to use public transportation during the games which greatly helped the traffic flow in the city (Barcelona Official Report, 1992).

Up to 1992, improving the host city environment was almost always an issue, no matter the motivations of the Games. The environment appears to relate to improving the image, the look of the host city, to present a better city or better country image. In 1992, the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, adopted the Agenda 21 and the sustainable development concept. Sustainable development was on the international agenda. IOC realised the importance of sustainable development and what sports can do to promote the concept. In 1994 the IOC working together with UNEP adopted the sustainable development concept for the Olympic Games. The Olympic Games in Lillehammer 1994 were the first green Games. The outcome of those Games made IOC more clear on the importance of the environment. In 1995 the Sports and Environment Commission was created, and environment become the third pillar of the Olympic charter together with sport and culture. Four years later in 1999 the Olympic Games Agenda 21 was implemented. The Olympic Games in Sydney 2000 were the first to follow the Agenda and the IOC adopted the Sydney Environmental Guidelines to be the benchmark for future planners. The 1994 Lillehammer and 2000 Sydney Games are discussed below with a focus on their environmental strategies.

1994 Lillehammer Olympic Games

The 1994 Olympic Games were held in Lillehammer, Norway. Lillehammer has a population of about 23 000, but during the two weeks of the Games it increased to 100 000, which led to pressure on the environment. The 1994 Lillehammer Winter Olympic Games' organisers decided to make the Lillehammer Games the first green Games. The Lillehammer Olympic Games became the first green games in the Olympic history. In June 1994, as a result of the Lillehammer Games, the IOC and the UNEP (United Nation Environmental Program) decided to make sports games in the future environmentally friendly events. A sustainable development concept was adopted, and environment became the third Olympic pillar together with sport and culture (IOC, 2003).

One of the key factors that made the Lillehammer Games green were the co-operation between the organisers and environmental groups(Project Environment-Friendly Olympics). The Olympic committee and the environmental groups came up with four guidelines for the Games:

1. companies were instructed to use natural materials wherever possible;
2. emphasis was placed on energy conservation in heating and cooling systems. An example is the Cavern Hall which saves about \$ 20,000 annually in heating because it was built inside the mountain;
3. a recycling program was developed for the entire winter games region(to recycle or compost 70% of all trash generated);
4. a stipulation was made that the arenas must harmonise with the surrounding landscape.

After the Games the Norwegian Society for the Conservation of Nature(NSCN), made an assessment of the Games. Some of the negative results of the Games were: lost wetland because of landfill, increase in use of private cars after the Games due to the improvement in road and parking infrastructure and the extensive use of land for arenas and roads. Some of the positive were: increased environmental awareness, remediation of damage to the landscape and the good co-operation inside the government and between the government and private and non-government sectors. Overall the NSCN was satisfied with the environmental results (Chernushenko, 1994).

As a general assessment the NSCN found that the co-operation between different sectors with different motivations was of importance to the good outcome of the Games. The NSCN believed that this would not have been possible working alone. The NSCN further stressed that the efforts made in Lillehammer is only a "first step in an ongoing process". In June of 1994 the Lillehammer Olympic Organising Committee and Project Environment Friendly Olympics was awarded the Global 500 Award by the United Nations Programme (Chernushenko, 1994).

2000 Sydney Olympic Games

The Olympic Games in Sydney 2000 had 10,651 athletes from 199 countries competing in 300 events. 6,7 million tickets to the games were sold and about 20,000 members of accredited media were reporting (IOC, 2003). The Environmental Guidelines for the Summer Olympic Games in Sydney were released in 1993. The Guidelines were prepared by the Government, the Greenpeace and other environmental groups. The IOC later adopted the Sydney environmental guidelines to be the benchmark for future planners.

The most important areas for Sydney were the development of Homebush Bay and the development of Sydney's Olympic venues. Transport and waste management were also considered significant for the environment. The Guidelines were put into legislation by the Olympic Co-ordination Authority(OCA) Act. This meant that the OCA had to consider the guidelines in all developments (Sydney Olympic Organising Committee, 2000).

The Homebush Bay

The Homebush Bay located 19 kilometres west of the Sydney city centre, was the site for the Olympic Park in Sydney. The Olympic Village, home of the athletes, was located adjacent to the Olympic Park (see figure 4). The Homebush bay, had previously been an industrial area with uncontrolled dumping. The Homebush Bay Development Guidelines centred on three key performance areas:

- conservation of species: flora and fauna, people and their environment;
- conservation of resources: water, energy, construction materials, open space, topsoil;
- pollution control: air, noise, light, water, soil and waste management.

(Sydney Olympic Organising Committee, 2000)

The Development of Sydney's Olympic Venues

The OCA's aim was to make the venue development ecologically sustainable. The authority focused on: conserving energy, conserving water, building materials, PVC and refrigerants. Prior to the Sydney Olympics in 2000, there were no regulations in Australia regarding energy performance, green house gas emission, and environmental impacts related to buildings. For the games, energy-efficient buildings were considered and advanced solar technology was introduced. For example, the PV (photovoltaic cells) were used on the roofs of the village (Sydney Olympic Organising Committee, 2000).

To conserve energy the OCA selected the venues to support transport efficiency. Most of the Games were to be conducted in two compact zones, which were linked by transportation. Another energy

conserving measure was to have the venues at a short distance from the Olympic Village, in Sydney's case 30 minutes' travel. Moreover, renewable energy was used. To conserve water, pollutants were removed from the waste water which was then recycled. The building materials used had to go through an assessment that was assessing life-cycle costing and cradle-to-grave- environmental implications (Chernushenko, 1994).



Figure 4 Homebush Bay, The Olympic Co-ordination Authority (OCA), Sydney 2000

Transport and Waste Management

The strategy of Sydney was to rely on public transportation during the Games. In the Waste Management sector emphasis was put on educating the public and to co-operate with the sponsors and service providers to develop policies to minimise the waste. Waste was recycled and during the Games recycled materials were used (Chernushenko, 1994).

Greenpeace Report

Based on the environmental guidelines implemented for the Sydney Games, Greenpeace did three assessments of the adherence by the city to meet those guidelines. One month before the games started(August 15, 2000), Greenpeace gave Sydney its final report card. Sydney scored a C or 6 out of 10 points. The score was a downgrading from the 1999 assessment where the city scored a B-, or 7 out of 10. Greenpeace was among other things disappointed with the International Olympic Committee. Greenpeace believes the IOC should be more active and supportive to the host city. Further Greenpeace believed that the OCA was difficult to communicate with and was obstructive to

environmental initiatives. Greenpeace believed that one of the major lessons learned was the co-operation problem between the OCA, who was responsible for the builders, and the SOCOG, who was responsible for the show managers. Greenpeace is of the opinion that the division of the two created communication problems. The successes of the Games were:

- The Waste Reclamation and Management scheme;
- The Integrated Waste Management strategy;
- The launch of a remediation system to Clean Up of Homebush Bay(dioxin-contaminated waste);
- The commitment to additional solar power systems.

The biggest failures of the Games were not avoiding ozone destructive chemicals, such as CFCs and HCFCs and greenhouse gases HFC in olympic venues, which was stated in the Environmental Guidelines. Further not even one high efficiency or alternative fuel vehicle of more than 3000 VIP cars was provided by the sponsor. This was a violation of the Environmental Guidelines. So while the spectators used public transport, the VIPs violated the Environmental Guidelines (Greenpeace, 2000).

Chapter 3 The Environmental Impacts of the Past Games

Reviewing past Olympic Games, one can see that the organisation of the Games has moved from small scale, poor organised, no development Games to large scale, good organised Games with significant impacts on the host city. This chapter has a focus on the environmental impacts on the host cities of the past Games. The impacts are summarised with a DPSIR model and a CLD diagram.

DPSIR Model of the Olympic Games

A DPSIR model is used to see the inter-relationship between Olympic Games and its environmental impacts on the host cities (see figure 5). The DPSIR model is a conceptual framework that offers a basis for analysing the inter-related factors that have impact on the environment. The aim of such an approach is:

- to be able to provide information on all of the different elements in the DPSIR chain;
- to demonstrate their interconnectedness;
- to estimate the effectiveness of Responses.

(European Environment Agency, 2003)

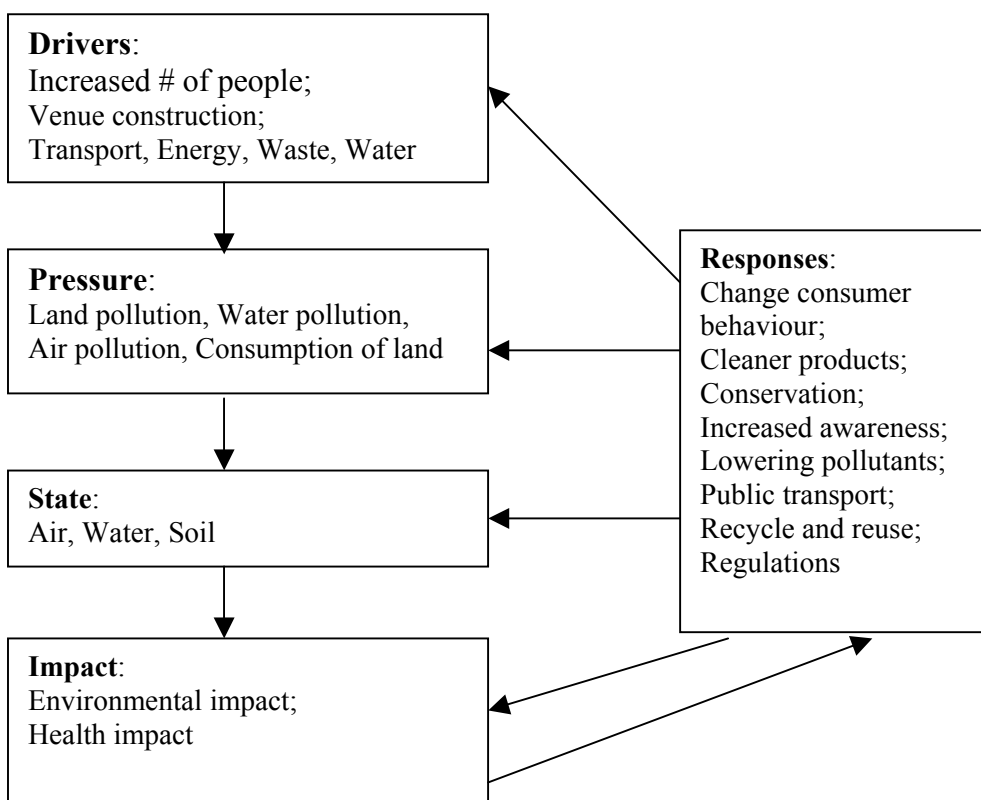


Figure 5 DPSIR model of the Environmental Impact of the Olympic Games, Borne', 2003

Another way is to look at each Games in four different periods as: the winning of the right to host the Games; the seven year preparation period; the staging of the Games themselves and the post-Games period. According to Cashman, the impacts can be:

- alterations in design of the city;
- changes to the physical and the built environment;
- the representation of a city and country and its culture;
- improvements in air, road and rail transport;
- increased costs and taxes;
- changes in governance and public decision-making;
- potential increased tourism and business activity;
- the creation of new sporting venues which have potential for post-Games community use;

(Cashman, 2003)

Before the Olympic Games

To be able to accommodate a large amount of visitors during the Games and to be able to hold all the sports events of the Games, more venues are built and more infrastructure and services are needed. This leads to fast track developments of city plans or alternate designs for the cities and has an effect on the land use and urban development of the cities. At the beginning of the Olympic history, the Games were small scale and there was little infrastructure development. The 1908 London Games were the first to build a new stadium and the 1932 Games of Los Angeles were the first to build an Olympic village. From the 1936 Games in Berlin and forward, especially after 1960, larger development projects that eventually have become whole city renovations have taken place. Not only new sport facilities has been developed but also new roads, subways, airports, hotels, parks, sewage systems and more have been developed. For example, the Games in Montreal 1976 fast tracked development plans and built a new airport and new roads and extended the subway with 20 km. Further new hotels and an Olympic park was built. The Games in Seoul 1988 spent US \$14 billion to improve the transport and the environment of the city. In Barcelona 1992, 15 new venues were built and 10 existing facilities were renovated. When land is used for venues and permanent infrastructure there is a risk for land loss, especially the agricultural land and the natural areas.

The development of the host cities could lead to an increase in pollution pressure on air, water and soil and has an impact on eco-systems and people's health. Examples are: Carbon Monoxide(CO), which cause heart and lung disease; Carbon Dioxide(CO₂), which has an effect on the environment through green house effects and climate gazes. The effects of a global climate change could lead to: increases in floods, loss of agricultural output due to drought, land area loss including beaches and

wetlands to sea-level rise , high-temperature events, fires, lose of species and forest area and significant damage to eco-systems(Jepma, Catrinus J. and Munasinghe, M,1998). Oxides of Nitrogen(NO_x) could react in the atmosphere to form Nitrogen Dioxide (NO₂). NO₂ could have an adverse effect on health. NO_x can contribute to smog formation of ground level Ozone, acid rain, and could damage vegetation. Volatile Organic Compounds (VOC), Hydrocarbons (HC) could cause respiratory disease and cancer, and have an environmentally indirect green house gas effect. Sulfa Dioxide(SO₂) is the major source of acid rain formation (Environmental Protection Agency, 2003). The particles can effect respiratory system and cause cancer, and could create “black smoke” (Naturvårdsverket, 2003).

The responses for pressures before the Games have been:

- Reuse existing facilities, many games used existing facilities. For example, the Games in Los Angeles 1984 used many existing facilities including the Olympic Stadium from the Games in 1932;
- Use environmental friendly materials for construction. In Lillehammer the construction companies were instructed to use natural materials as much as possible. In Sydney the building materials used had to go through an assessment assessing life-cycle costing and cradle-to grave- environmental implications;
- Energy conservation design for the buildings, in Lillehammer, energy conserved cooling and heating systems were used. In Sydney, energy- efficient building were use in construction;
- Water conservation systems, minimise land use in terms of road and facilities building. In Sydney most of the Games were to be conducted in two compact zones, which were linked by transportation;
- Minimise land use, use ecological land use planning, put geological, ecological, economic, health, and social factors into account when planning the Games. Moreover, preserve nature areas, minimise land use when building roads and parking lots and buildings. In Sydney the Homebush Bay that previously had been an industrial area with uncontrolled dumping was the site for the Olympic Park and the Olympic Village.

During the Olympic Games

The increase of people (overcrowding) during the Games leads to an increase in demand for infrastructure and service. As an example, Lillehammer has a population of about 23 000, but during the two weeks of the Games it increased to 100 000. In the Sydney 2000 Games, 6,7 million tickets to the games were sold. Demand for housing, water, energy and transport increases and more waste is generated during the Games. Further there is an increase in air, water and soil pollution.

The responses for pressures during the Games have been:

- The use of public transportation, bicycles and walking. In Munich, a 20 km extension of the subway was made for better public transportation and in Los Angeles 1984, a new 20-bus transit station was build for easy access;
- Waste Reduction Plans, in Sydney during the Games recycled materials were used and waste generated was recycled. In Lillehammer, 70% of trash generated was recycled or composted;
- Water consumption behaviour change, in Sydney pollutants were removed from the waste water which was then recycled;
- Energy Conservation Management, using renewable energy instead of fossil fuel. As an example, during the Sydney Olympic Games solar energy was used.
- Increasing the level of environmental awareness, for example, in the Soul Games the local community was involved and public awareness of environment was improved.

In the transport sector, the increase in demand of transport increases the pollution and has impacts on human health and ecosystems. The responses have been to use public transportation instead of private cars; develop and use low NO_x, disulpharisation and lower noise technology and use unleaded fuel. Further cycling and walking are promoted.

In the water sector, the increase in demand in water put pressure on the water resources and there is a risk to deplete the water resources. The responses have been reducing the water wastage, using water recycling, and changing consumer behaviour.

In the energy sector, the increase in demand for energy, especially the non-renewable energy, put pressure on ecosystems. The pressure come from extracting, transporting, processing and using the non-renewable energy sources, such as coal and oil. The responses have been: using renewable energy, better insulation of the buildings, increasing fuel efficiency of the motor vehicles, and changing consumer behaviour.

After the Olympic Games and in the Long Term

Improving the infrastructure is a major part of the Olympic Games preparation for the host cities. This could lead to an increase in the use of motor vehicles. According to NSCN, in Lillehammer there was an increase in the use of private cars after the Games due to the improvements in road and parking infrastructure. This increase will have continued negative impact on the environment. The improved infrastructure has also made it safer to drive, with less accidents and easier access and more convenient driving.

The Games with high environmental standards may have a positive long-term impact. After the Games, environmental friendly practices may become part of the usual business practises. For

example, as a result of the Sydney Olympic 2000, the Australian building industry is working towards more environmentally concerned approaches. This will minimise the negative impact on the environment.

Maintaining and using the venues will have less negative impacts on the environment if they are constructed in an environmentally friendly manner. For example, energy conserving and water conserving venues will be less costly to maintain and will have little negative impact on the environment. The Cavern Hall in Lillehammer saves about \$ 20,000 annually in heating cost because it was built inside the mountain.

The table in figure 6 summarises the DPSIR Model of the Olympic Games Environmental Impact:

Drivers	Pressure	State	Impact	Responses
Venue and infrastructure construction	Heavy metals, toxic; CO, CO ₂ , NO _x , SO ₂ , O ₃ , HC; Noise, dust; Land pollution; Water pollution; Land consumption.	Air; Water; Soil.	Carcinogenic; Heart and lung disease; Hearing loss; Stress, insomnia; headache; Climate change; Ozone depletion; Acid rain formation; Smoke; Land loss; Water depletion.	Reuse existing venues; Environmental friendly materials; Energy conservation design; Water conservation system; Minimise land use; Regulation on land use.
Increase of people during the Games	More demand for infrastructure and service; Overcrowding; Increase housing' and transport needs; Increase water, energy consumption; Increase waste generated; Increase pollution of air, water and land.	Air; Water; Soil.	Increase environmental health related disease; Increase inadequate infrastructure; Climate change; Depletion of nature resource; Ozone depletion; Acid rain formation.	Public transport; Promoting cycling; Waste reduction Recycling, reuse; avoid littering; Water consumption behaviour change; Energy conservation; Increase level of environmental awareness.

Transport	CO, CO ₂ , Nox, VOC, HC, SO ₂ , particles, lead, and noise.	Air; Water; Soil.	Carcinogenic; Heart and lung disease; Hearing loss; Stress, insomnia; headache; Accidents; Climate change; Ozone depletion; Acid rain formation; Smoke.	Low NO _x burners; Disulpharisation; Lower noise; Unleaded fuel; Public transport system; Promoting cycling and walking.
Waste	Land pollution; Water pollution; Air pollution; Overflowing sewage system by waste water; Increase chemical/ bacterial pollution in water body.	Air; Water; Soil.	Littering; Illegal dumping; Damage health.	Waste reduction prevention and minimisation; Separate, reuse, recycle; Increase level of the environmental awareness.
Water	Water demand vs. water availability	Air; Water; Soil.	Depletion of the water resources	Reduction of water wastage; Water recycling; Changing Consumer behaviour.
Energy (non-renewable)	Land disturbance; Pollute water, soil; Pollute air: CO, CO ₂ , SO ₂ , NO _x , toxic metals, particles, radioactive particles, smoke.	Air; Water; Soil.	Climate change; Acid rain formation; Environmental health related disease.	Renewable energy, phase out fossil fuels; Better insulation of the buildings; Demand-side management, change consumer behaviour; Increase the fuel efficiency of the motor vehicles.

Figure 6 Table of DPSIR Model of the Olympic Games Environmental Impact, Reference: Miller, 2002

CLD Diagram of the Olympic Games

The CLD shows interrelations between causes and effects from a systematic point of view. In the CLD model, the effects are showed as positive and negative through the + and – signs on the arrows. The commands R means it is a Reinforce loop, and B means a Balance loop.

In the CLD diagram (see figure 7), the Olympic Games (OG) leads to increases in venues and people (athletics, officials, and visitors). The increase in venues will lead to in increase in demand for water, energy and construction. The increase in construction will lead to an increase in waste generated. The increase in people will increase the demand for transport, accommodation, water, energy and consumption. It also generates more waste. The venues, infrastructure and new landfill will lead to more construction, which brings an increase in land use and in the use of energy, water and material. The increase in materials generates more waste. Soil waste generated can be divided into four kinds: recycling, composition, incineration and unsorted. The unsorted waste goes into landfill. However when the landfill becomes too full, waste will have to be exported or new landfill needs to be built, which increases the construction.

The responses in the squares decrease the environmental impacts of the Olympic Games. The reuse of old venues, public transport and existing housing programs decreases the construction, which leads to a decrease in material use and generates less waste. The green products(changed consumer behaviour) decrease the waste generated. The more recycling, composition, and incineration, the less unsorted waste goes to landfill. Reused and recycled water decrease the sewage waste, which leads to less construction and less waste into the ocean. Renewable materials decrease the waste generated from construction. Renewable energy instead of non-renewable energy decrease the environmental impact. Ecological land planning will minimise the land use.

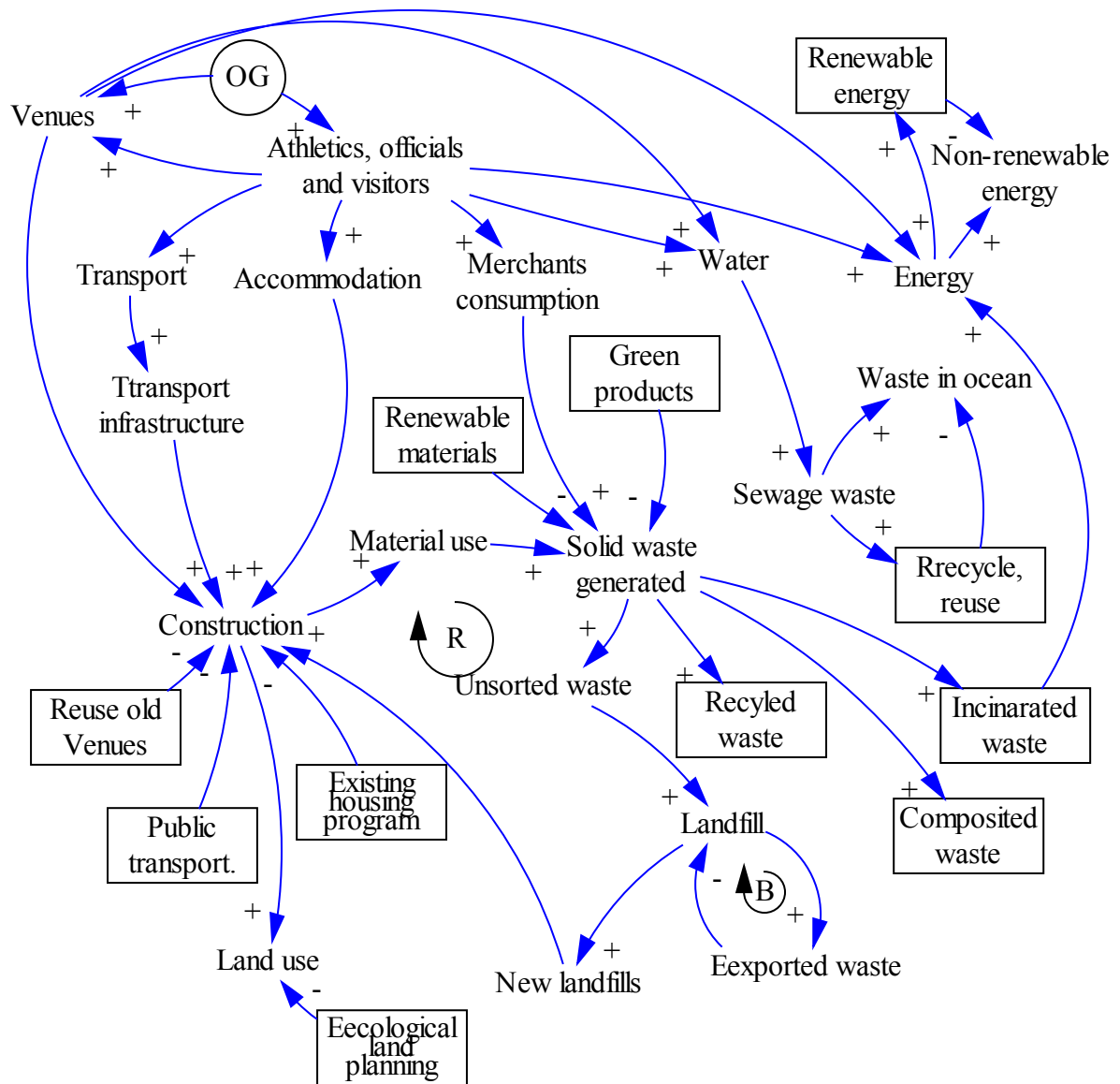


Figure 7 CLD Diagram of the Olympic Games Environmental Impact, Reference: Miller 2002

This chapter has summarised and analysed the environmental impacts on the host cities of the past Olympic Games before, during and after the Games. The findings are used in the next chapter together with an assessment of Beijing(China) and an analysis of the 2008 Olympic Action plan to give environmental recommendations to the host city of 2008 Olympic Games, Beijing.

Chapter 4 Case Study of Beijing 2008

Introduction

Beijing, capital of China was awarded the XXIX Olympic Games 2008 at the 112th IOC session in Moscow, beating among other cities Paris and Toronto. The IOC Evaluation Commission had recommended Beijing. "A Beijing Games would leave an unique legacy to China and to sports" (IOC, 2003).

In this chapter the political, economical, legal, geographical and cultural development from an environmental perspective in China is presented. After the presentation, the Olympic Action plan for Beijing 2008 is described. In the end of the chapter recommendations are given to Beijing based on the findings in previous chapters, together with a general analysis of Beijing(China) and an analysis of the Olympic Action Plan.

For China, being a developing country, economic development and reducing poverty have been the top priority since China's open door policy and reforms started in the 1970's (Fairbanks and Goldman, 1999). The environmental impact of the economic development has been recognised more and more through the course of economic development. This has made Chinese policy makers to look for a balance between economic development and environmental protection. The concept of sustainable development was adopted by China in 1992. In 1992, the China Council for International Co-operation on Environment and Development (CCICED) was also established. It includes 22 members from different United Nations committees and Western industrial countries. The CCICED has given advice for the Chinese policy making. In 1993, China joined the United Nation's committee for sustainable development, working together with western countries and the World Bank for technical improvement of its environment (Cheng, 1998).

However, by 1995 the end of the 8th five –year plan, China's goal of environmental protection was not achieved. The pollution condition reached a critical level and the government was not able to control the natural environment deterioration. In 1996 at the time of the inauguration of the 9th Five-year plan, two schematic action plans were introduced. One of the plans was the " Plan for Controlling the Total Volume of Major Pollutants Discharged in China", which was introduced to curb the growth in quantity of major industrial pollutants discharged. The other plan was " China's Cross-Century Green Engineering Project, The First Phrase(1996-2000)". This plan was introduced to control water and airpollution as well as reducing solid waste. The plan also aimed at protecting the ecological

environment, tackle global environmental problems and to improve key industries that pose a threat of pollution. The plan further aimed at upgrading the environmental agencies' administrative and monitoring capacity (Cheng, 1998).

Another issue is the legal enforcement of the environmental crimes in China. The first time environmental crimes appeared in China's criminal code was in 1997. A separate set of procedures for environmental crimes still does not exist. Environmental laws are not reinforced in China because environmental crimes have low priority and law enforcers have little knowledge of environmental crimes. Environmental Agencies do not understand the "criminal part" in the environmental crime and the technology capacity of law enforcement is limited (Cheng, 1998).

There are non-governmental environmental organisations(NGOs) in China at national and local levels. For example, Friends of Nature, the China Environmental Protection Foundation, the Centre for Green environmental development in Beijing, the Global Village of Beijing, China's Forum of Green University student with university students in Beijing, and the Institute of Environment and Development in Beijing. However, these NGO's are under close supervision of the Chinese government, and mainly act as "green socialisation agents", not "watchdogs" for Chinese policy makers. The main functions of these NGO's are raising funds from inside and outside China, exchanging technology and improving popular green consciousness (Cheng, 1998).



Figure 8 : Map of China, Lonely Planet, 2003

Beijing

Beijing is the capital of China located in the northern part of the country, on the northern flank of the Huabei Pingyun (North China Plain) (see figure 8). Beijing is in a basin surrounded by hills and over 100 kilometres from the coast. Dust filled winds come in from the Mongolian planes. Beijing's climate is seasonal with hot summers and cold winters. The temperature can reach almost 40 degrees in the summer (Microsoft, 2003).

The estimated population in 2000 was about 13,8 million (not including the numbers of temporary permit workers and illegal workers in Beijing). Beijing has a metropolitan area of 16,810 square km, Microsoft, 2003). The metropolitan area of Beijing (see figure 9) can be divided into three primary zones - 1) the central zone that includes the city centre, 2) the near suburb that surrounds the old walled city and includes schools, factories, and housing, and 3) the far suburb consisting of agricultural land providing fruits and dairy products to the city along with natural resources such as coal and lumber (About Inc., 2003).

The suburbs are growing rapidly. Industrialisation and urbanisation leads to agriculture land use shrinkage for more infrastructure and industrial building. Beijing is the second largest industrial centre in China after Shanghai. Industrial growth of Beijing has expanded into the rural areas of the municipality. Shijingshan has major iron and steel mills, Tongxian has motor vehicle production, Fengtai machinery industries and Fangshan petrochemicals (Microsoft, 2003). The geographic location and density population and industrial urban development together make Beijing one of the world's top ten polluted cities (World Health Organisation, 2003).

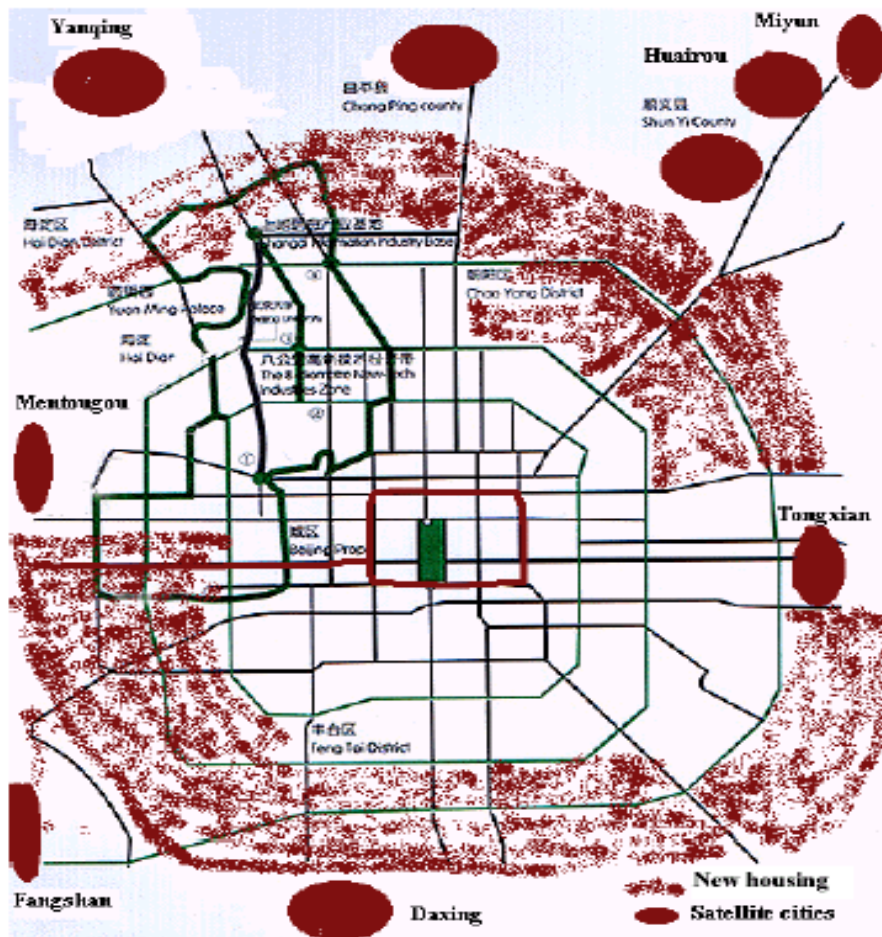


Figure 9 Beijing Metropolitan Map, KLR, p. 6, 2001

Beijing Olympic Action Plan

The Beijing Olympic Action Plan lists strategic phases: the Pre-preparation Phase - from December 2001 to June 2003, the Development Phase - from July 2003 to June 2006 and the Improvement and Operation Phase - from July 2006 to the opening of the 2008 Olympic Games. The major venues and constructions shall be finished by 2006. The Venues used will be located mainly in four places. One centre called The Olympic Green, will be located in the north end of the central axis of Beijing, and three others will be located in the Western Community Area, the University Area and the North Scenic Spot Area. Four additional venues in other areas will be renovated or extended for the use of the local community. Inside the city a total of 32 venues will be used, 19 will be newly constructed (6 temporary) and 13 are already existing facilities that will be renovated or expanded. Outside the city 5 venues will be used, three newly built and two existing that will be renovated. All the venues will function as culture and sports centres after the Games. The Olympic Village will be located inside the Olympic Green and contain 360,000 square meters of apartments. After the Games the facilities will be used sold as commercial housing (BOCOG, 2003).

In the Action Plan several environmental areas are discussed, the most important being: Pollution - including industrial, emissions from vehicles and coal burning. Further water pollution, waste control, environmental friendly technologies and materials and regional ecological systems will be discussed.

Air Pollution in the Urban Area of Beijing

Vehicle Emission Pollution

Air pollution is a major problem in many Chinese cities(including Beijing), automobile emissions being the most rapidly growing source. Some of the reasons are: the rapid rate of motorization, outdated vehicle technologies, high emission characteristics and inadequate road infrastructure. The infrastructure investments(roads) is only about 20% of other developed cities (KLR, 2001).

The Action plan focuses on the road network and traffic management. The plans are to: expand the light rail and subway network (see figure 10), the motorway and the urban streets. Furthermore the organisers plan to enlarge the airport, add more bus lines, build parking facilities and modernise transport control .

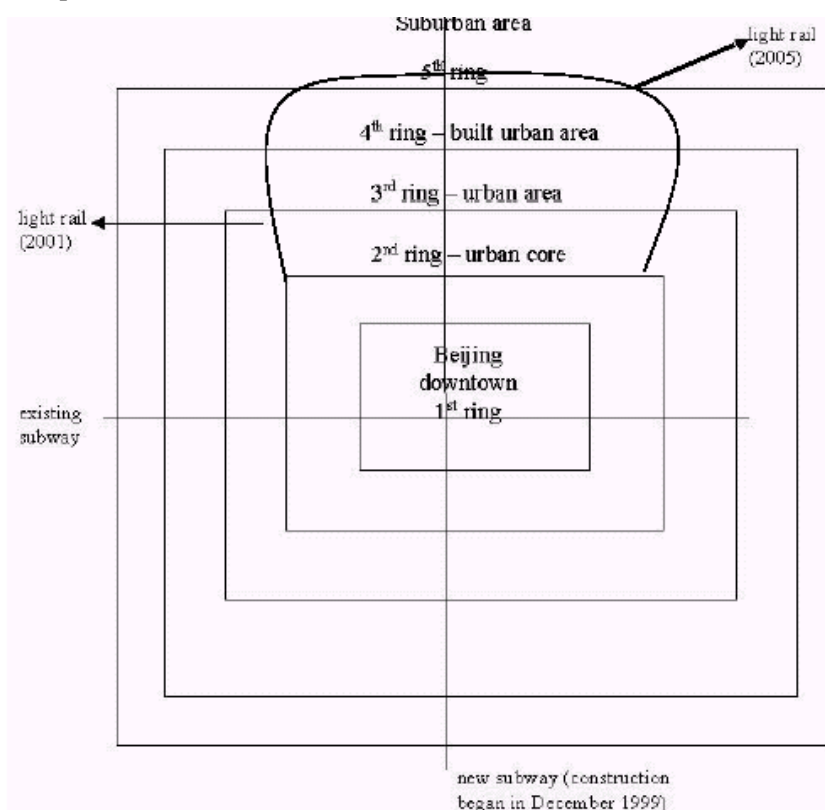


Figure 10: Beijing Subway Map, KLR, p. 7, 2001

Coal-Burning Pollution (Energy)

Another environmental challenge for Beijing is air pollution in the urban area. The main problem is the particle concentration in the ambient air. This still is at a relatively high level. Other pollutants are not of great concern since they already come close to or meet national standards.

According to the plan the power networks downtown Beijing will be expanded. In the rural areas the networks will be upgraded. The second natural gas transmission pipeline will be built. Alternative energy sources will be used and coal use will be phased out. Geothermal resources will be used to provide heating and cooling. Solar energy and bio-mass energy will be developed in rural areas. For industries, energy consumption reduction technologies will be introduced. The goal is that by 2008 coal and coke will count for less than 20% of the terminal energy structure (BOCOG, 2003).

Industrial Pollution

“The primary approaches include implementation of total discharge quantity control program, application of life-cycle control and recycle economy, readjusting the industrial structure and layout, improvement of environment management within the enterprise, popularisation of advanced technology, elimination of the outmoded technique and closing the enterprises with heavy pollution.” The Chinese government will relocate about 200 polluting factories that are now inside the fourth ring, also the chemical industrial zone in the Southeast suburbs will be relocated (BOCO, 2003).

Shortage of Water Resource

Water resource shortage is a main problem in Beijing. There is a “serious” lack of water used for ecological purposes. Further the structure in water consumption is irrational. Another challenge for Beijing is the lack of facilities collecting and treating the wastewater in rural areas. In the urban areas the sewage treatment rate is low. To protect the drinking water sources the government has implemented the “Plan for the Sustainable Utilisation of Water Resources in the Capital in the Early 21st Century (2001-2005)”. The quality of water in the Miyun and Guanting Reservoirs Miyun and Guanting Reservoirs will be guaranteed. Sewage treatment plants will be built in Lugouqiao, Qinghe, and Xiaohongmen, etc. to prevent water pollution The goal is that by 2008 more than 90% of the sewage in the urban area will be treated (BOCO, 2003).

Waste Control

In the waste control area the two projects Gaoantun Garbage Burning Plant and Jiaojiapo Garbage Burying Ground Tightening will be completed before the Games. The goal of the Chinese Government is to have all domestic waste in Beijing and its satellite cities treated by 2005(using reduction, separate collection and recycling). Further all hazardous waste shall be safely disposed (BOCO, 2003).

Environmental Friendly Technologies and Materials

Environmentally friendly materials will be used extensively in constructing venues and other facilities. Environmental friendly technologies and techniques will be promoted. Some of them are: pollution-

free burning, geothermal-operated pumps, solar energy power generating, solar energy heating (BOCOG, 2003).

Regional Ecological System

The plan is to control the soil erosion in the mountainous area and sandy bare land and to increase the green coverage in the city and surrounding areas. Beijing is for example lacking green areas in the downtown district. This creates a heat island effect because the lack of green affect. There will be 3 green shelters in the mountain area, plain area and urban and suburban area (BOCOG, 2003).

Summary and Recommendations for Beijing

The fast industrialisation of Beijing together with its population density and its troublesome geographical location makes Beijing one of the top ten polluted cities of the world. The political situation in China makes the government play an important role in preparing for the Games and implementing the Action Plan. Co-operation between environmental groups and the organisers is important, however as mentioned in the Beijing section, the organisers have strong influence on the NGOs. Beijing needs to separate the NGOs from the organisers to have an independent watchdog. Both the Games in Lillehammer and Sydney had environmental success much because of the environmental guidelines that were drawn up by the organisers together with different environmental groups.

The comprehensive action plan presents environmental problems of the Beijing and maps out clear guidelines to deal the problems and improve the environment of Beijing. The implementation of the action plan and following the guidelines in the action plan are of utmost importance. Reviewing the Beijing Olympic Action Plan, most important areas have been considered, however there are a few issues that should have extra consideration by the organisers of the Beijing Olympic Games:

Beijing needs to improve its transport infrastructure, both for the Olympic Games and for the long term. The road infrastructure is inadequate, mainly due to the rapid increase in motorisation. Compared to other developed cities Beijing's investments into infrastructure is low, so more investments should be made. However, the land use for permanent road and parking infrastructure should be carefully considered to minimise the negative impacts on agricultural land use and nature areas. Moreover, improved transport infrastructure carries a risk of increase in motor vehicle use, therefore improving the public transport sector and limiting private motor vehicle usage will be necessary.

Relocation of the industrial area to outside the city creates a new suburban area. Furthermore the sewage treatment facilities that will be built to prevent water pollution and the two projects in the

waste control area Gaoantun Garbage Burning Plant and Jiaojiapo Garbage Burying Ground

Tightening leads to the issue of land use. In other words there is a risk of taking over the agriculture land. Therefore in implementing the Action Plan the Chinese organisers have to consider the long term effects of the land use.

The use of environmentally friendly technologies and techniques should be emphasised in the construction of buildings and venues. When constructing the building and venues, environmentally friendly materials should be used. The environmentally friendly techniques should be continued after the Games.

The environmental awareness and education need to be increased. *Community involvement is important.* People needs to be informed about the environmental impacts, especially the health related problems. People should be aware of the advantages of using public transportation and bicycles instead of cars. In the waste management area people need to know the advantages of for example waste avoidance and recycling.

The table in figure 11 summarises the problem, action plan, outcome and recommendations of the Beijing Olympic Games, 2008:

Problem	Action Plan	Outcome	Recommendations
Vehicle Emission Pollution	Expand the light rail and subway network, the motorway and the urban streets; Enlarge the airport, add more bus lines, build parking facilities and modernise transport control.	Improve transport infrastructure; Better public transport; Increase in private motor vehicles due to better transport infrastructure.	More investment into public transportation sector; Limited private vehicle use; Minimise the land use for permanent road and parking infrastructure.
Coal-Burning Pollution (Energy)	Alternative energy sources, phase out coal use; Energy consumption reduction technologies.	Less pollution	Cost and time for developing new technologies; Continue environmental friendly practises after the Games.

Industrial Pollution	Cut industrial discharge; Relocate polluting factories and chemical industries.	Less pollution; Urbanisation; Industrialisation.	Minimise the land use for industries.
Shortage of Water Resource	Protect water resources; Build sewage treatment plants; Water conservation.	Reserve water resource; Less water pollution.	Increased environmental awareness and education; Minimise the land use of sewage systems.
Waste Control	Waste treatment (using reduction, separate collection and recycling); Safely dispose hazardous waste.	Less land, water and air pollution.	Increase the environmental awareness among the citizens; Minimise the land use for the waste management.
Environmental Friendly Technologies and Materials	Promote environmental friendly technologies; Constructing venues and other facilities with environmental friendly materials.	Less environmental impacts.	Cost and time for developing new technologies.
Regional Ecological System	Control the soil erosion in the mountainous area and sandy bare land; Increase green coverage.	Improve environment and protect ecosystems.	Regulations and community involvement.

Figure 11 PAOR table of Beijing Olympic Games 2008, Borne', 2003

Chapter 5 Conclusion and Ideas for Future Research

In the conclusion of the thesis I would first like to mention the difficulties to write the last part of the paper. When I visited the Olympic Committee in Beijing the fall of 2003, I found out that I was the first private person visiting the committee to ask questions about the Olympic Games in 2008. Much of the materials were classified since companies were still in the bidding process of the different projects.

There are many environmental impacts on a host city of a Olympic Games event, new venues and buildings are constructed, so land use has to be considered. The increase in people during the Games leads to an increase in demand for transport, water, energy and more waste get disposed. Those drivers could lead to for example climate change, ozone depletion, environmental health related disease and water resource depletion. Up to the Winter Olympics in Lillehammer 1994, not much attention was paid to the environment. In co-operation with the IOC and the UNEP, a sustainable development concept was adopted, and environment became the third Olympic pillar together with sport and culture. Some of the measures taken to limit the negative environmental impacts of the Olympic movement towards more sustainable development have been to : reuse existing facilities; use natural materials for construction, conserve energy, water conservation systems, waste management, and public transportation.

In preparing for the Olympic Games in 2008 the organisers have developed an Olympic Action Plan which if implemented limits the negative environmental effects and incorporates sustainable development into the Games. However the organisers need to put extra consideration into some areas such as transport infrastructure, landuse, building techniques and materials and to increase people's awareness.

Since the development of the Olympic Games in Beijing still is in the preparation stage, future research could include studies of Beijing at later stages and after the Games, when more information is available. Other research in the future could include studying the long term environmental impacts of "green" Games on the host cities.

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Appendix

The Games of the Olympiads and the Cities of the Olympic Games

I 1896 Athens, Greece
 II 1900 Paris, France
 III 1904 St. Louis, USA
 IV 1908 London, England
 V 1912 Stockholm, Sweden
 VI 1916 Cancelled due to W.W.I
 VII 1920 Antwerp, Belgium
 VIII 1924 Paris, France
 IX 1928 Amsterdam, The Netherlands
 X 1932 Los Angeles, U.S.A.
 XI 1936 Berlin, Germany
 XII 1940 Cancelled due to W.W.II
 XIII 1944 Cancelled due to W.W.II
 XIV 1948 London, England
 XV 1952 Helsinki, Finland
 XVI 1956 Melbourne, Australia
 XVII 1960 Rome, Italy
 XVIII 1964 Tokyo, Japan
 XIX 1968 Mexico City, Mexico
 XX 1972 Munich, Germany
 XXI 1976 Montreal, Canada
 XXII 1980 Moscow, U.S.S.R.
 XXIII 1984 Los Angeles, U.S.A.
 XXIV 1988 Seoul, South Korea
 XXV 1992 Barcelona, Spain
 XXVI 1996 Atlanta, U.S.A.
 XXVII 2000 Sydney, Australia

(IOC, 2003)

The Olympic Winter Games

I 1924 Chamonix, France
 II 1928 St. Moritz, Switzerland
 III 1932 Lake Placid, U.S.A.
 IV 1936 Garmisch-Partenkirchen, Germany
 1940 Cancelled due to W.W.II
 1944 Cancelled due to W.W.II
 V 1948 St. Moritz, Switzerland
 VI 1952 Oslo, Norway
 VII 1956 Cortina d'Ampezzo, Italy
 VIII 1960 Squaw Valley, U.S.A.
 IX 1964 Innsbruck, Austria
 X 1968 Grenoble, France
 XI 1972 Sapporo, Japan
 XII 1976 Innsbruck, Austria
 XIII 1980 Lake Placid, U.S.A.
 XIV 1984 Sarajevo, Yugoslavia
 XV 1988 Calgary, Canada
 XVI 1992 Albertville, France
 XVII 1994 Lillehammer, Norway
 XVIII 1998 Nagano, Japan
 XIX 2002 Salt Lake City, U.S.A.